1995

SERVICE F MANUAL

PLATFORM



CAMARO



FIREBIRD

BOOK 1 of 2

Includes all except Driveability and Emissions (6E) Electrical Diagnosis (8A)

GMP/95-F-1

1995 CHEVROLET CAMARO AND PONTIAC FIREBIRD SERVICE MANUAL BOOK 1

FOREWORD

This manual provides information on diagnosis, service procedures, adjustments and specifications for the 1995 Chevrolet Camaro and Pontiac Firebird.

An understanding of the material contained in this manual and in the appropriate Dealer Service Bulletins will help technicians to better serve vehicle owners.

The 1995 Camaro/Firebird service manual has been separated into two books:

Book 1 – Contains all sections EXCEPT Driveability and Emissions (Sections 6E and 6E3) and Electrical Diagnosis (Section 8A).

Book 2 – Contains Driveability and Emissions (Sections 6E and 6E3) and Electrical Diagnosis (Section 8A).

When reference is made in this manual to a brand name, number, or specific tool, an equivalent product may be used in place of the recommended item.

All information, illustrations and specifications contained in this literature are based on the latest product information available at the time of publication approval. The right is reserved to make changes at any time without notice.

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GENERAL MOTORS SERVICE MANUAL COMMENTS

If you find an error, omission or have a suggestion on any General Motors Service Manual, we want to hear from you.

United States - (General Motors Dealer Employees Only)

1-800-828-6860
(Monday - Thursday 8:00 AM to 8:00 PM EST)
(Friday 8:00 AM to 6:00 PM EST)
Fax #: 810-265-9327

Canada - (General Motors Dealer Employees Only)

Quebec, 1-800-263-7960, Select Option 5
Nationally, 1-800-263-7740, Select Option 5
Oshawa, Ontario "Local" Area, 644-7060, Select Option 5
(Monday - Friday 8:00 AM to 6:00 PM EST)
Fax #: 810-265-9327

These phone numbers can be called Monday through Friday. Be prepared to give the following information:

- Your name
- Your dealership's name
- Your phone number
- Model year and vehicle line
- Publication part number (if present)
- Vehicle Identification Number of vehicle being worked on.
- Section and page number(s)
- Description of problem

This phone number cannot provide technical assistance. Contact your regular technical assistance source.

The personnel answering this phone number will provide the author of the information with your comments and will follow-up until an answer is given.

If you wish to send examples or marked-up pages, the person who takes your call will tell you how to do that.

United States and Canadian Vehicle Owner/Operator

If you are the owner or operator of the vehicle, please give your comments to the applicable Customer Assistance Center. The phone number and address are in your Owner's Manual.

STG

GM Service Technology Group

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SECTION 0A

GENERAL INFORMATION

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

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SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) HANDLING

Refer to CAUTIONS and the SIR Component and Wiring Location view in Section 9J when performing service on or around SIR components or SIR wiring. SIR equipped vehicles can be identified by:

- Steering wheel hub marked "INFLATABLE RESTRAINT."
- "INFLATABLE RESTRAINT" indicator lamp in instrument cluster.
- Code "2," "3" or "5" for the seventh digit of the vehicle identification number (VIN).

DISCONNECTING THE BATTERY NEGATIVE CABLE ASSEMBLY

CAUTION: Before removing or installing any electrical unit or when a tool or equipment could easily come in contact with "live" exposed electrical terminals, disconnect the battery negative cable assembly to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "OFF" or "LOCK" position.

HANDLING ELECTROSTATIC DISCHARGE (ESD) SENSITIVE PARTS

Figure 1

NOTICE: When handling an electronic part that has an ESD sensitive label (Figure 1) or is identified as ESD sensitive in the list that follows, the service technician should follow these guidelines to reduce any possible electrostatic charge buildup on the service technician's body and the electronic part in the dealership:

1. Do not open package until it is time to install the part.
2. Do not touch electrical terminals of the part or its pigtail connector(s) with a finger or tool.
3. Before removing the part from its package, ground the package to a known good ground on the vehicle.
4. Always touch a known good ground before handling the part. This should be repeated while handling the part and more frequently after sliding across the seat, sitting down from a standing position or walking a distance.

Not all parts that can be damaged by ESD have an ESD label. Components that can be damaged by ESD are:

Inflatable restraint diagnostic energy reserve module (DERM) and resistor module

Powertrain control module (PCM)

Instrument panel cluster

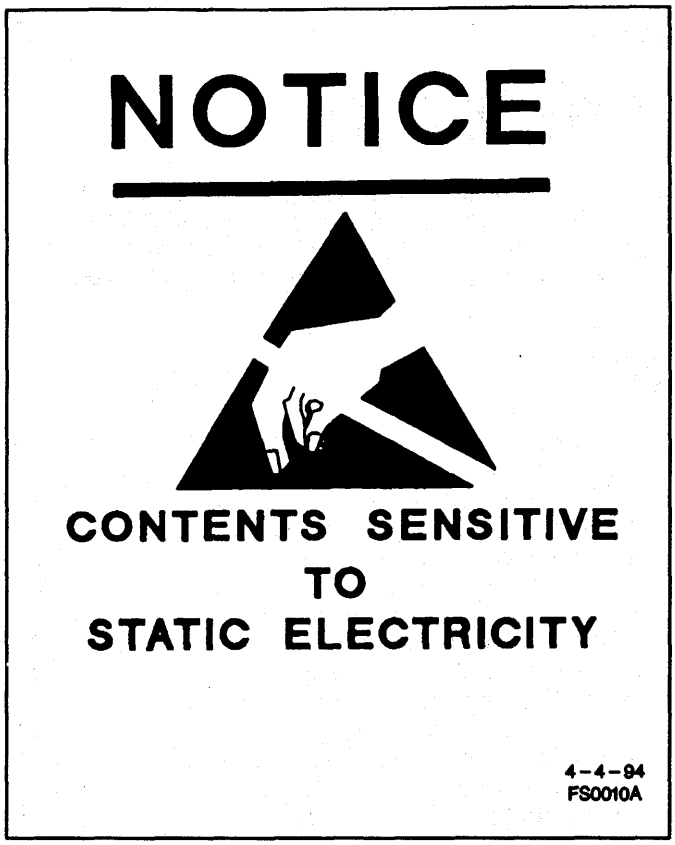


Figure 1 – ESD Sensitive Parts Label

Solid state components also can be damaged if they are bumped or dropped, or if they are laid on a metal work bench or on an electrically operated item such as a radio, a TV or an oscilloscope.

SPECIAL TOOL ORDERING INFORMATION

Special service tools that are shown in this service manual that have tool product numbers beginning with "J" or "BT" are available for worldwide distribution from:

Kent-Moore
SPX Corporation
29784 Little Mack
Roseville, MI 48066-2298
1-800-345-2233
Monday through Friday
8:00 a.m. through 8:00 p.m. EST
Telex: 244040 KMTR VR
Fax: 313-578-7375

General Motors dealers or Non General Motors Repair Facilities can purchase TECH 1 scan tools and accessories through Kent-Moore at the above address and phone number.

BODY IDENTIFICATION

A body identification tag is attached to the vehicle on the center of the radiator tie. The tag gives a schedule number and the last four digits of the vehicle identification number (VIN) sequence number. Refer to "Vehicle Identification Number" in this section

Paint codes, trim numbers, seat option codes and other body information are included on the Service Parts Identification Label. Refer to "Service Parts Identification Label" in this section.

FEDERAL VEHICLE THEFT PREVENTION STANDARD

Federal law requires General Motors to place a vehicle identification number (VIN) label on certain parts of selected vehicles. The purpose of the standard is to reduce motor vehicle thefts by making parts removed from stolen vehicles easier to trace and recover.

The label is permanently attached to an interior surface of the part and displays the complete VIN. The label on a replacement part contains the letter "R," the manufacturer's logo and the symbol "DOT."

Important

- THESE LABELS ARE NOT TO BE DEFACED, REMOVED OR COVERED. The labels must be shielded from paint, rustproofing and undercoating (dealer preparation included).

The theft deterrent labels are found on the front side door windows.

VEHICLE IDENTIFICATION NUMBER

Figures 2 through 4

The vehicle identification number (VIN) legally identifies the vehicle. A VIN plate is attached to the upper left of the instrument panel and can be seen from outside the vehicle. Each sequential unit number is prefixed by letters and numbers that are explained in Figure 2. The VIN also appears on the Vehicle Certificate of Title and Registration.

A derivative of the VIN is stamped on the engine and transmission. The code gives the model year, plant of manufacture and a sequence number that also indicates the car division. A VIN number is also stamped on the frame.

A bar code VIN is also on the vehicle identification plate.

MODEL IDENTIFICATION

Models (series) and body styles for the current year are listed in Figure 2.

ENGINE IDENTIFICATION

Figures 2 and 4 through 6

The VIN code (Figure 2) provides detailed engine information by the engine code letter located on the vehicle identification plate.

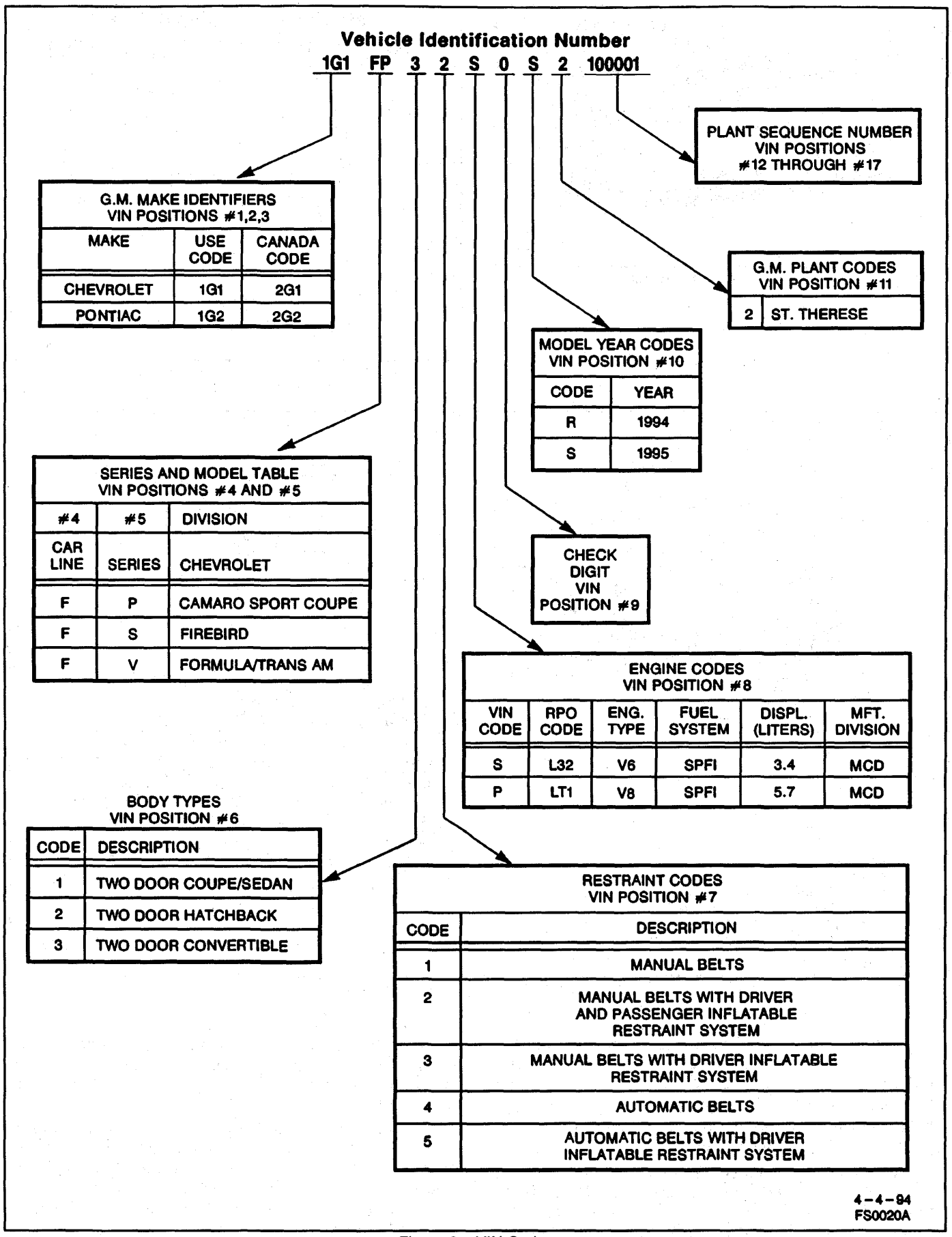


Figure 2 – VIN Codes

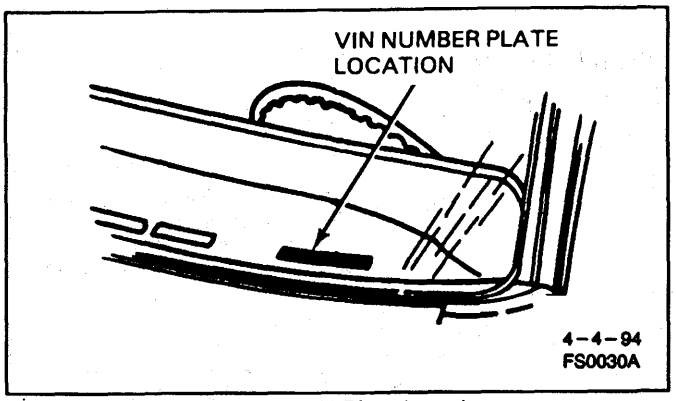


Figure 3 – VIN Plate Location

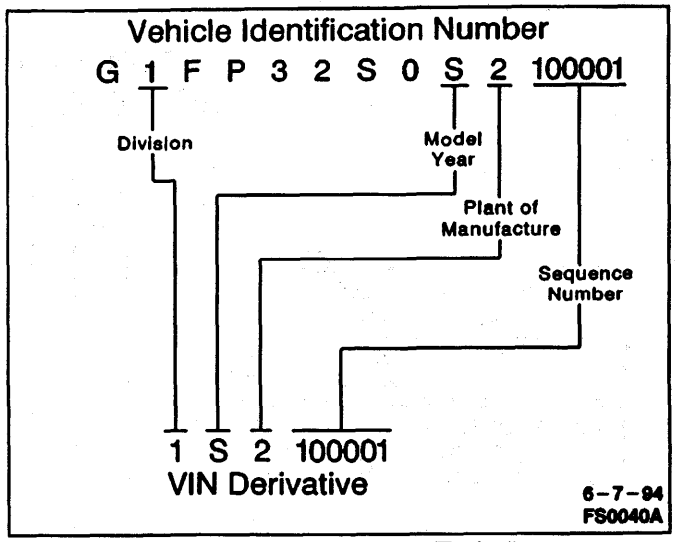


Figure 4 – VIN Derivative (Typical)

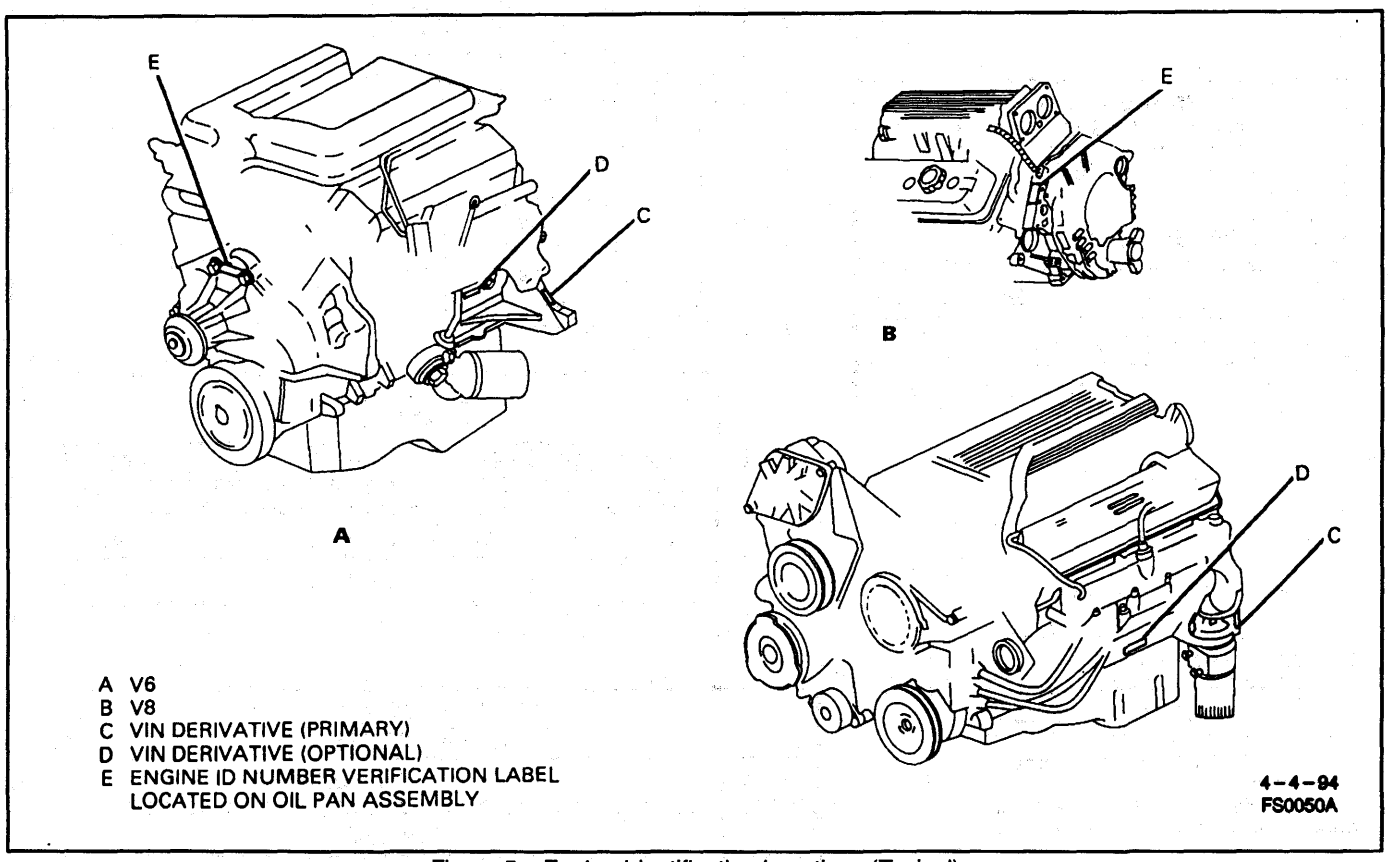


Figure 5 – Engine Identification Locations (Typical)

Stick-on-labels attached to the engine indicate the engine unit number and code. These labels also contain bar codes for in-plant identification.

Engines are stamped with an engine identification number which identifies the assembly plant, the month produced, the day produced and the engine type code.

All engines and transmissions are stamped with a VIN derivative, created from the complete VIN. Refer to "Vehicle Identification Number" in this section. The stamping contains nine positions. Position 1 is the GM car division identifier. Position 2 is the model year code. Position 3 is the car assembly plant code. Positions 4 through 9 contain the assembly plant sequential number of the vehicle (Figure 4).

If the engine in the vehicle is the original engine, information can be derived from the eighth VIN position letter or number (Figure 2). To determine if the engine is original, compare the VIN and the VIN derivative. The VIN derivative should be the same as positions 3 and 10 through 17 of the VIN.

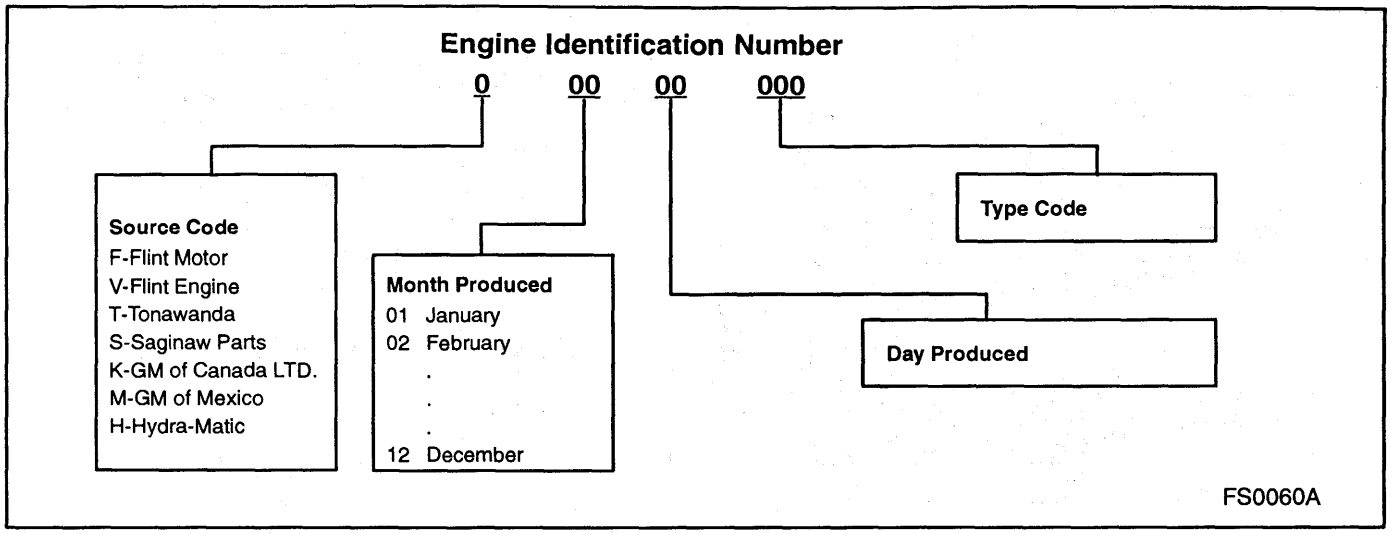


Figure 6 – Engine Identification Number

TRANSMISSION USAGE

Engine	Axle (RPO-Ratio)	Transmission
3.4L, V6 (VIN S)	GU5 3.23	M49-Borg-Warner Manual 5-Speed M30 Hydra-Matic 4L60-E
5.7L, V8 (VIN P)	GU2-2.73, GU5-3.23, GU6-3.42	M49 Borg-Warner Manual 5-Speed MM6 Borg-Warner Manual 6-Speed M30 Hydra-Matic 4L60-E

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Figure 7 – Transmission Usage Chart

TRANSMISSION USAGE

Figure 7

Transmission usage affects axle usage. The transmission usage chart lists each engine with the axles and transmissions used for each.

TRANSMISSION IDENTIFICATION

Figures 8 and 9

The transmission has two identifying stampings: the transmission identification and the VIN derivative. The transmission identification number gives the transmission model and when it was made. On the automatic transmission, the transmission identification number is located on the plate on the automatic transmission case. On the manual transmission, the transmission identification number is located either on the transmission case or the bell housing. The VIN derivative is created from the complete VIN and is stamped in either of 2 places (Figure 8). Refer to "Vehicle Identification Number" in this section. For more information on rear axle differential ratio codes, refer to SECTION 4B.

DIFFERENTIAL RATIOS AND TIRE INFORMATION

For differential ratios, refer to SECTION 4B. For tire information, refer to SECTION 3E.

GENERAL VEHICLE LIFTING AND JACKING

Figure 10

CAUTION: To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle at the opposite end from which components are being removed. The additional support will reduce the possibility of the vehicle's falling off the hoist. When removing major components of the vehicle while the vehicle is on a hoist, the vehicle frame should be chained to the hoist pads at the same end as the removed components to prevent tip-off. Failure to follow these precautionary measures could result in vehicle damage, serious personal injury or death.

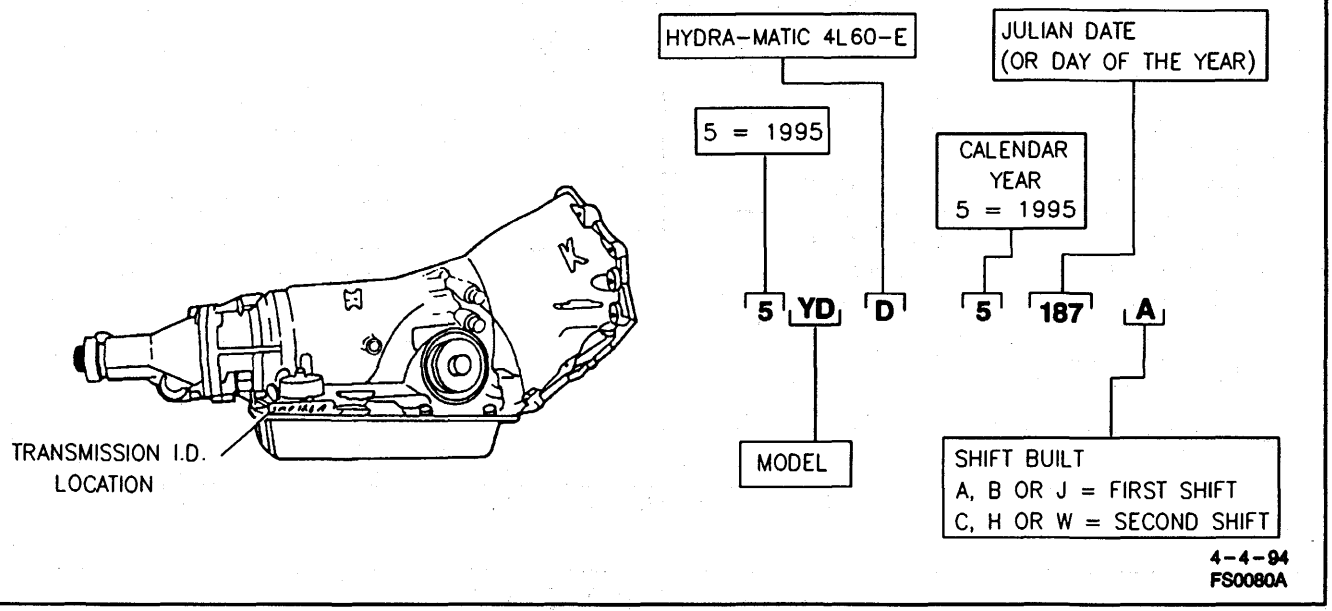


Figure 8 – Hydra-Matic 4L60-E Transmission I.D. Location

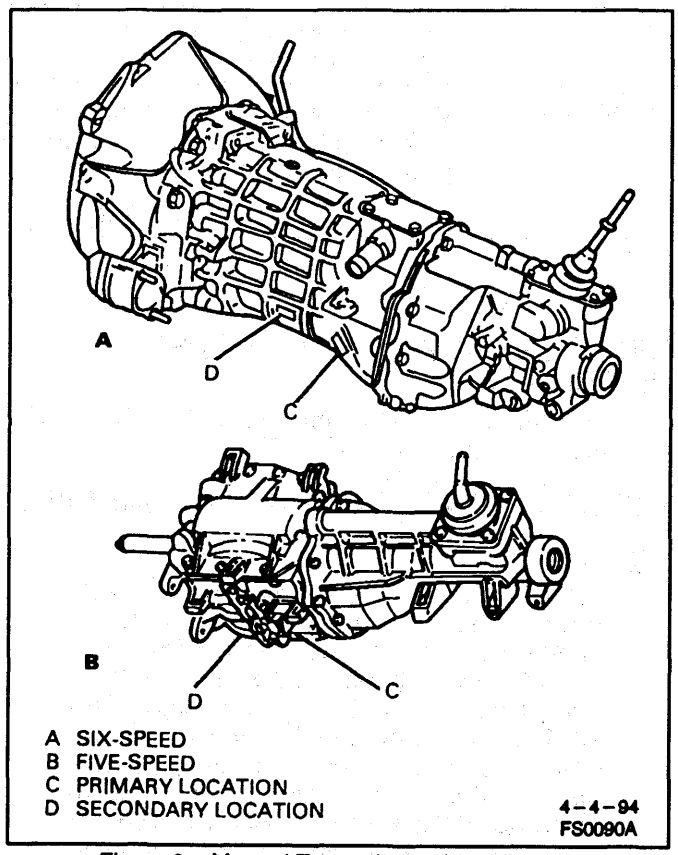


Figure 9 – Manual Transmission Identification

NOTICE: When jacking or lifting a vehicle at the frame side rails or other prescribed lift points, be certain that lift pads do not contact the catalytic converter, brake pipes or fuel lines. Such contact may result in damage or unsatisfactory vehicle performance.

When a vehicle is lifted with a vehicle jack or floor jack, the wheels at the opposite end should be blocked. Jackstands should be used to provide additional support. Jackstands should be placed under either the frame, the front suspension crossmember or the axle.

The vehicle should be on a clean, hard, level surface before any lifting procedure begins. All lifting equipment must meet weight standards and be in good working order. Make sure all vehicle loads are equally distributed and secure. If the only support for the vehicle is at the frame side rails, make sure the lifting equipment does not put too much stress on or weaken the frame side rails.

Recommended vehicle lifting points are shown in Figure 10. If any other hoist methods are used, take special care not to damage the fuel tank, filler neck, exhaust system or underbody.

LOCK CYLINDER CODING

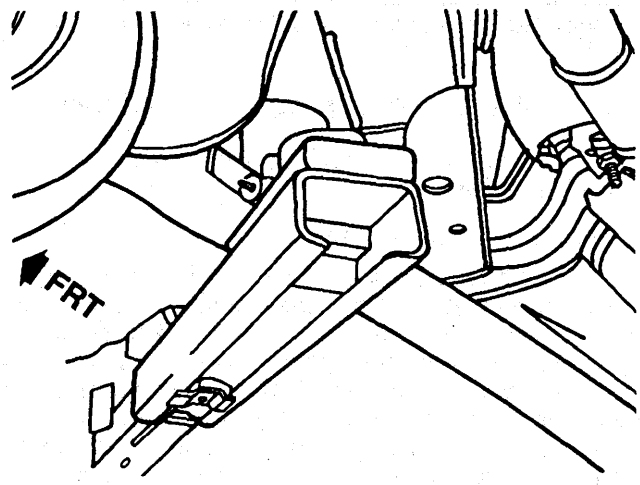
Key Identification and Usage

Figure 11

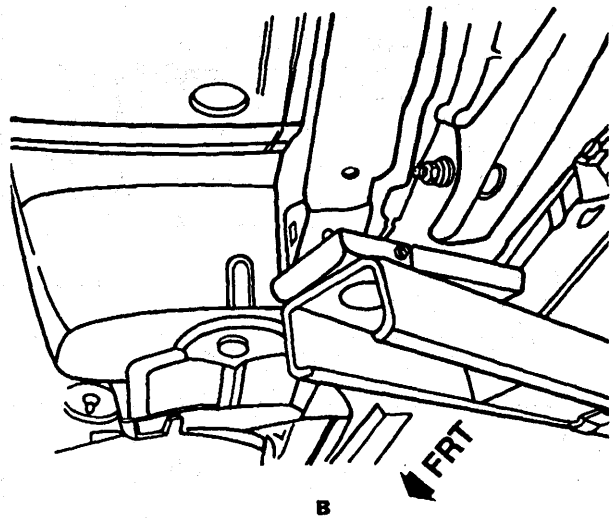
The lock cylinder keyway is designed so that other model keys will not enter a current model lock cylinder. Two noninterchangeable keys are used.

- Square-headed key is used in the ignition lock cylinder.
- Oval-headed key is used in all other lock cylinders.

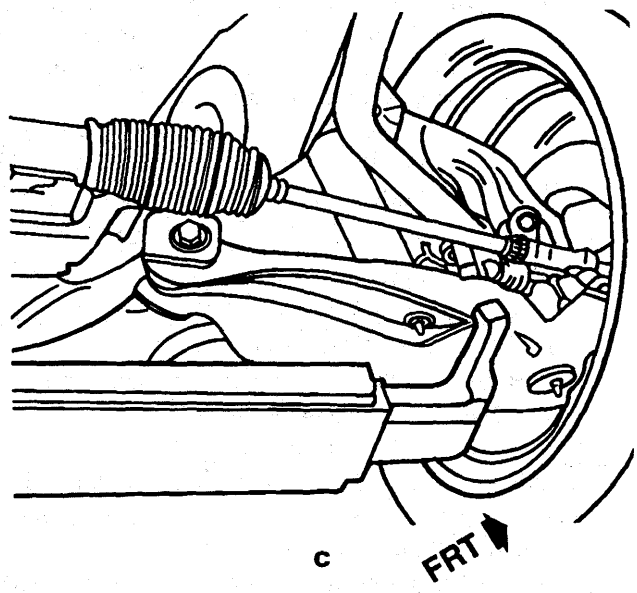
Key identification is obtained from the four-character key code stamped on the knockout portion of the key head and from an identification letter stamped on the key shank. After the code number has been recorded by the owner, the plugs should be knocked out of the key head. Using these numbers, owners of key-cutting equipment can determine the lock combination by consulting a code list available from equipment suppliers. If the key code numbers are not available from records or from the knockout plug, the lock combination (tumbler numbers and position) can be determined by laying the key on the diagram (Figure 11). For information on the square-headed ignition key and lock cylinder, refer to SECTION 9D.



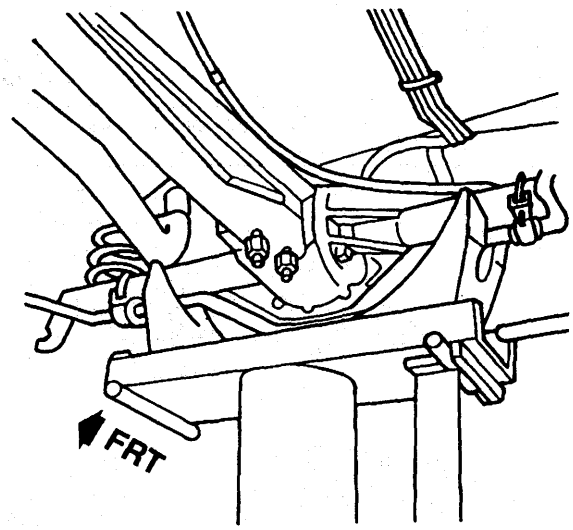
A



B



C



D

A USING FRAME CONTACT HOIST REARWARD OF FRONT TIRE
B USING FRAME CONTACT HOIST FORWARD OF REAR TIRE
C USING SUSPENSION CONTACT HOIST UNDER FRONT LOWER CONTROL ARM ASSEMBLY
D USING SUSPENSION CONTACT HOIST LIFTING ON REAR AXLE ASSEMBLY

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Figure 10 – Vehicle Lifting Points

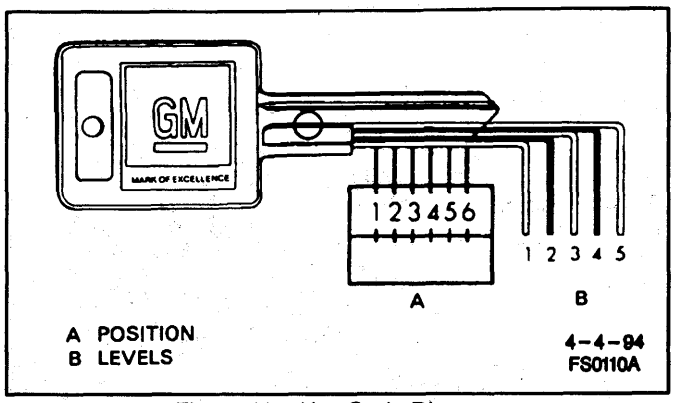


Figure 11 – Key Code Diagram

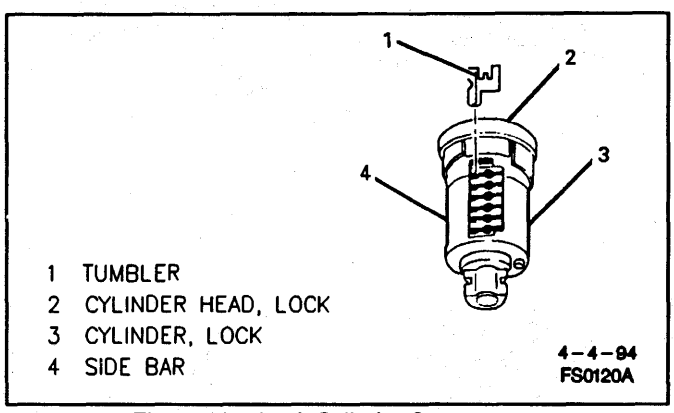


Figure 12 – Lock Cylinder Components

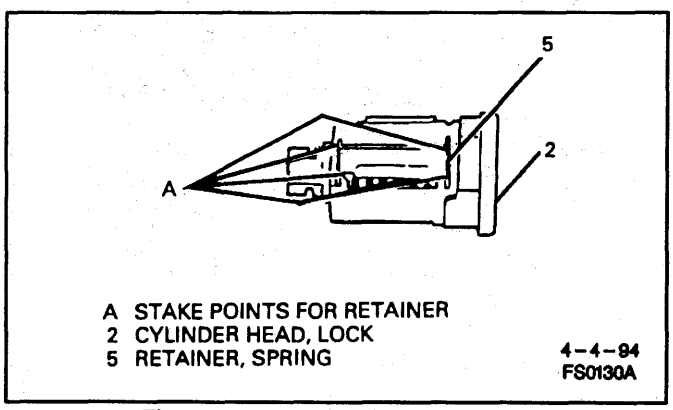


Figure 13 – Installing Spring Retainer

Cutting Keys

Figure 11

1. Determine special code from the code list or key code diagram.
2. Cut a blank key to proper level for each of six tumbler positions or according to directions supplied by the key-cutting equipment manufacturer.
3. Check key operation in lock cylinder.

Replacement Lock Cylinders

Figure 12

Lock cylinders (3) are available from service parts warehouses completely coded and with a new key. The new lock cylinder (3) has a locking bar staked in place. Tumblers (1) and springs are also available and must be assembled into the lock cylinder (3) according to the key code.

Assembling and Coding Lock Cylinders

All Lock Cylinders Except Rear Stowage Compartment

Figures 11 through 14

Tumblers (1) for all locks are shaped exactly alike, with the exception of the notch position on one side. As the key is inserted in the lock cylinder (3), tumblers (1) are lowered to the correct height so that notches on each tumbler (1) are at the same level. When the notches on all six tumblers line up, the side bar (4) is pushed into the notches by two small springs. This allows the lock cylinder (3) to turn in its bore. Five types of tumblers (1) are used to make the various lock combinations. Each tumbler (1) is coded according to a number, one through five, stamped on its side.

Assemble

1. Determine tumbler numbers and arrangement.
   - With the numerical key code, use code list provided by the key cutting equipment supplier.
   - Without the numerical key code or without the code list, refer to Figure 11.
     A. Lay key on the key code diagram. Be sure key is outlined by the diagram.
     B. Start with position number one. Find and record the lowest level (tumbler number) that is visible. Repeat for each of the remaining five positions.
2. Tumblers (1) in their proper slots in the order called for by the code (Figure 12).
   - Start with position number one, nearest open end or lock cylinder head (2).
3. Tumblers (1) by pulling side bar (4) out with fingers.
4. One tumbler spring (6) above each tumbler (1).
5. Spring retainer (5) so that end prongs slide into slots at each end of lock cylinder (3).
   - Press spring retainer (5) down (Figure 13).
6. Insert key into lock cylinder (3) to check for proper installation.
   - Side bar (4) will drop down if tumblers (1) are installed properly. If incorrectly assembled, take apart and assemble correctly.

   NOTICE: Use leather or wood at each vise jaw to prevent damage to the cylinder.
7. Remove key and secure lock cylinder (3) in a vise with spring retainer (5) exposed.
   A. Stake spring retainer (5) securely in place at each end. Use a suitable staking tool and stake cylinder metal over the spring retainer (5).

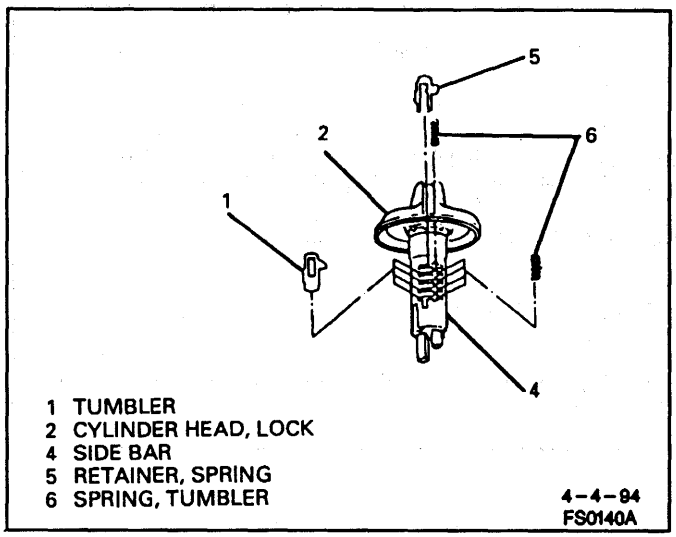


Figure 14 – Installing Tumblers

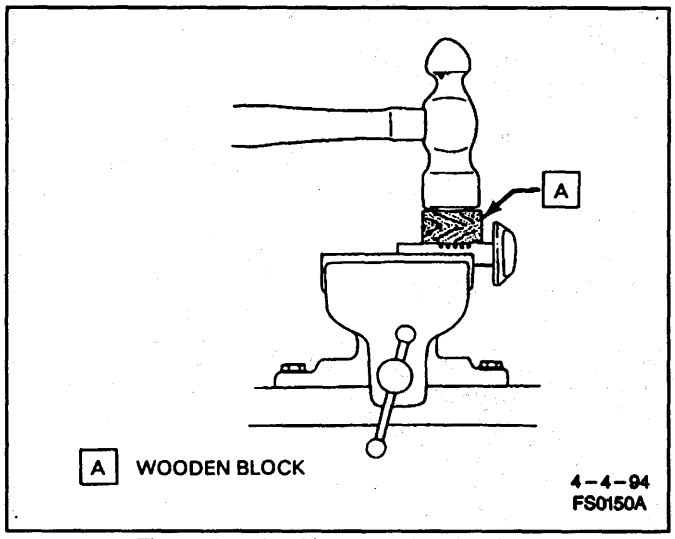


Figure 15 – Locking Tumblers in Place

B. Black lock cylinders should be lubricated with Multi-Purpose Lubricant (GM P/N 12345120 or equivalent) or light machine oil. All other lock cylinders should be lubricated with a general purpose silicone lubricant.

Rear Stowage Compartment Lock Cylinder

Figures 12, 14 and 15

A lock cylinder with snap-in tumblers (1) is used for the rear stowage compartment lock. The lock cylinder has four or five tumbler positions. The number one or two position (closest to the lock cylinder head (2)) is a brass retainer tumbler. The two through five positions or three through five positions are standard tumbler positions depending upon cylinder type. Therefore, only the last four or five tumbler combinations are required.

Assemble

1. Determine tumbler numbers and arrangement as previously described and install tumblers (1).
2. After installation, tap tumblers (1) flush with the cylinder.

METRIC FASTENERS

Figure 16

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

Many fasteners are metric. Metric fasteners may be close in dimension to well-known english fasteners in the inch system. Replacement fasteners must be the correct nominal diameter, thread pitch and strength.

Original equipment metric fasteners, except for exposed bumper bolts and other beauty bolts and cross-recess head screws, have numbers on their heads that identify them as metric. Cross-recess head screws can be identified by a Posidriv or a Type 1A cross-recess. Either type of cross-recess screwdriver can be used to remove Posidriv recess head screws, but Type 1A will perform better.

NOTICE: Most metric fasteners have a blue color coating. This coating should not be used to positively identify fasteners because not all metric fasteners are color-coated. Damage to the fastener or part could result if a english fastener is incorrectly used to replace a metric fastener.

Metric and english thread notations differ slightly. For example, the thread major diameter of a 1/4-20 bolt/screw is 1/4 inch, and the bolt/screw has 20 threads per inch. The thread major diameter of an M6.0x1 bolt/screw is 6.0 mm, and the bolt/screw has 1 mm between threads

FASTENER STRENGTH IDENTIFICATION

Figure 17

Most commonly used metric fastener strength property classes are 9.8 and 10.9. The class identification is embossed on the head of each bolt/screw. English fastener strength property classes range from grade 2 to 8. Radial lines are embossed on the head of each bolt/screw to identify the strength class. Some metric nuts are marked with strength identification numbers on the nut face (Figure 17).

When replacing fasteners, be careful to use bolts/screws and nuts of a strength class equal to, or higher than, the original fasteners (the same number marking or higher). Also select replacement fasteners of the correct size. Correct replacement bolts/screws and nuts are available through General Motors Service Parts Operation (GMSPO).

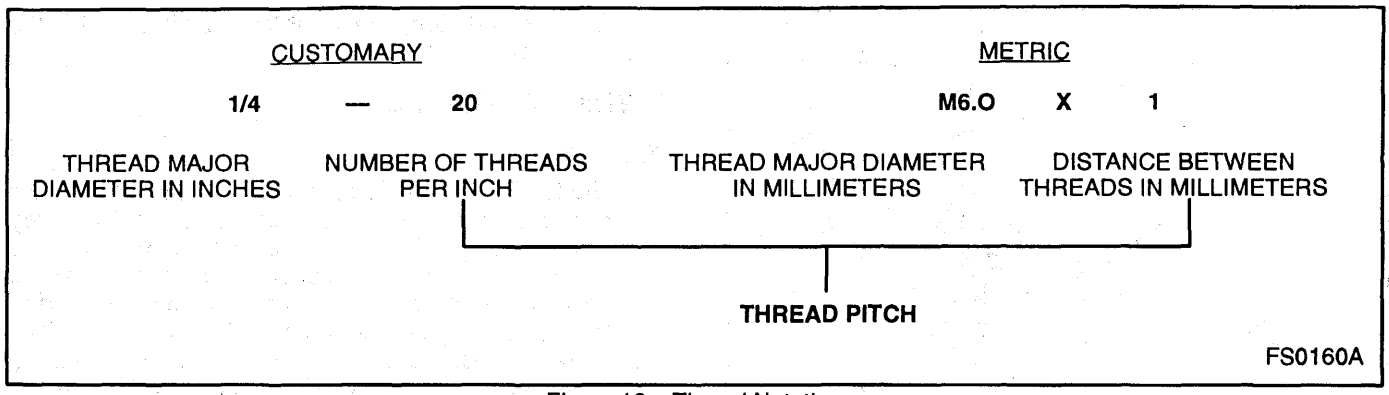


Figure 16 – Thread Notation

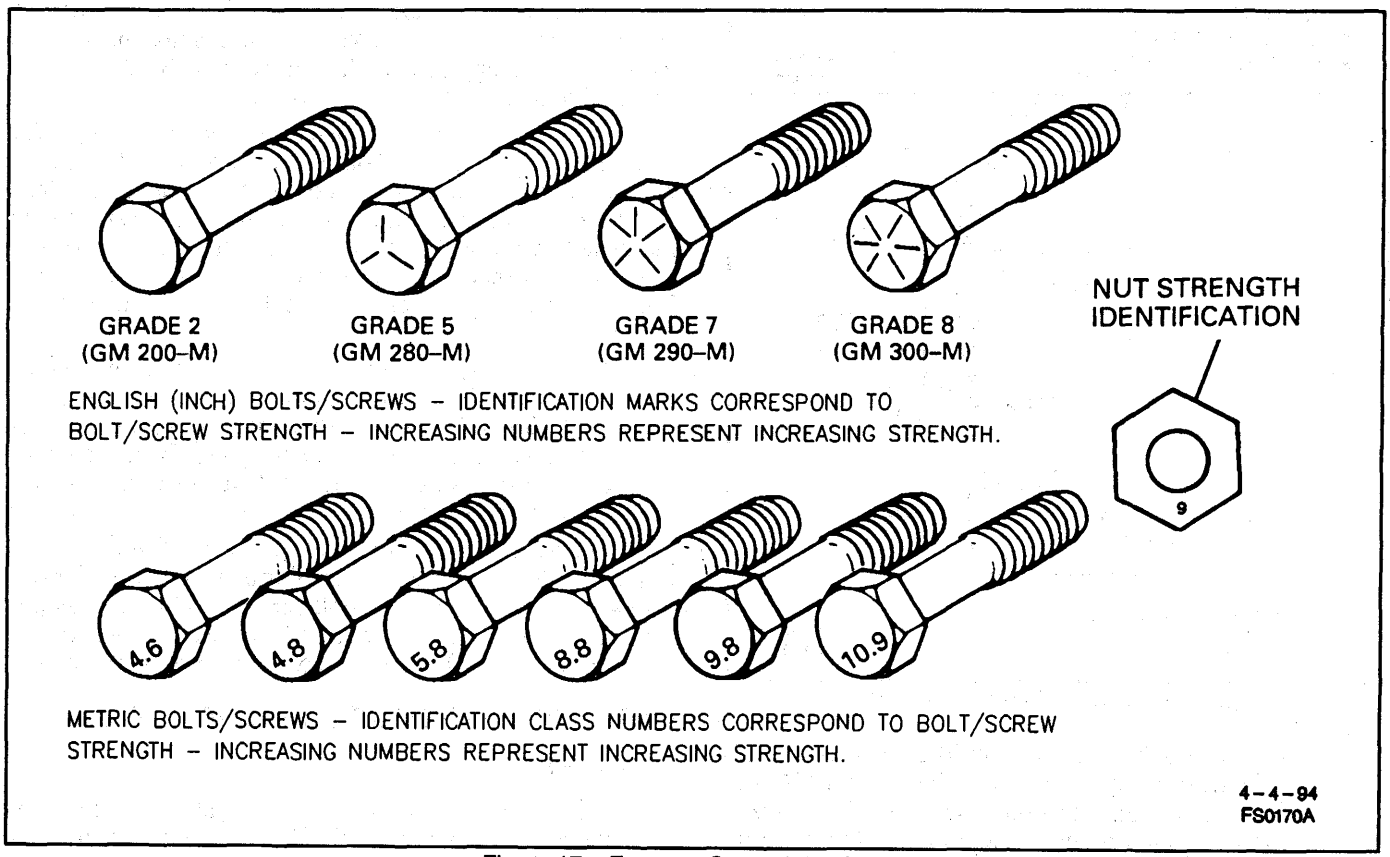


Figure 17 – Fastener Strength Markings

Many metric fasteners available in the aftermarket parts channels were designed to metric standards of countries other than the United States. The fasteners may have different strength or thread pitch and may not have the numbered head marking system. The metric fasteners used on GM products are designed to new international standards that might not be used by some nondomestic bolt/screw and nut suppliers.

PREVAILING TORQUE FASTENERS

Figures 18 and 19

A prevailing torque nut is designed to develop an interference between the nut and bolt/screw threads. This interference is usually created by distortion of the top of an all-metal nut or by a nylon patch in the threads in the middle of a hex flat. In other cases, a nylon insert may be used (Figure 18).

A prevailing torque bolt/screw is designed to develop an interference between the bolt/screw and nut threads or between the bolt/screw and tapped hole threads. This interference is created by distorting some of the threads or by using a nylon patch or adhesive (Figure 18).

Rusty or damaged bolts/screws and nuts should be replaced with new parts of the same strength class or higher. Clean, unrusted bolts/screws and nuts can be reused. Be sure to use the following recommendations:

1. Clean dirt and other foreign material from nut or bolt/screw.

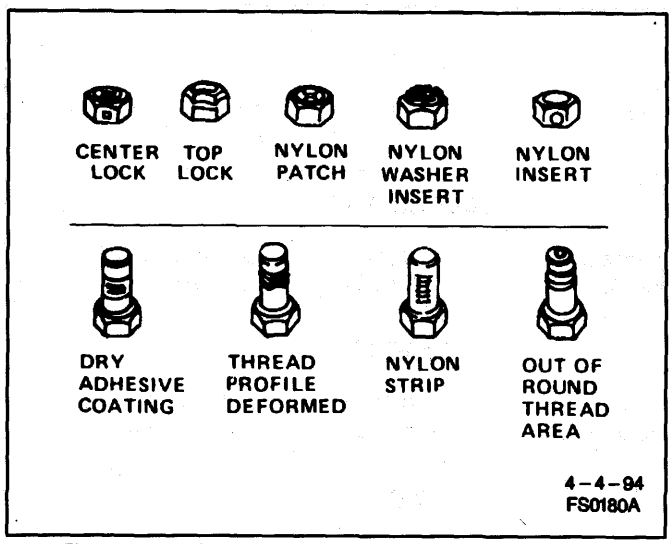


Figure 18 – Prevailing Torque Nuts and Bolts/Screws

2. Inspect nut or bolt/screw for cracks, elongation or other signs of abuse or overtightening.
   - If nut or bolt/screw is worn in any way, replace with a nut or bolt/screw of the same strength class or higher.
3. Assemble the parts and hand-start nut or bolt/screw.
4. Check that nut or bolt/screw develops the proper torque before it seats (Figure 19).
   - If nut or bolt/screw fails to develop torque correctly, replace with a nut or bolt/screw of the same strength class or higher.
5. Tighten fastener to the torque specified in the appropriate installation procedure in this manual.

ENGLISH-METRIC CONVERSIONS

Figure 20

To convert english units to metric units, multiply the english units by the conversion factor shown in Figure 20. To convert metric units to english units, divide the metric units by the conversion factor shown in Figure 20.

DECIMAL AND METRIC EQUIVALENTS

Figure 21

Inch-to-millimeter decimal equivalents are shown in Figure 21.

STANDARD NOMENCLATURE FOR ELECTRICAL/ELECTRONIC COMPONENTS AND SYSTEMS

Figures 22 and 23

Since the 1993 model, General Motors has been complying with the Society of Automotive Engineers (SAE) Recommended Practice J1930. J1930, an industry-wide standard that was adopted into government regulations, requires identical nomenclature for certain electrical/electronic components and systems that have the same function. The standard is also being applied to abbreviations, acronyms, and symbols in all GM service publications.

To make this standard work, some names and abbreviations are being replaced with those recommended by the SAE Standard. Figures 22 and 23 are a listing of former GM names and abbreviations beside the new J1930 name and abbreviations.

FASTENER TYPE	TORQUE UNITS	METRIC-SIZE FASTENERS							
		6	6.3	8	10	12	14	16	20
Nuts and All Metal Bolts/Screws	N•m	0.4	0.4	0.8	1.4	2.2	3.0	4.2	7.0
	Lb. In.	4	4	7	12	19	27	37	62
Adhesive or Nylon Coated Bolts/Screws	N•m	0.4	0.4	0.6	1.2	1.6	2.4	3.4	5.6
	Lb. In.	4	4	5	11	14	21	30	50
FASTENER TYPE	TORQUE UNITS	INCH-SIZE FASTENERS							
		.250	.312	.375	.437	.500	.562	.625	.750
Nuts and All Metal Bolts/Screws	N•m	0.4	0.6	1.4	1.8	2.4	3.2	4.2	6.2
	Lb. In.	4	5	12	16	21	28	37	55
Adhesive or Nylon Coated Bolts/Screws	N•m	0.4	0.6	1.0	1.4	1.8	2.6	3.4	5.2
	Lb. In.	4	5	9	12	16	23	30	49

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Figure 19 – Prevailing Torque Fastener Specifications

Multiply	by	to get equivalent number of:
LENGTH		
Inch	25.4	Millimeter (mm)
Foot	0.3048	meters (m)
Yard	0.9144	meters
Mile	1.609	kilometers (km)
AREA		
$Inch^2$	645.2	$millimeters^2$ (mm^2)
	6.45	$centimeters^2$ (cm^2)
$Foot^2$	0.0929	$meters^2$ (m^2)
$Yard^2$	0.836.1	$meters^2$
VOLUME		
$Inch^3$	16387.	mm^3
	16.397	cm^3
	0.0164	liters (L)
Quart	0.9464	liters
Gallon	3.7854	liters
$Yard^3$	0.7646	$meters^3$ (m^3)
MASS		
Pound	0.4536	kilograms (kg)
Ton	907.18	kilograms (kg)
Ton	0.907	tonne (t)
FORCE		
Kilogram	9.807	newtons (N)
Ounce	0.2780	newtons
Pound	4.448	newtons

Multiply	by	to get equivalent number of:
ACCELERATION		
$Foot/sec^2$	0.3048	$meter/sec^2$ (m/s^2)
$Inch/sec^2$	0.0254	$meter/sec^2$
TORQUE		
Pound-Inch	0.11298	newton-meters (N•m)
Pound-foot	1.3558	newton1-meters
POWER		
Horsepower	0.746	kilowatts (kW)
PRESSURE OR STRESS		
Inches of water	0.2491	kilopascals (kPa)
Pounds/sq. in.	6.895	kilopascals
ENERGY OR WORK		
BTU	1055.	joules (J)
Pound-foot	1.3558	joules
Kilowatt-hour	3600000. or 3.6×10^6	joules (J = one W.s)
LIGHT		
Foot Candle	10.764	$lumens/meter^2$ (lm/m^2)
VELOCITY		
Miles/hour	1.609 3	kilometers/hr. (km/h)

TEMPERATURE

To convert Fahrenheit temperature to Celsius temperature, use formula:
$°C = {}^{5}/_{9}\ (°F - 32)$

To convert Celsius temperature to Fahrenheit temperature, use formula:
$°F = {}^{9}/_{5}\ °C + 32)$

FUEL PERFORMANCE

Miles/gal $\div$ 235.215 = liters/100 Kilometers

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Figure 20 – English to SI Metric Conversion Table

DECIMAL AND METRIC EQUIVALENTS

Fractional inch	Decimal inch	Metric mm.	Fractional inch	Decimal inch	Metric mm.
1/64	.015625	.39688	33/64	.515625	13.09687
1/32	.03125	.79375	17/32	.53125	13.49375
3/64	.046875	1.19062	35/64	.546875	13.89062
1/16	.0625	1.58750	9/16	.5625	14.28750
5/64	.078125	1.98437	37/64	.578125	14.68437
3/32	.09375	2.38125	19/32	.59375	15.08125
7/64	.109375	2.77812	39/64	.609375	15.47812
1/8	.125	3.1750	5/8	.625	15.87500
9/64	.140625	3.57187	41/64	.640625	16.27187
5/32	.15625	3.96875	21/32	.65625	16.66875
11/64	.171875	4.36562	43/64	.671875	17.06562
3/16	.1875	4.76250	11/16	.6875	17.46250
13/64	.203125	5.15937	45/64	.703125	17.85937
7/32	.21875	5.55625	23/32	.71875	18.25625
15/64	.234375	5.95312	47/64	.734375	18.65312
1/4	.250	6.35000	3/4	.750	19.05000
17/64	.265625	6.74687	49/64	.765625	19.44687
9/32	.28125	7.14375	25/32	.78125	19.84375
19/64	.296875	7.54062	51/64	.796875	20.24062
5/16	.3125	7.93750	13/16	.8125	20.63750
21/64	.328125	8.33437	53/64	.828125	21.03437
11/32	.34375	8.73125	27/32	.84375	21.43125
23/64	.359375	9.12812	55/64	.859375	21.82812
3/8	.375	9.52500	7/8	.875	22.22500
25/64	.390625	9.92187	57/64	.890625	22.62187
13/32	.40625	10.31875	29/32	.90625	23.01875
27/64	.421875	10.71562	59/64	.921875	23.41562
7/16	.4375	11.11250	15/16	.9375	23.81250
29/64	.453125	11.50937	61/64	.953125	24.20937
15/32	.46875	11.90625	31/32	.96875	24.60625
31/64	.484375	12.30312	63/64	.984375	25.00312
1/2	.500	12.70000	1	1.00	25.40000

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Figure 21 – Inch-to-Millimeter Decimal Equivalents

Former FM Name	New SAE Name Term
Absolute Pressure Sensor Aps – APS	Manifold Absolute Pressure Sensor Aps – MAP Sensor
Air Cleaner Assembly	Air Cleaner – ACL
Air Cleaner Filter Element	Air Cleaner Filter – ACL Filter
Air Injection Reaction System – A.I.R. System	Secondary Air Injection System – A.I.R. System
Assembly Line Communication Link – ALCL	Data Link Connector – DLC
Assembly Line Data Link – ALDL	Data Link Connector – DLC
Barometric Pressure Sensor – BARO Sensor	Barometric Pressure Sensor – BARO Sensor
BCM-PCM Data Problem	BCM-PCM Data Link
Calibration Pack – CAL-PAK	Electronically Erasable Programmable Read Only Memory – EEPROM
Calibration Pack – CAL-PAK	Erasable Programmable Read Only Memory EPROM
Calibration Pack – CAL-PAK	Programmable Read Only Memory – PROM
Camshaft Sensor	Camshaft Position Sensor – CMP Sensor
Canister Purge – CP	Evaporator Emission Canister Purge – EVAP Canister Purge
Catalytic Converter – Cat. Conv.	Oxidation Catalytic Converter – OC
Catalytic Converter – Cat. Conv.	Three Way + Oxidation Catalytic Converter – TWC + OC
Catalytic Converter – Cat. Conv.	Three Way Catalytic Converter – TWC
Catalytic Converter – Cat. Conv.	Warm Up Oxidation Catalytic Converter – WU-OC
Catalytic Converter – Cat. Conv.	Warm Up Three Way Catalytic Converter – WU-TWC
Check Engine Indicator	Malfunction Indicator Lamp –MIL
Code	Diagnostic Trouble Code – DTC
Computer Command Control – CCC	Engine Control Module – ECM
Computer Controlled Coil Ignition – C31	Electronic Ignition – EL
Controlled Canister Purge – CCP	Evaporative Emission Canister Purge – EVAP Canister Purge
Coolant Temperature Sensor – CTS	Engine Coolant Temperature Sensor – ECT Sensor
Coolant Temperature Switch – CTS	Engine Coolant Temperature Sensor – ECT Switch
Detonation Sensor	Knock Sensor – KS
Diagnostic Circuit Check	On-Board-Diagnostic System Check – OBD System Check
Digital Electronic Fuel Injection – DEFI	Multiport Fuel Injection – MFI
Digital Electronic Fuel Injection – DEFI	Sequential Multiport Fuel Injection – SFI
Digital Fuel Injection – DFI	Multiport Fuel Injection – MFI
Digital Fuel Injection – DFI	Sequential Multiport Fuel Injection – SFI
Digital Ignition System – DIS	Electronic Ignition system – EI System
Distributor HEI Module	Distributor Ignition Control Module – DI Control Module
Distributorless Ignition System – DIS	Electronic Ignition System – EI System
Dual Bed Monolith – DBM	Oxidation Catalytic Converter – OC
Dual Bed Monolith – DBM	Three Way Catalytic Converter – TWC
Electronic Air Control – EAC	Secondary Air Injection bypass Valve – AIR Bypass Valve
Electronic Air Switching – EAS	Secondary Air Injection Switching Valve – AIR Switching Valve
Electronic Control Module – ECM	Engine Control Module – ECM
Electronic Fuel Injection – EFI	Multiport Fuel Injection System – MFI
Electronic Fuel Injection – EFI	Sequential Multiport Fuel Injection – SFI
Electronic Fuel Injection – EFI	Throttle Body Fuel Injection – TBI
Electronic Spark Control Circuit – ESC Circuit	Knock Sensor Circuit – KS Circuit
Electronic Spark Control System – ESC System	Knock Sensor System – KS System

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Figure 22 – Standard Nomenclature for Electrical/Electronic Components and Systems (1 of 2)

Former FM Name	New SAE Name Term
Electronic Spark Timing – EST	Ignition Control – IC
Electronic Spark Timing Circuit – EST Circuit	Ignition Control Circuit – IC Circuit
Electronic Vacuum Regulator Valve – EVRV	Exhaust Gas Recirculation Electronic Vacuum Regulator Solenoid Valve – EGR Electronic Vacuum Regulator Solenoid Valve
Engine Calibration Unit – ECU	Programmable Read Only Memory – PROM
Evaporative Emission Control System – EECS	Evaporative Emission System – EVAP System
Exhaust Gas Recirculation/Thermostatic Vacuum Switch – EGR/TVS	Exhaust Gas Recirculation Thermal Vacuum Valve – EGR TW
Fuel CAL-PAK Missing	Programmable Read Only Memory Missing – PROM Missing
High Energy Ignition – HEI	Distributor Ignition – DI
Lean Exhaust	Lean Heated Oxygen Sensor Signal – Lean HO_2S
Lean Exhaust	Lean Oxygen Sensor Signal – Lean HO_2S Signal
Manifold Air Temperature Sensor – MAT Sensor	Intake Air Temperature Sensor – IAT Sensor
MEM-CAL Error	Erasable Programmable Read Only – Only Memory – Error – PROM Error
MEM-CAL Error	Programmable Read Only Memory Error – PROM Error
Memory and Calibration Unit – MEM-CAL	Erasable Programmable Read Only Memory – EPROM
Memory and Calibration Unit – MEM-CAL	Programmable Read Only Memory – PROM
Multi-Port Fuel Injection – MPFI	Multi-Port Fuel Injection – MFI
Oxygen Sensor – O_2	Heated Oxygen Sensor – HO_2S
Oxygen Sensor – O_2	Oxygen Sensor – O_2S
Park/Neutral Switch – P/N Switch	Park/Neutral Position Switch – PNP Switch
Port Fuel Injection – PFI	Multi-Port Fuel Injection – MFI
Pulse Air Injection System – PAIR	Pulsed Secondary Air Injection System – PAIR System
Revolutions Per Minute – rpm	Engine Speed – RPM
Rich Exhaust	Rich Heated Oxygen Sensor Signal – Rich HO_2S Signal
Rich Exhaust	Rich Oxygen Sensor Signal – Rich O_2S Signal
"Scan" Data	Scan Tool Data – ST Data
Service Engine Soon Indicator – SES Indicator	Malfunction Indicator Lamp – MIL
Thermal vacuum Switch – TVS	Thermal Vacuum Valve – TVV
Thermostatic Air Cleaner – TAC	Air Cleaner – ACL
Throttle Body Injection – TBI	Throttle Body Fuel Injection – TBI
Throttle Position Sensor – TPS	Throttle Position Sensor – TPS
Throttle Position Switch – TPS	Closed Throttle Position Switch – CTP Switch
Throttle Switch	Closed Throttle Position Switch – CTP Switch
Throttle Switch	Wide Open Throttle Switch – WOT Switch
Tuned Port Injection – TPI	Multi-Port Fuel Injection – MFI
Viscous Converter Clutch – VCC	Torque Converter Clutch – TCC

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Figure 23 – Standard Nomenclature for Electrical/Electronic Components and Systems (2 of 2)

ABBREVIATIONS, ACRONYMS AND SYMBOLS

The following abbreviations may appear in this manual.

A

A	Amperes
A-6	Axial 6 Cylinder A/C Compressor
A/C	Air Conditioning
A/F	Air/Fuel (A/F Ratio)
ABDC	After Bottom Dead Center
ABS	(Body) Acrylonitrile-Butadiene-Styrene (Brake Antilock Brake System
ac	alternating current
AC	A GM Division
ACC	Automatic Climate Control
ACL	Air Cleaner
A/D	Analog-to-Digital
ADF	Air Deflector Valve
AIR	Air Injection Reaction
Al	Aluminum
ALC	Automatic Level Control
AM/FM	Amplitude Modulation/ Frequency Modulation
amp	amperes
API-GL	American Petroleum Institute-Gear Lubricant
APT	Adjustable Part Throttle
ARS	Automatic Restraint System
ASM	Assembly
ASR	Acceleration Slip Regulation
A/T	Automatic Transmission
ATC	Automatic Temperature Control
ATDC	After Top Dead Center
ATS	Air Temperature Sensor
Auto	Automatic
avg	average
AWD	All Wheel Drive
AWG	American Wire Gage

B

BARO	Barometric
bat	battery
B+	battery positive
BBDC	Before Bottom Dead Center
BCM	Body Control Module
BHP	Brake Horsepower
BLM	Block Learn Multiplier
BP	Back Pressure
BTDC	Before Top Dead Center
Btu	British thermal units

C

°C	Degrees Celsius
C LOOP	Closed Loop
C-4	Computer Controlled Catalytic Converter
CAD	Computer Aided Design
CAM	Camshaft
CCM	Central Control Module
CCOT	Cycling Clutch Orifice Tube
Cd	Cadmium
CD	Compact Disc
CDRV	Crankcase Depression Regulator Valve
CE	Commutator End
CEAB	Cold Engine Airbleed
CEMF	Counter Electromotive Force
cfm	cubic feet per minute
cg	center of gravity
CHA	Carburetor Hot Air
CID	Cubic Inch Displacement
ckt	circuit
CLCC	Closed Loop Carburetor Control
CLTBI	Closed Loop Throttle Body Injection
cm^3	cubic centimeter
CMP	Camshaft Position
CO	Carbon monoxide
COA	Carburetor Outside Air
CPA	Connector Position Assurance
CPS	Central Power Supply
CPU	Central Processing Unit
CRT	Cathode Ray Tube
CRTC	Cathode Ray Tube Controller
CTP	Closed Throttle Position
CTS	Cold Trapped Spark
cu ft or ft^3	cubic foot, or feet
cu in or in^3	cubic inch, or inches
CV	constant velocity (joint)
CYL	Cylinder(s)

D

dB	decibels
dBA	decibels on A-weighted scale
DBB	Dual Bed Bead
dc	direct current
DE	Drive End
DEC	Digital Electronic Controller
DERM	Diagnostic Energy Reserve Module
DI	Distributor Ignition
dia	diameter
DIFF	Differential
DIS	Distributorless Ignition System
DLC	Data Link Connector
DRL	Daytime Running Lamps
DTC	Diagnostic Trouble Code
DVM	Digital Volt Meter

E

E/P	Ethylene/Propylene
EBTCM	Electronic Brake Traction Control Module
ECC	Electronic Climate Control

ECI	Extended Compressor at Idle
ECM	Engine Control Module
ECS	Emission Control System
ECT	Engine Coolant Temperature Sensor, Engine Coolant Temperature Switch
EDES	Electric Divert/Electric Air Switching Valve
EEC	Evaporative Emission Control
EEPROM	Electronically Erasable Programmable Read Only Memory
EES	Evaporative Emission System
EE-VIR	Evacuator Equalized Values-In-Receiver
EEVIR	Evaporator Equalized Values in Receiver
EFE	Early Fuel Evaporation
EGR	Exhaust Gas Recirculation
EGR TVV	Exhaust Gas Recirculation Thermal Vacuum Valve
EI	Electronic Ignition
ELC	Electronic Level Control
EMF	Electromotive Force
EOS	Exhaust Oxygen Sensor
EPR	Exhaust Pressure Regulator
EPROM	Erasable Programmable Read Only Memory
ESD	Electrostatic Discharge
ETC	Electronic Temperature Control
ETCC	Electronic Touch Comfort Control, Electronic Touch Climate Control
ETR	Electronically Tuned Receiver
EVAP	Evaporator Emission

F

°F	Degrees Fahrenheit
FDC	Fuel Data Center
FEC	Fuel Evaporator Control
FED	Federal (all states except California)
FI	Fuel Injection
FICD	Fast Idle Control Diaphragm
4WAL	Four Wheel Antilock
ft	foot, feet
FWD	Front Wheel Drive, Four Wheel Drive

G

g	gravitational acceleration, grams
GA	gage
gal	gallon
gas	gasoline
GCW	Gross Combination Weight
Gen	Generator
GM	General Motors
gnd	ground

H

H_2O	water
H/CMPR	High Compression
HC	hydrocarbons
HD	Heavy Duty
HDC	Heavy Duty Cooling
hex	hexagon
Hg	mercury
Hi Alt	High Altitude
HIC	High Idle Compensator
HO_2S	Heated Oxygen Sensor
hp	horsepower
HPCA	Housing Pressure Cold Advance
HPL	High Pressure Liquid
HPV	High Pressure Vapor
HVAC	Heater-Vent-Air Conditioning
HVACM	Heater-Vent-Air Conditioning Module
HVM	Heater Vent Module
Hz	hertz

I

IAC	Idle Air Control
IAT	Intake Air Temperature
IC	Integrated Circuit, Ignition Control
ID	Inside Diameter, identification
IDI	Integrated Direct Ignition
ign	ignition
ILC	Idle Load Compensator
INJ	Injection
I/P	Instrument Panel
ISC	Idle Speed Control

K

KAM	Keep Alive Memory
kg	kilogram
kHz	kilohertz
km/h	kilometers per hour
km/L	kilometers per liter
kPa	kilopascals
KS	Knock Sensor
kV	kilovolts

L

L	liter
L4	Four Cylinder, In-Line Engine
L6	Six Cylinder, In-Line Engine
lb. ft.	pound feet (torque)
lb. in	pound inch (torque)
LCD	Liquid Crystal Display
LF	Left Front
LH	Left Hand
LR	Left Rear
lt	left

M

M/C	Mixture Control
MAF	Mass Air Flow
Man	Manual
MAP	Manifold Absolute Pressure

Max	Maximum
MDP	Manifold Differential Pressure
MFI	Multi-port Fuel Injection
mgd	million gallons per day
mi	miles
MIL	Malfunction Indicator Lamp
min	minimum
mL	milliliters
mm	millimeters
MFI	Multiport Fuel Injection
mpg	miles per gallon
mph	miles per hour
ms	millisecond
M/T	Manual Transmission
MV	megavolt
mV	millivolt
MVS	Metering Valve Sensor
MVSS	Motor Vehicle Safety Standards

N

NC	Normally Closed
NEG	Negative
NEU	neutral
NLGI	National Lubricating Grease Institute
Ni	nickel
N•m	Newton-meters (torque)
NO	Normally Open
NO_x	oxides of nitrogen
NPTC	National Pipe Thread Coarse
NPTF	National Pipe Thread Fine

O

O_2S	Oxygen Sensor
OBD	On-Board Diagnostic
OC	Oxidation Catalytic Converter
OD	Outside Diameter
OEM	Original Equipment Manufacturer
ORC	Oxidizing Reducer Converter
oz	ounce(s)

P

P/N	Part Number
PA	polyamide
PAIR	
PBT	polybutylene terephthalate
PC	polycarbonate
PCM	Powertrain Control Module
PCV	Positive Crankcase Ventilation
PE	polyethylene
PECV	Power Enrichment Control Valve
PEDESV	Pressure Operated Electric Divert/Air Electric Switching Valve
PF	phenol-formaldehyde
PFI	Port Fuel Injection
PM	Permanent Magnet (Generator)
PNP	Park/Neutral Position
POA	Pilot Operated Absolute Valve
POLYE	polyethylene
POLYF	polyfoam
POLYP	polypropylene
POLYU	polyurethane
POS	Positive
POT	Potentiometer (Variable Resistor)
POM	polyoxymethylene
PP	polypropylene
PPE	polyphenylene ether
ppm	parts per million
PROM	Programmable Read Only Memory
PS	Power Steering
PSPS	Power Steering Pressure Switch
psi	pounds per square inch
psia	pounds per square inch absolute
psig	pounds per square inch gage
pt.	pint
PTO	Power Take Off
PUR	polyurethane (thermoset)
PWM	Pulse Width Modulated

Q

qt.	quart(s)

R

R-4	Radial Four Cylinder Air Compressor
R-12	Refrigerant-12
R-134A	Refrigerant-R134A
RAM	Random Access Memory (non-permanent memory device)
RAP	Retained Accessory Power
Ref	Reference
RF	Right Front
RFI	Radio Frequency Interference
RH	Right Hand
RIM	Reaction Injection Molded Urethane
RPM	Engine Speed
RPO	Regular Production Option
RR	Right Rear
RRIM	Reinforced Reaction Injection Molded Urethane
rt	right
ROM	Read only Memory (permanent memory device)
RTV	Room Temperature Vulcanizing (sealer)
RVB	Rear Vacuum Brake
RVR	Response Vacuum Reducer
RWAL	Rear Wheel Antilock
RWD	Rear Wheel Drive

S

SAE	Society of Automotive Engineers
s	second(s)
SEO	Special Equipment Option
SES	Service Engine Soon
SI	System International (Modern Version of Metric System)
Si	silicone
SIR	Supplemental Inflatable Restraint
SLA	short/long arm
SMC	Sheet Molded Compound
SO_2	sulfur dioxide

sq ft, ft^2	square foot(feet)
sq in, in^2	square inch(es)
ST	Scan Tool
T	
TBI	Throttle Body Fuel Injection
TCC	Torque Converter Clutch, Transmission Converter Clutch
TCCTVMV	Torque Converter Clutch Trim Vacuum Modulator Valve
TDC	Top Dead Center
TEMP	Temperature
THM	Turbo Hydra-Matic
THERMAC	Thermostatic Air Cleaner
TP	Throttle Position
TPE	Thermo Plastic Elastomer
TPO	Thermo Plastic Olefin
TPU	Polyurethane (thermoplastic)
TRANS	Transmission
TRC	Throttle Return Control
Turbo	Turbocharger
TV	Throttle Valve
TVBV	Turbocharger Vacuum Bleed Valve
TVRS	Television and Radio Suppression
TVV	Thermal Vacuum Valve
TWC	Three Way Catalytic Converter
TWC+OC	Three Way + Oxidation Catalytic Converter
TXV	Thermal Expansion Valve
U	
U-joint	universal joint
V	
V	volt(s), voltage
V4	Four Cylinder Engine
V6	Six Cylinder Engine
V8	Eight Cylinder Engine
VAC	vacuum
VATS	Vehicle Anti-Theft System
VDV	Vacuum Delay Valve
vel	velocity
VF	Vacuum Fluorescent
VIN	Vehicle Identification Number
VIR	Valves In Receiver
VLV	Vacuum Limiting Valve
VLVMV	Vacuum Limiting Vacuum Modulator Valve
VMV	Vacuum Modulator Valve
VRV	Vacuum Reducer Valve
VSS	Vehicle Speed Sensor
W	
W/S	Windshield
WOT	Wide Open Throttle
WSS	Wheel Speed Sensor
WU-OC	Warm Up Oxidation Catalytic Converter
WU-TWC	Warm Up Three Way Catalytic Converter
X	
X-valve	expansion valve
Y	
yd	yard
Z	
Zn	zinc

REPLACEMENT LABELS

Replacement labels are available through GM Service Parts Operations for the following:

- Vehicle Emission Control Information (Exhaust Emission Tune Up)
- Spare Wheel Caution
- Superlight® Shock Absorber Information
- Jacking
- Spare Tire Storage
- Serpentine Belt Routing (when it is a separate label)
- Engine Fan Caution
- IRS/SIR Service Caution
- Odometer Reset

These and other labels will be found in the Standard Parts Catalog.

The Vehicle Certification Label, Tire Pressure Placard and Service Parts Identification Label are **NOT** available as service parts.

SERVICE PARTS IDENTIFICATION LABEL

Figure 24

The Service Parts Identification Label has been developed and placed on the vehicle to aid service and parts personnel in identifying parts and options originally installed on the vehicle. The label is attached to the inside of the instrument panel compartment.

OPTION CODES

Vehicle options are identified on the Service Parts Identification Label by option codes. Option codes are three-digit combinations of letters and numbers. They identify equipment installed on the vehicle, and trim and paint colors. Refer to "Option and Process Codes" in this section.

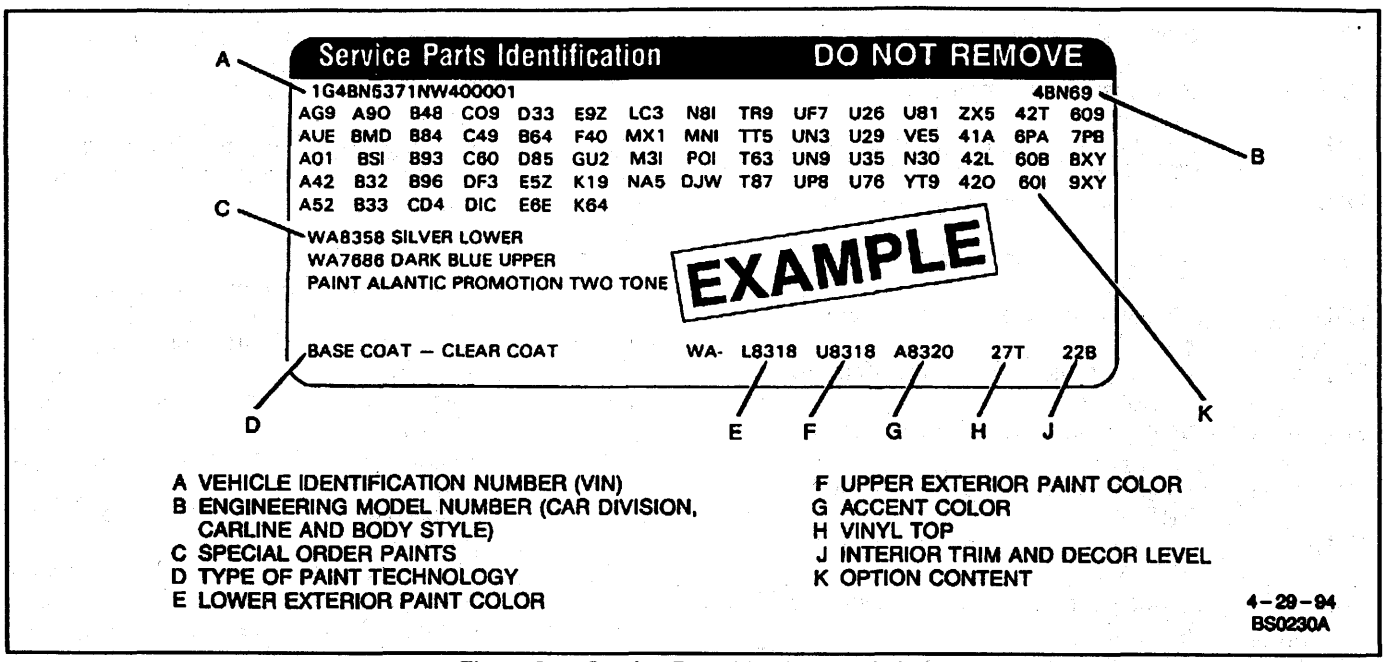
OPTION AND PROCESS CODES

AAA	Standard Equipment
Ab1	Adjuster, 6-Way Power, Driver Seat
ACM	Lead Units
AH3	Adjuster, 4-Way Manual, Driver Seat
AK5	Restraint System Front Seat, Inflatable, Driver and Passenger
AN4	Restraint Provisions, Child
AQ9	Seat, Passenger and Driver, Recline
AR9	Seat, Passenger and Driver, Recline (European Style)
AU0	Lock Control, Remote Entry
AU3	Lock, Side Door, Electric
AX4	Restraint Conversion Seat, Manual, European
A26	Window, European Glazing, All
A31	Window, Power Operated, Side
A90	Lock, Rear Compartment Lid, Remote Control, Electric
BF9	Delete Floor Mats
B35	Floor Mats, Rear, Carpeted Insert
B84	Ornamentation Exterior Molding, Body Side
CC1	Roof Hatch, Removable Glass Panels
C41	HVAC System, Heater
C49	Defogger, Rear Window Electric
C60	HVAC System, Air Conditioner, Manual Control
C9C	Paint Special (Black)
DD9	Mirror, Outside, LH and RH, Remote Control, Electric, Breakaway, Painted
DE4	Sunshade, Removable Hatch Roof
DG7	Mirror, Outside LH & RH, Remote Control, Electric, Painted
D35	Mirror, Outside LH Remote, RH Manual, Painted
FE2	Suspension System, Ride Handling
F41	Suspensions System, Firm Ride Handling, Front and Rear
GU2	Axle, Rear 2.73 Ratio
GU5	Axle, Rear 3.23 Ratio
GU6	Axle, Rear 3.42 Ratio
G80	Axle, Rear Positraction (Limited Slip)
ILD	Trim, Interior Design
IL2	Trim, Interior Design
IPB	Trim, Interior Design
IP2	Seat, Leather Sport Front Bucket, Driver and Passenger, Reclining
JIF	Brake Provisions, Special to Suit Foreign Regulations
J41	Brake System, Power, Front Disc, Rear Drum, Cast Iron
J65	Brake System, Power, Front and Rear Disc
KC4	Cooling System, Engine Oil
KG9	Generator, 140 Amp
K05	Heater, Engine Block
K34	Cruise Control, Automatic Electronic
K68	Generator, 105 Amp EXP
LT1	Engine, 5.7L (V8) MFI
L32	Engine, 3.4L (V6) MFI
MM5	Transmission – 5-Speed Manual (Merchandising Option)
MM6	Transmission, Manual, 6-Speed, Borg Warner, 85 mm, 2.66 1st, 0.50 6th, O/D
MN6	Transmission – 6-Speed Manual (Merchandising Option)
MX0	Transmission – Automatic O/D (Merchandising Option)
M30	Transmission – Automatic, 4-Speed, 4L60-E, Electronic
M49	Transmission, Manual, 5-Speed, Borg Warner, 77 mm, 3.75 1st, 0.76 5th, O/D
NA5	Emission System – Federal Requirements. Tier O.
NB6	Emission System – California Requirements
NB8	Emission System – Override California
NC3	Tailpipe Modifications
NF2	Emission System- Federal Requirement Tier 1
NK3	Steering Wheel, Sport, Soft Rim, Simulated Leather
NM8	Leaded Fuel System Compatible
NN5	Emission System- California Requirements, Override
NP5	Steering Wheel, Leather Wrapped
NW9	ASR-Traction Control
N36	Steering Wheel, 4 Spokes, Sport
N96	Wheel, 16 x 8, Cast Aluminum
PW7	Wheel, 16 x 8, Aluminum Styled
QA7	Wheel, 16 x 7.5, Aluminum
QB3	Wheel, 16 x 7.5, Steel
QF2	Tire, P245/50ZR16 BW R/PE ST TL AL3
QII	Tire, P215/60R16 BW R/PE ST TL AL3 94H
QLC	Tire, P245/50ZR16/N BL R/PE ST TL HW4
QMT	Tire, P235/55R16/N BL R/PE ST TL AL2
QPE	Tire, P215/60R16/N BL R/PE ST TL AL2
STE	Plant Code–St. Therese, PQ, GM of Canada
TR7	Headlamps, Automatic Control Leveling System
TU8	Lamp, Interior, Stop, High Level – Delete
T2H	Ornamentation, Exterior, Export
T2J	Ornamentation, Interior, Export
T39	Lamp Turn Signal, Auxiliary
T43	Spoiler, Rear
T61	Lighting- Daytime Running
T65	Lighting – Daytime Running Export
T72	Headlamps, Left Hand Rule of Road, Export
T79	Lamps, Fog Rear
T84	Headlamps, RH Rule Of Road
T90	Lamp Signaling and Marker, Export
T96	Lamp, Fog
UB3	Instrument Cluster, Oil, Coolant, Temperature, Volts, Trip Odometer, Tachometer

UD4	Alarm Vehicle Speed, 120 km/h
UD6	Alarm, Exhaust Temperature
UK1	Japanese Radio Frequencies
UK2	Lever, Directional Signal, Multifunction
UK3	Electronic System Accessory Control
UL2	European Radio Frequencies
UM6	Radio, AM/FM Stereo, Seek/Scan, Auto Reverse Cassette, Clock, ETR
UN6	Radio, AM/FM Stereo, Seek/Scan, Auto Reverse Music Search Cassette, Clock, ETR
UP3	Radio, AM Stereo and FM Stereo, Seek/Scan, Compact Disc, Equalizer, Clock, ETR
UQ0	Speaker System 4, Dual Front Door Mounted, Standard Range Quarter/Shelf
UT6	Radio AM Stereo and FM Stereo, Seek/Scan, Auto Reverse Music Search Cassette, Equalizer, Clock, ETR
UU8	Radio, AM/FM Stereo, Seek/Scan, Auto Reverse Music Search Cassette, HPS, Clock, ETR
UW2	Speaker System 10, Quad Front Door Mounted, Dual Rear Sail Panel, Amplifier
UW3	Radio AM/FM Stereo, Seek/Scan, Auto Reverse Music Search Cassette, Data System, Clock, ETR
UW6	Premium 6 Speaker System
UX1	Radio, AM Stereo and FM Stereo, Seek/Scan, Auto Reverse Music Search Cassette, Equalizer, Clock, ETR
U1C	Radio, AM/FM Stereo, Seek/Scan, Compact Disc, Clock, ETR
U1T	Radio, AM/FM Stereo, Seek/Scan, Compact Disc, HPS, Clock, ETR
U18	Speedometer Instrument, Kilometers
U19	Speedometer Instrument, Kilometers and Miles, Kilometer Odometer
U62	Speaker System 4, Dual Coax Front, Dual Coaxial Package Shelf
U65	Speaker System 5, Dual Front Door Mtd, Dual Ext Range Sail Panel, Single Rear Compartment
U73	Antenna, Fixed
U75	Antenna, Power
U82	Speaker System 3, Dual Door Mounted, Rear Package Shelf
VA5	Language Label, English
VB1	Shipping Label, Japan
VC1	Label, Price/Fuel Economy
VC3	Label, Price/Fuel Economy, US Territories
VC4	Label, Price/Fuel Economy, Puerto Rico
VG1	Protector Underhood Compound, Corrosion Preventive, Water Based, Clear
VG4	Protector Undervehicle Compound, Corrosion Preventive, Water Based, Black
VG7	Bumper Standard Label, Impact, 25 MPH, Notice to Buyer, California
VG9	Protector Wax, Exterior Body, Export
VH2	Bumper Standard Impact, 2.5 MPH, Hawaii
VH5	Plate, Vehicle Identification
VK3	License Plate, Front Mounting Package
VL4	License Plate, Front Mounting Package, EEC, Export
VL5	License Plate, Front Mounting Package, Export
VL7	Bumper Standard Impact, 5 MPH, Front and Rear, New York
VP6	Noise Control
VR6	Hook, Tie Down
VR7	Hook Tow, Rear, Second
V73	Vehicle Statement, US/Canada
V76	Hook, Tow
V78	Vehicle Statement - Delete
V87	Vehicle Statement, Gulf States Organization
WS9	Model Conversion Formula
WX7	Wiring Provisions
W66	Merchandised Package - Formula
Y81	Merchandised Package - Firebird
Y82	Merchandised Package - Trans Am, Base Coupe
Y84	Merchandised Package - Trans Am
Z28	Merchandised Package - Special Performance
Z49	Canadian Modifications
01U	Primary Color Exterior, Special
05P	Wheel Color Argent
05Q	Molding Color, Cyclamen
05U	Primary Color Exterior, Cyclamen
1LE	Performance Package Components
1SA	Package Option 01
1SB	Package Option 02
1SC	Package Option 03
1SD	Package Option 04
1SE	Package Option 05
1SF	Package Option 06
10I	Interior Trim - Arctic White
10T	Top Color - Arctic White
102	Trim Combination Leather, Arctic White
10Q	Molding Color – Arctic White
10U	Primary Color – Exterior, Arctic White
12B	Trim Combination – Cloth, Graphite
12D	Trim Combination – Cloth, Graphite
12I	Interior Trim – Graphite
122	Trim Combination – Leather, Graphite
13Q	Molding Color - Bright Silver Metallic
13U	Primary Color Exterior - Bright Silver Metallic
14B	Trim Combination – Cloth, Lt. Gray
14D	Trim Combination – Cloth, Lt. Gray
14I	Interior Trim – Lt. Gray
142	Trim Combination – Leather, Lt. Gray
17P	Wheel Color – Silver

40P	Wheel Color – White
41Q	Molding Color – Black
41T	Top Color - Black
41U	Primary Color – Exterior, Black
48Q	Molding Color – Dark Yellow Green Metallic
48U	Primary Color – Exterior, Dark Yellow Green Metallic
6AA	Suspension – Computer Selected. FRT, LH
6AB	Suspension – Computer Selected, FRT, LH
6AD	Suspension – Computer Selected, FRT, LH
6AE	Suspension – Computer Selected, FRT, LH
6AG	Suspension – Computer Selected, FRT, LH
6AH	Suspension – Computer Selected, FRT, LH
6AJ	Suspension – Computer Selected, FRT, LH
6AK	Suspension – Computer Selected, FRT, LH
6AZ	Suspension – Computer Selected, FRT, LH
6AM	Suspension – Computer Selected, FRT, LH
6AN	Suspension – Computer Selected, FRT, LH
6AR	Suspension – Computer Selected, FRT, LH
6AS	Suspension – Computer Selected, FRT, LH
6AT	Suspension – Computer Selected, FRT, LH
6AV	Suspension – Computer Selected, FRT, LH
6AW	Suspension – Computer Selected, FRT, LH
6AX	Suspension – Computer Selected, FRT, LH
6AY	Suspension – Computer Selected, FRT, LH
6BA	Suspension – Computer Selected, FRT, LH
6BB	Suspension – Computer Selected, FRT, LH
6BD	Suspension – Computer Selected, FRT, LH
6BE	Suspension – Computer Selected, FRT, LH
6BG	Suspension – Computer Selected, FRT, LH
6BH	Suspension – Computer Selected, FRT, LH
6BJ	Suspension – Computer Selected, FRT, LH
6BK	Suspension – Computer Selected, FRT, LH
6BL	Suspension – Computer Selected, FRT, LH
6BM	Suspension - Computer Selected, FRT, LH
6BN	Suspension - Computer Selected, FRT, LH
6GL	Suspension - Computer Selected, FRT, LH
6GM	Suspension - Computer Selected, FRT, LH
6GN	Suspension - Computer Selected, FRT, LH
6GR	Suspension - Computer Selected, FRT, LH
6HA	Suspension - Computer Selected, FRT, LH
6HB	Suspension - Computer Selected, FRT, LH
6HD	Suspension - Computer Selected, FRT, LH
6HE	Suspension - Computer Selected, FRT, LH
6HG	Suspension - Computer Selected, FRT, LH
6HW	Suspension - Computer Selected, FRT, LH
6HX	Suspension - Computer Selected, FRT, LH
6Z3	Speed Recorder
62T	Top Color - Light Beechwood Metallic
64B	Trim Combination – Cloth, Lt. Beige
64D	Trim Combination–Cloth, Lt. Beige
64I	Interior Trim – Lt. Beige
642	Trim Combination – Leather, Lt. Beige
7AA	Suspension – Computer Selected, FRT, RH
7AB	Suspension – Computer Selected, FRT, RH
7AD	Suspension – Computer Selected, FRT, RH
7AE	Suspension – Computer Selected, FRT, RH
7AG	Suspension – Computer Selected, FRT, RH
7AH	Suspension – Computer Selected, FRT, RH
7AJ	Suspension – Computer Selected, FRT, RH
7AK	Suspension – Computer Selected, FRT, RH
7AL	Suspension – Computer Selected, FRT, RH
7AM	Suspension – Computer Selected, FRT, RH
7AN	Suspension – Computer Selected, FRT, RH
7AR	Suspension – Computer Selected, FRT, RH
7AS	Suspension – Computer Selected, FRT, RH
7AT	Suspension – Computer Selected, FRT, RH
7AV	Suspension – Computer Selected, FRT, RH
7AW	Suspension – Computer Selected, FRT, RH
7AX	Suspension – Computer Selected, FRT, RH

7AY	Suspension – Computer Selected, FRT, RH
7BA	Suspension – Computer Selected, FRT, RH
7BB	Suspension – Computer Selected, FRT, RH
7BD	Suspension – Computer Selected, FRT, RH
7BE	Suspension – Computer Selected, FRT, RH
7BG	Suspension – Computer Selected, FRT, RH
7BH	Primary Color – Exterior, Medium Patriot Red
7BJ	Suspension – Computer Selected, FRT, RH
7BK	Suspension – Computer Selected, FRT, RH
7BL	Suspension – Computer Selected, FRT, RH
7BM	Suspension - Computer Selected, FRT, RH
7BN	Suspension - Computer Selected, FRT, RH
7GL	Suspension - Computer Selected, FRT, RH
7GM	Suspension - Computer Selected, FRT, RH
7GN	Suspension - Computer Selected, FRT, RH
7GR	Suspension - Computer Selected, FRT, RH
7HA	Suspension - Computer Selected, FRT, RH
7HB	Suspension - Computer Selected, FRT, RH
7HD	Suspension - Computer Selected, FRT, RH
7HE	Suspension - Computer Selected, FRT, RH
7HG	Suspension - Computer Selected, FRT, RH
7HW	Suspension - Computer Selected, FRT, RH
7HX	Suspension - Computer Selected, FRT, RH
70I	Interior Trim - Torch Red
702	Trim Combination Leather, Torch Red
71Q	Suspension – Computer Selected, FRT, RH
71U	Primary Color - Exterior, Medium Patriot Red
73B	Trim Combination Cloth - Flame Red
73I	Interior Trim - Flame Red
79Q	Molding Color - Mystic Teal Pearl
79U	Primary Color Exterior - Mystic Teal Pearl
8TB	Suspension – Computer Selected, RR, LH
8TC	Suspension – Computer Selected, RR, LH
8TD	Suspension – Computer Selected, RR, LH
8TF	Suspension – Computer Selected, RR, LH
8TH	Suspension – Computer Selected, RR, LH
8TJ	Suspension – Computer Selected, RR, LH
8TK	Molding Color – Medium Quasar Blue Metallic
8TM	Primary Color – Exterior, Medium Quasar Blue Metallic
8TP	Suspension - Computer Selected, RR, LH
80Q	Molding Color – Bright Red
	Primary Color – Exterior, Bright Red
80U	Suspension – Computer Selected, RR, RH
81Q	Suspension – Computer Selected, RR, RH
81U	Suspension – Computer Selected RR, RH
9TB	Suspension – Computer Selected, RR, RH
9TC	Suspension – Computer Selected, RR, RH
9TD	Suspension – Computer Selected, RR, RH
9TF	Suspension – Computer Selected, RR, RH
9TH	Suspension – Computer Selected, RR, RH
9TJ	Suspension – Computer Selected, RR, RH
9TK	Suspension – Computer Selected, RR, RH
9TM	Suspension – Computer Selected, RR, RH
9TP	Suspension - Computer Selected, RR, RH



A VEHICLE IDENTIFICATION NUMBER (VIN)
B ENGINEERING MODEL NUMBER (CAR DIVISION, CARLINE AND BODY STYLE)
C SPECIAL ORDER PAINTS
D TYPE OF PAINT TECHNOLOGY
E LOWER EXTERIOR PAINT COLOR
F UPPER EXTERIOR PAINT COLOR
G ACCENT COLOR
H VINYL TOP
J INTERIOR TRIM AND DECOR LEVEL
K OPTION CONTENT

4-29-94
BS0230A

Figure 24 – Service Parts Identification Label

SECTION 0B

MAINTENANCE AND LUBRICATION

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Normal Vehicle Use 0B-1
Schedule I 0B-1
Schedule II 0B-1
Explanation of Scheduled Maintenance Services 0B-1
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Chassis Lubrication 0B-4
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SCHEDULED MAINTENANCE SERVICE

NORMAL VEHICLE USE

The maintenance instructions contained in the Maintenance Schedule are based on the assumption that the vehicle will be used as designed:

- To carry passengers and cargo within the limitation indicated on the Tire Placard located on the edge of the driver's door.
- On reasonable road surfaces within legal operating limits.
- On unleaded gasoline.

SCHEDULE I

Figure 1

Follow Schedule I if the vehicle is operated under one or more of the following conditions:

- When most trips are less than 6 km (4 miles).
- Operating when outside temperatures remain below freezing and when most trips are less than 16 km (10 miles).
- When most trips include extended idling and/or frequent low-speed operation as in stop-and-go traffic.
- Towing a trailer. Do not exceed trailering limits. See the Owner's Manual for details.
- Operating in dusty areas.
- The vehicle is used in delivery service, police, taxi or other commercial applications.

SCHEDULE II

Figure 2

Follow Schedule II ONLY if none of the driving conditions specified in Schedule I apply.

EXPLANATION OF SCHEDULED MAINTENANCE SERVICES

Refer to Figures 1 and 2 for the schedules of time and/or mileage intervals. The following text and illustrations (Figures 3 and 4) give details of the required maintenance services.

Engine Oil and Oil Filter Change

ALWAYS USE SH QUALITY ENERGY CONSERVING II OILS OF PROPER VISCOSITY. Oils designated "SH" will protect better than SG, SF/CC or SF/CD oils. The "SH" designation may be shown alone or in combination with other designations such as SH/SG, etc.

SCHEDULED MAINTENANCE SERVICES

SCHEDULE I

Follow Schedule I if your vehicle is MAINLY driven under one or more of the following conditions:

- When most trips are less than 6 kilometers (4 miles).
- When most trips are less than 16 kilometers (10 miles) and outside temperatures remain below freezing.
- When most trips include extended idling and/or frequent low-speed operation as in stop-and-go traffic.†
- Towing a trailer.**
- Operating in dusty areas.

ITEM NO.	TO BE SERVICED	WHEN TO PERFORM Kilometers (Miles) or Months, Whichever Occurs First	The services shown in this schedule up tp 80 000 km (48,000 miles) are to be performed after 80 000 km (48,000 miles) at the same intervals.															
		KILOMETERS (000)	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
		MILES (000)	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
1	Engine Oil & Oil Filter Change*	Every 5 000 km (3,000 mi) or 3 mos	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
2	Chassis Lubrication	Every other oil change		•		•		•		•		•		•		•		•
3	Tire & Wheel Assembly Inspection & Rotation	At 10 000 km (6,000 mi) and then every 25 000 km (15,000 mi)		•				•				•				•		
4	Serpentine Drive Belt Inspection	Every 50 000 km (30 000 mi) or 24 mos										•						
5	Cooling System Service*																	
6	Transmission Service	See explanation for service interval																
7	Spark Plug Assembly Replacement*																	
8	Spark Plug Wire Assembly Inspection*‡	Every 50 000 km (30,000 mi)										•						
9	Air Cleaner & Crankcase Ventilation Filter Replacement*											•						
10	Fuel Tank, Cap & Lines Inspection*‡											•						

† Note. Schedule I should also be followed if the vehicle is used for delivery service, police, taxi or other commercial applications.

‡ The U.S. Environmental Protection Agency has determined that the failure to perform this maintenance Item will not nullify the emission warranty or limit recall liability prior to the completion of vehicle useful life. General Motors, however, urges that all recommended maintenance services be performed at the indicated intervals and the maintenance be recorded in section E of the owner's maintenance schedule.

* An Emission Control Service

** Do not exceed trailering limits See your Owner's Manual for details

Figure 1 – Maintenance Schedule I

SCHEDULED MAINTENANCE SERVICES
SCHEDULE II

Follow schedule II ONLY if none of the driving conditions specified in Schedule I apply.

ITEM NO.	TO BE SERVICED	WHEN TO PERFORM Kilometers (Miles) or Months, Whichever Occurs First	The services shown in this schedule up to 75 000 km (45,000 miles) are to be performed after 75 000 km (45,000 miles) at the same intervals.					
		KILOMETERS (000)	12..5	25	37.5	50	62.5	75
		MILES (000)	7.5	15	22.5	30	37.5	45
1.	Engine Oil Change*	Every 12 500 km (7,500 mi.) or 12 mos.	•	•	•	•	•	•
	Oil Filter Change*	At first and then every other oil change	•		•		•	
2.	Chassis Lubrication	Every 12 500 km (7,500 mi.) or 12 mos.	•	•	•	•	•	•
3.	Tire & Wheel Assembly Inspection & Rotation	At 12 500 km (7,500 mi.) and then every 25 000km (15,000mi.)	•		•		•	
4.	Serpentine Drive Belt Inspection	Every 50 000 km (30,000 mi.) or 24 mos.				•		
5.	Cooling System Service*							
6.	Transmission Service	See explanation for service interval.						
7.	Spark Plug Assembly Replacement*							
8.	Spark Plug Wire Assembly Inspection*‡	Every 50 000 km (30,000 mi.)				•		
9.	Air Cleaner & Crankcasse Ventilation Filter Replacement*					•		
10.	Fuel Tank Cap & Lines Inspection*‡					•		

‡ **The U.S. Environmental Protection Agency has determined that the failure to perform this maintenance item will not nullify the emission warranty or limit recall liability prior to the completion of vehicle useful life. General Motors, however, urges that all recommended maintenance services be performed at the indicated intervals and the maintenance be recorded in section E of the owner's maintenance schedule.**

• **An Emission Control Service.**

Figure 2 – Maintenance Schedule II

4–15–94
FS0020B

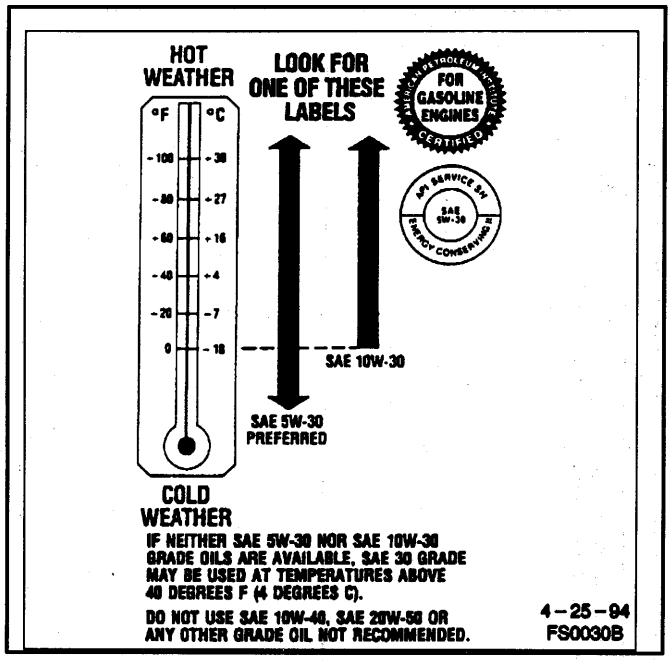


Figure 3 – Engine Oil Viscosity Recommendation

Engine oil viscosity (thickness) has an effect on fuel economy and cold-weather operation (starting and oil flow). Lower viscosity engine oils can provide better fuel economy and cold-weather performance; however, higher temperature weather conditions require higher viscosity engine oils for satisfactory lubrication. **Using oils of any viscosity other than those viscosities recommended could result in engine damage.**

When choosing an oil, consider the range of temperatures the vehicle will be operated in before the next oil change. Then, select the recommended oil viscosity from the chart (Figure 3).

Chassis Lubrication

Lubricate transmission shift linkage.

Tire and Wheel Inspection and Rotation

Figure 4

Check tires for abnormal wear or damage. To equalize wear and obtain maximum tire life, rotate as shown in Figure 4.

If the vehicle is equipped with P245/50ZR16 size tires, special rotation provisions must be followed because the tires are directional. See Figure 4 for the recommended rotation. Directional tires have color-coded arrows on both sides of the sidewall pointing in the direction the tires must roll for the correct performance.

If irregular or premature wear exists, check wheel alignment. Also, check for damaged wheels. Do not include the compact spare tire in rotation.

While the tire and wheels are removed, perform the brake systems inspection specified. Refer to "Each Time Oil Is Changed" in this section.

Serpentine Drive Belt Inspection

Inspect drive belt for cracks or fraying. If sections of the drive belt are missing, the drive belt should be replaced. Refer to SECTION 6A2A or SECTION 6A3A.

Cooling System Service

Drain, flush and refill system with new or approved recycled coolant. Refer to "Recommended Fluids and Lubricants" in this section, or SECTION 6B.

Front Wheel Bearing Repack

The front wheel bearings are not serviceable. Complete replacement of the front wheel bearing hubs is required.

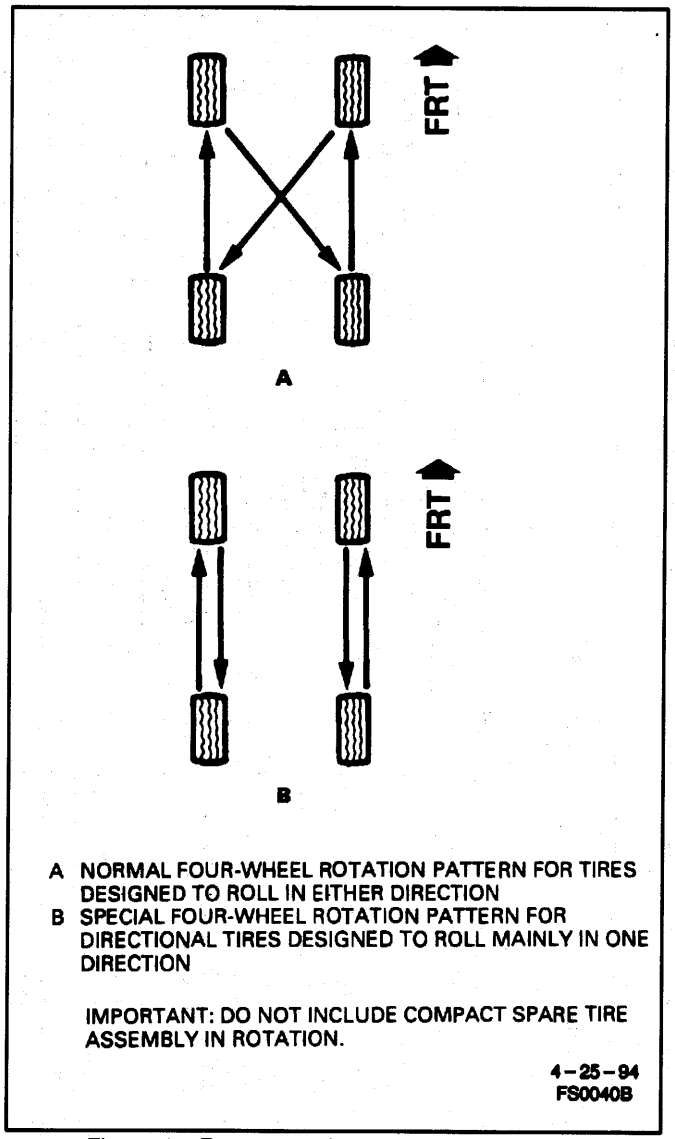


Figure 4 – Recommended Tire Rotation Pattern

Transmission Service

For the manual transmission, fluid does not require changing.

For the automatic transmission, change both the fluid and the filter every 25 000 km (15,000 miles) if the vehicle is mainly driven under one or more of these conditions:

- In heavy city traffic where outside temperature regularly reaches 32°C (90°F) or higher.
- On hilly or mountainous terrain.
- Frequent trailer pulling. Do not exceed trailering limits. See the Owner's Manual or dealership trailering brochure for details.
- Used for delivery service, police, taxi or other commercial applications.

If the vehicle is not used under any of these conditions, change both the fluid and filter (or service the screen) every 160 000 km (100,000 miles). Refer to SECTION 7A for more information.

Spark Plug Replacement

Replace spark plugs every 50 000 km (30,000 miles) on the 3.4L L32 engine and every 160 000 km (100,000 miles) on the 5.7L LT1 engine with type listed. Refer to "Maintenance Items" in this section.

Spark Plug Wire Inspection

Clean wires and inspect for burns, cracks or other damage. Check the wire boot fit at the ignition distributor and/or ignition distributor coil, and at the spark plugs. Replace the wires as needed.

Air Cleaner and Crankcase Ventilation Filter Replacement

Replace the air cleaner filter every 50 000 km (30,000 miles) or 36 months, whichever comes first. Replace more often under dusty conditions.

Fuel Tank, Cap and Lines Inspection

Inspect fuel tank, cap and lines for damage or leaks. Inspect fuel cap gasket for an even filler neck imprint or any damage. Inspect injections. Replace parts as needed. Periodic replacement of the fuel filter is not required.

OWNER INSPECTION AND SERVICES

Listed below are vehicle inspections and services that should be made by either the owner or a qualified technician at the frequencies indicated to help ensure proper safety, emission systems performance and dependability of the vehicle. Whenever repairs are necessary, have them completed at once.

Any safety related or emissions related components that could have been damaged in an accident should be inspected and all needed repairs should be performed before operating the vehicle.

WHILE OPERATING THE VEHICLE

Automatic transmission shift indicator operation – Make sure the indicator points to the gear chosen.

Horn assembly operation – Blow the horn assembly occasionally to make sure it works. Check all button locations.

Brake system operation – Be alert to abnormal sounds, increased brake pedal travel or repeated pulling to one side when braking. Also, if the brake warning lamp or antilock brake system warning lamp goes on or flashes, something may be wrong with part of the brake system.

Exhaust system operation – Be alert to any changes in the sound of the system or any smell of fumes. These are signs the system may be leaking or overheating. Have it inspected and repaired at once.

Tires, wheels and alignment operation – Be alert to a vibration of the steering wheel or seat at normal highway speeds. This may mean a wheel balance is needed. Also, a pull right or left on a straight and level road may show the need for a tire pressure adjustment or a wheel alignment.

Steering system operation – Be alert to changes in steering action. An inspection is needed when the steering wheel is harder to turn, or has too much free play, or if unusual sounds are noted when turning or parking.

Headlamp capsule aim – Take note of the light pattern occasionally. If beams seem to be improperly aimed, headlamps should be checked and adjusted as necessary.

AT EACH FUEL FILL

A fluid loss in any system (except windshield washer) may indicate a problem. Have the system inspected and repaired at once.

Engine oil level – Check level and add oil if necessary. The best time to check the engine oil level is when the oil is warm. After stopping the engine with the vehicle on a level surface, wait a few minutes for the oil to drain back to the oil pan. Pull out the oil level indicator and wipe it clean. Push the oil level indicator back down all the way. Pull out the oil level indicator keeping the tip down, and look at the oil level on it.

Add oil, if needed, to keep the oil level above the "ADD" line and within the cross-hatched operating range area. Avoid overfilling the engine since this may cause engine damage. Push the oil level indicator back down all the way after taking the reading.

If you check the oil level when the oil is cold, do not run the engine first. The cold oil will not drain back to the pan fast enough to give a true oil level.

Engine coolant level and condition – Check engine coolant level in the coolant reservoir and add coolant if necessary.

Windshield washer solvent level – Check washer solvent level in reservoir and add solvent if necessary.

Hood latch operation – When opening the hood, note the operation of the secondary latch. It should keep the hood from opening all the way when the primary latch is released. Make sure that the hood closes firmly.

AT LEAST MONTHLY

Tire and wheel inspection and pressure check – Check tires for abnormal wear or damage. Also check for damaged wheels. Pressure should be checked when tires are "cold." Maintain pressures as shown in "Tire Pressure Specifications" in this section, or the Tire Placard on the driver's door.

Lamp operation – Check operation of the license plate lamp, sidemarker lamps, headlamps (including high beams), fog lamps, parking lamps, taillamps, brake lamps (including the center high-mounted stoplamp), turn signals, backup lamps, hazard warning flasher and interior lamps.

Fluid leak check – Periodically inspect the surface beneath the vehicle for water, oil, fuel or other fluids after the vehicle has been parked for a while. Water dripping from the air conditioning system after use is normal. The cause of fuel leaks or fumes should be found and corrected at once.

AT LEAST TWICE A YEAR

Power steering system reservoir level – Check and keep at proper level. Refer to SECTION 3B1B.

Brake master cylinder reservoir level – Check fluid. Refer to SECTION 5A. Keep fluid at proper level. A low fluid level can indicate worn disc brake pads which may need to be serviced. Also refer to SECTION 5E1.

Weatherstrip lubrication – Clean the surface and then apply a thin film of silicone grease, GM P/N 12345579 or equivalent, using a clean cloth.

AT LEAST ANNUALLY

CAUTION: Before checking the holding ability of the parking brake and automatic transmission park mechanism, park on a fairly steep hill with enough room for movement in the downhill direction. To reduce the risk of personal injury or property damage, be prepared to apply the regular brakes promptly if the vehicle begins to move.

Parking brake and transmission park mechanism operation – To check the parking brake, with the engine running, parking brake set and transmission in "NEUTRAL," slowly remove foot pressure from the regular brake pedal until the vehicle is held only by the parking brake.

To check the automatic transmission park mechanism holding ability, release all brakes after shifting the transmission to "PARK."

CAUTION: Before performing the following transmission neutral start switch check, be sure to have enough room around the vehicle. Then, firmly apply both the parking brake and the regular brakes. Do not use the accelerator pedal. If the engine starts, be ready to turn off the ignition promptly. Take these precautions because the vehicle could move without warning and possibly cause personal injury or property damage.

Transmission neutral start switch operation – On automatic transmission vehicles, try to start the engine in each gear. The starter should crank only in "PARK" or "NEUTRAL."

On manual transmission vehicles, place the shift lever in "NEUTRAL," push the clutch pedal halfway and try to start. The starter should crank only when the clutch pedal is fully depressed.

Steering column lock operation – While parked, try to turn the key to "LOCK" in each gear range. On vehicles with automatic transmissions, the key should turn to "LOCK" only when the gear selector is in "PARK." On vehicles with key release button, try to turn to "LOCK" without depressing the button. The key should turn to "LOCK" only with the key button depressed.

Seatback latch operation – Be sure seatbacks latch on those vehicles with folding seats using mechanical latches.

Lap and shoulder belts condition and operation – Inspect belt system, including webbing, buckles, latch plates, retractor, guide loops and anchors.

Movable head restraint operation – Make sure movable head restraints stay in the desired position.

Seatback recliner operation (if equipped) – Make sure the recliner is holding by pushing and pulling on the top of the seatback while it is reclined.

Spare tire and jack storage – Be alert to rattles in rear of the vehicle. Make sure the spare tire, all jacking equipment and any covers or doors are securely stowed at all times. Oil the jack screw mechanism after each use.

Key lock service – Lubricate the key lock cylinder (except instrument panel compartment lock).

Body lubrication service – Lubricate all body door hinges, including the hood, fuel door and rear compartment hinges and latches, the instrument panel compartment door, and any folding seat hardware.

Lubricate all pivot points in the headlamp door assembly, including the spring links for each door.

Underbody flushing – At least every spring, flush from the underbody any corrosive materials used for ice and snow removal and dust control. Use plain water. Take care to thoroughly clean any areas where mud or other debris can collect. Sediment packed in closed areas of the vehicle should be loosened before being flushed.

Engine cooling system – Inspect coolant and freeze protection. Keep coolant at the proper mixture for proper freeze protection, corrosion inhibitor level and best engine operating temperature. Inspect hoses and replace if cracked, swollen or deteriorated. Clean outside of radiator and air conditioning condenser. Wash filler cap and neck. To help ensure proper operation, a pressure test of both the cooling system and cap is also recommended.

EACH TIME OIL IS CHANGED

Automatic transmission fluid level – Maintain level within operating range on the oil level indicator. Refer to SECTION 7A.

Manual transmission – Check fluid level and add as required. Refer to SECTION 7B.

Brake systems inspection – For convenience, the following should be done when wheels are removed for rotation: Inspect lines and hoses for proper hookup, binding, leaks, cracks, chafing, etc. Inspect disc brake pads for wear and rotors for surface condition. Also inspect drum brake linings for wear and cracks. Inspect other brake parts, including drums, wheel cylinders, parking brake, etc., at the same time. The parking brake is self-adjusting and no manual adjustment is required.

Inspect brakes more often if habit or conditions result in frequent braking.

Steering and suspension inspection – Inspect front and rear suspension and steering system for damaged, loose or missing parts, signs of wear or lack of lubrication. Inspect power steering lines and hoses for proper hookup, binding, leaks, cracks, chafing, etc.

Exhaust system inspection – Inspect complete system, including catalytic converter. Inspect body near the exhaust system. Look for broken, damaged, missing or out-of-position parts as well as open seams, holes, loose connections and other conditions which could cause a heat buildup in the floor pan or could let exhaust fumes seep into the trunk or passenger compartment. Check heat shields. Tighten connections or replace parts as necessary.

Throttle linkage inspection – Inspect for interference, binding, and damaged or missing parts.

Serpentine drive belt – Inspect drive belt for cracks, fraying, wear and proper tension. Drive belts cannot be adjusted. Replace tensioner or drive belt as needed. Refer to SECTION 6A2A or SECTION 6A3A.

Rear axle – Check fluid level and add if needed. To check or add fluid, hoist vehicle at suspension contact points. Refer to SECTION 0A. Keep vehicle level. Clean dirt or foreign material from around filler plug opening before removing the filler plug. Maintain fluid level from flush with bottom of opening to no lower than 14 mm (9/16 inch) below opening. Always replace filler plug. Tighten to 35 N•m (26 lb. ft.).

If the vehicle is used to pull a trailer, change lubricant every 12 500 km (7,500 miles) in either type differential.

Limited slip differentials should have fluid drained and refilled at the first 12 500 km (7,500 miles). Be sure to add limited slip additive.

RECOMMENDED FLUIDS AND LUBRICANTS

Engine oil – GM Goodwrench motor oil or equivalent for API service SH/SG of recommended viscosity.
Engine coolant – 50/50 mixture of water (preferably distilled) and good quality ethylene glycol base antifreeze or approved recycled coolant conforming to GM Specification 1825M (GM P/N 1052753 or equivalent).
Hydraulic brake system – Delco-Supreme 11® brake fluid (GM P/N 1052535) DOT-3 brake fluid.
Hydraulic clutch system – Hydraulic clutch fluid (GM P/N 12345347 or equivalent).
Power steering system – Power steering fluid meeting requirements of GM 9985010 (GM P/N 1050017, GM P/N 1052884 or equivalent). In cold climates use GM P/N 12345867, GM P/N 12345866 or equivalent. (System should be drained and refilled prior to using this fluid).
Automatic transmission – DEXRON®-III automatic transmission fluid.
Automatic transmission shift linkage – Engine oil. **Clutch linkage pivot points** – Engine oil.
Manual transmission – DEXRON®-III automatic transmission fluid.
Manual transmission shift linkage – Chassis lubricant meeting requirements of NLGI Grade 2, Category LB or GC-LB (GM P/N 1052497).
Key lock cylinders (except instrument panel compartment lock) – Lubricate with Multi-Purpose Lubricant (GM P/N 12345120 or equivalent) or synthetic SAE 5W–30 engine oil or silicone lubricant (GM P/N 1052276 or 1052277). Do not use aerosols.
Weatherstrips – Dielectric silicone grease (GM P/N 12345579 or equivalent).
Chassis lubrication – Chassis lubricant meeting requirements of NLGI Grade 2, Category LB or GC-LB (GM P/N 1052497 or equivalent).
Standard differential rear axle – SAE 80W-90 GL-5 gear lubricant or axle lubricant (GM P/N 12345977, or equivalent).
Limited slip differential rear axle – All models require 118 ml (4 fl. oz.) of limited slip differential additive lubricant (GM P/N 1052358 or equivalent) and axle lubricant (GM P/N 12345977, or equivalent) or SAE 80W-90 GL-5 gear lubricant.
Windshield washer solvent – GM Optikleen® Washer Solvent (GM P/N 1051515 or equivalent).
Hood latch and pivots – Engine oil.
Hood latch release pawl – Chassis lubricant meeting requirements of NLGI Grade 2, Category LB or GC-LB (GM P/N 1052497).
Hood and door hinges, hatchback lid hinge and linkage. Headlamp doors, if equipped. Rear folding seat. Fuel door hinge. Rear compartment lid hinges. – Engine oil or Lubriplate lubricant (GM P/N 1050104).

MAINTENANCE ITEMS

Air Cleaner Filter
- All VIN ..... AC Type A1163C

Engine Oil Filter
- 3.4L (VIN S) ..... AC Type PF47
- 5.7L (VIN P) ..... AC Type PF25

Fuel Filter
- All VIN ..... AC Type GF578

PCV Valve
- 3.4L (VIN S) ..... AC Type CV789C
- 5.7L (VIN P) ..... AC Type CV895C

Spark Plugs and Gap
- 3.4L (VIN S) ..... AC.R43TSK 1.14 mm (0.045″)
- 5.7L (VIN P) ..... AC.R45LTSP 1.27 mm (0.050″)

APPROXIMATE FLUID CAPACITIES

Air Conditioning
- R-134a ..... 0.91 kg (2.0 lb.)

Engine Crankcase
- Without Filter Change (All VIN) ..... 3.8 liters (4.0 qt.)
- With Filter Change
  - 3.4L (VIN S) ..... 3.8 liters (4.0 qt.)
  - 5.7L (VIN P) ..... 4.7 liters (5.0 qt.)

Fuel Tank ..... 58.7 liters (15.5 gal.)

Transmission
- Manual – Drain and Refill and Overhaul
  - Five-Speed ..... 2.8 liters (5.9 pt.)
  - Six-Speed ..... 3.8 liters (8.0 pt.)
- Automatic (HYDRA-MATIC 4L60-E)
- 3.4L (VIN S) Drain & Refill ..... 4.7 liters (10.0 pt.)
- 3.4L (VIN S) Overhaul ..... 7.9 liters (16.7 pt.)
- 5.7L (VIN P) Drain and Refill ..... 4.7 liters (10.0 pt.)
- 5.7L (VIN P) Overhaul ..... 10.6 liters (22.4 pt.)

Cooling System
- 3.4L (VIN S)
  - With Automatic Transmission ..... 11.6 liters (12.3 qt.)
  - With Manual Transmission ..... 11.8 liters (12.5 qt.)
- 5.7L (VIN P)
  - With Automatic Transmission ..... 14.3 liters (15.1 qt.)
  - With Manual Transmission ..... 14.5 liters (15.3 qt.)

Rear Axle – Drain and Refill ..... 1.7 liters (3.5 pt.)
Rear Axle – Additive ..... 118 milliliters (4 fl. oz.)

The capacities shown here are approximate. Add fluid as necessary to bring to appropriate level.

WHEEL NUT TORQUE

Wheel Nuts ..... 140 N•m (100 lb. ft.)

REAR AXLE FILLER PLUG TORQUE

Filler Plug ..... 35 N•m (26 lb. ft.)

BELT TENSION SPECIFICATIONS

Engines equipped with serpentine belts have an automatic tensioner. No adjustment of this belt is necessary.

TIRE PRESSURE SPECIFICATIONS

Compact Spare ..... 420 kPa (60 psi)
Front and Rear – All ..... 210 kPa (30 psi)

SECTION 1

HEATING AND AIR CONDITIONING

CONTENTS

Heater and Ventilation ..... Section 1A
Heater, Ventilation and Air Conditioning ..... Section 1B
Manual Control Air Conditioning ..... Section 1B1
HD6/HR6-HE Air Conditioning Compressor Service or Unit Repair R-134a ..... Section 1D2

SECTION 1A

HEATER AND VENTILATION

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

BASE HEATER SYSTEM

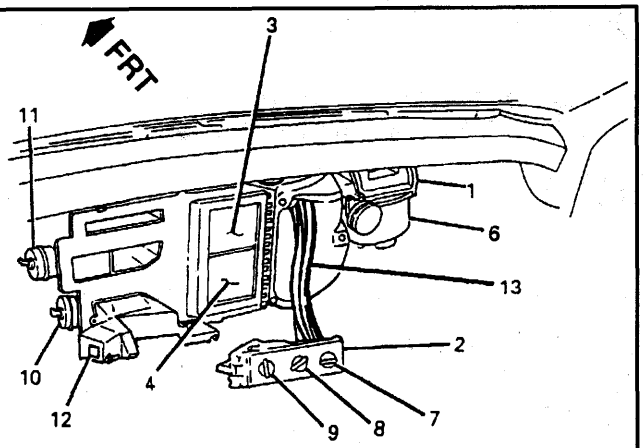
Figures 1 through 5

The base heater system provides heating, ventilation, side window defogging and windshield defrosting. Outside air is drawn from the plenum at the base of the windshield assembly into the heater module assembly (1) by the blower motor fan (18).

Within the heater module assembly (1), the air is heated as required and then routed through ducts to the proper outlets for discharge into the passenger compartment. A control assembly (2) in the instrument panel assembly allows the operator to control blower motor assembly speed, mode of operation and the temperature of the air coming from the heater system.

The heater module assembly (1) contains components that heat the air flowing through it and direct the air to the proper ducts and outlets. The heater module assembly (1) is a single unit, including the blower motor assembly (6), that is mounted to the rear surface of the dash front panel in front of the instrument panel assembly.

Hot coolant from the engine's cooling system is directed through the heater core (14) and returned to the cooling system when the engine is running. The heater core (14) transfers heat from the coolant to the air passing through the heater core fins. There is no hot water shut off valve in the heater system to prevent flow of coolant through the heater core (14).



1 MODULE ASSEMBLY, HEATER
2 CONTROL ASSEMBLY
3 VALVE, VENT MODE
4 VALVE, BI-LEVEL MODE
6 MOTOR ASSEMBLY, BLOWER
7 KNOB, MODE CONTROL
8 KNOB, TEMPERATURE CONTROL
9 KNOB, BLOWER MOTOR ASSEMBLY SPEED CONTROL
10 ACTUATOR, BI-LEVEL MODE VALVE
11 ACTUATOR, DEFROSTER/HEATER VALVE
12 OUTLET, FLOOR AIR
13 HARNESS, VACUUM

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Figure 1 – Heater Module Assembly and Controls

CONTROL ASSEMBLY

Figures 1 through 5

Three knobs in the instrument panel allow a front seat occupant to operate the heating and ventilation. These knobs are in the control assembly, in the center of the instrument panel, just above or below the radio, depending on the vehicle. To the left of the blower motor speed control knob is the control button for the electric rear window defogger (Pontiac only)

The controls are lit when the headlamps are on. Electrical power is provided by the instrument panel lighting circuit. The control assembly lamp is in parallel with the instrument cluster bulbs, the radio dial bulb and certain other interior illumination bulbs. Brightness of the dial illumination is controlled by the dimmer control of the headlamp switch. For electrical circuit diagrams and more information, refer to SECTION 8A.

Temperature Control Knob

The temperature control knob is the middle knob in the control assembly. It regulates the temperature of the air being discharged into the passenger compartment from the heater or ventilation system. The temperature control knob controls the position of a "door" called the temperature valve in the heater module assembly. The temperature valve governs the relative amounts of heated and unheated air discharged from the heater system. Full warm, full cool or any intermediate temperature mixture can be selected by moving the knob to the right (red area) for warm air and to the left (blue area) for cool air or anywhere in between.

Mode Control Knob

The right knob, called the mode control knob, is a rotary vacuum switch that regulates airflow from the outlets by routing engine vacuum to vacuum actuators at the heater module assembly. The mode control knob also controls an electrical switch that supplies power to operate the blower motor assembly for specific mode selections.

A choice of six operating modes can be selected by turning the mode control knob in the control assembly. From left to right, the six modes are "OFF," " " (vent), " " (bi-level), " " (heater), " " (blend) and " " (defrost).

"OFF" Mode

When the mode control knob is in the "OFF" position, no electrical power is supplied to the blower motor assembly. A limited flow of air, caused by movement of the vehicle, may come from the defrost outlet and the floor outlets. This is the only mode in which the blower motor assembly will not operate.

" " (Vent) Mode

With the mode control knob in the " " position, outside air is delivered through the instrument panel outlets to ventilate the vehicle. If preferred, the air may be warmed by setting the temperature control knob to the desired temperature.

" " (Bi-level) Mode

With the mode control knob in the " " position, electrical power is supplied to the blower motor assembly. Outside air is drawn in and heated (depending on the position of the temperature control knob). Then the airflow is split between the instrument panel outlets and the floor outlets. Blower motor assembly speed may be varied.

" " (Heater) Mode

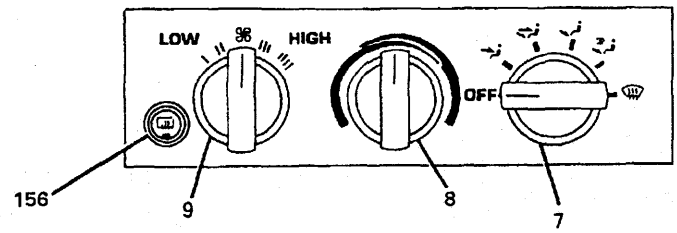
With the mode control knob in the " " position, outside air is drawn into the vehicle, heated (depending on the position of the temperature control knob) and directed to the floor air outlets. A small amount of air is routed to the windshield assembly through the defrost outlet.

Blower motor assembly speed may be varied as in other operating modes.

This mode is the normal selection for cold weather operation unless the windshield assembly must be cleared of heavy frost.

" " (Blend) Mode

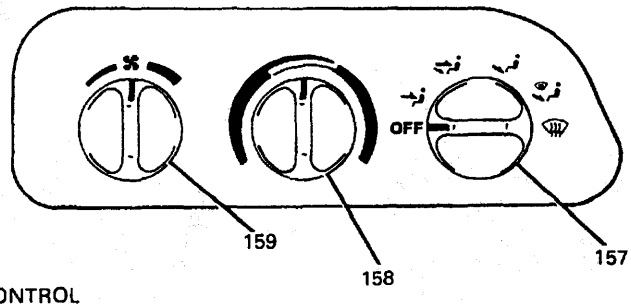
With the mode control knob in this position, outside air is drawn into the vehicle, heated (depending on the position of the temperature control knob) and split between the defrost outlet and the floor air outlets.



7 KNOB, MODE CONTROL
8 KNOB, TEMPERATURE CONTROL
9 KNOB, BLOWER MOTOR ASSEMBLY SPEED CONTROL
156 KNOB, REAR WINDOW DEFOGGER

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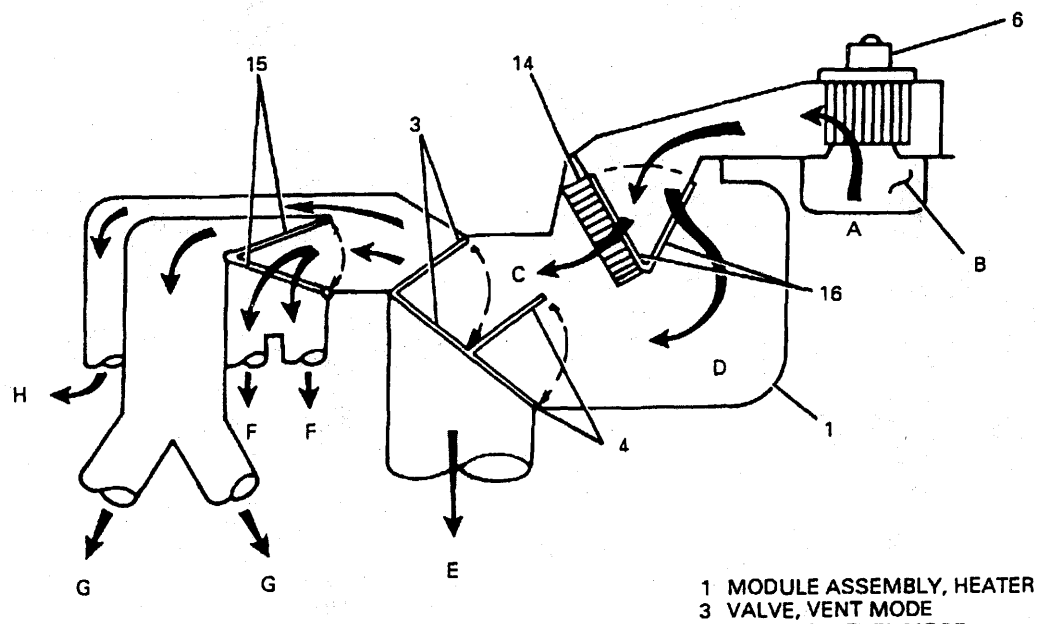
Figure 2 – Control Assembly – (Pontiac)



157 KNOB, MODE CONTROL
158 KNOB, TEMPERATURE CONTROL
159 KNOB, BLOWER MOTOR ASSEMBLY SPEED CONTROL

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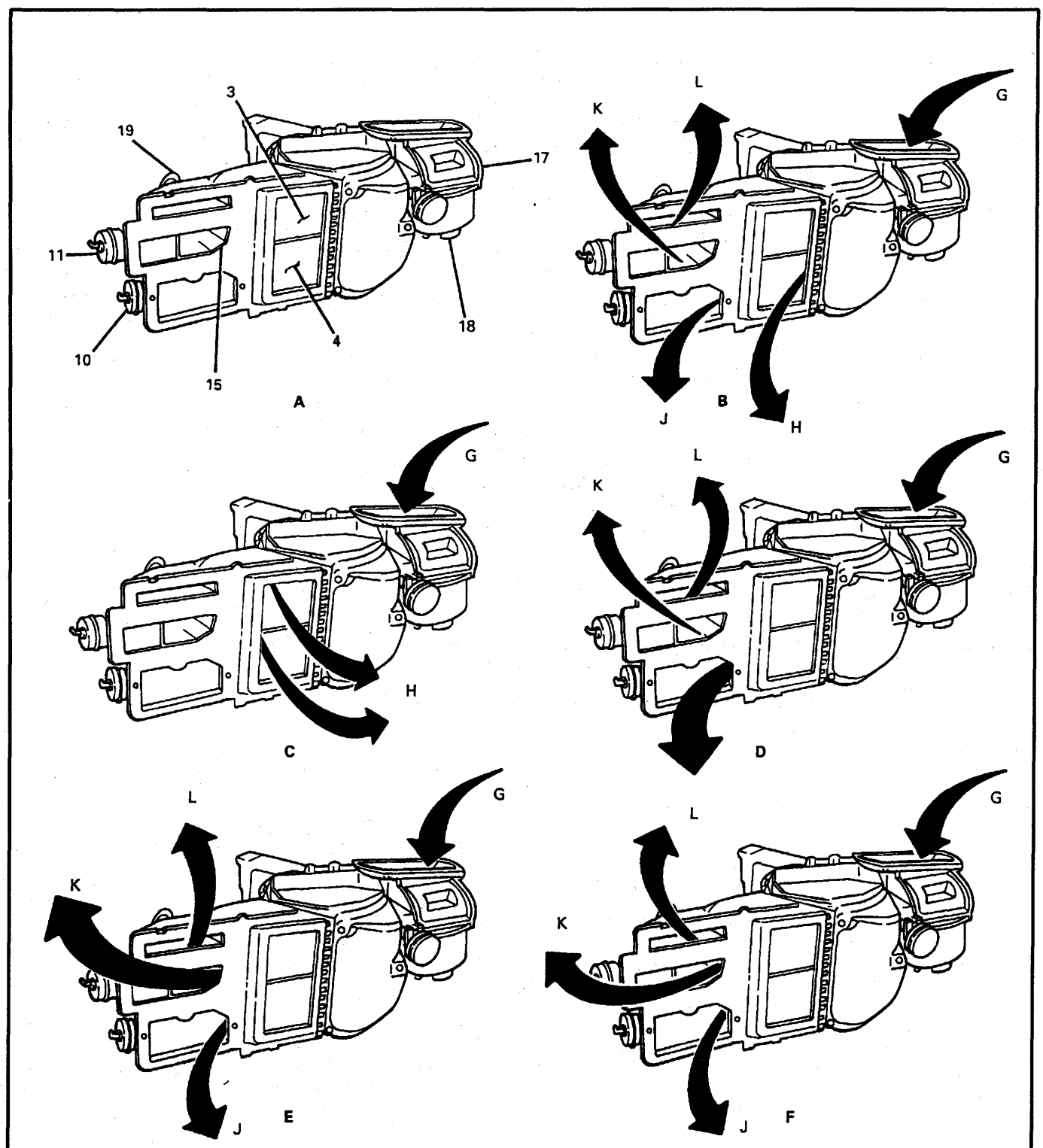
Figure 3 – Control Assembly – (Chevrolet)



A OUTSIDE AIR
B PLENUM
C HEATED AIR
D UNHEATED AIR
E TO INSTRUMENT PANEL OUTLETS
F TO FLOOR OUTLETS
G TO WINDSHIELD DEFROSTER OUTLETS
H TO SIDE WINDOW DEFOGGER OUTLETS
1 MODULE ASSEMBLY, HEATER
3 VALVE, VENT MODE
4 VALVE, BI-LEVEL MODE
6 MOTOR ASSEMBLY, BLOWER
14 CORE, HEATER
15 VALVE, DEFROSTER/HEATER
16 VALVE, TEMPERATURE

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Figure 4 – Heater Module Assembly Schematics



A COMPONENT LOCATIONS
B "BI-LEVEL" MODE AIRFLOW
C "VENT" MODE AIRFLOW
D "HEATER" MODE AIRFLOW
E "DEFROST" MODE AIRFLOW
F "BLEND" MODE AIRFLOW
G OUTSIDE AIR
H TO INSTRUMENT PANEL OUTLETS
J TO FLOOR AIR OUTLET
K TO WINDSHIELD DEFROSTER NOZZLES
L TO SIDE WINDOW DEFOGGER OUTLETS
3 VALVE, VENT MODE
4 VALVE, BI-LEVEL MODE
10 ACTUATOR, BI-LEVEL MODE VALVE
11 ACTUATOR, DEFROSTER/HEATER VALVE
15 VALVE, DEFROSTER/HEATER
17 HEATER ASSEMBLY
18 FAN, BLOWER MOTOR
19 ACTUATOR, VENT MODE VALVE

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Figure 5 – Operating Mode Airflow Distribution

" " (Defrost) Mode

With the mode control knob in the " " position, outside air is drawn into the vehicle, heated (depending on the position of the temperature control knob) and directed to the defrost outlet. A small amount of air is routed to the floor air outlets. Blower motor assembly speed may be varied.

Side Window Defogging

In all modes except "OFF" and " " (vent), air is supplied to the side window defrost outlets, located at the end of the instrument panel upper trim pad assembly.

Blower Motor Assembly Speed Control Knob

With the ignition switch in the "RUN" position, the blower motor assembly runs in all mode control knob positions except "OFF." Blower motor assembly speed is controlled by a four-position electrical blower switch at the left side of the control assembly. The blower switch provides a choice of low blower motor assembly speed, two medium blower motor assembly speeds and a high blower motor assembly speed.

The circuit to the blower motor assembly is completed to ground at the instrument panel assembly through the instrument panel wiring harness. Refer to SECTION 8A.

AIR DISTRIBUTION SYSTEM

Air enters the heater module assembly where it is heated as necessary before being sent to the proper outlets for discharge into the passenger compartment. Within the heater module, valves ("doors") guide the airflow in response to the positions of the temperature control knob and the mode control knob in the control assembly.

Vacuum System

Figure 6

All valves in the heater module assembly except the temperature valve are controlled by engine vacuum drawn from the vacuum tank in the engine compartment. The vacuum is routed by a vacuum selector valve in the control assembly to spring-loaded vacuum actuators on the heater module assembly. Vacuum stored in the vacuum tank is prevented from bleeding back to its source during conditions of low engine manifold vacuum (acceleration, hard pulling, etc.) by a check valve in the vacuum line.

The vacuum selector valve in the control assembly is controlled by the mode control knob. For each mode control knob position, the vacuum selector valve directs vacuum to specific hoses to overcome the force of the spring within the appropriate vacuum actuators. The vacuum selector valve also vents (to normal air pressure) the hoses to each remaining vacuum actuator, allowing the actuator's spring to expand. This results in the valves being properly positioned for the selected operating mode.

The bi-level and vent valves have two-position vacuum actuators. When vacuum is directed to either actuator's vacuum chamber, the vacuum pulls in a flexible diaphragm that forms one wall of the chamber. This draws a movable shaft attached to the diaphragm. The shaft is linked to the corresponding valve, and it operates the valve when vacuum is applied.

When the vacuum chamber is vented to normal air pressure, an external spring moves the shaft back to its original position. The shaft, in turn, returns the valve to its original position.

The defroster/heater valve has a three-position mode valve actuator with two vacuum hoses and two vacuum chambers, one at each end of the actuator. In effect, the three-position mode valve actuator acts like a pair of two-position actuators placed end-to-end. When vacuum is directed to either chamber, that chamber's diaphragm moves the mode valve operating linkage from its centered position to one extreme of travel. Venting that chamber while directing vacuum to the opposite chamber causes the linkage to move to its opposite extreme. Venting both chambers allows external torsion springs to center the linkage. The center position of the defroster/heater valve creates the blend mode.

Temperature Valve and Heater Core

Figure 4

The temperature of the air discharged from the heater system is regulated by controlling the relative amounts of warm and cool air that are mixed together downstream from the heater core area. The part of the total airflow that is allowed to pass through the heater core (14) is governed by the position of the temperature valve (16).

Hot coolant from the engine's cooling system is directed through the heater core (14). The heater core (14) transfers heat from the coolant to the air passing through the heater core fins.

Mode Valve Housing

After the heated and unheated airflows are mixed, the combined airflow comes to the mode valve housing. In vent mode " ", the vent mode valve actuator is engaged as well as the bi-level mode valve actuator. This directs all the air to the instrument panel outlets.

In bi-level mode " ", the vent mode valve remains closed (allowing air to the defroster/heater door), while the bi-level mode valve opens, allowing air to the instrument panel outlets. The defroster/heater door directs air to the floor air outlets. A small amount of air goes to the side window defrost outlets.

In heater mode " ", both the vent and bi-level doors remain closed and the defroster/heater door moves up, directing most of the air to the floor air outlets.

In blend mode " ", both chambers of the heater/defrost actuator are vented and the heater/defrost valve moves to a mid-position allowing air up to the defroster and down to the heater outlet. Both the vent and bi-level doors remain closed.

In defrost mode " ", the heater/defrost valve moves down and forces the air up to the defroster outlet. A small amount of air still flows to the heater outlet because of a fixed bleed.

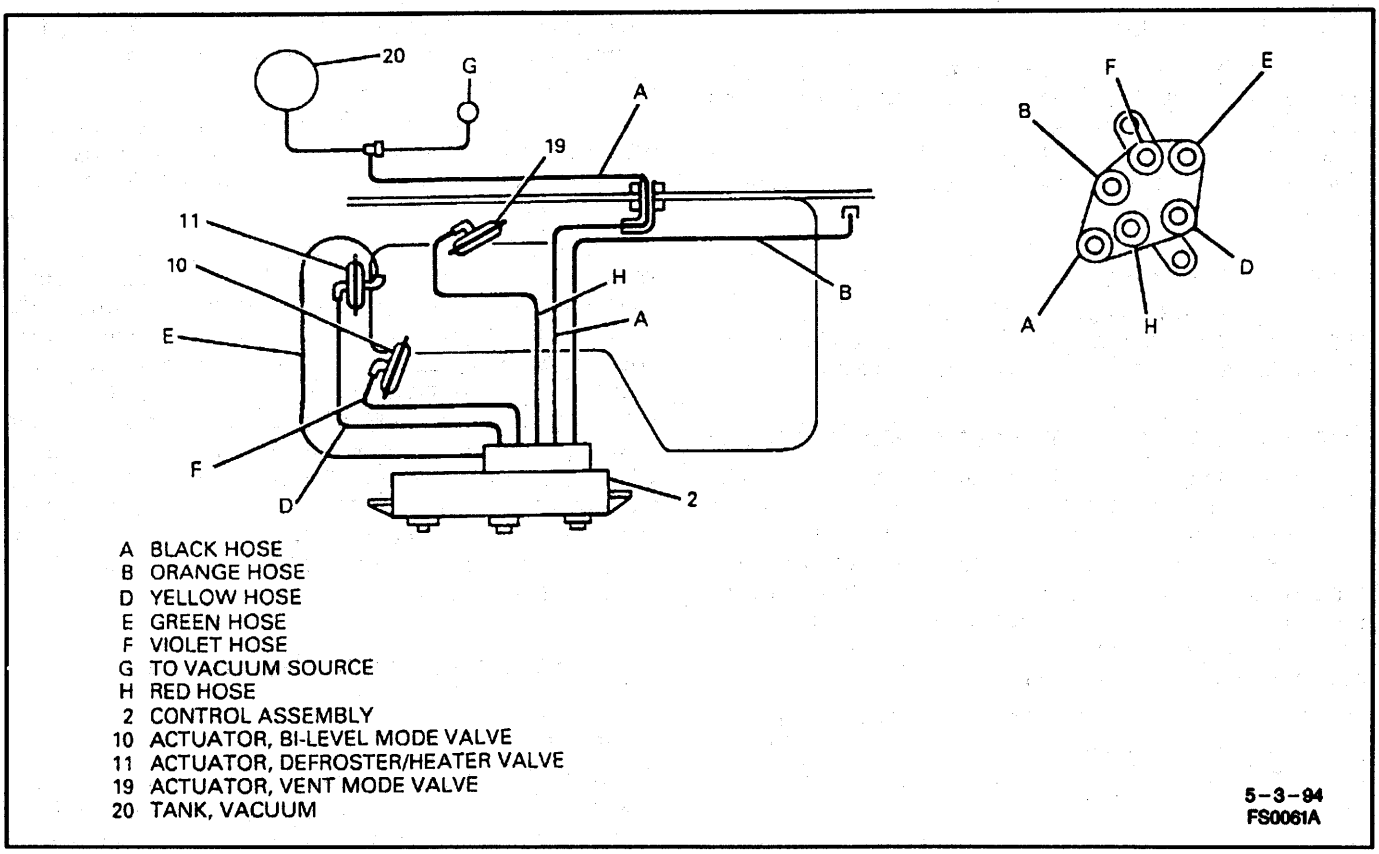


Figure 6 – Vacuum Circuit

Air Outlets

Figures 7 and 8

There are adjustable high-level air outlets in the instrument panel assembly. In addition, there are two side window defrost outlets, one at each end of the instrument panel. All outlets are fed by the air distributor assembly.

Ventilation

Figure 9

The air distribution system provides fresh air ventilation for the passenger compartment in all operating modes. Even in the "OFF" mode, fresh outside air is forced into the air distribution system by the forward movement of the vehicle.

After being warmed to the desired temperature, the air is discharged from the outlets. When all windows are closed, the addition of outside air builds a slight positive pressure within the passenger compartment. The pressure forces stale air to leave the vehicle through a pressure relief valve near the left side quarter panel in front of the rear fascia.

DIAGNOSIS

FUNCTIONAL TEST

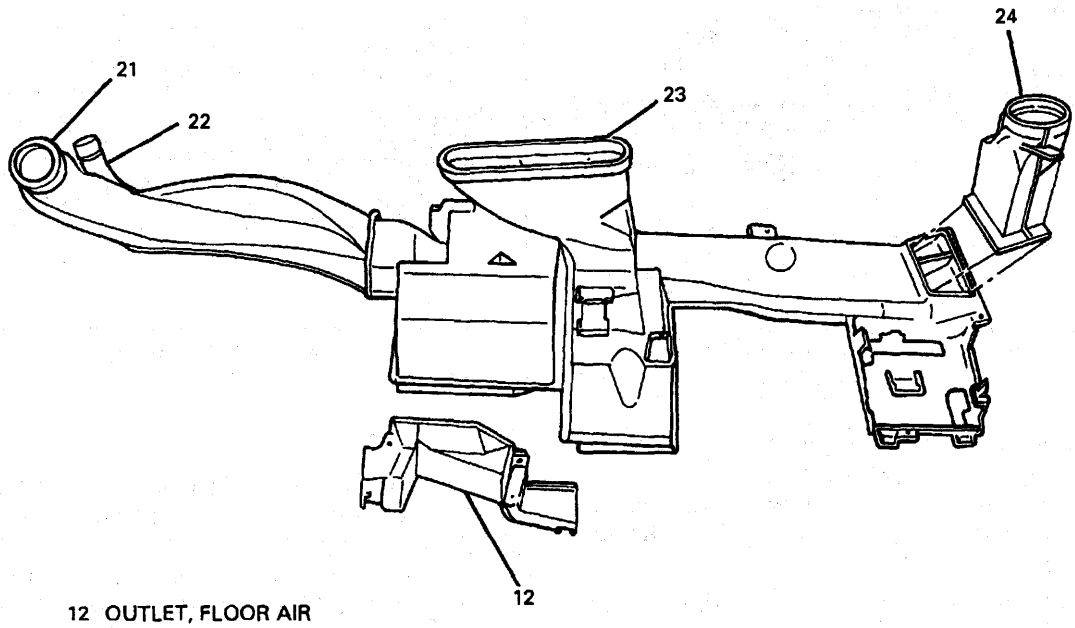
The following operational test sequence will aid in determining whether the heater system is working properly. Coolant temperature should be close to 90°C (194°F).

Preparation

- Engine should be started and allowed to idle for about 20 minutes or until thermostat is open.

Test

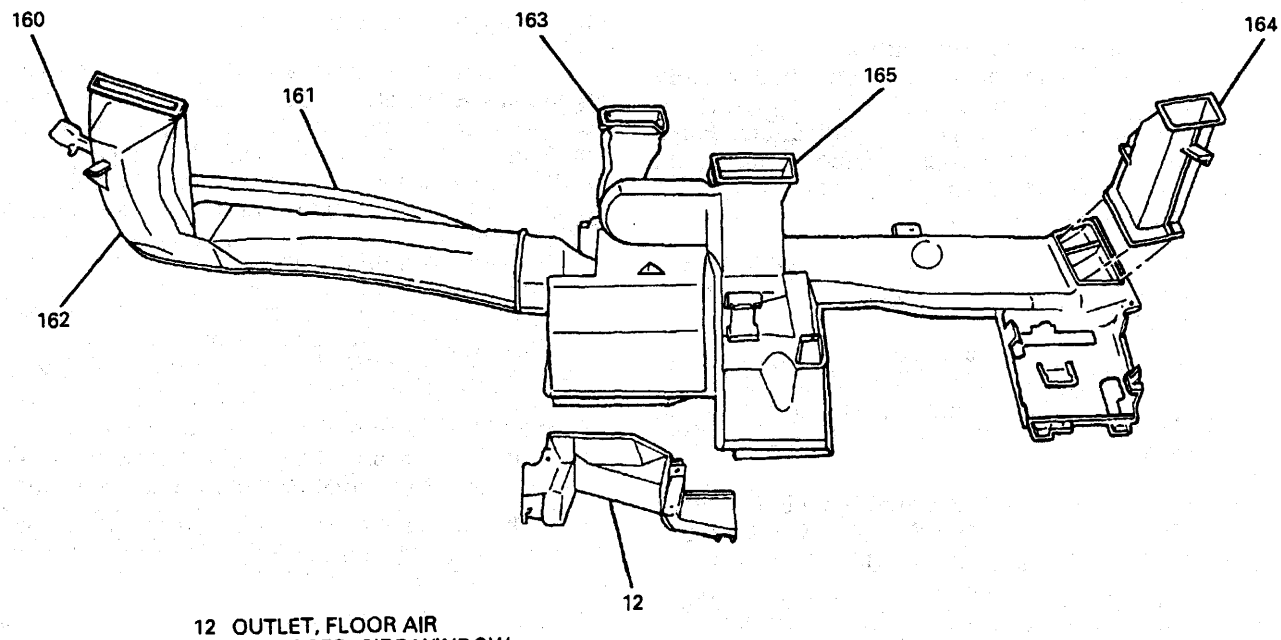
1. Set mode control knob to " " (bi-level), temperature control knob all the way to the left and blower switch to "HIGH."
   - Air at nearly the same temperature as outside air should come from all outlets.
2. Set mode control knob to " " (vent).
   - Air at nearly the same temperature as outside air should come from instrument panel outlets.
   - Air should not come from floor outlets, defroster nozzle or side window defogger outlets.
3. Move mode control knob to the " " (heater) position.
   - Most of the air should come from floor outlets with remainder coming out of defroster nozzle and defogger outlets.
   - Air should not come from instrument panel outlets in " " (heater) position.
   - All air from heater system should be at nearly the same temperature as outside air.



12 OUTLET, FLOOR AIR
21 OUTLET, LEFT-HAND
22 DEFOGGER, SIDE WINDOW
23 OUTLET, CENTER
24 OUTLET, RIGHT-HAND

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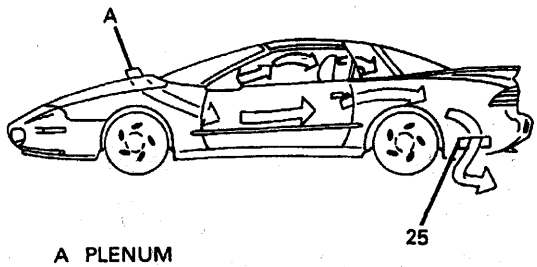
Figure 7 – Air Outlets – (Pontiac)



12 OUTLET, FLOOR AIR
160 DEFOGGER, SIDE WINDOW
161 OUTLET, LEFT-HAND EYEBROW
162 OUTLET, LEFT-HAND DRIVER
163 OUTLET, RIGHT-HAND EYEBROW
164 OUTLET, RIGHT-HAND PASSENGER
165 OUTLET, LEFT-HAND PASSENGER

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Figure 8 – Air Outlets – (Chevrolet)



A PLENUM
25 VALVE, PRESSURE RELIEF

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Figure 9 – Flow-Through Ventilation (Typical)

OUTSIDE AIR TEMPERATURE	–18°C (0°F)	–4°C (25°F)	10°C (50°F)	24°C (75°F)
HEATER AIR TEMPERATURE*	43°C (110°F)	50°C (125°F)	60°C (140°F)	66°C (150°F)

*Temperature at floor air outlet assembly controls at "HI" blower, "HEATER" mode and full warm, engine at operating temperature and vehicle speed of 48 km/h (30 mph).

Figure 10 – Heater Output Temperature Chart

4. Move the mode control knob from " " (heater) position to the " " (blend) position. Air should come equally from the defroster nozzle and the heater outlet with some air coming from the side window defogger.
5. Move mode control knob from " " (blend) position to " " (defrost) position.
   - Most of the air should be discharged onto the windshield from the defroster nozzle.
   - A small amount of air should also be discharged from floor outlets.
6. Move mode control knob back to " " (bi-level) position and rotate temperature control knob clockwise to full hot.
   - Air should come from instrument panel outlets, and its temperature should climb rapidly to approximately 55°C (131°F) or higher, depending upon outside air temperature. For a more precise heater output temperature check, refer to "Heater Output Temperature Check" in the following procedure.
   - Defroster nozzle airflow should diminish and airflow from floor outlets may increase slightly.
7. Rotate temperature control knob counterclockwise to full cold and check to be sure air temperature drops back to nearly the temperature of the outside air once again.
8. Slowly turn blower motor assembly speed control knob toward "OFF," stopping briefly at each intermediate position to feel the reduction of airflow.
   - Both airflow and blower noise should reduce noticeably at each intermediate step.

HEATER OUTPUT TEMPERATURE CHECK

Figure 10

The heat output of the heater system can be checked with the following procedure.

Preparation

With the engine sufficiently cool, the radiator cap should be removed and the engine started and allowed to idle (3.4L V6 engine only). Heater controls should be set to " " (heater) mode, temperature control knob turned all the way to full hot and "HIGH" blower speed. When coolant flow in the radiator is visible through the filler neck, the radiator cap should be installed (3.4L V6 engine only).

Important

- Do not remove radiator cap on 5.7L V8 engine while running.

Temperature Check

When the engine is warmed up (after approximately 20 minutes of operation), the vehicle should be driven. An accurate thermometer should be used to determine the temperature of the outside air and the temperature of the air discharged at the floor outlets with the vehicle being driven at 48 km/h (30 mph). Minimum acceptable heater output temperatures at four different outside air temperatures are shown in Figure 10.

Minimum acceptable heater output temperatures for outside air temperatures other than those shown in Figure 10 can be approximated by using the Fahrenheit scale and rounding off the outside air temperature to the nearest 5°. For every additional 5° of outside temperature, an additional 1.8° of heater output temperature should be allowed when the outside temperature is below 50°F. An additional 1.6° of heater output temperature should be allowed for every 5° of outside temperature when the outside temperature is above 50°.

INSUFFICIENT HEATING OR DEFROSTING

The most likely causes of insufficient heating outside the heater system include a low coolant level, a faulty thermostat, a partially or fully clogged heater core or heater hose, an obstruction to air circulation (often under the front seat) or an air leak past a faulty seal into the passenger compartment. For an organized diagnosis procedure, refer to Figures 11 and 12.

HIGH OR LOW HEATER CONTROL EFFORT

A kinked control cable, a binding valve or a faulty control assembly are possible causes of excessive temperature control knob effort. For an organized diagnosis procedure, refer to Figure 13.

BLOWER MOTOR ASSEMBLY NOISE

A constant air rush noise is typical of all heater systems when operating on "HIGH" blower speed. Some systems and modes may be worse than others. If possible, check a similar vehicle to determine whether the noise is typical or excessive. For diagnosis of excessive blower motor assembly noise, refer to Figures 14 and 15.

EXCESSIVE HEAT

The most likely cause of excessive heat from the heater system is a disconnected or nonfunctional temperature control cable assembly. Refer to "Temperature Control Cable Assembly" in this section. A hot air leak from the engine compartment to the blower inlet is also a remote possibility.

ON-VEHICLE SERVICE

REPLACEMENT PROCEDURES

Control Assembly and Vacuum Selector Valve and/or Blower Motor Assembly Switch

Figures 2, 3, 16 and 17

Remove or Disconnect

1. Control assembly trim plate (Pontiac only).
   - Pull control assembly trim plate rearward and off instrument panel lower trim pad.
2. Upper instrument panel cover panel (Chevrolet only).
3. Cluster trim plate (Chevrolet only). Refer to SECTION 8C.
4. Heater and air conditioning control bolts/screws (26).
5. Control assembly (2 or 162).
   - Pull control assembly (2 or 162) out far enough to reach the vacuum, electrical and temperature control cable connections.
6. Blower motor assembly switch connector.
7. Vacuum harness connector from vacuum selector valve.
8. Temperature control cable assembly from control assembly (2 or 162).
   - While releasing temperature control cable clips from control assembly, pry temperature control cable with small screwdriver from control assembly (2 or 162).
9. Vacuum selector valve, if necessary.
   - Remove two retaining screws and remove vacuum selector valve.
10. Blower motor assembly switch, if necessary.
    A. Remove blower motor assembly speed control knob (9 or 159) and retaining bolt/screw.
    B. Remove blower motor assembly switch.

Inspect

- Electrical terminals for corrosion. Remove corrosion or replace component as necessary
- Temperature and mode knobs for freedom of movement. Lubricate, repair or replace as necessary.
- Temperature control cable assembly for kinks, binding and other damage. Adjust, repair or replace as necessary.

Install or Connect

NOTICE: See "Notice" on page 1A-1 of this section.

1. Blower motor assembly switch, if removed.
   A. Hold blower motor assembly switch in position and install bolt/screw.
   B. Install blower motor assembly speed control knob (9 or 159).
2. Vacuum selector valve and retaining screws, if removed.
3. Temperature control cable assembly.
   A. Slip temperature control cable assembly into position on lever arm. Align shaft with temperature control cable slot.
   B. Press temperature control cable clip into slot in control assembly (2 or 162). Make sure all three clips are in place.
4. Vacuum harness connector to vacuum selector valve.
5. Blower motor assembly switch connector.
6. Control assembly (2 or 162).
7. Heater and air conditioning control bolts/screws (26).

Tighten

- Heater and air conditioning control bolts/screws (26) to 1.9 N•m (17 lb. in.).

8. Control assembly trim plate (Pontiac only).
   - Hold control assembly trim plate in position and press it forward to engage four retaining clips.
9. Cluster trim plate (Chevrolet only). Refer to SECTION 8C.
10. Upper instrument panel cover panel (Chevrolet only).
11. Test operation of temperature control knob, mode control knob and blower motor assembly switch.

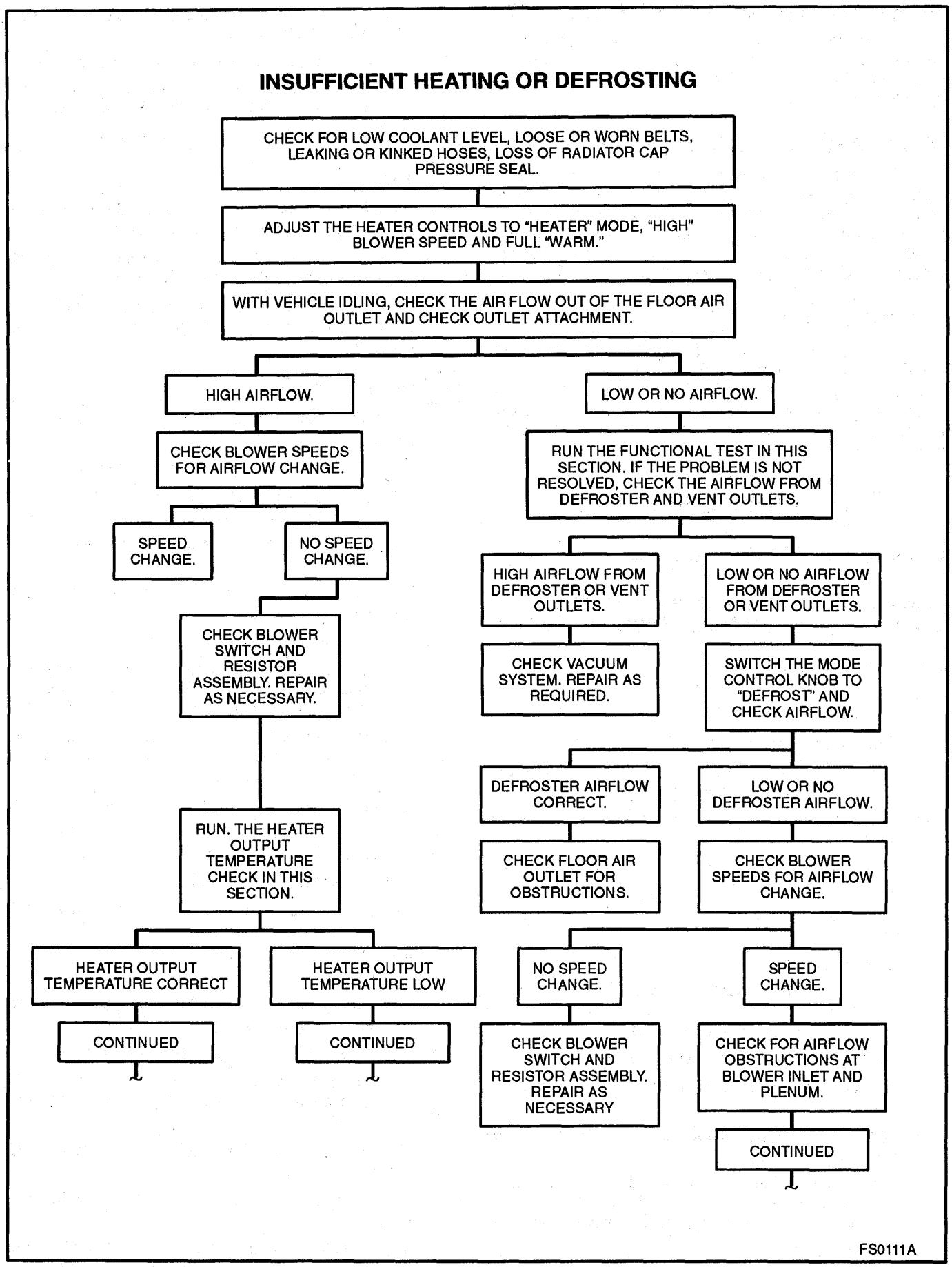


Figure 11 – Insufficient Heating or Defrosting Diagnostic Procedure (1 of 2)

INSUFFICIENT HEATING OR DEFROSTING (Continued)

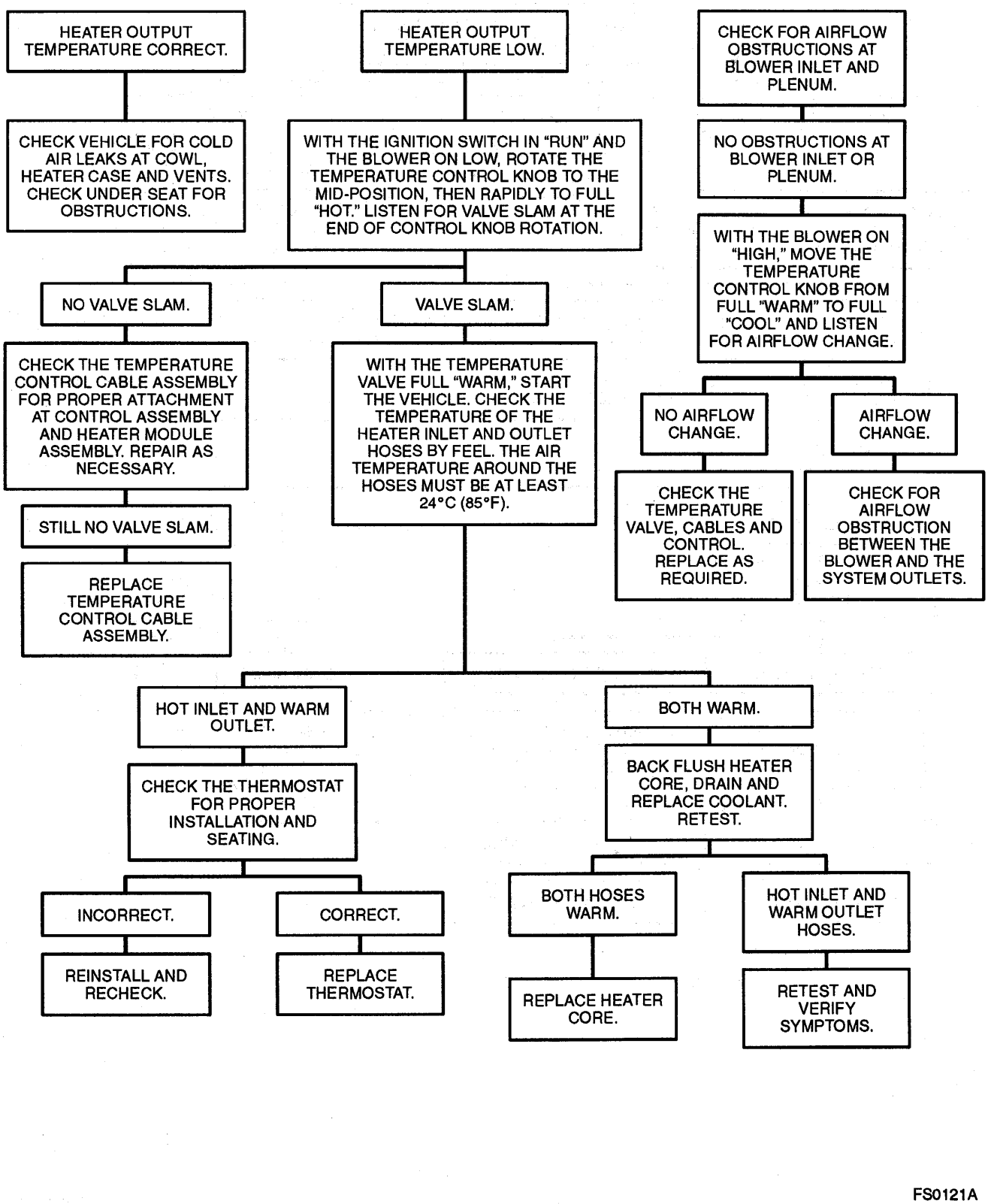


Figure 12 – Insufficient Heating or Defrosting Diagnostic Procedure (2 of 2)

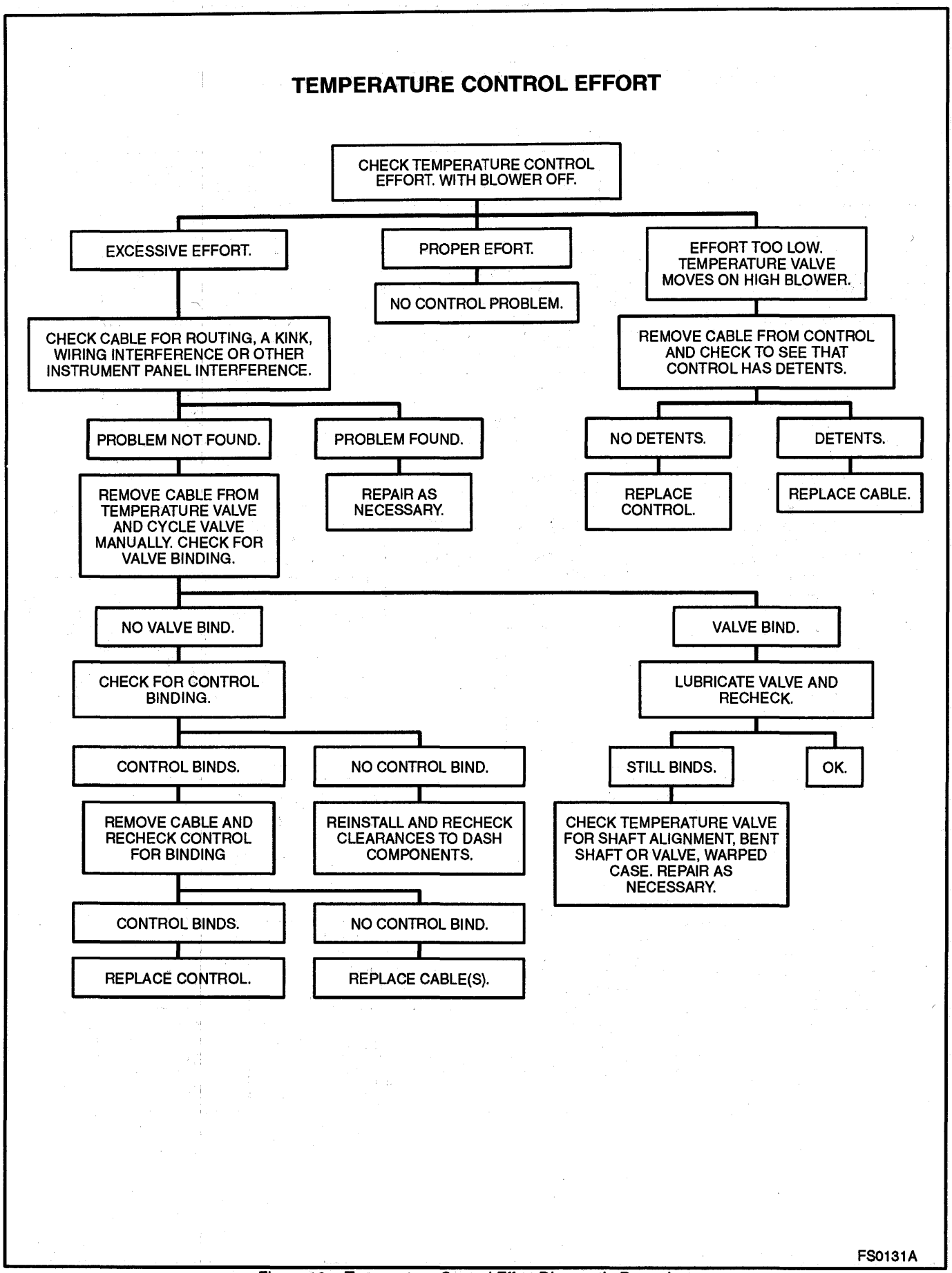


Figure 13 – Temperature Control Effort Diagnostic Procedure

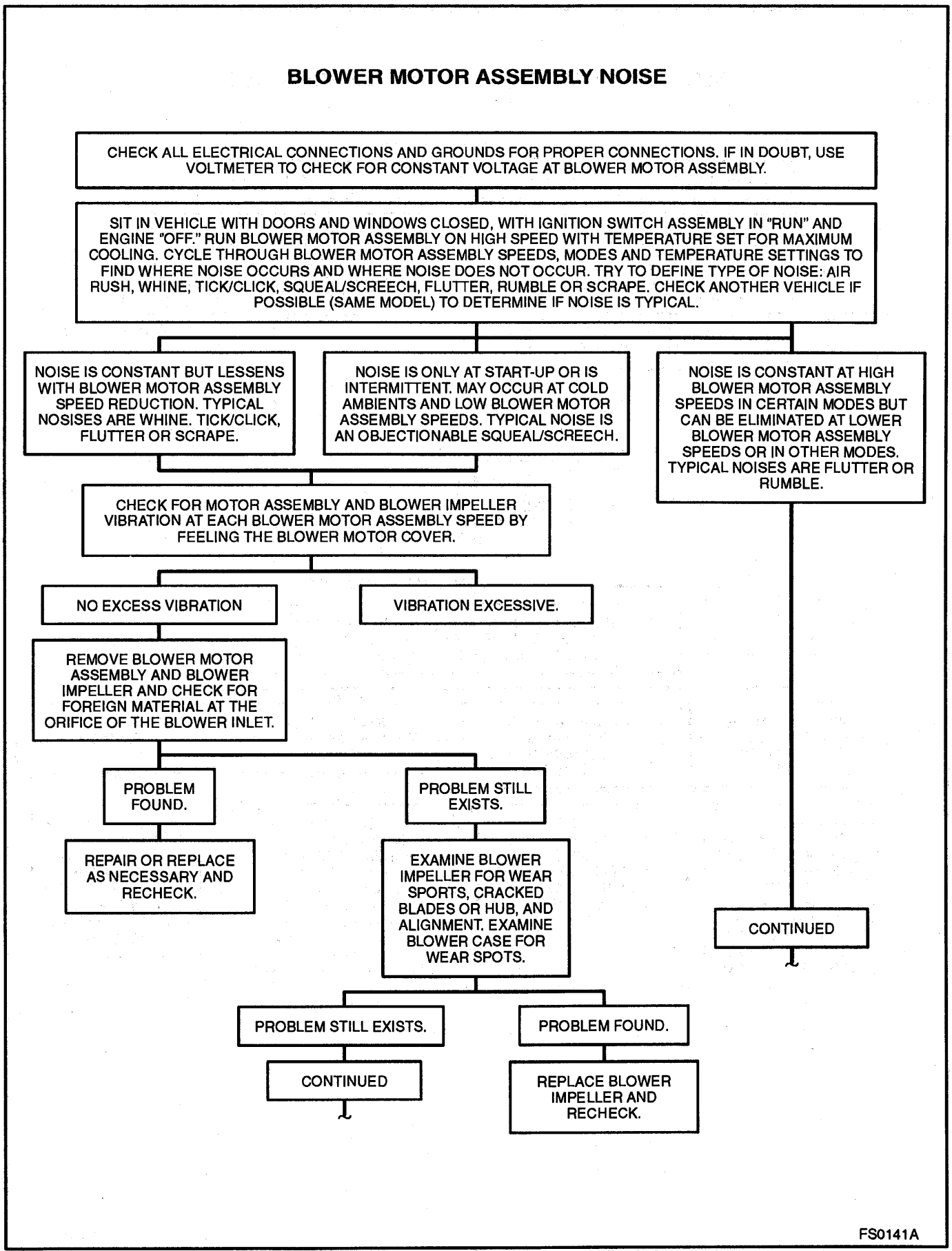


Figure 14 – Blower Motor Assembly Noise Diagnostic Procedure (1 of 2)

BLOWER MOTOR ASSEMBLY NOISE (Continued)

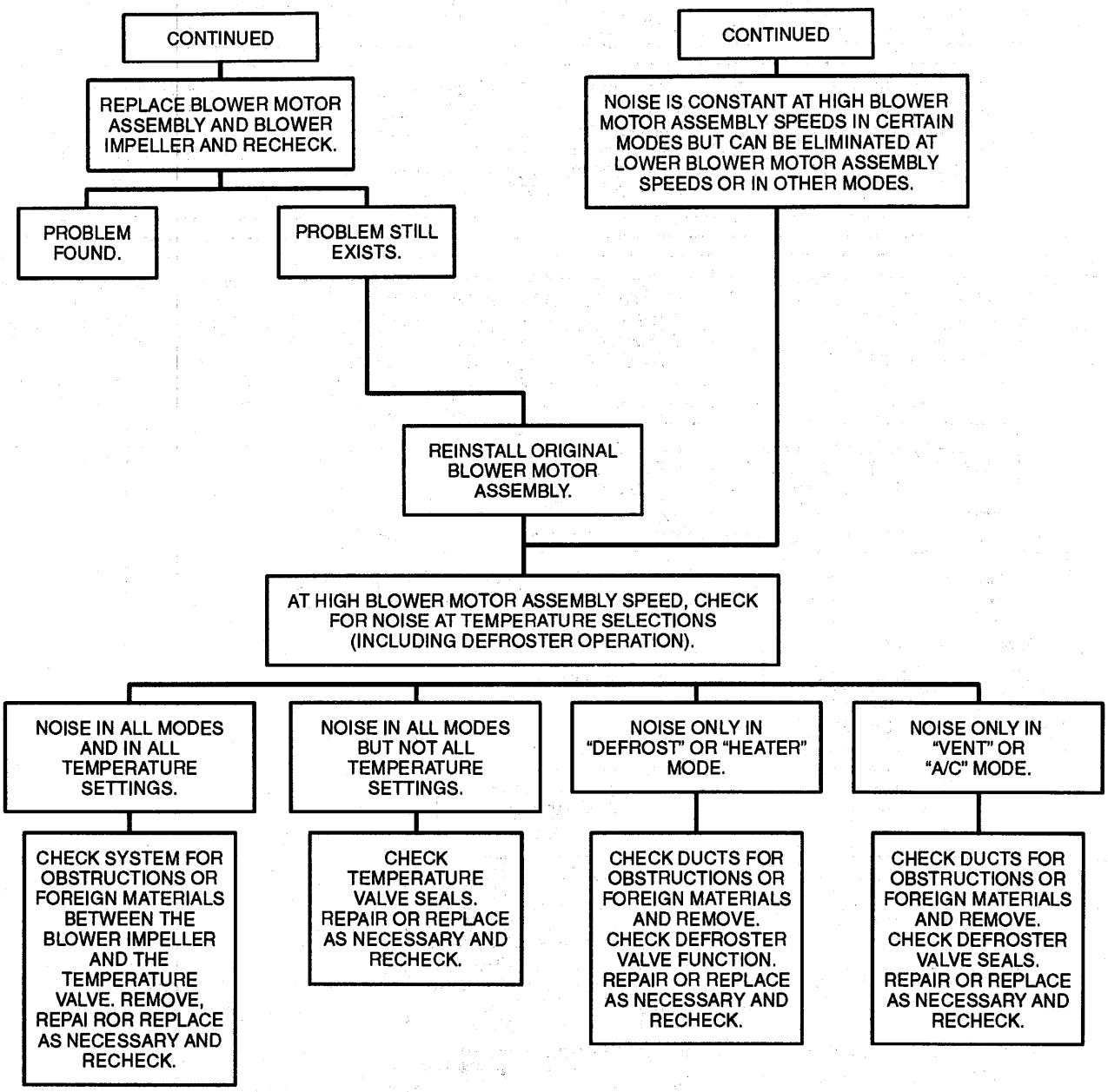
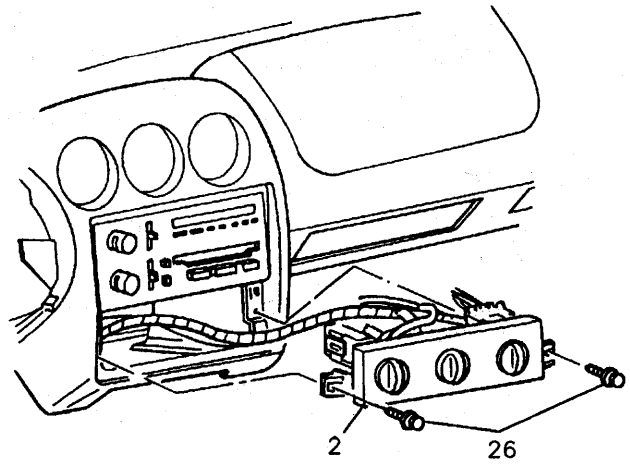


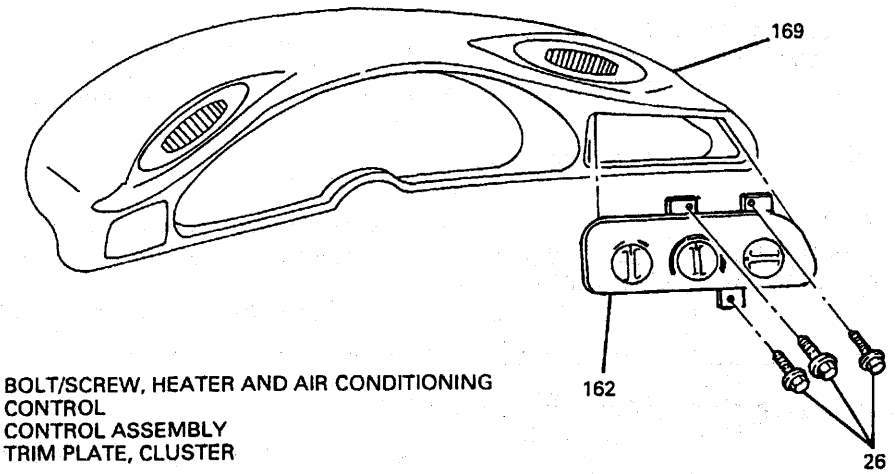
Figure 15 – Blower Motor Assembly Noise Diagnostic Procedure (2 of 2)



2 CONTROL ASSEMBLY
26 BOLT/SCREW, HEATER AND AIR CONDITIONING CONTROL

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Figure 16 – Control Assembly Removed – (Pontiac)



26 BOLT/SCREW, HEATER AND AIR CONDITIONING CONTROL
162 CONTROL ASSEMBLY
169 TRIM PLATE, CLUSTER

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Figure 17 – Control Assembly Removed – (Chevrolet)

Control Assembly Lamp Bulb

Figures 16 and 17

Remove or Disconnect

1. Control assembly trim plate (Pontiac only).
   - Pull control assembly trim plate forward and off instrument panel lower trim pad.
2. Cluster trim plate (Chevrolet only). Refer to SECTION 8C.
3. Heater and air conditioning control bolts/screws (26).
4. Control assembly (2 or 162).
   - Pull control assembly (2 or 162) out far enough to reach control assembly lamp bulb socket.
5. Bulb and socket by twisting socket.
6. Bulb from socket.
   - Pull bulb straight out from socket.

Inspect

- Control assembly lamp bulb socket for corrosion and damage. Clean or replace as necessary.
- Wires for damage and secure connection to bulb socket. Repair or replace as necessary.

Install or Connect

NOTICE: See "Notice" on page 1A-1 of this section.

1. New bulb.
   - Push bulb straight into socket.
2. Bulb and socket by twisting socket into place.
3. Control assembly (2 or 162).
4. Heater and air conditioning bolts/screws (26).

Tighten

- Heater and air conditioning control bolts/screws (26) to 1.9 N•m (17 lb. in.).

5. Control assembly trim plate (Pontiac only).
   - Hold control assembly trim plate in position and press it rearward to engage four retaining clips.
6. Cluster trim plate (Chevrolet only). Refer to SECTION 8C.
7. Test operation of control assembly lamp bulb.

Temperature Control Cable Assembly

Figures 16 through 18

Remove or Disconnect

1. Right instrument panel sound insulator assembly. Refer to SECTION 8C.
2. Temperature control cable assembly (5) at heater module assembly (1).
   - Remove temperature control cable bolt/screw (29).
3. Control assembly trim plate (Pontiac only).
   - Pull control cable assembly trim plate rearward and off instrument panel lower trim pad.
4. Cluster trim plate (Chevrolet only). Refer to SECTION 8C.
5. Heater and air conditioning control bolts/screws (26).
6. Control assembly (2 or 162).
   - Pull control assembly (2 or 162) out far enough to reach temperature control cable assembly connection.
7. Temperature control cable assembly (5).
   - While releasing temperature control cable clips from control assembly (2 or 162), pry temperature control cable with small screwdriver from control assembly (2 or 162).

Install or Connect

NOTICE: See "Notice" on page 1A-1 of this section.

1. Temperature control cable assembly (5) to control assembly (2 or 162).
   A. Slip temperature control cable into position over lever arm. Align shaft with temperature control cable slot.
   B. Press temperature control cable clip into slot in control assembly (2 or 162). Make sure all three clips are in place.
2. Control assembly (2 or 162).
3. Heater and air conditioning control bolts/screws (26).

Tighten

- Heater and air conditioning control bolts/screws (26) to 1.9 N•m (17 lb. in.).

4. Control assembly trim plate (Pontiac only).

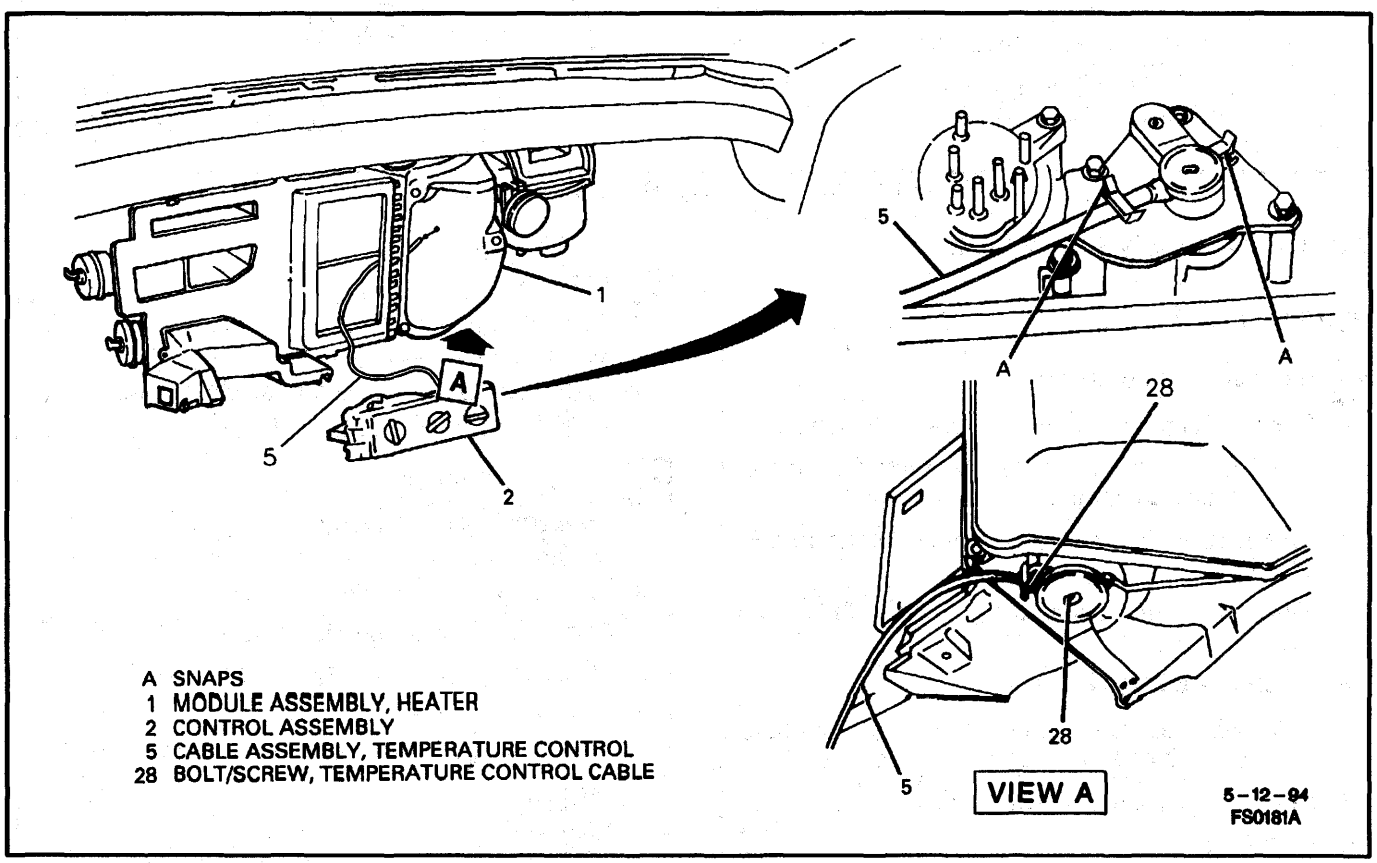


Figure 18 – Temperature Control Cable Assembly

- Hold control assembly trim plate in position and press it forward to engage four retaining clips.

5. Cluster trim plate (Chevrolet only). Refer to SECTION 8C.
6. Temperature control cable assembly (5) at heater module assembly (1) with temperature control cable bolt/screw (29).

Tighten

- Temperature control cable bolt/screw (29) to 1.9 N•m (17 lb. in.).

7. Right instrument panel sound insulator assembly. Refer to SECTION 8C.

Blower Motor Resistor Assembly

Figure 19

Remove or Disconnect

1. Key from ignition to assure that switch will remain in "OFF."
2. Right instrument panel sound insulator assembly. Refer to SECTION 8C.
3. Pull carpet assembly away from heater module assembly.
4. Blower motor resistor bolt/screw (31).
5. Blower motor resistor assembly (30).

Install or Connect

NOTICE: See "Notice" on page 1A-1 of this section.

1. Blower motor resistor assembly (30) and blower motor resistor bolt/screw (31).

Tighten

- Blower motor resistor bolt/screw (31) to 2 N•m (18 lb. in.).

2. Carpet assembly.

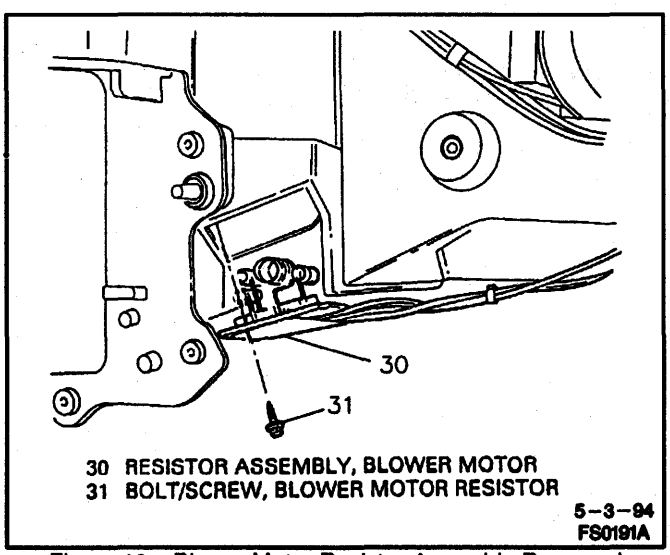


Figure 19 – Blower Motor Resistor Assembly Removed

3. Right instrument panel sound insulator assembly. Refer to SECTION 8C.
4. Test blower motor operation at all four speeds.

Blower Motor Assembly and Blower Motor Fan

Figure 20

Remove or Disconnect

1. Key from ignition switch to assure that switch will remain "OFF."
2. Right instrument panel sound insulator assembly and side trim panel. Refer to SECTION 8C.
3. Blower motor bolts/screws (32).
   - Blower motor assembly (6) and blower motor fan (18) will drop down.

Inspect

- Blower motor terminals for corrosion. Clean corrosion from terminals or replace blower motor assembly (6) as necessary.
- Flange of blower motor assembly (6) for damage or distortion that could cause an air leak. Repair as necessary.
- Blower motor fan (18) for damage and distortion. Repair or replace as necessary.

Install or Connect

NOTICE: See "Notice" on page 1A-1 of this section.

1. Blower motor assembly (6).
   - Guide blower motor assembly (6) and blower motor fan (18) into position, being careful not to catch blower motor fan (18) on protruding parts.
2. Blower motor bolts/screws (32).

Tighten

- Blower motor bolts/screws (32) to 2.3 N•m (20 lb. in.).

3. Right instrument panel sound insulator assembly and side trim panel. Refer to SECTION 8C.

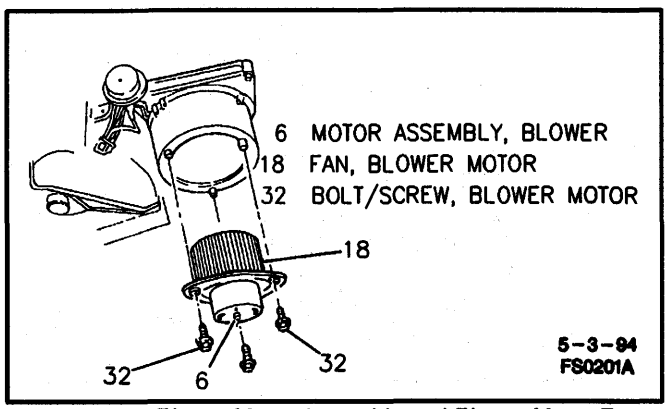


Figure 20 – Blower Motor Assembly and Blower Motor Fan Removed

4. Check blower operation.

Vacuum Harness

Figure 21

It is not necessary to replace an entire vacuum harness in case of a localized leakage or hose collapse. A repair can be made by cutting the hose and inserting a plastic retainer.

Remove or Disconnect

1. Open instrument panel compartment and push in on both sides of compartment. This will cause compartment to "drop" open completely for access to vacuum harness.
2. Vacuum hose connectors at vacuum actuators.
   - Trace each vacuum hose to its actuator on heater module assembly (1), noting its routing for reference during installation.
3. Pry apart vacuum interconnect and remove harness through instrument panel compartment.

Inspect

- Vacuum hoses for leaks by attempting to blow through hose while covering opposite end with a fingertip. Replace any hose that leaks.
- Vacuum switches and connecting hose at control assembly for leaks and proper function. Replace faulty components.

Install or Connect

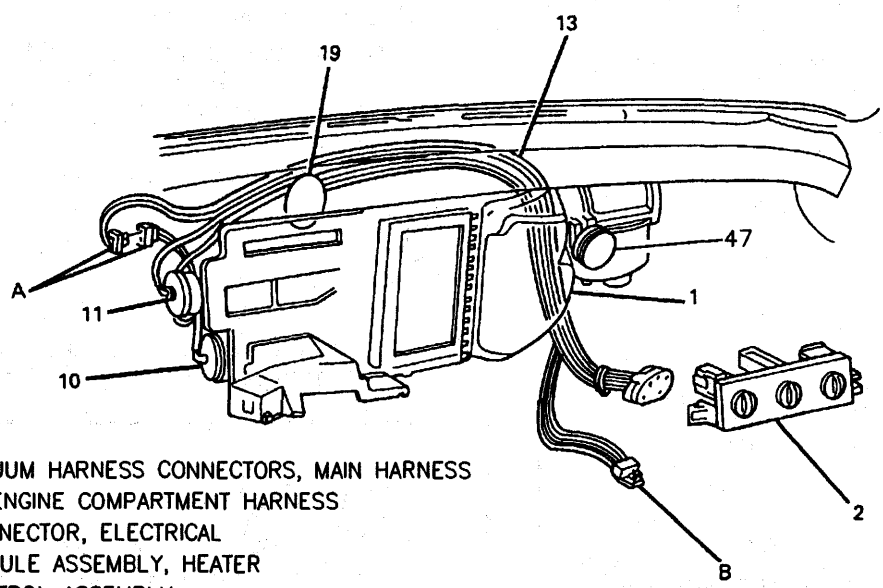
1. Vacuum harness.
2. Vacuum hose connectors to vacuum actuators.
   - Be sure connectors are snapped securely in place.
3. Push in on sides of instrument panel compartment and return it to its normal position.

Vacuum Tank

The vacuum tank that supplies the heater vacuum system is an oblong-shaped tank mounted below the front right-hand engine rail.

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Right lower side air baffle.
3. Vacuum line from lower connection.
4. Two vacuum tank mounting bolts/screws from top of vacuum tank.
5. Vacuum tank.



A VACUUM HARNESS CONNECTORS, MAIN HARNESS TO ENGINE COMPARTMENT HARNESS
B CONNECTOR, ELECTRICAL
1 MODULE ASSEMBLY, HEATER
2 CONTROL ASSEMBLY
10 ACTUATOR, BI-LEVEL MODE
11 ACTUATOR, DEFROSTER/HEATER VALVE
13 HARNESS, VACUUM
19 ACTUATOR, VENT MODE VALVE
47 ACTUATOR, AIR INLET VALVE

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Figure 21 – Vacuum Harness

Install or Connect

NOTICE: See "Notice" on page 1A-1 of this section.

1. Vacuum tank and vacuum tank mounting bolts/screws.

Tighten

- Vacuum tank mounting bolts/screws to 2.5 N•m (22 lb. in.).

2. Vacuum line to lower connection.
3. Right lower side air baffle.
4. Lower vehicle.

Vacuum Actuators

Figure 21

Defroster/Heater Valve

Remove or Disconnect

1. Instrument panel. Refer to SECTION 8C.
2. Defroster/heater valve actuator (11) from linkage.

Install or Connect

1. Defroster/heater valve actuator (11) to linkage.
2. Instrument panel. Refer to SECTION 8C.

Bi-Level Mode Valve

Remove or Disconnect

1. Front floor console assembly. Refer to SECTION 8C.
2. Floor air outlet.
3. Bi-level mode valve linkage bolt/screw from linkage.
4. Bi-level mode valve actuator (10).
   - Unsnap bi-level mode valve actuator (10).

Install or Connect

NOTICE: See "Notice" on page 1A-1 of this section.

1. Bi-level mode valve actuator (10).
   - Snap bi-level mode valve actuator (10) into place.
2. Bi-level mode valve linkage bolt/screw to linkage.

Tighten

- Bi-level mode valve linkage bolt/screw to 2.3 N•m (20 lb. in.).

3. Floor air outlet.
4. Front floor console assembly. Refer to SECTION 8C.

Vent Mode Valve

Remove or Disconnect

1. Instrument panel. Refer to SECTION 8C.
2. Vent mode valve linkage bolt/screw.
3. Vent mode valve actuator (19).
   - Disconnect linkage from vent mode valve actuator (19).

Install or Connect

NOTICE: See "Notice" on page 1A-1 of this section.

1. Vent mode valve actuator (19).
   - Connect linkage to vent mode valve actuator (19).
2. Vent mode valve linkage bolt/screw.

Tighten

- Vent mode valve linkage bolt/screw to 2.3 N•m (20 lb. in.).

3. Instrument panel. Refer to SECTION 8C.

Air Inlet Valve

Remove or Disconnect

1. Sound insulator assembly from both sides of vehicle.
2. Disable SIR. Refer to "Disabling the SIR System" in SECTION 8C.
3. Diagnostic energy reserve module from bracket.
4. Instrument panel compartment. Refer to SECTION 8C.
5. Heater module assembly cover.
6. Vacuum hose.
7. Air inlet valve actuator from linkage.

Install or Connect

1. Air inlet valve actuator to linkage.
2. Vacuum hose.
3. Heater module assembly cover.
4. Instrument panel compartment. Refer to SECTION 8C.
5. Diagnostic energy reserve module to bracket.
6. Enable SIR. Refer to "Enabling the SIR System" in SECTION 8C.
7. Sound insulator assembly to both sides of vehicle.

Air Deflectors

- Pontiac

  The right (passenger's side) and three center air deflectors of the heater system can be removed by closing the deflector and then gently easing the deflector and housing from the instrument panel assembly. The left-hand (driver's side) air deflector is part of the instrument panel cluster trim plate. Refer to SECTION 8C.
- Chevrolet

The left (driver's side) upper air deflectors can be removed by gently pushing in on the inboard edges of the deflector until it unseats from its snap. Gently pry the outboard snap with a small screwdriver until the outlet is free. The left (driver's side) lower air deflector is part of the knee bolster assembly. Refer to SECTION 8C. The right (passenger side) air deflectors can be removed by gently prying the outboard edges with a wide flat bladed tool. The outlets are snapped on either side to the deflector housing.

Heater Hose Assembly and Heater Hose Pipes

Figures 22 and 23

The heater hose inlet pipe (37) and heater hose outlet pipe (36) extend forward from the dash front panel next to the heater module assembly. The heater hose inlet pipe (37) is toward the left side of the vehicle from the heater hose outlet pipe (36).

On the 3.4L L32 engine, the heated coolant supply for the heater comes from a fitting at the front of the lower inlet manifold, just below the throttle body air inlet. A pipe from the fitting extends across the front of the engine and connects to a heater inlet hose assembly (33) that leads to a pipe mounted on the right side rail in the engine compartment. The rear end of the pipe is connected to a short inlet hose that leads to the heater hose inlet pipe (37). The fitting on the pipe across the front of the engine has two hose nipples that connect to short inlet and outlet hoses which heat the fuel injection system throttle body air inlet.

On the 5.7L LT1 engine, the heated coolant supply for the heater comes from a fitting at the water pump assembly.

On both engines, the heater hose outlet pipe (36) discharges coolant to a short heater outlet hose that is connected to a pipe mounted on the right side rail in the engine compartment. The forward end of the pipe is connected to an outlet hose that crosses in front of the engine and feeds the coolant into the water pump assembly.

The hoses are attached at each end with a spring tension clamp (34 and 35 or 151 and 152).

Remove or Disconnect

1. Engine coolant.
   - Drain enough coolant into a clean container for reuse.

   NOTICE: The heater core can be damaged if excessive force is applied on the core pipes during hose removal.
2. Heater hose assembly (33).
   A. Squeeze clamps with pliers and slide clamps (34 and 35 or 151 and 152) away from fittings.
   B. Remove heater hose assembly (33) by twisting and pulling. If hose will not come off heater hose inlet pipe (37) or outlet pipe (36) easily with this method, cut off hose forward of heater hose pipes. Then cut hose remaining on pipes lengthwise to remove it.
   C. Remove and discard hose clamps (34 and 35 or 151 and 152) if hose assembly (33) is to be reused.

Install or Connect

1. Heater hose assembly (33). If old hoses are being reused, replace original hose clamps with worm-gear clamps.
   A. Cut replacement hose(s) to same length as original hose(s), if necessary.
   B. If replacing rubber hoses, remove aluminum crimp and replace it with worm-gear clamps.
   C. Apply rubber lubricant to inside diameter of hose(s), if desired.
   D. Squeeze clamp ends and slip new hose clamp (34, 35, 151 or 152) over one end of heater hose. Push hose onto fitting with twisting motion. Hose end should be 1.0 mm (0.04 inch) away from touching nearest surface (dash front panel, fitting hex head, etc.).
   E. Install clamp (34, 35, 151 or 152) beyond any bead around fitting, but not closer than 3.0 mm (0.12 inch) to nearest surface (dash front panel, fitting hex head, etc.).
   F. Repeat hose and clamp installation procedure at other end of hose.
2. Engine coolant.
   - Use coolant drained earlier only if it is uncontaminated. Discard contaminated coolant and add fresh 50/50 coolant and water mixture.

Inspect

- Be sure installed hose does not sag or rub against other components. Adjust or support hose as necessary to correct hose position.
- Operate engine and check hose installation for leaks.
- Check coolant level after engine has been warmed up. Add coolant as necessary.

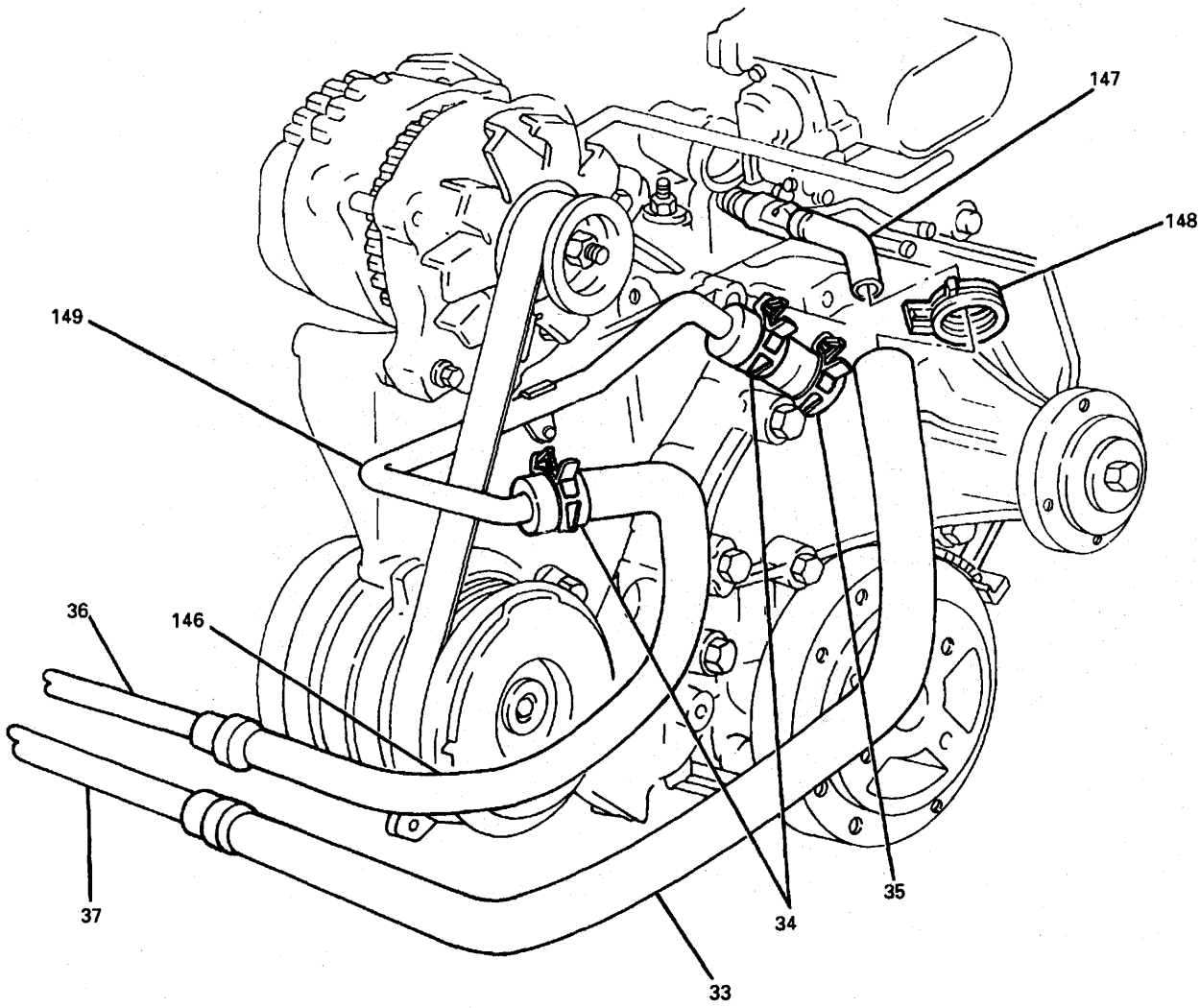
Heater Core

Figure 24

Remove or Disconnect

1. Hose pipe clamp bolt/screw (45) and hose pipe clamp (44).
   - Clamp off heater hoses.

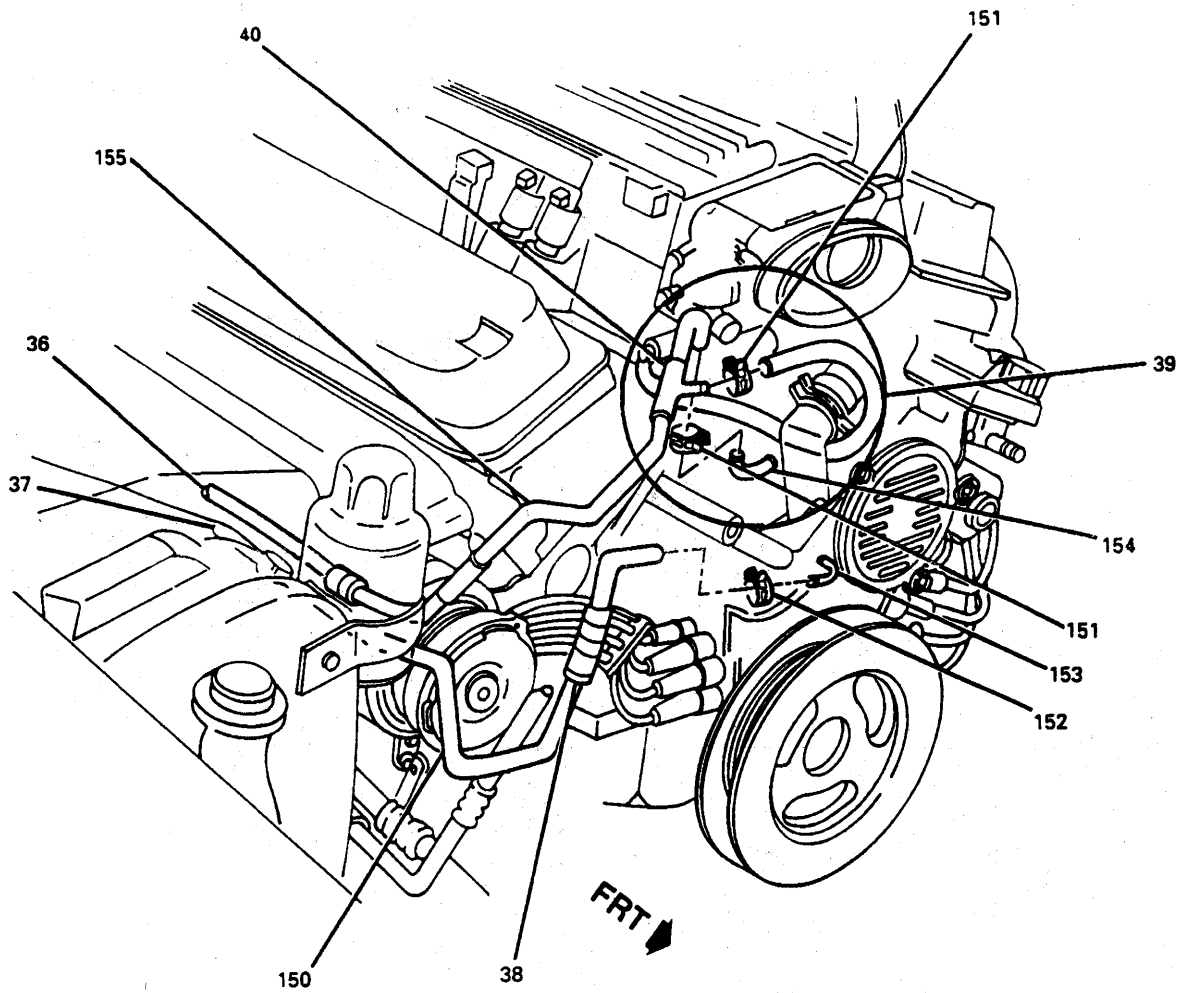
   NOTICE: Heater core can be damaged if too much force is applied to heater core pipes during hose removal.
2. Heater hose assembly from heater core pipes.
3. Open instrument panel compartment. Push in on sides of compartment to release it to reach heater core.
4. Heater module bolts/screws (41).

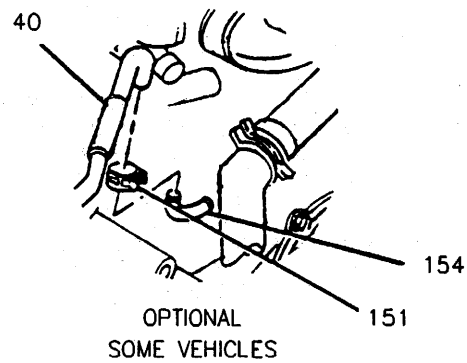


33 HOSE ASSEMBLY, HEATER INLET
34 CLAMP, HEATER OUTLET FRONT HOSE
35 CLAMP, HEATER INLET FRONT HOSE
36 PIPE, HEATER HOSE OUTLET
37 PIPE, HEATER HOSE INLET
146 HOSE ASSEMBLY, HEATER OUTLET
147 HOSE, THROTTLE BODY HEATER RETURN
148 CLAMP, THROTTLE BODY HEATER RETURN HOSE
149 PIPE, HEATER OUTLET

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Figure 22 – Heater Hose Assembly and Heater Hose Pipes (3.4L L32 Engine)





OPTIONAL
SOME VEHICLES

36 PIPE, HEATER HOSE OUTLET
37 PIPE, HEATER HOSE INLET
38 VALVE, FLOW CONTROL
39 HOSE, THROTTLE BODY HEATER RETURN
40 VALVE, BLEED
150 HOSE ASSEMBLY, HEATER INLET
151 CLAMP, HEATER OUTLET FRONT HOSE
152 CLAMP, HEATER INLET FRONT HOSE
153 PIPE, HEATER INLET
154 PIPE, HEATER OUTLET
155 HOSE ASSEMBLY, HEATER OUTLET

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Figure 23 – Heater Hose Assembly and Heater Hose Pipes (5.7L LT1 Engine)

5. Heater module assembly cover.
   - For vehicles equipped with A/C, remove air conditioning evaporator temperature sensor assembly from heater and air conditioning cover and remove air inlet valve actuator.
6. Heater core bolt/screw (42) and heater core clamp (43).
7. Heater core (14).
   - Carefully pull heater core toward you.

Install or Connect

NOTICE: See "Notice" on page 1A-1 of this section.

1. Heater core (14).

Important

- Lubricate heater pipes for good seal.
- Be sure seals around heater pipes remain in place when installing.
- To verify that seal is installed correctly, observe seal from inside engine compartment. If seal leaks, apply sealer GM P/N 3012078 between heater core pipes and evaporator housing.

2. Heater core bolt/screw (42) and heater core clamp (43).

Tighten

- Heater core bolt/screw to 1.8 N•m (16 lb. in.).

3. Hose pipe clamp bolt/screw (45) and hose pipe clamp (44).
   - Unclamp heater hoses.

Tighten

- Hose pipe clamp bolt/screw (45) to 1.8 N•m (16 lb. in.).

4. Heater hose assembly to heater core pipes.
5. Heater module assembly cover.
6. Heater module bolts/screws (41).

Tighten

- Heater module bolts/screws (41) to 2 N•m (18 lb. in.).
- For vehicles equipped with air conditioning, install air conditioning evaporator temperature sensor to heater core cover and install air inlet valve actuator.

7. Coolant.
   A. Fill cooling system.
   B. Operate engine and check for leaks at heater core pipes.
   C. Check coolant level after engine has been warmed up. Add coolant as necessary.
8. Instrument panel compartment.

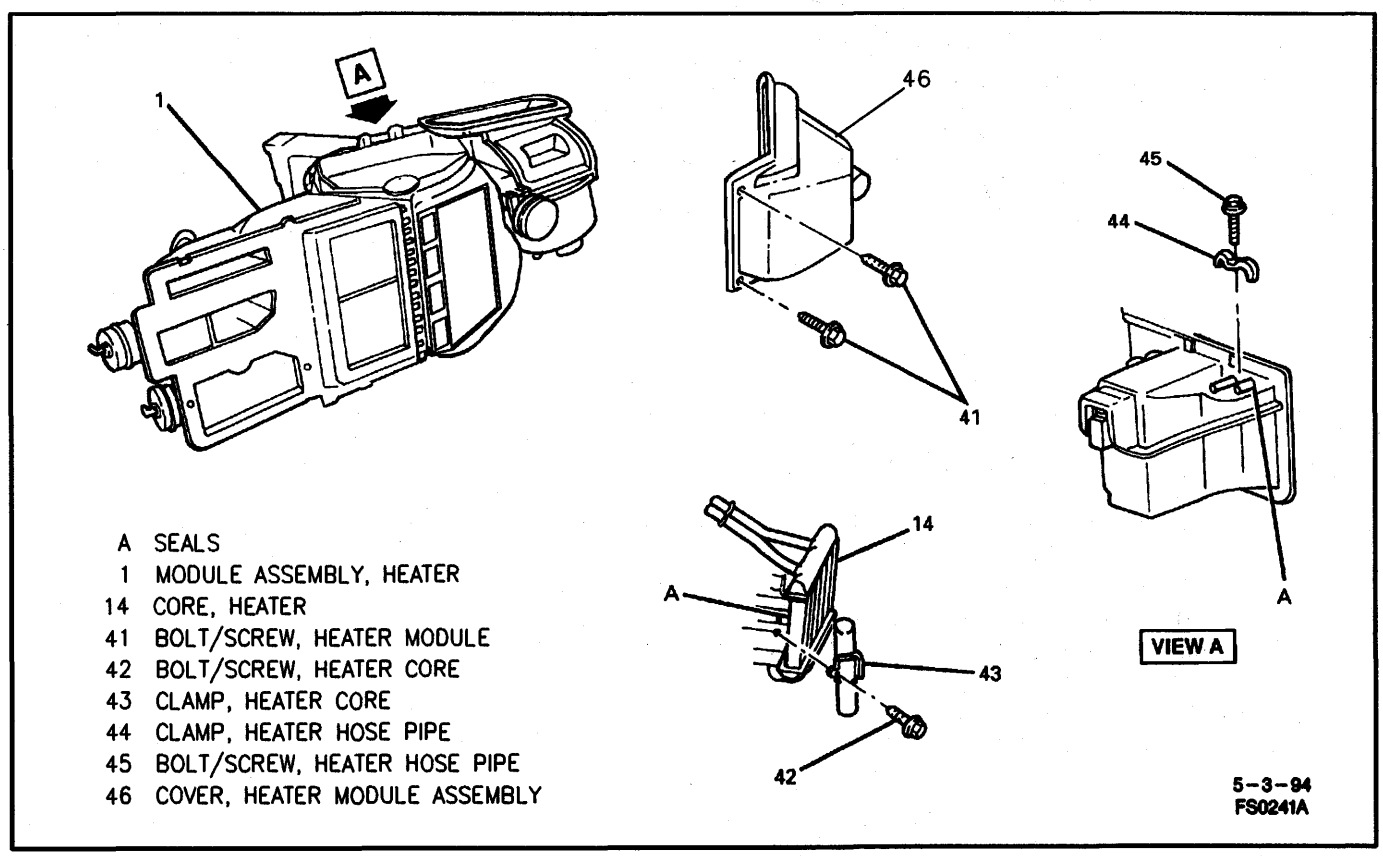


Figure 24 – Heater Core Removed

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Bi-Level Mode Valve Linkage Bolt/Screw	2.3 N•m (20 lb. in.)
Blower Motor Bolt/Screw	2.3 N•m (20 lb. in.)
Blower Motor Resistor Bolt/Screw	2 N•m (18 lb. in.)
Heater and A/C Control Bolt/Screw	1.9 N•m (17 lb. in.)
Heater Core Bolt/Screw	1.8 N•m (16 lb. in.)
Heater Hose Pipe Bolt/Screw	1.8 N•m (16 lb. in.)
Heater Module Bolt/Screw	2 N•m (18 lb. in.)
Hose Pipe Clamp Bolt/Screw	1.8 N•m (16 lb. in.)
Temperature Control Cable Bolt/Screw	1.9 N•m (17 lb. in.)
Vacuum Tank Mounting Bolt/Screw	2.5 N•m (22 lb. in.)
Vent Mode Valve Linkage Bolt/Screw	2.3 N•m (20 lb. in.)

ELECTRICAL SPECIFICATIONS

Blower Motor Fuse (Labeled "HVAC")	25 Amp. (White)
Control Assembly Dial Fuse (Labeled "IP DIMMER")	5 Amp. (Tan)
Control Assembly Dial Lamp Bulb Number	37

SECTION 1B

HEATER, VENTILATION AND AIR CONDITIONING

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

HEATER, VENTILATION AND AIR CONDITIONING SYSTEM OPERATION

NOTICE: The refrigeration system on this vehicle uses R-134a which is not compatible with refrigerant R-12. Before servicing the system always make sure the proper servicing equipment is used or the system could become severely damaged. Always refer to the service text and manufacturer instructions included with service equipment before proceeding.

The air conditioning system (C60) delivers air that has been heated or cooled and dehumidified for occupant comfort. It also provides power ventilation, windshield assembly and side window defrosting.

During most operating conditions, outside air is drawn through the heater and air conditioning module assembly by the blower motor assembly. Additional outside air is also forced into the vehicle by forward movement of the vehicle.

Within the evaporator module assembly, air is pushed by the blower motor assembly through the evaporator, then through the heater core depending on the temperature valve position, then into the passenger compartment. For air conditioning or defroster operation at ambient temperatures above 7°C (45°F), the refrigeration system will chill the evaporator to almost freezing. As the air passes through the evaporator, the air temperature drops which causes the moisture in the air to condense on the evaporator core fins. This moisture leaves the vehicle by gravity feed through a drain hole, dehumidifying the vehicle.

From the evaporator, some or all of the air may pass through the heater core assembly, which is warmed by engine coolant. Any of the air which is not to be heated will mix with the heated air before entering the passenger compartment.

When maximum air conditioning mode is selected, most of the air entering the blower motor assembly is taken from the passenger compartment (recirculated) where it is most likely to be cooler than the outside air. Only outside air is used in all other modes.

REFRIGERATION SYSTEM

Figures 1 and 2

Refrigerant-134a

CAUTION: Avoid breathing A/C Refrigerant-134a and lubricant vapor or mist. Exposure may irritate eyes, nose, and throat. To remove R-134a from the A/C system, use service equipment certified to meet the requirements of SAE J2210 (R-134a recycling equipment). If accidental system discharge occurs, ventilate work area before resuming service. Additional health and safety information may be obtained from refrigerant and lubricant manufacturers.

Like the coolant in the engine cooling system, the refrigerant is the substance in the air conditioning system that absorbs, carries and then releases heat. Although various substances are used as refrigerants in other types of refrigeration systems, past automotive air conditioning systems used a type called Refrigerant-12 (R-12).

This vehicle uses a new type of refrigerant called Refrigerant-134a (R-134a). It is a non-toxic, non-flammable, clear, colorless, liquefied gas.

While the R-134a A/C system is very similar to an R-12 A/C system, the differences in the refrigerant, lubricants, and service equipment are important.

NOTICE: R-134a refrigerant is not compatible with R-12 refrigerant in an air conditioning system. R-12 in a R-134a system will cause compressor failure, refrigerant oil sludge or poor air conditioning system performance.

Refrigerant-134a carries a charge of a special lubricating oil, polyalkylene glycol (PAG) refrigerant oil. GM PAG refrigerant oil will have a slight blue tint. The oil is hydroscopic (absorbs water from the atmosphere) and should be stored in closed containers.

Use only polyalkylene glycol (PAG) synthetic refrigerant oil for internal circulation through the R-134a A/C system and only mineral base 525 viscosity refrigerant oil on fittings threads and O-rings. If lubricants other than those specified are used, compressor failure and/or fitting seizure is likely to occur.

Air Conditioning Receiver and Dehydrator Assembly

The receiver and dehydrator assembly is located on the right side wheelhouse panel, just downstream from the condenser assembly. It functions as a moisture separator that receives refrigerant liquid and refrigerant oil from the condenser. It only allows refrigerant liquid and a small amount of oil to continue on to the thermostatic expansion valve assembly.

At the bottom of the receiver and dehydrator assembly is the desiccant, which acts as a drying agent for moisture that may have entered the system. A filter is also located near the bottom of the receiver and dehydrator assembly outlet pipe to keep any particles from plugging the thermostatic expansion valve assembly.

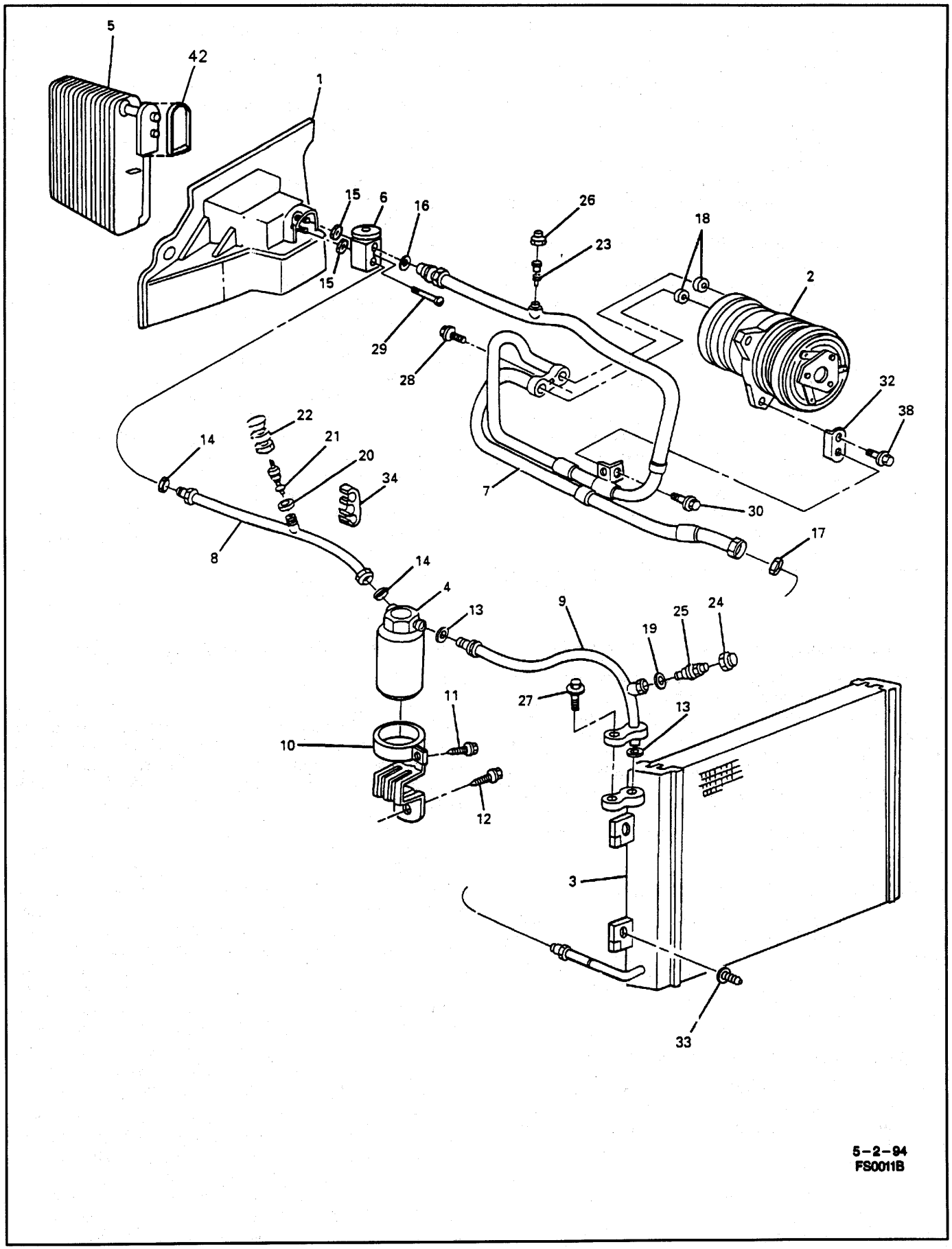


Figure 1 – Refrigeration System Components

1 MODULE ASSEMBLY, HEATER AND AIR CONDITIONING EVAPORATOR
2 COMPRESSOR ASSEMBLY, AIR CONDITIONING
3 CONDENSER ASSEMBLY, AIR CONDITIONING
4 RECEIVER AND DEHYDRATOR ASSEMBLY, AIR CONDITIONING
5 EVAPORATOR, AIR CONDITIONING
6 VALVE ASSEMBLY, AIR CONDITIONING THERMOSTATIC EXPANSION
7 HOSE ASSEMBLY, AIR CONDITIONING COMPRESSOR AND CONDENSER
8 TUBE, AIR CONDITIONING RECEIVED DEHYDRATOR
9 TUBE, AIR CONDITIONING RECEIVER DEHYDRATOR
10 BRACKET, AIR CONDITIONING RECEIVER DEHYDRATOR
11 BOLT/SCREW, AIR CONDITIONING RECEIVER DEHYDRATOR CLAMP
12 BOLT/SCREW, AIR CONDITIONING RECEIVER DEHYDRATOR BRACKET
13 O-RING, AIR CONDITIONING RECEIVER DEHYDRATOR TUBE
14 O-RING, AIR CONDITIONING EVAPORATOR TUBE
15 SEAL, AIR CONDITIONING EVAPORATOR TUBE
16 SEAL, AIR CONDITIONING COMPRESSOR AND CONDENSER HOSE
17 O-RING, AIR CONDITIONING CONDENSER FITTING
18 SEAL, AIR CONDITIONING COMPRESSOR HOSE
19 SEAL, AIR CONDITIONING REFRIGERANT SERVICE VALVE
20 O-RING, AIR CONDITIONING REFRIGERANT PRESSURE SENSOR
21 VALVE, AIR CONDITIONING REFRIGERANT PRESSURE SENSOR
22 SENSOR ASSEMBLY, AIR CONDITIONING REFRIGERANT PRESSURE
23 CORE, AIR CONDITIONING REFRIGERANT SERVICE VALVE
24 CAP, AIR CONDITIONING REFRIGERANT CHARGE VALVE (SERVICE VALVE)
25 VALVE, AIR CONDITIONING REFRIGERANT SERVICE
26 CAP, AIR CONDITIONING REFRIGERANT CHARGE VALVE
27 BOLT/SCREW, AIR CONDITIONING RECEIVER DEHYDRATOR TUBE
28 BOLT/SCREW, AIR CONDITIONING COMPRESSOR AND CONDENSER HOSE
29 BOLT/SCREW, AIR CONDITIONING THERMOSTATIC EXPANSION VALVE
30 BOLT/SCREW, AIR CONDITIONING COMPRESSOR AND CONDENSER HOSE CLIP BRACKET
32 BRACKET, AIR CONDITIONING COMPRESSOR HOSE CLIP
33 RETAINER, RADIATOR AIR UPPER BAFFLE
34 STRAP, AIR CONDITIONING COMPRESSOR AND CONDENSER HOSE
38 BOLT/SCREW, AIR CONDITIONING COMPRESSOR
42 GASKET, EVAPORATOR BLOCK

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Figure 2 – Refrigeration System Components – Legend

Air Conditioning Compressor Assembly

The air conditioning compressor assembly is driven by a belt from the engine crankshaft through the compressor clutch pulley. The compressor pulley rotates freely, without turning the compressor shaft, until an electromagnetic clutch coil is energized. When voltage is applied to energize the clutch coil, a clutch plate and hub assembly is drawn rearward toward the pulley. The magnetic force locks the clutch plate and pulley together as one unit to drive the compressor shaft. For unit repair information, refer to SECTION 1D2.

Air Conditioning Condenser Assembly

The air conditioning condenser assembly in front of the radiator assembly is made up of coils, which carry the refrigerant and cooling fins to provide rapid transfer of heat. The air passing through the condenser assembly cools the high-pressure refrigerant vapor, causing it to condense into a liquid.

Electric Engine Coolant Fan Assembly

Coolant fan assembly operation is crucial to the proper operation of the air conditioning system. The coolant fan assembly ensures the proper amount of air flow across the condenser throughout the vehicle operating range.

Fan assembly operation should be checked during any air conditioning diagnosis procedure. Special attention should be given to the fan assembly whenever excessive high side pressures are encountered.

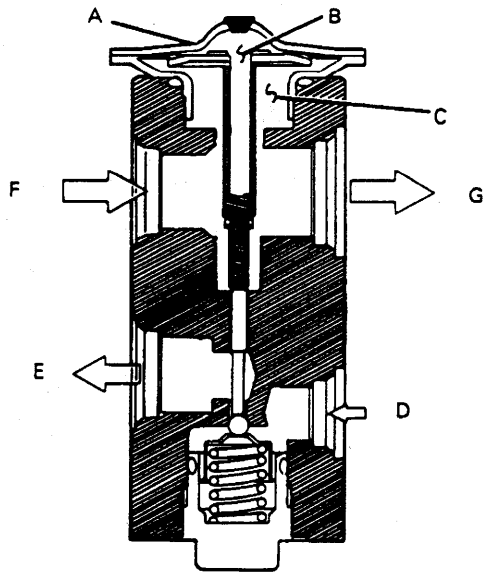
Thermostatic Expansion Valve Assembly

Figure 3

The purpose of the thermostatic expansion valve assembly is to regulate the flow of refrigerant through the evaporator to optimize its cooling performance. This is accomplished by monitoring the refrigerant conditions at the evaporator outlet and adjusting the inlet flow accordingly. This assures that all the liquid is evaporated before it is returned to the compressor assembly.

The refrigerant flow is controlled by the movement of a shaft that pushes a ball from its seat. As the ball is unseated, more flow is allowed through the evaporator. Shaft movement is controlled by the power dome which has two separate sides. The thermal side of the power dome is sealed and charged with refrigerant. The system side of the power dome is exposed to the pressure of the evaporator outlet or low side. Refrigerant exiting the evaporator flows over part of the thermal side of the power dome. The sealed refrigerant in the thermal side responds to the temperature changes of the refrigerant flowing out of the evaporator. As the refrigerant temperature rises, the pressure of the thermal side increases.

If the pressure on the thermal side of the power dome is greater than the pressure on the system side (the evaporator outlet or low-side pressure), the shaft moves down and pushes the ball off the seat allowing more refrigerant flow through the evaporator. When the opposite is true, the shaft moves up and reseats the ball reducing flow. A spring at the bottom of the thermostatic expansion valve assembly is not adjustable.



A POWER DOME
B THERMAL-SIDE PRESSURE
C AIR CONDITIONING SYSTEM LOW-SIDE PRESSURE
D FROM AIR CONDITIONING RECEIVER AND DEHYDRATOR ASSEMBLY (HIGH SIDE)
E TO AIR CONDITIONING EVAPORATOR (LOW SIDE)
F FROM AIR CONDITIONING EVAPORATOR
G TO AIR CONDITIONING COMPRESSOR ASSEMBLY

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Figure 3 – Thermostatic Expansion Valve Assembly

Although the thermostatic expansion valve assembly controls evaporator refrigerant flow, air conditioning capacity control (to prevent ice build-up) is managed by compressor cycling which is controlled by the powertrain control module (PCM).

Air Conditioning Evaporator

The evaporator is a device which cools and dehumidifies the air before it enters the vehicle. High-pressure refrigerant flows through the thermostatic expansion valve assembly and becomes low-pressure refrigerant before entering the evaporator. The heat in the air passing through the evaporator core is lost to the cooler surface of the core, thereby cooling the air. As the process of heat loss from the air to the evaporator core surface is taking place, any moisture (humidity) in the air condenses on the outside of the evaporator core and is drained off as water.

High Pressure Relief Valve

The compressor assembly is equipped with a pressure relief valve which is placed in the system as a safety factor. Under certain conditions, the refrigerant on the discharge side may exceed the designed operating pressure. To prevent system damage, the valve is designed to open automatically at approximately 3036 kPa (440 psi). Any condition that causes this valve to open should be corrected, and the refrigerant oil should be replaced as necessary. The air conditioning refrigerant pressure sensor should also be checked for proper calibration. Refer to SECTION 6E3 (DTC 61).

RELAYS AND SWITCHES

Blower Motor Assembly Relay

The blower motor assembly relay is used to provide battery voltage to the blower motor assembly only during high blower motor assembly speed. The blower motor resistor assembly is used to provide power to the blower motor assembly in all other speed settings. The blower motor relay is located under the instrument panel. Refer to SECTION 8A-63 for more information.

Air Conditioning Compressor Relay

The air conditioning compressor relay is used to provide battery voltage to the compressor clutch coil. The relay is controlled by the powertrain control module (PCM) only. The relay is located in the underhood electrical center. Refer to SECTION 8A-64 for more information.

Air Conditioning Refrigerant Pressure Sensor Assembly

The A/C refrigerant pressure sensor assembly attached to the air conditioning evaporator liquid line, senses refrigerant pressure on the air conditioning system high-side. The refrigerant pressure status is sent to the PCM. The purpose of this sensor is to inform the PCM of high-side pressure status so the PCM can:

- Control cooling fan assembly operation.
- Prevent compressor assembly operation if ambient temperatures are too cold.
- Disable the compressor assembly before high-side pressure becomes too high.
- Diagnosis of compressor controls.

Refer to SECTION 8A-64 for more information.

Air Conditioning Evaporator Temperature Sensor Assembly

The air conditioning evaporator temperature sensor assembly mounted to the heater and air conditioning evaporator module assembly has a probe inserted into the evaporator which measures evaporator temperature and sends a signal to the PCM. Within the probe is a thermistor which varies output according to temperature. The purpose of this sensor assembly is to inform the PCM of the evaporator temperature so the compressor assembly can be disabled before the evaporator freezes. The evaporator temperature sensor assembly is a solid state device, do not attempt to measure resistance. Measuring resistance across pins can cause sensor damage. Refer to SECTION 8A-64 for more information.

DIAGNOSIS

LEAK-TESTING THE REFRIGERATION SYSTEM

A refrigerant leak test should be performed on the system whenever a leak is suspected due to system indication of low charge or after any service operation which disturbs the components, lines, or connections. Many methods and special tools are available for this purpose; however, no matter which tool is used, care and diligence are the biggest keys to success.

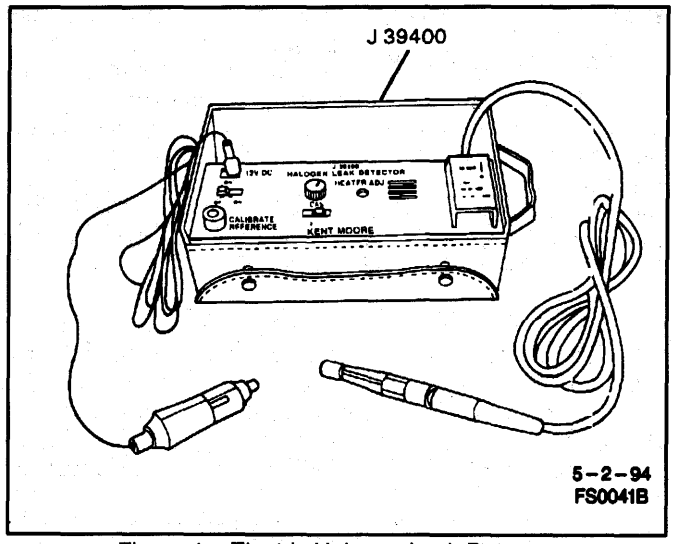


Figure 4 – Electric Halogen Leak Detector

Electric Halogen Leak Detector

Figures 4 and 5

Tool Required:

J 39400 Halogen Leak Detector

This type of leak detector has been found to be the most useful tool in locating refrigerant leaks. The J 39400 is a small unit which operates on 12 volts DC and provides an audible signal which increases in frequency when leaking refrigerant is detected. There are three settings: one for R-12, one for R-134a, and one for gross leaks. The gross leak setting is for isolating very large leaks already found at one of the other two settings. Care must be taken that the instrument is properly calibrated, per the included instructions, and that it is used at the proper setting for the type of refrigerant in the system being tested.

Evaporator Core

Because the evaporator core is contained in a closed module and is inaccessible to leak detectors, it is one of the most difficult parts of the air conditioning system to check for leaks. To leak-test the evaporator core:

1. Turn the blower motor assembly on to high for 15 or more seconds then shut it off.
2. Wait 10 minutes.
3. Remove blower motor resistor assembly. Refer to SECTION 1A.
4. Insert the leak detector probe into the resistor opening. If the detector goes to a solid alarm, a leak has been found.

Compressor and Block Fitting

1. Blow shop air behind and in front of the compressor clutch/pulley for at least 15 seconds.
2. Probe the compressor area. If the detector goes to a solid alarm, a leak has been found.

Fluorescent Leak Detector

Fluorescent detection additive is now approved by GM for use in R-134a systems.

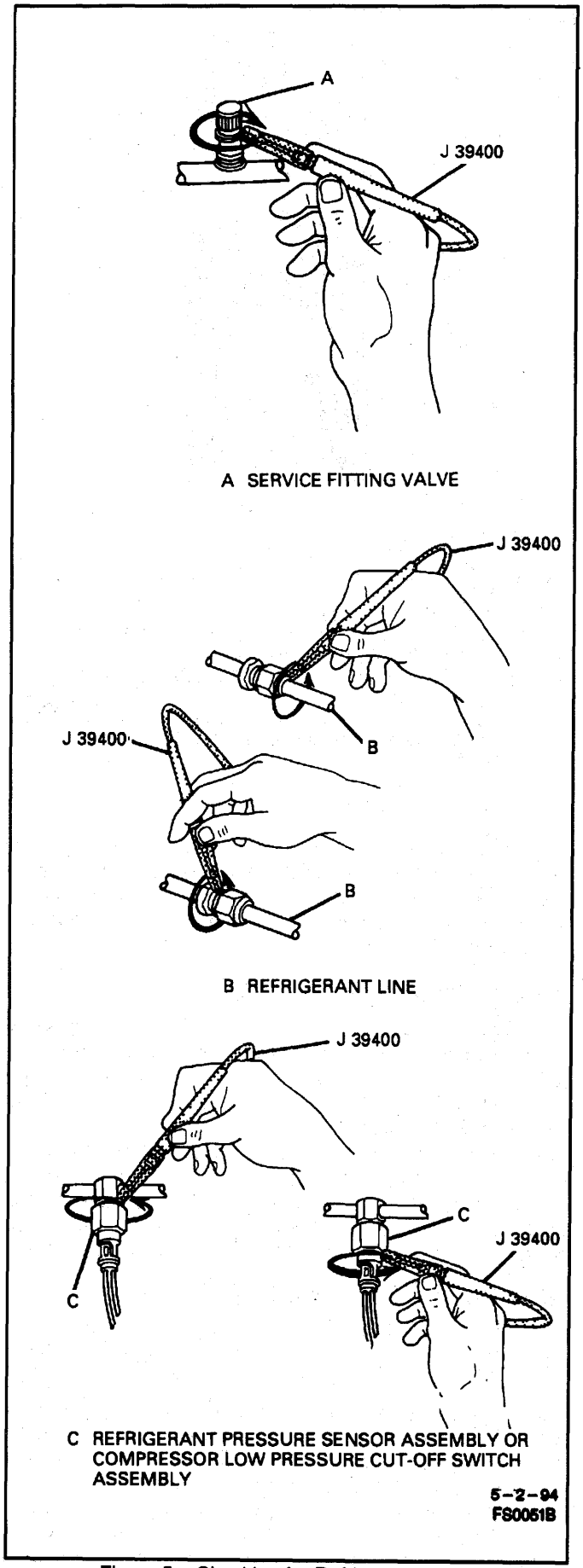


Figure 5 – Checking for Refrigerant Leaks

Liquid Leak Detectors and Pressure Testing

Due to their lack of sensitivity, liquid/bubble leak detectors have very limited usefulness and are not recommended.

CAUTION: R-134a service equipment or vehicle A/C systems should not be pressure tested or leak-tested with compressed air. Some mixtures of air/R134a have been shown to be combustible at elevated pressures. These mixtures are potentially dangerous and may result in fire or explosion causing injury or property damage. Additional health and safety information may be obtained from refrigerant and lubricant manufacturers.

ELIMINATING AIR CONDITIONING ODOR

Tool Required:

J 36645 A/C Evaporator Cleaning Gun

Some vehicles may experience odors emitted from the air conditioning system primarily at start up in hot, humid climates. This odor may be the result of debris in the evaporator module case and/or microbial growth on the evaporator core. To eliminate this condition, the following equipment and procedure should be used.

CAUTION: This procedure should only be performed on a cold vehicle to prevent the disinfectant from coming in contact with hot engine components which could cause irritating vapors to form.

Disinfectant can cause substantial, but temporary, eye injury. Do not get in eyes or on clothing. Wash thoroughly with soap and water after handling disinfectant. If disinfectant gets into eyes, hold eyelids open and flush with a steady, gentle stream of water for fifteen minutes. Obtain medical attention if irritation persists.

Important

- This procedure will eliminate debris or microbial growth which can cause odors but will not keep such debris or microbes present in the environment from causing a recurrence of the problem.

1. Remove heater core assembly. Refer to SECTION 1A.
2. Check evaporator module assembly case for debris, remove any debris present. If debris is imbedded into evaporator core face and cannot be removed, the core will have to be removed from vehicle and cleaned. If a large amount of debris is present in evaporator module assembly case, the air inlet screen will require sealing around the windshield wiper post holes and fender edges.
3. Place drain pan with at least a two-liter (two-quart) capacity below evaporator drain hole to collect disinfectant and rinse water runoff.
   - The evaporator drain hole is located at the bottom of the evaporator lower case approximately 25 mm (1 inch) from the dash panel assembly (engine compartment side).
4. Connect battery charger to avoid draining battery assembly during cleaning procedure.
5. Position pedestal fan and turn it on high speed to provide cross ventilation during cleaning procedure.
6. Turn ignition switch to the "RUN" position but do not start vehicle.
7. Set heater and air conditioning control assembly to "LOW" blower motor speed, full "HOT" and "HEATER."
8. Open all windows and doors and exit vehicle.
9. Pour small bottle of two-part GM Goodwrench air conditioning system disinfectant kit, GM P/N 25533404 or equivalent, into large bottle. Seal and invert large container once or twice to mix contents.
10. Use J 36645 or equivalent siphon-type parts-cleaning spray gun capable of delivering 60 ml (2 ounces) per minute of liquid when driven with 552 to 621 kPa (80 to 90 psi) of compressed air. Insert nozzle of spray gun through heater core opening and insert siphon hose into container of disinfectant. Direct spray toward evaporator face taking extra care to ensure adequate coverage of the corners and edges, completely saturating the entire core. Use entire container of solution.
11. Turn ignition switch to the "OFF" position and allow core to soak for five minutes.
12. Check underneath vehicle to verify proper drain operation. If necessary, unclog and increase drain plug hole with a rat-tail file.
13. Turn the ignition switch to the "RUN" position but do not start vehicle.
14. Thoroughly rinse evaporator core with one liter (one quart) of clean water using spray gun to remove any disinfectant residue.
15. Turn ignition switch to the "OFF" position and install heater core assembly. Refer to SECTION 1A.
16. Dispose of disinfectant and rinse water runoff collected in drain pan in an approved manner.

ON-VEHICLE SERVICE

REFRIGERATION SYSTEM SERVICES

Replacing O-Rings

Install new GM-approved service replacement air conditioning O-rings when a joint or a fitting is installed, except when the O-rings are provided on new replacement components. Unless service replacement O-rings of the specified part numbers are used, excessive leakage of Refrigerant-134a may occur. Refer to the part number for identification, not to the former color-coating method of identification, because some formerly color-coated service replacement O-rings may be black.

Air conditioning O-rings should be coated with mineral base 525 viscosity refrigerant oil just before installation and should be slipped onto the flange tube to assure

proper locating and sealing. To prevent the possibility of swelling and a reduction in sealing effectiveness, O-rings should not be allowed to soak in refrigerant oil. Before installation, the O-rings and the fittings should be examined to ensure that they have not been nicked or deformed. Nicked or deformed parts must be replaced or excessive refrigerant leakage may result.

Handling Refrigerant-134a

The air conditioning system in this vehicle contains Refrigerant-134a (R-134a). This chemical mixture requires special handling procedures to avoid personal injury.

Always wear goggles and wrap a clean cloth around fittings, valves, and connections when performing work that involves opening the refrigerant system. Always work in a well ventilated area and avoid breathing any refrigerant fumes. Do not weld or steam clean on or near any vehicle-installed air conditioning lines or components.

If R-134a should come in contact with any part of the body, flush the exposed area with water and immediately seek medical attention.

CAUTION: Avoid breathing A/C refrigerant and lubricant vapor or mist. Exposure may irritate eyes, nose, and throat. To remove R-134a from the A/C system, use service equipment certified to meet the requirements of SAE J2210 or SAE J2209. If accidental system discharge occurs, ventilate work area before resuming service. Additional health and safety information may be obtained from refrigerant and lubricant manufacturers.

Do not store or heat refrigerant containers above 125°F (52°C).

Do not heat a refrigerant container with an open flame; if container warming is required, place the bottom of the container in a pail of warm water.

Do not intentionally drop, puncture, or incinerate refrigerant containers.

Refrigerant will displace oxygen, therefore be certain to work in well ventilated areas to prevent suffocation.

If it is necessary to carry a container of "Dot CFR" Refrigerant-134a in a vehicle, it should not be carried in the passenger compartment. Only containers that meet DOT SPEC 4BA or 4BW should be used.

NOTICE: R-12 refrigerant and R-134a refrigerant must never be mixed, even in the smallest of amounts, as they are incompatible with each other. If the refrigerants are mixed, compressor failure is likely to occur.

Use only polyalkylene glycol (PAG) synthetic refrigerant oil for internal circulation through the R-134a A/C system and only mineral base 525 viscosity refrigerant oil on fitting threads and O-rings. If lubricants other than those specified are used, compressor failure and/or fitting seizure is likely to occur.

Do not introduce compressed air to any refrigerant container or refrigerant component, because contamination will occur.

Before attempting any service which requires opening refrigeration system lines or components, refer to "Handling of Refrigerant Lines and Fittings" and "Maintaining Chemical Stability" that follow. Carefully follow the instructions for refrigerant recovery and recycling, adding oil, evacuating, and recharging the refrigeration system.

All Refrigerant-134a disposable (colored blue) containers are shipped with a heavy metal screw cap to protect the valve and safety plug of the container from damage. It is good practice to replace the cap after each use of the container to continue protection.

Handling Refrigerant Lines and Fittings

CAUTION: For personal protection, goggles should be worn and a clean cloth wrapped around fittings, valves and connections when doing work that includes opening the refrigeration system. If Refrigerant-134a comes in contact with any part of the body, severe frostbite and personal injury can result. The exposed area should be flushed immediately with cold water and prompt medical help should be obtained.

- All metal tubing lines should be free of dents or kinks to prevent loss of system capacity due to line restriction.
- The flexible hose lines should never be bent to a radius of less than four times the diameter of the hose.
- The flexible hose lines should never to allowed to come within a distance of 63.5 mm (2 1/2 inches) of the exhaust manifold.
- Flexible hose lines should be inspected regularly for leaks or brittleness and replaced with new lines if deterioration or leaking is found.
- When disconnecting any fitting in the refrigeration system, the system must first be discharged of all Refrigerant-134a. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
- Once a refrigerant line is opened to the atmosphere, it should be capped or taped immediately to prevent entry of moisture and dirt.
- The use of the proper wrenches when making connections on O-ring fittings is important. The opposing fitting should always be backed up with a wrench to prevent distortion of connecting lines or components. Tighten all tubing connections to the specified torque for the fitting. Too little or too much torque when tightening can result in loose joints or deformed joint parts. Either condition can result in

refrigerant leakage and an inoperative air conditioning system. Refer to "Fitting Tightening Specifications" at the end of this section.

- O-rings and seals must be in perfect condition. A burr or piece of dirt may cause a refrigerant leak. Install new O-rings that have been lubricated with mineral base 525 viscosity refrigerant oil. Do not use PAG oil.
- Keep polyalkylene glycol (PAG) refrigerant oil off fitting threads. Long term contact of PAG oil on threads may cause future disassembly difficulties. Flush threads of fittings with mineral base 525 viscosity refrigerant oil. Do not use PAG oil. Do not wipe threads with a cloth.

Maintaining Chemical Stability in the Refrigeration System

The efficient operation and life of the air conditioning system is dependent upon the chemical stability of the refrigeration system. When foreign materials such as dirt, air, or moisture, contaminate the refrigeration system, the stability of the Refrigerant-134a and polyalkylene glycol (PAG) synthetic refrigerant oil will change. Contaminants will also affect pressure-temperature relationship, reduce efficient operation and possibly cause interior corrosion and abnormal wear of moving parts.

The following general practices should be observed to ensure the chemical stability in the system:

- Before breaking a refrigerant connection, wipe away any dirt or oil to reduce the possibility of dirt entering the system. Both sides of the connection should be capped, plugged or taped as soon as possible to prevent the entry of dirt, foreign material and moisture.
- Keep tools clean and dry. This includes the manifold gage set and replacement parts.
- When adding polyalkylene glycol (PAG) synthetic refrigerant oil, the transfer device and container should be exceptionally clean and dry to assure that refrigerant oil remains as moisture-free as possible.
- When it is necessary to "open" an A/C system, have everything needed ready and handy so that as little time as possible will be required to perform the operation. Do not leave the A/C system open any longer than is necessary.
- Any time the A/C system has been "opened," it should be properly evacuated before recharging with Refrigerant-134a.
- All service parts are dehydrated and sealed prior to shipping. They should remain sealed until just prior to making connections. All parts should be at room temperature before uncapping. This prevents condensation of moisture from the air entering the system. If for any reason caps are removed but the connections are not made, parts should be resealed as soon as possible.

REFRIGERANT RECOVERY AND RECYCLING, ADDING OIL, EVACUATING AND RECHARGING PROCEDURES

General Description

Figure 6

The J 39500 air conditioning refrigerant recovery, recycling and recharging (ACR^4) system removes Refrigerant-134a from the vehicle A/C system, recycles and recharges all with one hook-up.

Single pass filtering during recovery cycle, plus automatic multiple pass filtering during evacuation cycle assures constant supply of clean/dry refrigerant for A/C system charging.

NOTICE: R-12 and R-134a require separate and non-interchangeable sets of recovery, recycling, and recharging equipment, because the refrigerants and lubricants are not compatible and cannot be mixed even in the smallest amounts. Do not attempt to use one set of equipment for both R-12 and R-134a, as all equipment contains residual amounts of refrigerant and/or lubricant, which will result in contamination, and damage to the recovery/recycle equipment. Adaptors to convert from one size fitting to the other must never be used; refrigerant/lubricant contamination will occur and system failure may result.

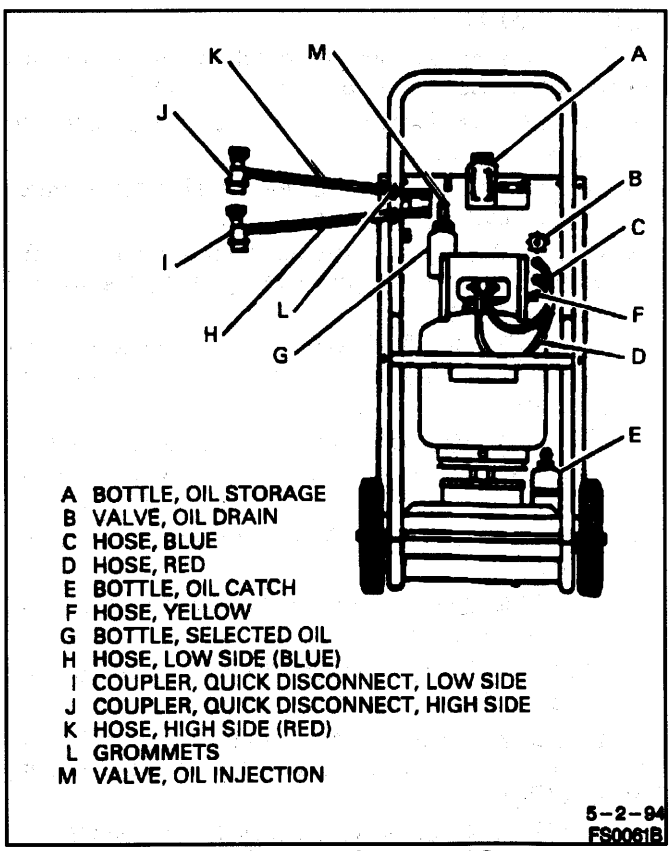


Figure 6 – Complete Operational Setup

Station (ACR^4) Setup and Maintenance

Initial Setup

Refer to the manufacturer instructions for all initial setup procedures.

Operation Setup

Figure 6

CAUTION: Always wear goggles and gloves when doing work that involves opening the refrigeration system. If liquid refrigerant comes into contact with the skin or eyes, injury may result.

CAUTION: Use only authorized 23 kg (50-pound) refillable refrigerant tanks (J 39500-50). Use of other tanks could cause personal injury and void the warranty.

NOTICE: Refrigerant-134a systems have special fittings (per SAE specifications) to avoid cross-contamination with Refrigerant-12 systems. Do not attempt to adapt this unit to Refrigerant-12 systems as severe system failure will result.

Connect high-side (red) and low-side (blue) hoses to the ACR^4 unit. Be sure to route hoses through hose reel bracket grommets.

Control Panel Functions

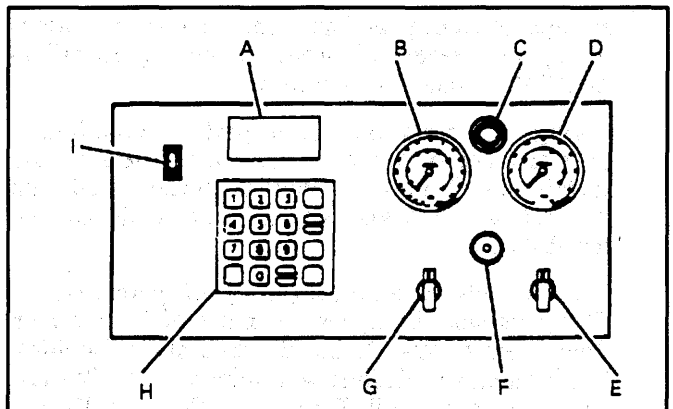
Figures 7 and 8

This section explains the functions of the various components of the unit control panel (Figure 7).

- **Main Power Switch** – supplies electrical power to the control panel.
- **Beeper** – emits an audible tone to alert the operator to unit operating functions.
- **Digital Display** – shows the time programmed for vacuum and the weight of refrigerant programmed for recharging.
- **Low-Side Manifold Gage** – when connected to an A/C system, this gage shows the system low-side pressure.
- **High-Side Manifold Gage** – when connected to an A/C system, this gage shows the system high-side pressure.
- **Moisture Indicator** – shows if the refrigerant is wet or dry.
- **Low-Side Valve** – connects the low side of the A/C system to the unit.
- **High-Side Valve** – connects the high side of the A/C system to the unit.

In addition to the number keys, the control panel contains special keys that accomplish specific operating functions (Figure 8).

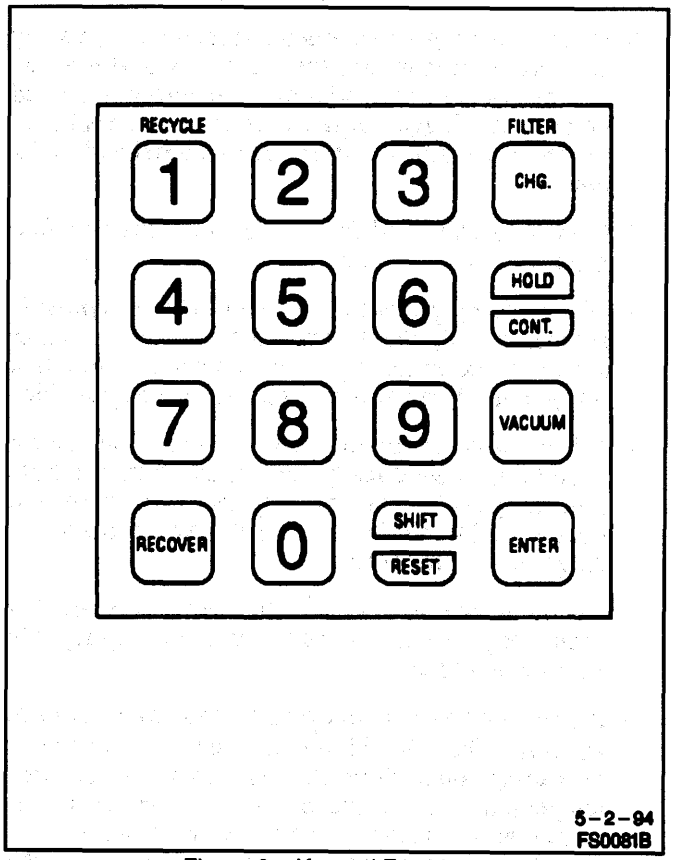
- **RECYCLE** – activates the recycling sequence.
- **RECOVER** – activates the recovery sequence.
- **SHIFT/RESET** – activates "shifted" position of keys on the keypad and resets the program mode.



A DISPLAY, DIGITAL
B GAGE, LOW SIDE
C BEEPER
D GAGE, HIGH SIDE
E VALVE, HIGH SIDE
F INDICATOR, MOISTURE
G VALVE, LOW SIDE
H KEYPAD
I SWITCH, MAIN POWER

5-2-94
FS0071B

Figure 7 – Control Panel



5-2-94
FS0081B

Figure 8 – Keypad Functions

- **FILTER** – automatically recovers and evacuates to 57 kPa (17 inches Hg) vacuum from the filter and low side of the unit.
- **CHG** – automatically charges the A/C system with the programmed amount of refrigerant.
- **HOLD/CONT** – interrupts the automatic cycle in the "HOLD" position, and then resumes functions in the "CONT" position. Press this button once for "HOLD" and again for "CONT."
- **VACUUM** – activates the vacuum and automatic recycling sequence.
- **ENTER** – enters programmed data into the unit control memory.

Digital Display Functions

For information regarding the functions of the digital display, refer to the manufacturer instructions.

Maintenance

Refer to manufacturer instructions for all maintenance procedures.

Refrigerant Recovery

Figures 6 through 9

Tools Required:

J 39500 Air Conditioning Refrigerant Recovery, Recycling and Recharging (ACR^4) System

J39500 50 lb. Refillable Recovery Tank

Important

- Use only the 23 kg (50-pound) unit refrigerant tank (J 39500-50) designed for the ACR^4. The unit overfill limitation mechanism has been calibrated specifically for use with this tank, and the tank valving is set up specifically for use with the unit.
- Connect battery charger to vehicle battery assembly to prevent battery assembly drain.

1. Attach the high-side (red) hose with the quick disconnect coupler to the high-side refrigerant service valve fitting of the vehicle A/C system. This valve is located in the receiver dehydrator tube, between the receiver and dehydrator assembly and the condenser assembly. Open the coupler valve after attachment.
2. Attach the low-side (blue) hose with the quick disconnect coupler to the low-side refrigerant charge valve fitting of the vehicle A/C system. This valve is located in the compressor and condenser hose assembly, between the compressor assembly and the thermostatic expansion valve assembly. Open the coupler valve after attachment.
3. Check the high-side and low-side gages on the unit control panel to be sure the A/C system has pressure. If there is no pressure, there is no refrigerant in the system to recover.

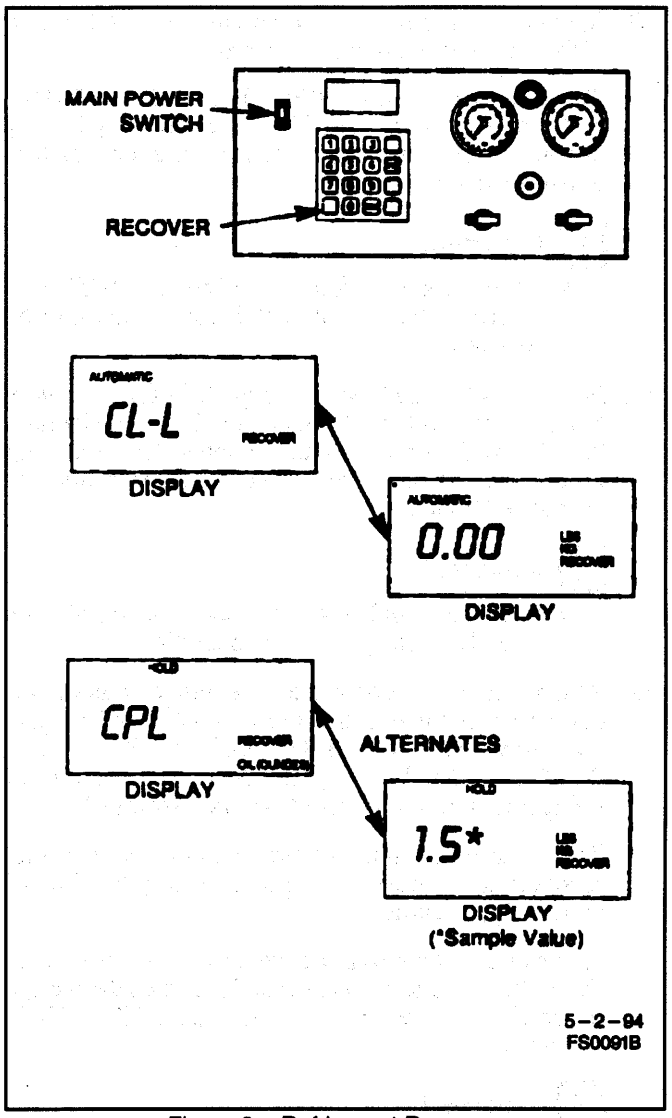


Figure 9 – Refrigerant Recovery

Important

- If there is no refrigerant in the A/C system, do not continue with the recovery operation. Air will be drawn into the recovery tank.

4. Open both the high-side and the low-side valves on the control panel (Figure 7).
5. Open both the red "GAS" (vapor) and the blue "LIQUID" valves on the tank.
6. Slowly open the oil drain valve to see if the oil separator contains oil (Figure 6).
   - If any oil drains into the catch bottle at the bottom of the unit, allow it to drain until there is no more oil in the separator.
7. Close the oil drain valve.
   - Dispose of the oil in the catch bottle in an appropriate manner and return the bottle to its place on the unit.
8. Plug the unit into the proper voltage outlet and turn on the "MAIN POWER" switch.

9. Start engine and run for one minute with A/C system "ON" in order to stabilize system.
10. Turn ignition switch "OFF," then back to "RUN," and blower motor assembly to "HIGH." A battery charger should be connected to prevent battery assembly drain.

Important

- Blower motor assembly setting to "HIGH" will increase the rate at which refrigerant can be recovered.

11. Press "RECOVER" on the keypad. Before recovery begins, the unit will clear itself of refrigerant. "CL-L" will appear on the display. The cleaning process takes from thirty seconds to three minutes to complete (Figure 9).

Important

- Maintain A/C blower motor assembly on "HIGH" during recovery operation.

12. When cleaning is complete. The unit will automatically start recovery, and the control panel display will show the unit is in the "RECOVER" mode of the "AUTOMATIC" cycle. Also, the weight of refrigerant being recovered will be displayed.
13. The compressor shuts off automatically when initial recovery has occurred, at approximately 57 kPa (17 inches Hg) vacuum.
14. At the end of the initial recovery process, the display shows "CPL" and then alternately flashes the weight of refrigerant recovered and "OIL/OZ" ("OIL/GMS").

Important

- A small amount of A/C system lubricating oil polyalkylene glycol (PAG) might be removed with the refrigerant during recovery. The amount of oil removed (often there will be none) will vary greatly depending on a variety of conditions of the vehicle being serviced. The ACR^4 separates the oil from the refrigerant.
- The "OIL/OZ" ("OIL/GMS") flashing is a reminder to always drain the recovered oil at this time. The same amount of oil must be replaced in to the A/C system later when the system is recharged with refrigerant.

15. Slowly open the oil drain valve and drain the oil into the calibrated oil catch bottle at the bottom of the unit (Figure 6).
16. After the oil is completely drained, close the valve.
17. Read and record the amount of oil removed in the catch bottle.
18. Dispose of the recovered oil in an appropriate manner. Never reuse this oil.
19. Check the control panel "LOW-SIDE GAGE."
    - If the A/C system has maintained a vacuum, the recovery is complete.
20. If the "LOW-SIDE GAGE" pressure rises above "0," this indicates the presence of more refrigerant in the system. In this case, press the "HOLD/CONT" key on the keypad to recover the additional refrigerant. Repeat this step as needed until the system maintains vacuum for two minutes.

Important

- If the display flashes "FULL" during the recovery process, and the unit shuts off, the unit tank is full.
- An empty unit tank (J 39500-50) must be installed to accommodate additional refrigerant, before proceeding to the next step in the recovery operation. Do not use any other kind of tank.
- It is possible to lower the amount of refrigerant in the unit tank by charging other vehicles.

Evacuation

Figures 10 and 11

The ACR^4 unit tank must contain sufficient R-134a refrigerant for A/C system charging. Check the amount of refrigerant in the tank by simultaneously pressing "RESET" and "ENTER" on the keypad to enter the diagnostic mode. Once in the diagnostic mode, press "7". When "7" is pressed, the ACR^4 unit will display the amount of R-134a refrigerant available in the tank. If less than 3.6 kg (8 pounds) is displayed, add new refrigerant to the tank. Refer to the manufacturer's instructions for adding refrigerant.

1. With the high side and low side hoses connected to the vehicle A/C system, open both the high-side (red) and the low-side (blue) valves on the unit control panel.
2. Open both the red "GAS" (vapor) and the blue "LIQUID" valves on the tank.

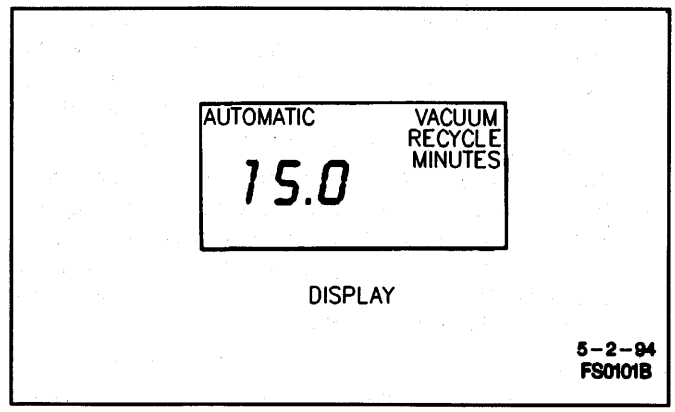


Figure 10 – System Evacuation (1 of 2)

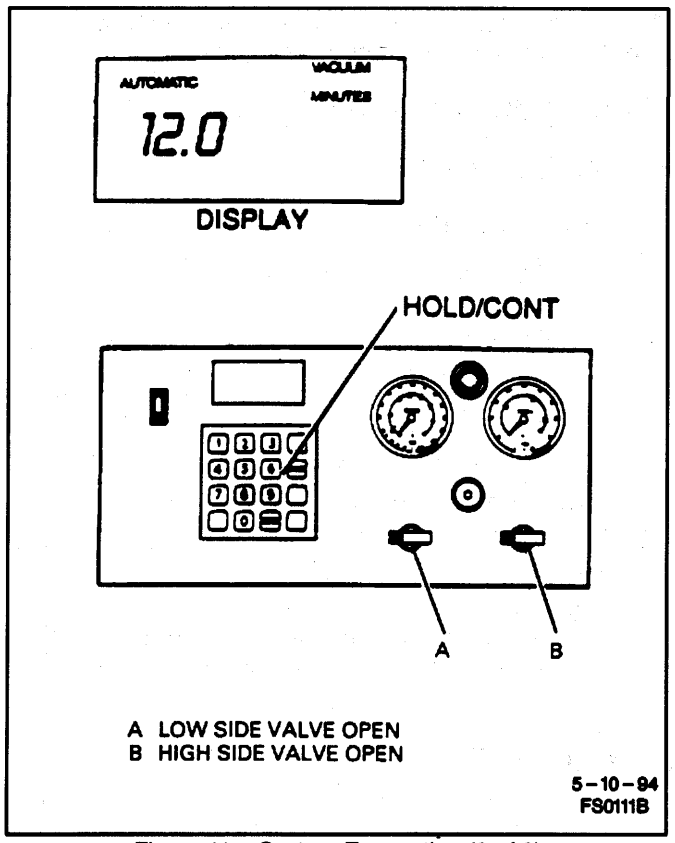


Figure 11 – System Evacuation (2 of 2)

Important

- To remove all the air and properly dry the A/C system, the unit automatically goes to a pre-programmed evacuation time.
- It is possible to evacuate longer. Press keys to enter time desired. New entry will show on the display. Press "ENTER," the display will blink indicating input of data (Figure 10).

3. Press "VACUUM" to start the vacuum pump. The display counts down the vacuum time to zero to indicate operation time remaining. The display reads "RECYCLE" five seconds after the vacuum pump starts and continues while the process takes place.

Important

- Automatic refrigerant recycling during each evacuation is a feature of the ACR[4] system. No action is required by the technician.
- The control panel "MOISTURE INDICATOR" must be green during recycling verifying refrigerant moisture content is within specifications. Yellow indicates a set condition requiring a filter/drier cartridge change. See the manufacturer instructions for this procedure.
- Non-condensable gases (mostly air) are automatically vented from the tank during the recycling process. An audible sound of pressure release may be heard as this happens. This is a normal function.

4. At approximately the 12-minute mark on the display (pump has run for three minutes), press "HOLD/CONT" key to stop vacuum pump (Figure 11).
   A. A "0" vacuum reading indicates a major system leak. Repair leak and restart evacuation procedure.
   B. If a vacuum reading of 91-101 kPa (27-30 inches of Hg) is indicated, close the low-side and high-side valves. Observe the vacuum level for a few minutes as a leak check of the A/C system. If vacuum is not maintained, find and repair the A/C system leak before continuing.
   C. If a vacuum reading of 91-101 kPa (27-30 inches of Hg) is maintained, open the high-side and low-side valves and press the "HOLD/CONT" key to restart the vacuum pump.
5. When the vacuum sequence has run the programmed time, the display shows "CPL" to indicate that evacuation is complete.

Important

- The vacuum pump oil must be changed frequently.
- When the pump has run for a total time of ten hours, the message "OIL" will flash on the control panel display as a reminder to change the oil.
- If the "OIL" warning flashes during operation, press "CONT" and change the oil before the next operation. See the manufacturer instructions for this procedure.

A/C System Oil Charge Replenishing

If oil was removed from the AC system during the recovery process or due to component replacement, it must be replenished at this time. Refer to "Refrigerant Oil Distribution" that follows for proper oil capacities.

1. Select the graduated bottle of replenishing polyalkylene glycol (PAG) synthetic refrigerant oil (GM P/N 12345923 or equivalent).
2. Adjust the O-ring around the PAG oil bottle to the required oil charge level.

   Example: If bottle oil level is at 4 ounces and 1/2 ounce of oil is required, adjust O-rings to 3 1/2 ounces as final level mark.
3. Install the bottle on the oil injection system on the back of the unit.

Important

- Keep the oil bottles tightly capped at all times to keep out moisture and contamination.
- Do not open the oil injection valve while there is positive pressure in the A/C system. This will result in oil blow-back through the bottle vent. A/C system vacuum is required for this operation.

- Never let the oil level drop below the pick-up tube while charging or replenishing. This will allow air into the A/C system.

4. Open the valve at the top of the plastic container and watch the level of oil being drawn into the system.
5. Close the valve when the required oil charge has been pulled into the system.

Refrigerant Oil Distribution

Compressor systems require 240 ml (8 fluid ounces) of polyalkylene glycol (PAG) synthetic refrigerant oil (GM P/N 12345923 or equivalent). During component replacement and conditions stated, new oil quantities should be added to the system as follows:

- Compressor assembly replaced.
  - If less than 30 ml (1 fluid ounce) is drained, add 60 ml (2 fluid ounces).
  - If more than 30 ml (1 fluid ounce) is drained, add same amount.
- Receiver and dehydrator assembly replaced.
  - Add 30 ml (1 fluid ounce) more than what was drained from old receiver and dehydrator assembly.
- Evaporator replaced.
  - Add 90 ml (3 fluid ounces) oil.
- Condenser assembly replaced.
  - Add 30 ml (1 fluid ounce) oil.

Refrigerant Oil Loss Due to a Large Leak

If the refrigerant charge is abruptly lost due to a large refrigerant leak, approximately 90 ml (3 fluid ounces) of refrigerant oil will be carried out of the system suspended in the refrigerant. Any failure that caused an abrupt refrigerant discharge will experience this oil loss. Failures that allow the refrigerant to seep or bleed off over time do not experience this oil loss.

Upon replacement of a component which caused a large refrigerant leak, add 90 ml (3 fluid ounces) of new polyalkylene glycol (PAG) synthetic refrigerant oil (GM P/N 12345923 or equivalent) plus the required amount of oil for the particular component (as outlined above).

Add the oil directly to the replaced component if possible. If the oil cannot easily be added to the replaced part, add the oil to the receiver dehydrator assembly.

The normal blue tint of the PAG oil may not be seen once the vehicle's A/C system has been run. Be sure to use the GM-approved PAG oil for this system.

Compressor System

Up to 120 ml (4 fluid ounces) of oil can collect in the crankcase. Therefore, it is important when replacing a compressor assembly that the oil in the old compressor crankcase be drained and measured (discard the oil after recording the amount).

All replacement compressor assemblies will be shipped with approximately 240 ml (8 fluid ounces) of oil in the crankcase. The oil must be drained and retained. Then replace the oil in the same amount as previously recorded from the old compressor assembly.

Charging the A/C System (Engine Off)

Figures 6, 12 and 13

Important

- The A/C system must be evacuated prior to charging.
- Check that the "LB/KG" switch on the back of the unit to be sure it is set for the desired units of weight system (operate switch with main power "OFF").

1. Close the low-side valve on the control panel.
2. Open the high-side valve on the control panel.
3. Press "CHG" on the keypad to be sure the unit is in the program mode.
4. Enter the amount of refrigerant charge to charge the A/C system by pressing the appropriate number keys. Be sure to use correct unit of weight (pounds or Kg).

Important

- Charge A/C system with amounts of R-134a specified. Do not overcharge.
- Charge A/C system (C60) with 0.91 kg (2.0 pounds).

5. Press "ENTER."
   - A blink of the display indicates the charge amount is in the unit memory.
6. Press "CHG" on the keyboard to begin the charging process.
7. The display shows "AUTOMATIC" and the amount of refrigerant programmed for charging.
   - The display counts down to zero as the charging process proceeds.
   - At the end of the process, the display shows "CPL."

Important

- If the transfer of refrigerant stops before complete, refer to "Unsuccessful Transfer" that follows.

Successful Transfer Complete

1. Close the high-side valve on the unit control panel (both valves should now be closed).
2. Start the vehicle and the A/C system and let run until the readings on the high-side and low-side gages stabilize. Compare readings, outlet temperatures and ambient temperature and humidity to the "Air Conditioning Performance Chart" in SECTION 1B1.
3. With the A/C system running, close the high-side coupler valve and disconnect the high-side (red) hose from the vehicle.

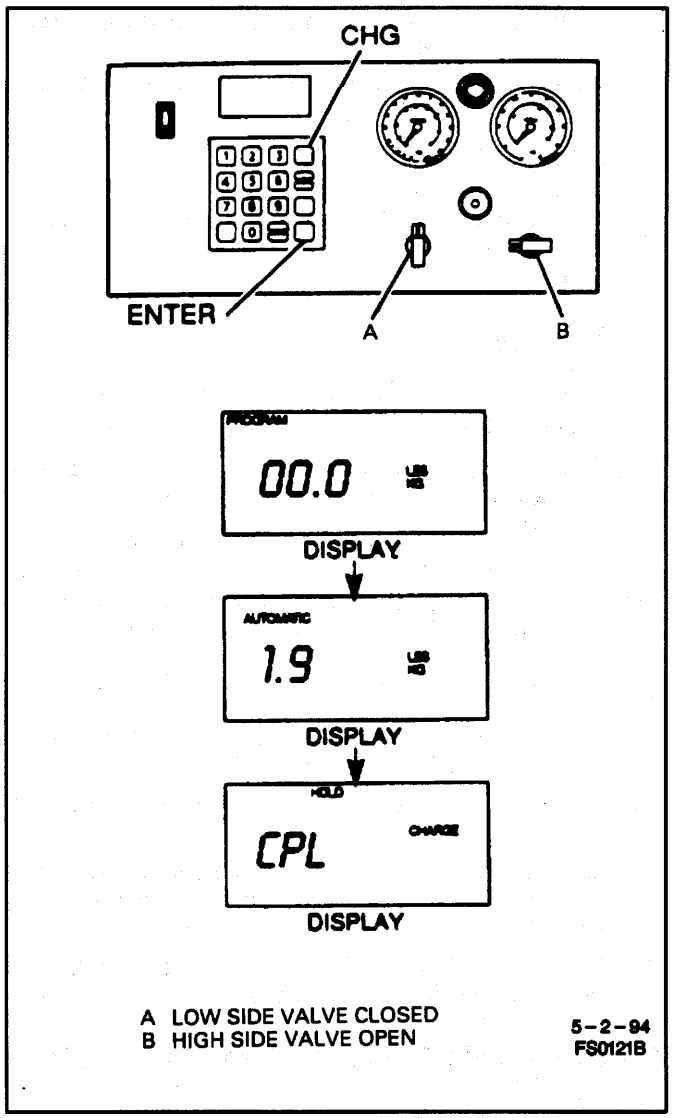


Figure 12 – System Charging (1 of 2)

4. Open both the high-side and low-side valves on the control panel.
5. Refrigerant from both hoses will be drawn quickly into the A/C system through the low-side (blue) hose.
6. Close the low-side coupler valve and disconnect from the vehicle.

Unsuccessful Transfer

On rare occasions, the total charge does not transfer to the vehicle A/C system. There are two reasons why this can occur.

1. If the transfer is too slow because the pressure in the unit tank and the vehicle A/C system are about the same, the unit will emit an audible signal and the display shows the weight remaining for transfer. In this case:
   A. Close the high-side valve (Figure 13).
   B. Open the low-side valve.
   C. Start the vehicle A/C system, and press "HOLD/CONT" on the keyboard. This will put the remainder of the charge into the A/C system.
   D. Continue with the previous procedure, "Successful Transfer Complete."
2. If the transfer will not complete and the display shows "CHECK REFRIGERANT," there is not enough refrigerant in the tank to complete the process. This condition requires the recovery of the partial charge of refrigerant in the vehicle A/C system and another complete evacuation and charge procedure.
   A. Press "HOLD/CONT" on the keypad to interrupt the cycle.
   B. Press "RESET" to reset the unit.
   C. Recover the refrigerant that has been charged into the system, refer to "Refrigerant Recovery" in this section.
3. Add refrigerant to the tank following the manufacturer instructions, and refer to "Evacuation" in this section.

REPLACEMENT PROCEDURES

CAUTION: For personal protection, goggles should be worn and a clean cloth wrapped around fittings, valves and connections when doing work that includes opening the refrigeration system. If Refrigerant-134a comes in contact with any part of the body, severe frostbite and personal injury can result. The exposed area should be flushed immediately with cold water and prompt medical help should be obtained.

NOTICE: Tighten all tubing connections to the specified torque for the fitting. Too little or too much torque when tightening can result in loose joints or deformed joint parts. Either condition can result in refrigerant leakage and an inoperative air conditioning system. Refer to "Fitting Tightening Specifications" at the end of this section.

Air Conditioning Compressor and Condenser Hose Assembly

Figures 1, 2 and 14

Remove or Disconnect

1. Recover refrigerant. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
2. Strap (34) from compressor and condenser hose assembly (7).
3. Compressor and condenser hose assembly fitting at thermostatic expansion valve assembly (6).
   - Discard seal (16).
4. Raise and suitably support vehicle. Refer to SECTION 0A.
5. Compressor and condenser hose assembly fitting at condenser assembly (3).

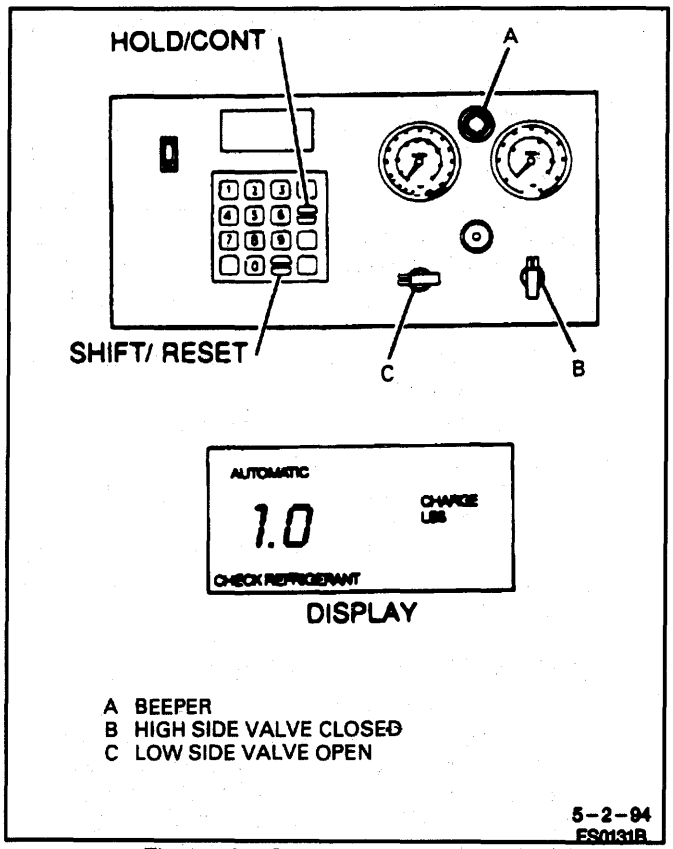


Figure 13 – System Charging (2 of 2)

- Use a back-up wrench to hold condenser assembly fitting while loosening compressor and condenser hose assembly fitting.
- Discard O-ring (17).

6. Bolt/screw (30).
7. Compressor assembly. Refer to "Air Conditioning Compressor Assembly" in this section.
8. Compressor and condenser hose assembly (7).
   - Discard seals (18).

Install or Connect

NOTICE: See "Notice" on page 1B-1 of this section.

1. Clean fittings with mineral base 525 viscosity refrigerant oil.
   - Do not allow refrigerant oil to enter A/C system.
2. Seals (18) to compressor and condenser hose assembly (7).
   - Lightly coat seals (18) with mineral base 525 viscosity refrigerant oil.
3. Compressor and condenser hose assembly (7) into position.
4. Compressor assembly. Refer to "Air Conditioning Compressor Assembly" in this section.
5. O-ring (17) to compressor and condenser hose assembly (7).
   - Coat O-ring (17) with mineral base 525 viscosity refrigerant oil.
6. Compressor and condenser hose assembly fitting to condenser assembly (3).

Tighten

- Compressor and condenser hose assembly fitting to 27 N•m (20 lb. ft.).

7. Bolt/screw (30).

Tighten

- Bolt/screw (30) to 10 N•m (89 lb. in.).

8. Lower vehicle.
9. Seal (16) to compressor and condenser hose assembly fitting.
   - Lightly coat seal (16) with mineral base 525 viscosity refrigerant oil.
10. Compressor and condenser hose assembly fitting to thermostatic expansion valve assembly (6).

Tighten

- Compressor and condenser hose assembly fitting to 37 N•m (27 lb. ft.).

11. Strap (34) to compressor and condenser hose assembly (7).
12. Charge A/C system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
13. Leak-test fittings. Refer to "Leak-Testing the Refrigeration System" in this section.

Air Conditioning Receiver Dehydrator Tube

Figures 1, 2 and 14

Remove or Disconnect

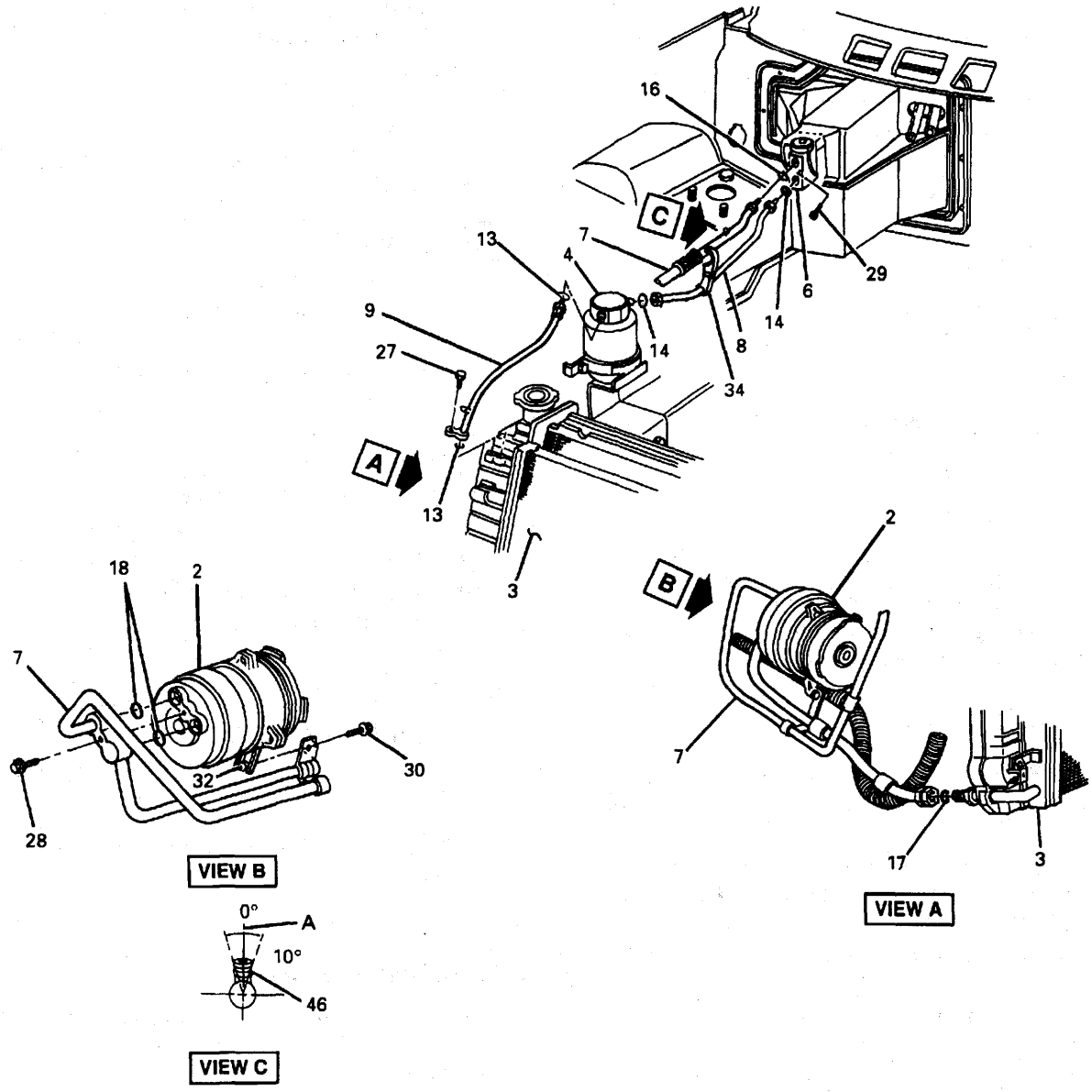
1. Recover refrigerant. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.

   CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

2. Battery negative cable assembly.
3. Bolt/screw (27).
4. Receiver dehydrator tube fitting at receiver and dehydrator assembly (4).
   - Use a back-up wrench to hold receiver and dehydrator assembly port while loosening receiver dehydrator tube fitting.
5. Receiver dehydrator tube (9).
   - Discard O-rings (13).

Install or Connect

NOTICE: See "Notice" on page 1B-1 of this section.



A VERTICAL REFERENCE LINE
2 COMPRESSOR ASSEMBLY, AIR CONDITIONING
3 CONDENSER ASSEMBLY, AIR CONDITIONING
4 RECEIVER DEHYDRATOR ASSEMBLY, AIR CONDITIONING
6 VALVE ASSEMBLY, AIR CONDITIONING THERMOSTATIC EXPANSION
7 HOSE ASSEMBLY, AIR CONDITIONING COMPRESSOR AND CONDENSER
8 TUBE, AIR CONDITIONING EVAPORATOR
9 TUBE ASSEMBLY, AIR CONDITIONING RECEIVER DEHYDRATOR
13 O-RING, AIR CONDITIONING RECEIVER DEHYDRATOR TUBE
14 O-RING, AIR CONDITIONING EVAPORATOR TUBE
16 SEAL, AIR CONDITIONING COMPRESSOR AND CONDENSER HOSE
17 O-RING, AIR CONDITIONING CONDENSER FITTING
18 SEAL, AIR CONDITIONING HOSE
27 BOLT/SCREW, AIR CONDITIONING RECEIVER DEHYDRATOR TUBE
28 BOLT/SCREW, AIR CONDITIONING COMPRESSOR AND CONDENSER HOSE
29 BOLT/SCREW, AIR CONDITIONING THERMOSTATIC EXPANSION VALVE
30 BOLT/SCREW, AIR CONDITIONING COMPRESSOR AND CONDENSER HOSE CLIP BRACKET
32 BRACKET, AIR CONDITIONING COMPRESSOR AND CONDENSER HOSE CLIP
34 STRAP, AIR CONDITIONING COMPRESSOR AND CONDENSER HOSE
46 VALVE, AIR CONDITIONING REFRIGERANT CHARGE

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Figure 14 – Refrigerant Lines and Hoses

1. Clean fittings with mineral base 525 viscosity refrigerant oil.
   - Do not allow refrigerant oil to enter A/C system.
2. O-rings (13) to receiver dehydrator tube (9).
   - Lightly coat O-rings (13) with mineral base 525 viscosity refrigerant oil.
3. Receiver dehydrator tube (9).
4. Bolt/screw (27).
   - Do not tighten at this time.
5. Receiver dehydrator tube fitting to receiver and dehydrator assembly (4).

Tighten

- Receiver dehydrator tube fitting to 27 N•m (20 lb. ft.).
- Bolt/screw (27) to 16 N•m (12 lb. ft.).

6. Battery negative cable assembly.
7. Charge A/C system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
8. Leak-test fittings. Refer to "Leak-Testing the Refrigeration System" in this section.

Air Conditioning Evaporator Tube

Figures 1, 2 and 14

Remove or Disconnect

1. Recover refrigerant. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
2. Electrical connector at refrigerant pressure sensor assembly (22).
3. Strap (34) from evaporator tube (8).
4. Receiver dehydrator tube. Refer to "Air Conditioning Receiver Dehydrator Tube" in this section.
5. Bolt/screw (12).
6. Evaporator tube fitting at receiver and dehydrator assembly (4).
   - Use a back-up wrench to hold receiver and dehydrator assembly port while loosening evaporator tube fitting.
7. Evaporator tube fitting at thermostatic expansion valve assembly (6).
8. Evaporator tube (8).
   - Discard O-rings (14).

Install or Connect

NOTICE: See "Notice" on page 1B-1 of this section.

1. Clean evaporator tube fittings with mineral base 525 viscosity refrigerant oil.
   - Do not allow refrigerant oil to enter evaporator tube (8).
2. O-rings to evaporator tube (8).
   - Lightly coat O-rings with mineral base 525 viscosity refrigerant oil.
3. Evaporator tube fitting at thermostatic expansion valve assembly (6).
   - Do not tighten at this time.
4. Evaporator tube fitting at receiver and dehydrator assembly (4).

Tighten

- Evaporator tube fitting at receiver and dehydrator assembly (4) to 7 N•m (62 lb. in.).
- Evaporator tube fitting at thermostatic expansion valve assembly (6) to 18 N•m (13 lb. ft.).

5. Bolt/screw (12).

Tighten

- Bolt/screw (12) to 14 N•m (10 lb. ft.).

6. Receiver dehydrator tube. Refer to "Air Conditioning Receiver Dehydrator Tube" in this section.
7. Strap (34) to evaporator tube (8).
8. Electrical connector at refrigerant pressure sensor (22).
9. Charge A/C system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
10. Leak-test fittings. Refer to "Leak-Testing the Refrigeration System" in this section.

Air Conditioning Thermostatic Expansion Valve Assembly

Figures 1, 2 and 14

Remove or Disconnect

1. Recover refrigerant. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
2. Evaporator tube. Refer to "Air Conditioning Evaporator Tube" in this section.
3. Compressor and condenser hose assembly fitting at thermostatic expansion valve assembly (6).
   - Discard seal (16).
4. Bolts/screws (29).
5. Thermostatic expansion valve assembly (6).
6. Seals (15) from evaporator (5).
   - Discard seals (15).

Install or Connect

NOTICE: See "Notice" on page 1B-1 of this section.

1. Seals (15) to evaporator (5).
   - Lightly coat seals with mineral base 525 viscosity refrigerant oil.
2. Thermostatic expansion valve assembly (6).
3. Bolts/screws (29).

Tighten

- Bolts/screws (29) to 7 N•m (62 lb. in.).

4. Clean compressor and condenser hose assembly fitting with mineral base 525 viscosity refrigerant oil.
   - Do not allow refrigerant oil to enter A/C system.
5. Seal (16) to compressor and condenser hose assembly (7).
   - Lightly coat seal with mineral base 525 viscosity refrigerant oil.
6. Compressor and condenser hose assembly fitting to thermostatic expansion valve assembly (6).

Tighten

- Compressor and condenser hose assembly fitting to 37 N•m (27 lb. ft.).

7. Evaporator tube. Refer to "Air Conditioning Evaporator Tube" in this section.
8. Charge A/C system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
9. Leak-test fittings. Refer to "Leak-Testing the Refrigeration System" in this section.

Air Conditioning Receiver and Dehydrator Assembly

Figures 1, 2 and 14

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Recover refrigerant. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
3. Bolt/screw (27).
4. Receiver dehydrator tube fitting at receiver and dehydrator assembly (4).
   - Use a back-up wrench to hold receiver and dehydrator assembly port while loosening receiver dehydrator tube fitting.
5. Receiver dehydrator tube (9).
   - Discard O-rings (13).
6. Bolt/screw (11) at receiver dehydrator bracket clamp.
7. Evaporator tube fitting at receiver and dehydrator assembly (4).
   - Use a back-up wrench to hold receiver and dehydrator assembly port while loosening evaporator tube fitting.
8. Receiver and dehydrator assembly (4) from bracket (10).
   - Discard O-ring (14).

Install or Connect

NOTICE: See "Notice" on page 1B-1 of this section.

1. If receiver and dehydrator assembly is being replaced, drain and measure amount of PAG oil in old receiver and dehydrator assembly. Add the drained amount plus 30 ml (1 fluid ounce) more of new PAG oil to new receiver and dehydrator assembly.
2. Receiver and dehydrator assembly (4) to bracket (10).
3. Clean fittings with mineral base 525 viscosity refrigerant oil.
   - Do not allow refrigerant oil to enter A/C system.
4. O-ring (14) to evaporator tube (8).
   - Lightly coat O-ring (14) with mineral base 525 viscosity refrigerant oil.
5. Evaporator tube fitting to receiver and dehydrator assembly (4).

Tighten

- Evaporator tube fitting to 7 N•m (62 lb. in.).

6. Bolt/screw (11) at receiver dehydrator bracket clamp.

Tighten

- Bolt/screw (11) to 9 N•m (80 lb. in.).

7. O-rings (13) to receiver dehydrator tube (9).
8. Receiver dehydrator tube (9).
9. Bolt/screw (27).
   - Do not tighten at this time.
10. Receiver dehydrator tube fitting to receiver and dehydrator assembly (4).

Tighten

- Receiver dehydrator tube fitting to 27 N•m (20 lb. ft.).
- Bolt/screw (27) to 16 N•m (12 lb. ft.).

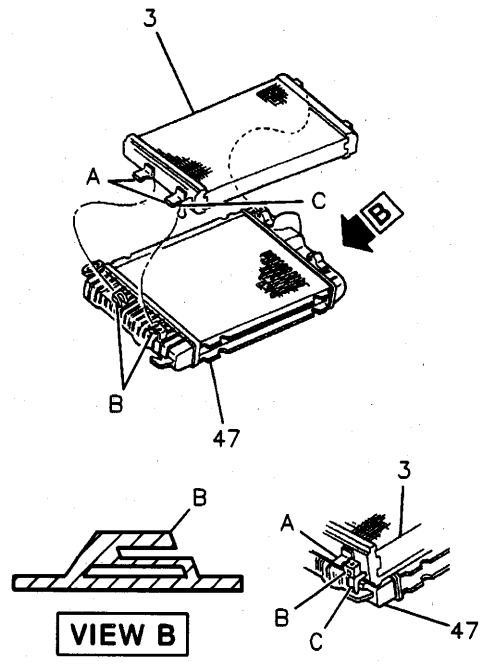
11. Battery negative cable assembly.
12. Charge A/C system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
13. Leak-test fittings. Refer to "Leak-Testing the Refrigeration System" in this section.

Air Conditioning Condenser Assembly

Figures 1, 2, 14 and 15

Remove or Disconnect

1. Recover refrigerant. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
2. Air intake duct. Refer to SECTION 6E3.



A TANG, CONDENSER ASSEMBLY RETAINING
B GROOVE
C CONDENSER TIBE
3 CONDENSER, AIR CONDITIONING
47 RADIATOR

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Figure 15 – Condenser Assembly

3. Air cleaner assembly. Refer to SECTION 6E3.
4. Upper radiator shroud assembly. Refer to SECTION 6B.
5. Raise and suitably support vehicle. Refer to SECTION 0A.
6. Hose assembly (7) at condenser assembly (3).
   - Discard O-ring (17).
7. Lower vehicle.
8. Receiver dehydrator tube. Refer to "Air Conditioning Receiver Dehydrator Tube" in this section.
9. Radiator air upper baffle from condenser assembly, if necessary. Refer to SECTION 6B.
10. Condenser assembly (3) from radiator assembly (47).
    - Disconnect retaining tangs from grooves.

Install or Connect

NOTICE: See "Notice" on page 1B-1 of this section.

1. Condenser assembly (3) to radiator assembly (47).
   - Retaining tangs must be fully seated in grooves (Figure 15).

Important

- If a retaining groove breaks, install the condenser finger to locate and drill a small hole into the existing boss. Use appropriate screw to fasten finger to the tab. Do not puncture radiator coolant tank when doing this procedure.

2. Radiator air upper baffle to condenser assembly, if removed. Refer to SECTION 6B.
3. Receiver dehydrator tube. Refer to "Air Conditioning Receiver Dehydrator Tube" in this section.
4. Raise and suitably support vehicle. Refer to SECTION 0A.
5. Clean hose assembly fitting and condenser assembly fitting with mineral base 525 viscosity refrigerant oil.
   - Do not allow refrigerant oil to enter A/C system.
6. O-ring (17) to hose assembly (7).
   - Lightly coat O-ring with mineral base 525 viscosity refrigerant oil.
7. Hose assembly (7) to condenser assembly (3).

Tighten

- Hose assembly fitting to 27 N•m (20 lb. ft.).

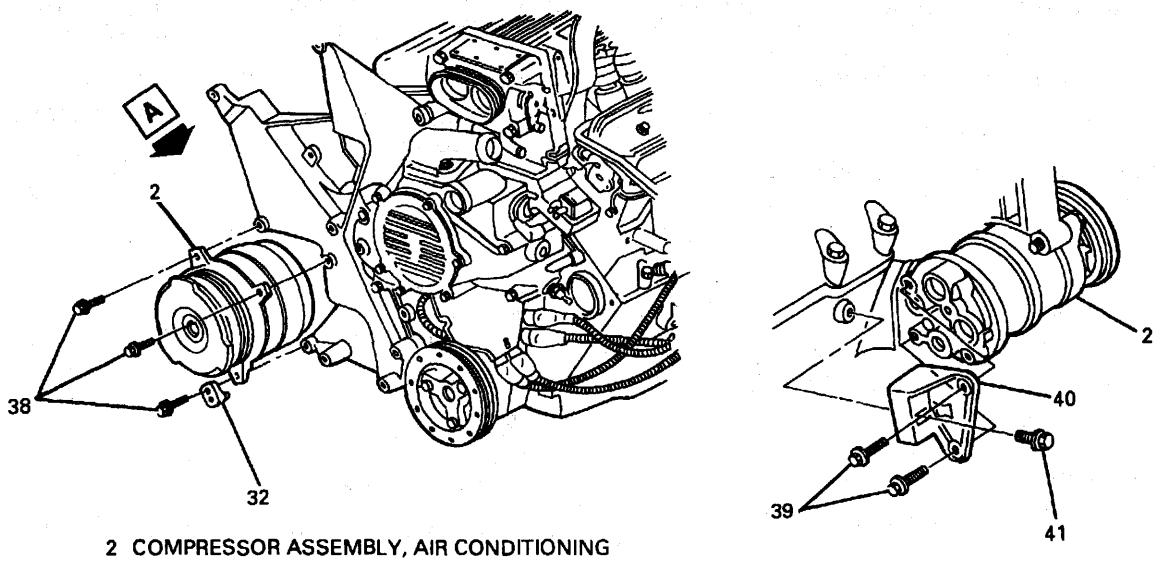
8. Lower vehicle.
9. Upper radiator shroud assembly. Refer to SECTION 6B.
10. Air cleaner assembly. Refer to SECTION 6E3.
11. Air intake duct. Refer to SECTION 6E3.
12. Charge A/C system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
13. Leak-test fittings. Refer to "Leak-Testing the Refrigeration System" in this section.

Air Conditioning Compressor Assembly

Figures 1, 2, 16 and 17

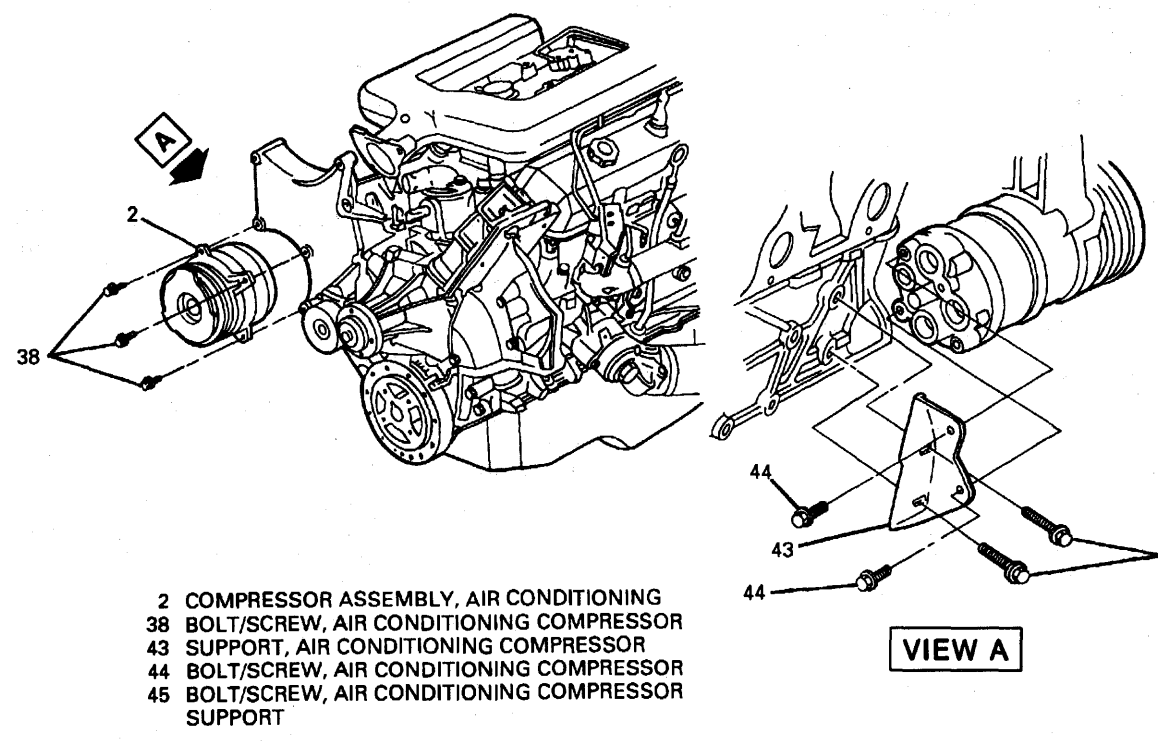
Remove or Disconnect

1. Recover refrigerant. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Serpentine drive belt. Refer to SECTION 6A2A (3.4L L32 engine) or SECTION 6A3A (5.7L LT1 engine).
4. Bolt/screw (30).
5. Bolt/screw (28).
6. Hose assembly (7) from compressor assembly (2).
   - Discard seals (18).



2 COMPRESSOR ASSEMBLY, AIR CONDITIONING
32 BRACKET, AIR CONDITIONING COMPRESSOR AND CONDENSER HOSE CLIP
38 BOLT/SCREW, AIR CONDITIONING COMPRESSOR
39 BOLT/SCREW, AIR CONDITIONING COMPRESSOR REAR BRACKET
40 BRACKET, AIR CONDITIONING COMPRESSOR REAR
41 BOLT/SCREW, AIR CONDITIONING COMPRESSOR REAR BRACKET

Figure 16 – Air Conditioning Compressor Assembly Mounting and Bracket (5.7L LT1 Engine)



2 COMPRESSOR ASSEMBLY, AIR CONDITIONING
38 BOLT/SCREW, AIR CONDITIONING COMPRESSOR
43 SUPPORT, AIR CONDITIONING COMPRESSOR
44 BOLT/SCREW, AIR CONDITIONING COMPRESSOR
45 BOLT/SCREW, AIR CONDITIONING COMPRESSOR SUPPORT

Figure 17 – Air Conditioning Compressor Assembly Mounting and Support (3.4L L32 Engine)

7. Lower transmission oil cooler pipe assembly at radiator assembly. Refer to SECTION 7A.
8. Electrical connector at compressor assembly (2).
9. Bolt/screw (41) on 5.7L LT1 engine only.
10. Bolts/screws (45) on 3.4L L32 engine only.
11. Bolts/screws (38).
12. Compressor assembly (2).
13. Bolts/screws (44) and support (43) on 3.4L L32 engine only, if necessary.
14. Bolts/screws (39) and bracket (40) on 5.7L LT1 engine only, if necessary.

Install or Connect

NOTICE: See "Notice" on page 1B-1 of this section.

1. Polyalkaline glycol (PAG) refrigerant oil.
   - If compressor assembly (2) is being replaced, drain refrigerant oil from both defective compressor and new replacement compressor. Measure amount removed from defective compressor. If measured amount is less than 30 ml (1 fluid ounce), add 60 ml (2 fluid ounces) to new replacement compressor. If more that 30 ml (1 fluid ounce) is drained from defective compressor add same amount to new compressor. Use PAG refrigerant oil GM P/N 12345923 or equivalent.
2. Bracket (40) and bolts/screws (39) on 5.7L LT1 engine only, if removed.

Tighten

- Bolts/screws (39) to 25 N•m (18 lb. ft.).

3. Support (43) and bolts/screws (44) on 3.4L L32 engine only, if removed.

Tighten

- Bolts/screws (44) to 25 N•m (18 lb. ft.).

4. Compressor assembly (2).
5. Bolts/screws (38).

Tighten

- Bolts/screws (38) to 50 N•m (37 lb. ft.).

6. Bolts/screws (45) on 3.4L L32 engine only.

Tighten

- Bolts/screws (45) to 50 N•m (37 lb. ft.).

7. Bolt/screw (41) on 5.7L LT1 engine only.

Tighten

- Bolt/screw (41) to 33 N•m (24 lb. ft.).

8. Electrical connector at compressor assembly (2).
9. Lower transmission oil cooler pipe assembly at radiator assembly. Refer to SECTION 7A.
10. Seals (18) to hose assembly (7).
    - Lightly coat seals with mineral base 525 viscosity refrigerant oil.
11. Hose assembly (7) to compressor assembly (2).
12. Bolt/screw (28).

Tighten

- Bolt/screw (28) to 33 N•m (24 lb. ft.).

13. Bolt/screw (30).

Tighten

- Bolt/screw (30) to 10 N•m (89 lb. in.).

14. Serpentine drive belt. Refer to SECTION 6A2A (3.4L L32 engine) or SECTION 6A3A (5.7L LT1 engine).
15. Lower vehicle.
16. Charge A/C system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
17. Leak-test A/C system. Refer to "Leak-Testing the Refrigeration System" in this section.

Air Conditioning Refrigerant Service Valve

Figures 1 and 2

Tool Required:

J 39037 Octagon Socket

Remove or Disconnect

1. Recover refrigerant. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
2. Valve cap (24).
3. Service valve (25).
   - Use J 39037 to remove valve.

Install or Connect

1. Service valve (25).
   - Coat seal (19) with mineral base 525 viscosity refrigerant oil.
   - Use J 39037 to install valve.

Tighten

- Service valve to (25) 11 N•m (97 lb. in.).

2. Valve cap (24).
3. Charge A/C system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.

4. Leak-test valve. Refer to "Leak-Testing the Refrigeration System" in this section.

Generator and Air Conditioning Compressor and Power Steering Pump Bracket Assembly (5.7L LT1 Engine)

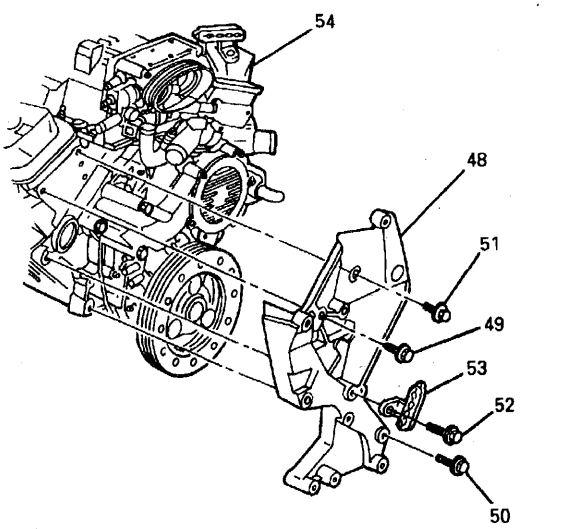
Figure 18

Remove or Disconnect

1. Generator assembly. Refer to SECTION 6D3.
2. Power steering pump assembly. Refer to SECTION 3B.
3. Air conditioning compressor assembly. Refer to "Air Conditioning Compressor Assembly" in this section.
4. Bolts/screws (49, 50, 51 and 52).
5. Spark plug wire support (53).
6. Bracket assembly (48).

Install or Connect

1. Bracket assembly (48).
2. Spark plug wire support (53).
3. Bolts/screws (49, 50, 51 and 52) loosely.



48 BRACKET ASSEMBLY, GENERATOR AND AIR CONDITIONING COMPRESSOR AND POWER STEERING PUMP
49 BOLT/SCREW, GENERATOR BRACKET
50 BOLT/SCREW, GENERATOR BRACKET
51 BOLT/SCREW, GENERATOR BRACKET
52 BOLT/SCREW, GENERATOR BRACKET
53 SUPPORT, SPARK PLUG WIRE
54 ENGINE ASSEMBLY (5.7L LT1)

5-2-94
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Figure 18 – Bracket Assembly (5.7L LT1 Engine)

Tighten

- In sequence:
  - Bolt/screw (49) to 33 N•m (24 lb. ft.).
  - Bolt/screw (50) to 33 N•m (24 lb. ft.).
  - Bolt/screw (51) to 33 N•m (24 lb. ft.).
  - Bolt/screw (52) to 33 N•m (24 lb. ft.).

4. Air conditioning compressor assembly. Refer to "Air Conditioning Compressor Assembly" in this section.
5. Power steering pump assembly. Refer to SECTION 3B.
6. Generator assembly. Refer to SECTION 6D3.
7. Bleed power steering system. Refer to SECTION 3B.
8. Charge A/C system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
9. Leak-test A/C fitting at rear of compressor assembly. Refer to "Leak-Testing the Refrigeration System" in this section.

Generator and Air Conditioning Compressor Bracket Assembly (3.4L L32 Engine)

Figure 19

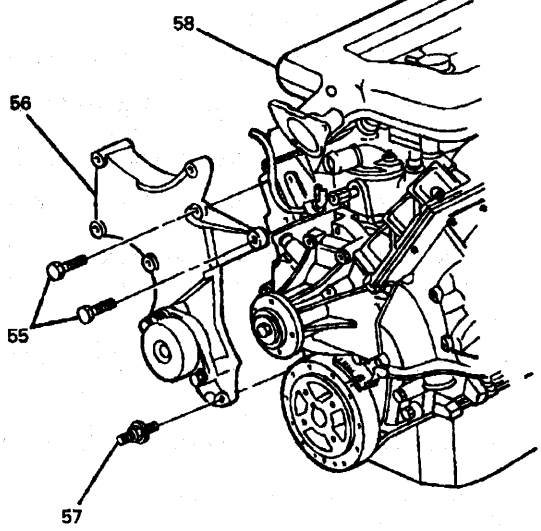
Remove or Disconnect

1. Generator assembly. Refer to SECTION 6D3.
2. Air conditioning compressor assembly. Refer to "Air Conditioning Compressor Assembly" in this section.
3. Serpentine drive belt tensioner assembly. Refer to SECTION 6A2A.
4. Bolts/screws (55).
5. Stud (57).
6. Bracket assembly (56).

Install or Connect

NOTICE: See "Notice" on page 1B-1 of this section.

1. Bracket assembly (56).
2. Stud (57).
   - Do not tighten at this time.
3. Bolts/screws (55).



55 BOLT/SCREW, GENERATOR BRACKET
56 BRACKET ASSEMBLY, GENERATOR AND AIR CONDITIONING COMPRESSOR
57 STUD, GENERATOR BRACKET
58 ENGINE ASSEMBLY (3 4L L32)

5-2-94
FS01918

Figure 19 – Bracket Assembly (3.4L L32 Engine)

Tighten

- Bolts/screws (55) to 33 N•m (24 lb. ft.).
- Stud (57) to 33 N•m (24 lb. ft.).

4. Serpentine drive belt tensioner assembly. Refer to SECTION 6A2A.
5. Air conditioning compressor assembly. Refer to "Air Conditioning Compressor Assembly" in this section.
6. Generator assembly. Refer to SECTION 6D3.
7. Charge A/C system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in this section.
8. Leak-test fitting at rear of compressor assembly. Refer to "Leak-Testing the Refrigeration System" in this section.

Compressor Assembly On-Vehicle Minor Component Replacement

Due to the limited clearance on the 5.7L LT1 engine, it is recommended that the compressor assembly be serviced after the compressor assembly is removed from the vehicle. Vehicles with 3.4L L32 engines have clearance to service compressor assembly minor components on-vehicle. For component replacement procedures, refer to SECTION 1D2.

SPECIFICATIONS

GENERAL SPECIFICATIONS

A/C System O-Ring and Fitting Lubricant	525 Viscosity Mineral Oil, GM P/N 12301108 or Equivalent
A/C System Internal Lubricant (Including Compressor Assembly)	Polyalkylene Glycol (PAG) Synthetic Refrigerant Oil GM P/N 12345923 or Equivalent
A/C System R-134a Charge Capacity	0.91 kg (2.0 lb.)

FASTENER TIGHTENING SPECIFICATIONS

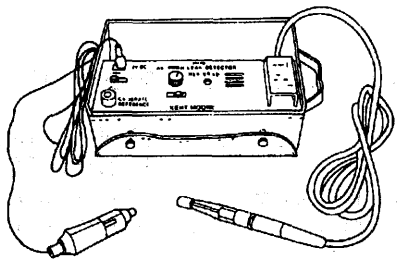
Air Conditioning Compressor Bolt/Screw (To Main Bracket, All Engines)	50 N•m (37 lb. ft.)
Air Conditioning Compressor (Rear Support) Bolt/Screw (To Compressor Assembly, 3.4L L32 Engine)	25 N•m (18 lb. ft.)
Air Conditioning Compressor and Condenser Hose Bolt/Screw	33 N•m (24 lb. ft.)
Air Conditioning Compressor and Condenser Hose Clip Bracket Bolt/Screw	10 N•m (89 lb. in.)
Air Conditioning Compressor Low Pressure Cutoff Switch Assembly	6 N•m (53 lb. in.)
Air Conditioning Compressor Rear Bracket Bolt/Screw (To Compressor Assembly, 5.7L LT1 Engine)	25 N•m (18 lb. ft.)
Air Conditioning Compressor Rear Bracket Bolt/Screw (To 5.7L LT1 Engine)	33 N•m (24 lb. ft.)
Air Conditioning Compressor Rear Support Bolt/Screw (To 3.4L L32 Engine)	50 N•m (37 lb. ft.)
Air Conditioning Receiver Dehydrator Bracket Bolt/Screw	14 N•m (10 lb. ft.)
Air Conditioning Receiver Dehydrator Bracket Clamp Bolt/Screw	9 N•m (80 lb. in.)
Air Conditioning Receiver Dehydrator Tube Bolt/Screw	16 N•m (12 lb. ft.)
Air Conditioning Refrigerant Pressure Sensor Assembly	6 N•m (53 lb. in.)
Air Conditioning Refrigerant Service Valve	11 N•m (97 lb. in.)
Air Conditioning Thermostatic Expansion Valve Bolt/Screw	7 N•m (62 lb. in.)
Generator Bracket Bolt/Screw	33 N•m (24 lb. ft.)
Generator Bracket Stud	33 N•m (24 lb. ft.)

FITTING TIGHTENING SPECIFICATIONS

Air Conditioning Compressor and Condenser Hose Assembly Fitting (At Condenser Assembly)	27 N•m (20 lb. ft.)
Air Conditioning Compressor and Condenser Hose Assembly Fitting (At Thermostatic Expansion Valve Assembly)	37 N•m (27 lb. ft.)
Air Conditioning Evaporator Tube Fitting (At Receiver and Dehydrator Assembly)	7 N•m (62 lb. in.)
Air Conditioning Evaporator Tube Fitting (At Thermostatic Expansion Valve Assembly)	18 N•m (13 lb. ft.)
Air Conditioning Receiver Dehydrator Tube Fitting (At Receiver and Dehydrator Assembly)	27 N•m (20 lb. ft.)

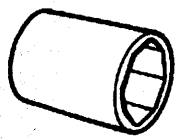
SPECIAL TOOLS

1



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2



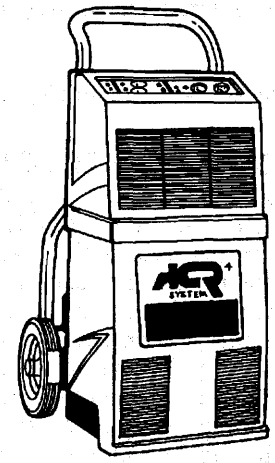
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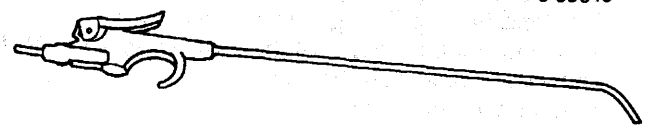
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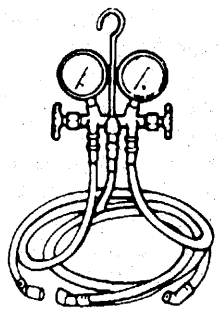
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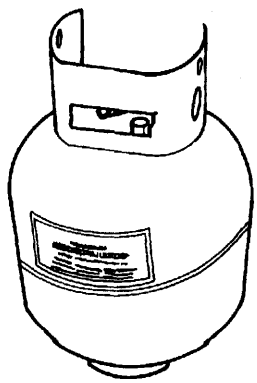
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7



J 39500-50

1. HALOGEN LEAK DETECTOR
2 OCTAGON SOCKET
3. PRECISION THERMOMETER
4. AIR CONDITIONING REFRIGERANT RECOVERY, RECYCLING AND RECHARGING (ACR⁴) SYSTEM
5 AIR CONDITIONING EVAPORATOR CLEANING GUN
6 R-134a MANIFOLD GAUGE SET
7 50 LB REFILLABLE RECOVERY TANK

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SECTION 1B1

MANUAL CONTROL AIR CONDITIONING

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location View in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

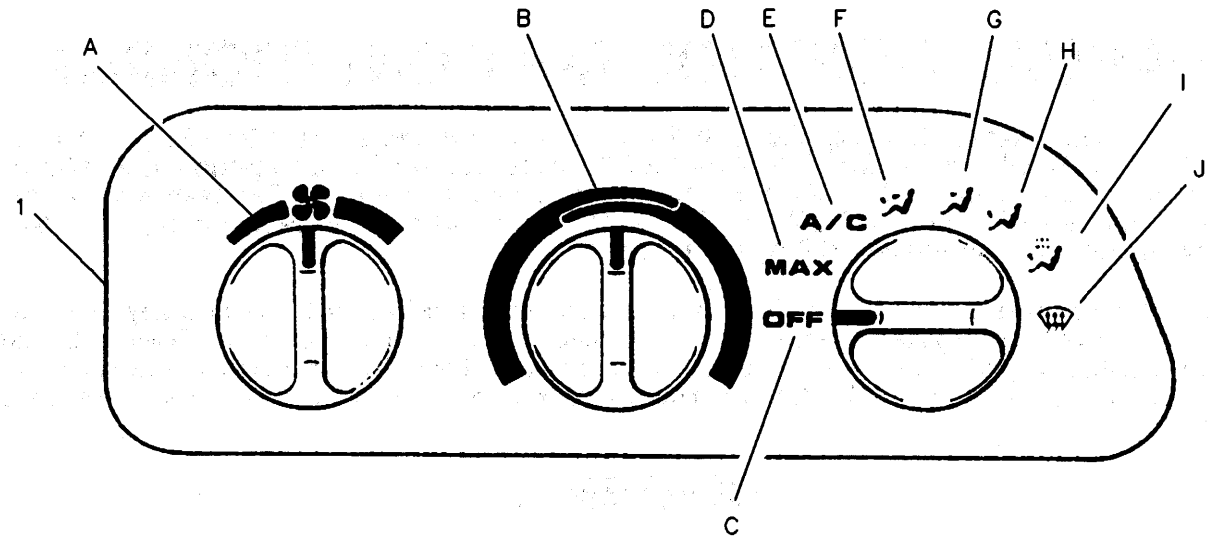
OVERVIEW

Figures 1 through 3

The air conditioning system (C60) delivers air that has been heated or cooled and dehumidified for occupant comfort. It also provides power ventilation, and windshield assembly defrosting and side window defogging.

During most operating conditions, outside air is drawn through the heater and air conditioning module assembly by the blower motor assembly. Additional outside air is also forced into the vehicle by forward movement of the vehicle.

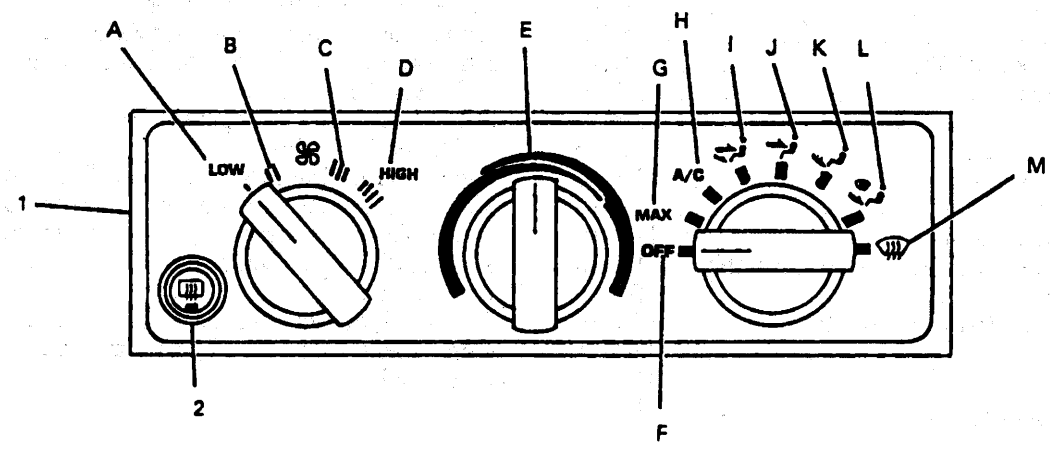
Within the heater and air conditioning evaporator module assembly, air is pushed by the blower motor assembly through the evaporator, then through the heater core assembly, depending on the temperature valve setting, and into the passenger compartment. For air conditioning or defroster operation at ambient temperatures above 7°C (45°F), the refrigeration system will chill the evaporator to almost freezing. As the air passes through the evaporator, the air temperature drops which causes moisture in the air to condense on the evaporator core fins. This moisture leaves the vehicle by gravity feed through a drain hole, dehumidifying the vehicle.



A BLOWER MOTOR SPEED CONTROL
B TEMPERATURE CONTROL
C "OFF" MODE
D "MAX A/C" MODE
E "NORMAL A/C" MODE
F "BI-LEVEL A/C" MODE
G "VENT" MODE
H "HEATER" MODE
I "DEFROST BLEND" MODE
J "DEFROST" MODE
1 CONTROL ASSEMBLY, HEATER AND AIR CONDITIONING

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Figure 1 – Heater and Air Conditioning Control Assembly – (Chevrolet)



A LOWER BLOWER MOTOR SPEED
B MEDIUM 1 BLOWER MOTOR SPEED
C MEDIUM 2 BLOWER MOTOR SPEED
D HIGH BLOWER MOTOR SPEED
E TEMPERATURE CONTROL
F "OFF" MODE
G "MAX A/C" MODE
H "NORMAL A/C" MODE
I "BI-LEVEL A/C" MODE
J "VENT" MODE
K "HEATER" MODE
L "DEFROST BLEND" MODE
M "DEFROST" MODE
1 CONTROL ASSEMBLY, HEATER AND AIR CONDITIONING
2 SWITCH ASSEMBLY, REAR WINDOW DEFOGGER

4-4-94
FS0021B1

Figure 2 – Heater and Air Conditioning Control Assembly – (Pontiac)

From the evaporator, some or all of the air may pass through the heater core assembly, which is warmed by engine coolant. Any of the air which is not to be heated will mix with the heated air before entering the passenger compartment.

When maximum air conditioning mode is selected, most of the air entering the blower motor assembly is taken from the passenger compartment (recirculated) where it is most likely to be cooler than the outside air. Only outside air is used in all other modes.

CONTROL ASSEMBLY

Temperature Control

Figures 1 and 2

The temperature control is mechanically linked to the air temperature valve (door) by a temperature control cable. Rotating the temperature control clockwise allows more of the incoming or recirculated air to flow through the heater core assembly, thus increasing the air temperature entering the vehicle. Rotating the temperature control counterclockwise decreases air flow through the heater core assembly, thus decreasing the air temperature entering the vehicle.

Mode Control

Figures 1 and 2

The mode control has eight settings: "OFF," "MAX," "A/C," "BI-LEVEL A/C," "VENT," "HEATER," "DEFROST BLEND," and "DEFROST." Some settings are symbols on the heater and air conditioning control assembly (1). These symbols are identified in Figures 1 and 2. Each setting is described below.

"OFF" Mode

At this setting, electrical power is not supplied to the blower motor assembly and A/C is not requested to the powertrain control module (PCM). A small amount of air which is forced into the heater and air conditioning module assembly by forward movement of the vehicle will still be discharged through the heater and defrost outlets. This is the only mode in which the blower motor assembly does not operate.

"MAX" A/C Mode

The "MAX" A/C setting is one of five settings which requests A/C operation to the PCM. At this setting the blower motor assembly will operate in one of the four blower motor speed control settings and air will be discharged from the instrument panel air outlets only.

To provide maximum air conditioning, most of the air entering the heater and air conditioning module assembly is taken from the vehicle interior (recirculated) where it is most likely cooler than the outside air. This is the only mode in which air is recirculated, all other modes use outside air only. This setting would be most useful during conditions of high temperature and humidity, or when the outside air may have an objectionable odor.

Normal "A/C" Mode

The normal "A/C" setting functions the same as "MAX" A/C setting, except only outside air enters the module. There may be a slight reduction of blower noise compared to "MAX" A/C mode because the recirculation valve (door) is closed.

"BI-LEVEL A/C" Mode

The "BI-LEVEL A/C" setting requests A/C to the PCM and allows the blower motor assembly to operate in one of four settings. Only outside air enters the module and air is distributed through the instrument panel outlets and the floor outlets with a small amount to the defrost outlet.

"VENT" Mode

The "VENT" setting does not request A/C to the PCM but allows the blower motor assembly to operate normally. This is one of two economy modes (other than "OFF") in which A/C is not requested. Air is discharged through the instrument panel outlets only.

"HEATER" Mode

The "HEATER" setting functions the same as the "VENT" setting, except most of the air is discharged through the floor outlets with a small amount discharged through the defroster outlets. The "HEATER" mode is the normal selection for cold weather operation unless windshield defrosting or side window defogging is required.

"DEFROST BLEND" Mode

The "DEFROST BLEND" setting allows operation of the blower motor assembly and sends an A/C request signal to the PCM for compressor operation. During this setting, air is discharged through the defroster and floor air outlets. This setting allows greater passenger comfort than "DEFROST" but is not as effective in defrosting the windshield assembly and side windows.

"DEFROST" Mode

The "DEFROST" setting functions the same as "DEFROST BLEND" setting except most of the air is discharged through the defroster outlets with a small amount going through the heater and side window defoggers.

Blower Motor Speed Control

Figures 1 and 2

With the ignition switch in the "RUN" position, the blower motor assembly runs in all mode control positions except "OFF." Blower motor assembly speed is controlled by a four-position electrical blower motor speed control switch at the left side of the control assembly. The blower motor speed control switch provides a choice of a low blower motor assembly speed, two medium speeds, and a high speed.

Electrical power is routed from the HVAC fuse number 3 in the fuse block to the mode control switch. The mode control switch breaks the circuit when it is in the "OFF" position, and closes the circuit in all other positions.

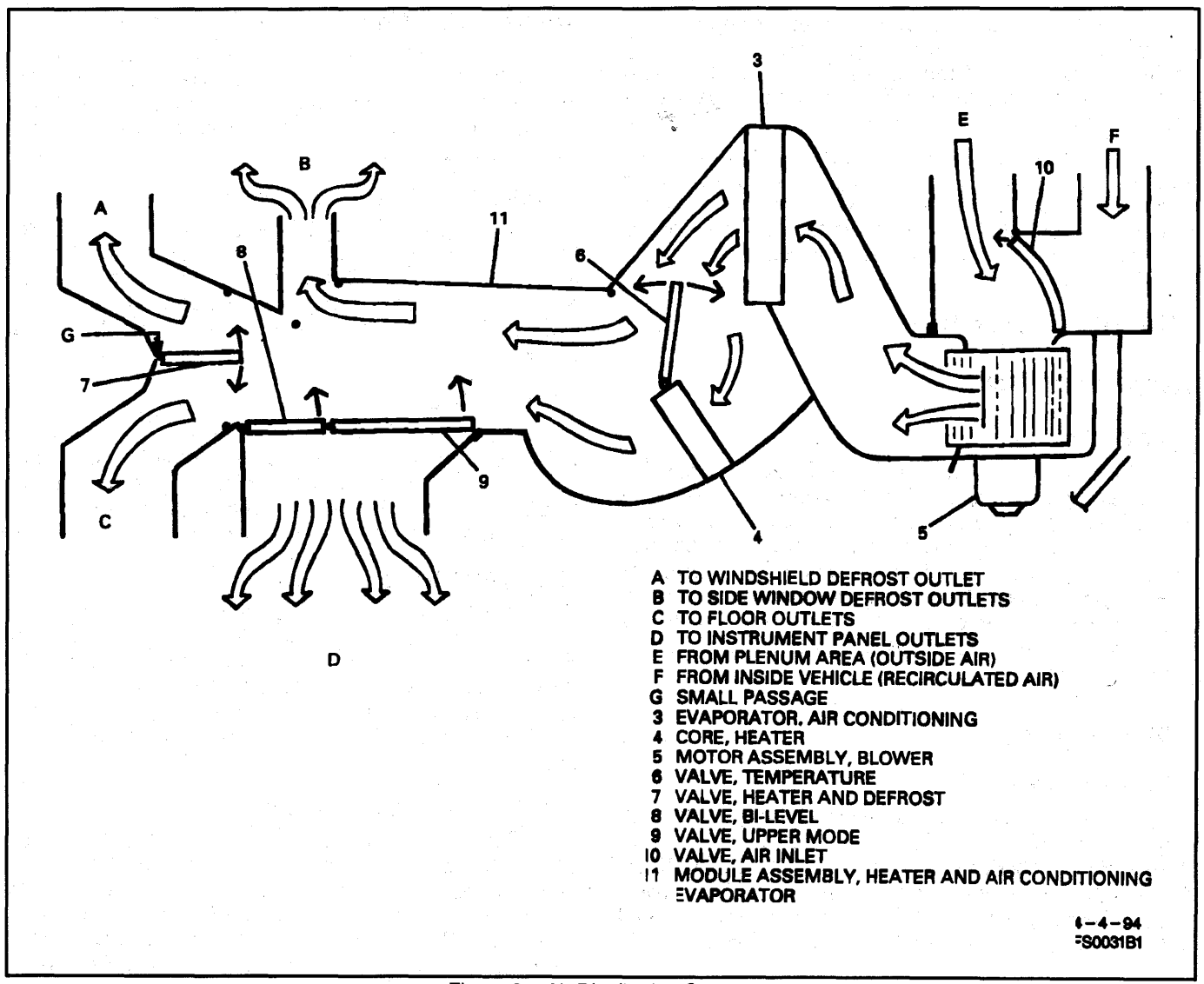


Figure 3 – Air Distribution System

From the mode control switch, the circuit then goes to the blower motor speed control switch. When the blower motor speed control switch is in "LOW," voltage is conducted to the resistor assembly. At the resistor assembly, the voltage passes through all three resistors and is reduced to provide the low blower motor assembly speed.

When the blower switch is in either of the two medium speed positions, it closes to send voltage through either two or one of the resistors in the resistor assembly. Because the current follows the path of least resistance, the circuit branch leading directly to all three resistors becomes ineffective and the current bypasses either one or two resistors, depending upon which medium speed position is selected. The reduced resistance increases current flow and blower motor assembly speed.

When the blower motor speed control switch is in the "HIGH" position, it energizes the high blower relay and power is taken from a separate circuit that is protected by a fusible link. This separate power circuit is "hot" at all times and has the capacity to handle the current demands of the blower motor assembly at high speed.

The circuit to the blower motor assembly is completed to ground at the instrument panel assembly through the instrument panel wiring harness. Refer to SECTION 8A for more electrical information.

AIR DISTRIBUTION SYSTEM

Figures 3 through 6

Air enters the heater and air conditioning evaporator module assembly where it may be cooled for air conditioning or defrost modes, and then heated as necessary before being sent to the proper outlets for discharge into the passenger compartment. Within the heater and air conditioning evaporator module assembly, valves (doors) guide the airflow in response to the position of the mode control.

Vacuum System

All valves in the heater and air conditioning evaporator module assembly except the temperature valve are controlled by engine vacuum drawn from the vacuum tank assembly, mounted to the right side body rail, just behind the radiator support. The vacuum is routed by a

vacuum selector valve in the control assembly to spring-loaded vacuum actuator assemblies on the heater and air conditioning evaporator module assembly. Vacuum stored in the vacuum tank assembly is prevented from bleeding back to its source during conditions of low engine manifold vacuum (acceleration, hard pulling, etc.) by a check valve in the vacuum source hose.

The vacuum selector valve in the control assembly is controlled by the mode control. For each mode control position, the vacuum selector valve directs vacuum to specific hoses to overcome the force of the spring within the appropriate vacuum actuator assemblies. The vacuum selector valve also vents the hoses to each remaining vacuum actuator assembly to normal air pressure, allowing the actuator spring to expand. This results in the valves (doors) being properly positioned for the selected operating mode.

The heater and defrost valve uses a three-position vacuum actuator. A three-position vacuum actuator has a diaphragm with a spring on both sides. At rest (no vacuum applied) the diaphragm will be in a mid-position, allowing for a "blend" mode. When vacuum is applied to either end of the diaphragm, the diaphragm will move the heater and defrost valve to either stop, which will direct airflow to either the defroster outlets or the floor outlets.

When air is directed to the floor outlets, as in "HEATER" mode, a small amount of air still bleeds through the defroster outlets to help eliminate re-fogging of the windshield.

Other Components

Other components of the air distribution system include the plenum, the blower motor assembly, the evaporator and the heater core assembly. The plenum provides a source of outside air to the system. The blower motor assembly draws air from the plenum or from the vehicle interior into the heater and air conditioning evaporator module assembly and forces it through the air distribution system to the outlets. The evaporator is a part of the refrigeration system. It cools the air from the blower motor assembly when operating in an air conditioning or defrosting mode. The heater core assembly provides heat which can be used to warm the air downstream from the evaporator.

Air Inlet Valve

The first valve in the air distribution system is the air inlet valve. This two-position valve controls the two air entrances which feed air to the blower motor assembly. When "MAX" A/C mode is selected, vacuum is applied to the air inlet vacuum actuator assembly and the air inlet valve opens the entrance which supplies inside air from the passenger compartment. In this position, the air inlet valve partially closes the entrance for outside air so only a slight amount can enter. Recirculating the cooled air inside the passenger compartment when outside temperature is very high gives a faster cool down to a more comfortable temperature.

When any other operating mode (including "OFF") is selected, the air inlet vacuum actuator assembly is vented to normal air pressure and the air inlet valve completely closes off the entrance for inside air. Only fresh outside air is used in the system in these modes.

Blower Motor Assembly and Evaporator

In any operating mode except "OFF," the blower motor assembly draws in air from the plenum and pushes it through the evaporator. When any air conditioning or defrost mode is selected, the air conditioning refrigeration system chills the core of the evaporator to slightly above freezing temperature. This cools the airflow and causes excess humidity to condense on the fins of the evaporator. The condensed moisture drips to the bottom of the case and drains out through a hole that lets the water fall on the road surface below the vehicle. From the evaporator, the air flows toward the temperature valve and heater core assembly.

Temperature Valve and Heater Core Assembly

The temperature control in the control assembly is linked to the temperature valve by a flexible control cable assembly. When the temperature control is rotated fully counterclockwise to the full "COLD" position, the temperature valve is held snugly against the air entrance to the heater core assembly. This causes all of the airflow from the evaporator to bypass the heater core assembly and there is no heat transfer.

As the temperature control is moved clockwise away from the full "COLD" position, the temperature valve begins to direct some air to the heater core assembly to allow some air to flow through it. The farther the temperature control is rotated clockwise, the more the temperature valve directs air through the heater core. Heating a greater proportion of the total airflow in this manner results in a warmer discharge of air because the heated and unheated airflows join and are mixed together thoroughly beyond the heater core.

When the temperature lever is rotated fully clockwise to the full "HOT" position, the temperature valve blocks off the passage that allows air to bypass the heater core assembly and causes all of the airflow to pass through the heater core assembly.

Bi-Level Valve

Figure 3

The bi-level valve (8) at its "at rest" (no vacuum) position, allows no air to the instrument panel outlets. The bi-level valve (8) can be opened by either the bi-level valve vacuum actuator assembly or the upper mode valve vacuum actuator assembly. When opened by the bi-level valve vacuum actuator assembly, as in "BI-LEVEL A/C" air will exit the instrument panel outlets, floor outlets and a small amount will exit the defroster outlets.

When the bi-level valve (8) is opened by the upper mode valve (9) vacuum actuator assembly, as in "MAX" A/C, normal "A/C" and "VENT" modes both valves move at the same time, directing all airflow through the instrument panel outlets.

Heater and Defrost Valve

Figure 3

The heater and defrost valve (7) is operated by a three-position heater and defrost vacuum actuator assembly. At its "at rest" (no vacuum applied to either side)

position, the heater and defrost valve (7) is positioned to allow airflow through both the floor outlets and defroster outlets, as when in "DEFROST BLEND" mode. During the "DEFROST" mode, vacuum is applied to one side of the heater and defrost vacuum actuator assembly, causing the heater and defrost valve (7) to direct all airflow to the defroster outlets. A small passage within the heater and air conditioning evaporator module assembly (11) will allow some air to bleed out the floor outlets. During the "HEATER" mode, vacuum is applied to the opposite side of the heater and defrost vacuum actuator assembly causing the heater and defrost valve (7) to direct all airflow to the floor outlets with a small bleed to the defroster outlets.

Ducts and Outlets

Figures 4 and 5

There are adjustable outlets in the instrument panel assembly. In addition, there are two side window defrost outlets, one at each end of the instrument panel. All outlets are fed by the air distributor assembly.

Heated or cooled air can be directed to the windshield assembly through the air distributor assembly and through the floor air outlet duct.

Ventilation

Figure 7

The air distribution system provides fresh air ventilation for the passenger compartment in all operating modes. A small amount of outside air is still provided in the "MAX" A/C mode while most of the air is recirculated. Even in the "OFF" mode, fresh outside air is forced into the air distribution system by the forward movement of the vehicle.

After being warmed or cooled to the desired temperature, the air is discharged from the outlets. When all windows are closed, the addition of outside air builds a slight positive pressure within the passenger compartment. The pressure forces stale air to leave the vehicle through a pressure relief valve assembly, near the left side quarter panel, behind the rear fascia.

REFRIGERATION SYSTEM

Figure 8

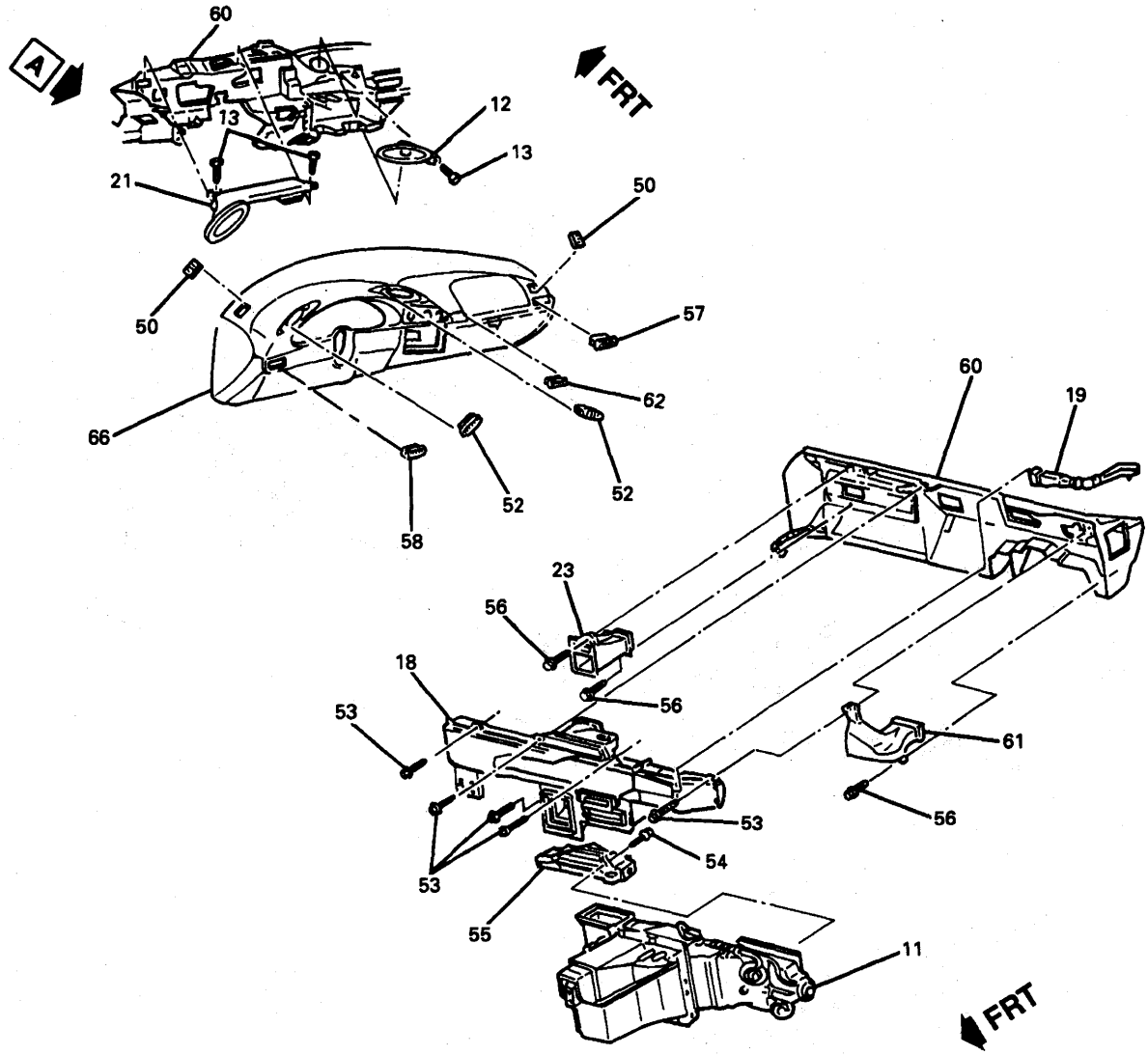
The refrigeration system cools the air flowing through the air distribution system during air conditioning operation. It also operates when the "DEFROST" or "DEFROST BLEND" mode is selected, dehumidifying the air to aid in fog removal from the windshield assembly. Refrigeration system components and their functions are as follows:

- Refrigerant circulates through the refrigeration system to absorb heat from the air being cooled, and to give off the heat to the air outside the vehicle. The refrigerant also carries a polyalkylene glycol (PAG) refrigerant oil throughout the system, primarily to lubricate parts of the compressor assembly (28).
- An engine-driven compressor assembly (28) pumps the refrigerant through the refrigeration system.
- A condenser assembly (29) cools the refrigerant in the same way that the engine cooling system radiator assembly cools the engine coolant.
- A receiver dehydrator assembly (30) dries and filters the refrigerant. It also separates the liquid and the vapor to provide only liquid to the thermostatic expansion valve assembly.
- Lines (metal tubes and nylon-core composite hoses) and leak-resistant connectors join the compressor assembly (28), condenser assembly (29), receiver dehydrator assembly (30), evaporator (3) and other components to provide a closed-loop circuit for the refrigerant.
- The A/C refrigerant pressure sensor assembly (26) attached to the air conditioning evaporator line and senses refrigerant pressure on the air conditioning system high side. One purpose of the A/C refrigerant pressure sensor assembly (26) is to inform the PCM of high side refrigerant pressure status so the PCM can disable the compressor assembly (28) before pressure becomes too high. The high side pressure signal is also used by the PCM for A/C diagnosis.
- The thermostatic expansion valve assembly (31) lowers the pressure of the refrigerant from the receiver dehydrator assembly (30) by metering the flow. This prepares the refrigerant to pick up heat.
- An evaporator (3) absorbs heat from the moving air and passes it on to the refrigerant inside the core of the evaporator (3). This causes the refrigerant to boil and leave the evaporator (3) as a vapor.
- The air conditioning evaporator temperature sensor assembly (25) mounted to the heater and air conditioning evaporator module assembly has a probe inserted into the evaporator (3) which measures evaporator temperature and sends a signal to the PCM. Within the probe is a thermistor which varies resistance according to temperature. The evaporator temperature sensor assembly is a solid state device and resistance cannot be measured directly. One purpose of this evaporator temperature sensor assembly (25) is to inform the PCM of the evaporator temperature so the compressor can be disabled before the evaporator (3) freezes. The temperature sensor assembly is also used by the PCM for A/C diagnosis.

Refrigerant-134a

CAUTION: Avoid breathing A/C Refrigerant-134a and lubricant vapor or mist. Exposure may irritate eyes, nose, and throat. To remove R-134a from the A/C system, use service equipment certified to meet the requirements of SAE J2210 (R-134a recycling equipment). If accidental system discharge occurs, ventilate work area before resuming service. Additional health and safety information may be obtained from refrigerant and lubricant manufacturers.

Like the coolant in the engine cooling system, the refrigerant is the substance in the air conditioning system that absorbs, carries and then releases heat. Past automotive air conditioning systems used a type called Refrigerant-12 (R-12).

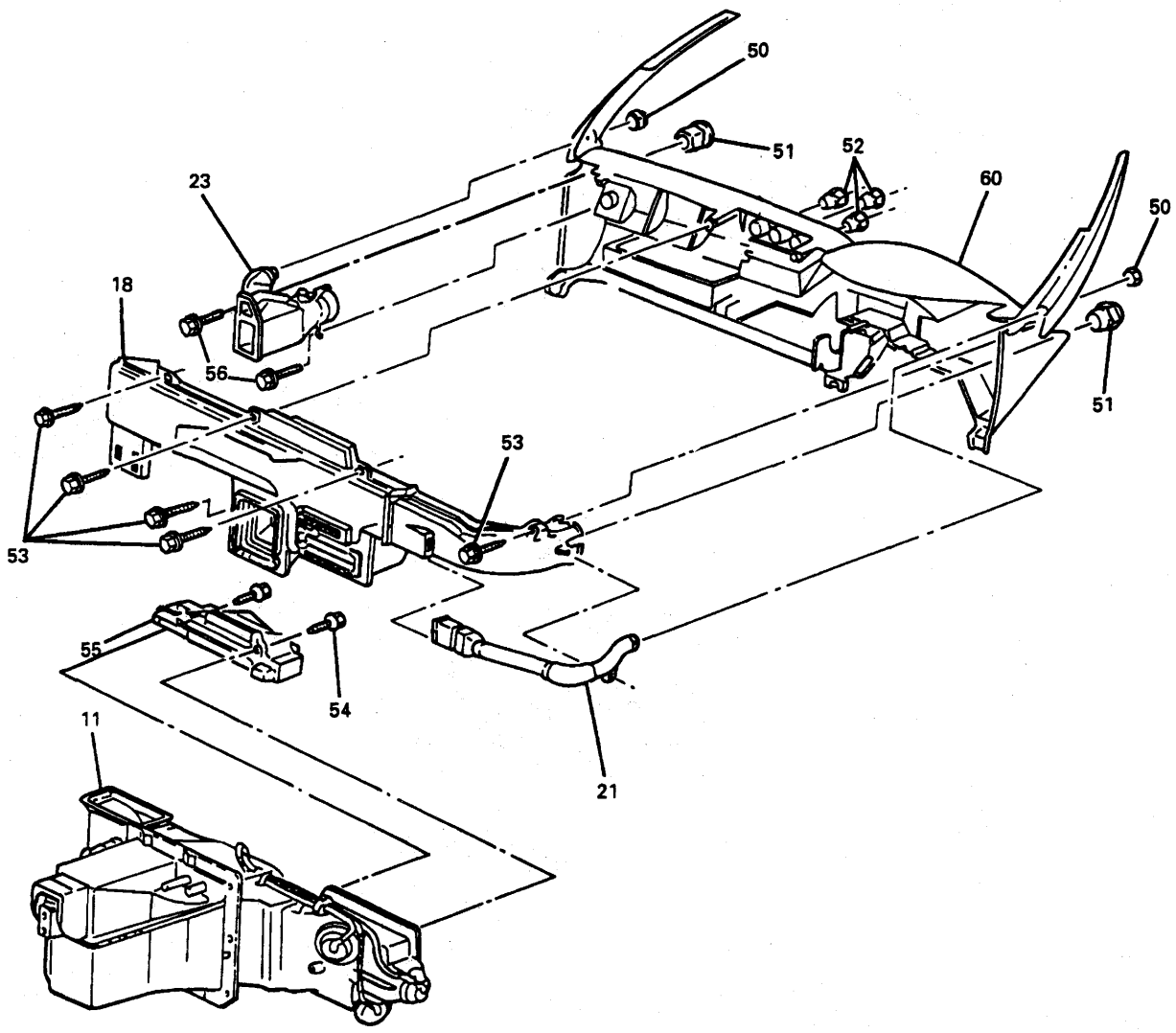


VIEW A

11 MODULE ASSY, HEATER AND AIR CONDITIONING EVAPORATOR
12 DUCT, INSTRUMENT PANEL CENTER AIR OUTLET
13 SCREW, INSTRUMENT PANEL CENTER AIR OUTLET DUCT
18 DISTRIBUTOR ASSY, WINDSHIELD DEFROSTER NOZZLE AND AIR
19 DUCT, SIDE WINDOW DEFOGGER OUTLET (LEFT SIDE)
21 DUCT, INSTRUMENT PANEL CENTER AIR OUTLET
23 DUCT, INSTRUMENT PANEL OUTER AIR OUTLET (RIGHT SIDE)
50 GRILLE, SIDE WINDOW DEFOGGER OUTLET
52 OUTLET, INSTRUMENT PANEL CENTER AIR
53 SCREW, AIR DISTRIBUTOR DUCT
54 SCREW, FLOOR AIR OUTLET DUCT
55 DUCT, FLOOR AIR OUTLET
56 SCREW, INSTRUMENT PANEL OUTER AIR OUTLET DUCT
57 OUTLET, INSTRUMENT UPPER OUTER AIR (RIGHT SIDE)
58 OUTLET, INSTRUMENT PANEL OUTER AIR (LEFT SIDE)
60 CARRIER ASSEMBLY, INSTRUMENT PANEL
61 DUCT, INSTRUMENT PANEL OUTER AIR OUTLET (LEFT SIDE)
62 OUTLET, INSTRUMENT PANEL CENTER AIR
66 PANEL ASSEMBLY, INSTRUMENT

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Figure 4 – Air Ducts and Outlets – (Chevrolet)



11 MODULE ASSEMBLY, HEATER AND AIR CONDITIONING EVAPORATOR
18 DISTRIBUTOR ASSEMBLY, WINDSHIELD DEFROSTER NOZZLE AND AIR
21 DUCT, SIDE WINDOW DEFOGGER OUTLET (LEFT SIDE)
23 DUCT, INSTRUMENT PANEL OUTER AIR OUTLET
50 GRILLE, SIDE WINDOW DEFOGGER OUTLET
51 OUTLET, INSTRUMENT PANEL OUTER AIR
52 OUTLET, INSTRUMENT PANEL CENTER AIR
53 SCREW, AIR DISTRIBUTOR DUCT
54 SCREW, FLOOR AIR OUTLET DUCT
55 DUCT, FLOOR AIR OUTLET
56 SCREW, INSTRUMENT PANEL OUTER AIR OUTLET DUCT
60 CARRIER ASSEMBLY, INSTRUMENT PANEL

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Figure 5 – Air Ducts and Outlets – (Pontiac)

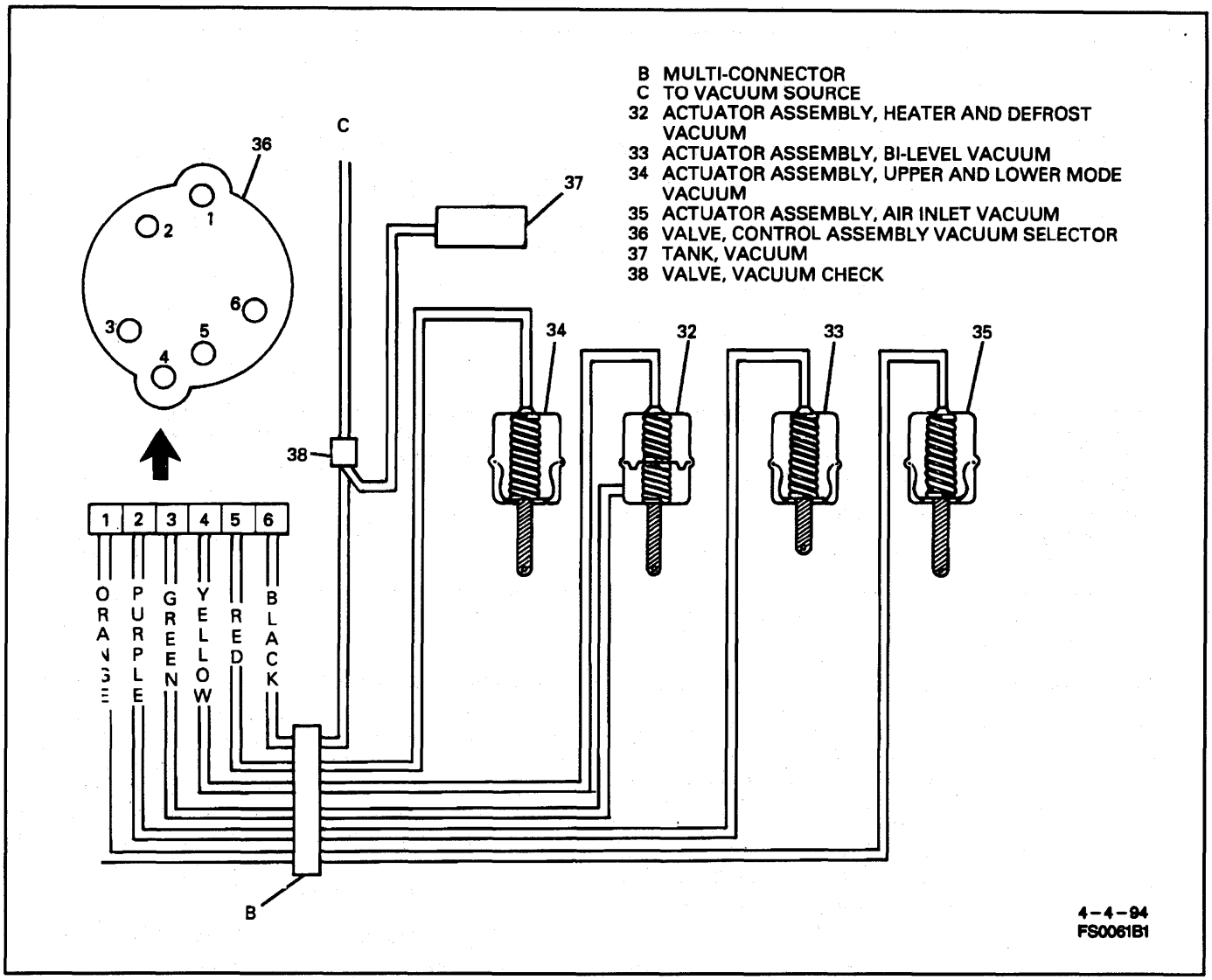


Figure 6 – Vacuum Circuit Diagram

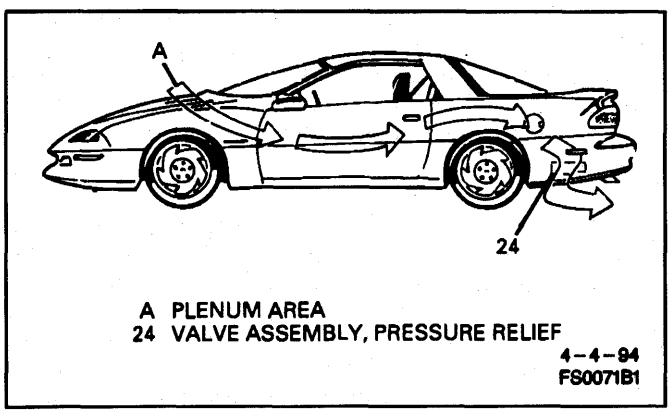


Figure 7 – Ventilation Airflow (Typical)

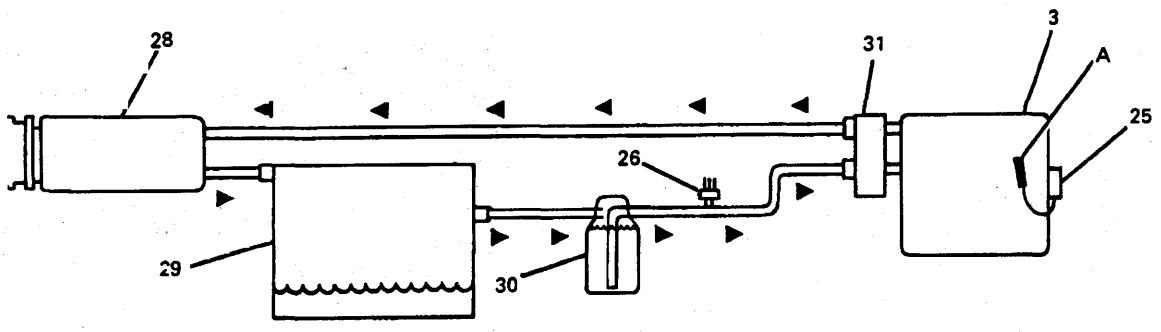
This vehicle uses a new type of refrigerant called Refrigerant-134a (R-134a). It is a non-toxic, non-flammable, clear colorless liquefied gas.

While the R-134a A/C system is very similar to an R-12 A/C system, the differences in the refrigerant, lubricants, and service equipment are important.

NOTICE: R-134a refrigerant is not compatible with R-12 refrigerant in an air conditioning system. R-12 in a R-134a system will cause compressor failure, refrigerant oil sludge or poor air conditioning system performance.

Refrigerant-134a carries a charge of a special lubricating oil, polyalkylene glycol (PAG) refrigerant oil. GM PAG refrigerant oil will have a slight blue tint. The oil is hydroscopic (absorbs water from the atmosphere) and should be stored in closed containers.

Use only polyalkylene glycol (PAG) synthetic refrigerant oil for internal circulation through the R-134A A/C system and only mineral base 525 viscosity refrigerant oil on fittings threads and O-rings. If lubricants other than those specified are used, compressor failure and/or fitting seizure is likely to occur.



A PROBE, AIR CONDITIONING EVAPORATOR TEMPERATURE SENSOR
3 EVAPORATOR, AIR CONDITIONING
25 SENSOR ASSEMBLY, AIR CONDITIONING EVAPORATOR TEMPERATURE
26 SENSOR ASSEMBLY, AIR CONDITIONING REFRIGERANT PRESSURE
28 COMPRESSOR ASSEMBLY, AIR CONDITIONING
29 CONDENSER ASSEMBLY, AIR CONDITIONING
30 RECEIVER DEHYDRATOR ASSEMBLY, AIR CONDITIONING
31 VALVE ASSEMBLY, AIR CONDITIONING THERMOSTATIC EXPANSION

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Figure 8 – Refrigeration System Schematic

Compressor Assembly

The compressor assembly (28) is belt driven from the engine crankshaft through the compressor clutch pulley. The compressor pulley rotates without driving the compressor shaft until an electromagnetic clutch coil is energized. When voltage is applied to energize the clutch coil, the clutch plate and hub assembly is drawn rearward toward the pulley. The magnetic force locks the clutch plate and pulley together as one unit to drive the compressor shaft.

As the compressor shaft is driven, the compressor assembly (28) compresses the low-pressure refrigerant vapor from the evaporator into a high-pressure, high-temperature vapor. Carried with the refrigerant is the refrigerant oil which is used to lubricate the compressor assembly (28).

The compressor assembly (28) has a unique lubrication system. The crankcase-suction bleed is routed through the rotating wobble-plate for lubrication of the wobble-plate bearing. The rotation acts as an oil separator, which removes some of the oil from the crankcase-suction bleed, rerouting it to the crankcase where it can lubricate the compressor mechanism.

Up to 118 ml (4 fluid ounces) of oil can collect in the crankcase. Therefore, it is important when replacing a compressor assembly (28) that the oil in the old compressor crankcase be drained and measured (discard after recording amount).

All replacement compressor assemblies from service parts will have 237 ml (8 fluid ounces) of oil in the crankcase. The oil must be drained and retained. Then replace the oil in the same amount as previously recorded from the old compressor assembly. For compressor assembly overhaul, refer to SECTION 1D2.

Condenser Assembly

The high-pressure refrigerant line from the compressor assembly (28) goes to the condenser assembly (29). The condenser assembly (29), is made up of coils which carry hot refrigerant vapor routed from the compressor assembly (28). Thin cooling fins on the coils transfer heat to the air passing through the condenser assembly (29). This cools the high-pressure refrigerant vapor and causes it to condense into a high-pressure liquid.

Thermostatic Expansion Valve Assembly

The thermostatic expansion valve assembly (31) controls the flow of refrigerant in the air conditioning system. The valve assembly (31) is a mechanical device and does not control compressor assembly cycling. The valve assembly (31) replaces the orifice tube used in the CCOT air conditioning systems. It functions by sensing pressure and temperature on the low side of the system and then meters the high side of the system to achieve optimal refrigeration performance.

Evaporator

Air passing through the evaporator (3) gives off some of its heat to the evaporator core fins when the refrigeration system is operating. Refer to "Air Distribution System" in this section. The heat is conducted through the thin metal walls of the evaporator core to the low-pressure liquid refrigerant flowing through the evaporator core tubes, causing the refrigerant to boil and vaporize. The refrigerant leaves the evaporator as a low-pressure vapor, carrying off the heat it absorbed from the evaporator surfaces.

Receiver Dehydrator Assembly

The receiver dehydrator assembly (30) serves as a refrigerant storage container. A bag of desiccant (a moisture absorbing material) in the base of the receiver dehy-

drator assembly (30) collects and holds any traces of moisture in the refrigerant that could otherwise create problems such as corrosion or freezing in the refrigeration system.

Recent improvements in refrigerant hose materials and the increased use of metal lines have reduced the chances of moisture entering the refrigerant system. The receiver dehydrator assembly (30) should be replaced if leaking as a result of perforation, damaged O-ring seat or damaged threads. If the system has been opened to outside air for an extended period, the dessicant may be moisture saturated and the receiver dehydrator assembly should be replaced.

DIAGNOSIS

FUNCTIONAL TEST

Figure 9

The following operational test sequence will aid in determining whether the air conditioning electrical, air, vacuum and refrigeration systems are working properly. Temperature of the air should be at least 16°C (60°F). The air conditioning system can not be properly tested unless it is at least this warm.

The engine should be started and allowed to idle for about 20 minutes or until the engine cooling system thermostat is open.

Perform steps 1-9 on Figure 9 and compare vehicle response to the normal system response shown on the chart. If vehicle does not respond correctly during any of these steps, begin diagnosis as noted below:

- Insufficient heating. Refer to SECTION 1A.
- Insufficient cooling. Refer to "Insufficient Cooling Check" in this section.
- Improper air delivery. Refer to "Improper Air Delivery" in this section.
- Blower motor assembly inoperative or incorrect speed. Refer to SECTION 8A.

INSUFFICIENT COOLING CHECK

Figure 10

To help eliminate any possible mis-diagnosis, "functional test" must be performed first. Insufficient cooling could be caused by one of several reasons. When the air conditioning compressor is inoperative, proper diagnosis of insufficient cooling must begin with an "on board diagnostic system check" of the PCM. Refer to SECTION 6E3.

IMPROPER AIR DELIVERY

Figures 11 and 12

System Description

The air distribution system is operated completely by vacuum, except for the electrically powered blower motor assembly (5). Engine vacuum is routed through a vacuum check valve (38) then to the control assembly vacuum selector valve (36) and to the vacuum tank (37). The vacuum check valve (38) is used to prevent vacuum loss due to heavy acceleration or steep uphill traveling.

HEADER AND AIR CONDITIONING CONTROL ASSEMBLY SETTING				SYSTEM RESPONSE					
STEP	MODE CONTROL LEVER SETTING	TEMPERATURE CONTROL LEVER SETTING	BLOWER MOTOR ASSEMBLY SWITCH	BLOWER MOTOR ASSEMBLY SPEED	HEATER OUTLETS	A/C OUTLETS	DEFROSTER OUTLETS	COMMENTS	OUTLET TEMPERATURE
1	OFF	COLD	LOW	OFF	NO AIR FLOW	NO AIR FLOW	NO AIR FLOW		AMBIENT
2	MAX A/C	COLD	LOW	LOW	NO AIR FLOW	AIR FLOW	NO AIR FLOW	A,E	AT LEAST 11°C (20°F) COOLER THAN AMBIENT
3	MAX A/C	COLD	LOW TO HIGH	LOW TO HIGH	NO AIR FLOW	AIR FLOW	NO AIR FLOW	B,E	AT LEAST 11°C (20°F) COOLER THAN AMBIENT
4	NORMAL A/C	MID-RANGE	HIGH	HIGH	NO AIR FLOW	AIR FLOW	NO AIR FLOW	A	SLIGHTLY WARM
5	BI-LEVEL A/C	COLD	HIGH	HIGH	AIR FLOW	AIR FLOW	MINIMUM AIR FLOW	A	AT LEAST 11°C (20°F) COOLER THAN AMBIENT
6	VENT	COLD	HIGH	HIGH	NO AIR FLOW	AIR FLOW	NO AIR FLOW	A	AMBIENT
7	HEATER	HOT	HIGH	HIGH	AIR FLOW	NO AIR FLOW	MINIMUM AIR FLOW	A,C,D	AT LEAST 49°C (120°F)
8	DEFROSTER BLEND	HOT	HIGH	HIGH	AIR FLOW	NO AIR FLOW	AIR FLOW	A,D	AT LEAST 49°C (120°F)
9	DEFROST	HOT	HIGH	HIGH	MINIMUM AIR FLOW	NO AIR FLOW	AIR FLOW	A,D	AT LEAST 49°C (120°F)

A ENGAGEMENT OF DETENT MUST BE FELT IN EACH MODE CONTROL LEVER SETTING.
B A NOTICEABLE BLOWER MOTOR ASSEMBLY SPEED INCREASE MUST OCCUR FROM LOW, MEDIUM LOW, MEDIUM HIGH AND HIGH.
C TEMPERATURE LEVER MUST TRAVEL FROM FULL COLD TO FULL HOT.
D AIR FLOW MUST ALSO BE PRESENT AT SIDE WINDOW DEFOGGER OUTLETS.
E INSTRUMENT PANEL OUTLETS MUST HOLD THEIR POSITION DURING HIGH BLOWER MOTOR ASSEMBLY SPEED BUT SHOULD BE MOVEABLE BY HAND.

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Figure 9 – Functional Test

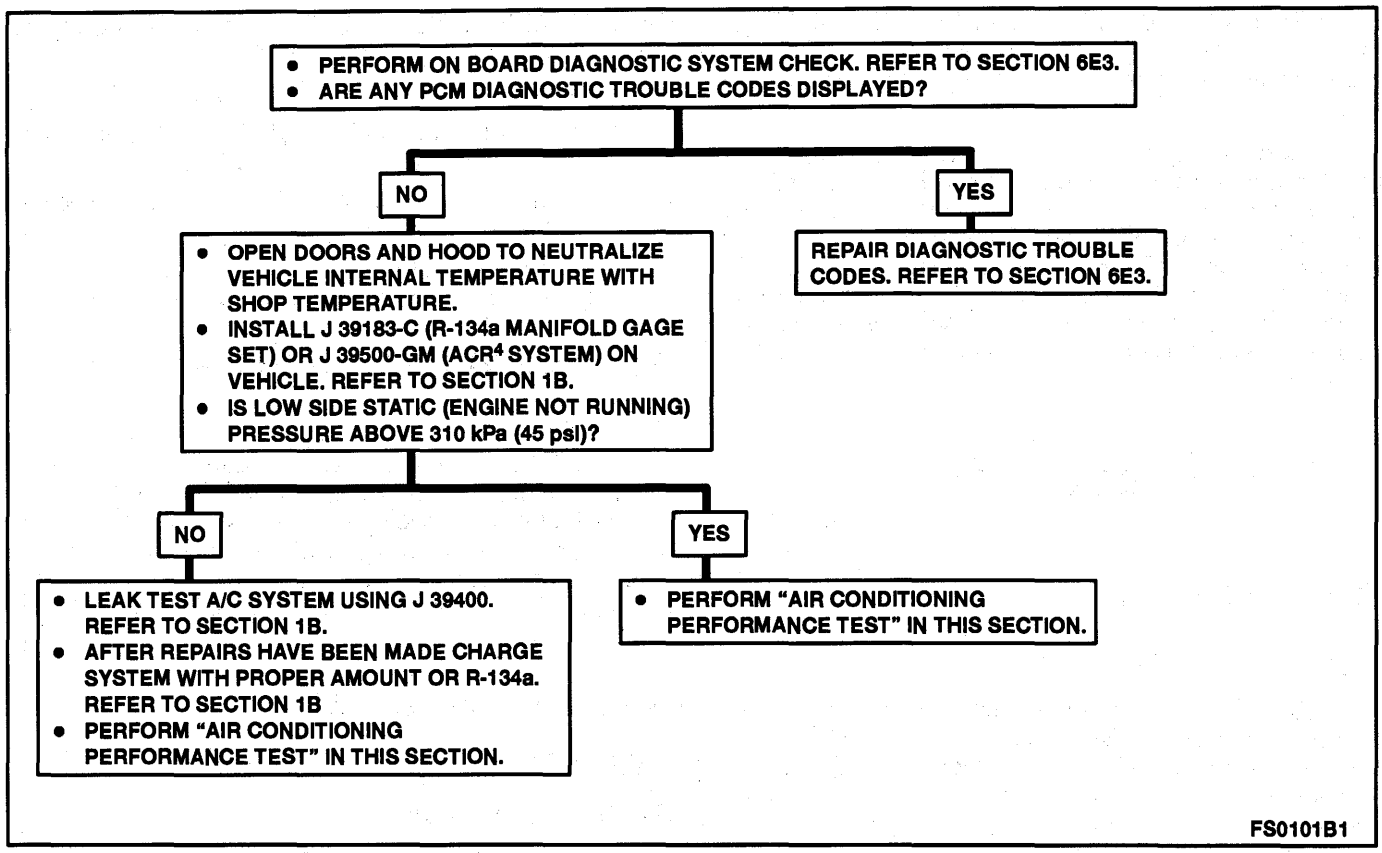


Figure 10 – Insufficient Cooling Check

When vacuum is applied to a vacuum actuator assembly (5), the air valve (door) moves to its correct position.

Preliminary Inspection

1. Inspect vacuum lines at engine assembly and vacuum check valve (38) for proper connection.
2. Disconnect vacuum line leading to engine assembly at vacuum check valve (38). Start engine assembly and check for presence of vacuum, if no vacuum is present, repair as required.
3. Disconnect vacuum line leading to vacuum tank (37) at vacuum check valve (38). Using hand vacuum pump, apply vacuum to vacuum line leading to vacuum tank (37). If vacuum does not hold, replace vacuum line and/or vacuum tank (37).
4. Disconnect vacuum line leading to control assembly (1) at vacuum check valve (38). Apply vacuum to check valve port. If vacuum does not hold, replace vacuum check valve (38).
5. Quickly rotate temperature control from "FULL COLD" to "FULL HOT" several times. Listen for temperature valve (6) to seat in both positions. If the sound indicates that the temperature valve (6) is not fully seating or opening, check the temperature control cable for proper operation. If problem persists, check that the temperature valve door operates freely with the blower off.
6. Make sure vacuum line seals are positioned correctly at vacuum line multi-connector above right-hand sound insulator panel assembly.
7. Perform diagnosis. Refer to Figure 12.

AIR CONDITIONING PERFORMANCE TEST

Figures 13, 14 and 15

Tools Required:

J 39500 ACR4 System or

J 39183-C R-134a Manifold Gauge Set

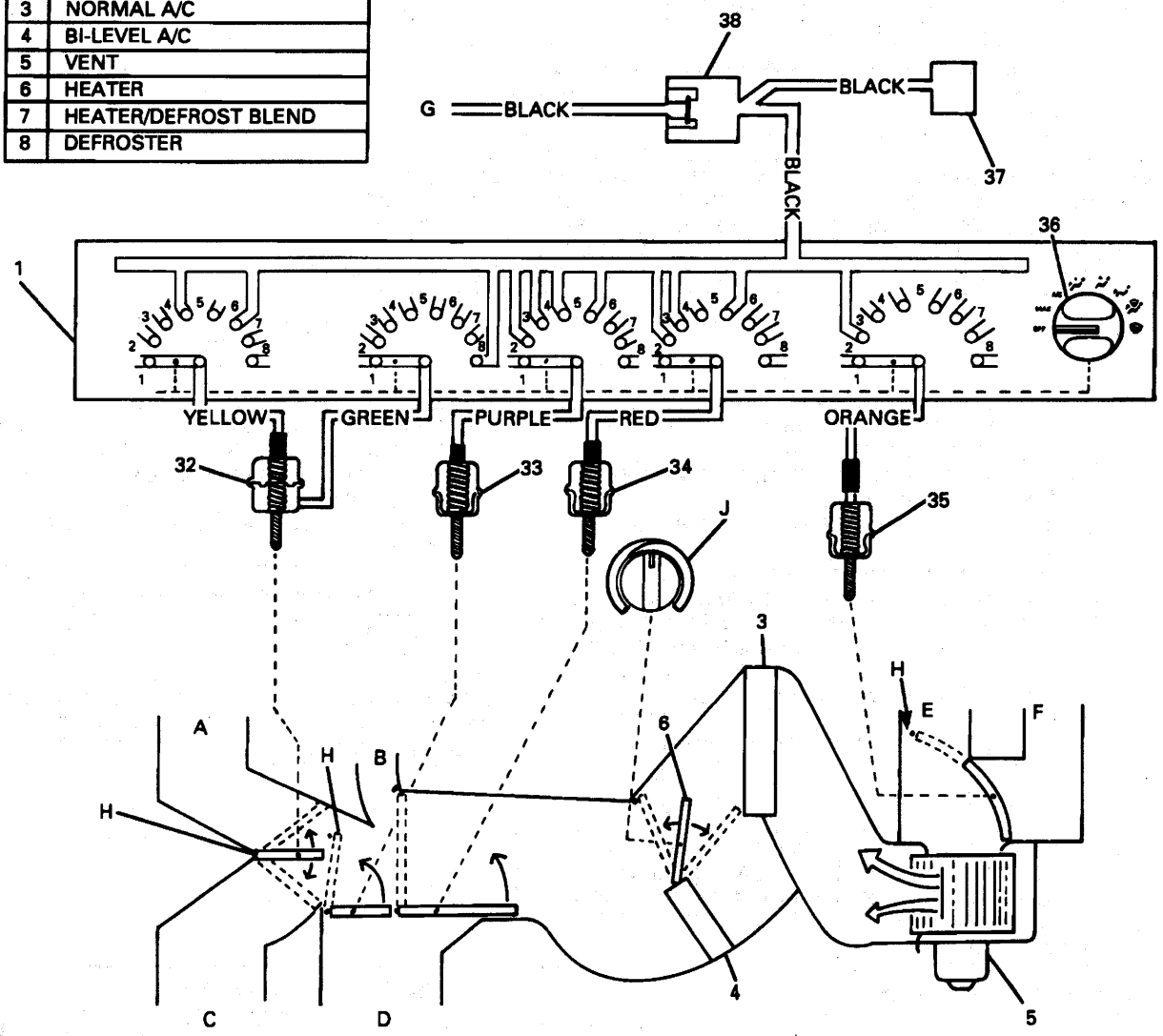
J 6742-03 Precision Thermometer (or Equivalent)

Before performing the air conditioning performance test, a functional test should be made to assure that the air distribution system valves are functioning properly to route all the air passing through the evaporator to the outlets. Refer to "Functional Test" in this section.

Performance testing provides a measure of air conditioning system operating efficiency by measuring and comparing pressures at the high-pressure and low-pressure sides of the refrigeration system, the temperature of the air being discharged into the passenger compartment, and the evaporator temperature.

Start with the air conditioning performance test in Figure 13, and compare vehicle air conditioning system performance with the chart in Figure 14. If system performance is not within specifications, proceed to the refrigeration system diagnostic chart in Figure 15 to pinpoint the problem.

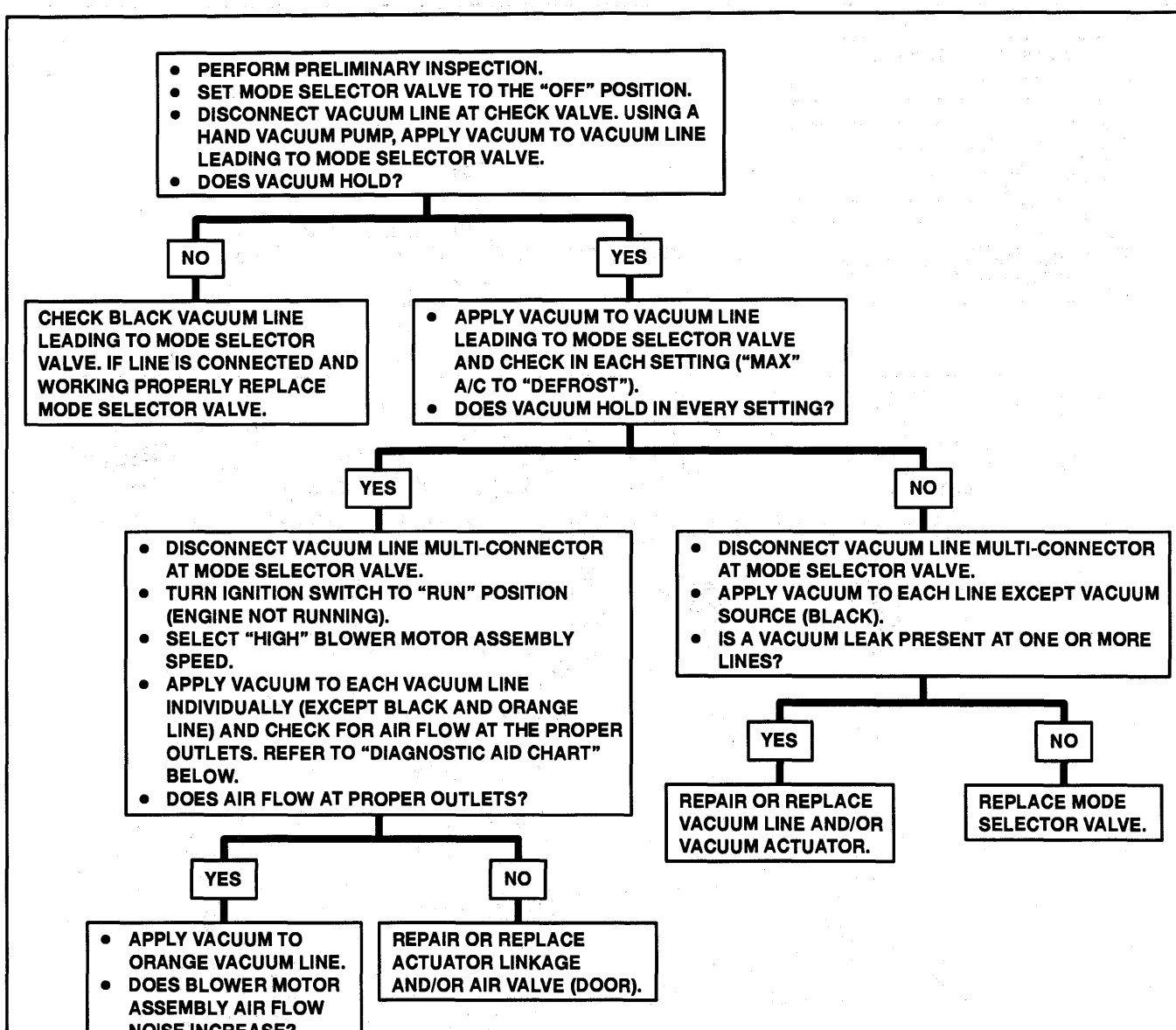
MODE CONTROL VACUUM VALVE POSITIONS	
1	OFF
2	MAX A/C
3	NORMAL A/C
4	BI-LEVEL A/C
5	VENT
6	HEATER
7	HEATER/DEFROST BLEND
8	DEFROSTER



A TO WINDSHIELD DEFROST OUTLETS
B TO SIDE WINDOW DEFROST OUTLETS
C TO FLOOR OUTLETS
D TO INSTRUMENT PANEL OUTLETS
E FROM PLENUM AREA (OUTSIDE AIR)
F FROM INSIDE VEHICLE (RECIRCULATED AIR)
G TO ENGINE ASSEMBLY (VACUUM SOURCE)
H PARTIALLY OPEN (WITH NO VACUUM)
J TEMPERATURE CONTROL
1 MODE, CONTROL VACUUM LOGIC DISPLAY
3 EVAPORATOR, AIR CONDITIONING
4 CORE ASSEMBLY, HEATER
5 MOTOR ASSEMBLY, BLOWER
6 VALVE, TEMPERATURE
32 ACTUATOR ASSEMBLY, HEATER AND DEFROST VACUUM
33 ACTUATOR ASSEMBLY, BI-LEVEL VACUUM
34 ACTUATOR ASSEMBLY, UPPER AND LOWER MODE VACUUM
35 ACTUATOR ASSEMBLY, AIR INLET VACUUM
36 VALVE, CONTROL ASSEMBLY VACUUM SELECTOR
37 TANK, VACUUM
38 VALVE, VACUUM CHECK

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Figure 11 – Improper Air Delivery Vacuum Schematic



DIAGNOSTIC AID CHART	
APPLY VACUUM TO:	AIR FLOW SHOULD BE DIVERTED TO:
RED VACUUM LINE	INSTRUMENT PANEL OUTLETS ONLY
YELLOW VACUUM LINE	SIDE WINDOW DEFOGGER AND FLOOR OUTLETS
PURPLE VACUUM LINE	SIDE WINDOW DEFOGGER, FLOOR AND INSTRUMENT PANEL OUTLETS
GREEN VACUUM LINE	WINDSHIELD AND SIDE WINDOW DEFOGGER OUTLETS
ORANGE VACUUM LINE	BLOWER MOTOR ASSEMBLY AIR NOISE INCREASE
NO VACUUM LINES (ALL INSTRUMENT LINES VENTED TO ATMOSPHERE)	ALL OUTLETS EXCEPT INSTRUMENT PANEL

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Figure 12 – Improper Air Delivery Diagnostic Chart

ON-VEHICLE SERVICE

BLOWER MOTOR ASSEMBLY RELAY

The blower motor assembly relay is located under the instrument panel. Refer to electrical diagnosis SECTION 8A.

AIR CONDITIONING COMPRESSOR RELAY

The air conditioning compressor relay is located in the underhood electrical center. Refer to electrical diagnosis SECTION 8A.

AIR CONDITIONING EVAPORATOR TEMPERATURE SENSOR ASSEMBLY

Figures 16 and 17

Remove or Disconnect

1. Heater core assembly. Refer to SECTION 1A.
2. Evaporator temperature sensor assembly electrical connector.
3. Evaporator temperature sensor assembly probe from evaporator.
   - Use needle-nose pliers to pull probe straight out.
4. Evaporator temperature sensor assembly (25) from heater and air conditioning evaporator module assembly (11).
   - Remove grommet with evaporator temperature sensor assembly (25).

Install or Connect

1. Evaporator temperature sensor assembly (25) to heater and air conditioning evaporator module assembly (11).
   - Seat grommet in heater and air conditioning module assembly (11).

Important

- Do not insert probe into existing hole. Use alternate location near the existing hole shown in the condensate screen and insert probe straight into evaporator. If probe is not inserted straight into evaporator, incorrect evaporator temperature reading may result, causing evaporator freeze-up.

2. Evaporator temperature sensor assembly probe straight into evaporator in new location near previous location.
3. Evaporator temperature sensor assembly electrical connector.
4. Heater core assembly. Refer to SECTION 1A.

AIR CONDITIONING REFRIGERANT PRESSURE SENSOR ASSEMBLY

Figure 18

Remove or Disconnect

1. Electrical connector at sensor assembly (26).
2. Sensor assembly (26) and seal (39).
   - Sensor assembly (26) is mounted on a Schrader® type valve so it is not necessary to discharge the refrigeration system.
   - Discard seal (39).

Install or Connect

1. New seal (39) to sensor assembly fitting.
   - Coat seal (39) with mineral base 525 viscosity refrigerant oil.
2. Sensor assembly (26).

Tighten

- Sensor assembly (26) to 6 N•m (53 lb. in.).

3. Electrical connector to sensor assembly (26).

AIR CONDITIONING EVAPORATOR

Figures 16, 17 and 19

Remove or Disconnect

1. Discharge refrigerant into a recovery station. Refer to SECTION 1B.
2. Right-hand instrument panel sound insulator panel assembly. Refer to SECTION 8C.
3. Heater hoses at heater core assembly. Refer to SECTION 1A.
4. Instrument panel compartment. Refer to SECTION 8C.
5. Heater core assembly. Refer to SECTION 1A.
6. Air conditioning evaporator temperature sensor assembly. Refer to "Air Conditioning Evaporator Temperature Sensor Assembly" in this section.
7. Temperature control cable assembly at temperature valve case assembly. Refer to SECTION 1A.
8. Bolts/screws (48) located in engine compartment from temperature valve case assembly (42).
9. Temperature valve case assembly (42).
   - Slide case assembly (42) downward to disengage upper case clip.
   - Remove from under the instrument panel assembly.
10. Thermostatic expansion valve assembly. Refer to SECTION 1B.

Important

- Remove perforated section of heater and air conditioning evaporator module assembly as one piece (it will be reused).

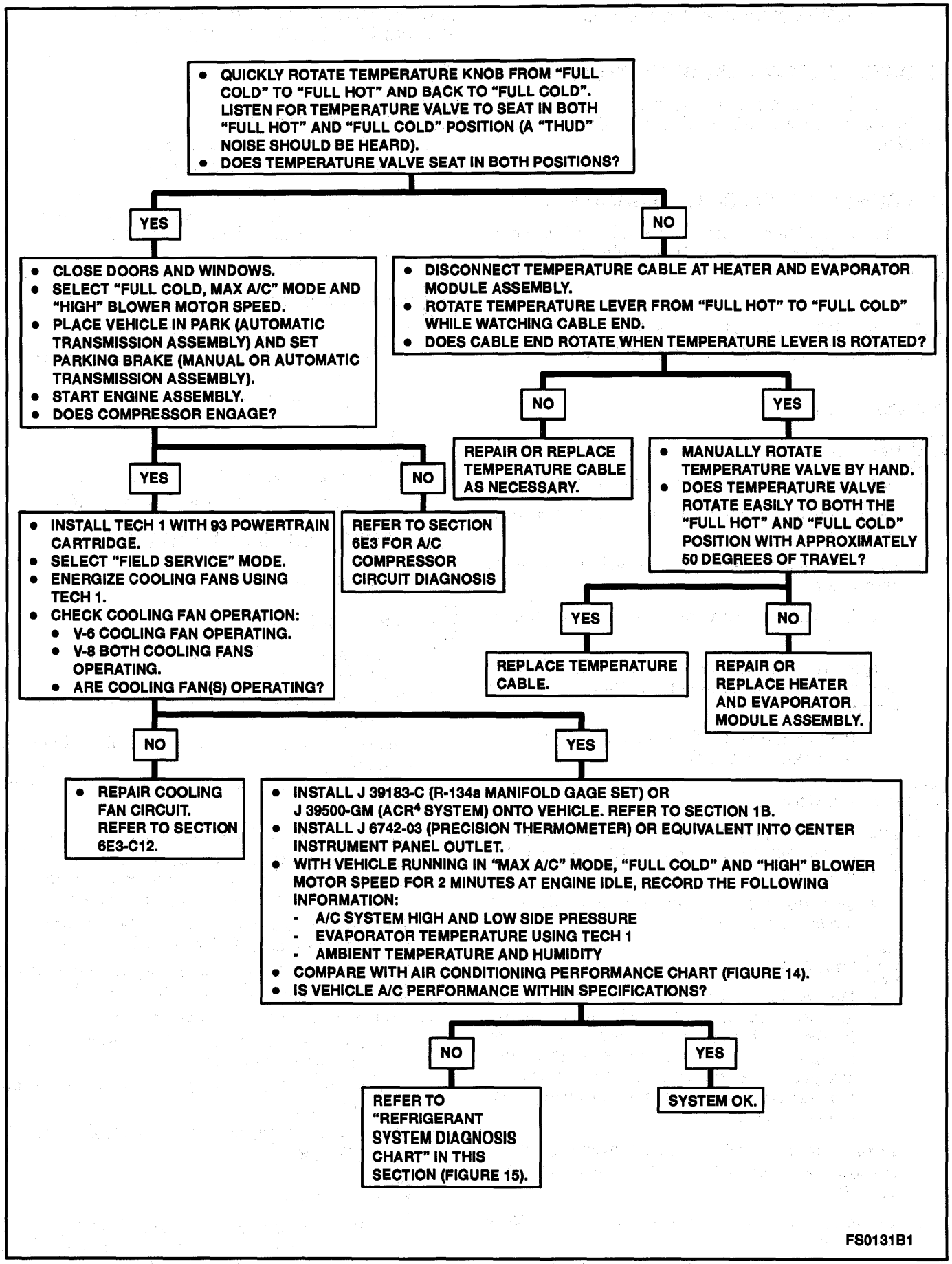


Figure 13 – Air Conditioning Performance Test

TEMPERATURE	HUMIDITY	GAGE PRESSURES LOW	GAGE PRESSURES HIGH	CENTER OUTLET TEMP	EVAP ASSEMBLY TEMP DISPLAYED ON TECH 1
21°-27°C	LESS THAN 50%	110-165 kPa (16-24 psi)	793-1310 kPa (115-190 psi)	3°-9°C (38°-48°F)	1°-6°C (33°-43°F)
(70°-80°F)	HIGHER THAN 50%	145-200 kPa (21-29 psi)	793-1379 kPa (115-200 psi)	4°-13°C (40°-55°F)	2°-10°C (35°-50°F)
27°-33°C	LESS THAN 50%	131-207 kPa (19-30 psi)	965-1482 kPa (140-215 psi)	3°-13°C (38°-55°F)	1°-10°C (33°-50°F)
(80°-90°F)	HIGHER THAN 50%	165-269 kPa (24-39 psi)	1034-1620 kPa (150-235 psi)	7°-18°C (45°-65°F)	4°-16°C (40°-60°F)
33°-38°C	LESS THAN 40%	172-290 kPa (25-42 psi)	1138-1793 kPa (165-260 psi)	7°-17°C (45°-63°F)	4°-14°C (40°-58°F)
(90°-100°F)	HIGHER THAN 40%	234-296 kPa (34-43 psi)	1276-1862 kPa (185-270 psi)	13°-20°C (55°-68°F)	10°-18°C (50°-65°F)
38°-44°C	LESS THAN 20%	255-296 kPa (37-43 psi)	1448-2000 kPa (210-290 psi)	12°-18°C (53°-64°F)	9°-16°C (48°-61°F)
(100°-110°F)	HIGHER THAN 20%	262-352 kPa (38-51 psi)	1517-2137 kPa (220-310 psi)	14°-21°C (58°-70°F)	13°-18°C (55°-65°F)
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Figure 14 – Air Conditioning Performance Chart

- Water can leak onto carpeting when doing this procedure. It is recommended that a mat be placed on passenger side floor.

11. Using a small hand saw, remove perforated section of heater and air conditioning evaporator module assembly (Figure 16).

Important

- This piece of material is required to keep condensate from draining inside vehicle.

12. Bolts/screws (41) retaining air conditioning evaporator (3).
13. Air conditioning evaporator (3) from heater and air conditioning module assembly (11).
    - Slide evaporator (3) to the left, then pull out through the opening enlarged in step 11.

Install or Connect

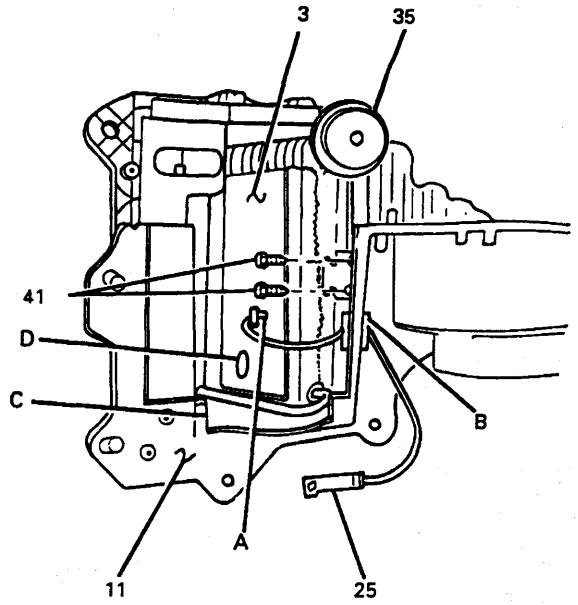
1. Transfer condensate screen to new evaporator (3).
2. Install new evaporator core gasket in same position as original with appropriate adhesive.
3. Air conditioning evaporator (3) to heater and air conditioning module assembly (11).
    - Insert evaporator (3) into module assembly (11) through the opening enlarged during removal, slide to the right until fully seated.
4. Bolts/screws (41) to air conditioning evaporator (3).
5. Thermostatic expansion valve assembly. Refer to SECTION 1B.
6. Apply sealer GM P/N 3012078 (do not use epoxy glue) between evaporator (3) and evaporator upper and lower case (44 and 45) just behind thermostatic expansion valve assembly to prevent air entry from the engine compartment into the passenger compartment.
7. Position perforated section of heater and air conditioning evaporator module assembly and use epoxy glue to adhere it to module assembly. After epoxy dries, use thumb to grade sealant on inside and outside to ensure water-tight seal.
8. Temperature valve case assembly (42).
    - Install from under instrument panel assembly.
    - Slide case assembly (42) upward into position until upper clip engages.
    - Engage snap on left edge of temperature valve case (42) to distributor case assembly (46).
9. Bolts/screws (48) to temperature valve case assembly (42).
    - Tighten bolts/screws (48) evenly to compress flange seal.
10. Temperature control cable assembly at temperature valve case assembly. Refer to SECTION 1A.
11. Air conditioning evaporator temperature sensor assembly. Refer to "Air Conditioning Evaporator Temperature Sensor Assembly" in this section.
12. Heater core assembly. Refer to SECTION 1A.
13. Instrument panel compartment. Refer to SECTION 8C.

PERFORM AIR CONDITIONING PERFORMANCE TEST BEFORE REFRIGERATION SYSTEM DIAGNOSIS

CONDITIONS				POSSIBLE FAULT	CORRECTIVE ACTION
CENTER OUTLET TEMP	LOS SIDE PRESSURE	HIGH SIDE PRESSURE	TECH 1 EVAPORATOR TEMPERATURE		
OK OR HIGH	OK OR HIGH	OK OR LOW	HIGHER	LOW REFRIGERANT CHARGE	RECOVER, MEASURE AND RECHARGE A/C SYSTEM. REFER TO SECTION 1B.
				RECEIVER AND DEHYDRATOR ASSEMBLY PLUGGED	CHECK FOR PRESSURE DIFFERENCE GREATER THAN 138 kPa (20 PSI) BETWEEN TECH 1 AND HIGH GAUGE, REPLACE RECEIVER AND DEHYDRATOR ASSEMBLY.
				DEBRIS PLUGGING THERMOSTATIC EXPANSION VALVE	CLEAN THERMOSTATIC EXPANSION VALVE.
				INOPERATIVE THERMOSTATIC EXPANSION VALVE	TEST THERMOSTATIC EXPANSION VALVE. SET A/C BLOWER ON LOW AND REV ENGINE TO 1,500 RPM. IF LOW GAGE GOES OR REMAINS ABOVE 193 kPa (28 PSI), THERMOSTATIC EXPANSION VALVE IS STUCK OPEN; REPLACE IT. IF LOW GAGE GOES BELOW 138 kPa (20 PSI) SYSTEM OK.
				EVAPORATOR TEMPERATURE SENSOR OUT OF POSITION	REINSTALL EVAPORATOR TEMPERATURE SENSOR. REFER TO "AIR CONDITIONING EVAPORATOR TEMPERATURE SENSOR ASSEMBLY" IN THIS SECTION.
HIGHER	HIGHER	LOW	HIGH	A/C COMPRESSOR FAULT	PERFORM COMPRESSOR TEST
				INOPERATIVE THERMOSTATIC EXPANSION VALVE	TEST THERMOSTATIC EXPANSION VALVE. SET A/C BLOWER ON LOW AND REV ENGINE TO 1,500 RPM. IF LOW GAGE GOES OR REMAINS ABOVE 193 kPa (28 PSI), THERMOSTATIC EXPANSION VALVE IS STUCK OPEN; REPLACE IT. IF LOW GAGE GOES BELOW 138 kPa (20 PSI) SYSTEM OK.
HIGHER	HIGHER	HIGHER	HIGHER	CONDENSOR AIR RESTRICTION	CLEAN, REMOVE RESTRICTION.
				CONDENSOR AIR RECIRCULATION	INSTALL OR REPOSITION AIR CONTROL BAFFLES.
				HIGH REFRIGERANT CHARGE	RECOVER, MEASURE AND RECHARGE A/C SYSTEM. REFER TO SECTION 1B.
				TOO MUCH REFRIGERANT OIL	FLUSH A/C SYSTEM. REFER TO SECTION 1B.
OK	OK	HIGH	OK	FAN PROBLEMS	CHECK FLOW DIRECTION, RELAY, ETC.
OK	OK OR LOW	OK	LOW	CIRCUIT FAULT	PERFORM A/C ELECTRICAL CIRCUIT TEST.

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Figure 15 – Refrigeration System Diagnostic Chart

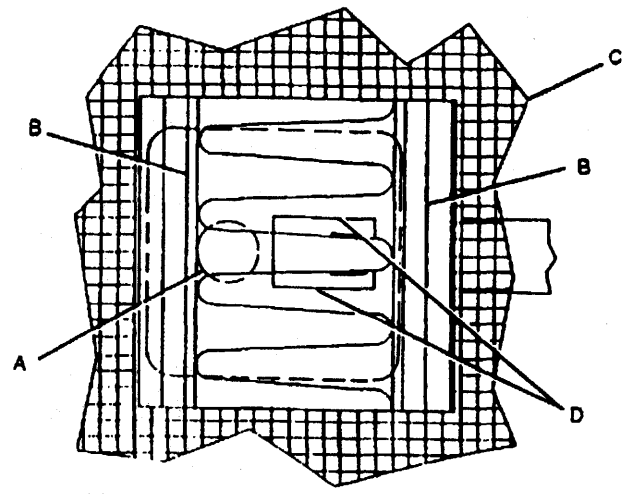


A PROBE
B GROMMET
C PERFORATION FOR AIR CONDITIONING EVAPORATOR REMOVAL
D SERVICE PROBE LOCATION
3 EVAPORATOR, AIR CONDITIONING
11 MODULE ASSEMBLY, HEATER AND AIR CONDITIONING EVAPORATOR
25 SENSOR ASSEMBLY, AIR CONDITIONING EVAPORATOR TEMPERATURE
35 ACTUATOR ASSEMBLY, AIR INLET VACUUM
41 BOLT/SCREW, AIR CONDITIONING EVAPORATOR

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Figure 16 – Air Conditioning Evaporator Temperature Sensor Assembly

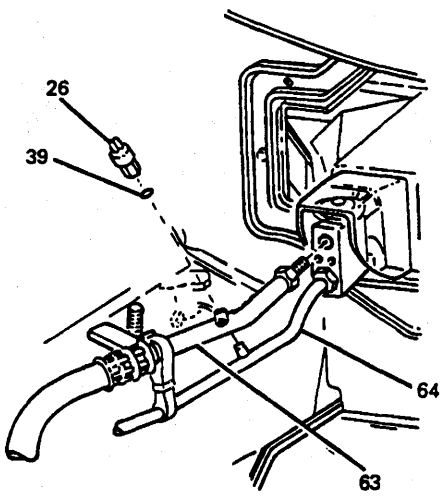
14. Heater hoses to heater core assembly. Refer to SECTION 1A.
15. Right-hand instrument panel sound insulator panel assembly. Refer to SECTION 8C.
16. Fill radiator and bleed cooling system. Refer to SECTION 6B.
17. Refrigerant oil into evaporator (3), if necessary.
    - If installing new evaporator (3), add 89 ml (3 fluid ounces) of polyalkylene glycol (PAG) synthetic refrigerant oil, GM P/N 12345923.



A SERVICE PROBE LOCATION
B AIR CONDITIONING EVAPORATOR TUBE PLATE
C CONDENSATE SCREEN
D BARBS

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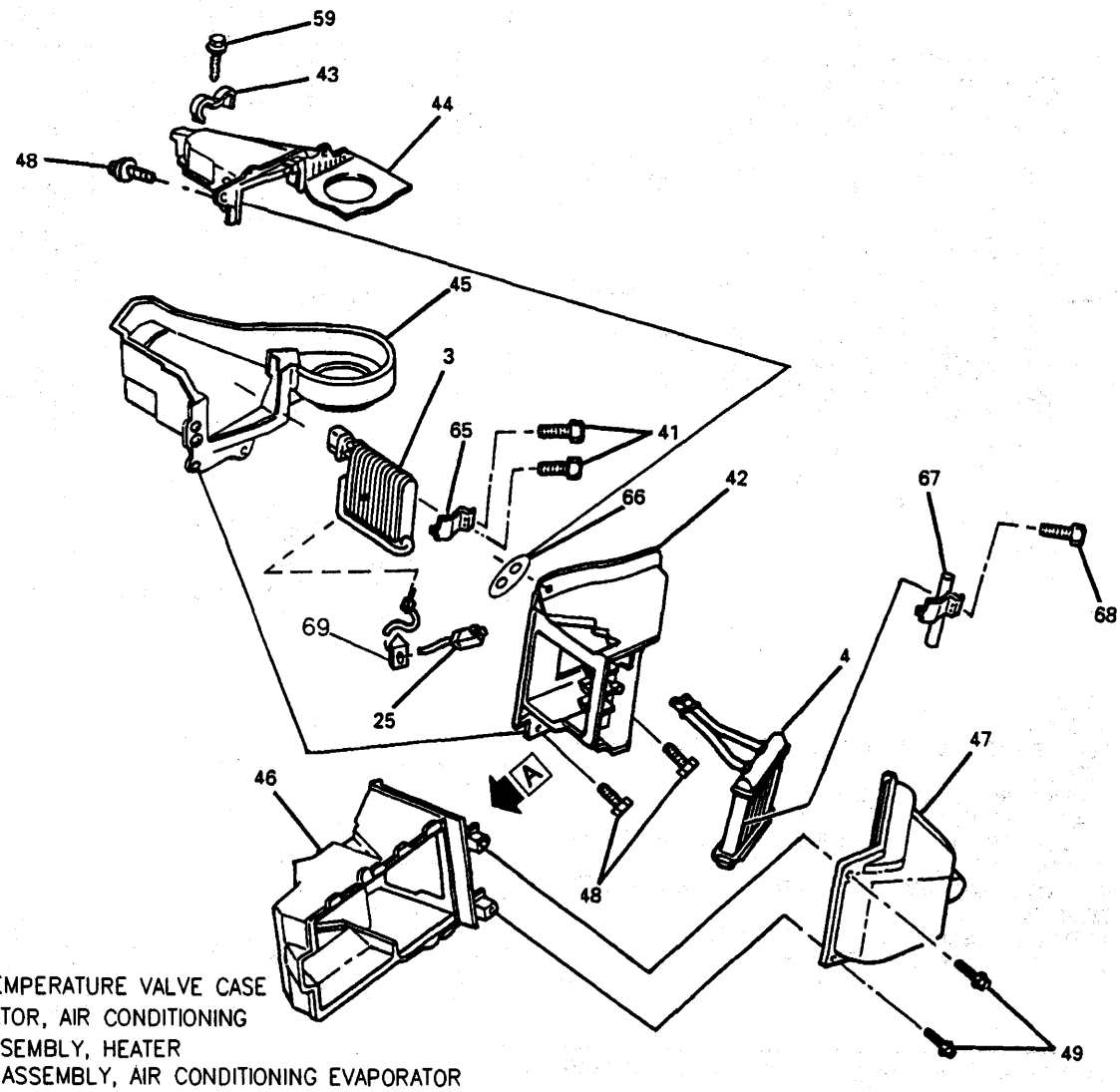
Figure 17 – Air Conditioning Evaporator Temperature Sensor Assembly Installation



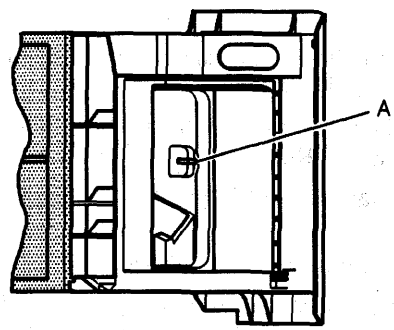
26 SENSOR ASSEMBLY, AIR CONDITIONING REFRIGERANT PRESSURE
39 SEAL, AIR CONDITIONING REFRIGERANT PRESSURE SENSOR
63 HOSE ASSEMBLY, AIR CONDITIONING COMPRESSOR AND CONDENSER
64 TUBE, AIR CONDITIONING EVAPORATOR

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Figure 18 – Air Conditioning Refrigerant Sensor



A SNAP, TEMPERATURE VALVE CASE
3 EVAPORATOR, AIR CONDITIONING
4 CORE ASSEMBLY, HEATER
25 SENSOR ASSEMBLY, AIR CONDITIONING EVAPORATOR TEMPERATURE
41 BOLT/SCREW, AIR CONDITIONING EVAPORATOR
42 CASE ASSEMBLY, TEMPERATURE VALVE
43 CLAMP, HEATER CORE TUBE
44 CASE, AIR CONDITIONING EVAPORATOR UPPER
45 CASE, AIR CONDITIONING EVAPORATOR LOWER
46 CASE, AIR DISTRIBUTOR UPPER
47 COVER, HEATER AND AIR CONDITIONING EVAPORATOR CASE
48 BOLT/SCREW, TEMPERATURE VALVE CASE ASSEMBLY
49 BOLT/SCREW, HEATER AND AIR CONDITIONING EVAPORATOR CASE OVER
59 BOLT/SCREW, HEATER CORE TUBE CLAMP
65 CLAMP, AIR CONDITIONING EVAPORATOR
66 SEAL, HEATER PIPE
67 BRACKET, HEATER CORE ASSEMBLY
68 BOLT/SCREW, HEATER CORE ASSEMBLY
69 GROMMET, TEMPERATURE SENSOR ASSEMBLY



VIEW A

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Figure 19 – Air Conditioning Evaporator and Components

SPECIFICATIONS

GENERAL SPECIFICATIONS

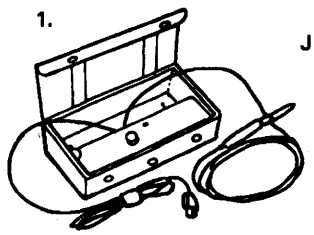
A/C System O-ring and Fitting Lubricant	Mineral Base 525 Viscosity Refrigerant Oil, GM P/N 12301108 or equivalent
A/C System Internal Lubricant (Including Compressor)	Polyalkylene Glycol (PAG) Synthetic Refrigerant Oil, GM P/N 12345923 or equivalent
A/C System R-134a Capacity	0.91 kg (2.0 lbs.)

COMPONENT TIGHTENING SPECIFICATIONS

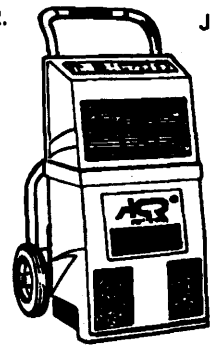
Air Conditioning Refrigerant Pressure Sensor Assembly	6 N•m (53 lb. in.)

SPECIAL TOOLS

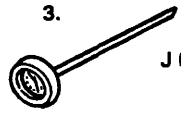
1. J 39400



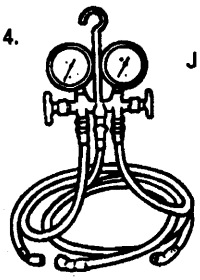
2. J 39500



3. J 6742-03



4. J 39183-C



1. R-12 AND R-134a HALOGEN LEAK DETECTOR
2. AIR CONDITIONING REFRIGERANT RECOVERY, RECYCLING AND RECHARGING SYSTEM (ACR⁴)
3. PRECISION THERMOMETER
4. R-134a MANIFOLD GAUGE SET

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BLANK

SECTION 1D2

HD6/HR6-HE AIR CONDITIONING COMPRESSOR SERVICE OR UNIT REPAIR R-134a

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under ON-VEHICLE SERVICE and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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General Description 1D2–1
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Compressor Clutch Coil 1D2–7
Major Compressor Repair Procedures 1D2–8
Compressor Shaft Seal Replacement 1D2–8
Seal Leak Detection 1D2–8
Compressor Pressure Relief Valve 1D2–10
Control Switches 1D2–11
Compressor Leak Testing 1D2–11
Bench-Check Procedures 1D2–11
Special Tools 1D2–12

GENERAL DESCRIPTION

The HD6/HR6–HE Automotive Conditioning Compressor and Clutch Assembly is a lightweight, six cylinder axial design consisting of three double ended pistons and weighs 5.8 kg (12.7 lbs.)

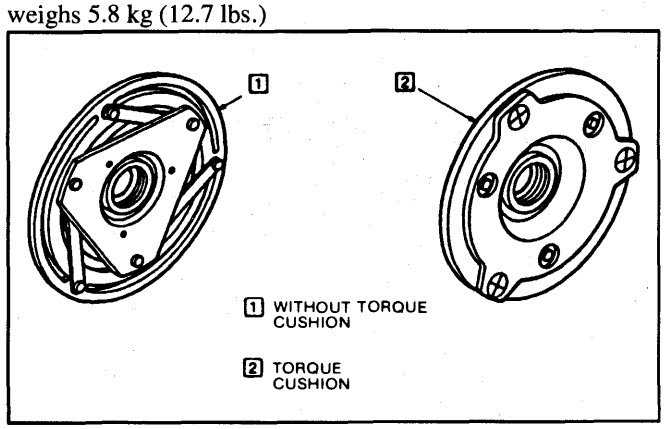


Fig. 1 Clutch Driver Designs

Although this compressor is the same for all vehicle applications, there are differences in installations, mounting brackets, pulleys, torque cushions and switches, none of which will affect the following overhaul procedures.

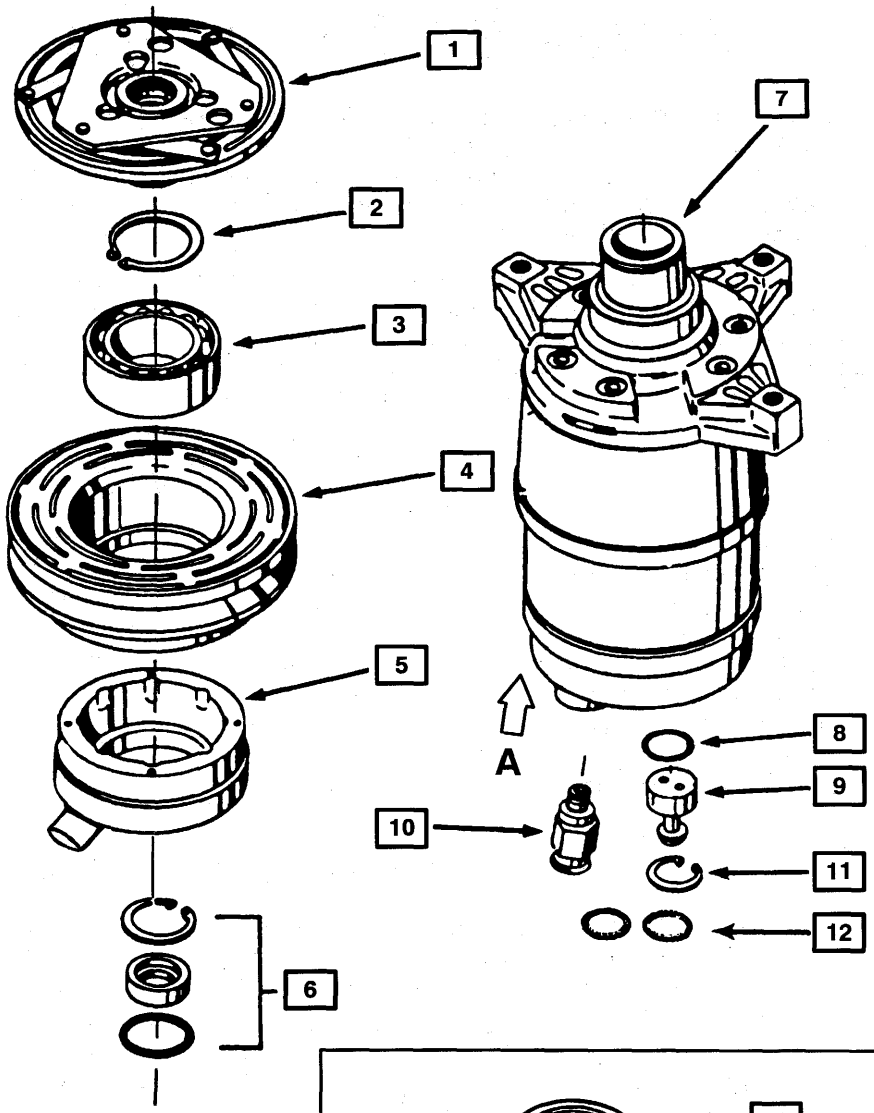
There are two clutch driver designs for these compressors. The clutch driver without a torque cushion and the clutch driver having a thin torque cushion (Fig. 1).

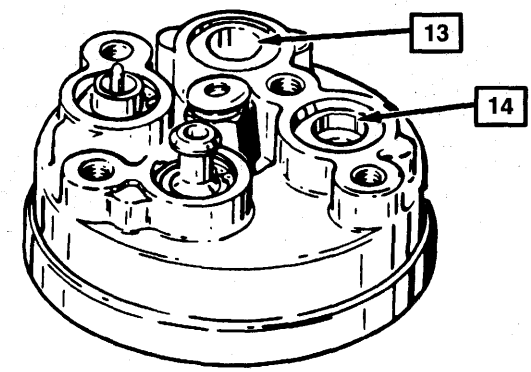
Service compressors are supplied with either the control switches assembled in the rear head or a plug may be found where a control switch is required. If the service compressor requires control switches, the plug may be removed from the appropriate rear head switch cavity of the replaced compressor and assembled as prescribed in this manual.

When servicing the compressor, keep dirt or foreign material from getting on or into the compressor parts and system. Clean tools and a clean work area are important for proper service. The compressor connections and the outside of the compressor should be cleaned before any "on vehicle" repairs, or before removal of the compressor. The parts must be kept clean at all times and any parts to be reassembled should be cleaned with trichloroethane, naphtha, stoddard solvent, kerosene or equivalent and dried with dry air. When necessary to use a cloth on any part, it should be of a non-lint producing type.

The operations described below are based on bench overhaul with the compressor removed from the vehicle, except as noted. They have been prepared in order of accessibility of the components. When a compressor is removed from the vehicle for servicing, the amount of PAG lubricant remaining in the compressor should be drained,

1 — CLUTCH DRIVER
2 — ROTOR BEARING RETAINER
3 — PULLEY BEARING
4 — PULLEY
5 — CLUTCH COIL ASSEMBLY
6 — SHAFT SEAL PARTS
7 — PUMP ASSEMBLY
8 — SWITCH O-RING
9 — SYSTEM CONTROL SWITCH
10 — HIGH PRESSURE RELIEF VALVE
11 — RETAINER RING SWITCH
12 — SUCTION/DISCHARGE PORT SEALING WASHERS
13 — SPECIAL 134a SUCTION PORT
14 — SPECIAL 134a DISCHARGE PORT





Compressor — Rear Head
As Viewed in Direction of Arrow "A"

Fig. 2 Compressor Components — Disassembly

measured and recorded. This PAG lubricant should then be discarded and an equal amount of new PAG lubricant added to the compressor.

The service compressor is shipped with 240 ml (8 oz.) of PAG lubricant. This lubricant should be drained and retained for use as replacement lubricant when service procedures require addition of new lubricant to compressor. NOTE: Replace only with GM approved PAG oil P/N 12345923.

Most minor repair procedures may be done on the vehicle without discharging the system. Major repair procedures require that the system be discharged of refrigerant.

METRIC THREAD SIZE INFORMATION

1. Compressor to mounting bracket bolts.
   Front M10 x 1.5 – 6H
   Rear M8 x 1.25 – 6H
2. Suction-discharge port screw.
   M10 x 1.5 – 6H
3. Compressor shaft.
   M9 x 1.25 – 6H
4. Internal hub-clutch drive assembly.
   M22 x 1.5 – 6H

UNIT REPAIR

MINOR COMPRESSOR REPAIR PROCEDURES

THE FOLLOWING OPERATIONS TO THE COMPRESSOR CLUTCH PLATE AND HUB, ROTOR AND BEARING, AND COIL ARE COVERED AS "MINOR" BECAUSE THEY MAY BE PERFORMED WITHOUT FIRST RECOVERING REFRIGERANT FROM THE SYSTEM OR REMOVING THE COMPRESSOR FROM THE VEHICLE.

The Compressor Shaft Seal assembly, control switches, and Pressure Relief Valve may also be serviced WITHOUT REMOVING THE compressor from the vehicle but these operations are covered later in this section as MAJOR REPAIR PROCEDURES because the system must be reclaimed, evacuated and recharged to complete service.

Illustrations used in describing these operations show the compressor removed from the vehicle only to more clearly illustrate the various operations.

When servicing the compressor, remove only the parts that preliminary diagnosis shows are in need of service. Refer to Figures 2 and 5 for information relative to part names and location.

Removal and installation of external compressor parts, and disassembly and assembly of internal parts, must be performed on a clean workbench. The work area, tools and parts must be kept clean at all times.

COMPRESSOR CLUTCH PLATE AND HUB ASSEMBLY

Remove or Disconnect

1. Clamp the holding fixture J 33026 in a vise and attach compressor to holding fixture with thumb screws J 33026–1 (Fig. 3).
2. With center screw forcing tip in place to thrust against the end of the shaft, thread the Clutch Plate and Hub Assembly Installer-Remover J 33013–B into the hub. Hold the body of the remover with a wrench and turn the center screw into the remover body to remove the clutch plate and hub assembly (Fig. 3).

   NOTICE: Do not drive or pound on the clutch hub or shaft. Internal damage to compressor may result. The forcing tip on J 33013–B remover-installer center screw must be flat or the end of the shaft/axial plate assembly will be damaged.
3. Remove the shaft key and retain for reassembly.

Install or Connect

1. Install the shaft key into the hub key groove (Fig. 4). Allow the key to project approximately 3.2mm (1/8") out of the keyway. The shaft key is curved slightly to provide an interference fit in the hub key groove.
2. Be sure the frictional surface of the clutch plate and the clutch rotor are clean before installing the clutch plate and hub assembly.
3. Align the shaft key with the shaft keyway and place the clutch plate and the hub assembly onto the compressor shaft.

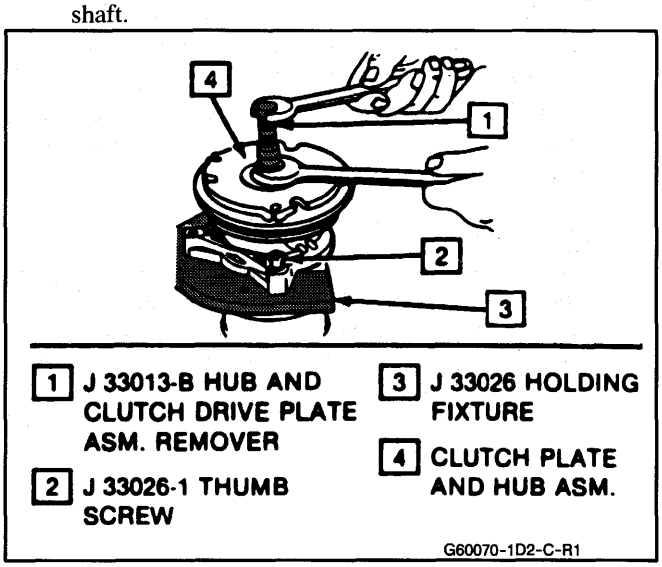


Fig. 3 Clutch Plate and Hub Assembly Removal

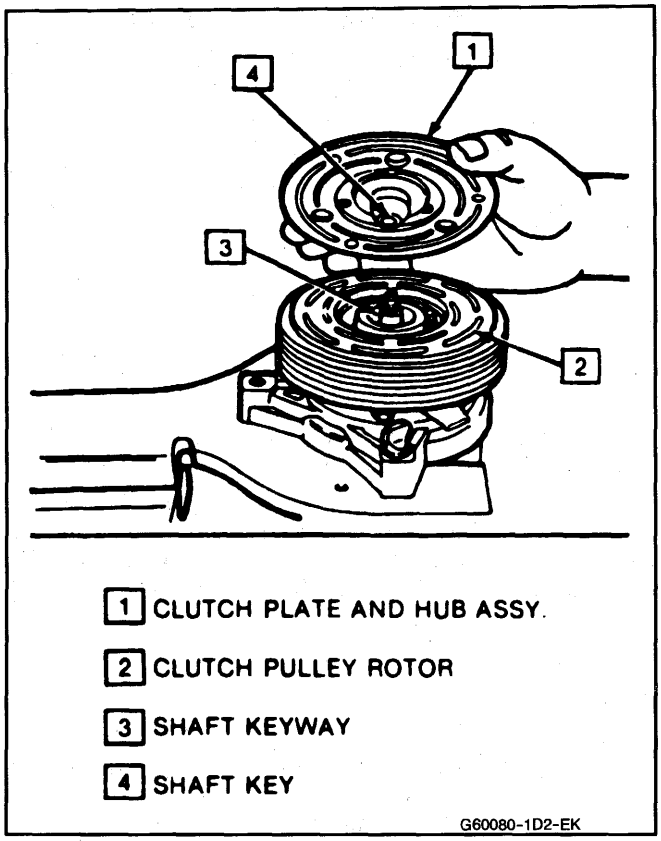


Fig. 4 Shaft Key, Clutch Plate/Hub Installation

4. Remove the forcing tip on J 33013–B clutch plate and hub assembly installer–remover center screw and reverse the body direction on the center screw, as shown in Figure 5.
5. Install the clutch plate and hub installer–remover J 33013–B with bearing as shown in Figure 8.

   The body of the J 33013–B installer–remover should be backed off sufficiently to allow the center screw to be threaded onto the end of the compressor shaft.
6. Hold the center screw with a wrench. Tighten the hex portion of the installer–remover J 33013–B body to press the hub onto the shaft. Tighten the body several turns, remove the installer and **check to see that the shaft key is still in place in the keyway before installing the clutch plate and hub assembly to its final position**. The air gap between frictional surfaces of the clutch plate and clutch rotor should be 0.50–0.76mm (.020–.030″).

NOTICE: If the center screw is threaded **fully** onto the end of the compressor shaft. or if the body of the installer is held and the center screw is rotated, the key will wedge and will break the clutch hub.

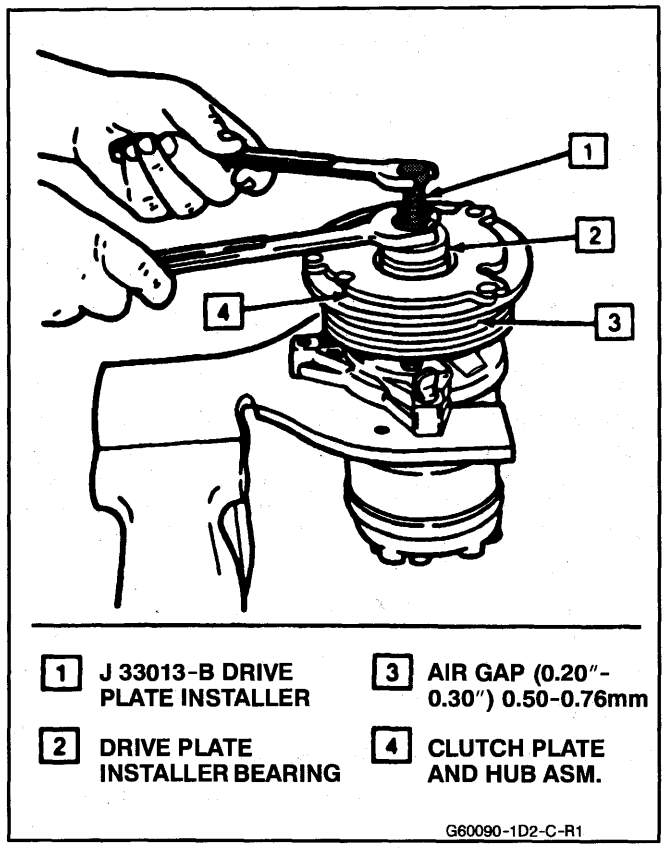


Fig. 5 Installing Clutch Plate & Hub Assembly

7. Remove installer J 33013–B, check for proper positioning of the shaft key (even or slightly above the clutch hub).
8. Spin the pulley rotor by hand to see that the rotor is not rubbing the clutch drive plate.

COMPRESSOR CLUTCH ROTOR AND/OR BEARING

Remove or Disconnect

1. Remove the clutch plate and hub assembly as described previously.
2. Remove rotor and bearing assembly retaining ring, using snap ring pliers J 6083 (Fig. 6).

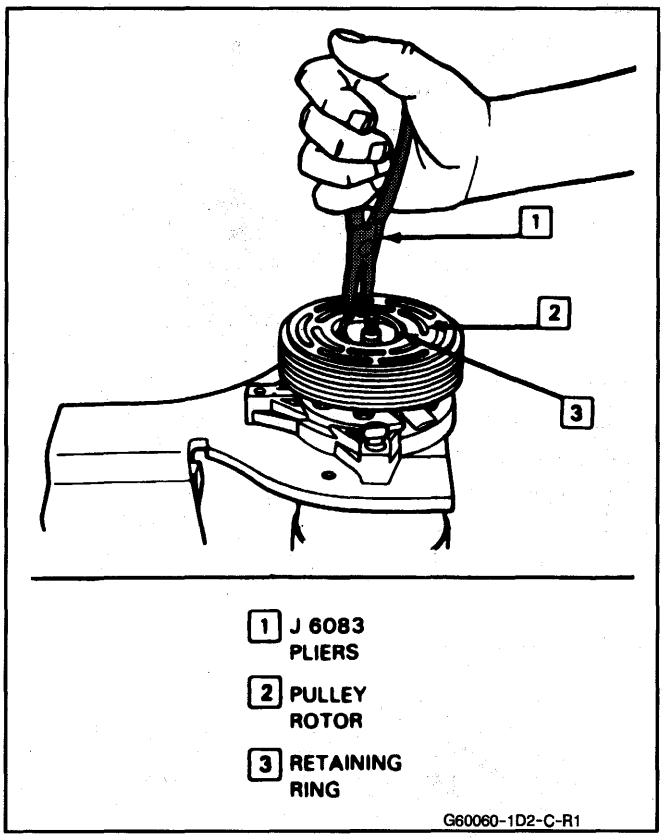


Fig. 6 Installing-Removing Pulley Rotor & Bearing Assembly Retaining Ring

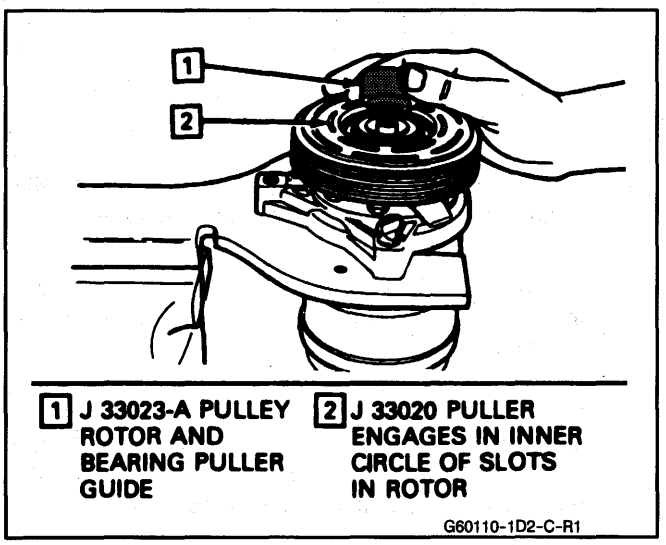


Fig. 7 Installing Pulley Rotor/Bearing Puller Guide

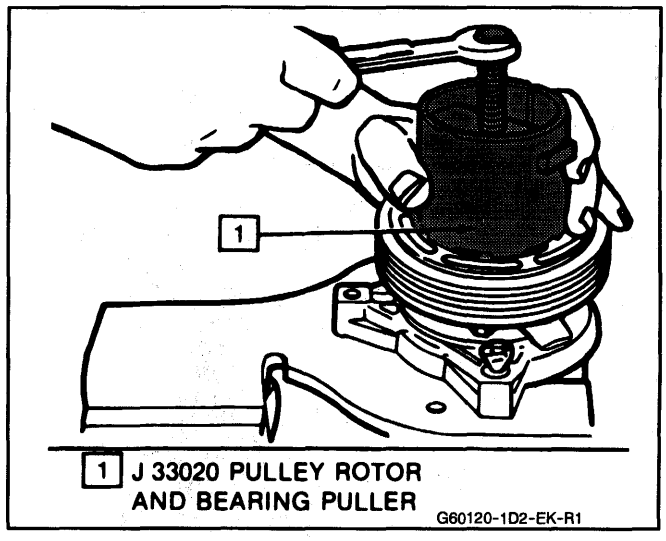


Fig. 8 Removing Pulley Rotor and Bearing Assembly

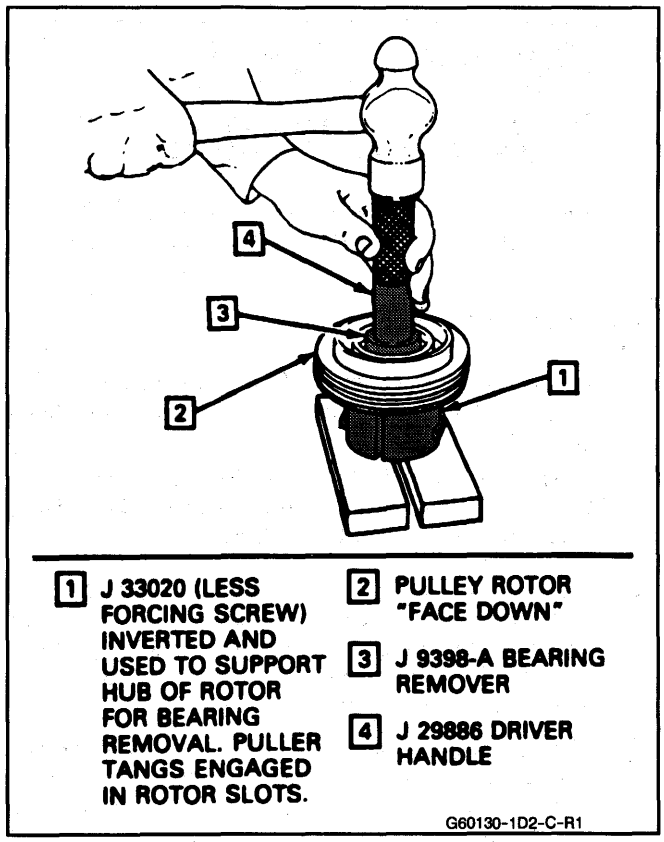


Fig. 9 Pulley Rotor Bearing Removal

3. Install pulley rotor and bearing puller guide J 33023–A to the front head (Fig. 7) and install J 33020 pulley rotor and bearing puller down into the inner circle of slots in the rotor. Turn the J 33020 puller clockwise in the slots in the rotor (Fig. 8).
4. Hold the J 33020 puller in place and tighten the puller screw against the puller guide to remove the pulley rotor and bearing assembly.
5. To prevent damage to the pulley rotor during bearing removal the rotor hub must be properly supported. Remove the forcing screw from J 33020 puller and, with the puller tangs still engaged in the rotor slots, invert the assembly onto a solid flat surface or blocks as shown in Figure 9.
6. Drive the bearing out of the rotor hub with rotor bearing remover J 9398–A and J 29886 universal handle (Fig. 9).

NOTICE: It is not necessary to remove the staking in front of the bearing to remove the bearing, however, it will be necessary to file away the old stake metal for proper clearance for the new bearing to be installed into the rotor bore or the bearing may be damaged.

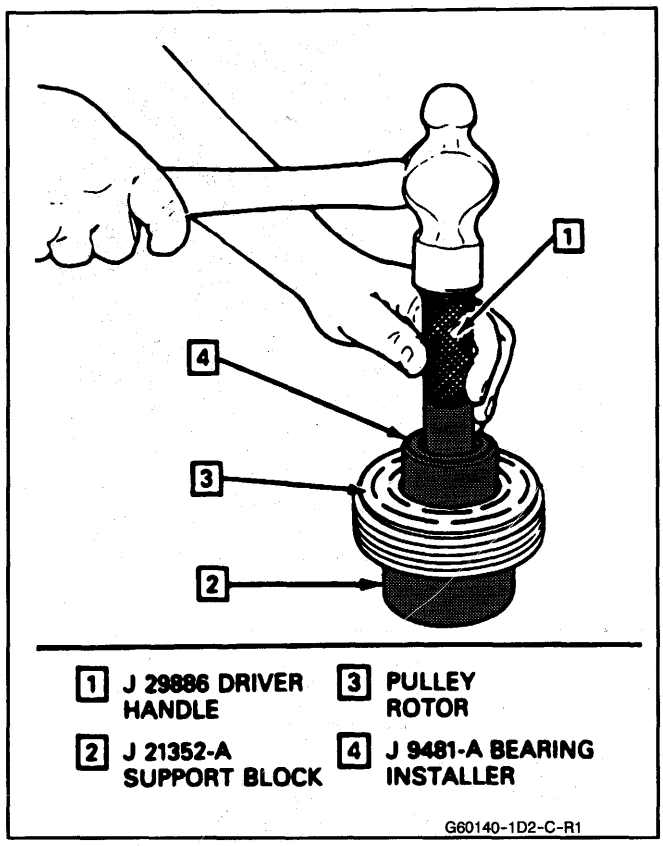


Fig. 10 Installing Pulley Rotor Bearing

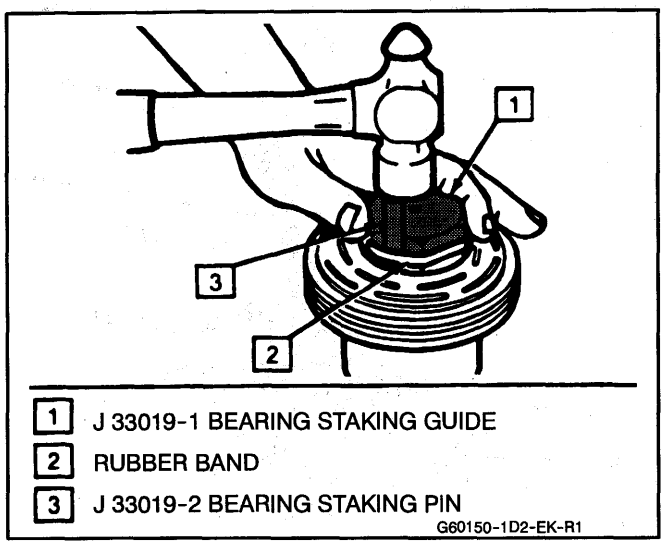


Fig. 11 Staking Bearing In Rotor Hub Bore

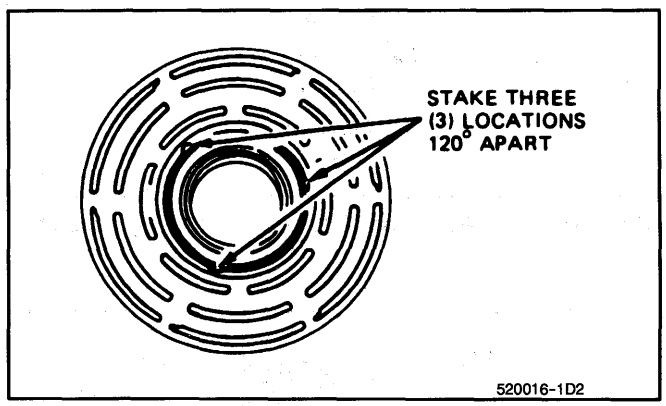


Fig. 12 Bearing Staked in Place

Install or Connect

1. Place the pulley rotor on the J 21352–A support block to fully support the rotor hub during bearing installation (Fig. 10).

   NOTICE: DO NOT support the rotor by resting the pulley rim on a flat surface during the bearing installation or the rotor face will be bent.

2. Align the new bearing squarely with the hub bore and using puller and bearing installer J 9481–A with universal handle J 29886, drive the bearing fully into the hub (Fig. 10). The installer will apply force to the outer race of the bearing, if used as shown.

3. Place bearing staking guide J 33019–1 and bearing staking pin J 33019–2 in the hub bore as shown in Figure 11. Shift the rotor and bearing assembly on the J 21352–A support block to give full support of the hub under the staking pin location. A heavy–duty rubber band may be used to hold the stake pin in the guide (Fig. 11), and the stake pin should be properly positioned in the guide after each impact on the pin.

4. Using care to prevent personal injury, strike the staking pin with a hammer until a metal stake, similar to the original, is formed **down to** but **not touching** the **bearing**.

   Noisy bearing operation and reduced bearing life may result if outer bearing race is deformed while staking, The stake metal should not contact the outer race of the bearing. Stake three places 120 degrees apart as shown in Figure 12.

5. With the compressor mounted to the J 33026 holding fixture, position the rotor and bearing assembly on the front head (Fig. 13).

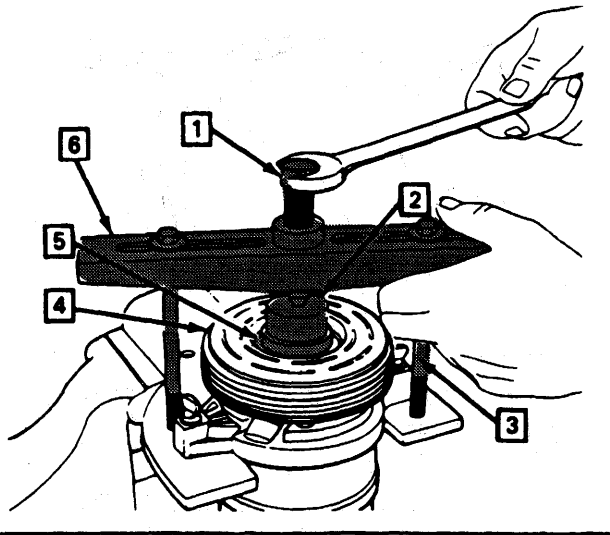
6. Position the J 33017 pulley, rotor and bearing installer and J 33023–A puller pilot directly over the inner race of the bearing (Fig. 13).

7. Position puller crossbar J 8433–1 on the puller pilot J 33023–A and assemble the two J 33026–2 through bolts and washers through the puller bar slots and thread them into the J 33026 holding fixture (Fig. 13). The thread of the through bolts should engage the full thickness of the holding fixture.

8. Tighten the center screw in the J 8433–1 puller crossbar to force the pulley rotor and bearing assembly onto the compressor front head (Fig. 13). Should the J 33017 pulley rotor and bearing installer slip off direct in-line contact with the inner race of the bearing, loosen the J 8433–1 center forcing screw and realign the installer and pilot so that the J 33017 installer will properly clear the front head.

9. Install rotor and bearing assembly retainer ring, using snap ring pliers J 6083 (Fig. 6).

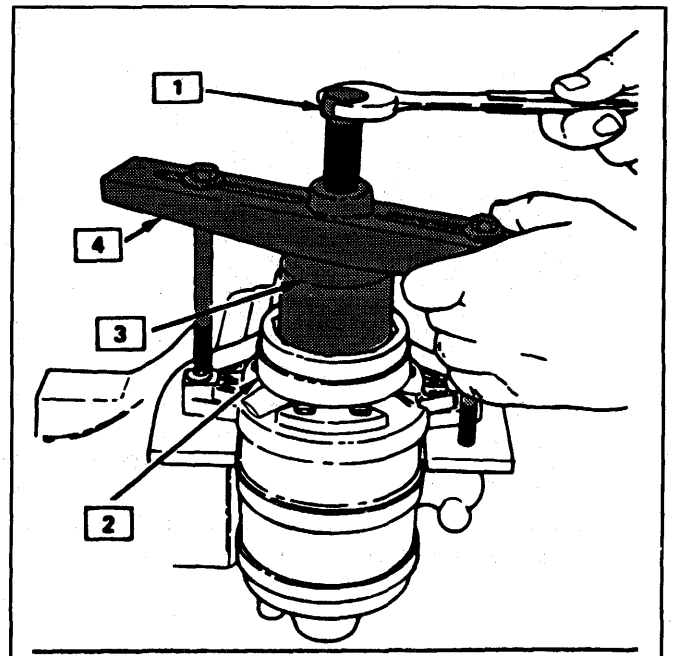
10. Reinstall clutch plate and hub assembly as described previously.



1 J 8433-3 SCREW
2 J 33023-A PULLER PILOT
3 J 33026-2 THROUGH BOLTS
4 PULLEY ROTOR
5 J 33017 PULLEY ROTOR AND BEARING INSTALLER
6 J 8433-1 CROSS BAR

G60170-1D2-C-R1

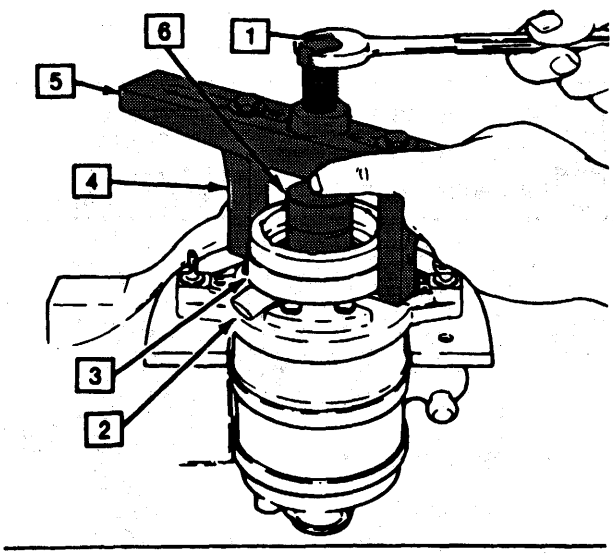
Fig. 13 Installing Pulley Rotor and Bearing Assembly



1–J 8433-3 SCREW
2–CLUTCH COIL ASSEMBLY
3–J 33024 CLUTCH COIL INSTALLER
4–J 8433-1 PULLER CROSS BAR

520019-1D2-R1

Fig. 15 Installing Clutch Coil Assembly



1 J 8433-3 SCREW
2 MARK COIL TERMINAL LOCATION ON HEAD
3 CLUTCH COIL ASSEMBLY
4 J 33025 PULLER LEG
5 J 8433-1 PULLER CROSS BAR
6 J 33023-A PULLER PILOT

G60180-1D2-C-R1

Fig. 14 Clutch Coil Assembly Removal

COMPRESSOR CLUTCH COIL

Remove or Disconnect

1. Perform Steps 1 through 4 of "Clutch Rotor and/or Bearings" removal procedure. **Mark clutch coil terminal location on compressor front head.**
2. Install J 33023–A puller pilot on front head of compressor (Fig. 14). Also install J 8433–1 puller crossbar with J 33025 puller legs as shown in Figure 14.
3. Tighten J 8433–3 forcing screw against the puller pilot to remove the clutch coil.

Install or Connect

1. Place the clutch coil assembly on the front head with the terminals positioned at the "marked" location.
2. Place the J 33024 clutch coil installer over the internal opening of the clutch coil housing and align installer with the compressor front head.
3. Center the J 8433–1 puller crossbar in the counter- sunk center hole of the J 33024 clutch coil installer. Install the J 33026–2 through bolts and washers through the crossbar slots and thread them into the holding fixture J 33026 to full fixture thickness (Fig. 15).
4. Turn the center forcing screw of the J 8433–1 puller crossbar to force the clutch coil onto the front head. Be sure clutch coil and J 33024 installer stay "in-line" during installation.

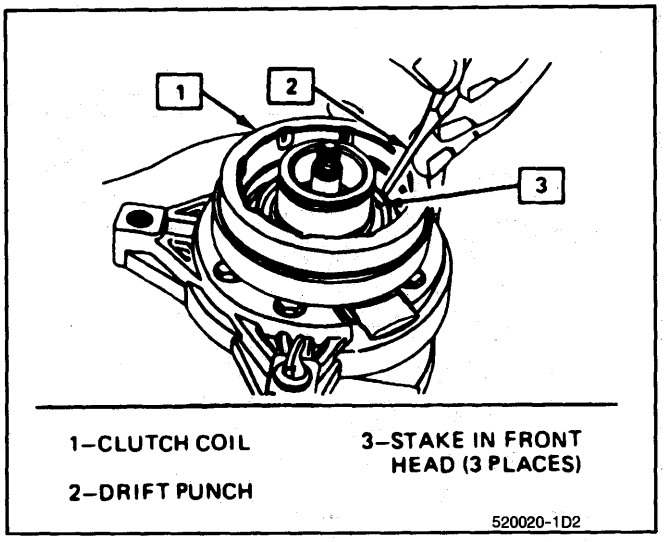


Fig. 16 Staking Clutch Coil to Front Head

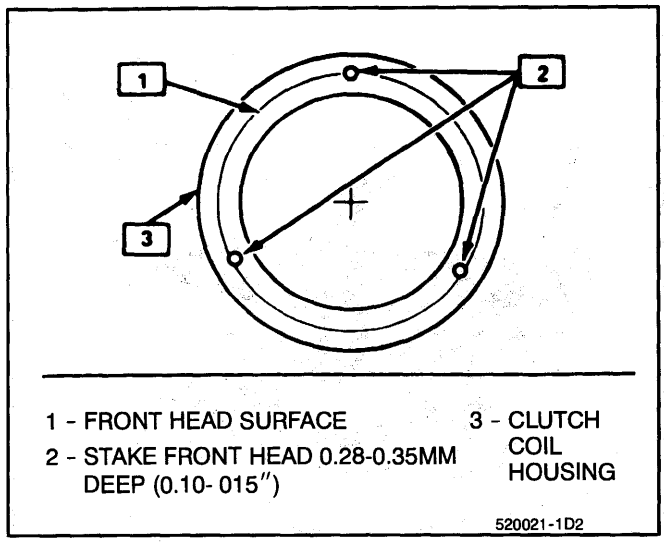


Fig. 17 Details of Stakes in Front Head for Clutch Coil

5. When coil is fully seated on the front head, use a 1/8″ diameter drift punch and stake the front head at three places 120 degrees apart (Fig. 16), to ensure clutch coil remains in position.
   - Stake size should be only one–half the area of the punch tip and be only approximately 0.28–0.35mm (.010–.015″) deep (Fig. 17).
6. Install rotor and bearing assembly and the clutch plate and hub assembly as described previously.

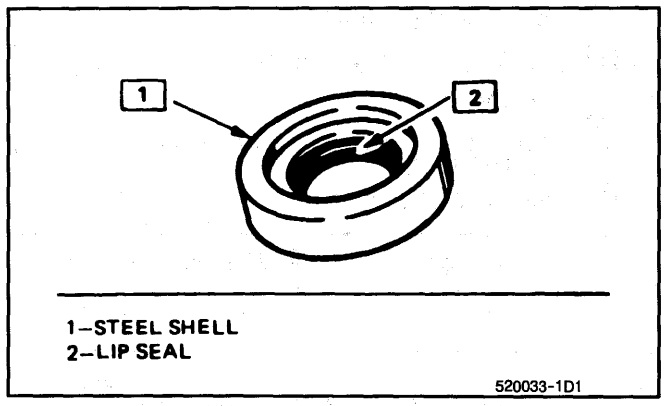


Fig. 18 Compressor Shaft Seal

MAJOR COMPRESSOR REPAIR PROCEDURES

When replacing the shaft seal assembly (Fig. 18), pressure relief valve or control switches (Fig. 19), it will be necessary to recover the refrigerant. Other than clutch repair procedures, the same holds true for any disassembly of the compressor.

A clean workbench covered with a sheet of clean paper, and a place (clean trays, etc.) for all parts being removed and replaced is important, as is the use of proper clean service tools.

NOTICE: Any attempt to use makeshift or inadequate service tools or equipment may result in damage and/or improper compressor operation.

All parts required for servicing the internal compressor are protected by a preservative process and packaged in a manner which will eliminate the necessity of cleaning, washing or flushing of the parts. The parts can be used in the internal assembly just as they are removed from the service package. **Seals and protective packaging should be left intact until just prior to installation.**

If the compressor rear head, front head or cylinder and shaft assembly is to be serviced or replaced, the oil in the compressor must be drained, measured, recorded and replaced.

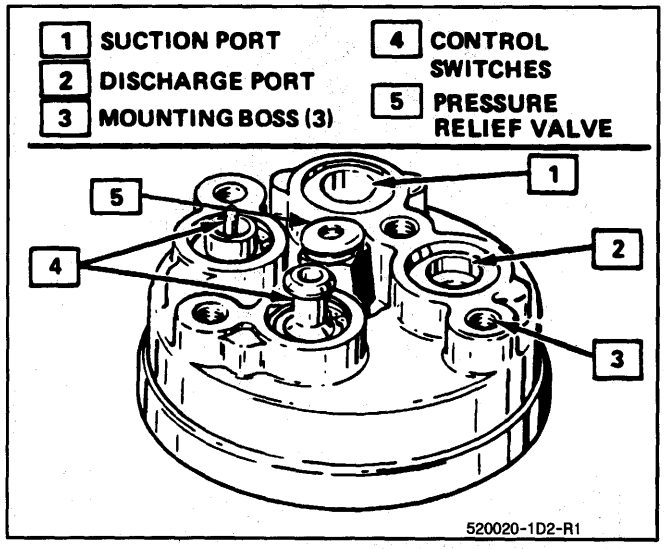


Fig. 19 Compressor — Rear Head

COMPRESSOR SHAFT SEAL REPLACEMENT

Seal Leak Detection

A shaft seal should not be changed because of small amounts of oil found on an adjacent surface but only after actual refrigerant leakage is found using an approved leak detector, J 39400 or equivalent.

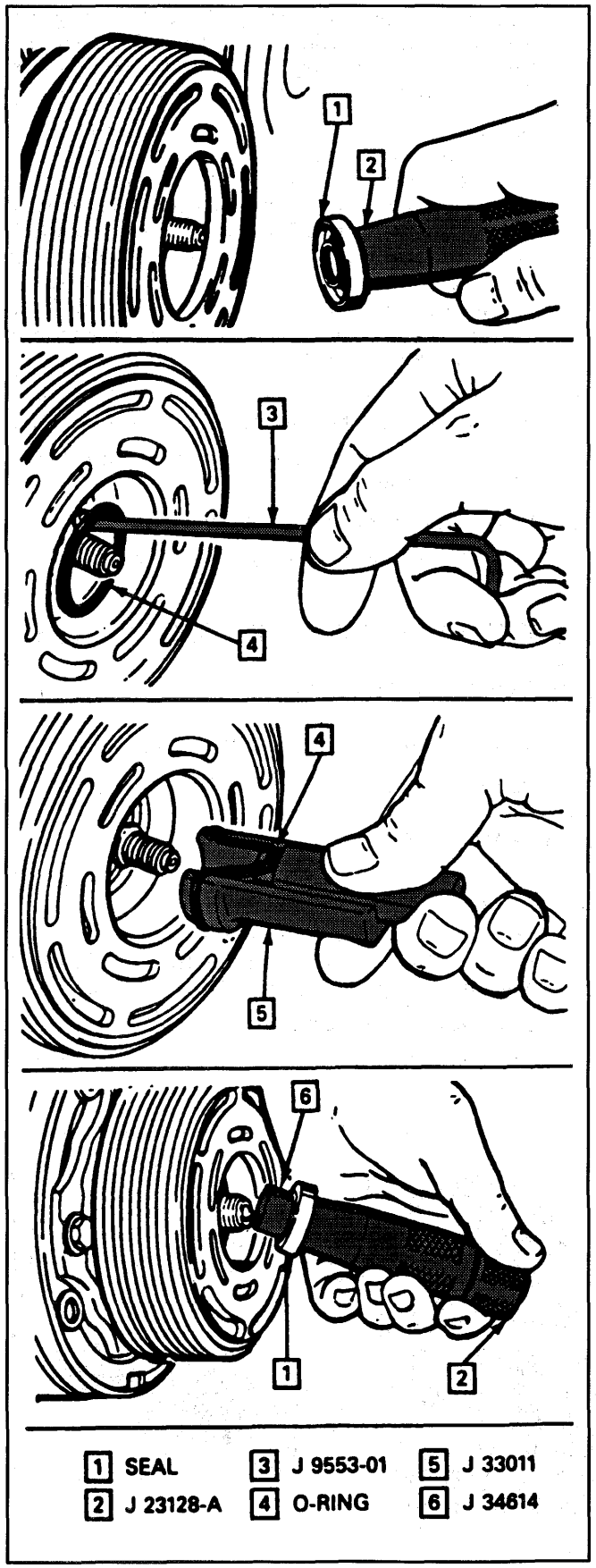


Fig. 20 Removing and Installing Shaft Seal and O-Ring

Remove or Disconnect

1. Recover the refrigerant using J 39500-GM.
2. Loosen and reposition compressor in mounting brackets, if necessary.
3. Remove clutch plate and hub assembly from compressor as described in minor repairs.
4. Remove the shaft seal retainer ring, using snap ring pliers J 5403 (Fig. 21).
5. Thoroughly clean inside of compressor neck area surrounding the shaft, the exposed portion of the seal, the retainer ring groove and the shaft itself. Any dirt or foreign material getting into compressor may cause damage.
6. Fully engage the knurled tangs of Seal Remover-Installer J 23128–A into the recessed portion of the Seal by turning the handle clockwise. Remove the Seal from the compressor with a rotary–pulling motion (Fig. 22). Discard the seal. The handle must be hand- tightened securely. Do not use a wrench or pliers.
7. Remove and discard the seal seat O-ring from the compressor neck using O-ring remover J 9553–0l, Figure 20.
8. Recheck the shaft and inside of the compressor neck for dirt or foreign material and be sure these areas are perfectly clean before installing new parts.

Clean

- Thoroughly clean O-ring seal groove in front head.

NOTICE: Seals should not be re-used. Always use a new specification service seal on rebuild (Fig. 18). Be sure that the seal to be installed is not scratched or damaged in anyway. Make sure that the seal seat and seal are free of lint and dirt that could damage the seal surface or prevent sealing.

Install or Connect

1. Dip the new seal seat O-ring in clean 525 viscosity refrigerant oil and assemble onto O-ring installer J 33011, Figure 20.
2. Insert the O-ring installer J 33011 into the compressor neck until the installer "bottoms". Lower the moveable slide of the O-ring installer to release the O-ring into the seal O-ring lower groove. (The compressor neck top groove is for the shaft seal retainer ring.) Rotate the installer to seat the O-ring and remove the installer.
3. Dip the new seal in clean 525 viscosity refrigerant oil and assemble seal to Seal Installer J 23128–A, by turning handle clockwise. The stamped steel case side of the lip seal must be engaged with knurled tangs of installer so that flared-out side of lip seal is facing and installed towards the compressor. Install seal protector J 34614, in the seal lip and place over the compressor shaft, Figure 22, and push the seal in place with a rotary motion or place the seal protector J 34014 over end of compressor shaft, Figure 22, and slide the new

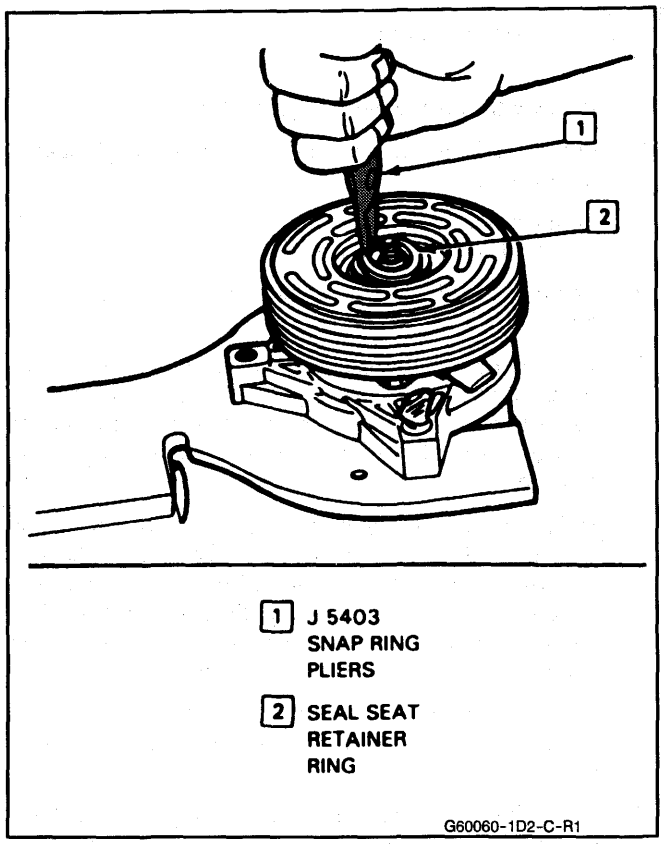


Fig. 21 Removing or Installing Shaft Seal Retaining Ring

seal onto the shaft with a rotary motion until it stops. Take care not to dislodge the O-ring. Be sure the seal makes good contact with the O-ring. Disengage the installer from the seal and remove the installer J 23128–A and the seal protector J 34614.

NOTICE: Handling and care of seal protector is important. If seal protector is nicked or the bottom flared, the new seal may be damaged during installation.

4. Install the new seal retainer ring with its flat side against the Seal, using Snap-Ring Pliers J 5403. See Figure 21. Use the sleeve from O-ring installer J 33011 to press in on the seal retainer ring so that it snaps into its groove.
5. To leak test, install compressor leak test fixture J 39893 on rear head of compressor and connect gage charging lines and J 39500-GM Refrigerant Recovery System. Pressurize suction and high-side of compressor with R-134a Refrigerant. Temporarily install (M9 x 1.25 thread on shaft) nut and, with the compressor in horizontal position, rotate the compressor shaft in normal direction of rotation several turns by hand. Leak test the seal area and correct and leak found. Recover the refrigerant. Remove shaft nut.
6. Remove any excess oil resulting from installing the new seal parts from the shaft and inside the compressor neck.
7. Install the clutch plate and hub assembly as described in minor repair procedures.
8. Reinstall compressor belt and tighten bracket.
9. Evacuate and charge the refrigerant system.

COMPRESSOR PRESSURE RELIEF VALVE

Remove or Disconnect

1. Recover the refrigerant using J 39500-GM.
2. Remove old pressure relief valve (Fig. 19).

Install or Connect

1. Clean valve seat area on rear head.
2. Lubricate O-ring of new pressure relief valve and O-ring assembly with new 525 viscosity refrigerant oil. Install new valve and torque in place, 9.0 N•m (6.1 lbs.–ft.)
3. Evacuate and recharge the system.
4. Leak test system.

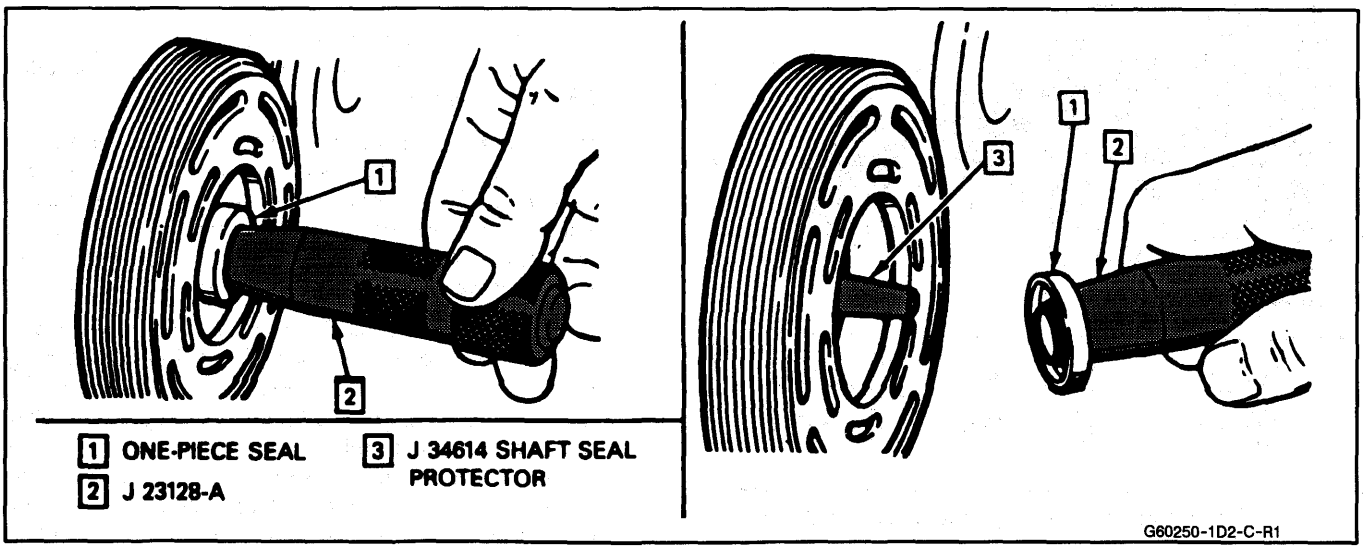


Fig. 22 Removing or Installing Shaft Seal

CONTROL SWITCHES

Figure 20

Remove or Disconnect

1. Recover the refrigerant.
2. Disconnect the electrical connector from the switch in the rear head of compressor.
3. Remove the switch retaining ring using J 5403 internal snap ring pliers.
4. Remove the switch from the compressor.
5. Remove old O-ring seal from the switch cavity using J 9553–01 O-ring removal tool.

If existing control switch is reinstalled in the compressor, a new O-ring seal must be used and preferably a new retainer ring should also be used. A new switch kit has the O-ring and retainer ring included.

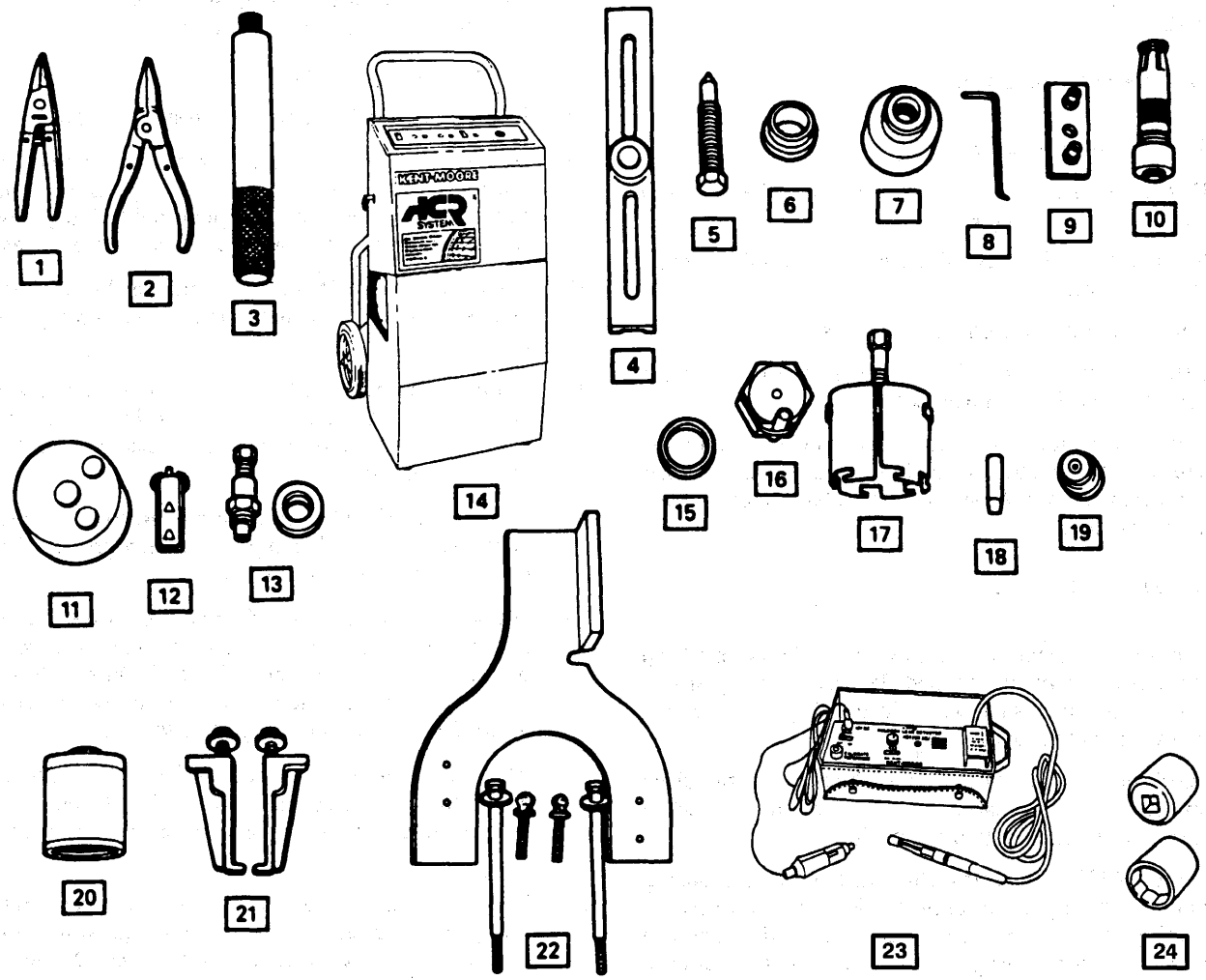
Install or Connect

1. Check switch cavity and O-ring groove in the rear head for dirt or foreign material and clean as necessary. Install a new O-ring coated with clean refrigerant oil into groove in switch cavity.
2. Lubricate the control switch housing with clean refrigerant oil and carefully insert switch into switch cavity until switch bottoms in cavity.
3. Using J 9533–1 snap ring pliers install switch retaining ring with high point of curved sides adjacent to switch housing. Be sure retaining ring is properly seated in switch cavity retaining groove. Leak test according to bench test procedure.

COMPRESSOR LEAK TESTING (EXTERNAL AND INTERNAL)

Bench-Check Procedure

1. Install test plate J 39893 on rear head of compressor.
2. Using J 39500-GM Refrigerant Recovery System, attach center hose of manifold gage set on charging station to a refrigerant drum standing in an upright drum.
3. Connect charging station high and low pressure lines to corresponding fittings on test plate J 39893. Suction port (low-side) of compressor has large internal opening. Discharge port (high-side) has smaller internal opening into compressor and deeper recess.
4. Open low pressure control, high pressure control and refrigerant control on charging station to allow refrigerant vapor to flow into compressor.
5. Using a leak detector, check for leaks at pressure relief valve, rear head switch location, compressor front and rear head seals, center cylinder seal, through bolt head gaskets and compressor shaft seal. After checking, shut off low pressure control and high-pressure control on charging station.
6. If an external leak is present, perform the necessary corrective measures and recheck for leaks to make certain the leak has been corrected.
7. Recover the refrigerant.
8. Disconnect both hoses from the test plate J 39893.
9. Add 90 ml (3 oz.) new PAG lubricant to the compressor assembly. Rotate the complete compressor assembly (not the crankshaft or drive plate hub) slowly several turns to distribute oil to all cylinder and piston areas.
10. Install a M9 x 1.25 threaded nut on the compressor crankshaft if the drive plate and clutch assembly are not installed.
11. Using a box-end wrench or socket and handle, rotate the compressor crankshaft or clutch drive plate on the crankshaft several turns to insure piston assembly to cylinder wall lubrication.
12. Using J 39500-GM Refrigerant Recovery System, connect J 9893 the charging station high-pressure line to the test plate high-side connector.
13. Using J 39500-GM Refrigerant Recovery System, connect the charging station low-pressure line to the low pressure port of the test plate J 39893. Oil will drain out of the compressor suction port if the compressor is positioned with the suction port downward.
14. Attach the compressor to the J 33026 holding fixture and mount the compressor in a vise so that the compressor will be in a horizontal position and the shaft can be turned with a wrench.
15. Using a wrench, rotate the compressor crankshaft or drive plate hub ten complete revolutions at a speed of approximately one-revolution per second. Turning the compressor at less than one-revolution per second can result in a lower pump-up pressure and disqualify a good pumping compressor.
16. Observe the reading on high-pressure gage at the completion of the tenth revolution of the compressor. The pressure reading for a good pumping compressor should be 690 kPa (100 psi) or above. A pressure reading of less than 620 kPa (90 psi) would indicate one or more suction and/or discharge valves leaking an internal leak, or an inoperative valve, and the refrigerant must be recovered and the compressor disassembled and checked for cause of leak. Repair as needed, reassemble and repeat the pump-up test. Externally leak test.
17. When the pressure pump-up test is completed, recover the refrigerant from the high-side and remove the test plate J 39893.
18. Tilt the compressor so that the compressor suction and discharge ports are down. Drain the PAG lubricant from the compressor.
19. Allow the compressor to drain for 10 minutes, then refill with the proper amount of PAG lubricant, per oil balance procedure in section 1B of the service manual. The PAG lubricant may be poured into the suction port. If further assembly or processing is required, a shipping plate or test plate J 39893 should be installed to keep out air, dirt and moisture until the compressor is installed.



1 — J 5403	SNAP RING PLIERS	13 — J 33013	HUB & DRIVE PLATE REMOVER & INSTALLER
2 — J 6083	SNAP RING PLIERS	14 — J 39500-GM	R134a A/C REFRIGERANT RECOVERY, RECYCLING AND RECHARGING SYSTEM (ACR[4])
3 — J 29886	DRIVER HANDLE	15 — J 33017	PULLEY & BEARING ASSEMBLY INSTALLER
4 — J 8433-1	PULLER BAR	16 — J 33019	BEARING STAKING TOOL
5 — J 8433-3	FORCING SCREW	17 — J 33020	PULLEY PULLER
6 — J 9398-A	BEARING REMOVER	18 — J 34614	SHAFT SEAL PROTECTOR
7 — J 9481-A	BEARING INSTALLER	19 — J 33023	PULLER PILOT
8 — J 9553-01	"O" RING REMOVER	20 — J 33024	CLUTCH COIL INSTALLER ADAPTER
9 — J 39893	PRESSURE TESTING CONNECTOR	21 — J 33025	CLUTCH COIL PULLER LEGS
10 — J 23128-A	SEAL SEAT REMOVER & INSTALLER	22 — J 34992	COMPRESSOR HOLDING FIXTURE
11 — J 21352-A	SUPPORT BLOCK	23 — J 39400	LEAK DETECTOR
12 — J 33011	"O" RING INSTALLER	24 — J 39037	HIGH-SIDE CHARGE VALVE SOCKET

Fig. 23 Compressor Overhaul — Special Tools

SECTION 3

STEERING, SUSPENSION, TIRES AND WHEELS

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Steering, Suspension, Tires and Wheels Diagnosis Section 3
Wheel Alignment ..... Section 3A
Power Steering Gear and Pump On-Vehicle Service ..... Section 3B
Power Steering Gear Unit Repair ..... Section 3B1A
Power Steering Pump Unit Repair ..... Section 3B1B
Front Suspension ..... Section 3C
Rear Suspension ..... Section 3D
Tires and Wheels ..... Section 3E
Steering Wheel and Column On-Vehicle Service ..... Section 3F
Supplemental Inflatable Restraint (SIR) Tilt Steering Column Unit Repair ..... Section 3F5B

SECTION 3

STEERING, SUSPENSION, TIRES AND WHEELS DIAGNOSIS

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

Since the problems in steering, suspension, tire and wheel assemblies involve several systems, they must all be considered when diagnosing a complaint. To avoid using the wrong symptom, always road test the vehicle first. Proceed with the following preliminary checks and correct any substandard conditions which are found.

Inspect

- Wrong pressure and uneven wear on tires.
- Loose connections or wear on joints from the steering column assembly to the steering gear assembly.
- Loose or damaged parts on the front and rear suspension or steering gear assembly.
- Out-of-round or out-of-balance tires, bent wheel assemblies and loose and/or rough wheel bearing assemblies.
- Leaks in power steering system. Also check the power steering fluid level and the accessory drive belt condition and tension. Refer to "Power Steering Pump Assembly Diagnosis" in this section.

The following symptom diagnosis tables may help you find the cause of a problem. The tables list a number of symptoms, along with associated possible causes. More information on any particular listing can be found in the sections referenced in the "Refer To" column.

GENERAL DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	REFER TO (SECTION)
BODY/CHASSIS – GENERAL		
Vehicle Pulls or Leads	• Misaligned front tire and wheel assembly.	3A
	• Mismatched or uneven tires.	3E
	• Broken or sagging spring.	3C, 3D
	• Radial tire lead/pull.	3E
	• Unbalanced steering gear valve spool.	3B, 3B1A
	• Dragging front brake assembly.	5
Shimmy, Shake or Vibration	• Bent tire and wheel assembly rim.	3E
	• Excessive tire and wheel assembly runout.	3E
	• Out-of-balance tire or wheel assembly.	3E
	• Excessive wheel bolt runout.	3E
	• Excessive brake drum assembly or brake rotor assembly imbalance.	5
	• Worn steering linkage components.	3B1A
	• Worn lower control arm ball stud assembly.	3C
	• Excessive loaded radial runout of tire.	3E
	• Worn suspension bushings.	3C, 3D
	• Blister or bump on tire.	–
	• Out-of-balance propeller shaft assembly.	4A
	• Foreign material lodged in wheel rim.	–
Abnormal Noise at Front End	• Damaged suspension components.	3C, 3D
	• Worn control arm bushings or steering linkage.	3B1A, 3C, 3D
	• Loose stabilizer shaft assembly or broken stabilizer shaft links.	3C, 3D
	• Loose wheel nuts.	3E
	• Loose suspension bolts/screws.	3C, 3D
	• Misadjusted steering gear assembly.	3B, 3B1A
	• Worn shock absorber assemblies or mountings.	3C, 3D
	• Improperly positioned spring.	3C, 3D
	• Scuffed tires.	–

SYMPTOM	POSSIBLE CAUSE	REFER TO (SECTION)
Low or Uneven Trim Height	• Broken, incorrect, or sagging spring.	3C, 3D
	• Overloaded vehicle.	–
Body Leans or Sways in Corners	• Loose stabilizer shaft assembly or broken stabilizer shaft links.	3C, 3D
	• Worn shock absorber assemblies or mountings.	3C, 3D
	• Broken or sagging spring.	3C, 3D
	• Overloaded vehicle.	–
Suspension Bottoms	• Overloaded vehicle.	–
	• Worn shock absorber assemblies.	3C, 3D
	• Incorrect, broken or sagging spring.	3C, 3D
"Dog" Tracking	• Damaged rear control arm or worn control arm bushing assembly.	3D
	• Bent rear axle assembly.	4B
TIRES/WHEELS – GENERAL		
Abnormal or Excessive Tire Wear	• Misaligned tire and wheel assembly.	3A, 3E
	• Excessive toe.	3A
	• Sagging or broken spring.	3C, 3D
	• Out-of-balance tire or wheel assembly.	3E
	• Worn shock absorber assemblies.	3C, 3D
	• Hard driving.	–
	• Overloaded vehicle.	–
	• Tires not rotated.	3E
	• Low or excessive inflation pressure.	3E
	• Bent suspension components.	3C, 3D
Wheel Assembly Tramp	• Out-of-balance tire or wheel assembly.	3E
	• Improper shock absorber assembly action.	3C, 3D
	• Blister or bump on tires.	–
Cupped Tires	• Misaligned tire and wheel assembly.	3A
	• Weak shock absorber assemblies.	3C, 3D
	• Worn wheel bearing assembly.	3C
	• Excessive tire or wheel assembly runout.	3E
	• Worn control arm ball stud assembly.	3C
	• Loose steering gear assembly adjustment.	3B, 3B1A
STEERING/STEERING WHEEL ASSEMBLY – GENERAL		
Poor Returnability	• Incorrect caster setting.	3A
	• Lack of lubrication at control arm ball stud assembly or tie rod ends.	0B
	• Bind in control arm ball stud assembly.	3C
	• Bind in steering column assembly.	3F, 3F5B
	• Misadjusted steering gear assembly.	3B, 3B1A
	• Incorrect steering gear valve spool.	3B, 3B1A
	• Intermediate steering shaft joints binding.	3B

SYMPTOM	POSSIBLE CAUSE	REFER TO (SECTION)
Hard Steering	• Hydraulic system – Perform test as outlined in "Power Steering System Test Procedure" in this section.	–
	• Misadjusted steering gear assembly.	3B, 3B1A
	• Bind or catch in steering gear assembly.	3B, 3B1A
	• Loose steering gear assembly mounting.	3B, 3B1A
	• Faulty pipe fitting seat.	3B, 3B1A
Too Much Play in Steering	• Loose steering gear assembly mounting.	3B, 3B1A
	• Loose or worn joints from steering column assembly to steering gear assembly.	3B, 3B1A, 3F
	• Misadjusted steering gear assembly.	3B, 3B1A
Wander or Poor Steering Stability	• Mismatched or uneven tires.	–
	• Worn shock absorber assemblies.	3C, 3D
	• Loose stabilizer shaft assembly.	3C, 3D
	• Broken or sagging spring assembly.	3C, 3D
	• Misadjusted steering gear assembly.	3B, 3B1A
	• Misaligned tire and wheel assembly.	3A, 3E
Erratic Steering When Braking	• Worn wheel bearing assembly.	3C
	• Broken or sagging spring assembly.	3C, 3D
	• Warped brake rotor assembly.	5
	• Sticking brake caliper piston.	5
	• Leaking wheel cylinder or brake caliper assembly.	5
	• Incorrect or uneven caster.	3A
Steering Wheel Assembly Kickback	• Air in power steering system.	3B
	• Loose steering gear assembly mounting.	3B, 3B1A
	• Loose or worn joints from steering column assembly to steering gear assembly.	3B, 3B1A, 3F
	• Loose tie rod ends.	3B1A
	• Worn or missing pipe fitting seat.	3B, 3B1A
	• Worn wheel bearing assembly.	3C
	• See "Too Much Play in Steering" for other possible causes.	–
Steering Wheel Assembly Surges or Jerks	• Bad or defective tire.	–
	• Sluggish steering gear valve spool.	3B, 3B1A
	• Loose or oil soaked accessory drive belt.	3B, 3B1B
	• Air in power steering system.	3B
RIDE		
Too Soft (Vehicles with FE1 suspension are designed for soft ride.)	• Incorrect shock absorber assemblies.	3C, 3D
	• Incorrect or sagging spring assembly.	3C, 3D
Too Harsh	• Incorrect shock absorber assemblies.	3C, 3D
	• Incorrect spring assembly.	3C, 3D
	• Incorrect tires or tire pressure.	3E

POWER STEERING GEAR ASSEMBLY DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	REFER TO (SECTION)
Hissing Noise	• This is commonly heard when steering wheel assembly is turned and vehicle is not moving, and especially so if brakes are applied. If noise is very objectionable, replace the gear with a partial service gear assembly. (A replacement gear will also have a slight noise, and is not always a cure for the condition.)	3B, 3B1A
	• Loose intermediate steering shaft universal joints.	3B
Rattle or Chucking Noise	• Outlet (pressure) hose assembly contacting frame.	3B, 3B1A
	• Loose tie rod ends.	3B1A
	• Loose steering gear assembly attachment.	3B, 3B1A
	• Loose pinion shaft assembly.	3B, 3B1A
If a rattle occurs when driving over bumps, check front brake linings for loose fit and missing antirattle clips.		
Poor Return of Steering Wheel Assembly to Center	• Misaligned front tire and wheel assembly.	3A
	• Worn wheel bearing assembly.	3C
	• Binding tie rod ends.	3B1A
	• Binding control arm ball stud assembly.	3C
	• Steering wheel assembly rubbing against turn signal switch housing.	3F
	• Misadjusted steering gear assembly.	3B, 3B1A
	• Tight or frozen steering gear coupling shaft assembly.	3F
	• Sticky or plugged steering gear valve spool.	3B, 3B1A
Momentary Increase in Effort When Turning Steering Wheel Assembly Fast to Right or Left	• High internal leakage.	3B, 3B1A, 3B1B
	• Sticking or damaged steering gear valve spool.	3B, 3B1A
	• Insufficient pump assembly pressure.	3B, 3B1B
	• Low fluid level.	3B, 3B1B
Steering Wheel Assembly Surges or Jerks When Turning with Engine Running, Especially During Parking	• Insufficient pump assembly pressure.	3B, 3B1B
	• Sticky flow control valve.	3B, 3B1B
Excessive Steering Wheel Assembly Kickback or Loose Steering	• Air in power steering system.	3B
	• Loose steering gear assembly adjustment.	3B, 3B1A
	• Loose tie rod ends.	3B1A
	• Worn wheel bearing assembly.	3C
	• Coupling assembly loose on stabilizer shaft assembly.	3B, 3C
	• Loose thrust bearing preload adjustment.	3B, 3B1A
	• Worn pipe fitting seat.	3B, 3B1A

SYMPTOM	POSSIBLE CAUSE	REFER TO (SECTION)
Hard Steering or Lack of Assist, Especially During Parking	• Brake assemblies applied while turning steering wheel assembly.	–
	• Damaged or worn steering gear coupling shaft assembly.	3F
	• Sticky flow control valve.	3B, 3B1B
	• Insufficient pump assembly pressure.	3B, 3B1B
	• Excessive internal pump assembly leakage.	3B, 3B1B
	• Excessive internal steering gear assembly leakage.	3B, 3B1A

C3154S

POWER STEERING PUMP ASSEMBLY DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	REFER TO SECTION 3B, 3B1B
Foamy, Milky Fluid, Low Fluid Level, Low Pressure	• Air in fluid.	
	• Internal pump assembly leakage.	
	• Extremely cold temperatures will cause air bubbles if fluid level is low.	
	• If fluid level is correct and pump assembly still foams, remove pump assembly; then remove reservoir assembly from pump assembly on 3.4L L32 engine. On 5.7L LT1 engine, remove pump assembly and remote reservoir assembly. Check soft plug and housing for cracks. If cracked, replace housing on 3.4L L32 engine or remote reservoir assembly on 5.7L LT1 engine.	
Low Pressure Due to Pump Assembly	• Stuck or inoperative flow control valve.	
	• Pressure plate not flat against ring.	
	• Extremely worn ring.	
	• Scored pressure plate, thrust plate or rotor.	
	• Vanes sticking in rotor slots.	
	• Cracked or broken thrust plate or pressure plate.	
	• High internal leakage.	
Low Pressure Due to Steering Gear Assembly	• Scored housing bore.	
	• Leakage at valve rings or seals.	

C3155S

SYMPTOM	POSSIBLE CAUSE	REFER TO SECTION 3B, 3B1B
Growling Noise in Pump Assembly	• Restricted hoses or steering gear assembly causing excessive back pressure. • Scored pressure plates, thrust plate or rotor. • Worn ring.	
Groaning Noise in Pump Assembly	• Air in fluid. • Low fluid level. • Loose pump assembly mounting.	
Rattling Noise in Pump Assembly	• Vanes sticking in rotor slots. • Improperly installed vane. • Damaged pump bearings.	
Swishing Noise in Pump Assembly	• Damaged flow control valve.	
Whining Noise in Pump Assembly	• Scored pump shaft bushing. • Scored pressure plates and vanes.	

C3156S

STEERING COLUMN ASSEMBLY DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	REFER TO SECTION 3F, 3F5B (except where noted)
LOCK SYSTEM		
Will Not Unlock	• Collapsed shear flange on sector shaft. • Damaged lock bolt. • Damaged lock cylinder. • Damaged housing. • Damaged sector. • Damaged rack. • Damaged or incorrectly cut key.	
Will Not Lock	• Broken or worn lock bolt spring. • Damaged sector. • Damaged lock cylinder. • Burr on lock bolt. • Damaged housing. • Damaged rack. • Interference between bowl and rack coupling. • Stuck ignition switch. • Restricted actuator rod. • Incorrectly installed sector.	

C3157S

SYMPTOM	POSSIBLE CAUSE	REFER TO SECTION 3F, 3F5B (except where noted)
High Lock Effort	• Damaged lock cylinder. • Damaged ignition switch. • Broken or deformed rack preload spring. • Burrs on sector, rack, housing, support or actuator rod coupling. • Bent sector shaft. • Damaged rack. • Park lock cable damaged or misadjusted. • Extreme misalignment of housing to cover. • Distorted coupling slot in rack. • Bent actuator rod. • Bent ignition switch mounting bracket. • Restricted actuator rod. • Worn or damaged key.	
Will Stick in "START"	• Deformed actuator rod. • Check items under "High Lock Effort."	
Key Cannot Be Removed in "OFF-LOCK"	• Incorrectly set ignition switch. • Damaged lock cylinder.	
Lock Cylinder Can Be Removed	• Missing lock cylinder retaining screw.	
High Effort in Lock Cylinder Between "OFF" and "OFF-LOCK"	• Distorted rack.	
Lock Bolt Hits Shaft Lock in "OFF" and "PARK"	• Incorrectly set ignition switch.	
STEERING COLUMN ASSEMBLY		
Noise in Steering Column Assembly	• Loose joints from steering column assembly to steering gear assembly. • Incorrectly aligned steering column assembly. • Unlubricated horn contact ring. • Lack of grease on bearings. • Loose sight shields. • Worn or broken upper or lower steering shaft bearing assembly. • Unseated lock plate retainer ring. • Unlubricated spherical joint.	3B, 3B1A 0B 0B 0B
High Steering Shaft Assembly Effort	• Misaligned steering column assembly. • Improperly installed or deformed dust seal. • Damaged upper or lower steering shaft bearing assembly. • Flash on inside diameter of shift tube. • Tight universal joint.	 4A

SYMPTOM	POSSIBLE CAUSE	REFER TO SECTION 3F, 3F5B (except where noted)
Lash in Steering Column Assembly	• Loose IP-to-steering column assembly upper and lower bracket mounting bolts/screws. • Broken weld nuts on jacket. • Sheared IP upper bracket capsule. • Loose shoes in housing. • Loose pivot pins. • Loose lock pin in housing support. • Loose housing support bolts/screws. • Loose steering column assembly upper and lower bracket-to-jacket bolts/screws. • Loose lower bracket-to-adapter and bearing assembly mounting bolts/screws.	
Housing Scraping Bowl	• Bent bowl or bowl not concentric with hub. • Improperly installed cover and housing end cap.	
Loose Steering Wheel Assembly	• Excessive clearance between holes in housing support or housing and pivot pin diameters. • Damaged or missing anti-lash spring in spheres. • Steering shaft upper bearing assembly not seated in housing. • Missing steering shaft upper bearing inner race. • Loose housing support bolts/screws. • Missing or broken bearing preload spring.	
Loose Steering Wheel Assembly (Every Other Tilt Position)	• Loose fit between shoe and pivot pins. • Shoe not free in slot.	
Steering Column Assembly Not Locking in Any Tilt Position	• Shoe seized on pivot pin. • Burrs or dirt on shoe grooves. • Weak or broken shoe lock spring.	
Steering Wheel Assembly Fails to Return to Top Tilt Position	• Bound up pivot pins. • Broken or weak wheel tilt spring. • Tight turn signal switch assembly wires.	
Noise When Tilting Steering Column Assembly	• Worn upper tilt bumpers. • Shoe lock spring rubbing in housing.	
TURN SIGNAL SWITCH ASSEMBLY **Important** • This diagnosis covers mechanical problems only. Refer to SECTION 8A for turn signal switch electrical diagnosis.		
Turn Signal Will Not Stay in Turn Position	• Foreign material or loose parts impeding movement of yoke. • Broken or missing detent or canceling spring. • None of the above; replace switch.	

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SYMPTOM	POSSIBLE CAUSE	REFER TO SECTION 3F, 3F5B (except where noted)
Turn Signal Will Not Cancel	• Loose switch mounting screws. • Broken switch or anchor bosses. • Broken, missing or out-of-position detent, return or canceling spring. • Worn canceling cam.	
Turn Signal Difficult to Operate	• Loose turn signal switch arm. • Broken or distorted yoke; replace switch. • Loose or misplaced springs. • Foreign parts and/or material. • Loose turn signal switch mounting screws.	
Turn Signal Will Not Indicate Lane Change	• Broken lane change pressure pad or spring hanger. • Broken, missing or misplaced lane change spring. • Jammed base or wires.	
Hazard Switch Cannot Be Turned "OFF"	• Foreign material between hazard support canceling leg and yoke. • If no foreign material is found, replace turn signal switch.	
Hazard Switch Will Not Stay "ON" or Difficult to Turn "OFF"	• Loose turn signal switch. • Interference with other components. • Foreign material interference. • None of the above; replace turn signal switch.	
No Turn Signal Lamps	• Electrical failure in chassis harness. • Inoperative turn signal flasher. • Loose chassis-to-column connector. Disconnect chassis-to-column connector and connect new turn signal switch to chassis and operate switch by hand. – If vehicle lamps now operate normally, turn signal switch is inoperative. – If vehicle lamps do not operate, refer to SECTION 8A.	
Turn Indicator Lamps "ON," But Not Flashing	• Inoperative turn signal flasher. • Loose chassis-to-column connection. • Inoperative turn signal switch. • To determine if turn signal switch is inoperative, substitute new turn signal switch into circuit and operate switch by hand. If vehicle lamps operate normally, turn signal switch is inoperative.	

SYMPTOM	POSSIBLE CAUSE	REFER TO SECTION 3F, 3F5B (except where noted)
Front or Rear Turn Signal Lamps Not Flashing	• Burned-out or damaged turn signal bulb. • High resistance connection to ground at bulb socket. • Loose chassis-to-column connector. Disconnect chassis-to-column connector and connect new turn signal switch into system and operate switch by hand. – If turn signal lamps are now "ON" and flashing, turn signal switch is inoperative. – If vehicle lamps do not operate, refer to SECTION 8A.	
No Turn Indicator Panel Lamps	• Burned out bulbs or opens, grounds in wiring harness from front turn signal bulb socket to indicator lights. Refer to SECTION 8A.	
Stoplamp Not "ON" When Turn Indicated	• Loose chassis-to-column connection. • Disconnect chassis-to-column connector and connect new turn signal switch into system and operate switch by hand. – If brake lamps work when switch is in turn position, turn signal switch is inoperative.	
Turn Signal Lamps Flash Very Slowly	• Loose chassis-to-column connection. • Disconnect chassis-to-column connector and connect new turn signal switch into system and operate switch by hand. – If lamps flash at a normal rate, turn signal switch is inoperative. – If lamps still flash very slowly, refer to SECTION 8A.	
Hazard Signal Lamps Will Not Flash – Turn Signal Functions Normally	• Blown fuse. • Inoperative hazard warning flasher. • Loose chassis-to-column connection. • Disconnect column-to-chassis connector and connect new turn signal switch into system, then press in hazard warning button and watch hazard warning lights. – If lamps now work normally, turn signal switch is inoperative. – If lamps do not flash, check wiring harness. Refer to SECTION 8A.	
IGNITION SWITCH		
Electrical System Will Not Function	• Damaged ignition switch. • Improperly adjusted ignition switch. • Loose connector at ignition switch.	
Switch Will Not Turn	• Damaged ignition switch. • Damaged lock cylinder.	
Switch Cannot Be Set Correctly	• Deformed switch actuator rod. • Sector to rack engaged in wrong tooth.	

C3161S

KEY REMINDER

Figures 1 through 10

Reminder Continues to Operate with Key Out, but Stops When Driver's Door is Closed

Inspect

- Chips, foreign material in lock cylinder bore.
- Sticky lock cylinder actuator tip.
- Damaged or broken reminder switch (3).

Reminder Does Not Sound with Key Fully Inserted in Lock Cylinder and the Driver's Door Open

Inspect

NOTICE: If you are using a multimeter to check continuity with voltage present in circuits, be sure to use a voltage setting. A multimeter set on a resistance scale will be damaged by the voltage from live circuits.

1. Reminder to see if power is available. Refer to SECTION 8A.
2. Chassis wiring for open circuit.
   A. Separate chassis connector (1) from column connector (2).
   B. Connect female contacts of terminals "E" and "F" on chassis connector (1). A bent paper clip will work as a jumper.
      - If reminder sounds, repair chassis wiring.
      - If reminder does not sound, go to step 3.

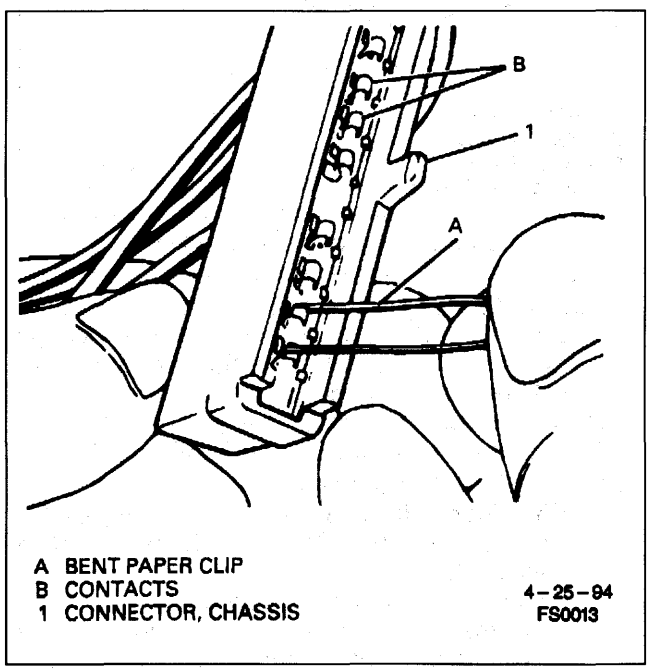


Figure 1 - Checking Reminder at Chassis Connector

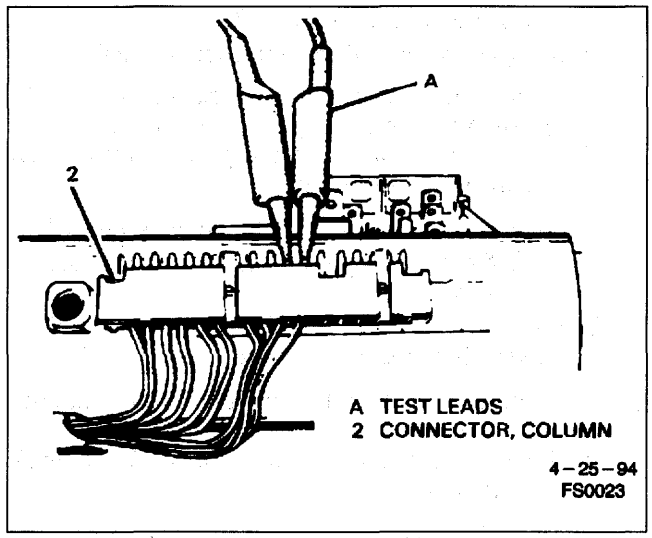


Figure 2 - Checking Reminder at Column Connector

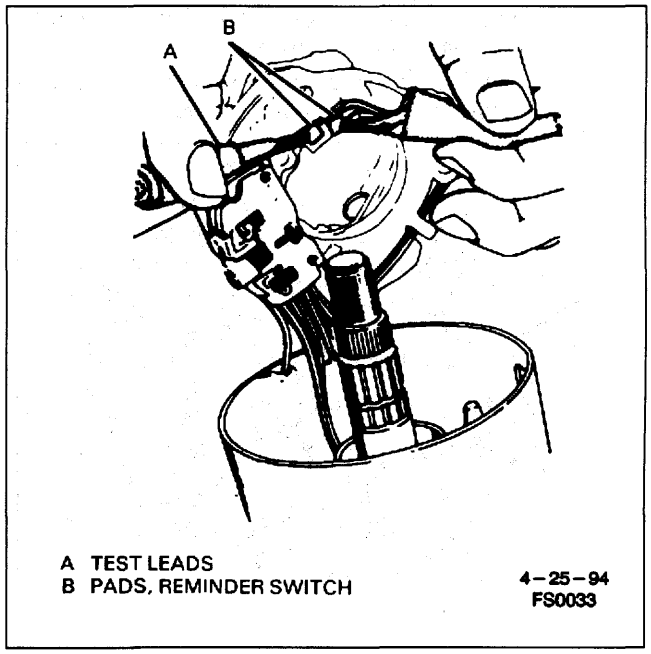


Figure 3 - Checking Reminder Switch Pads

3. Continuity between male "E" and "F" column connector contacts with a multimeter (or test light).
   A. Push key all the way into lock cylinder (4).
      - If there is continuity when key is in, and off when key is out, function is normal.
      - If there is no continuity, fault is in column. Go to step 4.
4. Probes of reminder switch (3) to ensure good contact with pads on signal switch.
   A. Disassemble upper end of column assembly until turn signal switch mounting bolts/screws have been removed.
   B. Lift turn signal switch to gain access to probes.
   C. Bend probes, if needed, then replace turn signal switch and tighten three bolts/screws.

D. Check function as in step 3.

5. Turn signal switch wiring for short or fault.
   A. Connect male contacts of terminals "E" and "F" of column connector (2) with a jumper.
   B. Check key reminder switch pads on turn signal switch with multimeter.
      - If there is continuity, function is normal.
      - If there is no continuity, replace turn signal switch.
6. Continuity of check key reminder switch probes, if problem has not been found.
   A. Connect a multimeter to probes on reminder switch (3).
   B. Fully insert and remove key from lock cylinder (4).
      - If there is continuity when key is in lock cylinder (4) and no continuity when key is out, function is normal. Retrace diagnostic steps starting at step 3.
      - If there is no continuity, fault is in lock cylinder (4) or reminder switch (3).

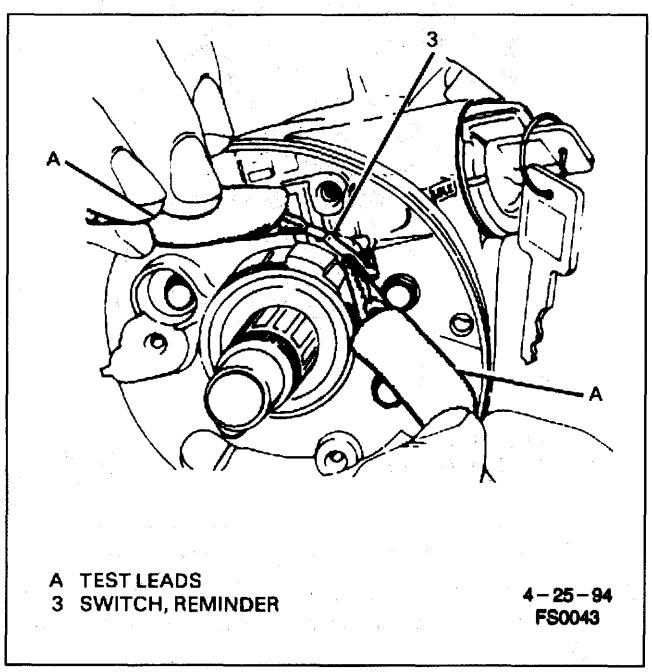


Figure 4 - Checking Reminder Switch

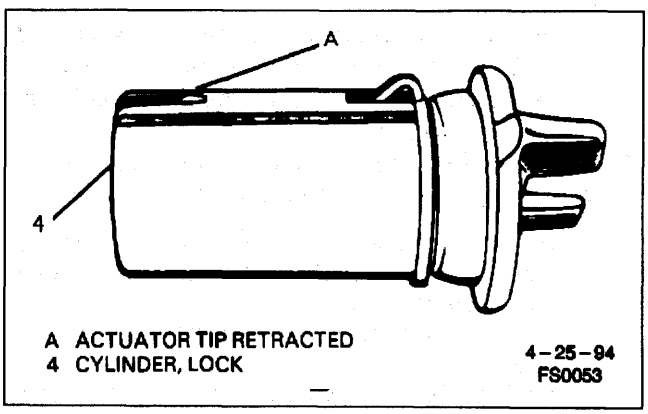


Figure 5 - Lock Cylinder Actuator - Key Removed

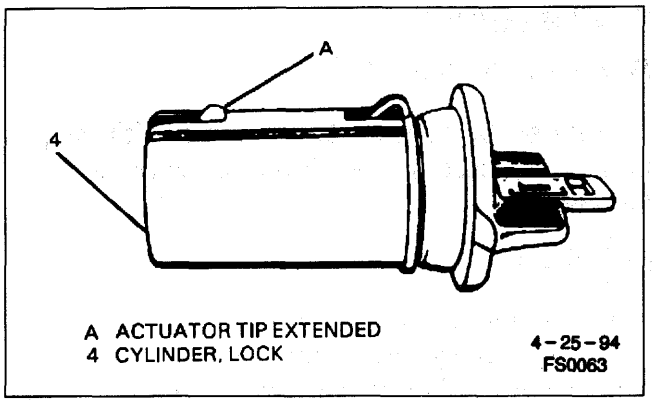


Figure 6 - Lock Cylinder Actuator - Key in Place

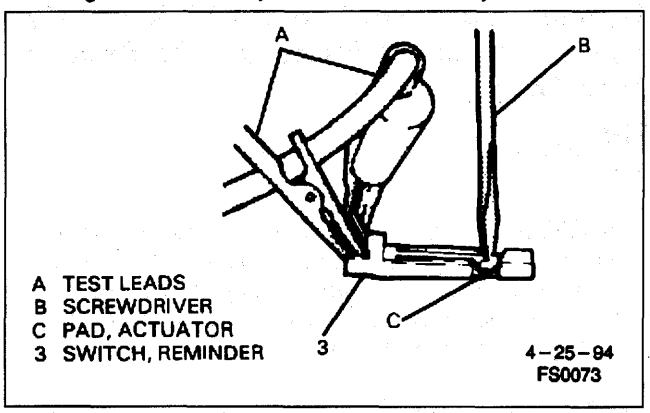


Figure 7 - Checking Key Reminder Switch Continuity

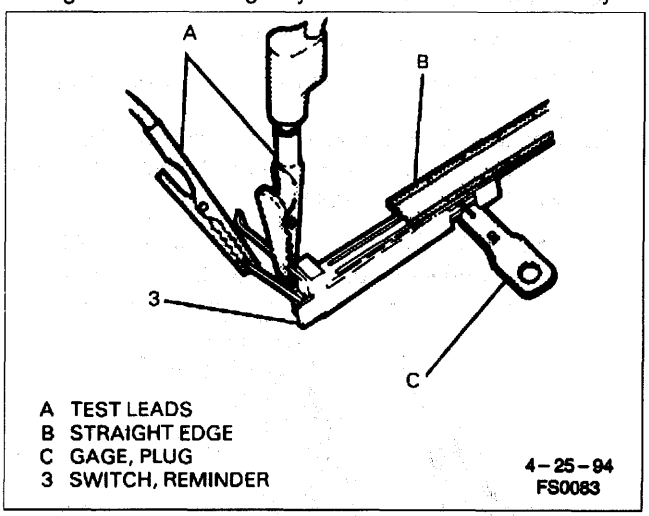


Figure 8 - Checking Contact Gap

7. Lock cylinder (4) for chips, burrs, or foreign material that may prevent actuator tip function.
   A. Key must be removed, or lock cylinder (4) must be in "RUN" position, before lock cylinder can be removed.
   B. Remove chips, burrs or foreign material.
   C. Reassemble and recheck (step 6).
8. Lock cylinder for damage.
   A. With lock cylinder removed, push key all the way in, turn to "RUN" position and then remove it.
      - The lock cylinder actuator tip should extend and retract smoothly. Total extension of tip should be 1.27 mm (0.050 inch).

- If not, replace lock cylinder (4). Reassemble and recheck per step 4.

9. Reminder switch (3) if it appears good but will not operate.
   A. Connect multimeter leads to reminder switch probes on reminder switch.
   B. Press on actuator pad until switch points touch.
   C. If there is no continuity, replace reminder switch.
10. Reminder switch contact gap.
   A. Connect multimeter leads to reminder switch probes on reminder switch (3).
   B. Press a 0.76 mm (0.030-inch) wire type plug gage with a flat piece of stock onto actuator pad.
      - If contact is not made (no continuity), decrease switch contact gap until positive contact is made.
11. Reminder switch contact gap, with positive contact gap set at 0.76 mm (0.030 inch) as outlined above.
   A. Use a 0.63 mm (0.025-inch) plug gap wire beneath flat stock.
      - If contact is made (continuity), increase switch contact gap.
   B. Reminder switch (3) is set properly when switch contact will touch 0.76 mm (0.0030-inch) wire but not 0.63 mm (0.025-inch) wire.

Reminder Keeps Operating with Key in Lock Cylinder, Driver's Door Open or Closed; Ceases When Key is Removed

Inspect

- Misadjusted or inoperative door jamb switch on driver's side.
- Shorted wire from signal switch to door jamb switch.
   A. This condition indicates lock cylinder (4) or reminder switch (3) is at fault. To verify, check for continuity at "E" and "F" male column connector contacts, with key removed from lock cylinder (4).
      - If continuity exits, fault is in column.
   B. Insert key into lock, then turn lock toward "START" position.
      - If reminder stops when key is in "RUN" position or when it is turned past "RUN" toward "START," problem is a sticky lock cylinder actuator.

For further diagnosis of key reminder, refer to SECTION 8A.

COLUMN-MOUNTED DIMMER SWITCH

No "LOW" or "HIGH" Beam

Inspect

1. Loose connector at dimmer switch.
2. Improper adjustment.
3. Internally damaged or worn switch. Refer to SECTION 8A.
   - Check continuity on switch at light green and tan switch terminals by pushing in plunger all the way. A click should be heard.
      — If there is no continuity, replace dimmer switch.
      — If there is continuity, refer to SECTION 8A.

PIVOT AND SWITCH ASSEMBLY

Switch Inoperative: No "LOW", "HIGH", and/or "WASH"

Inspect

1. Loose body-to-switch connector.
2. Broken or damaged switch.
3. Internally damaged or worn switch.
   - Connect a new switch without removing old one.
      — If system functions, replace switch.
      — If system doesn't function, refer to SECTION 8A.

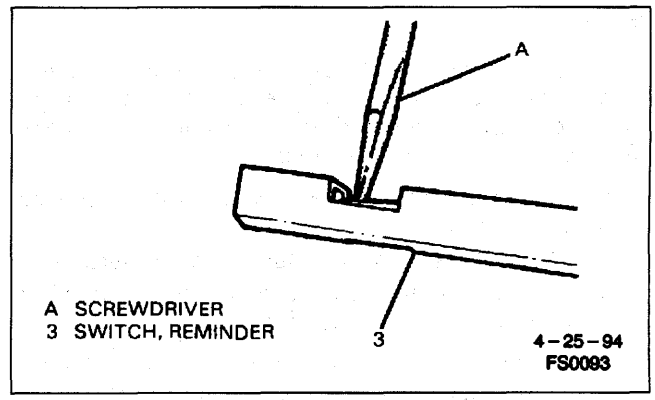


Figure 9 - Decreasing Switch Contact Gap

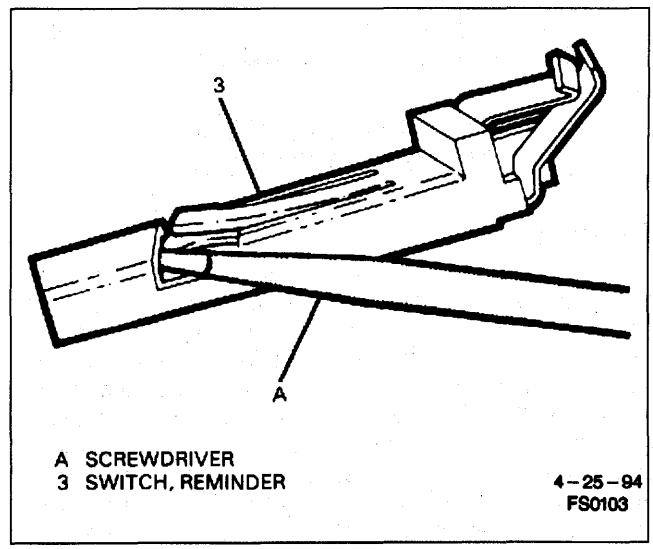


Figure 10 - Increasing Switch Contact Gap

POWER STEERING GEAR AND PUMP ASSEMBLIES LEAK

GENERAL PROCEDURE

Inspect

- For these common complaints about the power steering system:
  - — Fluid leakage on garage floor.
  - — Fluid leaks visible on steering gear assembly or pump assembly.
  - — Growling noise, especially when parking of when engine is cold.
  - — Loss of power steering when parking.
  - — Excessive steering effort required.
- For an overfilled reservoir assembly.
- For fluid aeration and overflow.
- Hose connections.
- Identify exact point of leakage. Refer to "External Leakage Check" in this section.
  - — Point from which fluid is dripping is not necessarily point where system is leaking. It is important to identify exact point of leakage.

EXTERNAL LEAKAGE CHECK

Figure 11

This procedure will help identify exact location of leak. Some leaks can easily be located but seepage type leaks may be more difficult. To locate seepage leaks, use the following method:

1. With engine off, wipe dry complete power steering system.
2. Check fluid level. Adjust fluid level as necessary.
3. Start engine, then turn steering wheel assembly from stop to stop several times.
   - Do not hold it at a stop for any length of time as this can damage pump assembly (5).
   - It is easier for someone else to operate steering wheel assembly while you search for seepage.
4. Find exact location of leak and repair.

SEAL REPLACEMENT RECOMMENDATIONS

Lip Seals

Lip seals, which seal rotating shafts, require special treatment. This type of seal is used on the hydraulic pump shaft and the pinion shaft of the steering gear assembly. When leakage occurs in this area, always replace the seal or seals, after inspecting and thoroughly cleaning the sealing surfaces. Replace the shaft if pitting is found. If corrosion in the lip seal contact zone is slight, clean the surface of the shaft with crocus cloth. Replace the hydraulic pump shaft of complete gear assembly only if the leakage cannot be stopped by smoothing with crocus cloth first.

O-Ring Seals

Whenever a part which forms a sealing surface for an O-ring is removed, the O-ring seal should also be replaced with a new O-ring seal. Lubricate all new O-ring seals with power steering fluid to ease assembly.

POWER STEERING SYSTEM TEST PROCEDURE

Tools Required:

J 5176-E Power Steering Pressure Tester 0-2000 PSI and

J 5176-92 18 mm Power Steering Gauge Adapter

J 25323-B Power Steering System Analyzer

J 29525-92 Power Steering Analyzer 18 mm Adapter

If a hydraulic or mechanical malfunction of the pump assembly or power steering gear assembly or power steering gear assembly is suspected, perform the following procedure to determine the cause.

NOTICE: See "Notice" on page 3-1 of this section.

1. Place drain pan under pump assembly on 3.4L L32 engine or remote reservoir assembly on 5.7L LT1 engine.
2. Disconnect outlet hose assembly at pump assembly on 3.4L L32 engine or remote reservoir assembly on 5.7L LT1 engine.
3. Connect spare pressure hose to pump assembly on 3.4L L32 engine or remote reservoir assembly on 5.7L LT1 engine.

Important

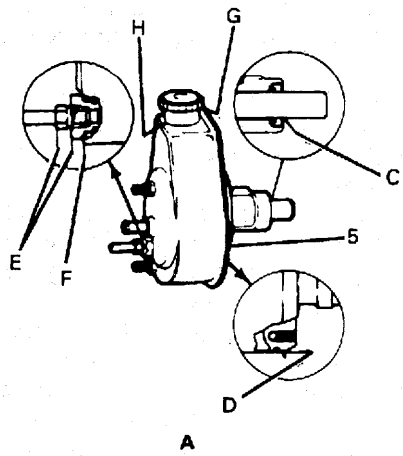
- The power steering system may be tested using J 5176-D or J 25325-A. Testing with J 25323-A will measure flow rate as well as pressure.

4. Connect J 5176-D and J 5176-92 or J 25323-A and J 29525-92 to outlet hose assembly and spare pressure hose.
5. Open valve on J 5176-D or J 25323-A.
6. Start engine and allow engine to reach normal operating temperature.
7. With engine at idle and valve open on J 5176-D or J 25323-A, pressure should be no more than 1 050 kPa (150 psi).

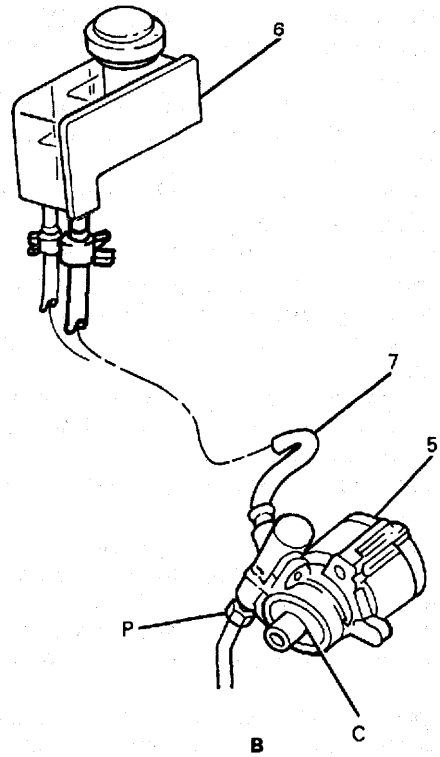
Important

- If pressure is more than 7 240 kPa (150 psi), check the hoses for restrictions and popper valve on steering gear assembly for proper assembly.

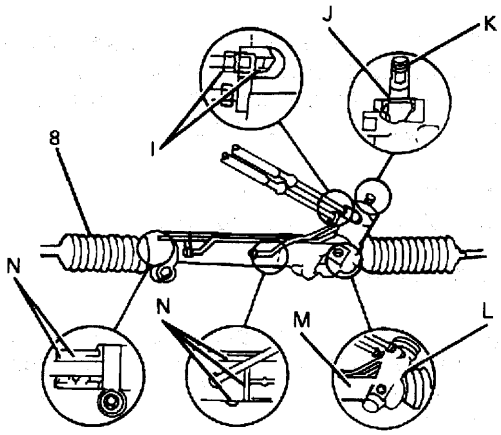
NOTICE: Do not leave the valve fully closed for more than 5 seconds as the pump assembly could be damaged.



A



B



A 3.4L L32 ENGINE
B 5.7L LT1 ENGINE
C REPLACE DRIVESHAFT SEAL. MAKE CERTAIN THAT DRIVESHAFT IS CLEAN AND FREE OF PITTING IN AREA.
D REPLACE HYDRAULIC PUMP FLOW CONTROL VALVE SEAL (O-RING).
E TORQUE HYDRAULIC PUMP HOSE FITTING NUT TO SPECIFICATIONS. IF LEAKAGE PERSISTS, REPLACE HYDRAULIC PUMP SEAL (O-RING).
F TORQUE HYDRAULIC PUMP FITTING TO SPECIFICATIONS IF LEAKAGE PERSISTS, REPLACE HYDRAULIC PUMP SEAL (O-RING).
G CHECK FLUID LEVEL. IF LEAKAGE PERSISTS WITH THE LEVEL CORRECT AND HYDRAULIC PUMP RESERVOIR CAP TIGHT, REPLACE HYDRAULIC PUMP RESERVOIR CAP.
H IF A CRACKED OR BENT HYDRAULIC PUMP FLUID RESERVOIR IS DETECTED, REPLACE HYDRAULIC PUMP FLUID RESERVOIR.
I TORQUE STEERING GEAR PIPE FITTING SEAT TO SPECIFICATIONS. IF LEAKAGE PERSISTS, REPLACE STEERING GEAR PIPE SEAL (O-RING).
J REPLACE GEAR WITH PARTIAL STEERING GEAR.
K IF LEAKAGE IS OBSERVED BETWEEN TORSION BAR AND STEERING GEAR PINION SHAFT, REPLACE WITH PARTIAL STEERING GEAR.
L IF LEAKAGE IS OBSERVED AT DRIVER SIDE AND IS NOT AFFECTED BY DIRECTION OF TURN, REPLACE WITH PARTIAL STEERING GEAR.
M IF LEAKAGE IS OBSERVED AT STEERING GEAR HOUSING END AND SPURTS WHEN BOTTOMED IN LEFT TURN, REPLACE WITH PARTIAL STEERING GEAR.
N IF LEAKAGE IS OBSERVED AT THESE POINTS, REPLACE WITH PARTIAL STEERING GEAR.
P TORQUE HYDRAULIC PUMP FITTING AND HYDRAULIC PUMP HOSE FITTING NUT TO SPECIFICATIONS. IF LEAKAGE PERSISTS, REPLACE HYDRAULIC PUMP SEAL (O-RING).
5 PUMP, POWER STEERING
6 RESERVOIR, POWER STEERING FLUID
7 HOSE, POWER STEERING FLUID OUTLET
8 GEAR, POWER STEERING

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Figure - 11 Power Steering Gear and Pump Assemblies Leak Diagnosis

8. Fully close valve on J 5176-D or J 25323-A three times and record pressure reading each time. Each reading should show at least 6 895 kPa (1,000 psi). The three readings should be within 345 kPa (50 psi) of each other.
   - If pressure readings are high enough and are within 345 kPa (50 psi) of each other, pump assembly is functioning properly.
   - If pressure readings are high enough but are not within 345 kPa (50 psi) of each other, control valve in pump assembly is sticking.
     A. Remove valve, clean it and remove any burrs using crocus cloth of fine hone.
     B. If system contains some contamination, flush it.
        - If pressure readings are less than 6 895 kPa (1,000 psi), replace flow control valve and recheck.

     — If pressures are still low, replace rotor and vanes.
9. If pump assembly checks to specification, leave valve open and turn steering wheel assembly (or have someone else turn it) to both sides.
   - Record highest pressures and compare with highest pump assembly pressure recorded earlier.

     — If pressure at both stops is not same as maximum pressure, steering gear assembly is leaking internally and must be repaired.
10. Turn off engine.
11. Remove J 5176-D and J 5176-92 or J 25323-A and J 29525-92.
12. Connect outlet hose assembly to pump assembly on 3.4L L32 engine or remote reservoir assembly on 5.7L LT1 engine.

Tighten

- Hydraulic pump hose fitting nut to 28 N.m (21 lb. ft.).

13. Bleed power steering system. Refer to SECTION 3B.

SHOCK ABSORBER ASSEMBLIES

The following procedure includes both on-vehicle and bench checks to be done when evaluating performance of shock absorber assemblies.

Important

- The single-tube shock absorber assemblies are highly gas pressurized and require a force of 445 N (100 pounds) to initiate shock absorber rod movement. Be careful not to dent or puncture the shock absorber assemblies, or they must be replaced.

Weak

1. Check and adjust tire pressures to pressures shown on tire placard.
2. Note load conditions under which vehicle is normally driven.
3. If practical, ride with owner to be sure you understand complaint before proceeding to next step.
4. Test each shock absorber assembly in turn by quickly pushing down, then lifting up, corner of the bumper nearest the shock absorber assembly being checked.
   A. Use same amount of effort on each test and note resistance on compression and rebound.
   B. Compare this with a similar vehicle having acceptable ride quality.
      - Shock absorber assemblies on both vehicles should provide the same feeling of resistance. If there is much difference between the two vehicles, go to next step.
5. Support vehicle to expose shock mounts.
6. Remove shock absorber assemblies. Refer to SECTION 3C.

CAUTION: The shock absorber assemblies are highly pressurized. Be sure to properly disassemble module or personal injury could result.

7. Disassemble plastic dust tube.
8. Remove shock absorber rod washer.

Important

- Do not fully compress shock absorber assembly. Shock absorber assemblies are highly gas charged and will extend when released.

9. Turn shock absorber assembly so lower mount is up and upper mount is down.
   - Compress shock absorber assembly against ground at various rates of speed through approximately one-half the length of the exposed chromed shock absorber rod (75 mm (3 inches) - rear; 50 mm (2 inches) - front).
10. Compare right and left shock absorber assemblies for compression resistance and rebound speed.
    - Right and left shock absorber assemblies should feel comparable.
    - Differences between front and rear shock absorber assemblies are normal.
    - If in doubt about condition, compare with a shock absorber assembly known to be good.

Noisy

1. Check all mountings for proper tightening.
   - A loose mounting will cause a noise.
2. If all mountings are intact, jounce vehicle as in step 4 in "Weak" above to isolate suspected unit.
3. If practical, ride with owner to be sure you understand complaint, before proceeding to next step.
4. Remove suspected shock absorber assembly. Refer to SECTION 3C.
5. Shake shock absorber assembly and listen for loose metallic parts inside shock absorber body.

- If suspicious noise is heard, replace shock absorber assembly.

6. Turn shock absorber assembly so lower mount is up and upper mount and rod is down.
   - Slowly compress shock absorber assembly. Do not allow chromed portion of shock absorber rod to pass below black seal cover.
7. Replace shock absorber assembly is seize is encountered wit more than 25 mm (1 inch) of chromed portion of shock absorber rod exposed above seal cover.

Leaks

1. Fully extend shock absorber assemblies (tire and wheel assemblies unsupported) to expose seal cover area for inspection.
2. Look for signs of leaks at top of shock absorber assembly.
   - A small amount of fluid is not cause for replacement. The seal permits some seepage to lubricate the shock absorber rod.
   - A leaking shock absorber assembly can easily be found because there will be an excessive amount of fluid on shock absorber assembly.
3. A leaking shock absorber assembly must be replaced.

TIRES

IRREGULAR OR PREMATURE WEAR

Figures 12 and 13

Irregular or premature tire wear has many causes. Some of them are: incorrect inflation pressures, lack of regular rotation, driving habits, or improper tire and wheel assembly assignment. If tire and wheel assembly alignment is reset due to a tire wear condition, always reset toe as close to zero degrees as the specification allows.

Rotate tires if following conditions are noted:

- Front and rear tire wear is unequal.
- Uneven wear exists across tread of any tire.
- Left and right front tire wear is unequal.

Check tire and wheel assembly alignment if following conditions are noted:

- Left and right front tire wear is unequal.
- Wear is uneven across tread of any front tire.
- Front tire treads have a scuffed appearance with "feather" edges on one side of tread ribs or blocks.

TREAD WEAR INDICATORS

Figure 12

The original equipment tires have built-in tread wear indicators to show when the tires should be replaced. These indicators will appear as 12.7 mm (1/2-inch) wide bands when the tire tread depth becomes 1.6 mm (1/16 inch). When the indicators appear in 2 or more grooves at 3 locations, replace the tire.

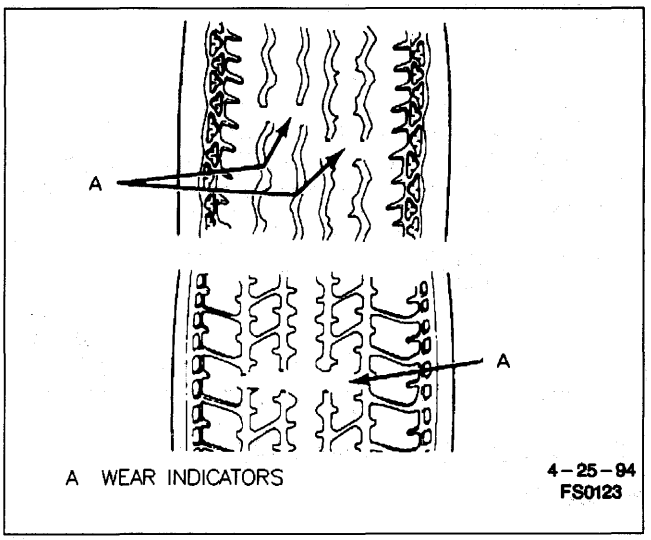


Figure 12 - Tread Wear Indicators

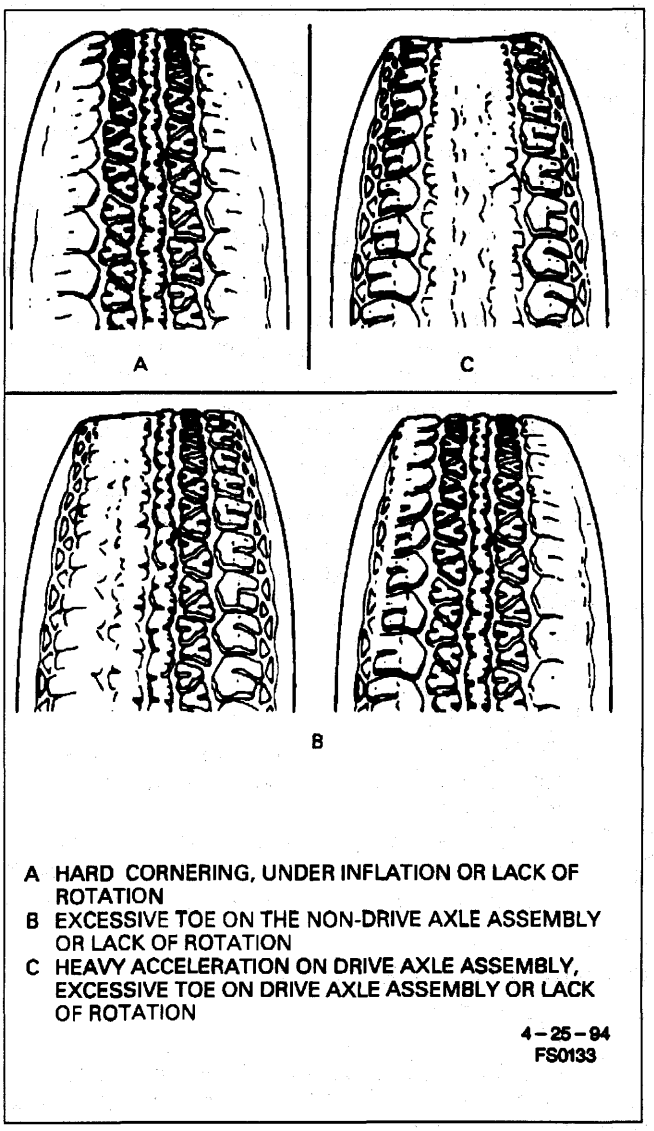


Figure 13 - Tire Wear Diagnosis

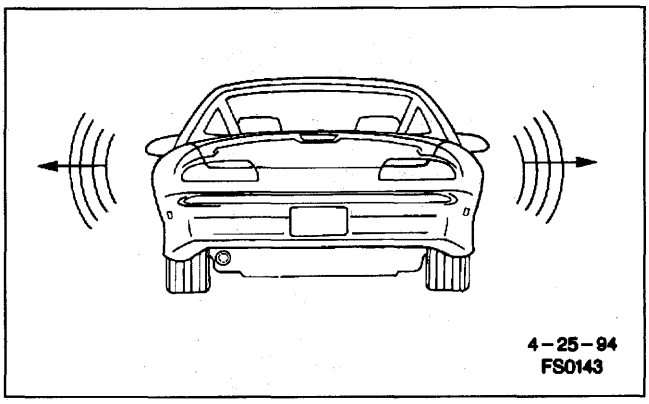


Figure 14 - Tire Waddle

TIRE WADDLE COMPLAINT

Figure 14

Tire waddle is side-to-side movement at the front and/or rear of the vehicle. It can be caused by the steel belt not being straight within the tire; or by excessive lateral runout of the tire or wheel assembly. It is most noticeable at low speed, about 8 to 48 km/h (5 to 30 mph). It may also appear as a ride roughness at 80 to 113 km/h (50 to 70 mph).

The vehicle can be road tested to see which end of the vehicle has the faulty tire. If the tire causing the tire waddle is on the rear, the rear end of the vehicle will waddle. From the driver's seat, it feels as if someone is pushing on the side of the vehicle.

If the faulty tire is on the front, the tire waddle is more easily seen. The front sheet metal appears to be moving back and forth. It feels as if the driver's seat is the pivot point in the vehicle.

A more time-consuming method of determining the faulty tire is substituting tire and wheel assemblies that are known to be good. Follow these steps:

1. Drive vehicle to determine if tire waddle is coming from front or rear.
2. Install tire and wheel assemblies known to be good from a similar vehicle in place of those on end of vehicle which is vibrating.
   - If tire waddle cannot be isolated to front or rear, start with rear tires.
3. Road test again.
   - If improvement is noted, install original tire and wheel assemblies one at a time until faulty tire is found.
   - If no improvement is noted, install tires known to be good in place of all four. Then, install originals one at a time until faulty tire is found.

RADIAL TIRE LEAD/PULL

Figure 15

Lead/pull is the deviation of the vehicle from a straight path on a level road with no pressure on the steering wheel assembly.

Lead is usually caused by:

- Poor tire construction.
- Uneven brake assemblies.
- Improper tire and wheel assembly alignment.

The way in which a tire is built can produce lead in a vehicle. An example of this is placement of the belt. Off-center belts on radial tires can cause the tire to develop aside force while rolling straight down the road and the tire will tend to roll like a cone.

The lead/pull correction chart should be used to make sure that the front tire and wheel assembly alignment is not mistaken for tire lead (Figure 15). Wheel assembly alignment, Refer to SECTION 3A.

- Rear tires will not cause lead.

VIBRATION

Figures 16 and 17

Inspect

- Improper tire inflation pressure.
- Bent rims from chuckhole or curb impact.
- Faulty tires, such as tread distortions, separations, or bulges.
  - — Slight sidewall indentations are normal and will not affect ride.
  - — Sidewall bulges are not normal and indicate impact damage.
- Mud or tar build-up on tire or wheel assembly.
- Replacement tire and wheel assembly does not conform to original part, or is of lesser quality or substitute design.
- Loose or missing balance weights or wheel nuts.
- Irregular or excessive tire wear.
- Bent or faulty drive axle assembly.

ROAD TEST

Before performing any work or testing, always road test the vehicle. Warming up the tires is necessary to eliminate any flat spotting. For vibrations that appear to be engine related, refer to SECTION 6. A road test is also necessary to determine the speed at which the vibration occurs. Low-speed vibration at speeds less than 64 km/h (40 mph) is usually related to runout. High-speed vibration at speeds greater than 64 km/h (40 mph) is usually the result of imbalance, but may be a product of both runout and imbalance.

TIRE AND WHEEL ASSEMBLY BALANCE

Before removing the tire and wheel assembly from the vehicle, mark the wheel bolt nearest the valve stem for future reference. Also mark the vehicle position (left front, etc.) on each tire.

Balance is the easiest procedure to perform and should be done first if the vibration occurs at highway speeds. An off-vehicle, two-plane dynamic balance should be performed first. This will correct any imbalance in the tire and wheel assembly. An on-vehicle finish balance may also be required. This may offset brake drum, rotor, drive axle, or wheel cover imbalance.

If balance does not correct the highway speed vibration, or if the vibration occurs at low speeds, runout may be the probable cause. Runout is the term used when components are checked for symmetry.

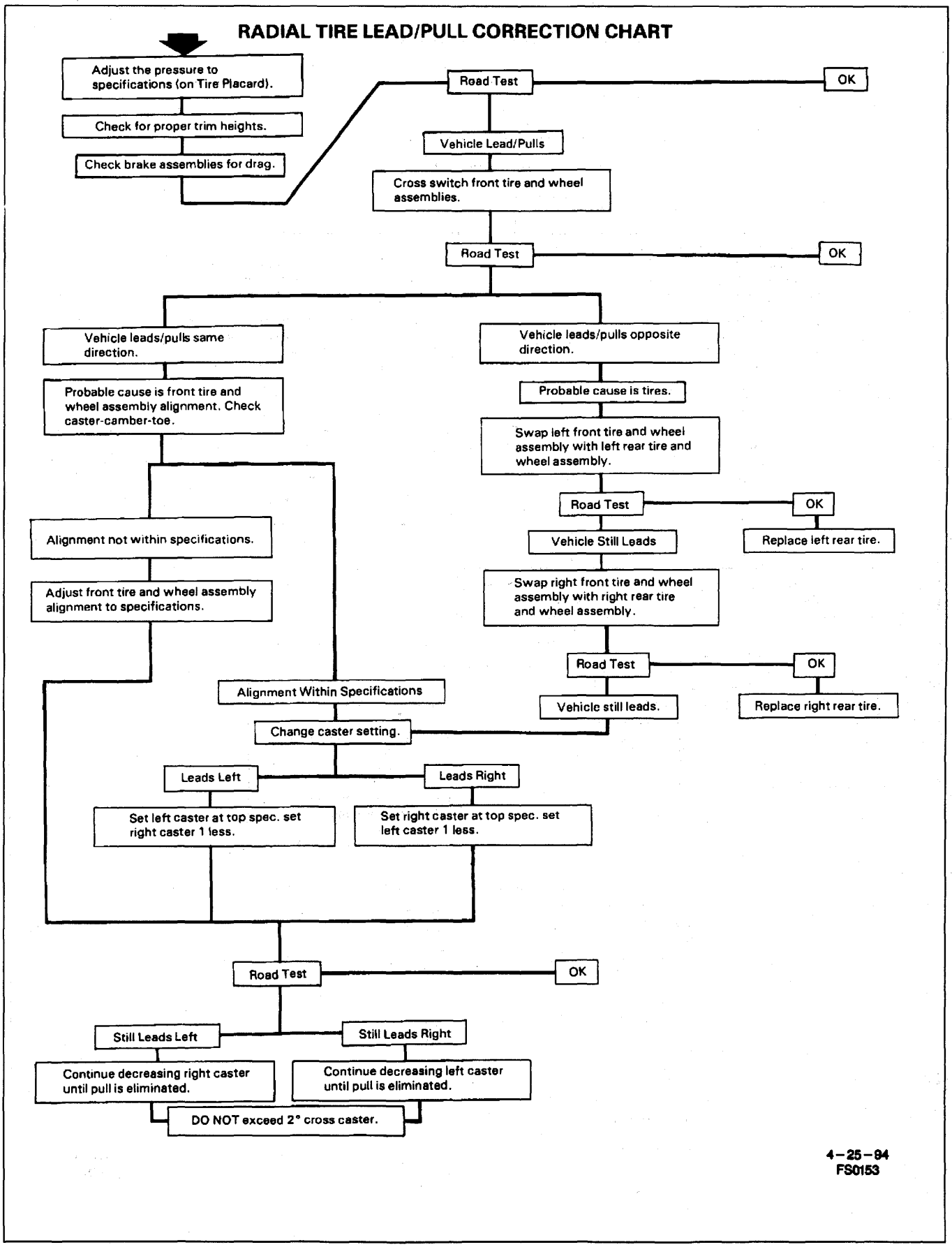


Figure 15 - Radial Tire Lead/ Pull Diagnosis

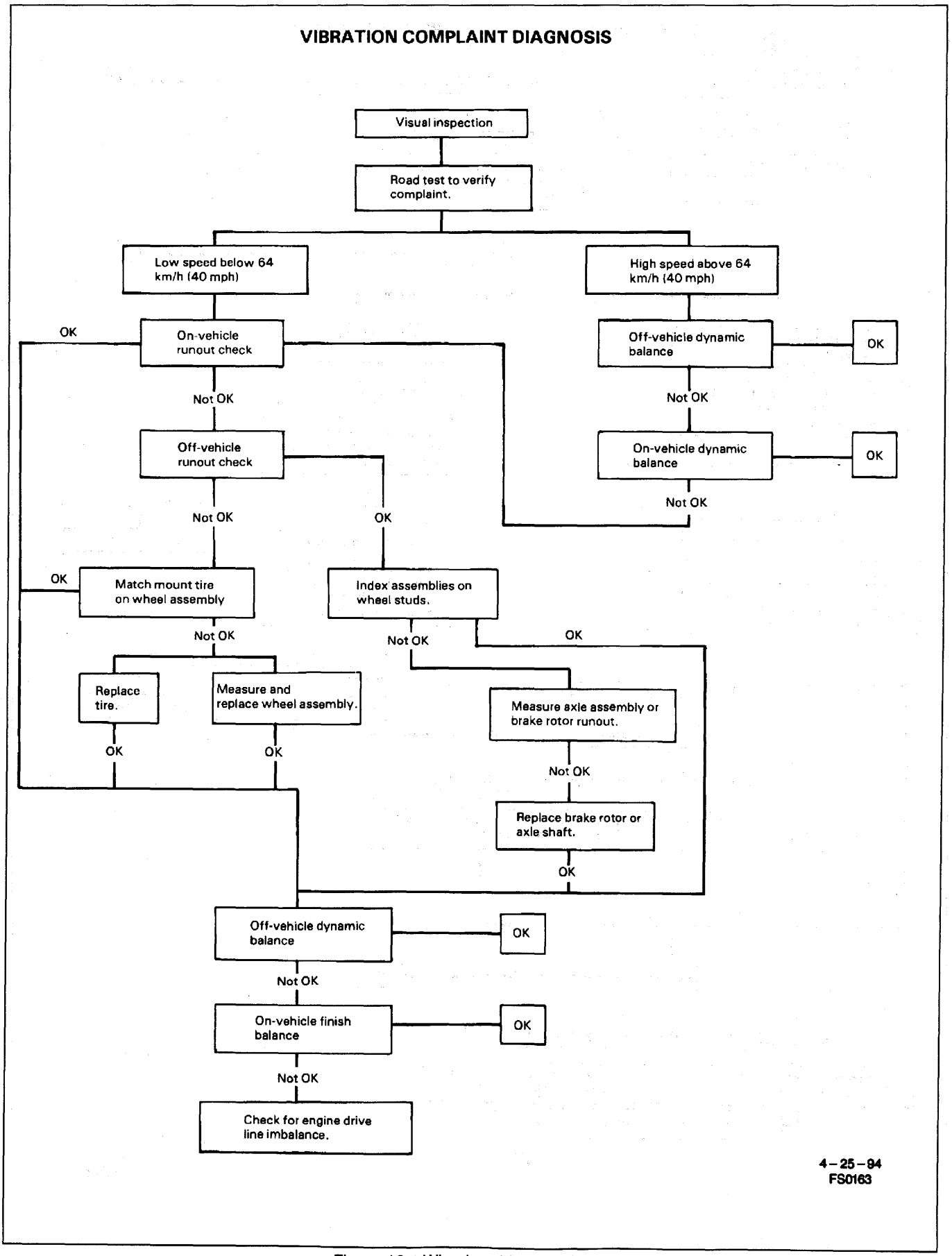


Figure 16 - Wheel and Tire Vibration

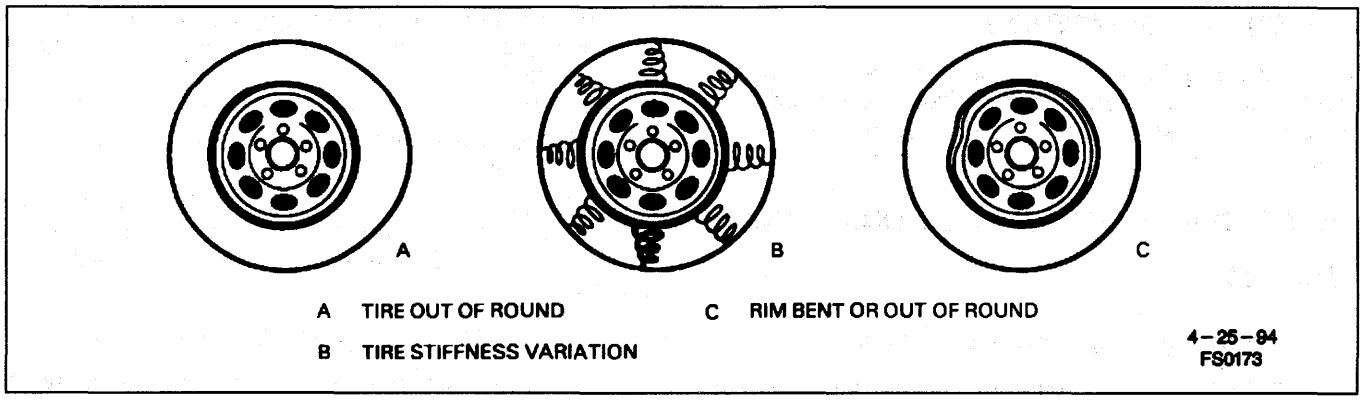


Figure 17 - Causes of Vibration/Runout

Runout can be caused by the drive axle assembly, the bearing assembly, or the way the wheel assembly attaches to the vehicle.

RUNOUT CHECK

This procedure may be stopped at whatever point the acceptable level of runout is reached.

1. Measure free runout of tire and wheel assembly on vehicle using a dial indicator with a roller wheel.
   - Lateral runout (side to side) should be measured on tires sidewall as close to tread shoulder as possible.
   - Radial runout (up and down) should b measured on center tread rib.
     — Some tread designs may require wrapping a piece of tape tightly around center tread circumference for better dial indicator contact.
2. Disregard any instantaneous indicator needle jumps due to sidewall depressions, tread blocks, etc.
3. Record total indicator reading, and location of high point of turnout.
4. If radial or lateral runout exceeds 1.52 mm (0.060 inch), mount tire and wheel assembly on a dynamic balance machine and remeasure runout.
   - Make sure wheel is centered on machine by wheel center pilot hole.
5. Record total indicator reading, and location of the high point of runout.
6. If radial or lateral runout exceeds 1.27 mm (0.050 inch), break down assembly and rotate tire on rim 180 degrees.
   - In many cases, rotating tire on wheel assembly will bring runout to an acceptable range.
   - Whenever a tire is rotated on the wheel assembly, in this way, the assembly must be rebalanced.
7. Reinflate, mount on dynamic balance machine and remeasure runout.
8. Record total indicator reading and location of high point of runout.
9. If radial or lateral runout still exceeds 1.27 mm (0.050 inch) and high point has moved approximately 180 degrees, following tire around rim, tire is faulty and should be replaced.
10. If second high point still exceeds 1.27 mm (0.050 inch) and is close to original high point, relative to the rim, wheel is faulty and should be replaced.
    A. Before replacing tire and wheel assembly, break down assembly and measure wheel separately.
    B. Replace wheel if radial runout exceeds 1.02 mm (0.040 inch), or lateral runout exceeds 1.14 mm (0.045 inch).
11. If runout of tire and wheel assembly is within limits when measured off the vehicle, yet exceeds the limits when measured on the vehicle, the attachment of tire and wheel assembly to hub is probable cause.
12. Rotate assembly two wheel bolts and recheck runout.
    - Several positions may have to be tried to find best location.
13. If runout can not be reduced to an acceptable level, remove tire and wheel assembly and measure hub stud runout.
14. If runout exceeds 0.76 mm (0.030 inch), replace hub or drive axle shaft.

TIRE FORCE VARIATION CHECK

Tire stiffness variation, or loaded radial runout can also cause a vibration. However, this is difficult to measure without a tire problem detector or a loaded radial runout buffer.

The tire problem detector is simply a roller drum that slowly rotates the tire, while under load, (mounted on the vehicle) measuring spindle movement.

The loaded radial runout buffer is a more automated machine that slowly rotates the tire under load with a roller drum off the vehicle and measures the tire's stiffness. It will then "match" the tire to the wheel by buffing off small amounts of rubber from the outer tread rows at the stiff spot. This procedure is usually effective, especially when used as a measuring device and for fine buffing only. This equipment requires careful use. Do not remove too much rubber.

Because this equipment is not always available, the most basic procedure of measuring free runout with a dial indicator, as previously detailed, is usually more practical. The free runout of the tire will usually correspond with the tire's stiff spot.

SUBSTITUTION METHOD

Install a known good set of tire and wheel assemblies. If these correct the vibration, the original tire and wheel assemblies should be reinstalled one at a time until the vibration returns.

TAPERED ROLLER BEARING DIAGNOSIS

Figure 18

When diagnosing a bearing condition:

1. Consider general condition of all parts during disassembly and inspection.
2. Identify bearing problem (Figure 18).
3. After identifying bearing problem, refer to diagnostic chart to identify cause and appropriate repair procedures.

TRIM HEIGHT

Figure 19

Incorrect trim heights can produce symptoms similar to those produced when there is a problem with the tire and wheel assembly alignment. Trim heights should be checked when diagnosing steering and vibration complaints (Figure 19).

In order to measure trim height accurately, make sure:

- Tires are at correct pressure as shown on tire placard "up to vehicle capacity."
- Fuel tank assembly is full.
- Vehicle has no additional weight or passengers.
- Seat assemblies are in full back position.
- Rear compartment is empty except for spare tire and jack assembly and simulated fuel load if required.
- Vehicle is on a known level floor.
- All door assemblies, hood assembly and rear compartment lid assembly are closed.

All dimensions shown on Figure 19 are measured vertical to the ground. Trim heights should be within +/- 10 mm (0.4 inch) to be considered correct.

Measuring "Z," "J" and :A" Dimensions

1. Lift front bumper of vehicle up approximately 38 mm (1 1/2 inches). Gently remove hands and let vehicle settle.
   A. Repeat operation for a total of 2 times.
   B. After second time, measure "Z," "J" and "A" dimensions.
2. Push front bumper down approximately 38 mm (1 1/2 inches). Gently remove hands and let vehicle rise on its own.
   A. Repeat operation for a total of 2 times.
   B. Measure "Z," "J" and "A" dimensions.
3. Calculate trim heights.
   - Trim heights are average of high and low measurements.
4. Verify trim heights with Figure 19.
5. Correct trim heights as necessary.

Measuring "D," "K" and "B" Dimensions

Repeat procedure as described for "Measuring "Z," "J" and "A" Dimensions using the rear bumper and measuring "D," "K" and "B" at the appropriate times.

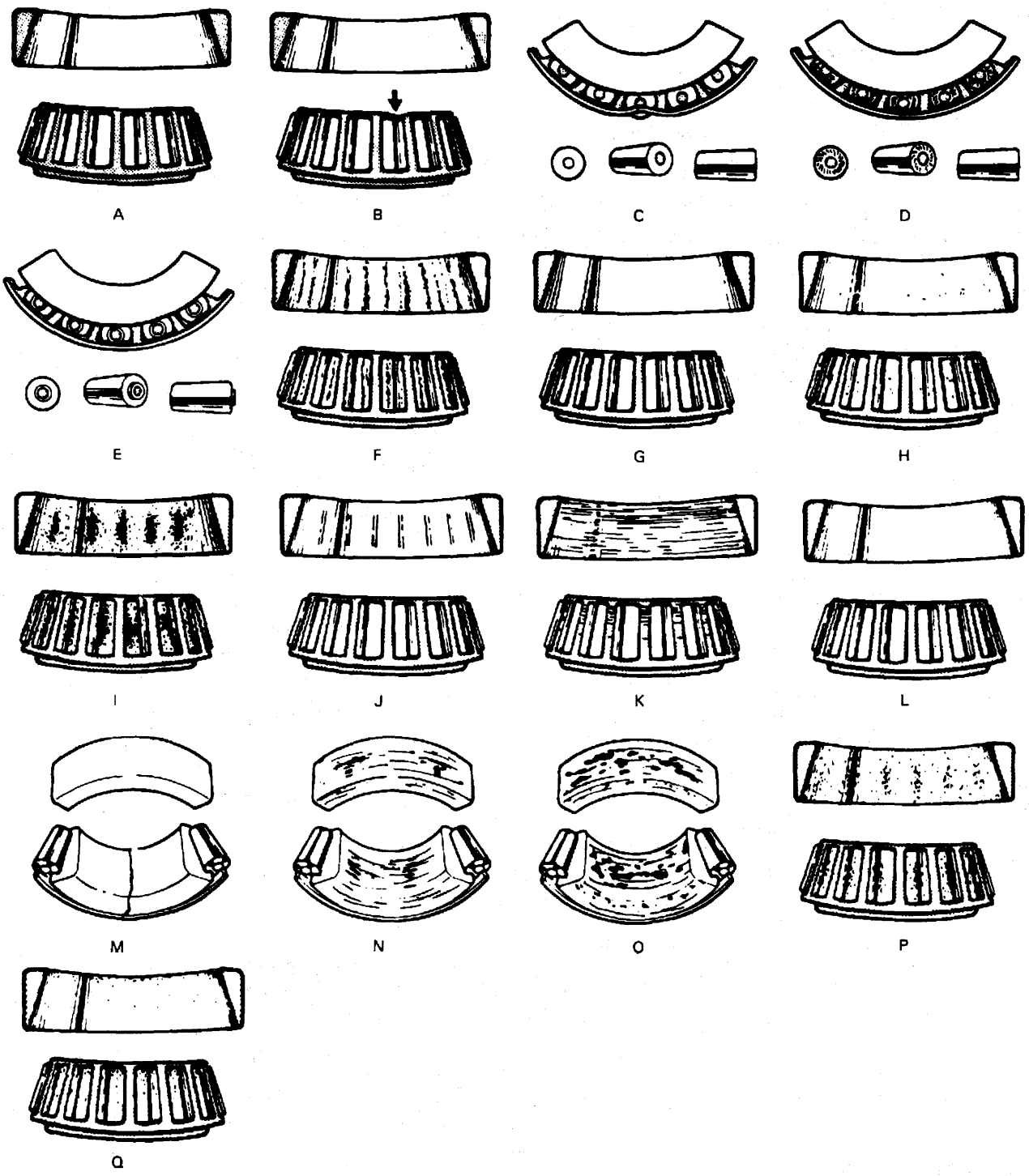
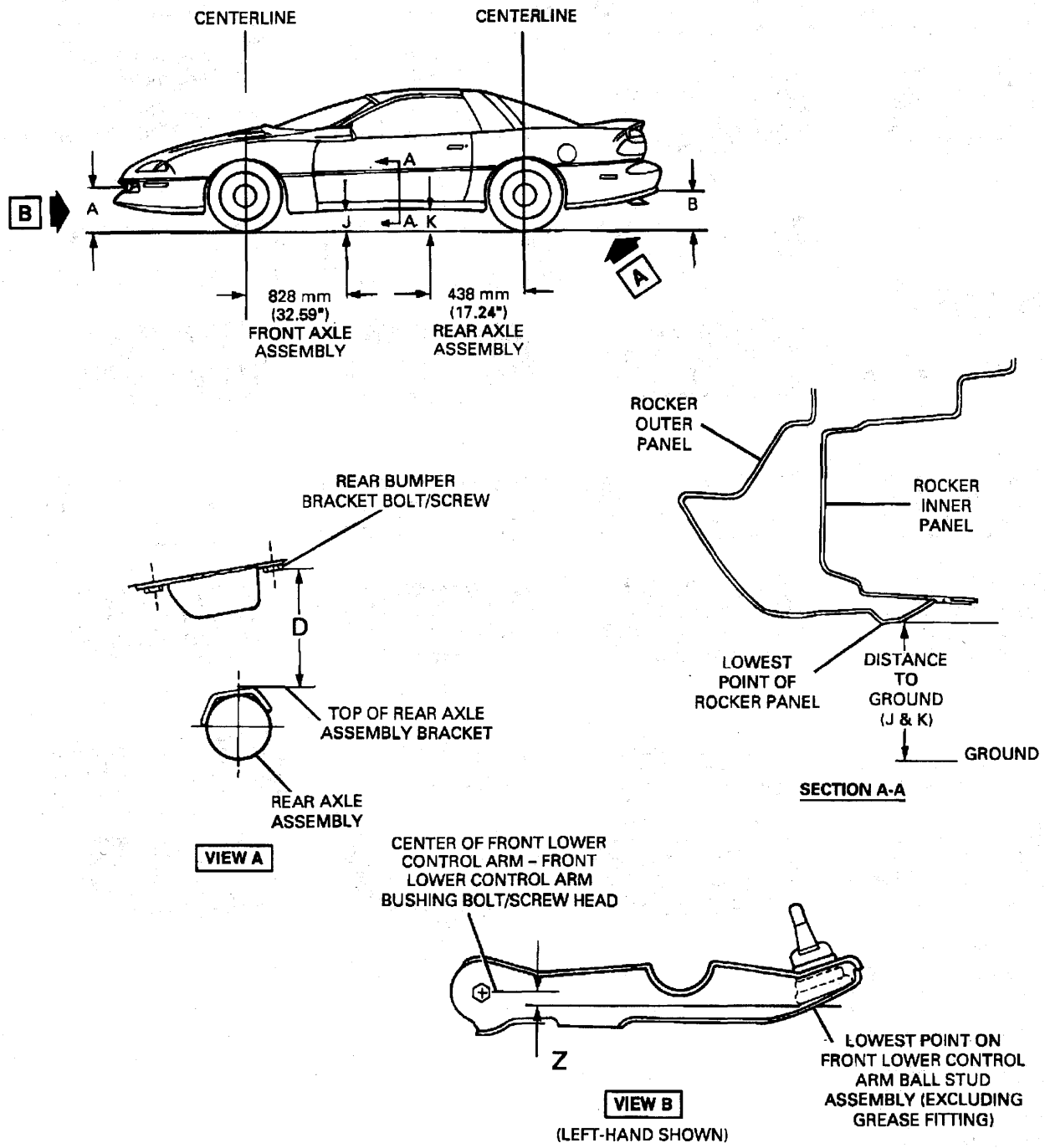


Figure 18 - Tapered Roller Bearing Diagnosis



SUSPENSION	TIRE	A		B		Z		D		J		K	
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch
F41	215-60	420	16.5	367	14.4	32	1.3	121	4.8	204	8.0	208	8.2
	235-55	420	16.5	367	14.4	30	1.2	118	4.6	204	8.0	208	8.4
FE2	235-55	420	16.5	367	14.4	31	1.2	118	4.6	204	8.0	208	8.4
	245-50	420	16.5	367	14.4	37	1.5	125	4.9	204	8.0	208	8.4

NOTE: Trim heights should be within ±10 mm (0.4 inch).

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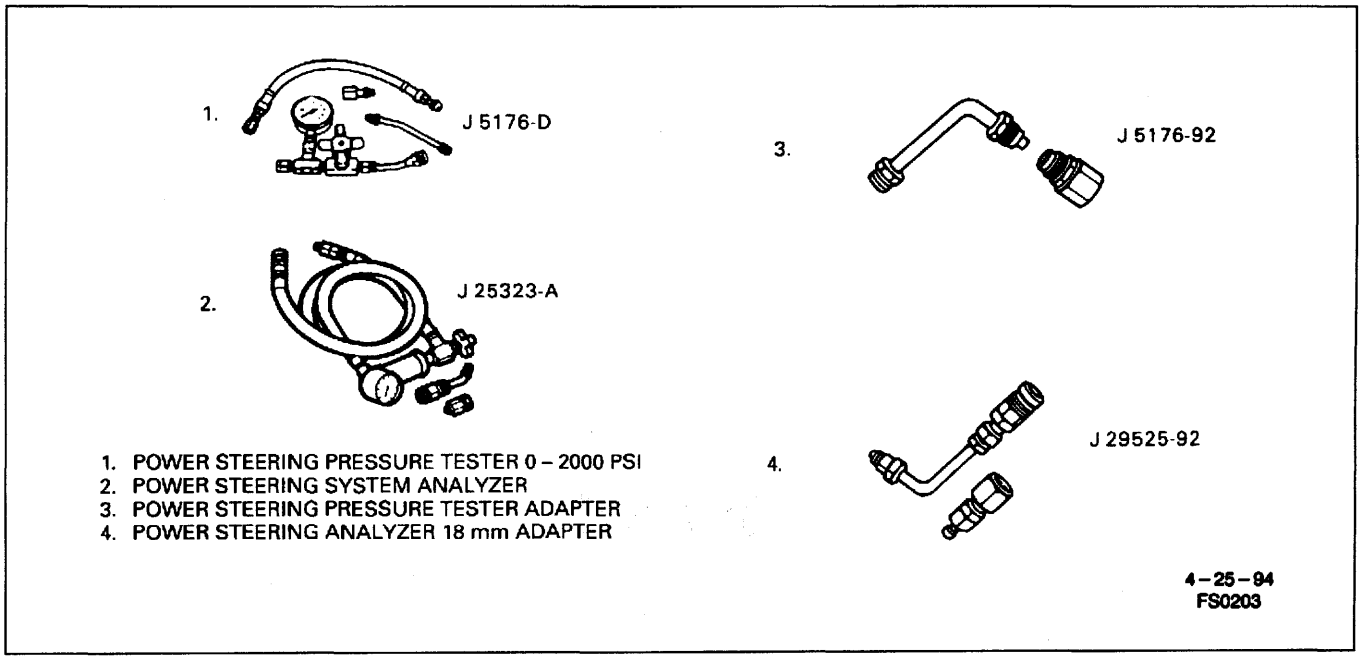
Figure 19 - Trim Height Diagnosis

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Hydraulic Pump Fitting	75 N·m (55 lb. ft.)
Hydraulic Pump Hose Fitting	28 N·m (21 lb. ft.)
Power Steering Gear Pipe Fitting Seat	28 N·m (21 lb. ft.)

SPECIAL TOOLS



BLANK

SECTION 3A

WHEEL ALIGNMENT

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

Tire and wheel assembly alignment refers to the angular relationship between the tire and wheel assemblies, the suspension attaching parts and the ground.

CASTER

Figures 1 and 2

Caster is the tilting of the front steering axis (at the top) either forward or backward from the vertical. A backward tilt is positive (+) and a forward tilt is negative (–). Caster influences directional control of the steering but does not affect tire wear and is adjustable only at the front tire and wheel assemblies.

Caster is affected by vehicle height, therefore, it is important to keep the body at its designated trim height. Overloading the vehicle or a weak or sagging rear spring will affect caster. When the rear of the vehicle is lower than its designated trim height, the front suspension moves to a more positive caster. If the rear of the vehicle is higher than its designated trim height, the front suspension moves to a less positive caster. For trim height information, refer to SECTION.

CAMBER

Figures 1 and 3

Camber is the tilting of the front tire and wheel assemblies from the vertical when viewed from the front of the vehicle. When the tire and wheel assemblies tilt outward at the top, the camber is positive (+). when the tire and wheel assemblies tilt inward at the top, the camber is negative (–). The amount of tilt is measured in degrees from the vertical and is called the camber angle. Camber setting influences directional control and tire wear.

When tire and wheel assemblies are set to a positive camber angle, they will tend to roll in a path away from the vehicle's true path. the effect of each tire and wheel assembly tends to cancel the other. The suspension geometry and camber setting are designed to keep the tire tread flat on the road through bumps or dips.

TOE

Figures 1 and 4

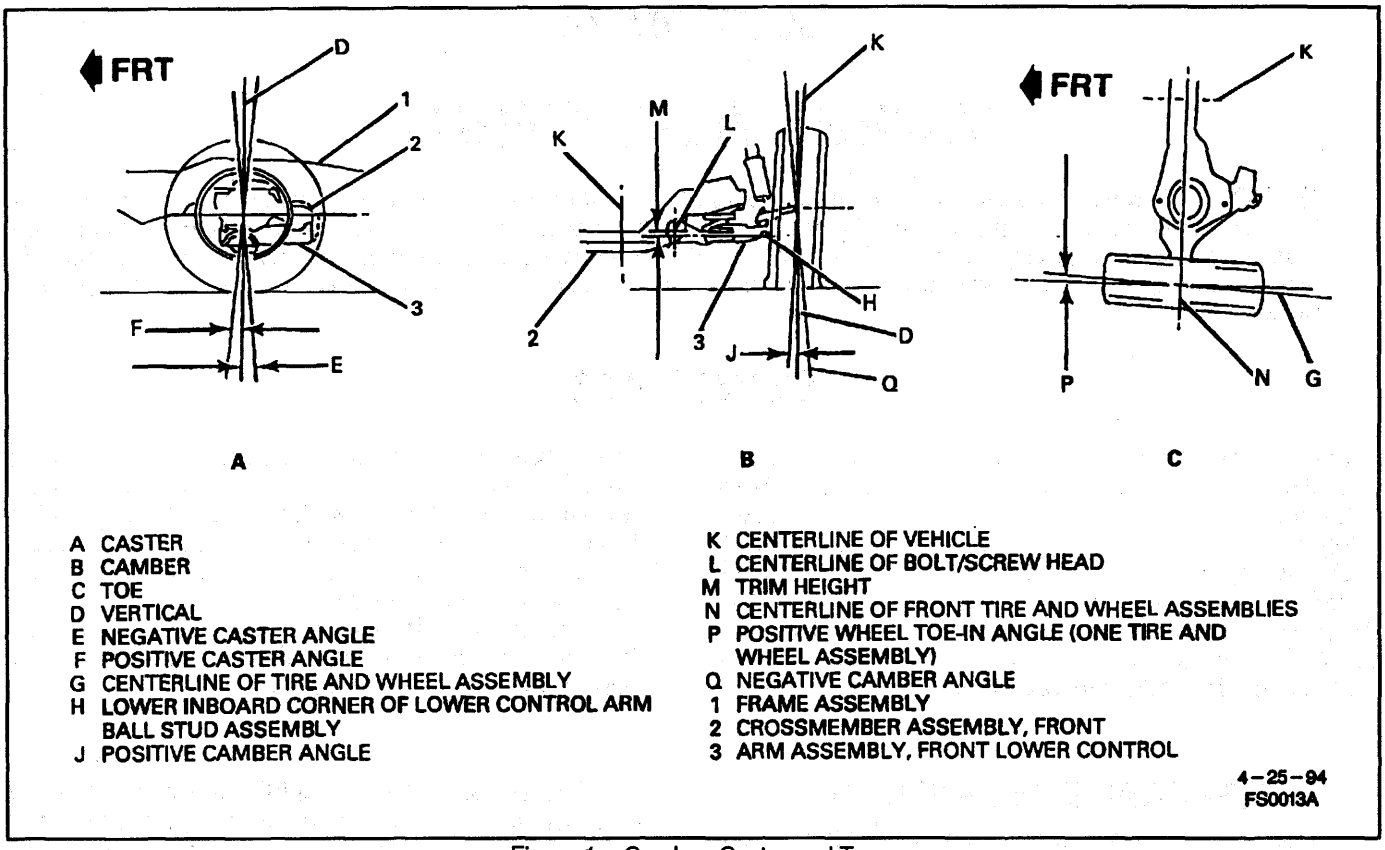
Toe is a measurement of how much the front tire and wheel assemblies are turned in or out from a straight-ahead position. When the tire and wheel assemblies are turned in, toe is positive (+). When the tire and wheel assemblies are turned out, toe is negative (–). The actual amount of toe is normally only a fraction of a degree. The purpose of toe is to ensure that the tire and wheel assembles roll parallel.

Toe also serves to offset the small deflections of the tire and wheel assembly support system which occur when the vehicle is rolling forward. In other words, even when the tire and wheel assemblies are set to toe in or out slightly when the vehicle is standing still, they tend to roll parallel on the road when the vehicle is moving. Toe affects tire wear.

THRUST ANGLE

Figure 5

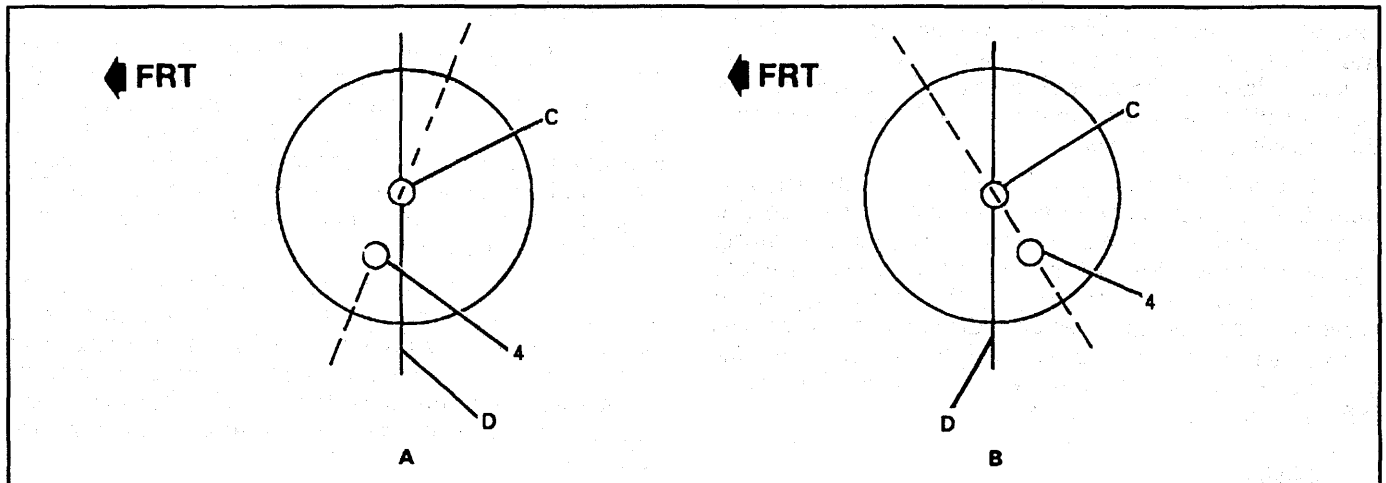
The front tire and wheel assemblies aim or steer the vehicle, but the rear tire and wheel assemblies control tracking. This tracking action is relative to thrust angle. Thrust angle is defined as the path that the rear tire and wheel assemblies will take. Ideally, the thrust angle is geometrically aligned with the body centerline.



A CASTER
B CAMBER
C TOE
D VERTICAL
E NEGATIVE CASTER ANGLE
F POSITIVE CASTER ANGLE
G CENTERLINE OF TIRE AND WHEEL ASSEMBLY
H LOWER INBOARD CORNER OF LOWER CONTROL ARM BALL STUD ASSEMBLY
J POSITIVE CAMBER ANGLE
K CENTERLINE OF VEHICLE
L CENTERLINE OF BOLT/SCREW HEAD
M TRIM HEIGHT
N CENTERLINE OF FRONT TIRE AND WHEEL ASSEMBLIES
P POSITIVE WHEEL TOE-IN ANGLE (ONE TIRE AND WHEEL ASSEMBLY)
Q NEGATIVE CAMBER ANGLE
1 FRAME ASSEMBLY
2 CROSSMEMBER ASSEMBLY, FRONT
3 ARM ASSEMBLY, FRONT LOWER CONTROL

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Figure 1 - Camber, Caster and Toe



A CASTER IS POSITIVE WHEN LOWER CONTROL BALL STUD ASSEMBLY IS AHEAD OR PULLING THE SPINDLE
B CASTER IS NEGATIVE WHEN THE LOWER CONTROL BALL STUD ASSEMBLY IS BEHIND OR PUSHING THE SPINDLE
C SPINDLE
D VERTICAL
4 STUD ASSEMBLY, FRONT LOWER CONTROL ARM BALL

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Figure 2 – Caster

PRELIMINARY INSPECTIONS

Steering and vibration complaints are not always the result of improper alignment. Another possibility is tire "lead" due to worn or improperly manufactured tires. "Lead" is the vehicle deviation from a straight path on a level road without pressure on the steering wheel assembly. To determine of the vehicle has a tire lead problem, refer to SECTION 3.

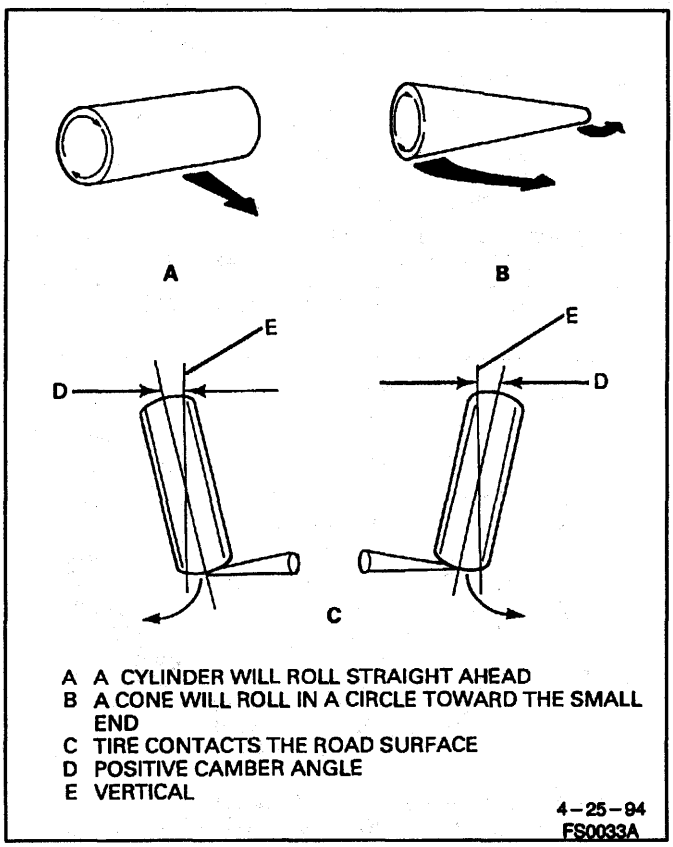


Figure 3 – Camber

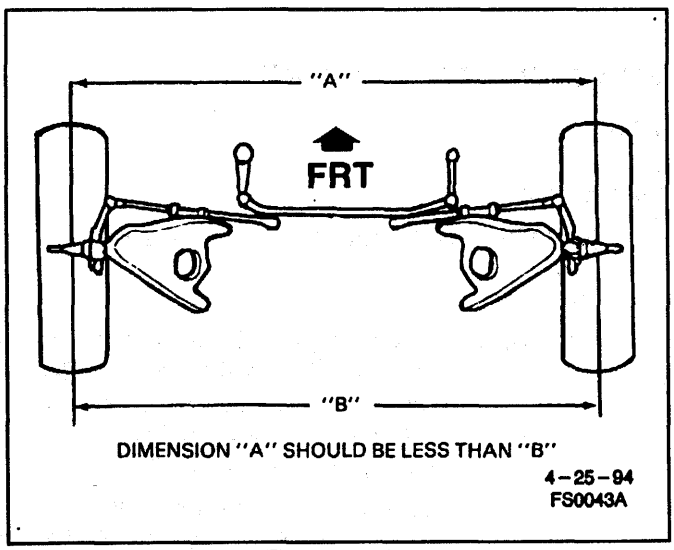


Figure 4 – Toe

Before making any adjustment affecting tire and wheel assembly alignment, make the following inspections to ensure correct alignment readings and alignment adjustments.

Inspect

- All tires for proper inflation pressures. Also check that all tires have about the same tread wear.
- Control arm ball stud assemblies. If they are loose, correct them before adjusting tire and wheel assembly alignment. Refer to SECTION 3C.

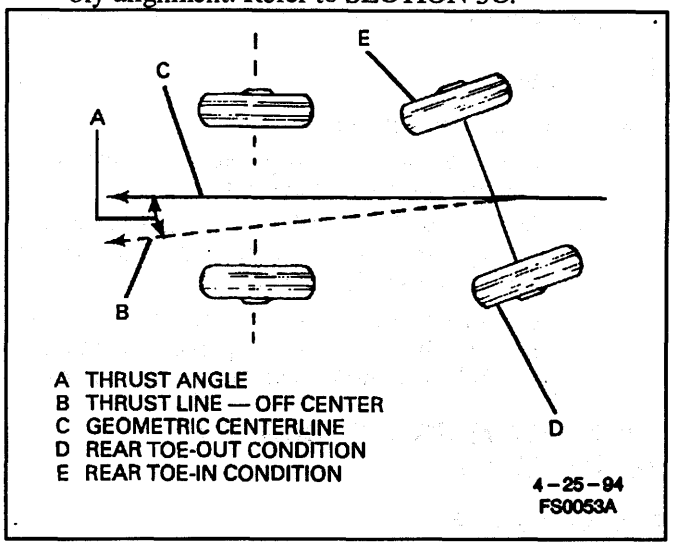


Figure 5 – Thrust Angle

- Tie rod ends. If they are loose, correct them before adjusting tire and wheel assembly alignment. Refer to SECTION 3B.
- Runout of tire and wheel assemblies. Refer to SECTION 3.
- Vehicle trim height. If out of limits and a correction is to be made, do so before adjusting alignment. Refer to SECTION 3 for trim height chart.
- Steering gear assembly for looseness at frame assembly.
- Control arm assemblies for loose bushing assemblies.
- Stabilizer shaft for loose or missing parts.
- Improperly operating shock absorber and spring assemblies.
- Suspension and steering components for damage. Replace parts as necessary.
- Vehicle for stability. The fuel tank assembly should be full, or the vehicle should have compensating ballast.
- Jounce vehicle lightly three times rear and three times front.

Consideration must be given to excess loads, such as tool boxes, sample cases, etc. If these items are normally carried in the vehicle, they should remain in the vehicle during alignment adjustments.

Consideration should also be given to the condition of the equipment being used to adjust alignment. Be sure to follow the equipment manufacturer's instructions. Regardless of the equipment used to adjust alignment, the

vehicle must be on a level surface, both front-to-rear and side-to-side.

ON-VEHICLE SERVICE

MEASURING FRONT ALIGNMENT ANGLES

Satisfactory vehicle operation may occur over a wide range of alignment settings. However, should the settings vary beyond the specifications shown at the end of this section, the alignment angles should be corrected.

Measure

- Front alignment angles.
  - A. Install alignment equipment according to the manufacturer's instructions.
  - B. Jounce the front and rear bumper assemblies lightly three times to normalize suspension prior to measuring angles.
  - C. Measure alignment angles and record the readings. If adjustments are required, make them in the following order: camber, caster, and toe.

FRONT CAMBER AND CASTER ADJUSTMENT

Figures 6 and 7

Tool Required:

J 38658 Camber/Caster Adjuster

Adjust

1. Jounced front bumper assembly three times to allow vehicle to return to normal height before making any adjustments in caster.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Loosen front lower control arm nuts. Refer to SECTION 0A.
4. Install J 38658 to slot holes in lower control arm assembly (3) and front crossmember assembly (2) (Figure 6).
5. Camber by rotating turnbuckle on J 38658.
   - Rotating turnbuckle clockwise will increase camber.
   - Rotating turnbuckle counterclockwise will decrease camber.
6. Install J 38658 to slot holes in lower control arm assembly (3) and front crossmember assembly (2) (Figure 7).
7. Caster by rotating turnbuckle on J 38658.
   - Rotating turnbuckle clockwise will increase caster.
   - Rotating turnbuckle counterclockwise will decrease caster.
8. Remove J 38658 from slot holes.
9. Tighten front lower control arm nuts. Refer to SECTION 3C.
10. Lower vehicle.

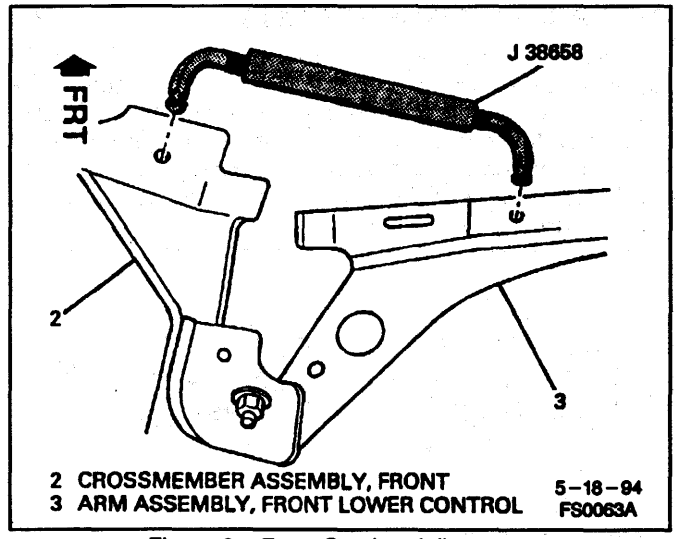


Figure 6 – Front Camber Adjustment

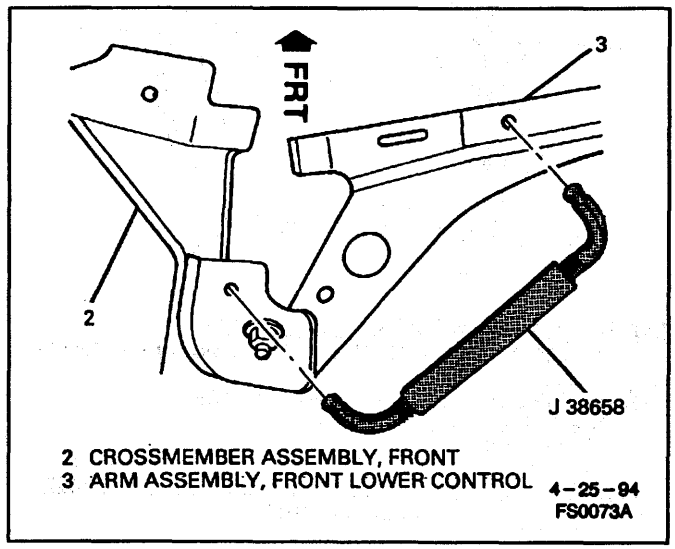


Figure 7 – Front Caster Adjustment

FRONT TOE ADJUSTMENT

Figure 8

Adjust

NOTICE: See "Notice" on page 3A-1 of this section.

- Toe
  - A. Make sure steering wheel assembly is set in a straight-ahead position within ± 3.5 degrees.
  - B. Toe adjustments are made separately at each individual tire and wheel assembly.
  - C. Loosen nut (8) on inner tie rod (7).
  - D. Toe to specification by turning inner tie rod (7). Refer to "Alignment Specifications" in this section.
    - Left and right toe adjustment should be equal within ± 0.2 degrees.

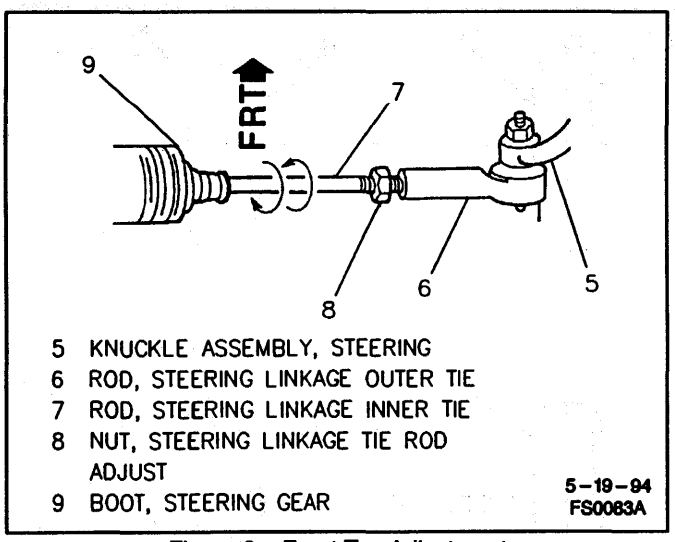


Figure 8 – Front Toe Adjustment

E. Make sure steering gear boot seal is not twisted.

Tighten

- Nut (7) to 47 N•m (35 lb. ft.).

F. Check specifications for adjustment. readjust by repeating steps if necessary.

MEASURING REAR ALIGNMENT ANGLES

Figure 9

After front tire and wheel assembly alignment has been completed, the rear alignment angles should be checked if there is excessive rear tire wear or tire and wheel assemblies do not track properly. Rear tire and wheel assemblies (14) should be parallel to and the same distance from the vehicle's centerline.

If tires do not track correctly after a front tire and wheel assembly alignment, no amount of adjustment will correct the problem. Poor tracking or excessive rear tire wear after a front tire and wheel assembly alignment usually indicates that the axle housing assembly. frame assembly or suspension arms have been bent.

Rear alignment angles can be checked as follows:

Measure

- Rear alignment angles.
  - A. Back vehicle squarely onto alignment machine.
  - B. Compensate for tire and wheel assembly run-out the same as for checking front tire and wheel assembly toe-in.
  - C. Check camber reading – which should be 0.0 degrees ± 0.6 degrees.
  - D. Check amount of toe – which should be 0.0 degrees ± 0.3 degrees.
    - When using an alignment machine to measure toeout, the measurement will read as toe-in on the scale.
    - When checking toe-in with a tram gage, the measurement will read correctly as toe-out. However, when using a tram gage, it will still be necessary to perform steps A and B to check camber.

REAR THRUST ANGLE ADJUSTMENT

If the thrust angle is not within specifications, inspect the upper and lower control arm assemblies for damage. If the control arm assemblies are not damaged, then check the frame dimensions. Refer to SECTION 10-3.

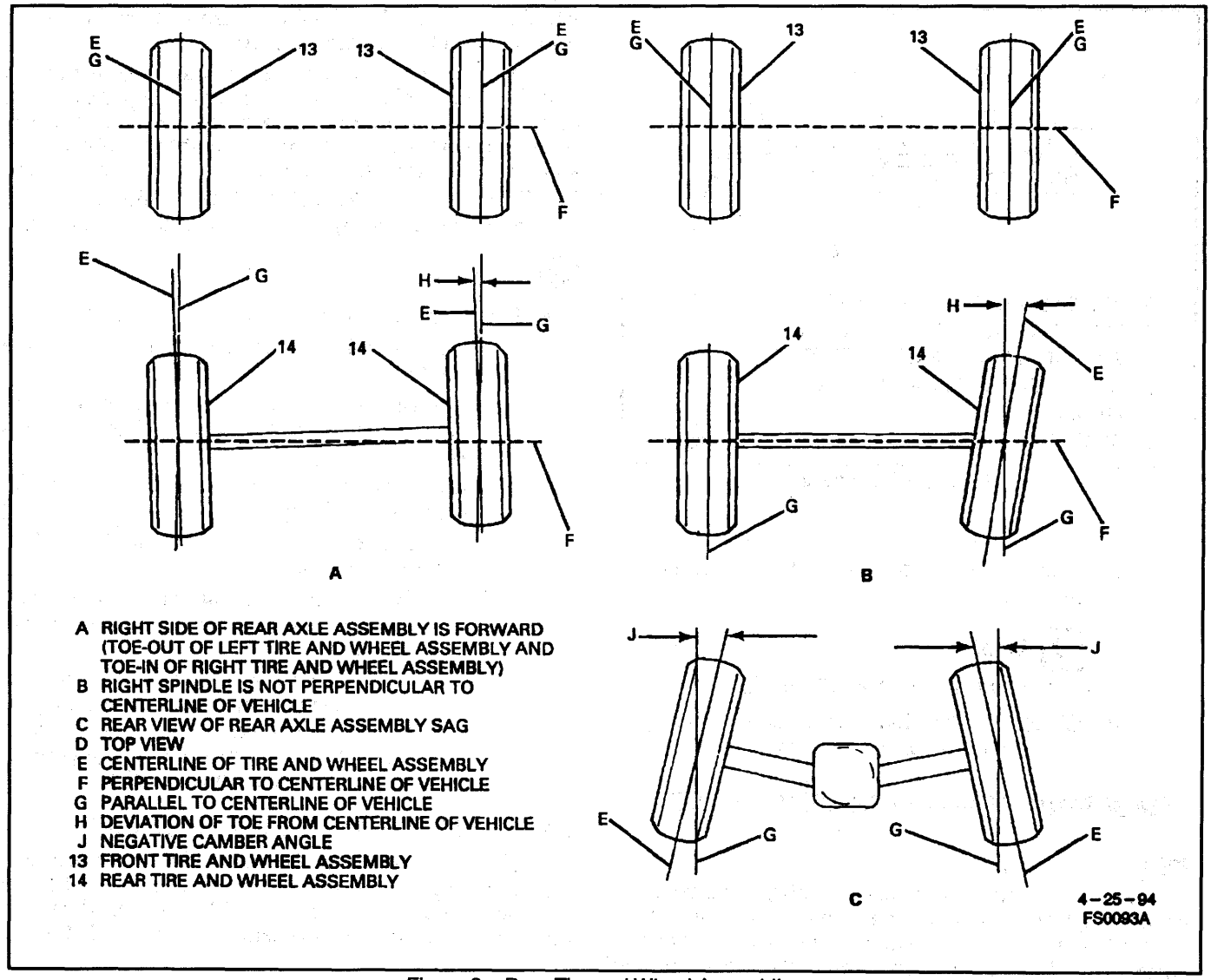


Figure 9 – Rear Tire and Wheel Assemblies

SPECIFICATIONS

TIRE AND WHEEL ASSEMBLY ALIGNMENT SPECIFICATIONS

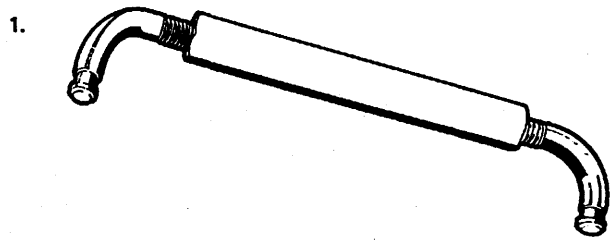
	SET	CHECK
Front		
Caster	4.4° ± 0.5°	4.4° ± 1.0°
Cross Caster	0.0° ± 0.7°	0.0° ± 0.7°
Camber	0.4° ± 0.5°	0.4° ± 1.0°
Cross Camber	0.0° ± 0.7°	0.0° ± 0.7°
Individual Toe	0.0° ± 0.1°	0.0° ± 0.1°
Total Toe	0.0° ± 0.2°	0.0° ± 0.2°
Steering Wheel Angle	0.0° ± 3.5°	0.0° ± 3.5°
Rear		
Camber	0.0° ± 0.6°	0.0° ± 1.6°
Cross Camber	0.0° ± 0.6°	0.0° ± 0.6°

Total Toe	0.0° ± 0.3°	0.0° ± 0.3°
Thrust Angle	0.0° ± 0.15°	0.0° ± 0.15°

FASTENER TIGHTENING SPECIFICATIONS

Steering Linkage Tie rod Adjust Nut	47 N•m (35 lb. ft.)

SPECIAL TOOLS



1. CAMBER/CASTER ADJUSTER

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BLANK

SECTION 3B

POWER STEERING GEAR AND PUMP ON-VEHICLE SERVICE

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque valve must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

NOTICE: Do not start the vehicle with any power steering gear inlet or outlet hoses disconnected. When disconnected, cap or plug all openings of components. failure to do so could result in contamination or loss of power steering fluid and damage to the system.

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GENERAL DESCRIPTION

POWER STEERING GEAR ASSEMBLY

Figures 1 and 2

The major internal components of the steering gear assembly (1) are the power steering gear pinion and valve shaft assembly, steering gear rack and piston assembly and tie rod assemblies (inner and outer tie rods). The steering gear rack and piston assembly is supported at its ends in the steering gear housing and sealed to prevent both external and leakage across the piston. The pinion and valve assembly intersects and meshes directly with the teeth of the rack and piston assembly. Manual steering is always available at times when the engine is not running or in the event of power steering pump assembly (4 or 32) or serpentine belt failure. Steering effort is increased under such conditions.

The movement of the gear assembly components, when either parked or moving, is aided by hydraulic pressure and fluid flow supplied by the power steering pump assembly (4 or 32). Pressurized fluid is directed by the valve during a steer maneuver and travels through external steel cylinder lines to act on the rack and piston assembly. When the vehicle is turned right, the steering valve is opened and routes pressurized fluid to the left side of the piston, while allowing fluid to escape from the right side and return to the valve area. The pressure of the fluid to escape from the right side and return to the valve area. the pressure of the fluid is converted to a mechanical force applied to the piston and the difference in force across the piston causes the rack to move to the right. The opposite occurs when the gear assembly (1) is turned to the left. whenever the pump assembly (4 or 32) provides pressurized fluid to the gear assembly (1) and the valve is operating correctly, the effort to steer the vehicle is created by this pressure difference at the piston. For information on power steering gear assembly unit repair, refer to SECTION 3B1A.

POWER STEERING PUMP ASSEMBLY

Figures 1 and 2

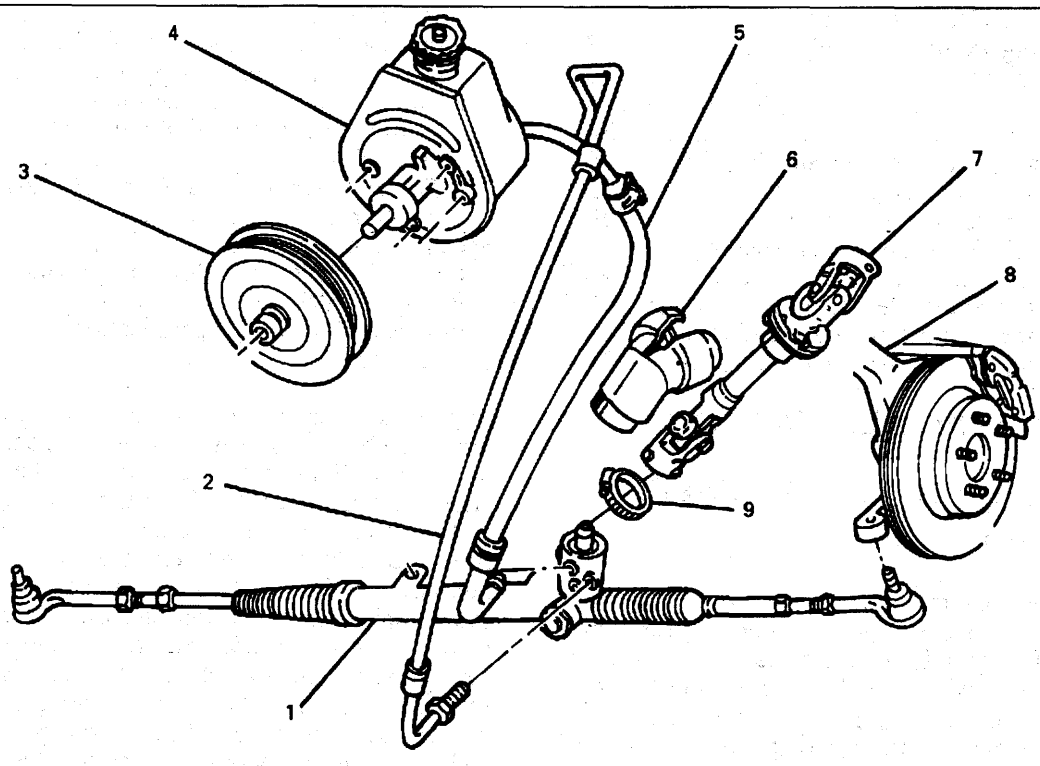
A constant displacement vane-type pump assembly provides hydraulic pressure and flow for the power steering system. The pump assembly (4 or 32) is located on the engine and is belt driven by the power steering pulley assembly (3 or 31).

The major components of the pump assembly (4 or 32) are the fluid reservoir. Drive shaft, pump housing, pump fitting, flow control valve and spring, thrust and pressure plates, pump ring, rotor and vanes.

The housing and component parts are "Submerged" in the fluid reservoir in the 3.4L L32 engine. The 5.7L LT1 engine has a remote reservoir assembly (10). The reservoir cap assemble (24) has a fluid level indicator attached to show the fluid level in the reservoir.

For the 3.4L L32 engine pump assembly (4), there are two bore openings at the rear of the housing. The larger opening contains all of the pump assembly components, except the flow control valve, spring and pump fitting, which are in the small bore. The flow control fitting, working with the flow control valve and spring, limits the maximum flow of the pump assembly (4). The pressure relief valve, inside the flow control valve, limits the maximum pump assembly (4) pressure. For the 5.7L LT1 engine pump assembly (32), the bore at the rear of the housing contains the same set of components as the 3.4L L32 engine pump assembly (4). The pressure relief valve, inside the flow control valve, limits the maximum pump assembly (4) pressure.

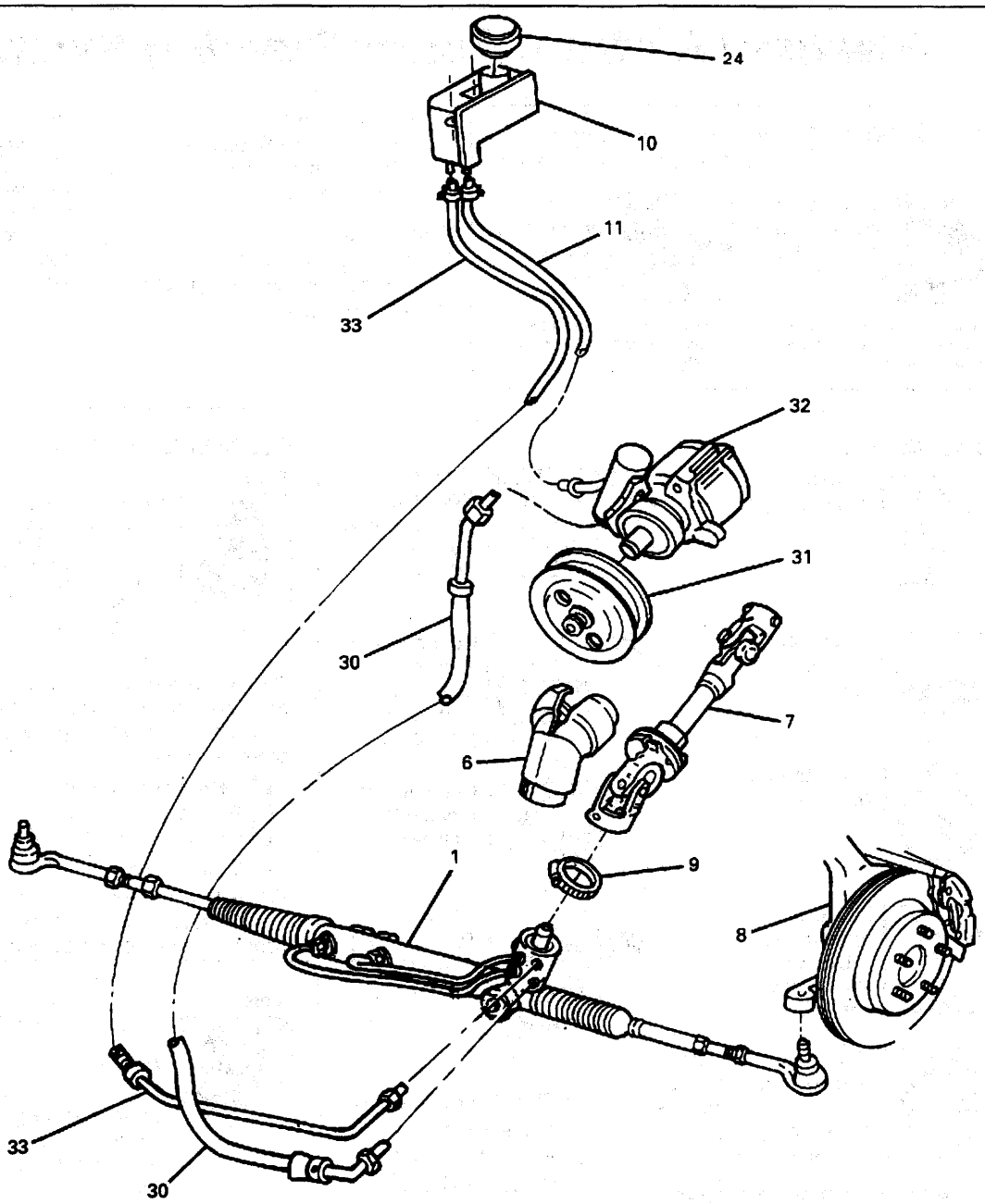
For the 5.7L LT1 engine pump assembly (32), the bore at the rear of the housing contains the same set of components as the 3.4L L32 engine pump assembly (4). The flow control valve, spring and pump fitting are located in the top of the pump housing, in the casting boss that runs across the housing. For information on power steering pump assembly unit repair, refer to SECTION 3B1B.



1 GEAR ASSEMBLY, POWER STEERING
2 HOSE ASSEMBLY, POWER STEERING GEAR INLET
3 PULLEY ASSEMBLY, POWER STEERING PUMP
4 PUMP ASSEMBLY, POWER STEERING
5 HOSE ASSEMBLY, POWER STEERING GEAR OUTLET
6 BOOT, STEERING GEAR
7 SHAFT ASSEMBLY, STEERING GEAR COUPLING
8 KNUCKLE ASSEMBLY, STEERING
9 CLAMP, STEERING GEAR COUPLING SHIELD

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Figure 1 - Power Steering System (3.4L L32 Engine)



1 GEAR ASSEMBLY, POWER STEERING
6 BOOT, STEERING GEAR
7 SHAFT ASSEMBLY, STEERING GEAR COUPLING
8 KNUCKLE ASSEMBLY, STEERING
9 CLAMP, STEERING GEAR COUPLING SHIELD
10 RESERVOIR ASSEMBLY, POWER STEERING FLUID
11 HOSE ASSEMBLY, POWER STEERING FLUID RESERVIOR
24 CAP ASSEMBLY, POWER STEERING FLUID RESERVOIR
30 HOSE ASSEMBLY, POWER STEERING GEAR INLET
31 PULLEY ASSEMBLY, POWER STEERING PUMP
32 PUMP ASSEMBLY, POWER STEERING
33 HOSE ASSEMBLY, POWER STEERING GEAR OUTLET

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Figure 2 - Power Steering System (5.7L LT1 Engine)

Bleeding Air from Power Steering Systems

Before bleeding: Inspect steering system. Check, and correct as needed:



Hoses must not touch any other part of vehicle.

- Steering system noise could be caused by hose touching frame, body, or engine



All hose connections must be tight.

- Loose connections might not leak but could allow air into system

When to bleed:
After any component replacement
After disconnecting fluid line
In case of steering system noise

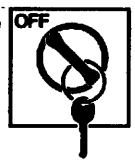
Why bleed?
To prevent pump damage
To ensure proper system operation
To stop steering system noise

Power Steering Fluid
Use only clean, new power steering fluid Fluid must be

Conventional Climate
GM #1052884 – 16 ounce
#1050017 – 32 ounce

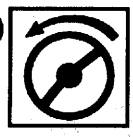
Cold Climate
GM #12345866 – 16 ounce
#12345867 – 32 ounce

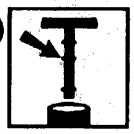
How to bleed:

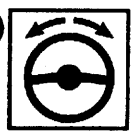
1. 

Switch ignition off.

2. 
Raise front wheels off ground.

3. 
Turn steering wheel full left.

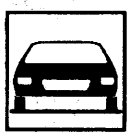
4. 
Fill fluid reservoir to "FULL COLD" level. Leave cap off

5. 
With assistant checking fluid level and condition, turn steering wheel lock-to-lock at least 20 times Engine remains off.
   - On systems with long return lines or fluid coolers, turn steering wheel lock-to-lock at least 40 times
   - Trapped air may cause fluid to overflow Thoroughly clean any spilled fluid to allow for leak check
   - Keep fluid level at "FULL COLD"

6. 
While turning wheel, check fluid constantly
   - No bubbles are allowed
   - For any sign of bubbles, recheck connections Repeat step 5

7. 

Start engine. With engine idling, maintain fluid level. Reinstall cap

8. 
Return wheels to center Lower front wheels to ground.

9. 

Keep engine running for two minutes

10. 
Turn steering wheel in both directions

Verify
- ☑ Smooth power assist
- ☑ Noiseless operation
- ☑ Proper fluid level
- ☑ No system leaks
- ☑ Proper fluid condition
- No bubbles, no foam, no discoloration

11. If all proper conditions apply, procedure is complete

12. If any problem remains, see "Special Conditions"

Special Conditions:

Fluid



- Foam or bubbles in fluid
  Fluid must be completely free of bubbles In step 5, be alert to periodic bubbles that could indicate a loose connection or leaky O-ring seal in either the return hose or pressure hose
- Discolored fluid
  (milky, opaque, or light tan color)

Switch ignition off Wait two minutes Recheck hose connections Repeat steps 7-10 If condition still exists, replace and check a possible cause
- ☑ Return hose clamps
- ☑ Return hose O-ring
- ☑ Pressure hose O-rings
- ☑ Gear cylinder line O-rings

Fill system and repeat bleed procedure for each possible cause Repeat steps 7-10 to verify whether noise has been eliminated

Noise



- Pump whine or groan

With engine running, recheck hoses for possible contact with frame body or engine If no contact is found, follow either method below to cool down fluid and repressurize system

Method 1: Normal Cool Down
Switch engine off
Wait for system to cool
Install reservoir cap

Method 2: Partial Fluid Replacement
Switch engine off
Use a suction device to remove fluid from reservoir
Refill with cool, clean fluid
Install reservoir cap

After either method of cooling, start engine and allow engine to come up to operating temperature If noise persists, remove and replace power steering pump Repeat bleed procedure following pump replacement

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Figure 3 - Bleeding Air from Power Steering Systems

SEAL REPLACEMENT

Lip Seals

Lip seals, which seal rotating shafts, require special treatment. This type of seal is used on the hydraulic pump shaft of the pump assembly. When leakage occurs in this area, always replace the seal or seals, after inspecting and thoroughly cleaning the sealing surfaces. Replace the shaft if pitting is found. If corrosion in the lip seal contact zone is slight, clean the surface of the shaft with crocus cloth. Replace the shaft only if the leakage cannot be stopped by smoothing with crocus cloth first.

O-Ring Seals

Whenever a part which forms a sealing surface for an O-ring is removed, the O-ring seal should also be removed and replaced with a new O-ring seal. Lubricate all new O-ring seals with power steering fluid to ease assembly.

ON-VEHICLE SERVICE

CHECKING AND ADDING POWER STEERING FLUID

Fluid level is indicated by marks on a fluid level indicator on the reservoir cap assembly.

NOTICE: When adding fluid or making a complete fluid change, always use the proper fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks. Refer to "Power Steering Fluid Recommendations" in this section.

If the fluid is about 77° C (170° F), the fluid level should be at the "H" mark.

If the fluid is about 21° C (70° F), the fluid level should be at the "C" mark.

POWER STEERING FLUID REPLACEMENT

The fluid replacement procedure is a two-stage process: first, flushing the old fluid from the system with new fluid: and second bleeding the system to remove trapped air. The following two sequences outline the steps in each procedure.

Flushing the Power Steering System

NOTICE: When adding fluid or making a complete fluid change, always use the proper fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks. Refer to "Power Steering Fluid Recommendations" in this section.

1. Raise and suitably support front of vehicle off ground until tire and wheel assemblies are free to turn. Refer to SECTION 0A.
2. Remove inlet hose assembly on 3.4L L32 engine or reservoir hose assembly on 5.7L LT1 engine at fluid reservoir inlet connector and plug fluid inlet connector port on fluid reservoir assembly.

Important

- Position inlet or reservoir hose assembly toward large container to catch draining fluid.

3. While an assistant is filling fluid reservoir assembly with fluid, start and run engine at idle.

NOTICE: Do not hold the steering wheel assembly against tire and wheel assembly stops while flushing system. Holding steering wheel assembly against stops will cause high power steering system pressure, overheating, and damage to the pump assembly and/or steering gear assembly.

4. Turn steering wheel assembly from stop to stop.
5. Continue draining until all old fluid is cleared from power steering system. Addition of approximately 0.94 liters (1 quart) of new fluid will be required to flush system.

Inspect

- Draining fluid while refilling fluid reservoir assembly.
  - — If necessary, replace all lines and disassemble, and clean or replace system components.
  - — Do not reuse any drained fluid.

6. Unplug fluid inlet connector port on fluid reservoir assembly and reconnect inlet hose assembly on 3.4L L32 engine and reservoir hose assembly on 5.7L LT1 engine at fluid reservoir inlet connector.
7. Turn engine off and fill fluid reservoir on 3.4L L32 engine and reservoir hose assembly on 5.7L LT1 engine to "C" mark on fluid level indicator. Continue with following procedure "Bleeding the Power Steering System."

Bleeding Air from Power Steering Systems

Figure 3

Refer to Figure 3 for recommended steering system bleed procedure.

POWER STEERING PUMP BELT (SERPENTINE BELT)

The pump assembly is driven by a serpentine belt. No adjustment of the serpentine belt is required. To remove or install the serpentine belt, refer to SECTION 6A2A or 6A3A.

POWER STEERING PUMP PULLEY ASSEMBLY

Figure 4

Tools Required:
J 25034-B Pump Pulley Remover
J 25033-B Pump Pulley Installer

Remove or Disconnect

1. Raise and suitably support vehicle on 5.7 LT1 engine only. Refer to SECTION 0A.
2. Drain engine coolant on 5.7 LT1 engine only. Refer to SECTION 6B.
3. Serpentine belt. Refer to SECTION 6A2A or 6A3A.
4. Lower vehicle on 5.7L LT1 engine only.
5. Front air intake duct. Refer to SECTION 1A.
6. Generator assembly on 5.7 LT1 engine only. Refer to SECTION 6D3.
7. Radiator outlet hose assembly from engine assembly on 5.7 LT1 engine only. Refer to SECTION 6D3.
8. Heater inlet and outlet hose assemblies from water pump assembly on 5.7L LT1 engine only. Refer to SECTION 1A.
9. Throttle body heater return hose from heater outlet hose assembly on 5.7L LT1 engine only. Refer to SECTION 1A.
10. Power steering pump bolts/screws on 5.7L LT1 engine only. Refer to "Power Steering Pump Assembly" in this section.
11. Inlet and reservoir hose assemblies from pump assembly on 5.7L LT1 engine only. Refer to "Power Steering Gear Inlet and Outlet Hose Assemblies" and "Power Steering Fluid Reservoir Assembly" in this section.
12. Pulley assembly (3 or 31) from pump assembly (4 or 32) using J 25034-B.

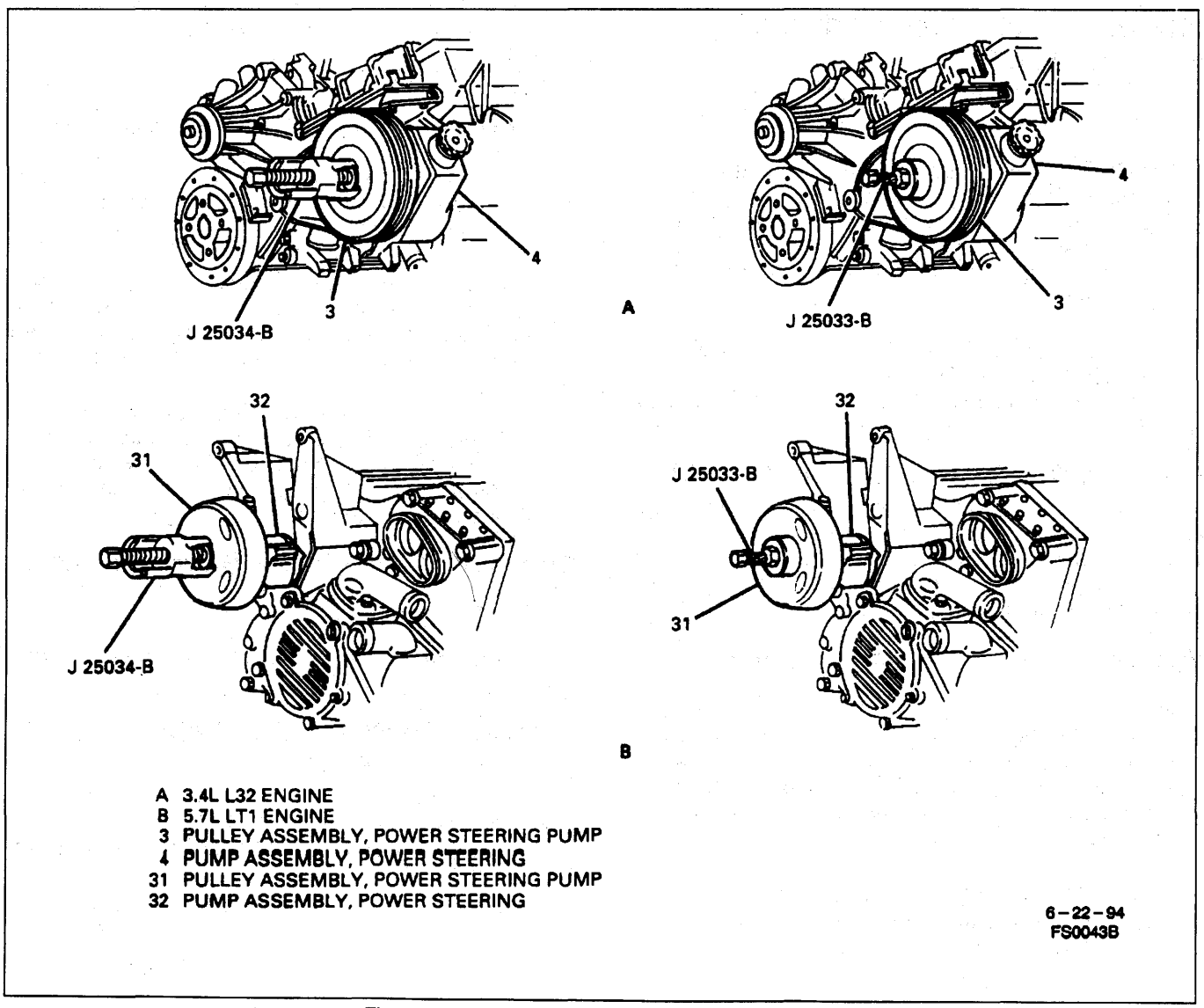


Figure 4 - Power Steering Pump Pulley Assembly

Install or Connect

1. Pulley assembly (3 or 31) to pump assembly (4 or 32) using J 25033-B

Important

- Face of pulley assembly hub must be flush with end of pump shaft before applying load to pulley assembly hub.
- Load required to press pulley assembly hub onto pump shaft must be greater than 6672 N (1,500 lbs.) but less than 31 136 N (7,000 lbs.).

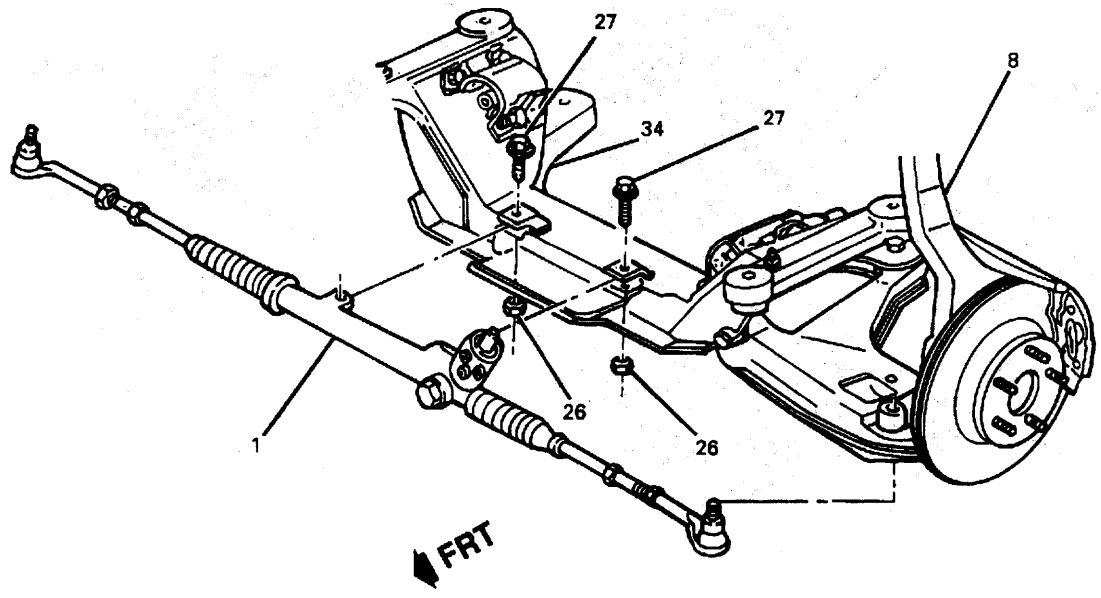
2. Inlet and reservoir hose assemblies to pump assembly on 5.7L LT1 engine only. Refer to "Power Steering Gear Inlet and outlet hose assemblies" and "Power Steering Fluid Reservoir Assembly" in this section.
3. Power steering pump bolts/screws on 5.7L LT1 engine only. Refer to "Refer to Power Steering Pump Assembly" in this section.
4. Throttle body heater return hose to heater outlet hose assembly on 5.7L LT1 engine only. Refer to SECTION 1A.
5. Heater inlet and outlet hose assemblies to water pump assembly on 5.7L LT1 engine only. Refer to SECTION 1A.
6. Radiator outlet hose assembly to engine assembly on 5.7L LT1 engine only. Refer to SECTION 6B.
7. Generator assembly on 5.7L LT1 engine only. Refer to SECTION 6D3.
8. Front air intake duct. Refer to SECTION 1A.
9. Raise and suitably support vehicle on 5.7L LT1 engine only. Refer to SECTION 0A.
10. Serpentine belt. Refer to SECTION 6A2A or SECTION 6A3A.
11. Lower vehicle on 5.7 LT1 engine only.
12. Refill and bleed engine coolant on 5.7L LT1 engine only. Refer to SECTION 6B.
13. Refill and bleed power steering system on 5.7L LT1 engine only. Refer to "Bleeding the Power Steering System" in this section.

POWER STEERING GEAR ASSEMBLY

Figure 5

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Special security wheel lock nuts, if equipped. Refer to SECTION 3E.
3. Tire and wheel assemblies. Refer to SECTION 3E.
4. Place drain pan under steering gear assembly (1).
5. Inlet and outlet hose assemblies from steering gear assembly. Refer to "Power Steering Gear Inlet and Outlet Hose Assemblies" in this section.
6. Steering linkage outer tie rod assembly from steering knuckle assembly. Refer to SECTION 3B1A.



1 GEAR ASSEMBLY, POWER STEERING
8 KNUCKLE ASSEMBLY, STEERING
26 NUT, STEERING GEAR
27 BOLT/SCREW, STEERING GEAR
34 CROSSMEMBER ASSEMBLY, FRONT

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Figure 5 - Power Steering Gear Assembly

7. Steering gear coupling shaft assembly from steering gear assembly. Refer to SECTION 3F.
8. Nuts (26) and bolts/screws (27).
9. Steering gear assembly (1).

Install or Connect

NOTICE: See "Notice" on page 3B-1 of this section.

1. Position steering gear assembly (1) to crossmember assembly (34).

Adjust

- Steering gear assembly (1) so it aligns as straight as possible with steering gear coupling shaft assembly.

2. Hand start bolts/screws (27) and nuts (26).
3. Position back-up wrench to nuts (26).

Tighten

- Bolts/screws (27) to 85 N·m (63 lb. ft.)

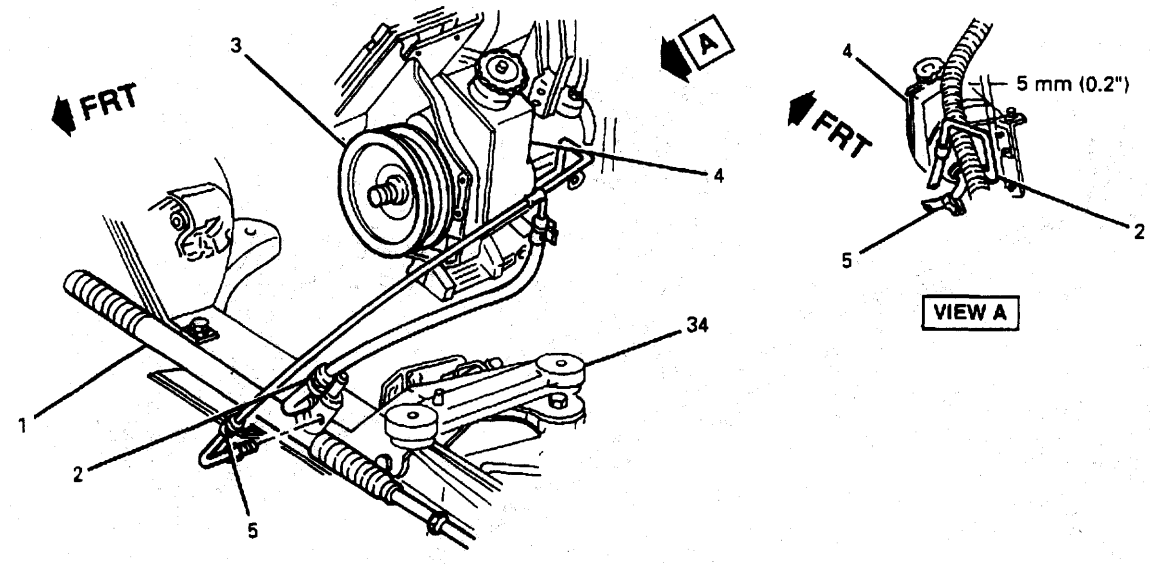
4. Steering gear assembly to steering gear coupling shaft assembly. Refer to SECTION 3F.
5. Steering linkage outer tie rod assemblies to steering knuckle assemblies. Refer to SECTION 3B1A.
6. Inlet and hose assemblies to steering gear assembly. Refer to "Power Steering Gear Inlet and Outlet Hose Assemblies" in this section.
7. Tire and wheel assemblies. Refer to SECTION 3E.
8. Special security wheel lock nuts, if equipped. Refer to SECTION 3E.
9. Lower vehicle.
10. Refill and bleed power steering system. Refer to "Bleeding the Power Steering System" in this section.

POWER STEERING GEAR INLET AND OUTLET HOSE ASSEMBLIES

Figures 6 and 7

Remove or Disconnect

1. Place drain pan under steering gear assembly (1) and pump assembly (4 or 32).
2. Outlet hose assembly (5) from pump assembly (4) on 3.4L L32 engine only.
3. Raise and suitably support vehicle. Refer to SECTION 0A.
4. Inlet and outlet hose assemblies (2 and 5 or 30 and 33) from steering gear assembly (1).
5. Inlet hose assembly (2) from pump assembly (4) on 3.4L L32 engine only.
6. Drain engine coolant on 5.7l LT1 engine only. Refer to SECTION 6B.



1 GEAR ASSEMBLY, POWER STEERING
2 HOSE ASSEMBLY, POWER STEERING GEAR INLET
3 PULLEY ASSEMBLY, POWER STEERING PUMP
4 PUMP ASSEMBLY, POWER STEERING
5 HOSE ASSEMBLY, POWER STEERING GEAR OUTLET
34 CROSSMEMBER ASSEMBLY, FRONT

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Figure 6 - Power Steering Gear Inlet and Outlet Hose Assemblies (3.4L L32 Engine).

7. Serpentine belt on 5.7L LT1 engine only. Refer to SECTION 6A3A.
8. Lower vehicle on 5.7L LT1 engine only.
9. Front intake duct on 5.7L LT1 engine only. Refer to SECTION 1A.
10. Generator assembly on 5.7L LT1 engine only. Refer to SECTION 6D3.
11. Radiator outlet hose assembly from engine assembly on 5.7L LT1 engine only. Refer to SECTION 1A.
12. Heater inlet and outlet hose assemblies from water pump assembly on 5.7L LT1 engine only. Refer to SECTION 1A.
13. Throttle body heater return hose from heater outlet assembly on 5.7L LT1 engine only. Refer to SECTION 1A.
14. Power steering pump bolts/screws on 5.7L LT1 engine only. Refer to "Power Steering Pump Assembly" in this section..
15. Inlet hose assembly (30) from pump assembly (32) on 5.7L LT1 engine only. 16.. Power steering fluid reservoir bolt/screw and power steering fluid reservoir retainer on 5.7L LT1 engine only. Refer to "Power Steering Fluid Reservoir Assembly" in this section.
16. Outlet hose assembly (33) from reservoir assembly (10) on 5.7L LT1 engine only.

Install or Connect

NOTICE: See "Notice" on page 3B-1 of this section.

NOTICE: Inlet and outlet hose assemblies must be installed to clear each other and all surrounding parts to prevent chafing. Use minimum clearance of 12 mm (0.47 inch). The outlet hose assembly must not be twisted during installation. Do not bend or distort inlet and outlet hose assemblies to make installation easier. Failure to follow these procedures could result in component damage.

1. Outlet hose assembly (33) to reservoir assembly (10) using clamp on 5.7L LT1 engine only. Lubricate as required.
2. Power steering fluid reservoir bolt/screw and power steering fluid reservoir retainer on 5.7L LT1 engine only. Refer to "Power Steering Fluid Reservoir Assembly" in this section.
3. Inlet hose assembly (30) to pump assembly (32) on 5.7L LT1 engine only.

Tighten

- Inlet hose assembly (30) to 28 N.m (21 lb. ft.).

4. Power steering pump bolts/screws on 5.7 LT1 engine only. Refer to "Power Steering Pump Assembly" in this section.

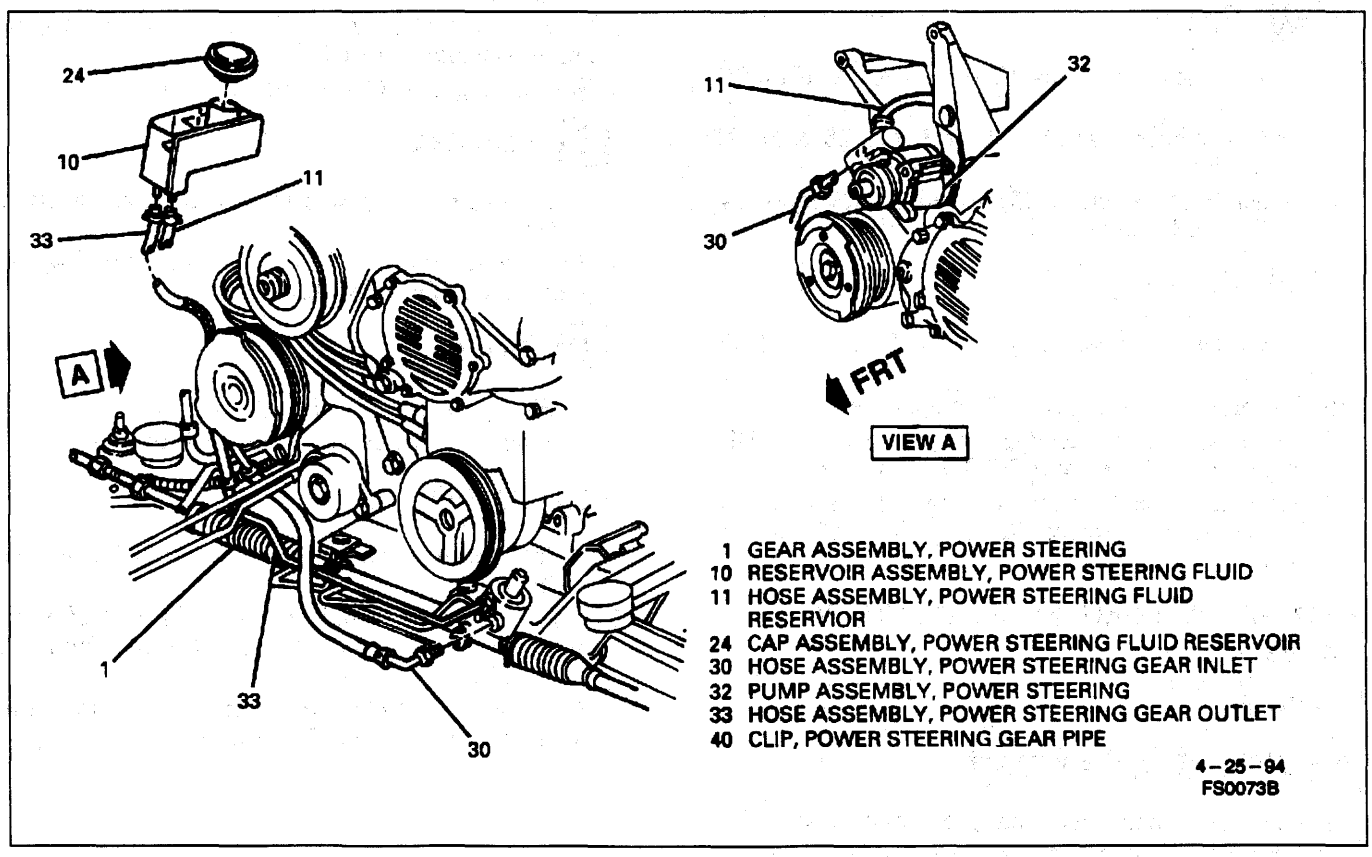


Figure 7 - Power Steering Gear and Outlet Hose Assemblies (5.7L LT1 Engine)

5. Throttle body heater return hose to heater outlet hose assembly on 5.7L LT1 engine only. Refer to SECTION 1A.
6. Heater inlet and outlet hose assemblies to water pump assembly on 5.7L LT1 engine only. Refer to SECTION 1A.
7. Radiator outlet hose assembly to engine assembly on 5.7L LT1 engine only. Refer to SECTION 6B.
8. Generator assembly on 5.7L LT1 engine only. Refer to SECTION 6D3.
9. Front air intake duct on 5.7L LT1 engine only. Refer to SECTION 1A.
10. Raise and suitably support vehicle on 5.7L LT1 engine only. Refer to SECTION 0A.
11. Serpentine belt on 5.7L LT1 engine only. Refer to SECTION 6A3A.
12. Inlet hose assembly (2) to pump assembly (4) on 3.4L L32 engine only.

Important

- Maintain at least 5 mm (0.20 inch) clearance between the inlet hose assembly (2) and the power steering pump support on the 3.4L L32 engine only.

Tighten

- Inlet hose assembly (2) to 28 N.m (21 lb. ft.).

13. Inlet and outlet hose assemblies (2 and 30 or 5 and 33) to steering gear assembly (1).

Tighten

- Inlet hose assembly (2 or 30) to 28 N.m (21 lb. ft.).
- Outlet hose assembly (5 or 33) to 28 N.m (21 lb. ft.).

14. Outlet hose assembly (5) to pump assembly (4) on 3.4L L32 engine only.

Tighten

- Outlet hose assembly (5) to 28 N.m (21 lb. ft.).

15. Lower vehicle on 5.7L LT1 engine only.
16. Refill and bleed engine coolant on 5.7L LT1 engine only. Refer to SECTION 6B.
17. Refill and bleed power steering system. Refer to "Bleeding the Power Steering System" in this section.

HYDRAULIC PUMP FLOW CONTROL VALVE

Figure 8

Remove or Disconnect

1. Place drain pan under pump assembly (4 or 32).
2. Inlet hose assembly (2 or 30) from fitting (15).
3. Fitting (15) and O-ring seal (14).

Important

- The flow control valve must be installed in the same orientation it was in when removed or flow control and pressure relief will be affected.

4. Flow control valve (13) and valve spring (12) from pump assembly (4 or 32) using magnet.

NOTICE: Do not disassemble the flow control valve.

Inspect

- Flow control valve (13) for free movement within housing bore.
  - — If sticking occurs check for burrs and clean as necessary.
  - — If necessary, replace flow control valve (13).

Install or Connect

NOTICE: See "Notice" on page 3B-1 of this section.

Important

- The flow control valve (13) should be installed face out, away from contact with the valve spring (12).

1. Valve spring (12) and flow control valve (13) to pump assembly (4 or 32).
2. New O-ring seal (14) to fitting (15).

Important

- Lubricate O-ring seal (14) with power steering fluid.

3. Hand start fitting (15) and O-ring seal (14) to pump assembly (4 or 32).

Tighten

- Fitting (15) to 75 N.m (55 lb. ft.).

4. Inlet hose assembly (2 or 30) to fitting (15).

Tighten

- Inlet hose assembly (2 or 30) to 28 N.m (21 lb. ft.).

5. Fill reservoir assembly with fluid. Refer to "Checking and Adding Power Steering Fluid" in this section.
6. Bleed system. Refer to "Bleeding air from the Power Steering System" in this section.

POWER STEERING PUMP SUPPORT

3.4L L32 Engine Only

Figure 9

Remove or Disconnect

1. Place drain pan under pump assembly (4).
2. Outlet hose assembly from pump assembly. Refer to "Power Steering Inlet and Outlet Hose Assemblies" in this section.
3. Bolts/screws (18) and nuts (19).
4. Support (17) from pump assembly (4) and brace assembly (35).

Install or Connect

NOTICE: See "Notice" on page 3B-1 of this section.

1. Position support (17) to pump assembly (4) and brace assembly (35).
2. Hand start nuts (19).
3. Hand start bolts/screws (18).

Tighten

- Nuts (19) to 50 N.m (37 lb. ft.).
- Bolts/screws (18) to 50 N.m (37 lb. ft.).

4. Outlet hose assembly to pump assembly. Refer to "Power Steering Gear and Outlet Hose Assemblies" in this section.
5. Refill and bleed power steering system. Refer to "Bleeding Air from the Power Steering System" in this section.

POWER STEERING PUMP ASSEMBLY

Figures 9 and 10

Remove or Disconnect

1. Place drain pan under pump assembly (4 or 32).
2. Raise and suitably support vehicle on 5.7L LT1 engine only. Refer to SECTION 0A.
3. Drain engine coolant on 5.7L LT1 engine only. Refer to SECTION 6B.
4. Serpentine belt. Refer to SECTION 6A2A or 6A3A.
5. Lower vehicle on 5.7L LT1 engine only.
6. Front air intake duct. Refer to SECTION 1A.
7. Generator assembly on 5.7L LT1 engine only. Refer to SECTION 6D3.
8. Radiator outlet hose assembly from engine assembly on 5.7L LT1 engine only. Refer to SECTION 6B.
9. Heater inlet and outlet hose assemblies from water pump assembly on 5.7L LT1 engine. Refer to SECTION 1A.

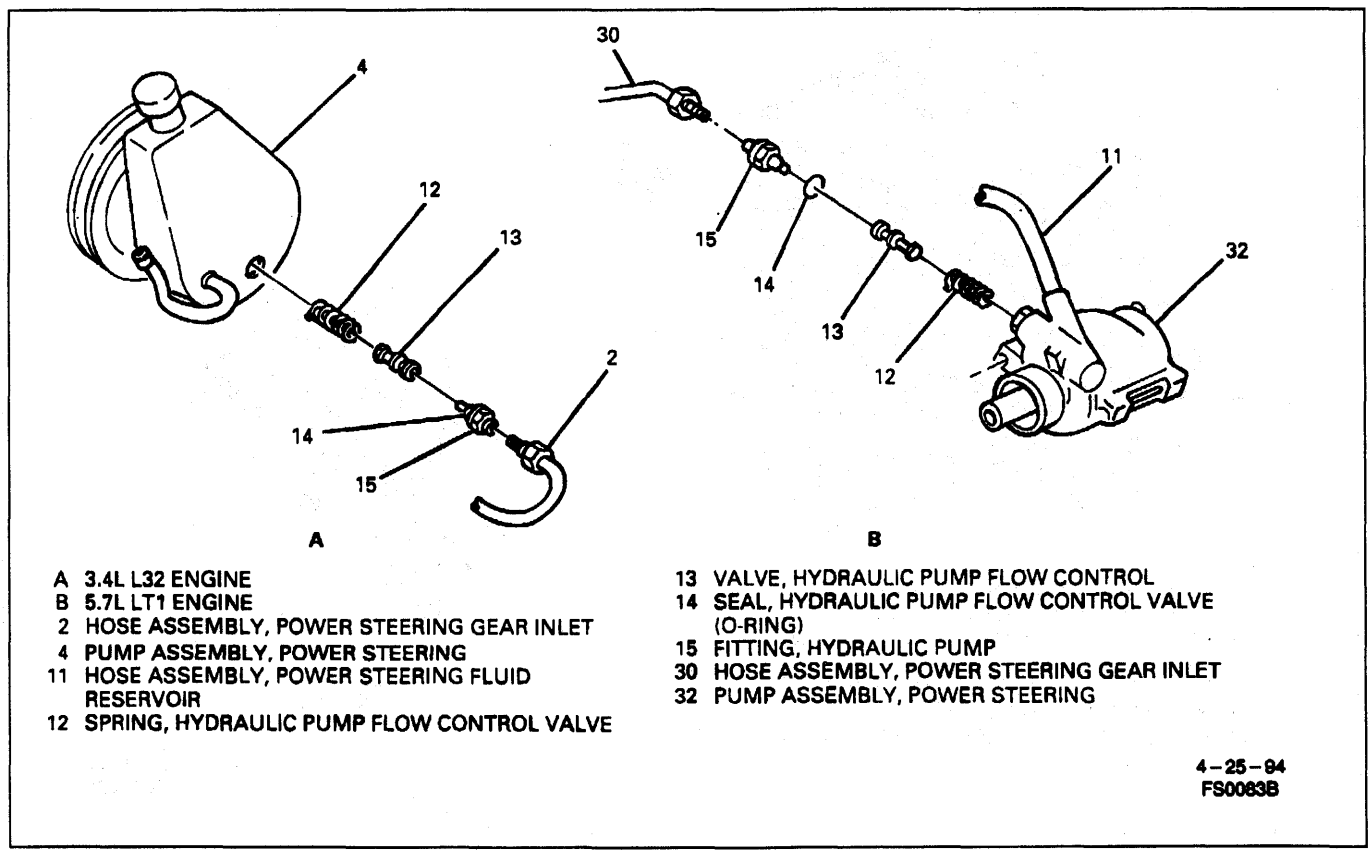


Figure 8 - Hydraulic Pump Flow Control Valve

10. Throttle body heater return from heater outlet hose assembly on 5.7L LT1 engine only. Refer to SECTION 1A.
11. Bolts/screws (21) on 5.7L LT1 engine only.
12. Inlet and outlet hose assemblies from pump assembly on 3.4L L32 engine only. Refer to "Power Steering Gear Inlet and Outlet Hose Assemblies" in this section.
13. Pulley assembly from pump assembly on 3.4L L32 engine only. Refer to "Power Steering Pump Pulley Assembly" in this section.
14. Inlet and reservoir hose assemblies from pump assembly on 5.7L LT1 engine only. Refer to "Power Steering Gear Inlet and Outlet Hose Assembly" in this section.
15. Pump support from pump assembly on 3.4L L32 engine only. Refer to "Power Steering Pump Support" in this section.
16. Bolts/screws (20) on 3.4L L32 engine only.
17. Pump assembly (4 or 32).

Install or Connect

NOTICE: See "Notice" on page 3B-1 of this section.

1. Position pump assembly (4) to brace assembly (35) on 3.4L L32 engine only.
2. Bolts/screws (20) on 3.4L L32 engine only.

Tighten

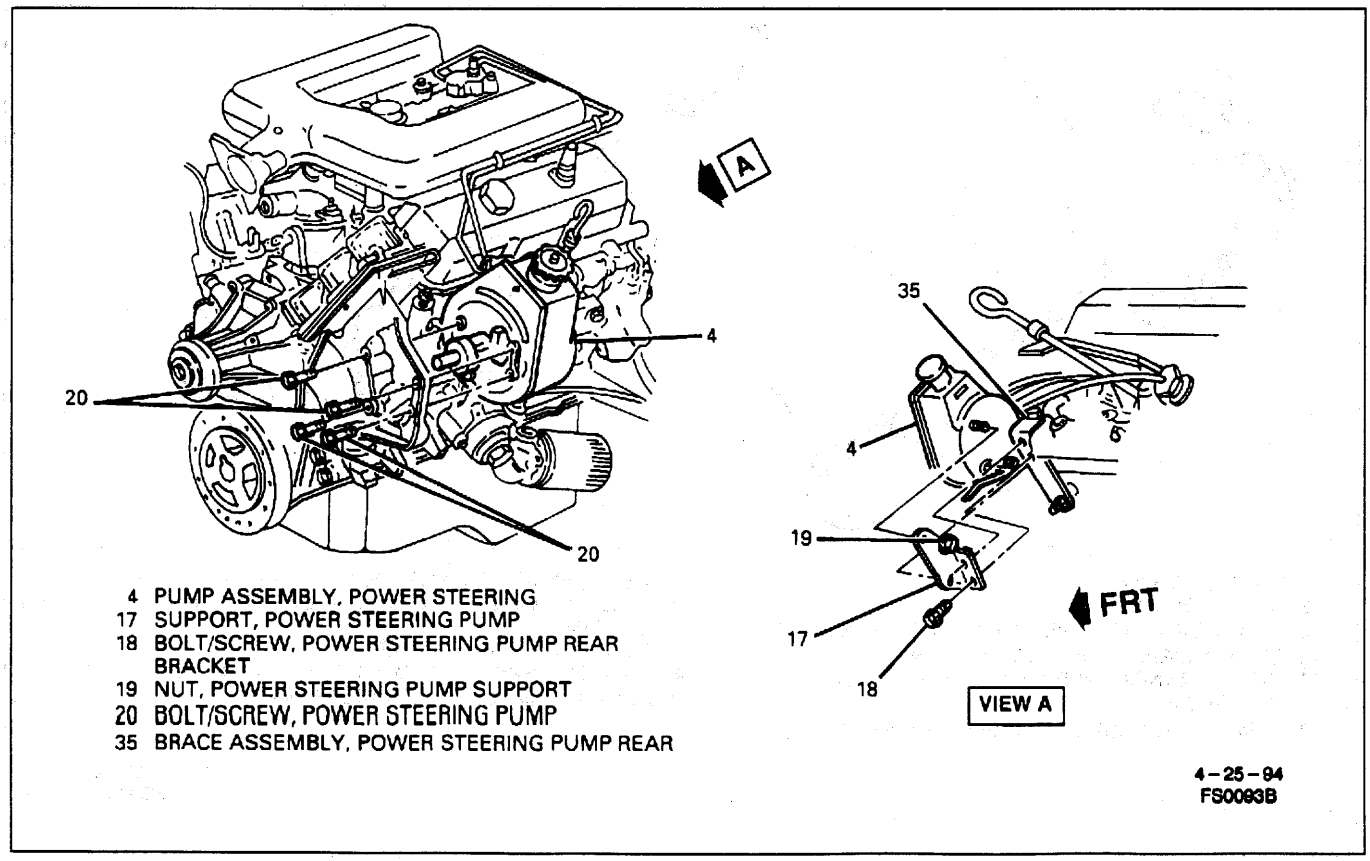
- Bolts/screws (20) to 50 N.m (37 lb. ft.).

3. Pump support to pump assembly on 3.4L L32 engine only. Refer to "Power Steering Pump Support" in this section.
4. Inlet and reservoir hose assemblies to pump assembly on 5.7L LT1 engine only. Refer to "Power Steering Gear Inlet and Outlet Hose Assemblies" and "Power Steering Fluid Reservoir Hose Assembly" in this section.
5. Pulley assembly to pump assembly on 3.4L L32 engine only. Refer to "Power Steering Pump Pulley Assembly" in this section.
6. Inlet and outlet hose assemblies to pump assembly on 3.4L L32 engine only. Refer to "Power Steering Gear Inlet and Outlet Hose Assemblies" in this section.
7. Position pump assembly (30) to bracket assembly (36) on 5.7L LT1 engine only.
8. Bolts/screws (21) on 5.7L LT1 engine only.

Tighten

- Bolts/screws (21) to 25 N.m (18 lb. ft.).

9. Throttle body heater return hose to heater outlet hose assembly on 5.7L LT1 engine only. Refer to SECTION 1A.
10. Heater inlet and outlet hose assemblies to water pump assembly on 5.7L LT1 engine only. Refer to SECTION 1A.



4 PUMP ASSEMBLY, POWER STEERING
17 SUPPORT, POWER STEERING PUMP
18 BOLT/SCREW, POWER STEERING PUMP REAR BRACKET
19 NUT, POWER STEERING PUMP SUPPORT
20 BOLT/SCREW, POWER STEERING PUMP
35 BRACE ASSEMBLY, POWER STEERING PUMP REAR

Figure 9 - Power Steering Pump Assembly (3.4L L32 Engine)

11. Radiator outlet hose assembly to engine assembly on 5.7l LT1 engine. Refer to SECTION 6B.
12. Generator assembly on 5.7L LT1 engine only. Refer to SECTION 6D3.
13. Front air intake duct. Refer to SECTION 1A.
14. Raise and suitably support vehicle on 5.7L LT1 engine only. Refer to SECTION 0A.
15. Serpentine belt. Refer to SECTION 6A2A or 6A3A.
16. Lower vehicle on 5.7L LT1 engine only.
17. Refill and bleed engine coolant system on 5.7L LT1 engine only. Refer to SECTION 6B.
18. Refill and bleed power steering system. Refer to "Bleeding Air from the Power Steering System" in this section.

Power Steering Fluid Reservoir Assembly

5.7 LT1 Engine only

Figure 11

Remove or Disconnect

1. Place drain pan under reservoir assembly (10).
2. cap assembly (24) from reservoir assembly (10).
3. Bolt/screw (22) and retainer (23).
4. Outlet hose assembly and reservoir hose assembly from reservoir assembly. Refer to "Power Steering Gear Inlet and Outlet Hose Assemblies" and "Power Steering Fluid Reservoir Hose Assembly" in this section.
5. Reservoir assembly (10).

Install or Connect

NOTICE: See "Notice" on page 3B-1 of this section.

1. Outlet hose assembly and reservoir hose assembly to reservoir assembly. Refer to "Power Steering Gear Inlet and Outlet Hose Assemblies: and "Power Steering Fluid Reservoir Hose Assembly" in this section.
2. Position reservoir assembly (10) to right front wheelhouse assembly.
3. Retainer (23) and bolt/screw (22).

Tighten

- Bolt/screw (22) to 10 N.m (89 lb. in.).

4. Cap assembly (24) to reservoir assembly (10).
5. Refill and bleed power steering system. Refer to "Bleeding Air from the Power Steering System" in this section.

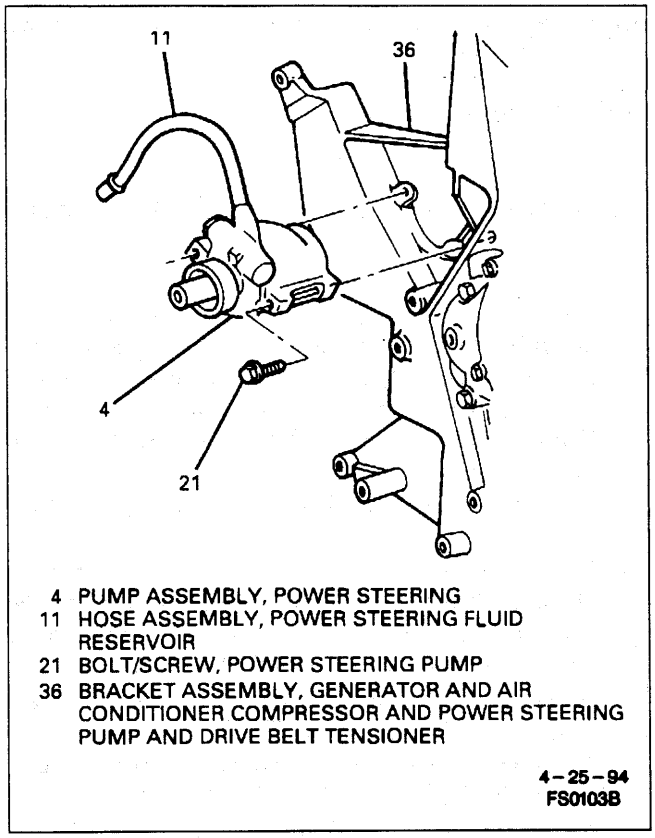


Figure 10 - Power Steering Pump Assembly (5.7L LT1 Engine)

Power Steering Fluid Reservoir Hose Assembly

5.7 LT1 Engine Only

Figure 7

Remove or Disconnect

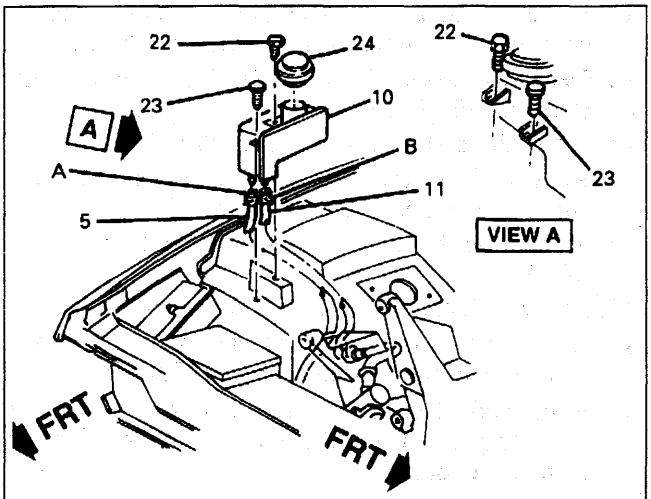
1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Drain engine coolant. Refer to SECTION 6B.
3. Serpentine belt. Refer to SECTION 6A3A.
4. Lower vehicle.
5. Front air intake duct. Refer to SECTION 0A
6. Generator assembly. Refer to SECTION 6D3.
7. Radiator outlet hose assembly from engine assembly. Refer to SECTION 6B.
8. Heater inlet and outlet hose assemblies from water pump assembly. Refer to SECTION 1A.
9. Throttle body heater return hose from heater outlet assembly. Refer to SECTION 1A.
10. Power steering pump bolts/screws. Refer to "Power Steering Pump Assembly" in this section.
11. Reservoir hose assembly (11) from reservoir assembly (10).
12. Power steering fluid reservoir bolt/screw and power steering fluid reservoir retainer from reservoir assembly. Refer to "Power Steering Fluid Reservoir Assembly" in this section.

13. Reservoir hose assembly (11) to reservoir assembly (10).

Install or Connect

NOTICE: See "Notice" on page 3B-1 of this section.

1. Reservoir hose assembly (11) to reservoir assembly (10) using clamp. Lubricate as required.
2. Power steering fluid reservoir retainer and power steering fluid reservoir bolt/screw. Refer to "Power Steering Fluid Reservoir Assembly" in this section.
3. Reservoir hose assembly (11) to pump assembly (32).
4. Power steering pump bolts/screws. Refer to "Power Steering Pump Assembly" in this section.
5. Throttle body heater return hose to heater outlet hose assembly. Refer to SECTION 1A.
6. Heater inlet and outlet hose assemblies to water pump assembly. Refer to SECTION 1A.
7. Radiator outlet hose assembly from engine assembly. Refer to SECTION 6B.
8. Generator assembly. Refer to SECTION 6D3.
9. Front air intake duct. Refer to SECTION 1A.
10. Raise and suitably support vehicle. Refer to SECTION OA.
11. Serpentine belt. Refer to SECTION 6A3A.
12. Lower vehicle.
13. Refill and bleed engine coolant. Refer to SECTION 6B.
14. Refill and bleed power steering system. Refer to "Bleeding Air from the Power Steering System" in this section.



A CLAMP, POWER STEERING HOSE ASSEMBLY
B CLAMP, POWER STEERING RESERVOIR HOSE ASSEMBLY
5 HOSE ASSEMBLY, POWER STEERING GEAR OUTLET
10 RESERVOIR ASSEMBLY, POWER STEERING FLUID
11 HOSE ASSEMBLY, POWER STEERING FLUID RESERVOIR
22 BOLT/SCREW, POWER STEERING FLUID RESERVOIR
23 RETAINER, POWER STEERING FLUID RESERVOIR
24 CAP ASSEMBLY, POWER STEERING FLUID RESERVOIR

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Figure 11 - Power Steering Fluid Reservoir Assembly (5.7L LT1 Engine)

SPECIFICATIONS

POWER STEERING FLUID RECOMMENDATIONS

Temperate Climate

Power Steering Fluid RequirementGM Power Steering Fluid P/N 1050017 or 1052884, or equivalent meeting GM Specification 9985010

Cold Climate

Power Steering Fluid RequirementGM Power Steering Fluid P/N 12345867 or 12345866 (System should be drained and refilled prior to using this fluid.)

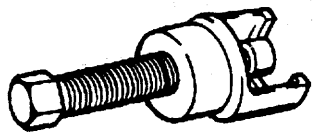
FITTING TIGHTENING SPECIFICATIONS

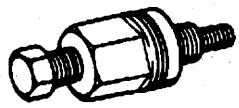
Hydraulic Pump Fitting-to-Power Steering Pump Assembly	75 N.m (55 lb. ft.)
Power Steering Gear Inlet Hose Assembly Fitting-to-Power Steering Gear Assembly	28 N.m (21 lb. ft.)
Power Steering Gear Inlet Hose Assembly Fitting-to-Power Steering Pump Assembly	28 N.m (21 lb. ft.)
Power Steering Gear Outlet Hose Assembly Fitting-to-Power Steering Gear Assembly	28 N.m (21 lb. ft.).

FASTENER TIGHTENING SPECIFICATIONS

Power Steering Fluid Reservoir Bolt/Screw	10 N.m (89 lb.in.)
Power Steering Pump Bolt/Screw- 3.4L L32 Engine	50 N.m (37 lb. ft.)
Power Steering Pump Bolt/Screw- 5.7L LT1 Engine	25 N.m (18 lb. ft.).
Power Steering Pump Rear Bracket Bolt/Screw	50 N.m (37 lb.. ft.)
Power Steering Pump Support Nut	50 N.m (37 lb. ft.)
Power Gear Bolt/Screw	85 N.m (63 lb. ft.)

SPECIAL TOOLS

1.  J 25034-B

2.  J 25033-B

1. PUMP PULLEY REMOVER
2. PUMP PULLEY INSTALLER

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SECTION 3B1A

POWER STEERING GEAR UNIT REPAIR

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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- Rack & Pinion Boot 3B1A-4
- Inner Tie Rod 3B1A-4
- Cylinder Line Assembly and O-Ring Seals 3B1A-5
- Pinion Seal, Dust Seal and Bearing Annulus Assembly 3B1A-6

Specifications 3B1A-9
- Fluid Capacities 3B1A-9
- Fastener Tightening Specifications 3B1A-9

Special Tools 3B1A-9

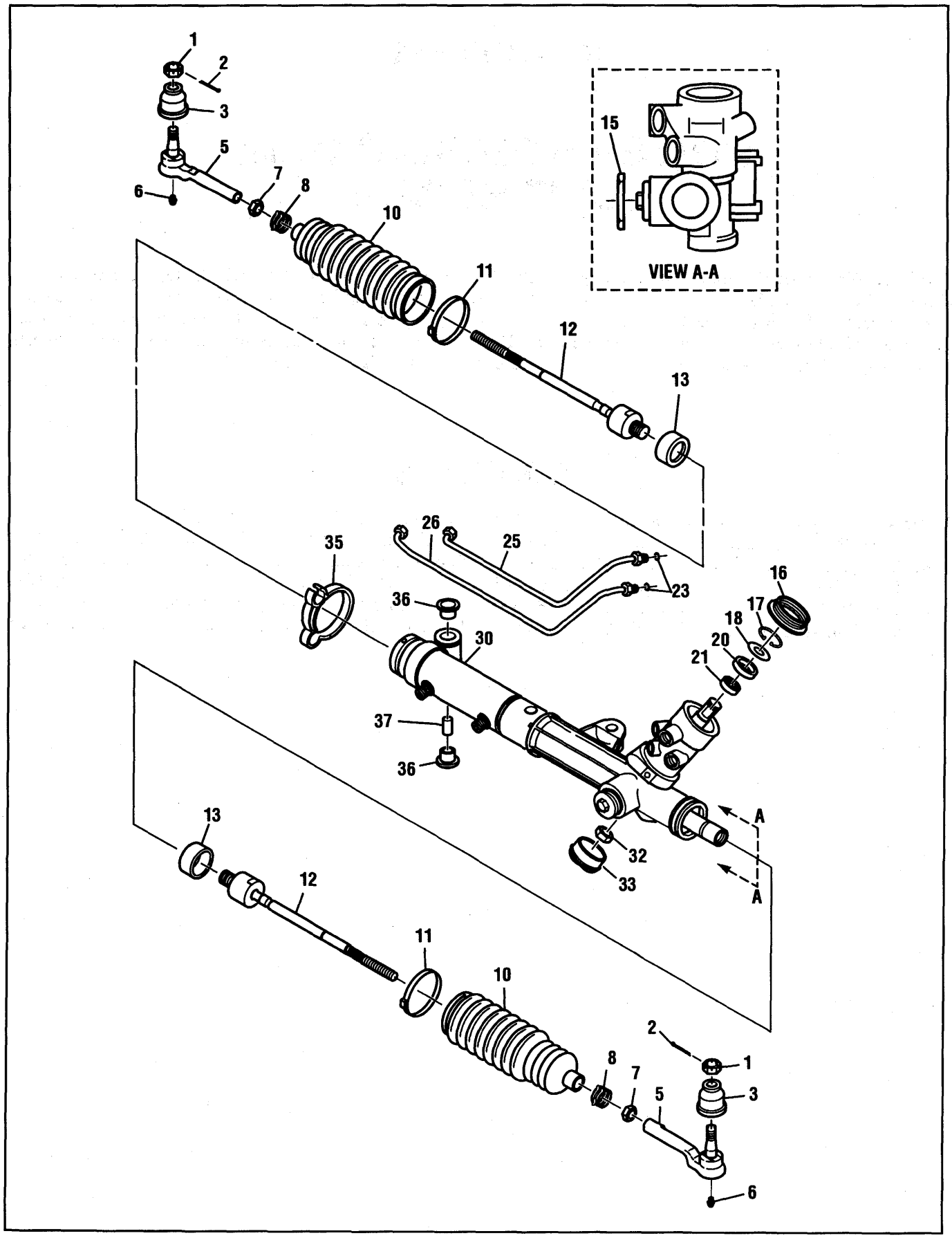


Figure 1 Power Rack and Pinion - End Take Off

Key No.	Part Name
1	NUT, HEXAGON SLOTTED
2	PIN, COTTER
3	SEAL, TIE ROD
5	ROD ASM, OUTER TIE
6	FITTING, LUBE (90 DEG ELBOW)
7	NUT, METRIC HEX (M14 X 1.5)
8	CLAMP, TIE ROD END
10	BOOT, RACK & PINION
11	CLAMP, SEAL RETAINING
12	ROD ASM, INNER TIE
13	RING, SHOCK DAMPENER
15	NUT, ADJUSTER PLUG LOCK
16	ADAPTER, SEAL
17	RING, RETAINING
18	SEAL, STUB SHAFT DUST
20	SEAL, STUB SHAFT
21	BEARING ANNULUS ASM, NEEDLE
23	SEAL, O-RING (4.50 I.D.)
25	LINE ASM, CYLINDER (RT)
26	LINE ASM, CYLINDER (LT)
30	GEAR ASM, RACK & PINION (PARTIAL)
32	NUT, HEX LOCK
33	COVER, DUST
35	CLIP, PIPE
36	BUSHING, STEERING GEAR
37	SLEEVE, STEERING GEAR BUSHING

Figure 2 Power Rack and Pinion – End Take Off – Legend

OUTER TIE ROD

Figures 1 thru 3

Tool Required:
J 24319-01 Universal Steering Linkage Puller

Remove or Disconnect

1. Cotter pin (2) and hex slotted nut (1) from outer tie rod assembly (5).
2. Loosen hex nut (7).
3. Outer tie rod (5) from steering knuckle with J 24319-01.
4. Outer tie rod (5) from inner tie rod (12).

Install or Connect

1. Outer tie rod assembly (5) to inner tie rod (12). Do not tighten hex nut (7).
2. Outer tie rod (5) to steering knuckle, hex slotted nut (1) to outer tie rod stud.

Tighten

- Hex slotted nut (1) to 47 N•m (35 lb. ft.).
- Tighten nut up to 1/6 additional turn, or 70 N•m (52 lb. ft.) maximum, to align cotter pin slot. Do not back off nut for cotter pin insertion.

3. Cotter pin (2) into hole in tie rod stud (5).

Adjust

- Toe by turning inner tie rod (12).

Important

- Be sure rack and pinion boot (10) is not twisted or puckered during toe adjustment.

Tighten

- Hex nut (7) against outer tie rod (5) to 68 N•m (50 lb. ft.).

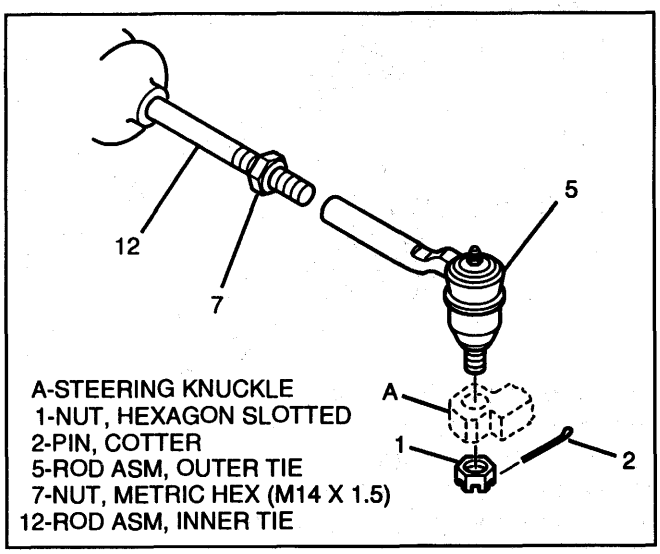


Figure 3 Outer Tie Rod Replacement

RACK BEARING PRELOAD (on vehicle adjustment)
Figure 15

Adjust

1. Make adjustment with front wheels raised and steering wheel centered. Be sure to check returnability of the steering wheel to center after adjustment.
2. Loosen adjuster plug lock nut (15) and turn adjuster plug clockwise until it bottoms in gear assembly (30), then back off 50° to 70° (approximately one flat).
3. Lock nut (15) to adjuster plug.

Tighten

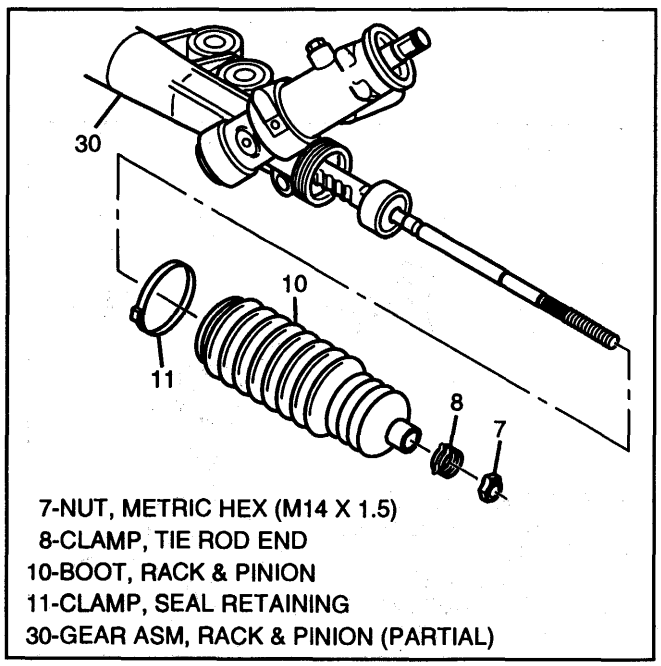
- Lock nut (15) to 75 N•m (55 lb. ft.) while holding adjuster plug stationary.

RACK & PINION BOOT
Figures 1 thru 6

Tool Required:
J 22610 Service Boot Clamp Installer

Remove or Disconnect

1. Do all steps of OUTER TIE ROD "Remove or Disconnect."
2. Hex nut (7) from inner tie rod assembly (12).
3. Tie rod end clamp (8).
4. Seal retaining clamp (11) with side cutters and discard.
5. Rack and pinion boot (10).



7-NUT, METRIC HEX (M14 X 1.5)
8-CLAMP, TIE ROD END
10-BOOT, RACK & PINION
11-CLAMP, SEAL RETAINING
30-GEAR ASM, RACK & PINION (PARTIAL)

Figure 4 Rack and Pinion Boot Replacement

Install or Connect

1. New seal retaining clamp (11) onto rack and pinion boot (10).
2. Apply grease to inner tie rod (12) and gear assembly (30) prior to boot installation (see Figure 5).
   - Boot (10) onto inner tie rod assembly (12).
3. Boot (10) onto gear assembly (30) until seated in gear assembly groove.

Important

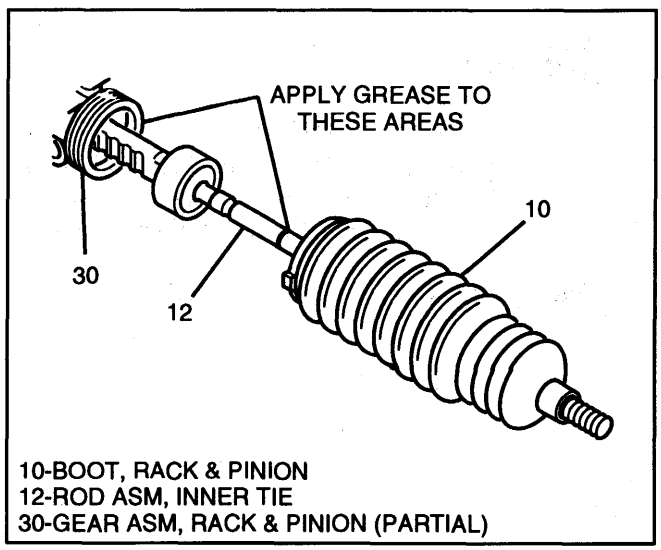
- Boot (10) must not be twisted, puckered or out of shape in any way. If the boot is not shaped properly, adjust by hand before installing seal retaining clamp (11).

4. Seal retaining clamp (11) on boot (10) with tool J 22610 and crimp as shown (see Figure 6).
5. Tie rod end clamp (8) with pliers on boot (10).
6. Hex nut (7) to inner tie rod assembly (12).
7. Do all steps of OUTER TIE ROD "Install or Connect."

INNER TIE ROD
Figures 1 thru 9

Remove or Disconnect

1. Rack and pinion assembly from vehicle (see Section 3B).
2. Do all steps of RACK & PINION BOOT "Remove or Disconnect."
3. Shock dampener (13) from inner tie rod assembly (12) and slide back on rack (see Figure 7).



10-BOOT, RACK & PINION
12-ROD ASM, INNER TIE
30-GEAR ASM, RACK & PINION (PARTIAL)

Figure 5 Boot Seal Grease Application

Notice: Steering gear rack must be held stationary during inner tie rod removal to prevent steering gear damage. Use an appropriate size wrench at the rack teeth to hold the rack during inner tie rod removal. For right side inner tie rod removal, it will be necessary to remove the left side boot to access the rack teeth.

4. Inner tie rod assembly (12) from rack assembly as follows: (See Figure 7.)
   - Place a wrench on flat of rack assembly.
   - Place another wrench on flats of inner tie rod housing.
   - Rotate inner tie rod housing counterclockwise until inner tie rod (12) separates from rack.

Install or Connect

1. Remove old Loctite® from threads of rack and inner tie rod.

Important

- Threads must be clean prior to Loctite application. Be sure Loctite® container expiration date has not passed. Do not use too much Loctite®. Use only enough to evenly coat threads.

2. Apply Loctite 262® to inner tie rod threads (see Figure 8).
3. If shock damper was removed, slide it onto steering gear.

Notice: Steering gear must be held stationary during inner tie rod installation to prevent steering gear damage.

4. Install inner tie rod assembly onto steering gear (see Figure 9).

Tighten

- Inner tie rod (12) to 100 N•m (74 lb. ft.)

5. Slide shock dampener up against inner tie rod assembly.
6. Do all steps of RACK & PINION BOOT "Install or Connect."
7. Rack and pinion assembly to vehicle (see Section 3B).

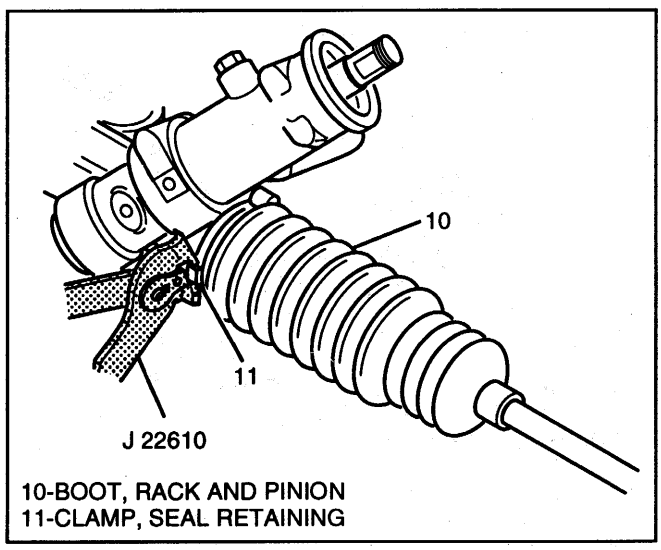
CYLINDER LINE ASSEMBLY and O-RING SEALS

Figures 1 and 2

Tools Required:
12mm Flare Nut Wrench
16mm Flare Nut Wrench

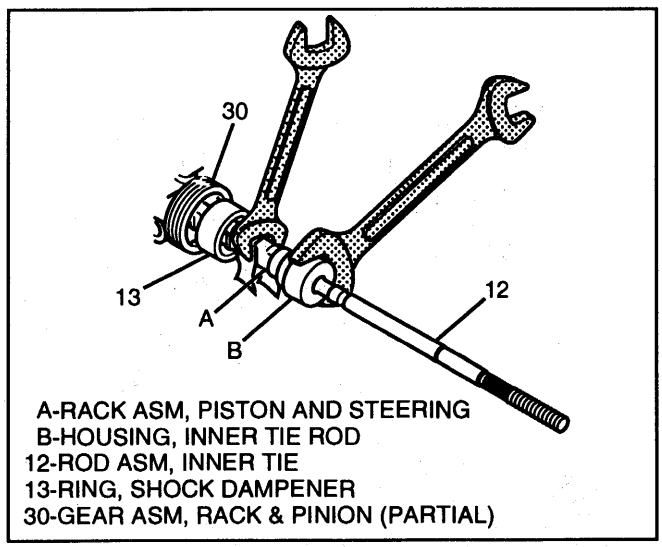
Remove or Disconnect

1. Loosen cylinder line fittings (25) or (26) on cylinder end of gear assembly (30).
2. Loosen fittings on cylinder line assemblies (25) or (26) at valve end of gear assembly (30).
3. Cylinder line assemblies (25) or (26) from rack and pinion gear assembly (30).
4. O-ring seals (23) from valve end of lines (25) or (26) and discard.



10-BOOT, RACK AND PINION
11-CLAMP, SEAL RETAINING

Figure 6 Boot Clamp Installation



A-RACK ASM, PISTON AND STEERING
B-HOUSING, INNER TIE ROD
12-ROD ASM, INNER TIE
13-RING, SHOCK DAMPENER
30-GEAR ASM, RACK & PINION (PARTIAL)

Figure 7 Inner Tie Rod Removal

Install or Connect

Inspect

Lines for:

- Cracks.
- Dents.
- Damage to threads.

Replace as needed.

1. New O-ring seals (23) to valve end of lines (25) or (26).
2. Cylinder line assemblies (25) or (26) to gear assembly (30).

Notice: Carefully align threads on all fittings and finger tighten to avoid stripping and cross-threading.

Tighten

- Valve end fittings to 16.9 N•m (12.5 lb. ft.).
- Cylinder end fittings to 27.0 N•m (20 lb. ft.).

PINION SEAL, DUST SEAL and BEARING ANNULUS ASSEMBLY

Figures 1, 2, 10 Thru 15

Tools Required:
J 29810 Stub Shaft Seal Protector
14 mm Crowfoot Wrench

Remove or Disconnect

1. Rack and pinion steering assembly from vehicle (see Section 3B).
2. Adjuster plug lock nut (15) from adjuster plug (see Figure 10).
3. Adjuster plug from gear assembly (30).
4. Adjuster spring and rack bearing.
5. Retaining ring (17) from valve bore of gear assembly (30).
6. Dust cover (33) from bottom of gear assembly (30) (see Figure 11).

Notice: Stub shaft must be held to prevent damage to the pinion teeth.

7. Hex lock nut (32) from lower end of pinion and valve assembly, while holding stub shaft with 14 mm Crowfoot Wrench (see Figure 11).

Notice: DO NOT hammer or pound on pinion and valve assembly. This will cause damage or loosen the drive pin.

Important

- When performing the following procedure, do not remove pinion and valve assembly from gear assembly. Press pinion and valve assembly only far enough to allow removal of bearing annulus and seal. Pinion and valve assembly removal is not required.

8. Use an arbor press (see Figure 12). Press on threaded end of pinion until it is possible to remove stub shaft dust seal (18), stub shaft seal (20), and stub shaft bearing annulus assembly (21) (see Figure 13).

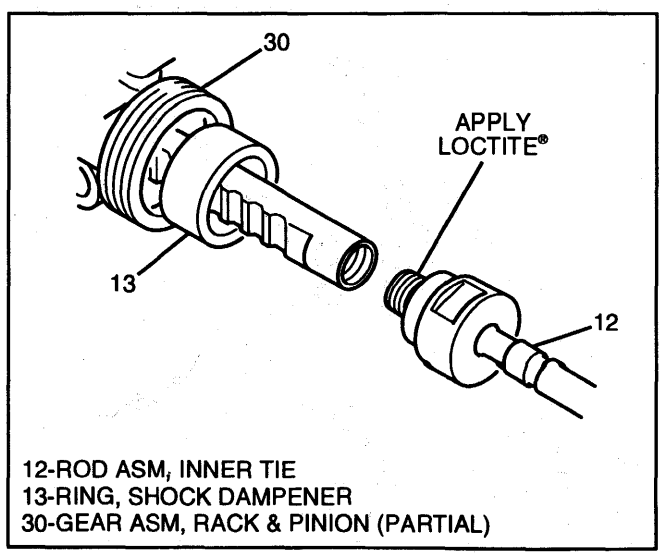


Figure 8 Inner Tie Rod Installation

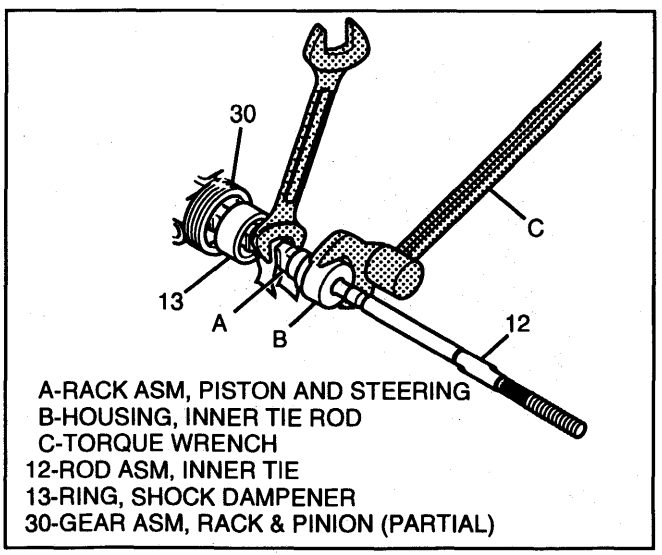


Figure 9 Inner Tie Rod Tightening

Install or Connect

Notice: If the stub shaft is not held, damage to the pinion teeth will occur.

1. Hex lock nut (32) onto pinion, while holding the valve stub shaft.

Tighten

- Hex lock nut (32) to 30 N•m (22 lb. ft.).

2. Dust cover (33) to gear assembly (30).
3. Stub shaft bearing annulus assembly (21) onto valve stub shaft.
4. Seal protector J 29810 onto valve stub shaft.
5. Apply a small quantity of grease between seals (20) and (18).
   - Stub shaft seal (20) and stub shaft dust seal (18) over protector and into gear assembly (30).
6. Retaining ring (17) into groove in gear assembly (30).
7. Lubricate stub shaft and dust seal area with grease.
8. Coat rack bearing, adjuster spring and adjuster plug with lithium base grease and install in gear assembly (30) (see Figure 15).

Adjust

- With rack centered in the gear assembly (30), turn adjuster plug clockwise until it bottoms in the gear assembly, then back off 50° to 70° (approximately one flat). Check rotational torque on pinion. Maximum pinion preload torque is 1.8 N•m (16 lb. in.) (see Figure 15).

9. Lock nut (15) to adjuster plug.

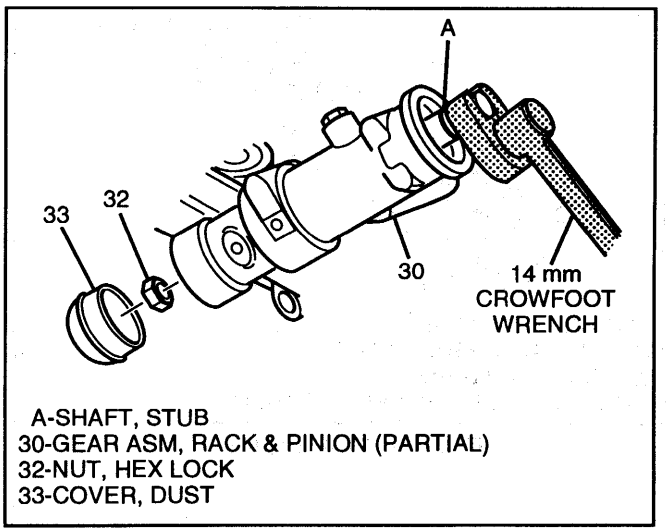
Tighten

- Lock nut (15) to 75 N•m (55 lb. ft.) while holding adjuster plug stationary.

10. Rack and pinion assembly into vehicle.

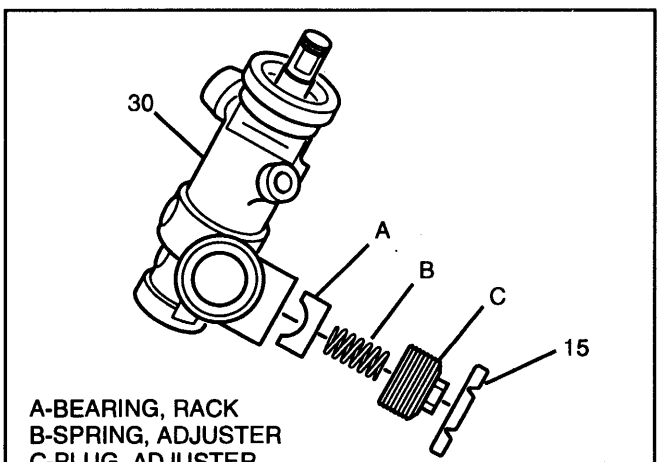
Important

- Flush and bleed power steering system (hoses, reservoir and cooler lines) with cold climate power steering fluid - GM Part #12345866 16-oz. or 12345867 32-oz. (see flushing and bleeding procedures, Section 3B).



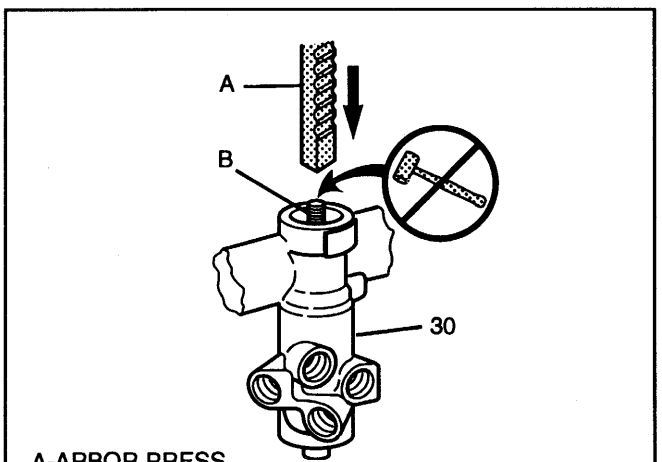
A-SHAFT, STUB
30-GEAR ASM, RACK & PINION (PARTIAL)
32-NUT, HEX LOCK
33-COVER, DUST

Figure 11 Retaining Ring and Lock Nut Removal



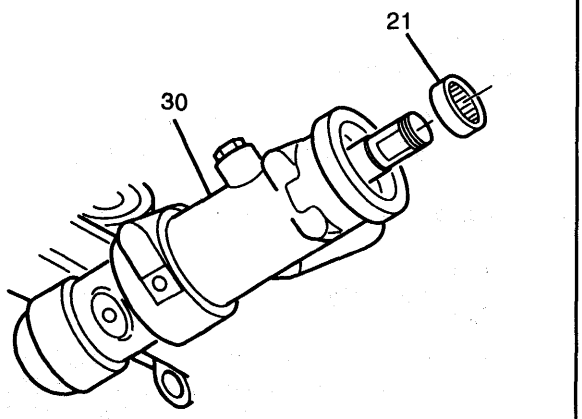
A-BEARING, RACK
B-SPRING, ADJUSTER
C-PLUG, ADJUSTER
15-NUT, ADJUSTER PLUG LOCK
30-GEAR ASM, RACK & PINION (PARTIAL)

Figure 10 Rack Bearing Removal



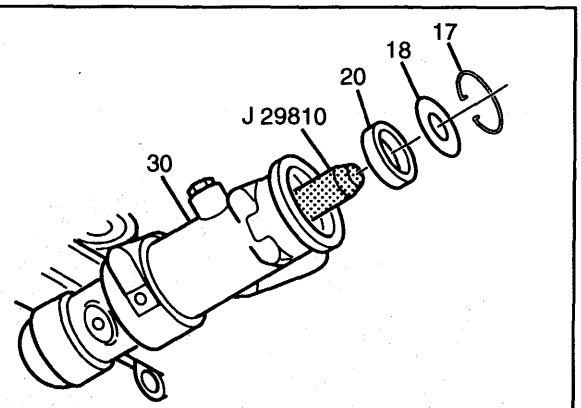
A-ARBOR PRESS
B-THREADED END OF PINION
30-GEAR ASM, RACK & PINION (PARTIAL)

Figure 12 Pressing Pinion



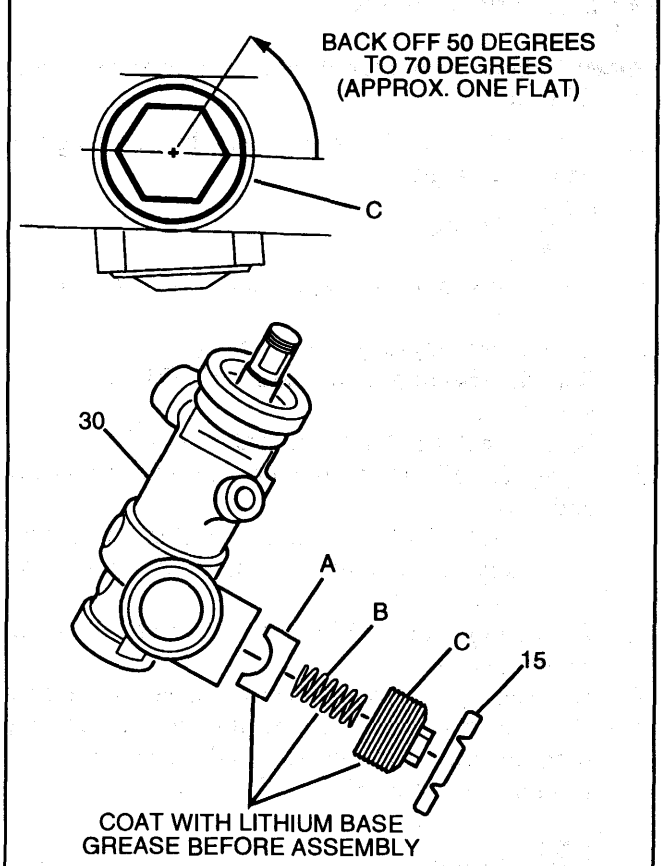
21-BEARING ANNULUS ASM, NEEDLE
30-GEAR ASM, RACK & PINION (PARTIAL)

Figure 13 Bearing Annulus Installation



17-RING, RETAINING
18-SEAL, STUB SHAFT DUST
20-SEAL, STUB SHAFT
30-GEAR ASM, RACK & PINION (PARTIAL)

Figure 14 Seal Installation



A-BEARING, RACK
B-SPRING, ADJUSTER
C-PLUG, ADJUSTER
15-NUT, ADJUSTER PLUG LOCK
30-GEAR ASM, RACK & PINION (PARTIAL)

Figure 15 Rack Bearing Installation and Adustment

SPECIFICATIONS

FLUID CAPACITIES

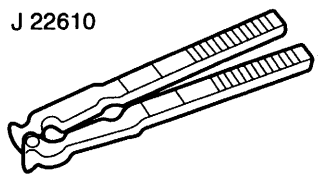
Lubricant ..... Cold Climate Power Steering Fluid 12345866 (16-oz.)
12345867 (32-oz.)
Capacity Complete System ..... 0.75 liter (1-1/2 pints)

FASTENER TIGHTENING SPECIFICATIONS

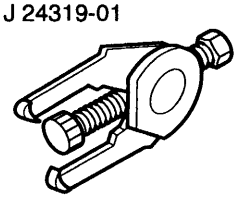
(1)	Hexagon Slotted Nut	47.0 N•m	(35 lb. ft.)
(7)	Hex Nut	68.0 N•m	(50 lb. ft.)
(12)	Inner Tie Rod	100.0 N•m	(74 lb. ft.)
(15)	Lock Nut	75.0 N•m	(55 lb. ft.)
(32)	Hex Lock Nut	30.0 N•m	(22 lb. ft.)
	Pinion Preload	1.8 N•m	(16 lb. in.)
	Valve End Fittings	16.9 N•m	(12.5 lb. ft.)
	Cylinder End Fittings	27.0 N•m	(20 lb. ft.)

SPECIAL TOOLS

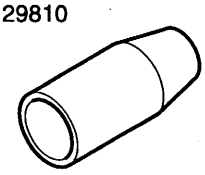
1. J 22610



2. J 24319-01



3. J 29810



1. SERVICE BOOT CLAMP INSTALLER
2. UNIVERSAL STEERING LINKAGE PULLER
3. STUB SHAFT SEAL PROTECTOR

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SECTION 3B1B

POWER STEERING PUMP UNIT REPAIR

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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P Series Power Steering Pump Assembly 3B1B-2
P Series Power Steering Pump Service 3B1B-3
Drive Shaft Seal Replacement 3B1B-3
Pump Reservoir Replacement 3B1B-3
End Plate and Rotating Group Replacement 3B1B-4

Subsection B: Reverse Rotation Power Steering Pump
Reverse Rotation Power Steering Pump Assembly 3B1B-5
Reverse Rotation Power Steering Pump Service 3B1B-6
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Hydraulic Pump Assembly 3B1B-7

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Special Tools 3B1B-9

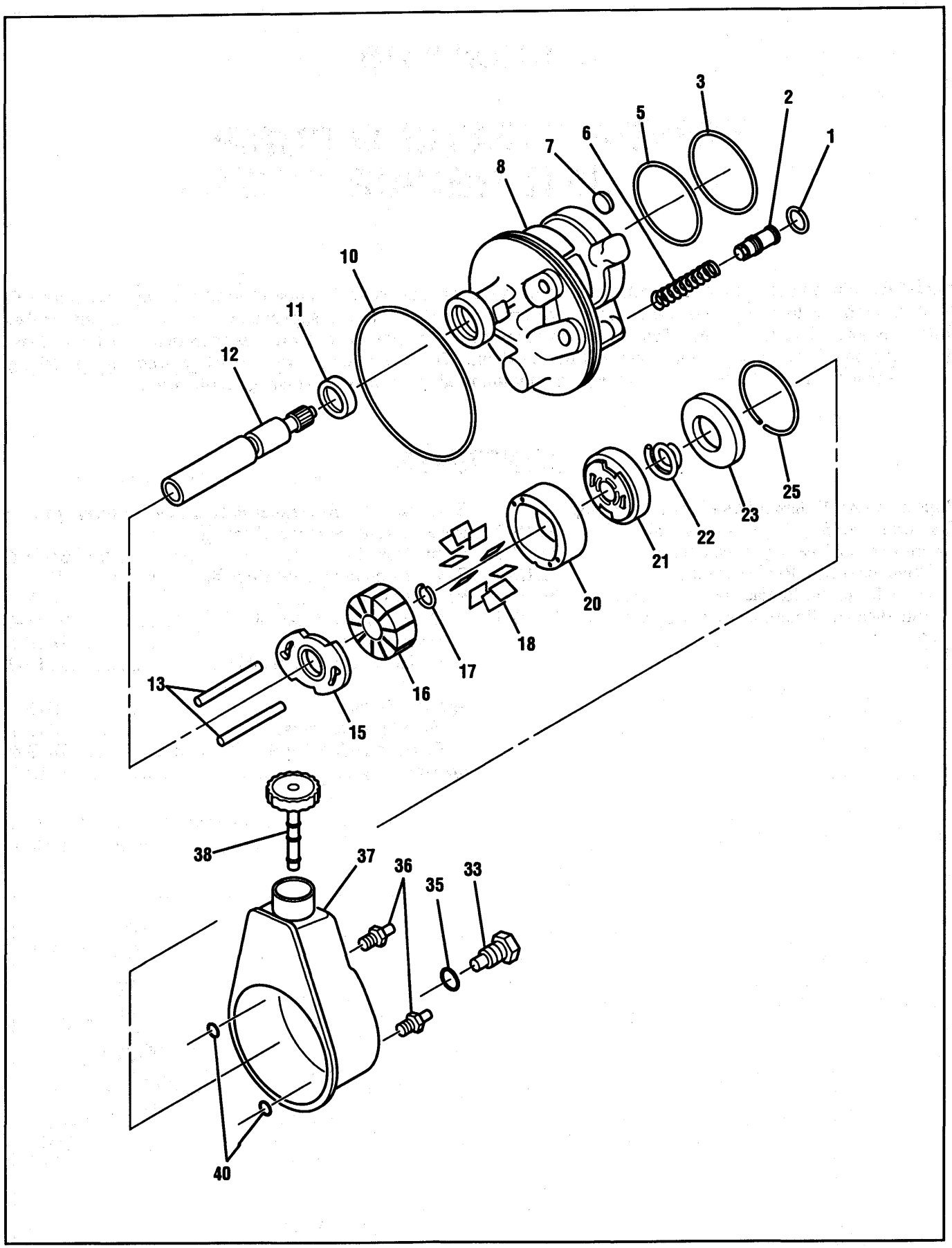


Figure 1 P Series Power Steering Pump

Key No.	Part Name
1	SEAL, O-RING
2	VALVE ASM, CONTROL
3	SEAL, O-RING
5	SEAL, O-RING
6	SPRING, FLOW CONTROL
7	MAGNET
8	HOUSING ASM, PUMP
10	SEAL, O-RING (HOUSING)
11	SEAL, DRIVE SHAFT
12	SHAFT, DRIVE
13	PIN, DOWEL
15	PLATE, THRUST
16	ROTOR, PUMP
17	RING, SHAFT RETAINING
18	VANE, PUMP
20	RING, PUMP
21	PLATE, PRESSURE
22	SPRING, PRESSURE PLATE
23	PLATE, END
25	RING, END PLATE RETAINING
33	FITTING ASM (CONNECTOR &)
35	SEAL, O-RING
36	BOLT, PUMP MOUNTING
37	RESERVOIR ASM
38	CAP ASM, RESERVOIR
40	SEAL, O-RING (HOUSING TO STUD)

Figure 2 P Series Power Steering Pump - Legend

DRIVE SHAFT SEAL REPLACEMENT
Figures 1 thru 3

Tool Required:
J 22670 Shaft Oil Seal Installer

Remove or Disconnect

- Power steering pump from vehicle. Refer to "Power Steering Pump Replacement" in section 3B.

Disassemble

- Protect drive shaft (12) with shim stock.
- Seal (11) by cutting with a chisel.

Assemble

- Lubricate seal (11) with power steering fluid.
- Seal (11) using J 22670.

Install or Connect

- Power steering pump. Refer to "Power Steering Pump Replacement" in section 3B.

PUMP RESERVOIR REPLACEMENT
Figure 1

Remove or Disconnect

- Power steering pump from vehicle. Refer to "Power Steering Pump Replacement" in section 3B.

Disassemble

- Drain power steering fluid from pump.

1. Bolts (36).
2. Fitting (33) and O-ring seal (35).
3. Control valve assembly (2) and flow control spring (6) from housing (8) if replacement is required.
4. Reservoir (37) from housing (8).
5. O-ring seals (1, 10, and 40).
6. Magnet (7).

Clean

- Magnet (7).

Inspect

- Welch plug in housing (8). Do not remove. If plug is deformed or dislodged, replace housing (8).

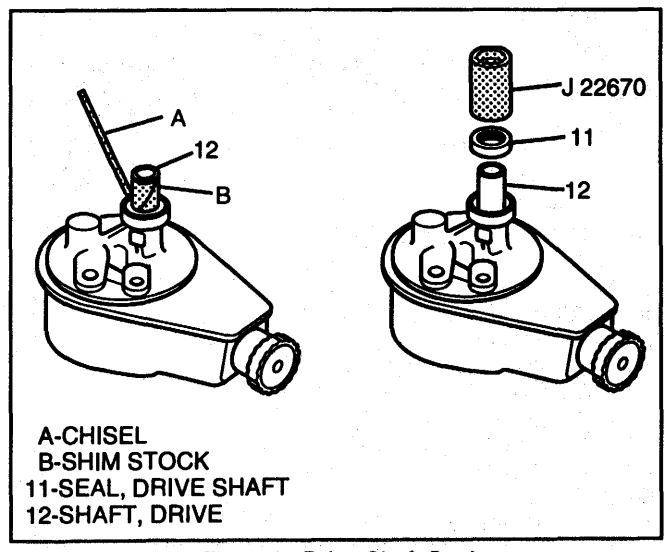


Figure 3 Drive Shaft Seal

Important

- Use new seals when assembling pump.

Assemble

- Lubricate O-ring seals (1, 10, 35 and 40) with power steering fluid.

1. Flow control spring (6) and control valve assembly (2) to housing (8). See Figure 1 for proper orientation.
2. O-ring seals (1, 10, and 40) to housing (8).
3. Magnet (7) to housing (8).
4. Reservoir (37) to housing (8).
5. O-ring seal (35) and fitting (33).

Notice: See "Notice" on page 3B1B-1 of this section.

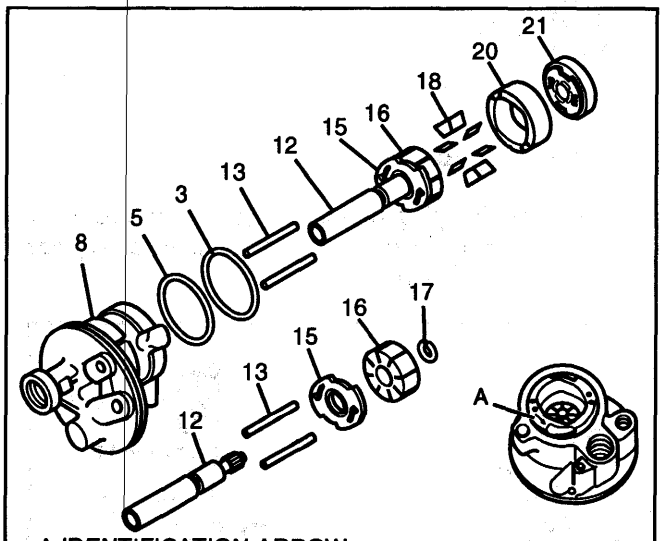
6. Bolts (36).

Tighten

- Bolts (36) to 58 N•m (43 lb. ft.).
- Fitting (33) to 75 N•m (55 lb. ft.).

Install or Connect

- Power steering pump. Refer to "Power Steering Pump Replacement" in section 3B.



A-IDENTIFICATION ARROW
3-SEAL
5-SEAL
8-HOUSING
12-SHAFT, DRIVE
13-PINS, DOWEL
15-PLATE, THRUST
16-ROTOR, PUMP
17-RING, SHAFT RETAINING
18-VANES, PUMP
20-RING, PUMP
21-PLATE, PRESSURE

Figure 4 Rotating Group

END PLATE AND ROTATING GROUP REPLACEMENT

Figures 1, 2 and 4

Remove or Disconnect

- Power steering pump from vehicle. Refer to "Power Steering Pump Replacement" in section 3B.

Disassemble

1. Pump reservoir. Refer to "Pump Reservoir Replacement" in this section.
2. Retaining ring (25).
3. End plate (23) and spring (22).

Notice: Examine exposed portion of pump drive shaft. If it is corroded, clean with crocus cloth before removing. This will prevent damage to the shaft bushing which might require replacement of the entire housing.

4. Pressure plate (21) by using a rubber mallet to tap lightly on the drive shaft (12).
5. Pump ring (20).
6. Pump vanes (18).
7. Shaft, rotor and thrust plate assembly.
8. Shaft retaining ring (17).
9. Pump rotor (16).
10. Thrust plate (15).
11. Drive shaft (12).
12. Dowel pins (13).
13. O-ring seals (3 and 5).

Important

- Use new seals and drive shaft retaining ring when assembling pump.

Assemble

- Lubricate O-ring seals (3 and 5) with power steering fluid.

1. O-ring seals (3 and 5) to housing (8).
2. Dowel pins (13) to housing (8).
3. Thrust plate (15) and pump rotor (16) to drive shaft (12) and secure with retaining ring (17).
4. Shaft, rotor and thrust plate assembly to housing (8).
5. Pump vanes (18) to pump rotor (16).
6. Pump ring (20) to housing (8) with identification arrow on top edge of ring (20) facing outward.
7. Pressure plate (21).
8. Spring (22) and end plate (23).
9. Retaining ring (25).
10. Pump reservoir (37). Refer to "Pump Reservoir Replacement" in this section.

Install or Connect

- Power steering pump. Refer to "Power Steering Pump Replacement" in section 3B.

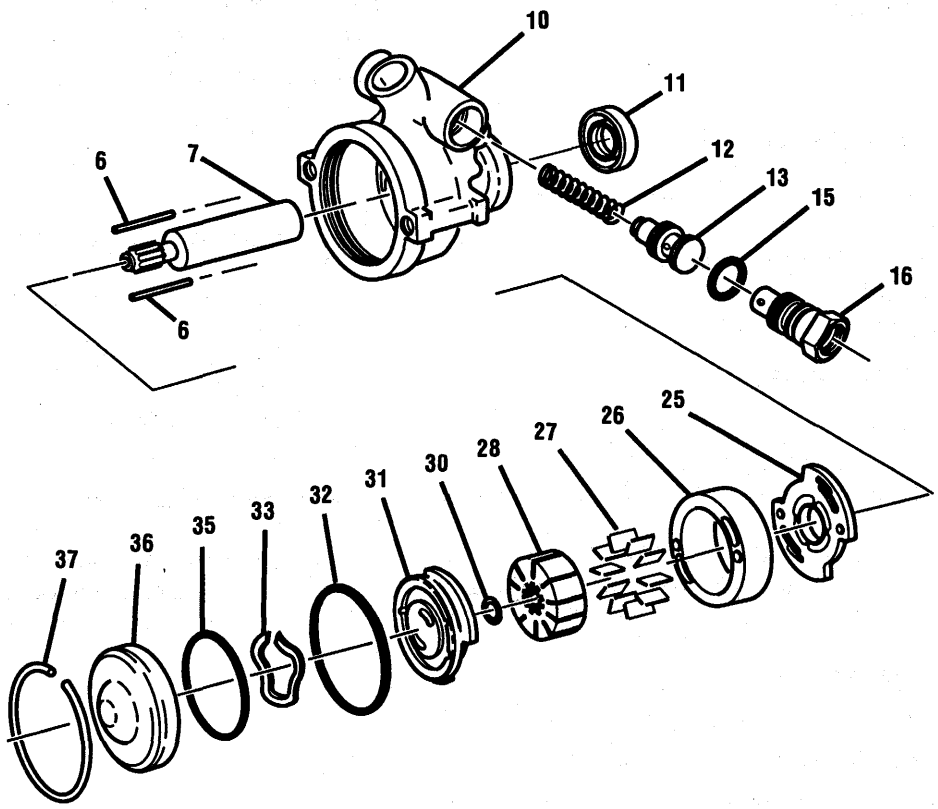


Figure 1 Power Steering Pump – Reverse Rotation

Key No.	Part Name
6	PIN, PUMP RING DOWEL
7	SHAFT, DRIVE
10	HOUSING ASM, BUSHING &
11	SEAL, DRIVE SHAFT
12	SPRING, FLOW CONTROL
13	VALVE ASM, CONTROL
15	SEAL, O-RING
16	FITTING, O-RING UNION
25	PLATE, THRUST
26	RING, PUMP
27	VANE, PUMP
28	ROTOR, PUMP
30	RING, SHAFT RETAINING
31	PLATE, PRESSURE
32	SEAL, O-RING
33	SPRING, PRESSURE PLATE
35	SEAL, O-RING
36	COVER, END
37	RING, RETAINING

Figure 2 Power Steering Pump – Reverse Rotation – Legend

CONTROL VALVE

Figure 1

Remove or Disconnect

1. Pump assembly from vehicle, if necessary for access.
2. O-ring union fitting (16) and O-ring (15).
3. Control valve assembly (13).
4. Flow control spring (12).

Install or Connect

1. Flow control spring (12).
2. Control valve assembly (13).
3. Lubricate new O-ring (15) with power steering fluid.
   - O-ring (15) on fitting (16).
4. Fitting (16) into hydraulic pump housing assembly (10).

Tighten

   - Fitting (16) to 75 N•m (55 lb. ft.).
5. Pump assembly to vehicle, if removed.

DRIVE SHAFT SEAL

(without disassembly of pump)

Figures 3 and 4

Tool Required:
J 7728 Shaft Oil Seal Installer

Remove or Disconnect

1. Pump assembly from vehicle, if necessary for access.
2. Protect drive shaft (7) with shim stock (see Figure 3).
3. Seal (11) and discard. (Use small chisel to cut drive shaft seal.)

Install or Connect

1. New drive shaft seal (11), lubricated with power steering fluid, using tool J 7728 (see Figure 4).
2. Pump assembly to vehicle, if removed.

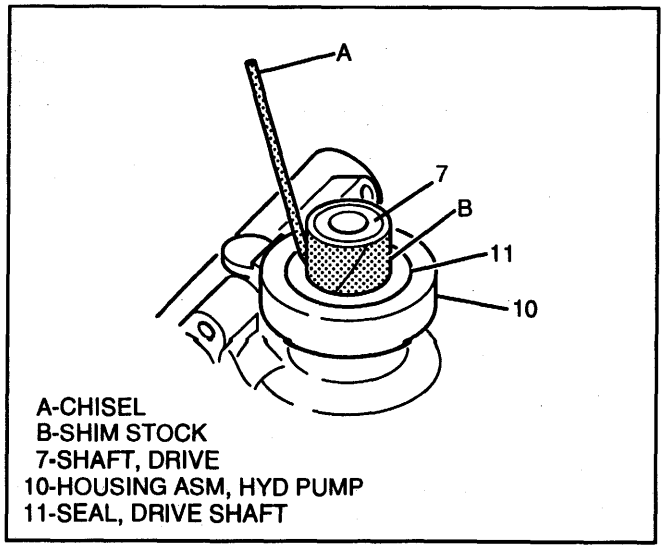


Figure 3 Shaft Seal Removal

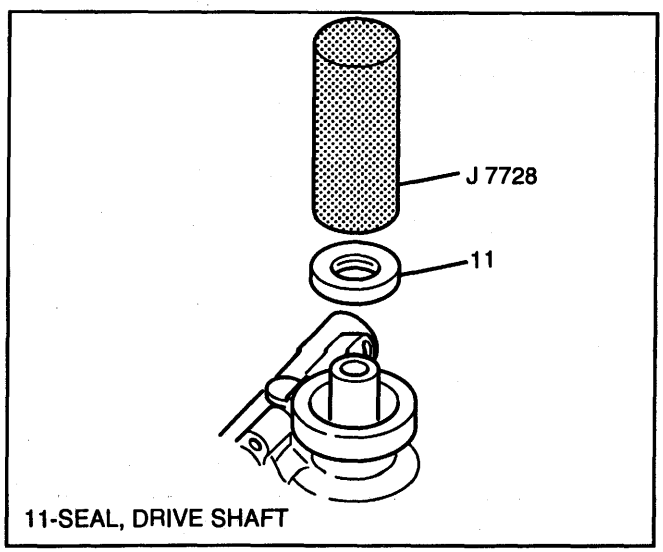


Figure 4 Seal Installation

HYDRAULIC PUMP ASSEMBLY

Figures 1, 4 thru 8

Tool Required:
J 7728 Shaft Oil Seal Installer

Disassemble

1. Retaining ring (37) using punch in access hole (see Figure 5).
2. Internal components of pump from pump housing (10) by gently pushing on drive shaft (7). Components should include pressure plate sub-assembly consisting of:
   - End cover (36).
   - O-ring seal (35).
   - Pressure plate spring (33).
   - Pressure plate (31).

   Drive shaft sub-assembly consisting of:
   - Pump rotor (28).
   - Thrust plate (25).
   - Drive shaft (7).
   - Shaft retaining ring (30).

   Pump ring (26) and vanes (27).
3. O-ring (32) from pump housing (10).
4. Dowel pins (6).
5. Drive shaft seal (11).
6. End cover (36), pressure plate spring (33) and O-ring (35) from pressure plate (31).
7. Pump ring (26) and vanes (27) from drive shaft sub-assembly.
8. Shaft retaining ring (30) from drive shaft (7).
9. Pump rotor (28) and thrust plate (25) from drive shaft (7).

Clean

- All parts in power steering fluid.
- Dry parts.

Inspect

- Pressure plate (31).
- Pump ring (26).
- Rotor (28).
- Vanes (27).
- Thrust plate (25).
- Drive shaft (7).

For scoring, pitting or chatter marks. If noted, replace appropriate parts.

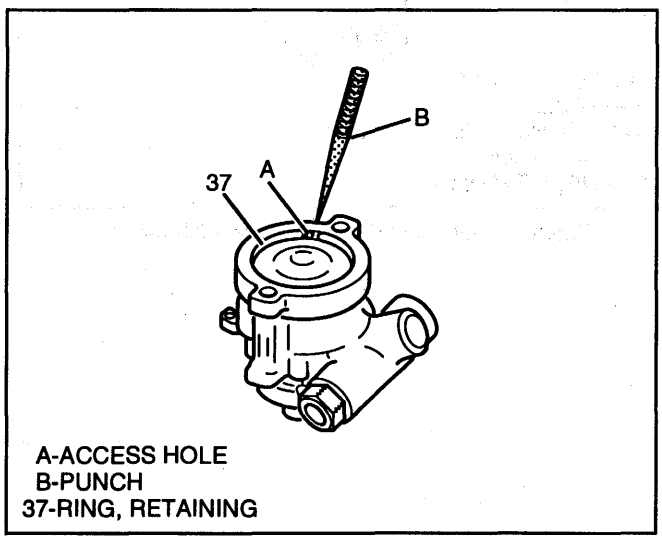


Figure 5 Retaining Ring Removal

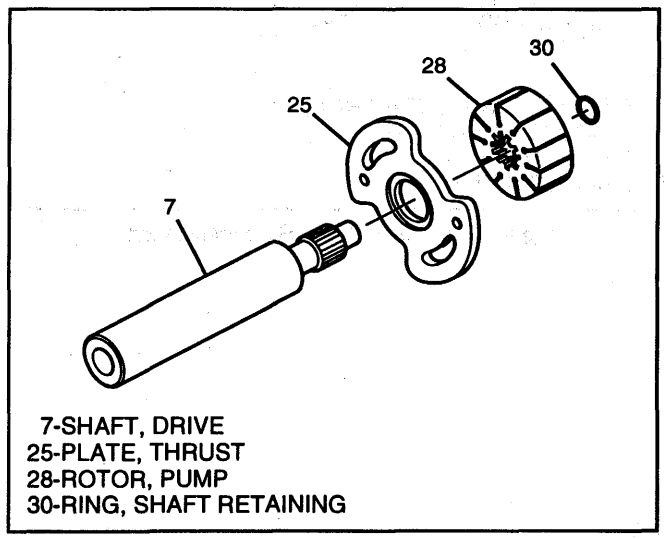


Figure 6 Retaining Ring Installation (Shaft)

Assemble

1. Lubricate new drive shaft seal (11) with power steering fluid.
   - Drive shaft seal (11) into pump housing (10) with tool J 7728 (see Figure 4).
2. Pump ring dowel pins (6) into pump housing (10).
3. Thrust plate (25) and pump rotor (28) to drive shaft (7) (see Figure 6).
4. New shaft retaining ring (30) onto drive shaft (7).
5. Drive shaft sub-assembly into pump housing (10).
6. Vanes (27) into pump rotor (28).
7. Pump ring (26), with holes positioned correctly onto dowel pins (6), in pump housing (10) (see Figure 7).
8. Lubricate new O-ring (32) with power steering fluid.
   - O-ring (32) into groove in pump housing (10).
9. Pressure plate (31).
10. Pressure plate spring (33).
11. Lubricate new O-ring (35) with power steering fluid.
    - O-ring (35) into end cover (36).
12. Lubricate outer edge of end cover (36) with power steering fluid.
13. Press end cover (36) into pump housing (10).
14. Retaining ring (37) into groove in pump housing (10), with ring opening near access hole in pump housing (see Figure 8).

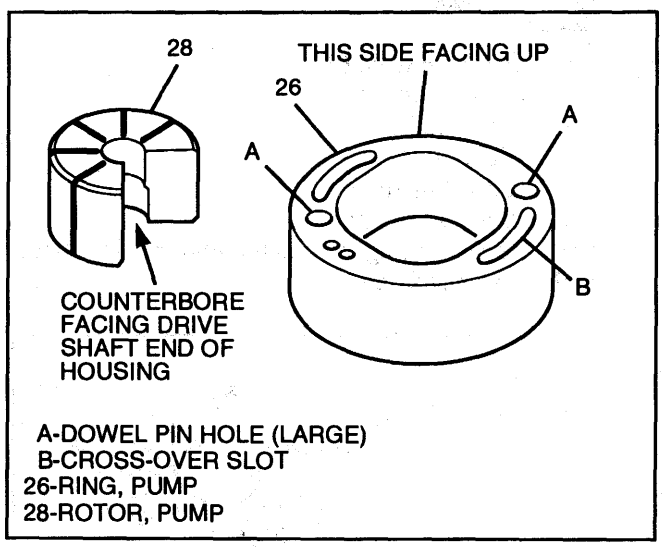


Figure 7 Rotor or Pump Ring Installation

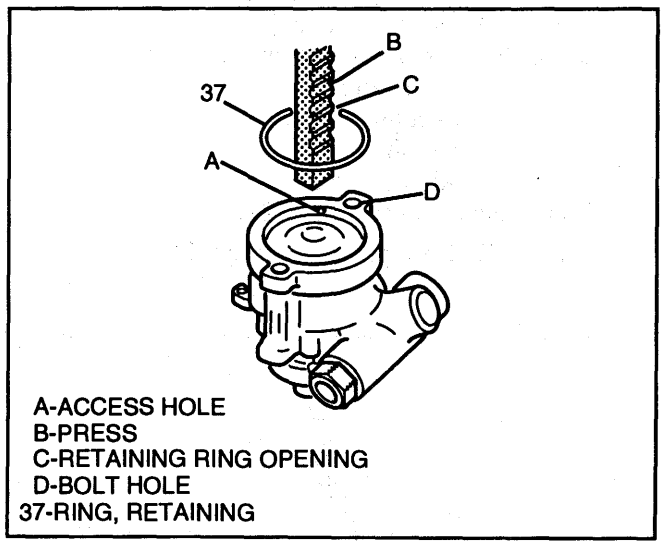


Figure 8 Retaining Ring Installation (Housing)

SPECIFICATIONS

FLUID CAPACITIES

Lubricant ..... GM Power Steering Fluid Part No. 1050017
or Equivalent meeting GM Specification 9985010
Capacity Complete System ..... 0.75 liter (1-1/2 pints)
Pump Only ..... 0.5 liter (1 pint)

FASTENER TORQUES

P Series Power Steering Pump

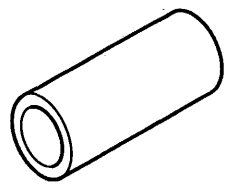
(33)	Connector and Fitting Assembly	75.0 N•m	(55 lb. ft.)
(36)	Pump Mounting Bolt	58.0 N•m	(43 lb. ft.)

Reverse Rotation Power Steering Pump

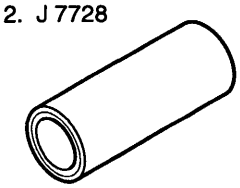
(16)	O-ring Union Fitting	75.0 N•m	(55 lb. ft.)

SPECIAL TOOLS

1. J 22670



2. J 7728



1. SHAFT OIL SEAL INSTALLER (P SERIES PUMP)
2. SHAFT OIL SEAL INSTALLER (REVERSE ROTATION PUMP)

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SECTION 3C

FRONT SUSPENSION

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

Figures 1 and 2

The short/long arm (SLA) front suspension assembly is designed to allow each wheel assembly to compensate for changes in the road surface level without appreciably affecting the opposite wheel assembly. Each wheel assembly is independently connected to the frame assembly by a steering knuckle assembly (6) and wheel hub assembly (44), shock absorber assembly (24) and spring assembly (23), upper and lower ball stud assemblies (2 and 10) and upper and lower control arm assemblies (1 and 17). The steering knuckle and hub assemblies (6 and 44) move in a prescribed three-dimensional arc. The front wheel assemblies are held in proper relationship to each other by two front tie rod axle assemblies. The front tie rod axle assemblies are connected to steering arms on the knuckles and to the steering gear assembly.

Spring assemblies (23) are mounted on the lower control arm assemblies (17). Ride control is provided by direct acting shock absorber assemblies (24). The upper portion of the shock absorber assembly is connected to the front upper shock absorber mount assembly (45). The upper mount assembly (45) extends through the upper control arm support (46) and the center wheelhouse assembly and attaches with two shock absorber upper mount bolts/screws (26) and two shock absorber upper mount nuts (25).

Side roll of the front suspension assembly is controlled by a stabilizer shaft (11). The stabilizer shaft is mounted to stabilizer shaft insulators (16) that are held to frame side rails by stabilizer shaft bracket assemblies. The ends of the stabilizer shaft (11) are connected to the lower control arm assemblies (17) by stabilizer shaft link assemblies (12) and are isolated by complaint bushings.

The inner ends of the lower control arm assembly (17) have pressed-in bushings. Bolts (passing through the bushings) attach the lower control arm assembly (17) to the crossmember assembly (20).

The upper control arm assembly (1) is attached to the steering knuckle assembly (6) with a nut (4) and cotter pin (3) and is bolted to the shock absorber assembly (24) through an upper control arm support (46) which attaches to the body.

The lower ball stud assembly (10) is a press fit in the lower control arm assembly (17) and is attached to the steering knuckle assembly (6) with a nut (8) and cotter pin (9).

Rubber seals are provided at ball socket assemblies to keep dirt and moisture from entering the stud assembly and damaging bearing surfaces.

The upper ball stud assembly (2) is riveted to the upper control arm assembly (1) and is attached to the steering knuckle assembly (6) with a nut (4) and cotter pin (3).

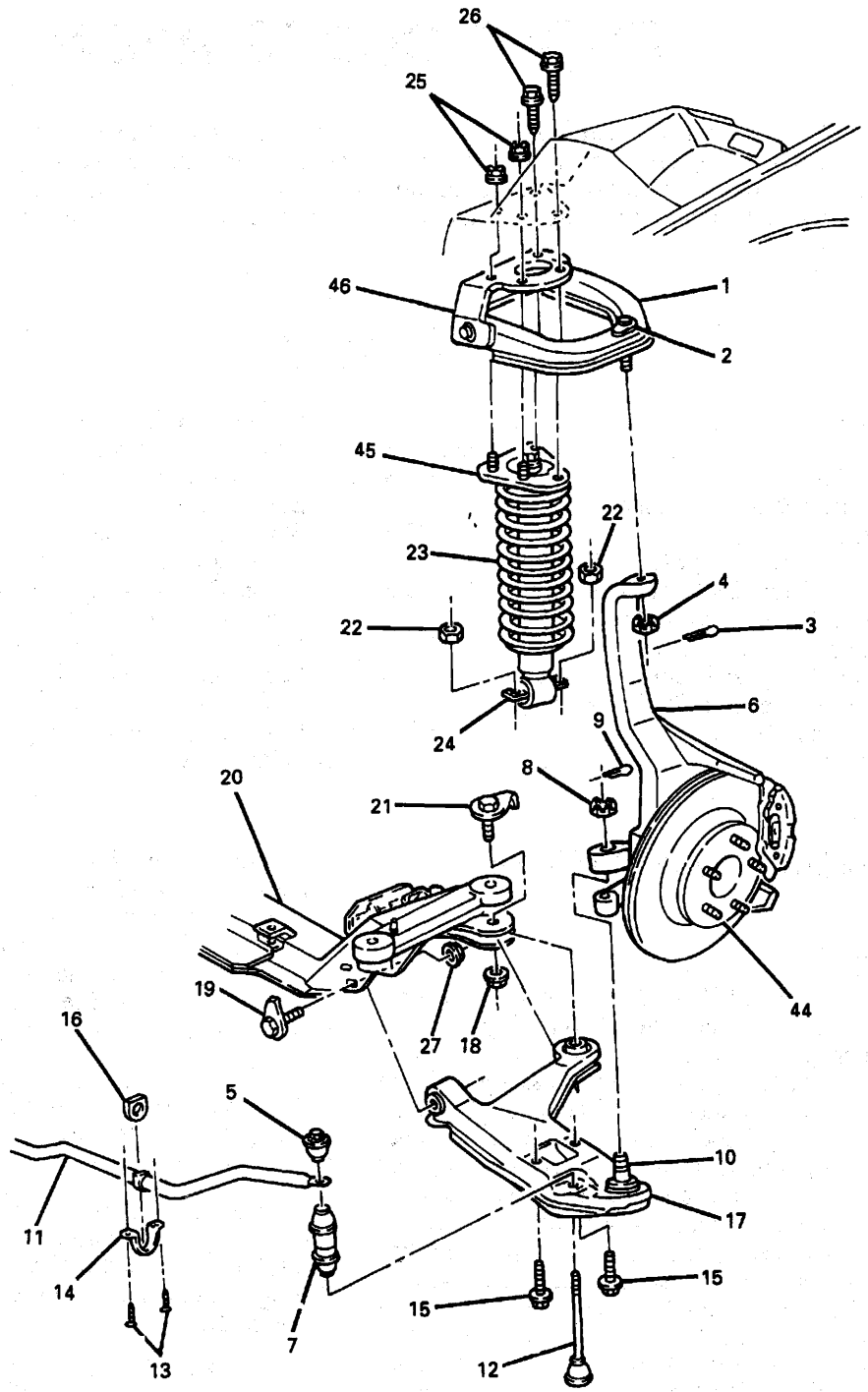


Figure 1 – Front Suspension Components

1 ARM, FRONT UPPER CONTROL
2 STUD, FRONT UPPER CONTROL ARM BALL
3 PIN, FRONT UPPER CONTROL ARM COTTER
4 NUT, FRONT UPPER CONTROL ARM
5 NUT, FRONT STABILIZER SHAFT LINK
6 KNUCKLE AND HUB, STEEERING
7 SLEEVE, FRONT STABILIZER SHAFT LINK
8 NUT, FRONT LOWER CONTROL ARM
9 PIN, FRONT LOWER CONTROL ARM COTTER
10 STUD, FRONT LOWER CONTROL ARM BALL
11 STABILIZER SHAFT, FRONT
12 LINK, FRONT STABILIZER SHAFT
13 BOLT/SCREW, FRONT STABILIZER SHAFT INSULATOR CLAMP
14 CLAMP, FRONT STABILIZER SHAFT INSULATOR
15 BOLT/SCREW, FRONT SHOCK ABSORBER
16 INSULATOR, FRONT STABILIZER SHAFT
17 ARM, FRONT LOWER CONTROL
18 NUT, FRONT LOWER CONTROL ARM
19 BOLT/SCREW, FRONT LOWER CONTROL ARM
20 CROSSMEMBER, FRONT
21 BOLT/SCREW, FRONT LOWER CONTROL ARM
22 NUT, FRONT SHOCK ABSORBER LOWER BRACKET
23 SPRING, FRONT
24 ABSORBER, FRONT SHOCK
25 NUT, FRONT SHOCK ABSORBER UPPER
26 BOLT/SCREW, FRONT SHOCK ABSORBER UPPER MOUNT
27 NUT, FRONT LOWER CONTROL ARM
44 HUB, FRONT WHEEL
45 MOUNT, FRONT UPPER SHOCK ABSORBER
46 SUPPORT, FRONT UPPER CONTROL ARM

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Figure 2 – Front Suspension Components - Legend

ON-VEHICLE SERVICE

CONTROL ARM BALL STUD ASSEMBLY INSPECTION

Figures 3 and 4

Inspect

- Ball stud assembly seals should be carefully inspected for cuts and tears. Whenever cuts or tears are found, ball stud assembly must be replaced.
- Ball studs for wear.

Lower Control Arm Ball Stud Assembly

Figure 3

Inspect

1. Raise vehicle and position floor stands under both lower control arm assemblies as near as possible to each ball stud assembly. Refer to SECTION 0A.

Important

- Vehicle must be stable and should not rock on floor stands.
- Wipe the ball joints clean and check the seals for cut or tears. If the seal is cut or torn, the ball joint MUST be replaced.

2. Position dial indicator against wheel rim.
3. Pry between the lower control arm and the steering knuckle while reading the dial indicator. Vertical deflection on the dial indicator should not exceed 1.19 mm (0.046875 inch).
   - If dial indicator reading exceeds 1.19 mm (0.046875 inch), replace ball stud assembly.
4. Anytime ball stud assembly is disconnected from steering knuckle assembly, check for looseness or if ball stud assembly can be twisted in its socket with your fingers. If either of these conditions exist, replace ball stud assembly.
5. Lower vehicle.

Upper Control Arm Ball Stud Assembly

Figure 4

Inspect

1. Raise vehicle and position floor stands under both lower control arm assemblies as near as possible to each ball stud assembly. Refer to SECTION 0A.

Important

- Vehicle must be stable and should not rock on floor stands.

2. Position dial indicator against wheel rim.
3. Grasp wheel assembly and push in on bottom of tire while pulling out at top. Read gage, then reverse push-pull procedure. Horizontal deflection on dial indicator should not exceed 3.18 mm (0.125 inch).
   - If dial indicator reading exceeds 3.18 mm (0.125 inch), replace ball stud assembly.
4. Anytime ball stud assembly is disconnected from steering knuckle assembly, check for looseness or if ball stud assembly can be twisted in its socket with your fingers. If either of these conditions exist, replace ball stud assembly.
5. Lower vehicle.

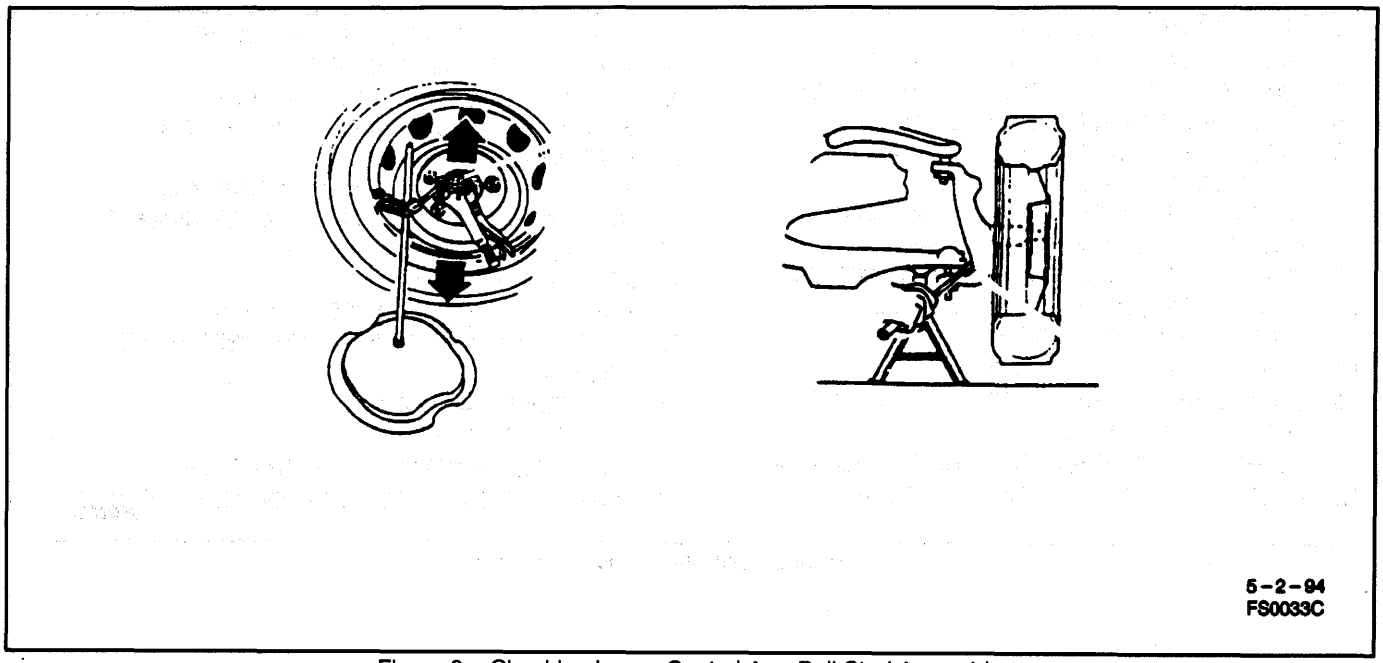


Figure 3 – Checking Lower Control Arm Ball Stud Assembly

CONTROL ARM BALL STUD ASSEMBLY REPLACEMENT

Lower Control Arm Ball Stud Assembly

Figures 5 through 10

Tools Required:

- J 39549 Ball Joint/Tie Rod Separator
- J 9519-7 Ball Joint Remover
- J 9519-9 Ball Joint Installer
- J 9519-18 Ball Joint Pressing Screw
- J 9519-23 Ball Joint C-Clamp

Remove or Disconnect

1. Raise and suitably support vehicle with floor stands under frame assembly. Refer to SECTION 0A.
2. Special security wheel lock nut, if equipped. Refer to SECTION 3E.
3. Tire and wheel assembly. Refer to SECTION 3E.
4. Place floor jack under lower control arm assembly (17).

Important

- Floor jack must remain under shock absorber assembly mounting location on lower control arm assembly (17) during removal and installation to hold spring assembly and lower control arm assembly in position.

5. Separate ball stud assembly from steering knuckle assembly, using J 39549.
6. Lower control arm cotter pin and loosen lower control arm nut.
7. Press ball stud assembly out of lower control arm assembly (17), using J 9519-7, J 9519-18 and J 9519-23.

Install or Connect

NOTICE: See "Notice" on page 3C-1 of this section.

1. Position ball stud assembly into lower control arm assembly (17) and press in, using J 9519-9, J 9519-18 and J 9519-23, until it bottoms on lower control arm assembly (17). Ball stud assembly must firmly press into lower control arm assembly (17). If it does not, replace lower control arm assembly (17).
2. Ball stud assembly to steering knuckle assembly.
3. Hand start lower control arm nut.

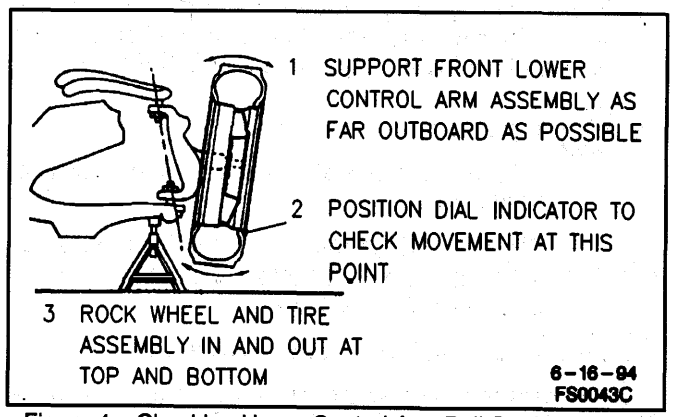


Figure 4 – Checking Upper Control Arm Ball Stud Assembly

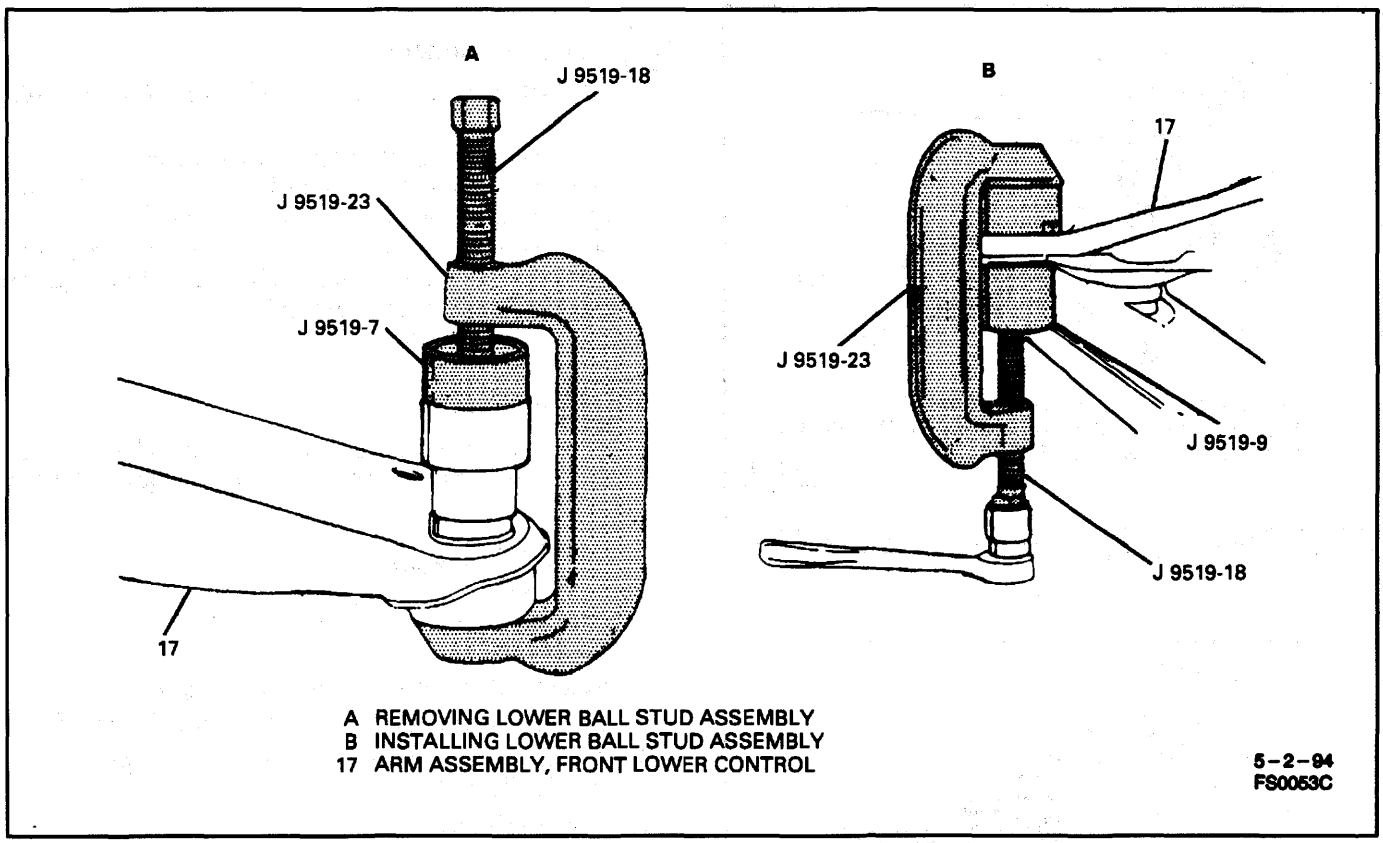


Figure 5 – Removing and Installing Lower Control Arm Ball Stud Assembly

Important

- Tighten nut enough to align nut slot with stud hole. Never loosen nut in order to align slot with hole.

Tighten

- Nut to 110 N•m (81 lb. ft.).

4. Lower control arm cotter pin.
5. Remove floor jack from under shock absorber assembly mounting location on lower control arm assembly (17).
6. Tire and wheel assembly. Refer to SECTION 3E.
7. Special security wheel lock nut, if equipped. Refer to SECTION 3E.
8. Check wheel assembly alignment. Refer to SECTION 3A.
9. Lower vehicle.

Upper Control Arm Ball Stud Assembly

Figures 6 through 10

Remove or Disconnect

Tool Required:

J 39549 Ball Joint/Tie Rod Separator

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Special security wheel lock nut, if equipped. Refer to SECTION 3E.
3. Tire and wheel assembly. Refer to SECTION 3E.
4. Place floor jack under shock absorber assembly mounting location on lower control arm assembly (17).

Important

- Floor jack must remain under the shock absorber assembly mounting location on lower control arm assembly (17) during removal and installation to hold the spring assembly and lower control arm assembly in position.

5. Loosen ball stud assembly (2) from steering knuckle assembly (6).
6. Cotter pin (3) and nut (4).
7. Support steering knuckle assembly (6) with floor stands.
8. Separate ball stud assembly (2) from upper control arm assembly (1), using J 39549.
9. With upper control arm assembly (1) in raised position, drill out four rivets approximately 6 mm (0.25 inch) deep, using 1/8-inch drill bit. Refer to Figure 7.
10. Drill off rivet heads, using 1/2-inch drill bit. Refer to Figure 8.

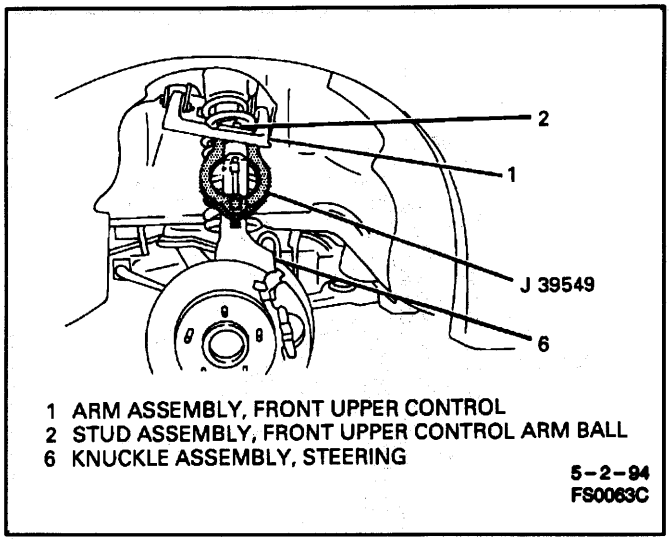


Figure 6 – Separating Upper Control Arm Ball Stud Assembly

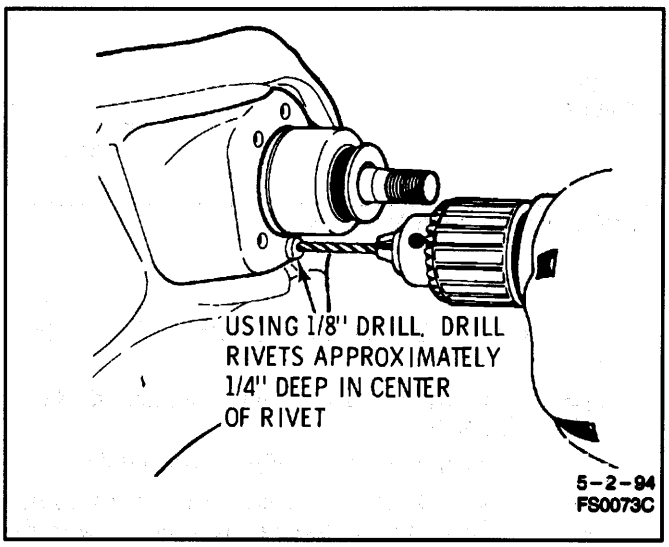


Figure 7 – Drilling Upper Control Arm Ball Stud Assembly Rivet

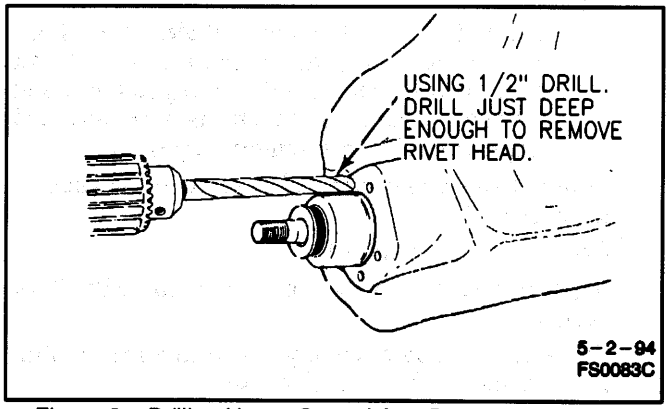


Figure 8 – Drilling Upper Control Arm Ball Stud Assembly Rivet Heads

11. Punch out rivets, using small punch, and remove ball stud assembly (2). Refer to Figure 9.

Install or Connect

NOTICE: See "Notice" on page 3C-1 of this section.

1. Position new ball stud assembly (2) and install four service kit bolts/screws (28) and nuts (29). Use specifications in ball stud assembly kit.
2. Remove temporary support from steering knuckle assembly (6), then connect ball stud assembly (2) to steering knuckle assembly (6).
3. Hand start nut (4).

Important

- Tighten nut enough to align slot with stud hole. Never loosen nut in order to align slot with hole.

Tighten

- Nut (4) to 53 N•m (39 lb. ft.)

4. Cotter pin (3).
5. Remove floor jack from under spring seat.
6. Tire and wheel assembly. Refer to SECTION 3E.
7. Special security wheel lock nut, if equipped. Refer to SECTION 3E.
8. Lower vehicle.

WHEEL HUB ASSEMBLY

Figure 11

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Special security wheel lock nut, if equipped. Refer to SECTION 3E.
3. Tire and wheel assembly. Refer to SECTION 3E.
4. Brake caliper assembly. Refer to SECTION 5B1.
5. Brake rotor assembly. Refer to SECTION 5B1.
6. Wheel speed sensor electrical connector and move aside. Refer to SECTION 5E1.
7. Bolts/screws (42) from hub assembly (44).
8. Pull hub assembly (44) from spindle.

Install or Connect

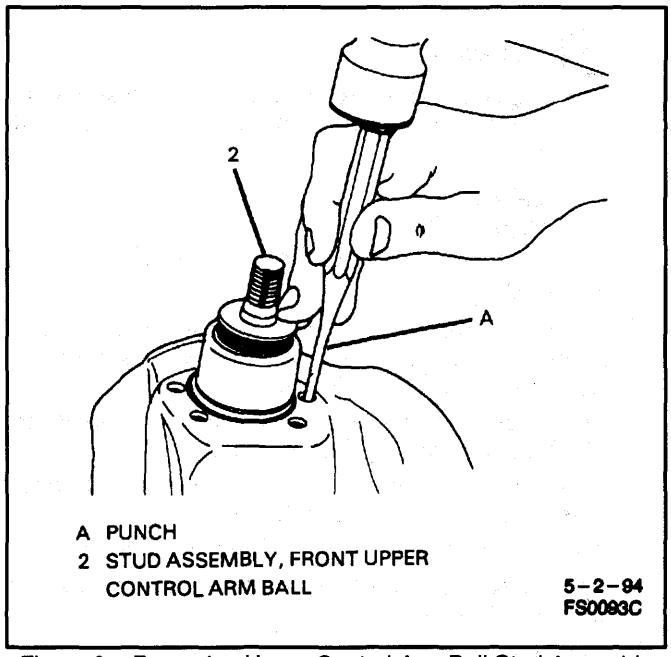
1. Position hub assembly (44) to spindle.
2. Bolts/screws (42).

Tighten

- Bolts/screws (42) to 86 N•m (63 lb. ft.).

Important

- Make sure wheel speed sensor electrical connector is reconnected to wheel speed sensor wire bracket (43) and wheel speed sensor or wires could be damaged.

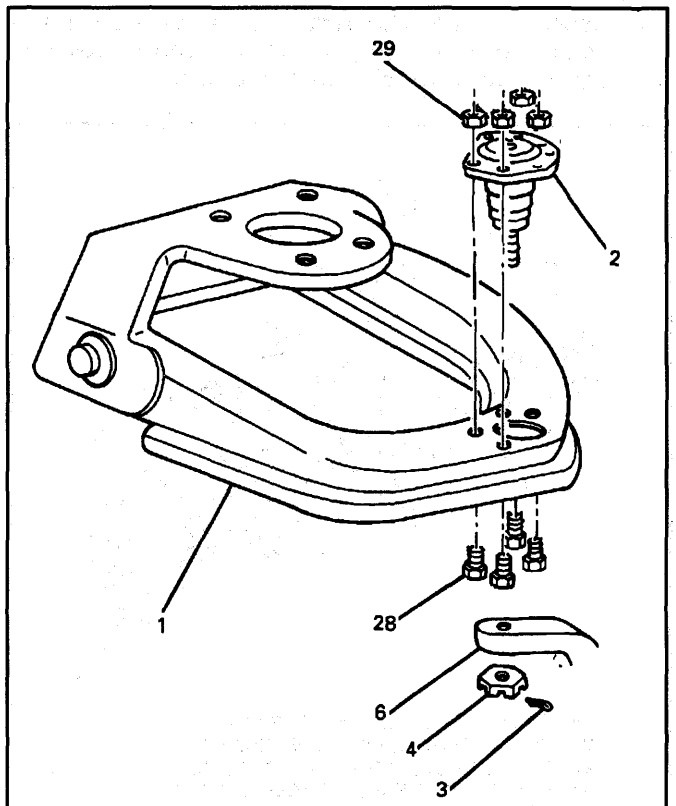


A PUNCH
2 STUD ASSEMBLY, FRONT UPPER CONTROL ARM BALL

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Figure 9 – Removing Upper Control Arm Ball Stud Assembly

3. Wheel speed sensor electrical connector. Refer to SECTION 5E1.
4. Brake rotor assembly. Refer to SECTION 5B1.
5. Brake caliper assembly. Refer to SECTION 5B1.
6. Tire and wheel assembly. Refer to SECTION 3E.
7. Special security wheel lock nut, if equipped. Refer to SECTION 3E.
8. Lower vehicle.



1 ARM ASSEMBLY, FRONT UPPER CONTROL
2 STUD ASSEMBLY, FRONT UPPER CONTROL BALL
3 PIN, FRONT UPPER CONTROL ARM COTTER
4 NUT, FRONT UPPER CONTROL ARM
6 KNUCKLE ASSEMBLY, STEERING
28 BOLT/SCREW, SERVICE KIT
29 NUT, SERVICE KIT

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Figure 10 – Upper Control Arm Ball Stud Assembly Attachment

FRONT WHEEL BOLT

Wheel Hub Assembly Removed

Tool Required:

J 6627-A Wheel Stud Remover

Remove or Disconnect

NOTICE: Do not damage wheel assembly mounting surface on hub assembly flange. Brake assembly disc must be supported before pressing wheel assembly bolt in or out.

- Hub assembly or disc bolts, using J 6627-A.

Install or Connect

NOTICE: See "Notice" on page 3C-1 of this section.

- New serrated bolt into hole in hub assembly. Tap lightly with hammer to start bolt serration in hole, making sure that bolt is square with hub flange.

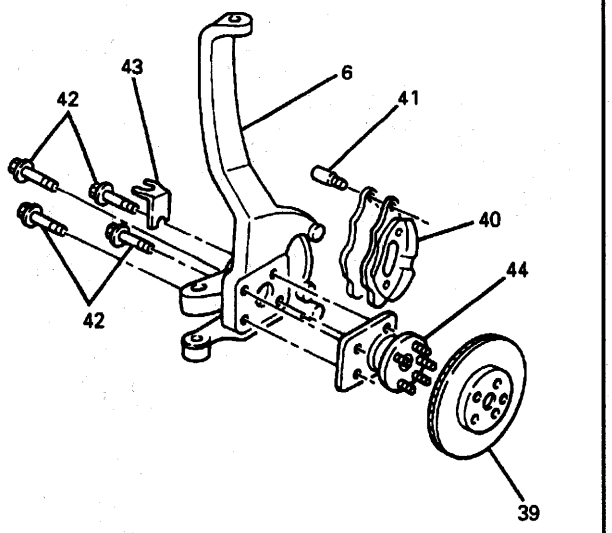
LOWER CONTROL ARM ASSEMBLY

Figure 12

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Special security wheel lock nut, if equipped. Refer to SECTION 3E.
3. Tire and wheel assembly. Refer to SECTION 3E.
4. Power steering gear assembly from steering knuckle assembly. Refer to SECTION 3B.
5. Stabilizer shaft link assembly. Refer to "Stabilizer Shaft Link Assembly" in this section.

6. Shock absorber and spring assembly from lower control arm assembly. Refer to "Shock Absorber and Spring Assembly" in this section.



6 KNUCKLE ASSEMBLY, STEERING
39 ROTOR ASSEMBLY, FRONT BRAKE
40 CALIPER ASSEMBLY, FRONT BRAKE
41 BOLT/SCREW, FRONT BRAKE CALIPER
42 BOLT/SCREW, FRONT WHEEL
43 BRACKET, WHEEL SPEED SENSOR WIRE
44 HUB ASSEMBLY, FRONT WHEEL

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Figure 11 – Front Wheel Hub Assembly

7. Separate lower control arm ball stud assembly from steering knuckle assembly. Refer to "Control Arm Ball Stud Assembly Replacement" in this section.
8. Lower control arm assembly (17) from steering knuckle assembly (6).
9. Bolts/screws (19 and 21) and nuts (27 and 18).
10. Lower control arm assembly (17).

Install or Connect

NOTICE: See "Notice" on page 3C-1 of this section.

1. Position lower control arm assembly (17) to cross-member assembly (20).
2. Hand tighten bolts/screws (19 and 21) and nuts (18 and 27).

Tighten

- Nuts (18) to 115 N•m (85 lb. ft.).
- Nuts (27) to 100 N•m (74 lb. ft.).

3. Position lower control arm assembly (17) to steering knuckle assembly (6).
4. Hand start nut (8).

Important

- Tighten nut enough to align slot with stud hole. Never loosen nut in order to align slot with hole.

Tighten

- Nut (8) to 110 N•m (81 lb. ft.).

5. Cotter pin (9).
6. Lower control arm assembly to shock absorber and spring assembly. Refer to "Shock Absorber and Spring Assembly" in this section.
7. Stabilizer shaft link assembly. Refer to "Stabilizer Shaft Link Assembly" in this section.
8. Power steering gear assembly to steering knuckle assembly. Refer to SECTION 3B.
9. Tire and wheel assembly. Refer to SECTION 3E.
10. Special security wheel lock nut, if equipped. Refer to SECTION 3E.
11. Lower vehicle.
12. Align wheel assembly. Refer to SECTION 3A.

LOWER CONTROL ARM BUSHING ASSEMBLY

The lower control arm bushing assembly can be serviced separately from the lower control arm assembly.

Front Bushing

Figures 12 and 13

Tools Required:

J 21474-3 Lower Control Arm Bushing Screw Assembly
J 21474-4 Lower Control Arm Bushing Nut Assembly
J 21474-5 Control Arm Bushing Receiver
J 21474-6 Control Arm Bushing Receiver
J 39875 Half Moon Spacer
J 39876 Lower Control Arm Bushing Receiver

Disassemble

1. Lower control arm assembly. Refer to "Lower Control Arm Assembly" in this section.
2. Remove lower control arm front bushing from lower control arm assembly (17).
   A. Place J 21474-3 through large end of J 21474-6.
   B. Thread J 21474-3 through front bushing and push it through open end of J 39876.
   C. Place thrust washer onto J 21474-3 with seam facing toward front bushing.
   D. Install J 39875 around outside of bushing to avoid metal distortion during removal.
   E. After making sure all tools are properly lined up with front bushing and control arm, install J 21474-4 and tighten until bushing is pushed all the way out (popping noise may be heard while removing).

5 NUT, FRONT STABILIZER SHAFT LINK ASSEMBLY
6 KNUCKLE ASSEMBLY, STEERING
7 SLEEVE, FRONT STABILIZER SHAFT LINK ASSEMBLY
8 NUT, FRONT LOWER CONTROL ARM
9 COTTER PIN, FRONT LOWER CONTROL ARM
10 BALL STUD ASSEMBLY, FRONT LOWER CONTROL ARM
11 STABILIZER SHAFT, FRONT
12 LINK ASSEMBLY, FRONT STABILIZER SHAFT
15 BOLT/SCREW, FRONT SHOCK ABSORBER
17 ARM ASSEMBLY, FRONT LOWER CONTROL
18 NUT, FRONT LOWER CONTROL ARM
19 BOLT/SCREW, FRONT LOWER CONTROL ARM
20 CROSSMEMBER ASSEMBLY, FRONT
21 BOLT/SCREW, FRONT LOWER CONTROL ARM
22 NUT, FRONT SHOCK ABSORBER LOWER BRACKET
23 SPRING ASSEMBLY, FRONT
24 ABSORBER ASSEMBLY, FRONT SHOCK
27 NUT, FRONT LOWER CONTROL ARM
44 HUB ASSEMBLY, FRONT WHEEL

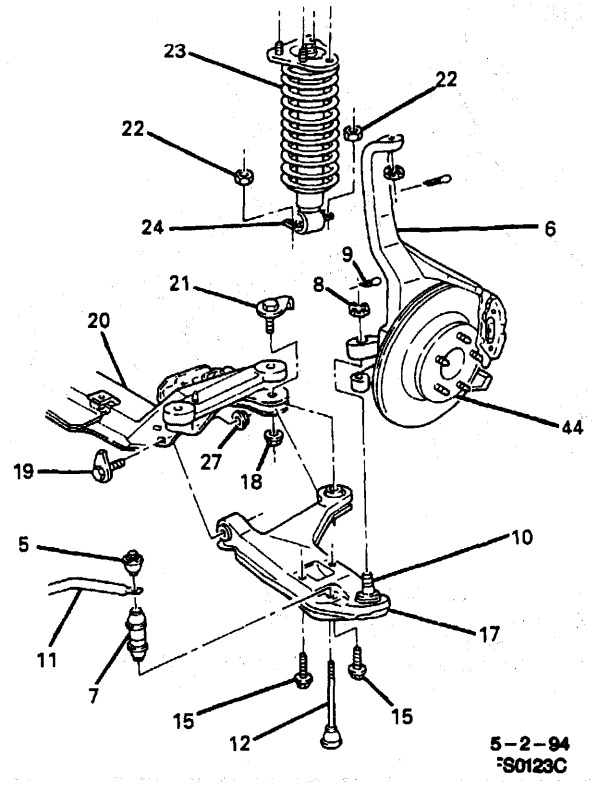


Figure 12 – Lower Control Arm Assembly

Assemble

NOTICE: See "Notice" on page 3C-1 of this section.

1. Lower control arm front bushing.
   A. Thread J 21474-3 through J 21474-5.
   B. Install J 21474-3 through new front bushing and into lower control arm.
   C. Thread J 21474-3 and accessories into lower control arm – front.
   D. Install J 39876 onto J 21474-3 with open end of J 39876 facing toward control arm.
   E. Install J 39875 around outside bushing to avoid metal distortion during installation.
   F. Place thrust washer onto threaded end of J 21474-3 with seam facing toward control arm.
   G. After making sure all tools are properly lined up with control arm and bushing, install J 21474-4 onto J 21474-3. Tighten J 21474-4 and J 21474-3 until bushing becomes flush with control arm.
2. Lower control arm assembly. Refer to "Lower Control Arm Assembly" in this section.

Rear Bushing

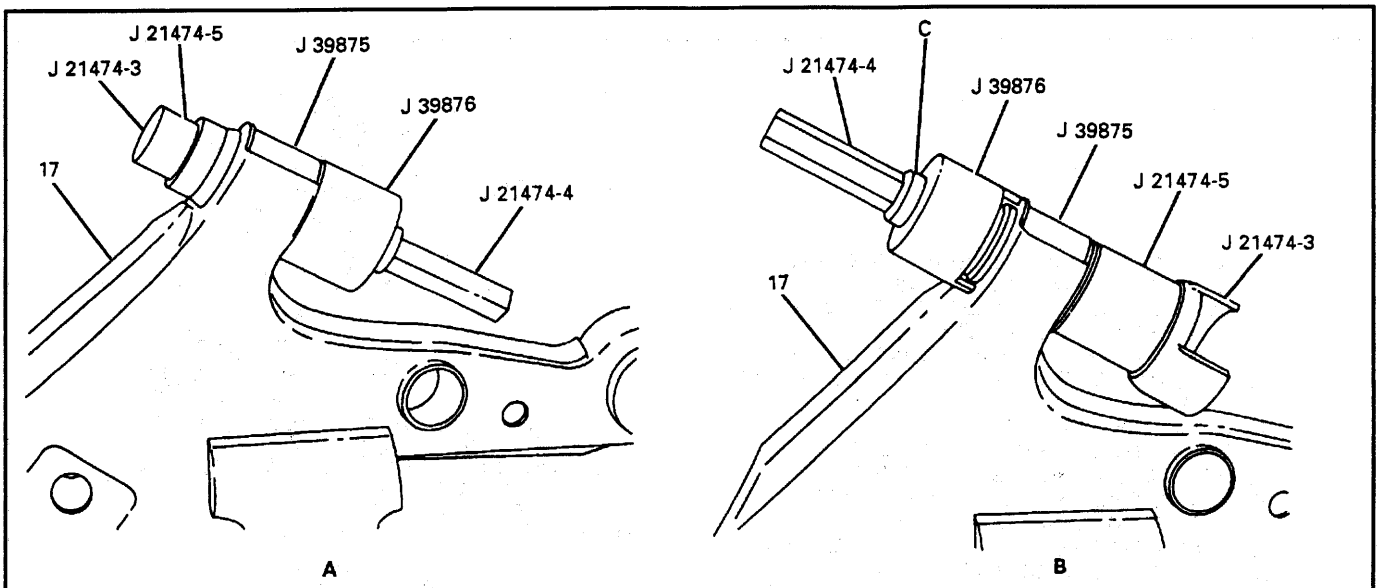
Figures 12 and 14

Tools Required:

- J 21474-3 Lower Control Arm Bushing Screw Assembly
- J 21474-4 Lower Control Arm Bushing Nut Assembly
- J 21474-5 Control Arm Bushing Receiver
- J 39874 Lower Control Arm Bushing Receiver
- J 39931 Lower Control Arm Bushing Receiver

Disassemble

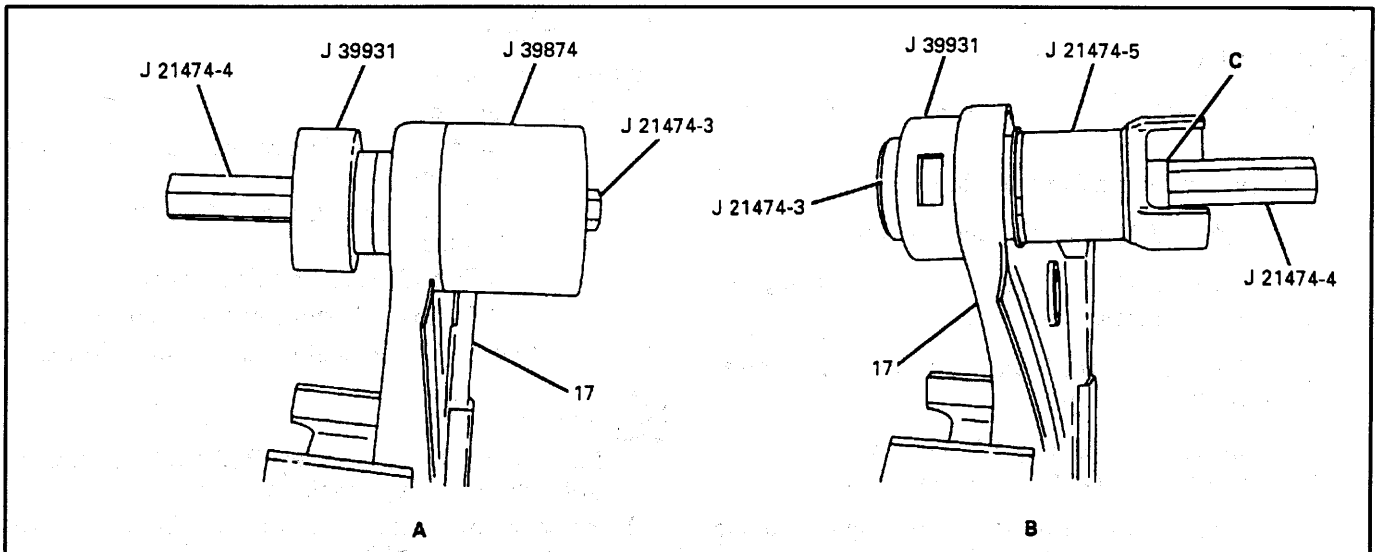
1. Lower control arm assembly. Refer to "Lower Control Arm Assembly" in this section.
2. Remove lower control arm rear bushing from lower control arm assembly (17).
   A. Install J 39874 onto J 21474-3 with sealed end of J 39874 facing head of screw.
   B. Run J 21474-3 through control arm bushing, control arm, and into small end of J 39931.
   C. Install thrust washer onto J 21474-3 with seam facing toward control arm.
   D. Install J 21474-4 onto J 21474-3, making sure all parts are lined up with control arm bushing.
   E. Tighten assembly until control arm bushing is able to be removed (popping noise may be heard while removing).



A REMOVING FRONT BUSHING
B INSTALLING FRONT BUSHING
C WASHER, THRUST
17 ARM ASSEMBLY, FRONT LOWER CONTROL

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Figure 13 – Removing and Installing Lower Control Arm Front Bushing Assembly



A REMOVING REAR BUSHING
B INSTALLING FRONT BUSHING
C WASHER, THRUST
17 ARM ASSEMBLY, FRONT LOWER CONTROL

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Figure 14 – Removing and Installing Lower Control Arm Rear Bushing Assembly

Assemble

NOTICE: See "Notice" on page 3C-1 of this section.

1. Lower control arm rear bushing.
   A. With lower control arm securely tightened in vise, place J 21474-3 through small end of J 39931.
   B. Install J 21474-3 through new rear bushing and then through closed end of lower control arm – rear.
   C. Place small end of J 21474-5 onto J 21474-3.
   D. Install thrust washer onto J 21474-3 with seam of washer facing toward control arm.
   E. Making sure all tools are lined up with bushing and control arm and that window is facing straight up and visible on J 39931, install J 21474-4 onto J 21474-3 and tighten until rubber protrusion on J 39931 side bottoms out against J 39931.
2. Lower control arm assembly. Refer to "Lower Control Arm Assembly" in this section.

SHOCK ABSORBER AND SPRING ASSEMBLY

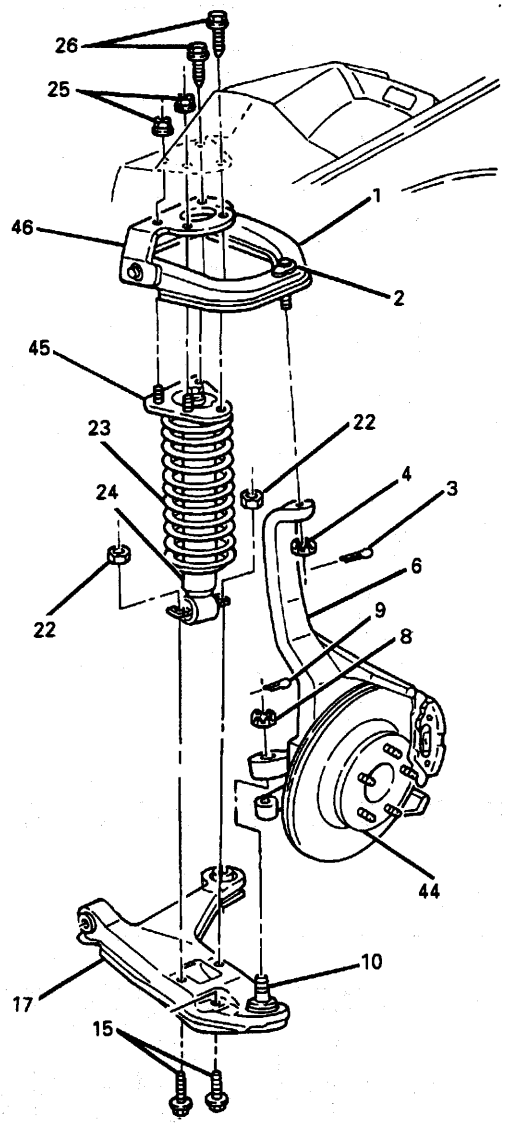
Figures 15 through 23

Tools Required:

- J 34013-B Strut Spring Compressor
- J 34013-114 Modular Shock Assembly Compressor Adapter
- J 34013-88 Strut Compressor Adapter
- J 39642 Modular Shock Nut Removal Set, 15 mm (0.60 inch)
- J 34013-115 Modular Shock Assembly Alignment Rod

Remove or Disconnect

1. Brake master cylinder nuts (driver-side only). Refer to SECTION 5A.
2. Move brake master cylinder assembly aside (driver-side only). Refer to SECTION 5A.
3. Bolts/screws (26) and nuts (25).
4. Raise and suitably support vehicle. Refer to SECTION 0A.
5. Special security wheel lock nut, if equipped. Refer to SECTION 3E.
6. Tire and wheel assembly. Refer to SECTION 3E.
7. Stabilizer shaft link assembly. Refer to "Stabilizer Shaft Link Assembly" in this section.
8. Nuts (22).
9. Bolts/screws (15).
10. Separate lower ball stud assembly from steering knuckle assembly. Refer to "Control Arm Ball Stud Assembly Replacement" in this section.



1 ARM ASSEMBLY, FRONT UPPER CONTROL
2 STUD ASSEMBLY, FRONT UPPER CONTROL ARM BALL
3 PIN, FRONT UPPER CONTROL ARM COTTER
4 NUT, FRONT UPPER CONTROL ARM
6 KNUCKLE ASSEMBLY, STEERING
8 NUT, FRONT LOWER CONTROL ARM
9 PIN, FRONT LOWER CONTROL ARM COTTER
10 STUD ASSEMBLY, FRONT LOWER CONTROL ARM BALL
15 BOLT/SCREW, FRONT SHOCK ABSORBER
17 ARM ASSEMBLY, FRONT LOWER CONTROL
22 NUT, FRONT SHOCK ABSORBER LOWER BRACKET
23 SPRING ASSEMBLY, FRONT
24 ABSORBER ASSEMBLY. FRONT SHOCK
25 NUT, FRONT SHOCK ABSORBER UPPER MOUNT
26 BOLT/SCREW. FRONT SHOCK ABSORBER UPPER MOUNT
44 HUB ASSEMBLY, FRONT WHEEL
45 MOUNT ASSEMBLY, FRONT UPPER SHOCK ABSORBER
46 SUPPORT, FRONT UPPER CONTROL ARM

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Figure 15 – Shock Absorber and Spring Assembly

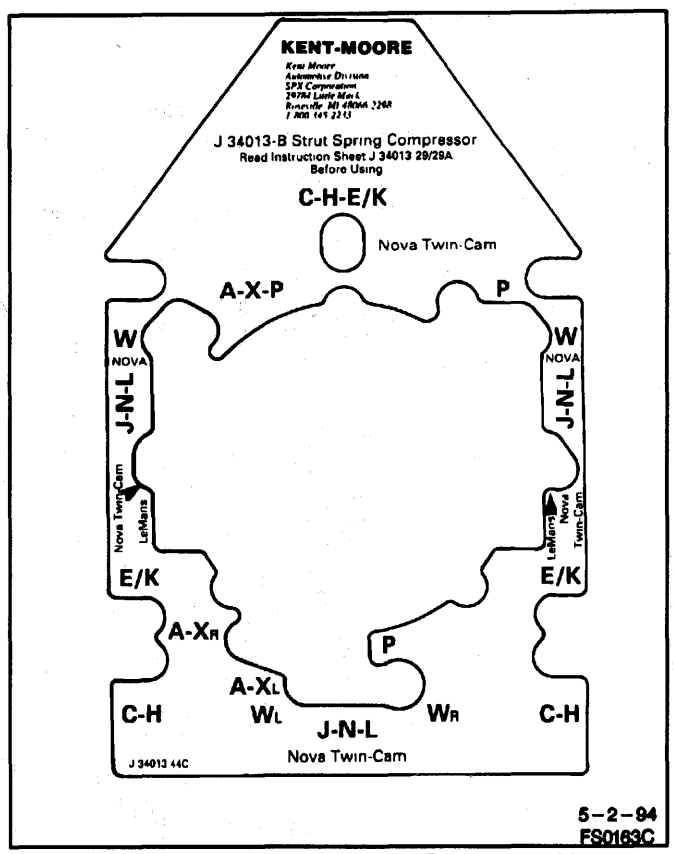


Figure 16 – Modular Shock Assembly Compressor Mounting Hole Location

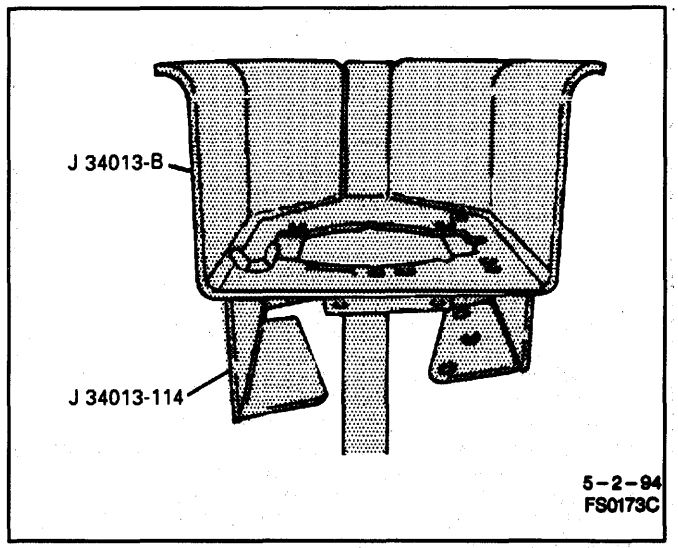


Figure 17 – Modular Shock Assembly Compressor Adapter – Driver-Side Position

Important

- Be sure to mark with chalk or paint (do not scribe) the lower mount location relative to the upper mount location before removing the shock absorber assembly or the assembly cannot be reinstalled.

11. Shock absorber and spring assembly (24 and 23).

Disassemble

1. Install J 34013-114 to J 34013-B. Use wing nuts to secure tool to mounting holes C-H (lower left corner) and P (upper right corner) for driver-side shock absorber assembly and to secure tool to mounting holes A-X-P (upper left corner) and C-H (lower right corner) for passenger-side shock absorber assembly.

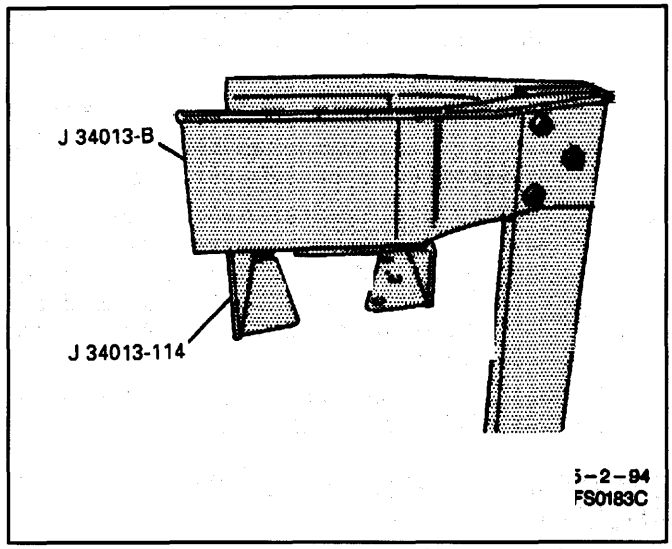


Figure 18 – Modular Shock Assembly Compressor Adapter – Passenger-Side Position

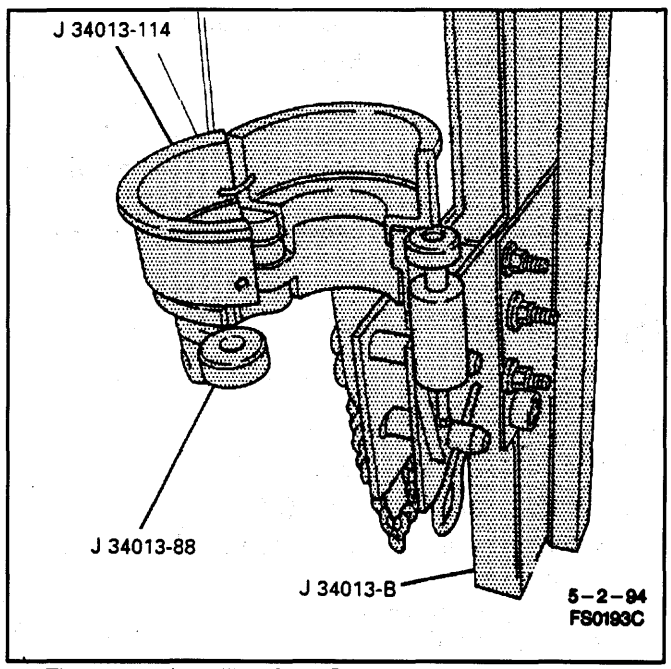


Figure 19 – Installing Strut Compressor Adapter to Strut Spring Compressor

Important

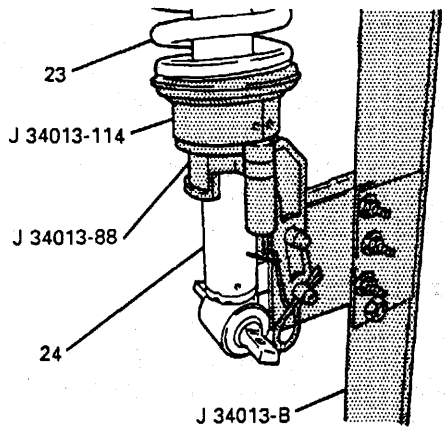
- Be sure J 34013-114 and J 34013-88 are aligned so they can open and close together. If the tools are not aligned properly, they will not open.

2. Install J 34013-114 and J 34013-88.

Important

- Be sure the top of the shock absorber assembly is flat against J 34013-114. The shock absorber assembly will not be aligned correctly if it does not lay flat against the tool.

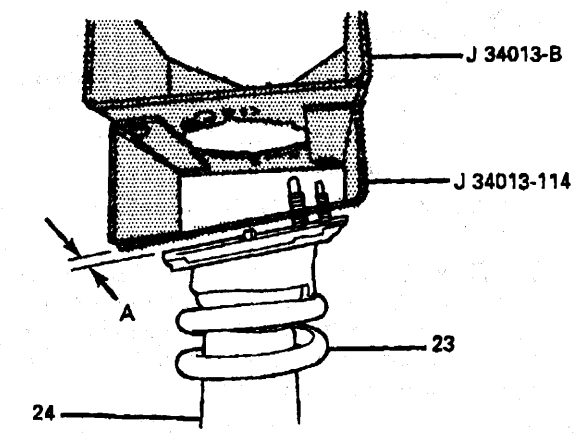
3. Shock absorber assembly to top of J 34013-114.



23 SPRING ASSEMBLY, FRONT
24 ABSORBER ASSEMBLY, FRONT SHOCK

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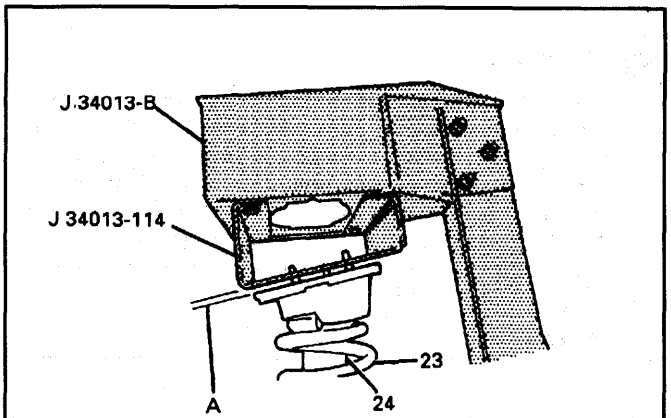
Figure 20 – Installing Shock Absorber Assembly to Strut Spring Compressor



A MATCHING ANGLE BETWEEN SHOCK ABSORBER ASSEMBLY AND J 34013-114
23 SPRING ASSEMBLY, FRONT
24 ABSORBER ASSEMBLY, FRONT SHOCK

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Figure 21 – Driver-Side Shock Absorber Assembly Installation



A MATCHING ANGLE BETWEEN SHOCK ABSORBER ASSEMBLY AND J 34013-114
23 SPRING ASSEMBLY, FRONT
24 ABSORBER ASSEMBLY, FRONT SHOCK

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Figure 22 – Passenger-Side Shock Absorber Assembly Installation

4. Install shock absorber assembly into J 34013-114 and J 34013-88.
5. Close J 34013-114 and J 34013-88 and install locking pin.

Important

- Be sure the mounting ears of the shock absorber assembly are facing downward toward the rear of J 34013-B or the shock absorber assembly will not align properly.

6. Turn screw on J 34013-B counterclockwise to raise shock absorber assembly up to J 34013-114. Be sure studs go through guide holes in J 34013-114 and the top of the shock absorber assembly is flat against the tool.

CAUTION: Do not over compress front spring assembly. Severe overloading may cause tool failure which could result in bodily injury.

7. Compress front spring assembly approximately 13 mm (0.50 inch) or three or four complete turns of the screw on J 34013-114.
8. Insert J 39642-1 on shock absorber nut, then insert J 39642-2 through J 39642-1 to hold shock absorber rod in place.
9. Remove shock absorber nut with J 39642-1 while holding shock absorber assembly rod from rotating with J 39642-2.
10. Discard shock absorber nut.
11. Turn J 34013-B clockwise to fully relieve spring assembly pressure.

Assemble

1. Install J 34013-114 to J 34013-B. Use wing nuts to secure J 34013-114 to J 34013-B mounting holes C-H (lower left corner) and P (upper right corner) for driver-side shock absorber assembly and to secure J 34013-114 to J 34013-B mounting holes A-X-P (upper left corner) and C-H (lower right corner) for passenger-side shock absorber assembly (Figures 17 and 18).
2. Install J 34013-114 and J 34013-88.

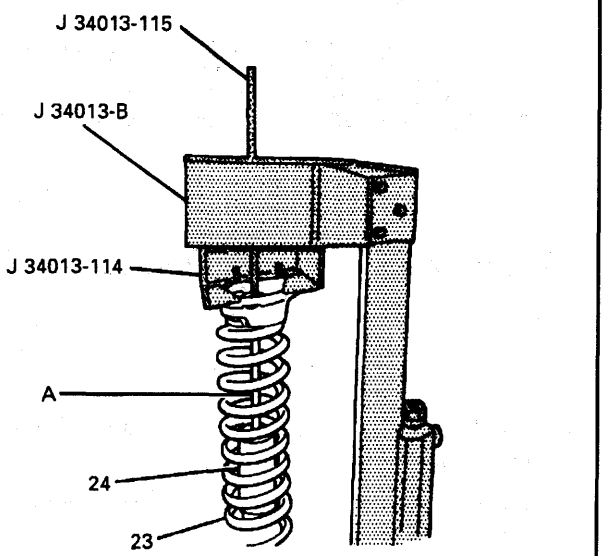


Figure 23 – Inserting Modular Shock Assembly Alignment Rod

3. Install shock absorber assembly to J 34013-114 and J 34013-88.

Important

- Be sure the mounting ears of the shock absorber assembly are facing downward. toward the rear of J 34013-B or the shock absorber assembly will not align properly.
- Be sure to mark with chalk or paint (do not scribe) the lower mount location relative to the upper mount location before removing the shock absorber assembly or the assembly cannot be reinstalled.

4. Close J 34013-114 and J 34013-88 and engage locking pin.
5. Make sure upper and lower spring seats are positioned correctly.
6. Shock absorber assembly to top of J 34013-114.

Important

- Be sure the top of the shock absorber assembly is flat against J 34013-114. The shock absorber assembly will not be aligned properly if it does not lay flat against the tool.

7. Turn screw on J 34013-B counterclockwise to raise shock absorber assembly up to J 34013-114 without compressing spring assembly. Be sure studs on shock absorber assembly go through guide holes in J 34013-114.

Important

- Only turn the screw until the shock absorber assembly is held in J 34013-B by itself. Do not load the spring assembly.

8. Place J 34013-115 down through top of J 34013-B through top of shock absorber assembly and onto shock absorber rod.

Important

- Make sure J 34013-115 is straight with the shock absorber assembly. If J 34013-115 is angled, repeat steps 1 through 5 until tool is straight.

CAUTION: Do not over compress spring assembly. Severe overloading may result in tool failure which could result in bodily injury.

9. Turn operating screw clockwise to compress spring assembly until threaded portion of the shock absorber rod is through the top of the shock absorber assembly.
10. Remove J 34013-115.

Important

- When installing front shock absorber nut, always replace it with a new one. Never install the same nut that has been removed.

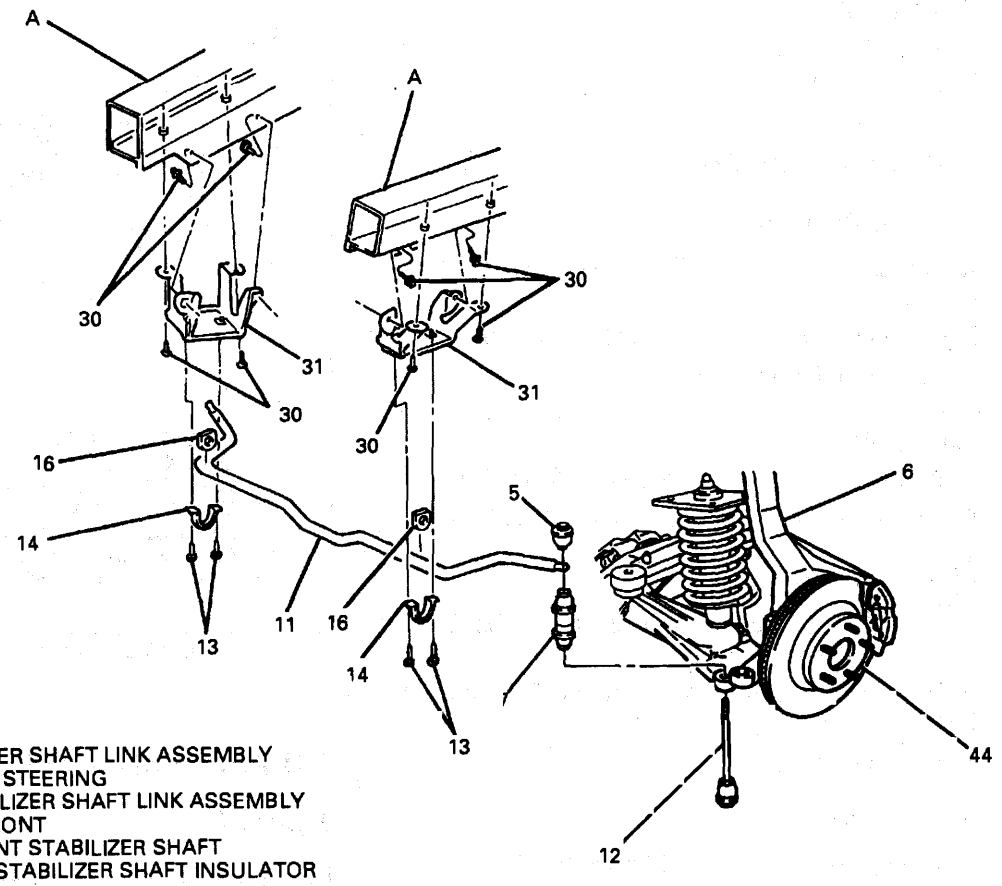
11. Insert new shock absorber nut on shock absorber rod.

NOTICE: Do not turn the shock absorber rod when tightening the shock absorber nut or the shock absorber assembly could be damaged. Keep the shock absorber rod in a stationary position when tightening the shock absorber nut.

12. Place J 39642-1 on shock absorber nut.
13. Insert J 39642-2 through J 39642-1 and tighten shock absorber nut.
14. Tighten shock absorber nut while holding onto J 39642-2.
15. Remove shock absorber assembly from J 34013-B.

Install or Connect

NOTICE: See "Notice" on page 3C-1 of this section.



A SIDE RAIL
5 NUT, FRONT STABILIZER SHAFT LINK ASSEMBLY
6 KNUCKLE ASSEMBLY, STEERING
7 SLEEVE, FRONT STABILIZER SHAFT LINK ASSEMBLY
11 STABILIZER SHAFT, FRONT
12 LINK ASSEMBLY, FRONT STABILIZER SHAFT
13 BOLT/SCREW, FRONT STABILIZER SHAFT INSULATOR CLAMP
14 CLAMP, FRONT STABILIZER SHAFT INSULATOR
16 INSULATOR, FRONT STABILIZER SHAFT
30 BOLT/SCREW, FRONT STABILIZER SHAFT BRACKET
31 BRACKET ASSEMBLY, FRONT STABILIZER SHAFT
44 HUB ASSEMBLY, FRONT WHEEL

Figure 24 – Stabilizer Shaft

1. Position shock absorber and spring assembly (24 and 23) to lower control arm assembly (17).
2. Bolts/screws (15) and nuts (22).

Tighten

- Bolts/screws (15) and nuts (22) to 65 N•m (48 lb. ft.).

3. Lower ball stud assembly to steering knuckle assembly. Refer to "Control Arm Ball Stud Assembly Replacement" in this section.
4. Stabilizer shaft link assembly. Refer to "Stabilizer Shaft Link Assembly" in this section.
5. Tire and wheel assembly. Refer to SECTION 3E.
6. Special security wheel lock nut, if equipped. Refer to SECTION 3E.
7. Lower vehicle.
8. Hand tighten bolts/screws (26) and nuts (25).

Tighten

- Bolts/screws (26) to 50 N•m (37 lb. ft.).
- Nuts (25) to 43 N•m (32 lb. ft.).

9. Position brake master cylinder assembly (driver-side only). Refer to SECTION 5A.
10. Brake master cylinder nuts (driver-side only). Refer to SECTION 5A.

STABILIZER SHAFT

Figure 24

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Stabilizer shaft link assembly. Refer to "Stabilizer Shaft Link Assembly" in this section.
3. Bolts/screws (13).

4. Clamps (14).
5. Stabilizer shaft (11).
6. Insulators (16).
7. Bolts/screws (30).
8. Bracket assemblies (31).

Install or Connect

NOTICE: See "Notice" on page 3C-1 of this section.

1. Position bracket assemblies (31) to side rail.
2. Hand start bolts/screws (30).

Tighten

- Bolts/screws (30) to 55 N•m (41 lb. ft.).

3. Place insulators (16) over stabilizer shaft (11).

Important

- The slit of the insulator must face the front of the vehicle.

4. Position clamps (14) over insulators (16) and stabilizer shaft (11).
5. Bolts/screws (13).

Tighten

- Bolts/screws (13) to 55 N•m (41 lb. ft.).

6. Stabilizer shaft link assembly. Refer to "Stabilizer Shaft Link Assembly" in this section.
7. Lower vehicle.

STABILIZER SHAFT LINK ASSEMBLY

Figure 25

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Nut (5).
3. Link assembly (12).
4. Sleeve (7).

Install or Connect

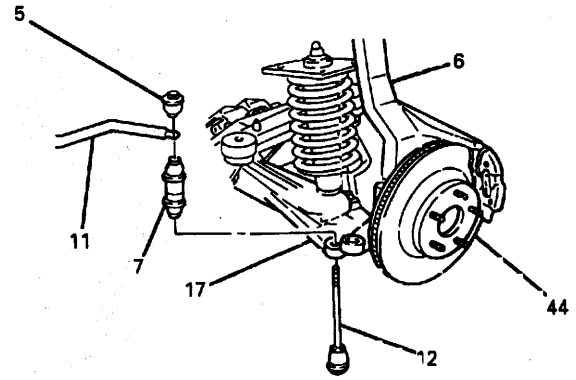
NOTICE: See "Notice" on page 3C-1 of this section.

1. Sleeve (7) between lower control arm assembly (17) and stabilizer shaft (11).
2. Link assembly (12) through lower control arm assembly (17), sleeve (7) and stabilizer shaft (11).
3. Nut (5).

Tighten

- Nut (5) to 23 N•m (17 lb. ft.).

4. Lower vehicle.



5 NUT, FRONT STABILIZER SHAFT LINK ASSEMBLY
6 KNUCKLE ASSEMBLY, STEERING
7 SLEEVE, FRONT STABILIZER SHAFT LINK ASSEMBLY
11 STABILIZER SHAFT, FRONT
12 LINK ASSEMBLY, FRONT STABILIZER SHAFT
17 ARM ASSEMBLY, FRONT LOWER CONTROL
44 HUB ASSEMBLY, FRONT WHEEL

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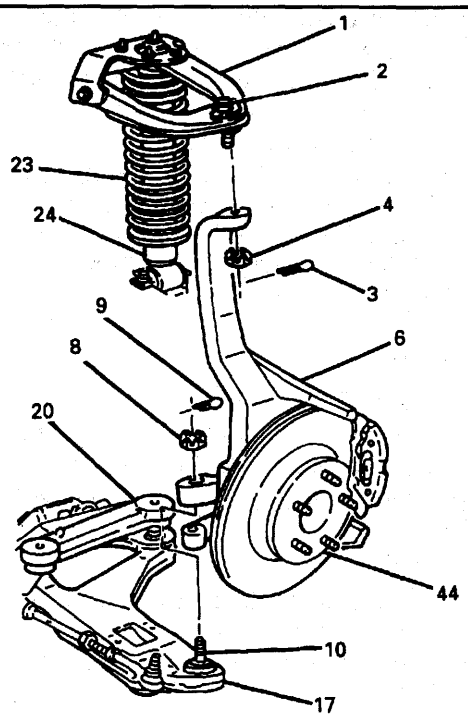
Figure 25 – Stabilizer Shaft Link Assembly

STEERING KNUCKLE ASSEMBLY

Figure 26

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Special security wheel lock nut, if equipped. Refer to SECTION 3E.
3. Tire and wheel assembly. Refer to SECTION 3E.
4. Brake caliper assembly and move aside. Refer to SECTION 5B1.
5. Brake rotor assembly. Refer to SECTION 5.
6. Wheel speed sensor electrical connector and move aside. Refer to SECTION 5E1.
7. Front wheel hub assembly from steering knuckle assembly. Refer to "Wheel Hub Assembly" in this section.
8. Power steering gear assembly from steering knuckle assembly. Refer to SECTION 3B.
9. Stabilizer shaft link assembly. Refer to "Stabilizer Shaft Link Assembly" in this section.
10. Front shock absorber bolts/screws. Refer to "Shock Absorber and Spring Assembly" in this section.
11. Separate lower ball stud assembly from steering knuckle assembly. Refer to "Control Arm Ball Stud Assembly Replacement" in this section.
12. Lower control arm assembly from steering knuckle assembly. Refer to "Lower Control Arm Assembly" in this section.
13. Separate upper ball stud assembly from steering knuckle assembly. Refer to "Control Arm Ball Stud Assembly Replacement" in this section.



1 ARM ASSEMBLY, FRONT UPPER CONTROL
2 STUD ASSEMBLY, FRONT UPPER CONTROL ARM BALL
3 PIN, FRONT UPPER CONTROL ARM COTTER
4 NUT, FRONT UPPER CONTROL ARM
6 KNUCKLE ASSEMBLY, STEERING
8 NUT, FRONT LOWER CONTROL ARM
9 PIN, FRONT LOWER CONTROL ARM COTTER
10 STUD ASSEMBLY, FRONT LOWER CONTROL ARM BALL
17 ARM ASSEMBLY, FRONT LOWER CONTROL
20 CROSSMEMBER ASSEMBLY, FRONT
23 SPRING ASSEMBLY, FRONT
24 ABSORBER ASSEMBLY, FRONT SHOCK
44 HUB ASSEMBLY, FRONT WHEEL

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Figure 26 – Steering Knuckle Assembly

14. Steering knuckle assembly from upper control arm assembly. Refer to "Upper Control Arm Assembly" in this section.
15. Steering knuckle and hub assemblies (6 and 44).

Install or Connect

NOTICE: See "Notice" on page 3C-1 of this section.

1. Position steering knuckle and hub assemblies (6 and 44) to upper control arm assembly (1).
2. Upper ball stud assembly to steering knuckle assembly. Refer to "Control Arm Ball Stud Assembly Replacement" in this section.
3. Position steering knuckle assembly to lower control arm assembly. Refer to "Lower Control Arm Assembly" in this section.
4. Lower ball stud assembly to steering knuckle assembly. Refer to "Control Arm Ball Stud Assembly Replacement" in this section.
5. Front shock absorber bolts/screws. Refer to "Shock Absorber and Spring Assembly" in this section.
6. Stabilizer shaft link assembly. Refer to "Stabilizer Shaft Link Assembly" in this section.
7. Power steering gear assembly to steering knuckle assembly. Refer to SECTION 3B.
8. Front wheel hub assembly to steering knuckle assembly. Refer to "Wheel Hub Assembly" in this section.

Important

- Make sure wheel speed sensor electrical connector is reconnected to wheel speed sensor wire bracket and wheel speed sensor or wires could be damaged.

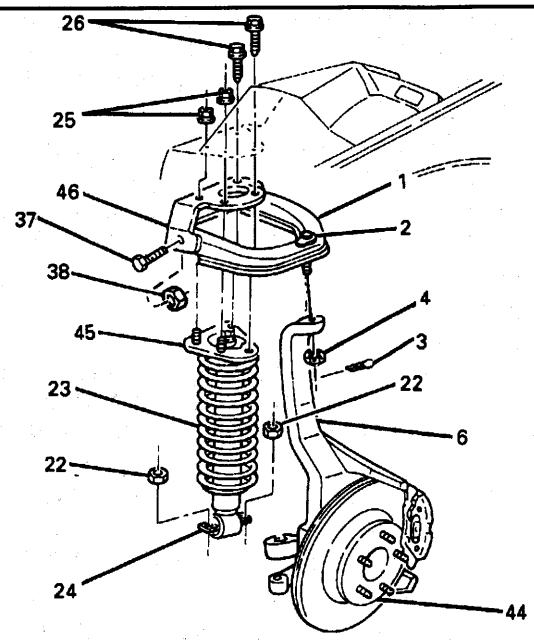
9. Wheel speed sensor electrical connector. Refer to SECTION 5E1.
10. Brake rotor assembly. Refer to SECTION 5.
11. Brake caliper assembly. Refer to SECTION 5B1.
12. Tire and wheel assembly. Refer to SECTION 3E.
13. Special security wheel lock nut, if equipped. Refer to SECTION 3E.
14. Lower vehicle.
15. Check wheel assembly toe alignment. Refer to SECTION 3A.

UPPER CONTROL ARM ASSEMBLY

Figure 27

Remove or Disconnect

1. Brake master cylinder nuts (driver-side only). Refer to SECTION 5A.
2. Move brake master cylinder assembly aside (driver-side only). Refer to SECTION 5A.
3. Bolts/screws (26) and nuts (25).
4. Raise and suitably support vehicle. Refer to SECTION 0A.
5. Special security wheel lock nut, if equipped. Refer to SECTION 3E.
6. Tire and wheel assembly. Refer to SECTION 3E.
7. Stabilizer shaft link assembly. Refer to "Stabilizer Shaft Link Assembly" in this section.
8. Front shock absorber bolts/screws. Refer to "Shock Absorber and Spring Assembly" in this section.
9. Separate upper ball stud assembly from steering knuckle assembly. Refer to "Control Arm Ball Stud Assembly Replacement" in this section.
10. Steering knuckle assembly (6) from upper control arm assembly (1)
11. Upper control arm assembly (1) and shock absorber assembly (24) from vehicle.
12. Support steering knuckle assembly (6) with floor stands.
13. Nuts and bolts/screws (37 and 38).
14. Upper control arm assembly (1) from shock absorber assembly. (24)



1 ARM ASSEMBLY, FRONT UPPER CONTROL
2 STUD ASSEMBLY, FRONT UPPER CONTROL ARM BALL
3 PIN, FRONT UPPER CONTROL ARM COTTER
4 NUT, FRONT UPPER CONTROL ARM
6 KNUCKLE ASSEMBLY, STEERING
22 NUT, FRONT SHOCK ABSORBER LOWER BRACKET
23 SPRING ASSEMBLY, FRONT
24 ABSORBER ASSEMBLY, FRONT SHOCK
25 NUT, FRONT SHOCK ABSORBER UPPER MOUNT
26 BOLT/SCREW, FRONT SHOCK ABSORBER UPPER MOUNT
37 BOLT/SCREW, FRONT UPPER CONTROL ARM
38 NUT, FRONT UPPER CONTROL ARM
44 HUB ASSEMBLY, FRONT WHEEL
45 MOUNT ASSEMBLY, FRONT UPPER SHOCK ABSORBER
46 SUPPORT, FRONT UPPER CONTROL ARM

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Figure 27 – Upper Control Arm Assembly

Install or Connect

NOTICE: See "Notice" on page 3C-1 of this section.

1. Position upper control arm assembly (1) to shock absorber assembly (24).
2. Bolts/screws and nuts (37 and 38).

Tighten

- Nuts (38) to 98 N•m (72 lb. ft.).

3. Upper control arm assembly (1) and shock absorber assembly (24) to vehicle.
4. Position steering knuckle assembly (6) to upper control arm assembly (1).
5. Upper ball stud assembly to steering knuckle assembly. Refer to "Control Arm Ball Stud Assembly Replacement" in this section.
6. Remove floor stands from steering knuckle assembly (6).
7. Front shock absorber bolts/screws. Refer to "Shock Absorber and Spring Assembly" in this section.
8. Stabilizer shaft link assembly. Refer to "Stabilizer Shaft Link Assembly" in this section.
9. Nuts (25) and bolts/screws (26).

   NOTICE: Do not turn the shock absorber assembly when tightening the upper mount nut or the shock absorber assembly could be damaged. Keep the shock absorber assembly in a stationary position when tightening the nut.

Tighten

- Nuts (25) to 43 N•m (32 lb. ft.).
- Bolts/screws (26) to 50 N•m (37 lb. ft.).

10. Tire and wheel assembly. Refer to SECTION 3E.
11. Special security wheel lock nut, if equipped. Refer to SECTION 3E.
12. Lower vehicle.
13. Position brake master cylinder assembly (driver-side only). Refer to SECTION 5A.
14. Brake master cylinder nuts (driver-side only). Refer to SECTION 5A.

UPPER CONTROL ARM BUSHING ASSEMBLY

The upper control arm bushing assembly can be serviced separately from the upper control arm assembly.

Figures 27 and 28

Tools Required:

- J 21474-5 Control Arm Bushing Receiver
- J 21474-18 Upper Control Arm Nut Assembly
- J 21474-19 Upper Control Arm Screw Assembly
- J 39872 Half Moon Spacer
- J 39930 Upper Control Arm Bushing Receiver/Installer

Disassemble

1. Upper control arm assembly. Refer to "Upper Control Arm Assembly" in this section.
2. Remove bolts/screws (37) and nuts (38).
3. Separate front upper control arm assembly (1) from front upper control arm support (46).
4. Remove upper control arm bushing from upper control arm assembly (1).
   A. Thread J 21474-19 through J 39930 (three tangs on J 39930 should be against head of screw).
   B. Thread J 21474-19 through inside of upper control arm bushing (it may be necessary to wiggle J 21474-19 until it slides through bushing).
   C. Run smaller end of J 21474-5 onto J 21474-19. Then, place thrust washer onto J 21474-19 with seams facing toward J 21474-5.
   D. Install J 39872 around outside of bushing to avoid metal distortion during removal.

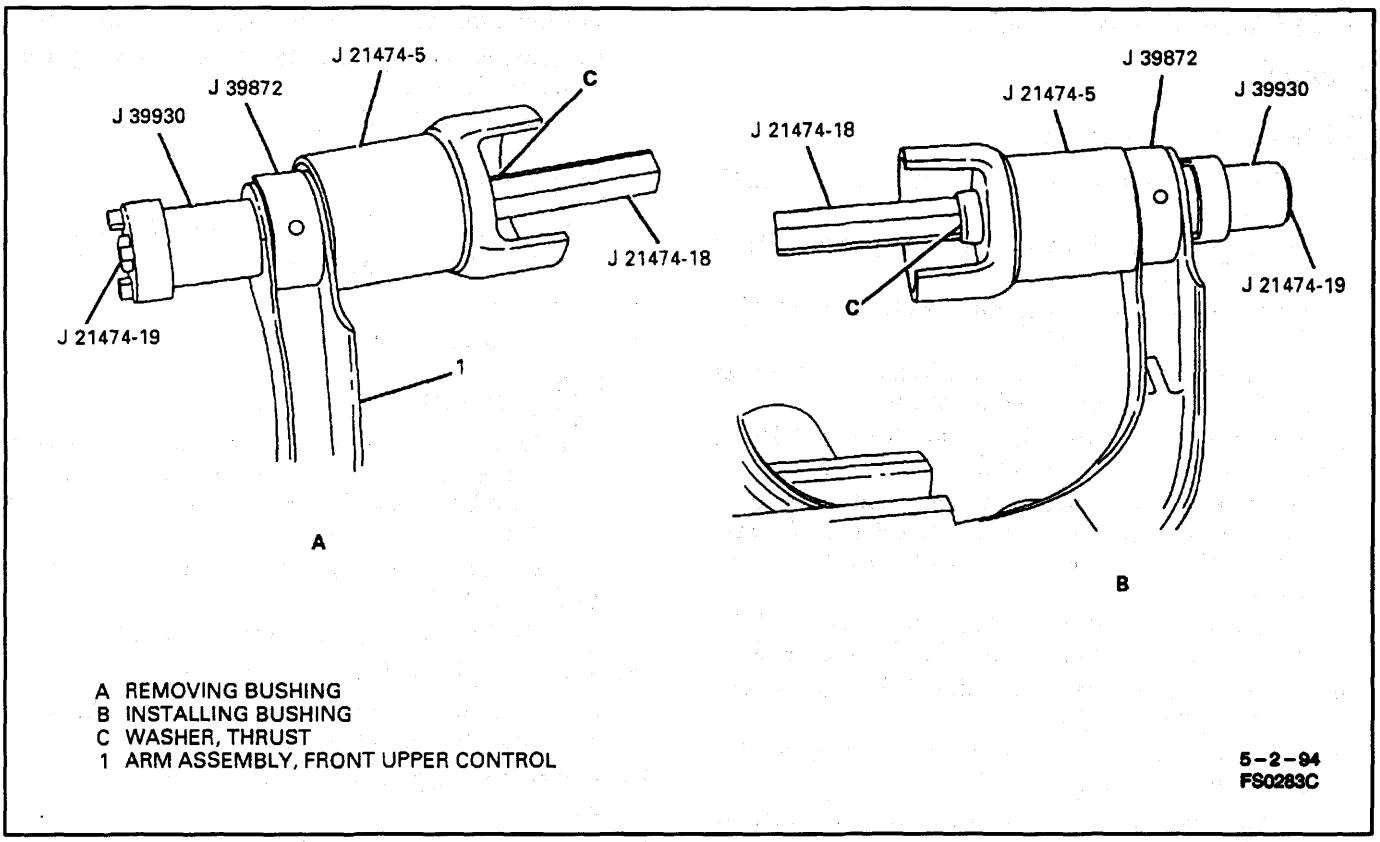


Figure 28 – Removing and Installing Upper Control Arm Bushing Assembly

E. Make sure both J 39930 and J 21474-5 are properly lined up and install J 21474-18 onto J 21474-19. Tighten J 21474-19 and J 21474-18 until bushing is pushed all the way out (popping noise may be heard when bushing breaks loose from control arm).

Assemble

NOTICE: See "Notice" on page 3C-1 of this section.

1. Upper control arm bushings.
   A. With control arm securely tightened in vise, thread J 21474-19 through J 39930 with tangs facing away from screw head.
   B. Install new upper control arm bushing onto J 21474-19 with three indentations facing toward three tangs on J 39930.
   C. Install threaded end of J 21474-19 into upper control arm from outer side of control arm.
   D. Install J 21474-5 onto J 21474-19 from inside of control arm.
   E. Install thrust washer onto J 21474-19 with seam facing toward control arm bushing.
   F. Install J 39872 around outside of bushing to avoid metal distortion during removal.
   G. Install J 21474-18 onto J 21474-19, making sure that three tanged prongs on J 39930 fit into indentations of bushing.
   H. Tighten assembly until bushing is installed flush with control arm.
2. Install front upper control arm assembly (1) to front upper control arm support (46).
3. Bolts/screws (37) and nuts (38).

Tighten

- Nuts (38) to 98 N•m (72 lb. ft.).

4. Upper control arm assembly. Refer to "Upper Control Arm Assembly" in this section.

WHEEL BEARING ASSEMBLY

The maintenance-free wheel bearing assembly does not need to be serviced separately from the hub assembly. Refer to "Wheel Hub Assembly" in this section.

CROSSMEMBER ASSEMBLY

Figure 29

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Special security wheel lock nuts, if equipped. Refer to SECTION 3E.
3. Front tire and wheel assemblies. Refer to SECTION 3E.
4. Stabilizer shaft link assemblies. Refer to "Stabilizer Shaft Link Assembly" in this section.
5. Front shock absorber bolts/screws. Refer to "Shock Absorber and Spring Assembly" in this section.
6. Separate lower control arm ball stud assemblies from steering knuckle assemblies. Refer to "Control Arm Ball Stud Assembly Replacement" in this section.
7. Front lower control arm bolts/screws and nuts. Refer to "Lower Control Arm Assembly" in this section.
8. Lower control arm assemblies (17) from crossmember assembly (20).
9. Steering gear bolts/screws from crossmember assembly. Refer to SECTION 3B.
10. Engine mount nuts and bolts/screws. Refer to SECTION 6A2A or 6A3A.
11. Support front and rear of engine assembly with jack stands.
12. Front brake pipe assembly. Refer to SECTION 5.
13. Wheel speed sensor electrical connector. Refer to SECTION 5E1.
14. Drivetrain and front suspension frame nut plug.
15. Nuts (34).
16. Bolts/screws (32 and 33).
17. Crossmember assembly (20) and reposition power steering gear assembly.

Install or Connect

NOTICE: See "Notice" on page 3C-1 of this section.

1. Position crossmember assembly (20) to side rails.
2. Crossmember assembly to power steering gear assembly. Refer to SECTION 3B.
3. Bolts/screws (32 and 33).

Tighten

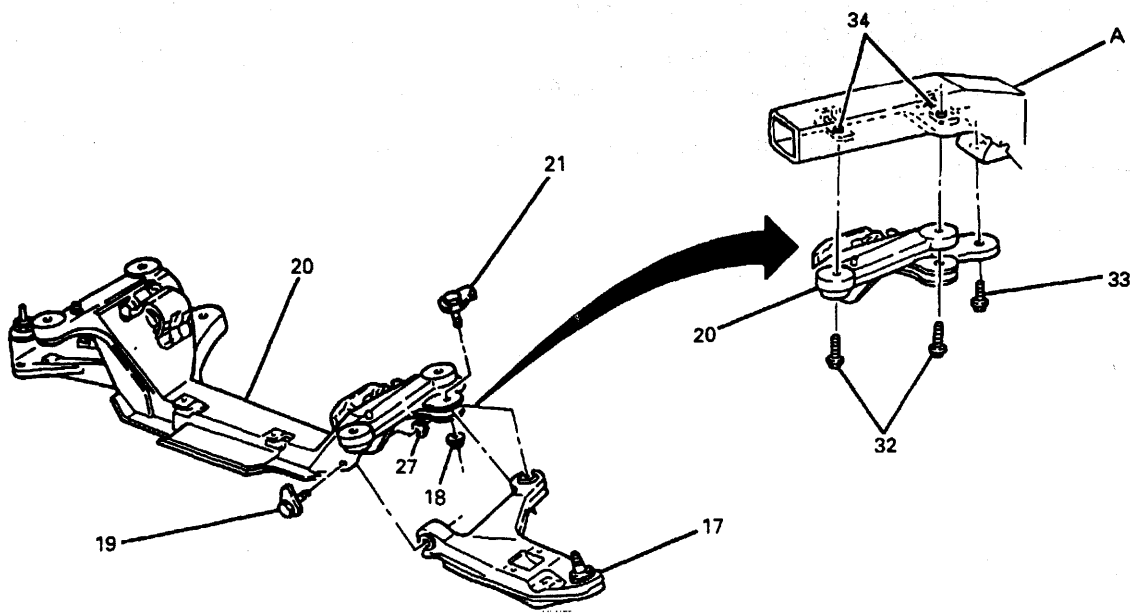
- Bolts/screws (32) to 125 N•m (92 lb. ft.).
- Bolts/screws (33) to 145 N•m (107 lb. ft.).

4. Nuts (34).
5. Drivetrain and front suspension frame nut plug.

Important

- Make sure wheel speed sensor electrical connector is reconnected to wheel speed sensor wire bracket and wheel speed sensor or wires could be damaged.

6. Wheel speed sensor electrical connector. Refer to SECTION 5E1.
7. Front brake pipe assembly. Refer to SECTION 5.
8. Remove jack stands from engine assembly.
9. Engine mount bolts/screws and nuts. Refer to SECTION 6A2A or 6A3A.
10. Power steering gear bolts/screws. Refer to SECTION 3B.
11. Position lower control arm assemblies (17) to crossmember assembly (20).
12. Front lower control arm bolts/screws and nuts.
13. Lower control arm ball stud assemblies to steering knuckle assemblies. Refer to "Control Arm Ball Stud Assembly Replacement" in this section.
14. Front shock absorber bolts/screws. Refer to "Shock Absorber and Spring Assembly" in this section.
15. Stabilizer shaft link assemblies. Refer to "Stabilizer Shaft Link Assembly" in this section.
16. Tire and wheel assemblies. Refer to SECTION 3E.
17. Special security wheel lock nuts, if equipped. Refer to SECTION 3E.
18. Lower vehicle.
19. Align wheel assemblies. Refer to SECTION 3A.



A SIDE RAIL
17 ARM ASSEMBLY, FRONT LOWER CONTROL
18 NUT, FRONT LOWER CONTROL ARM
19 BOLT/SCREW, FRONT LOWER CONTROL ARM
20 CROSSMEMBER ASSEMBLY, FRONT
21 BOLT/SCREW, FRONT LOWER CONTROL ARM
27 NUT, FRONT LOWER CONTROL ARM
32 BOLT/SCREW, FRONT CROSSMEMBER
33 BOLT/SCREW, FRONT CROSSMEMBER
34 NUT, FRONT CROSSMEMBER

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Figure 29 – Front Crossmember Assembly

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Front Crossmember-to-Drivetrain and Front Suspension Frame Nut Plug Bolt/Screw	145 N•m (107 lb. ft.)
Front Crossmember-to-Side Rail Bolt/Screw	125 N•m (92 lb. ft.)
Front Lower Control Arm-to-Front Crossmember Assembly Nut (Horizontal)	100 N•m (74 lb. ft.)
Front Lower Control Arm-to-Front Crossmember Assembly Nut (Vertical)	115 N•m (85 lb. ft.)
Front Lower Control Arm-to-Front Lower Control Arm Ball Stud Assembly Nut	110 N•m (81 lb. ft.)
Front Shock Absorber Bolt/Screw	65 N•m (48 lb. ft.)
Front Shock Absorber Lower Bracket Nut	65 N•m (48 lb. ft.)
Front Shock Absorber Upper Mount Bolt/Screw	50 N•m (37 lb. ft.)
Front Shock Absorber Upper Mount Nut	43 N•m (32 lb. ft.)
Front Stabilizer Shaft Bracket Bolt/Screw	55 N•m (41 lb. ft.)

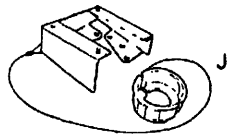
Front Stabilizer Shaft Insulator Clamp Bolt/Screw	55 N•m (41 lb. ft.)
Front Stabilizer Shaft Link Assembly	23 N•m (17 lb. ft.)
Front Stabilizer Shaft Link Assembly Nut	23 N•m (17 lb. ft.)
Front Upper Control Arm-to-Front Upper Control Arm Ball Stud Assembly Nut	53 N•m (39 lb. ft.)
Front Upper Control Arm-to-Front Upper Control Arm Support Nut	98 N•m (72 lb. ft.)
Front Wheel Bolt/Screw	86 N•m (63 lb. ft.)

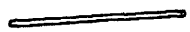
SPECIAL TOOLS

1.  J 24292-B

2  J 34013-B

3  J 34013-88

4  J 34013-114

5  J 34013-115

6  J 39549

7  J 39876

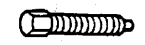
8  J 39930

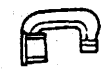
9  J 39931

10  J 39642

11  J 9519-7

12  J 9519-9

13  J 9519-18

14  J 9519-23

15  J 6627-A

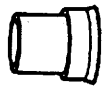
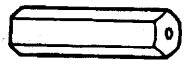
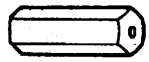
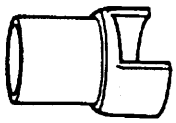
16  J 39872

17  J 39874

18  J 39875

1 BALL JOINT REMOVER
2 STRUT SPRING COMPRESSOR
3 STRUT COMPRESSOR ADAPTER
4 MODULAR SHOCK ASSEMBLY COMPRESSOR ADAPTER
5 MODULAR SHOCK ASSEMBLY ALIGNMENT ROD
6 BALL JOINT/TIE ROD SEPARATOR
7. LOWER CONTROL ARM BUSHING RECEIVER
8. UPPER CONTROL ARM BUSHING RECEIVER/INSTALLER
9 LOWER CONTROL ARM BUSHING RECEIVER
10 MODULAR SHOCK NUT REMOVAL SET, 15 mm (0.60 INCH)
11 BALL JOINT REMOVER
12. BALL JOINT INSTALLER
13. BALL JOINT PRESSING SCREW
14. BALL JOINT "C" CLAMP
15 WHEEL STUD REMOVER
16 HALF MOON SPACER
17. LOWER CONTROL ARM BUSHING RECEIVER
18. HALF MOON SPACER

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19		J 21474-3	22		J 21474-6
20		J 21474-4	23		J 21474-18
21		J 21474-5	24		J 21474-19

19. LOWER CONTROL ARM BUSHING SCREW ASSEMBLY
20 LOWER CONTROL ARM BUSHING NUT ASSEMBLY
21. CONTROL ARM BUSHING RECEIVER
22. CONTROL ARM BUSHING RECEIVER
23 UPPER CONTROL ARM NUT ASSEMBLY
24. UPPER CONTROL ARM SCREW ASSEMBLY

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SECTION 3D

REAR SUSPENSION

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not used, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

REAR AXLE SUSPENSION

Figure 1

The rear axle assembly (13) is attached to the vehicle with a link suspension system. The rear axle housing is connected to the floor panel assembly (7) by two lower control arm assemblies (6) and a tie rod assembly (11). A single torque arm (8) is used in place of an upper control arm assembly. It is rigidly mounted to the rear axle housing at the rear and through a torque arm bushing assembly to the transmission assembly at the front. On some vehicles, the torque arm (8) is also mounted to the propeller shaft assembly (9) with two bolts/screws. Rear springs (4) are used to support the weight of the vehicle, and ride control is provided by shock absorber assemblies (10) mounted to the rear of the rear axle housing. A stabilizer shaft (5) is also part of the suspension system.

The shock absorber assemblies (10) are mounted at the bottom with a nut to brackets welded to the rear of the rear axle housing, and at the top to the floor panel assembly with a nut. The only service the shock absorber assemblies require is replacement if they have lost their resistance, are damaged or are leaking fluid. For shock absorber assembly diagnosis, refer to SECTION 3.

ON-VEHICLE SERVICE

JOUNCE BUMPER ASSEMBLY

Figure 2

The jounce bumper assembly is located on top of the rear axle housing.

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Support rear axle assembly (13).
3. Bolts/screws (2).
4. Bumper assembly (1).

Install or Connect

NOTICE: See "Notice" on page 3D-1 of this section.

1. Bumper assembly (1) to bumper reinforcement.
2. Bolts/screws (2).

Tighten

- Bolts/screws (2) to 27 N•m (20 lb. ft.).

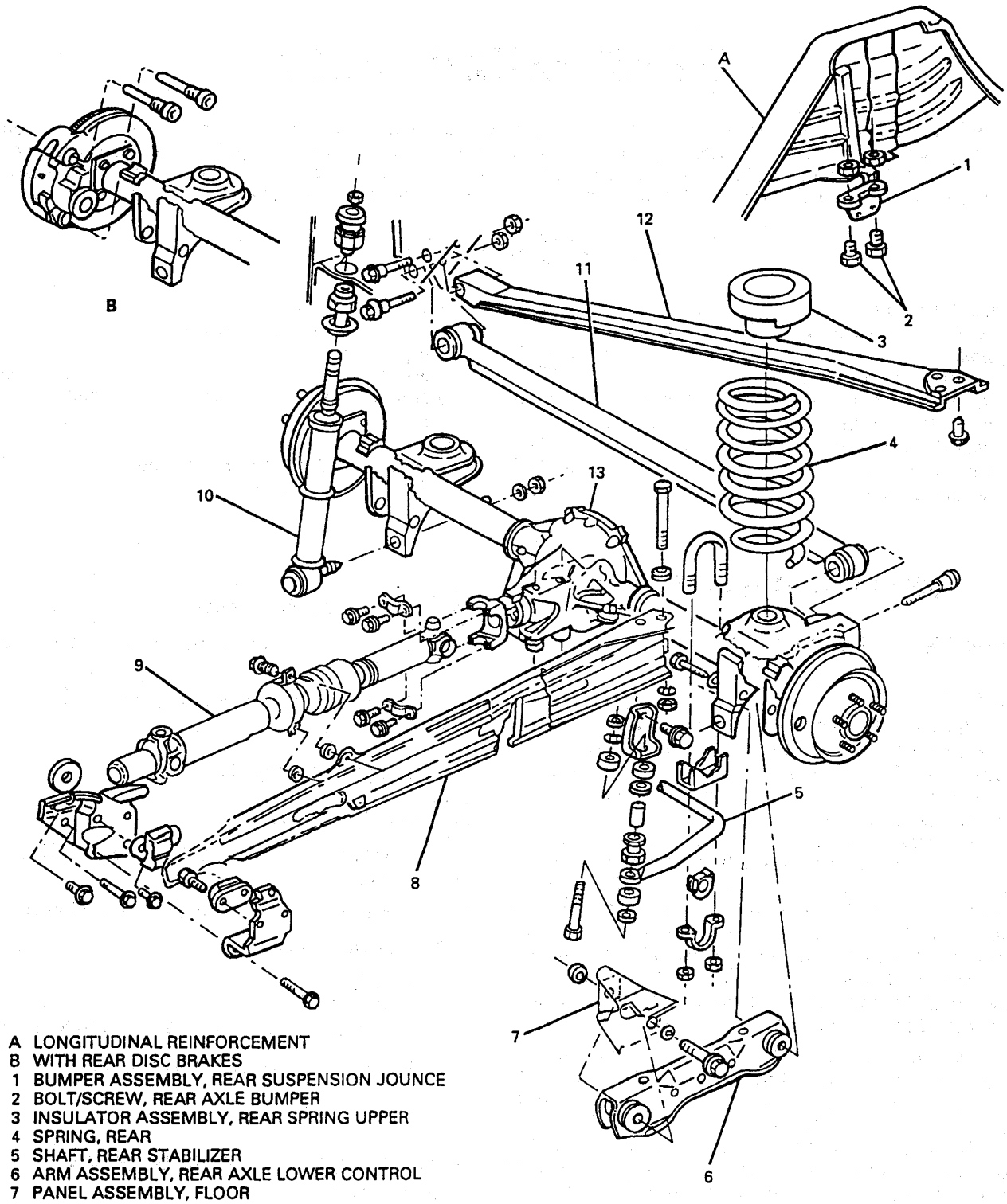
3. Remove rear axle assembly support.
4. Lower vehicle.

LOWER CONTROL ARM BUSHING ASSEMBLY

Figures 3 and 4

Important

- If both lower control arm assemblies are being replaced, remove and replace one control arm assembly at a time to prevent the rear axle assembly from rolling or slipping sideways, making replacement difficult.



A LONGITUDINAL REINFORCEMENT
B WITH REAR DISC BRAKES
1 BUMPER ASSEMBLY, REAR SUSPENSION JOUNCE
2 BOLT/SCREW, REAR AXLE BUMPER
3 INSULATOR ASSEMBLY, REAR SPRING UPPER
4 SPRING, REAR
5 SHAFT, REAR STABILIZER
6 ARM ASSEMBLY, REAR AXLE LOWER CONTROL
7 PANEL ASSEMBLY, FLOOR
8 ARM, REAR AXLE TORQUE
9 SHAFT ASSEMBLY, PROPELLER
10 ABSORBER ASSEMBLY, REAR SHOCK
11 ROD ASSEMBLY, REAR AXLE TIE
12 BRACE ASSEMBLY, REAR AXLE TIE ROD BRACKET
13 AXLE ASSEMBLY, REAR

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Figure 1 – Rear Axle Suspension (Typical)

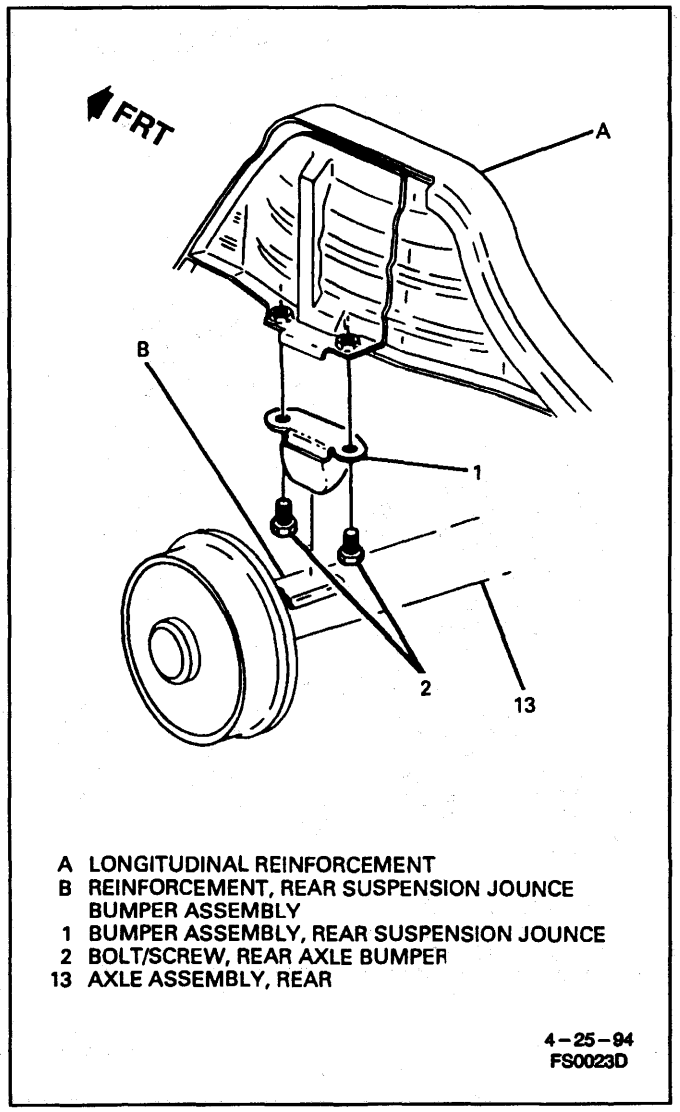


Figure 2 – Jounce Bumper Assembly

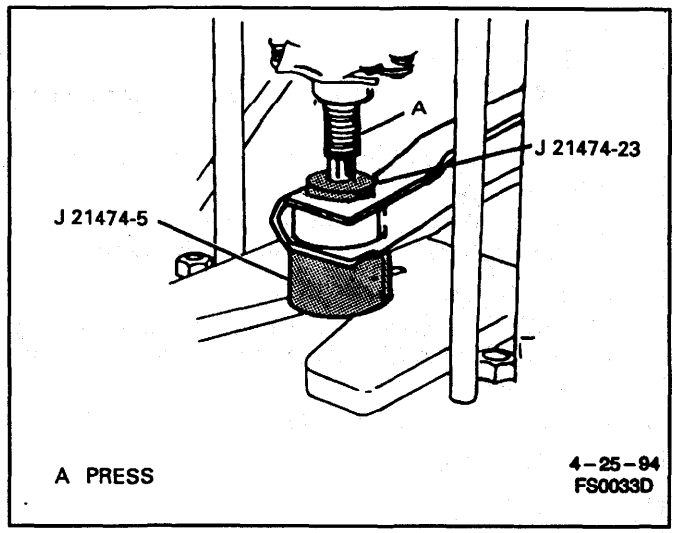


Figure 3 – Removing Lower Control Arm Bushing Assembly

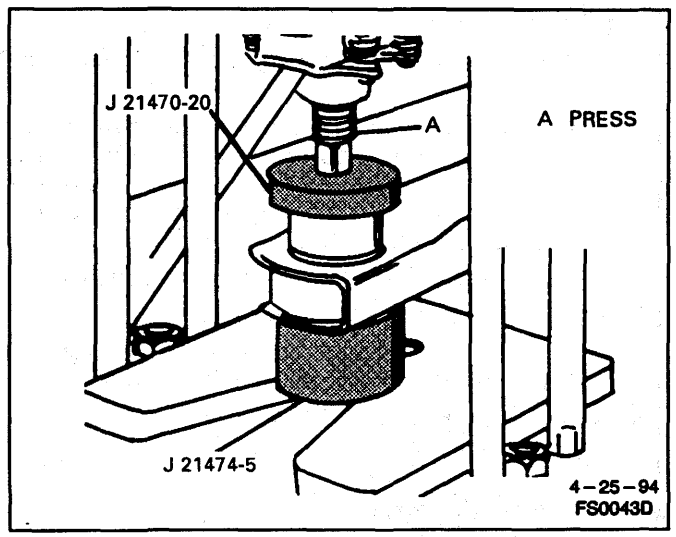


Figure 4 – Installing Lower Control Arm Bushing Assembly

Remove or Disconnect

Tools Required:

J 21474-5 Receiver

J 21474-20 Installer

J 21474-23 Remover

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Support rear axle assembly.
3. Lower control arm assembly. Refer to "Lower Control Arm Assembly" in this section.
4. Place J 21474-5 over flanged side of bushing assembly.
5. Use arbor press to force bushing assembly out of arm, using large OD of driver such as J 21474-23 contacting OD of outer sleeve.

Install or Connect

1. Reverse tool. See Figure 4.
2. Place J 21474-5 over flanged side of bushing assembly.
3. Bushing assembly into position with J 21474-20.
4. Lower control arm assembly. Refer to "Lower Control Arm Assembly" in this section.
5. Remove rear axle assembly support.
6. Lower vehicle.

REAR SPRINGS

Figure 5

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.

Important

- When raising vehicle, do not use twin post type hoist.

2. Support rear axle assembly (13) with adjustable lifting device.
3. Shock absorber nuts from rear axle assembly. Refer to "Shock Absorber Assembly" in this section.
4. Lower rear axle assembly (13).

NOTICE: Do not suspend rear axle assembly by brake hose assembly. Damage to hose assembly could result.

5. Upper insulator assembly (15).
6. Rear spring (4).

Install or Connect

1. Rear spring (4) to rear axle assembly (13).

Important

- Lower end of rear spring should be facing forward.
- It is important not to chip or damage the corrosion protection coating on the rear spring. Avoid contact with hard steel. If coating has been chipped or damaged, do not use rear spring until it has been replaced.

2. Upper insulator assembly (15) to rear spring (4).
3. Raise rear axle assembly (13).
4. Shock absorber nuts to rear axle assembly. Refer to "Shock Absorber Assembly" in this section.
5. Remove rear axle assembly support.
6. Lower vehicle.

REAR SPRING SEAT

Figure 5

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.

Important

- When raising vehicle, do not use twin post type hoist.

2. Support rear axle assembly (13) with an adjustable lifting device.
3. Shock absorber nuts from rear axle assembly Refer to "Shock Absorber Assembly" in this section.
4. Lower rear axle assembly (13).

NOTICE: Do not suspend rear axle assembly by brake hose assembly. Damage to hose assembly could result.

5. Upper insulator assembly and rear spring. Refer to "Rear Spring" in this section.
6. Spring seat (14).

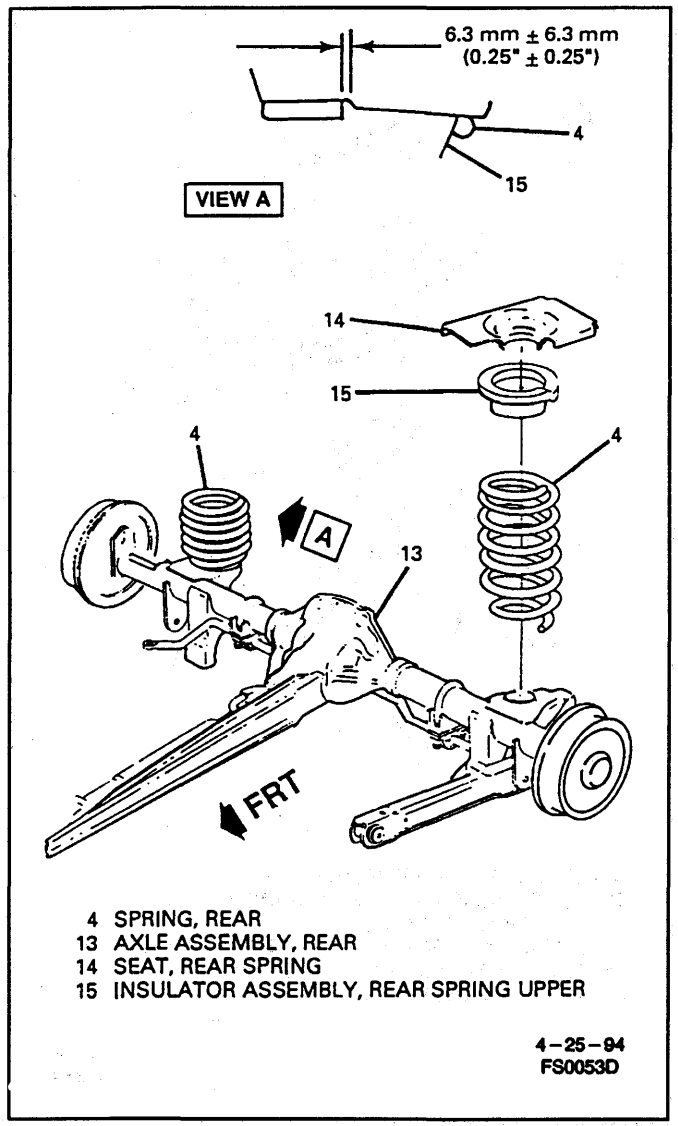


Figure 5 – Rear Spring and Upper Insulator Assembly

Install or Connect

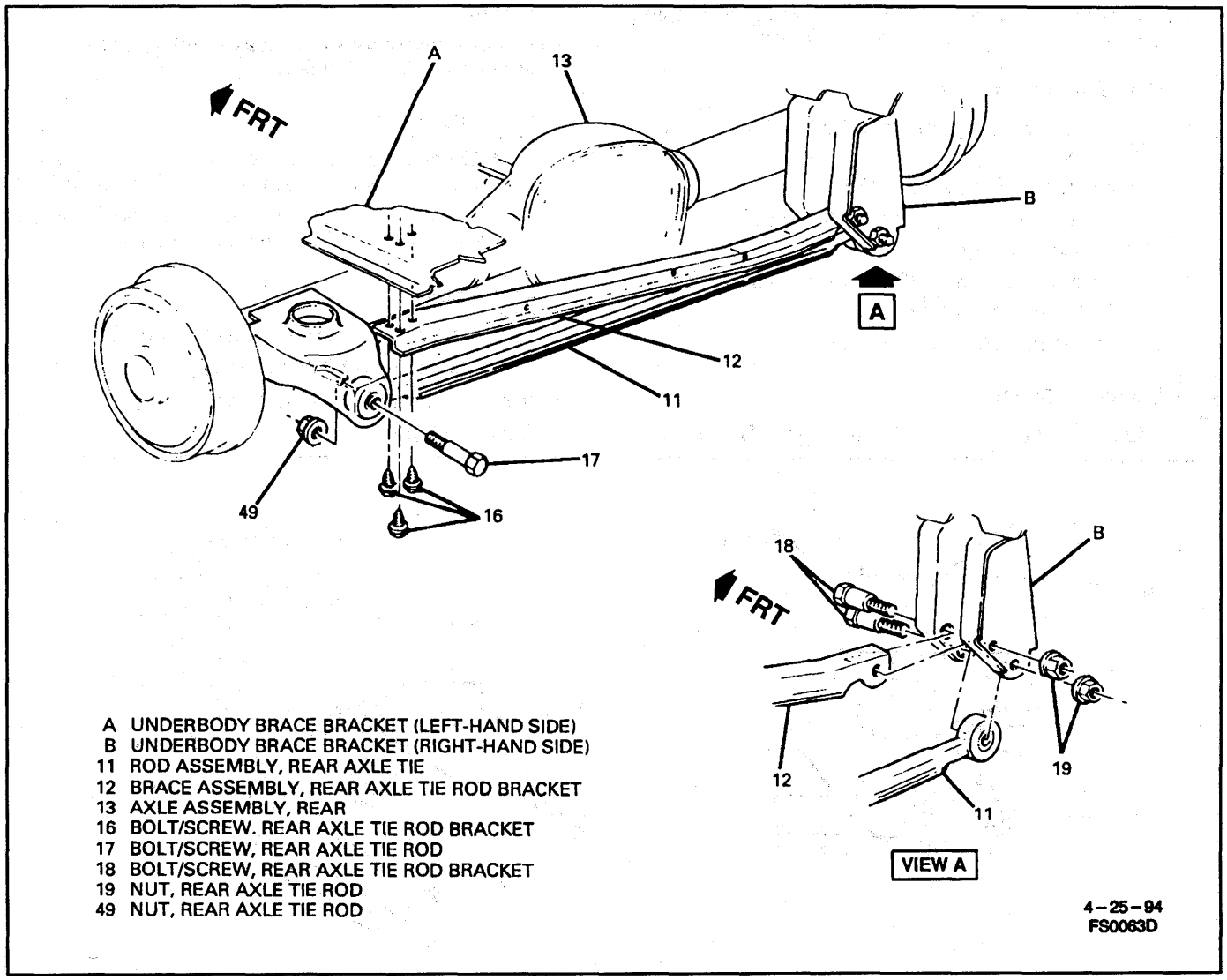
1. Position spring seat (14).
2. Rear spring and upper insulator assembly. Refer to "Rear Spring" in this section.
3. Raise rear axle assembly (13).
4. Shock absorber nut to rear axle assembly. Refer to "Shock Absorber Assembly" in this section.
5. Remove rear axle assembly support.
6. Lower vehicle.

TIE ROD ASSEMBLY

Figure 6

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Support rear axle assembly (13).
3. Bolt/screw (17) and nut (49).



A UNDERBODY BRACE BRACKET (LEFT-HAND SIDE)
B UNDERBODY BRACE BRACKET (RIGHT-HAND SIDE)
11 ROD ASSEMBLY, REAR AXLE TIE
12 BRACE ASSEMBLY, REAR AXLE TIE ROD BRACKET
13 AXLE ASSEMBLY, REAR
16 BOLT/SCREW. REAR AXLE TIE ROD BRACKET
17 BOLT/SCREW, REAR AXLE TIE ROD
18 BOLT/SCREW, REAR AXLE TIE ROD BRACKET
19 NUT, REAR AXLE TIE ROD
49 NUT, REAR AXLE TIE ROD

Figure 6 – Tie Rod Assembly

4. Bolts/screws (16 and 18) and nuts (19).
5. Tie rod assembly (11).
6. Brace assembly (12).

Install or Connect

NOTICE: See "Notice" on page 3D-1 of this section.

1. Position brace assembly (12) to right-hand underbody brace bracket.
2. Hand tighten one bolt/screw (18) and one nut (19).
3. Position tie rod assembly (11) to right-hand underbody brace bracket.
4. Hand tighten other bolt/screw (18) and other nut (19).
5. Bolts/screws (16 and 18) and nuts (19).

Tighten

- Bolts/screws (16) to 47 N•m (35 lb. ft.).
- Nuts (19) to 82 N•m (61 lb. ft.).

6. Bolt/screw (17) and nut (49).

Tighten

- Nut (49) to 82 N•m (61 lb. ft.).

7. Rear axle assembly support.
8. Lower vehicle.

LOWER CONTROL ARM ASSEMBLY

Figure 7

Important

- If both lower control arm assemblies are being replaced, remove and replace one arm at a time to

prevent rear axle assembly from rolling or slipping sideways, making replacement difficult.

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Support rear axle assembly (13).
3. Bolts/screws (20), nuts (22) and washers (21) from rear axle assembly (13).
4. Bolts/screws (20), nuts (22) and washers (21) from underbody pan assembly.
5. Lower control arm assembly (6).

Install or Connect

NOTICE: See "Notice" on page 3D-1 of this section.

1. Position lower control arm assembly (6) to rear axle assembly (13) and underbody pan assembly.

Important

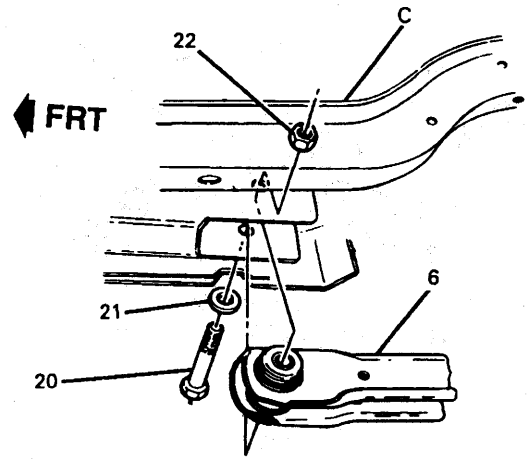
- Do not tighten bolts/screws (20) and nuts (22) unless the suspension is at curb height position.

2. Bolts/screws (20), nuts (22) and washers (21) to rear axle assembly (13) from inboard side out.

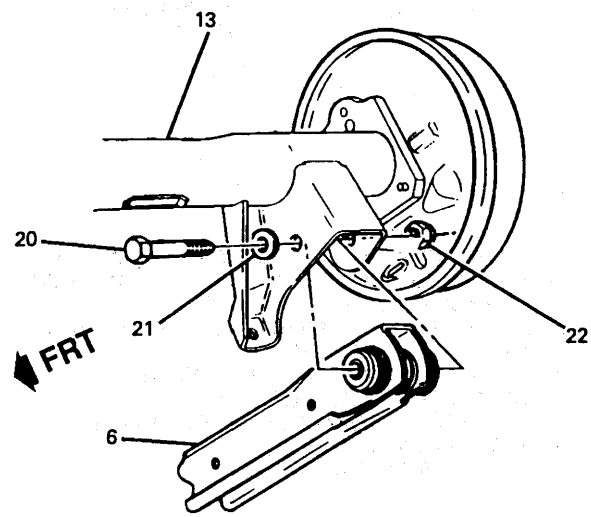
Tighten

- Bolts/screws (20) to 108 N•m (74 lb. ft.).
- Nuts (22) to 82 N•m (60 lb. ft.).

3. Remove rear axle assembly support.
4. Lower vehicle.



A



B

A FRONT OF LOWER CONTROL ARM ASSEMBLY (RIGHT-HAND SHOWN LEFT-HAND OPPOSITE)
B REAR OF LOWER CONTROL ARM ASSEMBLY (RIGHT-HAND SHOWN LEFT-HAND OPPOSITE)
C PAN ASSEMBLY, UNDERBODY

6 ARM ASSEMBLY, REAR AXLE LOWER CONTROL
13 AXLE ASSEMBLY, REAR
20 BOLT/SCREW, REAR AXLE LOWER CONTROL ARM
21 WASHER, REAR SUSPENSION CONTROL ARM
22 NUT, REAR AXLE LOWER CONTROL ARM

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Figure 7 – Lower Control Arm Assembly

TORQUE ARM

Figures 8 through 10

Remove or Disconnect

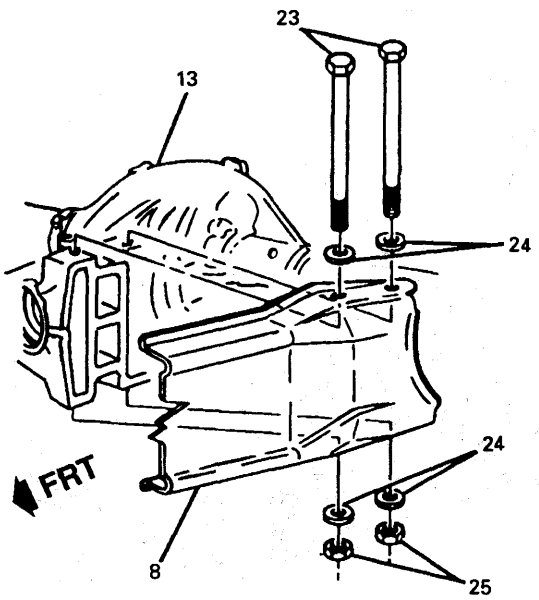
1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Support rear axle assembly (13) with an adjustable lifting device.

Important

- When raising vehicle, do not use twin post type hoist.

3. Torque arm from propeller shaft assembly, if equipped with split propeller shaft assembly. Refer to SECTION 4A.
4. Bolts/screws (23), washers (24) and nuts (25) from rear axle assembly (13).
5. Bolts/screws (28, 29 and 30) and nuts (27) from automatic transmission assembly, if equipped.

6. Bolts/screws (29 and 30) and nuts (27) from manual transmission assembly, if equipped.
7. Outer bracket assembly (31).
8. Inner bracket assembly (32).
9. Torque arm (8).



8 ARM, REAR AXLE TORQUE
13 AXLE ASSEMBLY, REAR
23 BOLT/SCREW, REAR AXLE TORQUE ARM
24 WASHER, REAR AXLE TORQUE ARM
25 NUT, REAR AXLE TORQUE ARM

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Figure 8 – Torque Arm to Rear Axle Assembly

Install or Connect

NOTICE: See "Notice" on page 3D-1 of this section.

1. Position inner bracket assembly (32) through transmission assembly.
2. Position outer bracket assembly (31) to inner bracket assembly (32) and loosely install nuts (27), and bolts/screws (28, 29 and 30).
3. Insert torque arm (8) into bracket assemblies (31 and 32).
4. Nuts (27) and bolts/screws (28, 29 and 30).

Tighten

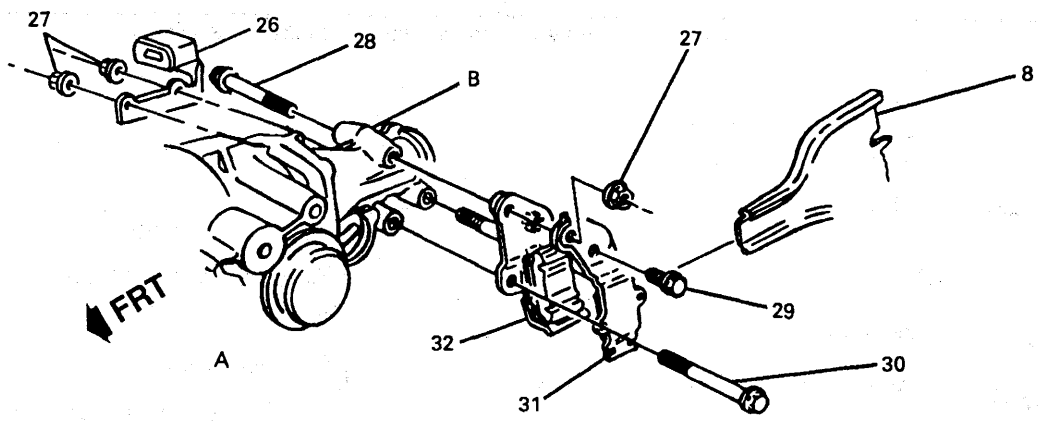
- Nuts (27) to 41 N•m (30 lb. ft.).
- Bolts/screws (28 and 30) to 50 N•m (37 lb. ft.).
- Bolts/screws (29) to 27 N•m (20 lb. ft.).

5. Position torque arm (8) to rear axle assembly (13).
6. Bolts/screws (23), washers (24) and nuts (25).

Tighten

- Bolts/screws (23) to 130 N•m (96 lb. ft.).
- Nuts (25) to 132 N•m (97 lb. ft.).

7. Torque arm to propeller shaft assembly, if equipped with propeller shaft assembly. Refer to SECTION 4A.
8. Rear axle assembly support.
9. Lower vehicle.



A WITH 700 R4 TRANSMISSION
B TRANSMISSION ASSEMBLY, AUTOMATIC
8 ARM, REAR AXLE TORQUE
26 BRACKET ASSEMBLY, CATALYTIC CONVERTER HANGER
27 NUT, REAR AXLE TORQUE ARM BRACKET
28 BOLT/SCREW, REAR AXLE TORQUE ARM INNER BRACKET
29 BOLT/SCREW, REAR AXLE TORQUE ARM OUTER BRACKET
30 BOLT/SCREW, REAR AXLE TORQUE ARM INNER BRACKET
31 BRACKET ASSEMBLY, REAR AXLE TORQUE ARM OUTER
32 BRACKET ASSEMBLY, REAR AXLE TORQUE ARM INNER

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Figure 9 – Torque Arm to Automatic Transmission Assembly

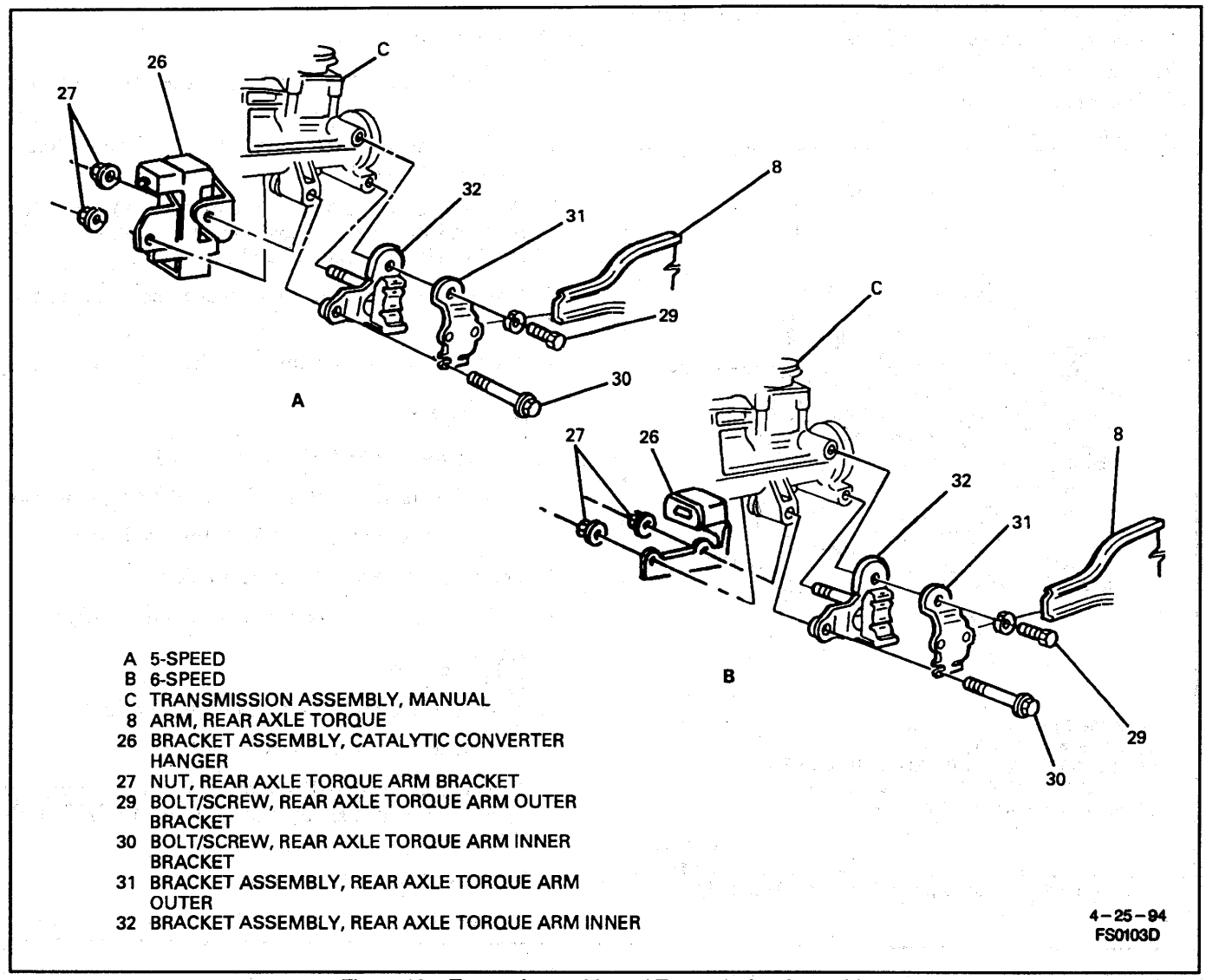


Figure 10 – Torque Arm to Manual Transmission Assembly

STABILIZER SHAFT

Figures 11 and 12

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Nut (41).
3. Link assembly. Refer to "Stabilizer Shaft Bracket and Link Assembly" in this section.
4. Bolts/screws (33) and nuts (36).
5. Clamp (37).
6. Insulator (38).
7. Bracket (34).
8. Stabilizer shaft (35).

Install or Connect

NOTICE: See "Notice" on page 3D-1 of this section.

Important

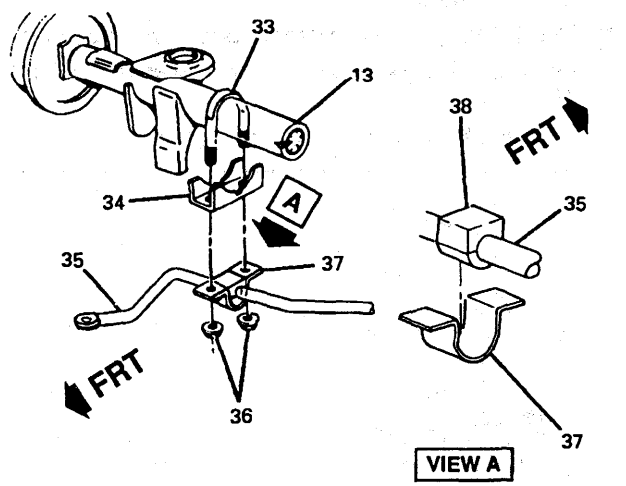
- The stabilizer shaft must be installed with the bend of the shaft facing down.

1. Place insulator (38) over stabilizer shaft (35).

Important

- The slit of the shaft insulator must face the rear of the vehicle.

2. Position clamp (37) to insulator (38) and stabilizer shaft (35).
3. Position bracket (39) to rear axle assembly (13).



13 AXLE ASSEMBLY, REAR
33 BOLT/SCREW, REAR STABILIZER SHAFT INSULATOR CLAMP
34 BRACKET, REAR STABILIZER SHAFT ROD
35 SHAFT, REAR STABILIZER
36 NUT, REAR STABILIZER SHAFT INSULATOR CLAMP
37 CLAMP, REAR STABILIZER SHAFT INSULATOR
38 INSULATOR, REAR STABILIZER SHAFT

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Figure 11 – Stabilizer Shaft

4. Bolts/screws (33) and nuts (36).
5. Stabilizer shaft link nut. Refer to "Stabilizer Shaft Bracket and Link Assembly" in this section.

Tighten

- Nuts (36) to 24 N•m (18 lb. ft.).

6. Link assembly. Refer to "Stabilizer Shaft Bracket and Link Assembly" in this section.
7. Lower vehicle.

STABILIZER SHAFT BRACKET AND LINK ASSEMBLY

Figure 12

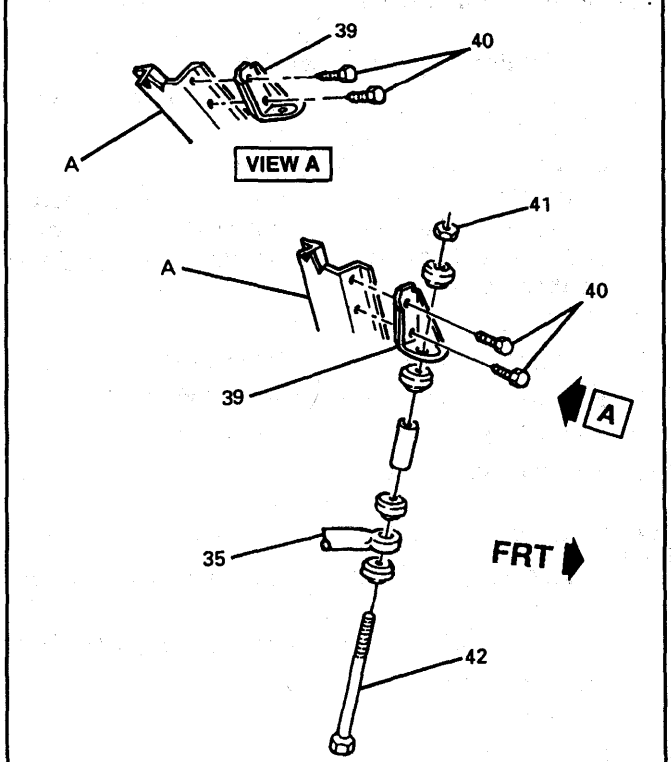
Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Nut (41).
3. Link assembly (42).
4. Bolts/screws (40).
5. Bracket (39).

Install or Connect

NOTICE: See "Notice" on page 3D-1 of this section.

1. Position bracket (39) to underbody pan assembly.



A PAN ASSEMBLY, UNDERBODY
35 SHAFT, REAR STABILIZER
39 BRACKET, REAR STABILIZER SHAFT
40 BOLT/SCREW, REAR STABILIZER SHAFT LINK
41 NUT, REAR STABILIZER SHAFT LINK
42 LINK ASSEMBLY, REAR STABILIZER SHAFT

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Figure 12 – Stabilizer Shaft Bracket and Link Assembly

2. Bolts/screws (40).

Tighten

- Bolts/screws (40) to 23 N•m (17 lb. ft.).

3. Position link assembly (42) to bracket (39).
4. Link assembly (42) and nut (41).

Tighten

- Link assembly (42) and nut (41) to 22 N•m (16 lb. ft.).

5. Lower vehicle.

SHOCK ABSORBER ASSEMBLY

Figure 13

Remove or Disconnect

1. Fold down seatback frame assembly.

2. Quarter trim panel assembly. Refer to SECTION 10-6.
3. Pull folding carpet assembly back.
4. Raise and suitably support vehicle. Refer to SECTION 0A.
5. Support rear axle assembly (13).

   NOTICE: Rear axle assembly must be supported before removing nut to avoid possible damage to brake hose lines, tie rod assembly and propeller shaft assembly.
6. Nut (43).
7. Retainer (44) and upper insulator (45).
8. Retainer (44) and lower insulator (46).
9. Nut (48) from rear axle assembly (13).
10. Shock absorber assembly (47).

Install or Connect

NOTICE: See "Notice" on page 3D-1 of this section.

1. Position shock absorber assembly (47) to rear axle assembly (13).
2. Nut (48).

Tighten

- Nut (48) to 90 N•m (66 lb. ft.).

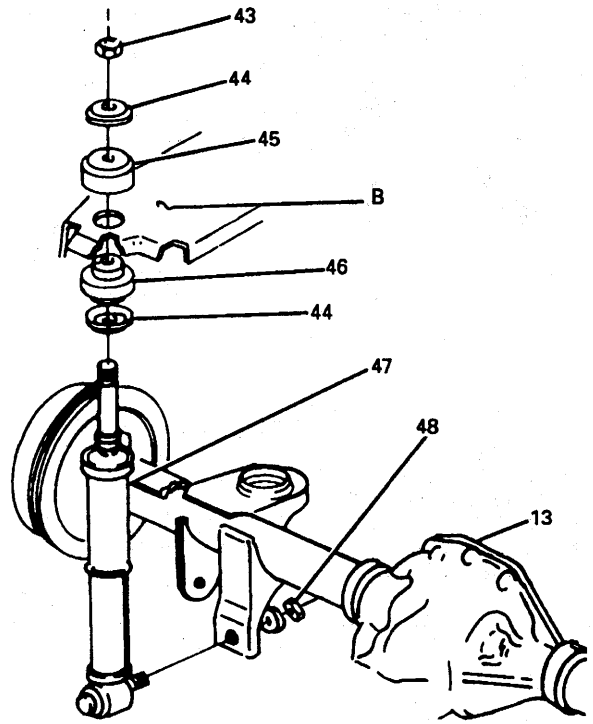
3. Lower insulator (46) and retainer (44) to shock absorber assembly (47).
4. Position shock absorber assembly (47) through underbody pan assembly and seat insulator.
5. Upper insulator (45) and retainer (44) to shock absorber assembly (47).
6. Hand start nut (43).

   NOTICE: Turning the shock absorber assembly while tightening the nut could damage the shock absorber assembly. To prevent damage, keep the shock absorber assembly stationary when tightening the nut.

Tighten

- Nut (43) to 17 N•m (13 lb. ft.).

7. Remove rear axle assembly support.
8. Lower vehicle.
9. Pull folding carpet assembly down into position.
10. Quarter trim panel assembly. Refer to SECTION 10-6.
11. Fold seatback frame assembly upright.



A TYPICAL REAR SHOCK ABSORBER ASSEMBLY INSTALLATION (RIGHT-HAND SHOWN)
B PAN ASSEMBLY, UNDERBODY
13 AXLE ASSEMBLY, REAR
43 NUT, REAR SHOCK ABSORBER
44 RETAINER, REAR SHOCK ABSORBER UPPER INSULATOR
45 INSULATOR, REAR SHOCK ABSORBER UPPER
46 INSULATOR, REAR SHOCK ABSORBER LOWER
47 ABSORBER ASSEMBLY, REAR SHOCK
48 NUT, REAR SHOCK ABSORBER

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Figure 13 – Shock Absorber Assembly

SPECIFICATIONS

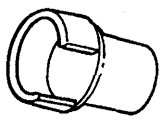
FASTENER TIGHTENING SPECIFICATIONS

Rear Axle Bumper Bolt/Screw	27 N•m (20 lb. ft.)
Rear Axle Lower Control Arm Bolt/Screw	108 N•m (80 lb. ft.)
Rear Axle Lower Control Arm Nut	82 N•m (60 lb. ft.)
Rear Axle Tie Rod Bracket-to-Left-Hand Brace Bracket Bolt/Screw	47 N•m (35 lb. ft.)
Rear Axle Tie Rod-to-Left-Hand Brace Bracket Nut	82 N•m (61 lb. ft.)
Rear Axle Tie Rod-to-Right-Hand Brace Bracket Nut	82 N•m (61 lb. ft.)
Rear Axle Torque Arm Bolt/Screw	130 N•m (96 lb. ft.)
Rear Axle Torque Arm Bracket Nut	41 N•m (30 lb. ft.)
Rear Axle Torque Arm Inner Bracket Bolt/Screw (Automatic Transmission	

Assembly and Manual Transmission Assembly)	50 N•m (37 lb. ft.)
Rear Axle Torque Arm Inner Bracket Bolt/Screw (Upper) (Automatic Transmission Assembly Only)	50 N•m (37 lb. ft.)
Rear Axle Torque Arm Nut	132 N•m (97 lb. ft.)
Rear Axle Torque Arm Outer Bracket Bolt/Screw	27 N•m (20 lb. ft.)
Rear Shock Absorber Nut (Lower)	90 N•m (66 lb. ft.)
Rear Shock Absorber Nut (Upper)	17 N•m (13 lb. ft.)
Rear Stabilizer Shaft Insulator Clamp Nut	24 N•m (18 lb. ft.)
Rear Stabilizer Shaft Link Bolt/Screw	23 N•m (17 lb. ft.)
Rear Stabilizer Shaft Link Nut	22 N•m (16 lb. ft.)

SPECIAL TOOLS

1.



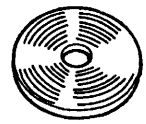
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2.



J 21474-20

3.



J 21474-23

1. BUSHING RECEIVER
2. BUSHING INSTALLER
3. BUSHING REMOVER

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BLANK

SECTION 3E

TIRES AND WHEELS

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

The factory-installed tire and wheel assemblies are designed to operate satisfactorily with loads up to and including the full load capacity when inflated to the recommended tire pressures.

Correct tire pressures and driving techniques have an important influence on tire life. Heavy cornering, excessively rapid acceleration, and unnecessarily sharp braking increase tire wear.

REPLACEMENT TIRES

Figure 1

A tire performance criteria (TPC) specification number is molded in the sidewall near the tire size of all original equipment tires. This specification number assures that the tire meets GM's performance standards for traction, endurance, dimension, noise, handling, rolling resistance, and others. Usually, a specific TPC number is assigned to each tire size.

Replacement tires should be the same size, load range and construction as the original tires. Replace the original tires with tires of the same TPC specification number. Use of any other tire size or type may seriously affect ride, handling, speedometer/odometer calibration, antilock brake system, vehicle ground clearance, and tire clearance to the body and chassis.

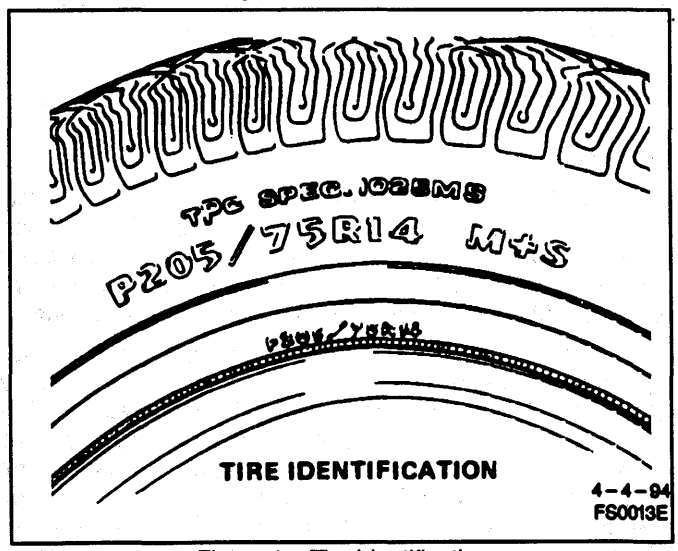


Figure 1 – Tire Identification

CAUTION: Do not mix different types of tires on the same vehicle, such as radial, bias, and bias-belted tires, except in emergencies because vehicle handling may be seriously affected and may result in loss of control. This caution does not apply to the compact spare furnished with the vehicle.

Tires should be replaced when:

- They are worn to a point where 1.6 mm (1/16 inch) or less tread remains, or cord or fabric is showing. To help detect this condition, tires have built-in tread wear indicators that appear between tread grooves when tread is worn to 1.6 mm (1/16 inch) or less. Replace tire when indicators appear in two or more adjacent grooves at three spots around tire.
- Tread or sidewall is cracked, cut or snagged deeply enough to expose cord or fabric.
- Tire has a bump, bulge or split. Slight sidewall indentations are normal and should not affect ride.
- Tire has a puncture, cut or other damage that cannot be correctly repaired because of size or location of damage.

It is recommended that new tires be installed in pairs on the same axle. If only one tire is replaced, it should be paired with the tire having the most tread.

ALL SEASON TIRES

Figure 1

Most GM vehicles are now equipped with steel belted all season radial tires as standard equipment. These tires qualify as snow tires, with a 37 percent higher average rating for snow traction than non-all season radial tires used previously. Other performance areas, such as wet traction, rolling resistance, tread life and air retention, were also improved slightly. These improvements were made by changing both tread design and tread compounds. These tires are identified by an "M+S" molded in the tire sidewall following the size. The suffix "MS" is also molded in the sidewall after the TPC specification number.

P-METRIC TIRES

Figure 2

All GM vehicles now use passenger-metric (P-metric) sized tires. P-metric tires are available in two load ranges: standard load with 210 kPa (30 psi) maximum pressure and extra load with 240 kPa (35 psi) maximum pressure. Most passenger vehicle tires are standard load.

Most P-metric tire sizes do not have exact corresponding alpha-numeric tire sizes. For example, a P205/75R15 is not exactly equal in size and load carrying capacity to an FR78-15. For this reason, replacement tires should be of the same TPC specification number (same size, load range, construction) as those originally on the vehicle. If P-metric tires must be replaced with other sizes, a tire dealer should be consulted. Tire companies can best recommend the closest match of alpha-numeric to P-metric sizes within their own tire lines.

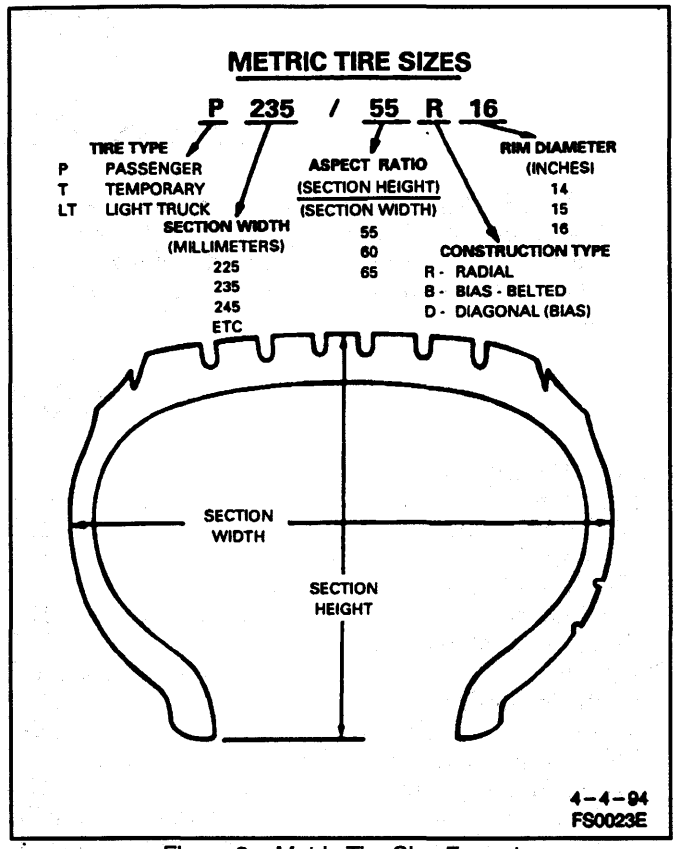


Figure 2 – Metric Tire Size Format

The metric term for tire pressure is the kilopascal (kPa). Tire pressure may be printed in both kPa and pounds per square inch (psi). One psi equals 6.9 kPa. Refer to the tire placard or "Specifications" in this section for tire pressures.

TIRE CHAIN USAGE

Figure 3

NOTICE: Tire chains should not be used with P245/50ZR16 or P235/55R16 tires. The chains could damage the vehicle. Tire chains are only recommended for emergency use or when required by law.

Due to limited tire-to-body clearance on certain vehicles, tire chain usage recommendations have been published in the Owner's Manual. When chains are to be used, most current GM vehicles require SAE Class "S" tire chains. These may also be designated as 1100 Series, Type PL tire chains. These chains are specially designed to limit the "fly off" effect that occurs when the tire and wheel assembly rotates.

Manufacturers of tire chains have a specific chain size for each tire and wheel assembly to ensure proper fit when installed. Therefore, specific chains should be obtained for the tire and wheel assemblies on which they are to be used. Rubber adjusters should not be used to take up slack or clearance in chains which are loose due to incorrect size. Always follow the chain manufacturer's installation instructions.

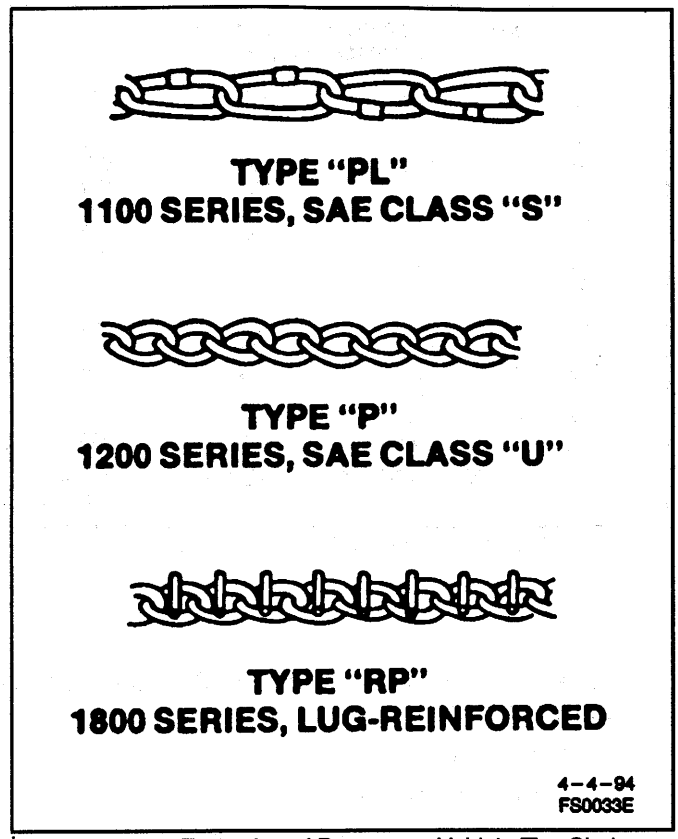


Figure 3 – Examples of Passenger Vehicle Tire Chains

Use of chains may adversely affect vehicle handling. When tire chains are installed:

- Adjust speed to road conditions
- Avoid sharp turns

In general, to help prevent chain damage to the vehicle:

- Install chains on rear tire and wheel assemblies as tightly as possible, then tighten them again after driving 0.4 to 0.8 km (1/4 to 1/2 mile). Use of chains on front tire and wheel assemblies is not recommended; chains may contact and possibly damage vehicle. If chains are to be used on front tire and wheel assemblies, be sure there is enough clearance.
- Do not exceed 70 km/h (45 mph), or chain manufacturer's speed limit, if lower.
- Drive in restrained manner and avoid large bumps, potholes, severe turns and other maneuvers which could cause tire and wheel assemblies to bounce up and down.
- Follow any other instructions of chain manufacturer which do not disagree with above.

Additional specific information is published in the Owner's Manual.

TIRE PLACARD

Figure 4

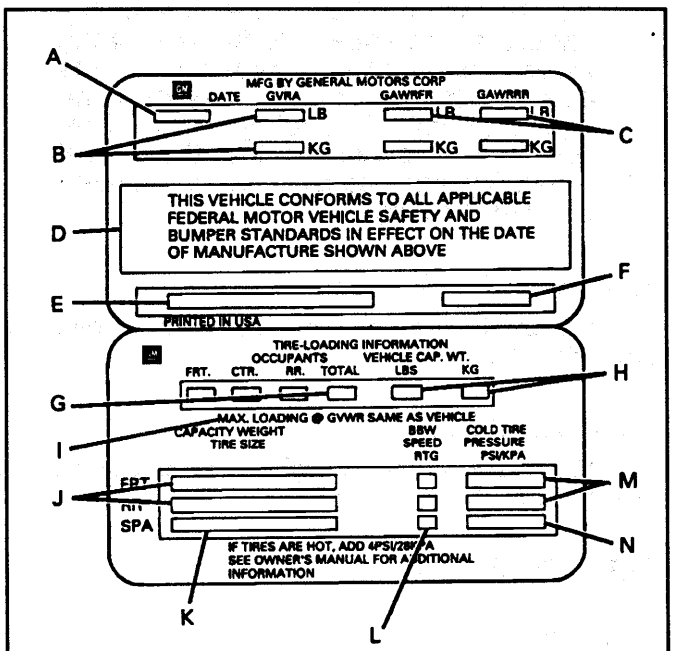
The tire placard is permanently located on the rear face of the driver's door, and should be referred to for tire information. The placard lists the maximum vehicle load, tire size (including spare), and cold inflation pressure (including spare).

WHEEL ASSEMBLIES

Wheel assemblies must be replaced if they are bent, dented, have excessive lateral or radial runout, leak air through welds, have elongated bolt holes, or if the wheel nuts will not stay tight. Wheel assemblies with runout greater than specified may cause objectionable vibrations.

Replacement wheel assemblies must be equivalent to the original equipment wheel assemblies in load capacity, diameter, rim width, offset, and mounting configuration. A wheel assembly of incorrect size or type may affect wheel assembly and bearing life, brake cooling, speedometer/odometer calibration, antilock brake system, vehicle ground clearance and tire clearance to the body and chassis.

Steel wheel assemblies can be identified by a two- or three-letter code stamped into the front side of the rim near the valve stem assembly. Aluminum wheel assemblies have the code, part number, and manufacturer ID cast into the inboard side.



A DATE
B GROSS VEHICLE WEIGHT RATING
C GROSS AXLE WEIGHT RATING FRONT & REAR
D CERTIFICATION STATEMENT
E VEHICLE IDENTIFICATION NUMBER
F VEHICLE CLASS TYPE: "PASSENGER CAR"
G MAXIMUM OCCUPANTS
H MAXIMUM VEHICLE CAPACITY WEIGHT
I MAXIMUM LOADING AT GVWR
J TIRE SIZE
K SPARE TIRE SIZE
L SPEED RATING
M TIRE PRESSURE WITH MAXIMUM OCCUPANTS FRONT & REAR
N SPARE TIRE PRESSURE

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Figure 4 – Tire Placard

ON-VEHICLE SERVICE

WHEEL ASSEMBLY REPAIR

Wheel assembly repairs that use welding, heating or peening are not approved. An inner tube is not an acceptable repair for leaky tire and wheel assemblies. Porosity in aluminum wheel assemblies can be repaired. Refer to "Aluminum Wheel Assembly Porosity Repair" in this section.

METRIC WHEEL NUTS AND BOLTS

A metric wheel nut is identified by the word "Metric" stamped on its face. The wheel bolt has the letter "M" stamped into its end. The thread size of the metric wheel nuts and bolts are indicated by a code, such as M12 x 1.5.

WHEEL BOLT REPLACEMENT

CAUTION: If any wheel bolt is damaged by a loose-running wheel assembly, all the bolts for that wheel assembly should be replaced. A loose-running wheel assembly may break only one bolt, but the other bolts may be damaged internally. Replacing only the broken bolt and remounting the wheel assembly may cause further damage and personal injury.

Front Wheel Bolt

For the front wheel bolt replacement procedure, refer to SECTION 3C.

Rear Wheel Bolt

For the rear wheel bolt replacement procedure, refer to SECTION 4B.

TIRE INFLATION

Figure 5

The pressure recommended for all models is carefully calculated to give a comfortable ride, responsive steering, and maximum tread wear, tire life and resistance to bruises. Valve stem assembly caps or extensions should be installed on the valve stem assemblies to keep out dust and water.

Tire pressure, with tires cold (after vehicle has sat for three hours or more, or driven less than one mile), should be checked monthly or before any extended trip. Set tire pressure to the specifications on the tire placard located on the rear face of driver's door or in "Tire Pressures" in this section. Tire pressure will increase about 6.9 kPa (1 psi) for every 5.5°C (10°F) temperature increase.

For sustained high-speed driving, tires should be set at the pressures recommended. Sustained driving at high speeds, where permitted by law, is not advised unless vehicle has special high-speed tires.

POUNDS PER SQUARE INCH (psi)
TO KILOPASCALS (kPa)

psi	kPa	psi	kPa
20	140	55	380
23	160	60	420
24	170	65	450
26	180	70	480
28	190	75	520
29	200	80	550
30	210	85	590
32	220	90	620
35	240	95	660
38	260	100	690
40	280	105	720
41	280	110	760
45	310	115	790
50	340	120	830

CONVERSION: psi x 6.895 = kPa

4-4-94
FS0053E

Figure 5 – Inflation Pressure Conversion

Tire pressure which is higher than that recommended can cause:

- Hard ride.
- Reduced handling.
- Tire bruising or carcass damage.
- Rapid tread wear at center of tire.

Tire pressure which is lower than that recommended can cause:

- Tire squeal on turns.
- Hard steering.
- Rapid and uneven wear on edge of tread.
- Tire rim bruises and rupture.
- Tire cord breakage.
- High tire temperatures.
- Reduced handling.
- High fuel consumption.

Unequal tire pressure on same axle can cause:

- Uneven braking.
- Steering lead.
- Reduced handling.
- Swerve on acceleration.

WHEEL ASSEMBLY REMOVAL AND INSTALLATION

Figures 6, 7 and 8

Penetrating oil has not been found to be effective in removing tight wheel assemblies. However, if it is used, it should be applied sparingly to the wheel assembly centerhole area only.

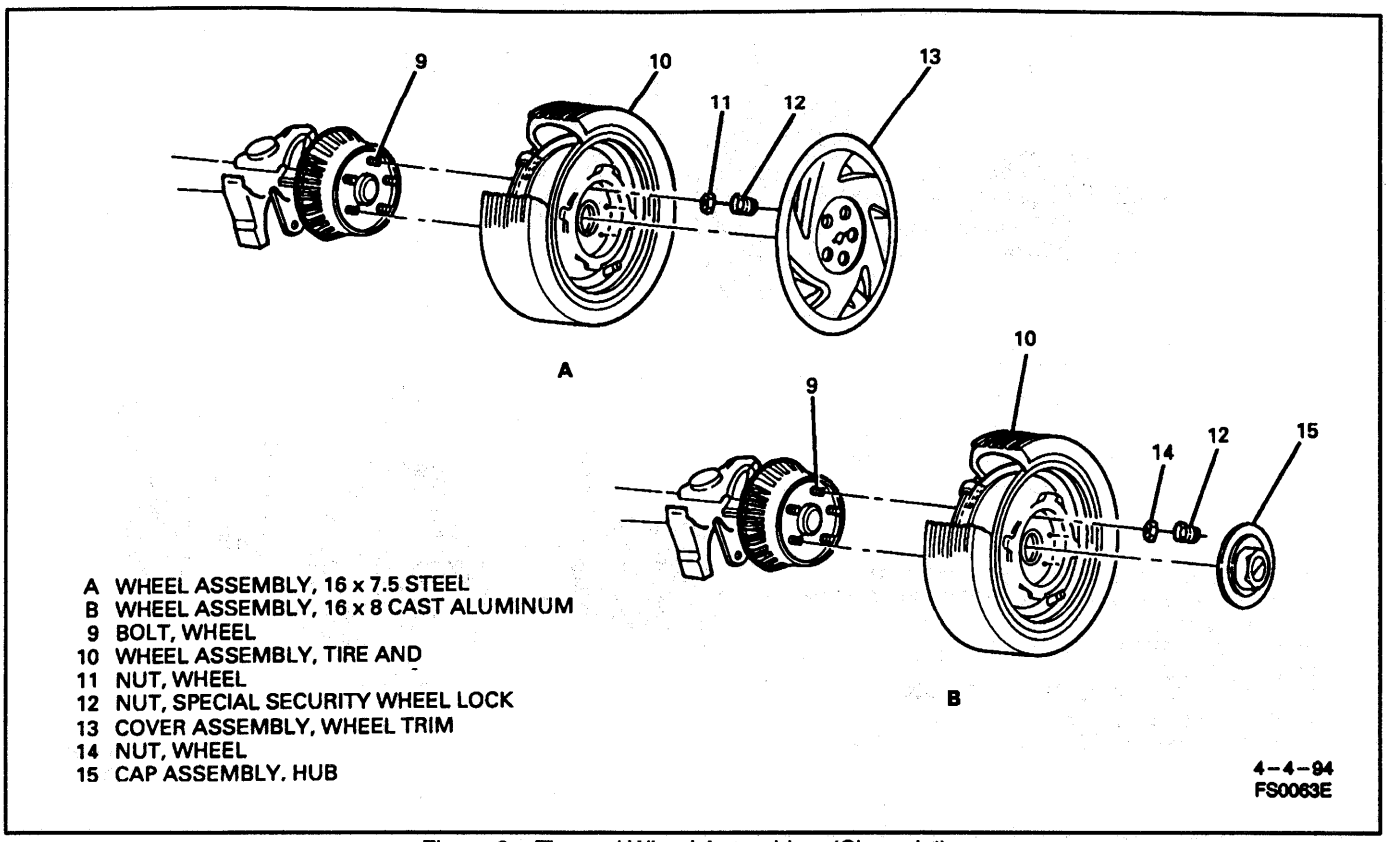


Figure 6 – Tire and Wheel Assembly – (Chevrolet)

CAUTION: If penetrating oil gets on the vertical surfaces between the wheel assembly and the rotor assembly or brake drum, it could cause the wheel assembly to work loose as the vehicle is driven, resulting in a loss of control and an injury accident. Never use heat to loosen a tight wheel assembly. It can shorten the life of the wheel assembly, studs, or spindle and bearing assemblies. Wheel nuts must be tightened in sequence and to the proper torque to avoid bending the wheel assembly or rotor assembly.

Sometimes wheel assemblies can be difficult to remove due to foreign material or a tight fit between the wheel assembly centerhole and the rotor assembly. Excessive force such as hammering the wheel assembly or tire can cause damage and is not recommended. Slight tapping on the tire sidewall using a large rubber mallet is acceptable.

The wheel assembly can be removed without damage as follows:

1. Retighten all wheel nuts on affected wheel assembly. Then loosen each nut two turns. Rock vehicle from side to side. If this is not effective, go to step 2.
2. Rock vehicle from "DRIVE" to "REVERSE" allowing vehicle to move several feet in each direction. Apply quick, hard jabs on the brake pedal assembly to loosen wheel assembly. If wheel assembly still does not loosen, then rock vehicle again from side to side as hard as possible using one or more person's body weight. If wheel assembly is still tight, repeat procedure.

Chevrolet

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Wheel nut caps, if equipped.
3. Hub cap (15) or wheel trim cover assembly (13).
4. Special security wheel lock nut (12), if equipped.
   - Use special security wheel lock key, located in the front floor console assembly.
5. Wheel nuts (11 or 14).
   - Mark location of the tire and wheel assemblies (10) to the hub assembly.
6. Tire and wheel assembly (10).

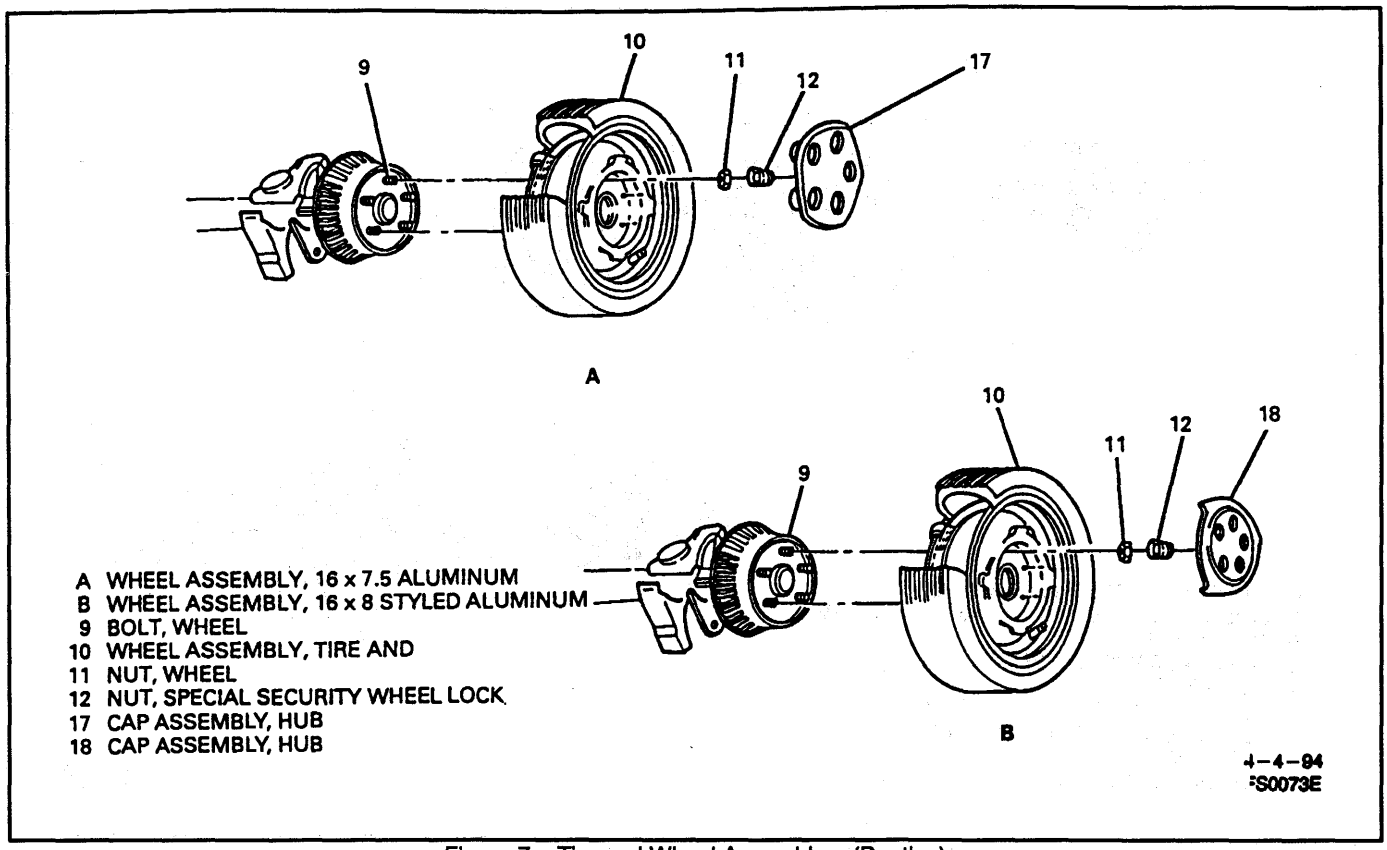


Figure 7 – Tire and Wheel Assembly – (Pontiac)

Clean

CAUTION: Before installing a wheel assembly, remove any buildup of corrosion on the wheel assembly mounting surface and brake drum or rotor assembly by scraping and wire brushing. Installing wheel assemblies without good metal-to-metal contact at the mounting surfaces can cause wheel nuts to loosen, which may later allow the wheel assembly to come off while the vehicle is in motion.

- Wheel nuts (11 or 14), bolts (9), wheel assembly (10) and brake drum or rotor assembly mounting surfaces.

Install or Connect

NOTICE: See "Notice" on page 3E-1 of this section.

1. Tire and wheel assembly (10).

   CAUTION: Never use oil or grease on bolts or wheel nuts. Tighten the wheel nuts with your fingers until they are snug. Then, tighten the wheel nuts (in the sequence shown) to the specified torque. Refer to "Specifications" in this section. Improperly tightened wheel nuts could eventually allow the wheel assembly to come off while the vehicle is moving, possibly causing loss of control, personal injury and property damage.

2. Wheel nuts (11 or 14).

   Tighten

   - Nuts (11 or 14) in sequence to 140 N•m (100 lb. ft.) (Figure 8).

3. Special security wheel lock nut (12), if equipped.
   - Use special security wheel lock key located in front floor console assembly.

Pontiac

Tighten

- Nut (12) to 140 N•m (100 lb. ft.).

4. Hub cap (15) or wheel trim cover assembly (13), if equipped.

   Tighten

   - Cover assembly (13) to 6 N•m (53 lb. in.).

5. Wheel nut caps, if equipped.
6. Lower vehicle.

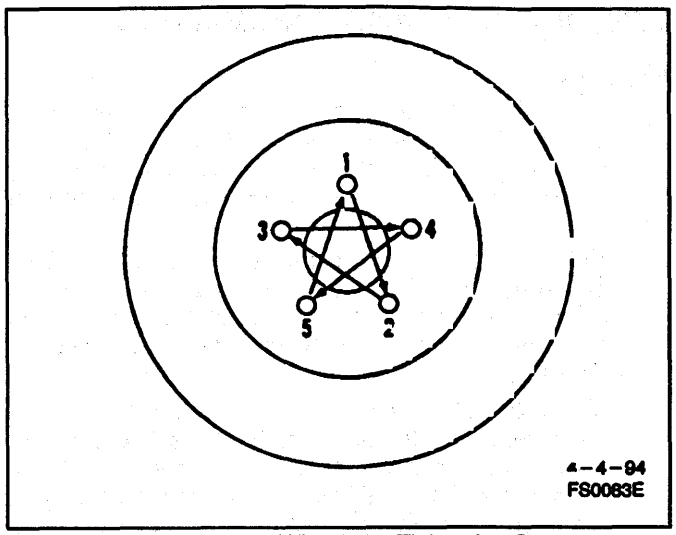


Figure 8 – Five-Hole Wheel Nut Tightening Sequence

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Wheel nut caps, if equipped.
3. Hub cap assembly (17 or 18).
4. Special security wheel lock nut (12), if equipped.
   - Use special security wheel lock key, located in the front floor console assembly.
5. Wheel nuts (11).
   - Mark location of the tire and wheel assemblies (10) to the hub assembly.
6. Tire and wheel assembly (10).

Clean

CAUTION: Before installing a wheel assembly, remove any buildup of corrosion on the wheel assembly mounting surface and brake drum or rotor assembly by scraping and wire brushing. Installing wheel assemblies without good metal-to-metal contact at the mounting surfaces can cause wheel nuts to loosen, which may later allow the wheel assembly to come off while the vehicle is in motion.

- Wheel nuts (11), bolts (9), wheel assembly (10) and brake drum or rotor assembly mounting surfaces.

Install or Connect

NOTICE: See "Notice" on page 3E-1 of this section.

1. Tire and wheel assembly (10).

CAUTION: Never use oil or grease on bolts or wheel nuts. Tighten the wheel nuts with your fingers until they are snug. Then, tighten the wheel nuts (in the sequence shown) to the specified torque. Refer to "Specifications" in this section. Improperly tightened wheel nuts could eventually allow the wheel assembly to come off while the vehicle is moving, possibly causing loss of control, personal injury and property damage.

2. Wheel nuts (11).

Tighten

- Nuts (11) in sequence to 140 N•m (100 lb. ft.) (Figure 8).

3. Special security wheel lock nut (12), if equipped.
   - Use special security wheel lock key located in front floor console assembly.

Tighten

- Nut (12) to 140 N•m (100 lb. ft.).

4. Hub cap assembly (17 or 18).

Tighten

- Cap assembly (17 or 18) to 6 N•m (53 lb. in.).

5. Wheel nut caps, if equipped.
6. Lower vehicle.

Tire and Wheel Assembly Rotation

Figure 9

To equalize wear, rotate tires at intervals specified in SECTION 0B. Whenever uneven tire wear is noticed, the cause should be investigated. Figure 9 shows the only methods of tire and wheel assembly rotation recommended.

Due to their design, radial tires tend to wear faster in the shoulder area, particularly in drive locations. Radial tires in non-drive locations may develop an irregular wear pattern that can generate tire noise. This wear makes regular rotation especially important.

Always use a four-wheel rotation. After rotation, be sure to check wheel nut torque and set tire pressure. Never use oil or grease on wheel assembly bolts or nuts.

On vehicles with P245/50ZR16 tires, special rotation provisions must be followed because the tires are directional. See Figure 9 for the recommended rotation.

Rotate the tires. If you have directional tires, be sure the color-coded arrows on the tires point in the direction the tires roll. Balance the tire and wheel assemblies using polyester-coated clip-on wheel balancing weights. Adjust tire pressures and tighten wheel nuts to the specified torque. Refer to "Wheel Assembly Removal and Installation" in this section.

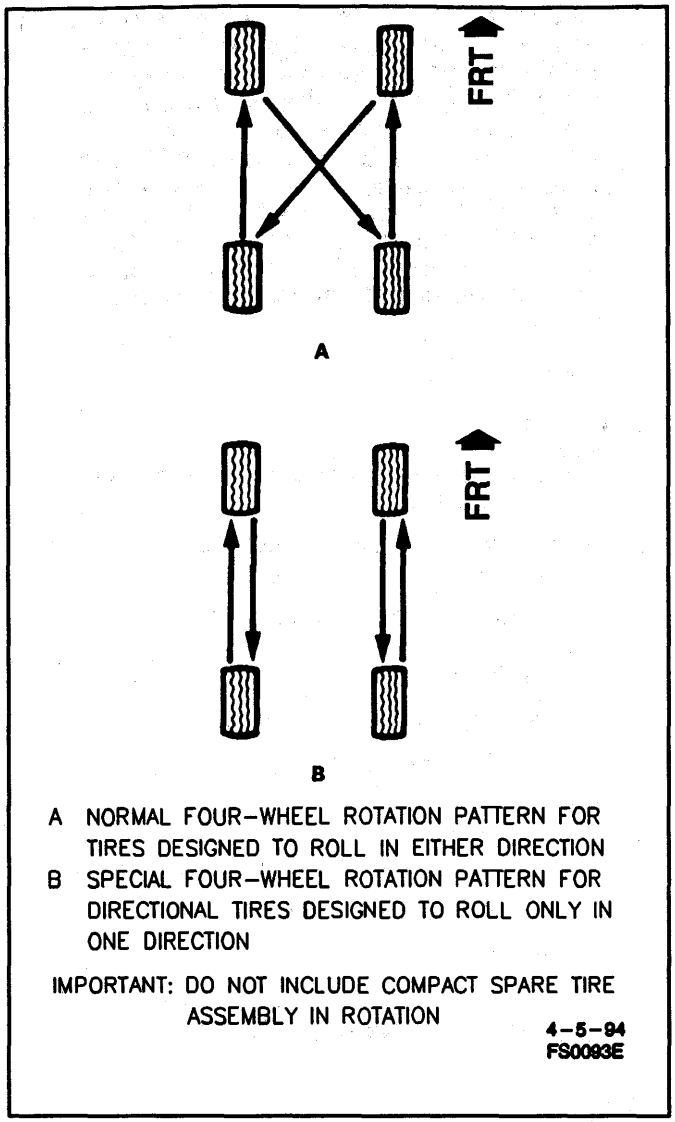


Figure 9 – Tire and Wheel Assembly Rotation

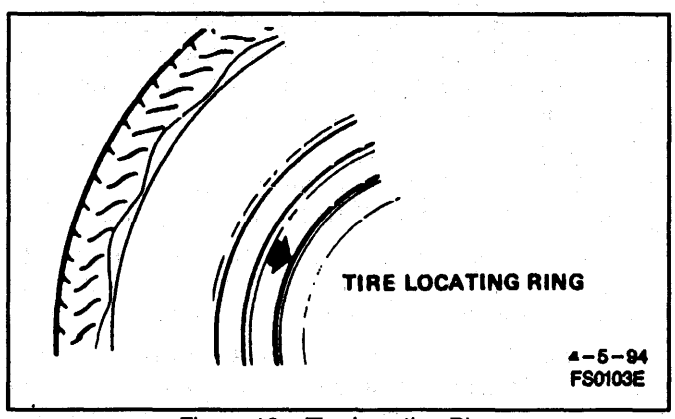


Figure 10 – Tire Locating Ring

TIRE MOUNTING AND DISMOUNTING

Figure 10

Use a tire changing machine to mount or dismount tires. Follow the equipment manufacturer's instructions. Do not use hand tools or tire irons to change a tire as they may damage the tire beads, wheel assembly rim or flanges.

NOTICE: Do not lubricate the tire beads or wheel assembly rim with a lubricant containing silicone. Silicone will allow the tire to rotate on the wheel assembly rim, throwing the tire and wheel assembly out of balance.

NOTICE: Do not attempt to break the tire bead loose before the tire has completely deflated. It takes about 70 seconds for the air to completely exhaust from a large tire. If the valve stem assembly is removed before this amount of time, the bead breaker on the tire changing machine could put enough force on the tire to bend the wheel assembly at the mounting surface. This could result in vibration, shimmy and cracking of the wheel assembly. Completely deflate the tire before attempting to break the tire bead loose.

Rim bead seats should be cleaned with a wire brush or coarse steel wool to remove old rubber and light rust or corrosion. Before mounting or dismounting a tire, the bead area should be well-lubricated with GM P/N 9985555 (50 percent lubricant and 50 percent water) or equivalent.

CAUTION: To avoid serious personal injury, do not stand over the tire when inflating. The bead may break when it snaps over safety hump. Do not exceed 280 kPa (40 psi) pressure when inflating any tire if beads are not seated. If 280 kPa (40 psi) pressure will not seat beads, deflate, relubricate and inflate. Overinflation may cause the bead to break and cause serious personal injury.

- After mounting, inflate tire so that beads are completely seated, but never exceed 280 kPa (40 psi).

Important

- When mounting blackwall tires, be sure the TPC specification number faces the outboard side of the vehicle.

Install the valve stem assembly and inflate to the pressure specified on the tire placard. Check the locating rings of the tire to be sure they show around the rim flanges on both sides of the wheel assembly.

Steel Wheel Assembly Mounting Surface Check

Figures 11 and 12

1. Place straight edge (about eight to nine inches long) with both hands on inboard mounting surface of wheel assembly.
2. Try to rock straight edge up and down.

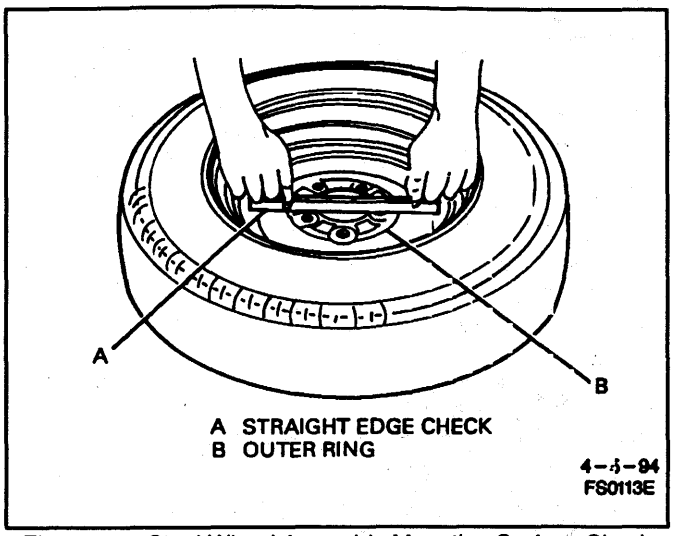


Figure 11 – Steel Wheel Assembly Mounting Surface Check

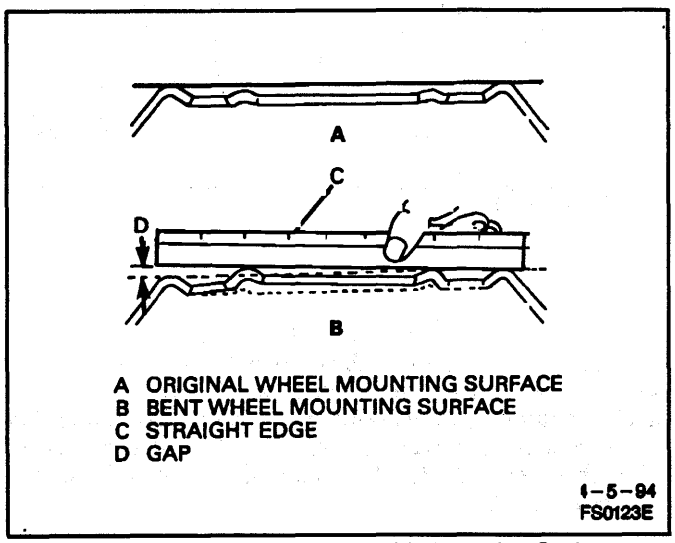


Figure 12 – Steel Wheel Assembly Mounting Surface

- The outer ring of mounting surface is normally raised above everything else inside it. If surface has been bent on a tire changer, it will be raised above outer ring and straight edge will rock on this position.

3. Repeat steps 1 and 2 at three or four different positions on inboard mounting surface.
4. If wheel assembly is bent, it must be replaced. Refer to "Wheel Assembly Removal and Installation" in this section.

TIRE REPAIR

There are many different materials and techniques on the market to repair tires, but not all work on some types of tires. Tire manufacturers have published detailed instructions on how and when to repair tires. The instructions can be obtained from the tire manufacturer. Repair of compact spare tire is not recommended.

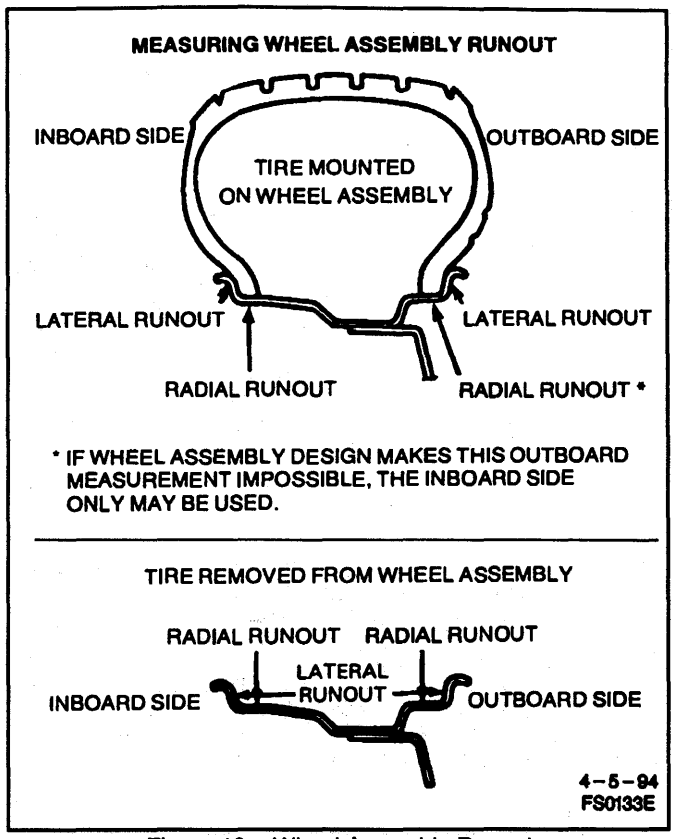


Figure 13 – Wheel Assembly Runout

MEASURING WHEEL ASSEMBLY RUNOUT

Figure 13

Wheel assembly runout should be measured with an accurate dial indicator. Measurements may be taken with the wheel assembly installed on the vehicle, or off the vehicle using an accurate mounting surface such as a wheel balancer. Measurements may be taken with or without the tire mounted on the wheel assembly.

Radial runout and lateral runout should be measured on both the inboard and outboard rim flanges. With the dial indicator firmly in position, slowly rotate the wheel assembly one revolution and record the total indicator reading. If any measurement exceeds specifications, and there is a vibration that wheel balancing will not correct, the wheel assembly should be replaced. Disregard any indicator readings caused by welds, paint runs, or scratches.

- Steel Wheel Assemblies
  - Radial runout 1.01 mm (0.040 inch)
  - Lateral runout 1.14 mm (0.045 inch)
- Aluminum Wheel Assemblies
  - Radial runout 0.76 mm (0.030 inch)
  - Lateral runout 0.76 mm (0.030 inch)

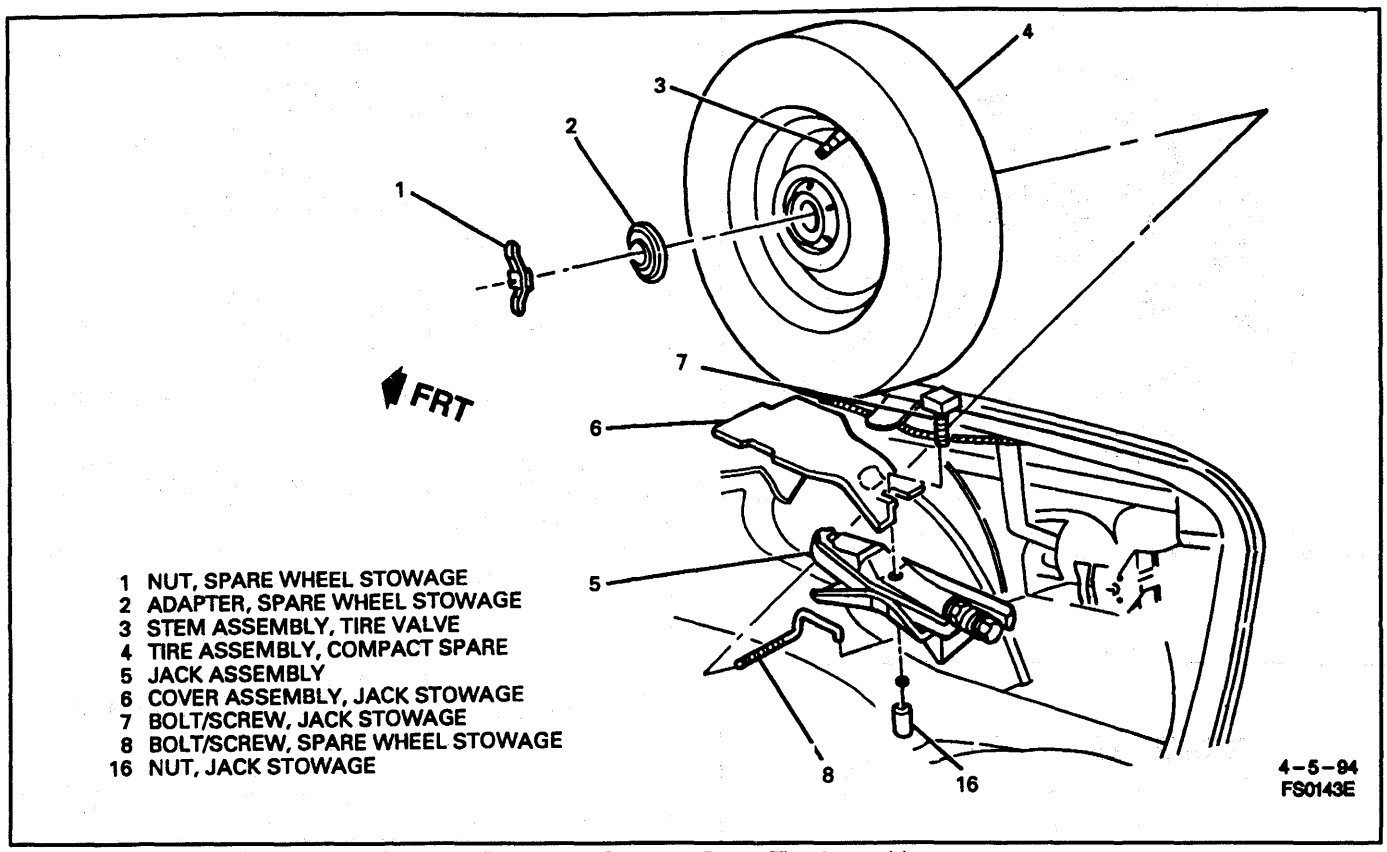


Figure 14 – Compact Spare Tire Assembly

COMPACT SPARE TIRE ASSEMBLY

Figure 14

Important

- Use of compact spare may result in activating a wheel sensor fault code. This will result in "ANTI-LOCK" warning lamp turning on and deactivation of antilock brake system. After replacing compact spare, recycling ignition switch will reset system.

  NOTICE: If the compact spare is used as a rear tire, do not drive faster than 80 km/h (50 mph). Damage to the rear axle assembly may occur if the compact spare is driven faster than 80 km/h (50 mph). This speed limitation does not apply when the compact spare is used as a front tire.

Some vehicles will be equipped with a high-pressure compact spare. The compact spare uses a narrow 4-inch wide rim, although the wheel assembly diameter is usually one inch larger than the road wheel assemblies.

NOTICE: The compact spare wheel assembly should not be used with standard tires, snow tires, wheel covers or trim rings. If such use is attempted, damage to these items or other parts of the vehicle may occur. The compact spare should be used only on vehicles that offer it as original equipment.

Inflation pressure of the compact spare must be periodically checked and maintained at 420 kPa (60 psi). It can be mounted and dismounted from its wheel assembly using present tire-changing equipment and procedures. As with other tires, the beads should completely seat at 280 kPa (40 psi).

CAUTION: To avoid serious personal injury, do not stand over tire when inflating. Bead may break when it snaps over safety hump. Do not exceed 280 kPa (40 psi) pressure when inflating any tire, including compact spares, if beads are not seated. If 280 kPa (40 psi) pressure will not seat beads, deflate, relubricate and inflate. Over-inflation may cause bead to break and cause serious personal injury.

The compact spare is designed to weigh less than standard tires and is easier to handle when need arises. Check inflation pressure as soon as practical after installing compact spare and adjust to 420 kPa (60 psi). Replacement of the compact spare should be made only by an authorized tire dealer.

NOTICE: Do not take the vehicle through an automatic car wash with the compact spare installed. The vehicle may get caught, which could result in property damage.

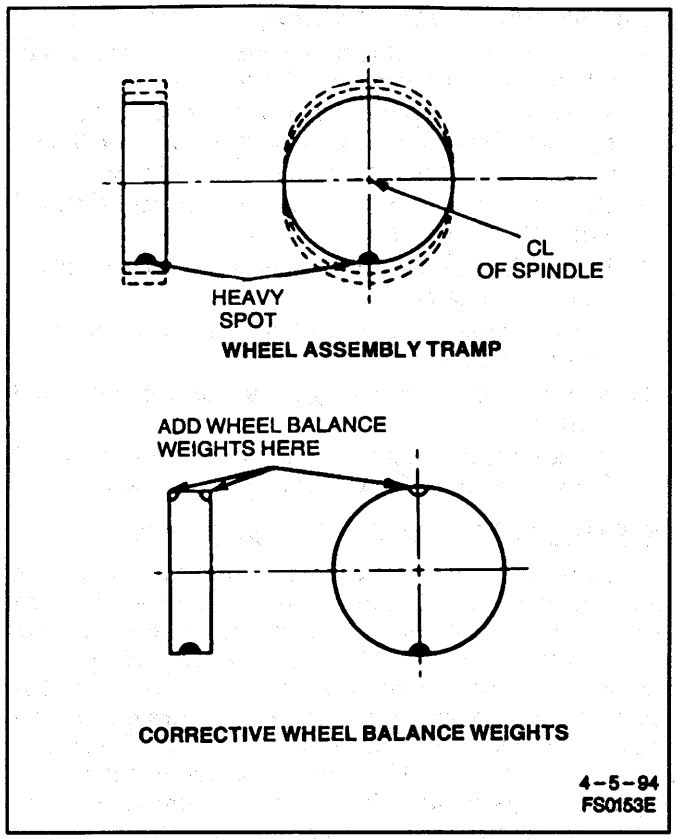


Figure 15 – Static Unbalance Correction

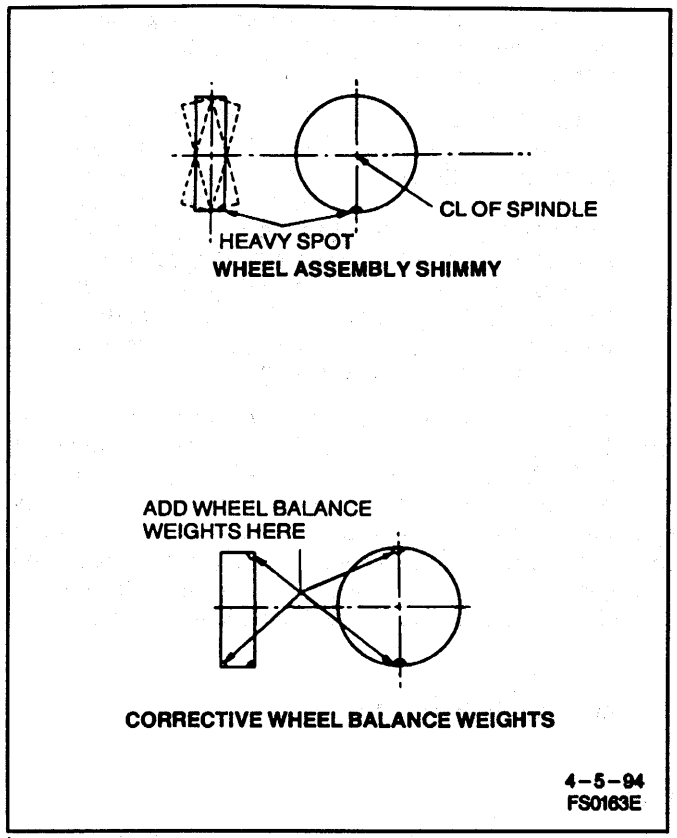


Figure 16 – Dynamic Unbalance Correction

BALANCING TIRE AND WHEEL ASSEMBLY

Figures 15 and 16

There are two methods used to balance tire and wheel assemblies: static and dynamic. Static balance is the equal distribution of weight around the wheel assembly. Wheel assemblies that are statically unbalanced cause a bouncing action called tramp.

Dynamic balance is the equal distribution of weight on each side of the centerline so that when the tire spins there is no tendency for the wheel assembly to move from side to side. Wheel assemblies that are dynamically unbalanced may cause shimmy.

General Balance Precautions

CAUTION: It is recommended that eye protection be used to prevent personal injury.

Deposits of foreign material must be cleaned from the inside of the wheel assembly. Stones should be removed from the tread in order to avoid operator injury during spin balancing and to obtain a good balance. The tire and wheel assembly should be inspected for any damage, then balanced according to the equipment manufacturer's recommendations.

Off-Vehicle Balancing

When balancing tire and wheel assemblies off the vehicle, use a balancer that pilots the wheel assembly by the centerhole (not the lug holes) if possible. Always follow the equipment manufacturer's instructions. Some electronic off-vehicle balancers are more accurate than the on-vehicle spin balancers, but do not correct for rotor assembly unbalance. If the vibration is not corrected by the off-vehicle balance, an on-vehicle balance may also be needed.

On-Vehicle Balancing

When needed, on-vehicle balancing will help correct vibrations due to brake drum, rotor assembly, and wheel cover imbalance.

When balancing on-vehicle, do not remove the balance weights from the off-vehicle dynamic balance. If more than one ounce of additional weight is required, it should be split between the inboard and outboard rim flanges.

The driven tire and wheel assemblies should be spun using the engine. Limit speed as stated in the following caution.

CAUTION: On vehicles equipped with limited slip rear axles, do not attempt to balance a tire on a drive wheel assembly with the other drive wheel assembly on the ground. The vehicle may drive through this wheel assembly and

cause the vehicle to move unexpectedly, resulting in personal injury and property damage.

CAUTION: Do not spin the drive wheel assemblies faster than 55 km/h (35 mph) as indicated by the speedometer. This limit is necessary because the speedometer indicates only one-half of the actual wheel speed when one drive wheel assembly is spinning and the other drive wheel assembly is stopped. Personal injury and damage may result from high-speed spinning.

To distinguish between standard rear axle and limited slip, raise rear of vehicle so both tires are clear of ground. With the transmission in "PARK" (in gear with a manual transmission) attempt to turn one wheel assembly by hand. If the wheel assembly can be turned easily, it is a standard rear axle: if the wheel assembly cannot be turned easily, it is a limited slip rear axle. Also, check for limited slip (G80) on the Service Parts Identification label.

Wheel Balance Weights

Figure 17

When static balancing, if more than 28 grams (1.0 ounce) are needed, the wheel balance weights should be split as equally as possible between the inboard and outboard flanges.

Assemblies with factory aluminum wheel assemblies must be balanced using special polyester-coated clip-on wheel balance weights. These weights are designed to fit over the thicker inboard and outboard rim flanges of the aluminum wheel assembly and should be installed with a nylon-coated hammer.

Adhesive wheel balance weights are also available for aluminum wheel assemblies. Use the following procedure to install adhesive wheel balance weights.

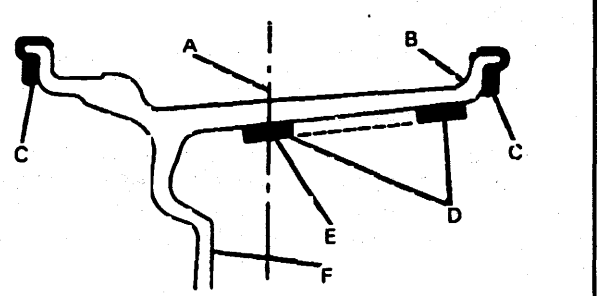


Figure 17 – Aluminum Wheel Balance Weight Placement

Adhesive Wheel Balance Weight Installation

1. Clean wheel assembly by sanding to bare aluminum where wheel balance weight is to be located.
2. Wipe wheel balance weight attachment area with mixture of half isopropyl alcohol and half water. Use clean cloth or paper towel for this operation.
3. Dry attachment area with hot air. Surface of wheel assembly should be warm to touch.
4. Warm adhesive backing on wheel balance weights to room temperature.
5. Remove tape from back of weights. Do not touch adhesive surface.
6. Apply wheel balance weight and press on with hand pressure.
7. Secure wheel balance weight with a 70 to 110 N (16 to 25 pound) force applied with a roller.

CORRECTING NON-UNIFORM TIRES

There are two ways to correct tires which cause a vibration even though they are properly balanced. One method uses an automatic machine which loads the tire and buffs small amounts of rubber from the stiff spots on the outer two tread rows. Correction by this method is usually permanent and, if done properly, does not significantly affect the appearance or tire tread life. Tire truing for free runout with a blade-type machine is not recommended as this reduces the tread life substantially and often does not permanently correct the problem.

Another method is to dismount the tire and rotate it 180 degrees on the rim. It is important that this be done only on tire and wheel assemblies which are known to be causing a vibration as it is just as likely to cause good tire and wheel assemblies to vibrate.

Refer to SECTION 3 for more details.

ALUMINUM WHEEL ASSEMBLIES

Aluminum Wheel Assembly Hub Cap

Remove or Disconnect

- Hub cap.
  - Use flat-bladed tool to pry off hub cap by inserting tool into slot between rim and hub cap.

Install or Connect

- Hub cap.
  - Use rubber mallet to fully seat hub cap into rim.

Aluminum Wheel Assembly Porosity Repair

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Tire and wheel assembly. Refer to "Wheel Assembly Removal and Installation" in this section.
3. Locate leaking areas by inflating tire to 280 kPa (40 psi) and dipping tire and wheel assembly into water bath.

4. Mark leak areas.
5. Mark tire at valve stem assembly.
6. Tire from wheel assembly. Refer to "Tire Mounting and Dismounting" in this section.
7. Scuff inside rim surface at leak area with number 80 grit sandpaper and clean area with general purpose cleaner such as 3M part number 08984 or equivalent.
8. Apply 3 mm (1/8-inch) thick layer of adhesive/sealant, GM P/N 1052366 or equivalent, to leak test area and allow six hours of drying time.

Install or Connect

1. Tire to wheel assembly. Refer to "Tire Mounting and Dismounting" in this section.
2. Align matchmark on tire with valve stem assembly.
3. Pressurize to 280 kPa (40 psi) and check for leaks.
4. Adjust tire pressure to meet specifications on tire placard.
5. Balance tire and wheel assemblies. Refer to "Balancing Tire and Wheel Assembly" in this section.
6. Tire and wheel assembly. Refer to "Wheel Assembly Removal and Installation" in this section.
7. Lower vehicle.

Aluminum Wheel Assembly Refinishing

A protective clearcoat or colorcoat is applied to the surface of original equipment cast-aluminum wheel assemblies. A surface break-down condition can begin to develop if frequent, repeated automatic car wash cleaning scratches or wears off the factory-applied protective clearcoat. Once the protective clearcoat is damaged, exposure to caustic cleaners and/or road salt further causes surface break-down. The service procedures detail how to strip, clean and recoat aluminum wheel assemblies that are affected by the above condition. Select and follow only those procedures for the conditions that apply to the wheel assemblies you are refinishing.

Required Materials

- Amchem Alumi Prep number 33, stock number DX533, or equivalent – cleaning and conditioning chemical for aluminum.
- Amchem Alodine number 1001, stock number DX501, or equivalent – coating chemical for aluminum.
- Ditzler Declear Acrylic Urethane Clear, stock number DAU-75, or equivalent.
- Ditzler Delthane Ultra-Urethane Additive, stock number DXR-80, or equivalent.

Initial Preparation

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
   - Matchmark tire for reinstallation of outboard wheel balance weights after recoating of wheel assembly.
2. Tire and wheel assembly from vehicle. Refer to "Wheel Assembly Removal and Installation" in this section.
3. Outboard wheel balance weights.

Clean

- Wheel assembly inside and out with water base all-purpose cleaner. Remove grease or oil with solvent cleaner.

Accent Color Preparation

- Sand over painted areas that do not require recoloring with number 400-grit wet or dry sandpaper to promote adhesion of clearcoat.

Surface Damage

CAUTION: Do not use vehicle power to rotate the wheel assembly while sanding or personal injury may result.

1. Mount wheel assembly on brake lathe and spin slowly.

   NOTICE: Do not use abrasive coarser than 80-grit or wheel assembly may be damaged.
2. Sand wheel assembly with backing block or pad by holding abrasive flat to surface of wheel assembly and moving slowly back and forth from center to outer edge to remove imperfections.
   A. First, sand with number 80-grit sandpaper.
   B. Follow with number 150-grit sandpaper.
   C. Finish with number 240-grit sandpaper.

Slight Clearcoat Damage on Unpainted Wheel Assemblies

CAUTION: Use of rubber gloves and eye protection is necessary to prevent personal injury.

1. Apply chemical stripper.
   A. Allow stripper to penetrate coating.
   B. Use a small 1/4-inch detail brush dipped in stripper to apply material around perimeter and spoke-like areas.
2. Remove stripper, following manufacturer's recommendations.

   CAUTION: Do not use vehicle power to rotate the wheel assembly while sanding or personal injury may result.
3. Sand wheel assembly with number 240-grit sandpaper while rotating wheel assembly on slowly spinning brake lathe or by mounting it on vehicle and spinning by hand.
   - This restores machined appearance and promotes adhesion of finish coats.

Recoating Procedure

CAUTION: Use of rubber gloves and eye protection is necessary to prevent personal injury.

1. Clean surface of contaminants by washing with soap and water.
2. Spray wheel assembly with Amchem number 33 or equivalent.
   A. Let wheel assembly soak for 1 to 3 minutes.
   B. Rinse with water and blow dry.
3. Spray wheel assembly with Amchem number 1001 or equivalent.
   A. Let wheel assembly soak for 1 to 3 minutes.
   B. Rinse with water and blow dry.
4. Mask off tire.

CAUTION: When applying any two part component paint system, wear proper respiratory protection such as Easi-Air Respirator, part number 06986, or equivalent. Follow the specific precautions provided by the paint manufacturer. Failure to follow these precautions may cause lung irritation and allergic respiratory reaction.

5. Finish wheel assembly with Ditzler Declear Acrylic Urethane Clear and Ditzler Ultra Urethane–Additive, or equivalents. Refer to labels for specific directions.
   A. First coat – light mist coat, let flash.
   B. Second coat – light, let flash.
   C. Third coat – heavy duty, wet coat.
6. Let wheel assembly dry for 24 hours or flash for 30 minutes. Force dry at 60°C (140°F) for 30 minutes and allow to cool for 30 minutes before mounting.

Install or Connect

1. Balance tire and wheel assembly. Refer to "Balancing Tire and Wheel Assembly" in this section.
   - Replace original wheel balance weights with polyester-coated wheel balance weights to avoid discoloration of wheel assembly.
2. Tire and wheel assembly. Refer to "Wheel Assembly Removal and Installation" in this section.
3. Lower vehicle.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Hub Cap Assembly – 16 x 7.5 Aluminum Wheel Assembly (Pontiac)	6 N•m (53 lb. in.)
Hub Cap Assembly – 16 x 8 Aluminum Wheel Assembly (Pontiac)	6 N•m (53 lb. in.)
Jack Stowage Bolt/Screw	6.5 N•m (58 lb. in.)
Special Security Wheel Lock Nut	140 N•m (100 lb. ft.)
Wheel Nut – M12 x 1.5	140 N•m (100 lb. ft.)
Wheel Trim Cover Assembly (Chevrolet)	6 N•m (53 lb. in.)

RUNOUT SPECIFICATIONS

Maximum Radial Runout	
Steel Wheel Assemblies	1.01 mm (0.040″)
Aluminum Wheel Assemblies	0.76 mm (0.030″)
Maximum Lateral Runout	
Steel Wheel Assemblies	1.14 mm (0.045″)
Aluminum Wheel Assemblies	0.76 mm (0.030″)

TIRE PRESSURES

Compact Spare	420 kPa (60 psi)
Front	210 kPa (30 psi)
Rear	210 kPa (30 psi)

SECTION 3F

STEERING WHEEL AND COLUMN ON-VEHICLE SERVICE

CAUTION: The procedures in this section must be followed in the order listed to temporarily disable the Supplemental Inflatable Restraint (SIR) System and prevent false diagnostic trouble codes from setting. Failure to follow procedures could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

STEERING COLUMN ASSEMBLY

Figure 1

The locking, energy-absorbing column assembly (15) includes three important features in addition to the steering function.

1. In a front-end collision, the energy-absorbing column assembly (15) is designed to collapse, minimizing the possibility of driver injury.
2. The steering column lock and ignition cylinder assembly are conveniently mounted on the column assembly (15).
3. When locked, the column-mounted lock acts as a theft deterrent by preventing the operation of both ignition and steering.

The turn signal lever assembly (5 or 31) (multifunction turn signal lever) controls the turn signals, headlamp high beam, windshield washer and wipers, and, if equipped, cruise control.

To ensure the energy-absorbing action, use only the specified bolts/screws and nuts and tighten them to their specified torques. Apply a thin coat of lithium grease to all friction points during reassembly.

When the column assembly (15) is removed from the vehicle, handle it with special care. Using a steering wheel puller other than the one recommended in this manual, hitting the end of the steering gear coupling shaft assembly (9) sharply, leaning on the column assembly (15) or dropping the column assembly (15) could shear or loosen the plastic fasteners that keep the column assembly (15) rigid.

IGNITION LOCK SYSTEMS

The automatic transmission assembly uses a park lock system. This system uses a flexible automatic transmission park lock cable assembly which is attached at one end to the automatic transmission control lever assembly and at the other end to the ignition switch mounted to the column assembly where it actuates a locking pin. This locking pin engages an ignition switch sliding contact when the lever assembly is in "REVERSE" and does not allow the ignition switch to move to the "LOCK" position. With the lever assembly in "PARK" and the ignition switch slider in "LOCK," the locking pin engages a cam on the cable assembly and prevents the lever assembly from being moved into another position.

A steering column key release lever assembly is used on vehicles with a manual transmission assembly. A manual transmission clutch start switch assembly is used so the manual transmission clutch pedal assembly must be depressed before the engine assembly will crank.

BRAKE TRANSMISSION SHIFT INTERLOCK (BTSI)

The brake transmission shift interlock (BTSI) system prevents the driver from shifting out of "PARK" without simultaneously pressing the brake pedal assembly. When energized, the BTSI solenoid assembly locks the automatic transmission control lever assembly.

When pressure is applied to the brake pedal assembly, the BTSI solenoid assembly is de-energized and releases the automatic transmission control lever assembly.

SUPPLEMENTAL INFLATABLE RESTRAINT (SIR)

The supplemental inflatable restraint (SIR) helps supplement the protection offered by the driver's seat belt assembly by deploying an air bag from the center of the steering wheel assembly during certain frontal crashes. The air bag deploys when the vehicle is involved in a frontal crash of sufficient force up to 30 degrees off the centerline of the vehicle. The steering column assembly is collapsible and should be inspected after an accident whether or not a deployment has occurred.

The SIR system components in the steering wheel and steering column assemblies are the inflatable restraint steering wheel module assembly and the SIR coil assembly. To obtain a detailed description of these components, refer to SECTION 9J.

LUBRICATION

Apply a thin coat of lithium grease to all friction points when reassembling components.

STEERING WHEEL ASSEMBLY CONTROLS

Pontiac

Figure 2

Steering wheel assembly controls enable remote control of the following sound system functions, if equipped:

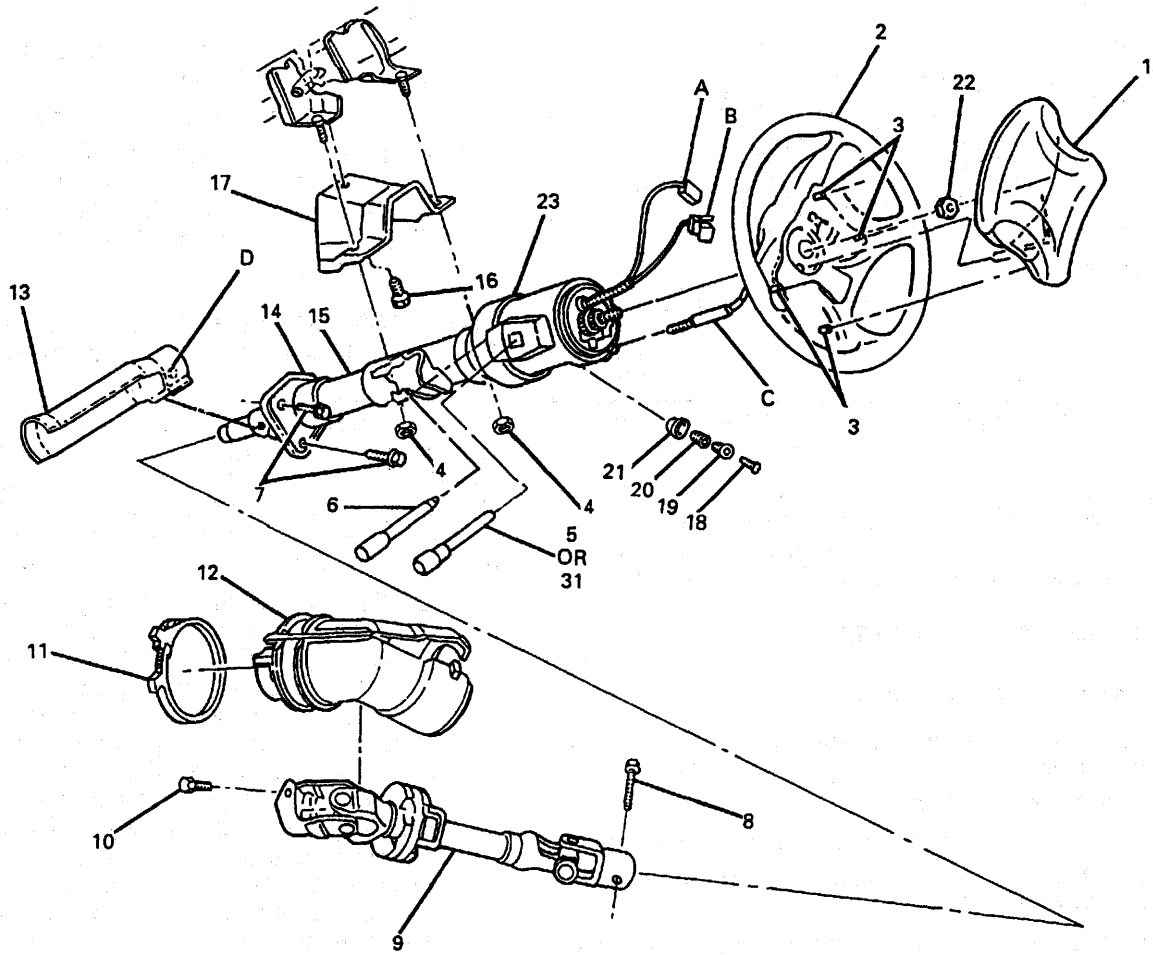
- **PLAY** – Starts playing cassette tape player or compact disc player.
- **VOL** (Volume) – Adjusts volume of AM/FM stereo, cassette tape player or compact disc player.
- **PRESET** – Selects preset stations.
- **AM/FM** – Switches between AM and FM bands.
- **SEEK** – Seeks the next station, either up or down.
- **MUTE** – Mutes volume of AM/FM stereo, cassette tape player or compact disc player.

ON-VEHICLE SERVICE

SERVICE PRECAUTIONS

CAUTION: When performing service on or around SIR components or SIR wiring, follow the procedures listed below to temporarily disable the SIR system. Failure to follow procedures could result in possible air bag deployment, personal injury or otherwise unneeded SIR system repairs.

The diagnostic energy reserve module (DERM) can maintain sufficient voltage to cause a deployment for up to ten minutes after the ignition switch is turned "OFF"



A CONNECTOR, RADIO ASSEMBLY ELECTRICAL (PONTIAC ONLY)
B CONNECTOR, SIR COIL ASSEMBLY ELECTRICAL
C LEAD, HORN
D BUTTON, STEERING GEAR COUPLING HEAT SHIELD
1 MODULE ASSEMBLY, INFLATABLE RESTRAINT STEERING WHEEL
2 WHEEL ASSEMBLY, STEERING
3 BOLT/SCREW, STEERING WHEEL
4 NUT, STEERING COLUMN UPPER SUPPORT
5 LEVER ASSEMBLY, TURN SIGNAL AND HEADLAMP DIMMER SWITCH AND CRUISE CONTROL ACTUATOR AND WINDSHIELD WIPER AND WINDSHIELD WASHER
6 LEVER ASSEMBLY, STEERING COLUMN TILT WHEEL RELEASE
7 BOLT/SCREW, STEERING COLUMN
8 BOLT/SCREW, INTERMEDIATE STEERING SHAFT
9 SHAFT ASSEMBLY, STEERING GEAR COUPLING
10 BOLT/SCREW, INTERMEDIATE STEERING SHAFT
11 CLAMP, STEERING GEAR COUPLING SHIELD
12 BOOT, STEERING GEAR
13 SHIELD, STEERING GEAR COUPLING HEAT
14 COVER ASSEMBLY, STEERING COLUMN DASH PANEL
15 COLUMN ASSEMBLY, STEERING
16 BOLT/SCREW, STEERING COLUMN GUIDE,
17 GUIDE, STEERING COLUMN
18 BOLT/SCREW, HAZARD WARNING SWITCH KNOB
19 BUTTON, HAZARD WARNING SWITCH
20 SPRING, HAZARD WARNING SWITCH KNOB
21 KNOB, HAZARD WARNING SWITCH
22 NUT, STEERING WHEEL
23 SEALER, STEERING COLUMN
31 LEVER ASSEMBLY, TURN SIGNAL AND HEADLAMP DIMMER SWITCH AND WINDSHIELD WIPER AND WINDSHIELD WASHER

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Figure 1 – Steering Column Assembly with SIR

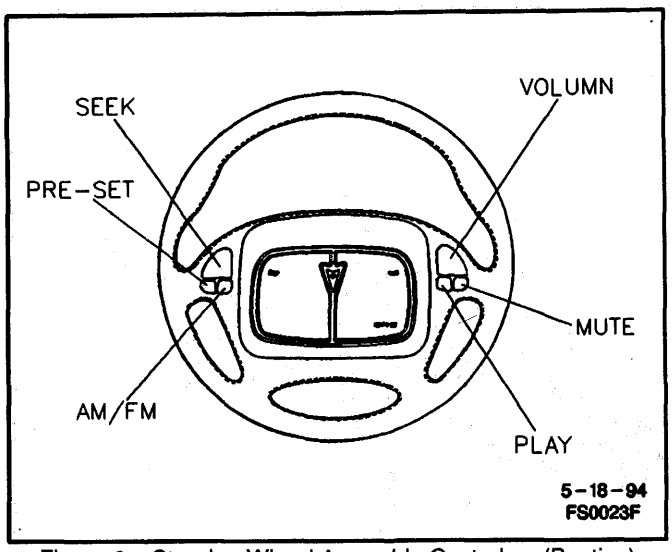


Figure 2 – Steering Wheel Assembly Controls – (Pontiac)

or the storage battery assembly is disconnected. Many of the service procedures require disconnection of the "AIR BAG" fuse and the inflator module circuits from the deployment loops to avoid an accidental deployment.

Disabling the SIR System

Remove or Disconnect

1. Turn steering wheel assembly so vehicle tire and wheel assemblies are pointing straight ahead.
2. Turn ignition switch to "LOCK."
3. "AIR BAG" fuse from instrument panel fuse block.
4. Left-hand instrument panel sound insulator assembly. Refer to SECTION 8C.
5. Connector position assurance (CPA) and yellow two-way SIR connector at base of steering column assembly.
6. Instrument panel compartment door assembly. Refer to SECTION 8C.
7. Connector position assurance (CPA) and yellow two-way SIR connector located near yellow 24-way DERM connector on instrument panel wiring harness assembly.

Important

- With "AIR BAG" fuse removed and ignition switch in "RUN," "AIR BAG" warning/indicator lamp on instrument panel cluster assembly will light. This is normal operation and does not indicate SIR system fault.

Enabling the SIR System

Install or Connect

1. Turn ignition switch to "LOCK."
2. Yellow two-way SIR connector and connector position assurance (CPA) located near yellow 24-way DERM connector on instrument panel wiring harness assembly.
3. Instrument panel compartment door assembly, refer to SECTION 8C.
4. Yellow two-way SIR connector and connector position assurance (CPA) at base of steering column assembly.
5. Left-hand instrument panel sound insulator assembly, refer to SECTION 8C.
6. "AIR BAG" fuse to instrument panel fuse block.
7. Turn ignition switch to "RUN" and verify "AIR BAG" warning/indicator lamp flashes seven times and then turns off. If "AIR BAG" warning/indicator lamp does not respond as described, refer to SECTION 9J.

Live (Undeployed) Inflatable Restraint Steering Wheel Module Assembly

Special care is necessary when handling and storing a live (undeployed) inflatable restraint steering wheel module assembly. The rapid gas generation produced during deployment of the air bag could cause the inflatable restraint steering wheel module assembly, or another object placed in front of it, to be thrown through the air in the unlikely event of an accidental deployment.

CAUTION: When carrying a live inflatable restraint steering wheel module assembly, make sure the bag opening is pointed away from you. Never carry the inflatable restraint steering wheel module assembly by the wires or electrical connector on the underside of it. In case of an accidental deployment, the bag will then deploy with minimal chance of injury. When placing a live inflatable restraint steering wheel module assembly on a bench or other surface, always face the bag and trim cover up, away from the surface. Never rest a steering column assembly on the steering wheel assembly with the inflatable restraint steering wheel module assembly face down and steering column assembly vertical. This is necessary so that a free space is provided to allow the air bag to expand in the unlikely event of accidental deployment.

Deployed Inflatable Restraint Steering Wheel Module Assembly

After the inflatable restraint steering wheel module assembly has been deployed, the surface of the air bag may contain a powdery residue. This powder consists primarily of corn starch (used to lubricate the bag as it inflates) and by-products of the chemical reaction. Sodium hydroxide dust (similar to lye soap) is produced as a by-product of the deployment reaction. The sodium hydroxide then quickly reacts with atmospheric moisture and is converted to sodium carbonate and sodium bicarbonate (baking soda). Therefore, it is unlikely that sodium hydroxide will be present after deployment. As with many service procedures, you should wear gloves and safety glasses.

Inflatable Restraint Steering Wheel Module Assembly Shipping Procedures

Service personnel should refer to the latest service bulletins for proper SIR inflatable restraint steering wheel module assembly shipping procedures.

Inflatable Restraint Steering Wheel Module Assembly Scrapping Procedures

During the course of a vehicle's useful life, certain situations may arise which will necessitate the disposal of a live (undeployed) inflatable restraint steering wheel module assembly. This information covers proper procedures for disposing of a live inflatable restraint steering wheel module assembly.

Before a live inflatable restraint steering wheel module assembly can be disposed of, it must be deployed. Live inflatable restraint steering wheel module assemblies must not be disposed of through normal refuse channels.

CAUTION: Failure to follow proper supplemental inflatable restraint (SIR) inflatable restraint steering wheel module assembly disposal procedures can result in air bag deployment which may cause personal injury. Undeployed inflatable restraint steering wheel module assemblies must not be disposed of through normal refuse channels. The undeployed inflatable restraint steering wheel module assembly contains substances that can cause severe illness or personal injury if the sealed container is damaged during disposal. Disposal in any manner inconsistent with proper procedures may be a violation of federal, state and/or local laws.

If a vehicle is the subject of a Product Liability Report related to the SIR system and is subject to a Preliminary Investigation (GM-1241), DO NOT DEPLOY the inflatable restraint steering wheel module assembly and DO NOT ALTER the SIR system in any manner. Refer to the applicable service bulletin on SIR shipping procedures for details on handling SIR systems involved with GM-1241. If a vehicle is the subject of a campaign affecting inflatable restraint steering wheel module assemblies, DO NOT DEPLOY the inflatable restraint steering wheel module assembly. Follow instructions in the campaign service bulletin for proper disposition of the inflatable restraint steering wheel module assembly.

If an inflatable restraint steering wheel module assembly is replaced under warranty, DO NOT DEPLOY the air bag. The inflatable restraint steering wheel module assembly may need to be returned, undeployed, to Inland Fisher Guide. Refer to procedures shown in the appropriate service bulletin regarding SIR shipping procedures.

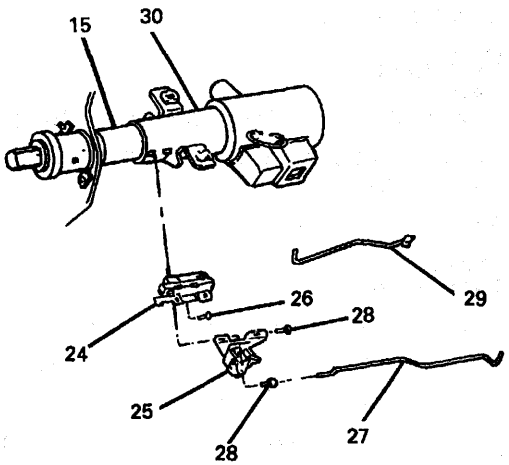
In situations which require deployment of a live (undeployed) inflatable restraint steering wheel module assembly, deployment may be accomplished inside or outside the vehicle. The method employed depends upon the final disposition of the particular vehicle. Refer to SECTION 9J.

IGNITION SWITCH AND DIMMER SWITCH ASSEMBLY

Figures 3 and 4

Remove or Disconnect

1. Left-hand instrument panel sound insulator assembly. Refer to SECTION 8C.
2. Instrument panel driver knee bolster assembly and deflector. Refer to SECTION 8C.
3. Disable SIR system. Refer to "Disabling the SIR System" in this section.
4. Ensure steering column lock and ignition cylinder assembly is in "LOCK" position.
5. Steering column upper support nuts from steering column support. Refer to "Steering Column Assembly Removal" in this section.
6. Lower column assembly (15).
7. Electrical connectors from dimmer switch assembly (25) and ignition switch (24).
8. Dimmer switch actuator rod (27).
9. Bolts/screws (28).
10. Dimmer switch assembly (25).
11. Bolt/screw (26).
12. Ignition switch actuator rod (29).
13. Ignition switch (24).
14. Automatic transmission park lock cable assembly, if equipped. Refer to SECTION 7A.



15 COLUMN ASSEMBLY, STEERING
24 SWITCH, IGNITION
25 SWITCH ASSEMBLY, DIMMER
26 BOLT/SCREW, IGNITION SWITCH
27 ROD, DIMMER SWITCH ACTUATOR
28 BOLT/SCREW, DIMMER AND IGNITION SWITCH
29 ROD, IGNITION SWITCH ACTUATOR
30 JACKET, STEERING COLUMN

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Figure 3 – Ignition Switch and Dimmer Switch Assembly

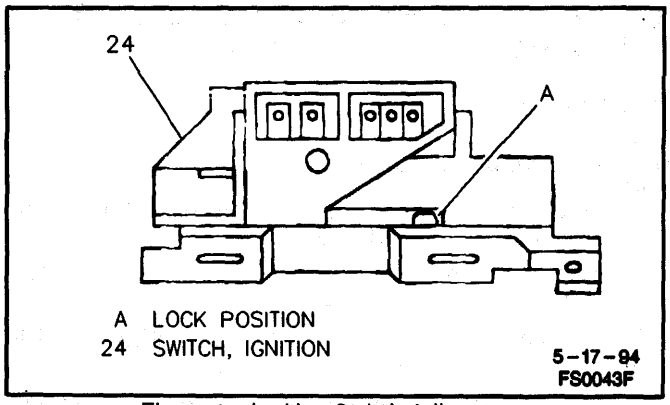


Figure 4 – Ignition Switch Adjustment

Install or Connect

NOTICE: See "Notice" on page 3F-1 of this section.

1. Automatic transmission park lock cable assembly, if equipped. Refer to SECTION 7A.
2. Ensure ignition switch (24) is in "LOCK" position.
   - Move switch slider to extreme right position and then move slider one detent left.
3. Ensure steering column lock and ignition cylinder assembly is in "LOCK" position.
4. Ignition switch (24) to jacket (30).
5. Ignition switch actuator rod (29) to ignition switch (24).
6. Bolt/screw (26).

Tighten

- Bolt/screw (26) to 2.5 N•m (22 lb. in.).

7. Position dimmer switch assembly (25) to ignition switch (24).
8. Bolts/screws (28).

Adjust

- Dimmer switch assembly (25).
  - Press switch mechanism slightly to insert 3/32-inch drill bit.
  - Move dimmer switch assembly (25) to remove lash.

Tighten

- Bolts/screws (28) to 4 N•m (35 lb. in.).

9. Dimmer switch actuator rod (27).
10. Electrical connectors to dimmer switch assembly (25) and ignition switch (24).
11. Raise column assembly (15).
12. Steering column upper support nuts to steering column support. Refer to "Steering Column Assembly Removal" in this section.
13. Enable SIR system. Refer to "Enabling the SIR System" in this section.
14. Instrument panel driver knee bolster assembly and deflector. Refer to SECTION 8C.
15. Left-hand instrument panel sound insulator assembly. Refer to SECTION 8C.

TURN SIGNAL LEVER ASSEMBLY

Figure 5

Remove or Disconnect

1. Steering column tilt wheel release lever assembly, if equipped with cruise control. Refer to "Steering Column Tilt Wheel Release Lever Assembly" in this section.
2. Access cover, if equipped with cruise control.
3. Electrical connectors, if equipped with cruise control.
4. Turn signal lever assembly (5 or 31) by grasping firmly and pulling straight out.

Install or Connect

1. Position tang on turn signal lever assembly (5 or 31) to notch in column assembly (15).

Important

- Be sure the wiper switch is in the "OFF" position before installing turn signal lever assembly (5 or 31).

2. Turn signal lever assembly (5 or 31) to column assembly (15).

Important

- Be sure the turn signal lever assembly (5 or 31) is fully seated.

3. Electrical connectors, if equipped with cruise control.
4. Access cover, if equipped with cruise control.
5. Steering column tilt wheel release lever assembly, if equipped with cruise control. Refer to "Steering Column Tilt Wheel Release Lever Assembly" in this section.

HAZARD WARNING SWITCH

The hazard warning switch does not require removal of the steering column assembly for replacement. For service information, refer to SECTION 3F5B.

Hazard Warning Switch Knob

Figure 6

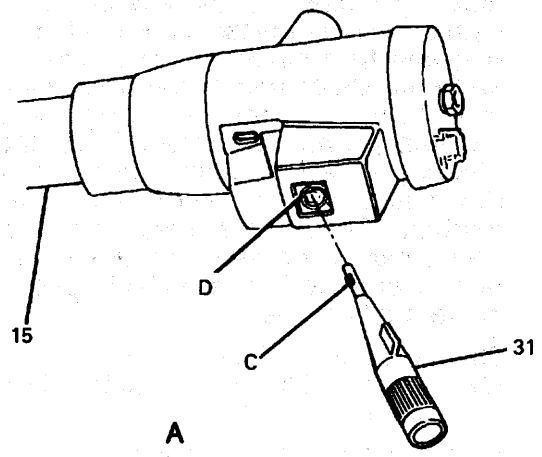
Remove or Disconnect

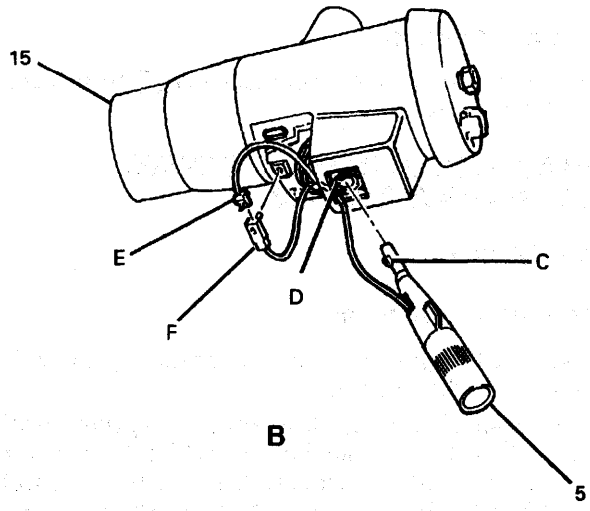
1. Bolt/screw (18).
2. Button (19), spring (20) and knob (21).

Install or Connect

NOTICE: See "Notice" on page 3F-1 of this section.

1. Knob (21), spring (20) and button (19).

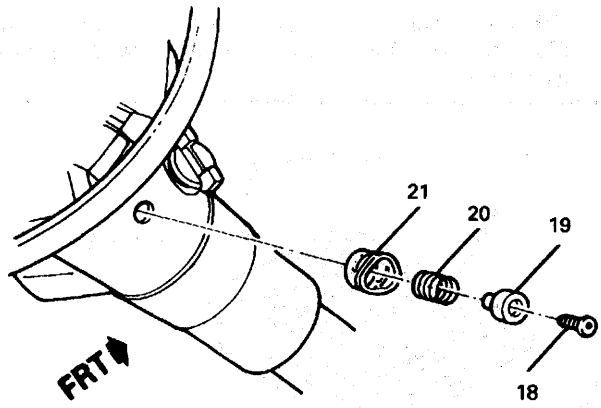




A WITHOUT CRUISE CONTROL
B WITH CRUISE CONTROL
C TANG
D NOTCH
E CONNECTOR, LEVER ASSEMBLY ELECTRICAL
F CONNECTOR, COLUMN ASSEMBLY ELECTRICAL
5 LEVER ASSEMBLY, TURN SIGNAL AND HEADLAMP DIMMER SWITCH AND CRUISE CONTROL ACTUATOR AND WINDSHIELD WIPER AND WINDSHIELD WASHER
15 COLUMN ASSEMBLY, STEERING
31 LEVER ASSEMBLY, TURN SIGNAL AND HEADLAMP DIMMER SWITCH AND WINDSHIELD WIPER AND WINDSHIELD WASHER

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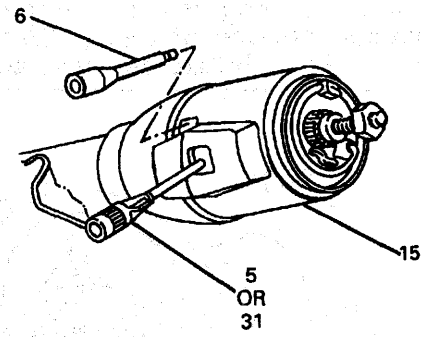
Figure 5 – Turn Signal Lever Assembly



18 BOLT/SCREW, HAZARD WARNING SWITCH KNOB
19 BUTTON, HAZARD WARNING SWITCH
20 SPRING, HAZARD WARNING SWITCH KNOB
21 KNOB, HAZARD WARNING SWITCH

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Figure 6 – Removing Hazard Warning Switch Knob



5 LEVER ASSEMBLY, TURN SIGNAL AND HEADLAMP DIMMER SWITCH AND CRUISE CONTROL ACTUATOR AND WINDSHIELD WIPER AND WINDSHIELD WASHER
6 LEVER ASSEMBLY, STEERING COLUMN TILT WHEEL RELEASE
15 COLUMN ASSEMBLY, STEERING
31 LEVER ASSEMBLY, TURN SIGNAL AND HEADLAMP DIMMER SWITCH AND WINDSHIELD WIPER AND WINDSHIELD WASHER

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Figure 7 – Steering Column Tilt Wheel Release Lever Assembly (Typical)

2. Bolt/screw (18).

Tighten

- Bolt/screw (18) to 0.7 N•m (6 lb. in.).

STEERING COLUMN TILT WHEEL RELEASE LEVER ASSEMBLY

Figure 7

Remove or Disconnect

- Grip tilt wheel release lever assembly (6) firmly and twist counterclockwise.

Install or Connect

- Grip tilt wheel release lever assembly (6) firmly, and twist clockwise.

INFLATABLE RESTRAINT STEERING WHEEL MODULE ASSEMBLY

Figures 8 and 9

Remove or Disconnect

1. Disable SIR system. Refer to "Disabling the SIR System" in this section.
2. Loosen bolts/screws (3) from back of steering wheel assembly (2) using number 30 TORX® driver (or equivalent) until inflatable restraint steering wheel module assembly (1) can be released from steering wheel assembly (2).
3. Inflatable restraint steering wheel module assembly (1 or 46) from steering wheel assembly (2).

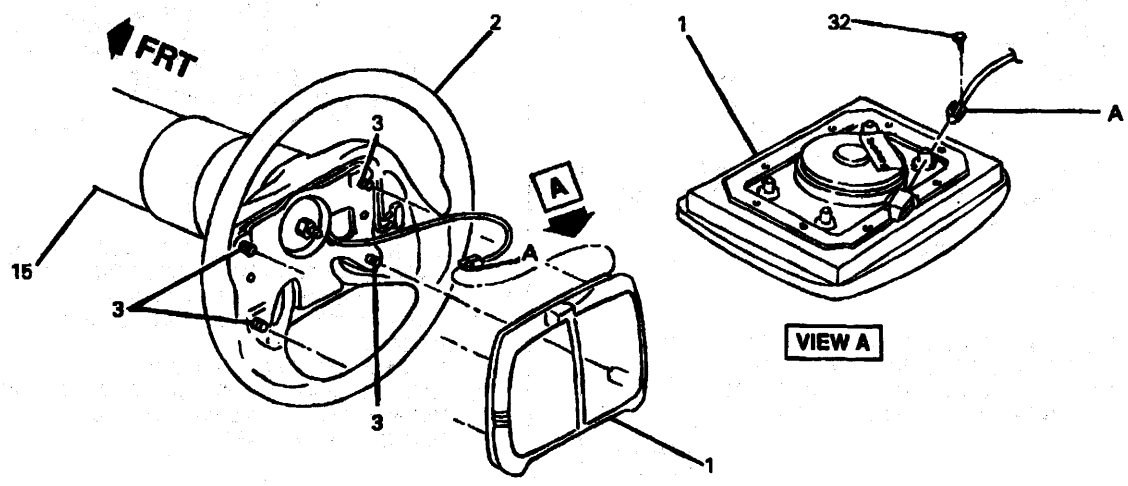
   CAUTION: When carrying a live inflatable restraint steering wheel module assembly, make sure the bag opening is pointed away from you. Never carry the inflatable restraint steering wheel module assembly by the wires or electrical connector on the underside of it. In case of an accidental deployment, the bag will then deploy with minimal chance of injury. When placing a live inflatable restraint steering wheel module assembly on a bench or other surface, always face the bag and trim cover up, away from the surface. Never rest a steering column assembly on the steering wheel assembly with the inflatable restraint steering wheel module assembly face down and steering column assembly vertical. This is necessary so to that a free space is provided to allow the air bag to expand in the unlikely event of accidental deployment.

4. SIR coil assembly electrical connector and retainer (32) from inflatable restraint steering wheel module assembly (1).
5. Radio control switch electrical connector from inflatable restraint steering wheel module assembly (1), if equipped.
6. Horn lead from column assembly (15).

Install or Connect

NOTICE: See "Notice" on page 3F-1 of this section.

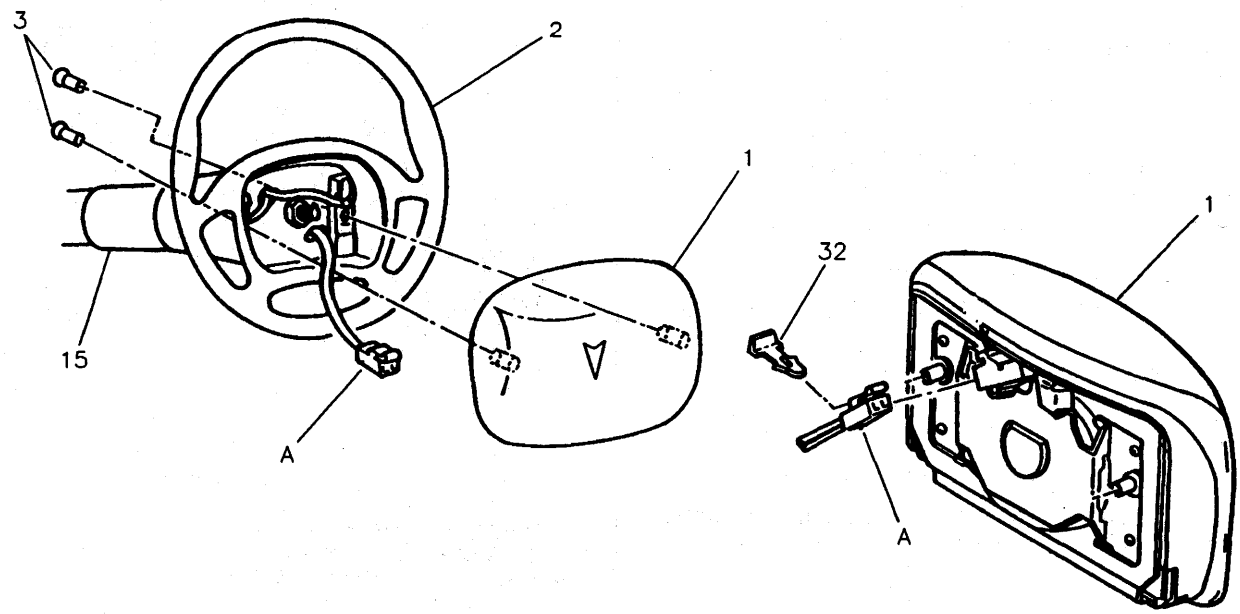
1. Horn lead to column assembly (15).
2. Radio control switch electrical connector to inflatable restraint steering wheel module assembly (1), if equipped.
3. SIR coil assembly electrical connector and retainer (32) to inflatable restraint steering wheel module assembly (1).



A CONNECTOR, SIR COIL ASSEMBLY ELECTRICAL
1 MODULE ASSEMBLY, INFLATABLE RESTRAINT STEERING WHEEL
2 WHEEL ASSEMBLY, STEERING
3 BOLT/SCREW, STEERING WHEEL
15 COLUMN ASSEMBLY, STEERING
32 RETAINER, INFLATABLE RESTRAINT STEERING WHEEL MODULE WIRING HARNESS ELECTRICAL CONNECTOR

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Figure 8 – Removing Inflatable Restraint Steering Wheel Module Assembly – (Chevrolet)



A CONNECTOR, SIR COIL ELECTRICAL
1 MODULE, INFLATABLE RESTRAINT STEERING WHEEL
2 WHEEL, STEERING
3 BOLT/SCREW, STEERING WHEEL
15 COLUMN ASSEMBLY, STEERING
32 RETAINER, INFLATABLE RESTRAINT STEERING WHEEL MODULE WIRING HARNESS ELECTRICAL CONNECTOR

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Figure 9 – Removing Inflatable Restraint Steering Wheel Module Assembly – (Pontiac)

4. Secure SIR coil assembly electrical connector to steering wheel assembly (2) by inserting thick section of wire into existing retainers.
5. Position inflatable restraint steering wheel module assembly (1) to steering wheel assembly (2).

Important

- Ensure wiring is not exposed or trapped between inflatable restraint steering wheel module assembly (1) and steering wheel assembly (2).

6. Bolts/screws (3).

Tighten

- Bolts/screws (3) to 2.8 N•m (25 lb. in.).

7. Enable SIR system. Refer to "Enabling the SIR System" in this section.

STEERING WHEEL HORN SWITCH ASSEMBLY

Chevrolet

Figure 10

Remove or Disconnect

1. Inflatable restraint steering wheel module assembly. Refer to "Inflatable Restraint Steering Wheel Module Assembly" in this section.
2. Bolt/screw (50).
3. Horn switch assembly (52) from inflatable restraint steering wheel module assembly (1).
   A. Lift up on edge of module cover at horn button to access horn switches.
   B. Press lock tang.
   C. Remove horn switch.

D. Repeat for remaining horn switch and remove horn switch assembly (52).

Install or Connect

NOTICE: See "Notice" on page 3F-1 of this section.

1. Horn switch assembly (52) to inflatable restraint steering wheel module assembly (1).
   A. Lift up on edge of module cover at horn button.
   B. Install horn switch assembly (52).
   C. Repeat for remaining horn switch assembly (52).
2. Bolt/screw (50).

Tighten

- Bolt/screw (50) to 1.9 N•m (17 lb. in.).

3. Inflatable restraint steering wheel module assembly. Refer to "Inflatable Restraint Steering Wheel Module Assembly" in this section.

STEERING WHEEL HORN SWITCH ASSEMBLY

Pontiac

Figure 11

Remove or Disconnect

1. Inflatable restraint steering wheel module assembly. Refer to "Inflatable Restraint Steering Wheel Module Assembly" in this section.
2. Horn wiring connector from steering column.
3. Bolts/screws (38).
4. Horn switch assembly (52) from steering wheel assembly (2).

Install or Connect

NOTICE: See "Notice" on page 3F-1 of this section.

1. Position horn switch assembly (52) to steering wheel assembly (2).
2. Bolts/screws (38).

Tighten

- Bolts/screws (38) to 1.9 N•m (17 lb. in.).

3. Horn wiring connector to steering column.
4. Inflatable restraint steering wheel module assembly. Refer to "Inflatable Restraint Steering Wheel Module Assembly" in this section.

STEERING WHEEL ASSEMBLY

Figure 12

Tools Required:

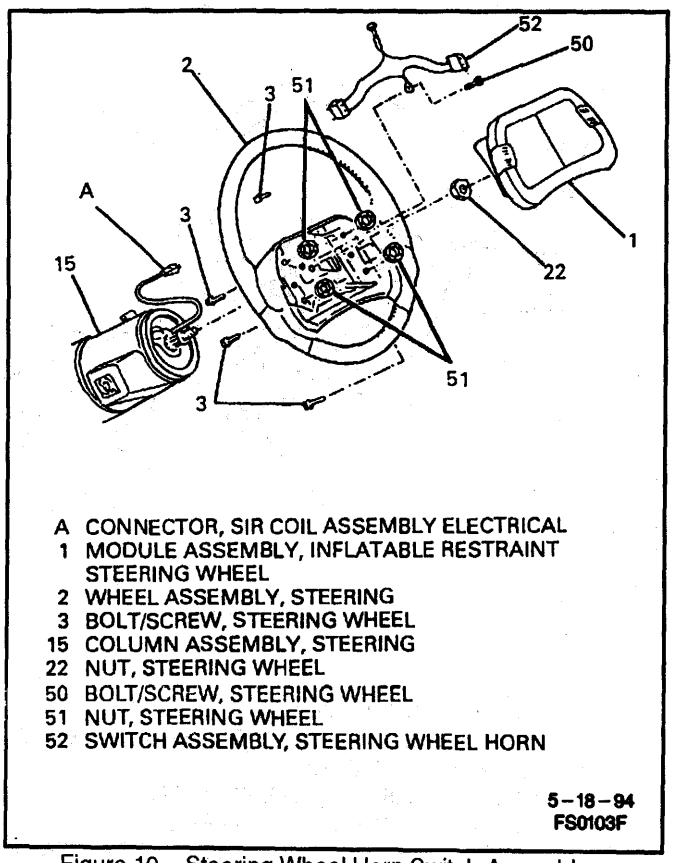


Figure 10 – Steering Wheel Horn Switch Assembly – (Chevrolet)

J 1859-A Steering Wheel Puller

J 38720 Steering Wheel Puller Bolts (Part of J 1859-A)

Remove or Disconnect

1. Inflatable restraint steering wheel module assembly. Refer to "Inflatable Restraint Steering Wheel Module Assembly" in this section.
2. Nut (22).

NOTICE: When removing the steering wheel assembly, use only the specified steering wheel puller. Under no conditions should the end of the steering column shaft be hammered on, as hammering could loosen the plastic injections which maintain steering column assembly rigidity.

NOTICE: When attaching J 1859-A and J 38720 to the steering wheel assembly, use care to prevent threading J 38720 (bolts) all the way through the steering wheel hub into the SIR coil assembly and damaging the SIR coil assembly.

3. Horn lead.
4. Steering wheel assembly (2), using J 1859-A and J 38720.
5. Steering wheel horn switch assembly.

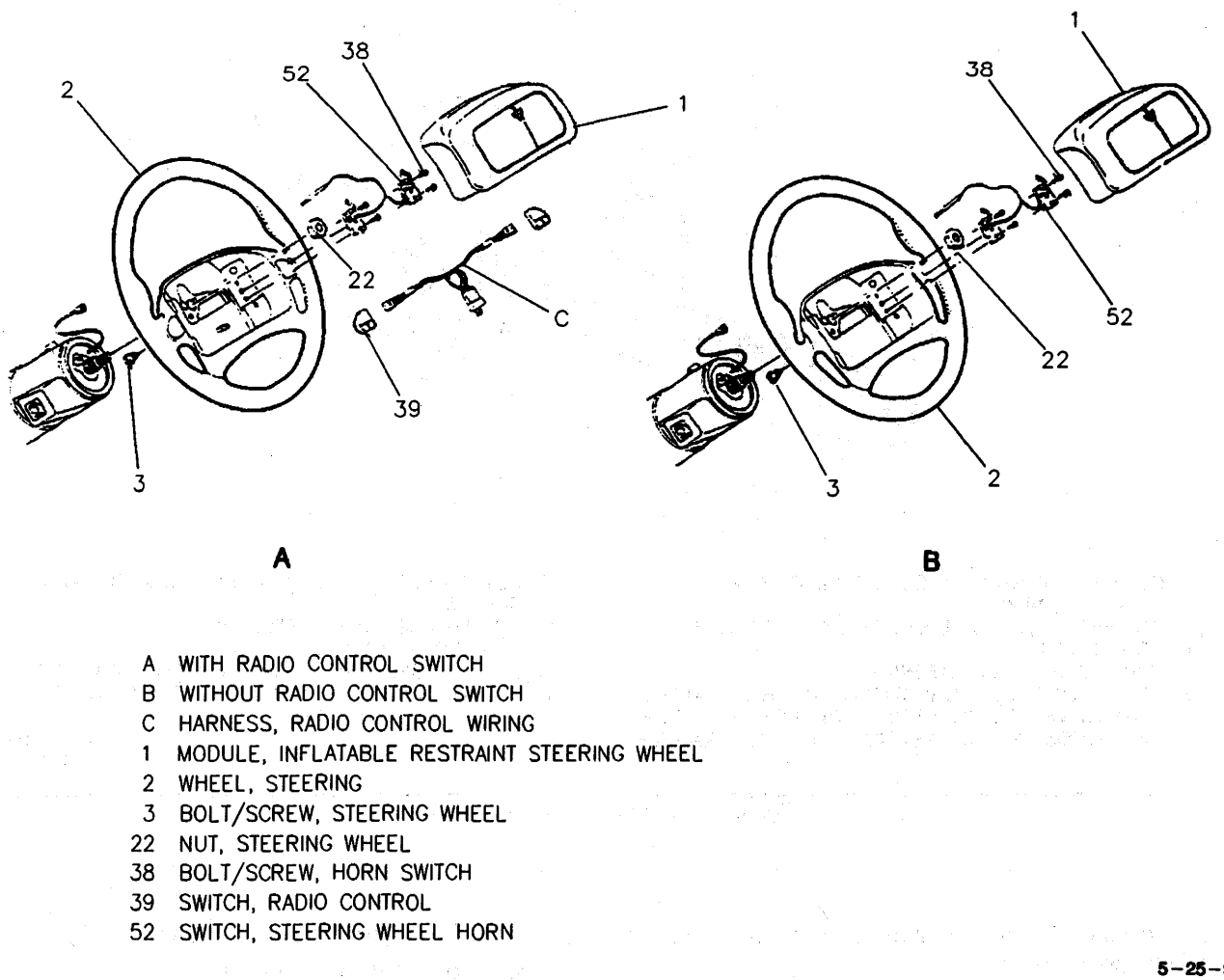


Figure 11 – Steering Wheel Horn Switch Contact Plate Assembly and Radio Control Switch Assembly – (Pontiac)

Install or Connect

NOTICE: See "Notice" on page 3F-1 of this section.

1. Route SIR coil assembly electrical connector to steering wheel assembly (2).
2. Steering wheel horn switch assembly.
3. Steering wheel assembly (2).

Important

- Align block tooth on steering wheel assembly (2) with block tooth on steering column shaft within one female serration.

4. Horn lead.
5. Nut (22).

Tighten

- Nut (22) to 43 N•m (32 lb. ft.).

6. Inflatable restraint steering wheel module assembly. Refer to "Inflatable Restraint Steering Wheel Module Assembly" in this section.

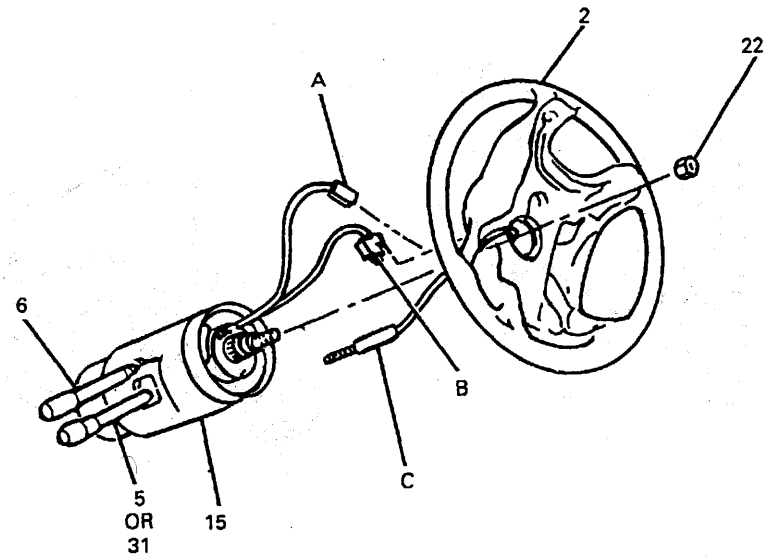
RADIO CONTROL SWITCH ASSEMBLY

Pontiac

Figure 11

Remove or Disconnect

1. Inflatable restraint steering wheel module assembly. Refer to "Inflatable Restraint Steering Wheel Module Assembly" in this section.
2. Radio control wire harness retainer.



A CONNECTOR, RADIO ASSEMBLY ELECTRICAL (PONTIAC ONLY)
B CONNECTOR, SIR COIL ASSEMBLY, ELECTRICAL
C LEAD, HORN
2 WHEEL ASSEMBLY, STEERING
5 LEVER ASSEMBLY, TURN SIGNAL AND HEADLAMP DIMMER SWITCH AND CRUISE CONTROL ACTUATOR AND WINDSHIELD WIPER AND WINDSHIELD WASHER
6 LEVER ASSEMBLY, STEERING COLUMN TILT WHEEL RELEASE
15 COLUMN ASSEMBLY, STEERING
22 NUT, STEERING WHEEL
31 LEVER ASSEMBLY, TURN SIGNAL AND HEADLAMP DIMMER SWITCH AND WINDSHIELD WIPER AND WINDSHIELD WASHER

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Figure 12 – Steering Wheel Assembly

3. Radio control switch assembly (39) from steering wheel assembly (2).
   - Pry out radio control switch at lower edge.
4. Wire harness connector from control(s).

Install or Connect

1. Wire harness connector to control(s).
2. Radio control switch assembly (39) to steering wheel assembly (2).
3. Radio control wire harness retainer.
4. Inflatable restraint steering wheel module assembly. Refer to "Inflatable Restraint Steering Wheel Module Assembly" in this section.

STEERING GEAR COUPLING SHAFT ASSEMBLY

Figure 13

Remove or Disconnect

NOTICE: Ensure the tire and wheel assemblies are pointing straight ahead and the steering wheel assembly is locked. Failure to do so may cause the steering wheel assembly to rotate, causing damage to the SIR coil assembly.

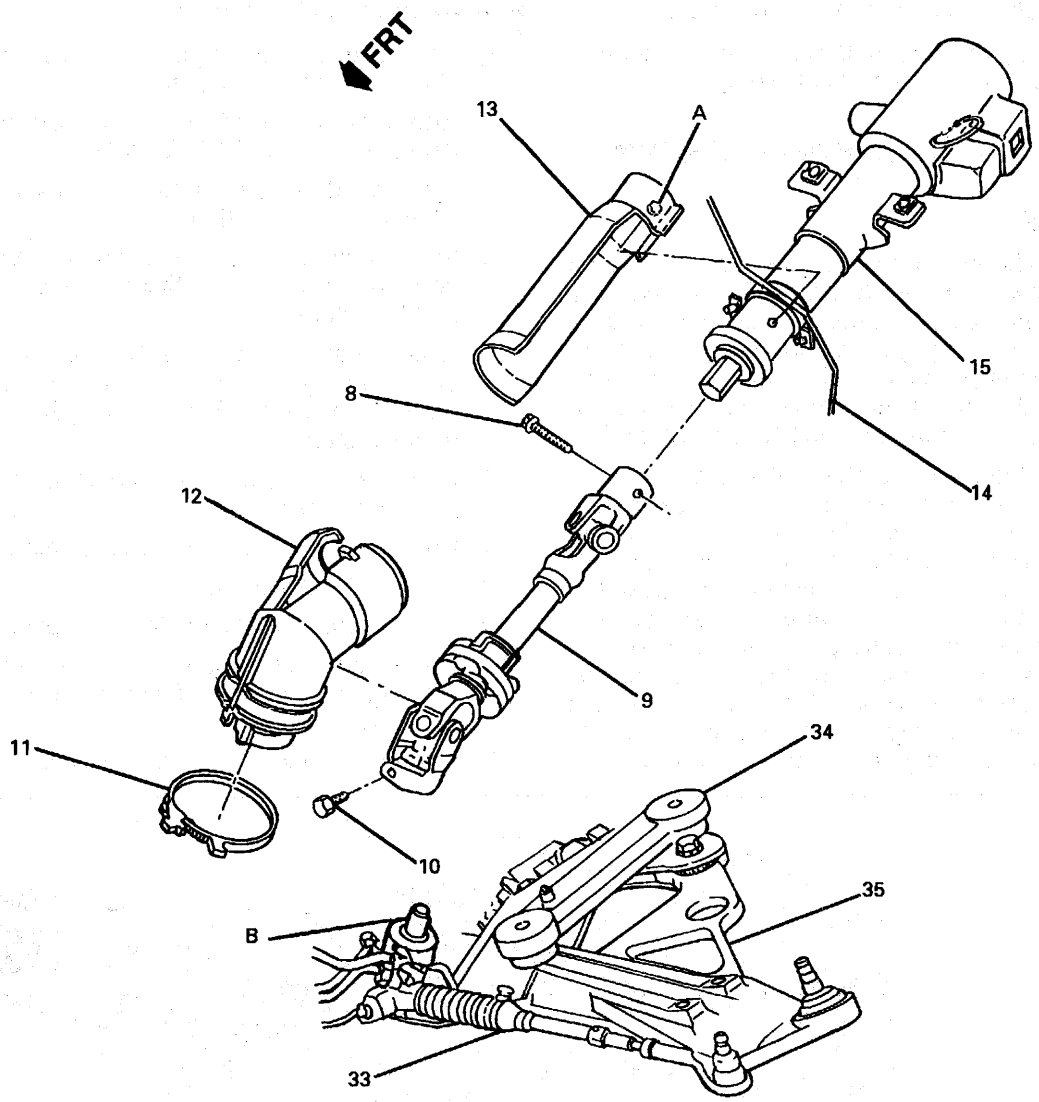
1. Bolt/screw (10) from gear assembly (33).
2. Clamp (11) from boot (12).
3. Shaft assembly (9) from gear assembly (33).
4. Boot (12) from shaft assembly (9).
5. Shield (13) from shaft assembly (9) and column assembly (15) on 5.7L LT1 engine only.
6. Bolt/screw (8) from column assembly (15).
7. Shaft assembly (9) from column assembly (15).

Install or Connect

NOTICE: See "Notice" on page 3F-1 of this section.

1. Position shaft assembly (9) to column assembly (15).
2. Bolt/screw (8)

   Tighten
   - Bolt/screw (8) to 47 N•m (35 lb. ft.).
3. Position boot (12) to shaft assembly (9) and secure with clamp (11). Do not close clamp (11).
4. Position shaft assembly (9) to body rail.
5. Remove clamp (11) from boot (12) and place over steering gear assembly casting.
6. Position shaft assembly (9) to gear assembly (33).
7. Bolt/screw (10).



A BUTTON, STEERING GEAR COUPLING HEAT SHIELD
B CASTING, STEERING GEAR ASSEMBLY
8 BOLT/SCREW, INTERMEDIATE STEERING SHAFT
9 SHAFT ASSEMBLY, STEERING GEAR COUPLING
10 BOLT/SCREW, INTERMEDIATE STEERING SHAFT
11 CLAMP, STEERING GEAR COUPLING SHIELD
12 BOOT, STEERING GEAR
13 SHIELD, STEERING GEAR COUPLING HEAT
14 COVER ASSEMBLY, STEERING COLUMN DASH PANEL
15 COLUMN ASSEMBLY, STEERING
33 GEAR ASSEMBLY, STEERING
34 CROSSMEMBER ASSEMBLY, FRONT
35 ARM ASSEMBLY, FRONT LOWER CONTROL

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Figure 13 – Steering Gear Coupling Shaft Assembly

Tighten

- Bolt/screw (10) to 47 N•m (35 lb. ft.).

8. Position shield (13) to shaft assembly (9) and column assembly (15) on 5.7L LT1 engine only.
9. Shield (13) by inserting button into hole in column assembly (15) on 5.7L LT1 engine only.

STEERING COLUMN ASSEMBLY REMOVAL

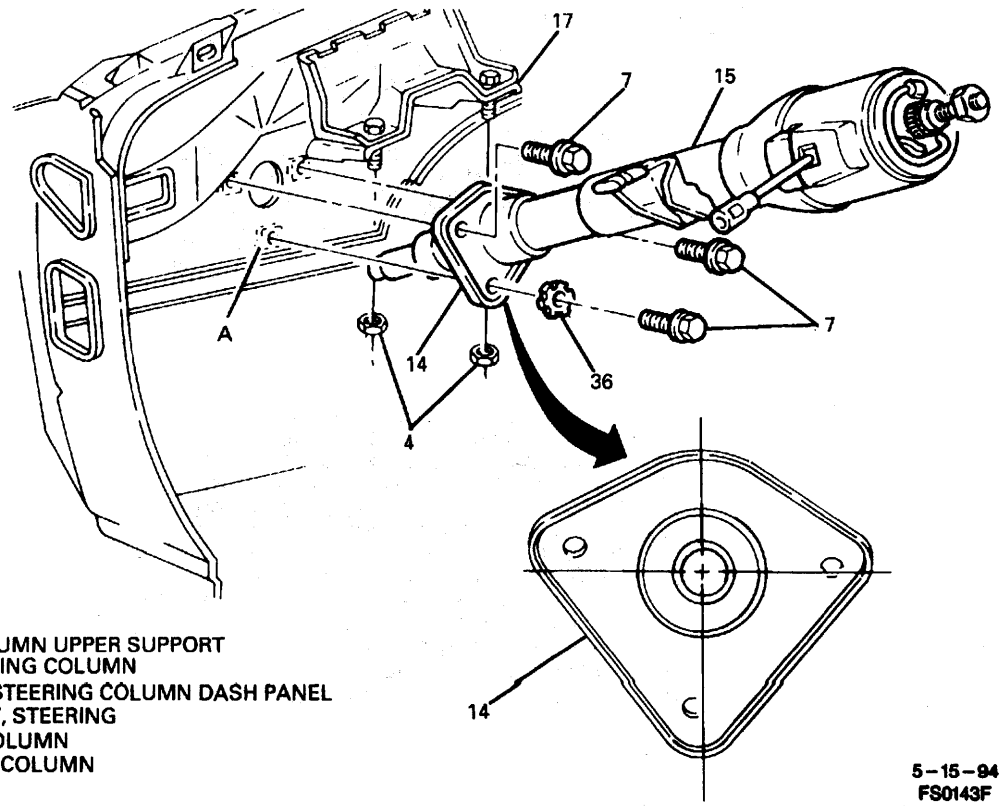
Figures 14 and 15

NOTICE: The tire and wheel assemblies must be straight ahead and the steering column assembly locked before disconnecting the steering column assembly or steering gear coupling shaft assembly from the steering gear assembly. Failure to do so will cause the SIR coil assembly to become uncentered, which will cause damage to the SIR coil assembly.

NOTICE: When the steering column assembly is removed from the vehicle, it is extremely susceptible to damage. Dropping the column assembly on its end could collapse the steering shaft assembly or loosen plastic injections that keep the column assembly rigid. Leaning on the column assembly could cause steering column jacket to bend or deform. Any of the above conditions could impair column assembly's collapsible design. If the steering wheel assembly must be removed, use only the specified steering wheel puller and steering wheel puller bolts. Never hammer on the end of the steering shaft because hammering could loosen plastic injections that keep the column assembly rigid.

Remove or Disconnect

1. Left-hand instrument panel sound insulator assembly. Refer to SECTION 8C.
2. Instrument panel driver knee bolster assembly and deflector. Refer to SECTION 8C.
3. Disable SIR system. Refer to "Disabling the SIR System" in this section.
4. Steering wheel assembly, if column assembly is to be replaced. Refer to "Steering Wheel Assembly" in this section.
5. Intermediate steering shaft bolt/screw from steering gear coupling shaft assembly and column assembly. Refer to "Steering Gear Coupling Shaft Assembly" in this section.
6. Bolts/screws (7) attaching cover assembly (14) to dash panel assembly.
7. Cover assembly (14) from dash panel assembly.
8. Electrical connectors.
9. Nuts (4) from steering column support.
10. Automatic transmission park lock cable assembly from ignition switch, if equipped. Refer to SECTION 7A.
11. Column assembly (15) from vehicle.



A NUT, WELD
4 NUT, STEERING COLUMN UPPER SUPPORT
7 BOLT/SCREW, STEERING COLUMN
14 COVER ASSEMBLY, STEERING COLUMN DASH PANEL
15 COLUMN ASSEMBLY, STEERING
17 GUIDE, STEERING COLUMN
36 WASHER, STEERING COLUMN

Figure 14 – Removing Steering Column Assembly

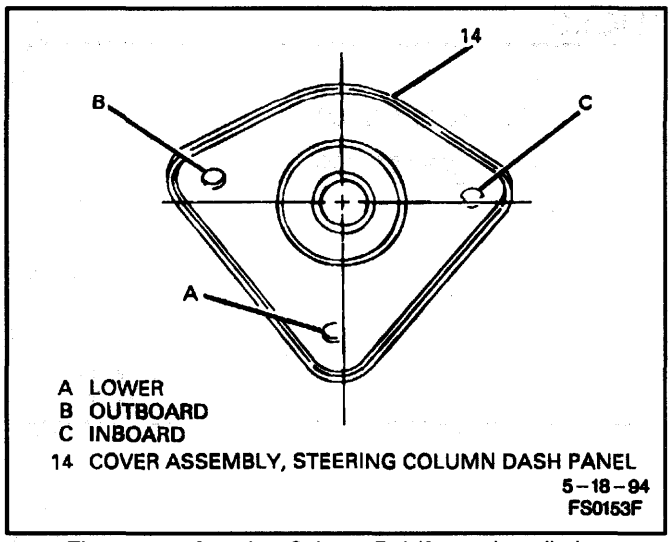


Figure 15 – Steering Column Bolt/Screw Installation Sequence

Install or Connect

NOTICE: If a service replacement steering column assembly is being installed, do not remove the antirotation pin until after the column assembly has been connected to the steering gear assembly. Removing the antirotation pin before the column assembly is connected to the steering gear assembly may damage the SIR coil assembly.

NOTICE: See "Notice" on page 3F-1 of this section.

1. Position column assembly (15) into vehicle.
2. Automatic transmission park lock cable assembly to ignition switch, if equipped. Refer to SECTION 7A.
3. Nuts (4) to steering column support.

Tighten

- Nuts (4) to 25 N•m (18 lb. ft.).

4. Intermediate steering shaft bolt/screw to steering gear coupling shaft assembly. Refer to "Steering Gear Coupling Shaft Assembly" in this section.

Important

- When installing the cover assembly (14) to the dash panel assembly, the lower bolt/screw (7) must be installed first followed in order by the outboard bolt/screw (7) and inboard bolt/screw (7). Refer to Figure 15.

5. Position cover assembly (14) to dash panel assembly.
6. Bolts/screws (7).
7. Electrical connectors.

Tighten

- Bolts/screws (7) to 18 N•m (14 lb. ft.).

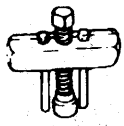
8. Steering wheel assembly, if column assembly is replaced. Refer to "Steering Wheel Assembly" in this section.
9. Enable SIR system. Refer to "Enabling the SIR System" in this section.
10. Instrument panel driver knee bolster assembly and deflector. Refer to SECTION 8C.
11. Left-hand instrument panel sound insulator assembly. Refer to SECTION 8C.

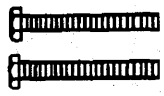
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Dimmer and Ignition Switch Bolt/Screw	4 N•m (35 lb. in.)
Hazard Warning Switch Knob Bolt/Screw	0.7 N•m (6 lb. in.)
Ignition Switch Bolt/Screw	2.5 N•m (22 lb. in.)
Inflatable Restraint Steering Wheel Mounting Plate Bolt/Screw (Pontiac Only)	1.9 N•m (17 lb. in.)
Intermediate Steering Shaft-to-Steering Column Assembly Bolt/Screw	47 N•m (35 lb. ft.)
Intermediate Steering Shaft-to-Steering Gear Assembly Bolt/Screw	47 N•m (35 lb. ft.)
Radio Control Switch Bolt/Screw (Pontiac Only)	1.9 N•m (17 lb. in.)
Steering Column Bolt/Screw	18 N•m (14 lb. ft.)
Steering Column Guide Bolt/Screw	25 N•m (18 lb. ft.)
Steering Column Upper Support Nut	25 N•m (18 lb. ft.)
Steering Wheel Bolt/Screw (Pontiac Only)	2.8 N•m (25 lb. in.)
Steering Wheel Horn Switch Contact Plate Shoulder Bolt/Screw (Pontiac Only)	2.8 N•m (25 lb. in.)
Steering Wheel Nut	43 N•m (32 lb. ft.)
Steering Wheel-to-Inflatable Restraint Steering Wheel Module Assembly Bolt/Screw (Chevrolet Only)	2.8 N•m (25 lb. in.)
Steering Wheel-to-Steering Wheel Horn Switch Assembly Bolt/Screw (Chevrolet Only)	1.9 N•m (17 lb. in.)

SPECIAL TOOLS

1  J 1859-A

2  J 38720

1 STEERING WHEEL PULLER

2 STEERING WHEEL PULLER BOLTS (PART OF J 1859-A)

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SECTION 3F5B

SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) TILT STEERING COLUMN FLOOR SHIFT UNIT REPAIR

CAUTION: The procedures in this section must be followed in the order listed to temporarily disable the Supplemental Inflatable Restraint (SIR) System and prevent false diagnostic codes from setting. Failure to follow procedures could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: Before removing or installing any electrical unit or when a tool or equipment could easily come in contact with "live" exposed electrical terminals, disconnect the negative battery cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "off" or "lock" position.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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- Upper Bearing Spring
- Upper Bearing Inner Race Seat
- Inner Race
- Turn Signal Switch Assembly
- Buzzer Switch Assembly
- Strg Col Pass Key Lock Cylinder Set
- Centering Infl Restraint Coil

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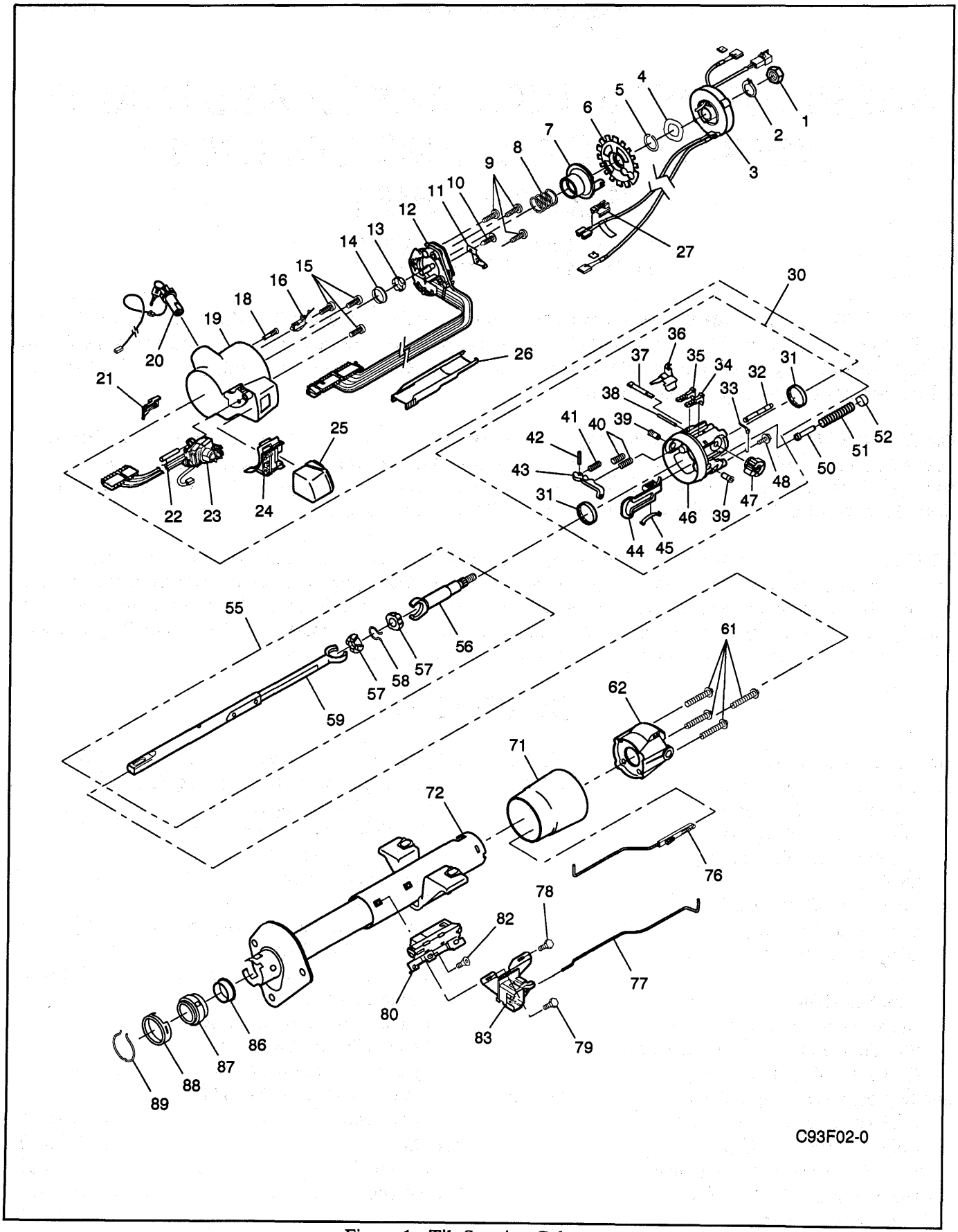


Figure 1 - Tilt Steering Column

1- NUT, HEX LOCKING (M14x1.5)
2- RING, RETAINING
3- COIL ASM, INFL RESTRAINT
4- WASHER, WAVE
5- RING, RETAINING
6- LOCK, SHAFT
7- CAM ASM, TURN SIG CANCEL
8- SPRING, UPPER BEARING
9- SCREW, BNDG HD CR RECESS
10- SCREW, RD WASH HD (M4.2x1.41)
11- ARM ASM, SIGNAL SWITCH
12- SWITCH ASM, TURN SIGNAL
13- SEAT, UPPER BRG INNER RACE
14- RACE, INNER
15- SCREW, PAN HD SOC TAP
16- SWITCH ASM, BUZZER
18- SCREW, LOCK RETAINING
19- COVER ASM, LOCK HOUSING
20- LOCK CYLINDER SET, STRG COL PASS KEY
21- ACTUATOR, DIMMER SW ROD
22- PIN, SWITCH ACTUATOR PIVOT
23- SWITCH ASM, PIVOT & (PULSE)
24- BASE PLATE, COL HSG CVR END
25- CAP, COL HSG COVER END
26- PROTECTOR, WIRING
27- SHROUD, CONNECTOR
30- HOUSING ASM, STRG COLUMN
31- BEARING ASM
32- BOLT, LOCK
33- SPRING, LOCK BOLT
34- SHOE, STEERING WHEEL LOCK
35- SHOE, STEERING WHEEL LOCK
36- SHIELD, WIRE PROTECTOR
37- SHAFT, DRIVE
38- PIN, DOWEL
39- PIN, PIVOT
40- SPRING, SHOE
41- SPRING, RELEASE LEVER
42- PIN, RELEASE LEVER
43- LEVER, SHOE RELEASE
44- RACK, SWITCH ACTUATOR
45- SPRING, RACK PRELOAD
46- HOUSING, STRG COLUMN
47- SECTOR, SWITCH ACTUATOR
48- SCREW, HEX WASHER HEAD
50- GUIDE, SPRING
51- SPRING, WHEEL TILT
52- RETAINER, SPRING
55- SHAFT ASM, STEERING COLUMN
56- SHAFT ASM, RACE & UPPER
57- SPHERE, CENTERING
58- SPRING, JOINT PRELOAD
59- SHAFT ASM, LOWER STEERING
61- SCREW, SUPPORT
62- SUPPORT ASM, STRG COL HSG
71- SHROUD, STRG COLUMN HOUSING
72- JACKET ASM, STRG COL
76- ACTUATOR ASM, IGNITION SWITCH
77- ROD, DIMMER SWITCH
78- SCREW, WASH HD (#10-24X.25)
79- SCREW, HEX WASH HD TAP
80- SWITCH ASM, IGNITION
82- SCREW, FLT HD (#10-24X.31)
83- SWITCH ASM, DIMMER
86- ADAPTER, LOWER BEARING
87- BEARING ASM
88- RETAINER, BEARING ADAPTER
89- CLIP, LOWER BEARING ADAPTER

Service Kits

201- RACK SERV KIT, COL SECTOR &
-INCLUDES: 14,31,33,44,47,48
202- SPRING SERV KIT, TILT COLUMN
-INCLUDES: 13,14,39,50,51,52
203- COIL SERV KIT, INFL RESTRAINT
-INCLUDES: 3,4,27
204- SPHERE SERV KIT, TILT COLUMN
-INCLUDES: 57,58
205- GREASE SERV KIT, (SYNTHETIC)

Figure 2 - Tilt Steering Column - Legend

SUB SECTION A - UPPER COLUMN

INCLUDES:
DISABLING THE SIR SYSTEM
ENABLING THE SIR SYSTEM
INFL RESTRAINT COIL ASSEMBLY
SHAFT LOCK
TURN SIGNAL CANCELLING CAM ASM
UPPER BEARING SPRING
UPPER BEARING INNER RACE SEAT
INNER RACE
TURN SIGNAL SWITCH ASSEMBLY
BUZZER SWITCH ASSEMBLY
STRG COL PASS KEY LOCK CYL SET
CENTERING INFL RESTRAINT COIL

Tools Required:
J 23653-C Lock Plate Compressor

SERVICE PRECAUTIONS

CAUTION: When performing service on or around SIR components or SIR wiring, follow the procedures listed below to temporarily disable the SIR system. Failure to follow procedures could result in possible air bag deployment, personal injury or otherwise unneeded SIR system repairs.

The DERM can maintain sufficient voltage to cause a deployment for up to 2 minutes after the ignition switch is turned "OFF" or the battery is disconnected. Many of the service procedures require disconnection of the "AIR BAG" fuse and the inflator module circuits from the deployment loops to avoid an accidental deployment.

DISABLING THE SIR SYSTEM

Remove or Disconnect

- Turn the steering wheel so that the vehicle's wheels are pointing straight ahead.
- Turn the ignition switch to "LOCK" and remove key.

1. "AIR BAG" fuse from I/P fuse block.
2. Lower sond insulator panel - LH. Refer to SECTION 8C.
3. Connector Position Assurance (CPA) retainer and yellow 2-way SIR connector at base of steering column.
4. I/P compartment door assembly, refer to SECTION 8C.
5. Connector Position Assurance (CPA) retainer and yellow 2-way SIR connector located near the yellow 24-way DERM harness connector.

Important

- With the "AIR BAG" fuse removed and ignition switch "ON", the "AIR BAG" warning lamp will be "ON". This is normal operation and does not indicate an SIR system malfunction.

ENABLING THE SIR SYSTEM

Install or Connect

- Turn ignition switch to "LOCK" and remove key.

1. Yellow 2-way SIR connector and CPA retainer located near the yellow 24-way DERM harness connector.
2. I/P compartment door assembly, refer to SECTION 8C.
3. Yellow 2-way SIR connector and CPA retainer at base of steering column.
4. Lower sound insulator panel-LH, refer to SECTION 8C.
5. "AIR BAG" fuse to I/P fuse block.
   - Turn ignition switch to "RUN" and verify that the "AIR BAG" warning lamp flashes 7 times and then turns "OFF". If it does not operate as described, perform the "SIR Diagnostic System Check" in SECTION 9J-A.

Important

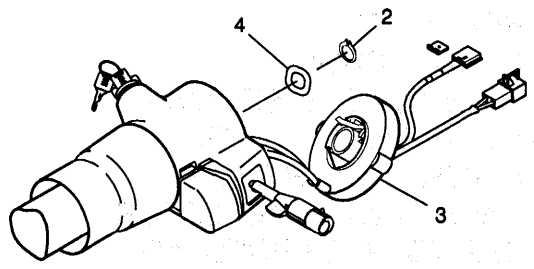
- Before doing any service procedures in this section, disabling the SIR system and removal of Inflator Module and Steering Wheel is needed. Columns equipped with Supplemental Inflatable Restraint (SIR) and Redundant Steering Wheel Control (RSWC) will have Inflatable Restraint coils with two wire leads. (SIR) wire leads are yellow with a yellow connector shroud. (RSWC) wire leads are grey with black connectors. (Refer to **"Disabling the SIR System"** in this section and service procedures in section 3F).

Remove or Disconnect

Figures 1 through 9 and 13

NOTICE: Place ignition to "LOCK" position to prevent uncentering coil assembly (3).

1. Disable the SIR system; Refer to **"Disabling the SIR System"** in this Section.
2. Negative (-) battery cable.



2 RING, RETAINING
3 COIL ASM, INFL RESTRAINT
4 WASHER, WAVE

Figure 3 - Removing Coil Assembly Off Shaft

3. Coil assembly retaining ring (2).
4. Inflatable restraint coil assembly (3).
   - Let switch hang freely if removal is not needed.
   - To remove coil (3), do steps 5 through 17 in this section.

5. Wave washer (4).
6. Shaft lock retaining ring (5) using J 23653-C to push down shaft lock (6).
   - Dispose of ring (5).

7. Shaft lock (6).
8. Turn signal cancelling cam assembly (7).
9. Upper bearing spring (8).

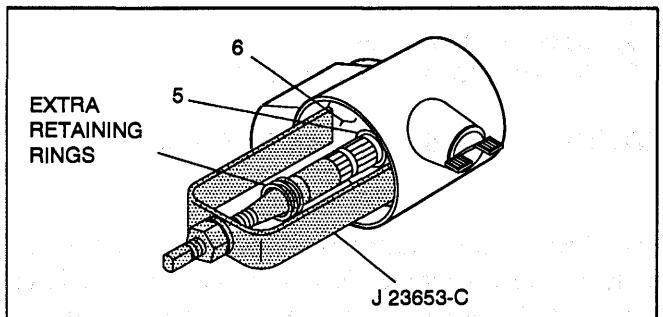


Figure 4 - Removing Shaft Lock Retaining Ring

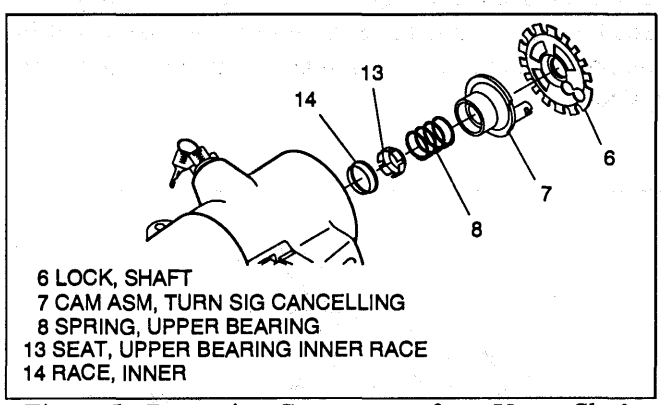


Figure 5 - Removing Components from Upper Shaft

10. Upper bearing inner race seat (13).
11. Inner race (14).
12. Turn signal to "RIGHT TURN" position (up).
13. Multi-function lever and hazard knob assembly. (See Section 3F)
14. Screw (10) and signal switch arm (11).
15. Turn signal switch screws (9).

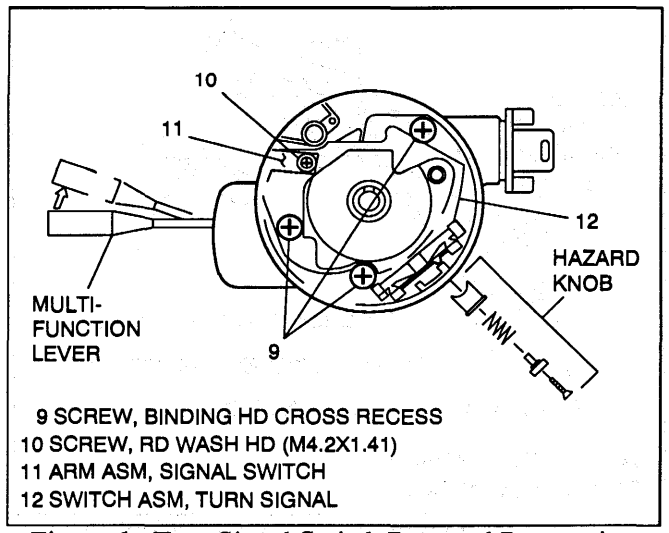


Figure 6 - Turn Signal Switch Removal Preparation

16. Turn signal switch assembly (12).
    - Let switch hang freely if removal is not needed.
    - To remove switch (12):
      A. Turn signal switch connector from bulkhead connector.
      B. Wiring protector (26).
      C. Gently pull wire harness through column.

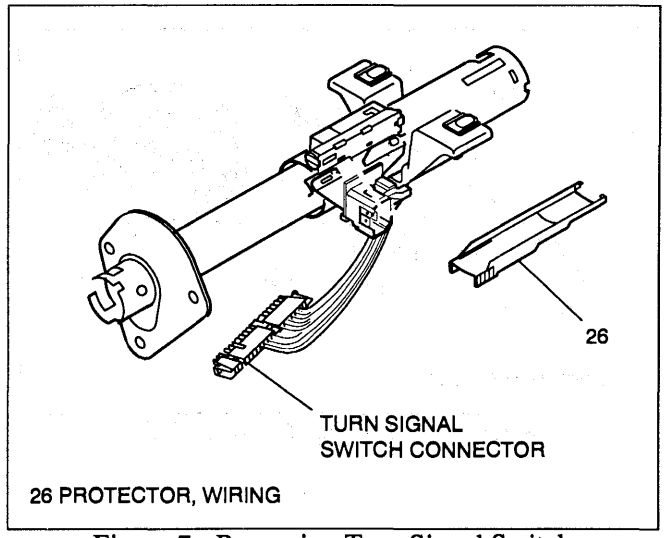


Figure 7 - Removing Turn Signal Switch

NOTICE: Coil assembly (3) will become uncentered if:
1) Steering column is separated from steering gear and is allowed to rotate, or
2) Centering spring is pushed down, letting hub rotate while coil (3) is removed from steering column. (If this occurs, see Figure 13)

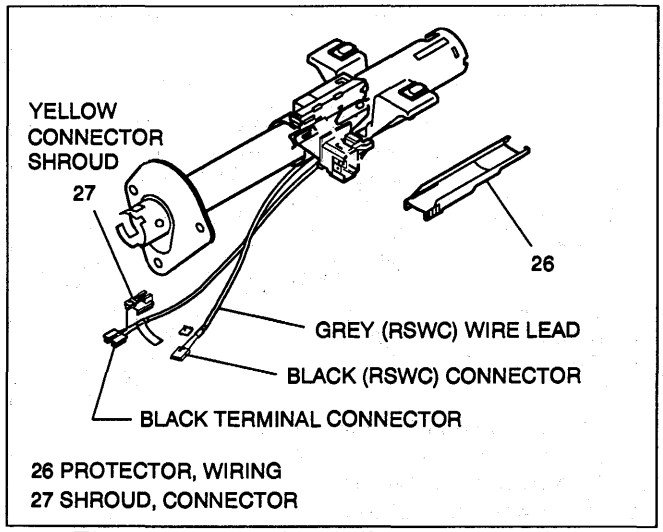


Figure 8 - Removing Coil Assembly Switch

17. Inflatable restraint coil assembly (3) with wire harness from column assembly.

    A. Wiring protector (26).
    B. Attach two lengths of mechanics wire to coil terminal connectors to aid in reassembly.
    C. Gently pull wires through column.

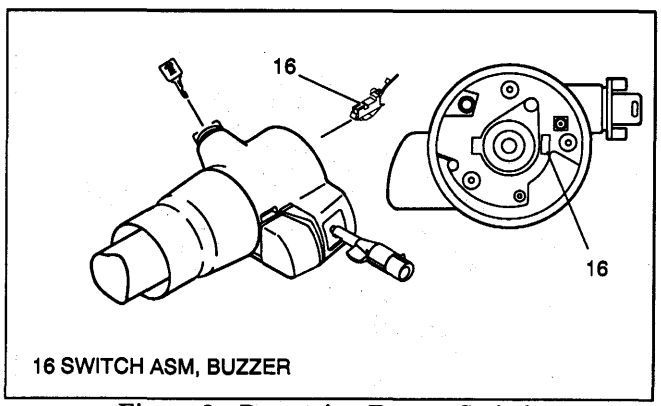


Figure 9 - Removing Buzzer Switch

18. Key from pass key lock cylinder set (20).
19. Buzzer switch assembly (16).
20. Reinsert key in pass key lock cylinder (20).
    - Key in "LOCK" position.
21. Lock retaining screw (18).
22. Pass key lock cylinder (20) and harness.
    - To remove lock cylinder (20):

        A. Terminal connector from bulkhead connector.
        B. Wiring protector (26).
        C. Attach a length of mechanics wire to terminal to aid in reassembly.
        D. Retaining clip from housing cover (19) and gently pull wire harness through column.

Install or Connect

Figures 1,10 through 15 and 26

NOTICE: See **"Notice"** on page 3F5B-1 of this section.

NOTICE: Ensure all fasteners are securely seated before applying needed torque. Failure to do may result in component damage or malfunctioning of steering column.

NOTICE: Route wire from pass key lock cylinder as shown and snap retaining clip into hole in housing (19). (See Figures 10 and 11) Failure to do so may result in component damage of malfunction of pass key lock cylinder.

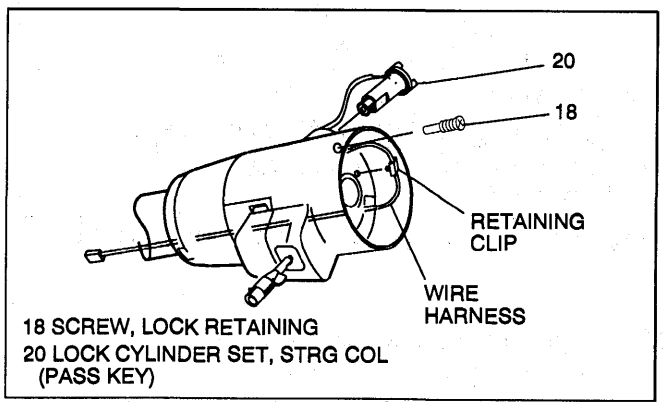


Figure 10 - Installing Pass Key Lock Cylinder Set

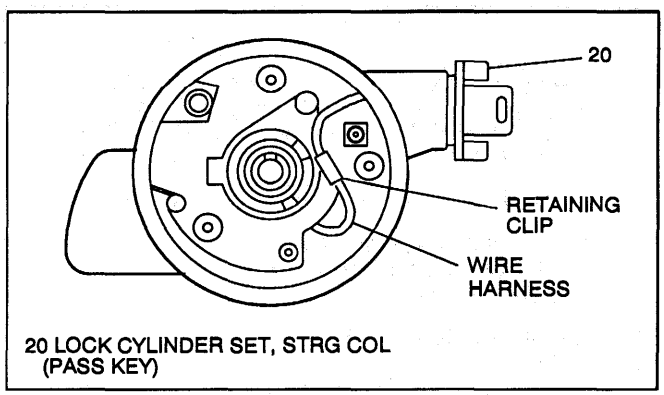


Figure 11 - Routing Pass Key Wire Harness

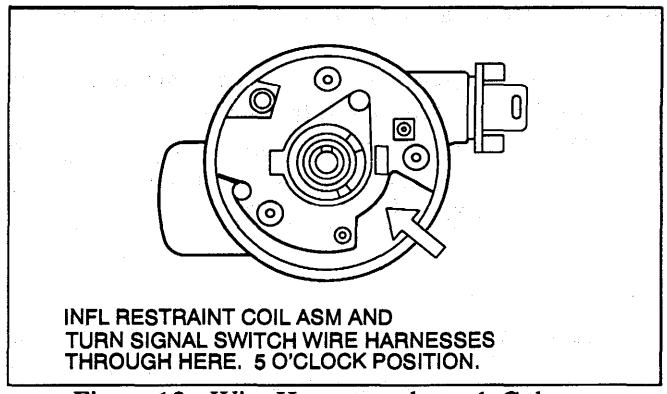


Figure 12 - Wire Harnesses through Column

1. Pass key lock cylinder (20).
   A. Wire terminal through column and snap retaining clip into hole in housing.
   B. Lock cylinder (20) connector to vehicle wire harness.

2. Lock retaining screw (18).

Tighten

- Tighten screw (18) to 2.5 N·m (22 lb.in.).

3. Key from pass key lock cylinder set (20).
4. Buzzer switch assembly (16).
5. Reinstall key in pass key lock cylinder set (20).
   - Key in "OFF-LOCK" position.

6. Turn signal switch assembly (12) wire harness through steering column.
   A. Let switch hang freely.
   B. Switch connector to bulkhead connector.

7. Coil assembly (3) wire harness through column.
   - Let coil hang freely.

8. Turn signal switch assembly (12) and screws (9).

Tighten

- Tighten screws (9) to 3.4 N·m (30 lb.in.).

9. Signal switch arm (11) with screw (10).

Tighten

- Tighten screw (10) to 2.3 N·m (20 lb.in.).

10. Hazard knob assembly and multi-function lever. (See Section 3F)
11. Inner race (14).
12. Upper bearing inner race seat (13).
13. Upper bearing spring (8).
14. Turn signal cancelling cam assembly (7).
    - Lubricate with grease, synthetic (service kit).

15. Shaft lock (6).
16. New shaft lock retaining ring (5) using J 23653-C to push down shaft lock (6).
    - Ring (5) must be firmly seated in groove on shaft.

NOTICE: Set steering shaft so that block tooth on upper steering shaft (56) is at the 12 o'clock position, wheels on vehicle should be straight ahead, then set ignition switch to "LOCK" position, to ensure no damage to coil assembly (3). (See Figure 26 for steering shaft orientation)

17. Wave washer (4).

NOTICE: Coil assembly (3) will become uncentered if:

1) Steering column is separated from steering gear and is allowed to rotate, or
2) Centering spring is pushed down, letting hub rotate while coil is removed from column. (If this occurs, see Figure 13)

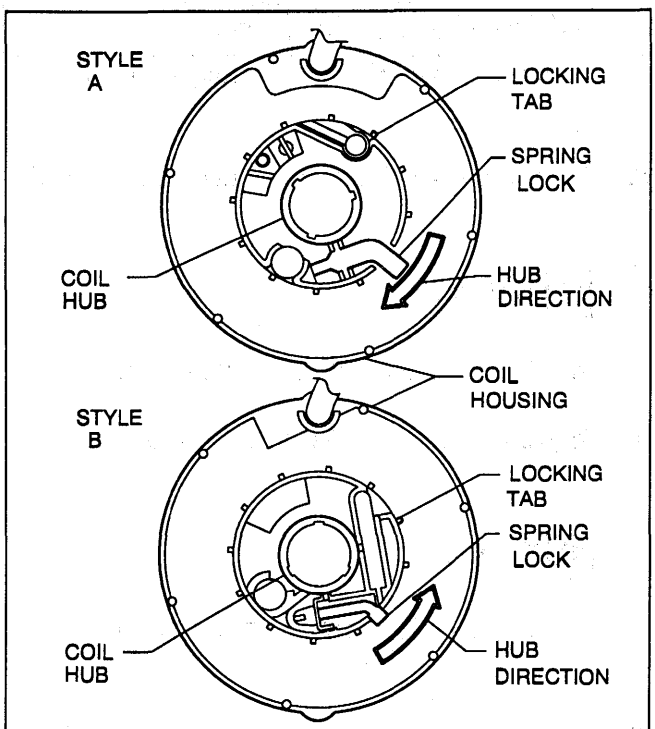


Figure 13 - Centering Coil Assembly

NOTICE: If a new coil assembly (3) is being installed, assemble pre-centered coil assembly (3) to steering column. Remove centering tab and dispose. (See Figure 13)

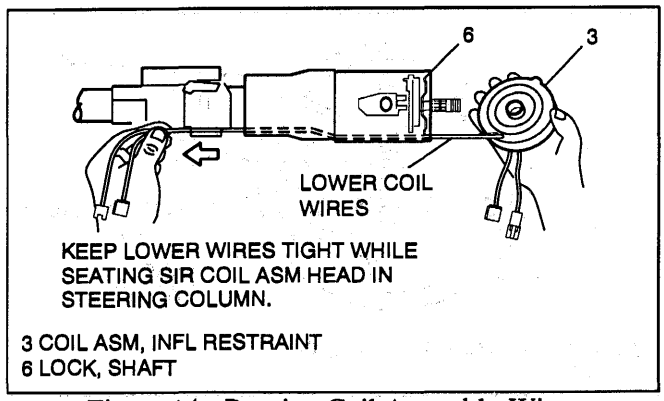


Figure 14 - Routing Coil Assembly Wires

NOTICE: Sir coil assembly wires must be kept tight with no slack while installing SIR coil assembly. Failure to do so may cause wires to be kinked near shaft lock area and cut when steering wheel is turned.

18. Ensure coil assembly (3) hub is centered.
19. Coil assembly (3).
    A. Pull wires tight while positioning SIR coil to steering shaft.
    B. Align opening in coil with horn tower and "locating bump" between two tabs on housing cover.
    C. Seat coil assembly into steering column.

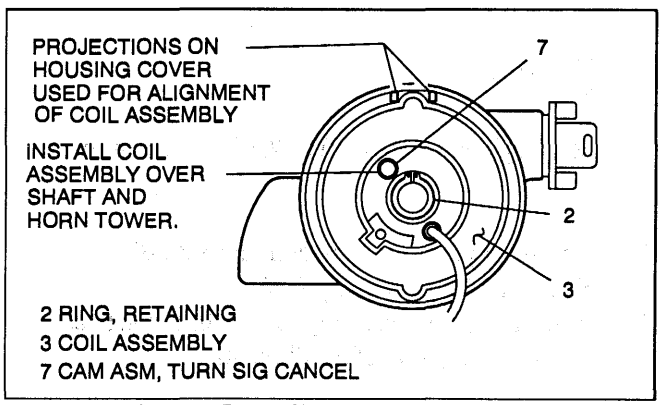


Figure 15 - Coil Assembly Installed

20. Coil assembly retaining ring (2).
    - Ring (2) must be firmly seated in groove on shaft.

NOTICE: Gently pull lower coil assembly, turn signal, pass key,and pivot & (pulse) wires to remove any wire kinks that may be inside steering column assembly. Failure to do so may cause damage to wire harness.

21. Wiring protector (26).
22. Refer to Section 3F to complete remaining steering column assembly.
23. Negative (-) battery cable.
24. If all service operations are completed, enable the SIR system; refer to **"Enabling the SIR System"** in this Section.

SUB SECTION B - HOUSING COVER

Figures 1,2,16 through 20

INCLUDES:

LOCK HOUSING COVER ASSEMBLY
COL HSG COVER END CAP
PIVOT & (PULSE) SWITCH ASSEMBLY
DIMMER SWITCH ROD ACTUATOR
TILT SPRING ASSEMBLY

Tools Required:
J 23653-C Lock Plate Compressor

Important

- Before doing any service procedures in this section, removal of Inflator Module and Steering Wheel is needed. (Refer to service procedures in Section 3F)

Important

- Remove only those components necessary to do repairs.

Remove or Disconnect

1. Do all steps, "Remove or Disconnect", Sub Section A.
2. Housing cover end cap (25).

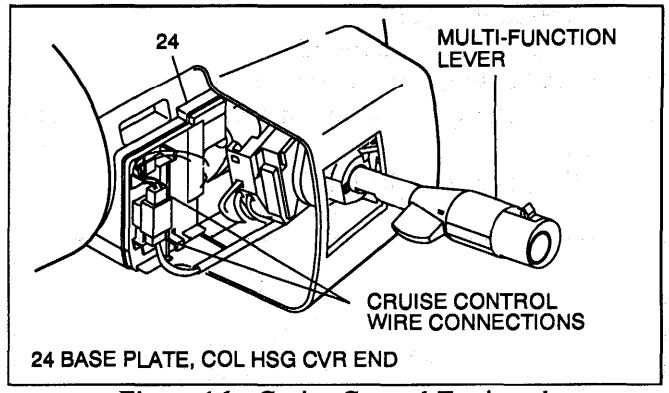


Figure 16 - Cruise Control Equipped Steering Columns

Important

- Remove cruise control and multi-function lever connectors from base plate (24) and disconnect.
- Remove multi-function lever. (See Section 3F)

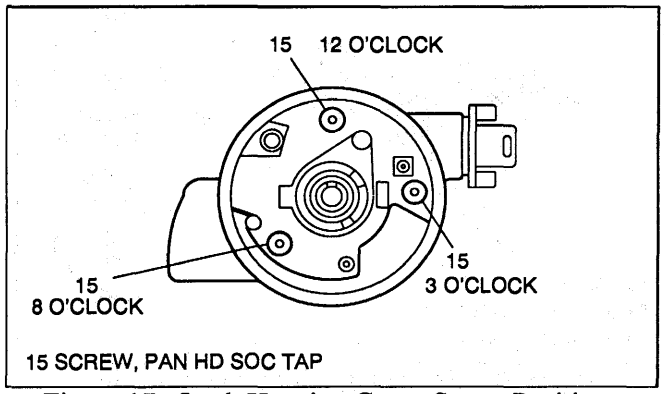


Figure 17 - Lock Housing Cover Screw Positions

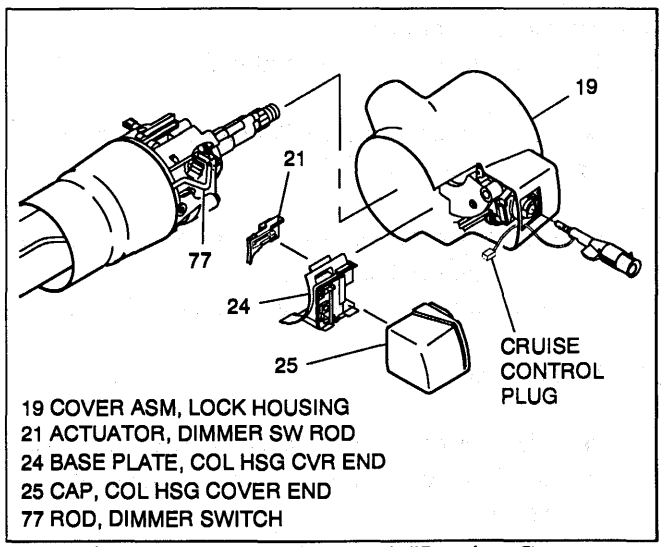


Figure 18 - Removing Lock Housing Cover

3. Cover screws (15).
4. Tilt lever. (See Section 3F)
5. Lock housing cover assembly (19).
6. Base plate (24) and dimmer switch rod actuator (21).
7. Wire protector shield (36).

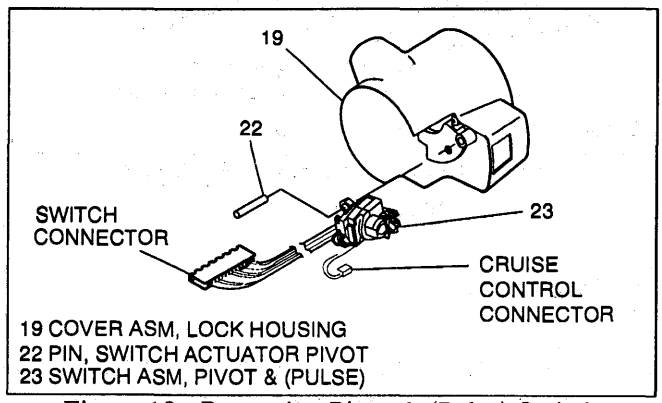


Figure 19 - Removing Pivot & (Pulse) Switch

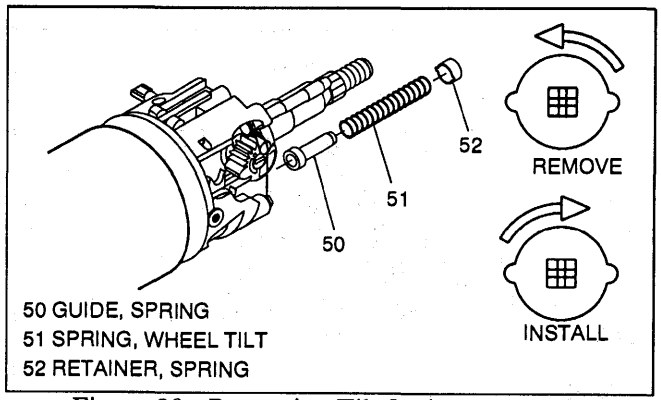


Figure 20 - Removing Tilt Spring Assembly

8. Switch actuator pivot pin (22).
9. Pivot & (pulse) switch assembly (23).
   - Let switch hang freely if removal is not needed.
   - To remove switch (23):
     A. Pivot & (pulse) switch connector from bulkhead connector.
     B. Gently pull wire harness through column.
10. Spring retainer (52).
    - Using a cross recess head screwdriver, push retainer down and turn counterclockwise to release.
11. Spring (51) and spring guide (50).

Install or Connect

NOTICE: See **"Notice"** on page 3F5B-1 of this section.

NOTICE: Ensure all fasteners are securely seated before applying needed torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Spring guide (50) and spring (51).
   - Lubricate with lithium grease.
2. Spring retainer (52).
   - Using a cross recess screwdriver push retainer down and turn clockwise to lock in place.
3. Pivot & (pulse) switch assembly (23) to lock housing cover assembly (19).
4. Switch actuator pivot pin (22) to switch (23) and cover (19).
5. Pivot & (pulse) switch wire harness through steering column.
   - Switch connector to bulkhead connector.
   - Wire protector shield (36).
6. Dimmer switch rod actuator (21) to base plate (24).
   - Lubricate with lithium grease.
7. Base plate (24) to lock housing cover assembly (19).
   - Bottom edge of dimmer switch rod actuator (21) must rest on bend in dimmer switch rod (77).
8. Lock housing cover assembly (19).
9. Screws (15). Tighten screw in 12 o'clock position first, screw in 8 o'clock position second, and screw in 3 o'clock position third.

Tighten

- Tighten screws (15) in same order to 9.0 N·m (80 lb.in.).

10. Install multi-function lever. (See Section 3F)
11. Plug multi-function lever and cruise control connectors together and mount on base plate (24).
12. Housing cover end cap (25).
13. Do all steps, "Install or Connect", Sub Section A.

SUB SECTION C - MID COLUMN

INCLUDES:

STEERING COLUMN HOUSING ASM
STEERING WHEEL LOCK SHOE
SWITCH ACTUATOR SECTOR
SWITCH ACTUATOR RACK
BEARING ASSEMBLY
LOCK BOLT
STEERING COL HSG SUPPORT ASM
STEERING SHAFT ASSEMBLY

Tools Required:
- J 23653-C Lock Plate Compressor
- J 21854-01 Pivot Pin Remover
- J 22635 Lock Shoe and Release Lever Pin Remover and Installer
- J 8092 Driver Handle
- J 38639 Strg Col Housing Bearing Installer

Important

- Before doing any service procedures in this section, removal of Inflator Module and Steering Wheel is needed. (Refer to service procedures in Section 3F)

Remove or Disconnect

Figures 1 through 28,30 and 34

1. Disable the SIR system; refer to **"Disabling the SIR System"** in this Section.
2. Negative (-) battery cable.
3. Steering column from vehicle. (See Section 3F)

NOTICE: Once steering column is removed from vehicle, the column is extremely susceptible to damage. Dropping steering column assembly on its end could collapse steering shaft or loosen plastic injections which maintain column rigidity. Leaning on steering column assembly could cause jacket to bend or deform. Any of the above damage could impair steering column's collapsible design. If it is necessary to remove steering wheel, use only the specified steering wheel puller. Under no conditions should the end of shaft be hammered on as hammering could loosen plastic injections which maintain steering column rigidity.

Inspect

- Steering column for accident damage. (See Figure 34)

4. Do steps 3 through 22, "Remove or Disconnect", Sub Section A.
5. Do steps 2 through 10, "Remove or Disconnect", Sub Section B.

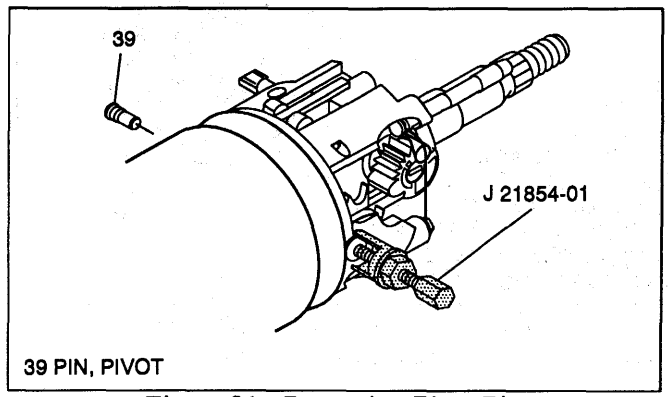


Figure 21 - Removing Pivot Pin

6. Pivot pins (39) using J 21854-01.
   - Reinstall tilt lever. (See Section 3F)
7. Steering column housing assembly (30).
   - Pull back on tilt lever and pull steering column housing assembly (30) down and away from column.

Important

- Remove only those components necessary to do repairs.

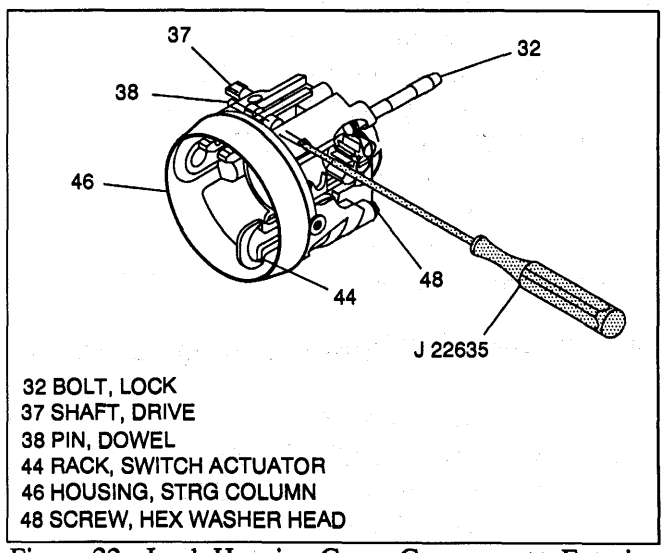


Figure 22 - Lock Housing Cover Components, Exterior

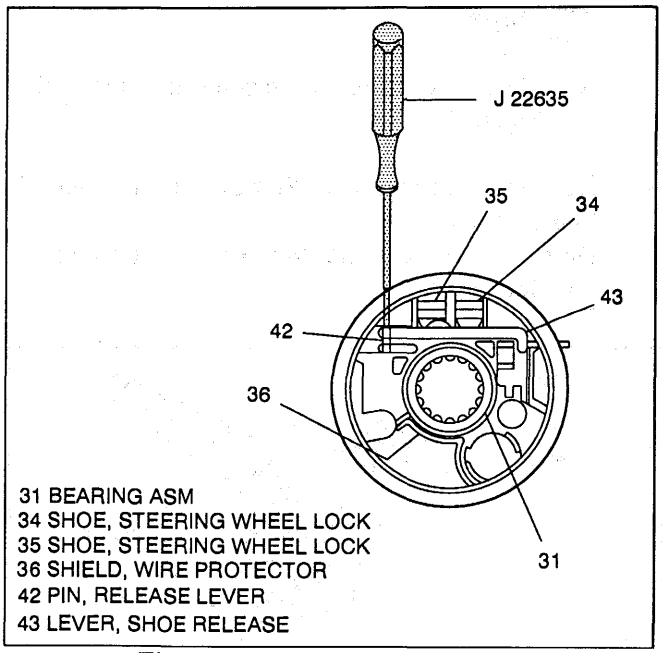


Figure 23 - Lock Housing Cover Components, Interior

Disassemble

Steering Column Housing Assembly

A. Bearing assembly (31).
B. Hex head screw (48).
C. Lock bolt spring (33).
D. Lock bolt (32).
E. Switch actuator rack (44) and rack preload spring (45).
F. Drive shaft (37).
G. Switch actuator sector (47).
I. Release lever pin (42) using J 22635.
J. Shoe release lever (43).
K. Release lever spring (41).
L. Dowel pin (38) using J 22635.
M. Lock shoes (34) and (35).
N. Shoe springs (40).

Assemble

Steering Column Housing Assembly

A. Shoe springs (40).
B. Lock shoes (34) and (35).
C. Dowel pin (38) using J 22635.
D. Release lever spring (41).
E. Shoe release lever (43).
F. Release lever pin (42) using J 22635.
G. Switch actuator sector (47).
H. Drive shaft (37).
I. Rack preload spring (45).
J. Switch actuator rack (44) to actuator sector (47).
K. Bearing assembly (31) lubricated with lithium grease to column housing (46) using J 38639 and J 8092.
L. Lock bolt (32).
M. Lock bolt spring (33). (See Figure 30)
N. Hex head screw (48).

Tighten

- Tighten screw (48) to 4.0 N·m (35 lb.in.).

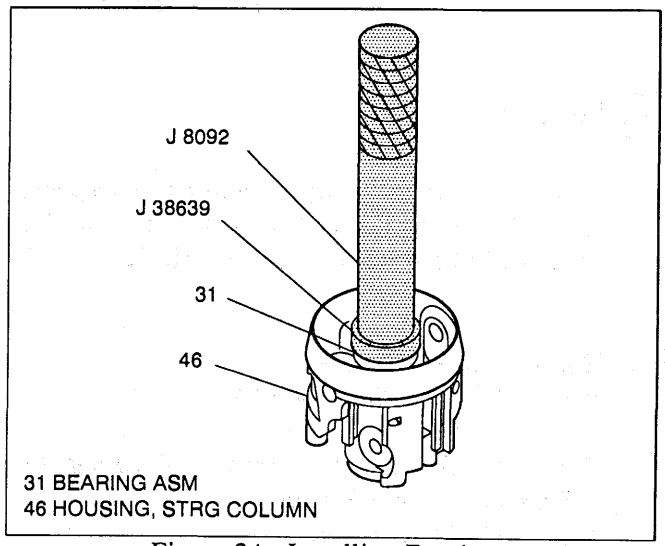


Figure 24 - Installing Bearings

8. Lower bearing adapter clip (89).
9. Bearing adapter retainer (88).
10. Lower bearing adapter (86) and bearing assembly (87).
11. Steering column shaft assembly (55).

Inspect

- Steering column shaft assembly (55) for accident damage. (See Figure 34)

Important

- Mark upper shaft assembly (56) and lower steering shaft asm (59) to ensure proper assembly. Failure to assemble properly will cause steering wheel to be turned 180 degrees. (See Figures 25 and 26)

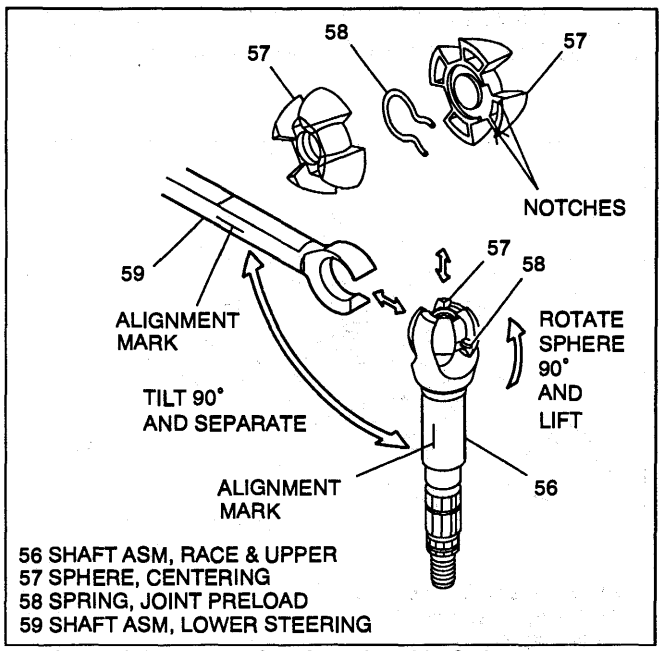


Figure 25 - Removing Steering Shaft Components

Important

- Remove only those components necessary to do repairs.

Disassemble

Steering Column Shaft Assembly

A. Upper shaft assembly (56), lower steering shaft assembly (59).
   - Tilt 90 degrees to each other and disengage.

B. Centering sphere (57) from upper shaft assembly (56).
   - Rotate sphere 90 degrees and slip out.

C. Joint preload spring (58) from centering sphere (57).

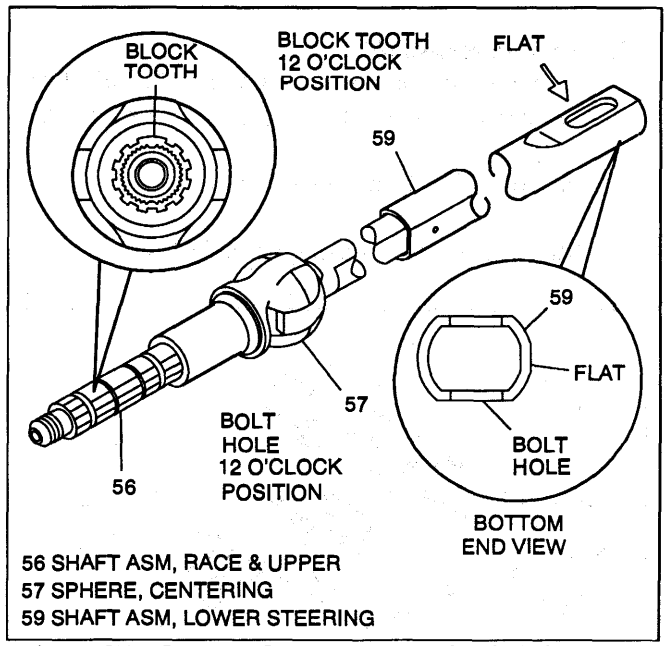


Figure 26 - Correct Upper to Lower Shaft Orientation

Assemble

Steering Column Shaft Assembly

A. Joint preload spring (58) to two centering sphere (57).

B. Centering sphere (57).
   - Lubricate with lithium grease, slip into upper shaft assembly (56), and rotate sphere 90 degrees.

C. Upper shaft assembly (56) to lower steering shaft assembly (59).
   - Line up marks and tilt assemblies 90 degrees to each other.

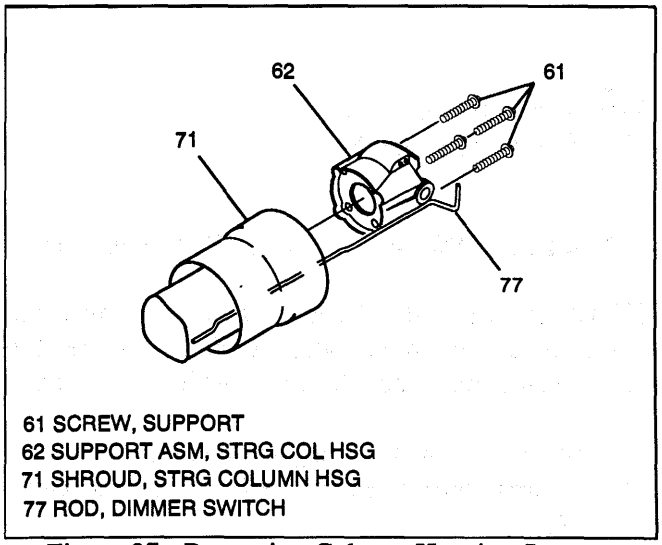
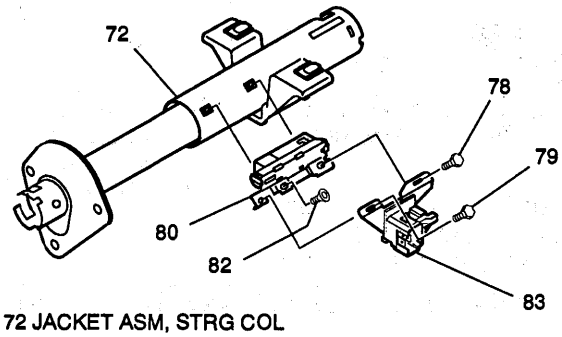


Figure 27 - Removing Column Housing Support

12. Support screws (61).
13. Column housing support assembly (62) with dimmer switch rod (77) from steering column jacket assembly (72).
    - Rod (77) from support (62).
14. Steering column housing shroud (71).



72 JACKET ASM, STRG COL
78 SCREW, WASH HD (#10-24X.25)
79 SCREW, HEX WASH HD TAP
80 SWITCH ASM, IGNITION
82 SCREW, FLT HD (#10-24X.31)
83 SWITCH ASM, DIMMER

Figure 28 - Removing Ignition and Dimmer Switches

15. Hex head tapping screw (79).
16. Washer head screw (78).
17. Dimmer switch assembly (83).
    - Dimmer switch (83) from vehicle wire harness.
18. Flat head screw (82).
    - Ignition switch assembly (80) from ignition switch actuator assembly (76).

Install or Connect

Figures 1 through 32

NOTICE: See **"Notice"** on page 3F5B-1 of this section.

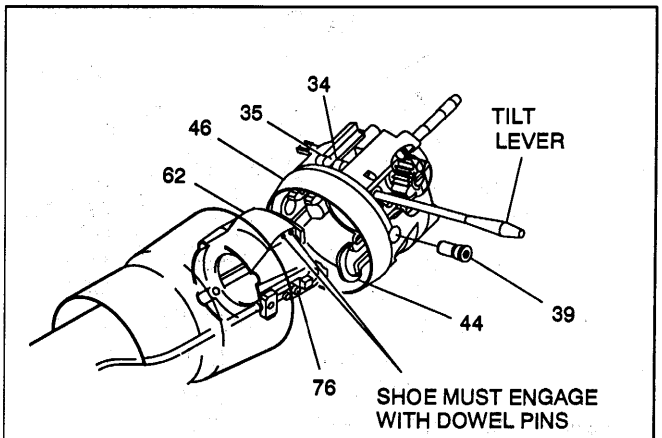
NOTICE: Ensure all fasteners are securely seated before applying needed torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Steering column housing shroud (71).
2. Column housing support (62) to jacket assembly (72).
3. Four support screws (61).

Tighten

- Tighten screws (61) to 8.8 N·m (77 lb.in.)

4. Dimmer switch rod (77) to housing support (62).
5. Actuator assembly (76) to housing support (62).



34 SHOE, STRG WHEEL LOCK
35 SHOE, STRG WHEEL LOCK
39 PIN, PIVOT
44 RACK, SWITCH ACTUATOR
46 HOUSING, STRG COLUMN
62 SUPPORT ASM, STRG COL HSG
76 ACTUATOR ASM, IGN SWITCH

Figure 29 - Installing Column Housing to Housing Support

6. Steering shaft assembly (55) to jacket assembly (72).
    - Lubricate with lithium grease.
7. Tilt lever. (See Section 3F)
8. Column housing assembly (30) to column.
    - Position column housing assembly (30) and align switch actuator rack (44) with pin on end of ignition switch actuator assembly (76).
    - Pull back on tilt lever, pushing column housing assembly (30) onto column housing support assembly (62).
    - Release tilt lever to lock shoes (34) and (35) onto dowel pins.
    - Remove tilt lever. (See Section 3F)

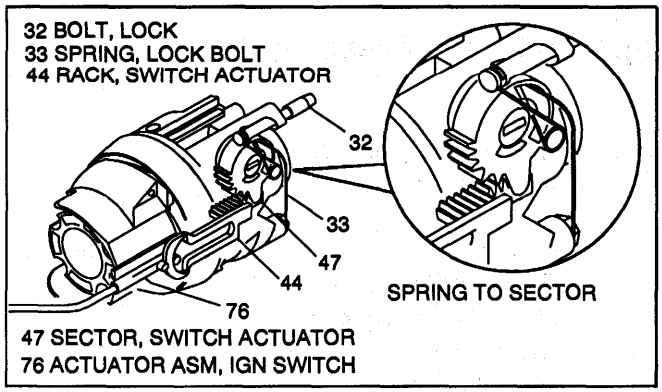


Figure 30 - Actuator Assembly to Actuator Rack Installed

9. Pivot pins (39).
   - Lubricate with lithium grease.
   - Press pin until firmly seated, two places.

10. Lower bearing adapter (86) and bearing assembly (87).
    - Lubricated with lithium grease.

11. Bearing adapter retainer (88).
12. Lower bearing adapter clip (89).
13. Do steps 1 through 12, "Install or Connect", Sub Section B.
14. Do steps, 1 through 21 "Install or Connect", Sub Section A.
15. To install ignition and dimmer switch assemblies, do all steps Ignition Switch Assembly, "Install or Connect", Sub Section D.

SUB SECTION D - LOWER COLUMN

INCLUDES:

DIMMER SWITCH ASSEMBLY
DIMMER SWITCH ADJUSTMENT
IGNITION SWITCH ASSEMBLY
IGNITION SWITCH ADJUSTMENT
ADAPTER & BEARING ASSEMBLY

NOTICE: Once steering column is removed from vehicle, the column is extremely susceptible to damage. Dropping steering column assembly on its end could collapse steering shaft or loosen plastic injections which maintain column rigidity. Leaning on steering column assembly could cause jacket to bend or deform. Any of the above damage could impair steering column's collapsible design. If it is necessary to remove steering wheel, use only the specified steering wheel puller. Under no conditions should the end of shaft be hammered on as hammering could loosen plastic injections which maintain steering column rigidity.

Inspect

- Steering column for accident damage. (See Figure 34)

Dimmer Switch Assembly

Remove or Disconnect

Figures 1,2,28 and 34

1. Disable the SIR system; refer to **"Disabling the SIR System"** in this Section.
2. Negative (-) battery cable.
3. Steering column from vehicle. (See Section 3F)
4. Hex head tapping screw (79).
5. Washer head screw (78).
6. Dimmer switch assembly (83) from rod (77).
   - Vehicle wire harness from dimmer switch (83).

Install or Connect

Figures 1,2,28 and 31

NOTICE: See **"Notice"** on page 3F5B-1 of this section.

NOTICE: Ensure all fasteners are securely seated before applying required torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Dimmer switch assembly (83).
2. Hex head tapping screw (79) and washer head screw (78).
   - Tighten finger tight.

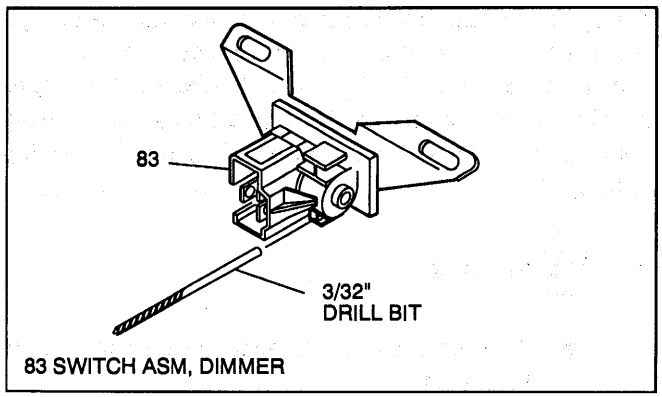


Figure 31 - Adjusting Dimmer Switch

Adjust

- Dimmer switch (83). (See Figure 31)

  A. Place 3/32-inch drill bit in hole on switch to limit travel.
  B. Position switch on column and push against dimmer switch rod (77) to remove all lash.
  C. Remove drill bit.

Tighten

- Tighten screw (79) to 2.5 N·m (22 lb.in.)

Tighten

- Tighten screw (78) to 4.0 N·m (35 lb.in.).

3. Vehicle wire harness to dimmer switch (83).
4. Steering column to vehicle. (See Section 3F)
5. Negative (-) battery cable.
6. If all service operations are completed, enable the SIR system; refer to **"Enabling the SIR System"** in this section.

Ignition Switch Assembly

Remove or Disconnect

Figures 1,2,28 and 34

1. Disable the SIR system; refer to **"Disabling the SIR System"** in this section.
2. Negative (-) battery cable.
3. Steering column from vehicle. (See Section 3F)
4. Hex head tapping screw (79).
5. Washer head screw (78).
6. Dimmer switch assembly (83) from rod (77).
7. Flat head screw (82).
8. Ignition switch assembly (80) from ignition switch actuator assembly (76).
   - Vehicle wire harness from ignition switch assembly (80).

Install or Connect

Figures 1,2,28,31 and 32

NOTICE: See **"Notice"** on page 3F5B-1 of this section.

NOTICE: Ensure all fasteners are securely seated before applying needed torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Lock cylinder (20) to "OFF-LOCK" position.

NOTICE: Install ignition switch (80) to jacket (72) with switch in "OFF-LOCK" position. (See Figure 32) New ignition switch will be pinned in "OFF-LOCK" position. Remove plastic pin after switch is assembled to column. Failure to do so may cause switch damage.

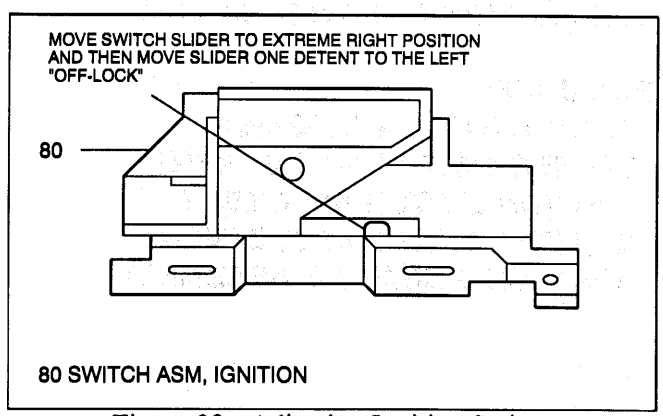


Figure 32 - Adjusting Ignition Switch

Adjust

- Ignition switch assembly (80).
  - A. Move switch slider to extreme right position.
  - B. Move switch slider one detent to left "OFF-LOCK" position.

2. Ignition switch assembly (80) to actuator assembly (76).
3. Flat head screw (82).

Tighten

- Tighten screw (82) to 3.7 N·m (33 lb.in.).

4. Dimmer switch assembly (83) to rod (77).
5. Hex head tapping screw (79) and washer head screw (78).
   - Tighten finger tight.

Adjust

- Dimmer switch (83). (See Figure 31)
  - A. Place 3/32-inch drill bit in hole on switch to limit travel.
  - B. Position switch on column and push against dimmer switch rod (77) to remove all lash.
  - C. Remove drill bit.

Tighten

- Tighten screw (79) to 2.5 N·m (22 lb.in.)

Tighten

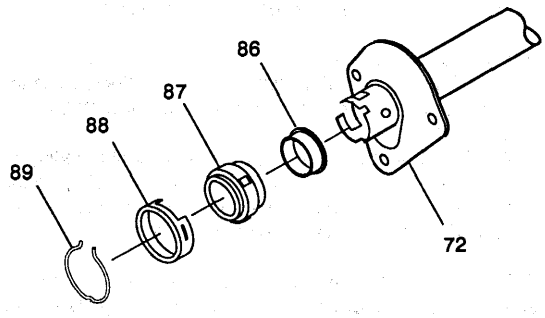
- Tighten screw (78) to 4.0 N·m (35 lb.in.).

6. Steering column to vehicle. (See Section 3F)
7. Vehicle wire harness to dimmer switch assembly (83).
8. Vehicle wire harness to ignition switch assembly (80).
9. Negative (-) battery cable.
10. If all service operations are completed, enable the SIR system; refer to **"Enabling the SIR System"** in this Section.

Adapter & Bearing Assembly

Remove or Disconnect
Figures 1,2,33 and 34

1. Disable the SIR system; refer to **"Disabling the SIR System"** in this section.
2. Negative (-) battery cable.
3. Steering column from vehicle. (See Section 3F)
4. Lower bearing adapter clip (89).
5. Bearing adapter retainer (88).
6. Lower bearing adapter (86) and bearing assembly (87).



72 JACKET ASM, STRG COL
86 ADAPTER, LOWER BEARING
87 BEARING ASM
88 RETAINER, BEARING ADAPTER
89 CLIP, LOWER BEARING ADAPTER

Figure 33 - Removing Lower Bearing Assembly

Install or Connect
Figures 1,2 and 33

NOTICE: See **"Notice"** on page 3F5B-1 of this section.

NOTICE: Ensure all fasteners are securely seated before applying needed torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Lower bearing adapter (86) and bearing assembly (87).
   - Lubricate inner surface with lithium grease.
2. Bearing adapter retainer (88).
3. Lower bearing adapter clip (89).
4. Steering column to vehicle. (See Section 3F)
5. Negative (-) battery cable.
6. If all service operations are completed, enable the SIR system; refer to **"Enabling the SIR System"** in this Section.

CHECKING STEERING COLUMN FOR ACCIDENT DAMAGE

NOTICE: Vehicles involved in accidents resulting in frame damage, major body or sheet metal damage, or where the steering column has been impacted, or where supplemental inflatable restraints systems deployed may also have a damaged or misaligned steering column.

CHECKING PROCEDURE

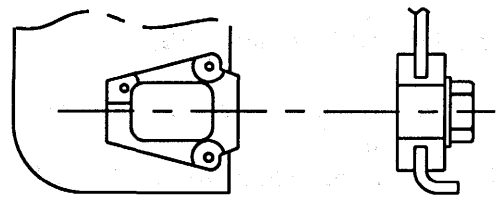
JACKET ASM, STEERING COLUMN

- Check capsules on steering column bracket assembly; all must be securely seated in bracket slots and checked for any loose conditions when pushed or pulled by hand (View A). If not, bracket should be replaced if bracket is bolted to the jacket assembly or the jacket assembly should be replaced if bracket is welded to jacket assembly.
- Check for jacket assembly collapse by measuring the distance from the lower edge of upper jacket to a defined point on the lower jacket (View C). If measured dimensions are not within specifications, a new jacket must be installed.

STEERING SHAFT ASM

- Visually inspect steering shaft for sheared injected plastic (View B). If steering shaft shows sheared plastic, a new steering shaft must be installed.
- Any frame damage that could cause a bent steering shaft must have steering shaft runout checked in the following manner: Using a dial indicator at lower end of steering shaft, have steering wheel rotated. Runout must not exceed 1.59mm.

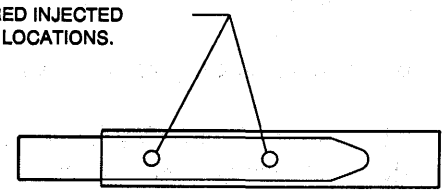
NOTICE: Inflatable restraint coil assembly must be removed from steering column and allowed to hang freely before shaft is rotated. Failure to do so could damage coil assembly.

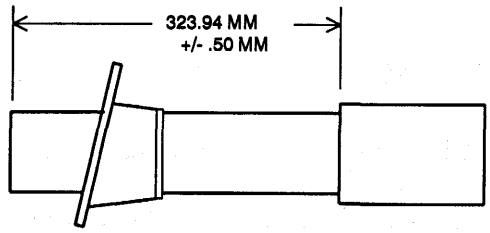


VIEW A
(CAPSULES)
CHECK FOR ANY LOOSE CONDITION WHEN PUSHED OR PULLED BY HAND.

CHECK FOR SHEARED INJECTED PLASTIC AT THESE LOCATIONS.

VIEW B
(STEERING SHAFT)





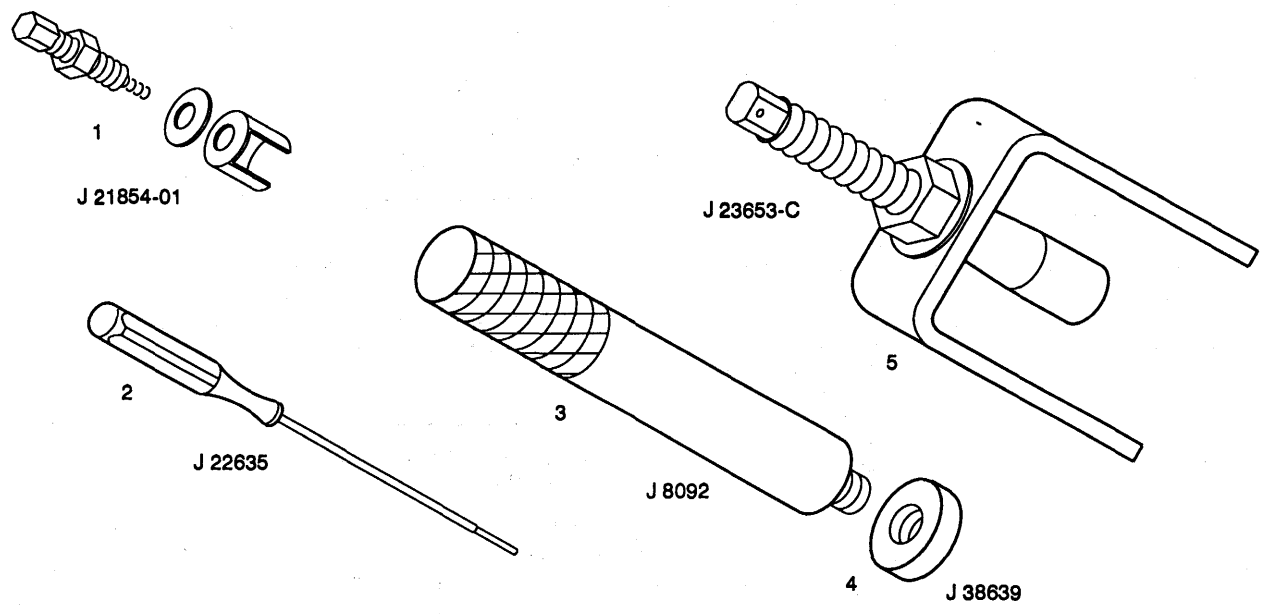
VIEW C (METHOD TO DETERMINE COLUMN COLLAPSE)
WITH LOWER BEARING REMOVED
MEASURE DISTANCE BETWEEN ARROWS.

Figure 34 - Checking Steering Column for Accident Damage

SPECIFICATIONS

FASTENER TORQUES

1	Steering Wheel-to-Shaft Nut	41.0 N·m (30 lb.ft.)
9	Turn Signal Switch Connecting Screws	3.4 N·m (30 lb.in.)
10	Turn Signal Switch Actuator Assembly Screw	2.3 N·m (20 lb.in.)
15	Lock Housing Cover Screws	9.0 N·m (80 lb.in.)
18	Lock Retaining Screw	2.5 N·m (22 lb.in.)
48	Lock Bolt Spring Screw	4.0 N·m (35 lb.in.)
61	Support-to-Jacket Screws	8.8 N·m (77 lb.in.)
78	Upper dimmer Switch Mounting Screw	4.0 N·m (35 lb.in.)
79	Lower dimmer Switch Mounting Screw	2.5 N·m (22 lb.in.)
82	Ignition Switch Mounting Screw	3.7 N·m (33 lb.in.)



1 PIVOT PIN REMOVER
2 LOCK SHOE AND RELEASE LEVER PIN REMOVER AND INSTALLER
3 DRIVER HANDLE
4 STEERING COLUMN HOUSING BEARING INSTALLER
5 LOCK PLATE COMPRESSOR

Figure 35 - Special Tools

BLANK

SECTION 4A

PROPELLER SHAFT

NOTICE:When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

PROPELLER SHAFT ASSEMBLIES

Figure 1

Torque is transmitted from the transmission assembly to the rear axle assembly through one or more of the propeller shaft assemblies (5, 6 and 10) and universal joint assemblies. The 3.4L L32 engine utilizes a two-piece propeller shaft assembly (6 and 10), while the 5.7L LT1 engine utilizes a one-piece propeller shaft assembly (5).

All propeller shaft assemblies (5, 6 and 10) have universal joints to accommodate angle variations between the transmission assembly and the rear axle assembly and/or the rear axle assembly position caused by suspension motion. The propeller shaft assemblies (5, 6 and 10) are connected to the transmission assembly with a splined slip yoke assembly (1 or 24) and to the rear axle assembly with a companion flange (fixed yoke). On the two-piece propeller shaft assembly (6 and 10), the rear portion of the front propeller shaft assembly (6) contains the center support bearing (7) and spline coupling. The spline coupling has internal splines which accept the rear propeller shaft assembly (10). The center support bearing (7) is pressed onto the OD of the coupling. On the front of the rear propeller shaft assembly (10) there is a propeller shaft joint (9)(sometimes called a constant velocity (CV) joint) that fits into the spline coupling of the front propeller shaft assembly (6).

NOTICE: If a vehicle is to be undercoated, the propeller shaft assembly must be kept free of undercoating material.Undercoating material or any other foreign material will upset the propeller shaft balance and produce serious vibration.

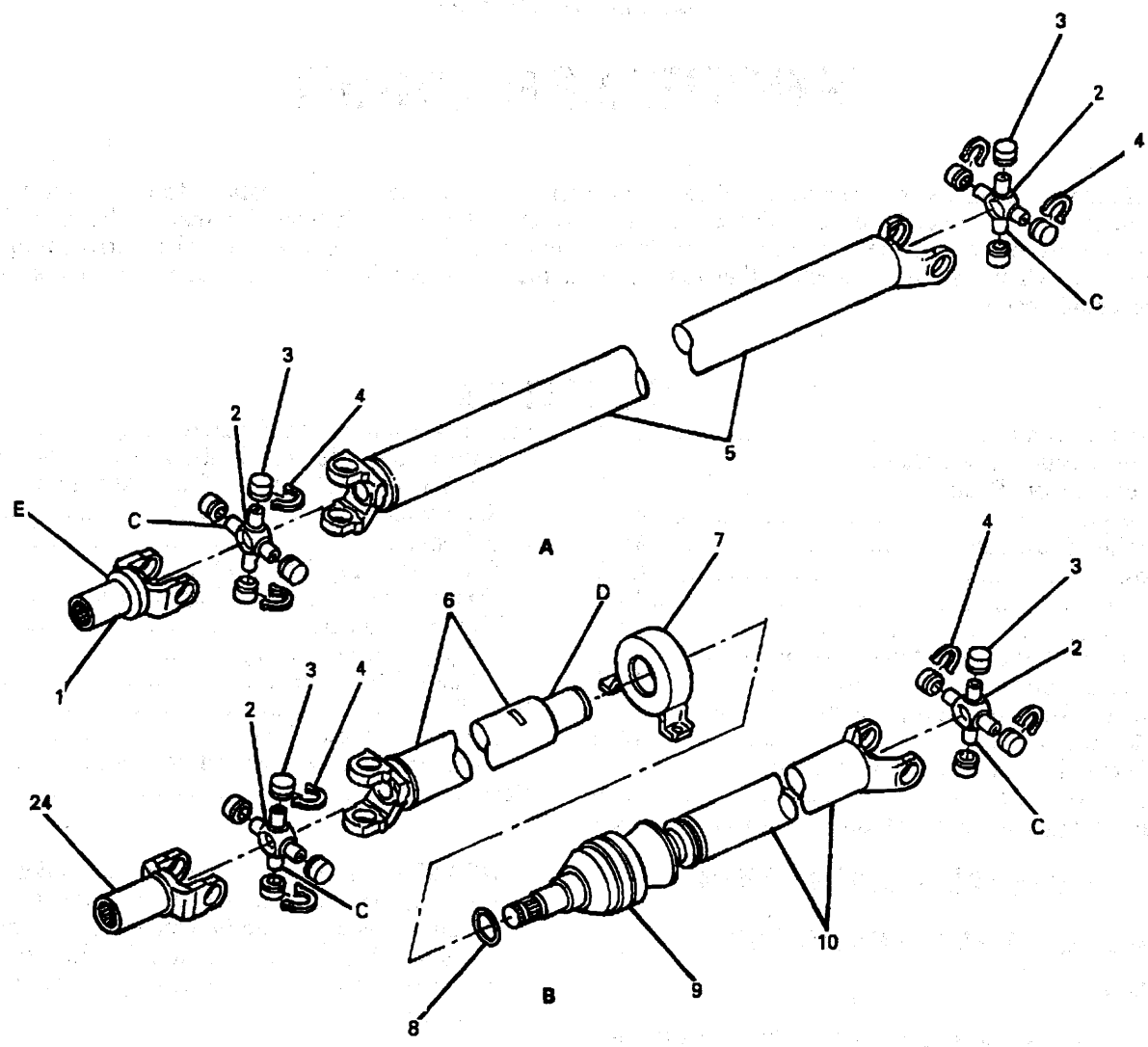
Important

- Before propeller shaft assembly removal, reference mark the propeller shaft assembly to ensure phased installation alignment. Some propeller shaft assemblies have alignment marks or arrows stamped on the shaft at the time of production.

CENTER SUPPORT BEARING

Figure 1

The center support bearing (7) supports the driveline when the two-piece propeller shaft assembly (6 and 10) is used. The center support bearing (7) is a ball-type bearing mounted in a rubber cushion that is mounted to the torque arm assembly. The center support bearing (7) is pre-lubricated and sealed by the manufacturer.



A SHAFT ASSEMBLY, ONE-PIECE PROPELLER
B SHAFT ASSEMBLY, TWO-PIECE PROPELLER
C TRUNNIONS
D COUPLING, SPLINE
E DAMPER, PROPELLER SHAFT SLIP YOKE ASSEMBLY
1 YOKE ASSEMBLY, PROPELLER SHAFT DAMPER AND SLIP
2 SPIDER, PROPELLER SHAFT UNIVERSAL JOINT
3 BEARING, PROPELLER SHAFT UNIVERSAL JOINT SPIDER
4 RING, PROPELLER SHAFT UNIVERSAL JOINT SPIDER BEARING RETAINER
5 SHAFT ASSEMBLY, PROPELLER
6 SHAFT ASSEMBLY, FRONT PROPELLER
7 BEARING, PROPELLER SHAFT CENTER SUPPORT
8 SEAL, REAR PROPELLER SHAFT
9 JOINT, PROPELLER SHAFT
10 SHAFT ASSEMBLY, REAR PROPELLER
24 YOKE ASSEMBLY, PROPELLER SHAFT FRONT SLIP

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Figure 1 - Propeller Shaft Assembly Components

UNIVERSAL JOINT

Figure 1

The universal joint basically connects two Y-shaped yokes by a crossmember called a spider (2). The spider (2) is shaped like a cross having arms of equal length called trunnions. The spider (2) allows the two yoke shafts to operate at any angle to each other. Universal joints are lubricated for life.

When torque is transmitted through any ordinary universal joint, the drive pinion gear yoke fluctuates slightly in speed. In other words, although the propeller shaft slip yoke assembly (1 or 24) rotates at a constant speed, the differential drive pinion gear yoke speeds up and slows down twice per revolution. This fluctuation of the pinion gear yoke is in direct proportion to the angle through which the universal joint is operating; the greater the angle, the greater the fluctuation.

Whenever two universal joints are used, this fluctuation effect can be eliminated by staggering the joints so that the two yokes are 90 degrees apart, provided the two joints are transmitting torque through the same angle.

Therefore, when two universal joints are used, the angles through which they operate must be very nearly the same. This allows the alternate acceleration and deceleration of one joint to be offset by the alternate deceleration and acceleration of the second joint. When the two joints do not run at approximately the same angle, operation is rough and an objectionable vibration is produced.

Universal joints are designed to handle the effects of various loadings and rear axle windup during acceleration. Within the designed angle variations the universal joint will operate efficiently and safely. When the design angle is change or exceeded, the operational life of the joint may decrease.

The universal joint spider bearings (3) used are the needle roller type. The needle roller bearings are held in place on the trunnions by round bearing caps. Production universal joint spider bearings (3) are retained by nylon injected rings instead of conventional retainer (snap) rings (4). All service replacement universal joints use retainer (snap) rings (4).

If it becomes necessary to replace a universal joint, the entire propeller shaft assembly (5, 6 or 10) must be removed from the vehicle. Care should be taken to avoid jamming or bending any parts of the assembly.

PROPELLER SHAFT JOINT

Figure 1

The propeller shaft joint (9) (sometimes called a constant velocity (CV) joint) is used on the two-piece propeller shaft assembly (6 and 10). The propeller shaft joint (9) allows the driveline angle to be adjusted according to the up and down movement of the vehicle without disturbing the power flow.

DIAGNOSIS

The following major component groups are usually the cause of or are related to vibration:

- Engine assembly and mounts.
- Transmission assembly.
- Tires, wheels and brake drum assemblies.
- Propeller shaft assemblies and universal joints. Before road testing a vehicle, check the following:
- All Fasteners for tightness at universal joint, wheel nuts and engine mounts.
- Tire air pressure.
- Load conditions.

ROAD TEST

Figure 2

Road test the vehicle to verify the complaint. Record the speed and rpm at which the greatest vibration occurs. The vibration is likely to be in the steering wheel or in the seat bottom. The road test can be helpful in locating the vibration source.

COAST TEST

Figure 2

NOTICE: When performing a "Coast Test" on a vehicle equipped with an automatic transmission assembly, caution must be taken when returning selector lever from "NEUTRAL" to "DRIVE" to avoid transmission damage. When shifting from "NEUTRAL" to "DRIVE," remember to:

1. Maintain engine speed at 1500 rpm.
2. Brake to 40 km/h (25 mph).
3. Return selector to "DRIVE."

Drive the vehicle past the vibration speed, shift into "NEUTRAL" and coast back through the vibration speed. During a coast test, two kinds of vibration normally occur: a shaking or a buzzing. A shaking vibration is usually a problem with the tires or a wheel and brake drum or brake rotor assembly. A buzzing vibration is usually a driveline problem.

To determine whether a propeller shaft assembly is causing the problem, drive the vehicle through the speed range and note at which speed (vehicle and/or engine) the problem is most pronounced. A tachometer may be used. Shift the transmission assembly into a lower gear range and drive the vehicle at the same engine speed as when the problem was most pronounced in direct drive. Note the effect on the problem.

To determine the engine speed if a tachometer is not used, divide vehicle speed by the transmission gear ratio in which the problem occurs.

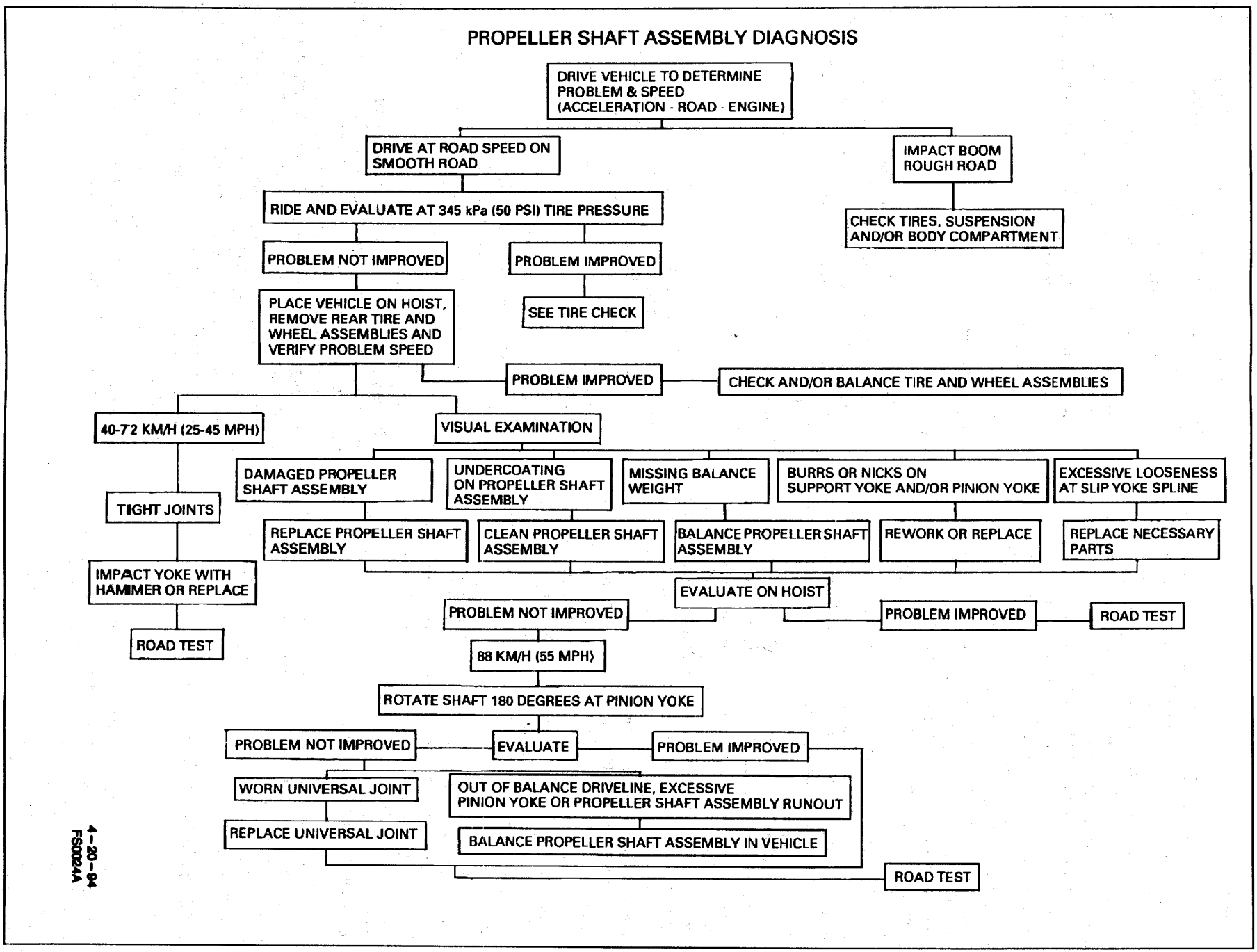


Figure 2 - Propeller Shaft Assembly Diagnostic Chart

Example: With the HYDRA-MATIC 4L60E automatic transmission in 2 range, divide by 1.63. If the problem is most pronounced in direct drive at 88 km/h (55 mph) the same engine speed would be produced in 2 range at 55 km/h (55/1.63 = 34 mph).

If the problem is still present at the same engine speed whether in direct drive or in the lower gear range, a propeller shaft assembly cannot be at fault since a propeller shaft speed varies. If the problem decreases or is eliminated in a different gear range at the same engine speed, a propeller shaft assembly may be at fault. Refer to "Propeller Shaft Assembly Runout Measurement", "Diagnosis of Propeller shaft Assembly and Universal Joint" and Figure 2.

DIAGNOSIS OF PROPELLER SHAFT ASSEMBLY AND UNIVERSAL JOINT

PROBLEM	POSSIBLE CAUSE	CORRECTION
Leak at front propeller shaft (An occasional drop of lubricant leaking from the slip yoke is normal and requires no attention.)	1. Rough outside surface on propeller shaft slip yoke.	1. Replace transmission seal if cut by burrs on slip yoke. Minor burrs can be smoothed by careful use of crocus cloth or honing with a fine stone. Replace slip yoke if outside surface is rough or burred badly.
	2. Fault rear transmission oil seal.	2. Replace the rear transmission oil seal. Bring transmission fluid up to proper level after correction.
Knock in driveline; clunking noise when vehicle is operated under float condition at 16 km/h (10 mph) in high gear or "NEUTRAL."	1. Worn or damaged universal joints. 2. Differential side gears worn.	1. Replace universal joints. 2. Replace differential side gears as required.
Ping, snap, or clinking noise in driveline.	1. Loose rear axle upper or lower control arm bolt/screw.	1. Tighten bolt/screw to specified torque.
	2. Worn or damaged universal joints.	2. Replace universal joints.
Scraping noise	1. Slinger rubbing on rear axle assembly.	1. Straighten slinger to remove interference.
	2. Brake drum assembly, if equipped, contacting backing plate.	2. Replace brake drum assembly or backing plate.

C3149S

ON-VEHICLE SERVICE

Important

- The driveline components in this vehicle have been factory system balanced. System balance provides a smoother running driveline operation. However, it is essential that the positions of all driveline components relative to the propeller shaft assembly and rear axle assembly be observed and **ACCURATELY REFERENCE MARKED PRIOR TO DISASSEMBLY.** These components include the propeller shaft assemblies, rear axle assemblies, differential drive pinion gear yoke, output shaft, etc.**ALL COMPONENTS MUST BE REASSEMBLED INTO THE EXACT RELATIONSHIP TO EACH OTHER AS THEY WERE WHEN REMOVED.** Additionally, the published specifications and torque values, as well as any measurements made prior to disassembly must be followed to maintain the factory balance.

PROPELLER SHAFT ASSEMBLY RUNOUT MEASUREMENT

Figure 3

Tool Required:
J 8001 Dial Indicator Set

Noise or vibration at high speed could be caused by a bent propeller shaft assembly. The propeller shaft assembly could have been damaged by rough handling or a collision. Check for propeller shaft assembly straightness.

1. Raise vehicle on a twin post hoist so that the rear is supported on the rear axle housing assembly and the wheels can spin. Refer to SECTION 0A.

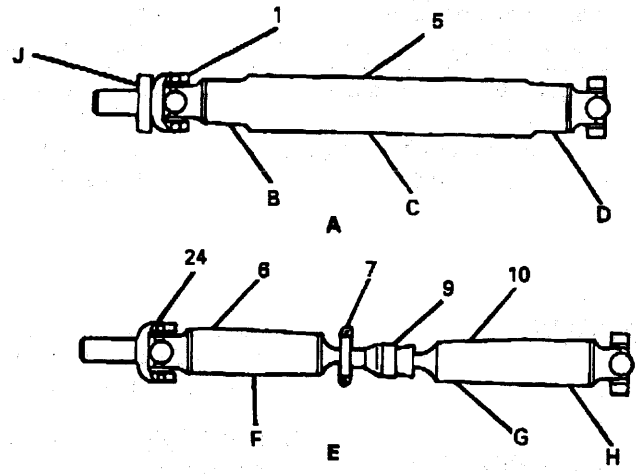
2. Mount J 8001 on a movable support that is high enough to permit contact of the indicator button with the propeller shaft assembly (5, 6 or 10), or mount J 8001 to a magnetic base and attach to a smooth place on the vehicle underbody. Readings are to be taken at points indicated in Figure 3.
3. With transmission in "NEUTRAL," check for runout by turning a rear wheel to rotate the propeller shaft assembly (5 or 6 and 10).
4. If runout exceeds 1.40 mm (0.055 inch), disconnect propeller shaft assembly (5 or 10) at differential drive pinion gear yoke and rotate the propeller shaft assembly (5 or 10) 180 degrees. Reinstall propeller shaft assembly (5 or 10). Check runout again.
5. If runout is still over specifications at the differential drive pinion gear yoke end, differential drive pinion gear yoke runout should be measured. Refer to "Differential Drive Pinion Gear Yoke Runout Measurement" in the following procedure. If run-out is still over specifications, replace the propeller shaft assembly (5, 6 or 10), but only after checking for vibration or noise.
6. Lower vehicle.

DIFFERENTIAL DRIVE PINION GEAR YOKE RUNOUT MEASUREMENT

Figure 4

Tools Required:
J 35819 Runout Gage
J 8001 Dial Indicator Set

1. Raise the vehicle on a twin post hoist so the rear is supported on the rear axle housing and the wheels can spin. Refer to SECTION 0A.
2. Remove propeller shaft assembly. Refer to "One and Two-Piece-Propeller Shaft Replacement" in this section.
3. Measure pinion gear yoke runout using J 35819 and J 8001. record runout amd mark high and low points of pinion gear yoke.
4. If pinion gear yoke runout is 0.15 mm (0.006 inch)or less, remove the pinion gear yoke balance weight, if used.No further action is required.
5. If pinion gear yoke runout is geater than 0.15 mm (0.006 inch), but less than 0.28 mm (0.011 inch) and the balance weight is at or near the low point of pinion gear yoke runout, no further action is required. If balance weight is not at or near the low point of pinion gear yoke runout, remove the weight.
6. If pinion gear runout is over 0.28 mm (0.011 inch), but no greater than 0.38 mm (0.015 inch) and the balance weight is at or near the low point of pinion gear yoke runout no further action is required.
7. If the balance weight is not at or near the low point of pinion gear runout, remove the weight and rotate the pinion gear yoke until runout is 0.25 mm (0.010 inch) or less.
8. If impossible to achieve 0.25 mm (0.010 inch) or less runout, install a new pinion gear yoke and recheck for 0.25 mm (0.010 inch) or less runout.



A ONE-PIECE PROPELLER SHAFT ASSEMBLY RUNOUT CHECK
B ONE-PIECE PROPELLER SHAFT ASSEMBLY FRONT RUNOUT MEASUREMENT POINT
C ONE-PIECE PROPELLER SHAFT ASSEMBLY CENTER RUNOUT MEASUREMENT POINT
D ONE-PIECE PROPELLER SHAFT ASSEMBLY REAR RUNOUT MEASUREMENT POINT
E TWO-PIECE PROPELLER SHAFT ASSEMBLY RUNOUT CHECK
F TWO-PIECE PROPELLER SHAFT ASSEMBLY CENTER RUNOUT MEASUREMENT POINT
G TWO-PIECE PROPELLER SHAFT ASSEMBLY FRONT RUNOUT MEASUREMENT POINT
H TWO-PIECE PROPELLER SHAFT ASSEMBLY REAR RUNOUT MEASUREMENT POINT
J DAMPER, PROPELLER SHAFT SLIP YOKE ASSEMBLY
1 YOKE ASSEMBLY, PROPELLER SHAFT DAMPER AND SLIP
5 SHAFT ASSEMBLY, PROPELLER
6 SHAFT ASSEMBLY, FRONT PROPELLER
7 BEARING, PROPELLER SHAFT CENTER SUPPORT
9 JOINT, PROPELLER SHAFT
10 SHAFT ASSEMBLY, REAR PROPELLER
24 YOKE ASSEMBLY, PROPELLER SHAFT FRONT SLIP

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Figure 3 - Checking Propeller Shaft Assembly Runout

Refer to SECTION 4B for pinion gear yoke replacement.
- Service replacement pinion gear yoke may be equipped with balance weights. These weights should not be removed.

9. Install propeller shaft assembly. Refer to "One and Two-Piece Propeller shaft Assembly Replacement" in this section.
10. Lower vehicle.

PROPELLER SHAFT ASSEMBLY BALANCE CHECK

Remove or Disconnect

NOTICE: See "Notice" on page 4A-1 of this section.

1. Raise vehicle on twin post hoist so wheels can spin. Refer to SECTION 0A.
2. Both rear tire and wheel assemblies. Refer to SECTION 3E.
3. Install wheel nuts with flat sides against rear brake drum or rotor assemblies.

Inspect

A. Propeller shaft assembly, universal joint, and attachments for mud, undercoating or loose fasteners.

Clean

- Propeller shaft assembly, universal joint, and attachments.

Clean

- Any loose attachments or fasteners to specifications. Refer to "specifications" in this section.

CAUTION: Do not run the vehicle faster than 88 km/h (55 mph). Stay clear of the universal joint and balance weight areas to avoid possible personal injury. Do not run the vehicle on the hoist for extended period due to the danger of overheating the transmission assembly or engine assembly.

B. Run vehicle in gear at speed where disturbance peaks. Observe intensity of disturbance.

NOTICE: On vehicles with an automatic transmission assembly, allow the driveline components to stop rotating with the transmission assembly in "NEUTRAL" before placing the transmission assembly in "PARK" or parts may be damaged.

C. Stop engine assembly.

4. Propeller shaft assembly from pinion gear yoke only. Refer to "One and Two-Piece Propeller Shaft Assembly Replacement" in this section.
   - Rotate propeller shaft assembly 180 degrees from original position.

Install or Connect

1. Propeller shaft to pinion gear yoke. Refer to "One and Two-Piece Propeller Shaft Assembly Replacement" in this section.
2. Remove wheel nuts.
3. Tire and wheel assemblies. Refer to SECTION 3E.
4. Determine position that gives best driveline response by road testing vehicle for final check of propeller shaft balance.
5. If balance is unacceptable, refer to "Propeller Shaft Assembly Balancing" in this section.

PROPELLER SHAFT ASSEMBLY BALANCE CHECK

Hose Clamp Method

Figures 5 through 7

1. Place vehicle on twin post hoist so that rear of vehicle is supported on rear axle housing and rear wheels are free to rotate. Refer to SECTION 0A.

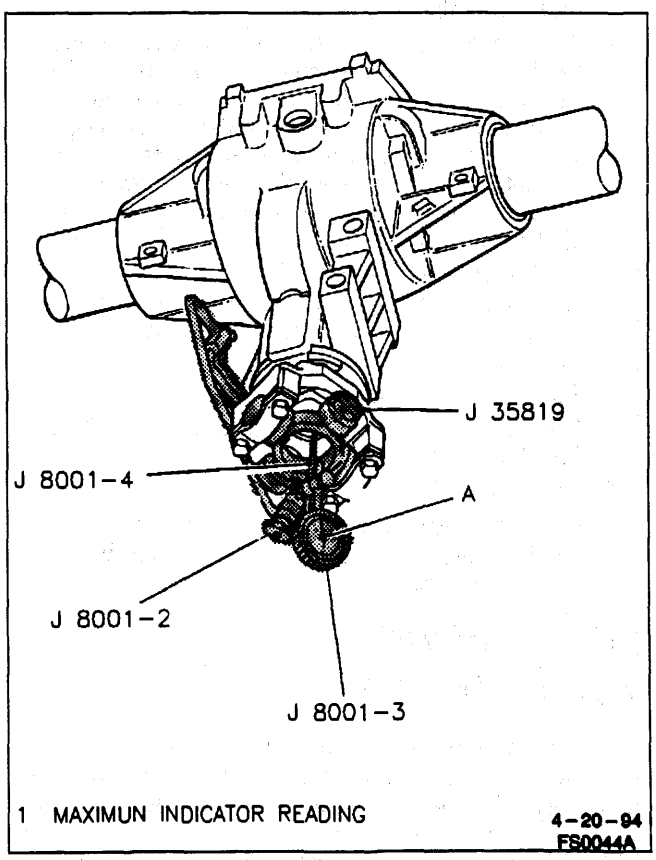


figure 4 - Differential Drive Pinion Gear Yoke Runout

2. Remove both rear tire and wheel assemblies. Refer to SECTION 3E. Install wheel nuts with flat sides next to rear brake drum or rotor assemblies.
3. Mark and number propeller shaft assembly (5) at four points, 90 degrees apart, at rear of propeller shaft assembly (5) just forward of balance weight.
4. Install two clamps (11) on rear of propeller shaft assembly (5) and slide them rearward until clamps (11) stop at nearest balance weight welded to tube.
   - Align both clamps (11) at any one of four marks made on propeller shaft assembly (5) in step 3 and tighten.

CAUTION: Do not run the vehicle faster than 88 km/h (55 mph).Stay clear of the universal joint and balance weight areas to avoid possible personal injury. Do not run the vehicle on the hoist for extended periods due to the danger of overheating the transmission assembly or engine assembly.

5. Run vehicle through speed range to 81-88 km/h (50-55 mph).Note amount of imbalance felt at front of rear axle housing assembly.
6. Loosen clamps (11) and rotate clamp heads 90 degrees to next mark on propeller shaft assembly (5). Tighten clamps (11) and repeat step 5.
7. Repeat step 6 until vehicle has been run with clamp heads located at all four marks on propeller shaft assembly (5).
8. Position clamps (11) at point of least imbalance. Rotate clamp heads away from each other 45 degrees, one on each side of the position.
   A. Run vehicle and note if balance has improved.
   B. In some cases it may be necessary to use one clamp (11) or possibly three clamps (11) in order to obtain good balance.
   C. Replace propeller shaft assembly (5) if three clamps (11) do not improve balance.
9. Continue to rotate clamps (11) apart in smaller angular increments until imbalance is at its minimum.
10. Remove wheel nuts.
11. Install tire and wheel assemblies. Refer to SECTION 3E.
12. Lower vehicle.
13. Road test vehicle to check final balance.
    - A small vibration felt while vehicle is on hoist may not be noticed on road test.

Strobe Light Method

Figures 5 through 9

If a strobe-light type wheel balancer is used, it will help in the balancing of the propeller shaft assembly. The balance pick-up unit should be placed directly under the nose of the rear axle housing assembly and as far forward as possible. Make up an extension for the balance pick-up unit by using 3/8.-inch tube and compression fittings (FIGURE 8).

1. Place vehicle on twin post hoist so rear of vehicle is supported on rear axle housing assembly and rear wheels are free to rotate. Lower rear hoist and allow rear axle assembly to rest on jackstands.
2. Remove both rear tire and wheel assemblies. Refer to SECTION 3E. Install wheel nuts with flat sides next to rear brake drum or rotor assemblies. System is now released and free to respond to propeller shaft assembly (5).
3. Mark and number propeller shaft assembly (5) at four points, 90 degrees apart, at rear of propeller shaft assembly (5) just forward of balance weights.
4. Place strobe light wheel balancer pick-up under pinion gear yoke in contact with rear axle housing assembly and as far forward as possible.

CAUTION: Do not run the vehicle faster than 88 km/h (55 mph).Stay clear of the universal joint and balance weight areas to avoid possible personal injury. Do not run the vehicle on the hoist for extended periods due to the danger of overheating the transmission or the engine assemblies.

5. Run vehicle in gear at speed where disturbance is at its peak.
6. Allow driveline to stabilize by holding at steady speed.
7. Point strobe light up at spinning propeller shaft assembly (5) and note position of one of the reference numbers.

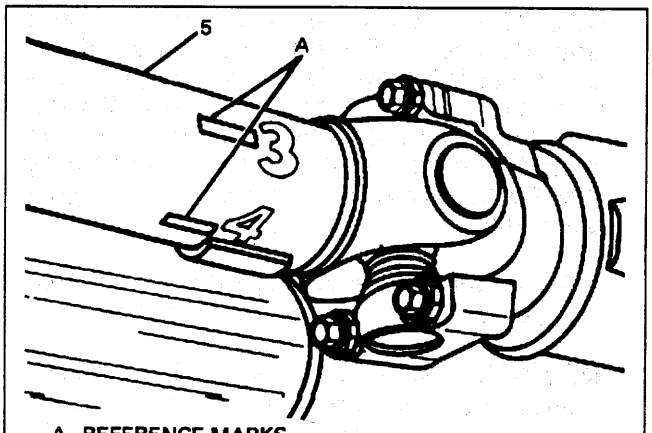


Figure 5 - Propeller/Shaft Reference Marks (One-Piece Propeller Shaft Shown, Two-Piece Propeller Shaft Similar)

NOTICE: On vehicles with an automatic transmission assembly, allow the driveline components to stop rotating with the transmission assembly in "NEUTRAL" before placing the transmission assembly in "PARK" or parts may be damaged.

8. Shut off engine assembly.
9. Position propeller shaft assembly (5) so reference numbers will be in same position as was noted while propeller shaft assembly (5) was rotating.
   - When strobe light flashed, heaviest point of propeller shaft assembly (5) was at bottom (6 o'clock). To balance propeller shaft assembly (5), it would be necessary to apply balancing weights (hose clamps) 180 degrees away from heaviest point or at top of propeller shaft assembly (5) (12 o'clock).
10. Install two screw-type clamps (11) on propeller shaft assembly (5) as close to rear as possible. Position both clamp heads 180 degrees from heaviest point of propeller shaft assembly (5) as indicated by strobe light. Tighten clamps (11).
11. Run vehicle through speed range 81-88 km/h (50-55 mph).
    A. If disturbance is not gone and strobe light shows clamp heads at bottom (6 o'clock) of propeller shaft assembly (5), go to step 12.
    B. If strobe light shows two clamp heads at top of propeller shaft assembly (5), add one more clamp (11) and check.
    C. If strobe light shows three clamp heads at top of propeller shaft assembly (5), remove propeller shaft assembly (5) and rotate 180 degrees on pinion gear yoke (14). Check again, without clamps (11).
    D. Repeat balancing, starting with step 10.

    Important

    - Do not use more than three clamps (11) to balance propeller shaft assembly (5).

    E. If propeller shaft assembly (5) still needs more than three clamps (11) at same clock position, replace propeller shaft assembly (5).
    F. If clamps (11) are also 180 degrees from their original position after rotating propeller shaft assembly (5) 180 degrees, pinion gear yoke (14) is out of balance and must be replaced.
    G. If strobe light shows clamps (11) at bottom of propeller shaft assembly (5), but disturbance still exists, go to step 12.
12. Rotate two of the clamps (11) equally away from each other toward top (one on each side of the position) in small increments until best balance is achieved. In some cases it may be necessary to use one clamp (11) or possibly three clamps (11) in order to obtain good balance. Replace propeller shaft assembly (5) if three clamps (11) do not correct problem.
13. Remove wheel nuts.
14. Install tire and wheel assemblies. Refer to SECTION 3E.
15. Remove strobe light and lower vehicle.
16. Road test vehicle to check final balance.
    - A small vibration felt while vehicle is on hoist, may not be noticed on road test.

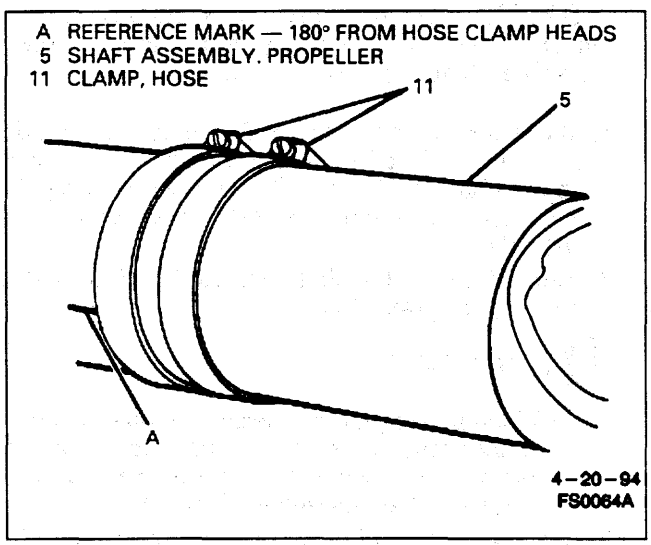


Figure 6 - Balance Hose Clamps (One-Piece Propeller Shaft Shown, Two-Piece Propeller Shaft Similar)

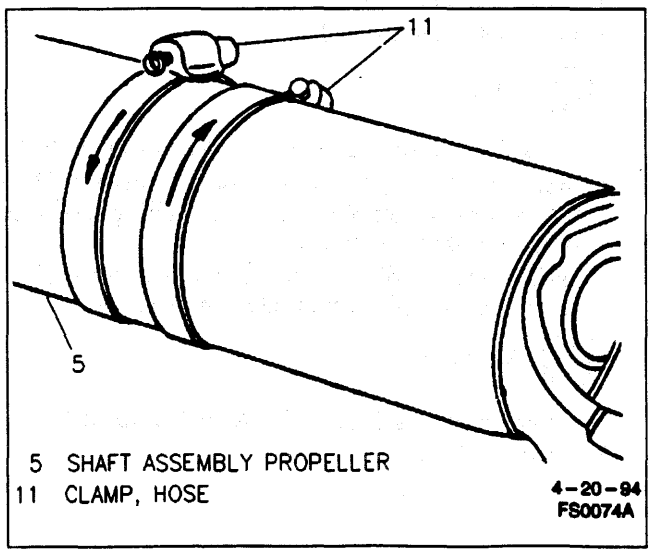


Figure 7 - Rotating Balance Hose Clamps (One-Piece Propeller Shaft Shown, Two-Piece Propeller Shaft Similar)

ONE AND TWO-PIECE PROPELLER SHAFT ASSEMBLY REPLACEMENT

FIGURE 10

Remove or Disconnect

NOTICE: Do not strike or drop the propeller shaft assembly, or allow the universal joints to bend to extreme angles, as this might fracture a joint internally.

1. Raise and suitably support vehicle. Refer to SECTION 0A.

2. Mark relationship of propeller shaft assembly (5 or 10) to pinion gear yoke (14).
3. Bolt/screws (16) from center support bearing (7), if removing two-piece propeller shaft assembly.
4. Center support bearing (7) and washers (17) from torque arm assembly (18), if removing two-piece propeller shaft assembly.
5. Four bolts/screws (12).
6. Two retainers (13).
7. Propeller shaft assembly (5 or 6 and 10) by withdrawing slip yoke assembly (1 or 24) from transmission assembly, moving propeller shaft assembly (5 or 6 and 10) rearward and passing it under housing assembly (15).
   - Support propeller shaft assembly (5 or 6 and 10) during removal.
   - If bearing caps are loose, tape them together to prevent dropping and losing needle roller bearings.

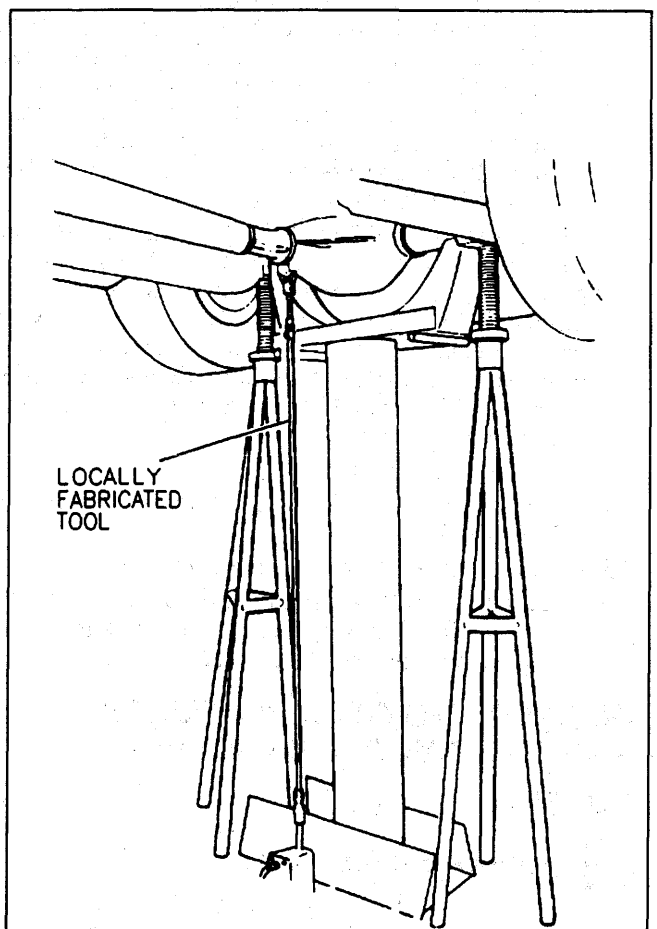


Figure 8 - Picking-up Differential Drive Pinion Gear Yoke

Inspect

1. Transmission output shaft splines for burrs.
2. Outer diameter of slip yoke assembly (1 or 24) for burrs.
3. Splines of slip yoke assembly (1 or 24) for damage, twisting or wear. They should agree in number and fit with transmission output shaft splines.
4. Pinion gear yoke (14) at universal joint cap connecting surface for burrs or foreign material.

Install or Connect

NOTICE: See "Notice" on page 4A-1 of this section.

NOTICE: The propeller shaft assemblies must be supported carefully during handling to avoid jamming or bending any of the parts.

NOTICE: To prevent transmission seal damage, do not place any tool between the propeller shaft slip yoke and splines.

1. Slip yoke assembly (1 or 24) onto transmission output shaft after lubricating spline with approximately 18 gm (0.6 ounce) of propeller shaft slip yoke lubricant GM P/N 1050169, or equivalent.
2. Rear of propeller shaft assembly (5 or 10) to pinion gear yoke (14).

Important

- When making the rear propeller shaft assembly connection, be sure to align the mark on pinion gear yoke (14) with the mark on propeller shaft assembly (5 or 10).

3. Rear universal joint to pinion gear yoke (14), making sure bearing caps are properly seated.
4. Two retainers (13).
5. Four bolts/screws 912).

Tighten

- Bolts/screws (12) evenly to 22 N.m (16 lb. ft.).

6. Washers (17) and center support bearing (7) to torque arm assembly (18), if installing two-piece propeller shaft assembly.
7. Bolts/screws (16) to center support bearing (7), if installing two-piece propeller shaft assembly.

Tighten

- Bolts/screws (16) to 50 N.m (37 lb. ft.).

8. Lower vehicle.

UNIT REPAIR

TWO-PIECE PROPELLER SHAFT ASSEMBLY

NOTICE: The two-piece propeller shaft assembly available with the 3.4L L32 engine is no longer serviceable for 1995. The propeller shaft assembly is replaced as a complete assembly only.

CENTER SUPPORT BEARING REPLACEMENT

NOTICE: The center support bearing used on the two-piece propeller shaft is no longer serviceable for 1995. The center support bearing assembly and two-piece propeller shaft must be replaced as a assembly.

UNIVERSAL JOINTS

When taking apart a propeller shaft assembly, two types of universal joints may be found: nylon injected ring and snap ring.

NOTICE: Never clamp propeller shaft tubing in a vise, as the tube may be dented. Always clamp on one of the yokes and support the shaft horizontally. Avoid damaging the propeller shaft slip yoke sealing surface. Nicks may damage the bushing or cut the transmission extension housing seal. Mark the slip joint and propeller shaft to ensure correct reassembly.

NYLON INJECTED RING TYPE

Figures 11 THROUGH 13

Tools Required:
J 9522-3 U-Joint Bearing Separator
J 9522-5 U-Joint Bearing Spacer Remover

Disassemble

1. Support propeller shaft assembly in a horizontal position in line with base plate of a press.
2. Place universal joint so that lower ear of shaft yoke is supported on a 1 1/8-inch socket.
3. Lower bearing cap (19) out of yoke ear by placing J 9522-3 on open horizontal bearing caps (19) and pressing lower bearing cap (19) out of yoke ear. This shears nylon injected ring on lower bearing cap (19). If bearing cap (19) is not completely removed, lift J 9522-3 and insert J 9522-5 between seal (23) and bearing cap (19). Complete removal of bearing cap (19) by pressing it out of yoke.
4. Rotate propeller shaft assembly. Shear opposite nylon injected ring.
5. Opposite bearing cap (19) out of yoke.
6. Spider (2) from yoke.
   - There are no bearing retainer grooves in production bearing caps (19), therefore, they cannot be reused.
   - If front universal joint is being replaced, remove pair of bearing caps (19) from propeller shaft slip yoke is same manner.

Clean

- Yoke in area locating retainer ring (4) to insure proper assembly.
- All sheared nylon from universal joint cup bore.

Important

- Production universal joints of this type cannot be reassembled. Nylon injected ring types are replaced by external snap ring types.

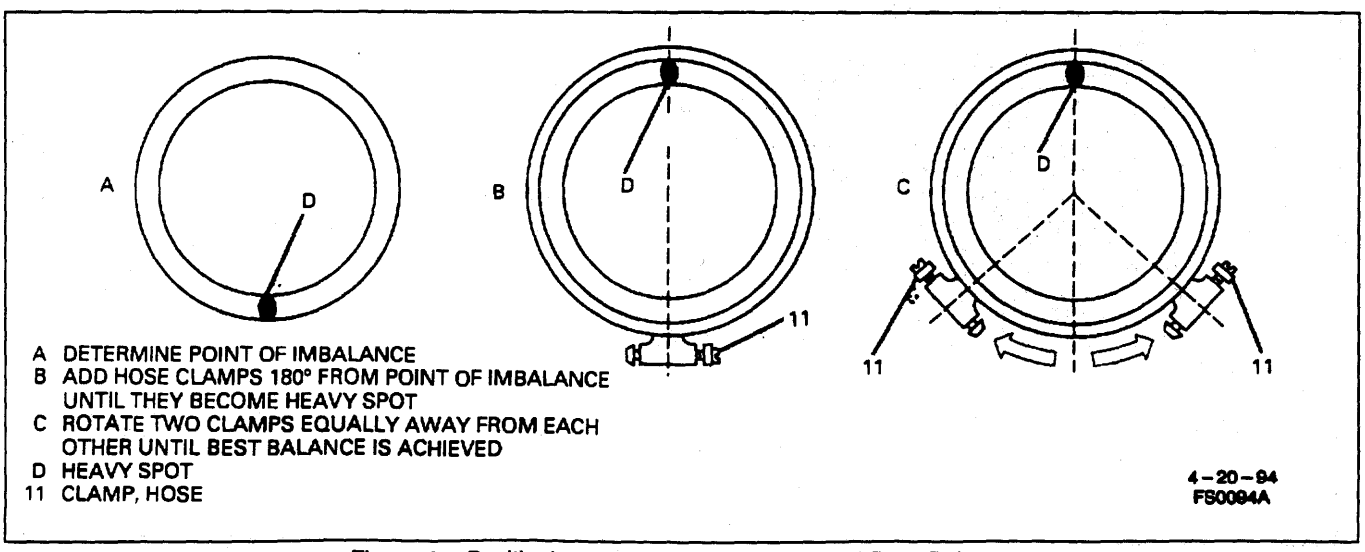
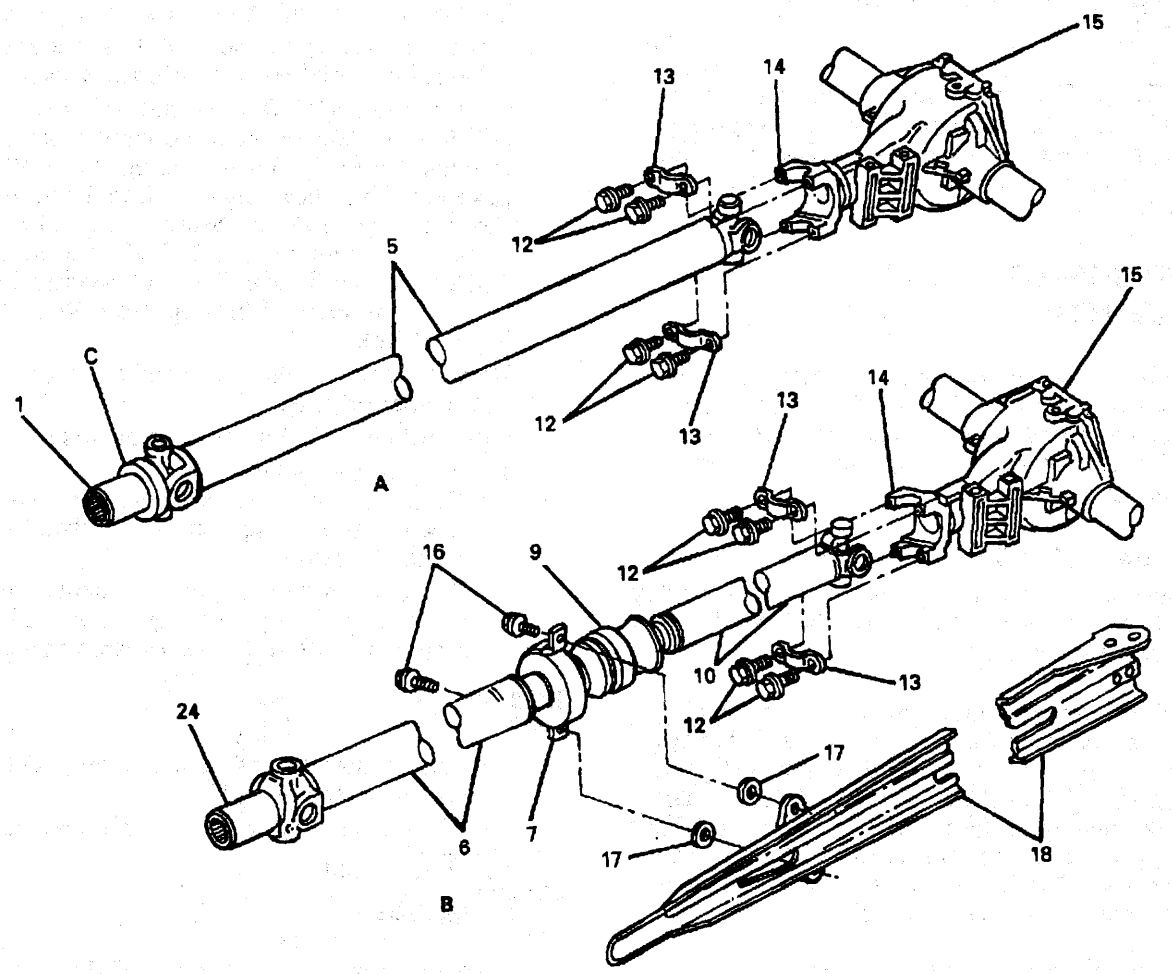


Figure 9 - Positioning Hose Clamps to Achieve Best Balance



A SHAFT ASSEMBLY, ONE-PIECE PROPELLER
B SHAFT ASSEMBLY, TWO-PIECE PROPELLER
C DAMPER, PROPELLER SHAFT SLIP YOKE ASSEMBLY
1 YOKE ASSEMBLY, PROPELLER SHAFT DAMPER AND SLIP
5 SHAFT ASSEMBLY, PROPELLER
6 SHAFT ASSEMBLY, FRONT PROPELLER
7 BEARING, PROPELLER SHAFT CENTER SUPPORT
9 JOINT, PROPELLER SHAFT
10 SHAFT ASSEMBLY, REAR PROPELLER
12 BOLT/SCREW, PROPELLER SHAFT
13 RETAINER, PROPELLER SHAFT
14 YOKE, DIFFERENTIAL DRIVE PINION GEAR
15 HOUSING ASSEMBLY, REAR AXLE
16 BOLT/SCREW, PROPELLER SHAFT
17 WASHER, PROPELLER SHAFT
18 ARM ASSEMBLY, REAR AXLE TORQUE
24 YOKE ASSEMBLY, PROPELLER SHAFT FRONT SLIP

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Figure 10 - Propeller Shaft Assemblies

When reassembling a propeller shaft assembly, always install a complete universal joint service kit. This kit includes one pregreased spider (2), four service bearing cap assemblies with seals (23), needle roller bearings (21), delrin round washers (20), delrin flat washers (22), grease and four retainer rings (4). Make sure that the seals (23) are in place on the service bearing caps (19) to hold the needle roller bearings (21) in place during handling.

Assemble

For universal joint assembly procedure, refer to "Snap Ring Type" in the following procedure.

Snap Ring Type

Figure 11 through 16

Tools Required:
J 9522-3 U-Joint Bearing Separator
J 9522-5 U-Joint Bearing Spacer Remover

NOTICE: Use care not to loosen or damage dust seals. If dust seals are loose or damaged, replace the entire universal joint.

These universal joints are designed for extended life and do not require periodic inspections or lubrication. When these joints are taken apart, repack bearings and lubricant reservoir at the end of the trunnions with chassis lubricant GM P/N 1052356 or GM P/N 1052497, or equivalent.

Disassemble

1. Retainer rings (4). If retainer ring (4) does not readily snap out of grooves, tap end of bearing cap (19) lightly to relieve pressure against retainer ring (4).
2. Support propeller shaft assembly in a horizontal position in line with base plate of a press.
3. Place universal joint so lower ear of yoke is supported on a 1 1/8-inch socket.
4. Lower bearing cap (19) out of yoke ear. Place J 9522-3 on open horizontal bearing cap (19). If bearing cap (19) is not completely removed, lift J 9522-3 and insert J 9522-5 between seal (23) and bearing cap (19) being removed.Complete removal of bearing cap (19) by pressing it out of yoke.
5. Rotate propeller shaft assembly and press opposite bearing cap (19) out of yoke.
6. Spider (2) form yoke.

Assemble

1. One bearing cap (19) part way into one side of yoke. Turn this yoke ear to the bottom.
   - Insert J 9522-3 seating trunnion in bearing cap (19).
2. Opposite bearing cap (19) part way.

Inspect

- Both trunnions to ensure positioning is straight and true into bearing caps (19).

3. Press against opposite bearing caps (19), working spider (2) all of the time to ensure free movement of trunnions in bearings.

Inspect

- Needle roller bearing (21) for binding. If binding, one or more needle roller bearings (21) has probably tipped under end of trunnion.

4. Stop pressing when one bearing retainer groove clears inside of yoke.

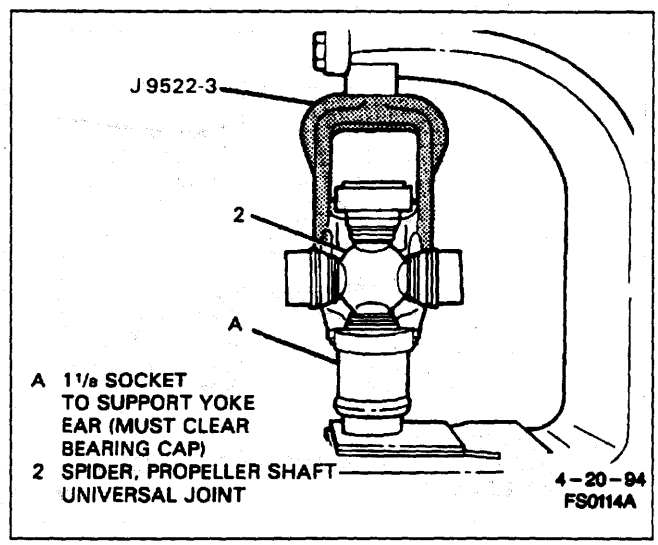


Figure 11 - Pressing Out Universal Joint Bearing

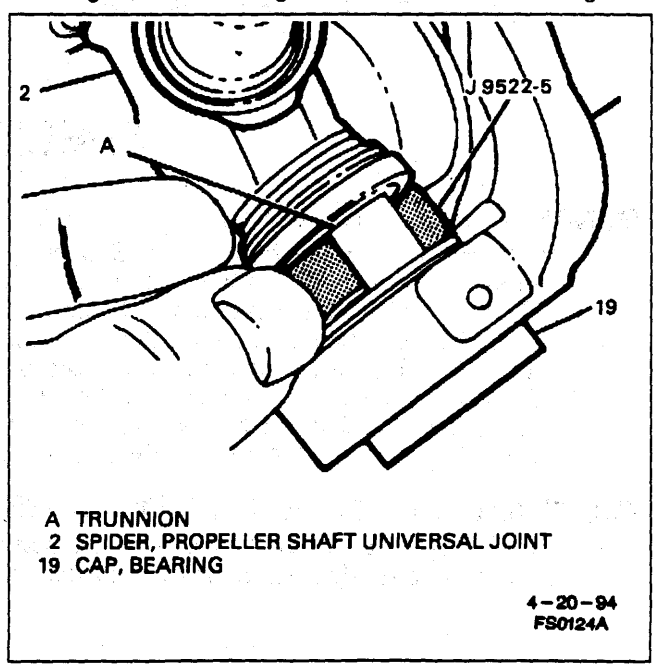
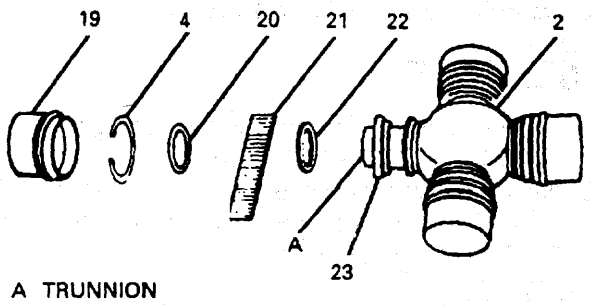


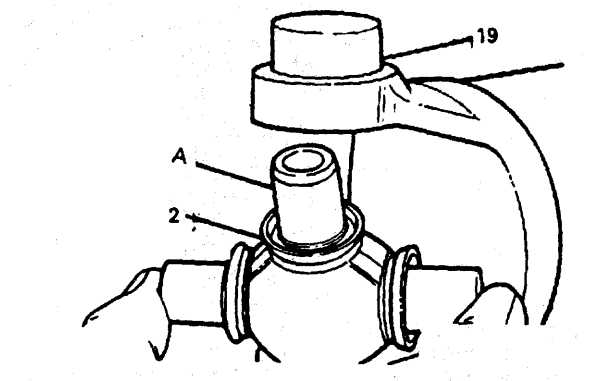
Figure 12 - Installing Universal Joint Bearing spacer Remover



A TRUNNION
2 SPIDER, PROPELLER SHAFT UNIVERSAL JOINT
4 RING, PROPELLER SHAFT UNIVERSAL JOINT SPIDER BEARING RETAINER
19 CAP, BEARING
20 WASHER, DELRIN ROUND
21 BEARING, NEEDLE ROLLER
22 WASHER, DELRIN FLAT
23 SEAL

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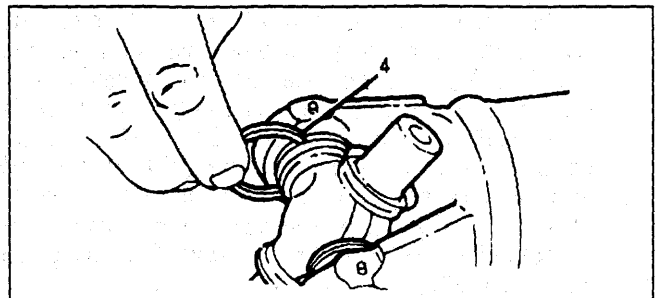
Figure 13 - Service Universal Joint



A TRUNNION
2 SPIDER, PROPELLER SHAFT UNIVERSAL JOINT
19 CAP, BEARING

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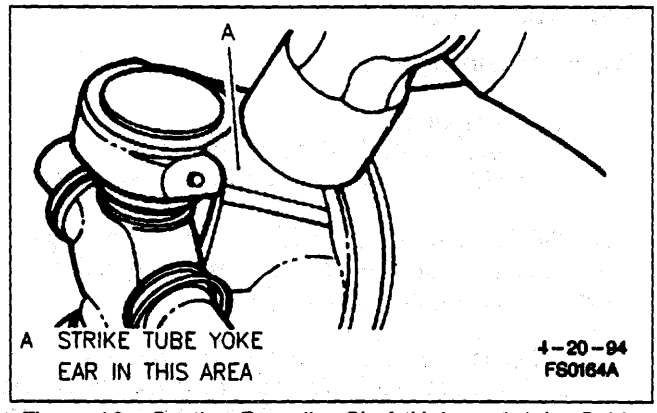
Figure 14 - Partially Inserter Bearing Cap



4 RING, PROPELLER SHAFT UNIVERSAL JOINT SPIDER BEARING RETAINER

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Figure 15 - Installing Propeller Shaft Universdal Joint Spider Bearing Retainer Ring



A STRIKE TUBE YOKE EAR IN THIS AREA

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Figure 16 - Seating Propeller Shaft Universal Joint Spider Bearing Retainer Ring

5. Retainer ring (4) by pressing into place.
   - Continue pressing until opposite side can be snapped into place. If needed, strike yoke firmly with a hammer to aid in seating the retainer rings (4). This springs yoke ears slightly.
6. Repeat steps 1 through 5 for other half of universal joint.

SPECIFICATIONS

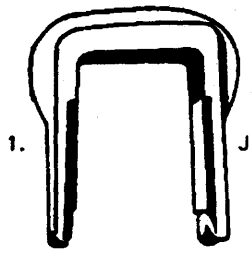
GENERAL SPECIFICATIONS

One-Piece Propeller Shaft Assembly Runout	
Front Propeller Shaft Assembly Runout	1.40 mm (0.055")
Center Propeller Shaft Assembly Runout	1.40 mm (0.055")
Rear Propeller Shaft Assembly Runout	1.40 mm (0.055")
Two-Piece Propeller Shaft Assembly Runout	1.40 mm (0.055")
Front Propeller Shaft Assembly Center Runout	1.40 mm (0.055")
Rear Propeller shaft Assembly Front Runout	1.40 mm (0.055")
Rear Propeller Shaft Assembly Rear Runout	1.40 mm (0.055")

FASTENER TIGHTENING SPECIFICATIONS

Propeller Shaft-to-Center Support Bearing Bolt/Screw	50 N·m (37 lb. ft.)
Propeller shaft-to-differential Yoke Bolt/Screw	22 N·m (16 lb. ft.)

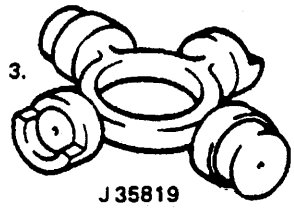
SPECIAL TOOLS



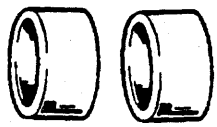
1. J 9522-3



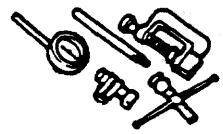
2. J 9522-5



3. J 35819



4. J 35819-100



5. J 8001

1. U-JOINT BEARING SEPARATOR
2. U-JOINT BEARING SPACER REMOVER
3. RUNOUT GAGE
4. RUNOUT GAUGE ADAPTER SLEEVES
5. DIAL INDICATOR SET

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BLANK

SECTION 4B

REAR AXLE

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

STANDARD REAR AXLE ASSEMBLY

Figures 1 through 4

The rear axle assembly is a semi-floating hypoid type in which the vehicle weight is carried on the housing assembly (16). The rear axle assembly is designed for use with an open driveline and coil spring assemblies. The rear axle assembly has a hypoid type ring gear (20) with the centerline of the drive pinion gear (23) below the centerline of the ring gear (20).

All parts necessary to transmit power from the propeller shaft to the rear tire and wheel assemblies are enclosed in the housing assembly (16). A removable steel cover (43) bolted to the rear of the housing assembly (16) permits service of the rear axle assembly without removing the entire assembly from the vehicle.

A universal joint connects the rear end of the propeller shaft to the yoke (3). The yoke (3) has a splined end which fits over and drives the drive pinion gear (23). Two preloaded tapered roller bearings support the drive pinion gear (23) in the housing assembly (16). The races of the inner bearing assembly (18) and the outer bearing assembly (7) are a tight press fit in the housing assembly (16). The inner bearing assembly (18) is a tight press fit onto the drive pinion gear (23). The outer bearing assembly (7) combines a light press fit to a close sliding fit on the yoke end of the pinion gear stem. The races of the inner and outer bearing assemblies (18 and 7) are pressed against shoulders recessed in the housing assembly (16).

Located on shaft 63 (Figure 3) near the hub is the rear wheel speed sensor ring used by the antilock brake system (ABS) and traction control system (TCS) to transmit rear wheel speed information. The sensor ring is a press fit on shaft (39) and is not serviceable. For more information refer to SECTION 5E2.

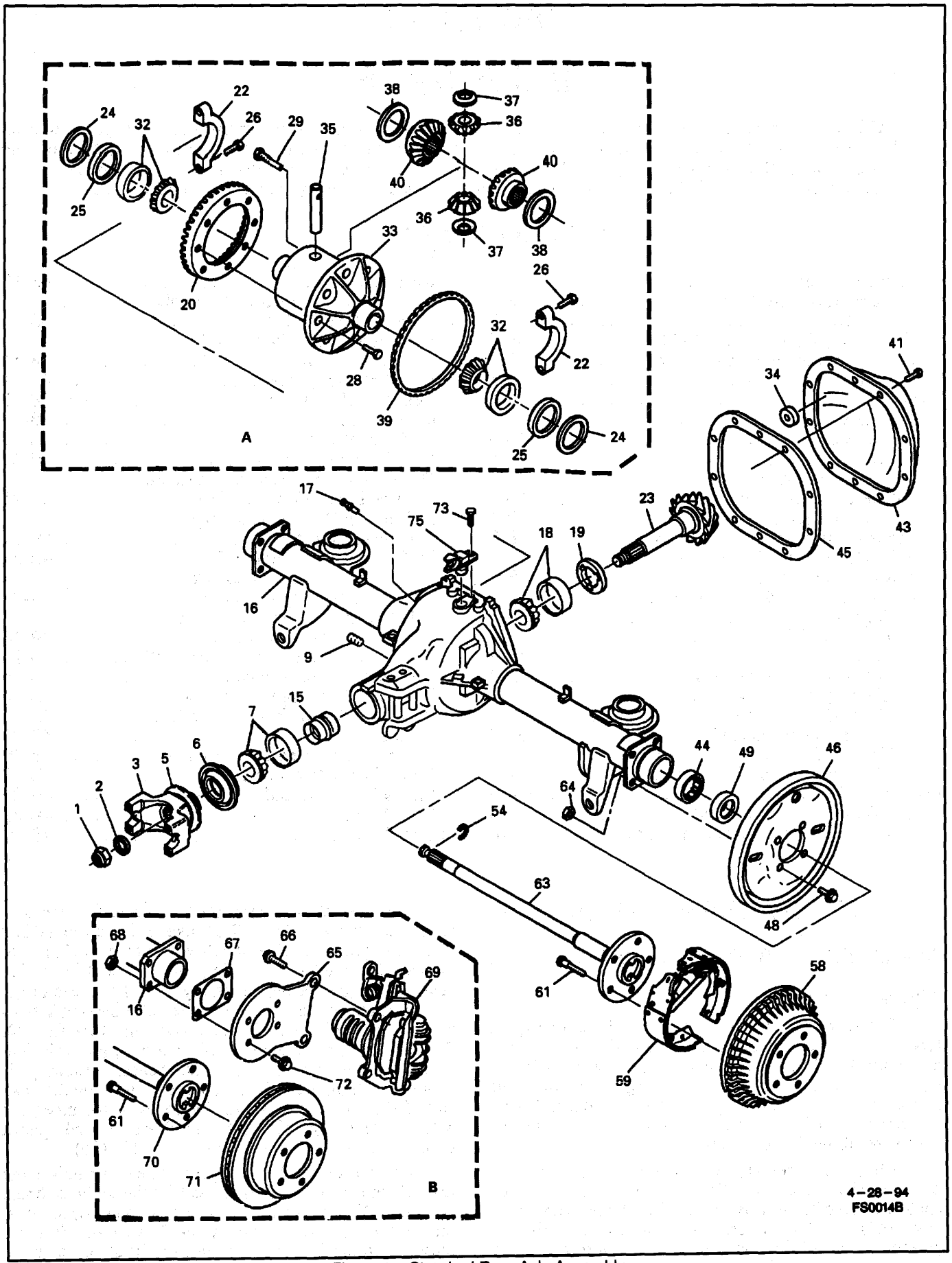


Figure 1 – Standard Rear Axle Assembly

A DIFFERENTIAL ASSEMBLY
B OPTIONAL DISC BRAKE ASSEMBLY
1 NUT, DIFFERENTIAL DRIVE PINION GEAR
2 WASHER, DIFFERENTIAL DRIVE PINION GEAR
3 YOKE, DIFFERENTIAL DRIVE PINION GEAR
5 DEFLECTOR, DIFFERENTIAL DRIVE PINION GEAR DIRT
6 SEAL, DIFFERENTIAL DRIVE PINION GEAR
7 BEARING ASSEMBLY, DIFFERENTIAL DRIVE PINION GEAR OUTER
9 PLUG, REAR AXLE HOUSING DRAIN
15 SPACER, DIFFERENTIAL DRIVE PINION GEAR BEARING
16 HOUSING, ASSEMBLY, REAR AXLE
17 VENT, REAR AXLE
18 BEARING ASSEMBLY, DIFFERENTIAL DRIVE PINION GEAR INNER
19 SHIM, DIFFERENTIAL DRIVE PINION GEAR
20 GEAR, DIFFERENTIAL RING
22 CAP, DIFFERENTIAL CARRIER BEARING
23 GEAR, DIFFERENTIAL DRIVE PINION
24 SHIM, DIFFERENTIAL BEARING
25 SPACER, DIFFERENTIAL BEARING
26 BOLT/SCREW, DIFFERENTIAL BEARING CAP
28 BOLT/SCREW, DIFFERENTIAL RING GEAR
29 BOLT/SCREW, DIFFERENTIAL PINION GEAR SHAFT LOCK
32 BEARING ASSEMBLY, DIFFERENTIAL
33 CASE, DIFFERENTIAL
34 MAGNET, REAR AXLE HOUSING CHIP COLLECTING
35 SHAFT, DIFFERENTIAL PINION GEAR
36 GEAR, DIFFERENTIAL PINION
37 WASHER, DIFFERENTIAL PINION GEAR THRUST
38 WASHER, DIFFERENTIAL SIDE GEAR THRUST
39 WHEEL, REAR WHEEL SPEED SENSOR RELUCTOR
40 GEAR, DIFFERENTIAL SIDE
41 BOLT/SCREW, REAR AXLE HOUSING
43 COVER, REAR AXLE HOUSING
44 BEARING ASSEMBLY, REAR AXLE SHAFT
45 GASKET, REAR AXLE HOUSING COVER
46 PLATE, REAR BRAKE BACKING
48 BOLT/SCREW, REAR BRAKE BACKING
49 SEAL, REAR AXLE SHAFT BEARING
54 LOCK, REAR AXLE SHAFT
58 DRUM ASSEMBLY, REAR BRAKE
59 BRAKE ASSEMBLY, REAR
61 BOLT/SCREW, REAR WHEEL
63 SHAFT REAR AXLE (DRUM BRAKE ASSEMBLIES)
64 NUT, REAR BRAKE BACKING PLATE
65 PLATE, REAR BRAKE CALIPER ASSEMBLY MOUNTING
66 BOLT/SCREW, CALIPER ASSEMBLY MOUNTING
67 SHIM, AXLE TUBE FLANGE
68 NUT, REAR BRAKE CALIPER MOUNTING PLATE
69 CALIPER ASSEMBLY, REAR BRAKE
70 SHAFT, REAR AXLE (DISC BRAKE ASSEMBLIES)
71 ROTOR ASSEMBLY, REAR BRAKE
72 BOLT/SCREW, REAR BRAKE BACKING PLATE
73 BOLT/SCREW, SENSOR PLUG MOUNTING
75 SENSOR ASSEMBLY, WHEEL SPEED

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Figure 2 – Standard Rear Axle Assembly – Legend

Tightening nut (1) compresses a collapsible spacer (15) that bears against the outer bearing assembly (7) and a shoulder on the pinion stem. This spacer (15) is used to enable automatic bearing preload adjustment and maintain a preload on both inner and outer bearing assemblies (18 and 7). Adjustment of the fore-and-aft position of the drive pinion gear (23) is obtained by placing selective shims (19) between the head of the drive pinion gear (23) and the inner bearing assembly (18).

The case (33) is one piece and is supported in the housing assembly (16) by two tapered roller side bearing assemblies (32). These are preloaded by inserting shims (24) between the bearing assemblies (32) and the housing assembly (16). The case (33) is positioned for proper differential ring gear-to-differential drive pinion gear backlash by varying the shim thickness from side to side. The ring gear (20) is bolted to the case (33). A speed sensor reluctor wheel (39) is press fit to the case (33). A wheel speed sensor assembly (75) is mounted to the housing assembly (16) (Figure 1) or the mounting plate (65) (Figure 3). This sensor provides wheel speed information to the electronic brake control module (EBCM) assembly. For further information, refer to SECTION 5E1.

The case (33) is one piece and is supported in the housing assembly (16) by two tapered roller side bearing assemblies (32). These are preloaded by inserting shims (24) between the bearing assemblies (32) and the housing assembly (16). The case (33) is positioned for proper differential ring gear-to-differential drive pinion gear backlash by varying the shim thickness from side to side. The ring gear (20) is bolted to the case (33). A speed sensor reluctor wheel (39) is press fit to the case (33). A wheel speed sensor assembly (75) is mounted to the housing assembly (16) (Figure 1) or the mounting plate (65) (Figure 3). This sensor provides wheel speed information to the electronic brake control module (EBCM) assembly. For further information, refer to SECTION 5E1.

Two side gears (40) have splined bores for driving the axle shafts (63 or 70). They are positioned to turn in counterbored cavities in the case (33). The pinion gears (36) have smooth bores and are held in position by a solid pinion gear shaft (35), mounted and locked in the case (33). All four gears are in mesh with each other. The pinion gears (36) turn freely on the pinion gear shaft (35), acting as idler gears when the rear wheel assemblies are turning at different speeds. The pinion gears (36) and side gears (40) are backed by steel thrust washers (37 and 38).

Operation

When the vehicle turns a corner, the differential assembly allows the outer rear tire and wheel assembly to turn faster than the inner tire and wheel assembly. The inner tire and wheel assembly, turning slower with respect to the outer tire and wheel assembly, slows its differential side gear (as the axle shaft is splined to the side gear). The differential pinion gears roll around the slowed differential side gear, driving the other differential side gear tire and wheel assembly faster.

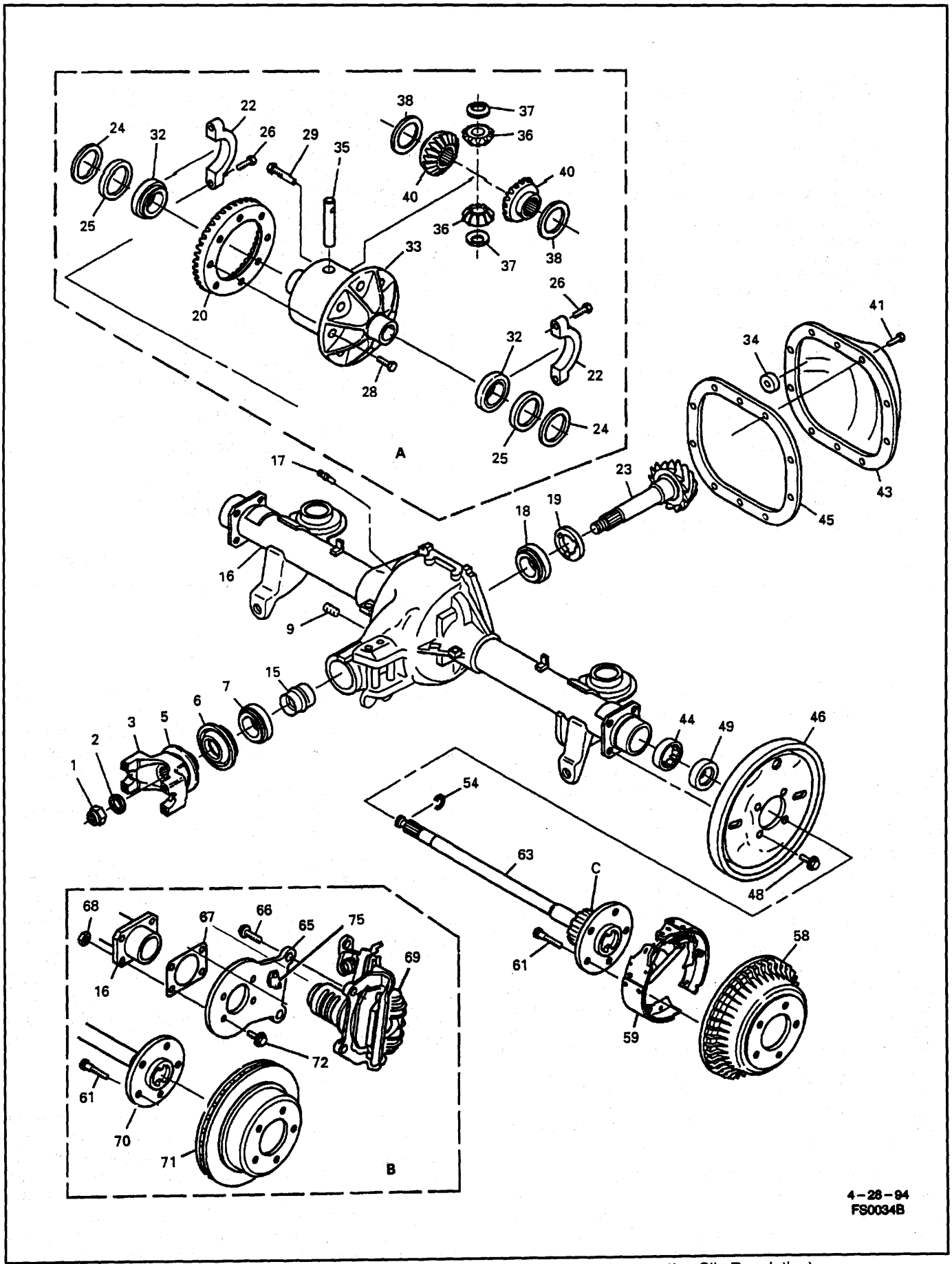


Figure 3 – Rear Axle Assembly Equipped With Traction Control (Acceleration Slip Regulation)

A DIFFERENTIAL ASSEMBLY
B OPTIONAL DISC BRAKE ASSEMBLY
C WHEEL, REAR WHEEL SPEED SENSOR RELUCTOR
1 NUT, DIFFERENTIAL DRIVE PINION GEAR
2 WASHER, DIFFERENTIAL DRIVE PINION GEAR
3 YOKE, DIFFERENTIAL DRIVE PINION GEAR
5 DEFLECTOR, DIFFERENTIAL DRIVE PINION GEAR DIRT
6 SEAL, DIFFERENTIAL DRIVE PINION GEAR
7 BEARING ASSEMBLY, DIFFERENTIAL DRIVE PINION GEAR OUTER
9 PLUG, REAR AXLE HOUSING DRAIN
15 SPACER, DIFFERENTIAL DRIVE PINION GEAR BEARING
16 HOUSING, ASSEMBLY, REAR AXLE
17 VENT, REAR AXLE
18 BEARING ASSEMBLY, DIFFERENTIAL DRIVE PINION GEAR INNER
19 SHIM, DIFFERENTIAL DRIVE PINION GEAR
20 GEAR, DIFFERENTIAL RING
22 CAP, DIFFERENTIAL CARRIER BEARING
23 GEAR, DIFFERENTIAL DRIVE PINION
24 SHIM, DIFFERENTIAL BEARING
25 SPACER, DIFFERENTIAL BEARING
26 BOLT/SCREW, DIFFERENTIAL BEARING CAP
28 BOLT/SCREW, DIFFERENTIAL RING GEAR
29 BOLT/SCREW, DIFFERENTIAL PINION GEAR SHAFT LOCK
32 BEARING ASSEMBLY, DIFFERENTIAL
33 CASE, DIFFERENTIAL
34 MAGNET, REAR AXLE HOUSING CHIP COLLECTING
35 SHAFT, DIFFERENTIAL PINION GEAR
36 GEAR, DIFFERENTIAL PINION
37 WASHER, DIFFERENTIAL PINION GEAR THRUST
38 WASHER, DIFFERENTIAL SIDE GEAR THRUST
40 GEAR, DIFFERENTIAL SIDE
41 BOLT/SCREW, REAR AXLE HOUSING
43 COVER, REAR AXLE HOUSING
44 BEARING ASSEMBLY, REAR AXLE SHAFT
45 GASKET, REAR AXLE HOUSING COVER
46 PLATE, REAR BRAKE BACKING
48 BOLT/SCREW, REAR BRAKE BACKING
49 SEAL, REAR AXLE SHAFT BEARING
54 LOCK, REAR AXLE SHAFT
58 DRUM ASSEMBLY, REAR BRAKE
59 BRAKE ASSEMBLY, REAR
61 BOLT/SCREW, REAR WHEEL
63 SHAFT REAR AXLE (DRUM BRAKE ASSEMBLIES)
64 NUT, REAR BRAKE BACKING PLATE
65 PLATE, REAR BRAKE CALIPER ASSEMBLY MOUNTING
66 BOLT/SCREW, CALIPER ASSEMBLY MOUNTING
67 SHIM, AXLE TUBE FLANGE
68 NUT, REAR BRAKE CALIPER MOUNTING PLATE
69 CALIPER ASSEMBLY, REAR BRAKE
70 SHAFT, REAR AXLE (DISC BRAKE ASSEMBLIES)
71 ROTOR ASSEMBLY, REAR BRAKE
72 BOLT/SCREW, REAR BRAKE BACKING PLATE
75 SENSOR ASSEMBLY, WHEEL SPEED

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Figure 4 – Rear Axle Equipped With Traction Control (Acceleration Slip Regulation) – Legend

LIMITED SLIP REAR AXLE ASSEMBLY

Limited slip rear axle assemblies have several definite operating characteristics. An understanding of these characteristics is necessary to aid diagnosis.

The energizing force comes from the thrust side of the gears. Consequently, a free spinning tire and wheel assembly may not have enough resistance to driving torque to apply the clutch packs or cones. If this occurs, applying the parking brake a few notches will provide enough resistance to energize the cones.

Energizing the cones is independent of acceleration; therefore, a very slow application of the throttle on starting is recommended to provide maximum traction by preventing "break away" of either rear tire and wheel assembly.

All rear axle parts of vehicles with the limited slip rear axle assembly are interchangeable with those equipped with the standard rear axle assembly, except for the differential case. It is similar in all respects to the standard differential case, with the addition of cone clutches splined to each side gear. The Auburn limited slip differential case is non-serviceable and must be replaced.

REAR AXLE ASSEMBLY IDENTIFICATION

Figure 5

The rear axle assembly identification code and manufacturer's code must be known before attempting to adjust or repair axle shafts or the differential assembly. Rear axle ratio, differential type, manufacturer, and build date information is stamped on the right axle tube on the forward side. The service parts identification label also has RPO codes for the rear axle assembly printed on it.

MAINTENANCE AND LUBRICATION

Figures 1 through 4

NOTICE: See "Notice" on page 4B-1 of this section.

To check or add lubricant, hoist vehicle at suspension contact points. Refer to SECTION 0A. Keep vehicle level. Clean dirt or foreign material from around plug opening before removing the plug (9). Maintain lubricant level from flush with bottom of opening to no lower than 15 mm (9/16 inch) below opening. Always replace plug (9). Tighten to 35 N•m (26 lb. ft.). Use GM P/N 1052271 axle lubricant or SAE 80W-90 GL-5 gear lubricant or equivalent.

Limited slip differential assemblies should have lubricant drained and refilled at the first 12 500 km (7,500 miles). Limited slip differential assemblies also require 118 ml (4 fl. oz.) of GM P/N 1052358 limited slip differential additive and GM P/N 1052271 axle lubricant or SAE 80W-90 GL-5 gear lubricant or equivalent.

If the vehicle is used to pull a trailer, change lubricant every 12 500 km (7,500 miles) in either type differential assembly.

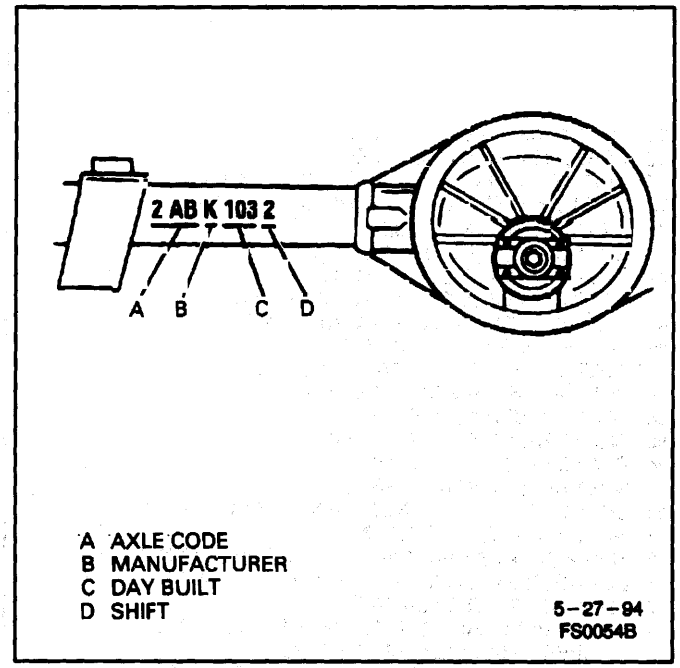


Figure 5 – Rear Axle Assembly Identification

DIAGNOSIS

Many noises reported as coming from the rear axle assembly actually originate from other sources such as tire and wheel assemblies, road surfaces, wheel bearing assemblies, engine assembly, transmission assembly, muffler or body. A thorough and careful check should be made to determine the source of the noise before taking apart the rear axle assembly. Noise which originates in other places cannot be corrected by adjustment or replacement of parts in the rear axle assembly. Rear axle differential gears, like any other mechanical device, are not absolutely quiet and should be accepted as being commercially quiet unless some abnormal noise is present.

To make a systematic check for axle noise under standard conditions, observe the following:

1. Check rear axle lubricant to ensure correct level, then drive vehicle far enough to thoroughly warm up rear axle lubricant.
2. Select a level asphalt road to reduce tire noise and body drumming.
3. Note speed at which noise occurs. Then stop vehicle and with the transmission assembly control lever in "NEUTRAL," run engine slowly up and down through engine speeds, corresponding to vehicle speed at which noise was most pronounced, to determine if it is caused by exhaust, muffler roar or other engine conditions.
4. Tire noise changes with different road surfaces, but rear axle noise does not. Temporarily inflating all tires to approximately 345 Kpa (50 psi) for test purposes only, will alter noise caused by the tires, but will not affect noise caused by the rear axle assembly. Rear axle noise usually stops when coasting at speeds under 48 km/h (30 mph). Tire noise continues, but with a lower tone as vehicle speed is reduced. Rear axle noise usually changes when comparing drive and coast, but tire noise remains about the same.
   - Distinguish between tire noise and rear axle noise by noting if noise varies with various speeds or sudden acceleration and deceleration. Exhaust and axle assembly noises show variations under these conditions while tire noise remains constant and is more noticeable at speeds of 32 to 48 km/h (20 to 30 mph). Check for tire noise by driving vehicle over smooth pavements or dirt roads (not gravel) with tires at normal pressure. If noise is caused by tires, it will noticeably change or disappear and appear again with changes in the road surface.
5. Loose or rough front wheel inner or outer bearing assemblies will cause a noise which may be confused with rear axle noise. Front wheel inner or outer bearing noise does not change when comparing drive and coast. Light application of the brake pedal assembly while holding the vehicle speed steady will often cause front wheel inner and outer bearing noise to diminish, as this takes some weight off the bearing assembly. Front wheel inner and outer bearing assemblies may be easily checked for noise by jacking up the tire and wheel assemblies and spinning them or by shaking the tire and wheel assemblies to determine if bearing assemblies are loose.
6. Rear suspension rubber bushings and spring insulators dampen out rear axle assembly noise when correctly installed. Check that no metallic contact exists between the spring and spring opening in the underbody or between lower control arm bushings and underbody or axle housing brackets. Metal-to-metal contact at those points may result in telegraphing road noise and normal axle noise which would not be objectionable if dampened by bushings.

REAR AXLE NOISES

Gear Noise

After the noise has been determined as being in the rear axle assembly, the type of noise should be established to help in making repairs if necessary.

Gear noise (whine) is audible from 32 to 89 km/h (20 to 55 mph) under four driving conditions:

1. Drive – Acceleration or heavy pull.
2. Road Load – Vehicle driving load or constant speed.
3. Float – Using enough throttle to keep the vehicle from driving the engine assembly, the vehicle slows down gradually but the engine assembly still pulls slightly.
4. Coast – Throttle closed and vehicle in gear. Gear noise most frequently has periods where noise is more noticeable, usually 64 to 80 km/h (40 to 50 mph) and 97 to 105 km/h (60 to 65 mph).

Bearing Noise

Bad bearing assemblies generally produce more of a rough growl or grating sound, rather than the whine typi-

cal of gear noise. Bearing noise frequently "wow-wows" at constant bearing rpm, indicating a faulty differential drive pinion gear or side bearing assembly. This noise could easily be confused with rear axle shaft bearing noise. Inspect and replace as required.

Rear Axle Shaft Bearing Noise

A rough rear axle shaft bearing assembly produces a noise that continues with the vehicle coasting at low speed and transmission assembly control lever in "NEUTRAL." Noise may diminish by gentle braking. With rear tire and wheel assemblies jacked up, spin rear tire and wheel assemblies by hand while listening at hub assemblies for evidence of rough (noisy) rear axle shaft bearing assembly.

Knock at Low Speeds

Low speed knock can be caused by a worn universal joint or a side gear hub counterbore in the differential case worn oversize. Inspect and replace universal joint or the differential case and side gear as required.

Backlash Clunk

Excessive clunk with acceleration and deceleration is caused by worn differential drive pinion gear shaft, worn differential case, excessive clearance between the rear axle shaft and side gear splines, excessive clearance between side gear hub and counterbore in case, worn differential drive pinion gear and side gear teeth, worn differential pinion gear thrust washers and excessive differential ring gear-to-differential drive pinion gear backlash. Remove worn parts and replace as required, selecting close fitting parts when possible. Adjust differential ring gear-to-differential drive pinion gear backlash. Refer to "Differential Ring Gear-to-Differential Drive Pinion Gear Backlash" in this section.

LIMITED SLIP REAR AXLE ASSEMBLY

Improper operation is generally indicated by clutch slippage or grabbing. Sometimes this produces a chatter or whirring sound. These sounds are not always indicative of failure as they could be produced from lack of proper lubrication. For example, under certain conditions where one tire and wheel assembly is on a very slippery surface and the other on dry pavement, wheel spin can occur if hard acceleration is attempted. Continued spinning may cause audible noise, such as a whirring sound, due to the cones lacking sufficient lubricant. This does not necessarily indicate a failure of the unit.

During regular operation (straight ahead driving) when both tire and wheel assemblies rotate at equal speeds, there is an equal driving force delivered to each tire and wheel assembly. When cornering, the inside tire and wheel assembly requires extra driving force causing slippage in the clutch cone. Consequently, the operational life of the limited slip unit is dependent upon equal rotation of both tire and wheel assemblies during straight ahead operation. If wheel rotation for both rear tire and wheel assemblies is not equal during straight ahead operation, the limited slip unit will constantly be functioning as if the vehicle were cornering. This will impose constant slippage on the clutch and will eventually lead to abnormal wear on the clutch cone.

Checking Limited Slip Operation

Figure 6

Tools Required:

J 2619-01 Slide Hammer
with 1/2 x 13 Adapter

J 21579 Axle Shaft Remover

1. Place transmission assembly control lever in "PARK" position, or in gear if manual transmission assembly, parking brake lever assembly released.
2. Raise both rear tire and assemblies off the floor.
3. Remove one tire and wheel assembly. Refer to SECTION 3E.
4. Install J 21579, 1/2 x 13 adapter from J 2619-01 and a torque wrench.
5. Measure torque required to rotate one tire and wheel assembly. Torque should be between 169 and 305 N•m (125 and 225 lb. ft.).
6. Place transmission assembly control lever in "NEUTRAL" position and lower one rear tire and wheel assembly to ground.
7. Measure torque required to rotate raised tire and wheel assembly. Torque should be between 58 and 91 N•m (43 and 67 lb. ft.).
8. Install tire and wheel assembly. Refer to SECTION 3E.

The differential case should be replaced as an assembly if any of the above checks do not fall within specifications.

INSPECTION AND DIAGNOSIS

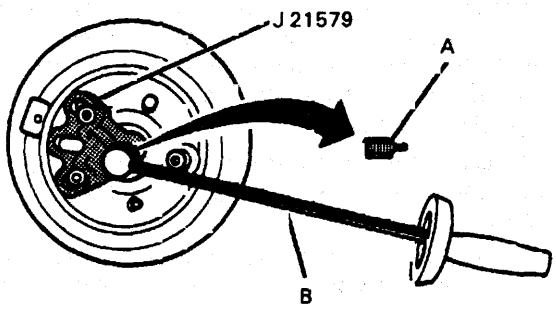
A close examination of the rear axle assembly prior to taking it apart will often reveal valuable information as to the extent and type of repairs or adjustments necessary. This information and the report of the malfunction provides a basis for determining the degree of tearing down required. Frequent causes of rear axle noise are improper backlash, differential drive pinion gear inner or outer bearing preload, differential side bearing preload, or a combination of these items. A few simple adjustments may be all that are necessary to correct the problem.

Before removing the differential case from the housing assembly, these items should be checked and the results recorded and analyzed: (1) backlash; (2) total differential assembly preload; and (3) tooth contact pattern.

Use care at all times to keep dirt and other foreign matter, such as grinder dust, soot, or sand, away from the rear axle assembly to prevent the possibility of subsequent failure.

REAR AXLE STANDARD AND LIMITED SLIP DIAGNOSIS

CONDITION	CAUSE
1. Noise is the same in "DRIVE" or when coasting.	a. Road noise. b. Tire noise. c. Front wheel bearing noise. d. Incorrect driveline angles.
2. Noise changes on a different type of road.	a. Tire noise. b. Road noise.
3. Noise tone lower as vehicle speed is lowered.	a. Tire noise.
4. Noise is produced with vehicle standing and driving.	a. Engine noise. b. Transmission noise.
5. Vibration.	a. Rough rear axle shaft bearing assembly. b. Unbalanced or damaged propeller shaft assembly. c. Tire unbalance. d. Worn universal joint in propeller shaft assembly. e. Incorrect driveline angles. f. Mis-indexed propeller shaft assembly at drive pinion gear yoke. g. Drive pinion gear yoke runout too great.
6. A knock or click approximately every two revolutions of rear wheel assembly.	a. Rear axle shaft bearing assembly.
7. Noise most pronounced on turns.	a. Differential side gear and pinion gear noise.
8. Continuous low pitch whirring or scraping noise starting at relatively low speed.	a. Drive pinion gear inner or outer bearing noise.
9. Drive noise, coast noise or float noise.	a. Ring and drive pinion gear noise.
10. Clunk on acceleration or deceleration.	a. Worn differential pinion gear shaft in case or side gear hub counterbore in case worn oversize. b. Worn universal joint on propeller shaft assembly. c. Differential drive pinion gear yoke lubrication insufficient.
11. Groan in forward or reverse.	a. Wrong lubricant in rear axle assembly.
12. Chatter on turns.	a. Wrong lubricant in rear axle assembly. b. Clutch cones worn (limited slip).
13. Clunk or knock on rough road operation.	a. Excessive end play of rear axle shafts.



A 1/2 x 13 ADAPTER FROM J 2619-01
B TORQUE WRENCH

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Figure 6 – Measuring Limited Slip Rotating Torque

Differential Ring Gear Tooth Nomenclature

Figure 7

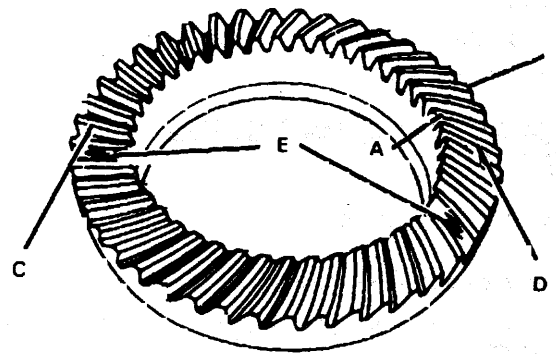
The side of the differential ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of the differential ring gear is referred to as the "toe" end. The end of the tooth farthest away from the center is the "heel" end. The toe end of the tooth is smaller than the heel end.

Tooth Contact Pattern Test

Figures 1 through 4, 7 and 8

Tool Required:

J 39446 ABS Exciter Ring Protector Kit



A TOE
B HEEL
C CONVEX SIDE (DRIVE)
D CONCAVE SIDE (COAST)
E CORRECT PATTERN

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Figure 7 – Differential Ring Gear Tooth Nomenclature

NOTICE: It is very important that tooth contact be tested before the differential assembly is taken apart. Variations in the differential assembly or differential drive pinion gear inner bearing assembly may cause the differential drive pinion gear to be too far away from, or close to, the differential ring gear. Thus, the tooth contact must be tested and corrected, if necessary, or the gears may be noisy.

NOTICE: See "Notice" on page 4B-1 of this section.

Clean

1. All dirt from area of cover (43) before removing cover (43).
2. Remove housing cover. Refer to "Rear Axle Housing Cover and Gasket" in this section.
3. Wipe oil out of the housing assembly (16) and carefully clean each tooth of the ring gear (20).
4. Select correct exciter ring protector from J 39446 and attach to speed sensor reluctor wheel (39) on vehicles with non–traction control rear axle assemblies only.
5. Use gear marking compound GM P/N 1052351 or equivalent and apply this mixture sparingly to all ring gear teeth, using a medium stiff brush. When properly used, the area of differential drive pinion gear tooth contact will be visible when hand load is applied.

Tighten

- Bolts/screws (26) to 75 N•m (55 lb. ft.).

6. Apply parking brake until a torque of 54 to 70 N•m (40 to 52 lb. ft.) is required to turn drive pinion gear (23).

   A test made without loading the gears will not give a satisfactory pattern. Turn yoke (3) with a wrench so that ring gear (20) rotates one full revolution. Reverse rotation so that ring gear (20) rotates one revolution in the opposite direction.
7. Observe pattern on the ring gear teeth and compare with Figure 8.
8. If pattern is acceptable, remove J 39446.
9. Install housing cover. Refer to "Rear Axle Housing Cover and Gasket" in this section.

Effects of Increasing Load on Tooth Contact Pattern

When the "load" on the differential ring and drive pinion gears is increased, such as when the vehicle is accelerated forward from standstill or from normal drive, the tooth contact will tend to spread out and, under very heavy load, will extend from near toe to near heel on the drive side. The entire contact also tends to shift toward the heel under increasingly heavier loads and will become somewhat broader with respect to tops and bottoms of teeth. The patterns obtained by this tooth contact pattern test approximate a light load and, for this reason, they will extend only about halfway.

The important thing to note is that the contact pattern is centrally located up and down on the face of the differential ring gear teeth.

Insufficiently preloaded drive pinion gear and differential bearing assemblies will also cause a change in tooth contact pattern under load.

Adjustments Affecting Tooth Contact

Figure 9

Two adjustments can be made which will affect the tooth contact pattern: backlash and position of drive pinion gear (23) in the housing assembly. The effects of bearing preloads are not readily apparent on hand-loaded tooth contact pattern tests.

Backlash is adjusted by means of shims (24). They move the entire differential assembly closer to or farther from the drive pinion gear (23). Shims (24) are also used to set differential bearing preload. If the thickness of the right shim (24) is increased, along with decreasing the left shim thickness, backlash will increase. The backlash will decrease if the left shim thickness is increased, along with a decrease in right shim thickness.

The position of the drive pinion gear (23) is adjusted by increasing or decreasing the shim thickness between the drive pinion gear head and race of the differential drive pinion gear inner bearing assembly. The shim (19) is used in the rear axle assembly to compensate for manufacturing tolerances. Increasing shim thickness moves the drive pinion gear (23) closer to the centerline of the ring gear (20). Decreasing shim thickness moves the drive pinion gear (23) farther away from the centerline of the ring gear (20).

Effects of Differential Drive Pinion Gear Position on Tooth Pattern

Figure 10

When the differential drive pinion gear is too far away from the centerline of the differential ring gear, the pattern will be a high heel contact on the drive side and high toe contact on the coast side. Moving the differential drive pinion gear closer to the centerline of the differential ring gear by decreasing backlash will cause the high heel contact on the drive side to move down and toward the toe: the high toe contact on the coast side will move down and toward the heel.

When the differential drive pinion gear is too close to the centerline of the differential ring gear, the pattern will be a low toe contact on the drive side, and a low heal contact on the coast side. Moving the differential drive pinion gear farther away from the differential ring gear by increasing backlash will cause low toe contact on the drive side to move up and toward the heel: the low heel contact on the coast side will move up and toward the toe.

ON-VEHICLE SERVICE

Before attempting any service procedures, the technician must know what type rear axle assembly is to be serviced. Refer to "Rear Axle Assembly Usage" in this section to identify codes, differential ring gear size, and ratios. Also, refer to the service parts identification label on the vehicle.

Most rear axle assembly service repairs can be made with the vehicle properly supported and the rear axle housing assembly lowered to its lowest travel. On some vehicles, it may be necessary to disconnect shock absorber assemblies to obtain additional clearance. When doing this, do not allow the rear brake hose assemblies to become kinked or stretched.

Lubricant may be drained by removing all rear axle housing bolts/screws and breaking the rear axle housing cover loose at the bottom.

If the rear axle housing assembly is removed for any reason, rear axle assembly service can be performed on the bench.

When a new differential ring gear and differential drive pinion gear are installed, the owner should be advised not to accelerate rapidly or exceed 80 km/h (50 mph) for the first 80 km (50 miles) of driving.

REAR AXLE LUBRICANT FILL AND CHECK

Figures 1 through 4

NOTICE: See "Notice" on 4B-1 of this section.

1. Raise and suitably support vehicle. Refer to SECTION 0A.
   - Keep vehicle level.
2. Clean dirt or foreign material from around plug opening before removing plug (9).
3. Remove plug (9).
4. Maintain axle lubricant level from flush with bottom of plug opening to no lower than 15 mm (9/16 inch) below plug opening.
5. Add or replace axle lubricant using GM P/N 12345977 axle lubricant or SAE 80W-90 GL-5 gear lubricant or equivalent.
6. If equipped with limited slip differential assemblies, add 118 ml (4 fl. oz.) of GM P/N 1052358 limited slip differential additive or equivalent.
7. Install plug (9).

   Tighten
   - Plug (9) to 35 N•m (26 lb. ft.).
8. Lower vehicle.

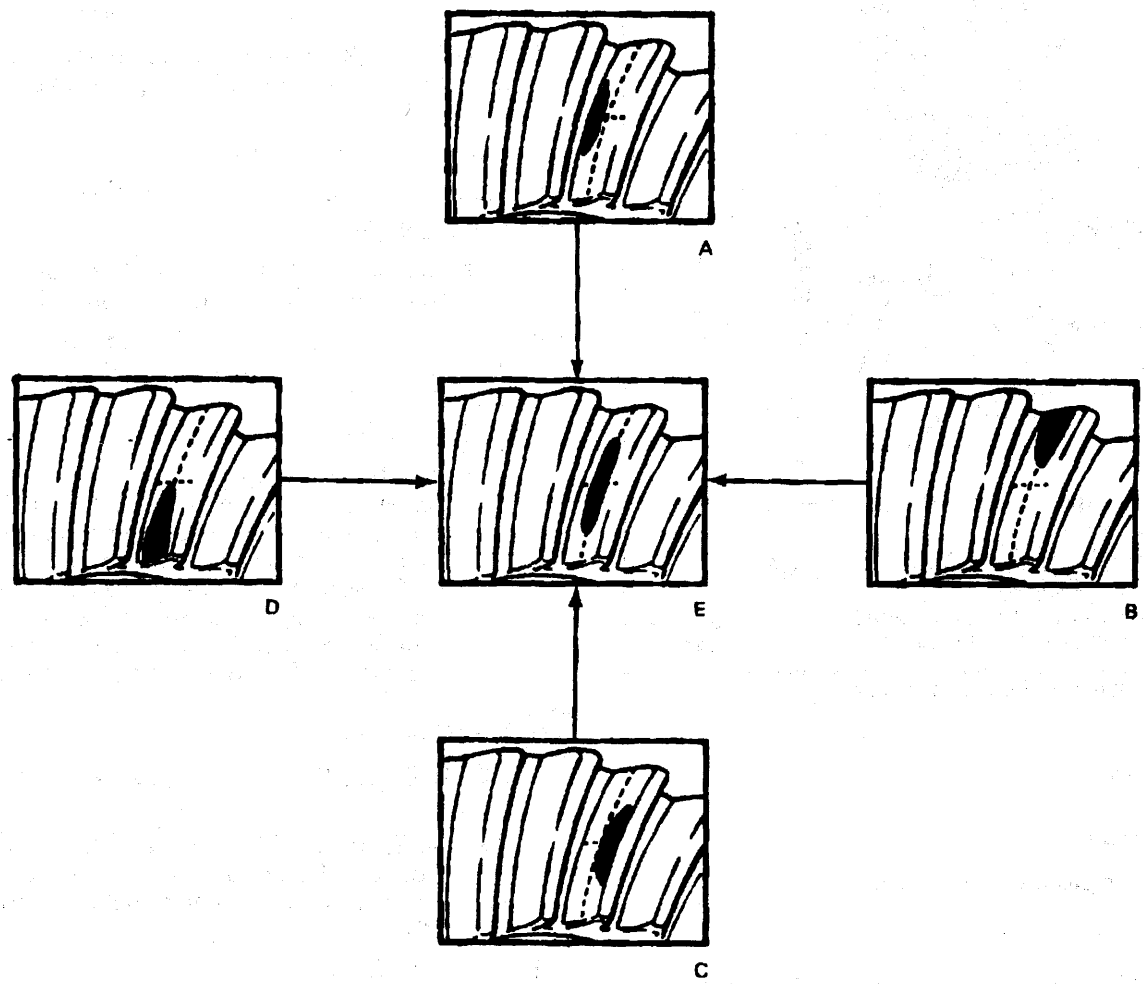
REAR AXLE HOUSING COVER AND GASKET

Figures 1 through 4

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Bolts/screws (41), parking brake cable guides and pry cover (43) loose.

   Clean
   - All dirt from area of cover (43) before removing cover (43).
3. Drain lubricant.



A LOW FLANK CONTACT: DECREASE DIFFERENTIAL DRIVE PINION GEAR BEARING SHIM THICKNESS – MOVES SMALLER DIAMETER OF DIFFERENTIAL DRIVE PINION GEAR OUT TOWARD DIFFERENTIAL RING GEAR CENTER LINE
B HEEL CONTACT: DECREASE BACKLASH – MOVES AREA OF DIFFERENTIAL DRIVE PINION GEAR CONTACT TOWARD TOE
C HIGH FACE CONTACT: INCREASE DIFFERENTIAL DRIVE PINION GEAR BEARING SHIM THICKNESS – MOVES LARGER DIAMETER OF DIFFERENTIAL DRIVE PINION GEAR IN TOWARD CENTER OF DIFFERENTIAL RING GEAR
D TOE CONTACT: INCREASE BACKLASH – MOVES AREA OF DIFFERENTIAL DRIVE PINION GEAR CONTACT TOWARD HEEL
E DESIRED PATTERN: IN CENTER OF DIFFERENTIAL RING GEAR TOOTH

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Figure 8 – Differential Ring Gear Tooth Contact Pattern Diagnosis Chart

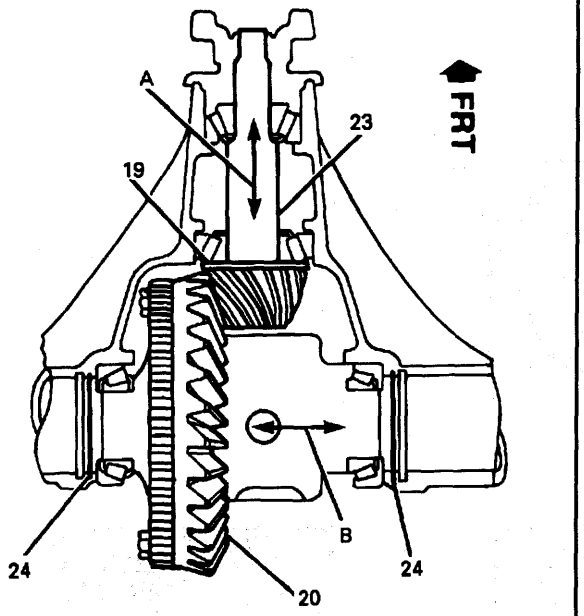


Figure 9 – Tooth Contact Adjustments

4. Gasket (45).

Clean

- Both gasket sealing surfaces.

Install or Connect

NOTICE: See "Notice" on page 4B-1 of this section.

1. New gasket (45) and cover (43).
2. Parking brake cable guides and bolts/screws (41).

Tighten

- Bolts/screws (41) in a crosswise pattern to 30 N•m (22 lb. ft.).

3. Lubricant. Refer to "Rear Axle Lubricant Fill and Check" in this section.
4. Lower vehicle.

REAR AXLE SHAFT

Figures 1 through 4, and 11

Tool Required:

J 39446 ABS Exciter Ring Protector Kit

Remove or Disconnect

1. Rear tire and wheel assembly. Refer to SECTION 3E.
2. Rear brake drum assembly and components, if equipped. Refer to SECTION 5C2.
3. Rear brake rotor assembly, if equipped. Refer to SECTION 5B2.
4. Rear axle housing cover. Refer to "Rear Axle Housing Cover and Gasket" in this section.
5. Install J 39446 to speed sensor reluctor wheel (39) on vehicles equipped with non–traction control rear axle assemblies.
6. Bolt/screw (29) from case (33).
7. Pinion gear shaft (35) from case (33).
8. Shaft lock (54).
   - Access by pushing flanged end of axle shaft (63 or 70) into housing assembly (16).
9. Axle shaft (63 or 70) from housing assembly (16), being careful not to damage seal (49).

Important

- If vehicle is equipped with traction control (acceleration slip regulation), be careful not to damage rear wheel speed sensor reluctor wheel located on axle shaft when removing the axle shaft assembly. If damage has occurred to the rear wheel speed sensor reluctor wheel on vehicles equipped with traction control, the rear axle shaft assembly must be replaced.

Install or Connect

NOTICE: See "Notice" on page 4B-1 of this section.

1. Axle shaft (63 or 70) into place, taking care that splines on end of axle shaft (63 or 70) do not damage seal (49) and that they engage with splines of side gear (40).
2. Shaft lock (54).
   - Push axle shaft (63 or 70) outward so that shaft lock (54) seats in counterbore of side gear (40).
3. Pinion gear shaft (35) through case (33), thrust washers (37) and pinion gears (36), aligning hole in pinion gear shaft (35) with lock bolt/screw hole in case (33).
4. Bolt/screw (29).

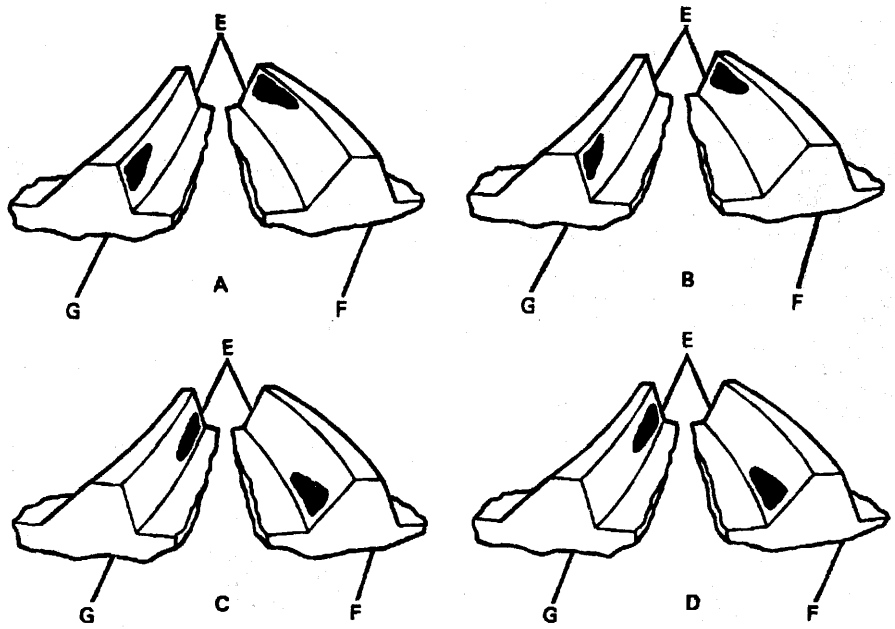
Important

- Coat bolt/screw (29) with Loctite® 242 or equivalent before installing.

Tighten

- Bolt/screw (29) to 36 N•m (27 lb. ft.).

5. Remove J 39446 from speed sensor reluctor wheel (39) if vehicle is equipped with standard rear axle assembly. If new speed sensor reluctor wheel (39) was installed, remove protective covering and throw away.
6. Rear axle housing cover. Refer to "Rear Axle Housing Cover and Gasket" in this section.



A DIFFERENTIAL DRIVE PINION GEAR TOO FAR AWAY FROM DIFFERENTIAL RING GEAR (INSUFFICIENT DIFFERENTIAL BEARING SHIM THICKNESS)
B EFFECT ON PATTERN AS DIFFERENTIAL BEARING SHIM THICKNESS IS INCREASED
C DIFFERENTIAL DRIVE PINION GEAR TOO CLOSE TO DIFFERENTIAL RING GEAR (EXCESSIVE DIFFERENTIAL BEARING SHIM THICKNESS)
D EFFECT ON PATTERN AS DIFFERENTIAL BEARING SHIM THICKNESS IS DECREASED
E TOE
F HEEL, COAST SIDE (CONCAVE)
G HEEL, DRIVE SIDE (CONVEX)

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Figure 10 – Differential Bearing Shim Thickness Effect on Tooth Pattern

7. Rear brake rotor assembly, if equipped. Refer to SECTION 5B2.
8. Rear brake drum assembly and components, if equipped. Refer to SECTION 5C2.
9. Rear tire and wheel assembly. Refer to SECTION 3E.

REAR AXLE SHAFT BEARING ASSEMBLY AND/OR BEARING SEAL

Figures 12 through 15

Tools Required:

J 2619-01 Slide Hammer with 1/2 x 13 Adapter

J 8092 Driver Handle

J 22813-01 Axle Bearing Remover

J 23765 Axle Bearing Installer

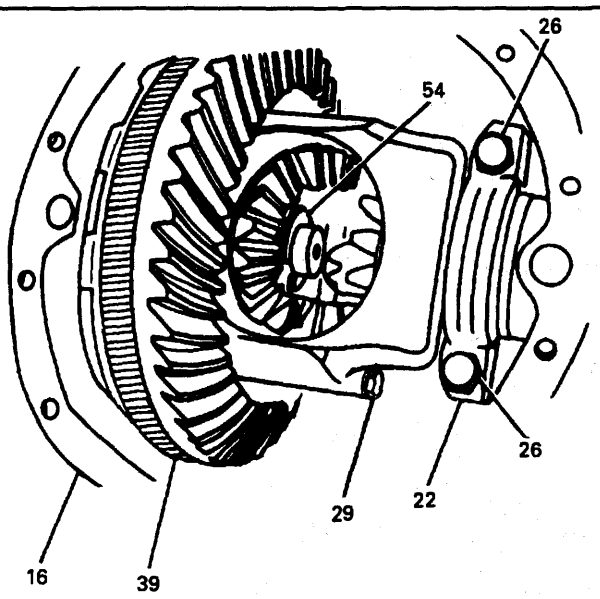
J 23771 Axle Oil Seal Installer

Remove or Disconnect

1. Rear axle shaft. Refer to "Rear Axle Shaft" in this section.
2. Rear brake backing plate, if equipped. Refer to SECTION 5C2.
3. Rear brake caliper anchor bracket and mounting plate, if equipped. Refer to SECTION 5B2.
4. Seal (49) from housing assembly (16) with a pry bar behind steel case of seal (49), being careful not to damage housing assembly (16).
5. Insert J 22813-01 into bore and position it behind shaft bearing assembly (44) so tangs on tool engage bearing outer race.
6. Shaft bearing assembly (44), using J 2619-01.

Install or Connect

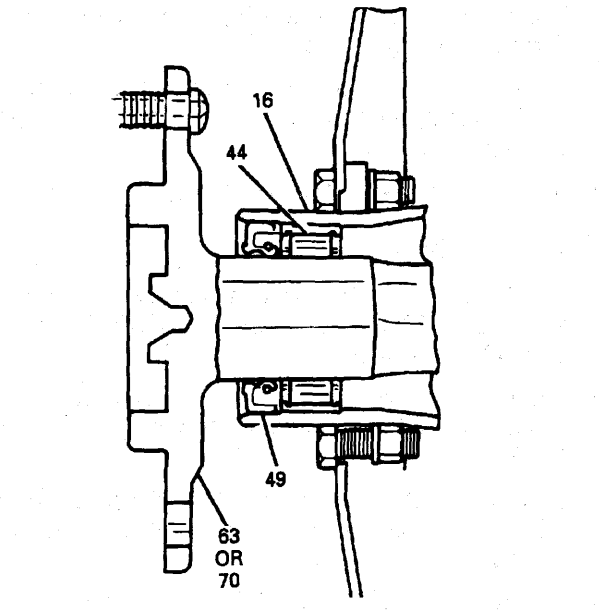
1. Lubricate new shaft bearing assembly (44) with GM P/N 12345977 axle lubricant or SAE 80W-90 GL-5 gear lubricant or equivalent.
2. Shaft bearing assembly (44) so that tool bottoms against shoulder in housing assembly (16), using J 23765 and J 8092.
3. Lubricate sealing lips with GM P/N 12345977 axle lubricant or SAE 80W-90 GL-5 gear lubricant or equivalent.
4. Position seal (49) on J 23771 and direct seal (49) into housing bore.
5. Seal (49) into place, flush with axle tube.
6. Rear brake backing plate, if equipped. Refer to SECTION 5C2.
7. Rear brake caliper anchor bracket and mounting plate, if equipped. Refer to SECTION 5B2.
8. Rear axle shaft. Refer to "Rear Axle Shaft" in this section.



16 HOUSING ASSEMBLY, REAR AXLE
22 CAP, DIFFERENTIAL CARRIER BEARING
26 BOLT/SCREW, DIFFERENTIAL BEARING CAP
29 BOLT/SCREW, DIFFERENTIAL PINION GEAR SHAFT LOCK
39 WHEEL, REAR WHEEL SPEED SENSOR RELUCTOR
54 LOCK, REAR AXLE SHAFT

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Figure 11 – Internal View of Rear Axle Housing Assembly (Typical)



16 HOUSING ASSEMBLY, REAR AXLE
44 BEARING ASSEMBLY, REAR AXLE SHAFT
49 SEAL, REAR AXLE SHAFT BEARING
63 SHAFT, REAR AXLE (DRUM BRAKE ASSEMBLY)
70 SHAFT, REAR AXLE (DISC BRAKE ASSEMBLY)

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Figure 12 – Rear Axle Shaft (Typical)

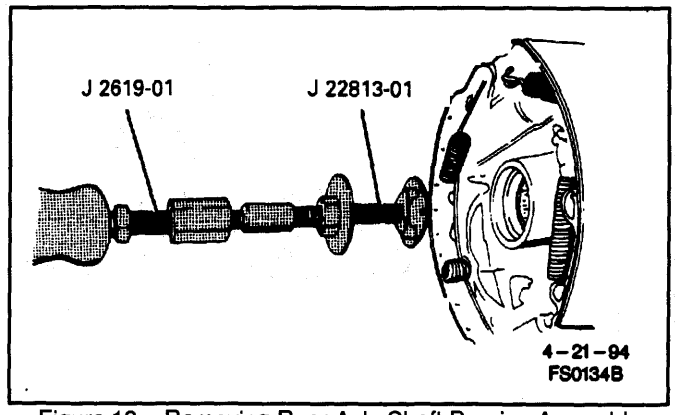


Figure 13 – Removing Rear Axle Shaft Bearing Assembly

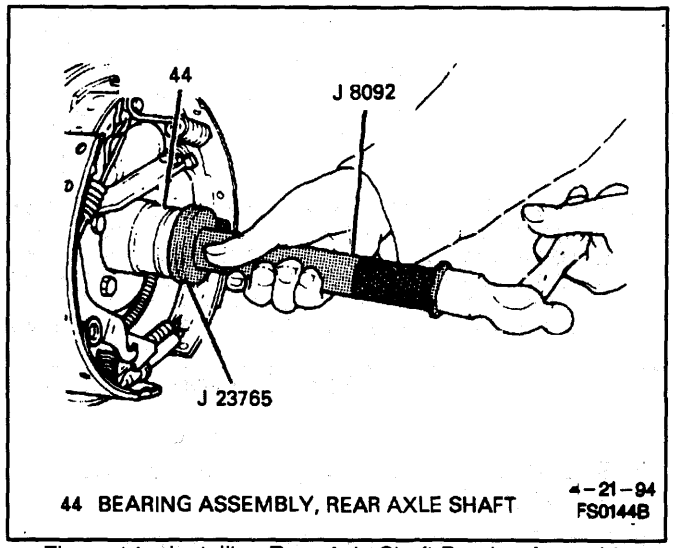


Figure 14 – Installing Rear Axle Shaft Bearing Assembly

Inspect

- Operation of rear axle assembly.

DIFFERENTIAL DRIVE PINION GEAR YOKE AND SEAL

Figures 1 through 4 and 16 through 19

Tools Required:

J 8614-2 Pinion Flange Remover Adapter
J 8614-3 Pinion Flange Remover Screw
J 8614-10 Pinion Flange Remover
J 23911 Pinion Oil Seal Installer

Remove or Disconnect

1. Both tire and wheel assemblies. Refer to SECTION 3E.
2. Rear brake drum assemblies, if equipped. Refer to SECTION 5C2.
3. Rear brake rotor assemblies, if equipped. Refer to SECTION 5B2.
4. Propeller shaft assembly from differential drive pinion gear yoke. Refer to SECTION 4A.

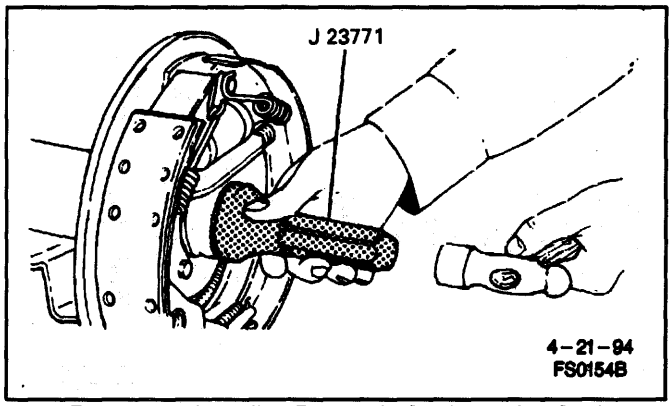


Figure 15 – Installing Rear Axle Shaft Bearing Seal

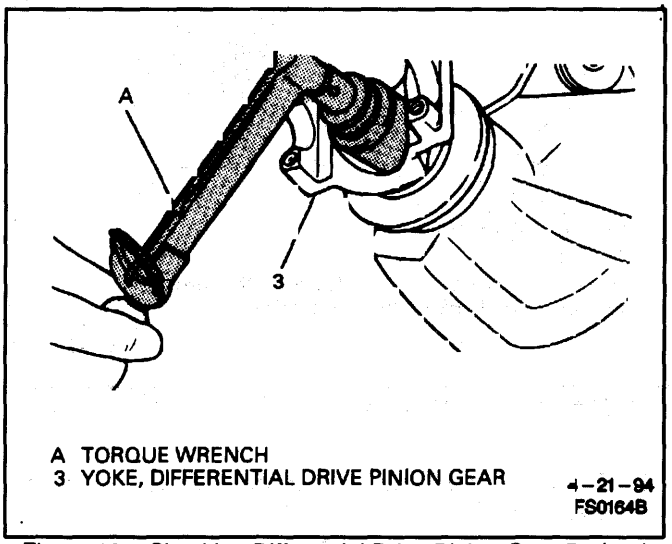


Figure 16 – Checking Differential Drive Pinion Gear Preload

5. Mark position of yoke (3), drive pinion gear (23) and nut (1) so proper drive pinion gear inner and outer bearing assembly preload can be maintained.
6. If joint bearing assemblies are not retained by a retainer strap, use a piece of tape to hold bearing assemblies on their journals.
7. Check preload with a pound-inch torque wrench and record. This will give combined drive pinion gear inner and outer bearing, axle shaft bearing and differential bearing preload.
8. Nut (1) and washer (2), using J 8614-10.
   - Use a suitable container to hold any fluid that may drain from rear axle assembly.
9. Yoke (3), using J 8614-2, J 8614-3 and J 8614-10.
10. Seal (6) by driving it out of housing assembly (16) with a blunt chisel. Do not damage housing assembly (16).

Inspect

- Differential drive pinion gear seal surface of yoke (3) for tool marks, nicks, or damage, such as a groove worn by seal (6). If damaged, replace yoke (3).
- Housing assembly bore and remove any burrs that might cause leaks around outer diameter (OD) of seal (6).

Install or Connect

NOTICE: See "Notice" on page 4B-1 of this section.

1. New seal (6), using J 23911.
2. Apply pinion gear seal lubricant, GM P/N 1050169 or equivalent, to the OD of yoke (3) and sealing lip of new seal (6).
3. Yoke (3).
4. Washer (2) and nut (1) finger tight.
5. While holding yoke (3), using J 8614-10, tighten nut gradually and turn drive pinion gear (23) several revolutions after each tightening to set the bearing assemblies. Check preload of bearing assemblies each time with a pound-inch torque wrench until preload is 0.3 to 0.6 N•m (3 to 5 lb. in.) more than reading obtained in removal procedure.
6. Propeller shaft assembly to differential drive pinion gear yoke. Refer to SECTION 4A.
7. Rear brake drum assemblies, if equipped. Refer to SECTION 5C2.
8. Rear brake rotor assemblies, if equipped. Refer to SECTION 5B2.
9. Tire and wheel assemblies. Refer to SECTION 3E.
10. Lubricant. Refer to "Rear Axle Lubricant Fill and Check" in this section.
11. Lower vehicle.

Inspect

- Operation of rear axle assembly.

REAR AXLE ASSEMBLY

Figures 1 through 4

Remove or Disconnect

1. Rear tire and wheel assemblies. Refer to SECTION 3E.
2. Mark propeller shaft assembly and yoke (3).
3. Propeller shaft assembly. Refer to SECTION 4A.
4. Rear stabilizer shaft. Refer to SECTION 3D.
5. Support housing assembly (16) with adjustable lifting device.
6. Shock absorber assemblies from housing assembly. Refer to SECTION 3D.
7. Rear axle tie rod assembly. Refer to SECTION 3D.
8. Rear brake (center) hose assembly from rear brake (center) hose assembly junction block. Refer to SECTION 5.

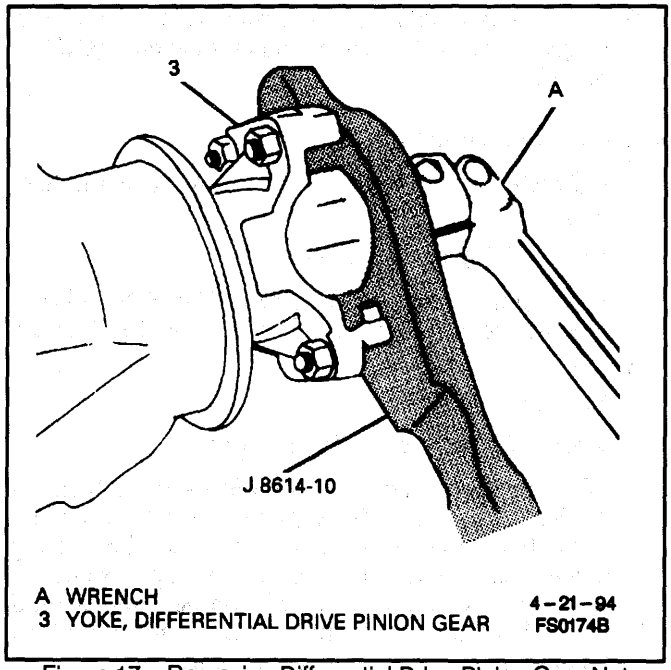


Figure 17 – Removing Differential Drive Pinion Gear Nut

9. Rear spring assemblies. Refer to SECTION 3D.
10. Parking brake cable assemblies from housing assembly. Refer to SECTION 5F.
11. Electrical connectors from wheel speed sensors if equipped with traction control (75).
12. Rear axle torque arm from housing assembly. Refer to SECTION 3D.
13. Rear axle lower control arm assemblies from housing assembly. Refer to SECTION 3D.
14. Housing assembly (16) with aid of helper.

Install or Connect

1. Housing assembly (16), with aid of helper.
2. Rear axle lower control arm assemblies to housing assembly. Refer to SECTION 3D.
3. Rear axle torque arm to housing assembly. Refer to SECTION 3D.
4. Electrical connectors to wheel speed sensors if equipped with traction control (75).
5 Parking brake cable assemblies to housing assembly. Refer to SECTION 5F.
6. Rear spring assemblies. Refer to SECTION 3D.
7. Rear brake (center) hose assembly to rear brake (center) hose assembly junction block. Refer to SECTION 5.
8. Rear axle tie rod assembly. Refer to SECTION 3D.
9. Shock absorber assemblies to housing assembly. Refer to SECTION 3D.

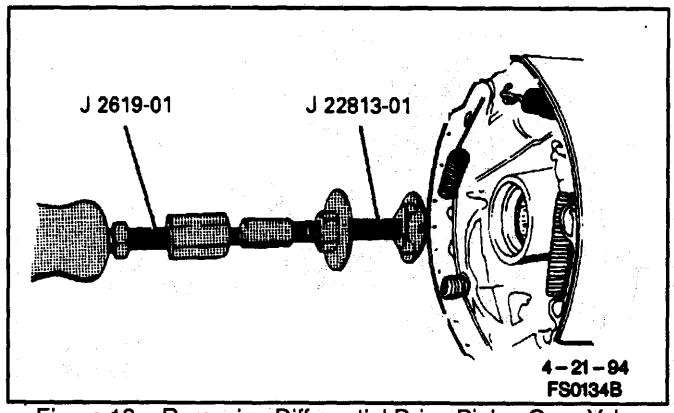


Figure 18 – Removing Differential Drive Pinion Gear Yoke

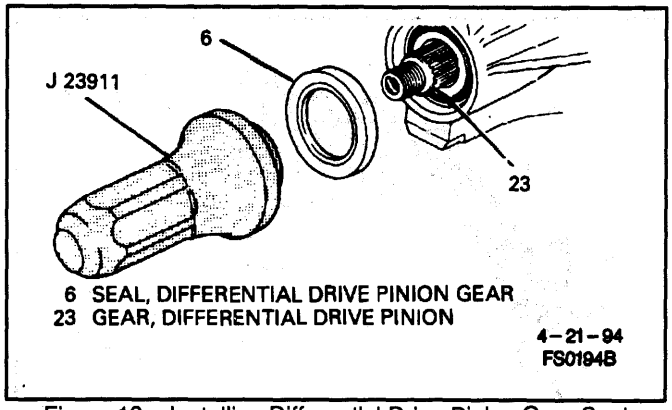


Figure 19 – Installing Differential Drive Pinion Gear Seal

10. Remove adjustable lifting device from housing assembly (16).
11. Rear stabilizer shaft. Refer to SECTION 3D.
12. Propeller shaft assembly. Refer to SECTION 4A.
13. Bleed hydraulic brake system. Refer to SECTION 5E1.
14. Rear tire and wheel assemblies. Refer to SECTION 3E.

Install or Connect

NOTICE: See "Notice" on page 4B-1 of this section.

1. Wheel bolt/screw (61), four washers and wheel nut (51) to axle shaft flange.
2. Wheel nut (51) until wheel bolt/screw (61) is completely seated against axle shaft flange.

Tighten

- Wheel nut (51) to 140 N•m (100 lb. ft.).

3. Remove wheel nut (51) and four washers.
4. Rear brake drum assembly, if equipped. Refer to SECTION 5C2.
5. Rear brake rotor assembly, if equipped. Refer to SECTION 5B2.
6. Rear tire and wheel assembly. Refer to SECTION 3E.

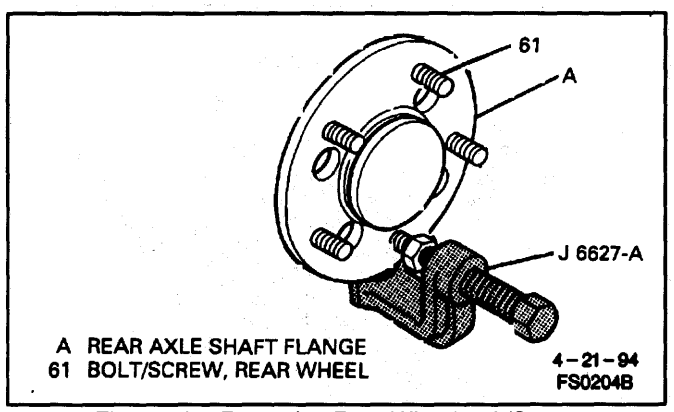


Figure 20 – Removing Rear Wheel Bolt/Screw

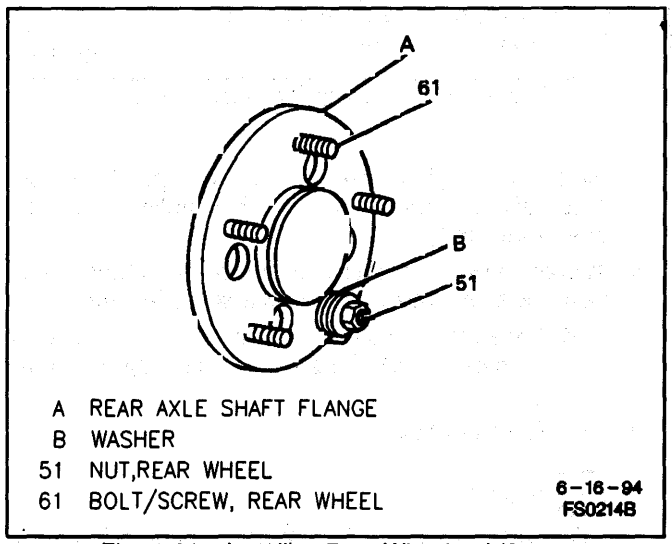


Figure 21 – Installing Rear Wheel Bolt/Screw

REAR WHEEL BOLT/SCREW

Figures 20 and 21

Tool Required:

J 6627-A Wheel Stud Remover

When replacing wheel bolts (hub studs), use the following guide:

- Stripped bolts/screws – Replace bolts/screws involved.
- One loose bolt/screw – Replace all bolts/screws.
- One broken bolt/screw – Replace all bolts/screws.
- Wheel bolt/screw hole elongated – Replace axle shaft.

Remove or Disconnect

1. Rear tire and wheel assembly. Refer to SECTION 3E.
2. Rear brake drum assembly, if equipped. Refer to SECTION 5C2.
3. Rear brake rotor assembly, if equipped. Refer to SECTION 5B2.
4. Wheel bolt/screw (61) from axle shaft flange using J 6627-A.

UNIT REPAIR

NOTICE: Any time components are removed or replaced within the rear axle housing assembly on vehicles with standard rear axle assemblies only, use J 39446, ABS Exciter Ring Protector Kit, to prevent damage to the rear wheel speed sensor reluctor wheel.

Important

- The driveline components in this vehicle have been factory system balanced. System balance provides a smoother running driveline operation. However, it is essential that the positions of all driveline components relative to the propeller shaft and rear axle assembly be observed and **ACCURATELY REFERENCE MARKED PRIOR TO DISASSEMBLY.** These components include the propeller shaft assemblies, rear axle assemblies, differential drive pinion gear yoke, output shaft, etc. **ALL COMPONENTS MUST BE REASSEMBLED IN THE EXACT RELATIONSHIP TO EACH OTHER AS THEY WERE WHEN REMOVED.** Additionally, the published specifications and torque values, as well as any measurements made prior to disassembly must be followed to maintain the factory balance.

When a new differential ring gear and drive pinion gear are installed, the original differential drive pinion gear yoke should be replaced with a service differential drive pinion gear yoke. The owner should be advised not to accelerate rapidly or exceed 80 km/h (50 mph) for the first 80 km (50 miles) of driving.

Any time the rear axle assembly is taken apart for service, the following cleaning and inspecting procedures should be followed:

- Select correct ABS exciter ring protector from J 39446 and attach to speed sensor reluctor wheel on vehicles with non–traction control rear axle assemblies only.

Clean

- All differential bearing assemblies thoroughly in clean solvent.

Inspect

- Bearing assemblies visually and by feel. Bearing assemblies should feel smooth when oiled and rotated while applying as much hand pressure as possible. Minute scratches and pits that appear on rollers and races at low mileage are due to the initial preload, and bearing assemblies having these marks should not be replaced.
- Sealing surface of differential drive pinion gear yoke for nicks, burrs, or rough tool marks which would

cause damage to the differential drive pinion gear seal and result in an oil leak. Replace if damaged.

- Housing assembly bore and remove any burrs that might cause leaks around the OD of the drive pinion gear seal.
- Differential ring gear and drive pinion gear teeth for excessive wear and scoring. If any of these conditions exist, replacement of the gears as a set will be required.
- Differential drive pinion gear shaft for unusual wear. Also, check the differential pinion and side gears and differential pinion gear thrust washers.
- Press fit of the differential bearing assembly inner race on the differential case hub by prying against the shoulder at the puller recess in the case. Differential bearing assemblies must be press fit on the hub.
- Rear axle assembly failures such as chipped bearing assemblies, loose (lapped-in) bearing assemblies, chipped gears, etc. are indications that foreign material is present. The rear axle housing assembly must be cleaned.
- Speed sensor reluctor wheel on vehicles with non–traction control rear axle assemblies for chipped or missing teeth; also check for looseness or wobble. Replace speed sensor reluctor wheel if damaged.

DIFFERENTIAL CASE

Figures 1 through 4 and 22 through 26

Tools Required:

J 22888-20 Differential Side Bearing Remover

J 8107-2 Differential Side Bearing Remover Plug

J 8092 Driver Handle

J 21465-13 Driver Handle Extension

J 25299 Differential Side Bearing Installer

J 25588 Side Bearing Shim Installer

J 39446 ABS Exciter Ring Protector Kit

Remove or Disconnect

Figures 1 through 4 and 22

Important

- Before removing the differential case from the rear axle housing assembly, differential ring gear-to-differential drive pinion gear backlash must be checked. Refer to "Differential Ring Gear-to-Differential Drive Pinion Gear Backlash" in this section. This will indicate gear or bearing wear or an error in backlash or preload setting which will help in determining the cause of axle noise.

1. Rear axle shafts. Refer to "Rear Axle Shaft" in this section.

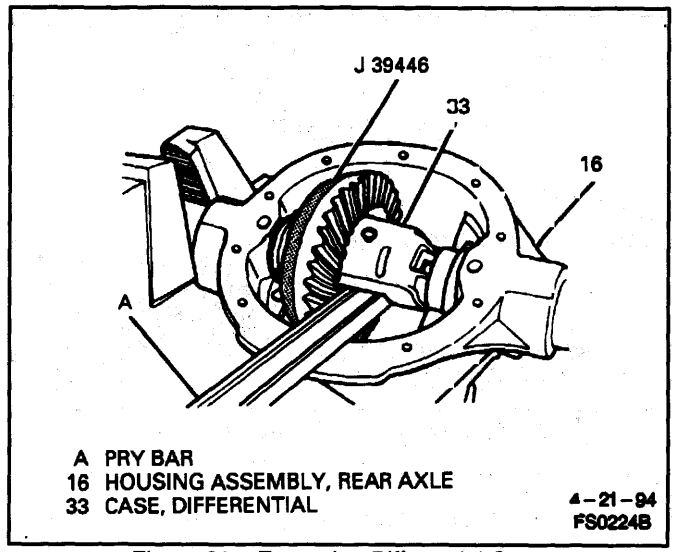


Figure 22 – Removing Differential Case

2. Bolt/screw (73) from wheel speed sensor assembly (75) on vehicles with standard rear axle assemblies only.
3. Wheel speed sensor assembly (75) on vehicles with non–traction control rear axle assemblies only.
   - Carefully place wheel speed sensor assembly (75) along side of housing assembly (16).
4. Bolts/screws (26).

Important

A. Bearing caps (22) should be marked "R" and "L" to make sure they will be assembled in their original locations.

B. Place right and left bearing outer races of bearing assemblies (32) and shims (24) in sets with marked bearing caps (22) so that they can be reinstalled in their original positions.

5. Shims (24).

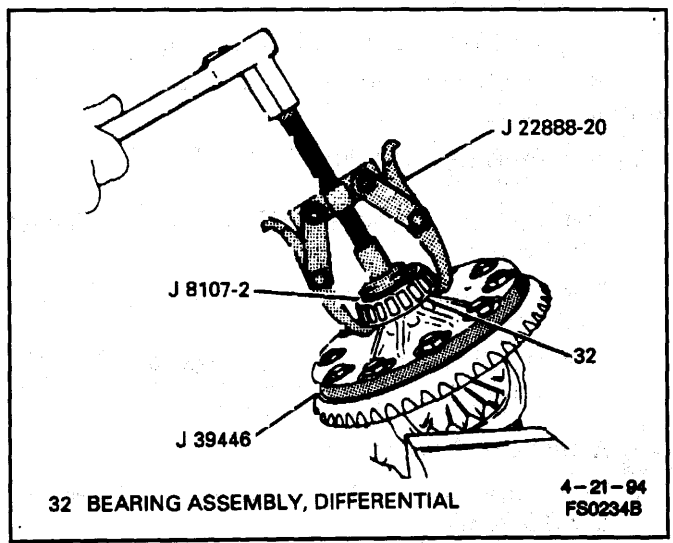


Figure 23 – Removing Differential Bearing Assembly

NOTICE: Exercise caution in prying on rear axle housing assembly so gasket sealing surface is not damaged.

6. Case (33) from housing assembly (16).

Disassemble

Figures 1 through 4 and 23

1. Differential bearing assembly (32) from case (33), if replacing, using J 22888-20 and J 8107-2. If removing an Auburn type limited slip differential case, skip step 2.
2. Pinion gears (36), thrust washers (37), side gears (40) and thrust washers (38) from case (33).
   - Mark side gears (40) and case (33) so side gears (40) can be reinstalled in their original position.
3. All bolts/screws (28) from case (33), if replacing ring gear (20) or speed sensor reluctor wheel (39).
   - Bolts/screws (28) are left-hand thread type.
   - Discard bolts/screws (28).
4. Ring gear (20) from case (33).
   - Do not pry between ring gear (20), speed sensor reluctor wheel (39) and case (33), if ring gear (20) is on tight.
     - Drive ring gear (20) from case (33) using brass drift and hammer.

Important

- Speed sensor reluctor wheel must be replaced if removed from vehicles with standard rear axle assemblies.

5. Speed sensor reluctor wheel (39) only if necessary, using brass hammer.
   - Discard speed sensor reluctor wheel (39).

Assemble

Figures 1 through 4, 24 and 25

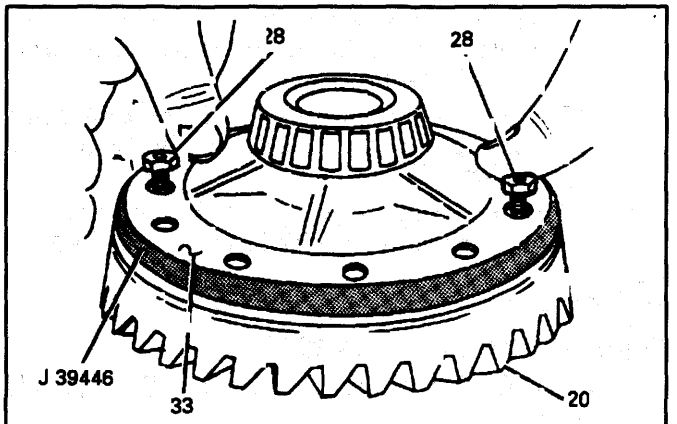
NOTICE: See "Notice" on page 4B-1 of this section.

Important

- Before assembling the differential assembly, lubricate all parts with GM P/N 12345977 axle lubricant or SAE 80W-90 GL-5 gear lubricant or equivalent.

Clean

- Connecting surfaces of ring gear (20) and case (33), if replacing ring gear (20).



20 GEAR, DIFFERENTIAL RING
28 BOLT/SCREW, DIFFERENTIAL RING GEAR (LEFT-HAND THREAD)
33 CASE, DIFFERENTIAL

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Figure 24 – Differential Ring Gear-to-Differential Case

CAUTION: Once the speed sensor reluctor wheel has been removed from the differential case, a new speed sensor reluctor wheel must be installed. The press fit may be lost if the speed sensor reluctor wheel is used more than once. This would allow the speed sensor reluctor wheel to rotate freely on the differential case causing a significant reduction in performance of the antilock brake system, which could result in bodily injury.

1. Speed sensor reluctor wheel (39), if removed from vehicles with non–traction control rear axle assemblies.
   - Carefully place speed sensor reluctor wheel (39) over case (33) on ring gear side.
2. Ring gear (20), if removed.
   - On vehicles with standard rear axle assemblies, position ring gear (20) over speed sensor reluctor wheel (39).
3. Two bolts/screws (28) into opposite sides of ring gear (20). If converting to an Auburn type limited slip differential case, skip to step 4.
   - Install remaining new bolts/screws (28) until just snug.

Tighten

- New bolts/screws (28) alternately in progressive stages to 120 N•m (89 lb. ft.).

4. Thrust washers (38), side gears (40), pinion gears (36) and thrust washers (37) into case (33).
   A. Position thrust washers (38) over side gear hubs and install side gears (40) in case (33). If same parts are reused, install in original sides.
   B. Position one pinion gear (36), without thrust washer (37), between side gears (40) and rotate side gears (40) until pinion gear (36) is directly opposite loading opening in case (33). Place other pinion gear (36) between side gears (40)

so that pinion gear shaft holes are in line: then rotate gears, lining up holes in pinion gears (36) with holes in case (33).

C. Rotate pinion gears (36) back toward loading opening just enough to permit sliding in thrust washers (37).

5. Differential bearing assemblies (32) to case (33), if removed, using J 8092, J 25299 and J 21465-13

Install or Connect

Figures 1 through 4 and 26

NOTICE: See "Notice" on page 4B-1 of this section.

1. Case (33) into housing assembly (16). Refer to "Differential Case" in this section.
2. Shims (24).

Important

- Do not attempt to reinstall the production shims as they may break when tapped into place.
- If service shims were previously installed, they can be reused, but whether using new or old differential bearing assemblies (32), adhere to the following procedure in all cases. If differential bearing assemblies (32) are used again, they must have original outer races in place. Refer to "Differential Bearing Assembly Preload Adjustment" in this section.
- Keep shim packs in their respective position, right or left side.

A. Select a shim 0.10 mm (0.004 inch) thicker than the one removed from the left side, then insert left side shim pack between the spacer and the left bearing race.

B. Loosely install bearing cap (22).

C. Select a shim 0.10 mm (0.004 inch) thicker than the one removed from the right side and insert between the spacer (25) and the right bearing assembly race.

D. It will be necessary to drive the right shim into position using J 25588.

3. Bolts/screws (26).

Tighten

- Bolts/screws (26) to 75 N•m (55 lb. ft.).

4. Check backlash and correct if necessary. Refer to "Differential Ring Gear-to-Differential Drive Pinion Gear Backlash" in this section.
5. Rear axle shafts (63 or 70). Refer to "Rear Axle Shaft" in this section.

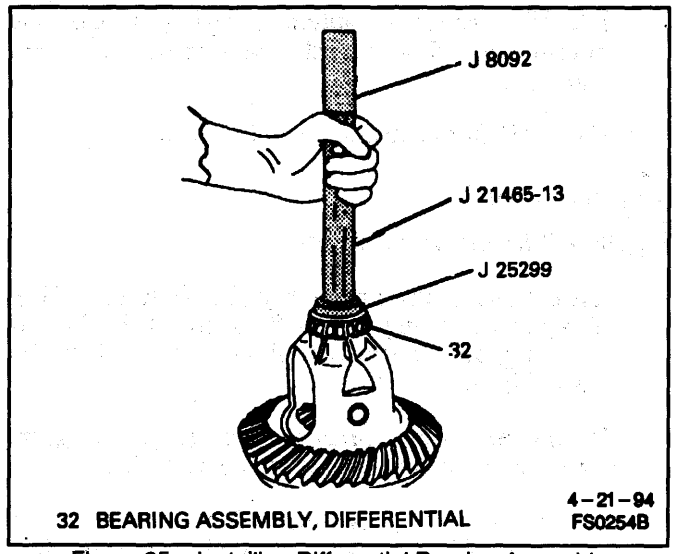


Figure 25 – Installing Differential Bearing Assembly

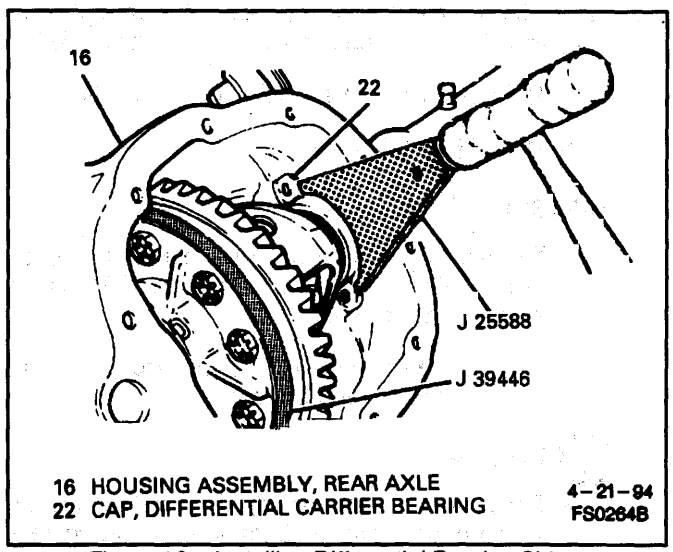


Figure 26 – Installing Differential Bearing Shims

6. Wheel speed sensor assembly (75) and bolt/screw (73), if removed.

Tighten

- Bolt/screw (73) to 10 N•m (89 lb. in.).

SPEED SENSOR RELUCTOR WHEEL

Refer to "Differential Case" above, for removal and installation of the speed sensor reluctor wheel on vehicles with non–traction control rear axle assemblies. On vehicles with traction control (acceleration slip regulation), the speed sensor reluctor wheel is not serviceable. If the speed sensor reluctor wheel is damaged, the rear axle drive shaft assembly must be replaced. Refer to "Rear Axle Shaft" in this section.

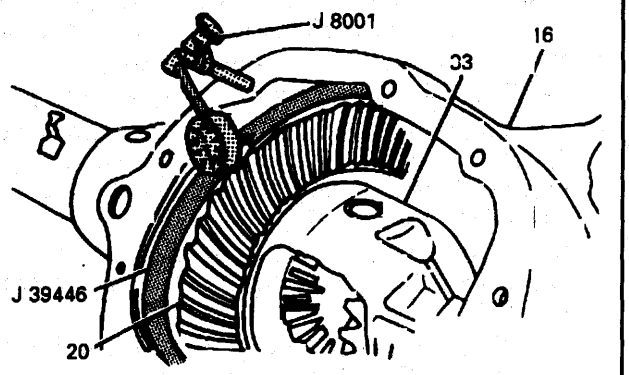


Figure 27 – Checking Differential Ring Gear-to-Differential Drive Pinion Gear Backlash

4.32 mm (0.170") SERVICE DIFFERENTIAL BEARING SPACER	
TOTAL THICKNESS OF BOTH PRODUCTION DIFFERENTIAL BEARING SHIMS REMOVED	TOTAL THICKNESS OF SERVICE DIFFERENTIAL BEARING SHIMS TO BE USED AS A STARTING POINT
10.57 mm (0.416")	1.52 mm (0.060")
10.92 mm (0.430")	1.78 mm (0.070")
11.18 mm (0.440")	2.03 mm (0.080")
11.43 mm (0.450")	2.29 mm (0.090")
11.68 mm (0.460")	2.54 mm (0.100")
11.94 mm (0.470")	2.79 mm (0.110")
12.19 mm (0.480")	3.05 mm (0.120")
12.45 mm (0.490")	3.30 mm (0.130")
12.70 mm (0.500")	3.56 mm (0.140")
12.95 mm (0.510")	3.81 mm (0.150")
13.21 mm (0.520")	4.06 mm (0.160")
13.46 mm (0.530")	4.32 mm (0.170")
13.97 mm (0.550")	4.83 mm (0.190")

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Figure 28 – Differential Bearing Shim Thickness

DIFFERENTIAL RING GEAR-TO-DIFFERENTIAL DRIVE PINION GEAR BACKLASH

Figure 27

Tool Required:

J 8001 Dial Indicator Set

Remove or Disconnect

- Rear axle housing cover. Refer to "Rear Axle Housing Cover and Gasket" in this section.

Measure

1. Rotate case (33) several times to seat bearing assemblies. Mount J 8001.
   A. Use a small button on indicator stem so that contact can be made near heel end of tooth.
   B. Set J 8001 so that stem is in line with gear rotation and perpendicular to tooth angle for accurate backlash reading.
2. Check backlash at three or four points around ring gear (20).
   A. Lash must not vary over 0.05 mm (0.002 inch) around ring gear (20).
   B. Drive pinion gear must be held stationary when checking backlash.

Important

- If variation is over 0.05 mm (0.002 inch), check for burrs, uneven bolting conditions or distorted case flange and make corrections as necessary.

Adjust

1. Backlash at the point of minimum lash should be between 0.13 mm and 0.23 mm (0.005 inch and 0.009 inch) for all new gears.
2. Backlash by increasing thickness of one shim and decreasing thickness of other shim the same amount.
   - For each 0.03 mm (0.001 inch) change in backlash desired, transfer 0.05 mm (0.002 inch) in shim thickness.
   - To decrease backlash 0.03 mm (0.001 inch), decrease thickness of right shim 0.05 mm (0.002 inch) and increase thickness of left shim 0.05 mm (0.002 inch). To increase backlash 0.05 mm (0.002 inch), increase thickness of right shim 0.10 mm (0.004 inch) and decrease thickness of left shim 0.10 mm (0.004 inch).
   - Refer to "Differential Bearing Assembly Preload Adjustment" in the following procedure for further information.

Install or Connect

- Rear axle housing cover. Refer to "Rear Axle Housing Cover and Gasket" in this section.

DIFFERENTIAL BEARING ASSEMBLY PRELOAD ADJUSTMENT

Figures 1 through 4 and 28

The differential bearing assembly preload adjustment is to be made before installing the drive pinion gear (23). If drive pinion gear (23) is installed, remove ring gear (20). Refer to "Differential Case" in this section.

Differential bearing assembly preload is adjusted by changing the thickness of both the right and left shims (24) by an equal amount.

By changing the thickness of both shims (24) equally, the original backlash will be maintained.

Production shims (24) are cast iron and vary in thickness from 5.33 mm to 6.91 mm (0.210 inch to 0.272 inch) in increments of 0.05 mm (0.002 inch).

Standard service spacers (25) are 4.32 mm (0.170 inch) thick and steel service shims (24) are available from 1.02 mm to 2.08 mm (0.040 inch to 0.082 inch) in increments of 0.05 mm (0.002 inch).

Important

- Do not attempt to reinstall the production shims (24) as they may break when tapped into place.
- If service shims (24) were previously installed, they can be reused, but whether using new or old differential bearing assemblies (32), adhere to the following procedure in all cases. If differential bearing assemblies (32) are used again, they must have original outer races in place.

Adjust

1. Determine the approximate thickness of shims (24) needed by measuring each production shim (24) or each service spacer (25) and shim pack.
   - In addition to the service spacer (25), service shims (24) will be needed. Select a starting point in service shim thickness. Refer to Figure 28.
2. Place case (33) with differential bearing assembly outer races in position in the housing assembly (16).
3. Slip the service spacer (25) between each differential bearing assembly race and housing assembly (16) with chamfered edge against housing assembly (16).

   NOTICE: Install the left side differential bearing cap loosely so the differential case may be moved while checking adjustments. Another differential bearing assembly cap bolt/screw can be added in the lower right side differential bearing cap hole. This will prevent the case from dropping while making shim adjustments.
4. Select one or two shims (24) totalling the amount shown in the right-hand column of Figure 28 and position between the right side differential bearing assembly race and service spacer (25).
   - Be sure left side differential bearing assembly race and spacer (25) are against left side of housing assembly (16).
5. Insert progressively larger feeler gage sizes 0.25 mm, 0.30 mm, 0.36 mm, etc. (0.010 inch, 0.012 inch, 0.014 inch, etc.) between the right shim (24) and service spacer (25) until there is noticeable increase in drag.
6. Push feeler gage downward until end of gage makes contact with housing assembly bore to obtain a correct reading.
   - The point just before additional drag begins is the correct feeler gage thickness.
7. Rotate case (33) while using feeler gage to ensure an even reading.
   - The original light drag is caused by weight of case (33) against housing assembly (16) while additional drag is caused by differential bearing assembly preload.
   - By starting with a thin feeler gage, a sense of "feel" is obtained so the beginning of preload can be recognized to obtain zero clearance.
   - It will be necessary to work case (33) in and out and to the left in order to insert feeler gage.
8. Remove left side differential bearing assembly cap (22) and shim (24) from housing assembly (16).
9. The total shim pack needed, with no preload on differential bearing assemblies (32), is the feeler gage reading found in step 7 plus the thickness of shims (24) installed in step 4.
10. Select two shims (24) of approximately equal size whose total thickness is equal to the value obtained in step 9.
    - These shims (24) will be installed between each differential bearing assembly race and service spacer (25) when case (33) is installed in housing assembly (16).
    - The preload will not be added until case (33) is installed.
11. If drive pinion gear is in position, install ring gear. Refer to "Differential Case" in this section.

DIFFERENTIAL DRIVE PINION GEAR

Figures 1 through 4, 16, 19, 29 and 30

Tools Required:

J 22536 Pinion Driver

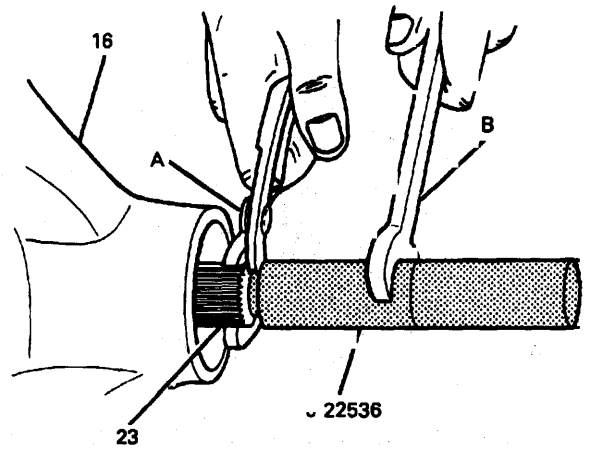
J 23911 Pinion Oil Seal Installer

Remove or Disconnect

1. Differential case. Refer to "Differential Case" in this section.
2. Check differential drive pinion gear inner and outer bearing assembly preload. If there is no preload reading, check for looseness of drive pinion gear (23) by shaking. Looseness could be caused by defective inner and outer bearing assemblies (18 and 7) or worn yoke (3). If the rear axle assembly was operated for an extended period with very loose inner and outer bearing assemblies (18 and 7), ring gear (20) and drive pinion gear (23) will also require replacement.
3. Differential drive pinion gear yoke. Refer to "Differential Drive Pinion Gear Yoke and Seal" in this section.
4. Drive pinion gear (23), using J 22536. Apply heavy hand pressure on J 22536 toward housing assembly (16) to keep outer bearing assembly (7) seated to avoid damage to outer race.

Install or Connect

1. If installing new ring gear and drive pinion gear, measure differential drive pinion gear depth. Refer to "Differential Drive Pinion Gear Depth" in this section.
2. Drive pinion gear (23) into housing assembly (16).
3. Differential drive pinion gear yoke (3).
   A. Install new seal (6) using J 23911.
   B. Apply pinion gear seal lubricant GM P/N 1050169 or equivalent to yoke (3) and sealing lip of new seal (6).



A CHANNEL LOCKING PLIERS
B WRENCH
16 HOUSING ASSEMBLY, REAR AXLE
23 GEAR, DIFFERENTIAL DRIVE PINION

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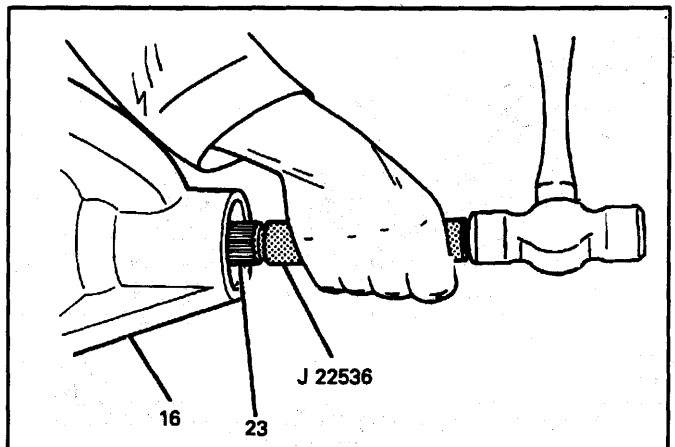
Figure 29 – Installing Differential Drive Pinion Gear Driver

C. Yoke (3).
D. Washer (2) and nut (1) finger tight.
E. Hold yoke (3).
F. While intermittently rotating drive pinion gear (23) to seat inner and outer bearing assemblies (18 and 7), tighten nut (1) until end play begins to be taken up.

Important

- When no further end play is detectable and when holder will no longer pivot freely as drive pinion gear (23) is rotated, preload specifications are being approached.
- No further tightening should be attempted until preload has been checked.
- After preload has been checked, final tightening should be done very carefully.
- Additional tightening of nut (1) can add many additional pound inches of torque.
- Nut (1) should be further tightened only slightly and preload should be checked after each tightening.
- Exceeding preload specifications will compress the collapsible spacer (15) too far and require installation of a new collapsible spacer (15).

4. Set preload at 1.7 N•m to 3.4 N•m (15 lb. in. to 30 lb. in.) on new inner and outer bearing assemblies (18 and 7) or 1.0 N•m to 1.7 N•m (10 lb. in. to 15 lb. in.) on used inner and outer bearing assemblies (18 and 7).
5. Rotate drive pinion gear (23) several times to ensure that inner and outer bearing assemblies (18 and 7) have been seated.
   A. Check preload again.



16 HOUSING ASSEMBLY, REAR AXLE
23 GEAR, DIFFERENTIAL DRIVE PINION

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Figure 30 – Removing Differential Drive Pinion Gear

   B. If preload has been reduced by rotating drive pinion gear (23), reset preload to specifications.
6. Differential case. Refer to "Differential Case" in this section.

Differential Drive Pinion Gear Outer Bearing Assembly

Figures 1 through 4 and 31

Tools Required:

J 8092 Driver Handle
J 7817 Front Pinion Bearing Cup Installer

Remove or Disconnect

1. Differential drive pinion gear from rear axle housing assembly. Refer to "Differential Drive Pinion Gear" in this section.
2. Differential drive pinion gear seal from rear axle housing assembly. Refer to "Differential Drive Pinion Gear Yoke and Seal" in this section.
3. Outer bearing assembly (7) from housing assembly (16).
4. Outer bearing assembly race from housing assembly (16), if replacing outer bearing assembly (7).
   - Drive race from housing assembly (16), using a punch in slots provided for this purpose.

Install or Connect

1. Outer bearing assembly race into housing assembly (16), if removed, using J 8092 and J 7817.
2. Outer bearing assembly (7) into housing assembly (16).
3. Differential drive pinion gear seal. Refer to "Differential Drive Pinion Gear Yoke and Seal" in this section.
4. Differential drive pinion gear. Refer to "Differential Drive Pinion Gear" in this section.

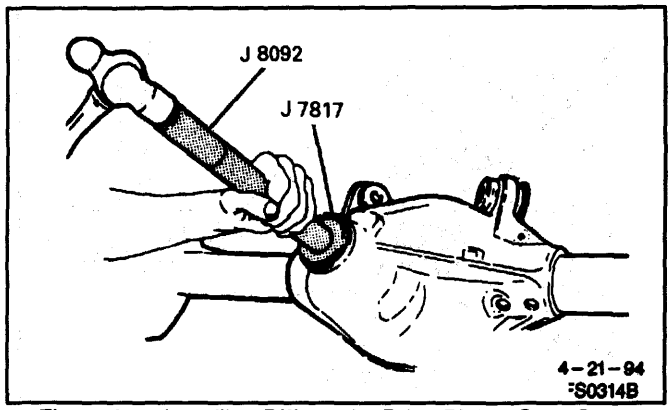


Figure 31 – Installing Differential Drive Pinion Gear Outer Bearing Assembly Race

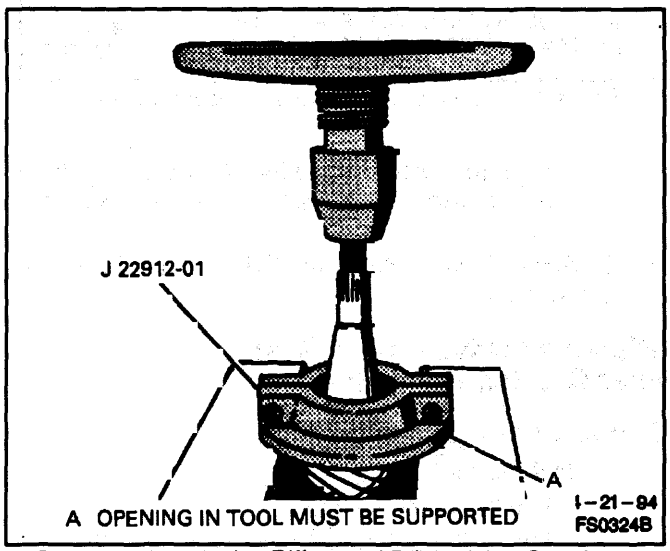


Figure 32 – Removing Differential Drive Pinion Gear Inner Bearing Assembly

Differential Drive Pinion Gear Inner Bearing Assembly

Figures 1 through 4 and 32 through 34

Tools Required:

J 22912-01 Rear Pinion Bearing Remover

J 8092 Driver Handle

J 29609 Rear Pinion Bearing Cup Installer

J 5590 Rear Pinion Bearing Cone Installer

Remove or Disconnect

1. Differential drive pinion gear. Refer to "Differential Drive Pinion Gear" in this section.
2. Spacer (15) from drive pinion gear (23).
   - Discard spacer (15).
3. Drive pinion gear inner bearing assembly race from housing assembly (16), if replacing inner bearing assembly (18).

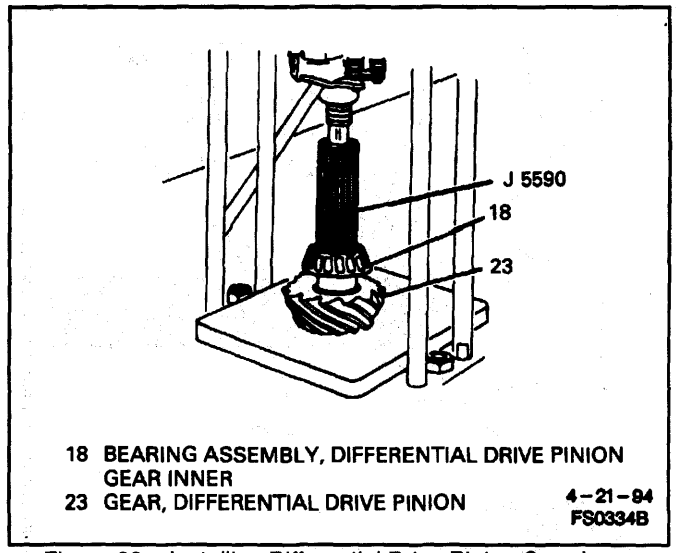


Figure 33 – Installing Differential Drive Pinion Gear Inner Bearing Assembly

   - Drive race from housing assembly (16) using a punch in slots provided for this purpose.
4. Drive inner bearing assembly (18) from drive pinion gear (23) using J 22912-01.

Install or Connect

1. Inner bearing assembly (18) onto drive pinion gear (23) using J 5590.
2. Drive inner bearing assembly race into housing assembly (16) using J 8092 and J 29609, if inner bearing assembly (18) was replaced.
3. New spacer (15) onto drive pinion gear (23).
4. Differential drive pinion gear. Refer to "Differential Drive Pinion Gear" in this section.

DIFFERENTIAL DRIVE PINION GEAR DEPTH

Figures 1 through 4, 35 and 36

Tools Required:

J 8001 Dial Indicator Set

J 23597-1 Pinion Setting Gage – Arbor

J 23597-11 Pinion Setting Gage – Gage Plate

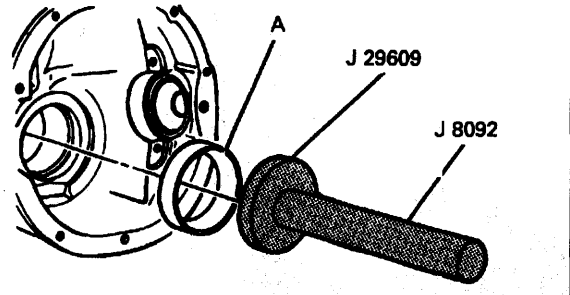
J 21777-40 Pinion Setting Gage – Rear Pilot Washer

J 21777-42 Pinion Setting Gage – Front Pilot Washer

J 21777-43 Pinion Setting Gage – Stud Assembly – Bolt

J 21777-45 Pinion Setting Gage – Side Bearing Discs

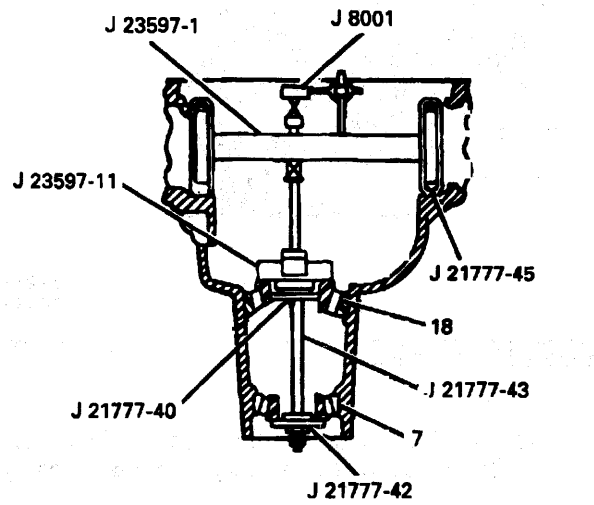
Differential drive pinion gear depth is measured with a pinion setting gage. The gage provides a "nominal" or "zero" pinion as a gaging reference.



A RACE, DIFFERENTIAL DRIVE PINION GEAR INNER BEARING ASSEMBLY

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Figure 34 – Installing Differential Drive Pinion Gear Inner Bearing Assembly Race



7 BEARING ASSEMBLY, DIFFERENTIAL DRIVE PINION GEAR OUTER

18 BEARING ASSEMBLY, DIFFERENTIAL DRIVE PINION GEAR INNER

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Figure 35 – Pinion Gage Plate Installed in Rear Axle Housing Assembly

Disassemble

- Differential case. Refer to "Differential Case" in this section.

Remove or Disconnect

- Differential drive pinion gear inner bearing assembly. Refer to "Differential Drive Pinion Gear Inner Bearing Assembly" in this section.

Clean

1. All parts of gage.
2. Differential bearing assembly bore.
3. Inner and outer bearing assembly cups.
4. Lubricate inner and outer bearing assemblies (18 and 7) with GM P/N 12345977 axle lubricant or SAE 80W-90 GL-5 gear lubricant or equivalent.

Install or Connect

NOTICE: See "Notice" on page 4B-1 of this section.

1. J 21777-40 through J 21777-43.
2. J 23597-11.
3. J 1777-42 and nut in housing assembly (16).

Tighten

- Nut to 2.3 N•m (20 lb. in.).

4. Rotate J 23597-11 to seat inner and outer bearing assemblies (18 and 7).
5. Mount J 8001 on J 23597-1 and preload indicator against plunger about 1.27 mm (0.050 inch).
6. J 21777-45 on J 23597-1 and position unit in housing assembly (16).
7. Bearing caps (22) and bolts/screws (26).

Tighten

- Bolts/screws (26) to 75 N·m (55 lb. ft.).

Measure

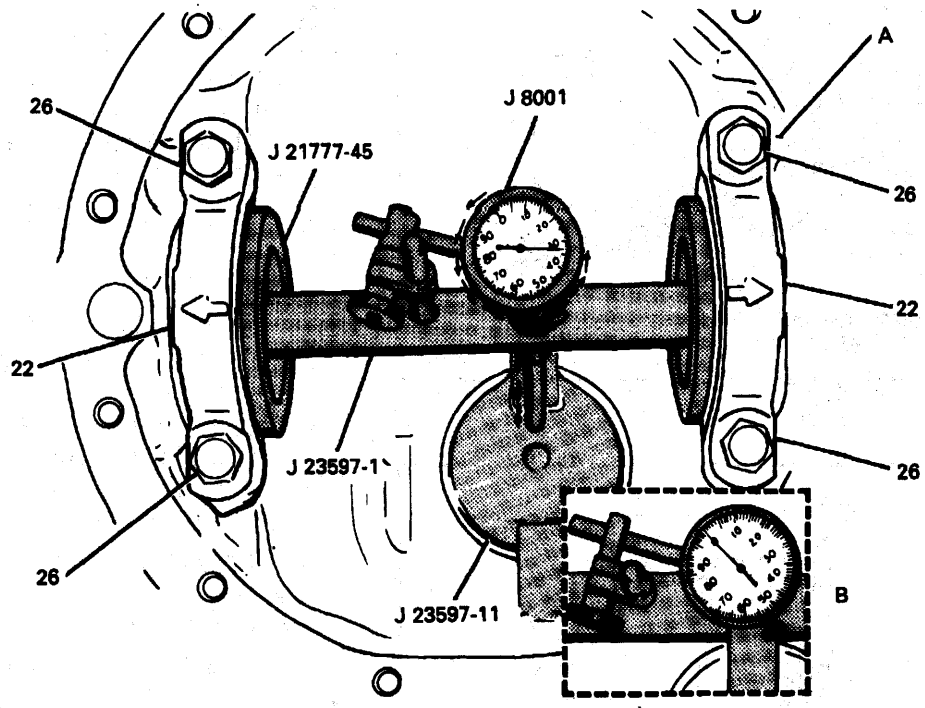
- Differential drive pinion gear depth.
  - A. Rotate J 23597-1 slowly back and forth until J 8001 reads the greatest deflection (the point where the needle changes direction). At that point, set J 8001 to zero.
  - B. Repeat rocking action to verify zero setting.
  - C. After zero setting is obtained, rotate J 23597-1 just until plunger no longer touches J 23597-11. This provides the gaging reference of a "zero" or "nominal" drive pinion gear (23).
  - D. Record J 8001 reading at pointer position. This indicates the proper shim to use. Example: if pointer moved counterclockwise 1.70 mm (0.067 inch) to a dial reading of 0.84 mm (0.033 inch), this indicates a shim thickness of 0.84 mm (0.033 inch).
  - E. Required shim thickness is EQUAL to J 8001 reading.
  - F. Shims are available in 0.03 mm to 0.94 mm (0.001 inch to 0.037 inch). Shim thickness is etched on the flat surface for easy identification.

Install or Connect

1. Loosen J 21777-43 and remove special tools and inner and outer bearing assemblies (18 and 7) from housing assembly (16).
2. Correct shim (19) on drive pinion gear (23).

Important

- Proper drive pinion gear depth setting is a two-step procedure.



A OFF GAGE BLOCK
B ON GAGE BLOCK
22 CAP, DIFFERENTIAL CARRIER BEARING
26 BOLT/SCREW, DIFFERENTIAL BEARING CAP

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Figure 36 – Checking Differential Drive Pinion Gear Depth

a. The set-up dimension arrived at using J 8001 is to be considered a starting point.

b. A ring gear tooth pattern check is necessary to fine tune the drive pinion gear depth and may indicate additional shim changes to the drive pinion gear stem. Refer to "Tooth Contact Pattern Test" in this section.

- Both procedures must be performed to ensure proper rear axle assembly performance.

3. Differential drive pinion gear inner and outer bearing assemblies. Refer to "Differential Drive Pinion Gear Inner Bearing Assembly" and "Differential Drive Pinion Gear Outer Bearing Assembly" in this section.

Assemble

- Differential case. Refer to "Differential Case" in this section.

Measure

- Preload of the total assembly at the drive pinion gear nut (1). With new inner and outer bearing assemblies (18 and 7), preload is 3.6 N•m to 6.2 N•m (32 lb. in. to 55 lb. in.) rotating torque with a new seal (6). With used inner and outer bearing assemblies (18 and 7), preload is 1.8 N•m to 3.1 N•m (16 lb. in. to 28 lb. in.) rotating torque with a new seal (6).

DIFFERENTIAL CASE (LIMITED SLIP)

Figure 37

The Auburn limited slip differential assembly case (80) is non-serviceable and must be replaced as an assembly. Removal and replacement of the differential case and service on the side bearings and ring gear is the same as for the standard rear axle assembly.

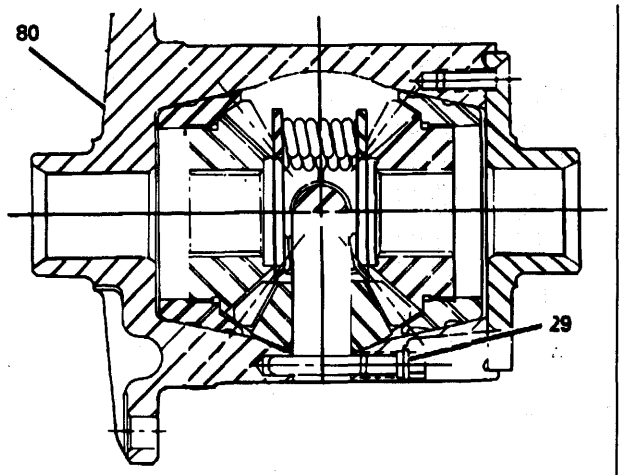
REAR AXLE HOUSING REPLACEMENT

It is not necessary to remove the rear axle housing assembly for any normal repairs. However, if the rear axle housing assembly is damaged, it may be removed and installed using the following procedures:

Rear Axle Housing Assembly with Drum Brakes

Remove or Disconnect

1. Rear axle assembly. Refer to "Rear Axle Assembly" in this section.
2. Rear brake pipe assemblies from rear wheel brake cylinders. Refer to SECTION 5.
3. Rear brake pipe assemblies from rear brake (center) hose assembly junction block. Refer to SECTION 5.
4. Rear brake (center) hose assembly junction block from housing assembly. Refer to SECTION 5.



29 BOLT/SCREW, DIFFERENTIAL PINION GEAR SHAFT LOCK
80 CASE, AUBURN DIFFERENTIAL (NON-SERVICEABLE)
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Figure 37 – Limited Slip Rear Axle Assembly – Auburn-Type

5. Rear brake pipe assemblies from housing assembly. Refer to SECTION 5.
6. Rear axle shaft bearing assemblies and seals. Refer to "Rear Axle Shaft Bearing Assembly and/or Bearing Seal" in this section.
7. Rear brake backing plates. Refer to SECTION 5C2.
8. Differential case. Refer to "Differential Case" in this section.
9. Differential drive pinion gear. Refer to "Differential Drive Pinion Gear" in this section.

Install or Connect

1. Differential drive pinion gear. Refer to "Differential Drive Pinion Gear " in this section.
2. Differential case. Refer to "Differential Case" in this section.
3. Rear brake backing plates. Refer to SECTION 5C2.
4. Rear axle shaft bearing assemblies and seals. Refer to "Rear Axle Shaft Bearing Assembly and/or Bearing Seal" in this section.
5. Rear brake pipe assemblies to housing assembly. Refer to SECTION 5.
6. Rear brake pipe assemblies to rear wheel brake cylinders. Refer to SECTION 5.
7. Rear brake (center) hose assembly junction block to housing assembly. Refer to SECTION 5.
8. Rear brake pipe assemblies to rear brake (center) hose assembly junction block. Refer to SECTION 5.
9. Rear axle assembly. Refer to "Rear Axle Assembly" in this section.

REAR AXLE ASSEMBLY WITH DISC BRAKES

Figures 1 through 4 and 38

A shim (67) may be installed between the rear brake caliper assembly mounting plate (65) and the axle shaft tube flange on the housing assembly (16). This shim (67) centers the rear brake caliper and pad assemblies over the brake rotor assembly (71), ensuring even brake pad assembly pressure during braking. This shim (67) may have to be changed when the housing assembly (16) is replaced.

Remove or Disconnect

- Rear axle assembly. Refer to "Rear Axle Assembly" in this section.

Disassemble

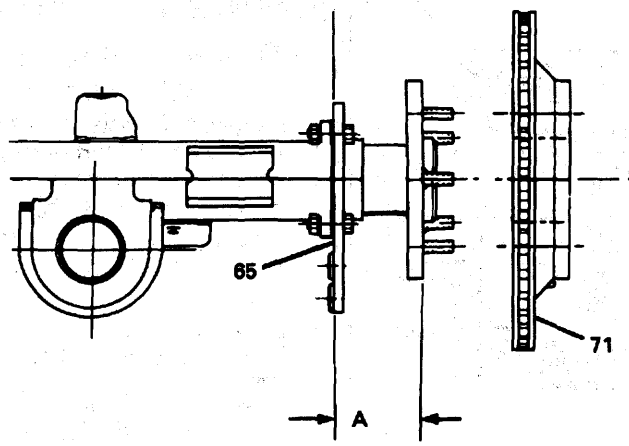
1. Rear brake pipe assemblies from brake hose assemblies. Refer to SECTION 5.
2. Rear brake pipe assemblies from rear brake (center) hose assembly junction block. Refer to SECTION 5.
3. Rear brake (center) hose assembly junction block from housing assembly. Refer to SECTION 5.
4. Rear brake pipe assemblies from housing assembly. Refer to SECTION 5.
5. Rear brake hose assemblies from housing assembly. Refer to SECTION 5.
6. Rear brake shaft bearing assemblies and seals. Refer to "Rear Axle Shaft Bearing Assembly and/or Bearing Seal" in this section.
7. Rear brake caliper anchor brackets and mounting plates. Refer to SECTION 5B2.
8. Shim (67), if installed.
9. Differential case. Refer to "Differential Case" in this section.
10. Differential drive pinion gear. Refer to "Differential Drive Pinion Gear" in this section.

Assemble

1. Differential drive pinion gear. Refer to "Differential Drive Pinion Gear" in this section.
2. Differential case. Refer to "Differential Case" in this section.
3. Rear brake caliper anchor brackets and mounting plates. Refer to SECTION 5B2.
4. Rear axle shaft bearing assemblies and seals, but do not tighten lock bolt/screw at this time. Leave lock bolt/screw finger tight. Refer to "Rear Axle Shaft Bearing Assembly and/or Bearing Seal" in this section.

Measure

1. Distance from rear face of rear brake caliper assembly mounting plate (65) (tube flange mounting surface) to front face of machined axle shaft tube flange, using a caliper.
2. Select shim (67). Refer to Figure 38.



DISTANCE "A"	SHIM THICKNESS REQUIRED*	GM PART NUMBER
68.625-69.79 mm (2.70"-2.74") 69.800-70.955 mm (2.75"-2.79")	NO SHIM REQUIRED 0.60 mm (0.024")	— 26034667

* ORIGINAL SHIM, IF INCLUDED, MAY BE PROPER THICKNESS TO REUSE.

A DIMENSION USED TO DETERMINE SHIM
65 PLATE, REAR BRAKE CALIPER ASSEMBLY MOUNTING
71 ROTOR ASSEMBLY, REAR BRAKE

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Figure 38 – Brake Caliper Assembly Mounting Plate Shim Selection

Disassemble

1. Rear axle shaft. Refer to "Rear Axle Shaft" in this section.
2. Rear brake caliper anchor brackets and mounting plates. Refer to SECTION 5B2.

Assemble

1. Shim (67), if necessary.
2. Rear brake caliper anchor brackets and mounting plates. Refer to SECTION 5B2.
3. Rear brake hose assemblies to housing assembly. Refer to SECTION 5.
4. Rear brake pipe assemblies to housing assembly. Refer to SECTION 5.
5. Rear brake (center) hose assembly junction block to housing assembly. Refer to SECTION 5.
6. Rear brake pipe assemblies to rear brake (center) brake assembly junction block. Refer to SECTION 5.
7. Rear brake pipe assemblies to brake hose assemblies. Refer to SECTION 5.

Install or Connect

- Rear axle assembly. Refer to "Rear Axle Assembly" in this section.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Use a reliable torque wrench to tighten the parts listed to make sure the parts are properly tightened without straining or distorting parts. These specifications are for clean and lightly-lubricated threads only; dry or dirty threads produce increased friction which prevents measurement of tightness.

Differential Bearing Cap Bolt/Screw	75 N•m (55 lb. ft.)
Differential Drive Pinion Gear Setting Gage Nut	2.3 N•m (20 lb. in.)
Differential Pinion Gear Shaft Lock Bolt/Screw	36 N•m (27 lb. ft.)
Differential Ring Gear (Left-Hand Thread) Bolt/Screw	120 N•m (89 lb. ft.)
Rear Axle Housing Bolt/Screw	30 N•m (22 lb. ft.)
Rear Axle Housing Drain (Fill) Plug	35 N•m (26 lb. ft.)
Sensor Plug Mounting Bolt/Screw	10 N•m (89 lb. in.)
Wheel Nut	120 N•m (89 lb. ft.)

GENERAL SPECIFICATIONS

Rear Axle Type	Semi-Floating Hypoid
Drive and Torque	Through 4 Arms
Ring and Drive Pinion Gear Set Type	Hypoid
Rear Axle Lubricant Capacity	1.65 L (3.5 pt.)
Rear Axle Lubricant	
Standard Differential	GM P/N 12345977 Axle Lubricant or SAE 80W-90 GL-5 Gear Lubricant or equivalent
Limited Slip Differential	118 ml (4 fl. oz.) GM P/N 1052358 Limited Slip Differential Lubricant and GM P/N 12345977 Axle Lubricant or SAE 80W-90 GL-5 Gear Lubricant or equivalent
Pinion Gear Seal Lubricant	GM P/N 1050169 or equivalent
Gear Marking Compound	GM P/N 1052351 or equivalent

LIMITS FOR FITTING AND ADJUSTING

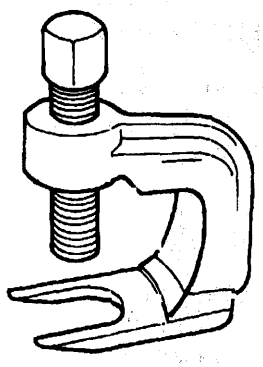
Differential Drive Pinion Gear Inner and Outer Bearing Preload (Measured at Drive Pinion Gear Nut)	
New Bearing Assemblies	1.7 – 3.4 N•m (15 – 30 lb. in.) Rotating Torque with New Seal
Used Bearing Assemblies	1.0 – 1.7 N•m (10 – 15 lb. in.) Rotating Torque with New Seal
Total Assembly Preload (Measured at Drive Pinion Gear Nut)	
New Bearing Assemblies	3.6 – 6.2 N•m (32 – 55 lb. in.) Rotating Torque with New Seal
Used Bearing Assemblies	1.8 – 3.1 N•m (16 – 28 lb. in.) Rotating Torque with New Seal
Differential Ring Gear-to-Differential Drive Pinion Gear Backlash	0.13 – 0.23 mm (0.005″ – 0.009″)

REAR AXLE ASSEMBLY USAGE

RING GEAR DIAMETER	AXLE GEAR RATIO	REAR BRAKE DRUM DISC	TEETH RING GEAR: PINION	AXLE RATIO
7.62"	2.73	— / DISC	41:15	GU2
	3.23	CAST IRON DRUM / DISC	42:13	GU5

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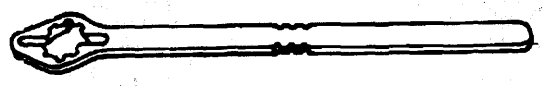
SPECIAL TOOLS

1  J 6627-A

1 WHEEL STUD REMOVER

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3  J 8614-10

1  J 8614-2

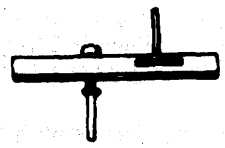
2  J 8614-3

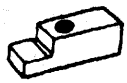
J 8614-01 SET

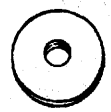
1 PINION FLANGE REMOVER ADAPTER
2 PINION FLANGE REMOVER SCREW
3 PINION FLANGE REMOVER

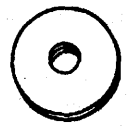
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1.  J 23597-1

2.  J 23597-11

3.  J 21777-40

4.  J 21777-42

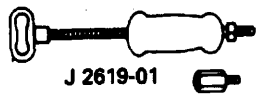
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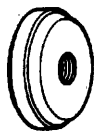
7 1/2" AND 7 5/8" RING GEAR REAR AXLE

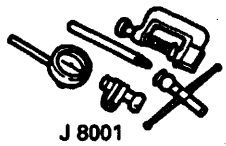
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2. PINION SETTING GAGE — GAGE PLATE
3. PINION SETTING GAGE — REAR PILOT WASHER
4. PINION SETTING GAGE — FRONT PILOT WASHER
5. PINION SETTING GAGE — STUD ASM-BOLT
6. PINION SETTING GAGE — SIDE BEARING DISCS

6.  J 21777-45

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1. 
J 2619-01

2. 
J 7817

3. 
J 8001

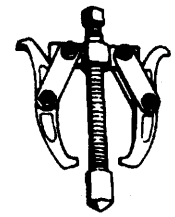
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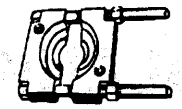
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6. 
J 21579

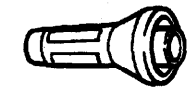
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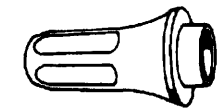
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9. 
J 22888-20

10. 
J 22912-01

11. 
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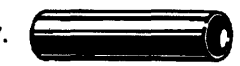
12. 
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13. 
J 23911

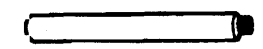
14. 
J 25299

15. 
J 25588

16. 
J 29609

17. 
J 5590

18. 
J 39446

19. 
J 21465-13

7 1/2" AND 7 5/8" RING GEAR REAR AXLE

1. SLIDE HAMMER WITH 1/2 X 13 ADAPTER
2. FRONT PINION BEARING CUP INSTALLER
3. DIAL INDICATOR SET
4. DRIVER HANDLE
5. DIFFERENTIAL SIDE BEARING REMOVER PLUG
6. AXLE SHAFT REMOVER
7. PINION DRIVER
8. AXLE BEARING REMOVER
9. DIFFERENTIAL SIDE BEARING REMOVER
10. REAR PINION BEARING REMOVER
11. AXLE BEARING INSTALLER
12. AXLE OIL SEAL INSTALLER
13. PINION OIL SEAL INSTALLER
14. DIFFERENTIAL SIDE BEARING INSTALLER
15. SIDE BEARING SHIM INSTALLER
16. REAR PINION BEARING CUP INSTALLER
17. REAR PINION BEARING CONE INSTALLER
18. ABS EXCITER RING PROTECTOR KIT
19. DRIVER HANDLE EXTENSION

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BLANK

BRAKES

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Front Disc Brakes ..... Section 5B1
Rear Disc Brakes ..... Section 5B2
Duo-Servo Drum Brakes ..... Section 5C2
Vacuum Booster System ..... Section 5D1
Antilock Brake System ..... Section 5E1
Antilock Brake System with Traction Control System ..... Section 5E2
Parking Brake ..... Section 5F

SECTION 5

BRAKES

CAUTION: Certain components in the Antilock Brake System are not intended to be serviced individually. Attempting to remove or disconnect certain system components may result in personal injury and/or improper system operation. Only those components with approved removal and installation procedures in Sections 5, 5E1 and 5E2 should be serviced.

CAUTION: When servicing brake parts, do not create dust by grinding, sanding brake linings, or by cleaning brake parts with a dry brush or compressed air. Many brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm. A water dampened cloth or water based solution should be used to remove any dust on brake parts. Equipment is commercially available to perform this washing function. These wet methods will prevent asbestos fibers from becoming airborne.

CAUTION: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- **Eye contact - rinse thoroughly with water.**
- **Skin contact - wash with soap and water.**

NOTICE: The use of rubber hoses or parts other than those specified for the Antilock Brake System may lead to functional problems requiring major overhaul. Replace all components included in repair kits used to service this system. Lubricate rubber parts with clean, fresh brake fluid to ease assembly. Do not use lubricated shop air on brake parts as damage to rubber components may result. If any hydraulic component is removed or brake pipe or hose assembly disconnected, it will be necessary to bleed the entire brake hydraulic system. The torque values specified are for dry, unlubricated fasteners.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen damage.

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GENERAL DESCRIPTION

BRAKE FLUID AND FLUID HANDLING

CAUTION: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- **Eye contact - rinse thoroughly with water.**
- **Skin contact - wash with soap and water.**

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring, cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen the damage.

Important

- Do not re-use fluid accumulated during brake hydraulic system bleeding.
- Always store brake fluid in a closed container. Reseal brake fluid containers immediately after use. Do not use fluid left in an open or improperly sealed container as it absorbs moisture or can become contaminated.

Substandard or Contaminated Brake Fluid

Use only hydraulic brake fluid GM P/N 1052535 or an equivalent DOT-3 fluid. **DO NOT** use power steering fluid, automatic transmission fluid or DOT-5 silicone hydraulic brake fluid.

Use of an improper fluid or one contaminated with mineral oil or water may cause the fluid to boil or the rubber components in the brake hydraulic system to deteriorate.

Flushing Brake Hydraulic System

The system must be flushed if there is any doubt about the condition of the fluid in the system or if fluid has been used which contains the slightest trace of petroleum or mineral oil based fluids. Approximately 1.5 liters (1.5 quarts) of hydraulic brake fluid is required to flush the brake hydraulic system. Refer to "Flushing Brake Hydraulic System" under "On-Vehicle Service" in this section for more information.

COMBINATION VALVE ASSEMBLY

The non-serviceable brake combination valve assembly is located under the hood, mounted to the ABS modulator assembly on the left engine compartment side inner rail assembly. The brake combination valve assembly incorporates the following functions into a single component:

Brake Pressure Differential Warning Switch

The brake pressure differential warning switch monitors the front and rear brake systems to measure any difference in hydraulic pressure between the two systems. If a sufficient pressure differential exists between the systems, an electrical ground is made energizing the red "BRAKE" warning lamp if the ignition is on. The brake combination valve assembly and brake pressure differential warning switch are also designed so the warning switch will latch in the warning position once a malfunction has occurred. The "BRAKE" warning lamp will turn off only after the malfunction is repaired and a pedal force sufficient to develop approximately 3 100 kPa (450 psi) hydraulic brake pressure is applied.

Brake Proportion Valve

The brake proportion valve improves front-to-rear brake balance under severe brake application. Severe brake application transfers part of the vehicle's rear weight to the front wheels. The resulting decrease in weight at the rear wheels can cause reduced brake efficiency. The brake proportion valve limits the pressure to the rear brakes to reduce the tendency for reduced brake efficiency. The proportion valve also has a by-pass feature which assures full system pressure to the rear brakes in the event of a front system brake failure. Full front system pressure is retained in the event of rear brake system malfunction.

CAUSES / SYMPTOM	Improper Brake Pedal Travel	Brake Pedal Travel Gradually (Increases)	Excessive Brake Pedal Effort	Excessive Braking Action	Brakes Slow to Respond	Brakes Slow to Release	Brakes Drag	Uneven Braking Action (Side to Side)	Uneven Braking Action (Front to Rear)	Scraping Noise from Brakes	Brakes Squeak Without Application	Brakes Squeak During Stop	Brakes Chatter (Roughness)	Brakes Groan at End of Stop	"Brake" Warning Lamp "On"	Premature Lining Wearout	Parking Brake Won't Hold	Parking Brake Won't Release	Brake Pulsation	Brake Pulls	DIAGNOSTIC SECTION
Leaking Brake Line or Conn.	X	XX							X						XX	X					5
Leaking Piston Seal	X	XX							X						X						5B
Leaking Master Cylinder (Internal)	X	XX							X						X						5A
Air in Brake System	XX				X				X						XX						5
Contaminated or Improper Brake Fluid	X				X	X	X	X	X						X						5
Leaking Vac. or Booster Sys.	XX		XX		X																5D1
Restricted Passage in Vacuum Booster		X	X		XX	X															5D1
Damaged Vacuum Booster	X	X	X	X	X	XX															5D1
Worn Out Brake Lining			X	X				X	X	X	X	X					X			X	5B,5C
Uneven Brake Lining Wear	X			X				X	X	X	X	XX					X			X	5B,5C
Glazed Brake Lining			XX		X			X	X		X	X									5B,5C
Incorrect Lining Material			X	X				X	XX		X	X		X		X	XX		X	X	5B,5C
Contaminated Brake Lining			X					XX	XX	X	X	X		X			X		X	X	5B,5C
Lining Damaged by Abusive Use	X		X	XX			X	X	X	X	X	X		X		X	X		X	X	5B,5C
Improper Rotor Surface Finish			XX	X				X	X								X			X	5B,5C
Scored Rotor				X				X	X		X	X	XX						X	X	5B
Improper Thickness Variation in Rotor	X												XX						XX		5B
Excessive Lateral Run-out in Rotor	X						X						X						X		5B
Brake Asm. Attachments Loose (Incl. Splash Shield)	X			X			X	X	X	X		X	X								5B
Restricted Brake Fluid Passage		X	X		X	X	X	X	X											X	5
Improperly Adj. Stoplamp Switch or Cruise Control Vacuum Dump	X						XX				X				XX						5
Brake Pedal Linkage Interference or Binding			X		X	XX	XX								X						5
Incorrect Vacuum Booster Pushrod Length	X						XX				X				X						5D1
Incorrect Front Wheel Align.								XX												XX	3A
Incorrect Tire Pressure								X												X	3A
Loose Front Suspension Parts							X	X		XX			X						X	X	3C
Out-of-balance Wheel Assm.													XX						X		3E
Operator Riding Brake Pedal			X				X								X						
Sticking Caliper or Caliper Pistons					X	X	XX	X	X		X				X	X	X			X	5B
Park. Brake Switch Ckt. Gnd.														XX							8A
Park. Brake Not Releasing						X	X	X						XX	X						5F
Low Brake Fluid	X								X						X						5
Caliper to Knuckle Clearance						X	X	X			X				X					X	5B
Improper Rear Brake Adj.	XX						X		X						X						5F
Low Engine Vacuum	XX		X		X																5
Excessive Vehicle Loading			X						XX			X			X						
Improperly Torqued Wheel Nuts													X						X		3E
Poor Drum Surface Finish				X									X						X		5C
Parking Brake Cables Seized							X								X	XX	XX				5F
Rotor Corroded			X					X		X			X						XX	X	5
Grease/Dirt on Rotor													X	XX							5
ABS Modulator RR Piston Seized			X						X						X						5E1

XX - INDICATES MORE PROBABLE CAUSE(S) X - INDICATES OTHER CAUSE(S)

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Figure 1 – Brake System Diagnosis

WARNING/INDICATOR LAMP OPERATION

Brake

The brake system uses a single red "BRAKE" warning lamp located in the instrument cluster assembly. When the ignition switch is in the "START" position, the "BRAKE" warning lamp should come on. It should go off when the ignition switch returns to the "RUN" position.

The following conditions will activate the "BRAKE" warning lamp:

1. Parking brake applied. Lamp should be on when parking brake is applied and ignition switch is "ON."
2. Brake pressure differential warning switch detects failure. Refer to SECTION 8A for diagnosis.
3. During engine cranking "BRAKE" warning lamp should remain on. This notifies driver that warning circuit is operating properly.

Antilock

The antilock brake system (ABS) uses three indicator lamps: the red "BRAKE" warning lamp, an amber "ABS INOP" indicator lamp and an amber "LOW TRAC" indicator lamp, all located in the instrument cluster assembly. Under normal conditions, these lamps should operate as follows:

1. When ignition is turned to "RUN" position, prior to starting engine, amber "ABS INOP" indicator lamp should go on and red "BRAKE" warning lamp should flash.
2. As engine is cranked, both red "BRAKE" warning lamp and amber "ABS INOP" indicator lamp should come on and "LOW TRAC" indicator lamp may come on and off.
3. When engine is started, amber "ABS INOP" and red "BRAKE" lamps should go out and "LOW TRAC" indicator lamp may come on and off.

The operation of these three indicator lamps is an important part of the antilock brake system (ABS) diagnosis. If the warning/indicator lamps turn on while driving the vehicle, this indicates a malfunction. If the warning/indicator lamps don't turn on under normal conditions as described above, service the lamps as soon as possible. For further information regarding warning/indicator lamp operation for the antilock brake system (ABS), refer to SECTION 5E1.

DIAGNOSIS

BRAKE SYSTEM TESTING

Brakes should be tested on a dry, clean, reasonably smooth and level roadway. A true test of brake performance cannot be made if the roadway is wet, greasy or covered with loose dirt so that all tires do not grip the road equally. Testing will also be affected if the roadway is crowned, which would throw the weight of the vehicle toward the wheels on one side. If the roadway is too rough, the wheels will tend to bounce.

Test brakes at different vehicle speeds with both light and heavy brake pedal force.

External Conditions That Affect Brake Performance

Tires

Tires having unequal contact and grip on the road will cause unequal braking. Tires must be equally inflated, and the tread pattern of right and left tires must be approximately equal.

Vehicle Loading

A heavily loaded vehicle requires more braking effort. When a vehicle has unequal loading, the most heavily loaded wheels require more braking power than others.

Wheel Alignment

Misalignment of the wheels, particularly excessive camber and caster, will cause the brakes to pull to one side.

BRAKE SYSTEM

Figure 1

For diagnosis of the brake hydraulic system, refer to Figure 1.

BRAKE PEDAL ASSEMBLY TRAVEL

Most low brake pedal assembly problems are caused by air in the brake system or misadjusted rear drum brakes. Bleed the system until air is purged and check rear brake adjustment. Refer to SECTION 5E1. Other less frequent causes of excessive brake pedal assembly travel are incorrect pushrod assembly length, rear brake shoe adjusters not operating, linings excessively worn, and brake hydraulic system leakage.

High brake pedal assembly force problems are usually caused by low engine assembly vacuum, a vacuum leak, or an improperly functioning vacuum booster assembly. These conditions would also result in higher than normal brake pedal assembly efforts.

Measure

Tool Required:

J 28662 Brake Pedal Effort Gage

1. Install J 28662 onto pedal assembly.
2. Hook end of tape measure over top edge of pedal assembly and measure the distance to rim of steering wheel assembly.
3. With engine running at idle and the shift lever in "NEUTRAL" and the wheel and tire assemblies blocked, apply brake pedal assembly with 445 N (100 lb.) force and remeasure. The difference between both readings is actual brake pedal assembly travel and should be between 51 to 89 mm (2.0 to 3.5 inches).
4. If brake pedal assembly travel is more than specifications, refer to Figure 1.

BRAKE FLUID LEAKS

With engine running at idle and the shift lever in "NEUTRAL," depress the brake pedal assembly and hold constant foot pressure. If the pedal assembly gradually falls away with constant pressure, the brake hydraulic system may be leaking. Perform visual check to confirm any suspected leak.

Check the master cylinder assembly fluid levels. While a slight drop in master cylinder reservoir level does result from normal lining wear, an abnormally low level in either reservoir indicates a leak in the system. The brake hydraulic system may be leaking either internally or externally. Refer to SECTION 5A. Also, the system may appear to pass this test but still have slight leakage.

Check for possible brake fluid leaks at the brake pipe assembly and brake hose assembly connections. If any signs of leakage are found, replace the brake pipe or hose assembly. Also, inspect the connecting brake component to determine if it is damaged and should be rebuilt or replaced. Check the brake caliper boots and rear wheel cylinder boots for leaks. If any brake fluid appears to be leaking, rebuild or replace the assembly. Refer to SECTION 5B1, SECTION 5B2 or SECTION 5C2.

When checking the brake fluid levels, the master cylinder rear reservoir may be as low as 25.4 mm (1 inch) from the top if the linings are worn. This is not abnormal.

Brake Hose and Pipe Assembly Inspection

NOTICE: Do not allow brake components to hang from the flexible hose assemblies as damage to the hoses may occur. Some brake hose assemblies have protective rings or covers to prevent direct contact of the hose with other chassis parts. Besides causing possible structural damage to the hose, excessive tension could cause the hose rings to move out of their proper locations.

Inspect

1. Flexible hydraulic brake hose assemblies, which transmit hydraulic pressure from steel brake pipe assembly on body to steel brake pipe assemblies on rear axle assembly and to brake caliper assemblies, at least twice a year when vehicle is on lift for lubrication.
2. Brake hose assemblies for road hazard damage, cracks, and chafing of outer cover, and for leaks and blisters.
   - A light and mirror may be needed for adequate inspection.
   - If any of the above conditions are observed on a brake hose assembly, it will be necessary to replace it.

BRAKE FLUID

NOTICE: Improper brake fluid, mineral oil or water in the brake fluid may cause rubber components in the brake hydraulic system to deteriorate. If brake master cylinder primary or secondary piston seals are swollen, the rubber parts have deteriorated. This deterioration may also be seen by swollen brake master cylinder reservoir seals, rear wheel cylinder piston boots or brake caliper piston boots.

If rubber deterioration is evident, disassemble all hydraulic parts and wash with alcohol. Dry parts with compressed air before assembly to keep alcohol out of the system. Replace all rubber parts in the system, including brake hose assemblies, master cylinder assembly rubber parts, and brake caliper assembly and wheel cylinder assembly boots and seals. Also replace the combination valve assembly and brake pressure modulator valve assembly, since they have rubber components inside which are not serviceable. Check for brake fluid on the linings. If excessive brake fluid is found, replace the linings.

The system must be flushed if there is any doubt as to the condition of brake fluid in the system or if a fluid has been used which contains the slightest trace of petroleum or mineral oil based fluids. Refer to SECTION 5E1 for complete brake hydraulic system flush and bleed procedures.

ON-VEHICLE SERVICE

BRAKE PEDAL ASSEMBLY WITH BRACKET

Figures 2 through 4

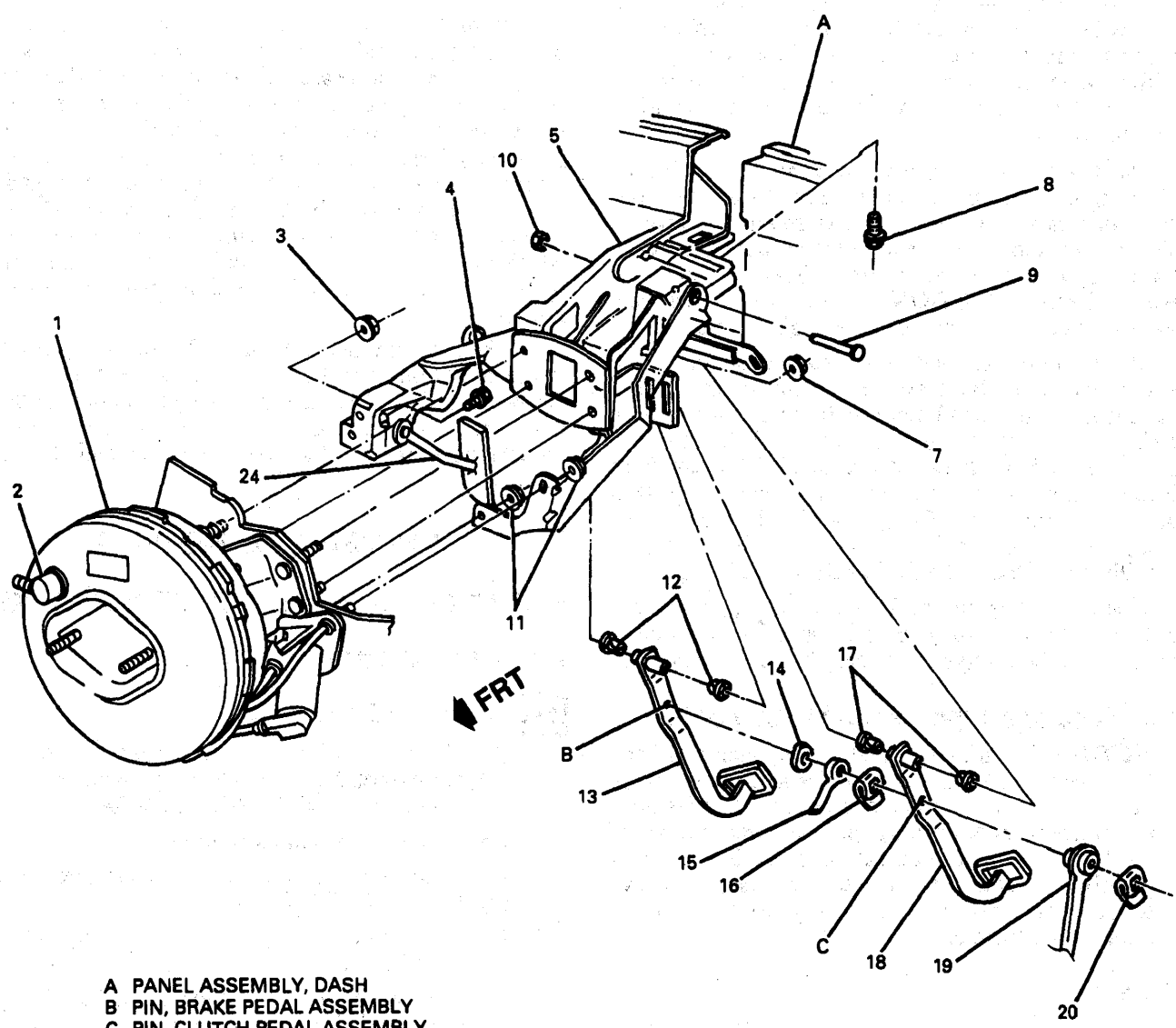
Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Left-hand instrument panel sound insulator assembly. Refer to SECTION 8C.
3. Electronic brake control module assembly. Refer to SECTION 5E1.
4. Release switch assembly, stoplamp and TCC switch assembly, and clutch switch assembly or clutch anticipate switch assembly if equipped, from pedal assembly with bracket. Refer to "Stoplamp and Cruise Control Switch Assemblies" in this section.
5. Clutch start switch assembly (29) from brake pedal assembly with bracket (5) on vehicle with manual transmission assembly.
6. Accelerator lever pedal assembly. Refer to SECTION 6C.
7. Retainer (16), brake pedal pushrod (15) and washer (14) from brake pedal assembly pin.
8. Retainer (20) and clutch pushrod (19) from clutch pedal assembly pin on vehicle with manual transmission assembly.
9. Nuts (3 and 7) and bolts/screws (4 and 8).
10. Nuts (11), on vehicle with manual transmission assembly.
11. Brake pedal assembly with bracket (5 or 6).

Install or Connect

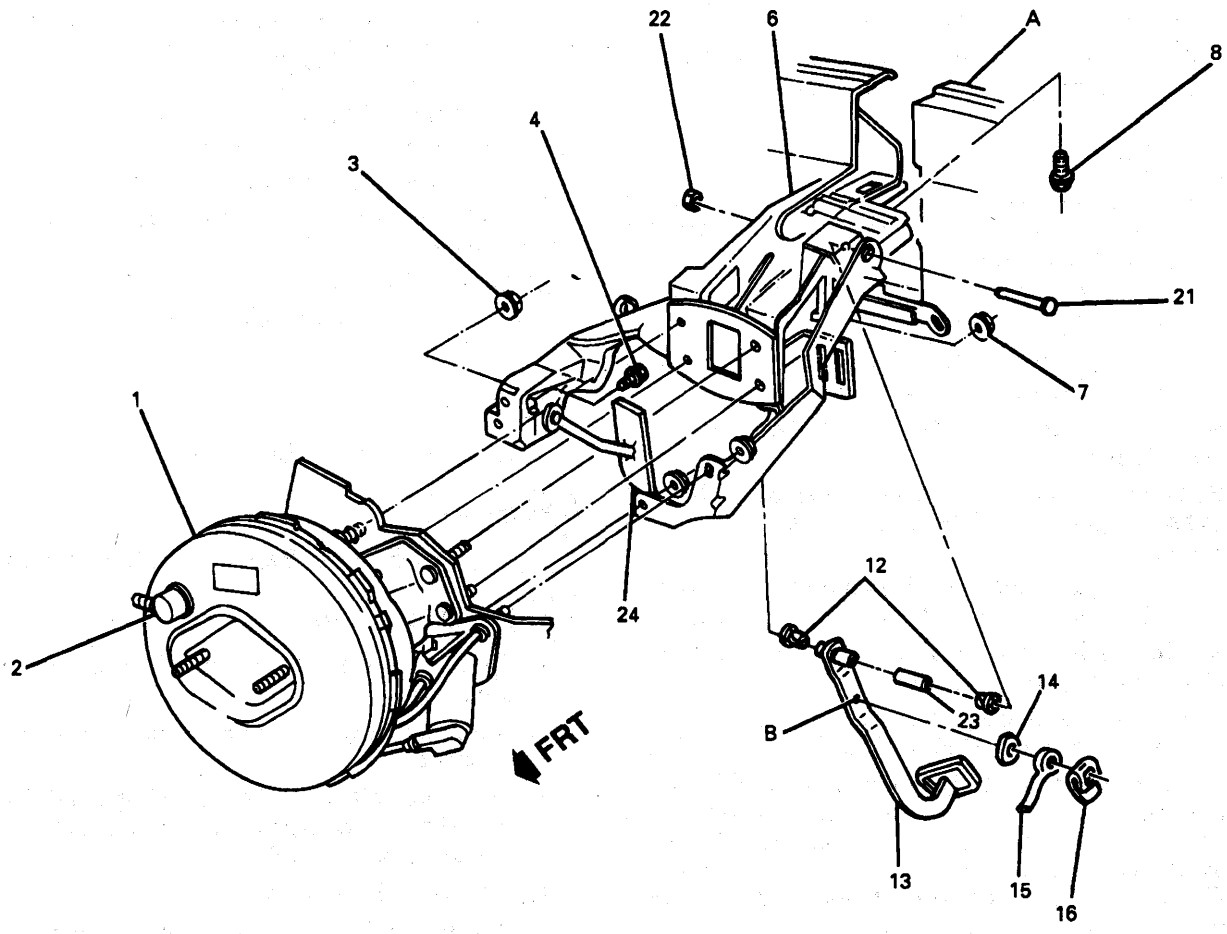
NOTICE: See "Notice" on page 5-1 of this section.



A PANEL ASSEMBLY, DASH
B PIN, BRAKE PEDAL ASSEMBLY
C PIN, CLUTCH PEDAL ASSEMBLY
1 BOOSTER ASSEMBLY, POWER BRAKE
2 VALVE, POWER BRAKE BOOSTER VACUUM CHECK
3 NUT, BRAKE PEDAL
4 BOLT/SCREW, BRAKE PEDAL BRACKET
5 PEDAL ASSEMBLY, BRAKE AND ACCELERATOR AND CLUTCH (WITH BRACKET)
7 NUT, BRAKE PEDAL BRACKET
8 BOLT/SCREW, BRAKE PEDAL BRACKET
9 BOLT/SCREW, BRAKE PEDAL PIVOT
10 NUT, BRAKE PEDAL PIVOT
11 NUT, CLUTCH MASTER CYLINDER
12 BUSHING, BRAKE PEDAL PIVOT
13 PEDAL ASSEMBLY, BRAKE
14 WASHER, BRAKE PEDAL PUSHROD
15 PUSHROD, BRAKE PEDAL
16 RETAINER, BRAKE PEDAL PUSHROD PIN
17 BUSHING, CLUTCH PEDAL PIVOT
18 PEDAL ASSEMBLY, CLUTCH
19 PUSHROD, CLUTCH MASTER CYLINDER
20 RETAINER, CLUTCH PEDAL LEVER PIN
24 PEDAL ASSEMBLY, ACCELERATOR LEVER

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Figure 2 – Brake Pedal Assembly (Manual Transmission)



A PANEL ASSEMBLY, DASH
B PIN, BRAKE PEDAL ASSEMBLY
1 BOOSTER ASSEMBLY, POWER BRAKE
2 VALVE, POWER BRAKE BOOSTER VACUUM CHECK
3 NUT, BRAKE PEDAL
4 BOLT/SCREW, BRAKE PEDAL BRACKET
6 PEDAL ASSEMBLY, BRAKE AND ACCELERATOR (WITH BRACKET)
7 NUT, BRAKE PEDAL BRACKET
8 BOLT/SCREW, BRAKE PEDAL BRACKET
12 BUSHING, BRAKE PEDAL PIVOT
13 PEDAL ASSEMBLY, BRAKE
14 WASHER, BRAKE PEDAL PUSHROD
15 PUSHROD, BRAKE PEDAL
16 RETAINER, BRAKE PEDAL PUSHROD PIN
21 BOLT/SCREW, BRAKE PEDAL PIVOT
22 NUT, BRAKE PEDAL PIVOT
23 SPACER, BRAKE PEDAL PIVOT
24 PEDAL ASSEMBLY, ACCELERATOR LEVER

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Figure 3 – Brake Pedal Assembly (Automatic Transmission)

Important

- When installing brake pedal assembly with bracket, make sure that dash panel insulator material does not get pinched between brake pedal assembly with bracket and dash panel.

1. Brake pedal assembly with bracket (5 or 6).
2. Nuts (11), on vehicle with manual transmission.
3. Nuts (3 and 7) and bolts/screws (4 and 8).

Tighten

- Nuts (7) to 20 N•m (15 lb. ft.) in sequence: inboard upper, outboard lower, outboard upper, inboard lower.
- Nuts (3) to 20 N•m (15 lb. ft.) and bolts/screws (4 and 8) to 25 N•m (18 lb. ft.).
- Nuts (11) to 27 N•m (20 lb. ft.) on vehicle with manual transmission assembly.

4. Accelerator lever pedal assembly. Refer to SECTION 6C.
5. Retainer (20) and clutch pushrod (19) to clutch pedal assembly pin on vehicle with manual transmission assembly.
   - Lubricate clutch pedal assembly pin with chassis lubricant, GM P/N 1052497 or equivalent.
6. Retainer (16), brake pedal pushrod (15) and washer (14) to brake pedal assembly pin.
   - Lubricate brake pedal assembly pin with chassis lubricant, GM P/N 1052497 or equivalent.
7. Release switch assembly, stoplamp and TCC switch assembly, and clutch switch assembly or clutch anticipate switch assembly if equipped, to pedal assembly with bracket. Refer to "Stoplamp and Cruise Control Switch Assemblies" in this section.
8. Electronic brake control module assembly. Refer to SECTION 5E1.
9. Clutch start switch assembly (29) to brake pedal assembly with bracket (5), on vehicle with manual transmission assembly.
10. Battery negative cable assembly.

Adjust

- Release switch assembly, stoplamp and TCC switch assembly, and clutch switch assembly or clutch anticipate switch assembly on vehicle with manual transmission assembly. Refer to "Stoplamp and Cruise Control Switch Assemblies" in this section.

BRAKE PEDAL ASSEMBLY

Figures 2 and 3

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Electronic brake control module assembly. Refer to SECTION 5E1.
3. Retainer (16), brake pedal pushrod (15) and washer (14) from brake pedal assembly pin.
4. Nut (10) and bolt/screw (9) on vehicle with manual transmission assembly.
   - Slide out bolt/screw (9) part way, giving just enough clearance to remove brake pedal assembly (13).
5. Nut (22) and bolt/screw (21) on vehicle with automatic transmission assembly.
6. Brake pedal assembly (13).
7. Bushings (12) from brake pedal assembly (13), if necessary.
8. Spacer (23) from brake pedal assembly (13) on vehicle with automatic transmission assembly, if necessary.

Clean

- All parts with suitable solvent.

Inspect

- All parts for wear. Repair or replace as needed.

Install or Connect

1. Spacer (23) to brake pedal assembly (13), if removed.
2. Bushings (12) to brake pedal assembly (13), if removed.
3. Lubricate bolt/screw (9) with chassis lubricant, GM P/N 1052497 or equivalent on vehicle with manual transmission assembly.
4. Brake pedal assembly (13).
5. Bolt/screw (9) and nut (10) on vehicle with manual transmission assembly.
6. Bolt/screw (21) and nut (22) on vehicle with automatic transmission assembly.

Tighten

- Nut (10 or 22) to 54 N•m (40 lb. ft.).

7. Retainer (16), brake pedal pushrod (15) and washer (14) to brake pedal assembly pin.
   - Lubricate brake pedal assembly pin with chassis lubricant, GM P/N 1052497 or equivalent.
8. Electronic brake control module assembly. Refer to SECTION 5E1.
9. Battery negative cable assembly.

Adjust

- Release switch assembly, and stoplamp and TCC switch assembly, and clutch switch assembly or clutch anticipate switch assembly if equipped. Refer to "Stoplamp and Cruise Control Switch Assemblies" in the following procedure.

STOPLAMP AND CRUISE CONTROL SWITCH ASSEMBLIES

Figure 4

Adjustment

The release switch assembly (27) must be adjusted at the same time the stoplamp and torque converter clutch (TCC) switch is adjusted. The clutch switch assembly (25) or clutch anticipate switch assembly (28) cannot be adjusted until after the clutch pedal assembly is installed.

NOTICE: Proper stoplamp switch assembly adjustment is essential. Improper stoplamp switch assembly adjustment will cause brake drag and excessive brake lining wear.

Adjust

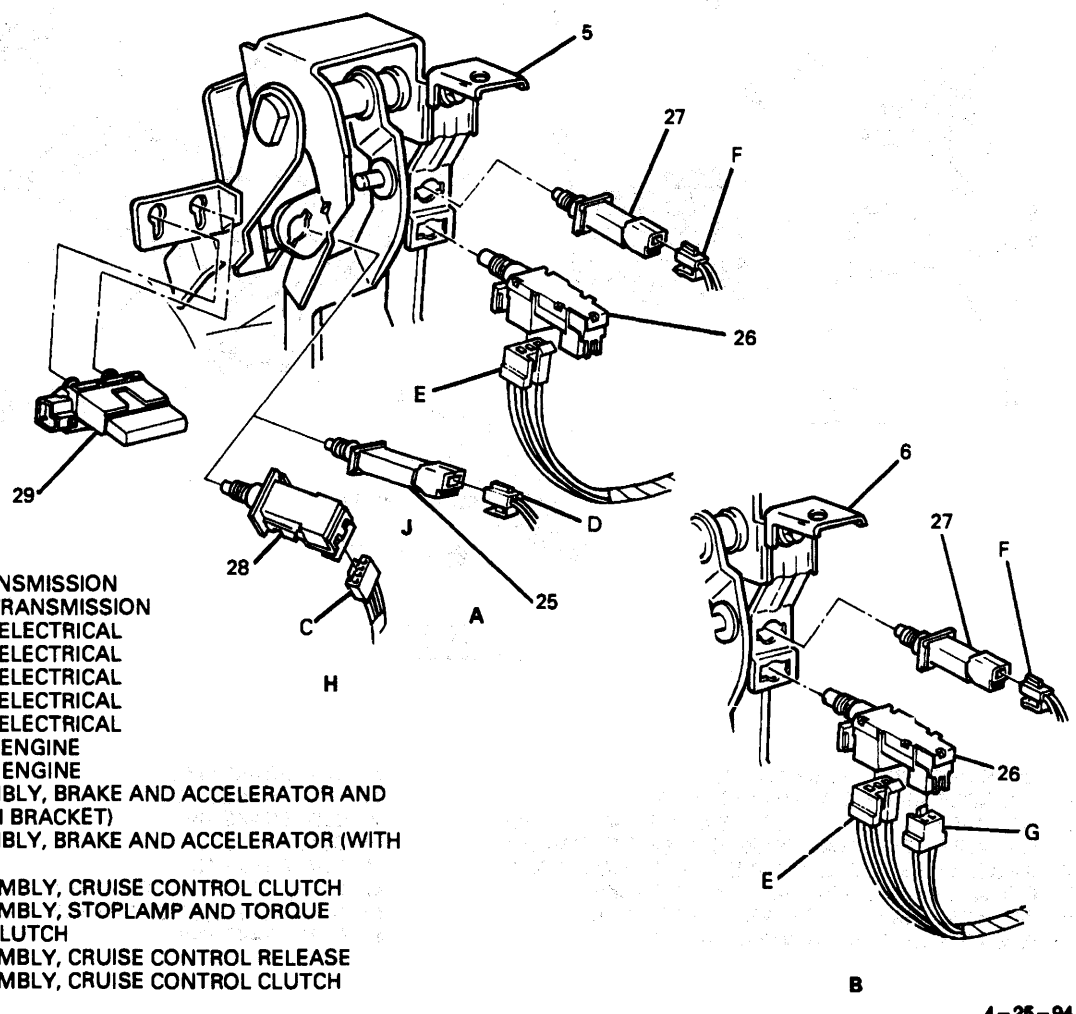
1. To adjust, depress brake pedal assembly or clutch pedal assembly and insert release switch assembly (27), stoplamp and TCC switch assembly (26) and clutch switch assembly (25) or clutch anticipate switch assembly (28) into pedal assembly with bracket (5 or 6) until retainer on release switch assembly (27), stoplamp and TCC switch assembly (26), or clutch switch assembly (25) or clutch anticipate switch assembly (28) is fully seated.

   NOTICE: Make sure to apply the proper amount of force to the brake pedal assembly during adjustment. Too much force could damage the vacuum booster assembly. Too little could cause dragging brakes.

2. Slowly pull brake or clutch pedal assembly rearward with a force of 222 N (50 pounds) until "click" sounds can no longer be heard. At this point, release switch assembly (27), stoplamp and TCC switch assembly (26), and clutch switch assembly (25) or clutch anticipate switch assembly (28) will have moved retainers to their adjusted position.

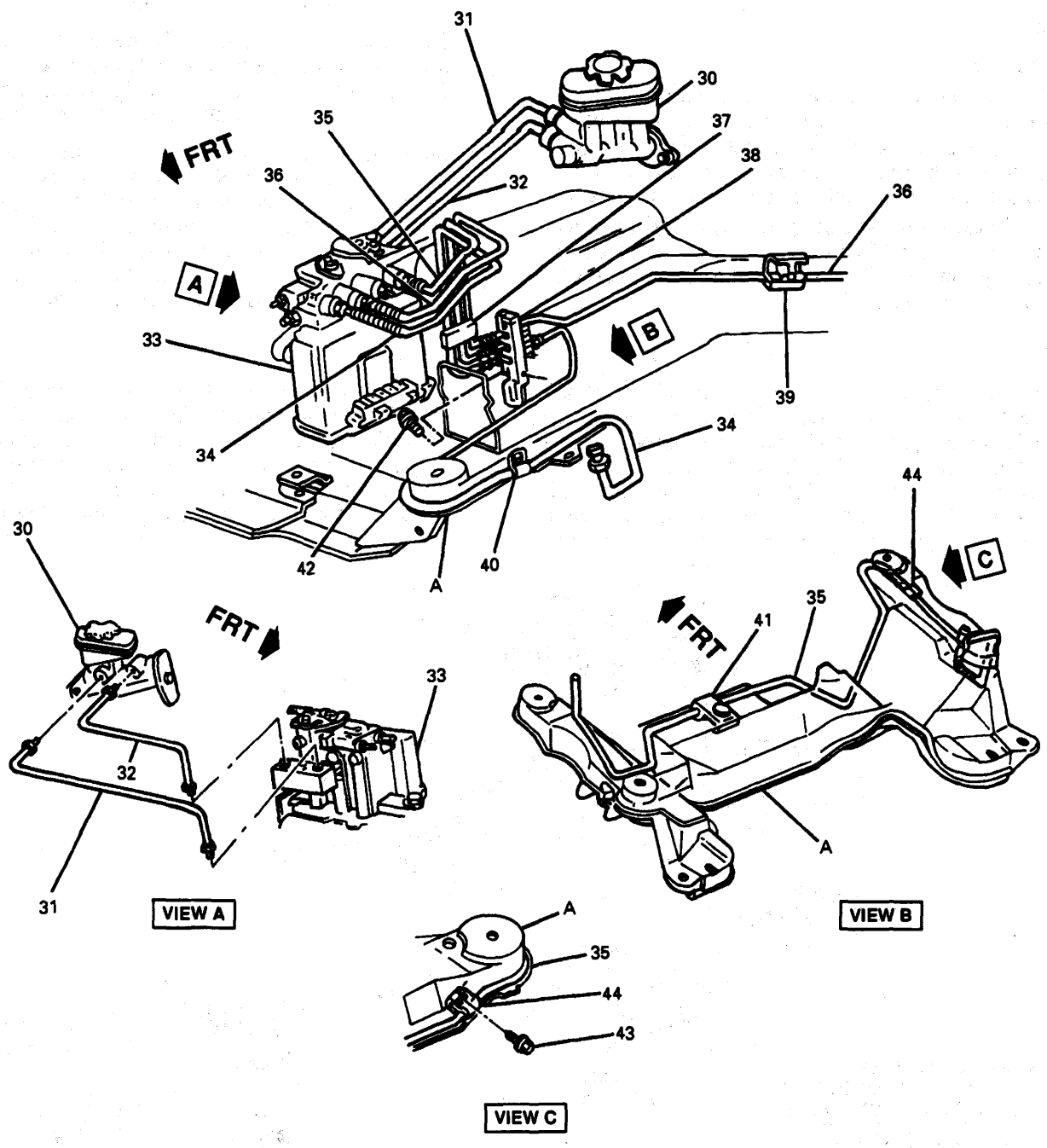
Measure

- Release switch assembly and stoplamp and TCC switch assembly contacts should be open at 25.4 mm (1 inch) or less of pedal assembly travel, and occur at the same time or before the onset of braking. The brake pedal assembly travel can be up to 25.4 mm (1 inch) before the cruise control system disengages.



A MANUAL TRANSMISSION
B AUTOMATIC TRANSMISSION
C CONNECTOR, ELECTRICAL
D CONNECTOR, ELECTRICAL
E CONNECTOR, ELECTRICAL
F CONNECTOR, ELECTRICAL
G CONNECTOR, ELECTRICAL
H WITH 3.4L L32 ENGINE
J WITH 5.7L LT1 ENGINE
5 PEDAL ASSEMBLY, BRAKE AND ACCELERATOR AND CLUTCH (WITH BRACKET)
6 PEDAL ASSEMBLY, BRAKE AND ACCELERATOR (WITH BRACKET)
25 SWITCH ASSEMBLY, CRUISE CONTROL CLUTCH
26 SWITCH ASSEMBLY, STOPLAMP AND TORQUE CONVERTER CLUTCH
27 SWITCH ASSEMBLY, CRUISE CONTROL RELEASE
28 SWITCH ASSEMBLY, CRUISE CONTROL CLUTCH ANTICIPATE
29 SWITCH ASSEMBLY, CLUTCH START

Figure 4 – Stoplamp and Cruise Control Switch Assemblies



A CROSSMEMBER ASSEMBLY, FRONT
30 CYLINDER ASSEMBLY, BRAKE MASTER
31 PIPE ASSEMBLY, FRONT BRAKE COMBINATION VALVE
32 PIPE ASSEMBLY, REAR BRAKE COMBINATION VALVE
33 VALVE ASSEMBLY, BRAKE PRESSURE MODULATOR
34 PIPE ASSEMBLY, LEFT-HAND FRONT BRAKE
35 PIPE ASSEMBLY, RIGHT-HAND FRONT BRAKE
36 PIPE ASSEMBLY, REAR BRAKE FRONT
37 CLIP, BRAKE PIPE
38 CLIP, BRAKE PIPE
39 CLIP, BRAKE PIPE
40 CLIP, BRAKE PIPE
41 CLIP, BRAKE PIPE
42 BOLT/SCREW, BRAKE PIPE CLIP
43 BOLT/SCREW, FRONT BRAKE FRONT PIPE CLIP
44 CLIP, BRAKE PIPE

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Figure 5 – Routing Front Brake Pipe Assemblies (Without Traction Control System)

BRAKE PIPE ASSEMBLIES-TO-BRAKE MASTER CYLINDER ASSEMBLY					
CALLOUT NUMBER	CIRCUIT	NUT SIZE	PIPE ASSEMBLY DIAMETER	APPROXIMATE BRAKE PIPE LINEAR LENGTH	NUT TIGHTENING SPECIFICATION
31	PRIMARY	M11 x 1.5	4.76 mm	411.0 mm (16.848")	32 N•m (24 LB. FT.)
32	SECONDARY	M11 x 1.5	4.76 mm	519.0 mm (20.895")	32 N•m (24 LB. FT.)

BRAKE PIPE ASSEMBLIES-TO-COMBINATION VALVE ASSEMBLY					
CALLOUT NUMBER	CIRCUIT	NUT SIZE	PIPE ASSEMBLY DIAMETER	APPROXIMATE BRAKE PIPE LINEAR LENGTH	NUT TIGHTENING SPECIFICATION
31	PRIMARY	M10 x 1.0	4.76 mm	411.0 mm (16.848")	18 N•m (13 LB. FT.)
32	SECONDARY	M10 x 1.0	4.76 mm	519.0 mm (20.895")	18 N•m (13 LB. FT.)

BRAKE PIPE ASSEMBLIES-TO-BRAKE PRESSURE MODULATOR VALVE ASSEMBLY					
CALLOUT NUMBER	CIRCUIT	NUT SIZE	PIPE ASSEMBLY DIAMETER	APPROXIMATE BRAKE PIPE LINEAR LENGTH	NUT TIGHTENING SPECIFICATION
34	LEFT-HAND FRONT	M10 x 1.0	4.76 mm	2321.50 mm (91.379")	32 N•m (24 LB. FT.)
35	RIGHT-HAND FRONT	M10 x 1.0	4.76 mm	1398.84 mm (55.072")	32 N•m (24 LB. FT.)
36	REAR	M12 x 1.5	6.00 mm	3736.0 mm (150.155")	32 N•m (24 LB. FT.)

BRAKE PIPE ASSEMBLIES-TO-BRAKE HOSE ASSEMBLIES					
CALLOUT NUMBER	CIRCUIT	NUT SIZE	PIPE ASSEMBLY DIAMETER	APPROXIMATE BRAKE PIPE LINEAR LENGTH	NUT TIGHTENING SPECIFICATION
34	LEFT-HAND FRONT	M10 x 1.0	4.76 mm	2321.50 mm (91.379")	15 N•m (11 LB. FT.)
35	RIGHT-HAND FRONT	M10 x 1.0	4.76 mm	1398.84 mm (55.072")	15 N•m (11 LB. FT.)

NUT COLOR CODE	
SIZE	COLOR
M10 x 1.0	OLIVE
M11 x 1.5	ORANGE
M12 x 1.0	OLIVE
M12 x 1.5	OLIVE
3/8-24 UNF	VIOLET

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Figure 6 – Front Brake Pipe Assemblies Specifications (Without Traction Control System)

Replacement

Remove or Disconnect

1. Left-hand instrument panel sound insulator assembly. Refer to SECTION 8C.
2. Electrical connectors.
3. Release switch assembly (27), stoplamp and TCC switch assembly (26), and clutch switch assembly (25) or clutch anticipate switch assembly (28), if equipped, from pedal assembly with bracket (5 or 6).

Install or Connect

1. Release switch assembly (27), stoplamp and TCC switch assembly (26), and clutch switch assembly (25) or clutch anticipate switch assembly (28), if equipped, to pedal assembly with bracket (5 or 6).
2. Electrical connectors.
3. Left-hand instrument panel sound insulator assembly. Refer to SECTION 8C.

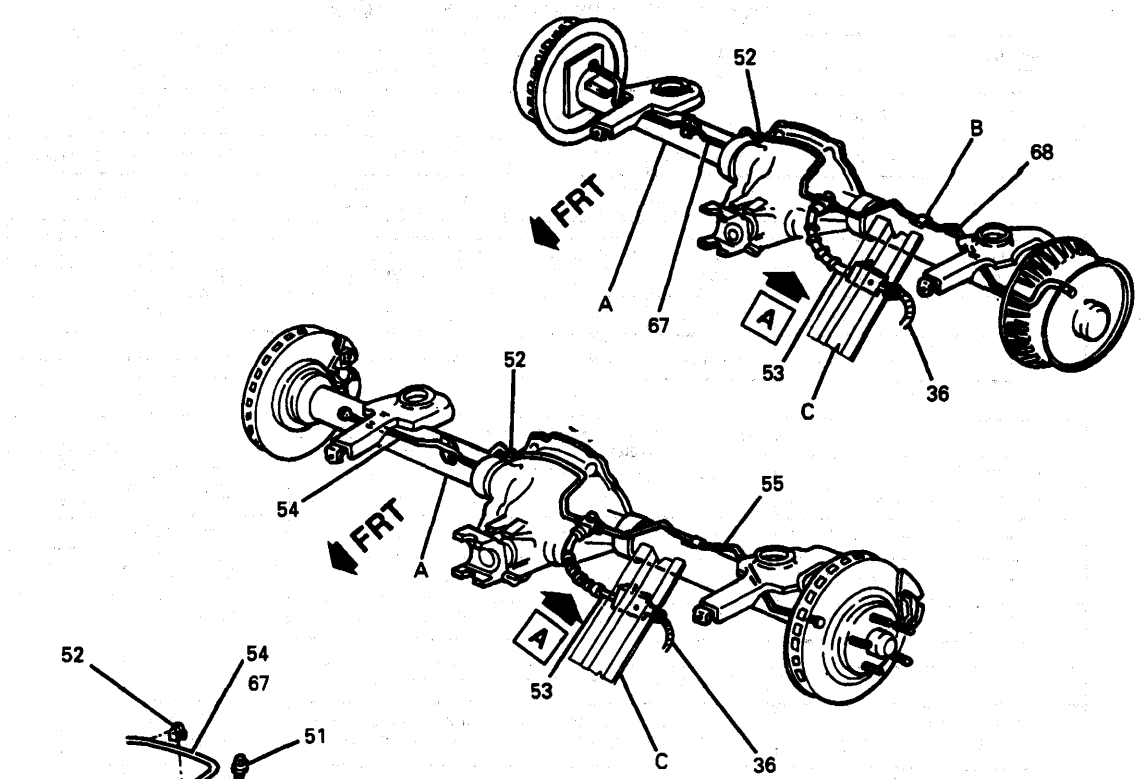
Adjust

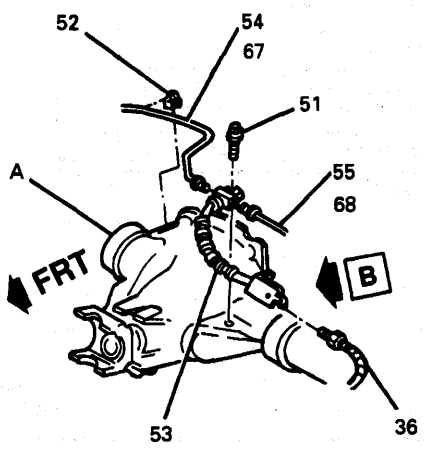
- Release switch assembly (27), stoplamp and TCC switch assembly (26), and clutch switch assembly (25) or clutch anticipate switch assembly (28), as outlined above.

BRAKE PIPE ASSEMBLY

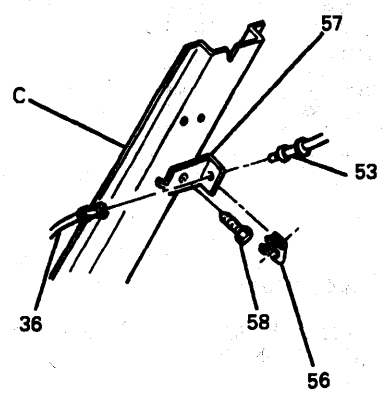
Figures 5 through 14

CAUTION: Always use double walled steel brake pipe when replacing brake pipe assemblies. The use of any other pipe is not recommended and may cause brake system failure. Carefully route and retain replacement brake pipe assemblies. Always use the correct fasteners and the original location for replacement brake pipe assemblies. Failure to properly route and retain brake pipe assemblies may cause damage to the brake pipe assemblies and cause brake system failure.





VIEW A



VIEW B

A AXLE ASSEMBLY, REAR
B CLIP, REAR AXLE RETAINER
C RAIL ASSEMBLY, REAR COMPARTMENT PANEL LONGITUDINAL
36 PIPE ASSEMBLY, REAR BRAKE FRONT
51 BOLT/SCREW, REAR BRAKE HOSE FITTING
52 CLIP, REAR BRAKE PIPE
53 HOSE ASSEMBLY, REAR BRAKE
54 PIPE ASSEMBLY, RIGHT-HAND REAR BRAKE
55 PIPE ASSEMBLY, LEFT-HAND REAR BRAKE
56 RETAINER, REAR BRAKE HOSE
57 BRACKET, REAR BRAKE HOSE
58 BOLT/SCREW, REAR BRAKE HOSE RETAINER
67 PIPE ASSEMBLY, RIGHT-HAND REAR BRAKE
68 PIPE ASSEMBLY, LEFT-HAND REAR BRAKE

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Figure 7 – Routing Rear Brake Pipe and Hose Assemblies (Without Traction Control System)

REAR BRAKE PIPE ASSEMBLIES - TO - REAR BRAKE HOSE ASSEMBLIES

CALLOUT NUMBER	CIRCUIT	NUT SIZE @ CENTER HOSE ASSEMBLY	NUT SIZE @ RIGHT AND LEFT HOSE ASSEMBLIES	PIPE ASSEMBLY DIAMETER	APPROXIMATE PIPE LINEAR LENGTH	NUT TIGHTENING SPECIFICATIONS	
						@ CENTER HOSE ASSEMBLY	@ RIGHT AND LEFT-HOSE ASSEMBLIES
54	RIGHT-HAND REAR DISC	3/8-24 UNF	M10 x 1.0	4.76 mm	890.49 mm (35.058")	24 N•m (18 LB. FT.)	17 N•m (13 LB. FT.)
55	LEFT-HAND REAR DISC	3/8-24 UNF	M10 x 1.0	4.76 mm	541.91 mm (21.335")	24 N•m (18 LB. FT.)	17 N•m (13 LB. FT.)
36	REAR	M12 x 1.0	—	6.00 mm	3826 mm (150.629")	15 N•m (11 LB. FT.)	—

REAR BRAKE PIPE ASSEMBLIES -TO - REAR WHEEL CYLINDERS

CALLOUT NUMBER	CIRCUIT	NUT SIZE @ CENTER HOSE ASSEMBLY	NUT SIZE @ WHEEL CYLINDER	PIPE ASSEMBLY DIAMETER	APPROXIMATE PIPE LINEAR LENGTH	NUT TIGHTENING SPECIFICATIONS	
						@ CENTER HOSE ASSEMBLY	@ RIGHT AND LEFT WHEEL CYLINDERS
67	RIGHT-HAND REAR DRUM	3/8-24 UNF	3/8-24 UNF	4.76 mm	1170.05 mm (46.064")	24 N•m (18 LB. FT.)	17 N•m (13 LB. FT.)
68	LEFT-HAND REAR DRUM	3/8-24 UNF	3/8-24 UNF	4.76 mm	884.30 mm (34.027")	24 N•m (18 LB. FT.)	17 N•m (13 LB. FT.)

NUT COLOR CODE	
SIZE	COLOR
M10 x 1.0	OLIVE
M11 x 1.5	ORANGE
M12 x 1.0	YELLOW
M12 x 1.5	BLACK
3/8-24 UNF	VIOLET

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Figure 8 – Rear Brake Pipe and Hose Assemblies Specifications (Without Traction Control System)

Refer to Figures 5 through 14 for brake pipe routing, tightening specifications and replacement. For information on the brake pressure modulator valve assembly, refer to SECTION 5E1. For information on the traction control brake pressure modulator valve assembly, refer to SECTION 5E2.

Important

- Rear brake front pipe assemblies (36, 117 or 118) should not be locally fabricated. These pipe assemblies should be ordered through your GM Parts Dealer.

Double Lap Flare

Figures 15 through 18

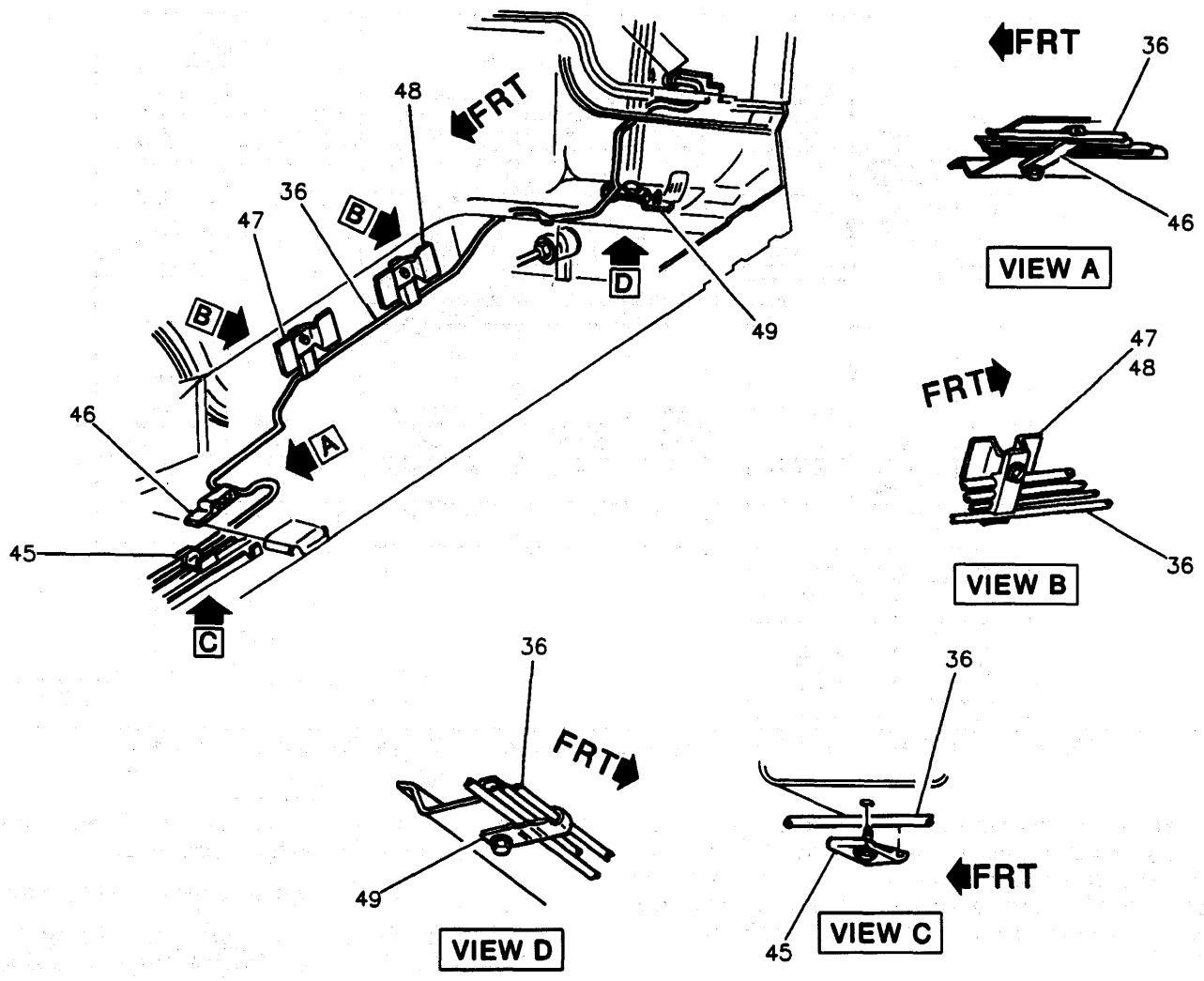
Double lap flares are to be used for rear brake rear pipe assemblies. All other brake pipe assemblies will use ISO flare.

Tool Required:

J 23530 Brake Line Flaring Tool (45 Degree Single and Double)

1. Obtain recommended tubing and steel fitting nuts of correct size.
   - Outside diameter of tubing is used to specify size.
2. Cut tubing to length.
   - Correct length may be determined by measuring old brake pipe assembly using string and adding 3 mm (1/8 inch) for each double flare.
3. Cut end square and chamfer inside and outside diameter of tubing with de-burring tool.
   - Remove all traces of lubricant from tubing.

   NOTICE: Do not use single lap flaring tools. Double lap flaring tools must be used to produce a flare strong enough to hold system pressure. Using single lap flaring tools could cause system damage. A single lap flare will split tubing while a double lap flare produces a well-formed, unbroken, reinforced double walled flare.
4. Double lap flare tubing ends using J 23530.
   A. Make sure fittings are installed before starting flare.
   B. Unscrew compression screw until swivel cone is at its highest point.
      - Swing strap to one side.
   C. Open lever handle so it is at right angle to rest of tool and revolve hexagonal tube lights to accommodate tubing (selection of six sizes).
   D. Be sure fitting nut is properly placed on tubing. Insert end of tube between two blocks until level with top of gage.
   E. Insert proper pin of gage into tubing and swing strap back in closed position. Tighten compression screw until gage bottoms on tool, then unscrew compression screw and swing strap to one side. Remove gage.



BRAKE PIPE ASSEMBLY TO BRAKE PRESSURE MODULATOR VALVE ASSEMBLY					
CALLOUT NUMBER	CIRCUIT	NUT SIZE	PIPE ASSEMBLY DIAMETER	APPROXIMATE PIPE LINEAR LENGTH	NUT TIGHTENING SPECIFICATION
36	REAR	M12 x 1.5	6.00 mm	3813.95 mm (150.155")	32 N•m (24 LB. FT.)

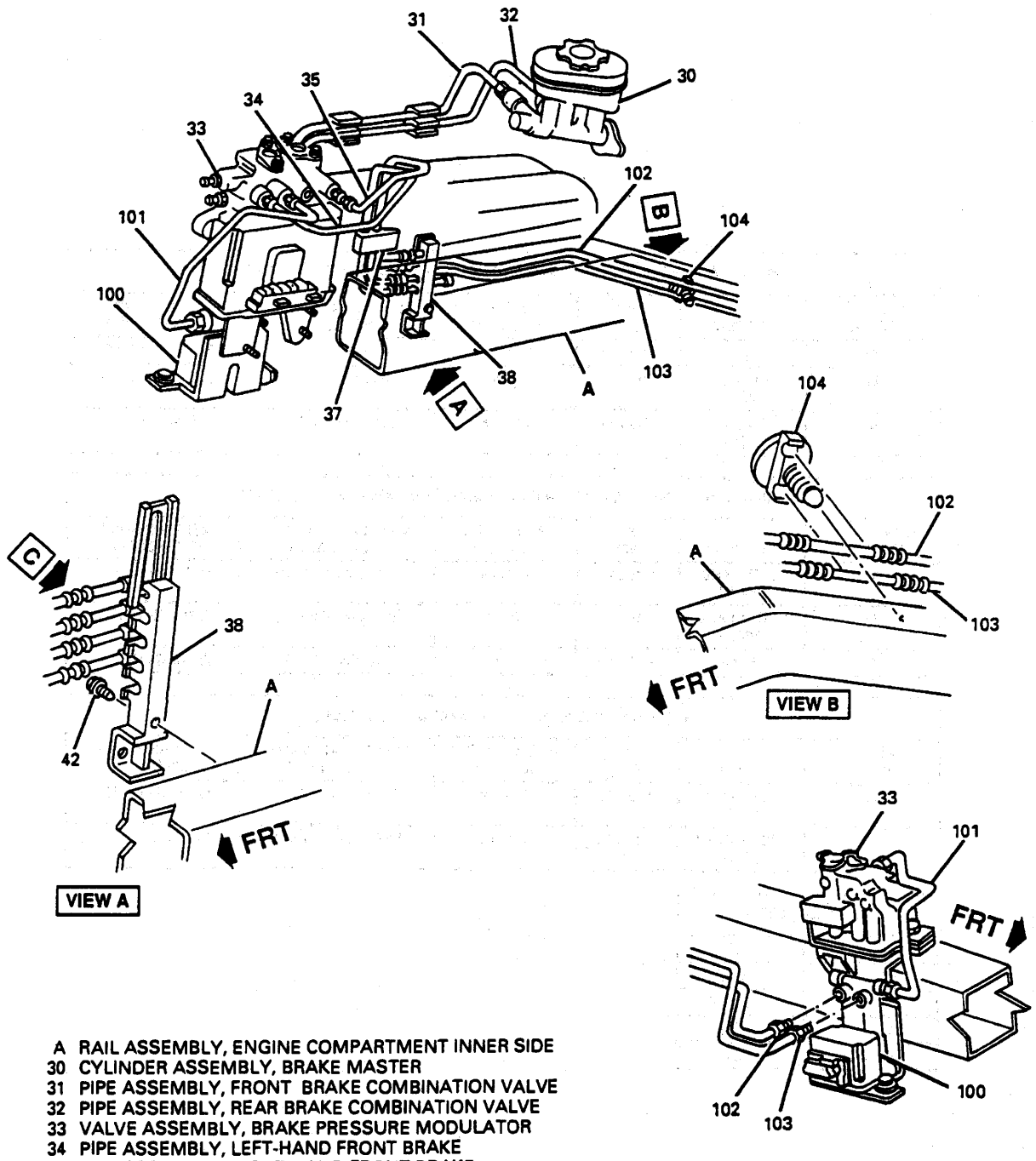
BRAKE PIPE ASSEMBLY TO REAR BRAKE (CENTER) HOSE ASSEMBLY					
CALLOUT NUMBER	CIRCUIT	NUT SIZE	PIPE ASSEMBLY DIAMETER	APPROXIMATE PIPE LINEAR LENGTH	NUT TIGHTENING SPECIFICATION
36	REAR	M12 x 1.0	6.00 mm	3813.95 mm (150.155")	24 N•m (18 LB. FT.)

NUT COLOR	
SIZE	COLOR
M10 x 1.0	OLIVE
M11 x 1.5	ORANGE
M12 x 1.0	YELLOW
M12 x 1.5	BLACK
3/8-24 UNF	VIOLET

36 PIPE ASSEMBLY, REAR BRAKE FRONT,
45 CLIP, BRAKE PIPE
46 CLIP, FUEL LINE RETAINER
47 CLIP, FUEL LINE RETAINER
48 CLIP, FUEL LINE RETAINER
49 CLIP, FUEL LINE RETAINER

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Figure 9 – Routing Underbody Rear Brake Front Pipe Assembly (Without Traction Control System)



A RAIL ASSEMBLY, ENGINE COMPARTMENT INNER SIDE
30 CYLINDER ASSEMBLY, BRAKE MASTER
31 PIPE ASSEMBLY, FRONT BRAKE COMBINATION VALVE
32 PIPE ASSEMBLY, REAR BRAKE COMBINATION VALVE
33 VALVE ASSEMBLY, BRAKE PRESSURE MODULATOR
34 PIPE ASSEMBLY, LEFT-HAND FRONT BRAKE
35 PIPE ASSEMBLY, RIGHT-HAND FRONT BRAKE
37 CLIP, BRAKE PIPE
38 CLIP, BRAKE PIPE
42 BOLT/SCREW, BRAKE PIPE CLIP
100 VALVE ASSEMBLY, TRACTION CONTROL BRAKE PRESSURE MODULATOR
101 PIPE ASSEMBLY, TRACTION CONTROL BRAKE PRESSURE MODULATOR VALVE
102 PIPE ASSEMBLY, RIGHT-HAND REAR BRAKE
103 PIPE ASSEMBLY, LEFT-HAND REAR BRAKE
104 CLIP, REAR BRAKE PIPE

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Figure 10 – Routing Front Brake Pipe Assemblies (With Traction Control System)

BRAKE PIPE ASSEMBLIES - TO - TRACTION CONTROL MODULATOR VALVE ASSEMBLY					
CALLOUT NUMBER	CIRCUIT	NUT SIZE	PIPE ASSEMBLY DIAMETER	APPROXIMATE BRAKE LINEAR LENGTH	NUT TIGHTENING SPECIFICATION
101	REAR	M12 x 1.5	6.00 mm	403.0 mm (15.86")	32 N•m (24 LB. FT.)
102	RIGHT-HAND REAR	M11 x 1.5	4.76 mm	3615.0 mm (142.32")	32 N•m (24 LB.FT.)
103	LEFT-HAND REAR	M10 x 1.0	4.76 mm	3630.0 mm (142.91")	32 N•m (24 LB. FT.)

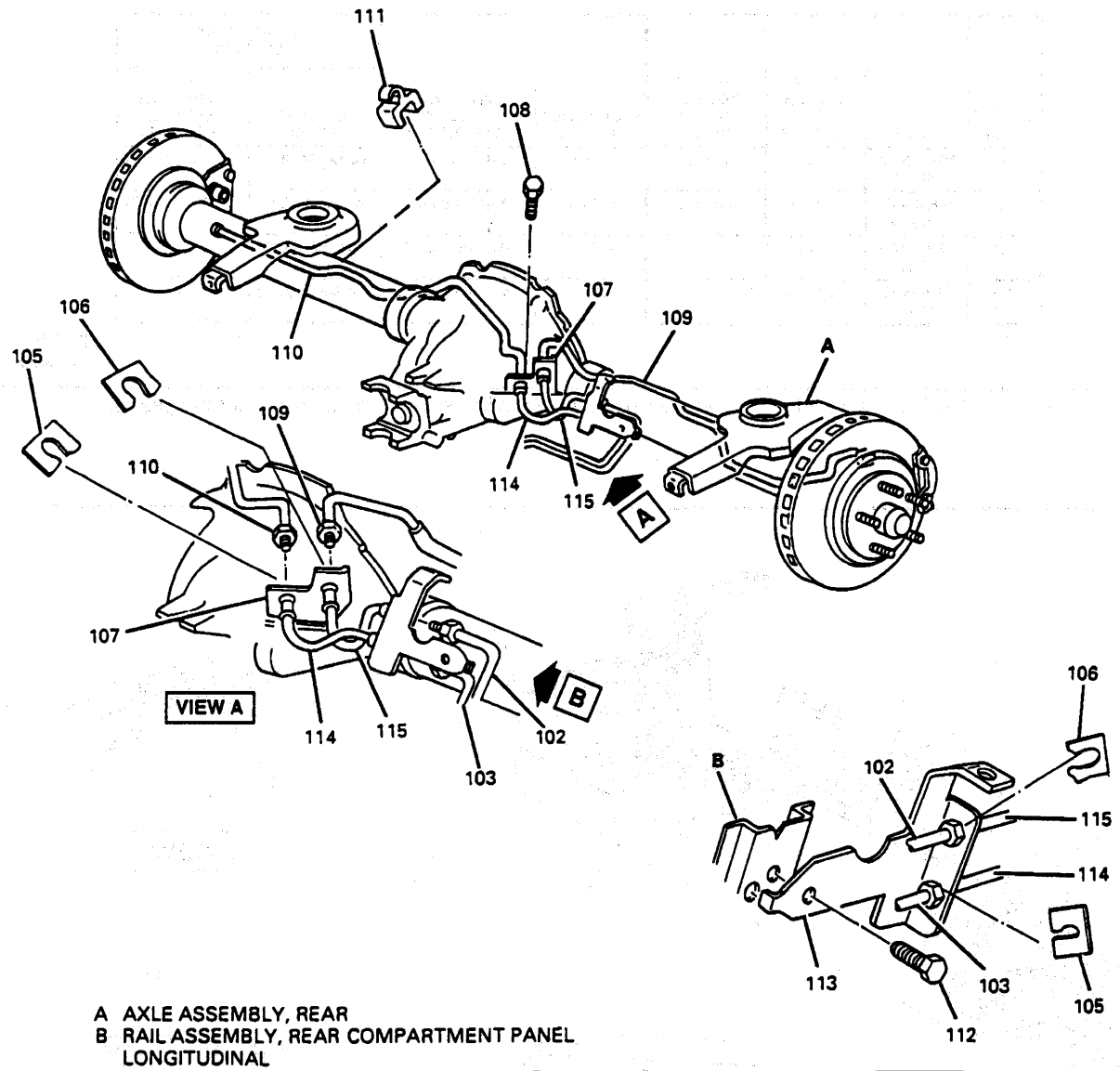
BRAKE PIPE ASSEMBLIES - TO - BRAKE PRESSURE MODULATOR VALVE ASSEMBLY					
CALLOUT NUMBER	CIRCUIT	NUT SIZE	PIPE ASSEMBLY DIAMETER	APPROXIMATE BRAKE LINEAR LENGTH	NUT TIGHTENING SPECIFICATION
34	LEFT-HAND FRONT	M10 x 1.0	4.76 mm	2321.50 mm (91.379")	32 N•m (24 LB. FT.)
35	RIGHT-HAND FRONT	M10 x 1.0	4.76 mm	1398.84 mm (55.072")	32 N•m (24 LB.FT.)
101	REAR	M12 x 1.5	6.00 mm	403.0 mm (15.86")	32 N•m (24 LB. FT.)

BRAKE PIPE ASSEMBLIES - TO - BRAKE HOSE ASSEMBLIES					
CALLOUT NUMBER	CIRCUIT	NUT SIZE	PIPE ASSEMBLY DIAMETER	APPROXIMATE BRAKE LINEAR LENGTH	NUT TIGHTENING SPECIFICATION
34	LEFT-HAND FRONT	M10 x 1.0	4.76 mm	2321.50 mm (91.379")	15 N•m (11 LB. FT.)
35	RIGHT-HAND FRONT	M10 x 1.0	4.76 mm	1398.84 mm (55.072")	15 N•m (11 LB.FT.)

NUT COLOR CODE	
SIZE	COLOR
M10 x 1.0	OLIVE
M10 x 1.5	ORANGE
M12 x 1.0	OLIVE
M12 x 1.5	OLIVE

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Figure 11 – Front Brake Pipe Assemblies Specifications (With Traction Control System)



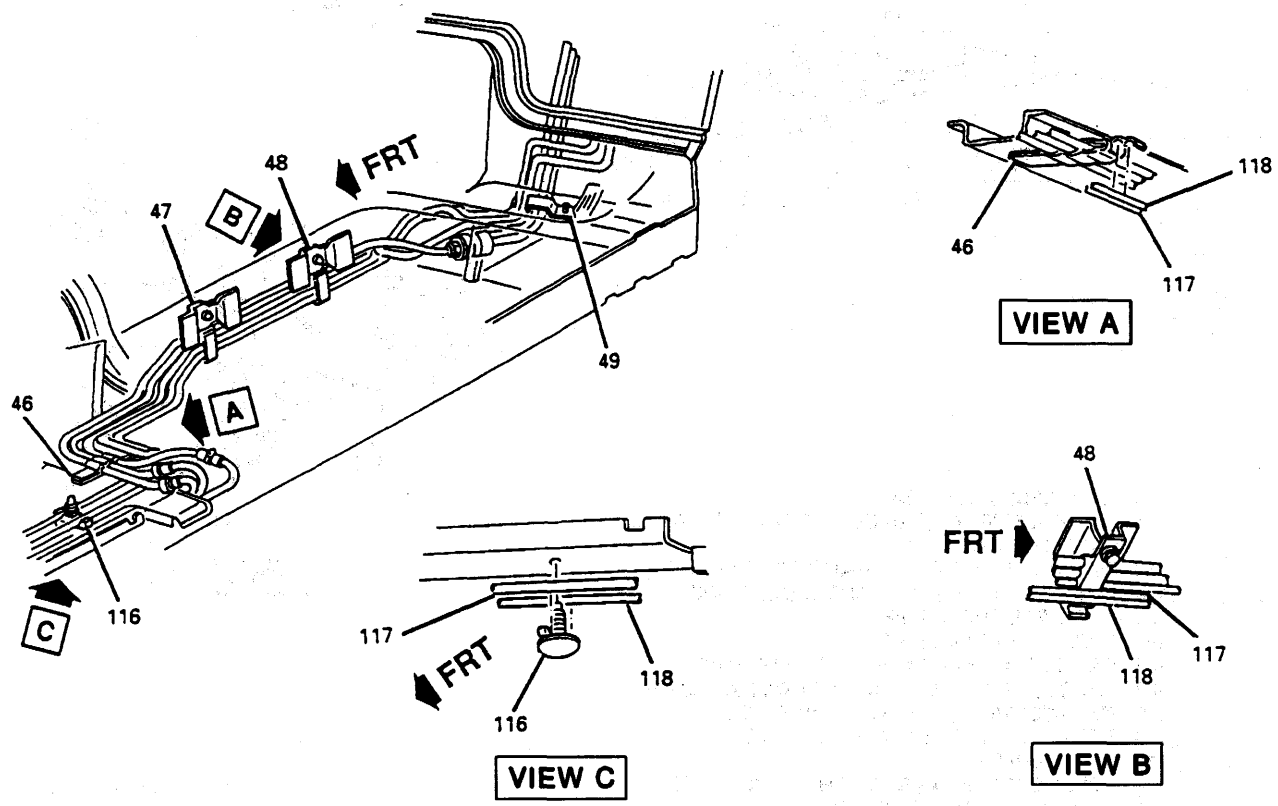
A AXLE ASSEMBLY, REAR
B RAIL ASSEMBLY, REAR COMPARTMENT PANEL LONGITUDINAL
102 PIPE ASSEMBLY, RIGHT-HAND REAR BRAKE
103 PIPE ASSEMBLY, LEFT-HAND REAR BRAKE
105 CLIP, REAR BRAKE PIPE
106 CLIP, REAR BRAKE PIPE
107 BRACKET ASSEMBLY, REAR BRAKE HOSE
108 BOLT/SCREW, REAR BRACKET HOSE ASSEMBLY
109 PIPE ASSEMBLY, LEFT-HAND REAR BRAKE
110 PIPE ASSEMBLY, RIGHT-HAND REAR BRAKE
111 CLIP, REAR BRAKE PIPE
112 BOLT/SCREW, REAR BRAKE HOSE BRACKET
113 BRACKET ASSEMBLY, REAR BRAKE HOSE
114 HOSE ASSEMBLY, REAR BRAKE
115 HOSE ASSEMBLY, REAR BRAKE

Figure 12 – Routing Rear Brake Pipe and Hose Assemblies (With Traction Control System)

REAR BRAKE PIPE ASSEMBLIES-TO-REAR BRAKE HOSE ASSEMBLIES							
						NUT TIGHTENING SPECIFICATIONS	
CALLOUT NUMBER	CIRCUIT	NUT SIZE @ CENTER HOSE ASSEMBLY	NUT SIZE @ RIGHT AND LEFT HOSE ASSEMBLIES	PIPE ASSEMBLY DIAMETER	APPROXIMATE BRAKE PIPE LINEAR LENGTH	@ CENTER HOSE ASSEMBLY	@ RIGHT AND LEFT-HOSE ASSEMBLIES
54	RIGHT-HAND REAR DISC	M10 x 1.0	M10 x 1.0	4.76 mm	867.0 mm (34.13")	24.0 Nm (18 LB. FT.)	17.0 Nm (13 LB. FT.)
55	LEFT-HAND REAR DISC	M12 x 1.0	M10 x 1.0	4.76 mm	566.0 mm (22.28")	24.0 Nm (18 LB. FT.)	17.0 Nm (13 LB. FT.)
114	RIGHT-HAND REAR	M12 x 1.0	—	4.76 mm	3815.0 mm (142.32")	17.0 Nm (13 LB. FT.)	—
115	LEFT-HAND REAR	M10 x 1.0	—	4.76 mm	3630.0 mm (142.91")	17.0 Nm (13 LB. FT.)	—

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Figure 13 – Rear Brake Pipe and Hose Assemblies Specifications (With Traction Control System)



46 CLIP, FUEL LINE RETAINER
47 CLIP, FUEL LINE RETAINER
48 CLIP, FUEL LINE RETAINER
49 CLIP, FUEL LINE RETAINER
116 CLIP, REAR BRAKE FRONT PIPE REAR
117 PIPE ASSEMBLY, RIGHT-HAND REAR BRAKE FRONT
118 PIPE ASSEMBLY, LEFT-HAND REAR BRAKE FRONT

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FS0145

Figure 14 – Routing Underbody Rear Brake Front Pipe Assemblies (With Traction Control System)

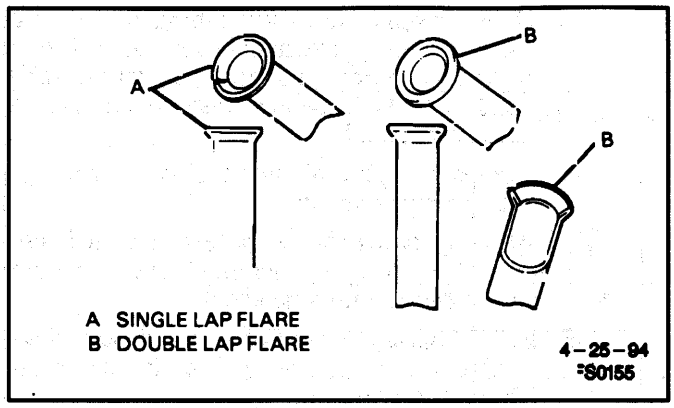


Figure 15 – Single Lap vs. Double Lap Flares

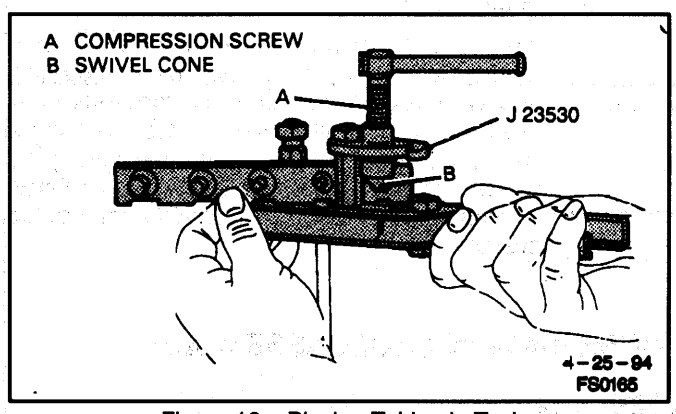


Figure 16 – Placing Tubing in Tool

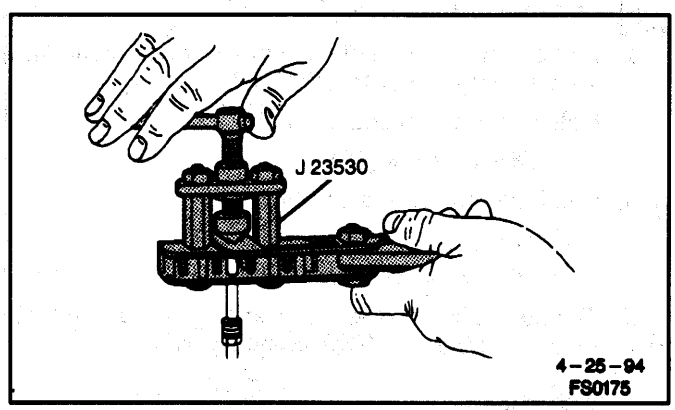


Figure 17 – Preparing for Double Lap Flare

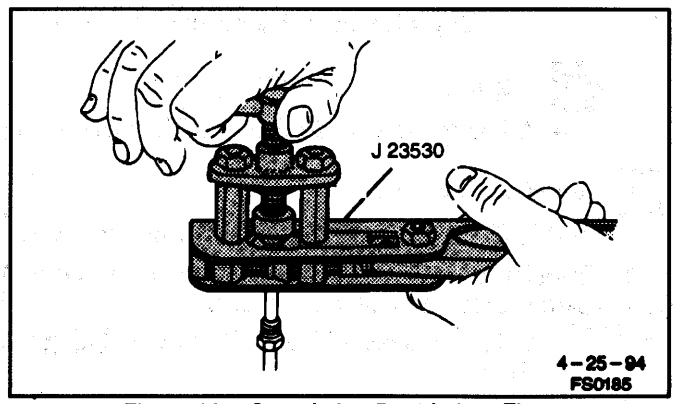


Figure 18 – Completing Double Lap Flare

F. Swing strap back in closed position, then tighten compression screw to flare cone downward to complete double lap flare.

G. Unscrew compression screw and open smaller lever handle to remove brake pipe assembly.

H. Inspect flared ends for splits, cracks, pits or excessive out-of-round which may cause leaks.

I. Blow out brake pipe assembly with dry compressed air to remove any foreign objects.

5. Bend new brake pipe assembly to match old pipe assembly using a tubing bender.

Important

- Minimum clearance of 19 mm (3/4 inch) must be maintained from all moving components and 13 mm (1/2 inch) from all vibrating components, unless brake pipe assembly is clipped to the component. For armor wrapped pipe, contact is permissible if there is no relative movement between pipe assembly and contact surface.

ISO Flare

Figures 19 through 21

ISO flares are NOT to be used for rear brake rear pipes.

Tool Required:

J 29803-A ISO Flaring Kit

1. Obtain recommended tubing and steel fitting nuts of correct size.
   - Outside diameter of tubing is used to specify size.
2. Cut tubing to length.
   - Correct length may be determined by measuring old brake pipe assembly using string and adding 3 mm (1/8 inch) for each ISO flare.
3. Cut end square and chamfer inside and outside diameter of tubing with de-burring tool.
   - Remove all traces of lubricant from tubing.
4. ISO flare tubing ends using J 29803-A.
   A. Make sure fittings are installed on tubing before starting flare.
   B. Clamp flaring tool body in vise.
   C. Select correct size collet and forming mandrel for tube size used.
   D. Insert proper forming mandrel into tool body. While holding mandrel in place with your finger, thread in forcing screw until it makes contact and begins to move forming mandrel. When contact is made, turn forcing screw back one complete turn.

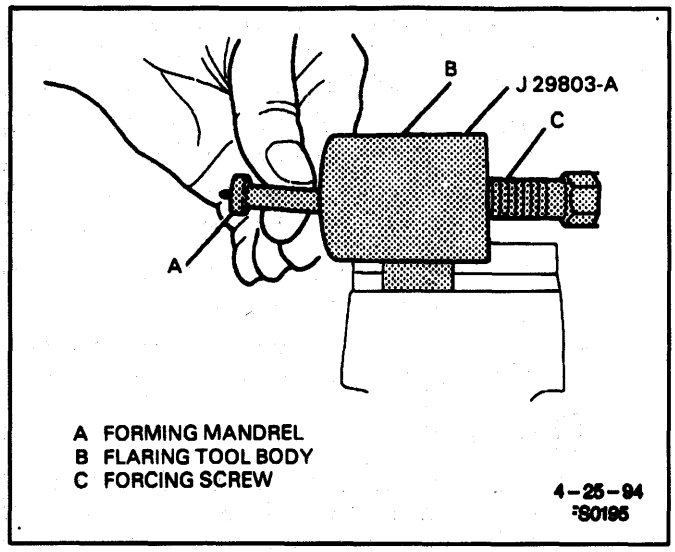


Figure 19 – Forming Mandrel and Forcing Screw

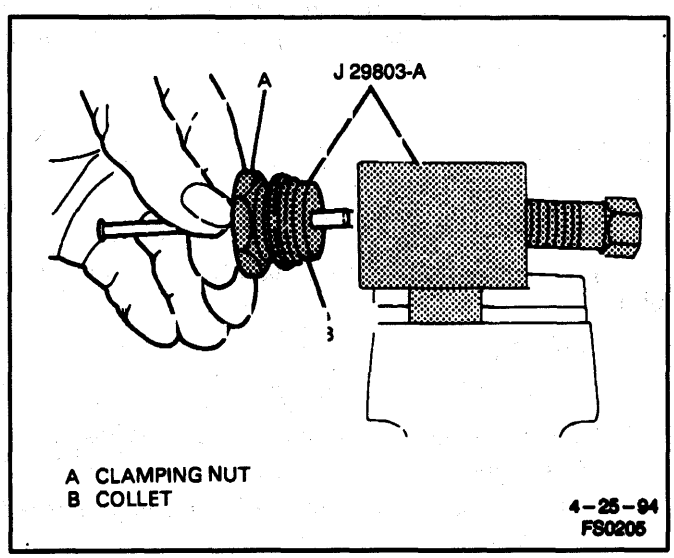


Figure 20 – Clamping Nut and Collet

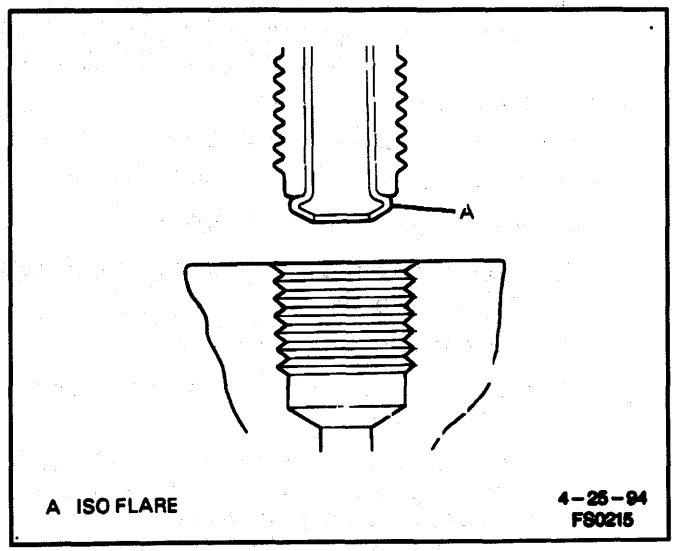


Figure 21 – ISO Flare

E. Slide clamping nut over tubing into correct collet. Leave approximately 19 mm (3/4 inch) of tubing extending out collet. Insert assembly into tool body. Tube end must contact face of forming mandrel.

F. Tighten clamping nut into tool body very tight or tube may push out.

G. Wrench tighten forcing screw in until it bottoms. Do not tighten forcing screw further or flare may become over-sized.

H. Back clamping nut out of tool body and disassemble clamping nut and collet assembly. Flare is now ready for use.

5. Bend new brake pipe assembly to match old pipe using a tube bender.
   - Minimum clearance of 19 mm (3/4 inch) must be maintained from all moving components and 13 mm (1/2 inch) from all vibrating components, unless brake pipe assembly is clipped to the component. For armor wrapped pipe, contact is permissible if there is no relative movement between pipe assembly and contact surface.

COMBINATION VALVE ASSEMBLY

Figure 22

Remove or Disconnect

1. Brake motor assembly from brake pressure modulator assembly. Refer to SECTION 5E1.
2. Bolts/screws (59) and seals (60).
   - Discard seals (60).
3. Combination valve assembly (62).
4. Seals (61).
   - Discard seals (61).
5. Transfer tubes (64 and 65) and seals (63 and 66) from combination valve assembly (62).

Clean

- All parts in clean, denatured alcohol.
  - Dry with unlubricated, compressed air.

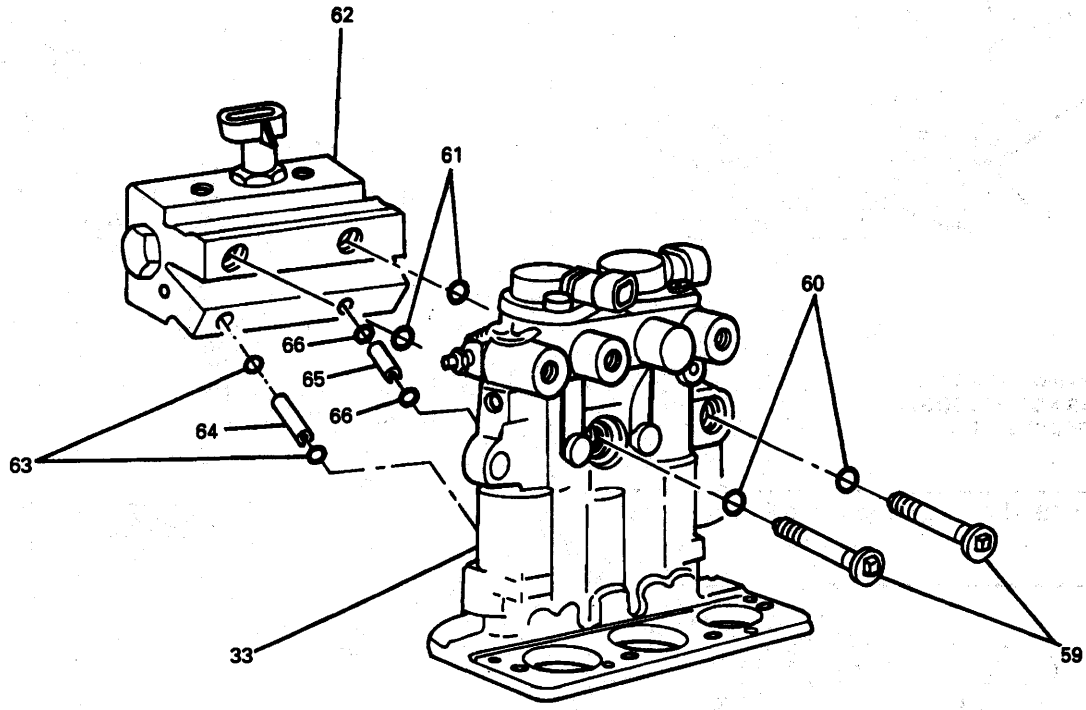
Inspect

- All parts for wear. Repair or replace as needed.

Install or Connect

NOTICE: See "Notice" on page 5-1 of this section.

1. Transfer tubes (64 and 65) and seals (63 and 66) to combination valve assembly (62).
   - Lubricate seals (63 and 66) with clean brake fluid.
2. New seals (61).
   - Lubricate seals (61) with clean brake fluid.



33 VALVE ASSEMBLY, BRAKE PRESSURE MODULATOR
59 BOLT/SCREW, BRAKE COMBINATION VALVE
60 SEAL. BRAKE COMBINATION VALVE
61 SEAL. BRAKE COMBINATION VALVE
62 VALVE ASSEMBLY, BRAKE COMBINATION
63 SEAL. TRANSFER TUBE
64 TUBE, TRANSFER
65 TUBE, TRANSFER
66 SEAL. TRANSFER TUBE

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Figure 22 – Combination Valve Assembly

3. Combination valve assembly (62).
4. New seals (60) and bolts/screws (59).
   - Lubricate seals (60) with clean brake fluid.

Tighten

   - Bolts/screws (59) to 16 N•m (12 lb. ft.).
5. Brake motor assembly to brake pressure modulator valve assembly. Refer to SECTION 5E1.

BRAKE HOSE ASSEMBLY

Front Brake Hose Assembly

Figure 23

Remove or Disconnect

1. Tire and wheel assembly. Refer to SECTION 3E.

Clean

   - Dirt and foreign material from front brake hose assembly (71) and front brake hose fitting (72).
2. Pipe assembly (34) from hose assembly (71).
   - Use a backup wrench on hose assembly fitting.
   - Be careful not to bend bracket (75) or pipe assembly (34).
3. Retainer (76) from hose assembly fitting at bracket (75).
4. Hose assembly (71) from bracket (75).
5. Fitting (72), hose assembly (71), and two gaskets (73) from caliper assembly (70).
   - Discard two gaskets (73).

Install or Connect

NOTICE: See "Notice" on page 5-1 of this section.

1. Fitting (72), hose assembly (71), and two new gaskets (73) to caliper assembly (70).
   - Lubricate hose assembly fitting threads with brake fluid.

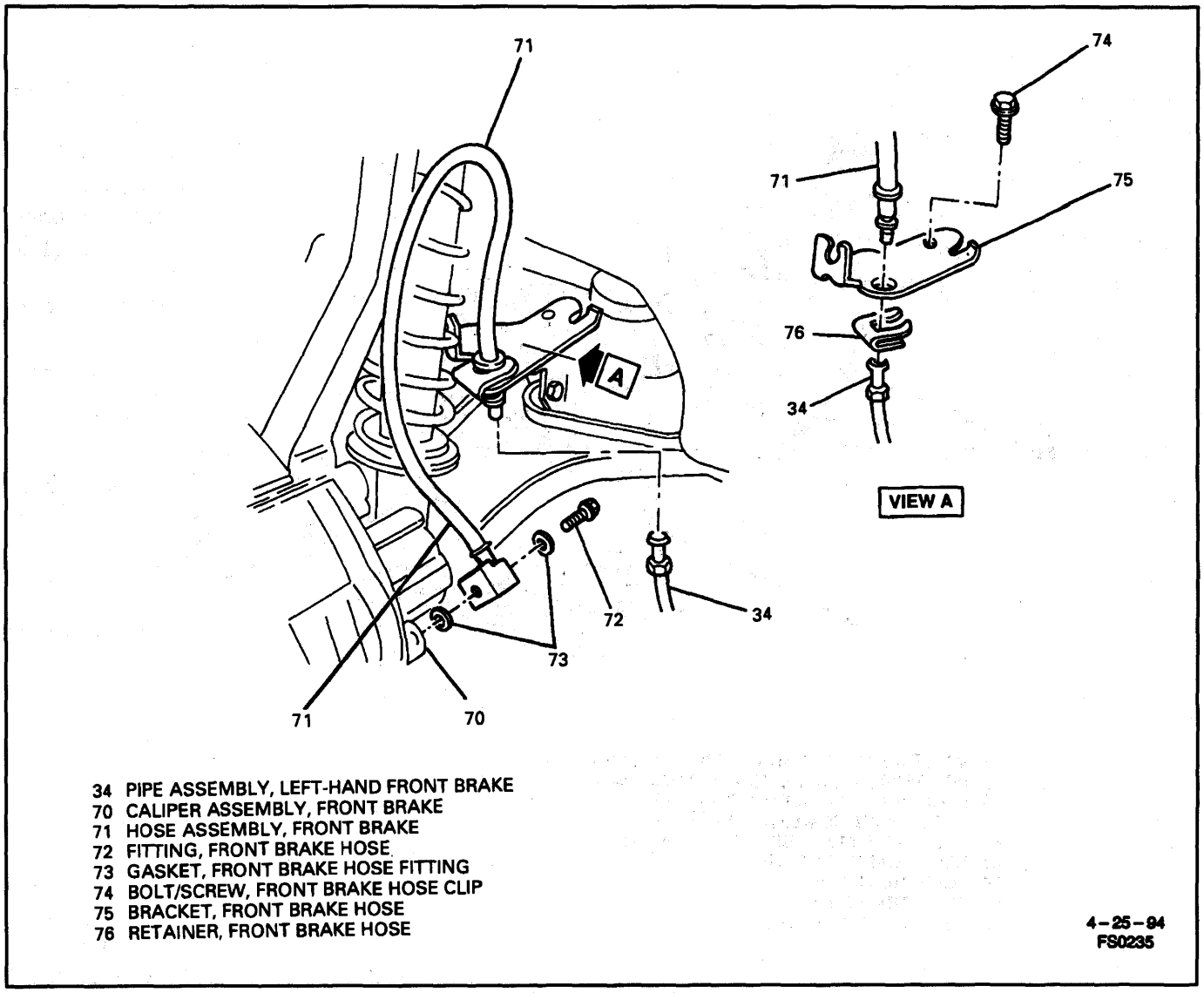


Figure 23 – Front Brake Hose Assembly (Left Side Shown, Right Side Similar)

- Hose assembly fitting flange must engage caliper assembly orientation ledge.

Tighten

- Fitting (72) to 44 N•m (32 lb. ft.).

2. Hose assembly (71) into bracket (75).
   - There should be no kinks in hose assembly (71).
3. Retainer (76) at bracket (75).
4. Pipe assembly (34) to hose assembly (71).
   - Use backup wrench on hose assembly fitting.
   - Make sure that hose assembly (71) does not make contact with any part of suspension. Check in extreme right and extreme left turn conditions.

Tighten

- Pipe assembly (34) to hose assembly (71) to 15 N•m (11 lb. ft.).

5. Bleed brake hydraulic system. Refer to SECTION 5E1.
6. Tire and wheel assembly. Refer to SECTION 3E.

Rear Brake (Center) Hose Assembly

Without Traction Control System

Figures 7, 8 and 9

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.

Clean

- Dirt and foreign material from hose assembly and pipe assembly fittings.

2. Pipe assembly (36) from hose assembly (53).
   - Use backup wrench on hose assembly fitting.
   - Be careful not to bend bracket (57) or pipe assembly (36).

3. Retainer (56) from bracket (57) and hose assembly (53).
4. Hose assembly (53).
5. Left rear pipe assembly (55 or 68) and right rear pipe assembly (54 or 67) from hose assembly (53).
   - Be careful not to bend left rear pipe assembly (55 or 68) and right rear pipe assembly (54 or 67).
6. Bolt/screw (51) and hose assembly (53) from rear axle assembly.
   - Note position of hose assembly (53) for proper location during installation.

Install or Connect

NOTICE: See "Notice" on page 5-1 of this section.

1. Hose assembly (53) and bolt/screw (51) to rear axle assembly.

   Tighten
   - Bolt/screw (51) to 21 N•m (15 lb. ft.).
2. Left rear pipe assembly (55 or 68) and right rear pipe assembly (54 or 67) to hose assembly (53).

   Tighten
   - Left rear pipe assembly (55 or 68) and right rear pipe assembly (54 or 67) at hose assembly (53) to 24 N•m (18 lb. ft.).
3. Hose assembly (53) into bracket (57).
   - Be sure hose assembly (53) is seated properly and not twisted.
4. Retainer (56) to bracket (57) and hose assembly (53).
5. Pipe assembly (36) to hose assembly (53).
   - Use backup wrench on hose assembly (53).
   - Be careful not to bend bracket (57) or pipe assembly (36).

   Tighten
   - Pipe assembly (36) to hose assembly (53) to 15 N•m (11 lb. ft.).
6. Bleed brake hydraulic system. Refer to SECTION 5E1.
7. Lower vehicle.

With Traction Control System

Figures 12, 13 and 14

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.

Clean
- Dirt and foreign material from hose assembly and pipe assembly fittings.

2. Pipe assembly (102) from hose assembly (115).
3. Pipe assembly (103) from hose assembly (114).
   - Use backup wrench on hose assembly fittings.
   - Be careful not to bend bracket assembly (113) or pipe assemblies (102 and 103).
4. Clip (105) from bracket assembly (113) and hose assembly (114).
5. Clip (106) from bracket assembly (113) and hose assembly (115).
6. Pipe assembly (109) from hose assembly (115).
7. Pipe assembly (110) from hose assembly (114).
   - Use backup wrench on hose assembly fittings.
   - Be careful not to bend bracket (107) or pipe assemblies (109 and 110).
8. Clip (105) from bracket assembly (107) and hose assembly (114).
9. Clip (106) from bracket assembly (107) and hose assembly (115).
10. Hose assembly (114).
11. Hose assembly (115).

Install or Connect

NOTICE: See "Notice" on page 5-1 of this section.

1. Hose assembly (115).
2. Hose assembly (114).
3. Clip (106) to bracket assembly (107) and hose assembly (115).
4. Clip (105) to bracket assembly (107) and hose assembly (114).
   - Be sure hose assemblies (114 and 115) are seated properly and not twisted.
5. Pipe assembly (110) to hose assembly (114).
6. Pipe assembly (109) to hose assembly (115).
   - Use backup wrench on hose assembly fittings.
   - Be careful not to bend bracket or pipe assemblies (109 and 110).

   Tighten
   - Pipe assembly (110) to hose assembly (114) to 17 N•m (13 lb. ft.).
   - Pipe assembly (109) to hose assembly (115) to 17 N•m (13 lb. ft.).
7. Clip (106) to bracket assembly (113) and hose assembly (115).
8. Clip (105) to bracket assembly (113) and hose assembly (114).
   - Be sure hose assemblies (114 and 115) are seated properly and not twisted.
9. Pipe assembly (103) to hose assembly (114).
10. Pipe assembly (102) to hose assembly (115).

- Use backup wrench on hose assembly fittings.
- Be careful not to bend bracket or pipe assemblies (102 and 103).

Tighten

- Pipe assembly (103) to hose assembly (114) to 17 N•m (13 lb. ft.).
- Pipe assembly (102) to hose assembly (115) to 17 N•m (13 lb. ft.).

11. Bleed brake hydraulic system. Refer to SECTION 5E1.
12. Lower vehicle.

Rear Brake Hose Assembly

Figure 24

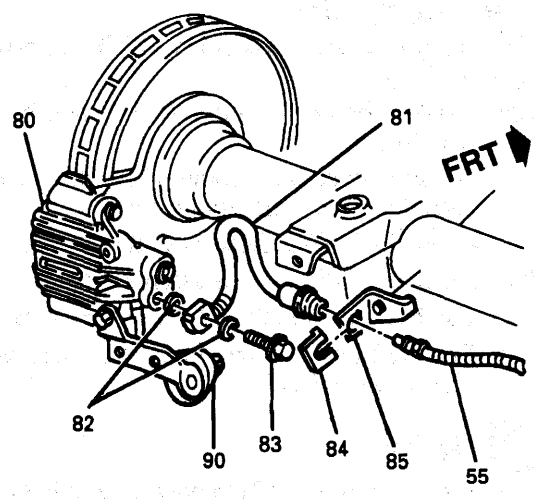
Remove or Disconnect

1. Wheel and tire assembly. Refer to SECTION 3E.

Clean

- Dirt and foreign material from hose assembly (81) and pipe assembly fitting.

2. Hose assembly (81) from pipe assembly (55).
   - Use backup wrench on hose assembly fitting.
   - Be careful not to bend bracket (85) and pipe assembly (55).
3. Retainer (84) from bracket (85) and hose assembly (81).



55 PIPE ASSEMBLY, LEFT-HAND REAR BRAKE
80 CALIPER ASSEMBLY, REAR BRAKE
81 HOSE ASSEMBLY, LEFT-HAND REAR BRAKE
82 GASKET, REAR BRAKE HOSE FITTING
83 FITTING, REAR BRAKE HOSE
84 RETAINER, REAR BRAKE HOSE
85 BRACKET, REAR BRAKE HOSE
90 DAMPENER ASSEMBLY, REAR BRAKE VIBRATION

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Figure 24 – Rear Disc Brake Hose Assembly (Typical) (Left Side Shown, Right Side Similar)

4. Fitting (83), two gaskets (82) and hose assembly (81) from caliper assembly (80).
   - Discard two gaskets (82).

Install or Connect

NOTICE: See "Notice" on page 5-1 of this section.

1. Fitting (83), two new gaskets (82) and hose assembly (81) to caliper assembly (80).
   - Lubricate hose assembly fitting threads with clean brake fluid.
   - Hose assembly fitting flange must engage caliper assembly orientation ledge.

Tighten

- Fitting (83) to 44 N•m (32 lb. ft.).

2. Retainer (84) to bracket (85) and hose assembly (81).
3. Hose assembly (81) to pipe assembly (55).
   - Use backup wrench on hose assembly fitting.
   - Be careful not to bend bracket (85) and pipe assembly (55).

Tighten

- Pipe assembly (55) to hose assembly (81) to 17 N•m (13 lb. ft.).

4. Bleed hydraulic brake system. Refer to SECTION 5E1.
5. Wheel and tire assembly. Refer to SECTION 3E.

FLUSHING BRAKE HYDRAULIC SYSTEM

NOTICE: Use only DOT 3 brake fluid from a clean, sealed container. Do not use any fluid from a container which is wet with water. Do not use DOT 5 silicone brake fluid. Improper brake fluid, mineral oil or water in the fluid may cause the brake fluid to boil or the rubber components to deteriorate. Keep all fluid containers capped to prevent contamination.

The system must be flushed if there is any doubt about the condition of fluid in the system or if fluid has been used which contains the slightest trace of petroleum or mineral oil based fluids. Approximately 1.5 liters (1.5 quarts) of brake fluid is required to flush the brake hydraulic system. All rubber parts, including brake hose assemblies, master cylinder assembly rubber parts, and brake caliper assembly and wheel cylinder assembly boots and seals that have been subjected to a contaminated fluid must be replaced. Also replace the combination valve assembly and brake pressure modulator assembly, since they have rubber components inside that are not serviceable. Refer to SECTION 5E1 for complete brake hydraulic system flush and bleed procedures.

SPECIFICATIONS

GENERAL SPECIFICATIONS

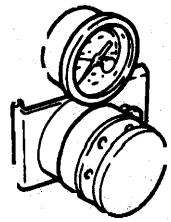
Brake Pedal Assembly Travel	51 to 89 mm (2.0 to 3.5″)
Brake pedal assembly travel maximum with 445 N (100 lb.) force applied to pedal with engine running at idle.	
Hydraulic Brake (Glycol) Fluid	GM P/N 1052535 or equivalent DOT-3 fluid
Brake Pipe Assembly Clearance (Minimum)	
Moving Components	19 mm (3/4″)
Vibrating Components	13 mm (1/2″)
Armor-Wrapped Pipe Assemblies	Contact is permitted if there is no relative movement between pipe assembly and contact surface

FASTENER TIGHTENING SPECIFICATIONS

Brake Combination Valve Bolt/Screw	16 N•m (12 lb. ft.)
Brake Pedal Bracket Bolt/Screw	25 N•m (18 lb. ft.)
Brake Pedal Bracket Nut	20 N•m (15 lb. ft.)
Brake Pedal Nut	20 N•m (15 lb. ft.)
Brake Pedal Pivot Nut	54 N•m (40 lb. ft.)
Brake Pipe Clip Bolt/Screw	5 N•m (44 lb. in.)
Clutch Master Cylinder Nut	27 N•m (20 lb. ft.)
Front Brake Combination Valve Pipe Assembly-to-Brake Combination Valve Assembly	18 N•m (13 lb. ft.)
Front Brake Combination Valve Pipe Assembly-to-Brake Master Cylinder Assembly	32 N•m (24 lb. ft.)
Front Brake Hose Fitting	44 N•m (32 lb. ft.)
Front Brake Pipe Assembly-to-Brake Pressure Modulator Valve Assembly	32 N•m (24 lb. ft.)
Front Brake Pipe Assembly-to-Front Brake Hose Assembly	15 N•m (11 lb. ft.)
Front Brake Front Pipe Clip Bolt/Screw	13 N•m (115 lb. in.)
Rear Brake (Center) Hose Fitting Bolt/Screw	21 N•m (15 lb. ft.)
Rear Brake Combination Valve Pipe Assembly-to-Brake Combination Valve Assembly	18 N•m (13 lb. ft.)
Rear Brake Combination Valve Pipe Assembly-to-Brake Master Cylinder Assembly	32 N•m (24 lb. ft.)
Rear Brake Front Pipe Assembly-to-Brake Pressure Modulator Valve Assembly	32 N•m (24 lb. ft.)
Rear Brake Front Pipe Assembly-to-Rear Brake (Center) Hose Assembly	15 N•m (11 lb. ft.)
Rear Brake Hose Fitting	44 N•m (32 lb. ft.)
Rear Brake Hose Bracket Bolt/Screw	10 N•m (89 lb. in.)
Rear Brake Pipe Assembly-to-Rear Brake (Center) Hose Assembly	24 N•m (18 lb. ft.)
Rear Brake Pipe Assembly-to-Rear Brake Hose Assembly	17 N•m (13 lb. ft.)
Rear Brake Pipe Assembly-to-Rear Wheel Cylinder	17 N•m (13 lb. ft.)
Rear Brake Pipe Assembly-to-Traction Control Brake Pressure Modulator Valve Pipe Assembly	32 N•m (24 lb. ft.)
Traction Control Brake Pressure Modulator Valve Pipe Assembly	32 N•m (24 lb. ft.)

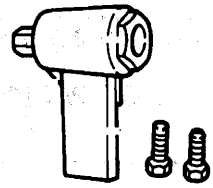
SPECIAL TOOLS

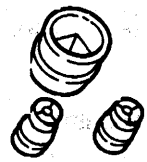
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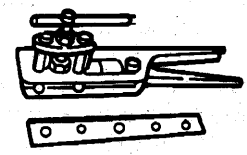
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1. BRAKE PEDAL EFFORT GAGE
2. ISO FLARING KIT
3. BRAKE LINE FLARING TOOL (45° SINGLE AND DOUBLE)

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SECTION 5A

MASTER CYLINDER

CAUTION: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- **Eye contact – rinse thoroughly with water.**
- **Skin contact – wash with soap and water.**

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen damage.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

MASTER CYLINDER ASSEMBLY

The brake master cylinder assembly is a composite design (plastic reservoir and aluminum body) incorporating a conventional front-to-rear brake system split. The brake master cylinder primary piston provides the fluid pressure to the front disc brakes, while the brake master cylinder secondary piston provides the fluid pressure to the rear drum or disc brakes. If pressure is lost from either system, the remaining system will function to stop the vehicle.

MASTER CYLINDER RESERVOIR

Figure 1

The reservoir (5) has a fluid level indicator mark located inside the neck of the reservoir fill opening. The reservoir cap must be removed to view the indicator mark.

BRAKE FLUID AND FLUID HANDLING

CAUTION: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- **Eye contact – rinse thoroughly with water.**
- **Skin contact – wash with soap and water.**

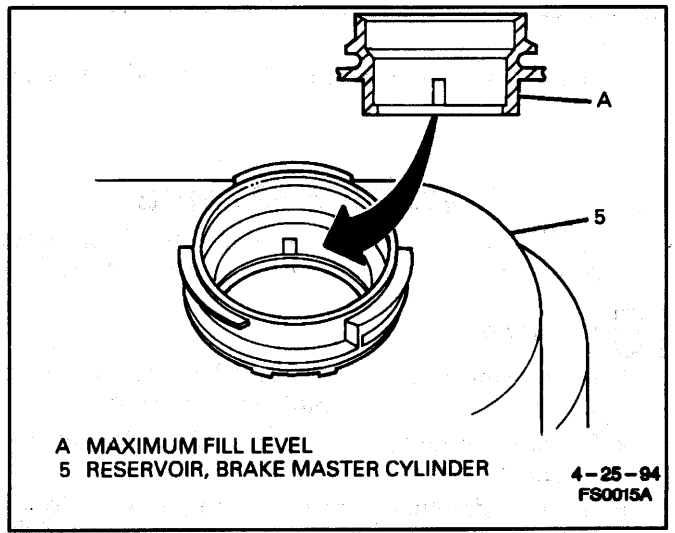


Figure 1 – Brake Fluid Level Indicator

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring cables or electrical connections. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush with water to lessen damage.

Important

- Do not re-use brake fluid accumulated during brake hydraulic system bleeding.
- Always store fluid in a closed container. Reseal containers immediately after use. Do not use fluid left in an open or improperly sealed container as it absorbs moisture or may be contaminated.

Substandard or Contaminated Brake Fluid

Use only brake fluid GM P/N 1052535 or an equivalent DOT-3 fluid. **DO NOT** use power steering fluid, automatic transmission fluid or DOT-5 silicone hydraulic brake fluid.

This deterioration may be seen by a swollen brake master cylinder reservoir diaphragm or swollen brake master cylinder primary or secondary seals. Deterioration of the rubber components may result in costly damage to the brake pressure modulator valve assembly, disc brake caliper assemblies and rear wheel cylinders.

If rubber deterioration is evident, the entire brake system must be flushed and all rubber components replaced. Refer to SECTION 5.

DIAGNOSIS

MASTER CYLINDER ASSEMBLY CHECK

1. Check for cracked brake master cylinder body or brake fluid around brake master cylinder assembly.
   - Leaks are indicated only if there is at least a drop of fluid.
   - A damp condition is not abnormal.
2. Check for binding brake pedal assembly linkage and incorrect power brake booster power piston pushrod assembly length.
   A. If both of these are satisfactory, disassemble brake master cylinder assembly and check for swollen or elongated primary or secondary piston seal(s).
   B. If swollen primary or secondary seals are found, substandard or contaminated brake fluid should be suspected.
   C. If contaminated, all components should be disassembled and cleaned. All rubber components, including those in the combination valve assembly, brake pressure modulator valve assembly, disc brake calipers and rear wheel cylinders, should be replaced and all brake pipe assemblies flushed.

MASTER CYLINDER ASSEMBLY

CONDITION	POSSIBLE CAUSE	CORRECTION
Grabby Brakes (Apparent On-Off Condition)	1. Insufficient brake fluid in master cylinder assembly.	1. Fill master cylinder reservoirs with approved brake fluid and check for leaks.
	2. Faulty master cylinder primary or secondary piston seals.	2. Repair or replace as necessary.
	3. Cracked master cylinder body.	3. Replace.

These checks will not determine all master cylinder assembly malfunctions. Refer to SECTION 5.

ON-VEHICLE SERVICE

NOTICE: Do not use lubricated shop air on brake parts as damage to rubber components may result.

Important

- Replace all components included in repair kits used to service this brake master cylinder assembly.
- Lubricate rubber parts with clean brake fluid to ease assembly.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake hydraulic system.
- The torque values specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench, free from all mineral oil materials.

FILLING MASTER CYLINDER RESERVOIR

The brake master cylinder reservoir must be kept properly filled to insure adequate reserve and to prevent air from entering the brake hydraulic system. However, because of expansion due to heat absorbed from the brakes and from the engine, the reservoir must **not** be overfilled.

A drop in brake fluid level is normal as the pads and linings wear. Filling the master cylinder reservoir before installing new pads and linings may result in brake fluid spillage once the new pads and linings are in place. Unless there is a leak in the brake hydraulic system, or if the brake hydraulic system has been serviced, topping off the master cylinder reservoir should not be necessary.

Thoroughly clean the master cylinder reservoir cap before removal to avoid getting dirt in reservoir. Remove reservoir cap and reservoir diaphragm.

NOTICE: Use only DOT-3 brake fluid from a clean, sealed container. Do not use any fluid from a container which is contaminated with water. Do not use DOT-5 silicone brake fluid. Improper brake fluid, mineral oil or water in the brake fluid may cause it to boil or the rubber components to deteriorate. Keep all containers capped to prevent contamination.

Add brake fluid GM P/N 1052535 or equivalent as required to bring fluid level to line located inside the neck of the reservoir fill opening.

MASTER CYLINDER ASSEMBLY

Figure 2

Remove or Disconnect

1. Brake fluid from reservoir (5).
   - Discard old fluid.
2. Brake pipe assemblies (1 and 2).
   - Plug brake pipe assemblies (1 and 2) to prevent fluid loss and contamination.
3. Nuts (18).
4. Master cylinder assembly (15).

Install or Connect

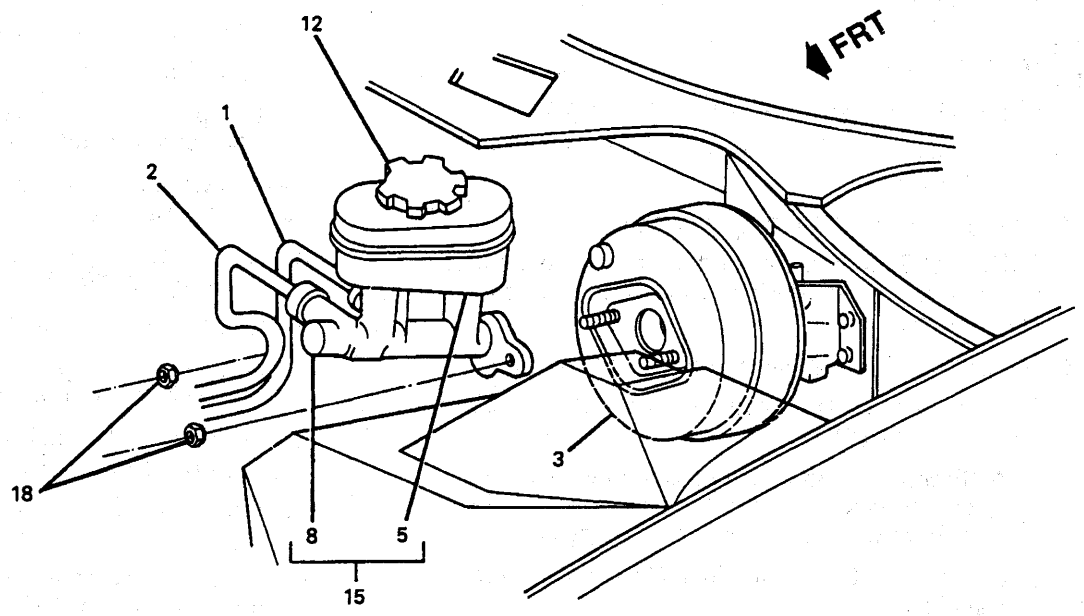
NOTICE: See "Notice" on page 5A-1 of this section.

1. Bench bleed master cylinder assembly. Refer to "Master Cylinder Assembly Bench Bleeding" in this section.
2. Master cylinder assembly (15).
3. Nuts (18).

Tighten

- Nuts (18) to 29 N•m (21 lb. ft.).

4. Fill master cylinder reservoir. Refer to "Filling Master Cylinder Reservoir" in this section.
5. Brake pipe assemblies (1 and 2) to master cylinder assembly (15) one at a time.
   A. Remove locally fabricated plug.
   B. Install brake pipe assembly fitting finger tight.



1 PIPE ASSEMBLY, FRONT BRAKE COMBINATION VALVE
2 PIPE ASSEMBLY, REAR BRAKE COMBINATION VALVE
3 BOOSTER ASSEMBLY, POWER BRAKE
5 RESERVOIR, BRAKE MASTER CYLINDER
8 BODY, BRAKE MASTER CYLINDER
12 CAP, BRAKE MASTER, CYLINDER RESERVOIR
15 CYLINDER ASSEMBLY, BRAKE MASTER
18 NUT, BRAKE MASTER CYLINDER

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Figure 2 – Brake Master Cylinder Assembly

6. Have assistant depress brake pedal assembly to remove air at loose brake pipe assembly fittings.

Tighten

- Fittings of brake pipe assemblies (1 and 2) to 32 N•m (24 lb. ft.).

7. Have assistant quickly release and pump brake pedal assembly several times.
8. If brake pedal assembly remains high and firm, start vehicle. If brake pedal assembly still feels firm, test drive vehicle. If brake pedal assembly feels soft or spongy, bleed entire brake hydraulic system. Refer to SECTION 5E1.

UNIT REPAIR

MASTER CYLINDER ASSEMBLY

Figure 3

Important

- Reservoir cap (12) and reservoir diaphragm (13) can be inspected and/or serviced without removing the master cylinder assembly from the vehicle.

Remove or Disconnect

- Brake master cylinder assembly. Refer to "Master Cylinder Assembly" under "On-Vehicle Service" in this section.

Disassemble

1. Cap (12) and diaphragm (13) from reservoir (5).
   - Wipe cap (12) and reservoir (5) clean before removing.
2. Empty brake fluid from reservoir (5).

   NOTICE: Take care not to damage the piston bore or retainer groove during primary piston retainer ring removal.
3. Ring (14) while depressing primary piston (20).
4. Primary piston (20), secondary piston (21), retainer (6) and spring (4).
   - To remove parts, apply clean, low pressure dry compressed air into outlet port near closed end of bore with other outlet port plugged.
5. Seals (7 and 10) and retainer (6) from secondary piston (21).

Inspect

- Cap (12) and diaphragm (13) for cuts, cracks, nicks and deformation.
- Brake master cylinder body bore for scoring or corrosion. If noted, replace cylinder body (8).
- Replace damaged parts.

Clean

- All parts in clean denatured alcohol.
- Dry with unlubricated compressed air.
- Abrasives should not be used in brake master cylinder body bore.

Assemble

1. Lubricate rubber parts with clean brake fluid to ease assembly.
2. Seals (7 and 10) and retainer (6) to secondary piston (21).
3. Lubricated secondary piston (21) and spring (4) into brake master cylinder body bore.
4. Lubricated primary piston (20) into brake master cylinder body bore.
5. Ring (14) while depressing primary piston (20).
6. Diaphragm (13) into cap (12).
7. Cap (12) onto reservoir (5).
8. Bench bleed master cylinder assembly. Refer to "Master Cylinder Assembly Bleeding" in the following procedure.

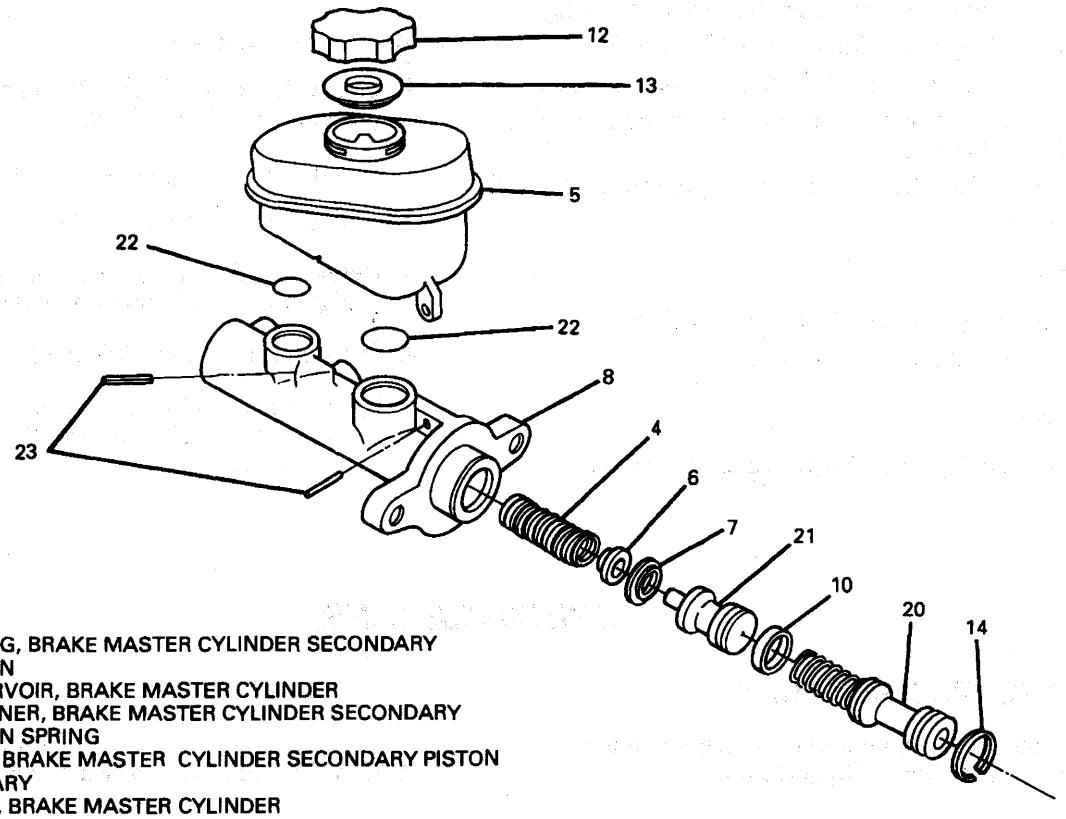
MASTER CYLINDER ASSEMBLY BENCH BLEEDING

Materials necessary for master cylinder assembly bench bleeding:

- One 11 x 1.5 mm tube fitting nut
- One 12 x 1.0 mm tube fitting nut
- Two pieces of 4.75 mm (3/16 inch) brake pipe tube approximately 50 mm (2 inches) long

1. Locally fabricate two plugs for plugging master cylinder assembly outlet ports.
   A. Fashion ISO flares on one end of each tube. Refer to SECTION 5.
   B. Install nuts onto flared tubes.
   C. One at a time, place approximately 13 mm (1/2 inch) of unflared tube in vise.
   D. Compress tube end with vise so that tube collapses completely.
   E. With tube still in vise, bend it to a 90 degree angle.
   F. Remove tube from vise and reinstall to fold tube end against itself to form air-tight seal.
2. Plug master cylinder assembly outlet ports with locally fabricated plugs.

   NOTICE: Do not overtighten vise or damage to the master cylinder assembly will result.
3. Place shop towels around master cylinder assembly to absorb bled fluid and mount master cylinder assembly in vise with front end tilted slightly down.



4 SPRING, BRAKE MASTER CYLINDER SECONDARY PISTON
5 RESERVOIR, BRAKE MASTER CYLINDER
6 RETAINER, BRAKE MASTER CYLINDER SECONDARY PISTON SPRING
7 SEAL, BRAKE MASTER CYLINDER SECONDARY PISTON PRIMARY
8 BODY, BRAKE MASTER CYLINDER
10 SEAL, BRAKE MASTER CYLINDER SECONDARY PISTON SECONDARY
12 CAP, BRAKE MASTER CYLINDER RESERVOIR
13 DIAPHRAGM, BRAKE MASTER CYLINDER RESERVOIR
14 RING, BRAKE MASTER CYLINDER PRIMARY PISTON RETAINER
20 PISTON, BRAKE MASTER CYLINDER PRIMARY
21 PISTON, BRAKE MASTER CYLINDER SECONDARY
22 0-RING
23 PIN, SPRING

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Figure 3 – Brake Master Cylinder Assembly Components

4. Fill master cylinder assembly with clean brake fluid.
5. Using tool with smooth rounded end, stroke primary piston about 25 mm (1 inch) several times.

Important

- As air is bled from master cylinder assembly, with outlets plugged, resistance to primary piston travel will not allow full 25 mm (1 inch) stroke.

6. Reposition master cylinder assembly in vise with front end of master cylinder assembly tilted slightly up. Again, stroke primary piston about 25 mm (1 inch) several times.
7. Reposition master cylinder assembly in vise to level position. Loosen two locally fabricated plugs one at a time and push primary piston into master cylinder bore to force air out of master cylinder assembly.

Important

- To prevent air from being sucked back into master cylinder assembly, tighten locally fabricated plugs before allowing primary piston to return to its original position. Repeat this step until no air escapes past locally fabricated plugs.

8. Install master cylinder assembly into vehicle. Refer to "Master Cylinder Assembly" under "On-Vehicle Service" in this section.

MASTER CYLINDER RESERVOIR

Figures 2 and 3

Remove or Disconnect

1. Brake master cylinder assembly. Refer to "Master Cylinder Assembly" under "On-Vehicle Service" in this section.

NOTICE: Do not clamp housing area of master cylinder body in vise or the part may be damaged.

2. Clamp flange of cylinder body (8) in a vise.
3. Drive out spring pins (23) using 1/8-inch punch.
4. Reservoir (5) by pulling straight up and away from cylinder body (8).
5. O-rings (22) from grooves in reservoir (5) and discard.

Inspect

- Reservoir (5) for cracks or deformation.
- Replace reservoir (5), if damaged.

Clean

1. Reservoir (5) with clean denatured alcohol.
2. Dry with unlubricated compressed air.

Install or Connect

1. Lubricate new O-rings (22) and grooves in reservoir (5) with clean brake fluid.
2. O-rings (22) into grooves in reservoir (5).
   - Make sure O-rings (22) are properly seated.
3. Reservoir (5) to cylinder body (8) by pressing straight down by hand into cylinder body (8).
4. Drive in spring pins (23) to retain reservoir (5).
5. Brake master cylinder assembly. Refer to "Master Cylinder Assembly" under "On-Vehicle Service" in this section.

SPECIFICATIONS

GENERAL SPECIFICATIONS

Brake Master Cylinder Body Bore Diameter	25.4 mm (1.00″)
Hydraulic Brake (Glycol) Fluid	GM P/N 1052535 or equivalent DOT-3 fluid

FASTENER TIGHTENING SPECIFICATIONS

Brake Master Cylinder Nut	29 N•m (21 lb. ft.)
Brake Pipe Fittings	
Front Brake Combination Valve Pipe Assembly	32 N•m (24 lb. ft.)
Rear Brake Combination Valve Pipe Assembly	32 N•m (24 lb. ft.)

SECTION 5B1

FRONT DISC BRAKES

CAUTION: When servicing brake parts, do not create dust by grinding, sanding brake linings, or by cleaning brake parts with a dry brush or compressed air. Many brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm. A water dampened cloth or water based solution should be used to remove any dust on brake parts. Equipment is commercially available to perform this washing function. These wet methods will prevent asbestos fibers from becoming airborne.

CAUTION: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- **Eye contact – rinse thoroughly with water.**
- **Skin contact – wash with soap and water.**

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen damage.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

FRONT BRAKE ROTOR ASSEMBLY

The rotor assembly is a highly machined, cast iron finned type. It is mounted on top of an integral hub bearing unit.

FRONT BRAKE CALIPER ASSEMBLY

The caliper assembly has a single bore and is mounted to the steering knuckle assembly with two bolts/screws.

When the brakes are applied, fluid pressure behind the piston increases. Pressure is exerted equally against the bottom of the piston and also against the bottom of the caliper housing bore. The pressure applied to the piston is transmitted to the inner pad assembly forcing the lining against the inner rotor surface. The pressure applied to the bottom of the caliper housing bore forces the caliper to slide on the caliper bolts/screws toward the center of the vehicle. This movement causes the outer section of the caliper to apply pressure against the back of the outer pad assembly, forcing the lining against the outer rotor assembly surface. As line pressure builds, the inner and outer pad assemblies are pressed against the rotor assembly surfaces with increased force, bringing the vehicle to a stop.

When the brake pedal assembly is released, line pressure is released and the piston seal and groove cause the piston to be slightly retracted, resulting in less drag on the rotor assembly by the inner and outer pad assemblies.

Outward movement of the piston and inward movement of the caliper assembly automatically compensate for lining wear. As the linings wear, the increased area behind the piston is filled with brake fluid from the brake master cylinder reservoir.

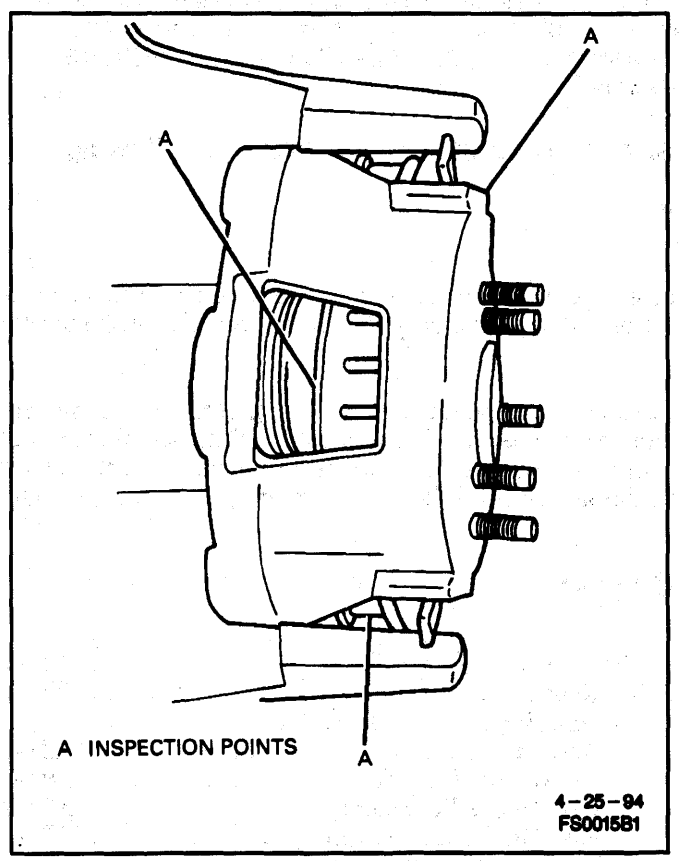


Figure 1 – Front Disc Brake Inner and Outer Pad Assemblies Inspection

DIAGNOSIS

FRONT DISC BRAKE INNER AND OUTER PAD ASSEMBLIES INSPECTION

Figure 1

Inspect

- Inner and outer pad assemblies at least twice a year when the wheels are removed (tire rotation, etc.). When inspecting front disc brakes, check both ends of the outer pad assembly by looking in at each end of the caliper assembly. These are the points at which the highest rate of wear normally occurs. Also, check the lining thickness of the inner pad assembly to make sure that it has not worn prematurely. Look through the hole in the top of the caliper assembly to view the inner pad assembly. Inner and outer pad assemblies should be replaced when the thickness of any lining is worn to within 0.76 mm (0.030 inch) of the shoe. All inner and outer pad assemblies should be replaced in axle sets.

All front disc brakes have a wear indicator that makes a noise when the linings wear to a degree where replacement is required. The wear indicator is an integral part of the outer pad assembly. When the lining is worn, the clip indicator contacts the rotor assembly and produces a warning noise.

Measure

- Flatness of inner and outer pad assembly linings. Place inner and outer pad assembly surfaces together and check for gap between surfaces. If more than 0.13 mm (0.005 inch) gap is measured midway between attaching lugs, inner and outer pad assemblies must be replaced.

FRONT BRAKE ROTOR ASSEMBLY INSPECTION

Front Brake Rotor Assembly Tolerance and Surface Finish

In manufacturing the rotor assembly, tolerances of the braking surfaces for flatness, thickness variation and lateral runout are very closely held. The maintenance of close tolerances on the shape of the braking surfaces is necessary to prevent brake roughness.

In addition to these tolerances, the surface finish must be held to a specified range of 60 R_a roughness or less. A new rotor assembly falls into this surface range, as will a rotor assembly that is refinished exactly as directed in "Refinishing Front Brake Rotor Assemblies" in this section. The control of the braking surface finish is necessary to avoid problems of hard pedal-apply, excessive brake fade, pulls and erratic performance and to extend lining life.

Light scoring of the rotor assembly surfaces not exceeding 1.5 mm (0.06 inch) in depth, which may result from normal use, will not affect brake operation.

Thickness Variation Check

Thickness variation can be checked by measuring the thickness of the front brake rotor assembly at four or more points around its circumference. All measurements must be made at the same distance in from the edge of the rotor assembly. A rotor assembly that varies by more than 0.013 mm (0.0005 inch) can cause brake pedal assembly pulsation and/or front end vibration during brake applications. A rotor assembly that does not meet these specifications should be refinished to specifications or replaced.

Lateral Runout Check

Figure 2

Tool Required:

J 8001 Dial Indicator Set

1. Clean surface of rotor assembly (1).
2. Install wheel nuts (13).

Tighten

- Wheel nuts (13) in a star pattern to 120 N•m (89 lb. ft.).

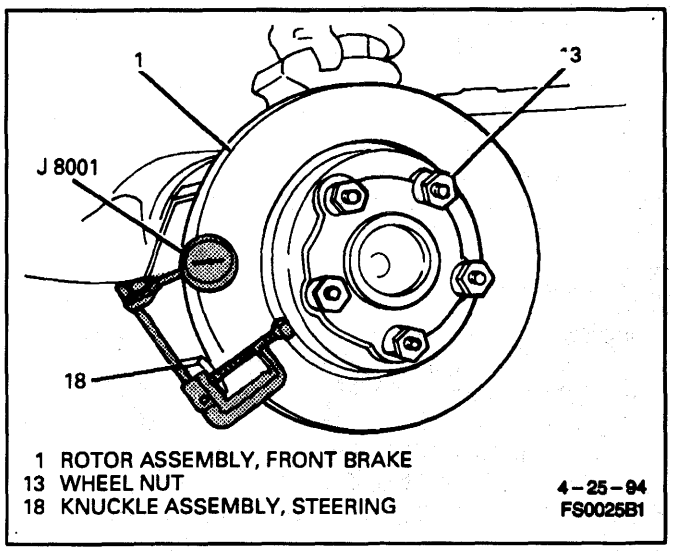


Figure 2 – Lateral Runout Check

3. Fasten J 8001 to steering knuckle assembly (18) so that indicator button contacts rotor assembly surface about 13 mm (0.5 inch) from rotor edge.
4. Set J 8001 to zero.
5. Move rotor assembly (1) one complete revolution, and observe total indicated runout (TIR).
   - Total indicated runout (TIR) should not be more than 0.15 mm (0.006 inch).
   - In some cases, excessive lateral runout of rotor assembly (1) can be improved by indexing rotor assembly (1) on hub one or two bolt positions from original position. Indexing the rotor assembly (1) requires removal and installation of the front brake caliper assembly. Refer to "Front Brake Caliper Assembly" under "On-Vehicle Service" in this section. If lateral runout cannot be corrected by indexing rotor assembly (1), check hub and front wheel bearing assembly for excessive lateral runout or looseness. If hub and bearing assembly lateral runout exceeds 0.040 mm (0.0015 inch) then replace hub and bearing assembly. If lateral runout of the hub and bearing assembly is within specifications then refinish or replace rotor assembly (1) as necessary.

NOTICE: Whenever the rotor assembly has been separated from the wheel bearing flange, clean any rust or foreign material from the mating surface of the wheel bearing flange and front brake rotor assembly. Failure to do this may result in increased lateral runout of the rotor assembly and brake pulsation.

- A rotor assembly that does not meet the lateral runout specification should be resurfaced or replaced as necessary.

FRONT BRAKE CALIPER ASSEMBLY INSPECTION

The front brake caliper assembly must be disassembled for inspection. Refer to "Front Brake Caliper Assembly" under "Unit Repair" in this section.

ON-VEHICLE SERVICE

NOTICE: Do not use lubricated shop air on brake parts as damage to rubber components may result.

Important

- Replace all components included in repair kits used to service this front brake caliper assembly.
- Lubricate rubber parts with clean brake fluid to ease assembly.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- Replace shoe and linings in axle sets only.
- The torque values specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench free from all mineral oil materials.

FRONT BRAKE CALIPER ASSEMBLY

Figures 3 through 7

Remove or Disconnect

1. Two-thirds of brake fluid from master cylinder assembly.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Tire and wheel assembly. Refer to SECTION 3E.
4. Reinstall wheel nuts to retain rotor assembly (1).
5. Push piston (9) into caliper housing bore to provide clearance between inner and outer pad assemblies (7 and 5) and rotor assembly (1).
   A. Position C-clamp on housing (12) and against outer pad assembly (5).
   B. Tighten clamp slowly to press piston (9) into caliper housing bore.

Important

- If removing caliper assembly only to access other brake parts, skip step 6.
- If fitting (14) is disconnected, caliper assembly must be bled during installation.

6. Fitting (14), two copper gaskets, hose assembly (16) from housing (12), if removing caliper assembly entirely from vehicle.
   A. Plug openings in hose assembly (16) and housing (12) to prevent brake fluid loss and contamination.
   B. Discard copper gaskets.
7. Front brake caliper bolts/screws with sleeves (2).
8. Caliper assembly from rotor assembly (1) and knuckle assembly (18).
   - If caliper assembly is not being removed from vehicle for unit repair, suspend it from front suspension using a locally fabricated wire hook.

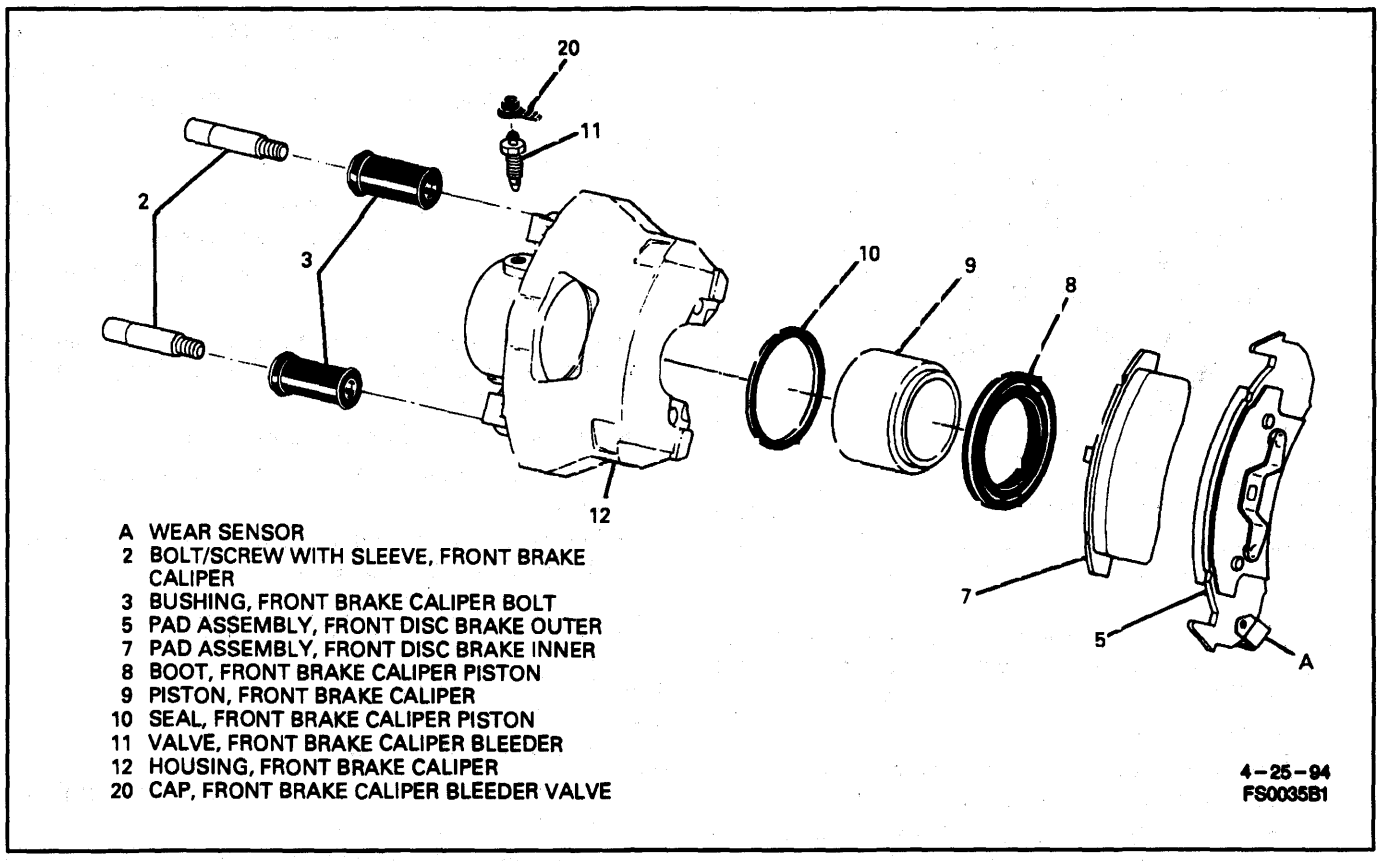


Figure 3 – Front Brake Caliper Assembly

Inspect

1. Bolts/screws with sleeves (2) for corrosion and bushings (3) for cuts and nicks.
   - If damage is found, use new parts, when installing caliper assembly.
   - Do not attempt to polish away corrosion.
2. Fitting (14).
   - If through-hole in fitting (14) is blocked, remove blockage or replace fitting (14).

Install or Connect

NOTICE: See "Notice" on page 5B1-1 of this section.

1. Lubricate inner diameters of bushings (3) with silicone grease GM P/N 1052863 or equivalent.
2. Bolts/screws with sleeves (2).

Inspect

A. Bolt/screw with sleeve (2) should slide through bushing (3) using only hand pressure.
   - If greater force is required or mechanical assistance is needed, remove bolt/screw with sleeve (2) along with bushing (3).

B. Mounting bores for corrosion.
   a. If mounting bores show signs of corrosion, remove corrosion using a 1-inch wheel cylinder housing brush.
   b. Clean mounting bores with clean denatured alcohol.

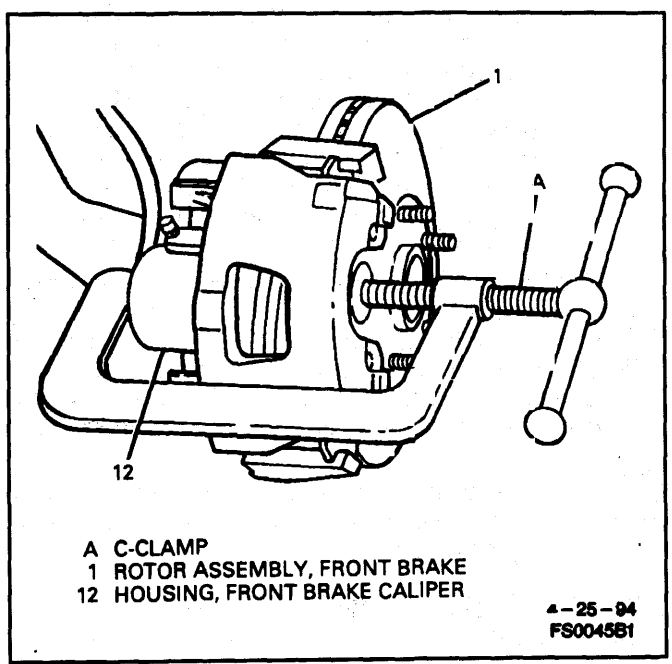
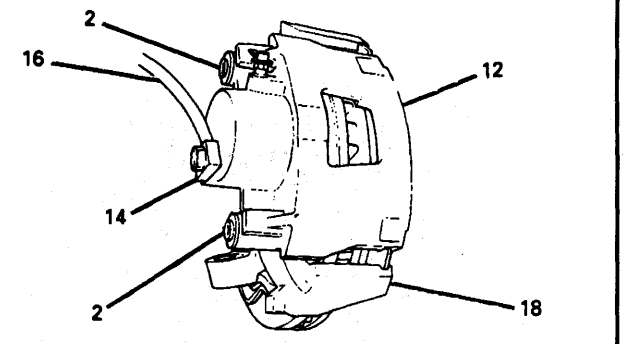


Figure 4 – Compressing Front Brake Caliper Piston



2 BOLT/SCREW WITH SLEEVE, FRONT BRAKE CALIPER
12 HOUSING, FRONT BRAKE CALIPER
14 FITTING, FRONT BRAKE HOSE
16 HOSE ASSEMBLY, FRONT BRAKE
18 KNUCKLE ASSEMBLY, STEERING

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Figure 5 – Front Brake Caliper Assembly Attachment

C. Replace bushings. Refer to "Front Brake Caliper Assembly" under "Unit Repair" in this section.

Tighten

- Bolts/screws with sleeves (2) to 51 N•m (38 lb. ft.).

3. Caliper assembly onto rotor assembly (1) and knuckle assembly (18).
4. Fitting (14), two new copper gaskets, and hose assembly (16) to housing (12), if removed.

Tighten

- Fitting (14) to 44 N•m (32 lb. ft.).

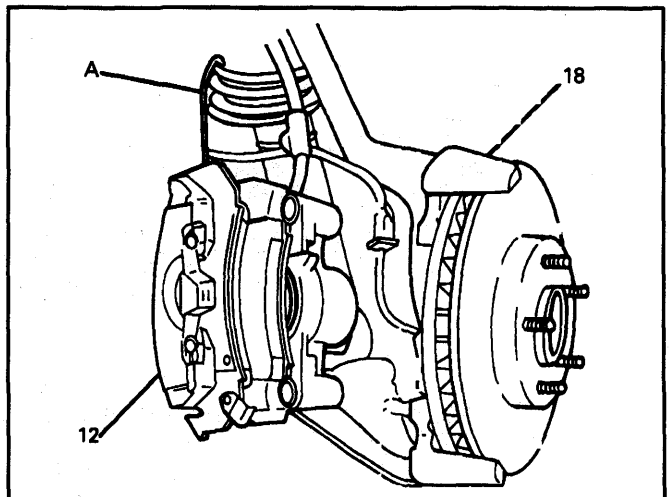
5. Wheel nuts securing rotor assembly to steering knuckle assembly flange.
6. Tire and wheel assembly. Refer to SECTION 3E.
7. Lower vehicle.
8. Fill master cylinder to proper level. Refer to SECTION 5A.
9. If hose assembly (16) was removed, bleed caliper assembly. Refer to SECTION 5E1.

FRONT DISC BRAKE INNER AND OUTER PAD ASSEMBLIES

Figures 3, 6 and 8 through 12

Remove or Disconnect

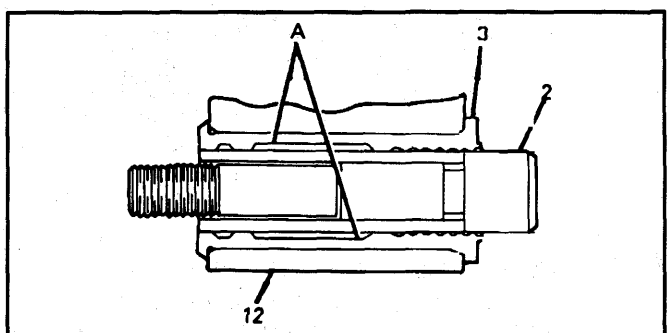
1. Front brake caliper assembly. Refer to "Front Brake Caliper Assembly" under "On-Vehicle Service" in this section.
2. Outer pad assembly (5). Use screwdriver to disengage buttons on shoe from holes in caliper housing.
3. Inner pad assembly (7).



A WIRE HOOK
12 HOUSING, FRONT BRAKE CALIPER
18 KNUCKLE ASSEMBLY, STEERING

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Figure 6 – Suspending Front Brake Caliper Assembly



A ADD SILICONE GREASE TO INNER DIAMETER OF BUSHING
2 BOLT/SCREW WITH SLEEVE, FRONT BRAKE CALIPER
3 BUSHING, FRONT BRAKE CALIPER BOLT
12 HOUSING, FRONT BRAKE CALIPER

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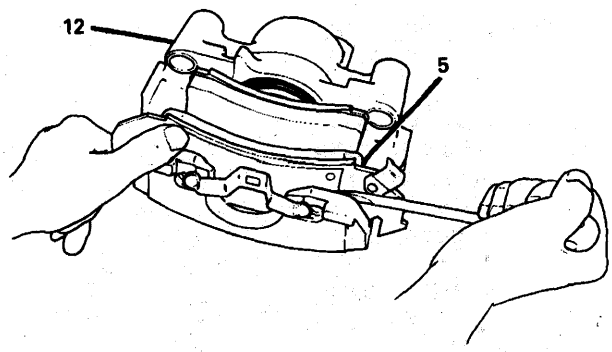
Figure 7 – Lubricating Front Brake Caliper Bolt Sleeve and Bushing

Clean

- Wipe outside surface of boot (8).
  - Use denatured alcohol.

Important

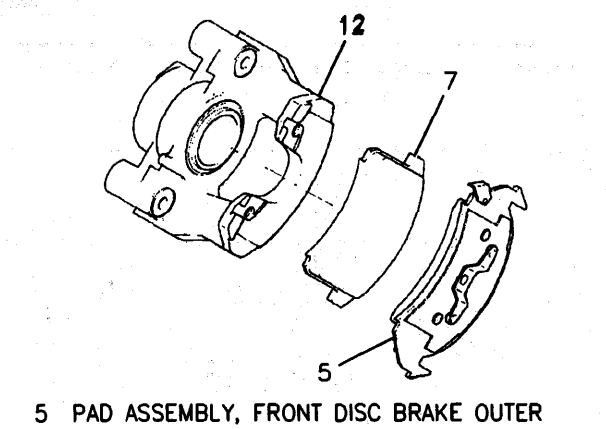
1. Bottom piston (9) into caliper housing bore.
   A. Use a large C-clamp positioned on housing (12) and inside piston well.
   B. Tighten clamp slowly to press piston (9) into caliper housing bore.
2. With piston (9) bottomed in caliper housing bore, lift inner edge of boot (8) next to piston (9) and press out any trapped air.



5 PAD ASSEMBLY, FRONT DISC BRAKE OUTER
12 HOUSING, FRONT BRAKE CALIPER

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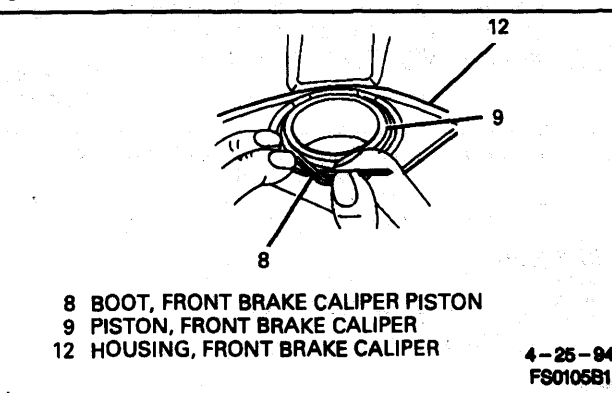
Figure 8 – Removing Outer Pad Assembly



5 PAD ASSEMBLY, FRONT DISC BRAKE OUTER
7 PAD ASSEMBLY, FRONT DISC BRAKE INNER
12 HOUSING, FRONT BRAKE CALIPER

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Figure 9 – Front Disc Brake Inner and Outer Pad Assemblies



8 BOOT, FRONT BRAKE CALIPER PISTON
9 PISTON, FRONT BRAKE CALIPER
12 HOUSING, FRONT BRAKE CALIPER

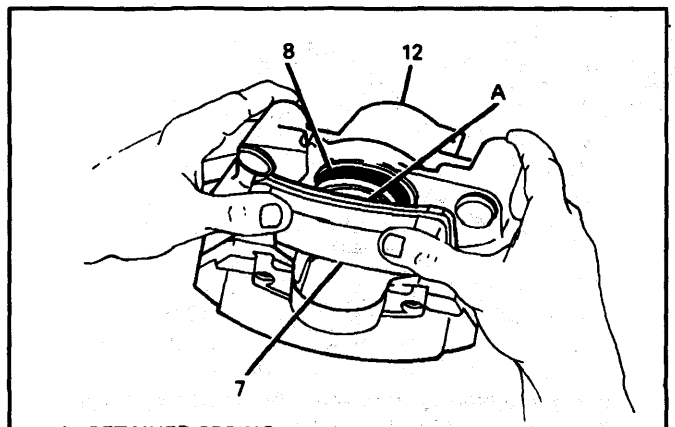
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Figure 10 – Lifting Front Brake Caliper Piston Boot

- Boot (8) must lay flat.

Install or Connect

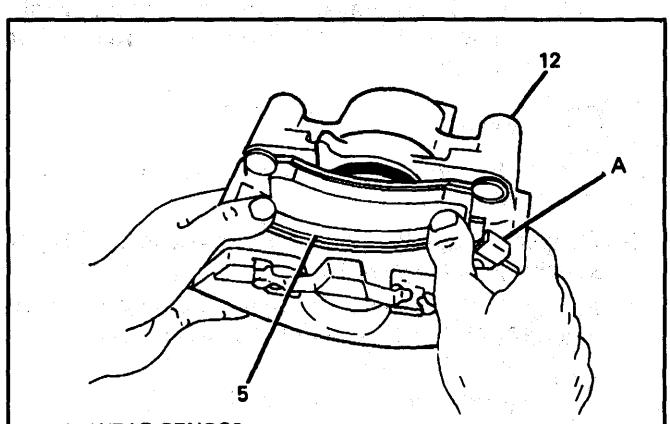
1. Inner pad assembly (7).
   A. Inner pad retainer spring into piston (9). The retainer spring is staked to the inner pad assembly (7).



A RETAINER SPRING
7 PAD ASSEMBLY, FRONT DISC BRAKE INNER
8 BOOT, FRONT BRAKE CALIPER PISTON
12 HOUSING, FRONT BRAKE CALIPER

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Figure 11 – Installing Front Disc Brake Inner Pad Assembly



A WEAR SENSOR
5 PAD ASSEMBLY, FRONT DISC BRAKE OUTER
12 HOUSING, FRONT BRAKE CALIPER

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Figure 12 – Installing Front Disc Brake Outer Pad Assembly

   B. Inner pad assembly (7) must lay flat against piston (9).
   C. Check that boot (8) and inner pad assembly (7) are not touching. If there is contact, remove inner pad assembly (7) and reseat or re-position boot (8).
2. Outer pad assembly (5).
   - Back of outer pad assembly (5) must lay flat against housing (12).
   - Wear sensor should be at trailing lower edge of outer pad assembly (5) during forward wheel rotation. If not, outer pad assembly (5) is on wrong side.
3. Front brake caliper assembly. Refer to "Front Brake Caliper Assembly" under "On-Vehicle Service" in this section.
4. Apply approximately 778 N (175 pounds) of force to brake pedal assembly three times to seat linings.

Important

- GM replacement brake lining material is recommended for all GM vehicles to maintain the balance between front and rear brake performance. GM replacement brake parts have been carefully selected to provide the proper brake balance for purposes of both stopping distance and controllability over the full range of operating conditions. Installation of front or rear brake lining material with performance different from that of the GM replacement parts recommended for this vehicle can change the intended brake balance of this vehicle.

FRONT BRAKE ROTOR ASSEMBLY

The rotor assembly is an integral part of the hub assembly. For removal procedure, refer to SECTION 3C.

UNIT REPAIR

REFINISHING FRONT BRAKE ROTOR ASSEMBLIES

Important

- **DO NOT** refinish rotor assemblies when performing routine brake maintenance such as replacing worn front disc brake inner and outer pad assemblies. Refinish a rotor assembly **ONLY** under the following circumstances:
  - There is a complaint of brake pulsation.
  - There is scoring greater than 1.5 mm (0.06 inch).

All rotor assemblies have a minimum thickness dimension cast into them. This dimension is the minimum wear dimension and not a refinish dimension. The minimum refinish dimension is greater than the discard dimension. Do not use a rotor assembly that will not meet specifications. Replace with a new rotor assembly. Refer to "Specifications" in this section.

Since accurate control of the rotor assembly tolerances is necessary for proper performance of the front disc brakes, the rotor assembly should be machined only with precision equipment. Equipment should be serviced on a regular basis following the manufacturer's recommended maintenance procedure.

When refinishing rotor assemblies, the attaching adapters, tool holders, vibration dampeners and tool bits must be in good condition. Always use sharp cutting tools or bits and use only replacement cutting bits recommended by the equipment manufacturer. Dull or worn tools leave a poor surface finish which will affect braking performance. Vibration dampening attachments should always be used when refinishing braking surfaces. These attachments eliminate tool chatter and will result in better surface finish. Make sure these adapters are clean and free of nicks.

On-Vehicle Procedure

Tool Required:

On-Vehicle Brake Lathe, such as Kent-Moore J 37704 On Disc Brake Lathe

In the cases where rotors are being refinished to correct a problem with brake pulsation, it is recommended that an on-vehicle brake lathe be used to achieve best results. Follow the equipment manufacturer's recommended specifications and procedure.

Off-Vehicle Procedure

Important

- Remove rust and scale from rotor assembly and steering knuckle spindle assembly mating surfaces. Failure to do so may introduce excessive lateral runout when the rotor assembly is mounted on the brake lathe, or when the rotor assembly is reinstalled on the steering knuckle spindle assembly.

Following are two recommended procedures that achieve adequate results using two different off-vehicle drum/disc brake lathes. (If any other lathe is used, follow that lathe's instructions and recommendations.)

Ammco Brake Lathe (Two-cut refinishing procedure)

	ROUGH CUT	FINISH CUT
Spindle Speed	150 rpm	150 rpm
Depth of Cut (per side)	0.15 mm to 0.64 mm (0.006 inch to 0.025 inch)	0.10 mm to 0.15 mm (0.004 inch to 0.006 inch)
Tool Cross Feed (per rev.)	0.25 mm (0.010 inch)	0.05 mm (0.002 inch)
Vibration Dampener	Yes	Yes
Sand Front Brake Rotor Assembly (Swirl Pattern)	No	Yes

Accuturn Brake Lathe, GM Dealer Equipment (One-cut refinishing procedure)

Locate the deepest score and turn the rotor micrometer knob until the tool bit bottoms out at the deepest point of the score. Zero the scale and back out the tool bit (repeat for opposite side of rotor). Advance the cutter handwheel until the bits have cleared the inner edges of the rotor face. Adjust the micrometer knobs for approximately 0.13 mm (0.005 inch) more than the first reading. This will ensure resurfacing the rotor in one cut.

Spindle Speed	105 rpm
Depth of Cut	As necessary
Tool Cross Feed (per revolution)	0.08 mm (0.003 inch)
Tool Bit Nose Radius	1/64
Vibration Dampener	Yes

Non-Directional Finishing

It is very important that the rotor surface be made non-directional by dressing the rotor surfaces with a sanding disc tool such as Ammco 8750 Safe Swirl Disc

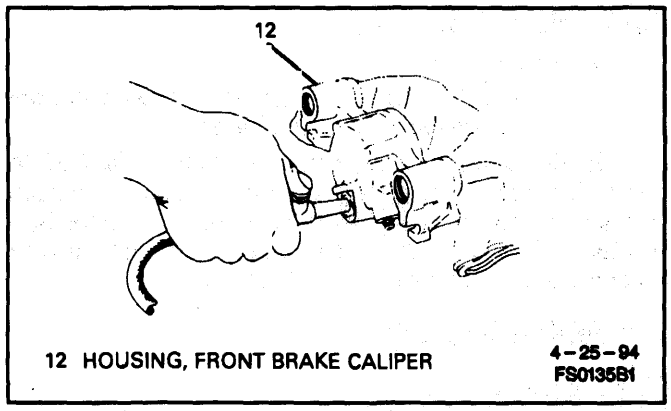


Figure 13 – Removing Front Brake Caliper Piston

Rotor Grinder, Accuturn 433179 Non-Directional Swirl Finisher, or equivalent, using 120 grit aluminum oxide sandpaper. Sand each rotor surface with moderate pressure for a minimum of 60 seconds. If the brake lathe is not equipped with an adequate non-directional finishing tool, an alternate method is to use a sanding block with 150 grit aluminum oxide sandpaper. With the rotor turning at the equipment manufacturer's highest recommended cutting speed, sand each rotor surface for a minimum of 60 seconds using moderate pressure. **After the rotor has been sanded, clean each surface with denatured alcohol or a suitable brake cleaner.**

The finished rotor assembly surface should be as close to that of a new front brake rotor assembly as possible. Failure to obtain the best possible finish may affect braking performance.

Important

- Front brake rotor assemblies should always be replaced if turning will result in a front brake rotor assembly that does not meet manufacturer specifications for minimum thickness. When installing new brake rotor assemblies, do not refinish the surfaces of these parts. New brake rotor assemblies have the correct level of surface finish.

Burnishing Front Brake Rotor Assemblies

After front brake pad assemblies have been replaced, it is very important that the new braking surface be broken in, or burnished. In addition, light corrosion on the rotors can be removed by burnishing the new braking surface. This can be accomplished by making 20 stops from 48 km/h (30 mph), using medium to firm brake pedal assembly pressure. Take care to avoid overheating the brakes.

FRONT BRAKE CALIPER ASSEMBLY

Figures 13 through 17

Tool Required:

J 26267 Dust Boot Seal Installer

Disassemble

NOTICE: Use clean shop towels to pad interior of caliper housing during piston removal.

1. Remove caliper assembly from vehicle. Refer to "Front Brake Caliper Assembly" under "On-Vehicle Service" in this section.
2. Bushings (3).

Inspect

A. Bushings (3) for nicks or cuts. Replace if damaged.

B. Mounting bores for corrosion.

   a. If mounting bores show signs of corrosion, remove corrosion using a 1-inch wheel cylinder honing brush.

   b. Clean mounting bores with clean denatured alcohol.

CAUTION: Do not place fingers in front of the piston in an attempt to catch or protect it when applying compressed air. This could result in serious injury.

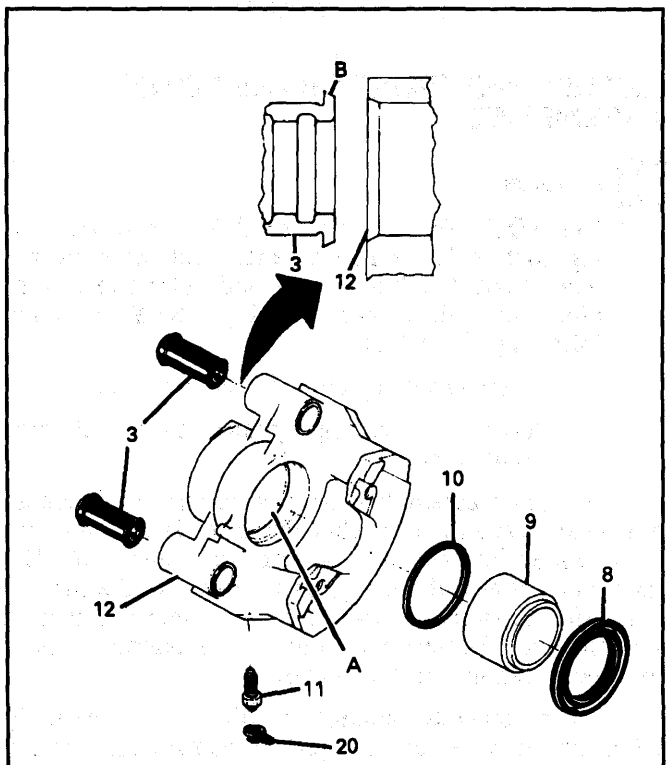


Figure 14 – Front Brake Caliper Assembly Components

3. Piston (9) from housing (12).
   - Apply compressed air to housing inlet hole.

Inspect

- Piston (9) for scoring, nicks, corrosion, and worn or damaged chrome plating.
  - Replace piston if any of above are found.

4. Boot (8) from housing (12).

NOTICE: Do not use a metal tool to remove piston seal from housing bore. Using a metal tool may damage caliper bore or seal groove.

5. Piston seal (10) from housing (12).

Inspect

- Caliper bore and seal groove for scoring, nicks, corrosion, and wear.
  - A. Use crocus cloth to polish out light corrosion.
  - B. Replace housing (12) if corrosion in and around seal groove will not clean up with crocus cloth.

6. Bleeder valve cap (20) and bleeder valve (11) from housing (12).

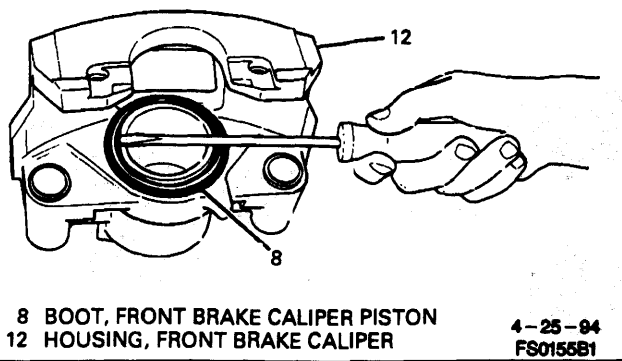
Assemble

NOTICE: See "Notice" on page 5B1-1 of this section.

Clean

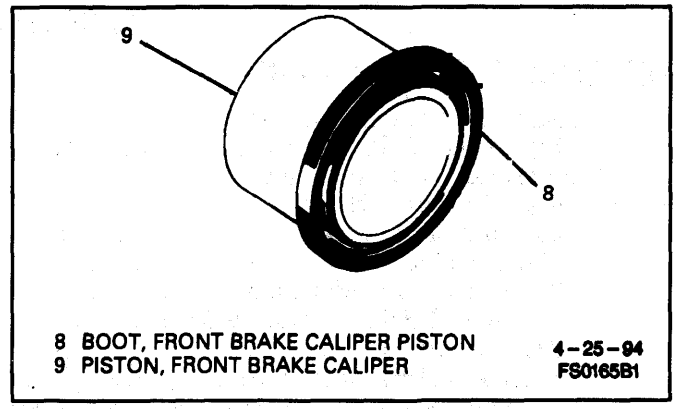
- A. All parts in clean denatured alcohol.
- B. Dry with unlubricated compressed air.
- C. Blow out all passages in housing (12) and bleeder valve (11).

1. Lubricate all rubber parts with clean brake fluid.
2. Bleeder valve (11) into housing (12).



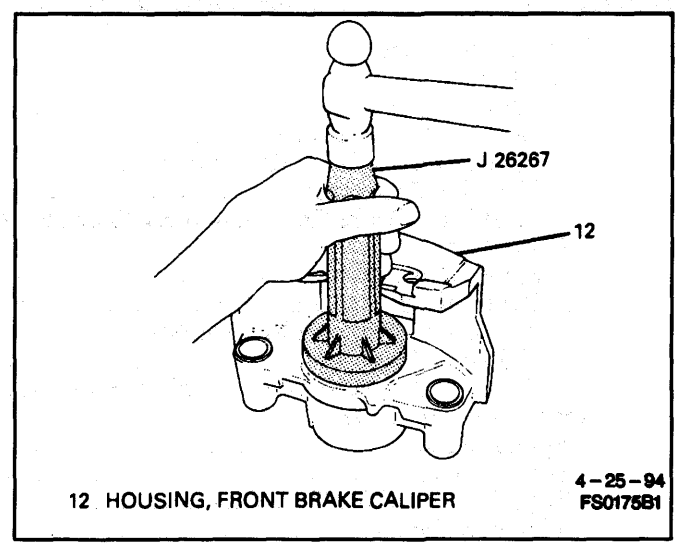
8 BOOT, FRONT BRAKE CALIPER PISTON
12 HOUSING, FRONT BRAKE CALIPER
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Figure 15 – Removing Front Brake Caliper Piston Boot



8 BOOT, FRONT BRAKE CALIPER PISTON
9 PISTON, FRONT BRAKE CALIPER
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Figure 16 – Installing Front Brake Caliper Piston Boot



12 HOUSING, FRONT BRAKE CALIPER
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Figure 17 – Seating Front Brake Caliper Piston Boot

Tighten

- Bleeder valve (11) to 13 N•m (115 lb. in.).

3. Replace bleeder valve cap (20).
4. Piston seal (10) into bore groove of housing (12).
   - Make sure piston seal (10) is not twisted.
5. Boot (8) onto piston (9).
6. Piston (9) with assembled boot (8) into bore of housing (12).
   - Push piston (9) to bottom of housing bore.
7. Seat boot (8) into counterbore of housing (12) using J 26267.
8. Bushings (3).
   - A. Lubricate beveled end of bushing (3) with GM P/N 1052863 or equivalent.
   - B. Pinch bushing (3) and install bevel end first.
   - C. Push bushing (3) through housing mounting bore.
9. Install caliper assembly. Refer to "Front Brake Caliper Assembly" under "On-Vehicle Service" in this section.

SPECIFICATIONS

GENERAL SPECIFICATIONS

Front Brake Caliper Assembly
- Front Brake Caliper Housing Bore Diameter ..... 63.50 mm (2.500″)

Front Brake Rotor Assembly
- Rotor Diameter (Nominal) ..... 278.00 mm (10.945″)
- Lateral Runout ..... 0.13 mm (0.005″)
- Thickness Variation ..... 0.013 mm (0.0005″)
- Rotor Thickness (Maximum) ..... 32.00 mm (1.260″)
- Minimum Thickness After Refinish ..... 31.74 mm (1.250″)
- Discard Thickness ..... 30.70 mm (1.209″)

All front brake rotor assemblies have a discard dimension cast into them. This is a wear dimension and not a refinish dimension. Any front brake rotor assembly which does not meet the specifications should be replaced.

ROTOR REFINISHING SPECIFICATIONS

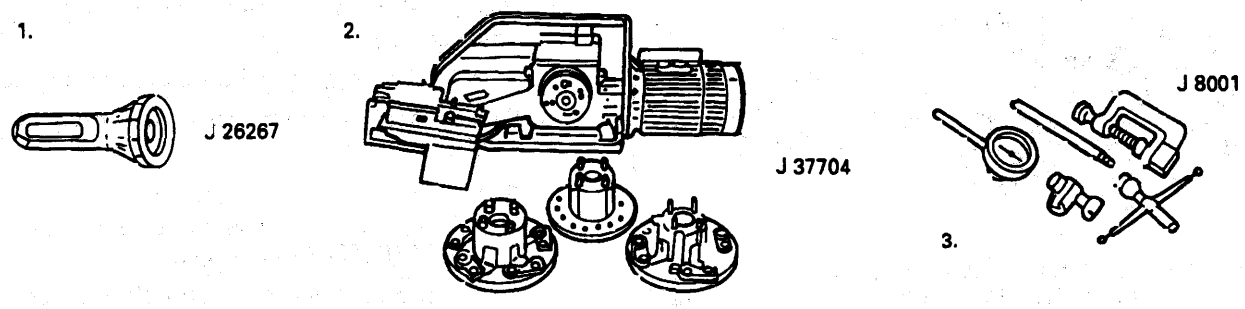
Ammco Brake Lathe
- Rough Cut
  - Spindle Speed ..... 150 rpm
  - Depth of Cut (Per Side) ..... 0.15 mm to 0.64 mm (0.006″ to 0.025″)
  - Tool Cross Feed (Per Revolution) ..... 0.25 mm (0.010″)
  - Vibration Dampener ..... Yes
  - Sand Front Brake Rotor Assembly (Swirl Pattern) ..... No
- Finish Cut
  - Spindle Speed ..... 150 rpm
  - Depth of Cut (Per Side) ..... 0.10 mm to 0.15 mm (0.004″ to 0.006″)
  - Tool Cross Feed (Per Revolution) ..... 0.05 mm (0.002″)
  - Vibration Dampener ..... Yes
  - Sand Front Brake Rotor Assembly (Swirl Pattern) ..... Yes

Accuturn Brake Lathe
- Spindle Speed ..... 105 rpm
- Depth of Cut ..... As necessary
- Tool Cross Feed (Per Revolution) ..... 0.08 mm (0.003″)
- Vibration Dampener ..... Yes

FASTENER TIGHTENING SPECIFICATIONS

- Front Brake Caliper Bleeder Valve ..... 13 N•m (115 lb. in.)
- Front Brake Caliper Bolt/Screw With Sleeve ..... 51 N•m (38 lb. ft.)
- Front Brake Hose Fitting ..... 44 N•m (32 lb. ft.)
- Wheel Nut ..... 120 N•m (89 lb. ft.)

SPECIAL TOOLS



1. DUST BOOT SEAL INSTALLER
2. ON DISC BRAKE LATHE
3. DIAL INDICATOR SET

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SECTION 5B2
REAR DISC BRAKES

CAUTION: When servicing brake parts, do not create dust by grinding, sanding brake linings, or by cleaning brake parts with a dry brush or compressed air. Many brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm. A water dampened cloth or water based solution should be used to remove any dust on brake parts. Equipment is commercially available to perform this washing function. These wet methods will prevent asbestos fibers from becoming airborne.

CAUTION: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- **Eye contact – rinse thoroughly with water.**
- **Skin contact – wash with soap and water.**

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen damage.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

The rear disc brake caliper assembly has a single piston in an aluminum housing which is suspended in the anchor bracket on two guide pins. Hydraulic pressure, created by applying force to the brake pedal assembly, acts equally against the piston and the bottom of the caliper bore to move the piston outward and to slide the caliper inward resulting in a clamping action on the rotor. This clamping action forces the linings against the rotor creating friction to stop the vehicle. When the parking brake is applied, the lever on the caliper causes the pushrod, the actuating collar and the clamp rod assembly to be moved outward and the caliper to slide inward, mechanically forcing the pad assemblies against the rotor assembly. Parking brake application is completely independent of the hydraulic braking system.

The rear disc brake rotor assembly is a composite cast iron type vented rotor assembly. It has a stamped sheet metal flange which is insert cast.

DIAGNOSIS

REAR DISC BRAKE INNER AND OUTER PAD ASSEMBLIES INSPECTION

Figure 1

Inspect

- Inner and outer pad assemblies at least twice a year when the wheels are removed (tire rotation, etc.).

When inspecting rear disc brakes, check both ends of the outer pad assembly by looking in at each end of the caliper assembly. These are the points at which the highest rate of wear normally occurs. Also, check the lining thickness of the inner pad assembly to make sure that it has not worn prematurely. Look through the hole in the top of the caliper assembly to view the inner pad assembly. Inner and outer pad assemblies should be replaced when the thickness of any lining is worn to within 0.76 mm (0.030 inch) of the shoe. All inner and outer pad assemblies should be replaced in axle sets.

All rear disc brakes have a wear indicator that makes a noise when the pad assembly linings wear to a degree where replacement is required. The wear indicator is an integral part of the inner pad assembly. When the pad assembly lining is worn, the clip indicator contacts the rotor assembly and produces a warning noise.

Measure

- Flatness of inner and outer pad assembly linings. Place inner and outer pad assembly surfaces together and check for gap between surfaces. If more than 0.13 mm (0.005 inch) gap is measured midway between attaching lugs, inner and outer pad assemblies must be replaced.

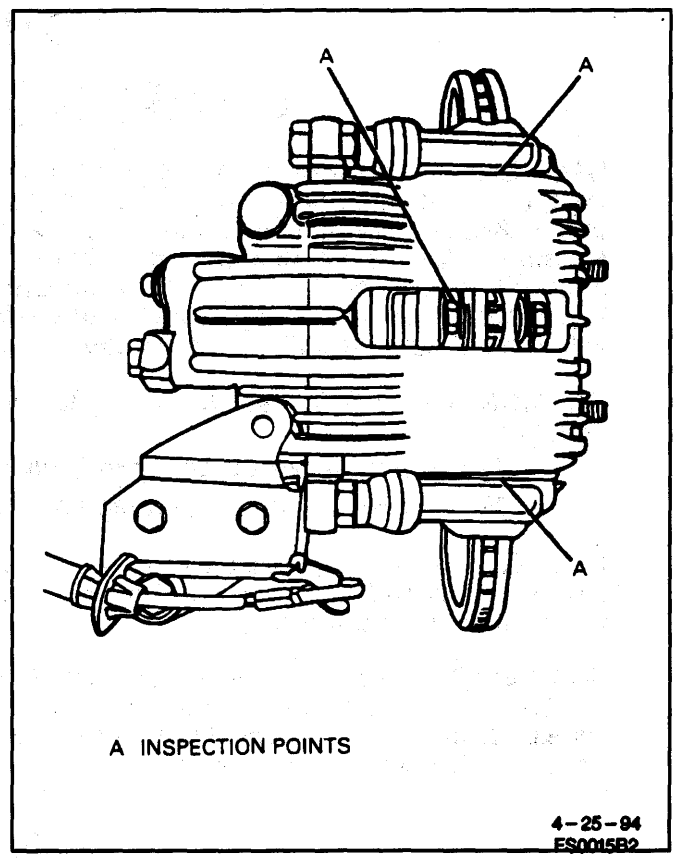


Figure 1 – Rear Disc Brake Inner and Outer Pad Assemblies Inspection

REAR BRAKE ROTOR ASSEMBLY INSPECTION

Rear Brake Rotor Assembly Tolerance and Surface Finish

In manufacturing the rotor assembly, tolerances of the braking surfaces for flatness, thickness variation and lateral runout are held very close. The maintenance of close tolerances on the shape of the braking surfaces is necessary to prevent brake roughness.

In addition to these tolerances, the surface finish must be held to a specified range of 60 R_a roughness or less. A new rotor assembly falls into this surface range, as will a rotor assembly that is refinished exactly as directed in "Refinishing Rear Brake Rotor Assemblies" in this section. The control of the braking surface finish is necessary to avoid problems of hard pedal-apply, excessive brake fade, pulls and erratic performance and to extend lining life.

Light scoring of the rotor assembly surfaces not exceeding 1.5 mm (0.06 inch) in depth, which may result from normal use, will not affect brake operation.

Thickness variation can be checked by measuring the thickness of the rear brake rotor assembly at four or more points around its circumference. All measurements must be made at the same distance in from the edge of the rotor assembly. A rotor assembly that varies by more than 0.013 mm (0.0005 inch) can cause brake pedal assembly pulsation and/or rear end vibration during brake applications. A rotor assembly that does not meet these specifications should be refinished to specifications or replaced.

Thickness Variation Check

Lateral Runout Check

Figure 2

Tool Required:

J 8001 Dial Indicator Set

1. Fasten J 8001 to rear brake caliper housing so that indicator button contacts rotor assembly surface about 13 mm (0.5 inch) from rotor edge.
2. Set J 8001 to zero.
   - Push in rear axle assembly while setting J 8001 to eliminate endplay.
3. Turn rotor assembly (39) one complete revolution, and observe total indicated runout (TIR).
   - Push in rear axle assembly while turning rotor assembly to eliminate endplay.
   - Total indicated runout (TIR) should not be more than 0.15 mm (0.006 inch).
4. In some cases, excessive lateral runout of rotor assembly (39) can be improved by indexing rotor assembly (39).
   A. Remove tire and wheel assembly. Refer to SECTION 3E.
   B. Remove rear brake caliper assembly. Refer to "Rear Brake Caliper Assembly" under "On-Vehicle Service" in this section.
   C. Index rotor assembly (39) on hub one or two bolt positions from original position.
5. Check lateral runout of rotor assembly (39).

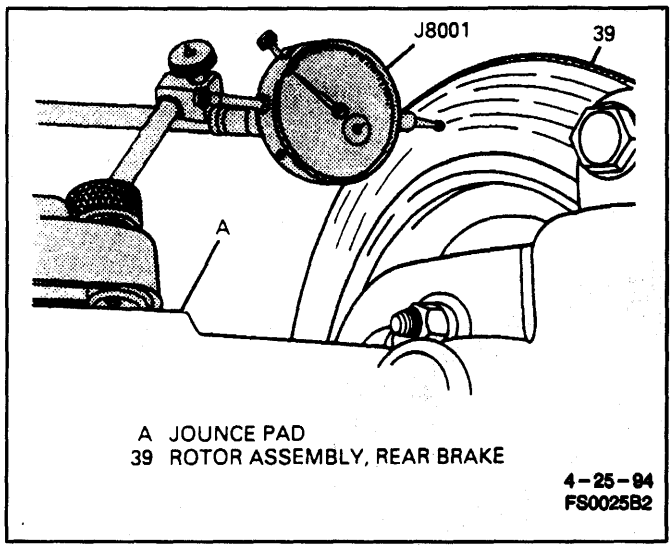


Figure 2 – Checking Lateral Runout

6. If lateral runout of rotor assembly (39) still exceeds 0.15 mm (0.006 inch), check rear axle shaft flange for excessive lateral runout or looseness.
   A. Reposition J 8001 so button contacts surface of axle shaft flange.
   B. Push axle shaft flange inward while turning the axle shaft flange one full revolution.
   C. Continue pushing in axle shaft flange while setting J 8001 to zero.
   D. While maintaining inward pressure, rotate axle shaft flange and note lateral runout.
   E. If axle shaft flange lateral runout exceeds 0.05 mm (0.002 inch), replace rear axle shaft. Refer to SECTION 4B.
   F. If axle shaft flange lateral runout is within specifications, refinish or replace rotor assembly (39) as necessary. Refer to "Refinishing Rear Brake Rotor Assemblies" under "Unit Repair" in this section.

   NOTICE: Whenever the rotor assembly has been separated from the wheel bearing flange, clean any rust or foreign material from the mating surface of the wheel bearing flange and front brake rotor assembly. Failure to do this may result in increased lateral runout of the rotor assembly and brake pulsation.
   G. A rotor assembly that does not meet the lateral runout specification should be resurfaced or replaced as necessary.

REAR BRAKE CALIPER ASSEMBLY INSPECTION

The rear brake caliper assembly must be disassembled for inspection. Refer to "Rear Brake Caliper Assembly" under "Unit Repair" in this section.

ON-VEHICLE SERVICE

NOTICE: Do not use lubricated compressed air on brake parts as damage to rubber components may result.

Important

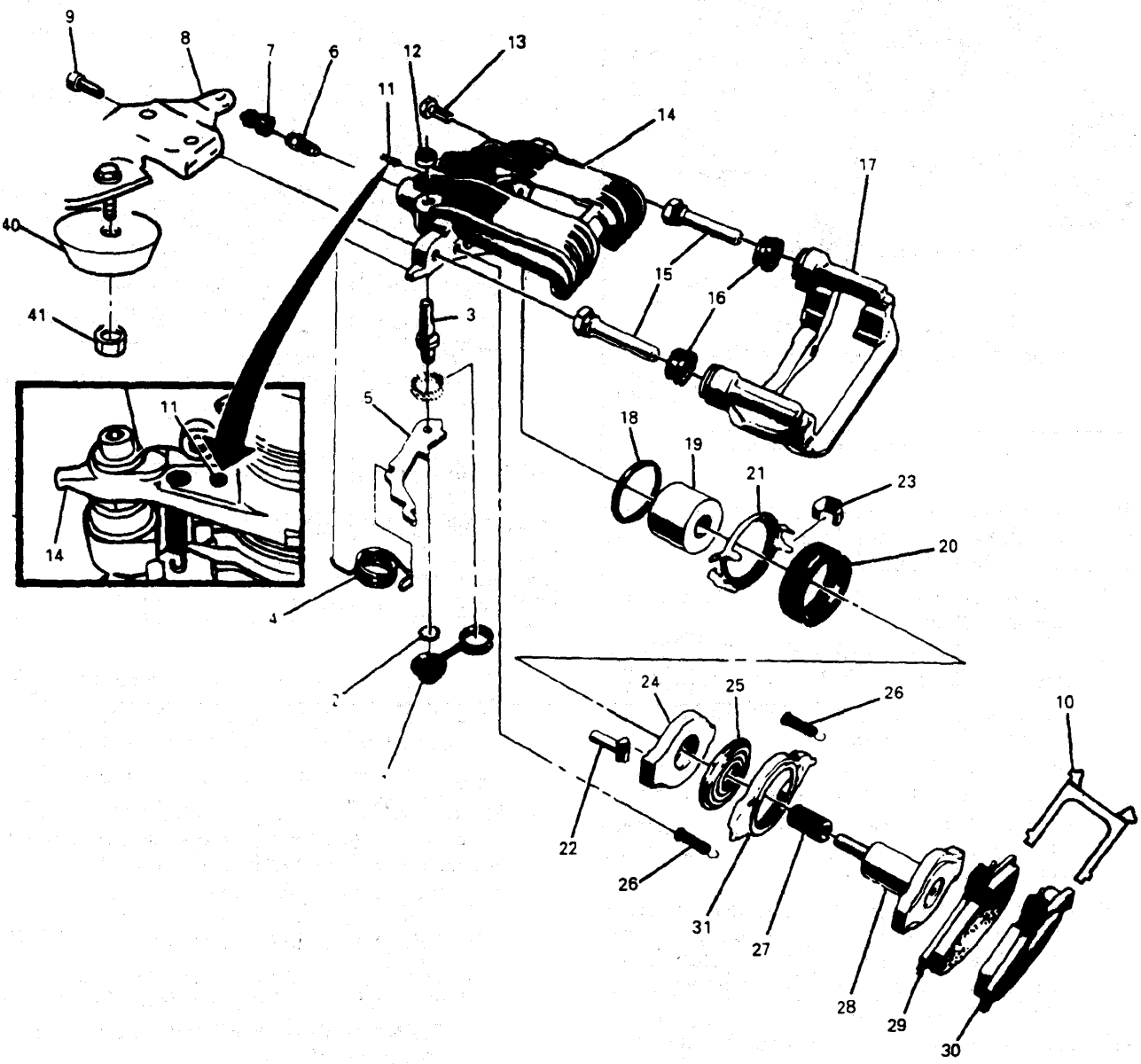
- Replace all components included in repair kits used to service this caliper assembly.
- Lubricate rubber parts with clean brake fluid to ease assembly.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake hydraulic system.
- Replace pad assemblies in axle sets only.
- The torque values specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench, free from all mineral oil materials.

REAR BRAKE CALIPER ASSEMBLY

Figures 3 through 6

Remove or Disconnect

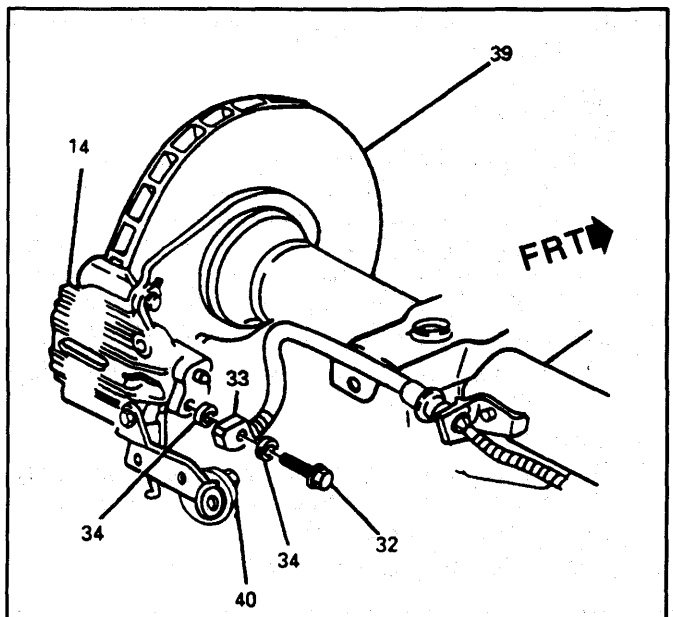
1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Parking brake cable assembly at equalizer. Refer to SECTION 5F.
3. Tire and wheel assembly. Refer to SECTION 3E.
   - Install wheel nuts to retain rotor assembly (39).
4. Brake hose fitting bolt/screw (32), brake hose fitting (33) and two gaskets (34) only if caliper assembly is being removed for overhaul.
   A. Discard old gaskets (34).
   B. Plug hole in caliper housing (14) and brake hose fitting (33).
5. Actuator lever return spring (4) only if defective.
   - Discard actuator lever return spring (4) if coils are opened.
6. Parking brake cable assembly (35) from parking brake actuator lever (5) and parking brake cable bracket (8).
7. Vibration dampener nut (41) and vibration dampener assembly (40) from parking brake cable bracket (8), if necessary.
8. Upper caliper guide pin bolt/screw (13) and discard.
9. Lower caliper guide pin bolt/screw (9) and discard, only if removing caliper assembly from vehicle.
10. Caliper housing (14) from rotor assembly (39) and anchor bracket (17).
    - If caliper overhaul or replacement is not required, hang caliper housing (14) from suspension to avoid damage to brake hose assembly.
11. Inner and outer pad assemblies (29 and 30) only if they are being replaced or if anchor bracket (17) is being removed.



1 SEAL, REAR PARKING BRAKE LEVER PIVOT PIN
2 CLIP, REAR PARKING BRAKE LEVER SPRAG
3 PIN, REAR PARKING BRAKE LEVER PIVOT
4 SPRING, REAR CALIPER PARKING BRAKE ACTUATOR LEVER RETURN
5 LEVER, REAR PARKING BRAKE ACTUATOR
6 VALVE, REAR BRAKE CALIPER BLEEDER,
7 CAP, REAR BRAKE CALIPER BLEEDER VALVE
8 BRACKET, PARKING BRAKE CABLE
9 BOLT/SCREW, LOWER CALIPER GUIDE PIN,
10 SHIM
11 SCREW, PARKING BRAKE LEVER ADJUSTER
12 NUT, REAR PARKING BRAKE LEVER PIVOT PIN,
13 BOLT/SCREW, UPPER CALIPER GUIDE PIN,
14 HOUSING, REAR BRAKE CALIPER
15 PIN, REAR BRAKE CALIPER GUIDE
16 BOOT, REAR BRAKE CALIPER GUIDE PIN
17 BRACKET, REAR BRAKE CALIPER ANCHOR
18 SEAL, REAR BRAKE CALIPER PISTON
19 PISTON, REAR BRAKE CALIPER
20 BOOT, ACTUATING COLLAR
21 RETAINER, ACTUATING COLLAR BOOT
22 PUSHROD
23 SPRING, PRELOAD
24 COLLAR, ACTUATING
25 BOOT, ACTUATING COLLAR
26 SPRING, REAR CALIPER PARKING BRAKE COLLAR RETURN
27 BUSHING
28 ROD, CLAMP
29 PAD ASSEMBLY, REAR DISC BRAKE INNER
30 PAD ASSEMBLY, REAR DISC BRAKE OUTER
31 RETAINER, ACTUATING COLLAR BOOT
40 DAMPENER ASSEMBLY, REAR BRAKE VIBRATION
41 NUT, REAR BRAKE VIBRATION DAMPENER,

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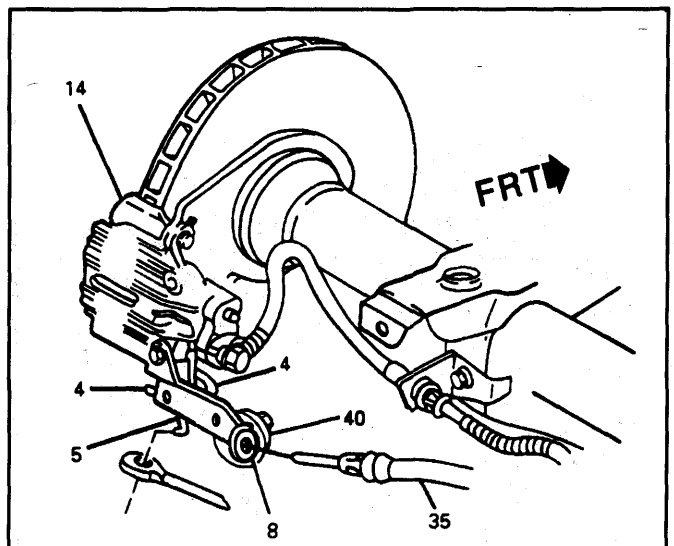
Figure 3 – Rear Brake Caliper Assembly Components



14 HOUSING, REAR BRAKE CALIPER
32 BOLT/SCREW, REAR BRAKE HOSE FITTING
33 FITTING, REAR BRAKE HOSE
34 GASKET, REAR BRAKE HOSE FITTING
39 ROTOR ASSEMBLY, REAR BRAKE
40 DAMPENER ASSEMBLY, REAR BRAKE VIBRATION

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Figure 4 – Removing Rear Brake Hose Fitting



4 SPRING, REAR CALIPER PARKING BRAKE ACTUATOR LEVER RETURN
5 LEVER, REAR PARKING BRAKE ACTUATOR
8 BRACKET, PARKING BRAKE CABLE
14 HOUSING, REAR BRAKE CALIPER
35 CABLE ASSEMBLY, PARKING BRAKE REAR
40 DAMPENER ASSEMBLY, REAR BRAKE VIBRATION

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Figure 5 – Parking Brake Cable Assembly Attachment

12. Shim (10), if inner and outer pad assemblies (29 and 30) were removed.

Inspect

1. Guide pins (15) for free movement in anchor bracket (17). Rear brake caliper guide pin boot (16) for proper seating in retaining groove of guide pin (15) and rear anchor bracket (17). Replace guide pins (15) or guide pin boots (16) if corroded, worn or damaged.
2. Inner and outer pad assemblies (29 and 30) for wear and maximum taper of 0.15 mm (0.006 inch).
   - Replace with new inner and outer pad assemblies (29 and 30) if they are tapered beyond specification.
     - Replace inner and outer pad assemblies (29 and 30) in sets of four.
3. Brake hose fitting bolt/screw (32).
   - If through-hole in brake hose fitting bolt/screw (32) is blocked, remove blockage or replace brake hose fitting bolt/screw (32).

Install or Connect

NOTICE: See "Notice" on page 5B2-1 of this section.

1. New shim (10), if removed.
2. Inner and outer pad assemblies (29 and 30), if removed.

Important

- Whenever rear disc brake inner and outer pad assemblies are replaced, immediately check the parking brake free-travel. Adjust as necessary. Refer to "Parking Brake Free-Travel Adjustment" in this section.

A. Outer pad assembly (30) with insulator is installed toward caliper housing (14). Inner pad assembly (29) with wear sensor is installed nearest to piston (19).

B. Wear sensor must be in leading position with forward wheel rotation. If not, use other inner pad assembly (29) in replacement kit.

3. Caliper housing (14) over rotor assembly (39) and into anchor bracket (17).
4. New upper caliper guide pin bolt/screw (13).

Tighten

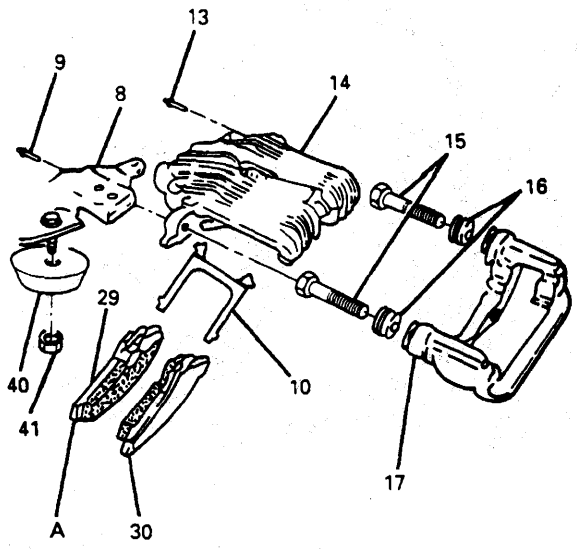
- Upper caliper guide pin bolt/screw (13) to 37 N•m (27 lb. ft.).

5. New lower caliper guide pin bolt/screw (9), if removed.

Tighten

- Lower caliper guide pin bolt/screw (9) to 37 N•m (27 lb. ft.).

6. Brake hose fitting (33), two new gaskets (34) and brake hose fitting bolt/screw (32), if removed.



A WEAR SENSOR
8 BRACKET, PARKING BRAKE CABLE
9 BOLT/SCREW, LOWER CALIPER GUIDE PIN,
10 SHIM
13 BOLT/SCREW, UPPER CALIPER GUIDE PIN,
14 HOUSING, REAR BRAKE CALIPER
15 PIN, REAR BRAKE CALIPER GUIDE
16 BOOT, REAR BRAKE CALIPER GUIDE PIN
17 BRACKET, REAR BRAKE CALIPER ANCHOR
29 PAD ASSEMBLY, REAR DISC BRAKE INNER
30 PAD ASSEMBLY, REAR DISC BRAKE OUTER
40 DAMPENER ASSEMBLY, REAR BRAKE VIBRATION
41 NUT, REAR BRAKE VIBRATION DAMPENER,

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Figure 6 – Rear Brake Caliper Assembly

Tighten

- Brake hose fitting bolt/screw (32) to 30 N•m (22 lb. ft.).

7. Vibration dampener assembly (40) and vibration dampener nut (41) to parking brake cable bracket (8), if removed.

Tighten

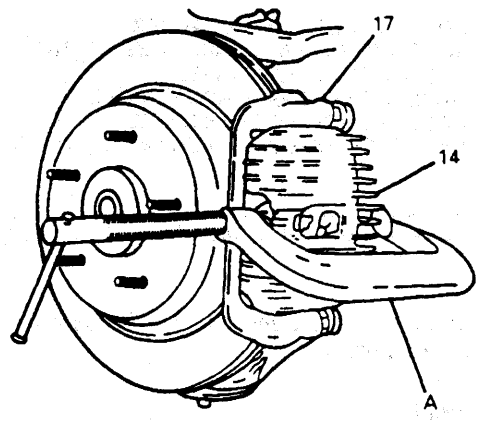
- Vibration dampener nut (41) to 50 N•m (37 lb. ft.).

8. Parking brake cable assembly (35) to parking brake cable bracket (8) and parking brake actuator lever (5), and parking brake cable equalizer.
9. Actuator lever return spring (4), if removed.
10. Bleed brake hydraulic system, if brake hose fitting was removed. Refer to SECTION 5E1.
11. Lower vehicle.
12. Cycle parking brake assembly.
13. Raise and suitably support vehicle. Refer to SECTION 0A.

Inspect

- Parking brake actuator levers to make sure they are against stops on caliper housing (14). If parking brake actuator levers are not on their stops, make sure actuator lever return spring (4) is correctly installed, then refer to SECTION 5F for parking brake linkage repairs.

14. Tire and wheel assembly. Refer to SECTION 3E.
    - Remove wheel nuts securing rotor assembly (39).
15. Lower vehicle.
16. With engine running, pump brake pedal assembly slowly and firmly three times to seat inner and outer pad assemblies (29 and 30).
17. Check brake hydraulic system for leaks.



A C-CLAMP
14 HOUSING, REAR BRAKE CALIPER
17 BRACKET, REAR BRAKE CALIPER ANCHOR

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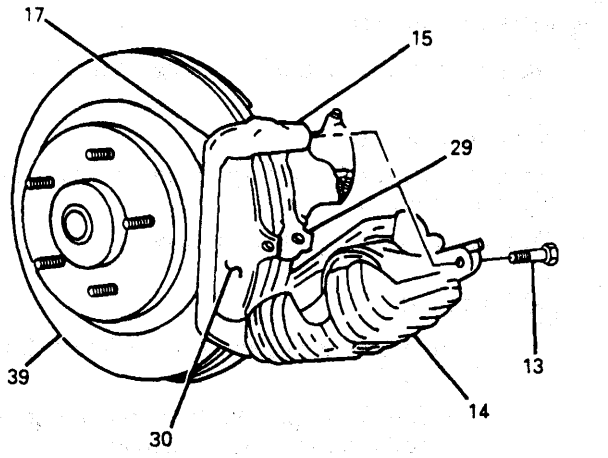
Figure 7 – Compressing Rear Brake Caliper Piston

REAR DISC BRAKE INNER AND OUTER PAD ASSEMBLIES

Figures 3, 7 and 8

Remove or Disconnect

1. Two-thirds of brake fluid from master cylinder reservoir.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Tire and wheel assembly. Refer to SECTION 3E.
    - Install wheel nuts to retain rotor assembly.
4. Position a C-clamp and tighten until piston (19) bottoms in base of caliper housing (14).
    - Make sure one end of C-clamp rests on brake hose fitting bolt/screw (32) and other end against outer pad assembly (30).



13 BOLT/SCREW, UPPER CALIPER GUIDE PIN,
14 HOUSING, REAR BRAKE CALIPER
15 PIN, REAR BRAKE CALIPER GUIDE
17 BRACKET, REAR BRAKE CALIPER ANCHOR
29 PAD ASSEMBLY, REAR DISC BRAKE INNER
30 PAD ASSEMBLY, REAR DISC BRAKE OUTER
39 ROTOR ASSEMBLY, REAR BRAKE

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Figure 8 – Rear Disc Brake Inner and Outer Pad Assembly Replacement

Important

- It is not necessary to remove the actuator lever return spring (4) to replace the inner and outer pad assemblies (29 and 30).

5. Upper caliper guide pin bolt/screw (13).
   - Discard upper caliper guide pin bolt/screw (13).
6. Inner and outer pad assemblies (29 and 30).
   A. Rotate caliper housing (14) about lower caliper guide pin bolt/screw (9) and guide pin (15). Be careful not to strain hose or cable conduit.
   B. Lift out inner and outer pad assemblies (29 and 30).
7. Shim (10).
   - Discard shim (10).

Clean

- All residue from shoe guide surfaces on anchor bracket (17) and caliper housing (14).

Inspect

- Guide pins (15) for free movement in anchor bracket (17).
- Rear brake caliper guide pin boot (16) for proper seating in retaining groove of guide pin (15) and rear anchor bracket (17).
  - Replace guide pins (15) or guide pin boots (16) if corroded or damaged. Refer to "Rear Brake Caliper Assembly" in this section.

Install or Connect

NOTICE: See "Notice" on page 5B2-1 of this section.

1. New shim (10).
2. New inner and outer pad assemblies (29 and 30).

Important

- Whenever rear disc brake inner and outer pad assemblies are replaced, immediately check the parking brake free-travel. Adjust as necessary. Refer to "Parking Brake Free-Travel Adjustment" in this section.

A. Outer pad assembly (30) with insulator is installed toward caliper housing (14). Inner pad assembly (29) with wear sensor is installed nearest the piston (19).

B. Wear sensor must be on leading edge of inner pad assembly (29) with forward wheel rotation. If not, use other inner pad assembly (29) in replacement kit.

C. Replace inner and outer pad assemblies (29 and 30) in axle sets only.

3. Rotate caliper housing (14) into its operating position.
   - Springs on outer pad assembly (30) must not stick through inspection hole in caliper housing (14). If springs are sticking through inspection hole in caliper housing (14), lift caliper housing (14) and reposition outer pad assembly (30).
4. New upper caliper guide pin bolt/screw (13).

Tighten

- Upper caliper guide pin bolt/screw (13) to 37 N•m (27 lb. ft.).

Inspect

- Rear brake caliper guide pin boot (16) for proper seating in retaining groove of guide pin (15) and rear anchor bracket (17).

5. With engine running, pump brake pedal assembly slowly and firmly to seat inner and outer pad assemblies (29 and 30).

Inspect

- Parking brake actuator levers (5) to ensure they are against stops on caliper housing (14).
  - If parking brake actuator levers are not on their stops, refer to SECTION 5F for parking brake linkage repairs.

6. Tire and wheel assembly. Refer to SECTION 3E.

- Remove wheel nuts securing rotor assembly (39).

7. Lower vehicle.
8. Fill master cylinder reservoirs. Refer to SECTION 5A.

REAR BRAKE CALIPER ANCHOR BRACKET AND MOUNTING PLATE

Figure 9

Remove or Disconnect

1. Caliper assembly. Refer to "Rear Brake Caliper Assembly" under "On-Vehicle Service" in this section.

Important

- Remove anchor bracket (17) only if it is damaged or if rotor assembly (39) is being removed for refinishing or other service operations.

2. Two mounting plate bolts/screws (36).
   - Discard mounting plate bolts/screws (36).
3. Anchor bracket (17) from mounting plate (38).

Install or Connect

NOTICE: See "Notice" on page 5B2-1 of this section.

1. Anchor bracket (17) to mounting plate (38).
2. Two new mounting plate bolts/screws (36).

Tighten

- Mounting plate bolts/screws (36) to 100 N•m (74 lb. ft.).
  - Check torque on both mounting plate bolts/screws (36) immediately.

3. Caliper assembly. Refer to "Rear Brake Caliper Assembly" under "On-Vehicle Service" in this section.

REAR BRAKE ROTOR ASSEMBLY

Figure 9

Rear brake rotor assembly can be removed without removal of caliper assembly from anchor bracket.

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Tire and wheel assembly. Refer to SECTION 3E.
3. Two mounting plate bolts/screws (36).
   - Discard mounting plate bolts/screws (36).
4. Anchor bracket (17) with assembled caliper assembly from mounting plate (38) and suspend them from rear suspension out of the way using locally fabricated wire hook.
5. Rotor assembly (39).

Install or Connect

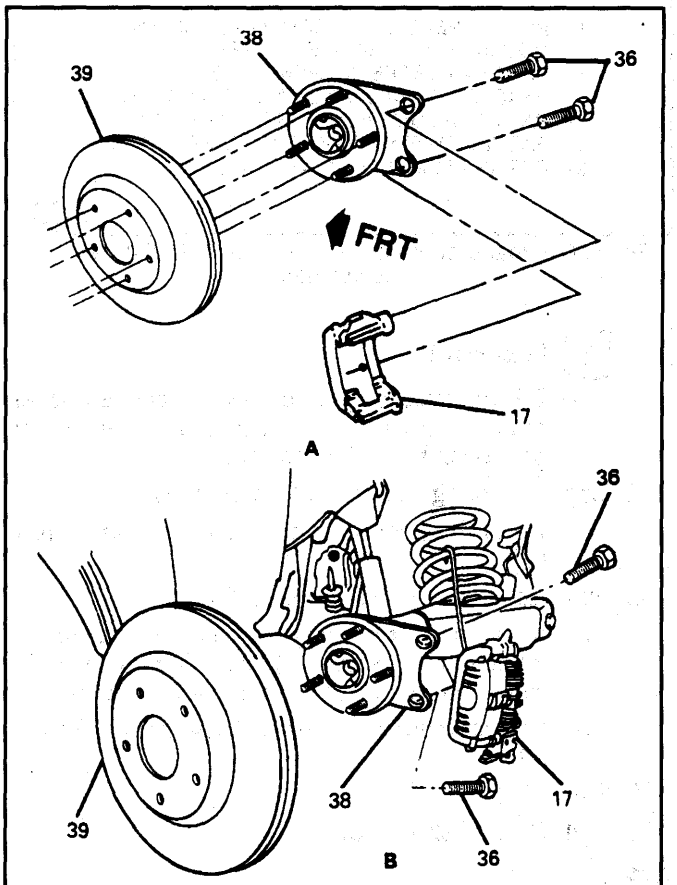
NOTICE: See "Notice" on page 5B2-1 of this section.

1. Rotor assembly (39).
2. Anchor bracket (17) with assembled caliper assembly to mounting plate (38).
3. Two new mounting plate bolts/screws (36).

Tighten

- Mounting plate bolts/screws (36) to 100 N•m (74 lb. ft.).
  - Check torque on both mounting plate bolts/screws (39) immediately.

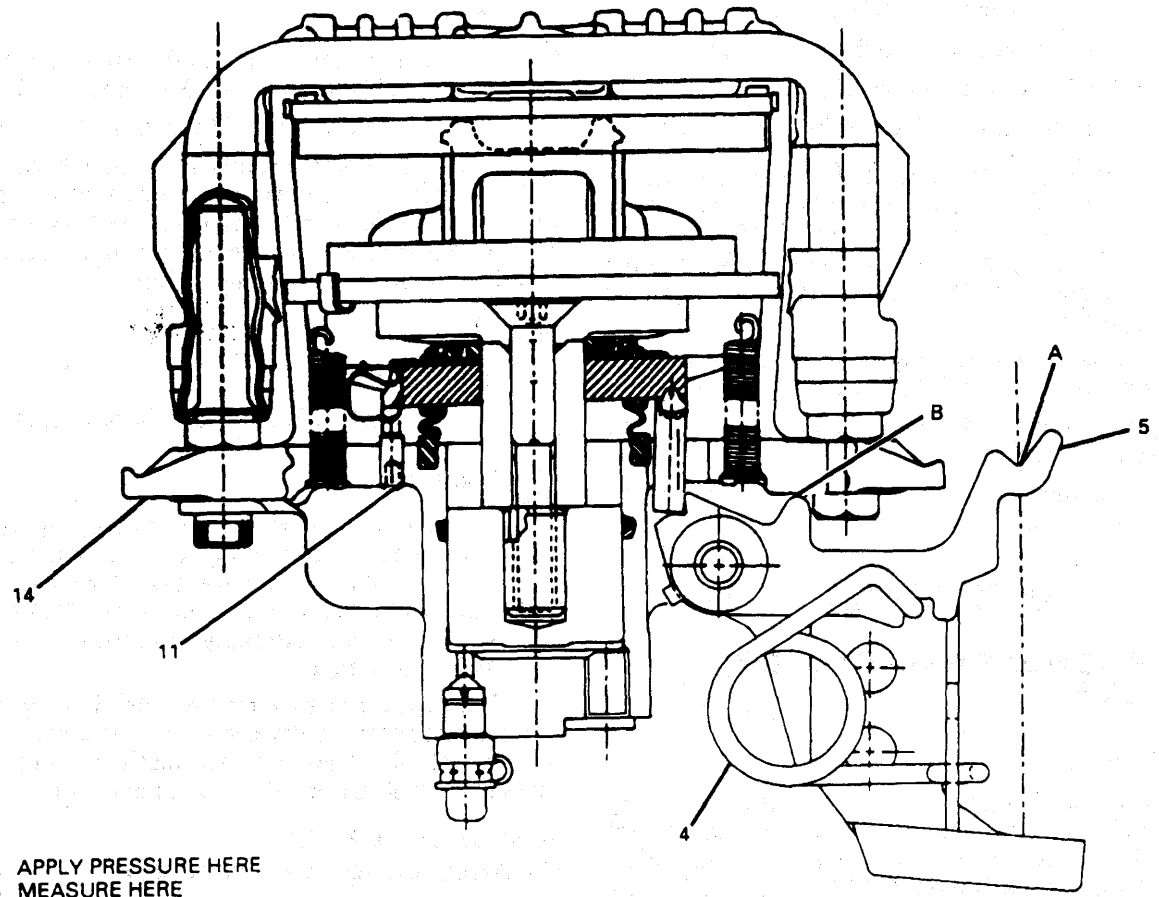
4. Tire and wheel assembly. Refer to SECTION 3E.
5. Lower vehicle.



A CALIPER ASSEMBLY REMOVED FROM ANCHOR BRACKET
B CALIPER ASSEMBLY AND ANCHOR BRACKET ASSEMBLED
17 BRACKET, REAR BRAKE CALIPER ANCHOR
36 BOLT/SCREW, REAR BRAKE CALIPER MOUNTING PLATE,
38 PLATE, REAR BRAKE CALIPER MOUNTING
39 ROTOR ASSEMBLY, REAR BRAKE

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Figure 9 – Rear Brake Rotor Assembly, Caliper Anchor Bracket, and Mounting Plate



A APPLY PRESSURE HERE
B MEASURE HERE
4 SPRING, REAR CALIPER PARKING BRAKE ACTUATOR LEVER RETURN
5 LEVER, REAR PARKING BRAKE ACTUATOR
11 SCREW, PARKING BRAKE LEVER ADJUSTER
14 HOUSING, REAR BRAKE CALIPER

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Figure 10 – Parking Brake Free-Travel Adjustment

PARKING BRAKE FREE-TRAVEL ADJUSTMENT

Figure 10

The adjustment process requires a second person to apply a light brake pedal load. Parking brake lever free-travel is set by the position of the adjuster screw (11). Turning the adjuster screw (11) clockwise increases the free-travel; turning the adjuster screw (11) counterclockwise decreases the free-travel.

NOTICE: Inner and outer pad assemblies must be new or parallel to within 0.15 mm (0.006 inch). Parking brake adjustment is not valid with heavily tapered pad assemblies and may cause caliper/parking brake binding.

Important

- Inspect old inner and outer pad assemblies and replace with new ones if they are tapered.
- Parking brake free-travel should only be changed if the caliper has been taken apart, or when the pad assemblies are replaced.
- This adjustment will not correct a condition where parking brake actuator levers will not return to their stops.

1. Disconnect parking brake cable assembly and remove actuator lever return spring (4).
2. Have an assistant apply light brake pedal load, enough to stop rotor from turning by hand.
   - This takes up all clearances and ensures that components are correctly aligned.
3. Apply light pressure to parking brake actuator lever (5).

Measure

- Free-travel between parking brake actuator lever (5) and caliper housing (14) at point B.

- Free-travel must be 0.61 mm to 0.71 mm (0.024 inch to 0.028 inch).

4. If free-travel is incorrect, do the following:
   A. Remove adjuster screw (11).
   B. Clean thread adhesive residue from threads.
   C. Coat threads with adhesive.
   D. Screw in adjuster screw (11) far enough to obtain 0.61 mm to 0.71 mm (0.024 inch to 0.028 inch) free-travel between parking brake actuator lever (5) and caliper housing (14) at point B.
5. Have assistant release brake pedal assembly, then apply brake pedal assembly firmly three times.
6. Recheck free-travel as described in steps 2 and 3 and adjust as necessary.
7. Install actuator lever return spring (4) and parking brake cable assembly

UNIT REPAIR

REFINISHING REAR BRAKE ROTOR ASSEMBLIES

Important

- DO NOT refinish rotor assemblies when performing routine brake maintenance such as replacing worn rear disc brake inner and outer pad assemblies. Refinish a rotor assembly ONLY under the following circumstances:
  - There is a complaint of brake pulsation.
  - There is scoring greater than 1.5 mm (0.06 inch).

All rotor assemblies have a minimum thickness dimension cast into them. This dimension is the minimum wear dimension and not a refinish dimension. The minimum refinish dimension is greater than the discard dimension. Do not use a rotor assembly that will not meet specifications. A rotor assembly that has been refinished too thin will not have proper heat transfer capabilities. Replace with a new rotor assembly. Refer to "Specifications" in this section.

Since accurate control of the rotor assembly tolerances is necessary for proper performance of the rear disc brakes, the rotor assembly should be machined only with precision equipment. Equipment should be serviced on a regular basis following the manufacturer's recommended maintenance procedure.

When refinishing rotor assemblies, the attaching adapters, tool holders, vibration dampeners and tool bits must be in good condition. Always use sharp cutting tools or bits and use only replacement cutting bits recommended by the equipment manufacturer. Dull or worn tools leave a poor surface finish which will affect braking performance. Vibration dampening attachments should always be used when refinishing braking surfaces. These attachments eliminate tool chatter and will result in better surface finish. Make sure these adapters are clean and free of nicks.

On-Vehicle

Tool Required:

On-Vehicle Brake Lathe, such as Kent-Moore J 37704 On Disc Brake Lathe

J 37160-A Brake Rotor Mounting Adapter

In the cases where rotors are being refinished to correct a problem with brake pulsation, it is recommended that an on-vehicle brake lathe be used to achieve best results. Follow the equipment manufacturer's recommended specifications and procedure.

Off-Vehicle

Tool Required:

J 37160-A Brake Rotor Mounting Adapter

Important

- Remove rust and scale from rotor assembly and rear axle shaft flange mating surfaces. Failure to do so may introduce excessive lateral runout when the rotor assembly is mounted on the brake lathe, or when the rotor assembly is reinstalled on the rear axle shaft flange.

Following are two recommended procedures that achieve adequate results using two different off-vehicle drum/disc brake lathes. (If any other lathe is used, follow that lathe's instructions and recommendations.)

Ammco Brake Lathe (Two-cut refinishing procedure)

	ROUGH CUT	FINISH CUT
Spindle Speed	150 rpm	150 rpm
Depth of Cut (per side)	0.15 mm to 0.64 mm (0.006 inch to 0.025 inch)	0.10 mm to 0.15 mm (0.004 inch to 0.006 inch)
Tool Cross Feed (per rev.)	0.25 mm (0.010 inch)	0.05 mm (0.002 inch)
Vibration Dampener	Yes	Yes
Sand Rear Brake Rotor Assembly (Swirl Pattern)	No	Yes

Accuturn Brake Lathe, GM Dealer Equipment (One-cut refinishing procedure)

Locate the deepest score and turn the rotor micrometer knob until the tool bit bottoms out at the deepest point of the score. Zero the scale and back out the tool bit (repeat for opposite side of rotor). Advance the cutter handwheel until the bits have cleared the inner edges of the rotor face. Adjust the micrometer knobs for approximately 0.13 mm (0.005 inch) more than the first reading. This will ensure resurfacing the rotor in one cut.

Spindle Speed	105 rpm
Depth of Cut	As necessary
Tool Cross Feed (per revolution)	0.08 mm (0.003 inch)
Tool Bit Nose Radius	1/64
Vibration Dampener	Yes

Non-Directional Finishing

It is very important that the rotor surface be made non-directional by dressing the rotor surfaces with a sanding disc tool such as Ammco 8750 Safe Swirl Disc Rotor Grinder, Accuturn 433179 Non-Directional Swirl Finisher, or equivalent, using 120 grit aluminum oxide sandpaper. Sand each rotor surface with moderate pressure for a minimum of 60 seconds. If the brake lathe is not equipped with an adequate non-directional finishing tool, an alternate method is to use a sanding block with 150 grit aluminum oxide sandpaper. With the rotor turning at the equipment manufacturer's highest recommended cutting speed, sand each rotor surface for a minimum of 60 seconds using moderate pressure. **After the rotor has been sanded, clean each surface with denatured alcohol or a suitable brake cleaner.**

The finished rotor assembly surface should be as close to that of a new rear brake rotor assembly as possible. Failure to obtain the best possible finish may affect braking performance.

Important

- Rear brake rotor assemblies should always be replaced if turning will result in a rear brake rotor assembly that does not meet manufacturer specifications for minimum thickness. When installing new brake rotor assemblies, do not refinish the surfaces of these parts. New brake rotor assemblies have the correct level of surface finish.

Burnishing Rear Brake Rotor Assemblies

After rear brake pad assemblies have been replaced, it is very important that the new braking surface be broken in, or burnished. In addition, light corrosion on the rotors can be removed by burnishing the new parking brake surface. This can be accomplished by making 20 stops from 48 km/h (30 mph), using medium to firm brake pedal assembly pressure. Allow 0.8 km (0.5 mile) to 1.6 km (1.0 mile) between stops to avoid overheating the brakes.

REAR BRAKE CALIPER ASSEMBLY

Figures 3, 11 and 12

Disassemble

1. Remove caliper assembly. Refer to "Rear Brake Caliper Assembly" under "On-Vehicle Service" in this section.
2. Two collar return springs (26) from actuating collar boot retainer (31).
3. Actuating collar (24) with assembled parts.
   - Firmly but gently pull actuating collar (24) with assembled parts out of caliper housing (14) by pulling on both ends of actuating collar boot retainer (31).
4. Clamp rod (28) and bushing (27) from actuating collar (24).
   - Discard bushing (27).

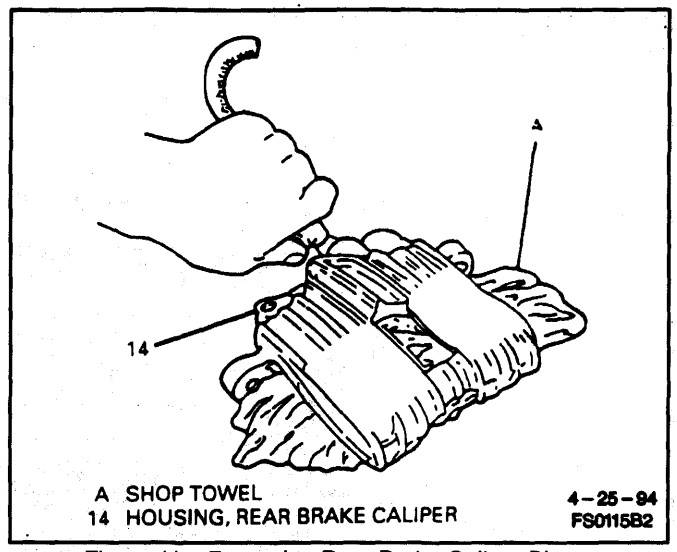


Figure 11 – Removing Rear Brake Caliper Piston

5. Actuating collar boot retainers (21 and 31), actuating collar boots (20 and 25) and pushrod (22) from actuating collar (24).
   A. Bend back actuating collar boot retainer tabs and take apart.
   B. Remove preload spring (23) from actuating collar boot retainer (21).
   C. Remove pushrod (22) from actuating collar boot retainer (21).
   D. Remove and discard actuating collar boot retainers (21 and 31) and actuating collar boots (20 and 25).

CAUTION: Do not place fingers in front of the piston in an attempt to catch or protect it when applying compressed air. The piston can fly out with force and could result in serious injury.

Important

- Use clean shop towels to pad the inside of the caliper housing (14) during rear brake caliper piston removal.

NOTICE: To prevent damage, be careful when handling rear brake caliper piston.

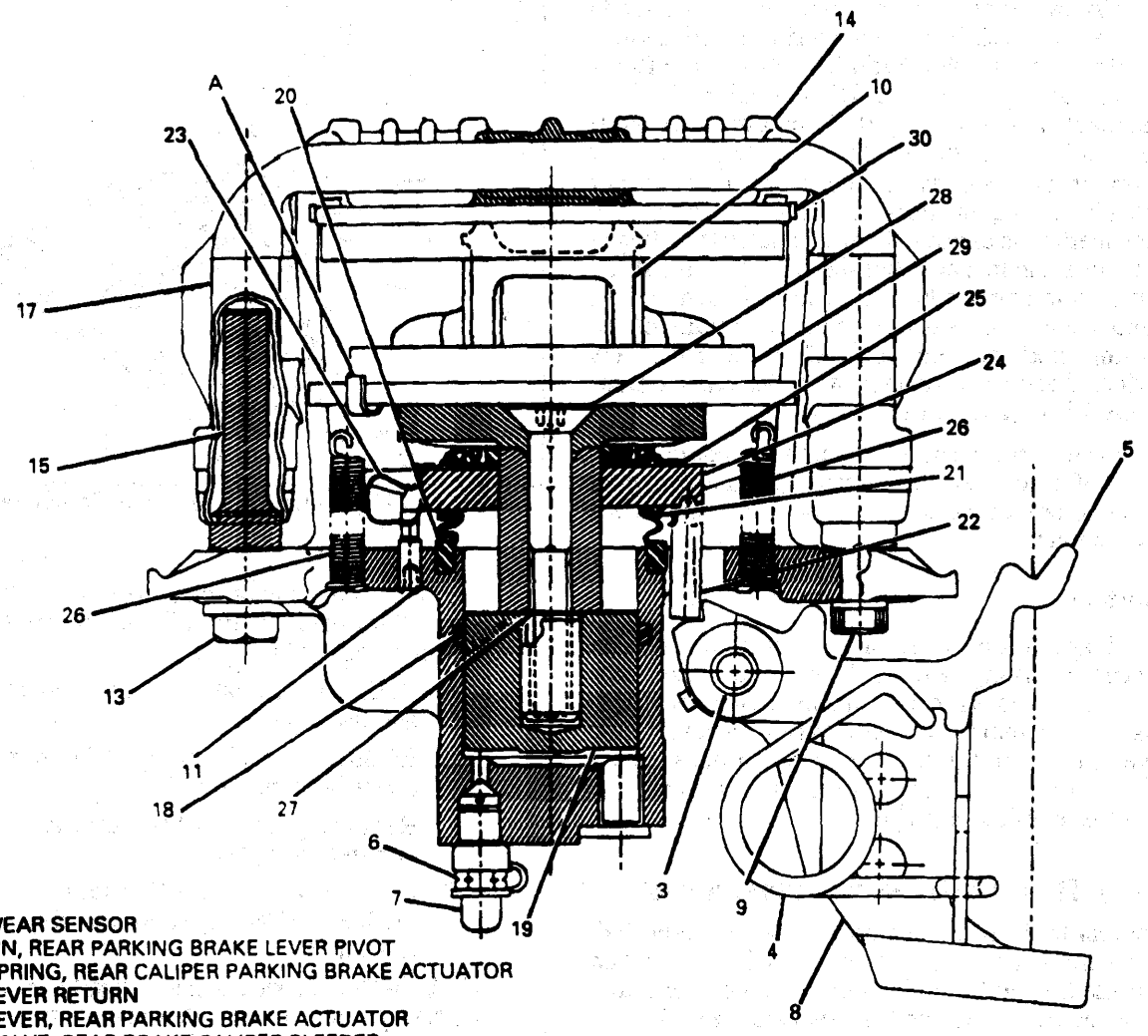
6. Piston (19) by directing dry, filtered compressed air into brake hose port of caliper housing (14).

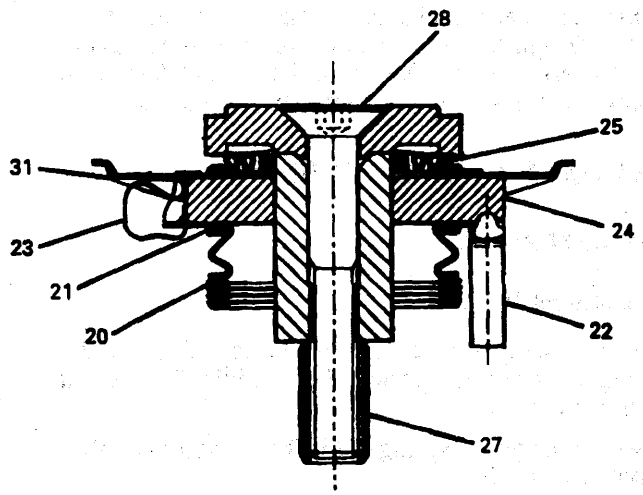
Inspect

- Piston (19) for scoring, nicks, corrosion and wear.
  - Replace piston (19) if necessary.

NOTICE: Do not use a metal tool to remove piston seal. Metal tools may damage the caliper housing bore or the piston seal groove.

7. Piston seal (18).
   - Use small wood or plastic tool.
8. Bleeder valve cap (7) and bleeder valve (6).





A WEAR SENSOR
3 PIN, REAR PARKING BRAKE LEVER PIVOT
4 SPRING, REAR CALIPER PARKING BRAKE ACTUATOR LEVER RETURN
5 LEVER, REAR PARKING BRAKE ACTUATOR
6 VALVE, REAR BRAKE CALIPER BLEEDER,
7 CAP, REAR BRAKE CALIPER BLEEDER VALVE
8 BRACKET, PARKING BRAKE CABLE
9 BOLT/SCREW, LOWER CALIPER GUIDE PIN,
10 SHIM
11 SCREW, PARKING BRAKE LEVER ADJUSTER
13 BOLT/SCREW, UPPER CALIPER GUIDE PIN,
14 HOUSING, REAR BRAKE CALIPER
15 PIN, REAR BRAKE CALIPER GUIDE
17 BRACKET, REAR BRAKE CALIPER ANCHOR
18 SEAL, REAR BRAKE CALIPER PISTON
19 PISTON, REAR BRAKE CALIPER
20 BOOT, ACTUATING COLLAR
21 RETAINER, ACTUATING COLLAR BOOT
22 PUSHROD
23 SPRING, PRELOAD
24 COLLAR, ACTUATING
25 BOOT, ACTUATING COLLAR
26 SPRING, REAR CALIPER PARKING BRAKE COLLAR RETURN
27 BUSHING
28 ROD, CLAMP
29 PAD ASSEMBLY, REAR DISC BRAKE INNER
30 PAD ASSEMBLY, REAR DISC BRAKE OUTER
31 RETAINER, ACTUATING COLLAR BOOT

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Figure 12 – Rear Brake Caliper Assembly – Cutaway View

- Discard bleeder valve cap (7).

9. Parking brake lever pivot pin seal (1), sprag clip (2), actuator lever return spring (4) and parking brake actuator lever (5) from parking brake lever pivot pin (3).
   - Discard sprag clip (2).

Inspect

- Contact points on parking brake actuator lever (5) and parking brake lever pivot pin (3) for wear and corrosion.
  - Replace if necessary.

10. Parking brake lever pivot pin (3) and pivot pin nut (12), if worn.
11. Adjuster screw (11) from caliper housing (14).
    - Discard if damaged or worn.

Inspect

- Caliper anchor bracket (17) for wear and damage.
  - Replace if necessary. Refer to "Rear Brake Caliper Anchor Bracket and Mounting Plate" in this section.

Clean

- Pad assembly contact area on anchor bracket (17).

12. Two guide pins (15) and guide pin boots (16) from anchor bracket (17).

Clean

1. All parts not included in repair kit in denatured alcohol.
2. Use dry, filtered compressed air to dry parts.
3. Blow out all passages in caliper housing (14) and bleeder valve (6).

Inspect

- Caliper housing bore for scoring and corrosion. Replace caliper housing (14) if badly scored or corroded around seal area.

Assemble

NOTICE: See "Notice" on page 5B2-1 of this section.

1. Lubricate new piston seal (18) and caliper housing bore seal groove with silicone grease or clean brake fluid.
2. New piston seal (18) into caliper housing seal groove.
   - Make sure piston seal (18) is not twisted.
3. Lubricate bore of caliper housing (14) and piston (19) with clean brake fluid.
4. Piston (19) into bore of caliper housing (14).
   - Push down by hand to bottom of bore.

Inspect

- Actuating collar (24) and clamp rod (28) for corrosion and excessive wear on working faces.
  - If corrosion or excessive wear is present, replace actuating collar assembly.

5. Pushrod (22), new inner and outer actuating collar boots (20 and 25) and new actuating collar boot retainers (21 and 31) to actuating collar (24).
   A. Lightly coat actuating collar (24) with liquid lubricant provided in repair kit. Do not use any other fluid or grease.
   B. Install preload spring (23) into new actuating collar boot retainer (21).
   C. Install new inner and outer actuating collar boots (20 and 25) into new actuating collar boot retainers (21 and 31).
   D. Install pushrod (22) to new actuating collar boot retainer (21).
   E. Clamp new actuating collar boot retainers (21 and 31) firmly against actuating collar (24).
   F. Bend tabs on new actuating collar boot retainer (21) to hold actuating collar assembly together.
6. Clamp rod (28) to actuating collar (24) and actuating collar boot (25).
   A. Lightly coat clamp rod (28) with liquid lubricant provided in repair kit.
   B. Slide clamp rod (28) through holes in actuating collar boot (25) and actuating collar (24).
   C. Actuating collar boot (25) must be against reaction plate on clamp rod (28).
7. New bushing (27) to clamp rod (28).
   - Lubricate outside of bushing (27) with provided lubricant.
8. Clamp rod (28) with assembled parts into connecting hole in piston (19).
   A. Lubricate grooved bead of actuating collar boot (20) and boot groove in caliper housing (14) with provided lubricant. Use remaining liquid lubricant to coat actuating collar (24), especially around center hole.
   B. Push clamp rod (28) firmly to bottom of connecting hole in piston (19).
   C. Pull on actuating collar (24) and seat actuating collar boot (20) into boot groove in caliper housing (14).
   D. Make sure that pushrod (22) enters hole in caliper housing (14).
9. Two collar return springs (26) to actuating collar boot retainer (31).
   - Actuating collar boot retainer (31) must enter collar return springs (26) at end of second spring coil.
10. New bleeder valve cap (7) and bleeder valve (6) into caliper housing (14).

Tighten

- Bleeder valve (6) to 11 N•m (97 lb. in.).

11. Parking brake lever pivot pin (3) and new pivot pin nut (12) to caliper housing (14), if removed.

Tighten

- Pivot pin nut (12) to 22 N•m (16 lb. ft.).

12. Lubricate parking brake actuator lever (5) and parking brake lever pivot pin (3) with grease provided in repair kit.
13. Pivot pin seal (1), parking brake actuator lever (5), new sprag clip (2) and actuator lever return spring (4), in that order.
    A. Teeth of sprag clip (2) must face away from parking brake actuator lever (5).
    B. Snap pivot pin seal cap over parking brake lever pivot pin (3).
14. Adjuster screw (11) into caliper housing (14) until actuating collar (24) is about parallel to piston bore face of caliper housing (14).
15. New guide pin boots (16) and guide pins (15).
    A. Lubricate two guide pins (15) with grease provided in repair kit.
    B. Slide guide pin boots (16) on guide pins (15).
    C. Fill guide pin boots (16) with provided grease.
    D. Assemble to anchor bracket (17).
    E. Make sure guide pin boots (16) fit into grooves of guide pins (15) and anchor bracket (17).
16. Install caliper assembly. Refer to "Rear Brake Caliper Assembly" under "On-Vehicle Service" in this section.

SPECIFICATIONS

GENERAL SPECIFICATIONS

Rear Brake Caliper Assembly	
Rear Brake Caliper Housing Bore Diameter (Nominal)	40.50 mm (1.595″)
Rear Brake Rotor Assembly	
Rotor Diameter (Nominal)	293.00 mm (11.535″)
Lateral Runout	
Rear Brake Rotor Assembly (On-Vehicle Condition)	0.15 mm (0.006″)
Rear Axle Shaft Flange	0.05 mm (0.002″)
Thickness Variation	0.013 mm (0.0005″)
Rotor Thickness (Maximum)	20.00 mm (0.787″)
Minimum Thickness After Refinish	18.63 mm (0.733″)
Discard Thickness	18.40 mm (0.724″)

All rear brake rotor assemblies have a discard dimension cast into them. This is a wear dimension and not a refinish dimension. Any rear brake rotor assembly which does not meet the specifications should be replaced.

ROTOR REFINISHING SPECIFICATIONS

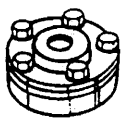
Ammco Brake Lathe	
Rough Cut	
Spindle Speed	150 rpm
Depth of Cut (Per Side)	0.15 mm to 0.64 mm (0.006″ to 0.025″)
Tool Crossfeed (Per Revolution)	0.25 mm (0.010″)
Vibration Dampener	Yes
Sand Front Brake Rotor Assembly (Swirl Pattern)	No
Finish Cut	
Spindle Speed	150 rpm
Depth of Cut (Per Side)	0.10 mm to 0.15 mm (0.004″ to 0.006″)
Tool Crossfeed (Per Revolution)	0.05 mm (0.002″)
Vibration Dampener	Yes
Sand Front Brake Rotor Assembly (Swirl Pattern)	Yes
Accuturn Brake Lathe	
Spindle Speed	105 rpm
Depth of Cut	As necessary
Tool Crossfeed (Per Revolution)	0.08 mm (0.003″)
Vibration Dampener	Yes

FASTENER TIGHTENING SPECIFICATIONS

Lower Caliper Guide Pin Bolt/Screw	37 N•m (27 lb. ft.)
Rear Brake Caliper Bleeder Valve	11 N•m (97 lb. in.)
Rear Brake Caliper Mounting Plate Bolt/Screw	100 N•m (74 lb. ft.)
Rear Brake Hose Fitting Bolt/Screw	44 N•m (33 lb. ft.)
Rear Brake Vibration Dampener Nut	50 N•m (37 lb. ft.)
Rear Parking Brake Lever Pivot Pin Nut	22 N•m (16 lb. ft.)
Upper Caliper Guide Pin Bolt/Screw	37 N•m (27 lb. ft.)

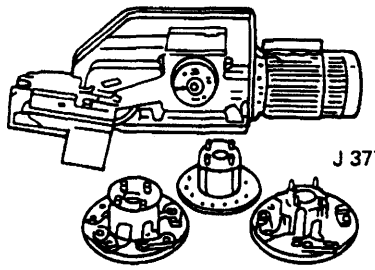
SPECIAL TOOLS

1.



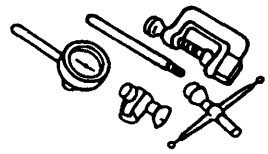
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2.



J 37704

3.



J 8001

1. BRAKE ROTOR MOUNTING ADAPTER
2. ON DISC BRAKE LATHE
3. DIAL INDICATOR SET

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BLANK

SECTION 5C2

DUO-SERVO DRUM BRAKES

CAUTION: When servicing brake parts, do not create dust by grinding, sanding brake linings or by cleaning brake parts with a dry brush or compressed air. Many brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm. A water dampened cloth or water based solution should be used to remove any dust on brake parts. Equipment is commercially available to perform this washing function. These wet methods will prevent asbestos fibers from becoming airborne.

CAUTION: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- **Eye contact – rinse thoroughly with water.**
- **Skin contact – wash with soap and water.**

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen damage.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

The rear drum brake assembly is a duo-servo design. In the duo-servo brake, the force which the rear wheel cylinder applies to the primary shoe is multiplied by the primary lining friction to provide a very large force applied to the secondary shoe. Adjustment for both the primary and secondary shoe and lining assemblies is automatic during reverse brake applications.

The rear brake drum assembly has a honed friction surface that reduces shoe slap, increases lining life, and reduces the break-in time.

DIAGNOSIS

PRIMARY AND SECONDARY SHOES INSPECTION

When the thickness of any lining is worn within 0.76 mm (0.030 inch) of the primary or secondary shoe, the primary and secondary shoes must be replaced. Replace shoes in axle sets only.

DRUM ASSEMBLY INSPECTION

Pulsation in the brake pedal assembly is usually corrected by servicing the front brakes. Service the rear brakes only if the problem persists.

To determine if the front or rear brakes are at fault, drive the vehicle in an area away from people and moving

traffic (such as a large parking lot), and at a slow speed. Lightly apply the parking brake assembly, and feel for the pulsation. Be careful not to lock the brakes and flat-spot the rear tires. If the pulsation is not noticed, the fault is probably in the front brakes.

When drum assemblies are removed, thoroughly clean and inspect them for cracks, scores, deep grooves, out-of-round and taper.

Surface Finish

Normal light scoring of the drum assembly surfaces not exceeding 0.51 mm (0.020 inch) in depth will not affect brake operation.

Inside Diameter Check

The nominal inside diameter of the drum assembly is 241.30 mm (9.500 inches).

Out-of-Round or Taper Check

An out-of-round or tapered drum assembly makes accurate primary or secondary shoe adjustment impossible and is likely to cause excessive wear of other parts of brake mechanism due to its eccentric action. An out-of-round drum assembly can also cause severe and irregular tire tread wear as well as a pulsating brake pedal assembly. When the drum assembly exceeds the specification limits in taper and/or out-of-round, refinish drum assembly to true up the braking surface. Out-of-round as well as taper and wear can be accurately measured with an inside micrometer fitted with proper extension rods.

When measuring a drum assembly for out-of-round, taper, and wear, take measurements at the open and closed edges of machined surface and at right angles (90 degrees) to each other.

Runout Check

Runout for drum assemblies is not to exceed 0.15 mm (0.006 inch).

Balance

During manufacture, weights are used to balance drum assemblies. These weights must not be removed.

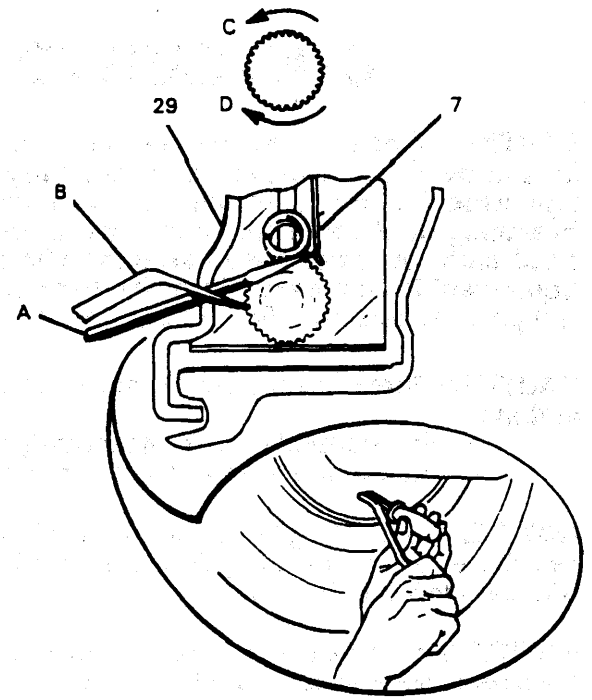
After drum assemblies have been refinished or if difficulty is experienced in maintaining proper wheel balance, drum assemblies should be checked for balance. Drum assemblies may be checked for balance on most off-the-vehicle wheel balancers.

ON-VEHICLE SERVICE

NOTICE: Do not use lubricated shop air on brake parts as damage to rubber components may result.

Important

- Replace all components included in repair kits used to service this drum brake.
- Lubricate parts as specified.



A SCREWDRIVER USED ONLY WHEN BACKING OFF ADJUSTMENT
B BRAKE ADJUSTING TOOL
C STAR WHEEL ROTATION TO RETRACT REAR BRAKE SHOES
D STAR WHEEL ROTATION TO EXPAND REAR BRAKE SHOES
7 ACTUATOR, REAR BRAKE SHOE ADJUST
29 PLATE, REAR BRAKE BACKING

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Figure 1 – Backing Off Rear Brake Shoe Adjustment

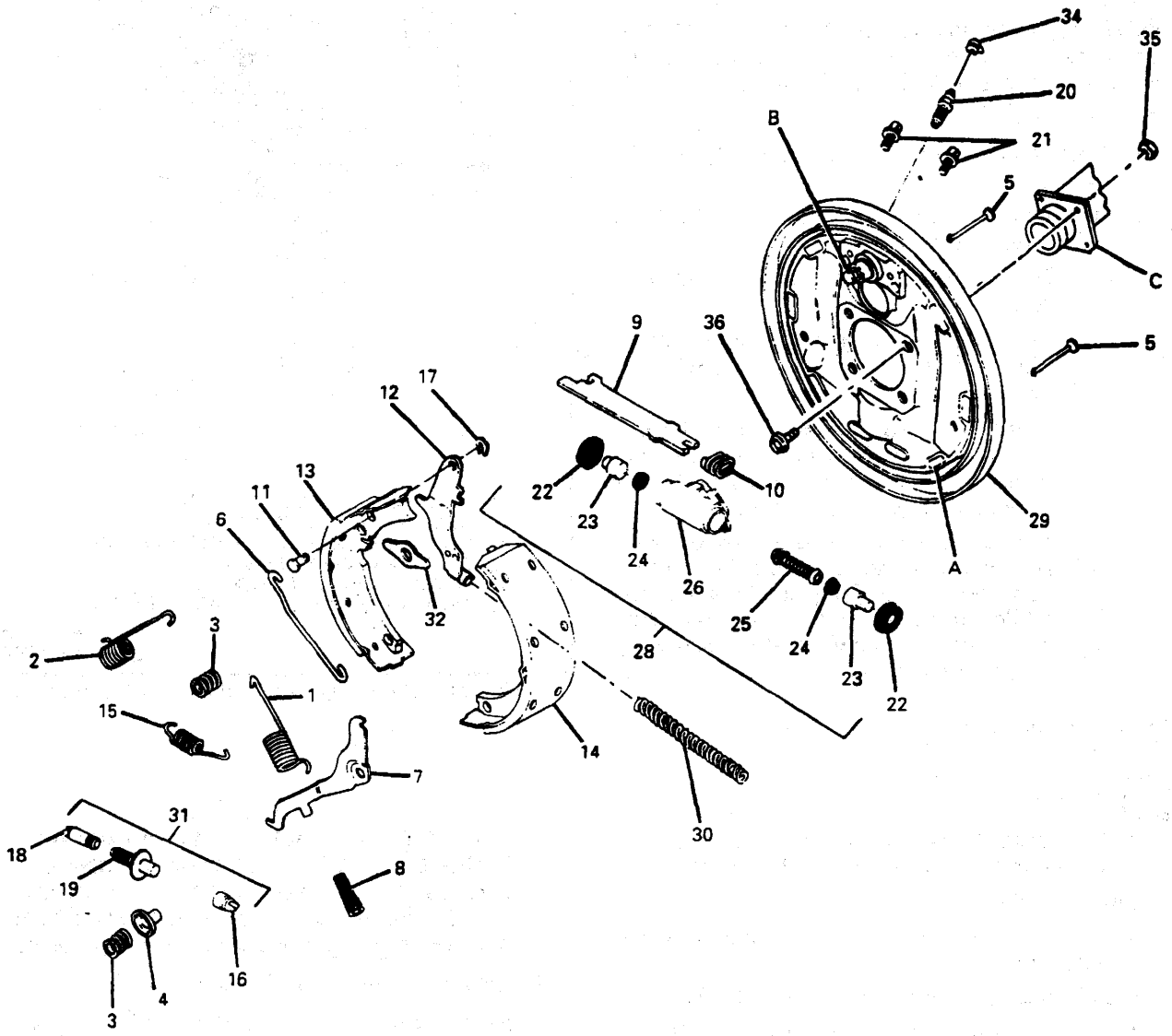
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- Replace shoe and lining assemblies in axle sets only.
- The torque values specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench, free from all mineral oil materials.

DRUM ASSEMBLY

Figure 1

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Tire and wheel assembly. Refer to SECTION 3E.
   - Mark relationship of wheel to axle flange.



A SHOE PAD
B ANCHOR PIN
C REAR AXLE ASSEMBLY FLANGE
1 SPRING, REAR BRAKE SHOE RETURN
2 SPRING, REAR BRAKE SHOE RETURN
3 SPRING, REAR BRAKE SHOE HOLD-DOWN
4 PIVOT, REAR BRAKE SHOE ADJUST ACTUATOR
5 PIN, REAR BRAKE SHOE
6 LINK, REAR BRAKE SHOE ADJUST ACTUATOR
7 ACTUATOR, REAR BRAKE SHOE ADJUST
8 SPRING, REAR BRAKE SHOE ADJUST ACTUATOR RETURN
9 STRUT, REAR PARKING BRAKE LEVER
10 SPRING, REAR PARKING BRAKE LEVER STRUT
11 PIN, REAR PARKING BRAKE LEVER PIVOT
12 LEVER ASSEMBLY, REAR PARKING BRAKE
13 SHOE, REAR BRAKE PRIMARY
14 SHOE, REAR BRAKE SECONDARY
15 SPRING, REAR BRAKE SHOE ADJUST
16 SOCKET, REAR BRAKE SHOE ADJUST
17 RING, REAR PARKING BRAKE LEVER RETAINER
18 NUT, REAR BRAKE SHOE ADJUST
19 ADJUSTER, REAR BRAKE SHOE
20 VALVE, REAR BRAKE BLEEDER
21 BOLT/SCREW, REAR WHEEL CYLINDER,
22 BOOT, REAR WHEEL CYLINDER PISTON
23 PISTON, REAR WHEEL CYLINDER
24 SEAL, REAR WHEEL CYLINDER PISTON
25 SPRING, REAR WHEEL CYLINDER PISTON
26 BODY, REAR WHEEL CYLINDER
28 CYLINDER, REAR WHEEL
29 PLATE, REAR BRAKE BACKING
30 SPRING, PARKING BRAKE CABLE RETURN
31 ADJUSTER ASSEMBLY, REAR BRAKE SHOE
32 GUIDE, REAR BRAKE SHOE
34 CAP, BLEEDER VALVE
35 NUT, REAR BRAKE BACKING PLATE
36 BOLT/SCREW, REAR BRAKE BACKING PLATE

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Figure 2 – Rear Brake Assembly Components

NOTICE: Be careful not to drop the brake drum assemblies during handling. Out-of-round can occur from even the smallest fall, resulting in brake pulsation.

NOTICE: Do not pry against the splash shield that surrounds the backing plate in an attempt to free the drum assembly. This will bend the splash shield.

3. Drum assembly.
   A. Mark relationship of drum assembly to axle flange.
   B. If you have trouble removing rear brake drum assembly, try the following:
      a. Make sure parking brake assembly is released.
      b. Disconnect parking brake cable assemblies from equalizer. Refer to SECTION 5F.
      c. Remove adjusting hole cover or knockout plate from backing plate (29) and back off adjusting screw, using screwdriver and brake adjusting tool.
      d. Use rubber mallet to tap gently on outer rim of drum and/or around inner drum diameter by axle flange and/or axle pilot, while pulling outward on drum assembly. Take care not to deform drum assembly by excessive use of force.

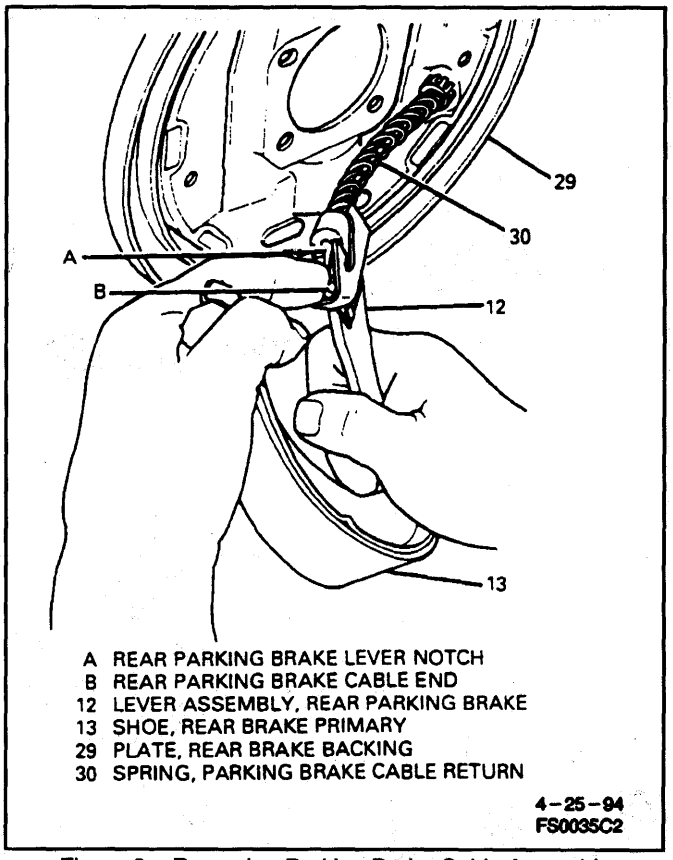


Figure 3 – Removing Parking Brake Cable Assembly

Install or Connect

Adjust

- Rear drum brake assemblies. Refer to "Rear Drum Brake Adjustment" in this section.

1. Drum assembly.
   - Align locating marks on drum assembly and axle flange.
2. Tire and wheel assembly. Refer to SECTION 3E.
   - Align locating marks on wheel and axle flange.
   - If knockout plate was removed, an adjusting hole cover, GM P/N 5464803 must be installed.
   - If parking brake cable assemblies were disconnected from equalizer, install to equalizer.
3. Lower vehicle.
4. Cycle parking brake lever assembly three times.

PRIMARY AND SECONDARY SHOES

Figures 2 through 4

Tools Required:

J 8049 Brake Spring Remover and Installer

J 8057 Brake Spring Pliers

Remove or Disconnect

1. Drum assembly. Refer to "Drum Assembly" under "On-Vehicle Service" in this section.

CAUTION: Keep fingers away from rear brake shoe return springs to prevent fingers from being pinched between rear brake shoe return spring and shoe web or return spring and backing plate.

2. Return springs (1 and 2) using J 8049.
3. Hold-down springs (3) and pins (5) using suitable pliers.
4. Actuator pivot (4).
5. Actuator link (6) while lifting up on actuator (7).
6. Actuator (7) and actuator return spring (8).
7. Shoe guide (32), strut (9) and strut spring (10).
8. Primary shoe (13) and secondary shoe (14) from backing plate (29) and parking brake rear cable assembly.
9. Adjuster assembly (31) and spring (15).
10. Parking brake cable assembly from parking brake lever assembly (12) by pushing parking brake lever assembly (12) into parking brake cable return spring (30). Disengage cable end from parking brake lever assembly (12).
11. Primary shoe (13) with parking brake lever assembly (12) and parking brake cable return spring (30).
12. Parking brake lever assembly (12).

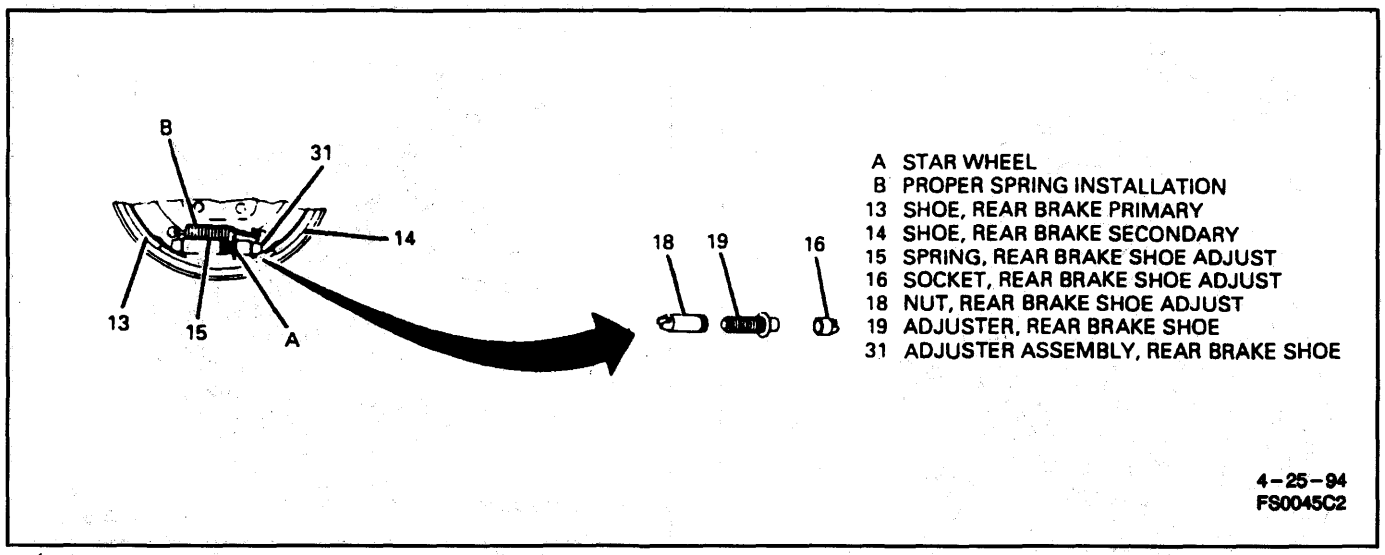


Figure 4 – Rear Brake Shoe Adjuster Assembly

A. Pry open retainer ring (17), remove and discard.
B. Push out pivot pin (11).

Clean

1. Adjuster assembly (31).
   A. Clean adjusting screw threads with wire brush.
   B. Wash all components in clean denatured alcohol.
   C. Apply brake lubricant, GM P/N 9985907 or equivalent, to adjuster threads, inside diameter of adjust socket (16) and adjust socket face.
      - Adequate lubrication is achieved when a continuous bead of lubricant is at open end of adjust nut (18) and adjust socket (16) when threads are fully engaged.
2. Backing plate (29) and lubricate contact surfaces with brake lubricant, GM P/N 9985907 or equivalent.

Inspect

1. Threads of adjuster (19) for smooth rotation over full length.
2. All parts.
   - If any parts are of doubtful strength or quality due to discoloration from heat, overstress, or wear, the parts should be replaced.

Install or Connect

NOTICE: See "Notice" on page 5C2-1 of this section.

1. Parking brake lever assembly (12).
   A. Insert pivot pin (11) through holes in primary shoe (13) and parking brake lever assembly (12).
   B. Install and crimp new retainer ring (17).
2. Parking brake cable assembly to parking brake lever assembly (12) by pulling back parking brake cable return spring (30). Engage cable end into parking brake lever assembly (12).
3. Adjuster assembly (31) and spring (15).
4. Primary shoe (13) and secondary shoe (14) to backing plate (29) and parking brake rear cable assembly.
5. Strut (9) and strut spring (10) by spreading primary shoe (13) and secondary shoe (14) apart. For proper positioning:
   A. Strut end without strut spring (10) engages parking brake lever assembly (12) and primary shoe (13) or secondary shoe (14).
   B. Strut end with strut spring (10) engages opposite primary shoe (13) or secondary shoe (14).
6. Shoe guide (32).
7. Actuator (7) and actuator return spring (8).
8. Pins (5), actuator pivot (4) and hold-down springs (3).
9. Actuator link (6) on anchor pin.
10. Actuator link (6) into actuator (7) while holding up on actuator (7).
11. Return springs (1 and 2) using J 8057.
12. Drum assembly. Refer to "Drum Assembly" under "On-Vehicle Service" in this section.

WHEEL CYLINDER

Figure 5

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.

Clean

- Dirt and foreign material around wheel cylinder (28) and rear brake rear pipe assembly.

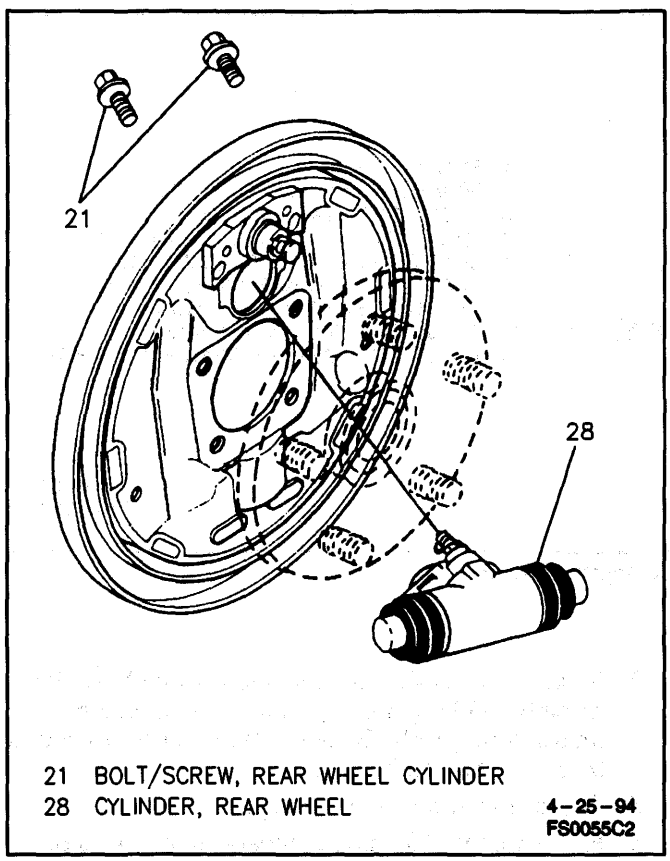


Figure 5 – Rear Wheel Cylinder

2. Primary and secondary shoes. Refer to "Primary and Secondary Shoes" in this section.
3. Brake pipe fitting and rear brake rear pipe assembly.
   - Plug opening in rear brake rear pipe assembly to prevent brake fluid loss and contamination.
4. Bolts/screws (21).
5. Wheel cylinder (28).

Install or Connect

NOTICE: See "Notice" on page 5C2-1 of this section.

1. Wheel cylinder (28).
   - Hold in place with wooden block between wheel cylinder (28) and axle flange.
2. Bolts/screws (21).

Tighten

- Bolts/screws (21) to 18 N•m (13 lb.ft.).

3. Rear brake rear pipe assembly.

Tighten

- Brake pipe fitting to 17 N•m (13 lb. ft.).

4. Primary and secondary shoes. Refer to "Primary and Secondary Shoes" in this section.
5. Lower vehicle.
6. Bleed brake hydraulic system. Refer to SECTION 5E1.

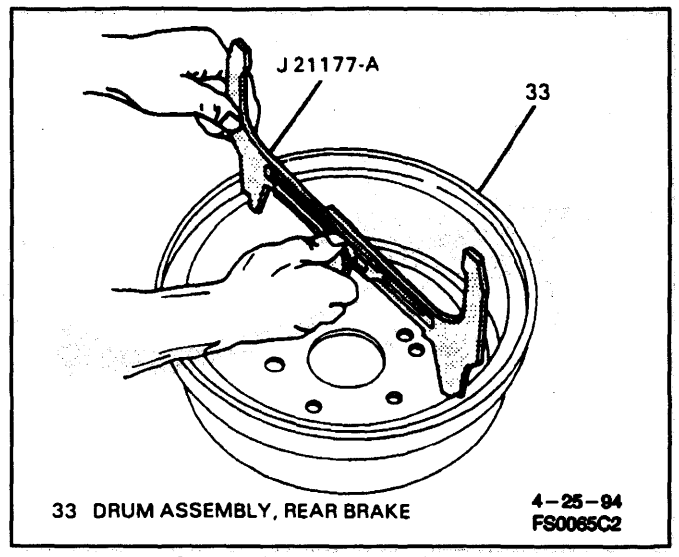


Figure 6 – Setting Tool to Rear Brake Drum Assembly

BACKING PLATE

Figure 2

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Primary and secondary shoes. Refer to "Primary and Secondary Shoes" in this section.
3. Rear axle shaft. Refer to SECTION 4B.
4. Parking brake cable assembly from rear brake backing plate. Refer to SECTION 5F.
5. Brake pipe assembly from wheel cylinder (28).
6. Wheel cylinder. Refer to "Wheel Cylinder" under "On-Vehicle Service" in this section.
7. Backing plate bolts/screws (36) and nuts (35).
8. Backing plate (29) from axle flange.

Install or Connect

NOTICE: See "Notice" on page 5C2-1 of this section.

1. Backing plate (29) to axle flange.
2. Backing plate bolts/screws (36) and nuts (35).

Tighten

- Backing plate nuts (35) to 58 N•m (43 lb. ft.).

3. Wheel cylinder. Refer to "Wheel Cylinder" under "On-Vehicle Service" in this section.
4. Rear brake rear pipe assembly to wheel cylinder (28).

Tighten

- Brake pipe fitting to 17 N•m (13 lb. ft.).

5. Parking brake cable assembly to brake backing plate. Refer to SECTION 5F.
6. Rear axle shaft. Refer to SECTION 4B.

7. Primary and secondary shoes. Refer to "Primary and Secondary Shoes" in this section.
8. Bleed brake hydraulic system. Refer to SECTION 5E1.

Adjust

- Rear drum brake assemblies. Refer to "Rear Drum Brake Adjustment" in this section.

9. Lower vehicle.
10. Cycle parking brake lever assembly three times.

REAR DRUM BRAKE ADJUSTMENT

Figures 4, 6 and 7

Tool Required:

J 21177-A Drum-to-Brake Shoe Clearance Gage

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Tire and wheel assemblies. Refer to SECTION 3E.
   - Mark relationship of wheel to axle flange.
3. Drum assemblies. Refer to "Drum Assembly" under "On-Vehicle Service" in this section.

Adjust

- Rear brake assemblies.
  A. Set J 21177-A so that it contacts inside diameter of drum assembly (33).
  B. Position J 21177-A over primary and secondary shoes (13 and 14).
  C. Turn star wheel on adjuster (19) until primary and secondary shoes (13 and 14) contact J 21177-A.
     - Outside diameter of primary shoe (13) and secondary shoe (14) will be approximately 1.27 mm (0.050 inch) less than inside diameter of drum assembly (33) on each wheel.

Install or Connect

1. Drum assemblies. Refer to "Drum Assembly" under "On-Vehicle Service" in this section.
2. Tire and wheel assemblies. Refer to SECTION 3E.
3. Lower vehicle.
4. Make several stops, applying firm force to brake pedal assembly.
   - Repeat until ample pedal reserve is built up.

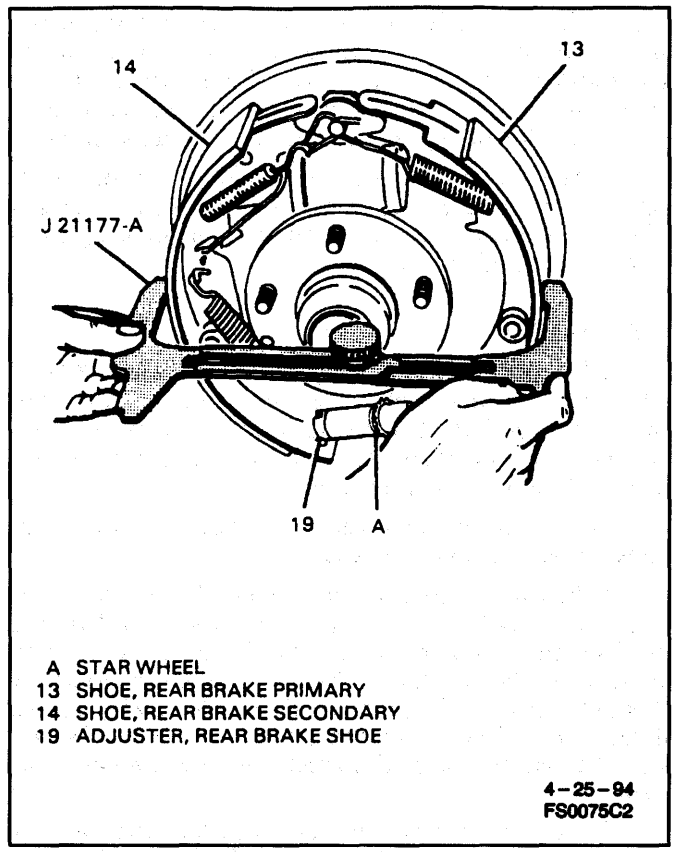


Figure 7 – Setting Rear Brake Primary and Secondary Shoes to Tool

UNIT REPAIR

DRUM ASSEMBLY

Cracked, Scored or Grooved

A cracked drum assembly is unsafe for further service and must be replaced. Do not attempt to weld a cracked drum assembly.

Smooth up any slight scores. Heavy or extensive scoring will cause excessive brake lining wear, and it may be necessary to refinish the drum braking surface.

If the brake linings are slightly worn, but still reusable, and the drum assembly is grooved, polish the drum assembly with fine emery cloth but do not refinish. Eliminating all grooves in the drum assembly and smoothing the ridges on the shoe linings would require removing too much metal and lining, while if left alone, the grooves and ridges match and satisfactory service can be obtained.

If brake linings are to be replaced, refinish a grooved drum assembly. A grooved drum assembly, if used with new lining, will not only wear the lining, but will make it difficult, if not impossible, to obtain proper brake performance.

Out-of-Round or Tapered

An out-of-round or tapered drum assembly prevents accurate rear brake shoe adjustment and is likely to cause excessive wear of other brake parts due to its eccentric action. An out-of-round drum assembly can also cause severe and irregular tire tread wear as well as a pulsating

brake pedal assembly. When the drum assembly exceeds the specification limits in taper and/or out-of-round, refinish drum assembly to true up the braking surface. Out-of-round as well as taper and wear can be accurately measured with an inside micrometer and extension rods.

When measuring a drum assembly for out-of-round, taper, and wear, take measurements at the open and closed edges of the machined surface and at right angles (90 degrees) to each other.

Refinishing

All drum assemblies have a maximum diameter cast into them. This diameter is the maximum wear diameter and not a refinish diameter. Do not refinish a drum assembly that will not meet the specifications. Refer to "Specifications" at the end of this section.

Any drum assembly that does not meet specifications shown should be replaced.

When refinishing a drum assembly, resurface the drum assembly to no more than a dimension of 0.76 mm (0.030 inch) less than the discard diameter. The refinish diameter is the maximum diameter the drum assembly should be refinished to, and still allow safe braking action. If this dimension is exceeded, the drum assembly will wear beyond the discard diameter during normal brake wear.

If a drum assembly must be refinished, remove only enough metal to obtain a true, smooth braking surface. If a drum assembly does not clean-up when refinished to a maximum rebore diameter as shown at the end of this section, replace it. Removal of more metal will affect heat dissipation and may cause rear brake drum assembly distortion.

When refinishing drum assemblies, always use sharp cutting tools or bits. Dull or worn tools leave a poor surface finish which will affect initial braking performance. Vibration dampening attachments should always be used when refinishing braking surfaces. These attachments eliminate tool chatter and will result in better surface finish.

The optimum spindle speed for refinishing braking surfaces is 200 rpm. Crossfeed for rough cutting should range from 0.15-0.25 mm (0.006-0.010 inch) per revolution. Finish cuts should be made at crossfeeds no greater than 0.05 mm (0.002 inch) per revolution.

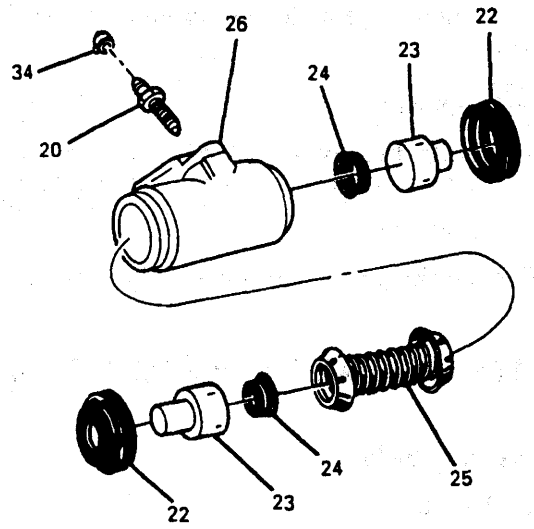
After making the finish cuts, sand the brake drum friction surface for at least 60 seconds. Use 150 grit aluminum oxide sandpaper on a curved sanding block. Make smooth in-and-out motions with the block while sanding. This procedure will simulate the original factory surface finish.

Replacing Drum Assemblies

When installing new drum assemblies, do not refinish the braking surface. New drum assemblies have the correct level of surface finish.

Balance

During manufacture, weights are used to balance drum assemblies. Do not remove these weights.



20 VALVE, REAR BRAKE BLEEDER.
22 BOOT, REAR WHEEL CYLINDER PISTON
23 PISTON, REAR WHEEL CYLINDER
24 SEAL, REAR WHEEL CYLINDER PISTON
25 SPRING, REAR WHEEL CYLINDER PISTON
26 BODY, REAR WHEEL CYLINDER
34 CAP, BLEEDER VALVE

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Figure 8 – Rear Wheel Cylinder Components

After drum assemblies have been refinished, or when maintaining proper wheel balance is difficult, check the drum assemblies for balance. They can be checked on most off-the-vehicle balancers. If found to be out of balance, replace drum assembly.

NOTICE: Be careful not to drop the brake drum assemblies during handling. Out-of-round can occur from even the smallest fall, resulting in brake pulsation.

WHEEL CYLINDER

Figure 8

Disassemble

1. Wheel cylinder completely from vehicle. Refer to "Wheel Cylinder" under "On-Vehicle Service" in this section.
2. Boots (22).
3. Pistons (23) and seals (24).
4. Piston spring (25).
5. Bleeder valve cap (34).
6. Bleeder valve (20) from wheel cylinder body (26).

Inspect

- Wheel cylinder bore for scoring, nicks, corrosion and wear.

Clean

1. All parts in clean denatured alcohol.
2. Dry with unlubricated compressed air.
3. Lubricate new seals (24) with clean brake fluid.

Assemble

NOTICE: See "Notice" on page 5C2-1 of this section.

1. Bleeder valve (20).

Tighten

- Bleeder valve (20) to 6 N•m (53 lb. in.).

2. Bleeder valve cap (34).
3. Piston spring (25).
4. Seals (24), pistons (23) and boots (22).
5. Wheel cylinder. Refer to "Wheel Cylinder" under "On-Vehicle Service" in this section.

SPECIFICATIONS

GENERAL SPECIFICATIONS

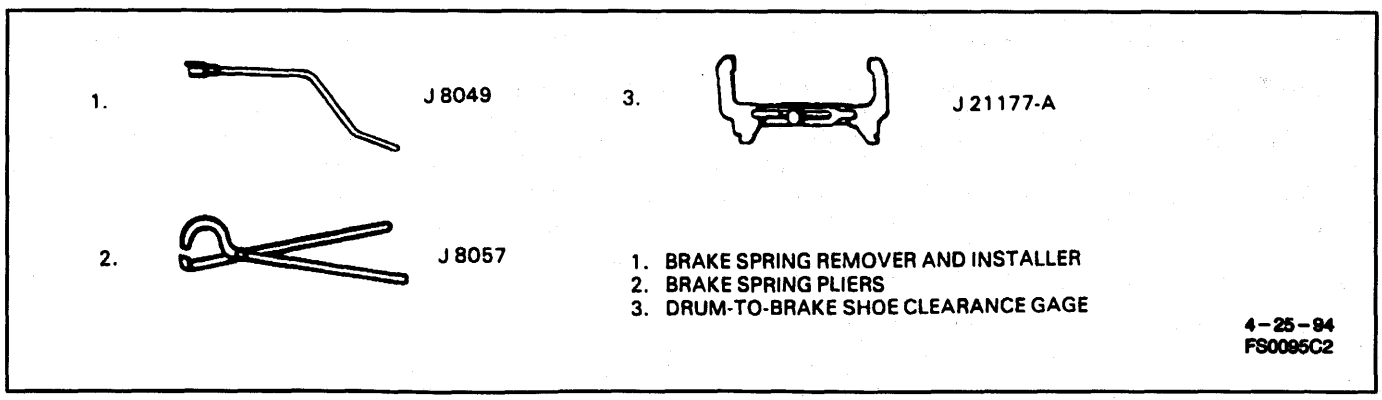
Rear Wheel Cylinder Bore Diameter	20.6 mm (0.81″)
Brake Lubricant	GM P/N 9985907
Rear Brake Drum Assembly	
Inside Diameter (Nominal)	241.30 mm (9.500″)
Runout	0.15 mm (0.006″)
Maximum Refinish Diameter	242.82 mm (9.560″)
Discard Diameter	243.59 mm (9.590″)

All rear brake drum assemblies have a discard dimension cast into them. This is a wear dimension and not a refinish dimension. Any rear brake drum assembly which does not meet the specification should be replaced.

FASTENER TIGHTENING SPECIFICATIONS

Rear Brake Backing Plate Nut	58 N•m (43 lb. ft.)
Rear Brake Bleeder Valve	6 N•m (53 lb. in.)
Rear Brake Rear Pipe Fitting	17 N•m (13 lb. ft.)
Rear Wheel Cylinder Bolt/Screw	18 N•m (13 lb. ft.)

SPECIAL TOOLS



BLANK

SECTION 5D1

VACUUM BOOSTER SYSTEM

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

CONTENTS

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Power Brake Booster Assembly 5D1-1
Diagnosis ..... Refer to Section 5
On-Vehicle Service 5D1-1
Power Brake Booster Assembly 5D1-1
Power Brake Booster Vacuum Hose and Routing 5D1-4
Vacuum Check Valve 5D1-4
Output Rod Gaging Procedure 5D1-4
Specifications 5D1-5
Fastener Tightening Specifications 5D1-5
Special Tools 5D1-5

GENERAL DESCRIPTION

POWER BRAKE BOOSTER ASSEMBLY

The power brake booster assembly is a tandem vacuum suspended unit. In a normal operating mode, with the service brakes in the released position, the tandem vacuum suspended booster assembly operates with vacuum on both sides of its diaphragms. When the brakes are applied, air at atmospheric pressure is admitted to one side of each diaphragm. The air is then drawn from the booster through the vacuum check valve to the vacuum source.

NOTICE: Internal components of this booster are not serviceable. The housing must not be unstaked and separated. Separating the housing will cause permanent deformation, preventing the booster assembly from holding proper volume.

ON-VEHICLE SERVICE

NOTICE: Do not use lubricated shop air on brake parts as damage to rubber parts may result.

Important

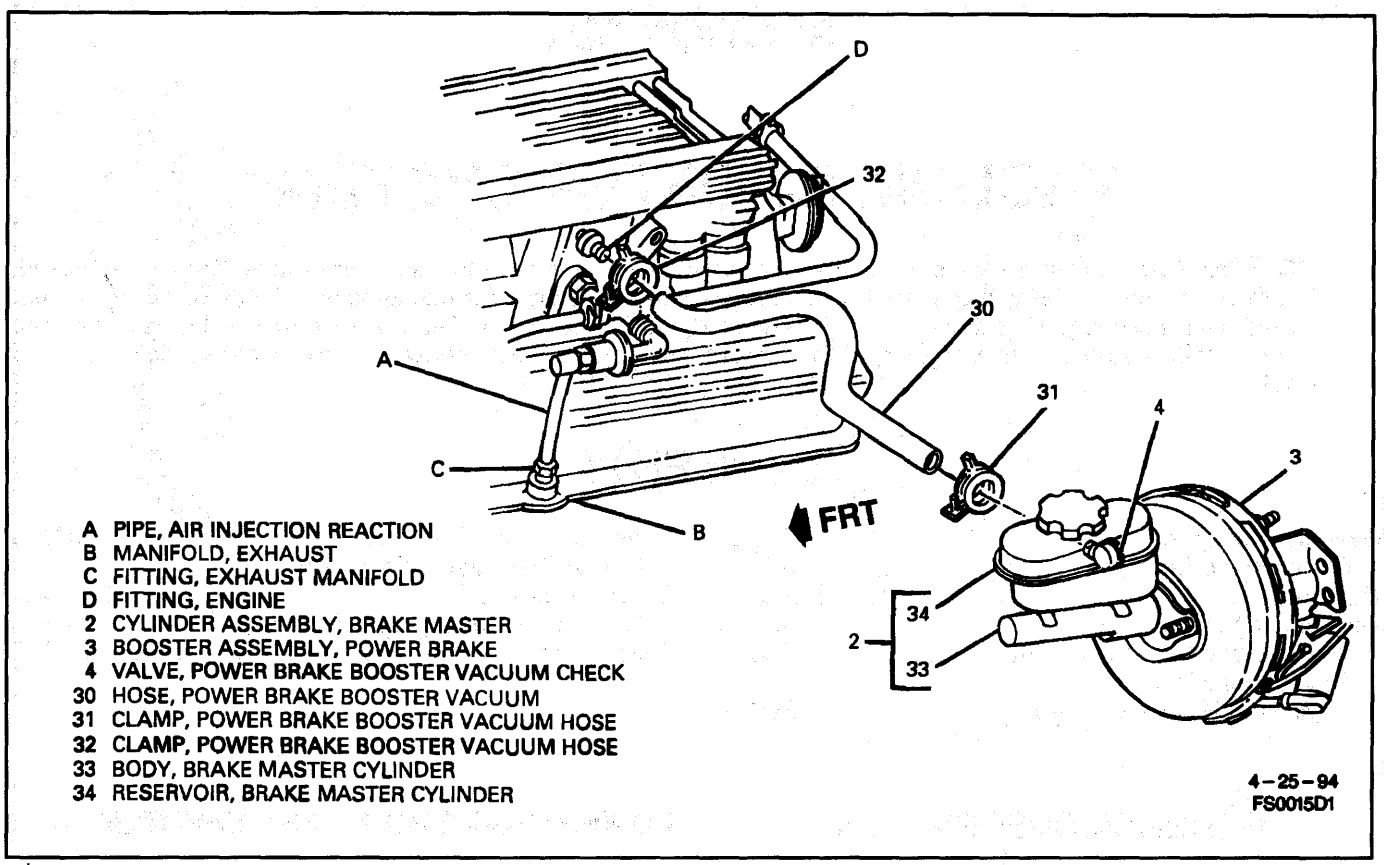
- Replace all components included in repair kits used to service the booster assembly.
- Lubricate rubber parts with silicone grease to ease assembly.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake hydraulic system.
- The torque values specified are for dry, unlubricated fasteners.

POWER BRAKE BOOSTER ASSEMBLY

Figures 1 through 3

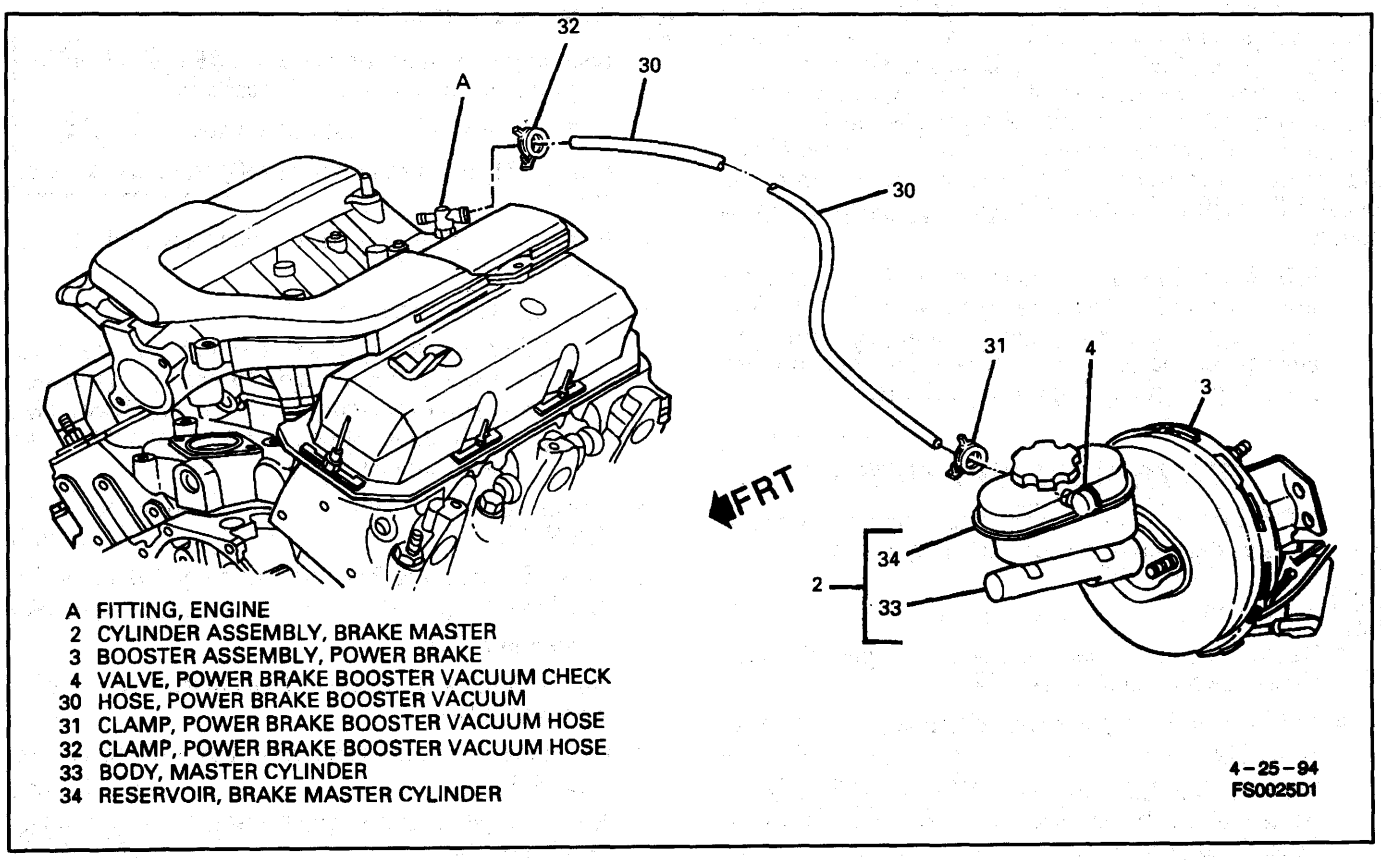
Remove or Disconnect

1. Secondary air injection system (AIR) pipe from fitting on exhaust manifold, if necessary.
   - Move AIR pipe out of the way.
2. Clamp (31) and vacuum hose (30) from check valve (4).
3. Nuts (1) attaching master cylinder assembly (2) to booster assembly (3).
4. Master cylinder assembly (2).
   - Move master cylinder assembly (2) forward and toward driver's side to provide clearance for booster assembly (3). This will flex brake pipe assemblies slightly. Take care not to bend or distort brake pipes assemblies.
5. Lower sound insulator assembly. Refer to SECTION 8C.
6. Nuts (5) attaching booster assembly (3) to brake pedal assembly (20).
7. Loosen nut (40).
8. On vehicle with manual transmission assembly, loosen nuts (41).
9. Pull back on brake pedal assembly (20) to access nuts (35).
10. Nuts (35) attaching booster assembly (3) to dash panel assembly.
    - Discard nuts (35) needed for production purposes only.



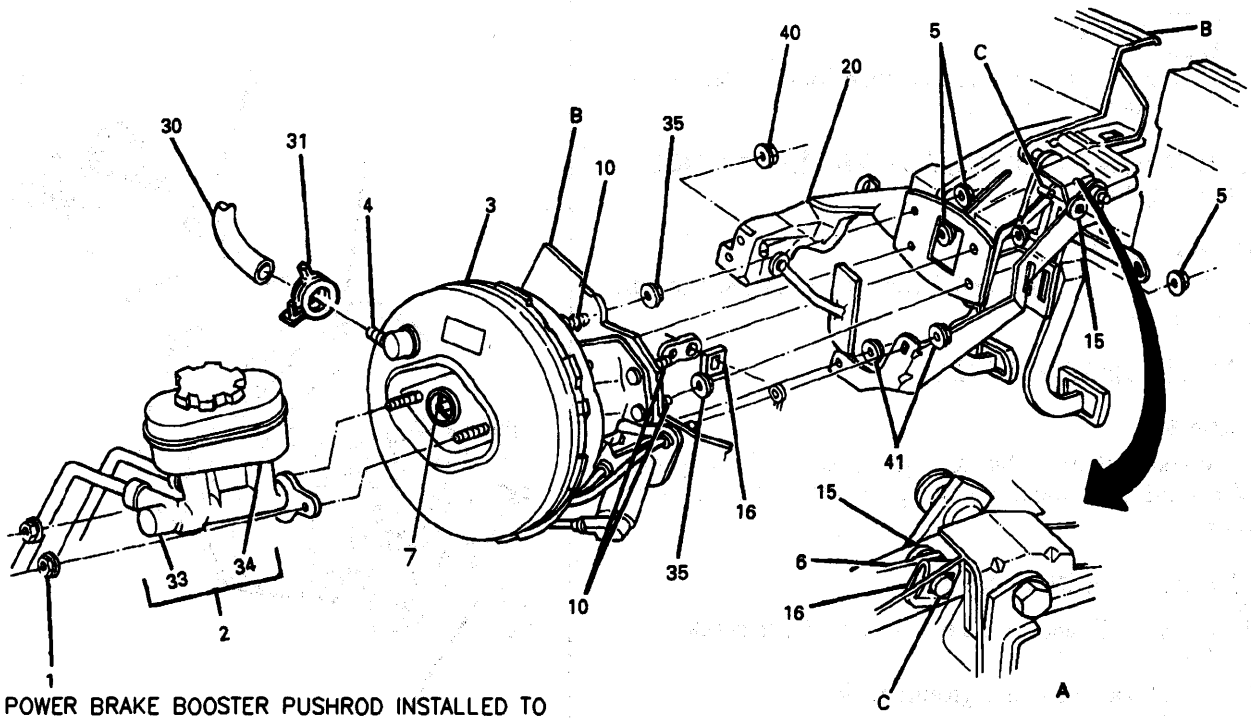
A PIPE, AIR INJECTION REACTION
B MANIFOLD, EXHAUST
C FITTING, EXHAUST MANIFOLD
D FITTING, ENGINE
2 CYLINDER ASSEMBLY, BRAKE MASTER
3 BOOSTER ASSEMBLY, POWER BRAKE
4 VALVE, POWER BRAKE BOOSTER VACUUM CHECK
30 HOSE, POWER BRAKE BOOSTER VACUUM
31 CLAMP, POWER BRAKE BOOSTER VACUUM HOSE
32 CLAMP, POWER BRAKE BOOSTER VACUUM HOSE
33 BODY, BRAKE MASTER CYLINDER
34 RESERVOIR, BRAKE MASTER CYLINDER

Figure 1 – Vacuum Booster Hose Routing (5.7L LT1 Engine)



A FITTING, ENGINE
2 CYLINDER ASSEMBLY, BRAKE MASTER
3 BOOSTER ASSEMBLY, POWER BRAKE
4 VALVE, POWER BRAKE BOOSTER VACUUM CHECK
30 HOSE, POWER BRAKE BOOSTER VACUUM
31 CLAMP, POWER BRAKE BOOSTER VACUUM HOSE
32 CLAMP, POWER BRAKE BOOSTER VACUUM HOSE
33 BODY, MASTER CYLINDER
34 RESERVOIR, BRAKE MASTER CYLINDER

Figure 2 – Vacuum Booster Hose Routing (3.4L L32 Engine)



A POWER BRAKE BOOSTER PUSHROD INSTALLED TO BRAKE PEDAL LEVER PIN
B PANEL ASSEMBLY, DASH
C PIN, BRAKE PEDAL LEVER
1 NUT, BRAKE MASTER CYLINDER
2 CYLINDER ASSEMBLY, BRAKE MASTER
3 BOOSTER ASSEMBLY, POWER BRAKE
4 VALVE, POWER BRAKE BOOSTER VACUUM CHECK
5 NUT, BRAKE PEDAL BRACKET
6 PUSHROD, POWER BRAKE BOOSTER
7 OUTPUT ROD, POWER BRAKE BOOSTER
10 BOLT/SCREW, POWER BRAKE BOOSTER MOUNTING
15 WASHER, BRAKE PEDAL PUSHROD
16 RETAINER, BRAKE PEDAL PUSHROD
20 PEDAL ASSEMBLY, BRAKE AND ACCELERATOR AND CLUTCH (WITH BRACKET)
30 HOSE, POWER BRAKE BOOSTER VACUUM
31 CLAMP, POWER BRAKE BOOSTER VACUUM HOSE
33 BODY, BRAKE MASTER CYLINDER
34 RESERVOIR, BRAKE MASTER CYLINDER (PUSH-ON)
35 NUT, POWER BRAKE BOOSTER ASSEMBLY
40 NUT, BRAKE PEDAL
41 NUT, CLUTCH MASTER CYLINDER

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Figure 3 – Removing and Installing Power Brake Booster Assembly (Manual Transmission Shown – Automatic Transmission Similar)

11. Pushrod (6) from brake pedal pin.
    A From inside vehicle, remove retainer (16) and washer (15).
    B Tilt entire booster assembly (3) slightly to work pushrod (6) off brake pedal pin without putting undue side pressure on pushrod (6).
12. Booster assembly (3) from vehicle.

Install or Connect

NOTICE: See "Notice" on page 5D1-1 of this section.

1. Booster assembly (3) onto vehicle.
2. Pushrod (6) to brake pedal pin.
    A. Tilt entire booster assembly (3) slightly to work pushrod (6) off brake pedal pin without putting undue side pressure on pushrod (6).
    B. From inside vehicle, install washer (15) and retainer (16).
3. Nuts (5).

Tighten

- Nuts (5) to 20 N•m (15 lb. ft.) in sequence: inboard upper, outboard lower, outboard upper, inboard lower.
- Nuts (40) to 20 N•m (15 lb. ft.).
- Nuts (41) to 27 N•m (20 lb. ft.) on vehicle with manual transmission assembly.

4. Master cylinder assembly (2) to booster assembly (3) and nuts (1).

Tighten

- Nuts (1) to 29 N•m (31 lb. ft.).

5. Vacuum hose (30) and clamp (31) to check valve (4).
6. Lower sound insulator assembly. Refer to SECTION 8C.
7. AIR pipe to fitting on exhaust manifold, if removed.

Tighten

- AIR pipe-to-exhaust manifold fitting to 55 N•m (41 lb. ft.).

POWER BRAKE BOOSTER VACUUM HOSE AND ROUTING

Figures 1 and 2

Refer to Figures 1 and 2 for routing of the vacuum hose (30).

VACUUM CHECK VALVE

Figure 4

Vacuum check valve and grommet can be inspected and/or serviced without removing booster assembly from vehicle.

Remove or Disconnect

1. Clamp (31) and vacuum hose (30) from check valve (4).
2. Check valve (4) and grommet (9).

Inspect

- Grommet (9) and vacuum hose (30) for cuts, nicks and excessive wear.
  - Replace grommet (9) or vacuum hose (30) if damaged.

Clean

1. All parts in denatured alcohol.
2. Dry with unlubricated compressed air.

Install or Connect

1. Lubricate inner and outer diameters of grommet (9) with thin layer of silicone grease GM P/N 1234559 or equivalent.
2. Grommet (9) and check valve (4).
3. Vacuum hose (30) and clamp (31) to vacuum check valve (4).

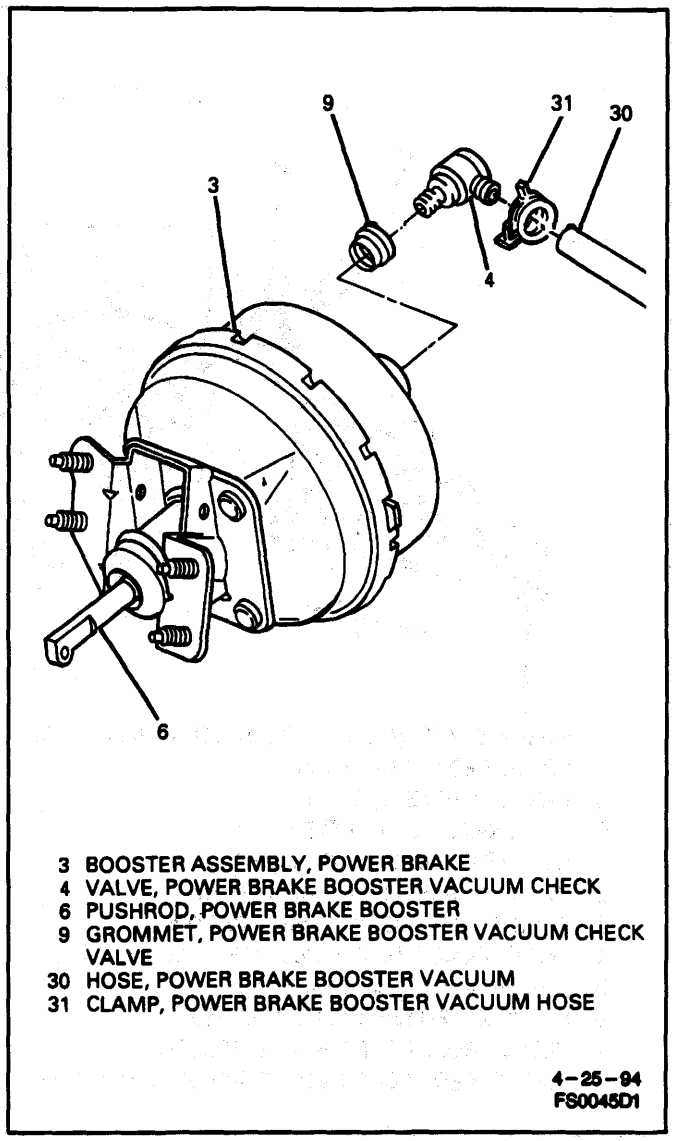


Figure 4 – Vacuum Valve and Grommet

OUTPUT ROD GAGING PROCEDURE

Figure 5

Tool Required:

J 37839 Pushrod Height Gage

Measure

1. Gage booster assembly with 85.0 kPa (25 in. Hg.) vacuum or maximum engine vacuum available.
   - Booster assembly can be gaged without being installed on vehicle, if a suitable vacuum source is available.
2. Position J 37839 over pushrod (7).
   - Check both maximum and minimum rod length.

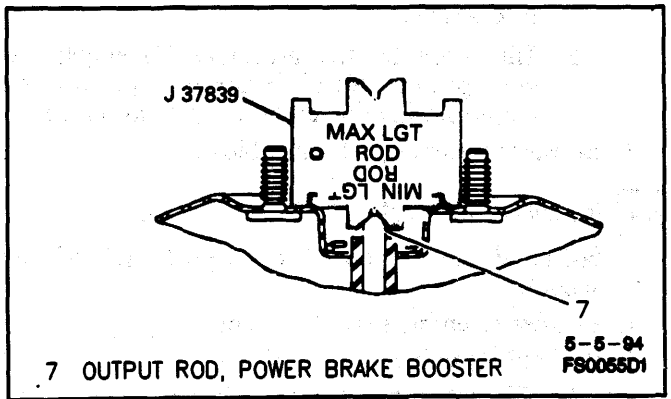


Figure 5 – Gaging Power Brake Booster Output Rod

3. If output rod (7) length does not fall between maximum and minimum dimensions, use a service-adjustable output rod to obtain correct length.

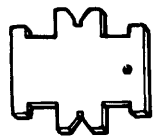
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Brake Master Cylinder Nut	29 N•m (21 lb. ft.)
Brake Pedal Bracket Nut	20 N•m (15 lb. ft.)
Brake Pedal Nut	20 N•m (15 lb. ft.)
Clutch Master Cylinder Nut	27 N•m (20 lb. ft.)
Secondary Air Injection System (AIR) Pipe-to-Exhaust Manifold Fitting	55 N•m (41 lb. ft.)

SPECIAL TOOLS

1.



J 37839

1. PUSHROD HEIGHT GAGE

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BLANK

SECTION 5E1

ANTILOCK BRAKE SYSTEM

CAUTION: To help avoid personal injury due to poor braking, DO NOT tap into the vehicle's brake system to operate a trailer brake system.

NOTICE: Always use the correct fasteners in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications: Some bolts are designed to permanently stretch. If a stronger fastener is used, the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent. Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used, part damage may occur. Fasteners that need to be replaced when removed will be called out. Fasteners that require thread locker or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

NOTICE: The use of rubber hoses or parts other than those specified for the Antilock Brake System (ABS) may lead to functional problems requiring replacement of the hydraulic parts. Replace all components included in repair kits used to service this system. Lubricate rubber parts with clean, fresh brake fluid to ease assembly. Do not use lubricated shop air on brake past as damage to rubber components may result. If any hydraulic component is removed or brake line disconnected, it is necessary to bleed the entire brake system. The fastener tightening specifications specified are for dry, unlubricated fasteners.

NOTICE: Use only Supreme 11 (GM 1052542) or equivalent DOT 3 brake fluid. The use of DOT 5 (silicone) brake fluid is not recommended. Reduced braking performance or durability may result.

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring, cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen the damage.

DELCO CHASSIS ABS VI TECHNICAL ASSISTANCE

For 1995 model year, Delco Chassis Division has an ABS VI field service plan in place. This plan has been developed to improve customer satisfaction. The plan is set up to help Delco Chassis understand each field malfunction and to allow us to obtain all of the failed components back for detailed analysis. With this direct field contact, we are able to continuously improve our ABS system components.

The plan consists of a Technical Assistance Hotline, staffed by Delco Chassis personnel, that you must phone to create a technical assistance case or to order parts for some ABS VI malfunctions. Please be prepared to provide specific diagnostic trouble code information, VIN and dealer code when phoning for a part or for assistance. The phone number is 1-800-523-0203.

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GENERAL DESCRIPTION

ABBREVIATIONS/DEFINITIONS

Several abbreviations are commonly used throughout this section. They are presented here for reference.

ABS ..... Antilock Brake System
B+ ..... Battery Voltage
CKT ..... Circuit
CPA ..... Connector Position Assurance
DLC ..... Data Link Connector
DTC ..... Diagnostic Trouble Codes
DVM ..... Digital Multimeter
EBCM ..... Electronic Brake Control Module
ESB ..... Expansion Spring Brake
Infinite Open Circuit/Unmeasurable High Resistance
MSC ..... Mass Storage Cartridge

BASIC KNOWLEDGE REQUIRED

Before using this section, it is important that you have a basic knowledge of the following items. Without this basic knowledge, it will be difficult to use the diagnostic procedures contained in this section.

If you need a review of basic electrical troubleshooting knowledge, SECTION 8A contains helpful information in the introduction. Basic use of circuit testing tools is also covered in SECTION 8A.

Additionally, electrical/electronic courses are offered through General Motors Service Training.

Basic Electrical Circuits - You should understand the basic theory of electricity and know the meaning of voltage, current (amps) and resistance (ohms). You should understand what happens in a circuit with an open or shorted wire. You should be able to read and understand a wiring diagram.

Use of Circuit Testing Tools - You should be familiar with the High Impedance Multimeter (DVM) J 39200. You should be able to measure voltage, resistance and current and be familiar with the meter controls and how to use them correctly.

Important

- When measuring the resistance to ground of a circuit or component, make sure to use a solid, unpainted chassis ground or the negative battery terminal.

SYSTEM OPERATION

Base Braking Mode

Under normal operating conditions, the brake systems will operate using conventional braking by means of brake pedal force, the vacuum booster, and the compact master cylinder. Each front channel consists of a motor, solenoid, ESB, ball screw, piston, and check valve. As illustrated in Figure 1, under normal operating conditions (base brakes), the piston is held in the upmost (or "home") position and the solenoid is open (not energized). This is accomplished by turning the ball screw via the motor to drive the nut upwards. Once at the upmost position, the piston is held by an Expansion Spring Brake (ESB). Two paths are available to transfer braking pressure to the wheel: (1) through the modulator, around the check valve, and out to the wheel, (2) through the modulator, past the normally open solenoid, and out to the wheel. The solenoid in the front circuits provides an alternate brake pressure path to the wheel. With this arrangement, if the ABS were to lose power or malfunction with the piston not in its home position, a redundant brake fluid path is available. See Figure 1.

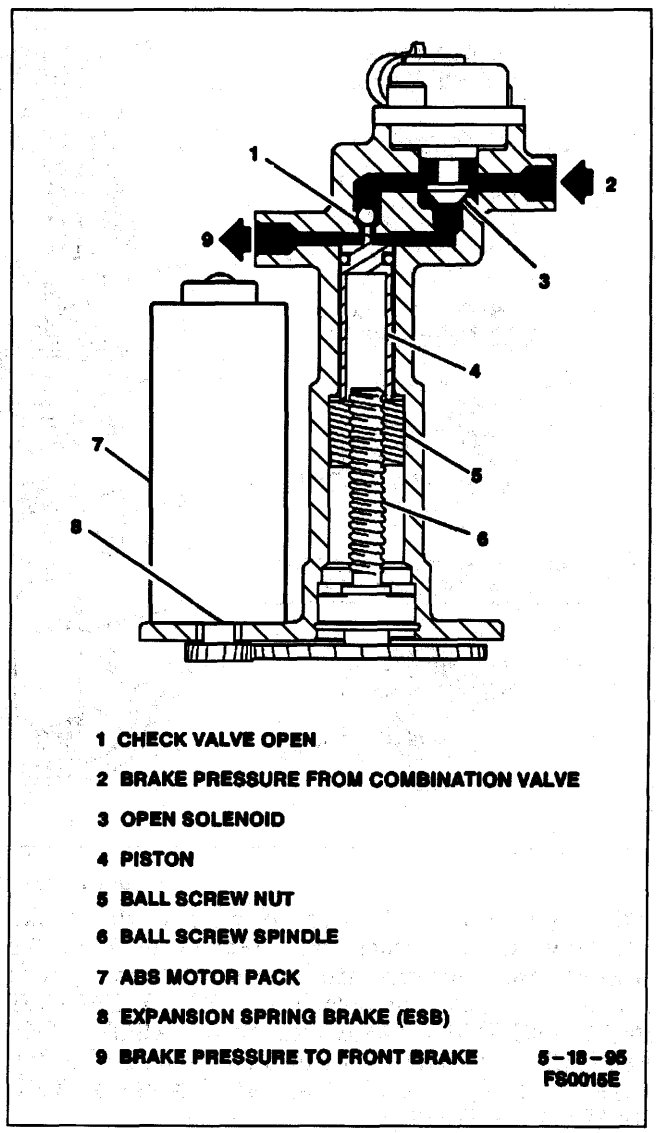


Figure 1 - Front Base Braking Mode

The rear channels operate in a similar manner except no solenoid exists.

Antilock Braking Mode

ABS VI has been designed to improve the controllability and steerability of a vehicle during braking. ABS VI accomplishes this objective by controlling the hydraulic pressure applied to each wheel brake. Antilock braking occurs only when the brake switch is closed and a microprocessor, located in the EBCM, determines one or more wheels is about to lose during braking. The EBCM will then allow the

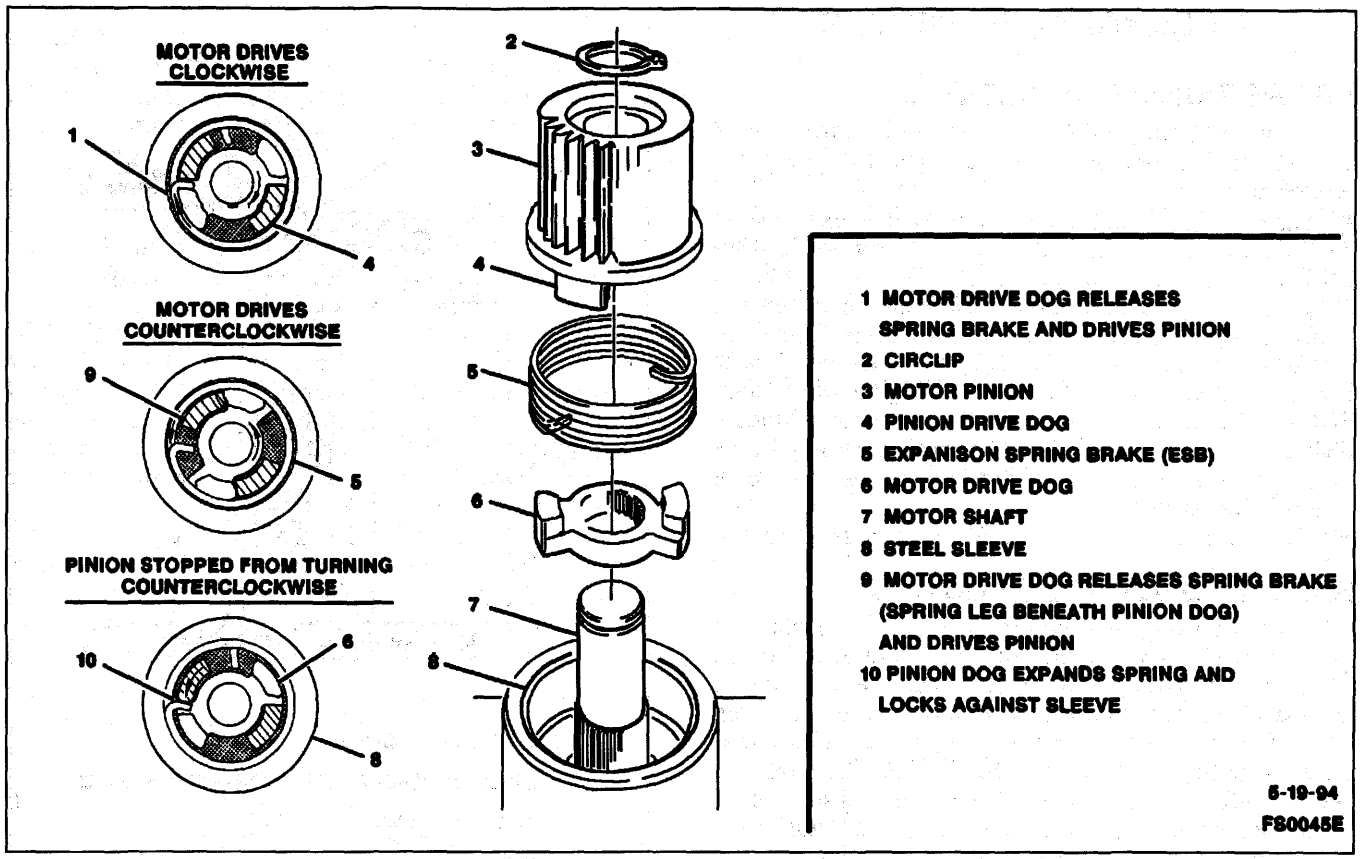


Figure 2 - Expansion Spring Brake

ABS hydraulic modulator to change the brake pressures several times each second to keep the wheel(s) from locking and provide the driver with maximum vehicle controllability. ABS VI CANNOT INCREASE THE BRAKE PRESSURE ABOVE THE MASTER CYLINDER PRESSURE APPLIED BY THE DRIVER, AND CANNOT APPLY THE BRAKES BY ITSELF.

The result is greatly improved braking, enabling the driver to more easily maintain steerability and to bring the vehicle to a controlled stop. ABS VI provides effective braking and directional control over a wide range of road surfaces and driving conditions.

If any wheel(s) begins to approach lock-up, the EBCM will control the three (3) motors and two (2) solenoids, appropriately, to control brake pressure to the affected wheel(s). During front wheel ABS operation, the solenoids are turned "ON" to isolate that brake pressure path to the wheel (see Figure 3). The EBCM then provides controlled current to the motors to regulate the speed and amount of movement. As the motors move backwards, the piston follows the nut downward, allowing the check valve to seat. The brake pressure to the wheel is now a function of the controlled volume within the piston chamber. To reduce brake pressure, the motor drives the nut further downward. To reapply or increase brake pressure, the motor drives the nut and piston upward. If ABS was entered during low brake pressure, such as on ice, and dry pavement is then encountered during reapply, the piston is driven all the way to the top. This results in the unseating of the check valve, and a return to base brakes until sufficient brake pressure exists to cause the wheel to approach lock-up again. At this point, the ABS cycle would start again. This process can occur in less than one second if the driver is pressing firmly on the brake pedal.

Total brake pressure during ABS is limited to the brake pressure present when ABS was entered. Also, any time wheel brake pressure exceeds the brake pressure at the master cylinder (caused by reduced force on the brake pedal), the check valve unseats and a small volume of brake fluid is returned to the master cylinder. In this manner, ABS VI CANNOT INCREASE BRAKE PRESSURE ABOVE MASTER CYLINDER PRESSURE APPLIED BY THE DRIVER AND CANNOT APPLY THE BRAKES BY ITSELF. When ABS is no longer required, the pistons are returned to their upmost (or "home") position and are held by the ESBs (refer to "ESB Operation," found in this section). The solenoid on the front channels are simultaneously opened to again provide a redundant base braking path.

The rear channel operates in a similar manner except no solenoid is used (refer to Figure 4). Both rear brake pressures are controlled by the same motor and both rear brake pressures are controlled together. If either rear wheel begins to lock, brake pressure to both rear wheels is reduced to maximize vehicle stability.

There is no rear solenoid due to the nature of the braking system. The vast majority of braking is accomplished with the front brakes. If an ABS failure were to occur that affected the operation of the rear base brakes, a diagnostic trouble code would be stored

and the EBCM would turn "ON" both the amber ABS and the red BRAKE warning lamps.

ESB Operation

The Expansion Spring Brake (ESB) is used to hold the piston in the upmost (or "home") position. An ESB is a spring that is retained in a housing at a close tolerance. One end of the spring is in contact with the motor drive dog and the other end is in contact with the pinion drive dog (see Figure 2). In normal braking, brake pressure is present on the top of the piston, applying a downward force. The force applies a counterclockwise torque to the motor pinion which tries to rotate the spring counterclockwise. The counterclockwise torque expands the spring outward within the housing and prevents gear rotation.

When the motor is turned "ON" and tries to drive the ball screw nut, the end of the ESB in contact with the motor drive dog rotates inward causing the spring to contract in its housing allowing the motor to rotate the modulator gear (see Figure 2). The most common application of this principle is in window crank mechanisms, where a small amount of force on the crank handle allows the window to be lowered or raised, but the weight of the window or force on the window will not allow the window to move downward. For the ESB, brake pressure on the top of the pistons corresponds to the weight of the window and the motor corresponds to the window crank handle.

System - Self Test (Initialization)

During initialization, the EBCM will not only perform self-diagnostics, but will also verify motor, modulator, solenoid, relay, and lamp operation to ensure all components are functioning properly. The EBCM also checks the wheel speed sensor circuitry for open circuits and shorts to ground or voltage at this time. If the EBCM detects a malfunction in either itself or other ABS VI components, it will store a Diagnostic Trouble Code (DTC) and turn "ON" the amber ABS warning lamp if applicable.

The amber ABS warning lamp will be "ON" for about 3 seconds with the key in the "RUN" position. During cranking the amber ABS warning lamp will be "ON" and then remain "ON" for about 3 seconds after the engine starts. A slight mechanical noise may be

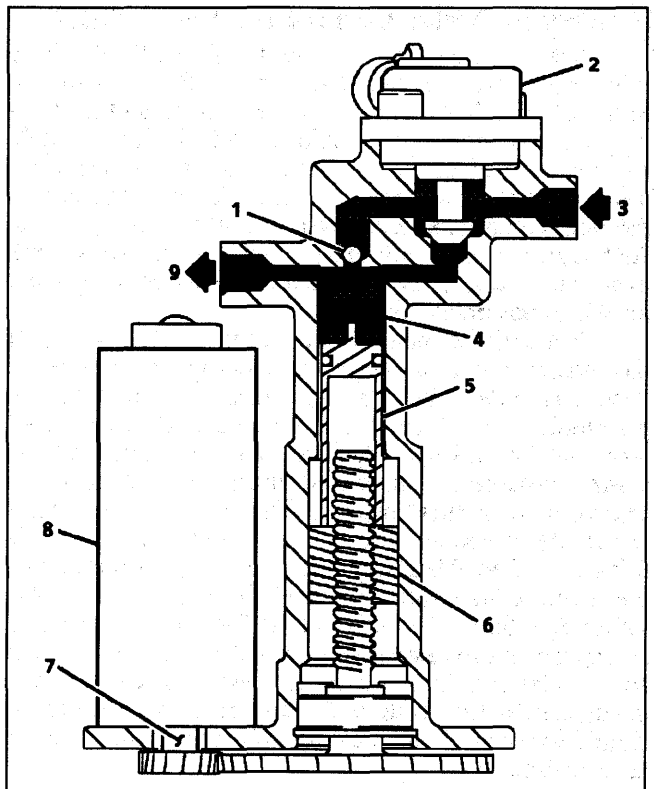


Figure 3 - Front ABS Braking Mode

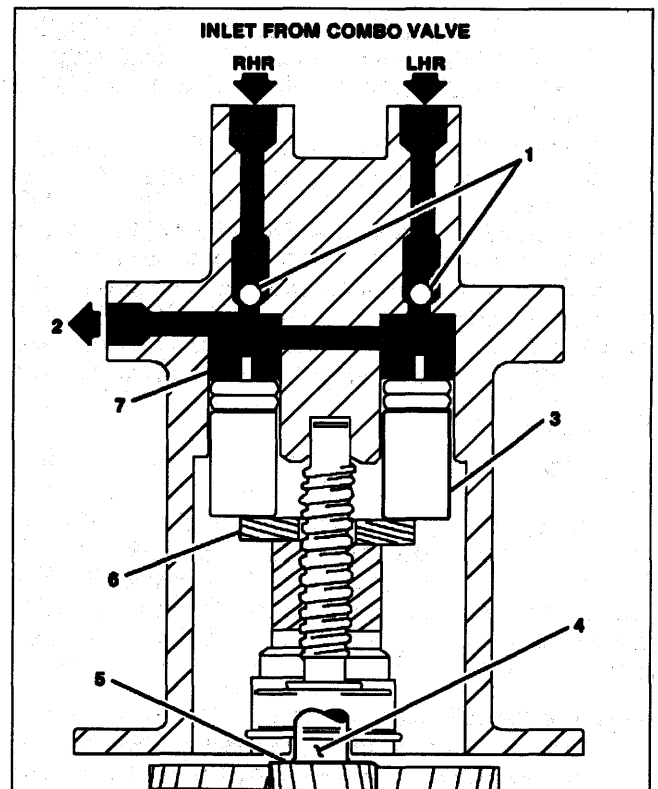


Figure 4 - Rear ABS Braking Mode

heard during the system initialization, which is normal. The entire initialization is run about 2-3 seconds after the engine starts. If your foot is on the brake pedal when the engine is started, the system will not initialize until your foot is removed or 5 km/h (3 mph) is reached. If foot pressure on the pedal interrupts the system initialization, a slight movement in the pedal may be felt.

Warning Lamp Operation

Normal Lamp Operation

The standard brake system uses a single red BRAKE warning lamp located in the instrument panel cluster. The antilock brake system uses the same red BRAKE warning lamp, an amber ABS warning lamp and a blue ABS active lamp ("LOW TRAC").

1. When the ignition is turned to the "RUN" position, the "ABS INOP", "LOW TRAC", and "BRAKE" lamps all turn "ON" for approximately three seconds, then turn "OFF."
2. As the engine is cranked, both the "ABS INOP" lamp and the "BRAKE" lamp will turn "ON" and remain "ON."
3. After the engine is started, the "ABS INOP", "LOW TRAC", and "BRAKE" lamps will be "ON" for approximately three seconds then turn "OFF."
4. Anytime the EBCM determines that the vehicle has entered a braking event where ABS is required, the "LOW TRAC" lamp will turn "ON" to indicate that ABS is active. The "LOW TRAC" lamp will remain "ON" for approximately 3 to 4 seconds after the ABS event is completed. For further information regarding "ABS INOP", "LOW TRAC", and "BRAKE" lamp operation, refer to "Warning Lamps" in this section.

Tires and ABS

Spare Tire

Using the compact spare supplied with the vehicle will not affect the operation of ABS.

The EBCM software can compensate for this smaller tire. However, increased stopping distances may occur due to reduced tire tread depth on compact spare tires.

Replacement Tires

Tire size is important for proper performance of the ABS. Replacement tires should be the same size load range and construction as the original tires. Replace tires in axle sets and only with tires of the same TPC (Tire Performance Criteria) specification number. Use of any other tire size or type may seriously affect the ABS operation. For more information on original equipment and replacement tires, refer to SECTION 3E.

SYSTEM COMPONENTS

The ABS VI Antilock Braking System (ABS) consists of a conventional hydraulic brake system plus antilock components. The conventional brake system includes a vacuum power booster, master cylinder, front disc brakes, rear disc or drum brakes, interconnecting hydraulic brake lines, brake fluid level switch, and a red BRAKE warning lamp.

The ABS components include a hydraulic modulator/motor pack assembly, an Electronic Brake Control Module (EBCM), a system enable relay, three wheel speed sensors, interconnecting wiring, an amber ABS warning lamp, and an amber ABS active lamp (refer to Figure 5).

ABS Hydraulic Modulator/Motor Pack Assembly

The ABS hydraulic modulator/motor pack assembly controls hydraulic pressure to the front and rear calipers or rear wheel cylinders by modulating hydraulic pressure to prevent wheel lock-up.

The basic ABS hydraulic modulator configuration consists of gear subassemblies, ball screws, nuts, pistons, and hydraulic check valves. The ABS motor pack consists of three motors, three drive gears, and three ESBs. For more information, refer to "Base Braking Mode" and "Antilock Braking Mode" in this section.

Electronic Brake Control Module (EBCM)

The controlling element of ABS VI is a microprocessor based Electronic Brake Control Module, or EBCM. Inputs to the system include four wheel speed sensors, the brake switch, ignition switch, and unswitched battery voltage. Outputs include three bi-directional motor controls, three lamp controls, two solenoid controls, and the system enable relay. A serial data line, located in terminal "M" of the Data Link Connector (DLC), is provided for service diagnostic tools and assembly plant testing.

The EBCM monitors the speed of each wheel. If any wheel begins to approach lock-up and the brake switch is "ON," the EBCM controls the motors and solenoids to reduce brake pressure to the wheel approaching lock-up. Once the wheel regains traction, brake pressure is increased until the wheel again begins to approach lock-up. This cycle repeats until either the vehicle comes to a stop, the brake is released, or no wheels approach lock-up. Additionally, the EBCM monitors itself, each input (except the serial data line) and each output for proper operation. If any system malfunction is detected, the EBCM will store a DTC in nonvolatile memory (DTCs will not disappear if the battery is disconnected). Refer to "Self-Diagnostics" in this section for more detailed information.

NOTICE: There is no serviceable or removable PROM. The EBCM must be replaced as an assembly.

Front Wheel Speed Sensors

The front wheel speed sensors consist of a variable reluctance sensor. The sensor and toothed ring are part of the hub and bearing assembly. As teeth pass by the sensor, an AC voltage with a frequency proportional to the speed of the wheel is generated. The magnitude of the voltage increases with increasing

speed. The sensor is not repairable, nor is the air gap adjustable. The entire front bearing assembly must be replaced.

Front Wheel Speed Sensor Rings

The front wheel speed sensor toothed rings are an integral part of the hub and bearing assembly. Like the front wheel speed sensors themselves, they are not serviceable. If a malfunction is detected in either the sensor or the toothed ring, the entire hub and bearing assembly must be replaced.

Rear Wheel Speed Sensor and Ring

A single rear wheel speed sensor is used for this ABS application and is located on the rear differential. It operates in the same manner as the front wheel speed sensors; refer to "Front Wheel Speed Sensors." However, the toothed ring is located within the rear differential and contains 106 equally spaced teeth. The sensors and toothed rings are not repairable and no provision for air gap adjustment exists.

ABS Relay

The ABS relay is a normally-open contact type relay, and has special contact material to handle the high currents required for ABS VI operation. The relay allows battery voltage and current to be supplied to the EBCM, which supplies power to the ABS motors and solenoids.

Brake Combination Valve

Refer to "Brake Combination Valve" in SECTION 5A.

Wiring Harness

The wiring harness is the mechanism by which the EBCM is electrically connected to power and ground, wheel speed sensors, motors, solenoids, fuses, switches, lamps, the enable relay and the serial communications port. The components, considered part of the wiring harness, are the wires that provide electrical interconnection and connectors/terminals that provide an electrical/mechanical interface from the wire to a system component.

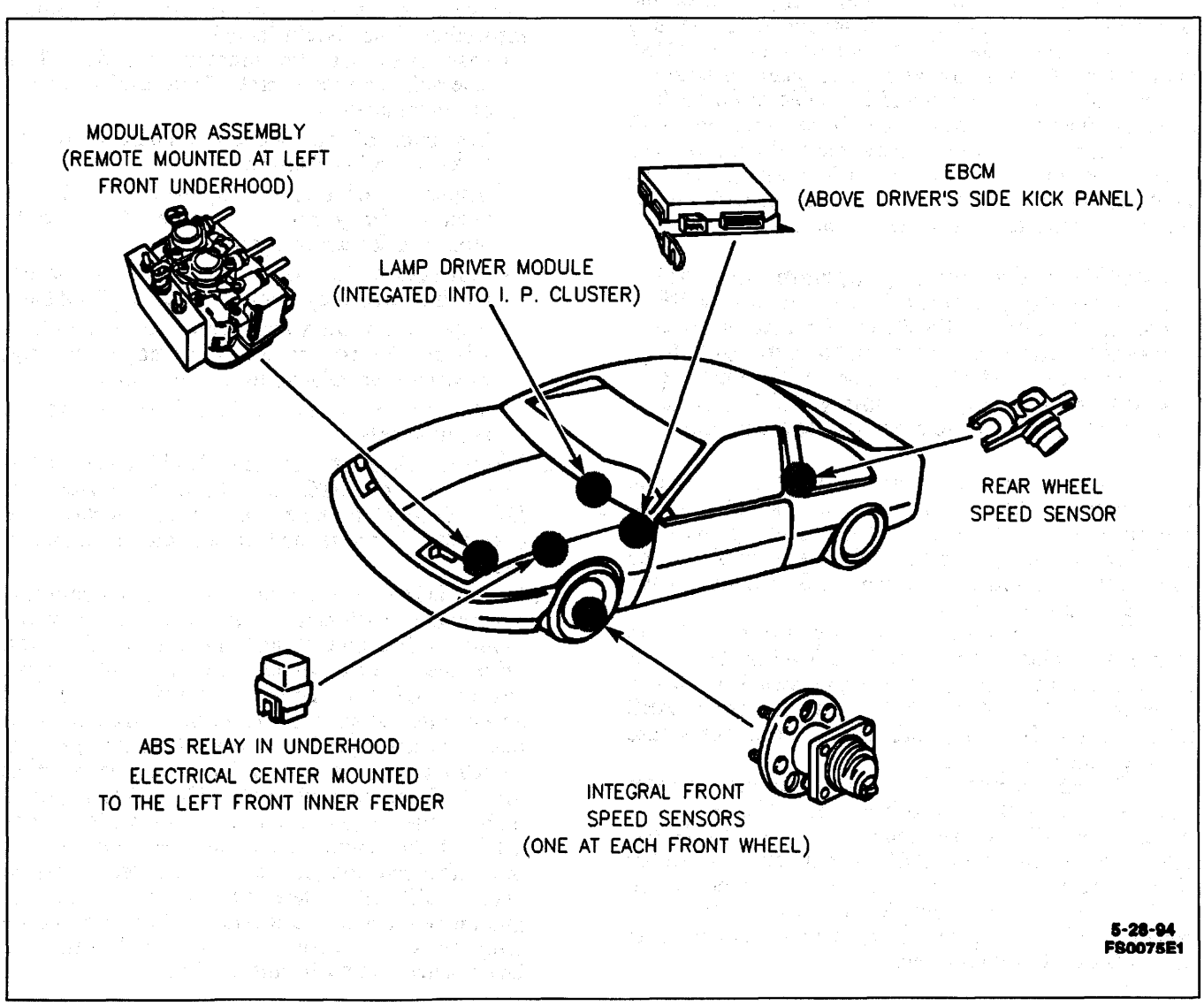


Figure 5 - ABS-VI Component Location View

Wheel Speed Sensor Jumper Harness

Between each wheel speed sensor and the main wiring harness is a jumper harness made up of highly flexible twisted pair wiring. This wiring exists because the main harness must connect to the suspension of the vehicle, thus the wiring in this area is subjected to the same motion as a spring or shock absorber. Consequently, any repair to this section of wiring will result in stiffening and therefore, eventual failure due to wire fatigue. For this reason, THE WHEEL SPEED SENSOR JUMPER HARNESSES ARE NOT REPAIRABLE AND MUST BE REPLACED. DO NOT ATTEMPT TO SOLDER, SPLICE, OR CRIMP THESE HARNESSES AS EVENTUAL FAILURE WILL LIKELY RESULT. Refer to "On-Vehicle Service" in this section.

Warning Lamps

The Electronic Brake Control Module (EBCM) continuously monitors itself and the other ABS VI components. If the EBCM detects a malfunction with the system, the amber ABS warning lamp will either flash or light continuously (solid lamp) to alert the driver of the malfunction. The amber ABS warning lamp will flash if the EBCM attempts to turn "ON" the red BRAKE warning lamp in conjunction with the amber ABS warning lamp and is unable to do so. The lamp is flashed to warn the driver that an ABS malfunction exists which may have degraded base brake performance. No Antilock braking will be available. The vehicle must be serviced immediately to regain full base and ABS braking ability.

CAUTION: The braking system may not be working properly if the amber ABS warning lamp is flashing. Driving with a flashing ABS warning lamp can lead to an accident. If the amber ABS warning lamp is flashing, pull safely off the road and have the vehicle towed for service.

A solid amber ABS warning lamp indicates that a malfunction has been detected that affects the operation of ABS. No antilock braking will be available. Normal, non-antilock brake performance will remain. In order to regain ABS braking ability, the ABS must be serviced

The red BRAKE warning lamp will be illuminated when a low brake fluid level in the master cylinder is sensed, the parking brake switch is closed, or under control of the EBCM when certain ABS DTCs are set. This lamp indicates to the driver a base brake problem may exist.

The ABS active "LOW TRAC" amber indicator lamp is used to alert the driver when ABS is active. Anytime the EBCM determines that the vehicle has entered an event where ABS is required, the amber "LOW TRAC" lamp will turn "ON" to indicate that ABS is active. The amber "LOW TRAC" lamp will remain "ON" for approximately 3 to 4 seconds after the ABS event is completed.

Fuses and Fusible Links

The vehicle's power distribution system consists of fuses, fusible links, circuit breakers, and the ignition switch. Fusible links are short pieces of wire several sizes smaller than the circuit wire to which they supply power. They are covered with special high temperature insulation. When conducting an improperly high current flow, they will melt and stop current flow. They are designed to protect the vehicle's electrical system from electrical shorts in circuits that are not protected by circuit breakers or fuses. For fuse and fusible link locations, refer to SECTIONS 8A-10 and 8A-11.

DIAGNOSIS-ELECTRICAL

DIAGNOSTIC PROCESS

When servicing the ABS VI, the following steps should be followed in order. Failure to follow these steps may result in the loss of important diagnostic data and may lead to difficult and time-consuming diagnosis procedures:

1. Perform a vehicle preliminary diagnosis inspection. This should include:
   - Inspection of the master cylinder fluid reservoir for proper brake fluid level and signs of contamination.
   - Inspection of the hydraulic modulator for any leaks or wiring damage.
   - Inspection of brake components at all four wheels. Verify no drag exists. Also, verify proper brake apply operation.
   - Inspection for worn or damaged wheel bearings that may allow a wheel to "wobble."
   - Inspection of the wheel speed sensors and their wiring. Verify proper undamaged wiring, especially at vehicle attachment points.
   - Verify tires meet legal tread depth requirements.
2. Perform "Diagnostic System Check" found in this section. If any DTCs are displayed, select "F1: DTC History" to note the last malfunction that occurred. Diagnose and repair this malfunction first.
3. If no DTCs are present, or no mechanical component malfunctions are present, or if the failure is intermittent and not reproducible, test drive the vehicle while using the auto trigger feature of the Tech 1. Perform normal acceleration, stopping, and turning maneuvers. If this does not reproduce the malfunction, perform an ABS stop, on a low coefficient surface such as gravel, from approximately 48-80 km/h (30-50 mph) while triggering the snapshot mode on any DTC. If the failure is still not reproducible, use the enhanced diagnostic information found in DTC HISTORY to determine whether or not this malfunction should be diagnosed further based on frequency of failure. Refer to "Enhanced Diagnostics" found in this section.

4. Once all system malfunctions have been corrected, clear the ABS DTCs.

SELF-DIAGNOSTICS

The EBCM contains sophisticated on-board diagnostics that, when accessed with a Tech 1 or T-100 (this service manual is written for the use of Tech 1), are designed to identify the source of any system malfunction as specifically as possible, including whether or not the malfunction is intermittent. There are 80 diagnostic trouble codes to assist with diagnosis.

When using the Tech 1 with ABS VI, the last diagnostic trouble code is specifically identified, and specific ABS data is stored at the time of this malfunction. Also, in addition to the last DTC set, there is information about the first five DTCs set. Using the Tech 1, each input and output can be monitored, thus enabling malfunction confirmation and repair verification. Manual control of components and automated functional tests are also available when using the Tech 1. Details of many of these functions are contained in the following sections.

DISPLAYING DIAGNOSTIC TROUBLE CODES (DTCs)

Diagnostic trouble codes can be read through the use of the Tech 1 scan tool. There are no provisions for "Flash Code" diagnostics.

CLEARING DIAGNOSTIC TROUBLE CODES (DTCs)

The DTCs in EBCM memory are erased in one of two ways:

1. Tech 1.
2. Ignition cycle default.

These two methods are detailed below. Be sure to verify proper system operation and absence of DTCs when the clearing procedure is completed.

The Tech 1 will not permit DTC clearing until all DTCs have been displayed. Also, DTCs cannot be cleared by unplugging the EBCM, disconnecting the battery cables, or turning the ignition "OFF" (except on an ignition cycle default).

Tech 1 Method

The Tech 1 method is the only method to be used when servicing a vehicle. Select "F2: DTC(s)" for diagnostic trouble codes. After DTCs have been viewed completely, Tech 1 will ask, "CLEAR DTCs"?; answer "YES." Tech 1 will then read, "HISTORY DATA WILL BE LOST. CLEAR DTCs"? Answer "YES" and DTCs will be cleared.

Ignition Cycle Default

If no diagnostic trouble codes occur for 100 drive cycles [a drive cycle occurs when the ignition is turned "ON" and the vehicle is driven faster than 16 km/h (10 mph)], any existing DTCs are automatically cleared from the EBCM memory.

INTERMITTENTS AND POOR CONNECTIONS

As with most electronic systems, intermittent malfunctions may be difficult to accurately diagnose. The following is a method to try to isolate an intermittent malfunction, especially wheel speed circuitry.

If an ABS malfunction occurs, the amber ABS warning lamp warning lamp will be "ON" during the ignition cycle in which the malfunction was detected. If it is an intermittent problem which seems to have corrected itself (ABS warning lamp warning lamp "OFF"), a diagnostic trouble code will be stored. Also stored will be the history data of the DTC at the time the malfunction occurred. The Tech 1 must be used to read DTC history data.

Most intermittent malfunctions are caused by faulty electrical connections or wiring. Refer to "Intermittent and Poor Connections" in SECTION 8A-4 for a very detailed explanation of how to locate and repair intermittent conditions.

TECH 1 DIAGNOSTICS

The Tech 1, when plugged into the DLC, becomes part of the vehicles electronic system. The Tech 1 can perform the following functions:

- Display ABS data.
- Display and clear ABS diagnostic trouble codes.
- Control ABS components.
- Perform extensive ABS diagnosis.
- Provide diagnostic testing for intermittent ABS conditions.

Each test mode has specific diagnosis capabilities which depend upon various keystrokes. In general, five keys control sequencing: "YES," "NO," "EXIT," "UP ARROW" and "DOWN ARROW." The F0 through F9 keys select operating modes, perform functions within an operating mode, or enter DTC or model year designations.

In general, the Tech 1 has six test modes for diagnosing the ABS. The six test modes are as follows:

- **MODE F0: DATA LIST** - In this test mode, the Tech 1 continuously monitors wheel speed data, brake switch status and other inputs and outputs.
- **MODE F1: DTC HISTORY** - In this mode, DTC history data is displayed. This data includes how many ignition cycles since the DTC occurred, along with other information for the last DTC set. The first five and last DTC set are included in the DTC history data.
- **MODE F2: DIAGNOSTIC TROUBLE CODES** - In this test mode, diagnostic trouble codes stored by the EBCM, both current ignition cycle and history, may be displayed or cleared.
- **MODE F3: SNAPSHOT** - In this test mode, the Tech 1 captures data before and after a system malfunction (auto trigger) from a forced manual key press, or from a DTC setting.

- **MODE F4: MISC. TESTS** - In this test mode, the Tech 1 performs various ABS functional tests to assist in problem isolation during troubleshooting.
- **MODE F5: MOTOR REHOME** - In this mode, the Tech 1 commands the EBCM to rehome the motors on the hydraulic modulator/master cylinder assembly. This mode should always be used prior to bleeding the brake system.

Enhanced Diagnostics

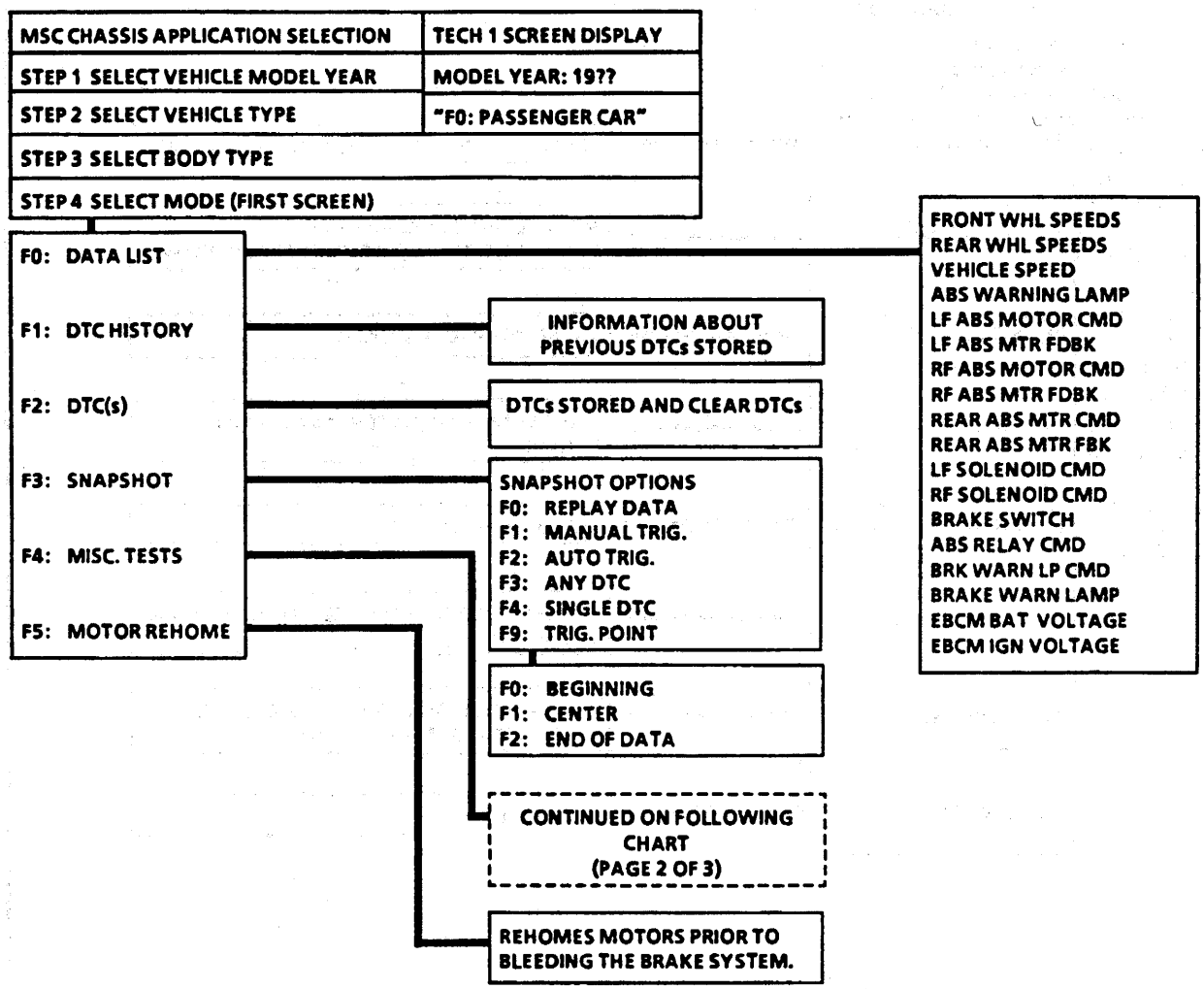
Enhanced diagnostic information, found in the DTC HISTORY function of the Tech 1, is designed to provide the service technician with specific malfunction occurrence information. For each of the first five and the very last diagnostic trouble code set, data is stored to identify the specific DTC, the number of occurrences, and the number of drive cycles since the malfunction first and last occurred [a drive cycle occurs when the ignition is turned to "RUN" and the vehicle is driven faster than 16 km/h (10 mph)]. However, if a malfunction is present, the drive cycle counter will increment by turning the ignition to "RUN" and "OFF." These first five diagnostic trouble codes are also stored in the order of occurrence. The order in which the first five DTCs occurred can be useful in determining if a previous malfunction is linked to the most recent malfunction, such as an intermittent wheel speed sensor which later becomes completely open.

During difficult diagnosis situations, this information can be used to identify malfunction occurrence trends. Did the malfunction only occurrence over a large number of drive cycles, indicating an unusual condition present when it occurred? Does the malfunction occur infrequently over a large number of drive cycles, indicating that special diagnosis techniques may be required to identify the source of the malfunction?

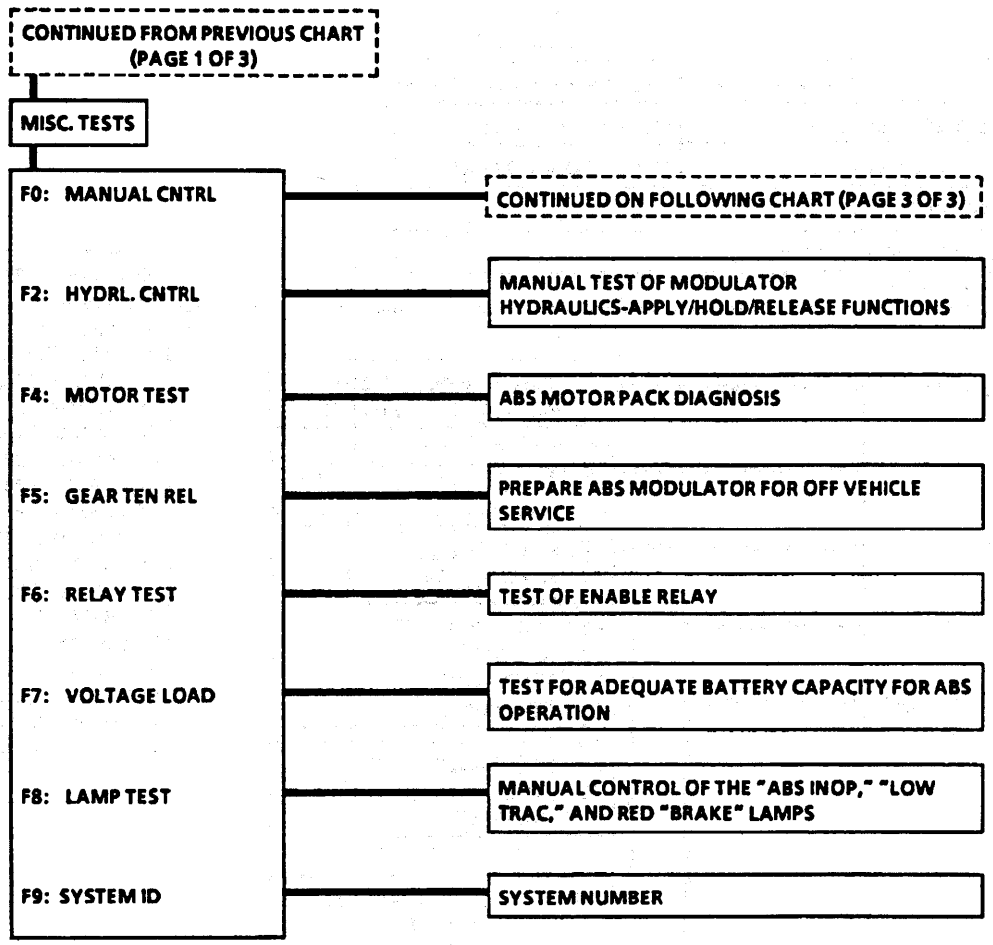
If, for example, a malfunction occurred 1 out of 50 drive cycles, the malfunction is intermittent and has not recurred for 49 drive cycles. This malfunction may be difficult or impossible to duplicate and may have been caused by a severe vehicle impact (large pot hole, speed bump at high speed, etc.) that momentarily opened an electrical connection or caused unusual vehicle suspension movement. Problem resolution is unlikely, and the problem may never recur (check diagnostic aids provided for that DTC). If, for example, the malfunction occurred 3 out of 15 drive cycles, the odds of finding the cause are still not good, but you know how often it occurs. If the malfunction occurred 10 out of 20 drive cycles, the odds of finding the cause are very good, as the malfunction may be easily reproduced. By using the additional malfunction data, you can also determine if a malfunction is randomly intermittent or if it has not recurred for long periods of time due to weather changes or a repair prior to this visit.

Say a DTC occurred 10 of 20 drive cycles but has not recurred for 10 drive cycles. This means the malfunction occurred 10 of 10 drive cycles but has not reoccurred since. A significant environmental change or a repair may have occurred 10 drive cycles ago. A repair may not be necessary if customer information can confirm a recent repair. If no repair was made, the service technician can focus on diagnosis techniques used to locate difficult-to-recreate problems, such as those suggested in "Diagnostic Aids" for the DTC in question.

DIAGNOSTIC PROCESS
(Page 1 of 3)

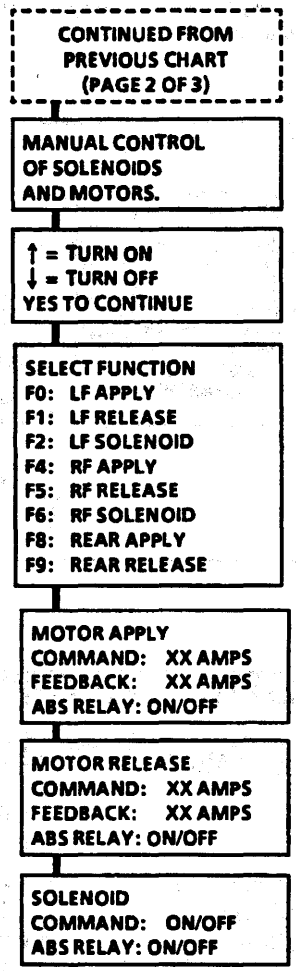


DIAGNOSTIC PROCESS
(Page 2 of 3)

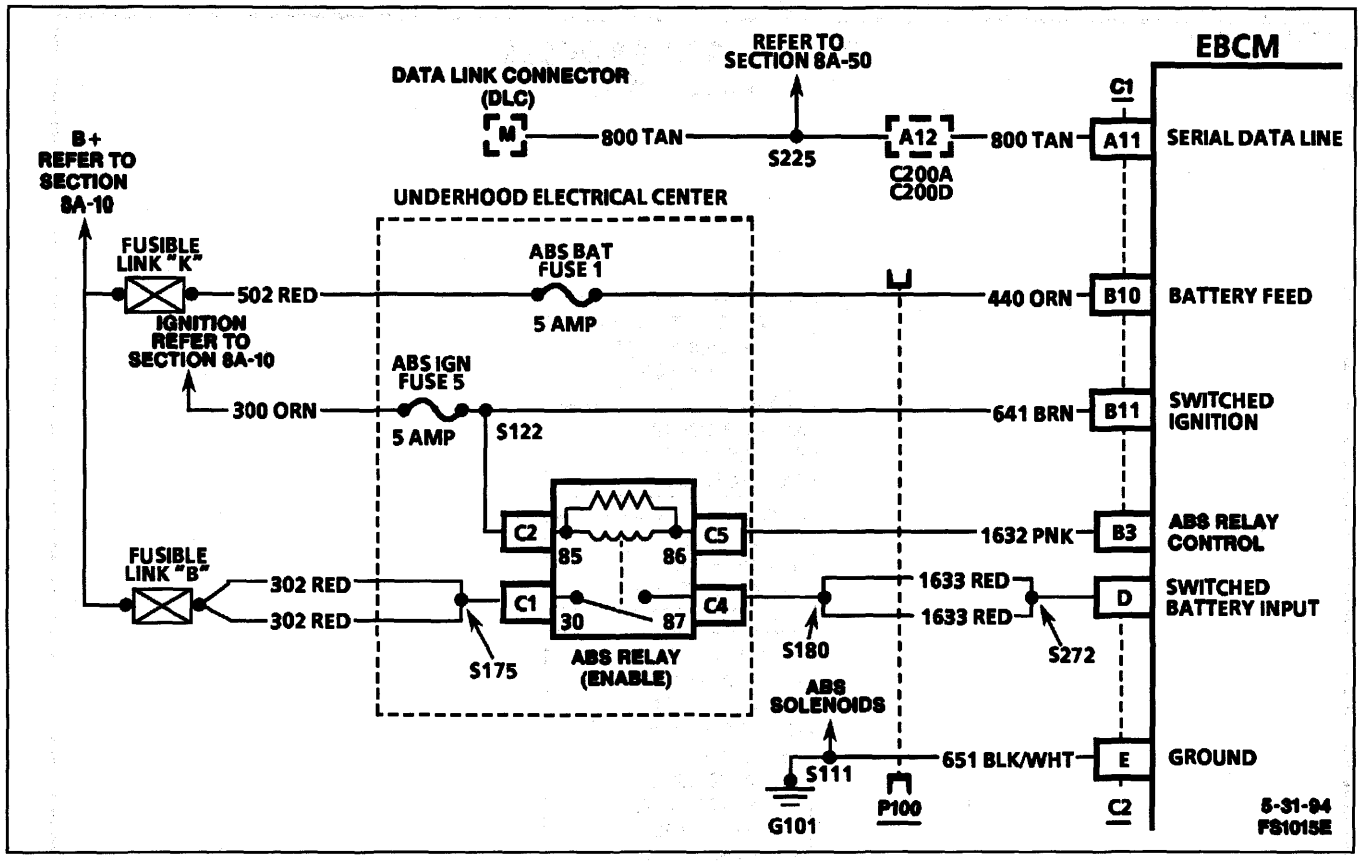


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DIAGNOSTIC PROCESS
(Page 3 of 3)



C1596S



DIAGNOSTIC SYSTEM CHECK
(Page 1 of 4)

System Description:

The diagnostic system check is an organized approach to identifying a problem created by an Antilock Brake Control System (ABS VI) malfunction. It must be the starting point for any ABS VI complaint diagnosis because it directs the service technician to the next logical step in diagnosing the complaint.

Serial data is transmitted by the EBCM through terminal "A11". The EBCM is supplied switched ignition voltage through terminal "B11", battery voltage through terminal "B10" and switched battery voltage through terminal "D". The EBCM ground is provided through terminal "E".

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Indicates if EBCM is transmitting data.
2. Checks for a serial data line malfunction.
3. Checks for proper Tech 1 connection to DLC.
4. Checks for open ABS BAT 5 amp Fuse 1.
5. Checks for open ABS IGN 5 amp Fuse 5.
6. Checks for high resistance in the EBCM ground circuit.
7. Checks for current DTCs.
8. Checks for proper ABS warning lamp operation.
9. Checks for history DTCs.

Diagnostic Aids:

Excessive resistance in the ground or power supply circuits will not allow communication with the EBCM. If communication with the EBCM is not possible, ensure the ABS VI ground connection is good and that there is no excessive resistance in any of the power supply circuits.

DIAGNOSTIC SYSTEM CHECK

(Page 1 of 4)

NOTICE: ENSURE MASS STORAGE CARTRIDGE IS UPDATED TO INCLUDE THE LATEST AVAILABLE VERSION OF THE CHASSIS APPLICATION.

1
- VERIFY ALL EBCM CONNECTORS ARE CONNECTED PROPERLY.
- INSTALL TECH 1.
- IGNITION "ON."
- WITHIN ABS PORTION OF MASS STORAGE CARTRIDGE CHASSIS APPLICATION, SELECT "F0: DATA LIST."

IS DATA BEING RECEIVED FROM THE EBCM?

NO

2 DOES TECH 1 DISPLAY "NO COMMUNICATIO N WITH VEHICLE. CHECK DLC CONNECTOR"?

NO

3
- ENSURE TECH 1 DLC CONNECTOR IS CONNECTED PROPERLY TO DLC.

IS CONNECTION GOOD?

NO

RECONNECT TECH 1 DLC CONNECTOR. RETURN TO FIRST STEP IN THIS CHART.

YES

4
- IGNITION "OFF."
- REMOVE AND INSPECT ABS/BAT FUSE 1, 5 AMP.

IS FUSE BLOWN?

NO

5
- INSTALL ABS/BAT FUSE 1, 5 AMP.
- REMOVE AND INSPECT ABS/IGN FUSE 5, 5 AMP.

IS FUSE BLOWN?

NO

6
- DISCONNECT NEGATIVE BATTERY CABLE.
- INSTALL ABS/IGN FUSE 5, 5 AMP.
- DISCONNECT 8-WAY EBCM CONNECTOR.
- USING J 39200, MEASURE RESISTANCE BETWEEN THE NEGATIVE BATTERY TERMINAL AND 8-WAY EBCM HARNESS CONNECTOR TERMINAL "E".

IS RESISTANCE 2Ω OR LESS?

YES

GO TO PAGE 4 OF 4 OF THIS DIAGNOSTIC SYSTEM CHECK.

NO

REPAIR OPEN OR HIGH RESISTANCE IN CKT 651. RETURN TO FIRST STEP IN THIS CHART.

YES

GO TO PAGE 3 OF 4 OF THIS DIAGNOSTIC SYSTEM CHECK.

YES

GO TO PAGE 2 OF 4 OF THIS DIAGNOSTIC SYSTEM CHECK.

YES

REFER TO SECTION 8A-50.

7
- SELECT "F2: DTC(s)."

ARE ANY CURRENT DTCs DISPLAYED?

YES

REFER TO APPLICABLE DTC CHART.

NO

8
- IGNITION "OFF" FOR 10 SECONDS.
- TURN IGNITION "ON" AND OBSERVE "ABS INOP" LAMP.

DID LAMP ILLUMINATE FOR 3 SECONDS AND THEN GO "OFF"?

YES

9
- SELECT "F1: DTC HISTORY."

ARE ANY HISTORY DTCs PRESENT?

NO

TO FURTHER DIAGNOSE CUSTOMER COMPLAINT, REFER TO "DIAGNOSTIC PROCESS," STEP 3, IN THIS SECTION.

YES

REVIEW "ENHANCED DIAGNOSTICS" INFORMATION IN THIS SECTION.

NO

DOES "ABS INOP" LAMP ILLUMINATE INTERMITTENTLY?

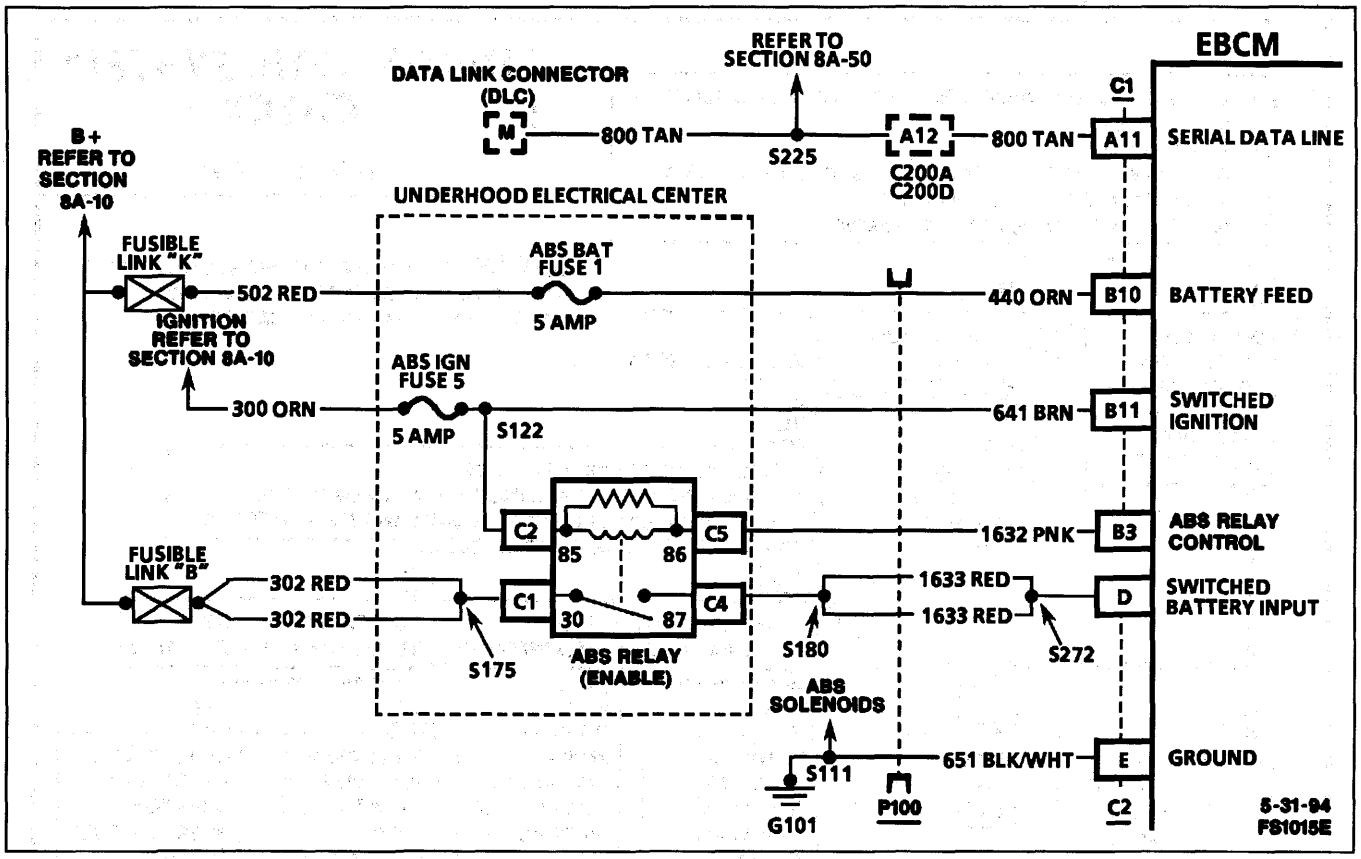
NO

GO TO CHART A FOR "ABS INOP" LAMP "ON" OR "OFF". CONSTANTLY, NO DTCs STORED.

YES

GO TO CHART B FOR "ABS INOP" LAMP "ON" INTERMITTENTLY , NO DTCs STORED.

C1597S



DIAGNOSTIC SYSTEM CHECK
(Page 2 of 4)

System Description:

The diagnostic system check is an organized approach to identifying a problem created by an Antilock Brake Control System (ABS VI) malfunction. It must be the starting point for any ABS VI complaint diagnosis because it directs the service technician to the next logical step in diagnosing the complaint.

Serial data is transmitted by the EBCM through terminal "A11". The EBCM is supplied switched ignition voltage through terminal "B11", battery voltage through terminal "B10" and switched battery voltage through terminal "D". The EBCM ground is provided through terminal "E".

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

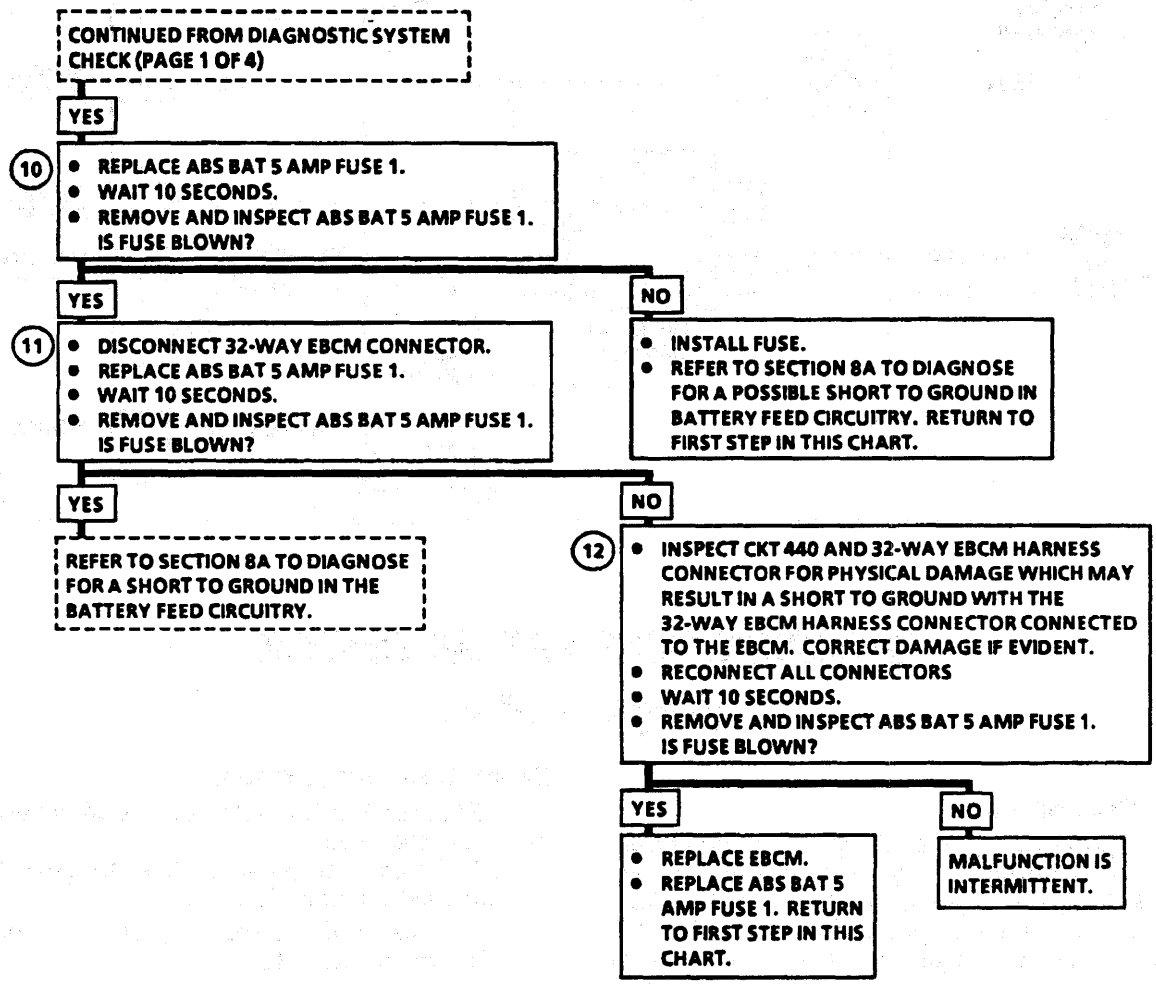
10. Checks for possible short to ground in the battery feed circuitry.
11. Checks for possible short to ground in the EBCM.
12. Ensures short to ground is not due to physical damage of the circuitry.

Diagnostic Aids:

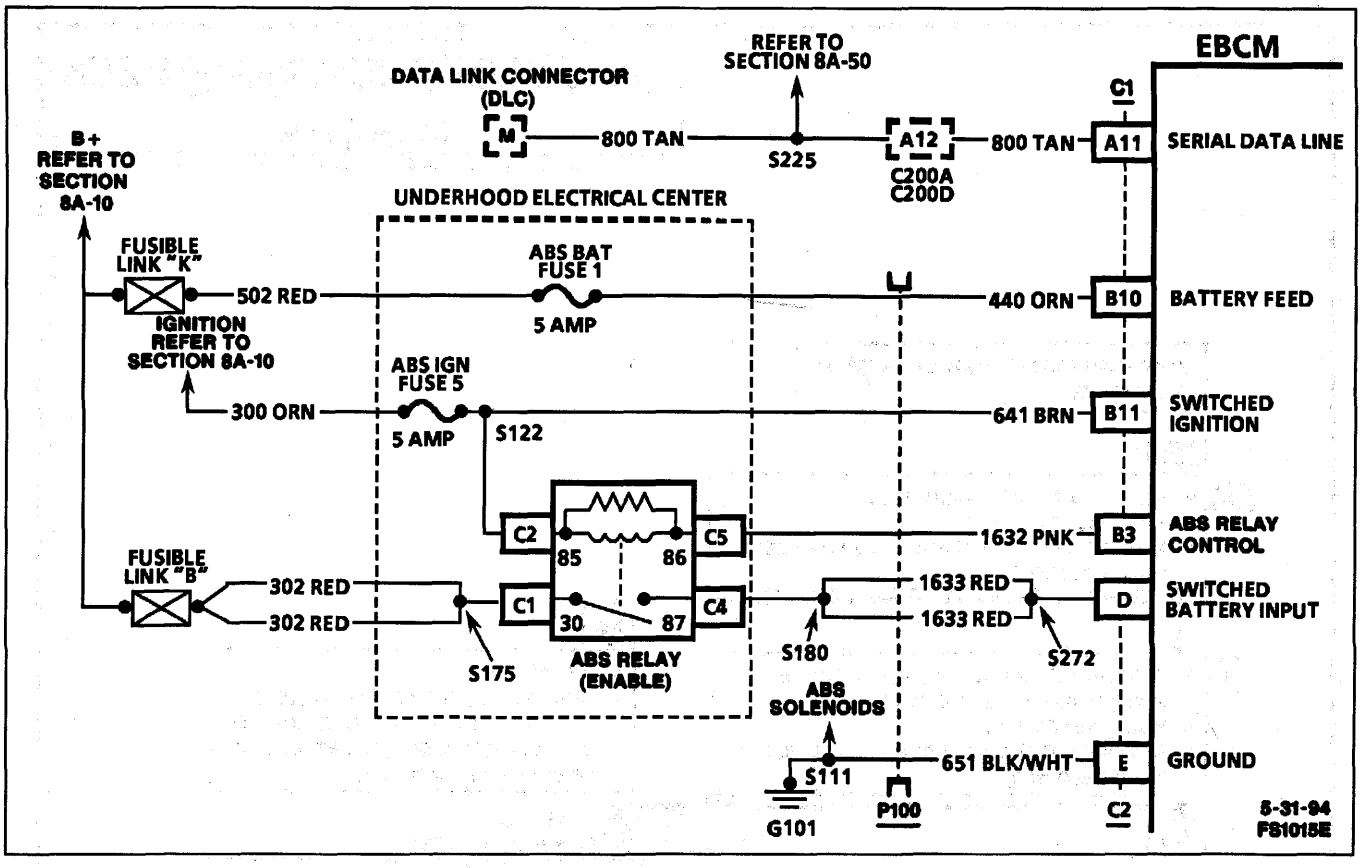
Excessive resistance in the ground or power supply circuits will not allow communication with the EBCM. If communication with the EBCM is not possible, ensure the ABS VI ground connection is good and that there is no excessive resistance in any of the power supply circuits.

DIAGNOSTIC SYSTEM CHECK

(Page 2 of 4)



C1598S



DIAGNOSTIC SYSTEM CHECK
(Page 3 of 4)

System Description:

The diagnostic system check is an organized approach to identifying a problem created by an Antilock Brake Control System (ABS VI) malfunction. It must be the starting point for any ABS VI complaint diagnosis because it directs the service technician to the next logical step in diagnosing the complaint.

Serial data is transmitted by the EBCM through terminal "A11". The EBCM is supplied switched ignition voltage through terminal "B11", battery voltage through terminal "B10" and switched battery voltage through terminal "D". The EBCM ground is provided through terminal "E".

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

13. Checks for possible short to ground in the switched ignition circuitry.
14. Isolates the short to ground to either the circuitry or the EBCM.
15. Ensures short to ground is not due to physical damage of the circuitry.

Diagnostic Aids:

Excessive resistance in the ground or power supply circuits will not allow communication with the EBCM. If communication with the EBCM is not possible, ensure the ABS VI ground connection is good and that there is no excessive resistance in any of the power supply circuits.

DIAGNOSTIC SYSTEM CHECK

(Page 3 of 4)

CONTINUED FROM DIAGNOSTIC SYSTEM CHECK (PAGE 1 OF 4)

YES

(13)
- REPLACE 5 AMP ABS IGN FUSE 5.
- IGNITION "ON."
- WAIT 10 SECONDS THEN TURN IGNITION "OFF."
- REMOVE AND INSPECT 5 AMP ABS IGN FUSE 5. IS FUSE BLOWN?

YES

(14)
- DISCONNECT 32-WAY EBCM CONNECTOR.
- REPLACE 5 AMP ABS IGN FUSE 5.
- IGNITION "ON."
- WAIT 10 SECONDS THEN TURN IGNITION "OFF."
- REMOVE AND INSPECT 5 AMP ABS IGN FUSE 5. IS FUSE BLOWN?

NO

INSTALL 5 AMP ABS IGN FUSE 5. REFER TO SECTION 8A TO DIAGNOSE FOR A POSSIBLE SHORT TO GROUND IN THE SWITCHED IGNITION CIRCUITRY. RETURN TO FIRST STEP IN THIS CHART.

NO

(15)
- INSPECT CKT 641 AND 32-WAY EBCM HARNESS CONNECTOR FOR PHYSICAL DAMAGE WHICH MAY RESULT IN A SHORT TO GROUND WITH THE 32-WAY EBCM HARNESS CONNECTOR CONNECTED TO THE EBCM. CORRECT DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- IGNITION "ON."
- WAIT 10 SECONDS THEN TURN IGNITION "OFF."
- REMOVE AND INSPECT 5 AMP ABS IGN FUSE 5. IS FUSE BLOWN?

YES

REFER TO SECTION 8A TO REPAIR A SHORT TO GROUND IN ONE OF THE CKT 641 BRANCHES EXITING THE 5 AMP ABS IGN FUSE 5. REPLACE 5 AMP ABS IGN FUSE 5. RETURN TO THE FIRST STEP IN THIS CHART.

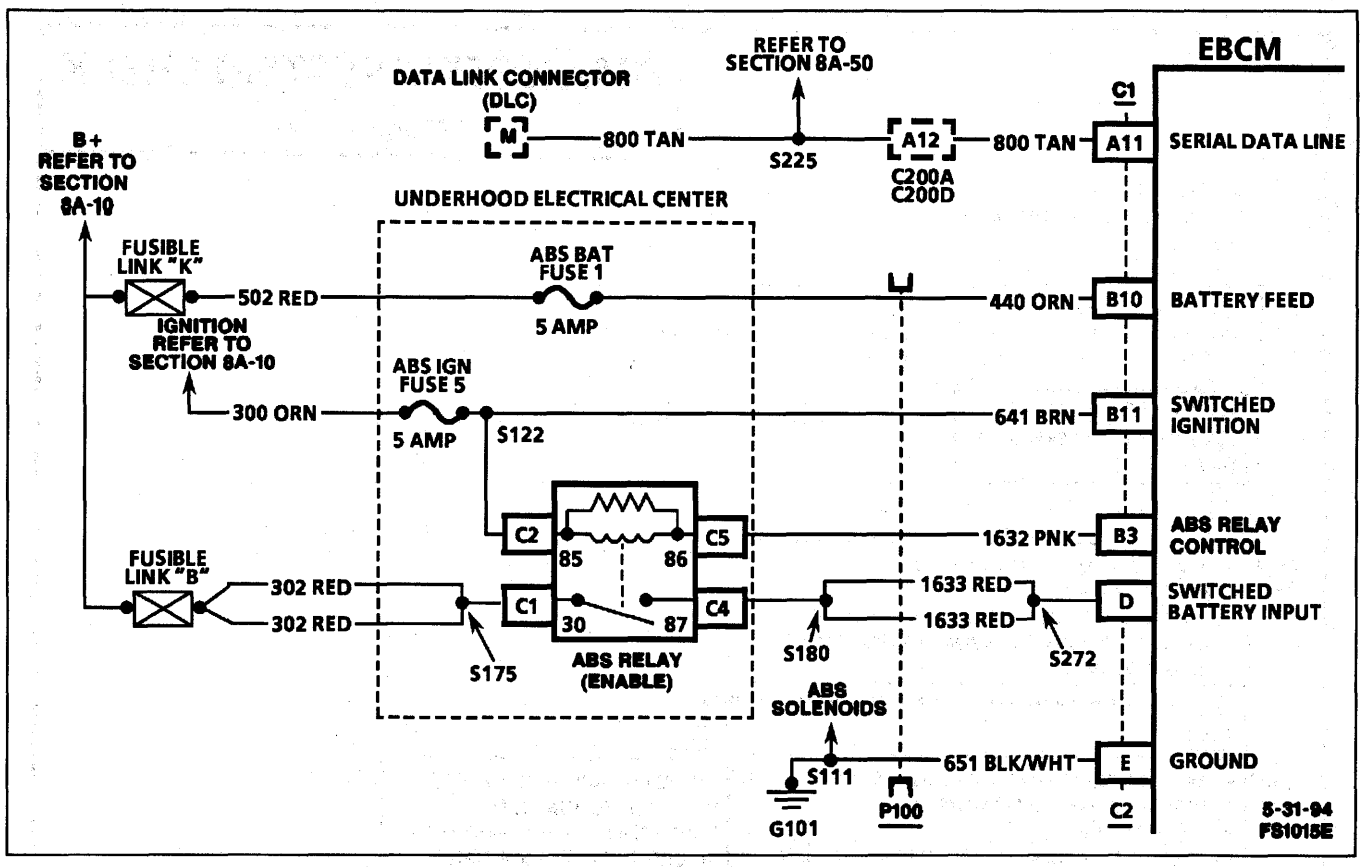
YES

REPLACE EBCM. REPLACE 5 AMP ABS IGN FUSE 5. RETURN TO FIRST STEP IN THIS CHART.

NO

MALFUNCTION IS INTERMITTENT.

C1599S



DIAGNOSTIC SYSTEM CHECK
(Page 4 of 4)

System Description:

The diagnostic system check is an organized approach to identifying a problem created by an Antilock Brake Control System (ABS VI) malfunction. It must be the starting point for any ABS VI complaint diagnosis because it directs the service technician to the next logical step in diagnosing the complaint.

Serial data is transmitted by the EBCM through terminal "A11". The EBCM is supplied switched ignition voltage through terminal "B11", battery voltage through terminal "B10" and switched battery voltage through terminal "D". The EBCM ground is provided through terminal "E".

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

16. Checks for proper battery voltage at the EBCM.
17. Checks for high resistance in the battery feed circuitry.
18. Checks for high resistance in the switched ignition feed circuitry.
19. Ensures malfunction is not due to poor terminal contact.
20. Checks for high resistance in the switched ignition circuit between the fuse block and the EBCM.

Diagnostic Aids:

Excessive resistance in the ground or power supply circuits will not allow communication with the EBCM. If communication with the EBCM is not possible, ensure the ABS VI ground connection is good and that there is no excessive resistance in any of the power supply circuits.

DIAGNOSTIC SYSTEM CHECK

(Page 4 of 4)

CONTINUED FROM DIAGNOSTIC SYSTEM CHECK (PAGE 1 OF 4)

16
- DISCONNECT 32-WAY EBCM CONNECTOR.
- USING J 39200, MEASURE VOLTAGE BETWEEN GROUND AND 32-WAY EBCM HARNESS CONNECTOR TERMINAL "B10".

IS VOLTAGE GREATER THAN 10 VOLTS?

YES

17
- DISCONNECT POSITIVE BATTERY CABLE.
- USING J 39200, MEASURE RESISTANCE BETWEEN POSITIVE BATTERY CABLE TERMINAL AND 32-WAY EBCM HARNESS CONNECTOR TERMINAL "B10".

IS RESISTANCE 2Ω OR LESS?

YES

18
- IGNITION "ON." (THIS IS DONE TO PROVIDE CIRCUIT CONTINUITY.)
- USING J 39200, MEASURE RESISTANCE BETWEEN POSITIVE BATTERY CABLE TERMINAL AND 32-WAY EBCM HARNESS CONNECTOR TERMINAL "B11".

IS RESISTANCE 2Ω OR LESS?

YES

19
- INSPECT EBCM AND EBCM CONNECTOR TERMINALS FOR POOR TERMINAL CONTACT.
- INSPECT BATTERY TERMINALS AND BATTERY CABLE TERMINALS FOR A POOR CONNECTION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT."

IS POOR TERMINAL CONTACT OR A POOR CONNECTION EVIDENT?

NO

- RECONNECT EBCM CONNECTORS AND BATTERY CABLES. PROCEED TO SECTION 8A-50.

YES

REPLACE TERMINALS OR REPAIR POOR CONNECTION INTEGRITY. RETURN TO FIRST STEP IN THIS CHART.

NO

20
- IGNITION "OFF."
- REMOVE ABS IGN 5 AMP FUSE 5.
- USING J 39200, MEASURE RESISTANCE BETWEEN EACH ABS IGN 5 AMP FUSE 5 BLOCK TERMINAL AND 32-WAY EBCM HARNESS CONNECTOR TERMINAL "B11".

IS RESISTANCE 2Ω OR LESS FOR EITHER MEASUREMENT?

YES

REFER TO SECTION 8A TO REPAIR OPEN OR HIGH RESISTANCE BETWEEN POSITIVE BATTERY CABLE TERMINAL AND ABS IGN 5 AMP FUSE 5 BLOCK TERMINAL. RETURN TO THE FIRST STEP IN THIS CHART.

NO

REPAIR OPEN OR HIGH RESISTANCE IN CKT 641. INSTALL ABS IGN 5 AMP FUSE 5. RETURN TO FIRST STEP IN THIS CHART.

NO

REPAIR OPEN IN CKT 440. RETURN TO FIRST STEP IN THIS CHART.

NO

REPAIR HIGH RESISTANCE IN CKT 440. RETURN TO FIRST STEP IN THIS CHART.

C1600S

DIAGNOSTIC TROUBLE CODE AND SYMPTOM TABLE		PAGE #
CHART	**SYMPTOM**	
A	"ABS INOP" Lamp "ON" or "OFF" Constantly, No DTCs Stored	5E1-29
B	"ABS INOP" Lamp "ON" Intermittently, No DTCs Stored	5E1-30
C	"Low TRAC" Indicator Lamp "ON" With Ignition "OFF," No DTCs Stored	5E1-31
D	Tech 1 Displays Undefined DTCs	5E1-32
DIAGNOSTIC TROUBLE CODE	**DESCRIPTION**	
11	ABS Warning or Low Trac Lamp Ckt Malfunction (1 of 2)	5E1-34
14	ABS Enable Relay Contact Circuit Open (1 of 3)	5E1-38
15	ABS Rly Contact Ckt Short to Batt or Always Closed	5E1-44
16	ABS Enable Relay Coil Circuit Open	5E1-46
17	ABS Enable Relay Coil Circuit Shorted to Gnd	5E1-48
18	ABS Enable Relay Coil Circuit Shorted to Batt	5E1-50
21	Left Front Wheel Speed = 0	5E1-52
22	Right Front Wheel Speed = 0	5E1-54
24	Rear Wheel Speed = 0	5E1-56
25	Left Front Excessive Wheel Speed Variation	5E1-58
26	Right Front Excessive Wheel Speed Variation	5E1-60
28	Rear Excessive Wheel Speed Variation	5E1-62
32	LF Wheel Speed Snr Ckt Open or Short to Gnd/Batt (1 of 3)	5E1-64
33	RF Wheel Speed Snr Ckt Open or Short to Gnd/Batt (1 of 3)	5E1-70
35	RR Wheel Speed Snr Ckt Open or Short to Gnd/Batt (1 of 3)	5E1-76
36	Low System Voltage (1 of 2)	5E1-82
37	High System Voltage	5E1-86
38	Left Front ESB Will Not Hold Motor	5E1-88
41	Right Front ESB Will Not Hold Motor	5E1-90
42	Rear ESB Will Not Hold Motor	5E1-92
44	Left Front ABS Channel Will Not Move	5E1-94
45	Right Front ABS Channel Will Not Move	5E1-96
46	Rear ABS Channel Will Not Move	5E1-98
47	Left Front ABS Motor Free Spins (1 of 2)	5E1-100
48	Right Front ABS Motor Free Spins (1 of 2)	5E1-104
51	Rear ABS Motor Free Spins (1 of 2)	5E1-108
52	Left Front ABS Channel in Release Too Long	5E1-112
53	Right Front ABS Channel in Release Too Long	5E1-114
54	Rear ABS Channel in Release Too Long	5E1-116
55	EBCM Malfunction	5E1-118
56	Left Front ABS Motor Circuit Open	5E1-120
57	Left Front ABS Motor Circuit Shorted to Gnd	5E1-122
58	Left Front ABS Motor Circuit Shorted to Batt	5E1-124
61	Right Front ABS Motor Circuit Open	5E1-126
62	Right Front ABS Motor Circuit Shorted to Gnd	5E1-128
63	Right Front ABS Motor Circuit Shorted to Batt	5E1-130
64	Rear ABS Motor Circuit Open	5E1-132
65	Rear ABS Motor Circuit Shorted to Gnd	5E1-134

T5148

DIAGNOSTIC TROUBLE CODE AND SYMPTOM TABLE		PAGE #
CHART	SYMPTOM	
66	Rear ABS Motor Circuit Open Shorted to Batt	5E1-136
76	Left Front Sol Circuit Open or Shorted to Batt	5E1-138
77	Left Front Solenoid Circuit Shorted to Gnd	5E1-140
78	Right Front Sol Circuit Open or Shorted to Batt	5E1-142
81	Right Front Solenoid Circuit Shorted to Gnd	5E1-144
82	Calibration Malfunction	5E1-146
86	EBCM Turned "ON" the Red "BRAKE" Warning Lamp	5E1-148
87	Red "BRAKE" Warning Lamp Circuit Open	5E1-150
88	Red "BRAKE" Warning Lamp Ckt Shorted to Batt	5E1-152
91	Open Brake Switch During Deceleration	5E1-154
92	Open Brake Switch When ABS Was Required	5E1-156
93	DTC 91 or 92 Set in Current or Prev. Ign. Cycle	5E1-158
94	Brake Switch Contacts Always Closed	5E1-160
95	Brake Switch Circuit Open	5E1-162
96	Rear Brake Lamp Circuit Open	5E1-164

T5148(Cont'd)

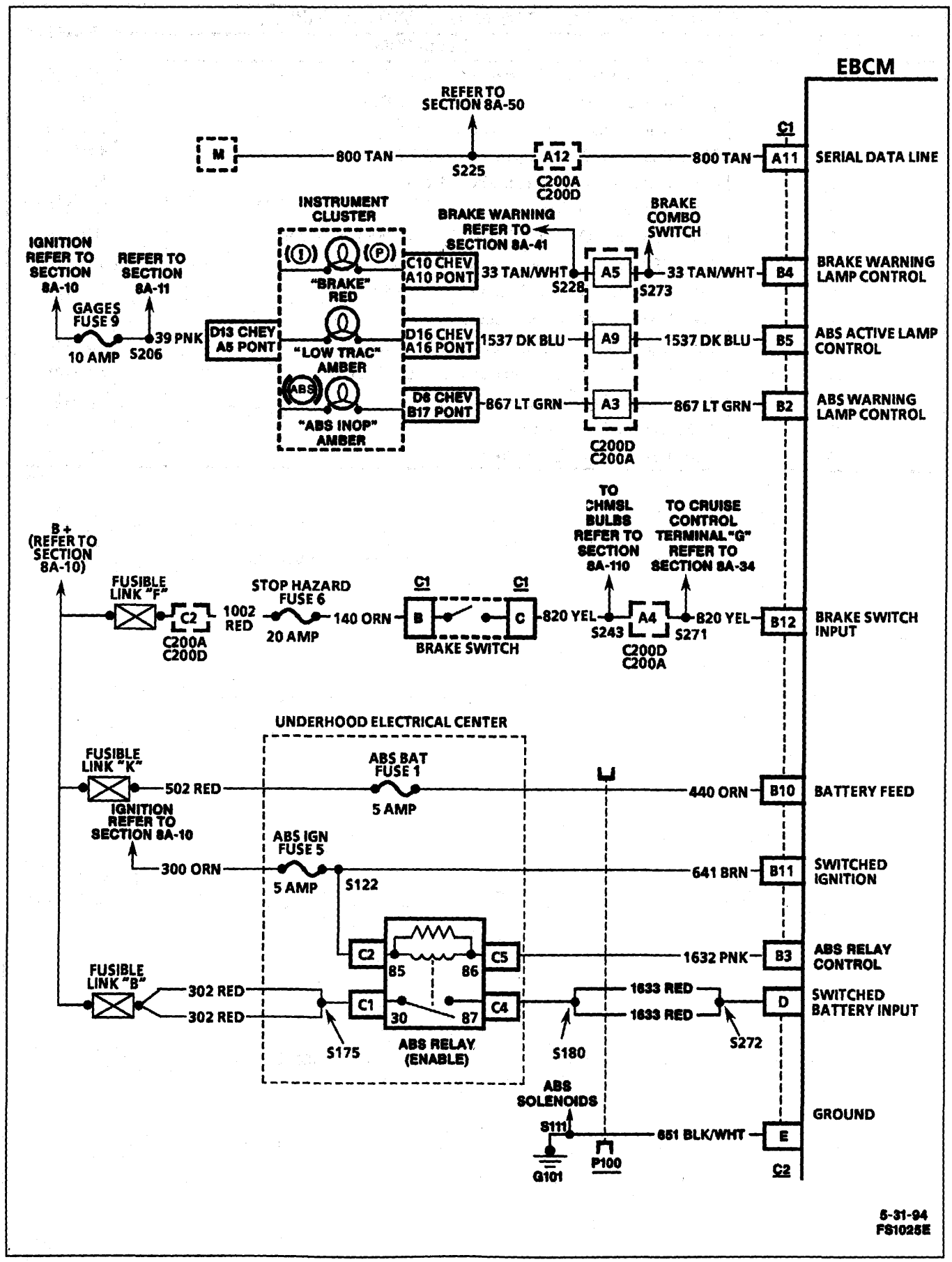


Figure 6 - Wiring Diagram (1 of 2)

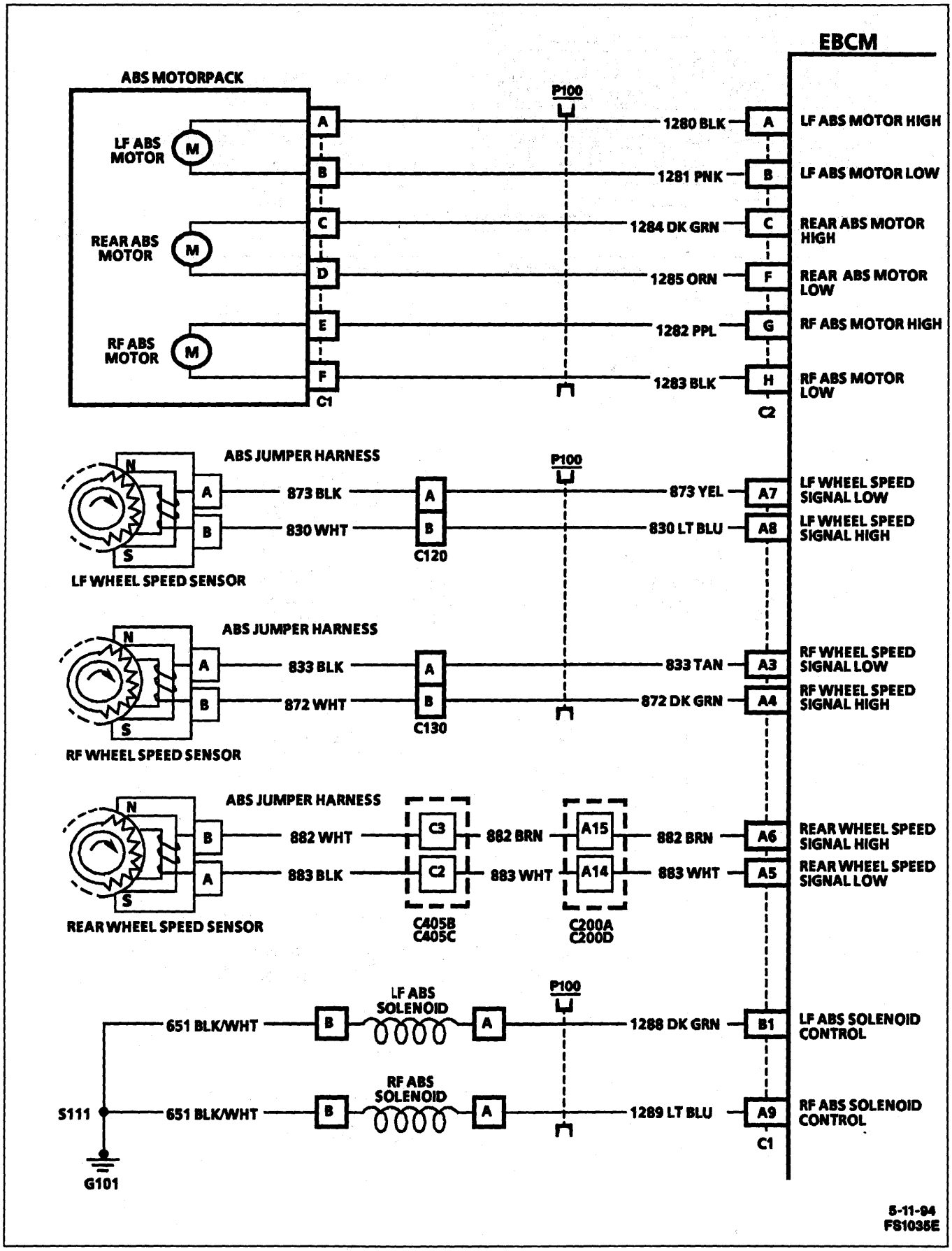
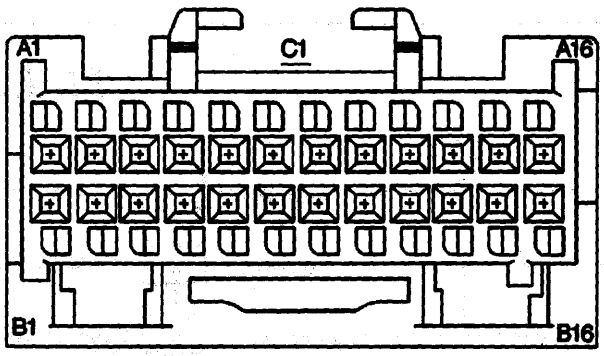


Figure 7 - Wiring Diagram (2 of 2)



32 – WAY F MICRO – PACK 100 SERIES
DK RED

ELECTRONIC BRAKE/TRACTION
CONTROL MODULE (EBTCM)

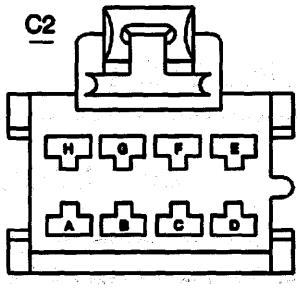
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FS0125E

Figure 8 - EBCM Connector Face View (1 of 2)

EBCM 32-WAY CONNECTOR

CONNECTOR TERMINAL	CIRCUIT NO.	COLOR	CIRCUIT DESCRIPTION
A1	PLUGGED		NOT USED
A2	PLUGGED		NOT USED
A3	833	TAN	RF WHEEL SPEED SIGNAL LOW
A4	872	DK GRN	RF WHEEL SPEED SIGNAL HIGH
A5	883	WHT	REAR WHEEL SPEED SIGNAL LOW
A6	882	BRN	REAR WHEEL SPEED SIGNAL HIGH
A7	873	YEL	LF WHEEL SPEED SIGNAL LOW
A8	830	LT BLU	LF WHEEL SPEED SIGNAL HIGH
A9	1289	LT BLU	RF ABS SOLENOID CONTROL
A10	PLUGGED		NOT USED
A11	800	TAN	SERIAL DATA LINE
A12	PLUGGED		NOT USED
A13	PLUGGED		NOT USED
A14	PLUGGED		NOT USED
A15	PLUGGED		NOT USED
A16	PLUGGED		NOT USED
B1	1288	DK GRN	LF ABS SOLENOID CONTROL
B2	867	LT GRN	ABS WARNING LAMP CONTROL
B3	1632	PNK	ABS ENABLE RELAY CONTROL
B4	33	TAN/WHT	BRAKE WARNING LAMP CONTROL
B5	1537	DK BLU	ABS ACTIVE LAMP CONTROL
B6	PLUGGED		NOT USED
B7	PLUGGED		NOT USED
B8	PLUGGED		NOT USED
B9	PLUGGED		NOT USED
B10	440	ORN	BATTERY FEED
B11	641	BRN	SWITCHED IGNITION
B12	820	YEL	BRAKE SWITCH INPUT
B13	PLUGGED		NOT USED
B14	PLUGGED		NOT USED
B15	PLUGGED		NOT USED
B16	PLUGGED		NOT USED

C1601S



ELECTRONIC BRAKE/TRACTION CONTROL MODULE (EBTCM)

8 – WAY F METRI – PACK 280 SERIES
LR GRY

5-28-94
FS0135E

Figure 9 - EBCM Connector Face View (2 of 2)

EBCM 8-WAY CONNECTOR

PIN	CIRCUIT NO.	COLOR	CIRCUIT
A	1280	BLK	LF ABS MOTOR HIGH
B	1281	PNK	LF ABS MOTOR LOW
C	1284	DK GRN	REAR ABS MOTOR HIGH
D	1633	RED	SWITCHED BATTERY
E	651	BLK/WHT	GROUND
F	1285	ORN	REAR ABS MOTOR LOW
G	1282	PPL	RF ABS MOTOR HIGH
H	1283	BLK	RF ABS MOTOR LOW

C1602S

CHART A
"ABS INOP" LAMP "ON" OR "OFF" CONSTANTLY, NO DTCs STORED

NOTICE: DIAGNOSTIC SYSTEM CHECK MUST BE COMPLETED BEFORE USING THIS CHART.

- IGNITION "OFF."
- INSTALL TECH 1.
- IGNITION "ON."
- USING TECH 1, SELECT "F4: MISC. TESTS."
- SELECT "F8: LAMP TEST" AND ATTEMPT TO TURN "ON" THE "ABS INOP" LAMP.

DID THE "ABS INOP" LAMP TURN "ON"?

YES

- USING TECH 1 LAMP TEST, ATTEMPT TO "FLASH" THE "ABS INOP" LAMP.

DID THE "ABS INOP" LAMP "FLASH"?

YES

MALFUNCTION IS NOT PRESENT AT THIS TIME. INTERMITTENTS COULD BE CAUSED BY INCORRECT WIRING HARNESS ROUTING OR LOOSE CONNECTIONS. INSPECT ALL CONNECTORS AND TERMINALS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.

NO

INSPECT THE "ABS INOP" BULB TO VERIFY BULB IS GOOD. REPLACE ANY BLOWN BULBS. IF BULB IS GOOD, REFER TO SECTION 8A-81 FOR FURTHER DIAGNOSIS OF INSTRUMENT CLUSTER.

C1603S

CHART B

"ABS INOP" LAMP "ON" INTERMITTENTLY, NO DTCs STORED

NOTICE: DIAGNOSTIC SYSTEM CHECK MUST BE COMPLETED BEFORE USING THIS CHART.

1
- IGNITION "OFF."
- DISCONNECT 8-WAY EBCM CONNECTOR.
- DISCONNECT NEGATIVE BATTERY TERMINAL.
- DISCONNECT POSITIVE BATTERY TERMINAL.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN THE NEGATIVE BATTERY CABLE TERMINAL AND TERMINAL "E" OF THE 8-WAY EBCM HARNESS CONNECTOR.
- OBSERVE MEASURED RESISTANCE WHILE "WIGGLING" WIRE HARNESS AND CONNECTORS.

IS RESISTANCE ALWAYS 2Ω OR LESS?

YES

2
- DISCONNECT 32-WAY EBCM CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN POSITIVE BATTERY CABLE TERMINAL AND TERMINAL "B10" OF THE 32-WAY EBCM HARNESS CONNECTOR.
- OBSERVE MEASURED RESISTANCE WHILE "WIGGLING" WIRE HARNESS AND CONNECTORS.

IS RESISTANCE ALWAYS 2Ω OR LESS?

YES

3
- TURN IGNITION SWITCH "ON" (THIS IS DONE TO COMPLETE THE IGNITION CIRCUIT).
- USING J 39200, MEASURE THE RESISTANCE BETWEEN POSITIVE BATTERY CABLE TERMINAL AND TERMINAL "B11" OF THE 32-WAY EBCM HARNESS CONNECTOR.
- OBSERVE MEASURED RESISTANCE WHILE "WIGGLING" WIRE HARNESS AND CONNECTORS.

IS RESISTANCE ALWAYS 2Ω OR LESS?

YES

4
- CHECK POSITIVE BATTERY TERMINAL AND POSITIVE BATTERY CABLE TERMINAL FOR A POOR CONNECTION.
- INSPECT TERMINALS "B11" AND "B10" OF THE 32-WAY EBCM CONNECTOR AND TERMINAL "E" OF THE 8-WAY EBCM CONNECTOR FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT."

IS THERE EVIDENCE OF POOR TERMINAL CONTACT OR CORROSION?

NO

5
- IGNITION "OFF."
- RECONNECT ALL CONNECTORS.
- IGNITION "ON."

IS "ABS INOP" LAMP "ON" INTERMITTENTLY WITH NO DTCs SET?

NO

MALFUNCTION IS NOT PRESENT AT THIS TIME. INTERMITTENTS MAY BE CAUSED BY INCORRECT WIRING HARNESS ROUTING OR LOOSE GROUND CONNECTIONS. REFER TO SECTION 8A-4, "INTERMITTENTS AND POOR CONNECTIONS."

YES

REPLACE EBCM.

NO

REPAIR INTERMITTENT OPEN OR HIGH RESISTANCE IN CKT 651. REFER TO SECTION 8A-4, "INTERMITTENTS AND POOR CONNECTIONS."

NO

REPAIR INTERMITTENT OPEN OR HIGH RESISTANCE IN CKTs 440 OR 502. REFER TO SECTION 8A-4, "INTERMITTENTS AND POOR CONNECTIONS."

NO

REPAIR INTERMITTENT OPEN OR HIGH RESISTANCE IN CKTs 641 OR 300. REFER TO SECTION 8A-4, "INTERMITTENTS AND POOR CONNECTIONS."

YES

REPLACE TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR SIGNS OF CORROSION. REPAIR CONNECTION INTEGRITY IF POOR CONTACT EXISTS AT BATTERY.

C1604S

CHART C

"LOW TRAC" INDICATOR LAMP "ON" WITH IGNITION "OFF," NO DTCs STORED

NOTICE: DIAGNOSTIC SYSTEM CHECK MUST BE COMPLETED BEFORE USING THIS CHART.

- IGNITION "OFF."
- OBSERVE THE "LOW TRAC" INDICATOR LAMP. IS THE "LOW TRAC" INDICATOR LAMP "ON"?

NO

MALFUNCTION IS NOT PRESENT AT THIS TIME. INTERMITTENTS COULD BE CAUSED BY INCORRECT WIRING HARNESS ROUTING OR LOOSE CONNECTIONS. INSPECT ALL CONNECTORS AND TERMINALS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.

YES

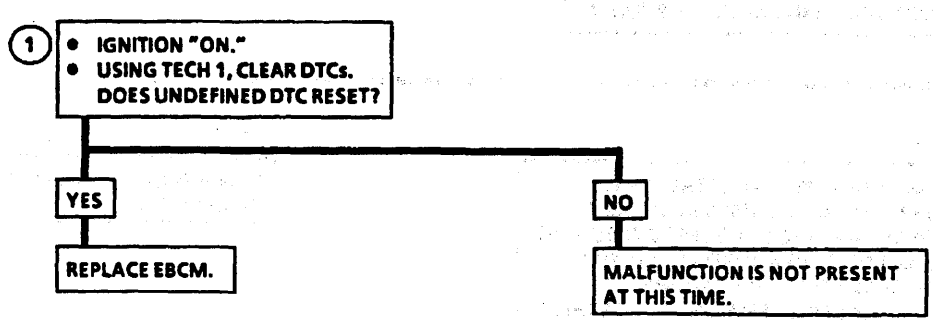
REPAIR SHORT TO VOLTAGE ON CKT 1537.

C1605S

CHART D
TECH 1 DISPLAYS UNDEFINED DTCs

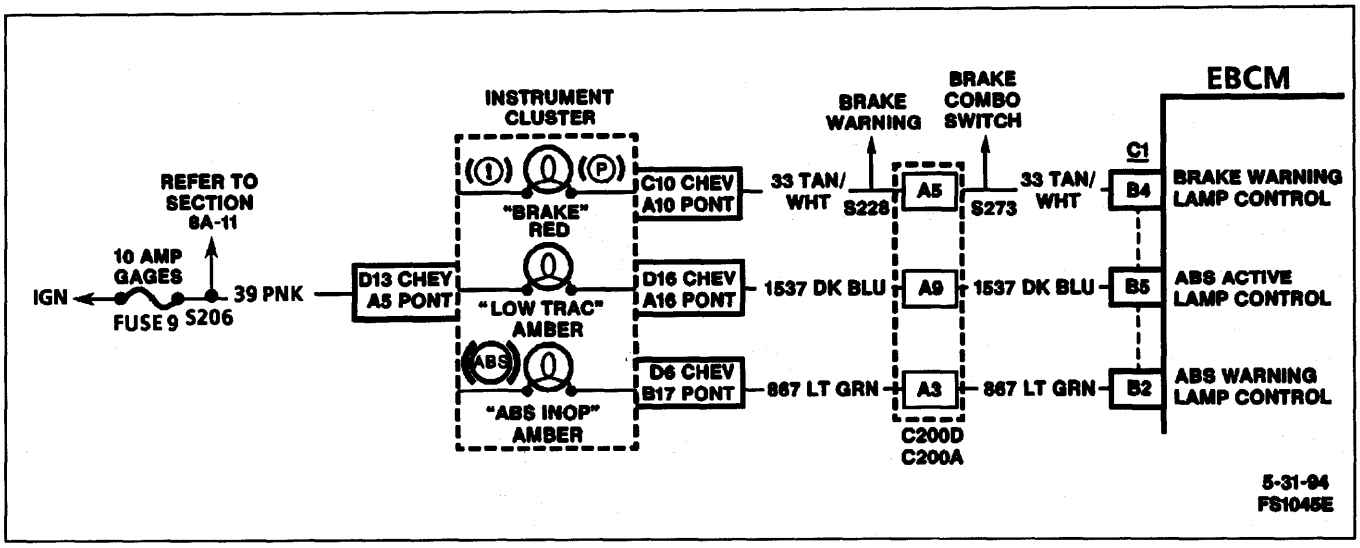
Important

- USE THIS CHART IF ANY OF THE FOLLOWING UNDEFINED DTCs ARE SET - 12, 13, 23, 27, 31, 34, 43, 67, 68, 71, 72, 73, 75, 83, 84, 85, 97, OR 98.



C1606S

BLANK



DTC 11
(Page 1 of 2)
ABS WARNING OR LOW TRAC LAMP CKT MALFUNCTION

Circuit Description:

This DTC checks the state of both the amber ABS warning lamp, and the amber ABS active lamp, "LOW TRAC" to identify a situation in which the driver could not be alerted to a system malfunction or of possible slippery driving conditions. Due to an integral lamp driver module within the instrument panel cluster, the EBCM must provide a ground to turn the amber ABS warning lamp "OFF." The amber ABS active lamp circuit is such that the EBCM provides a ground to turn "ON" the amber ABS active lamp.

DTC Will Set When:

DTC 11 can only be set during the three second bulb check or when either of the lamps are commanded "ON." If the EBCM cannot control either the amber ABS warning lamp or the amber ABS active lamp for two seconds, a malfunction exists.

Action Taken:

A malfunction DTC is stored; however, ABS is not disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Determines if the ABS warning lamp can be properly controlled.
2. Determines if the ABS warning lamp is "ON" constantly.
3. Checks for other DTCs which could turn "ON" the ABS warning lamp.
4. Determines if the ABS warning lamp can be turned "OFF" manually.
5. Checks the integrity of the ABS warning lamp circuitry.
6. Checks for a short to voltage on the ABS warning lamp circuitry.
7. Determines if a malfunctioning EBCM is the cause of DTC 11.
8. Verifies that the other I/P indicator lamps function properly.
9. Determines if the ABS warning lamp can be turned "ON" manually.
10. Checks for a short to ground in the ABS warning lamp circuitry.
11. Verifies condition of the 10 amp "GAGES" Fuse 9.
12. Determines if DTC 11 was set due to an EBCM malfunction.

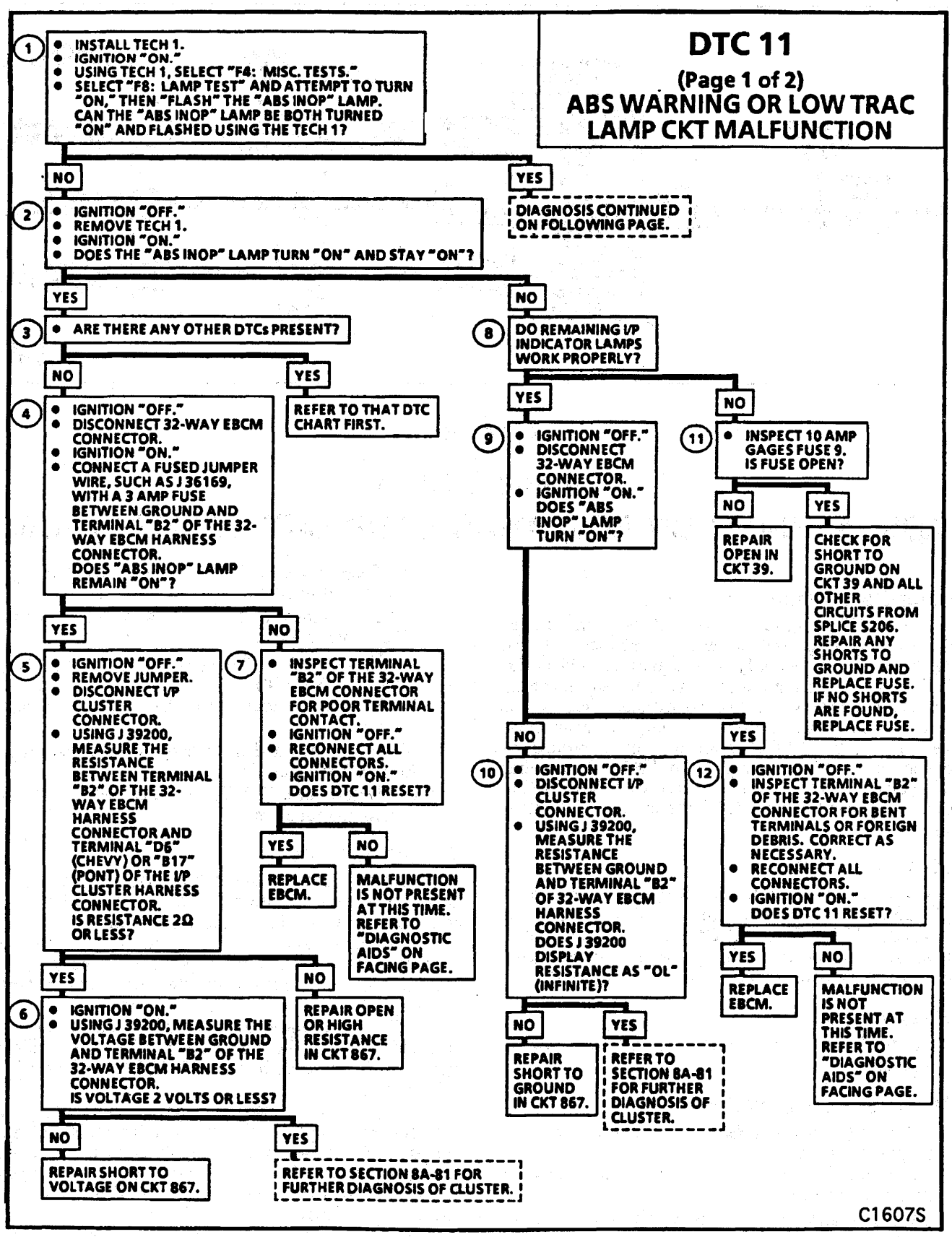
Diagnostic Aids:

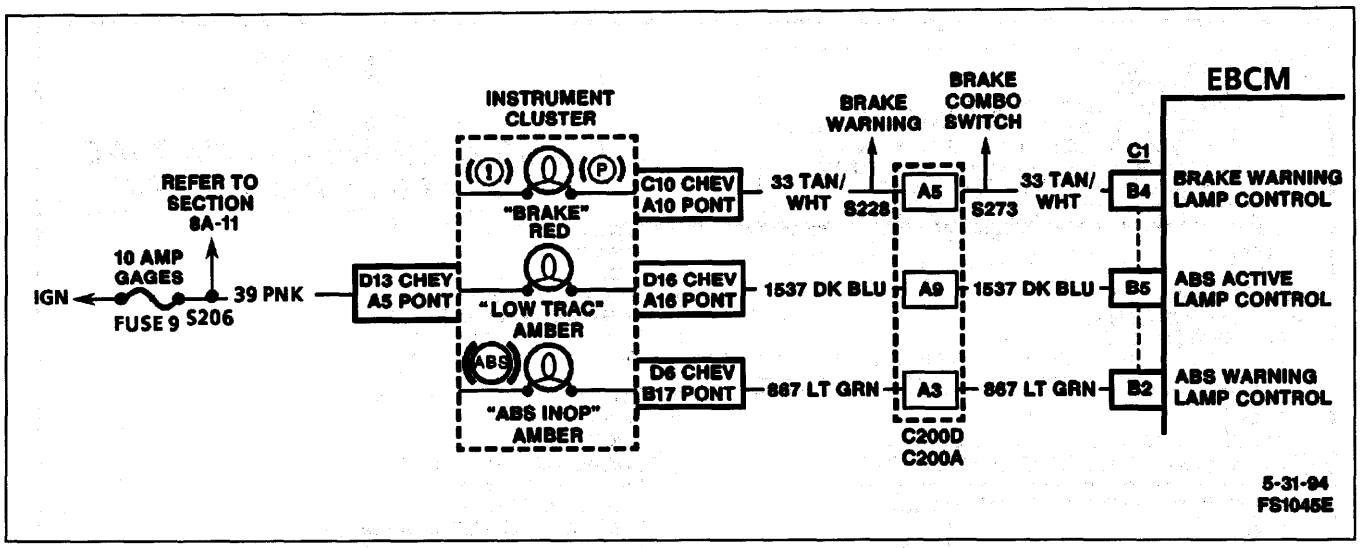
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The lamp test function of the Tech 1 may be used to command the lamp on" while looking for an intermittent malfunction in the ABS warning lamp circuitry.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.


DTC 11
(Page 1 of 2)
ABS WARNING OR LOW TRAC LAMP CKT MALFUNCTION
1
• INSTALL TECH 1.
• IGNITION "ON."
• USING TECH 1, SELECT "F4: MISC. TESTS."
• SELECT "F8: LAMP TEST" AND ATTEMPT TO TURN "ON," THEN "FLASH" THE "ABS INOP" LAMP. CAN THE "ABS INOP" LAMP BE BOTH TURNED "ON" AND FLASHED USING THE TECH 1?
NO
YES
DIAGNOSIS CONTINUED ON FOLLOWING PAGE.
2
• IGNITION "OFF."
• REMOVE TECH 1.
• IGNITION "ON."
• DOES THE "ABS INOP" LAMP TURN "ON" AND STAY "ON"?
YES
NO
3
• ARE THERE ANY OTHER DTCs PRESENT?
NO
YES
REFER TO THAT DTC CHART FIRST.
4
• IGNITION "OFF."
• DISCONNECT 32-WAY EBCM CONNECTOR.
• IGNITION "ON."
• CONNECT A FUSED JUMPER WIRE, SUCH AS J 36169, WITH A 3 AMP FUSE BETWEEN GROUND AND TERMINAL "B2" OF THE 32-WAY EBCM HARNESS CONNECTOR.
DOES "ABS INOP" LAMP REMAIN "ON"?
YES
NO
5
• IGNITION "OFF."
• REMOVE JUMPER.
• DISCONNECT I/P CLUSTER CONNECTOR.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "B2" OF THE 32-WAY EBCM HARNESS CONNECTOR AND TERMINAL "D6" (CHEVY) OR "B17" (PONT) OF THE I/P CLUSTER HARNESS CONNECTOR.
IS RESISTANCE 2Ω OR LESS?
YES
NO
6
• IGNITION "ON."
• USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B2" OF THE 32-WAY EBCM HARNESS CONNECTOR.
IS VOLTAGE 2 VOLTS OR LESS?
NO
YES
REPAIR SHORT TO VOLTAGE ON CKT 867.
REFER TO SECTION 8A-81 FOR FURTHER DIAGNOSIS OF CLUSTER.
REPAIR OPEN OR HIGH RESISTANCE IN CKT 867.
7
• INSPECT TERMINAL "B2" OF THE 32-WAY EBCM CONNECTOR FOR POOR TERMINAL CONTACT.
• IGNITION "OFF."
• RECONNECT ALL CONNECTORS.
• IGNITION "ON."
DOES DTC 11 RESET?
YES
NO
REPLACE EBCM.
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
8
DO REMAINING I/P INDICATOR LAMPS WORK PROPERLY?
YES
NO
9
• IGNITION "OFF."
• DISCONNECT 32-WAY EBCM CONNECTOR.
• IGNITION "ON."
DOES "ABS INOP" LAMP TURN "ON"?
NO
YES
10
• IGNITION "OFF."
• DISCONNECT I/P CLUSTER CONNECTOR.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "B2" OF 32-WAY EBCM HARNESS CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
NO
YES
REPAIR SHORT TO GROUND IN CKT 867.
REFER TO SECTION 8A-81 FOR FURTHER DIAGNOSIS OF CLUSTER.
11
• INSPECT 10 AMP GAGES FUSE 9.
IS FUSE OPEN?
NO
YES
REPAIR OPEN IN CKT 39.
CHECK FOR SHORT TO GROUND ON CKT 39 AND ALL OTHER CIRCUITS FROM SPLICE S206. REPAIR ANY SHORTS TO GROUND AND REPLACE FUSE. IF NO SHORTS ARE FOUND, REPLACE FUSE.
12
• IGNITION "OFF."
• INSPECT TERMINAL "B2" OF THE 32-WAY EBCM CONNECTOR FOR BENT TERMINALS OR FOREIGN DEBRIS. CORRECT AS NECESSARY.
• RECONNECT ALL CONNECTORS.
• IGNITION "ON."
DOES DTC 11 RESET?
YES
NO
REPLACE EBCM.
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
C1607S



DTC 11
(Page 2 of 2)
ABS WARNING OR LOW TRAC LAMP CKT MALFUNCTION

Circuit Description:

This DTC checks the state of both the amber ABS warning lamp, and the amber ABS active lamp, "LOW TRAC" to identify a situation in which the driver could not be alerted to a system malfunction or of possible slippery driving conditions. Due to an integral lamp driver module within the instrument panel cluster, the EBCM must provide a ground to turn the amber ABS warning lamp "OFF." The amber ABS active lamp circuit is such that the EBCM provides a ground to turn "ON" the amber ABS active lamp.

DTC Will Set When:

DTC 11 can only be set during the three second bulb check or when either of the lamps are commanded "ON." If the EBCM cannot control either the amber ABS warning lamp or the amber ABS active lamp for two seconds, a malfunction exists.

Action Taken:

A malfunction DTC is stored; however, ABS is not disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

13. Determines if the ABS active lamp can be properly controlled.
14. Determines if the ABS active lamp is "ON" constantly.
15. Checks for a short to ground in the ABS active lamp circuitry.
16. Determines if DTC 11 was set due to a EBCM malfunction.
17. Determines if DTC 11 was set due to a EBCM malfunction.
18. Determines if the ABS active lamp can be controlled manually.
19. Verifies the integrity of the ABS active lamp circuitry.
20. Determines if there is a short to voltage in the ABS active lamp circuitry.
21. Determines if DTC 11 was set due to an EBCM malfunction.

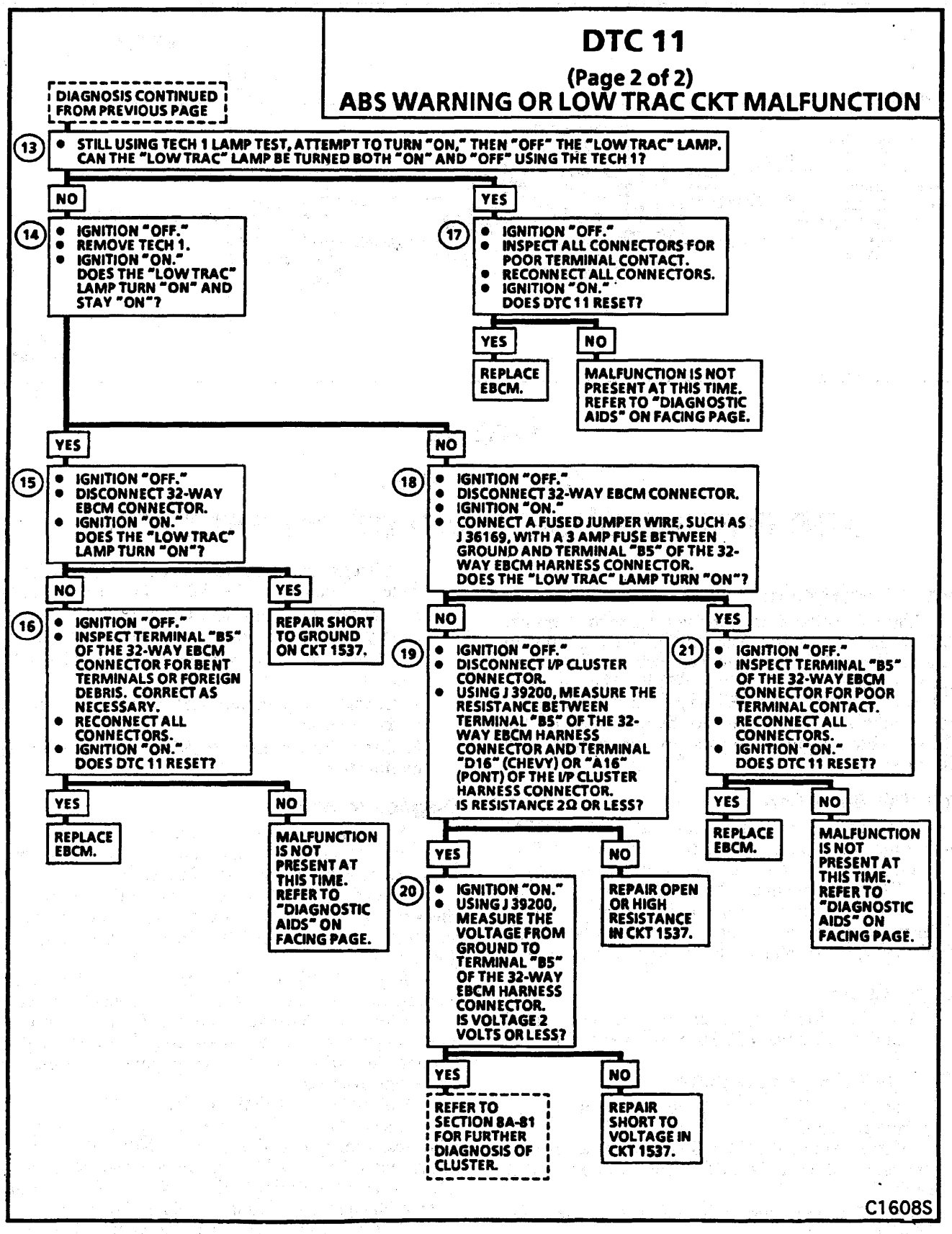
Diagnostic Aids:

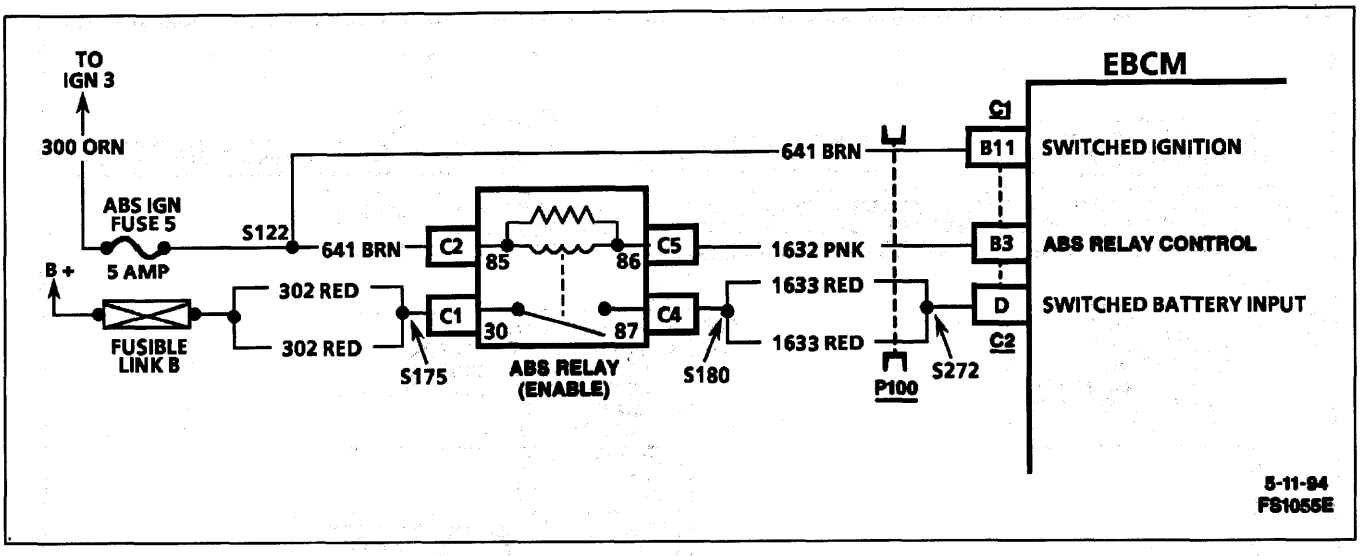
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The lamp test function of the Tech 1 may be used to command the lamp "ON" while looking for an intermittent malfunction in the ABS active lamp circuitry.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.


DTC 11
(Page 2 of 2)
ABS WARNING OR LOW TRAC CKT MALFUNCTION
DIAGNOSIS CONTINUED FROM PREVIOUS PAGE
13
• STILL USING TECH 1 LAMP TEST, ATTEMPT TO TURN "ON," THEN "OFF" THE "LOW TRAC" LAMP. CAN THE "LOW TRAC" LAMP BE TURNED BOTH "ON" AND "OFF" USING THE TECH 1?
NO
YES
14
• IGNITION "OFF."
• REMOVE TECH 1.
• IGNITION "ON."
DOES THE "LOW TRAC" LAMP TURN "ON" AND STAY "ON"?
17
• IGNITION "OFF."
• INSPECT ALL CONNECTORS FOR POOR TERMINAL CONTACT.
• RECONNECT ALL CONNECTORS.
• IGNITION "ON."
DOES DTC 11 RESET?
YES
NO
REPLACE EBCM.
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
YES
NO
15
• IGNITION "OFF."
• DISCONNECT 32-WAY EBCM CONNECTOR.
• IGNITION "ON."
DOES THE "LOW TRAC" LAMP TURN "ON"?
18
• IGNITION "OFF."
• DISCONNECT 32-WAY EBCM CONNECTOR.
• IGNITION "ON."
• CONNECT A FUSED JUMPER WIRE, SUCH AS J 36169, WITH A 3 AMP FUSE BETWEEN GROUND AND TERMINAL "B5" OF THE 32-WAY EBCM HARNESS CONNECTOR.
DOES THE "LOW TRAC" LAMP TURN "ON"?
NO
YES
16
• IGNITION "OFF."
• INSPECT TERMINAL "B5" OF THE 32-WAY EBCM CONNECTOR FOR BENT TERMINALS OR FOREIGN DEBRIS. CORRECT AS NECESSARY.
• RECONNECT ALL CONNECTORS.
• IGNITION "ON."
DOES DTC 11 RESET?
REPAIR SHORT TO GROUND ON CKT 1537.
NO
YES
19
• IGNITION "OFF."
• DISCONNECT I/P CLUSTER CONNECTOR.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "B5" OF THE 32-WAY EBCM HARNESS CONNECTOR AND TERMINAL "D16" (CHEVY) OR "A16" (PONT) OF THE I/P CLUSTER HARNESS CONNECTOR.
IS RESISTANCE 2Ω OR LESS?
21
• IGNITION "OFF."
• INSPECT TERMINAL "B5" OF THE 32-WAY EBCM CONNECTOR FOR POOR TERMINAL CONTACT.
• RECONNECT ALL CONNECTORS.
• IGNITION "ON."
DOES DTC 11 RESET?
YES
NO
REPLACE EBCM.
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
YES
NO
20
• IGNITION "ON."
• USING J 39200, MEASURE THE VOLTAGE FROM GROUND TO TERMINAL "B5" OF THE 32-WAY EBCM HARNESS CONNECTOR.
IS VOLTAGE 2 VOLTS OR LESS?
REPAIR OPEN OR HIGH RESISTANCE IN CKT 1537.
YES
NO
REFER TO SECTION 8A-81 FOR FURTHER DIAGNOSIS OF CLUSTER.
REPAIR SHORT TO VOLTAGE IN CKT 1537.
C1608S



DTC 14
(Page 1 of 3)
ABS ENABLE RELAY CONTACT CIRCUIT OPEN

Circuit Description:

Ignition voltage is supplied through terminal "C2" of the ABS relay. The EBCM then is able to energize the pull-in coil by completing the ground circuit at terminal "B3" of the EBCM. The magnetic field created closes the ABS relay contacts and allows battery voltage and current to be supplied to the EBCM, which supplies power to the motors and solenoids.

DTC Will Set When:

DTC 14 can be set anytime after the EBCM commands the ABS relay "ON" (the relay is first commanded "ON" during the three second bulb check). This test monitors the availability of current and voltage to the motors and solenoids. This malfunction indicates voltage is not available and would therefore not allow ABS operation if required.

Action Taken:

A malfunction DTC is stored, ABS is disabled and the amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks to see if DTC 16 is also set as current or history. If DTC 16 is also set, proceed to that chart first.
2. Verifies that the malfunction is currently present.
3. Verifies that the relay can be turned "ON" and provide voltage to the EBCM.
4. Checks for high resistance in the switched battery circuit from the ABS relay to the EBCM.
5. Checks for high resistance in the switched battery circuit from the battery to the ABS relay.
6. Checks for high resistance in the ABS relay contacts.
7. Checks for poor terminal contact or corrosion at the connectors.
8. Determines if the EBCM is the cause of the malfunction.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

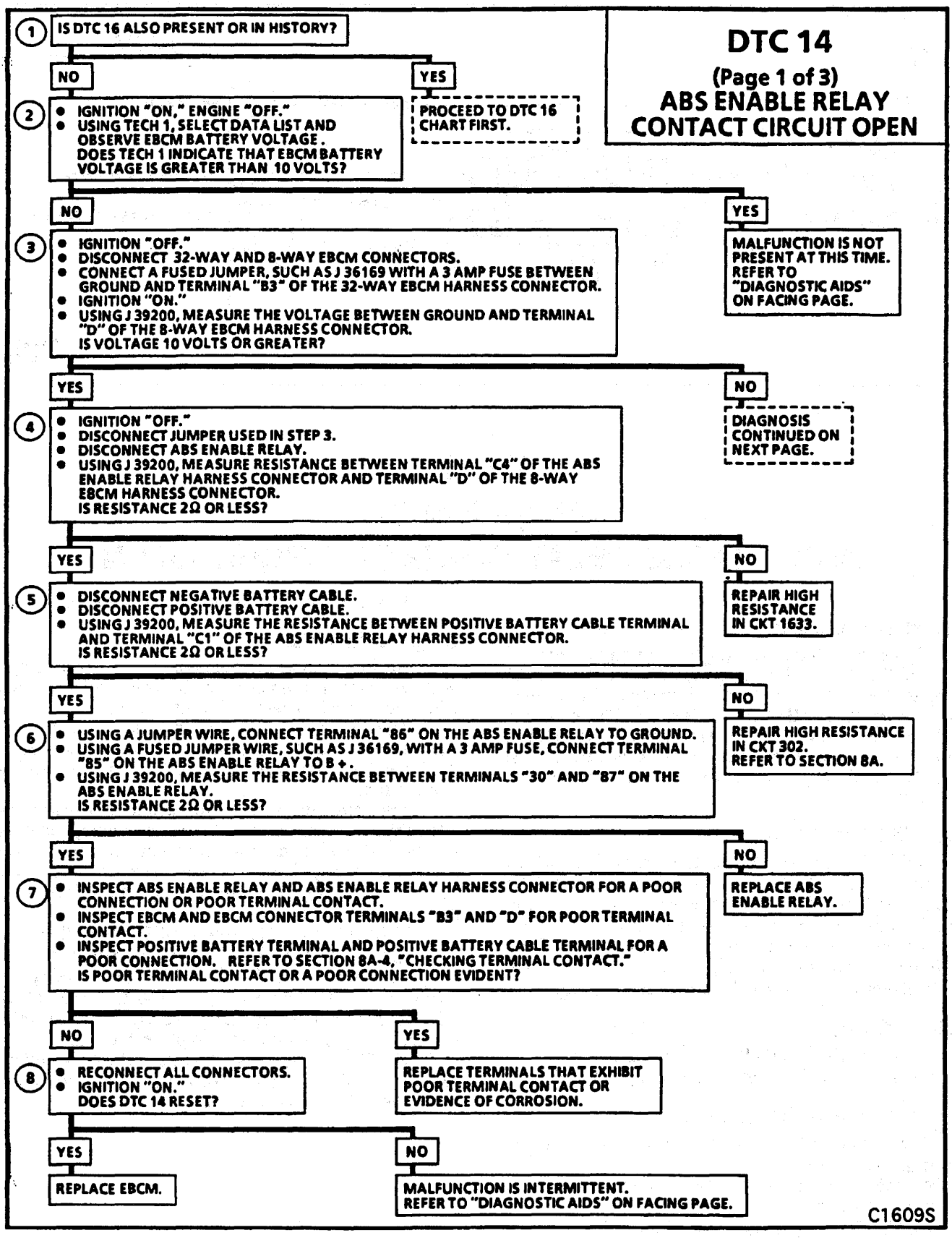
The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

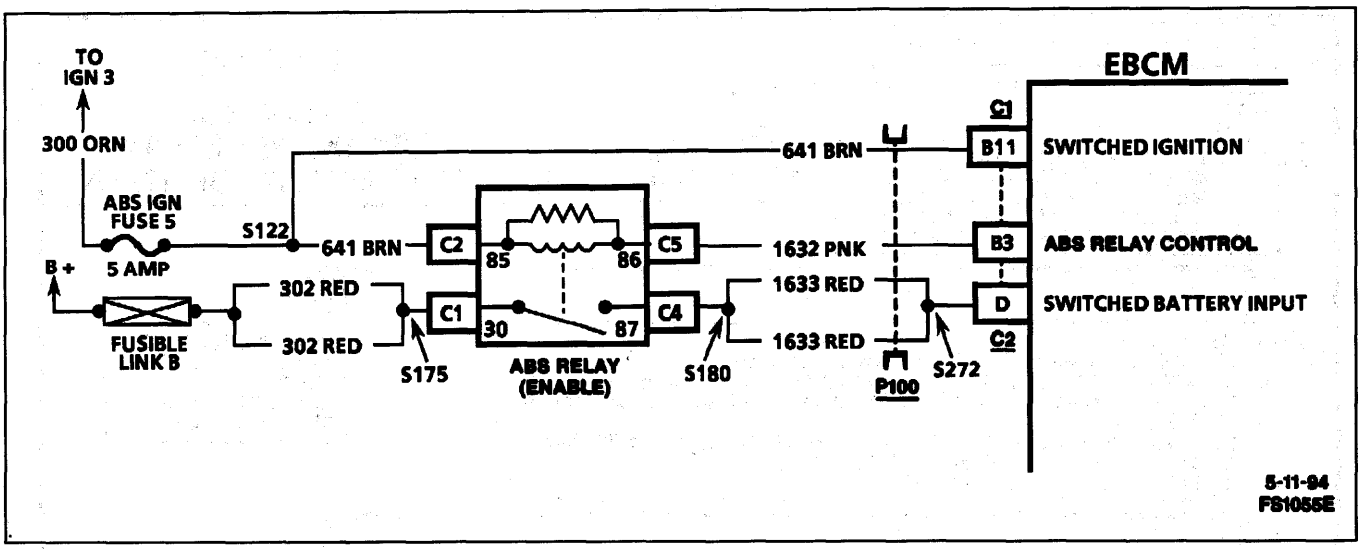
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

VIBRATION, TEMPERATURE EFFECTS:

Check for vibration effects by performing the relay test function of the Tech 1. With the relay test commanded "ON," lightly tap the top and sides of the relay while monitoring relay voltage. If the relay voltage changes significantly, replace the relay.

If DTC 14 only sets when the vehicle is initially started in cold ambient conditions (temperature less than 32F-0C), replace the relay.


DTC 14
(Page 1 of 3)
ABS ENABLE RELAY CONTACT CIRCUIT OPEN
1
IS DTC 16 ALSO PRESENT OR IN HISTORY?
NO
YES
PROCEED TO DTC 16 CHART FIRST.
2
• IGNITION "ON," ENGINE "OFF."
• USING TECH 1, SELECT DATA LIST AND OBSERVE EBCM BATTERY VOLTAGE.
DOES TECH 1 INDICATE THAT EBCM BATTERY VOLTAGE IS GREATER THAN 10 VOLTS?
NO
YES
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
3
• IGNITION "OFF."
• DISCONNECT 32-WAY AND 8-WAY EBCM CONNECTORS.
• CONNECT A FUSED JUMPER, SUCH AS J 36169 WITH A 3 AMP FUSE BETWEEN GROUND AND TERMINAL "B3" OF THE 32-WAY EBCM HARNESS CONNECTOR.
• IGNITION "ON."
• USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "D" OF THE 8-WAY EBCM HARNESS CONNECTOR.
IS VOLTAGE 10 VOLTS OR GREATER?
YES
NO
DIAGNOSIS CONTINUED ON NEXT PAGE.
4
• IGNITION "OFF."
• DISCONNECT JUMPER USED IN STEP 3.
• DISCONNECT ABS ENABLE RELAY.
• USING J 39200, MEASURE RESISTANCE BETWEEN TERMINAL "C4" OF THE ABS ENABLE RELAY HARNESS CONNECTOR AND TERMINAL "D" OF THE 8-WAY EBCM HARNESS CONNECTOR.
IS RESISTANCE 2Ω OR LESS?
YES
NO
REPAIR HIGH RESISTANCE IN CKT 1633.
5
• DISCONNECT NEGATIVE BATTERY CABLE.
• DISCONNECT POSITIVE BATTERY CABLE.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN POSITIVE BATTERY CABLE TERMINAL AND TERMINAL "C1" OF THE ABS ENABLE RELAY HARNESS CONNECTOR.
IS RESISTANCE 2Ω OR LESS?
YES
NO
REPAIR HIGH RESISTANCE IN CKT 302. REFER TO SECTION 8A.
6
• USING A JUMPER WIRE, CONNECT TERMINAL "86" ON THE ABS ENABLE RELAY TO GROUND.
• USING A FUSED JUMPER WIRE, SUCH AS J 36169, WITH A 3 AMP FUSE, CONNECT TERMINAL "85" ON THE ABS ENABLE RELAY TO B+.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINALS "30" AND "87" ON THE ABS ENABLE RELAY.
IS RESISTANCE 2Ω OR LESS?
YES
NO
REPLACE ABS ENABLE RELAY.
7
• INSPECT ABS ENABLE RELAY AND ABS ENABLE RELAY HARNESS CONNECTOR FOR A POOR CONNECTION OR POOR TERMINAL CONTACT.
• INSPECT EBCM AND EBCM CONNECTOR TERMINALS "B3" AND "D" FOR POOR TERMINAL CONTACT.
• INSPECT POSITIVE BATTERY TERMINAL AND POSITIVE BATTERY CABLE TERMINAL FOR A POOR CONNECTION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT."
IS POOR TERMINAL CONTACT OR A POOR CONNECTION EVIDENT?
NO
YES
REPLACE TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION.
8
• RECONNECT ALL CONNECTORS.
• IGNITION "ON."
DOES DTC 14 RESET?
YES
NO
REPLACE EBCM.
MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
C1609S



DTC 14
(Page 2 of 3)
ABS ENABLE RELAY CONTACT CIRCUIT OPEN

Circuit Description:

Ignition voltage is supplied through terminal "C2" of the ABS relay. The EBCM then is able to energize the pull-in coil by completing the ground circuit at terminal "B3" of the EBCM. The magnetic field created closes the ABS relay contacts and allows battery voltage and current to be supplied to the EBCM, which supplies power to the motors and solenoids.

DTC Will Set When:

DTC 14 can be set anytime after the EBCM commands the ABS relay "ON" (the relay is first commanded "ON" during the three second bulb check). This test monitors the availability of current and voltage to the motors and solenoids. This malfunction indicates voltage is not available and would therefore not allow ABS operation if required.

Action Taken:

A malfunction DTC is stored, ABS is disabled and the amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

9. Checks for high resistance in the entire ABS relay coil circuit.
10. Verifies proper battery condition.
11. Verifies proper voltage is available at the ABS relay.
12. Checks for an open in the switched battery circuit from the relay to the EBCM.
13. Verifies the condition of the ABS relay.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

VIBRATION, TEMPERATURE EFFECTS:

Check for vibration effects by performing the relay test function of the Tech 1. With the relay test commanded "ON," lightly tap the top and sides of the relay while monitoring relay voltage. If the relay voltage changes significantly, replace the relay.

If DTC 14 only sets when the vehicle is initially started in cold ambient conditions (temperature less than 32F-0C), replace the relay.

DTC 14
(Page 2 of 3)
ABS ENABLE RELAY CONTACT CIRCUIT OPEN

DIAGNOSIS CONTINUED FROM PREVIOUS PAGE.

9
- IGNITION "OFF."
- REMOVE JUMPER WIRE INSTALLED IN STEP 3, IF NOT ALREADY REMOVED.
- DISCONNECT NEGATIVE BATTERY CABLE.
- DISCONNECT POSITIVE BATTERY CABLE.
- WITH BATTERY STILL DISCONNECTED, TURN IGNITION SWITCH TO "RUN." THIS COMPLETES THE IGNITION CIRCUIT TO THE ABS ENABLE RELAY.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "B3" OF THE 32-WAY EBCM HARNESS CONNECTOR AND THE POSITIVE BATTERY CABLE TERMINAL. IS RESISTANCE 95Ω OR LESS WHEN MEASURED AT APPROXIMATELY 20 °C (68°F)?

YES

10
- USING J 39200, MEASURE THE VOLTAGE BETWEEN THE NEGATIVE AND POSITIVE BATTERY TERMINALS. IS VOLTAGE 10 VOLTS OR GREATER?

YES

11
- IGNITION "OFF."
- RECONNECT POSITIVE BATTERY CABLE.
- RECONNECT NEGATIVE BATTERY CABLE.
- DISCONNECT ABS ENABLE RELAY.
- MEASURE THE VOLTAGE BETWEEN TERMINAL "C1" OF THE ABS ENABLE RELAY HARNESS CONNECTOR AND GROUND. IS VOLTAGE 10 VOLTS OR GREATER?

YES

12
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C4" OF THE ABS ENABLE RELAY HARNESS CONNECTOR AND TERMINAL "D" OF THE 8-WAY EBCM HARNESS CONNECTOR. IS RESISTANCE 2Ω OR LESS?

YES

13
- USING A JUMPER WIRE, CONNECT TERMINAL "86" ON THE ABS ENABLE RELAY TO GROUND.
- USING A FUSED JUMPER WIRE, SUCH AS J 36169, WITH A 3 AMP FUSE, CONNECT TERMINAL "85" ON THE ABS ENABLE RELAY TO VOLTAGE.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINALS "30" AND "87" ON THE ABS ENABLE RELAY. IS RESISTANCE 2Ω OR LESS?

YES

MALFUNCTION WAS MOST LIKELY DUE TO A POOR CONNECTION. INSPECT ALL CONNECTORS AND TERMINALS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT EVIDENCE OF POOR TERMINAL CONTACT OR CORROSION.

NO

DIAGNOSIS CONTINUED ON NEXT PAGE.

NO

REFER TO SECTION 6D3 TO CORRECT LOW VOLTAGE CONDITION.

NO

REPAIR OPEN OR HIGH RESISTANCE IN CKT 302.

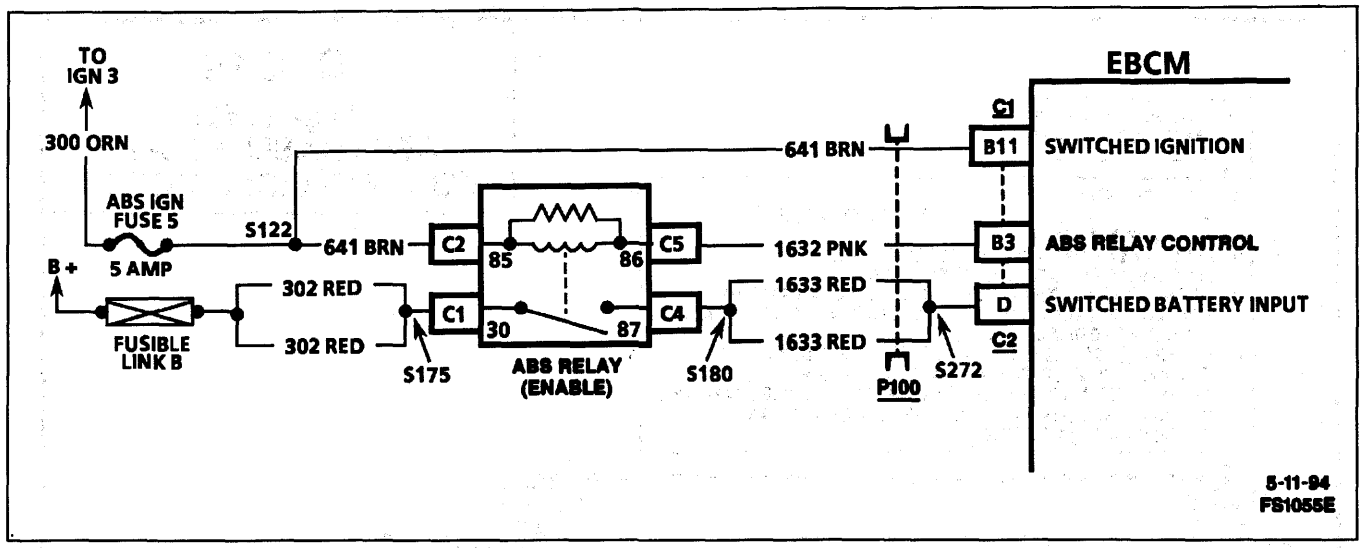
NO

REPAIR OPEN OR HIGH RESISTANCE IN CKT 1633.

NO

REPLACE ABS ENABLE RELAY.

C1610S



DTC 14
(Page 3 of 3)
ABS ENABLE RELAY CONTACT CIRCUIT OPEN

Circuit Description:

Ignition voltage is supplied through terminal "C2" of the ABS relay. The EBCM then is able to energize the pull-in coil by completing the ground circuit at terminal "B3" of the EBCM. The magnetic field created closes the ABS relay contacts and allows battery voltage and current to be supplied to the EBCM, which supplies power to the motors and solenoids.

DTC Will Set When:

DTC 14 can be set anytime after the EBCM commands the ABS relay "ON" (the relay is first commanded "ON" during the three second bulb check). This test monitors the availability of current and voltage to the motors and solenoids. This malfunction indicates voltage is not available and would therefore not allow ABS operation if required.

Action Taken:

A malfunction DTC is stored, ABS is disabled and the amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

14. Checks for proper resistance of the ABS relay coil.

15. Checks for high resistance in the ABS relay control circuit between the ABS relay and the EBCM.

16. Checks for high resistance in the ABS relay control circuit between the battery and the ABS relay.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

VIBRATION, TEMPERATURE EFFECTS:

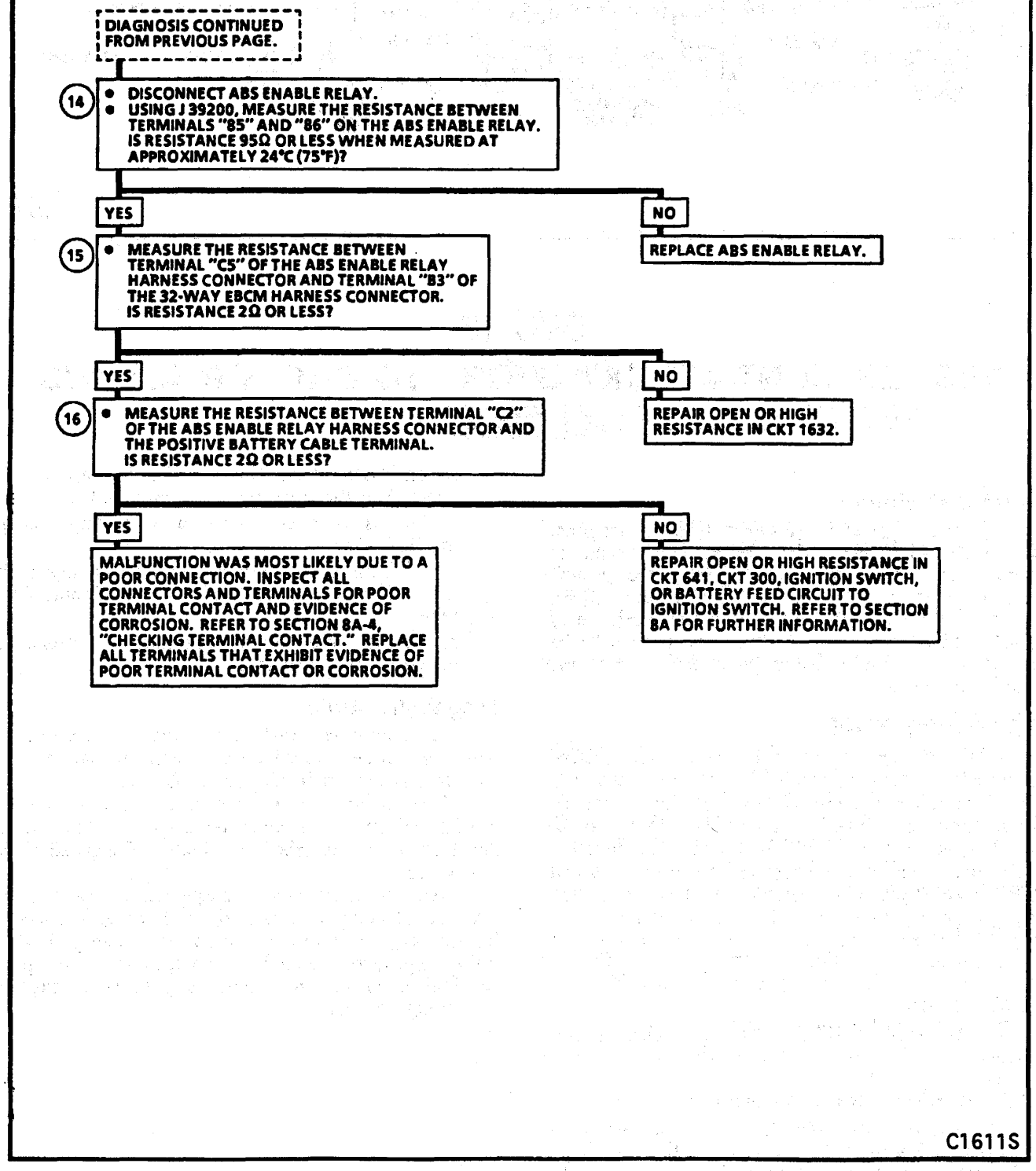
Check for vibration effects by performing the relay test function of the Tech 1. With the relay test commanded "ON," lightly tap the top and sides of the relay while monitoring relay voltage. If the relay voltage changes significantly, replace the relay.

If DTC 14 only sets when the vehicle is initially started in cold ambient conditions (temperature less than 32F-0C), replace the relay.

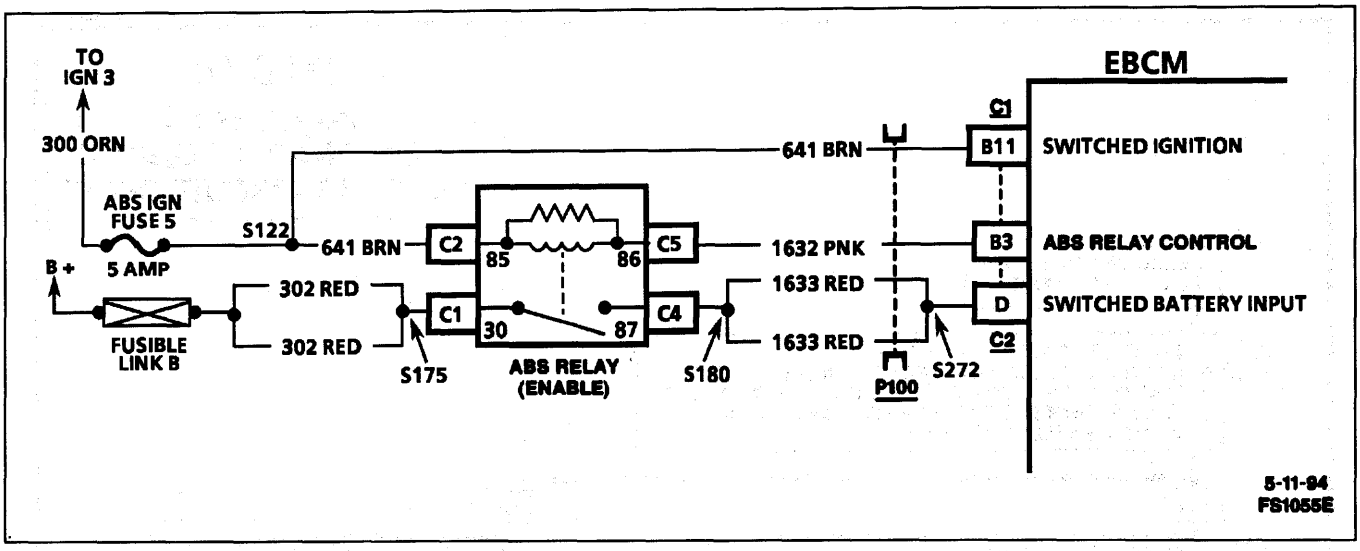
DTC 14

(Page 3 of 3)

ABS ENABLE RELAY CONTACT CIRCUIT OPEN



C1611S



DTC 15
ABS RLY CONTACT CKT SHORT TO BATT OR ALWAYS CLOSED

Circuit Description:

Ignition voltage is supplied through terminal "C2" of the ABS relay. The EBCM then is able to energize the pull-in coil by completing the ground circuit at connector "C1", terminal "B3" of the EBCM. The magnetic field created closes the ABS relay contacts and allows battery voltage and current to be supplied to the EBCM, which supplies power to the motors and solenoids.

DTC Will Set When:

DTC 15 can be set only before the EBCM commands the ABS relay "ON." This test determines if the ABS relay is energized when it should not be. This malfunction would not allow the ABS relay to remove power to the EBCM. If a second malfunction were to occur that requires the ABS relay to be turned "OFF," that malfunction cannot be removed if the relay cannot be controlled. The malfunction must be present for three consecutive drive cycles before the DTC is set.

Action Taken:

A malfunction DTC is stored. ABS is not disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Determines if any other DTCs are present.
2. Indicates that the EBCM is capable of controlling the ABS relay as commanded.
3. Checks for a possible short to battery voltage in CKT 1633.
4. Determines whether the short to voltage is in CKT 1633 or as a result of a malfunctioning ABS relay.
5. Checks for a possible intermittent malfunction in wiring or connectors.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

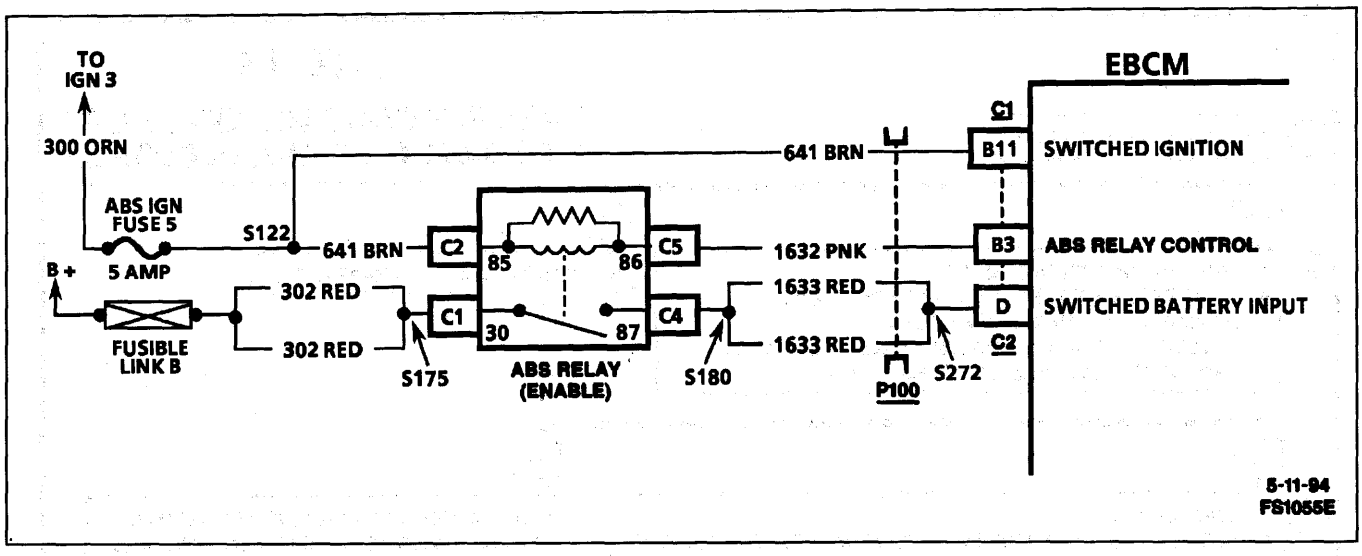
Any circuitry, that is suspected of causing the intermittent complaint, should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 15
ABS RLY CONTACT CKT SHORT TO BATT OR ALWAYS CLOSED

1. ARE ANY OTHER DTCs SET?
   - YES → PROCEED TO THAT DTC CHART FIRST.
   - NO →
2. • IGNITION "ON," ENGINE "OFF."
   • USING THE RELAY TEST FUNCTION OF THE TECH 1, COMMAND ABS ENABLE RELAY "OFF."
   DOES TECH 1 INDICATE THAT ABS ENABLE RELAY IS "OFF" AND BATTERY VOLTAGE IS LESS THAN 5 VOLTS?
   - YES → MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - NO →
3. • IGNITION "OFF."
   • DISCONNECT 32-WAY AND 8-WAY EBCM HARNESS CONNECTORS.
   • IGNITION "ON."
   • USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "D" OF THE 8-WAY EBCM CONNECTOR.
   IS VOLTAGE 2 VOLTS OR LESS?
   - YES →
5. • IGNITION "OFF."
   • INSPECT CKT 1633 AND THE 8-WAY EBCM HARNESS CONNECTOR FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WHEN ALL CONNECTORS ARE CONNECTED. REPAIR DAMAGE IF EVIDENT.
   • RECONNECT 8-WAY AND 32-WAY EBCM CONNECTORS.
   • IGNITION "ON."
   • USING RELAY TEST FUNCTION OF TECH 1, COMMAND ABS ENABLE RELAY "OFF."
   DOES TECH 1 INDICATE THAT ABS ENABLE RELAY IS "OFF" AND BATTERY VOLTAGE IS LESS THAN 5 VOLTS?
   - NO → REPLACE EBCM.
   - YES → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - NO →
4. • IGNITION "OFF."
   • DISCONNECT ABS ENABLE RELAY.
   • IGNITION "ON."
   • MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "D" OF THE 8-WAY EBCM HARNESS CONNECTOR.
   IS VOLTAGE 2 VOLTS OR LESS?
   - YES → REPLACE ABS ENABLE RELAY.
   - NO → REPAIR SHORT TO VOLTAGE IN CKT 1633.

AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs, AND TEST DRIVE VEHICLE FOR 3 DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING ABOVE 16 km/h (10 MPH), AND THEN KEYING DOWN

C1612S



DTC 16
ABS ENABLE RELAY COIL CIRCUIT OPEN

Circuit Description:

Ignition voltage is supplied through terminal "C2" of the ABS relay. The EBCM then is able to energize the pull-in coil by completing the ground circuit at connector "C1", terminal "B3" of the EBCM. The magnetic field created closes the ABS relay contacts and allows battery voltage and current to be supplied to the EBCM, which supplies power to the motors and solenoids.

DTC Will Set When:

DTC 16 can be set only after DTC 14 has been set. This test detects an open in the ABS relay coil circuit. An open in this circuit will not allow the ABS relay to be energized thus preventing voltage and current to the motors and solenoids. If this malfunction is present and the ignition is turned "OFF" before 5 km/h (3 mph) is reached, DTC 14 is set alone.

Action Taken:

A malfunction DTC is stored, ABS is disabled and the amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Indicates the EBCM is capable of controlling the ABS relay as commanded.
2. Checks to ensure that voltage is available to the pull-in coil of the ABS relay.
3. Ensures that there is continuity through the pull-in coil of the ABS relay.
4. Verifies the integrity of the ABS relay control circuit.
5. Ensures malfunction was not due to poor terminal contact.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the frequency of the malfunction is high, but is currently intermittent, check for high coil resistance by measuring between relay terminals "C2" and" C5" using a J 39200. If resistance shows greater than 100 ohms, replace the relay.

Any circuitry, that is suspected of causing the intermittent complaint, should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 16
ABS ENABLE RELAY COIL CIRCUIT OPEN

1
- IGNITION "ON," ENGINE "OFF."
- USING THE RELAY TEST FUNCTION OF THE TECH 1, COMMAND THE ABS ENABLE RELAY "ON."

DOES TECH 1 INDICATE ABS ENABLE RELAY "ON" AND BATTERY VOLTAGE ABOVE 10 VOLTS?

NO

2
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "C2" OF THE ABS ENABLE RELAY CONNECTOR.

IS VOLTAGE 10 VOLTS OR GREATER?

YES

3
- USING THE RELAY TEST FUNCTION OF THE TECH 1, COMMAND THE ABS ENABLE RELAY "OFF."
- MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "C5" OF THE ABS ENABLE RELAY CONNECTOR.

IS VOLTAGE 10 VOLTS OR GREATER?

YES

4
- IGNITION "OFF."
- DISCONNECT 32-WAY EBCM CONNECTOR.
- IGNITION "ON."
- MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B3" OF THE 32-WAY EBCM HARNESS CONNECTOR.

IS VOLTAGE 10 VOLTS OR GREATER?

YES

5
- IGNITION "OFF."
- INSPECT 32-WAY EBCM CONNECTOR TERMINAL "B3" FOR POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION. REFER TO SECTION 8A-4 "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.
- RECONNECT ALL CONNECTORS.
- IGNITION "ON."

DOES DTC 16 SET AS A CURRENT DTC?

YES

REPLACE EBCM.

NO

MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO

REPAIR OPEN OR HIGH RESISTANCE IN CKT 1632.

NO

CHECK FOR INTERMITTENT CONNECTIONS AT ABS ENABLE RELAY. IF OK, REPLACE ABS RELAY.

NO

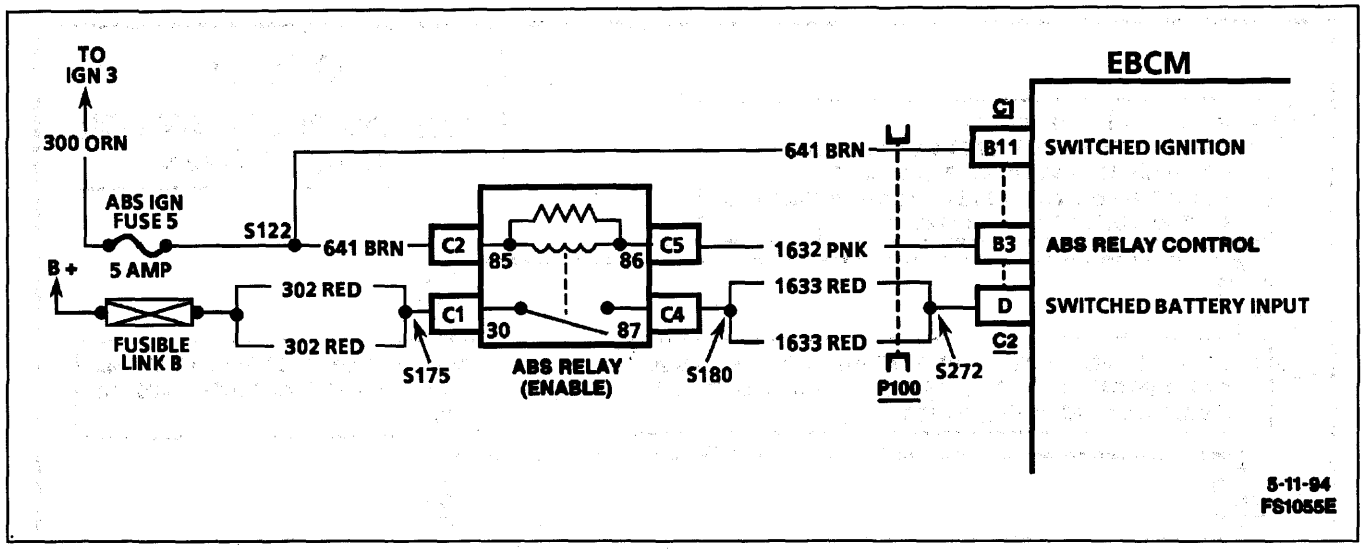
REPAIR OPEN OR HIGH RESISTANCE IN CKT 641 OR ABS IGN FUSE 5.

YES

MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN KEYING DOWN.

C1613S



DTC 17
ABS ENABLE RELAY COIL CIRCUIT SHORTED TO GND

Circuit Description:

Ignition voltage is supplied through terminal "C2" of the ABS relay. The EBCM then is able to energize the pull-in coil by completing the ground circuit at terminal "B3" of the EBCM. The magnetic field created closes the ABS relay contacts and allows battery voltage and current to be supplied to the EBCM, which supplies voltage to the motors and solenoids.

DTC Will Set When:

DTC 17 can be set before the EBCM commands the ABS relay "ON." This test determines if the ABS relay is energized when it should not be. This malfunction would not allow the ABS relay to remove power to the EBCM. If a second malfunction were to occur that requires the ABS relay to be turned "OFF," that malfunction cannot be removed if the relay cannot be controlled.

Action Taken:

A malfunction DTC is stored. ABS is not disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Indicates that the EBCM is capable of controlling the ABS relay as commanded.
2. Checks to ensure that the ABS relay or control CKT 1632 are not shorted to ground.
3. Checks to see if the EBCM is internally shorted to ground. A grounded terminal "B3" would cause the ABS relay to be energized any time the ignition was in the "ON" position.
4. Checks for a short to ground in control CKT 1632 or a defective relay.

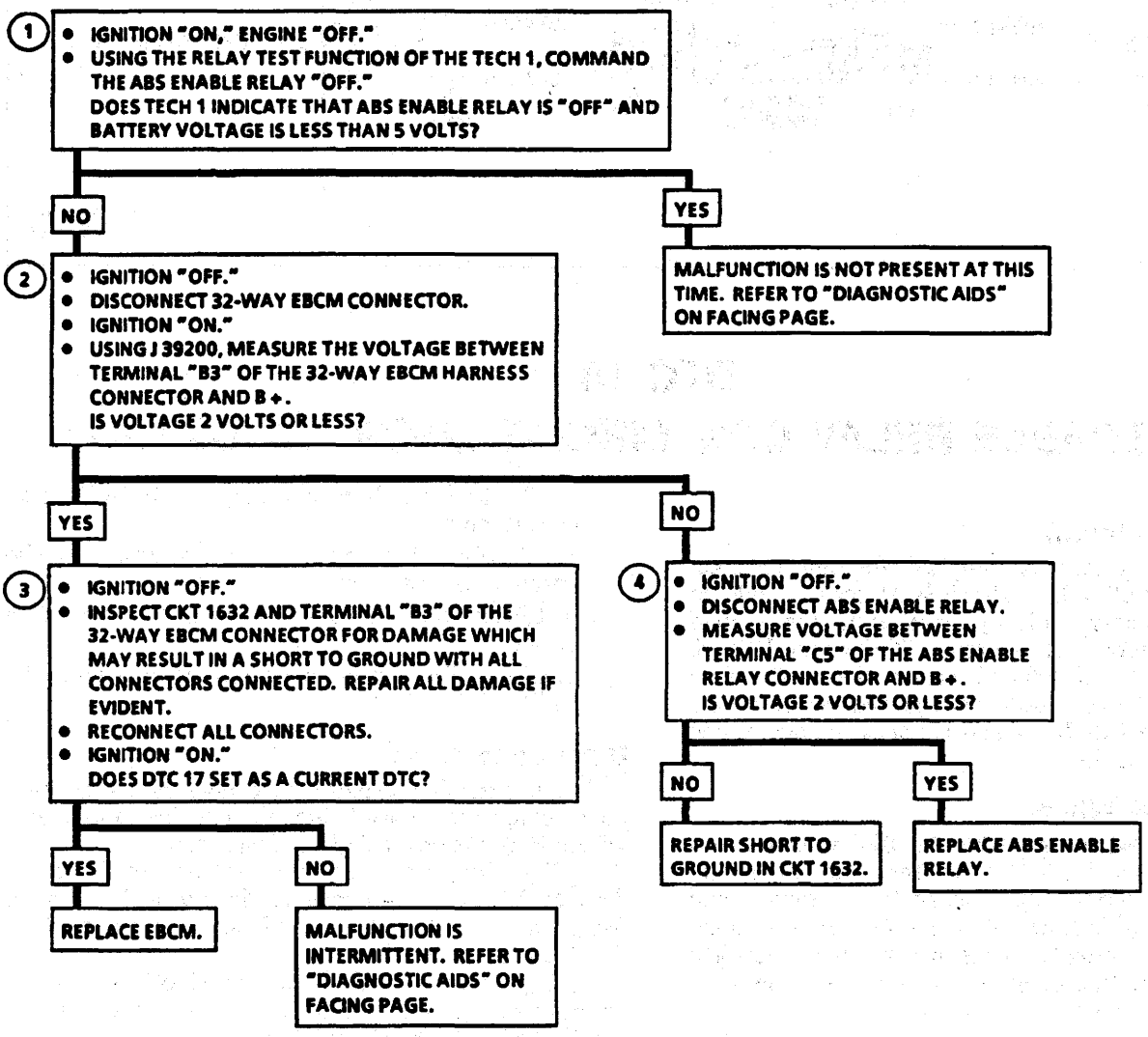
Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

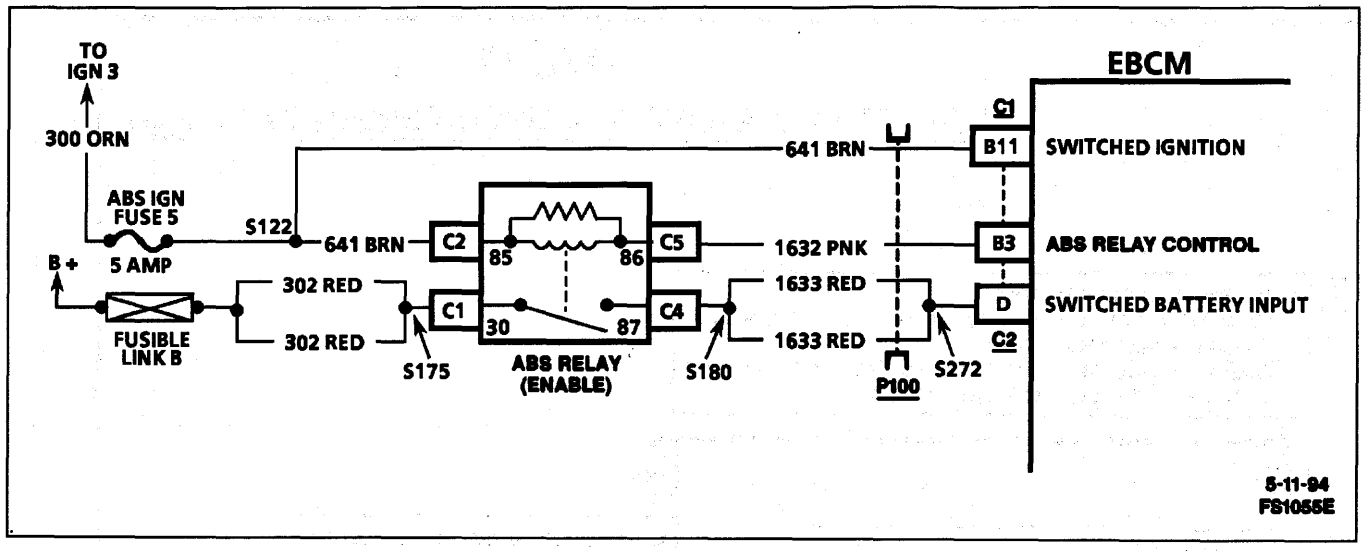
Any circuitry, that is suspected of causing the intermittent complaint, should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 17
ABS ENABLE RELAY COIL CIRCUIT SHORTED TO GND



AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN KEYING DOWN.

C1614S



DTC 18
ABS ENABLE RELAY COIL CIRCUIT SHORTED TO BATT

Circuit Description:

Ignition voltage is supplied through terminal "C2" of the ABS relay. The EBCM then is able to energize the pull-in coil by completing the ground circuit at connector "C1", terminal "B3" of the EBCM. The magnetic field created closes the ABS relay contacts and allows battery voltage and current to be supplied to the EBCM, which supplies voltage to the motors and solenoids.

DTC Will Set When:

DTC 18 can be set after the EBCM commands the ABS relay "ON." This test monitors the availability of current and voltage to the motors and solenoids. A malfunction of this type will not allow voltage to be available to the motors and solenoids; therefore, ABS operation would not be allowed if required.

Action Taken:

A malfunction DTC is stored, ABS is disabled and the amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Indicates that the EBCM is capable of controlling the ABS relay as commanded.
2. Checks for a short to voltage on the ABS relay control circuit.
3. Verifies that the ABS relay coil has the appropriate resistance.
4. Checks for ABS relay contacts that are failed closed.
5. Checks for possible poor terminal contact at the EBCM.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry, that is suspected of causing the intermittent complaint, should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 18

ABS ENABLE RELAY COIL CIRCUIT SHORTED TO BATT

1. • IGNITION "ON," ENGINE "OFF."
   • USING RELAY TEST FUNCTION OF TECH 1, COMMAND ABS ENABLE RELAY "ON."
   DOES TECH 1 INDICATE ABS ENABLE RELAY "ON" AND BATTERY VOLTAGE ABOVE 10 VOLTS?

NO

2. • IGNITION "OFF."
   • DISCONNECT ABS ENABLE RELAY.
   • DISCONNECT 32-WAY EBCM CONNECTOR.
   • IGNITION "ON."
   • USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B3" OF THE 32-WAY EBCM HARNESS CONNECTOR.
   IS VOLTAGE 2 VOLTS OR LESS?

YES

3. • IGNITION "OFF."
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C2" AND TERMINAL "C5" OF THE ABS ENABLE RELAY.
   IS RESISTANCE 40Ω OR GREATER?

YES

4. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINALS "30" AND "B7" OF THE ABS ENABLE RELAY.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

5. • INSPECT CKT 1632 AND TERMINAL "B3" OF THE 32-WAY EBCM CONNECTOR FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
   • RECONNECT ALL CONNECTORS.
   • IGNITION "ON."
   DOES DTC 18 SET AS A CURRENT DTC?

YES

REPLACE EBCM.

NO

MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO

REPLACE ABS ENABLE RELAY.

NO

REPLACE ABS ENABLE RELAY.

NO

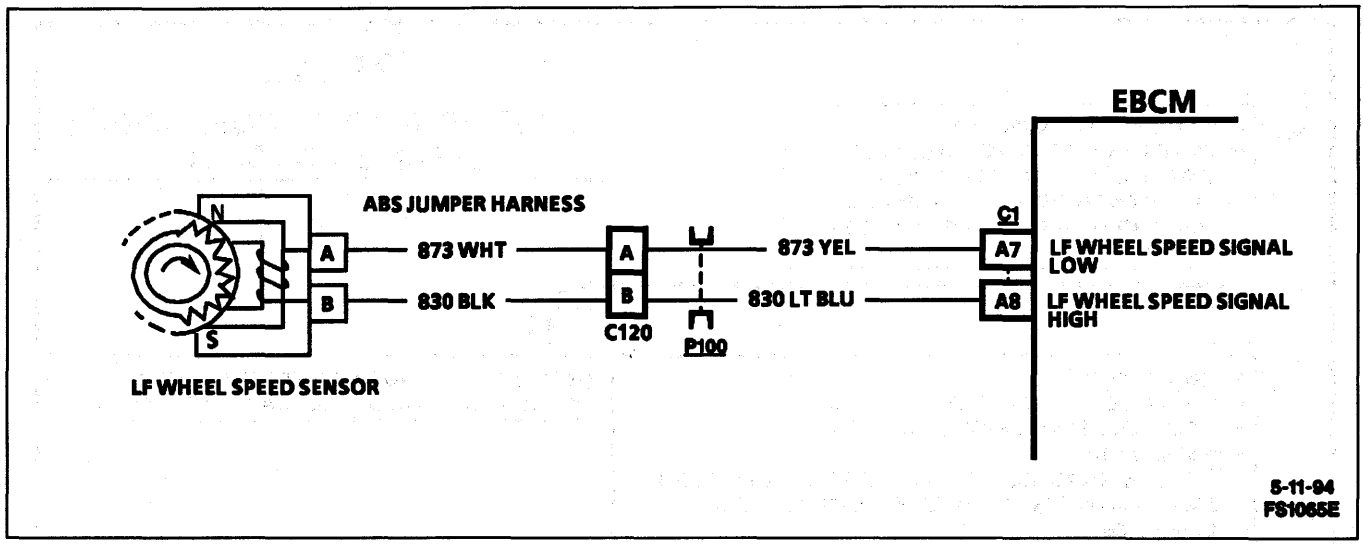
REPAIR SHORT TO VOLTAGE IN CKT 1632.

YES

MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN KEYING DOWN.

C1615S



DTC 21
LEFT FRONT WHEEL SPEED = 0

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 21 can be set when the vehicle is not in an ABS event. If the left front wheel speed = 0 and the vehicle's reference speed is greater than 8 km/h (5 mph), a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled and the amber ABS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step identifies a wheel speed sensor or circuitry that is damaged and visibly apparent.
2. Checks to see that the wheel speed sensor coil is within proper resistance values.
3. Verifies that the wheel speed sensor can generate an appropriate output signal.
4. This ensures that the wheel speed circuitry is not shorted together.
5. Ensures that the malfunction was not due to physical damage.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water). Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 21
LEFT FRONT WHEEL SPEED = 0

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

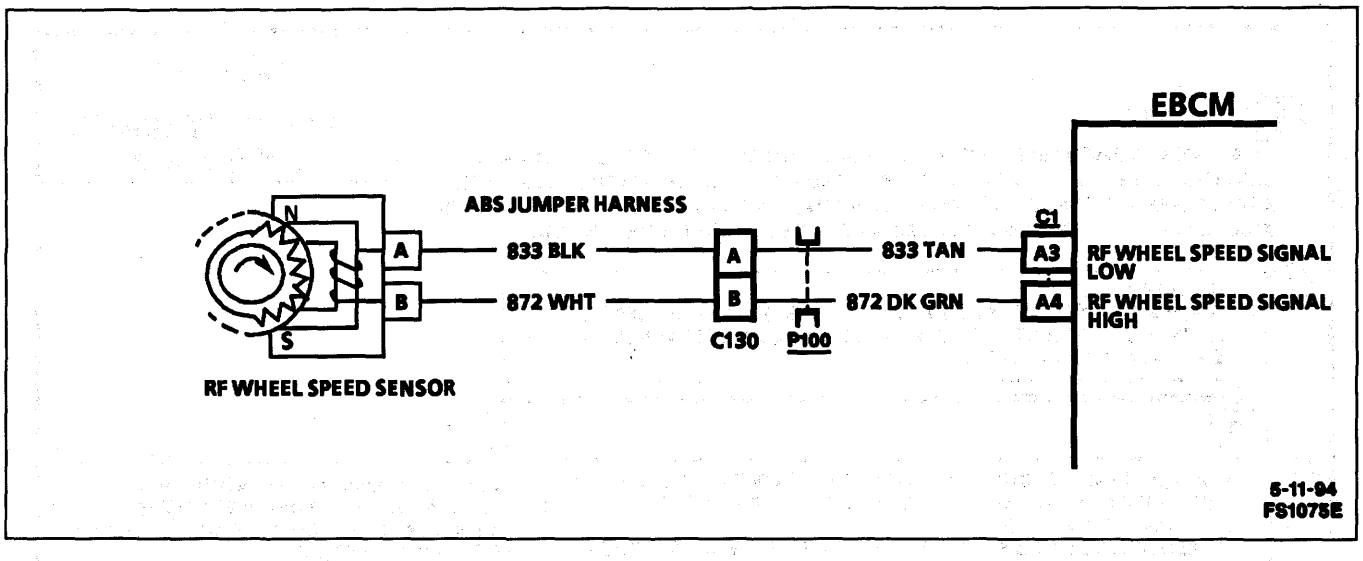
1. • IGNITION "OFF."
   • PHYSICALLY INSPECT THE LEFT FRONT WHEEL SPEED SENSOR, LEFT FRONT WHEEL SPEED SENSOR JUMPER HARNESS, AND CONNECTORS FOR DAMAGE.
   IS PHYSICAL DAMAGE INDICATED?
   - YES → REPLACE WHEEL SPEED SENSOR AND/OR JUMPER HARNESS IF DAMAGED. DRIVE VEHICLE ABOVE 24 km/h (15 MPH) TO ENSURE DTC 21 DOES NOT SET.
   - NO →
2. • DISCONNECT LEFT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN SENSOR TERMINALS "A" AND "B."
   IS RESISTANCE BETWEEN 1020 AND 1137Ω WHEN SENSOR IS 20°C (68°F)?
   (IF TEMPERATURE OF THE SENSOR IS SUSPECTED TO BE OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)
   - NO → REPLACE WHEEL SPEED SENSOR.
   - YES →
3. • WITH J 39200 STILL CONNECTED, SELECT A/C VOLTAGE SCALE.
   • SPIN WHEEL BY HAND WHILE OBSERVING VOLTAGE.
   IS VOLTAGE AT LEAST 100 mV (VOLTAGE WILL INCREASE AS WHEEL SPEED INCREASES)?
   - NO → REPLACE WHEEL SPEED SENSOR.
   - YES →
4. • IGNITION "OFF."
   • DISCONNECT 32-WAY EBCM CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A7" AND "A8" OF THE 32-WAY EBCM HARNESS CONNECTOR.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
   - NO → REPAIR SHORT BETWEEN CKTs 830 AND 873.
   - YES →
5. • INSPECT CKTs 830 AND 873 AND 32-WAY EBCM CONNECTOR FOR DAMAGE WHICH MAY RESULT IN A SHORT BETWEEN CKTs 830 AND 873 WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
   • RECONNECT ALL CONNECTORS.
   • TEST DRIVE VEHICLE ABOVE 24 km/h (15 MPH) FOR AT LEAST 30 SECONDS.
   DOES DTC 21 SET AS A CURRENT DTC?
   - NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - YES → REPLACE EBCM.

FRONT WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	804 TO 1066
5 TO 43	41 TO 110	956 TO 1240
44 TO 93	111 TO 200	1112 TO 1463

C1616S



DTC 22
RIGHT FRONT WHEEL SPEED = 0

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 22 can be set when the vehicle is not in an ABS event. If the right front wheel speed = 0 and the vehicle's reference speed is greater than 8 km/h (5 mph), a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled and the amber ABS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step identifies a wheel speed sensor or circuitry that is damaged and visibly apparent.
2. Checks to see that the wheel speed sensor coil is within proper resistance values.
3. Verifies that the wheel speed sensor can generate an appropriate output signal.
4. This ensures that the wheel speed circuitry is not shorted together.
5. Ensures that the malfunction was not due to physical damage.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water). Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 22
RIGHT FRONT WHEEL SPEED = 0

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

1
- IGNITION "OFF."
- PHYSICALLY INSPECT THE RIGHT FRONT WHEEL SPEED SENSOR, RIGHT FRONT WHEEL SPEED SENSOR JUMPER HARNESS, AND CONNECTORS FOR DAMAGE.

IS PHYSICAL DAMAGE INDICATED?

YES → REPLACE WHEEL SPEED SENSOR AND/OR JUMPER HARNESS IF DAMAGED. DRIVE VEHICLE ABOVE 24 km/h (15 MPH) TO ENSURE DTC 22 DOES NOT SET.

NO

2
- DISCONNECT RIGHT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN SENSOR TERMINALS "A" AND "B."

IS RESISTANCE BETWEEN 1020 AND 1137Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF THE SENSOR IS SUSPECTED TO BE OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

NO → REPLACE WHEEL SPEED SENSOR.

YES

3
- WITH J 39200 STILL CONNECTED, SELECT A/C VOLTAGE SCALE.
- SPIN WHEEL BY HAND WHILE OBSERVING VOLTAGE.

IS VOLTAGE AT LEAST 100 mV (VOLTAGE WILL INCREASE AS WHEEL SPEED INCREASES)?

NO → REPLACE WHEEL SPEED SENSOR.

YES

4
- IGNITION "OFF."
- DISCONNECT 32-WAY EBCM CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A3" AND "A4" OF THE 32-WAY EBCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

NO → REPAIR SHORT BETWEEN CKTs 833 AND 872.

YES

5
- INSPECT CKTs 833 AND 872 AND 32-WAY EBCM CONNECTOR FOR DAMAGE WHICH MAY RESULT IN A SHORT BETWEEN CKTs 833 AND 872 WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- TEST DRIVE VEHICLE ABOVE 24 km/h (15 MPH) FOR AT LEAST 30 SECONDS.

DOES DTC 22 SET AS A CURRENT DTC?

NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

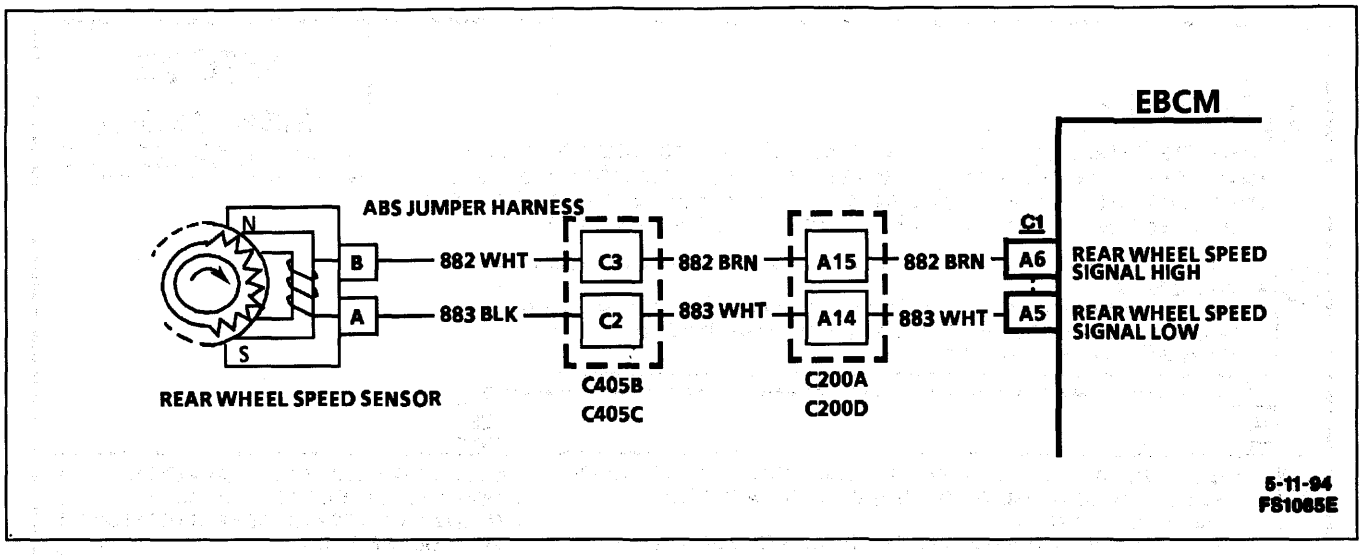
YES → REPLACE EBCM.

FRONT WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	804 TO 1066
5 TO 43	41 TO 110	956 TO 1240
44 TO 93	111 TO 200	1112 TO 1463

C1617S



DTC 24
REAR WHEEL SPEED = 0

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 24 can be set when the vehicle is not in an ABS event. If the rear wheel speed = 0 and the vehicle's reference speed is greater than 8 km/h (5 mph), a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled and the amber ABS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step identifies a wheel speed sensor or circuitry that is damaged and visibly apparent.
2. Checks to see that the wheel speed sensor coil is within proper resistance values.
3. Verifies that the wheel speed sensor can generate an appropriate output signal.
4. Verifies that the wheel speed circuitry is not shorted together.
5. Ensures that the malfunction was not due to physical damage.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water). Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 24
REAR WHEEL SPEED = 0

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

1
- IGNITION "OFF."
- PHYSICALLY INSPECT THE REAR WHEEL SPEED SENSOR, WHEEL SPEED SENSOR JUMPER HARNESS, AND CONNECTORS FOR DAMAGE.

IS PHYSICAL DAMAGE INDICATED?

YES → REPLACE WHEEL SPEED SENSOR AND/OR WHEEL SPEED SENSOR JUMPER HARNESS IF DAMAGED. DRIVE VEHICLE ABOVE 24 km/h (15 MPH) TO ENSURE DTC 24 DOES NOT SET.

NO

2
- DISCONNECT REAR WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN SENSOR TERMINALS "A" AND "B."

IS RESISTANCE BETWEEN 969 AND 1185Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF THE SENSOR IS SUSPECTED TO BE OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

NO → REPLACE WHEEL SPEED SENSOR.

YES

3
- WITH J 39200 STILL CONNECTED, SELECT A/C VOLTAGE SCALE.
- VEHICLE TRANSMISSION IN NEUTRAL.
- SPIN WHEEL BY HAND WHILE OBSERVING VOLTAGE.

IS VOLTAGE AT LEAST 100 mV (VOLTAGE WILL INCREASE AS WHEEL SPEED INCREASES)?

NO → REPLACE WHEEL SPEED SENSOR.

YES

4
- IGNITION "OFF."
- DISCONNECT 32-WAY EBCM CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A5" AND "A6" OF THE 32-WAY EBCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

NO → REPAIR SHORT BETWEEN CKTs 882 AND 883.

YES

5
- INSPECT CKTs 882 AND 883 AND 32-WAY EBCM CONNECTOR FOR DAMAGE WHICH MAY RESULT IN A SHORT BETWEEN CKTs 882 AND 883 WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- TEST DRIVE VEHICLE ABOVE 24 km/h (15 MPH) FOR AT LEAST 30 SECONDS.

DOES DTC 24 SET AS A CURRENT DTC?

NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

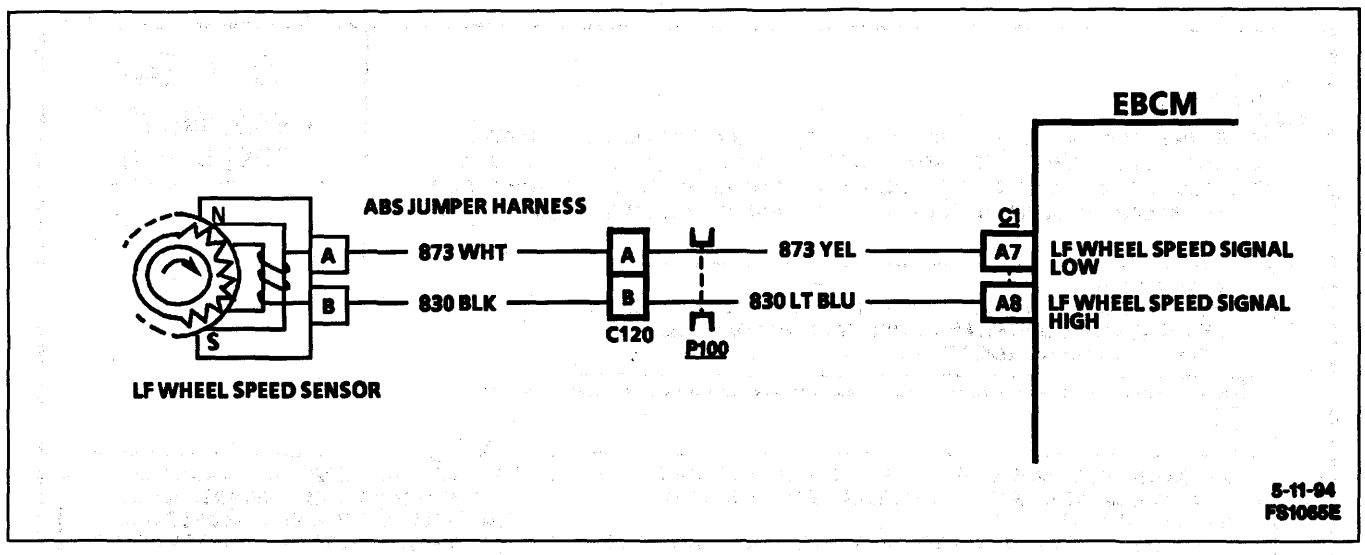
YES → REPLACE EBCM.

REAR WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	763 TO 1110
5 TO 43	41 TO 110	908 TO 1292
44 TO 93	111 TO 200	1057 TO 1525

C1618S



DTC 25
LEFT FRONT EXCESSIVE WHEEL SPEED VARIATION

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 25 can be set when the brake is "OFF." The purpose of this test is to detect a situation in which the left front wheel acceleration or deceleration is beyond specified limits.

Action Taken:

A malfunction DTC is stored, ABS are disabled and the amber ABS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step identifies a wheel speed sensor or circuitry that is damaged and visibly apparent.
2. Checks to see that the wheel speed sensor coil is within proper resistance values.
3. Verifies that the wheel speed sensor can generate an appropriate output signal.
4. This ensures that the wheel speed circuitry is not shorted together.
5. Ensures that the malfunction was not due to physical damage.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water). Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 25
LEFT FRONT EXCESSIVE WHEEL SPEED VARIATION

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

1
- IGNITION "OFF."
- PHYSICALLY INSPECT THE LEFT FRONT WHEEL SPEED SENSOR, LEFT FRONT WHEEL SPEED SENSOR JUMPER HARNESS, AND CONNECTORS FOR DAMAGE.

IS PHYSICAL DAMAGE INDICATED?

YES → REPLACE WHEEL SPEED SENSOR AND/OR JUMPER HARNESS IF DAMAGED. DRIVE VEHICLE ABOVE 24 km/h (15 MPH) TO ENSURE DTC 25 DOES NOT SET.

NO

2
- DISCONNECT LEFT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN SENSOR TERMINALS "A" AND "B."

IS RESISTANCE BETWEEN 1020 AND 1137Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF THE SENSOR IS SUSPECTED TO BE OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

NO → REPLACE WHEEL SPEED SENSOR.

YES

3
- WITH J 39200 STILL CONNECTED, SELECT A/C VOLTAGE SCALE.
- SPIN WHEEL BY HAND WHILE OBSERVING VOLTAGE.

IS VOLTAGE AT LEAST 100 mV (VOLTAGE WILL INCREASE AS WHEEL SPEED INCREASES)?

NO → REPLACE WHEEL SPEED SENSOR.

YES

4
- IGNITION "OFF."
- DISCONNECT 32-WAY EBCM CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A7" AND "A8" OF THE 32-WAY EBCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

NO → REPAIR SHORT BETWEEN CKTs 830 AND 873.

YES

5
- INSPECT CKTs 830 AND 873 AND 32-WAY EBCM CONNECTOR FOR DAMAGE WHICH MAY RESULT IN A SHORT BETWEEN CKTs 830 AND 873 WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- TEST DRIVE VEHICLE ABOVE 24 km/h (15 MPH) FOR AT LEAST 30 SECONDS.

DOES DTC 25 SET AS A CURRENT DTC?

NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

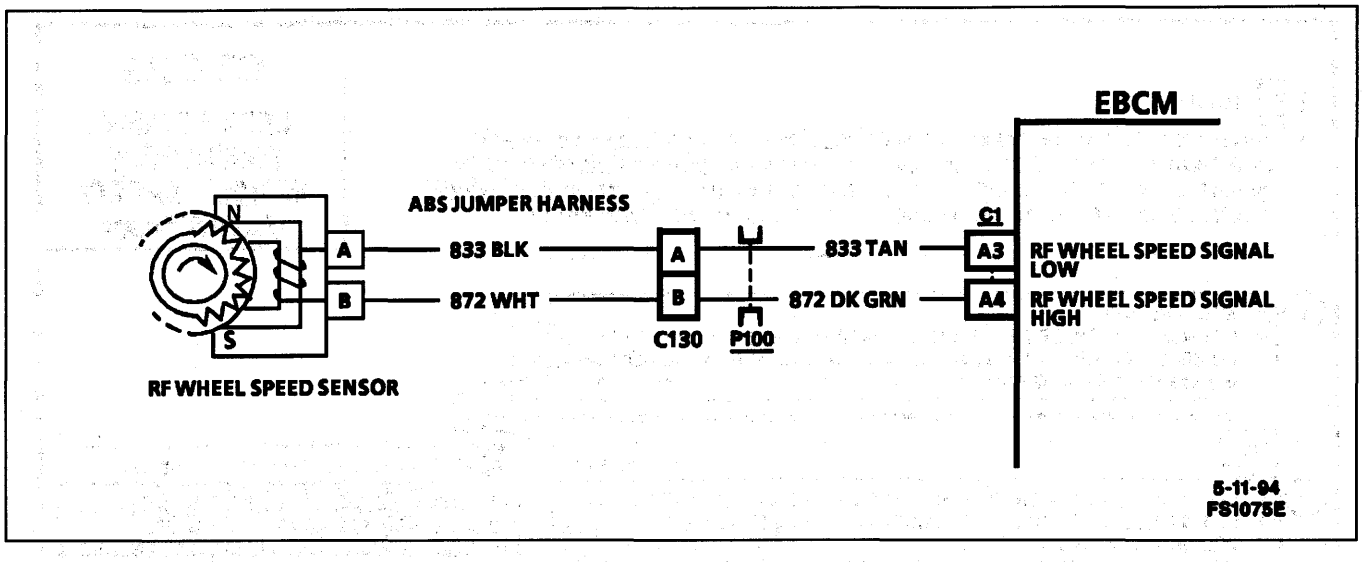
YES → REPLACE EBCM.

FRONT WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	804 TO 1066
5 TO 43	41 TO 110	956 TO 1240
44 TO 93	111 TO 200	1112 TO 1463

C1619S



DTC 26
RIGHT FRONT EXCESSIVE WHEEL SPEED VARIATION

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 26 can be set when the brake is "OFF." The purpose of this test is to detect a situation in which the right front wheel acceleration or deceleration is beyond specified limits.

Action Taken:

A malfunction DTC is stored, ABS are disabled and the ABS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step identifies a wheel speed sensor or circuitry that is damaged and visibly apparent.
2. Checks to see that the wheel speed sensor coil is within proper resistance values.
3. Verifies that the wheel speed sensor can generate an appropriate output signal.
4. This ensures that the wheel speed circuitry is not shorted together.
5. Ensures that the malfunction was not due to physical damage.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water). Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 26
RIGHT FRONT EXCESSIVE WHEEL SPEED VARIATION

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

1
- IGNITION "OFF."
- PHYSICALLY INSPECT THE RIGHT FRONT WHEEL SPEED SENSOR, RIGHT FRONT WHEEL SPEED SENSOR JUMPER HARNESS, AND CONNECTORS FOR DAMAGE.

IS PHYSICAL DAMAGE INDICATED?

NO

YES → REPLACE WHEEL SPEED SENSOR AND/OR JUMPER HARNESS IF DAMAGED. DRIVE VEHICLE ABOVE 24 km/h (15 MPH) TO ENSURE DTC 26 DOES NOT SET.

2
- DISCONNECT RIGHT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN SENSOR TERMINALS "A" AND "B."

IS RESISTANCE BETWEEN 1020 AND 1137Ω WHEN SENSOR IS 20°C (68°F)?
(IF TEMPERATURE OF THE SENSOR IS SUSPECTED TO BE OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)

YES

NO → REPLACE WHEEL SPEED SENSOR.

3
- WITH J 39200 STILL CONNECTED, SELECT A/C VOLTAGE SCALE.
- SPIN WHEEL BY HAND WHILE OBSERVING VOLTAGE.

IS VOLTAGE AT LEAST 100 mV (VOLTAGE WILL INCREASE AS WHEEL SPEED INCREASES)?

YES

NO → REPLACE WHEEL SPEED SENSOR.

4
- IGNITION "OFF."
- DISCONNECT 32-WAY EBCM CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A3" AND "A4" OF THE 32-WAY EBCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

NO → REPAIR SHORT BETWEEN CKTs 833 AND 872.

5
- INSPECT CKTs 833 AND 872 AND 32-WAY EBCM CONNECTOR FOR DAMAGE WHICH MAY RESULT IN A SHORT BETWEEN CKTs 833 AND 872 WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- TEST DRIVE VEHICLE ABOVE 24 km/h (15 MPH) FOR AT LEAST 30 SECONDS.

DOES DTC 26 SET AS A CURRENT DTC?

YES → REPLACE EBCM.

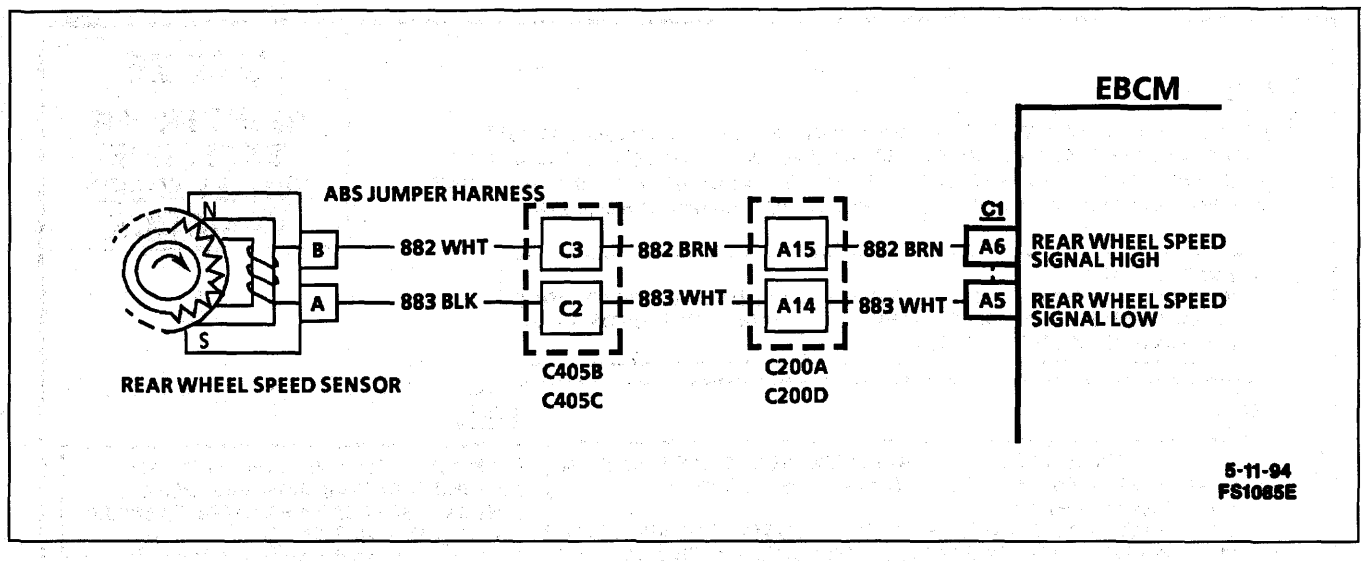
NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

FRONT WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	804 TO 1066
5 TO 43	41 TO 110	956 TO 1240
44 TO 93	111 TO 200	1112 TO 1463

C1620S



DTC 28
REAR EXCESSIVE WHEEL SPEED VARIATION

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 28 can be set when the brake is "OFF." The purpose of this test is to detect a situation in which the rear wheel acceleration or deceleration is beyond specified limits.

Action Taken:

A malfunction DTC is stored, ABS are disabled and the amber ABS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step identifies a wheel speed sensor or circuitry that is damaged and visibly apparent.
2. Checks to see that the wheel speed sensor coil is within proper resistance values.
3. Verifies that the wheel speed sensor can generate an appropriate output signal.
4. This ensures that the wheel speed circuitry is not shorted together.
5. Ensures that the malfunction was not due to physical damage.
6. Checks rear sensor toothed ring for physical damage.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 28
REAR EXCESSIVE WHEEL SPEED VARIATION

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

1
- IGNITION "OFF."
- PHYSICALLY INSPECT THE REAR WHEEL SPEED SENSOR, WHEEL SPEED SENSOR JUMPER HARNESS, AND CONNECTORS FOR DAMAGE.

IS PHYSICAL DAMAGE INDICATED?

YES → REPLACE WHEEL SPEED SENSOR AND/OR WHEEL SPEED SENSOR JUMPER HARNESS IF DAMAGED. DRIVE VEHICLE ABOVE 24 km/h (15 MPH) TO ENSURE DTC 28 DOES NOT SET.

NO

2
- DISCONNECT REAR WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN SENSOR TERMINALS "A" AND "B."

IS RESISTANCE BETWEEN 969 AND 1185Ω WHEN SENSOR IS 20°C (68°F)?
(IF TEMPERATURE OF THE SENSOR IS SUSPECTED TO BE OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)

NO → REPLACE WHEEL SPEED SENSOR.

YES

3
- WITH J 39200 STILL CONNECTED, SELECT A/C VOLTAGE SCALE.
- VEHICLE TRANSMISSION IN NEUTRAL.
- SPIN WHEEL BY HAND WHILE OBSERVING VOLTAGE.

IS VOLTAGE AT LEAST 100 mV (VOLTAGE WILL INCREASE AS WHEEL SPEED INCREASES)?

NO → REPLACE WHEEL SPEED SENSOR.

YES

4
- IGNITION "OFF."
- DISCONNECT 32-WAY EBCM CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A5" AND "A6" OF THE 32-WAY EBCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

NO → REPLACE WHEEL SPEED SENSOR.

YES

5
- INSPECT CKTs 882 AND 883 AND 32-WAY EBCM CONNECTOR FOR DAMAGE WHICH MAY RESULT IN A SHORT BETWEEN CKTs 882 AND 883 WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- TEST DRIVE VEHICLE ABOVE 24 km/h (15 MPH) FOR AT LEAST 30 SECONDS.

DOES DTC 28 SET AS A CURRENT DTC?

NO → REPAIR SHORT BETWEEN CKTs 882 AND 883.

YES

6
- INSPECT REAR SENSOR TOOTHED RING IN REAR AXLE DIFFERENTIAL FOR MISSING TEETH OR OTHER PHYSICAL DAMAGE. REFER TO SECTION 4B.

IS ANY PHYSICAL DAMAGE INDICATED?

NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

YES → REPLACE TOOTHED RING. REFER TO SECTION 4B.

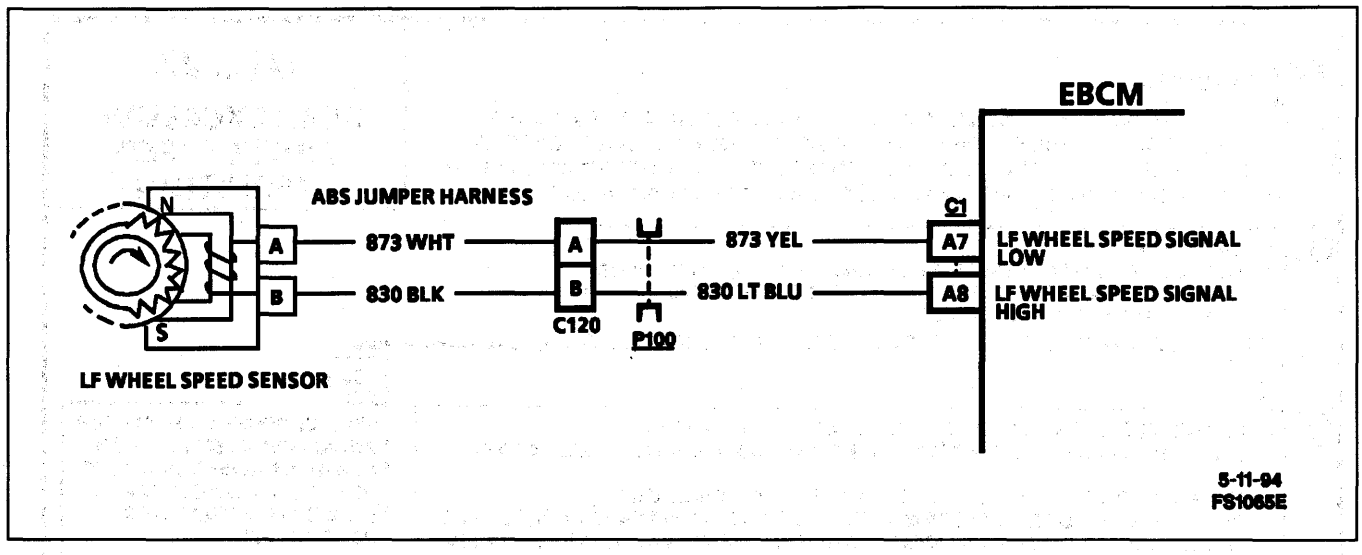
NO → REPLACE EBCM.

REAR WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	763 TO 1110
5 TO 43	41 TO 110	908 TO 1292
44 TO 93	111 TO 200	1057 TO 1525

C1621S



DTC 32
(Page 1 of 3)
LF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring often referred to as the air gap.

DTC Will Set When:

DTC 32 can be set anytime after initialization. If either of the left front wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS are disabled and the amber ABS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for proper resistance of the wheel speed sensor coil.
2. Checks for a short to ground in the wheel speed sensor wiring.
3. Checks for a short to voltage in the wheel speed sensor wiring.
4. Checks for a short to voltage in CKT 873.
5. Checks for a short to voltage in CKT 830.
6. Ensures that the malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

DTC 32

(Page 1 of 3)

LF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

1
- IGNITION "OFF."
- USING A 5% SALT WATER SOLUTION (TWO TEASPOONS OF SALT TO 12 OZ. WATER), THOROUGHLY SPRAY THE LEFT FRONT WHEEL SPEED SENSOR JUMPER HARNESS.
- DISCONNECT 32-WAY EBCM HARNESS CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINALS "A7" AND "A8" OF THE 32-WAY EBCM HARNESS CONNECTOR.

IS RESISTANCE BETWEEN 1020 AND 1137Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF SENSOR IS SUSPECTED TO OTHER THAN 20°C (68°F), REFER TO THE TABLE ON PAGE 2 OF 2 OF THIS DTC CHART FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

NO → DIAGNOSIS CONTINUED ON PAGE 2 OF 3 OF THIS DTC CHART.

YES

2
- MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A7" OF THE 32-WAY EBCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

NO → DIAGNOSIS CONTINUED ON PAGE 3 OF 3 OF THIS DTC CHART.

YES

3
- IGNITION "ON."
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A7" OF THE 32-WAY EBCM HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

YES

6
- IGNITION "OFF."
- INSPECT TERMINALS "A7" AND "A8" OF THE 32-WAY EBCM HARNESS CONNECTOR FOR POOR TERMINAL CONTACT AND CONTAMINATION. ALSO INSPECT CKTs 830 AND 873 FOR DAMAGE WHICH MAY RESULT IN AN OPEN CIRCUIT, SHORT TO GROUND, OR SHORT TO VOLTAGE. REPAIR ALL DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- IGNITION "ON."

DOES DTC 32 SET AS A CURRENT DTC?

YES → REPLACE EBCM.

NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO

4
- IGNITION "OFF."
- DISCONNECT LEFT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- IGNITION "ON."
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A7" OF THE 32-WAY EBCM HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

NO → REPAIR SHORT TO VOLTAGE IN CKT 873.

YES

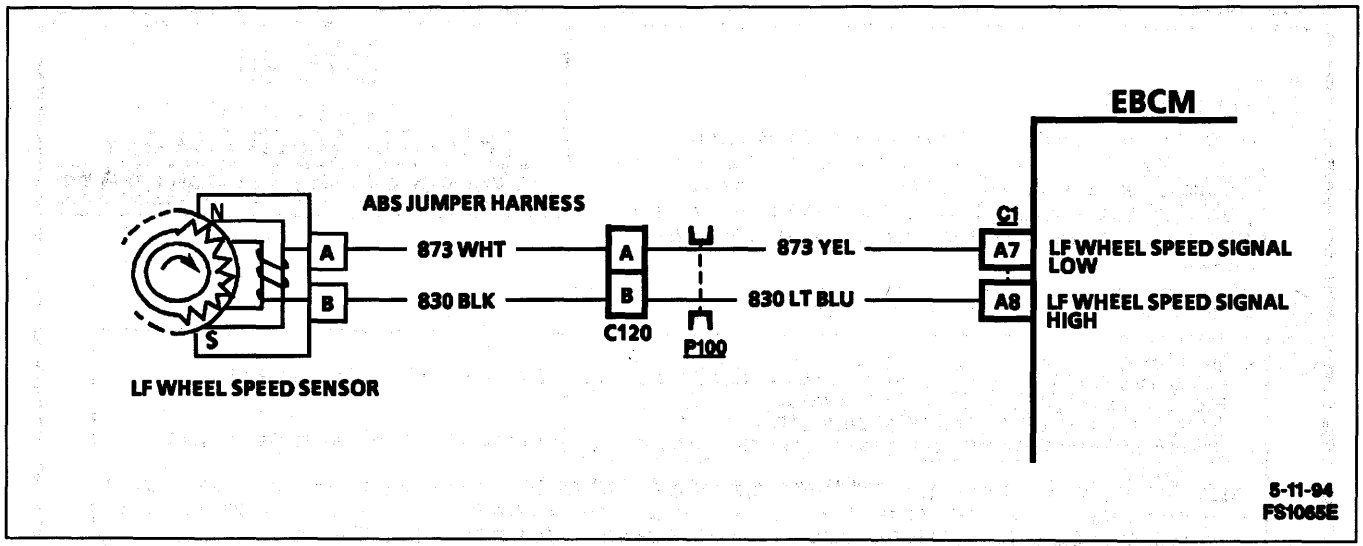
5
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A8" OF THE 32-WAY EBCM HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

NO → REPAIR SHORT TO VOLTAGE IN CKT 830.

YES → MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WHEN ALL COMPONENTS ARE CONNECTED. REPAIR ALL DAMAGE IF FOUND. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION.

C1622S



DTC 32
(Page 2 of 3)
LF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 32 can be set anytime after initialization. If either of the left front wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS are disabled and the amber ABS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

7. Checks for high resistance in CKT 873.
8. Checks for high resistance in CKT 830.
9. Verifies proper resistance of the wheel speed sensor coil.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 32

(Page 2 of 3)

LF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

DIAGNOSIS CONTINUED FROM PAGE 1 OF 3 OF THIS DTC CHART.

7. • DISCONNECT LEFT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A7" OF THE 32-WAY EBCM HARNESS CONNECTOR AND TERMINAL "B" OF THE LEFT FRONT WHEEL SPEED SENSOR HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?

   YES

8. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A8" OF THE 32-WAY EBCM HARNESS CONNECTOR AND TERMINAL "A" OF THE LEFT FRONT WHEEL SPEED SENSOR HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?

   YES

9. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE LEFT FRONT WHEEL SPEED SENSOR CONNECTOR.
   IS RESISTANCE BETWEEN 1020 AND 1137Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF SENSOR IS SUSPECTED TO OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

   YES

MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN HIGH RESISTANCE WHEN ALL COMPONENTS ARE CONNECTED. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION. REPAIR ALL DAMAGE IF FOUND.

NO

REPLACE WHEEL SPEED SENSOR.

NO

REPAIR HIGH RESISTANCE IN CKT 830 (WHEEL SPEED SENSOR JUMPER MUST BE REPLACED IF DAMAGED).

NO

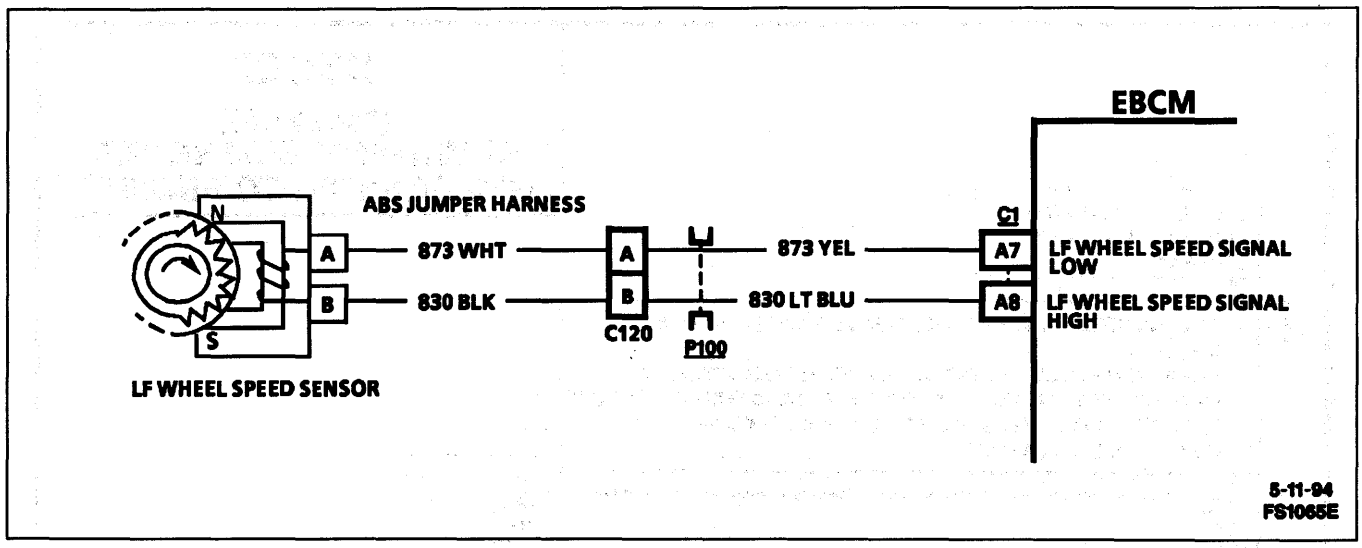
REPAIR HIGH RESISTANCE IN CKT 873 (WHEEL SPEED SENSOR JUMPER MUST BE REPLACED IF DAMAGED).

FRONT WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	804 TO 1066
5 TO 43	41 TO 110	956 TO 1240
44 TO 93	111 TO 200	1112 TO 1463

C1623S



DTC 32
(Page 3 of 3)
LF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 32 can be set anytime after initialization. If either of the left front wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS are disabled and the amber ABS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

10. Checks for a short to ground in CKT 873.
11. Checks for a short to ground in CKT 830.
12. Checks for a short to ground in the wheel speed sensor jumper harness.
13. Verifies that the wheel speed sensor is not internally shorted to ground.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 32

(Page 3 of 3)
LF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

DIAGNOSIS CONTINUED FROM PAGE 1 OF 3 OF THIS DTC CHART.

(10)
- DISCONNECT CONNECTOR C120 (LOCATED LH INNER FRAME RAIL).
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A7" OF THE 32-WAY EBCM HARNESS CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

(11)
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A8" OF THE 32-WAY EBCM HARNESS CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

NO

REPAIR SHORT TO GROUND IN CKT 873.

YES

(12)
- THOROUGHLY RESPRAY THE LEFT FRONT WHEEL SPEED SENSOR JUMPER HARNESS WITH THE SALT WATER SOLUTION.

IMPORTANT: DO NOT ALLOW WATER TO ENTER ANY WHEEL SPEED SENSOR CONNECTOR.

- DISCONNECT LEFT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A," THEN "B" OF THE LEFT FRONT WHEEL SPEED SENSOR HARNESS CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE) FOR BOTH MEASUREMENTS?

NO

REPAIR SHORT TO GROUND IN CKT 830.

YES

(13)
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A" OF THE LEFT FRONT WHEEL SPEED SENSOR CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

NO

REPLACE LEFT FRONT WHEEL SPEED SENSOR JUMPER HARNESS.

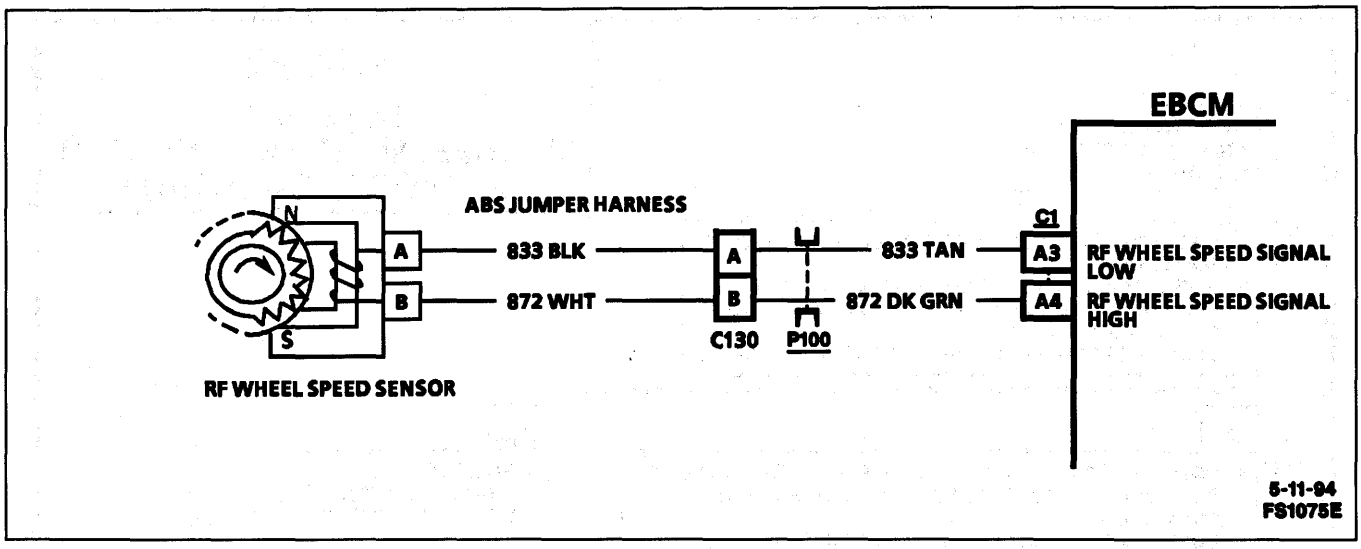
YES

MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN A SHORT TO GROUND WHEN ALL COMPONENTS ARE CONNECTED. PAY PARTICULAR ATTENTION TO THE JUMPER HARNESS, SMALL NICKS OR CUTS CAN CAUSE A MALFUNCTION. REPAIR ANY DAMAGE IF FOUND. JUMPER HARNESS MUST BE REPLACED IF DAMAGED. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION.

NO

REPLACE WHEEL SPEED SENSOR.

C1624S



DTC 33
(Page 1 of 3)
RF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 33 can be set anytime after initialization. If either of the right front wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS are disabled and the amber ABS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for proper resistance of the wheel speed sensor coil.
2. Checks for a short to ground in the wheel speed sensor wiring.
3. Checks for a short to voltage in the wheel speed sensor wiring.
4. Checks for a short to voltage in CKT 833.
5. Checks for a short to voltage in CKT 872.
6. Ensures that the malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

DTC 33

(Page 1 of 3)

RF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

1
- IGNITION "OFF."
- USING A 5% SALT WATER SOLUTION (TWO TEASPOONS OF SALT TO 12 OZ. WATER), THOROUGHLY SPRAY THE RIGHT FRONT WHEEL SPEED SENSOR JUMPER HARNESS.
- DISCONNECT 32-WAY EBCM HARNESS CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINALS "A3" AND "A4" OF THE 32-WAY EBCM HARNESS CONNECTOR.

IS RESISTANCE BETWEEN 1020 AND 1137Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF SENSOR IS SUSPECTED TO OTHER THAN 20°C (68°F), REFER TO THE TABLE ON PAGE 2 OF 2 OF THIS DTC CHART FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

YES →

2
- MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A3" OF THE 32-WAY EBCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES →

3
- IGNITION "ON."
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A3" OF THE 32-WAY EBCM HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

NO →

4
- IGNITION "OFF."
- DISCONNECT RIGHT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- IGNITION "ON."
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A3" OF THE 32-WAY EBCM HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

YES →

5
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A4" OF THE 32-WAY EBCM HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

YES →

MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WHEN ALL COMPONENTS ARE CONNECTED. REPAIR ALL DAMAGE IF FOUND. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION.

NO →

REPAIR SHORT TO VOLTAGE IN CKT 872.

NO →

REPAIR SHORT TO VOLTAGE IN CKT 833.

NO →

DIAGNOSIS CONTINUED ON PAGE 2 OF 3 OF THIS DTC CHART.

NO →

DIAGNOSIS CONTINUED ON PAGE 3 OF 3 OF THIS DTC CHART.

YES →

6
- IGNITION "OFF."
- INSPECT TERMINALS "A3" AND "A4" OF THE 32-WAY EBCM HARNESS CONNECTOR FOR POOR TERMINAL CONTACT AND CONTAMINATION. ALSO INSPECT CKTs 833 AND 872 FOR DAMAGE WHICH MAY RESULT IN AN OPEN CIRCUIT, SHORT TO GROUND, OR SHORT TO VOLTAGE. REPAIR ALL DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- IGNITION "ON."

DOES DTC 33 SET AS A CURRENT DTC?

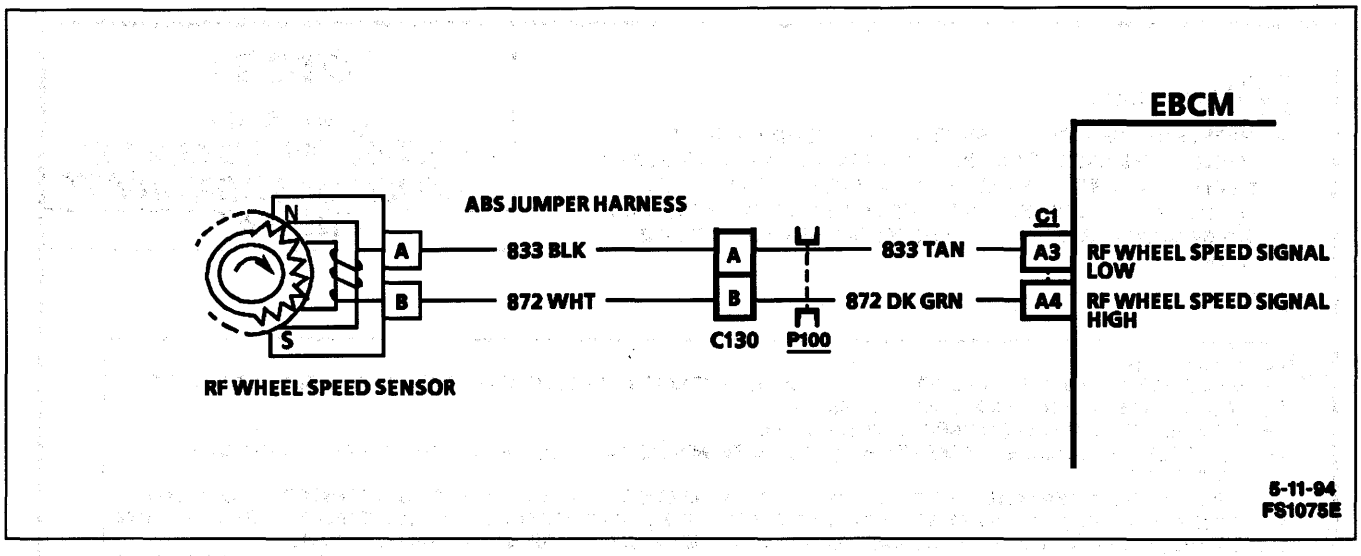
YES →

REPLACE EBCM.

NO →

MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

C1625S



DTC 33
(Page 2 of 3)
RF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 33 can be set anytime after initialization. If either of the right front wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS are disabled and the ABS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

7. Checks for high resistance in CKT 833.
8. Checks for high resistance in CKT 872.
9. Verifies proper resistance of the wheel speed sensor coil.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 33

(Page 2 of 3)
RF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

DIAGNOSIS CONTINUED FROM PAGE 1 OF 3 OF THIS DTC CHART.

7

- DISCONNECT RIGHT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A3" OF THE 32-WAY EBCM HARNESS CONNECTOR AND TERMINAL "A" OF THE RIGHT FRONT WHEEL SPEED SENSOR HARNESS CONNECTOR.
  IS RESISTANCE 2Ω OR LESS?

YES

8

- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A4" OF THE 32-WAY EBCM HARNESS CONNECTOR AND TERMINAL "B" OF THE RIGHT FRONT WHEEL SPEED SENSOR HARNESS CONNECTOR.
  IS RESISTANCE 2Ω OR LESS?

YES

9

- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE RIGHT FRONT WHEEL SPEED SENSOR CONNECTOR.
  IS RESISTANCE BETWEEN 1020 AND 1137Ω WHEN SENSOR IS 20°C (68°F)? (*IF TEMPERATURE OF SENSOR IS SUSPECTED TO OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.*)

YES

MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN HIGH RESISTANCE WHEN ALL COMPONENTS ARE CONNECTED. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION. REPAIR ALL DAMAGE IF FOUND.

NO

REPLACE WHEEL SPEED SENSOR.

NO

REPAIR HIGH RESISTANCE IN CKT 872 (WHEEL SPEED SENSOR JUMPER MUST BE REPLACED IF DAMAGED).

NO

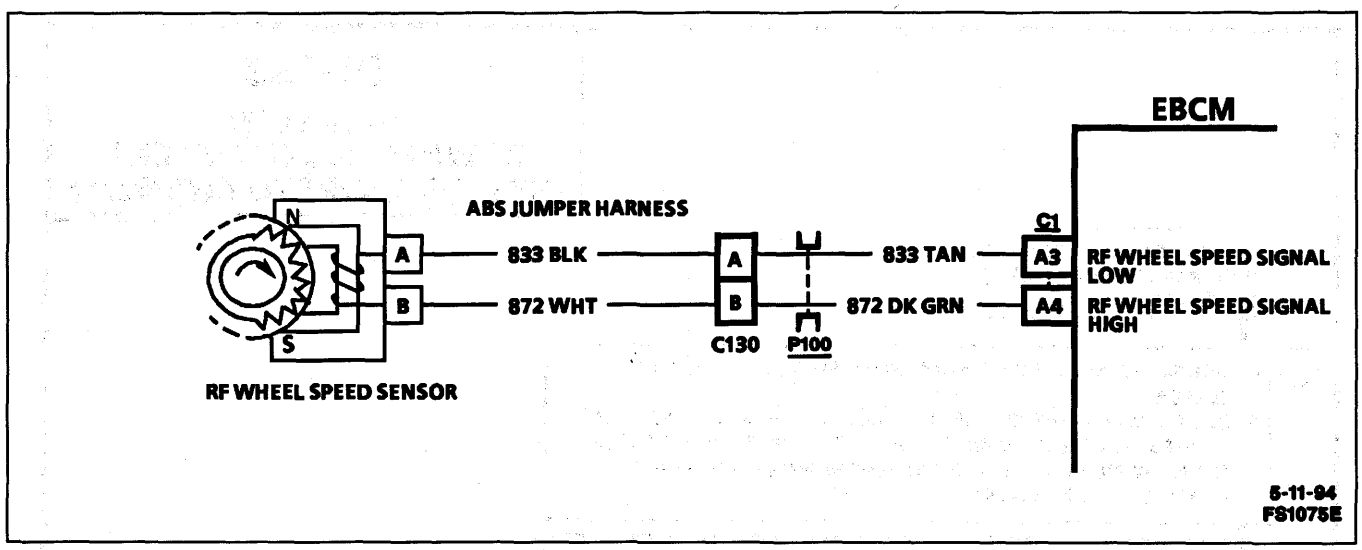
REPAIR HIGH RESISTANCE IN CKT 833 (WHEEL SPEED SENSOR JUMPER MUST BE REPLACED IF DAMAGED).

FRONT WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	804 TO 1066
5 TO 43	41 TO 110	956 TO 1240
44 TO 93	111 TO 200	1112 TO 1463

C1626S



DTC 33
(Page 3 of 3)
RF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 33 can be set anytime after initialization. If either of the right front wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS are disabled and the ABS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

10. Checks for a short to ground in CKT 833.
11. Checks for a short to ground in CKT 872.
12. Checks for a short to ground in the wheel speed sensor jumper harness.
13. Verifies that the wheel speed sensor is not internally shorted to ground.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 33

(Page 3 of 3)

RF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

DIAGNOSIS CONTINUED FROM PAGE 1 OF 3 OF THIS DTC CHART.

10
- DISCONNECT CONNECTOR C130 (LOCATED RH INNER FRAME RAIL).
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A3" OF THE 32-WAY EBCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

11
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A4" OF THE 32-WAY EBCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

12
- THOROUGHLY RESPRAY THE RIGHT FRONT WHEEL SPEED SENSOR JUMPER HARNESS WITH THE SALT WATER SOLUTION.

IMPORTANT: DO NOT ALLOW WATER TO ENTER ANY WHEEL SPEED SENSOR CONNECTOR.

- DISCONNECT RIGHT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A," THEN "B" OF THE RIGHT FRONT WHEEL SPEED SENSOR HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE) FOR BOTH MEASUREMENTS?

YES

13
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A" OF THE RIGHT FRONT WHEEL SPEED SENSOR CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN A SHORT TO GROUND WHEN ALL COMPONENTS ARE CONNECTED. PAY PARTICULAR ATTENTION TO THE JUMPER HARNESS, SMALL NICKS OR CUTS CAN CAUSE A MALFUNCTION. REPAIR ANY DAMAGE IF FOUND. JUMPER HARNESS MUST BE REPLACED IF DAMAGED. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION.

NO

REPLACE WHEEL SPEED SENSOR.

NO

REPLACE RIGHT FRONT WHEEL SPEED SENSOR.

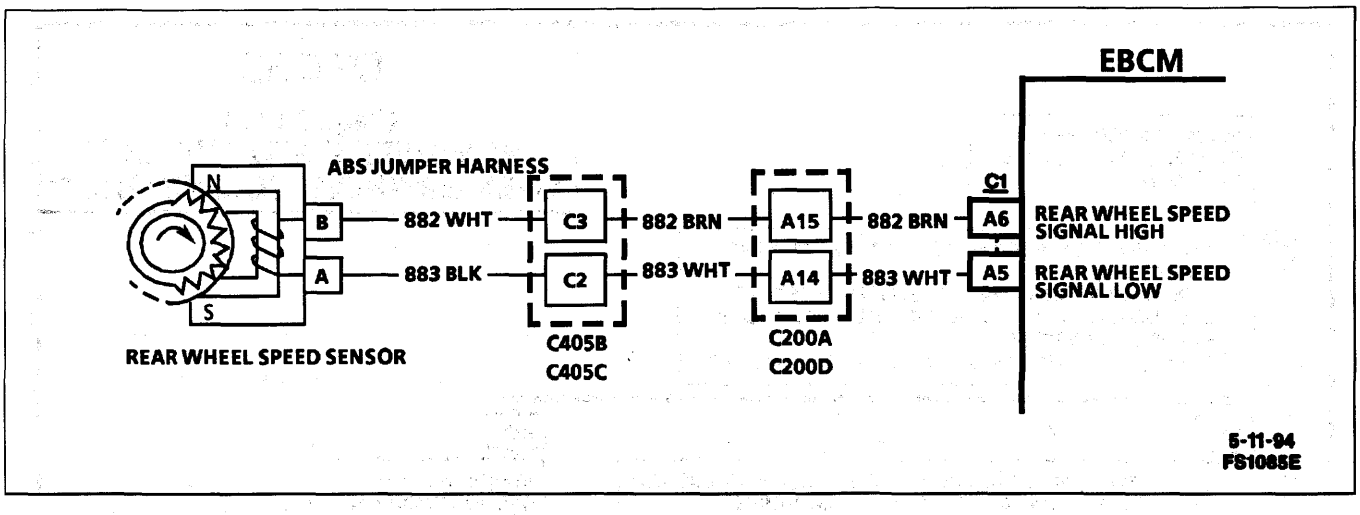
NO

REPAIR SHORT TO GROUND IN CKT 872.

NO

REPAIR SHORT TO GROUND IN CKT 833.

C1627S



DTC 35
(Page 1 of 3)
REAR WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 35 can be set anytime after initialization. If the rear wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS are disabled and the amber ABS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for proper resistance of the wheel speed sensor coil.
2. Checks for a short to ground in the wheel speed sensor wiring.
3. Checks for a short to voltage in the wheel speed sensor wiring.
4. Checks for a short to voltage in CKT 883.
5. Checks for a short to voltage in CKT 882.
6. Ensures that the malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 35

(Page 1 of 3)
RR WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

1
- IGNITION "OFF."
- USING A 5% SALT WATER SOLUTION (TWO TEASPOONS OF SALT TO 12 OZ. WATER), THOROUGHLY SPRAY THE REAR WHEEL SPEED SENSOR JUMPER HARNESS.
- DISCONNECT 32-WAY EBCM HARNESS CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINALS "A5" AND "A6" OF THE 32-WAY EBCM HARNESS CONNECTOR.

IS RESISTANCE BETWEEN 969 AND 1185Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF SENSOR IS SUSPECTED TO OTHER THAN 20°C (68°F), REFER TO THE TABLE ON PAGE 2 OF 2 OF THIS DTC CHART FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

YES

2
- MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A5" OF THE 32-WAY EBCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

3
- IGNITION "ON."
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A5" OF THE 32-WAY EBCM HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

NO

4
- IGNITION "OFF."
- DISCONNECT REAR WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- IGNITION "ON."
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A5" OF THE 32-WAY EBCM HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

YES

5
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A6" OF THE 32-WAY EBCM HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

YES

MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WHEN ALL COMPONENTS ARE CONNECTED. REPAIR ALL DAMAGE IF FOUND. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION.

NO

REPAIR SHORT TO VOLTAGE IN CKT 882.

NO

REPAIR SHORT TO VOLTAGE IN CKT 883.

NO

DIAGNOSIS CONTINUED ON PAGE 2 OF 3 OF THIS DTC CHART.

NO

DIAGNOSIS CONTINUED ON PAGE 3 OF 3 OF THIS DTC CHART.

YES

6
- IGNITION "OFF."
- INSPECT TERMINALS "A5" AND "A6" OF THE 32-WAY EBCM HARNESS CONNECTOR FOR POOR TERMINAL CONTACT AND CONTAMINATION. ALSO INSPECT CKTs 882 AND 883 FOR DAMAGE WHICH MAY RESULT IN AN OPEN CIRCUIT, SHORT TO GROUND, OR SHORT TO VOLTAGE. REPAIR ALL DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- IGNITION "ON."

DOES DTC 35 SET AS A CURRENT DTC?

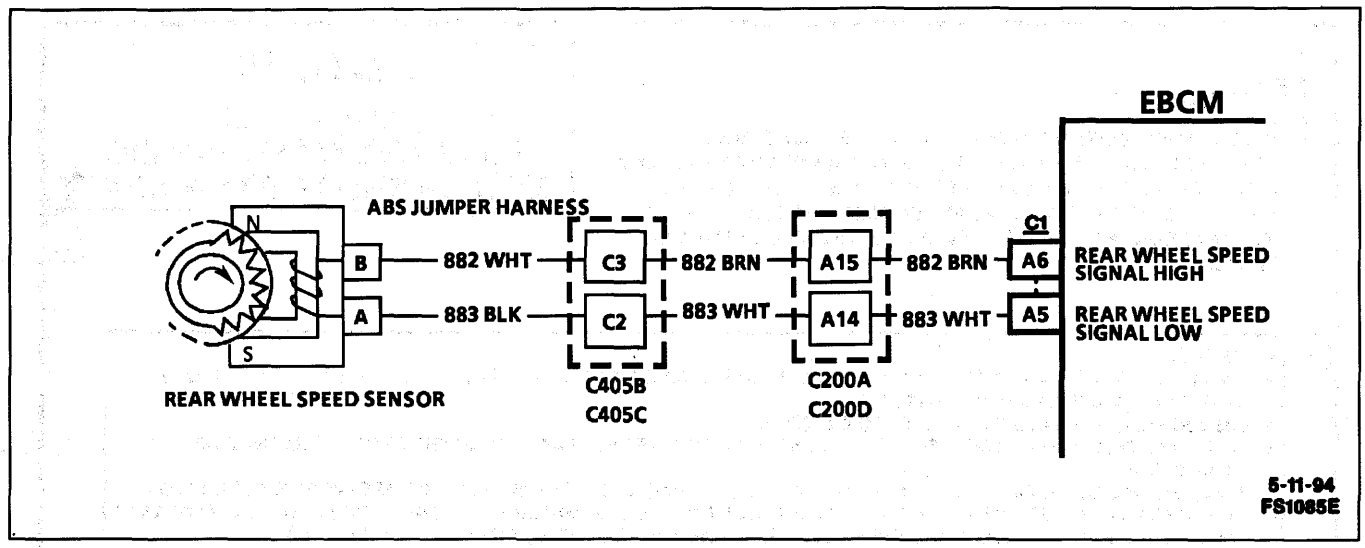
YES

REPLACE EBCM.

NO

MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

C1628S



DTC 35
(Page 2 of 3)
REAR WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal (AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 35 can be set anytime after initialization. If either of the right rear wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS are disabled and the amber ABS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

7. Checks for high resistance in CKT 883.
8. Checks for high resistance in CKT 882.
9. Verifies proper resistance of the wheel speed sensor coil.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 35

(Page 2 of 3)

RR WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

DIAGNOSIS CONTINUED FROM PAGE 1 OF 3 OF THIS DTC CHART.

7

- DISCONNECT REAR WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A5" OF THE 32-WAY EBCM HARNESS CONNECTOR AND TERMINAL "A" OF THE REAR WHEEL SPEED SENSOR HARNESS CONNECTOR.

IS RESISTANCE 2Ω OR LESS?

YES

8

- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A6" OF THE 32-WAY EBCM HARNESS CONNECTOR AND TERMINAL "B" OF THE REAR WHEEL SPEED SENSOR HARNESS CONNECTOR.

IS RESISTANCE 2Ω OR LESS?

YES

9

- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE REAR WHEEL SPEED SENSOR CONNECTOR.

IS RESISTANCE BETWEEN 969 AND 1185Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF SENSOR IS SUSPECTED TO OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

YES

MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN HIGH RESISTANCE WHEN ALL COMPONENTS ARE CONNECTED. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION. REPAIR ALL DAMAGE IF FOUND.

NO

REPLACE WHEEL SPEED SENSOR.

NO

REPAIR HIGH RESISTANCE IN CKT 883 (WHEEL SPEED SENSOR JUMPER MUST BE REPLACED IF DAMAGED).

NO

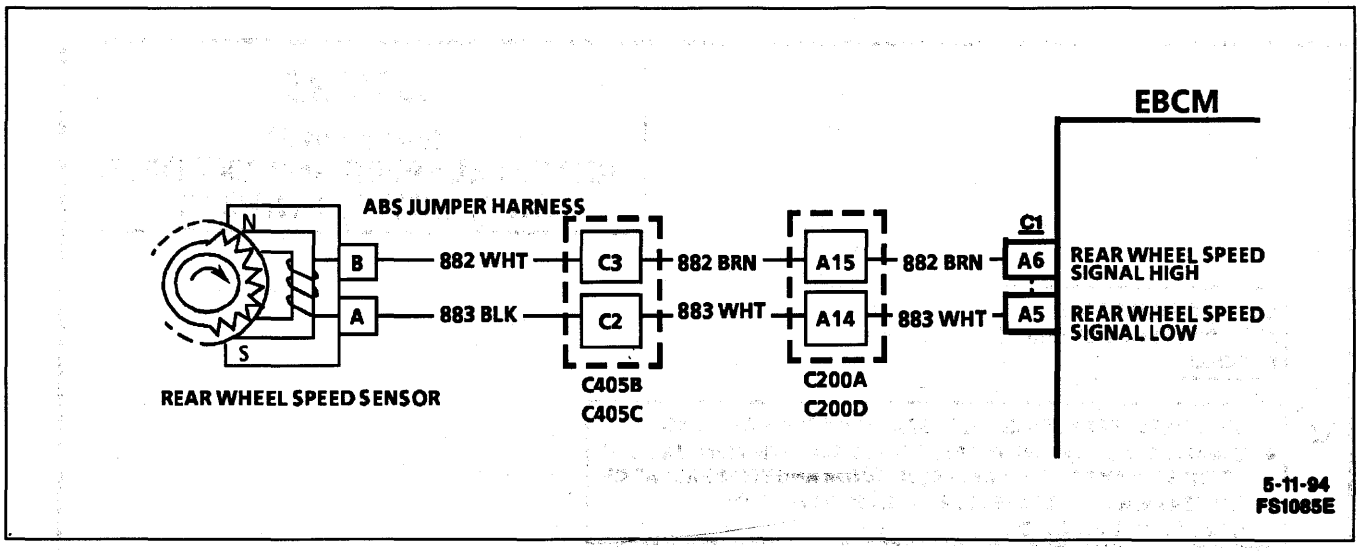
REPAIR HIGH RESISTANCE IN CKT 882 (WHEEL SPEED SENSOR JUMPER MUST BE REPLACED IF DAMAGED).

REAR WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	763 TO 1110
5 TO 43	41 TO 110	908 TO 1292
44 TO 93	111 TO 200	1057 TO 1525

C1629S



DTC 35
(Page 3 of 3)
REAR WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 35 can be set anytime after initialization. If the rear wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS are disabled and the amber ABS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

10. Checks for a short to ground in CKT 883.
11. Checks for a short to ground in CKT 882.
12. Checks for a short to ground in the wheel speed sensor jumper harness.
13. Verifies that the wheel speed sensor is not internally shorted to ground.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water). Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24 km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 35

(Page 3 of 3)

RR WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

DIAGNOSIS CONTINUED FROM PAGE 1 OF 3 OF THIS DTC CHART.

10
- DISCONNECT CONNECTOR C405B, C405C (LOCATED ON THE LH SIDE REAR UNDER BODY, BEHIND REAR SEAT).
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A5" OF THE 32-WAY EBCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

11
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A6" OF THE 32-WAY EBCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

12
- THOROUGHLY RESPRAY THE REAR WHEEL SPEED SENSOR JUMPER HARNESS WITH THE SALT WATER SOLUTION.

IMPORTANT: DO NOT ALLOW WATER TO ENTER ANY WHEEL SPEED SENSOR CONNECTOR.

- DISCONNECT REAR WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A," THEN "B" OF THE REAR WHEEL SPEED SENSOR HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE) FOR BOTH MEASUREMENTS?

YES

13
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A" OF THE REAR WHEEL SPEED SENSOR CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN A SHORT TO GROUND WHEN ALL COMPONENTS ARE CONNECTED. PAY PARTICULAR ATTENTION TO THE JUMPER HARNESS, SMALL NICKS OR CUTS CAN CAUSE A MALFUNCTION. REPAIR ANY DAMAGE IF FOUND. JUMPER HARNESS MUST BE REPLACED IF DAMAGED. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION.

NO

REPLACE WHEEL SPEED SENSOR.

NO

REPLACE REAR WHEEL SPEED SENSOR JUMPER HARNESS.

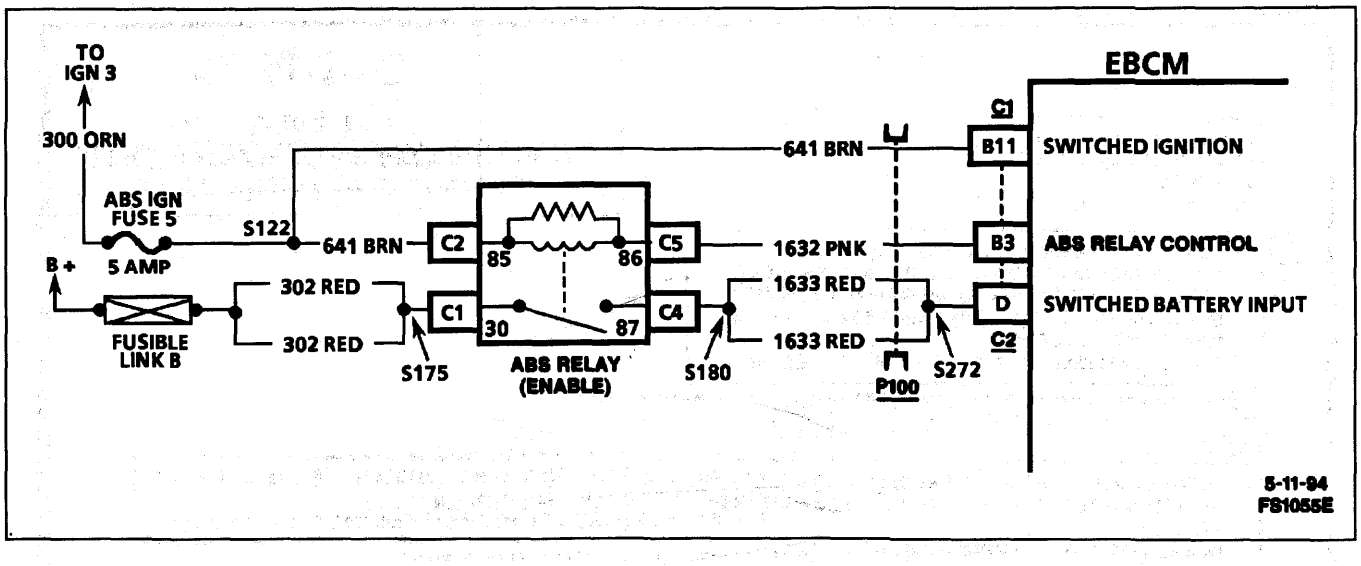
NO

REPAIR SHORT TO GROUND IN CKT 882.

NO

REPAIR SHORT TO GROUND IN CKT 883.

C1630S



DTC 36
(Page 1 of 2)
LOW SYSTEM VOLTAGE

Circuit Description:

This DTC is used to monitor the voltage level available to the EBCM. If the voltage drops below 11.5 volts, full performance of the ABS system cannot be guaranteed. During ABS operation, there are several current requirements that will cause battery voltage to drop. Because of this, voltage is monitored prior to ABS to indicate good charging system condition and also during ABS when voltage may drop significantly.

DTC Will Set When:

DTC 36 can only be set if the vehicle's speed is greater than 5 km/h (3 mph). If the switched battery voltage is less than 11.5 volts non-ABS or less than 9.0 volts ABS, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled and the amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks to see what voltage is readily available at terminal "D" of the EBCM. If voltage is representative of good charging system condition, a malfunction is not present.
2. Isolates the condition to high circuit resistance, or improper charging system operation.
3. Isolates which circuit is the source of the low voltage condition.
4. Checks for high resistance in CKT 302.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

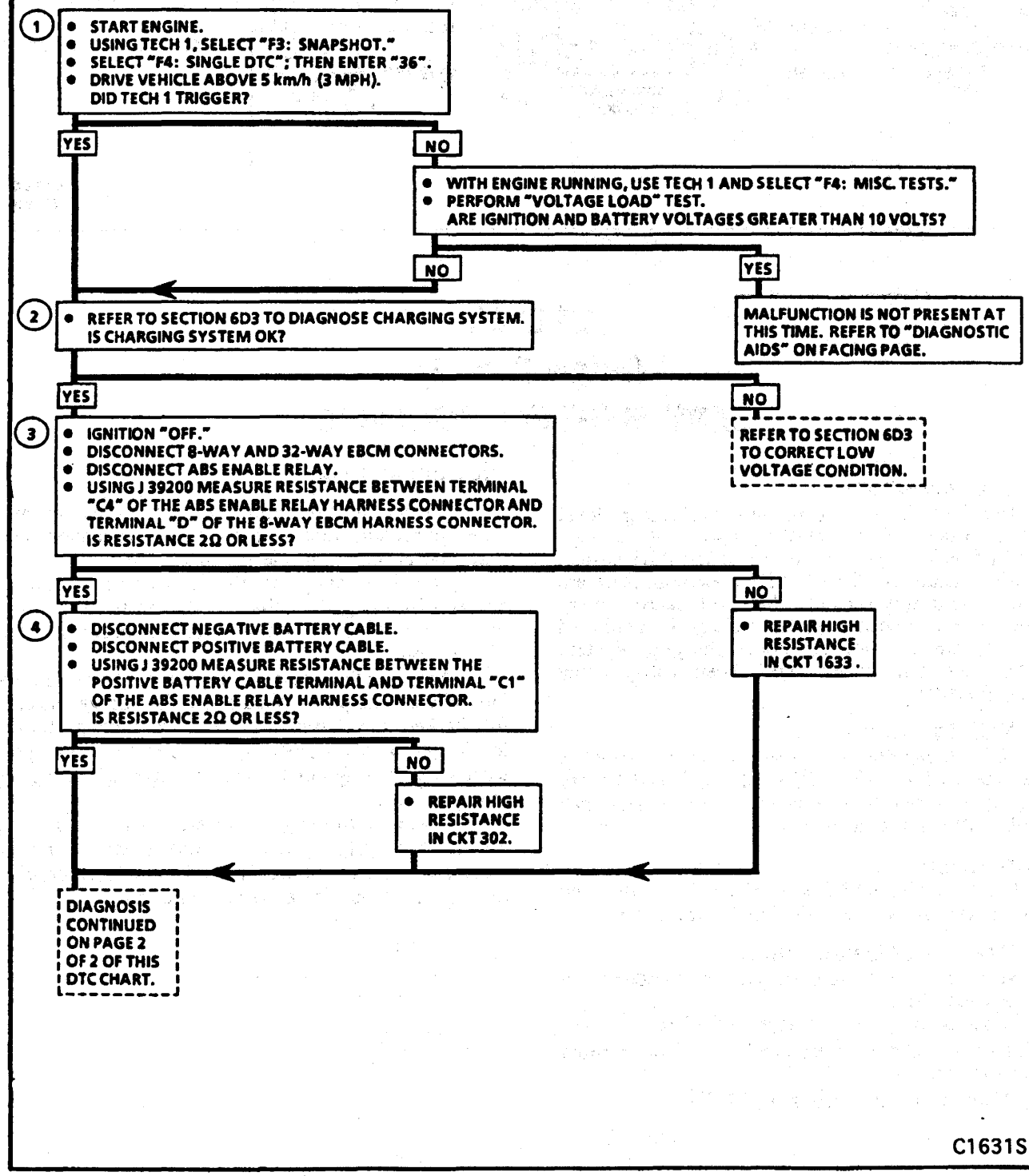
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

While performing a voltage load test, if it is noted that only ignition voltage drops below acceptable voltage levels, CKT 641 should be checked for high resistance or an open condition.

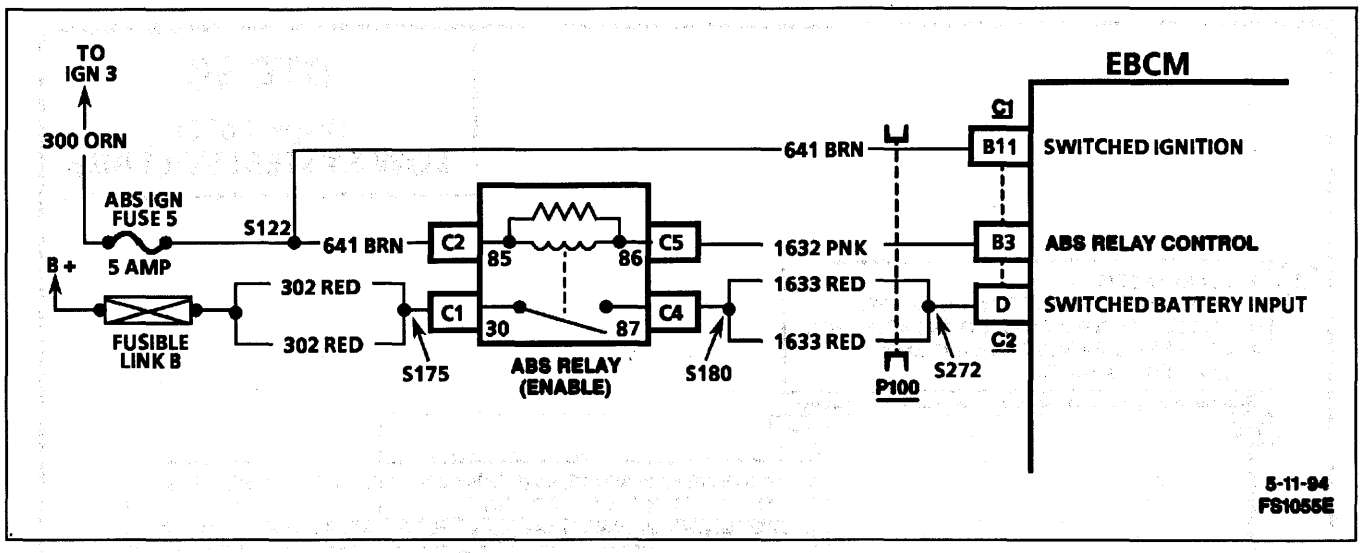
DTC 36

(Page 1 of 2)

LOW SYSTEM VOLTAGE



C1631S



DTC 36
(Page 2 of 2)
LOW SYSTEM VOLTAGE

Circuit Description:

This DTC is used to monitor the voltage level available to the EBCM controller. If the voltage drops below 11.5 volts, full performance of the ABS system cannot be guaranteed. During ABS operation, there are several current requirements that will cause battery voltage to drop. Because of this, voltage is monitored prior to ABS to indicate good charging system condition and also during ABS when voltage may drop significantly.

DTC Will Set When:

DTC 36 can only be set if the vehicle's speed is greater than 5 km/h (3 mph). If the switched battery voltage is less than 11.5 volts non-ABS or less than 9.0 volts ABS, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled and the amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

5. Checks for high resistance in CKT 641.
6. Checks for high resistance in the ignition fused feed circuit.
7. Checks for malfunctioning EBCM.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

While performing a voltage load test, if it is noted that only ignition voltage drops below acceptable voltage levels, CKT 641 should be checked for high resistance or an open condition.

DTC 36

(Page 2 of 2)

LOW SYSTEM VOLTAGE

DIAGNOSIS CONTINUED FROM PAGE 1 OF 2 OF THIS DTC CHART.

5
- REMOVE ABS IGN 5 AMP FUSE 5.
- USING J 39200 MEASURE RESISTANCE BETWEEN EACH ABS IGN 5 AMP FUSE 5 BLOCK TERMINAL AND TERMINAL "B11" OF THE 32-WAY EBCM HARNESS CONNECTOR. IS EITHER MEASUREMENT 2Ω OR LESS?

YES

6
- WITH BATTERY CABLES DISCONNECTED, TURN IGNITION "ON" (THIS PROVIDES IGNITION CIRCUIT CONTINUITY).
- USING J 39200, MEASURE RESISTANCE BETWEEN POSITIVE BATTERY CABLE TERMINAL AND EACH ABS IGN 5 AMP FUSE 5 BLOCK TERMINAL. IS EITHER MEASUREMENT 2Ω OR LESS ?

YES

7
- IGNITION "OFF."
- INSPECT ABS ENABLE RELAY AND ABS ENABLE RELAY HARNESS CONNECTOR FOR POOR TERMINAL CONTACT. INSPECT 8-WAY AND 32-WAY EBCM HARNESS CONNECTORS FOR A POOR CONNECTION TO THE EBCM. INSPECT POSITIVE BATTERY CABLE TERMINAL FOR POOR CONTACT TO THE BATTERY. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE TERMINALS IF POOR CONTACT IS EVIDENT.
- RECONNECT ALL CONNECTORS.
- DRIVE VEHICLE ABOVE 5 km/h (3 MPH). DOES DTC 36 SET AS A CURRENT DTC?

YES

REPLACE EBCM.

NO

MALFUNCTION IS MOST LIKELY DUE TO A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

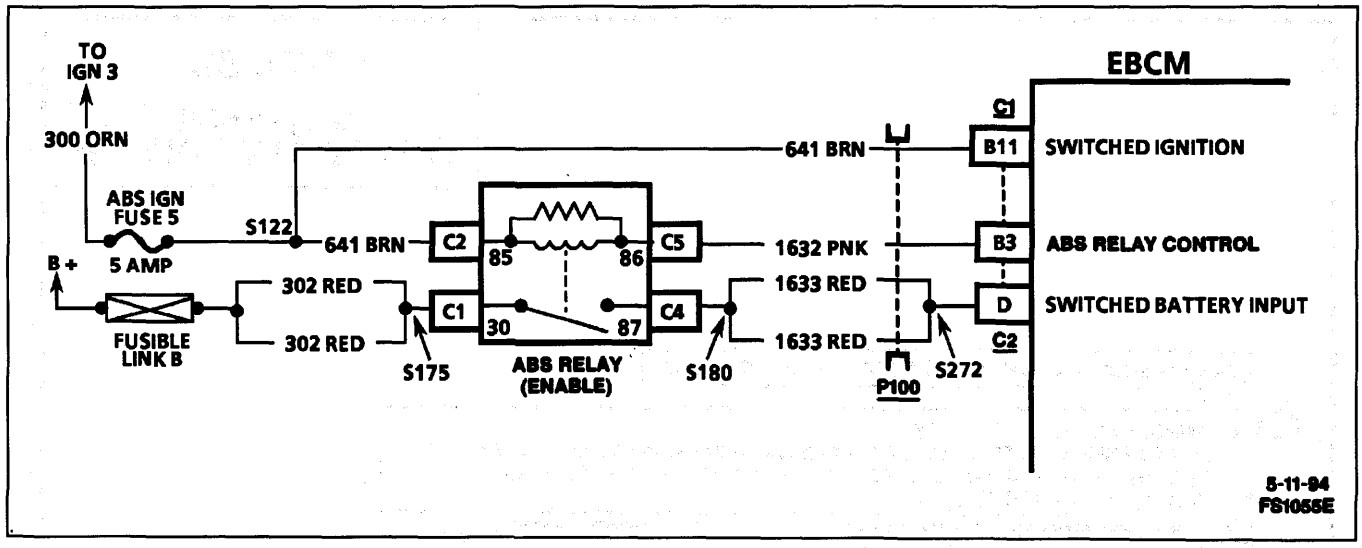
NO

REFER TO SECTION 8A TO REPAIR HIGH RESISTANCE IN THE "IGNITION SWITCH 'RUN' FUSE FEED" CIRCUIT.

NO

REPAIR HIGH RESISTANCE IN CKT 641.

C1632S



DTC 37
HIGH SYSTEM VOLTAGE

Circuit Description:

This DTC is designed to detect high vehicle voltage levels prior to any required motor movement (initialization or ABS). If excessive voltage exists, demagnetization of the motor magnets may occur, which would eventually affect or eliminate ABS performance.

DTC Will Set When:

DTC 37 can only be set if the vehicle's speed is greater than 5 km/h (3 mph). If the switched battery voltage is greater than 17 volts, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS are disabled and the amber ABS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks the voltage level being received by the EBCM.
2. Checks to see if high voltage condition is due to charging system malfunction.
3. Checks for poor terminal contact which may cause an intermittent malfunction, or a malfunctioning EBCM.

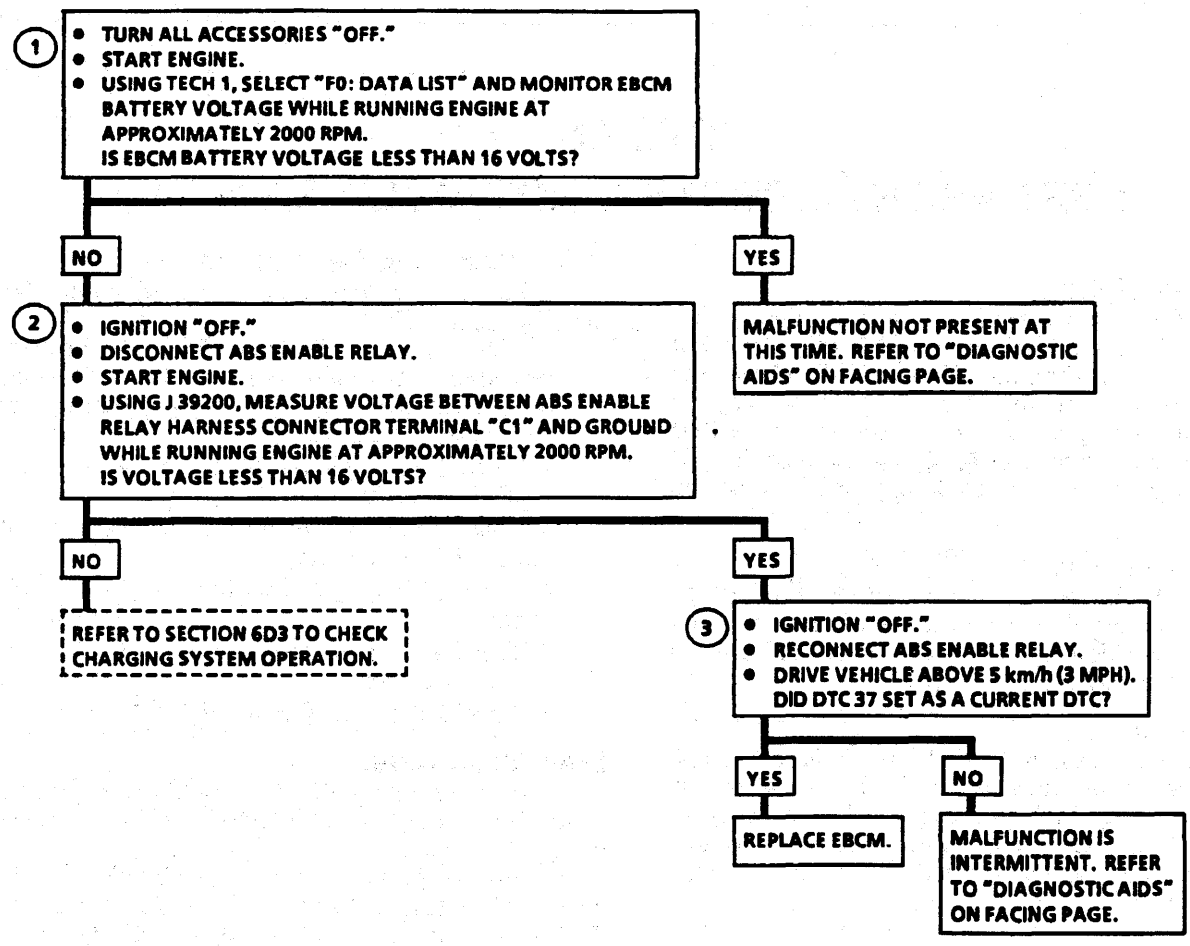
Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

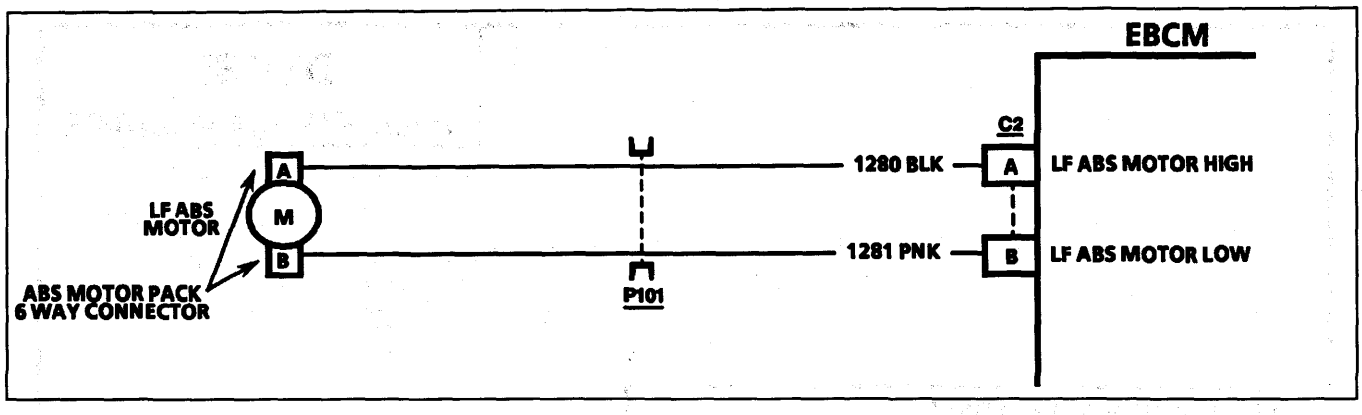
The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 37
HIGH SYSTEM VOLTAGE



C1633S



DTC 38
LEFT FRONT ESB WILL NOT HOLD MOTOR

Circuit Description:

This DTC is designed to detect a slipping left front ESB. During initialization and braking, the left front motor is re-homed. If the ESB slips, the motor/piston will move. During the next key to "RUN" initialization, a re-home of the motor verifies the motor/piston remained at the home position. If motor movement is detected, the ESB must be slipping.

DTC Will Set When:

DTC 38 can be set during initialization. If the EBCM detects that the ESB could not hold the piston in the home position, a malfunction exists. DTC 86 is always set with DTC 38.

Action Taken:

If an ESB cannot hold a piston in the home position, the piston may be back driven when the brake pedal is applied, causing the brake pedal to drop. A malfunction DTC is stored, ABS is disabled. The amber ABS and the red BRAKE warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks the left front ESB. A broken or defective ESB would result in the left front piston being back driven by hydraulic pressure and pedal movement would result.
2. Checks for high resistance in the ABS motor "HIGH" circuitry.
3. This step checks for high resistance in the ABS motor "LOW" circuitry.
4. Checks for proper resistance of the ABS motor windings.
5. Checks for poor terminal contact or corrosion in the connectors.
6. Checks for a malfunctioning EBCM.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

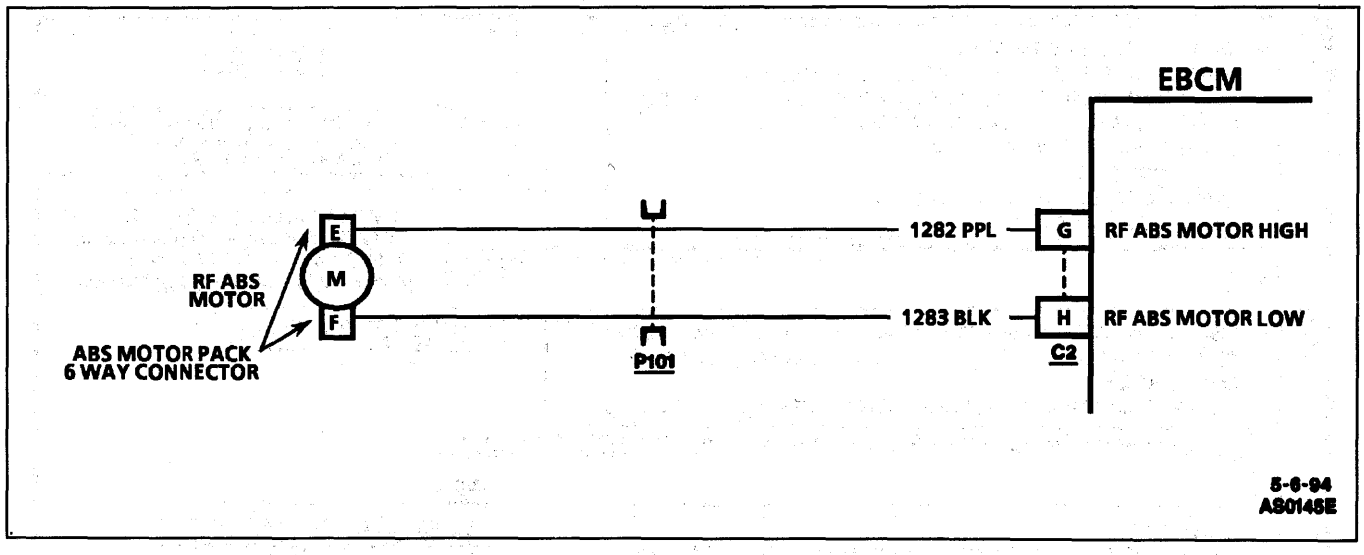
The static modulator test function of the Tech 1 or T-100 may be used to locate an intermittent malfunction associated with the ESB.

DTC 38
LEFT FRONT ESB WILL NOT HOLD MOTOR

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

1. • IGNITION "ON," ENGINE "OFF."
   • PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
   • USING TECH 1 MISC. TESTS, SELECT MANUAL CONTROL FUNCTION.
   • SELECT MOTOR APPLY FUNCTION OF THE LEFT FRONT ABS CHANNEL AND APPLY THE MOTOR.
   • WAIT 5 SECONDS.
   • APPLY FIRM PRESSURE ON BRAKE PEDAL.
   DID BRAKE PEDAL FALL?
   - YES → REPLACE ABS MOTOR PACK.
   - NO →
2. • VISUALLY INSPECT THE 6-WAY ABS MOTOR PACK AND 8-WAY EBCM CONNECTORS FOR PROPER WIRE COLOR/CONNECTOR CAVITY COMBINATION.
   ARE THE PROPER WIRES LOCATED IN THE PROPER CONNECTOR CAVITIES?
   - NO → USING THE CIRCUIT DIAGRAMS LOCATED IN THE FRONT OF THIS SECTION, PLACE THE PROPER WIRES INTO THE PROPER CONNECTOR CAVITIES. CLEAR DTCs AND RECHECK SYSTEM.
   - YES →
3. • IGNITION "OFF."
   • DISCONNECT 6-WAY ABS MOTOR PACK CONNECTOR AND 8-WAY EBCM CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "A" OF THE 8-WAY EBCM HARNESS CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPAIR HIGH RESISTANCE IN CKT 1280.
   - YES →
4. • MEASURE THE RESISTANCE BETWEEN TERMINAL "B" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "B" OF THE 8-WAY EBCM HARNESS CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPAIR HIGH RESISTANCE IN CKT 1281.
   - YES →
5. • MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE ABS MOTOR PACK CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPLACE ABS MOTOR PACK.
   - YES →
6. • INSPECT THE 6-WAY ABS MOTOR PACK CONNECTOR AND 8-WAY EBCM CONNECTOR FOR POOR TERMINAL CONTACT OR CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT."
   DO ANY TERMINALS EXHIBIT POOR CONTACT OR EVIDENCE OF CORROSION?
   - YES → REPLACE TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION.
   - NO →
7. • IGNITION "OFF."
   • RECONNECT ALL CONNECTORS.
   • START ENGINE WITH FOOT OFF BRAKE.
   • ALLOW ENGINE TO RUN FOR AT LEAST 10 SECONDS.
   • REPEAT ABOVE IGNITION CYCLE SEQUENCE TWO MORE TIMES.
   DID DTC 38 SET IN THE LAST THREE IGNITION CYCLES?
   - NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - YES → REPLACE EBCM.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH) AND THEN KEYING DOWN. C1634S



DTC 41
RIGHT FRONT ESB WILL NOT HOLD MOTOR

Circuit Description:

This DTC is designed to detect a slipping right front ESB. During initialization and braking, the right front motor is re-homed. If the ESB slips, the motor/piston will move. During the next key to "RUN" initialization, a re-home of the motor verifies the motor/piston remained at the home position. If motor movement is detected, the ESB must be slipping.

DTC Will Set When:

DTC 41 can be set during initialization. If the EBCM detects that the ESB could not hold the piston in the home position, a malfunction exists. DTC 86 is always set with DTC 41.

Action Taken:

If an ESB cannot hold a piston in the home position, the piston may be back driven when the brake pedal is applied, causing the brake pedal to drop. A malfunction DTC is stored, ABS is disabled. The amber ABS and the red BRAKE warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks the right front ESB. A broken or defective ESB would result in the right front piston being back driven by hydraulic pressure, and pedal movement would result.
2. Ensures that the proper motor circuits are located in the proper connector cavities.
3. Checks for high resistance in the ABS motor "HIGH" circuitry.
4. This step checks for high resistance in the ABS motor "LOW" circuitry.
5. Checks for proper resistance of the ABS motor windings.
6. Checks for poor terminal contact or corrosion in the connectors.
7. Checks for a malfunctioning EBCM.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

The static modulator test function of the Tech 1 or T-100 may be used to locate an intermittent malfunction associated with the ESB.

DTC 41

RIGHT FRONT ESB WILL NOT HOLD MOTOR

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

1
- IGNITION "ON," ENGINE "OFF."
- PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
- USING TECH 1 MISC. TESTS, SELECT MANUAL CONTROL FUNCTION.
- SELECT MOTOR APPLY FUNCTION OF THE RIGHT FRONT ABS CHANNEL AND APPLY THE MOTOR.
- WAIT 5 SECONDS.
- APPLY FIRM PRESSURE ON BRAKE PEDAL.

DID BRAKE PEDAL FALL?

YES → REPLACE ABS MOTOR PACK.

NO

2
- VISUALLY INSPECT THE 6-WAY ABS MOTOR PACK AND 8-WAY EBCM CONNECTORS FOR PROPER WIRE COLOR/CONNECTOR CAVITY COMBINATION.

ARE THE PROPER WIRES LOCATED IN THE PROPER CONNECTOR CAVITIES?

NO → USING THE CIRCUIT DIAGRAMS LOCATED IN THE FRONT OF THIS SECTION, PLACE THE PROPER WIRES INTO THE PROPER CONNECTOR CAVITIES. CLEAR DTCs AND RECHECK SYSTEM.

YES

3
- IGNITION "OFF."
- DISCONNECT 6-WAY ABS MOTOR PACK CONNECTOR AND 8-WAY EBCM CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "E" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "G" OF THE 8-WAY EBCM HARNESS CONNECTOR.

IS RESISTANCE 1.5Ω OR LESS?

NO → REPAIR HIGH RESISTANCE IN CKT 1282.

YES

4
- MEASURE THE RESISTANCE BETWEEN TERMINAL "F" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "H" OF THE 8-WAY EBCM HARNESS CONNECTOR.

IS RESISTANCE 1.5Ω OR LESS?

NO → REPAIR HIGH RESISTANCE IN CKT 1283.

YES

5
- MEASURE THE RESISTANCE BETWEEN TERMINAL "E" AND TERMINAL "F" OF THE ABS MOTOR PACK CONNECTOR.

IS RESISTANCE 1.5Ω OR LESS?

NO → REPLACE ABS MOTOR PACK.

YES

6
- INSPECT THE 6-WAY ABS MOTOR PACK CONNECTOR AND 8-WAY EBCM CONNECTOR FOR POOR TERMINAL CONTACT OR CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT."

DO ANY TERMINALS EXHIBIT POOR CONTACT OR EVIDENCE OF CORROSION?

YES → REPLACE TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION.

NO

7
- IGNITION "OFF."
- RECONNECT ALL CONNECTORS.
- START ENGINE WITH FOOT OFF BRAKE.
- ALLOW ENGINE TO RUN FOR AT LEAST 10 SECONDS.
- REPEAT ABOVE IGNITION CYCLE SEQUENCE TWO MORE TIMES.

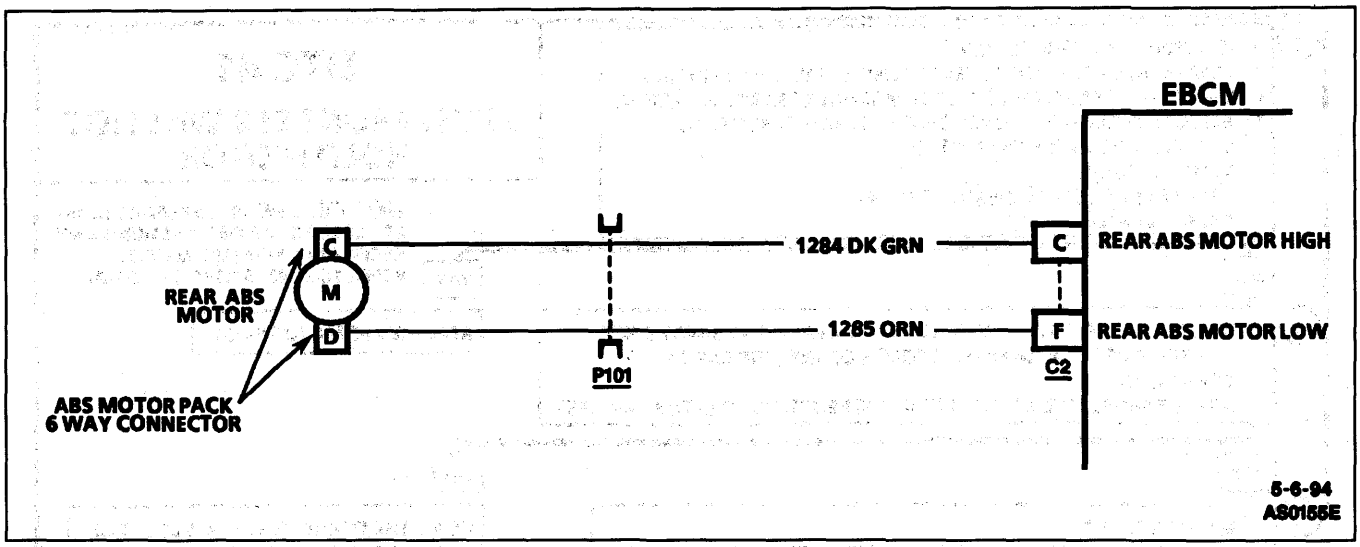
DID DTC 41 SET IN THE LAST THREE IGNITION CYCLES?

NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

YES

REPLACE EBCM.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 KM/H (10 MPH) AND THEN KEYING DOWN. C1635S



DTC 42
REAR ESB WILL NOT HOLD MOTOR

Circuit Description:

This DTC is designed to detect a slipping rear axle ESB. During initialization and braking, the rear motor is re-homed. If the ESB slips, the motor/piston will move. During the next key to "RUN" initialization, a re-home of the motor verifies the motor/piston remained at the home position. If motor movement is detected, the ESB must be slipping.

DTC Will Set When:

DTC 42 can be set during initialization. If the EBCM detects that the ESB could not hold the piston in the home position, a malfunction exists. DTC 86 is always set with DTC 42.

Action Taken:

If an ESB can hold a piston in the home position, the piston may be back driven when the brake pedal is applied, causing the brake pedal to drop. A malfunction DTC is stored, ABS is disabled. The amber ABS and the red BRAKE warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks the rear axle ESB. A broken or defective ESB would result in the rear axle pistons being back driven by hydraulic pressure and wheel movement would result.
2. Ensures that the proper motor circuits are located in the proper connector cavities.
3. Checks for high resistance in the ABS motor "HIGH" circuitry.
4. Checks for high resistance in the ABS motor "LOW" circuitry.
5. Checks for proper resistance of the ABS motor windings.
6. Checks for poor terminal contact or corrosion in the connectors.
7. Checks for a malfunctioning EBCM.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

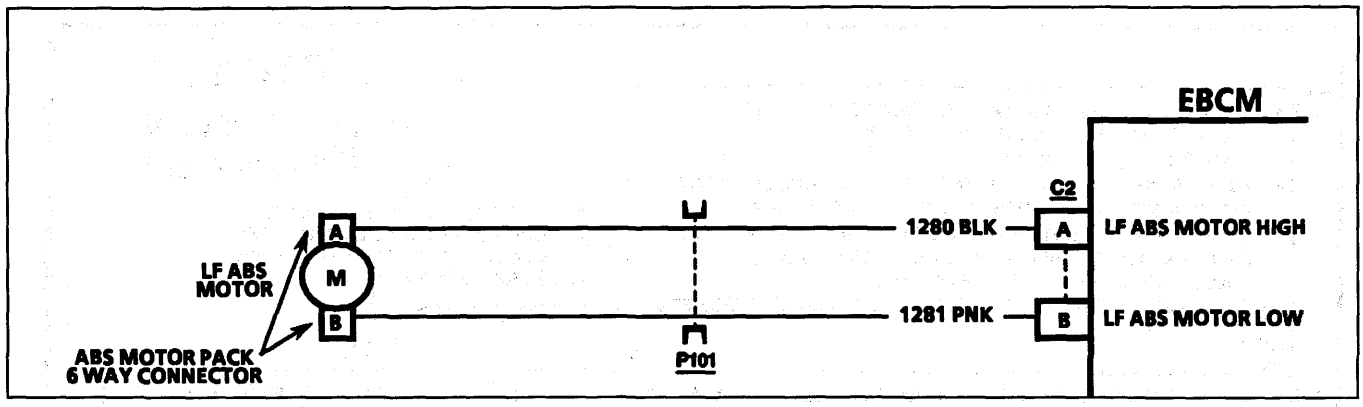
The static modulator test function of the Tech 1 or T-100 may be used to locate an intermittent malfunction associated with the ESB.

DTC 42
REAR ESB WILL NOT HOLD MOTOR

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

1. • RAISE THE VEHICLE SUCH THAT THE REAR WHEELS ARE APPROXIMATELY SIX INCHES OFF THE FLOOR.
   • IGNITION "ON," ENGINE "OFF."
   • PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
   • APPLY FIRM PRESSURE ON BRAKE PEDAL AND RELEASE.
   • REAPPLY VERY FIRM PRESSURE ON BRAKE PEDAL AND HAVE AN ASSISTANT TRY TO SPIN THE REAR WHEELS BY HAND.
   COULD ASSISTANT SPIN THE REAR WHEELS?
   - YES → REPLACE ABS MOTOR PACK.
   - NO →
2. • VISUALLY INSPECT THE 6-WAY ABS MOTOR PACK AND 8-WAY EBCM CONNECTORS FOR PROPER WIRE COLOR/CONNECTOR CAVITY COMBINATION.
   ARE THE PROPER WIRES LOCATED IN THE PROPER CONNECTOR CAVITIES?
   - NO → USING THE CIRCUIT DIAGRAMS LOCATED IN THE FRONT OF THIS SECTION, PLACE THE PROPER WIRES INTO THE PROPER CONNECTOR CAVITIES. CLEAR DTCs AND RECHECK SYSTEM.
   - YES →
3. • IGNITION "OFF."
   • DISCONNECT 6-WAY ABS MOTOR PACK CONNECTOR AND 8-WAY EBCM CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "C" OF THE 8-WAY EBCM HARNESS CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPAIR HIGH RESISTANCE IN CKT 1284.
   - YES →
4. • MEASURE THE RESISTANCE BETWEEN TERMINAL "D" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "F" OF THE 8-WAY EBCM HARNESS CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPAIR HIGH RESISTANCE IN CKT 1285.
   - YES →
5. • MEASURE THE RESISTANCE BETWEEN TERMINAL "C" AND TERMINAL "D" OF THE ABS MOTOR PACK CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPLACE ABS MOTOR PACK.
   - YES →
6. • INSPECT THE 6-WAY ABS MOTOR PACK CONNECTOR AND 8-WAY EBCM CONNECTOR FOR POOR TERMINAL CONTACT OR CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT."
   DO ANY TERMINALS EXHIBIT POOR CONTACT OR EVIDENCE OF CORROSION?
   - YES → REPLACE TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION.
   - NO →
7. • IGNITION "OFF."
   • RECONNECT ALL CONNECTORS.
   • START ENGINE WITH FOOT OFF BRAKE.
   • ALLOW ENGINE TO RUN FOR AT LEAST 10 SECONDS.
   • REPEAT ABOVE IGNITION CYCLE SEQUENCE TWO MORE TIMES.
   DID DTC 42 SET IN THE LAST THREE IGNITION CYCLES?
   - NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - YES → REPLACE EBCM.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH) AND THEN KEYING DOWN. C1636S



DTC 44
LEFT FRONT ABS CHANNEL WILL NOT MOVE

Circuit Description:

This DTC is designed to detect bound-up ESB, a stuck ABS motor, or a seized ABS hydraulic modulator. When the release is commanded during initialization, the ESB should release the ABS motor, resulting in sensed current being less than commanded current (motor is spinning freely). If the ABS motor is not moving, sensed current will be equal to stall current.

DTC Will Set When:

DTC 44 can be set during normal operation. If the EBCM detects a condition in which it cannot move the motor in either direction, a malfunction exists.

Action Taken:

This malfunction indicates the channel cannot be moved properly. A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

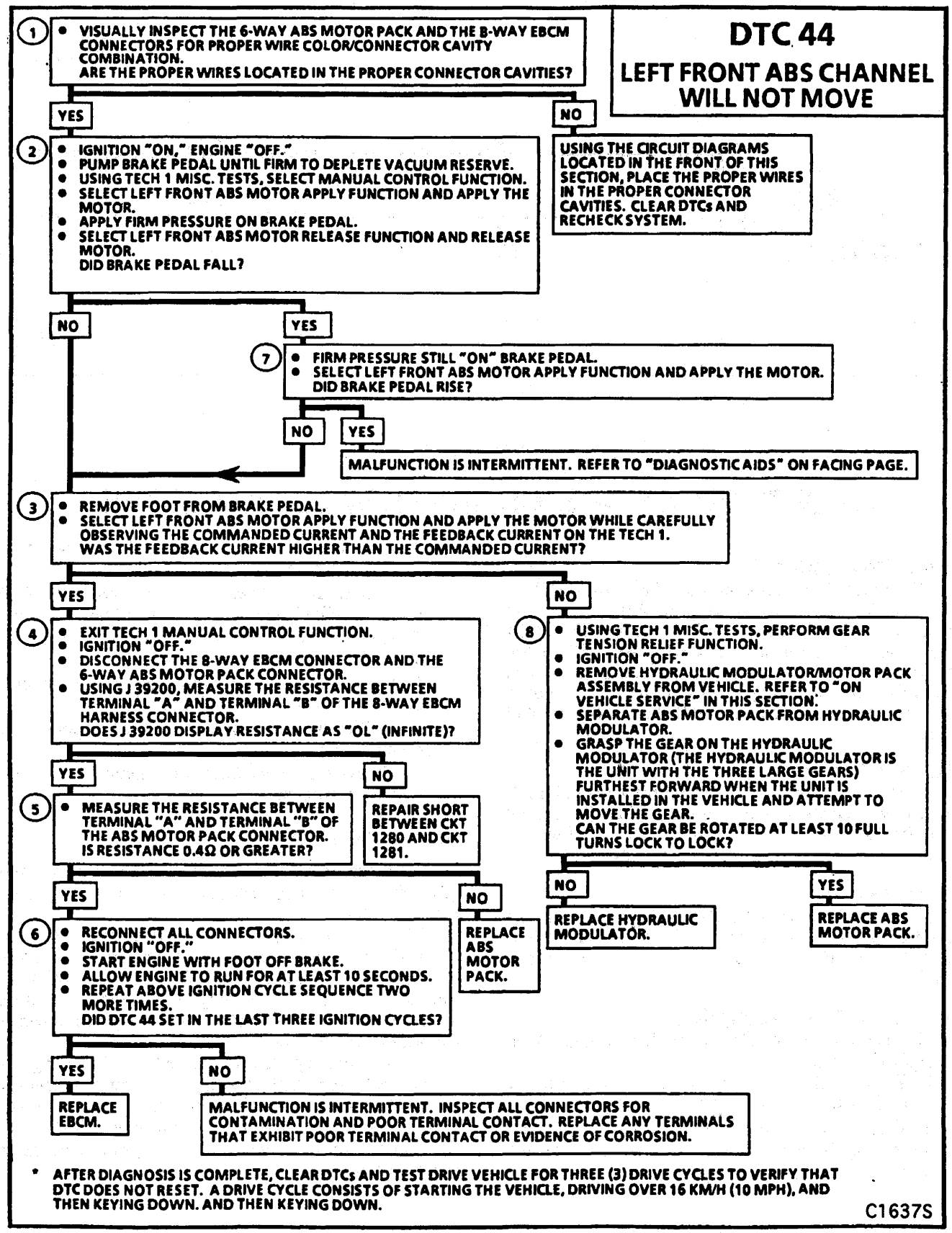
1. Ensures that the proper motor circuits are located in the proper connector cavities.
2. Checks for proper ABS motor movement during apply and release commands from the Tech 1.
3. Compares EBCM command current to motor feedback current.
4. Checks for a shorted circuit between the ABS motor "HIGH" and ABS motor "LOW" circuits.
5. Checks for an ABS motor that is internally shorted.
6. Determines if the malfunction is caused by a defective EBCM or poor terminal contact.
7. Verifies that the ABS motor can actually apply when commanded.
8. Checks for proper hydraulic modulator gear and piston movement.

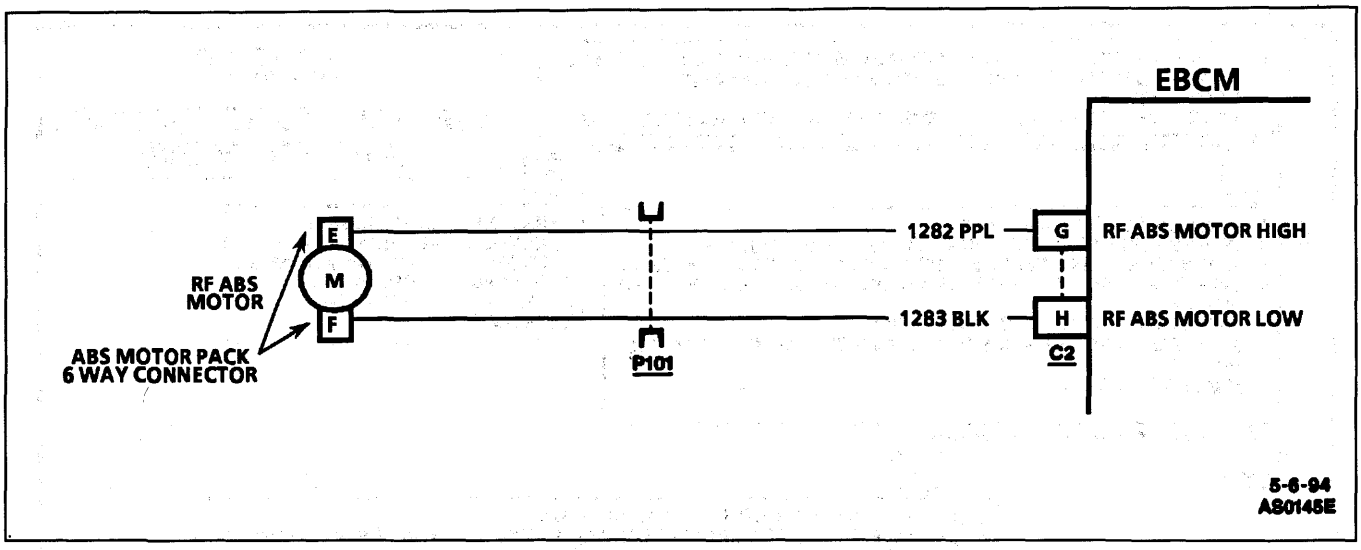
Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. DTC 44 may set after modulator disassembly if the modulator pistons are positioned at the bottom of their bore.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.


DTC 44
LEFT FRONT ABS CHANNEL WILL NOT MOVE
1
• VISUALLY INSPECT THE 6-WAY ABS MOTOR PACK AND THE 8-WAY EBCM CONNECTORS FOR PROPER WIRE COLOR/CONNECTOR CAVITY COMBINATION.
ARE THE PROPER WIRES LOCATED IN THE PROPER CONNECTOR CAVITIES?
YES
NO
USING THE CIRCUIT DIAGRAMS LOCATED IN THE FRONT OF THIS SECTION, PLACE THE PROPER WIRES IN THE PROPER CONNECTOR CAVITIES. CLEAR DTCs AND RECHECK SYSTEM.
2
• IGNITION "ON," ENGINE "OFF."
• PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
• USING TECH 1 MISC. TESTS, SELECT MANUAL CONTROL FUNCTION.
• SELECT LEFT FRONT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR.
• APPLY FIRM PRESSURE ON BRAKE PEDAL.
• SELECT LEFT FRONT ABS MOTOR RELEASE FUNCTION AND RELEASE MOTOR.
DID BRAKE PEDAL FALL?
NO
YES
7
• FIRM PRESSURE STILL "ON" BRAKE PEDAL.
• SELECT LEFT FRONT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR.
DID BRAKE PEDAL RISE?
NO
YES
MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
3
• REMOVE FOOT FROM BRAKE PEDAL.
• SELECT LEFT FRONT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR WHILE CAREFULLY OBSERVING THE COMMANDED CURRENT AND THE FEEDBACK CURRENT ON THE TECH 1.
WAS THE FEEDBACK CURRENT HIGHER THAN THE COMMANDED CURRENT?
YES
NO
4
• EXIT TECH 1 MANUAL CONTROL FUNCTION.
• IGNITION "OFF."
• DISCONNECT THE 8-WAY EBCM CONNECTOR AND THE 6-WAY ABS MOTOR PACK CONNECTOR.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE 8-WAY EBCM HARNESS CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
YES
NO
5
• MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE ABS MOTOR PACK CONNECTOR.
IS RESISTANCE 0.4Ω OR GREATER?
REPAIR SHORT BETWEEN CKT 1280 AND CKT 1281.
YES
NO
6
• RECONNECT ALL CONNECTORS.
• IGNITION "OFF."
• START ENGINE WITH FOOT OFF BRAKE.
• ALLOW ENGINE TO RUN FOR AT LEAST 10 SECONDS.
• REPEAT ABOVE IGNITION CYCLE SEQUENCE TWO MORE TIMES.
DID DTC 44 SET IN THE LAST THREE IGNITION CYCLES?
REPLACE ABS MOTOR PACK.
YES
NO
REPLACE EBCM.
MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS FOR CONTAMINATION AND POOR TERMINAL CONTACT. REPLACE ANY TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION.
8
• USING TECH 1 MISC. TESTS, PERFORM GEAR TENSION RELIEF FUNCTION.
• IGNITION "OFF."
• REMOVE HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY FROM VEHICLE. REFER TO "ON VEHICLE SERVICE" IN THIS SECTION.
• SEPARATE ABS MOTOR PACK FROM HYDRAULIC MODULATOR.
• GRASP THE GEAR ON THE HYDRAULIC MODULATOR (THE HYDRAULIC MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS) FURTHEST FORWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE AND ATTEMPT TO MOVE THE GEAR.
CAN THE GEAR BE ROTATED AT LEAST 10 FULL TURNS LOCK TO LOCK?
NO
YES
REPLACE HYDRAULIC MODULATOR.
REPLACE ABS MOTOR PACK.
* AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 KM/H (10 MPH), AND THEN KEYING DOWN. AND THEN KEYING DOWN.
C1637S



DTC 45
RIGHT FRONT ABS CHANNEL WILL NOT MOVE

Circuit Description:

This DTC is designed to detect bound-up ESB, a stuck ABS motor, or a seized ABS hydraulic modulator. When the release is commanded during initialization, the ESB should release the ABS motor, resulting in sensed current being less than commanded current (motor is spinning freely). If the ABS motor is not moving, sensed current will be equal to stall current.

DTC Will Set When:

DTC 45 can be set during normal operation. If the EBCM detects a condition in which it cannot move the ABS motor in either direction, a malfunction exists.

Action Taken:

This malfunction indicates the channel cannot be moved properly. A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Ensures that the proper motor circuits are located in the proper connector cavities.
2. Checks for proper ABS motor movement during apply and release commands from the Tech 1.
3. Compares EBCM command current to motor feedback current.
4. Checks for shorted circuit between the ABS motor "HIGH" and ABS motor "LOW" circuits.
5. Checks for an ABS motor that is internally shorted.
6. Checks to see if malfunction is due to poor terminal contact or the EBCM.
7. Verifies that the motor can actually apply when commanded.
8. Checks for proper hydraulic modulator gear and piston movement.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. DTC 45 may set after modulator disassembly if the modulator pistons are positioned at the bottom of their bore.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 45
RIGHT FRONT ABS CHANNEL WILL NOT MOVE

1 • VISUALLY INSPECT THE 6-WAY ABS MOTOR PACK AND THE 8-WAY EBCM CONNECTORS FOR PROPER WIRE COLOR/CONNECTOR CAVITY COMBINATION.
ARE THE PROPER WIRES LOCATED IN THE PROPER CONNECTOR CAVITIES?

- NO → USING THE CIRCUIT DIAGRAMS LOCATED IN THE FRONT OF THIS SECTION, PLACE THE PROPER WIRES IN THE PROPER CONNECTOR CAVITIES. CLEAR DTCs AND RECHECK SYSTEM.
- YES →

2
- IGNITION "ON," ENGINE "OFF."
- PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
- USING TECH 1 MISC. TESTS, SELECT MANUAL CONTROL FUNCTION.
- SELECT RIGHT FRONT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR.
- APPLY FIRM PRESSURE ON BRAKE PEDAL.
- SELECT RIGHT FRONT ABS MOTOR RELEASE FUNCTION AND RELEASE MOTOR.
DID BRAKE PEDAL FALL?

- NO →
- YES →

7
- FIRM PRESSURE STILL "ON" BRAKE PEDAL.
- SELECT RIGHT FRONT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR.
DID BRAKE PEDAL RISE?

- NO →
- YES → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

3
- REMOVE FOOT FROM BRAKE PEDAL.
- SELECT RIGHT FRONT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR WHILE CAREFULLY OBSERVING THE COMMANDED CURRENT AND THE FEEDBACK CURRENT ON THE TECH 1.
WAS THE FEEDBACK CURRENT HIGHER THAN THE COMMANDED CURRENT?

- YES →
- NO →

4
- IGNITION "OFF."
- DISCONNECT THE 8-WAY EBCM CONNECTOR AND THE 6-WAY ABS MOTOR PACK CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "G" AND TERMINAL "H" OF THE 8-WAY EBCM HARNESS CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

- YES →
- NO → REPAIR SHORT BETWEEN CKT 1282 AND CKT 1283.

5
- MEASURE THE RESISTANCE BETWEEN TERMINAL "E" AND TERMINAL "F" OF THE ABS MOTOR PACK CONNECTOR.
IS RESISTANCE 0.4 Ω OR GREATER?

- YES →
- NO → REPLACE ABS MOTOR PACK.

6
- RECONNECT ALL CONNECTORS.
- EXIT TECH 1 MANUAL CONTROL FUNCTION.
- IGNITION "OFF."
- START ENGINE WITH FOOT OFF BRAKE.
- ALLOW ENGINE TO RUN FOR AT LEAST 10 SECONDS.
- REPEAT ABOVE IGNITION CYCLE SEQUENCE TWO MORE TIMES.
DID DTC 45 SET IN THE LAST THREE IGNITION CYCLES?

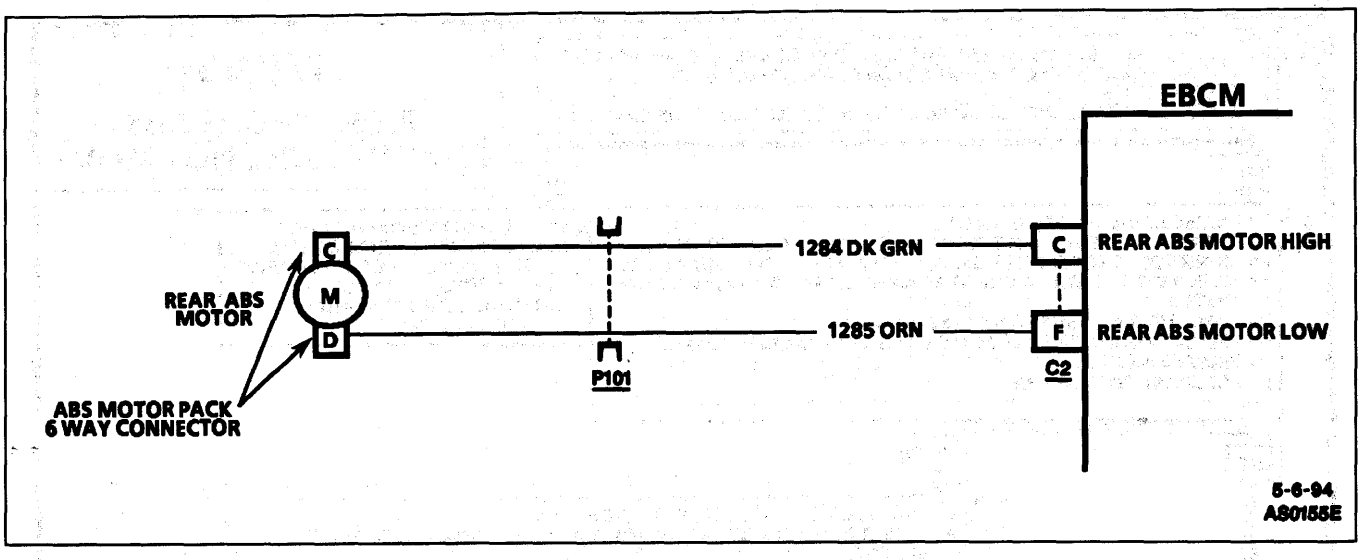
- YES → REPLACE EBCM.
- NO → MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS FOR CONTAMINATION AND POOR TERMINAL CONTACT. REPLACE ANY TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION.

8
- USING TECH 1 MISC. TESTS, PERFORM GEAR TENSION RELIEF FUNCTION.
- IGNITION "OFF."
- REMOVE HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY FROM VEHICLE. REFER TO "ON VEHICLE SERVICE" IN THIS SECTION.
- SEPARATE ABS MOTOR PACK FROM HYDRAULIC MODULATOR.
- GRASP THE GEAR ON THE HYDRAULIC MODULATOR (THE HYDRAULIC MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS) FURTHEST REARWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE AND ATTEMPT TO MOVE THE GEAR.
CAN THE GEAR BE ROTATED AT LEAST 10 FULL TURNS LOCK TO LOCK?

- NO → REPLACE HYDRAULIC MODULATOR.
- YES → REPLACE ABS MOTOR PACK.

* AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 KM/H (10 MPH), AND THEN KEYING DOWN.

C1638S



DTC 46
REAR ABS CHANNEL WILL NOT MOVE

Circuit Description:

This DTC is designed to detect bound-up ESB, a stuck ABS motor, or a seized hydraulic modulator. When the release is commanded during initialization, the ESB should release the ABS motor, resulting in sensed current being less than commanded current (motor is spinning freely). If the ABS motor is not moving, sensed current will be equal to stall current.

DTC Will Set When:

DTC 46 can be set during normal operation. If the EBCM detects a condition in which it cannot move the motor in either direction, a malfunction exists.

Action Taken:

This malfunction indicates the channel cannot be moved properly. A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

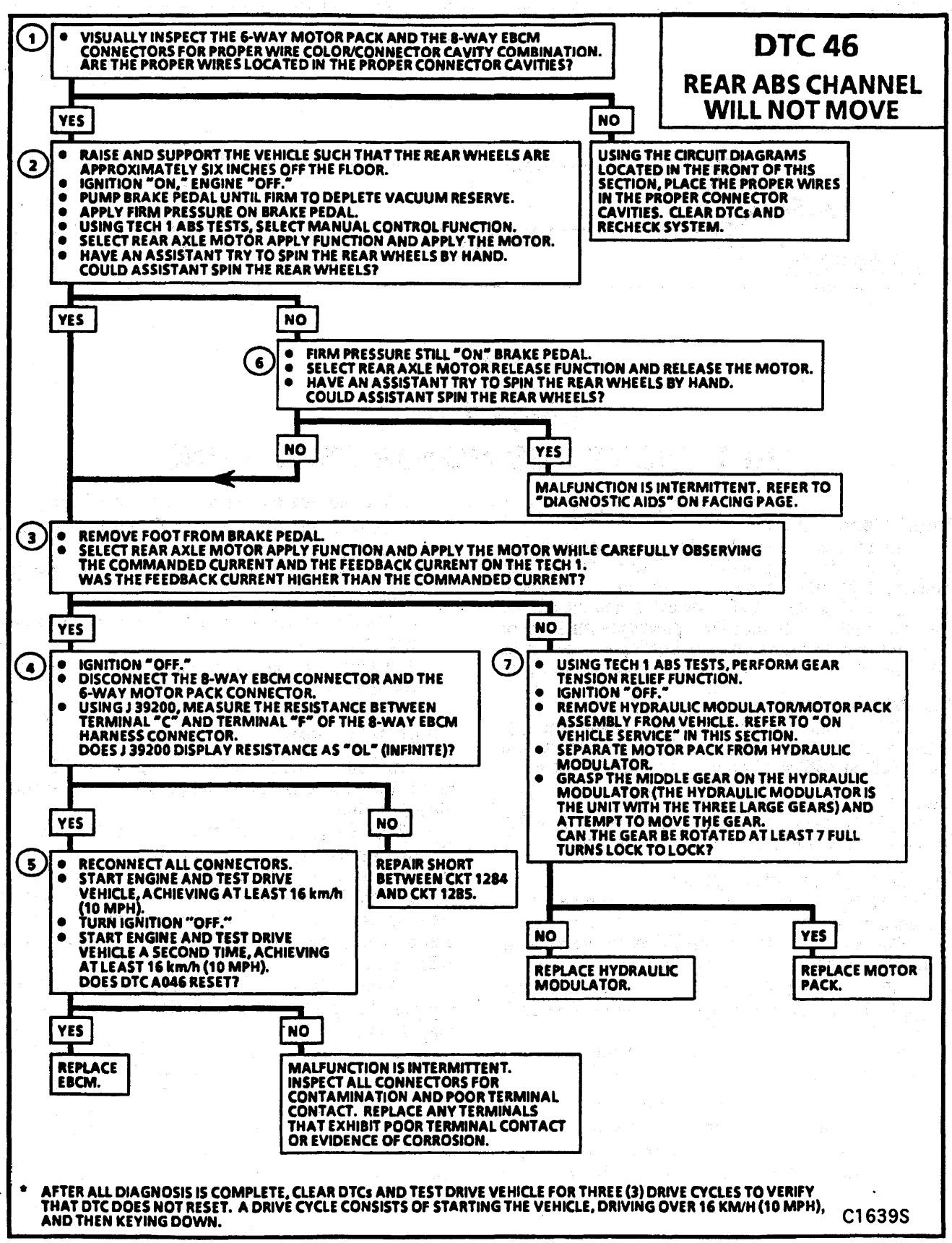
1. Ensures that the proper motor circuits are located in the proper connector cavities.
2. Checks for proper ABS motor movement during apply and release commands from the Tech 1.
3. Compares EBCM command current to ABS motor feedback current.
4. Checks for a short circuit between the ABS motor "HIGH" and ABS motor "LOW" circuits.
5. Checks for an ABS motor that is internally shorted.
6. Checks to see if malfunction is due to poor terminal contact or the EBCM.
7. Verifies that the motor can actually release when commanded.
8. Checks for proper hydraulic modulator gear and piston movement.

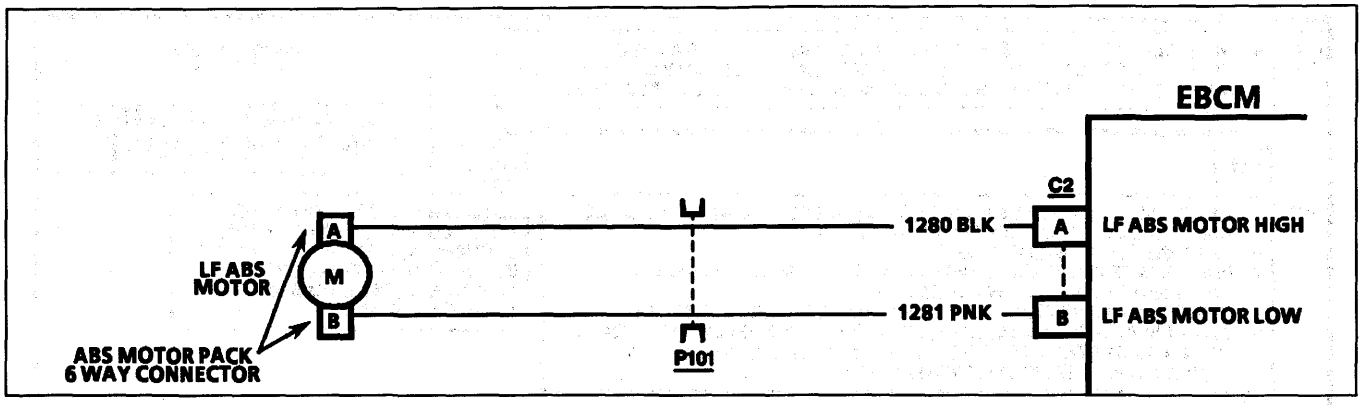
Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks or binds.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. DTC 46 may set after modulator disassembly if the modulator pistons are positioned at the bottom of their bore. Depending on the frequency of the malfunction, a physical inspection of the mechanical parts suspected may be necessary.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.


DTC 46
REAR ABS CHANNEL WILL NOT MOVE
1
• VISUALLY INSPECT THE 6-WAY MOTOR PACK AND THE 8-WAY EBCM CONNECTORS FOR PROPER WIRE COLOR/CONNECTOR CAVITY COMBINATION. ARE THE PROPER WIRES LOCATED IN THE PROPER CONNECTOR CAVITIES?
YES
NO
USING THE CIRCUIT DIAGRAMS LOCATED IN THE FRONT OF THIS SECTION, PLACE THE PROPER WIRES IN THE PROPER CONNECTOR CAVITIES. CLEAR DTCs AND RECHECK SYSTEM.
2
• RAISE AND SUPPORT THE VEHICLE SUCH THAT THE REAR WHEELS ARE APPROXIMATELY SIX INCHES OFF THE FLOOR.
• IGNITION "ON," ENGINE "OFF."
• PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
• APPLY FIRM PRESSURE ON BRAKE PEDAL.
• USING TECH 1 ABS TESTS, SELECT MANUAL CONTROL FUNCTION.
• SELECT REAR AXLE MOTOR APPLY FUNCTION AND APPLY THE MOTOR.
• HAVE AN ASSISTANT TRY TO SPIN THE REAR WHEELS BY HAND. COULD ASSISTANT SPIN THE REAR WHEELS?
YES
NO
6
• FIRM PRESSURE STILL "ON" BRAKE PEDAL.
• SELECT REAR AXLE MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR.
• HAVE AN ASSISTANT TRY TO SPIN THE REAR WHEELS BY HAND. COULD ASSISTANT SPIN THE REAR WHEELS?
NO
YES
MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
3
• REMOVE FOOT FROM BRAKE PEDAL.
• SELECT REAR AXLE MOTOR APPLY FUNCTION AND APPLY THE MOTOR WHILE CAREFULLY OBSERVING THE COMMANDED CURRENT AND THE FEEDBACK CURRENT ON THE TECH 1. WAS THE FEEDBACK CURRENT HIGHER THAN THE COMMANDED CURRENT?
YES
NO
4
• IGNITION "OFF."
• DISCONNECT THE 8-WAY EBCM CONNECTOR AND THE 6-WAY MOTOR PACK CONNECTOR.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C" AND TERMINAL "F" OF THE 8-WAY EBCM HARNESS CONNECTOR. DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
YES
NO
5
• RECONNECT ALL CONNECTORS.
• START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
• TURN IGNITION "OFF."
• START ENGINE AND TEST DRIVE VEHICLE A SECOND TIME, ACHIEVING AT LEAST 16 km/h (10 MPH). DOES DTC A046 RESET?
REPAIR SHORT BETWEEN CKT 1284 AND CKT 1285.
YES
NO
REPLACE EBCM.
MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS FOR CONTAMINATION AND POOR TERMINAL CONTACT. REPLACE ANY TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION.
7
• USING TECH 1 ABS TESTS, PERFORM GEAR TENSION RELIEF FUNCTION.
• IGNITION "OFF."
• REMOVE HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY FROM VEHICLE. REFER TO "ON VEHICLE SERVICE" IN THIS SECTION.
• SEPARATE MOTOR PACK FROM HYDRAULIC MODULATOR.
• GRASP THE MIDDLE GEAR ON THE HYDRAULIC MODULATOR (THE HYDRAULIC MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS) AND ATTEMPT TO MOVE THE GEAR. CAN THE GEAR BE ROTATED AT LEAST 7 FULL TURNS LOCK TO LOCK?
NO
YES
REPLACE HYDRAULIC MODULATOR.
REPLACE MOTOR PACK.
* AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 KM/H (10 MPH), AND THEN KEYING DOWN.
C1639S



DTC 47
(Page 1 of 2)
LEFT FRONT ABS MOTOR FREE SPINS

Circuit Description:

This DTC is designed to detect a stripped nut or gear assembly during initialization. During the homing sequence, the piston should reach the top of the bore resulting in a stalled ABS motor. If this does not occur, the ABS motor must be spinning with little or no resistance, indicating a nut/screw or gear malfunction.

DTC Will Set When:

DTC 47 can only be set during initialization. If the feedback current is less than the command current for a specified period of time, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks to see if the corresponding open motor DTC is also set.
2. Verifies that the ABS motor was actually applied as command by observing feedback current.
3. Verifies that the ABS motor can release.
4. Verifies that the ABS motor can be applied by observing pedal movement.
5. Checks for an open in the ABS motor "HIGH" circuitry.
6. Checks for an open in the ABS motor "LOW" circuitry.
7. Checks for an ABS motor that is internally shorted.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. If the DTC only occurs once and DTC 56 also occurs, refer to DTC 56. If intermittent and enhanced diagnostics shows this DTC occurs during ABS, refer to DTC 56.

Depending on the frequency of the malfunction, a physical inspection of the mechanical parts suspected may be necessary.

DTC 47

(Page 1 of 2)

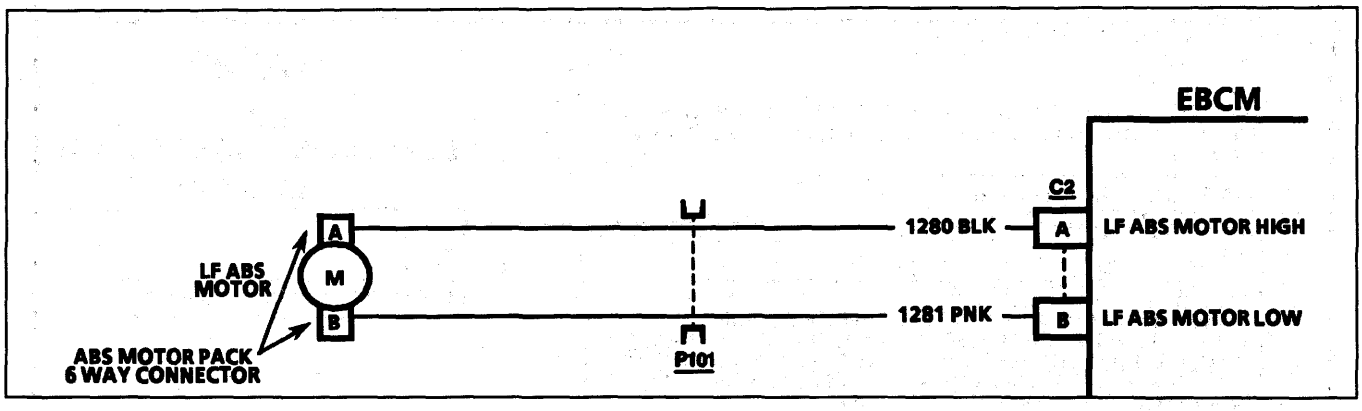
LEFT FRONT ABS MOTOR FREE SPINS

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

1. IS DTC 56 ALSO CURRENTLY SET?
   - YES → PROCEED TO DTC 56 CHART FIRST.
   - NO →
2. • IGNITION "ON," ENGINE "OFF."
   • PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
   • USING TECH 1 MISC. TESTS, SELECT MANUAL CONTROL FUNCTION.
   • SELECT LEFT FRONT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR WHILE CAREFULLY OBSERVING THE COMMAND CURRENT AND FEEDBACK CURRENT ON THE TECH 1.
   WERE BOTH COMMAND AND FEEDBACK CURRENT 10 AMPS?
   - YES →
3. • APPLY FIRM PRESSURE ON BRAKE PEDAL.
   • SELECT LEFT FRONT ABS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR.
   DID THE BRAKE PEDAL FALL AND WERE BOTH COMMAND AND FEEDBACK CURRENT 6 AMPS?
   - NO → GO TO STEP 5.
   - YES →
4. • FIRM PRESSURE STILL ON BRAKE PEDAL.
   • SELECT LEFT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR (THIS MOVES THE PISTON TO THE TOP OF ITS BORE.)
   DID BRAKE PEDAL RISE?
   - YES → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - NO →
5. • USING TECH 1 MISC. TESTS, PERFORM GEAR TENSION RELIEF FUNCTION.
   • IGNITION "OFF."
   • DISCONNECT 6-WAY ABS MOTOR PACK CONNECTOR AND 8-WAY EBCM CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "A" OF THE 8-WAY EBCM HARNESS CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPAIR HIGH RESISTANCE IN CKT 1280.
   - YES →
6. • MEASURE THE RESISTANCE BETWEEN TERMINAL "B" OF THE 6-WAY ABS MOTOR PARK HARNESS CONNECTOR AND TERMINAL "B" OF THE 8-WAY EBCM HARNESS CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPAIR HIGH RESISTANCE IN CKT 1281.
   - YES →
7. • MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE ABS MOTOR PACK CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPLACE ABS MOTOR PACK.
   - YES → DIAGNOSIS CONTINUED ON NEXT PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN KEYING DOWN.

C1640S



DTC 47
(Page 2 of 2)
LEFT FRONT ABS MOTOR FREE SPINS

Circuit Description:

This DTC is designed to detect a stripped nut or gear assembly during initialization. During the homing sequence, the piston should reach the top of the bore resulting in a stalled motor. If this does not occur, the motor must be spinning with little or no resistance, indicating a nut/screw or gear malfunction.

DTC Will Set When:

DTC 47 can only be set during initialization. If the feedback current is less than the command current for a specified period of time, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

8. Checks for a stripped gear on the ABS motor pack (unit with three small gears).
9. Checks for a stripped gear on the hydraulic modulator (unit with three large gears).
10. Checks to see if the ABS motor pack has an internal malfunction.
11. Checks for a malfunctioning hydraulic modulator.
12. Ensures malfunction was not due to poor terminal contact.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. If the DTC only occurs once and DTC 56 also occurs, refer to DTC 56. If intermittent and enhanced diagnostics shows this DTC occurs during ABS, refer to DTC 56.

Depending on the frequency of the malfunction, a physical inspection of the mechanical parts suspected may be necessary.

DTC 47
(Page 2 of 2)
LEFT FRONT ABS MOTOR FREE SPINS

DIAGNOSIS CONTINUED FROM PREVIOUS PAGE.

8
- REMOVE HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY FROM VEHICLE (REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION).
- REMOVE GEAR COVER.
- CHECK FOR STRIPPED GEAR ON ABS MOTOR PACK; ABS MOTOR PACK IS THE UNIT WITH THE THREE SMALL GEARS. THE LEFT FRONT GEAR IS THE GEAR FURTHEST FORWARD WHEN THE ASSEMBLY IS INSTALLED IN THE VEHICLE. IS THE ABS MOTOR PACK GEAR STRIPPED?

YES → REPLACE ABS MOTOR PACK.

NO

9
- CHECK FOR A STRIPPED GEAR ON HYDRAULIC MODULATOR; MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS. THE LEFT FRONT GEAR IS THE GEAR FURTHEST FORWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE. IS THE MODULATOR GEAR STRIPPED?

YES → REPLACE HYDRAULIC MODULATOR GEAR.

NO

10
- RECONNECT ELECTRICAL CONNECTORS
- SECURELY POSITION HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY IN VEHICLE WITH GEAR COVER REMOVED SUCH THAT THE GEAR SET CAN BE OBSERVED. BE CAREFUL NOT TO DAMAGE GEAR SET OR ALLOW THE HYDRAULIC MODULATOR TO MOVE WHILE TESTING.
- IGNITION "ON."
- USING TECH 1 MISC. TESTS SELECT MANUAL CONTROL FUNCTION.
- SELECT LEFT FRONT ABS MOTOR APPLY AND APPLY THE MOTOR WHILE OBSERVING THE GEAR SET FURTHEST FORWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE.
- SELECT LEFT FRONT ABS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR WHILE STILL OBSERVING THE GEAR SET.
- SELECT LEFT FRONT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR. DID GEAR SET MOVE IN BOTH DIRECTIONS FOR AT LEAST ONE REVOLUTION?

NO → REPLACE ABS MOTOR PACK.

YES

11
- USING TECH 1 MISC. TESTS, PERFORM GEAR TENSION RELIEF FUNCTION.
- IGNITION "OFF."
- SEPARATE THE ABS MOTOR PACK FROM THE HYDRAULIC MODULATOR.
- GRASP THE GEAR ON THE HYDRAULIC MODULATOR (THE HYDRAULIC MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS) FURTHEST FORWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE AND ATTEMPT TO MOVE THE GEAR. CAN THE GEAR BE ROTATED MORE THAN 13 FULL TURNS LOCK TO LOCK?

YES → REPLACE THE HYDRAULIC MODULATOR.

NO

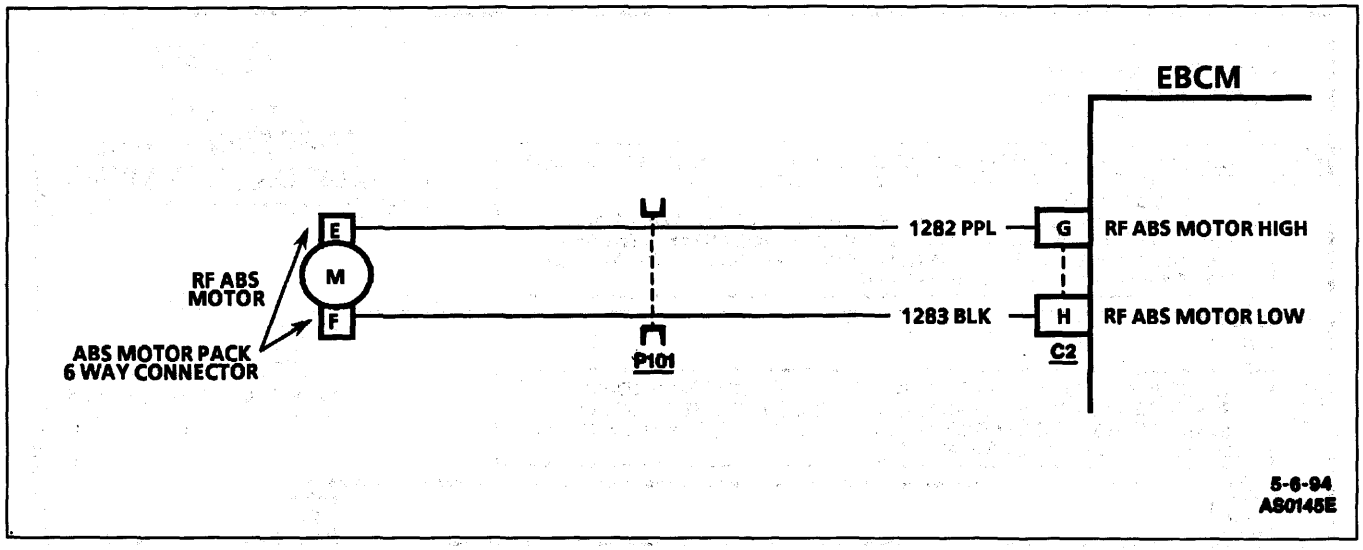
12
- INSPECT ALL CONNECTORS AND TERMINALS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4 "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.
- REINSTALL HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY IN VEHICLE.
- RECONNECT ALL CONNECTORS.
- IGNITION "OFF."
- START ENGINE WITH FOOT OFF BRAKE.
- ALLOW ENGINE TO RUN FOR AT LEAST 10 SECONDS.
- REPEAT ABOVE IGNITION CYCLE SEQUENCE TWO MORE TIMES. DID DTC 47 SET IN THE LAST THREE IGNITION CYCLES?

YES → REPLACE EBCM.

NO → MALFUNCTION IS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN KEYING DOWN.

C1641S



DTC 48
(Page 1 of 2)
RIGHT FRONT ABS MOTOR FREE SPINS

Circuit Description:

This DTC is designed to detect a stripped nut or gear assembly during initialization. During the homing sequence, the piston should reach the top of the bore resulting in a stalled ABS motor. If this does not occur, the ABS motor must be spinning with little or no resistance, indicating a nut/screw or gear malfunction.

DTC Will Set When:

DTC 48 can only be set during initialization. If the feedback current is less than the command current for a specified period of time, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks to see if the corresponding open motor DTC is also set.
2. Verifies that the ABS motor was actually applied as command by observing feedback current.
3. Verifies that the ABS motor can release.
4. Verifies that the ABS motor can be applied by observing pedal movement.
5. Checks for high resistance in the ABS motor "HIGH" circuitry.
6. Checks for high resistance in the ABS motor "LOW" circuitry.
7. Checks for proper resistance of the ABS motor windings.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. If the DTC only occurs once and DTC 61 also occurs, refer to DTC 61. If intermittent and enhanced diagnostics shows this DTC occurs during ABS, refer to DTC 61.

Depending on the frequency of the malfunction, a physical inspection of the mechanical parts suspected may be necessary.

DTC 48

(Page 1 of 2)

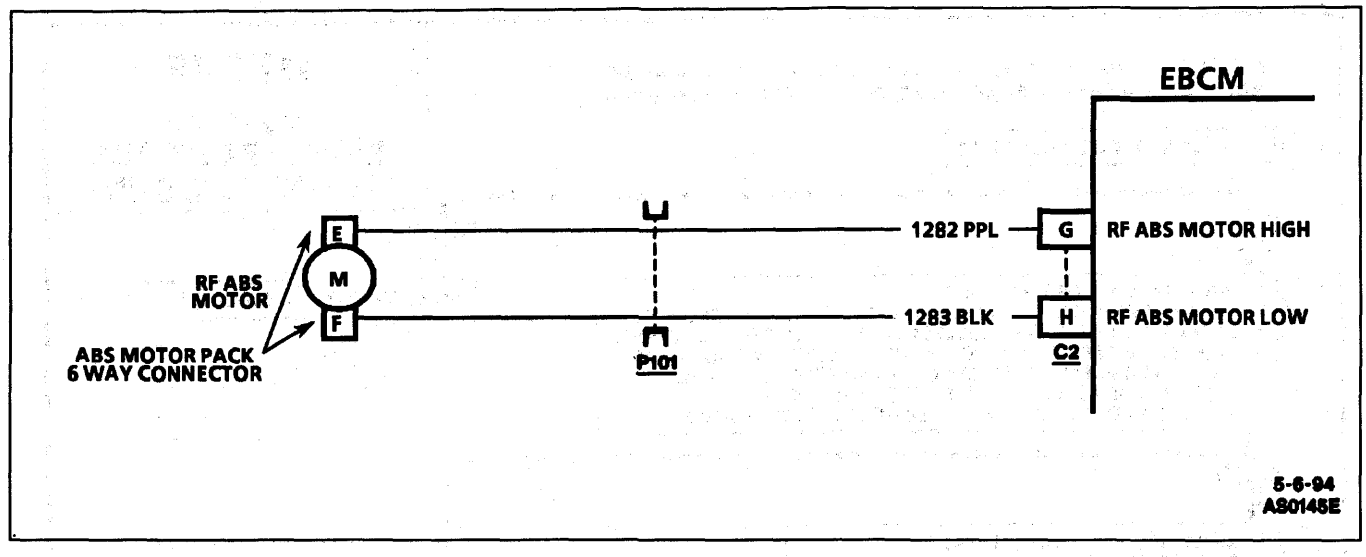
RIGHT FRONT ABS MOTOR FREE SPINS

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

1. IS DTC 61 ALSO CURRENTLY SET?
   - YES → PROCEED TO DTC 61 CHART FIRST.
   - NO →
2. • IGNITION "ON," ENGINE "OFF."
   • PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
   • USING TECH 1 MISC. TESTS, SELECT MANUAL CONTROL FUNCTION.
   • SELECT RIGHT FRONT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR WHILE CAREFULLY OBSERVING THE COMMAND CURRENT AND FEEDBACK CURRENT ON THE TECH 1.
   WERE BOTH COMMAND AND FEEDBACK CURRENT 10 AMPS?
   - YES →
3. • APPLY FIRM PRESSURE ON BRAKE PEDAL.
   • SELECT RIGHT FRONT ABS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR.
   DID THE BRAKE PEDAL FALL AND WERE BOTH COMMAND AND FEEDBACK CURRENT 6 AMPS?
   - NO → GO TO STEP 5.
   - YES →
4. • FIRM PRESSURE STILL ON BRAKE PEDAL.
   • SELECT RIGHT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR (THIS MOVES THE PISTON TO THE TOP OF ITS BORE.)
   DID BRAKE PEDAL RISE?
   - YES → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - NO →
5. • USING TECH 1 MISC. TESTS, PERFORM GEAR TENSION RELIEF FUNCTION.
   • IGNITION "OFF."
   • DISCONNECT 6-WAY ABS MOTOR PACK CONNECTOR AND 8-WAY EBCM CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "E" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "G" OF THE 8-WAY EBCM HARNESS CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPAIR HIGH RESISTANCE IN CKT 1282.
   - YES →
6. • MEASURE THE RESISTANCE BETWEEN TERMINAL "F" OF THE 6-WAY ABS MOTOR PARK HARNESS CONNECTOR AND TERMINAL "H" OF THE 8-WAY EBCM HARNESS CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPAIR HIGH RESISTANCE IN CKT 1283.
   - YES →
7. • MEASURE THE RESISTANCE BETWEEN TERMINAL "E" AND TERMINAL "F" OF THE ABS MOTOR PACK CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPLACE ABS MOTOR PACK.
   - YES → DIAGNOSIS CONTINUED ON NEXT PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN KEYING DOWN.

C1642S



DTC 48
(Page 2 of 2)
RIGHT FRONT ABS MOTOR FREE SPINS

Circuit Description:

This DTC is designed to detect a stripped nut or gear assembly during initialization. During the homing sequence, the piston should reach the top of the bore resulting in a stalled ABS motor. If this does not occur, the ABS motor must be spinning with little or no resistance, indicating a nut/screw or gear malfunction.

DTC Will Set When:

DTC 48 can only be set during initialization. If the feedback current is less than the command current for a specified period of time, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

8 Checks for a stripped gear on the ABS motor pack (unit with three small gears).

9 Checks for a stripped gear on the hydraulic modulator (unit with three large gears).

10 Checks to see if the ABS motor pack has an internal malfunction.

11 Checks for a malfunctioning hydraulic modulator.

12 Ensures malfunction was not due to poor terminal contact.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. If the DTC only occurs once and DTC 61 also occurs, refer to DTC 61. If intermittent and enhanced diagnostics shows this DTC occurs during ABS, refer to DTC 61.

Depending on the frequency of the malfunction, a physical inspection of the mechanical parts suspected may be necessary.

DIAGNOSIS CONTINUED FROM PREVIOUS PAGE.

DTC 48

(Page 2 of 2)
RIGHT FRONT ABS MOTOR FREE SPINS

8

- REMOVE HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY FROM VEHICLE. (REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.)
- REMOVE GEAR COVER.
- CHECK FOR STRIPPED GEAR ON ABS MOTOR PACK; ABS MOTOR PACK IS THE UNIT WITH THE THREE SMALL GEARS. THE RIGHT FRONT GEAR IS THE GEAR FURTHEST REARWARD WHEN THE ASSEMBLY IS INSTALLED IN THE VEHICLE. IS THE ABS MOTOR PACK GEAR STRIPPED?

YES → REPLACE ABS MOTOR PACK.

NO

9

- CHECK FOR A STRIPPED GEAR ON HYDRAULIC MODULATOR; MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS. THE RIGHT FRONT GEAR IS THE GEAR FURTHEST REARWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE. IS THE MODULATOR GEAR STRIPPED?

YES → REPLACE HYDRAULIC MODULATOR GEAR.

NO

10

- RECONNECT ELECTRICAL CONNECTORS.
- SECURELY POSITION HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY IN VEHICLE WITH GEAR COVER REMOVED SUCH THAT THE GEAR SET CAN BE OBSERVED. BE CAREFUL NOT TO DAMAGE GEAR SET OR ALLOW THE HYDRAULIC MODULATOR TO MOVE WHILE TESTING.
- IGNITION "ON."
- USING TECH 1 MISC. TESTS, SELECT MANUAL CONTROL FUNCTION.
- SELECT RIGHT FRONT ABS MOTOR APPLY AND APPLY THE MOTOR WHILE OBSERVING THE GEAR SET FURTHEST REARWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE.
- SELECT RIGHT FRONT ABS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR WHILE STILL OBSERVING THE GEAR SET.
- SELECT RIGHT FRONT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR. DID GEAR SET MOVE IN BOTH DIRECTIONS FOR AT LEAST ONE REVOLUTION?

NO → REPLACE ABS MOTOR PACK.

YES

11

- USING TECH 1 MISC. TESTS, PERFORM GEAR TENSION RELIEF FUNCTION.
- IGNITION "OFF."
- SEPARATE THE ABS MOTOR PACK FROM THE HYDRAULIC MODULATOR.
- GRASP THE GEAR ON THE HYDRAULIC MODULATOR (THE HYDRAULIC MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS) FURTHEST REARWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE AND ATTEMPT TO MOVE THE GEAR. CAN THE GEAR BE ROTATED MORE THAN 13 FULL TURNS LOCK TO LOCK?

YES → REPLACE THE HYDRAULIC MODULATOR.

NO

12

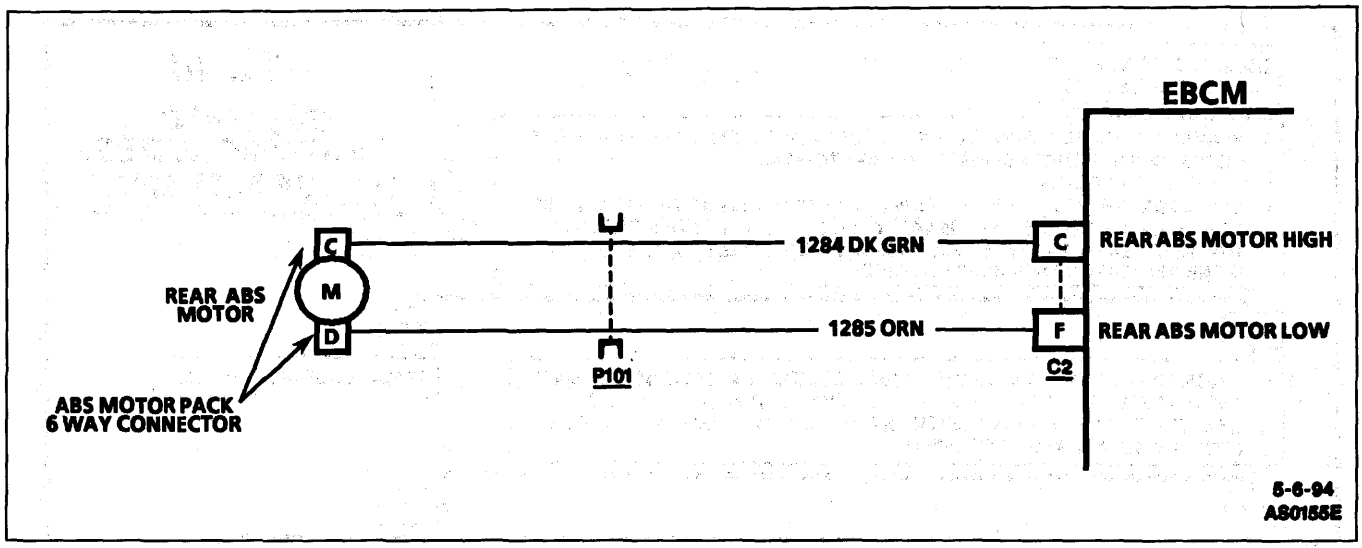
- INSPECT ALL CONNECTORS AND TERMINALS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4 "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.
- REINSTALL HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY IN VEHICLE.
- RECONNECT ALL CONNECTORS.
- IGNITION "OFF."
- START ENGINE WITH FOOT OFF BRAKE.
- ALLOW ENGINE TO RUN FOR AT LEAST 10 SECONDS.
- REPEAT ABOVE IGNITION CYCLE SEQUENCE TWO MORE TIMES. DID DTC 48 SET IN THE LAST THREE IGNITION CYCLES?

YES → REPLACE EBCM.

NO → MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN KEYING DOWN.

C1643S



DTC 51
(Page 1 of 2)
REAR ABS MOTOR FREE SPINS

Circuit Description:

This DTC is designed to detect a stripped nut or gear assembly during initialization. During the homing sequence, the piston should reach the top of the bore resulting in a stalled ABS motor. If this does not occur, the ABS motor must be spinning with little or no resistance, indicating a nut/screw or gear malfunction.

DTC Will Set When:

DTC 51 can be set during initialization. If the feedback current is less than the command current for a specified period of time, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks to see if the corresponding open ABS motor DTC is also set.
2. Verifies that the ABS motor was actually applied as command by observing feedback current.
3. Verifies that the ABS motor can release.
4. Verifies that the ABS motor can be applied by observing pedal movement.
5. Checks for high resistance in the ABS motor "HIGH" circuitry.
6. Checks for high resistance in the ABS motor "LOW" circuitry.
7. Checks for proper resistance of the ABS motor windings.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. If the DTC only occurs once and DTC 64 also occurs, refer to DTC 64. If intermittent and enhanced diagnostics show this DTC occurs during ABS, refer to DTC 64.

Depending on the frequency of the malfunction, a physical inspection of the mechanical parts suspected may be necessary.

DTC 51
(Page 1 of 2)
REAR ABS MOTOR FREE SPINS

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

1. IS DTC 64 ALSO CURRENTLY SET?
   - YES → PROCEED TO DTC 64 CHART FIRST.
   - NO →
2. - IGNITION "ON," ENGINE "OFF."
   - PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
   - USING TECH 1 MISC. TESTS, SELECT MANUAL CONTROL FUNCTION.
   - SELECT REAR AXLE ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR WHILE CAREFULLY OBSERVING THE COMMAND CURRENT AND FEEDBACK CURRENT ON THE TECH 1.

   WERE BOTH COMMAND AND FEEDBACK CURRENT 10 AMPS?
   - YES →
3. - APPLY FIRM PRESSURE ON BRAKE PEDAL.
   - SELECT REAR AXLE ABS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR.

   DID THE BRAKE PEDAL FALL AND WERE BOTH COMMAND AND FEEDBACK CURRENT 6 AMPS?
   - NO → GO TO STEP 5.
   - YES →
4. - FIRM PRESSURE STILL ON BRAKE PEDAL.
   - SELECT REAR AXLE ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR (THIS MOVES THE PISTON TO THE TOP OF ITS BORE.)

   DID BRAKE PEDAL RISE?
   - YES → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - NO →
5. - USING TECH 1 MISC. TESTS, PERFORM GEAR TENSION RELIEF FUNCTION.
   - IGNITION "OFF."
   - DISCONNECT 6-WAY ABS MOTOR PACK CONNECTOR AND 8-WAY EBCM CONNECTOR.
   - USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "C" OF THE 8-WAY EBCM HARNESS CONNECTOR.

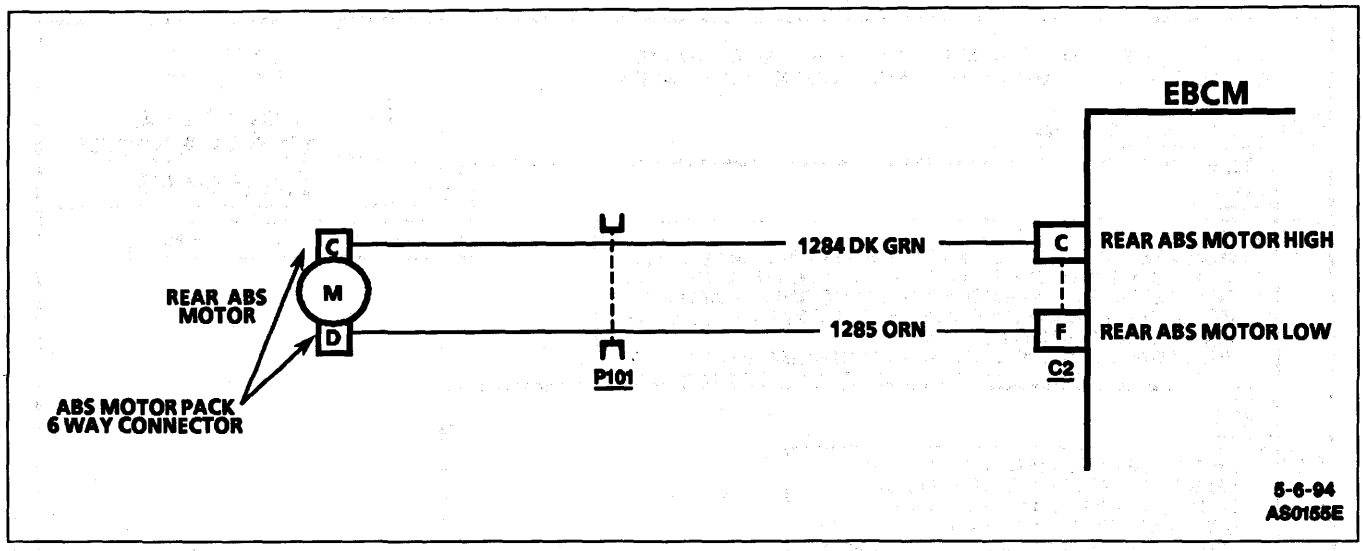
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPAIR HIGH RESISTANCE IN CKT 1284.
   - YES →
6. - MEASURE THE RESISTANCE BETWEEN TERMINAL "D" OF THE 6-WAY ABS MOTOR PARK HARNESS CONNECTOR AND TERMINAL "F" OF THE 8-WAY EBCM HARNESS CONNECTOR.

   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPAIR HIGH RESISTANCE IN CKT 1285.
   - YES →
7. - MEASURE THE RESISTANCE BETWEEN TERMINAL "C" AND TERMINAL "D" OF THE ABS MOTOR PACK CONNECTOR.

   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPLACE ABS MOTOR PACK.
   - YES → DIAGNOSIS CONTINUED ON NEXT PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN KEYING DOWN.

C1644S



DTC 51
(Page 2 of 2)
REAR ABS MOTOR FREE SPINS

Circuit Description:

This DTC is designed to detect a stripped nut or gear assembly during initialization. During the homing sequence, the piston should reach the top of the bore resulting in a stalled motor. If this does not occur, the ABS motor must be spinning with little or no resistance, indicating a nut/screw or gear malfunction.

DTC Will Set When:

DTC 51 can be set during initialization. If the feedback current is less than the command current for a specified period of time, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS are disabled. The amber ABS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

8. Checks for a stripped gear on the ABS motor pack (unit with three small gears).
9. Checks for a stripped gear on the hydraulic modulator (unit with three large gears).
10. Checks to see if the ABS motor pack has an internal malfunction.
11. Checks for a malfunctioning hydraulic modulator.
12. Ensures malfunction was not due to poor terminal contact.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. If the DTC only occurs once and DTC 64 also occurs, refer to DTC 64. If intermittent and enhanced diagnostics show this DTC occurs during ABS, refer to DTC 64.

Depending on the frequency of the malfunction, a physical inspection of the mechanical parts suspected may be necessary.

DTC 51
(Page 2 of 2)
REAR ABS MOTOR FREE SPINS

DIAGNOSIS CONTINUED FROM PREVIOUS PAGE.

(8)
- REMOVE HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY FROM VEHICLE (REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION).
- REMOVE GEAR COVER.
- CHECK FOR STRIPPED GEAR ON ABS MOTOR PACK; ABS MOTOR PACK IS THE UNIT WITH THE THREE SMALL GEARS. THE REAR AXLE GEAR IS THE MIDDLE GEAR OF THE THREE.

IS THE ABS MOTOR PACK GEAR STRIPPED?

NO

(9)
- CHECK FOR A STRIPPED GEAR ON HYDRAULIC MODULATOR; MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS. THE REAR AXLE GEAR IS THE MIDDLE GEAR OF THE THREE.

IS THE MODULATOR GEAR STRIPPED?

NO

(10)
- RECONNECT ELECTRICAL CONNECTORS
- SECURELY POSITION HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY IN VEHICLE WITH GEAR COVER REMOVED SUCH THAT THE GEAR SET CAN BE OBSERVED. BE CAREFUL NOT TO DAMAGE GEAR SET OR ALLOW THE HYDRAULIC MODULATOR TO MOVE WHILE TESTING.
- IGNITION "ON."
- USING TECH 1 MISC. TESTS, SELECT MANUAL CONTROL FUNCTION.
- SELECT REAR AXLE ABS MOTOR APPLY AND APPLY THE MOTOR WHILE OBSERVING THE MIDDLE GEAR SET.
- SELECT REAR AXLE ABS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR WHILE STILL OBSERVING THE GEAR SET.
- SELECT REAR AXLE ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR.

DID GEAR SET MOVE IN BOTH DIRECTIONS FOR AT LEAST ONE REVOLUTION?

YES

(11)
- USING TECH 1 MISC. TESTS, PERFORM GEAR TENSION RELIEF FUNCTION.
- IGNITION "OFF."
- SEPARATE THE ABS MOTOR PACK FROM THE HYDRAULIC MODULATOR.
- GRASP THE MIDDLE GEAR ON THE HYDRAULIC MODULATOR (THE HYDRAULIC MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS) AND ATTEMPT TO MOVE THE GEAR.

CAN THE GEAR BE ROTATED MORE THAN 8 FULL TURNS LOCK TO LOCK?

NO

(12)
- INSPECT ALL CONNECTORS AND TERMINALS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4 "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.
- REINSTALL HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY IN VEHICLE.
- RECONNECT ALL CONNECTORS.
- IGNITION "OFF."
- START ENGINE WITH FOOT OFF BRAKE.
- ALLOW ENGINE TO RUN FOR AT LEAST 10 SECONDS.
- REPEAT ABOVE IGNITION CYCLE SEQUENCE TWO MORE TIMES.

DID DTC 51 SET IN THE LAST THREE IGNITION CYCLES?

YES

REPLACE EBCM.

NO

MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

YES

REPLACE ABS MOTOR PACK.

YES

REPLACE HYDRAULIC MODULATOR GEAR.

NO

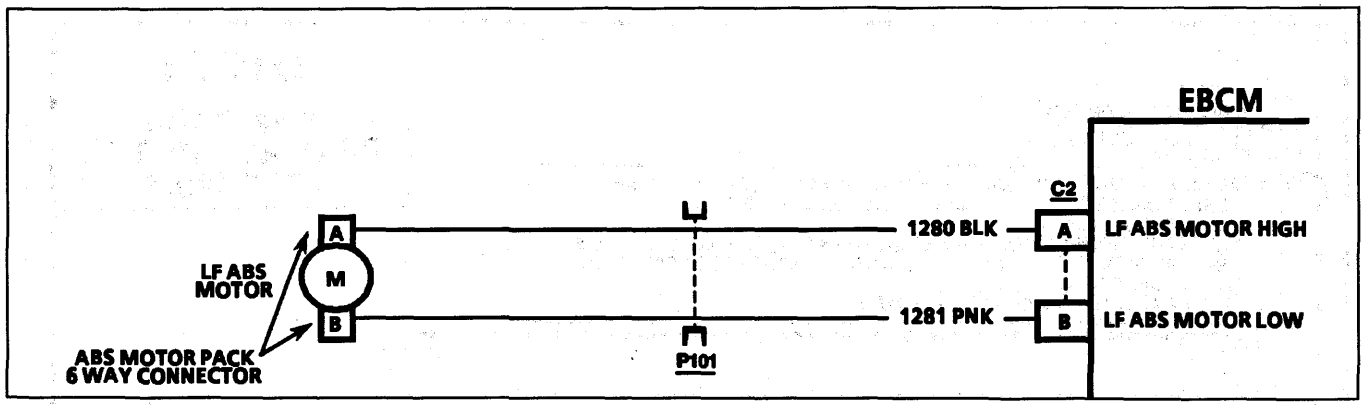
REPLACE ABS MOTOR PACK.

YES

REPLACE THE HYDRAULIC MODULATOR.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN KEYING DOWN.

C1645S



DTC 52
LEFT FRONT ABS CHANNEL IN RELEASE TOO LONG

Circuit Description:

This DTC will diagnose an ABS motor that is energized longer than expected. This could occur if a wheel speed sensor is malfunctioning, the ABS motor does not turn, the left front solenoid mechanically fails open, or the ABS motor wires are crossed.

DTC Will Set When:

DTC 52 can be set only during an ABS stop. If the EBCM commands the left front ABS channel in release for three seconds, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Identifies a malfunction in a wheel speed sensor that may cause the system to be in release too long.
2. Identifies an ABS motor as being failed or wired incorrectly.
3. Checks for a solenoid that may have mechanically failed open.
4. Verifies proper solenoid operation.
5. If Step 3 has failed, this serves to isolate the cause of the hydraulic malfunction, to either the solenoid or the ABS hydraulic modulator assembly.
6. Determines whether a malfunctioning motor pack or hydraulic modulator is the reason for DTC 52 being set.

Diagnostic Aids:

An intermittent malfunction may be caused by a mechanical part of the system that sticks or binds.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. DTC 52 may occur if on ice and steering wheel is turned to lock during braking. Using the Tech 1, perform hydraulic test to ensure total brake system is functional.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Important

EXCESSIVE DRAG OR HIGH RESISTANCE IN THE BASE BRAKE OR SUSPENSION SYSTEM MUST BE INSPECTED AND CORRECTED BEFORE PROCEEDING WITH DTC DIAGNOSIS.

DTC 52

LEFT FRONT ABS CHANNEL IN RELEASE TOO LONG

ARE ANY WHEEL SPEED DTCs CURRENTLY SET?

- YES: PROCEED TO THAT DTC CHART FIRST.
- NO

1
- USING TECH 1, SELECT "F0: DATA LIST" AND TEST VEHICLE DURING A STEADY DECEL CONDITION FROM 35 MPH TO 0 MPH WHILE MONITORING ALL WHEEL SPEEDS.
- DO ANY OF THE WHEEL SPEEDS INDICATE ERRATIC OR INTERMITTENT OPERATION?

- YES: PROCEED TO WHEEL SPEED = 0 DTC FOR AFFECTED WHEEL.
- NO

2
- IGNITION "ON."
- USING TECH 1 MANUAL CONTROL FUNCTION, SELECT LEFT FRONT ABS MOTOR APPLY AND APPLY MOTOR.
- APPLY FIRM PRESSURE ON BRAKE PEDAL.
- SELECT LEFT FRONT ABS MOTOR RELEASE AND COMMAND RELEASE OF MOTOR.
- DID BRAKE PEDAL FALL?

- NO
  - BRAKE PEDAL DID NOT MOVE
  - BRAKE PEDAL ROSE: REPAIR CROSSED WIRES (CKTs 1280 and 1281) TO LEFT FRONT ABS MOTOR.
- YES

3
- REMOVE FOOT FROM BRAKE PEDAL.
- USING TECH 1 MANUAL CONTROL FUNCTION, SELECT LEFT FRONT SOLENOID AND COMMAND THE SOLENOID "ON."
- APPLY FIRM PRESSURE TO BRAKE PEDAL.
- DID BRAKE PEDAL FALL?

- YES: PROCEED TO STEP 5 OF THIS CHART.
- NO

4
- FIRM PRESSURE STILL APPLIED TO BRAKE PEDAL.
- USING TECH 1, COMMAND LEFT FRONT SOLENOID "OFF."
- DID BRAKE PEDAL FALL?

- YES

6
- USING TECH 1 PERFORM GEAR TENSION RELIEF FUNCTION.
- IGNITION "OFF."
- REMOVE HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY FROM VEHICLE.
- SEPARATE ABS MOTOR PACK FROM HYDRAULIC MODULATOR.
- GRASP THE GEAR ON THE HYDRAULIC MODULATOR (HYDRAULIC MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS) FURTHEST FORWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE AND ATTEMPT TO ROTATE THE GEAR IN EITHER DIRECTION.
- CAN THE GEAR BE MOVED BY HAND?

- YES: REPLACE ABS MOTOR PACK.
- NO: REPLACE ABS HYDRAULIC MODULATOR.

- NO

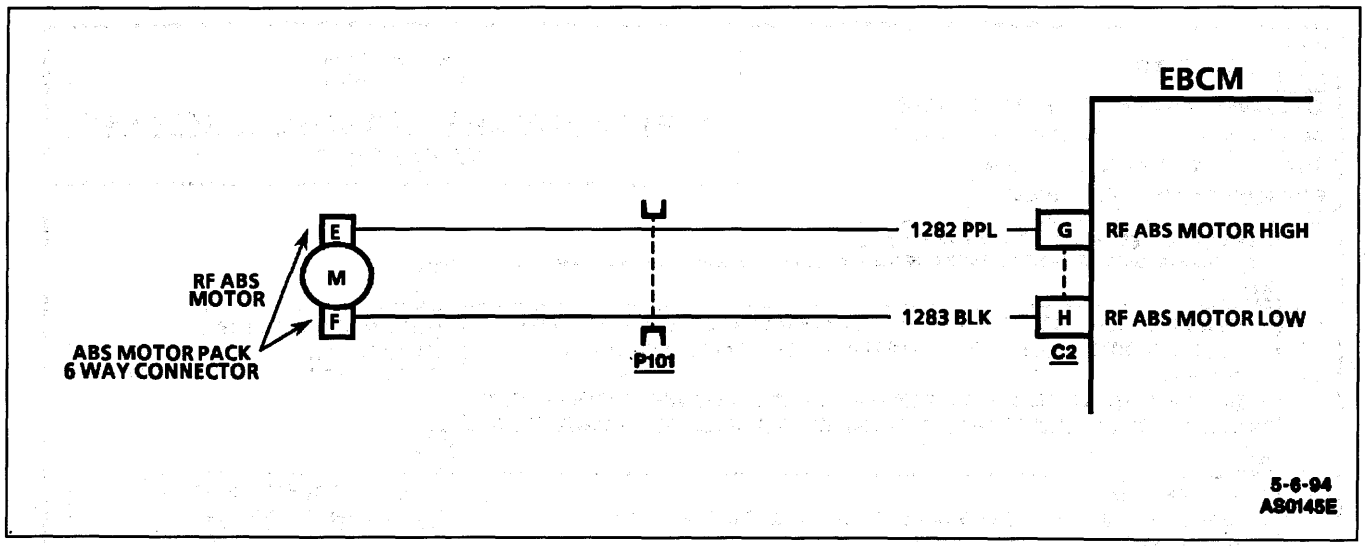
5
- REMOVE FOOT FROM BRAKE PEDAL.
- IGNITION "OFF."
- PHYSICALLY SWITCH THE LEFT FRONT SOLENOID WITH RIGHT FRONT SOLENOID.
- IGNITION "ON."
- USING TECH 1 MANUAL CONTROL FUNCTION, SELECT LEFT FRONT SOLENOID AND COMMAND THE SOLENOID "ON."
- APPLY FIRM PRESSURE TO BRAKE PEDAL.
- DID BRAKE PEDAL FALL?

- YES: REPLACE ABS HYDRAULIC MODULATOR.
- NO: REPLACE THE SOLENOID WHICH WAS ORIGINALLY IN THE LEFT FRONT CHANNEL.

- YES: MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16km/h (10 MPH) AND THEN KEYING DOWN.

C1646S



DTC 53

RIGHT FRONT ABS CHANNEL IN RELEASE TOO LONG

Circuit Description:

This DTC will diagnose a motor that is energized longer than expected. This could occur if a wheel speed sensor is malfunctioning, the motor does not turn, the right front solenoid mechanically fails open, or the ABS motor wires are crossed.

DTC Will Set When:

DTC 53 can be set only during an ABS stop. If the EBCM commands the right front channel in release for three seconds, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Identifies a malfunction in a wheel speed sensor that may cause the system to be in release too long.
2. Identifies a motor as being failed or wired incorrectly.
3. Checks for a solenoid that may have mechanically failed open.
4. If Step 3 has failed, this serves to isolate the cause of the hydraulic malfunction, to either the solenoid or the ABS hydraulic modulator assembly.
5. Checks for a solenoid that may have mechanically failed closed.
6. Determines whether a malfunction motor pack or hydraulic modulator is the reason for DTC 53 being set.

Diagnostic Aids:

An intermittent malfunction may be caused by a mechanical part of the system that sticks or binds.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. DTC 53 may occur on ice if steering wheel is turned to lock during braking. Using the Tech 1 perform hydraulic test to ensure total brake system is functional.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 53
RIGHT FRONT ABS CHANNEL IN RELEASE TOO LONG

Important

EXCESSIVE DRAG OR HIGH RESISTANCE IN THE BASE BRAKE OR SUSPENSION SYSTEM MUST BE INSPECTED AND CORRECTED BEFORE PROCEEDING WITH DTC DIAGNOSIS.

ARE ANY WHEEL SPEED DTCs CURRENTLY SET?

- YES → PROCEED TO THAT DTC CHART FIRST.
- NO →

(1)
- USING TECH 1, SELECT "F0: DATA LIST " AND TEST VEHICLE DURING A STEADY DECEL CONDITION FROM 35 MPH TO 0 MPH WHILE MONITORING ALL WHEEL SPEEDS.
DO ANY OF THE WHEEL SPEEDS INDICATE ERRATIC OR INTERMITTENT OPERATION?

- YES → PROCEED TO WHEEL SPEED = 0 DTC FOR AFFECTED WHEEL.
- NO →

(2)
- IGNITION "ON."
- USING TECH 1 MANUAL CONTROL FUNCTION, SELECT RIGHT FRONT ABS MOTOR APPLY AND APPLY MOTOR.
- APPLY FIRM PRESSURE ON BRAKE PEDAL.
- SELECT RIGHT FRONT ABS MOTOR RELEASE AND COMMAND RELEASE OF MOTOR.
DID BRAKE PEDAL FALL?

- NO →

BRAKE PEDAL DID NOT MOVE

(6)
- USING TECH 1 PERFORM GEAR TENSION RELIEF FUNCTION.
- IGNITION "OFF."
- REMOVE HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY FROM VEHICLE.
- SEPARATE ABS MOTOR PACK FROM HYDRAULIC MODULATOR.
- GRASP THE GEAR ON THE HYDRAULIC MODULATOR (HYDRAULIC MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS) FURTHEST REARWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE AND ATTEMPT TO ROTATE THE GEAR IN EITHER DIRECTION.
CAN THE GEAR BE MOVED BY HAND?

- YES → REPLACE ABS MOTOR PACK.
- NO → REPLACE ABS HYDRAULIC MODULATOR.

- YES →

(3)
- REMOVE FOOT FROM BRAKE PEDAL.
- USING TECH 1 MANUAL CONTROL FUNCTION, SELECT RIGHT FRONT SOLENOID AND COMMAND THE SOLENOID "ON."
- APPLY FIRM PRESSURE TO BRAKE PEDAL.
DID BRAKE PEDAL FALL?

- NO →

(4)
- FIRM PRESSURE STILL APPLIED TO BRAKE PEDAL.
- USING TECH 1, COMMAND RIGHT FRONT SOLENOID "OFF."
DID BRAKE PEDAL FALL?

- NO →

(5)
- REMOVE FOOT FROM BRAKE PEDAL.
- IGNITION "OFF."
- PHYSICALLY SWITCH THE RIGHT FRONT SOLENOID WITH THE LEFT FRONT SOLENOID.
- IGNITION "ON."
- USING TECH 1 MANUAL CONTROL FUNCTION, SELECT RIGHT FRONT SOLENOID AND COMMAND THE SOLENOID "ON."
- APPLY FIRM PRESSURE TO BRAKE PEDAL.
DID BRAKE PEDAL FALL?

- YES → REPLACE ABS HYDRAULIC MODULATOR.
- NO → REPLACE THE SOLENOID WHICH WAS ORIGINALLY IN THE RIGHT FRONT CHANNEL.

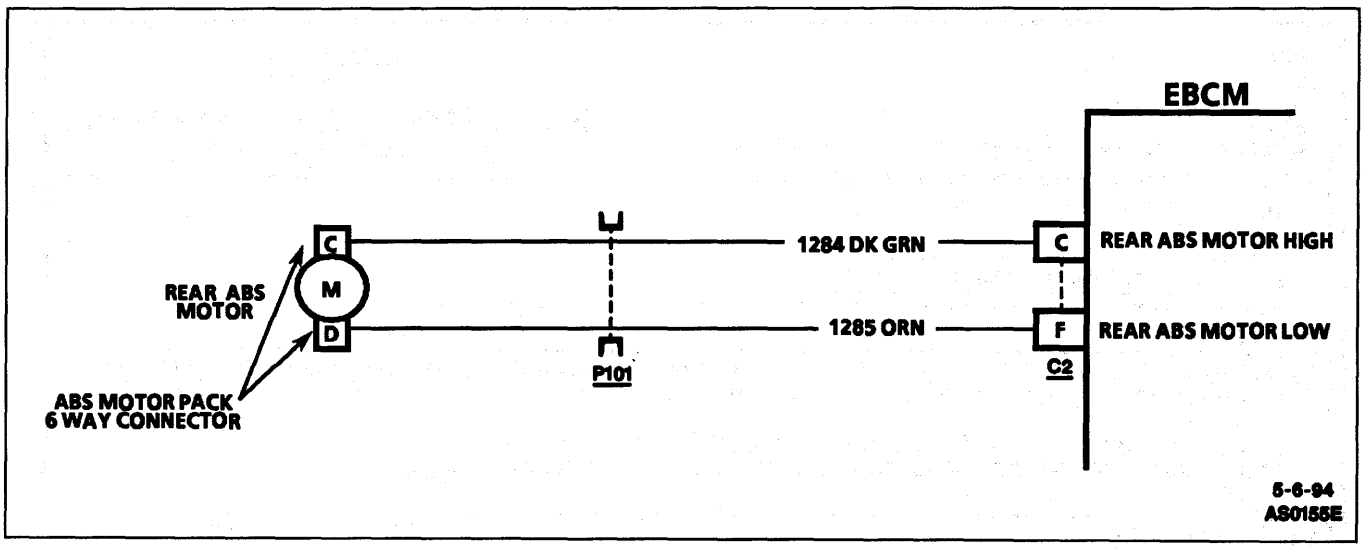
- YES → PROCEED TO STEP 5 OF THIS CHART.

- NO → MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

BRAKE PEDAL ROSE → REPAIR CROSSED WIRES (CKTs 1282 AND 1283) TO RIGHT FRONT ABS MOTOR.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16km/h (10 MPH) AND THEN KEYING DOWN.

C1647S



DTC 54
REAR ABS CHANNEL IN RELEASE TOO LONG

Circuit Description:

This DTC will diagnose an ABS motor that is energized longer than expected. This could occur if a wheel speed sensor is malfunctioning, the ABS motor does not turn, or the ABS motor wires are crossed.

DTC Will Set When:

DTC 54 can be set only during an ABS stop. If the EBCM commands the rear axle channel in release for three seconds, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Identifies a malfunction in a wheel speed sensor that may cause the system to be in release too long.
2. Checks for a wheel that may stick or bind because of a mechanical malfunction.
3. Checks to see if the ABS motor is capable of moving and applying the hydraulic piston for the rear wheels.
4. Ensures that the ABS motor wiring is not crossed.
5 Isolates the fault of a "no-apply" situation to either the ABS motor pack or ABS hydraulic modulator assembly.

Diagnostic Aids:

An intermittent malfunction may be caused by a mechanical part of the system that sticks or binds.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. Using the Tech 1, perform hydraulic test to ensure total brake system is functional.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

IMPORTANT: EXCESSIVE DRAG OR HIGH RESISTANCE IN THE BASE BRAKE OR SUSPENSION SYSTEM MUST BE INSPECTED AND CORRECTED BEFORE PROCEEDING WITH DTC DIAGNOSIS.

DTC 54
REAR ABS CHANNEL IN RELEASE TOO LONG

ARE ANY WHEEL SPEED DTCs CURRENTLY SET?

- **YES** → PROCEED TO THAT DTC CHART FIRST.
- **NO** →

1
- USING TECH 1, SELECT "F0: DATA LIST" AND TEST VEHICLE DURING A STEADY DECEL CONDITION FROM 35 MPH TO 0 MPH WHILE MONITORING ALL WHEEL SPEEDS ON TECH 1 DATA LIST.

DO ANY OF THE WHEEL SPEEDS INDICATE ERRATIC OR INTERMITTENT OPERATION?

- **YES** → PROCEED TO WHEEL SPEED = 0 DTC FOR AFFECTED WHEEL.
- **NO** →

2
- RAISE REAR OF VEHICLE AND SUPPORT AS INDICATED IN SECTION 0A.
- SPIN BOTH REAR WHEELS AND CONFIRM PHYSICAL CONDITION OF BASE BRAKE SYSTEM.

COULD BOTH REAR WHEELS BE SPUN FREELY BY HAND?

- **NO** → REPAIR SOURCE OF RESISTANCE IN BASE BRAKE SYSTEM.
- **YES** →

3
- IGNITION "ON," ENGINE "OFF."
- USING MANUAL CONTROL FUNCTION OF TECH 1, SELECT REAR AXLE ABS MOTOR APPLY.
- APPLY FIRM PRESSURE ON BRAKE PEDAL.
- COMMAND APPLY OF REAR ABS MOTOR AND TRY TO SPIN REAR WHEELS BY HAND.

COULD REAR WHEELS BE SPUN BY HAND?

- **NO** → MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
- **YES** →

4
- WITH FIRM PRESSURE ON BRAKE PEDAL STILL APPLIED, COMMAND A RELEASE OF THE REAR AXLE ABS MOTOR.

CAN WHEELS BE MOVED?

- **NO** → REPAIR CROSSED WIRES AT REAR ABS MOTOR CIRCUIT.
- **YES** →

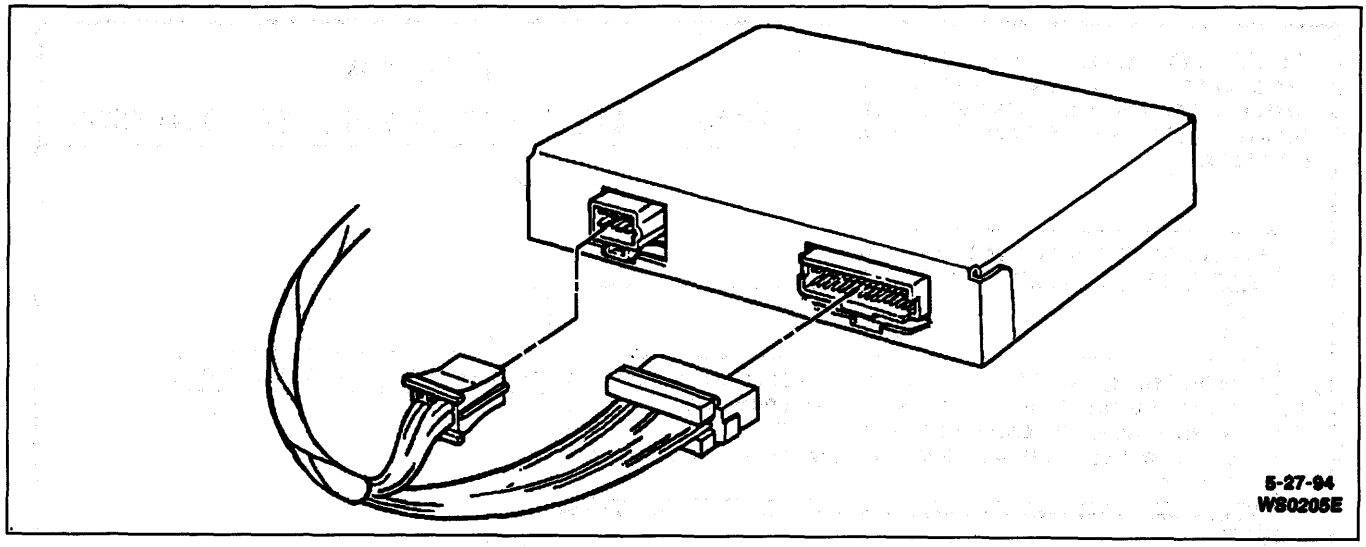
5
- USING TECH 1, PERFORM GEAR TENSION RELIEF FUNCTION.
- IGNITION "OFF."
- REMOVE HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY FROM VEHICLE.
- SEPARATE ABS MOTOR PACK FROM HYDRAULIC MODULATOR.
- CONNECT ABS MOTOR PACK WIRING.
- IGNITION "ON."
- USING TECH 1, PERFORM MOTOR TEST.

DO ALL THREE ABS MOTOR PACK GEARS (SMALL GEARS) SPIN FREELY?

- **NO** → REPLACE ABS MOTOR PACK.
- **YES** → REPLACE ABS HYDRAULIC MODULATOR.

AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE DRIVING OVER 16 KM/H (10 MPH), AND THEN KEYING DOWN.

C1648S



DTC 55
EBCM MALFUNCTION

Circuit Description:

This DTC identifies an internal malfunction detected by the EBCM ABS motor driver interface, (MDI) custom integrated circuit (IC). It also ensures the cause of the Malfunction is not the result of a problem with the ABS relay under a DTC malfunction.

Action Taken:

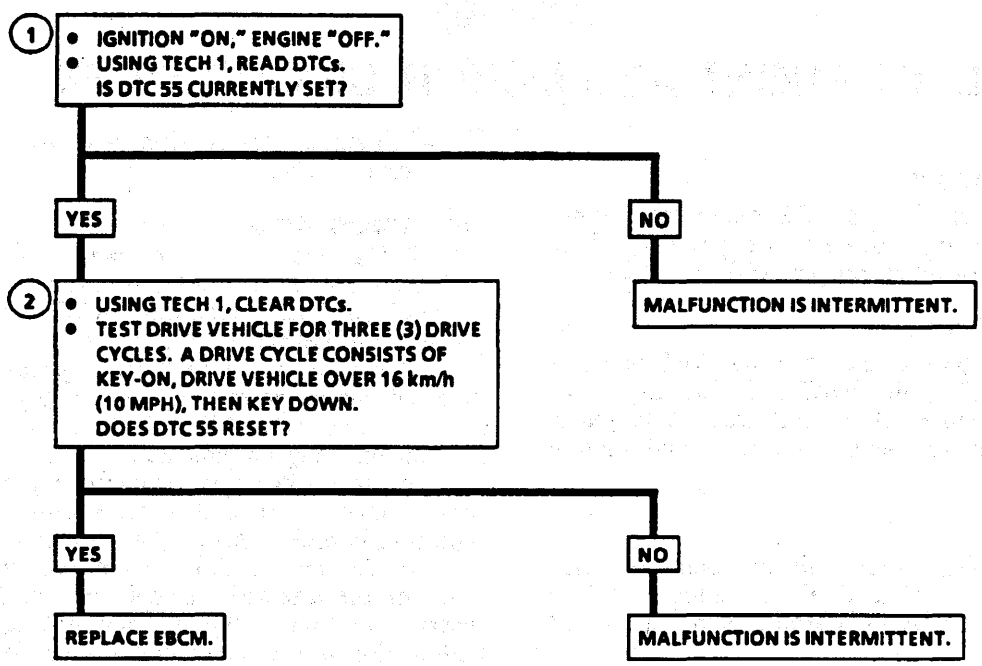
A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

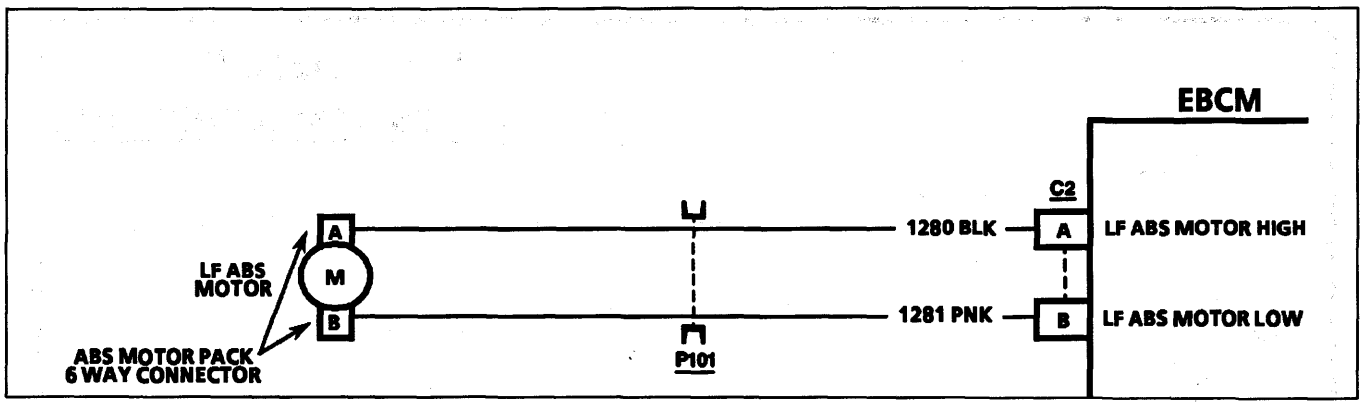
Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks to see if the malfunction is still present.
2. Checks to see if the malfunction is intermittent.

DTC 55
EBCM MALFUNCTION



C1649S



DTC 56
LEFT FRONT ABS MOTOR CIRCUIT OPEN

Circuit Description:

This DTC identifies an ABS motor that cannot be energized due to an open in its circuitry. This malfunction will not allow proper ABS operation.

DTC Will Set When:

DTC 56 can be set only when the ABS motor is commanded "OFF." If the EBCM detects an out of range voltage on either of the left front ABS motor circuits indicating an open circuit, a malfunction exists.

Action Taken:

An open ABS motor will not activate when requested. A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1 Checks for proper resistance of the ABS motor.

2 Checks for an open in the ABS motor "HIGH" circuitry.

3 Checks for an open in the ABS motor "LOW" circuitry.

4 Ensures malfunction was not due to poor terminal contact.

Diagnostic Aids:

Using Tech 1, select manual control function, and exercise ABS motor movement of affected channel in both directions while applying light pressure on the brake pedal.

If erratic or "jumpy" brake pedal movement is detected while performing an "apply" or "release" function of the ABS motor, an intermittent malfunction may be indicated.

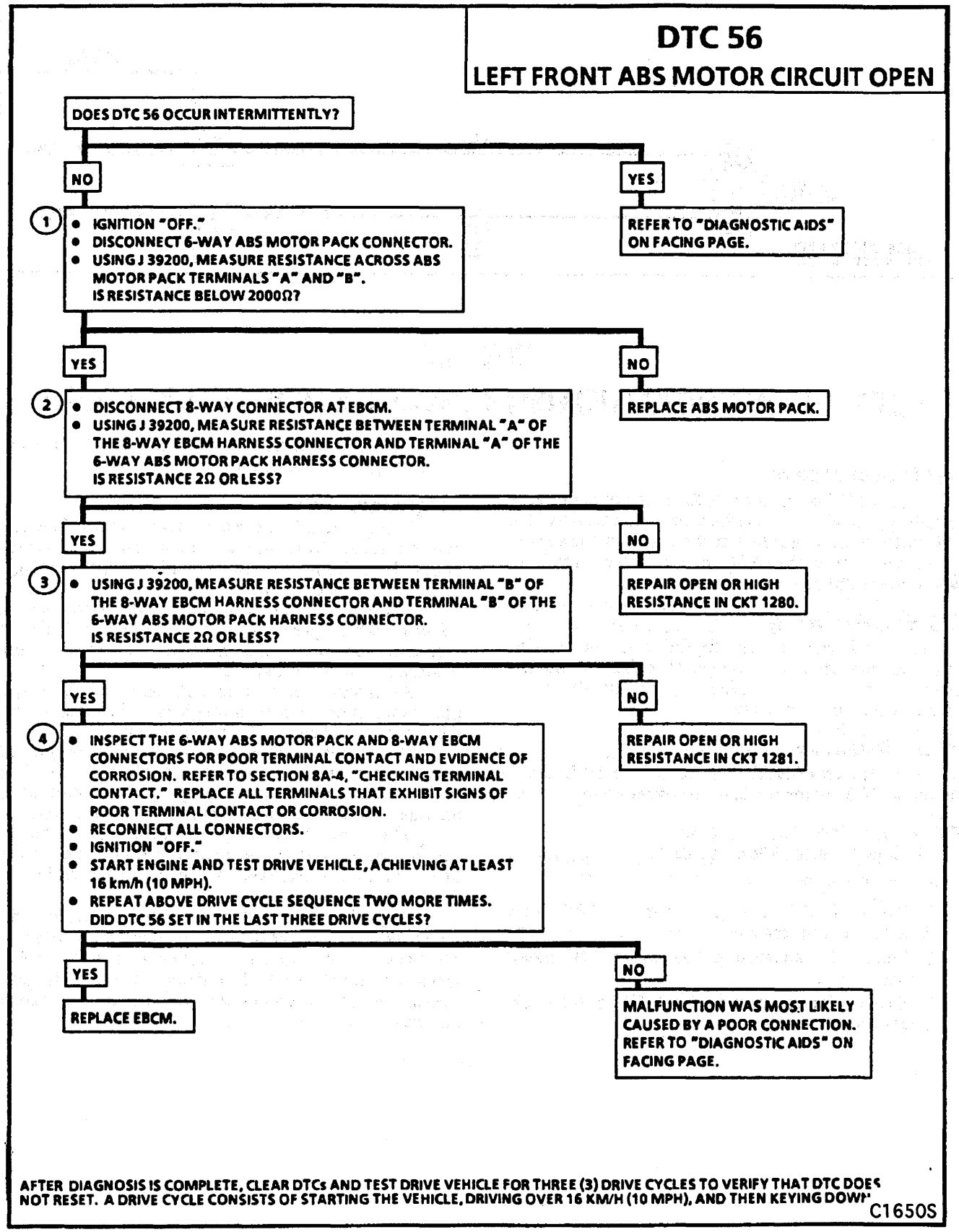
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

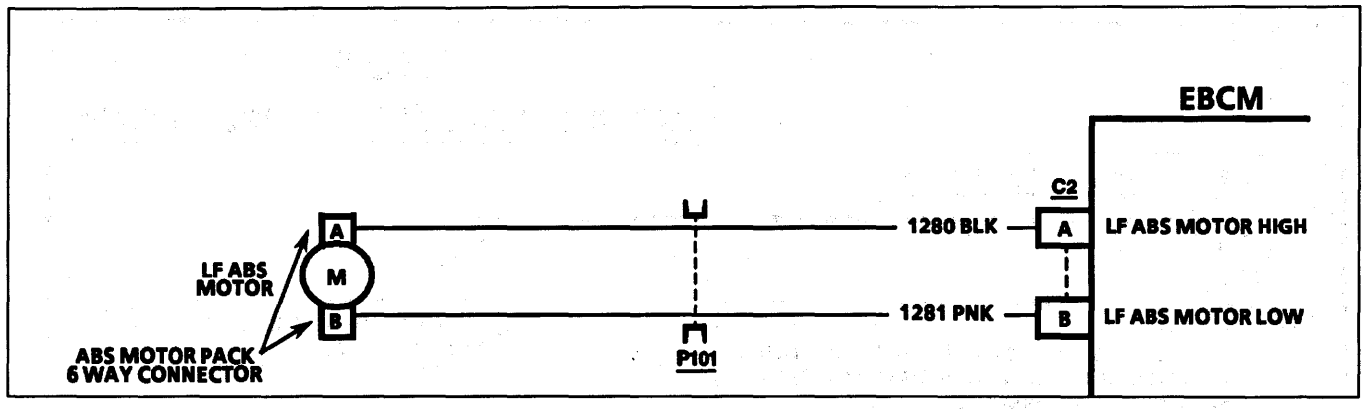
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 56
LEFT FRONT ABS MOTOR CIRCUIT OPEN



AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 KM/H (10 MPH), AND THEN KEYING DOWN

C1650S



DTC 57
LEFT FRONT ABS MOTOR CIRCUIT SHORTED TO GND

Circuit Description:

This DTC identifies an ABS motor circuit that is shorted to ground. This malfunction will not allow the ABS motor to be controlled at the commanded current rate or will cause the ABS motor driver circuit to allow current directly to ground.

DTC Will Set When:

DTC 57 can be set anytime. If the EBCM detects an out of range voltage on either of the left front ABS motor circuits indicating a circuit shorted to ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to ground in the ABS motor "HIGH" circuitry.
2. Checks for a short to ground in the ABS motor "LOW" circuitry.
3. Checks for an ABS motor that is internally shorted to ground.
4. Ensures malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

Using Tech 1, select manual control function, and exercise ABS motor movement of affected channel in both directions while applying light pressure on the brake pedal.

If erratic or "jumpy" brake pedal movement is detected while performing an "apply" or "release" function of the ABS motor, an intermittent malfunction may be indicated.

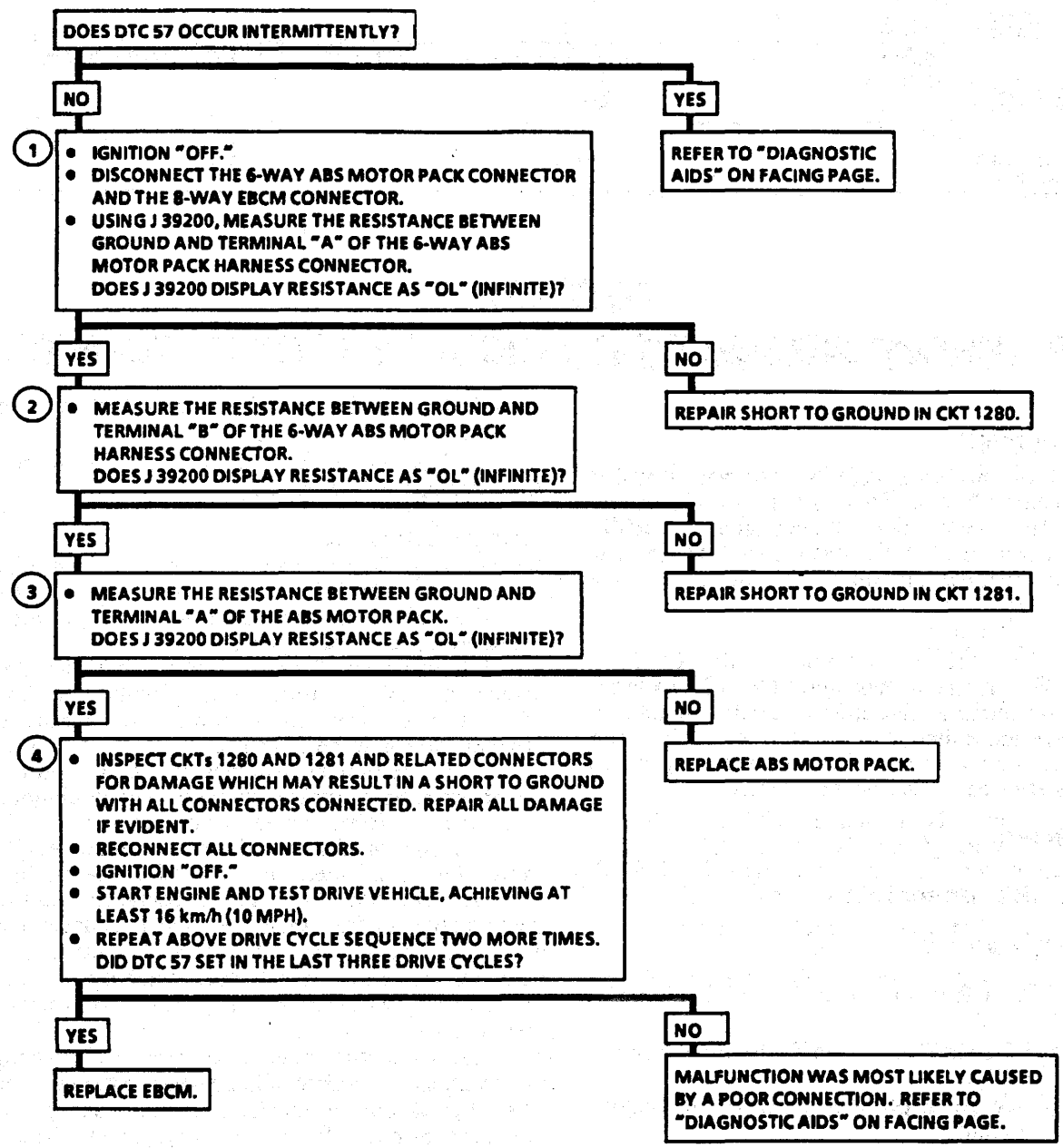
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

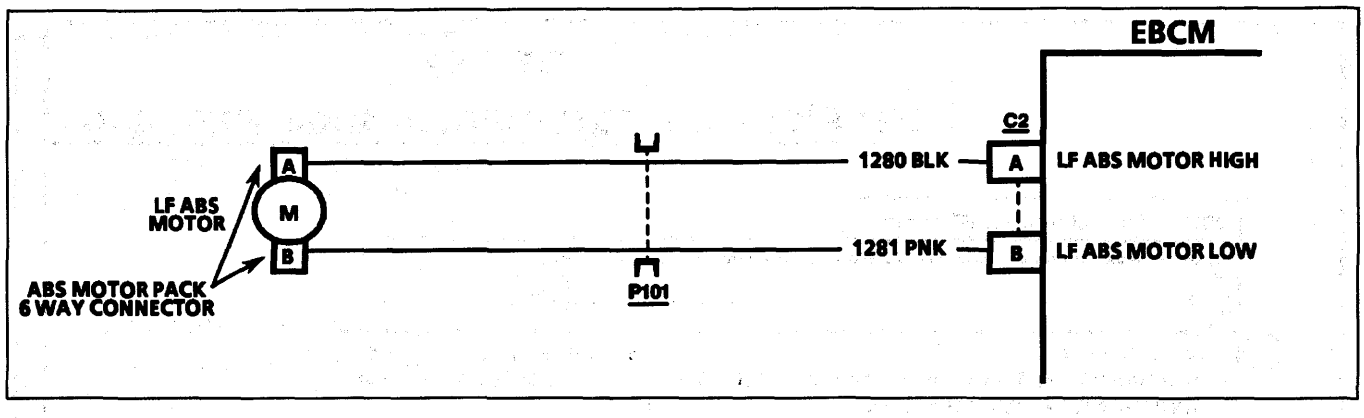
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 57
LEFT FRONT ABS MOTOR CIRCUIT SHORTED TO GND



AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN KEYING DOWN.

C1651S



DTC 58
LEFT FRONT ABS MOTOR CIRCUIT SHORTED TO BATT

Circuit Description:

This DTC identifies an ABS motor circuit that is shorted to battery or an ABS motor that has low or no resistance. This malfunction will not allow the ABS motor to be controlled at the commanded current rate or will cause the ABS motor to turn in the opposite direction, or not at all.

DTC Will Set When:

DTC 58 can be set only when the ABS motor is commanded "OFF." If the EBCM detects an out of range voltage on either of the left front ABS motor circuits indicating a circuit shorted to battery or an ABS motor shorted, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to voltage in the ABS motor "HIGH" circuitry.
2. Checks for a short to voltage in the ABS motor "LOW" circuitry.
3. Checks for a short between the "HIGH" and "LOW" motor circuits.
4. Checks for an ABS motor that is internally shorted.
5. Ensures malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

Using Tech 1, select manual control function, and exercise ABS motor movement of affected channel in both directions while applying light pressure on the brake pedal.

If erratic or "jumpy" brake pedal movement is detected while performing an "apply" or "release" function of the ABS motor, an intermittent malfunction may be indicated.

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

DTC 58

LEFT FRONT ABS MOTOR CIRCUIT SHORTED TO BATT

DOES DTC 58 OCCUR INTERMITTENTLY?

- NO
- YES → REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

1. • IGNITION "OFF."
   • DISCONNECT THE 6-WAY ABS MOTOR PACK CONNECTOR AND THE 8-WAY EBCM CONNECTOR.
   • IGNITION "ON."
   • USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.
   IS VOLTAGE 1 VOLT OR LESS?
   - YES
   - NO → REPAIR SHORT TO VOLTAGE IN CKT 1280.

2. • MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.
   IS VOLTAGE 1 VOLT OR LESS?
   - YES
   - NO → REPAIR SHORT TO VOLTAGE IN CKT 1281.

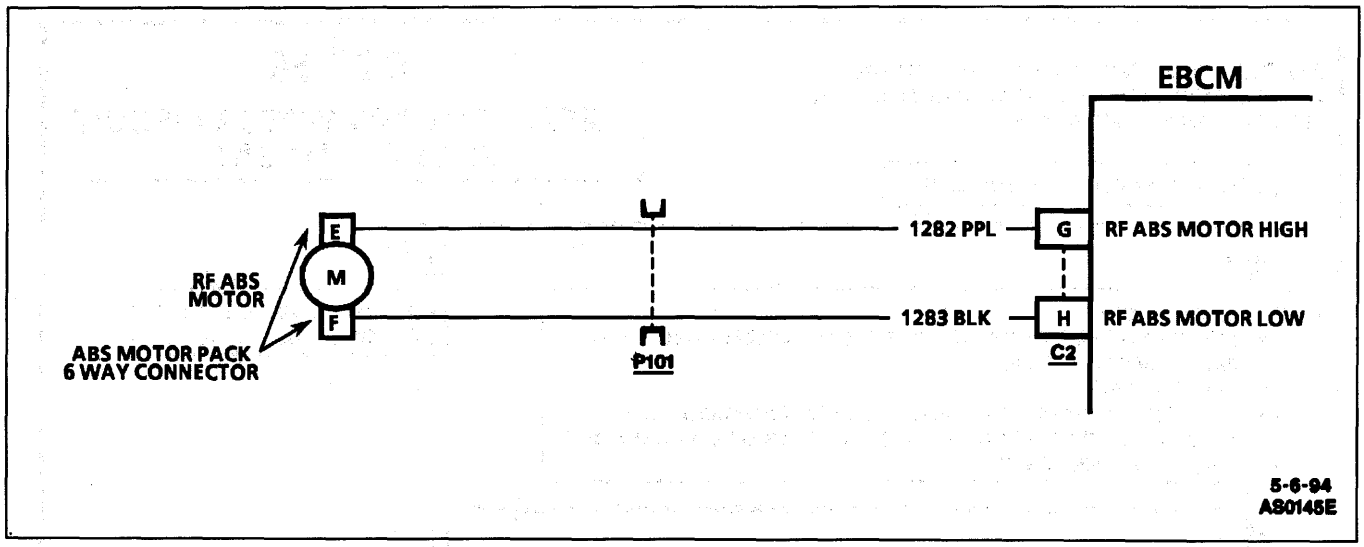
3. • IGNITION "OFF."
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
   - YES
   - NO → REPAIR SHORT BETWEEN CKTs 1280 AND 1281.

4. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE ABS MOTOR PACK.
   IS RESISTANCE GREATER THAN 0.4Ω?
   - YES
   - NO → REPLACE ABS MOTOR PACK.

5. • INSPECT CKTs 1280 AND 1281 AND RELATED CONNECTORS FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
   • RECONNECT ALL CONNECTORS.
   • IGNITION "OFF."
   • START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
   • REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
   DID DTC 58 SET IN THE LAST THREE DRIVE CYCLES?
   - YES → REPLACE EBCM.
   - NO → MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 KM/H (10 MPH), AND THEN KEYING DOWN.

C1652S



DTC 61
RIGHT FRONT ABS MOTOR CIRCUIT OPEN

Circuit Description:

This DTC identifies an ABS motor that cannot be energized due to an open in its circuitry. This malfunction will not allow proper ABS operation.

DTC Will Set When:

DTC 61 can be set only when the ABS motor is commanded "OFF." If the EBCM detects an out of range voltage on either of the right front ABS motor circuits indicating an open circuit, a malfunction exists.

Action Taken:

An open ABS motor will not activate when requested. A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1 Checks for proper resistance of the ABS motor.

2 Checks for an open in the ABS motor "HIGH" circuitry.

3 Checks for an open in the ABS motor "LOW" circuitry.

4 Ensures malfunction was not due to poor terminal contact.

Diagnostic Aids:

Using Tech 1, select manual control function, and exercise ABS motor movement of affected channel in both directions while applying light pressure on the brake pedal.

If erratic or "jumpy" brake pedal movement is detected while performing an "apply" or "release" function of the ABS motor, an intermittent malfunction may be indicated.

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 61
RIGHT FRONT ABS MOTOR CIRCUIT OPEN

DOES DTC 61 OCCUR INTERMITTENTLY?

YES → REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO

1. • IGNITION "OFF."
   • DISCONNECT 6-WAY ABS MOTOR PACK CONNECTOR.
   • USING J 39200, MEASURE RESISTANCE ACROSS ABS MOTOR PACK TERMINALS "E" AND "F".
   IS RESISTANCE BELOW 2000Ω?

YES

2. • DISCONNECT 8-WAY CONNECTOR AT EBCM.
   • USING J 39200, MEASURE RESISTANCE BETWEEN TERMINAL "G" OF THE 8-WAY EBCM HARNESS CONNECTOR AND TERMINAL "E" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?

YES

3. • USING J 39200, MEASURE RESISTANCE BETWEEN TERMINAL "H" OF THE 8-WAY EBCM HARNESS CONNECTOR AND TERMINAL "F" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?

YES

4. • INSPECT THE 6-WAY ABS MOTOR PACK AND 8-WAY EBCM CONNECTORS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.
   • RECONNECT ALL CONNECTORS.
   • IGNITION "OFF."
   • START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
   • REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
   DID DTC 61 SET IN THE LAST THREE DRIVE CYCLES?

YES → REPLACE EBCM.

NO → MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

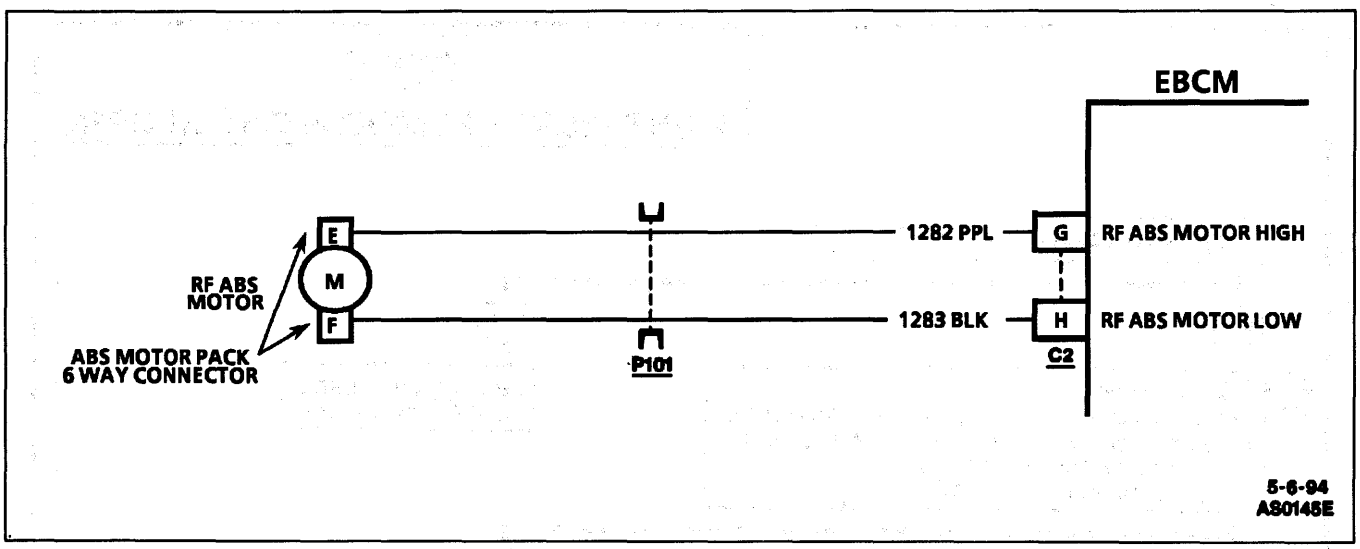
NO → REPLACE ABS MOTOR PACK.

NO → REPAIR OPEN OR HIGH RESISTANCE IN CKT 1282.

NO → REPAIR OPEN OR HIGH RESISTANCE IN CKT 1283.

AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN KEYING DOWN.

C1653S



DTC 62
RIGHT FRONT ABS MOTOR CIRCUIT SHORTED TO GND

Circuit Description:

This DTC identifies an ABS motor circuit that is shorted to ground. This malfunction will not allow the ABS motor to be controlled at the commanded current rate or will cause the ABS motor driver circuit to allow current directly to ground.

DTC Will Set When:

DTC 62 can be set anytime. If the EBCM detects an out of range voltage on either of the right front ABS motor circuits indicating a circuit shorted to ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to ground in the ABS motor "HIGH" circuitry.
2. Checks for a short to ground in the ABS motor "LOW" circuitry.
3. Checks for an ABS motor that is internally shorted to ground.
4. Ensures malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

Using Tech 1, select manual control function, and exercise ABS motor movement of affected channel in both directions while applying light pressure on the brake pedal.

If erratic or "jumpy" brake pedal movement is detected while performing an "apply" or "release" function of the ABS motor, an intermittent malfunction may be indicated.

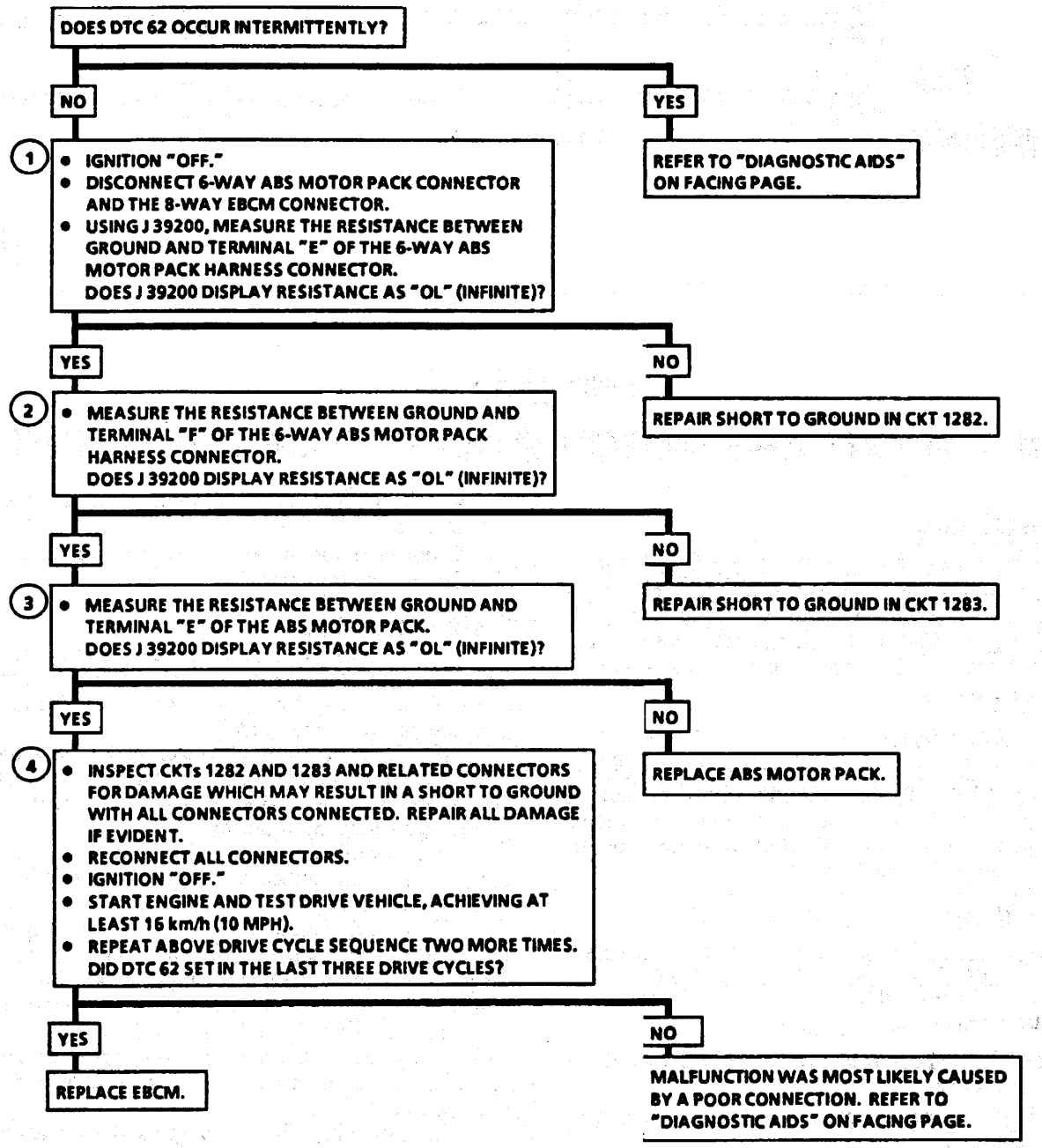
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

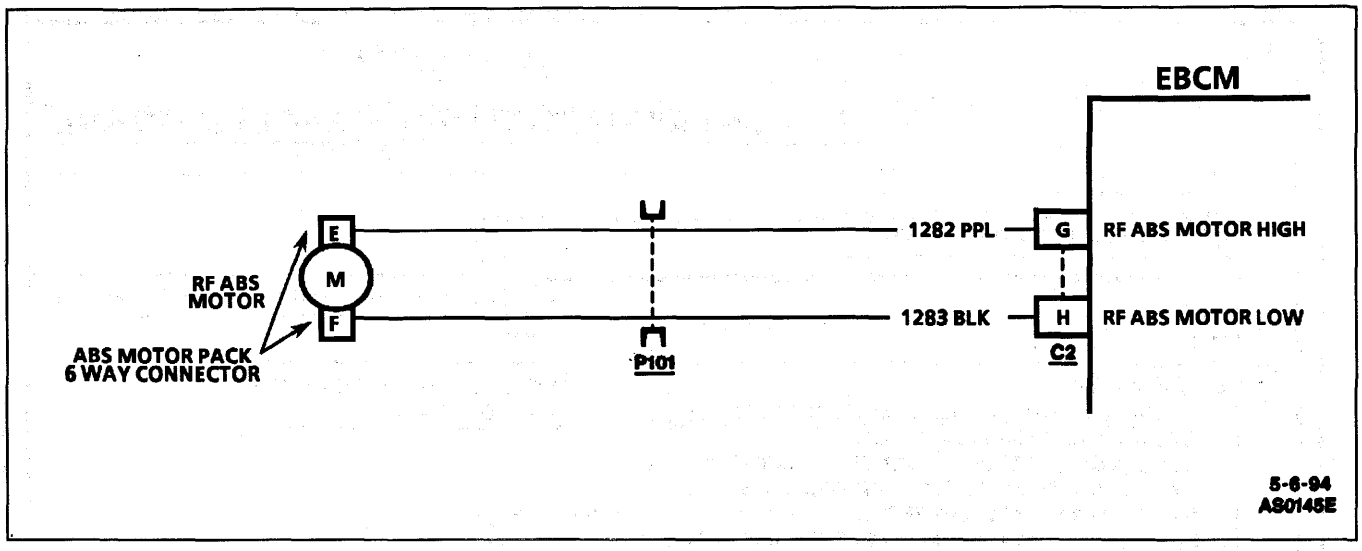
Any circuitry, that is suspected as causing the intermittent complaint, should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 62
RIGHT FRONT ABS MOTOR CIRCUIT SHORTED TO GND



AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN KEYING DOWN.

C1654S



DTC 63
RIGHT FRONT ABS MOTOR CIRCUIT SHORTED TO BATT

Circuit Description:

This DTC identifies an ABS motor circuit that is shorted to battery or an ABS motor that has low or no resistance. This malfunction will not allow the ABS motor to be controlled at the commanded current rate or will cause the ABS motor to turn in the opposite direction, or not at all.

DTC Will Set When:

DTC 63 can be set only when the ABS motor is commanded "OFF." If the EBCM detects an out of range voltage on either of the right front ABS motor circuits indicating a circuit shorted to battery or an ABS motor shorted, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to voltage in the ABS motor "HIGH" circuitry.
2. Checks for a short to voltage in the ABS motor "LOW" circuitry.
3. Checks for short circuit between ABS motor "HIGH" and motor "LOW".
4. Checks for an ABS motor that is internally shorted.
5. Ensures malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

Using Tech 1, select manual control function, and exercise ABS motor movement of affected channel in both directions while applying light pressure on the brake pedal.

If erratic or "jumpy" brake pedal movement is detected while performing an "apply" or "release" function of the ABS motor, an intermittent malfunction may be indicated.

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

DTC 63
RIGHT FRONT MOTOR CIRCUIT SHORTED TO BATT

DOES DTC 63 OCCUR INTERMITTENTLY?

NO

YES

REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

(1)
- IGNITION "OFF."
- DISCONNECT THE 6-WAY ABS MOTOR PACK CONNECTOR AND THE 8-WAY EBCM CONNECTOR.
- IGNITION "ON."
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "E" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

YES

NO

REPAIR SHORT TO VOLTAGE IN CKT 1282.

(2)
- MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "F" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

YES

NO

REPAIR SHORT TO VOLTAGE IN CKT 1283.

(3)
- IGNITION "OFF."
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "E" AND TERMINAL "F" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

NO

REPAIR SHORT BETWEEN CKTs 1282 AND 1283.

(4)
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "E" AND TERMINAL "F" OF THE ABS MOTOR PACK.

IS RESISTANCE GREATER THAN 0.4Ω?

YES

NO

REPLACE ABS MOTOR PACK.

(5)
- INSPECT CKTs 1282 AND 1283 AND RELATED CONNECTORS FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- IGNITION "OFF."
- START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
- REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.

DID DTC 63 SET IN THE LAST THREE DRIVE CYCLES?

YES

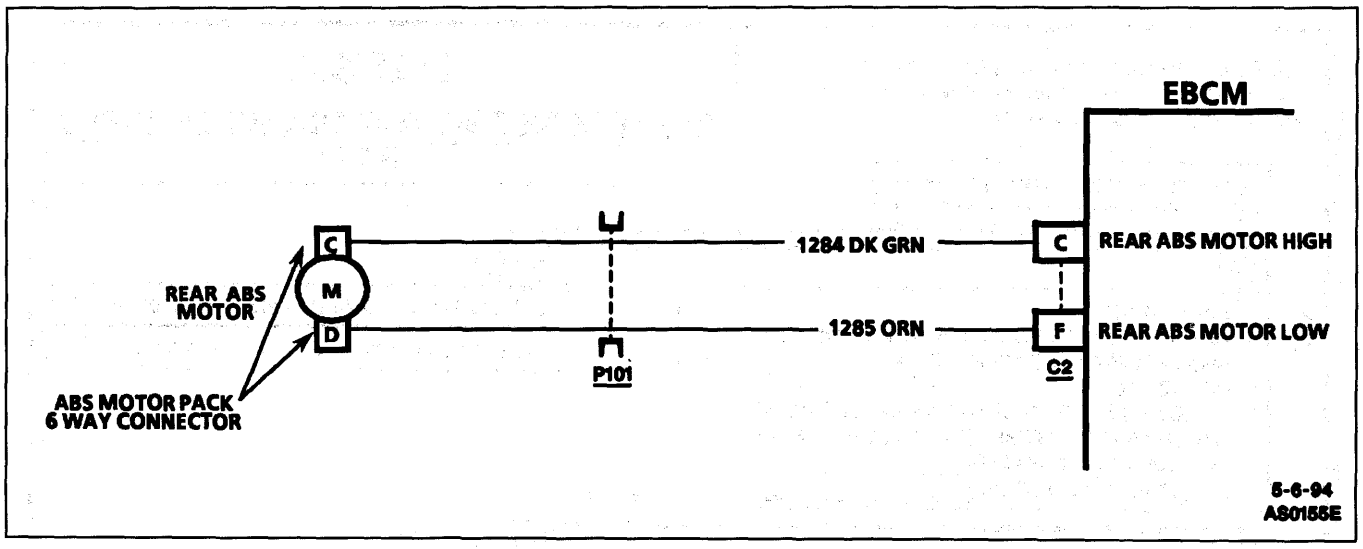
REPLACE EBCM.

NO

MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 KM/H (10 MPH), AND THEN KEYING DOWN

6-24-93 C1655S



DTC 64
REAR ABS MOTOR CIRCUIT OPEN

Circuit Description:

This DTC identifies an ABS motor that cannot be energized due to an open in its circuitry. This malfunction will not allow proper ABS operation.

DTC Will Set When:

DTC 64 can be set only when the ABS motor is commanded "OFF." If the EBCM detects an out of range voltage on either of the rear axle ABS motor circuits indicating an open circuit, a malfunction exists.

Action Taken:

An open ABS motor will not activate when requested. A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This checks for proper resistance of the ABS motor.
2. Checks for an open in the ABS motor "HIGH" circuitry.
3. Checks for an open in the ABS motor "LOW" circuitry.
4. Ensures malfunction was not due to poor terminal contact.

Diagnostic Aids:

Using Tech 1, select manual control function, and exercise ABS motor movement of affected channel in both directions while applying light pressure on the brake pedal.

If erratic or "jumpy" brake pedal movement is detected while performing an "apply" or "release" function of the ABS motor, an intermittent malfunction may be indicated.

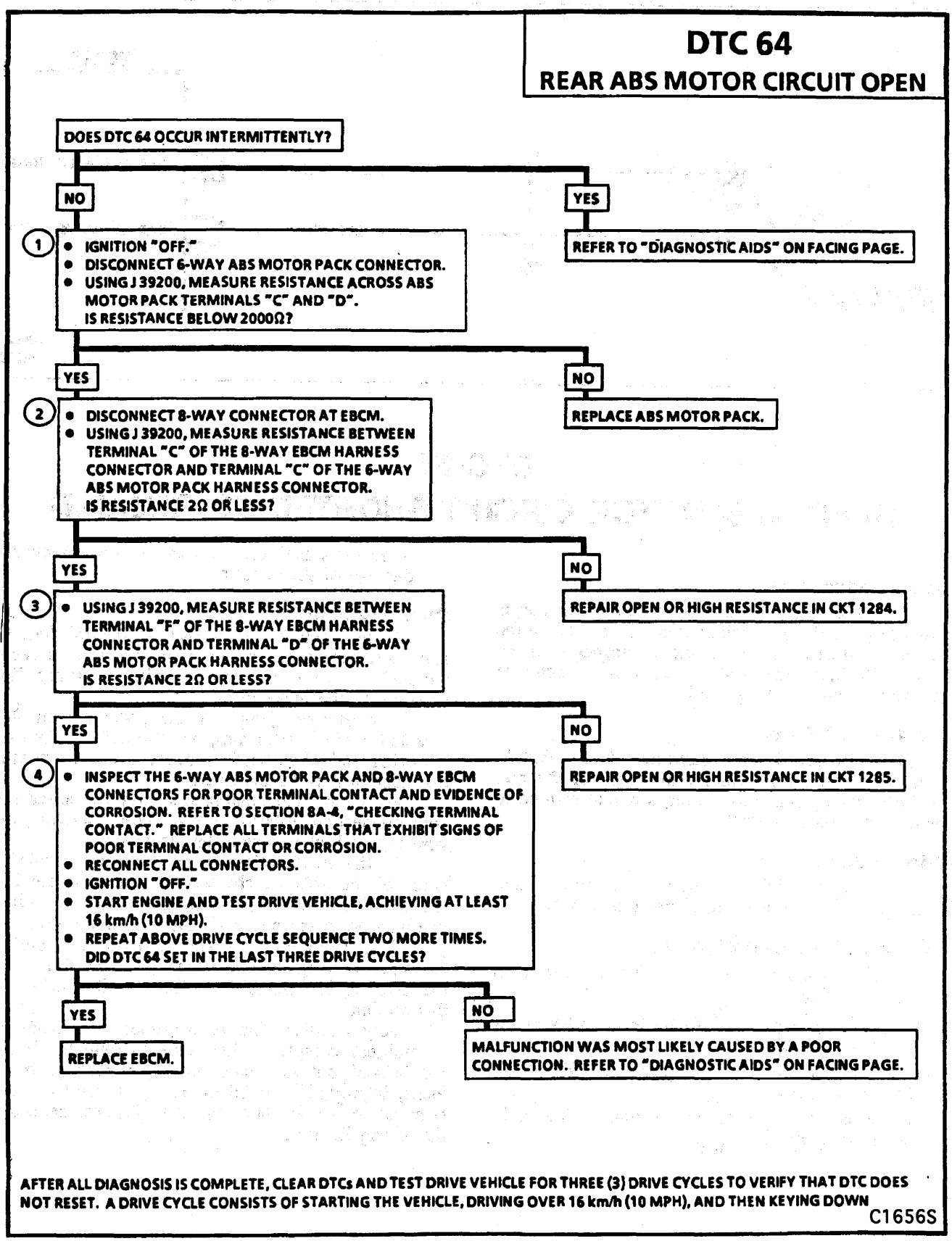
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

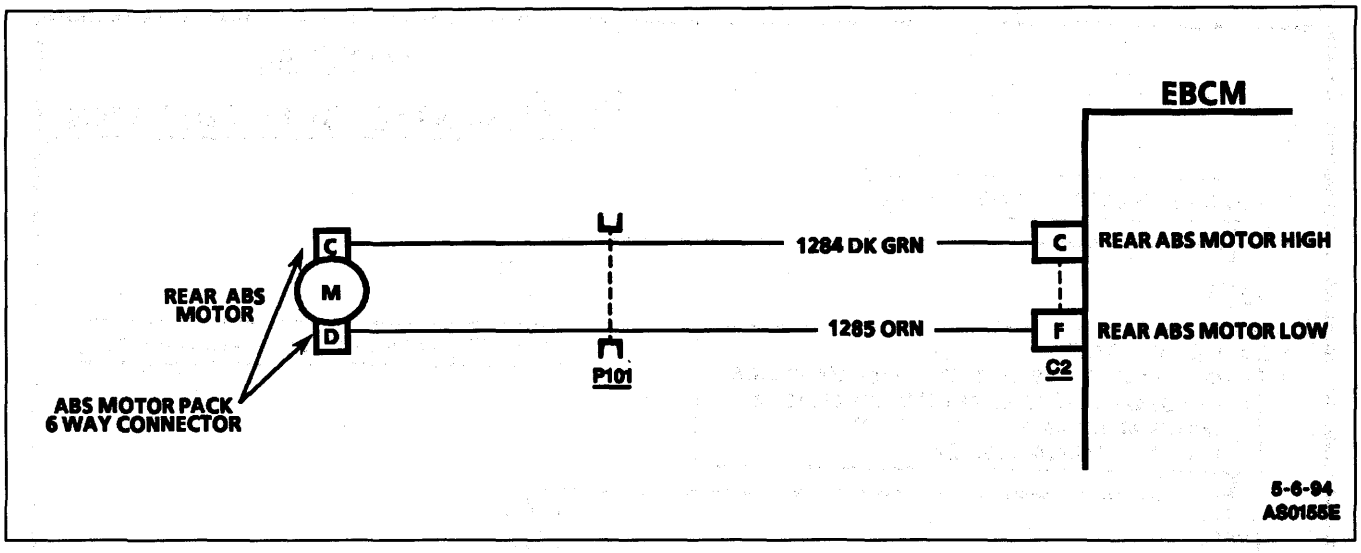
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 64
REAR ABS MOTOR CIRCUIT OPEN



AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN KEYING DOWN

C1656S



DTC 65
REAR ABS MOTOR CIRCUIT SHORTED TO GROUND

Circuit Description:

This DTC identifies an ABS motor circuit that is shorted to ground. This malfunction will not allow the ABS motor to be controlled at the commanded current rate or will cause the ABS motor driver circuit to allow current directly to ground.

DTC Will Set When:

DTC 65 can be set anytime. If the EBCM detects an out of range voltage on either of the rear axle ABS motor circuits indicating a circuit shorted to ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS are disabled. The amber ABS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to ground in the ABS motor "HIGH" circuitry.
2. Checks for a short to ground in the ABS motor "LOW" circuitry.
3. Checks for an ABS motor that is internally shorted to ground.
4. Ensures malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

Using Tech 1, select manual control function, and exercise ABS motor movement of affected channel in both directions while applying light pressure on the brake pedal.

If erratic or "jumpy" brake pedal movement is detected while performing an "apply" or "release" function of the ABS motor, an intermittent malfunction may be indicated.

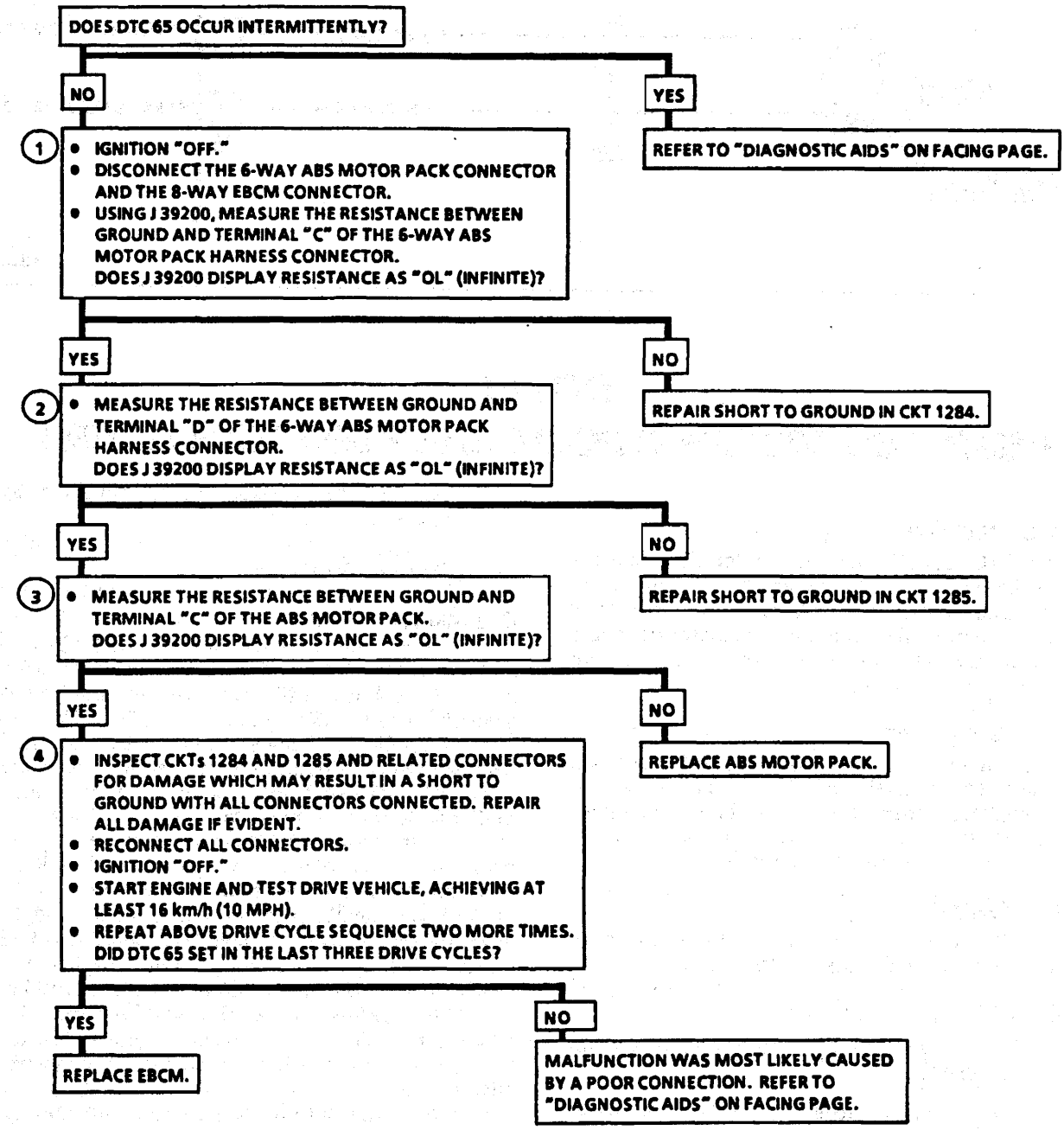
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

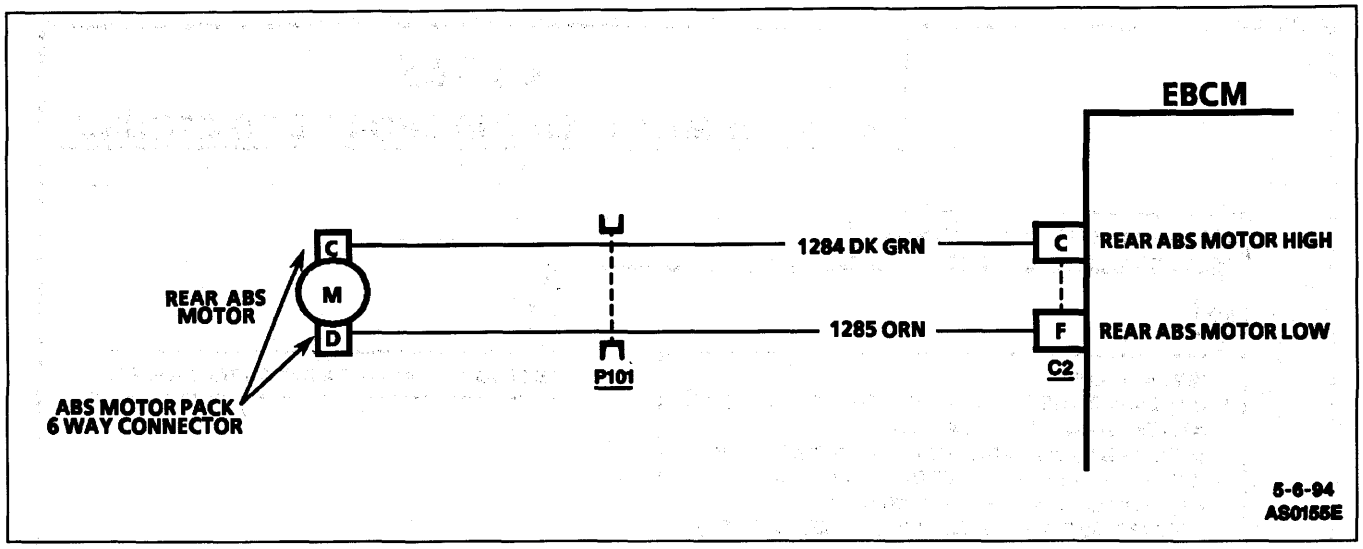
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 65
REAR ABS MOTOR CIRCUIT SHORTED TO GROUND



AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN KEYING DOWN.

C1657S



DTC 66
REAR ABS MOTOR CIRCUIT SHORTED TO BATTERY

Circuit Description:

This DTC identifies an ABS motor circuit that is shorted to battery or an ABS motor that has low or no resistance. This malfunction will not allow the ABS motor to be controlled at the commanded current rate or will cause the ABS motor to turn in the opposite direction, or not turn at all.

DTC Will Set When:

DTC 66 can be set only when the ABS motor is commanded "OFF." If the EBCM detects an out of range voltage on either of the rear ABS axle motor circuits indicating a circuit shorted to battery or an ABS motor shorted, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to voltage in the ABS motor "HIGH" circuitry.
2. Checks for a short to voltage in the ABS motor "LOW" circuitry.
3. Checks for a short circuit between motor "HIGH" and motor "LOW".
4. Checks for an ABS motor that is internally shorted.
5. Ensures malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

Using Tech 1, select manual control function, and exercise ABS motor movement of affected channel in both directions while applying light pressure on the brake pedal.

If erratic or "jumpy" brake pedal movement is detected while performing an "apply" or "release" function of the ABS motor, an intermittent malfunction may be indicated.

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 65
REAR ABS MOTOR CIRCUIT SHORTED TO BATTERY

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

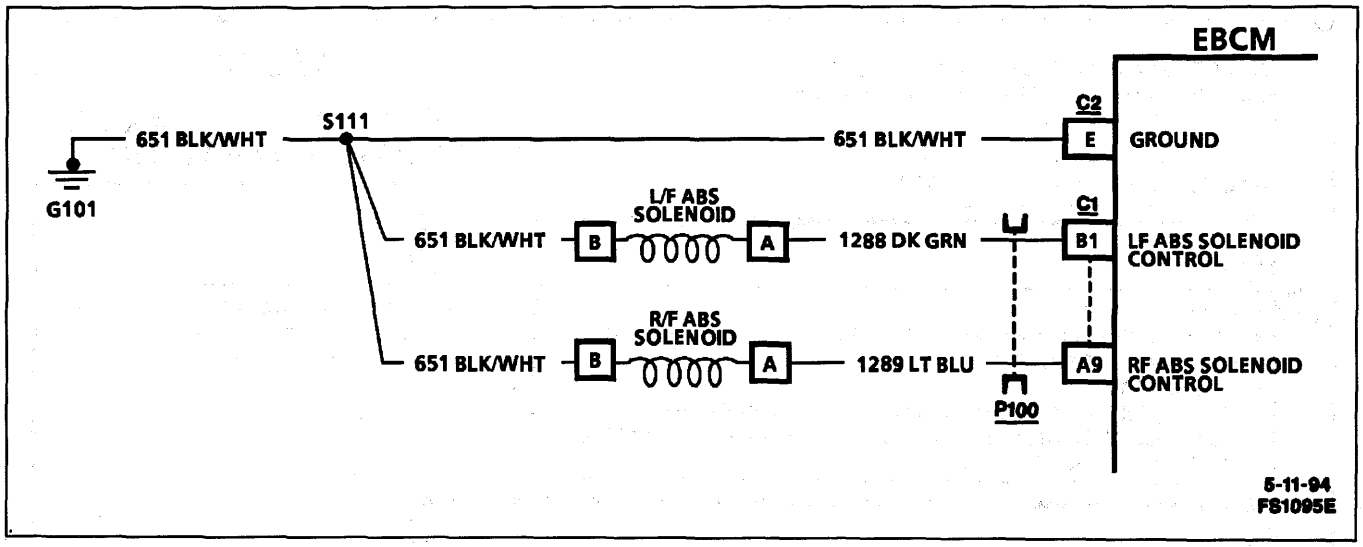
DOES DTC 66 OCCUR INTERMITTENTLY?

- YES → REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
- NO →

1. • IGNITION "OFF."
   • DISCONNECT THE 6-WAY ABS MOTOR PACK CONNECTOR AND THE 8-WAY EBCM CONNECTOR.
   • IGNITION "ON."
   • USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "C" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR. IS VOLTAGE 1 VOLT OR LESS?
   - NO → REPAIR SHORT TO VOLTAGE IN CKT 1284.
   - YES →
2. • MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "D" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR. IS VOLTAGE 1 VOLT OR LESS?
   - NO → REPAIR SHORT TO VOLTAGE IN CKT 1285.
   - YES →
3. • IGNITION "OFF."
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C" AND TERMINAL "D" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR. DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
   - NO → REPAIR SHORT BETWEEN CKTs 1284 AND 1285.
   - YES →
4. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C" AND TERMINAL "D" OF THE ABS MOTOR PACK. IS RESISTANCE GREATER THAN 0.4Ω?
   - NO → REPLACE ABS MOTOR PACK
   - YES →
5. • INSPECT CKTs 1284 AND 1285 AND RELATED CONNECTORS FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
   • RECONNECT ALL CONNECTORS.
   • IGNITION "OFF."
   • START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
   • REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES. DID DTC 66 SET IN THE LAST THREE DRIVE CYCLES?
   - NO → MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - YES → REPLACE EBCM.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 KM/H (10 MPH), AND THEN KEYING DOWN.

C1658S



DTC 76
LEFT FRONT SOL CIRCUIT OPEN OR SHORTED TO BATT

Circuit Description:

This DTC identifies a solenoid that cannot be energized due to an open in its circuitry, or a solenoid that is always energized due to a short to battery in its circuitry between the driver and the solenoid. An open will not allow proper ABS operation, but the short to battery simply turns "ON" the solenoid. A path for base brakes is still allowed once the motor re-homes and the check ball is lifted off its seat during key "ON" initialization.

DTC Will Set When:

DTC 76 can be set only when the solenoid is commanded "OFF." If the EBCM detects an excessive voltage in the left front solenoid control circuit, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to voltage in the control circuitry of the solenoid.
2. Checks for an open in the control circuit of the solenoid.
3. Checks the solenoid coil for proper resistance.
4. Checks for an open in the solenoid ground circuit.
5. Checks for a possible intermittent malfunction in the solenoid circuitry due to poor terminal contact.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 76
LEFT FRONT SOL CIRCUIT OPEN OR SHORTED TO BATT

1. • IGNITION "OFF."
   • DISCONNECT 32-WAY EBCM CONNECTOR.
   • IGNITION "ON," ENGINE "OFF."
   • USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B1" OF THE 32-WAY EBCM HARNESS CONNECTOR.
   IS VOLTAGE 1 VOLT OR LESS?
   - YES
   - NO → REPAIR SHORT TO VOLTAGE IN CKT 1288.

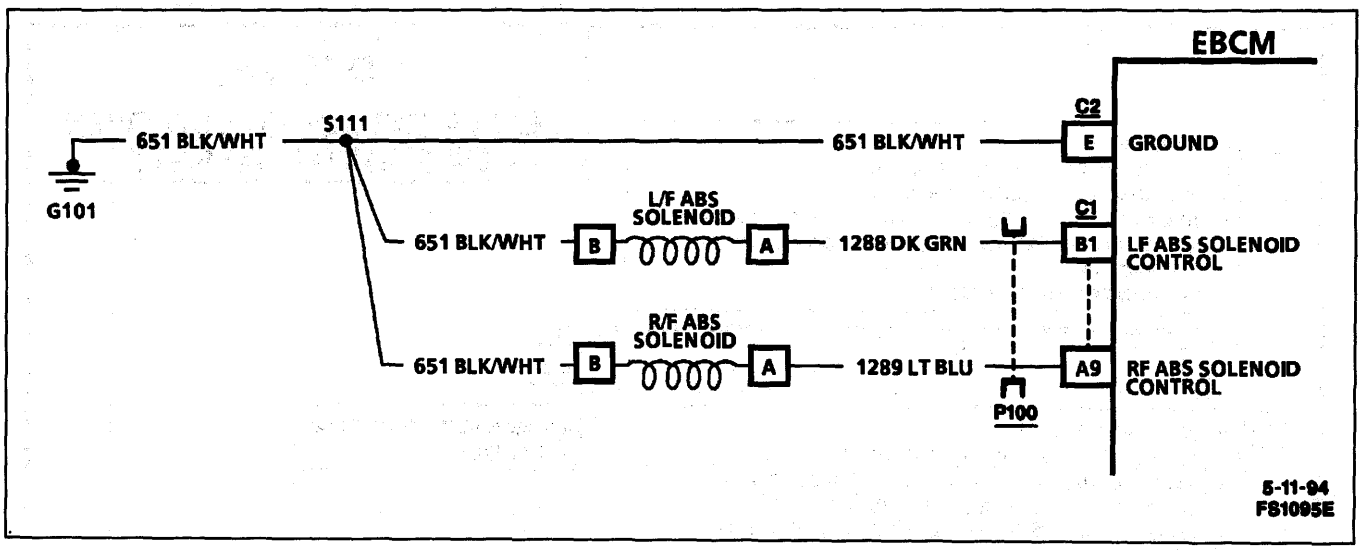
2. • IGNITION "OFF."
   • DISCONNECT LEFT FRONT SOLENOID CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "B1" OF THE 32-WAY EBCM HARNESS CONNECTOR AND TERMINAL "A" OF THE LEFT FRONT SOLENOID HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?
   - YES
   - NO → REPAIR OPEN OR HIGH RESISTANCE IN CKT 1288.

3. • MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE LEFT FRONT SOLENOID.
   IS RESISTANCE BETWEEN 2.5 AND 5Ω?
   - YES
   - NO → REPLACE LEFT FRONT SOLENOID.

4. • MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "B" OF THE LEFT FRONT SOLENOID HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?
   - YES
   - NO → REPAIR OPEN OR HIGH RESISTANCE IN CKT 651.

5. • INSPECT LEFT FRONT SOLENOID AND 32-WAY EBCM HARNESS CONNECTORS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.
   • INSPECT CKT 1288 FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WITH ALL CONNECTORS CONNECTED. REPAIR DAMAGE IF EVIDENT.
   • RECONNECT ALL CONNECTORS.
   • IGNITION "ON."
   DOES DTC 76 SET AS A CURRENT DTC?
   - YES → REPLACE EBCM.
   - NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

C1659S



DTC 77
LEFT FRONT SOLENOID CIRCUIT SHORTED TO GND

Circuit Description:

This DTC identifies a solenoid that cannot be energized due to an open in its driver circuitry, or a short to ground between the solenoid driver and the solenoid. These malfunctions can affect ABS operation since the flow of brake fluid to the wheel cylinder cannot be stopped, making ABS operation for that channel impossible.

DTC Will Set When:

DTC 77 can be set only when the solenoid is commanded "ON." If the EBCM detects the left front solenoid control circuit voltage is out of specification, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a solenoid that is internally shorted to ground.
2. Checks for a solenoid that is not within proper resistance values.
3. Indicates if a short to ground exists in the solenoid circuitry.
4. Checks for a possible intermittent malfunction in the solenoid circuitry due to poor terminal contact.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 77

LEFT FRONT SOLENOID CIRCUIT SHORTED TO GND

1
- IGNITION "OFF."
- DISCONNECT LEFT FRONT SOLENOID CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A" OF THE LEFT FRONT SOLENOID.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

2
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE LEFT FRONT SOLENOID.

IS RESISTANCE BETWEEN 2.5 AND 5.0 Ω?

YES

3
- DISCONNECT 32-WAY EBCM CONNECTOR.
- MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "B1" OF THE 32-WAY EBCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

4
- INSPECT CKT 1288 AND THE LEFT FRONT SOLENOID AND 32-WAY EBCM HARNESS CONNECTORS FOR DAMAGE WHICH MAY RESULT IN A SHORT TO GROUND WITH ALL CONNECTORS CONNECTED. REPAIR DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- START ENGINE WITH FOOT OFF BRAKE.
- ALLOW ENGINE TO RUN FOR AT LEAST 10 SECONDS.

DOES DTC 77 SET AS A CURRENT DTC?

YES

REPLACE EBCM.

NO

MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO

REPAIR SHORT TO GROUND IN CKT 1288.

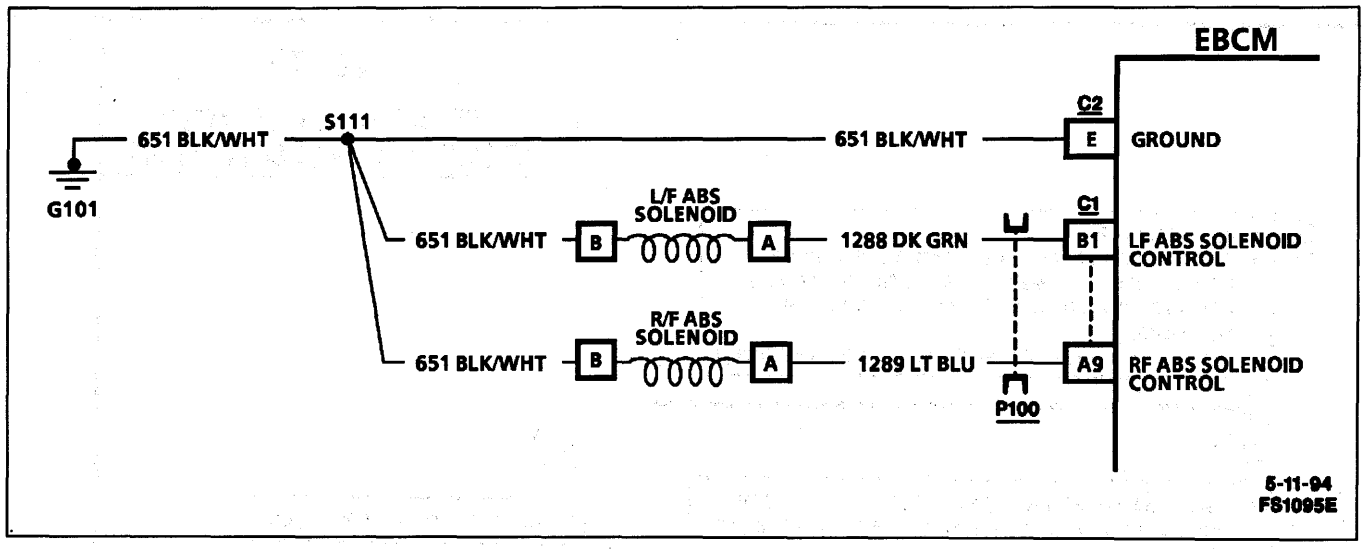
NO

REPLACE LEFT FRONT SOLENOID.

NO

REPLACE LEFT FRONT SOLENOID.

C1660S



DTC 78
RIGHT FRONT SOL CIRCUIT OPEN OR SHORTED TO BATT

Circuit Description:

This DTC identifies a solenoid that cannot be energized due to an open in its circuitry, or a solenoid that is always energized due to a short to battery in its circuitry between the driver and the solenoid. An open will not allow proper ABS operation, but the short to battery simply turns "ON" the solenoid. A path for base brakes is still allowed once the motor re-homes and the check ball is lifted off its seat during key "ON" initialization.

DTC Will Set When:

DTC 78 can be set only when the solenoid is commanded "OFF." If the EBCM detects an excessive voltage in the right front solenoid control circuit, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to voltage in the control circuitry of the solenoid.
2. Checks for an open in the control circuit of the solenoid.
3. Checks the solenoid coil for proper resistance.
4. Checks for an open in the solenoid ground circuit.
5. Checks for a possible intermittent malfunction in the solenoid circuitry due to poor terminal contact.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 78

RIGHT FRONT SOL CIRCUIT OPEN OR SHORTED TO BATT

1
- IGNITION "OFF."
- DISCONNECT 32-WAY EBCM CONNECTOR.
- IGNITION "ON," ENGINE "OFF."
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A9" OF THE 32-WAY EBCM HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

YES

2
- IGNITION "OFF."
- DISCONNECT RIGHT FRONT SOLENOID CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A9" OF THE 32-WAY EBCM HARNESS CONNECTOR AND TERMINAL "A" OF THE RIGHT FRONT SOLENOID HARNESS CONNECTOR.

IS RESISTANCE 2Ω OR LESS?

YES

3
- MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE RIGHT FRONT SOLENOID.

IS RESISTANCE BETWEEN 2.5 AND 5Ω?

YES

4
- MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "B" OF THE RIGHT FRONT SOLENOID HARNESS CONNECTOR.

IS RESISTANCE 2Ω OR LESS?

YES

5
- INSPECT RIGHT FRONT SOLENOID AND 32-WAY EBCM HARNESS CONNECTORS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.
- INSPECT CKT 1289 FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WITH ALL CONNECTORS CONNECTED. REPAIR DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- IGNITION "ON."

DOES DTC 78 SET AS A CURRENT DTC?

YES

REPLACE EBCM.

NO

MALFUNCTION IS MOST LIKELY DUE TO POOR TERMINAL CONTACT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO

REPAIR SHORT TO VOLTAGE IN CKT 1289.

NO

REPAIR OPEN OR HIGH RESISTANCE IN CKT 1289.

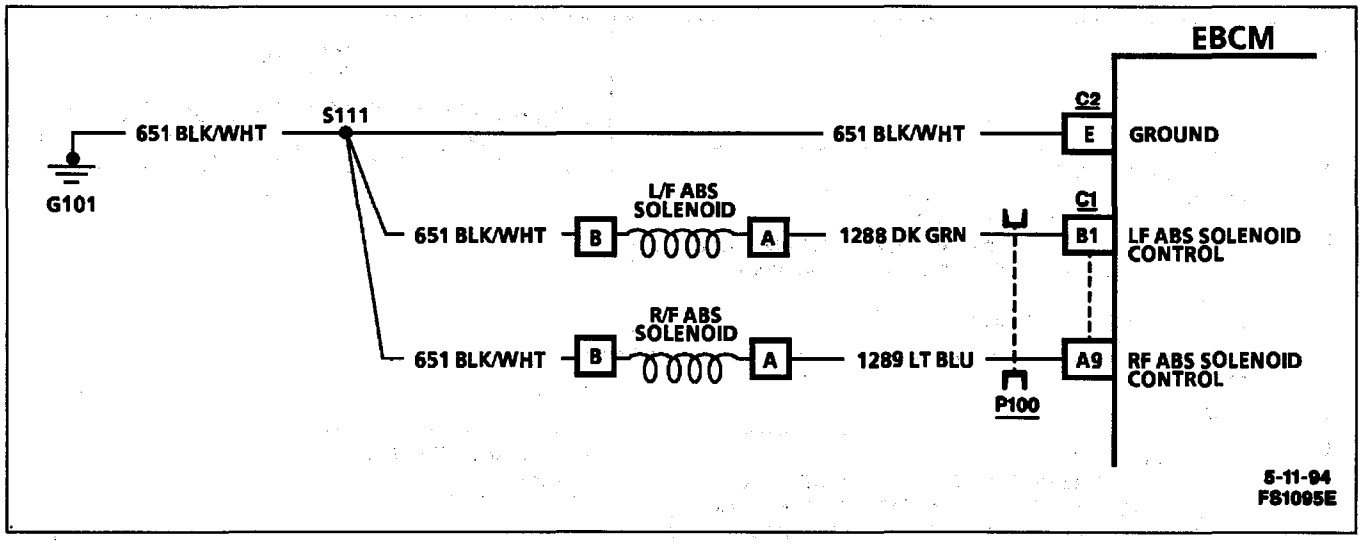
NO

REPLACE RIGHT FRONT SOLENOID.

NO

REPAIR OPEN OR HIGH RESISTANCE IN CKT 651.

C1661S



DTC 81
RIGHT FRONT SOLENOID CIRCUIT SHORTED TO GND

Circuit Description:

This DTC identifies a solenoid that cannot be energized due to an open in its driver circuitry, or a short to ground between the solenoid driver and the solenoid. These malfunctions can affect ABS operation since the flow of brake fluid to the wheel cylinder cannot be stopped, making ABS operation for that channel impossible.

DTC Will Set When:

DTC 81 can be set only when the solenoid is commanded "ON." If the EBCM detects the right front solenoid control circuit voltage is out of specification, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a solenoid that is internally shorted to ground.
2. Checks for a solenoid that is not within proper resistance values.
3. Indicates if a short to ground exists in the solenoid circuitry.
4. Checks for a possible intermittent malfunction in the solenoid circuitry due to poor terminal contact.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 81

RIGHT FRONT SOLENOID CIRCUIT SHORTED TO GND

1
- IGNITION "OFF."
- DISCONNECT RIGHT FRONT SOLENOID CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A" OF THE RIGHT FRONT SOLENOID.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

2
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE RIGHT FRONT SOLENOID.

IS RESISTANCE BETWEEN 2.5 AND 5.0 Ω?

YES

3
- DISCONNECT 32-WAY EBCM CONNECTOR.
- MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A9" OF THE 32-WAY EBCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

4
- INSPECT CKT 1289 AND THE RIGHT FRONT SOLENOID AND 32-WAY EBCM HARNESS CONNECTORS FOR DAMAGE WHICH MAY RESULT IN A SHORT TO GROUND WITH ALL CONNECTORS CONNECTED. REPAIR DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- START ENGINE WITH FOOT OFF BRAKE.
- ALLOW ENGINE TO RUN FOR AT LEAST 10 SECONDS.

DOES DTC 81 SET AS A CURRENT DTC?

YES

REPLACE EBCM.

NO

MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO

REPAIR SHORT TO GROUND IN CKT 1289.

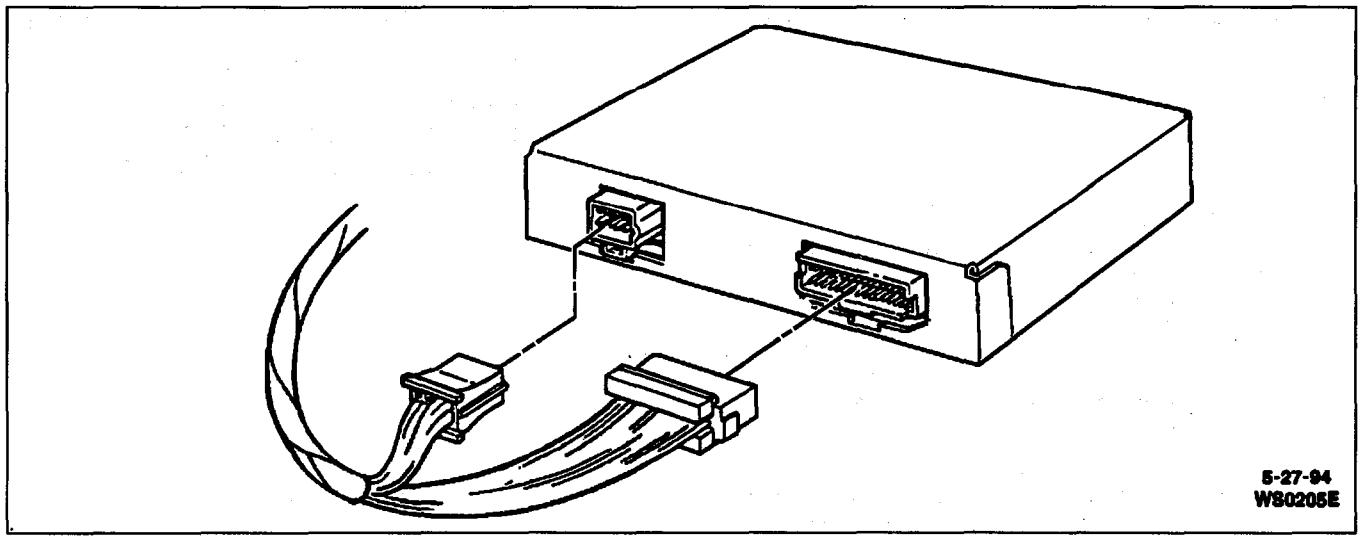
NO

REPLACE RIGHT FRONT SOLENOID.

NO

REPLACE RIGHT FRONT SOLENOID.

C1662S



DTC 82
CALIBRATION MALFUNCTION

Circuit Description:

This DTC allows the EBCM to check for a calibration malfunction by comparing the calibration value to a known value stored in the EEPROM.

This DTC is also used as a security measure to prevent improper use of calibrations or changes to these calibrations that may alter the designed function of ABS.

DTC Will Set When:

DTC 82 can be set at key-up. If the program identifier is incorrect or the memory checksum is incorrect, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

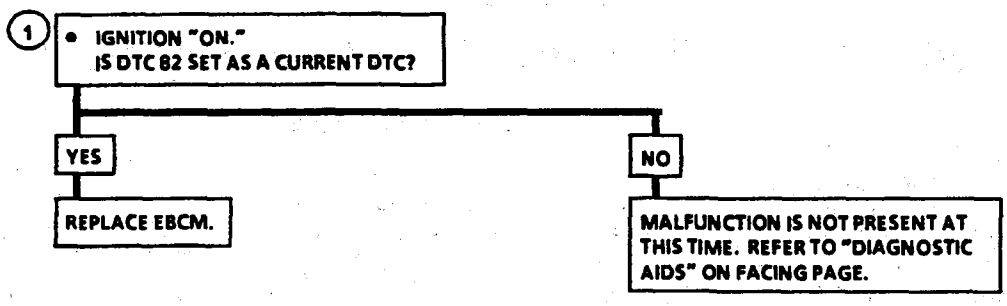
1. Checks to see if the malfunction is present during diagnosis. If present, the EBCM is not functioning correctly and must be replaced.

Diagnostic Aids:

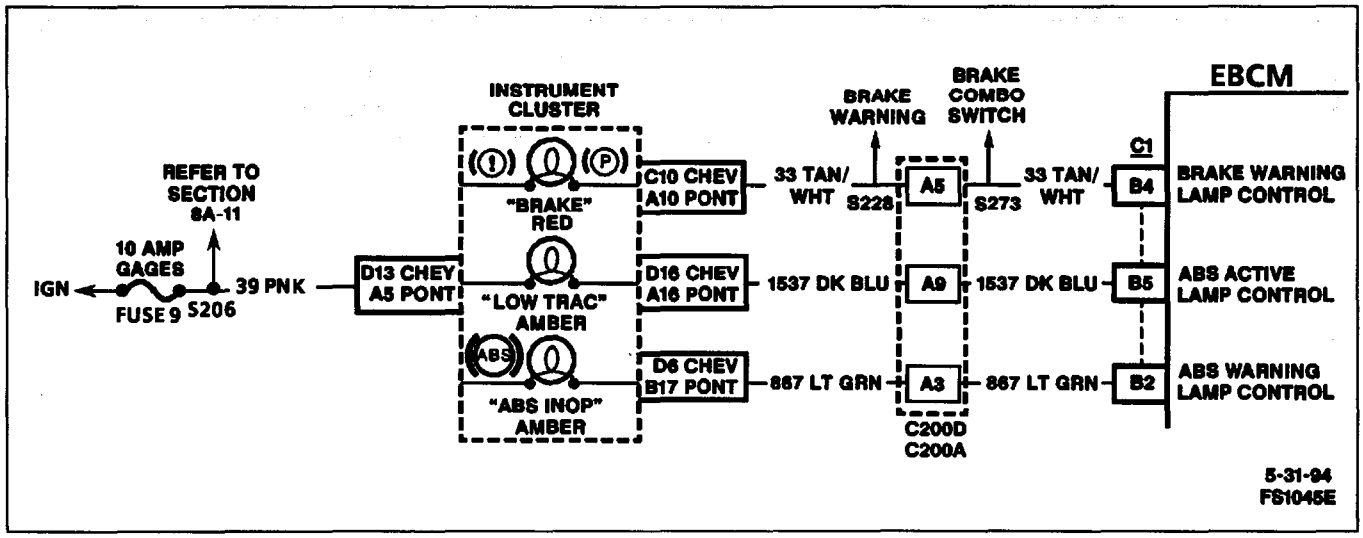
An intermittent DTC 82 may be caused by a bad cell in the EEPROM that is sensitive to temperature changes. If DTC 82 failed more than once, but is intermittent, replace EBCM.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

DTC 82
CALIBRATION MALFUNCTION



C1663S



DTC 86
EBCM TURNED "ON" THE RED BRAKE WARNING LAMP

Circuit Description:

This DTC is provided as an information only DTC, and reflects the status of the command issued by the ABS EBCM to illuminate the red BRAKE warning lamp. If another DTC issues a command to illuminate the red BRAKE warning lamp, DTC 86 will be stored in EEPROM as a history DTC at the conclusion of the ignition cycle.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Serves to identify if a DTC other than DTC 86 commanded the red BRAKE warning lamp "ON."

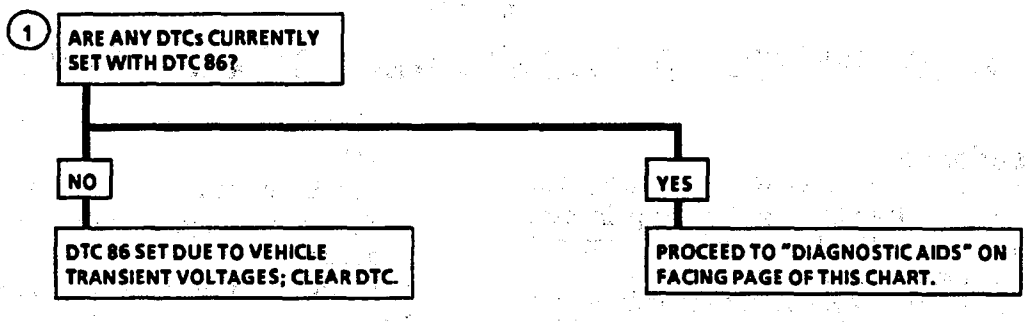
Diagnostic Aids:

Any ABS mechanical DTC that issues a command to illuminate the red BRAKE warning lamp will also result in DTC 86 being stored in EEPROM during shut down. These DTCs are: 38, 41, 42, 46, and 51. If the motor car not in their home position, certain electrical DTCs will also command the red BRAKE warning lamp "ON." These DTCs are: 14, 16, 18, 55, 56, 57, 58, 61, 62, 63, 64, 65, 66, 144, and 145.

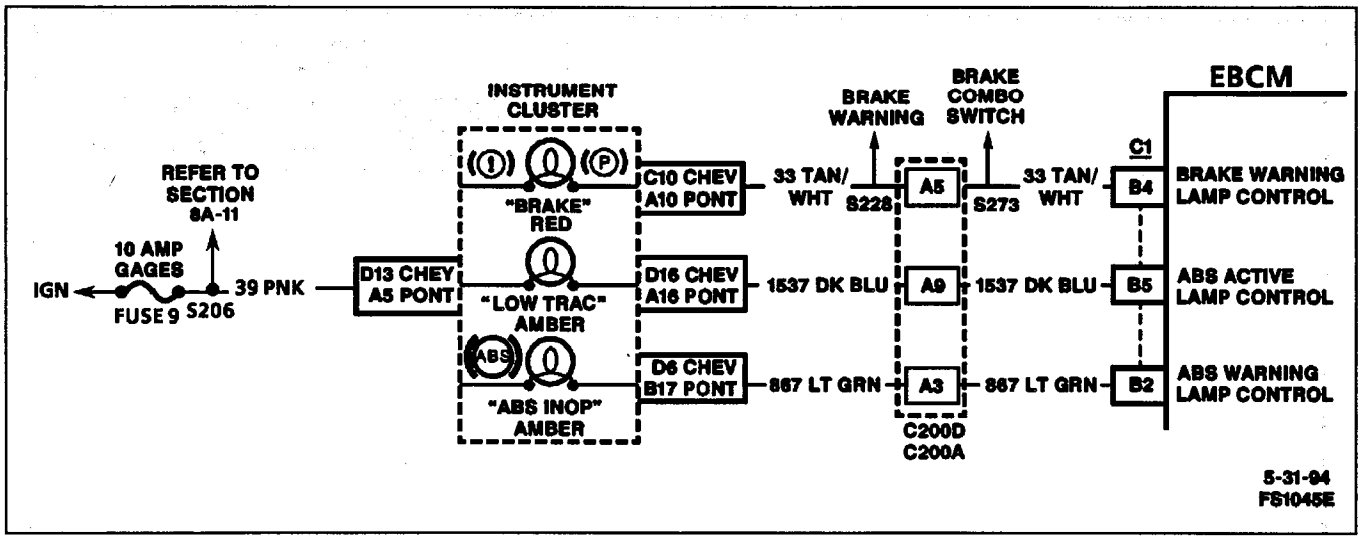
If any of these DTCs are indicated along with DTC 86, they must be corrected prior to addressing a DTC 86 malfunction.

DTC 86

EBCM TURNED "ON" THE RED "BRAKE" WARNING LAMP



C1664S



DTC 87
RED BRAKE WARNING LAMP CIRCUIT OPEN

Circuit Description:

This DTC is used to verify the EBCM has continuity to the red BRAKE warning lamp in case the EBCM must turn it "ON." This will only occur if an ABS malfunction is detected that may degrade base brake operation. Because ABS is not the only device controlling the red BRAKE warning lamp (parking brake and brake fluid level switch or may also turn "ON" the red BRAKE warning lamp) a short to ground in this circuit cannot be detected.

DTC Will Set When:

DTC 87 can be set after initialization is completed. If the red BRAKE warning lamp circuit voltage is out of specification indicating an open circuit, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is not disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

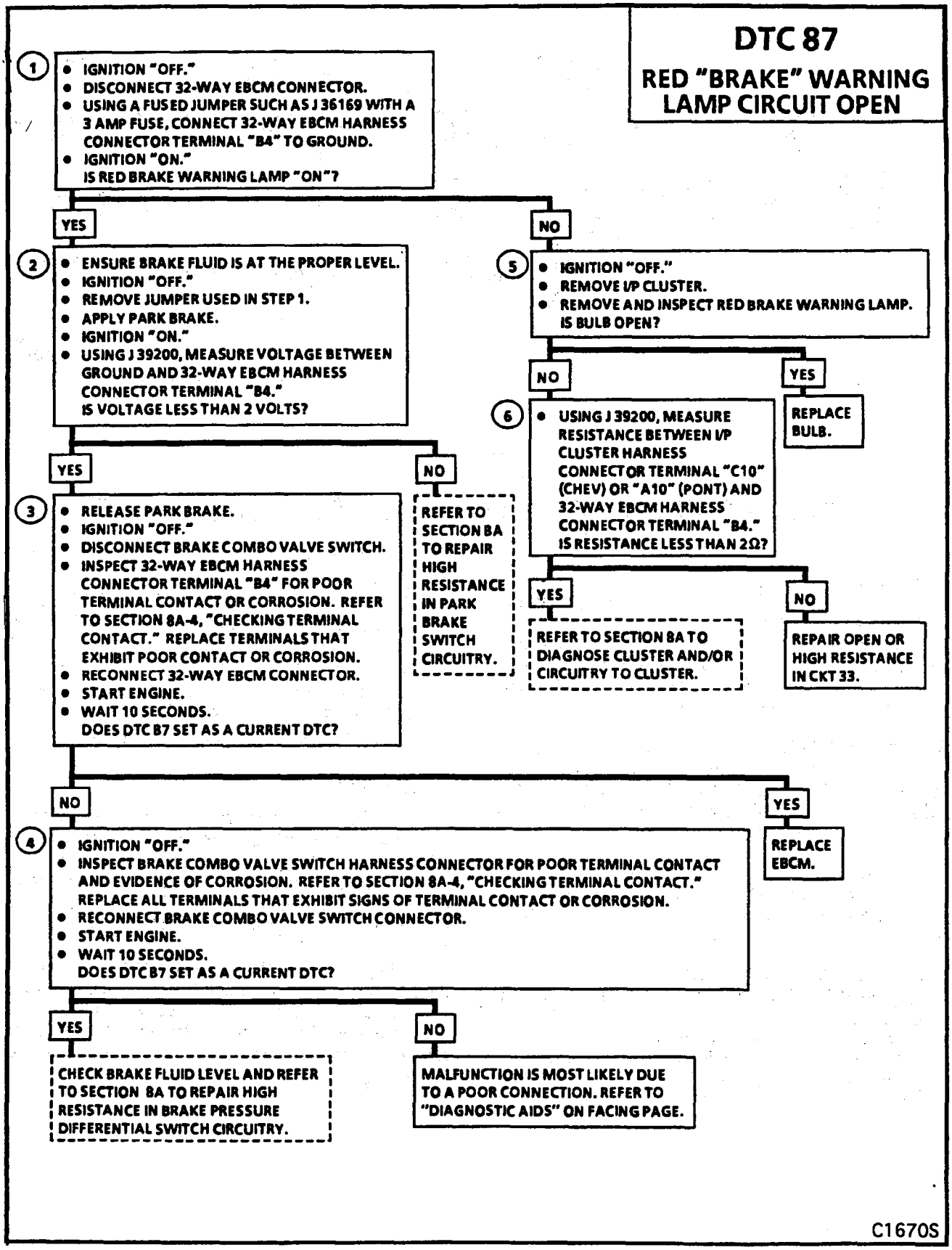
1. Identifies if the ground circuit to the red BRAKE warning lamp is completed by a source other than the EBCM.
2. Checks for high resistance in park brake circuitry.
3. Checks for malfunctioning EBCM.
4. Checks for high resistance in brake pressure differential switch circuitry.
5. Checks for malfunctioning ABS warning lamp bulb.
6. Checks for open or high resistance in CKT 33.

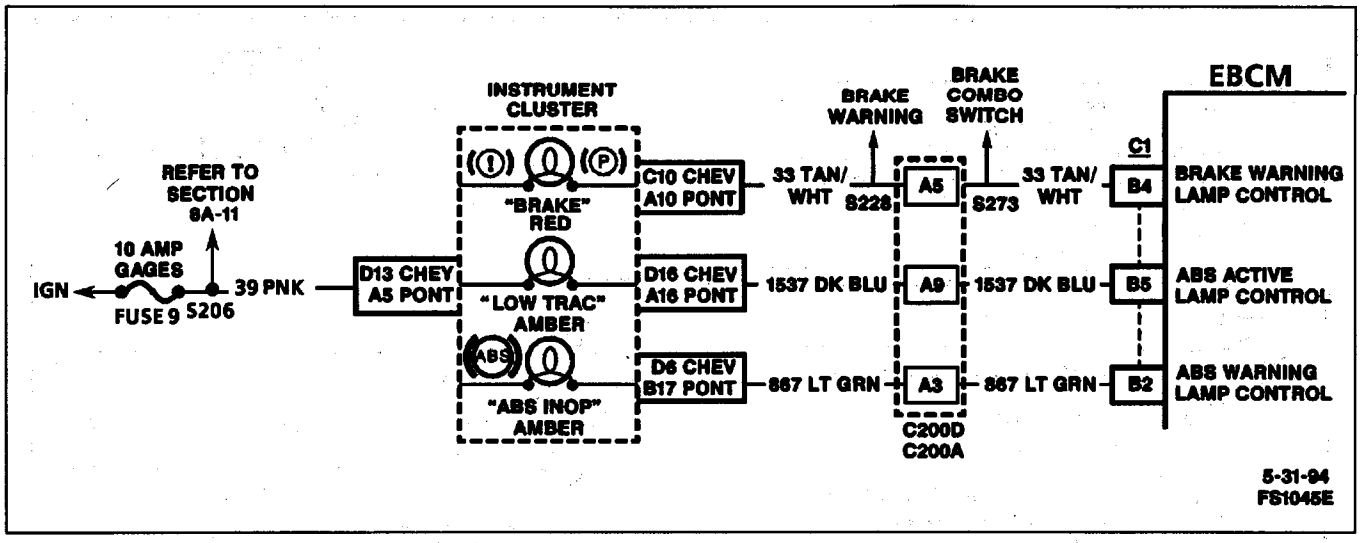
Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. If a Tech 1 or T-100 are not available, the parking brake handle may be lifted to verify proper lamp operation and continuity of CKTs 3 and 39.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.


DTC 87
RED "BRAKE" WARNING LAMP CIRCUIT OPEN
1
• IGNITION "OFF."
• DISCONNECT 32-WAY EBCM CONNECTOR.
• USING A FUSED JUMPER SUCH AS J 36169 WITH A 3 AMP FUSE, CONNECT 32-WAY EBCM HARNESS CONNECTOR TERMINAL "B4" TO GROUND.
• IGNITION "ON."
IS RED BRAKE WARNING LAMP "ON"?
YES
NO
2
• ENSURE BRAKE FLUID IS AT THE PROPER LEVEL.
• IGNITION "OFF."
• REMOVE JUMPER USED IN STEP 1.
• APPLY PARK BRAKE.
• IGNITION "ON."
• USING J 39200, MEASURE VOLTAGE BETWEEN GROUND AND 32-WAY EBCM HARNESS CONNECTOR TERMINAL "B4."
IS VOLTAGE LESS THAN 2 VOLTS?
5
• IGNITION "OFF."
• REMOVE I/P CLUSTER.
• REMOVE AND INSPECT RED BRAKE WARNING LAMP.
IS BULB OPEN?
NO
YES
REPLACE BULB.
6
• USING J 39200, MEASURE RESISTANCE BETWEEN I/P CLUSTER HARNESS CONNECTOR TERMINAL "C10" (CHEV) OR "A10" (PONT) AND 32-WAY EBCM HARNESS CONNECTOR TERMINAL "B4."
IS RESISTANCE LESS THAN 2Ω?
YES
REFER TO SECTION 8A TO DIAGNOSE CLUSTER AND/OR CIRCUITRY TO CLUSTER.
NO
REPAIR OPEN OR HIGH RESISTANCE IN CKT 33.
YES
NO
REFER TO SECTION 8A TO REPAIR HIGH RESISTANCE IN PARK BRAKE SWITCH CIRCUITRY.
3
• RELEASE PARK BRAKE.
• IGNITION "OFF."
• DISCONNECT BRAKE COMBO VALVE SWITCH.
• INSPECT 32-WAY EBCM HARNESS CONNECTOR TERMINAL "B4" FOR POOR TERMINAL CONTACT OR CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE TERMINALS THAT EXHIBIT POOR CONTACT OR CORROSION.
• RECONNECT 32-WAY EBCM CONNECTOR.
• START ENGINE.
• WAIT 10 SECONDS.
DOES DTC B7 SET AS A CURRENT DTC?
NO
YES
REPLACE EBCM.
4
• IGNITION "OFF."
• INSPECT BRAKE COMBO VALVE SWITCH HARNESS CONNECTOR FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF TERMINAL CONTACT OR CORROSION.
• RECONNECT BRAKE COMBO VALVE SWITCH CONNECTOR.
• START ENGINE.
• WAIT 10 SECONDS.
DOES DTC B7 SET AS A CURRENT DTC?
YES
NO
CHECK BRAKE FLUID LEVEL AND REFER TO SECTION 8A TO REPAIR HIGH RESISTANCE IN BRAKE PRESSURE DIFFERENTIAL SWITCH CIRCUITRY.
MALFUNCTION IS MOST LIKELY DUE TO A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
C1670S



DTC 88
RED BRAKE WARNING LAMP CKT SHORTED TO BATT

Circuit Description:

This DTC identifies a short to battery between the EBCM and the red BRAKE warning lamp, or an open driver that does not allow the red BRAKE warning lamp to be illuminated by the EBCM. This will only occur if an ABS malfunction is detected that may degrade base brake operation.

DTC Will Set When:

DTC 88 can be set only at the beginning of the three second bulb check. If the EBCM detects battery voltage on the red BRAKE warning lamp control circuit, a malfunction exists.

Action Taken:

A malfunction DTC is stored. ABS is not disabled, however the ABS warning lamp will flash to indicate a malfunction exists.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Identifies if the ground circuit to the red BRAKE warning lamp is being completed by a source other than the EBCM.
2. Identifies if the malfunction is currently present.
3. By removing the 10 amp "GAGES" Fuse 9, the voltage source is eliminated. This test indicates if voltage is being supplied from a source other than the gauge fuse.
4. Ensures malfunction was not due to physical damage of the circuitry.
5. Checks for DTC 86 also being set.

Diagnostic Aids:

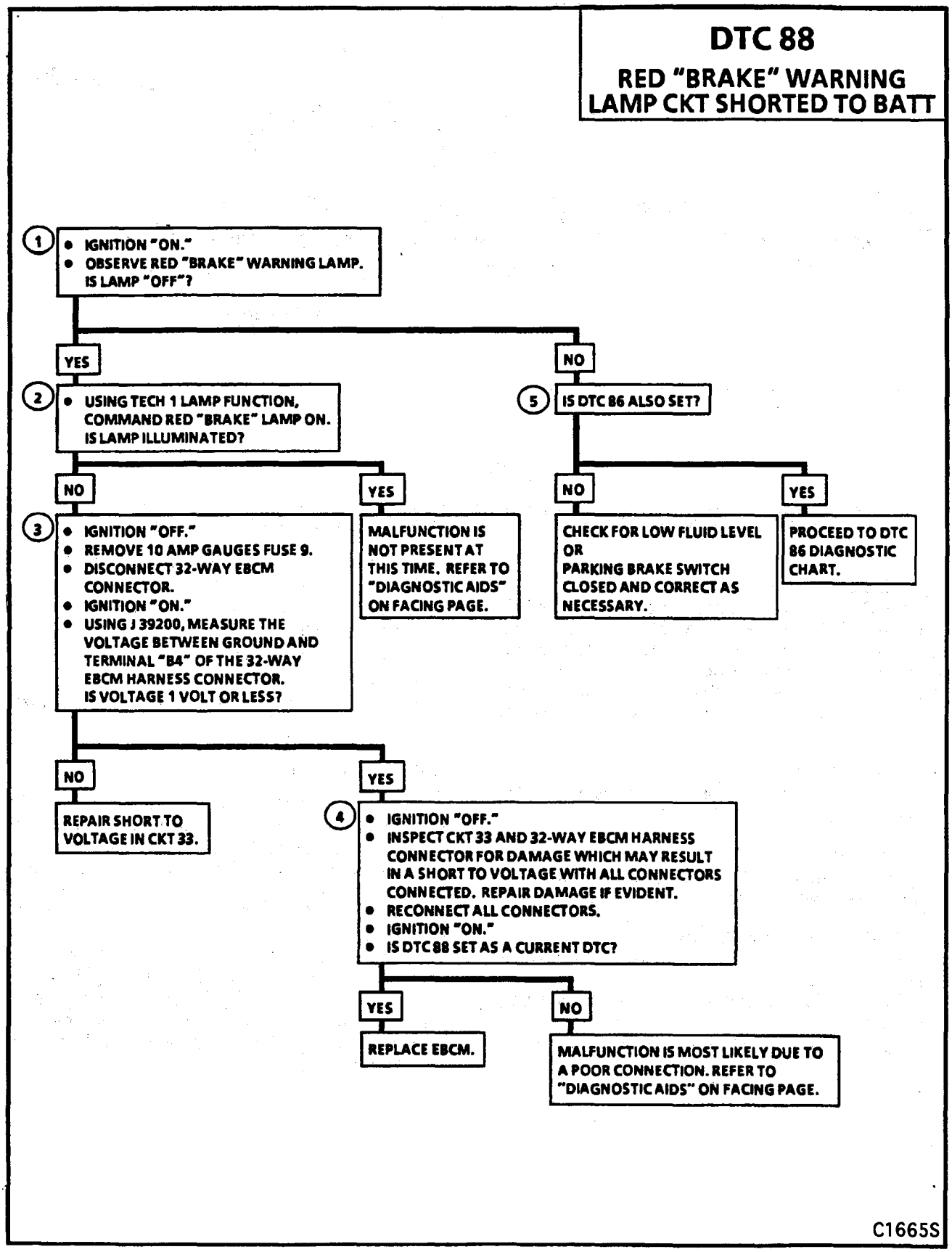
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

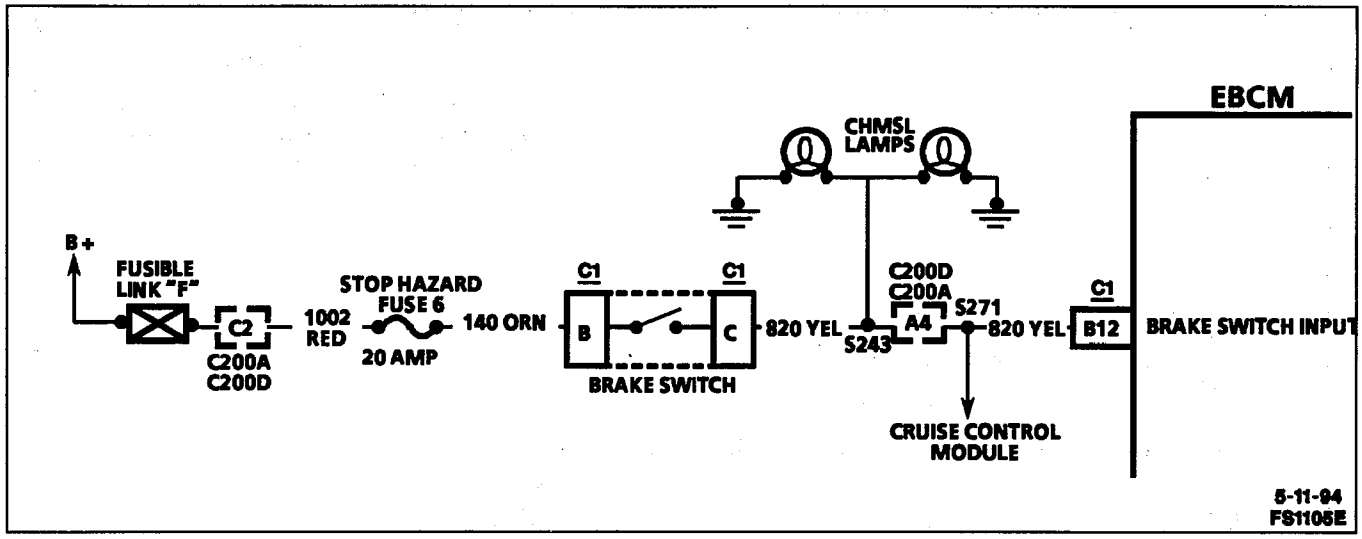
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 88

RED "BRAKE" WARNING LAMP CKT SHORTED TO BATT



C1665S



DTC 91
OPEN BRAKE SWITCH DURING DECELERATION

Circuit Description:

This DTC is used to detect an open brake switch in the non-ABS mode. The EBCM looks for deceleration rates that would indicate braking action and verifies this assumption by requiring several repeats of this detection method. In each case, ABS will not be available since a brake switch signal is not seen.

DTC Will Set When:

DTC 91 can be set if three deceleration cycles occur with the brake switch "OFF."

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

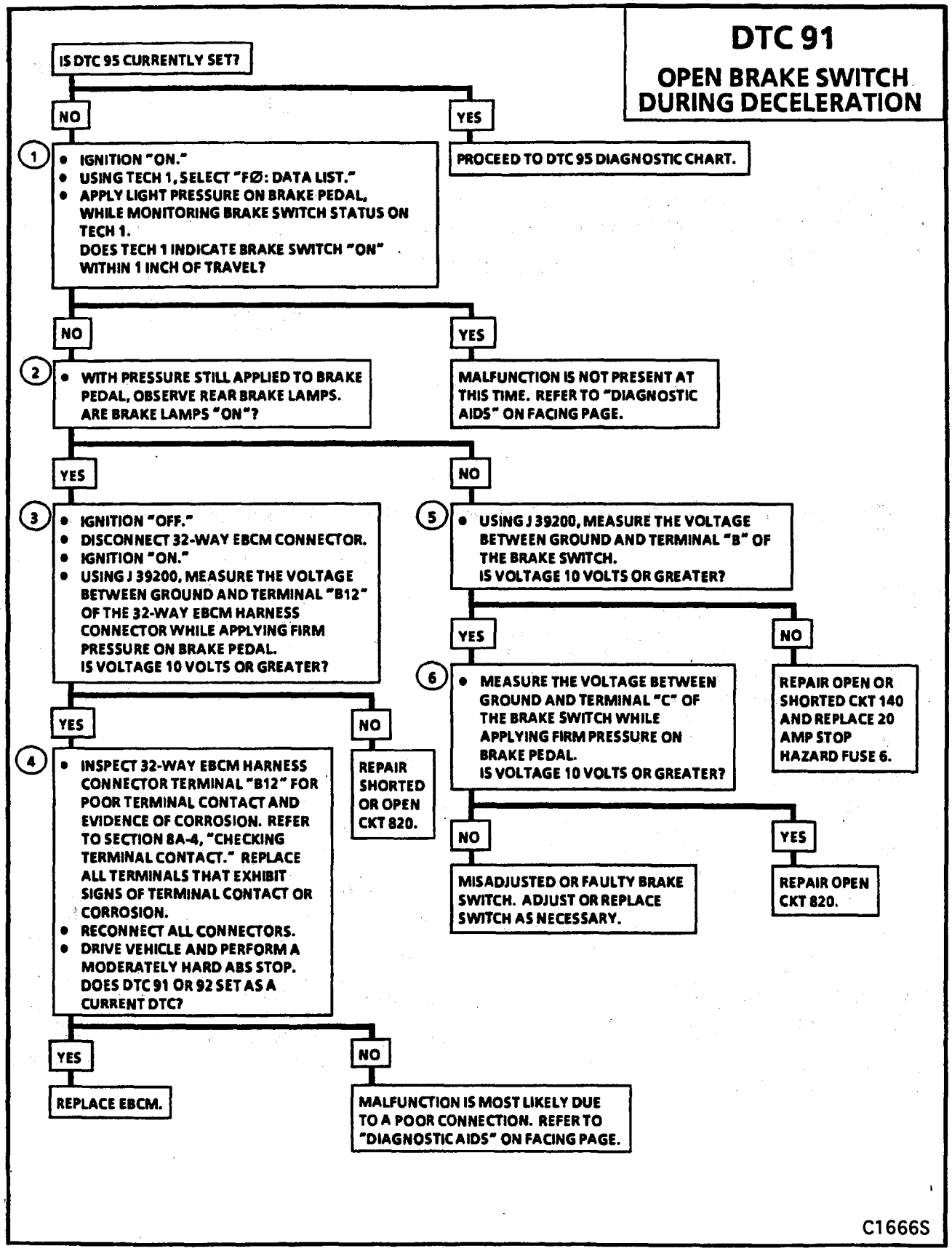
1. Indicates if the brake switch signal is being received by the EBCM.
2. Indicates if an open circuit exists in the brake switch or brake lamp circuitry.
3. Isolates the open circuit to either the brake switch input circuitry, or the EBCM.
4. Ensures malfunction was not due to poor terminal contact.
5. Verifies that voltage is available at the brake switch.
6. Verifies that the brake switch is functioning properly.

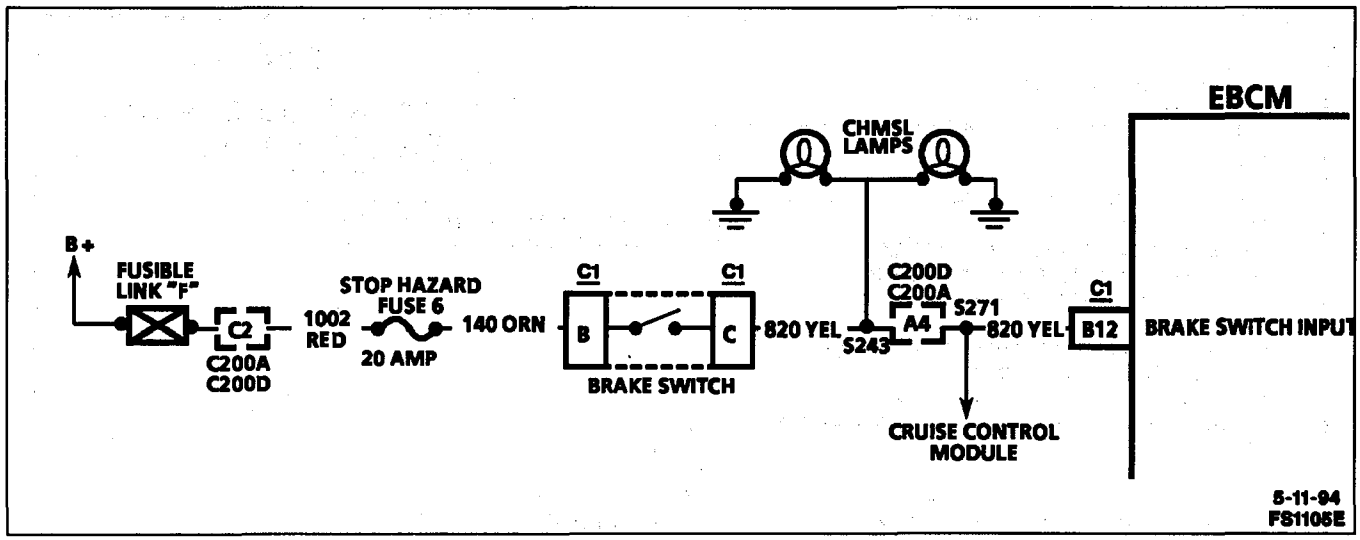
Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.


DTC 91
OPEN BRAKE SWITCH DURING DECELERATION
IS DTC 95 CURRENTLY SET?
NO
YES
PROCEED TO DTC 95 DIAGNOSTIC CHART.
1
• IGNITION "ON."
• USING TECH 1, SELECT "FØ: DATA LIST."
• APPLY LIGHT PRESSURE ON BRAKE PEDAL, WHILE MONITORING BRAKE SWITCH STATUS ON TECH 1.
DOES TECH 1 INDICATE BRAKE SWITCH "ON" WITHIN 1 INCH OF TRAVEL?
NO
YES
2
• WITH PRESSURE STILL APPLIED TO BRAKE PEDAL, OBSERVE REAR BRAKE LAMPS.
ARE BRAKE LAMPS "ON"?
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
YES
NO
3
• IGNITION "OFF."
• DISCONNECT 32-WAY EBCM CONNECTOR.
• IGNITION "ON."
• USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B12" OF THE 32-WAY EBCM HARNESS CONNECTOR WHILE APPLYING FIRM PRESSURE ON BRAKE PEDAL.
IS VOLTAGE 10 VOLTS OR GREATER?
5
• USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B" OF THE BRAKE SWITCH.
IS VOLTAGE 10 VOLTS OR GREATER?
YES
NO
YES
NO
4
• INSPECT 32-WAY EBCM HARNESS CONNECTOR TERMINAL "B12" FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF TERMINAL CONTACT OR CORROSION.
• RECONNECT ALL CONNECTORS.
• DRIVE VEHICLE AND PERFORM A MODERATELY HARD ABS STOP.
DOES DTC 91 OR 92 SET AS A CURRENT DTC?
REPAIR SHORTED OR OPEN CKT 820.
6
• MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "C" OF THE BRAKE SWITCH WHILE APPLYING FIRM PRESSURE ON BRAKE PEDAL.
IS VOLTAGE 10 VOLTS OR GREATER?
REPAIR OPEN OR SHORTED CKT 140 AND REPLACE 20 AMP STOP HAZARD FUSE 6.
YES
NO
NO
YES
REPLACE EBCM.
MALFUNCTION IS MOST LIKELY DUE TO A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
MISADJUSTED OR FAULTY BRAKE SWITCH. ADJUST OR REPLACE SWITCH AS NECESSARY.
REPAIR OPEN CKT 820.
C1666S



DTC 92
OPEN BRAKE SWITCH WHEN ABS WAS REQUIRED

Circuit Description:

This DTC is run to determine the proper operation of the brake switch. This is important because ABS is activated when the brake switch is "ON." If the brake switch is "OFF," ABS will never be activated. Since this malfunction is difficult to detect under normal braking conditions, this malfunction is only detected when ABS is required.

DTC Will Set When:

DTC 92 can be set if the vehicle's speed is greater than 8 km/h (5 mph). If the brake was not "ON" and a release was required on two channels for 0.5 seconds, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

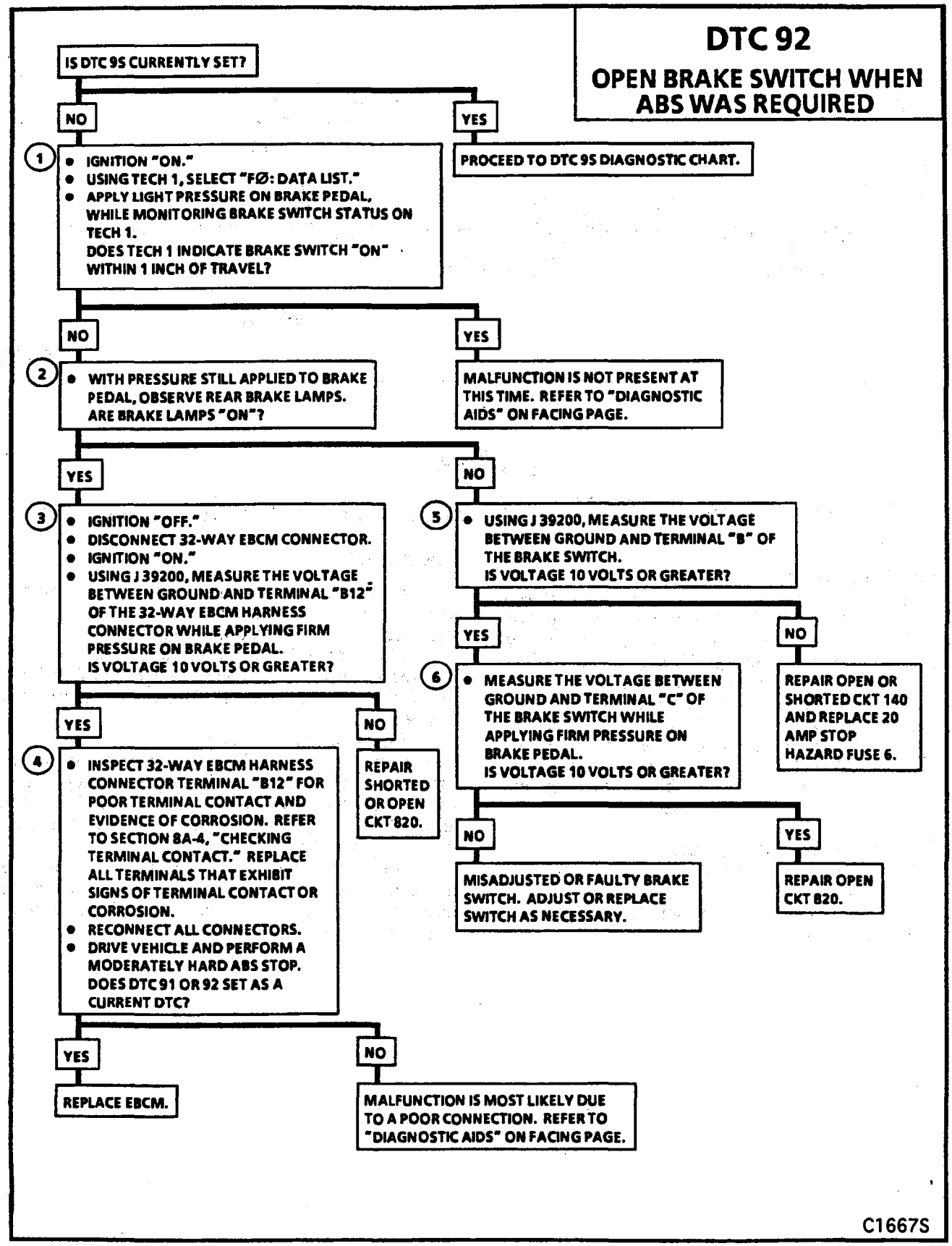
1. Indicates if the brake switch signal is being received by the EBCM.
2. Indicates if an open circuit exists in the brake switch or brake lamp circuitry.
3. Isolates the open circuit to either the brake switch input circuitry, or the EBCM.
4. Ensures malfunction was not due to poor terminal contact.
5. Verifies the voltage is available at the brake switch.
6. Verifies that the brake switch is functioning properly.

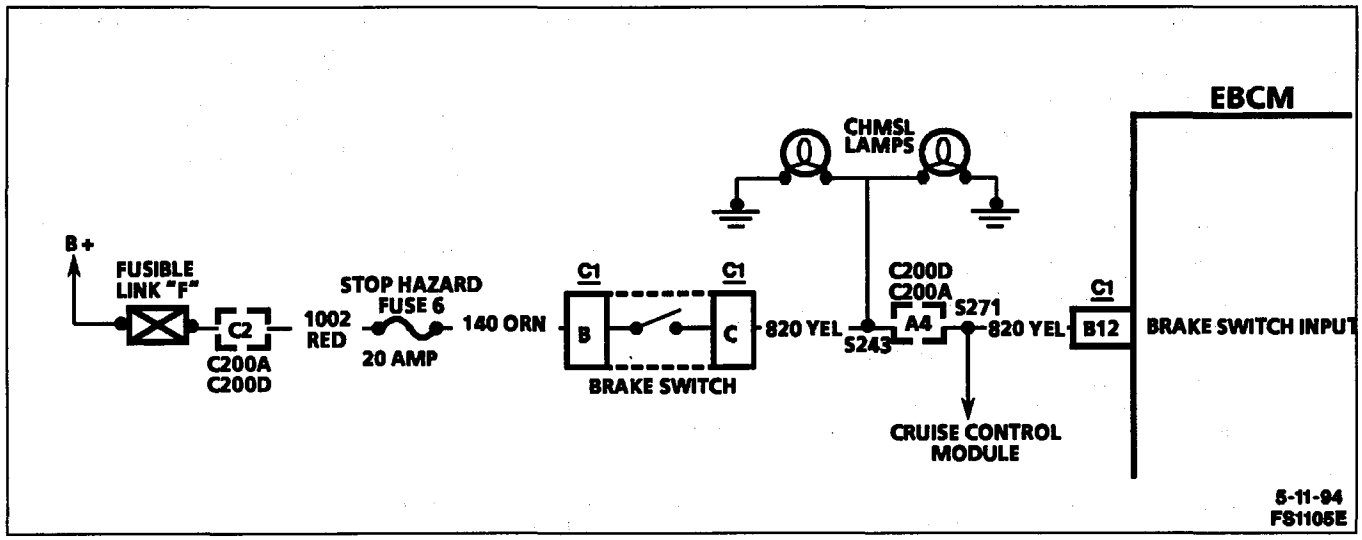
Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.


DTC 92
OPEN BRAKE SWITCH WHEN ABS WAS REQUIRED
IS DTC 9S CURRENTLY SET?
NO
YES
PROCEED TO DTC 9S DIAGNOSTIC CHART.
1
• IGNITION "ON."
• USING TECH 1, SELECT "FØ: DATA LIST."
• APPLY LIGHT PRESSURE ON BRAKE PEDAL, WHILE MONITORING BRAKE SWITCH STATUS ON TECH 1.
DOES TECH 1 INDICATE BRAKE SWITCH "ON" WITHIN 1 INCH OF TRAVEL?
NO
YES
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
2
• WITH PRESSURE STILL APPLIED TO BRAKE PEDAL, OBSERVE REAR BRAKE LAMPS.
ARE BRAKE LAMPS "ON"?
YES
NO
3
• IGNITION "OFF."
• DISCONNECT 32-WAY EBCM CONNECTOR.
• IGNITION "ON."
• USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B12" OF THE 32-WAY EBCM HARNESS CONNECTOR WHILE APPLYING FIRM PRESSURE ON BRAKE PEDAL.
IS VOLTAGE 10 VOLTS OR GREATER?
YES
NO
4
• INSPECT 32-WAY EBCM HARNESS CONNECTOR TERMINAL "B12" FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF TERMINAL CONTACT OR CORROSION.
• RECONNECT ALL CONNECTORS.
• DRIVE VEHICLE AND PERFORM A MODERATELY HARD ABS STOP.
DOES DTC 91 OR 92 SET AS A CURRENT DTC?
REPAIR SHORTED OR OPEN CKT 820.
YES
NO
REPLACE EBCM.
MALFUNCTION IS MOST LIKELY DUE TO A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
5
• USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B" OF THE BRAKE SWITCH.
IS VOLTAGE 10 VOLTS OR GREATER?
YES
NO
REPAIR OPEN OR SHORTED CKT 140 AND REPLACE 20 AMP STOP HAZARD FUSE 6.
6
• MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "C" OF THE BRAKE SWITCH WHILE APPLYING FIRM PRESSURE ON BRAKE PEDAL.
IS VOLTAGE 10 VOLTS OR GREATER?
NO
YES
MISADJUSTED OR FAULTY BRAKE SWITCH. ADJUST OR REPLACE SWITCH AS NECESSARY.
REPAIR OPEN CKT 820.
C1667S



DTC 93
DTC 91 OR 92 SET IN CURRENT OR PREV. IGN CYCLE

Circuit Description:

This DTC is the second portion of DTCs 91 and 92. If DTCs 91 or 92 failed during the last ignition cycle, DTC 93 becomes a current failure during the next ignition cycle, keeping ABS disabled until a brake switch "ON" state is seen. When a change is seen during an ignition cycle in which DTC 93 is a current malfunction, DTC 91 or 92 will clear itself at the end of the current ignition cycle, and ABS and will be enabled at the start of the next ignition cycle. DTC 93 alone indicates 91 or 92 failed previously, but is intermittent, or has been corrected.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Indicates which DTC (either 91 or 92) caused DTC 93 to set.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

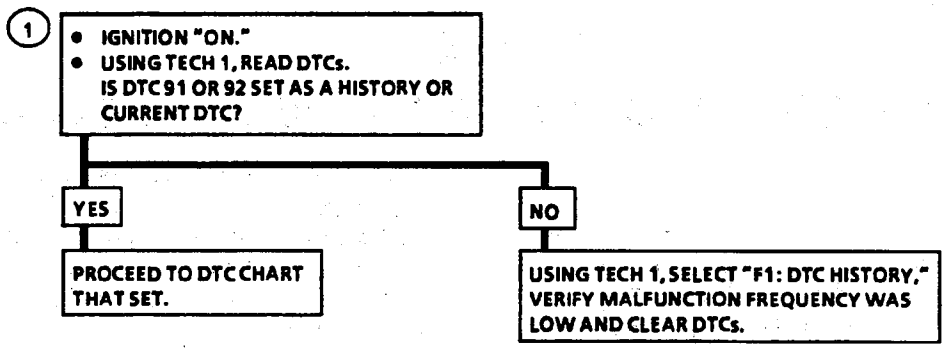
The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

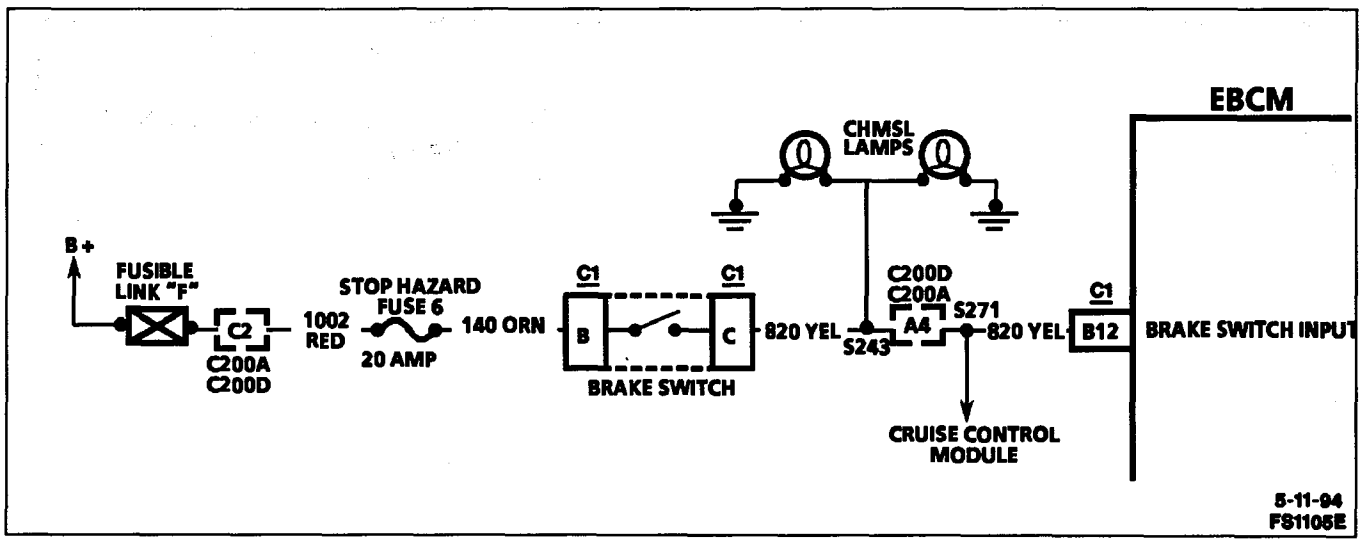
Also, verify proper brake switch operation using the data list of the Tech 1. As the brake is applied, the data list should display the brake switch "ON" within 1 inch of travel.

DTC 93

DTC 91 OR 92 SET IN CURRENT OR PREV. IGN CYCLE



C1668S



DTC 94
BRAKE SWITCH CONTACTS ALWAYS CLOSED

Circuit Description:

This DTC is run to determine the proper operation of the brake switch. This is important because ABS is activated when the brake switch is "ON" and deactivated when the brake switch is "OFF." If the brake switch is always "ON," ABS operation will always be requested resulting in potential modulator cycling on rough roads.

DTC Will Set When:

DTC 94 can be set when the vehicle reaches at least 40 km/h (25 mph). If the brake was never "OFF" during two consecutive drive cycles, a malfunction exists.

Action Taken:

A malfunction DTC is stored. ABS is not disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks if the malfunction is currently present.
2. Isolates the cause of the malfunction to either a malfunctioning or misadjusted brake switch, or a short to voltage in the brake switch circuitry.
3. Checks for unwanted voltage on the brake switch input circuit.
4. Checks for a possible intermittent malfunction.

Diagnostic Aids:

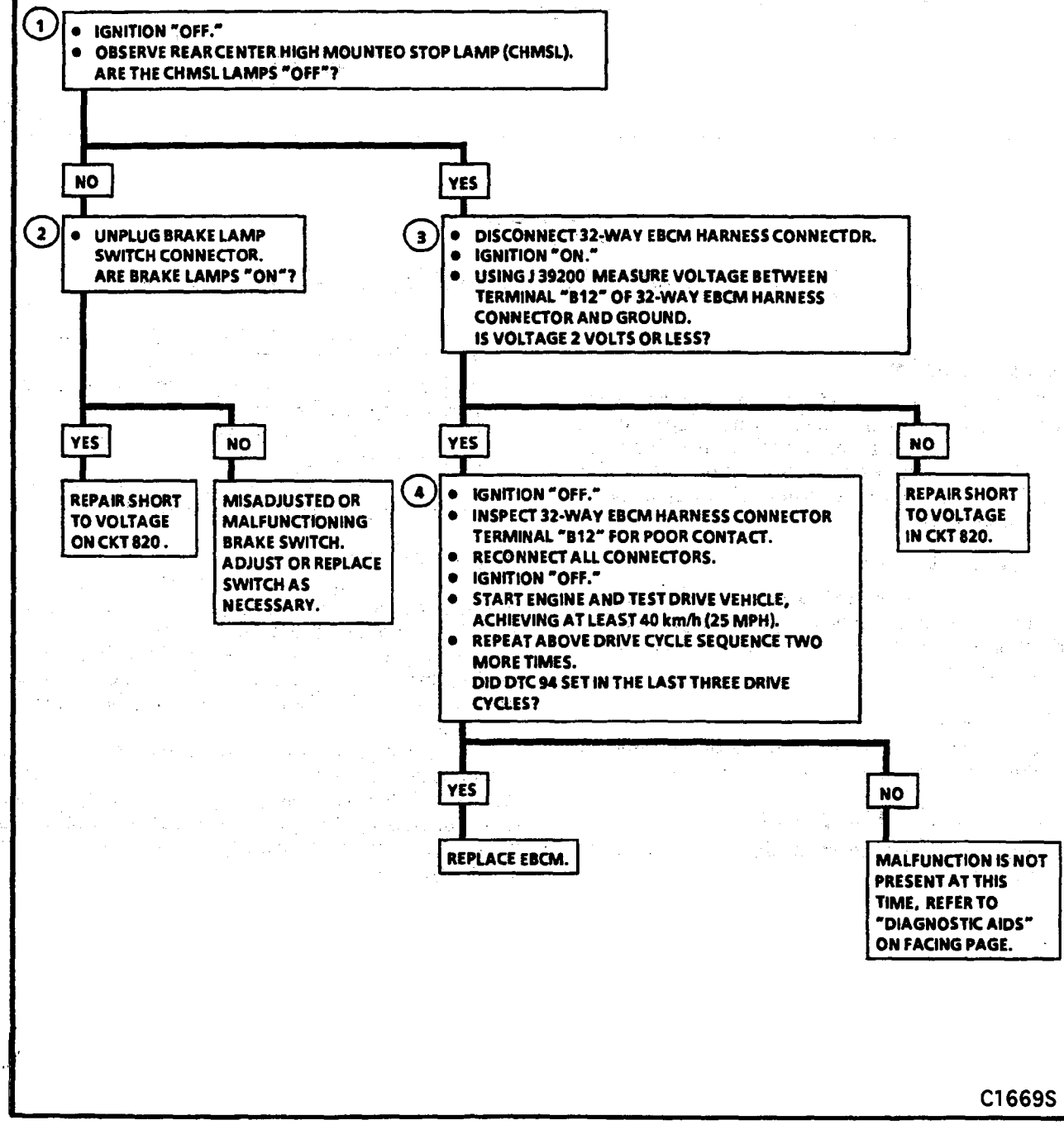
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

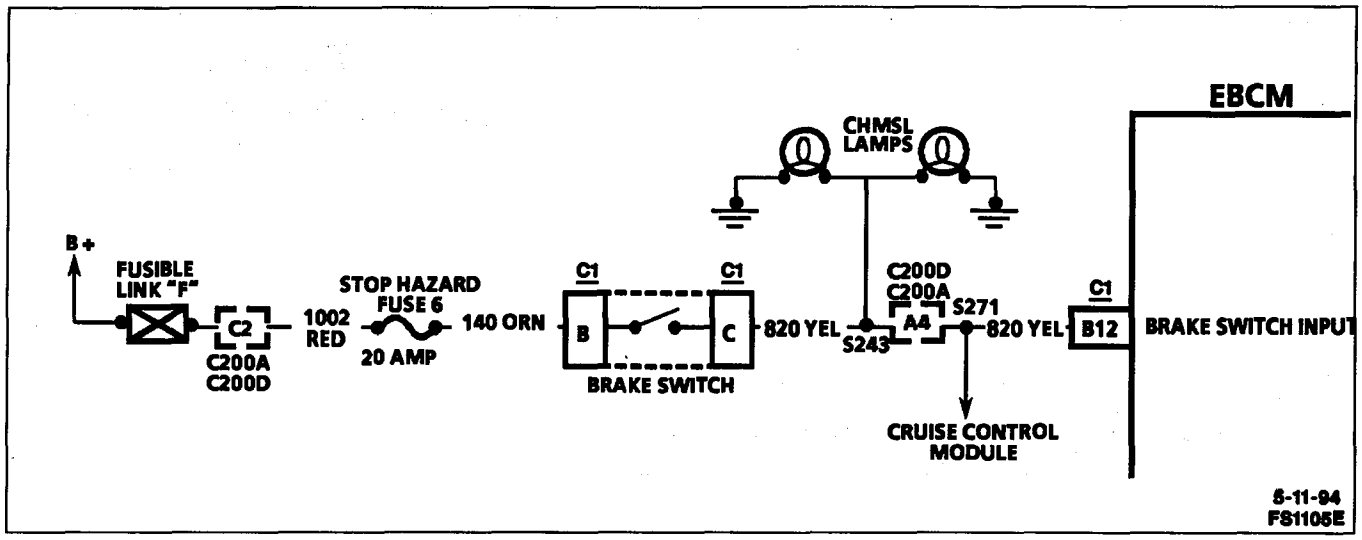
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 94

BRAKE SWITCH CONTACTS ALWAYS CLOSED



C1669S



DTC 95
BRAKE SWITCH CIRCUIT OPEN

Circuit Description:

This DTC is used to identify open brake switch circuitry that prevents the brake switch input to the EBCM from changing states when the brake is applied. This DTC is used in conjunction with DTCs 91 and 92 to determine the cause of an open brake switch malfunction.

DTC Will Set When:

DTC 95 can be set after initialization is completed. If the brake switch input voltage is out of specification for one second indicating an open circuit, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled. The amber ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Is used to confirm that an open in the brake switch circuitry currently exists.
2. Indicates if the brake switch signal is being received by the EBCM.
3. Indicates if an open circuit exists in the brake switch or brake lamp circuitry.
4. Isolates the open circuit to either the brake switch input circuitry, or the EBCM.

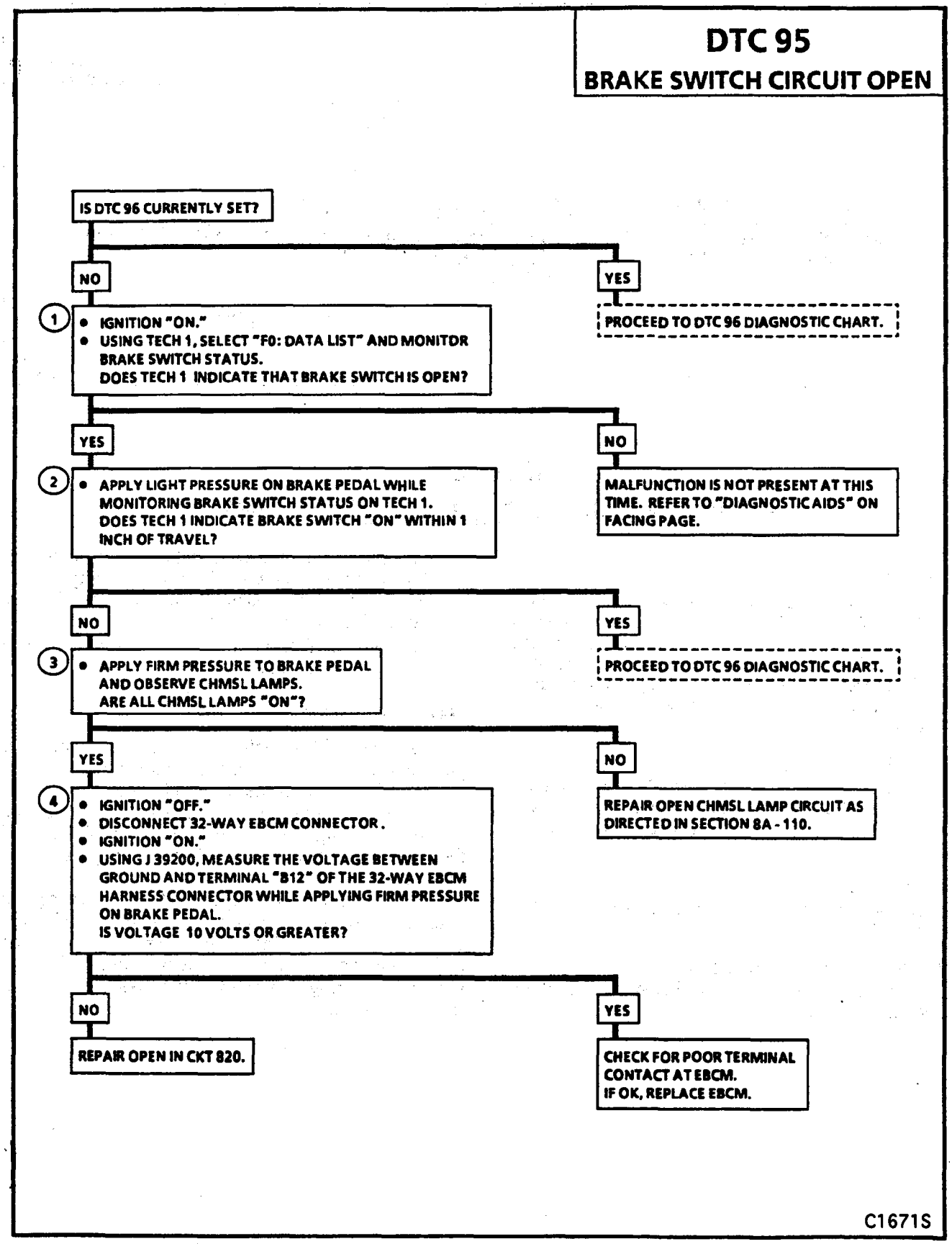
Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

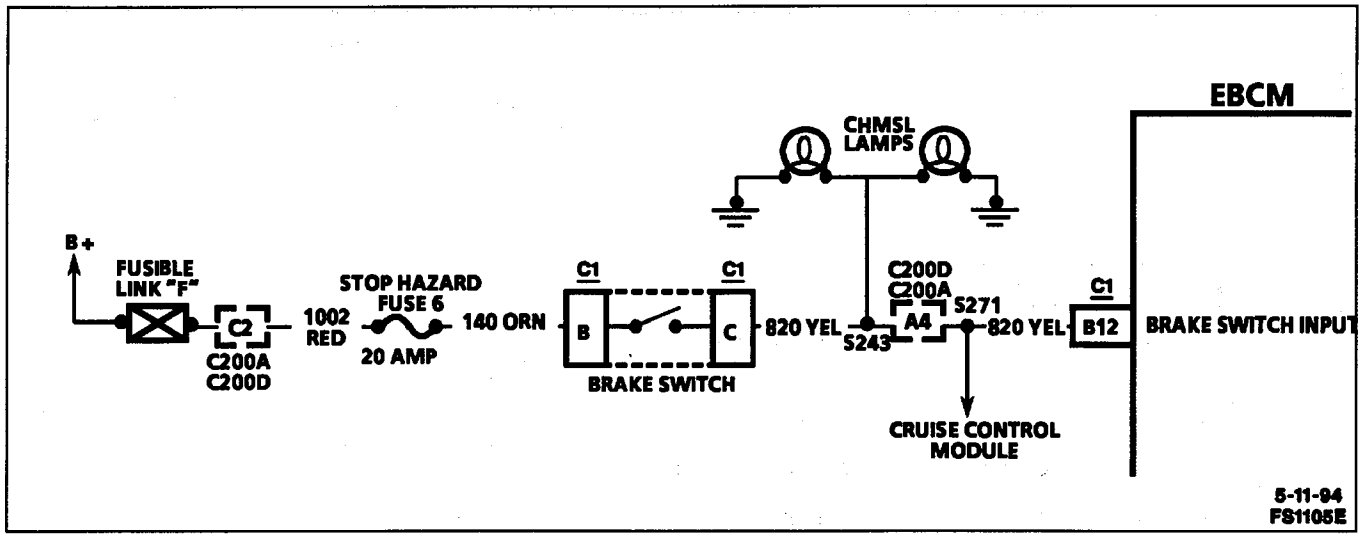
The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 95
BRAKE SWITCH CIRCUIT OPEN



C1671S



DTC 96
REAR BRAKE LAMP CIRCUIT OPEN

Circuit Description:

This DTC is designed to isolate the cause of a DTC 95 malfunction and indicate to the driver ABS is still available. If DTC 95 fails with DTC 96, the Center High Mounted Stop Lamp (CHMSL) circuit is open. The presence of battery voltage at the brake switch input indicates a valid brake switch input is still available.

DTC Will Set When:

DTC 96 can be set only after DTC 95 has been set. If the EBCM detects battery voltage on the brake switch input circuit for 0.5 seconds, a malfunction exists.

Action Taken:

A malfunction DTC is stored, however, ABS is not disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. As a result of a malfunction of an additional brake switch circuit DTC, this DTC may be set. To insure proper diagnosis, any additional brake switch DTCs must be repaired first.
2. Identifies if the malfunction is currently present in the brake circuit.

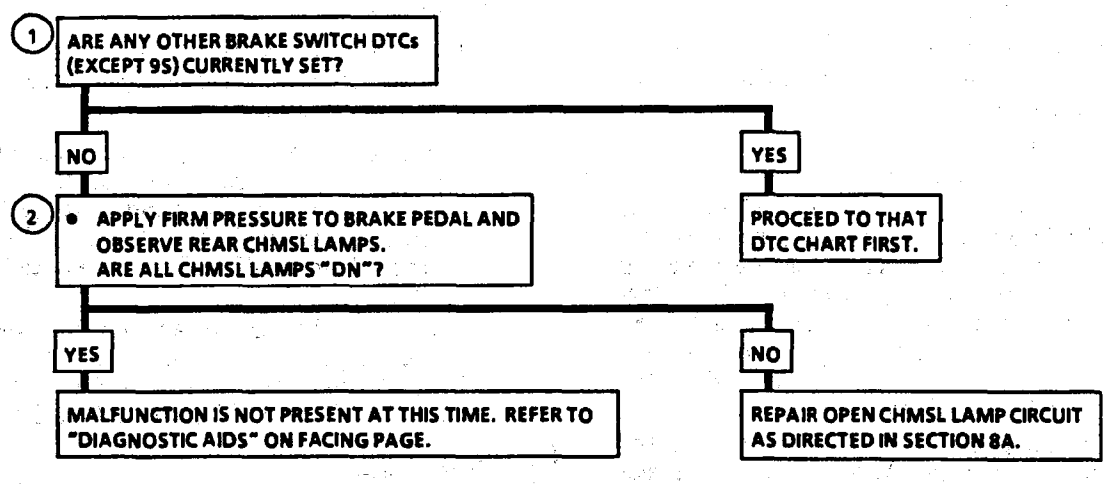
Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 96
REAR BRAKE LAMP CIRCUIT OPEN



C1672S

DIAGNOSIS/MISC. TEST (F4)

MANUAL CONTROL (F0)

This function can be used to manually control the ABS VI motors and solenoids.

ABS Motor Test (Apply/Release)

Each motor can be manually turned "ON" for up to 5 seconds, at a current of 10 amps applied (forward) or 6 amps released (reverse). After running the motors, the command and feedback currents will be stored in a snapshot buffer. This information can be reviewed, when instructed to do so by the service manual, to determine if the motors are operating properly.

The test below describes how the front motors will normally operate, the rear motor can be tested in a similar manner, except there will be only a slight pedal drop (bump) and rise during the test.

1. Ignition "OFF."
2. Install Tech 1 with MSC.
3. Ignition to "RUN," engine "OFF."
4. Pump brake pedal until firm to deplete vacuum from power booster.
5. Select manual control.
6. Depress and hold brake pedal.
7. Using the Tech 1, "Release" one of the ABS motors. The brake pedal should move smoothly toward the floor. As the pedal drops, the feedback current should momentarily drop to only a few amps (indicating motor movement) and then become equal to command current (6 amps). This indicates the motor is no longer moving since the piston has reached the bottom of the bore.
8. With the brake pedal still depressed and at the floor, "Apply" the same ABS motor. The brake pedal should now smoothly rise back to the top of its travel. The feedback current should momentarily drop to a few amps, then quickly increase to the command current (10 amps). This indicates the motor is no longer moving since the piston has reached the top of the bore ("home" position).

Solenoid Test ("ON/OFF")

Only use this test when no DTCs are stored and you suspect a leaky ABS solenoid or check valve.

1. Ignition "OFF."
2. Install Tech 1 with MSC.
3. Ignition to "RUN," engine "OFF."
4. Pump brake pedal and deplete vacuum from power booster.
5. Select manual control (F0).
6. Select left front or right front motor release.
7. "Release" the motor for the channel being tested. Review the motor command and feedback currents to be sure the motor released properly. Refer to "Motor (Apply/Release)" in this section.
8. Select the solenoid for the same channel as that being tested.
9. With no brake pedal pressure applied, turn the solenoid "ON."
10. Depress the brake pedal. It should be very high and firm.
    - If the pedal goes nearly to the floor, the solenoid is leaking or not closing and/or the check valve is leaking, proceed to Step 12.
11. With brake pressure still applied, turn the solenoid "OFF." The brake pedal should move toward the floor. This verifies normal solenoid operation. END OF TEST.
    - If the pedal does not move toward the floor, the solenoid is stuck "ON," proceed to Step 12.
12. Verify that the solenoid connectors are connected to the proper solenoids, (the right front solenoid is the one on the rear of the ABS hydraulic modulator, closest to the brake booster). If the wiring is incorrect, move the connectors to the proper solenoid and repeat this entire test starting with Step 1.
    A. Physically switch the two solenoids.
    B. Repeat the entire test starting at Step 1 for the channel in question.
    - If the test now works properly, test the other channel. If the test fails for this channel, replace the solenoid currently installed in this channel. Refer to "ABS Hydraulic Modulator Solenoid" under "On-Vehicle Service" in this section.
    - If the test fails for the same channel, the check valve is leaking. Replace ABS hydraulic modulator. Refer to "ABS Hydraulic Modulator" under "Unit Repair" in this section.

Important

- After performing Step 12, it is necessary to bleed the brake system. Refer to "Bleeding Procedure" in this section.

HYDRAULIC CONTROL TEST (F2)

This test is used to verify base brake apply and ABS release, hold, and apply function.

1. Ignition "OFF."
2. Raise the vehicle such that all wheels to be tested are off the ground.
3. Install Tech 1 with MSC.
4. Ignition to "RUN," engine "OFF," vehicle transmission in neutral.
5. Select a channel to test; left front, right front, or rear. When testing the rear brakes, both rear wheels should rotate or not rotate simultaneously at various points in the test; this is true because both rear brake pressures are controlled together.
6. Firmly depress brake pedal. Pedal should remain high and firm.
7. Have an assistant attempt to rotate the wheel being tested. If the wheel does not rotate, base brake apply is working properly.

8. With the brake pedal still depressed, press the = key on the Tech 1 to start the test. The Tech 1 will display "Release" on the screen. Your assistant should be able to rotate the wheel being tested during the release portion of the test (approximately 2 seconds long). This verifies ABS pressure release. The brake pedal should remain high and firm. (If the brake pedal moves toward the floor, verify the solenoid electrical connectors are connected to the correct solenoids.)
9. The Tech 1 will switch to the "Hold" mode and display the word "Hold" on the screen along with an 18 second decrement counter. With the brake pedal still depressed, have your assistant attempt to rotate the wheel. The wheel should rotate for the full 18 seconds of the test. If the wheel does not rotate for the full 18 seconds it could indicate that either the check valve or the solenoid may be leaking. This verifies ABS pressure hold.
10. When the hold portion of the test is complete, brake pressure will be applied and a slight bump may be felt in the pedal. This is normal. The assistant should not be able to rotate the wheel at this point. This verifies ABS apply.

ABS MOTOR TEST (F4)

Once the motor pack has been separated from the hydraulic modulator, this test will help determine if the motor pack is operating properly.

The Tech 1 will rotate the motors in one direction, then the other.

- If any motor does not turn in both directions, the motor pack is malfunctioning and must be replaced. The motor pack is not serviceable and must be replaced as an assembly. Refer to "Motor Pack" under "Unit Repair" in this section.
- If all three ABS motors and both TCS motors rotate, try to rotate each gear on the hydraulic modulator, refer to "No Gear Movement" in this section.

NO GEAR MOVEMENT

After the ABS motor pack has been removed, rotate each gear by hand on the ABS hydraulic modulator (unit with large gears). The front gears (non-center gears) should be able to be rotated approximately 12.25 full turns lock to lock. If the gear does not turn freely or at least 12 turns are not possible, replace the ABS hydraulic modulator.

The rear gear (center gear) should rotate approximately 7.25 turns. If the gear does not turn freely or at least 7 turns are not possible, replace the ABS hydraulic modulator.

Refer to "ABS Hydraulic Modulator" under "Unit Repair" in this section if replacement of the ABS hydraulic modulator is indicated above.

GEAR TENSION RELIEF (F5)

When the displacement cylinder pistons are in the "home" position, each motor has prevailing torque. This torque results in "gear tension," or force on each gear that makes motor pack separation difficult. To avoid injury, or damage to the gears, the "Gear Tension Relief Function" briefly reverses each motor to eliminate the prevailing torque.

Always perform the "Gear Tension Relief Function" prior to removing the ABS hydraulic modulator/motor pack assembly from the vehicle.

RELAY TEST (F6)

This test allows the user to turn the relay "ON" and "OFF" using the "UP ARROW" and the "DOWN ARROW" keys on the Tech 1. The battery voltage supplied to the EBCM through the relay contacts is displayed on the screen during the test.

When the relay is commanded "ON," the voltage should be equal to the battery voltage. When the relay is "OFF," the voltage should drop below 2 volts.

NOTICE: Voltage will not drop to zero when the relay contacts are open due to capacitors in the EBCM. If voltage drops below 2 volts, the relay is operating properly.

VOLTAGE LOAD TEST (F7)

The ABS VI system can draw significant amounts of current when operating. This test turns "ON" many of the system components to load-test the vehicle's electrical system.

If low voltage malfunctions or intermittent ABS operations are occurring, this test will allow you to monitor the ignition and switched battery inputs to the EBCM. If only one of these two inputs drops below 10 volts during testing, a high resistance may be present in that power feed circuit. If both inputs drop below 10 volts the vehicle's electrical system needs to be diagnosed. In either case, the Tech 1 will display that the "Voltage Load Test" failed.

LAMP TEST (F8)

This test allows the user to control the warning/indicator lamps associated with ABS VI. It can be used to check the lamp circuits. The amber ABS lamp can be turned "ON" or flashed. The red BRAKE warning lamp and the amber "LOW TRAC" lamp can be turned "ON" and "OFF."

SYSTEM ID (F9)

This feature is used to determine the ABS VI version and to provide manufacturing information on the EBCM.

MOTOR REHOME (F5)

The motor rehome function is initiated by pressing the F5 key from the Tech 1 "Select Mode" menu. The motor rehome function must ALWAYS be used prior to bleeding the brake system. This function will return all of the hydraulic modulator pistons to their upmost or "home" position. This allows all fluid paths within the modulator to be open so that the modulator can be properly bled.

ON-VEHICLE SERVICE

SERVICE PRECAUTIONS

CAUTION: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- Eye contact - rinse thoroughly with water.
- Skin contact - wash with soap and water.
- If ingested - consult a physician immediately.

CAUTION: To help avoid personal injury due to poor braking, DO NOT tap into the vehicle's brake system to operate a trailer brake system.

NOTICE: Always use the correct fasteners in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications: Some bolts are designed to permanently stretch. If a stronger fastener is used, the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent. Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used, part damage may occur. Fasteners that need to be replaced when removed will be called out. Fasteners that require thread locker or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

NOTICE: The use of rubber hoses or parts other than those specified for the Antilock Brake System (ABS) may lead to functional problems requiring replacement of the hydraulic parts. Replace all components included in repair kits used to service this system. Lubricate rubber parts with clean, fresh brake fluid to ease assembly. Do not use lubricated shop air on brake parts as damage to rubber components may result. If any hydraulic component is removed or brake line disconnected, it is necessary to bleed all or part of the brake system. The fastener tightening specifications listed are for dry, unlubricated fasteners.

NOTICE: Use only Supreme 11 (GM 1052542) or equivalent DOT 3 brake fluid. The use of DOT 5 (silicone) brake fluid is not recommended. Reduced braking performance or durability may result.

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring, cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen the damage.

CHECKING AND ADDING FLUID

Refer to SECTION 5A.

FLUSHING PROCEDURE

Important

- If evidence of contamination is present in the vehicle's brake fluid, the entire brake system must be flushed following one of the procedures outlined below.
- After flushing the entire brake system, all rubber components must be replaced. Components which must be replaced include: brake hose assemblies, master cylinder rubber parts, brake caliper and wheel cylinder boots and seals, combination valve assembly, ABS hydraulic modulator, TCS hydraulic modulator and ABS solenoids. Refer to the proper "On-Vehicle Service" for replacement procedures.
- After all rubber components have been replaced, the entire brake system must be re-flushed following one of the procedures outlined below.
- Once the second flushing procedure has been performed, a complete system bleed must be performed, refer to "Bleeding Procedure" in this section.

NOTICE: Use only DOT 3 brake fluid from a clean, sealed container. Do not use any fluid from a container which is wet with water. Do not use DOT 5 silicone brake fluid. Improper brake fluid, mineral oil (from such things as engine oil, transmission fluid, etc.), or water in the fluid may cause the brake fluid to boil or the rubber components to deteriorate. Keep all fluid containers capped to prevent contamination.

- The system must be flushed if there is any doubt about the condition of fluid in the system or if fluid has been used which contains the slightest trace of mineral oil (from such things as engine oil, transmission fluid, etc.).

Flushing Preparation

NOTICE: The flushing prep procedure must be performed prior to using "Pressure Flush" or "Manual Flush" procedures.

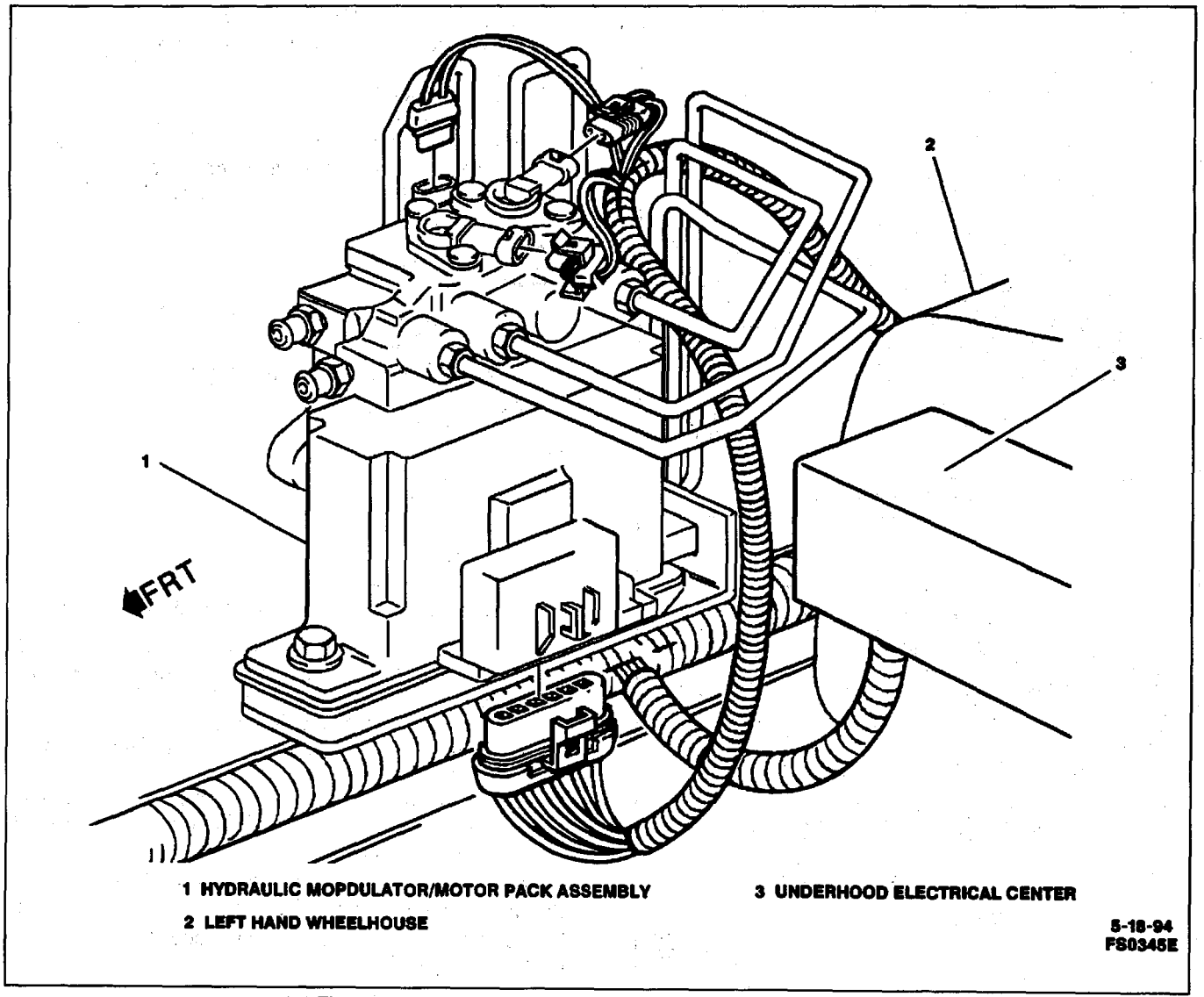


Figure 10 - ABS Hydraulic Modulator/Motor Pack Assembly

Important

- Do Not place your foot on the brake pedal through this entire procedure unless specifically directed to do so.

1. Remove foot from brake pedal.
2. Start engine and allow it to run for at least 10 seconds while observing the amber ABS warning lamp.
3. If the amber ABS warning lamps turned "ON" and stayed "ON" after about 10 seconds, the flushing procedure must be stopped and a Tech 1 must be used to diagnose the ABS malfunction.
4. If the amber ABS warning lamps turned "ON" for approximately 3 seconds, then turned "OFF" and stayed "OFF," turn the ignition "OFF."
5. Repeat Steps 1 through 4 one more time.
6. The entire brake system should now be flushed following either "Pressure Flush" or "Manual Flush" outlined below.

Pressure Flush

Tool Required: J 35589, Bleeding Adapter

NOTICE: Pressure bleeding equipment can be used to perform the flush procedure. The pressure bleeding equipment used for flushing must be of the diaphragm type. It must have a rubber diaphragm between the air supply and the brake fluid to prevent air, moisture, and other contaminants from entering the hydraulic system.

Clean

1. Fluid reservoir cover and surrounding area.

Remove or Disconnect

2. Fluid reservoir cover.
3. Any remaining brake fluid in reservoir.

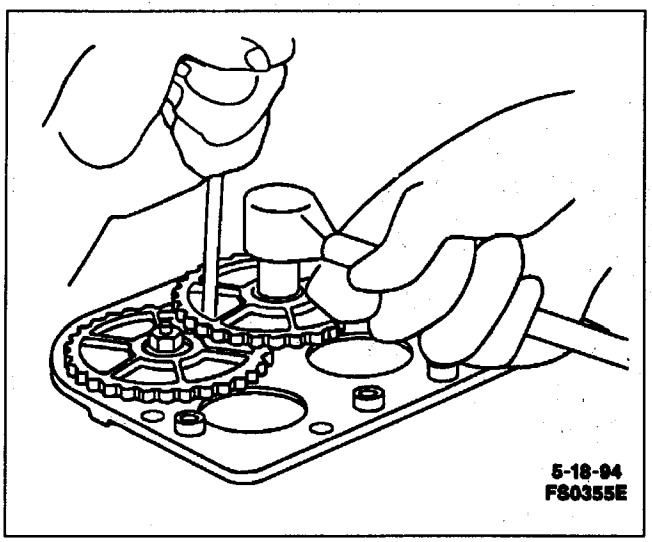


Figure 11 - Gear Removal (Typical)

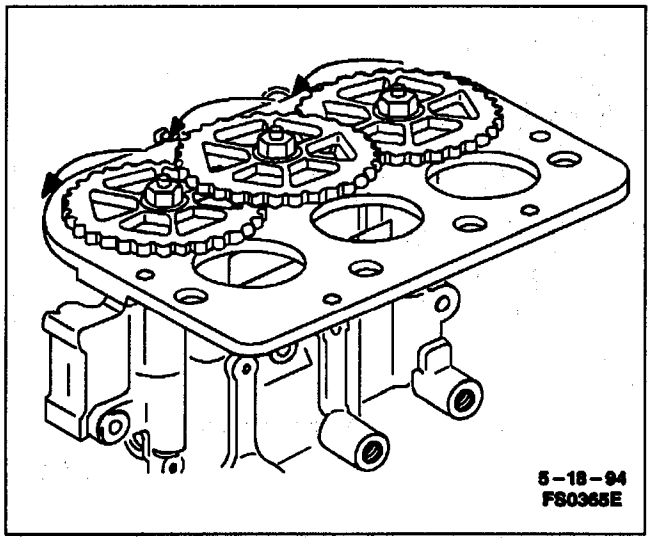


Figure 12 - Gear Positioning (Typical)

Inspect

4. Refill reservoir with clean DOT 3 brake fluid to proper level.

Install or Connect

5. Bleeder adapter J 35589 to brake fluid reservoir.
6. Bleeder adapter to pressure bleeding equipment.

Adjust

7. Pressure bleeding equipment to 35-70 kPa (5-10 psi) and wait for approximately 30 seconds to insure there is no leakage.
8. Pressure bleed equipment to 205-240 kPa (30-35 psi).
9. Proceed as follows with pressure bleeding equipment connected and pressurized:
   A. Attach a clear plastic hose to the rearward bleeder valve on the ABS hydraulic modulator. Place the other end of the hose in a container to collect draining brake fluid. Do not submerge hose end into fluid.
   B. Slowly open bleeder valve and allow fluid to flow until clean brake fluid flows or until at least 118 ml (4 ounces) of fluid is accumulated.
   C. Close valve.
   D. Repeat above procedure for the forward bleeder valve until clean brake fluid flows or until at least 118 ml (4 ounces) of fluid is accumulated.

Tighten

- ABS hydraulic modulator bleeder valve to 9 N·m (80 lb. in.).

10. Raise vehicle and suitably support.

Important

- Flush sequence:
  — Right rear.
  — Left rear.
  — Right front.
  — Left front.

11. Flush wheel brakes in sequence shown above.
    A. Attach bleeder hose to bleeder valve at each wheel and place the other end into a container to collect draining brake fluid. Do not submerge hose end in fluid.
    B. Slowly open bleeder valve and allow fluid to flow.
    C. Close valve when clean brake fluid begins to flow or at least 235 ml (8 ounces) of fluid is accumulated.
12. Repeat Step 11 on left rear wheel brake.
13. Repeat Step 11 on right front wheel brake.
14. Repeat Step 11 on left front wheel brake.
15. Lower vehicle.
16. Remove bleeder adapter.
17. Replace all rubber components listed under "Flushing Procedure," refer to the appropriate "On-Vehicle Service" section.
18. Repeat flushing preparation and flushing procedure Steps 4-16 one more time.

Inspect

19. Fluid level in reservoir and fill to correct level if necessary.

Install or Connect

20. Fluid reservoir cap.
21. Bleed the entire brake hydraulic system; refer to "Bleeding Procedure" in this section.

Manual Flush

Important

- In the following steps, use a suitable container and/or shop rags to catch fluid and prevent it from contacting any painted surfaces.

Clean

1. Fluid reservoir cover and surrounding area.

Remove or Disconnect

2. Fluid reservoir cover.
3. Any remaining brake fluid in reservoir.

Inspect

4. Refill reservoir with clean DOT 3 brake fluid to proper level.

Install or Connect

5. Fluid reservoir cover.
6. Flush ABS hydraulic modulator as follows:
   A. Attach a clear plastic bleeder hose to rearward bleeder valve on the ABS hydraulic modulator and place the other end of hose in a container to collect draining brake fluid. Do not submerge hose end into fluid.
   B. Slowly open rearward bleeder valve one half to one full turn.
   C. Depress brake pedal until fluid begins to flow.
   D. Close valve and release brake pedal. Repeat above steps until clean brake fluid flows or at least 118 ml (4 ounces) of fluid is accumulated.
   E. Repeat above procedure for the forward bleeder valve until clean brake fluid flows or at least 118 ml (4 ounces) of brake fluid is accumulated.

Tighten

- ABS hydraulic modulator bleeder valves to 9 N.m (80 lb. in.).

Remove or Disconnect

7. Fluid reservoir cover.

Inspect

8. Fluid level in reservoir and fill to correct level if necessary.

Install or Connect

9. Fluid reservoir cover.
10. Raise vehicle and suitably support.

Important

- Flush sequence:
  — Right rear.
  — Left rear.
  — Right front.
  — Left front.

11. Flush wheel brakes in sequence shown above.
    A. Attach bleeder hose to bleeder valve at each wheel and place the other end into a container to collect draining brake fluid. Do not submerge hose end in fluid.
    B. Open bleeder valve.
    C. Slowly depress brake pedal.
    D. Close valve and slowly release brake pedal.
    E. Repeat above procedure until clean brake fluid flows or at least 235 ml (8 ounces) of fluid is accumulated.
12. Repeat Step 11 on left rear brake.
13. Repeat Step 11 on right front brake.
14. Repeat Step 11 on left front brake.
15. Lower vehicle.
16. Replace all rubber components listed under "Flushing Procedure," refer to the appropriate "On-Vehicle Service" section.
17. Repeat flushing preparation and flushing procedure Steps 4-15 one more time.

Inspect

18. Fluid level in reservoir and fill to correct level if necessary.

Install or Connect

19. Fluid reservoir cap.
20. Bleed the entire brake hydraulic system; refer to "Bleeding Procedure" in this section.

BLEEDING PROCEDURE

NOTICE: If any brake component is repaired or replaced such that air is allowed to enter the brake system, the entire bleeding procedure MUST be followed.

NOTICE: Use only SUPREME 11 (GM 1052542) or equivalent DOT 3 brake fluid from a clean, sealed container. Do not use fluid from an open container that may be contaminated with water. The use of DOT 5 (silicone) brake fluid is not recommended. Reduced braking performance or durability may result.

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring, cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen the damage.

NOTICE: Prior to bleeding the brakes, the front and rear displacement cylinder pistons must be returned to the topmost position. The preferred method uses a Tech 1 to perform the rehoming procedure. If a Tech 1 is not available, the second procedure may be used, but it is extremely important that the procedure be followed exactly as outlined.

With Tech 1 (Preferred Method)

1. Using a Tech 1 or T-100 (CAMS), select "F5: Motor Rehome." The motor rehome function cannot be performed if current DTCs are present. If DTCs are present, the vehicle must be repaired and DTCs cleared before performing the motor rehome function.
2. The entire brake system should now be bled following either "Pressure Bleeding" or "Manual Bleeding" outlined below.

Without Tech 1

NOTICE: This method can only be used if the amber ABS warning lamp is not illuminated and no DTCs are present.

Important

- Do not place your foot on the brake pedal through this entire procedure unless specifically directed to do so.

1. Remove foot from brake pedal.
2. Start engine and allow it to run for at least 10 seconds while observing the amber ABS warning lamp.
3. If the amber ABS warning lamp turned "ON" and stayed "ON" after about 10 seconds, the bleeding procedure must be stopped and a Tech 1 must be used to diagnose the ABS malfunction.
4. If the amber ABS warning lamp turned "ON" for approximately 3 seconds, then turned "OFF" and stayed "OFF," turn the ignition "OFF."
5. Repeat Steps 1 through 4 one more time.
6. The entire brake system should now be bled following either "Pressure Bleeding" or "Manual Bleeding" outlined below.

Pressure Bleeding

Tool Required: J 35589, Bleeding Adapter

NOTICE: Use only DOT 3 brake fluid from a clean, sealed container. Do not use fluid from an open container that may be contaminated with water. Do not use DOT 5 brake fluid.

NOTICE: Pressure bleeding equipment must be of the diaphragm type. It must have a rubber diaphragm between the air supply and the brake fluid to prevent air, moisture and other contaminants from entering the hydraulic system.

Clean

1. Fluid reservoir cover and surrounding area.

Remove or Disconnect

2. Fluid reservoir cover.

Inspect

3. Fluid to be at proper level. Refer to SECTION 5A. Add clean brake fluid as required.

Install or Connect

4. Bleeder adapter J 35589 to brake fluid reservoir.
5. Bleeder adapter to pressure bleeding equipment.

Adjust

6. Pressure bleed equipment to 35-70 kPa (5-10 psi) and wait for approximately 30 seconds to insure there is no leakage.
7. Pressure bleed equipment to 205-240 kPa (30-35 psi).
8. Proceed as follows with pressure bleeding equipment connected and pressurized:
   A. Attach a clear plastic bleeder hose to the rearward bleeder valve on the ABS hydraulic modulator. Submerge opposite hose end in a clean container partially filled with clean brake fluid.
   B. Slowly open bleeder valve and allow fluid to flow until no air is seen in fluid.
   C. Close valve when fluid flows without any air bubbles.
   D. Repeat Steps 9B and 9C until no air bubbles are present.
   E. Relocate the bleeder hose on the forward ABS hydraulic modulator bleeder valve and repeat Steps 9A through 9D.

Tighten

- ABS hydraulic modulator bleeder valves to 9 N.m (80 lb. in.).

Important

- Use a shop cloth to catch escaping brake fluid. Take care to prevent fluid from running down motor pack and entering the motor pack base or into the electrical connector. Also, do not allow brake fluid to contact any painted surfaces as surface damage will occur. If brake fluid does contact any surface, flush surface with water to lessen damage.

9. Proceed to bleed the master cylinder brake connections as follows with pressure bleeding equipment connected and pressurized:
   A. Slowly loosen the forward brake pipe tube nut on the master cylinder and check for air in escaping fluid.
   B. When air flow ceases, immediately tighten tube nut.

Tighten

- Master cylinder tube nut to 32 N.m (24 lb. ft.).

   C. Repeat Steps 10A and 10B for the rearward master cylinder brake pipe connection.

10. Proceed to bleed the brake combination valve connections as follows with pressure bleeding equipment connected and pressurized:
    A. Slowly loosen the forward brake pipe tube nut on the brake combination valve and check for air in escaping fluid.
    B. When air flow ceases, immediately tighten tube nut.

Tighten

- Brake combination valve tube nut to 18 N.m (13 lb. ft.).

    C. Repeat Steps 11A and 11B for the rearward brake combination valve pipe connection.
11. Proceed to bleed the ABS hydraulic modulator brake connections as follows with pressure bleeding equipment connected and pressurized:
    A. Slowly loosen the forward brake pipe tube nut on the ABS hydraulic modulator and check for air in escaping fluid.
    B. When air flow ceases, immediately tighten tube nut.

Tighten

- ABS hydraulic modulator tube nut to 32 N.m (24 lb. ft.).

    C. Repeat Steps 12A and 12B for the remaining ABS hydraulic modulator brake pipe connections, moving from front to rear.
12. Raise vehicle and suitably support.
13. Proceed as follows to bleed the rear wheel brakes:
    A. Attach a clear plastic bleeder hose to the right rear wheel bleeder valve and submerge opposite hose end in a clean container partially filled with clean brake fluid.
    B. Slowly open bleeder valve and allow fluid to flow.
    C. Close valve when fluid begins to flow without any air bubbles. Tap lightly on the caliper or backing plate to dislodge any trapped air bubbles.
    D. Relocate bleeder hose to the left rear wheel bleeder valve and repeat Steps 13A through 16C.
14. Remove pressure to the pressure bleeding equipment.
15. Attach a clear plastic bleeder hose to the right front wheel bleeder valve and submerge opposite hose end in a clean container partially filled with clean brake fluid.
16. Turn the ignition to "RUN," engine "OFF."
17. Open the bleeder valve and apply the brake until the red BRAKE warning lamp turns "ON." This shuttles the brake pressure differential warning valve.
18. Close bleeder valve.
19. Reapply pressure to pressure bleeding equipment.
20. Turn the ignition "OFF."

Important

- Do not reapply the brakes after closing the bleeder valve.

21. Lower vehicle.
22. Repeat the entire Step 8.
23. Raise vehicle and suitably support.
24. Repeat the entire Step 13.
25. Proceed as follows to bleed the front wheel brakes:
    A. Attach a clear plastic bleeder hose to the right front wheel bleeder valve and submerge opposite hose end in a clean container partially filled with clean brake fluid.
    B. Slowly open bleeder valve and allow fluid to flow.
    C. Close valve when fluid begins to flow without any air bubbles. Tap lightly on the caliper to dislodge any trapped air bubbles.
    D. Relocate bleeder hose to the left front wheel bleeder valve and repeat Steps 25A through 25C.
26. Lower vehicle.
27. Remove pressure bleeding equipment, including bleeder adapter J 35589.

Inspect

28. Fluid level in reservoir and fill to proper level if necessary.

Install or Connect

29. Fluid reservoir cap.

Inspect

30. With ignition to "RUN" apply brake pedal with moderate force and hold. Note pedal travel and feel.
    - If pedal feels firm and constant and pedal travel is not excessive, start the engine. With the engine running, recheck the pedal travel. If it's still firm and constant and pedal travel is not excessive, go to Step 31.
    - If pedal feels soft or has excessive travel either initially or after the engine is started, the following procedure may be used. With the Tech 1, "Release" then "Apply" each ABS motor 2 to 3 times and cycle each ABS solenoid 5 to 10 times. This procedure will ensure all trapped air has been removed from the ABS hydraulic modulator bores. Now repeat bleeding procedure starting at Step 1.
31. Road test the vehicle.
    - Make several normal (non ABS) stops from a moderate speed to ensure proper brake system function. Allow adequate cooling time between stops.

Manual Bleeding

NOTICE: Use only DOT 3 brake fluid from a clean, sealed container. Do not use brake fluid from an open container that may be contaminated with water. Do not use DOT 5 brake fluid.

Important

- In the following steps, use a suitable container and/or shop cloths to catch fluid and prevent it from contacting any painted surfaces.

Clean

1. Fluid reservoir cover and surrounding area.

Remove or Disconnect

2. Fluid reservoir cover.

Inspect

3. Fluid level in reservoir and fill to the correct level if necessary.

Install or Connect

4. Fluid reservoir cover.
5. Prime ABS hydraulic modulator as follows:
   A. Attach clear plastic bleeder hose to the rearward bleeder valve on the ABS hydraulic modulator. Submerge opposite hose end in a clean container partially filled with clean brake fluid.
   B. Slowly open rearward bleeder valve one half to one full turn.
   C. Depress brake pedal and hold until fluid begins to flow.
   D. Close valve and release brake pedal.
   E. Repeat Steps 5B and 5D until no air bubbles are present.
   F. Relocate the bleeder hose on the forward ABS hydraulic modulator bleeder valve and repeat Steps 5A through 5E.

Important

- Once fluid is seen to flow from both ABS hydraulic modulator bleeder valves, the ABS hydraulic modulator is sufficiently full of fluid. However, it may not be completely purged of air. At this point move to the wheel brakes and bleed them. This ensures that the lowest points in the system are completely free of air and then the ABS hydraulic modulator can be purged of any remaining air.

Remove or Disconnect

6. Fluid reservoir cover.

Inspect

7. Fluid level in reservoir and fill to the correct level if necessary.

Install or Connect

8. Fluid reservoir cover.
9. Raise vehicle and suitable support.

Important

- Bleed sequence:
  — Right rear.
  — Left rear.
  — Right front.
  — Left front.

10. Bleed wheel brakes in sequence shown above.
    A. Attach a clear plastic bleeder hose to the bleeder valve at each wheel and submerge opposite hose end in a clean container partially filled with clean brake fluid.
    B. Open bleeder valve.
    C. Slowly depress brake pedal.
    D. Close valve and slowly release brake pedal.
    E. Wait 5 seconds.
    F. Repeat Steps 10B through 10E until the brake pedal feels firm and no air bubbles are observed in the bleeder hose.
       - To assist in freeing entrapped air, tap lightly on caliper or backing plate with a rubber mallet.
11. Repeat Step 10 on left rear wheel brake.
12. Repeat Step 10 on right front wheel brake.
13. Repeat Step 10 on left front wheel brake.
14. Lower vehicle.

Remove or Disconnect

15. Fluid reservoir cover.

Inspect

16. Fluid level in reservoir and fill to the correct level if necessary.

Install or Connect

17. Fluid reservoir cover.
18. Bleed the ABS hydraulic modulator.
    A. Attach a clear plastic bleeder hose to the rearward bleeder valve on the ABS hydraulic modulator. Submerge opposite hose end in a clean container partially filled with clean brake fluid.
    B. Depress brake pedal with moderate force.
    C. Slowly open rearward bleeder valve one half to one full turns and allow fluid to flow.
    D. Close valve and slowly release brake pedal.
    E. Wait 5 seconds.
    F. Repeat Steps 18B through 18E until the no air bubbles are observed in the bleeder hose.

G. Relocate the bleeder hose on the forward ABS hydraulic modulator bleeder valve and repeat Steps 18A through 18F.

Tighten

- ABS hydraulic modulator bleeder valves to 9 N.m (80 lb. in.).

Remove or Disconnect

19. Fluid reservoir cover.

Inspect

20. Fluid level in reservoir and fill to the correct level if necessary.

Install or Connect

21. Fluid reservoir cover.

Inspect

22. With ignition to "RUN" apply brake pedal with moderate force and hold. Note pedal travel and feel.
    - If pedal feels firm and constant and pedal travel is not excessive, start the engine. With the engine running, recheck the pedal travel. If it's still firm and constant and pedal travel is not excessive, go to Step 23.
    - If pedal feels soft or has excessive travel either initially or after the engine is started, the following procedure may be used. With the Tech 1, "Release" then "Apply" each ABS motor 2 to 3 times and cycle each ABS solenoid 5 to 10 times. When finished, be sure to "Apply" the front and rear motors on the ABS hydraulic modulator. This procedure will ensure all trapped air has been removed from the ABS hydraulic modulator bores. Now repeat bleeding procedure starting at Step 1.
23. Road test the vehicle.
    - Make several normal (non-ABS) stops from a moderate speed to ensure proper brake system function. Allow adequate cooling time between stops.

ABS HYDRAULIC MODULATOR BLEEDER VALVES

Figure 13

Remove or Disconnect

- Damaged bleeder valve or valves.

Install or Connect

- New bleeder valve or valves.

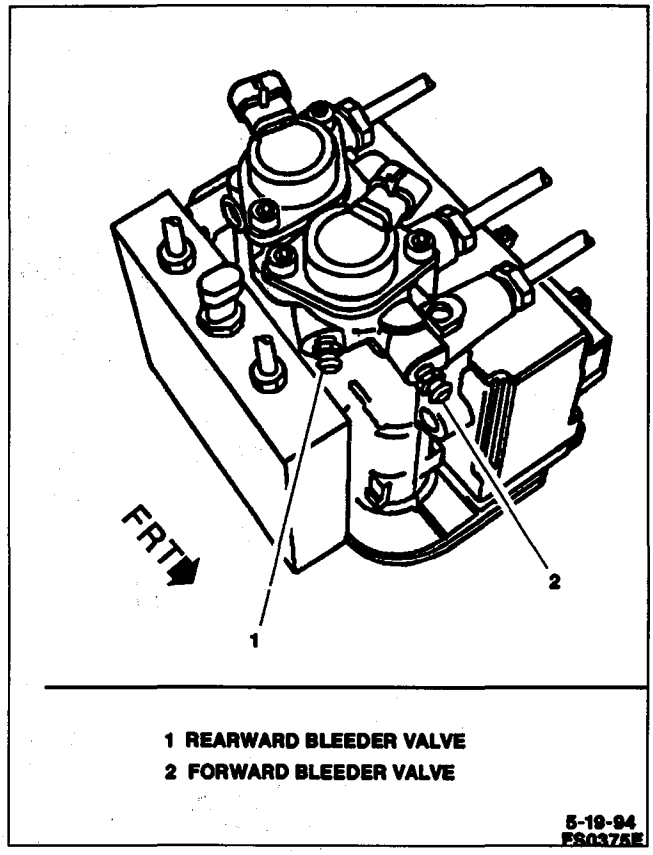


Figure 13 - ABS Hydraulic Modulator Bleeder Valve Locations

Tighten

- Bleeder valve to 9 N.m (80 lb. in.).

ABS HYDRAULIC MODULATOR SOLENOID

Figure 14

Remove or Disconnect

1. Solenoid electrical connector.
2. Torx® head bolts.
3. Solenoid.

Important

- Be sure the seal is still attached to the solenoid when it is removed. If not, check solenoid bore in modulator.
- Do not attempt to disassemble solenoid, it is serviceable only as an assembly.
- Lubricate seal on new solenoid with clean brake fluid.

Install or Connect

1. New solenoid.
    - Verify that the solenoid lip seal is properly positioned before solenoid is installed in ABS hydraulic modulator (refer to Figure 14).

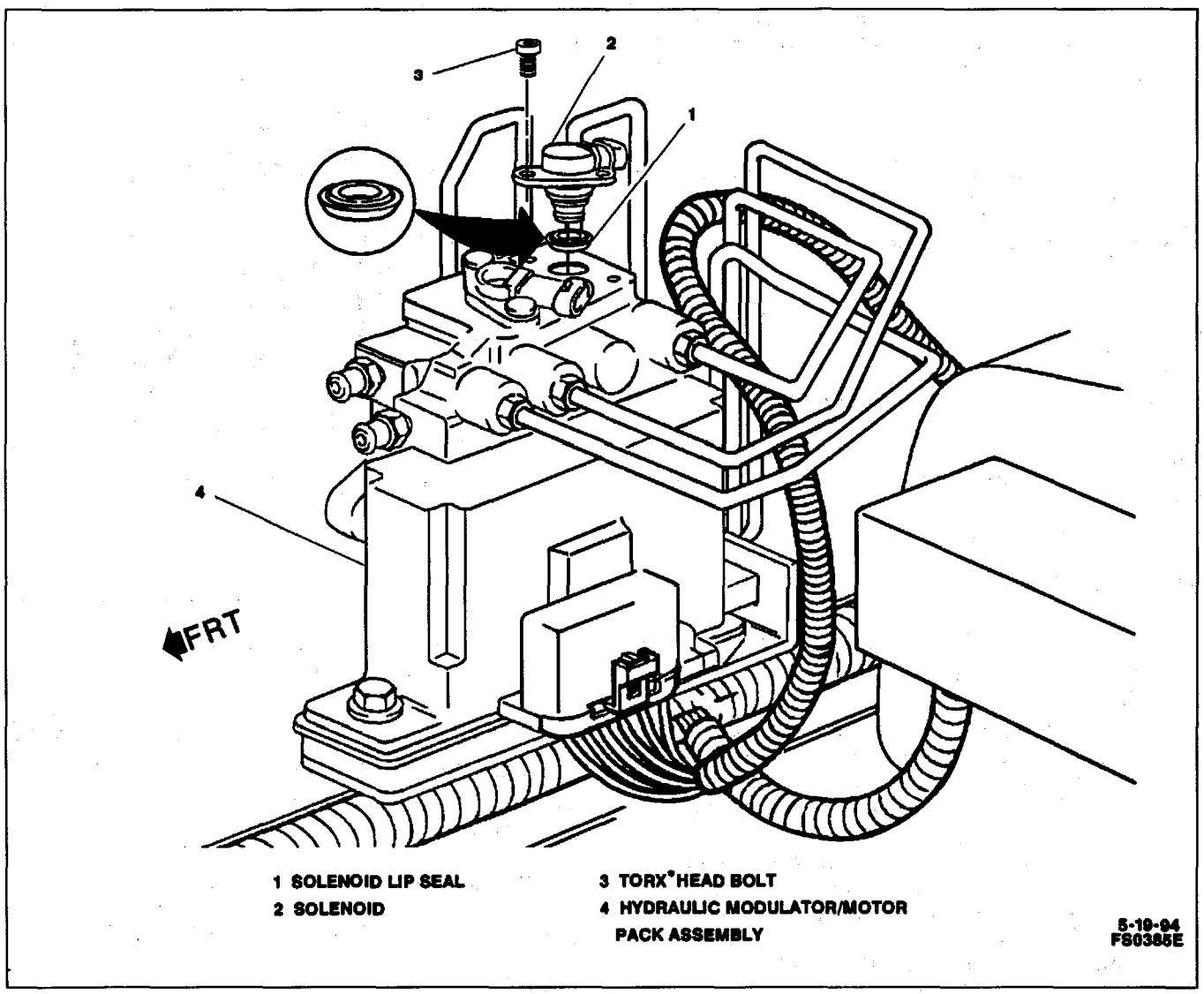


Figure 14 - Hydraulic Modulator Solenoid Removal

- Position solenoid so that its electrical connector will face the same direction as the solenoid that was removed.
- By hand, press down firmly on solenoid until its flange seats on ABS hydraulic modulator.

2. Torx® head bolts.

Tighten

- Bolts to 4.5 N.m (40 lb. in.).

3. Solenoid electrical connector to solenoid.

Important

- Make sure the solenoid connectors are installed on correct solenoids.
- It is necessary to bleed the entire system. Refer to "Bleeding System" in this section.

ABS HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY

Figure 10

CAUTION: To help avoid personal injury, due to a retained load on the ABS hydraulic modulator, the gear tension relief function of the Tech 1 must be performed prior to the removal of the ABS hydraulic modulator.

Remove or Disconnect

1. Using Tech 1, perform "Gear Tension Relief Sequence," as outlined in this section.
2. Air cleaner duct assembly.
3. Two solenoid electrical connectors.
4. Brake pressure differential warning switch electrical connector.
5. 6-pin motor pack electrical connector.

6. Five brake pipes (two to master cylinder, two to wheel brakes, one to TCS modulator).
   - Place shop cloth on top of motor pack to catch any dripping fluid. Take care not to allow any brake fluid to enter the bottom of the motor pack or the electrical connectors. Plug open brake pipes to prevent fluid loss and contamination.
7. Bolt attaching front of ABS hydraulic modulator/motor pack assembly to frame rail.
8. ABS hydraulic modulator/motor pack assembly from vehicle.

Install or Connect

1. ABS hydraulic modulator/motor pack assembly in vehicle.
2. Bolt attaching ABS hydraulic modulator/motor pack assembly to frame rail.

Tighten

- Bolt to 9.0 N.m (80 lb. in.).

3. Five brake pipes to ABS hydraulic modulator/motor pack assembly.
4. 6-pin motor pack electrical connector.
5. Brake pressure differential warning switch electrical connector.
6. Two solenoid electrical connectors.
7. Air cleaner duct assembly.

Important

- Bleed entire brake system as outlines in "Bleeding System" in this section.

Tighten

- Two brake combination valve tube nuts to 18 N.m (13 lb. ft.).
- Three hydraulic modulator tube nuts to 32 N.m (24 lb. ft.).

ELECTRONIC BRAKE CONTROL MODULE (EBCM)

Figure 15

Remove or Disconnect

1. Fasteners on lower sound insulator panel under steering column.
2. Lower sound insulator panel from vehicle.
3. Manual transmission only: left side kick panel.
4. Nut attaching EBCM bracket to upper I/P.
5. Push in retainer ("Christmas Tree") attaching EBCM bracket to side wall.

Important

- It will be necessary to cut the push in retainer head off to remove EBCM bracket. Do not attempt to pry fastener out as damage to the EBCM bracket may result.

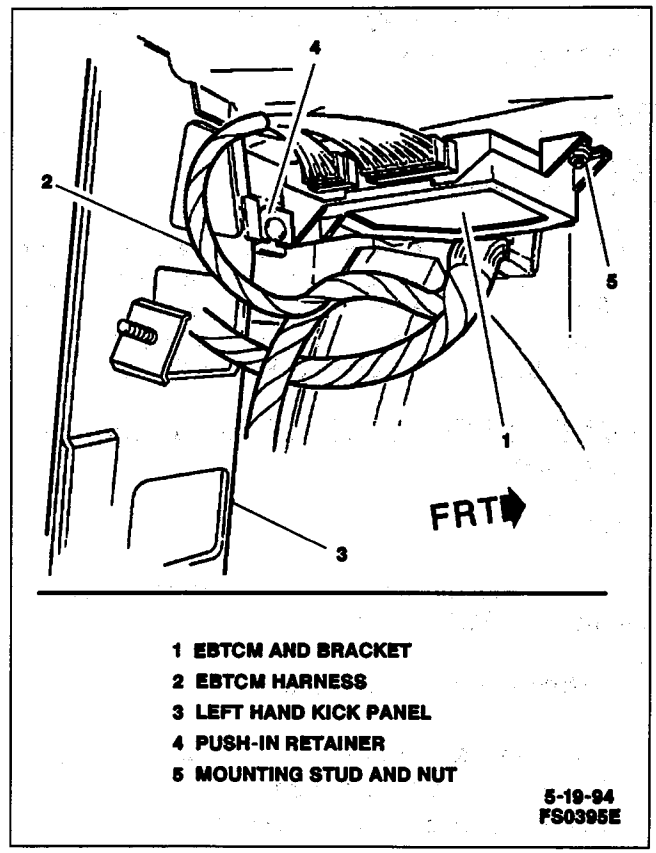


Figure 15 - EBCM Location

6. EBCM and EBCM bracket from mounting place.
7. EBCM electrical connectors.
8. EBCM from vehicle.
9. Remaining portion of push in retainer.

Important

- It is necessary to remove the destroyed retainer to insure proper retaining force when installing the new push in retainer.

Install or Connect

1. EBCM electrical connectors.
2. EBCM and EBCM bracket into mounting location.
3. New push in retainer ("Christmas Tree") attaching EBCM bracket to side wall.
4. Nut attaching EBCM bracket to upper I/P.

Tighten

- Nut to 25.0 N.m (18.5 lb. ft.).

5. Manual transmission only: left side kick panel.
6. Lower sound insulator panel and fasteners.

FRONT WHEEL BEARING AND SPEED SENSOR ASSEMBLY

Figure 16

Important

- The front wheel speed sensors and rings are integral with the hub and bearing assemblies. Should a speed sensor or ring require replacement, the entire hub and bearing assembly must be replaced. Refer to SECTION 3C.

FRONT WHEEL SPEED SENSOR JUMPER HARNESS

Figure 17

Raise and support vehicle on a suitable hoist as indicated in SECTION 0A.

Remove or Disconnect

1. Connector from wheel speed sensor.
2. Harness from retaining clips.
3. Harness grommets from retainers.
4. Upper jumper harness connector attached to inside of frame rail.

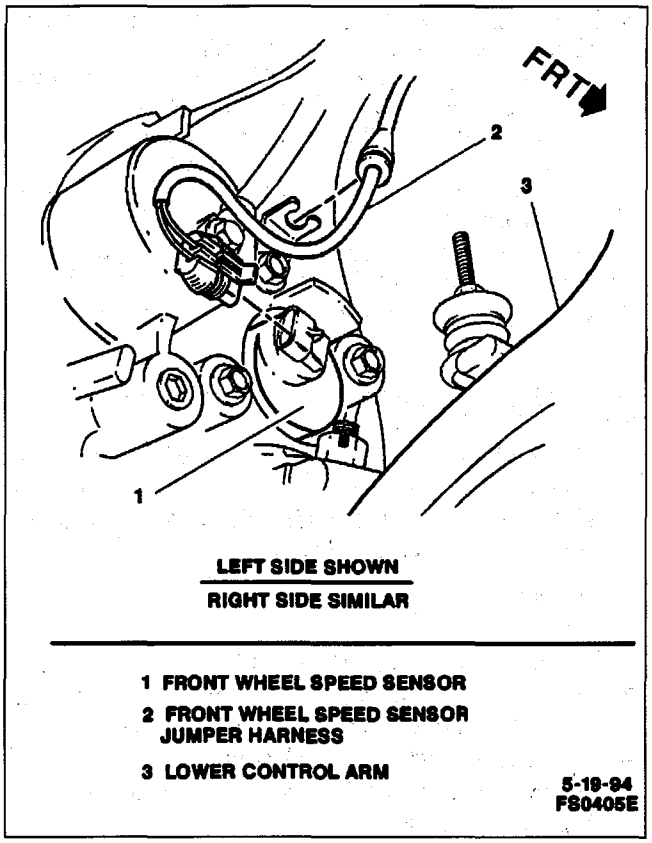


Figure 16 - Front Wheel Bearing and Speed Sensor Assembly

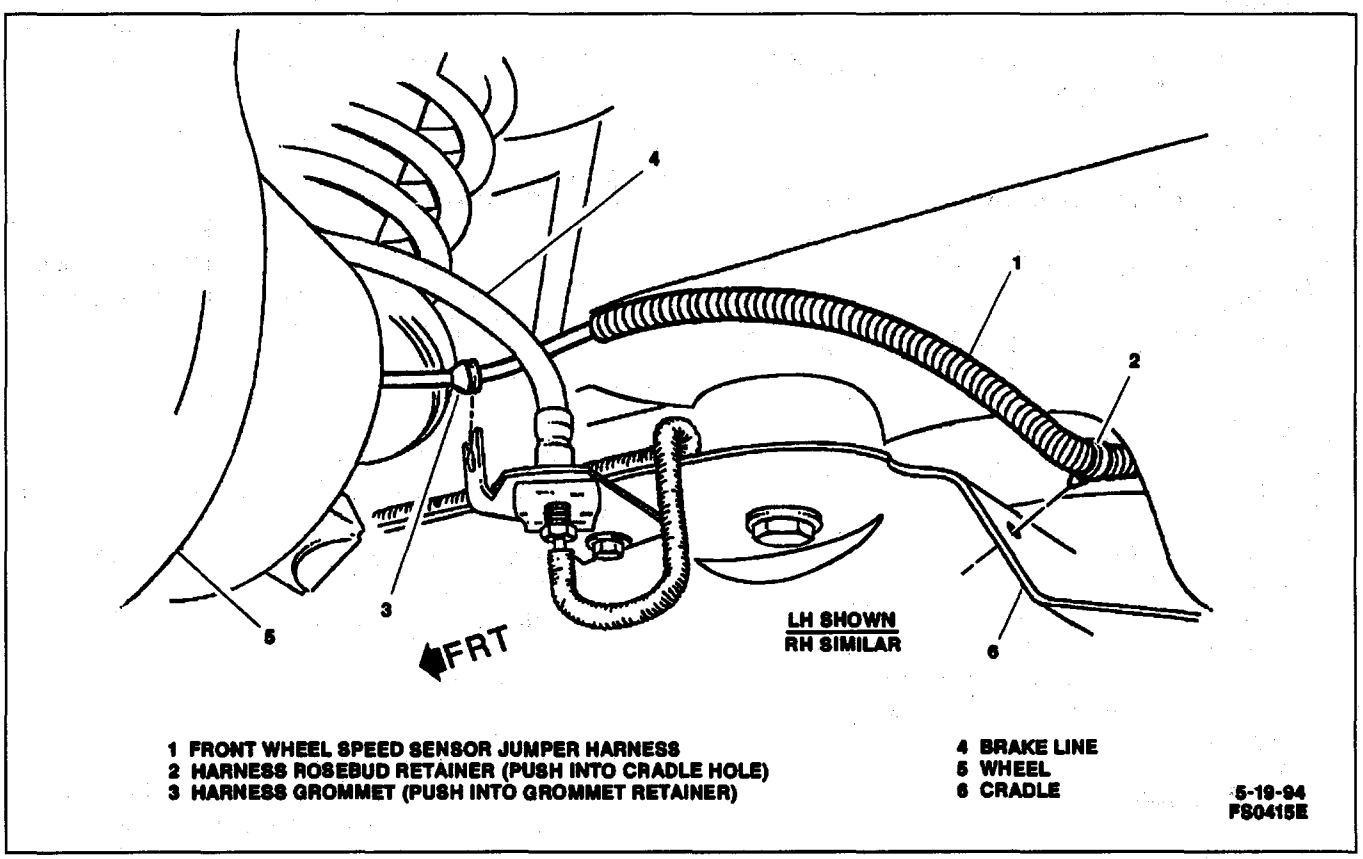


Figure 17 - Front Wheel Speed Sensor Jumper Harness

Install or Connect

1. Upper jumper harness connector attached to inside of frame rail.
2. Harness to retaining clips.
3. Harness rubber grommets into retainers.
4. Connector to wheel speed sensor.

REAR WHEEL SPEED SENSOR

Figure 18

Raise and support vehicle on a suitable hoist as indicated in SECTION 0A.

Remove or Disconnect

1. Connector from wheel speed sensor.
2. Bolt attaching sensor to backing plate.
3. Sensor from backing plate.

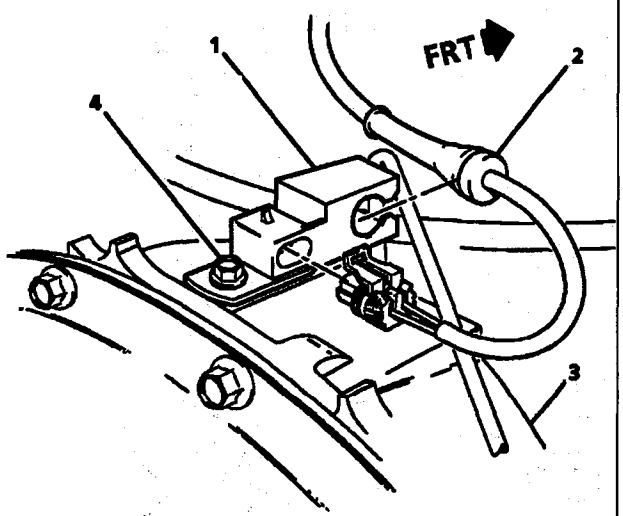
Install or Connect

1. Sensor into backing plate.
2. Bolt attaching sensor to backing plate.

Tighten

- Bolt to 10 N.m (89 lb. in.).

3. Connector to wheel speed sensor.



1 REAR WHEEL SPEED SENSOR
2 REAR WHEEL SPEED SENSOR JUMPER HARNESS
3 REAR AXLE HOUSING
4 REAR WHEEL SPEED SENSOR MOUNTING BOLT

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Figure 18 - Rear Wheel Speed Sensor

REAR WHEEL SPEED SENSOR TOOTHED RINGS

Important

- The rear wheel speed sensor toothed rings are an integral part of the rear axle shafts. If it has been determined that the toothed rings must be replaced, refer to SECTION 4B for removal and installation procedures.

REAR WHEEL SPEED SENSOR JUMPER HARNESS

Remove or Disconnect

1. Connector from wheel speed sensors.
2. Jumper harness grommet from retainer.
3. Upper jumper harness connector from rear body pass-thru connector.

Install or Connect

1. Upper jumper harness connector to rear body pass-thru connector.
2. Connector to wheel speed sensors.
3. Jumper harness grommet into retainer.

ABS RELAY

Figure 19

Remove or Disconnect

1. ABS relay cover.
2. ABS relay from connector.

Install or Connect

1. ABS relay to connector.
2. ABS relay cover.

BRAKE COMBINATION VALVE

Refer to SECTION 5A.

WARNING/INDICATOR LAMPS

Refer to SECTION 8C for replacement procedures and detailed information.

ELECTRICAL CONNECTORS

Figure 20

Some ABS VI components are equipped with electrical connectors using a Connector Position Assurance (CPA) lock. This feature insures that when the connectors are installed they are aligned properly and connected securely.

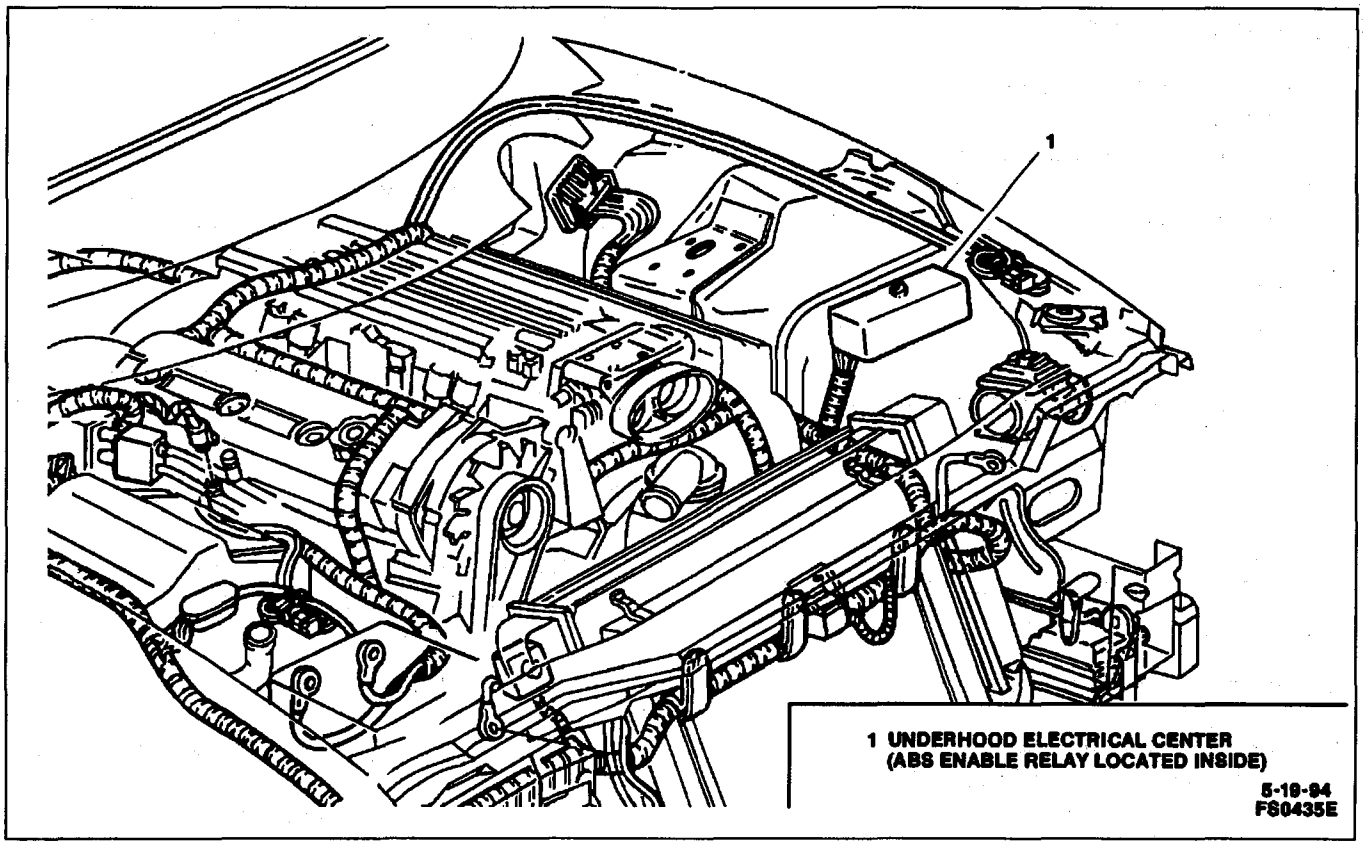


Figure 19 - ABS Relay Location

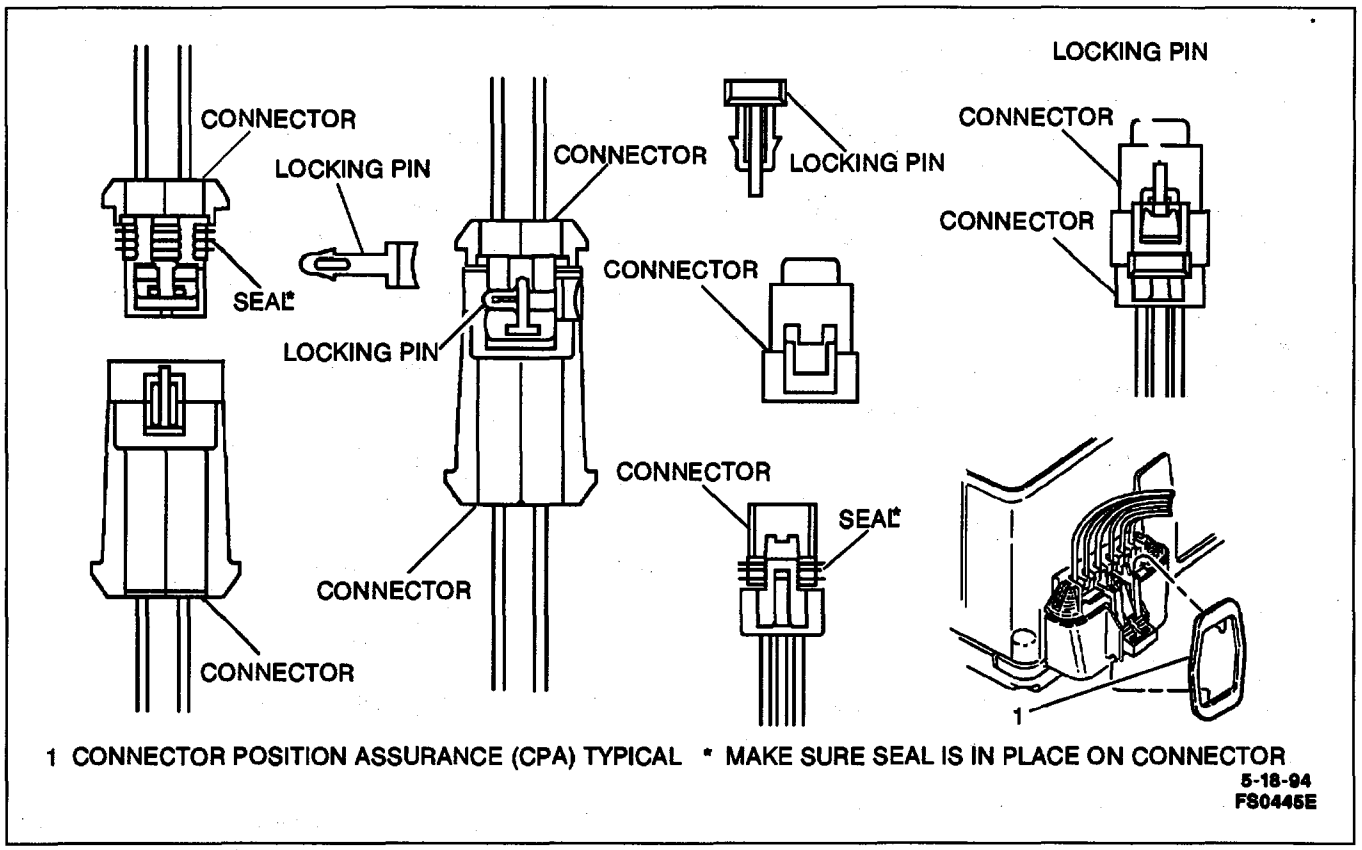


Figure 20 - ABS VI Electrical Connectors (Typical)

Important

- Remove the lock before separating the electrical connectors.
- Take care not to damage the locking pin during removal.
- Make sure that the rubber connector seal is in place on the connector before and after connection.
- Always install the lock after the connection is made.

FUSE AND FUSIBLE LINKS

Refer to SECTION 8A-11 for repair or replacement information.

UNIT REPAIR

CAUTION: To help avoid personal injury, due to a retained load on the ABS hydraulic modulator/motor pack assembly, the gear tension relief function of the Tech 1 must be performed prior to removal of the ABS hydraulic modulator/motor pack assembly.

NOTICE: The following service procedures shall be performed only after the ABS hydraulic modulator/motor pack assemblies have been removed from the vehicle. Do not perform these procedures with the unit installed on the vehicle. Complete overhaul of the ABS hydraulic modulator/motor pack assemblies are not authorized - only the following steps. These steps will break the unit down into major components for replacement purposes.

GEAR COVER

Figure 21

Disassemble

1. Torx® head screws attaching gear cover.
2. Remove gear cover.

Assemble

1. Gear cover to hydraulic modulator/motor pack assembly.
2. Torx® head screws.

Tighten

- Torx® bolts to 4 N.m (35 lb. in.).

MOTOR PACK

Figure 21

Disassemble

1. Remove gear cover.
2. Torx® head screws attaching motor pack.

Important

- Use care when handling motor pack to ensure motor pack connector is not damaged, or accidental intrusion of brake fluid into the motor pack does not occur. This may result in a premature failure of the motor pack.
- Take care in handling the motor pack. If dropped or damaged during handling, the motor pack must be replaced.

3. Remove motor pack.

Important

- If disassembly of the hydraulic modulator/motor pack assembly was due to a ABS hydraulic functional test that did not pass, the "Automated Motor Pack Diagnosis Test" described in this section should be performed at this time to isolate the motor pack or hydraulic modulator.
- No repair of the motor pack is authorized. Replace as an assembly.

Assemble

1. With the hydraulic modulator upside down, and the gears facing you, rotate each hydraulic modulator gear counterclockwise until movement stops. This procedure will position the pistons very close to their "home" position of the modulator bore, simplifying the brake bleeding procedure (refer to Figure 14).
2. Motor pack to hydraulic modulator.

Important

- Take care in handling the motor pack. If dropped or damaged during handling the motor pack must be replaced.
- Align each of the three ABS motor pack pinions (two on TCS) with the hydraulic modulator gears.

3. Torx® head screws.

Tighten

- Torx® head screws to 4.5 N.m (40 lb. in.).

4. Gear cover to hydraulic modulator/motor pack assembly.

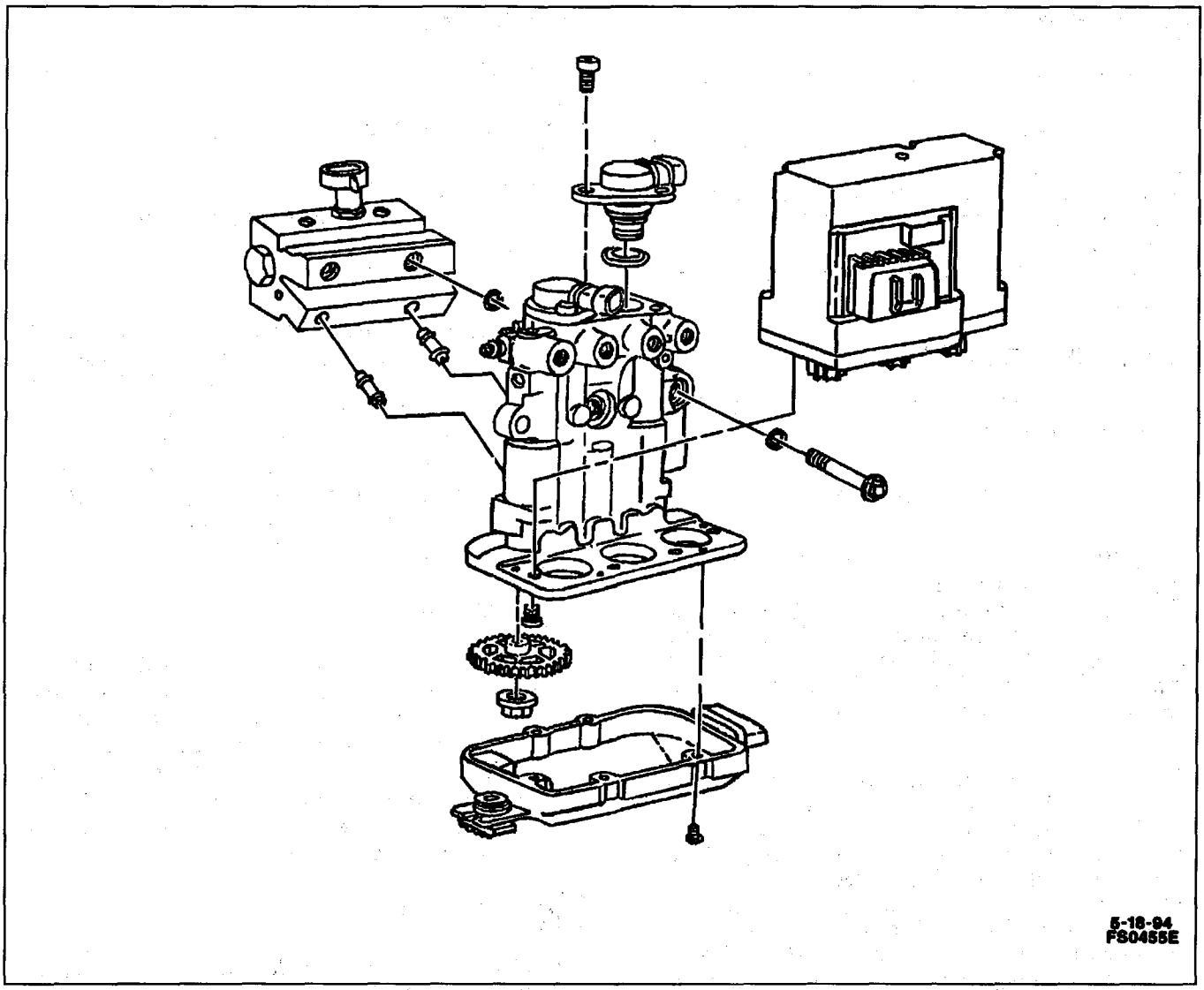


Figure 21 - ABS Hydraulic Modulator Components

GEAR REPLACEMENT (Typical)

Figures 11 and 12

Important

- Do not attempt to repair damaged motor packs or hydraulic modulators. Other than modulator drive gear replacement, repair of these assemblies is not authorized. Do not lubricate or oil gears on motor pack.

CAUTION: The modulator drive gears are under spring load and will turn during disassembly. After removing hydraulic modulator drive gear cover, exercise extreme care not to place fingers into the gear set, since fingers can be pinched by rotating gears.

Disassemble

1. Hydraulic modulator. Refer to "Hydraulic Modulator" in this section.
2. Torx® head screws attaching gear cover.
3. Motor pack to hydraulic modulator Torx® head screws.

Important

- Take care in handling the motor pack. If dropped or damaged in the handling, the motor pack must be replaced.

4. Separate motor pack from hydraulic modulator.
5. Three ABS modulator drive gears (two on TCS) to modulator drive shaft retaining nuts.
6. Gears from modulator (refer to Figure 11).

NOTICE: Do not allow gear to turn while removing the retaining nut, since the modulator piston can hit the top of the modulator bore, damaging the piston. Turn the modulator gear to position the piston in the center of its travel. Place a screwdriver through the holes in the gears (not between the gears) into the recessed hole in the modulator base. This will prevent the gear from turning, aiding in gear removal.

NOTICE: Do not allow gear to turn while tightening the retaining nut, since the modulator piston can bottom out in the modulator bore damaging the piston. Turn the modulator gear to position the piston in the center of its travel. Place a screwdriver through the holes in the gears (not between the gears) into the recessed hole in the modulator base. This will prevent the gear from turning, aiding in gear installation (refer to Figure 11).

Assemble

1. Position hydraulic modulator drive gears onto hydraulic modulator drive shaft.
2. Three ABS (two on TCS) gear retaining nuts.

Tighten

- Nuts to 8.5 N.m (76 lb. in.).

3. With the hydraulic modulator upside down, and the gears facing you, rotate each hydraulic modulator gear counterclockwise until movement stops. This procedure will position the pistons very close to their "home" position of the hydraulic modulator bore, simplifying the brake bleeding procedure (refer to Figure 14).
4. Position motor pack onto hydraulic modulator, aligning the three ABS motor pack gears (two on TCS) with the modulator gears.

Important

- Take care in handling the motor pack. If dropped or damaged during handling, the motor pack must be replaced.

5. Motor pack to hydraulic modulator Torx® head screws.

Tighten

- Torx® head screws 4.5 N.m (40 lb. in.).

6. Gear cover onto hydraulic modulator with Torx® head screws.

Tighten

- Torx® head screws to 4 N.m (35 lb. in.).

7. Hydraulic modulator. Refer to "Hydraulic Modulator" in this section.

HYDRAULIC MODULATOR

Figure 21

Disassemble

1. Remove gear cover. Refer to "Gear Cover" in this section.
2. Remove motor pack. Refer to "Motor Pack" in this section.
3. Two hydraulic modulator to brake combo valve banjo bolts; separate hydraulic modulator from brake combo valve.
4. Two transfer tubes with O-rings from brake combo valve or hydraulic modulator.
5. Banjo bolt O-rings from brake combo valve and hydraulic modulator.

Important

- If hydraulic modulator is to be replaced, install the three gears in the same location on replacement hydraulic modulator. Refer to "Gear Replacement" in this section.
- No repair of the hydraulic modulator is authorized. Replace as an assembly.
- Refer to SECTION 5A for repair of brake combo valve.
- Use new transfer tube assemblies when assembling the hydraulic modulator/brake combo valve assembly. Make sure two O-rings are properly installed on each transfer tube.

Assemble

1. Two transfer assemblies.
   - Lubricate transfer tube assembly O-rings with clean brake fluid.
   - Install transfer tube assemblies in ports in hydraulic modulator and push in by hand to bottom.
2. Lubricate new banjo bolt O-ring with clean brake fluid and install into the brake combo valve and hydraulic modulator.
3. Hydraulic modulator to brake combo valve.
   - Hold brake combo value and rock into position on hydraulic modulator inserting transfer tube assemblies into brake combo valve ports.
4. Two hydraulic modulator to brake combo valve banjo bolts.

Tighten

- Banjo bolts to 16 N.m (12 lb. ft.).

5. With the hydraulic modulator upside down, and the gears facing you, rotate each hydraulic modulator gear counterclockwise until movement stops. This procedure will position the pistons very close to their "home" position of the modulator bore simplifying the brake bleeding procedure (refer to Figure 14).
6. Motor pack to hydraulic modulator.

7. Gear cover to hydraulic modulator/motor pack assembly.

MASTER CYLINDER

Refer to SECTION 5A for repair of master cylinder.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

ABS Hydraulic Modulator Bleeder Valves	9.0 N·m (80 lb. in.)
ABS Hydraulic Modulator Solenoid Torx® Head Bolt	4.5 N·m (40 lb. in.)
Electronic Brake Control Module (EBCM) Nut	25 N·m (18.5 lb. ft.)
ABS Hydraulic Modulator Mounting Bolt	9.0 N·m (80 lb. in.)
Three Hydraulic Modulator Brake Pipe Tube Nuts	32 N·m (24 lb. ft.)
Two Brake Combination Valve Brake Pipe Tube Nuts	18 N·m (13 lb. ft.)
Two Master Cylinder Brake Pipe Tube Nuts	32 N·m (24 lb. ft.)
Modulator Drive Gear Nuts	8.5 N·m (75 lb. in.)
Torx® Head Screws Attaching Gear Cover	4.0 N·m (35 lb. in.)
Torx® Head Screws Attaching Motor Pack	4.5 N·m (40 lb. in.)
Two Banjo Bolts Attaching Brake Combination Valve to ABS Hydraulic Modulator	16 N·m (12 lb. ft.)

SPECIAL TOOLS

Figure 22

The J 39200 High Impedance Multimeter is the only DVM authorized for use in diagnosing and servicing the ABS VI system.

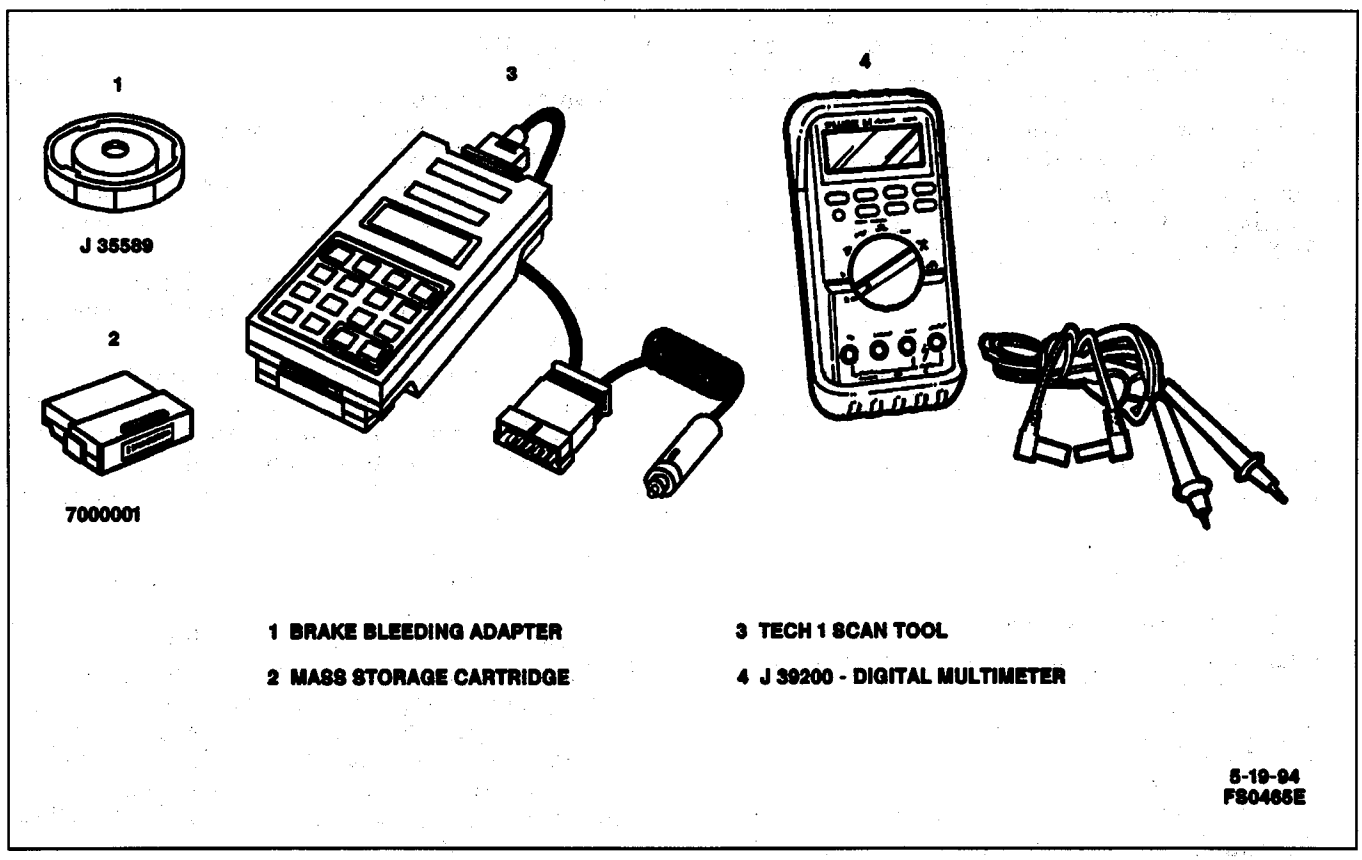


Figure 22 - ABS VI Special Tools

SECTION 5E2

ANTILOCK BRAKE SYSTEM WITH TRACTION CONTROL

CAUTION: To help avoid personal injury due to poor braking, DO NOT tap into the vehicle's brake system to operate a trailer brake system.

NOTICE: Always use the correct fasteners in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications: Some bolts are designed to permanently stretch. If a stronger fastener is used, the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent. Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used, part damage may occur. Fasteners that need to be replaced when removed will be called out. Fasteners that require thread locker or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

NOTICE: The use of rubber hoses or parts other than those specified for the Antilock Brake System (ABS) may lead to functional problems requiring replacement of the hydraulic parts. Replace all components included in repair kits used to service this system. Lubricate rubber parts with clean, fresh brake fluid to ease assembly. Do not use lubricated shop air on brake past as damage to rubber components may result. If any hydraulic component is removed or brake line disconnected, it is necessary to bleed the entire brake system. The fastener tightening specifications specified are for dry, unlubricated fasteners.

NOTICE: Use only Supreme 11 (GM 1052542) or equivalent DOT 3 brake fluid. The use of DOT 5 (silicone) brake fluid is not recommended. Reduced braking performance or durability may result.

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring, cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen the damage.

DELCO CHASSIS ABS VI TECHNICAL ASSISTANCE

For 1995 model year, Delco Chassis Division has an ABS VI field service plan in place. This plan has been developed to improve customer satisfaction. The plan is set up to help Delco Chassis understand each field malfunction and to allow us to obtain all of the failed components back for detailed analysis. With this direct field contact, we are able to continuously improve our ABS system components.
The plan consists of a Technical Assistance Hotline, staffed by Delco Chassis personnel, that you must phone to create a technical assistance case or to order parts for some ABS VI malfunctions. Please be prepared to provide specific diagnostic trouble code information, VIN and dealer code when phoning for a part or for assistance. The phone number is 1-800-523-0203.

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GENERAL DESCRIPTION

ABBREVIATIONS/DEFINITIONS

Several abbreviations are commonly used throughout this section. They are presented here for reference.

ABS.....Antilock Brake System
B+.....Battery Voltage
CKT.....Circuit
CPA.....Connector Position Assurance
DLC.....Data Link Connector
DTC.....Diagnostic Trouble Codes
DVM.....Digital Multimeter
EBTCM.....Electronic Brake Traction Control Module
ESB.....Expansion Spring Brake
Infinite.....Open Circuit/Unmeasurable High Resistance
MSC.....Mass Storage Cartridge
TCS.....Traction Control System

BASIC KNOWLEDGE REQUIRED

Before using this section, it is important that you have a basic knowledge of the following items. Without this basic knowledge, it will be difficult to use the diagnostic procedures contained in this section.

If you need a review of basic electrical troubleshooting knowledge, SECTION 8A contains helpful information in the introduction. Basic use of circuit testing tools is also covered in SECTION 8A.

Additionally, electrical/electronic courses are offered through General Motors Service Training.

- Basic Electrical Circuits - You should understand the basic theory of electricity and know the meaning of voltage, current (amps) and resistance (ohms). You should understand what happens in a circuit with an open or shorted wire. You should be able to read and understand a wiring diagram.
- Use of Circuit Testing Tools - You should be familiar with the High Impedance Multimeter (DVM) J 39200. You should be able to measure voltage, resistance and current and be familiar with the meter controls and how to use them correctly.

Important

- When measuring the resistance to ground of a circuit or component, make sure to use a solid, unpainted chassis ground or the negative battery terminal.

SYSTEM OPERATION

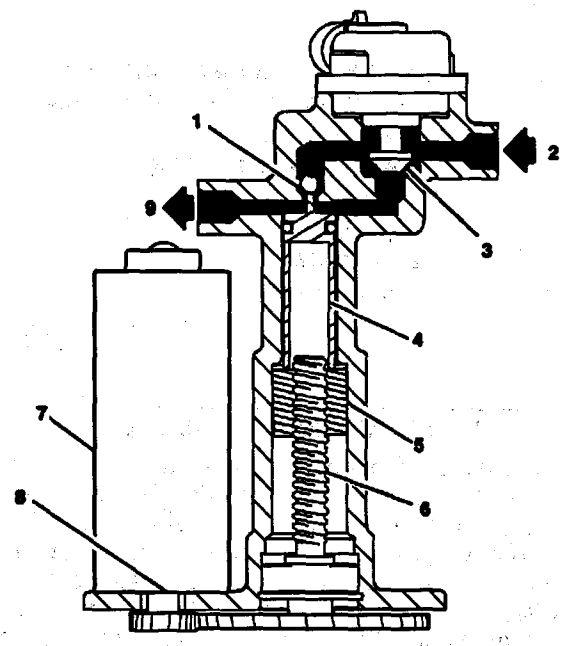
The Antilock Brake System and the Traction Control System (ABS VI/TCS) are both part of the same hydraulic and electric system. Both systems use many of the same components and a problem in either system may disable the other system until it is repaired. Antilock braking controls wheel slip when braking; traction control controls wheel slip when accelerating.

Base Braking Mode

Under normal operating conditions, the brake system will operate using conventional braking by means of brake pedal force, the vacuum booster, and the compact master cylinder. For the front wheels, the brake fluid flows from the master cylinder, through the ABS hydraulic modulator, and then out to the front wheels. The fluid flow to the rear wheels flows first through the master cylinder, through the ABS hydraulic modulator, through the TCS hydraulic modulator, and then out to the rear wheels.

ABS Hydraulic Modulator Fluid Flow

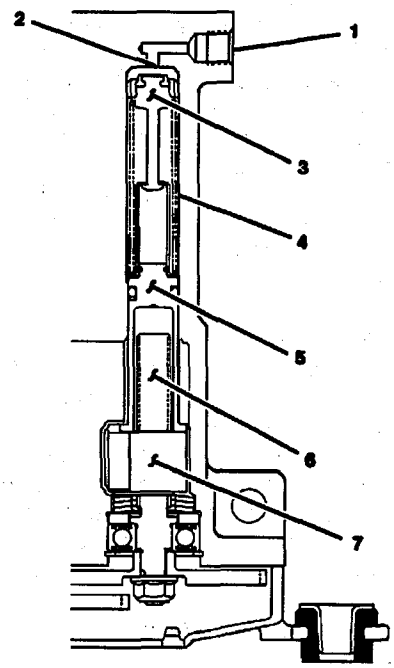
Each front ABS channel consists of a motor, solenoid, ESB, ball screw, piston, and check valve. Under normal operating conditions (base brakes),the piston is held in the up most (or "home") position and the solenoid is open (not energized), (refer to Figure 1). This is accomplished by turning the ball screw via the motor to drive the nut upwards. Once at the up most position, the piston is held by an Expansion Spring Brake (ESB). Two paths are available to transfer braking pressure to the front wheels: (1)



1 CHECK VALVE OPEN
2 BRAKE PRESSURE FROM COMBINATION VALVE
3 OPEN SOLENOID
4 PISTON
5 BALL SCREW NUT
6 BALL SCREW SPINDLE
7 ABS MOTOR PACK
8 EXPANSION SPRING BRAKE (ESB)
9 BRAKE PRESSURE TO FRONT BRAKE

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Figure 1 - ABS Front Base Braking Mode



1 INLET PORT FROM ABS MODULATOR
2 OUTLET PORT (NOT SHOWN) TO REAR BRAKE CALIPER
3 POPPET VALVE (UNSEATED)
4 SPRING
5 PISTON
6 BALL SCREW
7 BALL SCREW NUT

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Figure 2 - Modulator Base Braking Mode

through the ABS modulator, around the check valve, and out to the front wheels, (2) through the ABS modulator, past the normally open solenoid, and out to the front wheels. The solenoids in the front circuits provide an alternate brake pressure path to the front wheels. With this arrangement, if ABS were to lose power or malfunction with the piston not in its home position, a redundant brake fluid path is available, (see Figure 1). The rear ABS channels operate in a similar manner except no solenoid exists. The fluid flows from the master cylinder, through the ABS modulator, through the TCS modulator, and then out to the rear wheel brakes.

TCS Hydraulic Modulator Fluid Flow

Each TCS channel consists of a motor, piston, ball screw, spring, and poppet valve. Under normal operating conditions (base brakes) the piston is located in the downward (or "home") position and the poppet valve is unseated, (refer to Figure 2). This is accomplished by turning the ball screw via the motor to drive the nut downward. The brake fluid enters the inlet port of the TCS modulator, flows past the unseated poppet valve to the outlet port of the TCS modulator, and then out to the rear calipers. There are no solenoid valves or ESBs within the TCS modulator.

Antilock Braking Mode

ABS VI has been designed to improve the controllability and steerability of a vehicle during braking. ABS VI accomplishes this objective by controlling the hydraulic pressure applied to each wheel brake. Antilock braking occurs only when the brake switch is closed and a microprocessor, located in the EBTCM, determines one or more wheels is about to lose traction during braking. The EBTCM will then allow the hydraulic modulator to change the brake pressures several times each second to keep the wheel(s) from locking and provide the driver with maximum vehicle controllability. ABS VI CANNOT INCREASE THE BRAKE PRESSURE ABOVE THE MASTER CYLINDER PRESSURE APPLIED BY THE DRIVER, AND CANNOT APPLY THE BRAKES BY ITSELF.

The result is greatly improved braking, enabling the driver to more easily maintain steerability and to bring the vehicle to a controlled stop. ABS VI provides effective braking and directional control over a wide range of road surfaces and driving conditions.

If any wheel(s) begins to approach lock-up, the EBTCM will control the three (3) motors and two (2) solenoids, appropriately, to control brake pressure to the affected wheel(s). During front wheel ABS operation, the solenoids are turned "ON" to isolate that brake pressure path to the wheel (see Figure 5). The EBTCM then provides controlled current to the motors to regulate the speed and amount of movement. As the motors move backwards, the piston follows the nut downward, allowing the check valve to seat. The brake pressure to the wheel is now a function of the controlled volume within the piston chamber. To reduce brake pressure, the motor drives the nut further downward. To reapply or increase brake pressure, the motor drives the nut and piston upward. If ABS was entered during low brake pressure, such as on ice, and dry pavement is then encountered during reapply, the piston is driven all the way to the top. This results in the unseating of the check valve, and a return to base brakes until sufficient brake pressure exists to cause the wheel to approach lock-up again. At this point, the ABS cycle would start again. This process can occur in less than one second if the driver is pressing firmly on the brake pedal.

Total brake pressure during ABS is limited to the brake pressure present when ABS was entered. Also, anytime wheel brake pressure exceeds the brake pressure at the master cylinder (caused by reduced force on the brake pedal), the check valve unseats and a small volume of brake fluid is returned to the master cylinder. In this manner, ABS VI CANNOT INCREASE BRAKE PRESSURE ABOVE MASTER CYLINDER PRESSURE APPLIED BY THE DRIVER AND CANNOT APPLY THE BRAKES BY ITSELF. When ABS is no longer required, the pistons are returned to their up most (or "home") position and are held by the ESBs (refer to "ESB Operation," found in this section). The solenoids on the front channels

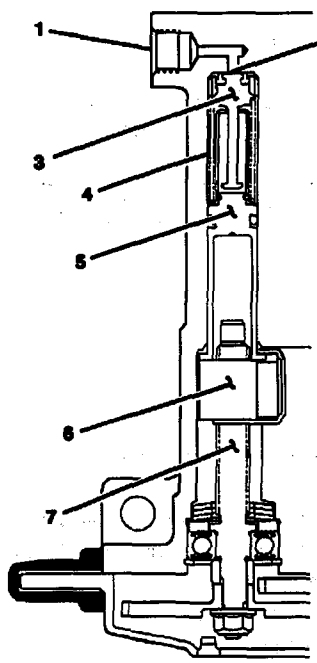
are simultaneously opened to again provide a redundant base braking path.

The rear channel operates in a similar manner except no solenoid is used (refer to Figure 6). Both rear brake pressures are controlled by the same motor and both rear brake pressures are controlled together. If either rear wheel begins to lock, brake pressure to both rear wheels is reduced to maximize vehicle stability.

There is no rear solenoid due to the nature of the braking system. The vast majority of braking is accomplished with the front brakes. If an ABS failure were to occur that affected the operation of the rear base brakes, a diagnostic trouble code would be stored and the EBTCM would turn "ON" both the "ABS INOP" lamp and the "BRAKE" warning lamp.

Traction Control Mode

The Traction Control System (TCS) is an add on to the ABS VI Antilock brake system. The TCS provides the capability to control wheel spin at each driven wheel. This improves the ability to maintain vehicle stability and acceleration (drive traction) under changing road and vehicle load conditions.



1 INLET PORT FROM ABS MOLULATOR
2 OUTLET PORT (NOT SHOWN) TO REAR BRAKE CALIPERS
3 POPPET VALVE (SEATED)
4 SPRING
5 PISTON
6 BALL SCREW NUT
7 BALL SCREW

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Figure 3 - Traction Control Mode

Traction Control occurs when the EBTCM determines one or more of the drive wheels are accelerating too rapidly and the brake switch is "OFF." The EBTCM processes wheel speed sensor data and can control wheel slip by utilizing up to three different methods; 1. By commanding the PCM to retard ignition timing, thereby reducing engine torque; 2 by utilizing the throttle adjuster motor to reduce the throttle angle, thereby reducing engine torque and 3. by brake intervention through the use of the TCS hydraulic modulator;.

The EBTCM can control one or both of the TCS motors simultaneously. The TCS motors are bi-directional and are used with the gear assemblies to drive the ball screws and pistons in the TCS modulator. The bi-directional motors allow pressure to be applied, held, or released from the wheels. During TCS operation, the ball screws and pistons are driven upward from their home position. This process seats the poppet valve (thus isolating the master cylinder). The brake pressure to the wheel is now a function of the controlled volume within the piston chamber (refer to Figure 3). As drive wheel speed is reduced, the pistons are driven downward to their home position. This unseats the poppet valve and releases fluid pressure from the rear brake calipers. This process of apply, hold, and release can repeat itself several times a second, until drive wheel speed is reduced a prescribed amount.

The EBTCM also controls the throttle adjuster motor and sends commands via a PWM signal to the PCM to retard ignition timing, thereby reducing engine torque and wheel slip.

TCS cannot be entered if the brake switch is "ON." Base brakes and ABS take precedence over TCS in all conditions. If TCS is being utilized and the brake switch is depressed, the EBTCM will immediately command the TCS motors to re-home the TCS ball screws and pistons. The applied brake pressure from the master cylinder can overcome the poppet valve spring to apply brake pressure immediately to the wheels during the re-home operation.

TCS THERMAL SHUTDOWN MODE

During prolonged TCS operation, brake lining temperatures may rise to a higher than desired level and the lining wear rate may increase. For this reason, the TCS system incorporates a brake thermal model which estimates brake temperatures during braking and TCS operation. The program calculates potential brake temperature based on time vs. amount of and duration of TCS brake applications. If the brakes or TCS Modulator reach a potential over temperature condition the TCS Modulator is disabled but the PCM will still control the adjuster assembly and spark control. If the adjuster assembly reaches a potential over temperature condition the TCS system will disable. The amber TCS warning lamp will come "ON" and TCS will remain disabled until the brake linings are cooled to the proper temperature. The TCS system will automatically re-enable at this time. No DTC's will be stored.

Normally TCS will not disable during a traction event, but if the maximum temperature threshold is reached, it will disable.

ESB OPERATION

The Expansion Spring Brake (ESB) is used to hold the ABS piston in the up most (or "home") position. ESBs are used only in the ABS modulator. An ESB is a spring that is retained in a housing at a close tolerance. One end of the spring is in contact with the motor drive dog and the other end is in contact with the pinion drive dog (refer to Figure 4). In normal braking, brake pressure is present on the top of the ABS piston, applying a downward force. The force applies a counterclockwise torque to the motor pinion which tries to rotate the spring counterclockwise. The counterclockwise torque expands the spring outward within the housing and prevents gear rotation.

When the motor is turned "ON" and tries to drive the ball screw nut, the end of the ESB in contact with the motor drive dog rotates inward causing the spring to contract in its housing allowing the motor to rotate the modulator gear (refer to Figure 4). The most common application of this principle is in window crank mechanisms, where a small amount of force on the crank handle allows the window to be lowered or raised, but the weight of the window or force on the window will not allow the window to move downward. For the ESB, brake pressure on the top of the pistons corresponds to the weight of the window and the motor corresponds to the window crank handle.

SYSTEM - SELF TEST (INITIALIZATION)

During initialization, the EBTCM will not only perform self-diagnostics, but will also verify motor, modulator, solenoid, relay, and lamp operation to ensure all ABS and TCS components are functioning properly. The EBTCM also checks the wheel speed sensor circuitry for open circuits and shorts to ground or voltage at this time. If the EBTCM detects a malfunction in either itself or other ABS VI/TCS components, it will store a Diagnostic Trouble Code (DTC) and turn "ON" the ABS warning lamp, the TCS warning lamp, or the red "BRAKE" warning lamp if applicable. See "Warning Lamp Operation" in this section for normal lamp operation during initialization (Steps 1-3). A slight mechanical noise may be heard during the system initialization, which is normal. The entire initialization is run about 2-3 seconds after the engine starts. If your foot is on the brake pedal when the engine is started, the system will not initialize until your foot is removed or 5 km/h (3 mph) is reached. If foot pressure on the pedal interrupts the system initialization, a slight movement in the pedal may be felt.

Warning Lamp Operation

Normal Lamp Operation

The Standard brake system uses a single red "BRAKE" warning lamp located in the instrument panel cluster. The antilock brake system uses the red "BRAKE" warning lamp and an amber ABS warning lamp ("ABS INOP"). The traction control system uses

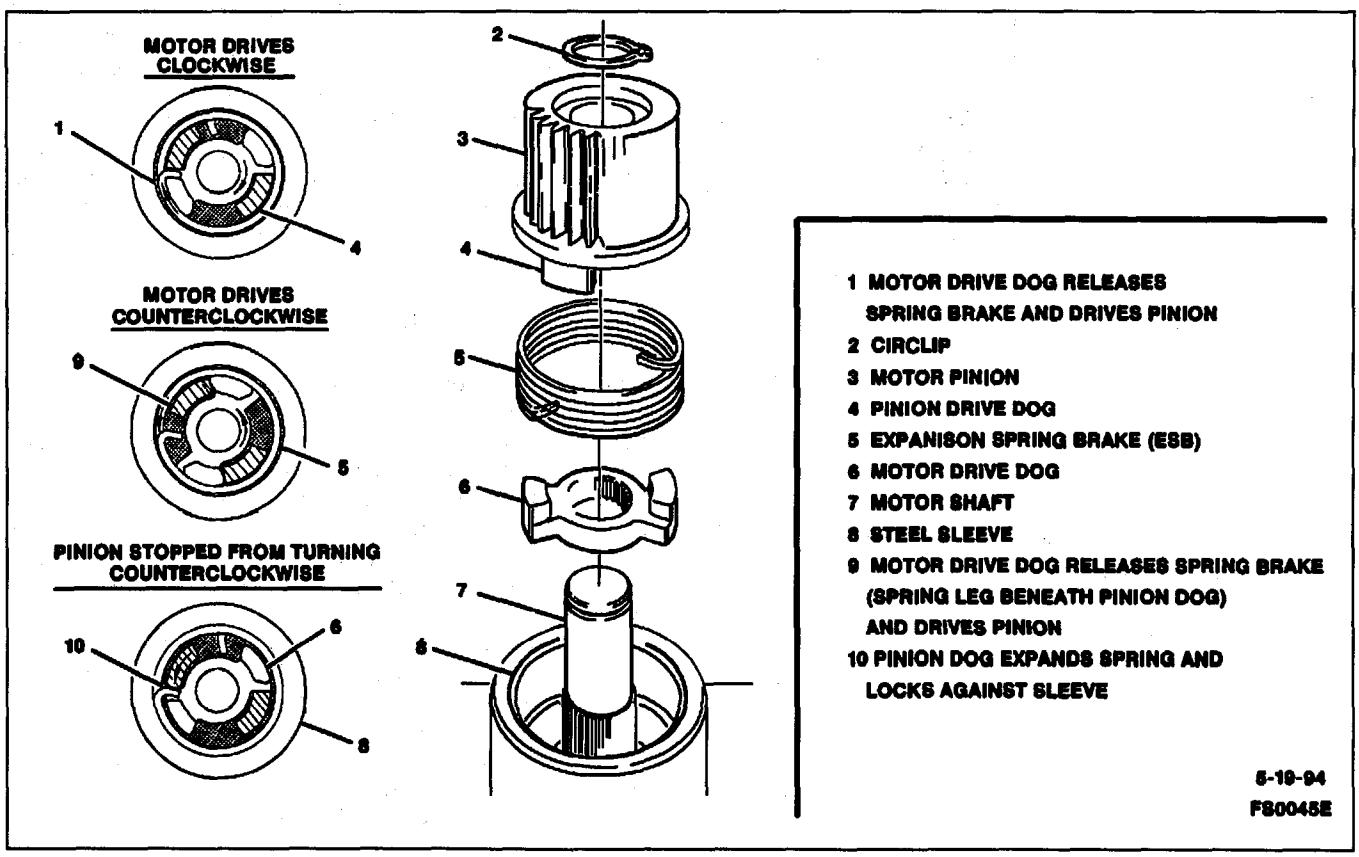


Figure 4 - Expansion Spring Brake

the red "BRAKE" warning lamp and an amber TCS warning lamp ("TCS OFF" PONT) ("ASR" CHEVY). A blue ABS/TCS active lamp ("LOWTRAC") is illuminated during an ABS or TCS event and for several seconds after the event is complete. Throughout this manual, the lamps will be referred to by their function, not by what is indicated on the instrument panel cluster.

1. When the ignition is turned to the "RUN" position, the BRAKE, ABS warning, TCS warning, and ABS/TCS active lamps are turned "ON" for approximately three seconds, then turn "OFF."
2. As the engine is cranked, the BRAKE, ABS warning, TCS warning, and the ABS/TCS active lamps will turn "ON" and remain "ON."
3. After the engine is started, the BRAKE, ABS warning, TCS warning, and the ABS/TCS active lamps will remain "ON" for approximately three seconds, then turn "OFF."

Warning Lamps

The Electronic Brake Traction Control Module (EBTCM) continuously monitors itself and the other ABS VI/TCS components. If the EBTCM detects a malfunction with the system, the ABS warning lamp or TCS warning lamp will either flash or light continuously (solid lamp) to alert the driver of the malfunction. The ABS warning lamp will flash if the EBTCM attempts to turn "ON" the red "BRAKE" warning lamp in conjunction with the ABS warning lamp and is unable to do so. The lamp is flashed to warn the driver that an ABS malfunction exists which may have degraded base brake performance. No Antilock braking will be available. The vehicle must be serviced immediately to regain full base and ABS braking ability.

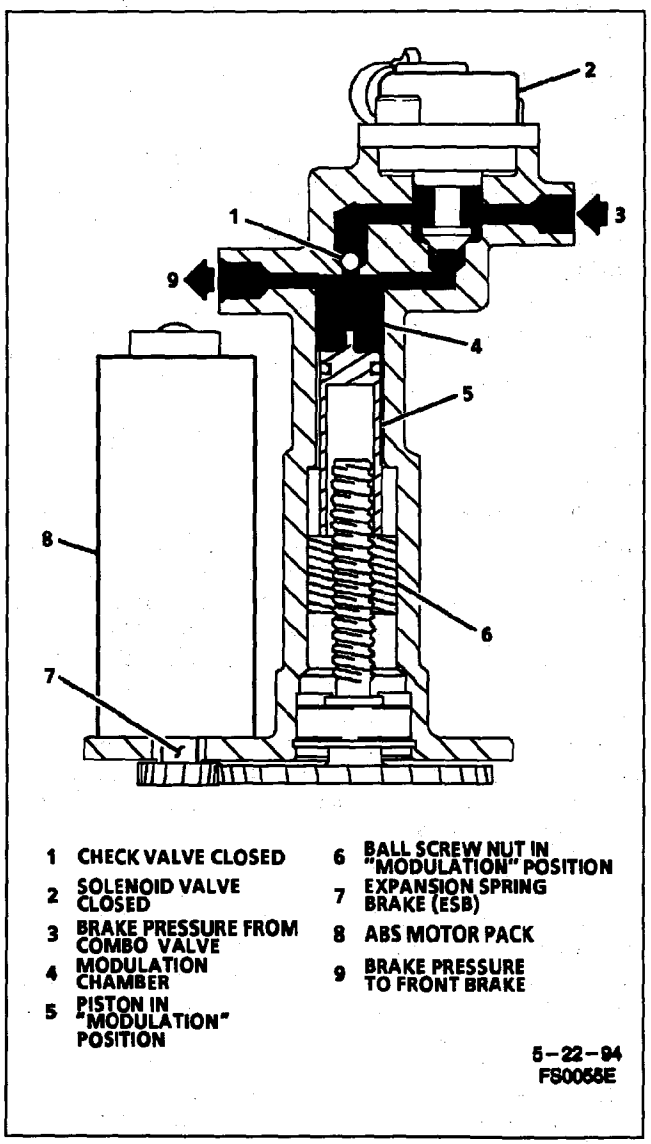


Figure 5 - Front ABS Braking Mode

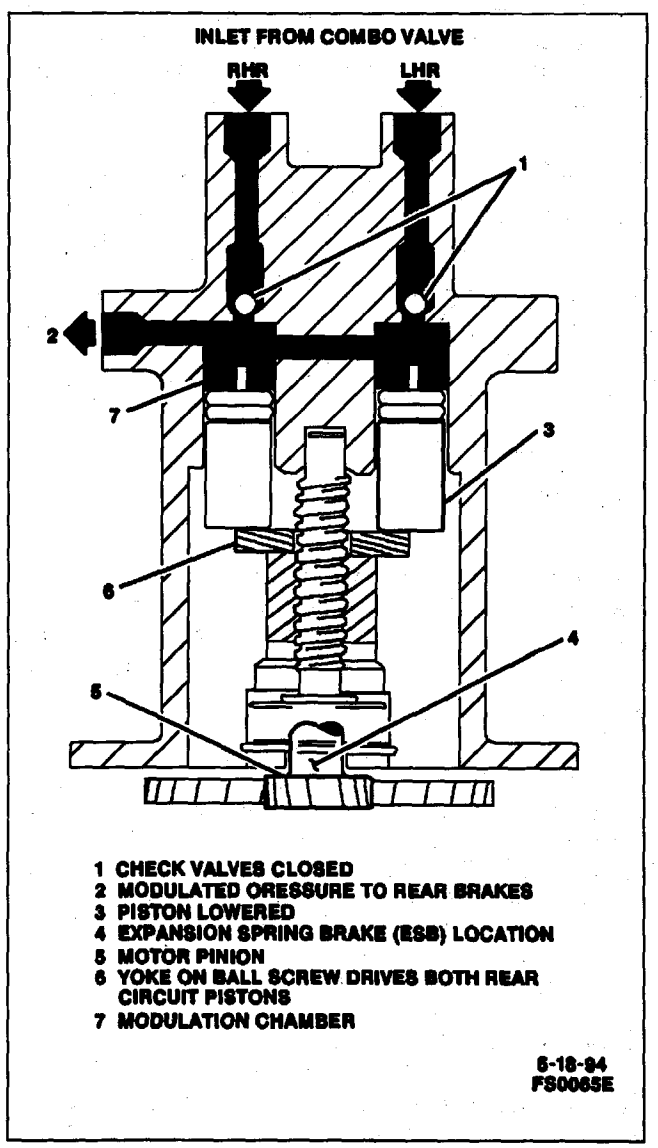


Figure 6 - Rear ABS Braking Mode

CAUTION: The braking system may not be working properly if the ABS warning lamp is flashing. Driving with a flashing "ABS INOP" lamp can lead to an accident. If the ABS warning lamp is flashing, pull safely off the road and have the vehicle towed for service.

A solid ABS warning lamp indicates that a malfunction has been detected that affects the operation of ABS. No antilock braking will be available. Normal, non-antilock brake performance will remain. In order to regain ABS braking ability, the ABS must be serviced. If the EBTCM detects a problem with the TCS, the amber TCS warning lamp will illuminate to alert the driver of the problem. A solid TCS warning lamp indicates that a problem has been detected that affects the operation of the TCS. No traction control will be available, however base braking and ABS will be unaffected.

The amber ABS warning lamp will be turned "ON" along with the amber TCS warning lamp anytime the EBTCM suspects the ABS operation has been degraded due to a system malfunction.

The red BRAKE warning lamp will be illuminated when a low brake fluid level in the master cylinder is sensed, the parking brake switch is closed, or under control of the EBTCM when certain ABS or TCS DTCs are set. This lamp indicates to the driver a base brake problem may exist.

The ABS/TCS active "LOW TRAC" indicator lamp is used to alert the driver when ABS or TCS is active. Anytime the EBTCM determines that the vehicle has entered an event where ABS or TCS is required, the "LOW TRAC" lamp will turn "ON" to indicate that ABS or TCS is active. The "LOW TRAC" lamp will remain "ON" for approximately 3 to 4 seconds after the ABS or TCS event is completed.

Tires and ABS

Spare Tire

Using the compact spare supplied with the vehicle will not affect the operation of ABS VI/TCS. The EBTCM software can compensate for this smaller tire. However, increased stopping distances may occur due to reduced tire tread width on compact spare tires.

Replacement Tires

Tire size is important for proper performance of the ABS VI/TCS. Replacement tires should be the same size load range and construction as the original tires. Replace tires in axle sets and only with tires of the same TPC (Tire Performance Criteria) specification number. Use of any other tire size or type may seriously affect the ABS VI/TCS operation. For more information on original equipment and replacement tires, refer to SECTION 3E.

SYSTEM COMPONENTS

The ABS VI/TCS Antilock Braking Traction Control System consists of a conventional hydraulic brake system plus antilock and traction control components. The conventional brake system includes a vacuum power booster, master cylinder, front disc brakes, rear disc brakes, interconnecting hydraulic brake lines, low fluid sensor, and a red "BRAKE" warning lamp.

The ABS VI/TCS components include separate hydraulic modulator/motorpack assemblies, an integrated Electronic Brake Traction Control Module (EBTCM),a throttle adjuster assembly, four wheel speed sensors, separate ABS and TCS enable relays, a TCS enable switch, an amber ABS warning lamp, an amber TCS warning lamp, a common ABS/TCS active lamp, and interconnecting wiring.

ABS Hydraulic Modulator/Motor Pack Assembly

The ABS hydraulic modulator/motor pack assembly controls hydraulic pressure to the front and rear calipers by modulating hydraulic pressure to prevent wheel lock-up. The basic hydraulic modulator configuration consists of gear subassemblies, ball screws, nuts, pistons, and hydraulic check valves. The motor pack consists of three motors, three drive gears, and three ESBs. For more information, refer to "Base Braking Mode" and "Antilock Braking Mode" in this section.

TCS Hydraulic Modulator/Motor Pack Assembly

The TCS hydraulic modulator/motor pack assembly controls drive wheel slip during acceleration by modulating brake pressure to the drive wheel brake calipers to prevent slip. The basic hydraulic modulator configuration consists of gear subassemblies, ball screws, nuts, pistons, and hydraulic poppet valves. The motor pack consists of two motors and two drive gears. For more information refer to "Base Braking Mode" or "Traction Control Mode" in this section.

Electronic Brake Traction Control Module (EBTCM)

The controlling element of ABS VI/TCS is a microprocessor based Electronic Brake Traction Control Module, or EBTCM. Inputs to the system include four wheel speed sensors, the brake switch, switched ignition voltage, unswitched ignition voltage, and serial data communications with the PCM. Outputs include five bi-directional motor controls, five lamp controls, two solenoid controls (ABS), and the ABS and TCS enable relays. A serial data link, located in terminal "M" of the Data Link Connector (DLC), is provided for service diagnostic tools and assembly plant testing.

The EBTCM monitors the speed of each wheel. If any wheel begins to approach lock-up and the brake switch is "ON," the EBTCM controls the ABS motors and solenoids to reduce brake pressure to the wheel approaching lock-up. Once the wheel regains traction, brake pressure is increased until the wheel again begins to approach lock-up. This cycle repeats until either the vehicle comes to a stop, the brake is released, or no wheels approach lock-up. Additionally, if one of more of the drive wheels are accelerating too rapidly, the EBTCM sends commands to the throttle

adjuster motor and to the PCM to reduce engine torque and to the TCS motors to apply and release the brakes several times each second to reduce driven wheel speed to a prescribed amount over the non-driven wheel speed. Once the wheel regains traction, brake pressure is decreased and engine torque reduction is no longer requested. This cycle repeats until traction control is no longer necessary.

The EBTCM monitors itself, each input and each output for proper operation. If any system malfunction is detected, the EBTCM will store a DTC in nonvolatile memory (DTCs will not disappear if the battery is disconnected). Refer to "Self-Diagnostics" in this section for more detailed information.

NOTICE: There is no serviceable or removable PROM. The EBTCM must be replaced as an assembly.

Throttle Adjuster Assembly

The adjuster assembly is mounted in the engine compartment, and is used as a cable extender. It allows the throttle lever cam on the throttlebody to reduce the throttle angle when the TCS system requests it. This reduces engine power to control wheel spin. The EBTCM provides the control logic.

Front Wheel Speed Sensors

The front wheel speed sensors consist of a variable reluctance sensor. The sensor and toothed ring are part of the hub and bearing assembly. As teeth pass by the sensor, an AC voltage with a frequency proportional to the speed of the wheel is generated. The magnitude of the voltage increases with increasing speed. The sensor is not repairable, nor is the air gap adjustable. The entire front bearing assembly must be replaced.

Front Wheel Speed Sensor Rings

The front wheel speed sensor toothed rings are an integral part of the hub and bearing assembly. Like the front wheel speed sensors themselves, they are not serviceable. If a malfunction is detected in either the sensor or the toothed ring, the entire hub and bearing assembly must be replaced.

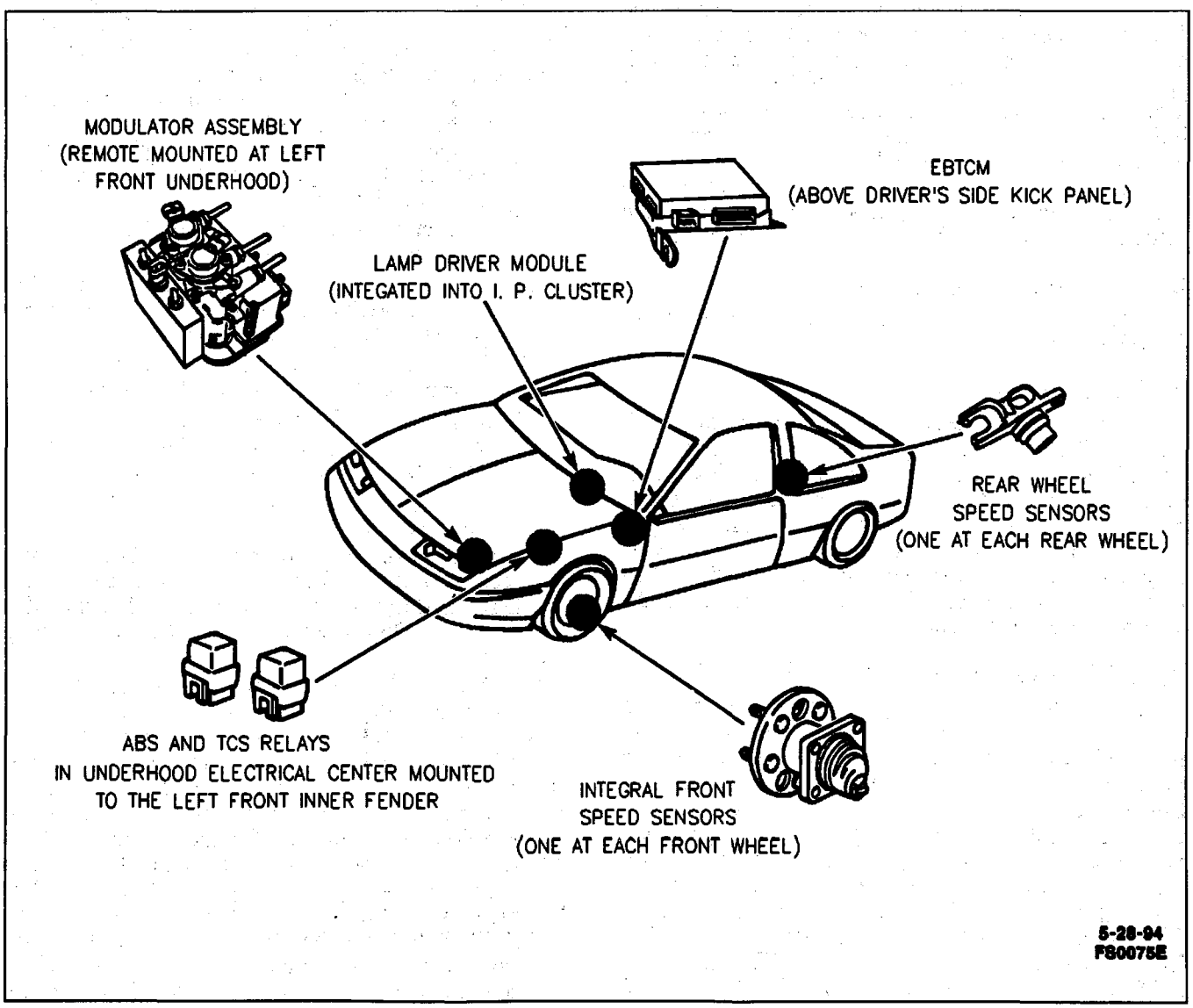


Figure 7 - ABS VI/TCS Component Location View

Rear Wheel Speed Sensors and Rings

The rear wheel speed sensors operate in the same manner as the front wheel speed sensors; refer to "Front Wheel Speed Sensors." However, the rear wheel speed sensors are mounted at each end of the rear axle housing. The toothed rings are an integral part of the rear axle shafts. The sensors and toothed rings are not repairable and no provision for air gap adjustment exists.

ABS and TCS Relays

The ABS and TCS relays are normally-open contact type relays, and have special contact material to handle the high currents required for ABS VI/TCS operation. The relays allow battery voltage and current to be supplied to the EBTCM, which supplies power to the ABS motors and solenoids and to the TCS motors.

TCS Enable Switch

The TCS enable switch is a momentary contact switch used to enable or disable the Traction Control System. The switch assembly consists of a momentary contact press button switch and an indicator lamp. The Traction Control System can be enabled and disabled during an ignition cycle by pressing the switch. Each Ignition to "RUN" resets the TCS to enable. This insures a consistent state at startup for the driver. The indicator lamp within the switch assembly will illuminate when TCS is enabled.

When the TCS enable switch is depressed, the TCS will be disabled. The indicator lamp in the switch assembly will turn "OFF" when TCS is disabled.

Brake Combination Valve

Refer to "Brake Combination Valve" in SECTION 5A.

Wiring Harness

The wiring harness is the mechanism by which the EBTCM is electrically connected to power and ground, wheel speed sensors, motors, solenoids, fuses, switches, lamps, the enable relay and the serial communications port. The components, considered part of the wiring harness, are the wires that provide electrical interconnection and connectors/terminals that provide an electrical/mechanical interface from the wire to a system component.

Wheel Speed Sensor Jumper Harness

Between each wheel speed sensor and the main wiring harness is a jumper harness made up of highly flexible twisted pair wiring. This wiring exists because the main harness must connect to the suspension of the vehicle, thus the wiring in this area is subjected to the same motion as a spring or shock absorber. Consequently, any repair to this section of wiring will result in stiffening and therefore, eventual failure due to wire fatigue. For this reason, THE WHEEL SPEED SENSOR JUMPER HARNESSES ARE NOT REPAIRABLE AND MUST BE REPLACED. DO NOT ATTEMPT TO SOLDER, SPLICE, OR CRIMP THESE HARNESSES AS EVENTUAL FAILURE WILL LIKELY RESULT. Refer to "On-Vehicle Service" in this section.

Fuses and Fusible Links

The vehicle's power distribution system consists of fuses, fusible links, circuit breakers, and the ignition switch. Fusible links are short pieces of wire several sizes smaller than the circuit wire to which they supply power. They are covered with special high temperature insulation. When conducting an improperly high current flow, they will melt and stop current flow. They are designed to protect the vehicle's electrical system from electrical shorts in circuits that are not protected by circuit breakers or fuses. For fuse and fusible link locations, refer to SECTIONS 8A-10 and 8A-11.

DIAGNOSIS-ELECTRICAL

DIAGNOSTIC PROCESS

When servicing the ABS VI/TCS, the following steps should be followed in order. Failure to follow these steps may result in the loss of important diagnostic data and may lead to difficult and time-consuming diagnosis procedures:

1. Perform a vehicle preliminary diagnosis inspection. This should include:
   - Inspection of the master cylinder fluid reservoir for proper brake fluid level and signs of contamination.
   - Inspection of the hydraulic modulator for any leaks or wiring damage.
   - Inspection of brake components at all four wheels. Verify no drag exists. Also, verify proper brake apply operation.
   - Inspection for worn or damaged wheel bearings that may allow a wheel to "wobble."
   - Inspection of the wheel speed sensors and their wiring. Verify proper undamaged wiring, especially at vehicle attachment points.
   - Verify tires meet legal tread depth requirements.
2. Perform "Diagnostic System Check" found in this section. If any DTCs are displayed, select "F1: DTC History" to note the last malfunction that occurred. Diagnose and repair this malfunction first.
3. If no DTCs are present, or no mechanical component malfunctions are present, or if the failure is intermittent and not reproducible, test drive the vehicle while using the auto trigger feature of the Tech 1. Perform normal acceleration, stopping, and turning maneuvers. If this does not reproduce the malfunction, perform an ABS stop, on a low coefficient surface such as gravel, from approximately 48-80 km/h (30-50 mph) while triggering the snapshot mode on any DTC. Still using the Tech 1 auto trigger feature, perform a TCS event on a low coefficient surface, such as gravel, from a stop. If the failure is still

not reproducible, use the enhanced diagnostic information found in DTC HISTORY to determine whether or not this malfunction should be diagnosed further based on frequency of failure. Refer to "Enhanced Diagnostics" found in this section.

4. Once all system malfunctions have been corrected, clear the ABS and TCS DTCs.

SELF-DIAGNOSTICS

The EBTCM contains sophisticated on-board diagnostics that, when accessed with a Tech 1 or T-100 (this service manual is written for the use of Tech 1), are designed to identify the source of any system malfunction as specifically as possible, including whether or not the malfunction is intermittent. There are 80 diagnostic trouble codes to assist with diagnosis.

When using the Tech 1 with ABS/TCS VI, the last diagnostic trouble code is specifically identified, and specific ABS or TCS data is stored at the time of this malfunction. Also, in addition to the last DTC set, there is information about the first five DTCs set. Using the Tech 1, each input and output can be monitored, thus enabling malfunction confirmation and repair verification. Manual control of components and automated functional tests are also available when using the Tech 1. Details of many of these functions are contained in the following sections.

DISPLAYING DIAGNOSTIC TROUBLE CODES (DTCs)

Diagnostic trouble codes can be read through the use of the Tech 1 scan tool. There are no provisions for "Flash Code" diagnostics.

CLEARING DIAGNOSTIC TROUBLE CODES (DTCs)

The DTCs in EBTCM memory are erased in one of two ways:

1. Tech 1.
2. Ignition cycle default.

These two methods are detailed below. Be sure to verify proper system operation and absence of DTCs when the clearing procedure is completed.

The Tech 1 will not permit DTC clearing until all DTCs have been displayed. Also, DTCs cannot be cleared by unplugging the EBTCM, disconnecting the battery cables, or turning the ignition "OFF" (except on an ignition cycle default).

Tech 1 Method

The Tech 1 method is the only method to be used when servicing a vehicle. Select "F2: DTC(s)" for diagnostic trouble codes. After DTCs have been viewed completely, Tech 1 will ask, "CLEAR DTCs"?; answer "YES." Tech 1 will then read, "HISTORY DATA WILL BE LOST. CLEAR DTCs"? Answer "YES" and DTCs will be cleared.

Ignition Cycle Default

If no diagnostic trouble codes occur for 100 drive cycles [a drive cycle occurs when the ignition is turned "ON" and the vehicle is driven faster than 16 km/h (10 mph)], any existing DTCs are automatically cleared from the EBTCM memory.

INTERMITTENTS AND POOR CONNECTIONS

As with most electronic systems, intermittent malfunctions may be difficult to accurately diagnose. The following is a method to try to isolate an intermittent malfunction, especially wheel speed circuitry.

If an ABS or TCS malfunction occurs, the ABS warning lamp or TCS warning lamp will be "ON" during the ignition cycle in which the malfunction was detected. If it is an intermittent problem which seems to have corrected itself (ABS warning lamp or TCS warning lamp "OFF"), a diagnostic trouble code will be stored. Also stored will be the history data of the DTC at the time the malfunction occurred. The Tech 1 must be used to read DTC history data.

Most intermittent malfunctions are caused by faulty electrical connections or wiring. Refer to "Intermittent and Poor Connections" in SECTION 8A-4 for a very detailed explanation of how to locate and repair intermittent conditions.

TECH 1 DIAGNOSTICS

The Tech 1, when plugged into the DLC, becomes part of the vehicles electronic system. The Tech 1 can perform the following functions:

- Display ABS and TCS data.
- Display and clear ABS and TCS diagnostic trouble codes.
- Control ABS and TCS components.
- Perform extensive ABS and TCS diagnosis.
- Provide diagnostic testing for intermittent ABS and TCS conditions.

Each test mode has specific diagnosis capabilities which depend upon various keystrokes. In general, five keys control sequencing: "YES," "NO," "EXIT," "UP ARROW" and "DOWN ARROW." The F0 through F9 keys select operating modes, perform functions within an operating mode, or enter DTC or model year designations.

In general, the Tech 1 has six test modes for diagnosing the ABS and TCS. The six test modes are as follows:

- **MODE F0: DATA LIST** - In this test mode, the Tech 1 continuously monitors wheel speed data, brake switch status and other inputs and outputs.
- **MODE F1: DTC HISTORY** - In this mode, DTC history data is displayed. This data includes how many ignition cycles since the DTC occurred, along with other information for the last DTC set. The first five and last DTC set are included in the DTC history data.

- **MODE F2: DIAGNOSTIC TROUBLE CODES** - In this test mode, diagnostic trouble codes stored by the EBTCM, both current ignition cycle and history, may be displayed or cleared.
- **MODE F3: SNAPSHOT** - In this test mode, the Tech 1 captures data before and after a system malfunction (auto trigger) from a forced manual key press, or from a DTC setting.
- **MODE F4: MISC. TESTS** - In this test mode, the Tech 1 performs various ABS functional tests to assist in problem isolation during troubleshooting.
- **MODE F6: BLEED PREP** - In the first part of this mode, the Tech 1 commands the EBTCM to re-home the motors on the ABS hydraulic modulator and the TCS hydraulic modulator. In the second part of bleed prep, the Tech 1 cycles the TCS modulator to move any trapped air that may be remaining to the top of the TCS modulator so that it may be removed when bleeding is continued. This mode must ALWAYS be used prior to bleeding the brake system.

Enhanced Diagnostics

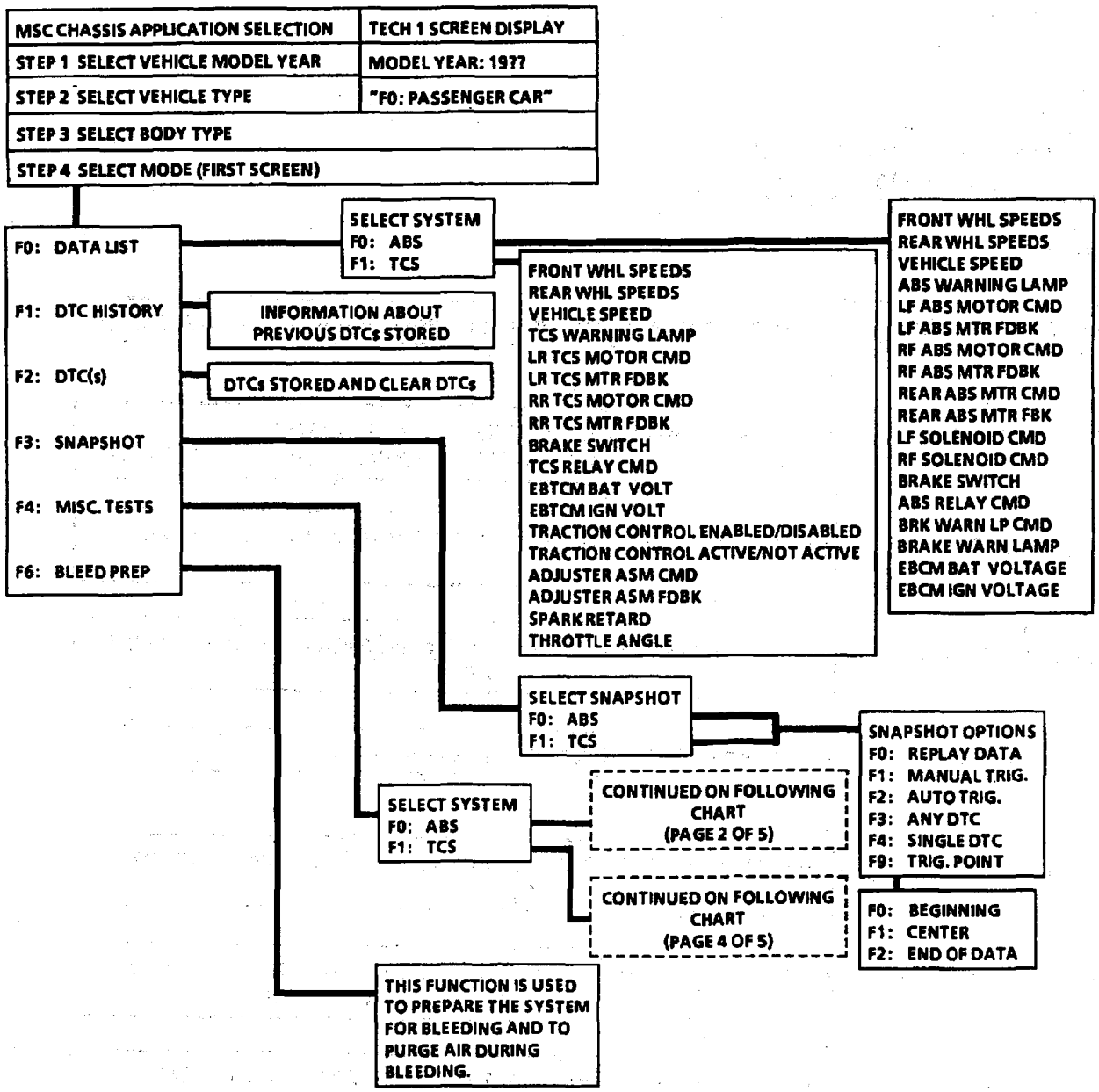
Enhanced diagnostic information, found in the DTC HISTORY function of the Tech 1, is designed to provide the service technician with specific malfunction occurrence information. For each of the first five and the very last diagnostic trouble code set, data is stored to identify the specific DTC, the number of occurrences, and the number of drive cycles since the malfunction first and last occurred [a drive cycle occurs when the ignition is turned to "RUN" and the vehicle is driven faster than 16 km/h (10 mph)]. However, if a malfunction is present, the drive cycle counter will increment by turning the ignition to "RUN" and "OFF." These first five diagnostic trouble codes are also stored in the order of occurrence. The order in which the first five DTCs occurred can be useful in determining if a previous malfunction is linked to the most recent malfunction, such as an intermittent wheel speed sensor which later becomes completely open.

During difficult diagnosis situations, this information can be used to identify malfunction occurrence trends. Did the malfunction only occurrence over a large number of drive cycles, indicating an unusual condition present when it occurred? Does the malfunction occur infrequently over a large number of drive cycles, indicating that special diagnosis techniques may be required to identify the source of the malfunction?

If, for example, a malfunction occurred 1 out of 50 drive cycles, the malfunction is intermittent and has not recurred for 49 drive cycles. This malfunction may be difficult or impossible to duplicate and may have been caused by a severe vehicle impact (large pot hole, speed bump at high speed, etc.) that momentarily opened an electrical connection or caused unusual vehicle suspension movement. Problem resolution is unlikely, and the problem may never recur (check diagnostic aids provided for that DTC). If, for example, the malfunction occurred 3 out of 15 drive cycles, the odds of finding the cause are still not good, but you know how often it occurs. If the malfunction occurred 10 out of 20 drive cycles, the odds of finding the cause are very good, as the malfunction may be easily reproduced. By using the additional malfunction data, you can also determine if a malfunction is randomly intermittent or if it has not recurred for long periods of time due to weather changes or a repair prior to this visit.

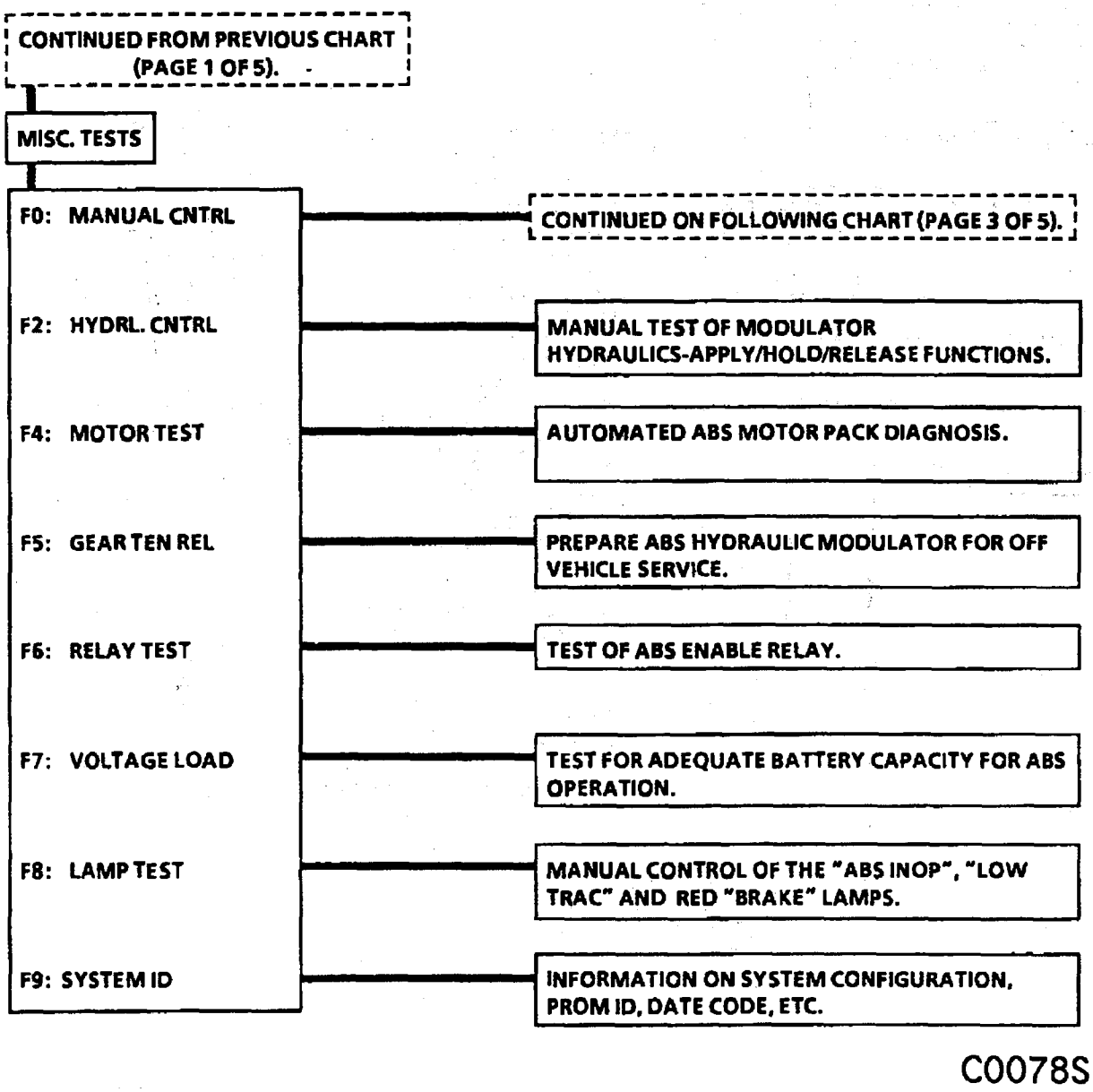
Say a DTC occurred 10 of 20 drive cycles but has not recurred for 10 drive cycles. This means the malfunction occurred 10 of 10 drive cycles but has not reoccurred since. A significant environmental change or a repair may have occurred 10 drive cycles ago. A repair may not be necessary if customer information can confirm a recent repair. If no repair was made, the service technician can focus on diagnosis techniques used to locate difficult-to-recreate problems, such as those suggested in "Diagnostic Aids" for the DTC in question.

DIAGNOSTIC PROCESS
(Page 1 of 5)



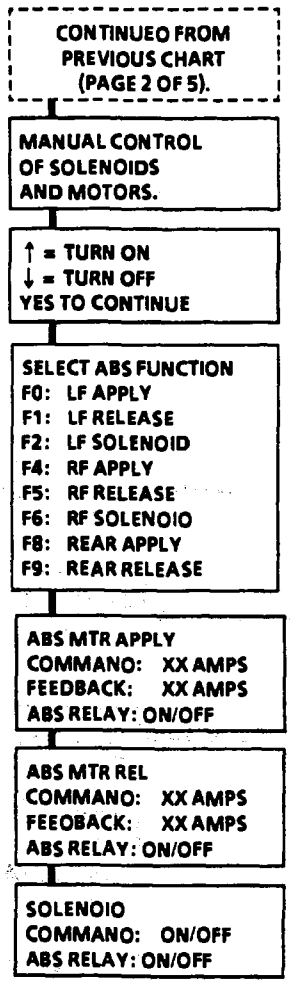
C0077S

DIAGNOSTIC PROCESS
(Page 2 of 5)



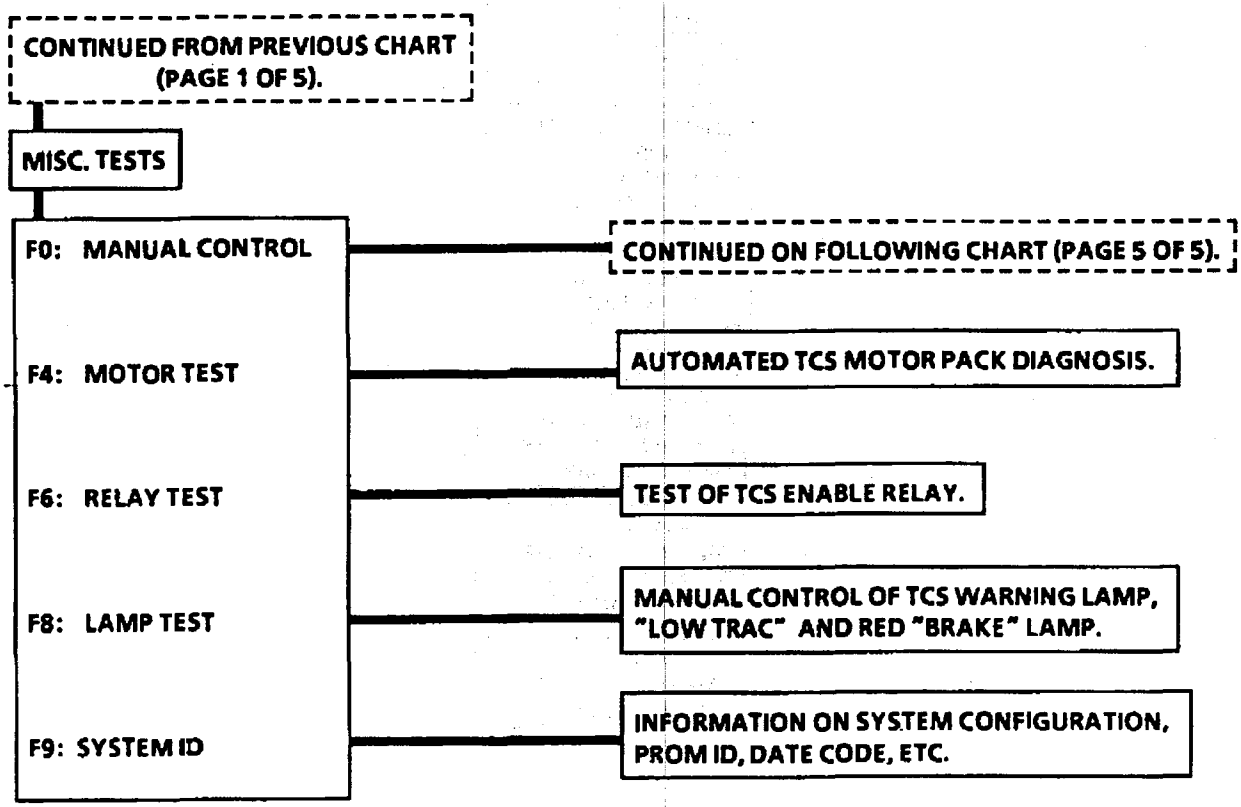
C0078S

DIAGNOSTIC PROCESS
(Page 3 of 5)



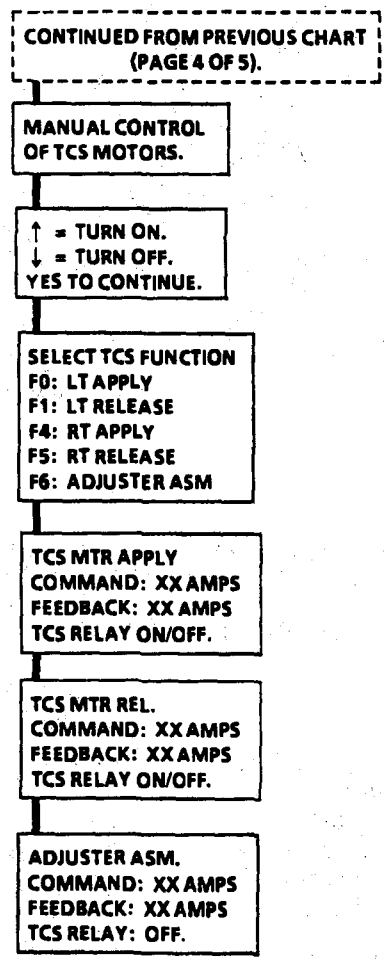
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DIAGNOSTIC PROCESS
(Page 4 of 5)

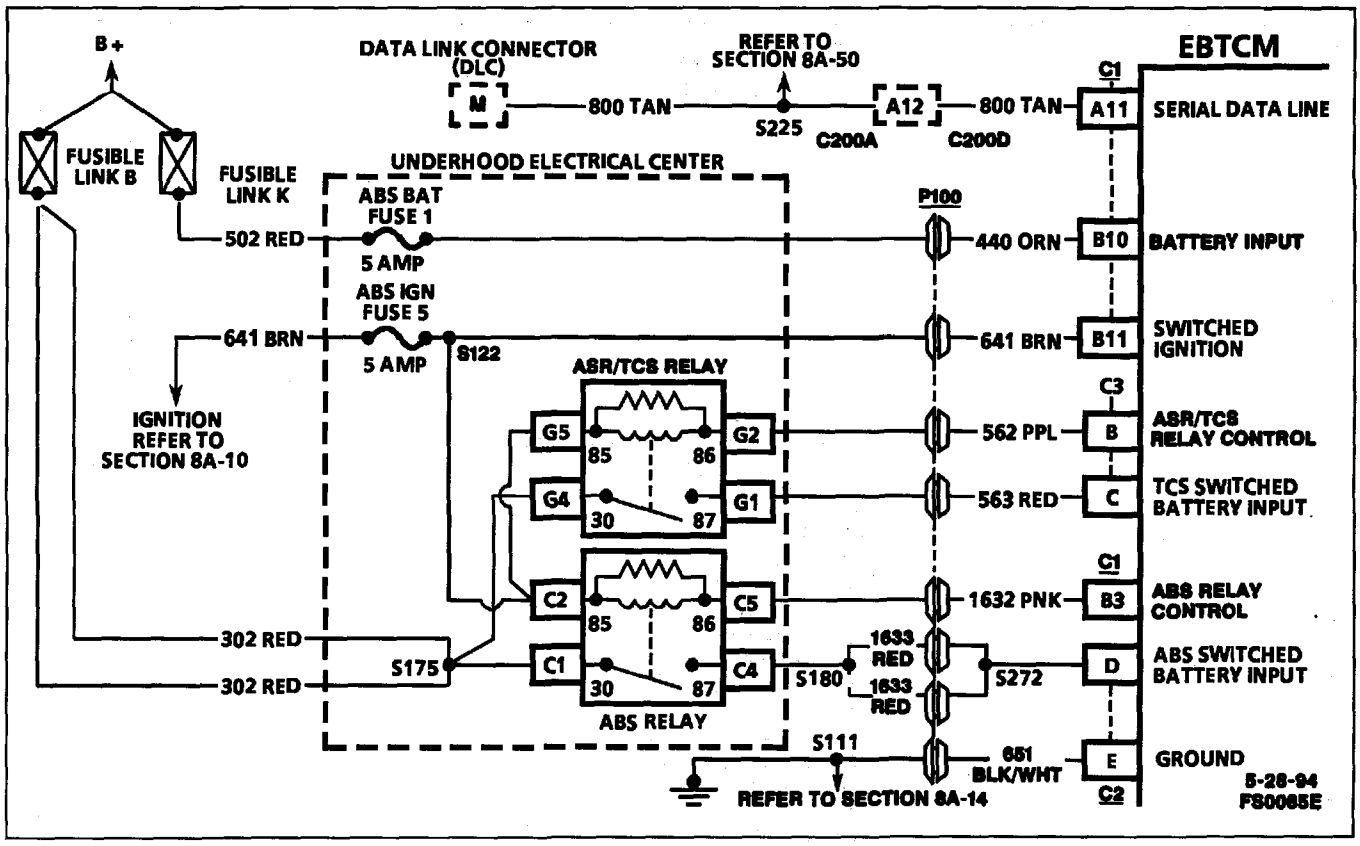


C0080S

DIAGNOSTIC PROCESS
(Page 5 of 5)



C0081S



DIAGNOSTIC SYSTEM CHECK
(Page 1 of 4)

System Description:

The diagnostic system check is an organized approach to identifying a problem created by an Antilock Brake Traction Control System (ABS VI/TCS) malfunction. It must be the starting point for any ABS VI/TCS complaint diagnosis because it directs the service technician to the next logical step in diagnosing the complaint.

Serial data is transmitted by the EBTCM through connector "C1", terminal "A11". The EBTCM is supplied switched ignition voltage through connector "C1", terminal "B11", battery voltage through connector "C1", terminal "B10" and switched battery voltage through connector "C2", terminal" D" and terminal "C". The EBTCM ground is provided through connector "C2", terminal "E".

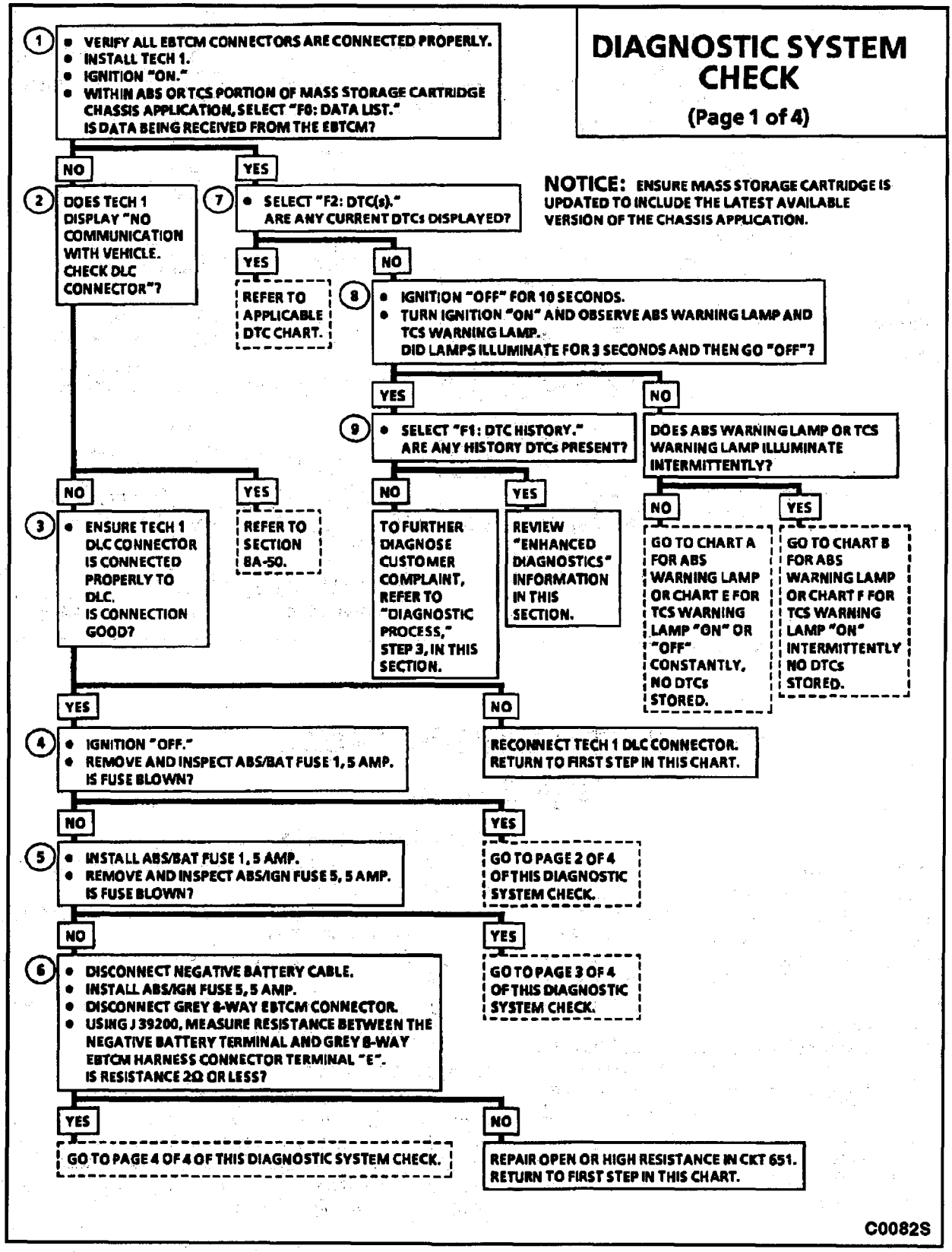
Chart Test Description:

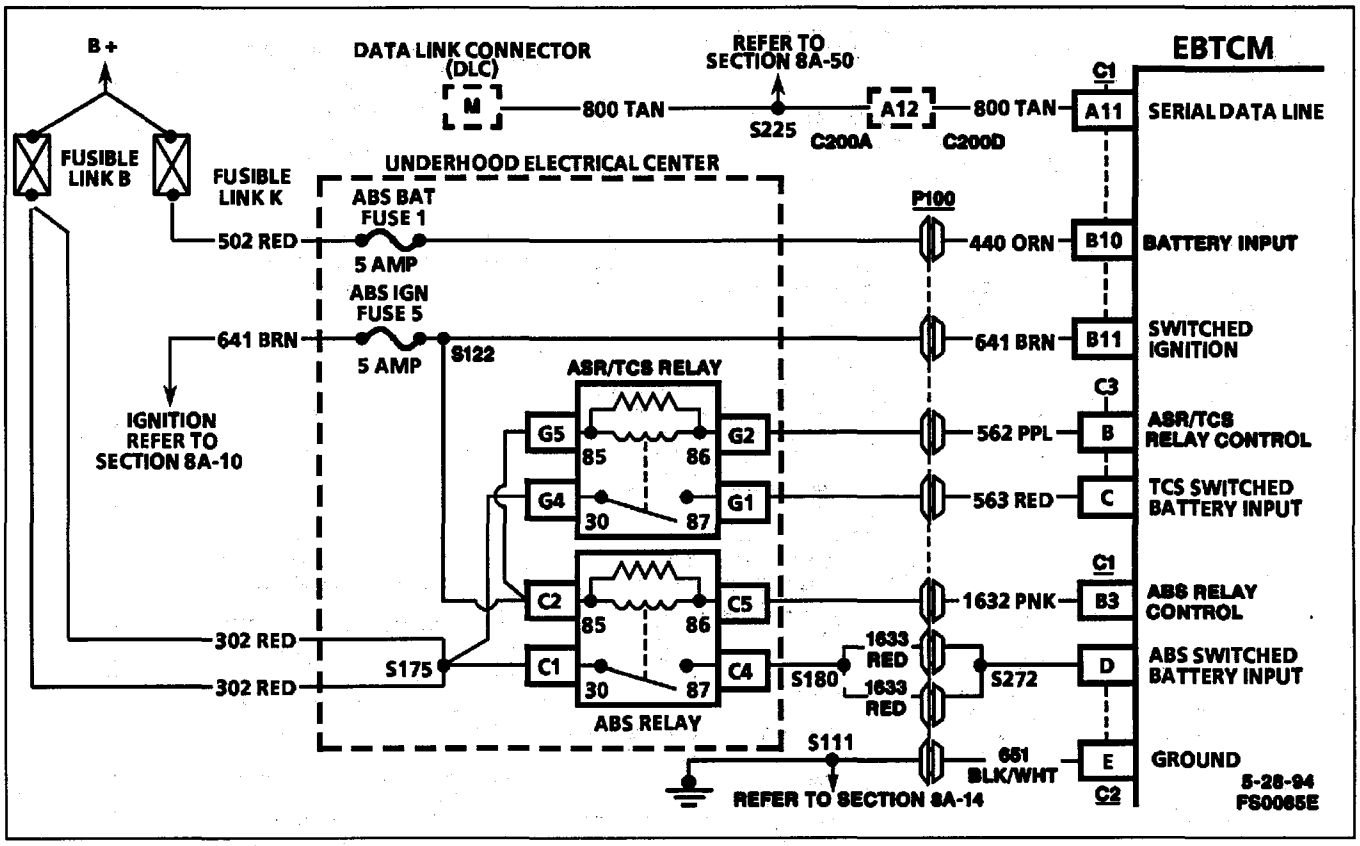
Number(s) below refer to circled number(s) on the diagnostic chart.

1. Indicates if EBTCM is transmitting data.
2. Checks for a serial data line malfunction.
3. Checks for proper Tech 1 connection to DLC.
4. Checks for open ABS BAT 5 amp Fuse 1.
5. Checks for open ABS IGN 5 amp Fuse 5.
6. Checks for high resistance in the EBTCM ground circuit.
7. Checks for current DTCs.
8. Checks for proper ABS and TCS warning lamp operation.
9. Checks for history DTCs.

Diagnostic Aids:

Excessive resistance in the ground or power supply circuits will not allow communication with the EBTCM. If communication with the EBTCM is not possible, ensure the ABS VI/TCS ground connection is good and that there is no excessive resistance in any of the power supply circuits.


DIAGNOSTIC SYSTEM CHECK
(Page 1 of 4)
NOTICE: ENSURE MASS STORAGE CARTRIDGE IS UPDATED TO INCLUDE THE LATEST AVAILABLE VERSION OF THE CHASSIS APPLICATION.
1 • VERIFY ALL EBTCM CONNECTORS ARE CONNECTED PROPERLY. • INSTALL TECH 1. • IGNITION "ON." • WITHIN ABS OR TCS PORTION OF MASS STORAGE CARTRIDGE CHASSIS APPLICATION, SELECT "F0: DATA LIST." IS DATA BEING RECEIVED FROM THE EBTCM?
NO
YES
2 DOES TECH 1 DISPLAY "NO COMMUNICATION WITH VEHICLE. CHECK DLC CONNECTOR"?
7 • SELECT "F2: DTC(s)." ARE ANY CURRENT DTCs DISPLAYED?
YES
NO
REFER TO APPLICABLE DTC CHART.
8 • IGNITION "OFF" FOR 10 SECONDS. • TURN IGNITION "ON" AND OBSERVE ABS WARNING LAMP AND TCS WARNING LAMP. DID LAMPS ILLUMINATE FOR 3 SECONDS AND THEN GO "OFF"?
YES
NO
9 • SELECT "F1: DTC HISTORY." ARE ANY HISTORY DTCs PRESENT?
DOES ABS WARNING LAMP OR TCS WARNING LAMP ILLUMINATE INTERMITTENTLY?
NO
YES
NO
YES
NO
YES
3 • ENSURE TECH 1 DLC CONNECTOR IS CONNECTED PROPERLY TO DLC. IS CONNECTION GOOD?
REFER TO SECTION 8A-50.
TO FURTHER DIAGNOSE CUSTOMER COMPLAINT, REFER TO "DIAGNOSTIC PROCESS," STEP 3, IN THIS SECTION.
REVIEW "ENHANCED DIAGNOSTICS" INFORMATION IN THIS SECTION.
GO TO CHART A FOR ABS WARNING LAMP OR CHART E FOR TCS WARNING LAMP "ON" OR "OFF" CONSTANTLY, NO DTCs STORED.
GO TO CHART B FOR ABS WARNING LAMP OR CHART F FOR TCS WARNING LAMP "ON" INTERMITTENTLY NO DTCs STORED.
YES
NO
4 • IGNITION "OFF." • REMOVE AND INSPECT ABS/BAT FUSE 1, 5 AMP. IS FUSE BLOWN?
RECONNECT TECH 1 DLC CONNECTOR. RETURN TO FIRST STEP IN THIS CHART.
NO
YES
5 • INSTALL ABS/BAT FUSE 1, 5 AMP. • REMOVE AND INSPECT ABS/IGN FUSE 5, 5 AMP. IS FUSE BLOWN?
GO TO PAGE 2 OF 4 OF THIS DIAGNOSTIC SYSTEM CHECK.
NO
YES
6 • DISCONNECT NEGATIVE BATTERY CABLE. • INSTALL ABS/IGN FUSE 5, 5 AMP. • DISCONNECT GREY 8-WAY EBTCM CONNECTOR. • USING J 39200, MEASURE RESISTANCE BETWEEN THE NEGATIVE BATTERY TERMINAL AND GREY 8-WAY EBTCM HARNESS CONNECTOR TERMINAL "E". IS RESISTANCE 2Ω OR LESS?
GO TO PAGE 3 OF 4 OF THIS DIAGNOSTIC SYSTEM CHECK.
YES
NO
GO TO PAGE 4 OF 4 OF THIS DIAGNOSTIC SYSTEM CHECK.
REPAIR OPEN OR HIGH RESISTANCE IN CKT 651. RETURN TO FIRST STEP IN THIS CHART.
C0082S



DIAGNOSTIC SYSTEM CHECK
(Page 2 of 4)

System Description:

The diagnostic system check is an organized approach to identifying a problem created by an Antilock Brake Traction Control System (ABS VI/TCS) malfunction. It must be the starting point for any ABS VI/TCS complaint diagnosis because it directs the service technician to the next logical step in diagnosing the complaint.

Serial data is transmitted by the EBTCM through connector "C1", terminal "A11". The EBTCM is supplied switched ignition voltage through connector "C1", terminal "B11", battery voltage through connector "C1", terminal "B10" and switched battery voltage through connector "C2", terminal" D" and terminal "C". The EBTCM ground is provided through connector "C2", terminal "E".

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

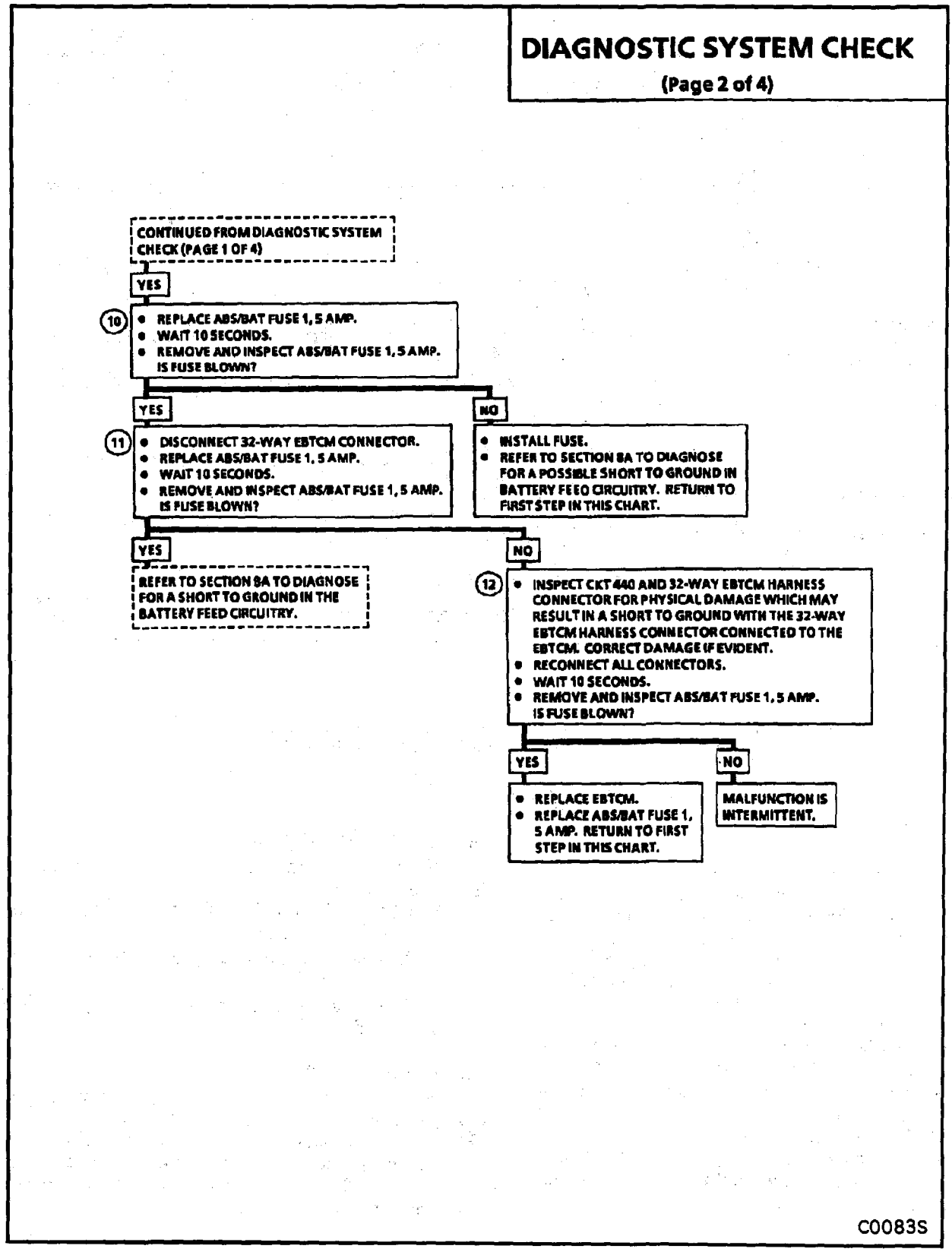
10. Checks for possible short to ground in the battery feed circuitry.

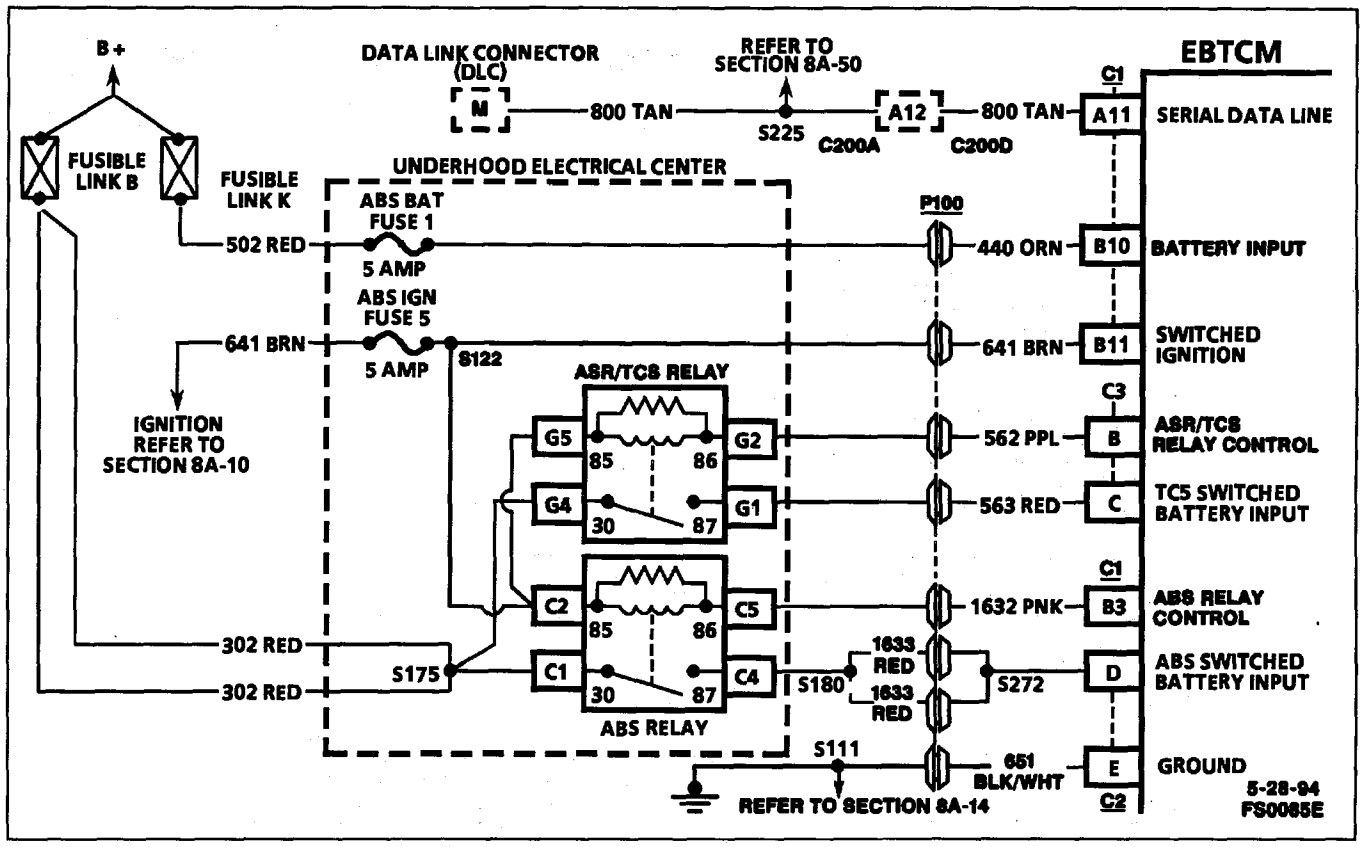
11. Checks for possible short to ground in the EBTCM.

12. Ensures short to ground is not due to physical damage of the circuitry.

Diagnostic Aids:

Excessive resistance in the ground or power supply circuits will not allow communication with the EBTCM. If communication with the EBTCM is not possible, ensure the ABS VI/TCS ground connection is good and that there is no excessive resistance in any of the power supply circuits.


DIAGNOSTIC SYSTEM CHECK
(Page 2 of 4)
CONTINUED FROM DIAGNOSTIC SYSTEM CHECK (PAGE 1 OF 4)
YES
10
• REPLACE ABS/BAT FUSE 1, 5 AMP.
• WAIT 10 SECONDS.
• REMOVE AND INSPECT ABS/BAT FUSE 1, 5 AMP. IS FUSE BLOWN?
YES
NO
11
• DISCONNECT 32-WAY EBTCM CONNECTOR.
• REPLACE ABS/BAT FUSE 1, 5 AMP.
• WAIT 10 SECONDS.
• REMOVE AND INSPECT ABS/BAT FUSE 1, 5 AMP. IS FUSE BLOWN?
• INSTALL FUSE.
• REFER TO SECTION 8A TO DIAGNOSE FOR A POSSIBLE SHORT TO GROUND IN BATTERY FEED CIRCUITRY. RETURN TO FIRST STEP IN THIS CHART.
YES
NO
REFER TO SECTION 8A TO DIAGNOSE FOR A SHORT TO GROUND IN THE BATTERY FEED CIRCUITRY.
12
• INSPECT CKT 440 AND 32-WAY EBTCM HARNESS CONNECTOR FOR PHYSICAL DAMAGE WHICH MAY RESULT IN A SHORT TO GROUND WITH THE 32-WAY EBTCM HARNESS CONNECTOR CONNECTED TO THE EBTCM. CORRECT DAMAGE IF EVIDENT.
• RECONNECT ALL CONNECTORS.
• WAIT 10 SECONDS.
• REMOVE AND INSPECT ABS/BAT FUSE 1, 5 AMP. IS FUSE BLOWN?
YES
NO
• REPLACE EBTCM.
• REPLACE ABS/BAT FUSE 1, 5 AMP. RETURN TO FIRST STEP IN THIS CHART.
MALFUNCTION IS INTERMITTENT.
C0083S



DIAGNOSTIC SYSTEM CHECK
(Page 3 of 4)

System Description:

The diagnostic system check is an organized approach to identifying a problem created by an Antilock Brake Traction Control System (ABS VI/TCS) malfunction. It must be the starting point for any ABS VI/TCS complaint diagnosis because it directs the service technician to the next logical step in diagnosing the complaint.

Serial data is transmitted by the EBTCM through connector "C1", terminal "A11". The EBTCM is supplied switched ignition voltage through connector "C1", terminal "B11", battery voltage through connector "C1", terminal "B10" and switched battery voltage through connector "C2", terminal" D" and terminal "C". The EBTCM ground is provided through connector "C2", terminal "E".

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

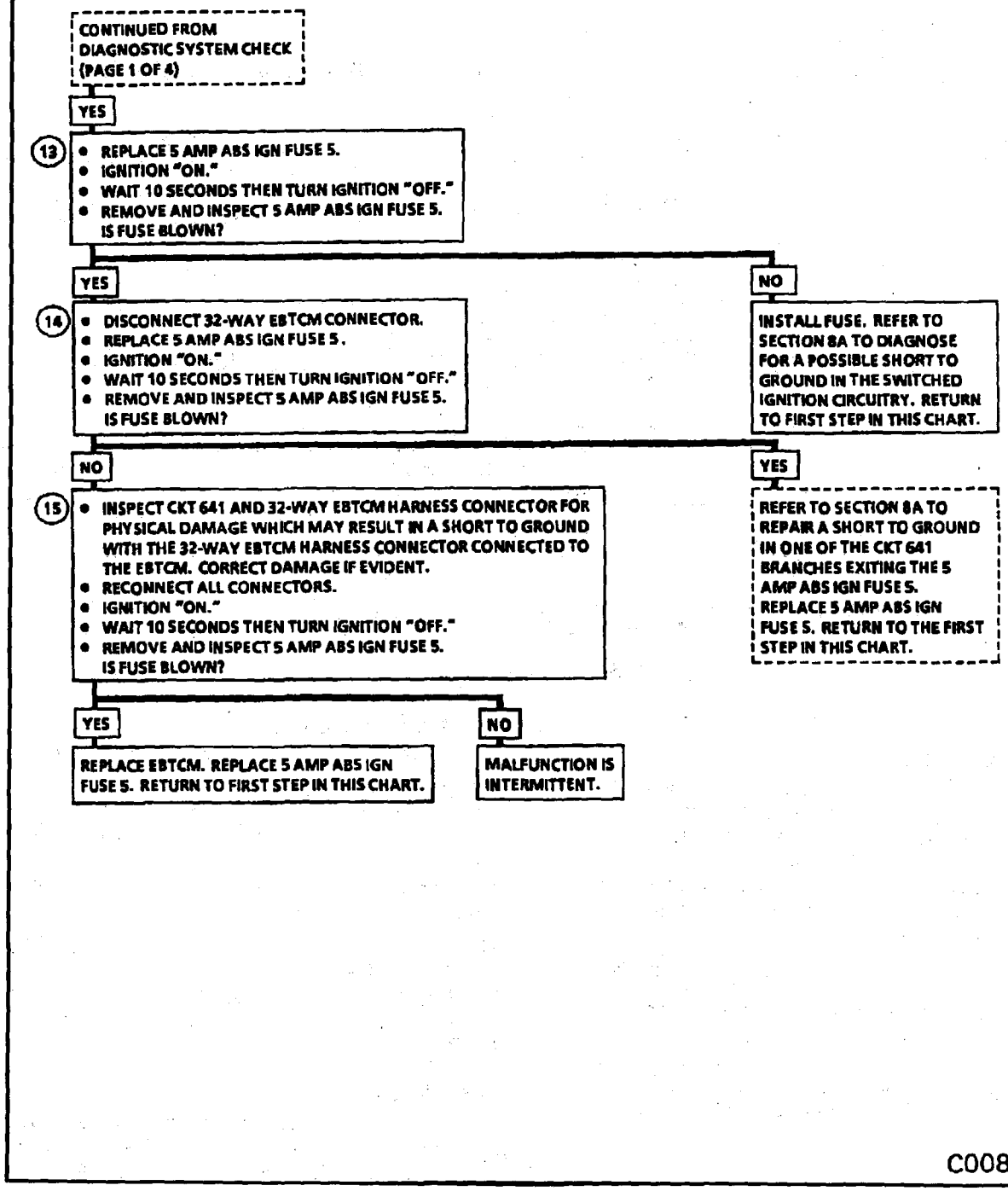
13. Checks for possible short to ground in the switched ignition circuitry.
14. Isolates the short to ground to either the circuitry or the EBTCM.
15. Ensures short to ground is not due to physical damage of the circuitry.

Diagnostic Aids:

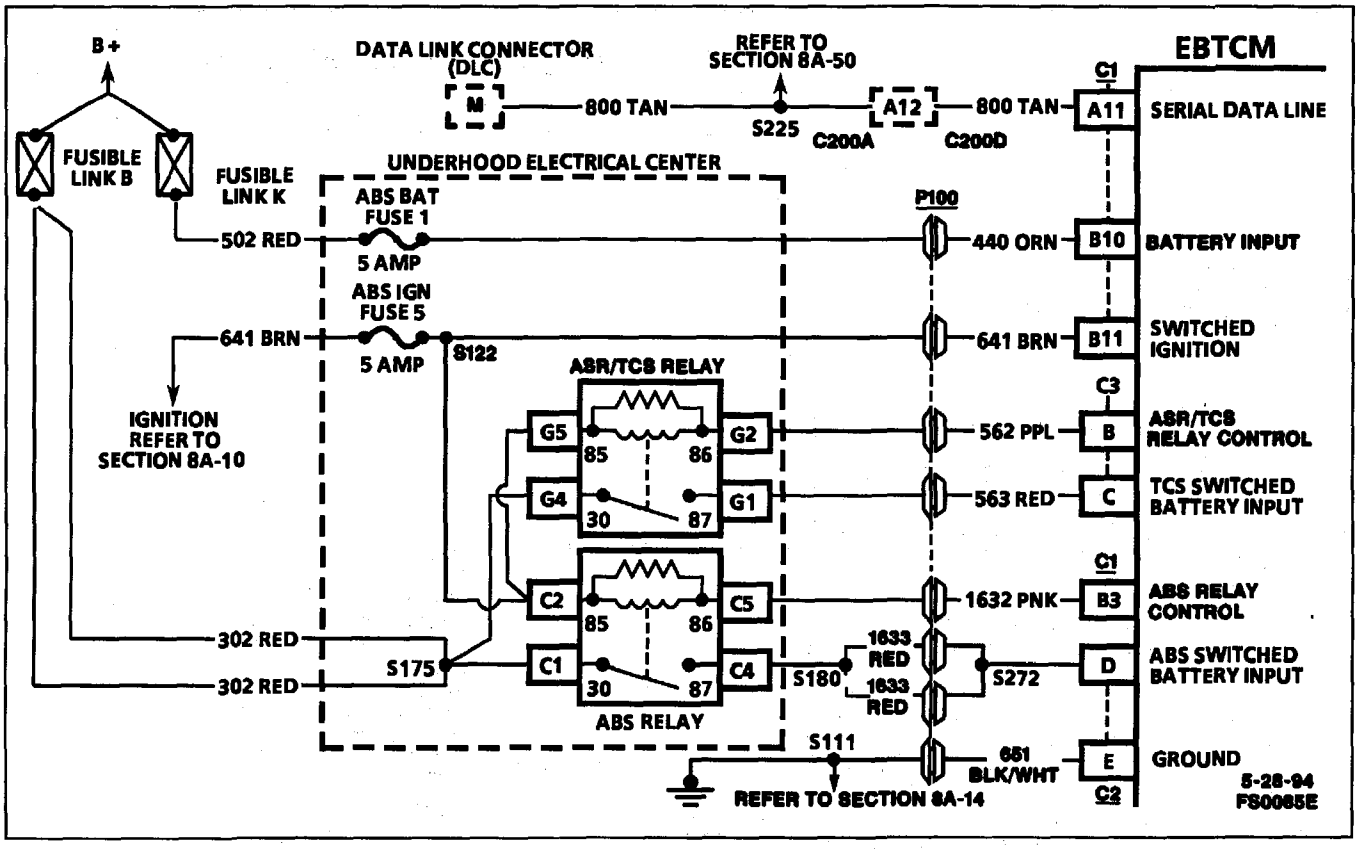
Excessive resistance in the ground or power supply circuits will not allow communication with the EBTCM. If communication with the EBTCM is not possible, ensure the ABS VI/TCS ground connection is good and that there is no excessive resistance in any of the power supply circuits.

DIAGNOSTIC SYSTEM CHECK

(Page 3 of 4)



C0084S



DIAGNOSTIC SYSTEM CHECK
(Page 4 of 4)

System Description:

The diagnostic system check is an organized approach to identifying a problem created by an Antilock Brake Traction Control System (ABS VI/TCS) malfunction. It must be the starting point for any ABS VI/TCS complaint diagnosis because it directs the service technician to the next logical step in diagnosing the complaint.

Serial data is transmitted by the EBTCM through connector "C1", terminal "A11". The EBTCM is supplied switched ignition voltage through connector "C1", terminal "B11", battery voltage through connector "C1", terminal "B10" and switched battery voltage through connector "C2", terminal" D" and terminal "C". The EBTCM ground is provided through connector "C2", terminal "E".

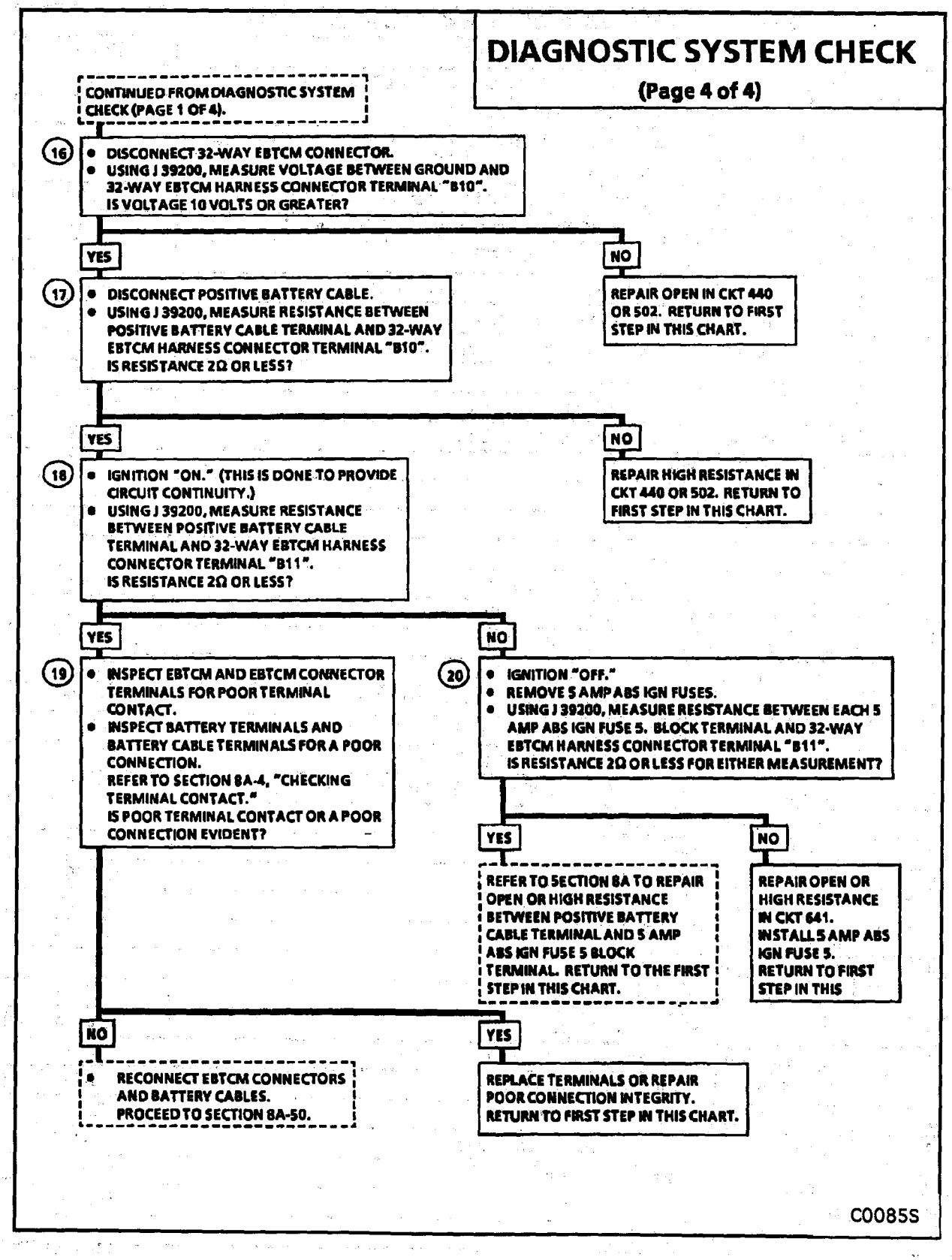
Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

16. Checks for an open in CKT 440 or 502.
17. Checks for high resistance in CKT 440 or 502.
18. Checks for high resistance in the switched ignition feed circuitry.
19. Ensures malfunction is not due to poor terminal contact.
20. Checks for high resistance in the switched ignition circuit between the fuse block and the EBTCM.

Diagnostic Aids:

Excessive resistance in the ground or power supply circuits will not allow communication with the EBTCM. If communication with the EBTCM is not possible, ensure the ABS VI/TCS ground connection is good and that there is no excessive resistance in any of the power supply circuits.


DIAGNOSTIC SYSTEM CHECK
(Page 4 of 4)
CONTINUED FROM DIAGNOSTIC SYSTEM CHECK (PAGE 1 OF 4).
16
• DISCONNECT 32-WAY EBTCM CONNECTOR.
• USING J 39200, MEASURE VOLTAGE BETWEEN GROUND AND 32-WAY EBTCM HARNESS CONNECTOR TERMINAL "B10".
IS VOLTAGE 10 VOLTS OR GREATER?
YES
NO
REPAIR OPEN IN CKT 440 OR 502. RETURN TO FIRST STEP IN THIS CHART.
17
• DISCONNECT POSITIVE BATTERY CABLE.
• USING J 39200, MEASURE RESISTANCE BETWEEN POSITIVE BATTERY CABLE TERMINAL AND 32-WAY EBTCM HARNESS CONNECTOR TERMINAL "B10".
IS RESISTANCE 2Ω OR LESS?
YES
NO
REPAIR HIGH RESISTANCE IN CKT 440 OR 502. RETURN TO FIRST STEP IN THIS CHART.
18
• IGNITION "ON." (THIS IS DONE TO PROVIDE CIRCUIT CONTINUITY.)
• USING J 39200, MEASURE RESISTANCE BETWEEN POSITIVE BATTERY CABLE TERMINAL AND 32-WAY EBTCM HARNESS CONNECTOR TERMINAL "B11".
IS RESISTANCE 2Ω OR LESS?
YES
NO
19
• INSPECT EBTCM AND EBTCM CONNECTOR TERMINALS FOR POOR TERMINAL CONTACT.
• INSPECT BATTERY TERMINALS AND BATTERY CABLE TERMINALS FOR A POOR CONNECTION.
REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT."
IS POOR TERMINAL CONTACT OR A POOR CONNECTION EVIDENT?
20
• IGNITION "OFF."
• REMOVE 5 AMP ABS IGN FUSES.
• USING J 39200, MEASURE RESISTANCE BETWEEN EACH 5 AMP ABS IGN FUSE 5. BLOCK TERMINAL AND 32-WAY EBTCM HARNESS CONNECTOR TERMINAL "B11".
IS RESISTANCE 2Ω OR LESS FOR EITHER MEASUREMENT?
YES
NO
REFER TO SECTION 8A TO REPAIR OPEN OR HIGH RESISTANCE BETWEEN POSITIVE BATTERY CABLE TERMINAL AND 5 AMP ABS IGN FUSE 5 BLOCK TERMINAL. RETURN TO THE FIRST STEP IN THIS CHART.
REPAIR OPEN OR HIGH RESISTANCE IN CKT 641. INSTALL 5 AMP ABS IGN FUSE 5. RETURN TO FIRST STEP IN THIS
NO
• RECONNECT EBTCM CONNECTORS AND BATTERY CABLES.
PROCEED TO SECTION 8A-50.
YES
REPLACE TERMINALS OR REPAIR POOR CONNECTION INTEGRITY. RETURN TO FIRST STEP IN THIS CHART.
C0085S

DIAGNOSTIC TROUBLE CODE AND SYMPTOM TABLE		
CHART	**SYMPTOM**	**PAGE**
A	"ABS INOP" Lamp "ON" or "OFF" Constantly, No DTCs Stored	5E2-34
B	"ABS INOP" Lamp "ON" Intermittently, No DTCs Stored	5E2-35
C	"LOW TRAC" Indicator Lamp "ON" With Ignition "OFF", No DTCs Stored	5E2-36
D	Tech 1 Displays Undefined DTCs	5E2-37
E	TCS (Amber) Warning Lamp "ON" or "OFF" Constantly, No DTCs Stored	5E2-38
F	TCS (Amber) Warning Lamp "ON" Intermittently, No DTCs Stored	5E2-39
DTC	**DESCRIPTION**	
11	ABS Warning or Low Trac Lamp CKT Malfunction (1 of 2)	5E2-40
14	ABS Enable Relay Contact Circuit Open (1 of 3)	5E2-44
15	ABS Rly Contact CKT Short to Batt or Always Closed	5E2-50
16	ABS Enable Relay Coil Circuit Open	5E2-52
17	ABS Enable Relay Coil Circuit Shorted to Gnd	5E2-54
18	ABS Enable Relay Coil Circuit Shorted to Batt	5E2-56
21	Left Front Wheel Speed = 0	5E2-58
22	Right Front Wheel Speed = 0	5E2-60
23	Left Rear Wheel Speed = 0	5E2-62
24	Right Rear Wheel Speed = 0	5E2-64
25	Left Front Excessive Wheel Speed Variation	5E2-66
26	Right Front Excessive Wheel Speed Variation	5E2-68
27	Left Rear Excessive Wheel Speed Variation	5E2-70
28	Right Rear Excessive Wheel Speed Variation	5E2-72
32	LF Wheel Speed Snr CKT Open or Short to Gnd/Batt (1 of 3)	5E2-74
33	RF Wheel Speed Snr CKT Open or Short to Gnd/Batt (1 of 3)	5E2-80
34	LR Wheel Speed Snr CKT Open or Short to Gnd/Batt (1 of 3)	5E2-86
35	RR Wheel Speed Snr CKT Open or Short to Gnd/Batt (1 of 3)	5E2-92
36	Low System Voltage (1 of 2)	5E2-98
37	High System Voltage	5E2-102
38	Left Front ESB Will Not Hold Motor	5E2-104
41	Right Front ESB Will Not Hold Motor	5E2-106
42	Rear ESB Will Not Hold Motor	5E2-108
44	Left Front ABS Channel Will Not Move	5E2-110
45	Right Front ABS Channel Will Not Move	5E2-112
46	Rear ABS Channel Will Not Move	5E2-114
47	Left Front ABS Motor Free Spins (1 of 2)	5E2-116
48	Right Front ABS Motor Free Spins (1 of 2)	5E2-120
51	Rear ABS Motor Free Spins (1 of 2)	5E2-124
52	Left Front ABS Channel in Release Too Long	5E2-128
53	Right Front ABS Channel in Release Too Long	5E2-130
54	Rear ABS Channel in Release Too Long	5E2-132
55	EBTCM Malfunction (ABS)	5E2-134
56	Left Front ABS Motor Circuit Open	5E2-136
57	Left Front ABS Motor Circuit Shorted to Gnd	5E2-138
58	Left Front ABS Motor Circuit Shorted to Batt	5E2-140
61	Right Front ABS Motor Circuit Open	5E2-142

T5145

DIAGNOSTIC TROUBLE CODE AND SYMPTOM TABLE		
62	Right Front ABS Motor Circuit Shorted to Gnd	5E2-144
63	Right Front ABS Motor Circuit Shorted to Batt	5E2-146
64	Rear ABS Motor Circuit Open	5E2-148
65	Rear ABS Motor Circuit Shorted to Ground	5E2-150
66	Rear ABS Motor Circuit Shorted to Battery	5E2-152
75	PCM to EBTCM Serial Data Malfunction	5E2-154
76	Left Front Sol Circuit Open or Shorted to Batt	5E2-156
77	Left Front Solenoid Circuit Shorted to Gnd	5E2-158
78	Right Front Sol Circuit Open or shorted to Batt	5E2-160
81	Right Front Solenoid Circuit Shorted to Gnd	5E2-162
82	Calibration Malfunction	5E2-164
86	EBTCM Turned "ON" the Red "BRAKE" Warning Lamp	5E2-166
87	Red "BRAKE" Warning Lamp Circuit Open	5E2-168
88	Red "BRAKE" Warning Lamp Ckt Shorted to Batt	5E2-170
91	Open Brake Switch During Deceleration	5E2-172
92	Open Brake Switch When ABS Was Required	5E2-174
93	DTC 91 or 92 Set in Current or Prev. Ign. Cycle	5E2-176
94	Brake Switch Contacts Always Closed	5E2-178
95	Brake Switch Circuit Open	5E2-180
96	Rear Brake Lamp Circuit Open	5E2-182
111	TCS Warning Lamp or Active Circuit Malfunction	5E2-184
114	TCS Enable Relay Contact Circuit Open (1 of 3)	5E2-190
116	TCS Enable Relay Coil Circuit Open	5E2-196
118	TCS Enable Relay Coil Circuit Shorted to Batt	5E2-198
123	PCM to EBTCM TP Sensor Circuit Malfunction	5E2-200
136	Low System Voltage (TCS) (1 of 2)	5E2-202
144	Left TCS Channel Will Not Move	5E2-206
145	Right TCS Channel Will Not Move	5E2-208
146	Adjuster Assembly Will Not Move	5E2-210
147	Left TCS Motor Free Spins (1 of 2)	5E2-212
148	Right TCS Motor Free Spins (1 of 2)	5E2-216
154	Adjuster Assembly Malfunction	5E2-220
155	EBTCM Malfunction (TCS)	5E2-222
156	Left TCS Motor Circuit Open	5E2-224
157	Left TCS Motor Circuit Shorted to GND	5E2-226
158	Left TCS Motor Circuit Shorted to BATT	5E2-228
161	Right TCS Motor Circuit Open	5E2-230
162	Right TCS Motor Shorted to GND	5E2-232
163	Right TCS Motor Shorted to BATT	5E2-234
164	Adjuster Assembly Motor Circuit Open	5E2-236
165	Adjusted Assembly Motor Circuit Shorted to Gnd	5E2-238
166	Adjuster Assembly Motor Circuit Shorted to Batt	5E2-240

T5145(Cont'd)

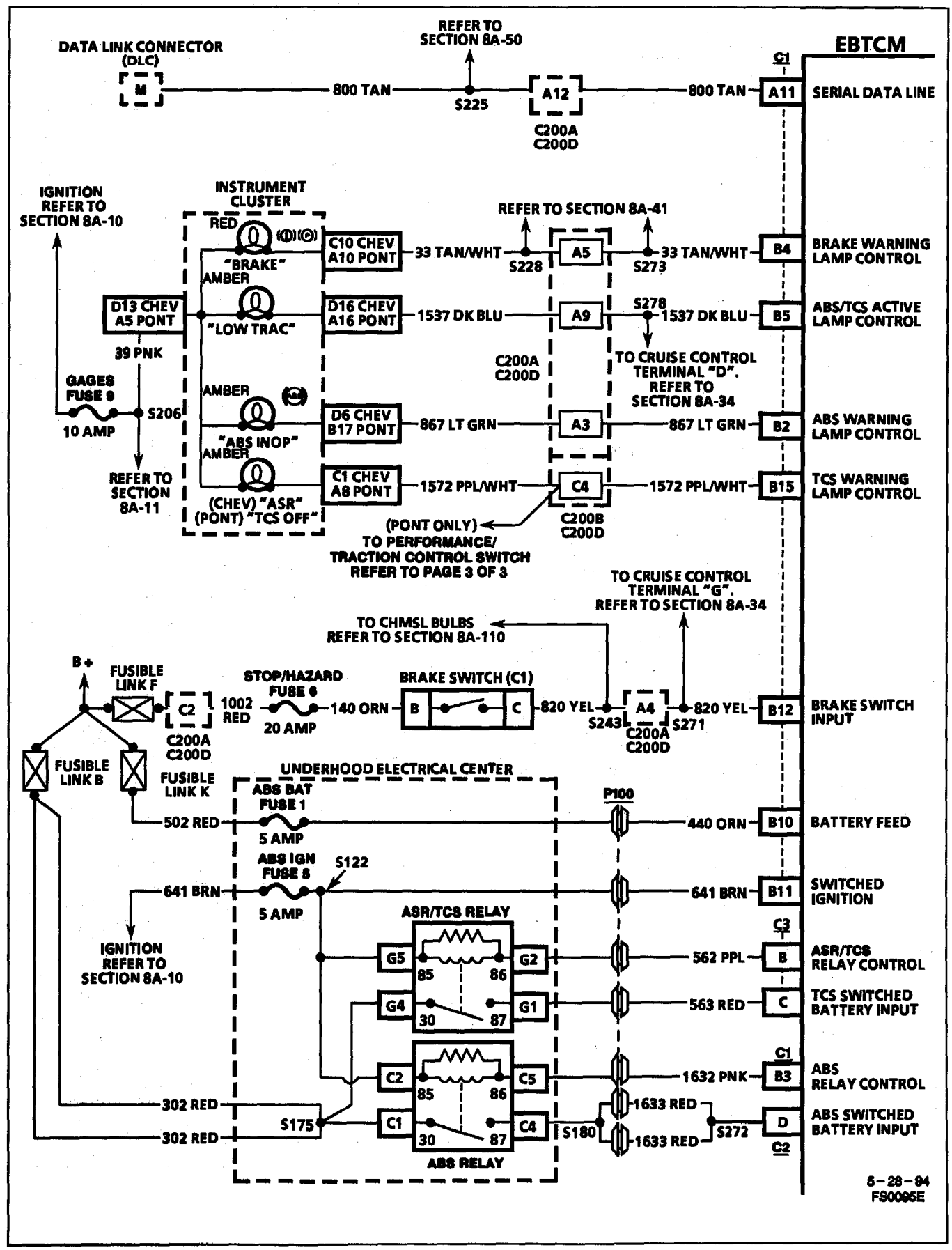


Figure 8 - Wiring Diagram (1 of 3)

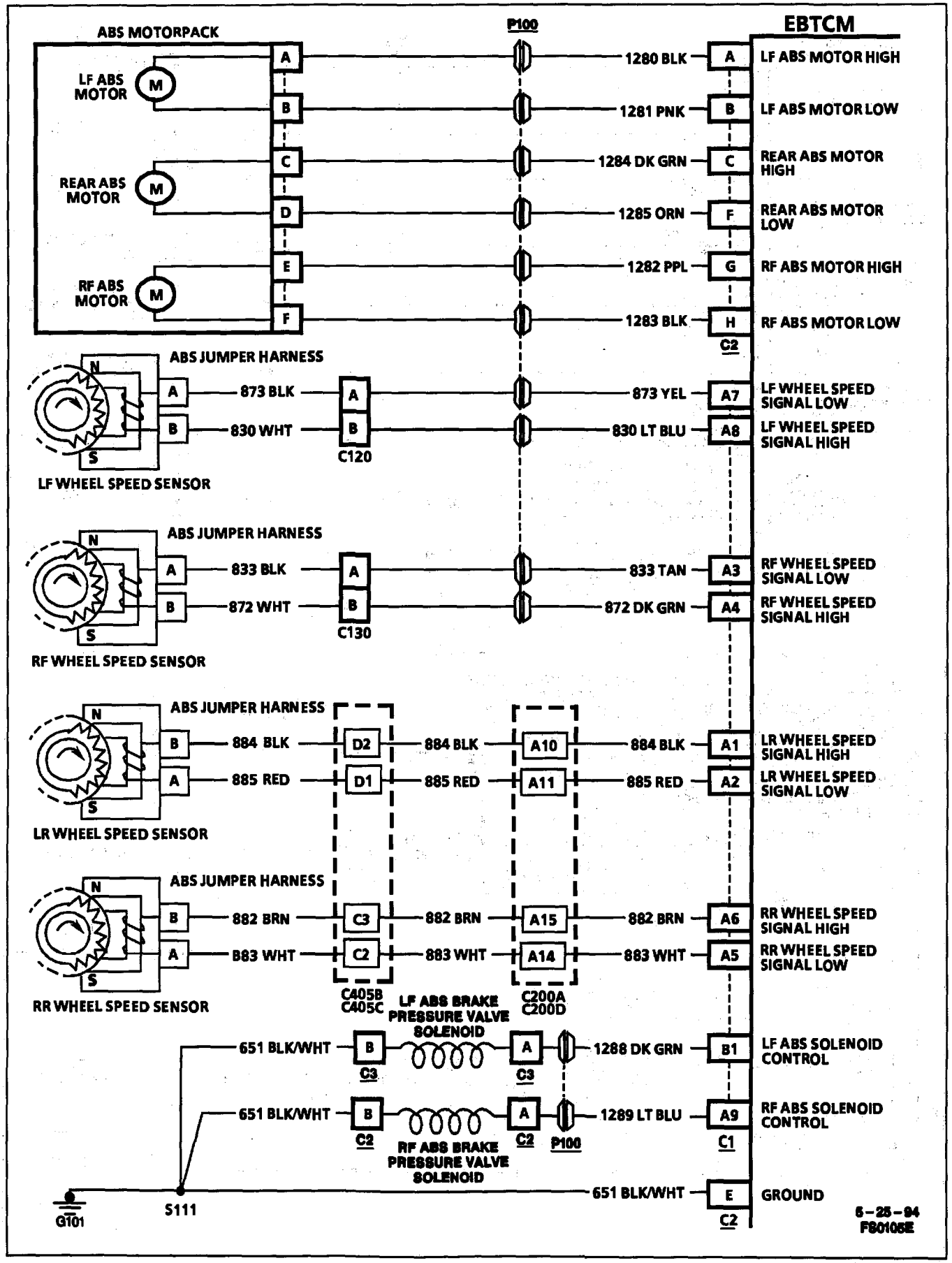


Figure 9 - Wiring Diagram (2 of 3)

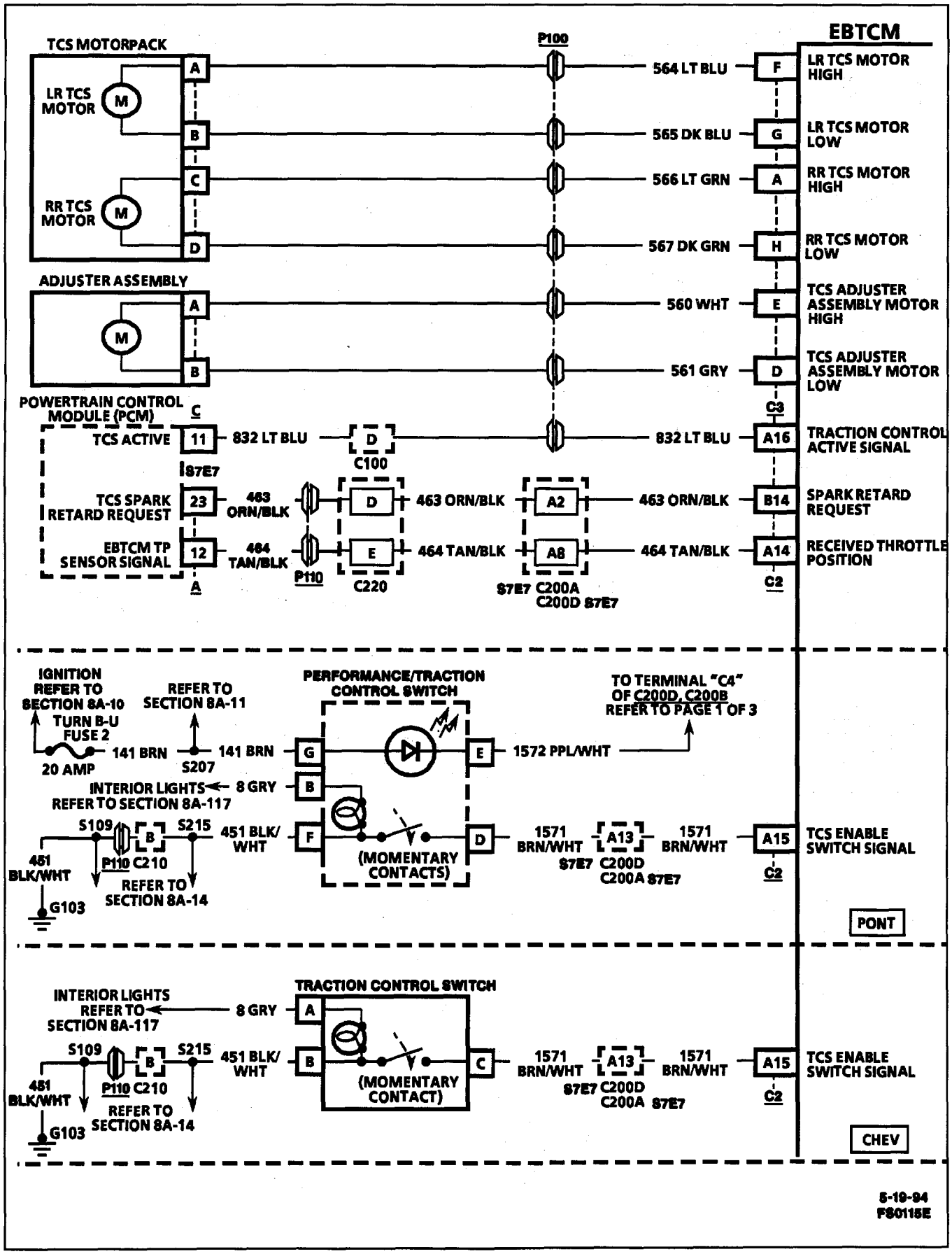
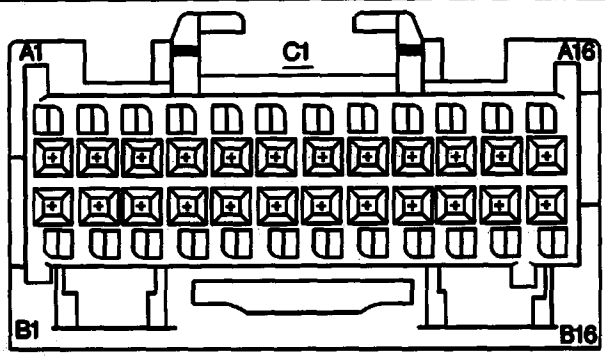


Figure 10 - Wiring Diagram (3 of 3)



32 – WAY F MICRO – PACK 100 SERIES
DK RED

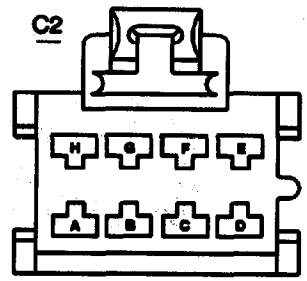
ELECTRONIC BRAKE/TRACTION
CONTROL MODULE (EBTCM)

5-28-94
FS0125E

Figure 11 - EBTCM Connector Face View (1 of 3)

CONNECTOR TERMINAL	CIRCUIT NO.	COLOR	CIRCUIT DESCRIPTION
A1	884	BLK	LR WHEEL SPEED SIGNAL HIGH
A2	885	RED	LR WHEEL SPEED SIGNAL LOW
A3	883	TAN	RF WHEEL SPEED SIGNAL LOW
A4	872	DK GRN	RF WHEEL SPEED SIGNAL HIGH
A5	883	WHT	RR WHEEL SPEED SIGNAL LOW
A6	882	BRN	RR WHEEL SPEED SIGNAL HIGH
A7	873	YEL	LF WHEEL SPEED SIGNAL LOW
A8	830	LT BLU	LF WHEEL SPEED SIGNAL HIGH
A9	1289	LT BLU	RF ABS SOLENOID CONTROL
A10	PLUGGED		NOT USED
A11	800	TAN	SERIAL DATA LINE
A12	PLUGGED		NOT USED
A13	PLUGGED		NOT USED
A14	464	TAN/BLK	RECEIVED THROTTLE POSITION
A15	1571	BRN/WHT	TCS CONTROL SWITCH SIGNAL
A16	832	LT BLU	TRACTION CONTROL ACTIVE SIGNAL
B1	1288	DK GRN	LF ABS SOLENOID CONTROL
B2	867	LT GRN	ABS WARNING LAMP CONTROL
B3	1632	PNK	ABS RELAY CONTROL
B4	33	TAN/WHT	BRAKE WARNING LAMP CONTROL
B5	1537	DK BLU	ABS/TCS ACTIVE LAMP CONTROL
B6	PLUGGED		NOT USED
B7	PLUGGED		NOT USED
B8	PLUGGED		NOT USED
B9	PLUGGED		NOT USED
B10	440	ORN	BATTERY FEED
B11	641	BRN	SWITCHED IGNITION
B12	820	YEL	BRAKE SWITCH INPUT
B13	PLUGGED		NOT USED
B14	463	ORN/BLK	SPARK RETARD REQUEST
B15	1572	PPL/WHT	TCS WARNING LAMP CONTROL
B16	PLUGGED		NOT USED

T5103



ELECTRONIC BRAKE/TRACTION CONTROL MODULE (EBTCM)

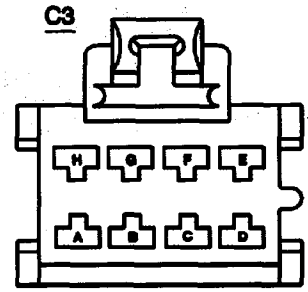
8 – WAY F METRI – PACK 280 SERIES
LR GRY

5-28-94
FS0135E

Figure 12 - EBTCM Connector Face View (2 of 3)

PIN	CIRCUIT NO.	COLOR	CIRCUIT
A	1280	BLK	LF ABS MOTOR HIGH
B	1281	PNK	LF ABS MOTOR LOW
C	1284	DK GRN	REAR ABS MOTOR HIGH
D	1633	RED	ABS SWITCHED BATTERY INPUT
E	651	BLK/WHT	GROUND
F	1285	ORN	REAR ABS MOTOR LOW
G	1282	PPL	RF ABS MOTOR HIGH
H	1283	BLK	RF ABS MOTOR LOW

C1582S



ELECTRONIC BRAKE/TRACTION CONTROL MODULE (EBTCM)

8 – WAY F METRI – PACK 280 SERIES
BLK

5-18-94
FS0145E

Figure 13 - EBTCM Connector Face View (3 of 3)

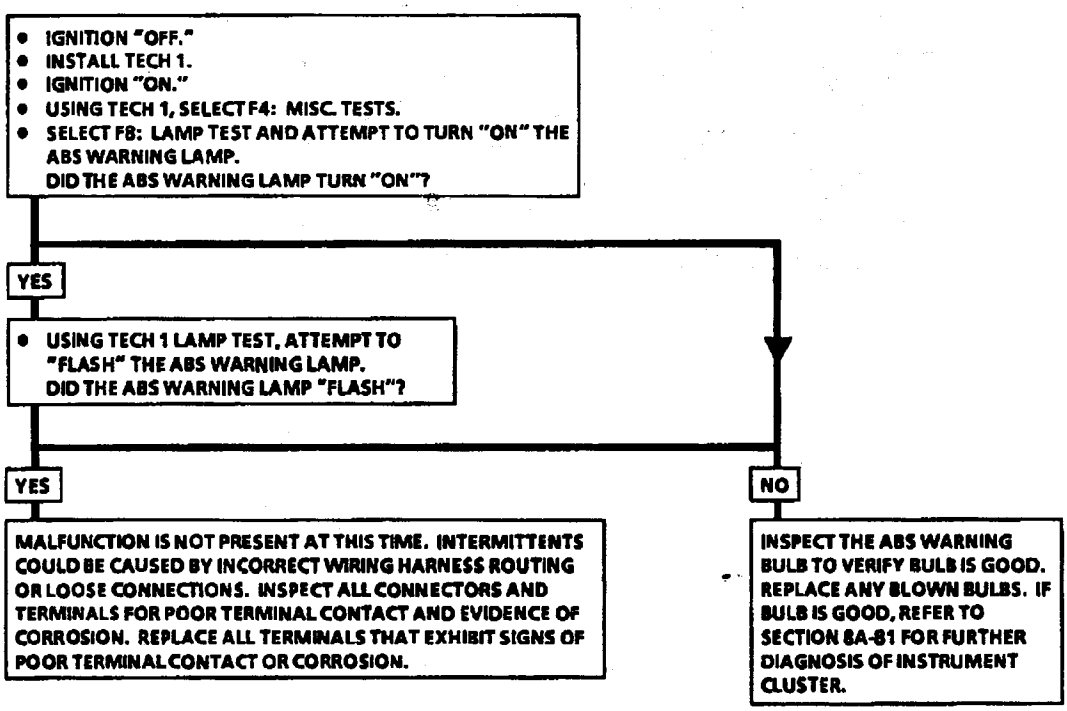
PIN	CIRCUIT NO.	COLOR	CIRCUIT
A	566	LT GRN	RR TCS MOTOR HIGH
B	562	PPL	TCS ENABLE RELAY CONTROL
C	563	RED	TCS SWITCHED BATTERY INPUT
D	561	GRY	TCS ADJUSTER ASSEMBLY MOTOR LOW
E	560	WHT	TCS ADJUSTER ASSEMBLY MOTOR HIGH
F	564	LT BLU	LR TCS MOTOR HIGH
G	565	DK BLU	LR TCS MOTOR LOW
H	567	DK GRN	RR TCS MOTOR LOW

C1581S

CHART A

ABS (AMBER) WARNING LAMP "ON" OR "OFF" CONSTANTLY, NO DTCs STORED

NOTICE: DIAGNOSTIC SYSTEM CHECK MUST BE COMPLETED BEFORE USING THIS CHART.



C0086S

CHART B

ABS (AMBER) WARNING LAMP "ON" INTERMITTENTLY, NO DTCs STORED

NOTICE: DIAGNOSTIC SYSTEM CHECK *MUST* BE COMPLETED BEFORE USING THIS CHART.

- IGNITION "OFF."
- DISCONNECT GREY 8-WAY EBTCM CONNECTOR.
- DISCONNECT NEGATIVE BATTERY TERMINAL.
- DISCONNECT POSITIVE BATTERY TERMINAL.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN THE NEGATIVE BATTERY CABLE TERMINAL AND TERMINAL "E" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR.
- OBSERVE MEASURED RESISTANCE WHILE "WIGGLING" WIRE HARNESS AND CONNECTORS.

IS RESISTANCE ALWAYS 2Ω OR LESS?

YES

- DISCONNECT 32-WAY EBTCM CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN POSITIVE BATTERY CABLE TERMINAL AND TERMINAL "B10" OF THE 32-WAY EBTCM HARNESS CONNECTOR.
- OBSERVE MEASURED RESISTANCE WHILE "WIGGLING" WIRE HARNESS AND CONNECTORS.

IS RESISTANCE ALWAYS 2Ω OR LESS?

NO

REPAIR INTERMITTENT OPEN OR HIGH RESISTANCE IN CKT 651. REFER TO SECTION 8A-4, "INTERMITTENTS AND POOR CONNECTIONS."

YES

- TURN IGNITION SWITCH "ON" (THIS IS DONE TO COMPLETE THE IGNITION CIRCUIT).
- USING J 39200, MEASURE THE RESISTANCE BETWEEN POSITIVE BATTERY CABLE TERMINAL AND TERMINAL "B11" OF THE 32-WAY EBTCM HARNESS CONNECTOR.
- OBSERVE MEASURED RESISTANCE WHILE "WIGGLING" WIRE HARNESS AND CONNECTORS.

IS RESISTANCE ALWAYS 2Ω OR LESS?

NO

REPAIR INTERMITTENT OPEN OR HIGH RESISTANCE IN CKTs 502 OR 440. REFER TO SECTION 8A-4, "INTERMITTENTS AND POOR CONNECTIONS."

YES

- CHECK POSITIVE BATTERY TERMINAL AND POSITIVE BATTERY CABLE TERMINAL FOR A POOR CONNECTION.
- INSPECT TERMINALS "B11" AND "B10" OF THE 32-WAY EBTCM CONNECTOR AND TERMINAL "E" OF THE GREY 8-WAY EBTCM CONNECTOR FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT."

IS THERE EVIDENCE OF POOR TERMINAL CONTACT OR CORROSION?

NO

REPAIR INTERMITTENT OPEN OR HIGH RESISTANCE IN CKT 641. REFER TO SECTION 8A-4, "INTERMITTENTS AND POOR CONNECTIONS."

NO

- IGNITION "OFF."
- RECONNECT ALL CONNECTORS.
- IGNITION "ON."

IS ABS WARNING LAMP "ON" INTERMITTENTLY WITH NO DTCs SET?

YES

REPLACE TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR SIGNS OF CORROSION. REPAIR CONNECTION INTEGRITY IF POOR CONTACT EXISTS AT BATTERY.

NO

MALFUNCTION IS NOT PRESENT AT THIS TIME. INTERMITTENTS MAY BE CAUSED BY INCORRECT WIRING HARNESS ROUTING OR LOOSE GROUND CONNECTIONS. REFER TO SECTION 8A-4, "INTERMITTENTS AND POOR CONNECTIONS."

YES

REPLACE EBTCM.

C0087S

CHART C

ABS/TCS ACTIVE INDICATOR LAMP "ON" WITH IGNITION "OFF," NO DTCs STORED

NOTICE: DIAGNOSTIC SYSTEM CHECK MUST BE COMPLETED BEFORE USING THIS CHART.

- IGNITION "OFF."
- OBSERVE THE ABS/TCS ACTIVE WARNING LAMP. IS THE ABS/TCS ACTIVE WARNING LAMP "ON"?

NO

MALFUNCTION IS NOT PRESENT AT THIS TIME. INTERMITTENTS COULD BE CAUSED BY INCORRECT WIRING HARNESS ROUTING OR LOOSE CONNECTIONS. INSPECT ALL CONNECTORS AND TERMINALS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.

YES

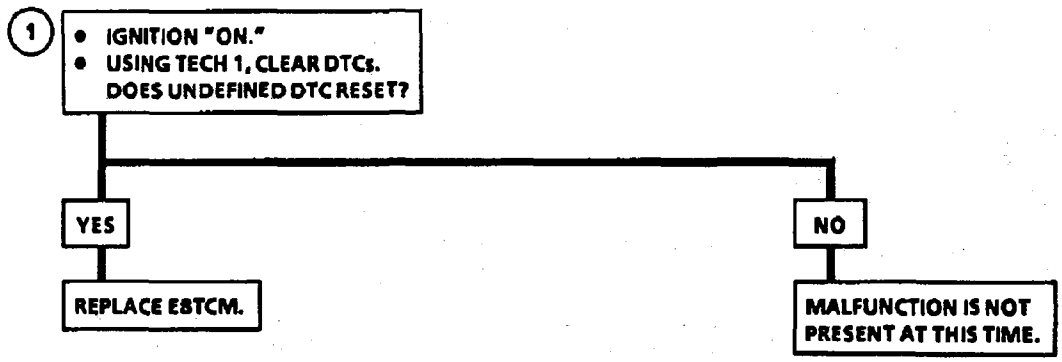
REPAIR SHORT TO VOLTAGE ON CKT 1537.

C0088S

CHART D

TECH 1 DISPLAYS UNDEFINED DTCs

NOTICE: USE THIS CHART IF ANY OF THE FOLLOWING UNDEFINED DTCs ARE SET: 12, 13, 31, 43, 67, 68, 71, 72, 73, 74, 83, 84, 85, 97, 98, 112, 113, 115, 117, 121, 122, 124, 125, 126, 127, 128, 131, 132, 133, 134, 135, 137, 138, 141, 142, 143, 151, 152, 153, 167, OR 168.



C0089S

CHART E

TCS (AMBER) WARNING LAMP "ON" OR "OFF" CONSTANTLY, NO DTCs STORED

NOTICE: DIAGNOSTIC SYSTEM CHECK MUST BE COMPLETED BEFORE USING THIS CHART.

- IGNITION "OFF."
- INSTALL TECH 1.
- IGNITION "ON."
- USING TECH 1, SELECT F4: MISC. TESTS.
- SELECT F8: LAMP TEST AND ATTEMPT TO TURN "ON" THE TCS WARNING LAMP.
  DID THE TCS WARNING LAMP TURN "ON"?

YES

- USING TECH 1 LAMP TEST, ATTEMPT TO "FLASH" THE TCS WARNING LAMP.
  DID THE TCS WARNING LAMP "FLASH"?

YES

MALFUNCTION IS NOT PRESENT AT THIS TIME. INTERMITTENTS COULD BE CAUSED BY INCORRECT WIRING HARNESS ROUTING OR LOOSE CONNECTIONS. INSPECT ALL CONNECTORS AND TERMINALS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.

NO

INSPECT THE TCS WARNING BULB TO VERIFY BULB IS GOOD. REPLACE ANY BLOWN BULBS. IF BULB IS GOOD, REFER TO SECTION 8A-81 FOR FURTHER DIAGNOSIS OF INSTRUMENT CLUSTER.

C0090S

CHART F

TCS (AMBER) WARNING LAMP "ON" INTERMITTENTLY, NO DTCs STORED

NOTICE: DIAGNOSTIC SYSTEM CHECK MUST BE COMPLETED BEFORE USING THIS CHART.

- IGNITION "OFF."
- DISCONNECT GREY 8-WAY EBTCM CONNECTOR.
- DISCONNECT NEGATIVE BATTERY TERMINAL.
- DISCONNECT POSITIVE BATTERY TERMINAL.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN THE NEGATIVE BATTERY CABLE TERMINAL AND TERMINAL "E" OF THE GREY 8-WAY EBTCM HARNESS CONNECTOR.
- OBSERVE MEASURED RESISTANCE WHILE "WIGGLING" WIRE HARNESS AND CONNECTORS.

IS RESISTANCE ALWAYS 2Ω OR LESS?

YES

- DISCONNECT 32-WAY EBTCM CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN POSITIVE BATTERY CABLE TERMINAL AND TERMINAL "B10" OF THE 32-WAY EBTCM HARNESS CONNECTOR.
- OBSERVE MEASURED RESISTANCE WHILE "WIGGLING" WIRE HARNESS AND CONNECTORS.

IS RESISTANCE ALWAYS 2Ω OR LESS?

NO

REPAIR INTERMITTENT OPEN OR HIGH RESISTANCE IN CKT 651. REFER TO SECTION 8A-4, "INTERMITTENTS AND POOR CONNECTIONS."

YES

- TURN IGNITION SWITCH "ON" (THIS IS DONE TO COMPLETE THE IGNITION CIRCUIT).
- USING J 39200, MEASURE THE RESISTANCE BETWEEN POSITIVE BATTERY CABLE TERMINAL AND TERMINAL "B11" OF THE 32-WAY EBTCM HARNESS CONNECTOR.
- OBSERVE MEASURED RESISTANCE WHILE "WIGGLING" WIRE HARNESS AND CONNECTORS.

IS RESISTANCE ALWAYS 2Ω OR LESS?

NO

REPAIR INTERMITTENT OPEN OR HIGH RESISTANCE IN CKTs 502 OR 440. REFER TO SECTION 8A-4, "INTERMITTENTS AND POOR CONNECTIONS."

YES

- CHECK POSITIVE BATTERY TERMINAL AND POSITIVE BATTERY CABLE TERMINAL FOR A POOR CONNECTION.
- INSPECT TERMINALS "B11" AND "B10" OF THE 32-WAY EBTCM CONNECTOR AND TERMINAL "E" OF THE GREY 8-WAY EBTCM CONNECTOR FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT."

IS THERE EVIDENCE OF POOR TERMINAL CONTACT OR CORROSION?

NO

REPAIR INTERMITTENT OPEN OR HIGH RESISTANCE IN CKT 641. REFER TO SECTION 8A-4, "INTERMITTENTS AND POOR CONNECTIONS."

YES

REPLACE TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR SIGNS OF CORROSION. REPAIR CONNECTION INTEGRITY IF POOR CONTACT EXISTS AT BATTERY.

NO

- IGNITION "OFF."
- RECONNECT ALL CONNECTORS.
- IGNITION "ON."

IS TCS WARNING LAMP "ON" INTERMITTENTLY WITH NO DTCs SET?

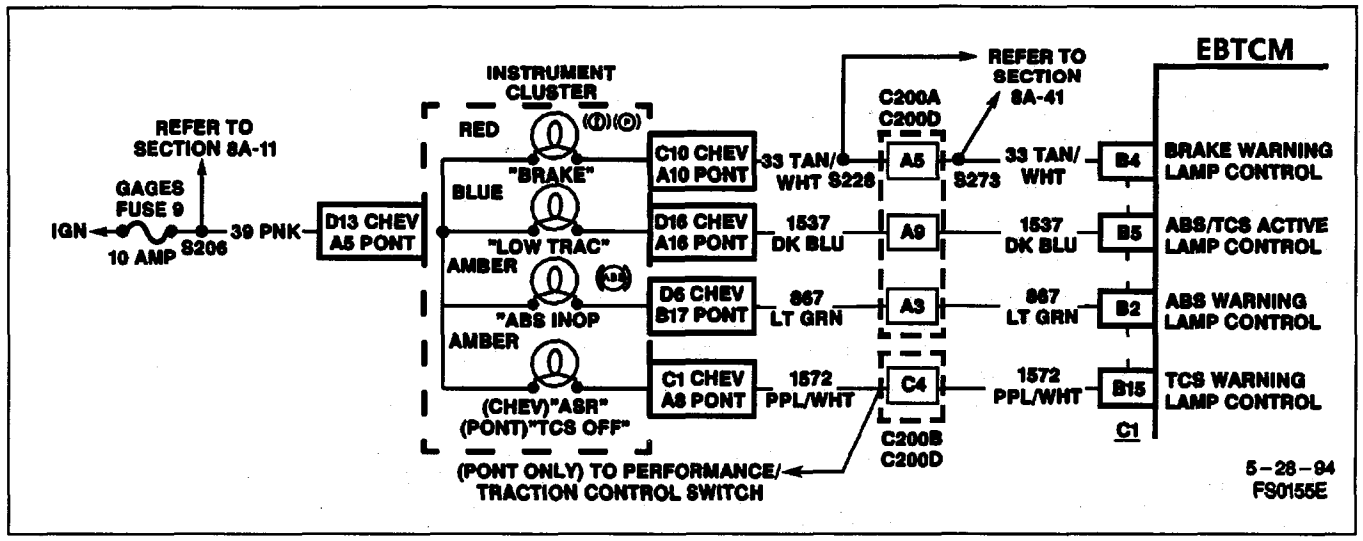
YES

REPLACE EBTCM.

NO

MALFUNCTION IS NOT PRESENT AT THIS TIME. INTERMITTENTS MAY BE CAUSED BY INCORRECT WIRING HARNESS ROUTING OR LOOSE GROUND CONNECTIONS. REFER TO SECTION 8A-4, "INTERMITTENTS AND POOR CONNECTIONS."

C0091S



DTC 11
(Page 1 of 2)
ABS WARNING OR LOW TRAC LAMP CKT MALFUNCTION

Circuit Description:

This DTC checks the state of both the ABS warning lamp and the ABS/TCS active lamp to identify a situation in which the driver could not be alerted to a system malfunction or of possible slippery driving conditions. Due to an integral lamp driver module within the instrument panel cluster, the EBTCM must provide a ground to turn the ABS warning lamp "OFF." The ABS/TCS active lamp circuit is such that the EBTCM provides a ground to turn "ON" the ABS/TCS active lamp.

DTC Will Set When:

DTC 11 can only be set during the three second bulb check or when either of the lamps are commanded "ON." If the EBTCM cannot control either the ABS warning lamp or the ABS/TCS active lamp for two seconds, a malfunction exists.

Action Taken:

A malfunction DTC is stored; however, ABS or TCS are not disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Determines if the ABS warning lamp can be properly controlled.
2. Determines if the lamp is "ON" constantly.
3. Checks for other DTCs which could turn "ON" the ABS warning lamp.
4. Determines if the ABS warning lamp can be turned "OFF" manually.
5. Checks the integrity of the ABS warning lamp circuitry.
6. Checks for a short to voltage on the ABS warning lamp circuitry.
7. Determines if a malfunctioning EBTCM is the cause of DTC 11.
8. Verifies that the other I/P indicator lamps function properly.
9. Determines if the ABS warning lamp can be turned "ON" manually.
10. Verifies condition of Fuse 9.
11. Determines if DTC 11 was set due to an EBTCM malfunction.
12. Checks for a short to ground in the ABS warning lamp circuitry.

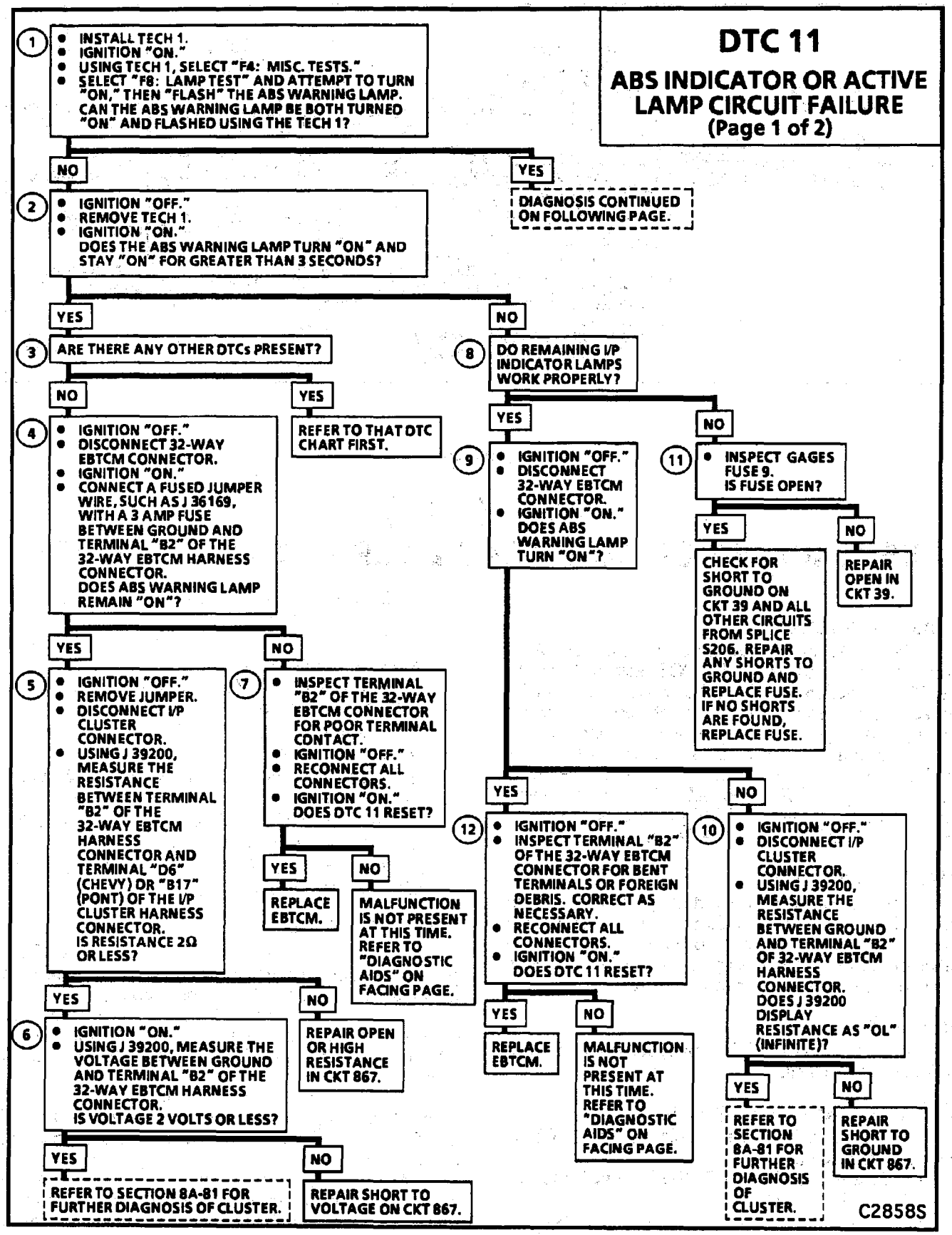
Diagnostic Aids:

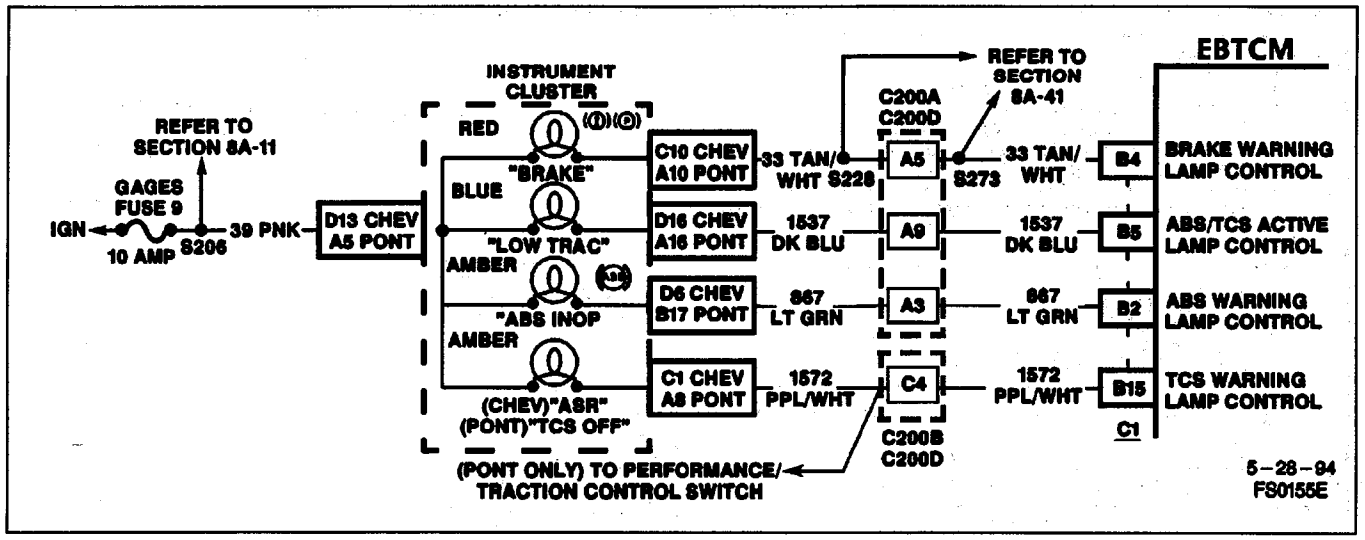
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The lamp test function of the Tech 1 may be used to command the lamp on" while looking for an intermittent malfunction in the ABS warning lamp circuitry.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.


DTC 11
ABS INDICATOR OR ACTIVE LAMP CIRCUIT FAILURE
(Page 1 of 2)
1 • INSTALL TECH 1. • IGNITION "ON." • USING TECH 1, SELECT "F4: MISC. TESTS." • SELECT "F8: LAMP TEST" AND ATTEMPT TO TURN "ON," THEN "FLASH" THE ABS WARNING LAMP. CAN THE ABS WARNING LAMP BE BOTH TURNED "ON" AND FLASHED USING THE TECH 1?
NO
YES
DIAGNOSIS CONTINUED ON FOLLOWING PAGE.
2 • IGNITION "OFF." • REMOVE TECH 1. • IGNITION "ON." DOES THE ABS WARNING LAMP TURN "ON" AND STAY "ON" FOR GREATER THAN 3 SECONDS?
YES
NO
3 ARE THERE ANY OTHER DTCs PRESENT?
NO
YES
REFER TO THAT DTC CHART FIRST.
4 • IGNITION "OFF." • DISCONNECT 32-WAY EBTCM CONNECTOR. • IGNITION "ON." • CONNECT A FUSED JUMPER WIRE, SUCH AS J 36169, WITH A 3 AMP FUSE BETWEEN GROUND AND TERMINAL "B2" OF THE 32-WAY EBTCM HARNESS CONNECTOR. DOES ABS WARNING LAMP REMAIN "ON"?
YES
NO
5 • IGNITION "OFF." • REMOVE JUMPER. • DISCONNECT I/P CLUSTER CONNECTOR. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "B2" OF THE 32-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "D6" (CHEVY) OR "B17" (PONT) OF THE I/P CLUSTER HARNESS CONNECTOR. IS RESISTANCE 2Ω OR LESS?
7 • INSPECT TERMINAL "B2" OF THE 32-WAY EBTCM CONNECTOR FOR POOR TERMINAL CONTACT. • IGNITION "OFF." • RECONNECT ALL CONNECTORS. • IGNITION "ON." DOES DTC 11 RESET?
YES
NO
REPLACE EBTCM.
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
YES
NO
6 • IGNITION "ON." • USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B2" OF THE 32-WAY EBTCM HARNESS CONNECTOR. IS VOLTAGE 2 VOLTS OR LESS?
REPAIR OPEN OR HIGH RESISTANCE IN CKT 867.
YES
NO
REFER TO SECTION 8A-81 FOR FURTHER DIAGNOSIS OF CLUSTER.
REPAIR SHORT TO VOLTAGE ON CKT 867.
8 DO REMAINING I/P INDICATOR LAMPS WORK PROPERLY?
YES
NO
9 • IGNITION "OFF." • DISCONNECT 32-WAY EBTCM CONNECTOR. • IGNITION "ON." DOES ABS WARNING LAMP TURN "ON"?
11 • INSPECT GAGES FUSE 9. IS FUSE OPEN?
YES
NO
CHECK FOR SHORT TO GROUND ON CKT 39 AND ALL OTHER CIRCUITS FROM SPLICE S206. REPAIR ANY SHORTS TO GROUND AND REPLACE FUSE. IF NO SHORTS ARE FOUND, REPLACE FUSE.
REPAIR OPEN IN CKT 39.
YES
NO
12 • IGNITION "OFF." • INSPECT TERMINAL "B2" OF THE 32-WAY EBTCM CONNECTOR FOR BENT TERMINALS OR FOREIGN DEBRIS. CORRECT AS NECESSARY. • RECONNECT ALL CONNECTORS. • IGNITION "ON." DOES DTC 11 RESET?
10 • IGNITION "OFF." • DISCONNECT I/P CLUSTER CONNECTOR. • USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "B2" OF 32-WAY EBTCM HARNESS CONNECTOR. DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
YES
NO
REPLACE EBTCM.
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
YES
NO
REFER TO SECTION 8A-81 FOR FURTHER DIAGNOSIS OF CLUSTER.
REPAIR SHORT TO GROUND IN CKT 867.
C2858S



DTC 11
(Page 2 of 2)
ABS WARNING OR LOW TRAC LAMP CKT MALFUNCTION

Circuit Description:

This DTC checks the state of both the ABS warning lamp and the ABS/TCS active lamp to identify a situation in which the driver could not be alerted to a system malfunction or of possible slippery driving conditions. Due to an integral lamp driver module within the instrument panel cluster, the EBTCM must provide a ground to turn the ABS warning lamp "OFF." The ABS/TCS active lamp circuit is such that the EBTCM provides a ground to turn "ON" the ABS/TCS active lamp.

DTC Will Set When:

DTC 11 can only be set during the three second bulb check or when either of the lamps are commanded "ON." If the EBTCM cannot control either the ABS warning lamp or the ABS/TCS active lamp for two seconds, a malfunction exists.

Action Taken:

A malfunction DTC is stored; however, ABS or TCS are not disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

13. Determines if the ABS/TCS active lamp can be properly controlled.
14. Determines if the ABS/TCS active lamp is "ON" constantly.
15. Checks for a short to ground in the ABS/TCS active lamp circuitry.
16. Determines if DTC 11 was set due to a EBTCM malfunction.
17. Determines if DTC 11 was set due to a EBTCM malfunction.
18. Determines if the ABS/TCS active lamp can be controlled manually.
19. Verifies the integrity of the ABS/TCS active lamp circuitry.
20. Determines if there is a short to voltage in the ABS/TCS active lamp circuitry.
21. Determines if DTC 11 was set due to an EBTCM malfunction.

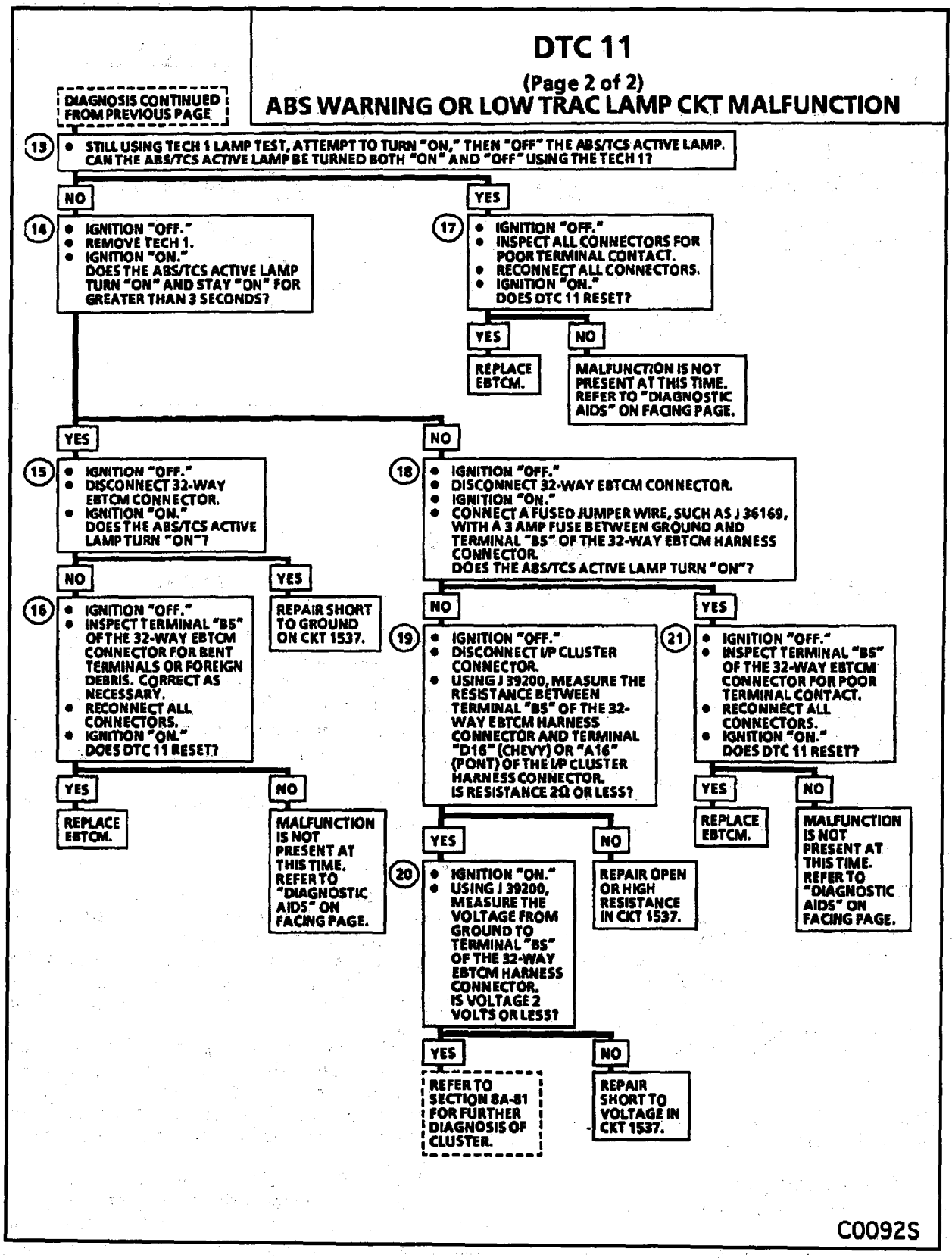
Diagnostic Aids:

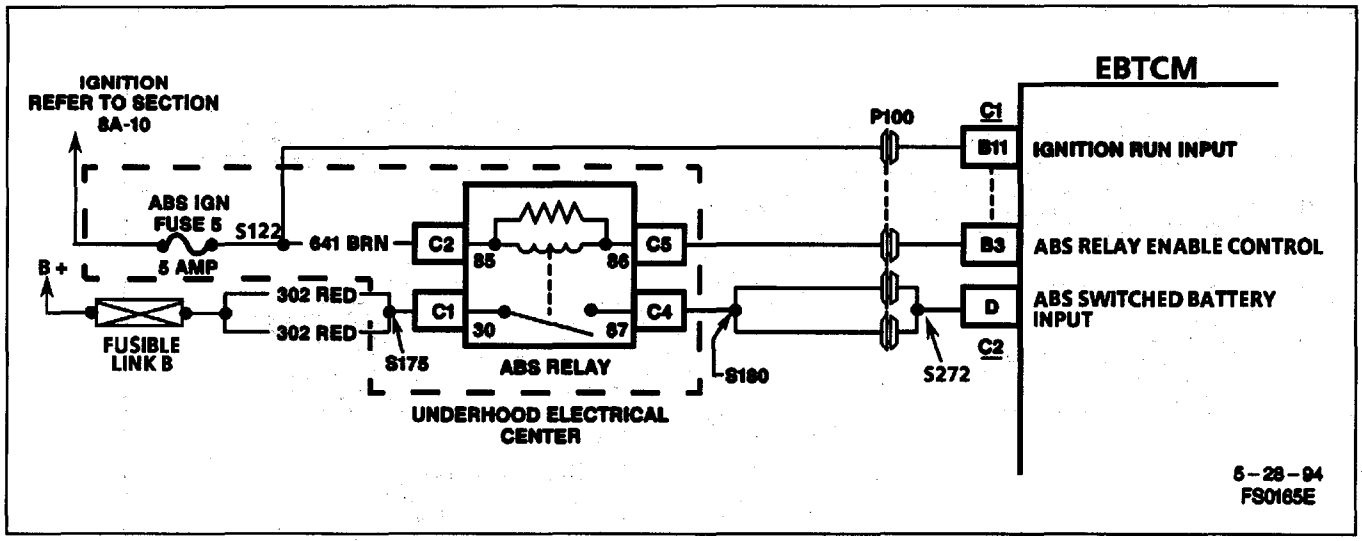
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The lamp test function of the Tech 1 may be used to command the lamp on" while looking for an intermittent malfunction in the ABS/TCS active lamp circuitry.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.


DTC 11
(Page 2 of 2)
ABS WARNING OR LOW TRAC LAMP CKT MALFUNCTION
DIAGNOSIS CONTINUED FROM PREVIOUS PAGE
13 • STILL USING TECH 1 LAMP TEST, ATTEMPT TO TURN "ON," THEN "OFF" THE ABS/TCS ACTIVE LAMP. CAN THE ABS/TCS ACTIVE LAMP BE TURNED BOTH "ON" AND "OFF" USING THE TECH 1?
NO
YES
14 • IGNITION "OFF." • REMOVE TECH 1. • IGNITION "ON." DOES THE ABS/TCS ACTIVE LAMP TURN "ON" AND STAY "ON" FOR GREATER THAN 3 SECONDS?
17 • IGNITION "OFF." • INSPECT ALL CONNECTORS FOR POOR TERMINAL CONTACT. • RECONNECT ALL CONNECTORS. • IGNITION "ON." DOES DTC 11 RESET?
YES
NO
REPLACE EBTCM.
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
YES
NO
15 • IGNITION "OFF." • DISCONNECT 32-WAY EBTCM CONNECTOR. • IGNITION "ON." DOES THE ABS/TCS ACTIVE LAMP TURN "ON"?
18 • IGNITION "OFF." • DISCONNECT 32-WAY EBTCM CONNECTOR. • IGNITION "ON." • CONNECT A FUSED JUMPER WIRE, SUCH AS J 36169, WITH A 3 AMP FUSE BETWEEN GROUND AND TERMINAL "B5" OF THE 32-WAY EBTCM HARNESS CONNECTOR. DOES THE ABS/TCS ACTIVE LAMP TURN "ON"?
NO
YES
16 • IGNITION "OFF." • INSPECT TERMINAL "B5" OF THE 32-WAY EBTCM CONNECTOR FOR BENT TERMINALS OR FOREIGN DEBRIS. CORRECT AS NECESSARY. • RECONNECT ALL CONNECTORS. • IGNITION "ON." DOES DTC 11 RESET?
REPAIR SHORT TO GROUND ON CKT 1537.
NO
YES
19 • IGNITION "OFF." • DISCONNECT I/P CLUSTER CONNECTOR. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "B5" OF THE 32-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "D16" (CHEVY) OR "A16" (PONT) OF THE I/P CLUSTER HARNESS CONNECTOR. IS RESISTANCE 2Ω OR LESS?
21 • IGNITION "OFF." • INSPECT TERMINAL "B5" OF THE 32-WAY EBTCM CONNECTOR FOR POOR TERMINAL CONTACT. • RECONNECT ALL CONNECTORS. • IGNITION "ON." DOES DTC 11 RESET?
YES
NO
REPLACE EBTCM.
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
YES
NO
20 • IGNITION "ON." • USING J 39200, MEASURE THE VOLTAGE FROM GROUND TO TERMINAL "B5" OF THE 32-WAY EBTCM HARNESS CONNECTOR. IS VOLTAGE 2 VOLTS OR LESS?
REPAIR OPEN OR HIGH RESISTANCE IN CKT 1537.
YES
NO
REFER TO SECTION 8A-81 FOR FURTHER DIAGNOSIS OF CLUSTER.
REPAIR SHORT TO VOLTAGE IN CKT 1537.
C0092S



DTC 14
(Page 1 of 3)
ABS ENABLE RELAY CONTACT CIRCUIT OPEN

Circuit Description:

Ignition voltage is supplied through terminal "C2" of the ABS relay. The EBTCM then is able to energize the pull-in coil by completing the ground circuit at connector "C1", terminal "B3" of the EBTCM. The magnetic field created closes the ABS relay contacts and allows battery voltage and current to be supplied to the EBTCM, which supplies power to the motors and solenoids.

DTC Will Set When:

DTC 14 can be set anytime after the EBTCM commands the ABS relay "ON" (the relay is first commanded "ON" during the three second bulb check). This test monitors the availability of current and voltage to the motors and solenoids. This malfunction indicates voltage is not available and would therefore not allow ABS operation if required.

Action Taken:

A malfunction DTC is stored, ABS is disabled and the ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks to see if DTC 16 is also set as current or history. If DTC 16 is also set, proceed to that chart first.
2. Verifies that the malfunction is currently present.
3. Verifies that the relay can be turned "ON" and provide voltage to the EBTCM.
4. Checks for high resistance in the switched battery circuit from the relay to the EBTCM.
5. Checks for high resistance in the switched battery circuit from the battery to the relay.
6. Checks for high resistance in the relay contacts.
7. Checks for poor terminal contact or corrosion at the connectors.
8. Determines if the EBTCM is the cause of the malfunction.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

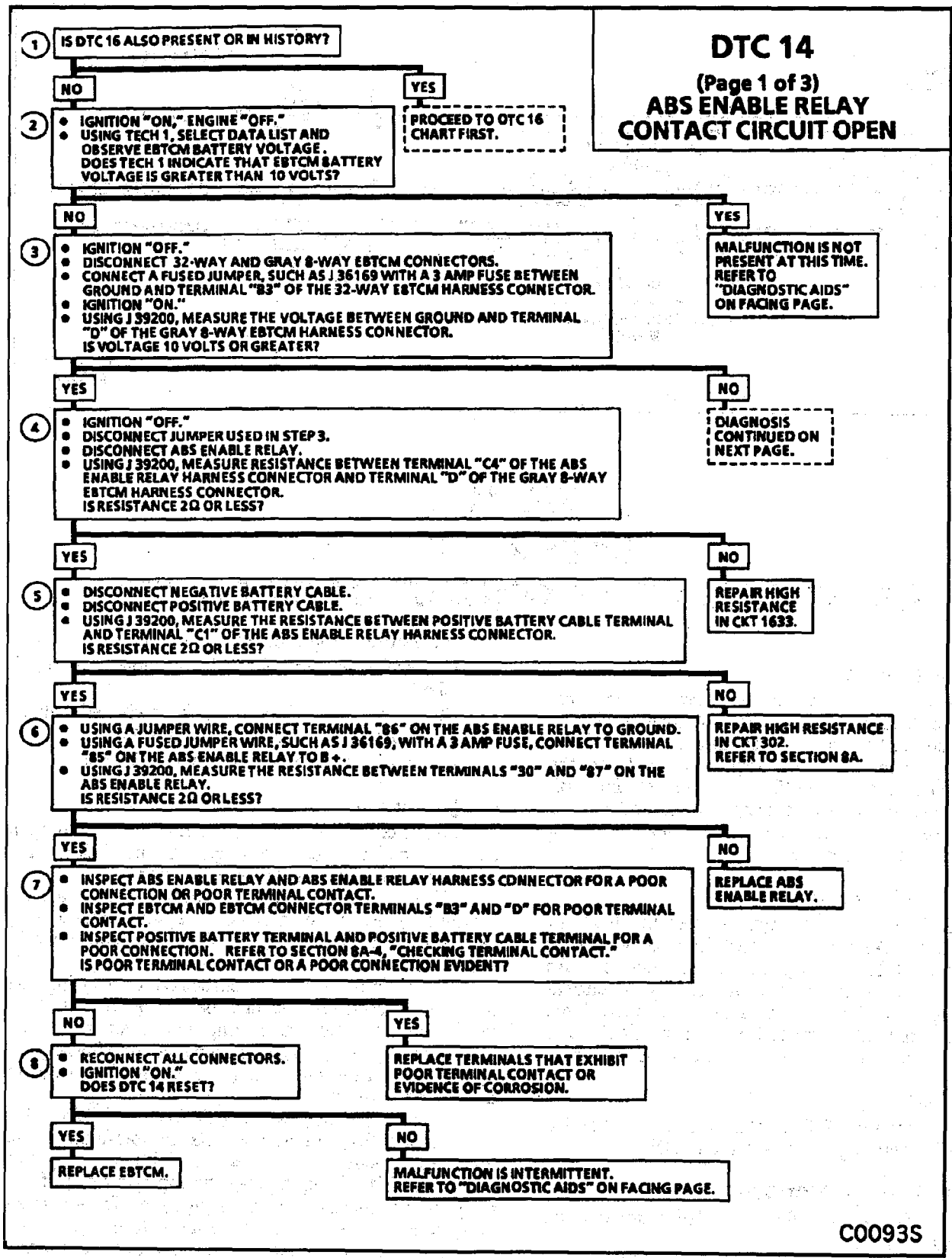
The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

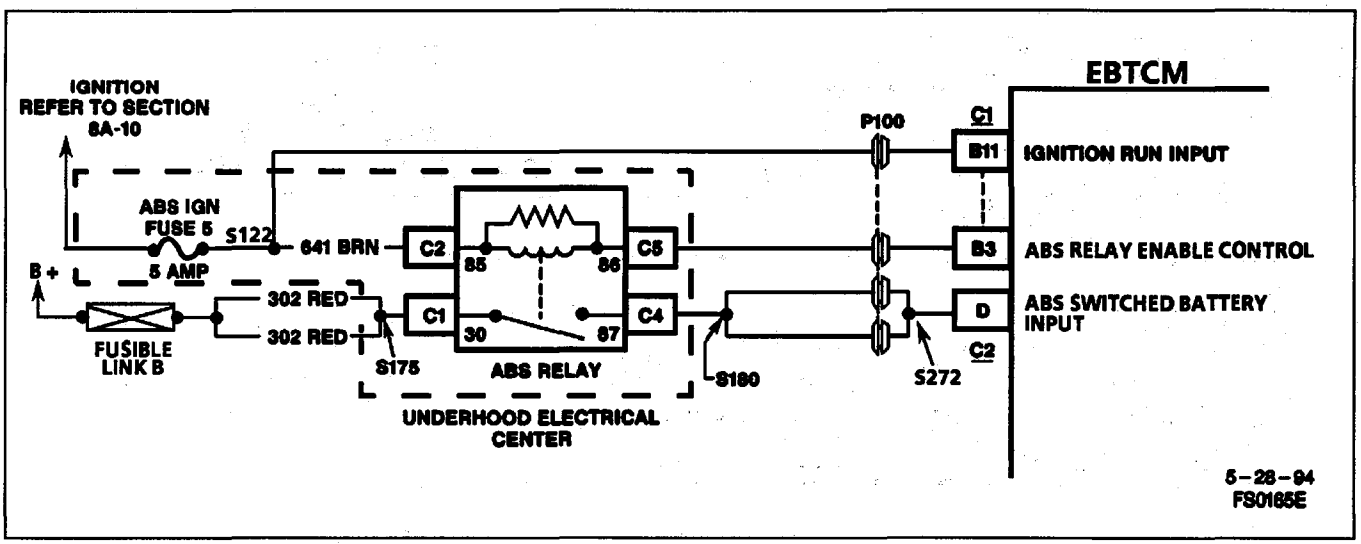
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

VIBRATION, TEMPERATURE EFFECTS:

Check for vibration effects by performing the relay test function of the Tech 1. With the relay test commanded "ON," lightly tap the top and sides of the relay while monitoring relay voltage. If the relay voltage changes significantly, replace the relay.

If DTC 14 only sets when the vehicle is initially started in cold ambient conditions (temperature less than 32° F-0° C), replace the relay.


DTC 14
(Page 1 of 3)
ABS ENABLE RELAY CONTACT CIRCUIT OPEN
1 IS DTC 16 ALSO PRESENT OR IN HISTORY?
NO
YES
PROCEED TO DTC 16 CHART FIRST.
2 • IGNITION "ON," ENGINE "OFF."
• USING TECH 1, SELECT DATA LIST AND OBSERVE EBTCM BATTERY VOLTAGE.
DOES TECH 1 INDICATE THAT EBTCM BATTERY VOLTAGE IS GREATER THAN 10 VOLTS?
NO
YES
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
3 • IGNITION "OFF."
• DISCONNECT 32-WAY AND GRAY 8-WAY EBTCM CONNECTORS.
• CONNECT A FUSED JUMPER, SUCH AS J 36169 WITH A 3 AMP FUSE BETWEEN GROUND AND TERMINAL "B3" OF THE 32-WAY EBTCM HARNESS CONNECTOR.
• IGNITION "ON."
• USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "D" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR.
IS VOLTAGE 10 VOLTS OR GREATER?
YES
NO
DIAGNOSIS CONTINUED ON NEXT PAGE.
4 • IGNITION "OFF."
• DISCONNECT JUMPER USED IN STEP 3.
• DISCONNECT ABS ENABLE RELAY.
• USING J 39200, MEASURE RESISTANCE BETWEEN TERMINAL "C4" OF THE ABS ENABLE RELAY HARNESS CONNECTOR AND TERMINAL "D" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR.
IS RESISTANCE 2Ω OR LESS?
YES
NO
REPAIR HIGH RESISTANCE IN CKT 1633.
5 • DISCONNECT NEGATIVE BATTERY CABLE.
• DISCONNECT POSITIVE BATTERY CABLE.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN POSITIVE BATTERY CABLE TERMINAL AND TERMINAL "C1" OF THE ABS ENABLE RELAY HARNESS CONNECTOR.
IS RESISTANCE 2Ω OR LESS?
YES
NO
REPAIR HIGH RESISTANCE IN CKT 302. REFER TO SECTION 8A.
6 • USING A JUMPER WIRE, CONNECT TERMINAL "86" ON THE ABS ENABLE RELAY TO GROUND.
• USING A FUSED JUMPER WIRE, SUCH AS J 36169, WITH A 3 AMP FUSE, CONNECT TERMINAL "85" ON THE ABS ENABLE RELAY TO B+.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINALS "30" AND "87" ON THE ABS ENABLE RELAY.
IS RESISTANCE 2Ω OR LESS?
YES
NO
REPLACE ABS ENABLE RELAY.
7 • INSPECT ABS ENABLE RELAY AND ABS ENABLE RELAY HARNESS CONNECTOR FOR A POOR CONNECTION OR POOR TERMINAL CONTACT.
• INSPECT EBTCM AND EBTCM CONNECTOR TERMINALS "B3" AND "D" FOR POOR TERMINAL CONTACT.
• INSPECT POSITIVE BATTERY TERMINAL AND POSITIVE BATTERY CABLE TERMINAL FOR A POOR CONNECTION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT."
IS POOR TERMINAL CONTACT OR A POOR CONNECTION EVIDENT?
NO
YES
REPLACE TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION.
8 • RECONNECT ALL CONNECTORS.
• IGNITION "ON."
DOES DTC 14 RESET?
YES
NO
MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
REPLACE EBTCM.
C0093S



DTC 14
(Page 2 of 3)
ABS ENABLE RELAY CONTACT CIRCUIT OPEN

Circuit Description:

Ignition voltage is supplied through terminal "C2" of the ABS relay. The EBTCM then is able to energize the pull-in coil by completing the ground circuit at connector "C1", terminal "B3" of the EBTCM. The magnetic field created closes the ABS relay contacts and allows battery voltage and current to be supplied to the EBTCM, which supplies power to the motors and solenoids.

DTC Will Set When:

DTC 14 can be set anytime after the EBTCM commands the ABS relay "ON" (the relay is first commanded "ON" during the three second bulb check). This test monitors the availability of current and voltage to the motors and solenoids. This malfunction indicates voltage is not available and would therefore not allow ABS operation if required.

Action Taken:

A malfunction DTC is stored, ABS is disabled and the ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

9. Checks for high resistance in the entire relay coil circuit.
10. Verifies proper battery condition.
11. Verifies proper voltage is available at the ABS relay.
12. Checks for an open in the switched battery circuit from the relay to the EBTCM.
13. Verifies the condition of the ABS relay.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

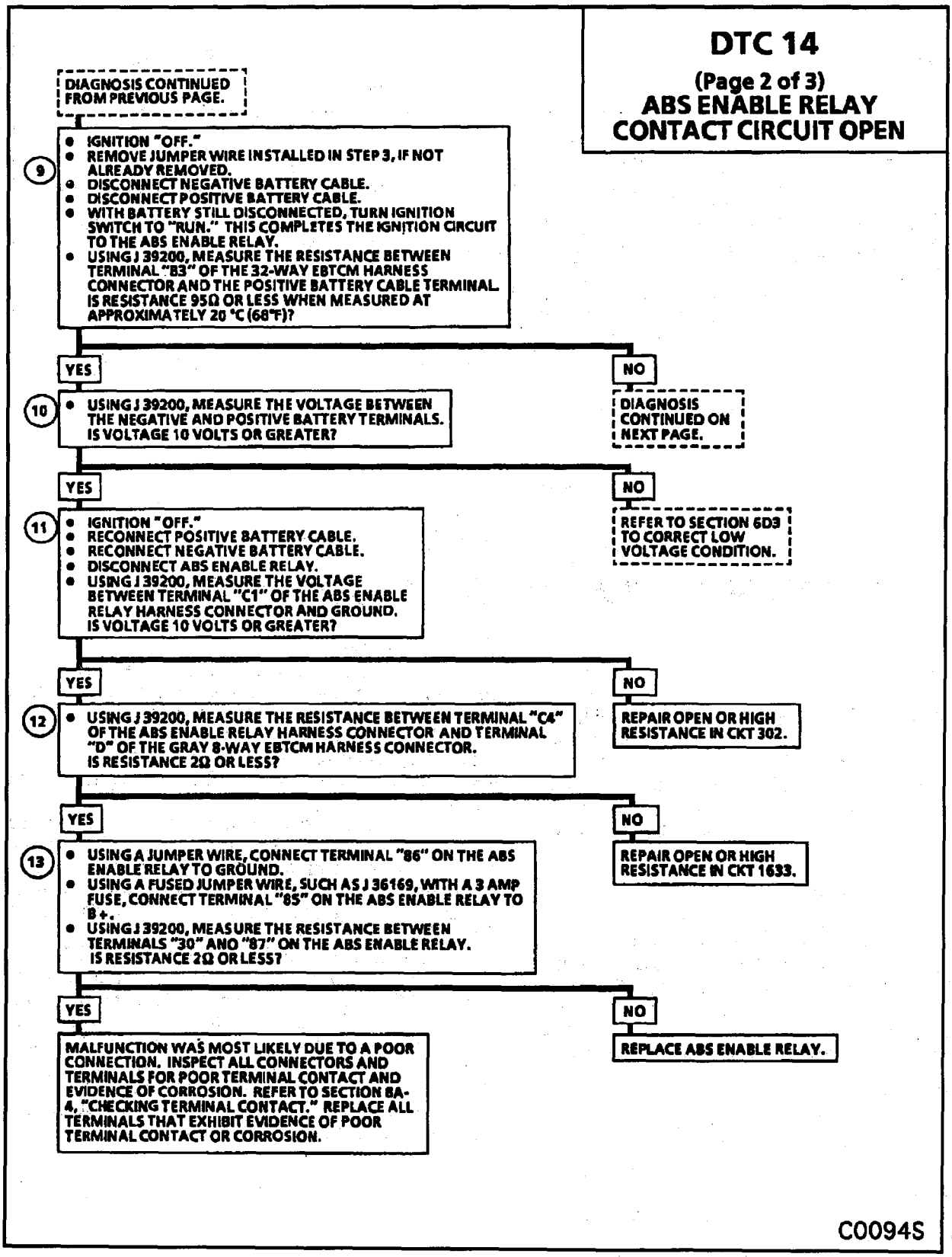
The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

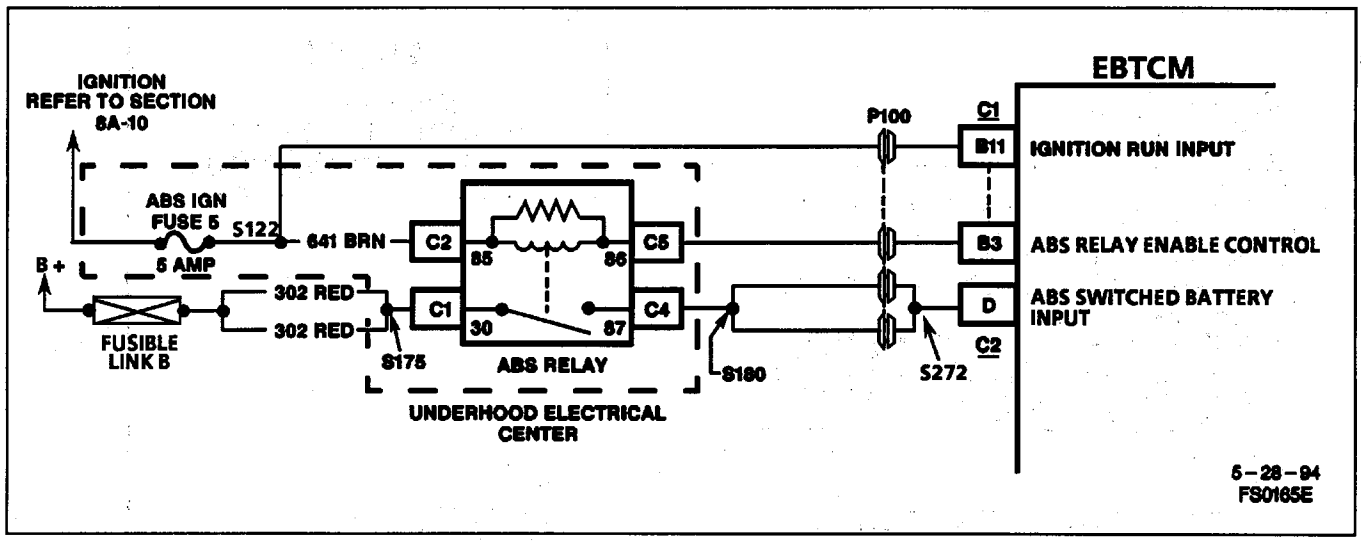
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

VIBRATION, TEMPERATURE EFFECTS:

Check for vibration effects by performing the relay test function of the Tech 1. With the relay test commanded "ON," lightly tap the top and sides of the relay while monitoring relay voltage. If the relay voltage changes significantly, replace the relay.

If DTC 14 only sets when the vehicle is initially started in cold ambient conditions (temperature less than 32° F-0° C), replace the relay.


DTC 14
(Page 2 of 3)
ABS ENABLE RELAY
CONTACT CIRCUIT OPEN
DIAGNOSIS CONTINUED FROM PREVIOUS PAGE.
9
• IGNITION "OFF."
• REMOVE JUMPER WIRE INSTALLED IN STEP 3, IF NOT ALREADY REMOVED.
• DISCONNECT NEGATIVE BATTERY CABLE.
• DISCONNECT POSITIVE BATTERY CABLE.
• WITH BATTERY STILL DISCONNECTED, TURN IGNITION SWITCH TO "RUN." THIS COMPLETES THE IGNITION CIRCUIT TO THE ABS ENABLE RELAY.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "B3" OF THE 32-WAY EBTCM HARNESS CONNECTOR AND THE POSITIVE BATTERY CABLE TERMINAL. IS RESISTANCE 95Ω OR LESS WHEN MEASURED AT APPROXIMATELY 20 °C (68°F)?
YES
NO
10
• USING J 39200, MEASURE THE VOLTAGE BETWEEN THE NEGATIVE AND POSITIVE BATTERY TERMINALS. IS VOLTAGE 10 VOLTS OR GREATER?
DIAGNOSIS CONTINUED ON NEXT PAGE.
YES
NO
11
• IGNITION "OFF."
• RECONNECT POSITIVE BATTERY CABLE.
• RECONNECT NEGATIVE BATTERY CABLE.
• DISCONNECT ABS ENABLE RELAY.
• USING J 39200, MEASURE THE VOLTAGE BETWEEN TERMINAL "C1" OF THE ABS ENABLE RELAY HARNESS CONNECTOR AND GROUND. IS VOLTAGE 10 VOLTS OR GREATER?
REFER TO SECTION 6D3 TO CORRECT LOW VOLTAGE CONDITION.
YES
NO
12
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C4" OF THE ABS ENABLE RELAY HARNESS CONNECTOR AND TERMINAL "D" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR. IS RESISTANCE 2Ω OR LESS?
REPAIR OPEN OR HIGH RESISTANCE IN CKT 302.
YES
NO
13
• USING A JUMPER WIRE, CONNECT TERMINAL "86" ON THE ABS ENABLE RELAY TO GROUND.
• USING A FUSED JUMPER WIRE, SUCH AS J 36169, WITH A 3 AMP FUSE, CONNECT TERMINAL "85" ON THE ABS ENABLE RELAY TO B+.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINALS "30" AND "87" ON THE ABS ENABLE RELAY. IS RESISTANCE 2Ω OR LESS?
REPAIR OPEN OR HIGH RESISTANCE IN CKT 1633.
YES
NO
MALFUNCTION WAS MOST LIKELY DUE TO A POOR CONNECTION. INSPECT ALL CONNECTORS AND TERMINALS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT EVIDENCE OF POOR TERMINAL CONTACT OR CORROSION.
REPLACE ABS ENABLE RELAY.
C0094S



DTC 14
(Page 3 of 3)
ABS ENABLE RELAY CONTACT CIRCUIT OPEN

Circuit Description:

Ignition voltage is supplied through terminal "C2" of the ABS relay. The EBTCM then is able to energize the pull-in coil by completing the ground circuit at connector "C1", terminal "B3" of the EBTCM. The magnetic field created closes the ABS relay contacts and allows battery voltage and current to be supplied to the EBTCM, which supplies power to the motors and solenoids.

DTC Will Set When:

DTC 14 can be set anytime after the EBTCM commands the ABS relay "ON" (the relay is first commanded "ON" during the three second bulb check). This test monitors the availability of current and voltage to the motors and solenoids. This malfunction indicates voltage is not available and would therefore not allow ABS operation if required.

Action Taken:

A malfunction DTC is stored, ABS is disabled and the ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

14. Checks for proper resistance of the relay coil.

15. Checks for high resistance in the ABS enable relay control circuit between the relay and the EBTCM.

16. Checks for high resistance in the ABS enable relay control circuit between the battery and the relay.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

VIBRATION, TEMPERATURE EFFECTS:

Check for vibration effects by performing the relay test function of the Tech 1. With the relay test commanded "ON," lightly tap the top and sides of the relay while monitoring relay voltage. If the relay voltage changes significantly, replace the relay.

If DTC 14 only sets when the vehicle is initially started in cold ambient conditions (temperature less than 32° F-0° C), replace the relay.

DTC 14

(Page 3 of 3)

ABS ENABLE RELAY CONTACT CIRCUIT OPEN

DIAGNOSIS CONTINUED FROM PREVIOUS PAGE.

14
- DISCONNECT ABS ENABLE RELAY.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINALS "85" AND "86" ON THE ABS ENABLE RELAY. IS RESISTANCE 95Ω OR LESS WHEN MEASURED AT APPROXIMATELY 24°C (75°F)?

YES

15
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C5" OF THE ABS ENABLE RELAY HARNESS CONNECTOR AND TERMINAL "B3" OF THE 32-WAY EBTCM HARNESS CONNECTOR. IS RESISTANCE 2Ω OR LESS?

YES

16
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C2" OF THE ABS ENABLE RELAY HARNESS CONNECTOR AND THE POSITIVE BATTERY CABLE TERMINAL. IS RESISTANCE 2Ω OR LESS?

YES

MALFUNCTION WAS MOST LIKELY DUE TO A POOR CONNECTION. INSPECT ALL CONNECTORS AND TERMINALS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT EVIDENCE OF POOR TERMINAL CONTACT OR CORROSION.

NO

REPAIR OPEN OR HIGH RESISTANCE IN CKT 641, CKT 300, IGNITION SWITCH, OR BATTERY FEED CIRCUIT TO IGNITION SWITCH. REFER TO SECTION 8A FOR FURTHER INFORMATION.

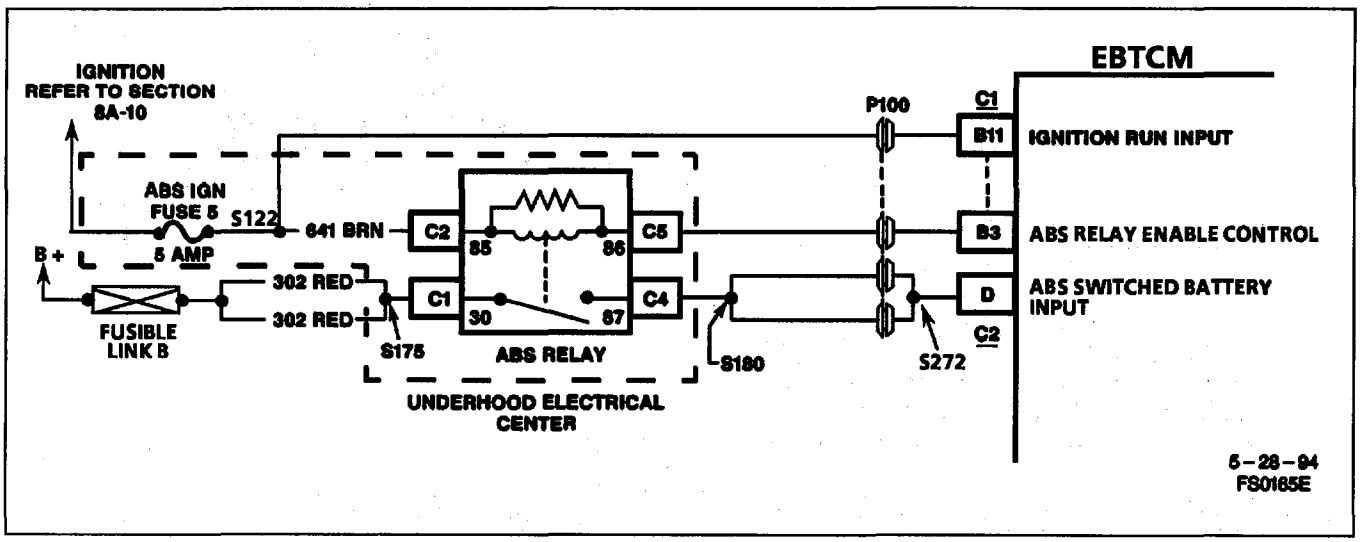
NO

REPAIR OPEN OR HIGH RESISTANCE IN CKT 1632.

NO

REPLACE ABS ENABLE RELAY.

C0095S



DTC 15
ABS RLY CONTACT CKT SHORT TO BATT OR ALWAYS CLOSED

Circuit Description:

Ignition voltage is supplied through terminal "C2" of the ABS relay. The EBTCM then is able to energize the pull-in coil by completing the ground circuit at connector "C1", terminal "B3" of the EBTCM. The magnetic field created closes the ABS relay contacts and allows battery voltage and current to be supplied to the EBTCM, which supplies power to the motors and solenoids.

DTC Will Set When:

DTC 15 can be set only before the EBTCM commands the relay "ON." This test determines if the ABS relay is energized when it should not be. This malfunction would not allow the ABS relay to remove power to the EBTCM. If a second malfunction were to occur that requires the ABS relay to be turned "OFF," that malfunction cannot be removed if the relay cannot be controlled. The malfunction must be present for three consecutive drive cycles before the DTC is set.

Action Taken:

A malfunction DTC is stored. ABS is not disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

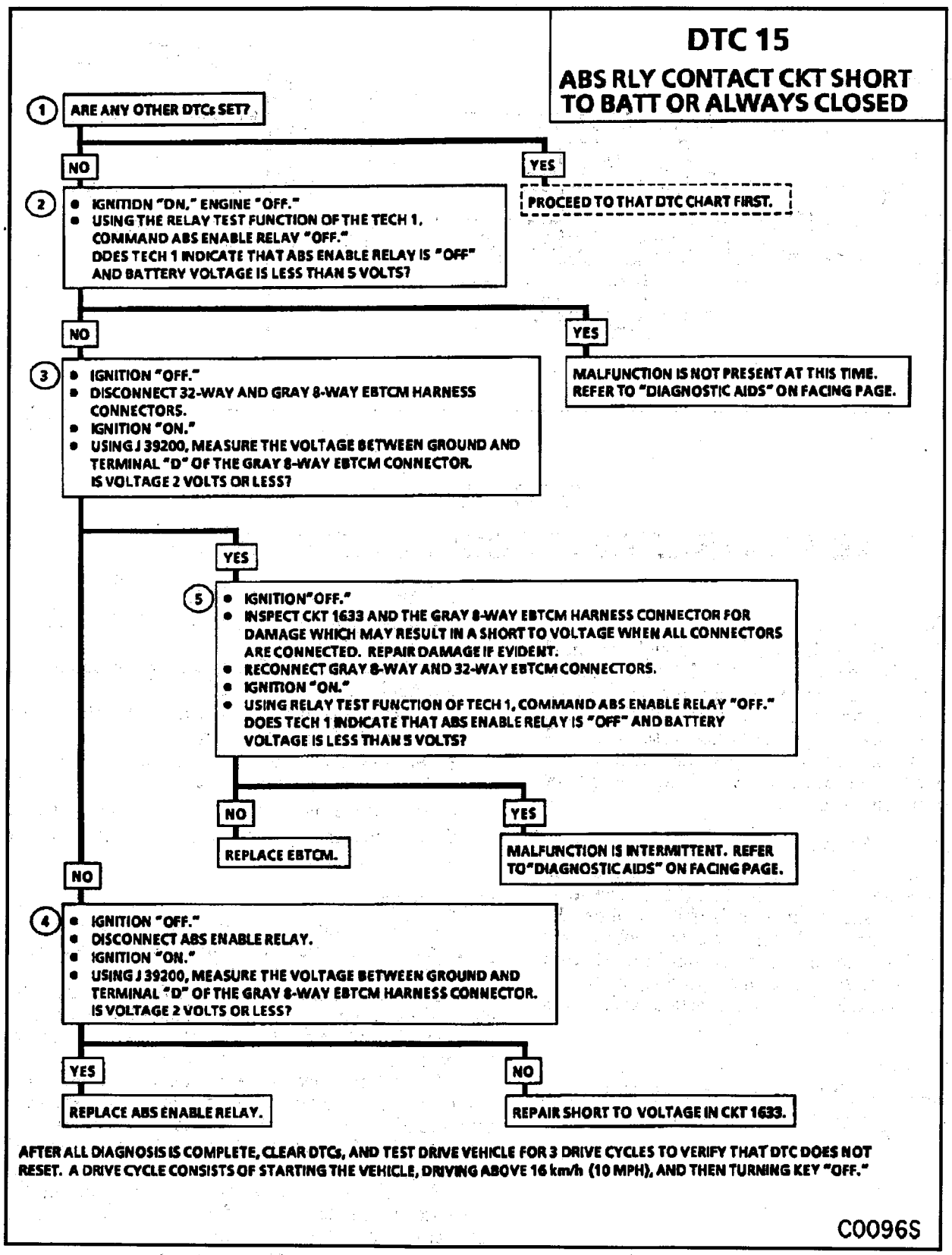
1. Determines if any other DTCs are present.
2. Indicates that the EBTCM is capable of controlling the ABS relay as commanded.
3. Checks for a possible short to battery voltage in CKT 1633.
4. Determines whether the short to voltage is in CKT 1633 or as a result of a malfunctioning relay.
5. Checks for a possible intermittent malfunction in wiring or connectors.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

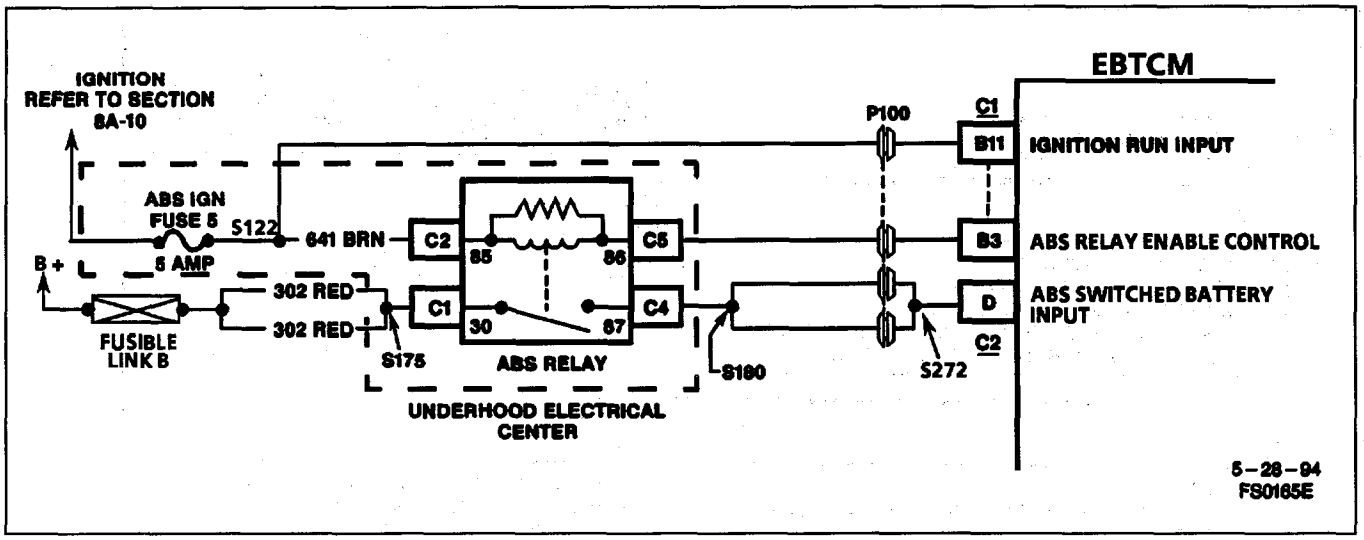
The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry, that is suspected of causing the intermittent complaint, should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.



AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs, AND TEST DRIVE VEHICLE FOR 3 DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING ABOVE 16 km/h (10 MPH), AND THEN TURNING KEY "OFF."

C0096S



DTC 16
ABS ENABLE RELAY COIL CIRCUIT OPEN

Circuit Description:

Ignition voltage is supplied through terminal "C2" of the ABS relay. The EBTCM then is able to energize the pull-in coil by completing the ground circuit at connector "C1", terminal "B3" of the EBTCM. The magnetic field created closes the ABS relay contacts and allows battery voltage and current to be supplied to the EBTCM, which supplies power to the motors and solenoids.

DTC Will Set When:

DTC 16 can be set only after DTC 14 has been set. This test detects an open in the ABS enable relay coil circuit. An open in this circuit will not allow the ABS relay to be energized thus preventing voltage and current to the motors and solenoids. If this malfunction is present and the ignition is turned "OFF" before 5 km/h (3 mph) is reached, DTC 14 is set alone.

Action Taken:

A malfunction DTC is stored, ABS is disabled and the ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Indicates the EBTCM is capable of controlling the ABS relay as commanded.
2. Checks to ensure that voltage is available to the pull-in coil of the ABS relay.
3. Ensures that there is continuity through the pull-in coil of the ABS relay.
4. Verifies the integrity of the relay control circuit.
5. Ensures malfunction was not due to poor terminal contact.

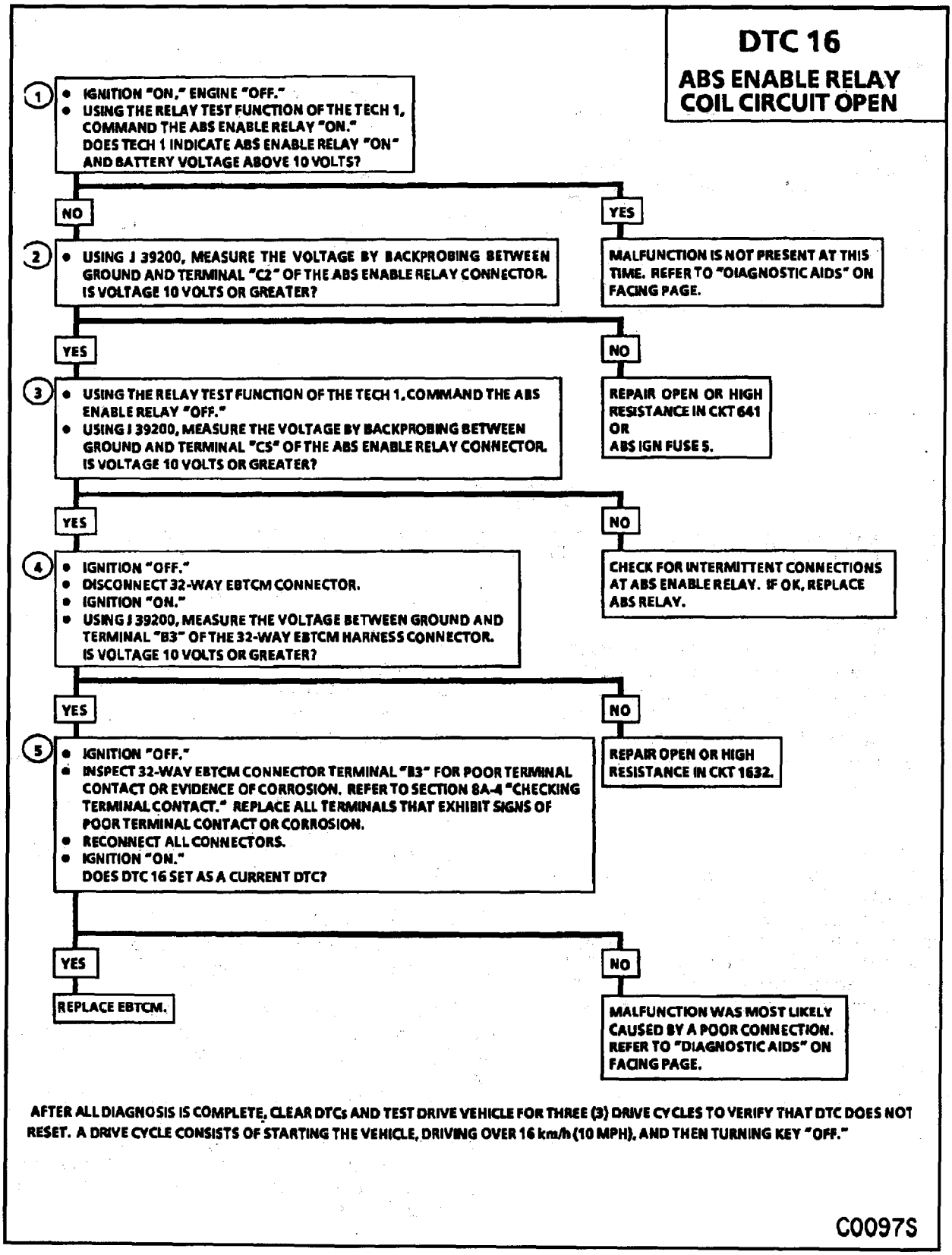
Diagnostic Aids:

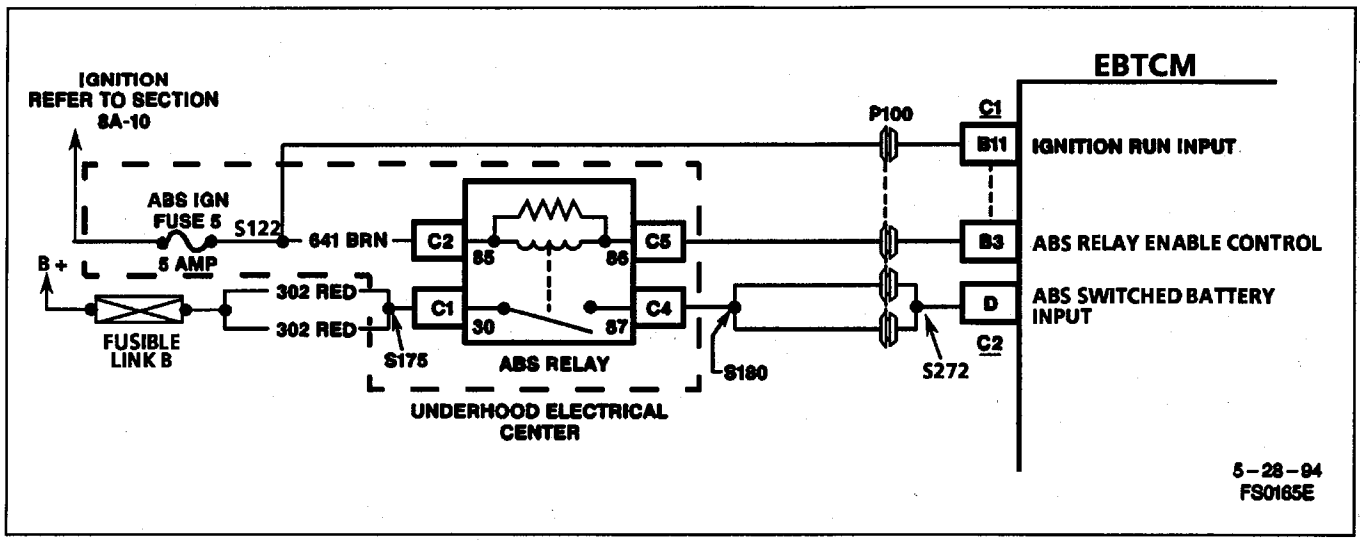
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the frequency of the malfunction is high, but is currently intermittent, check for high coil resistance by measuring between relay terminals "C2" and" C5" using a J 39200. If resistance shows greater than 100 ohms, replace the relay.

Any circuitry, that is suspected of causing the intermittent complaint, should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.


DTC 16
ABS ENABLE RELAY COIL CIRCUIT OPEN
1
• IGNITION "ON," ENGINE "OFF."
• USING THE RELAY TEST FUNCTION OF THE TECH 1, COMMAND THE ABS ENABLE RELAY "ON." DOES TECH 1 INDICATE ABS ENABLE RELAY "ON" AND BATTERY VOLTAGE ABOVE 10 VOLTS?
NO
YES
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
2
• USING J 39200, MEASURE THE VOLTAGE BY BACKPROBING BETWEEN GROUND AND TERMINAL "C2" OF THE ABS ENABLE RELAY CONNECTOR. IS VOLTAGE 10 VOLTS OR GREATER?
YES
NO
REPAIR OPEN OR HIGH RESISTANCE IN CKT 641 OR ABS IGN FUSE 5.
3
• USING THE RELAY TEST FUNCTION OF THE TECH 1, COMMAND THE ABS ENABLE RELAY "OFF."
• USING J 39200, MEASURE THE VOLTAGE BY BACKPROBING BETWEEN GROUND AND TERMINAL "C5" OF THE ABS ENABLE RELAY CONNECTOR. IS VOLTAGE 10 VOLTS OR GREATER?
YES
NO
CHECK FOR INTERMITTENT CONNECTIONS AT ABS ENABLE RELAY. IF OK, REPLACE ABS RELAY.
4
• IGNITION "OFF."
• DISCONNECT 32-WAY EBTCM CONNECTOR.
• IGNITION "ON."
• USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B3" OF THE 32-WAY EBTCM HARNESS CONNECTOR. IS VOLTAGE 10 VOLTS OR GREATER?
YES
NO
REPAIR OPEN OR HIGH RESISTANCE IN CKT 1632.
5
• IGNITION "OFF."
• INSPECT 32-WAY EBTCM CONNECTOR TERMINAL "B3" FOR POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION. REFER TO SECTION 8A-4 "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.
• RECONNECT ALL CONNECTORS.
• IGNITION "ON."
DOES DTC 16 SET AS A CURRENT DTC?
YES
NO
REPLACE EBTCM.
MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY "OFF."
C0097S



DTC 17
ABS ENABLE RELAY COIL CIRCUIT SHORTED TO GND

Circuit Description:

Ignition voltage is supplied through terminal "C2" of the ABS relay. The EBTCM then is able to energize the pull-in coil by completing the ground circuit at terminal "B3" of the EBTCM. The magnetic field created closes the ABS relay contacts and allows battery voltage and current to be supplied to the EBTCM, which supplies voltage to the motors and solenoids.

DTC Will Set When:

DTC 17 can be set before the EBTCM commands the ABS relay "ON." This test determines if the ABS relay is energized when it should not be. This malfunction would not allow the ABS relay to remove power to the EBTCM. If a second malfunction were to occur that requires the ABS relay to be turned "OFF," that malfunction cannot be removed if the relay cannot be controlled.

Action Taken:

A malfunction DTC is stored. ABS is not disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Indicates that the EBTCM is capable of controlling the ABS relay as commanded.
2. Checks to ensure that the ABS relay or control CKT 1632 are not shorted to ground.
3. Checks to see if the EBTCM is internally shorted to ground. A grounded terminal "B3" would cause the ABS relay to be energized any time the ignition was in the "ON" position.
4. Checks for a short to ground in control CKT 1632 or a defective relay.

Diagnostic Aids:

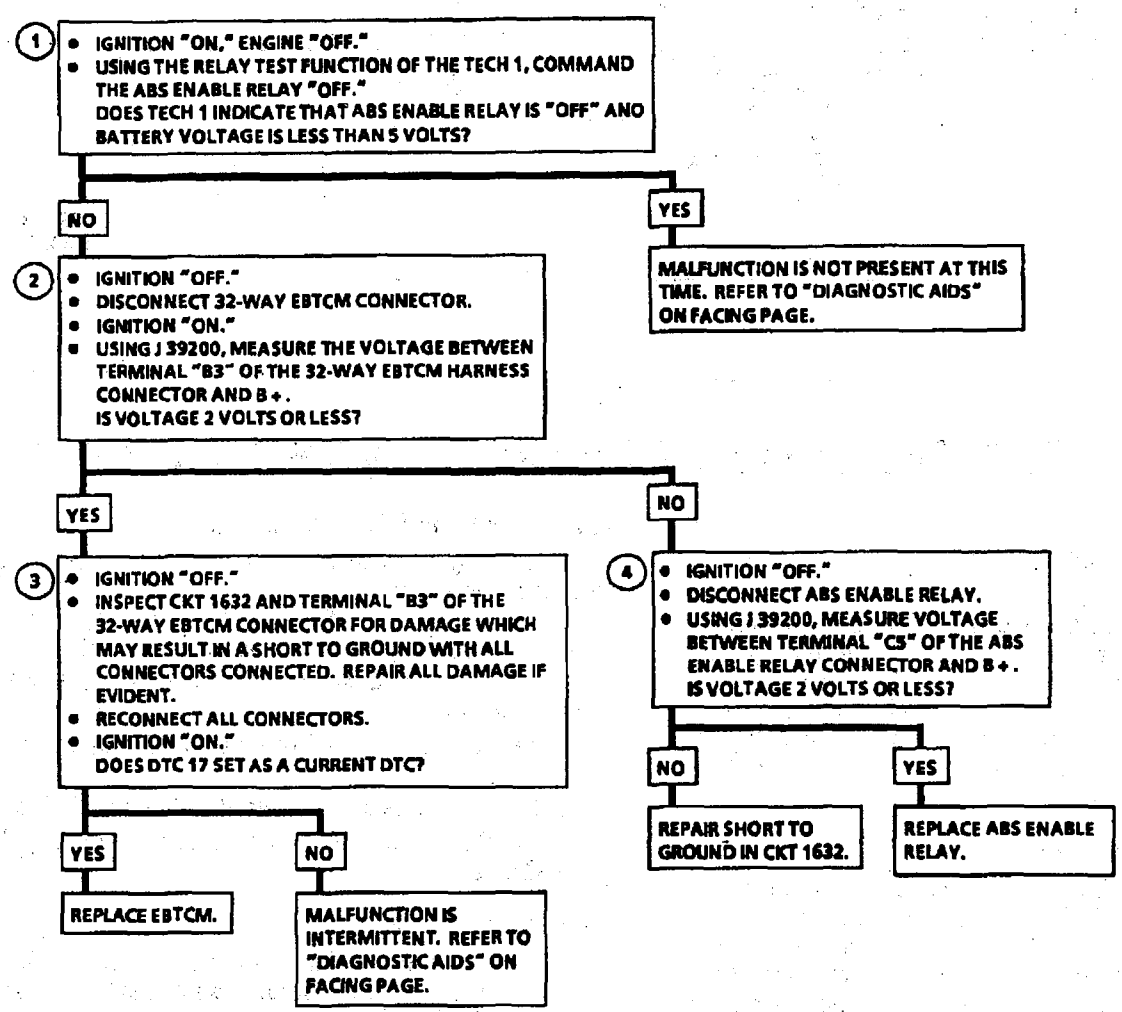
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry, that is suspected of causing the intermittent complaint, should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

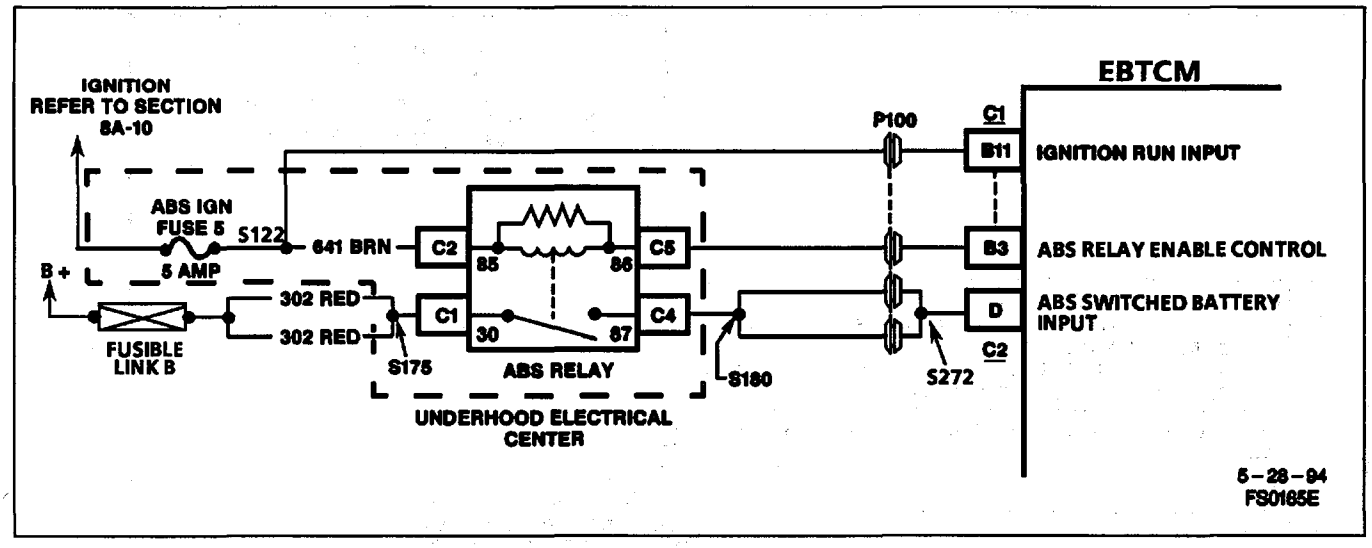
DTC 17

ABS ENABLE RELAY COIL CIRCUIT SHORTED TO GROUND



AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY "OFF."

C0098S



DTC 18
ABS ENABLE RELAY COIL CIRCUIT SHORTED TO BATT

Circuit Description:

Ignition voltage is supplied through terminal "C2" of the ABS relay. The EBTCM then is able to energize the pull-in coil by completing the ground circuit at connector "C1", terminal "B3" of the EBTCM. The magnetic field created closes the ABS relay contacts and allows battery voltage and current to be supplied to the EBTCM, which supplies voltage to the motors and solenoids.

DTC Will Set When:

DTC 18 can be set after the EBTCM commands the ABS relay "ON." This test monitors the availability of current and voltage to the motors and solenoids. A malfunction of this type will not allow voltage to be available to the motors and solenoids; therefore, ABS operation would not be allowed if required.

Action Taken:

A malfunction DTC is stored, ABS is disabled and the ABS warning lamp is turned "ON." DTCs 14, 15, 16, 17 ,18, 36, 37

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Indicates that the EBTCM is capable of controlling the ABS relay as commanded.
2. Checks for a short to voltage on the relay control circuit.
3. Verifies that the relay coil has the appropriate resistance.
4. Checks for relay contacts that are failed closed.
5. Checks for possible poor terminal contact at the EBTCM.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry, that is suspected of causing the intermittent complaint, should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 18

ABS ENABLE RELAY COIL CIRCUIT SHORTED TO BATT

1. • IGNITION "ON," ENGINE "OFF."
   • USING RELAY TEST FUNCTION OF TECH 1, COMMAND ABS ENABLE RELAY "ON."
   DOES TECH 1 INDICATE ABS ENABLE RELAY "ON" AND BATTERY VOLTAGE ABOVE 10 VOLTS?
   - NO
   - YES → MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

2. • IGNITION "OFF."
   • DISCONNECT ABS ENABLE RELAY.
   • DISCONNECT 32-WAY EBTCM CONNECTOR.
   • IGNITION "ON."
   • USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B3" OF THE 32-WAY EBTCM HARNESS CONNECTOR.
   IS VOLTAGE 2 VOLTS OR LESS?
   - YES
   - NO → REPAIR SHORT TO VOLTAGE IN CKT 1632.

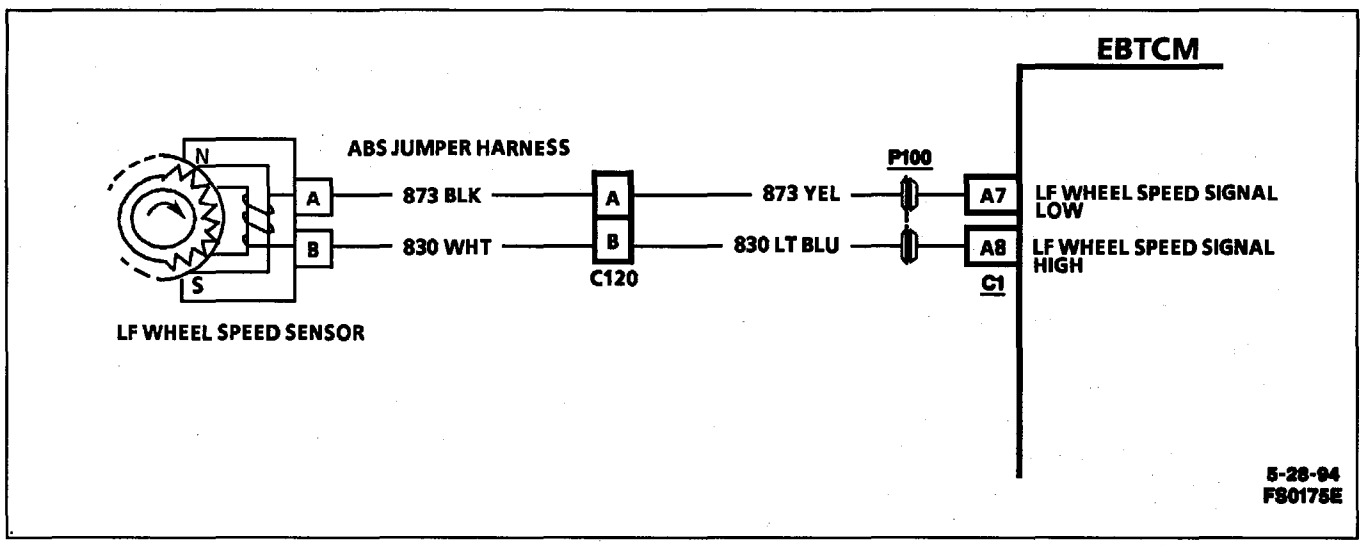
3. • IGNITION "OFF."
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C2" AND TERMINAL "C5" OF THE ABS ENABLE RELAY.
   IS RESISTANCE 40Ω OR GREATER?
   - YES
   - NO → REPLACE ABS ENABLE RELAY.

4. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINALS "30" AND "87" OF THE ABS ENABLE RELAY.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
   - YES
   - NO → REPLACE ABS ENABLE RELAY.

5. • INSPECT CKT 1632 AND TERMINAL "B3" OF THE 32-WAY EBTCM CONNECTOR FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
   • RECONNECT ALL CONNECTORS.
   • IGNITION "ON."
   DOES DTC 18 SET AS A CURRENT DTC?
   - YES → REPLACE EBTCM.
   - NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY OFF.

C0099S



DTC 21
LEFT FRONT WHEEL SPEED = 0

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 21 can be set when the vehicle is not in an ABS or TCS event. If the left front wheel speed=0 and the vehicle's reference speed is greater than 8 km/h (5 mph), a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step identifies a wheel speed sensor or circuitry that is damaged and visibly apparent.
2. Checks to see that the wheel speed sensor coil is within proper resistance values.
3. Verifies that the wheel speed sensor can generate an appropriate output signal.
4. This ensures that the wheel speed circuitry is not shorted together.
5. Ensures that the malfunction was not due to physical damage.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS or TCS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray down the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water). Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 21
LEFT FRONT WHEEL SPEED = 0

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

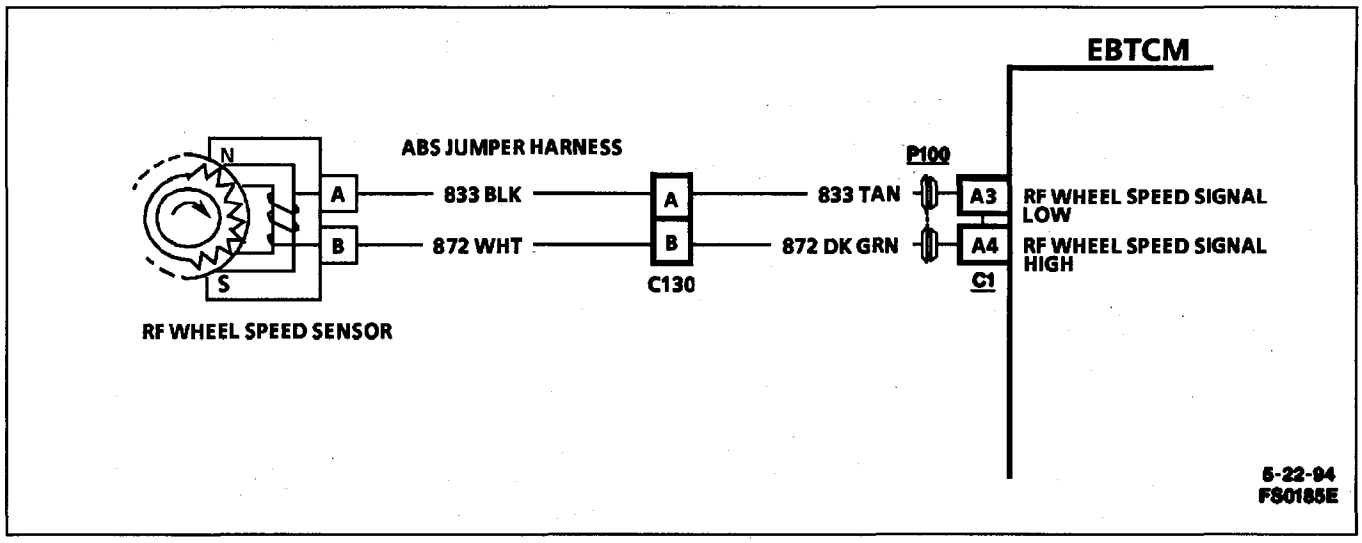
1. • IGNITION "OFF."
   • PHYSICALLY INSPECT THE LEFT FRONT WHEEL SPEED SENSOR, LEFT FRONT WHEEL SPEED SENSOR JUMPER HARNESS, AND CONNECTORS FOR DAMAGE.
   IS PHYSICAL DAMAGE INDICATED?
   - YES → REPLACE WHEEL SPEED SENSOR AND/OR JUMPER HARNESS IF DAMAGED. DRIVE VEHICLE ABOVE 24 km/h (15 MPH) TO ENSURE DTC 21 DOES NOT SET.
   - NO →
2. • DISCONNECT LEFT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN SENSOR TERMINALS "A" AND "B."
   IS RESISTANCE BETWEEN 1020 AND 1137Ω WHEN SENSOR IS 20°C (68°F)?
   (IF TEMPERATURE OF THE SENSOR IS SUSPECTED TO BE OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)
   - NO → REPLACE WHEEL SPEED SENSOR.
   - YES →
3. • WITH J 39200 STILL CONNECTED, SELECT A/C VOLTAGE SCALE.
   • SPIN WHEEL BY HAND WHILE OBSERVING VOLTAGE.
   IS VOLTAGE AT LEAST 100 mV (VOLTAGE WILL INCREASE AS WHEEL SPEED INCREASES)?
   - NO → REPLACE WHEEL SPEED SENSOR.
   - YES →
4. • IGNITION "OFF."
   • DISCONNECT 32-WAY EBTCM CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A7" AND "A8" OF THE 32-WAY EBTCM HARNESS CONNECTOR.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
   - NO → REPAIR SHORT BETWEEN CKTs 830 AND 873.
   - YES →
5. • INSPECT CKTs 830 AND 873 AND 32-WAY EBTCM CONNECTOR FOR DAMAGE WHICH MAY RESULT IN A SHORT BETWEEN CKTs 830 AND 873 WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
   • RECONNECT ALL CONNECTORS.
   • TEST DRIVE VEHICLE ABOVE 24 km/h (15 MPH) FOR AT LEAST 30 SECONDS.
   DOES DTC 21 SET AS A CURRENT DTC?
   - NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - YES → REPLACE EBTCM.

FRONT WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	804 TO 1066
5 TO 43	41 TO 110	956 TO 1240
44 TO 93	111 TO 200	1112 TO 1463

C0100S



DTC 22
RIGHT FRONT WHEEL SPEED = 0

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 22 can be set when the vehicle is not in an ABS or TCS event. If the right front wheel speed=0 and the vehicle's reference speed is greater than 8 km/h (5 mph), a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step identifies a wheel speed sensor or circuitry that is damaged and visibly apparent.
2. Checks to see that the wheel speed sensor coil is within proper resistance values.
3. Verifies that the wheel speed sensor can generate an appropriate output signal.
4. This ensures that the wheel speed circuitry is not shorted together.
5. Ensures that the malfunction was not due to physical damage.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS or TCS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water). Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 22
RIGHT FRONT WHEEL SPEED = 0

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

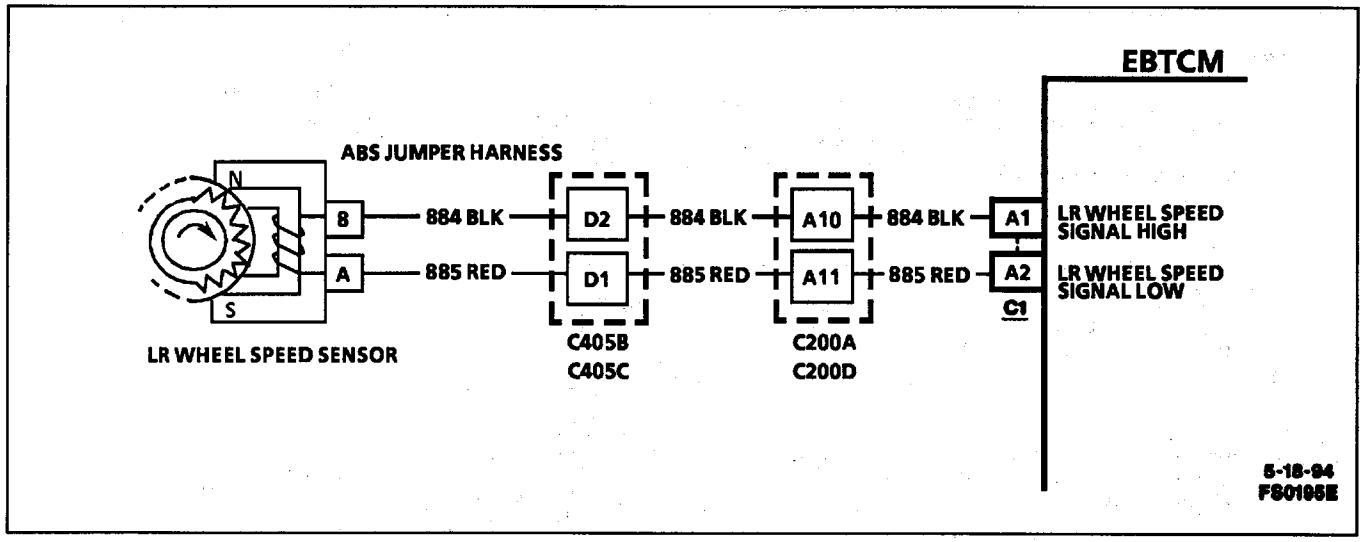
1. • IGNITION "OFF."
   • PHYSICALLY INSPECT THE RIGHT FRONT WHEEL SPEED SENSOR, RIGHT FRONT WHEEL SPEED SENSOR JUMPER HARNESS, AND CONNECTORS FOR DAMAGE.
   IS PHYSICAL DAMAGE INDICATED?
   - YES → REPLACE WHEEL SPEED SENSOR AND/OR JUMPER HARNESS IF DAMAGED. DRIVE VEHICLE ABOVE 24 km/h (15 MPH) TO ENSURE DTC 22 DOES NOT SET.
   - NO →
2. • DISCONNECT RIGHT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN SENSOR TERMINALS "A" AND "B."
   IS RESISTANCE BETWEEN 1020 AND 1137Ω WHEN SENSOR IS 20°C (68°F)?
   (IF TEMPERATURE OF THE SENSOR IS SUSPECTED TO BE OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)
   - NO → REPLACE WHEEL SPEED SENSOR.
   - YES →
3. • WITH J 39200 STILL CONNECTED, SELECT A/C VOLTAGE SCALE.
   • SPIN WHEEL BY HAND WHILE OBSERVING VOLTAGE.
   IS VOLTAGE AT LEAST 100 mV (VOLTAGE WILL INCREASE AS WHEEL SPEED INCREASES)?
   - NO → REPLACE WHEEL SPEED SENSOR.
   - YES →
4. • IGNITION "OFF."
   • DISCONNECT 32-WAY EBTCM CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A3" AND "A4" OF THE 32-WAY EBTCM HARNESS CONNECTOR.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
   - NO → REPAIR SHORT BETWEEN CKTs 833 AND 872.
   - YES →
5. • INSPECT CKTs 833 AND 872 AND 32-WAY EBTCM CONNECTOR FOR DAMAGE WHICH MAY RESULT IN A SHORT BETWEEN CKTs 833 AND 872 WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
   • RECONNECT ALL CONNECTORS.
   • TEST DRIVE VEHICLE ABOVE 24 km/h (15 MPH) FOR AT LEAST 30 SECONDS.
   DOES DTC 22 SET AS A CURRENT DTC?
   - NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - YES → REPLACE EBTCM.

FRONT WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	804 TO 1066
5 TO 43	41 TO 110	956 TO 1240
44 TO 93	111 TO 200	1112 TO 1463

C0101S



DTC 23
LEFT REAR WHEEL SPEED = 0

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 23 can be set when the vehicle is not in an ABS or TCS event. If the left rear wheel speed=0 and the vehicle's reference speed is greater than 8 km/h (5 mph), a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step identifies a wheel speed sensor or circuitry that is damaged and visibly apparent.
2. Checks to see that the wheel speed sensor coil is within proper resistance values.
3. Verifies that the wheel speed sensor can generate an appropriate output signal.
4. Verifies that the wheel speed circuitry is not shorted together.
5. Ensures that the malfunction was not due to physical damage.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS or TCS warning lamp is "ON" only during moist environmental changes (rain, snow, vehicle wash),all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water). Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 23
LEFT REAR WHEEL SPEED = 0

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

1
- IGNITION "OFF."
- PHYSICALLY INSPECT THE LEFT REAR WHEEL SPEED SENSOR, WHEEL SPEED SENSOR JUMPER HARNESS, AND CONNECTORS FOR DAMAGE.

IS PHYSICAL DAMAGE INDICATED?

YES → REPLACE WHEEL SPEED SENSOR AND/OR WHEEL SPEED SENSOR JUMPER HARNESS IF DAMAGED. DRIVE VEHICLE ABOVE 24 km/h (15 MPH) TO ENSURE DTC 23 DOES NOT SET.

NO →

2
- DISCONNECT LEFT REAR WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN SENSOR TERMINALS "A" AND "B."

IS RESISTANCE BETWEEN 2579 AND 3315Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF THE SENSOR IS SUSPECTED TO BE OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

NO → REPLACE WHEEL SPEED SENSOR.

YES →

3
- WITH J 39200 STILL CONNECTED, SELECT A/C VOLTAGE SCALE.
- VEHICLE TRANSMISSION IN NEUTRAL.
- SPIN WHEEL BY HAND WHILE OBSERVING VOLTAGE.

IS VOLTAGE AT LEAST 100 mV (VOLTAGE WILL INCREASE AS WHEEL SPEED INCREASES)?

NO → REPLACE WHEEL SPEED SENSOR.

YES →

4
- IGNITION "OFF."
- DISCONNECT 32-WAY EBTCM CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A1" AND "A2" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

NO → REPAIR SHORT BETWEEN CKTs 884 AND 885.

YES →

5
- INSPECT CKTs 884 AND 885 AND 32-WAY EBTCM CONNECTOR FOR DAMAGE WHICH MAY RESULT IN A SHORT BETWEEN CKTs 884 AND 885 WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- TEST DRIVE VEHICLE ABOVE 24 km/h (15 MPH) FOR AT LEAST 30 SECONDS.

DOES DTC 23 SET AS A CURRENT DTC?

NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

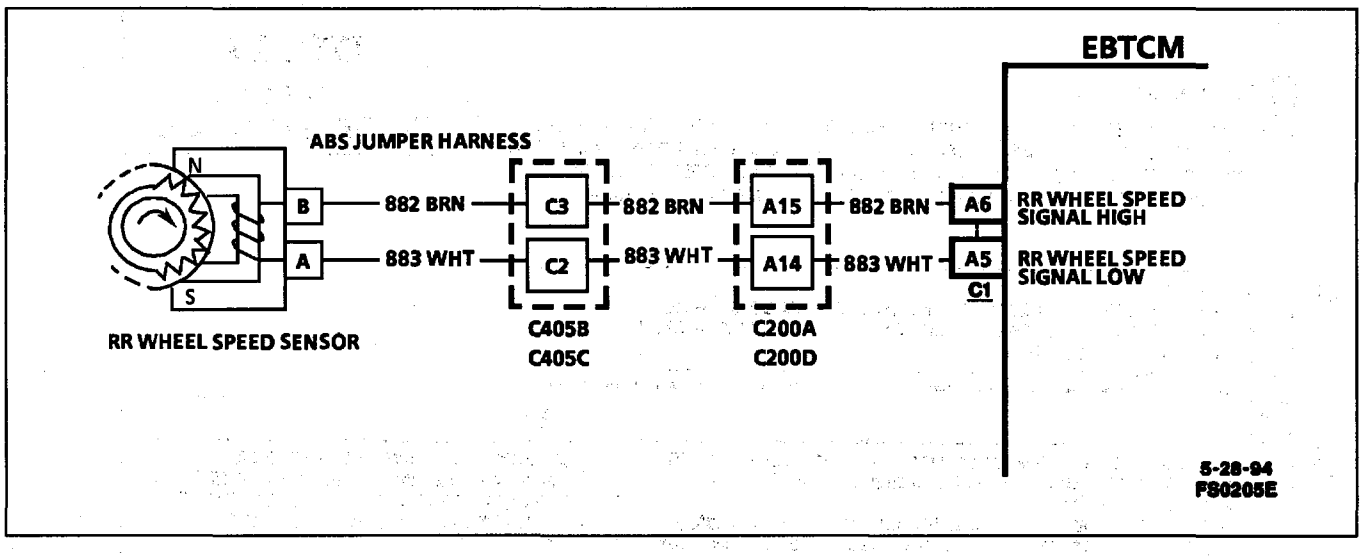
YES → REPLACE EBTCM.

REAR WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	2032 TO 3107
5 TO 43	41 TO 110	2417 TO 3615
44 TO 93	111 TO 200	2812 TO 4266

C0102S



DTC 24
RIGHT REAR WHEEL SPEED = 0

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 24 can be set when the vehicle is not in an ABS or TCS event. If the right rear wheel speed=0 and the vehicle's reference speed is greater than 8 km/h (5 mph), a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step identifies a wheel speed sensor or circuitry that is damaged and visibly apparent.
2. Checks to see that the wheel speed sensor coil is within proper resistance values.
3. Verifies that the wheel speed sensor can generate an appropriate output signal.
4. Verifies that the wheel speed circuitry is not shorted together.
5. Ensures that the malfunction was not due to physical damage.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS or TCS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water). Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 24
RIGHT REAR WHEEL SPEED = 0

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

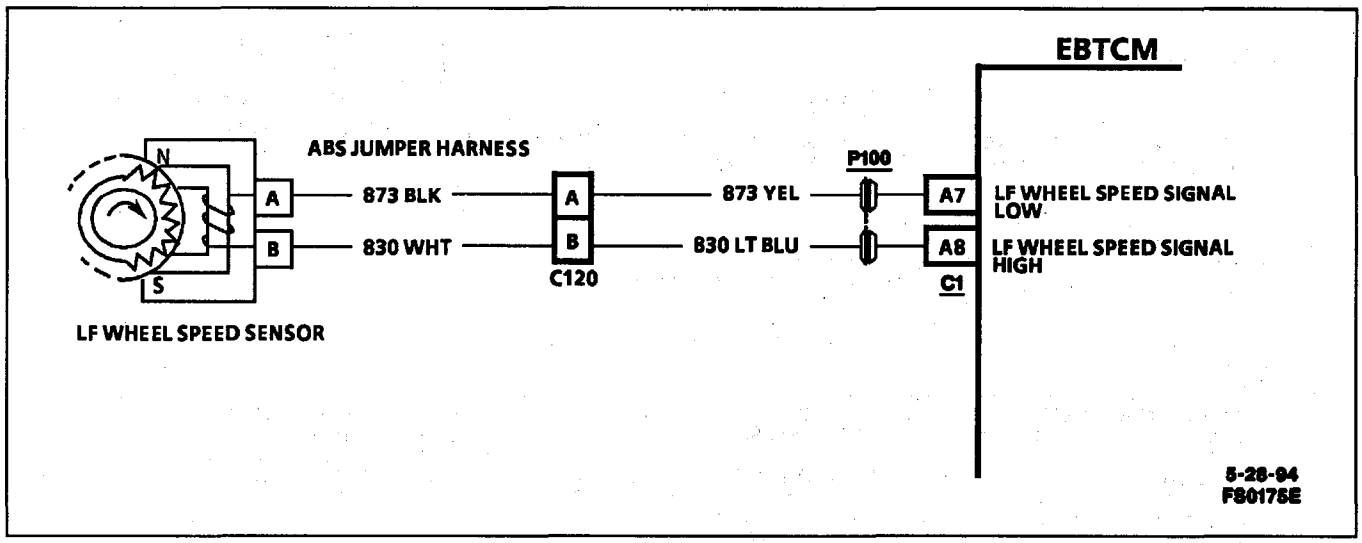
1. • IGNITION "OFF."
   • PHYSICALLY INSPECT THE RIGHT REAR WHEEL SPEED SENSOR, WHEEL SPEED SENSOR JUMPER HARNESS, AND CONNECTORS FOR DAMAGE.
   IS PHYSICAL DAMAGE INDICATED?
   - YES → REPLACE WHEEL SPEED SENSOR AND/OR WHEEL SPEED SENSOR JUMPER HARNESS IF DAMAGED. DRIVE VEHICLE ABOVE 24 km/h (15 MPH) TO ENSURE DTC 24 DOES NOT SET.
   - NO →
2. • DISCONNECT RIGHT REAR WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN SENSOR TERMINALS "A" AND "B."
   IS RESISTANCE BETWEEN 2579 AND 3315Ω WHEN SENSOR IS 20°C (68°F)?
   (IF TEMPERATURE OF THE SENSOR IS SUSPECTED TO BE OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)
   - NO → REPLACE WHEEL SPEED SENSOR.
   - YES →
3. • WITH J 39200 STILL CONNECTED, SELECT A/C VOLTAGE SCALE.
   • VEHICLE TRANSMISSION IN NEUTRAL.
   • SPIN WHEEL BY HAND WHILE OBSERVING VOLTAGE.
   IS VOLTAGE AT LEAST 100 mV (VOLTAGE WILL INCREASE AS WHEEL SPEED INCREASES)?
   - NO → REPLACE WHEEL SPEED SENSOR.
   - YES →
4. • IGNITION "OFF."
   • DISCONNECT 32-WAY EBTCM CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A5" AND "A6" OF THE 32-WAY EBTCM HARNESS CONNECTOR.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
   - NO → REPAIR SHORT BETWEEN CKTs 882 AND 883.
   - YES →
5. • INSPECT CKTs 882 AND 883 AND 32-WAY EBTCM CONNECTOR FOR DAMAGE WHICH MAY RESULT IN A SHORT BETWEEN CKTs 882 AND 883 WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
   • RECONNECT ALL CONNECTORS.
   • TEST DRIVE VEHICLE ABOVE 24 km/h (15 MPH) FOR AT LEAST 30 SECONDS.
   DOES DTC 24 SET AS A CURRENT DTC?
   - NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - YES → REPLACE EBTCM.

REAR WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	2032 TO 3107
5 TO 43	41 TO 110	2417 TO 3615
44 TO 93	111 TO 200	2812 TO 4266

C0103S



DTC 25
LEFT FRONT EXCESSIVE WHEEL SPEED VARIATION

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 25 can be set when the brake is "OFF." The purpose of this test is to detect a situation in which the left front wheel acceleration or deceleration is beyond specified limits.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step identifies a wheel speed sensor or circuitry that is damaged and visibly apparent.
2. Checks to see that the wheel speed sensor coil is within proper resistance values.
3. Verifies that the wheel speed sensor can generate an appropriate output signal.
4. This ensures that the wheel speed circuitry is not shorted together.
5. Ensures that the malfunction was not due to physical damage.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS or TCS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water). Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 25
LEFT FRONT EXCESSIVE WHEEL SPEED VARIATION

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

1
- IGNITION "OFF."
- PHYSICALLY INSPECT THE LEFT FRONT WHEEL SPEED SENSOR, LEFT FRONT WHEEL SPEED SENSOR JUMPER HARNESS, AND CONNECTORS FOR DAMAGE.

IS PHYSICAL DAMAGE INDICATED?

YES → REPLACE WHEEL SPEED SENSOR AND/OR JUMPER HARNESS IF DAMAGED. DRIVE VEHICLE ABOVE 24 km/h (15 MPH) TO ENSURE DTC 25 DOES NOT SET.

NO

2
- DISCONNECT LEFT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN SENSOR TERMINALS "A" AND "B."

IS RESISTANCE BETWEEN 1020 AND 1137Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF THE SENSOR IS SUSPECTED TO BE OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

NO → REPLACE WHEEL SPEED SENSOR.

YES

3
- WITH J 39200 STILL CONNECTED, SELECT A/C VOLTAGE SCALE.
- SPIN WHEEL BY HAND WHILE OBSERVING VOLTAGE.

IS VOLTAGE AT LEAST 100 mV (VOLTAGE WILL INCREASE AS WHEEL SPEED INCREASES)?

NO → REPLACE WHEEL SPEED SENSOR.

YES

4
- IGNITION "OFF."
- DISCONNECT 32-WAY EBTCM CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A7" AND "A8" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

NO → REPAIR SHORT BETWEEN CKTs 830 AND 873.

YES

5
- INSPECT CKTs 830 AND 873 AND 32-WAY EBTCM CONNECTOR FOR DAMAGE WHICH MAY RESULT IN A SHORT BETWEEN CKTs 830 AND 873 WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- TEST DRIVE VEHICLE ABOVE 24 km/h (15 MPH) FOR AT LEAST 30 SECONDS.

DOES DTC 25 SET AS A CURRENT DTC?

NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

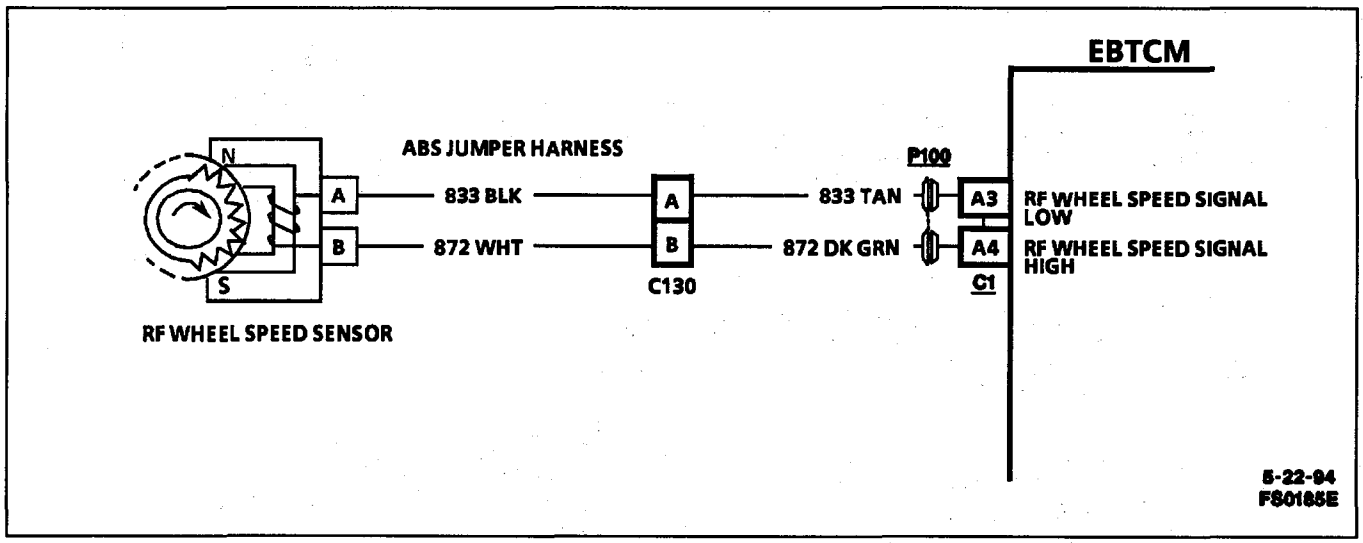
YES → REPLACE EBTCM.

FRONT WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	804 TO 1066
5 TO 43	41 TO 110	956 TO 1240
44 TO 93	111 TO 200	1112 TO 1463

C0104S



DTC 26
RIGHT FRONT EXCESSIVE WHEEL SPEED VARIATION

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 26 can be set when the brake is "OFF." The purpose of this test is to detect a situation in which the right front wheel acceleration or deceleration is beyond specified limits.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step identifies a wheel speed sensor or circuitry that is damaged and visibly apparent.
2. Checks to see that the wheel speed sensor coil is within proper resistance values.
3. Verifies that the wheel speed sensor can generate an appropriate output signal.
4. This ensures that the wheel speed circuitry is not shorted together.
5. Ensures that the malfunction was not due to physical damage.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS or TCS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water). Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 26
RIGHT FRONT EXCESSIVE WHEEL SPEED VARIATION

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

1
- IGNITION "OFF."
- PHYSICALLY INSPECT THE RIGHT FRONT WHEEL SPEED SENSOR, RIGHT FRONT WHEEL SPEED SENSOR JUMPER HARNESS, AND CONNECTORS FOR DAMAGE.

IS PHYSICAL DAMAGE INDICATED?

YES → REPLACE WHEEL SPEED SENSOR AND/OR JUMPER HARNESS IF DAMAGED. DRIVE VEHICLE ABOVE 24 km/h (15 MPH) TO ENSURE DTC 26 DOES NOT SET.

NO →

2
- DISCONNECT RIGHT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN SENSOR TERMINALS "A" AND "B."

IS RESISTANCE BETWEEN 1020 AND 1137 Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF THE SENSOR IS SUSPECTED TO BE OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

NO → REPLACE WHEEL SPEED SENSOR.

YES →

3
- WITH J 39200 STILL CONNECTED, SELECT A/C VOLTAGE SCALE.
- SPIN WHEEL BY HAND WHILE OBSERVING VOLTAGE.

IS VOLTAGE AT LEAST 100 mV (VOLTAGE WILL INCREASE AS WHEEL SPEED INCREASES)?

NO → REPLACE WHEEL SPEED SENSOR.

YES →

4
- IGNITION "OFF."
- DISCONNECT 32-WAY EBTCM CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A3" AND "A4" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

NO → REPAIR SHORT BETWEEN CKTs 833 AND 872.

YES →

5
- INSPECT CKTs 833 AND 872 AND 32-WAY EBTCM CONNECTOR FOR DAMAGE WHICH MAY RESULT IN A SHORT BETWEEN CKTs 833 AND 872 WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- TEST DRIVE VEHICLE ABOVE 24 km/h (15 MPH) FOR AT LEAST 30 SECONDS.

DOES DTC 26 SET AS A CURRENT DTC?

NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

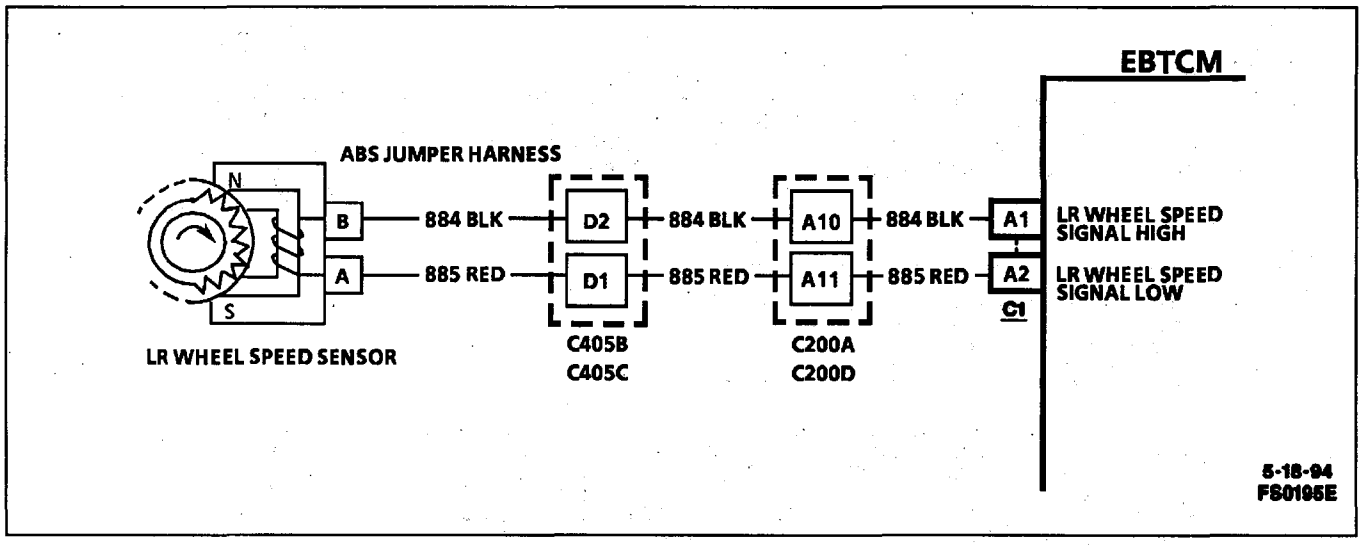
YES → REPLACE EBTCM.

FRONT WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	804 TO 1066
5 TO 43	41 TO 110	956 TO 1240
44 TO 93	111 TO 200	1112 TO 1463

C0105S



DTC 27
LEFT REAR EXCESSIVE WHEEL SPEED VARIATION

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 27 can be set when the brake is "OFF." The purpose of this test is to detect a situation in which the left rear wheel acceleration or deceleration is beyond specified limits.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step identifies a wheel speed sensor or circuitry that is damaged and visibly apparent.
2. Checks to see that the wheel speed sensor coil is within proper resistance values.
3. Verifies that the wheel speed sensor can generate an appropriate output signal.
4. This ensures that the wheel speed circuitry is not shorted together.
5. Ensures that the malfunction was not due to physical damage.
6. Checks rear sensor toothed ring for physical damage.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS or TCS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water). Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 27
LEFT REAR EXCESSIVE WHEEL SPEED VARIATION

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

1
- IGNITION "OFF."
- PHYSICALLY INSPECT THE LEFT REAR WHEEL SPEED SENSOR, WHEEL SPEED SENSOR JUMPER HARNESS, AND CONNECTORS FOR DAMAGE.

IS PHYSICAL DAMAGE INDICATED?

YES → REPLACE WHEEL SPEED SENSOR AND/OR WHEEL SPEED SENSOR JUMPER HARNESS IF DAMAGED. DRIVE VEHICLE ABOVE 24 km/h (15 MPH) TO ENSURE DTC 27 DOES NOT SET.

NO

2
- DISCONNECT LEFT REAR WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN SENSOR TERMINALS "A" AND "B."

IS RESISTANCE BETWEEN 2579 AND 3315Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF THE SENSOR IS SUSPECTED TO BE OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

NO → REPLACE WHEEL SPEED SENSOR.

YES

3
- WITH J 39200 STILL CONNECTED, SELECT AC VOLTAGE SCALE.
- VEHICLE TRANSMISSION IN NEUTRAL.
- SPIN WHEEL BY HAND WHILE OBSERVING VOLTAGE.

IS VOLTAGE AT LEAST 100 mV (VOLTAGE WILL INCREASE AS WHEEL SPEED INCREASES)?

NO → REPLACE WHEEL SPEED SENSOR.

YES

4
- IGNITION "OFF."
- DISCONNECT 32-WAY EBTCM CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A1" AND "A2" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

NO → REPLACE WHEEL SPEED SENSOR.

YES

5
- INSPECT CKTs 884 AND 885 AND 32-WAY EBTCM CONNECTOR FOR DAMAGE WHICH MAY RESULT IN A SHORT BETWEEN CKTs 884 AND 885 WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- TEST DRIVE VEHICLE ABOVE 24 km/h (15 MPH) FOR AT LEAST 30 SECONDS.

DOES DTC 27 SET AS A CURRENT DTC?

NO → REPAIR SHORT BETWEEN CKTs 884 AND 885.

YES

6
- INSPECT LEFT REAR SENSOR TOOTHED RING FOR MISSING TEETH OR OTHER PHYSICAL DAMAGE. REFER TO SECTION 4B.

IS ANY PHYSICAL DAMAGE INDICATED?

NO → REPLACE EBTCM.

NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

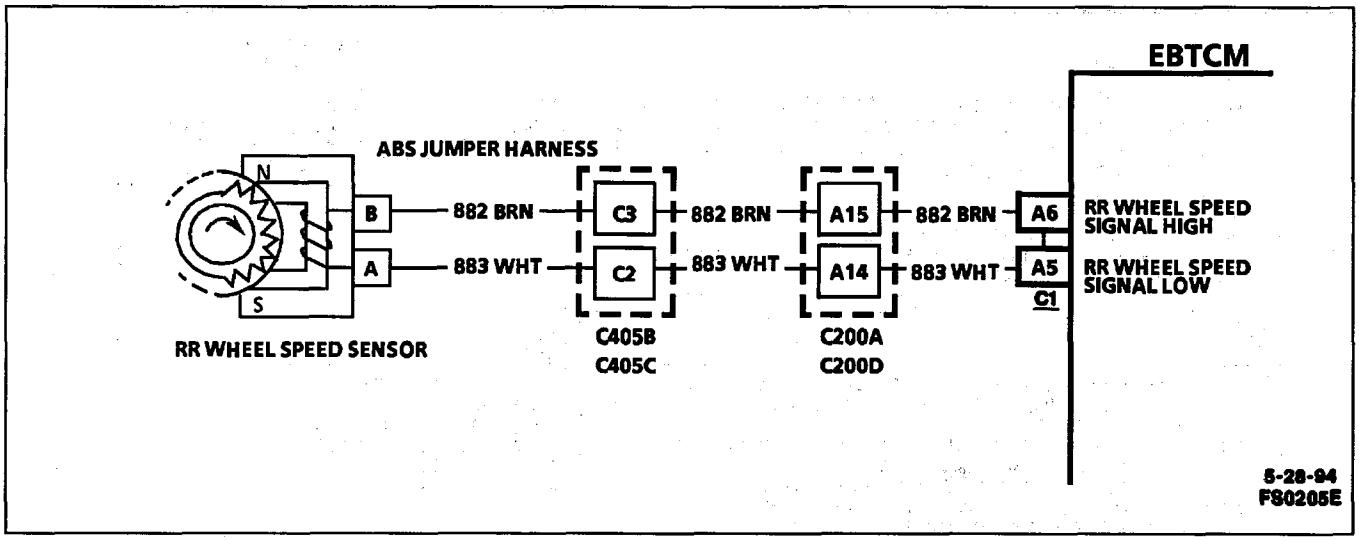
YES → REPLACE TOOTHED RING. REFER TO SECTION 4B.

REAR WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	2032 TO 3107
5 TO 43	41 TO 110	2417 TO 3615
44 TO 93	111 TO 200	2812 TO 4266

C0106S



DTC 28
RIGHT REAR EXCESSIVE WHEEL SPEED VARIATION

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 28 can be set when the brake is "OFF." The purpose of this test is to detect a situation in which the right rear wheel acceleration or deceleration is beyond specified limits.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step identifies a wheel speed sensor or circuitry that is damaged and visibly apparent.
2. Checks to see that the wheel speed sensor coil is within proper resistance values.
3. Verifies that the wheel speed sensor can generate an appropriate output signal.
4. This ensures that the wheel speed circuitry is not shorted together.
5. Ensures that the malfunction was not due to physical damage.
6. Checks rear sensor toothed ring for physical damage.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS or TCS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 28
RIGHT REAR EXCESSIVE WHEEL SPEED VARIATION

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

1
- IGNITION "OFF."
- PHYSICALLY INSPECT THE RIGHT REAR WHEEL SPEED SENSOR, WHEEL SPEED SENSOR JUMPER HARNESS, AND CONNECTORS FOR DAMAGE.

IS PHYSICAL DAMAGE INDICATED?

YES → REPLACE WHEEL SPEED SENSOR AND/OR WHEEL SPEED SENSOR JUMPER HARNESS IF DAMAGED. DRIVE VEHICLE ABOVE 24 km/h (15 MPH) TO ENSURE DTC 28 DOES NOT SET.

NO

2
- DISCONNECT RIGHT REAR WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN SENSOR TERMINALS "A" AND "B."

IS RESISTANCE BETWEEN 2579 AND 3315Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF THE SENSOR IS SUSPECTED TO BE OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

NO → REPLACE WHEEL SPEED SENSOR.

YES

3
- WITH J 39200 STILL CONNECTED, SELECT A/C VOLTAGE SCALE.
- VEHICLE TRANSMISSION IN NEUTRAL.
- SPIN WHEEL BY HAND WHILE OBSERVING VOLTAGE.

IS VOLTAGE AT LEAST 100 mV (VOLTAGE WILL INCREASE AS WHEEL SPEED INCREASES)?

NO → REPLACE WHEEL SPEED SENSOR.

YES

4
- IGNITION "OFF."
- DISCONNECT 32-WAY EBTCM CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A5" AND "A6" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

NO → REPAIR SHORT BETWEEN CKTs 882 AND 883.

YES

5
- INSPECT CKTs 882 AND 883 AND 32-WAY EBTCM CONNECTOR FOR DAMAGE WHICH MAY RESULT IN A SHORT BETWEEN CKTs 882 AND 883 WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- TEST DRIVE VEHICLE ABOVE 24 km/h (15 MPH) FOR AT LEAST 30 SECONDS.

DOES DTC 28 SET AS A CURRENT DTC?

NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

YES

6
- INSPECT RIGHT REAR SENSOR TOOTHED RING FOR MISSING TEETH OR OTHER PHYSICAL DAMAGE. REFER TO SECTION 4B.

IS ANY PHYSICAL DAMAGE INDICATED?

YES → REPLACE TOOTHED RING. REFER TO SECTION 4B.

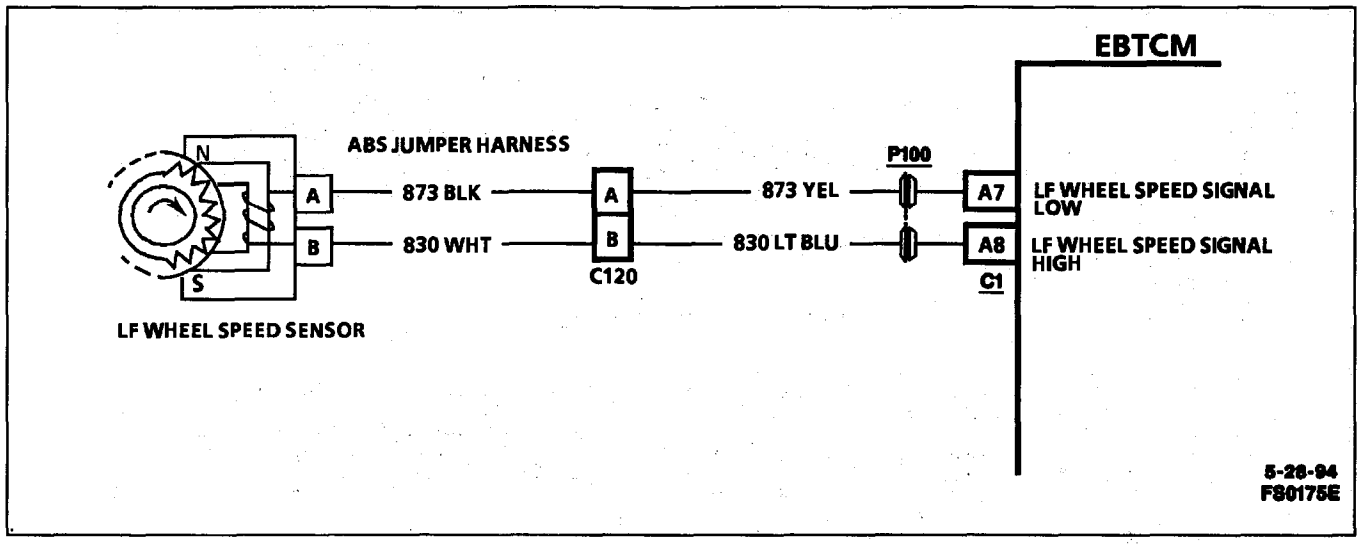
NO → REPLACE EBTCM.

REAR WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	2032 TO 3107
5 TO 43	41 TO 110	2417 TO 3615
44 TO 93	111 TO 200	2812 TO 4266

C0107S



DTC 32
(Page 1 of 3)
LF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring often referred to as the air gap.

DTC Will Set When:

DTC 32 can be set anytime after initialization. If either of the left front wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for proper resistance of the wheel speed sensor coil.
2. Checks for a short to ground in the wheel speed sensor wiring.
3. Checks for a short to voltage in the wheel speed sensor wiring.
4. Checks for a short to voltage in CKT 873.
5. Checks for a short to voltage in CKT 830.
6. Ensures that the malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS or TCS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 32

(Page 1 of 3)
LF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

1
- IGNITION "OFF."
- USING A 5% SALT WATER SOLUTION (TWO TEASPOONS OF SALT TO 12 OZ. WATER), THOROUGHLY SPRAY THE LEFT FRONT WHEEL SPEED SENSOR JUMPER HARNESS.
- DISCONNECT 32-WAY EBTCM HARNESS CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINALS "A7" AND "A8" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

IS RESISTANCE BETWEEN 1020 AND 1137Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF SENSOR IS SUSPECTED TO BE OTHER THAN 20°C (68°F), REFER TO THE TABLE ON PAGE 2 OF 2 OF THIS DTC CHART FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

YES

2
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A7" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

3
- IGNITION "ON."
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A7" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

NO

4
- IGNITION "OFF."
- DISCONNECT LEFT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- IGNITION "ON."
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A7" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

YES

5
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A8" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

YES

MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WHEN ALL COMPONENTS ARE CONNECTED. REPAIR ALL DAMAGE IF FOUND. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION.

NO

REPAIR SHORT TO VOLTAGE IN CKT 830.

NO

REPAIR SHORT TO VOLTAGE IN CKT 873.

YES

6
- IGNITION "OFF."
- INSPECT TERMINALS "A7" AND "A8" OF THE 32-WAY EBTCM HARNESS CONNECTOR FOR POOR TERMINAL CONTACT AND CONTAMINATION. ALSO INSPECT CKTs 830 AND 873 FOR DAMAGE WHICH MAY RESULT IN AN OPEN CIRCUIT, SHORT TO GROUND, OR SHORT TO VOLTAGE. REPAIR ALL DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- IGNITION "ON."

DOES DTC 32 SET AS A CURRENT DTC?

YES

REPLACE EBTCM.

NO

MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

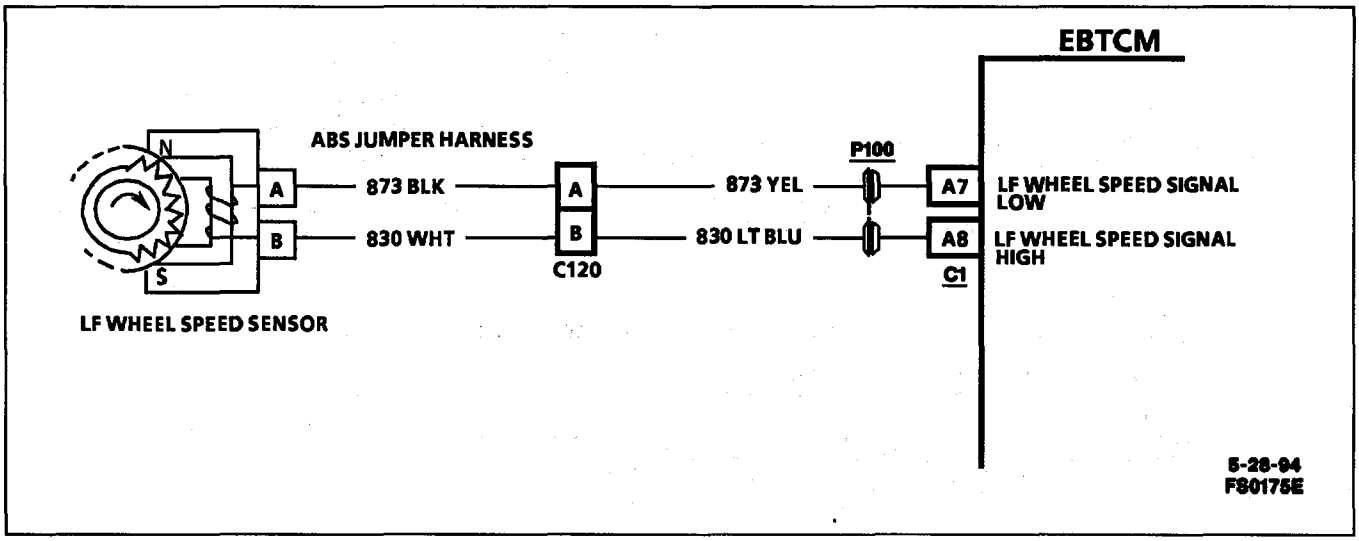
NO

DIAGNOSIS CONTINUED ON PAGE 3 OF 3 OF THIS DTC CHART.

NO

DIAGNOSIS CONTINUED ON PAGE 2 OF 3 OF THIS DTC CHART.

C0108S



DTC 32
(Page 2 of 3)
LF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 32 can be set anytime after initialization. If either of the left front wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

7. Checks for high resistance in CKT 873.
8. Checks for high resistance in CKT 830.
9. Verifies proper resistance of the wheel speed sensor coil.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS or TCS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 32

(Page 2 of 3)

LF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

DIAGNOSIS CONTINUED FROM PAGE 1 OF 3 OF THIS DTC CHART.

7. • DISCONNECT LEFT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A7" OF THE 32-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "A" OF THE LEFT FRONT WHEEL SPEED SENSOR HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?

   YES

8. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A8" OF THE 32-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "B" OF THE LEFT FRONT WHEEL SPEED SENSOR HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?

   YES

9. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE LEFT FRONT WHEEL SPEED SENSOR CONNECTOR.
   IS RESISTANCE BETWEEN 1020 AND 1137Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF SENSOR IS SUSPECTED TO OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

   YES

MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN HIGH RESISTANCE WHEN ALL COMPONENTS ARE CONNECTED. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION. REPAIR ALL DAMAGE IF FOUND.

NO

REPAIR HIGH RESISTANCE IN CKT 873 (WHEEL SPEED SENSOR JUMPER MUST BE REPLACED IF DAMAGED).

NO

REPAIR HIGH RESISTANCE IN CKT 830 (WHEEL SPEED SENSOR JUMPER MUST BE REPLACED IF DAMAGED).

NO

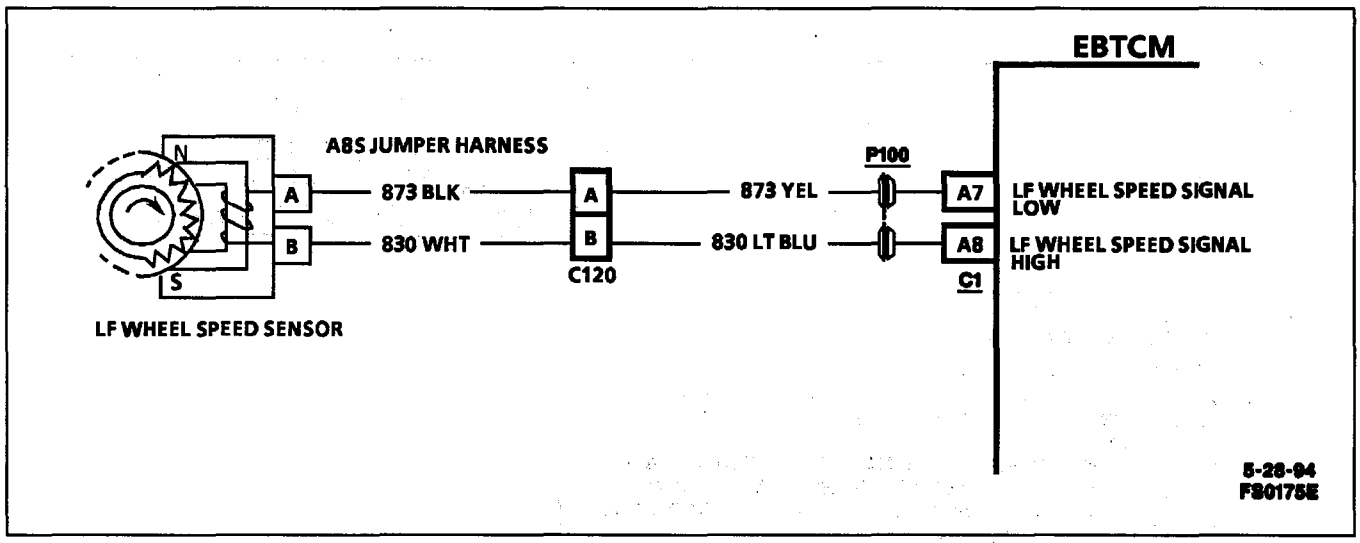
REPLACE WHEEL SPEED SENSOR.

FRONT WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	804 TO 1066
5 TO 43	41 TO 110	956 TO 1240
44 TO 93	111 TO 200	1112 TO 1463

C0109S



DTC 32
(Page 3 of 3)
LF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 32 can be set anytime after initialization. If either of the left front wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

10. Checks for a short to ground in CKT 873.
11. Checks for a short to ground in CKT 830.
12. Checks for a short to ground in the wheel speed sensor jumper harness.
13. Verifies that the wheel speed sensor is not internally shorted to ground.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

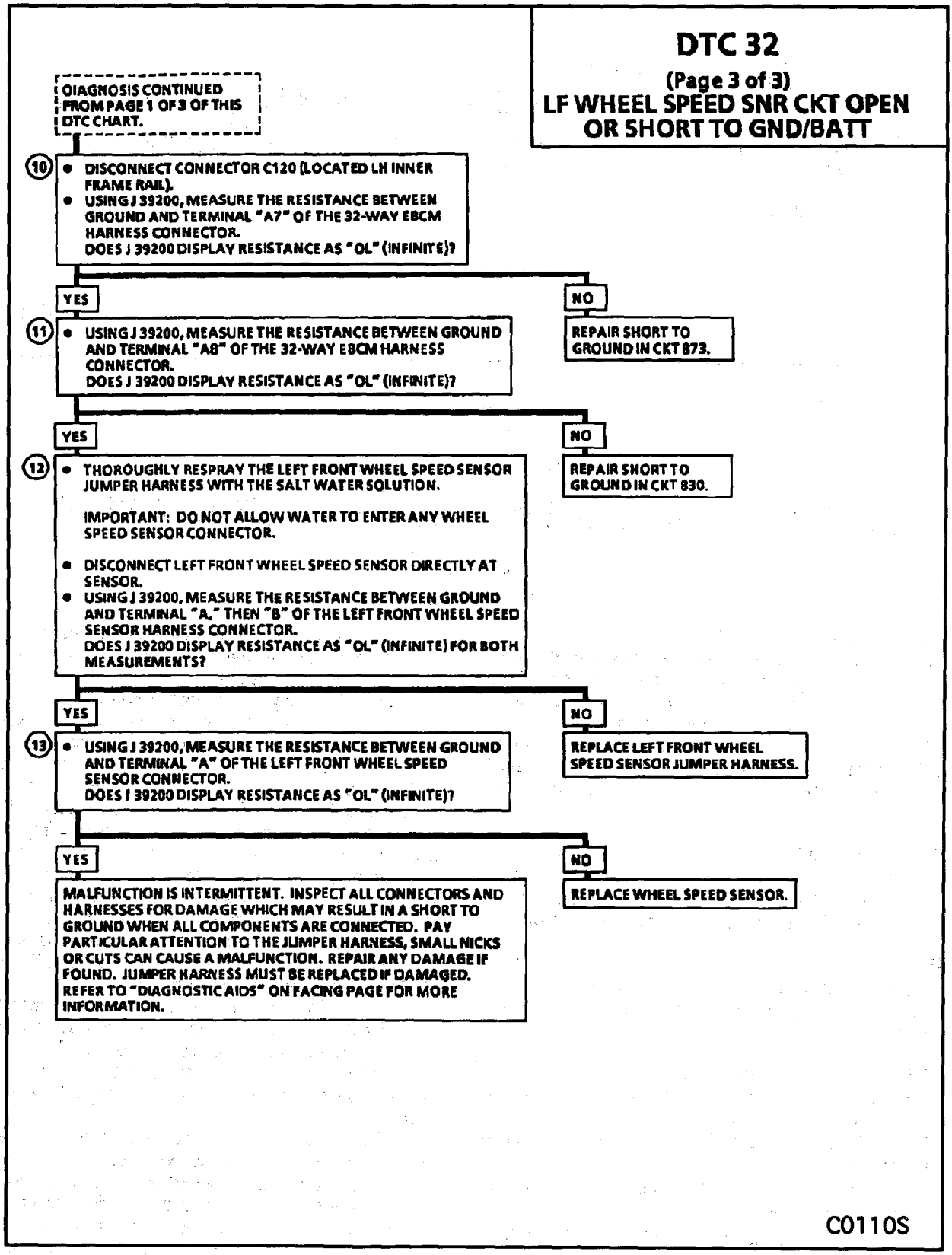
The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

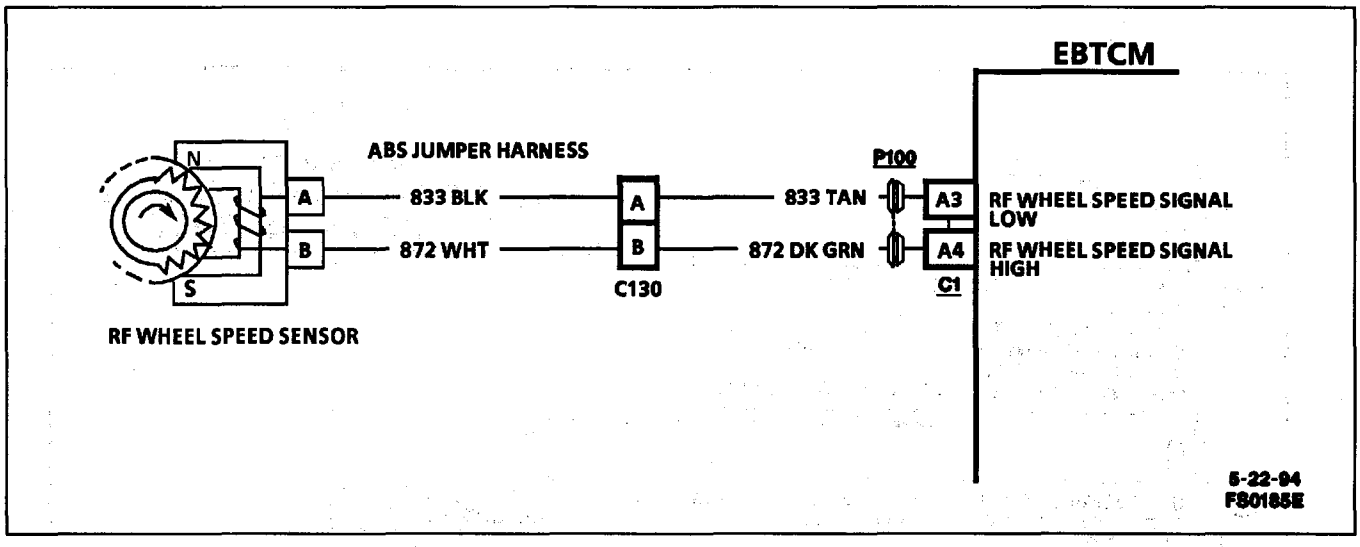
If the customer's comments reflect that the ABS or TCS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.


DTC 32
(Page 3 of 3)
LF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT
DIAGNOSIS CONTINUED FROM PAGE 1 OF 3 OF THIS DTC CHART.
10
• DISCONNECT CONNECTOR C120 (LOCATED LH INNER FRAME RAIL).
• USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A7" OF THE 32-WAY EBCM HARNESS CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
YES
NO
REPAIR SHORT TO GROUND IN CKT 873.
11
• USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A8" OF THE 32-WAY EBCM HARNESS CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
YES
NO
REPAIR SHORT TO GROUND IN CKT 830.
12
• THOROUGHLY RESPRAY THE LEFT FRONT WHEEL SPEED SENSOR JUMPER HARNESS WITH THE SALT WATER SOLUTION.
IMPORTANT: DO NOT ALLOW WATER TO ENTER ANY WHEEL SPEED SENSOR CONNECTOR.
• DISCONNECT LEFT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A," THEN "B" OF THE LEFT FRONT WHEEL SPEED SENSOR HARNESS CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE) FOR BOTH MEASUREMENTS?
YES
NO
REPLACE LEFT FRONT WHEEL SPEED SENSOR JUMPER HARNESS.
13
• USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A" OF THE LEFT FRONT WHEEL SPEED SENSOR CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
YES
NO
REPLACE WHEEL SPEED SENSOR.
MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN A SHORT TO GROUND WHEN ALL COMPONENTS ARE CONNECTED. PAY PARTICULAR ATTENTION TO THE JUMPER HARNESS, SMALL NICKS OR CUTS CAN CAUSE A MALFUNCTION. REPAIR ANY DAMAGE IF FOUND. JUMPER HARNESS MUST BE REPLACED IF DAMAGED. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION.
C0110S



DTC 33
(Page 1 of 3)
RF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 33 can be set anytime after initialization. If either of the right front wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for proper resistance of the wheel speed sensor coil.
2. Checks for a short to ground in the wheel speed sensor wiring.
3. Checks for a short to voltage in the wheel speed sensor wiring.
4. Checks for a short to voltage in CKT 833.
5. Checks for a short to voltage in CKT 872.
6. Ensures that the malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS or TCS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 33

(Page 1 of 3)

RF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

1
- IGNITION "OFF."
- USING A 5% SALT WATER SOLUTION (TWO TEASPOONS OF SALT TO 12 OZ. WATER), THOROUGHLY SPRAY THE RIGHT FRONT WHEEL SPEED SENSOR JUMPER HARNESS.
- DISCONNECT 32-WAY EBTCM HARNESS CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINALS "A3" AND "A4" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

IS RESISTANCE BETWEEN 1020 AND 1137Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF SENSOR IS SUSPECTED TO OTHER THAN 20°C (68°F), REFER TO THE TABLE ON PAGE 2 OF 2 OF THIS DTC CHART FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

YES

2
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A3" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

NO

DIAGNOSIS CONTINUED ON PAGE 2 OF 3 OF THIS DTC CHART.

YES

3
- IGNITION "ON."
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A3" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

NO

DIAGNOSIS CONTINUED ON PAGE 3 OF 3 OF THIS DTC CHART.

NO

4
- IGNITION "OFF."
- DISCONNECT RIGHT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- IGNITION "ON."
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A3" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

YES

5
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A4" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

NO

REPAIR SHORT TO VOLTAGE IN CKT 833.

YES

MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WHEN ALL COMPONENTS ARE CONNECTED. REPAIR ALL DAMAGE IF FOUND. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION.

NO

REPAIR SHORT TO VOLTAGE IN CKT 872.

YES

6
- IGNITION "OFF."
- INSPECT TERMINALS "A3" AND "A4" OF THE 32-WAY EBTCM HARNESS CONNECTOR FOR POOR TERMINAL CONTACT AND CONTAMINATION. ALSO INSPECT CKTs 833 AND 872 FOR DAMAGE WHICH MAY RESULT IN AN OPEN CIRCUIT, SHORT TO GROUND, OR SHORT TO VOLTAGE. REPAIR ALL DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- IGNITION "ON."

DOES DTC 33 SET AS A CURRENT DTC?

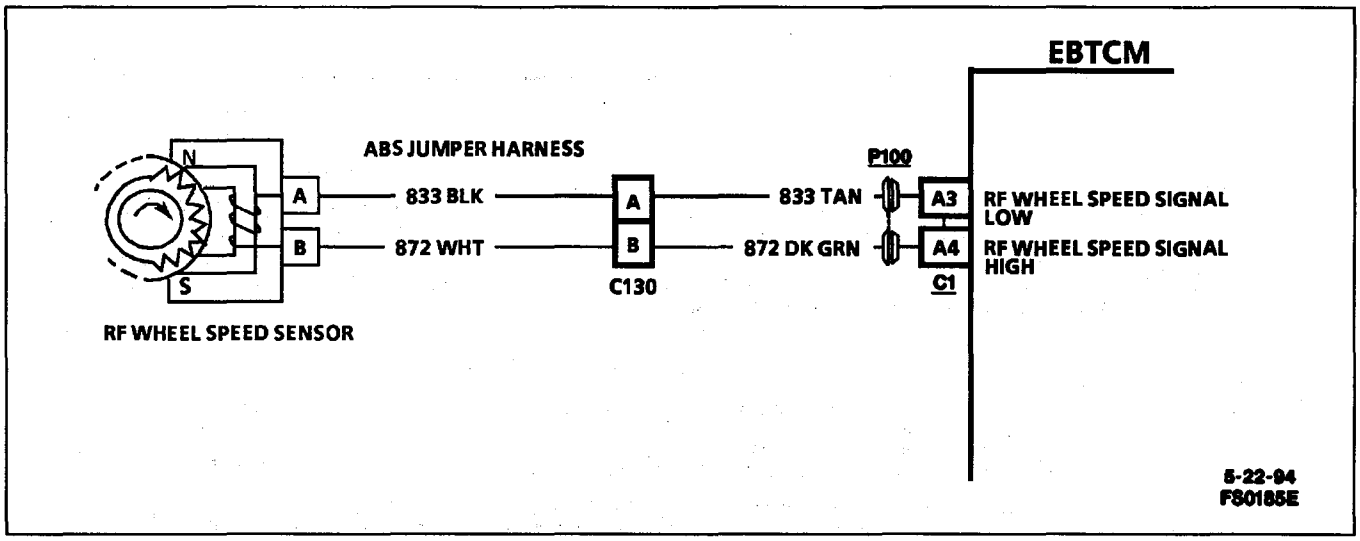
YES

REPLACE EBTCM.

NO

MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

C0111S



DTC 33
(Page 2 of 3)
RF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 33 can be set anytime after initialization. If either of the right front wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

7. Checks for high resistance in CKT 833.
8. Checks for high resistance in CKT 872.
9. Verifies proper resistance of the wheel speed sensor coil.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS or TCS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 33

(Page 2 of 3)

RF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

DIAGNOSIS CONTINUED FROM PAGE 1 OF 3 OF THIS DTC CHART.

7. • DISCONNECT RIGHT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A3" OF THE 32-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "A" OF THE RIGHT FRONT WHEEL SPEED SENSOR HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?
   - YES → 8
   - NO → REPAIR HIGH RESISTANCE IN CKT 833 (WHEEL SPEED SENSOR JUMPER MUST BE REPLACED IF DAMAGED).

8. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A4" OF THE 32-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "B" OF THE RIGHT FRONT WHEEL SPEED SENSOR HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?
   - YES → 9
   - NO → REPAIR HIGH RESISTANCE IN CKT 872 (WHEEL SPEED SENSOR JUMPER MUST BE REPLACED IF DAMAGED).

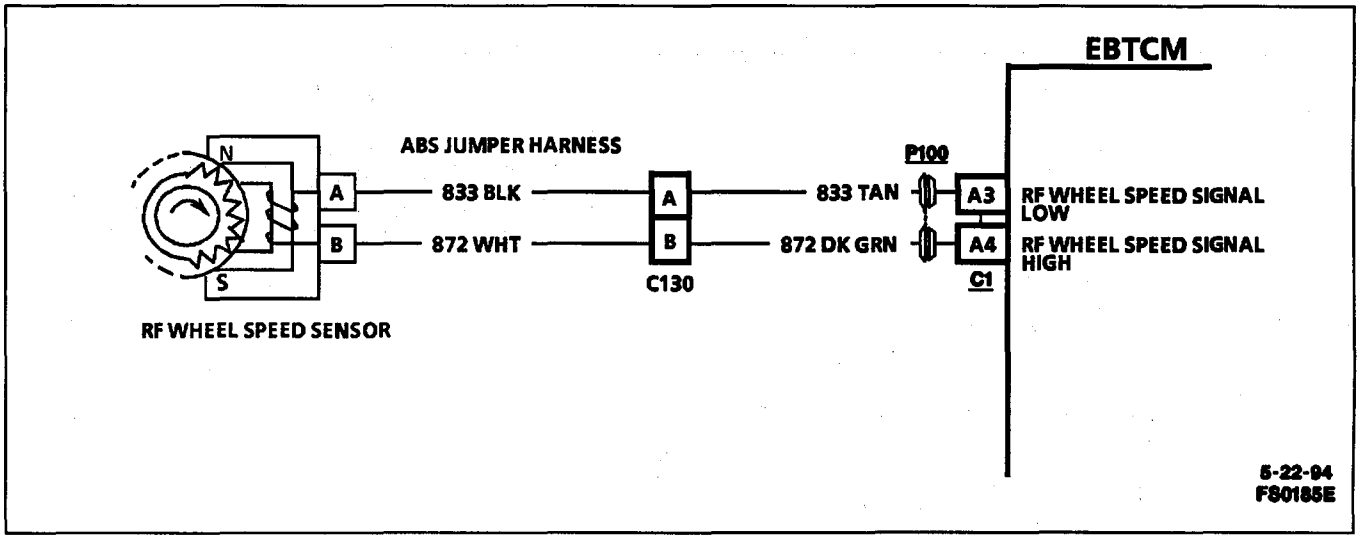
9. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE RIGHT FRONT WHEEL SPEED SENSOR CONNECTOR.
   IS RESISTANCE BETWEEN 1020 AND 1137Ω WHEN SENSOR IS 20°C (68°F)? (*IF TEMPERATURE OF SENSOR IS SUSPECTED TO OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.*)
   - YES → MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN HIGH RESISTANCE WHEN ALL COMPONENTS ARE CONNECTED. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION. REPAIR ALL DAMAGE IF FOUND.
   - NO → REPLACE WHEEL SPEED SENSOR.

FRONT WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	804 TO 1066
5 TO 43	41 TO 110	956 TO 1240
44 TO 93	111 TO 200	1112 TO 1453

C0112S



DTC 33
(Page 3 of 3)
RF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 33 can be set anytime after initialization. If either of the right front wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

10. Checks for a short to ground in CKT 833.
11. Checks for a short to ground in CKT 872.
12. Checks for a short to ground in the wheel speed sensor jumper harness.
13. Verifies that the wheel speed sensor is not internally shorted to ground.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS or TCS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 33

(Page 3 of 3)

RF WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

DIAGNOSIS CONTINUED FROM PAGE 1 OF 3 OF THIS DTC CHART.

10
- DISCONNECT CONNECTOR C130 (LOCATED RH INNER FRAME RAIL).
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A3" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

11
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A4" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

12
- THOROUGHLY RESPRAY THE RIGHT FRONT WHEEL SPEED SENSOR JUMPER HARNESS WITH THE SALT WATER SOLUTION.

IMPORTANT: DO NOT ALLOW WATER TO ENTER ANY WHEEL SPEED SENSOR CONNECTOR.

- DISCONNECT RIGHT FRONT WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A," THEN "B" OF THE RIGHT FRONT WHEEL SPEED SENSOR HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE) FOR BOTH MEASUREMENTS?

YES

13
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A" OF THE RIGHT FRONT WHEEL SPEED SENSOR CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN A SHORT TO GROUND WHEN ALL COMPONENTS ARE CONNECTED. PAY PARTICULAR ATTENTION TO THE JUMPER HARNESS, SMALL NICKS OR CUTS CAN CAUSE A MALFUNCTION. REPAIR ANY DAMAGE IF FOUND. JUMPER HARNESS MUST BE REPLACED IF DAMAGED. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION.

NO

REPLACE WHEEL SPEED SENSOR.

NO

REPLACE RIGHT FRONT WHEEL SPEED SENSOR JUMPER HARNESS.

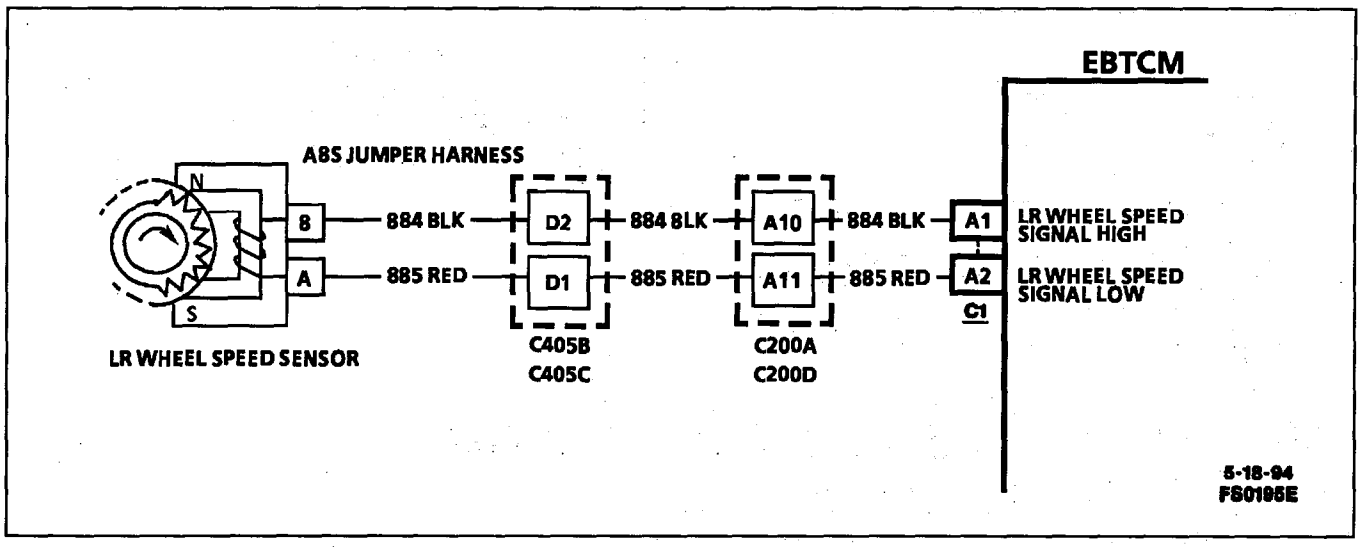
NO

REPAIR SHORT TO GROUND IN CKT 872.

NO

REPAIR SHORT TO GROUND IN CKT 833.

C0113S



DTC 34
(Page 1 of 3)
LR WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 34 can be set anytime after initialization. If either of the left rear wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for proper resistance of the wheel speed sensor coil.
2. Checks for a short to ground in the wheel speed sensor wiring.
3. Checks for a short to voltage in the wheel speed sensor wiring.
4. Checks for a short to voltage in CKT 885.
5. Checks for a short to voltage in CKT 884.
6. Ensures that the malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS or TCS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 34
(Page 1 of 3)
LR WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

1
- IGNITION "OFF."
- USING A 5% SALT WATER SOLUTION (TWO TEASPOONS OF SALT TO 12 OZ. WATER), THOROUGHLY SPRAY THE LEFT REAR WHEEL SPEED SENSOR JUMPER HARNESS.
- DISCONNECT 32-WAY EBTCM HARNESS CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINALS "A1" AND "A2" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

IS RESISTANCE BETWEEN 2579 AND 3315Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF SENSOR IS SUSPECTED TO BE OTHER THAN 20°C (68°F), REFER TO THE TABLE ON PAGE 2 OF 2 OF THIS DTC CHART FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

YES

2
- USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A2" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

3
- IGNITION "ON."
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A2" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

NO

4
- IGNITION "OFF."
- DISCONNECT LEFT REAR WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- IGNITION "ON."
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A2" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

YES

5
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A1" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

YES

MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WHEN ALL COMPONENTS ARE CONNECTED. REPAIR ALL DAMAGE IF FOUND. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION.

NO

REPAIR SHORT TO VOLTAGE IN CKT 884.

NO

REPAIR SHORT TO VOLTAGE IN CKT 885.

NO

DIAGNOSIS CONTINUED ON PAGE 2 OF 3 OF THIS DTC CHART.

NO

DIAGNOSIS CONTINUED ON PAGE 3 OF 3 OF THIS DTC CHART.

YES

6
- IGNITION "OFF."
- INSPECT TERMINALS "A2" AND "A1" OF THE 32-WAY EBTCM HARNESS CONNECTOR FOR POOR TERMINAL CONTACT AND CONTAMINATION. ALSO INSPECT CKTs 884 AND 885 FOR DAMAGE WHICH MAY RESULT IN AN OPEN CIRCUIT, SHORT TO GROUND, OR SHORT TO VOLTAGE. REPAIR ALL DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- IGNITION "ON."

DOES DTC 34 SET AS A CURRENT DTC?

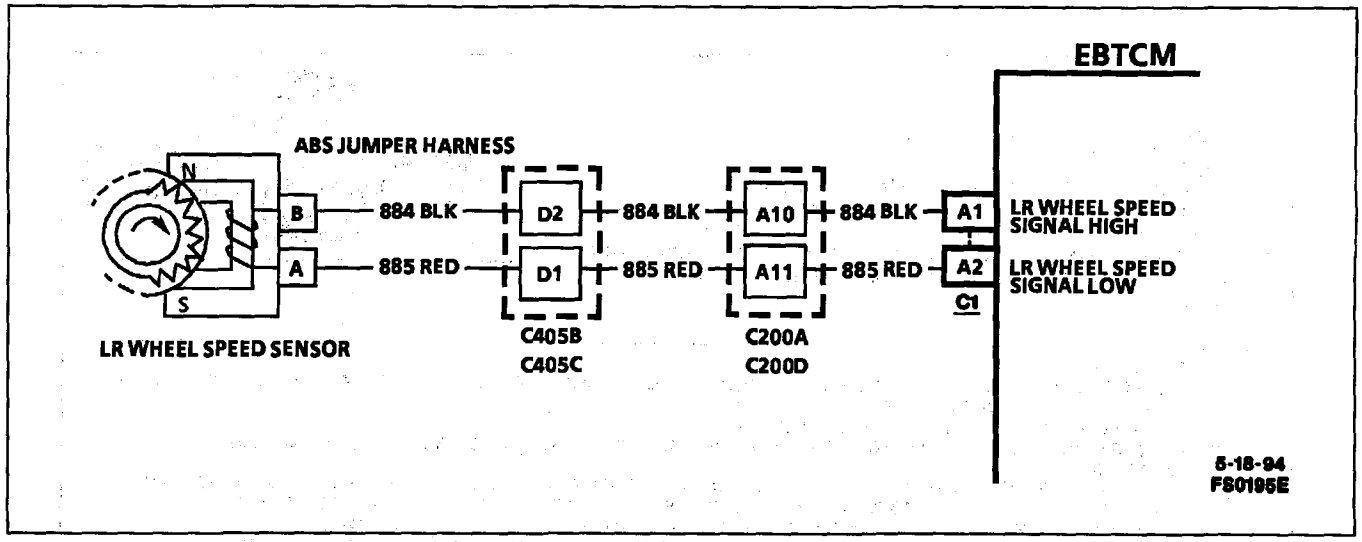
YES

REPLACE EBTCM.

NO

MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

C0114S



DTC 34
(Page 2 of 3)
LR WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 34 can be set anytime after initialization. If either of the left rear wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

7. Checks for high resistance in CKT 885.
8. Checks for high resistance in CKT 884.
9. Verifies proper resistance of the wheel speed sensor coil.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS or TCS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 34

(Page 2 of 3)

LR WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

DIAGNOSIS CONTINUED FROM PAGE 1 OF 3 OF THIS DTC CHART.

7. • DISCONNECT LEFT REAR WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A2" OF THE 32-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "A" OF THE LEFT REAR WHEEL SPEED SENSOR HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?

   YES

8. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A1" OF THE 32-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "B" OF THE LEFT REAR WHEEL SPEED SENSOR HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?

   YES

9. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE LEFT REAR WHEEL SPEED SENSOR CONNECTOR.
   IS RESISTANCE BETWEEN 2579 AND 3315Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF SENSOR IS SUSPECTED TO BE OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

   YES

MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN HIGH RESISTANCE WHEN ALL COMPONENTS ARE CONNECTED. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION. REPAIR ALL DAMAGE IF FOUND.

NO

REPLACE WHEEL SPEED SENSOR.

NO

REPAIR HIGH RESISTANCE IN CKT 885 (WHEEL SPEED SENSOR JUMPER MUST BE REPLACED IF DAMAGED).

NO

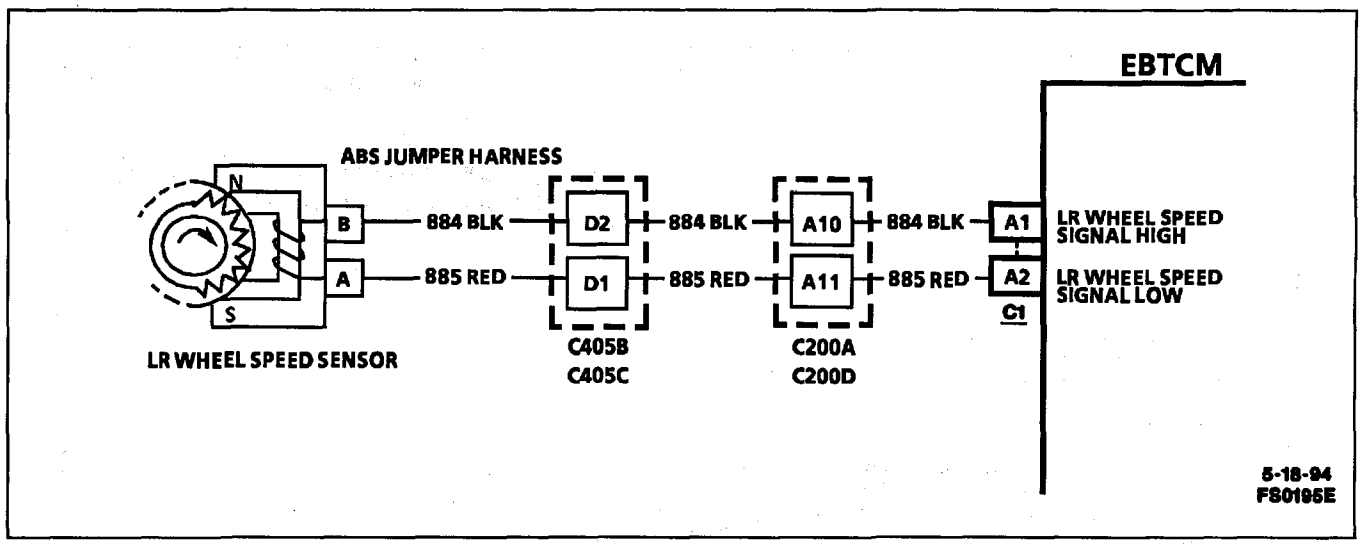
REPAIR HIGH RESISTANCE IN CKT 884 (WHEEL SPEED SENSOR JUMPER MUST BE REPLACED IF DAMAGED).

REAR WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	2032 TO 3107
5 TO 43	41 TO 110	2417 TO 3615
44 TO 93	111 TO 200	2812 TO 4266

C0115S



DTC 34
(Page 3 of 3)
LR WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 34 can be set anytime after initialization. If either of the left rear wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

10. Checks for a short to ground in CKT 885.
11. Checks for a short to ground in CKT 884.
12. Checks for a short to ground in the wheel speed sensor jumper harness.
13. Verifies that the wheel speed sensor is not internally shorted to ground.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

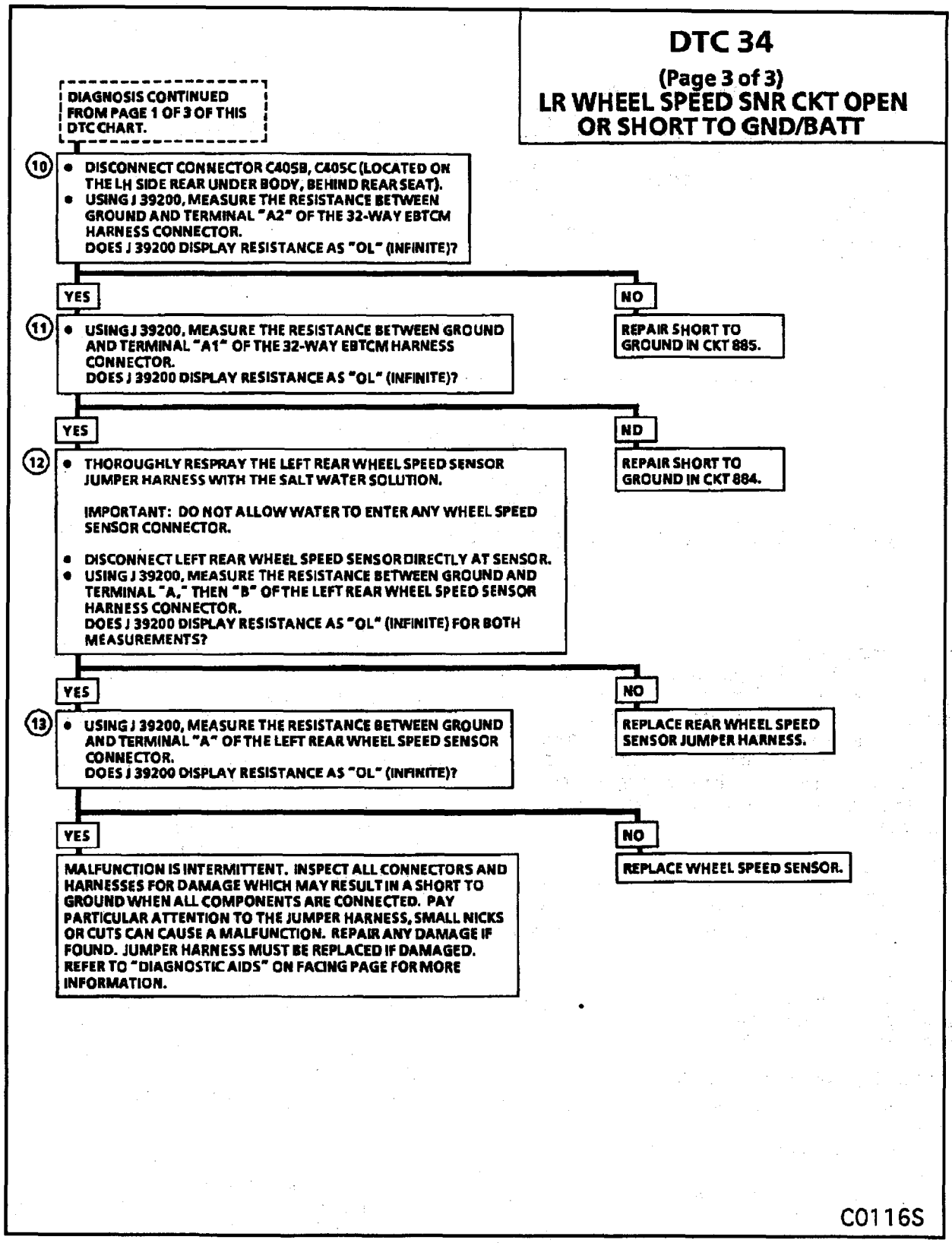
The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

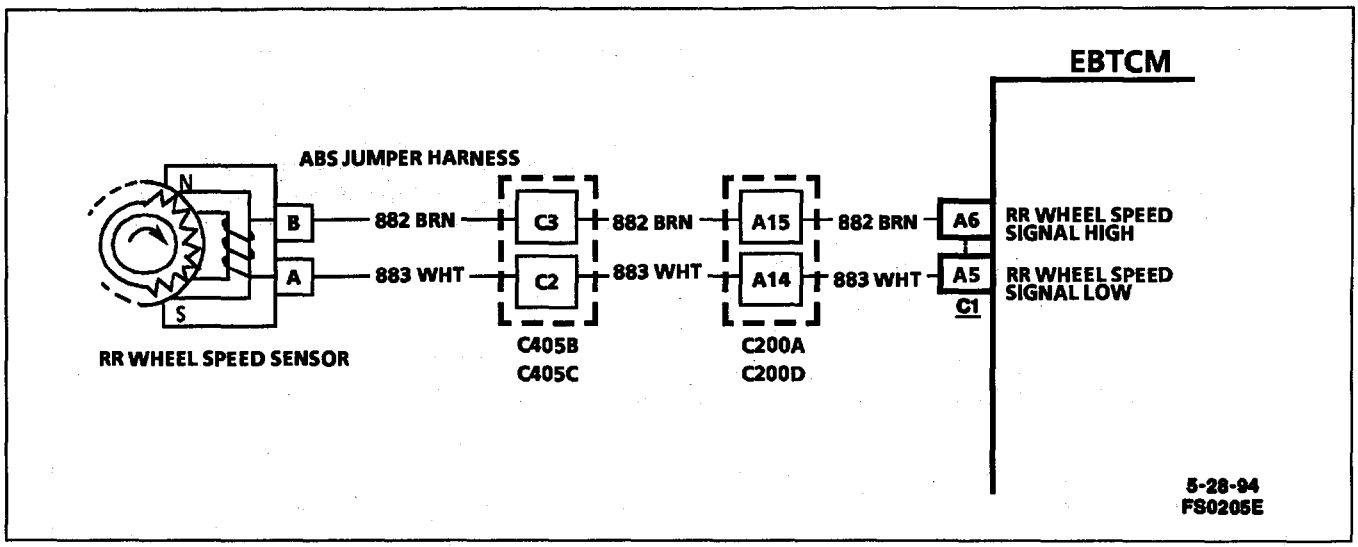
If the customer's comments reflect that the ABS or TCS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.


DTC 34
(Page 3 of 3)
LR WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT
DIAGNOSIS CONTINUED FROM PAGE 1 OF 3 OF THIS DTC CHART.
10
• DISCONNECT CONNECTOR C405B, C405C (LOCATED ON THE LH SIDE REAR UNDER BODY, BEHIND REAR SEAT).
• USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A2" OF THE 32-WAY EBTCM HARNESS CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
YES
NO
REPAIR SHORT TO GROUND IN CKT 885.
11
• USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A1" OF THE 32-WAY EBTCM HARNESS CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
YES
NO
REPAIR SHORT TO GROUND IN CKT 884.
12
• THOROUGHLY RESPRAY THE LEFT REAR WHEEL SPEED SENSOR JUMPER HARNESS WITH THE SALT WATER SOLUTION.
IMPORTANT: DO NOT ALLOW WATER TO ENTER ANY WHEEL SPEED SENSOR CONNECTOR.
• DISCONNECT LEFT REAR WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A," THEN "B" OF THE LEFT REAR WHEEL SPEED SENSOR HARNESS CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE) FOR BOTH MEASUREMENTS?
YES
NO
REPLACE REAR WHEEL SPEED SENSOR JUMPER HARNESS.
13
• USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A" OF THE LEFT REAR WHEEL SPEED SENSOR CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
YES
NO
REPLACE WHEEL SPEED SENSOR.
MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN A SHORT TO GROUND WHEN ALL COMPONENTS ARE CONNECTED. PAY PARTICULAR ATTENTION TO THE JUMPER HARNESS, SMALL NICKS OR CUTS CAN CAUSE A MALFUNCTION. REPAIR ANY DAMAGE IF FOUND. JUMPER HARNESS MUST BE REPLACED IF DAMAGED. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION.
C0116S



DTC 35
(Page 1 of 3)
RR WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 35 can be set anytime after initialization. If either of the right rear wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for proper resistance of the wheel speed sensor coil.
2. Checks for a short to ground in the wheel speed sensor wiring.
3. Checks for a short to voltage in the wheel speed sensor wiring.
4. Checks for a short to voltage in CKT 883.
5. Checks for a short to voltage in CKT 882.
6. Ensures that the malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS or TCS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 35

(Page 1 of 3)

RR WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Important

- WHEEL SPEED SENSOR INTERMITTENT MALFUNCTIONS MAY BE DIFFICULT TO LOCATE. CARE SHOULD BE TAKEN NOT TO DISTURB ANY ELECTRICAL CONNECTIONS PRIOR TO AN INDICATED STEP OF THIS CHART. THIS WILL ENSURE THAT AN INTERMITTENT CONNECTION WILL NOT BE CORRECTED BEFORE THE SOURCE OF THE MALFUNCTION IS FOUND.

1
- IGNITION "OFF."
- USING A 5% SALT WATER SOLUTION (TWO TEASPOONS OF SALT TO 12 OZ. WATER), THOROUGHLY SPRAY THE RIGHT REAR WHEEL SPEED SENSOR JUMPER HARNESS.
- DISCONNECT 32-WAY EBTCM HARNESS CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINALS "A5" AND "A6" OF THE 32-WAY EBTCM HARNESS CONNECTOR.
  IS RESISTANCE BETWEEN 2579 AND 3315Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF SENSOR IS SUSPECTED TO BE OTHER THAN 20°C (68°F), REFER TO THE TABLE ON PAGE 2 OF 2 OF THIS DTC CHART FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

YES

2
- USING J 39200 MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A5" OF THE 32-WAY EBTCM HARNESS CONNECTOR. DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

NO

DIAGNOSIS CONTINUED ON PAGE 2 OF 3 OF THIS DTC CHART.

YES

3
- IGNITION "ON."
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A5" OF THE 32-WAY EBTCM HARNESS CONNECTOR. IS VOLTAGE 1 VOLT OR LESS?

NO

DIAGNOSIS CONTINUED ON PAGE 3 OF 3 OF THIS DTC CHART.

NO

4
- IGNITION "OFF."
- DISCONNECT RIGHT REAR WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
- IGNITION "ON."
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A5" OF THE 32-WAY EBTCM HARNESS CONNECTOR. IS VOLTAGE 1 VOLT OR LESS?

YES

5
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A6" OF THE 32-WAY EBTCM HARNESS CONNECTOR. IS VOLTAGE 1 VOLT OR LESS?

YES

MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WHEN ALL COMPONENTS ARE CONNECTED. REPAIR ALL DAMAGE IF FOUND. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION.

NO

REPAIR SHORT TO VOLTAGE IN CKT 882.

NO

REPAIR SHORT TO VOLTAGE IN CKT 883.

YES

6
- IGNITION "OFF."
- INSPECT TERMINALS "A5" AND "A6" OF THE 32-WAY EBTCM HARNESS CONNECTOR FOR POOR TERMINAL CONTACT AND CONTAMINATION. ALSO INSPECT CKTs 882 AND 883 FOR DAMAGE WHICH MAY RESULT IN AN OPEN CIRCUIT, SHORT TO GROUND, OR SHORT TO VOLTAGE. REPAIR ALL DAMAGE IF EVIDENT.
- RECONNECT ALL CONNECTORS.
- IGNITION "ON."
  DOES DTC 35 SET AS A CURRENT DTC?

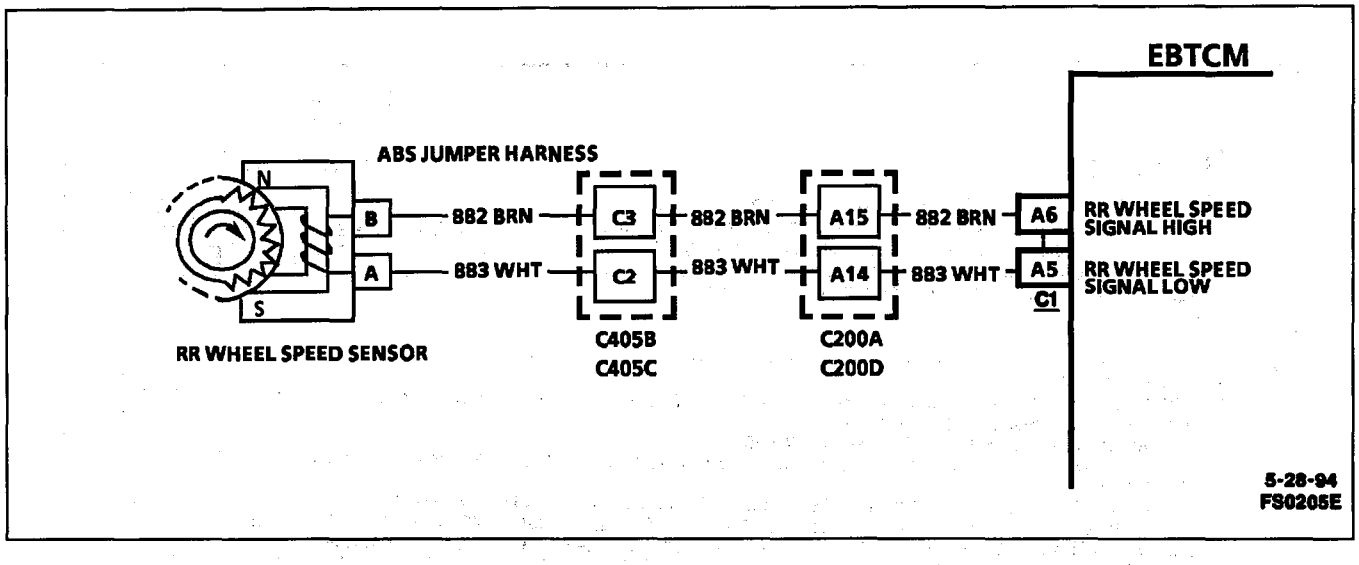
YES

REPLACE EBTCM.

NO

MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

C0117S



DTC 35
(Page 2 of 3)
RR WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal (AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 35 can be set anytime after initialization. If either of the right rear wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

7. Checks for high resistance in CKT 883.
8. Checks for high resistance in CKT 882.
9. Verifies proper resistance of the wheel speed sensor coil.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the customer's comments reflect that the ABS or TCS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water).Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.

DTC 35

(Page 2 of 3)

RR WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

DIAGNOSIS CONTINUED FROM PAGE 1 OF 3 OF THIS DTC CHART.

7. • DISCONNECT RIGHT REAR WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A5" OF THE 32-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "A" OF THE RIGHT REAR WHEEL SPEED SENSOR HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?

   YES

8. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A6" OF THE 32-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "B" OF THE RIGHT REAR WHEEL SPEED SENSOR HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?

   YES

9. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE RIGHT REAR WHEEL SPEED SENSOR CONNECTOR.
   IS RESISTANCE BETWEEN 2579 AND 3315Ω WHEN SENSOR IS 20°C (68°F)? *(IF TEMPERATURE OF SENSOR IS SUSPECTED TO BE OTHER THAN 20°C (68°F), REFER TO THE TABLE BELOW FOR APPLICABLE SENSOR RESISTANCE VALUES; THE VALUES IN THE TABLE ARE FOR TEMPERATURE OF THE SENSOR, NOT AIR TEMPERATURE.)*

   YES

MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN HIGH RESISTANCE WHEN ALL COMPONENTS ARE CONNECTED. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION. REPAIR ALL DAMAGE IF FOUND.

NO (from 7): REPAIR HIGH RESISTANCE IN CKT 883 (WHEEL SPEED SENSOR JUMPER MUST BE REPLACED IF DAMAGED).

NO (from 8): REPAIR HIGH RESISTANCE IN CKT 882 (WHEEL SPEED SENSOR JUMPER MUST BE REPLACED IF DAMAGED).

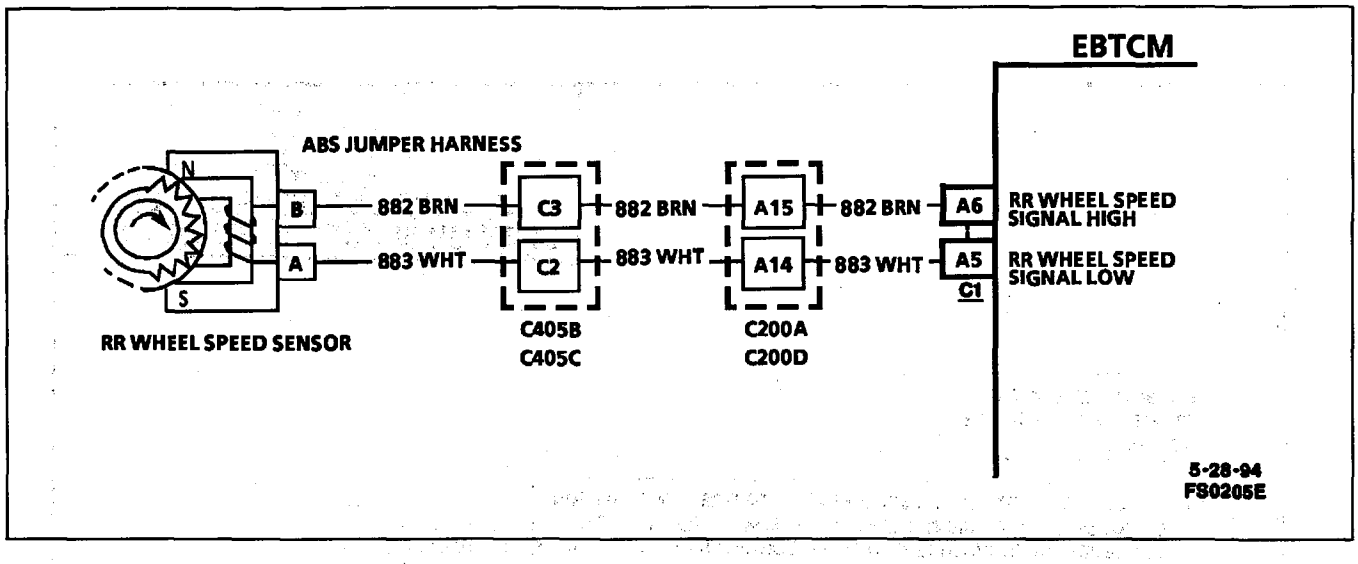
NO (from 9): REPLACE WHEEL SPEED SENSOR.

REAR WHEEL SPEED SENSOR

TEMPERATURE OF SENSOR VS. SENSOR RESISTANCE (APPROXIMATE)

TEMP. (°C)	TEMP. (°F)	RESISTANCE (OHMS)
-34 TO 4	-30 TO 40	2032 TO 3107
5 TO 43	41 TO 110	2417 TO 3615
44 TO 93	111 TO 200	2812 TO 4266

C0118S



DTC 35
(Page 3 of 3)
RR WHEEL SPEED SNR CKT OPEN OR SHORT TO GND/BATT

Circuit Description:

As a toothed ring passes by the wheel speed sensor, changes in the electromagnetic field cause the wheel speed sensor to produce a sinusoidal(AC) voltage signal whose frequency is proportional to wheel speed. The magnitude of this signal is directly related to wheel speed and the proximity of the wheel speed sensor to the toothed ring, often referred to as the air gap.

DTC Will Set When:

DTC 35 can be set anytime after initialization. If either of the right rear wheel speed circuits are open or shorted to voltage or ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

10. Checks for a short to ground in CKT 883.
11. Checks for a short to ground in CKT 882.
12. Checks for a short to ground in the wheel speed sensor jumper harness.
13. Verifies that the wheel speed sensor is not internally shorted to ground.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

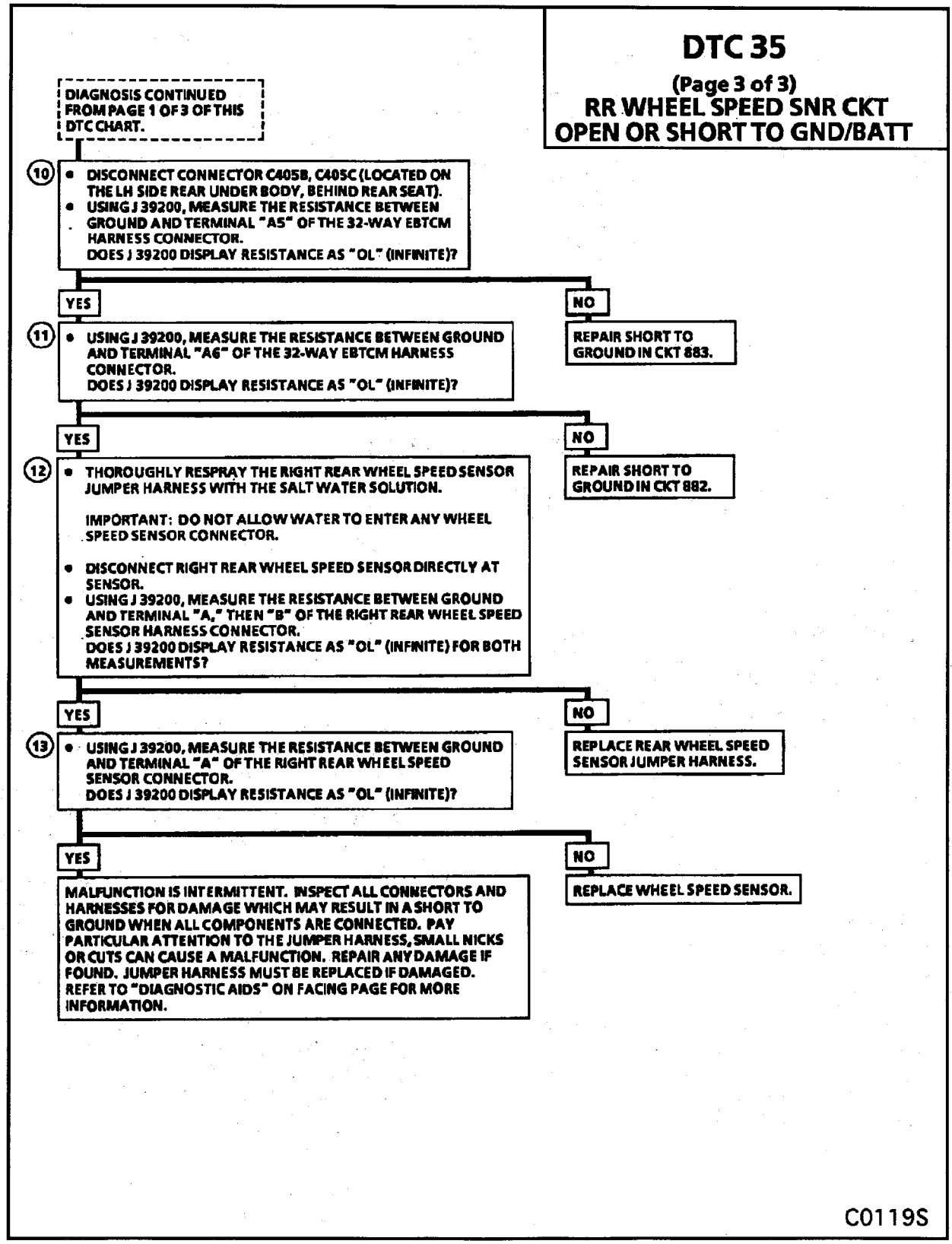
The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

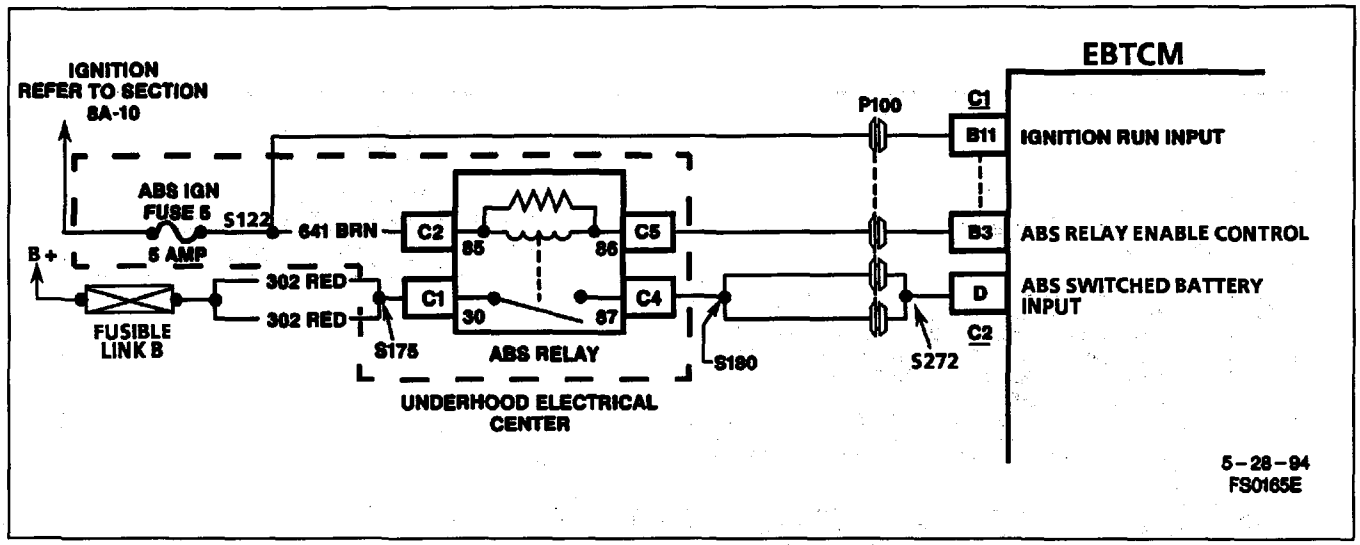
If the customer's comments reflect that the ABS or TCS warning lamps are "ON" only during moist environmental changes (rain, snow, vehicle wash), all wheel speed sensor circuitry should be thoroughly inspected for signs of water intrusion. If DTC is not current, clear DTCs and simulate the effects of water intrusion. Use the following procedure. Spray the suspected area with a 5% salt water solution (two teaspoons of salt to 12 oz. of water). Test drive vehicle over various road surfaces (bumps, turns, etc.) above 24 km/h (15 mph) for at least 30 seconds. If DTC returns, replace suspected harness.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

Resistance of the wheel speed sensor will increase with an increase in sensor temperature.

When replacing a wheel speed sensor, inspect the sensor terminals and harness connector for corrosion and/or water intrusion. If evidence of corrosion or water intrusion exists, replace wheel speed sensor jumper harness. Likewise, if replacing a wheel speed sensor jumper harness, inspect sensor terminals. If evidence of corrosion or water intrusion exists, replace wheel speed sensor. Refer to "On-Vehicle Service" in this section.


DTC 35
(Page 3 of 3)
RR WHEEL SPEED SNR CKT
OPEN OR SHORT TO GND/BATT
DIAGNOSIS CONTINUED FROM PAGE 1 OF 3 OF THIS DTC CHART.
10
• DISCONNECT CONNECTOR C405B, C405C (LOCATED ON THE LH SIDE REAR UNDER BODY, BEHIND REAR SEAT).
• USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A5" OF THE 32-WAY EBTCM HARNESS CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
YES
NO
REPAIR SHORT TO GROUND IN CKT 883.
11
• USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A6" OF THE 32-WAY EBTCM HARNESS CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
YES
NO
REPAIR SHORT TO GROUND IN CKT 882.
12
• THOROUGHLY RESPRAY THE RIGHT REAR WHEEL SPEED SENSOR JUMPER HARNESS WITH THE SALT WATER SOLUTION.
IMPORTANT: DO NOT ALLOW WATER TO ENTER ANY WHEEL SPEED SENSOR CONNECTOR.
• DISCONNECT RIGHT REAR WHEEL SPEED SENSOR DIRECTLY AT SENSOR.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A," THEN "B" OF THE RIGHT REAR WHEEL SPEED SENSOR HARNESS CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE) FOR BOTH MEASUREMENTS?
YES
NO
REPLACE REAR WHEEL SPEED SENSOR JUMPER HARNESS.
13
• USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A" OF THE RIGHT REAR WHEEL SPEED SENSOR CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
YES
NO
REPLACE WHEEL SPEED SENSOR.
MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS AND HARNESSES FOR DAMAGE WHICH MAY RESULT IN A SHORT TO GROUND WHEN ALL COMPONENTS ARE CONNECTED. PAY PARTICULAR ATTENTION TO THE JUMPER HARNESS, SMALL NICKS OR CUTS CAN CAUSE A MALFUNCTION. REPAIR ANY DAMAGE IF FOUND. JUMPER HARNESS MUST BE REPLACED IF DAMAGED. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE FOR MORE INFORMATION.
C0119S



DTC 36
(Page 1 of 2)
LOW SYSTEM VOLTAGE

Circuit Description:

This DTC is used to monitor the voltage level available to the EBTCM. If the voltage drops below 11.5 volts, full performance of the ABS system cannot be guaranteed. During ABS operation, there are several current requirements that will cause battery voltage to drop. Because of this, voltage is monitored prior to ABS to indicate good charging system condition and also during ABS when voltage may drop significantly.

DTC Will Set When:

DTC 36 can only be set if the vehicle's speed is greater than 5 km/h (3 mph). If the switched battery voltage is less than 11.5 volts non-ABS or less than 9.0 volts ABS, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled and the ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks to see what voltage is readily available at terminal "D" of the EBTCM. If voltage is representative of good charging system condition, a malfunction is not present.
2. Isolates the condition to high circuit resistance, or improper charging system operation.
3. Isolates which circuit is the source of the low voltage condition.
4. Checks for high resistance in CKT 302.

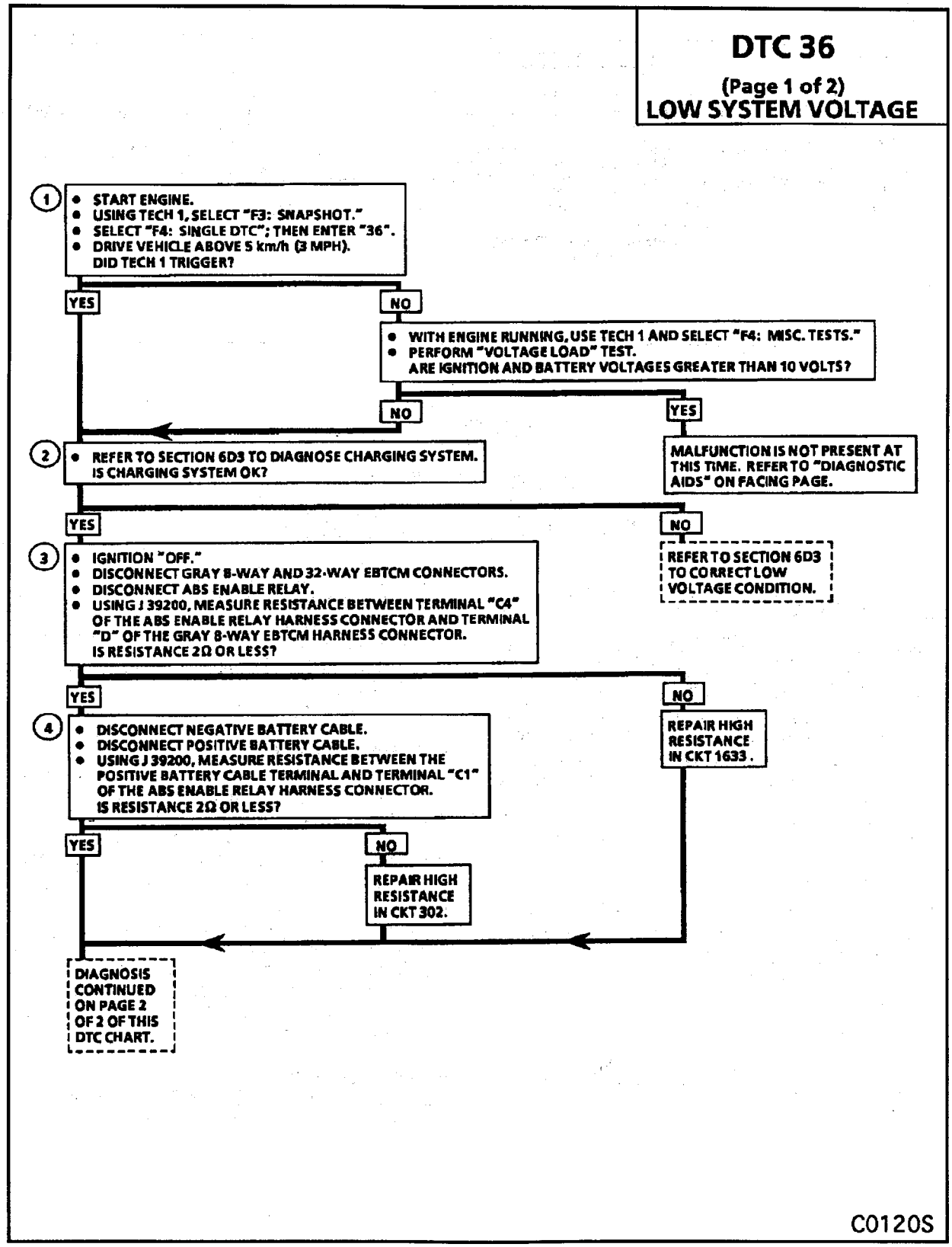
Diagnostic Aids:

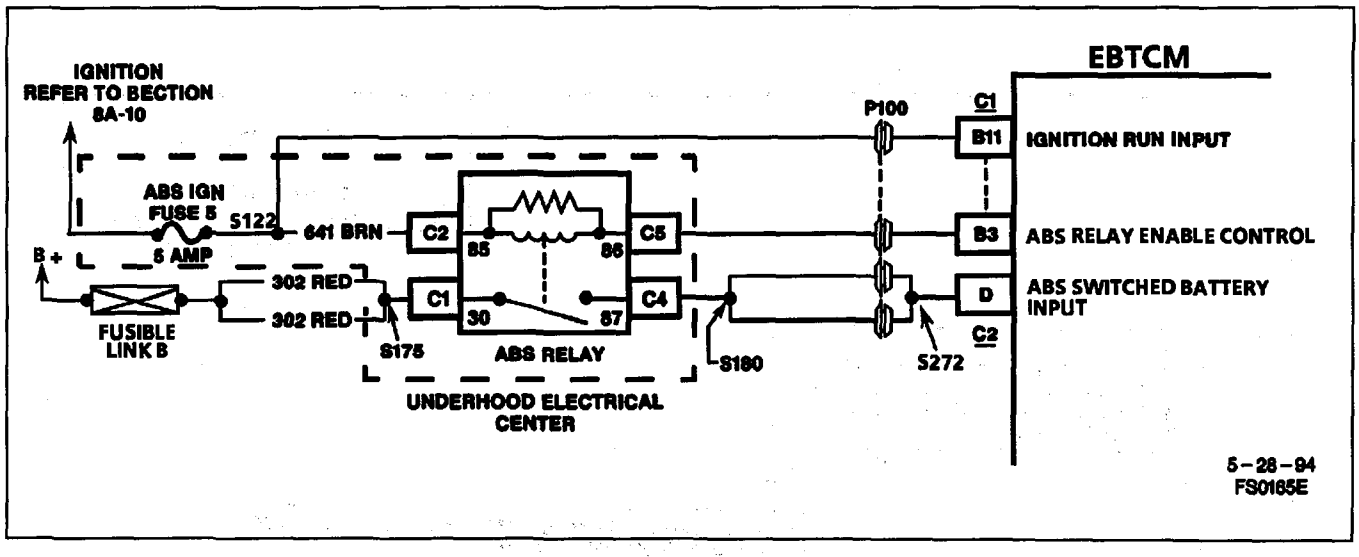
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

While performing a voltage load test, if it is noted that only ignition voltage drops below acceptable voltage levels, CKT 641 should be checked for high resistance or an open condition.


DTC 36
(Page 1 of 2)
LOW SYSTEM VOLTAGE
1
• START ENGINE.
• USING TECH 1, SELECT "F3: SNAPSHOT."
• SELECT "F4: SINGLE DTC"; THEN ENTER "36".
• DRIVE VEHICLE ABOVE 5 km/h (3 MPH).
DID TECH 1 TRIGGER?
YES
NO
• WITH ENGINE RUNNING, USE TECH 1 AND SELECT "F4: MISC. TESTS."
• PERFORM "VOLTAGE LOAD" TEST.
ARE IGNITION AND BATTERY VOLTAGES GREATER THAN 10 VOLTS?
NO
YES
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
2
• REFER TO SECTION 6D3 TO DIAGNOSE CHARGING SYSTEM.
IS CHARGING SYSTEM OK?
YES
NO
REFER TO SECTION 6D3 TO CORRECT LOW VOLTAGE CONDITION.
3
• IGNITION "OFF."
• DISCONNECT GRAY 8-WAY AND 32-WAY EBTCM CONNECTORS.
• DISCONNECT ABS ENABLE RELAY.
• USING J 39200, MEASURE RESISTANCE BETWEEN TERMINAL "C4" OF THE ABS ENABLE RELAY HARNESS CONNECTOR AND TERMINAL "D" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR.
IS RESISTANCE 2Ω OR LESS?
YES
NO
REPAIR HIGH RESISTANCE IN CKT 1633.
4
• DISCONNECT NEGATIVE BATTERY CABLE.
• DISCONNECT POSITIVE BATTERY CABLE.
• USING J 39200, MEASURE RESISTANCE BETWEEN THE POSITIVE BATTERY CABLE TERMINAL AND TERMINAL "C1" OF THE ABS ENABLE RELAY HARNESS CONNECTOR.
IS RESISTANCE 2Ω OR LESS?
YES
NO
REPAIR HIGH RESISTANCE IN CKT 302.
DIAGNOSIS CONTINUED ON PAGE 2 OF 2 OF THIS DTC CHART.
C0120S



DTC 36
(Page 2 of 2)
LOW SYSTEM VOLTAGE

Circuit Description:

This DTC is used to monitor the voltage level available to the EBTCM controller. If the voltage drops below 11.5 volts, full performance of the ABS system cannot be guaranteed. During ABS operation, there are several current requirements that will cause battery voltage to drop. Because of this, voltage is monitored prior to ABS to indicate good charging system condition and also during ABS when voltage may drop significantly.

DTC Will Set When:

DTC 36 can only be set if the vehicle's speed is greater than 5 km/h (3 mph). If the switched battery voltage is less than 11.5 volts non-ABS or less than 9.0 volts ABS, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is disabled and the ABS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

5. Checks for high resistance in CKT 641.
6. Checks for high resistance in the ignition fused feed circuit.
7. Checks for malfunctioning EBTCM.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

While performing a voltage load test, if it is noted that only ignition voltage drops below acceptable voltage levels, CKT 641 should be checked for high resistance or an open condition.

DTC 36

(Page 2 of 2)

LOW SYSTEM VOLTAGE

DIAGNOSIS CONTINUED FROM PAGE 1 OF 2 OF THIS DTC CHART.

(5)
- REMOVE ABS IGN FUSE 5.
- USING J 39200, MEASURE RESISTANCE BETWEEN EACH ABS IGN FUSE 5 BLOCK TERMINAL AND TERMINAL "B11" OF THE 32-WAY EBTCM HARNESS CONNECTOR. IS EITHER MEASUREMENT 2Ω OR LESS?

YES

(6)
- WITH BATTERY CABLES DISCONNECTED, TURN IGNITION "ON."
- USING J 39200, MEASURE RESISTANCE BETWEEN POSITIVE BATTERY CABLE TERMINAL AND EACH ABS IGN FUSE 5 BLOCK TERMINAL. IS EITHER MEASUREMENT 2Ω OR LESS ?

YES

(7)
- IGNITION "OFF."
- INSPECT ABS ENABLE RELAY AND ABS ENABLE RELAY HARNESS CONNECTOR FOR POOR TERMINAL CONTACT. INSPECT GRAY 8-WAY AND 32-WAY EBTCM HARNESS CONNECTORS FOR A POOR CONNECTION TO THE EBTCM. INSPECT POSITIVE BATTERY CABLE TERMINAL FOR POOR CONTACT TO THE BATTERY. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE TERMINALS IF POOR CONTACT IS EVIDENT.
- RECONNECT ALL CONNECTORS.
- DRIVE VEHICLE ABOVE 5 km/h (3 MPH). DOES DTC 36 SET AS A CURRENT DTC?

YES

REPLACE EBTCM.

NO

MALFUNCTION IS MOST LIKELY DUE TO A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

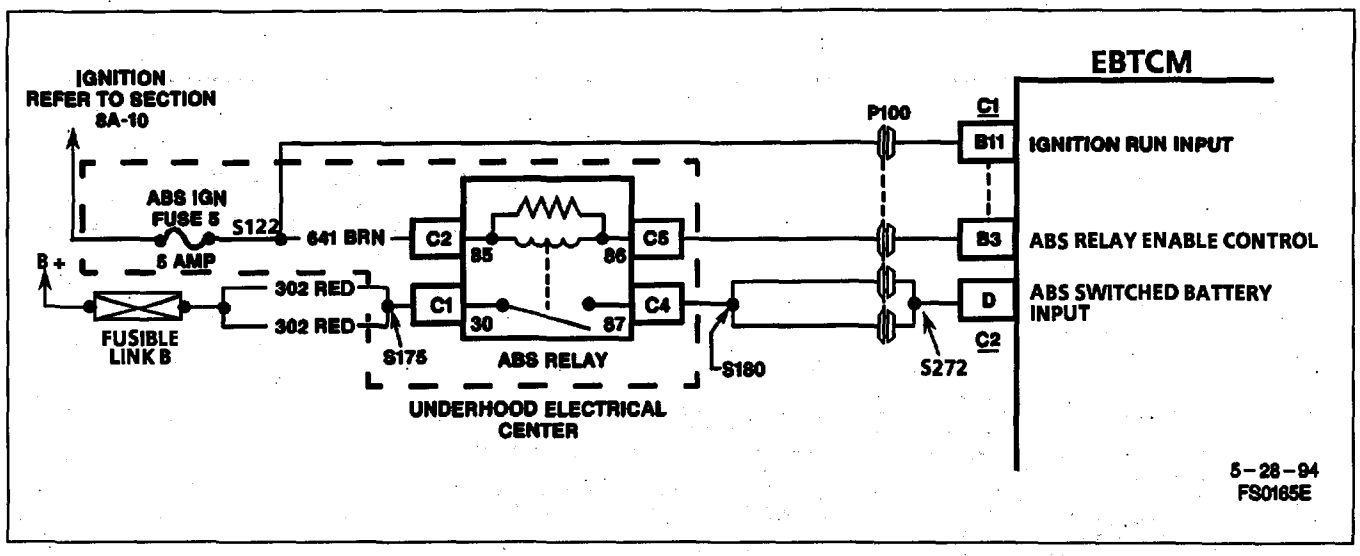
NO

REFER TO SECTION 8A TO REPAIR HIGH RESISTANCE IN THE "IGNITION SWITCH 'RUN' FUSE FEED" CIRCUIT.

NO

REPAIR HIGH RESISTANCE IN CKT 641.

C0121S



DTC 37
HIGH SYSTEM VOLTAGE

Circuit Description:

This DTC is designed to detect high vehicle voltage levels prior to any required motor movement (initialization or ABS/TCS). If excessive voltage exists, demagnetization of the motor magnets may occur, which would eventually affect or eliminate ABS/TCS performance.

DTC Will Set When:

DTC 37 can only be set if the vehicle's speed is greater than 5 km/h (3 mph). If the switched battery voltage is greater than 17 volts, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled and the ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks the voltage level being received by the EBTCM.
2. Checks to see if high voltage condition is due to charging system malfunction.
3. Checks for poor terminal contact which may cause an intermittent malfunction, or a malfunctioning EBTCM.

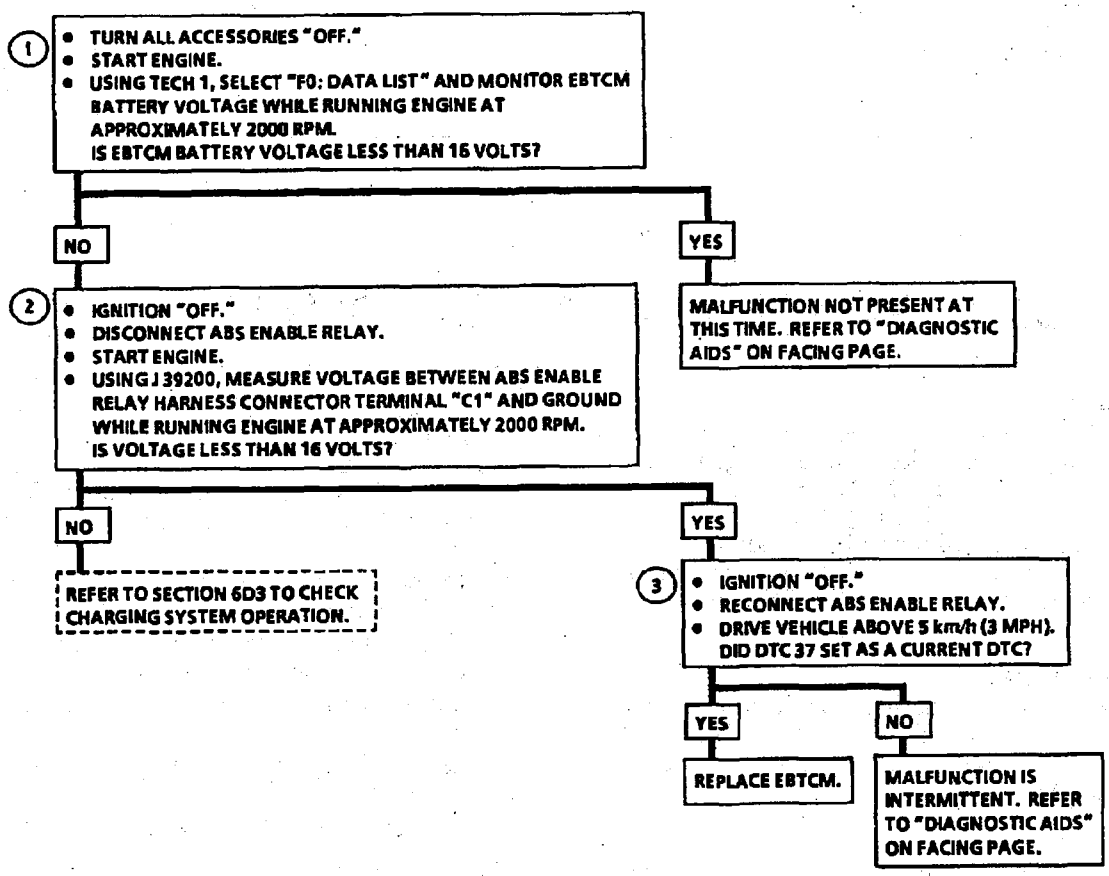
Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

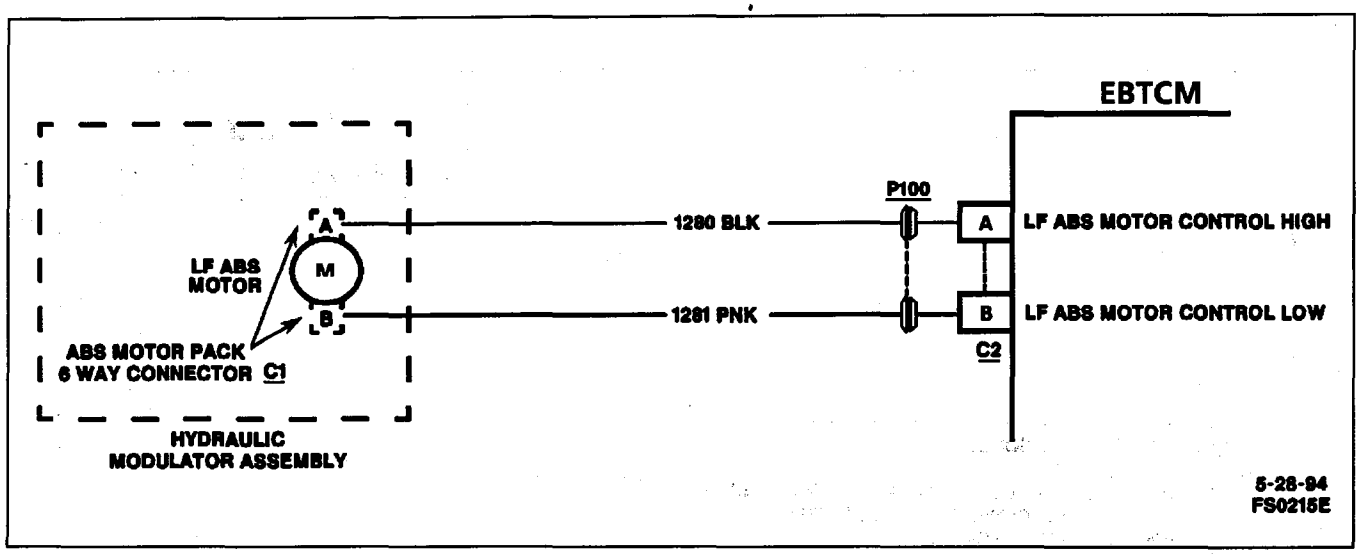
The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 37
HIGH SYSTEM VOLTAGE



C0122S



DTC 38
LEFT FRONT ESB WILL NOT HOLD MOTOR

Circuit Description:

This DTC is designed to detect a slipping left front ESB. During initialization and braking, the left front motor is re-homed. If the ESB slips, the motor/piston will move. During the next key to "RUN" initialization, a re-home of the motor verifies the motor/piston remained at the home position. If motor movement is detected, the ESB must be slipping.

DTC Will Set When:

DTC 38 can be set during initialization. If the EBTCM detects that the ESB could not hold the piston in the home position, a malfunction exists. DTC 86 is always set with DTC 38.

Action Taken:

If an ESB cannot hold a piston in the home position, the piston may be back driven when the brake pedal is applied, causing the brake pedal to drop. A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps and the red BRAKE warning lamp are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks the left front ESB. A broken or defective ESB would result in the left front piston being back driven by hydraulic pressure and pedal movement would result.
2. Checks for high resistance in the ABS motor "HIGH" circuitry.
3. This step checks for high resistance in the ABS motor "LOW" circuitry.
4. Checks for proper resistance of the ABS motor windings.
5. Checks for poor terminal contact or corrosion in the connectors.
6. Checks for a malfunctioning EBTCM.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

The static modulator test function of the Tech 1 or T-100 may be used to locate an intermittent malfunction associated with the ESB.

DTC 38
LEFT FRONT ESB WILL NOT HOLD MOTOR

1. • IGNITION "ON," ENGINE "OFF."
   • PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
   • USING TECH 1 MISC. TESTS, SELECT MANUAL CONTROL FUNCTION.
   • SELECT ABS MOTOR APPLY FUNCTION OF THE LEFT FRONT CHANNEL AND APPLY THE MOTOR.
   • WAIT 5 SECONDS.
   • APPLY FIRM PRESSURE ON BRAKE PEDAL.
   DID BRAKE PEDAL FALL?
   - YES → REPLACE ABS MOTOR PACK.
   - NO →

2. • EXIT TECH 1 MANUAL CONTROL FUNCTION
   • IGNITION "OFF."
   • DISCONNECT 6-WAY ABS MOTOR PACK CONNECTOR AND GRAY 8-WAY EBTCM CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "A" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPAIR HIGH RESISTANCE IN CKT 1280.
   - YES →

3. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "B" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "B" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPAIR HIGH RESISTANCE IN CKT 1281.
   - YES →

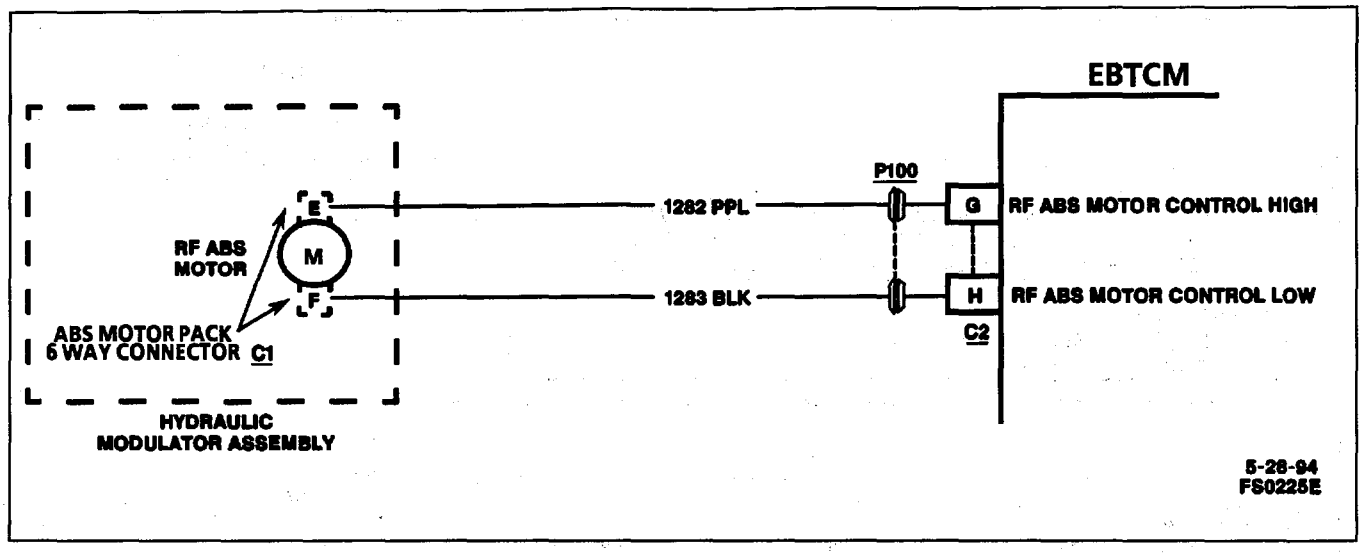
4. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE MOTOR PACK CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPLACE ABS MOTOR PACK.
   - YES →

5. • INSPECT THE 6-WAY ABS MOTOR PACK CONNECTOR AND GRAY 8-WAY EBTCM CONNECTOR FOR POOR TERMINAL CONTACT OR CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT."
   DO ANY TERMINALS EXHIBIT POOR CONTACT OR EVIDENCE OF CORROSION?
   - YES → REPLACE TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION.
   - NO →

6. • IGNITION "OFF."
   • RECONNECT ALL CONNECTORS.
   • START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
   • REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
   DOES DTC 38 SET IN THE LAST THREE DRIVE CYCLE?
   - YES → REPLACE EBTCM.
   - NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY OFF.

C1580S



DTC 41
RIGHT FRONT ESB WILL NOT HOLD MOTOR

Circuit Description:

This DTC is designed to detect a slipping right front ESB. During initialization and braking, the right front motor is re-homed. If the ESB slips, the motor/piston will move. During the next key "ON" initialization, a re-home of the motor verifies the motor/piston remained at the home position. If motor movement is detected, the ESB must be slipping.

DTC Will Set When:

DTC 41 can be set during initialization. If the EBTCM detects that the ESB could not hold the piston in the home position, a malfunction exists. DTC 86 is always set with DTC 41.

Action Taken:

If an ESB cannot hold a piston in the home position, the piston may be back driven when the brake pedal is applied, causing the brake pedal to drop. A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps and the red BRAKE warning lamp are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

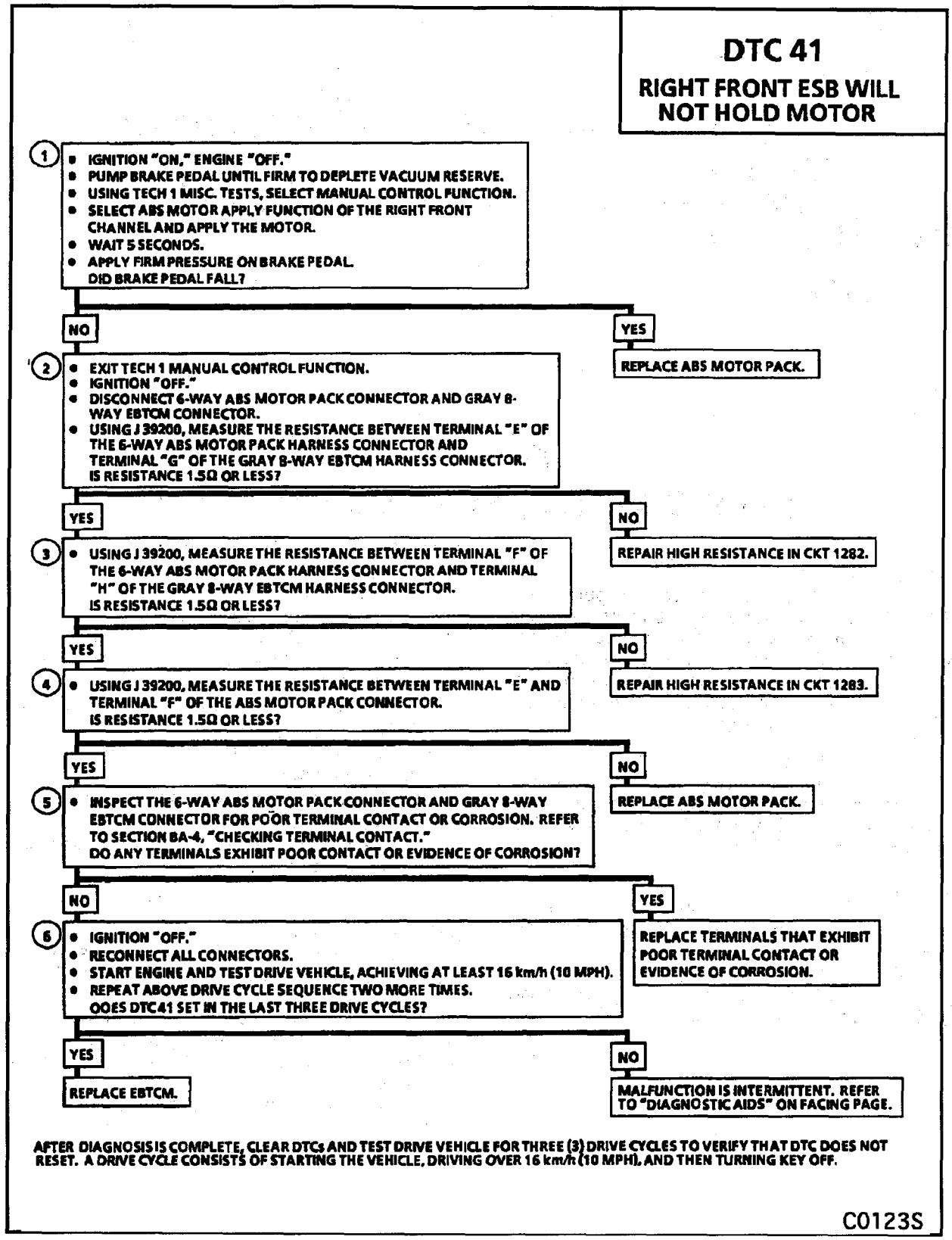
1. Checks the right front ESB. A broken or defective ESB would result in the right front piston being back driven by hydraulic pressure, and pedal movement would result.
2. Checks for high resistance in the ABS motor "HIGH" circuitry.
3. This step checks for high resistance in the ABS motor "LOW" circuitry.
4. Checks for proper resistance of the ABS motor windings.
5. Checks for poor terminal contact or corrosion in the connectors.
6. Checks for a malfunctioning EBTCM.

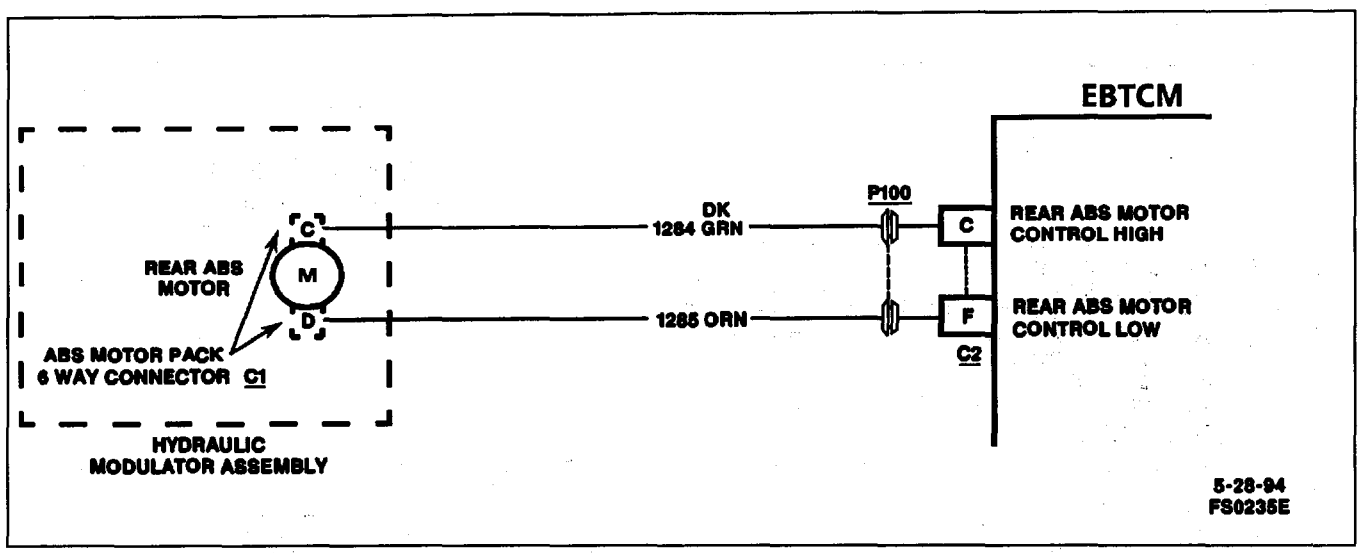
Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

The static modulator test function of the Tech 1 or T-100 may be used to locate an intermittent malfunction associated with the ESB.


DTC 41
RIGHT FRONT ESB WILL NOT HOLD MOTOR
1
• IGNITION "ON," ENGINE "OFF."
• PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
• USING TECH 1 MISC. TESTS, SELECT MANUAL CONTROL FUNCTION.
• SELECT ABS MOTOR APPLY FUNCTION OF THE RIGHT FRONT CHANNEL AND APPLY THE MOTOR.
• WAIT 5 SECONDS.
• APPLY FIRM PRESSURE ON BRAKE PEDAL.
DID BRAKE PEDAL FALL?
NO
YES
REPLACE ABS MOTOR PACK.
2
• EXIT TECH 1 MANUAL CONTROL FUNCTION.
• IGNITION "OFF."
• DISCONNECT 6-WAY ABS MOTOR PACK CONNECTOR AND GRAY 8-WAY EBTCM CONNECTOR.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "E" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "G" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR.
IS RESISTANCE 1.5Ω OR LESS?
YES
NO
REPAIR HIGH RESISTANCE IN CKT 1282.
3
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "F" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "H" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR.
IS RESISTANCE 1.5Ω OR LESS?
YES
NO
REPAIR HIGH RESISTANCE IN CKT 1283.
4
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "E" AND TERMINAL "F" OF THE ABS MOTOR PACK CONNECTOR.
IS RESISTANCE 1.5Ω OR LESS?
YES
NO
REPLACE ABS MOTOR PACK.
5
• INSPECT THE 6-WAY ABS MOTOR PACK CONNECTOR AND GRAY 8-WAY EBTCM CONNECTOR FOR POOR TERMINAL CONTACT OR CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT."
DO ANY TERMINALS EXHIBIT POOR CONTACT OR EVIDENCE OF CORROSION?
NO
YES
REPLACE TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION.
6
• IGNITION "OFF."
• RECONNECT ALL CONNECTORS.
• START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
• REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
DOES DTC41 SET IN THE LAST THREE DRIVE CYCLES?
YES
NO
REPLACE EBTCM.
MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY OFF.
C0123S



DTC 42
REAR ESB WILL NOT HOLD MOTOR

Circuit Description:

This DTC is designed to detect a slipping rear axle ESB. During initialization and braking, the rear motor is re-homed. If the ESB slips, the motor/piston will move. During the next key "ON" initialization, a re-home of the motor verifies the motor/piston remained at the home position. If motor movement is detected, the ESB must be slipping.

DTC Will Set When:

DTC 42 can be set during initialization. If the EBTCM detects that the ESB could not hold the piston in the home position, a malfunction exists. DTC 86 is always set with DTC 42.

Action Taken:

If an ESB can hold a piston in the home position, the piston may be back driven when the brake pedal is applied, causing the brake pedal to drop. A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps and the red BRAKE warning lamp are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks the rear axle ESB. A broken or defective ESB would result in the rear axle pistons being back driven by hydraulic pressure and wheel movement would result.
2. Checks for high resistance in the ABS motor "HIGH" circuitry.
3. Checks for high resistance in the ABS motor "LOW" circuitry.
4. Checks for proper resistance of the ABS motor windings.
5. Checks for poor terminal contact or corrosion in the connectors.
6. Checks for a malfunctioning EBTCM.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

The static modulator test function of the Tech 1 or T-100 may be used to locate an intermittent malfunction associated with the ESB.

DTC 42
REAR ESB WILL NOT HOLD MOTOR

1. • RAISE THE VEHICLE SUCH THAT THE REAR WHEELS ARE APPROXIMATELY SIX INCHES OFF THE FLOOR.
   • IGNITION "ON," ENGINE "OFF."
   • PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
   • APPLY FIRM PRESSURE ON BRAKE PEDAL AND RELEASE.
   • REAPPLY VERY FIRM PRESSURE ON BRAKE PEDAL AND HAVE AN ASSISTANT TRY TO SPIN THE REAR WHEELS BY HAND.
   COULD ASSISTANT SPIN THE REAR WHEELS?
   - YES → REPLACE ABS MOTOR PACK.
   - NO →

2. • IGNITION "OFF."
   • DISCONNECT 6-WAY ABS MOTOR PACK CONNECTOR AND GRAY 8-WAY EBTCM CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "C" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPAIR HIGH RESISTANCE IN CKT 1284.
   - YES →

3. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "D" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "F" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPAIR HIGH RESISTANCE IN CKT 1285.
   - YES →

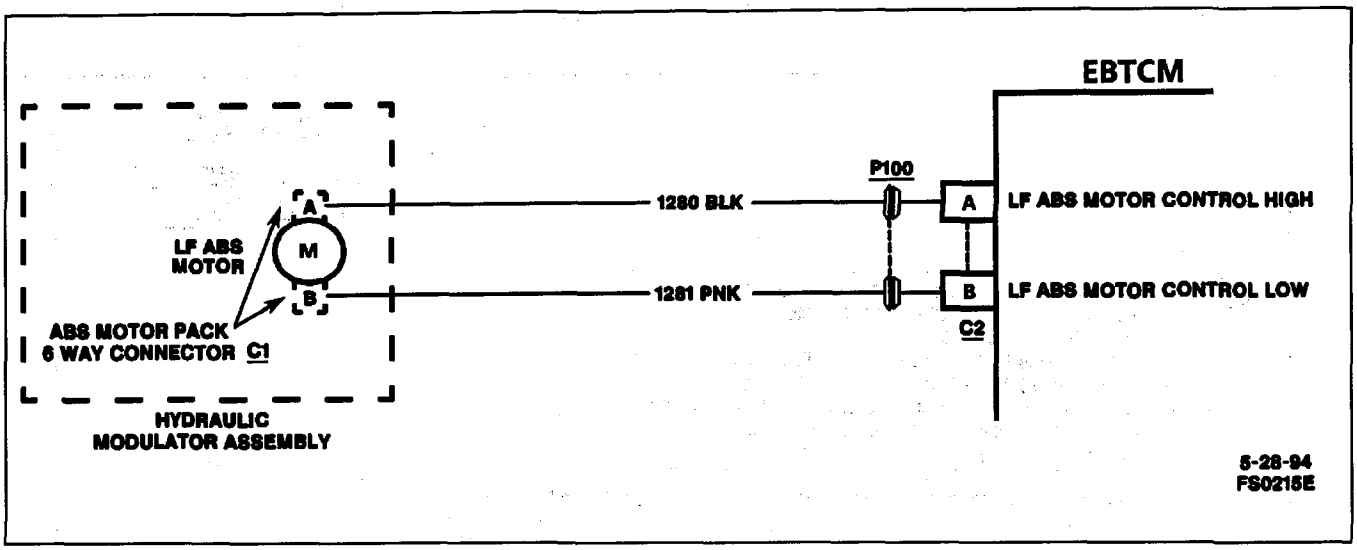
4. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C" AND TERMINAL "D" OF THE ABS MOTOR PACK CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPLACE ABS MOTOR PACK.
   - YES →

5. • INSPECT THE 6-WAY ABS MOTOR PACK CONNECTOR AND GRAY 8-WAY EBTCM CONNECTOR FOR POOR TERMINAL CONTACT OR CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT."
   DO ANY TERMINALS EXHIBIT POOR CONTACT OR EVIDENCE OF CORROSION?
   - YES → REPLACE TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION.
   - NO →

6. • IGNITION "OFF."
   • RECONNECT ALL CONNECTORS.
   • START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
   • REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
   DOES DTC 42 SET IN THE LAST THREE DRIVE CYCLES?
   - YES → REPLACE EBTCM.
   - NO → MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH) AND THEN TURNING KEY OFF.

C0124S



DTC 44
LEFT FRONT ABS CHANNEL WILL NOT MOVE

Circuit Description:

This DTC is designed to detect bound-up ESB, a stuck ABS motor, or a seized ABS hydraulic modulator. When the release is commanded during initialization, the ESB should release the ABS motor, resulting in sensed current being less than commanded current (motor is spinning freely). If the ABS motor is not moving, sensed current will be equal to stall current.

DTC Will Set When:

DTC 44 can be set during normal operation. If the EBTCM detects a condition in which it cannot move the motor in either direction, a malfunction exists.

Action Taken:

This malfunction indicates the channel cannot be moved properly. A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for proper ABS motor movement during apply and release commands from the Tech
2. Compares EBTCM command current to motor feedback current.
3. Checks for a shorted circuit between the ABS motor "HIGH" and ABS motor "LOW" circuits.
4. Checks for an ABS motor that is internally shorted.
5. Determines if the malfunction is caused by a defective EBTCM or poor terminal contact.
6. Verifies that the ABS motor can actually apply when commanded.
7. Checks for proper hydraulic modulator gear and piston movement.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. DTC 44 may set after modulator disassembly if the modulator pistons are positioned at the bottom of their bore.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 44
LEFT FRONT ABS CHANNEL WILL NOT MOVE

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

1
- IGNITION "ON," ENGINE "OFF."
- PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
- USING TECH 1 MISC. TESTS, SELECT MANUAL CONTROL FUNCTION.
- SELECT LEFT FRONT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR.
- APPLY FIRM PRESSURE ON BRAKE PEDAL.
- SELECT LEFT FRONT ABS MOTOR RELEASE FUNCTION AND RELEASE MOTOR.

DID BRAKE PEDAL FALL?

NO → **2**

YES → **6**
- MAINTAIN FIRM PRESSURE ON BRAKE PEDAL.
- SELECT LEFT FRONT MOTOR APPLY FUNCTION AND APPLY THE MOTOR.

DID BRAKE PEDAL RISE?

NO → **2**

YES → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

2
- REMOVE FOOT FROM BRAKE PEDAL.
- SELECT LEFT FRONT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR WHILE CAREFULLY OBSERVING THE COMMANDED CURRENT AND THE FEEDBACK CURRENT ON THE TECH 1.

WAS THE FEEDBACK CURRENT HIGHER THAN THE COMMANDED CURRENT?

YES → **3**

NO → **7**

3
- EXIT TECH 1 MANUAL CONTROL.
- IGNITION "OFF."
- DISCONNECT THE GRAY 8-WAY EBTCM CONNECTOR AND THE 6-WAY ABS MOTOR PACK CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

NO → **4**

NO → REPAIR SHORT BETWEEN CKT 1280 AND CKT 1281.

4
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE ABS MOTOR PACK CONNECTOR.

IS RESISTANCE 0.4Ω OR GREATER?

YES → **5**

NO → REPLACE ABS MOTOR PACK.

5
- IGNITION "OFF."
- RECONNECT ALL CONNECTORS.
- START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
- REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.

DOES DTC 44 SET IN THE LAST THREE DRIVE CYCLES?

YES → REPLACE EBTCM.

NO → MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS FOR CONTAMINATION AND POOR CONTACT. REPLACE ANY TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION.

7
- USING TECH 1 MISC. TESTS, PERFORM GEAR TENSION RELIEF FUNCTION.
- IGNITION "OFF."
- REMOVE HYDAULIC MODULATOR/MASTER CYLINDER ASSEMBLY FROM VEHICLE. REFER TO "ON VEHICLE SERVICE" IN THIS SECTION.
- SEPARATE ABS MOTOR PACK FROM HYDRAULIC MODULATOR.
- GRASP THE GEAR ON THE HYDRAULIC MODULATOR (THE HYDRAULIC MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS) FURTHEST FORWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE AND ATTEMPT TO MOVE THE GEAR.

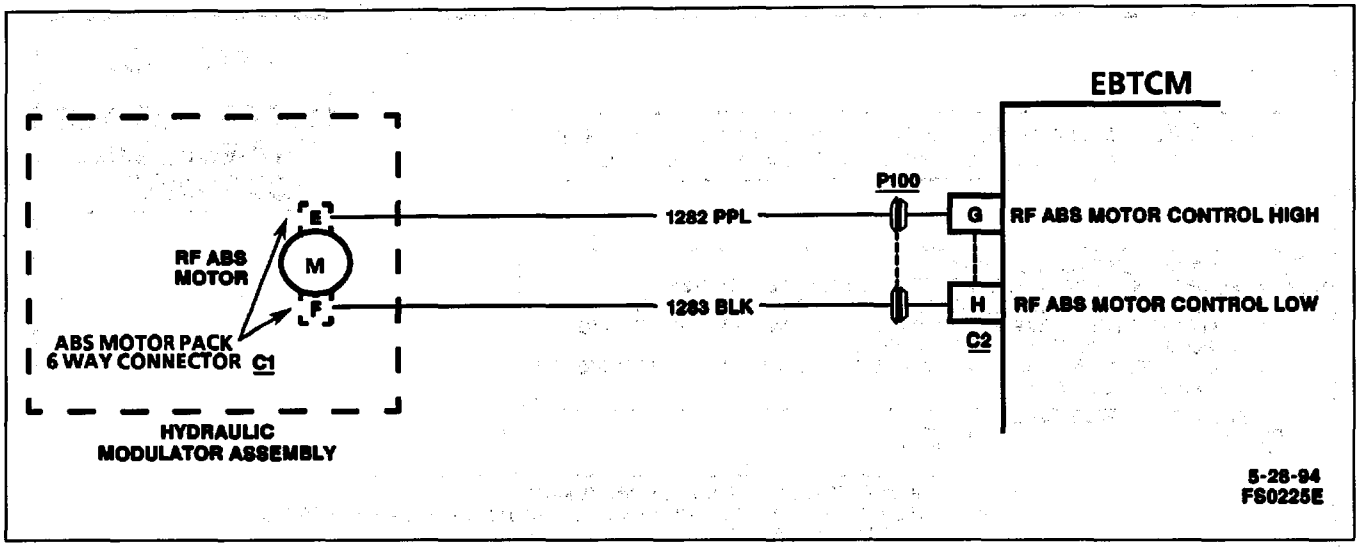
CAN THE GEAR BE ROTATED AT LEAST 10 FULL TURNS LOCK TO LOCK?

YES → REPLACE ABS MOTOR PACK.

NO → REPLACE HYDRAULIC MODULATOR.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN IGNITION OFF.

C2859S



DTC 45
RIGHT FRONT ABS CHANNEL WILL NOT MOVE

Circuit Description:

This DTC is designed to detect bound-up ESB, a stuck ABS motor, or a seized ABS hydraulic modulator. When the release is commanded during initialization, the ESB should release the ABS motor, resulting in sensed current being less than commanded current (motor is spinning freely). If the ABS motor is not moving, sensed current will be equal to stall current.

DTC Will Set When:

DTC 45 can be set during normal operation. If the EBTCM detects a condition in which it cannot move the ABS motor in either direction, a malfunction exists.

Action Taken:

This malfunction indicates the channel cannot be moved properly. A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for proper motor movement during apply and release commands from the Tech 1.
2. Compares EBTCM command current to motor feedback current.
3. Checks for shorted circuit between the ABS motor "HIGH" and ABS motor "LOW" circuits.
4. Checks for an ABS motor that is internally shorted.
5. Checks to see if malfunction is due to poor terminal contact or the EBTCM.
6. Verifies that the motor can actually apply when commanded.
7. Checks for proper hydraulic modulator gear and piston movement.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. DTC 45 may set after modulator disassembly if the modulator pistons are positioned at the bottom of their bore.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 45
RIGHT FRONT ABS CHANNEL WILL NOT MOVE

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

1. • IGNITION "ON," ENGINE "OFF."
   • PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
   • USING TECH 1 MISC. TESTS, SELECT MANUAL CONTROL FUNCTION.
   • SELECT RIGHT FRONT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR.
   • APPLY FIRM PRESSURE ON BRAKE PEDAL.
   • SELECT RIGHT FRONT ABS MOTOR RELEASE FUNCTION AND RELEASE MOTOR.
   DID BRAKE PEDAL FALL?
   - NO → 2
   - YES → 6

6. • MAINTAIN FIRM PRESSURE ON BRAKE PEDAL.
   • SELECT RIGHT FRONT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR.
   DID BRAKE PEDAL RISE?
   - NO → 2
   - YES → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

2. • REMOVE FOOT FROM BRAKE PEDAL.
   • SELECT RIGHT FRONT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR WHILE CAREFULLY OBSERVING THE COMMANDED CURRENT AND THE FEEDBACK CURRENT ON THE TECH 1.
   WAS THE FEEDBACK CURRENT HIGHER THAN THE COMMANDED CURRENT?
   - YES → 3
   - NO → 7

3. • EXIT TECH 1 MANUAL CONTROL FUNCTION.
   • IGNITION "OFF."
   • DISCONNECT THE GRAY 8-WAY EBTCM CONNECTOR AND THE 6-WAY ABS MOTOR PACK CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "G" AND TERMINAL "H" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
   - YES → 4
   - NO → REPAIR SHORT BETWEEN CKT 1282 AND CKT 1283.

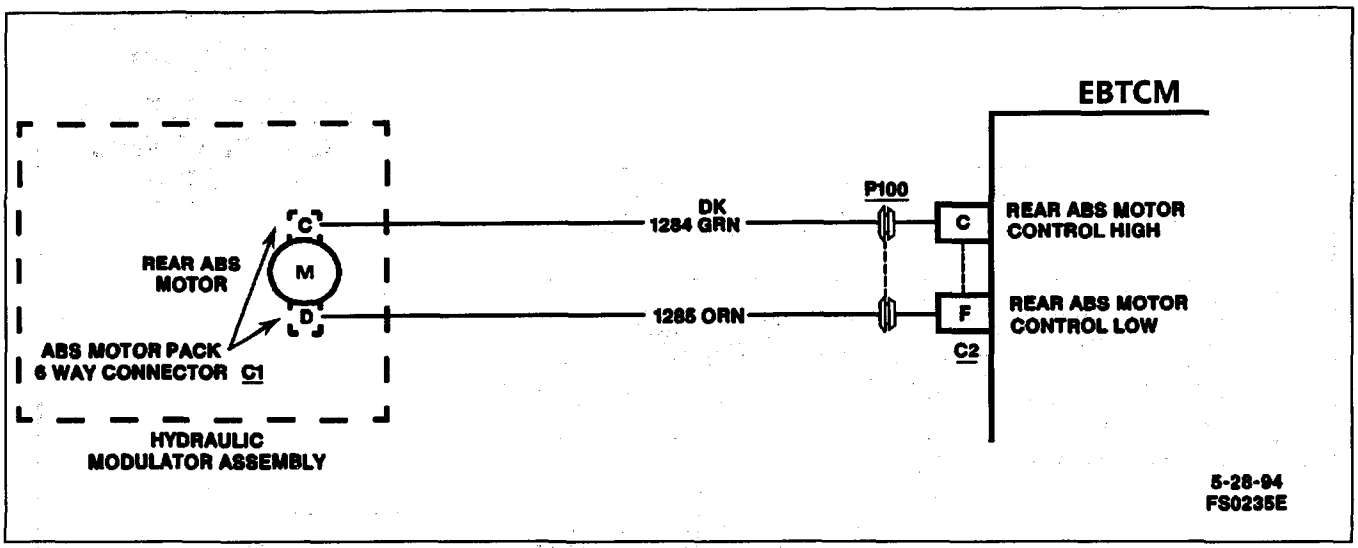
4. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "E" AND TERMINAL "F" OF THE ABS MOTOR PACK CONNECTOR.
   IS RESISTANCE 0.4Ω OR GREATER?
   - YES → 5
   - NO → REPLACE ABS MOTOR PACK.

5. • IGNITION "OFF."
   • RECONNECT ALL CONNECTORS.
   • START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
   • REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
   DOES DTC 45 SET IN THE LAST THREE DRIVE CYCLES?
   - YES → REPLACE EBTCM.
   - NO → MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS FOR CONTAMINATION AND POOR TERMINAL CONTACT. REPLACE ANY TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION.

7. • USING TECH 1 MISC. TESTS, PERFORM GEAR TENSION RELIEF FUNCTION.
   • IGNITION "OFF."
   • REMOVE HYDRAULIC MODULATOR/MASTER CYLINDER ASSEMBLY FROM VEHICLE. REFER TO "ON VEHICLE SERVICE" IN THIS SECTION.
   • SEPARATE ABS MOTOR PACK FROM HYDRAULIC MODULATOR.
   • GRASP THE GEAR ON THE HYDRAULIC MODULATOR (THE HYDRAULIC MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS) FURTHEST REARWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE AND ATTEMPT TO MOVE THE GEAR.
   CAN THE GEAR BE ROTATED AT LEAST 10 FULL TURNS LOCK TO LOCK?
   - YES → REPLACE ABS MOTOR PACK.
   - NO → REPLACE HYDRAULIC MODULATOR.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN IGNITION OFF.

C2860S



DTC 46
REAR ABS CHANNEL WILL NOT MOVE

Circuit Description:

This DTC is designed to detect bound-up ESB, a stuck ABS motor, or a seized hydraulic modulator. When the release is commanded during initialization, the ESB should release the ABS motor, resulting in sensed current being less than commanded current (motor is spinning freely). If the ABS motor is not moving, sensed current will be equal to stall current.

DTC Will Set When:

DTC 46 can be set during normal operation. If the EBTCM detects a condition in which it cannot move the motor in either direction, a malfunction exists.

Action Taken:

This malfunction indicates the channel cannot be moved properly. A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for proper motor movement during apply and release commands from the Tech 1.
2. Compares EBTCM command current to ABS motor feedback current.
3. Checks for a short circuit between the ABS motor "HIGH" and ABS motor "LOW" circuits.
4. Checks for an ABS motor that is internally shorted.
5. Checks to see if malfunction is due to poor terminal contact or the EBTCM.
6. Verifies that the motor can actually release when commanded.
7. Checks for proper hydraulic modulator gear and piston movement.

Diagnostic Aids:

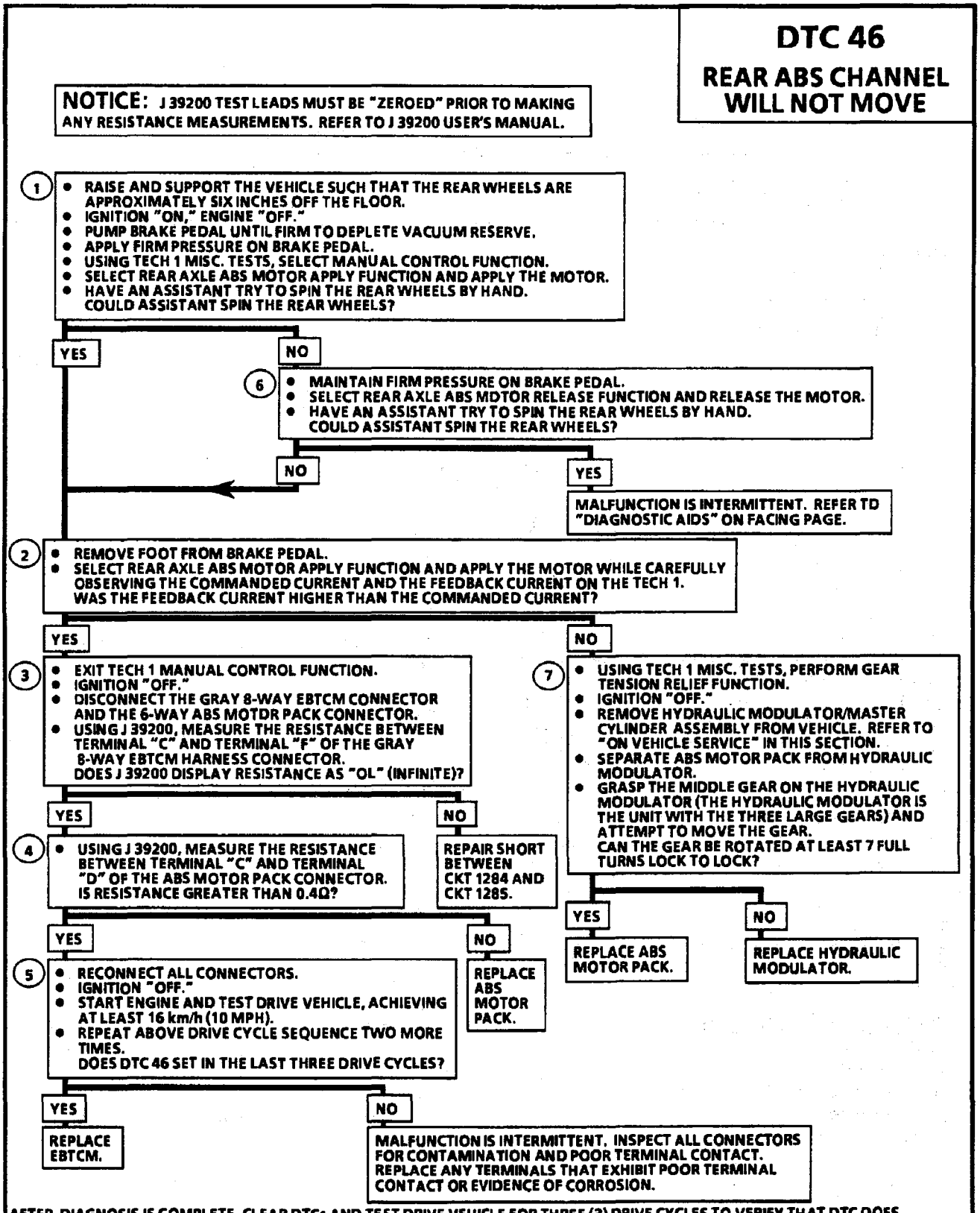
An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks or binds.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. DTC 46 may set after modulator disassembly if the modulator pistons are positioned at the bottom of their bore. Depending on the frequency of the malfunction, a physical inspection of the mechanical parts suspected may be necessary.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

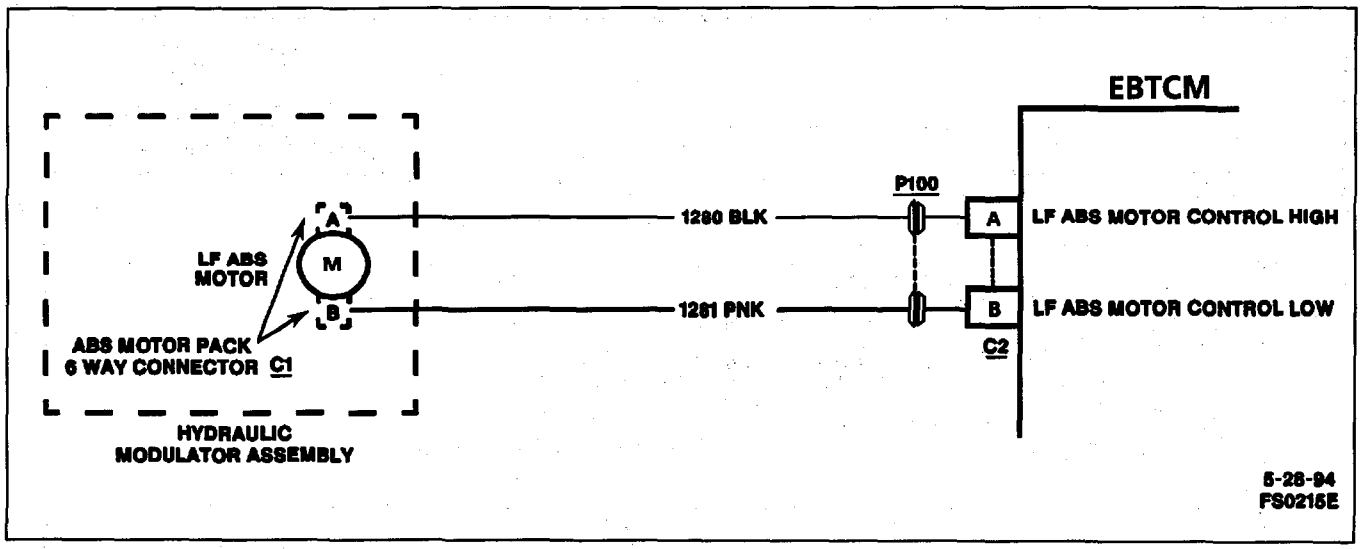
DTC 46
REAR ABS CHANNEL WILL NOT MOVE

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.



AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN IGNITION OFF.

C2861S



DTC 47
(Page 1 of 2)
LEFT FRONT ABS MOTOR FREE SPINS

Circuit Description:

This DTC is designed to detect a stripped nut or gear assembly during initialization. During the homing sequence, the piston should reach the top of the bore resulting in a stalled ABS motor. If this does not occur, the ABS motor must be spinning with little or no resistance, indicating a nut/screw or gear malfunction.

DTC Will Set When:

DTC 47 can only be set during initialization. If the feedback current is less than the command current for a specified period of time, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks to see if the corresponding open motor DTC is also set.
2. Verifies that the ABS motor was actually applied as command by observing feedback current.
3. Verifies that the ABS motor can release.
4. Verifies that the ABS motor can be applied by observing pedal movement.
5. Checks for an open in the ABS motor "HIGH" circuitry.
6. Checks for an open in the ABS motor "LOW" circuitry.
7. Checks for an ABS motor that is internally shorted.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. If the DTC only occurs once and DTC 56 also occurs, refer to DTC 56. If intermittent and enhanced diagnostics shows this DTC occurs during ABS, refer to DTC 56.

Depending on the frequency of the malfunction, a physical inspection of the mechanical parts suspected may be necessary.

DTC 47
(1 OF 2)
LEFT FRONT ABS MOTOR FREE SPINS

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

1. IS DTC 56 ALSO CURRENTLY SET?
   - YES → PROCEED TO DTC 56 CHART FIRST.
   - NO →
2.
   - IGNITION "ON," ENGINE "OFF."
   - PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
   - USING TECH 1 MISC. TESTS, SELECT MANUAL CONTROL FUNCTION.
   - SELECT LEFT FRONT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR WHILE CAREFULLY OBSERVING THE COMMAND CURRENT AND FEEDBACK CURRENT ON THE TECH 1.

   WERE BOTH COMMAND AND FEEDBACK CURRENT APPROXIMATELY 10 AMPS?
   - YES →
3.
   - APPLY FIRM PRESSURE ON BRAKE PEDAL.
   - SELECT LEFT FRONT ABS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR.

   DID THE BRAKE PEDAL FALL AND WERE BOTH COMMAND AND FEEDBACK CURRENT APPROXIMATELY 6 AMPS?
   - NO → GO TO STEP 5.
   - YES →
4.
   - MAINTAIN FIRM PRESSURE ON BRAKE PEDAL.
   - SELECT LEFT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR (THIS MOVES THE PISTON TO THE TOP OF ITS BORE.)

   DID BRAKE PEDAL RISE?
   - YES → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - NO →
5.
   - USING TECH 1 MISC. TESTS, PERFORM GEAR TENSION RELIEF FUNCTION.
   - IGNITION "OFF."
   - DISCONNECT 6-WAY ABS MOTOR PACK CONNECTOR AND GRAY 8-WAY EBTCM CONNECTOR.
   - USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "A" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR.

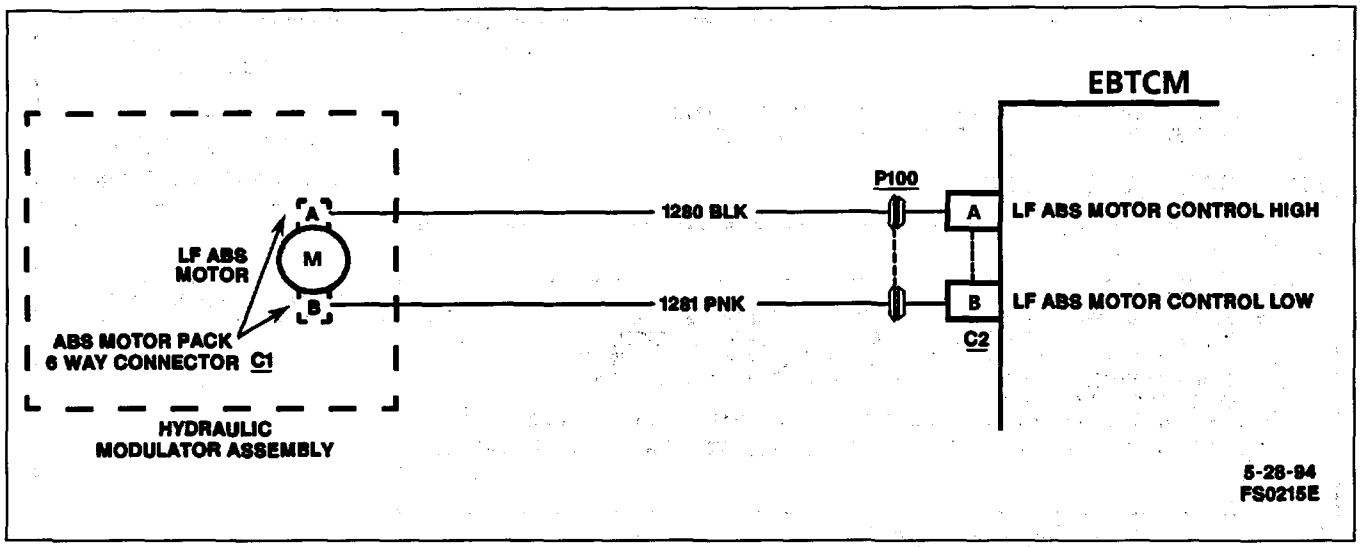
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPAIR HIGH RESISTANCE IN CKT 1280.
   - YES →
6.
   - USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "B" OF THE 6-WAY ABS MOTOR PARK HARNESS CONNECTOR AND TERMINAL "B" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR.

   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPAIR HIGH RESISTANCE IN CKT 1281.
   - YES →
7.
   - USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE ABS MOTOR PACK CONNECTOR.

   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPLACE ABS MOTOR PACK.
   - YES → DIAGNOSIS CONTINUED ON NEXT PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH) AND THEN IGNITION "OFF."

C2862S



DTC 47
(Page 2 of 2)
LEFT FRONT ABS MOTOR FREE SPINS

Circuit Description:

This DTC is designed to detect a stripped nut or gear assembly during initialization. During the homing sequence, the piston should reach the top of the bore resulting in a stalled motor. If this does not occur, the motor must be spinning with little or no resistance, indicating a nut/screw or gear malfunction.

DTC Will Set When:

DTC 47 can only be set during initialization. If the feedback current is less than the command current for a specified period of time, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

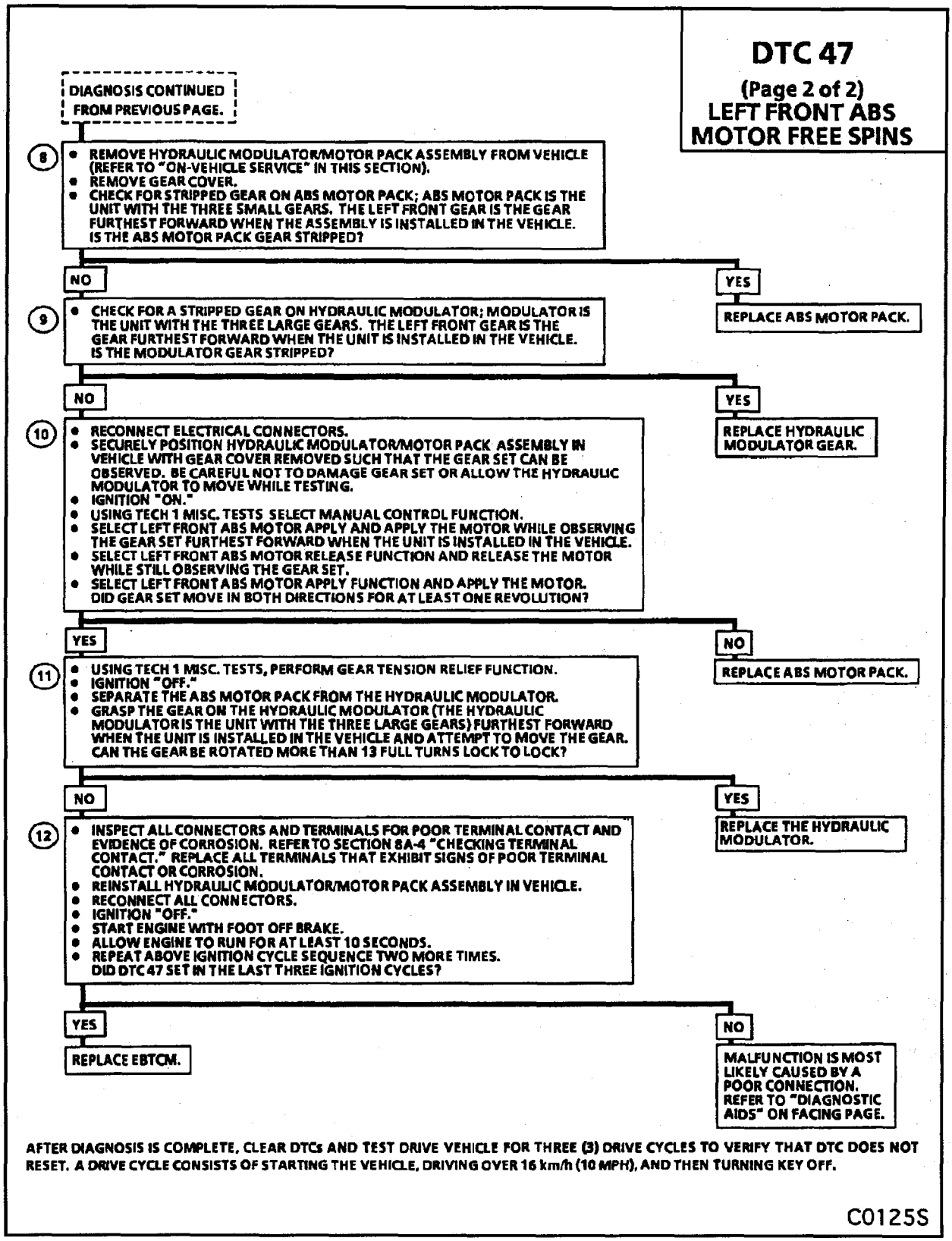
8. Checks for a stripped gear on the ABS motor pack (unit with three small gears).
9. Checks for a stripped gear on the hydraulic modulator (unit with three large gears).
10. Checks to see if the ABS motor pack has an internal malfunction.
11. Checks for a malfunctioning hydraulic modulator.
12. Ensures malfunction was not due to poor terminal contact.

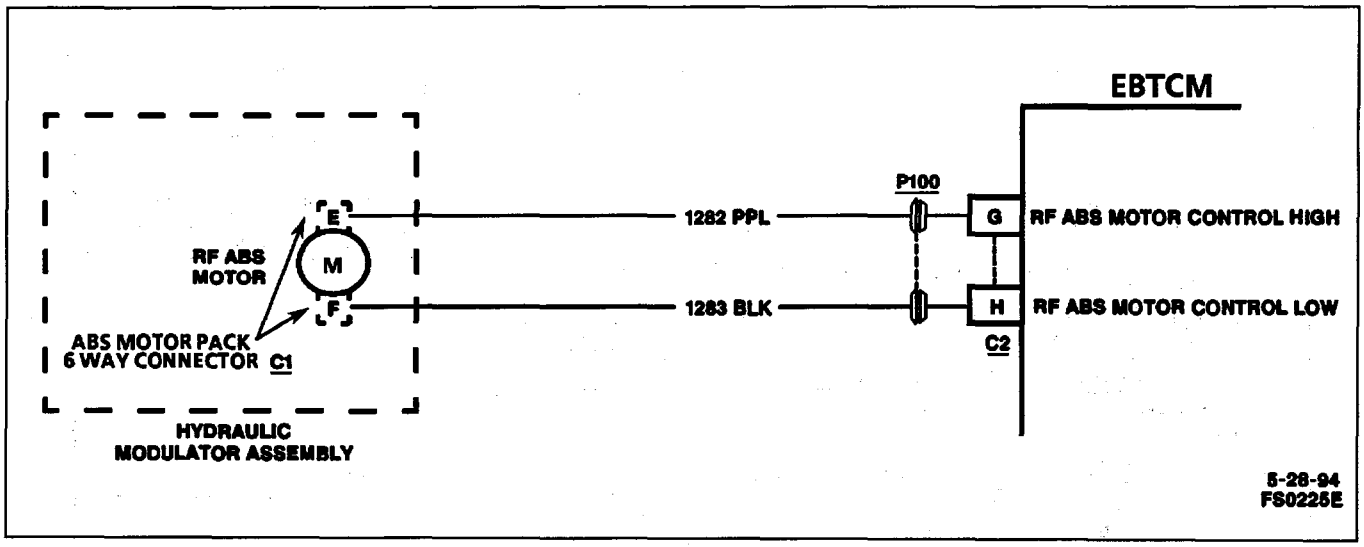
Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. If the DTC only occurs once and DTC 56 also occurs, refer to DTC 56. If intermittent and enhanced diagnostics shows this DTC occurs during ABS, refer to DTC 56.

Depending on the frequency of the malfunction, a physical inspection of the mechanical parts suspected may be necessary.


DTC 47
(Page 2 of 2)
LEFT FRONT ABS MOTOR FREE SPINS
DIAGNOSIS CONTINUED FROM PREVIOUS PAGE.
8
• REMOVE HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY FROM VEHICLE (REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION).
• REMOVE GEAR COVER.
• CHECK FOR STRIPPED GEAR ON ABS MOTOR PACK; ABS MOTOR PACK IS THE UNIT WITH THE THREE SMALL GEARS. THE LEFT FRONT GEAR IS THE GEAR FURTHEST FORWARD WHEN THE ASSEMBLY IS INSTALLED IN THE VEHICLE. IS THE ABS MOTOR PACK GEAR STRIPPED?
NO
YES
REPLACE ABS MOTOR PACK.
9
• CHECK FOR A STRIPPED GEAR ON HYDRAULIC MODULATOR; MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS. THE LEFT FRONT GEAR IS THE GEAR FURTHEST FORWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE. IS THE MODULATOR GEAR STRIPPED?
NO
YES
REPLACE HYDRAULIC MODULATOR GEAR.
10
• RECONNECT ELECTRICAL CONNECTORS.
• SECURELY POSITION HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY IN VEHICLE WITH GEAR COVER REMOVED SUCH THAT THE GEAR SET CAN BE OBSERVED. BE CAREFUL NOT TO DAMAGE GEAR SET OR ALLOW THE HYDRAULIC MODULATOR TO MOVE WHILE TESTING.
• IGNITION "ON."
• USING TECH 1 MISC. TESTS SELECT MANUAL CONTROL FUNCTION.
• SELECT LEFT FRONT ABS MOTOR APPLY AND APPLY THE MOTOR WHILE OBSERVING THE GEAR SET FURTHEST FORWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE.
• SELECT LEFT FRONT ABS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR WHILE STILL OBSERVING THE GEAR SET.
• SELECT LEFT FRONT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR. DID GEAR SET MOVE IN BOTH DIRECTIONS FOR AT LEAST ONE REVOLUTION?
YES
NO
REPLACE ABS MOTOR PACK.
11
• USING TECH 1 MISC. TESTS, PERFORM GEAR TENSION RELIEF FUNCTION.
• IGNITION "OFF."
• SEPARATE THE ABS MOTOR PACK FROM THE HYDRAULIC MODULATOR.
• GRASP THE GEAR ON THE HYDRAULIC MODULATOR (THE HYDRAULIC MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS) FURTHEST FORWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE AND ATTEMPT TO MOVE THE GEAR. CAN THE GEAR BE ROTATED MORE THAN 13 FULL TURNS LOCK TO LOCK?
NO
YES
REPLACE THE HYDRAULIC MODULATOR.
12
• INSPECT ALL CONNECTORS AND TERMINALS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4 "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.
• REINSTALL HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY IN VEHICLE.
• RECONNECT ALL CONNECTORS.
• IGNITION "OFF."
• START ENGINE WITH FOOT OFF BRAKE.
• ALLOW ENGINE TO RUN FOR AT LEAST 10 SECONDS.
• REPEAT ABOVE IGNITION CYCLE SEQUENCE TWO MORE TIMES. DID DTC 47 SET IN THE LAST THREE IGNITION CYCLES?
YES
REPLACE EBTCM.
NO
MALFUNCTION IS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY OFF.
C0125S



DTC 48
(Page 1 of 2)
RIGHT FRONT ABS MOTOR FREE SPINS

Circuit Description:

This DTC is designed to detect a stripped nut or gear assembly during initialization. During the homing sequence, the piston should reach the top of the bore resulting in a stalled ABS motor. If this does not occur, the ABS motor must be spinning with little or no resistance, indicating a nut/screw or gear malfunction.

DTC Will Set When:

DTC 48 can only be set during initialization. If the feedback current is less than the command current for a specified period of time, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks to see if the corresponding open motor DTC is also set.
2. Verifies that the ABS motor was actually applied as command by observing feedback current.
3. Verifies that the ABS motor can release.
4. Verifies that the ABS motor can be applied by observing pedal movement.
5. Checks for high resistance in the ABS motor "HIGH" circuitry.
6. Checks for high resistance in the ABS motor "LOW" circuitry.
7. Checks for proper resistance of the ABS motor windings.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. If the DTC only occurs once and DTC 61 also occurs, refer to DTC 61. If intermittent and enhanced diagnostics shows this DTC occurs during ABS, refer to DTC 61.

Depending on the frequency of the malfunction, a physical inspection of the mechanical parts suspected may be necessary.

DTC 48

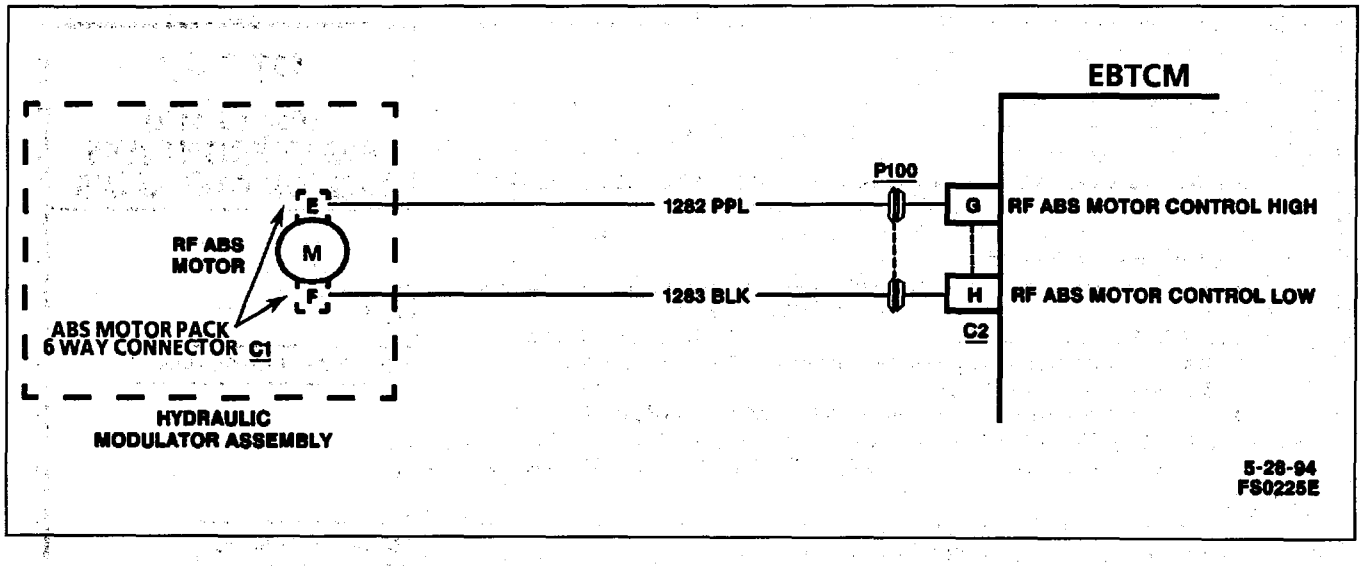
(Page 1 of 2)

RIGHT FRONTABS MOTOR FREE SPINS

1. IS DTC 61 ALSO CURRENTLY SET?
   - YES → PROCEED TO DTC 61 CHART FIRST.
   - NO →
2. • IGNITION "ON," ENGINE "OFF."
   • PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
   • USING TECH 1 MISC. TESTS, SELECT MANUAL CONTROL FUNCTION.
   • SELECT RIGHT FRONT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR WHILE CAREFULLY OBSERVING THE COMMAND CURRENT AND FEEDBACK CURRENT ON THE TECH 1.
   WERE BOTH COMMAND AND FEEDBACK CURRENT APPROXIMATELY 10 AMPS?
   - YES →
3. • APPLY FIRM PRESSURE ON BRAKE PEDAL.
   • SELECT RIGHT FRONT ABS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR.
   DID THE BRAKE PEDAL FALL AND WERE BOTH COMMAND AND FEEDBACK CURRENT APPROXIMATELY 6 AMPS?
   - NO → GO TO STEP 5
   - YES →
4. • MAINTAIN FIRM PRESSURE ON BRAKE PEDAL.
   • SELECT RIGHT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR (THIS MOVES THE PISTON TO THE TOP OF ITS BORE.)
   DID BRAKE PEDAL RISE?
   - YES → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - NO →
5. • USING TECH 1 MISC. TESTS, PERFORM GEAR TENSION RELIEF FUNCTION.
   • IGNITION "OFF."
   • DISCONNECT 6-WAY ABS MOTOR PACK CONNECTOR AND GRAY 8-WAY EBTCM CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "E" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "G" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPAIR HIGH RESISTANCE IN CKT 1282.
   - YES →
6. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "F" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "H" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPAIR HIGH RESISTANCE IN CKT 1283.
   - YES →
7. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "E" AND TERMINAL "F" OF THE ABS MOTOR PACK CONNECTOR.
   IS RESISTANCE 1.5Ω OR LESS?
   - NO → REPLACE ABS MOTOR PACK.
   - YES → DIAGNOSIS CONTINUED ON NEXT PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN IGNITION OFF.

C2864S



DTC 48
(Page 2 of 2)
RIGHT FRONT ABS MOTOR FREE SPINS

Circuit Description:

This DTC is designed to detect a stripped nut or gear assembly during initialization. During the homing sequence, the piston should reach the top of the bore resulting in a stalled ABS motor. If this does not occur, the ABS motor must be spinning with little or no resistance, indicating a nut/screw or gear malfunction.

DTC Will Set When:

DTC 48 can only be set during initialization. If the feedback current is less than the command current for a specified period of time, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

8. Checks for a stripped gear on the ABS motor pack (unit with three small gears).
9. Checks for a stripped gear on the hydraulic modulator (unit with three large gears).
10. Checks to see if the ABS motor pack has an internal malfunction.
11. Checks for a malfunctioning hydraulic modulator.
12. Ensures malfunction was not due to poor terminal contact.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. If the DTC only occurs once and DTC 61 also occurs, refer to DTC 61. If intermittent and enhanced diagnostics shows this DTC occurs during ABS, refer to DTC 61.

Depending on the frequency of the malfunction, a physical inspection of the mechanical parts suspected may be necessary.

DIAGNOSIS CONTINUED FROM PREVIOUS PAGE.

DTC 48
(Page 2 of 2)
RIGHT FRONT ABS MOTOR FREE SPINS

(8)
- REMOVE HYDRAULIC MODULATOR/MASTER CYLINDER ASSEMBLY FROM VEHICLE. (REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.)
- REMOVE GEAR COVER.
- CHECK FOR STRIPPED GEAR ON ABS MOTOR PACK; ABS MOTOR PACK IS THE UNIT WITH THE THREE SMALL GEARS. THE RIGHT FRONT GEAR IS THE GEAR FURTHEST REARWARD WHEN THE ASSEMBLY IS INSTALLED IN THE VEHICLE. IS THE ABS MOTOR PACK GEAR STRIPPED?

YES → REPLACE ABS MOTOR PACK.

NO

(9)
- CHECK FOR A STRIPPED GEAR ON HYDRAULIC MODULATOR; MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS. THE RIGHT FRONT GEAR IS THE GEAR FURTHEST REARWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE. IS THE MODULATOR GEAR STRIPPED?

YES → REPLACE HYDRAULIC MODULATOR GEAR.

NO

(10)
- RECONNECT ELECTRICAL CONNECTORS
- SECURELY POSITION HYDRAULIC MODULATOR/MASTER CYLINDER ASSEMBLY IN VEHICLE WITH GEAR COVER REMOVED SUCH THAT THE GEAR SET CAN BE OBSERVED. BE CAREFUL NOT TO DAMAGE GEAR SET OR ALLOW THE HYDRAULIC MODULATOR TO MOVE WHILE TESTING.
- IGNITION "ON."
- USING TECH 1 MISC. TESTS, SELECT MANUAL CONTROL FUNCTION.
- SELECT RIGHT FRONT ABS MOTOR APPLY AND APPLY THE MOTOR WHILE OBSERVING THE GEAR SET FURTHEST REARWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE.
- SELECT RIGHT FRONT ABS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR WHILE STILL OBSERVING THE GEAR SET.
- SELECT RIGHT FRONT ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR. DID GEAR SET MOVE IN BOTH DIRECTIONS FOR AT LEAST ONE REVOLUTION?

NO → REPLACE ABS MOTOR PACK.

YES

(11)
- USING TECH 1 MISC. TESTS, PERFORM GEAR TENSION RELIEF FUNCTION.
- IGNITION "OFF."
- SEPARATE THE ABS MOTOR PACK FROM THE HYDRAULIC MODULATOR.
- GRASP THE GEAR ON THE HYDRAULIC MODULATOR (THE HYDRAULIC MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS) FURTHEST REARWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE AND ATTEMPT TO MOVE THE GEAR. CAN THE GEAR BE ROTATED MORE THAN 13 FULL TURNS LOCK TO LOCK?

YES → REPLACE THE HYDRAULIC MODULATOR.

NO

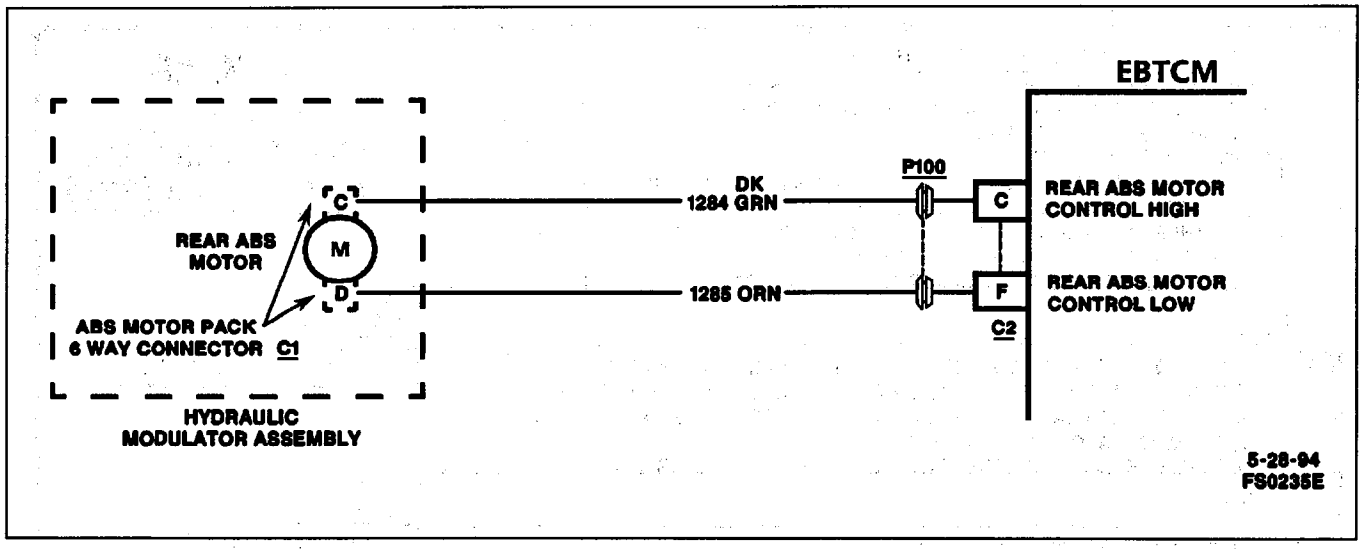
(12)
- INSPECT ALL CONNECTORS AND TERMINALS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4 "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.
- REINSTALL HYDRAULIC MODULATOR/MASTER CYLINDER ASSEMBLY IN VEHICLE.
- RECONNECT ALL CONNECTORS.
- IGNITION "OFF."
- START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
- REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES. DOES DTC 48 SET IN THE LAST THREE DRIVE CYCLES?

YES → REPLACE EBTCM.

NO → MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 KM/H (10 MPH), AND THEN TURNING KEY OFF.

C1579S



DTC 51
(Page 1 of 2)
REAR ABS MOTOR FREE SPINS

Circuit Description:

This DTC is designed to detect a stripped nut or gear assembly during initialization. During the homing sequence, the piston should reach the top of the bore resulting in a stalled ABS motor. If this does not occur, the ABS motor must be spinning with little or no resistance, indicating a nut/screw or gear malfunction.

DTC Will Set When:

DTC 51 can be set during initialization. If the feedback current is less than the command current for a specified period of time, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks to see if the corresponding open ABS motor DTC is also set.
2. Verifies that the ABS motor was actually applied as command by observing feedback current.
3. Verifies that the ABS motor can release.
4. Verifies that the ABS motor can be applied by observing pedal movement.
5. Checks for high resistance in the ABS motor "HIGH" circuitry.
6. Checks for high resistance in the ABS motor "LOW" circuitry.
7. Checks for proper resistance of the ABS motor windings.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. If the DTC only occurs once and DTC 64 also occurs, refer to DTC 64. If intermittent and enhanced diagnostics show this DTC occurs during ABS, refer to DTC 64.

Depending on the frequency of the malfunction, a physical inspection of the mechanical parts suspected may be necessary.

DTC 51
(1 OF 2)
REAR AXLE ABS MOTOR FREE SPINS

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

1. IS DTC 64 ALSO CURRENTLY SET?
   - YES → PROCEED TO DTC 64 CHART FIRST.
   - NO →
2. - IGNITION "ON," ENGINE "OFF."
   - PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
   - USING TECH 1 MISC. TESTS, SELECT MANUAL CONTROL FUNCTION.
   - SELECT REAR AXLE ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR WHILE CAREFULLY OBSERVING THE COMMAND CURRENT AND FEEDBACK CURRENT ON THE TECH 1.

   WERE BOTH COMMAND AND FEEDBACK CURRENT APPROXIMATELY 10 AMPS?
   - YES →
3. - APPLY FIRM PRESSURE ON BRAKE PEDAL.
   - SELECT REAR AXLE ABS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR.

   DID THE BRAKE PEDAL FALL AND WERE BOTH COMMAND AND FEEDBACK CURRENT APPROXIMATELY 6 AMPS?
   - YES →
4. - MAINTAIN FIRM PRESSURE ON BRAKE PEDAL.
   - SELECT REAR AXLE ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR (THIS MOVES THE PISTON TO THE TOP OF ITS BORE.)

   DID BRAKE PEDAL RISE?
   - NO →
5. - USING TECH 1 MISC. TESTS, PERFORM GEAR TENSION RELIEF FUNCTION.
   - IGNITION "OFF."
   - DISCONNECT 6-WAY ABS MOTOR PACK CONNECTOR AND GRAY 8-WAY EBTCM CONNECTOR.
   - USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "C" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR.

   IS RESISTANCE 1.5Ω OR LESS?
   - YES →
6. - USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "D" OF THE 6-WAY ABS MOTOR PARK HARNESS CONNECTOR AND TERMINAL "F" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR.

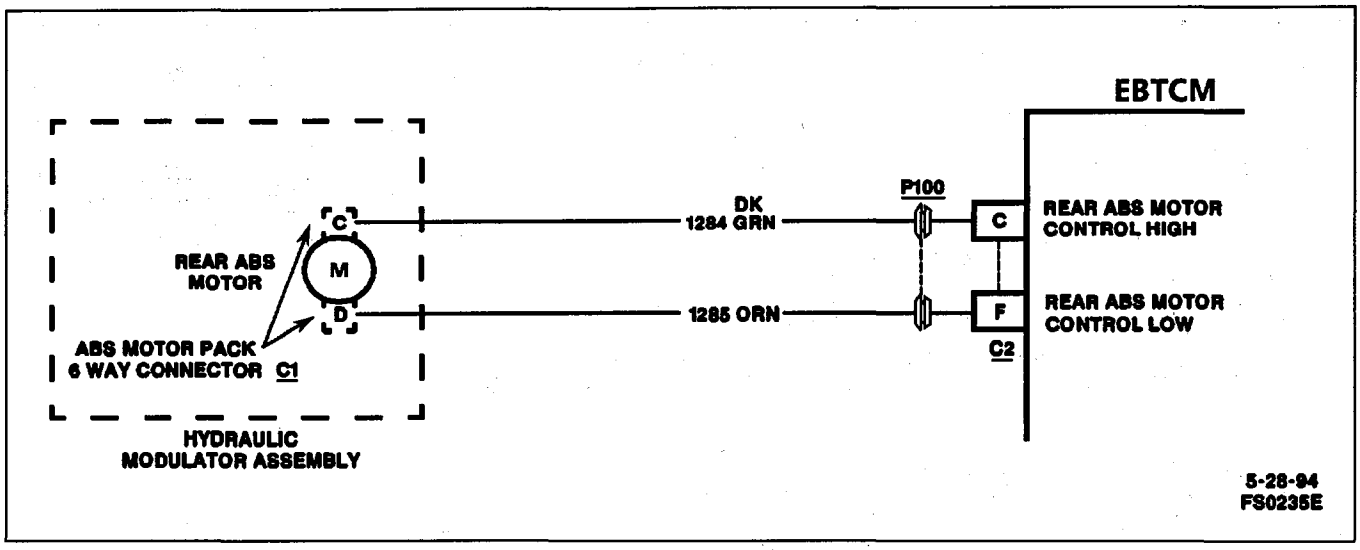
   IS RESISTANCE 1.5Ω OR LESS?
   - YES →
7. - USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C" AND TERMINAL "D" OF THE ABS MOTOR PACK CONNECTOR.

   IS RESISTANCE 1.5Ω OR LESS?
   - YES → DIAGNOSIS CONTINUED ON NEXT PAGE.
   - NO → REPLACE ABS MOTOR PACK.

- NO → REPAIR HIGH RESISTANCE IN CKT 1285.
- NO → REPAIR HIGH RESISTANCE IN CKT 1284.
- YES → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
- NO → GO TO STEP 5.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN IGNITION OFF.

C2863S



DTC 51
(Page 2 of 2)
REAR ABS MOTOR FREE SPINS

Circuit Description:

This DTC is designed to detect a stripped nut or gear assembly during initialization. During the homing sequence, the piston should reach the top of the bore resulting in a stalled motor. If this does not occur, the ABS motor must be spinning with little or no resistance, indicating a nut/screw or gear malfunction.

DTC Will Set When:

DTC 51 can be set during initialization. If the feedback current is less than the command current for a specified period of time, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

8. Checks for a stripped gear on the ABS motor pack (unit with three small gears).
9. Checks for a stripped gear on the hydraulic modulator (unit with three large gears).
10. Checks to see if the ABS motor pack has an internal malfunction.
11. Checks for a malfunctioning hydraulic modulator.
12. Ensures malfunction was not due to poor terminal contact.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. If the DTC only occurs once and DTC 64 also occurs, refer to DTC 64. If intermittent and enhanced diagnostics show this DTC occurs during ABS, refer to DTC 64.

Depending on the frequency of the malfunction, a physical inspection of the mechanical parts suspected may be necessary.

DTC 51
(Page 2 of 2)
REAR ABS MOTOR FREE SPINS

DIAGNOSIS CONTINUED FROM PREVIOUS PAGE.

(8)
- REMOVE HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY FROM VEHICLE (REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION).
- REMOVE GEAR COVER.
- CHECK FOR STRIPPED GEAR ON ABS MOTOR PACK; ABS MOTOR PACK IS THE UNIT WITH THE THREE SMALL GEARS. THE REAR AXLE GEAR IS THE MIDDLE GEAR OF THE THREE.

IS THE ABS MOTOR PACK GEAR STRIPPED?

YES → REPLACE ABS MOTOR PACK.

NO

(9)
- CHECK FOR A STRIPPED GEAR ON HYDRAULIC MODULATOR; MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS. THE REAR AXLE GEAR IS THE MIDDLE GEAR OF THE THREE.

IS THE MODULATOR GEAR STRIPPED?

YES → REPLACE HYDRAULIC MODULATOR GEAR.

NO

(10)
- RECONNECT ELECTRICAL CONNECTORS.
- SECURELY POSITION HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY IN VEHICLE WITH GEAR COVER REMOVED SUCH THAT THE GEAR SET CAN BE OBSERVED. BE CAREFUL NOT TO DAMAGE GEAR SET OR ALLOW THE HYDRAULIC MODULATOR TO MOVE WHILE TESTING.
- IGNITION "ON."
- USING TECH 1 MISC. TESTS, SELECT MANUAL CONTROL FUNCTION.
- SELECT REAR AXLE ABS MOTOR APPLY AND APPLY THE MOTOR WHILE OBSERVING THE MIDDLE GEAR SET.
- SELECT REAR AXLE ABS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR WHILE STILL OBSERVING THE GEAR SET.
- SELECT REAR AXLE ABS MOTOR APPLY FUNCTION AND APPLY THE MOTOR.

DID GEAR SET MOVE IN BOTH DIRECTIONS FOR AT LEAST ONE REVOLUTION?

NO → REPLACE ABS MOTOR PACK.

YES

(11)
- USING TECH 1 MISC. TESTS, PERFORM GEAR TENSION RELIEF FUNCTION.
- IGNITION "OFF."
- SEPARATE THE ABS MOTOR PACK FROM THE HYDRAULIC MODULATOR.
- GRASP THE MIDDLE GEAR ON THE HYDRAULIC MODULATOR (THE HYDRAULIC MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS) AND ATTEMPT TO MOVE THE GEAR.

CAN THE GEAR BE ROTATED MORE THAN 8 FULL TURNS LOCK TO LOCK?

YES → REPLACE THE HYDRAULIC MODULATOR.

NO

(12)
- INSPECT ALL CONNECTORS AND TERMINALS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4 "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.
- REINSTALL HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY IN VEHICLE.
- RECONNECT ALL CONNECTORS.
- IGNITION "OFF."
- START ENGINE WITH FOOT OFF BRAKE.
- ALLOW ENGINE TO RUN FOR AT LEAST 10 SECONDS.
- REPEAT ABOVE IGNITION CYCLE SEQUENCE TWO MORE TIMES.

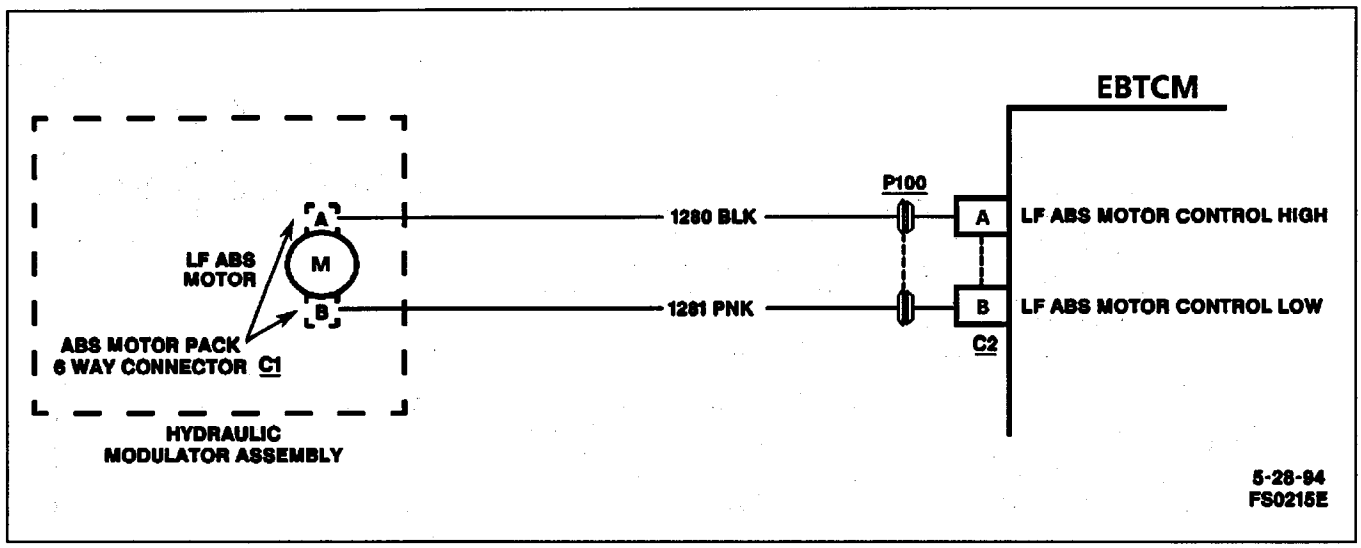
DID DTC 51 SET IN THE LAST THREE IGNITION CYCLES?

YES → REPLACE EBTCM.

NO → MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY OFF.

C0126S



DTC 52
LEFT FRONT ABS CHANNEL IN RELEASE TOO LONG

Circuit Description:

This DTC will diagnose an ABS motor that is energized longer than expected. This could occur if a wheel speed sensor is malfunctioning, the ABS motor does not turn, the left front solenoid mechanically fails open, or the ABS motor wires are crossed.

DTC Will Set When:

DTC 52 can be set only during an ABS stop. If the EBTCM commands the left front ABS channel in release for three seconds, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Identifies a malfunction in a wheel speed sensor that may cause the system to be in release too long.
2. Identifies an ABS motor as being failed or wired incorrectly.
3. Checks for a solenoid that may have mechanically failed open.
4. Verifies proper solenoid operation.
5. If Step 3 has failed, this serves to isolate the cause of the hydraulic malfunction, to either the solenoid or the ABS hydraulic modulator assembly.
6. Determines whether a malfunctioning motor pack or hydraulic modulator is the reason for DTC 52 being set.

Diagnostic Aids:

An intermittent malfunction may be caused by a mechanical part of the system that sticks or binds.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. DTC 52 may occur if on ice and steering wheel is turned to lock during braking. Using the Tech 1, perform hydraulic test to ensure total brake system is functional.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 52
LEFT FRONT ABS CHANNEL IN RELEASE TOO LONG

Important

EXCESSIVE ORAG OR HIGH RESISTANCE IN THE BASE BRAKE OR SUSPENSION SYSTEM MUST BE INSPECTEO AND CORRECTED BEFORE PROCEEDING WITH DTC DIAGNOSIS.

ARE ANY WHEEL SPEED DTCs CURRENTLY SET?

YES → PROCEED TO THAT DTC CHART FIRST.

NO

1. • USING TECH 1, SELECT "F0: DATA LIST" AND TEST VEHICLE DURING A STEADY DECEL CONDITION FROM 35 MPH TO 0 MPH WHILE MONITORING ALL WHEEL SPEEDS.
   DO ANY OF THE WHEEL SPEEDS INDICATE ERRATIC OR INTERMITTENT OPERATION?

YES → PROCEED TO WHEEL SPEED = 0 DTC FOR AFFECTED WHEEL.

NO

2. • IGNITION "ON."
   • USING TECH 1 MANUAL CONTROL FUNCTION, SELECT LEFT FRONT ABS MOTOR APPLY AND APPLY MOTOR.
   • APPLY FIRM PRESSURE ON BRAKE PEDAL.
   • SELECT LEFT FRONT ABS MOTOR RELEASE AND COMMAND RELEASE OF MOTOR.
   DID BRAKE PEDAL FALL?

YES

3. • REMOVE FOOT FROM BRAKE PEDAL.
   • USING TECH 1 MANUAL CONTROL FUNCTION, SELECT LEFT FRONT SOLENOID AND COMMAND THE SOLENOID "ON."
   • APPLY FIRM PRESSURE TO BRAKE PEDAL.
   DID BRAKE PEDAL FALL?

NO

4. • FIRM PRESSURE STILL APPLIED TO BRAKE PEDAL.
   • USING TECH 1, COMMAND LEFT FRONT SOLENOID "OFF."
   DID BRAKE PEDAL FALL?

YES → PROCEED TO STEP 5 OF THIS CHART.

NO

5. • REMOVE FOOT FROM BRAKE PEDAL.
   • IGNITION "OFF."
   • PHYSICALLY SWITCH THE LEFT FRONT SOLENOID WITH RIGHT FRONT SOLENOID.
   • IGNITION "ON."
   • USING TECH 1 MANUAL CONTROL FUNCTION, SELECT LEFT FRONT SOLENOID AND COMMAND THE SOLENOID "ON."
   • APPLY FIRM PRESSURE TO BRAKE PEDAL.
   OID BRAKE PEDAL FALL?

YES → REPLACE ABS HYDRAULIC MODULATOR.

NO → REPLACE THE SOLENOID WHICH WAS ORIGINALLY IN THE LEFT FRONT CHANNEL.

NO

BRAKE PEDAL DID NOT MOVE

BRAKE PEDAL ROSE → REPAIR CROSSED WIRES (CKTs 1280 and 1281) TO LEFT FRONT ABS MOTOR.

6. • USING TECH 1 PERFORM GEAR TENSION RELIEF FUNCTION.
   • IGNITION "OFF."
   • SEPARATE ABS MOTOR PACK FROM HYDRAULIC MODULATOR.
   • GRASP THE GEAR ON THE HYDRAULIC MODULATOR (HYDRAULIC MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS) FURTHEST FORWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE AND ATTEMPT TO ROTATE THE GEAR IN EITHER DIRECTION.
   CAN THE GEAR BE MOVED BY HAND?

YES → REPLACE ABS MOTOR PACK.

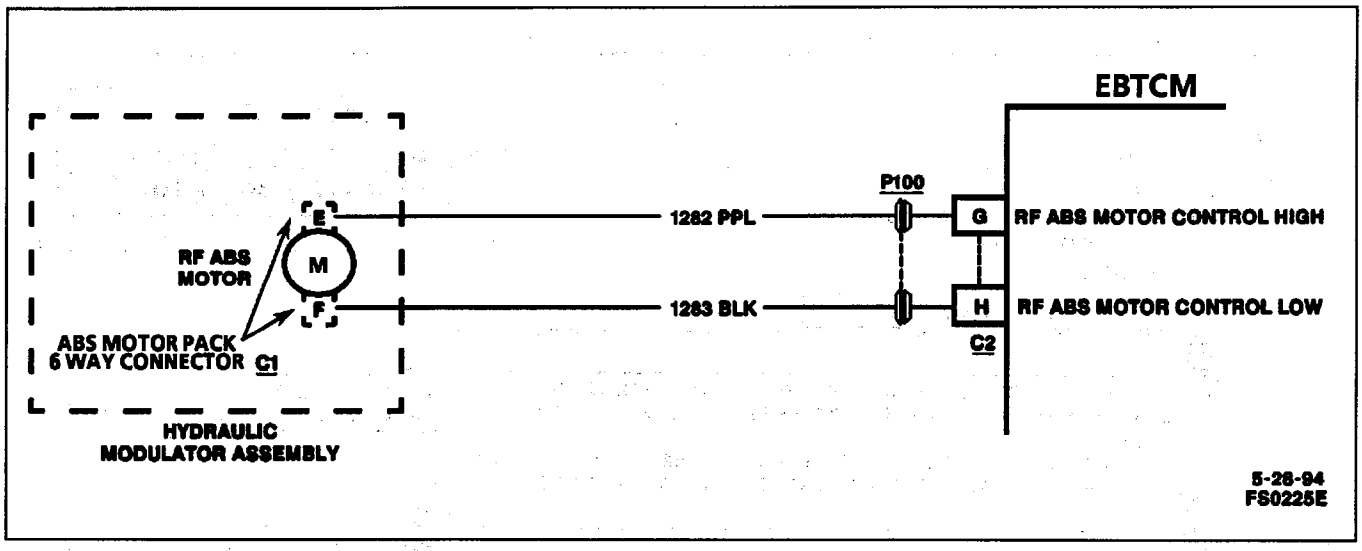
NO → REPLACE ABS HYDRAULIC MODULATOR.

YES

MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16km/h (10 MPH) AND THEN TURNING KEY OFF.

C0127S



DTC 53
RIGHT FRONT ABS CHANNEL IN RELEASE TOO LONG

Circuit Description:

This DTC will diagnose a motor that is energized longer than expected. This could occur if a wheel speed sensor is malfunctioning, the motor does not turn, the right front solenoid mechanically fails open, or the ABS motor wires are crossed.

DTC Will Set When:

DTC 53 can be set only during an ABS stop. If the EBTCM commands the right front channel in release for three seconds, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Identifies a malfunction in a wheel speed sensor that may cause the system to be in release too long.
2. Identifies a motor as being failed or wired incorrectly.
3. Checks for a solenoid that may have mechanically failed open.
4. If Step 3 has failed, this serves to isolate the cause of the hydraulic malfunction, to either the solenoid or the ABS hydraulic modulator assembly.
5. Checks for a solenoid that may have mechanically failed closed.
6. Determines whether a malfunction motor pack or hydraulic modulator is the reason for DTC 53 being set.

Diagnostic Aids:

An intermittent malfunction may be caused by a mechanical part of the system that sticks or binds.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. DTC 53 may occur on ice if steering wheel is turned to lock during braking. Using the Tech 1 perform hydraulic test to ensure total brake system is functional.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 53
RIGHT FRONT ABS CHANNEL IN RELEASE TOO LONG

Important

EXCESSIVE DRAG OR HIGH RESISTANCE IN THE BASE BRAKE OR SUSPENSION SYSTEM MUST BE INSPECTED AND CORRECTED BEFORE PROCEEDING WITH DTC DIAGNOSIS.

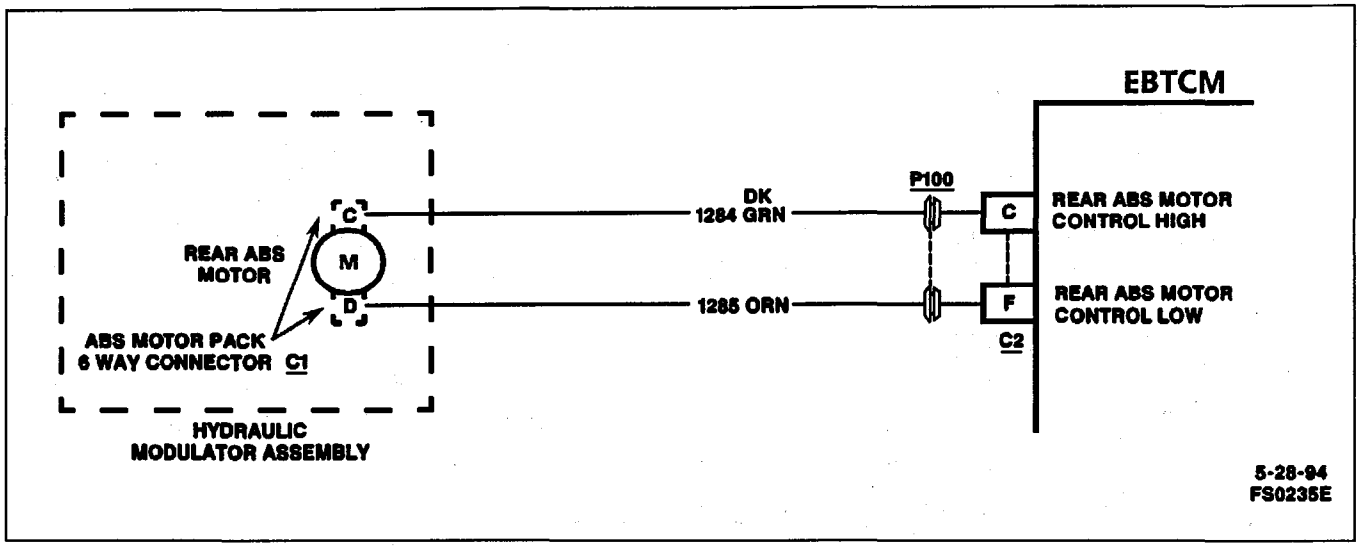
ARE ANY WHEEL SPEED DTCs CURRENTLY SET?

- YES → PROCEED TO THAT DTC CHART FIRST.
- NO →

1. • USING TECH 1, SELECT "F0: DATA LIST" AND TEST VEHICLE DURING A STEADY DECEL CONDITION FROM 35 MPH TO 0 MPH WHILE MONITORING ALL WHEEL SPEEDS.
   DO ANY OF THE WHEEL SPEEDS INDICATE ERRATIC OR INTERMITTENT OPERATION?
   - YES → PROCEED TO WHEEL SPEED = 0 DTC FOR AFFECTED WHEEL.
   - NO →
2. • IGNITION "ON."
   • USING TECH 1 MANUAL CONTROL FUNCTION, SELECT RIGHT FRONT ABS MOTOR APPLY AND APPLY MOTOR.
   • APPLY FIRM PRESSURE ON BRAKE PEDAL.
   • SELECT RIGHT FRONT ABS MOTOR RELEASE AND COMMAND RELEASE OF MOTOR.
   DID BRAKE PEDAL FALL?
   - NO →
     - BRAKE PEDAL DID NOT MOVE →
6. • USING TECH 1 PERFORM GEAR TENSION RELIEF FUNCTION.
   • IGNITION "OFF."
   • SEPARATE ABS MOTOR PACK FROM HYDRAULIC MODULATOR.
   • GRASP THE GEAR ON THE HYDRAULIC MODULATOR (HYDRAULIC MODULATOR IS THE UNIT WITH THE THREE LARGE GEARS) FURTHEST REARWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE AND ATTEMPT TO ROTATE THE GEAR IN EITHER DIRECTION.
   CAN THE GEAR BE MOVED BY HAND?
   - YES → REPLACE ABS MOTOR PACK.
   - NO → REPLACE ABS HYDRAULIC MODULATOR.
     - BRAKE PEDAL ROSE → REPAIR CROSSED WIRES (CKTs 1282 AND 1283) TO RIGHT FRONT ABS MOTOR.
   - YES →
3. • REMOVE FOOT FROM BRAKE PEDAL.
   • USING TECH 1 MANUAL CONTROL FUNCTION, SELECT RIGHT FRONT SOLENOID AND COMMAND THE SOLENOID "ON."
   • APPLY FIRM PRESSURE TO BRAKE PEDAL.
   DID BRAKE PEDAL FALL?
   - YES → PROCEED TO STEP 5 OF THIS CHART.
   - NO →
4. • FIRM PRESSURE STILL APPLIED TO BRAKE PEDAL.
   • USING TECH 1, COMMAND RIGHT FRONT SOLENOID "OFF."
   DID BRAKE PEDAL FALL?
   - NO →
5. • REMOVE FOOT FROM BRAKE PEDAL.
   • IGNITION "OFF."
   • PHYSICALLY SWITCH THE RIGHT FRONT SOLENOID WITH THE LEFT FRONT SOLENOID.
   • IGNITION "ON."
   • USING TECH 1 MANUAL CONTROL FUNCTION, SELECT RIGHT FRONT SOLENOID AND COMMAND THE SOLENOID "ON."
   • APPLY FIRM PRESSURE TO BRAKE PEDAL.
   DID BRAKE PEDAL FALL?
   - YES → REPLACE ABS HYDRAULIC MODULATOR.
   - NO → REPLACE THE SOLENOID WHICH WAS ORIGINALLY IN THE RIGHT FRONT CHANNEL.
   - YES → MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16km/h (10 MPH) AND THEN TURNING KEY OFF.

C0128S



DTC 54
REAR ABS CHANNEL IN RELEASE TOO LONG

Circuit Description:

This DTC will diagnose an ABS motor that is energized longer than expected. This could occur if a wheel speed sensor is malfunctioning, the ABS motor does not turn, or the ABS motor wires are crossed.

DTC Will Set When:

DTC 54 can be set only during an ABS stop. If the EBTCM commands the rear axle channel in release for three seconds, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Identifies a malfunction in a wheel speed sensor that may cause the system to be in release too long.
2. Checks for a wheel that may stick or bind because of a mechanical malfunction.
3. Checks to see if the ABS motor is capable of moving and applying the hydraulic piston for the rear wheels.
4. Ensures that the ABS motor wiring is not crossed.
5. Isolates the fault of a "no-apply" situation to either the ABS motor pack or ABS hydraulic modulator assembly.

Diagnostic Aids:

An intermittent malfunction may be caused by a mechanical part of the system that sticks or binds.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. Using the Tech 1, perform hydraulic test to ensure total brake system is functional.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 54
REAR ABS CHANNEL IN RELEASE TOO LONG

Important

- EXCESSIVE DRAG OR HIGH RESISTANCE IN THE BASE BRAKE OR SUSPENSION SYSTEM MUST BE INSPECTED AND CORRECTED BEFORE PROCEEDING WITH DTC DIAGNOSIS.

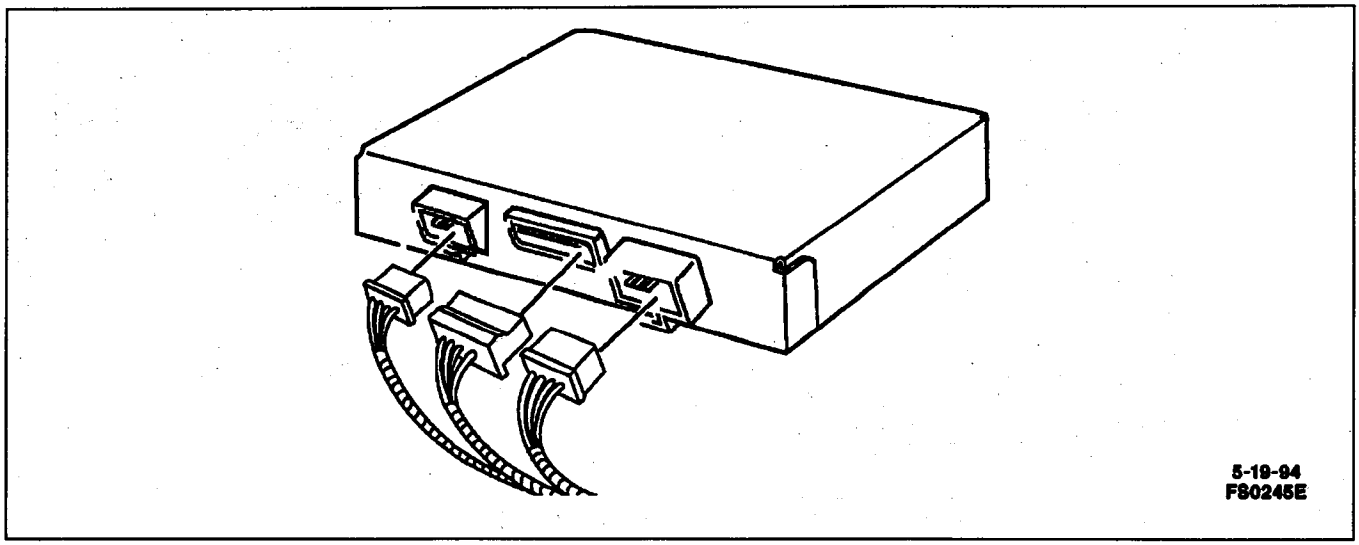
ARE ANY WHEEL SPEED DTCs CURRENTLY SET?

- YES → PROCEED TO THAT DTC CHART FIRST.
- NO →

1. • USING TECH 1, SELECT "F0: DATA LIST" AND TEST VEHICLE DURING A STEADY DECEL CONDITION FROM 35 MPH TO 0 MPH WHILE MONITORING ALL WHEEL SPEEDS. DO ANY OF THE WHEEL SPEEDS INDICATE ERRATIC OR INTERMITTENT OPERATION?
   - YES → PROCEED TO WHEEL SPEED = 0 DTC FOR AFFECTED WHEEL.
   - NO →
2. • RAISE REAR OF VEHICLE AND SUPPORT AS INDICATED IN SECTION 0A.
   • SPIN BOTH REAR WHEELS AND CONFIRM PHYSICAL CONDITION OF BASE BRAKE SYSTEM.
   COULD BOTH REAR WHEELS BE SPUN FREELY BY HAND?
   - NO → REPAIR SOURCE OF RESISTANCE IN BASE BRAKE SYSTEM.
   - YES →
3. • IGNITION "ON."
   • USING MANUAL CONTROL FUNCTION OF TECH 1, SELECT REAR AXLE ABS MOTOR APPLY.
   • APPLY FIRM PRESSURE ON BRAKE PEDAL.
   • COMMAND APPLY OF REAR ABS MOTOR AND TRY TO SPIN REAR WHEELS BY HAND.
   COULD REAR WHEELS BE SPUN BY HAND?
   - NO → MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - YES →
4. • WITH FIRM PRESSURE ON BRAKE PEDAL STILL APPLIED, COMMAND A RELEASE OF THE REAR AXLE ABS MOTOR.
   CAN WHEELS BE MOVED?
   - NO → REPAIR CROSSED WIRES AT REAR ABS MOTOR (CKTs 1284 AND 1285).
   - YES →
5. • USING TECH 1, PERFORM GEAR TENSION RELIEF FUNCTION.
   • SEPARATE ABS MOTOR PACK FROM HYDRAULIC MODULATOR.
   • CONNECT ABS MOTOR PACK WIRING.
   • IGNITION "ON."
   • USING TECH 1, PERFORM MOTOR TEST.
   DO ALL THREE ABS MOTOR PACK GEARS (SMALL GEARS) SPIN FREELY?
   - YES → REPLACE ABS HYDRAULIC MODULATOR.
   - NO → REPLACE ABS MOTOR PACK.

AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY OFF.

C0129S



DTC 55
EBTCM MALFUNCTION (ABS)

Circuit Description:

This DTC identifies an internal malfunction detected by the EBTCM ABS motor driver interface custom integrated circuit.

Action Taken:

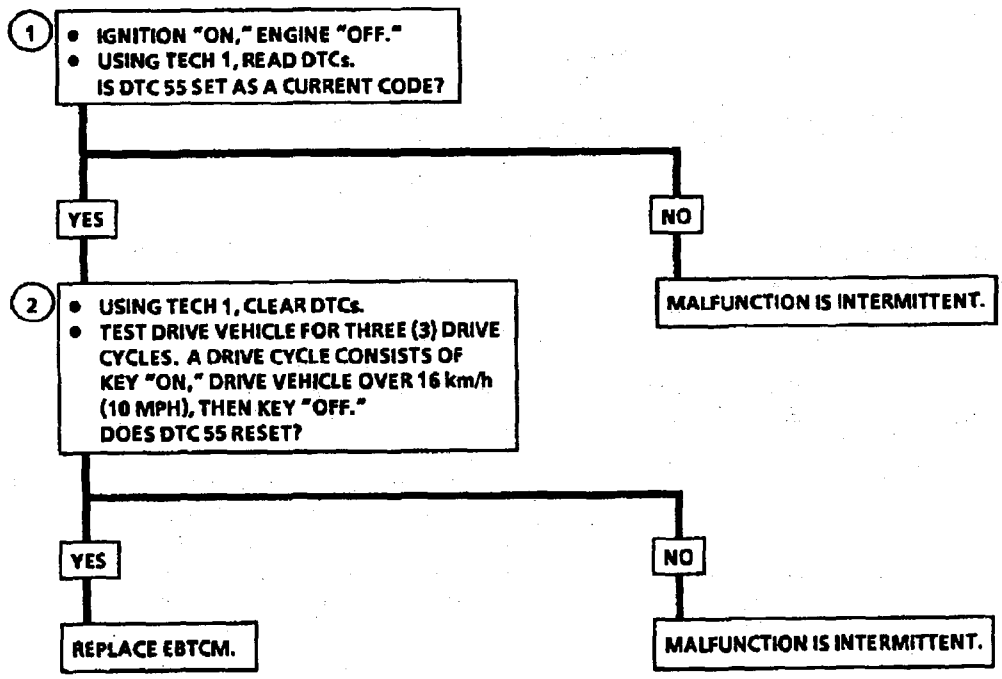
A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

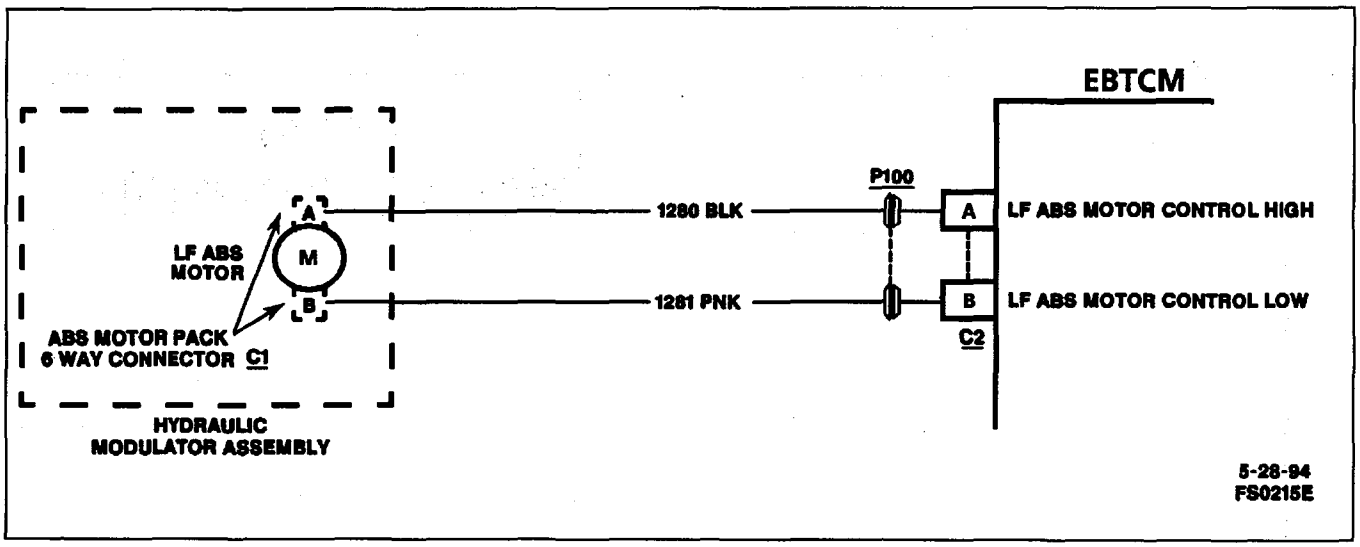
Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks to see if the malfunction is still present.
2. Checks to see if the malfunction is intermittent.

DTC 55
EBTCM MALFUNCTION (ABS)



C0130S



DTC 56
LEFT FRONT ABS MOTOR CIRCUIT OPEN

Circuit Description:

This DTC identifies an ABS motor that cannot be energized due to an open in its circuitry. This malfunction will not allow proper ABS operation.

DTC Will Set When:

DTC 56 can be set only when the ABS motor is commanded "OFF." If the EBTCM detects an out of range voltage on either of the left front ABS motor circuits indicating an open circuit, a malfunction exists.

Action Taken:

An open ABS motor will not activate when requested. A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for proper resistance of the ABS motor.
2. Checks for an open in the ABS motor "HIGH" circuitry.
3. Checks for an open in the ABS motor "LOW" circuitry.
4. Ensures malfunction was not due to poor terminal contact.

Diagnostic Aids:

Using Tech 1, select manual control function, and exercise ABS motor movement of affected channel in both directions while applying light pressure on the brake pedal.

If erratic or "jumpy" brake pedal movement is detected while performing an "apply" or "release" function of the ABS motor, an intermittent malfunction may be indicated.

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 56
LEFT FRONT ABS MOTOR CIRCUIT OPEN

DOES DTC 56 OCCUR INTERMITTENTLY?

NO

YES → REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

1. • IGNITION "OFF."
   • DISCONNECT 6-WAY ABS MOTOR PACK CONNECTOR.
   • USING J 39200, MEASURE RESISTANCE ACROSS ABS MDTOR PACK TERMINALS "A" AND "B".
   IS RESISTANCE BELOW 2000Ω?

YES

NO → REPLACE ABS MOTOR PACK.

2. • DISCONNECT GRAY 8-WAY CONNECTOR AT EBTCM.
   • USING J 39200, MEASURE RESISTANCE BETWEEN TERMINAL "A" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "A" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?

YES

NO → REPAIR OPEN OR HIGH RESISTANCE IN CKT 1280.

3. • USING J 39200, MEASURE RESISTANCE BETWEEN TERMINAL "B" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "B" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?

YES

NO → REPAIR OPEN OR HIGH RESISTANCE IN CKT 1281.

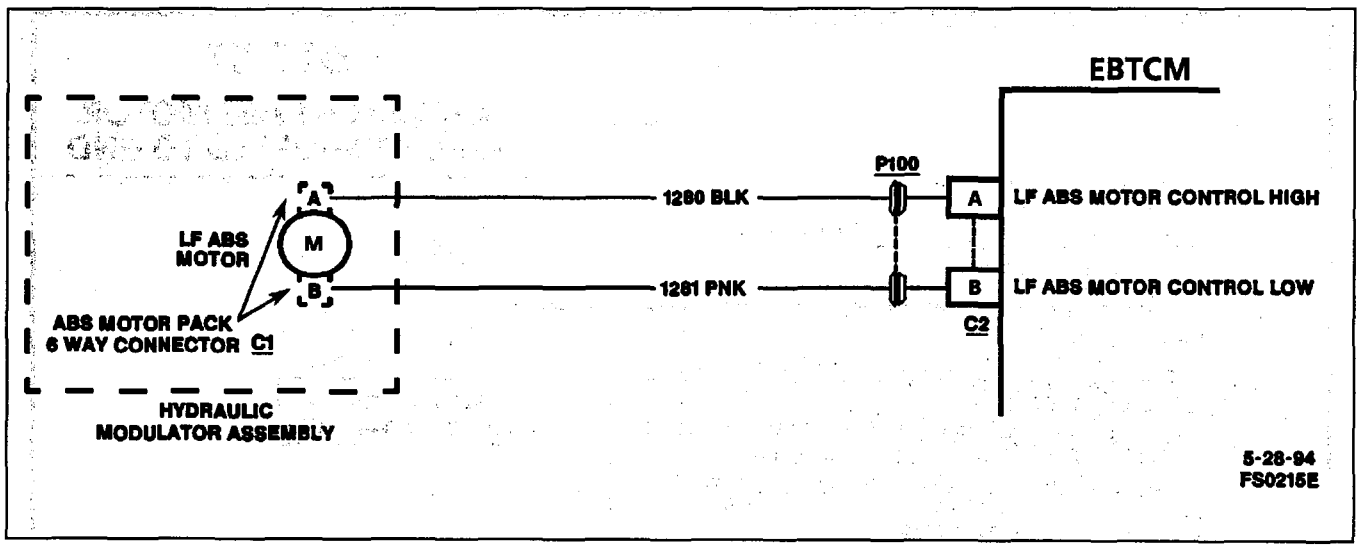
4. • INSPECT THE 6-WAY ABS MOTOR PACK AND GRAY 8-WAY EBTCM CONNECTORS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION BA-4, "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.
   • IGNITION "OFF."
   • RECONNECT ALL CONNECTORS.
   • START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
   • REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
   DID DTC 56 SET IN THE LAST THREE DRIVE CYCLES?

YES → REPLACE EBTCM.

NO → MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN IGNITION OFF.

C1578S



DTC 57
LEFT FRONT ABS MOTOR CIRCUIT SHORTED TO GND

Circuit Description:

This DTC identifies an ABS motor circuit that is shorted to ground. This malfunction will not allow the ABS motor to be controlled at the commanded current rate or will cause the ABS motor driver circuit to allow current directly to ground.

DTC Will Set When:

DTC 57 can be set anytime. If the EBTCM detects an out of range voltage on either of the left front ABS motor circuits indicating a circuit shorted to ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to ground in the ABS motor "HIGH" circuitry.
2. Checks for a short to ground in the ABS motor "LOW" circuitry.
3. Checks for an ABS motor that is internally shorted to ground.
4. Ensures malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

Using Tech 1, select manual control function, and exercise ABS motor movement of affected channel in both directions while applying light pressure on the brake pedal.

If erratic or "jumpy" brake pedal movement is detected while performing an "apply" or "release" function of the ABS motor, an intermittent malfunction may be indicated.

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 57
LEFT FRONT ABS MOTOR CIRCUIT SHORTED TO GND

DOES DTC 57 OCCUR INTERMITTENTLY?

NO

YES → REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

1. • IGNITION "OFF."
   • DISCONNECT THE 6-WAY ABS MOTOR PACK CONNECTOR AND THE GRAY 8-WAY EBTCM CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

NO → REPAIR SHORT TO GROUND IN CKT 1280.

2. • USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "B" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

NO → REPAIR SHORT TO GROUND IN CKT 1281.

3. • USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A" OF THE ABS MOTOR PACK.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

NO → REPLACE ABS MOTOR PACK.

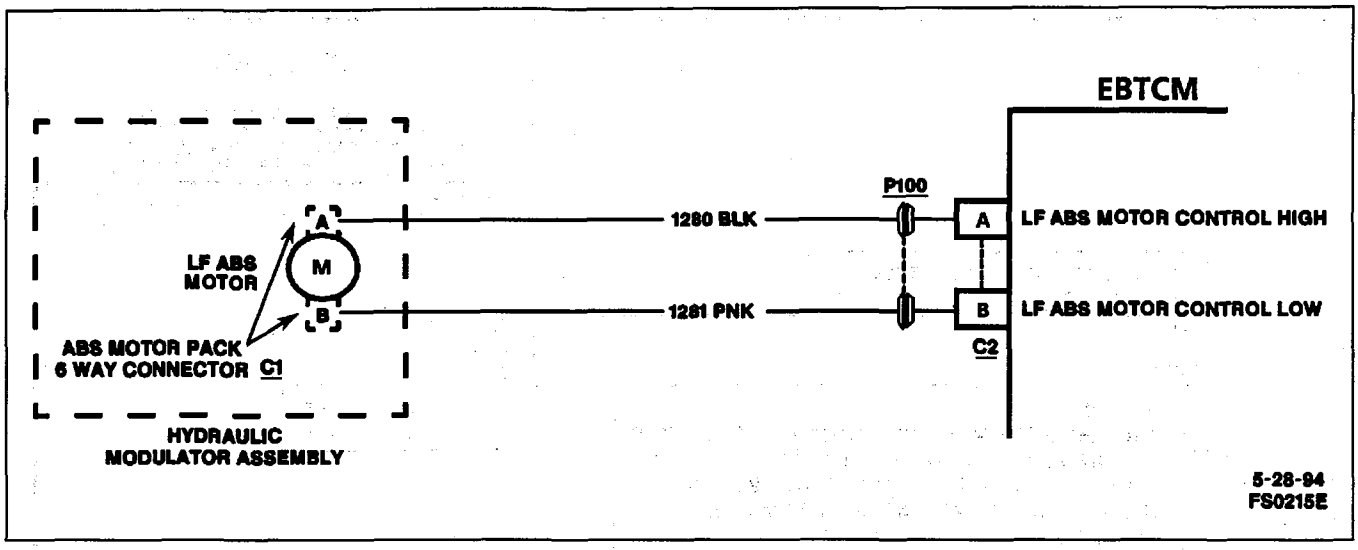
4. • INSPECT CKTs 1280 AND 1281 AND RELATED CONNECTORS FOR DAMAGE WHICH MAY RESULT IN A SHORT TO GROUND WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
   • IGNITION "OFF."
   • RECONNECT ALL CONNECTORS.
   • START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
   • REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
   DID DTC 57 SET IN THE LAST THREE DRIVE CYCLES?

YES → REPLACE EBTCM.

NO → MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN IGNITION OFF.

C1577S



DTC 58
LEFT FRONT ABS MOTOR CIRCUIT SHORTED TO BATT

Circuit Description:

This DTC identifies an ABS motor circuit that is shorted to battery or an ABS motor that has low or no resistance. This malfunction will not allow the ABS motor to be controlled at the commanded current rate or will cause the ABS motor to turn in the opposite direction, or not at all.

DTC Will Set When:

DTC 58 can be set only when the ABS motor is commanded "OFF." If the EBTCM detects an out of range voltage on either of the left front ABS motor circuits indicating a circuit shorted to battery or an ABS motor shorted, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to voltage in the ABS motor "HIGH" circuitry.
2. Checks for a short to voltage in the ABS motor "LOW" circuitry.
3. Checks for a short between the "HIGH" and "LOW" motor circuits.
4. Checks for an ABS motor that is internally shorted.
5. Ensures malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

Using Tech 1, select manual control function, and exercise ABS motor movement of affected channel in both directions while applying light pressure on the brake pedal.

If erratic or "jumpy" brake pedal movement is detected while performing an "apply" or "release" function of the ABS motor, an intermittent malfunction may be indicated.

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

DTC 58
LEFT FRONT ABS MOTOR CIRCUIT SHORTED TO BATT

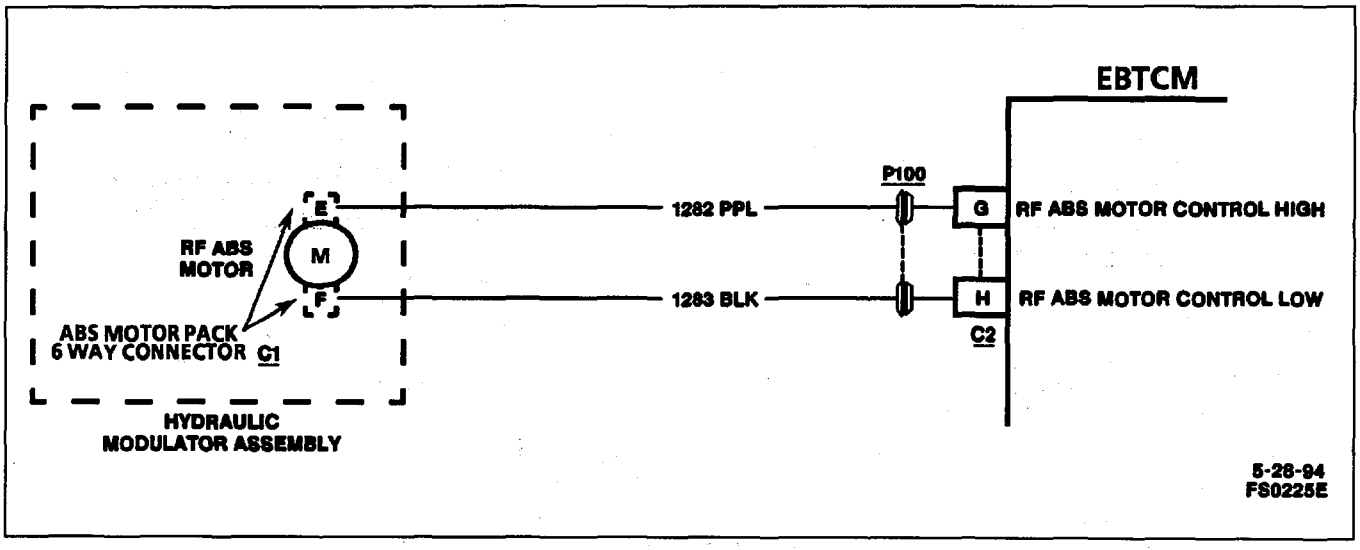
DOES DTC 58 OCCUR INTERMITTENTLY?

- YES → REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
- NO →

1. • IGNITION "OFF."
   • DISCONNECT THE 6-WAY ABS MOTOR PACK CONNECTOR AND THE GRAY 8-WAY EBTCM CONNECTOR.
   • IGNITION "ON."
   • USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A" OF THE 6-WAY ABS MOTDR PACK HARNESS CONNECTOR. IS VOLTAGE 1 VOLT OR LESS?
   - NO → REPAIR SHORT TO VOLTAGE IN CKT 1280.
   - YES →
2. • USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR. IS VOLTAGE 1 VOLT OR LESS?
   - NO → REPAIR SHORT TO VOLTAGE IN CKT 1281.
   - YES →
3. • IGNITION "OFF."
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR. DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
   - NO → REPAIR SHORT BETWEEN CKTs 1280 AND 1281.
   - YES →
4. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE ABS MOTOR PACK. IS RESISTANCE GREATER THAN 0.4Ω?
   - NO → REPLACE ABS MOTOR PACK.
   - YES →
5. • INSPECT CKTs 1280 AND 1281 AND RELATED CONNECTORS FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
   • RECONNECT ALL CONNECTORS.
   • IGNITION "OFF."
   • START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
   • REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES. DID DTC 58 SET IN THE LAST THREE DRIVE CYCLES?
   - NO → MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - YES → REPLACE EBTCM.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY OFF.

C0131S



DTC 61
RIGHT FRONT ABS MOTOR CIRCUIT OPEN

Circuit Description:

This DTC identifies an ABS motor that cannot be energized due to an open in its circuitry. This malfunction will not allow proper ABS operation.

DTC Will Set When:

DTC 61 can be set only when the ABS motor is commanded "OFF." If the EBTCM detects an out of range voltage on either of the right front ABS motor circuits indicating an open circuit, a malfunction exists.

Action Taken:

An open ABS motor will not activate when requested. A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for proper resistance of the ABS motor.
2. Checks for an open in the ABS motor "HIGH" circuitry.
3. Checks for an open in the ABS motor "LOW" circuitry.
4. Ensures malfunction was not due to poor terminal contact.

Diagnostic Aids:

Using Tech 1, select manual control function, and exercise ABS motor movement of affected channel in both directions while applying light pressure on the brake pedal.

If erratic or "jumpy" brake pedal movement is detected while performing an "apply" or "release" function of the ABS motor, an intermittent malfunction may be indicated.

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 61
RIGHT FRONT ABS MOTOR CIRCUIT OPEN

DOES DTC 61 OCCUR INTERMITTENTLY?

NO

YES → REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

1. • IGNITION "OFF."
   • DISCONNECT 6-WAY ABS MOTOR PACK CONNECTOR.
   • USING J 39200, MEASURE RESISTANCE ACROSS ABS MOTOR PACK TERMINALS "E" AND "F".
   IS RESISTANCE BELOW 2000Ω?

YES

NO → REPLACE ABS MOTOR PACK.

2. • DISCONNECT GRAY 8-WAY CONNECTOR AT EBTCM.
   • USING J 39200, MEASURE RESISTANCE BETWEEN TERMINAL "G" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "E" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?

YES

NO → REPAIR OPEN OR HIGH RESISTANCE IN CKT 1282.

3. • USING J 39200, MEASURE RESISTANCE BETWEEN TERMINAL "H" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "F" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?

YES

NO → REPAIR OPEN OR HIGH RESISTANCE IN CKT 1283.

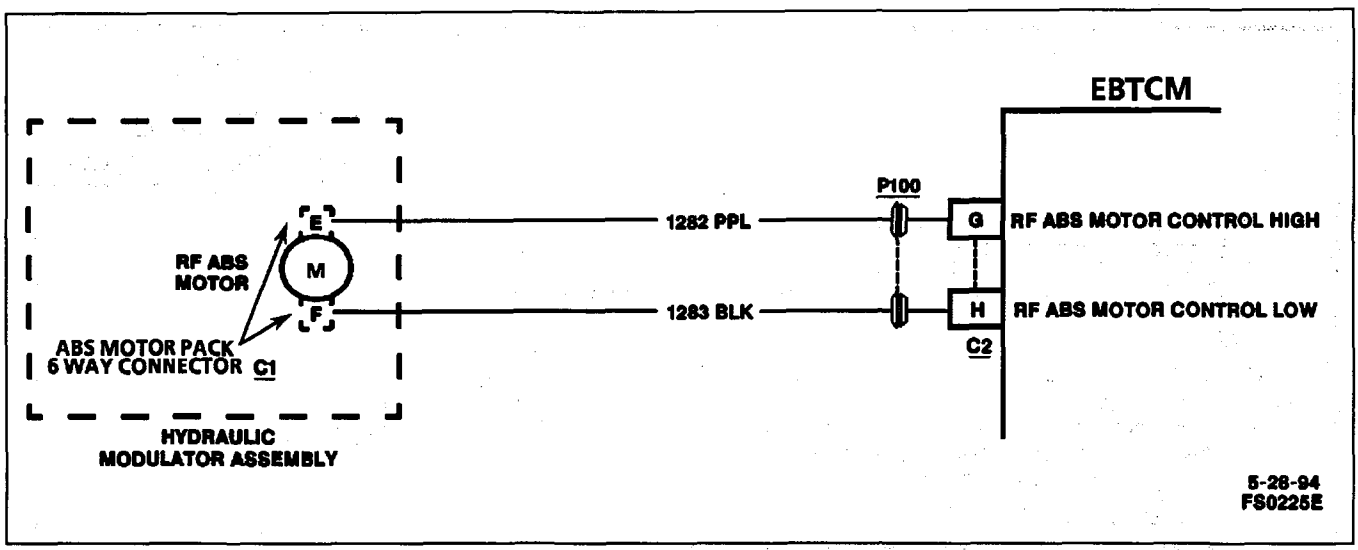
4. • INSPECT THE 6-WAY ABS MOTOR PACK AND GRAY 8-WAY EBTCM CONNECTORS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.
   • IGNITION "OFF."
   • RECONNECT ALL CONNECTORS.
   • START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
   • REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
   DID DTC 61 SET IN THE LAST THREE DRIVE CYCLES?

YES → REPLACE EBTCM.

NO → MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY OFF.

C1584S



DTC 62
RIGHT FRONT ABS MOTOR CIRCUIT SHORTED TO GND

Circuit Description:

This DTC identifies an ABS motor circuit that is shorted to ground. This malfunction will not allow the ABS motor to be controlled at the commanded current rate or will cause the ABS motor driver circuit to allow current directly to ground.

DTC Will Set When:

DTC 62 can be set anytime. If the EBTCM detects an out of range voltage on either of the right front ABS motor circuits indicating a circuit shorted to ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to ground in the ABS motor "HIGH" circuitry.
2. Checks for a short to ground in the ABS motor "LOW" circuitry.
3. Checks for an ABS motor that is internally shorted to ground.
4. Ensures malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

Using Tech 1, select manual control function, and exercise ABS motor movement of affected channel in both directions while applying light pressure on the brake pedal.

If erratic or "jumpy" brake pedal movement is detected while performing an "apply" or "release" function of the ABS motor, an intermittent malfunction may be indicated.

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry, that is suspected as causing the intermittent complaint, should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 62
RIGHT FRONT ABS MOTOR CIRCUIT SHORTED TO GND

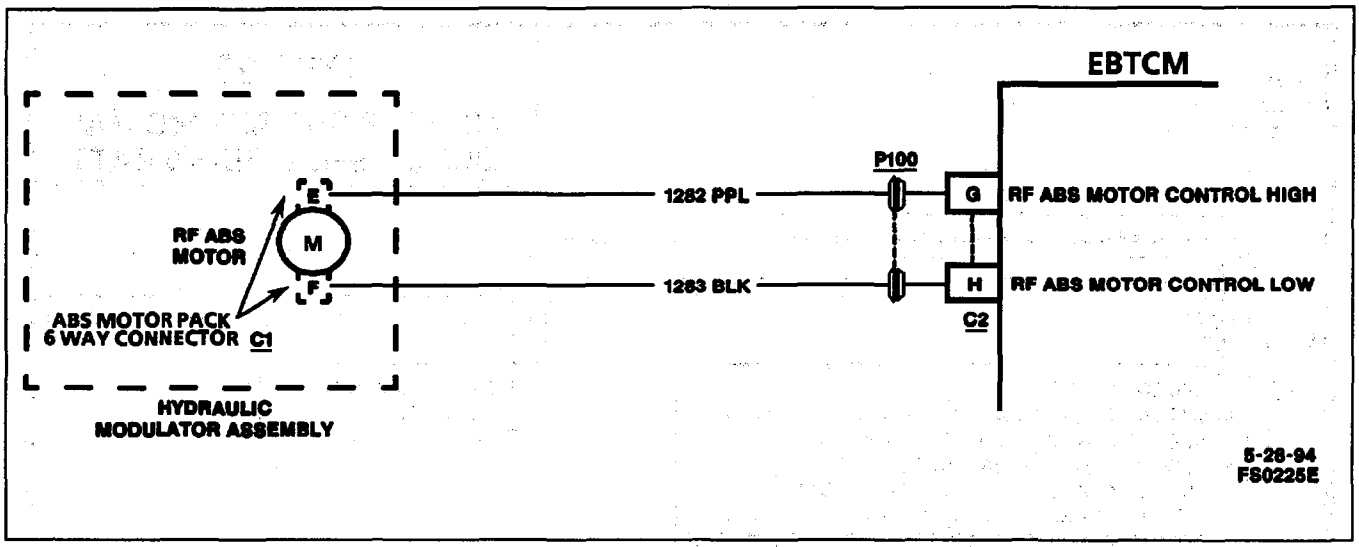
DOES DTC 62 OCCUR INTERMITTENTLY?

- YES → REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
- NO →

1. • IGNITION "OFF."
   • DISCONNECT 6-WAY ABS MOTOR PACK CONNECTOR AND THE GRAY B-WAY EBTCM CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "E" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
   - NO → REPAIR SHORT TO GROUND IN CKT 12B2.
   - YES →
2. • USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "F" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
   - NO → REPAIR SHORT TO GROUND IN CKT 1283.
   - YES →
3. • USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "E" OF THE ABS MOTOR PACK.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
   - NO → REPLACE ABS MOTOR PACK.
   - YES →
4. • INSPECT CKTs 12B2 AND 1283 AND RELATED CONNECTORS FOR DAMAGE WHICH MAY RESULT IN A SHORT TO GROUND WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
   • IGNITION "OFF."
   • RECONNECT ALL CONNECTORS.
   • START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
   • REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
   DID DTC 62 SET IN THE LAST THREE DRIVE CYCLES?
   - NO → MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - YES → REPLACE EBTCM.

AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY OFF.

C1585S



DTC 63
RIGHT FRONT ABS MOTOR CIRCUIT SHORTED TO BATT

Circuit Description:

This DTC identifies an ABS motor circuit that is shorted to battery or an ABS motor that has low or no resistance. This malfunction will not allow the ABS motor to be controlled at the commanded current rate or will cause the ABS motor to turn in the opposite direction, or not at all.

DTC Will Set When:

DTC 63 can be set only when the ABS motor is commanded "OFF." If the EBTCM detects an out of range voltage on either of the right front ABS motor circuits indicating a circuit shorted to battery or an ABS motor shorted, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to voltage in the ABS motor "HIGH" circuitry.
2. Checks for a short to voltage in the ABS motor "LOW" circuitry.
3. Checks for short circuit between ABS motor "HIGH" and motor "LOW".
4. Checks for an ABS motor that is internally shorted.
5. Ensures malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

Using Tech 1, select manual control function, and exercise ABS motor movement of affected channel in both directions while applying light pressure on the brake pedal.

If erratic or "jumpy" brake pedal movement is detected while performing an "apply" or "release" function of the ABS motor, an intermittent malfunction may be indicated.

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 63
RIGHT FRONT ABS MOTOR CIRCUIT SHORTED TO BATT

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

DOES DTC 63 OCCUR INTERMITTENTLY?

- **NO**
- **YES** → REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

1
- IGNITION "OFF."
- DISCONNECT THE 6-WAY ABS MOTOR PACK CONNECTOR AND THE GRAY 8-WAY EBTCM CONNECTOR.
- IGNITION "ON."
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "E" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

- **YES**
- **NO** → REPAIR SHORT TO VOLTAGE IN CKT 1282.

2
- USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "F" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.

IS VOLTAGE 1 VOLT OR LESS?

- **YES**
- **NO** → REPAIR SHORT TO VOLTAGE IN CKT 1283.

3
- IGNITION "OFF."
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "E" AND TERMINAL "F" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

- **YES**
- **NO** → REPAIR SHORT BETWEEN CKTs 1282 AND 1283.

4
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "E" AND TERMINAL "F" OF THE ABS MOTOR PACK.

IS RESISTANCE GREATER THAN 0.4Ω?

- **YES**
- **NO** → REPLACE ABS MOTOR PACK.

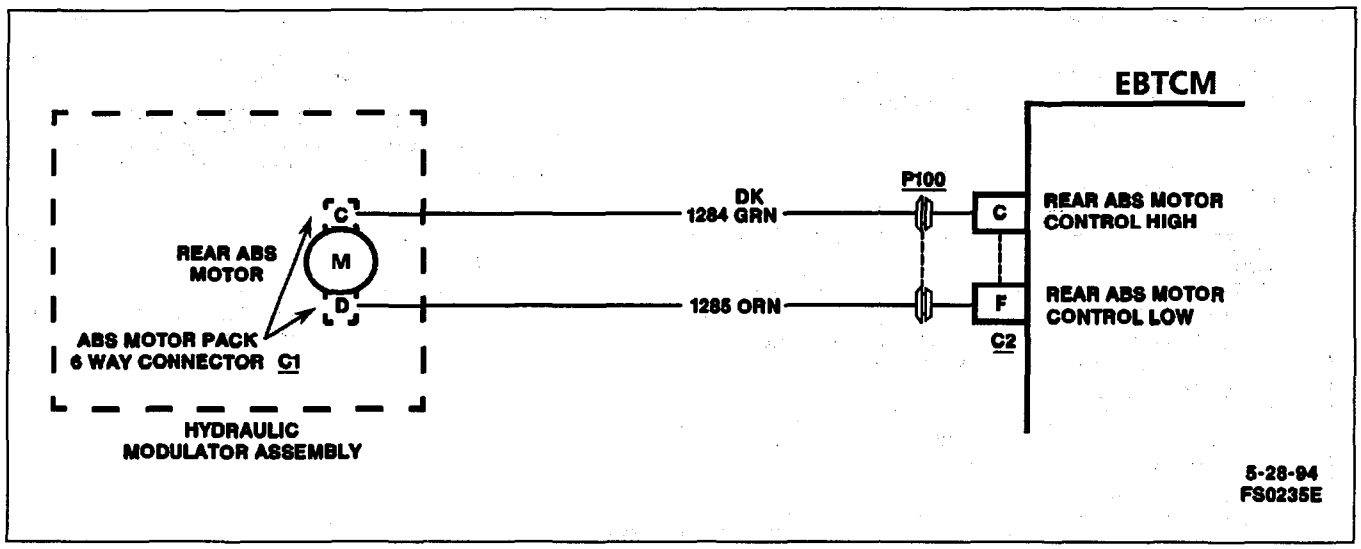
5
- INSPECT CKTs 1282 AND 1283 AND RELATED CONNECTORS FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
- IGNITION "OFF."
- RECONNECT ALL CONNECTORS.
- START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
- REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.

DID DTC 63 SET IN THE LAST THREE DRIVE CYCLES?

- **YES** → REPLACE EBTCM.
- **NO** → MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY OFF.

C1586S



DTC 64
REAR ABS MOTOR CIRCUIT OPEN

Circuit Description:

This DTC identifies an ABS motor that cannot be energized due to an open in its circuitry. This malfunction will not allow proper ABS operation.

DTC Will Set When:

DTC 64 can be set only when the ABS motor is commanded "OFF." If the EBTCM detects an out of range voltage on either of the rear axle ABS motor circuits indicating an open circuit, a malfunction exists.

Action Taken:

An open ABS motor will not activate when requested. A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This checks for proper resistance of the ABS motor.
2. Checks for an open in the ABS motor "HIGH" circuitry.
3. Checks for an open in the ABS motor "LOW" circuitry.
4. Ensures malfunction was not due to poor terminal contact.

Diagnostic Aids:

Using Tech 1, select manual control function, and exercise ABS motor movement of affected channel in both directions while applying light pressure on the brake pedal.

If erratic or "jumpy" brake pedal movement is detected while performing an "apply" or "release" function of the ABS motor, an intermittent malfunction may be indicated.

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 64
REAR ABS MOTOR CIRCUIT OPEN

DDES DTC 64 OCCUR INTERMITTENTLY?

NO

YES

REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

1
- IGNITION "OFF."
- DISCDNNECT 6-WAY ABS MOTOR PACK CDNNECTDR.
- USING J 39200, MEASURE RESISTANCE ACROSS ABS MOTOR PACK TERMINALS "C" AND "D". IS RESISTANCE BELOW 2000Ω?

YES

NO

REPLACE ABS MOTOR PACK.

2
- DISCONNECT GRAY 8-WAY CONNECTOR AT EBTCM.
- USING J 39200, MEASURE RESISTANCE BETWEEN TERMINAL "C" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "C" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR. IS RESISTANCE 2Ω OR LESS?

YES

ND

REPAIR OPEN OR HIGH RESISTANCE IN CKT 1284.

3
- USING J 39200, MEASURE RESISTANCE BETWEEN TERMINAL "F" OF THE GRAY 8-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "D" OF THE 6-WAY ABS MOTOR PACK HARNESS CDNNECTOR. IS RESISTANCE 2Ω OR LESS?

YES

NO

REPAIR OPEN OR HIGH RESISTANCE IN CKT 1285.

4
- INSPECT THE 6-WAY ABS MOTOR PACK AND GRAY 8-WAY EBTCM CONNECTORS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORRDSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CDNTACT OR CORROSION.
- IGNITION "OFF."
- RECONNECT ALL CONNECTORS.
- START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
- REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES. DID DTC 64 SET IN THE LAST THREE DRIVE CYCLES?

YES

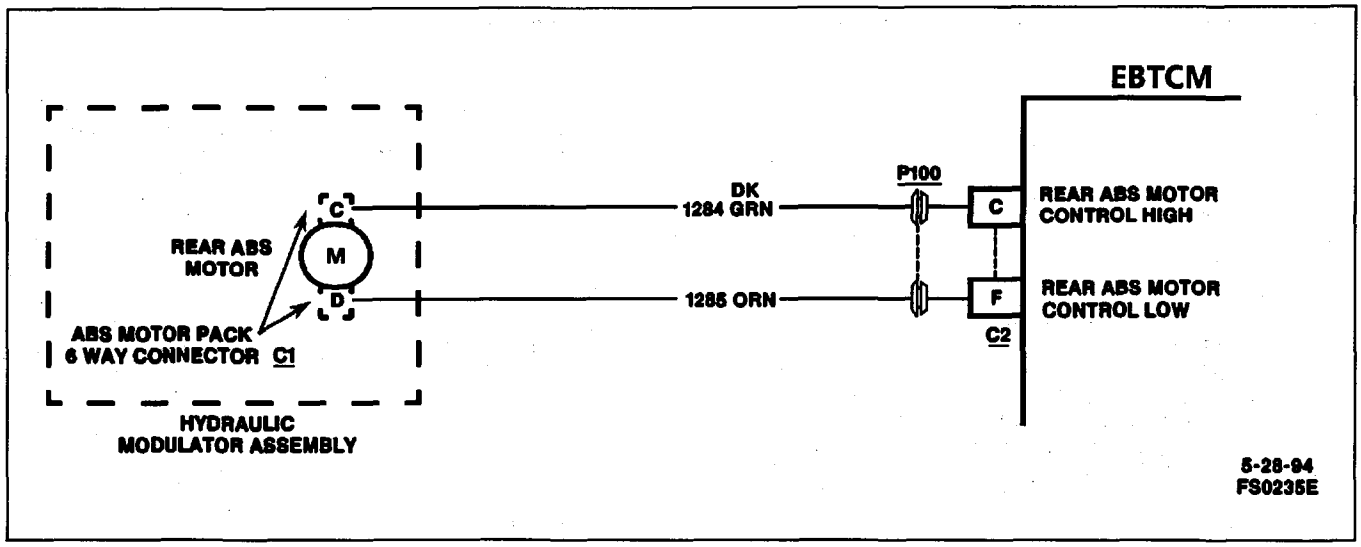
REPLACE EBTCM.

NO

MALFUNCTIDN WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY OFF.

C1587S



DTC 65
REAR ABS MOTOR CIRCUIT SHORTED TO GROUND

Circuit Description:

This DTC identifies an ABS motor circuit that is shorted to ground. This malfunction will not allow the ABS motor to be controlled at the commanded current rate or will cause the ABS motor driver circuit to allow current directly to ground.

DTC Will Set When:

DTC 65 can be set anytime. If the EBTCM detects an out of range voltage on either of the rear axle ABS motor circuits indicating a circuit shorted to ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to ground in the ABS motor "HIGH" circuitry.
2. Checks for a short to ground in the ABS motor "LOW" circuitry.
3. Checks for an ABS motor that is internally shorted to ground.
4. Ensures malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

Using Tech 1, select manual control function, and exercise ABS motor movement of affected channel in both directions while applying light pressure on the brake pedal.

If erratic or "jumpy" brake pedal movement is detected while performing an "apply" or "release" function of the ABS motor, an intermittent malfunction may be indicated.

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 65
REAR ABS MOTOR CIRCUIT SHORTED TO GROUND

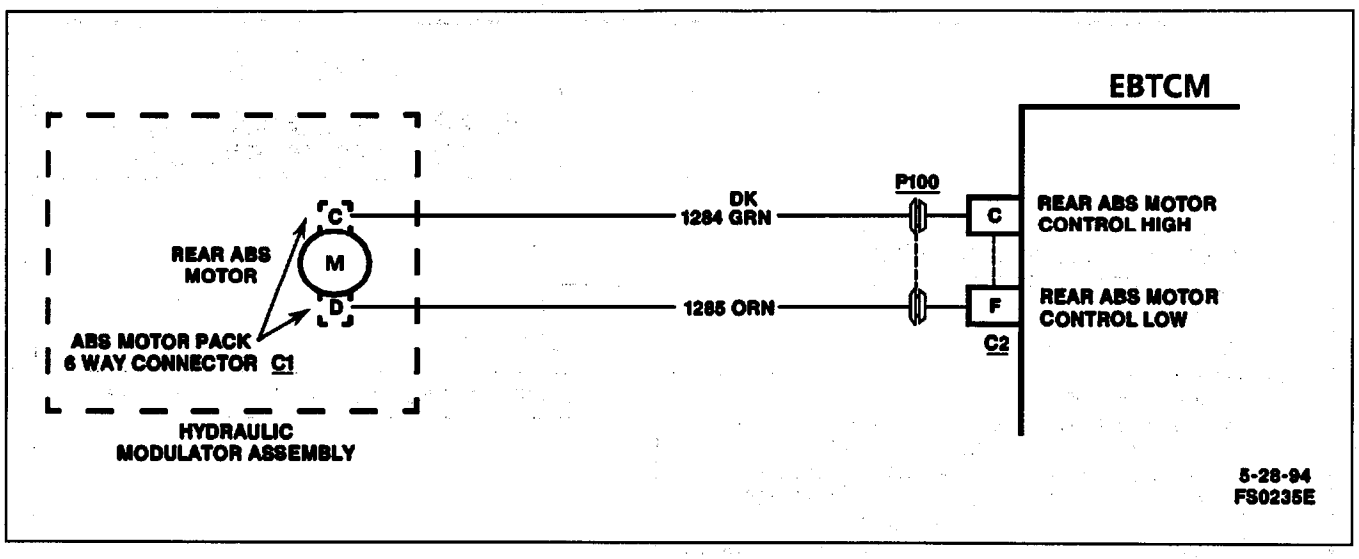
DOES DTC 65 OCCUR INTERMITTENTLY?

- YES → REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
- NO →

1. • IGNITION "OFF."
   • DISCONNECT THE 6-WAY ABS MOTOR PACK CONNECTOR AND THE GRAY 8-WAY EBTCM CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "C" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTDR.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
   - NO → REPAIR SHORT TO GROUND IN CKT 1284.
   - YES →
2. • USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "D" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
   - NO → REPAIR SHORT TO GROUND IN CKT 1285.
   - YES →
3. • USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "C" OF THE ABS MOTOR PACK.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
   - NO → REPLACE ABS MOTOR PACK.
   - YES →
4. • INSPECT CKTs 1284 AND 1285 AND RELATED CONNECTORS FOR DAMAGE WHICH MAY RESULT IN A SHORT TO GROUND WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
   • IGNITION "OFF."
   • RECONNECT ALL CONNECTORS.
   • START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
   • REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
   DID DTC 65 SET IN THE LAST THREE DRIVE CYCLES?
   - NO → MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - YES → REPLACE EBTCM.

AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY OFF.

C1588S



DTC 66
REAR ABS MOTOR CIRCUIT SHORTED TO BATTERY

Circuit Description:

This DTC identifies an ABS motor circuit that is shorted to battery or an ABS motor that has low or no resistance. This malfunction will not allow the ABS motor to be controlled at the commanded current rate or will cause the ABS motor to turn in the opposite direction, or not turn at all.

DTC Will Set When:

DTC 66 can be set only when the ABS motor is commanded "OFF." If the EBTCM detects an out of range voltage on either of the rear ABS axle motor circuits indicating a circuit shorted to battery or an ABS motor shorted, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to voltage in the ABS motor "HIGH" circuitry.
2. Checks for a short to voltage in the ABS motor "LOW" circuitry.
3. Checks for a short circuit between motor "HIGH" and motor "LOW".
4. Checks for an ABS motor that is internally shorted.
5. Ensures malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

Using Tech 1, select manual control function, and exercise ABS motor movement of affected channel in both directions while applying light pressure on the brake pedal.

If erratic or "jumpy" brake pedal movement is detected while performing an "apply" or "release" function of the ABS motor, an intermittent malfunction may be indicated.

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

DTC 66
REAR ABS MOTOR CIRCUIT SHORTED TO BATTERY

DOES DTC 66 OCCUR INTERMITTENTLY?

NO

YES → REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

1. • IGNITION "OFF."
   • DISCONNECT THE 6-WAY ABS MDTOR PACK CONNECTOR AND THE GRAY 8-WAY EBTCM CONNECTOR.
   • IGNITION "ON."
   • USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "C" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.
   IS VOLTAGE 1 VOLT OR LESS?

YES

NO → REPAIR SHORT TO VOLTAGE IN CKT 1284.

2. • USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "D" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.
   IS VOLTAGE 1 VOLT OR LESS?

YES

NO → REPAIR SHORT TO VOLTAGE IN CKT 1285.

3. • IGNITION "OFF."
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C" AND TERMINAL "D" OF THE 6-WAY ABS MOTOR PACK HARNESS CONNECTOR.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

NO → REPAIR SHORT BETWEEN CKTs 1284 AND 1285.

4. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C" AND TERMINAL "D" OF THE ABS MOTOR PACK.
   IS RESISTANCE GREATER THAN 0.4Ω?

YES

NO → REPLACE ABS MOTOR PACK

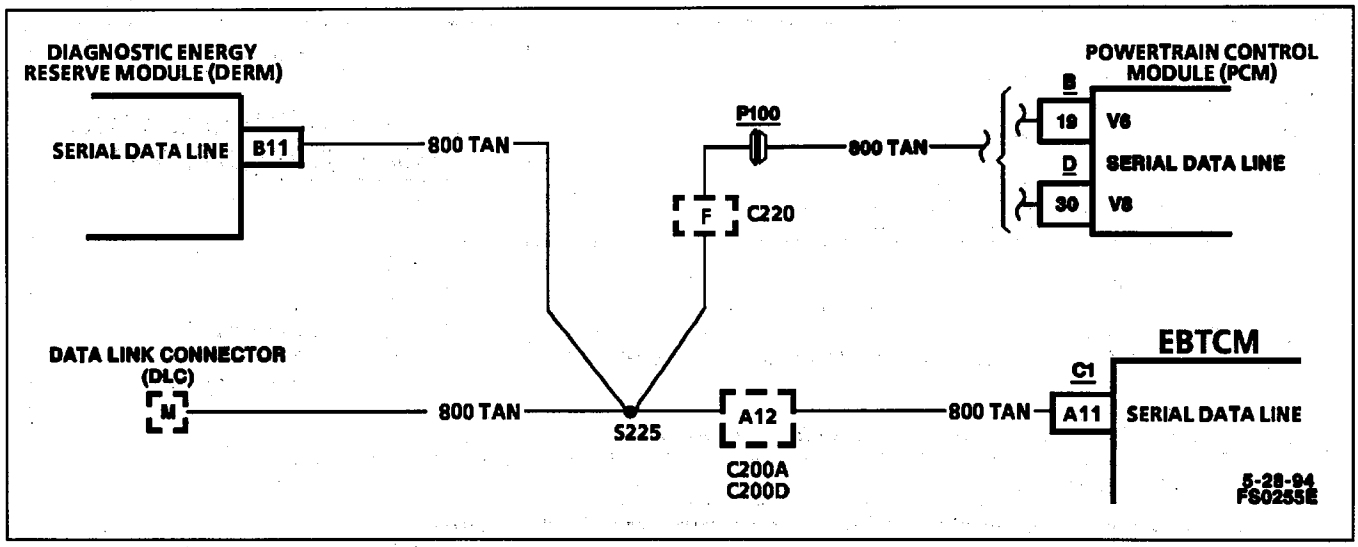
5. • INSPECT CKTs 1284 AND 1285 AND RELATED CONNECTORS FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
   • IGNITION "OFF."
   • RECONNECT ALL CONNECTORS.
   • START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
   • REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
   DID DTC 66 SET IN THE LAST THREE DRIVE CYCLES?

YES → REPLACE EBTCM.

NO → MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY OFF.

C1589S



DTC 75
PCM TO EBTCM SERIAL DATA MALFUNCTION

Circuit Description:

The serial data communications circuit is used to transmit messages from one electronic control unit to another when interface is necessary between systems. The ABS VI/TCS systems depends on information from the PCM for proper operation.

DTC Will Set When:

DTC 75 will set when the vehicle speed is greater than 3 mph and there is a malfunction on the serial data circuit, or if the PCM has not broadcasted a serial message for at least 10 seconds.

Action Taken:

A malfunction DTC is stored, TCS is disabled. The amber TCS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step tests the test equipment.
2. Checks other systems on the circuit.
3. Checks for short to ground on serial data line.
4. Checks for short to voltage on serial data line.
5. Checks for poor terminal contact or corrosion which can cause malfunction.
6. Attempts to establish communication with modules.

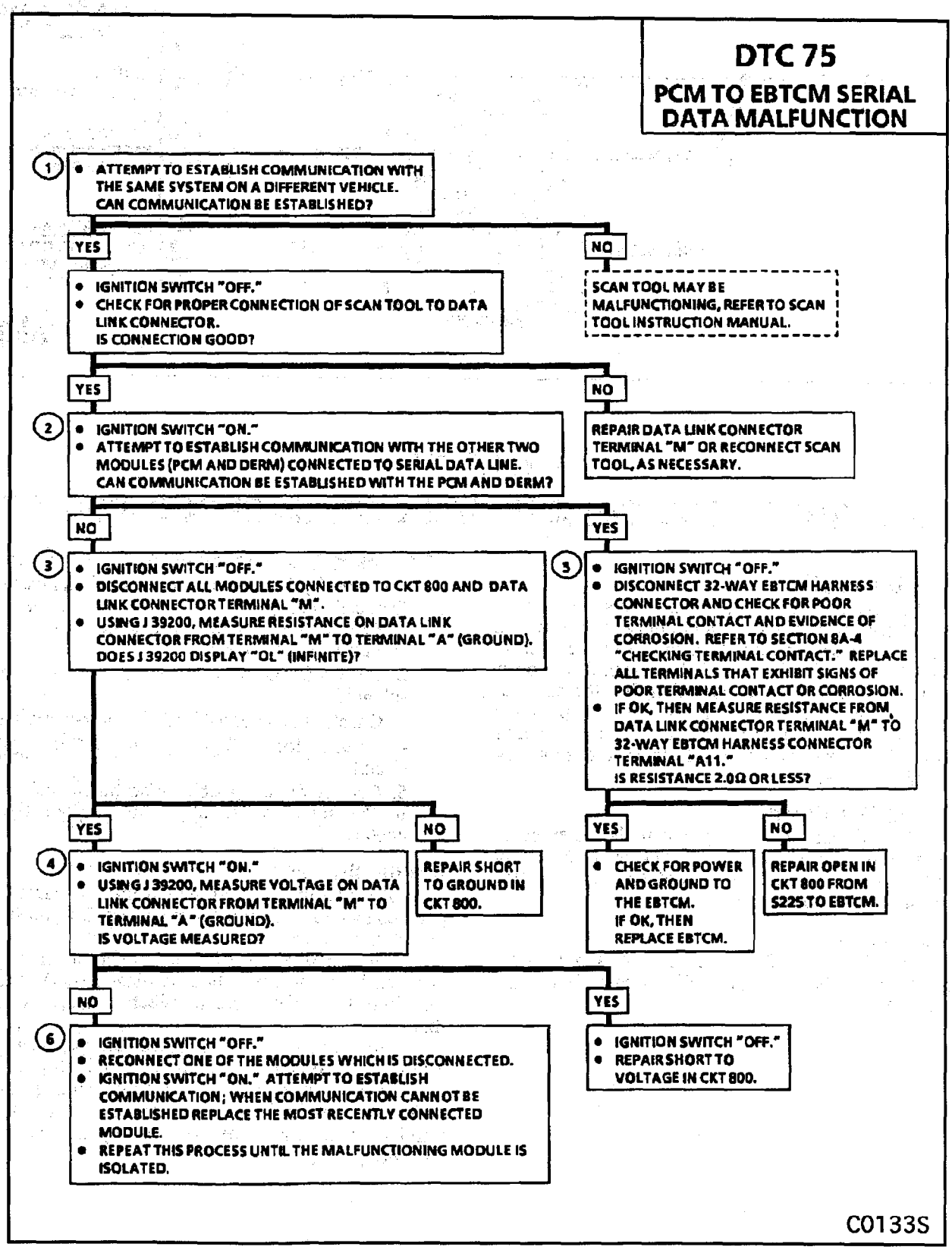
Diagnostic Aids:

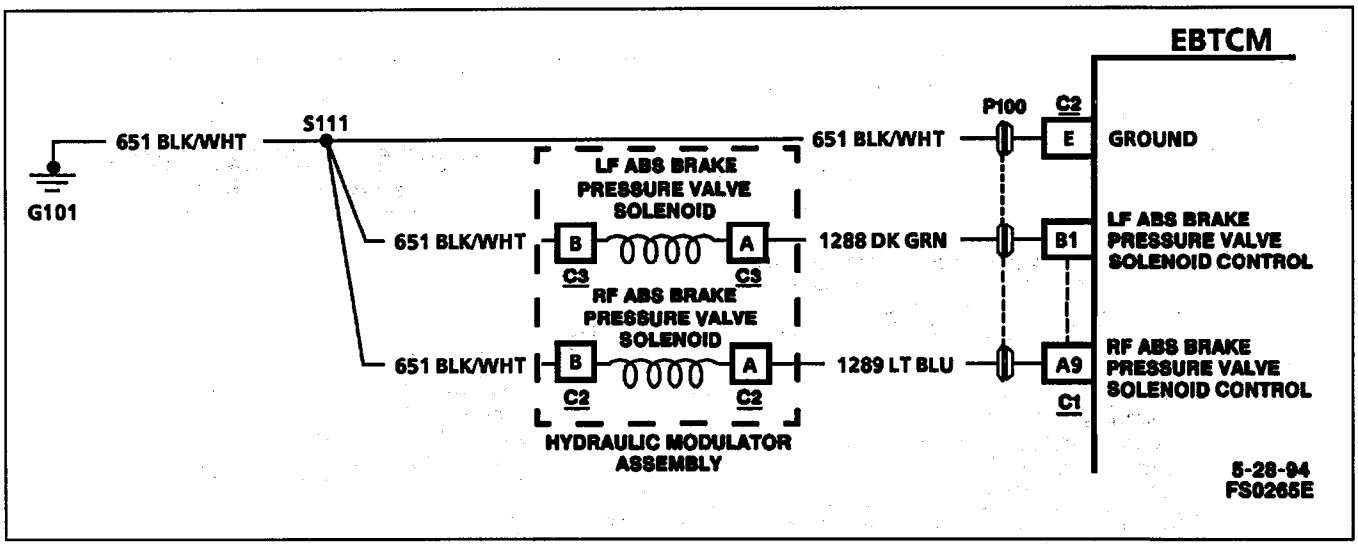
When DTC 75 is current (malfunction in CKT 800), no communication can be established with the Tech 1 scan tool. When the malfunction is removed, DTC 75 will be stored in system memory.

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.


DTC 75
PCM TO EBTCM SERIAL DATA MALFUNCTION
1
• ATTEMPT TO ESTABLISH COMMUNICATION WITH THE SAME SYSTEM ON A DIFFERENT VEHICLE. CAN COMMUNICATION BE ESTABLISHED?
YES
NO
• IGNITION SWITCH "OFF."
• CHECK FOR PROPER CONNECTION OF SCAN TOOL TO DATA LINK CONNECTOR. IS CONNECTION GOOD?
SCAN TOOL MAY BE MALFUNCTIONING, REFER TO SCAN TOOL INSTRUCTION MANUAL.
YES
NO
2
• IGNITION SWITCH "ON."
• ATTEMPT TO ESTABLISH COMMUNICATION WITH THE OTHER TWO MODULES (PCM AND DERM) CONNECTED TO SERIAL DATA LINE. CAN COMMUNICATION BE ESTABLISHED WITH THE PCM AND DERM?
REPAIR DATA LINK CONNECTOR TERMINAL "M" OR RECONNECT SCAN TOOL, AS NECESSARY.
NO
YES
3
• IGNITION SWITCH "OFF."
• DISCONNECT ALL MODULES CONNECTED TO CKT 800 AND DATA LINK CONNECTOR TERMINAL "M".
• USING J 39200, MEASURE RESISTANCE ON DATA LINK CONNECTOR FROM TERMINAL "M" TO TERMINAL "A" (GROUND). DOES J 39200 DISPLAY "OL" (INFINITE)?
5
• IGNITION SWITCH "OFF."
• DISCONNECT 32-WAY EBTCM HARNESS CONNECTOR AND CHECK FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4 "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.
• IF OK, THEN MEASURE RESISTANCE FROM DATA LINK CONNECTOR TERMINAL "M" TO 32-WAY EBTCM HARNESS CONNECTOR TERMINAL "A11." IS RESISTANCE 2.0Ω OR LESS?
YES
NO
YES
NO
4
• IGNITION SWITCH "ON."
• USING J 39200, MEASURE VOLTAGE ON DATA LINK CONNECTOR FROM TERMINAL "M" TO TERMINAL "A" (GROUND). IS VOLTAGE MEASURED?
REPAIR SHORT TO GROUND IN CKT 800.
• CHECK FOR POWER AND GROUND TO THE EBTCM. IF OK, THEN REPLACE EBTCM.
REPAIR OPEN IN CKT 800 FROM S225 TO EBTCM.
NO
YES
6
• IGNITION SWITCH "OFF."
• RECONNECT ONE OF THE MODULES WHICH IS DISCONNECTED.
• IGNITION SWITCH "ON." ATTEMPT TO ESTABLISH COMMUNICATION; WHEN COMMUNICATION CANNOT BE ESTABLISHED REPLACE THE MOST RECENTLY CONNECTED MODULE.
• REPEAT THIS PROCESS UNTIL THE MALFUNCTIONING MODULE IS ISOLATED.
• IGNITION SWITCH "OFF."
• REPAIR SHORT TO VOLTAGE IN CKT 800.
C0133S



DTC 76
LEFT FRONT SOL CIRCUIT OPEN OR SHORTED TO BATT

Circuit Description:

This DTC identifies a solenoid that cannot be energized due to an open in its circuitry, or a solenoid that is always energized due to a short to battery in its circuitry between the driver and the solenoid. An open will not allow proper ABS operation, but the short to battery simply turns "ON" the solenoid. A path for base brakes is still allowed once the motor re-homes and the check ball is lifted off its seat during key "ON" initialization.

DTC Will Set When:

DTC 76 can be set only when the solenoid is commanded "OFF." If the EBTCM detects an excessive voltage in the left front solenoid control circuit, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to voltage in the control circuitry of the solenoid.
2. Checks for an open in the control circuit of the solenoid.
3. Checks the solenoid coil for proper resistance.
4. Checks for an open in the solenoid ground circuit.
5. Checks for a possible intermittent malfunction in the solenoid circuitry due to poor terminal contact.

Diagnostic Aids:

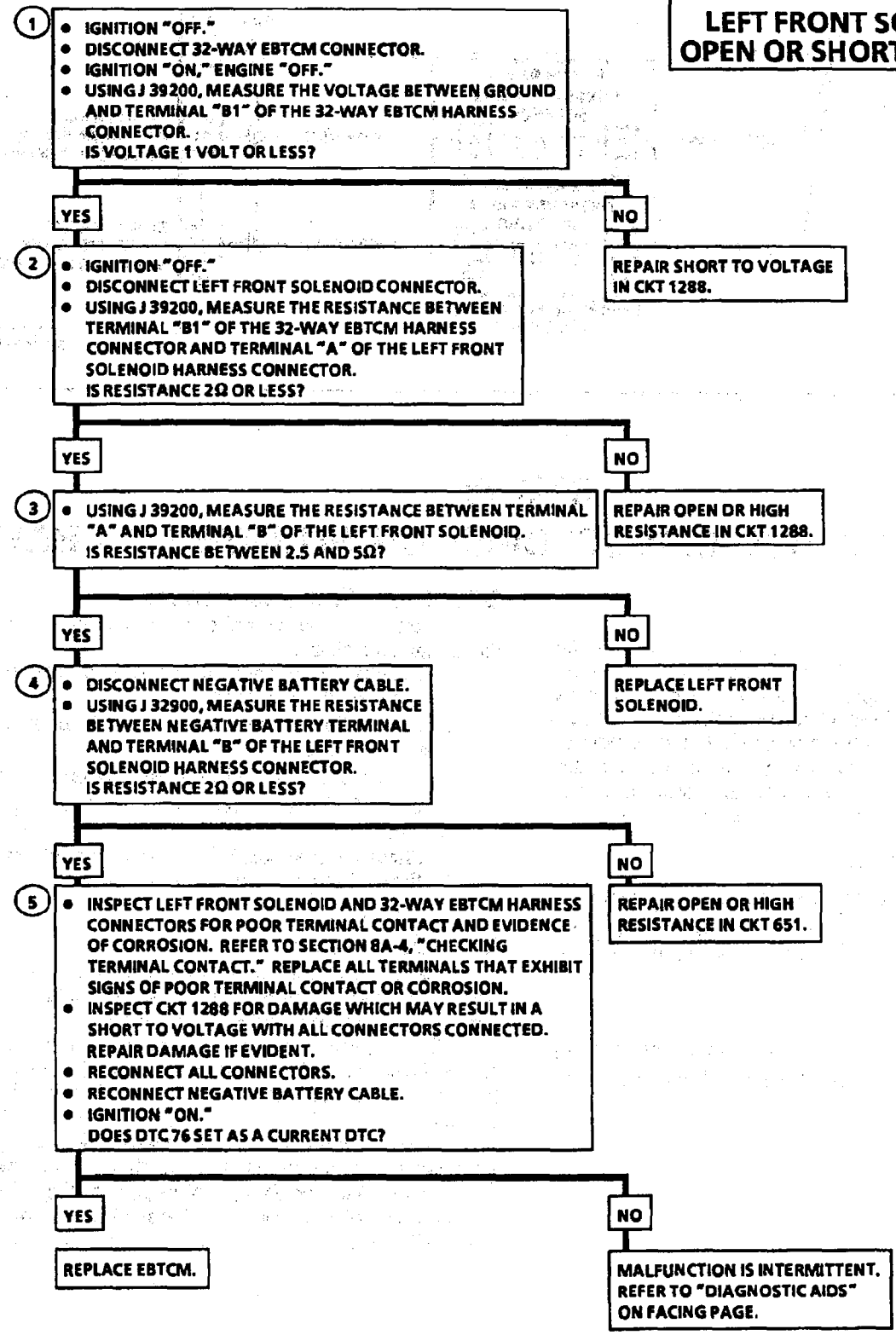
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

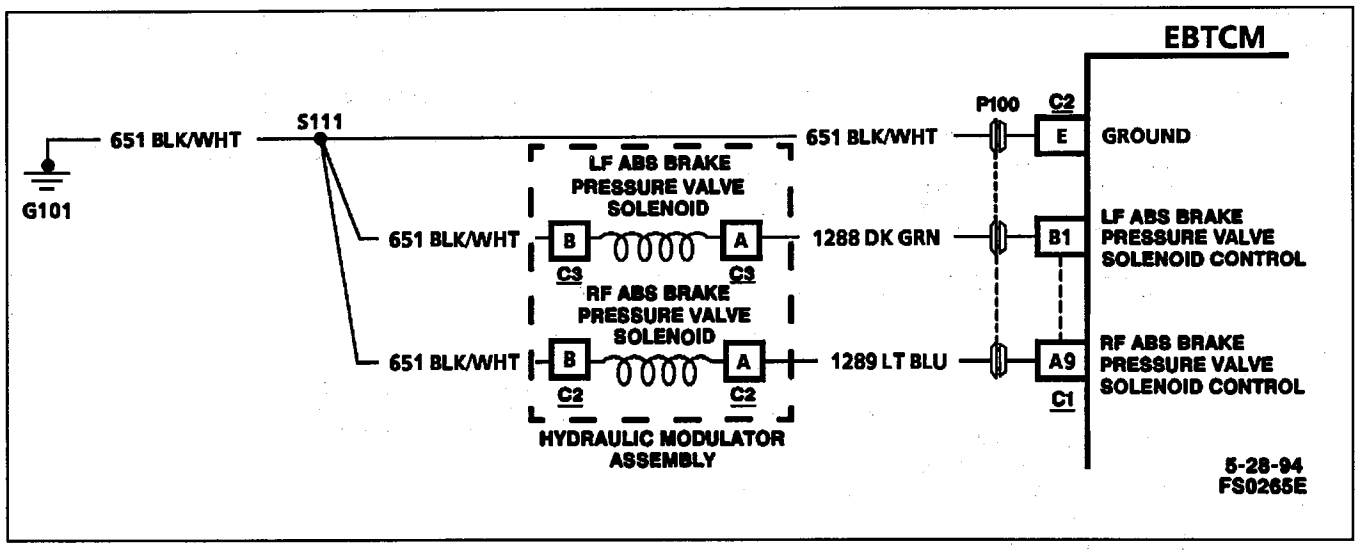
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 76

LEFT FRONT SOL CIRCUIT OPEN OR SHORTED TO BATT



C0134S



DTC 77
LEFT FRONT SOLENOID CIRCUIT SHORTED TO GND

Circuit Description:

This DTC identifies a solenoid that cannot be energized due to an open in its driver circuitry, or a short to ground between the solenoid driver and the solenoid. These malfunctions can affect ABS operation since the flow of brake fluid to the wheel cylinder cannot be stopped, making ABS operation for that channel impossible.

DTC Will Set When:

DTC 77 can be set only when the solenoid is commanded "ON." If the EBTCM detects the left front solenoid control circuit voltage is out of specification, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

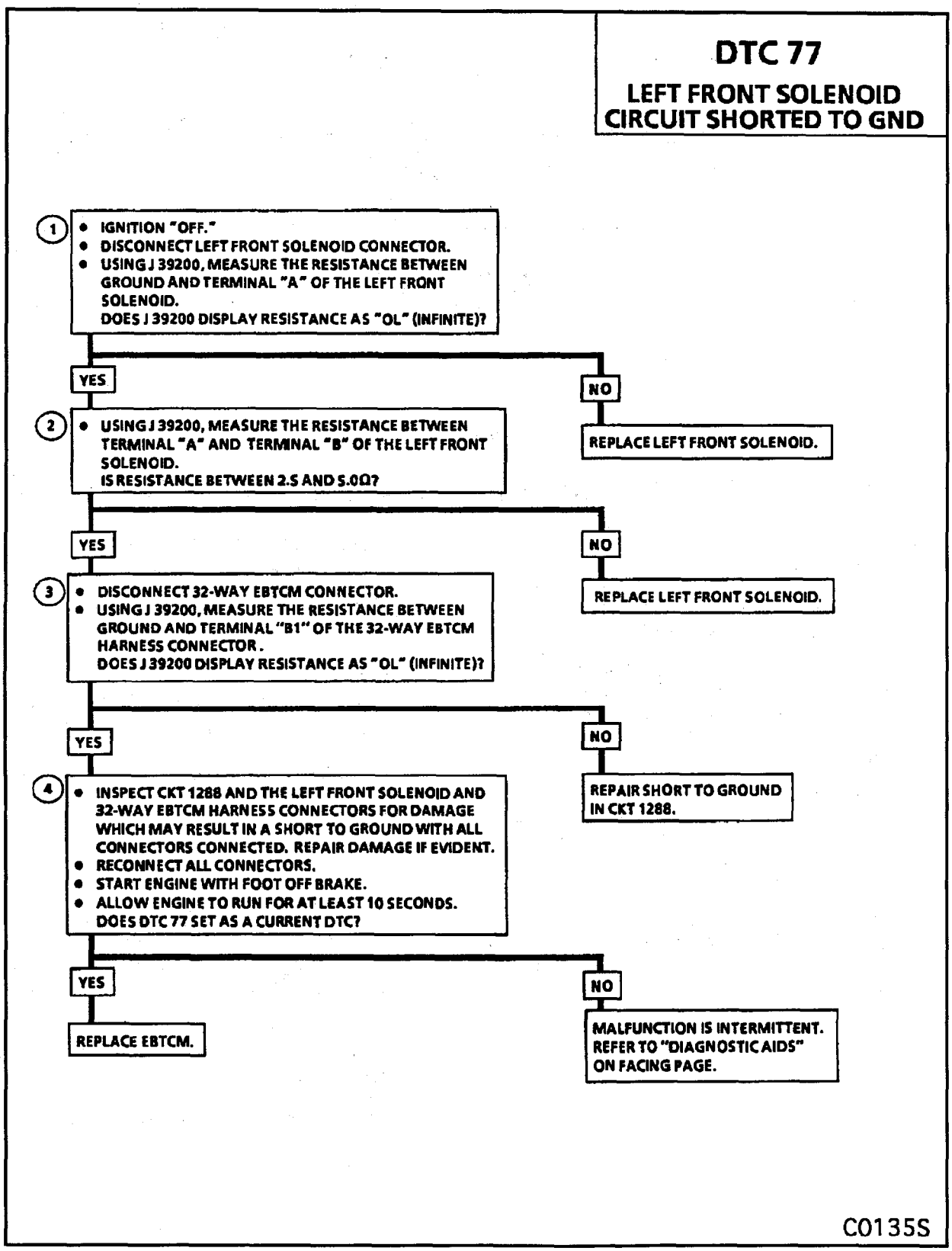
1. Checks for a solenoid that is internally shorted to ground.
2. Checks for a solenoid that is not within proper resistance values.
3. Indicates if a short to ground exists in the solenoid circuitry.
4. Checks for a possible intermittent malfunction in the solenoid circuitry due to poor terminal contact.

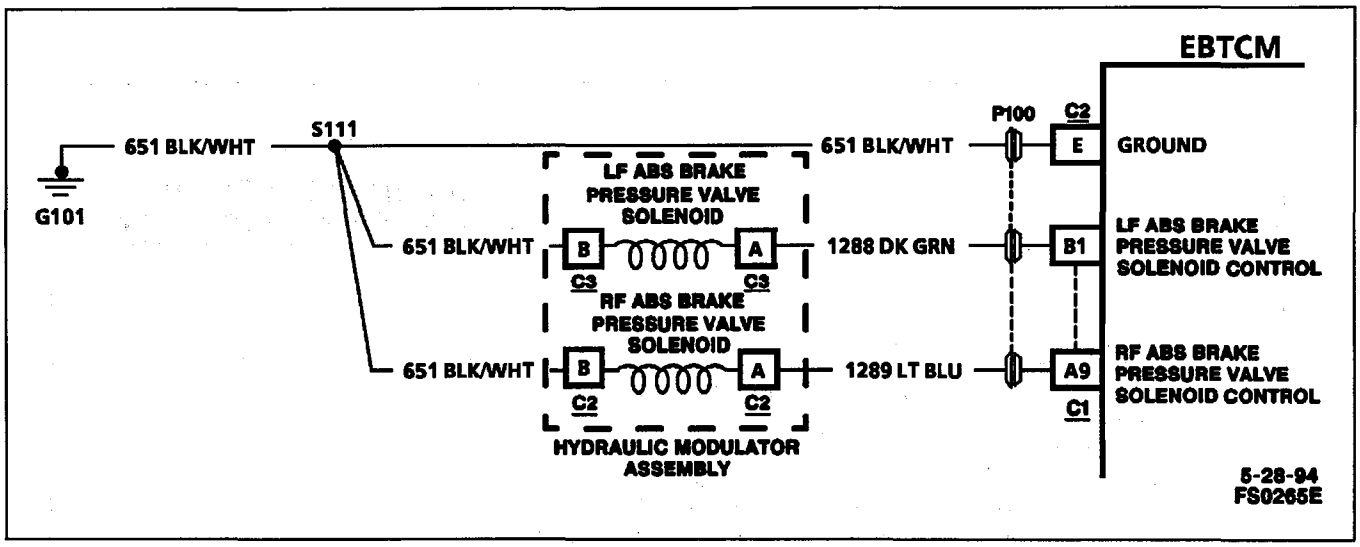
Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.


DTC 77
LEFT FRONT SOLENOID CIRCUIT SHORTED TO GND
1
• IGNITION "OFF."
• DISCONNECT LEFT FRONT SOLENOID CONNECTOR.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A" OF THE LEFT FRONT SOLENOID.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
YES
NO
REPLACE LEFT FRONT SOLENOID.
2
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE LEFT FRONT SOLENOID.
IS RESISTANCE BETWEEN 2.5 AND 5.0Ω?
YES
NO
REPLACE LEFT FRONT SOLENOID.
3
• DISCONNECT 32-WAY EBTCM CONNECTOR.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "B1" OF THE 32-WAY EBTCM HARNESS CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
YES
NO
REPAIR SHORT TO GROUND IN CKT 1288.
4
• INSPECT CKT 1288 AND THE LEFT FRONT SOLENOID AND 32-WAY EBTCM HARNESS CONNECTORS FOR DAMAGE WHICH MAY RESULT IN A SHORT TO GROUND WITH ALL CONNECTORS CONNECTED. REPAIR DAMAGE IF EVIDENT.
• RECONNECT ALL CONNECTORS.
• START ENGINE WITH FOOT OFF BRAKE.
• ALLOW ENGINE TO RUN FOR AT LEAST 10 SECONDS.
DOES DTC 77 SET AS A CURRENT DTC?
YES
NO
REPLACE EBTCM.
MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
C0135S



DTC 78
RIGHT FRONT SOL CIRCUIT OPEN OR SHORTED TO BATT

Circuit Description:

This DTC identifies a solenoid that cannot be energized due to an open in its circuitry, or a solenoid that is always energized due to a short to battery in its circuitry between the driver and the solenoid. An open will not allow proper ABS operation, but the short to battery simply turns "ON" the solenoid. A path for base brakes is still allowed once the motor re-homes and the check ball is lifted off its seat during key "ON" initialization.

DTC Will Set When:

DTC 78 can be set only when the solenoid is commanded "OFF." If the EBTCM detects an excessive voltage in the right front solenoid control circuit, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

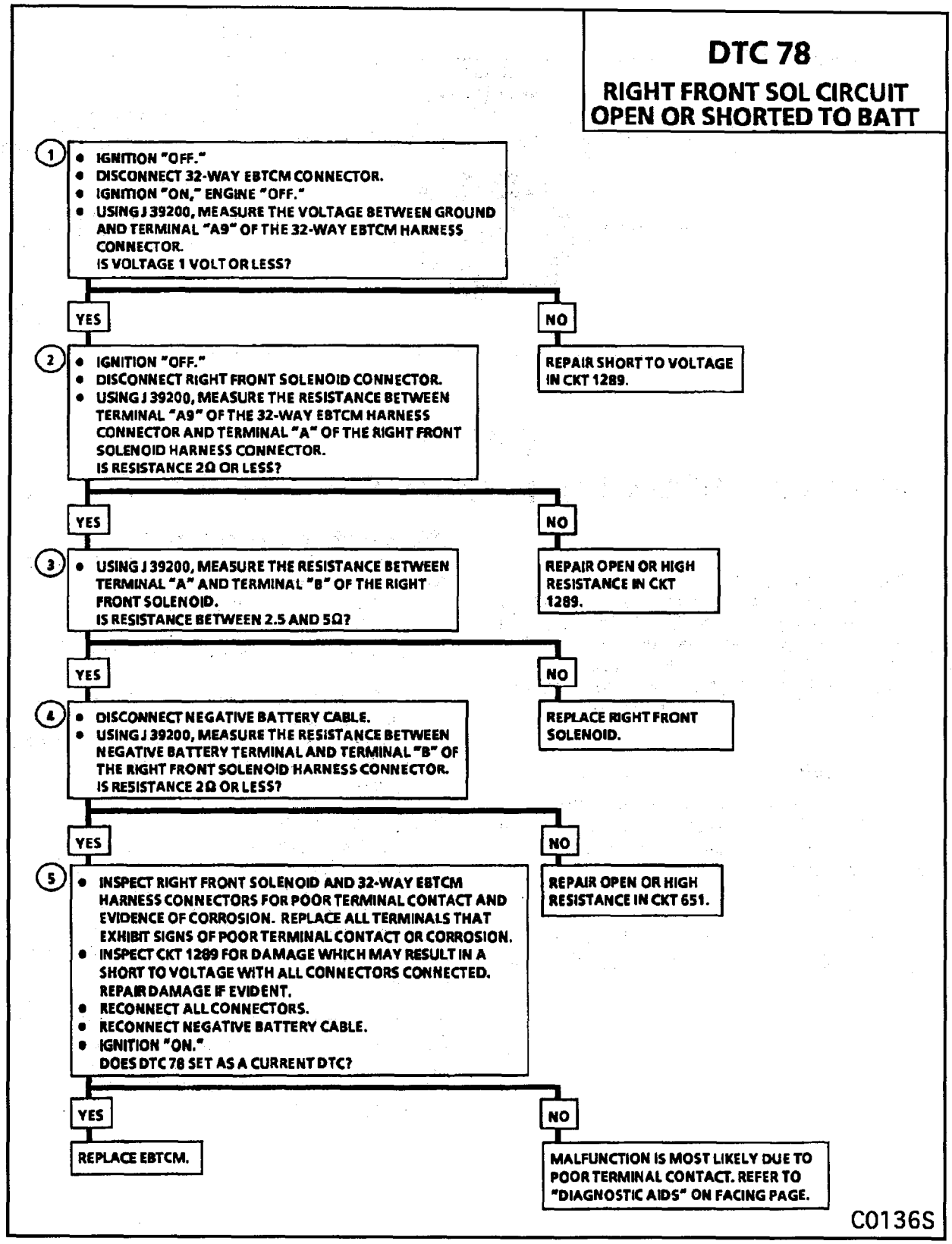
1. Checks for a short to voltage in the control circuitry of the solenoid.
2. Checks for an open in the control circuit of the solenoid.
3. Checks the solenoid coil for proper resistance.
4. Checks for an open in the solenoid ground circuit.
5. Checks for a possible intermittent malfunction in the solenoid circuitry due to poor terminal contact.

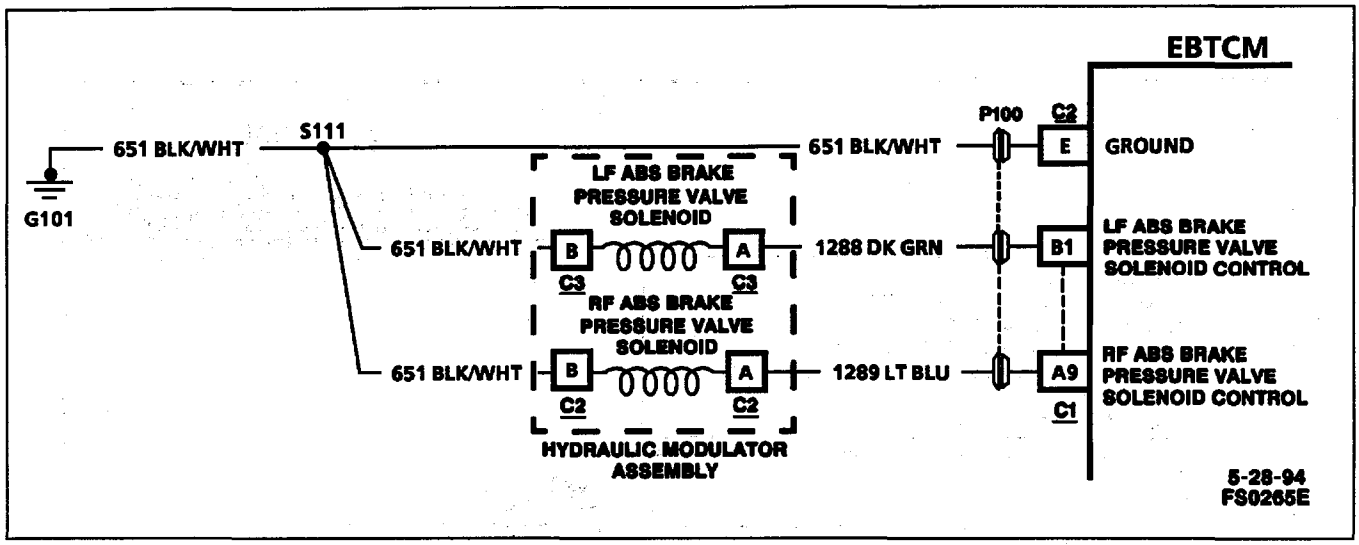
Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.


DTC 78
RIGHT FRONT SOL CIRCUIT OPEN OR SHORTED TO BATT
1
• IGNITION "OFF."
• DISCONNECT 32-WAY EBTCM CONNECTOR.
• IGNITION "ON," ENGINE "OFF."
• USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A9" OF THE 32-WAY EBTCM HARNESS CONNECTOR.
IS VOLTAGE 1 VOLT OR LESS?
YES
NO
REPAIR SHORT TO VOLTAGE IN CKT 1289.
2
• IGNITION "OFF."
• DISCONNECT RIGHT FRONT SOLENOID CONNECTOR.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A9" OF THE 32-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "A" OF THE RIGHT FRONT SOLENOID HARNESS CONNECTOR.
IS RESISTANCE 2Ω OR LESS?
YES
NO
REPAIR OPEN OR HIGH RESISTANCE IN CKT 1289.
3
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE RIGHT FRONT SOLENOID.
IS RESISTANCE BETWEEN 2.5 AND 5Ω?
YES
NO
REPLACE RIGHT FRONT SOLENOID.
4
• DISCONNECT NEGATIVE BATTERY CABLE.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN NEGATIVE BATTERY TERMINAL AND TERMINAL "B" OF THE RIGHT FRONT SOLENOID HARNESS CONNECTOR.
IS RESISTANCE 2Ω OR LESS?
YES
NO
REPAIR OPEN OR HIGH RESISTANCE IN CKT 651.
5
• INSPECT RIGHT FRONT SOLENOID AND 32-WAY EBTCM HARNESS CONNECTORS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.
• INSPECT CKT 1289 FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WITH ALL CONNECTORS CONNECTED. REPAIR DAMAGE IF EVIDENT.
• RECONNECT ALL CONNECTORS.
• RECONNECT NEGATIVE BATTERY CABLE.
• IGNITION "ON."
DOES DTC 78 SET AS A CURRENT DTC?
YES
REPLACE EBTCM.
NO
MALFUNCTION IS MOST LIKELY DUE TO POOR TERMINAL CONTACT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
C0136S



DTC 81
RIGHT FRONT SOLENOID CIRCUIT SHORTED TO GND

Circuit Description:

This DTC identifies a solenoid that cannot be energized due to an open in its driver circuitry, or a short to ground between the solenoid driver and the solenoid. These malfunctions can affect ABS operation since the flow of brake fluid to the wheel cylinder cannot be stopped, making ABS operation for that channel impossible.

DTC Will Set When:

DTC 81 can be set only when the solenoid is commanded "ON." If the EBTCM detects the right front solenoid control circuit voltage is out of specification, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

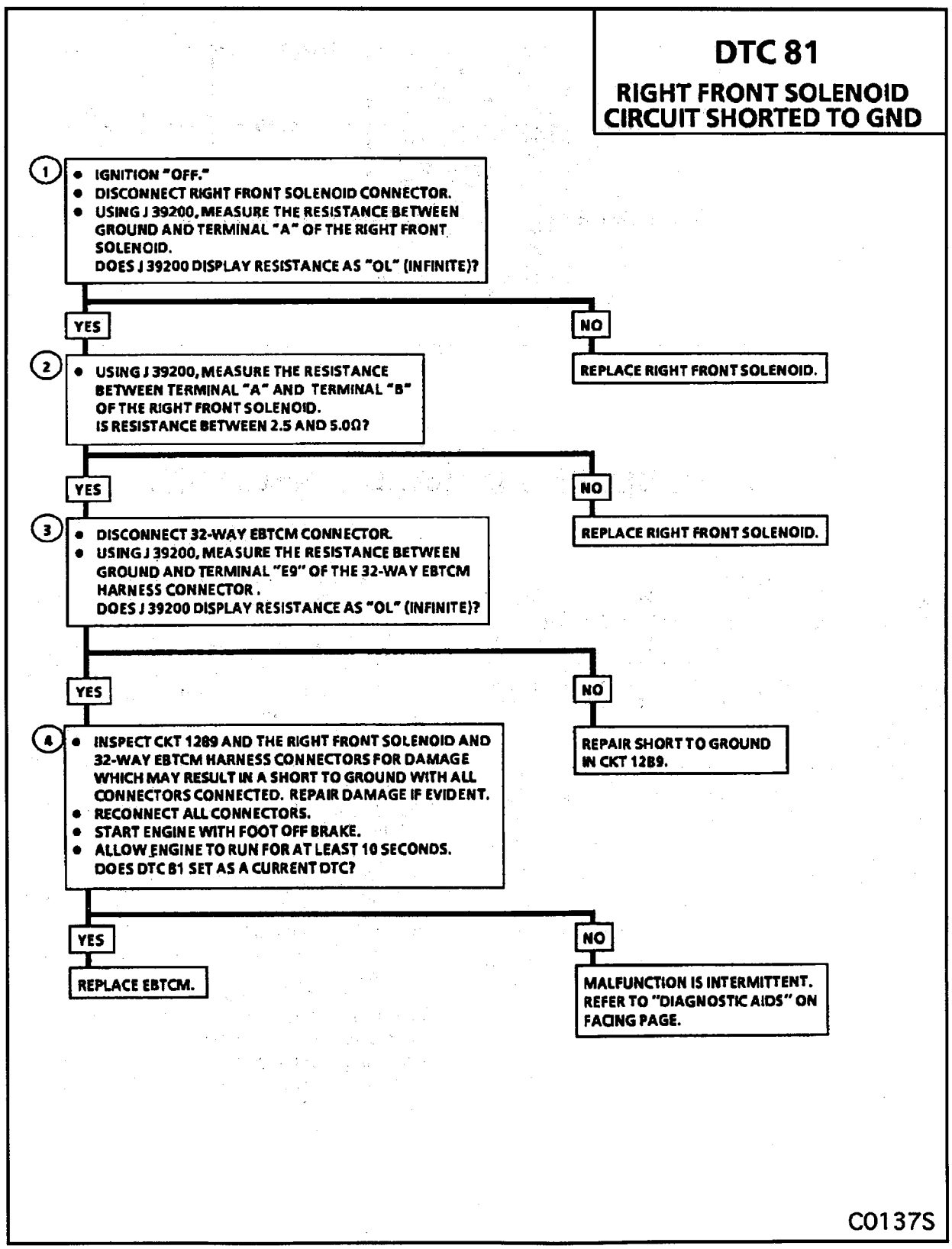
1. Checks for a solenoid that is internally shorted to ground.
2. Checks for a solenoid that is not within proper resistance values.
3. Indicates if a short to ground exists in the solenoid circuitry.
4. Checks for a possible intermittent malfunction in the solenoid circuitry due to poor terminal contact.

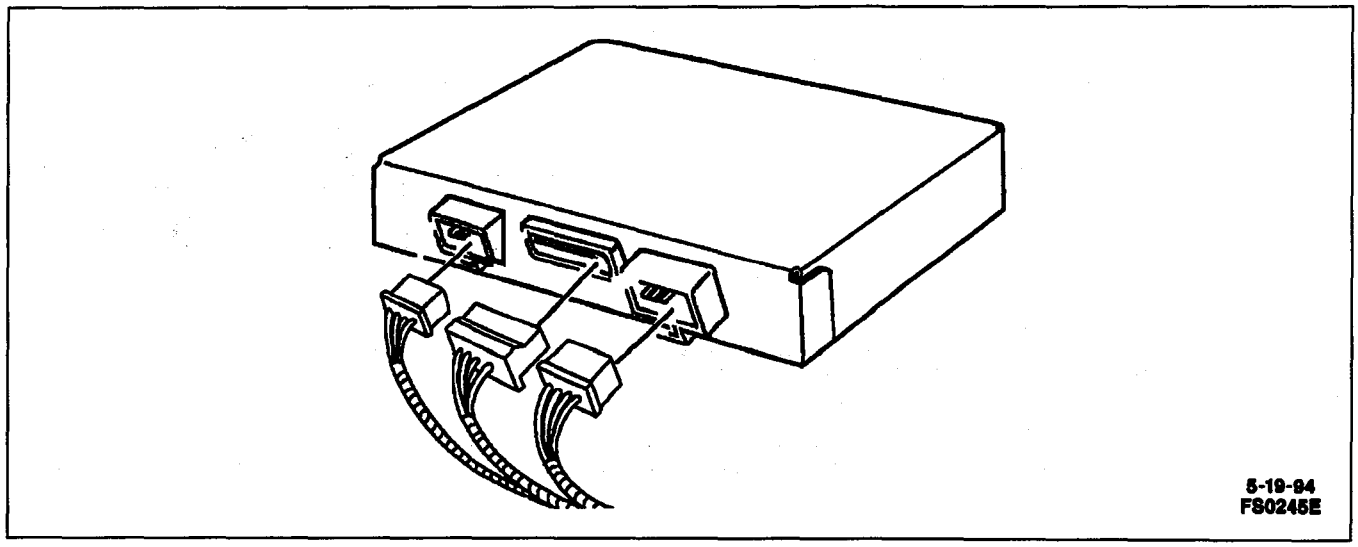
Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.


DTC 81
RIGHT FRONT SOLENOID CIRCUIT SHORTED TO GND
1
• IGNITION "OFF."
• DISCONNECT RIGHT FRONT SOLENOID CONNECTOR.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "A" OF THE RIGHT FRONT SOLENOID.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
YES
NO
REPLACE RIGHT FRONT SOLENOID.
2
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE RIGHT FRONT SOLENOID.
IS RESISTANCE BETWEEN 2.5 AND 5.0Ω?
YES
NO
REPLACE RIGHT FRONT SOLENOID.
3
• DISCONNECT 32-WAY EBTCM CONNECTOR.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "E9" OF THE 32-WAY EBTCM HARNESS CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
YES
NO
REPAIR SHORT TO GROUND IN CKT 1289.
4
• INSPECT CKT 1289 AND THE RIGHT FRONT SOLENOID AND 32-WAY EBTCM HARNESS CONNECTORS FOR DAMAGE WHICH MAY RESULT IN A SHORT TO GROUND WITH ALL CONNECTORS CONNECTED. REPAIR DAMAGE IF EVIDENT.
• RECONNECT ALL CONNECTORS.
• START ENGINE WITH FOOT OFF BRAKE.
• ALLOW ENGINE TO RUN FOR AT LEAST 10 SECONDS.
DOES DTC B1 SET AS A CURRENT DTC?
YES
REPLACE EBTCM.
NO
MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
C0137S



DTC 82
CALIBRATION MALFUNCTION

Circuit Description:

This DTC allows the EBTCM to check for a calibration malfunction by comparing the calibration value to a known value stored in the EEPROM.

This DTC is also used as a security measure to prevent improper use of calibrations or changes to these calibrations that may alter the designed function of ABS and TCS.

DTC Will Set When:

DTC 82 can be set at key-up. If the program identifier is incorrect or the memory checksum is incorrect, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

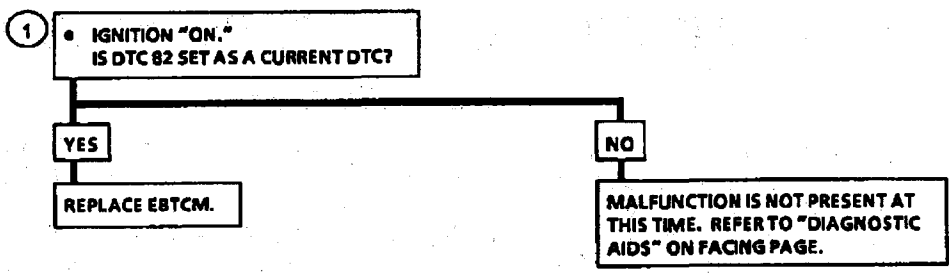
1. Checks to see if the malfunction is present during diagnosis. If present, the EBTCM is not functioning correctly and must be replaced.

Diagnostic Aids:

An intermittent DTC 82 may be caused by a bad cell in the EEPROM that is sensitive to temperature changes. If DTC 82 failed more than once, but is intermittent, replace EBTCM.

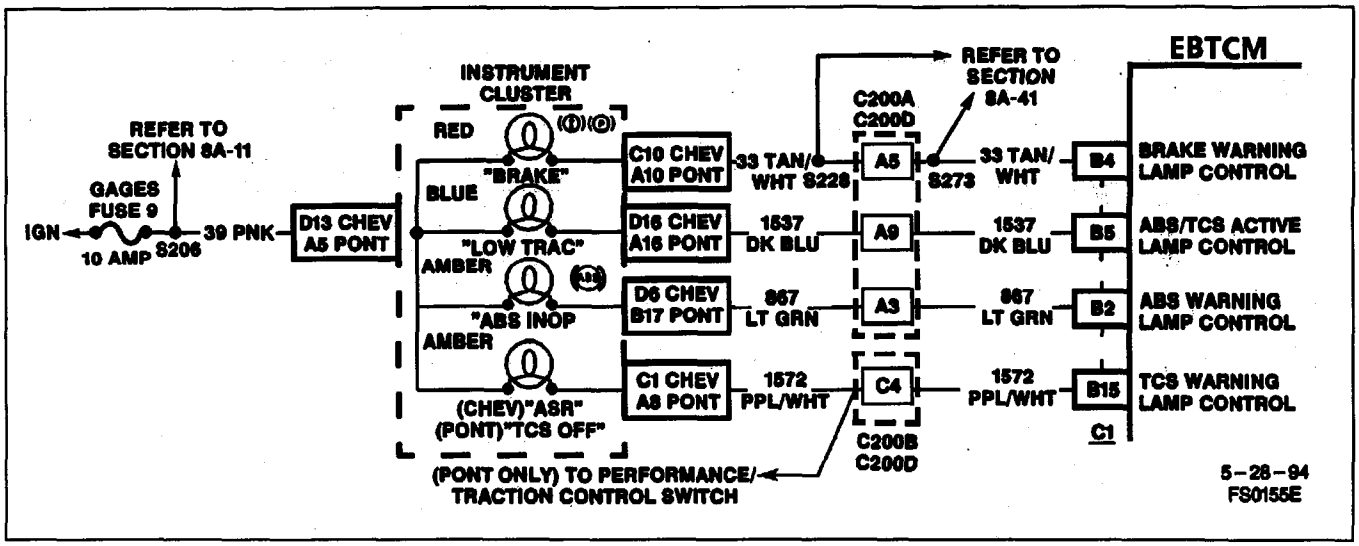
The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

DTC 82
CALIBRATION MALFUNCTION



THIS CHART ASSUMES THAT A CURRENT DTC IS STORED INDICATING THAT THIS MALFUNCTION IS PRESENT.

C0138S



DTC 86
EBTCM TURNED "ON" THE RED BRAKE WARNING LAMP

Circuit Description:

This DTC is provided as an information only DTC, and reflects the status of the command issued by the ABS EBTCM to illuminate the red BRAKE warning lamp. If another DTC issues a command to illuminate the red BRAKE warning lamp, DTC 86 will be stored in EEPROM as a history DTC at the conclusion of the ignition cycle.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Serves to identify if a DTC other than DTC 86 commanded the red BRAKE warning lamp "ON."

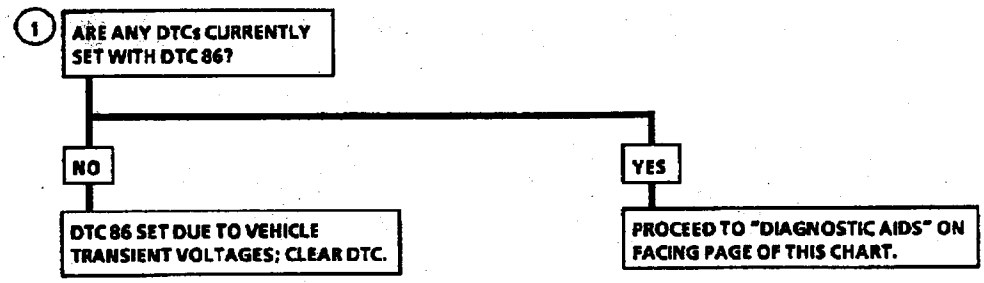
Diagnostic Aids:

Any ABS mechanical DTC that issues a command to illuminate the red BRAKE warning lamp will also result in DTC 86 being stored in EEPROM during shut down. These DTCs are: 38, 41, 42, 46, and 51. If the motor car not in their home position, certain electrical DTCs will also command the red BRAKE warning lamp "ON." These DTCs are: 14, 16, 18, 55, 56, 57, 58, 61, 62, 63, 64, 65, 66, 144, and 145.

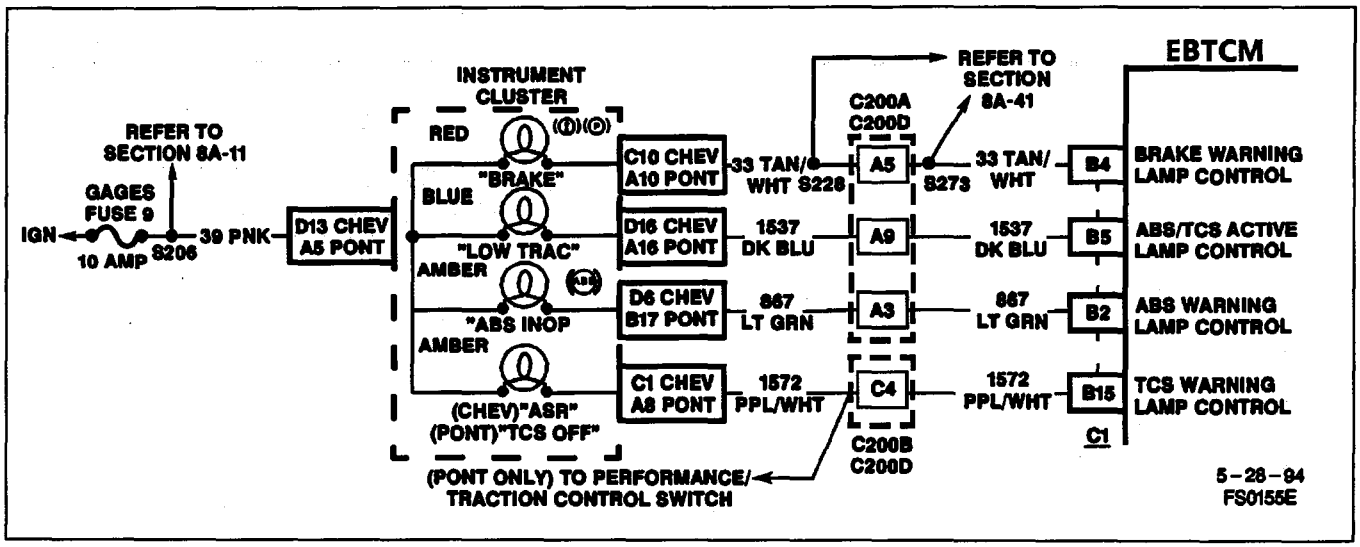
If any of these DTCs are indicated along with DTC 86, they must be corrected prior to addressing a DTC 86 malfunction.

DTC 86

EBTCM TURNED "ON" THE RED "BRAKE" WARNING LAMP



C0139S



DTC 87
RED BRAKE WARNING LAMP CIRCUIT OPEN

Circuit Description:

This DTC is used to verify the EBTCM has continuity to the red BRAKE warning lamp in case the EBTCM must turn it "ON." This will only occur if an ABS malfunction is detected that may degrade base brake operation. Because ABS is not the only device controlling the red BRAKE warning lamp (parking brake and low fluid sensor may also turn "ON" the lamp) a short to ground in this circuit cannot be detected.

DTC Will Set When:

DTC 87 can be set after initialization is completed. If the red BRAKE warning lamp circuit voltage is out of specification indicating an open circuit, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS is not disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

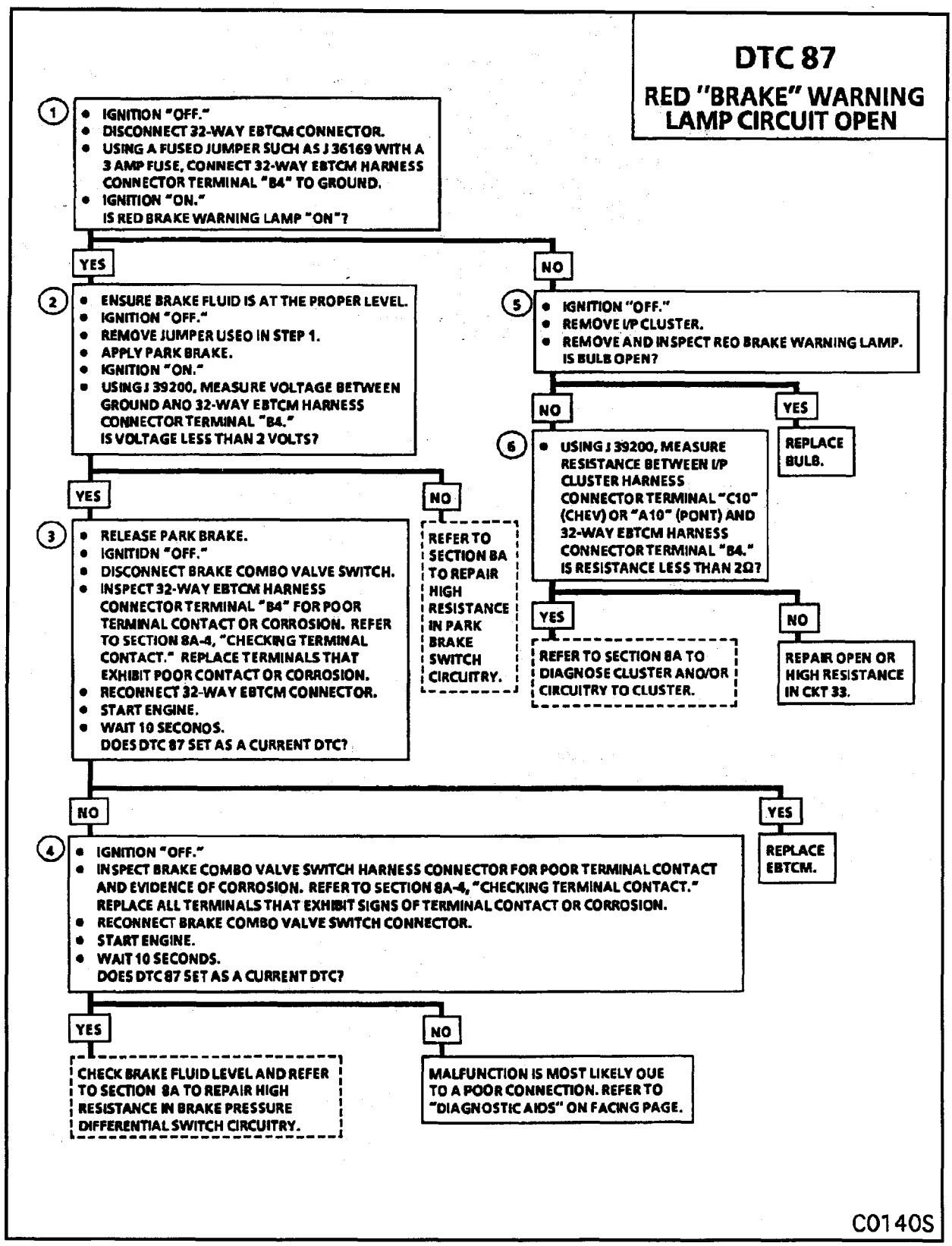
1. Identifies if the ground circuit to the red BRAKE warning lamp is completed by a source other than the EBTCM.
2. Checks for high resistance in park brake circuitry.
3. Checks for malfunctioning EBTCM.
4. Checks for high resistance in brake pressure differential switch circuitry.
5. Checks for malfunctioning warning lamp bulb.
6. Checks for open or high resistance in CKT 33.

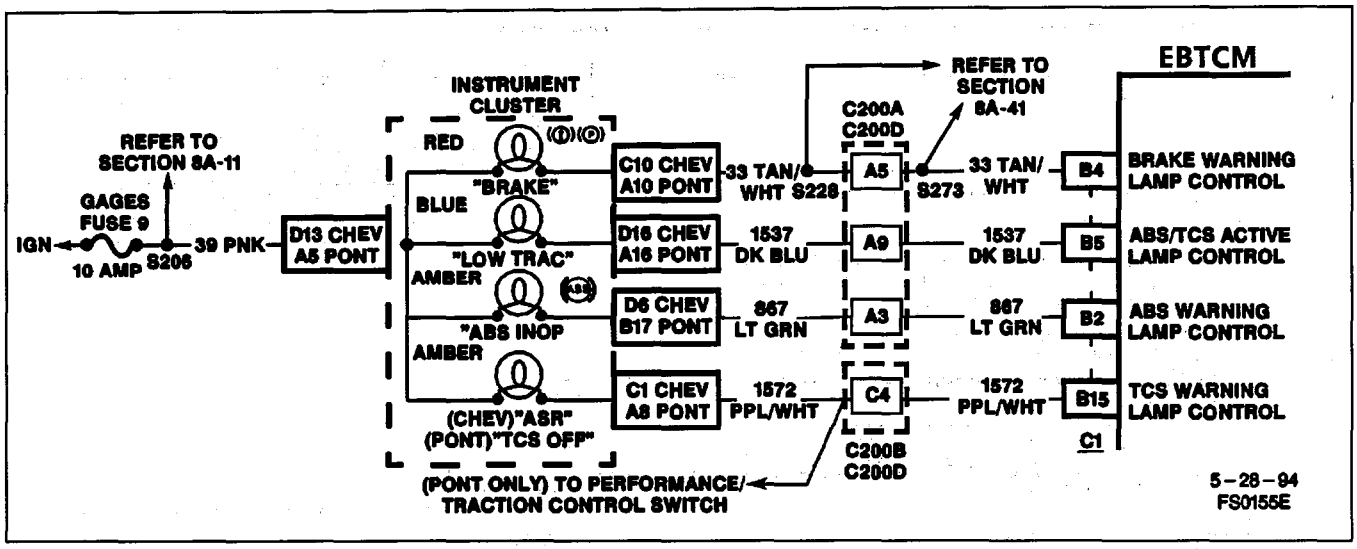
Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. If a Tech 1 or T-100 are not available, the parking brake handle may be lifted to verify proper lamp operation and continuity of CKTs 3 and 39.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.


DTC 87
RED "BRAKE" WARNING LAMP CIRCUIT OPEN
1
• IGNITION "OFF."
• DISCONNECT 32-WAY EBTCM CONNECTOR.
• USING A FUSED JUMPER SUCH AS J 36169 WITH A 3 AMP FUSE, CONNECT 32-WAY EBTCM HARNESS CONNECTOR TERMINAL "B4" TO GROUND.
• IGNITION "ON."
IS RED BRAKE WARNING LAMP "ON"?
YES
NO
2
• ENSURE BRAKE FLUID IS AT THE PROPER LEVEL.
• IGNITION "OFF."
• REMOVE JUMPER USED IN STEP 1.
• APPLY PARK BRAKE.
• IGNITION "ON."
• USING J 39200, MEASURE VOLTAGE BETWEEN GROUND AND 32-WAY EBTCM HARNESS CONNECTOR TERMINAL "B4."
IS VOLTAGE LESS THAN 2 VOLTS?
YES
NO
3
• RELEASE PARK BRAKE.
• IGNITION "OFF."
• DISCONNECT BRAKE COMBO VALVE SWITCH.
• INSPECT 32-WAY EBTCM HARNESS CONNECTOR TERMINAL "B4" FOR POOR TERMINAL CONTACT OR CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE TERMINALS THAT EXHIBIT POOR CONTACT OR CORROSION.
• RECONNECT 32-WAY EBTCM CONNECTOR.
• START ENGINE.
• WAIT 10 SECONDS.
DOES DTC 87 SET AS A CURRENT DTC?
REFER TO SECTION 8A TO REPAIR HIGH RESISTANCE IN PARK BRAKE SWITCH CIRCUITRY.
NO
YES
4
• IGNITION "OFF."
• INSPECT BRAKE COMBO VALVE SWITCH HARNESS CONNECTOR FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF TERMINAL CONTACT OR CORROSION.
• RECONNECT BRAKE COMBO VALVE SWITCH CONNECTOR.
• START ENGINE.
• WAIT 10 SECONDS.
DOES DTC 87 SET AS A CURRENT DTC?
REPLACE EBTCM.
NO
YES
CHECK BRAKE FLUID LEVEL AND REFER TO SECTION 8A TO REPAIR HIGH RESISTANCE IN BRAKE PRESSURE DIFFERENTIAL SWITCH CIRCUITRY.
MALFUNCTION IS MOST LIKELY DUE TO A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
5
• IGNITION "OFF."
• REMOVE I/P CLUSTER.
• REMOVE AND INSPECT RED BRAKE WARNING LAMP.
IS BULB OPEN?
NO
YES
REPLACE BULB.
6
• USING J 39200, MEASURE RESISTANCE BETWEEN I/P CLUSTER HARNESS CONNECTOR TERMINAL "C10" (CHEV) OR "A10" (PONT) AND 32-WAY EBTCM HARNESS CONNECTOR TERMINAL "B4."
IS RESISTANCE LESS THAN 2Ω?
YES
NO
REFER TO SECTION 8A TO DIAGNOSE CLUSTER AND/OR CIRCUITRY TO CLUSTER.
REPAIR OPEN OR HIGH RESISTANCE IN CKT 33.
C0140S



DTC 88
RED BRAKE WARNING LAMP CKT SHORTED TO BATT

Circuit Description:

This DTC identifies a short to battery between the EBTCM and the red BRAKE warning lamp, or an open driver that does not allow the red BRAKE warning lamp to be illuminated by the EBTCM. This will only occur if an ABS malfunction is detected that may degrade base brake operation.

DTC Will Set When:

DTC 88 can be set only at the beginning of the three second bulb check. If the EBTCM detects battery voltage on the red BRAKE warning lamp control circuit, a malfunction exists.

Action Taken:

A malfunction DTC is stored. ABS is not disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Identifies if the ground circuit to the red BRAKE warning lamp is being completed by a source other than the EBTCM.
2. Identifies if the malfunction is currently present.
3. By removing the "GAGES" Fuse 9, the voltage source is eliminated. This test indicates if voltage is being supplied from a source other than the gauge fuse.
4. Ensures malfunction was not due to physical damage of the circuitry.
5. Checks for DTC 86 also being set.

Diagnostic Aids:

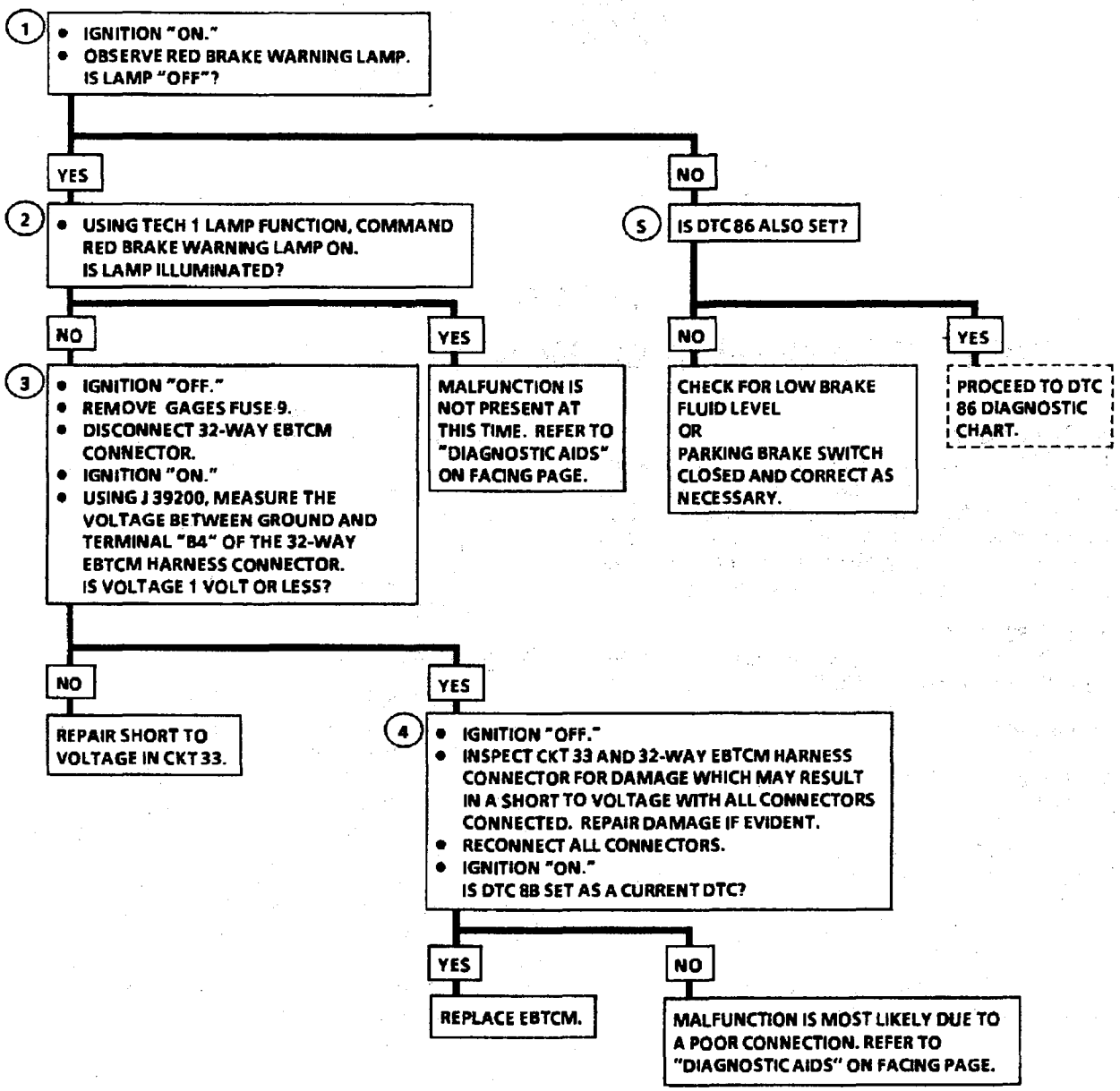
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

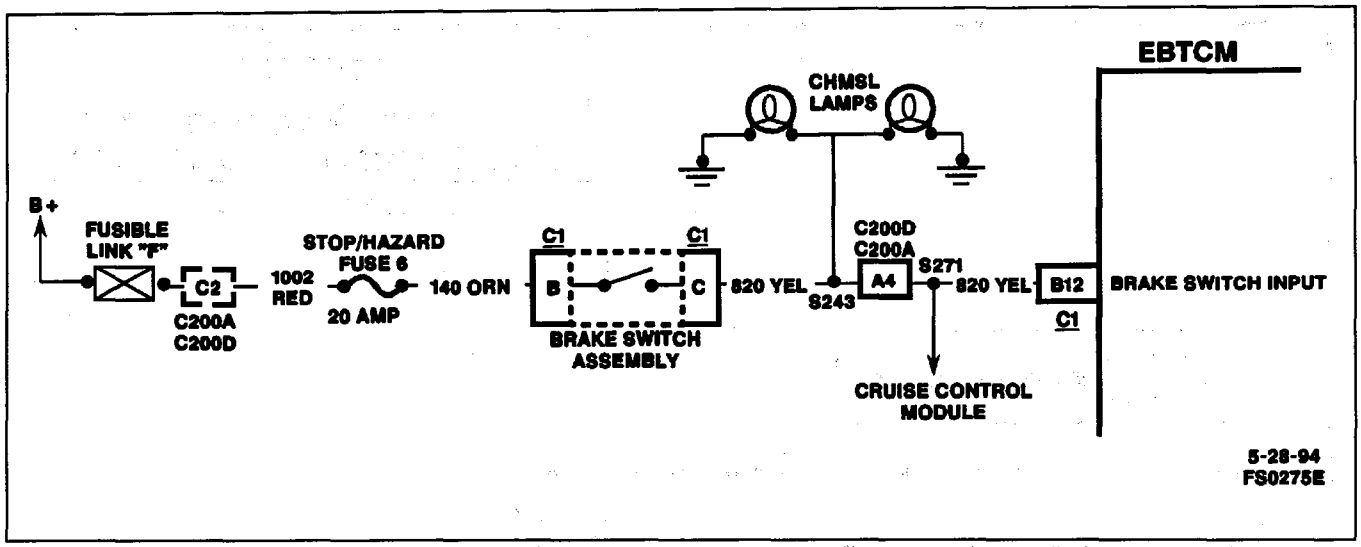
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 88

RED BRAKE WARNING LAMP CIRCUIT SHORTED TO BATTERY



C2865S



DTC 91
OPEN BRAKE SWITCH DURING DECELERATION

Circuit Description:

This DTC is used to detect an open brake switch in the non-ABS mode. The EBTCM looks for deceleration rates that would indicate braking action and verifies this assumption by requiring several repeats of this detection method. In each case, ABS will not be available since no brake switch is seen.

DTC Will Set When:

DTC 91 can be set if three deceleration cycles occur with the brake switch "OFF."

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

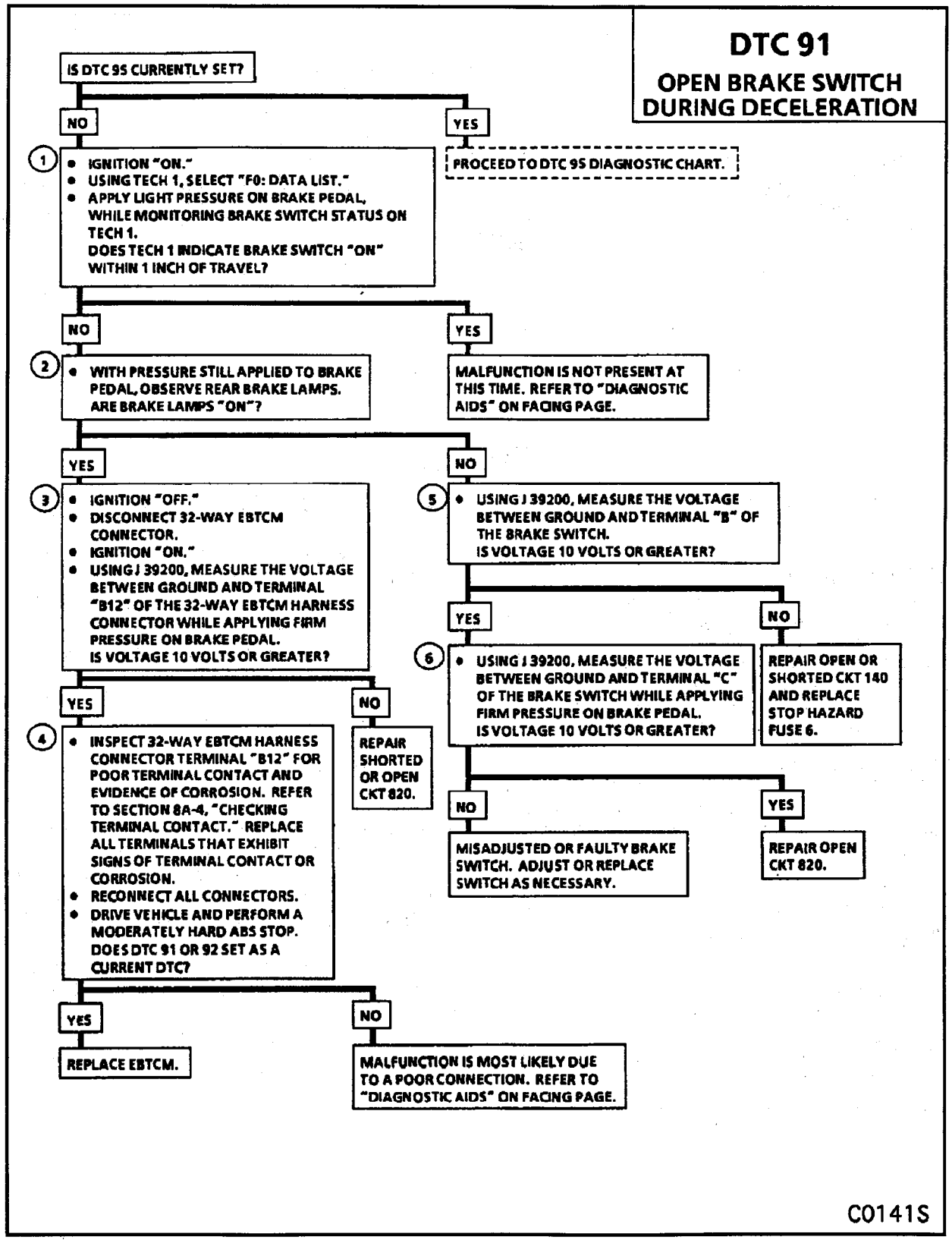
1. Indicates if the brake switch signal is being received by the EBTCM.
2. Indicates if an open circuit exists in the brake switch or brake lamp circuitry.
3. Isolates the open circuit to either the brake switch input circuitry, or the EBTCM.
4. Ensures malfunction was not due to poor terminal contact.
5. Verifies that voltage is available at the brake switch.
6. Verifies that the brake switch is functioning properly.

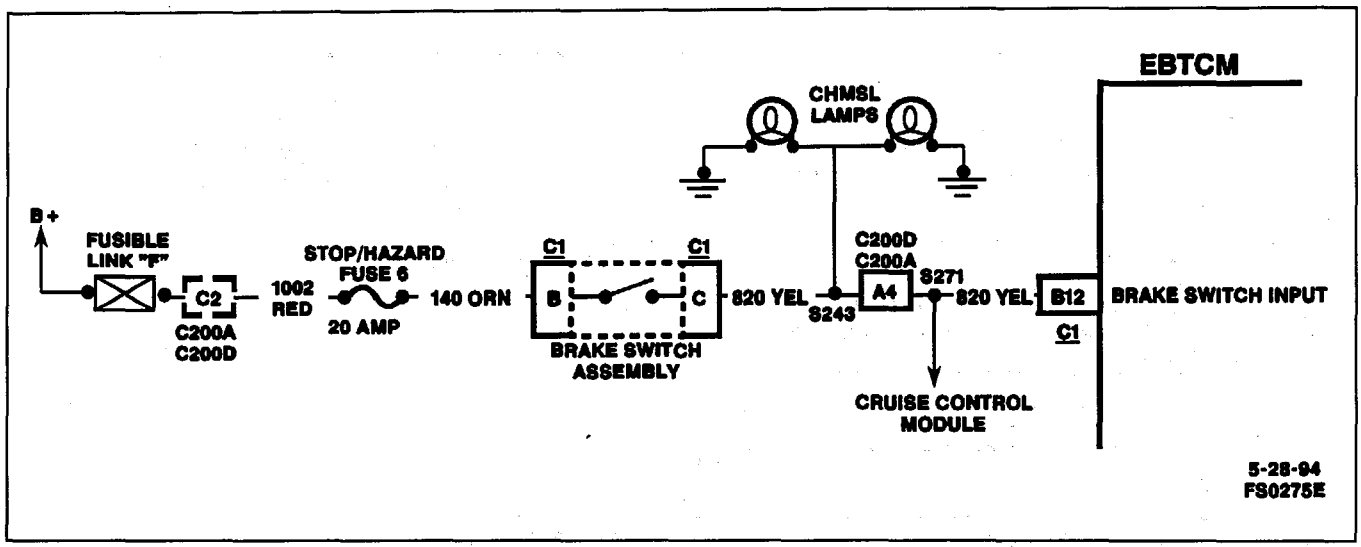
Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.


DTC 91
OPEN BRAKE SWITCH DURING DECELERATION
IS DTC 9S CURRENTLY SET?
NO
YES
PROCEED TO DTC 9S DIAGNOSTIC CHART.
1
• IGNITION "ON."
• USING TECH 1, SELECT "F0: DATA LIST."
• APPLY LIGHT PRESSURE ON BRAKE PEDAL, WHILE MONITORING BRAKE SWITCH STATUS ON TECH 1.
DOES TECH 1 INDICATE BRAKE SWITCH "ON" WITHIN 1 INCH OF TRAVEL?
NO
YES
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
2
• WITH PRESSURE STILL APPLIED TO BRAKE PEDAL, OBSERVE REAR BRAKE LAMPS.
ARE BRAKE LAMPS "ON"?
YES
NO
3
• IGNITION "OFF."
• DISCONNECT 32-WAY EBTCM CONNECTOR.
• IGNITION "ON."
• USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B12" OF THE 32-WAY EBTCM HARNESS CONNECTOR WHILE APPLYING FIRM PRESSURE ON BRAKE PEDAL.
IS VOLTAGE 10 VOLTS OR GREATER?
YES
NO
REPAIR SHORTED OR OPEN CKT 820.
4
• INSPECT 32-WAY EBTCM HARNESS CONNECTOR TERMINAL "B12" FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF TERMINAL CONTACT OR CORROSION.
• RECONNECT ALL CONNECTORS.
• DRIVE VEHICLE AND PERFORM A MODERATELY HARD ABS STOP.
DOES DTC 91 OR 92 SET AS A CURRENT DTC?
YES
NO
REPLACE EBTCM.
MALFUNCTION IS MOST LIKELY DUE TO A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
5
• USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B" OF THE BRAKE SWITCH.
IS VOLTAGE 10 VOLTS OR GREATER?
YES
NO
REPAIR OPEN OR SHORTED CKT 140 AND REPLACE STOP HAZARD FUSE 6.
6
• USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "C" OF THE BRAKE SWITCH WHILE APPLYING FIRM PRESSURE ON BRAKE PEDAL.
IS VOLTAGE 10 VOLTS OR GREATER?
NO
YES
MISADJUSTED OR FAULTY BRAKE SWITCH. ADJUST OR REPLACE SWITCH AS NECESSARY.
REPAIR OPEN CKT 820.
C0141S



DTC 92
OPEN BRAKE SWITCH WHEN ABS WAS REQUIRED

Circuit Description:

This DTC is run to determine the proper operation of the brake switch. This is important because ABS is activated when the brake switch is "ON." If the brake switch is "OFF," ABS will never be activated. Since this malfunction is difficult to detect under normal braking conditions, this malfunction is only detected when ABS is required.

DTC Will Set When:

DTC 92 can be set if the vehicle's speed is greater than 8 km/h (5 mph). If the brake was not "ON" and a release was required on two channels for 0.5 seconds, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

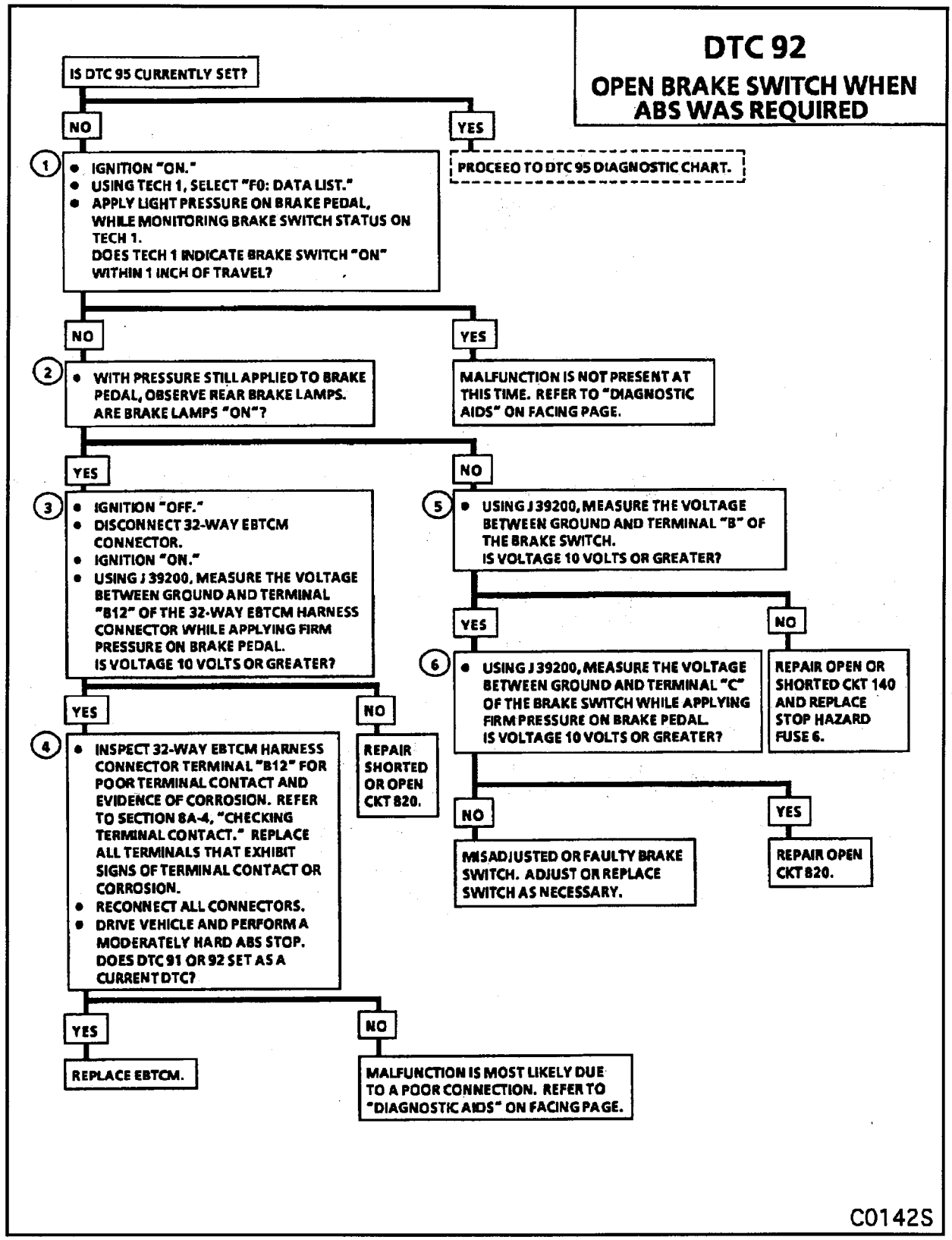
1. Indicates if the brake switch signal is being received by the EBTCM.
2. Indicates if an open circuit exists in the brake switch or brake lamp circuitry.
3. Isolates the open circuit to either the brake switch input circuitry, or the EBTCM.
4. Ensures malfunction was not due to poor terminal contact.
5. Verifies the voltage is available at the brake switch.
6. Verifies that the brake switch is functioning properly.

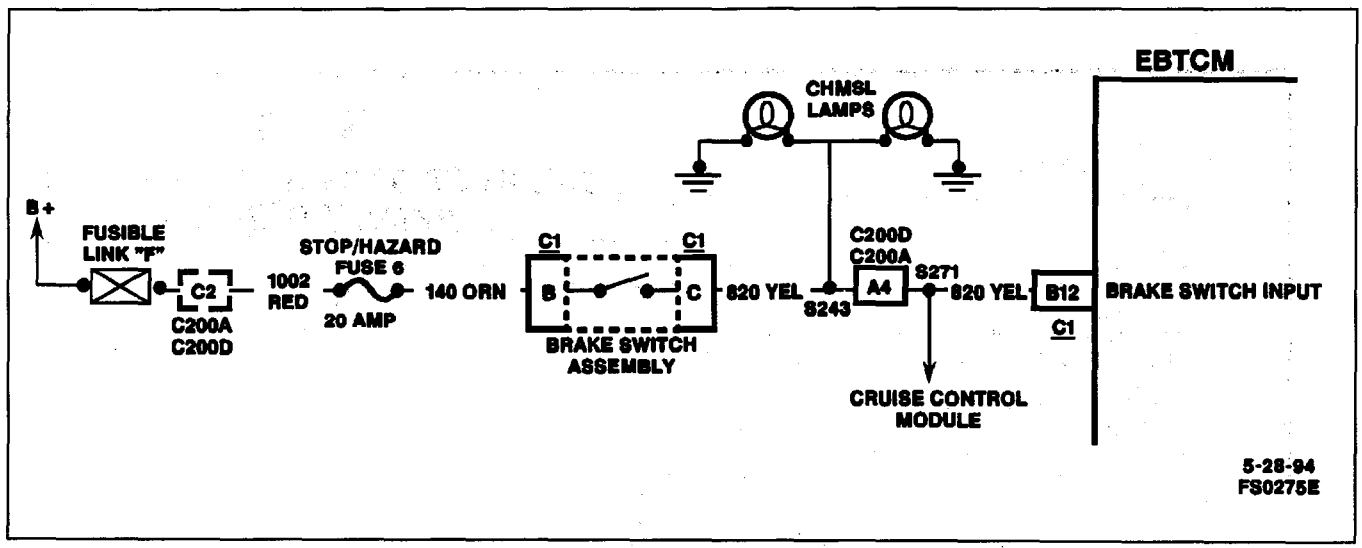
Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.


DTC 92
OPEN BRAKE SWITCH WHEN ABS WAS REQUIRED
IS DTC 95 CURRENTLY SET?
NO
YES
PROCEED TO DTC 95 DIAGNOSTIC CHART.
1
• IGNITION "ON."
• USING TECH 1, SELECT "F0: DATA LIST."
• APPLY LIGHT PRESSURE ON BRAKE PEDAL, WHILE MONITORING BRAKE SWITCH STATUS ON TECH 1.
DOES TECH 1 INDICATE BRAKE SWITCH "ON" WITHIN 1 INCH OF TRAVEL?
NO
YES
2
• WITH PRESSURE STILL APPLIED TO BRAKE PEDAL, OBSERVE REAR BRAKE LAMPS.
ARE BRAKE LAMPS "ON"?
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
YES
NO
3
• IGNITION "OFF."
• DISCONNECT 32-WAY EBTCM CONNECTOR.
• IGNITION "ON."
• USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B12" OF THE 32-WAY EBTCM HARNESS CONNECTOR WHILE APPLYING FIRM PRESSURE ON BRAKE PEDAL.
IS VOLTAGE 10 VOLTS OR GREATER?
5
• USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B" OF THE BRAKE SWITCH.
IS VOLTAGE 10 VOLTS OR GREATER?
YES
NO
YES
NO
4
• INSPECT 32-WAY EBTCM HARNESS CONNECTOR TERMINAL "B12" FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF TERMINAL CONTACT OR CORROSION.
• RECONNECT ALL CONNECTORS.
• DRIVE VEHICLE AND PERFORM A MODERATELY HARD ABS STOP.
DOES DTC 91 OR 92 SET AS A CURRENT DTC?
REPAIR SHORTED OR OPEN CKT 820.
6
• USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "C" OF THE BRAKE SWITCH WHILE APPLYING FIRM PRESSURE ON BRAKE PEDAL.
IS VOLTAGE 10 VOLTS OR GREATER?
REPAIR OPEN OR SHORTED CKT 140 AND REPLACE STOP HAZARD FUSE 6.
NO
YES
MISADJUSTED OR FAULTY BRAKE SWITCH. ADJUST OR REPLACE SWITCH AS NECESSARY.
REPAIR OPEN CKT 820.
YES
NO
REPLACE EBTCM.
MALFUNCTION IS MOST LIKELY DUE TO A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
C0142S



DTC 93
DTC 91 OR 92 SET IN CURRENT OR PREV. IGN CYCLE

Circuit Description:

This DTC is the second portion of DTCs 91 and 92. If DTCs 91 or 92 failed during the last ignition cycle, DTC 93 becomes a current failure during the next ignition cycle, keeping ABS and TCS disabled until a brake switch "ON" state is seen. When a change is seen during an ignition cycle in which DTC 93 is a current malfunction, DTC 91 or 92 will clear itself at the end of the current ignition cycle, and ABS and will be enabled at the start of the next ignition cycle. DTC 93 alone indicates 91 or 92 failed previously, but is intermittent, or has been corrected.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Indicates which DTC (either 91 or 92) caused DTC 93 to set.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

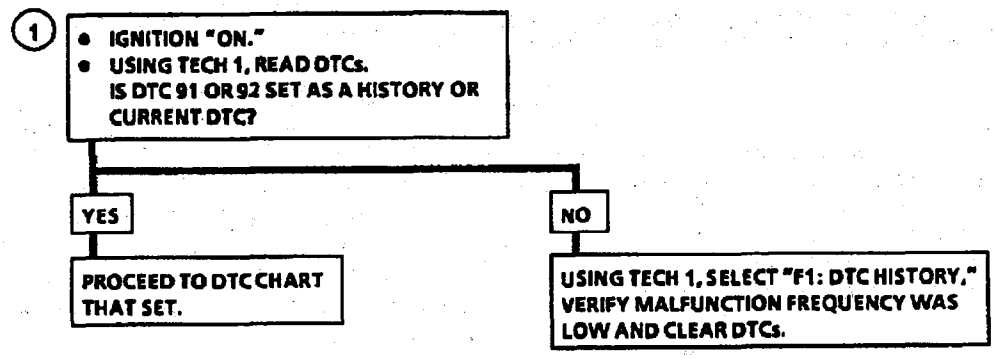
The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

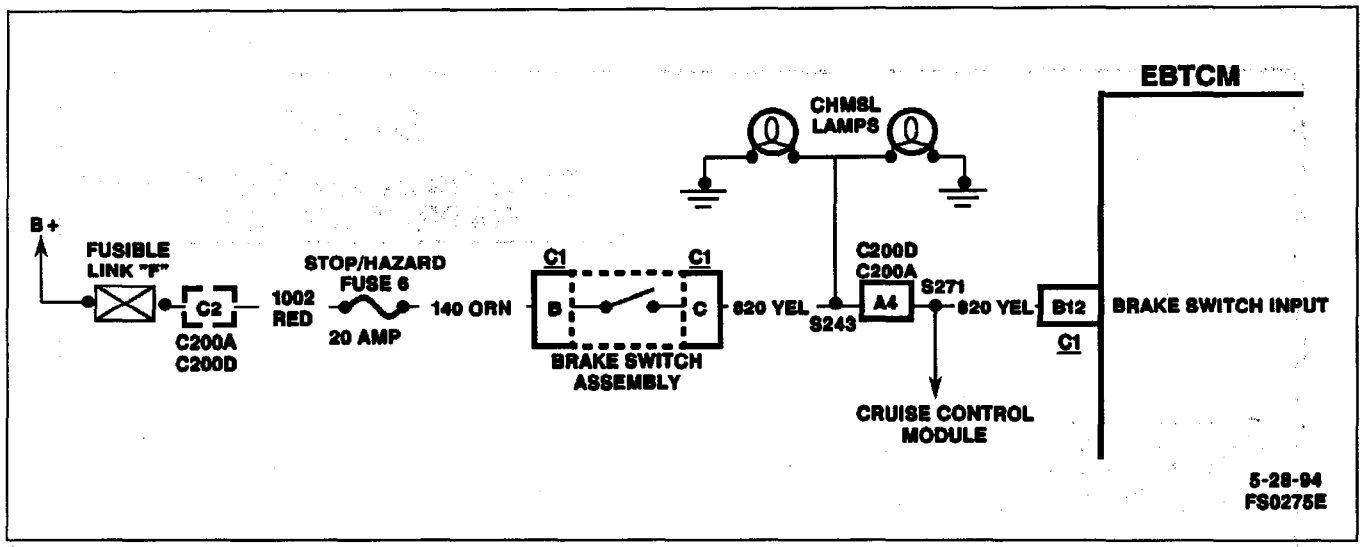
Also, verify proper brake switch operation using the data list of the Tech 1. As the brake is applied, the data list should display the brake switch "ON" within 1 inch of travel.

DTC 93

DTC 91 OR 92 SET IN CURRENT OR PREV. IGN CYCLE



C0143S



DTC 94
BRAKE SWITCH CONTACTS ALWAYS CLOSED

Circuit Description:

This DTC is run to determine the proper operation of the brake switch. This is important because ABS is activated when the brake switch is "ON" and turned "OFF" when the brake is "OFF." If the brake switch is always "ON," ABS operation will always be requested resulting in potential modulator cycling on rough roads.

DTC Will Set When:

DTC 94 can be set when the vehicle reaches at least 40 km/h (25 mph). If the brake was never "OFF" during two consecutive drive cycles, a malfunction exists.

Action Taken:

A malfunction DTC is stored. ABS is not disabled; however, TCS is disabled and the TCS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

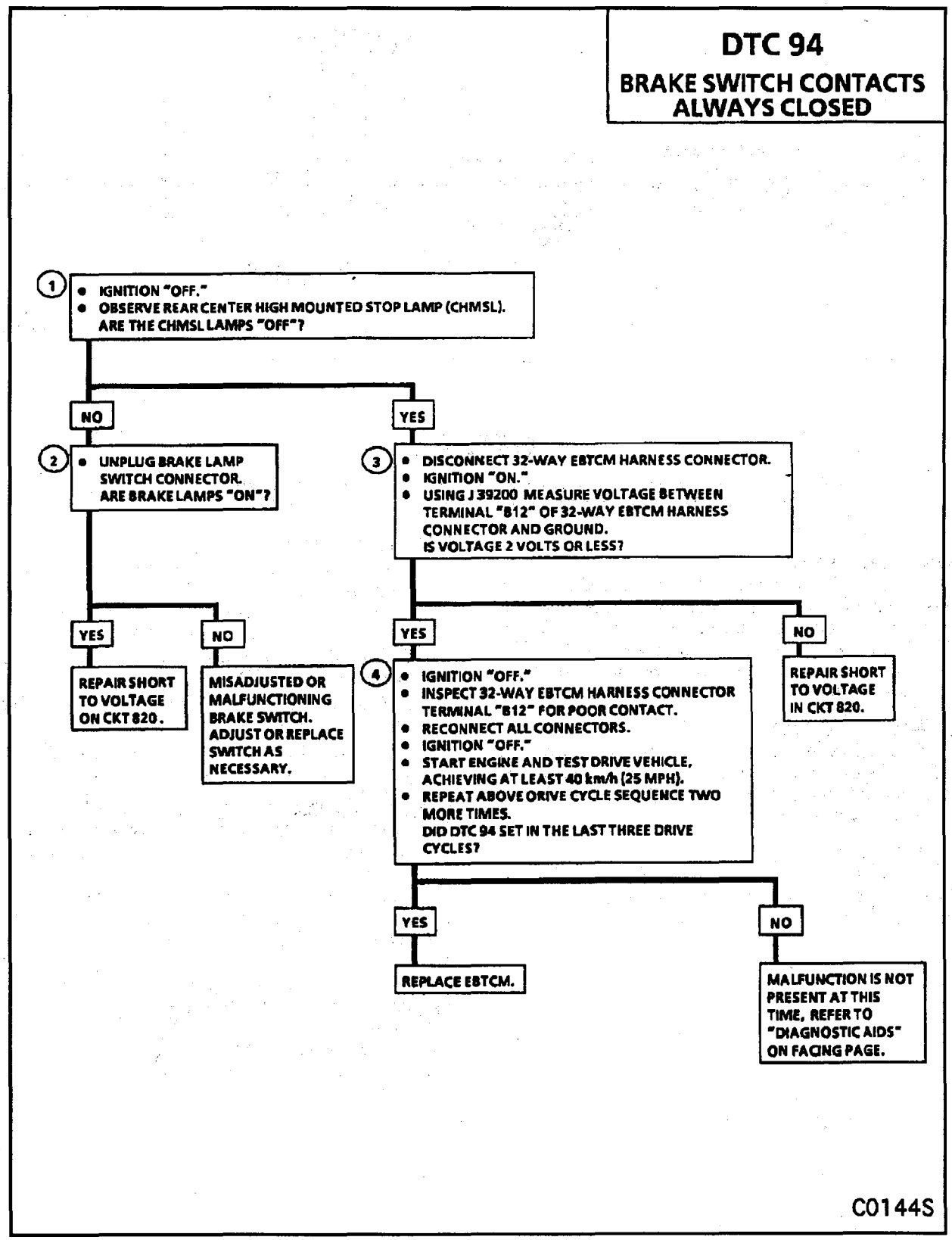
1. Checks if the malfunction is currently present.
2. Isolates the cause of the malfunction to either a malfunctioning or misadjusted brake switch, or a short to voltage in the brake switch circuitry.
3. Checks for unwanted voltage on the brake switch input circuit.
4. Checks for a possible intermittent malfunction.

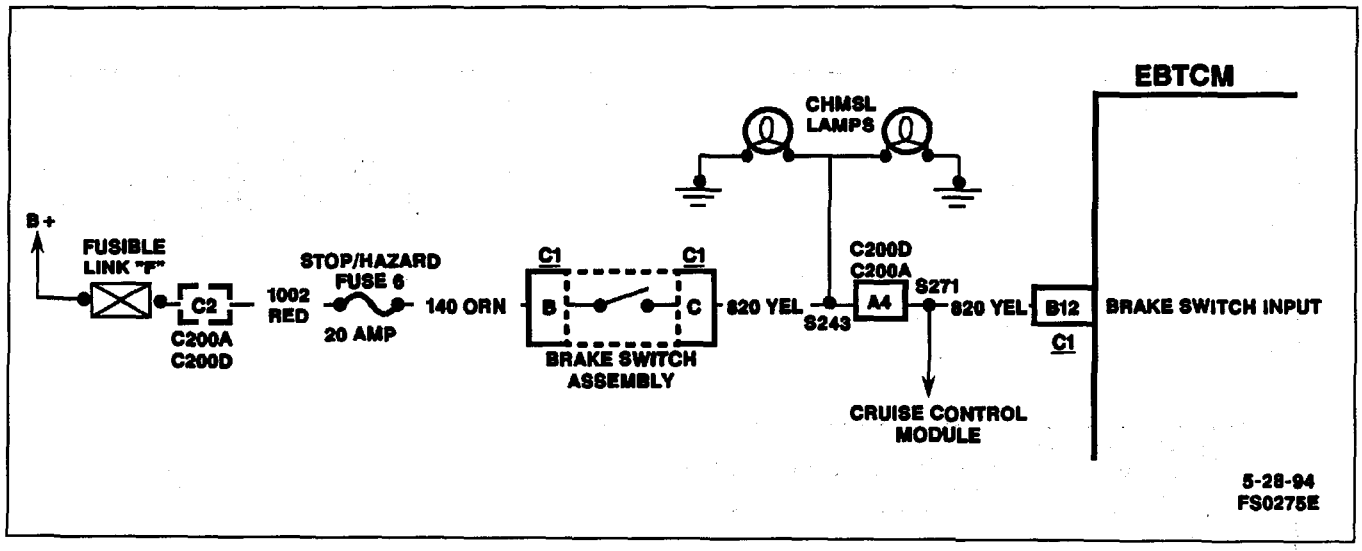
Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.


DTC 94
BRAKE SWITCH CONTACTS ALWAYS CLOSED
1
• IGNITION "OFF."
• OBSERVE REAR CENTER HIGH MOUNTED STOP LAMP (CHMSL). ARE THE CHMSL LAMPS "OFF"?
NO
YES
2
• UNPLUG BRAKE LAMP SWITCH CONNECTOR. ARE BRAKE LAMPS "ON"?
3
• DISCONNECT 32-WAY EBTCM HARNESS CONNECTOR.
• IGNITION "ON."
• USING J 39200 MEASURE VOLTAGE BETWEEN TERMINAL "B12" OF 32-WAY EBTCM HARNESS CONNECTOR AND GROUND. IS VOLTAGE 2 VOLTS OR LESS?
YES
NO
REPAIR SHORT TO VOLTAGE ON CKT 820.
MISADJUSTED OR MALFUNCTIONING BRAKE SWITCH. ADJUST OR REPLACE SWITCH AS NECESSARY.
YES
NO
REPAIR SHORT TO VOLTAGE IN CKT 820.
4
• IGNITION "OFF."
• INSPECT 32-WAY EBTCM HARNESS CONNECTOR TERMINAL "B12" FOR POOR CONTACT.
• RECONNECT ALL CONNECTORS.
• IGNITION "OFF."
• START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 40 km/h (25 MPH).
• REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES. DID DTC 94 SET IN THE LAST THREE DRIVE CYCLES?
YES
NO
REPLACE EBTCM.
MALFUNCTION IS NOT PRESENT AT THIS TIME, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
C0144S



DTC 95
BRAKE SWITCH CIRCUIT OPEN

Circuit Description:

This DTC is used to identify open brake switch circuitry that prevents the brake switch input to the EBTCM from changing states when the brake is applied. This DTC is used in conjunction with DTCs 91 and 92 to determine the cause of an open brake switch malfunction.

DTC Will Set When:

DTC 95 can be set after initialization is completed. If the brake switch input voltage is out of specification for one second indicating an open circuit, a malfunction exists.

Action Taken:

A malfunction DTC is stored, ABS and TCS are disabled. The amber ABS and TCS warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

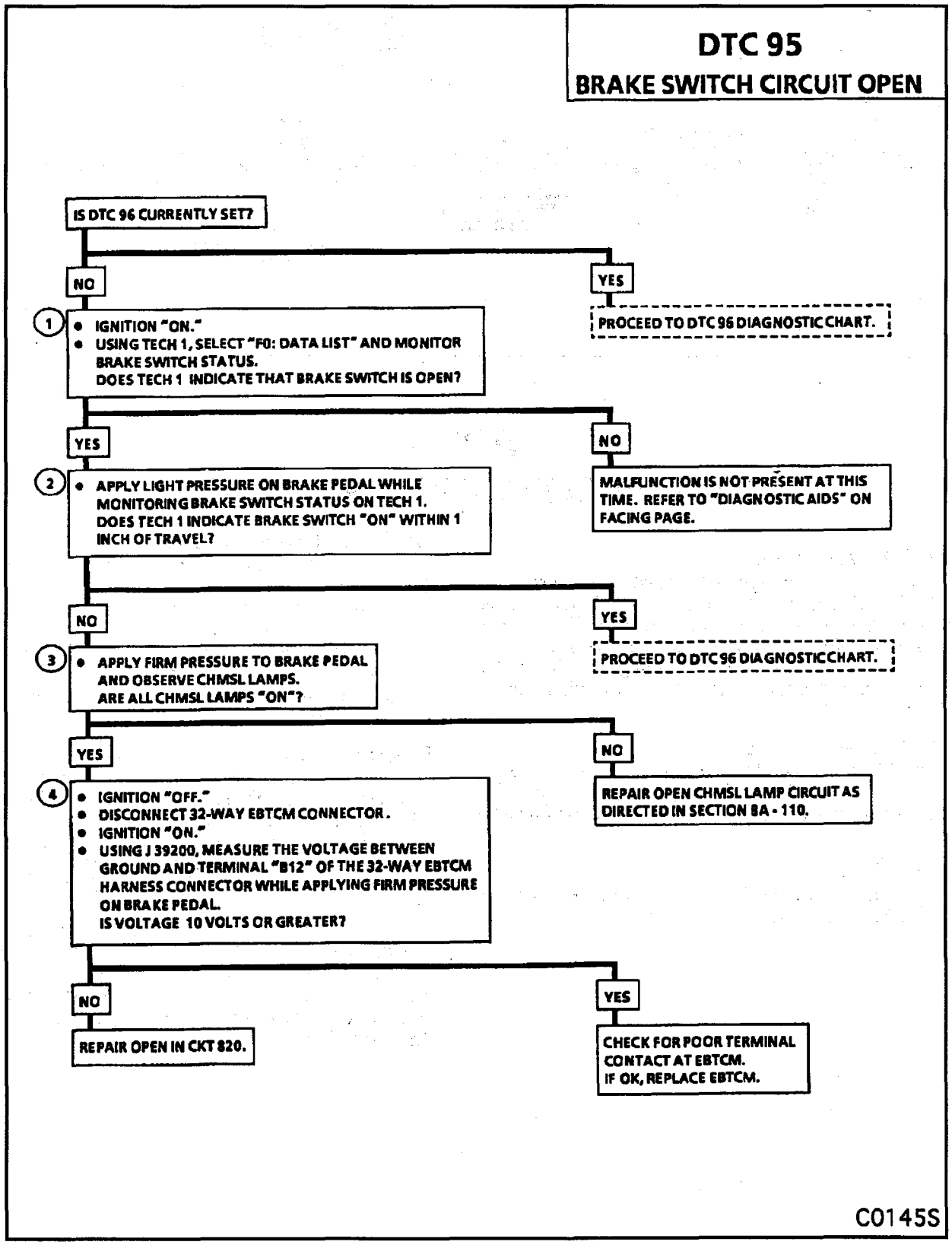
1. Is used to confirm that an open in the brake switch circuitry currently exists.
2. Indicates if the brake switch signal is being received by the EBTCM.
3. Indicates if an open circuit exists in the brake switch or brake lamp circuitry.
4. Isolates the open circuit to either the brake switch input circuitry, or the EBTCM.

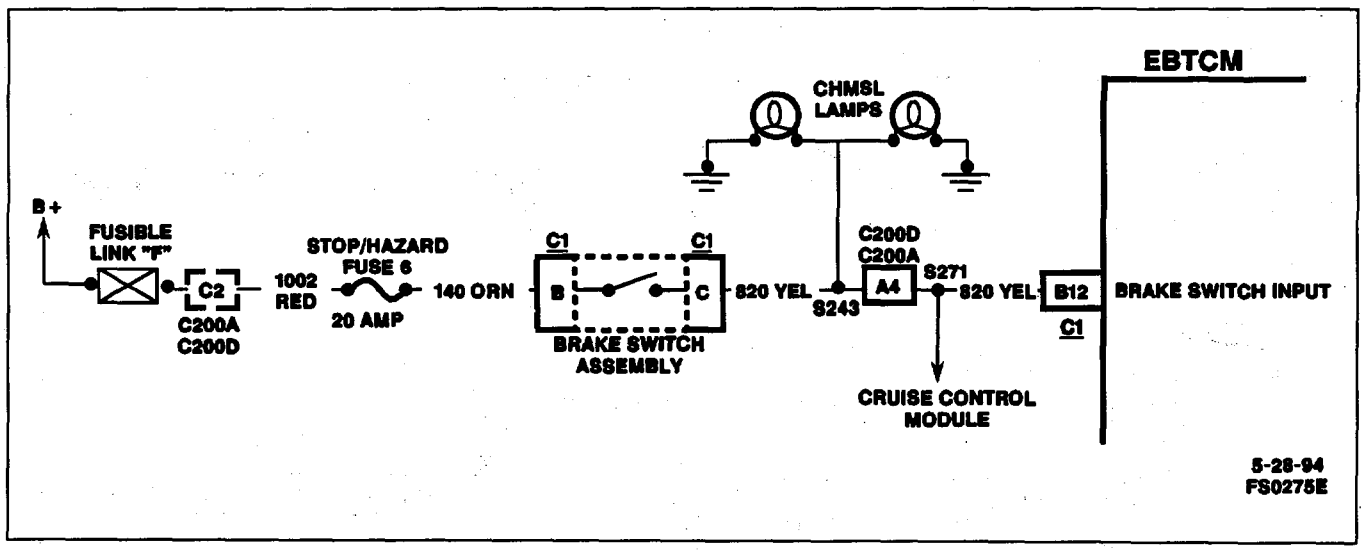
Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.


DTC 95
BRAKE SWITCH CIRCUIT OPEN
IS DTC 96 CURRENTLY SET?
NO
YES
PROCEED TO DTC 96 DIAGNOSTIC CHART.
1
• IGNITION "ON."
• USING TECH 1, SELECT "F0: DATA LIST" AND MONITOR BRAKE SWITCH STATUS.
DOES TECH 1 INDICATE THAT BRAKE SWITCH IS OPEN?
YES
NO
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
2
• APPLY LIGHT PRESSURE ON BRAKE PEDAL WHILE MONITORING BRAKE SWITCH STATUS ON TECH 1.
DOES TECH 1 INDICATE BRAKE SWITCH "ON" WITHIN 1 INCH OF TRAVEL?
NO
YES
PROCEED TO DTC 96 DIAGNOSTIC CHART.
3
• APPLY FIRM PRESSURE TO BRAKE PEDAL AND OBSERVE CHMSL LAMPS.
ARE ALL CHMSL LAMPS "ON"?
YES
NO
REPAIR OPEN CHMSL LAMP CIRCUIT AS DIRECTED IN SECTION 8A - 110.
4
• IGNITION "OFF."
• DISCONNECT 32-WAY EBTCM CONNECTOR.
• IGNITION "ON."
• USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B12" OF THE 32-WAY EBTCM HARNESS CONNECTOR WHILE APPLYING FIRM PRESSURE ON BRAKE PEDAL.
IS VOLTAGE 10 VOLTS OR GREATER?
NO
YES
REPAIR OPEN IN CKT 820.
CHECK FOR POOR TERMINAL CONTACT AT EBTCM.
IF OK, REPLACE EBTCM.
C0145S



DTC 96
REAR BRAKE LAMP CIRCUIT OPEN

Circuit Description:

This DTC is designed to isolate the cause of a DTC 95 malfunction and indicate to the driver ABS is still available. If DTC 95 fails with DTC 96, the Center High Mounted Stop Lamp (CHMSL) circuit is open. The presence of battery voltage at the brake switch input indicates a valid brake switch input is still available.

DTC Will Set When:

DTC 96 can be set only after DTC 95 has been set. If the EBTCM detects battery voltage on the brake switch input circuit for 0.5 seconds, a malfunction exists.

Action Taken:

A malfunction DTC is stored, however, ABS is not disabled. DTCs 91,92,93,94,95,96

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. As a result of a malfunction of an additional brake switch circuit DTC, this DTC may be set. To insure proper diagnosis, any additional brake switch DTCs must be repaired first.
2. Identifies if the malfunction is currently present in the brake circuit.

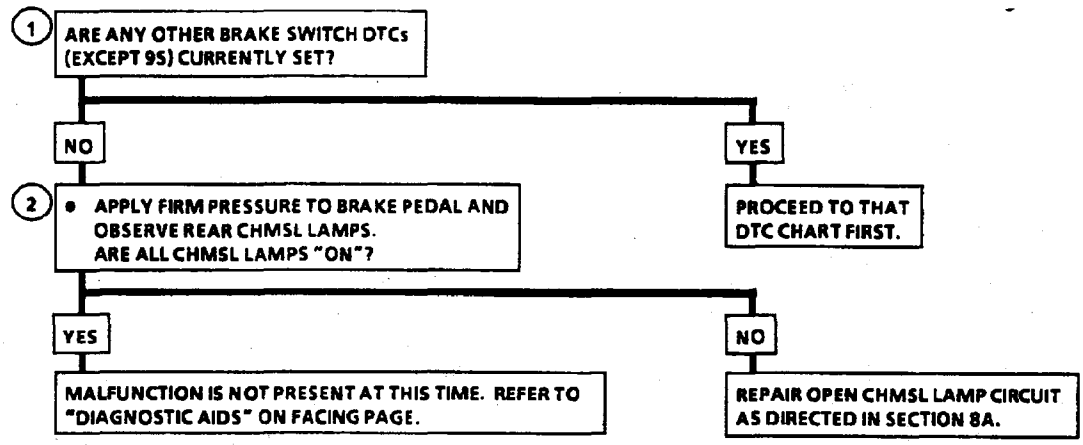
Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

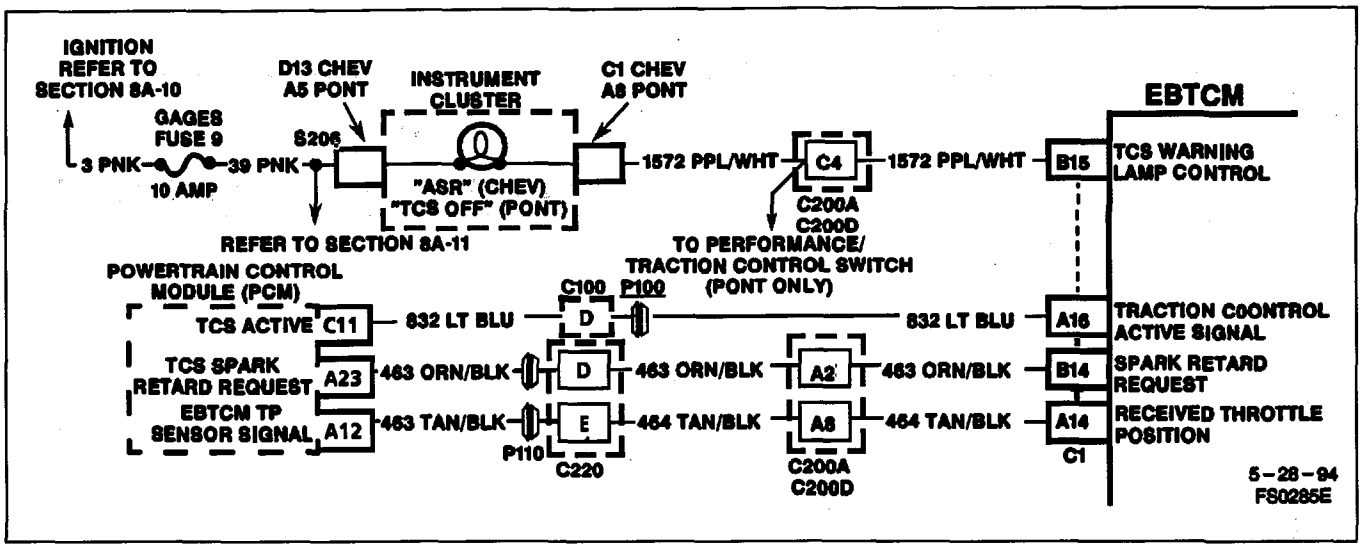
The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 96
REAR BRAKE LAMP CIRCUIT OPEN



C0146S



DTC 111
(Page 1 of 3)
TCS WARNING LAMP OR ACTIVE CIRCUIT MALFUNCTION

Circuit Description:

This DTC checks the state of both the TCS warning lamp and the TCS active circuit to identify a situation in which the driver could not be alerted to a system malfunction or the availability of traction control. The EBTCM turns the amber TCS warning lamp "ON," by providing a ground. The TCS active circuit is such that the EBTCM provides a ground to signal the PCM that TCS is active.

DTC Will Set When:

DTC 111 can be set any time. The TCS warning lamp will set DTC 111 if open or shorted to ground during the 3 second bulb check. In addition a malfunction exists if the TCS warning lamp is opened any time after the bulb check for more than 2 seconds. Shorts to voltage on the TCS warning lamp are detected anytime after the bulb check is complete and the EBTCM is commanding the lamp "OFF."

Shorts to voltage on the TCS active circuit when the EBTCM is commanding it "ON" and the malfunction exists for 2 seconds will set DTC 111. An open on the TCS active circuit will set DTC 111 if the malfunction exists for 2 seconds. An open on the spark retard line while the TCS is not active will set DTC 111 if the malfunction is present in excess of 2 seconds. A short to ground malfunction exists if the TCS active circuit is commanded "OFF" by the EBTCM and the short is present for 2 seconds.

Action Taken:

A malfunction DTC is stored, however ABS and TCS are not disabled.

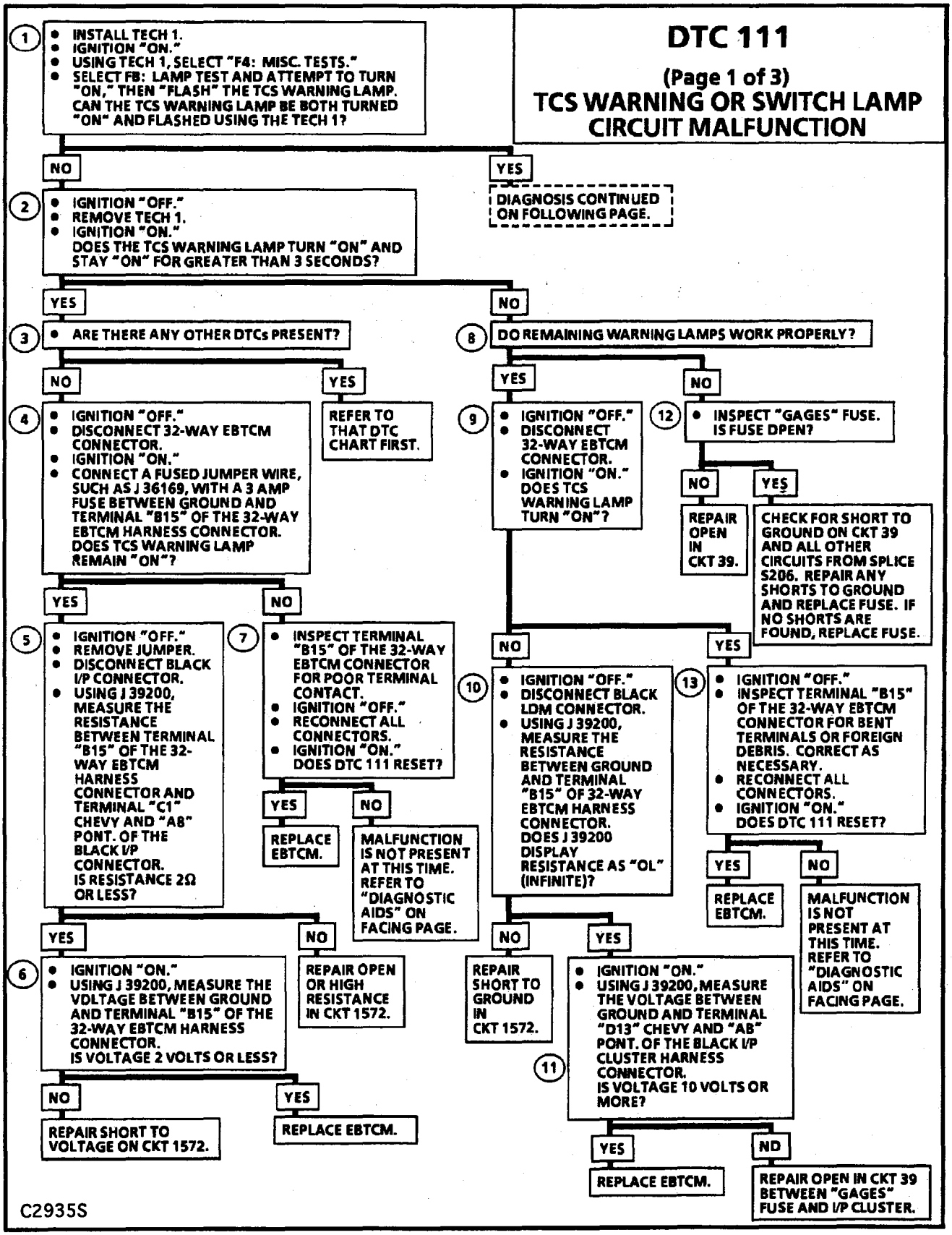
DTC Chart Test Description:

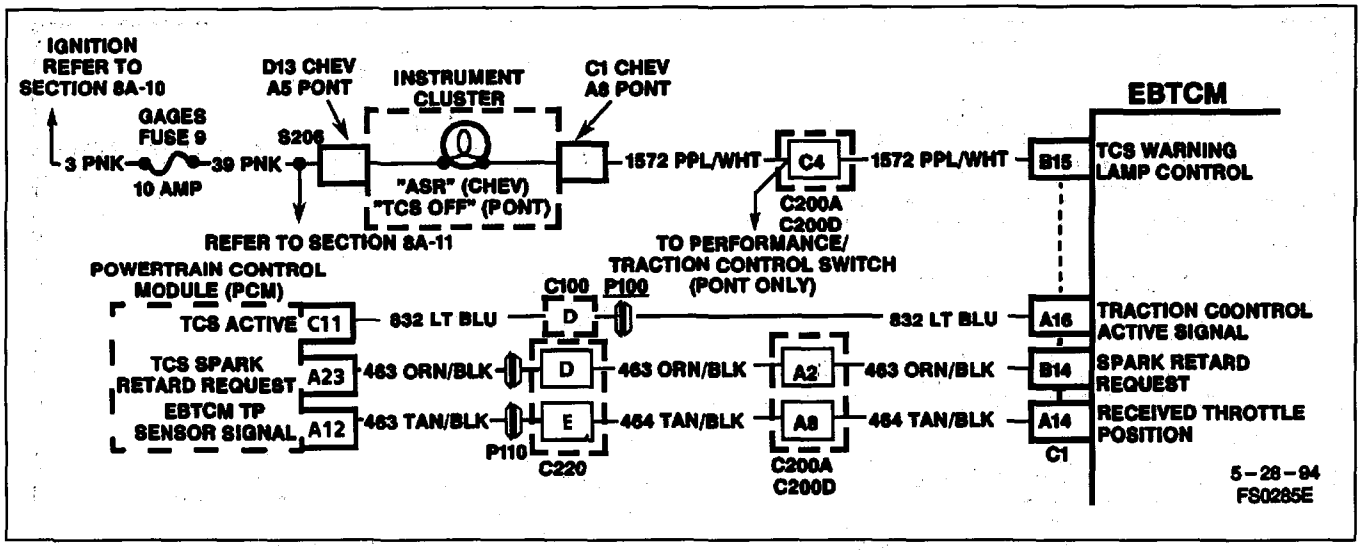
Number(s) below refer to circled number(s) on the diagnostic chart.

1. Determines if the TCS warning lamp can be properly controlled.
2. determines if the lamp is "ON" constantly.
3. Checks for other DTCs which could turn "ON" the TCS warning lamp.
4. Determines if the TCS warning lamp can be turned "OFF" manually.
5. Checks the integrity of the TCS warning lamp circuitry.
6. Checks for a short to voltage on the TCS warning lamp circuitry.
7. Determines if a malfunctioning EBTCM is the cause of DTC 111.
8. Verifies that the other I/P indicator lamps function properly.
9. Determines if the TCS warning lamp can be turned "ON" manually.
10. Checks for a short to ground in the TCS warning lamp circuitry.
11. Checks for a open between the "Gages" fuse and the I/P cluster.
12. Verifies condition of the "Gages" fuse.
13. Determines if DTC 111 was set due to a EBTCM malfunction.

Diagnostic Aids:

Refer to Page 3 of 3 of this chart for diagnostic aids.


DTC 111
(Page 1 of 3)
TCS WARNING OR SWITCH LAMP CIRCUIT MALFUNCTION
1
• INSTALL TECH 1.
• IGNITION "ON."
• USING TECH 1, SELECT "F4: MISC. TESTS."
• SELECT F8: LAMP TEST AND ATTEMPT TO TURN "ON," THEN "FLASH" THE TCS WARNING LAMP. CAN THE TCS WARNING LAMP BE BOTH TURNED "ON" AND FLASHED USING THE TECH 1?
NO
YES
DIAGNOSIS CONTINUED ON FOLLOWING PAGE.
2
• IGNITION "OFF."
• REMOVE TECH 1.
• IGNITION "ON."
DOES THE TCS WARNING LAMP TURN "ON" AND STAY "ON" FOR GREATER THAN 3 SECONDS?
YES
NO
3
• ARE THERE ANY OTHER DTCs PRESENT?
NO
YES
REFER TO THAT DTC CHART FIRST.
4
• IGNITION "OFF."
• DISCONNECT 32-WAY EBTCM CONNECTOR.
• IGNITION "ON."
• CONNECT A FUSED JUMPER WIRE, SUCH AS J 36169, WITH A 3 AMP FUSE BETWEEN GROUND AND TERMINAL "B15" OF THE 32-WAY EBTCM HARNESS CONNECTOR.
DOES TCS WARNING LAMP REMAIN "ON"?
YES
NO
5
• IGNITION "OFF."
• REMOVE JUMPER.
• DISCONNECT BLACK I/P CONNECTOR.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "B15" OF THE 32-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "C1" CHEVY AND "A8" PONT. OF THE BLACK I/P CONNECTOR.
IS RESISTANCE 2Ω OR LESS?
7
• INSPECT TERMINAL "B15" OF THE 32-WAY EBTCM CONNECTOR FOR POOR TERMINAL CONTACT.
• IGNITION "OFF."
• RECONNECT ALL CONNECTORS.
• IGNITION "ON."
DOES DTC 111 RESET?
YES
NO
REPLACE EBTCM.
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
YES
NO
6
• IGNITION "ON."
• USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B15" OF THE 32-WAY EBTCM HARNESS CONNECTOR.
IS VOLTAGE 2 VOLTS OR LESS?
REPAIR OPEN OR HIGH RESISTANCE IN CKT 1572.
NO
YES
REPAIR SHORT TO VOLTAGE ON CKT 1572.
REPLACE EBTCM.
8
DO REMAINING WARNING LAMPS WORK PROPERLY?
YES
NO
9
• IGNITION "OFF."
• DISCONNECT 32-WAY EBTCM CONNECTOR.
• IGNITION "ON."
DOES TCS WARNING LAMP TURN "ON"?
12
• INSPECT "GAGES" FUSE.
IS FUSE OPEN?
NO
YES
REPAIR OPEN IN CKT 39.
CHECK FOR SHORT TO GROUND ON CKT 39 AND ALL OTHER CIRCUITS FROM SPLICE S206. REPAIR ANY SHORTS TO GROUND AND REPLACE FUSE. IF NO SHORTS ARE FOUND, REPLACE FUSE.
NO
YES
10
• IGNITION "OFF."
• DISCONNECT BLACK LDM CONNECTOR.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN GROUND AND TERMINAL "B15" OF 32-WAY EBTCM HARNESS CONNECTOR.
DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
13
• IGNITION "OFF."
• INSPECT TERMINAL "B15" OF THE 32-WAY EBTCM CONNECTOR FOR BENT TERMINALS OR FOREIGN DEBRIS. CORRECT AS NECESSARY.
• RECONNECT ALL CONNECTORS.
• IGNITION "ON."
DOES DTC 111 RESET?
YES
NO
REPLACE EBTCM.
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
NO
YES
REPAIR SHORT TO GROUND IN CKT 1572.
11
• IGNITION "ON."
• USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "D13" CHEVY AND "AB" PONT. OF THE BLACK I/P CLUSTER HARNESS CONNECTOR.
IS VOLTAGE 10 VOLTS OR MORE?
YES
ND
REPLACE EBTCM.
REPAIR OPEN IN CKT 39 BETWEEN "GAGES" FUSE AND I/P CLUSTER.
C2935S



DTC 111
(Page 2 of 3)
TCS WARNING LAMP OR ACTIVE CIRCUIT MALFUNCTION

Circuit Description:

This DTC checks the state of both the TCS warning lamp and the TCS active circuit to identify a situation in which the driver could not be alerted to a system malfunction or the availability of traction control. The EBTCM turns the amber TCS warning lamp "ON," by providing a ground. The TCS active circuit is such that the EBTCM provides a ground to signal the PCM that TCS is active.

DTC Will Set When:

DTC 111 can be set any time. The TCS warning lamp will set DTC 111 if open or shorted to ground during the 3 second bulb check. In addition a malfunction exists if the TCS warning lamp is opened any time after the bulb check for more than 2 seconds. Shorts to voltage on the TCS warning lamp are detected anytime after the bulb check is complete and the EBTCM is commanding the lamp "OFF."

Shorts to voltage on the TCS active circuit when the EBTCM is commanding it "ON" and the malfunction exists for 2 seconds will set DTC 111. An open on the TCS active circuit will set DTC 111 if the malfunction exists for 2 seconds. An open on the spark retard line while the TCS is not active will set DTC 111 if the malfunction is present in excess of 2 seconds. A short to ground malfunction exists if the TCS active circuit is commanded "OFF" by the EBTCM and the short is present for 2 seconds.

Action Taken:

A malfunction DTC is stored, however ABS and TCS are not disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

14. Determines if the switch lamp can be properly controlled. (Pont Only)
15. Determines id the switch lamp is "ON" constantly.
16. Checks for a short to ground in the switch lamp circuitry (Pont Only)
17. Determines if DTC 111 was set due to an EBTCM malfunction.
18. Determines if DTC 111 was set due to an EBTCM malfunction.
19. Determines if there is an open in CKT 41 or ABS fuse.
20. Determines if the switch lamp can be controlled manually.
21. Verifies the integrity of the switch lamp circuitry.
22. Determines if there is a short to voltage in the switch lamp circuitry.
23. Determines if DTC 111 was set due to an EBTCM malfunction.

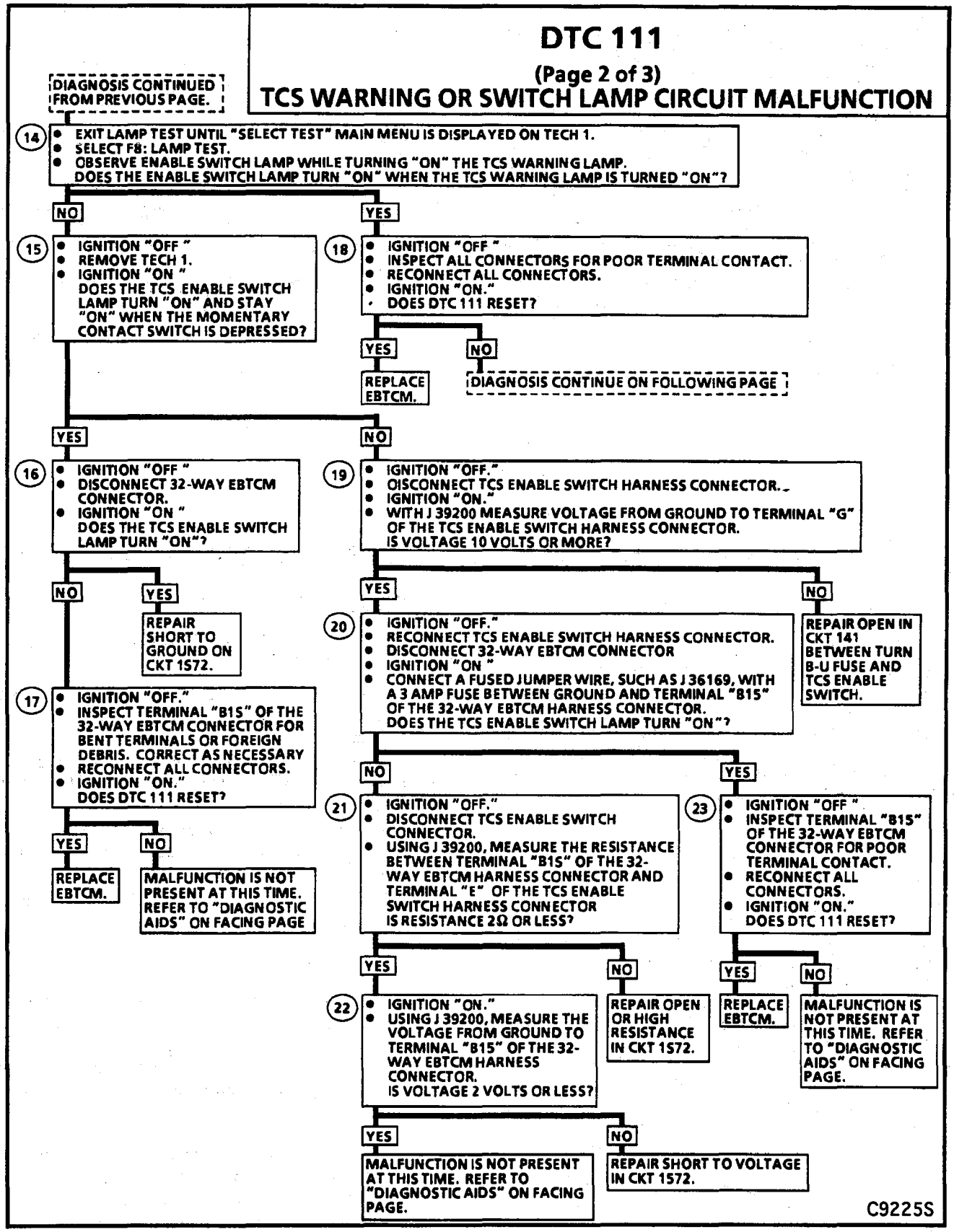
Diagnostic Aids:

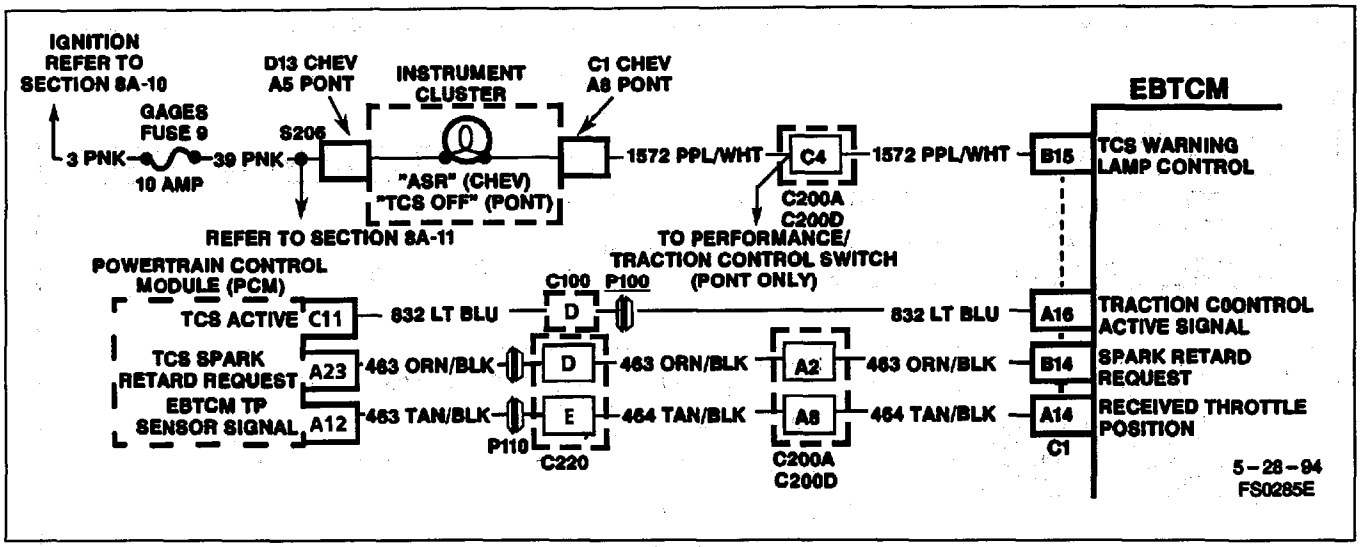
Refer to page 3 of 3 of this chart for diagnostic aids.

DTC 111

(Page 2 of 3)

TCS WARNING OR SWITCH LAMP CIRCUIT MALFUNCTION





DTC 111
(Page 3 of 3)
TCS WARNING LAMP OR ACTIVE CIRCUIT MALFUNCTION

Circuit Description:

This DTC checks the state of both the TCS warning lamp and the TCS active circuit to identify a situation in which the driver could not be alerted to a system malfunction or the availability of traction control. The EBTCM turns the amber TCS warning lamp "ON," by providing a ground. The TCS active circuit is such that the EBTCM provides a ground to signal the PCM that TCS is active.

DTC Will Set When:

DTC 111 can be set any time. The TCS warning lamp will set DTC 111 if open or shorted to ground during the 3 second bulb check. In addition a malfunction exists if the TCS warning lamp is opened any time after the bulb check for more than 2 seconds. Shorts to voltage on the TCS warning lamp are detected anytime after the bulb check is complete and the EBTCM is commanding the lamp "OFF."

Shorts to voltage on the TCS active circuit when the EBTCM is commanding it "ON" and the malfunction exists for 2 seconds will set DTC 111. An open on the TCS active circuit will set DTC 111 if the malfunction exists for 2 seconds. An open on the spark retard line while the TCS is not active will set DTC 111 if the malfunction is present in excess of 2 seconds. A short to ground malfunction exists if the TCS active circuit is commanded "OFF" by the EBTCM and the short is present for 2 seconds.

Action Taken:

A malfunction DTC is stored, however ABS and TCS are not disabled.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

24. Checks for or high resistance in spark retard request line (CKT 463) between PCM and EBTCM.
25. Check for short to voltage in spark retard request line (CKT 463) between PCM and EBTCM.
26. Checks for short to ground in spark retard request line (CKT 463) between PCM and EBTCM.
27. Checks for poor terminal contact or corrosion in the connectors in CKT 463.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 111

(Page 3 of 3)
TCS WARNING LAMP OR ACTIVE CIRCUIT MALFUNCTION

DIAGNOSIS CONTINUED FROM PREVIOUS PAGE.

(24)
- IGNITION "OFF."
- DISCONNECT PCM CONNECTOR "A" 32-WAY EBTCM CONNECTOR.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "23" OF THE PCM HARNESS CONNECTOR "A" AND TERMINAL "B14" DF THE 32-WAY EBTCM HARNESS CONNECTOR.

IS RESISTANCE 2Ω OR LE$S.?

YES

(25)
- USING J 39200 MEASURE VOLTAGE BETWEEN TERMINAL "B14" OF THE 32-WAY EBTCM CONNECTOR AND GROUND.

IS VOLTAGE 2 VOLTS OR LESS?

YES

(26)
- USING J 39200 MEASURE RESISTANCE BETWEEN GROUND AND TERMINAL "B14" OF THE 32-WAY EBTCM HARNESS CONNECTOR.

DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES

(27)
- INSPECT TERMINALS "D" OF CONNECTOR C220, "A2" OF CONNECTOR C200 A/D, PCM CONNECTOR "A" AND 32-WAY EBTCM CONNECTOR FOR POOR TERMINAL CONTACT OR CORROSION. REFER TD SECTION 8A-4, "CHECKING TERMINAL CONTACT."

DO ANY TERMINALS EXHIBIT POOR CONTACT OR EVIDENCE OF CORROSION?

NO

- IGNITION "OFF."
- RECONNECT ALL CONNECTORS.
- START ENGINE.

DOES DTC 111 SET AS A CURRENT DTC?

YES

REPLACE EBTCM.

NO

MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO

REPLACE TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION.

NO

REPAIR SHORT TO GROUND IN CKT 463.

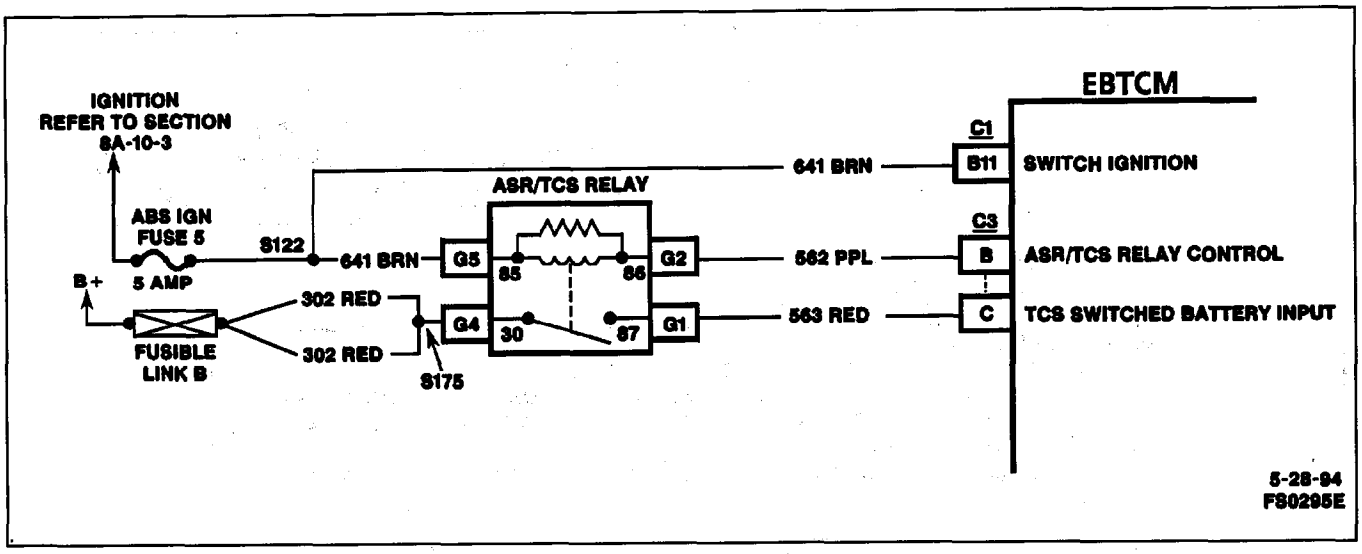
NO

REPAIR SHORT TO VOLTAGE IN CKT 463.

NO

REPAIR OPEN OR HIGH RESISTANCE IN CKT 463.

C2936S



DTC 114
(Page 1 of 3)
TCS ENABLE RELAY CONTACT CIRCUIT OPEN

Circuit Description:

Ignition voltage is supplied through terminal "G5" of the ASR/TCS relay. The EBTCM then is able to energize the pull-in coil by completing the ground circuit at connector "C3",terminal "B" of the EBTCM. The magnetic field created closes the ASR/TCS relay contacts and allows battery voltage and current to be supplied to the EBTCM, which supplies power to the motors and solenoids.

DTC Will Set When:

DTC 114 can be set anytime after the EBTCM commands the ASR/TCS relay "ON" (the relay is first commanded "ON" during the three second bulb check). This test monitors the availability of current and voltage to the motors and solenoids. This malfunction indicates voltage is not available and would therefore not allow TCS operation if required.

Action Taken:

A malfunction DTC is stored, TCS is disabled and the amber TCS warning lamp is turned "ON." The red BRAKE warning lamp is turned "ON" if the TCS is active at the time of malfunction.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks to see if DTC 116 is also set as current or history. If DTC 116 is also set, proceed to that chart first.
2. Verifies that the malfunction is currently present. 3. Verifies that the relay can be turned "ON" and provide voltage to the EBTCM.
4. Checks for high resistance in the switched battery circuit from the relay to the EBTCM.
5. Checks for high resistance in the switched battery circuit from the battery to the relay.
6. Checks for high resistance in the relay contacts.
7. Checks for poor terminal contact or corrosion at the connectors.
8. Determines if the EBTCM is the cause of the malfunction.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

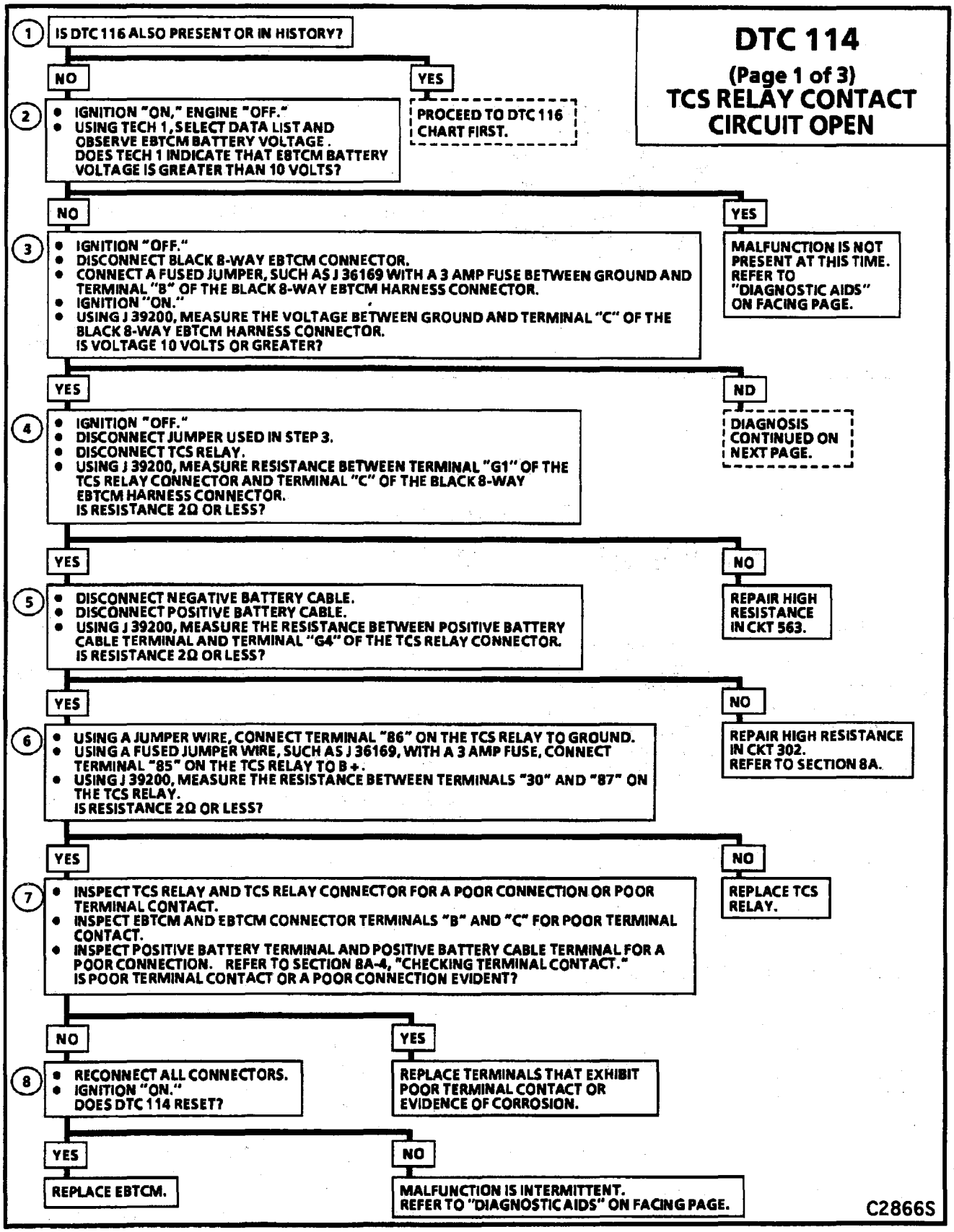
The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

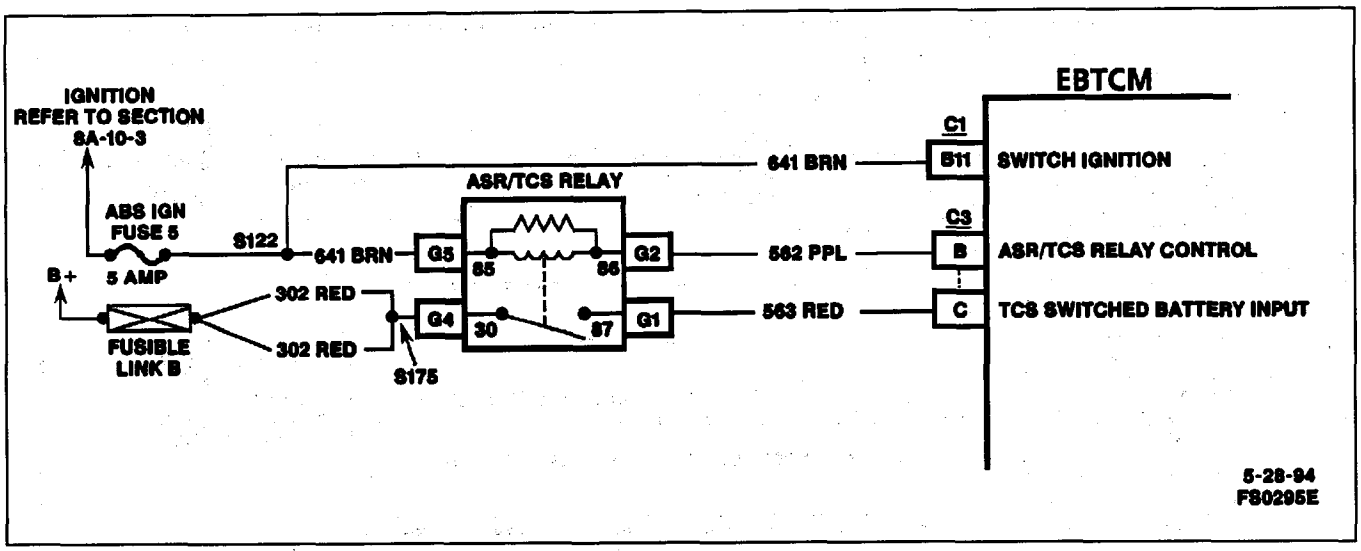
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

VIBRATION, TEMPERATURE EFFECTS:

Check for vibration effects by performing the relay test function of the Tech 1. With the relay test commanded "ON," lightly tap the top and sides of the relay while monitoring relay voltage. If the relay voltage changes significantly, replace the relay.

If DTC 114 only sets when the vehicle is initially started in cold ambient conditions (temperature less than 32° F-0° C), replace the relay.


DTC 114
(Page 1 of 3)
TCS RELAY CONTACT CIRCUIT OPEN
1
IS DTC 116 ALSO PRESENT OR IN HISTORY?
NO
YES
PROCEED TO DTC 116 CHART FIRST.
2
• IGNITION "ON," ENGINE "OFF."
• USING TECH 1, SELECT DATA LIST AND OBSERVE EBTCM BATTERY VOLTAGE. DOES TECH 1 INDICATE THAT EBTCM BATTERY VOLTAGE IS GREATER THAN 10 VOLTS?
NO
YES
MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
3
• IGNITION "OFF."
• DISCONNECT BLACK 8-WAY EBTCM CONNECTOR.
• CONNECT A FUSED JUMPER, SUCH AS J 36169 WITH A 3 AMP FUSE BETWEEN GROUND AND TERMINAL "8" OF THE BLACK 8-WAY EBTCM HARNESS CONNECTOR.
• IGNITION "ON."
• USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "C" OF THE BLACK 8-WAY EBTCM HARNESS CONNECTOR. IS VOLTAGE 10 VOLTS OR GREATER?
YES
ND
DIAGNOSIS CONTINUED ON NEXT PAGE.
4
• IGNITION "OFF."
• DISCONNECT JUMPER USED IN STEP 3.
• DISCONNECT TCS RELAY.
• USING J 39200, MEASURE RESISTANCE BETWEEN TERMINAL "G1" OF THE TCS RELAY CONNECTOR AND TERMINAL "C" OF THE BLACK 8-WAY EBTCM HARNESS CONNECTOR. IS RESISTANCE 2Ω OR LESS?
YES
NO
REPAIR HIGH RESISTANCE IN CKT 563.
5
• DISCONNECT NEGATIVE BATTERY CABLE.
• DISCONNECT POSITIVE BATTERY CABLE.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN POSITIVE BATTERY CABLE TERMINAL AND TERMINAL "G4" OF THE TCS RELAY CONNECTOR. IS RESISTANCE 2Ω OR LESS?
YES
NO
REPAIR HIGH RESISTANCE IN CKT 302. REFER TO SECTION 8A.
6
• USING A JUMPER WIRE, CONNECT TERMINAL "86" ON THE TCS RELAY TO GROUND.
• USING A FUSED JUMPER WIRE, SUCH AS J 36169, WITH A 3 AMP FUSE, CONNECT TERMINAL "85" ON THE TCS RELAY TO B+.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINALS "30" AND "87" ON THE TCS RELAY. IS RESISTANCE 2Ω OR LESS?
YES
NO
REPLACE TCS RELAY.
7
• INSPECT TCS RELAY AND TCS RELAY CONNECTOR FOR A POOR CONNECTION OR POOR TERMINAL CONTACT.
• INSPECT EBTCM AND EBTCM CONNECTOR TERMINALS "B" AND "C" FOR POOR TERMINAL CONTACT.
• INSPECT POSITIVE BATTERY TERMINAL AND POSITIVE BATTERY CABLE TERMINAL FOR A POOR CONNECTION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." IS POOR TERMINAL CONTACT OR A POOR CONNECTION EVIDENT?
NO
YES
REPLACE TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION.
8
• RECONNECT ALL CONNECTORS.
• IGNITION "ON."
DOES DTC 114 RESET?
YES
NO
REPLACE EBTCM.
MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
C2866S



DTC 114
(Page 2 of 3)
TCS ENABLE RELAY CONTACT CIRCUIT OPEN

Circuit Description:

Ignition voltage is supplied through terminal "G5" of the ASR/TCS relay. The EBTCM then is able to energize the pull-in coil by completing the ground circuit at connector "C3",terminal "B" of the EBTCM. The magnetic field created closes the ASR/TCS relay contacts and allows battery voltage and current to be supplied to the EBTCM, which supplies power to the motors and solenoids.

DTC Will Set When:

DTC 114 can be set anytime after the EBTCM commands the ASR/TCS relay "ON" (the relay is first commanded "ON" during the three second bulb check). This test monitors the availability of current and voltage to the motors and solenoids. This malfunction indicates voltage is not available and would therefore not allow TCS operation if required.

Action Taken:

A malfunction DTC is stored, TCS is disabled and the amber TCS warning lamp is turned "ON." The red BRAKE warning lamp is turned "ON" if the TCS is active at the time of malfunction.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

9. Checks for high resistance in the entire relay coil circuit.
10. Verifies proper battery condition.
11. Verifies proper voltage is available at the ASR/TCS relay.
12. Checks for an open in the switched battery circuit from the relay to the EBTCM.
13. Verifies the condition of the ASR/TCS relay.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

VIBRATION, TEMPERATURE EFFECTS:

Check for vibration effects by performing the relay test function of the Tech 1. With the relay test commanded "ON," lightly tap the top and sides of the relay while monitoring relay voltage. If the relay voltage changes significantly, replace the relay.

If DTC 114 only sets when the vehicle is initially started in cold ambient conditions (temperature less than 32° F-0° C), replace the relay.

DTC 114
(PAGE 2 OF 3)
TCS RELAY CONTACT CIRCUIT OPEN

DIAGNOSIS CONTINUED FROM PREVIOUS PAGE.

9
- IGNITION "OFF."
- REMOVE JUMPER WIRE INSTALLED IN STEP 3, IF NOT ALREADY REMOVED.
- DISCONNECT NEGATIVE BATTERY CABLE.
- DISCONNECT POSITIVE BATTERY CABLE.
- WITH BATTERY STILL DISCONNECTED, TURN IGNITION SWITCH TO "RUN." THIS COMPLETES THE IGNITION CIRCUIT TO THE TCS RELAY.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "B" OF THE BLACK 8-WAY EBTCM HARNESS CONNECTOR AND THE POSITIVE BATTERY CABLE TERMINAL. IS RESISTANCE 95Ω OR LESS WHEN MEASURED AT APPROXIMATELY 20 °C (68°F)?

YES

NO → DIAGNOSIS CONTINUED ON NEXT PAGE.

10
- USING J 39200, MEASURE THE VOLTAGE BETWEEN THE POSITIVE AND NEGATIVE BATTERY TERMINALS. IS VOLTAGE 10 VOLTS OR GREATER?

YES

NO → REFER TO SECTION 6D3 TO CORRECT LOW VOLTAGE CONDITION.

11
- IGNITION "OFF."
- RECONNECT POSITIVE BATTERY CABLE.
- RECONNECT NEGATIVE BATTERY CABLE.
- DISCONNECT TCS RELAY.
- USING J 39200, MEASURE THE VOLTAGE BETWEEN TERMINAL "G4" OF THE TCS RELAY CONNECTOR AND GROUND. IS VOLTAGE 10 VOLTS OR GREATER?

YES

NO → REPAIR OPEN OR HIGH RESISTANCE IN CKT 302.

12
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "G1" OF THE TCS RELAY CONNECTOR AND TERMINAL "C" OF THE BLACK 8-WAY EBTCM HARNESS CONNECTOR. IS RESISTANCE 2Ω OR LESS?

YES

NO → REPAIR OPEN OR HIGH RESISTANCE IN CKT 563.

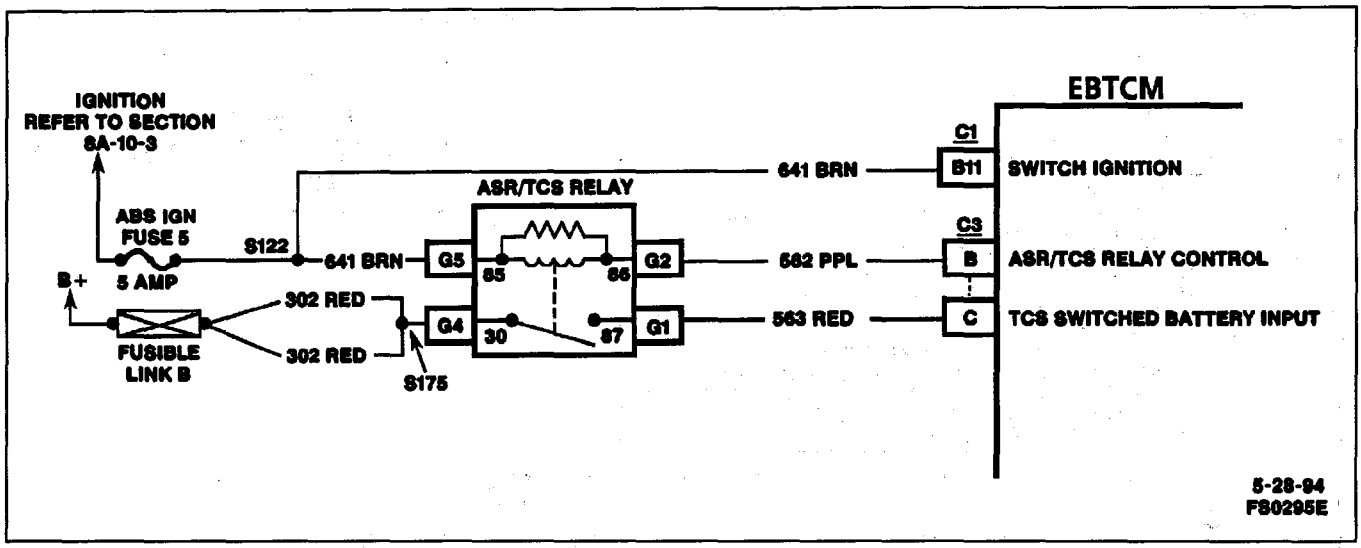
13
- USING A JUMPER WIRE, CONNECT TERMINAL "86" ON THE TCS ENABLE RELAY TO GROUND.
- USING A FUSED JUMPER WIRE, SUCH AS J 36169, WITH A 3 AMP FUSE, CONNECT TERMINAL "85" ON THE TCS RELAY TO VOLTAGE.
- USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINALS "30" AND "87" ON THE TCS RELAY. IS RESISTANCE 2Ω OR LESS?

YES

NO → REPLACE TCS RELAY.

YES → MALFUNCTION WAS MOST LIKELY DUE TO A POOR CONNECTION. INSPECT ALL CONNECTORS AND TERMINALS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT EVIDENCE OF POOR TERMINAL CONTACT OR CORROSION.

C2867S



DTC 114
(Page 3 of 3)
TCS ENABLE RELAY CONTACT CIRCUIT OPEN

Circuit Description:

Ignition voltage is supplied through terminal "G5" of the ASR/TCS relay. The EBTCM then is able to energize the pull-in coil by completing the ground circuit at connector "C3",terminal "B" of the EBTCM. The magnetic field created closes the ASR/TCS relay contacts and allows battery voltage and current to be supplied to the EBTCM, which supplies power to the motors and solenoids.

DTC Will Set When:

DTC 114 can be set anytime after the EBTCM commands the ASR/TCS relay "ON" (the relay is first commanded "ON" during the three second bulb check). This test monitors the availability of current and voltage to the motors and solenoids. This malfunction indicates voltage is not available and would therefore not allow TCS operation if required.

Action Taken:

A malfunction DTC is stored, TCS is disabled and the amber TCS warning lamp is turned "ON." The red BRAKE warning lamp is turned "ON" if the TCS is active at the time of malfunction.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

14. Checks for proper resistance of the relay coil.
15. Checks for high resistance in the ASR/TCS relay control circuit between the relay and the EBTCM.
16. Checks for high resistance in the ASR/TCS relay control circuit between the battery and the relay.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

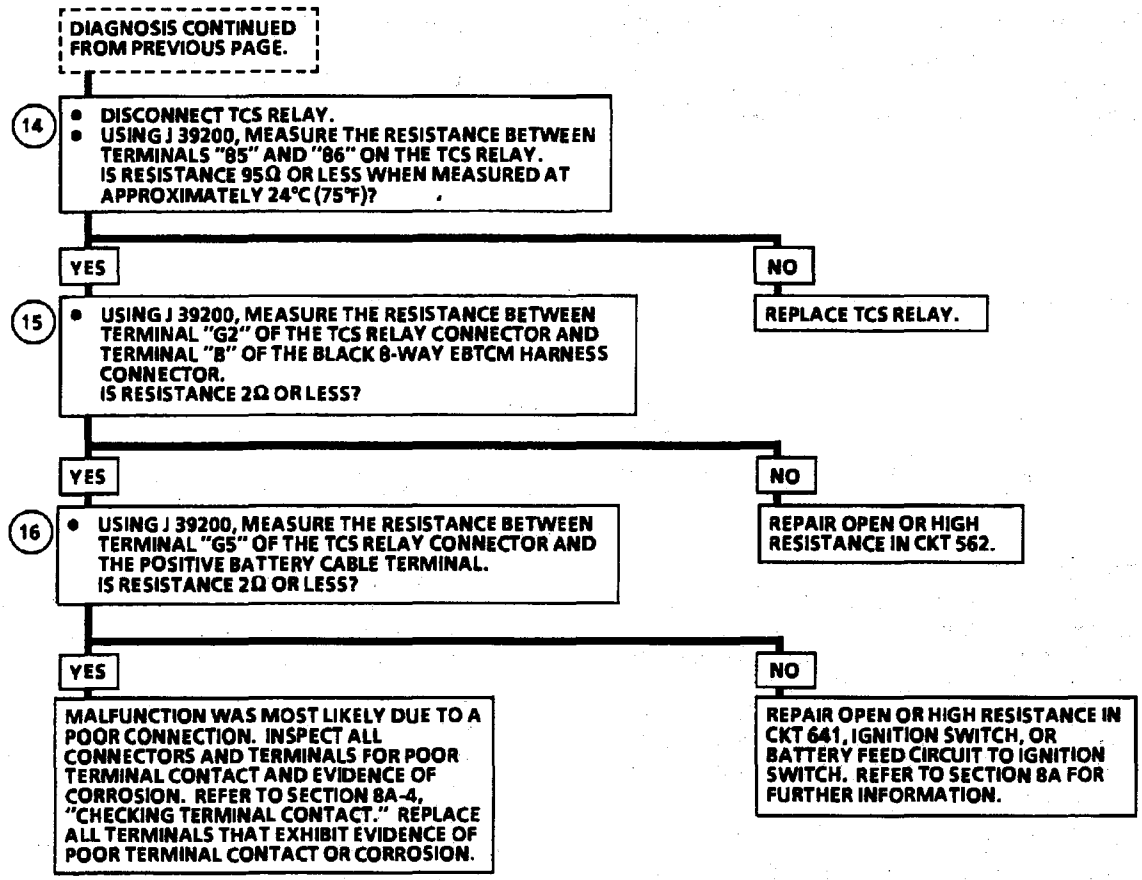
VIBRATION, TEMPERATURE EFFECTS:

Check for vibration effects by performing the relay test function of the Tech 1. With the relay test commanded "ON," lightly tap the top and sides of the relay while monitoring relay voltage. If the relay voltage changes significantly, replace the relay.

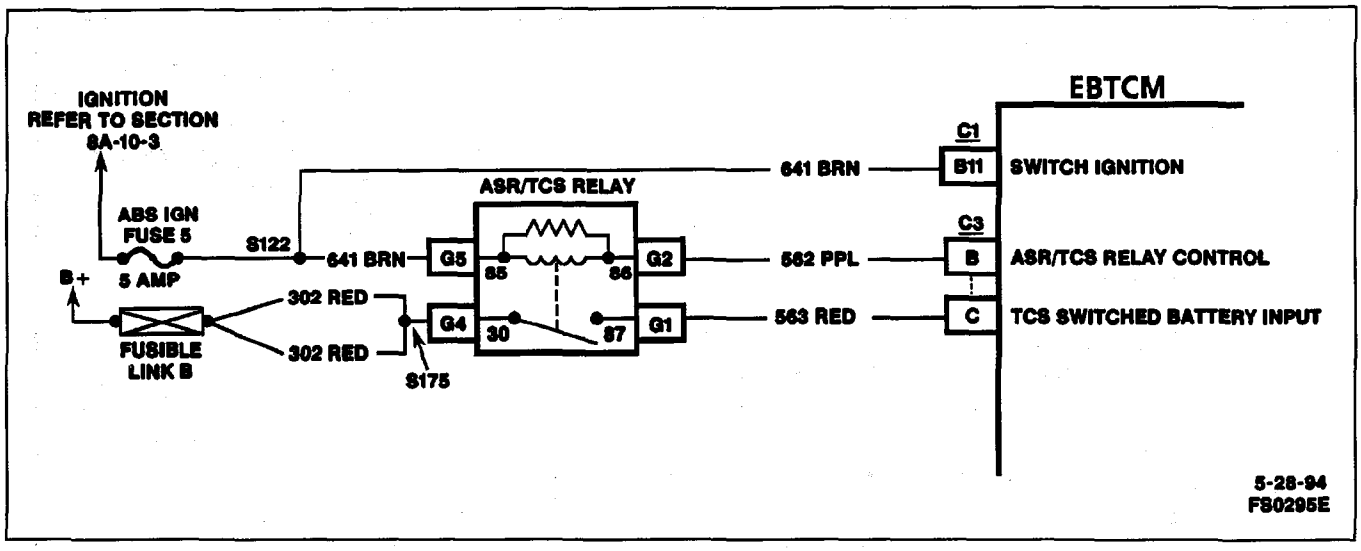
If DTC 114 only sets when the vehicle is initially started in cold ambient conditions (temperature less than 32° F-0° C), replace the relay.

DTC 114

(Page 3 of 3) TCS RELAY CONTACT CIRCUIT OPEN



C2868S



DTC 116
TCS ENABLE RELAY COIL CIRCUIT OPEN

Circuit Description:

Ignition voltage is supplied through terminal "G5" of the ASR/TCS relay. The EBTCM then is able to energize the pull-in coil by completing the ground circuit at connector "C3",terminal "B" of the EBTCM. The magnetic field created closes the ASR/TCS relay contacts and allows battery voltage and current to be supplied to the EBTCM, which supplies power to the motors and solenoids.

DTC Will Set When:

DTC 116 can be set only after DTC 114 has been set. This test detects an open in the ASR/TCS relay coil circuit. An open in this circuit will not allow the ASR/TCS relay to be energized thus preventing voltage and current to the motors and solenoids. If this malfunction is present and the ignition is turned "OFF" before 5 km/h (3 mph) is reached, DTC 114 is set alone.

Action Taken:

A malfunction DTC is stored, TCS is disabled and the amber TCS warning lamp is turned "ON." The red BRAKE warning lamp is turned "ON" if the TCS is active at the time of malfunction.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Indicates the EBTCM is capable of controlling the ASR/TCS relay as commanded.
2. Checks to ensure that voltage is available to the pull-in coil of the ASR/TCS relay.
3. Ensures that there is continuity through the pull-in coil of the ASR/TCS relay.
4. Verifies the integrity of the relay control circuit.
5. Ensures malfunction was not due to poor terminal contact.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

If the frequency of the malfunction is high, but is currently intermittent, check for high coil resistance by measuring between relay terminals "G1" and "G2" using a J 39200. If resistance shows greater than 100 ohms, replace the relay.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 116
TCS RELAY COIL CIRCUIT OPEN

1
- IGNITION "ON," ENGINE "OFF."
- USING THE RELAY TEST FUNCTION OF THE TECH 1, COMMAND THE TCS RELAY "ON."

DOES TECH 1 INDICATE TCS RELAY "ON" AND BATTERY VOLTAGE ABOVE 10 VOLTS?

NO

2
- USING J 39200, MEASURE THE VOLTAGE BY BACKPROBING BETWEEN GROUND AND TERMINAL "G5" OF THE TCS RELAY CONNECTOR.

IS VOLTAGE 10 VOLTS OR GREATER?

YES

3
- USING THE RELAY TEST FUNCTION OF THE TECH 1, COMMAND THE TCS RELAY "OFF."
- USING J 39200, MEASURE THE VOLTAGE BY BACKPROBING BETWEEN GROUND AND TERMINAL "G2" OF THE TCS RELAY CONNECTOR.

IS VOLTAGE 10 VOLTS OR GREATER?

YES

4
- IGNITION "OFF."
- DISCONNECT BLACK 8-WAY EBTCM CONNECTOR.
- IGNITION "ON."
- MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B" OF THE BLACK 8-WAY EBTCM HARNESS CONNECTOR.

IS VOLTAGE 10 VOLTS OR GREATER?

YES

5
- IGNITION "OFF."
- INSPECT BLACK 8-WAY EBTCM CONNECTOR TERMINAL "B" FOR POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION. REFER TO SECTION 8A-4 "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.
- RECONNECT ALL CONNECTORS.
- IGNITION "ON."

DOES DTC 116 SET AS A CURRENT DTC?

YES

REPLACE EBTCM.

NO

MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO

REPAIR OPEN OR HIGH RESISTANCE IN CKT 562.

NO

CHECK FOR INTERMITTENT CONNECTIONS AT TCS RELAY. IF OK, REPLACE TCS RELAY.

NO

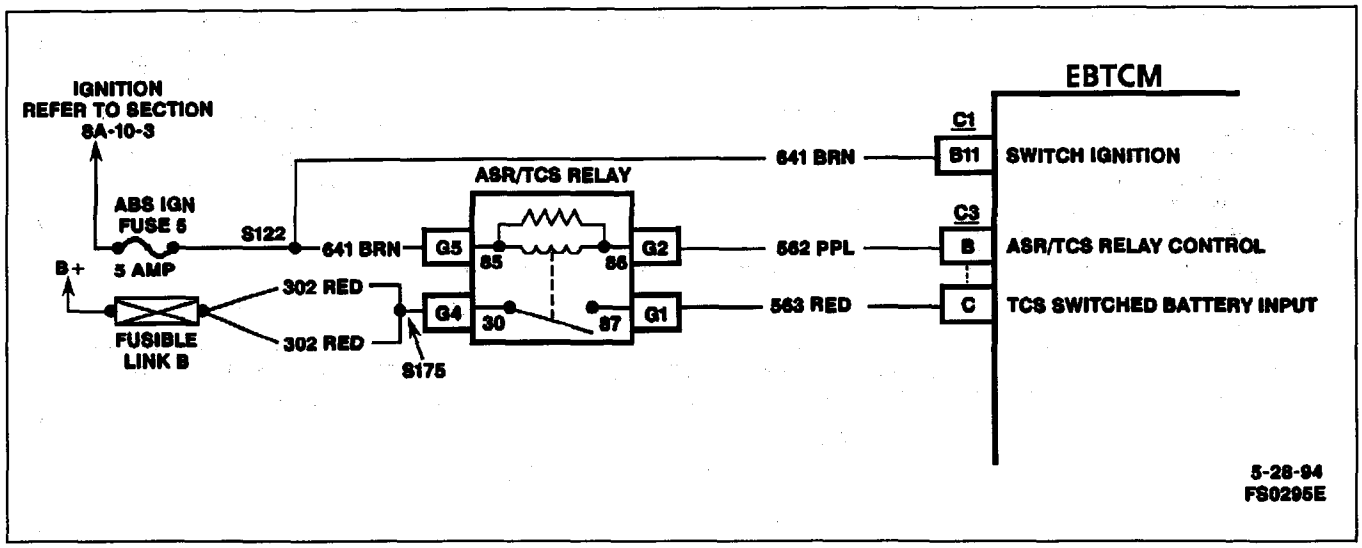
REPAIR OPEN OR HIGH RESISTANCE IN CKT 641 OR ABS IGN FUSE 5.

YES

MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN IGNITION "OFF."

C2869S



DTC 118
TCS ENABLE RELAY COIL CIRCUIT SHORTED TO BATT

Circuit Description:

Ignition voltage is supplied through terminal "G5" of the ASR/TCS relay. The EBTCM then is able to energize the pull-in coil by completing the ground circuit at connector "C3",terminal "B" of the EBTCM. The magnetic field created closes the ASR/TCS relay contacts and allows battery voltage and current to be supplied to the EBTCM, which supplies voltage to the motors and solenoids.

DTC Will Set When:

DTC 118 can be set after the EBTCM commands the ASR/TCS relay "ON." This test monitors the availability of current and voltage to the motors and solenoids. A malfunction of this type will not allow voltage to be available to the motors and solenoids; therefore, TCS operation would not be allowed if required.

Action Taken:

A malfunction DTC is stored, TCS is disabled and the amber TCS warning lamp is turned "ON." The red BRAKE warning lamp is turned "ON" if the TCS is active at the time of malfunction.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Indicates that the EBTCM is capable of controlling the ASR/TCS relay as commanded.
2. Checks for a short to voltage on the relay control circuit.
3. Verifies that the relay coil has the appropriate resistance.
4. Checks for relay contacts that are failed closed.
5. Checks for possible poor terminal contact at the EBTCM.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 118
TCS RELAY COIL CIRCUIT SHORTED TO BATT

1. • IGNITION "ON," ENGINE "OFF."
   • USING RELAY TEST FUNCTION OF TECH 1, COMMAND TCS RELAY "ON."
   DOES TECH 1 INDICATE TCS RELAY "ON" AND BATTERY VOLTAGE ABOVE 10 VOLTS?
   - NO
   - YES → MALFUNCTION IS NOT PRESENT AT THIS TIME. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

2. • IGNITION "OFF."
   • DISCONNECT TCS RELAY.
   • DISCONNECT BLACK 8-WAY EBTCM CONNECTOR.
   • IGNITION "ON."
   • USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B" OF THE BLACK 8-WAY EBTCM HARNESS CONNECTOR.
   IS VOLTAGE 2 VOLTS OR LESS?
   - YES
   - NO → REPAIR SHORT TO VOLTAGE IN CKT 562.

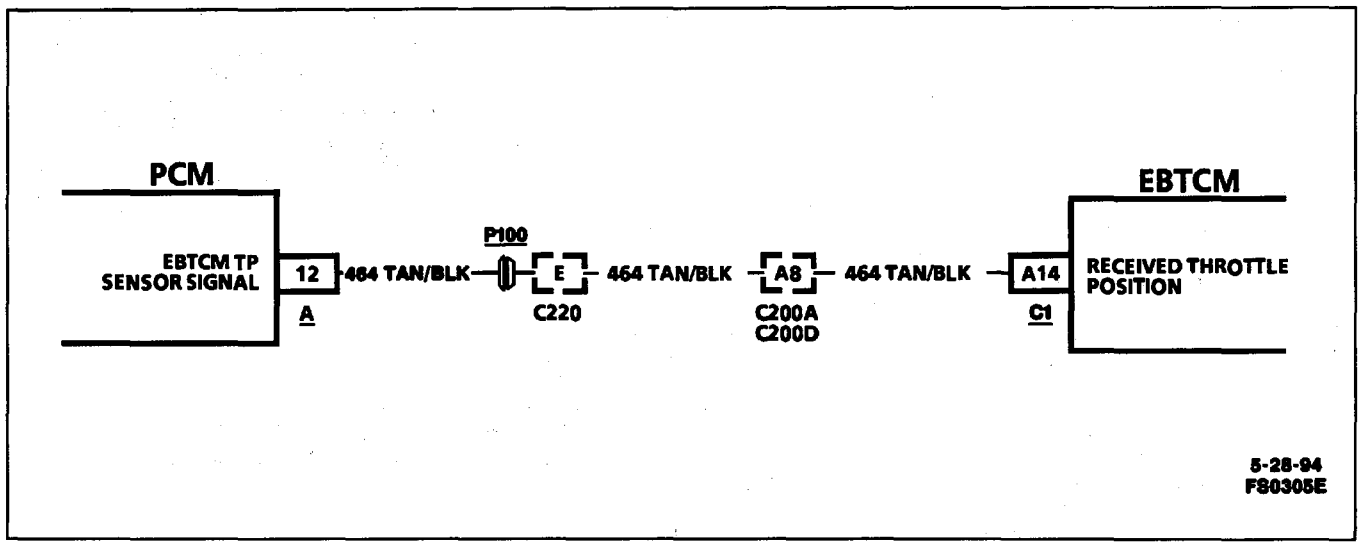
3. • IGNITION "OFF."
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "G5" AND TERMINAL "G2" OF THE TCS RELAY.
   IS RESISTANCE 40Ω OR GREATER?
   - YES
   - NO → REPLACE TCS RELAY.

4. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINALS "30" AND "87" OF THE TCS RELAY.
   DOES J 39200 DISPLAY RESISTANCE AS "DL" (INFINITE)?
   - YES
   - NO → REPLACE TCS RELAY.

5. • INSPECT CKT 562 AND TERMINAL "B" OF THE BLACK 8-WAY EBTCM CONNECTOR FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
   • RECONNECT ALL CONNECTORS.
   • IGNITION "ON."
   DOES DTC 118 SET AS A CURRENT DTC?
   - YES → REPLACE EBTCM.
   - NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN IGNITION "OFF."

C2870S



DTC 123
PCM TO EBTCM TP SENSOR CIRCUIT MALFUNCTION

Circuit Description:

The traction control system uses the antilock brake system in conjunction with the PCM fuel and ignition controls to limit drive wheel slippage during acceleration. The PCM controlled portion of the traction control system reduces engine torque by altering spark timing and controlling throttle position. The EBTCM sends a spark retard request to the PCM via a Pulse Width Modulated (PWM) signal requesting the desired spark level for proper traction control system operation (CKT 463). The PCM then provides a throttle position PWM signal (CKT 464) informing the EBTCM what the actual throttle position of the engine is.

DTC Will Set When:

DTC 123 will set when there is a malfunction in the throttle position circuit (CKT 464) or if the signal is out of range.

Action Taken:

A malfunction DTC is stored, TCS is disabled at the end of the current TCS cycle and the amber TCS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart,

1. Checks for proper voltage at the PCM terminal.
2. Checks for short to voltage in CKT 464.
3. Ensures malfunction was not due to physical damage of circuitry.
4. Checks for open in CKT 464.
5. Checks for short to ground in CKT 464.
6. Checks for possible poor terminal contact at the EBTCM.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

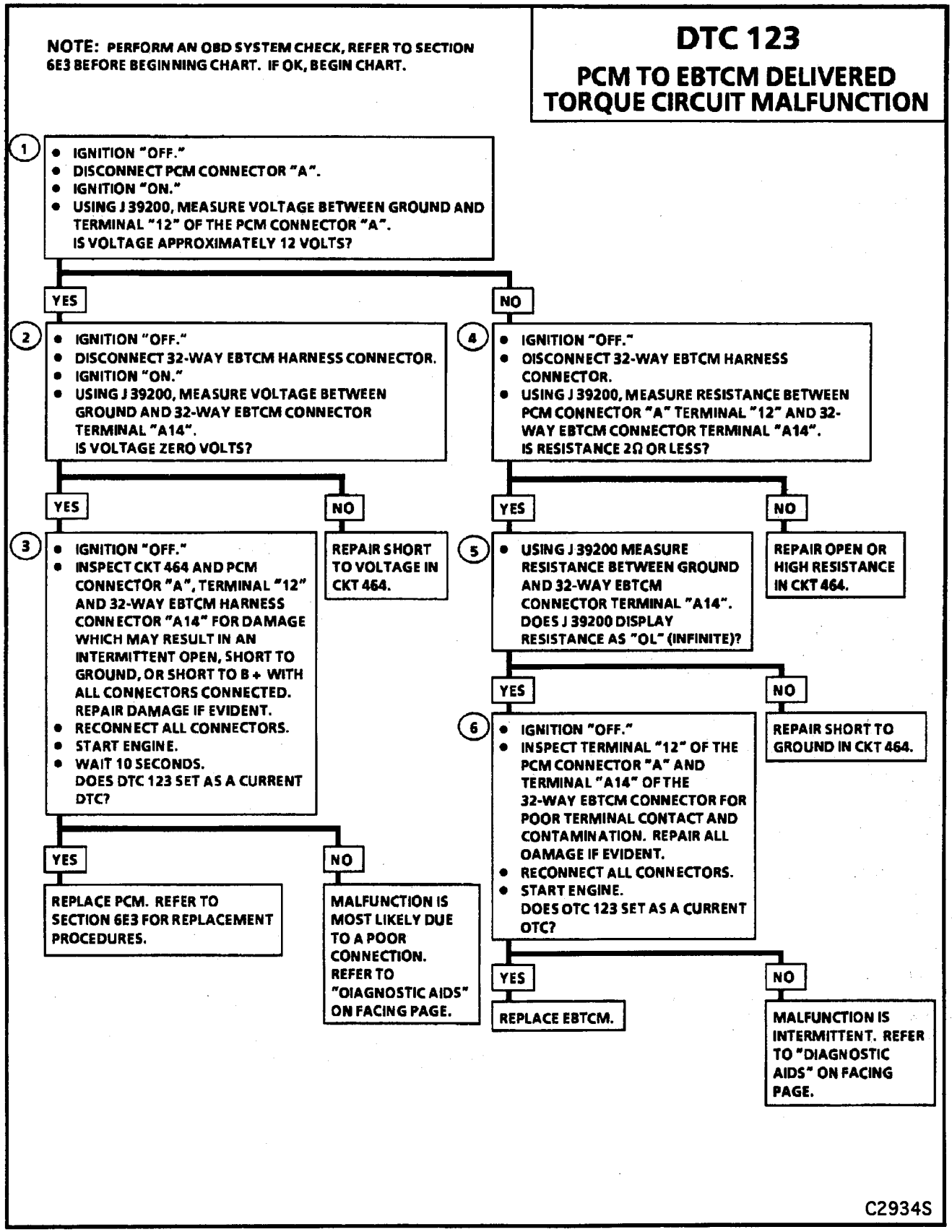
The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaints should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

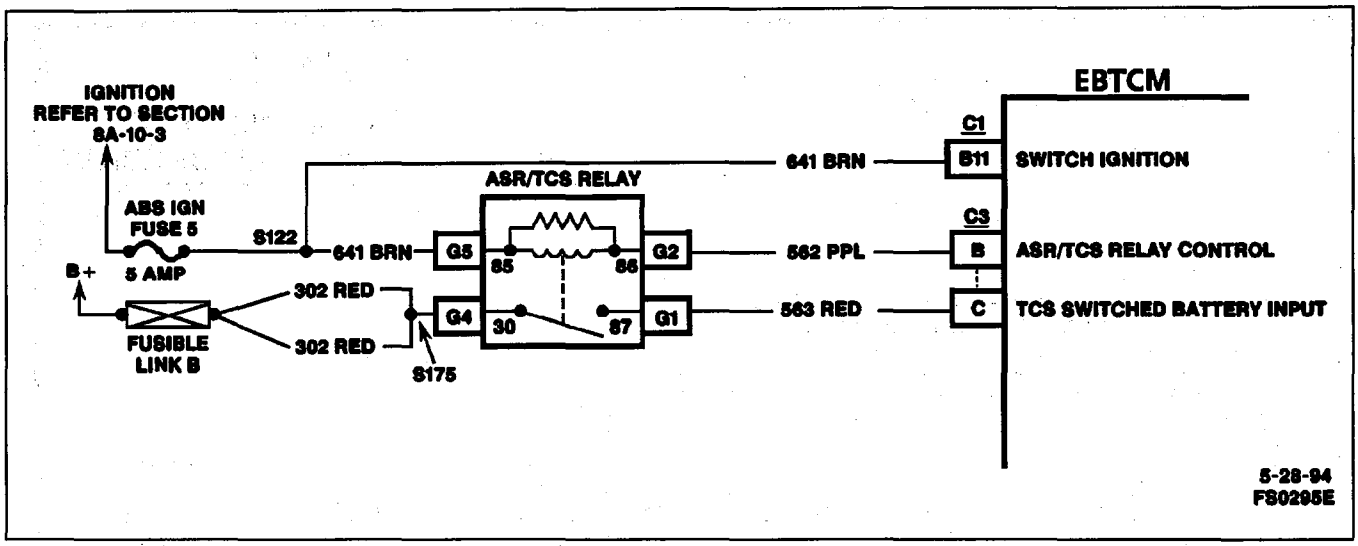
Before beginning diagnostics perform a "OBD" system check. (Refer to Section 6E3). If OK begin chart.

NOTE: PERFORM AN OBD SYSTEM CHECK, REFER TO SECTION 6E3 BEFORE BEGINNING CHART. IF OK, BEGIN CHART.

DTC 123
PCM TO EBTCM DELIVERED TORQUE CIRCUIT MALFUNCTION



C2934S



DTC 136
(Page 1 of 2)
LOW SYSTEM VOLTAGE (TCS)

Circuit Description:

This DTC is used to monitor the voltage level available to the EBTCM controller. If the voltage drops below 11.5 volts, full performance of the TCS system cannot be guaranteed. During TCS operation, there are several current requirements that will cause battery voltage to drop. Because of this, voltage is monitored prior to TCS to indicate good charging system condition and also during TCS when voltage may drop significantly.

DTC Will Set When:

DTC 136 can only be set if the vehicle's speed is greater than 5 km/h (3 mph). If the switched battery voltage is less than 11.5 volts non-TCS or less than 9.0 volts TCS, a malfunction exists.

Action Taken:

A malfunction DTC is stored, TCS is disabled and the amber TCS warning lamp is turned "ON." The red BRAKE warning lamp is turned "ON" if the TCS is active at the time of malfunction.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks to see what voltage is readily available at connector "C3",terminal "C" of the EBTCM
2. Isolates the condition to high circuit resistance, or improper charging system operation.
3. Isolates which circuit is the source of the low voltage condition.
4. Checks for high resistance in CKT 302.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

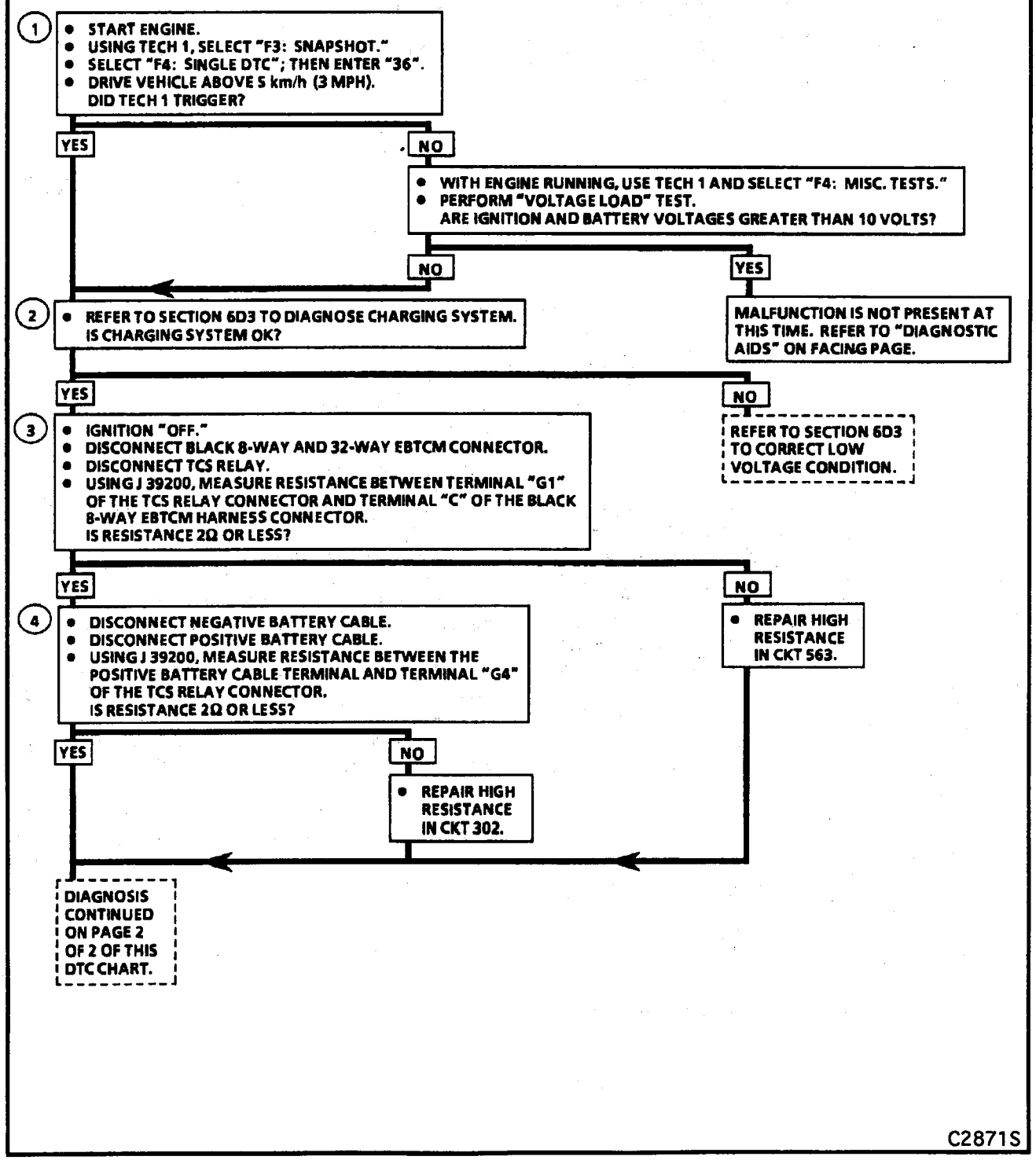
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

While performing a voltage load test, if it is noted that only ignition voltage drops below acceptable voltage levels, CKT 641 should be checked for high resistance or an open condition.

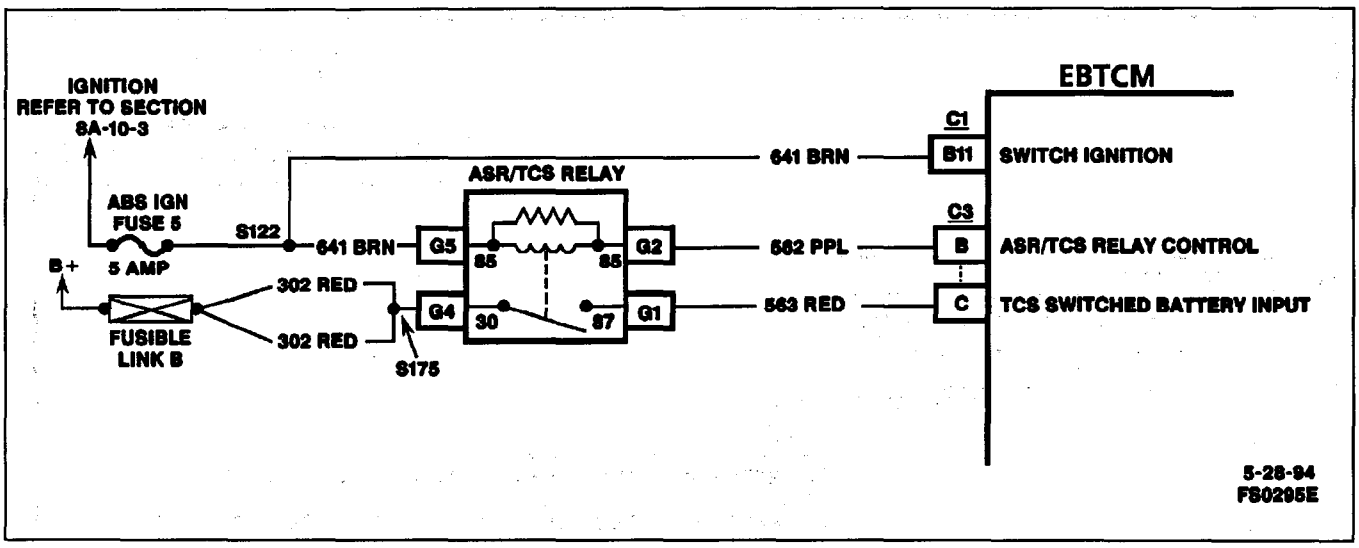
DTC 136

(Page 1 of 2)

LOW SYSTEM VOLTAGE



C2871S



DTC 136
(Page 2 of 2)
LOW SYSTEM VOLTAGE (TCS)

Circuit Description:

This DTC is used to monitor the voltage level available to the EBTCM controller. If the voltage drops below 11.5 volts, full performance of the TCS system cannot be guaranteed. During TCS operation, there are several current requirements that will cause battery voltage to drop. Because of this, voltage is monitored prior to TCS to indicate good charging system condition and also during TCS when voltage may drop significantly.

DTC Will Set When:

DTC 136 can only be set if the vehicle's speed is greater than 5 km/h (3 mph). If the switched battery voltage is less than 11.5 volts non-TCS or less than 9.0 volts TCS, a malfunction exists.

Action Taken:

A malfunction DTC is stored, TCS is disabled and the amber TCS warning lamp is turned "ON." The red BRAKE warning lamp is turned "ON" if the TCS is active at the time of malfunction.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

5. Checks for high resistance in CKT 641.
6. Checks for high resistance in the ignition fuse feed circuit.
7. Checks for malfunctioning EBTCM.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

While performing a voltage load test, if it is noted that only ignition voltage drops below acceptable voltage levels, CKT 641 should be checked for high resistance or an open condition.

DTC 136

(Page 2 of 2)

LOW SYSTEM VOLTAGE

DIAGNOSIS CONTINUED FROM PAGE 1 OF 2 OF THIS OTC CHART.

5
- REMOVE ABS IGN FUSE 5.
- USING J 39200, MEASURE RESISTANCE BETWEEN EACH ABS IGN FUSE 5 BLOCK TERMINAL AND TERMINAL "B11" OF THE 32-WAY EBTCM HARNESS CONNECTOR. IS EITHER MEASUREMENT 2Ω OR LESS?

YES

6
- WITH BATTERY CABLES DISCONNECTED. TURN IGNITION "ON."
- USING J 39200, MEASURE RESISTANCE BETWEEN POSITIVE BATTERY CABLE TERMINAL AND EACH ABS IGN FUSE 5 BLOCK TERMINAL. IS EITHER MEASUREMENT 2Ω OR LESS ?

NO

REPAIR HIGH RESISTANCE IN CKT 641.

YES

7
- IGNITION "OFF."
- INSPECT TCS RELAY AND TCS RELAY CONNECTOR FOR POOR TERMINAL CONTACT. INSPECT BLACK 8-WAY AND 32-WAY EBTCM HARNESS CONNECTORS FOR A POOR CONNECTION TO THE EBTCM. INSPECT POSITIVE BATTERY CABLE TERMINAL FOR POOR CONTACT TO THE BATTERY. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE TERMINALS IF POOR CONTACT IS EVIDENT.
- RECONNECT ALL CONNECTORS.
- DRIVE VEHICLE ABOVE 5 km/h (3 MPH). DOES DTC 136 SET AS A CURRENT DTC?

NO

REFER TO SECTION 8A TO REPAIR HIGH RESISTANCE IN THE "IGNITION SWITCH 'RUN' FUSE FEED" CIRCUIT.

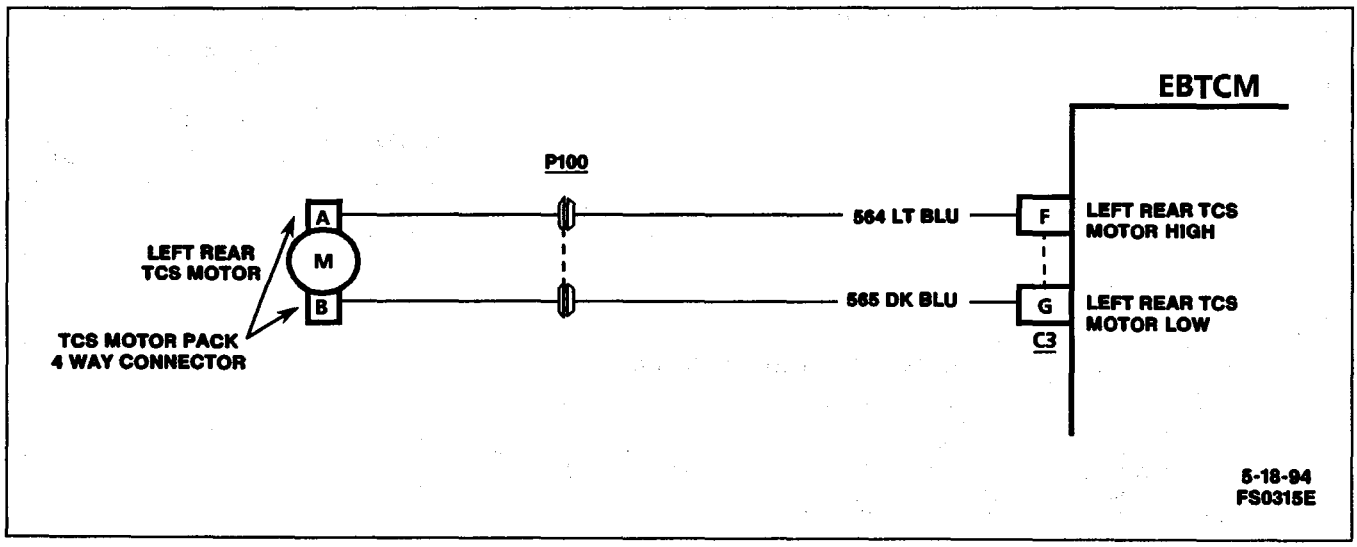
YES

REPLACE EBTCM.

NO

MALFUNCTION IS MOST LIKELY DUE TO A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

C2872S



DTC 144
LEFT TCS CHANNEL WILL NOT MOVE

Circuit Description:

This DTC is designed to detect a stuck TCS motor or a seized hydraulic modulator. During initialization or after a TCS cycle, the EBTCM commands the TCS motor in the reverse direction and the forward direction to ensure that the motor moves properly. If the TCS motor does not move, improper current feedback will be detected by the EBTCM, and a DTC will set.

DTC Will Set When:

DTC 144 can be set during initialization or after a TCS cycle. If the EBTCM detects a condition in which it cannot move the motor in either direction, a malfunction exists.

Action Taken:

A malfunction DTC is stored, TCS is disabled. The amber TCS warning and the red BRAKE warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for proper TCS motor movement during apply and release commands from the Tech 1.
2. Verifies that the TCS motor can actually apply when commanded.
3. Compares EBTCM command current to motor feedback current.
4. Checks for a short circuit between the TCS motor "HIGH" and TCS motor "LOW" circuits.
5. Checks for a TCS motor that is internally shorted.
6. Determines if the malfunction is caused by a defective EBTCM or poor terminal contact.
7. Checks for proper hydraulic modulator gear and piston movement.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

NOTICE: J 39200 TEST LEADS MUST BE "ZERDED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

DTC 144
LEFT TCS CHANNEL WILL NOT MOVE

1. • RAISE VEHICLE.
   • IGNITION "ON," ENGINE "OFF."
   • PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
   • USING TECH 1 MISC. TEST, SELECT MANUAL CONTROL FUNCTION.
   • FOOT OFF BRAKE PEDAL.
   • SELECT LEFT REAR TCS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR.
   DDES THE LEFT REAR WHEEL ROTATE?

NO → YES

2. • USING TECH 1 MISC. TEST, SELECT MANUAL CONTROL FUNCTION.
   • FOOT OFF BRAKE PEDAL.
   • SELECT LEFT REAR TCS MOTOR APPLY FUNCTION AND APPLY THE MOTOR.
   DOES THE LEFT REAR WHEEL RDTATE?

YES → YES

NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

3. • FOOT OFF BRAKE PEDAL.
   • SELECT LEFT REAR TCS MOTOR RELEASE FUNCTION AND RELEASE THE TCS MOTOR WHILE CAREFULLY OBSERVING THE COMMANDED CURRENT AND THE FEEDBACK CURRENT ON THE TECH 1.
   WAS FEEDBACK CURRENT HIGHER THAN THE COMMANDED CURRENT?

YES → NO

4. • EXIT TECH 1 MANUAL CONTROL.
   • IGNITION "OFF."
   • DISCONNECT THE BLACK 8-WAY EBTCM CONNECTOR AND THE 4-WAY TCS MOTOR PACK CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "F" AND TERMINAL "G" OF THE BLACK 8-WAY EBTCM HARNESS CONNECTOR.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES → ND

5. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE TCS MOTOR PACK CONNECTOR.
   IS RESISTANCE GREATER THAN 0.4Ω?

ND → REPAIR SHORT BETWEEN CKT 564 AND CKT 565.

YES → NO

6. • IGNITION "OFF."
   • RECONNECT ALL CONNECTORS.
   • START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
   • REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
   DOES DTC 144 SET IN THE LAST THREE DRIVE CYCLES?

YES → REPLACE EBTCM.

NO → MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS FOR CONTAMINATION AND POOR CONTACT. REPLACE ANY TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION.

7. • IGNITION "OFF."
   • REMOVE TCS MODULATOR/MOTOR PACK ASSEMBLY FROM VEHICLE, REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.
   • SEPARATE TCS MOTOR PACK FROM HYDRAULIC MODULATOR.
   • GRASP THE GEAR ON THE HYDRAULIC MODULATOR (THE LEFT TCS CHANNEL IS FURTHEST REARWARD AS THE MODULATOR/MOTOR PACK SITS IN VEHICLE).
   CAN THE GEAR BE ROTATED AT LEAST 7 FULL TURNS LOCK TO LOCK?

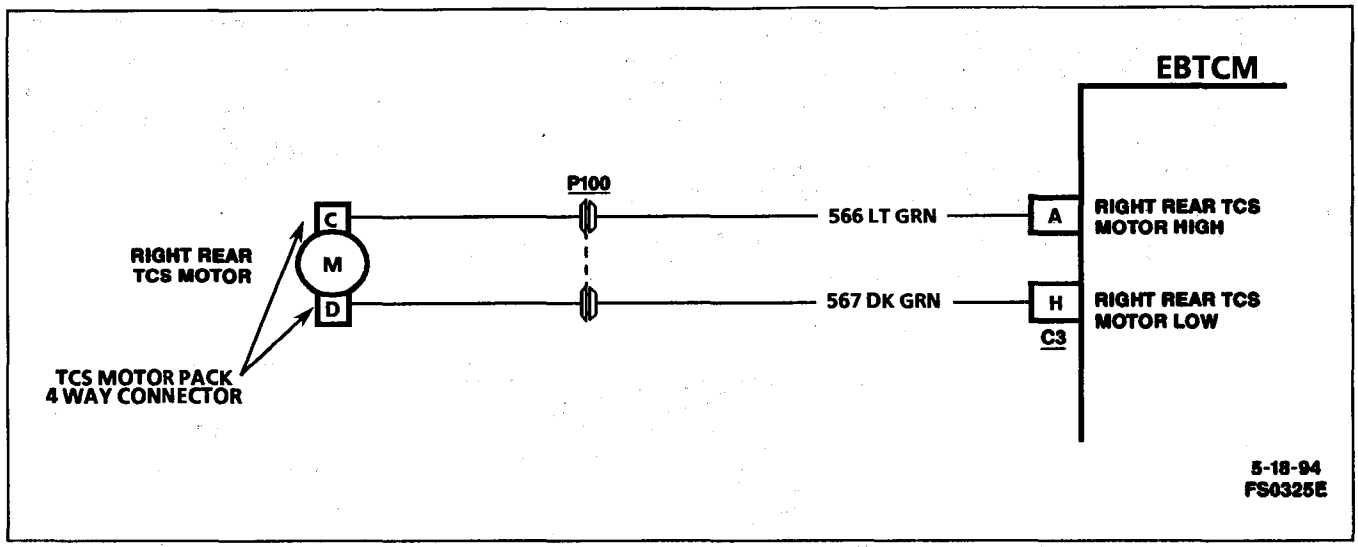
NO → REPLACE HYDRAULIC MODULATOR.

YES → REPLACE TCS MOTOR PACK.

NO → REPLACE TCS MOTOR PACK

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN IGNITION "OFF."

C2873S



DTC 145
RIGHT TCS CHANNEL WILL NOT MOVE

Circuit Description:

This DTC is designed to detect a stuck TCS motor or a seized hydraulic modulator. During initialization or after a TCS event, the EBTCM commands the TCS motor in the reverse direction and the forward direction to ensure that the motor moves properly. If the TCS motor does not move, improper current feedback will be detected by the EBTCM, and a DTC will set.

DTC Will Set When:

DTC 145 can be set during initialization or after a TCS cycle. If the EBTCM detects a condition in which it cannot move the motor in either direction, a malfunction exists.

Action Taken:

A malfunction DTC is stored, TCS is disabled. The amber TCS warning and the red BRAKE warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for proper TCS motor movement during apply and release commands from the Tech 1.
2. Verifies that the motor can actually apply when commanded.
3. Compares EBTCM command current to motor feedback current.
4. Checks for short circuit between TCS motor "HIGH" and TCS motor "LOW" circuits.
5. Checks for a TCS motor that is internally shorted.
6. Checks to see if malfunction is due to poor terminal contact or the EBTCM.
7. Checks for proper hydraulic modulator gear and piston movement.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

DTC 145
RIGHT TCS CHANNEL WILL NOT MOVE

1. • RAISE VEHICLE.
   • IGNITION "ON," ENGINE "OFF."
   • PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
   • USING TECH 1 MISC. TEST, SELECT MANUAL CONTROL FUNCTION.
   • FOOT OFF BRAKE PEDAL.
   • SELECT RIGHT REAR TCS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR.
   DOES THE RIGHT REAR WHEEL ROTATE?

NO → 3

YES →

2. • USING TECH 1 MISC. TEST, SELECT MANUAL CONTROL FUNCTION.
   • FOOT OFF BRAKE PEDAL.
   • SELECT RIGHT REAR TCS MOTOR APPLY FUNCTION AND APPLY THE MOTOR.
   • DDES THE RIGHT REAR WHEEL ROTATE?

YES → 3

NO → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

3. • FOOT OFF BRAKE PEDAL.
   • SELECT RIGHT REAR TCS MOTOR RELEASE FUNCTION AND RELEASE THE TCS MOTOR WHILE CAREFULLY OBSERVING THE COMMANDED CURRENT AND THE FEEDBACK CURRENT ON THE TECH 1.
   WAS FEEDBACK CURRENT HIGHER THAN THE COMMANDED CURRENT?

YES → 4

NO → 7

4. • EXIT TECH 1 MANUAL CONTROL.
   • IGNITION "OFF."
   • DISCONNECT THE BLACK 8-WAY EBTCM CONNECTOR AND THE 4-WAY TCS MOTOR PACK CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "H" OF THE BLACK 8-WAY EBTCM HARNESS CONNECTOR.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?

YES → 5

NO → REPAIR SHORT BETWEEN CKT 566 AND CKT 567.

5. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C" AND TERMINAL "D" OF THE TCS MOTOR PACK CONNECTOR.
   IS RESISTANCE GREATER THAN 0.4Ω?

YES → 6

NO → REPLACE TCS MOTOR PACK.

6. • IGNITION "OFF."
   • RECONNECT ALL CONNECTORS.
   • START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
   • REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
   DOES DTC 145 SET IN THE LAST THREE DRIVE CYCLES?

YES → REPLACE EBTCM.

NO → MALFUNCTION IS INTERMITTENT. INSPECT ALL CONNECTORS FOR CONTAMINATION AND POOR CONTACT. REPLACE ANY TERMINALS THAT EXHIBIT POOR TERMINAL CONTACT OR EVIDENCE OF CORROSION.

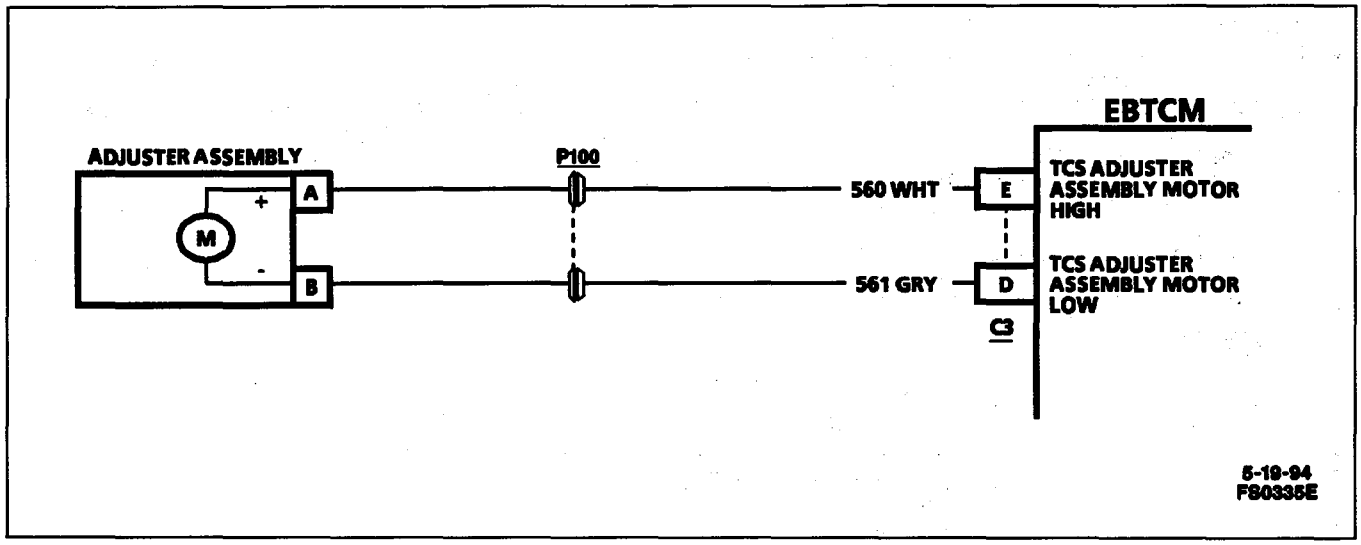
7. • IGNITION "OFF."
   • REMOVE TCS MODULATOR/MOTOR PACK ASSEMBLY FROM VEHICLE, REFER TO "ON VEHICLE SERVICE" IN THIS SECTION.
   • SEPARATE TCS MOTOR PACK FROM HYDRAULIC MODULATOR.
   • GRASP THE GEAR ON THE HYDRAULIC MODULATOR. (THE RIGHT TCS CHANNEL IS FURTHEST FORWARD AS THE MODULATOR/MOTOR PACK SITS IN VEHICLE).
   CAN THE GEAR BE ROTATED AT LEAST 7 FULL TURNS LOCK TO LOCK?

NO → REPLACE HYDRAULIC MODULATOR.

YES → REPLACE TCS MOTOR PACK.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN IGNITION OFF.

C2874S



DTC 146
ADJUSTER ASSEMBLY WILL NOT MOVE

Circuit Description:

This DTC is designed to detect a stalled or frozen TCS adjuster assembly motor. During initialization, the adjuster assembly motor is commanded through a test sequence to determine if it can be moved for proper TCS operation. If the adjuster assembly motor cannot be moved, improper current feedback will be detected by the EBTCM, and a DTC will set.

DTC Will Set When:

DTC 146 can be set during and after initialization of the adjuster assembly. If the EBTCM detects a condition in which it cannot move the adjuster assembly motor, a malfunction exists. DTC 146 will not set during a TCS event.

Action Taken:

A malfunction DTC is stored, TCS modulator motors are commanded "HOME", TCS is disabled and the amber TCS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks to see if DTC's 154, 164,165 or 166 are set.
2. Checks for any mechanical binding of the adjuster assembly, attached cables, and components to which the cables are attached, which could cause excessive load on the adjuster assembly.
3. Checks for initialization with throttle position between 10% to 60%.

Diagnostic Aids:

It may be helpful to disconnect all cables from the adjuster assembly and move them manually throughout their entire operating range. Also check the components to which the cables are attached for binding.

Important

- After cables are reconnected to the adjuster assembly, perform "Adjustment Procedure Adjuster Assembly—Accelerator and Cruise Control Cables" in this section.

DTC 146
ADJUSTER ASSEMBLY WILL NOT MOVE

BEFORE BEGINNING TESTING, INSPECT ALL ADJUSTER ASSEMBLY CABLES AND LINKAGES TO WHICH THEY ATTACH TO ENSURE NO OBVIOUS PROBLEMS THAT COULD CAUSE BINDING OR STICKING EXIST.

1. • IS DTC 154, 164, 165, OR 166 SET?

YES → REPAIR DTC 154, 164, 165 OR 166.

NO

2. • IGNITION "OFF."
   • HAVE ASSISTANT DEPRESS ACCELERATOR PEDAL SMOOTHLY AND FULLY TO WIDE OPEN THROTTLE (WOT), THEN SLOWLY RETURN TO IDLE POSITION WHILE INSPECTING CABLES AND LINKAGES TO WHICH THEY ARE ATTACHED FOR SMOOTH OPERATION.
   DO ALL CABLES AND LINKAGES MOVE SMOOTHLY AND EVENLY WITH NO BINDING?

NO → REPAIR LINKAGES AND/OR REPLACE CABLES, AND/OR REPAIR OR REPLACE COMPONENTS AS NEEDED TO RESTORE SMOOTH OPERATION.

IMPORTANT: AFTER CABLES ARE REATTACHED TO THE ADJUSTER ASSEMBLY OR COMPONENTS, OR AFTER CABLES ARE REPLACED, PERFORM "ADJUSTMENT PROCEDURE - ADJUSTER ASSEMBLY-THROTTLE AND CRUISE CONTROL CABLES." IN THIS SECTION.

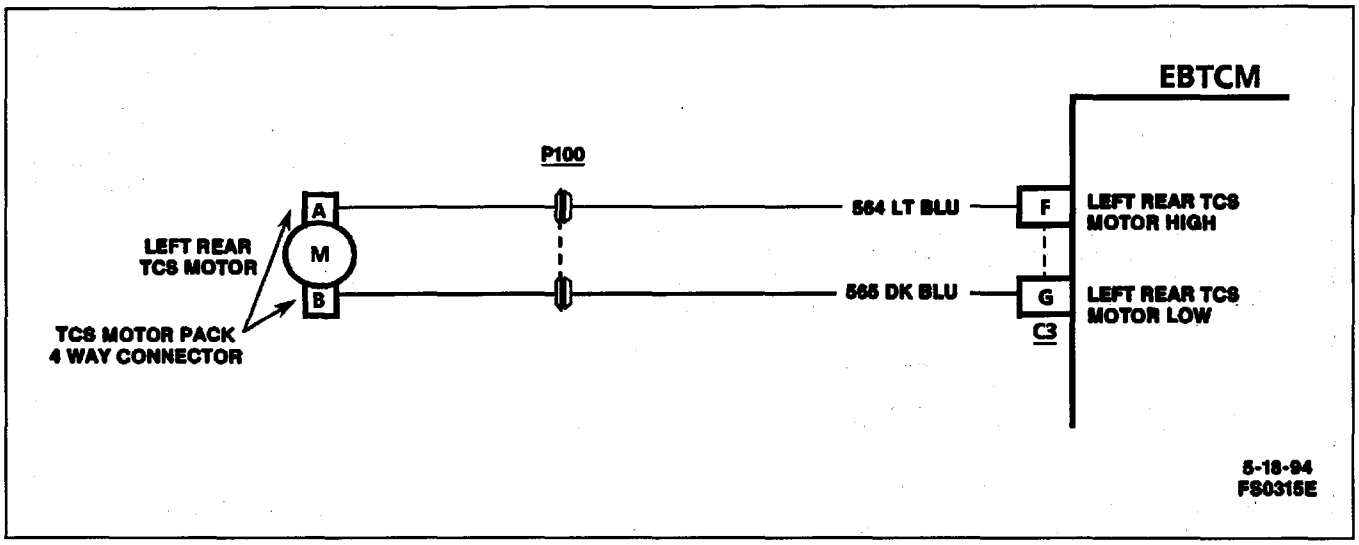
YES

3. • CLEAR DTC(s), WAIT 15 SECONDS, IGNITION "OFF."
   • CONNECT TECH 1 WITH MASS STORAGE CARTRIDGE.
   • START ENGINE.
   • SELECT TECH 1 DATA LIST AND MONITOR THROTTLE POSITION.
   • APPLY BRAKES.
   • DEPRESS AND HOLD ACCELERATOR PEDAL AT A THROTTLE ANGLE BETWEEN 10% AND 60% FOR NO LESS THAN FOUR SECONDS, THEN RELEASE.
   DOES DTC 146 RESET?

YES → REPLACE ADJUSTER ASSEMBLY.

NO → NO TROUBLE FOUND, SEE "DIAGNOSTIC AIDS" ON FACING PAGE.

C2933S



DTC 147
(Page 1 of 2)
LEFT TCS MOTOR FREE SPINS

Circuit Description:

This DTC is designed to detect a stripped nut or gear assembly during initialization. During the homing sequence, the piston should reach the bottom of the bore resulting in a stalled TCS motor. If this does not occur, the TCS motor must be spinning with little or no resistance, indicating a nut/screw or gear malfunction.

DTC Will Set When:

DTC 147 can only be set during initialization. If the feedback current is less than the command current for a specified period of time, a malfunction exists.

Action Taken:

A malfunction DTC is stored, TCS is disabled. The amber TCS warning and red BRAKE warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

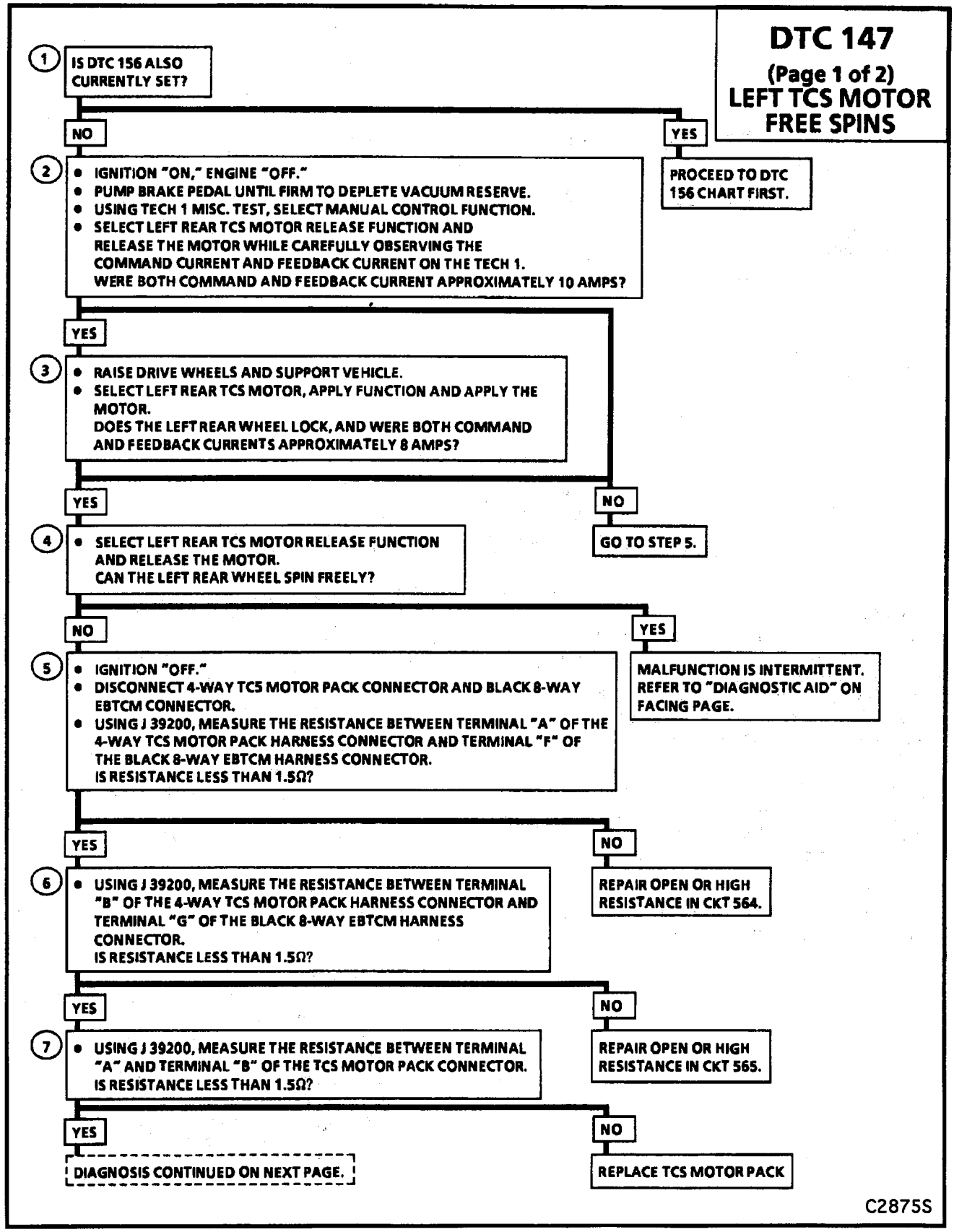
1. Checks to see if the corresponding open motor DTC is also set.
2. Verifies that the TCS motor was released as commanded by observing feedback current.
3. Verifies that the TCS motor can be applied as commanded by observing feedback current.
4. Verifies that the TCS motor can be released by observing wheel movement.
5. Checks for an open in the TCS motor "HIGH" circuitry.
6. Checks for an open in the TCS motor "LOW" circuitry.
7. Checks for a TCS motor that is internally shorted.

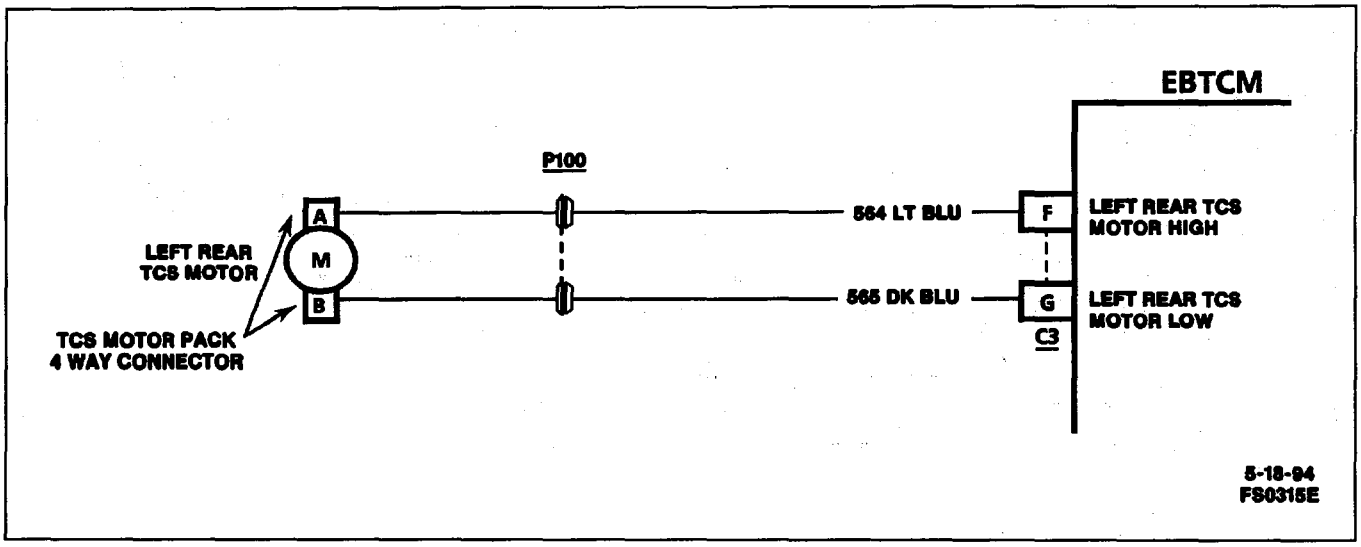
Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. If the DTC only occurs once and DTC 56 also occurs, refer to DTC 56. If intermittent and enhanced diagnostics shows this DTC occurs during ABS, refer to DTC 56.

Depending on the frequency of the malfunction, a physical inspection of the mechanical parts suspected may be necessary.


DTC 147
(Page 1 of 2)
LEFT TCS MOTOR FREE SPINS
1
IS DTC 156 ALSO CURRENTLY SET?
NO
YES
PROCEED TO DTC 156 CHART FIRST.
2
• IGNITION "ON," ENGINE "OFF."
• PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
• USING TECH 1 MISC. TEST, SELECT MANUAL CONTROL FUNCTION.
• SELECT LEFT REAR TCS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR WHILE CAREFULLY OBSERVING THE COMMAND CURRENT AND FEEDBACK CURRENT ON THE TECH 1.
WERE BOTH COMMAND AND FEEDBACK CURRENT APPROXIMATELY 10 AMPS?
YES
3
• RAISE DRIVE WHEELS AND SUPPORT VEHICLE.
• SELECT LEFT REAR TCS MOTOR, APPLY FUNCTION AND APPLY THE MOTOR.
DOES THE LEFT REAR WHEEL LOCK, AND WERE BOTH COMMAND AND FEEDBACK CURRENTS APPROXIMATELY 8 AMPS?
YES
NO
GO TO STEP 5.
4
• SELECT LEFT REAR TCS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR.
CAN THE LEFT REAR WHEEL SPIN FREELY?
NO
YES
MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AID" ON FACING PAGE.
5
• IGNITION "OFF."
• DISCONNECT 4-WAY TCS MOTOR PACK CONNECTOR AND BLACK 8-WAY EBTCM CONNECTOR.
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" OF THE 4-WAY TCS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "F" OF THE BLACK 8-WAY EBTCM HARNESS CONNECTOR.
IS RESISTANCE LESS THAN 1.5Ω?
YES
NO
REPAIR OPEN OR HIGH RESISTANCE IN CKT 564.
6
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "B" OF THE 4-WAY TCS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "G" OF THE BLACK 8-WAY EBTCM HARNESS CONNECTOR.
IS RESISTANCE LESS THAN 1.5Ω?
YES
NO
REPAIR OPEN OR HIGH RESISTANCE IN CKT 565.
7
• USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE TCS MOTOR PACK CONNECTOR.
IS RESISTANCE LESS THAN 1.5Ω?
YES
NO
REPLACE TCS MOTOR PACK
DIAGNOSIS CONTINUED ON NEXT PAGE.
C2875S



DTC 147
(Page 2 of 2)
LEFT TCS MOTOR FREE SPINS

Circuit Description:

This DTC is designed to detect a stripped nut or gear assembly during initialization. During the homing sequence, the piston should reach the bottom of the bore resulting in a stalled TCS motor. If this does not occur, the TCS motor must be spinning with little or no resistance, indicating a nut/screw or gear malfunction.

DTC Will Set When:

DTC 147 can only be set during initialization. If the feedback current is less than the command current for a specified period of time, a malfunction exists.

Action Taken:

A malfunction DTC is stored, TCS is disabled. The amber TCS warning the red BRAKE warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

8. Checks for a stripped gear on the TCS motor pack (unit with two small gears).
9. Checks for a stripped gear on the hydraulic modulator (unit with two large gears).
10. Checks to see if the TCS motor pack has an internal malfunction.
11. Checks for a malfunctioning hydraulic modulator.
12. Ensures malfunction was not due to poor terminal contact.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. If the DTC only occurs once and DTC 56 also occurs, refer to DTC 56. If intermittent and enhanced diagnostics shows this DTC occurs during ABS, refer to DTC 56.

Depending on the frequency of the malfunction, a physical inspection of the mechanical parts suspected may be necessary.

DTC 147
(Page 2 of 2)
LEFT TCS MOTOR FREE SPINS

DIAGNOSIS CONTINUED FROM PREVIOUS PAGE.

8
- REMOVE TCS HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY FROM VEHICLE. (REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.)
- REMDVE GEAR COVER.
- CHECK FOR STRIPPED GEAR ON TCS MOTOR PACK; TCS MOTOR PACK IS THE UNIT WITH TWO SMALL GEARS. THE LEFT FRONT GEAR IS THE GEAR FURTHEST REARWARD AS THE MODULATOR/MOTOR PACK SITS IN THE VEHICLE.
IS THE TCS MOTOR PACK GEAR STRIPPED?

YES → REPLACE TCS MOTOR PACK.

NO

9
- CHECK FOR A STRIPPED GEAR ON THE HYDRAULIC MODULATOR; THE MODULATOR IS THE UNIT WITH THE TWO LARGE GEARS. THE LEFT FRONT GEAR IS THE GEAR FURTHEST REARWARD AS THE MODULATDR/MOTOR PACK SITS IN VEHICLE.
IS THE MODULATOR GEAR STRIPPED?

YES → REPLACE HYDRAULIC MODULATOR GEAR.

NO

10
- RECONNECT ELECTRICAL CONNECTORS.
- SECURELY POSITION HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY IN VEHICLE WITH GEAR COVER REMOVED SUCH THAT THE GEAR SET CAN BE OBSERVED. BE CAREFUL NOT TO DAMAGE GEAR SET OR ALLOW THE HYDRAULIC MODULATOR TO MOVE WHILE TESTING.
- IGNITION "ON."
- USING TECH 1 MISC. TEST, SELECT MANUAL CONTROL FUNCTION.
- SELECT LEFT REAR TCS MOTOR APPLY AND APPLY THE MOTOR WHILE OBSERVING THE GEAR SET FURTHEST REARWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE.
- SELECT LEFT REAR TCS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR WHILE STILL OBSERVING THE GEAR SET.
- SELECT LEFT REAR TCS MOTOR APPLY FUNCTION AND APPLY THE MOTOR.
DID GEAR SET MOVE IN BOTH DIRECTIONS FOR AT LEAST ONE REVOLUTION?

NO → REPLACE TCS MOTOR PACK.

YES

11
- IGNITION "OFF."
- SEPARATE THE TCS MOTOR PACK FROM THE HYDRAULIC MODULATOR.
- GRASP THE GEAR ON THE HYDRAULIC MODULATOR (THE HYDRAULIC MODULATOR IS THE UNIT WITH THE TWO LARGE GEARS) FURTHEST REARWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE AND ATTEMPT TO MOVE THE GEAR.
CAN THE GEAR BE ROTATED MORE THAN 8 FULL TURNS LOCK TO LOCK?

YES → REPLACE THE HYDRAULIC MODULATOR.

NO

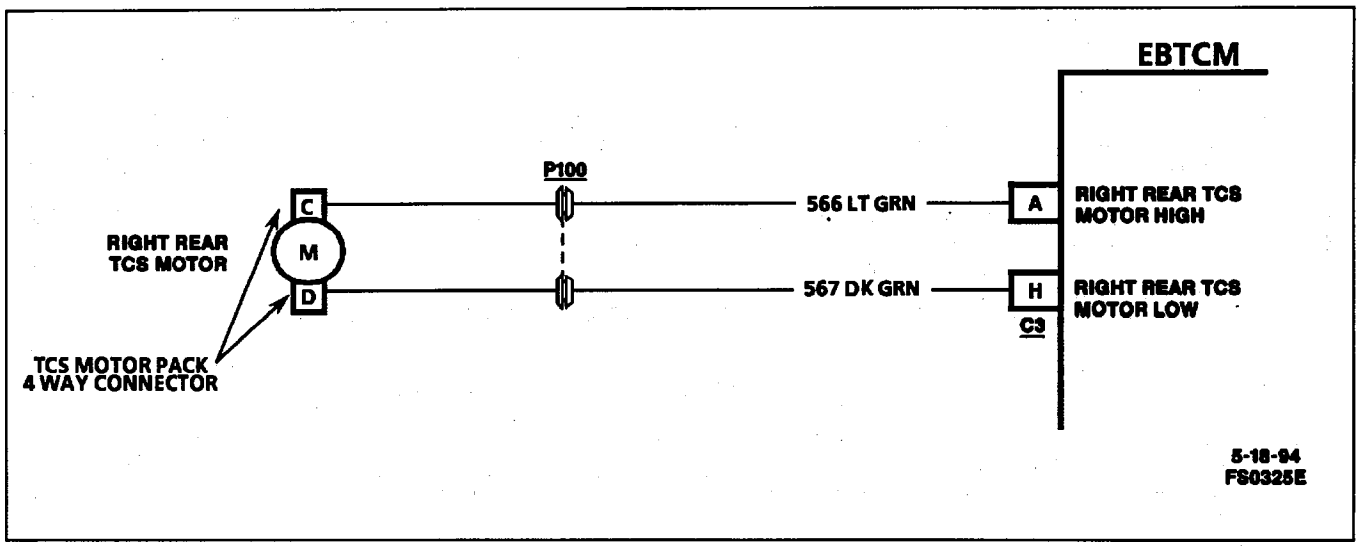
12
- INSPECT ALL CONNECTORS AND TERMINALS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4 "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.
- REINSTALL HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY IN VEHICLE.
- RECONNECT ALL CONNECTORS.
- IGNITION "OFF."
- START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
- REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
DOES DTC 147 SET IN THE LAST THREE DRIVE CYCLES?

YES → REPLACE EBTCM

YES → MALFUNCTION WAS MOSTLY LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN IGNITION OFF.

C2876S



DTC 148
(Page 1 of 2)
RIGHT TCS MOTOR FREE SPINS

Circuit Description:

This DTC is designed to detect a stripped nut or gear assembly during initialization. During the homing sequence, the piston should reach the bottom of the bore resulting in a stalled TCS motor. If this does not occur, the TCS motor must be spinning with little or no resistance, indicating a nut/screw or gear malfunction.

DTC Will Set When:

DTC 148 can only be set during initialization. If the feedback current is less than the command current for a specified period of time, a malfunction exists.

Action Taken:

A malfunction DTC is stored, TCS is disabled. The amber TCS warning and red BRAKE warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks to see if the corresponding open motor DTC is also set.
2. Verifies that the TCS motor was released as commanded by observing feedback current.
3. Verifies that the TCS motor can be applied as commanded by observing feedback current.
4. Verifies that the TCS motor can be released by observing wheel movement.
5. Checks for an open in the TCS motor "HIGH" circuitry.
6. Checks for an open in the TCS motor "LOW" circuitry.
7. Checks for a TCS motor that is internally shorted.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. If the DTC only occurs once and DTC 61 also occurs, refer to DTC 61. If intermittent and enhanced diagnostics shows this DTC occurs during ABS, refer to DTC 61.

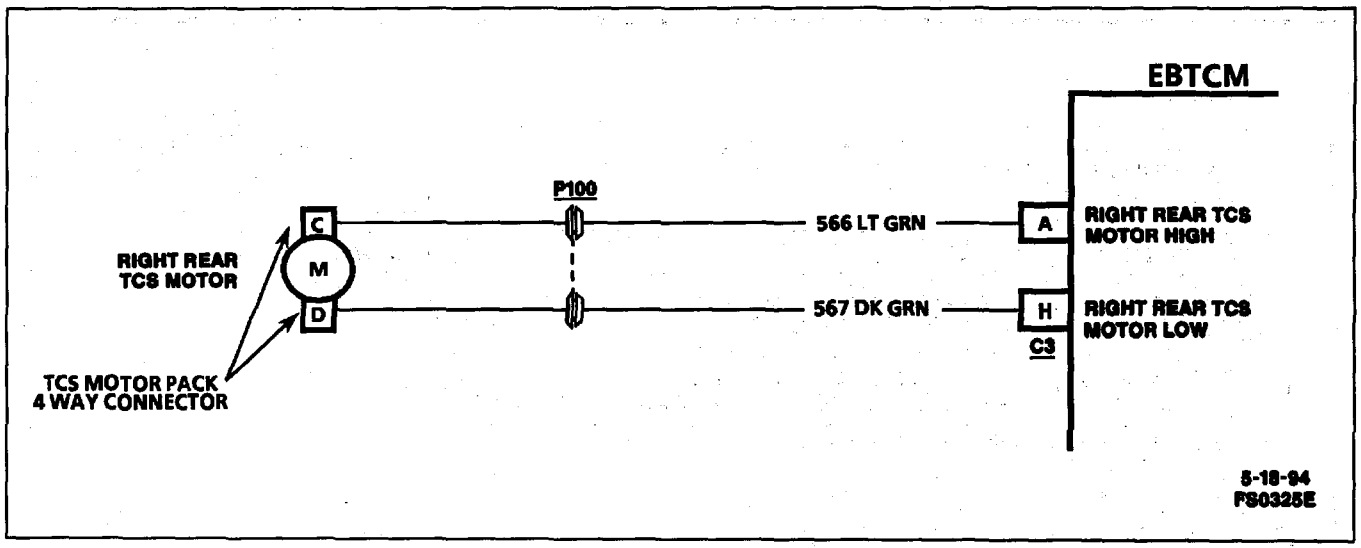
Depending on the frequency of the malfunction, a physical inspection of the mechanical parts suspected may be necessary.

DTC 148
(Page 1 of 2)
RIGHT TCS MOTOR FREE SPINS

1. IS DTC 161 ALSO CURRENTLY SET?
   - YES → PROCEED TO DTC 161 CHART FIRST.
   - NO →
2. • IGNITION "ON," ENGINE "OFF."
   • PUMP BRAKE PEDAL UNTIL FIRM TO DEPLETE VACUUM RESERVE.
   • USING TECH 1 MISC. TEST, SELECT MANUAL CONTROL FUNCTION.
   • SELECT RIGHT REAR TCS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR WHILE CAREFULLY OBSERVING THE COMMAND CURRENT AND FEEDBACK CURRENT ON THE TECH 1.
   WERE BOTH COMMAND AND FEEDBACK CURRENT APPROXIMATELY 10 AMPS?
   - YES →
3. • RAISE DRIVE WHEELS AND SUPPORT VEHICLE.
   • SELECT RIGHT REAR TCS MOTOR, APPLY FUNCTION AND APPLY THE MOTOR.
   DOES THE RIGHT REAR WHEEL LOCK, AND WERE BOTH COMMAND AND FEEDBACK CURRENTS APPROXIMATELY 8 AMPS?
   - YES →
4. • SELECT RIGHT REAR TCS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR.
   CAN THE RIGHT REAR WHEEL SPIN FREELY?
   - NO →
5. • IGNITION "OFF."
   • DISCONNECT 4-WAY TCS MOTOR PACK CONNECTOR AND BLACK 8-WAY EBTCM CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C" OF THE 4-WAY TCS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "A" OF THE BLACK 8-WAY EBTCM HARNESS CONNECTOR.
   IS RESISTANCE LESS THAN 1.5Ω?
   - YES →
6. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "D" OF THE 4-WAY TCS MOTOR PACK HARNESS CONNECTOR AND TERMINAL "H" OF THE BLACK 8-WAY EBTCM HARNESS CONNECTOR.
   IS RESISTANCE LESS THAN 1.5Ω?
   - YES →
7. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C" AND TERMINAL "D" OF THE TCS MOTOR PACK CONNECTOR.
   IS RESISTANCE LESS THAN 1.5Ω?
   - YES → DIAGNOSIS CONTINUED ON NEXT PAGE.

- NO → GO TO STEP 5.
- YES → MALFUNCTION IS INTERMITTENT. REFER TO "DIAGNOSTIC AID" ON FACING PAGE.
- NO → REPAIR OPEN OR HIGH RESISTANCE IN CKT 566.
- NO → REPAIR OPEN OR HIGH RESISTANCE IN CKT 567.
- NO → REPLACE TCS MOTOR PACK

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN IGNITION OFF. C2877S



DTC 148
(Page 2 of 2)
RIGHT TCS MOTOR FREE SPINS

Circuit Description:

This DTC is designed to detect a stripped nut or gear assembly during initialization. During the homing sequence, the piston should reach the bottom of the bore resulting in a stalled TCS motor. If this does not occur, the TCS motor must be spinning with little or no resistance, indicating a nut/screw or gear malfunction.

DTC Will Set When:

DTC 148 can only be set during initialization. If the feedback current is less than the command current for a specified period of time, a malfunction exists.

Action Taken:

A malfunction DTC is stored, TCS is disabled, and the TCS warning and the red "BRAKE" warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

8. Checks for a stripped gear on the TCS motor pack (unit with two small gears).
9. Checks for a stripped gear on the hydraulic modulator (unit with two large gears).
10. Verifies that the TCS motor can be applied under a load situation.
11. Verifies that the hydraulic modulator is functioning properly.
12. Ensures malfunction was not due to poor terminal contact.

Diagnostic Aids:

An intermittent malfunction in this DTC may result from a mechanical part of the system that sticks, binds, or slips.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section. If the DTC only occurs once and DTC 61 also occurs, refer to DTC 61.

If intermittent and enhanced diagnostics shows this DTC occurs during ABS, refer to DTC 61.

Depending on the frequency of the malfunction, a physical inspection of the mechanical parts suspected may be necessary.

DIAGNOSIS CONTINUED FROM PREVIOUS PAGE.

DTC 148
(Page 2 of 2)
RIGHT TCS MOTOR FREE SPINS

8 • REMOVE TCS HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY FROM VEHICLE. (REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.)
• REMOVE GEAR COVER.
• CHECK FOR STRIPPED GEAR ON TCS MOTOR PACK; TCS MOTOR PACK IS THE UNIT WITH TWO SMALL GEARS. THE RIGHT REAR GEAR IS THE GEAR FURTHEST FORWARD AS THE MODULATOR/MOTOR PACK SITS IN THE VEHICLE.
IS THE TCS MOTOR PACK GEAR STRIPPED?

YES → REPLACE TCS MOTOR PACK.

NO

9 • CHECK FOR A STRIPPED GEAR ON THE HYDRAULIC MODULATOR; THE MODULATOR IS THE UNIT WITH THE TWO LARGE GEARS. THE RIGHT REAR GEAR IS THE GEAR FURTHEST FORWARD AS THE MODULATOR/MOTOR PACK SITS IN VEHICLE.
IS THE MODULATOR GEAR STRIPPED?

YES → REPLACE HYDRAULIC MODULATOR GEAR.

NO

10 • RECONNECT ELECTRICAL CONNECTORS.
• SECURELY POSITION HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY IN VEHICLE WITH GEAR COVER REMOVED SUCH THAT THE GEAR SET CAN BE OBSERVED. BE CAREFUL NOT TD DAMAGE GEAR SET OR ALLOW THE HYDRAULIC MODULATOR TO MOVE WHILE TESTING.
• IGNITION "ON."
• USING TECH 1 MISC. TEST, SELECT MANUAL CONTROL FUNCTION.
• SELECT RIGHT REAR TCS MOTOR APPLY AND APPLY THE MOTOR WHILE OBSERVING THE GEAR SET FURTHEST FDRWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE.
• SELECT RIGHT REAR TCS MOTOR RELEASE FUNCTION AND RELEASE THE MOTOR WHILE STILL OBSERVING THE GEAR SET.
• SELECT LEFT REAR TCS MOTOR APPLY FUNCTION AND APPLY THE MOTOR.
DID GEAR SET MOVE IN BOTH DIRECTIONS FOR AT LEAST ONE REVOLUTION?

NO → REPLACE TCS MOTOR PACK.

YES

11 • IGNITION "OFF."
• SEPARATE THE TCS MOTOR PACK FROM THE HYDRAULIC MODULATDR.
• GRASP THE GEAR ON THE HYDRAULIC MODULATOR (THE HYDRAULIC MODULATOR IS THE UNIT WITH THE TWO LARGE GEARS) FURTHEST FORWARD WHEN THE UNIT IS INSTALLED IN THE VEHICLE AND ATTEMPT TO MOVE THE GEAR.
CAN THE GEAR BE ROTATED MORE THAN 8 FULL TURNS LOCK TO LOCK?

YES → REPLACE THE HYDRAULIC MODULATOR.

NO

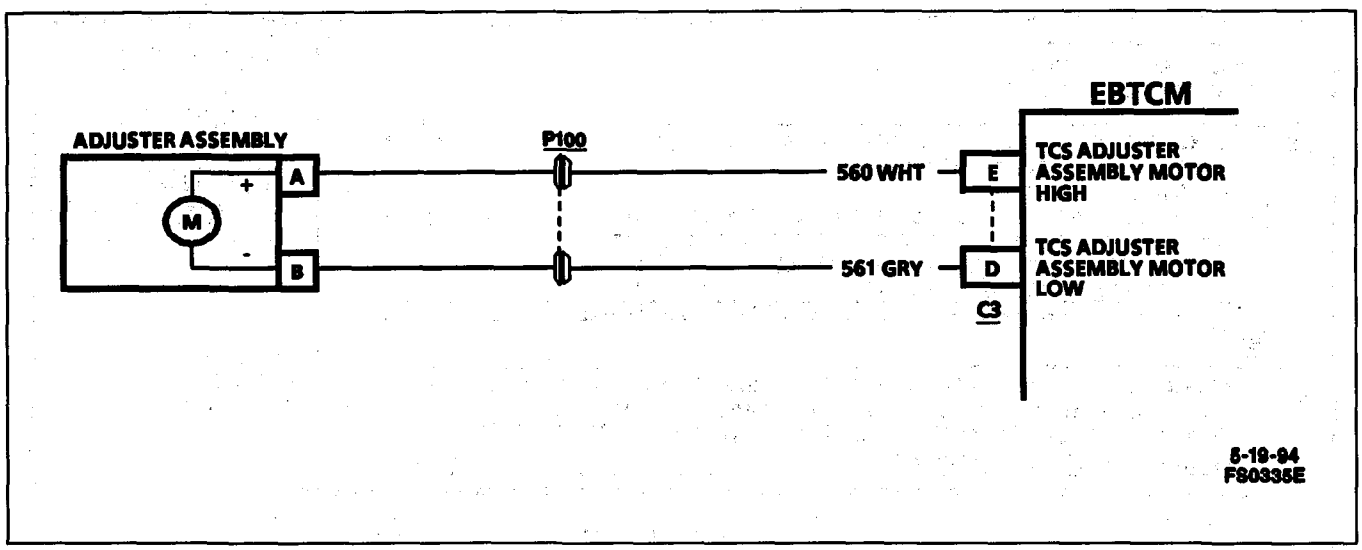
12 • INSPECT ALL CONNECTORS AND TERMINALS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4 "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.
• REINSTALL HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY IN VEHICLE.
• RECONNECT ALL CONNECTORS.
• IGNITION "OFF."
• START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
• REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
DOES DTC 148 SET IN THE LAST THREE DRIVE CYCLES?

YES → REPLACE EBTCM

YES → MALFUNCTION WAS MOSTLY LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN IGNITION OFF.

C2878S



DTC 154
ADJUSTER ASSEMBLY MALFUNCTION

Circuit Description:

This DTC is designed to detect malfunctions of the adjuster assembly that can not be detected by the adjuster assembly electrical tests or the initialization movement test, it is necessary to monitor the performance of the adjuster assembly during a TCS event. The TPS monitors the actual position of the adjuster assembly while the EBTCM commands a target position. A malfunction exists is the difference between the two positions becomes larger then a calibration value indicative of a non-responding adjuster assembly.

DTC Will Set When:

If (during an TCS event) the EBTCM delivers current greater than 16 amps to the adjuster assembly for more than three seconds without the adjuster assembly reaching it's desired position.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks to see if DTC 146 set, since DTC 146 conditions might affect DTC 154.
2. Checks for any mechanical binding of the adjuster assembly, attached cables, and components to which the cables are attached, which could cause excessive load on the adjuster assembly.
3. Since DTC 154 only sets during an TCS, this check raises the vehicle on a hoist such that the rear wheels will spin while the fronts do not, inducing the system into attempting TCS control. This chart ensures the throttle angle must be greater than 10% and less than 60%, and the system must attempt TCS control for greater than 3 seconds to ensure that the DTC setting throttle and timing parameters are met when checking for a DTC 154.

Diagnostic Aids:

It may be helpful to disconnect all cables from the adjuster assembly and move them manually throughout their entire operating range. Also check the components to which the cables are attached for binding.

Important

- After cables are reconnected to the adjuster assembly, perform "Adjustment Procedure—Adjuster Assembly—Accelerator and Cruise Control Cables" in this section.

DTC 154
ADJUSTER ASSEMBLY MALFUNCTION

BEFORE BEGINNING TESTING, INSPECT ALL ADJUSTER ASSEMBLY CABLES AND LINKAGES TO WHICH THEY ATTACH TO ENSURE NO OBVIOUS PROBLEMS THAT COULD CAUSE BINDING OR STICKING EXIST.

1. • IS DTC 146 SET?

   YES → REPAIR DTC 146.

   NO

2. • IGNITION "OFF."
   • HAVE ASSISTANT DEPRESS ACCELERATOR PEDAL SMOOTHLY AND FULLY TO WIDE OPEN THROTTLE (WOT), THEN SLOWLY RETURN TO IDLE POSITION WHILE INSPECTING CABLES AND LINKAGES TO WHICH THEY ARE ATTACHED FOR SMOOTH OPERATION.
   DO ALL CABLES AND LINKAGES MOVE SMOOTHLY AND EVENLY WITH NO BINDING?

   NO → REPAIR LINKAGES AND/OR REPLACE CABLES, AND/OR REPAIR OR REPLACE COMPONENTS AS NEEDED TO RESTORE SMOOTH OPERATION.

   IMPORTANT: AFTER CABLES ARE REATTACHED TO THE ADJUSTER ASSEMBLY OR COMPONENTS, OR AFTER CABLES ARE REPLACED, PERFORM "ADJUSTMENT PROCEDURE - ADJUSTER ASSEMBLY-THROTTLE AND CRUISE CONTROL CABLES." IN THIS SECTION.

   IF A NEW TP SENSOR OR THROTTLE BODY IS INSTALLED, BE SURE TO PERFORM "TP SENSOR LEARN PROCEDURE" IN THIS SECTION.

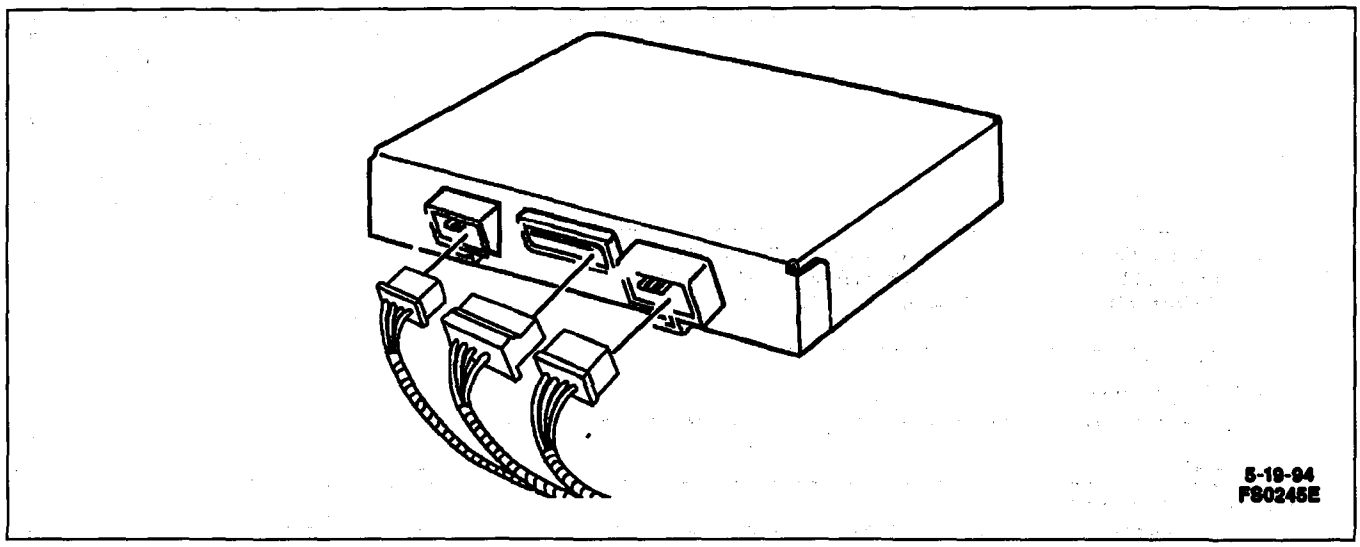
   YES

3. • CLEAR DTC(s), WAIT 15 SECONDS, IGNITION "OFF."
   • CONNECT TECH 1 WITH MASS STORAGE CARTRIDGE.
   • START ENGINE.
   • SELECT TECH 1 DATA LIST AND MONITOR THROTTLE POSITION.
   • APPLY BRAKES.
   • PUT VEHICLE IN GEAR.
   • RELEASE BRAKES (AND CLUTCH, IF MANUAL TRANS).
   • DEPRESS AND HOLD ACCELERATOR PEDAL AT A THROTTLE ANGLE BETWEEN 15% AND 45% FOR NO LESS THAN FOUR SECONDS, THEN RELEASE.
   DOES DTC 154 RESET?

   YES → REPLACE ADJUSTER ASSEMBLY.

   NO → NO TROUBLE FOUND, SEE "DIAGNOSTIC AIDS" ON FACING PAGE.

C2932S



DTC 155
EBTCM MALFUNCTION (TCS)

Circuit Description:

This DTC identifies an internal malfunction detected by the EBTCM TCS motor driver interface custom integrated circuit.

Action Taken:

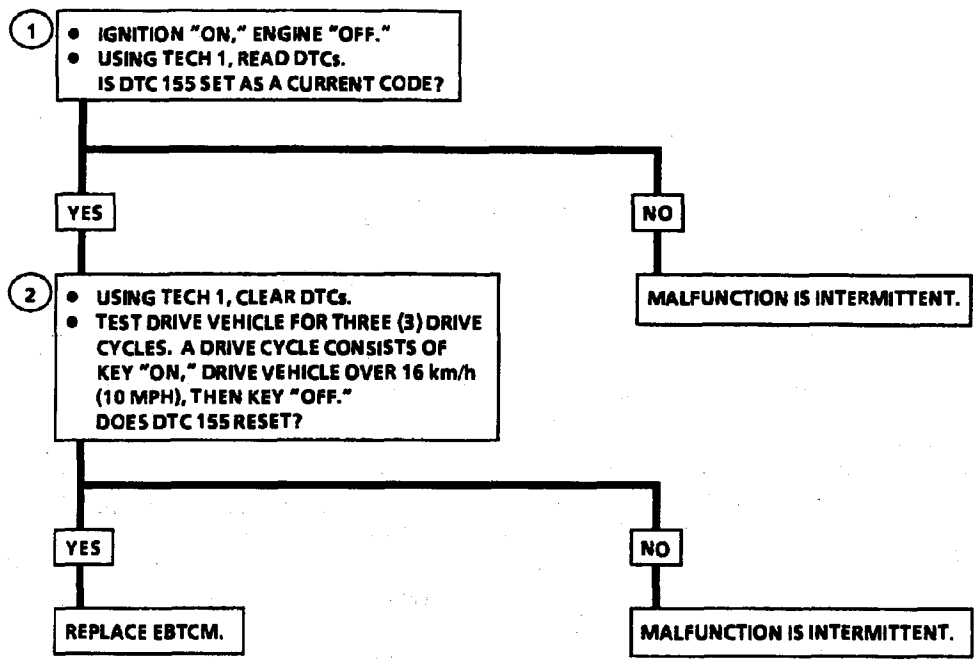
A malfunction DTC is stored, TCS is disabled and the amber TCS warning lamp is turned "ON." The red BRAKE warning lamp is turned "ON" if the rear ABS motor is not in the home position.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

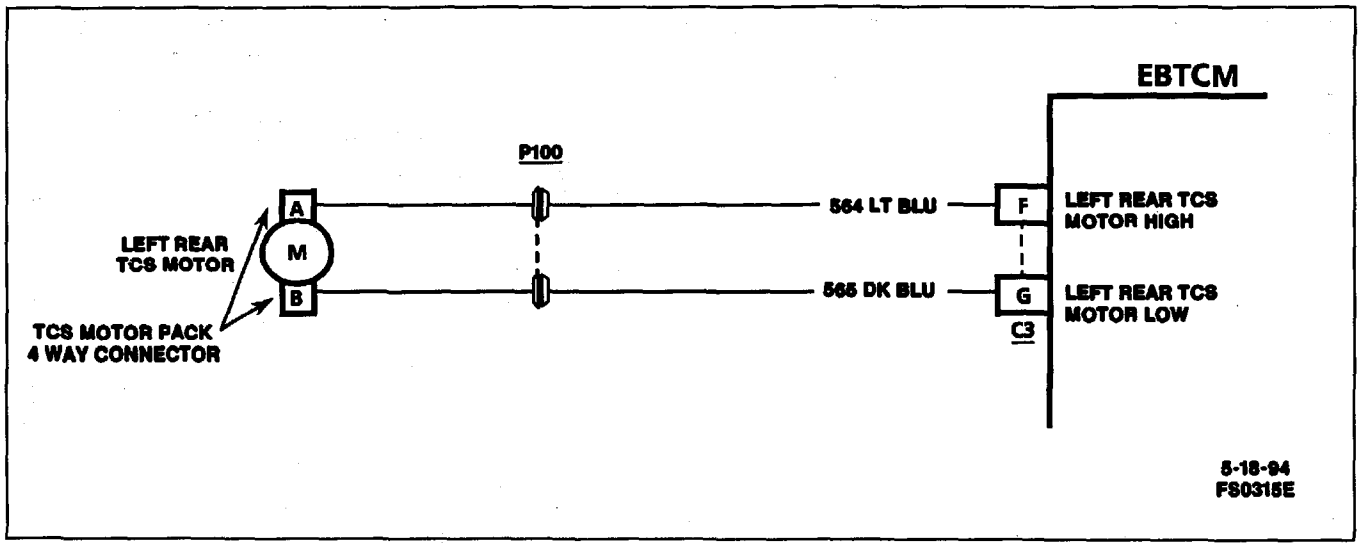
1. Checks to see if the malfunction is still present.
2. Checks to see if the malfunction is intermittent.

DTC 155
EBTCM MALFUNCTION



AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN IGNITION OFF.

C2879S



DTC 156
LEFT TCS MOTOR CIRCUIT OPEN

Circuit Description:

This DTC identifies a TCS motor that cannot be energized due to an open in its circuitry. This malfunction will not allow proper TCS operation.

DTC Will Set When:

DTC 156 can be set only when the TCS motor is commanded "OFF." If the EBTCM detects an out of range voltage on either of the left TCS motor circuits indicating an open circuit, a malfunction exists.

Action Taken:

An open TCS motor will not activate when requested. A malfunction DTC is stored, TCS is disabled and the amber TCS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for proper resistance of the TCS motor.
2. Checks for an open in the TCS motor "HIGH" circuitry.
3. Checks for an open in the TCS motor "LOW" circuitry.
4. Ensures malfunction was not due to poor terminal contact.

Diagnostic Aids:

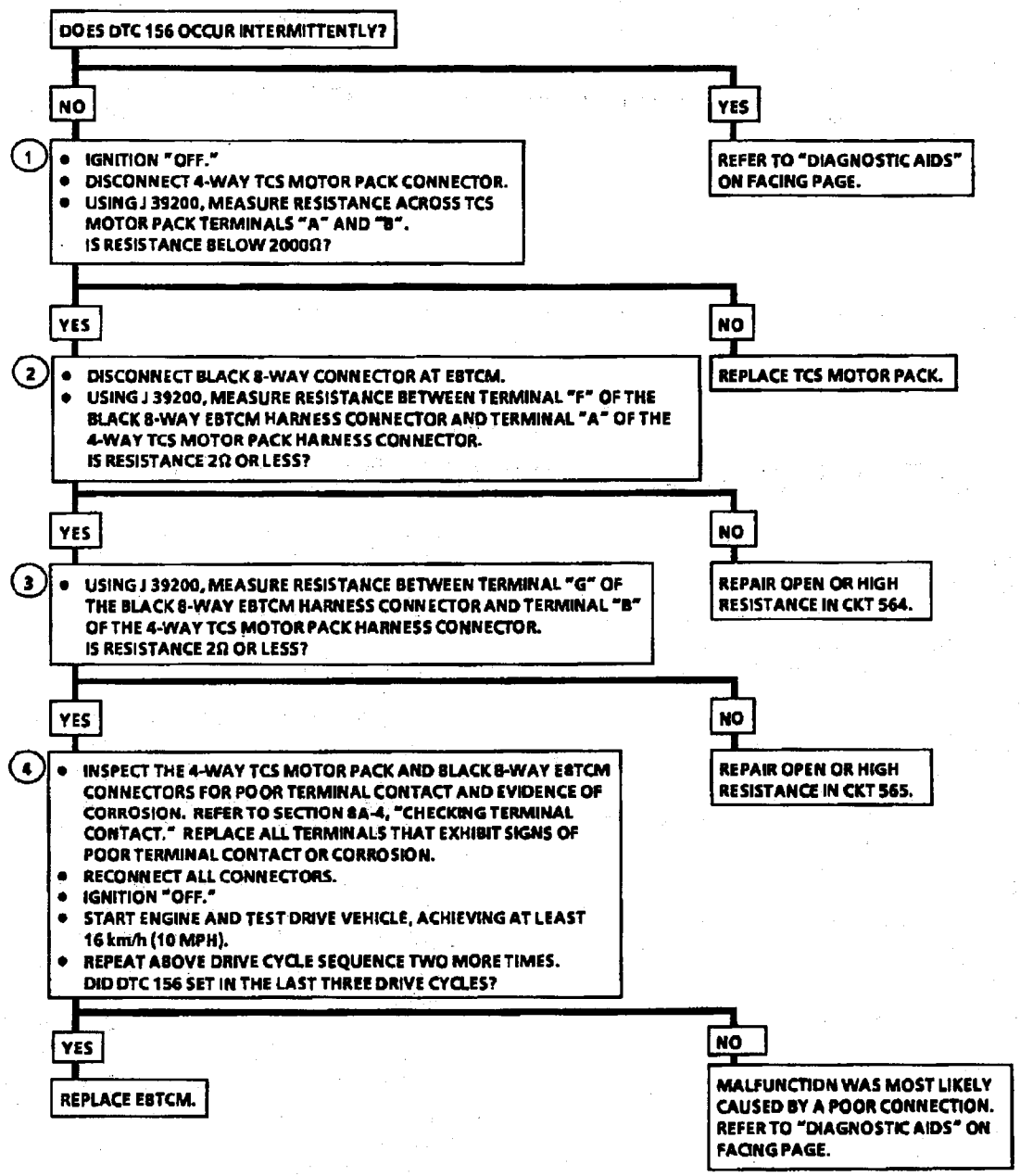
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

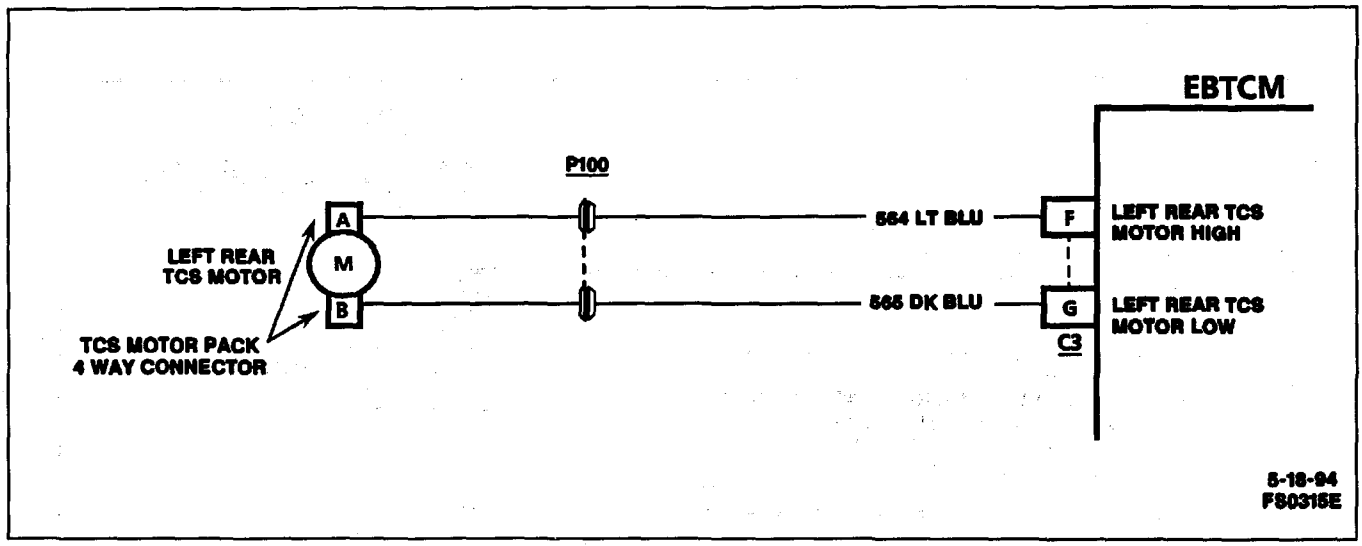
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 156
LEFT TCS MOTOR CIRCUIT OPEN



AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 KM/H (10 MPH), AND THEN TURNING KEY "OFF."

C0147S



DTC 157
LEFT TCS MOTOR CIRCUIT SHORTED TO GND

Circuit Description:

This DTC identifies an TCS motor circuit that is shorted to ground. This malfunction will not allow the TCS motor to be controlled at the commanded current rate or will cause the driver circuit to allow current directly to ground.

DTC Will Set When:

DTC 157 can be set anytime. If the EBTCM detects an out of range voltage on either of the left TCS motor circuits indicating a circuit shorted to ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, TCS is disabled. The amber TCS and the red BRAKE warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to ground in the TCS motor "HIGH" circuitry.
2. Checks for a short to ground in the TCS motor "LOW" circuitry.
3. Checks for an TCS motor that is internally shorted to ground.
4. Ensures malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

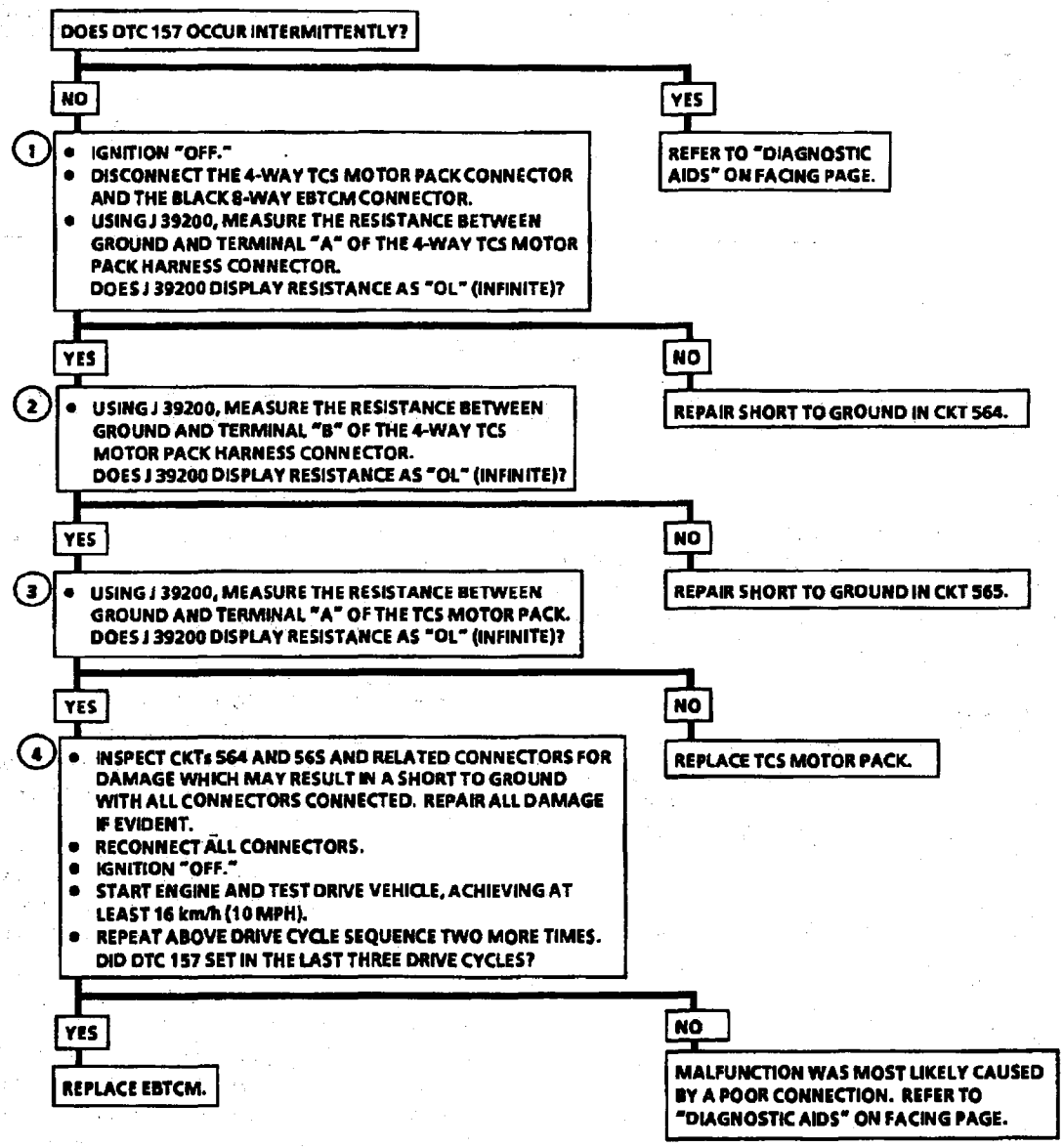
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

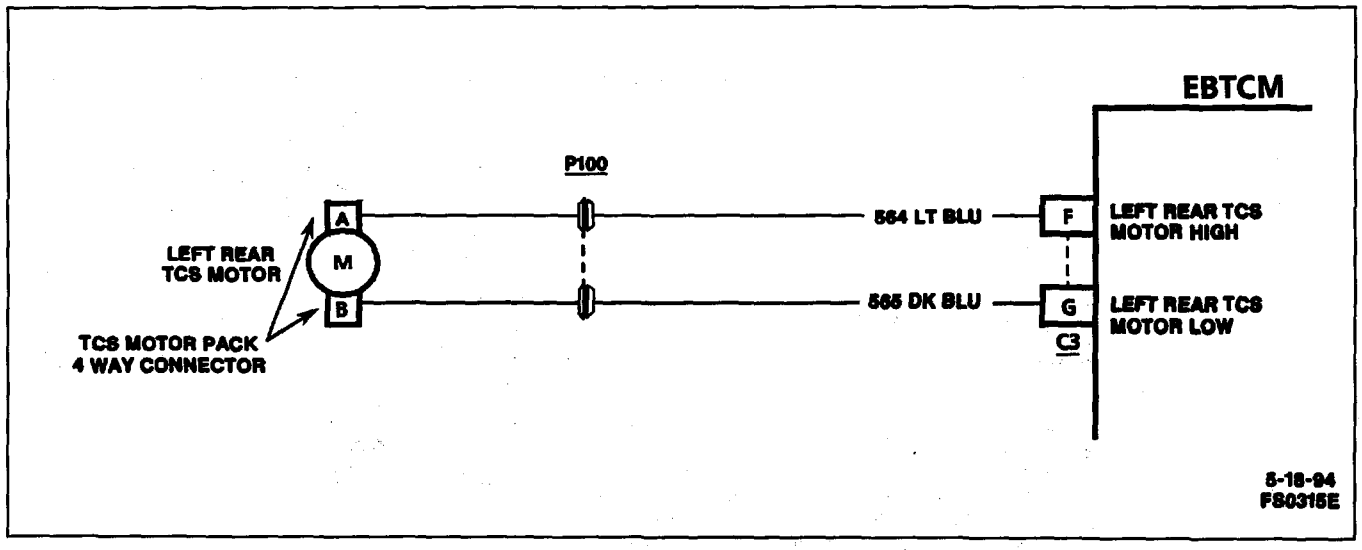
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 157
LEFT TCS MOTOR CIRCUIT SHORTED TO GND



AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY "OFF."

C0148S



DTC 158
LEFT TCS MOTOR CIRCUIT SHORTED TO BATT

Circuit Description:

This DTC identifies a TCS motor circuit that is shorted to battery or a TCS motor that has low or no resistance. This malfunction will not allow the TCS motor to be controlled at the commanded current rate or will cause the TCS motor to turn in the opposite direction, or not at all.

DTC Will Set When:

DTC 158 can be set only when the TCS motor is commanded "OFF." If the EBTCM detects an out of range voltage on either of the left TCS motor circuits indicating a circuit shorted to battery or a TCS motor shorted, a malfunction exists.

Action Taken:

A malfunction DTC is stored, TCS is disabled. The amber TCS and the red BRAKE warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to voltage in the TCS motor "HIGH" circuitry.
2. Checks for a short to voltage in the TCS motor "LOW" circuitry.
3. Checks for a short between the "HIGH" and "LOW" motor circuits.
4. Checks for a TCS motor that is internally shorted.
5. Ensures malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 158
LEFT TCS MOTOR CIRCUIT SHORTED TO BATT

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

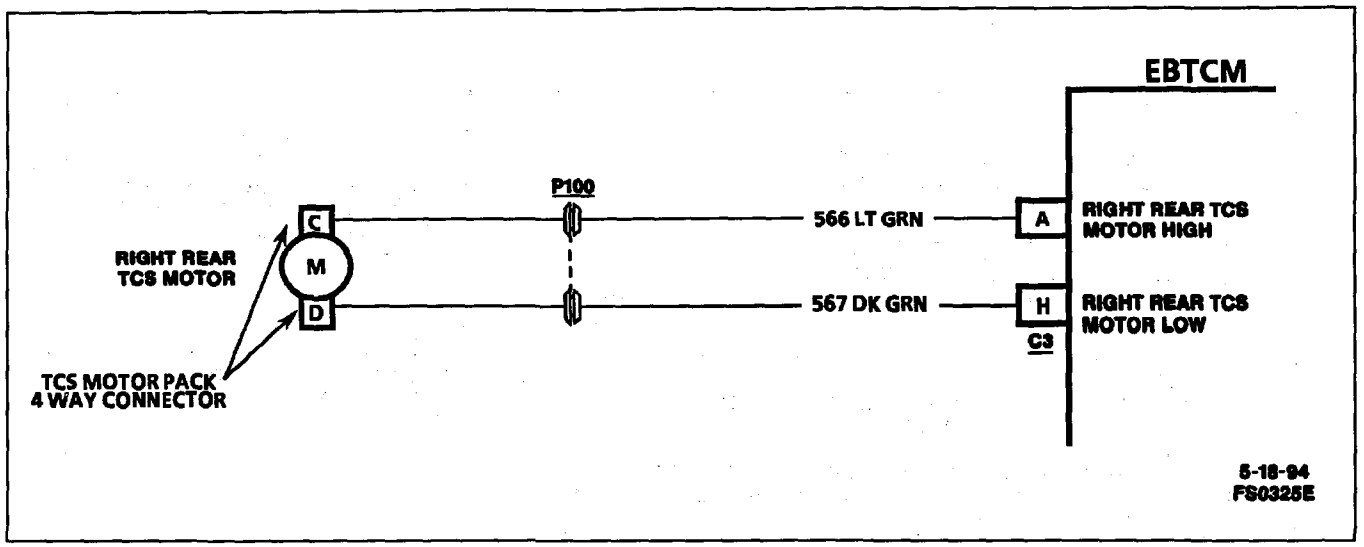
DOES DTC 158 OCCUR INTERMITTENTLY?

- YES → REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
- NO →

1. • IGNITION "OFF."
   • DISCONNECT THE 4-WAY TCS MOTOR PACK CONNECTOR AND THE BLACK 8-WAY EBTCM CONNECTOR.
   • IGNITION "ON."
   • USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A" OF THE 4-WAY TCS MOTOR PACK HARNESS CONNECTOR.
   IS VOLTAGE 1 VOLT OR LESS?
   - NO → REPAIR SHORT TO VOLTAGE IN CKT 564.
   - YES →
2. • USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B" OF THE 4-WAY TCS MOTOR PACK HARNESS CONNECTOR.
   IS VOLTAGE 1 VOLT OR LESS?
   - NO → REPAIR SHORT TO VOLTAGE IN CKT 565.
   - YES →
3. • IGNITION "OFF."
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE 4-WAY TCS MOTOR PACK HARNESS CONNECTOR.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
   - NO → REPAIR SHORT BETWEEN CKTs 564 AND 565.
   - YES →
4. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE TCS MOTOR PACK.
   IS RESISTANCE GREATER THAN 0.4Ω?
   - NO → REPLACE TCS MOTOR PACK.
   - YES →
5. • INSPECT CKTs 564 AND 565 AND RELATED CONNECTORS FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
   • RECONNECT ALL CONNECTORS.
   • IGNITION "OFF."
   • START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
   • REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
   DID DTC 158 SET IN THE LAST THREE DRIVE CYCLES?
   - NO → MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - YES → REPLACE EBTCM.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 KM/H (10 MPH), AND THEN TURNING KEY "OFF."

C0149S



DTC 161
RIGHT TCS MOTOR CIRCUIT OPEN

Circuit Description:

This DTC identifies a TCS motor that cannot be energized due to an open in its circuitry. This malfunction will not allow proper TCS operation.

DTC Will Set When:

DTC 161 can be set only when the TCS motor is commanded "OFF." If the EBTCM detects an out of range voltage on either of the right TCS motor circuits indicating an open circuit, a malfunction exists.

Action Taken:

An open motor will not activate when requested. A malfunction DTC is stored, TCS is disabled and the amber TCS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for proper resistance of the TCS motor.
2. Checks for an open in the TCS motor "HIGH" circuitry.
3. Checks for an open in the TCS motor "LOW" circuitry.
4. Ensures malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

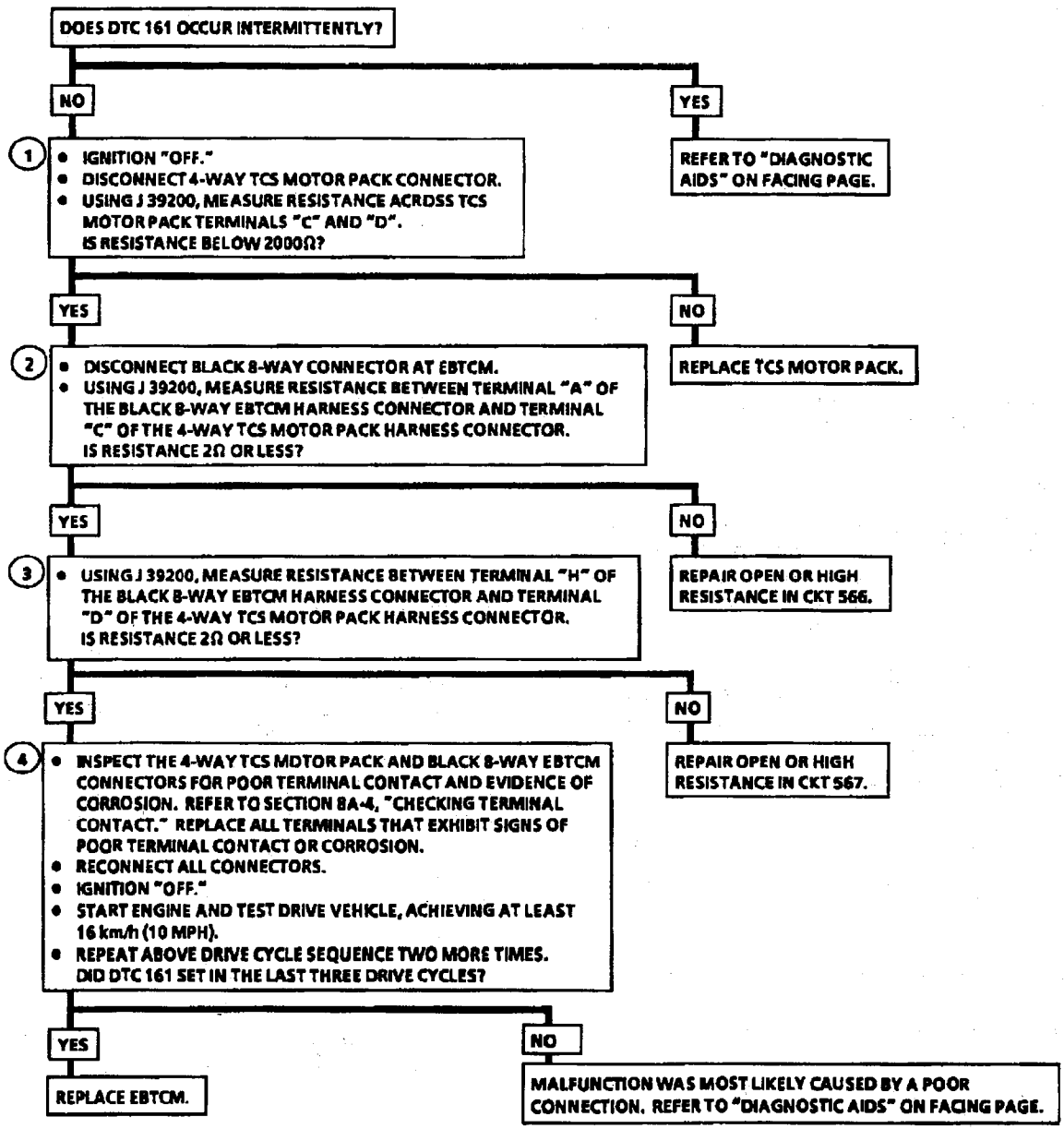
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

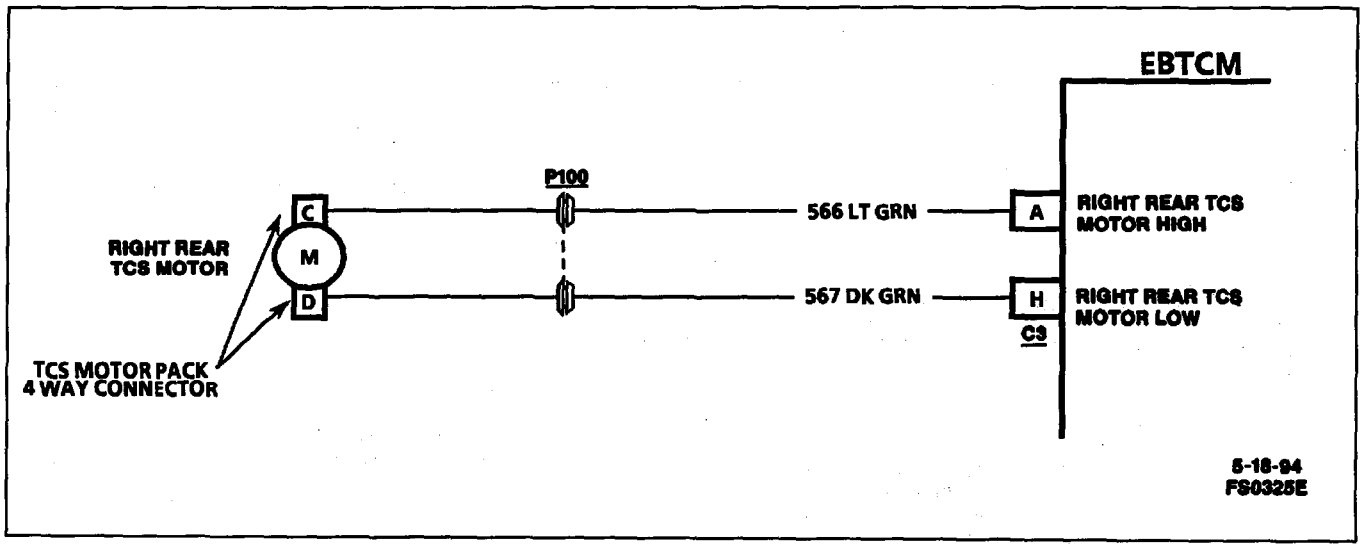
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 161
RIGHT TCS MOTOR CIRCUIT OPEN



AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY "OFF."

C0150S



DTC 162
RIGHT TCS MOTOR CIRCUIT SHORTED TO GND

Circuit Description:

This DTC identifies a TCS motor circuit that is shorted to ground. This malfunction will not allow the TCS motor to be controlled at the commanded current rate or will cause the TCS motor driver circuit to allow current directly to ground.

DTC Will Set When:

DTC 162 can be set anytime. If the EBTCM detects an out of range voltage on either of the right TCS motor circuits indicating a circuit shorted to ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, TCS is disabled. The amber TCS and the red BRAKE warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to ground in the TCS motor "HIGH" circuitry.
2. Checks for a short to ground in the TCS motor "LOW" circuitry.
3. Checks for a TCS motor that is internally shorted to ground.
4. Ensures malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

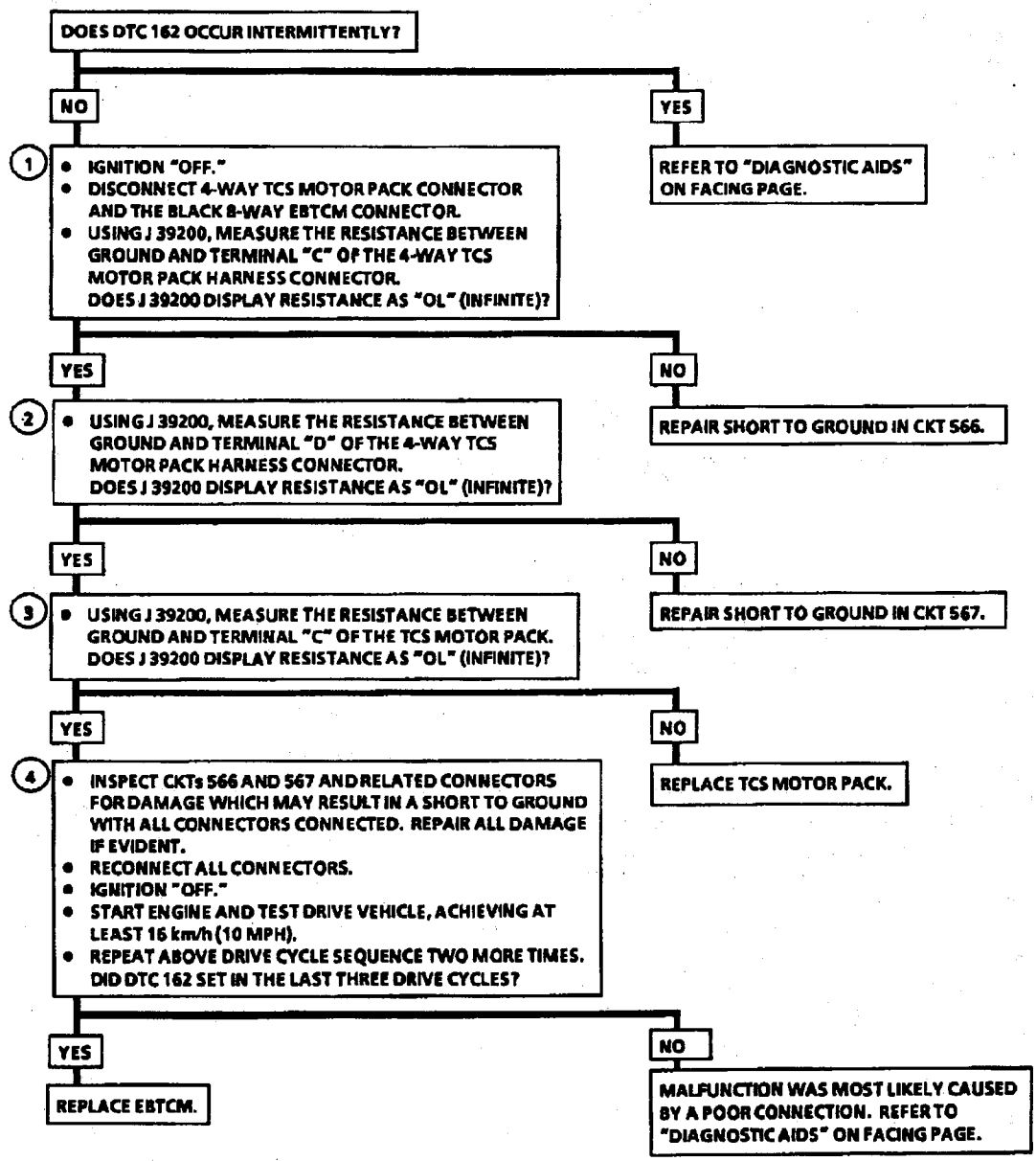
An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

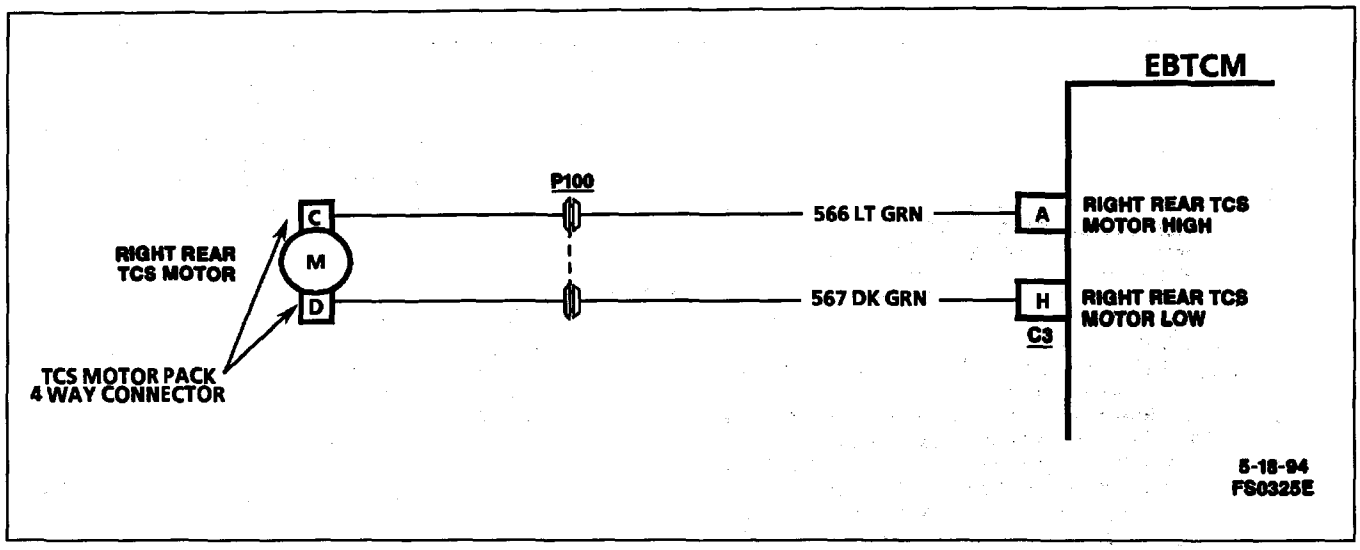
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 162
RIGHT TCS MOTOR CIRCUIT SHORTED TO GND



AFTER ALL DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY "OFF."

C0151S



DTC 163
RIGHT TCS MOTOR CIRCUIT SHORTED TO BATT

Circuit Description:

This DTC identifies a TCS motor circuit that is shorted to battery or a TCS motor that has low or no resistance. This malfunction will not allow the TCS motor to be controlled at the commanded current rate or will cause the TCS motor to turn in the opposite direction or not at all.

DTC Will Set When:

DTC 163 can be set only when the TCS motor is commanded "OFF." If the EBTCM detects an out of range voltage on either of the right TCS motor circuits indicating a circuit shorted to battery or a TCS motor shorted, a malfunction exists.

Action Taken:

A malfunction DTC is stored, TCS is disabled. The amber TCS and the red BRAKE warning lamps are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to voltage in the TCS motor "HIGH" circuitry.
2. Checks for a short to voltage in the TCS motor "LOW" circuitry.
3. Checks for short circuit between TCS motor "HIGH" and motor "LOW".
4. Checks for proper resistance of the TCS motor.
5. Ensures malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

If the malfunction is not current, wiggle the wires of the affected channel and check if the DTC resets. This will help to pinpoint an intermittent malfunction in the motor circuitry or connections.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 163
RIGHT TCS MOTOR CIRCUIT SHORTED TO BATT

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

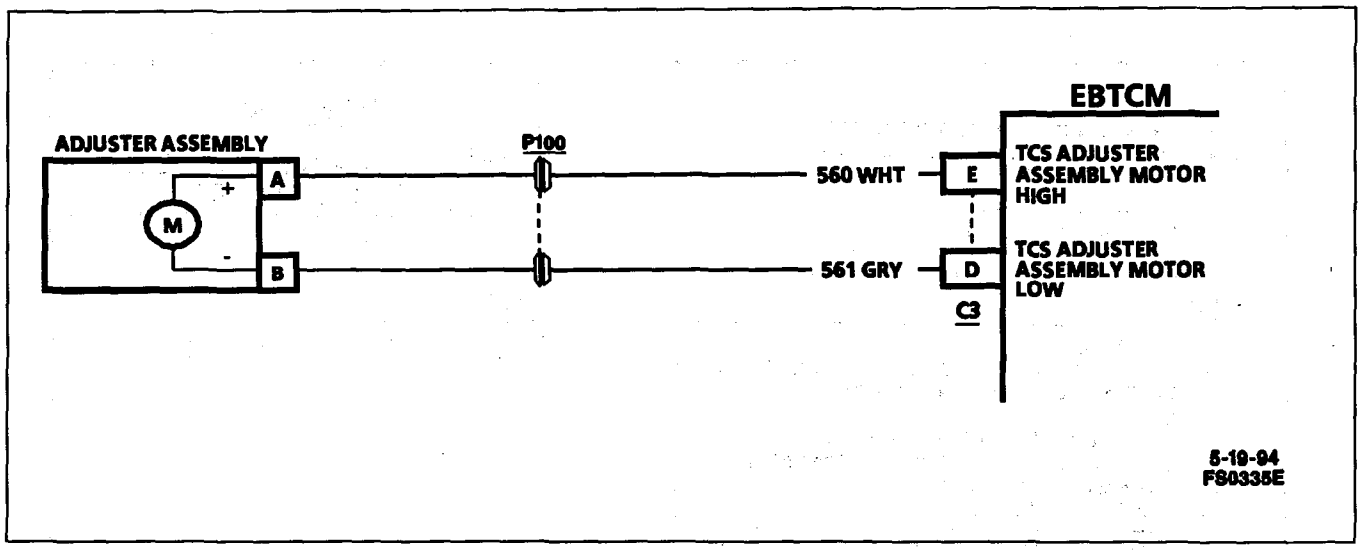
DOES DTC 163 OCCUR INTERMITTENTLY?

- YES → REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
- NO →

1. • IGNITION "OFF."
   • DISCONNECT THE 4-WAY TCS MOTOR PACK CONNECTOR AND THE BLACK 8-WAY EBTCM CONNECTOR.
   • IGNITION "ON."
   • USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "C" OF THE 4-WAY TCS MOTOR PACK HARNESS CONNECTOR.
   IS VOLTAGE 1 VOLT OR LESS?
   - NO → REPAIR SHORT TO VOLTAGE IN CKT 566.
   - YES →
2. • USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "D" OF THE 4-WAY TCS MOTOR PACK HARNESS CONNECTOR.
   IS VOLTAGE 1 VOLT OR LESS?
   - NO → REPAIR SHORT TO VOLTAGE IN CKT 567.
   - YES →
3. • IGNITION "OFF."
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C" AND TERMINAL "D" OF THE 4-WAY TCS MOTOR PACK HARNESS CONNECTOR.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
   - NO → REPAIR SHORT BETWEEN CKTs 566 AND 567.
   - YES →
4. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "C" AND TERMINAL "D" OF THE TCS MOTOR PACK.
   IS RESISTANCE GREATER THAN 0.4Ω?
   - NO → REPLACE TCS MOTOR PACK.
   - YES →
5. • INSPECT CKTs 566 AND 567 AND RELATED CONNECTORS FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
   • RECONNECT ALL CONNECTORS.
   • IGNITION "OFF."
   • START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
   • REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
   DID DTC 163 SET IN THE LAST THREE DRIVE CYCLES?
   - NO → MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - YES → REPLACE EBTCM.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 KM/H (10 MPH), AND THEN TURNING KEY "OFF."

C0152S



DTC 164
ADJUSTER ASSEMBLY MOTOR CIRCUIT OPEN

Circuit Description:

This DTC identifies a TCS adjuster assembly motor that cannot be energized due to an open in its circuitry.

DTC Will Set When:

DTC 164 can be set only when the adjuster assembly motor is commanded "OFF." If the EBTCM detects an out of range voltage on either of the adjuster assembly circuits indicating an open circuit, a malfunction exists.

Action Taken:

An open adjuster assembly motor will not activate when requested. A malfunction DTC is stored, TCS is disabled, and the amber TCS warning lamp is turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for proper resistance of the adjuster assembly motor.
2. Checks for an open in the adjuster assembly motor "HIGH" circuitry.
3. Checks for an open in the adjuster assembly motor "LOW" circuitry.
4. Ensures malfunction was not due to poor terminal contact.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 164
ADJUSTER ASSEMBLY MOTOR CIRCUIT OPEN

1. • IGNITION "OFF."
   • DISCONNECT THE ADJUSTER ASSEMBLY MOTOR CONNECTOR.
   • USING J 39200, MEASURE THE RESISTANCE ACROSS ADJUSTER ASSEMBLY MOTOR TERMINALS "A" AND "B".
   IS RESISTANCE LESS THAN 15Ω?
   - YES
   - NO → REPLACE ADJUSTER ASSEMBLY MOTOR.

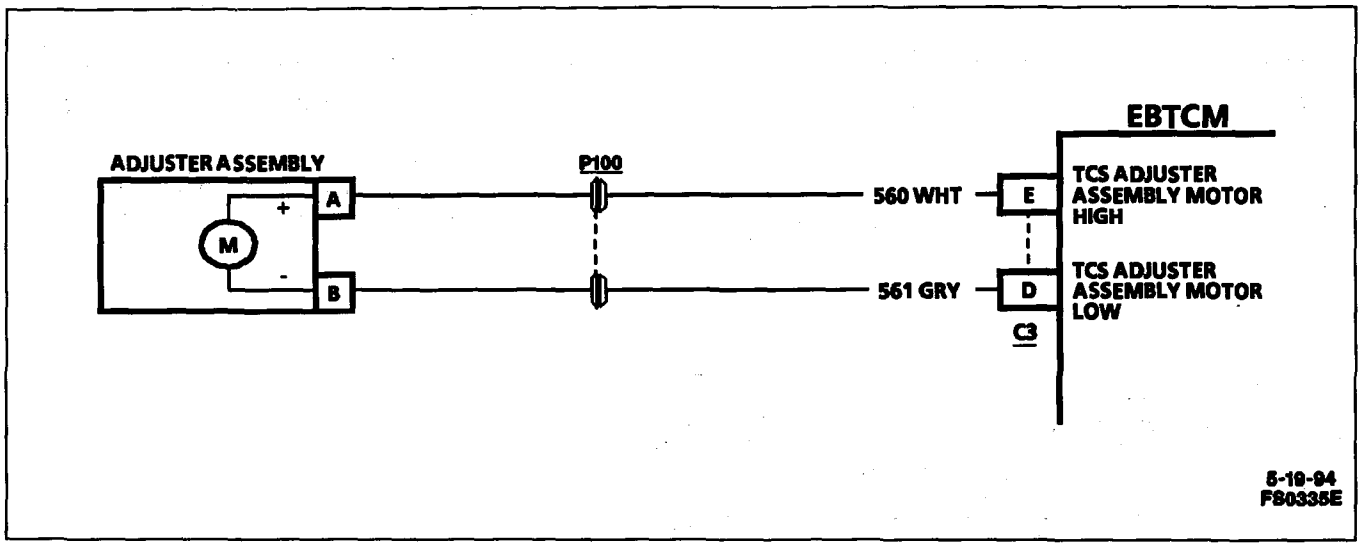
2. • DISCONNECT BLACK 8-WAY CONNECTOR AT EBTCM.
   • USING J 39200, MEASURE RESISTANCE BETWEEN TERMINAL "E" OF THE BLACK 8-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "A" OF THE ADJUSTER ASSEMBLY HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?
   - YES
   - NO → REPAIR OPEN OR HIGH RESISTANCE IN CKT 560.

3. • USING J 39200, MEASURE RESISTANCE BETWEEN TERMINAL "D" OF THE BLACK 8-WAY EBTCM HARNESS CONNECTOR AND TERMINAL "B" OF THE ADJUSTER ASSEMBLY HARNESS CONNECTOR.
   IS RESISTANCE 2Ω OR LESS?
   - YES
   - NO → REPLACE OPEN OR HIGH RESISTANCE IN CKT 561.

4. • INSPECT THE ADJUSTER ASSEMBLY MOTOR AND BLACK 8-WAY EBTCM CONNECTORS FOR POOR TERMINAL CONTACT AND EVIDENCE OF CORROSION. REFER TO SECTION 8A-4, "CHECKING TERMINAL CONTACT." REPLACE ALL TERMINALS THAT EXHIBIT SIGNS OF POOR TERMINAL CONTACT OR CORROSION.
   • RECONNECT ALL CONNECTORS.
   • IGNITION "OFF."
   • START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
   • REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
   DID DTC 164 SET IN THE LAST THREE DRIVE CYCLES?
   - YES → REPLACE EBTCM.
   - NO → MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY "OFF."

C0153S



DTC 165
ADJUSTER ASSEMBLY MOTOR CIRCUIT SHORTED TO GND

Circuit Description:

This DTC identifies a TCS adjuster assembly motor circuit that is shorted to ground. This malfunction will not allow the adjuster assembly motor to be controlled at the commanded current rate or will cause the driver circuit to allow current directly to ground.

DTC Will Set When:

DTC 165 can be set anytime. If the EBTCM detects an out of range voltage on either of the adjuster assembly circuits indicating a circuit shorted to ground, a malfunction exists.

Action Taken:

A malfunction DTC is stored, TCS is disabled. The amber TCS and the red BRAKE warning lamp are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to ground in the adjuster assembly motor "HIGH" circuitry.
2. Checks for a short to ground in the adjuster assembly motor "LOW" circuitry.
3. Checks for an adjuster assembly motor that is internally shorted to ground.
4. Ensures malfunction was not due to physical damage of the circuitry.

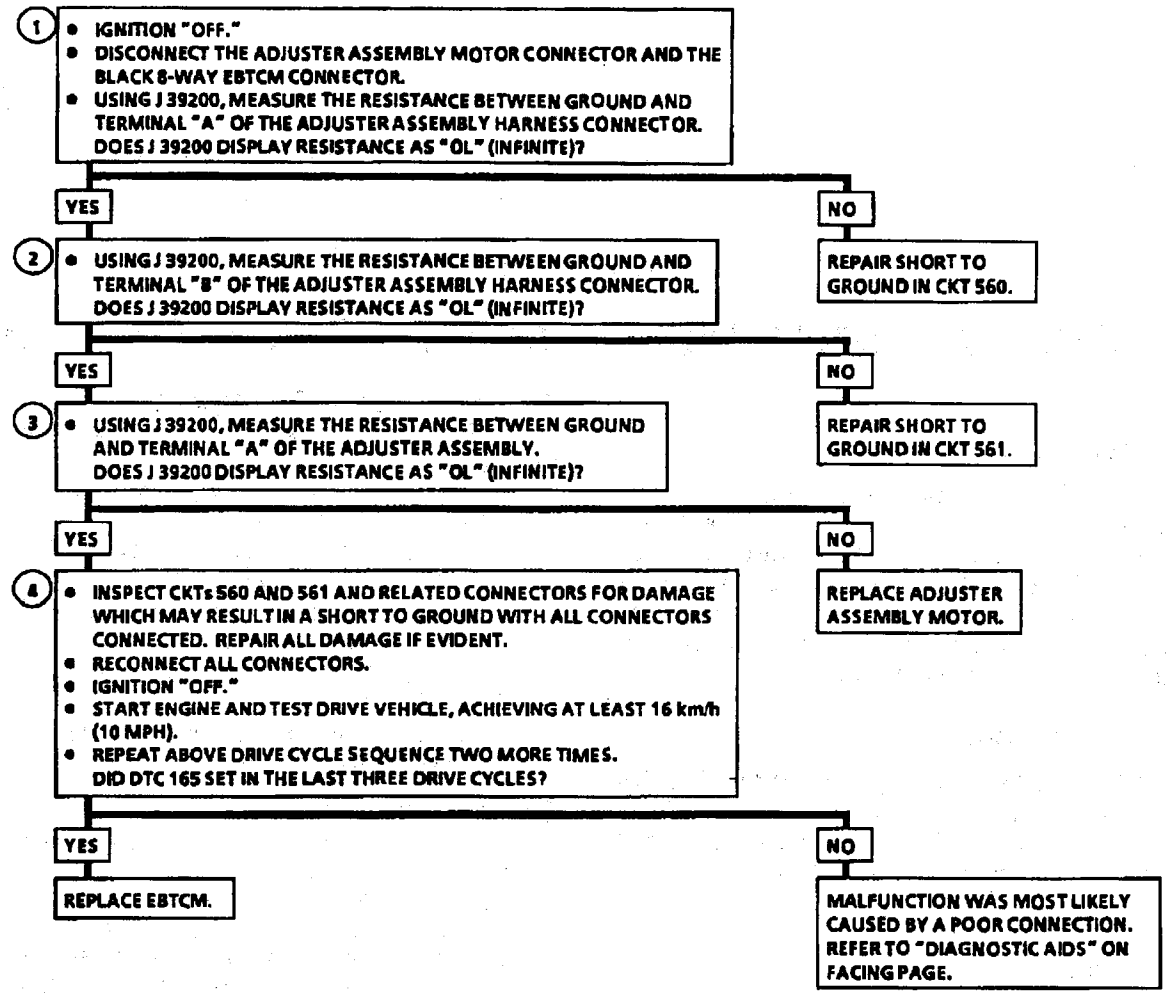
Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

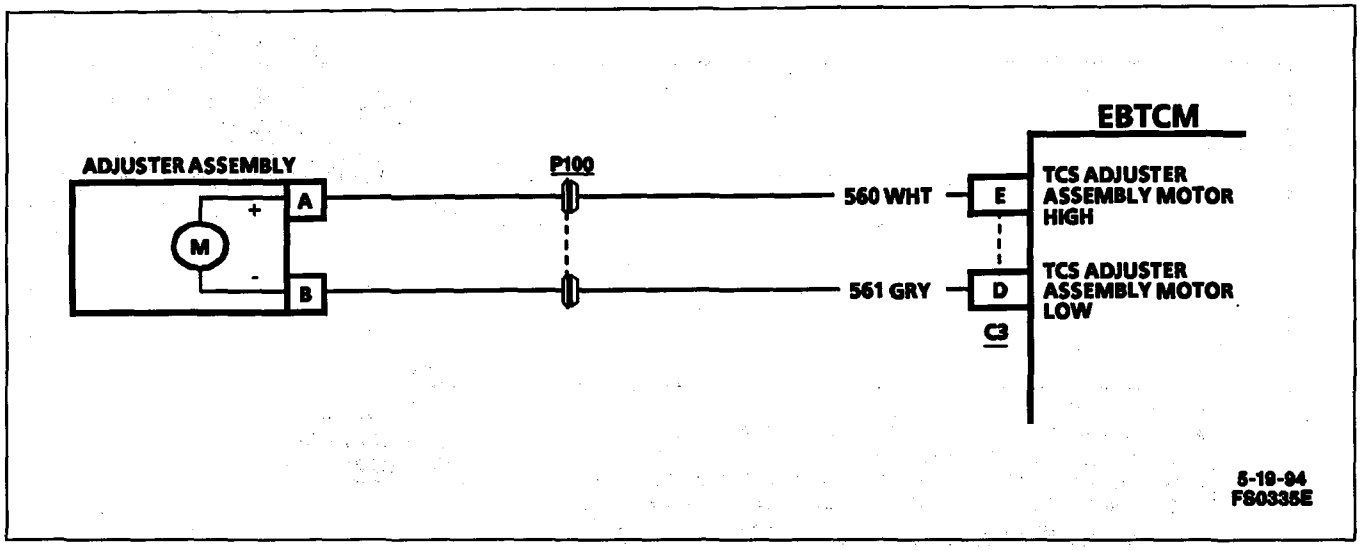
Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

DTC 165
ADJUSTER ASSEMBLY MOTOR CIRCUIT SHORTED TO GND



AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY "OFF."

C0154S



DTC 166
ADJUSTER ASSEMBLY MOTOR CIRCUIT SHORTED TO BATT

Circuit Description:

This DTC identifies an adjuster assembly motor circuit that is shorted to battery or an adjuster assembly motor that has low or no resistance. This malfunction will not allow the adjuster assembly motor to be controlled at the commanded current rate or will cause the adjuster assembly motor to turn in the opposite direction, or not at all.

DTC Will Set When:

DTC 166 can be set at any time. If the EBTCM detects an out of range voltage on either of the adjuster assembly circuits indicating a circuit shorted to battery or an adjuster assembly motor shorted, a malfunction exists.

Action Taken:

A malfunction DTC is stored, TCS is disabled. The amber TCS and the red BRAKE warning lamp are turned "ON."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks for a short to voltage in the adjuster assembly motor "HIGH" circuitry.
2. Checks for a short to voltage in the adjuster assembly motor "LOW" circuitry.
3. Checks for a short between the "HIGH" and "LOW" motor circuits..
4. Checks for an adjuster assembly motor that is internally shorted.
5. Ensures malfunction was not due to physical damage of the circuitry.

Diagnostic Aids:

An intermittent malfunction may be caused by a poor connection, rubbed through wire insulation, or a wire that is broken inside the insulation.

The frequency of the malfunction can be checked by using the enhanced diagnostic function of the Tech 1, as described in "Tech 1 Diagnostics" in this section.

Any circuitry that is suspected of causing the intermittent complaint should be thoroughly checked for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wiring connections or physical damage to the wiring harness.

NOTICE: J 39200 TEST LEADS MUST BE "ZEROED" PRIOR TO MAKING ANY RESISTANCE MEASUREMENTS. REFER TO J 39200 USER'S MANUAL.

DTC 166
ADJUSTER ASSEMBLY MOTOR CIRCUIT SHORTED TO BATT

1. • IGNITION "OFF."
   • DISCONNECT THE ADJUSTER ASSEMBLY MOTOR CONNECTOR AND THE BLACK 8-WAY EBTCM CONNECTOR.
   • IGNITION "ON."
   • USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "A" OF THE ADJUSTER ASSEMBLY HARNESS CONNECTOR.
   IS VOLTAGE 1 VOLT OR LESS?
   - YES
   - NO → REPAIR SHORT TO VOLTAGE IN CKT 560.

2. • USING J 39200, MEASURE THE VOLTAGE BETWEEN GROUND AND TERMINAL "B" OF THE ADJUSTER ASSEMBLY HARNESS CONNECTOR.
   IS VOLTAGE 1 VOLT OR LESS?
   - YES
   - NO → REPAIR SHORT TO VOLTAGE IN CKT 561.

3. • IGNITION "OFF."
   • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE ADJUSTER ASSEMBLY HARNESS CONNECTOR.
   DOES J 39200 DISPLAY RESISTANCE AS "OL" (INFINITE)?
   - YES
   - NO → REPAIR SHORT BETWEEN CKTs 560 AND 561.

4. • USING J 39200, MEASURE THE RESISTANCE BETWEEN TERMINAL "A" AND TERMINAL "B" OF THE ADJUSTER ASSEMBLY MOTOR.
   IS RESISTANCE GREATER THAN 0.5Ω?
   - YES
   - NO → REPLACE ADJUSTER ASSEMBLY MOTOR.

5. • INSPECT CKTs 560 AND 561 AND RELATED CONNECTORS FOR DAMAGE WHICH MAY RESULT IN A SHORT TO VOLTAGE WITH ALL CONNECTORS CONNECTED. REPAIR ALL DAMAGE IF EVIDENT.
   • RECONNECT ALL CONNECTORS.
   • IGNITION "OFF."
   • START ENGINE AND TEST DRIVE VEHICLE, ACHIEVING AT LEAST 16 km/h (10 MPH).
   • REPEAT ABOVE DRIVE CYCLE SEQUENCE TWO MORE TIMES.
   DID DTC 166 SET IN THE LAST THREE DRIVE CYCLES?
   - YES → REPLACE EBTCM.
   - NO → MALFUNCTION WAS MOST LIKELY CAUSED BY A POOR CONNECTION. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

AFTER DIAGNOSIS IS COMPLETE, CLEAR DTCs AND TEST DRIVE VEHICLE FOR THREE (3) DRIVE CYCLES TO VERIFY THAT DTC DOES NOT RESET. A DRIVE CYCLE CONSISTS OF STARTING THE VEHICLE, DRIVING OVER 16 km/h (10 MPH), AND THEN TURNING KEY "OFF."

C0155S

DIAGNOSIS/MISC. TEST (F4)

MANUAL CONTROL (F0)

This function can be used to manually control the ABS VI/TCS motors and solenoids.

ABS Motor Test (Apply/Release)

Each motor can be manually turned "ON" for up to 5 seconds, at a current of 10 amps applied (forward) or 6 amps released (reverse). After running the motors, the command and feedback currents will be stored in a snapshot buffer. This information can be reviewed, when instructed to do so by the service manual, to determine if the motors are operating properly.

The test below describes how the front motors will normally operate, the rear motor can be tested in a similar manner, except there will be only a slight pedal drop (bump) and rise during the test.

1. Ignition "OFF."
2. Install Tech 1 with MSC.
3. Ignition to "RUN," engine "OFF."
4. Pump brake pedal until firm to deplete vacuum from power booster.
5. Select manual control.
6. Depress and hold brake pedal.
7. Using the Tech 1, "Release" one of the ABS motors. The brake pedal should move smoothly toward the floor. As the pedal drops, the feedback current should momentarily drop to only a few amps (indicating motor movement) and then become equal to command current (6 amps). This indicates the motor is no longer moving since the piston has reached the bottom of the bore.
8. With the brake pedal still depressed and at the floor, "Apply" the same ABS motor. The brake pedal should now smoothly rise back to the top of its travel. The feedback current should momentarily drop to a few amps, then quickly increase to the command current (10 amps). This indicates the motor is no longer moving since the piston has reached the top of the bore ("home" position).

TCS Motor Test (Apply/Release)

Each motor can be manually turned "ON" for up to 5 seconds, at a current of 8 amps applied (forward) or 10 amps released (reverse). After running the motors, the command and feedback currents will be stored in a snapshot buffer. This information can be reviewed, when instructed to do so by the service manual, to determine if the motors are operating properly.

1. Ignition "OFF."
2. Install Tech 1 with MSC.
3. Ignition to "RUN," engine "OFF."
4. Raise the vehicle such that all wheels to be tested are off the ground.
5. Select manual control (F0).
6. Using the Tech 1, "Apply" one of the motors. The feedback current should momentarily drop to only a few amps (indicating motor movement), and then become equal to command current (8 amps). This indicates the motor is no longer moving since the piston has reached the top of the bore.
7. With the specific motor still applied, have an assistant try to spin the wheel that has been applied. The wheel should not move indicating the motor is applied.
8. With the Tech 1, now "Release" one of the motors. The feedback current should momentarily drop to only a few amps (indicating motor movement) and then become equal to command current (10 amps). This indicates the motor is no longer moving since the piston has reached the bottom of the bore or ("home" position). Now the wheel should spin freely.

Solenoid Test ("ON/OFF")

Only use this test when no DTCs are stored and you suspect a leaky ABS solenoid or check valve.

1. Ignition "OFF."
2. Install Tech 1 with MSC.
3. Ignition to "RUN," engine "OFF."
4. Pump brake pedal and deplete vacuum from power booster.
5. Select manual control (F0).
6. Select left front or right front motor release.
7. "Release" the motor for the channel being tested. Review the motor command and feedback currents to be sure the motor released properly. Refer to "Motor (Apply/Release)" in this section.
8. Select the solenoid for the same channel as that being tested.
9. With no brake pedal pressure applied, turn the solenoid "ON."
10. Depress the brake pedal. It should be very high and firm.
    - If the pedal goes nearly to the floor, the solenoid is leaking or not closing and/or the check valve is leaking, proceed to Step 12.
11. With brake pressure still applied, turn the solenoid "OFF." The brake pedal should move toward the floor. This verifies normal solenoid operation. END OF TEST.
    - If the pedal does not move toward the floor, the solenoid is stuck "ON," proceed to Step 12.
12. Verify that the solenoid connectors are connected to the proper solenoids, (the right front solenoid is the one on the rear of the ABS hydraulic modulator, closest to the brake booster). If the wiring is incorrect, move the connectors to the proper solenoid and repeat this entire test starting with Step 1.
    A. Physically switch the two solenoids.
    B. Repeat the entire test starting at Step 1 for the channel in question.

- If the test now works properly, test the other channel. If the test fails for this channel, replace the solenoid currently installed in this channel. Refer to "ABS Hydraulic Modulator Solenoid" under "On-Vehicle Service" in this section.
- If the test fails for the same channel, the check valve is leaking. Replace ABS hydraulic modulator. Refer to "ABS Hydraulic Modulator" under "Unit Repair" in this section.

Important

- After performing Step 12, it is necessary to bleed the brake system. Refer to "Bleeding Procedure" in this section.

HYDRAULIC CONTROL TEST (F2)

This test is used to verify base brake apply and ABS release, hold, and apply function.

1. Ignition "OFF."
2. Raise the vehicle such that all wheels to be tested are off the ground.
3. Install Tech 1 with MSC.
4. Ignition to "RUN," engine "OFF," vehicle transmission in neutral.
5. Select a channel to test; left front, right front, or rear. When testing the rear brakes, both rear wheels should rotate or not rotate simultaneously at various points in the test; this is true because both rear brake pressures are controlled together.
6. Firmly depress brake pedal. Pedal should remain high and firm.
7. Have an assistant attempt to rotate the wheel being tested. If the wheel does not rotate, base brake apply is working properly.
8. With the brake pedal still depressed, press the = key on the Tech 1 to start the test. The Tech 1 will display "Release" on the screen. Your assistant should be able to rotate the wheel being tested during the release portion of the test (approximately 2 seconds long). This verifies ABS pressure release. The brake pedal should remain high and firm. (If the brake pedal moves toward the floor, verify the solenoid electrical connectors are connected to the correct solenoids.)
9. The Tech 1 will switch to the "Hold" mode and display the word "Hold" on the screen along with an 18 second decrement counter. With the brake pedal still depressed, have your assistant attempt to rotate the wheel. The wheel should rotate for the full 18 seconds of the test. If the wheel does not rotate for the full 18 seconds it could indicate that either the check valve or the solenoid may be leaking. This verifies ABS pressure hold.
10. When the hold portion of the test is complete, brake pressure will be applied and a slight bump may be felt in the pedal. This is normal. The assistant should not be able to rotate the wheel at this point. This verifies ABS apply.

ABS AND TCS MOTOR TEST (F4)

Once the motor pack has been separated from the hydraulic modulator, this test will help determine if the motor pack is operating properly.

The Tech 1 will rotate the motors in one direction, then the other.

- If any motor does not turn in both directions, the motor pack is malfunctioning and must be replaced. The motor pack is not serviceable and must be replaced as an assembly. Refer to "Motor Pack" under "Unit Repair" in this section.
- If all three ABS motors and both TCS motors rotate, try to rotate each gear on the hydraulic modulator, refer to "No Gear Movement" in this section.

ABS NO GEAR MOVEMENT

After the ABS motor pack has been removed, rotate each gear by hand on the ABS hydraulic modulator (unit with large gears). The front gears (non-center gears) should be able to be rotated approximately 12.25 full turns lock to lock. If the gear does not turn freely or at least 12 turns are not possible, replace the ABS hydraulic modulator.

The rear gear (center gear) should rotate approximately 7.25 turns. If the gear does not turn freely or at least 7 turns are not possible, replace the ABS hydraulic modulator.

Refer to "ABS Hydraulic Modulator" under "Unit Repair" in this section if replacement of the ABS hydraulic modulator is indicated above.

TCS NO GEAR MOVEMENT

After the TCS motor pack has been removed, rotate each gear by hand on the TCS hydraulic modulator (unit with two large gears). The gears should be able to be rotated approximately 7.25 full turns lock to lock. If the gear does not turn freely or at least 7 turns are not possible, replace the TCS hydraulic modulator.

Refer to "TCS Hydraulic Modulator" under "Unit Repair" in this section if replacement of the TCS hydraulic modulator is indicated above.

GEAR TENSION RELIEF (F5)

When the displacement cylinder pistons are in the "home" position, each motor has prevailing torque. This torque results in "gear tension," or force on each gear that makes motor pack separation difficult. To avoid injury, or damage to the gears, the "Gear Tension Relief Function" briefly reverses each motor to eliminate the prevailing torque.

Always perform the "Gear Tension Relief Function" prior to removing the ABS hydraulic modulator/motor pack assembly from the vehicle.

ABS AND TCS RELAY TEST (F6)

This test allows the user to turn the relay "ON" and "OFF" using the "UP" and "DOWN" arrow keys on the Tech 1. The battery voltage supplied to the EBTCM through the relay contacts is displayed on the screen during the test.

When the relay is commanded "ON," the voltage should be equal to the battery voltage. When the relay is "OFF," the voltage should drop below 2 volts.

NOTICE: Voltage will not drop to zero when the relay contacts are open due to capacitors in the EBTCM. If voltage drops below 2 volts, the relay is operating properly.

VOLTAGE LOAD TEST (F7)

The ABS VI/TCS system can draw significant amounts of current when operating. This test turns "ON" many of the system components to load-test the vehicle's electrical system.

If low voltage malfunctions or intermittent ABS/TCS operations are occurring, this test will allow you to monitor the ignition and switched battery inputs to the EBTCM. If only one of these two inputs drops below 10 volts during testing, a high resistance may be present in that power feed circuit. If both inputs drop below 10 volts the vehicle's electrical system needs to be diagnosed. In either case, the Tech 1 will display that the "Voltage Load Test" failed.

LAMP TEST (F8)

This test allows the user to control the warning/indicator lamps associated with ABS VI/TCS. It can be used to check the lamp circuits. The amber ABS INOP lamp and the amber TCS warning lamp can be turned "ON" or flashed. The red BRAKE warning lamp and the blue "LOW TRAC" lamp can be turned "ON" and "OFF."

SYSTEM ID (F9)

This feature is used to determine the ABS VI version and whether the system includes Traction Control (TCS) system configuration, and to provide manufacturing information on the EBTCM.

BLEED PREP (F6)

The bleed prep function is initiated by pressing the (F6) key from the Tech 1 "Select Mode" menu. The bleed prep function must ALWAYS be used prior to bleeding the brake system. This is a two part function. The first part of this function will return all of the hydraulic modulator pistons to their "home" position. This allows all fluid paths within the modulators to be open so that the modulators can be properly bled. The second part of bleed prep cycles the TCS modulator to move any trapped air that may be remaining to the top of the TCS modulator so that it may be removed when bleeding the system is continued.

Important

- The bleed prep function cannot be performed if certain current DTCs are present. If current DTCs are present, the vehicle must be repaired and DTCs cleared before performing the bleed prep function.

ON-VEHICLE SERVICE

SERVICE PRECAUTIONS

CAUTION: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- Eye contact - rinse thoroughly with water.
- Skin contact - wash with soap and water.
- If ingested - consult a physician immediately.

CAUTION: To help avoid personal injury due to poor braking, DO NOT tap into the vehicle's brake system to operate a trailer brake system.

NOTICE: When fasteners are removed, always install them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread-locking compound, will be called out. The correct fastener tightening specification must be used when installing fasteners that require it. If the above conditions are not followed, parts of the system could be damaged.

NOTICE: The use of rubber hoses or parts other than those specified for the Antilock Brake System (ABS) may lead to functional problems requiring replacement of the hydraulic parts. Replace all components included in repair kits used to service this system. Lubricate rubber parts with clean, fresh brake fluid to ease assembly. Do not use lubricated shop air on brake parts as damage to rubber components may result. If any hydraulic component is removed or brake line disconnected, it is necessary to bleed all or part of the brake system. The fastener tightening specifications listed are for dry, unlubricated fasteners.

NOTICE: Use only Supreme 11 (GM 1052542) or equivalent DOT 3 brake fluid. The use of DOT 5 (silicone) brake fluid is not recommended. Reduced braking performance or durability may result.

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring, cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen the damage.

CHECKING AND ADDING FLUID

Refer to SECTION 5A.

FLUSHING PROCEDURE

Important

- If evidence of contamination is present in the vehicle's brake fluid, the entire brake system must be flushed following one of the procedures outlined below.
- After flushing the entire brake system, all rubber components must be replaced. Components which must be replaced include: brake hose assemblies, master cylinder rubber parts, brake caliper and wheel cylinder boots and seals, combination valve assembly, ABS hydraulic modulator, TCS hydraulic modulator and ABS solenoids. Refer to the proper "On-Vehicle Service" for replacement procedures.
- After all rubber components have been replaced, the entire brake system must be re-flushed following one of the procedures outlined below.
- Once the second flushing procedure has been performed, a complete system bleed must be performed, refer to "Bleeding Procedure" in this section.

NOTICE: Use only DOT 3 brake fluid from a clean, sealed container. Do not use any fluid from a container which is wet with water. Do not use DOT 5 silicone brake fluid. Improper brake fluid, mineral oil (from such things as engine oil, transmission fluid, etc.), or water in the fluid may cause the brake fluid to boil or the rubber components to deteriorate. Keep all fluid containers capped to prevent contamination.

- The system must be flushed if there is any doubt about the condition of fluid in the system or if fluid has been used which contains the slightest trace of mineral oil (from such things as engine oil, transmission fluid, etc.).

Flushing Preparation

NOTICE: The flushing prep procedure must be performed prior to using "Pressure Flush" or "Manual Flush" procedures.

Important

- Do Not place your foot on the brake pedal through this entire procedure unless specifically directed to do so.

1. Remove foot from brake pedal.
2. Start engine and allow it to run for at least 10 seconds while observing the ABS and TCS warning lamp.
3. If the ABS or TCS warning lamps turned "ON" and stayed "ON" after about 10 seconds, the flushing procedure must be stopped and a Tech 1 must be used to diagnose the ABS or TCS malfunction.
4. If the ABS or TCS warning lamps turned "ON" for approximately 3 seconds, then turned "OFF" and stayed "OFF," turn the ignition "OFF."
5. Repeat Steps 1 through 4 one more time.
6. The entire brake system should now be flushed following either "Pressure Flush" or "Manual Flush" outlined below.

Pressure Flush

Tool Required: J 35589, Bleeding Adapter

NOTICE: Pressure bleeding equipment can be used to perform the flush procedure. The pressure bleeding equipment used for flushing must be of the diaphragm type. It must have a rubber diaphragm between the air supply and the brake fluid to prevent air, moisture, and other contaminants from entering the hydraulic system.

Clean

1. Fluid reservoir cover and surrounding area.

Remove or Disconnect

2. Fluid reservoir cover.
3. Any remaining brake fluid in reservoir.

Inspect

4. Refill reservoir with clean DOT 3 brake fluid to proper level.

Install or Connect

5. Bleeder adapter J 35589 to brake fluid reservoir.
6. Bleeder adapter to pressure bleeding equipment.

Adjust

7. Pressure bleeding equipment to 35-70 kPa (5-10 psi) and wait for approximately 30 seconds to insure there is no leakage.
8. Pressure bleed equipment to 205-240 kPa (30-35 psi).
9. Proceed as follows with pressure bleeding equipment connected and pressurized:
   A. Attach a clear plastic hose to the rearward bleeder valve on the ABS hydraulic modulator. Place the other end of the hose in a container to collect draining brake fluid. Do not submerge hose end into fluid.
   B. Slowly open bleeder valve and allow fluid to flow until clean brake fluid flows or until at least 118 ml (4 ounces) of fluid is accumulated.
   C. Close valve.

D. Repeat above procedure for the forward bleeder valve until clean brake fluid flows or until at least 118 ml (4 ounces) of fluid is accumulated.

Tighten

- ABS hydraulic modulator bleeder valve to 9 N.m (80 lb. in.).

10. Raise vehicle and suitably support.

Important

- Flush sequence:
  - — Right rear.
  - — Left rear.
  - — Right front.
  - — Left front.

11. Flush wheel brakes in sequence shown above.
    A. Attach bleeder hose to bleeder valve at each wheel and place the other end into a container to collect draining brake fluid. Do not submerge hose end in fluid.
    B. Slowly open bleeder valve and allow fluid to flow.
    C. Close valve when clean brake fluid begins to flow or at least 235 ml (8 ounces) of fluid is accumulated.
12. Repeat Step 11 on left rear wheel brake.
13. Repeat Step 11 on right front wheel brake.
14. Repeat Step 11 on left front wheel brake.
15. Lower vehicle.
16. Remove bleeder adapter.
17. Replace all rubber components listed under "Flushing Procedure," refer to the appropriate "On-Vehicle Service" section.
18. Repeat flushing preparation and flushing procedure Steps 4-16 one more time.

Inspect

19. Fluid level in reservoir and fill to correct level if necessary.

Install or Connect

20. Fluid reservoir cap.
21. Bleed the entire brake hydraulic system; refer to "Bleeding Procedure" in this section.

Manual Flush

Important

- In the following steps, use a suitable container and/or shop rags to catch fluid and prevent it from contacting any painted surfaces.

Clean

1. Fluid reservoir cover and surrounding area.

Remove or Disconnect

2. Fluid reservoir cover.
3. Any remaining brake fluid in reservoir.

Inspect

4. Refill reservoir with clean DOT 3 brake fluid to proper level.

Install or Connect

5. Fluid reservoir cover.
6. Flush ABS hydraulic modulator as follows:
   A. Attach a clear plastic bleeder hose to rearward bleeder valve on the ABS hydraulic modulator and place the other end of hose in a container to collect draining brake fluid. Do not submerge hose end into fluid.
   B. Slowly open rearward bleeder valve one half to one full turn.
   C. Depress brake pedal until fluid begins to flow.
   D. Close valve and release brake pedal. Repeat above steps until clean brake fluid flows or at least 118 ml (4 ounces) of fluid is accumulated.
   E. Repeat above procedure for the forward bleeder valve until clean brake fluid flows or at least 118 ml (4 ounces) of brake fluid is accumulated.

Tighten

- ABS hydraulic modulator bleeder valves to 9 N.m (80 lb. in.).

Remove or Disconnect

7. Fluid reservoir cover.

Inspect

8. Fluid level in reservoir and fill to correct level if necessary.

Install or Connect

9. Fluid reservoir cover.
10. Raise vehicle and suitably support.

Important

- Flush sequence:
  - — Right rear.
  - — Left rear.
  - — Right front.
  - — Left front.

11. Flush wheel brakes in sequence shown above.
    A. Attach bleeder hose to bleeder valve at each wheel and place the other end into a container to collect draining brake fluid. Do not submerge hose end in fluid.
    B. Open bleeder valve.

C. Slowly depress brake pedal.
D. Close valve and slowly release brake pedal.
E. Repeat above procedure until clean brake fluid flows or at least 235 ml (8 ounces) of fluid is accumulated.

12. Repeat Step 11 on left rear brake.
13. Repeat Step 11 on right front brake.
14. Repeat Step 11 on left front brake.
15. Lower vehicle.
16. Replace all rubber components listed under "Flushing Procedure," refer to the appropriate "On-Vehicle Service" section.
17. Repeat flushing preparation and flushing procedure Steps 4-15 one more time.

Inspect

18. Fluid level in reservoir and fill to correct level if necessary.

Install or Connect

19. Fluid reservoir cap.
20. Bleed the entire brake hydraulic system; refer to "Bleeding Procedure" in this section.

BLEEDING PROCEDURE

NOTICE: If any brake component is repaired or replaced such that air is allowed to enter the brake system, the entire bleeding procedure MUST be followed.

NOTICE: Use only SUPREME 11 (GM 1052542) or equivalent DOT 3 brake fluid from a clean, sealed container. Do not use fluid from an open container that may be contaminated with water. The use of DOT 5 (silicone) brake fluid is not recommended. Reduced braking performance or durability may result.

NOTICE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring, cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen the damage.

NOTICE: Prior to bleeding the brakes, the front and rear displacement cylinder pistons, on the ABS hydraulic modulator, must be returned to the topmost position. The TCS hydraulic modulator must be rehomed a minimum of 4 full times. This method uses a Tech 1 to perform the rehoming procedure. You will not be able to bleed this system without the Tech 1 or T-100 (CAMS).

Important

- Using a Tech 1 or T-100 (CAMS), select "F6: Bleed Prep." The bleed prep function cannot be performed if certain current DTCs are present. If DTCs are present, the vehicle must be repaired and DTCs cleared before performing the bleed prep function.
- The entire brake system should now be bled following either "Pressure Bleeding" or "Manual Bleeding" outlined below.
- If the amber ABS or TCS warning lamps are turned "ON" and stay "ON" after about 10 seconds, the bleeding procedure must be stopped and a Tech 1 must be used to diagnose the ABS or TCS malfunction.
- Do not place your foot on the brake pedal through this entire procedure unless specifically directed to do so.

Pressure Bleeding

Tool Required: J 35589, Bleeding Adapter

NOTICE: Use only DOT 3 brake fluid from a clean, sealed container. Do not use fluid from an open container that may be contaminated with water. Do not use DOT 5 brake fluid.

NOTICE: Pressure bleeding equipment must be of the diaphragm type. It must have a rubber diaphragm between the air supply and the brake fluid to prevent air, moisture and other contaminants from entering the hydraulic system.

Clean

1. Fluid reservoir cover and surrounding area.

Remove or Disconnect

2. Fluid reservoir cover.

Inspect

3. Fluid to be at proper level. Refer to SECTION 5A. Add clean brake fluid as required.

Install or Connect

4. Bleeder adapter J 35589 to brake fluid reservoir.
5. Bleeder adapter to pressure bleeding equipment.

Adjust

6. Pressure bleed equipment to 35-70 kPa (5-10 psi) and wait for approximately 30 seconds to insure there is no leakage.
7. Pressure bleed equipment to 205-240 kPa (30-35 psi).

8. Using Tech 1 or T-100 (CAMS), select "F6: Bleed Prep" function and follow the Tech 1 or T-100 (CAMS) as instructed. After completion of the bleed prep function, proceed with Step 9.
9. Proceed as follows with pressure bleeding equipment connected and pressurized:
   A. Attach a clear plastic bleeder hose to the rearward bleeder valve on the ABS hydraulic modulator. Submerge opposite hose end in a clean container partially filled with clean brake fluid.
   B. Slowly open bleeder valve and allow fluid to flow until no air is seen in fluid.
   C. Close valve when fluid flows without any air bubbles.
   D. Repeat Steps 9B and 9C until no air bubbles are present.
   E. Relocate the bleeder hose on the forward ABS hydraulic modulator bleeder valve and repeat Steps 9A through 9D.

Tighten

- ABS hydraulic modulator bleeder valves to 9 N.m (80 lb. in.).

Important

- Use a shop cloth to catch escaping brake fluid. Take care to prevent fluid from running down motor pack and entering the motor pack base or into the electrical connector. Also, do not allow brake fluid to contact any painted surfaces as surface damage will occur. If brake fluid does contact any surface, flush surface with water to lessen damage.

10. Proceed to bleed the master cylinder brake connections as follows with pressure bleeding equipment connected and pressurized:
    A. Slowly loosen the forward brake pipe tube nut on the master cylinder and check for air in escaping fluid.
    B. When air flow ceases, immediately tighten tube nut.

Tighten

- Master cylinder tube nut to 32 N.m (24 lb. ft.).

    C. Repeat Steps 10A and 10B for the rearward master cylinder brake pipe connection.
11. Proceed to bleed the brake combination valve connections as follows with pressure bleeding equipment connected and pressurized:
    A. Slowly loosen the forward brake pipe tube nut on the brake combination valve and check for air in escaping fluid.
    B. When air flow ceases, immediately tighten tube nut.

Tighten

- Brake combination valve tube nut to 18 N.m (13 lb. ft.).

    C. Repeat Steps 11A and 11B for the rearward brake combination valve pipe connection.
12. Proceed to bleed the ABS hydraulic modulator brake connections as follows with pressure bleeding equipment connected and pressurized:
    A. Slowly loosen the forward brake pipe tube nut on the ABS hydraulic modulator and check for air in escaping fluid.
    B. When air flow ceases, immediately tighten tube nut.

Tighten

- ABS hydraulic modulator tube nut to 32 N.m (24 lb. ft.).

    C. Repeat Steps 12A and 12B for the remaining ABS hydraulic modulator brake pipe connections, moving from front to rear.
13. Proceed to bleed the TCS hydraulic modulator brake connections as follows with pressure bleeding equipment connected and pressurized:
    A. Slowly loosen the forward brake pipe tube nut on the TCS hydraulic modulator and check for air in escaping fluid.
    B. When air flow ceases, immediately tighten tube nut.

Tighten

- TCS hydraulic modulator tube nut to 32 N.m (24 lb. ft.).

    C. Repeat Steps 13A and 13B for the remaining TCS hydraulic modulator brake pipe connections.
14. Raise vehicle and suitably support.
15. Proceed as follows to bleed the rear wheel brakes:
    A. Attach a clear plastic bleeder hose to the right rear wheel bleeder valve and submerge opposite hose end in a clean container partially filled with clean brake fluid.
    B. Slowly open bleeder valve and allow fluid to flow.
    C. Close valve when fluid begins to flow without any air bubbles. Tap lightly on the caliper or backing plate to dislodge any trapped air bubbles.
    D. Relocate bleeder hose to the left rear wheel bleeder valve and repeat Steps 15A through 15C.
16. Remove pressure to the pressure bleeding equipment.
17. Attach a clear plastic bleeder hose to the right front wheel bleeder valve and submerge opposite hose end in a clean container partially filled with clean brake fluid.
18. Turn the ignition to "RUN," engine "OFF."

19. Open the bleeder valve and apply the brake until the red BRAKE warning lamp turns "ON." This shuttles the brake pressure differential warning valve.
20. Close bleeder valve.
21. Reapply pressure to pressure bleeding equipment.
22. Turn the ignition "OFF."

Important

- Do not reapply the brakes after closing the bleeder valve.

23. Lower vehicle.
24. Repeat the entire Step 9.
25. Raise vehicle and suitably support.
26. Repeat the entire Step 15.
27. Proceed as follows to bleed the front wheel brakes:
    A. Attach a clear plastic bleeder hose to the right front wheel bleeder valve and submerge opposite hose end in a clean container partially filled with clean brake fluid.
    B. Slowly open bleeder valve and allow fluid to flow.
    C. Close valve when fluid begins to flow without any air bubbles. Tap lightly on the caliper to dislodge any trapped air bubbles.
    D. Relocate bleeder hose to the left front wheel bleeder valve and repeat Steps 27A through 27C.
28. Continuing with the Tech 1 or T-100 (CAMS), press "ENTER" to initialize the TCS modulator for bleeding. Follow the Tech 1 or T-100 (CAMS) as directed.
29. Proceed as follows to bleed the rear wheel brakes only:
    A. Attach a clear plastic bleeder hose to the right rear wheel bleeder valve and submerge opposite hose end in a clean container partially filled with clean brake fluid.
    B. Slowly open bleeder valve and allow fluid to flow.
    C. Close valve when fluid begins to flow without any air bubbles. Tap lightly on the caliper or backing plate to dislodge any trapped air bubbles.
    D. Relocate bleeder hose to the left rear wheel bleeder valve and repeat Steps 29A through 29C.

Important

- This procedure must be followed to insure all air has been removed from the TCS hydraulic modulator.

30. Lower vehicle.
31. Remove pressure bleeding equipment, including bleeder adapter J 35589.

Inspect

32. Fluid level in reservoir and fill to proper level if necessary.

Install or Connect

33. Fluid reservoir cap.

Inspect

34. With ignition to "RUN" apply brake pedal with moderate force and hold. Note pedal travel and feel.
    - If pedal feels firm and constant and pedal travel is not excessive, start the engine. With the engine running, recheck the pedal travel. If it's still firm and constant and pedal travel is not excessive, go to Step 35.
    - If pedal feels soft or has excessive travel either initially or after the engine is started, the following procedure may be used. With the Tech 1, "Release" then "Apply" each ABS motor 2 to 3 times and cycle each ABS solenoid 5 to 10 times. When finished, be sure to "Apply" the front and rear motors on the ABS hydraulic modulator. "Apply" and "Release" each TCS motor 2 to 3 times. When finished be sure to "Release" each motor on the TCS hydraulic modulator. This procedure will ensure all trapped air has been removed from the ABS and TCS hydraulic modulator bores. Now repeat bleeding procedure starting at Step 1.
35. Road test the vehicle.
    - Make several normal (non ABS) stops from a moderate speed to ensure proper brake system function. Allow adequate cooling time between stops.

Manual Bleeding

NOTICE: Use only DOT 3 brake fluid from a clean, sealed container. Do not use brake fluid from an open container that may be contaminated with water. Do not use DOT 5 brake fluid.

Important

- In the following steps, use a suitable container and/or shop cloths to catch fluid and prevent it from contacting any painted surfaces.

Clean

1. Fluid reservoir cover and surrounding area.

Remove or Disconnect

2. Fluid reservoir cover.

Inspect

3. Fluid level in reservoir and fill to the correct level if necessary.

Install or Connect

4. Fluid reservoir cover.
5. Using Tech 1 or T-100 (CAMS), select "F6: Bleed Prep" function and follow the Tech 1 or T-100 (CAMS) as instructed. After completion of the bleed prep function proceed with Step 6.
6. Prime ABS hydraulic modulator as follows:
   A. Attach clear plastic bleeder hose to the rearward bleeder valve on the ABS hydraulic modulator. Submerge opposite hose end in a clean container partially filled with clean brake fluid.
   B. Slowly open rearward bleeder valve one half to one full turn.
   C. Depress brake pedal and hold until fluid begins to flow.
   D. Close valve and release brake pedal.
   E. Repeat Steps 6B and 6D until no air bubbles are present.
   F. Relocate the bleeder hose on the forward ABS hydraulic modulator bleeder valve and repeat Steps 6A through 6E.

Important

- Once fluid is seen to flow from both ABS hydraulic modulator bleeder valves, the ABS hydraulic modulator is sufficiently full of fluid. However, it may not be completely purged of air. At this point move to the wheel brakes and bleed them. This ensures that the lowest points in the system are completely free of air and then the ABS hydraulic modulator can be purged of any remaining air.

Remove or Disconnect

7. Fluid reservoir cover.

Inspect

8. Fluid level in reservoir and fill to the correct level if necessary.

Install or Connect

9. Fluid reservoir cover.
10. Raise vehicle and suitable support.

Important

- Bleed sequence:
  — Right rear.
  — Left rear.
  — Right front.
  — Left front.

11. Bleed wheel brakes in sequence shown above.
    A. Attach a clear plastic bleeder hose to the bleeder valve at each wheel and submerge opposite hose end in a clean container partially filled with clean brake fluid.
    B. Open bleeder valve.
    C. Slowly depress brake pedal.
    D. Close valve and slowly release brake pedal.
    E. Wait 5 seconds.
    F. Repeat Steps 11B through 11E until the brake pedal feels firm and no air bubbles are observed in the bleeder hose.
       - To assist in freeing entrapped air, tap lightly on caliper or backing plate with a rubber mallet.
12. Repeat Step 11 on left rear wheel brake.
13. Repeat Step 11 on right front wheel brake.
14. Repeat Step 11 on left front wheel brake.
15. Continuing with the Tech 1 or T-100 (CAMS), press "ENTER" to initialize the TCS modulator for bleeding. Follow the Tech 1 or T-100 (CAMS) as directed.
16. Proceed as follows to bleed the rear wheel brakes only:
    A. Attach a clear plastic bleeder hose to the right rear wheel bleeder valve and submerge opposite hose end in a clean container partially filled with clean brake fluid.
    B. Slowly open bleeder valve.
    C. Slowly depress brake pedal.
    D. Close valve when fluid begins to flow without any air bubbles. Tap lightly on the caliper or backing plate to dislodge any trapped air bubbles.
    E. Relocate bleeder hose to the left rear wheel bleeder valve and repeat Steps 16A through 16D.

Important

- This procedure must be followed to insure all air has been removed from the TCS hydraulic modulator.

Remove or Disconnect

17. Fluid reservoir cover.

Inspect

18. Fluid level in reservoir and fill to the correct level if necessary.

Install or Connect

19. Fluid reservoir cover.
20. Bleed the ABS hydraulic modulator.
    A. Attach a clear plastic bleeder hose to the rearward bleeder valve on the ABS hydraulic modulator. Submerge opposite hose end in a clean container partially filled with clean brake fluid.
    B. Depress brake pedal with moderate force.

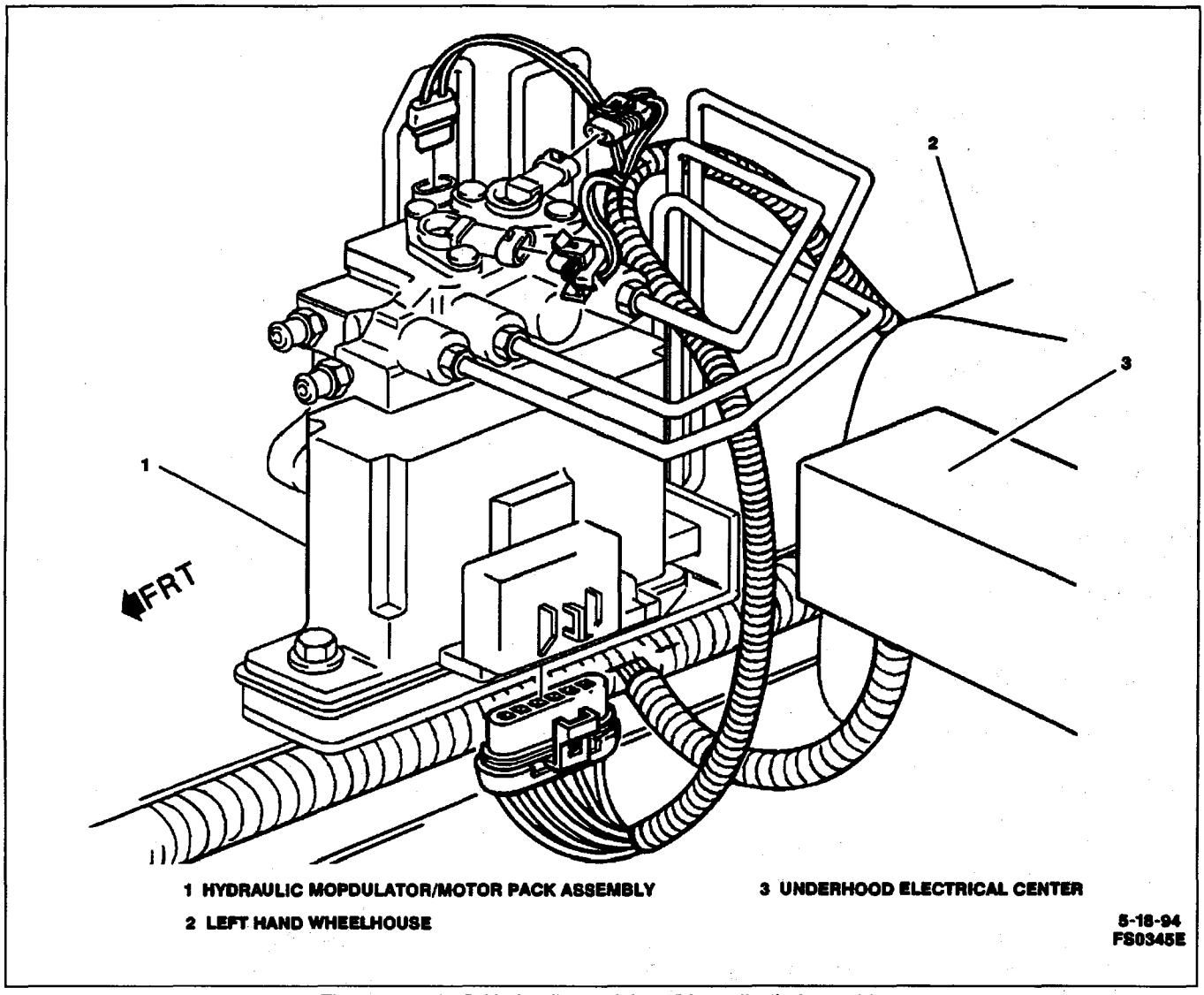


Figure 14 - ABS Hydraulic Modulator/Motor Pack Assembly

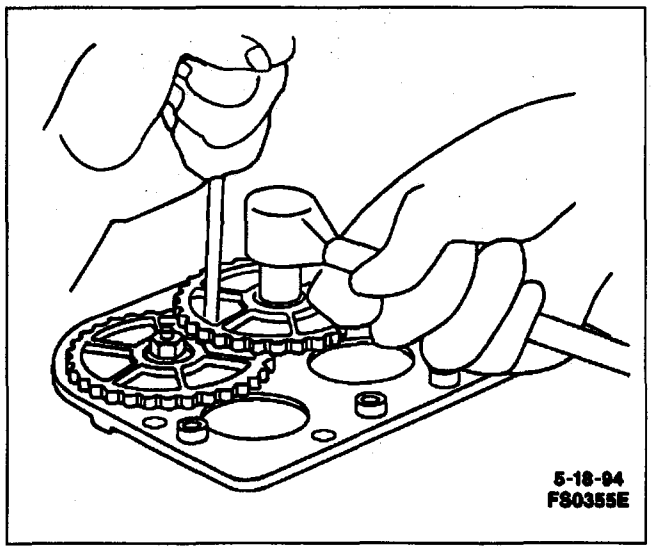


Figure 15 - Gear Removal (Typical)

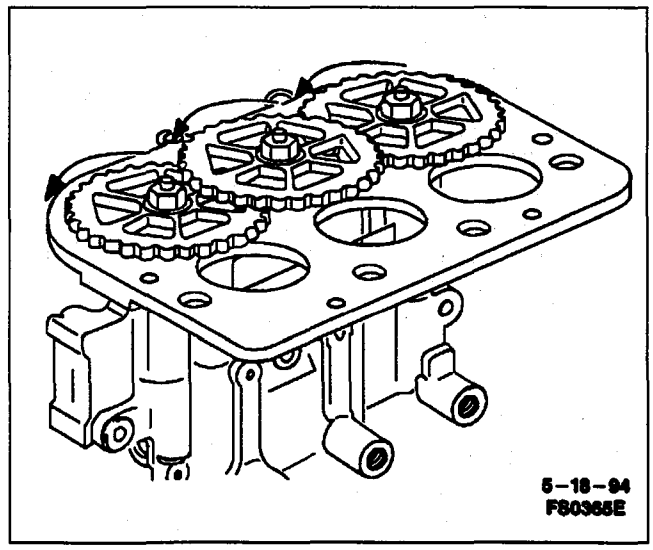


Figure 16 - Gear Positioning (Typical)

C. Slowly open rearward bleeder valve one half to one full turn and allow fluid to flow.
D. Close valve and slowly release brake pedal.
E. Wait 5 seconds.
F. Repeat Steps 20B through 20E until the no air bubbles are observed in the bleeder hose.
G. Relocate the bleeder hose on the forward ABS hydraulic modulator bleeder valve and repeat Steps 20A through 20F.

Tighten

- ABS hydraulic modulator bleeder valves to 9 N.m (80 lb. in.).

Remove or Disconnect

21. Fluid reservoir cover.

Inspect

22. Fluid level in reservoir and fill to the correct level if necessary.

Install or Connect

23. Fluid reservoir cover.

Inspect

24. With ignition to "RUN" apply brake pedal with moderate force and hold. Note pedal travel and feel.
    - If pedal feels firm and constant and pedal travel is not excessive, start the engine. With the engine running, recheck the pedal travel. If it's still firm and constant and pedal travel is not excessive, go to Step 25.
    - If pedal feels soft or has excessive travel either initially or after the engine is started, the following procedure may be used. With the Tech 1, "Release" then "Apply" each ABS motor 2 to 3 times and cycle each ABS solenoid 5 to 10 times. When finished, be sure to "Apply" the front and rear motors on the ABS hydraulic modulator. "Apply" and "Release" each TCS motor 2 to 3 times. When finished be sure to "Release" each motor on the TCS hydraulic modulator. This procedure will ensure all trapped air has been removed from the ABS and TCS hydraulic modulator bores. Now repeat bleeding procedure starting at Step 1.
25. Road test the vehicle.
    - Make several normal (non-ABS) stops from a moderate speed to ensure proper brake system function. Allow adequate cooling time between stops.

ABS HYDRAULIC MODULATOR BLEEDER VALVES

Figure 17

Remove or Disconnect

- Damaged bleeder valve or valves.

Install or Connect

- New bleeder valve or valves.

Tighten

- Bleeder valve to 9 N.m (80 lb. in.).

ABS HYDRAULIC MODULATOR SOLENOID

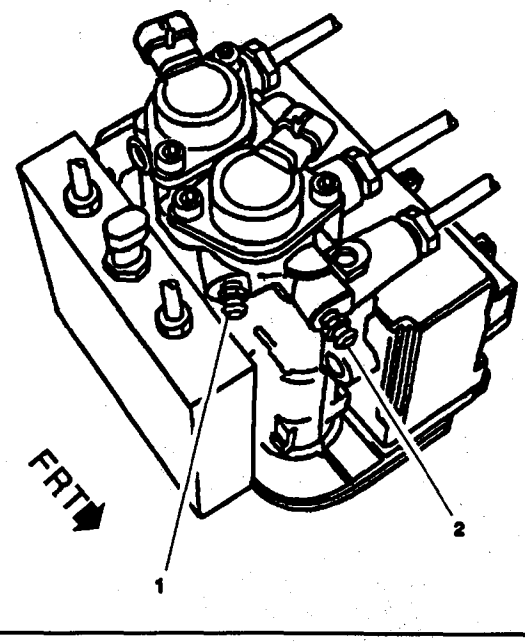
Figure 18

Remove or Disconnect

1. Solenoid electrical connector.
2. Torx® head bolts.
3. Solenoid.

Important

- Be sure the seal is still attached to the solenoid when it is removed. If not, check solenoid bore in modulator.



1 REARWARD BLEEDER VALVE
2 FORWARD BLEEDER VALVE

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Figure 17 - ABS Hydraulic Modulator Bleeder Locations

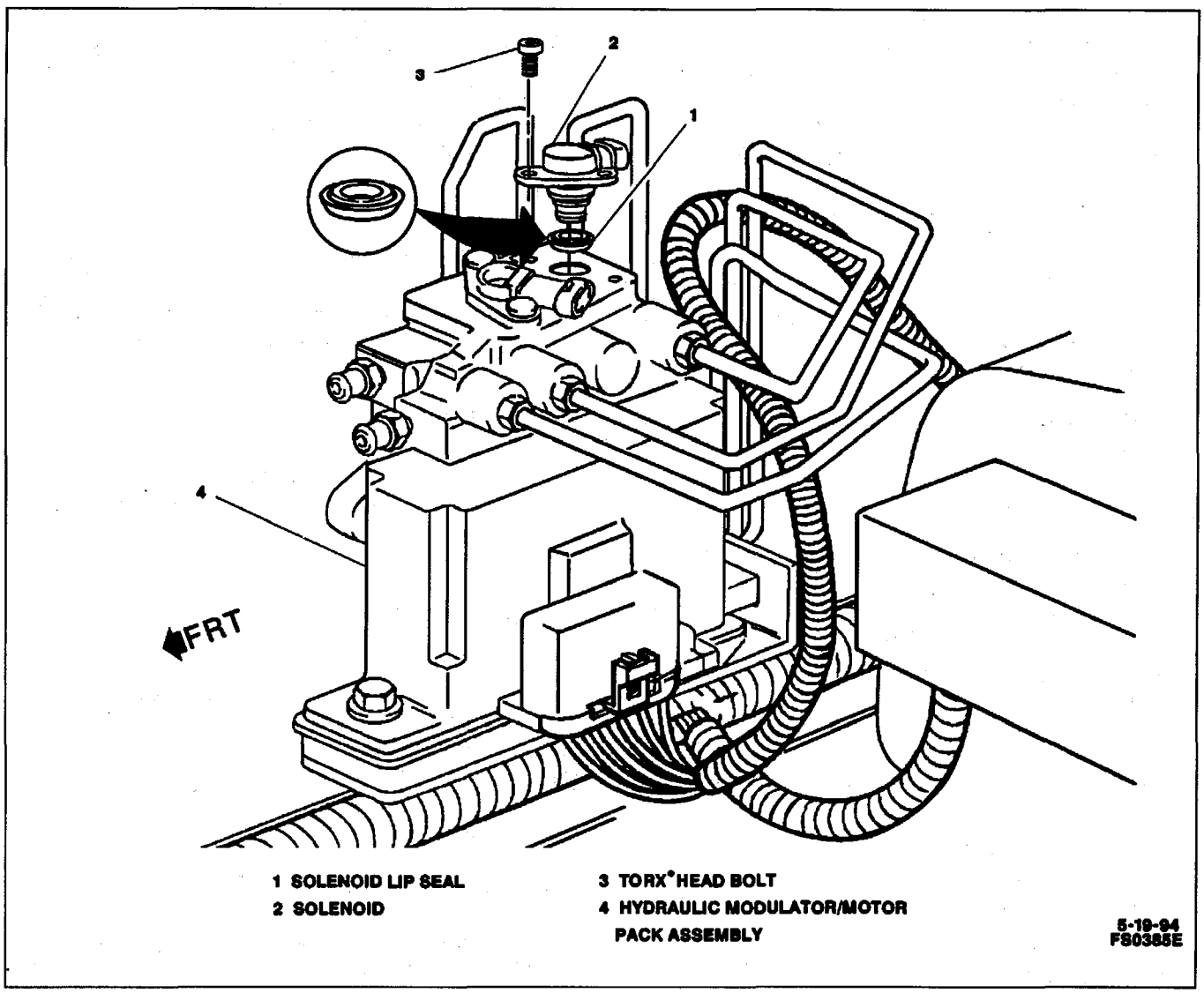


Figure 18 - Hydraulic Modulator Solenoid Removal

- Do not attempt to disassemble solenoid, it is serviceable only as an assembly.
- Lubricate seal on new solenoid with clean brake fluid.

Install or Connect

1. New solenoid.
   - Verify that the solenoid lip seal is properly positioned before solenoid is installed in ABS hydraulic modulator (refer to Figure 16).
   - Position solenoid so that its electrical connector will face the same direction as the solenoid that was removed.
   - By hand, press down firmly on solenoid until its flange seats on ABS hydraulic modulator.
2. Torx® head bolts.

Tighten

- Bolts to 4.5 N.m (40 lb. in.).

3. Solenoid electrical connector to solenoid.

Important

- Make sure the solenoid connectors are installed on correct solenoids.
- It is necessary to bleed the entire system. Refer to "Bleeding System" in this section.

ABS HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY

Figure 14

CAUTION: To help avoid personal injury, due to a retained load on the ABS hydraulic modulator, the gear tension relief function of the Tech 1 must be performed prior to the removal of the ABS hydraulic modulator.

Remove or Disconnect

1. Using Tech 1, perform "Gear Tension Relief Sequence," as outlined in this section.

2. Air cleaner duct assembly.
3. Two solenoid electrical connectors.
4. Brake pressure differential warning switch electrical connector.
5. 6-pin motor pack electrical connector.
6. Five brake pipes (two to master cylinder, two to wheel brakes, one to TCS modulator).
   - Place shop cloth on top of motor pack to catch any dripping fluid. Take care not to allow any brake fluid to enter the bottom of the motor pack or the electrical connectors. Plug open brake pipes to prevent fluid loss and contamination.
7. Bolt attaching front of ABS hydraulic modulator/motor pack assembly to frame rail.
8. ABS hydraulic modulator/motor pack assembly from vehicle.

Install or Connect

1. ABS hydraulic modulator/motor pack assembly in vehicle.
2. Bolt attaching ABS hydraulic modulator/motor pack assembly to frame rail.

Tighten

- Bolt to 9.0 N.m (80 lb. in.).

3. Five brake pipes to ABS hydraulic modulator/motor pack assembly.
4. 6-pin motor pack electrical connector.
5. Brake pressure differential warning switch electrical connector.
6. Two solenoid electrical connectors.
7. Air cleaner duct assembly.

Important

- Bleed entire brake system as outlines in "Bleeding System" in this section.

Tighten

- Two brake combination valve tube nuts to 18 N.m (13 lb. ft.).
- Three hydraulic modulator tube nuts to 32 N.m (24 lb. ft.).

TCS HYDRAULIC MODULATOR/MOTOR PACK ASSEMBLY

Remove or Disconnect

1. 4-pin motor pack electrical connector.
2. Three brake pipes (one to ABS hydraulic modulator, two to wheel brakes).
   - Place shop cloth on top of motor pack to catch any dripping fluid. Take care not to allow any brake fluid to enter the bottom of the motor pack or the electrical connectors. Plug open brake pipes to prevent fluid loss and contamination.
3. Bolt attaching front of the TCS hydraulic modulator/motor pack assembly to mounting bracket.
4. TCS hydraulic modulator/motor pack assembly from vehicle.

Install or Connect

1. TCS hydraulic modulator/motor pack assembly in vehicle.
2. Bolt attaching the TCS hydraulic modulator/motor pack assembly to mounting bracket.

Tighten

- Bolt to 9.0 N.m (80 lb. in.).

3. Three brake pipes to hydraulic modulator/motor pack assembly.
4. 4-pin motor pack electrical connector.

Important

- Bleed entire brake system as outlined in "Bleeding System" in this section.

ELECTRONIC BRAKE TRACTION CONTROL MODULE (EBTCM)

Figure 19

Remove or Disconnect

1. Fasteners on lower sound insulator panel under steering column.
2. Lower sound insulator panel from vehicle.
3. Manual transmission only: left side kick panel.
4. Nut attaching EBTCM bracket to upper I/P.
5. Push in retainer ("Christmas Tree") attaching EBTCM bracket to sidewall.

Important

- It will be necessary to cut the push in retainer head off to remove EBTCM bracket. Do not attempt to pry fastener out as damage to the EBTCM bracket may result.

6. EBTCM and EBTCM bracket from mounting place.
7. EBTCM electrical connectors.
8. EBTCM from vehicle.
9. Remaining portion of push in retainer.

Important

- It is necessary to remove the destroyed retainer to insure proper retaining force when installing the new push in retainer.

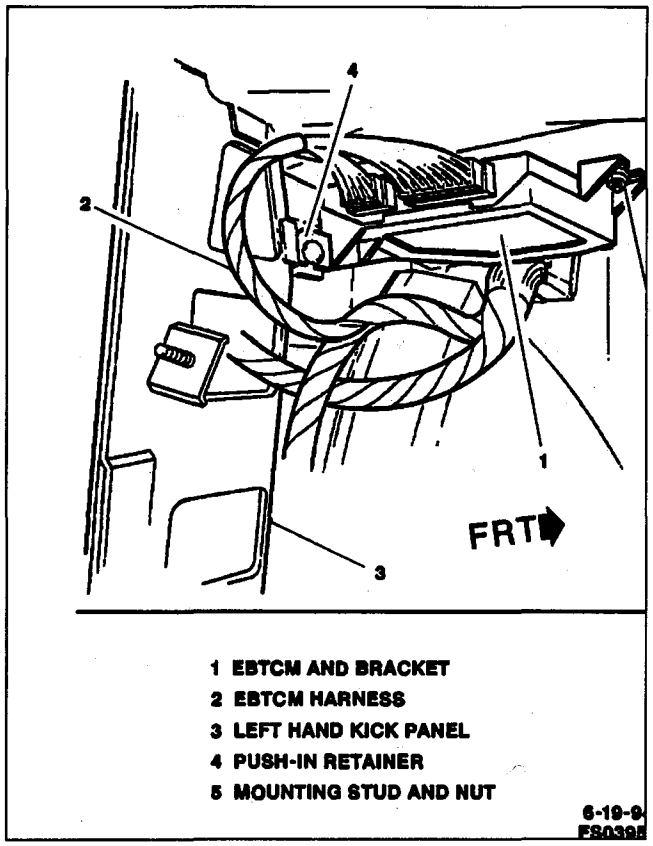


Figure 19 - EBTCM Location

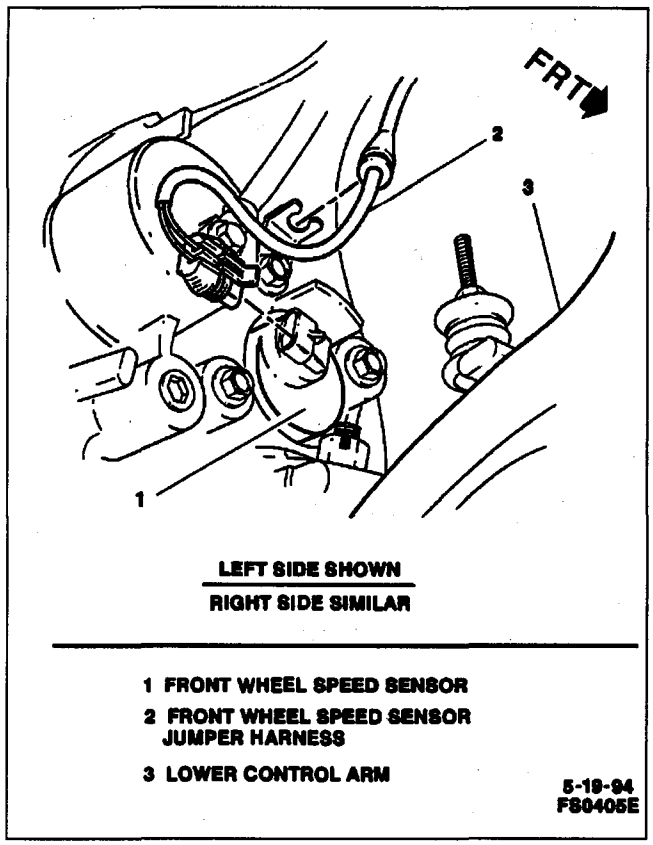


Figure 20 - Front Wheel Bearing and Speed Sensor Assembly

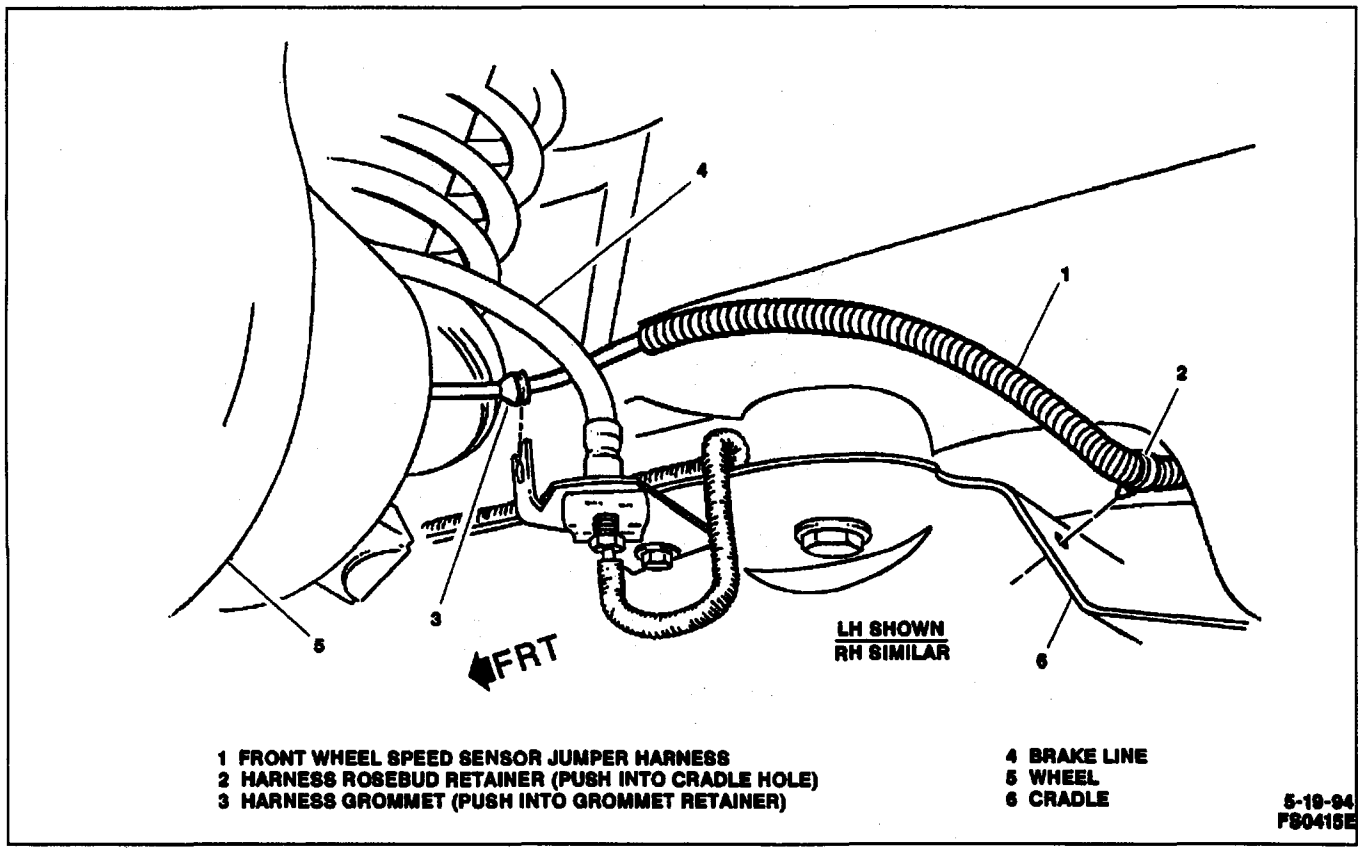


Figure 21 - Front Wheel Speed Sensor Jumper Harness

Install or Connect

1. EBTCM electrical connectors.
2. EBTCM and EBTCM bracket into mounting location.
3. New push in retainer ("Christmas Tree") attaching EBTCM bracket to sidewall.
4. Nut attaching EBTCM bracket to upper I/P.

Tighten

- Nut to 25.0 N.m (18.5 lb. ft.).

5. Manual transmission only: left side kick panel.
6. Lower sound insulator panel and fasteners.

ADJUSTER ASSEMBLY

Figures 22, 23, 24

Remove or Disconnect

1. Two piece cover from adjuster assembly.
2. Cover from throttle body.
3. Accelerator cable from throttle body.
4. Cables from adjuster assembly (3).
5. Adjuster assembly electrical connector.
6. Nuts attaching adjuster assembly to bracket (2).

Install or Connect

1. Nuts attaching adjuster assembly to bracket (2).
2. Adjuster assembly electrical connector.
3. Cables to the adjuster assembly.
4. Accelerator cable to throttle body.
5. All covers on throttle body and adjuster assembly.
6. Perform adjuster assembly procedure.

ADJUSTER ASSEMBLY CABLE ADJUSTMENT PROCEDURE

Adjuster Assembly Replacement

Figures 22, 23, 24

Important

- The adjuster assembly cable must always be adjusted each time the adjuster assembly is removed and/or replaced to ensure optimum system performance. See this section for adjustment procedure.

Remove or Disconnect

1. Adjuster assembly splash cover.
2. Cable cam cover.
3. Throttle body lever shield attaching screw and shield.
4. Throttle body cable from throttle body lever.

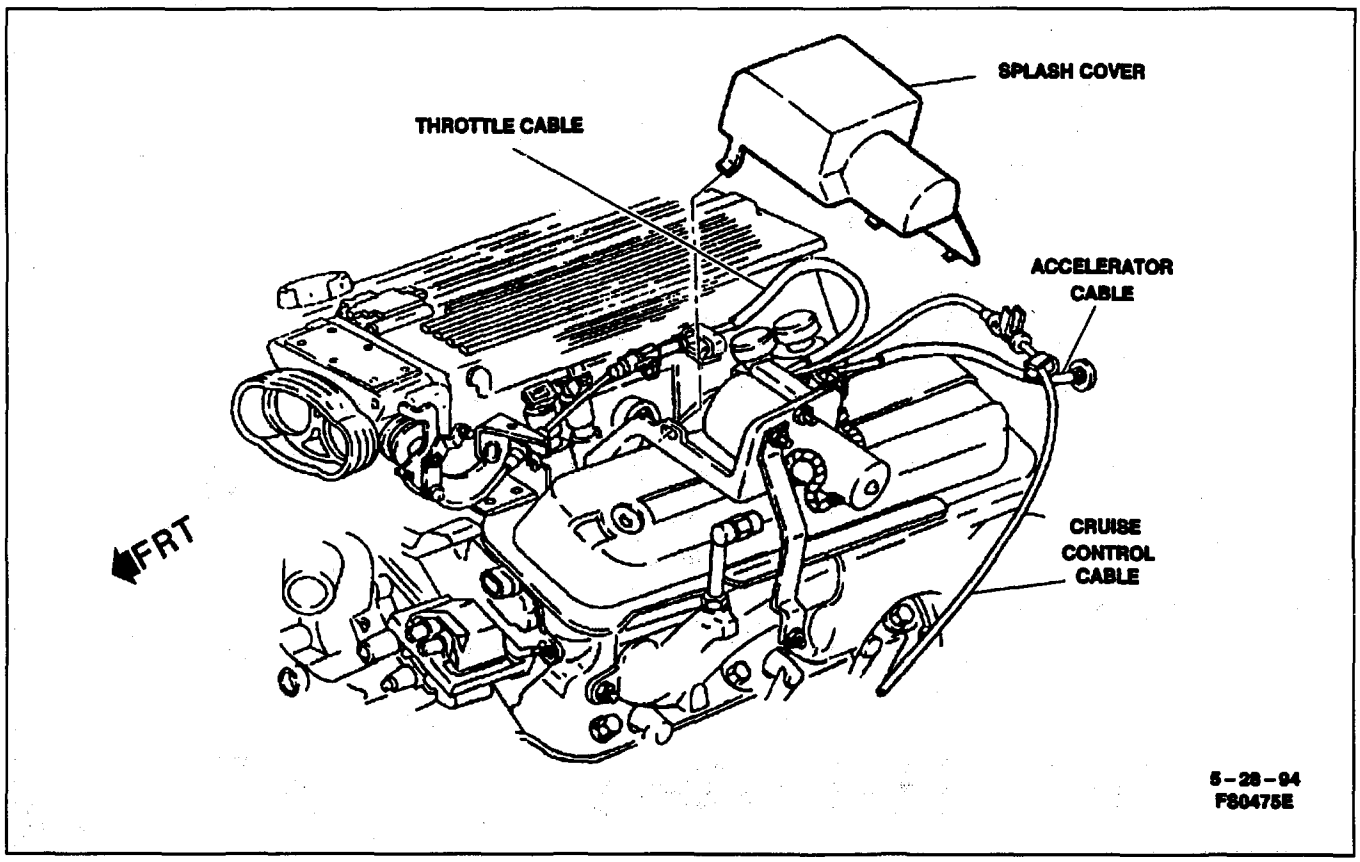


Figure 22 - Adjuster Assembly Splash Cover

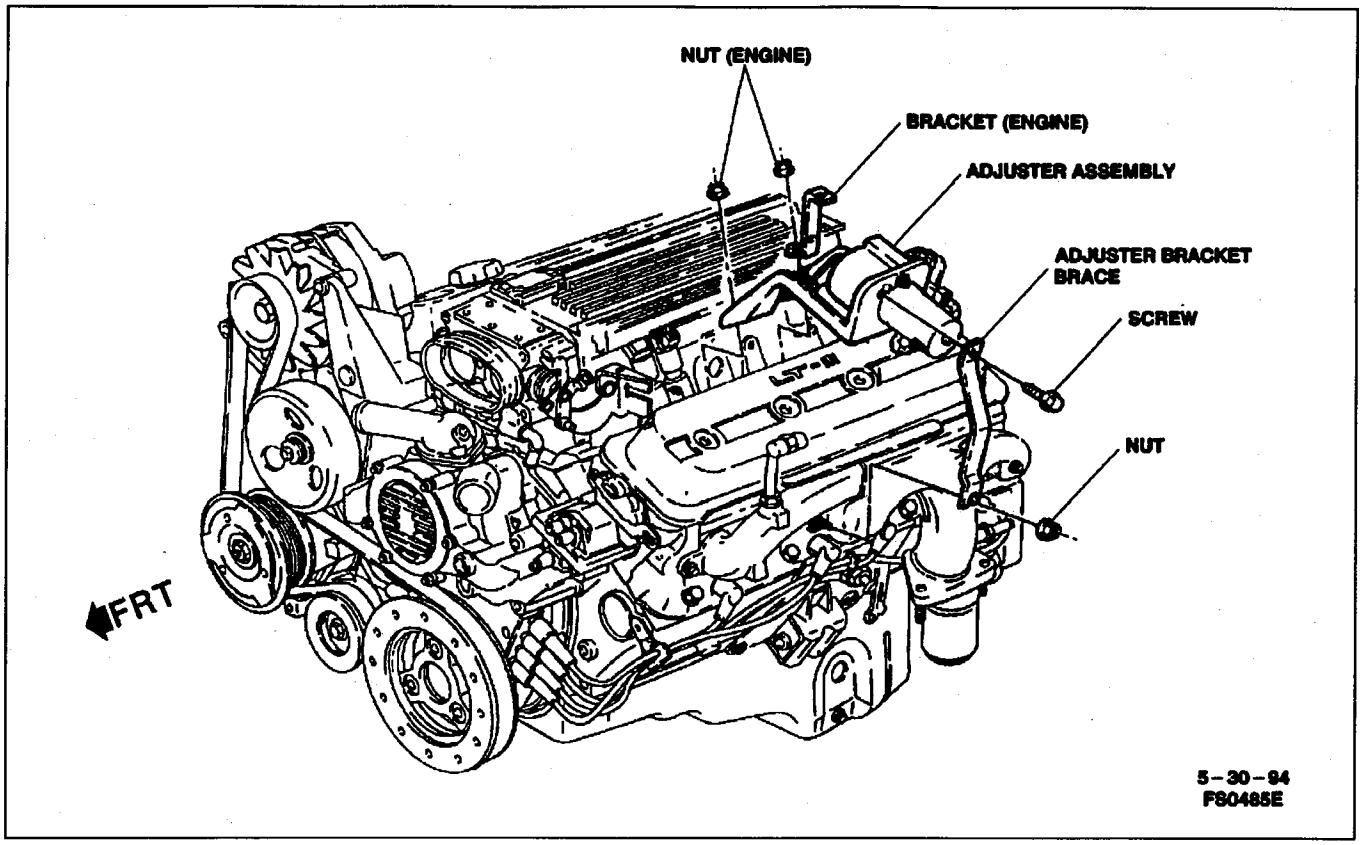


Figure 23 - Adjuster Assembly - Accelerator and Cruise Control

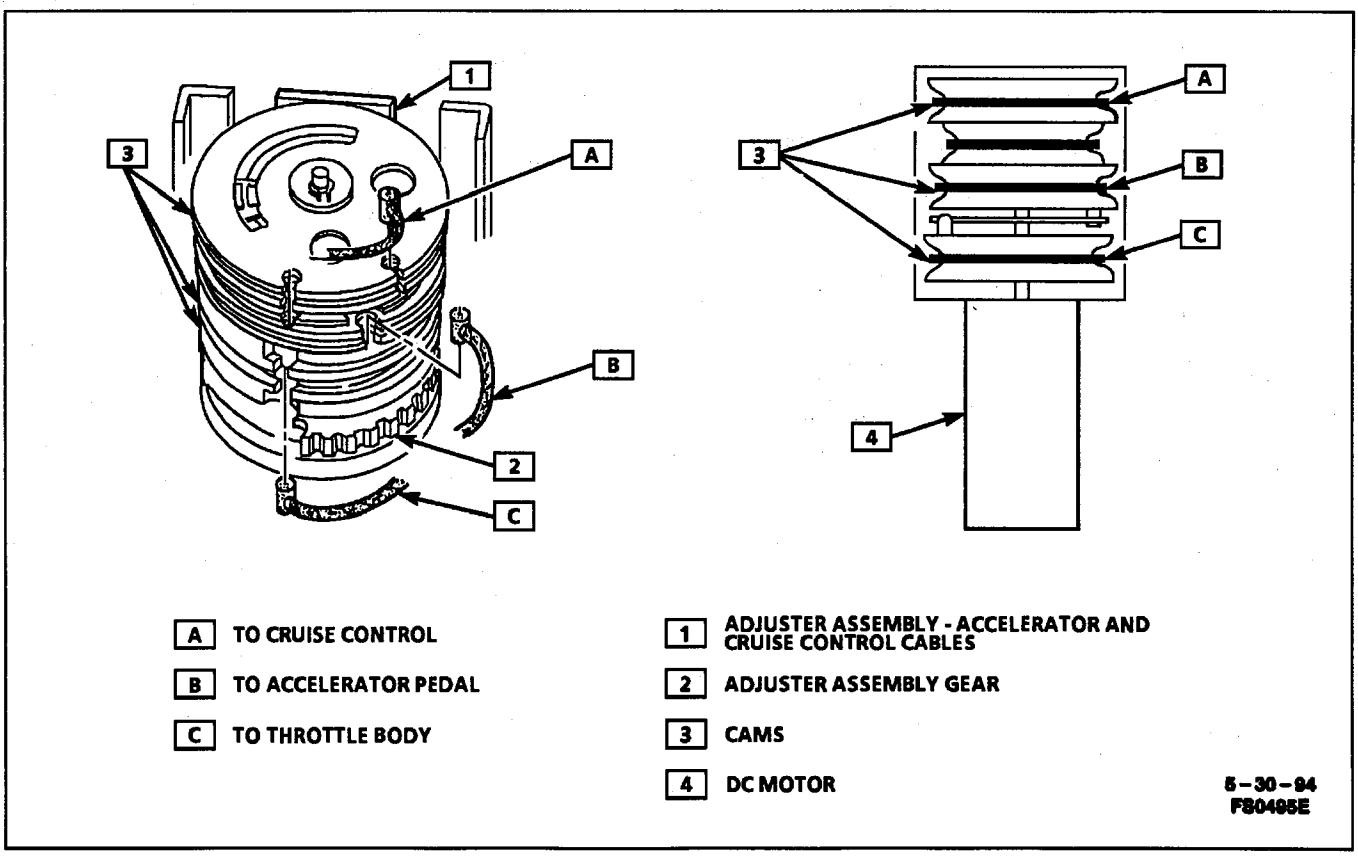


Figure 24 - Adjuster Assembly Cable Locations

5. Adjuster assembly electrical connector.
6. Nuts attaching adjuster assembly to bracket (2).
7. Cables from adjuster assembly.
8. Adjuster assembly.

Install or Connect

1. Position adjuster assembly near mounting bracket.
2. Cables on adjuster assembly.
3. Adjuster assembly to mounting bracket.
4. Adjuster assembly attaching nuts.

Tighten

- Adjuster assembly attaching nuts to 25 N.m (18 lb. ft.).

5. Adjuster assembly electrical connector.
6. Throttle body cable to throttle body lever.

Adjust

- Adjuster assembly cables. Refer to the adjustment procedure in this section.

7. Cable cam cover.
8. Adjuster assembly splash cover.
9. Throttle body lever shield and attaching screw.

Tighten

- Throttle body lever shield and attaching screw to 2 N.m (18 lb. in.).

Important

- Adjuster assembly cable locations (Figure 24):
  - — Throttle body to adjuster assembly cable on cam closest to adjuster assembly DC motor.
  - — Accelerator pedal to adjuster assembly cable on middle cam.
  - — Cruise module to adjuster assembly cable on cam farthest from adjuster assembly DC motor.

ADJUSTMENT PROCEDURE - THROTTLE BODY AND CRUISE CONTROL CABLES

Figures 25, 26, 27

Throttle body, accelerator pedal control, and cruise control cables must be fully installed before making adjustments.

Adjust

- Throttle body cable.
  1. Remove throttle body lever cover.
  2. Unlock throttle body cable and cruise control cable adjusters by pulling up locking tabs (Figure 26).
  3. Hold throttle body lever firmly at stop/idle position.
  4. Pull throttle body cable assembly just rearward of the adjuster lock to remove slack from cable.

Important

- Do not disturb cable after removing slack.

  5. Lock throttle body cable adjuster by pushing tab down.

Important

- The clip that is part of the cruise control cable assembly that gets attached to the brake booster should not be installed until after the adjustment is made.

  6. Hold throttle body lever firmly at stop/idle position.
  7. Pull cruise control cable assembly just rearward of the adjuster lock (between lock assembly and cruise control module) to remove slack from cable.

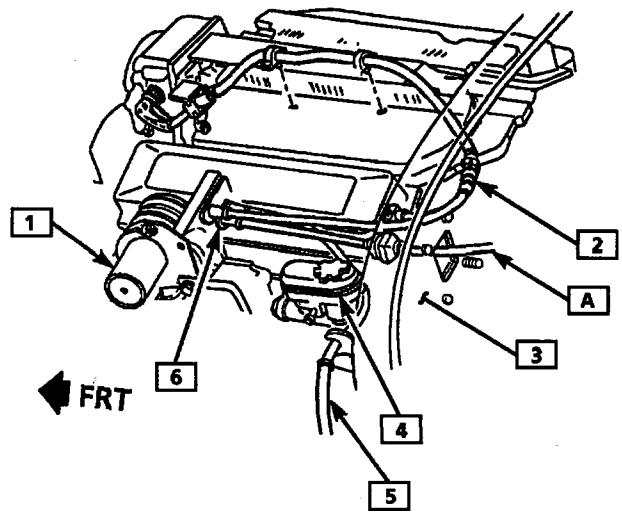
Important

- Do not disturb cable after removing slack.

  8. Lock cruise control cable adjuster by pushing tab down.
  9. Check that throttle body lever returns fully to stop/idle position. If throttle body lever does not return to stop/idle position repeat procedure.
  10. Install throttle body lever cover and screw.
  11. Attach cruise control cable clip to brake booster.

Important

- Cables should never be adjusted so tight that tension from cable will not allow throttle to close solidly. If cable is adjusted too tight, the cable will prevent engine from returning to idle and will cause unstable idle quality.
- Using a Tech 1 with a mass storage cartridge, check throttle angle percentage by depressing the accelerator pedal. When accelerator pedal is fully depressed, throttle opening should be 100%. When the accelerator pedal is released, throttle opening should return to 0%. If proper results are not obtained, check cables for kinks or damage and repeat procedure.



1 ADJUSTER ASSEMBLY
2 THROTTLE BODY CABLE ADJUSTER
3 DASH PANEL
4 MASTER CYLINER
5 CRUISE CONTROL CABLE
6 ACCELERATOR PEDAL AND CRUISE CONTROL CABLE ASSEMBLY
A TO ACCELERATOR PEDAL

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Figure 25 - Adjuster Assembly Cable Routing

THROTTLE BODY CABLE REPLACEMENT

Figures 25, 26, 27

Important

- The adjuster assembly adjustment procedure outlined in this section must be followed each time the throttle body cable is removed and replaced to ensure optimum system performance.

Remove or Disconnect

1. Throttle body cable routing clips.
2. Throttle body lever shield attaching screw and shield.
3. Cable from throttle body.
4. Adjuster assembly splash cover.
5. Adjuster assembly cable cam cover.
6. Cable from adjuster assembly.

Install or Connect

1. Throttle body cable to adjuster assembly.
2. Accelerator cable routing clips.
3. Cable to throttle body.

Adjust

- Accelerator and cruise control cables. Refer to "Adjustment Procedure - Adjuster Assembly -Accelerator and Cruise Control Cables" in this section.

4. Adjuster assembly cable cam cover.
5. Adjuster assembly splash cover.
6. Throttle body lever shield and attaching screw at throttle body.

Tighten

- Throttle body lever shield attaching screw to 2.0 N·m (18 lb. in.).

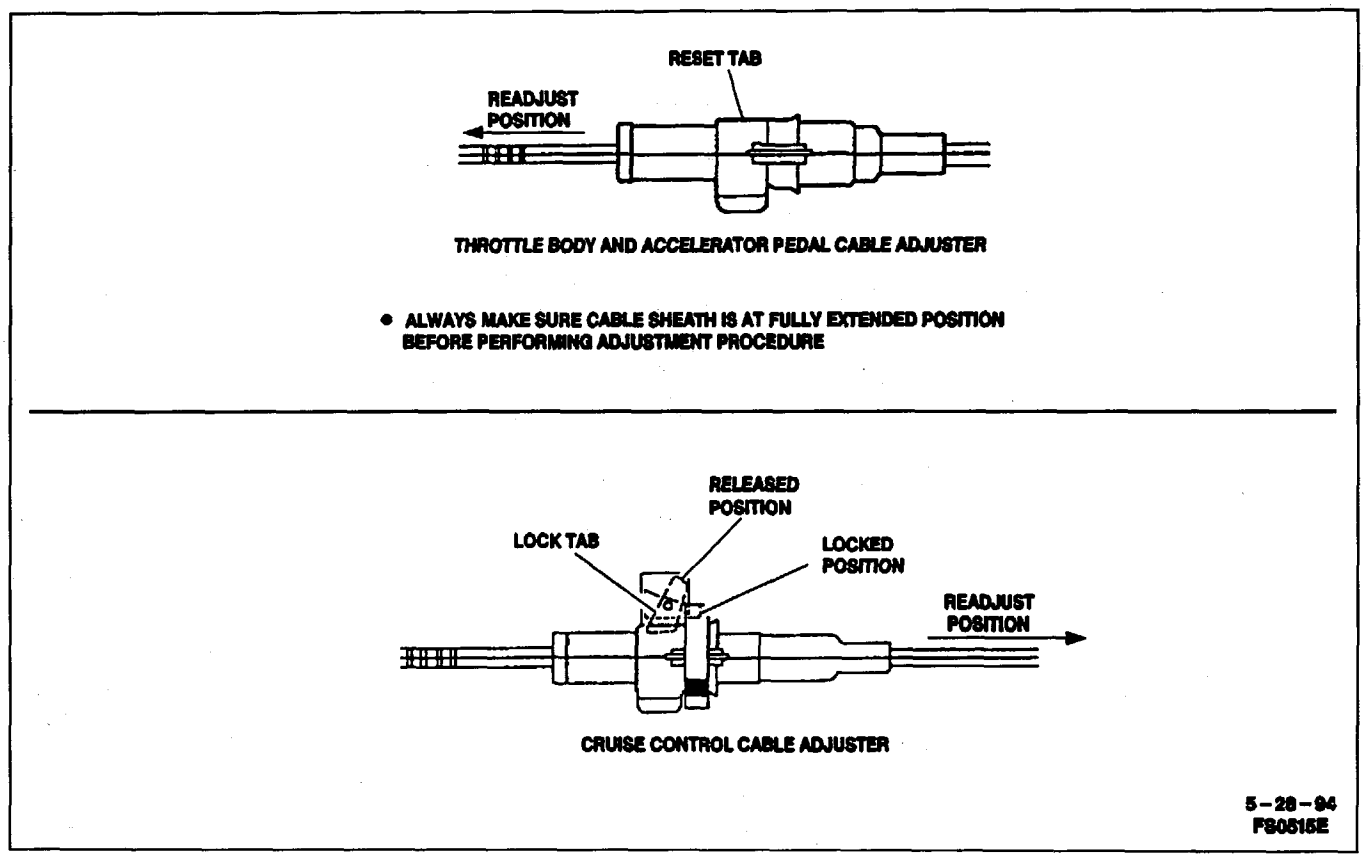


Figure 26 - Cable Adjustment Mechanisms

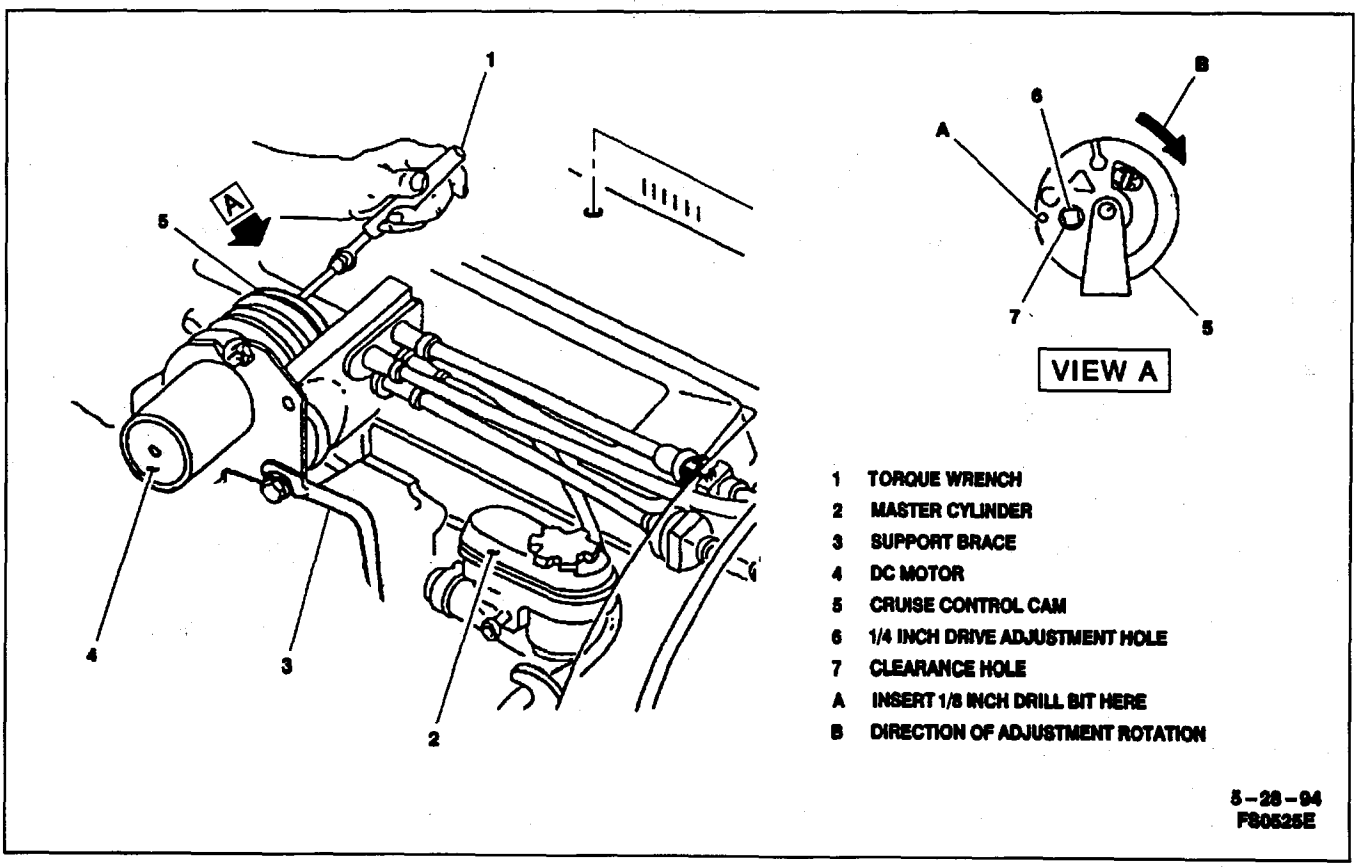


Figure 27 - Adjusting Cables

ACCELERATOR PEDAL CABLE AND CRUISE CONTROL CABLE REPLACEMENT

Figures 25, 26, 27

Important

- The adjuster assembly adjustment procedure outlined in this section must be followed each time the accelerator and cruise control cables are removed and/or replaced to ensure optimum system performance.

Remove or Disconnect

1. Lower instrument panel trim.
2. Sound insulator.
3. Accelerator cable from accelerator pedal assembly.
4. Adjuster assembly splash cover.
5. Adjuster assembly cam cover.
6. Cruise control and accelerator pedal cables from adjuster assembly.
7. Accelerator cable from dash panel by using a small flat blade screwdriver. Depress each tang with the tip of the screwdriver to release.
8. Cruise control cable from cruise control module. Refer to SECTION 9B.

Install or Connect

1. Accelerator and cruise control cables to adjuster assembly.
2. Push accelerator cable tangs into dash panel.
3. Accelerator cable to accelerator pedal.
4. Cruise control cable to cruise control module.

Adjust

- Accelerator and cruise control cables. Refer to "Adjustment Procedure - Adjuster Assembly Accelerator and Cruise Control Cables" in this section.

5. Cable cam cover to adjuster assembly.
6. Adjuster assembly splash cover.
7. Sound insulator.
8. Lower instrument panel trim.

ACCELERATOR PEDAL REPLACEMENT

Figure 28

Remove or Disconnect

1. Lower instrument panel trim.
2. Sound insulator.
3. Accelerator cable from accelerator pedal.
4. Accelerator pedal attaching nut.
5. Accelerator pedal stop attaching bolt and accelerator pedal stop.
6. Accelerator pedal.

Install or Connect

Important

- The mounting surface between support and dash panel must be free of insulation. The carpet and padding in the pedal and tunnel area must be positioned to lay flat and be free of wrinkles and bunches.

1. Accelerator pedal and attaching nut.
2. Accelerator pedal stop and attaching bolt.

Tighten

- Accelerator pedal stop and attaching nut and bolt to 25 N.m (18 lb. ft.).

3. Accelerator cable on accelerator pedal.

Inspect

- Check for complete throttle opening and closing positions by operating accelerator pedal. Also check for poor carpet fit under the accelerator pedal.
- Throttle should operate freely without bind between full closed and wide open throttle.

4. Sound insulator.
5. Lower instrument panel trim.

FRONT WHEEL BEARING AND SPEED SENSOR ASSEMBLY

Figure 20

Important

- The front wheel speed sensors and rings are integral with the hub and bearing assemblies. Should a speed sensor or ring require replacement, the entire hub and bearing assembly must be replaced. Refer to SECTION 3C.

FRONT WHEEL SPEED SENSOR JUMPER HARNESS

Figure 21

Raise and support vehicle on a suitable hoist as indicated in SECTION 0A.

Remove or Disconnect

1. Connector from wheel speed sensor.
2. Harness from retaining clips.
3. Harness grommets from retainers.
4. Upper jumper harness connector attached to inside of frame rail.

Install or Connect

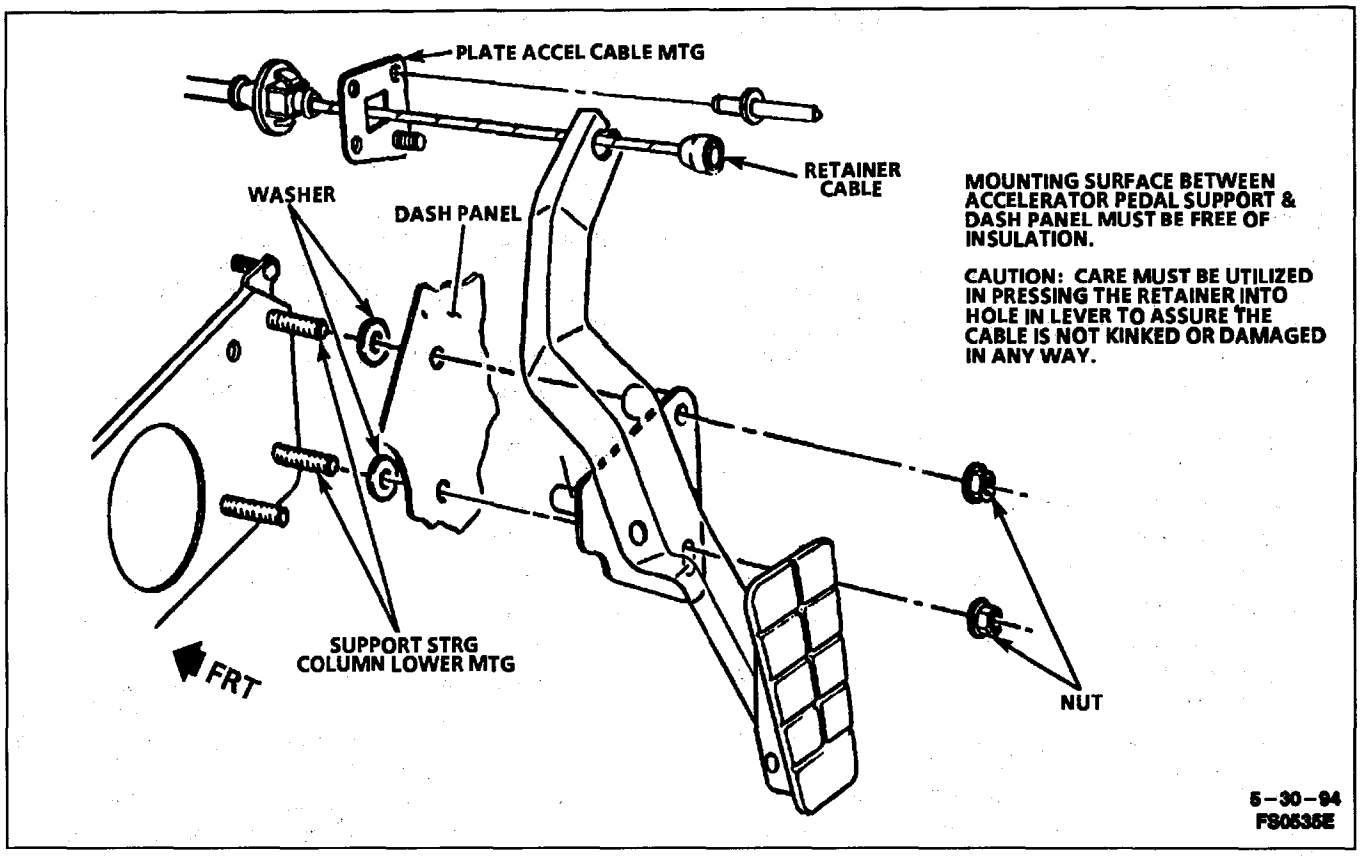


Figure 28 - Accelerator Control - Passenger Compartment

1. Upper jumper harness connector attached to inside of frame rail.
2. Harness to retaining clips.
3. Harness rubber grommets into retainers.
4. Connector to wheel speed sensor.

REAR WHEEL SPEED SENSOR

Figure 29

Raise and support vehicle on a suitable hoist as indicated in SECTION 0A.

Remove or Disconnect

1. Connector from wheel speed sensor.
2. Bolt attaching sensor to backing plate.
3. Sensor from backing plate.

Install or Connect

1. Sensor into backing plate.
2. Bolt attaching sensor to backing plate.

Tighten

- Bolt to 10 N.m (89 lb. in.).

3. Connector to wheel speed sensor.

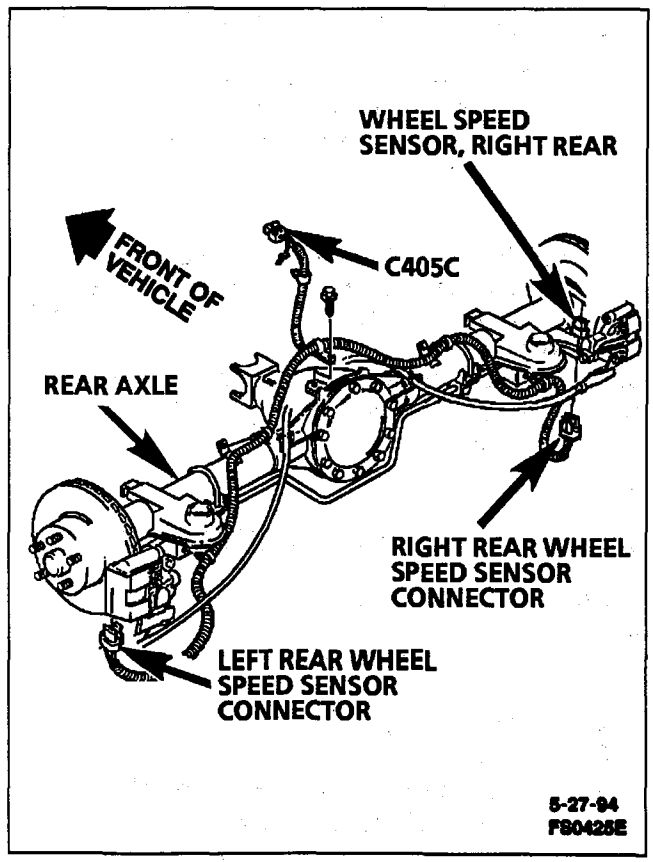


Figure 29 - Rear Wheel Speed Sensors

REAR WHEEL SPEED SENSOR TOOTHED RINGS

Important

- The rear wheel speed sensor toothed rings are an integral part of the rear axle shafts. If it has been determined that the toothed rings must be replaced, refer to SECTION 4B for removal and installation procedures.

REAR WHEEL SPEED SENSOR JUMPER HARNESS

Remove or Disconnect

1. Connector from wheel speed sensors.
2. Jumper harness grommet from retainer.
3. Upper jumper harness connector from rear body pass-thru connector.

Install or Connect

1. Upper jumper harness connector to rear body pass-thru connector.
2. Connector to wheel speed sensors.
3. Jumper harness grommet into retainer.

ABS RELAY

Figure 30

Remove or Disconnect

1. ABS relay cover.
2. ABS relay from connector.

Install or Connect

1. ABS relay to connector.
2. ABS relay cover.

ASR/TCS RELAY

Figure 30

Remove or Disconnect

1. ASR/TCS relay cover.
2. ASR/TCS relay from connector.

Install or Connect

1. ASR/TCS relay to connector.
2. ASR/TCS relay cover.

BRAKE COMBINATION VALVE

Refer to SECTION 5A.

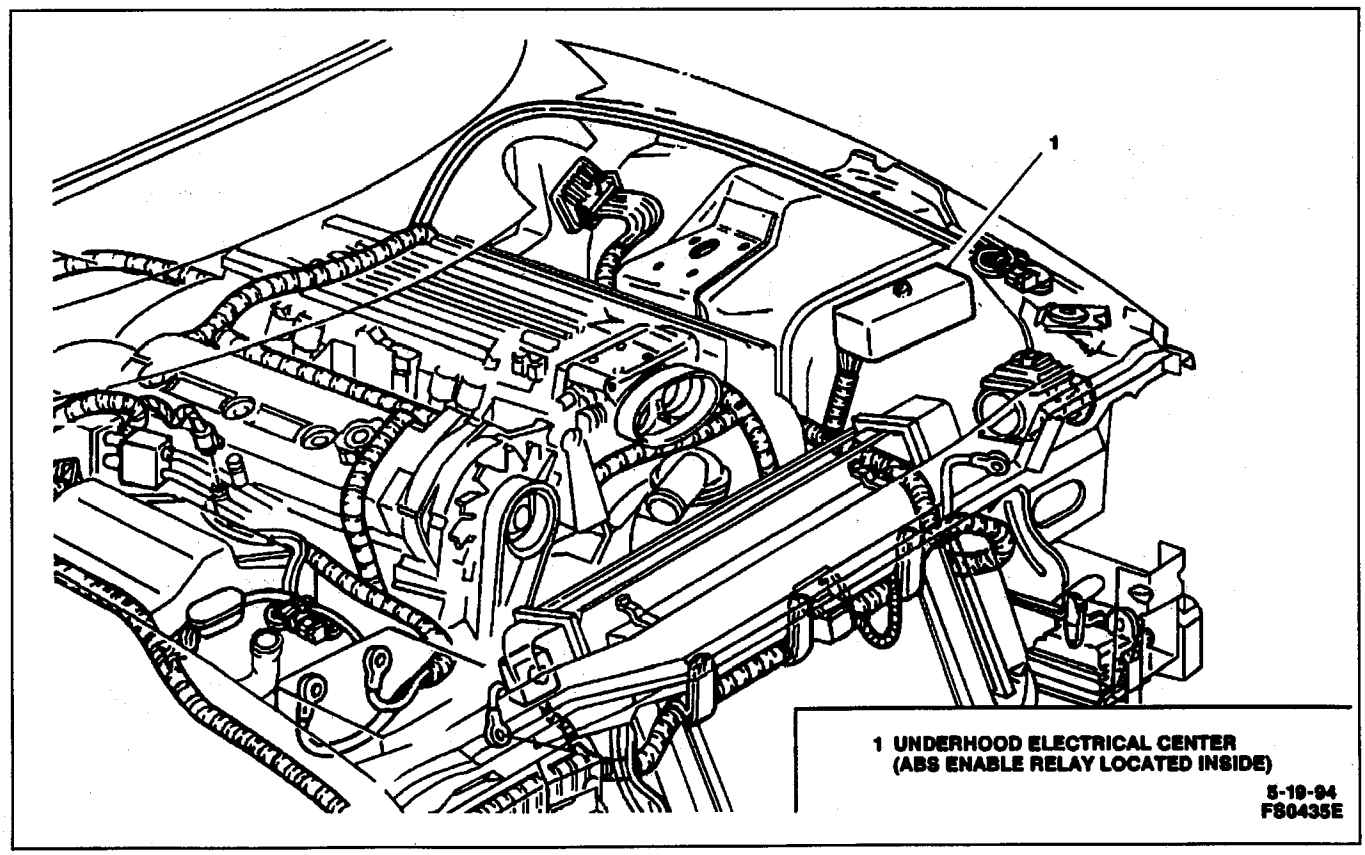


Figure 30 - ABS and AST/TCS Relays Location

WARNING/INDICATOR LAMPS

Refer to SECTION 8C for replacement procedures and detailed information.

ELECTRICAL CONNECTORS

Figure 31

Some ABS VI/TCS components are equipped with electrical connectors using a Connector Position Assurance (CPA) lock. This feature insures that when the connectors are installed they are aligned properly and connected securely.

Important

- Remove the lock before separating the electrical connectors.
- Take care not to damage the locking pin during removal.
- Make sure that the rubber connector seal is in place on the connector before and after connection.
- Always install the lock after the connection is made.

FUSE AND FUSIBLE LINKS

Refer to SECTION 8A-11 for repair or replacement information.

UNIT REPAIR

CAUTION: To help avoid personal injury, due to a retained load on the ABS hydraulic modulator/motor pack assembly, the gear tension relief function of the Tech 1 must be performed prior to removal of the ABS hydraulic modulator/motor pack assembly.

NOTICE: The following service procedures shall be performed only after the ABS and TCS hydraulic modulator/motor pack assemblies have been removed from the vehicle. Do not perform these procedures with the unit installed on the vehicle. Complete overhaul of the ABS and TCS hydraulic modulator/motor pack assemblies are not authorized - only the following steps. These steps will break the unit down into major components for replacement purposes.

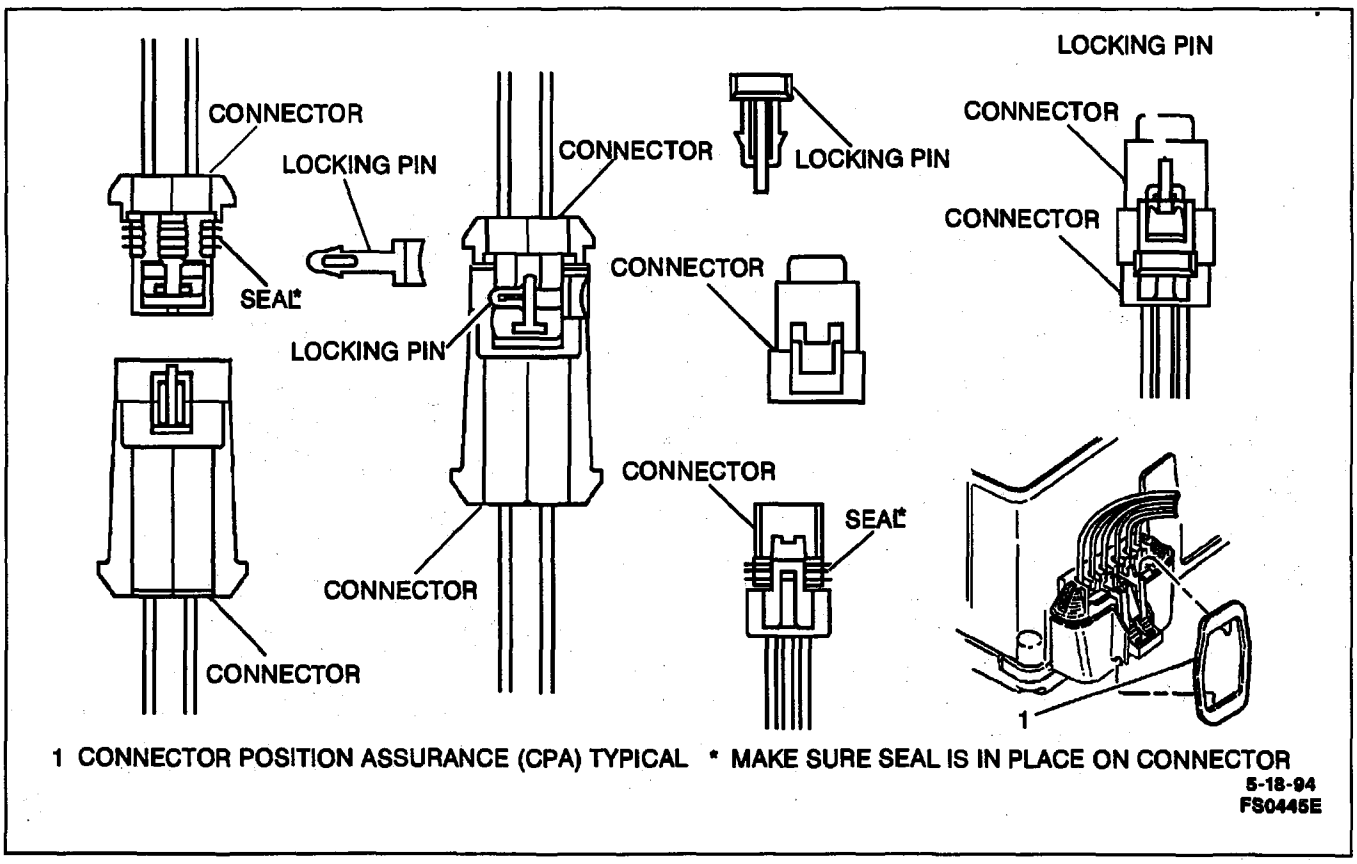


Figure 31 - ABS VI/TCS Electrical Connectors (Typical)

GEAR COVER (ABS/TCS)

Figure 32

Disassemble

1. Torx® head screws attaching gear cover.
2. Remove gear cover.

Assemble

1. Gear cover to hydraulic modulator/motor pack assembly.
2. Torx® head screws.

Tighten

- Torx® bolts to 4 N·m (35 lb. in.).

MOTOR PACK (ABS/TCS)

Figure 32

Disassemble

1. Remove gear cover.
2. Torx® head screws attaching motor pack.

Important

- Use care when handling motor pack to ensure motor pack connector is not damaged, or accidental intrusion of brake fluid into the motor pack does not occur. This may result in a premature failure of the motor pack.
- Take care in handling the motor pack. If dropped or damaged during handling, the motor pack must be replaced.

3. Remove motor pack.

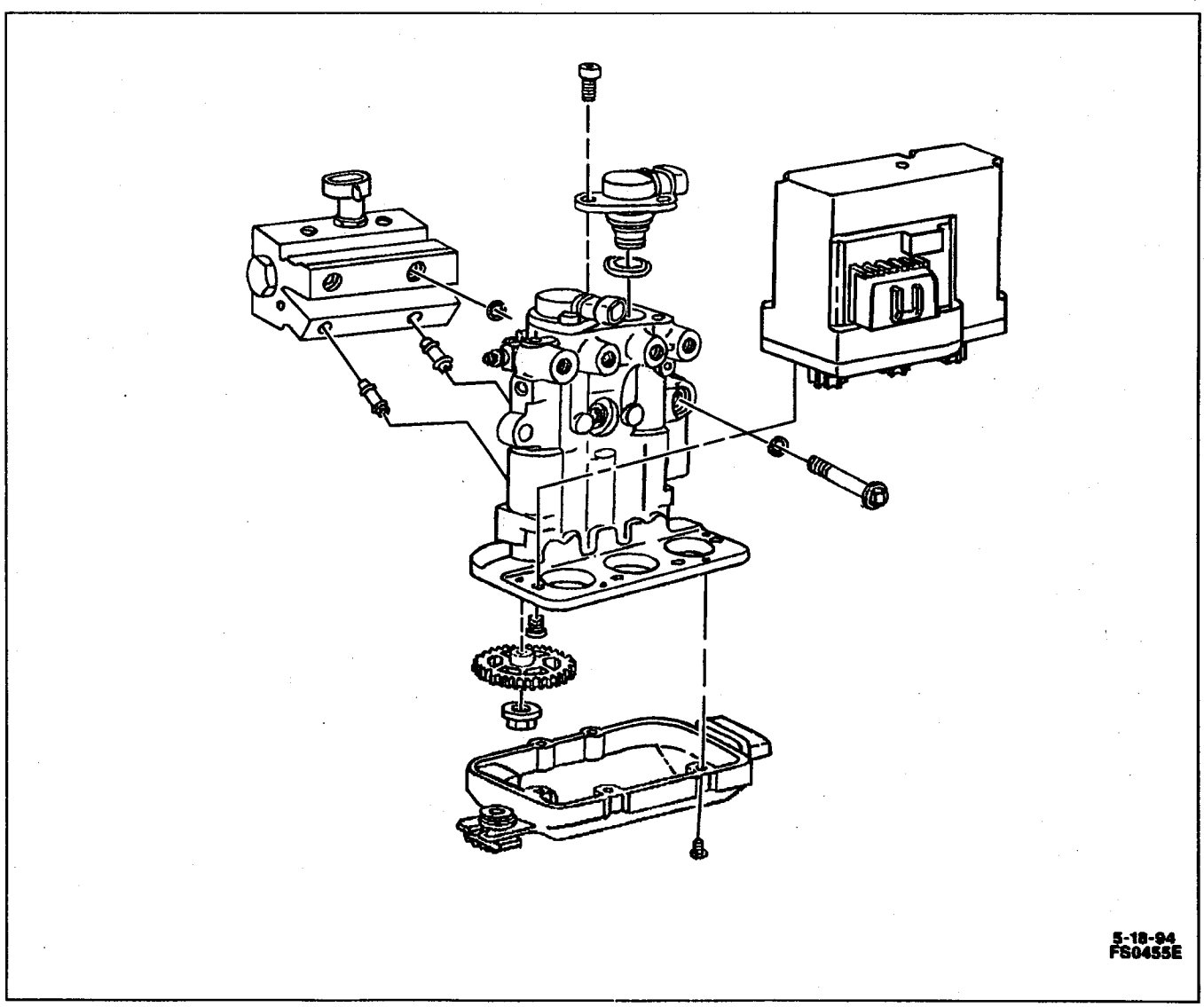


Figure 32 - ABS Hydraulic Modulator Components

Important

- If disassembly of the hydraulic modulator/motor pack assembly was due to a ABS or TCS hydraulic functional test that did not pass, the "Automated Motor Pack Diagnosis Test" described in this section should be performed at this time to isolate the motor pack or hydraulic modulator.
- No repair of the motor pack is authorized. Replace as an assembly.

Assemble

1. With the hydraulic modulator upside down, and the gears facing you, rotate each hydraulic modulator gear counterclockwise until movement stops. This procedure will position the pistons very close to their "home" position of the modulator bore, simplifying the brake bleeding procedure (refer to Figure 14).
2. Motor pack to hydraulic modulator.

Important

- Take care in handling the motor pack. If dropped or damaged during handling the motor pack must be replaced.
- Align each of the three ABS motor pack pinions (two on TCS) with the hydraulic modulator gears.

3. Torx® head screws.

Tighten

- Torx® head screws to 4.5 N.m (40 lb. in.).

4. Gear cover to hydraulic modulator/motor pack assembly.

GEAR REPLACEMENT (Typical)

Figures 15 and 16

Important

- Do not attempt to repair damaged motor packs or hydraulic modulators. Other than modulator drive gear replacement, repair of these assemblies is not authorized. Do not lubricate or oil gears on motor pack.

CAUTION: The modulator drive gears are under spring load and will turn during disassembly. After removing hydraulic modulator drive gear cover, exercise extreme care not to place fingers into the gear set, since fingers can be pinched by rotating gears.

Disassemble

1. Hydraulic modulator. Refer to "Hydraulic Modulator" in this section.
2. Torx® head screws attaching gear cover.
3. Motor pack to hydraulic modulator Torx® head screws.

Important

- Take care in handling the motor pack. If dropped or damaged in the handling, the motor pack must be replaced.

4. Separate motor pack from hydraulic modulator.
5. Three ABS modulator drive gears (two on TCS) to modulator drive shaft retaining nuts.
6. Gears from modulator (refer to Figure 13).

NOTICE: Do not allow gear to turn while removing the retaining nut, since the modulator piston can hit the top of the modulator bore, damaging the piston. Turn the modulator gear to position the piston in the center of its travel. Place a screwdriver through the holes in the gears (not between the gears) into the recessed hole in the modulator base. This will prevent the gear from turning, aiding in gear removal.

NOTICE: Do not allow gear to turn while tightening the retaining nut, since the modulator piston can bottom out in the modulator bore damaging the piston. Turn the modulator gear to position the piston in the center of its travel. Place a screwdriver through the holes in the gears (not between the gears) into the recessed hole in the modulator base. This will prevent the gear from turning, aiding in gear installation (refer to Figure 13).

Assemble

1. Position hydraulic modulator drive gears onto hydraulic modulator drive shaft.
2. Three ABS (two on TCS) gear retaining nuts.

Tighten

- Nuts to 8.5 N.m (76 lb. in.).

3. With the hydraulic modulator upside down, and the gears facing you, rotate each hydraulic modulator gear counterclockwise until movement stops. This procedure will position the pistons very close to their "home" position of the hydraulic modulator bore, simplifying the brake bleeding procedure (refer to Figure 14).
4. Position motor pack onto hydraulic modulator, aligning the three ABS motor pack gears (two on TCS) with the modulator gears.

Important

- Take care in handling the motor pack. If dropped or damaged during handling, the motor pack must be replaced.

5. Motor pack to hydraulic modulator Torx® head screws.

Tighten

- Torx® head screws 4.5 N.m (40 lb. in.).

6. Gear cover onto hydraulic modulator with Torx® head screws.

Tighten

- Torx® head screws to 4 N.m (35 lb. in.).

7. Hydraulic modulator. Refer to "Hydraulic Modulator" in this section.

ABS HYDRAULIC MODULATOR

Figure 32

Disassemble

1. Remove gear cover. Refer to "Gear Cover" in this section.
2. Remove motor pack. Refer to "Motor Pack" in this section.
3. Two hydraulic modulator to brake combo valve banjo bolts; separate hydraulic modulator from brake combo valve.
4. Two transfer tubes with O-rings from brake combo valve or hydraulic modulator.
5. Banjo bolt O-rings from brake combo valve and hydraulic modulator.

Important

- If hydraulic modulator is to be replaced, install the three gears in the same location on replacement hydraulic modulator. Refer to "Gear Replacement" in this section.
- No repair of the hydraulic modulator is authorized. Replace as an assembly.
- Refer to SECTION 5A for repair of brake combo valve.
- Use new transfer tube assemblies when assembling the hydraulic modulator/brake combo valve assembly. Make sure two O-rings are properly installed on each transfer tube.

Assemble

1. Two transfer assemblies.
   - Lubricate transfer tube assembly O-rings with clean brake fluid.
   - Install transfer tube assemblies in ports in hydraulic modulator and push in by hand to bottom.
2. Lubricate new banjo bolt O-ring with clean brake fluid and install into the brake combo valve and hydraulic modulator.
3. Hydraulic modulator to brake combo valve.
   - Hold brake combo value and rock into position on hydraulic modulator inserting transfer tube assemblies into brake combo valve ports.
4. Two hydraulic modulator to brake combo valve banjo bolts.

Tighten

- Banjo bolts to 16 N.m (12 lb. ft.).

5. With the hydraulic modulator upside down, and the gears facing you, rotate each hydraulic modulator gear counterclockwise until movement stops. This procedure will position the pistons very close to their "home" position of the modulator bore simplifying the brake bleeding procedure (refer to Figure 14).
6. Motor pack to hydraulic modulator.
7. Gear cover to hydraulic modulator/motor pack assembly.

TCS HYDRAULIC MODULATOR

Disassemble

1. Remove gear cover. Refer to "Gear Cover" in this section.
2. Remove motor pack. Refer to "Motor Pack" in this section.

Important

- If hydraulic modulator is to be replaced, install the two gears in the same location on replacement hydraulic modulator. Refer to "Gear Replacement" in this section.
- No repair of the hydraulic modulator is authorized. Replace as an assembly.

Assemble

1. With the hydraulic modulator upside down, and the gears facing you, rotate each hydraulic modulator gear clockwise until movement stops. This procedure will position the pistons very close to their "home" position of the modulator bore simplifying the brake bleeding procedure (refer to Figure 14).
2. Motor pack to hydraulic modulator.
3. Gear cover to hydraulic modulator/motor pack assembly.

MASTER CYLINDER

Refer to SECTION 5A for repair of master cylinder.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

ABS Hydraulic Modulator Bleeder Valves	9.0 N.m (80 lb. in.)
ABS Hydraulic Modulator Solenoid Torx® Head Bolt	4.5 N.m (40 lb. in.)
Electronic Brake Traction Control Module (EBCM) Nut	25 N.m (18.5 lb. ft.)
ABS Hydraulic Modulator Mounting Bolt	9.0 N.m (80 lb. in.)
TCS Hydraulic Modulator Mounting Bolt	9.0 N.m (80 lb. in.)
Three Hydraulic Modulator Brake Pipe Tube Nuts	32 N.m (24 lb. ft.)
Two Brake Combination Valve Brake Pipe Tube Nuts	18 N.m (13 lb. ft.)
Two Master Cylinder Brake Pipe Tube Nuts	32 N.m (24 lb. ft.)
Modulator Drive Gear Nuts	8.5 N.m (75 lb. in.)
Torx® Head Screws Attaching Gear Cover	4.0 N.m (35 lb. in.)
Torx® Head Screws Attaching Motor Pack	4.5 N.m (40 lb. in.)
Two Banjo Bolts Attaching Brake Combination Valve to ABS Hydraulic Modulator	16 N.m (12 lb. ft.)

SPECIAL TOOLS

Figure 33

The J 39200 High Impedance Multimeter is the only DVM authorized for use in diagnosing and servicing the ABS VI/TCS system.

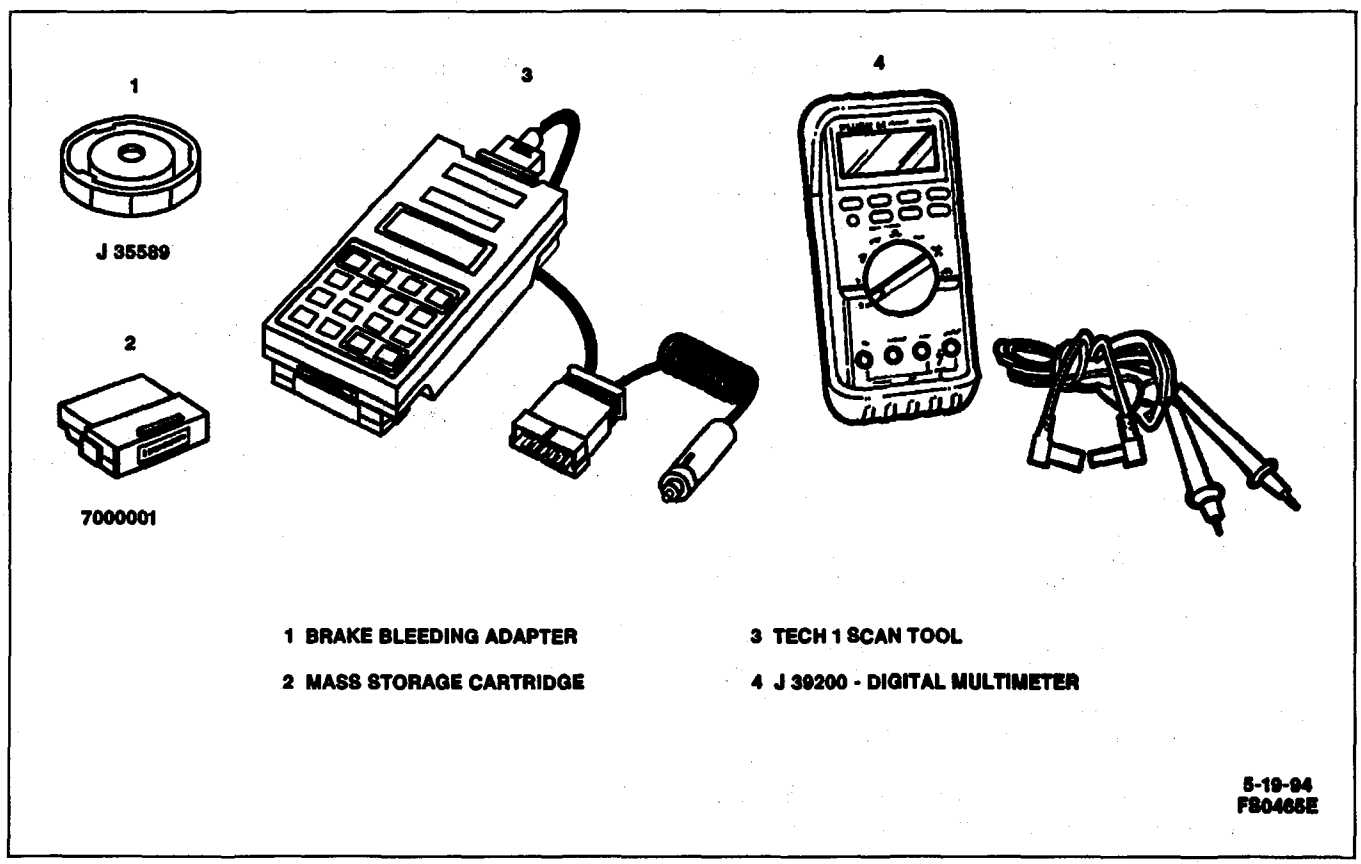


Figure 33 - ABS VI/TCS Special Tools

SECTION 5F

PARKING BRAKE

CAUTION: When servicing brake parts, do not create dust by grinding, sanding brake linings, or by cleaning brake parts with a dry brush or compressed air. Many brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm. A water dampened cloth or water based solution should be used to remove any dust on brake parts. Equipment is commercially available to perform this washing function. These wet methods will prevent asbestos fibers from becoming airborne.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

PARKING BRAKE SYSTEM

The parking brake system allows the rear brake assemblies to be mechanically applied by lifting the parking brake lever assembly. On vehicles with rear drum brakes, this system mechanically forces the rear brake shoes outward, forcing the rear primary and secondary shoes against the brake drum assemblies. On vehicles with rear disc brakes, this system mechanically forces the rear brake inner and outer pad assemblies against the brake rotor assembly.

PARKING BRAKE LEVER ASSEMBLY

This vehicle is equipped with a self-adjusting parking brake lever assembly. This mechanism automatically takes up any slack in the cable assemblies and provides the correct amount of tension in the cable assemblies when the system is engaged. The parking brake cable assemblies cannot be manually adjusted.

When operating correctly, the rear parking brake actuator levers on the rear disc brake caliper assemblies or the rear drum brake assemblies will fully return to their mechanical stops when the parking brake lever assembly is fully released.

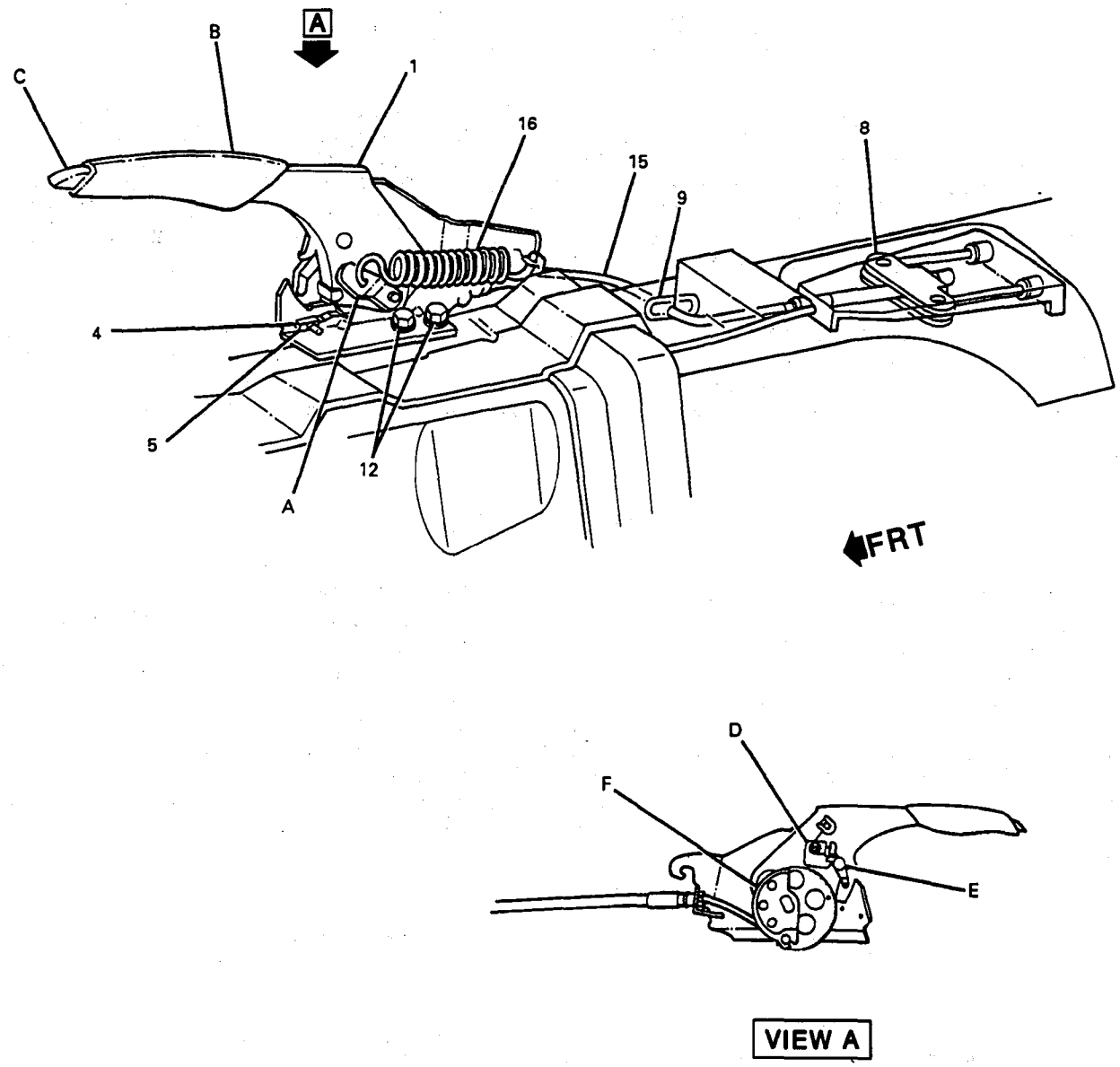
CABLE ASSEMBLIES

Three separate cables are used in the parking brake system. The left and right rear cable assemblies are joined to the front cable assembly at the equalizer, with the rear cable assemblies running to the rear of the vehicle.

This vehicle is equipped with coated parking brake cable assemblies. The wire strand is coated with a plastic material which slides over plastic seals inside the conduit end fittings. This is for corrosion protection and reduced parking brake effort.

"BRAKE" WARNING LAMP

The red "BRAKE" warning lamp will illuminate when the ignition switch is in "START" and the parking brake lever assembly is applied or not fully released. The parking brake warning switch assembly, located in the parking brake lever assembly, will ground the "BRAKE" warning lamp circuit and cause the "BRAKE" warning lamp to illuminate.



A ARM, ADJUSTER
B GRIP, PARKING BRAKE LEVER
C BUTTON, PARKING BRAKE LEVER RELEASE
D PAWL, ADJUST
E PIN, ADJUST PAWL
F PULLEY, PARKING BRAKE LEVER
1 LEVER ASSEMBLY, PARKING BRAKE
4 SWITCH, PARKING BRAKE INDICATOR
5 BOLT/SCREW, PARKING BRAKE INDICATOR SWITCH
8 EQUALIZER, PARKING BRAKE CABLE
9 GROMMET, PARKING BRAKE CABLE
12 BOLT/SCREW, PARKING BRAKE LEVER.
15 CABLE ASSEMBLY, PARKING BRAKE FRONT
16 SPRING, PRETENSION

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Figure 1 – Parking Brake Lever Assembly

ON-VEHICLE SERVICE

LUBRICATION

Figure 1

NOTICE: Do not lubricate the parking brake cable assemblies. Lubrication destroys the plastic coating on the parking brake cable assemblies.

If the parking brake lever assembly (1) does not fully return, lubricate the following parts using GM P/N 1052497:

- Adjust pawl pin.
- Handle ratchet.
- Adjusting ratchet.

PARKING BRAKE LEVER ASSEMBLY

Figures 1 and 2

Tool Required:

J 37043 Parking Brake Cable Release Tool

Remove or Disconnect

1. Front floor console assembly. Refer to SECTION 8C.
2. Light switch and wiring from parking brake indicator switch (4).
3. Bolt/screw (5) and parking brake indicator switch (4) from parking brake lever assembly (1).
4. With parking brake lever assembly (1) in up position, remove pretension spring (16).
5. With parking brake lever assembly (1) in down position, rotate adjuster arm toward front of vehicle until a 3 mm metal pin can be inserted into hole.
   A. Remove and discard remaining piece of plastic shear pin.
   B. Insert 3 mm metal pin into hole, locking out self adjuster.
6. If there is sufficient parking brake cable slack, skip to step 10.
7. Raise and suitably support vehicle. Refer to SECTION 0A.
8. Rear cable assemblies (17 and 18) from equalizer (8).
9. Lower vehicle.
10. Bend back cable retainer tab on pulley.
11. Barrel-shaped front cable end fitting from adjuster track on pulley.
12. Two bolts/screws (12) and parking brake lever assembly (1) from floor pan.
13. Front cable assembly (15) and casing from parking brake lever assembly (1) and bracket, using J 37043.

Install or Connect

NOTICE: See "Notice" on page 5F-1 of this section.

1. Front cable assembly (15) and casing to parking brake lever assembly (1) and bracket.
2. Two bolts/screws (12) and parking brake lever assembly (1) to floor pan.

Tighten

- Bolts/screws (12) to 12 N•m (106 lb. in.).

3. Bolt/screw (5) and parking brake indicator switch (4).

Tighten

- Bolt/screw (5) to 2.8 N•m (25 lb. in.).

4. Light switch and wiring to parking brake indicator switch (4).
5. Barrel-shaped front cable end fitting to adjuster track on pulley.
6. Bend cable retainer tab to original position on pulley.
7. If rear cable assemblies (17 and 18) were not disconnected from equalizer, skip to step 11.
8. Raise and suitably support vehicle. Refer to SECTION 0A.
9. Rear cable assemblies (17 and 18) to equalizer (8).
10. Lower vehicle.
11. Rotate adjuster arm toward rear of vehicle and fully raise parking brake lever assembly (1).
12. Pretension spring (16).
13. Remove 3 mm metal pin from hole.
14. Cycle parking brake lever assembly (1) three times.
15. Front floor console assembly. Refer to SECTION 8C.

CABLE ASSEMBLIES

NOTICE: Handling these cables while servicing the parking brake system requires extra care. Damage to the plastic coating will reduce corrosion protection and if the damaged area passes through the seal, increased parking brake effort could result. Contacting the coating with sharp-edged tools, or with sharp surfaces of the vehicle underbody, should be avoided.

Front Cable Assembly

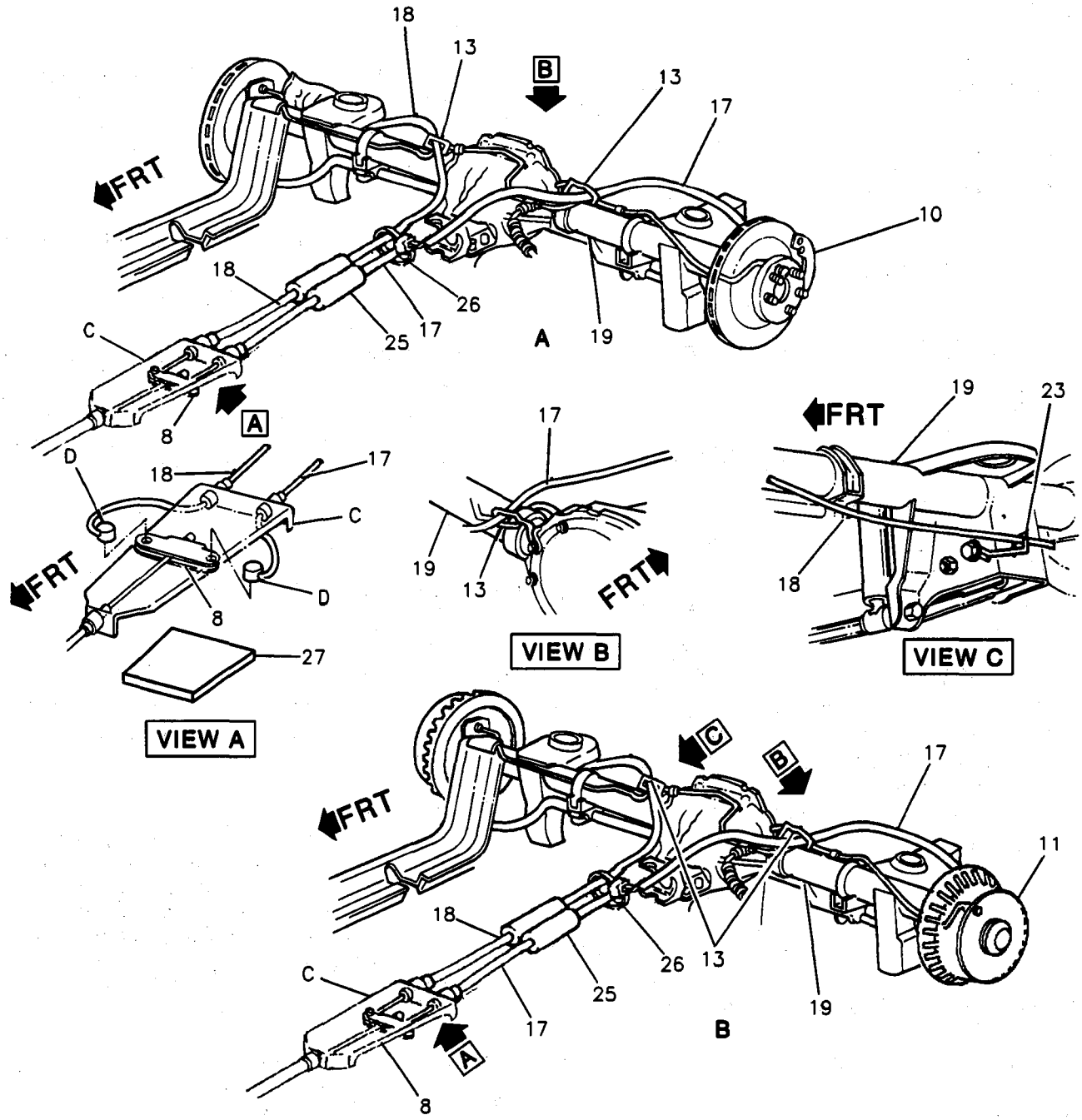
Figures 1 and 2

Tool Required:

J 37043 Parking Brake Cable Release Tool

Remove or Disconnect

1. Front floor console assembly. Refer to SECTION 8C.
2. With parking brake lever assembly (1) in up position, remove pretension spring (16).
3. With parking brake lever assembly (1) in down position, rotate adjuster arm toward front of vehicle until a 3 mm metal pin can be inserted into hole.
   A. Remove remaining piece of plastic shear pin from hole.



A WITH DISC BRAKE ASSEMBLIES
B WITH DRUM BRAKE ASSEMBLIES
C BRACKET, UNDERBODY
D FITTING, PARKING BRAKE REAR CABLE END
8 EQUALIZER, PARKING BRAKE CABLE
10 CALIPER ASSEMBLY, REAR BRAKE
11 DRUM ASSEMBLY, REAR BRAKE
13 GUIDE, PARKING BRAKE REAR CABLE
17 CABLE ASSEMBLY, LEFT PARKING BRAKE REAR
18 CABLE ASSEMBLY, RIGHT PARKING BRAKE REAR
23 GUIDE, PARKING BRAKE REAR CABLE (DRUM BRAKE ASSEMBLIES ONLY)
25 ANTI-RATTLE BUMPERS, FOAM
26 STRAP, TIE
27 SOUND DEADENER, FLOOR PANEL

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Figure 2 – Parking Brake Cable Routing

B. Insert 3 mm metal pin into hole, locking out self adjuster.

4. Pull parking brake lever assembly (1) all the way back.
5. Raise and suitably support vehicle. Refer to SECTION 0A.
6. Left and right rear cable assemblies (17 and 18) from equalizer (8).
7. Fitting of front cable assembly (15) from bracket, using J 37043.
8. Grommet (9) from slot in underbody assembly.
9. Lower vehicle.
10. Bend back cable retainer tab on pulley.
11. Barrel-shaped front cable end fitting from adjuster track on pulley.
12. Front cable assembly (15) and casing from parking brake lever assembly (1), using J 37043.
13. Front cable assembly (15) from floor pan.

Install or Connect

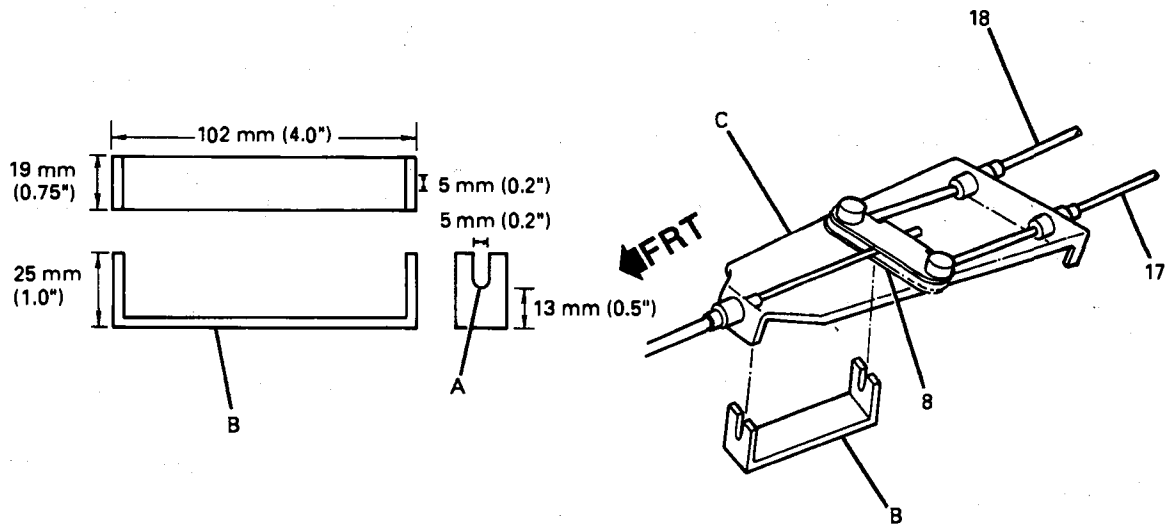
1. Front cable assembly (15) and grommet (9) into slot in floor pan.
   A. Soapy water can be used as lubricant.
   B. Feed forward end of grommet (9) into slot.
   C. Use a small, curved, flat-ended pry bar to gently press rearward end into slot.
   - Be sure grommet (9) is properly seated in slot in floor pan.
2. Front parking brake cable casing to parking brake lever assembly (1).
3. Barrel-shaped front cable end fitting into adjuster track on pulley.
4. Bend cable retainer tab to original position on pulley.
5. Make sure parking brake lever assembly (1) is in down position.
6. Raise and suitably support vehicle. Refer to SECTION 0A.
7. Rear cable assemblies (17 and 18) to equalizer (8).
8. Lower vehicle.
9. With parking brake lever assembly (1) in up position, install pretension spring (16).
10. Remove 3 mm metal pin from hole.
11. Cycle parking brake lever assembly (1) three times.
12. Front floor console assembly. Refer to SECTION 8C.

Rear Cable Assembly (Drum Brakes)

Figures 2, 3 and 4

Tool Required:

J 37043 Parking Brake Cable Release Tool



A SURFACE OF NOTCHES MUST BE SMOOTH
B SPACER, PARKING BRAKE CABLE EQUALIZER
C BRACKET, UNDERBODY
8 EQUALIZER, PARKING BRAKE CABLE
17 CABLE ASSEMBLY, LEFT PARKING BRAKE REAR
18 CABLE ASSEMBLY, RIGHT PARKING BRAKE REAR

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Figure 3 – Parking Brake Cable Equalizer Spacer (Locally Fabricated)

This vehicle is equipped with a blind cable system at the brake drum assembly. The rear parking brake cable assembly can be installed to the brake drum assembly without disassembling the brake drum assembly.

Remove or Disconnect

1. Fully disengage parking brake lever assembly. Be sure handle is down and brake indicator lamp is not lit. If parking brake lever assembly is partially engaged, it will not be possible to pull equalizer (8) rearward in step 3.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Left or right rear cable assembly (17 or 18) from equalizer (8).
   A. Pull equalizer (8) rearward to gain necessary cable slack.
   B. Insert locally fabricated spacer to hold equalizer (8) in place as shown in Figure 3.
   C. Remove left or right rear cable assembly (17 or 18) from equalizer (8).
4. Left or right rear cable assembly (17 or 18) and casing from underbody bracket and retainer.
   - Use J 37043 to compress retainer fingers on casing and pull left or right rear cable assembly (17 or 18) from underbody bracket.
5. Pull rear cable assemblies (17 and 18) through guides (13 and 23) installed on rear axle housing assembly (19).
6. Tire and wheel assembly. Refer to SECTION 3E.
   - Mark relationship of wheel to axle flange.
7. Drum assembly (11).
8. Left or right rear cable assembly (17 or 18) from backing plate.
   - Use J 37043 to compress retainer fingers and pull out left or right rear cable assembly (17 or 18).
9. Cable end fitting from parking brake lever assembly. Refer to SECTION 5C2.

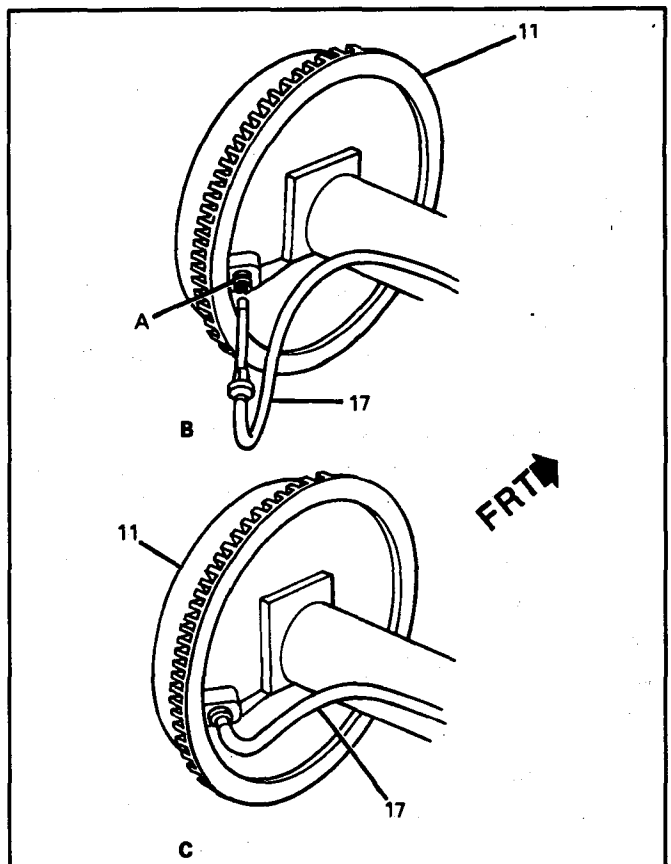
Install or Connect

1. Drum assembly (11).

Important

- When reassembling drum brake assembly, make sure guide spring projects through hole in backing plate so that cable insertion can be performed.

2. Feed left rear cable assembly (17) through guide (13) or right rear cable assembly (18) through guides (13 and 23) on rear axle housing assembly (19).
3. Cable end fitting into parking brake lever assembly. This can be done by inserting tear-drop shaped end fitting into guide spring until a click is heard. After click is heard, pull on cable to ensure connection has been made.

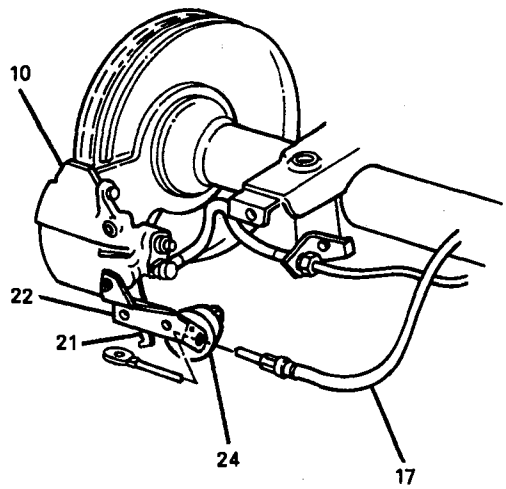


A SPRING, GUIDE
B LEFT PARKING BRAKE REAR CABLE ASSEMBLY PRIOR TO INSTALLATION
C LEFT PARKING BRAKE REAR CABLE ASSEMBLY INSTALLED
11 DRUM ASSEMBLY, REAR BRAKE
17 CABLE ASSEMBLY, LEFT PARKING BRAKE REAR

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Figure 4 – Installing Rear Parking Brake Cable Assembly to Rear Brake Drum Assembly

4. Left or right rear cable assembly (17 or 18) to backing plate.
   - Ensure that retainer fingers are seated.
5. Tire and wheel assembly. Refer to SECTION 3E.
   - Align previous marks on axle flange and wheel.
6. Left or right rear cable assembly (17 or 18) into underbody bracket.
   - If it was necessary to remove the tie strap from the brake cables, then a new tie strap must be installed in its original position.
7. Left or right rear cable assembly (17 or 18) to equalizer (8).
8. Remove locally fabricated spacer.
9. Lower vehicle.
10. Cycle parking brake lever assembly three times.



10 CALIPER ASSEMBLY, REAR BRAKE
17 CABLE ASSEMBLY, LEFT PARKING BRAKE REAR
21 LEVER, REAR PARKING BRAKE ACTUATOR
22 BRACKET, PARKING BRAKE CABLE
24 DAMPENER ASSEMBLY, REAR BRAKE VIBRATION

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Figure 5 – Installing Rear Parking Brake Cable Assembly to Rear Disc Brake Caliper Assembly

Rear Cable Assembly (Disc Brakes)

Figures 2, 3 and 5

Tool Required:

J 37043 Parking Brake Cable Release Tool

Remove or Disconnect

1. Fully disengage parking brake lever assembly. Be sure handle is down and brake indicator lamp is not lit. If parking brake lever assembly is partially engaged, it will not be possible to pull equalizer (8) rearward in step 3.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Left or right rear cable assembly (17 or 18) from equalizer (8).
   A. Pull equalizer (8) rearward to gain necessary parking brake cable slack.
   B. Insert locally fabricated spacer to hold equalizer (8) in place as shown in Figure 3.
   C. Remove left or right rear cable assembly (17 or 18) from equalizer (8).
4. Left or right rear cable assembly (17 or 18) and casing from underbody bracket.
   - Compress retainer fingers on casing using J 37043 and pull left or right rear cable assembly (17 or 18) from underbody bracket.
5. Pull left or right rear cable assembly (17 or 18) through guide (13) installed on rear axle housing assembly (19).
6. Tire and wheel assembly. Refer to SECTION 3E.
   - Mark relationship of wheel to axle flange.
7. Left or right rear cable assembly (17 or 18) from actuator lever (21) and cable bracket (22).
   A. Pull all parking brake cable slack to caliper end of parking brake cable assembly.
   B. Remove left or right rear cable assembly (17 or 18) from tang on actuator lever (21).
   C. Using J 37043, compress retainer fingers on cable casing and pull from cable bracket (22).

Install or Connect

1. Left or right rear cable assembly (17 or 18) to actuator lever (21) and cable bracket (22).
   - Seat retainer fingers into cable bracket (22).
2. Tire and wheel assembly. Refer to SECTION 3E.
3. Feed left or right rear cable assembly (17 or 18) through guide (13) on rear axle housing assembly (19).
4. Left or right rear cable assembly (17 or 18) into underbody bracket.
   - If it was necessary to remove the tie strap from the brake cables, then a new tie strap must be installed in its original position.

5. Left or right rear cable assembly (17 or 18) to equalizer (8).
6. Remove locally fabricated spacer.
7. Lower vehicle.
8. Cycle parking brake lever assembly three times.

PARKING BRAKE ADJUSTMENT

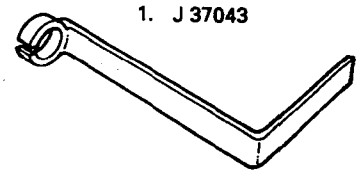
Adjustments are not normally necessary after replacing the parking brake cable assemblies or the parking brake lever assembly. Refer to SECTION 5B2 for parking brake free-travel adjustment procedures and to SECTION 5C2 for rear drum brake adjustment.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Parking Brake Indicator Switch Bolt/Screw	2.8 N•m (25 lb. in.)
Parking Brake Lever Bolt/Screw	12 N•m (106 lb. in.)

SPECIAL TOOLS



1. PARKING BRAKE CABLE RELEASE TOOL

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FS0065F

SECTION 6

ENGINE

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SECTION 6

ENGINE GENERAL DESCRIPTION

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

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ALL NEW GENERAL MOTORS VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENT POINTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAPS, ETC., FOR PURPOSES OF SERVICING THE PRODUCT MUST BE STRICTLY FOLLOWED AND, WHEREVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

DESCRIPTION OF SECTION 6

Section 6A - ENGINE MECHANICAL

This section contains information of the mechanical parts of the engine, such as the block, crankshaft, pistons, valve train, and camshaft. Overhaul procedures, removal and replacement procedures, and specifications are also covered. The specific subsections are:

- 6A2A - 3.4 Liter V6 Engine On-Vehicle Service
- 6A2B - 3.4 Liter V6 Engine Unit Repair
- 6A3A - 5.7 Liter V8 Engine On-Vehicle Service
- 6A3B - 5.7 Liter V8 Engine Unit Repair

SECTION 6B - COOLING AND RADIATOR

Engine cooling system components such as the radiator, water pump, hoses, thermostat, and cooling fan, are covered in this section.

SECTION 6C - ENGINE FUEL

This section contains information on all the parts of the fuel system except the Multiport Fuel Injection (MFI) components. Items covered are: fuel tank, fuel pump, fuel filter, and fuel lines.

SECTION 6D - ENGINE ELECTRICAL

Items covered in this section are the battery, generator, starter, distributor, engine wire harness, spark plugs and wires. Ignition system diagnosis can be found in the appropriate 6E Section as a "C-4" chart. Specific subsections are:

- 6D - Engine Electrical
- 6D1 - Battery
- 6D2 - Cranking System
- 6D3 - Charging System
- 6D4 - Ignition System
- 6D5 - Engine Wiring

SECTION 6E - DRIVEABILITY AND EMISSIONS - GENERAL INFORMATION

This section covers emission control systems, general information, and diagnostic procedures which will lead to repairing performance and driveability related problems. Emission components are covered, as well as removal and replacement procedures.

Instructions on use of special tools are also given.

Specific subsections are:

- 6E - Driveability and Emissions - General Information
- 6E3 (3.4L) - Driveabilty and Emissions - Fuel Injection (Port) (3.4L)
- 6E3 (5.7L) - Driveability and Emissions - Fuel Injection (Port) (5.7L)

SECTION 6F - EXHAUST SYSTEM

This section has information on all exhaust system parts, such as tailpipes, mufflers, and the catalytic converter.

GENERAL INFORMATION

CLEANLINESS AND CARE

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the ten-thousandths of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of engine oil should be applied to friction areas during assembly to protect and lubricate the surfaces on initial operation. Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Whenever valve train components are removed for service, they should be kept in order. They should be installed in the same locations, and with the same mating surfaces, as when removed. Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wiring harness or other electrical parts.

GENERAL INFORMATION ON ENGINE SERVICE

Important

THE FOLLOWING INFORMATION ON ENGINE SHOULD BE NOTED CAREFULLY, AS IT IS IMPORTANT IN PREVENTING DAMAGE AND IN CONTRIBUTING TO RELIABLE PERFORMANCE.

When raising or supporting the engine for any reason, do not use a jack under the oil pan. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen resulting in a damaged oil pick-up unit.

When working on the engine, remember that the 12-volt electrical system is capable of causing short circuits. When performing any work where electrical terminals could possibly be grounded, the ground cable of the battery should be disconnected at the battery.

Any time the air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material which could follow that intake passage into the cylinder and cause extensive damage when the engine is started.

IN THE MECHANICAL PROCEDURES DESCRIBED IN THIS SECTION, REFERENCES WILL BE MADE TO THE REMOVAL OF EQUIPMENT SUCH AS POWER STEERING PUMP, AIR CONDITIONING COMPRESSOR, ETC.

SHOULD IT BECOME NECESSARY TO REMOVE ANY SUCH ITEM TO PERFORM OTHER SERVICES, REFER TO THE APPROPRIATE SECTION OF THIS SERVICE MANUAL FOR SPECIFIC INFORMATION.

ENGINE PERFORMANCE DIAGNOSIS

Engine performance diagnosis procedures are covered in Section 6E and should be consulted for diagnosis of any driveability, emissions, or "Service Engine Soon" light complaint.

Refer to:

- SECTION 6E - Driveability and Emissions - General Information
- SECTION 6E3 (3.4L) - Driveability and Emissions -Fuel Injection (Port) (3.4L)
- SECTION 6E3 (5.7L) - Driveability and Emissions -Fuel Injection (Port) (5.7L)

ENGINE MECHANICAL DIAGNOSIS

The following diagnostic information covers common problems and possible causes. When the proper diagnosis is made, the problem should be corrected by adjustment, repair or part replacement as required. Refer to the appropriate section of the manual for these procedures.

EXCESSIVE OIL LOSS

Excessive oil consumption, not due to leaks, is the use of 2 quarts (1.9L) or more of engine oil within 2,000 miles or 3,200 kilometers.

- External oil leaks. Tighten bolt and/or replace gaskets and seals as necessary.
- Improper reader of oil level indicator (dipstick). Check oil with vehicle on a level surface and allow adequate drain-down time.
- Improper oil viscosity. Use recommended SAE viscosity for prevailing temperatures. Refer to SECTION 0B for engine oil specifications.
- Continuous high speed driving, and/or severe usage such as trailer hauling, will normally cause decreased oil mileage.
- Crankcase ventilation system malfunctioning.
- Valve guides and/or valve stem seals worn, or seals omitted. Ream guides and install oversize service valves and/or new valve stem seals.
- Piston rings broken, improperly installed, worn, or not seated. Allow adequate time for rings to seat. Replace broken or worn rings as necessary.
- Piston improperly installed or misfitted.

OIL LEAK DIAGNOSIS

Most oil leaks are easily located and repaired by visually finding the leak and replacing or repairing the necessary parts. On some occasions a fluid leak may be difficult to locate or repair. The following procedure may help in locating and repairing most leaks.

Finding the Leak

1. Identify the fluid, determine whether it is engine oil, automatic transmission fluid, power steering fluid, etc.
2. At what point is the fluid leaking from? After running the vehicle at normal operating temperature, park the vehicle over a large sheet of paper. After a few minutes, the approximate location of the leak should be found by the drippings on the paper.
3. Visually check around the suspected component. Check around all gasket mating surfaces for leaks. A mirror is useful for finding leaks in areas that are hard to reach.
4. If the leak still cannot be found, it may be necessary to clean the suspected area with a degreaser, steam or spray solvent. Clean the area well, then dry the area. Operate the vehicle for several miles at normal operating temperature and varying speeds. After operating the vehicle, visually check the suspected component. If leak still cannot be located, try using the powder or black light and dye method.

Powder Method

1. Clean the suspected area.
2. Apply an aerosol-type powder (such as foot powder) to the suspected area.
3. Operate the vehicle under normal operating conditions.
4. Visually inspect the suspected component. The leak path to the source should be found by tracing the white powder surface.

Black Light and Dye Method

A dye and light kit is available for finding leaks. Refer to the manufacturer's directions when using the kit.

1. Pour specified amount of dye into leaking component.

2. Operate the vehicle under normal operating conditions as directed in the kit.
3. Direct the light toward the suspected area. The dyed fluid will appear as a yellow path leading to the source.

Repairing the Leak

Once the origin of the leak has pinpointed and traced back to its source, the cause of the leak must be determined in order for it to be repaired properly. If a gasket is replaced, but the sealing flange is bent, the new gasket will not repair the leak. The bent flange must be repaired also. Before attempting to repair a leak, check to be sure that the following conditions are correct as they may cause a leak.

Gaskets

Inspect

- Fluid level/pressure is too high.
- Crankcase ventilation system malfunctioning.
- Improperly tightened fasteners or dirty/damaged threads.
- Warped flanges or sealing surface.
- Scratches, burrs or other damage to the sealing surface.
- Damaged or worn gasket.
- Cracking or porosity of the component.
- Improper sealant used (where applicable).

Seals

- Fluid level/pressure is too high.
- Crankcase ventilation system malfunctioning.
- Damaged seal bore (scratched, burred or nicked).
- Damaged or worn seal.
- Improper installation.
- Cracks in components.
- Shaft surface scratched, nicked or damaged.
- Loose or worn bearing causing excess seal wear.

LOW OR NO OIL PRESSURE

- Low oil level. Fill to full mark on oil level indicator.
- Slow idle speed.
- Incorrect or malfunctioning oil pressure switch.
- Incorrect or malfunctioning oil pressure switch.
- Improper oil viscosity or diluted oil. Install oil of proper viscosity for expected temperature, or install new oil if diluted with moisture or unburned mixtures.
- Oil pump worn or dirty.
- Plugged oil filter.
- Oil pickup screen loose or plugged.
- Hole in oil pickup tube.
- Excessive bearing clearance. Replace if necessary.
- Cracked, porous or plugged oil galleries. Repair or replace block.
- Gallery plugs missing or misinstalled. Install plugs or repair as necessary.
- Camshaft worn, or poorly machined. Replace camshaft.

ENGINE NOISE DIAGNOSIS

There are four steps to diagnosing engine noise. You must determine:

1. Type of noise.
2. Under which operating conditions it exists.
3. At what rate, and at what location in the engine.
4. Compare sounds in other engines to make sure the condition is not normal.

Identify the type of noise, for example, a light rattle or a low rumble. Determine the exact operating conditions under which the noise appears.

Remember, engine noises are generally synchronized to either speed (caused by the crankshaft, connecting rods or pistons) or one-half engine speed (valve train noises). Try to determine the rate at which the noise is occurring.

MAIN BEARING NOISE

Damaged or worn main bearing noise is revealed by dull thuds or knocks which happen on every engine revolution, and this noise is loudest when the engine is under heavy load.

Excessive crankshaft end play is indicated by an intermittent rap or knock sharper than a worn main bearing. Causes of main bearing noises include:

- Low oil pump pressure.
- Thin, diluted or dirty oil and/or filter.
- Excessive main bearing clearance.
- Excessive crankshaft end play.
- Out-or-round crankshaft journals.
- Excessive belt tension.
- Loose crankshaft pulley.
- Loose flywheel or torque converter.
- Loose main bearing cap.

CONNECTING ROD BEARING NOISE

A damaged or worn connecting rod bearing will produce knock under all speeds. During the early stages of wear, connecting rod noise may be confused with piston slap or loose wrist pins. Connecting rod knock noise increases in volume with engine speed and is at its loudest on deceleration. Causes of connecting rod bearing noise include:

- Excessive bearing clearance.
- Worn crankshaft connecting rod journal.
- Thin, diluted or dirty oil and/or filter.
- Low oil pressure.
- Crankshaft connecting rod journals our-of-round.
- Misaligned connecting rod.
- Connecting rod bolts not properly torqued.

- Wrong bearing inserts or misaligned bearing half.

TIMING GEAR OR CHAIN AND SPROCKET NOISES

Engines designed with timing gears, to those equipped with timing chain and sprockets, can produce different noises. The most common noise is a high frequency, light knocking sound. this sound will generally be the same in intensity whether the engine is idling, operating at high speeds, or under load, causes of timing gear or chain and sprocket noises include:

- Worn timing chain and/or gears.
- Misaligned gears.
- Excessive backlash.
- Damaged tooth.
- Gear or sprocket loose on shaft.
- Too much end play in the carnshaft or crankshaft.

PISTON NOISES

Piston pin, piston, and connecting rod noises are hard to separate. A loose piston pin, for example, causes a sharp double knock usually heard when the engine is idling, or during sudden acceleration then deceleration of the engine. A piston pin that has been improperly fitted will emit a light ticking noise that is rnore noticeable with no load on the engine.

Excessive piston-to-cylinder bore clearance will cause piston slap noise. The noise is sirnilar to a rnetallic knock, as if the piston were "slapping" the cylinder wall during its stroke. As with rnost engine noises, understanding the cause of the noise will help you imagine what the noise sounds like. An indication of piston slap is a decrease in noise as the engine warms up. When the engine is cold, the piston-to-bore clearance is greater and piston slap will be louder. Causes of piston noises include:

- Worn of loose piston pin or bushing.
- Improper fit of pin.
- Excessive piston-to-cylinder bore clearance (piston slap).
- Lack of lubrication.
- Carbon deposits on top of piston striking cylinder head.
- Worn or broken piston ring land.
- Broken or cracked piston.
- Misaligned connecting rods.
- Worn or damaged rings.
- Worn or out-of-round cylinder walls.
- Excessive ring land clearance.
- Insufficient ring-end gap clearance.
- Piston 180 degrees out of position.
- Incorrect piston cam grind.

VALVE MECHANISM OR VALVE TRAIN NOISES

A light taping at one-half engine speed, or any varying frequency, can indicate a valve train problern. These tapping noises increase with engine speed.

Before attempting to judge valve train noises, thoroughly warm up the engine. This will bring all engine components to a normal state of expansion. Also, run the engine at various speeds and listen for engine noise with the hood closed while sitting in the driver's seat.

If the valve mechanism is abnormally noisy, remove the rocker arm covers and use an engine stethoscope to determine which values or valve train parts are causing the noise.

CAUTION: This procedure is not recommended on engines with stainless steel exhaust manifolds because manifold temperature will exceed the flash point of the oil causing a fire with possible personal injury.

Causes of valve mechanism noises include:

- Broken or weak valve spring(s).
- Sticking or warped valves.
- Bent pushrods.
- Dirty, stuck, worn or defective valve lifters.
- Damaged or improperly machined camshaft lobes.
- Insufficient or poor oil supply to valve train (low oil pressure).
- Excessive valve stern-to-guide clearance.
- Worn valve guides.
- Worn rocker arms or pushrods.
- Broken rocker arm studs.
- Loose or worn rocker arm attachments.
- Missing or mispositioned lifter guides (roller lifter engines).

FLYWHEEL NOISES (AUTOMATIC TRANSMISSION)

A loose or cracked flywheel will produce an irregular thud or click. To test for a loose or cracked flywheel, operate the vehicle at approximately 20 rnph (32 km/h) and shut off the engine. If a thud is heard, the flywheel rnay be loose or damaged. This type of thud is loudest on deceleration. Loose torque converter-to-flywheel or flywheel-to-crankshaft bolts will sound similar to bearing knock. This condition produces several raps during quick acceleration on a free running engine. Depending on the idle srnoothness, when the transmission is in gear, the noise rnay or rnay not appear. Check the torque converter-to-flywheel and flywheel-to-crankshaft bolts before atternpting to investigate any bearing-related knock.

NOTICE: Be sure the converter-to-flywheel bolts are not too long. Converter bolts that are too long rnay dirnple the torque converter clutch surface causing a shudder condition.

ENGINE KNOCK DIAGNOSIS

Noises in engines are sometimes characteristic of the design. Compare the sounds in other engines to make sure the condition is not normal.

KNOCKS COLD AND CONTINUES FOR TWO TO THREE MINUTES AND INCREASES WITH TORQUE

- Flywheel contacting splash shield. Reposition splash shield.
- Loose or broken balancer or drive pulleys. Tighten or replace as necessary.
- Excessive piston-to-bore clearance. Replace piston.
- Bent connecting rod.
- Cold engine piston knock usually disappears when the cylinder is grounded out. Cold engine piston knock which disappears in 1.5 minutes should be considered acceptable.

HEAVY KNOCK HOT WITH TORQUE APPLIED

- Broken balancer or pulley hub. Replace parts as necessary.
- Loose torque converter bolts.
- Exhaust system grounded. Reposition as necessary.
- Flywheel cracked.
- Excessive main bearing clearance. Replace as necessary.
- Excessive rod bearing clearance. Replace as necessary.

LIGHT KNOCK HOT

- Detonation or spark knock. Check operation of Knock Sensor (KS) system. Refer to SECTION 6E3. Check engine timing and fuel quality.
- Loose torque converter bolts. Tighten bolts.
- Exhaust leak at manifold. Tighten bolts and/or replace manifold.
- Excessive rod bearing clearance. Replace bearings as necessary.

KNOCKS ON INITIAL START-UP BUT ONLY LASTS A FEW SECONDS

- Improper oil viscosity. Install proper oil viscosity for expected temperatures. Refer to SECTION 0B for engine oil specifications.
- Hydraulic lifter bleed down. Clean, test and replace as necessary.
  - — When the engine is stopped, some valves will be open. Spring pressure against lifters will tend to bleed lifter down. Attempts to repair should be made only if the problem is consistent.
  - — An engine that is operated for only short periods between start-ups may have lifter noise that last for a few minutes. This is a normal condition.
- Excessive crankshaft end clearance. Replace crankshaft thrust bearing.
- Excessive front main bearing clearance. Replace worn parts.

KNOCKS AT IDLE HOT

- A/C compressor or generator bearing. Replace as necessary.
- Valve train. Replace parts as necessary.
- Improper oil viscosity. Install proper viscosity oil for expected temperature. Refer to SECTION 0B for engine oil specifications.
- Excessive piston pin clearance. Replace piston and pin.
- Connecting rod alignment. Check and replace rods as necessary.
- Loose crankshaft balancer. Torque and/or replace worn parts.
- Piston pin offset to wrong side. Install correct piston.

ENGINE COMPRESSION TEST

A compression pressure test is performed on the engine cylinders to determine the condition of the rings, valves and head gasket.

Remove or Disconnect

1. Run engine until it reaches normal operating temperature. Battery must be at or near full charge.
2. Turn engine off.
3. Remove Powertrain Control Module fuse.
4. Spark plugs from all cylinders.
5. Air duct from throttle body.
   - Block throttle plate in open position.

Measure

- Engine compression.
  - A. Install compression gage firmly to cylinder spark plug hole.
  - B. Have a helper crank the engine through at least four compression strokes in the cylinder being tested and check the readings on the gage at each stroke. Record the results.
  - C. Disconnect gage.
  - D. Repeat compression test for each cylinder.

Inspect

- Record compression readings from all cylinders. The lowest reading should not be less than 70 percent of the highest and no cylinder reading should be less than 689 kPa (100 psi).
- Problem areas can be identified as follows:
  - — Normal - Compression builds up quick and evenly to specified compression on each cylinder.

— Piston Rings - Compression is low on first stroke and tends to build up on following strokes, but does not reach normal. Compression improves considerably with the addition of oil. Use approximately three squirts from a plunger type oiler.
— Valves - Compression is low on first stroke and it does not tend to build up in following strokes. Compression does not improve much with the addition of oil. Use approximately three squirts from a plunger type oiler.
— Head Gaskets - Leaking head gaskets give nearly the same test results as valve problems but may be recognized by engine coolant in the crankcase. Head gasket leakage between two cylinders will give low readings on both cylinders.

Install or Connect

1. Remove block from throttle plate.
2. Air duct to throttle body.
3. Spark plugs.
4. Install Powertrain Control Module fuse.

BLANK

SECTION 6A2A

3.4 LITER V6 ENGINE ON-VEHICLE SERVICE

RPO L32 – VIN S

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J-B under "On-Vehicle Service" and the SIR Components and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or unneeded SIR system repairs.

CAUTION: Before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with "live" or "hot at all times" exposed electrical terminals, disconnect the battery negative cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "OFF" or "LOCK" position.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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ON-VEHICLE SERVICE

FUEL SYSTEM PRESSURE RELIEF

CAUTION:

- **To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing fuel system components.**
- **After relieving system pressure, a small amount of fuel may be released when servicing fuel lines or connections. In order to reduce the chance of personal injury, cover fuel pipe fittings with a shop towel before disconnecting, to catch any fuel that may leak out. Place the towel in an approved container when disconnect is completed.**

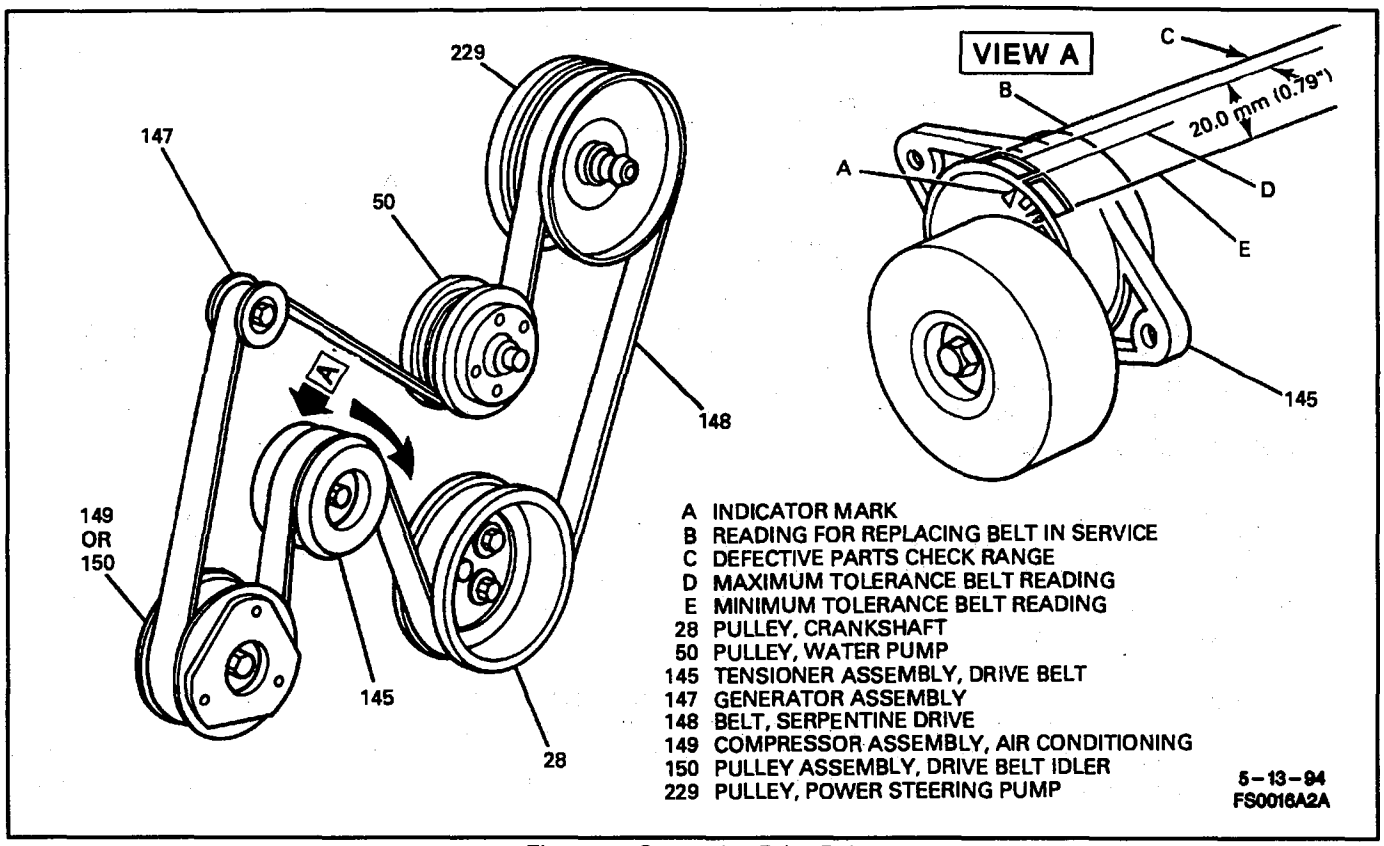


Figure 1 – Serpentine Drive Belt

Tool Required:

J 34730-1 Fuel Pressure Gage

1. Disconnect battery negative cable assembly terminal to avoid possible fuel discharge if an additional attempt is made to start the engine.
2. Loosen fuel filler cap to relieve tank vapor pressure.
3. Connect J 34730-1 to fuel pressure connection. Wrap a shop towel around fitting while connecting J 34730-1 to avoid spilling.
4. Install bleed hose into an approved container and open valve to bleed system pressure. Fuel connections are now safe for servicing.
5. Drain any fuel remaining in J 34730-1 into an approved container.

SERPENTINE DRIVE BELT AND TENSIONER ASSEMBLY

Figures 1 and 2

NOTICE: Routine inspection of the belt may reveal cracks in the belt ribs. These cracks will not impair belt performance and therefore should not be considered a problem requiring belt replacement. However, the belt should be replaced if belt slip occurs or if sections of the belt ribs are missing.

A single serpentine drive belt is used to drive all engine accessories. All belt driven accessories are rigidly mounted with belt tension maintained by a spring loaded tensioner assembly.

The indicator on the movable portion of the tensioner assembly must be within the limits of the marks of the stationary portion of the tensioner assembly. Any reading outside of these limits indicates either a defective belt or tensioner assembly.

Drive Belt

Inspect

- Belt length scale on drive belt tensioner assembly for proper installed length. If belt length scale does not indicate proper installed length, install a new drive belt.

Remove or Disconnect

CAUTION: See "Caution" on page 6A2A-1 of this section.

1. Battery negative cable assembly.
2. Lift drive belt tensioner assembly (145) downward (clockwise) off drive belt using a socket and handle on tensioner pulley bolt/screw.
3. Drive belt (148).

Install or Connect

1. Drive belt (148) over tensioner pulley by pushing down on drive belt tensioner assembly (145).
   - Be sure drive belt (148) is aligned into proper grooves of accessory drive pulleys.
2. Battery negative cable assembly.

Drive Belt Tensioner Assembly

Remove or Disconnect

1. Drive belt (148) by lifting drive belt tensioner assembly (145) downward (clockwise) off drive belt using a socket and handle on tensioner pulley bolt/screw.
2. Drive belt tensioner bolts/screws (152).
3. Drive belt tensioner assembly (145).

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Drive belt tensioner assembly (145).
2. Drive belt tensioner bolts/screws (152).

Tighten

- Drive belt tensioner bolts/screws (152) to 33 N•m (24 lb. ft.).

3. Drive belt (148) over tensioner pulley by pushing down on drive belt tensioner assembly (145).
   - Be sure drive belt (148) is aligned into proper grooves of accessory drive pulleys.

Drive Belt Idler Pulley

The drive belt idler pulley assembly is used in place of the A/C compressor when the vehicle is not equipped with air conditioning.

Remove or Disconnect

1. Drive belt (148) by lifting drive belt tensioner assembly (145) downward (clockwise) off drive belt using a socket and handle on tensioner pulley bolt/screw.
2. Idler pulley bolts/screws (151).
3. Drive belt idler pulley assembly (150).

Install or Connect

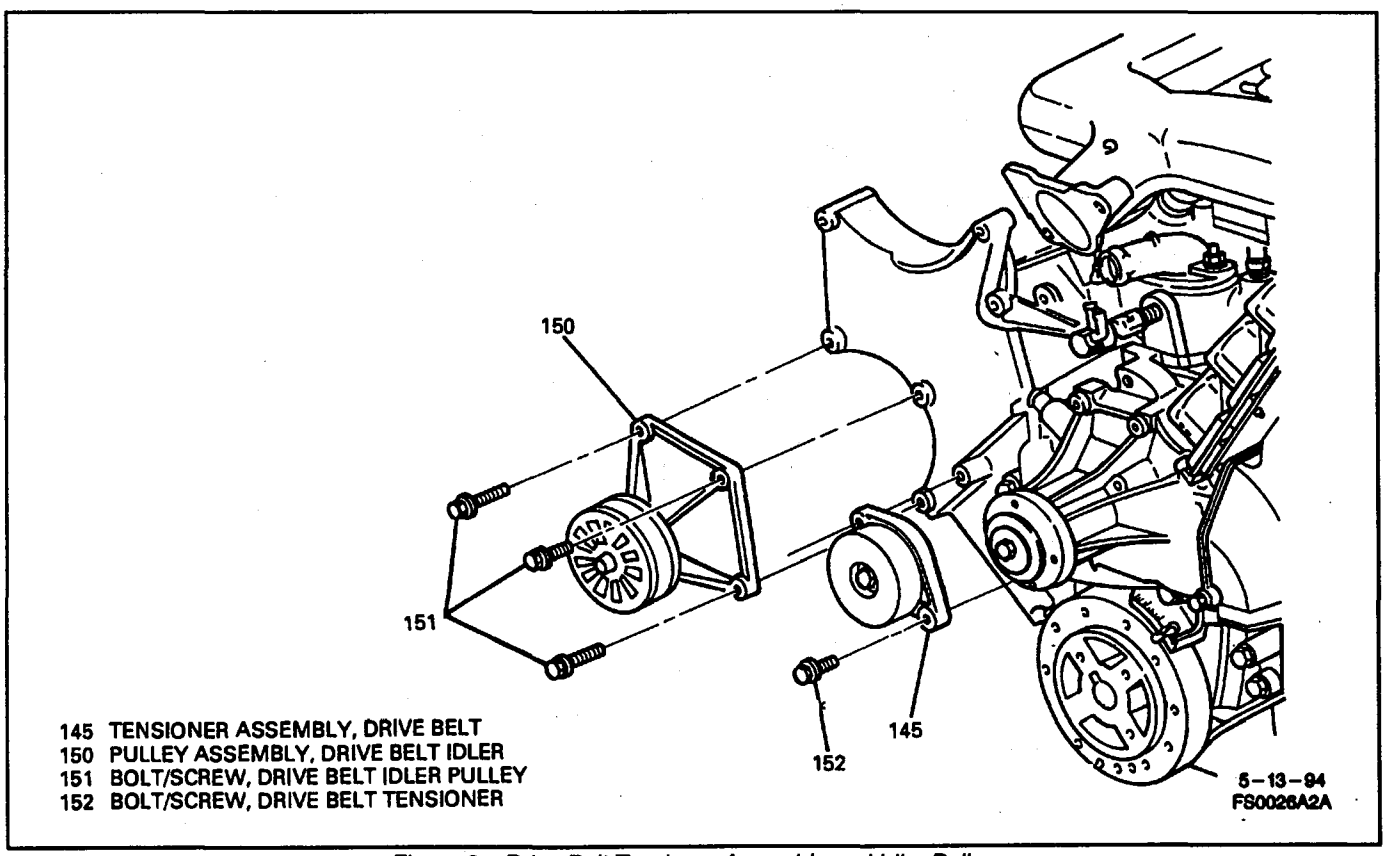
NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Drive belt idler pulley assembly (150).
2. Idler pulley bolts/screws (151).

Tighten

- Idler pulley bolts/screws (151) to 50 N•m (37 lb. ft.).

3. Drive belt (148) over tensioner pulley by pushing down on drive belt tensioner assembly (145).
   - Be sure belt is aligned into proper grooves of accessory drive pulleys.



145 TENSIONER ASSEMBLY, DRIVE BELT
150 PULLEY ASSEMBLY, DRIVE BELT IDLER
151 BOLT/SCREW, DRIVE BELT IDLER PULLEY
152 BOLT/SCREW, DRIVE BELT TENSIONER

Figure 2 – Drive Belt Tensioner Assembly and Idler Pulley

ENGINE MOUNT ASSEMBLIES AND BRACKETS

Figure 3

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, crankshaft pulley, or any sheet metal. Due to small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen, resulting in a damaged oil pickup unit.

Inspect

- Engine mounts for damage to rubber portions of mount.
  - Rubber surface covered with heat check cracks.
  - Rubber cushion separated from plate of mount.
  - Rubber cushion split through center.

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Exhaust crossover pipe. Refer to SECTION 6F.
3. Engine mount through-bolts/screws (120) and nuts (117).
4. Raise engine with a jacking fixture.
5. Engine mount bolts/screws (118) and mount assemblies (119).
6. Engine bracket bolts/screws and brackets (116).

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Engine brackets (116) and bolts/screws.
2. Engine mount assemblies (119) and bolts/screws (118).

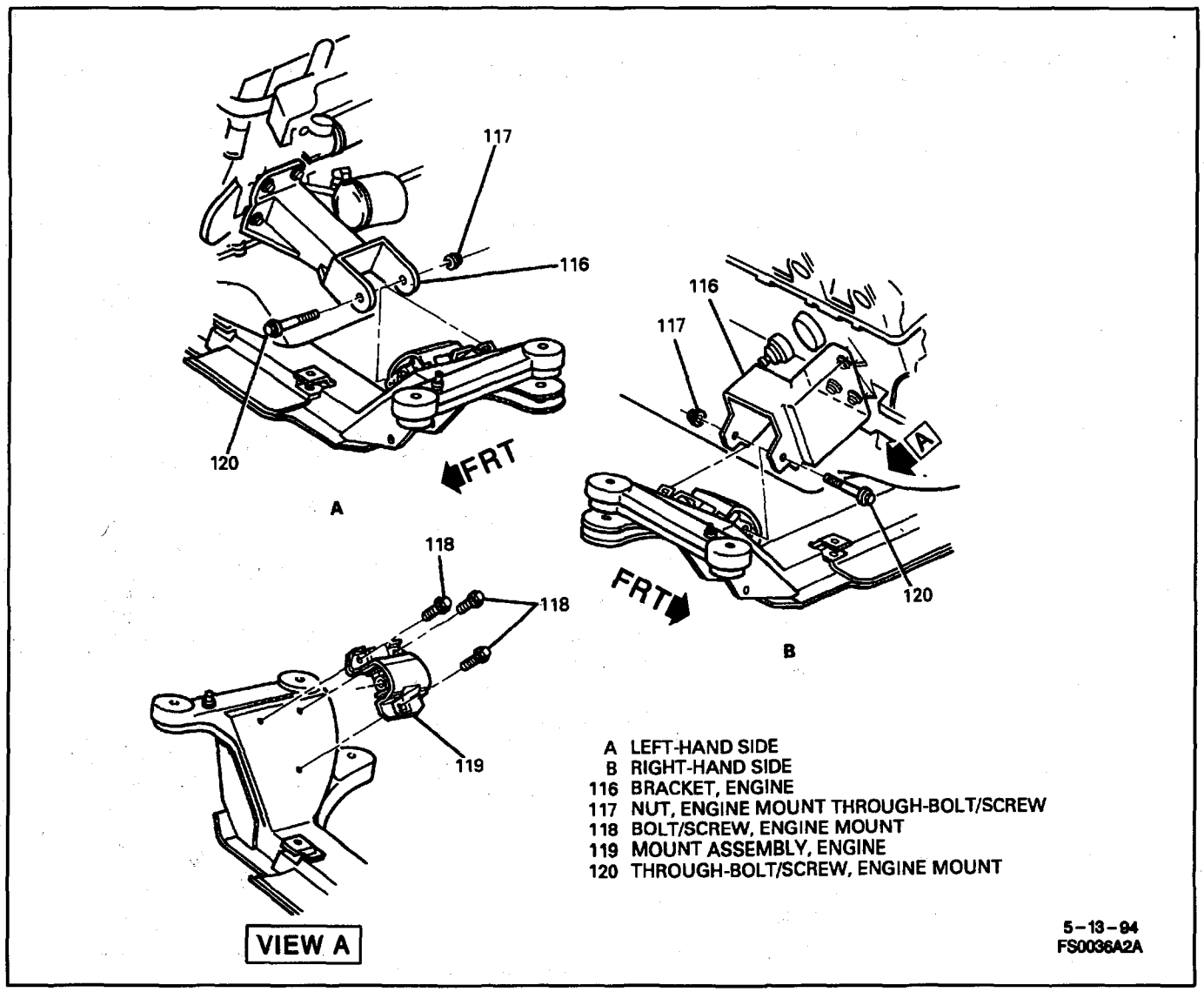


Figure 3 – Engine Mount Assemblies and Brackets

Tighten

- Engine mount bolts/screws (118) and bracket bolts/screws to 58 N•m (43 lb. ft.).

3. Lower engine.
4. Engine mount through-bolts/screws (120) and nuts (117).

Tighten

- Engine mount through-bolt/screw nuts (117) to 80 N•m (59 lb. ft.).

-or-

- Engine mount through-bolts/screws (120) to 95 N•m (70 lb. ft.).

5. Exhaust crossover pipe. Refer to SECTION 6F.
6. Lower vehicle.

OIL LEVEL INDICATOR AND TUBE ASSEMBLIES

Remove or Disconnect

1. Nut securing tube bracket to left cylinder head stud bolt/screw.
2. Level indicator and tube assemblies from engine block.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Clean tube assembly and apply sealant, GM P/N 12345493 or equivalent, around tube 12.7 mm (0.50 inch) below bead.
2. Tube assembly into engine block and rotate into position.
3. Nut securing tube bracket.

Tighten

- Oil level indicator tube nut to 21 N•m (15 lb. ft.).

4. Level indicator.

UPPER INTAKE MANIFOLD ASSEMBLY

Figures 4 and 5

Remove or Disconnect

CAUTION: See "Caution" on page 6A2A-1 of this section.

1. Battery negative cable assembly.
2. Drain coolant. Refer to SECTION 6B.
3. Throttle body air duct.
4. Fuel rail injector wiring harness connectors.
5. Wiring harness retaining nut and lay harness aside.
6. Accelerator cable bracket bolts/screws, bracket and cables from throttle body assembly.
7. Relieve fuel system pressure. Refer to "Fuel System Pressure Relief" in this section.
8. Fuel pipe connectors.
9. Fuel pipe bracket bolts/screws.
10. Fuel pipe hold down plate bolt/screw (167).
11. Fuel pipe assembly and reposition.
12. Coolant hoses from throttle body assembly.
13. Fuel rail stud (169).
14. Fuel pressure regulator vacuum hose.
15. Wiring harness electrical connectors from the following:
    - Idle air control
    - Throttle position sensor
    - Manifold absolute pressure sensor
    - Evaporative emissions canister purge solenoid valve
16. Blow dirt out of injector bores with compressed air.
17. Fuel rail assembly (166).
18. Vacuum harness assembly.
19. Exhaust gas recirculation (EGR) flexible pipe bolts/screws and reposition EGR flexible pipe assembly and gasket at upper intake manifold assembly (155).
20. Upper intake manifold bolts/screws (156).
21. Upper intake manifold assembly (155) and gasket (154).

Clean

- Upper intake manifold bolts/screws (156).
- Upper intake manifold sealing surfaces.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Upper intake manifold gasket (154) and manifold assembly (155).
2. Upper intake manifold bolts/screws (156).

Tighten

- Upper intake manifold bolts/screws (156) to 25 N•m (18 lb. ft.).

3. EGR flexible pipe gasket, pipe assembly and bolts/screws at upper intake manifold assembly (155).
   A. Apply teflon sealant GM P/N 1052080 to threads of bolts/screws.
   B. Gasket must be installed with text "tube side" facing the tube.

Tighten

- EGR flexible pipe bolts/screws to 26 N•m (19 lb. ft.).

4. Vacuum harness assembly.

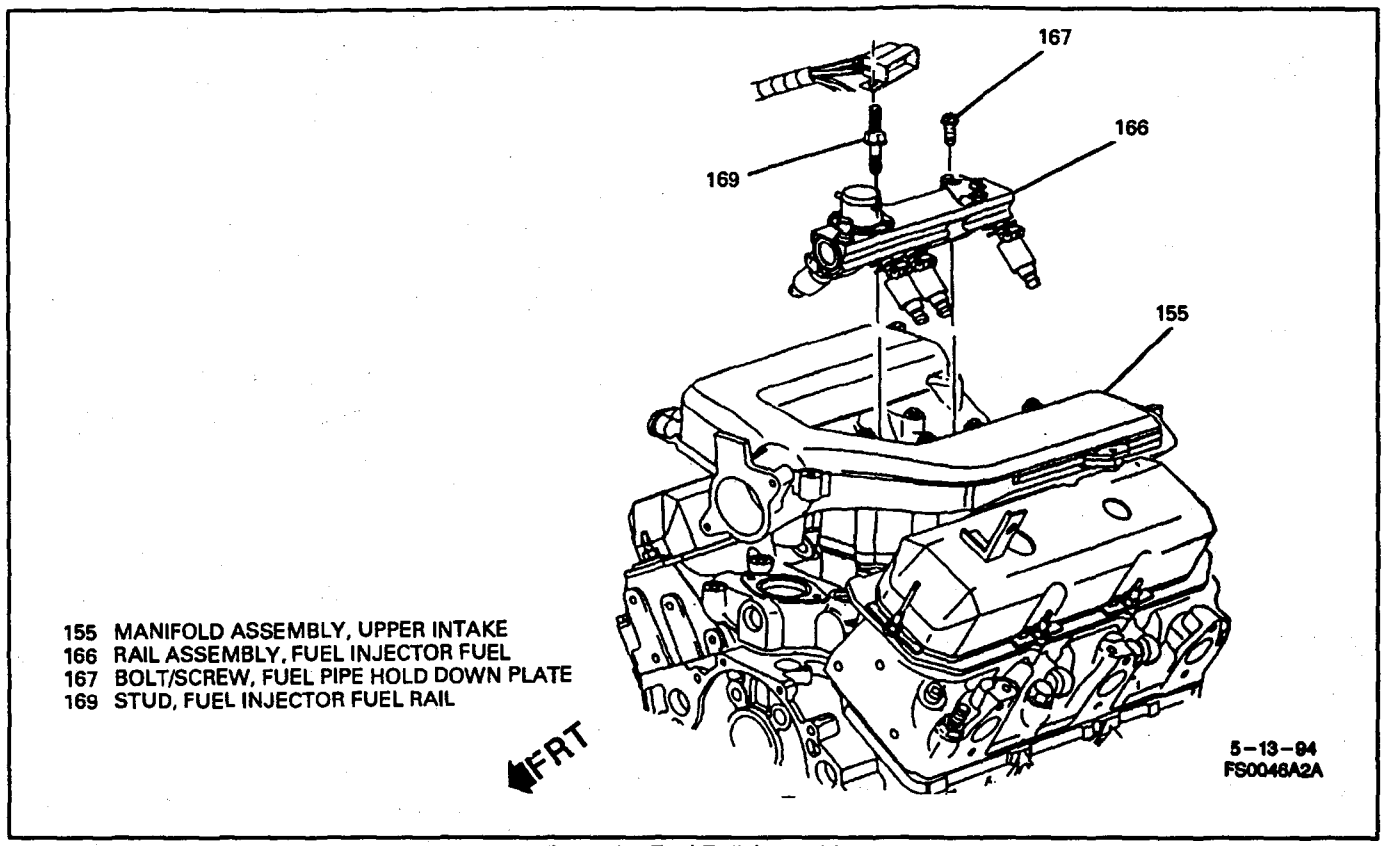


Figure 4 – Fuel Rail Assembly

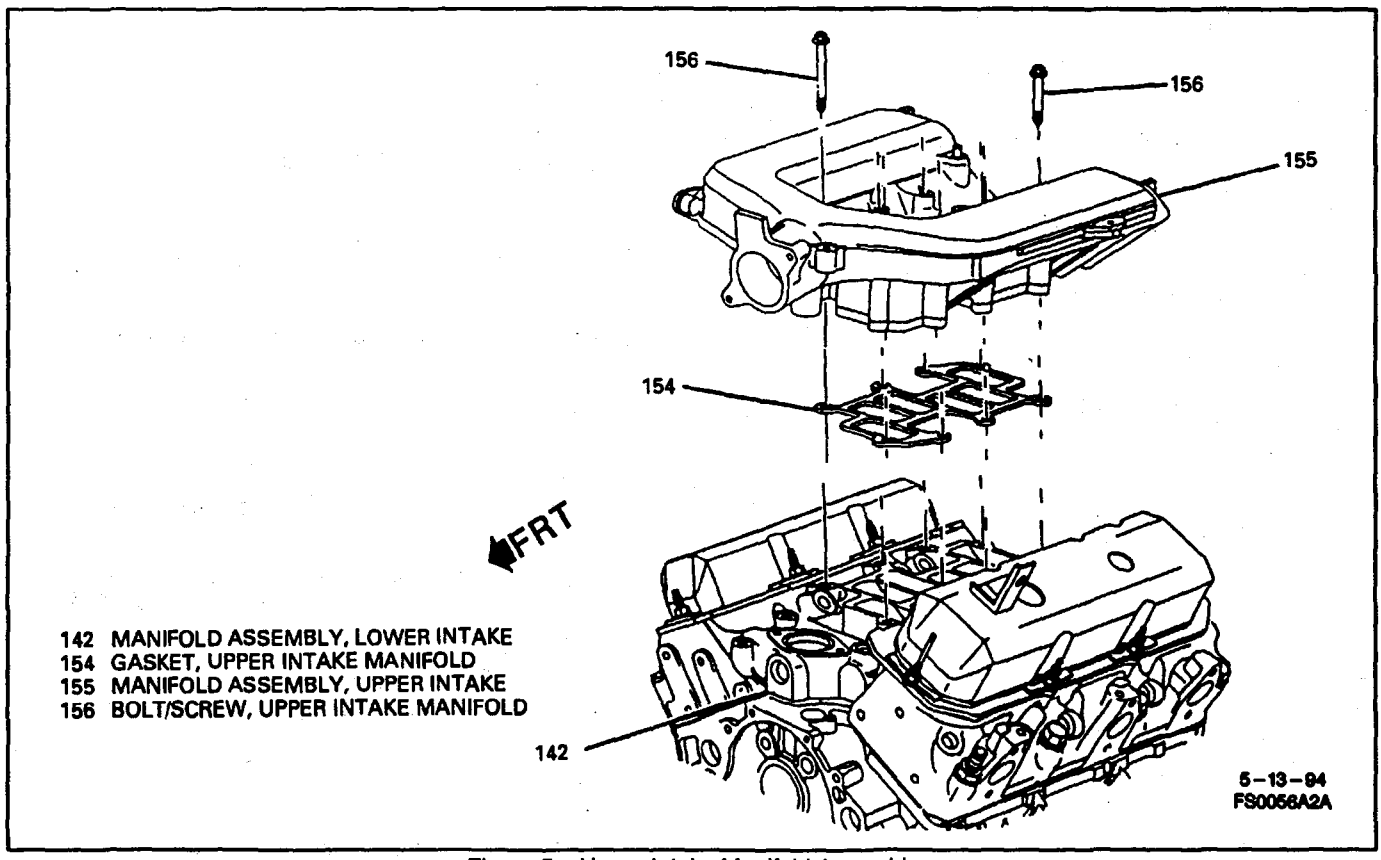


Figure 5 – Upper Intake Manifold Assembly

Important

- Do not press on the regulator cover or piedmont valve when installing fuel rail assembly.

5. Fuel rail assembly (166).
   A. Lightly lubricate fuel injector O-rings using clean engine oil.
   B. Install injectors of fuel rail assembly (166) into bores of manifold.
   C. Carefully press on fuel rail assembly (166) with palms of both hands until injectors are fully seated.
6. Fuel rail stud (169).

Tighten

- Fuel rail stud (169) to 25 N•m (18 lb. ft.).

7. Wiring harness electrical connectors to the following:
   - Idle air control
   - Throttle position sensor
   - Manifold absolute pressure sensor
   - Evaporative emissions canister purge solenoid valve
8. Fuel pressure regulator vacuum hose.
9. Fuel rail wiring harness retaining nut.
10. Fuel pipe assembly to fuel rail assembly (166).
    - Slide fuel line hold down plate over fuel pipe assembly.
11. Fuel pipe hold down plate bolt/screw (167).
    - Apply teflon sealant GM P/N 1052080 to threads of bolt/screw (167).

Tighten

- Fuel pipe hold down plate bolt/screw (167) to 25 N•m (18 lb. ft.)

12. Fuel pipe bracket bolts/screws.
13. Accelerator cable bracket, bolts/screws and cables.

Tighten

- Accelerator cable bracket bolts/screws to 10 N•m (90 lb. in.).
- Fuel pipe bracket-to-front brace bolt/screw to 8 N•m (71 lb. in.)
- Fuel pipe bracket-to-intake manifold assembly bolt/screw to 10 N•m (89 lb. ft.).

14. Fuel pipe connectors.
15. Fuel rail injector wiring harness connectors.
16. Coolant hoses to throttle body assembly.
17. Throttle body air duct.
18. Battery negative cable assembly.
19. Refill with coolant. Refer to SECTION 6B.

VALVE ROCKER ARM COVER ASSEMBLIES

Figure 6

Right Side

Remove or Disconnect

1. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this Section.
2. EGR valve adapter bolt/screw, stud, and adapter with EGR valve assembly from exhaust manifold assembly.
3. Crankcase vent pipe.
4. Spark plug wiring harness assembly from clips.
5. Nuts (192) and reinforcements (193).
6. Valve rocker arm cover assembly (194) and gasket (195).

Clean

- Rocker cover assembly and cylinder head gasket surfaces.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Valve rocker arm cover gasket (195) and cover assembly (194).
2. Reinforcements (193) and nuts (192).

Tighten

- Nuts (192) to 10 N•m (89 lb. in.).

3. Spark plug wiring harness assembly to clips.
4. Crankcase vent pipe.
5. EGR valve adapter, bolt/screw and stud with EGR valve assembly to exhaust manifold assembly.

Tighten

- EGR valve adapter bolt/screw and stud to 31 N•m (23 lb. ft.).

6. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.

Left Side

Remove or Disconnect

1. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.
2. PCV valve and hose assembly.
3. Spark plug wire harness assembly from clips.
4. Nuts (192) and reinforcements (193).
5. Valve rocker arm cover assembly (194) and gasket (195).

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

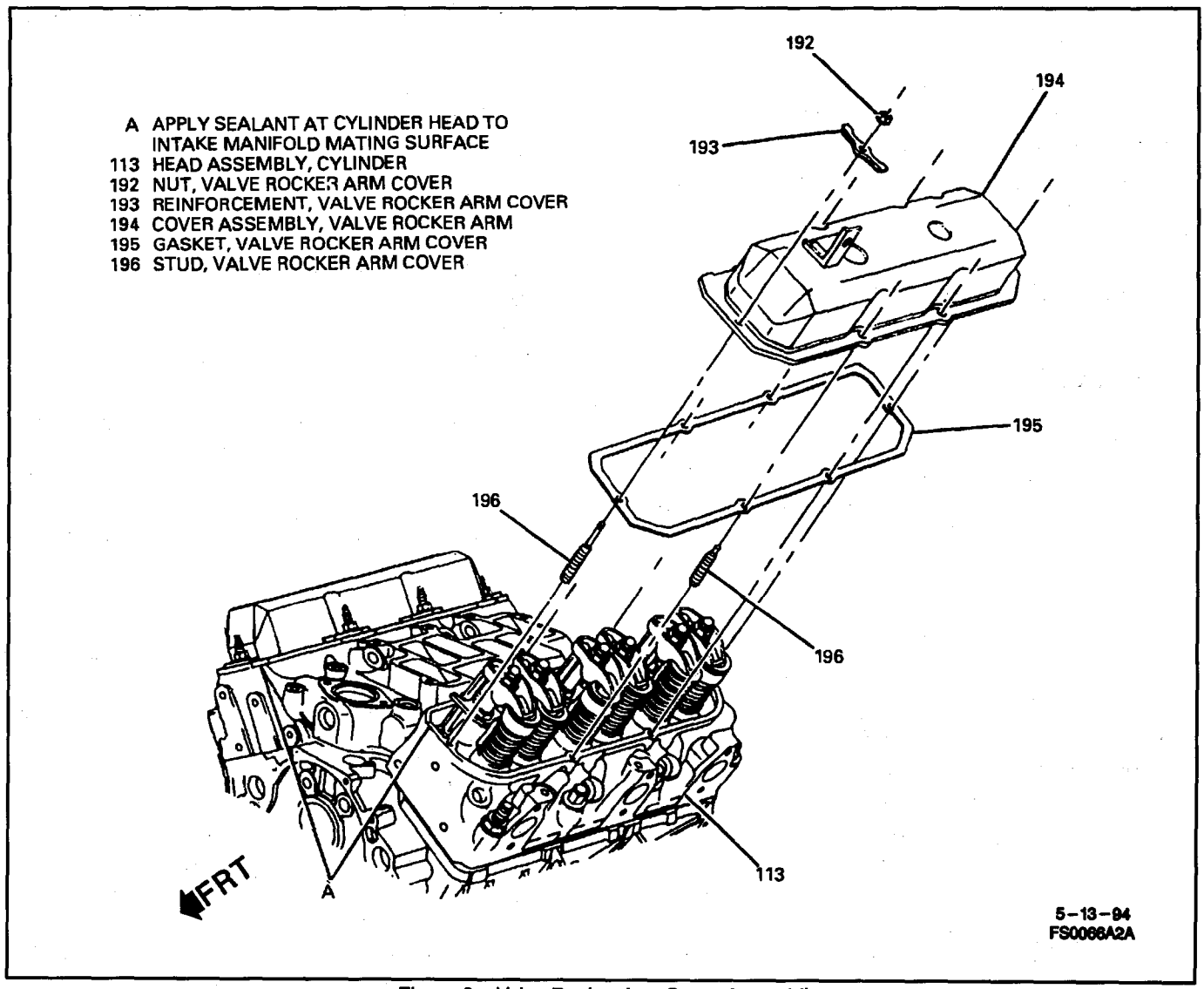


Figure 6 – Valve Rocker Arm Cover Assemblies

1. Valve rocker arm cover gasket (195) and cover assembly (194).
2. Reinforcements (193) and nuts (192).

Tighten

- Nuts (192) to 10 N•m (89 lb. in.).

3. Spark plug wire harness assembly to clips.
4. PCV valve and hose assembly.
5. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.

VALVE ROCKER ARMS AND PUSHROD ASSEMBLIES

Figure 7

Remove or Disconnect

1. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
2. Valve rocker arm nuts (124) and balls (123).
3. Valve rocker arms (122) and pushrod assemblies (93).
   - Place valve rocker arms (122), balls (123) and pushrod assemblies (93) in a rack so they can be reinstalled in same locations from which they were removed.

Important

- Refer to SECTION 6A2B for inspection of the rocker arms, studs and pushrod assemblies.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

Important

- When installing valve rocker arms (122), balls (123) and pushrod assemblies (93), coat their

bearing surfaces with prelube, GM P/N 1052365 or equivalent. Install these components in the locations from which they were removed.

1. Pushrod assemblies (93). Make sure pushrod assemblies (93) seat in lifter sockets.
2. Valve rocker arms (122).
3. Valve rocker arm balls (123) and nuts (124).

Adjust

A. Turn crankshaft assembly until arrow on crankshaft hub and balancer assembly are in 12 o'clock position and number 1 cylinder is in firing position (top dead center).
   - Watch number 1 cylinder valves as arrow approaches 12 o'clock position. If a valve moves as the arrow moves to position, the engine is in number 6 cylinder firing position. Crankshaft assembly must then be turned one more time to reach number 1 cylinder firing position.

B. With engine in number 1 cylinder firing position, the following valves can be adjusted:
   - Exhaust 1, 2, 3
   - Intake 1, 5, 6

C. Back off rocker arm nut (124) until lash is felt in pushrod assembly (93). Then tighten rocker arm nut (124) until all lash is removed. Zero lash can be felt by moving pushrod assembly (93) up and down using thumb and forefinger until there is no more movement.

D. When all free play has been removed, tighten rocker arm nut (124) one additional turn.

E. Turn crankshaft assembly one revolution until hub arrow is again at 12 o'clock position. This is number 6 cylinder firing position. The following valves can now be adjusted:
   - Exhaust 4, 5, 6
   - Intake 2, 3, 4

4. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.

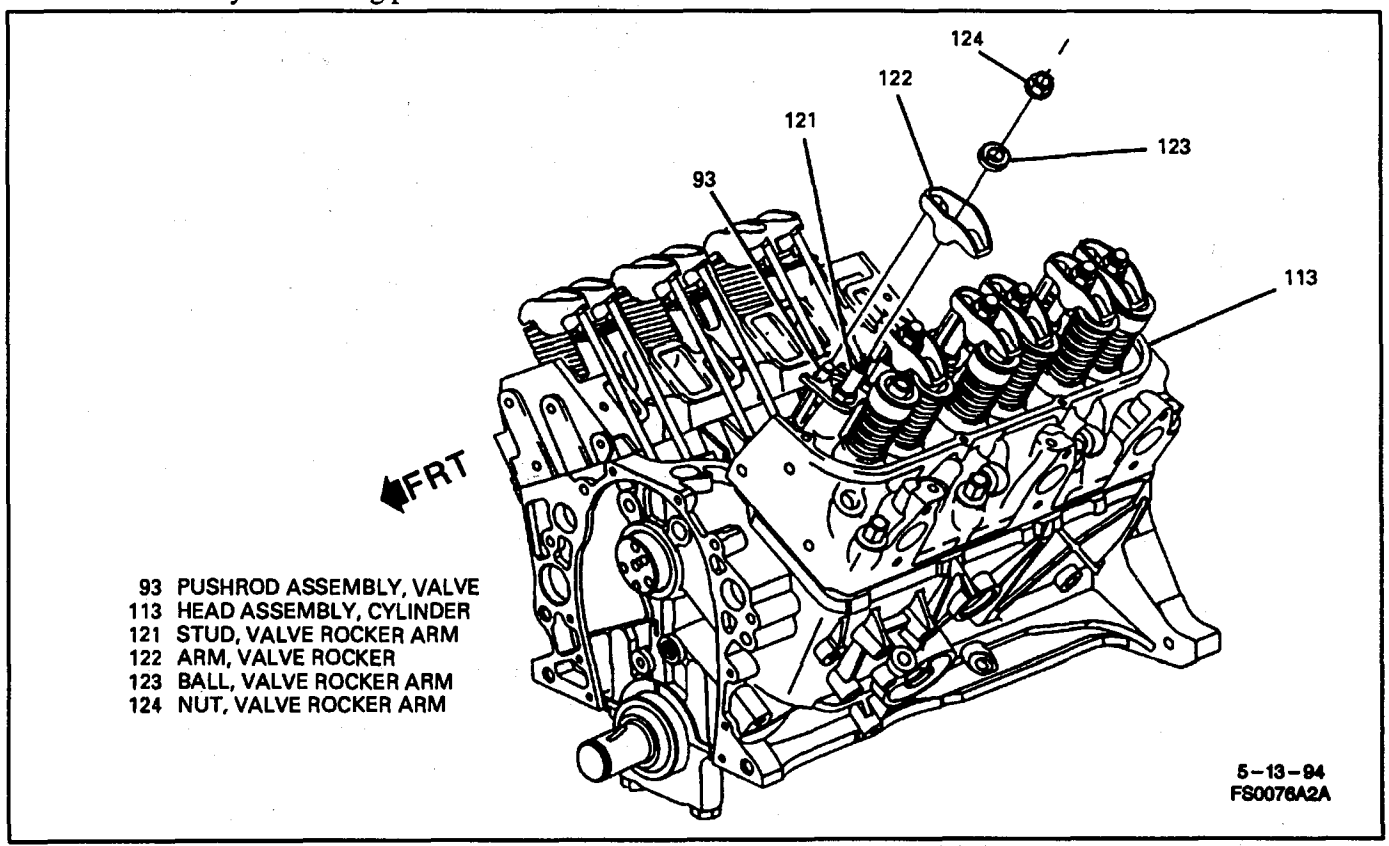


Figure 7 – Valve Rocker Arms and Pushrod Assemblies

LOWER INTAKE MANIFOLD ASSEMBLY

Figure 8

Remove or Disconnect

1. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.
2. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
3. Upper radiator hose from lower intake manifold assembly (142).
4. Heater hose from lower intake manifold assembly (142).
5. Wiring harness ground leads.

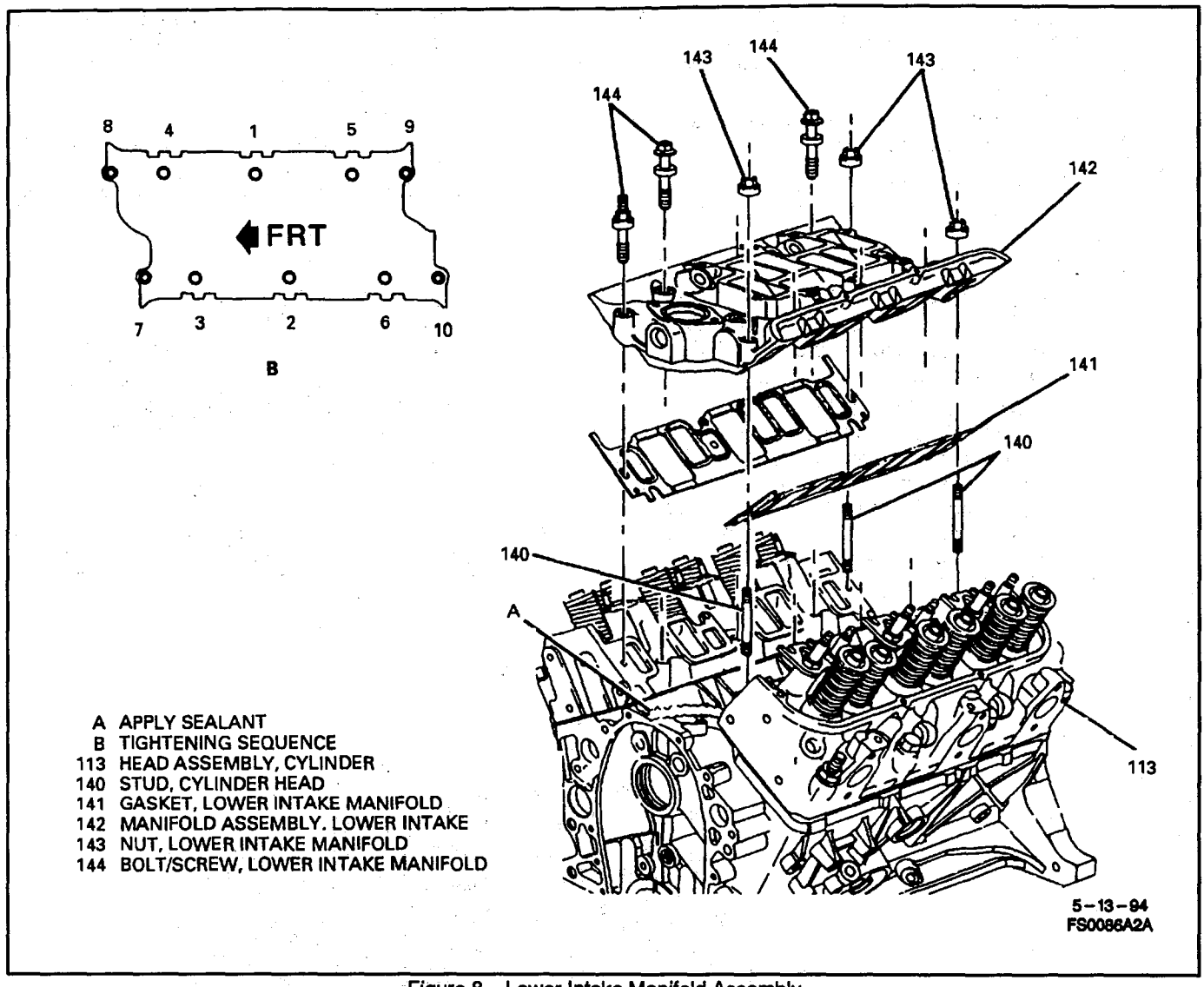


Figure 8 – Lower Intake Manifold Assembly

6. Manifold bolts/screws (144) and nuts (143).
7. Lower intake manifold assembly (142) and gaskets (141).

Install or Connect

1. Gaskets (141).
2. Apply sealant GM P/N 12345739 at engine block to manifold mating surface. Bead should be 2.0-3.0 mm (0.08-0.12 inch) wide and 3.0-5.0 mm (0.12-0.20 inch) thick.
3. Lower intake manifold assembly (142).
4. Manifold bolts/screws (144) and nuts (143).

Tighten

- Manifold bolts/screws (144) and nuts (143) to 30 N•m (22 lb. ft.).

5. Wiring harness ground leads.
6. Heater hose.
7. Upper radiator hose.
8. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
9. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.

VALVE LIFTER ASSEMBLIES

Figures 9 and 10

No service parts are available for valve lifter assemblies. They are replaced as a unit when worn and when a new camshaft assembly is installed.

Valve lifters should be kept in order so they may be installed in their original position. Some engines will have both standard and 0.25 mm (.010 inch) oversize (O.S.) valve lifters.

Where oversize lifters are used, the cylinder case will be marked with a daub of white paint and/or "0.25 mm O.S." stamped on the lifter boss.

If the lifters are removed, they must be installed in their original location. If replacement is necessary, use lifters with a narrow flat ground along the lower 3/4 of lifter. These flats provide additional oil to the cam lobe and lifter surfaces.

Remove or Disconnect

1. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.
2. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
3. Lower intake manifold assembly. Refer to "Lower Intake Manifold Assembly" in this section.
4. Valve rocker arms and pushrod assemblies. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
5. Valve lifter assembly (94).

Important

- Refer to SECTION 6A2B for cleaning and inspection of the valve lifter assemblies.

Install or Connect

1. Coat lifters with prelube, GM P/N 1052365 or equivalent.
2. Valve lifter assembly (94).
3. Valve rocker arms and pushrod assemblies. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
4. Lower intake manifold assembly. Refer to "Lower Intake Manifold Assembly" in this section.
5. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
6. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.

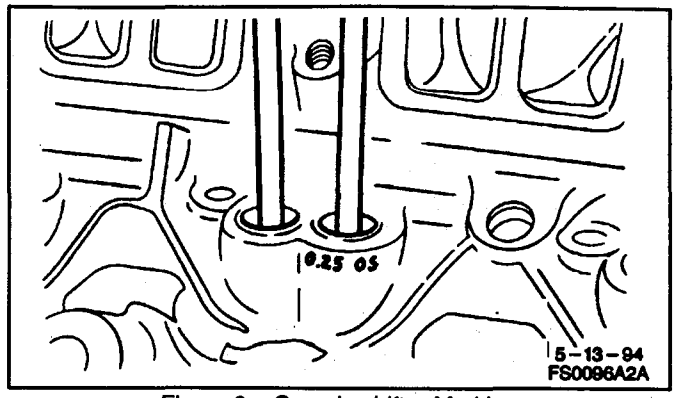


Figure 9 – Oversize Lifter Marking

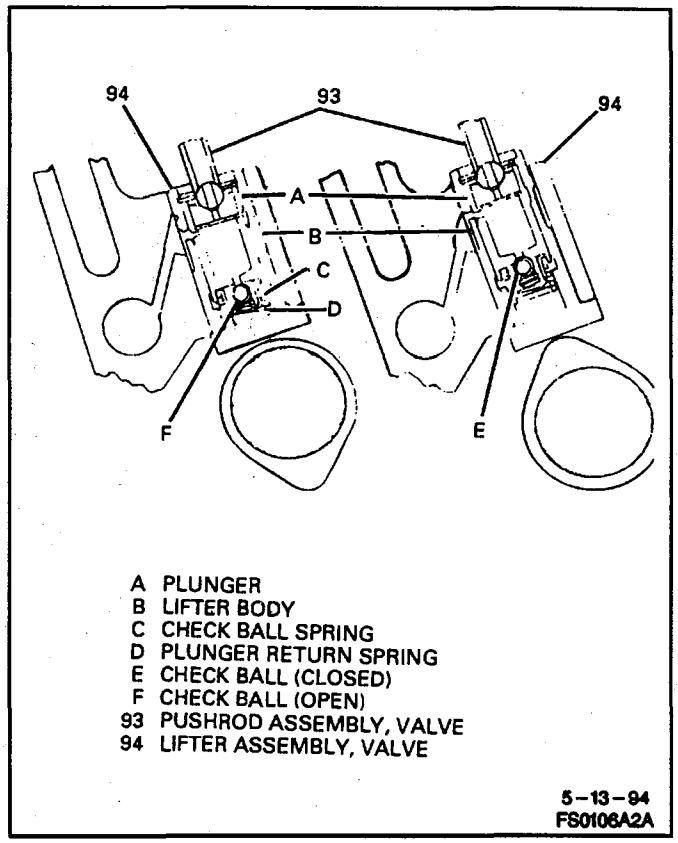


Figure 10 – Valve Lifter Assembly Operation

EXHAUST MANIFOLD ASSEMBLIES

Figures 11 and 12

Left Side

Remove or Disconnect

CAUTION: See "Caution" on page 6A2A-1 of this section.

1. Battery negative cable assembly.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Exhaust crossover pipe. Refer to SECTION 6F.
4. Lower vehicle.
5. Oxygen sensor electrical connector.
6. Secondary air injection check valve pipe bracket nut and reposition pipe (manual transmission only).
7. Exhaust manifold bolts/screws (102).
8. Exhaust manifold assembly (105) and heat shields (103 and 104).
9. Exhaust manifold gasket (106).

Clean

- Exhaust manifold and cylinder head sealing surfaces.

Install or Connect

1. Exhaust manifold gasket (106).
2. Exhaust manifold assembly (105) and heat shields (103 and 104).
3. Exhaust manifold bolts/screws (102).

Tighten

- Exhaust manifold bolts/screws (102) to 25 N•m (18 lb. ft.).

4. Oxygen sensor electrical connector.
5. Secondary air injection check valve pipe bracket nut (manual transmission only).

Tighten

- Secondary air injection check valve pipe bracket nut to 25 N•m (18 lb. ft.).

6. Raise and suitably support vehicle. Refer to SECTION 0A.
7. Exhaust crossover pipe. Refer to SECTION 6F.
8. Lower vehicle.
9. Battery negative cable assembly.

Right Side

Remove or Disconnect

CAUTION: See "Caution" on page 6A2A-1 of this section.

1. Battery negative cable assembly.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Exhaust crossover pipe. Refer to SECTION 6F.

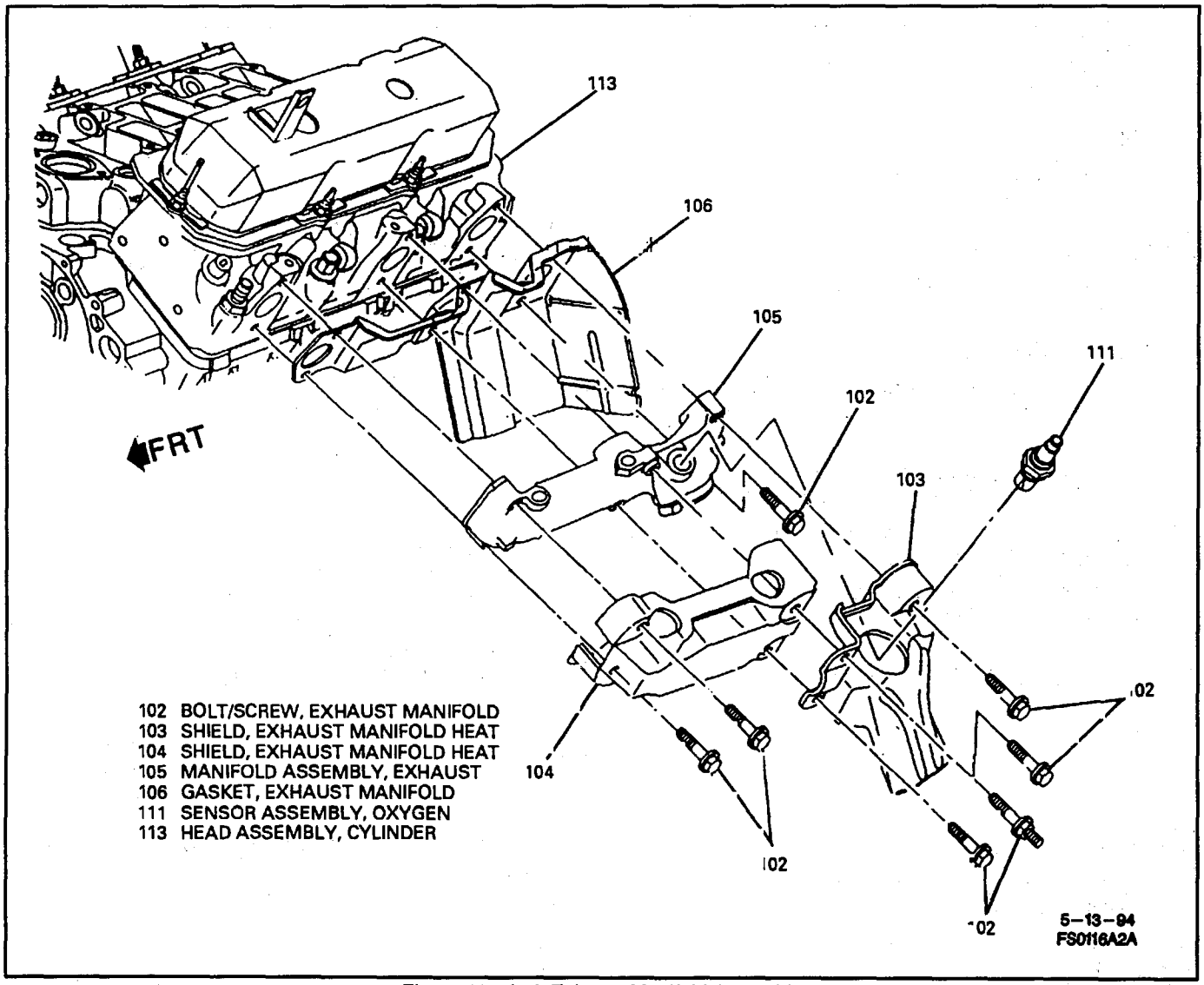


Figure 11 – Left Exhaust Manifold Assembly

4. Transmission filler tube. Refer to SECTION 7A.
5. A/C compressor rear bracket bolts/screws. Refer to SECTION 1B.
6. Rear two exhaust manifold bolts/screws (202).
7. Lower vehicle.
8. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
9. Oxygen sensor electrical connector.
10. Generator. Refer to SECTION 6D3.
11. A/C compressor from bracket and reposition. Refer to SECTION 1B.

12. Generator rear "Y" brace. Refer to SECTION 6D3.
13. EGR valve, adapter, and flexible pipe. Refer to SECTION 6E3.
14. Secondary air injection pipe assembly from exhaust manifold assembly (215) (manual transmission only). Refer to SECTION 6E3.
15. Exhaust manifold front and middle bolts/screws (202).
16. Exhaust manifold assembly (215), heat shields (203 and 205) and gasket (216).

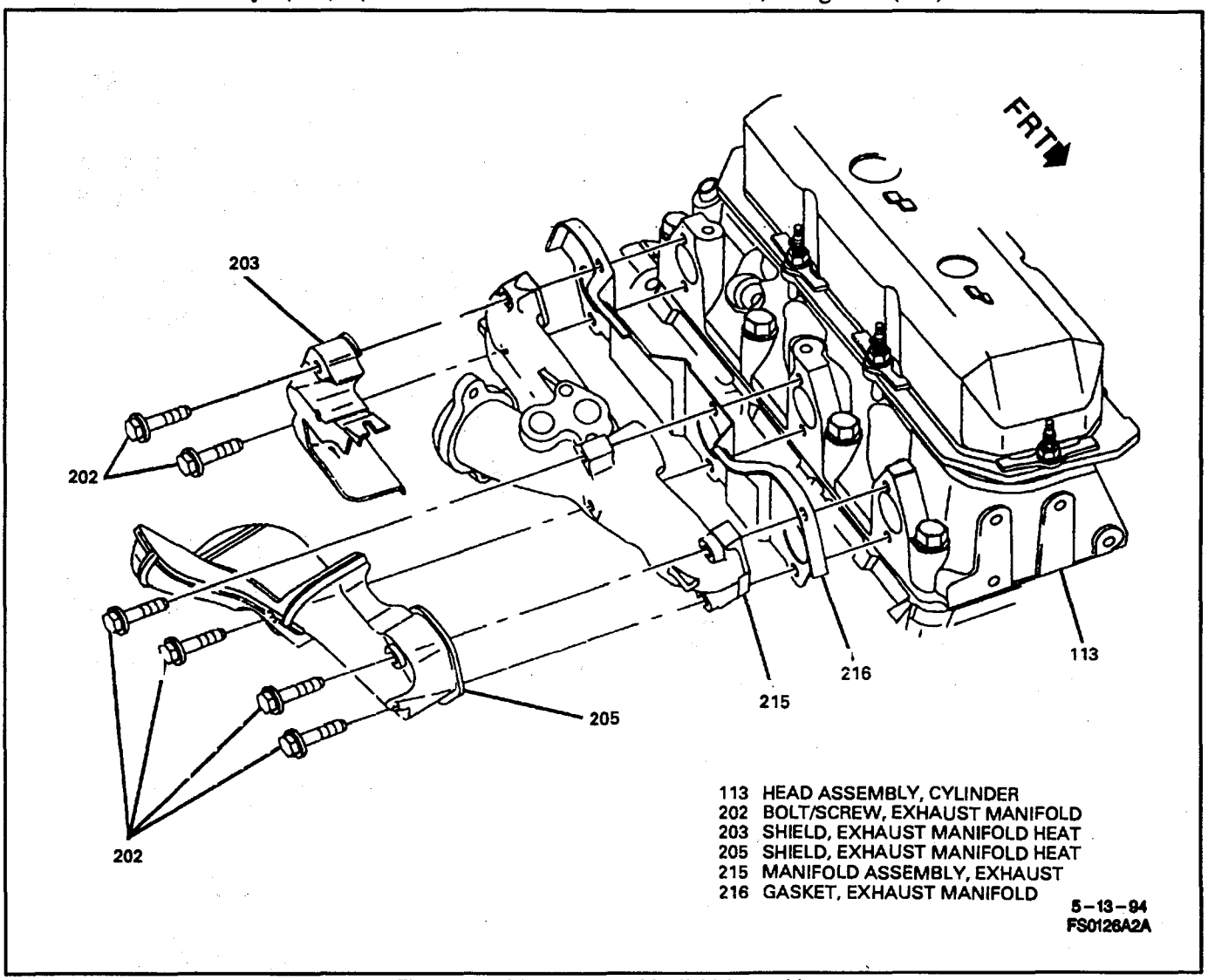


Figure 12 – Right Exhaust Manifold Assembly

Clean

- Exhaust manifold and cylinder head sealing surfaces.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Exhaust manifold gasket (216).
2. Exhaust manifold assembly (215) and heat shields (203 and 205).
3. Exhaust manifold front and middle bolts/screws (202).

Tighten

- Exhaust manifold bolts/screws (202) to 25 N•m (18 lb. ft.).

4. EGR valve adapter and flexible pipe. Refer to SECTION 6E3.
5. Generator rear "Y" brace. Refer to SECTION 6D3.
6. Generator. Refer to SECTION 6D3.
7. A/C compressor. Refer to SECTION 1B.
8. Oxygen sensor electrical connector.
9. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
10. Raise and suitably support vehicle. Refer to SECTION 0A.

11. Transmission filler tube. Refer to SECTION 7A.
12. A/C compressor rear bracket bolts/screws. Refer to SECTION 1B.
13. Exhaust crossover pipe. Refer to SECTION 6F.
14. Exhaust manifold rear bolts/screws (202).

Tighten

- Exhaust manifold rear bolts/screws (202) to 25 N•m (18 lb. ft.).

15. Lower vehicle.
16. Battery negative cable assembly.
17. Refill transmission. Refer to SECTION 7A.

CRANKSHAFT BALANCER ASSEMBLY

Figures 13 and 14

Tools Required:

J 24420-B Torsional Damper Remover

J 29113 Torsional Damper Installer

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
3. Crankshaft balancer bolt/screw and washer.
4. Crankshaft pulley bolts/screws and pulley.
5. Crankshaft balancer assembly (27) using J 24420-B.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Crankshaft balancer assembly (27) using J 29113.
2. Remove J 29113.
3. Crankshaft pulley and bolts/screws.
4. Crankshaft balancer washer and bolt/screw.

Important

- If balancer assembly is replaced, new balance weights of the same size must be installed on the new balancer assembly in the same hole locations as the old balancer assembly.

Tighten

- Crankshaft balancer bolt/screw to 78 N•m (58 lb. ft.).
- Crankshaft pulley bolts/screws to 50 N•m (37 lb. ft.).

5. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
6. Lower vehicle.

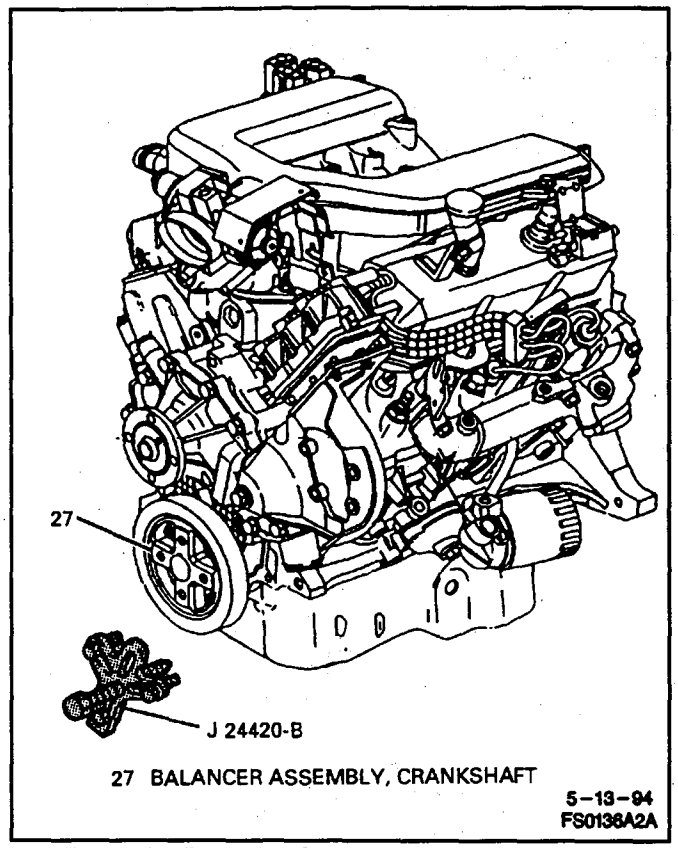


Figure 13 – Removing Crankshaft Balancer Assembly

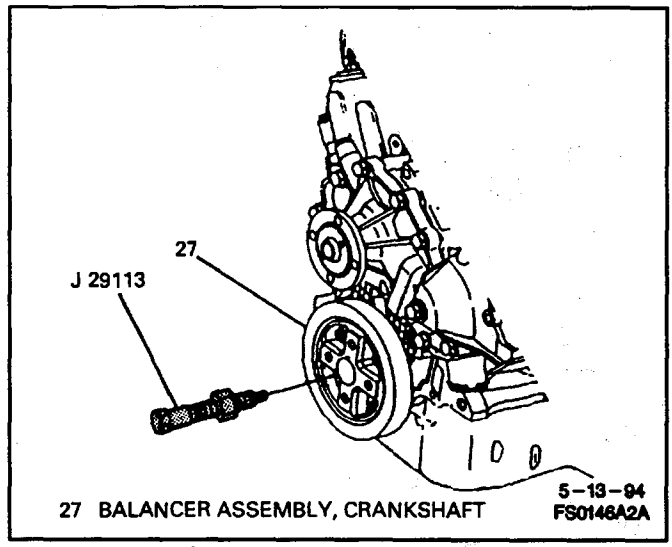


Figure 14 – Installing Crankshaft Balancer Assembly

ENGINE FRONT COVER ASSEMBLY

Figure 15

Remove or Disconnect

1. Throttle body air duct.
2. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
3. Water pump assembly. Refer to SECTION 6B.

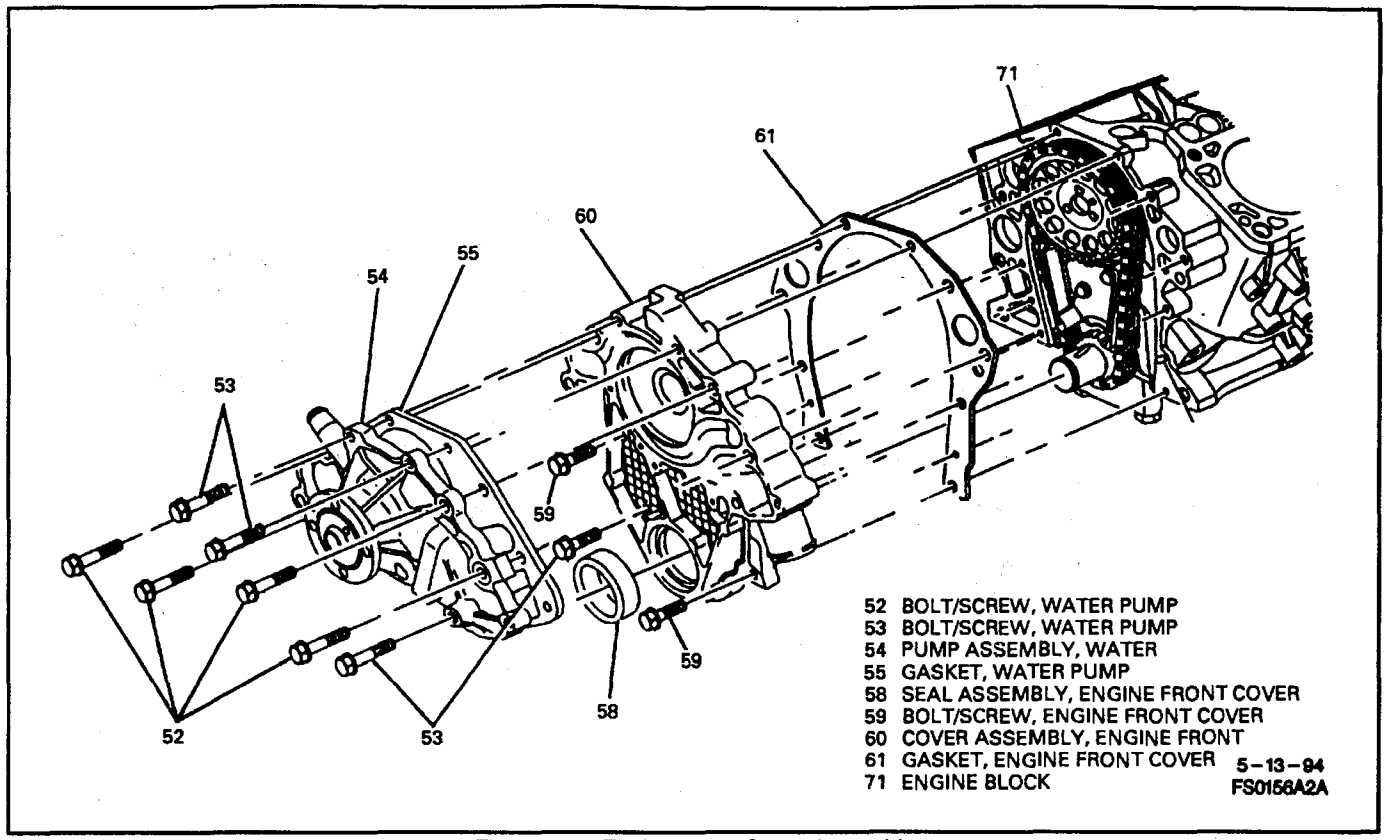


Figure 15 – Engine Front Cover Assembly

4. Crankshaft balancer assembly. Refer to "Crankshaft Balancer Assembly" in this section.
5. Power steering pump and bracket. Refer to SECTION 3B.
6. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
7. Lower radiator hose from the front cover assembly.
8. Crankshaft sensor.
9. Engine front cover bolts/screws (59).
10. Engine front cover assembly (60) and gasket (61).

Clean

- Engine front cover and engine block gasket surfaces.

Inspect

- Engine front cover assembly (60) for damage to the seals or gasket surface. Refer to SECTION 6A2B to replace front cover seals if necessary.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Gasket (61) and engine front cover assembly (60).
   - Coat both sides of lower tabs of gasket (61) with sealer, GM P/N 1052080.
2. Engine front cover bolts/screws (59).

Tighten

- Engine front cover bolts/screws (59) to 21 N•m (15 lb. ft.).

3. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
4. Crankshaft sensor.
5. Lower radiator hose.
6. Crankshaft balancer assembly. Refer to "Crankshaft Balancer Assembly" in this section.
7. Lower vehicle.
8. Water pump assembly. Refer to SECTION 6B.
9. Power steering pump and bracket. Refer to SECTION 3B.
10. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
11. Throttle body air duct.

TIMING CHAIN ASSEMBLY, AND CRANKSHAFT AND CAMSHAFT SPROCKETS

Figures 16 through 19

Tools Required:

J 23444-A Crankshaft Sprocket Remover

J 38612 Crankshaft Sprocket Installer

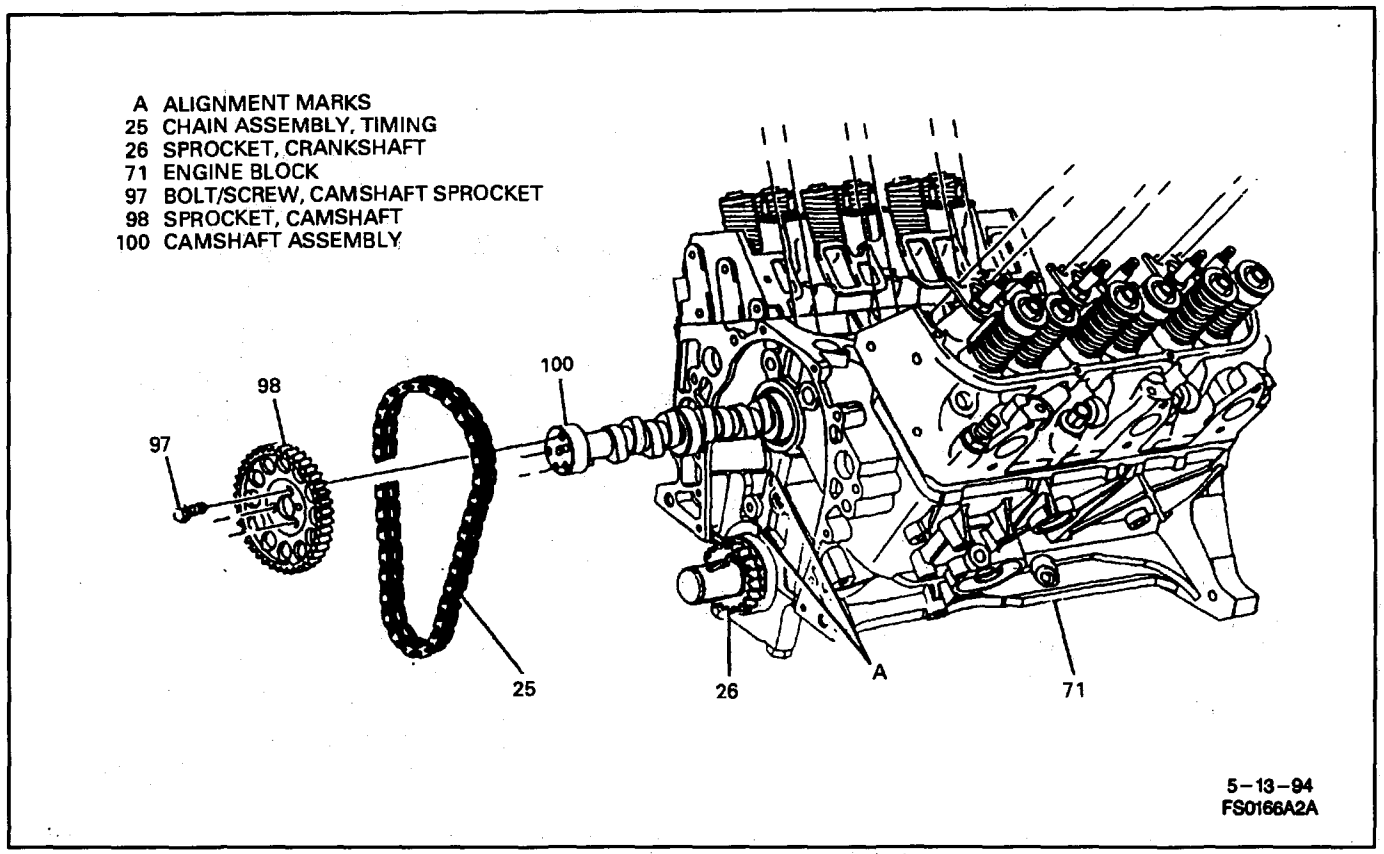


Figure 16 – Camshaft Assembly, Sprockets and Timing Chain Assembly

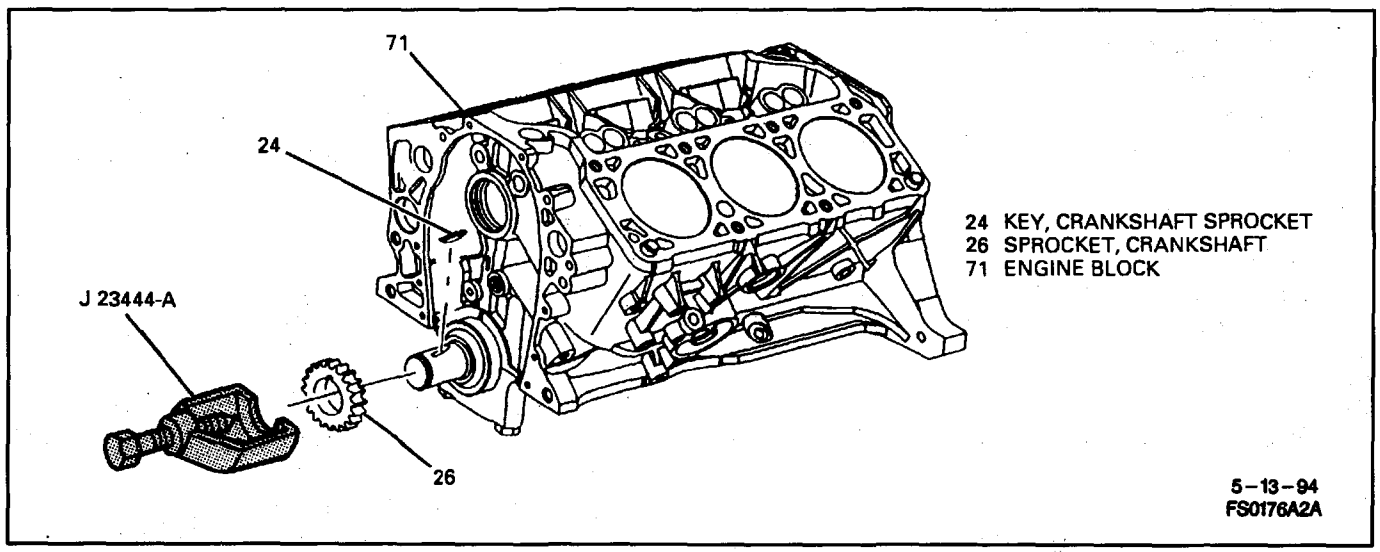


Figure 17 – Removing Crankshaft Sprocket

Remove or Disconnect

1. Engine front cover assembly. Refer to "Engine Front Cover Assembly" in this section.
2. Rotate crankshaft assembly (22) until timing marks punched on crankshaft sprocket (26) and camshaft sprocket (98) are aligned to marks on engine block (71) or timing chain dampener. See Figure 16. This is the number 4 piston at top dead center.
3. Camshaft sprocket bolts/screws (97).
4. Camshaft sprocket (98) and timing chain assembly (25).
5. Crankshaft sprocket (26) using J 23444-A.
6. Timing chain dampener bolts/screws (62) and dampener (63).

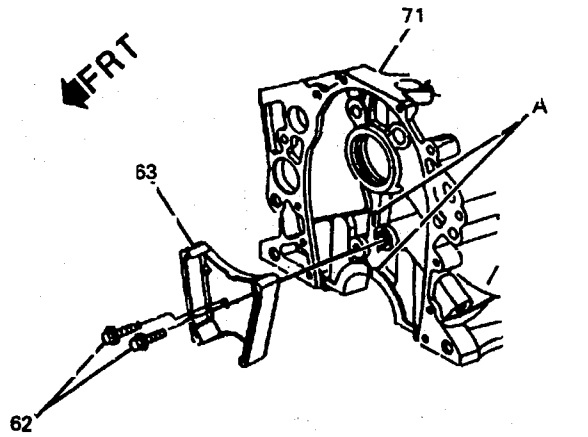


Figure 18 – Timing Chain Dampener

7. Key (24), if necessary.

Inspect

- Refer to SECTION 6A2B for component inspection.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Key (24), if previously removed.
2. Crankshaft sprocket (26) using J 38612.
3. Camshaft sprocket (98) and timing chain assembly (25).
   - Make sure timing marks on camshaft and crankshaft sprockets are aligned with marks cast into engine block.
   - Coat crankshaft and camshaft sprockets with engine oil.
4. Camshaft sprocket bolts/screws (97).

Tighten

- Camshaft sprocket bolts/screws (97) to 24 N•m (18 lb. ft.).

5. Timing chain dampener (63) and bolts/screws (62).

Tighten

- Bolts/screws (62) to 21 N•m (15 lb. ft.).

6. Engine front cover assembly. Refer to "Engine Front Cover Assembly" in this section.

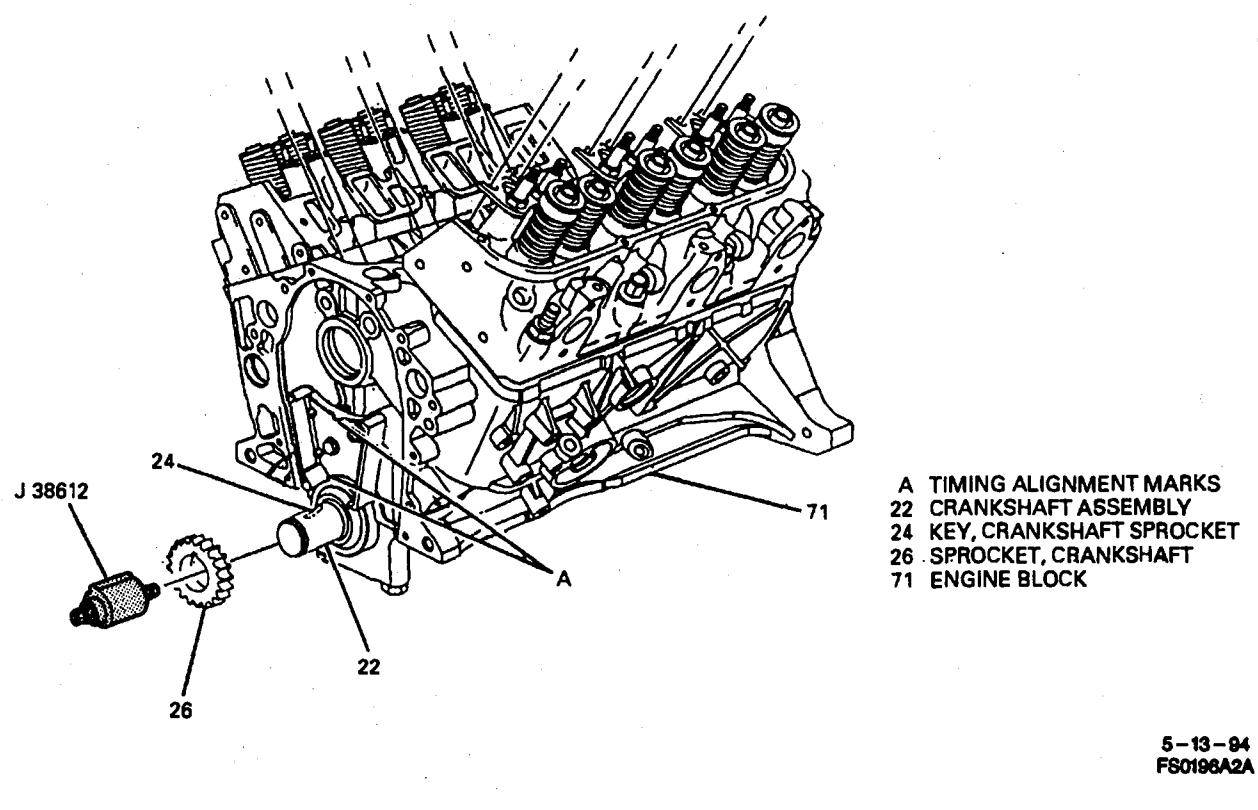


Figure 19 – Installing Crankshaft Sprocket

CAMSHAFT ASSEMBLY

Figures 20, 21 and 22

Measuring Camshaft Lobe Lift

Tool Required:

J 8520 Cam Lobe Lift Indicator

Measuring lobe lift procedure is similar to that used for checking valve timing. If improper valve operation is indicated, measure lift of each pushrod in consecutive order and record readings.

1. Remove valve rocker arm. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
2. Position J 8520 with ball socket adapter on pushrod. Make sure pushrod is in lifter socket.
3. Rotate crankshaft slowly in direction of rotation until lifter is on heel of camshaft lobe. At this point, pushrod is in its lowest position.
4. Set dial indicator on zero, then rotate crankshaft slowly until pushrod is in fully raised position (Figure 20).
5. Compare total lift recorded from dial indicator with specifications.
6. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
7. Install and adjust rocker arms. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.

Remove or Disconnect

1. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.
2. Valve rocker arms and pushrod assemblies. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
3. Lower intake manifold assembly. Refer to "Lower Intake Manifold Assembly" in this section.
4. Bolt/screw (91), clamp (92) and oil pump drive assembly (90).
5. Engine front cover assembly. Refer to "Engine Front Cover Assembly" in this section.
6. Camshaft sprocket. Refer to "Timing Chain Assembly, and Crankshaft and Camshaft Sprockets" in this section.
7. Valve lifter assemblies. Refer to "Valve Lifter Assemblies" in this section.
8. Discharge air conditioning system. Refer to SECTION 1B.
9. Air conditioning compressor and condenser hose from condenser.
10. Air conditioning receiver and dehydrator hose from condenser.
11. Radiator assembly with air conditioning condenser. Refer to SECTION 6B.
12. Air conditioning condenser support assembly.

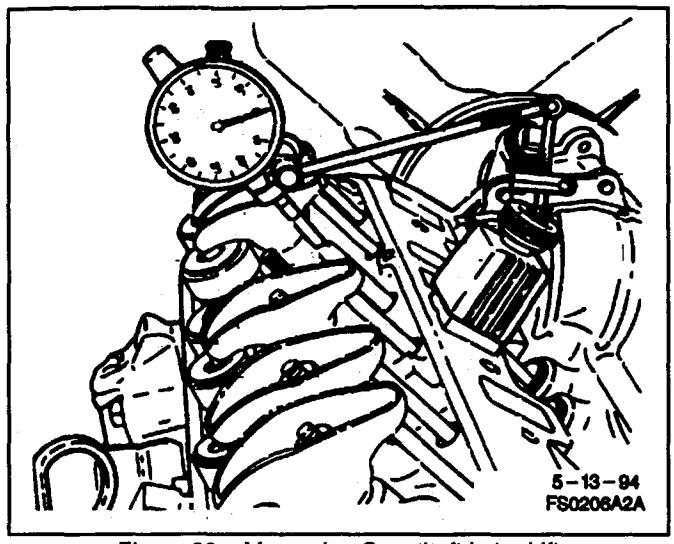


Figure 20 – Measuring Camshaft Lobe Lift

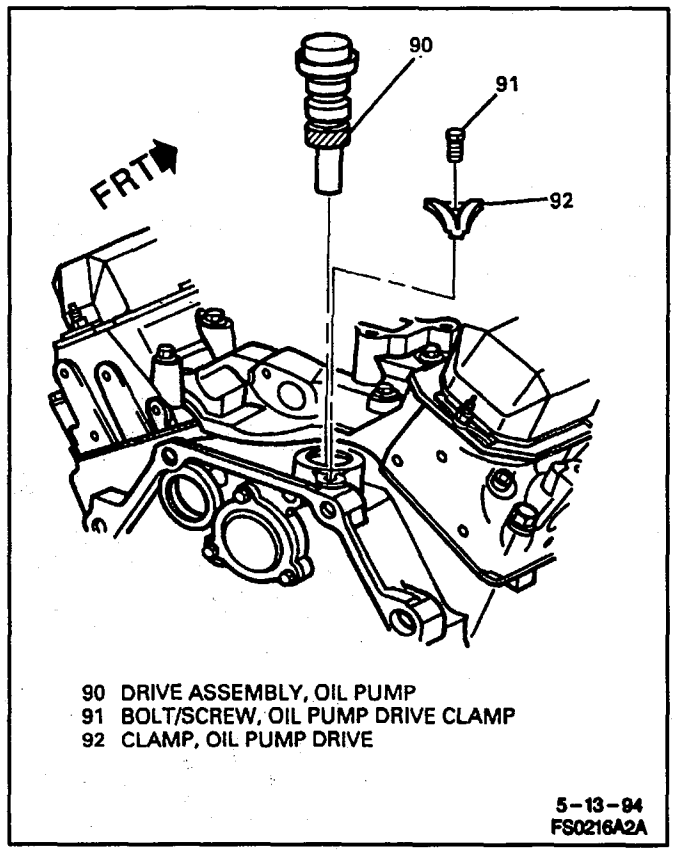


Figure 21 – Oil Pump Drive Assembly

NOTICE: All camshaft journals are the same diameter so care must be used in removing the camshaft to avoid damage to the bearings.

13. Camshaft assembly (100).
    A. Install three 5/16-18 x 4-inch bolts/screws in camshaft bolt/screw holes.
    B. Carefully rotate and pull camshaft assembly (100) out of bearings.

Important

- Refer to "Cleaning, Inspection and Repair" in SECTION 6A2B for inspection and measurement procedures for camshaft assembly.

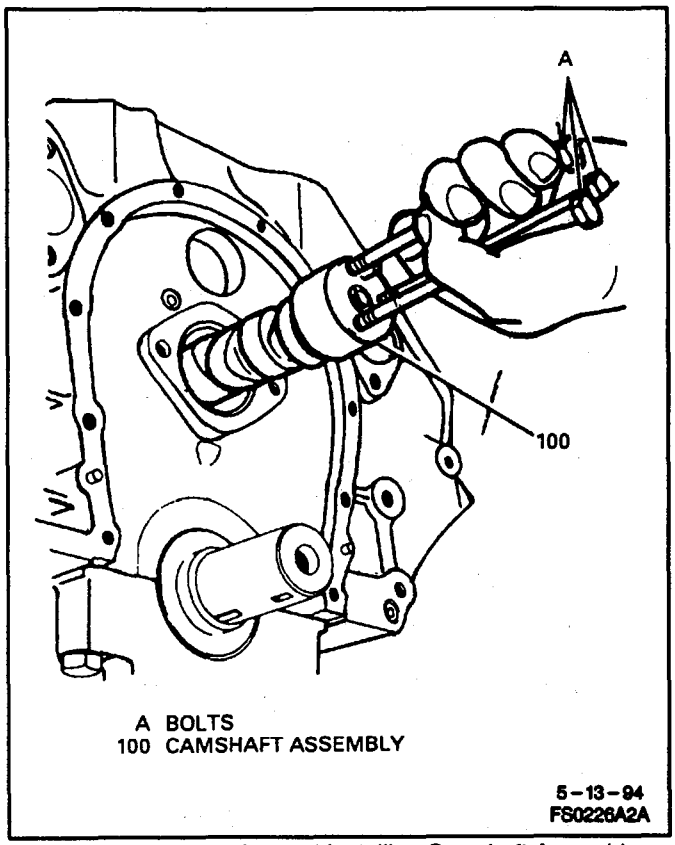


Figure 22 – Removing and Installing Camshaft Assembly

Inspect

- Camshaft bearings for scratches, pits, or loose fit in their bores. Replace camshaft bearings, if necessary. Refer to SECTION 6A2B.

Install or Connect

NOTICE: See "Notice" on page 6A2A of this section.

1. When installing a new camshaft assembly (100), coat camshaft lobes with "Molykote" or its equivalent.
2. When installing a new camshaft assembly (100), replace all valve lifter assemblies to ensure durability of camshaft lobes and lifter rollers.
3. Lubricate all camshaft journals with engine oil.
4. Camshaft assembly (100).
5. Air conditioning condenser support assembly.
6. Radiator assembly with air conditioning condenser. Refer to SECTION 6B.
7. Air conditioning receiver and dehydrator hose to condenser.
8. Air conditioning compressor and condenser hose to condenser.
9. Charge air conditioning system. Refer to SECTION 1B.
10. Valve lifter assemblies. Refer to "Valve Lifter Assemblies" in this section.
11. Camshaft sprocket. Refer to "Timing Chain Assembly, Crankshaft and Camshaft Sprockets" in this section.
12. Engine front cover assembly. Refer to "Engine Front Cover Assembly" in this section.
13. Oil pump drive assembly (90), clamp (92) and bolt/screw (91).
    - Lubricate oil pump drive gear with prelube, GM P/N 1052365 or equivalent.
    - Lubricate assembly with engine oil for ease of installation.

Tighten

- Oil pump drive clamp bolt/screw (91) to 34 N•m (25 lb. ft.).

14. Lower intake manifold assembly. Refer to "Lower Intake Manifold Assembly" in this section.
15. Valve rocker arms and pushrod assemblies. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
16. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.

VALVE SPRINGS AND STEM SEALS

Figures 23 and 24

Tools Required:

J 23590 Spark Plug Port Adapter
J 5892-D Valve Spring Compressor (Head-On)
J 23738-A Valve Stem Seal Tester

Remove or Disconnect

1. Valve rocker arms and pushrod assemblies at cylinder to be serviced. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
2. Spark plug at cylinder to be serviced.
3. Install J 23590 to spark plug hole and apply compressed air to hold valve (125 or 132) in place.

   NOTICE: When using the valve spring compressor, be careful not to scratch or gouge the valve stem.
4. Compress valve spring (128 or 135) using J 5892-D (Figure 23).
5. Valve stem key (131 or 139).
6. Valve spring cap (130 or 138), and oil shield (137) on exhaust valves.
7. Valve spring (128 or 135) and dampener (127 or 134).
8. Intake valve stem oil seal (126).
9. Valve stem O-ring seal (129 or 136).

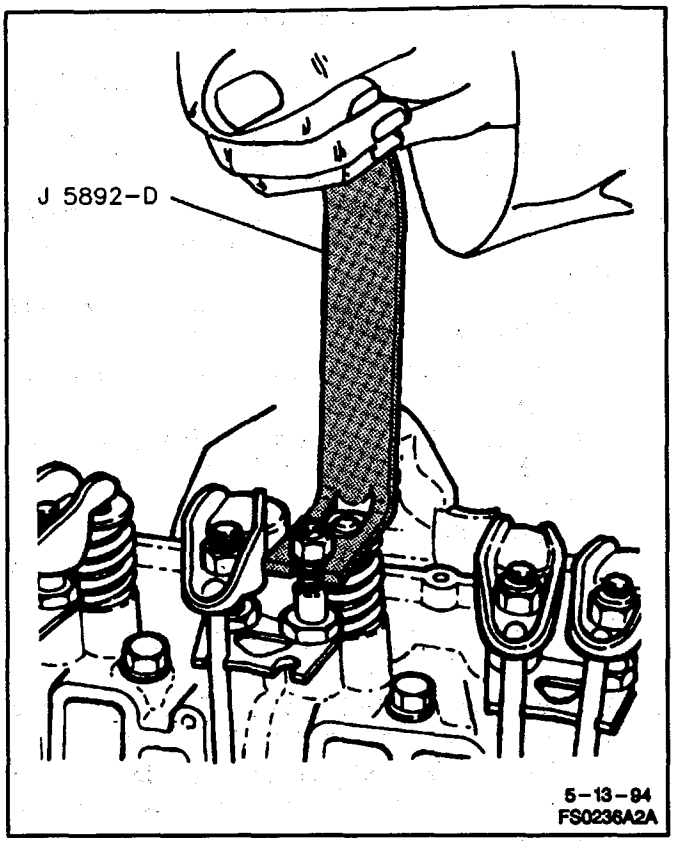
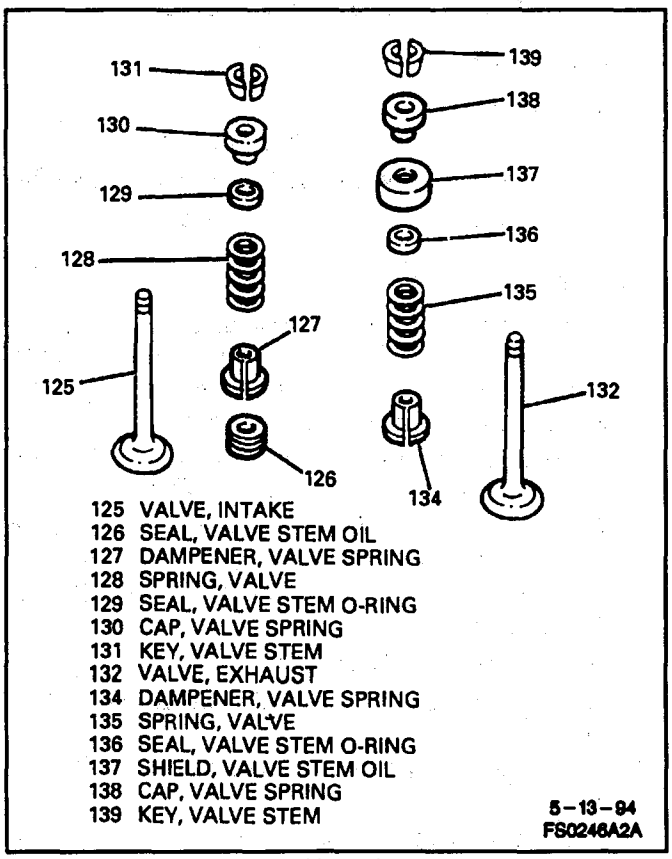


Figure 23 – Compressing Valve Spring



125 VALVE, INTAKE
126 SEAL, VALVE STEM OIL
127 DAMPENER, VALVE SPRING
128 SPRING, VALVE
129 SEAL, VALVE STEM O-RING
130 CAP, VALVE SPRING
131 KEY, VALVE STEM
132 VALVE, EXHAUST
134 DAMPENER, VALVE SPRING
135 SPRING, VALVE
136 SEAL, VALVE STEM O-RING
137 SHIELD, VALVE STEM OIL
138 CAP, VALVE SPRING
139 KEY, VALVE STEM

Figure 24 – Valve Assemblies

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Intake valve stem oil seal (126) and seat seal against cylinder head, or valve spring shim, if equipped.
2. Valve stem O-ring seal (129 or 136).
3. Valve spring dampener (127 or 134) and spring (128 or 135).
4. Valve spring oil shield (137) on exhaust valve and valve cap (130 or 138).
5. Compress valve spring (128 or 135) using J 5892-D.
6. Valve stem key (131 or 139).
   A. Use grease to hold key in place while disconnecting J 5892-D.
   B. Remove J 23590.
   C. Make sure key seats properly in upper groove of valve stem.
   D. Tap end of stem with a plastic-faced hammer to seat key, if necessary.
7. Spark plug.

Tighten

- Spark plug to 15 N•m (11 lb. ft.).

8. Valve rocker arms and pushrod assemblies. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.

Inspect

- Valve stem O-ring seal (129 or 136) for leaks.
  - Place J 23738-A in position over end of valve stem and against valve spring cap (130 or 138). Operate J 23738-A and make sure no air leaks past valve stem O-ring seals (129 or 136).

Measure

- Valve spring installed height.
  - Use a narrow, thin scale and measure from bottom of valve spring (128 or 135) on dampener lip to bottom inside of oil shield (137) for exhaust valve (132) and to top of valve spring cap (130) for intake valve (125). If measurement exceeds specified height, install valve spring seat shims as necessary. Do not shim so height is less than specified.

CYLINDER HEAD ASSEMBLY AND GASKET

Figure 25

Tool Required:

J 36660 Torque Angle Meter

Left Cylinder Head Assembly

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.

2. Drain coolant. Refer to SECTION 6B.
3. Lower vehicle.
4. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.
5. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
6. Lower intake manifold assembly. Refer to "Lower Intake Manifold Assembly" in this section.

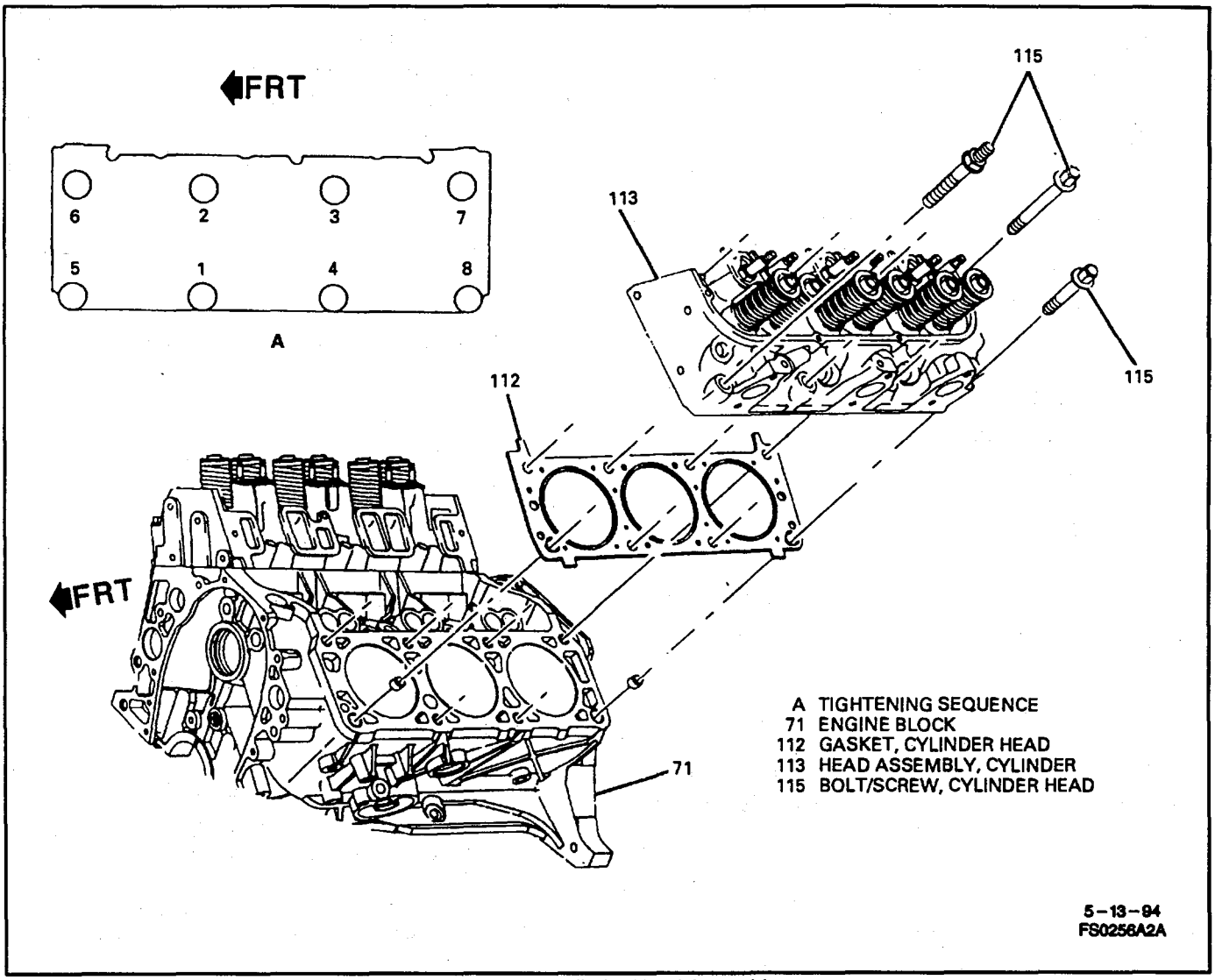


Figure 25 – Cylinder Head Assembly

7. Left exhaust manifold assembly. Refer to "Exhaust Manifold Assemblies" in this section.
8. Oil level indicator and tube assemblies. Refer to "Oil Level Indicator and Tube Assemblies" in this section.
9. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
10. Coolant temperature sensor connector.
11. Spark plug wires from spark plugs.
12. Spark plugs.
13. Engine lift bracket.
14. Wiring harness clip from rear of cylinder head assembly (113).
15. Secondary air injection pipe bracket bolt/screw.
16. Power steering pump assembly and brackets and lay aside. Refer to SECTION 3B1.
17. Loosen rocker arms until pushrod assemblies can be removed.
18. Cylinder head bolts/screws (115).
19. Cylinder head assembly (113) and gasket (112).

Important

- Refer to SECTION 6A2B for cylinder head assembly cleaning, inspection and repair.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. New cylinder head gasket (112).
2. Cylinder head assembly (113) over locator pins and gasket (112).
3. Coat threads of cylinder head bolts/screws (115) with sealing compound, GM P/N 1052080 or equivalent.
4. Cylinder head bolts/screws (115) finger tight.

Tighten

- Cylinder head bolts/screws (115) in sequence to 55 N•m (41 lb. ft.) (Figure 25).
- Turn cylinder head bolts/screws (115) in sequence an additional 90 degrees using J 36660

5. Pushrod assemblies and rocker arms. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
6. Power steering pump assembly and brackets. Refer to SECTION 3B.
7. Secondary air injection pipe bracket bolt/screw.
8. Spark plugs.

Tighten

- Spark plugs to 15 N•m (11 lb. ft.).

9. Spark plug wire harness assembly to spark plugs.
10. Wiring harness clip to rear of cylinder head assembly (113).
11. Engine lift bracket.
12. Coolant temperature sensor connector.
13. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
14. Oil level indicator and tube assemblies. Refer to "Oil Level Indicator and Tube Assemblies" in this section.
15. Left exhaust manifold assembly. Refer to "Exhaust Manifold Assemblies" in this section.
16. Lower intake manifold assembly. Refer to "Lower Intake Manifold Assembly" in this section.
17. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
18. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.
19. Refill with coolant. Refer to SECTION 6B.

Right Cylinder Head Assembly

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Drain coolant. Refer to SECTION 6B.
3. Lower vehicle.
4. Serpentine drive belt tensioner assembly. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
5. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.
6. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
7. Lower intake manifold assembly. Refer to "Lower Intake Manifold Assembly" in this section.
8. Right exhaust manifold assembly. Refer to "Exhaust Manifold Assemblies" in this section.
9. Generator and brackets. Refer to SECTION 6D3.
10. Spark plug wires from spark plugs.
11. Spark plugs.
12. Loosen rocker arms until pushrod assemblies can be removed.
13. Cylinder head bolts/screws (115).
14. Cylinder head assembly (113) and gasket (112).

Important

- Refer to SECTION 6A2B for cylinder head assembly cleaning, inspection and repair.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. New cylinder head gasket (112).
2. Cylinder head assembly (113) over locator pins and gasket (112).
3. Coat threads of cylinder head bolts/screws (115) with sealing compound, GM P/N 1052080 or equivalent.
4. Cylinder head bolts/screws (115) finger tight.

Tighten

- Cylinder head bolts/screws (115) in sequence to 55 N•m (41 lb. ft.) (Figure 25).
- Turn cylinder head bolts/screws (115) in sequence an additional 90 degrees using J 36660

5. Pushrod assemblies and rocker arms. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
6. Spark plugs.

Tighten

- Spark plugs to 15 N•m (11 lb. ft.).

7. Spark plug wires to spark plugs.
8. Generator and brackets. Refer to SECTION 6D3.
9. Right exhaust manifold assembly. Refer to "Exhaust Manifold Assemblies" in this section.
10. Lower intake manifold assembly. Refer to "Lower Intake Manifold Assembly" in this section.
11. Valve rocker arm covers. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
12. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.
13. Serpentine drive belt tensioner assembly. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
14. Refill with coolant. Refer to SECTION 6B.

OIL PAN ASSEMBLY

Figure 26

Remove or Disconnect

CAUTION: See "Caution" on page 6A2A-1 of this section.

1. Battery negative cable assembly.
2. Air intake duct.
3. Raise and suitably support vehicle. Refer to SECTION 0A.
4. Drain engine oil.
5. Wiring harness clips from left side of oil pan assembly (1).
6. Oil level sensor connector.
7. Oil level sensor assembly.
8. Exhaust crossover pipes from exhaust manifold assemblies. Refer to SECTION 6F.
9. Exhaust pipe hanger bolt/screw and reposition pipe. Refer to SECTION 6F.
10. Transmission fluid cooler lines from clip at oil pan assembly (automatic transmission).
11. Starter motor assembly. Refer to SECTION 6D2.
12. Converter cover bolts/screws and cover (automatic transmission). Refer to SECTION 7A.
13. Engine mount through-bolts/screws.
14. Raise engine with jacking fixture.
15. Oil pan bolts/screws (12), studs (13), nuts (11) and reinforcements (10).
16. Oil pan assembly (1) and gasket (2).
    - Rotate crankshaft assembly to reposition counterweights if necessary.

Important

- If adequate clearance is not available, to remove the oil pan assembly from the engine, follow these steps:
  A. With engine raised from its mounts, place jackstands at either end of engine frame assembly for additional support.
  B. Loosen engine frame assembly mounting bolts/screws NO MORE THAN SIX COMPLETE REVOLUTIONS.

Clean

1. Oil pan and engine block gasket surfaces.
2. Apply a small amount of sealer, GM P/N 12345739 or equivalent, where oil pan gasket tabs seat on rear crankshaft bearing cap groove.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Oil pan gasket (2) and oil pan assembly (1).
2. Oil pan nuts (11), reinforcements (10), bolts/screws (12) and studs (13).

Tighten

- Front corner oil pan nuts (11) to 33 N•m (24 lb. ft.).
- Rear corner oil pan bolts/screws to 25 N•m (18 lb. ft.)
- Oil pan side rail bolts/screws (12) to 10 N•m (89 lb. in.).
- Oil pan studs (13) to 6 N•m (53 lb. in.).

3. Lower engine.
4. Engine mount through-bolts/screws.
5. Oil level sensor assembly.

Tighten

- Engine mount through-bolts/screws to 95 N•m (70 lb. ft.)
- Engine oil level sensor assembly to 22 N•m (16 lb. ft.).

6. Converter cover and bolts/screws (automatic transmission). Refer to SECTION 7A.
7. Starter motor assembly. Refer to SECTION 6D2.
8. Transmission fluid cooler lines to clip at oil pan assembly (automatic transmission).
9. Exhaust pipe hanger bolt/screw.
10. Exhaust crossover pipes to exhaust manifold assemblies. Refer to SECTION 6F.
11. Oil level sensor connector.
12. Wiring harness clips to oil pan assembly (1).
13. Lower vehicle.
14. Air intake duct.
15. Refill engine with oil.
16. Battery negative cable assembly.

OIL PUMP ASSEMBLY

Figure 27

Remove or Disconnect

1. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
2. Bolt/screw (16) attaching oil pump assembly (17) to rear crankshaft bearing cap.
3. Oil pump assembly (17) and driveshaft (18).

Important

- Refer to SECTION 6A2B for oil pump assembly cleaning, inspection and repair.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Oil pump assembly (17) and driveshaft (18).
   - Align slot on end of intermediate shaft (18) with drive tang on oil pump drive assembly.

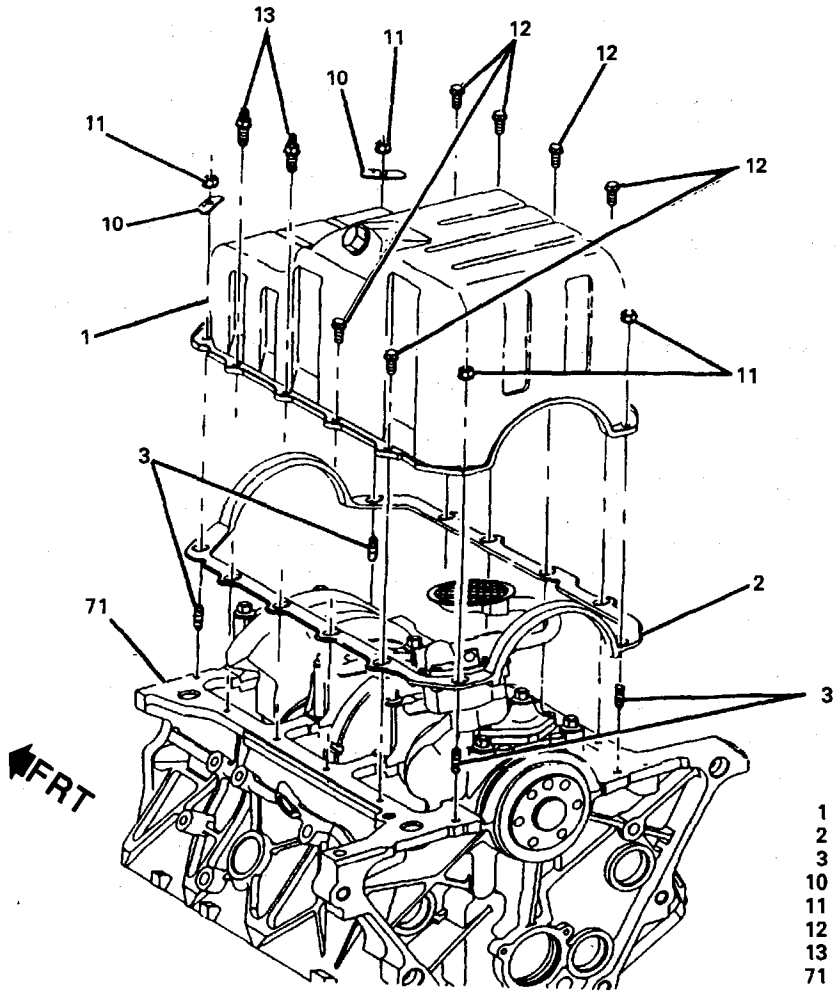


Figure 26 – Oil Pan Assembly

2. Bolt/screw (16) attaching oil pump assembly (17) to rear crankshaft bearing cap.

Tighten

- Bolt/screw (16) to 41 N•m (30 lb. ft.).

3. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.

CONNECTING ROD BEARINGS

Figures 28, 29 and 30

Connecting rod bearings are the precision insert type and do not use shims for adjustment. Do not file connecting rods or rod caps. If clearances are found to be excessive, a new bearing will be required. Service bearings are available in standard size and 0.013 and 0.026 mm undersize for use with new and used standard size crankshafts.

Remove or Disconnect

1. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
2. Oil pump assembly. Refer to "Oil Pump Assembly" in this section.

Important

- Place matchmarks or numbers on connecting rod assemblies (83) and connecting rod caps (81). Connecting rod caps (81) must be assembled to their original connecting rod assemblies (83).

3. Connecting rod nuts (80).
4. Connecting rod cap (81) and bearings (82).

- Keep bearings (82) with their original connecting rod assembly (83) and cap (81) for reassembly.
- Wipe oil from bearings (82) and crankpins.

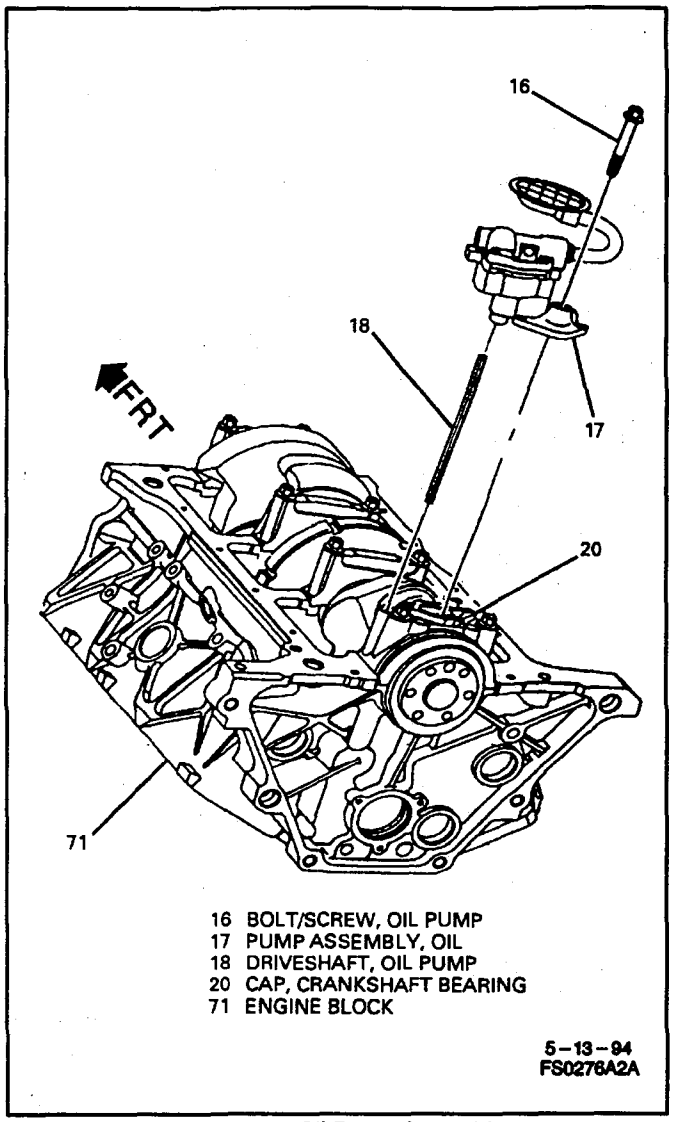


Figure 27 – Oil Pump Assembly

Inspect

- Bearings (82) for excessive wear or damage.

Measure

1. Crankpin for out-of-round and taper with a micrometer. Refer measurements to "Specifications" in this section.
   - If not within specifications, replace or recondition crankshaft assembly.
   - If installing new bearings (82), determine new bearing size from the maximum crankpin diameter.
2. Bearing clearances, using gaging plastic.

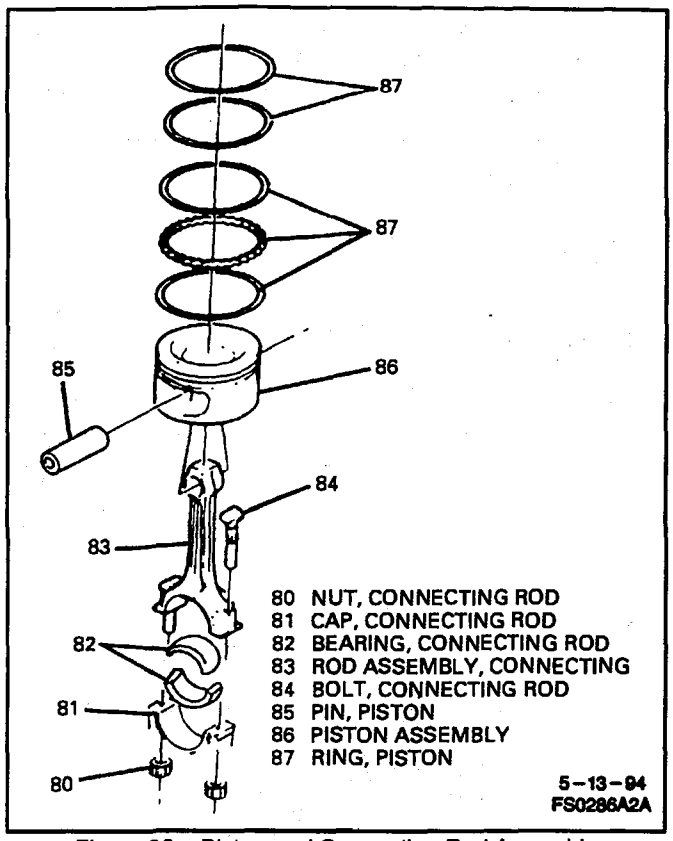


Figure 28 – Piston and Connecting Rod Assembly

A. Place piece of gaging plastic the full width of bearing (82), (parallel to crankshaft assembly) onto the crankpin.
   - Gaging plastic should be positioned in middle of bearing (82). Bearing (82) is thickest in center and bearing clearance must be measured at this location.
B. Install connecting rod cap (81) with bearing (82) onto connecting rod assembly (83).
C. Install connecting rod nuts (80).

Tighten

- Connecting rod nuts (80), evenly, to 50 N•m (37 lb. ft.).

NOTICE: Do not turn the crankshaft assembly with the gaging plastic installed or the accuracy of the measurement will be affected.

D. Remove connecting rod nuts (80) and cap (81). Gaging plastic will be found adhering to either connecting rod cap (81) or crankshaft journal and is measured without removing it.
E. Measure gaging plastic at its widest, using scale provided with gaging plastic. Refer measurements to "Specifications" in this section.
   - If clearance is greater than specified, select an undersize bearing (82) and remeasure clearance.
   - If clearance cannot be brought to specifications, regrind crankpin. If crankpin is

already at maximum undersize, replace crankshaft assembly (22).

F. Remove all gaging plastic material after measuring.

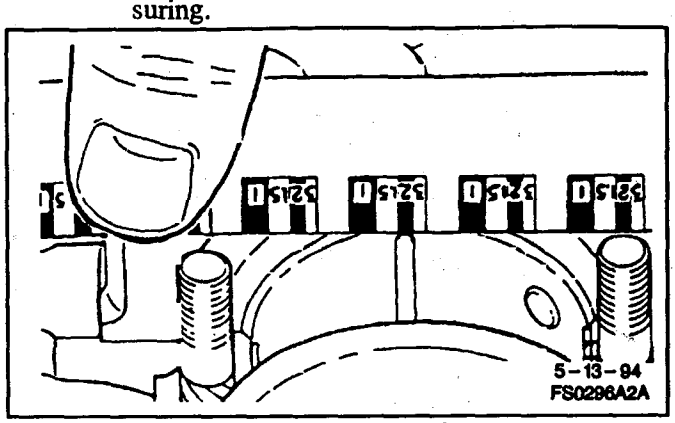


Figure 29 – Measuring Bearing Clearance

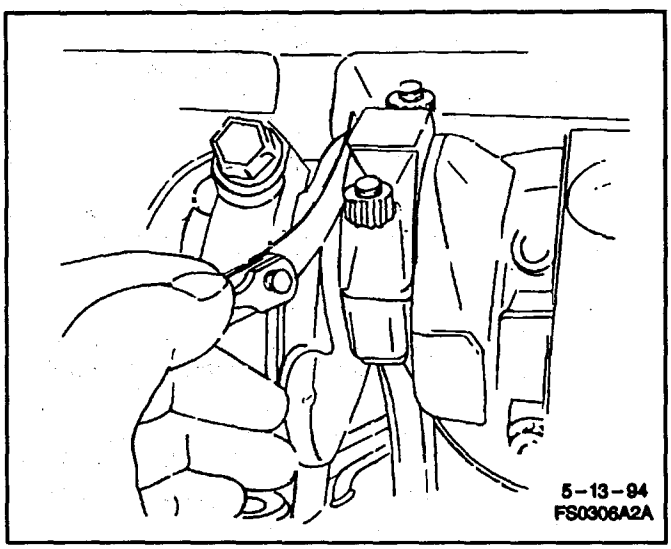


Figure 30 – Measuring Connecting Rod Side Clearance

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Coat inside surface of bearings (82) with engine oil.
2. Connecting rod cap (81) and bearings (82).
3. Connecting rod nuts (80).

Tighten

- Connecting rod nuts (80), evenly, to 50 N•m (37 lb. ft.).

Measure

- Connecting rod side clearance.
  - A. When all connecting rod bearings (82) have been installed, tap each connecting rod assembly (83) lightly parallel to crankpin to make sure they have clearance.
  - B. Measure side clearance between connecting rod caps (81) using a feeler gage, or dial indicator.
  - C. Rod side clearance should be 0.18 to 0.44 mm (0.007 to 0.017 inch).
4. Oil pump assembly. Refer to "Oil Pump Assembly" in this section.
5. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.

PISTON AND CONNECTING ROD ASSEMBLIES

Figures 28 and 31

Tools Required:

J 5239 Connecting Rod Bolt Guide Set

J 8037 Piston Ring Compressor

Remove or Disconnect

1. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
2. Oil pump assembly. Refer to "Oil Pump Assembly" in this section.
3. Cylinder head assembly. Refer to "Cylinder Head Assembly and Gasket" in this section.
4. Ring ridge.
   - A. Turn crankshaft assembly (22) until piston assembly (86) is at bottom of its stroke.
   - B. Place a cloth on top of piston assembly (86).
   - C. Use a ridge reamer to remove ring ridge.
   - D. Turn crankshaft assembly (22) so piston assembly (86) is at top of its stroke.
   - E. Remove cloth and cutting debris.

Important

- Place matchmarks or numbers on connecting rod assemblies (83) and connecting rod caps (81). Connecting rod caps (81) must be assembled to their original connecting rod assemblies (83).

5. Connecting rod nuts (80) and cap (81).
6. Connecting rod assembly (83) and piston assembly (86) out of top of engine block using J 5239.

Important

- Refer to SECTION 6A2B for cleaning, inspection and repair of piston and connecting rod assembly.

Clean

1. Cylinder bores with hot water and detergent or with a light honing.
2. Swab bores with engine oil and a clean, dry cloth.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Coat piston assembly (86), piston rings, cylinder bore, and bearing surfaces with engine oil.
2. Piston assembly (86) into its original bore using J 5239 and J 8037 and lightly tapping top of piston assembly (86) with a wooden hammer handle.
   A. When installing piston assembly (86) and connecting rod assembly (83), stamped arrow on piston assembly (86) must point to front of engine while flange on connecting rod assembly (83) must face toward front of piston on left hand assembly and face toward rear of piston on right hand assembly.
   B. Hold J 8037 firmly against engine block until all piston rings have entered cylinder bore.
3. Connecting rod caps (81) onto their original connecting rod assemblies (83).
   - Align matchmarks or numbers which were placed on connecting rod assembly (83) and connecting rod cap (81) during removal.
4. Connecting rod nuts (80).

Tighten

- Connecting rod nuts (80), evenly, to 50 N•m (37 lb. ft.).

Inspect

- Connecting rod assembly (83) for binding by prying back and forth with a suitable tool. If necessary, loosen and retighten connecting rod cap (81).

Measure

- Connecting rod side clearance. Refer to "Specifications" in this section.

5. Cylinder head assembly. Refer to "Cylinder Head Assembly and Gasket" in this section.
6. Oil pump assembly. Refer to "Oil Pump Assembly" in this section.
7. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.

CRANKSHAFT BEARINGS

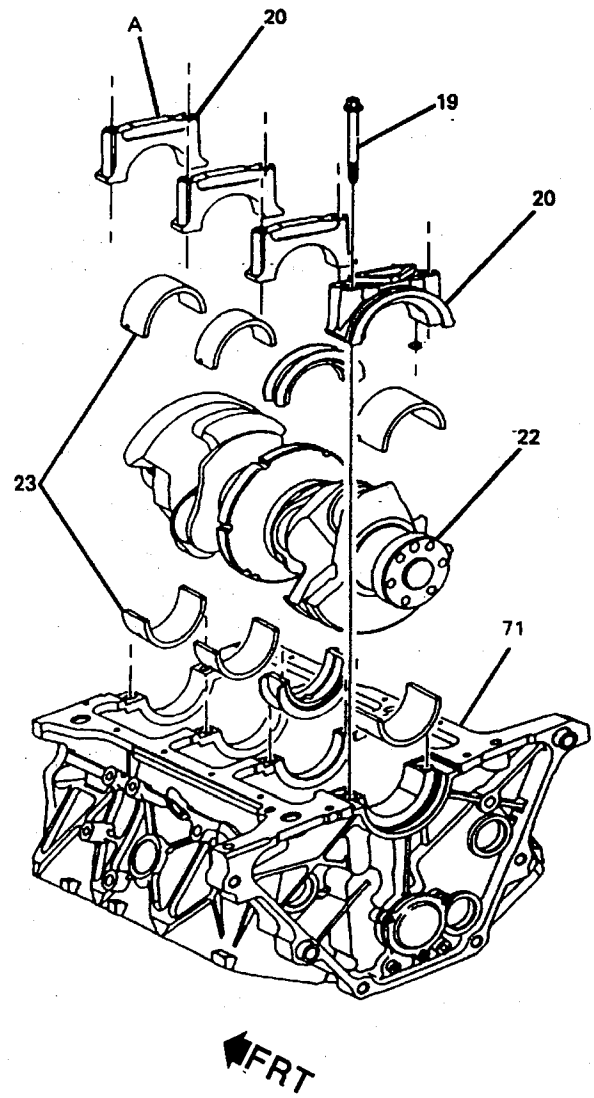
Figures 31 and 32

Tools Required:

J 8080 Main Bearing Shell Remover and Installer

J 36660 Torque Angle Meter

Crankshaft bearings are of the precision insert type. If clearances are found to be excessive, a new bearing, both upper and lower halves, will be required. Service bearings are available in both standard size and undersize. Replace both bearing shells as a set.



A ASSEMBLE WITH ARROWS ON CAP TOWARD FRONT OF ENGINE
19 BOLT/SCREW, CRANKSHAFT BEARING CAP
20 CAP, CRANKSHAFT BEARING
22 CRANKSHAFT ASSEMBLY
23 BEARING, CRANKSHAFT
71 ENGINE BLOCK

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Figure 31 – Crankshaft Assembly

Remove or Disconnect

1. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
2. Oil pump assembly. Refer to "Oil Pump Assembly" in this section.
3. Spark plugs.
4. Cap (20) and lower crankshaft bearing (23) requiring replacement.
5. Insert J 8080 into oil hole in crankshaft journal.
6. Rotate crankshaft assembly (22) allowing J 8080 to push against insert's straight (unnotched) side. This will roll upper crankshaft bearing (23) out of block.
7. Remove J 8080 from crankshaft assembly (22).

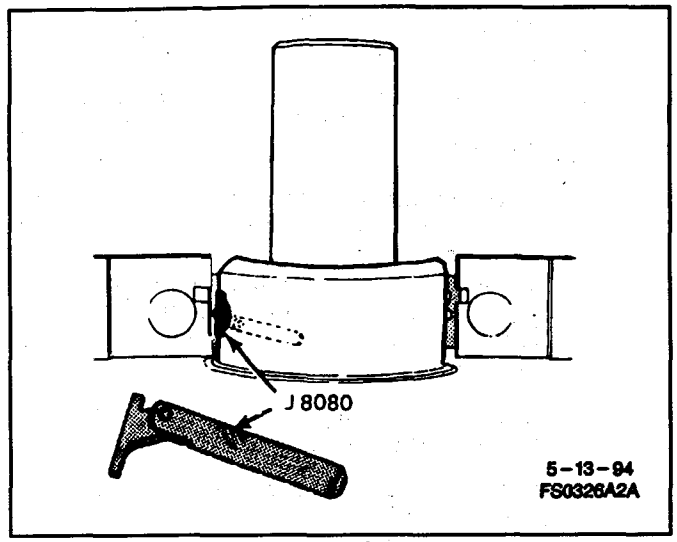


Figure 32 – Removing Crankshaft Bearing

Inspect

- In general, lower half of crankshaft bearing insert (except number 1 bearing) shows a greater wear and most distress from fatigue. If upon inspection lower half is suitable for use, it can be assumed that upper half is also satisfactory. If lower half shows evidence of wear or damage, both upper and lower halves should be replaced. Never replace one half without replacing other half.

Important

- To obtain most accurate results when checking crankshaft bearing clearances, use gaging plastic.
- When engine is in vehicle, crankshaft assembly must be supported upward to remove any clearance from upper bearing. Total clearance can then be measured between lower bearing and journal.
- To assure proper seating of crankshaft assembly, all bearing cap bolts/screws should be at their specified torque. In addition, prior to checking fit of bearings, surface of crankshaft journal and bearing should be wiped clean of oil.

Measure

1. With oil pan and oil pump assemblies removed, and starting with rear crankshaft bearing, remove bearing cap and wipe oil from journal and bearing cap.
2. Place a piece of gaging plastic full width of bearing (parallel to crankshaft assembly) on journal.

Important

- Do not rotate crankshaft assembly while gaging plastic is between bearing and journal.

3. Install bearing cap and evenly tighten retaining bolts/screws to specifications. Bearing cap must be tightened to specification in order to assure proper reading. Variations in torque affect compression of gaging plastic.

Tighten

- Crankshaft bearing cap bolts/screws (19) to 50 N•m (37 lb. ft.).
- Turn crankshaft bearing cap bolts/screws (19) an additional 77 degrees using J 36660.

4. Remove bearing caps. Flattened gaging plastic will be found adhering to either bearing shell or journal.
5. Without removing gaging plastic, measure its compressed width (at widest point) with graduations on gaging plastic envelope. Normally crankshaft bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal 0.005 mm (0.0002 inch maximum), be sure to fit to maximum diameter of journal. If bearing is fitted to minimum diameter, and journal is out-of-round 0.005 mm (0.0002 inch) or more, interference between bearing and journal will result in rapid bearing failure. If flattened gaging plastic tapers toward middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of bearing or journal. Be sure to measure journal with a micrometer if flattened gaging plastic indicates this difference.
6. If bearing clearance is within specifications, bearing insert is satisfactory. If clearance is not within specifications, replace insert. Always replace both upper and lower inserts as a unit. When bearing cap is installed and clearance is less than 0.032 mm (0.0012 inch), inspect for burrs or nicks.
7. An undersize bearing may produce proper clearance. If not, it will be necessary to regrind crankshaft journal for use with next undersize bearing. After selecting new bearing, recheck clearance.
8. Proceed to next bearing. When checking number 1 crankshaft bearing, remove serpentine drive belt so as to prevent tapered reading with gaging plastic. After all bearings have been checked, rotate crankshaft assembly to see that there is no excessive drag.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Crankshaft bearings (23) into engine block (71) and crankshaft bearing caps (20).
   A. Coat crankshaft bearings (23) with oil.
   B. Insert plain (unnotched) end between crankshaft assembly and indented or notched side of block. Rotate bearing into place using J 8080 as previously described, and remove J 8080 from oil hole in crankshaft journal.
2. Crankshaft bearing caps (20) with assembled crankshaft bearings (23) with arrows pointing toward front of engine.
3. Crankshaft bearing cap bolts/screws (19) .
   - With crankshaft assembly (22), crankshaft bearings (23) and crankshaft bearing caps (20) installed and bolts/screws (19) started, thrust crankshaft assembly (22) rearward to set and align bearing caps (20). Then force crankshaft assembly forward to align crankshaft thrust bearing.

Tighten

- Crankshaft bearing cap bolts/screws (19) to 50 N•m (37 lb. ft.).
- Turn crankshaft bearing cap bolts/screws (19) evenly an additional 77 degrees using J 36660.

Measure

- Crankshaft end play, using a dial indicator or feeler gage. Refer to "Specifications" in this section.
  – If using a feeler gage, measure between front of number three crankshaft bearing cap (20) and crankshaft thrust surface.

4. Oil pump assembly. Refer to "Oil Pump Assembly" in this section.
5. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
6. Spark plugs.

FLYWHEEL ASSEMBLY

Figure 33

Flywheel Assembly Replacement

Remove or Disconnect

1. Transmission assembly. Refer to SECTION 7A for an automatic transmission or SECTION 7B for a manual transmission and SECTION 7C for the clutch.
2. Flywheel bolts/screws (36), retainer (34) and flywheel assembly (33).

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Flywheel assembly (33), retainer (34) and flywheel bolts/screws (36).

Tighten

- Flywheel bolts/screws (36) to 83 N•m (61 lb. ft.).

2. Transmission assembly. Refer to SECTION 7A for an automatic transmission or SECTION 7B for a manual transmission and SECTION 7C for the clutch.

Flywheel Assembly Balancing

Figure 33

Inspect

- Flywheel assembly (33) for missing or loose converter-to-flywheel bolts/screws. Tighten or replace as necessary.
- Converter for damage or missing balance weights. If converter is damaged or balance weights are missing, replace converter.
- If flywheel assembly (33) is replaced, new balance weights of same size must be installed on new flywheel assembly in same hole locations as old flywheel assembly.

CRANKSHAFT REAR OIL SEAL ASSEMBLY

Tool Required:

J 34686 Rear Main Bearing Oil Seal Installer

Figures 34 and 35

Remove or Disconnect

1. Flywheel assembly. Refer to "Flywheel Assembly Replacement" under "Flywheel Assembly" in this section.
   - Care should be taken not to nick crankshaft sealing surface when removing seal.
2. Crankshaft rear oil seal assembly.
   - Insert a screwdriver or similar tool through dust lip at an angle as shown in Figure 34. Pry seal out by moving handle of tool towards end of crankshaft. Repeat as necessary around seal.

Install or Connect

1. Coat new seal assembly entirely with engine oil.
2. Seal assembly onto J 34686.
3. J 34686 onto rear of crankshaft assembly. Tighten screws snugly to ensure seal assembly will be installed squarely over crankshaft assembly.

4. Crankshaft rear oil seal assembly to crankshaft assembly.

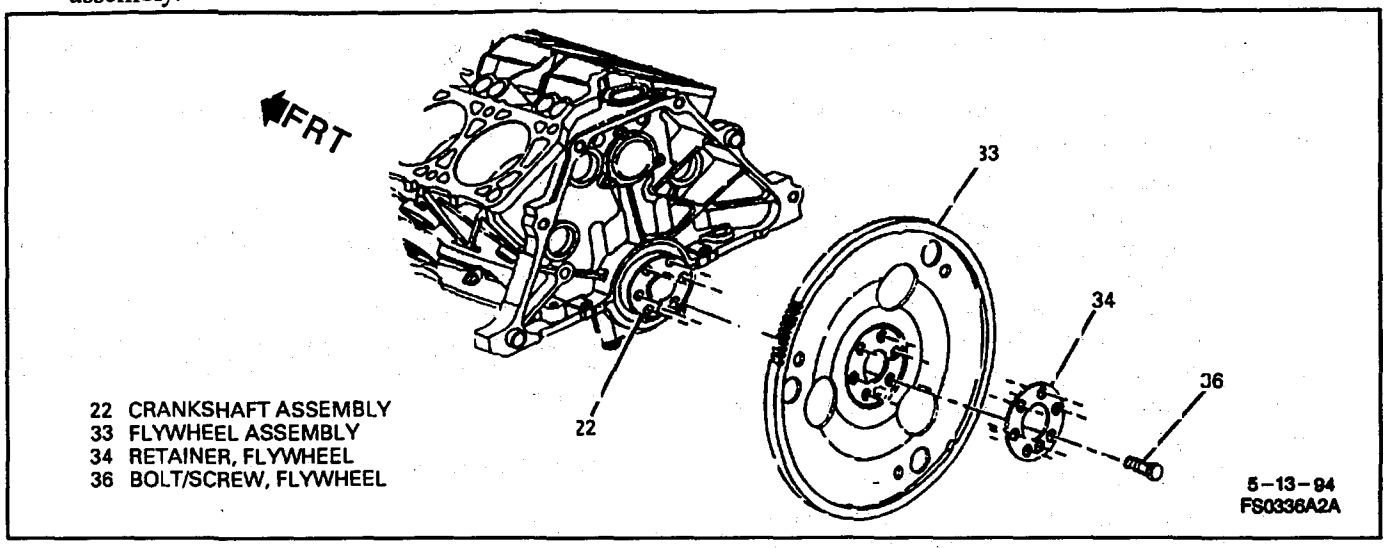


Figure 33 – Flywheel Assembly

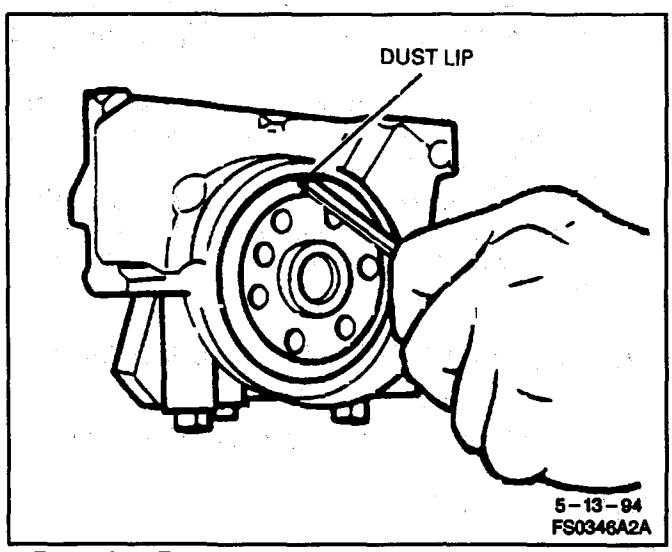


Figure 34 – Removing Crankshaft Rear Oil Seal Assembly

5. Tighten wing nut on J 34686 until it bottoms.
6. Remove J 34686 from crankshaft assembly.
7. Flywheel assembly. Refer to "Flywheel Assembly Replacement" in this section.

ENGINE ASSEMBLY

Remove or Disconnect

CAUTION: See "Caution" on page 6A2A-1 of this section.

1. Battery negative cable assembly.
2. Battery positive cable assembly.
3. Raise and suitably support vehicle. Refer to SECTION OA.
4. Front wheels and tires. Refer to SECTION 3E.
5. Drain coolant. Refer to SECTION 6B.
6. Drain engine oil.
7. Exhaust crossover pipe assembly from intermediate pipe. Refer to SECTION 6F.
8. Converter bolts/screws (automatic transmission). Refer to SECTION 7A.
9. Front fascia lower deflectors. Refer to SECTION 10-5.
10. Stabilizer bar bolts/screws. Refer to SECTION 3C.
11. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
12. Transmission fluid cooler lines from radiator assembly (automatic transmission). Refer to SECTION 6B.
13. Lower radiator hose from radiator assembly. Refer to SECTION 6B.
14. Heater hoses from pipes at engine assembly. Refer to SECTION 1B1.
15. Electrical ground straps from right side of engine block.
16. Shift linkage from transmission assembly. Refer to SECTION 7A or SECTION 7B.
17. Propeller shaft assembly after matchmarking. Refer to SECTION 4A.
18. Torque arm from transmission assembly. Refer to SECTION 3D.
19. Steering gear coupling shaft from rack and pinion assembly. Refer to SECTION 3F.
20. Electrical ground straps from left side of frame rail.
21. Lower vehicle.
22. Air intake duct.
23. Fuel pipe assembly. Refer to "Upper Intake Manifold Assembly" in this section.
24. Cruise and accelerator control cables from throttle body assembly. Refer to SECTION 6E3.

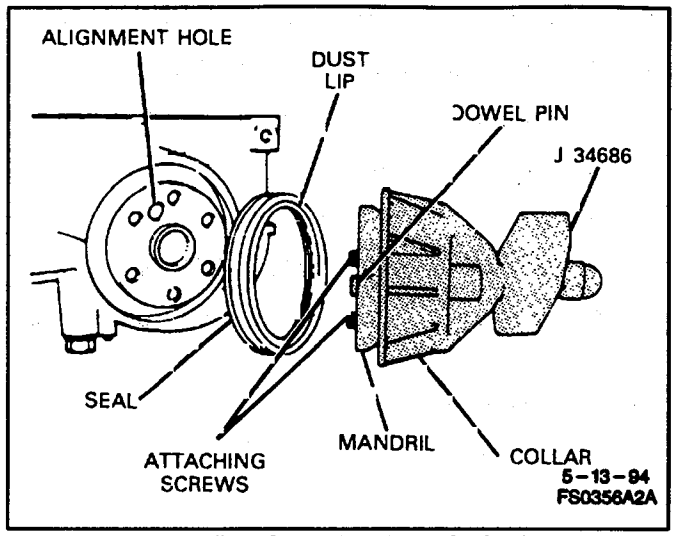


Figure 35 – Installing Crankshaft Rear Oil Seal Assembly

25. Upper radiator hose from intake manifold assembly. Refer to SECTION 6B.
26. Lower radiator hose from front cover assembly. Refer to SECTION 6B.
27. Brake booster vacuum hose.
28. "Y" brace from right exhaust manifold assembly. Refer to SECTION 6D3.
29. Generator and air conditioning compressor bracket and reposition. Refer to SECTION 6D3.
30. Brace lines from antilock brake system (ABS) brake combination valve. Refer to SECTION 5.
31. Brake lines and clips from ABS hydraulic modulator assembly. Refer to SECTION 5.
32. Right-hand body hinge pillar trim panel assembly. Refer to SECTION 10-5.
33. Three engine wiring harness connectors (blue, black and white connectors) and evaporator temperature sensor connector.
34. Forward lamp wiring harness connectors.
35. Powertrain control module (PCM) and harness.
    - Place PCM and harness on top of engine.
36. Engine wire harness through front of dash.
    - Place harness on top of engine.
37. Positive lead at generator.
38. Positive lead at junction block.
39. Negative lead at mounting stud (located next to the junction block).
40. Lower shock attachment bolts/screws and nuts from lower control arm.
41. Upper control arm ball stud assembly from steering knuckle assembly. Refer to SECTION 3C.
42. Raise and suitably support vehicle. Refer to SECTION OA.
43. Position lift table under engine and engine frame assembly. Use Kent-Moore tool number 204-BX-75G or equivalent.
44. Engine frame and transmission support bolts/screws. Refer to SECTION 10-3.
45. Raise vehicle from engine, transmission and engine frame assemblies.
46. Secure strut assemblies to engine frame.
47. Transmission assembly. Refer to SECTION 7A or SECTION 7B.
48. Clutch housing and clutch assembly (manual transmission). Refer to SECTION 7C.
49. Power steering lines from power steering pump assembly. Refer to SECTION 3B.
50. Engine mount through-bolts/screws.
51. Engine assembly from engine frame.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Engine assembly to engine frame.
2. Engine mount through-bolts/screws.

Tighten

- Engine mount through-bolts/screws to 95 N•m (70 lb. ft.).

3. Power steering lines to power steering pump. Refer to SECTION 3B.
4. Clutch housing and clutch assembly. Refer to SECTION 7C.
5. Transmission assembly. Refer to SECTION 7A or SECTION 7B.
6. Position engine lift table and install engine, transmission and engine frame assemblies by lowering vehicle to crossmember assembly.
7. Engine frame and transmission support bolts/screws. Refer to SECTION 10-3.
8. Engine lift table.
9. Lower vehicle.
10. Upper control arm ball stud assembly to steering knuckle assembly. Refer to SECTION 3C.
11. Lower shock attachment bolts/screws and nuts to lower control arm.
12. Negative lead at mounting stud (located next to junction block).
13. Positive lead at generator.
14. Engine wire harness though front of dash.

Important

- When reinstalling engine wiring harness back through front of dash, the rubber grommet MUST BE INSTALLED PROPERLY to ensure correct sealing. If grommet is torn or damaged for any reason, it must be replaced.

15. ECM and harness.
16. Forward lamp wiring harness connectors.
17. Wiring harness connectors.
18. Right-hand body hinge pillar trim panel assembly. Refer to SECTION 10-5.

19. Brake lines and clips to ABS hydraulic modulator assembly. Refer to SECTION 5.
20. Brake lines to ABS brake combination valve. Refer to SECTION 5.
21. Generator and air conditioning compressor bracket and reposition. Refer to SECTION 6D3.
22. "Y" brace to right exhaust manifold assembly. Refer to SECTION 6D3.
23. Brake booster vacuum hose.
24. Lower radiator hose to front cover assembly. Refer to SECTION 6B.
25. Upper radiator hose to intake manifold assembly. Refer to SECTION 6B.
26. Cruise and accelerator control cables to throttle body assembly. Refer to SECTION 6E3.
27. Fuel pipe assembly. Refer to "Upper Intake Manifold Assembly" in this section.
28. Raise and suitably support vehicle. Refer to SECTION OA.
29. Electrical ground straps to left side of frame rail.
30. Steering gear coupling shaft to rack and pinion assembly. Refer to SECTION 3F.
31. Torque arm to transmission assembly. Refer to SECTION 3D.
32. Propeller shaft assembly. Refer to SECTION 4A.
33. Shift linkage to transmission assembly. Refer to SECTION 7A or SECTION 7B.
34. Electrical ground straps to right side of engine block.
35. Heater hoses to pipes at engine assembly. Refer to SECTION 1B1.
36. Lower radiator hose to radiator assembly. Refer to SECTION 6B.
37. Transmission fluid cooler lines to radiator assembly (automatic transmission). Refer to SECTION 6B.
38. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in the section.
39. Stabilizer bar bolts/screws. Refer to SECTION 3C.
40. Front fascia lower deflectors. Refer to SECTION 10-5.
41. Converter bolts/screws (automatic transmission). Refer to SECTION 7A.
42. Exhaust crossover pipe assembly from intermediate pipe. Refer to SECTION 6F.
43. Lower vehicle.
44. Refill with engine oil. Refer to SECTION OA.
45. Refill with engine coolant. Refer to SECTION 6B.
46. Front wheels and tires. Refer to SECTION 3E.
47. Battery positive cable assembly.
48. Battery negative cable assembly.
49. Bleed brake system. Refer to SECTION 5E1.
50. Bleed power steering system. Refer to SECTION 3B.
51. Air intake duct.
52. Align wheels. Refer to SECTION 3A.

THREAD REPAIR

Figure 36

Damaged threads may be reconditioned by drilling out, re-threading and installing a suitable thread insert. General purpose thread repair kits are available commercially.

CAUTION: Wear safety glasses to avoid eye damage.

1. Determine size, pitch and depth of damaged thread. If necessary, adjust stop collars on cutting tool and tap to required depth.

Important

- Refer to kit manufacturer's instructions regarding size of drill and tap to be used.

2. Drill out damaged thread. Clean out chips.
3. Tap hole.
   A. Lubricate tap with light engine oil.
   B. Clean thread.

Important

- Avoid build-up of chips. Back out tap every few turns and remove chips.

4. Thread the thread insert onto mandrel of installer. Engage tang of insert onto end on mandrel.
5. Lubricate insert with light engine oil (except when installing in aluminum) and install.

Important

- When correctly installed, insert should be flush to one turn below surface.

6. If tang of insert does not break off when backing out installer, break tang off with a drift pin.

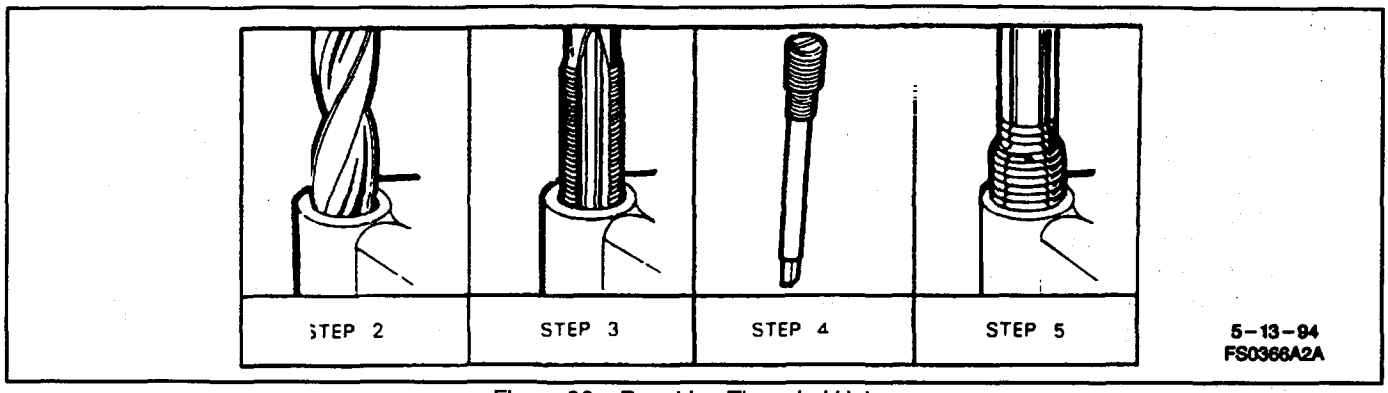


Figure 36 – Repairing Threaded Holes

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Accelerator Control Cable Bracket Bolt/Screw	10 N•m (90 lb. in.)
Camshaft Sprocket Bolt/Screw	24 N•m (18 lb. ft.)
Connecting Rod Nut	50 N•m (37 lb. ft.)
Crankshaft Balancer Bolt/Screw	78 N•m (58 lb. ft.)
Crankshaft Bearing Cap Bolt/Screw (plus 77 degrees)	50 N•m (37 lb. ft.)
Crankshaft Pulley Bolt/Screw	50 N•m (37 lb. ft.)
Cylinder Head Bolt/Screw (plus 90 degrees)	55 N•m (41 lb. ft.)
Drive Belt Idler Pulley Bolt/Screw	50 N•m (37 lb. ft.)
Drive Belt Tensioner Bolt/Screw	33 N•m (24 lb. ft.)
EGR Flexible Pipe Bolt/Screw	26 N•m (19 lb. ft.)
EGR Valve Adapter Tube Bolt/Screw	31 N•m (23 lb. ft.)
Engine Bracket Bolt/Screw	58 N•m (43 lb. ft.)
Engine Front Cover Bolt/Screw	21 N•m (15 lb. ft.)
Engine Mount Through-Bolt/Screw	95 N•m (70 lb. ft.)
Engine Mount Through-Bolt/Screw Nut	80 N•m (59 lb. ft.)
Engine Mount-to-Frame Bolt/Screw	58 N•m (43 lb. ft.)
Engine Oil Level Sensor Assembly	22 N•m (16 lb. ft.)
Exhaust Manifold Bolt/Screw	25 N•m (18 lb. ft.)
Flywheel Bolt/Screw	83 N•m (61 lb. ft.)
Fuel Injector Fuel Rail Stud	25 N•m (18 lb. ft.)
Fuel Pipe Bracket-to-Front Brace Bolt/Screw	8 N•m (71 lb. in.)
Fuel Pipe Bracket-to-Intake Manifold Bolt/Screw	10 N•m (89 lb. in.)
Fuel Pipe Hold Down Plate Bolt/Screw	25 N•m (18 lb. ft.)
Lower Intake Manifold Bolt/Screw	30 N•m (22 lb. ft.)
Oil Level Indicator Tube Nut	21 N•m (15 lb. ft.)
Oil Pan	
Front Corner Bolt/Screw and Nut	33 N•m (24 lb. ft.)
Rear Corner Bolt/Screw	25 N•m (18 lb. ft.)
Side Rail Bolt/Screw	10 N•m (89 lb. in.)
Stud	6 N•m (53 lb. in.)
Oil Pan Drain Plug	25 N•m (18 lb. ft.)
Oil Pump Drive Clamp Bolt/Screw	34 N•m (25 lb. ft.)
Oil Pump-to-Crankshaft Bearing Cap Bolt/Screw	41 N•m (30 lb. ft.)
Secondary Air Injection Check Valve Pipe Bracket Bolt/Screw	25 N•m (18 lb. ft.)
Secondary Air Injection Pipe Fitting	25 N•m (18 lb. ft.)
Timing Chain Dampener Bolt/Screw	21 N•m (15 lb. ft.)
Upper Intake Manifold Bolt/Screw	25 N•m (18 lb. ft.)
Valve Rocker Arm Cover Nut	10 N•m (89 lb. in.)

ENGINE ASSEMBLY SPECIFICATIONS (3.4L L32)

General

Type	V6
Displacement	3.4L (204 CID)
Bore	92 mm (3.622″)
Stroke	84 mm (3.312″)
Compression Ratio	9.0:1
Firing Order	1-2-3-4-5-6
Oil Pressure (Minimum at operating temperature)	103 kPa (15 psig) at 1,100 engine rpm
Oil Filter Torque	16 N•m (12 lb. ft.)

Cylinder Bore

Diameter	92.020-92.038 mm (3.6228-3.6235″)
Out-of-Round	0.007 mm (0.0003″) MAX.

Piston Assembly

Diameter	91.977-91.992 mm (3.6211-3.6217″)
Piston Bore Clearance	0.028-0.061 mm (0.0011-0.0024″)

Piston Rings

Piston Compression Ring	
Groove Clearance	
Top	0.05-0.09 mm (0.002-0.0035″)
2nd	0.05-0.09 mm (0.002-0.0035″)
Gap	
Top	0.18-0.41 mm (0.007-0.016″)
2nd	0.48-0.74 mm (0.019-0.029″)
Piston Oil Ring	
Groove Clearance-MAX	0.20 mm (0.008″)
Gap	0.25-0.76 mm (0.010-0.030″)

Piston Pin

Diameter	22.9915-22.9964 mm (0.9052-0.9054″)
Clearance in Piston Assembly	0.0116-0.0218 mm (0.0005-0.0009″)
Fit In Connecting Rod Assembly	0.0165-0.0464 mm (0.00065-0.0018″) Interference

Crankshaft Assembly

Main Journal	
Diameter-All	67.239-67.257 mm (2.6473-2.6483″)
Taper-Max	0.005 mm (0.0002″) MAX.
Out-of-Round	0.005 mm (0.0002″) MAX.
Crankshaft Bearing Clearance	0.032-0.077 mm (0.0012-0.0030″)
Crankshaft Thrust Bearing Clearance	0.032-0.077 mm (0.0012-0.0030″)
Crankshaft Assembly End Play	0.06-0.21 mm (0.0024-0.0083″)

Connecting Rod Assembly

Connecting Rod Journal	
Diameter	50.768-50.784 mm (1.9987-1.9994″)
Taper-Max	0.005 mm (0.0002″)
Out-of-Round-Max	0.005 mm (0.0002″)
Rod Bearing Clearance	0.028-0.082 mm (0.0011-0.0032″)
Rod Side Clearance	0.18-0.44 mm (0.007-0.017″)

Camshaft Assembly

Journal Diameter	47.44-47.52 mm (1.868-1.871″)
Bearing Inside Diameter	47.523-47.549 mm (1.871-1.872″)
Journal Clearance	0.026-0.101 mm (0.001-0.004″)
Lobe Lift	
Intake	6.67 mm (0.2626″)
Exhaust	6.94 mm (0.2732″)

Valve System

Lifter Assembly	Hydraulic
Rocker Arm Ratio	1.50:1
Valve Lash	1 ± 1/2 turn down from zero lash

- Face Angle ..... 45°
- Seat Angle ..... 46°
- Seat Runout ..... 0.025 mm (0.001″) MAX.
- Seat Width
  - Intake ..... 1.55-1.85 mm (0.061-0.073″)
  - Exhaust ..... 1.70-2.00 mm (0.067-0.079″)
- Stem Clearance
  - Intake ..... 0.0356 mm-0.0686 mm (0.0014-0.0027″)
  - Exhaust ..... 0.0381 mm-0.0737 mm (0.0015-0.0029″)
- Valve Spring
  - Free Length ..... 48.5 mm (1.91″)
  - Pressure
    - Closed ..... 356 N at 40.9 mm (80 lb. at 1.61″)
    - Open ..... 841 N at 30.5 mm (190 lb. at 1.20″)
  - Installed Height ..... 40.9 mm (1.61″)
  - Approximate # of Coils 4

Oil Pump

- Gear Lash ..... 0.094-0.195 mm (0.0037-0.0077″)
- Gear Pocket
  - Depth ..... 30.53-30.61 mm (1.202-1.205″)
  - Diameter ..... 38.202-38.252 mm (1.504-1.506″)
- Gear
  - Length ..... 30.45-30.48 mm (1.199-1.200″)
  - Diameter ..... 38.05-38.10 mm (1.498-1.500″)
  - Side Clearance ..... 0.08-0.10 mm (0.003-0.004″)
  - End Clearance ..... 0.05-0.152 mm (0.002-0.006″)
- Valve-to-Bore Clearance ..... 0.038-0.089 mm (0.0015-0.0035″)

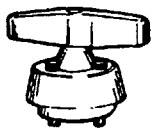
SPECIAL TOOLS

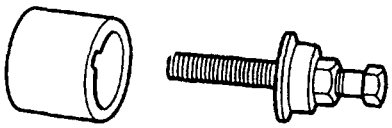
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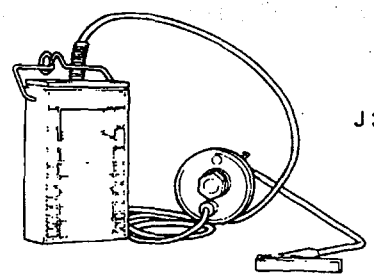
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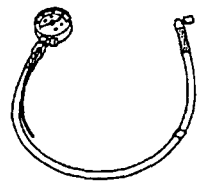
7.  J 5892-C

8.  J 8520

9.  J 23590

10.  J 23738-A

11.  J 36660

12.  J 34730-1

13.  J 8080

14.  J 5239

1. CRANKSHAFT SPROCKET REMOVER
2. TORSIONAL DAMPER INSTALLER
3. PISTON RING COMPRESSOR
4. TORSIONAL DAMPER REMOVER
5. REAR MAIN BEARING OIL SEAL INSTALLER
6. CRANKSHAFT SPROCKET INSTALLER
7. VALVE SPRING COMPRESSOR
8. CAM LOBE LIFT INDICATOR
9. SPARK PLUG PORT ADAPTER
10. VALVE STEM SEAL TESTER
11. TORQUE ANGLE METER
12. FUEL PRESSURE GAGE
13. MAIN BEARING SHELL REMOVER & INSTALLER
14. CONNECTING ROD BOLT GUIDE SET

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SECTION 6A2B

3.4 LITER UNIT REPAIR RPO L32—VIN S

NOTICE: Always use the correct fastener in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications:

- Some bolts are designed to permanently stretch, and if a stronger fastener is used, the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent.
- Other bolts are designed to break if over tightened to prevent part damage. Using a stronger fastener may cause part damage to occur. Fasteners that need to be replaced when removed will be called out. Fasteners that require thread lockers or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

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GENERAL DESCRIPTION

ENGINE CONSTRUCTION

Figures 1 through 4

Cylinder Block

The cylinder block is made of cast alloy iron and has six cylinders arranged in a "V" shape with three cylinders in each bank. The cylinder banks are set at a 60° angle from each other.

The right bank cylinders are (1,3,5) and the left bank cylinders are (2,4,6).

Four main bearings support the crankshaft which is retained by bearing caps that are machined with the block for proper alignment and clearances.

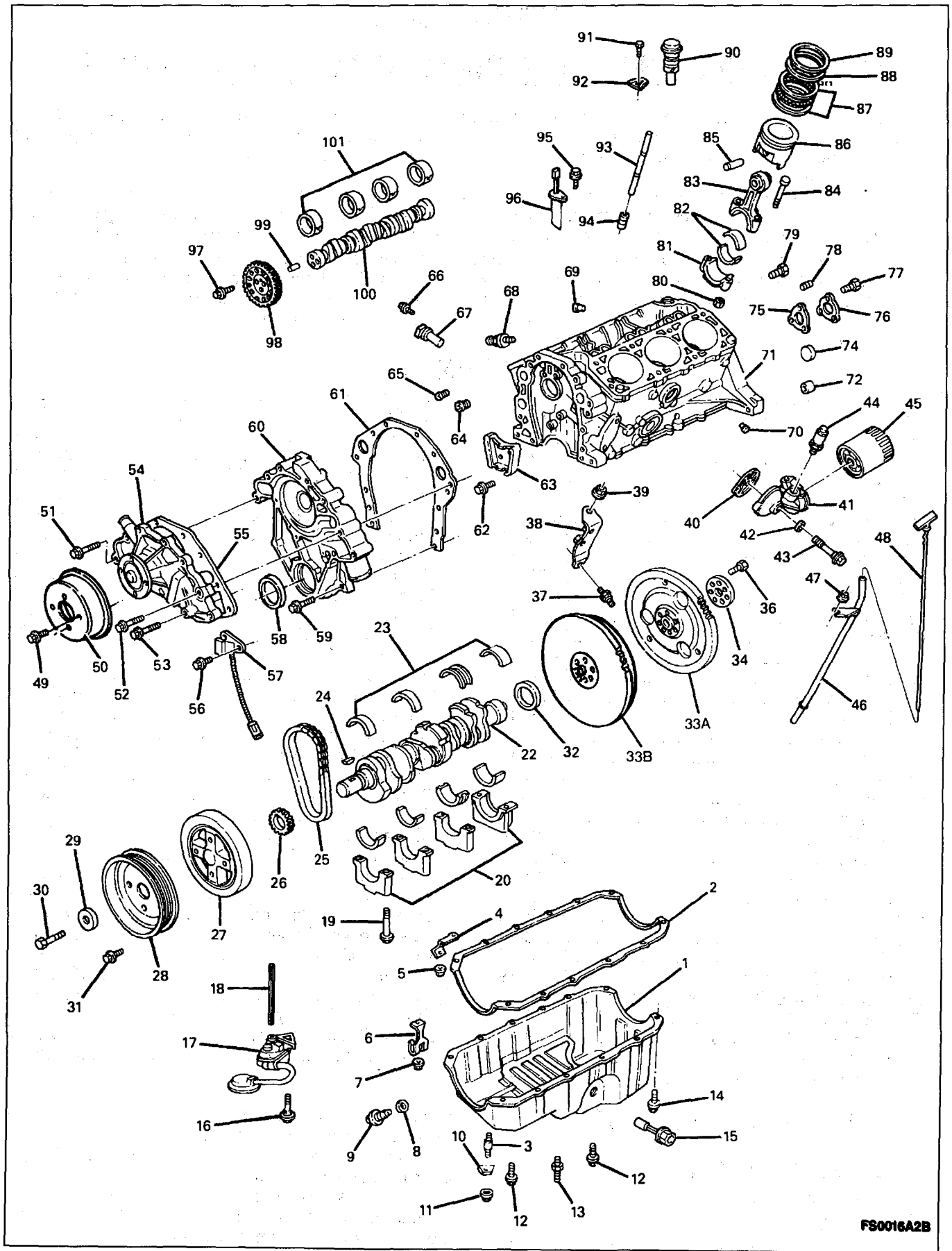


Figure 1 Engine Disassembled View 1 of 2

1 PAN, OIL
2 GASKET, OIL PAN
3 STUD, OIL PAN
4 CLIP, WIRING HARNESS
5 NUT, OIL PAN
6 CLIP, OIL COOLER PIPE
7 NUT, OIL PAN
8 WASHER, OIL DRAIN PLUG
9 PLUG, OIL DRAIN
10 REINFORCEMENT, OIL PAN
11 NUT, OIL PAN
12 BOLT, OIL PAN - SMALL
13 STUD, OIL PAN
14 BOLT, OIL PAN - LARGE
15 SENSOR, OIL LEVEL
16 BOLT, OIL PUMP
17 PUMP ASSEMBLY, OIL
18 ROD, OIL PUMP DRIVE
19 BOLT, MAIN BEARING CAP
20 CAP, MAIN BEARING
21 O-RING
22 CRANKSHAFT
23 BEARING, MAIN
24 KEY, CRANKSHAFT
25 CHAIN, TIMING
26 SPROCKET, CRANKSHAFT
27 DAMPER, TORSIONAL
28 PULLEY, CRANKSHAFT
29 WASHER, TORSIONAL DAMPER
30 BOLT, TORSIONAL DAMPER
31 BOLT, COOLANT PUMP PULLEY
32 SEAL, REAR MAIN
33A FLYWHEEL, AUTOMATIC TRANSMISSION
33B FLYWHEEL, MANUAL TRANSMISSION
34 REINFORCEMENT, FLYWHEEL
36 BOLT, FLYWHEEL
37 STUD, BRACE
38 BRACE, POWER STEERING PUMP
39 NUT, BRACE
40 GASKET, OIL FILTER ADAPTER
41 ADAPTER, OIL FILTER
42 O-RING
43 BOLT, OIL FILTER ADAPTER
44 SENSOR, OIL PRESSURE
45 FILTER, OIL
46 TUBE, OIL LEVEL INDICATOR
47 NUT, OIL LEVEL INDICATOR TUBE
48 INDICATOR, OIL LEVEL
49 BOLT, COOLANT PUMP PULLEY
50 PULLEY, COOLANT PUMP
51 BOLT, COOLANT PUMP - SMALL
52 BOLT, COOLANT PUMP - LARGE
53 BOLT, COOLANT PUMP - MEDIUM
54 PUMP, COOLANT
55 GASKET, COOLANT PUMP
56 BOLT, CRANKSHAFT POSITION SENSOR
57 SENSOR, CRANKSHAFT POSITION
58 SEAL, FRONT COVER OIL
59 BOLT, ENGINE FRONT COVER
60 COVER, ENGINE FRONT
61 GASKET, ENGINE FRONT COVER
62 BOLT, TIMING CHAIN DAMPER
63 DAMPER, TIMING CHAIN
64 PLUG, OIL GALLERY - 1/8"
65 PLUG, OIL GALLERY - 1/4"
66 BOLT, IGNITION TIMING SENSOR
67 SENSOR, IGNITION TIMING
68 SENSOR, KNOCK
69 PLUG, COOLANT JACKET
70 PLUG, COOLANT JACKET
71 BLOCK, ENGINE
72 DOWEL
74 PLUG, COOLANT JACKET
75 GASKET, REAR CAMSHAFT COVER
76 COVER, REAR CAMSHAFT
77 BOLT, REAR CAMSHAFT COVER
78 PLUG, OIL GALLERY - 1/4"
79 PLUG, OIL GALLERY - 3/8"
80 NUT, CONNECTING ROD
81 CAP, CONNECTING ROD
82 BEARING, CONNECTING ROD
83 ROD, CONNECTING
84 BOLT, CONNECTING ROD
85 PIN, PISTON
86 PISTON
87 RINGS, OIL CONTROL
88 RING, LOWER COMPRESSION
89 RING, UPPER COMPRESSION
90 DRIVE ASSEMBLY, OIL PUMP
91 BOLT, DRIVE ASSEMBLY CLAMP
92 CLAMP, OIL PUMP DRIVE ASSEMBLY
93 PUSHROD
94 LIFTER
95 BOLT, CAMSHAFT POSITION SENSOR
96 SENSOR, CAMSHAFT POSITION
97 BOLT, CAMSHAFT SPROCKET
98 SPROCKET, CAMSHAFT
99 PIN, DOWEL
100 CAMSHAFT
101 BEARING, CAMSHAFT

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Figure 2 Legend View 1

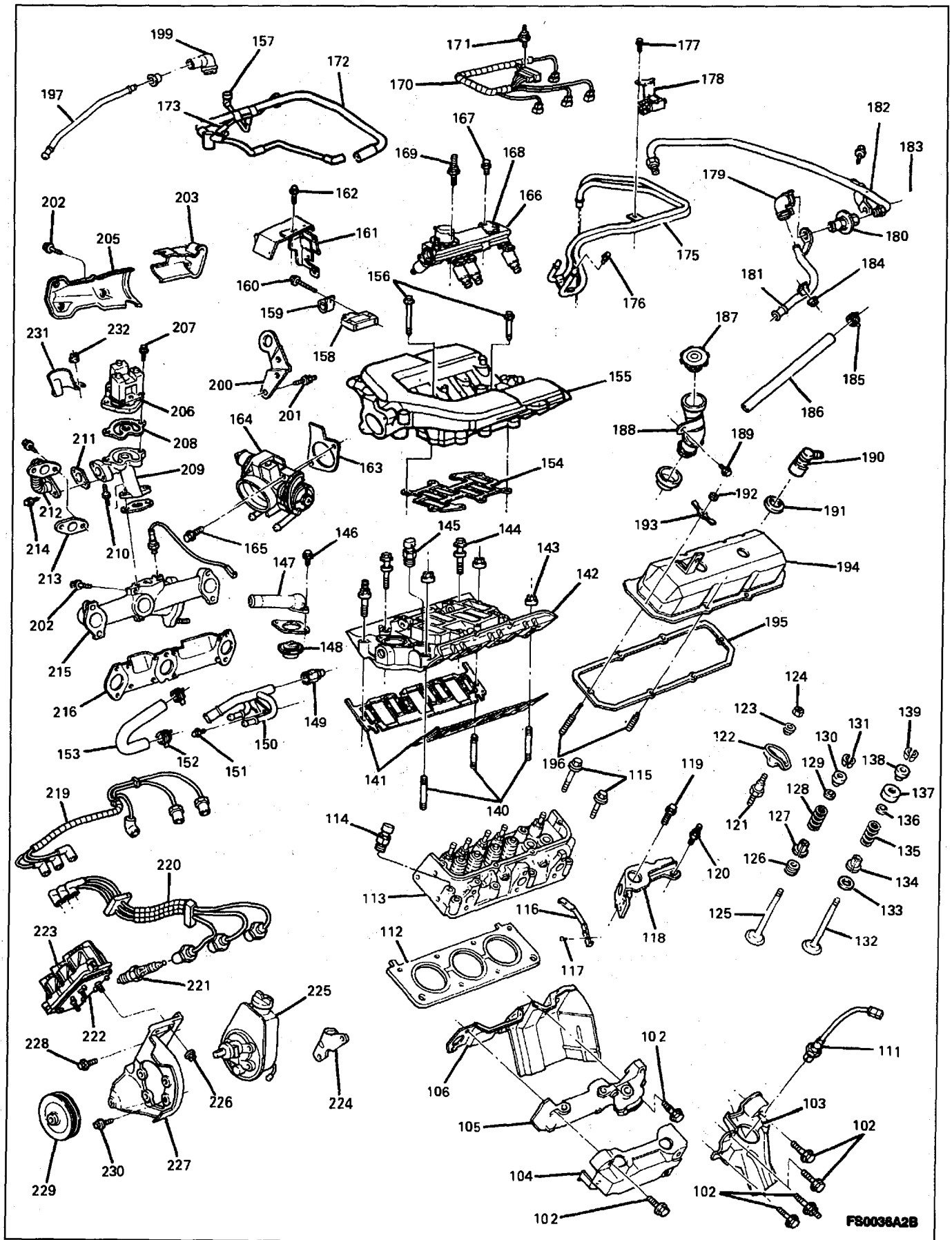


Figure 3 Engine Disassembled View 2 of 2

102 BOLT, EXHAUST MANIFOLD
103 SHIELD, EXHAUST MANIFOLD HEAT
104 SHIELD, EXHAUST MANIFOLD HEAT
105 MANIFOLD, EXHAUST - LEFT
106 GASKET, EXHAUST MANIFOLD
111 SENSOR, OXYGEN
112 GASKET, CYLINDER HEAD
113 HEAD, CYLINDER
114 SENSOR, COOLANT TEMPERATURE GAGE
115 BOLT, CYLINDER HEAD
116 BRACE, FUEL LINE
117 BOLT, FUEL LINE BRACE
118 BRACKET, FRONT ENGINE LIFT
119 BOLT, FRONT ENGINE LIFT BRACKET
120 STUD, FRONT ENGINE LIFT BRACKET
121 STUD, ROCKER ARM
122 ARM, ROCKER
123 BALL, ROCKER ARM
124 NUT, ROCKER ARM
125 VALVE, INTAKE
126 SEAL, INTAKE VALVE STEM
127 DAMPER, SPRING
128 SPRING, VALVE
129 O-RING
130 CAP, SPRING
131 KEY
132 VALVE, EXHAUST
133 SHIM - SELECTIVE
134 DAMPER, SPRING
135 SPRING, VALVE
136 O-RING
137 SHEDDER, OIL
138 CAP, SPRING
139 KEY
140 STUD, LOWER INTAKE MANIFOLD
141 GASKET, LOWER INTAKE MANIFOLD
142 MANIFOLD, LOWER INTAKE
143 NUT, LOWER INTAKE MANIFOLD
144 BOLT, LOWER INTAKE MANIFOLD
145 SENSOR, COOLANT TEMPERATURE
146 BOLT, THERMOSTAT HOUSING
147 HOUSING, THERMOSTAT
148 THERMOSTAT
149 NIPPLE, HEATER INLET
150 PIPE, HEATER INLET
151 SCREW, HEATER INLET PIPE
152 CLAMP, HOSE
153 HOSE, HEATER INLET
154 GASKET, UPPER INTAKE MANIFOLD
155 MANIFOLD, UPPER INTAKE
156 BOLT, UPPER INTAKE MANIFOLD
157 TUBE, VACUUM
158 SENSOR, MAP
159 CLIP, ENGINE WIRING HARNESS
160 SCREW, MAP SENSOR
161 BRACKET, ACCELERATOR CABLE
162 BOLT, ACCELERATOR CABLE BRACKET
163 GASKET, THROTTLE BODY
164 BODY, THROTTLE
165 BOLT,THROTTLE BODY
166 RAIL ASSEMBLY, FUEL INJECTOR
167 BOLT, FUEL LINE HOLD DOWN PLATE
168 PLATE, FUEL LINE HOLD DOWN
169 STUD, FUEL RAIL ASSEMBLY
170 HARNESS, FUEL INJECTOR RAIL
171 STUD, FUEL RAIL HARNESS
172 HARNESS, VACUUM
173 HOSE, FUEL PRESSURE REGULATOR VACUUM
175 LINE, FUEL
176 SCREW, FUEL LINE RETAINING
177 SCREW, EVAP CANISTER PURGE
178 CANISTER PURGE, EVAP
179 HOSE, SECONDARY AIR INJECTION
180 VALVE, AIR CHECK
181 PIPE, SECONDARY AIR INJECTION
182 PIPE, SECONDARY AIR INJECTION
183 BOLT, AIR PIPE
184 NUT, AIR PIPE
185 CLAMP, AIR HOSE
186 HOSE, SECONDARY AIR INJECTION
187 CAP, OIL FILL
188 TUBE, OIL FILL
189 SCREW, OIL FILL TUBE
190 VALVE, PCV
191 GROMMET
192 NUT, VALVE ROCKER COVER
193 REINFORCEMENT, VALVE ROCKER COVER
194 COVER, VALVE ROCKER
195 GASKET, VALVE ROCKER COVER
196 STUD, VALVE ROCKER COVER
197 TUBE, CRANKCASE VENT
199 FITTING, TUBE
200 BRACKET, REAR ENGINE LIFT
201 STUD, REAR ENGINE LIFT BRACKET
202 BOLT, EXHAUST MANIFOLD
203 SHIELD, EXHAUST MANIFOLD HEAT
205 SHIELD, EXHAUST MANIFOLD HEAT
206 VALVE, EGR
207 BOLT, EGR VALVE
208 GASKET, EGR VALVE
209 PIPE, EGR ADAPTER
210 BOLT, EGR ADAPTER PIPE
211 GASKET, EGR ADAPTER PIPE
212 PIPE, FLEXIBLE ADAPTER
213 GASKET, FLEXIBLE ADAPTER PIPE
214 BOLT, FLEXIBLE ADAPTER PIPE
215 MANIFOLD, EXHAUST - RIGHT
216 GASKET, EXHAUST MANIFOLD
217 SENSOR, OXYGEN
219 WIRES, SPARK PLUG - RIGHT
220 WIRES, SPARK PLUG - LEFT
221 PLUG, SPARK
222 SYSTEM, ELECTRONIC IGNITION
223 COIL, ELECTRONIC IGNITION
224 BRACKET, REAR POWER STEERING PUMP
225 PUMP, POWER STEERING
226 NUT, ELECTRONIC IGNITION SYSTEM
227 BRACKET, POWER STEERING PUMP
228 BOLT, POWER STEERING PUMP BRACKET
229 PULLEY, POWER STEERING PUMP
230 BOLT, POWER STEERING PUMP
231 SHIELD, SPARK PLUG WIRING
232 NUT, SPARK PLUG WIRING SHIELD

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Figure 4 Legend View 2

Cylinder Head

The cast iron cylinder heads have individual intake and exhaust ports for each cylinder. Valve guides are integral, and rocker arms are retained on individual threaded studs with locking nuts.

Crankshaft and Bearings

The crankshaft is cast nodular iron with deep rolled fillets on all six crankpins and all four main journals. Four steel-backed aluminum bearings are used, with the #3 bearing being the end-thrust bearing.

Camshaft and Drive

The camshaft is cast alloy iron with tapered 13.2 mm wide lobes, offset from the lifters and tapered to provide positive valve lifter rotation. The camshaft is supported by four journals and includes an oil pump drive gear.

Pistons and Connecting Rods

The pistons are cast aluminum with steel struts using two compression rings and one oil control ring. The piston pin is offset 0.8 mm towards the major thrust side. This allows a gradual change in thrust pressure against the cylinder wall as the piston travels its path. Pins are chromium steel and have a floating fit in the pistons. They are retained in the connecting rods by a press fit.

Connecting rods are made of forged steel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal.

Valve Train

A very simple ball-pivot and rocker type valve train is used. Motion is transmitted from the camshaft through the hydraulic lifter and pushrod to the rocker arm. The rocker arm pivots on its ball and transmits the camshaft motion to the valve. The rocker arm ball locates on a stud, threaded into the head, and is retained by a nut. The pushrod is located by a guide plate held under the rocker arm stud, assuring that the rocker arm operates in the plane of the valve.

Intake Manifold

The intake manifold is a two-piece cast aluminum unit. It centrally supports a fuel rail with six fuel injectors.

Exhaust Manifolds

The exhaust manifolds are cast nodular iron.

ENGINE LUBRICATION

Figures 5 through 8

Full pressure lubrication, through a full flow oil filter is furnished by a gear type oil pump. Oil is drawn up through the pickup screen and tube, and passed through the pump to the oil filter.

The oil filter is a full flow paper element unit. An oil filter bypass is used to ensure adequate oil supply, should the filter become plugged or develop excessive pressure drop. The bypass is designed to open at 69-83 kPa (10-12 psi).

A new priority oil delivery system supplies oil first to the crankshaft journals. The passages supplying oil to the crankshaft main bearings also supply oil to the camshaft bearings through intersecting vertical drilled holes. Oil from the crankshaft main bearings is supplied to the connecting rod bearings by means of intersecting passages drilled in the crankshaft. The front cam bearing has a 0.25 mm deep slot on its outside diameter to supply oil to the cam sprocket thrust face, and oil passages from the camshaft journals supply oil to the hydraulic lifters.

The hydraulic lifters pump oil up through the pushrods to the rocker arms. Oil draining back from the rocker arms is directed by cast dams in the crankcase casting to supply the camshaft lobes. Oil also drains past specific hydraulic lifter flats to oil camshaft lobes directly.

DISASSEMBLY

FLYWHEEL

Figure 9

Remove or Disconnect

1. Flywheel retaining bolts (36).
2. Flywheel (33).

DRAINING THE ENGINE

Remove or Disconnect

1. Oil drain plug (9) and drain engine oil.
2. Oil filter (45).
3. Coolant drain plugs (69 and 70) and drain coolant.

UPPER INTAKE MANIFOLD

Figure 10 and 11

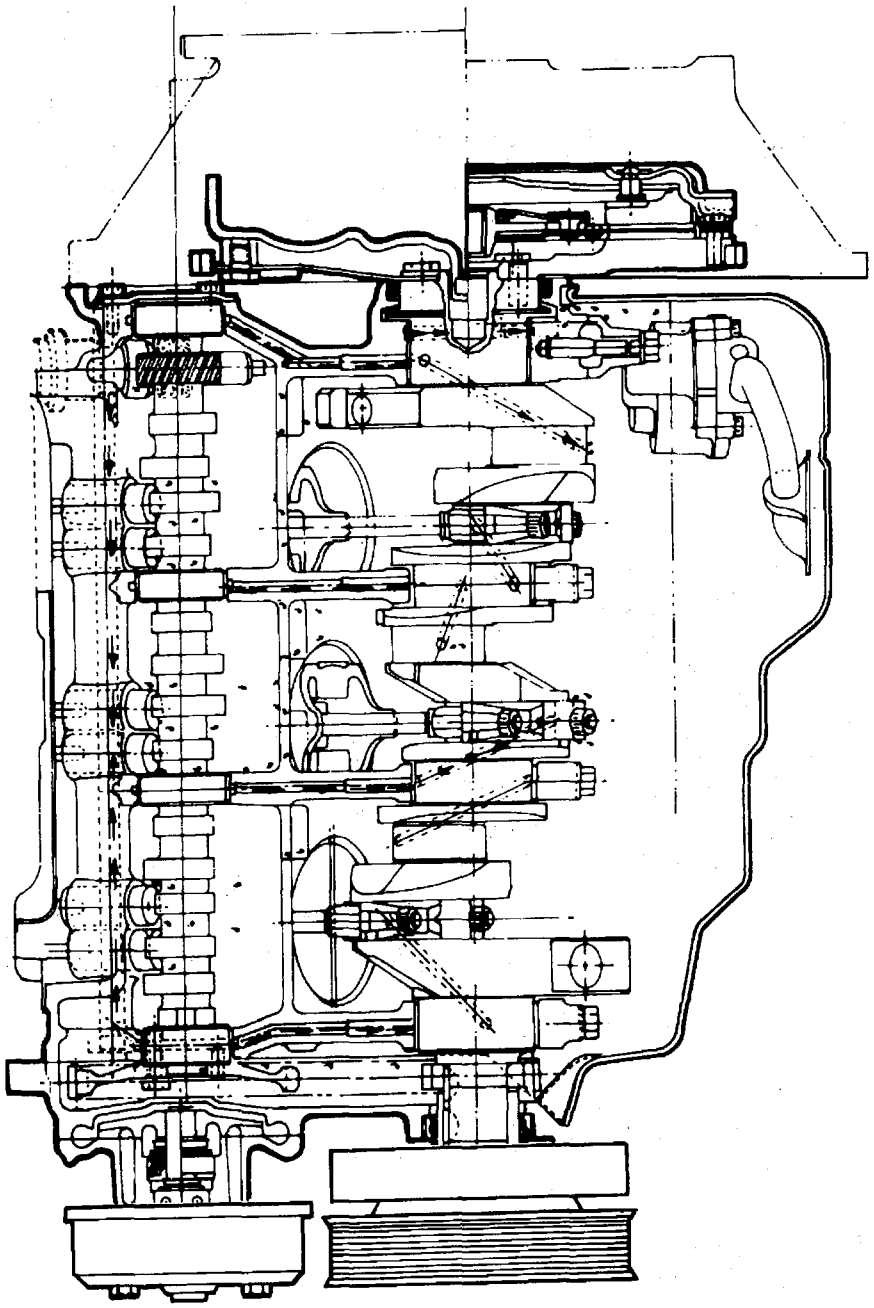
Remove or Disconnect

1. Throttle body heater hose clamps (152) and hoses (153).
2. Fuel line clamp bolts (176 and 177).

Important

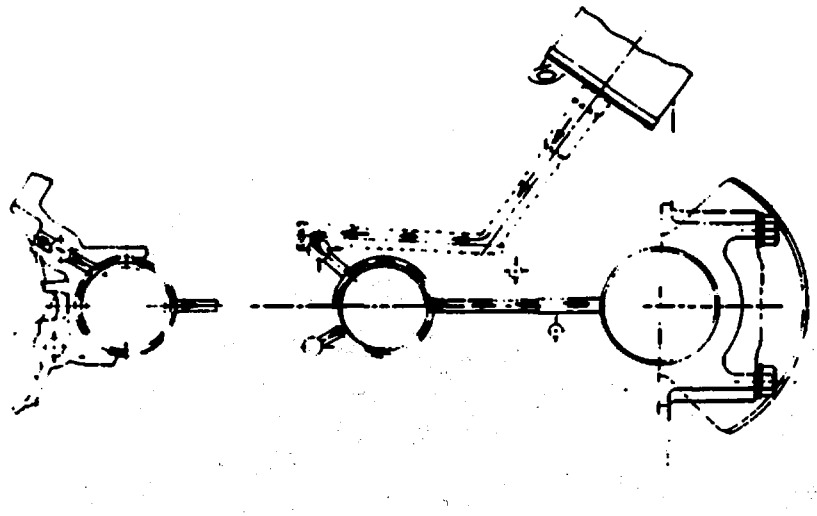
- The fuel line hold down plate and pivot bolt are part of the fuel rail assembly. Do not remove the pivot bolt.

3. Fuel line hold down plate bolt (167).
   - Rotate fuel line hold down plate (168) counter-clockwise.
4. Fuel lines (175).
5. Fuel injector rail wiring harness retaining nut.
6. Fuel rail stud (169).
7. Fuel pressure regulator vacuum hose (173).

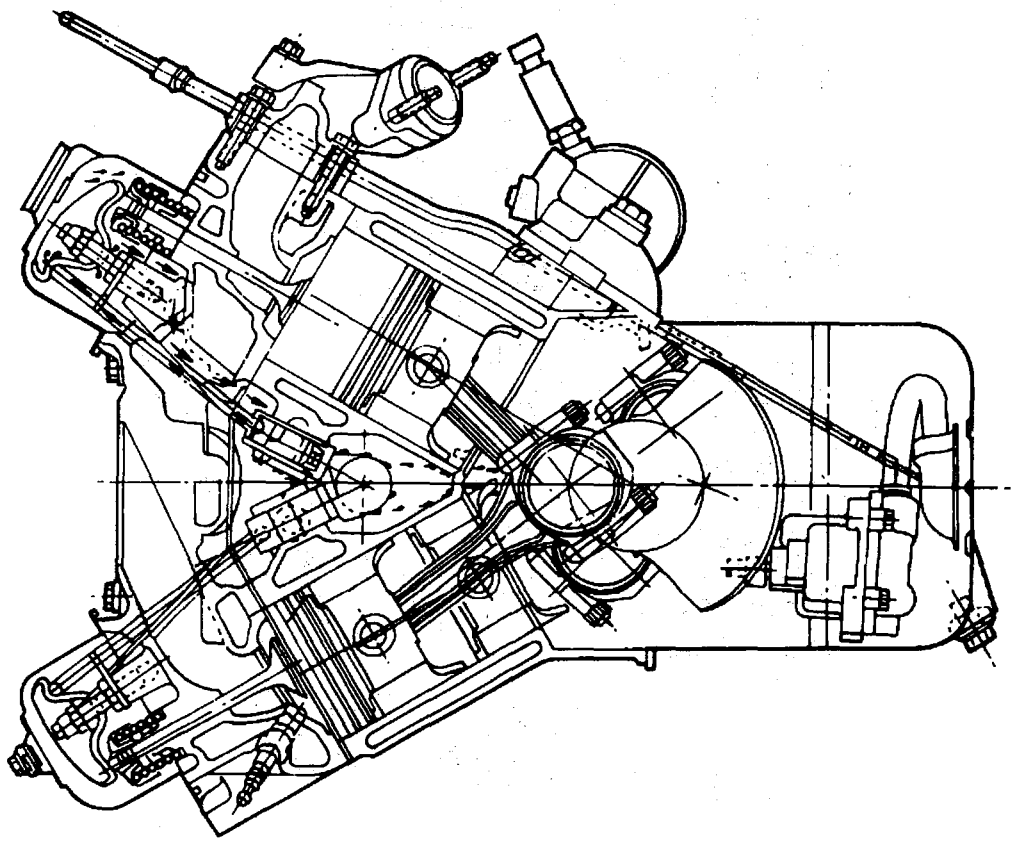


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Figure 5 Engine Lubrication View 1 of 4



TYPICAL FOR FRONT & REAR OILING
FROM LEFT BANK TO RIGHT BANK



FS0066A2B

Figure 6 Engine Lubrication View 2 of 4

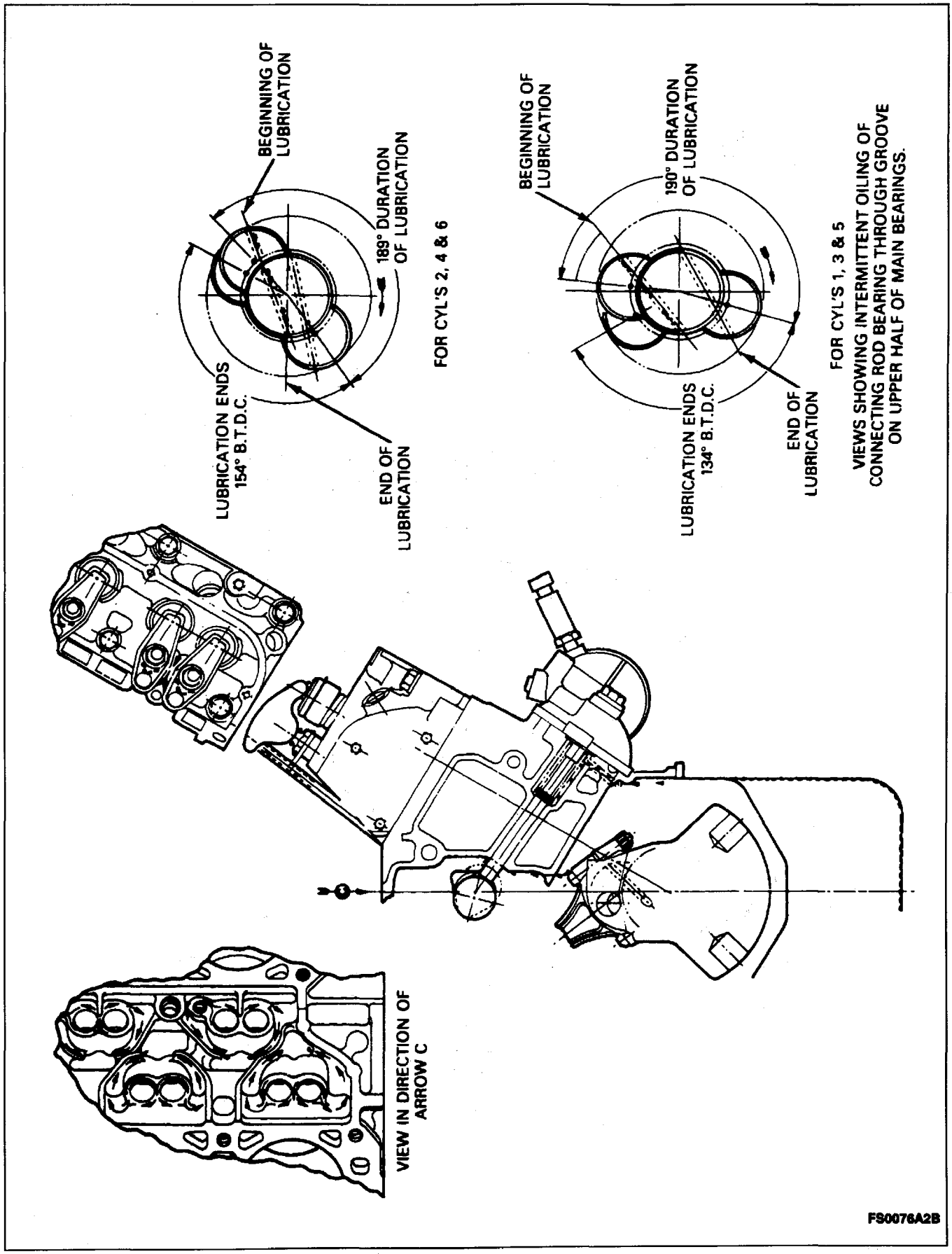


Figure 7 Engine Lubrication View 3 of 4

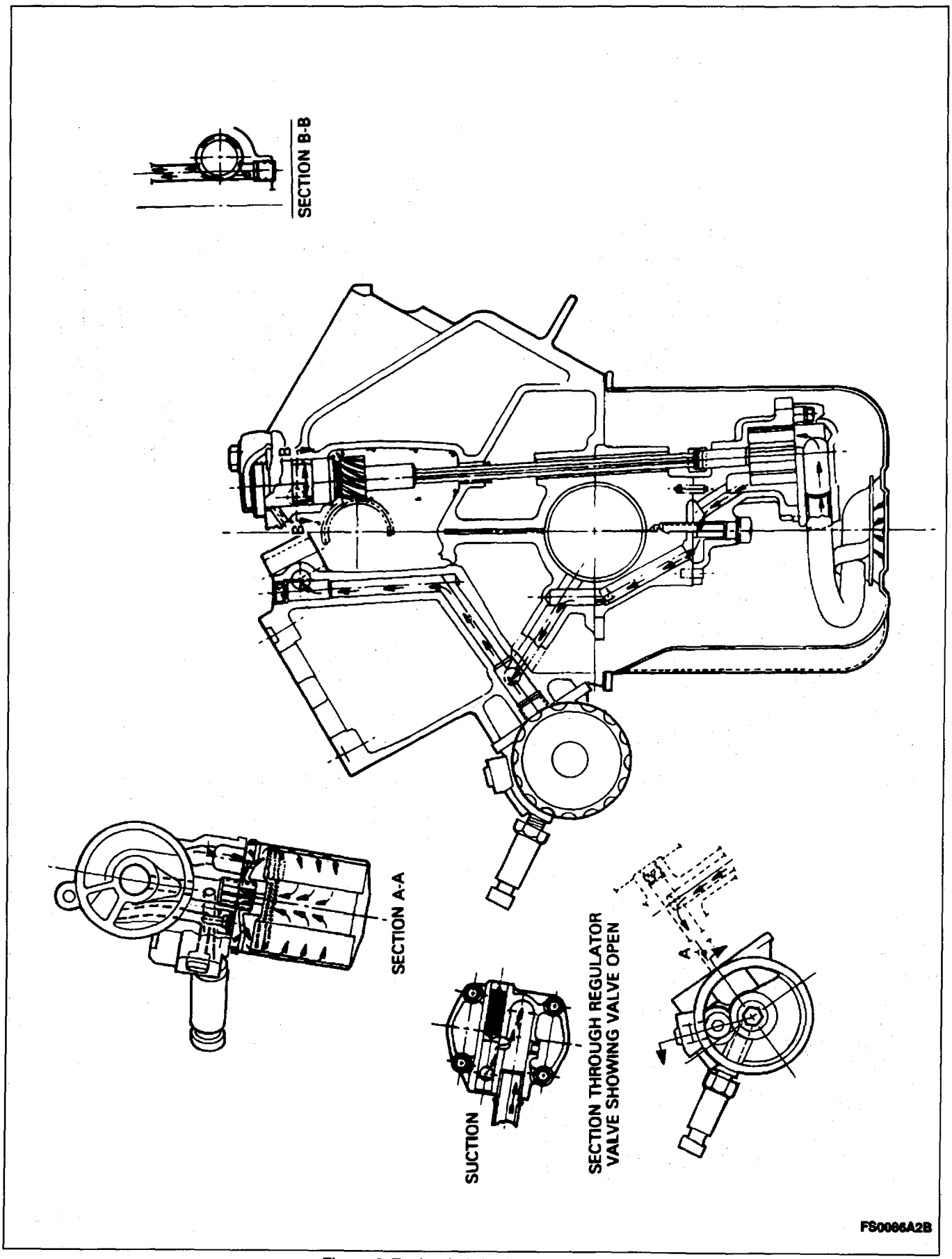


Figure 8 Engine Lubrication View 4 of 4

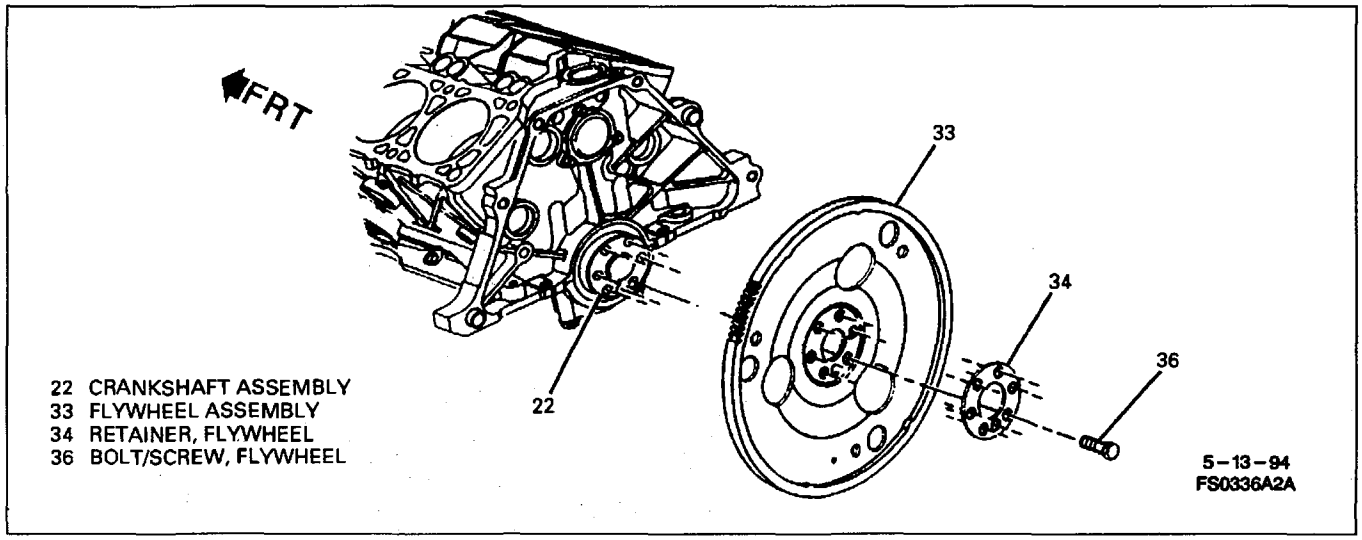


Figure 9 Flywheel

8. Coolant sensor electrical connector.
9. Blow dirt out of injector bores with compressed air.
10. Fuel injector rail assembly (166).
    - Pry carefully on injector rail (166). Remove injectors one side at a time.
11. PCV valve (190).
12. EGR flexible tube bolts at upper intake manifold (155).
13. MAP sensor electrical connector.
14. Upper intake manifold bolts (156).
15. Upper intake manifold (155) and gasket (154).

VALVE ROCKER COVER

Figure 12

Remove or Disconnect

1. Nuts (192) and reinforcements (193).
2. Valve rocker cover (194) and gasket (195).

VALVE ROCKER ARM AND PUSHROD

Figure 13

Remove or Disconnect

1. Rocker arm nuts (124).
    - Place valve train parts in a rack so that they can be installed in the same location which they were removed.
2. Rocker arms (122) and balls (123).
3. Pushrods (93).

LOWER INTAKE MANIFOLD

Figure 14

Remove or Disconnect

1. Retaining bolts (144) and nuts (143).
2. Lower intake manifold (142) and gaskets (141).

VALVE LIFTERS

Figure 13

Remove or Disconnect

1. Valve lifters (94).

EXHAUST MANIFOLD

Figures 15 and 16

Remove or Disconnect

1. Serpentine drive belt.
2. Rear A/C compressor bracket mounting bolts and bracket.
3. Generator pencil brace bolts and braces.
4. A/C compressor and generator mounting bracket bolts.
5. A/C compressor and generator mounting bracket.
6. AIR pipe fitting from right exhaust manifold, if equipped.
7. AIR pipe retaining nut (184) and bolt (183), if equipped.
8. Secondary air injection pipe assembly, if equipped.
9. Exhaust manifold retaining bolts (102 and 202).
10. Exhaust manifolds (105 and 215) and heat shields (103, 104, 203 and 205).
11. Exhaust manifold gaskets (106 and 216).

OIL PAN

Figure 17

Remove or Disconnect

1. Oil pan nuts (11) and reinforcements (10).
2. Oil pan bolts (12) and studs (13).
3. Oil pan (1) and gasket (2).

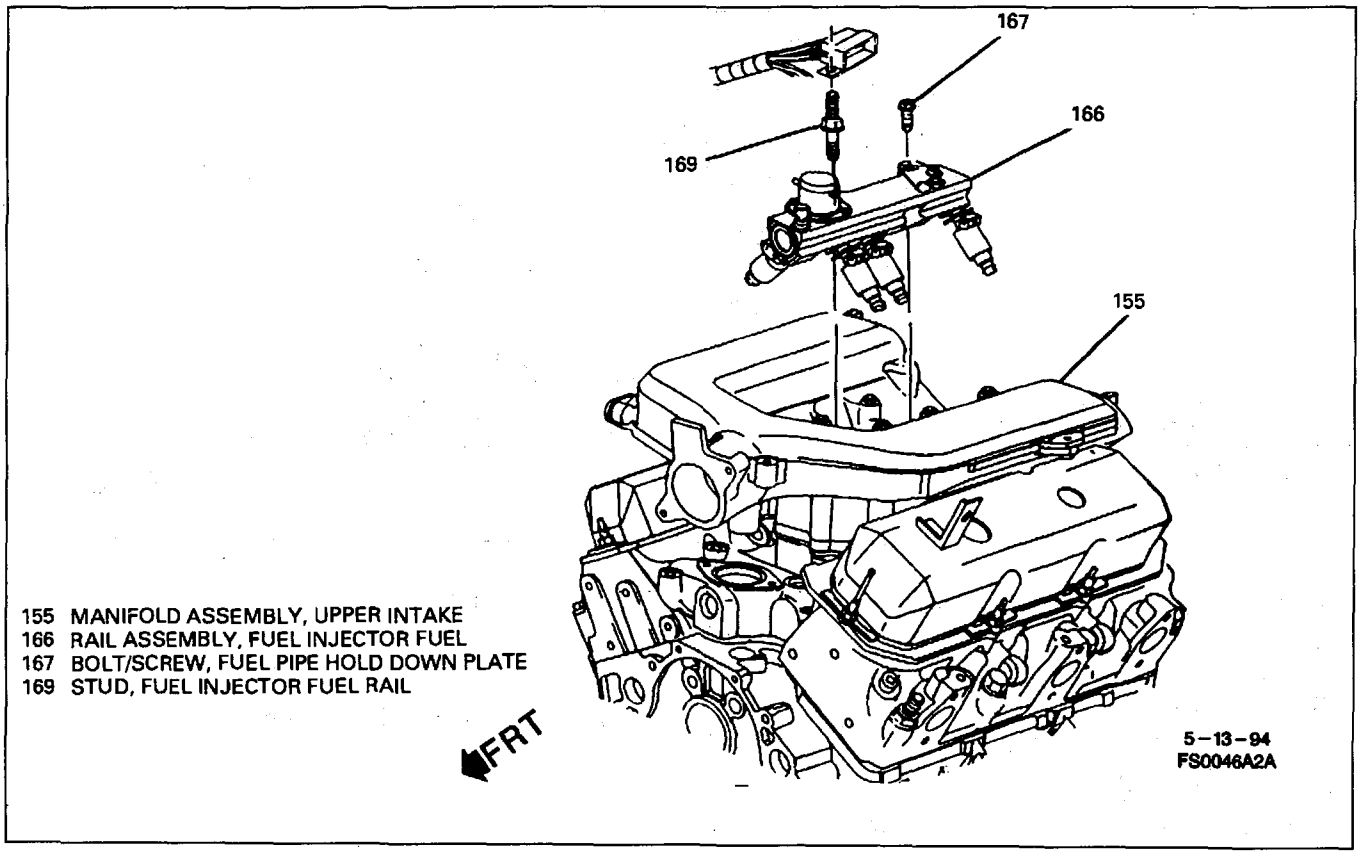


Figure 10 Fuel Injector Rail

ELECTRONIC IGNITION MODULE

Tools Required:
J 25034-B Power Steering Pump Pulley Remover
J 25034-5 Adapter

Remove or Disconnect

1. Power steering pump pulley (229) using J 25034-B and J 25034-5.
2. Power steering pump bracket retaining bolts.
3. Power steering pump bolts (228) and pump (225).
4. Electronic ignition module nuts (226) and electronic ignition module (223).

COOLANT PUMP

Figure 69

Remove or Disconnect

1. Power steering pump mounting bracket bolts (230) and bracket (227).
2. Coolant pump pulley bolts (49) and pulley (50).
3. Coolant pump bolts (51, 52 and 53).
4. Coolant pump (54) and gasket (55).

TORSIONAL DAMPER

Figure 18

Tool Required:
J 24420-B Torsional Damper Remover

Remove or Disconnect

1. Torsional damper bolt (30) and washer (29).
2. Crankshaft pulley bolts (31) and pulley (28).
3. Torsional damper (27) using J 24420-B.

ENGINE FRONT COVER

Figure 69

Remove or Disconnect

1. Engine front cover bolts (59).
2. Engine front cover (60) and gasket (61).

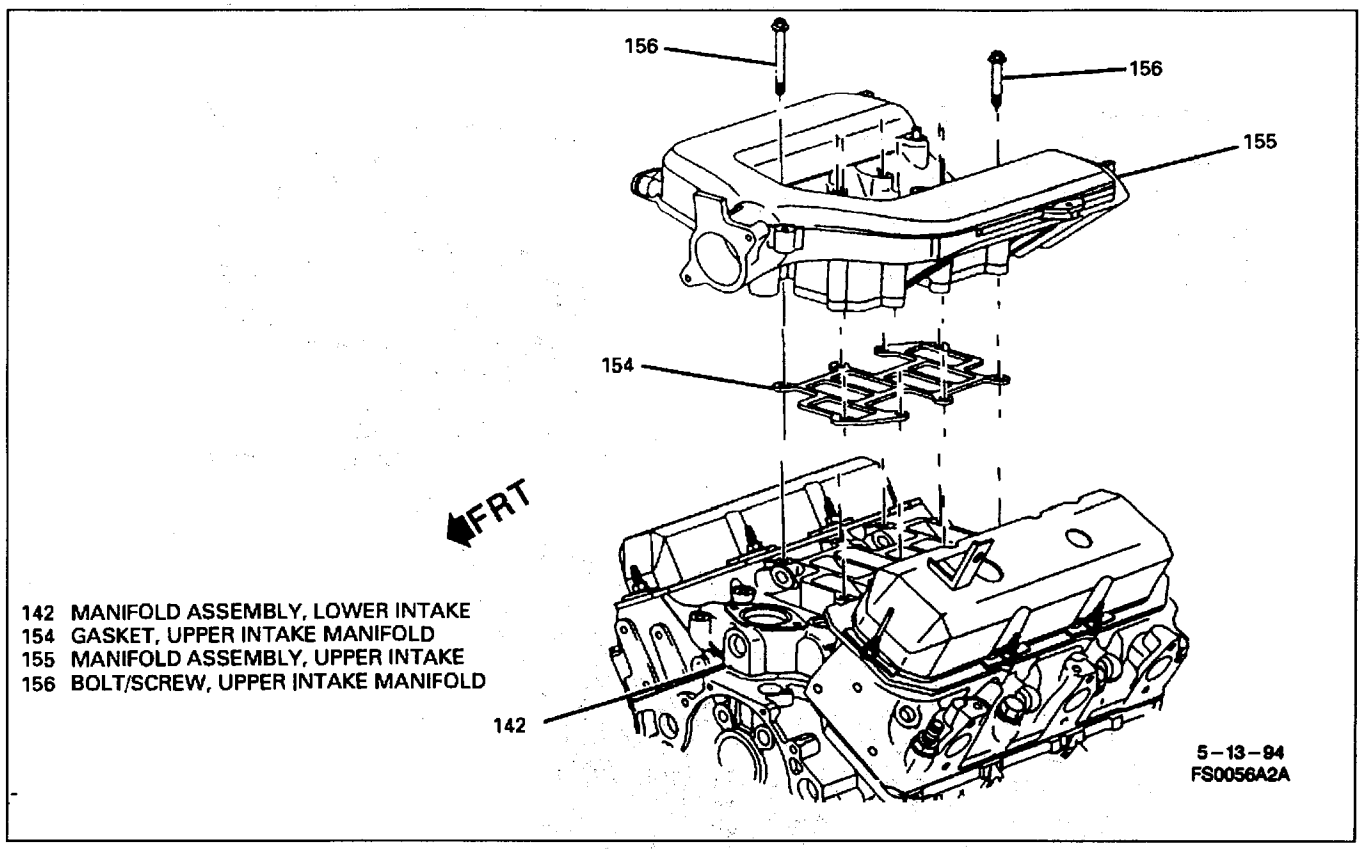
TIMING CHAIN AND SPROCKETS

Figure 68

Tool Required:
J 5825 Crankshaft Sprocket Remover

Remove or Disconnect

1. Cam sprocket bolts (97).
2. Cam sprocket (98) and timing chain (25).
3. Crankshaft sprocket (26) using J 5825.
4. Timing chain damper bolts (62) and damper (63).



142 MANIFOLD ASSEMBLY, LOWER INTAKE
154 GASKET, UPPER INTAKE MANIFOLD
155 MANIFOLD ASSEMBLY, UPPER INTAKE
156 BOLT/SCREW, UPPER INTAKE MANIFOLD

Figure 11 Upper Intake Manifold

CAMSHAFT

Figure 68

Remove or Disconnect

1. Oil pump driven gear hold down clamp bolt (91) and clamp (92).
2. Oil pump driven gear assembly (90).

NOTICE: Camshaft journals are all the same diameter so care must be used when removing the camshaft to avoid bearing damage.

3. Camshaft (100).
   - Install three 4-inch bolts in the camshaft bolt holes.
   - Carefully rotate and pull the camshaft (100) out of the camshaft bearings.

CYLINDER HEAD

Right

Figure 64

Remove or Disconnect

1. Pencil brace bracket bolts.
2. Cylinder head bolts (115).
3. Cylinder head (113) and gasket (112).

Left

Figure 64

Remove or Disconnect

1. Power steering pump bracket bolts and bracket (224).
2. Oil level indicator tube nut (47).
3. Engine lift bracket bolts (119 and 120) and bracket (118).
4. Engine coolant temperature sensor (114).
5. Cylinder head bolts (115).
6. Cylinder head (113) and gasket (112).

OIL PUMP

Figure 20

Remove or Disconnect

1. Oil pump bolt (16).
2. Oil pump (17) and drive rod (18).

PISTON AND CONNECTING ROD

Figures 21 and 37

Remove or Disconnect

1. Mark the piston (86) with the number of the cylinder from which it is being removed.
2. Mark the connecting rod (83) and the rod cap (81) so that they can be assembled correctly.

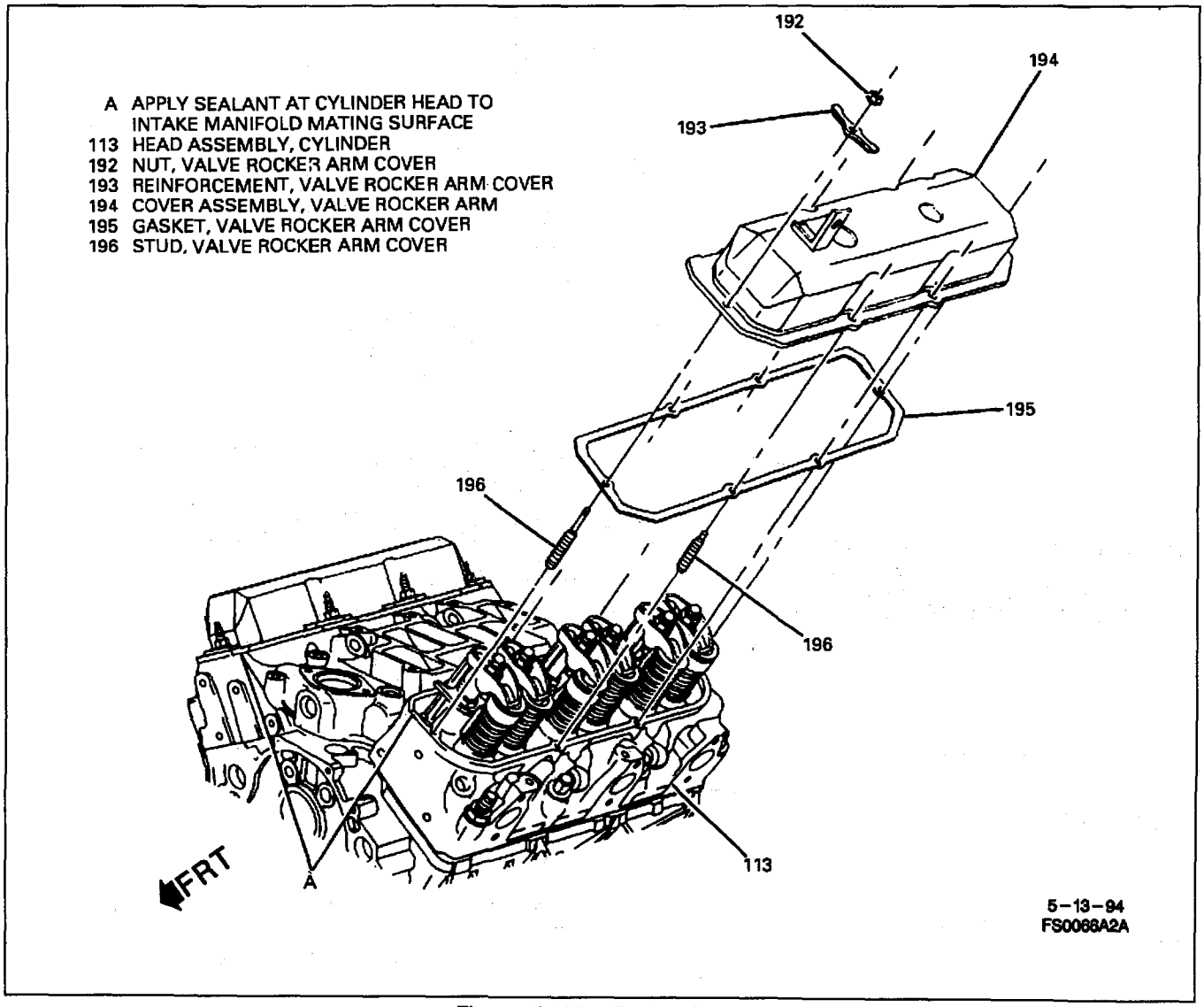


Figure 12 Valve Rocker Cover

3. Turn the crankshaft (22) to bottom dead center.

Clean

- Carbon from the top end of the cylinder.

4. Connecting rod nut (80) and cap (81).

NOTICE: If there is a pronounced ridge at the top of the piston travel, this ridge must be removed with a ridge reamer before removing piston and connecting rod assembly. Do not use force. Avoid breaking piston rings and damaging the piston.

NOTICE: Install thread protector to avoid damage to the crankshaft journal.

5. Connecting rod (83) and piston assembly (86). Push out with a suitable tool.

CRANKSHAFT

Figure 22

Remove or Disconnect

1. Main bearing cap bolts (19).
2. Main bearing caps (20) and lower bearing halves (23).
3. Crankshaft (22).
4. Upper bearing halves (23).

REAR MAIN SEAL

Figure 23

Remove or Disconnect

1. Rear main seal from crankshaft (32).

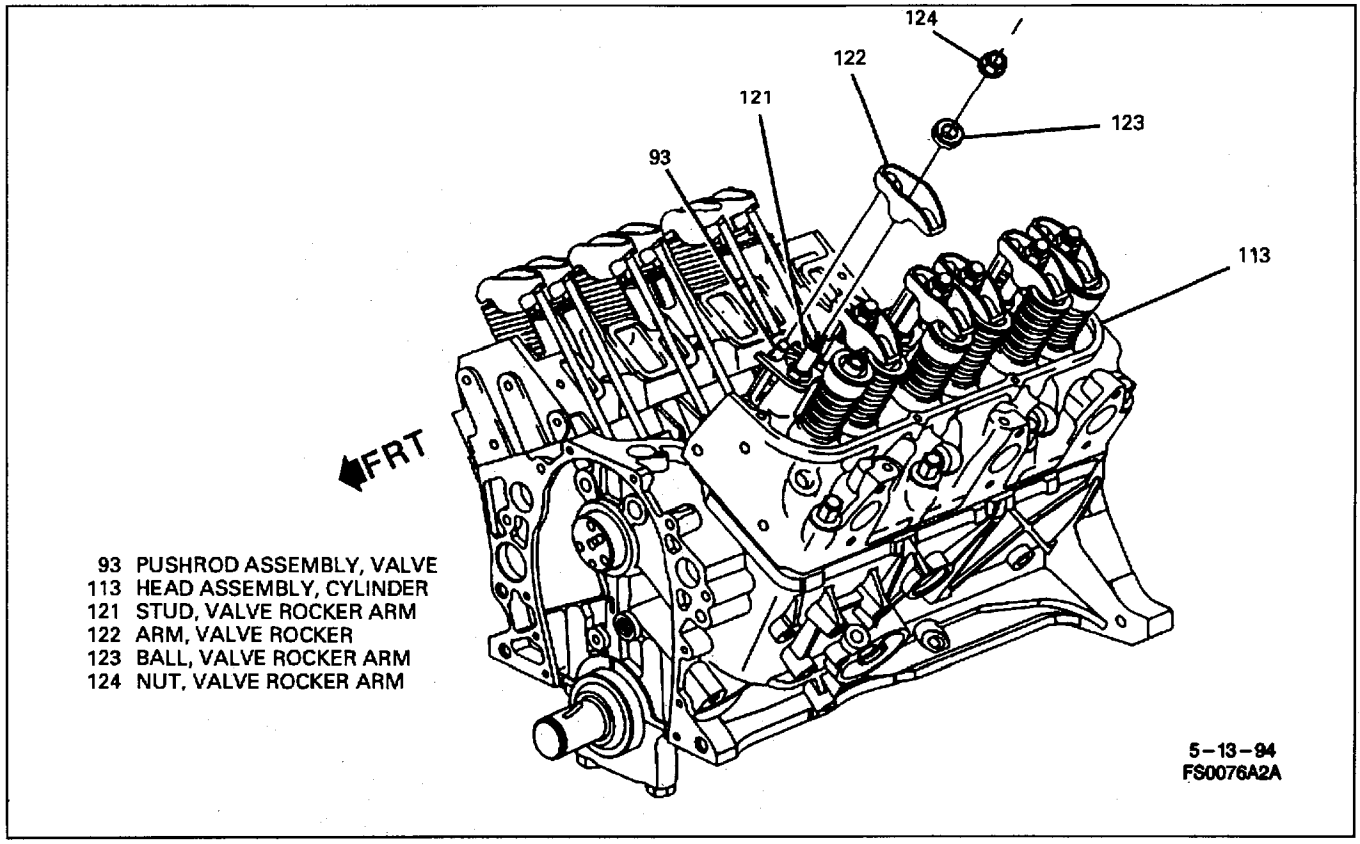


Figure 13 Valve Rocker Arms and Pushrods

CAMSHAFT BEARINGS

Figure 24

Tool Required:
J 33049 Camshaft Bearing Remover/Installer

Remove or Disconnect

1. Camshaft cover bolts (77), cover (76) and gasket (75).
2. Camshaft bearings (101).
   A. Select the proper expander assembly and driving washer.
   B. Assemble J 33049. Tighten the expander assembly snug with the camshaft bearing.
   C. Drive out bearings.

Disassemble

- Camshaft bearings (101) must not be re-used after they have been removed.

CLEANING, INSPECTION AND REPAIR

CYLINDER BLOCK

Figures 25 through 29

Tool Required:
J 8087 Cylinder Bore Checking Gage

Disassemble

1. Oil filter adapter bolt (43).
2. Oil filter adapter (41) and gasket (40).
3. Knock sensor.
4. Ignition timing sensor retaining bolt (66) and sensor (67).
5. Camshaft sensor retaining bolt (95).
6. Camshaft sensor (96).
7. Coolant jacket plugs (74).
8. Coolant jacket threaded plugs (69 and 70).
9. Oil gallery plugs (64, 65, 78 and 79).

Important

- Caustic cleaning solution destroys the bearing material. All bearings must be replaced after cleaning with a caustic solution. Do not clean bearing material or aluminum parts with caustic solutions.

Clean

- Sealing material from mating surfaces.
- Boil in caustic solution.
- Flush with clean water or steam.
- Oil passages.
- All blind holes.
- Spray or wipe cylinder bores and machined surfaces with engine oil.

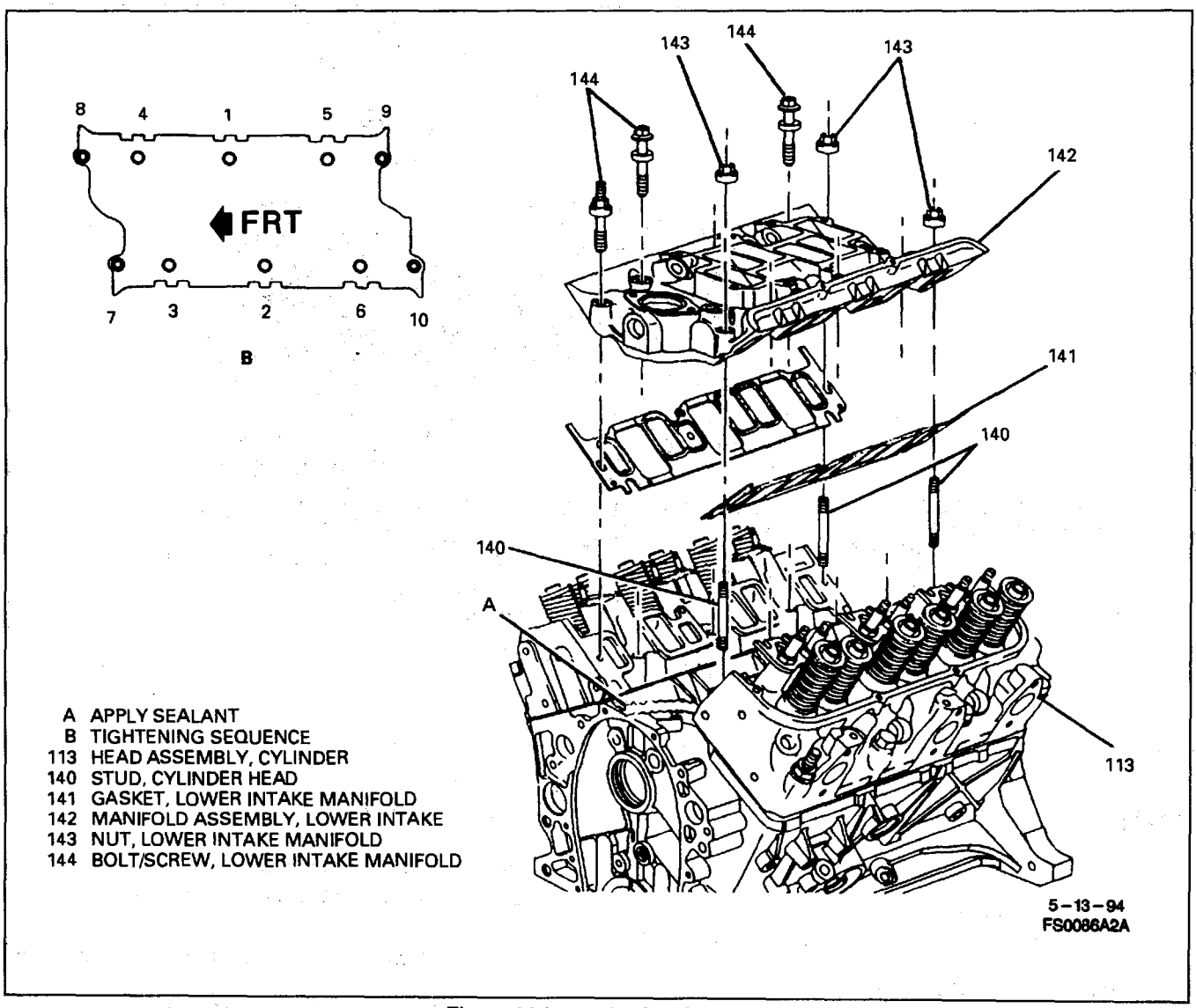


Figure 14 Lower Intake Manifold

Inspect

- Check surface for flatness. Use a straight edge and a feeler gage (Figure 25). If the cylinder head deck flatness exceeds 0.1 mm (0.004 inch), the surface should be machined flat. If more than 0.25 mm (0.010 inch) must be removed, replace the block.
- Oil pan rail and timing cover attaching area for nicks. Minor irregularities may be cleaned up with a flat mill file.
- Head bolt tapped holes.
- Transaxle case mating surface.

NOTICE: If this surface is not flat, a broken flywheel may result.

- Temporarily install the crankshaft. Measure crankshaft flange run-out. Refer to "Crankshaft" in Cleaning, Inspection and Repair of this section.

Measure

- Cylinder block flange surface runout at six mounting hole bosses (Figure 26).
  1. Hold gage plate flat against the crankshaft flange (Figure 27).
  2. Place dial indicator stem on the transaxle mounting bolt hole boss (Figure 27) and set indicator to 0.
  3. Take and record the readings obtained on the remaining transaxle mounting bolt hole bosses "A-F" to "1-6". Measurements should not vary more than 0.25 mm (0.010 inch).
  4. If the readings vary more than 0.25 mm (0.010 inch), recheck crankshaft flange run-out. If the run-out is excessive, replace the crankshaft.

Inspect

1. Threaded holes. If necessary, clean with a tap or drill out and install thread inserts. Refer to "Thread Repair" in Cleaning, Inspection and Repair of this section.

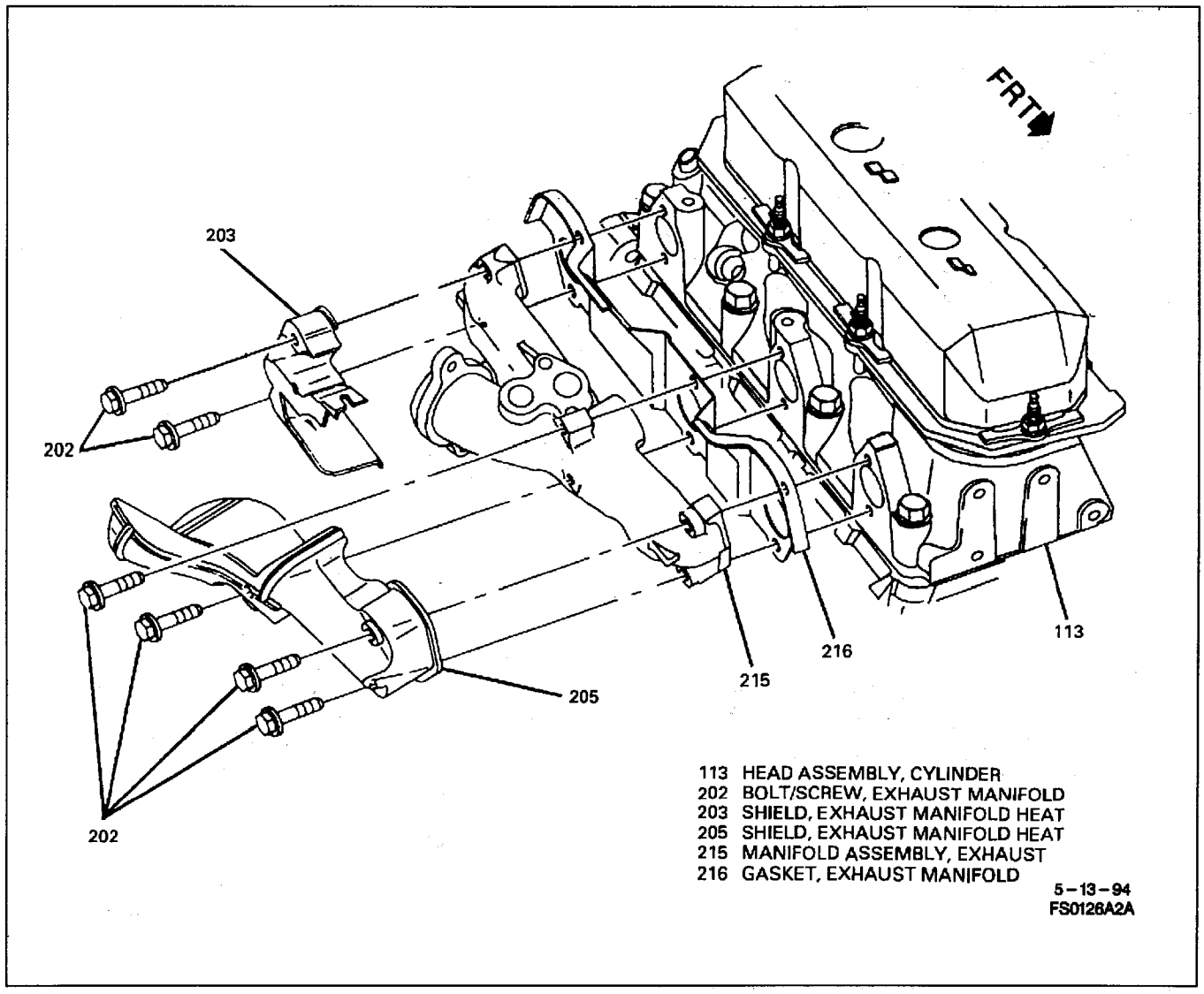


Figure 15 Exhaust Manifold - Right

Important

- The following inspections as well as reconditioning, if necessary, must be carried out with the main bearing caps installed and tightened to specification.
- Make sure main bearing caps are installed correctly, with the arrows pointing toward the front of the engine.

2. Camshaft and Crankshaft bearing bores, using J 8087, measure concentricity and alignment.
3. Cylinder bore, with J 8087 measure for wear, taper, run-out and ridging (Figures 28 and 29).
   - If the bore is worn out of specifications, it may be rebored, honed and fitted with oversize pistons. The smallest available oversize should be selected. Refer to "Pistons and Connecting Rods" in Cleaning, Inspection and Repair of this section.

Important

- Leave sufficient material to allow finish honing in conjunction with fitting the piston.
- If the bore is glazed but otherwise serviceable, break the glaze lightly with a hone and replace the piston rings.
- Make sure the honing stones are clean, sharp and straight. Move the hone slowly up and down to produce a cross-hatch pattern. Clean bore thoroughly with soap and water. Dry and rub in clean engine oil; then measure.

THREAD REPAIR

Figure 30

Damaged threads may be reconditioned by drilling out, rethreading and installing a suitable thread insert.

CAUTION: Wear safety glasses to avoid eye damage.

1. Determine size, pitch and depth of damaged thread. If necessary, adjust stop collars on cutting tool and tap to the required depth.

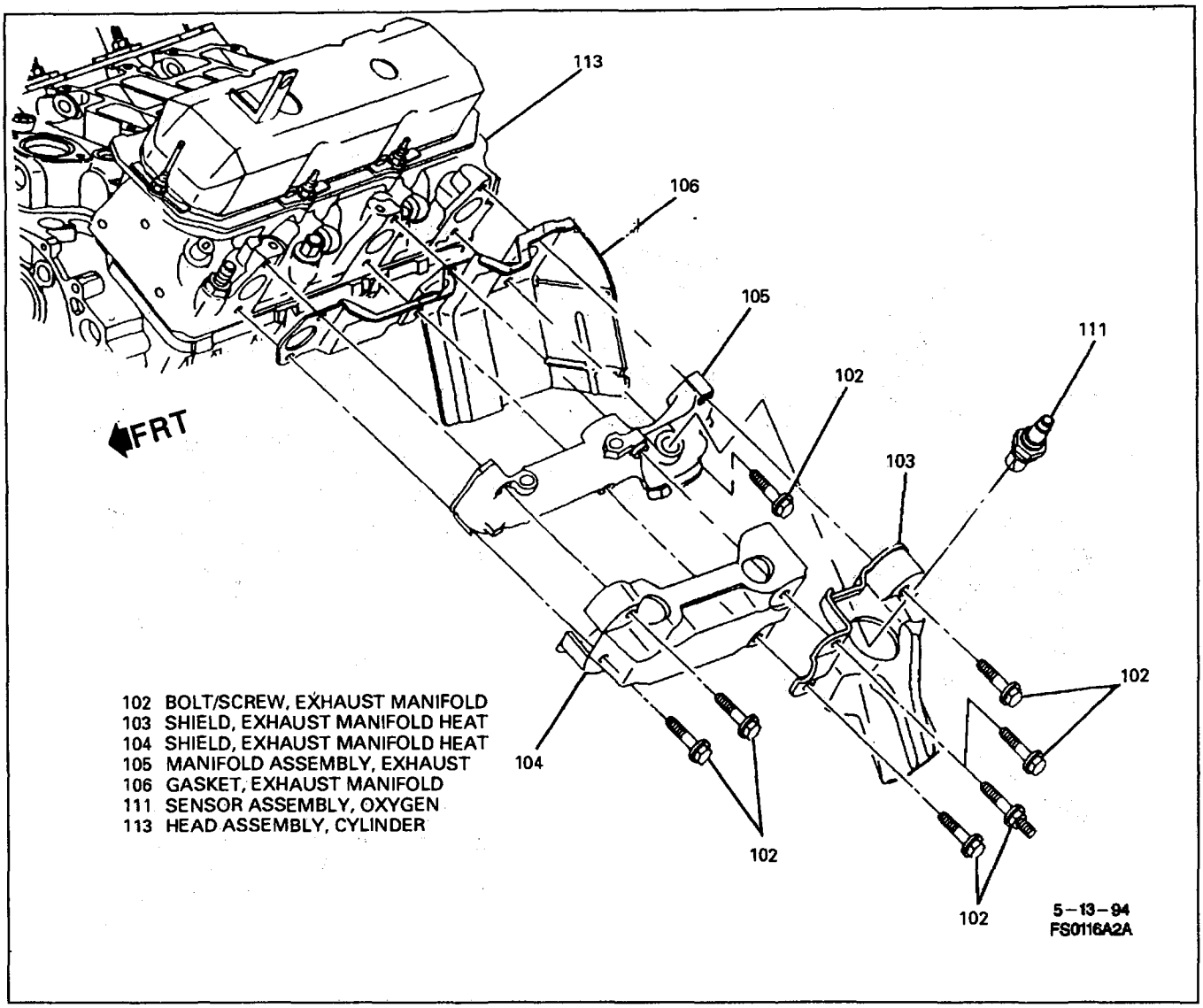


Figure 16 Exhaust Manifold - Left

Important

- Refer to the kit manufacturer's instructions regarding the size of the drill and tap to be used.

2. Drill out damaged thread. Clean out chips. Refer to Figure 30-step 2.
3. Tap hole. Lubricate tap with light engine oil. Clean the thread. Refer to Figure 30-step 3.

Important

- Avoid build-up of chips. Back out the tap every few turns and remove chips.

4. Thread the thread insert onto the mandrel of the installer (Figure 30-step 4). Engage the tang of the insert onto the end of the mandrel.
5. Lubricate the insert with light engine oil (except when installing in aluminum) and install. Refer to Figure 30-step 5.

Important

- When correctly installed, the insert should be flush to one turn below the surface.

6. If the tang of the insert does not break off when backing out the installer, break the tang off with a drift pin.

CRANKSHAFT

Figure 22

Clean

- Oil, sludge and carbon.
- Probe oil passages for obstructions.

Inspect

- Keyway.
- Threads.

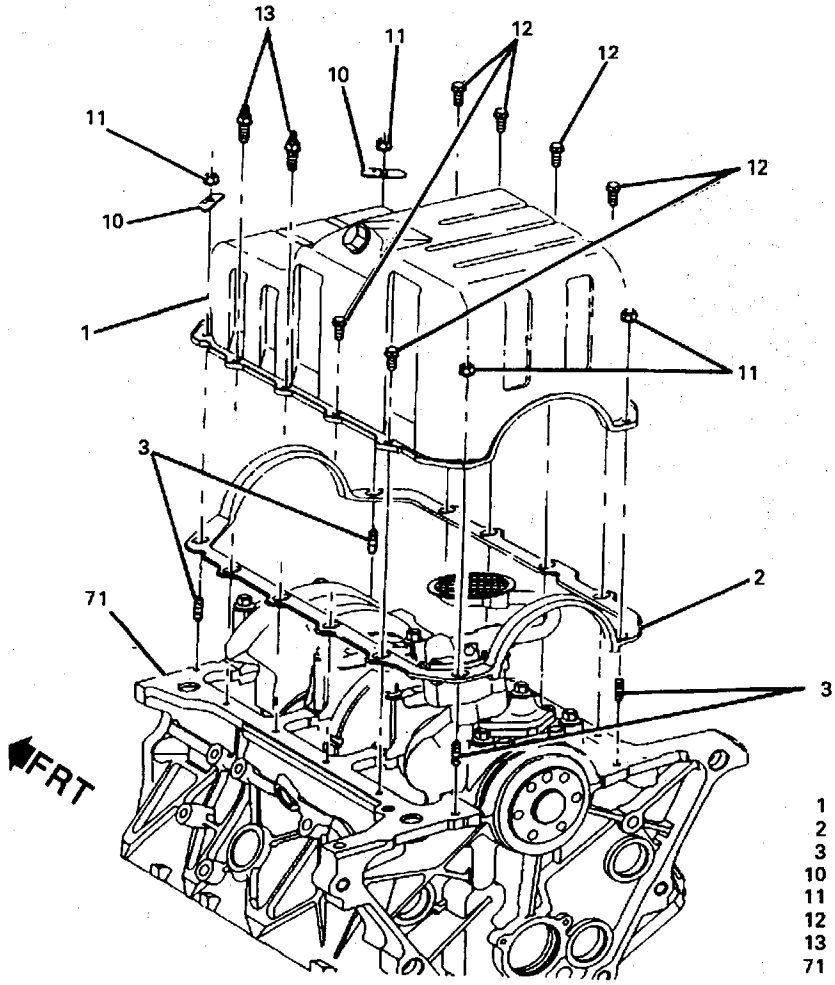


Figure 17 Oil Pan

- Bearing journals and thrust surfaces for:
  - — Cracks.
  - — Chips.
  - — Gouges.
  - — Roughness.
  - — Grooves.
  - — Overheating (discoloration).
- Corresponding bearing inserts for embedded foreign material and determine its source.

Important

- If cracks, severe gouges or burned spots are found, the crankshaft must be replaced. Slight roughness may be removed with a fine polishing cloth soaked in clean engine oil. Burrs may be removed with a fine oil stone.

Measure

- Crankshaft journals. With a micrometer measure taper and run-out. If the readings are within specifications. Refer to "Engine Specifications" in this section, note results for later selection of bearing inserts. If not within limits, the crankshaft must be replaced.

Important

- Note the location of main bearing high spots. If they are not in line, the crankshaft is bent and must be replaced.

PISTONS AND CONNECTING RODS

Figures 31 through 37

Tool Required:
J 24086-B Piston Pin Remover/Installer

Disassemble

CAUTION: Use care when handling the piston. Worn piston rings are sharp and may cause bodily injury.

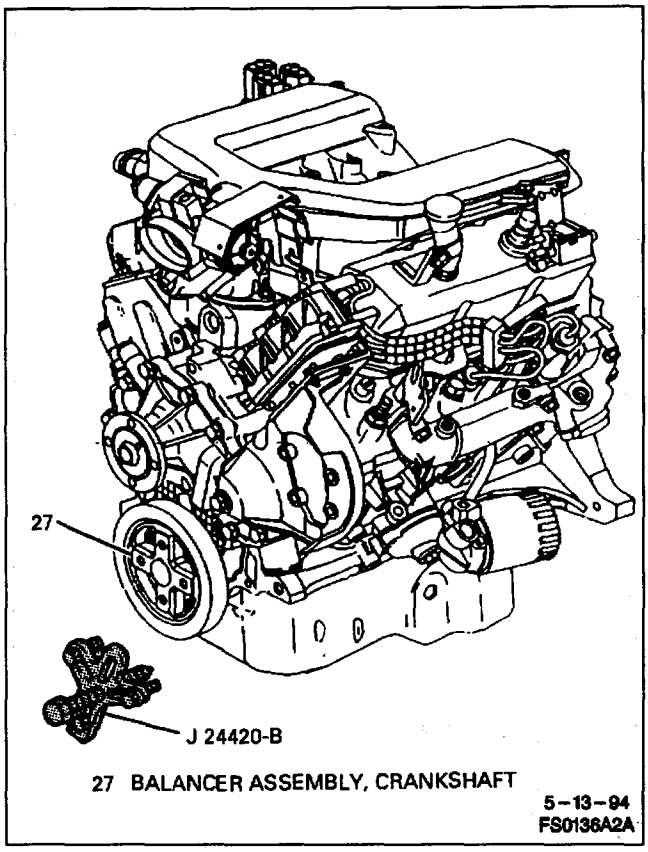


Figure 18 Torsional Damper Removal

1. Piston rings (87, 88 and 89). Use a suitable tool to expand the rings. Piston rings must not be re-used.
2. Place the piston (86) and connecting rod (83) assembly into J 24086-B and press out the piston pin. Refer to Figure 31. Be sure the flat side or inside of piston is up when installing piston and rod assembly into fork.

Important

- Make sure no load is put on piston (86) during disassembly.

CAUTION: Avoid inhaling fumes or exposure of the skin to carburetor cleaning fluid, as bodily injury may result.

Clean

- Piston (86), piston pin (85) and connecting rod (83) of:
  - — Sludge.
  - — Carbon.
    - It is essential that the piston ring grooves are cleaned of carbon to the bare metal.
  - — Varnish from the piston pin (85) by soaking in carburetor cleaning solution.
    - Do not scrape the piston skirt.

Inspect

1. Connecting rod (83) for:
   - Bending or twisting.
     - A. Install the connecting rod cap (81).
     - B. Place the connecting rod assembly (83) on a checking fixture and check for bending or twisting.

       Do not attempt to straighten the connecting rod.
       - — The connecting rods should not be bent more than 0.007 inch for every three inches of rod length.
       - — The connecting rods should not be twisted more then 0.0015 inch for every inch of rod length. If bent or twisted, replace.
       - — Check new connecting rods before using them.
   - Outside of the connecting rod bearing and the ID of the connecting rod lower end for wear indicating high spots in the connecting rod lower end.
   - Upper end for scoring.

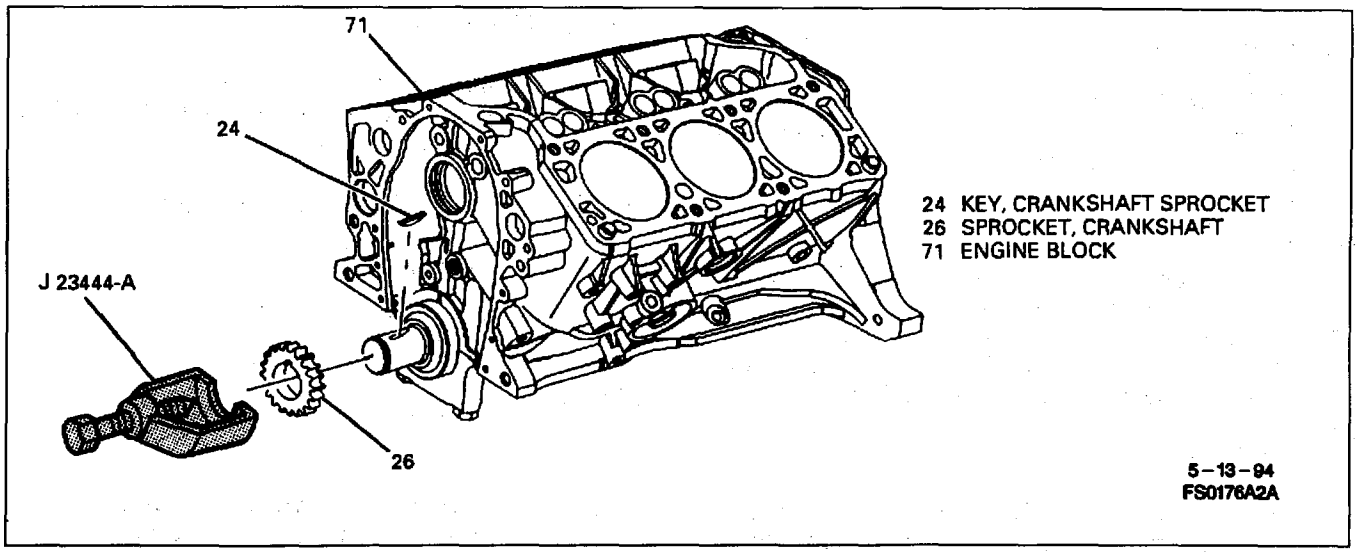


Figure 19 Crankshaft Sprocket Removal

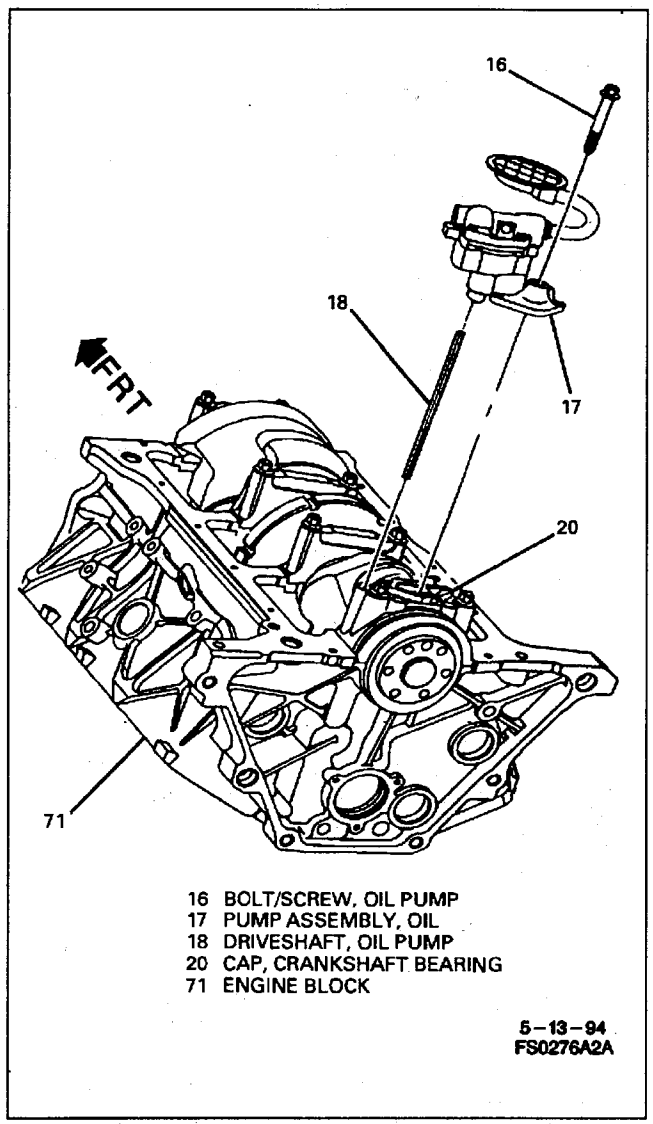


Figure 20 Oil Pump

2. Piston pin (85) for:
   - Scoring.
   - Galling caused by improper installation.
   - Fit in connecting rod and piston.
3. Piston (86) for:
   - Scoring of the skirt.
   - Cracks.
   - Broken ring groove lands.
   - Wear.

Piston to Bore Clearance

Important

- When fitting pistons, both piston and cylinder bore condition must be considered together. Production and service pistons have the same nominal weight and can be intermixed without affecting engine balance. If necessary, used pistons may be fitted selectively to any cylinder of the engine, providing they are in good condition and the same weight.

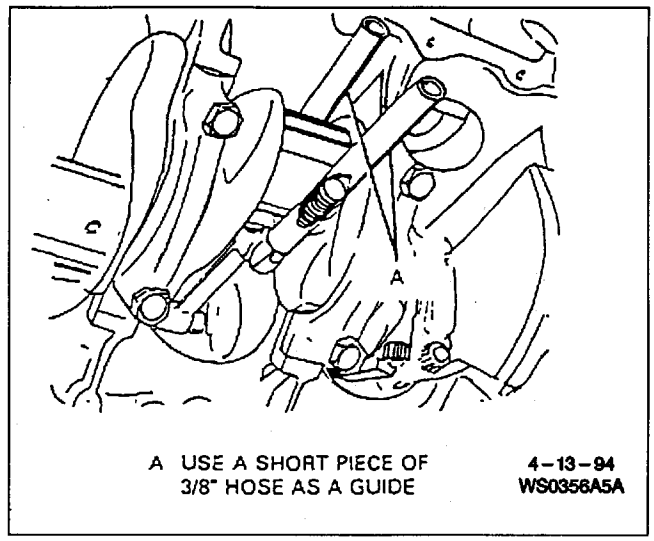


Figure 21 Connecting Rod Protector

- Do not cut oversize pistons down or engine balance will be affected.

Measure

1. Piston diameter. When measuring piston for size or taper, measurement must be made as shown with the piston pin removed (Figure 33). If worn or damaged, replace with a standard or oversize piston.

Important

- Finish hone when selecting piston.

2. Cylinder bore (Figure 32), with a telescoping gage. If worn beyond specifications, rebore and hone to size.
3. Subtract piston diameter from cylinder bore diameter to determine piston-to-bore clearance.
4. Compare piston-to-bore clearance with specifications in "Engine Specifications" of this section to determine if clearance is in acceptable range.
5. If used piston is not acceptable, check service piston sizes and determine if a new piston can be selected. (Service pistons are available in standard, and several oversizes.)
6. If cylinder bore must be reconditioned, measure new piston diameter then hone cylinder bore to correct clearance.
7. Select new piston and mark piston to identify the cylinder for which it was fitted.

Piston Pin Bore-to-Piston Pin Clearance

Measure

1. Measure the piston pin bore diameter with an inside micrometer.
2. Measure the piston pin diameter with a micrometer.
3. Subtract piston pin bore diameter from piston pin diameter to determine clearance.

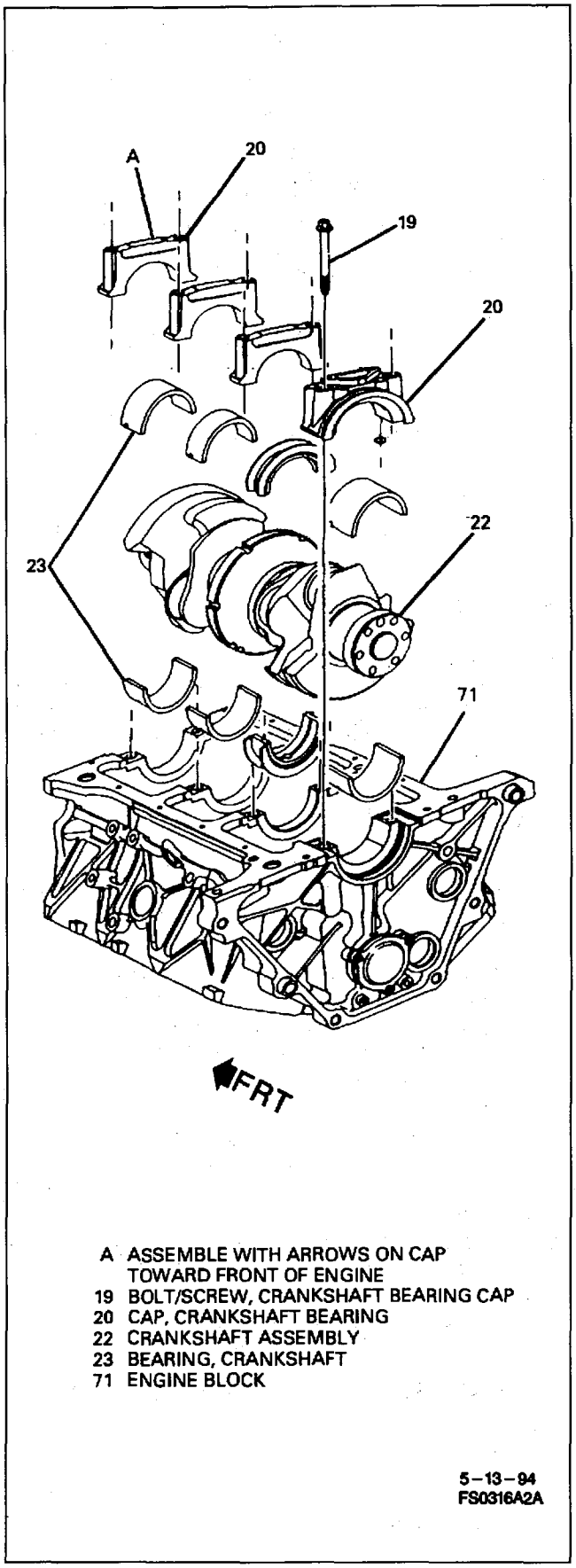


Figure 22 Crankshaft

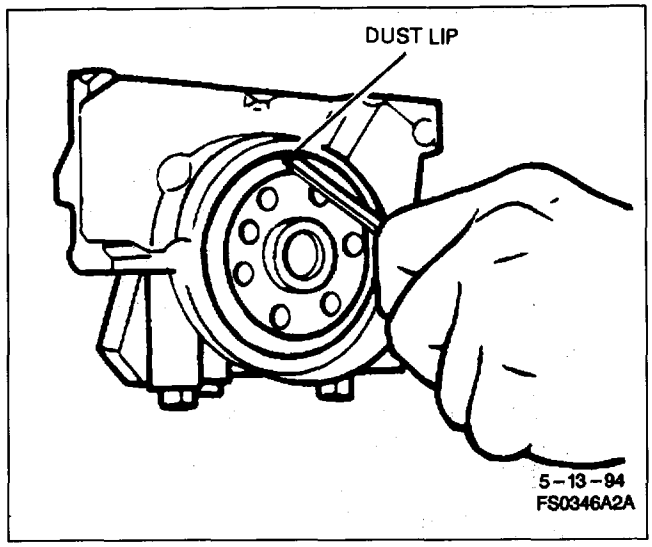


Figure 23 Removing Rear Main Seal

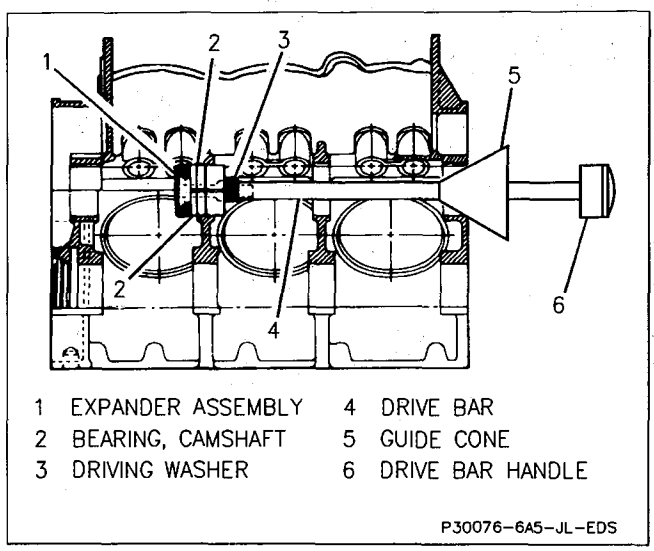


Figure 24 Removing/Installing Camshaft Bearings

4. Compare clearance with Specifications in "Engine Specifications" of this section to determine if clearance is in acceptable range.
5. If it is not acceptable, replace piston assembly.

Piston Compression Ring End Gap

Important

- Do not reuse piston rings. Fit rings to match the cylinder they will be used in.

Measure

1. Place piston into the cylinder at the bottom of the ring travel.
2. Place a piston ring on top of the piston.
3. Back off the piston.
4. Measure the ring gap (Figure 34). If the gap is below specification, increase the gap by carefully filing off excess material.

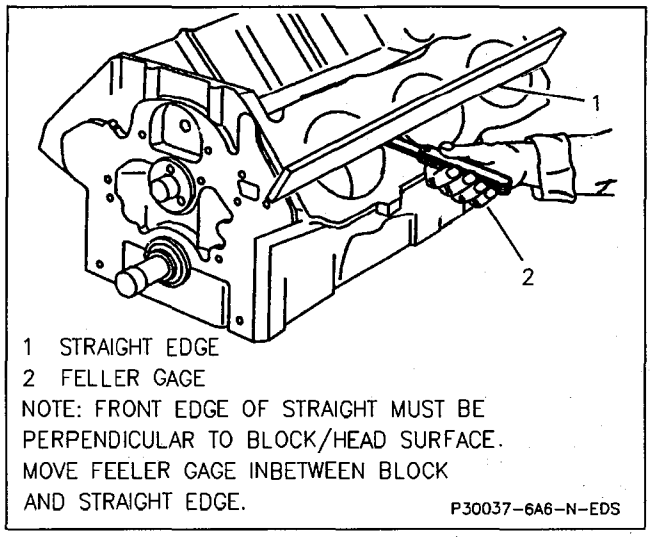


Figure 25 Measuring Cylinder Block for Flatness

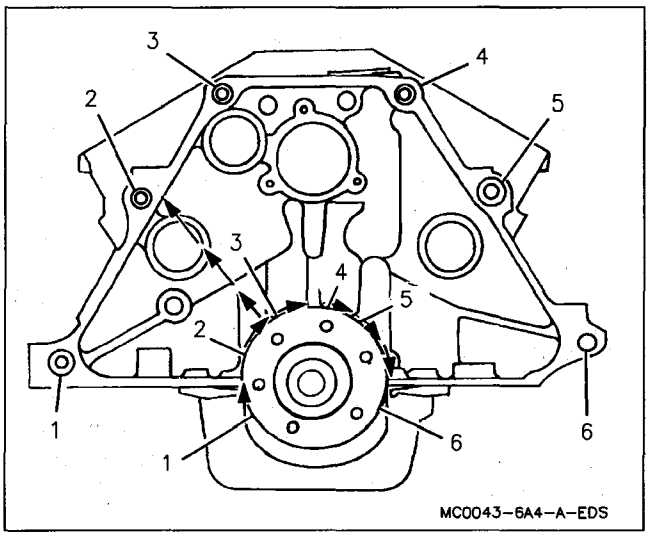


Figure 26 Transaxle Mounting Surface Checking Points

Piston Ring Side Clearance

Important

- Do not attempt to cut the ring groove, although high spots in the ring groove may be cleaned up by careful use of a point file.

Measure

1. Piston compression ring side clearance.
2. Roll the piston ring around the groove in which it is to be installed and measure the side clearance (Figure 35). If the ring is too thick, try another ring. Refer to "Engine Specifications" in this section for specifications.

Assemble

Important

- Make sure that the arrow on top of the piston faces towards the front of the engine.

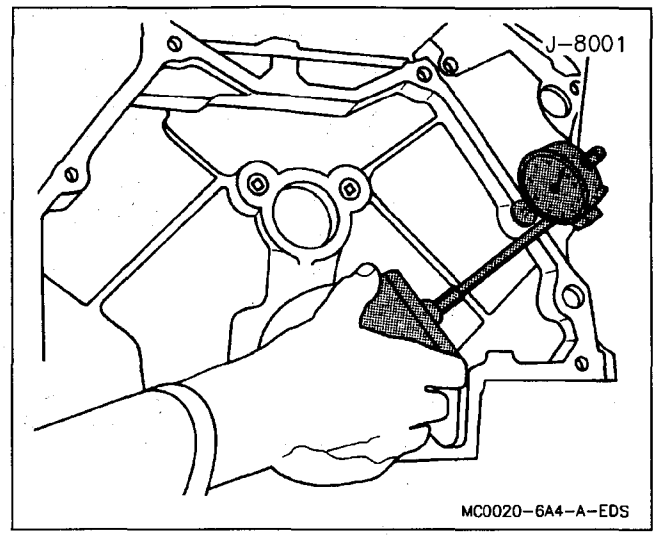


Figure 27 Measuring Transaxle Mounting Surface

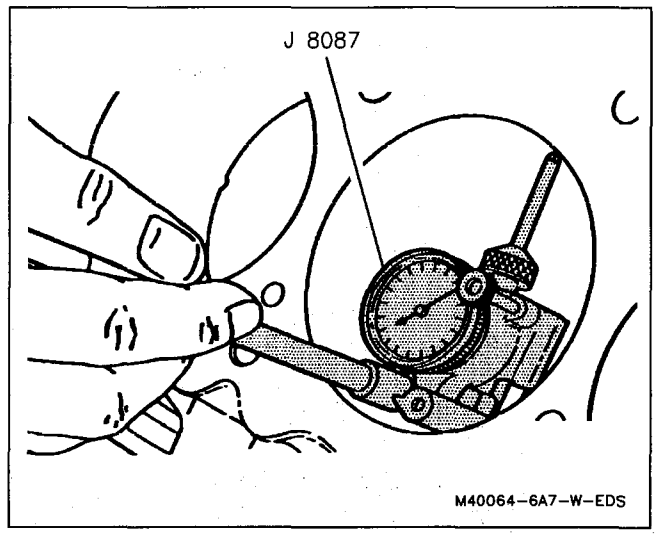


Figure 28 Measuring Cylinder Bore

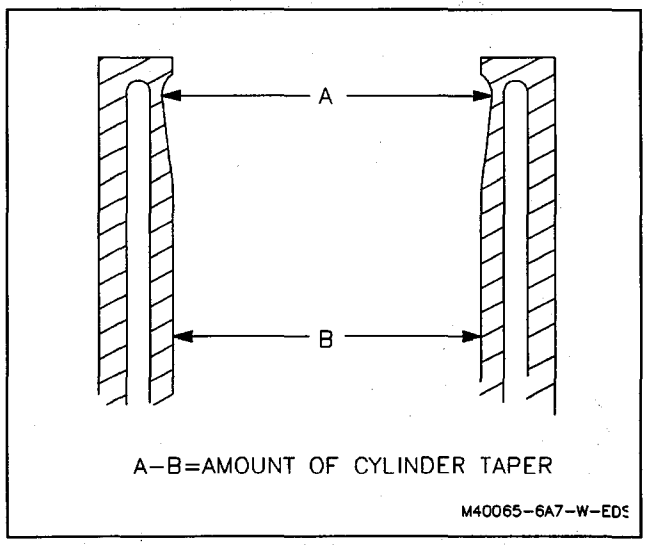


Figure 29 Cylinder Wear Pattern

1. Place piston (86) and connecting rod (83) into J 24086-B (Figure 37).
2. Coat the piston pin (85) with clean engine oil.
3. Press the piston pin (85) into place.

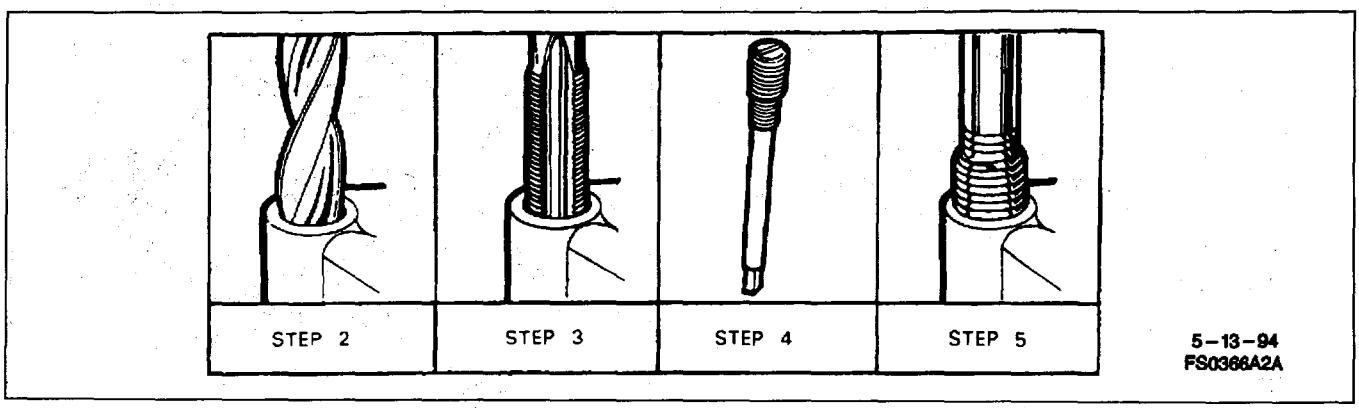


Figure 30 Repairing Threaded Holes

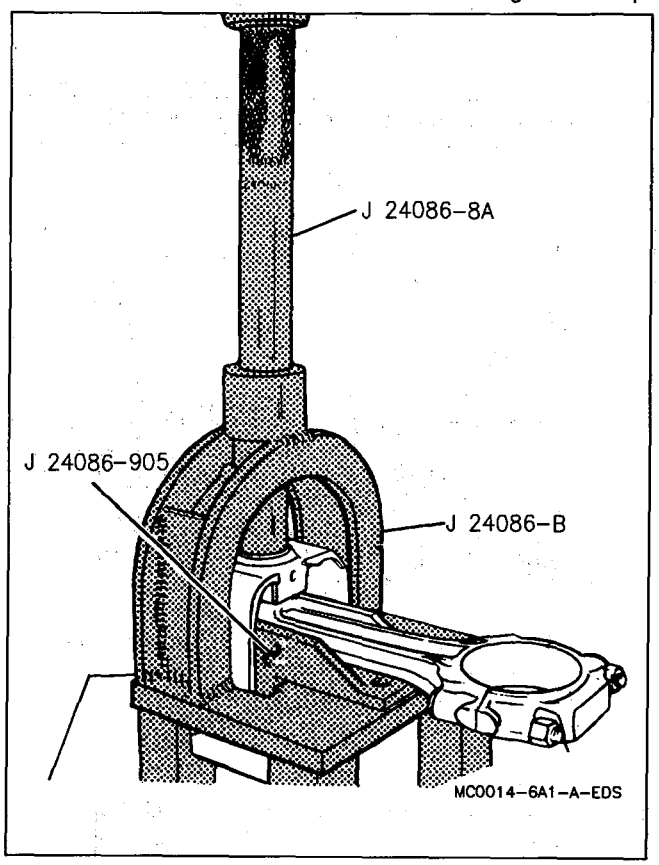


Figure 31 Removing Piston Pin

Inspect

- Piston (86) for freedom of movement.

4. Oil control ring assembly (87).
   - Expander.
   - Lower oil control ring.
   - Upper oil control ring.

NOTICE: Use a piston ring expander to install the rings. Avoid expanding the rings more than necessary, which may cause ring damage.

5. Upper and lower compression ring (88 and 89). Manufacturer's mark facing up.

Important

- In order to provide an effective compression seal, the ring gaps must be staggered.

MAIN BEARING AND ROD BEARING SELECTION

Figures 38 through 40

Evaluate bearings as specified in this section. If the engine is out of the vehicle and upside down, the crankshaft will rest on the upper bearings and the total clearance can be measured between the lower bearing and journal. If the engine is to remain in the vehicle, the crankshaft must be supported upward to remove any clearance from the upper bearing. The total clearance can then be measured between the lower bearing and journal.

Engine bearings are of the precision insert type. They are available for service use in standard and various undersizes (Figure 38).

NOTICE: Bearing inserts must not be shimmed, scraped or filed. Do not touch the bearing surface of the insert with bare fingers. Skin oil and acids will etch the bearing surface.

Inspect

1. Bearing surfaces for:
   - Wear.
   - Gouges.
   - Embedded foreign material. If foreign material is found, determine its nature and source. Inspect oil pan sludge and residue.
   - Uneven side-to-side wear. If uneven wear is found, check for a bent crankshaft or tapered bearing journals.
2. Outer surfaces for:
   - Wear. Surface wear indicates either movement of the insert or high spots in the surrounding material (spot wear).
   - Overheating (discoloration).
   - Looseness or rotation (flattened tangs and wear grooves).
3. Thrust surfaces (main thrust bearing) for:
   - Wear.
   - Grooving. Grooves are caused by irregularities of the crankshaft thrust surface. Refer to "Crankshaft" in Cleaning, Inspection and Repair of this section.

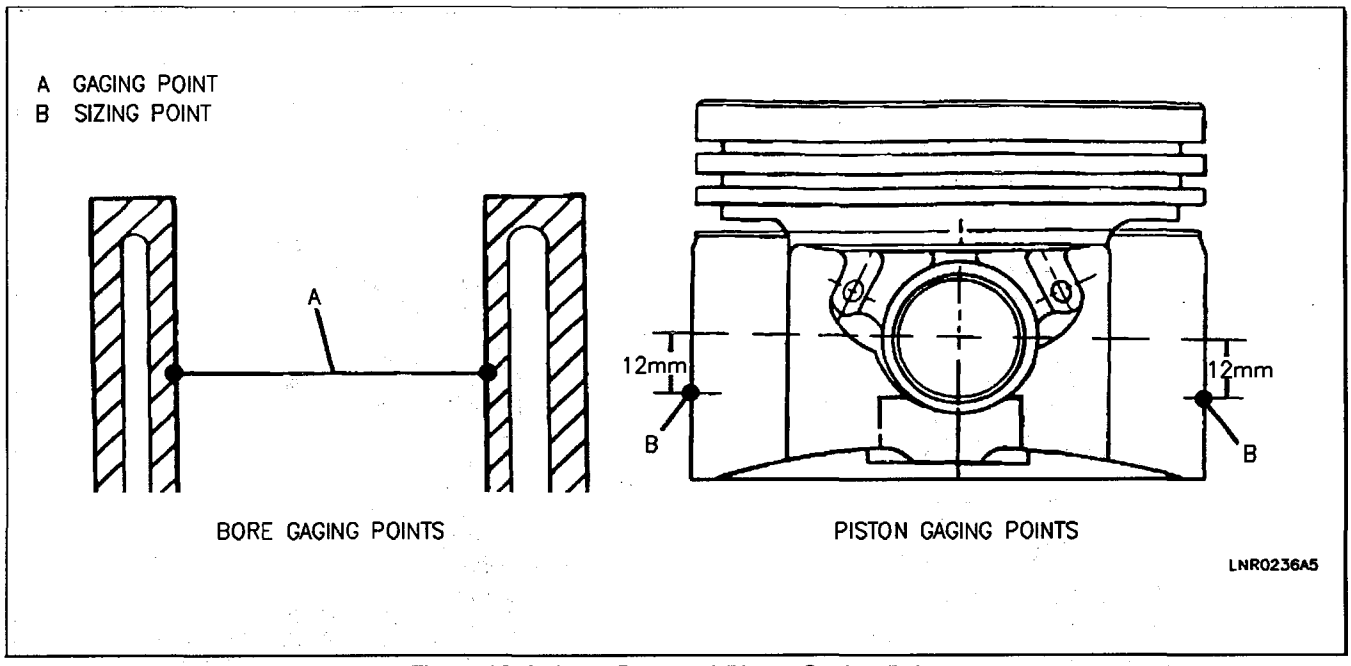


Figure 32 Cylinder Bore and Piston Gaging Points

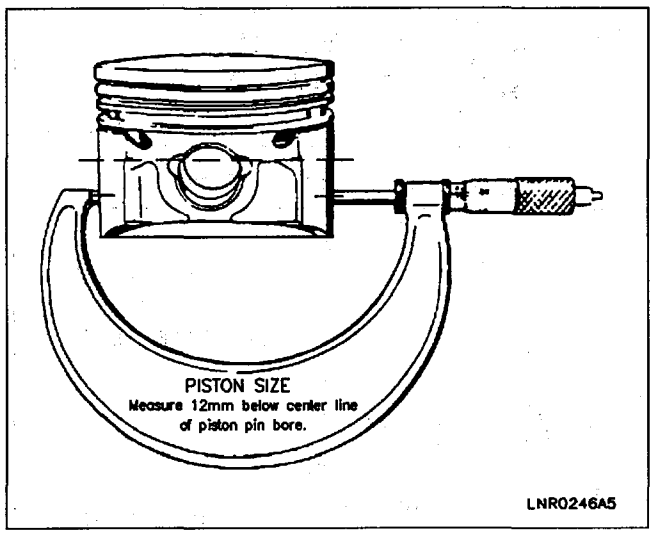


Figure 33 Measuring Piston

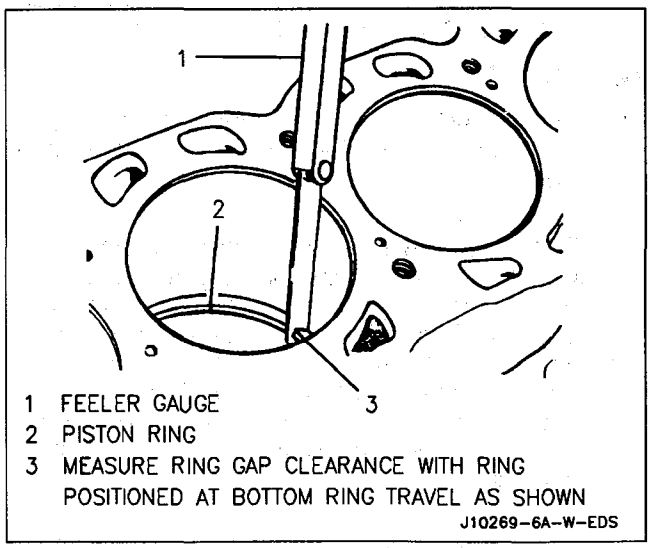


Figure 34 Measuring Piston Ring Gap

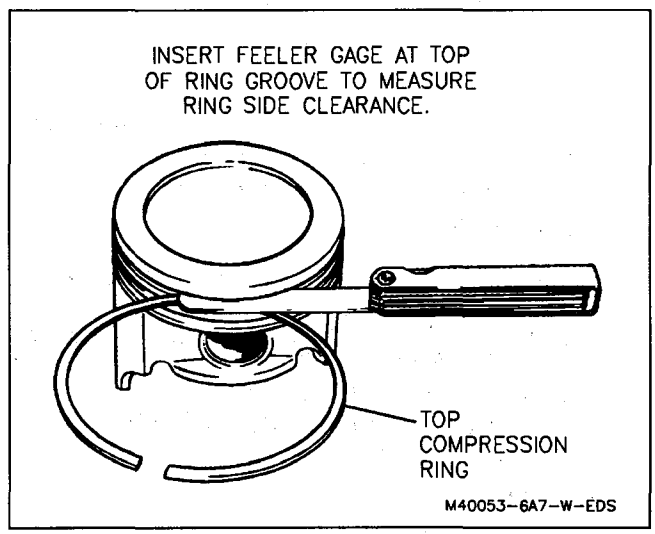


Figure 35 Measuring Piston Ring Side Clearance

Important

- Bearing failure, other than normal wear, must be investigated carefully. Inspect the crankshaft or connecting rod and the bearing bores.

4. Connecting rods or main bearing bores as follows:
   A. Tighten the bearing cap to specifications.
   B. Measure the bore for taper and out of round (Figure 39).
   C. No taper or out of round should exist.

Measure

- Bearing clearance. To determine the correct replacement insert size, the bearing clearance must be measured accurately. Either of the following two methods may be used, however, method "A" gives more reliable results and is preferred.

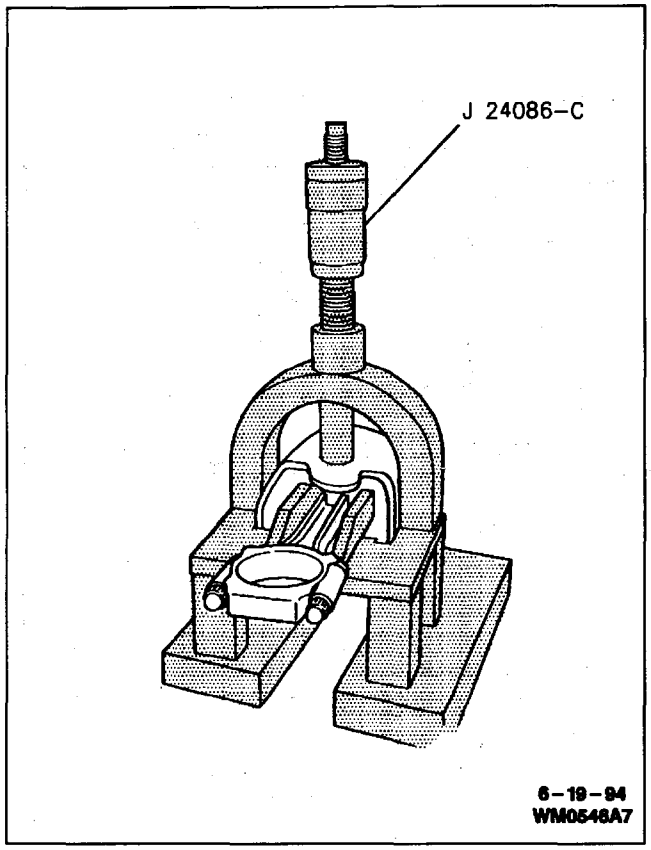


Figure 36 Installing Piston Pin

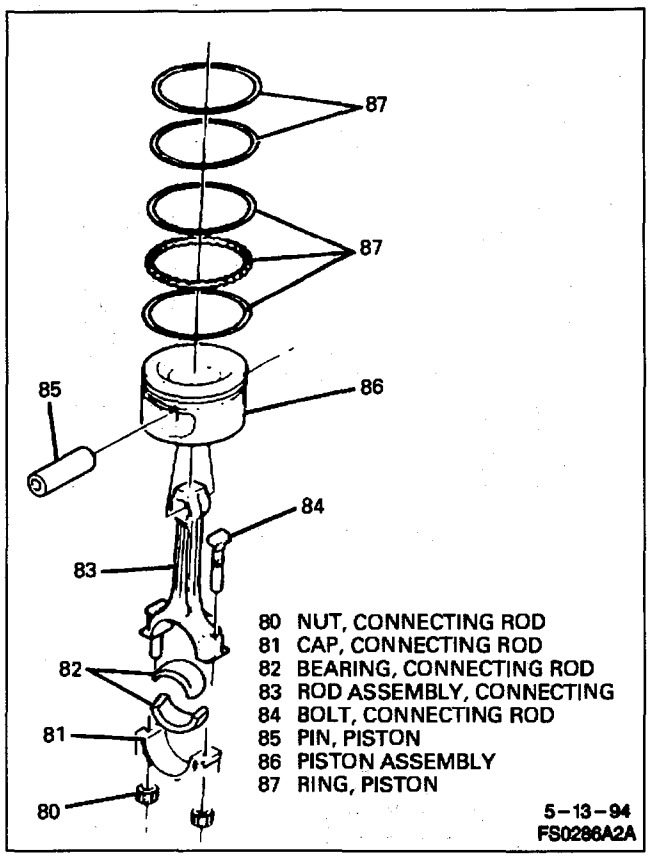


Figure 37 Piston and Rod Assembly

Important

- Method "A" yields measurement from which the bearing clearance can be computed. Method "B" yields the bearing clearance directly. Method "B" does not give any indication of bearing run-out.
- Do not mix inserts of different nominal size in the same bearing bore.

Method "A"

1. Measure the journal diameter with a micrometer in several places, approximately 90° apart, and average the measurements.
2. Measure taper and run-out. Refer to "Engine Specifications" for allowable limits.
3. Install bearing inserts and tighten bearing cap bolts or nuts to specification. Measure ID with an inside micrometer.

Important

- The bearing cap must be tightened to specification when the measurement is taken.
- Measure the connecting rod ID in the same direction as the length of the rod.

4. Select a set of bearing inserts that will produce the desired clearance, refer to "Engine Specifications" in this section. If the specified clearances cannot be met, the crankshaft journal must be re-conditioned and undersized bearing inserts installed. Replace both bearing shells as a set.

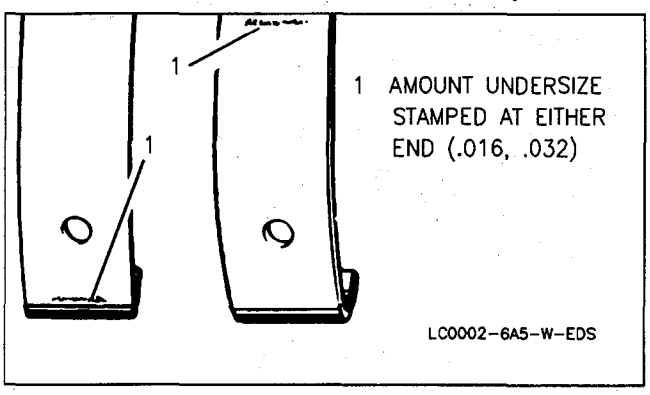


Figure 38 Main Bearing Insert Markings

Method "B"

1. Clean and install the used bearing inserts.
2. Place a piece of gaging plastic across the entire bearing width.

NOTICE: In order to prevent the possibility of cylinder block and/or main bearing cap damage, the main bearing caps are to be tapped into their cylinder block cavity using a brass or leather mallet before attaching bolts are installed. Do not use attaching bolts to pull main bearing caps into their seats. Failure to observe this information may damage a cylinder block or bearing cap.

3. Seat the bearing cap carefully by tapping it lightly with a suitable tool.

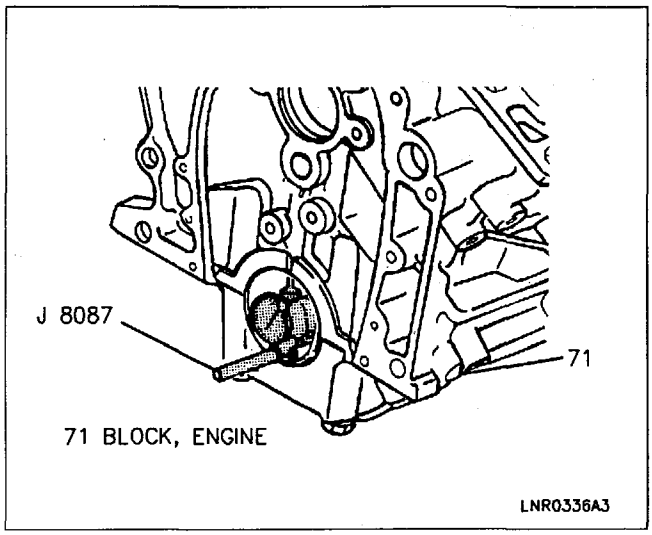


Figure 39 Measuring Bearing Bore

4. Bearing cap bolts or nuts.

Tighten

- Main bearing cap bolts (19) evenly to 50 N.m (37 lb. ft.).
- Turn main bearing cap bolts (19) evenly an additional 77° using J 36660.
- Rod cap nuts (80) evenly to 50 N.m (37 lb. ft.).

Important

- Do not rotate the crankshaft.

5. Remove the bearing cap, leaving the gaging plastic in place. It does not matter whether the gaging plastic adheres to the journal or to the bearing cap.
6. Measure the gaging plastic at its widest point with the scale printed on the gaging plastic package (Figure 40).
7. Remove all traces of the gaging plastic after measuring.
8. Select a set of bearing inserts that will produce the desired clearance refer to "Engine Specifications" in this section. Replace both bearing shells as a set.

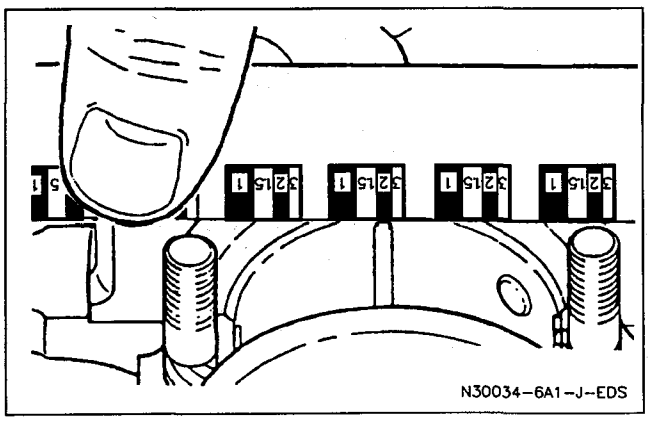


Figure 40 Measuring Bearing Clearance

OIL PUMP UNIT REPAIR

Figure 41 through 46

Tool Required:
J 21882 Oil Suction Tube Installer

Disassemble

1. Drain oil from pump.
2. Drive shaft (18).

Important

- Do not remove pickup tube from cover unless loose or broken.

3. Pump cover bolts and cover.
4. Pump gears.

CAUTION: The pressure regulator valve spring in some models is under pressure. Exercise caution when removing the retaining pin, as bodily injury may result.

5. Pressure regulator valve.
   - Cotter pin.
   - Spring.
   - Valve. If the valve is stuck, soak the pump housing in carburetor cleaning solvent.

CAUTION: Avoid breathing of fumes or exposure of the skin to the cleaning solvent, as bodily injury may result.

Clean

- All parts of sludge, oil and varnish.
- Varnish may be removed by soaking in carburetor or cleaning solvent.

Inspect

- For foreign material and determine source.
- Pump housing and cover for:
  - — Cracks.
  - — Scoring.
  - — Casting imperfections.
  - — Damaged threads.
  - — Do not attempt to repair the pump housing.
  - — If in doubt, replace the spring.
- Idler gear shaft. If loose in the housing, replace the pump.
- Pressure regulator valve for:
  - — Scoring.
  - — Sticking. Burrs may be removed with a fine oil stone.
- Pressure regulator valve spring for:
  - — Loss of tension.
  - — Bending.

- Suction pipe and screen assembly for:
  — Looseness, if permanently pressed into the pump body. If the suction pipe is loose, bent or has been removed, the pump body cover and suction pipe must be replaced.
  — Broken wire mesh or screen.
- Gears for:
  — Chipping.
  — Galling.
  — Wear.
- Drive shaft and drive shaft extension for: Wear.
  — Looseness.
  — Wear.

Measure

Figures 42 through 46

- Refer to "Engine Specifications" in this section for Specifications.
- Gear lash. Install gears, and measure in several places (Figure 42).
- Pump housing gear pocket (Figure 43).
- Gears (Figure 44).
- Gear side clearance (Figure 45).
- Gear end clearance (Figure 46).

Important

- When deciding pump serviceability based on end clearance, consider depth of wear pattern in the pump cover.

Assemble

1. Lubricate all internal parts with engine oil during assembly.
2. Pump gears.

NOTICE: To avoid engine damage, use only original equipment gaskets. The gasket thickness is critical to proper functioning of the pump.

3. Cover and gasket.

Tighten

- Pump cover bolts to 10 N·m (89 lb. in.).

4. Pressure regulator valve and spring.

Important

- Make sure the cotter pin is properly secured.

5. Cotter pin.
6. Apply sealer GM P/N 1050026 (or equivalent), to a new pipe, and tap into place with a plastic hammer, using J 21882.

Important

- Whenever the oil pump is overhauled, clean the oil pan of oil and sludge; replace the oil filter; and fill crankcase with clean oil.

Inspect

1. Oil pressure as follows:
   A. Prime engine oil galleries by removing engine oil pump drive unit and rotate oil pump drive shaft using drill motor and appropriate socket and extension.
   B. Remove the oil pressure sending unit and install a pressure gage.

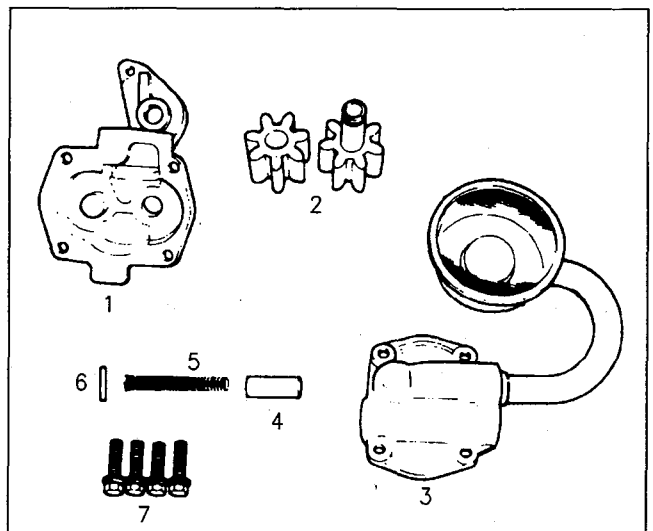


Figure 41 Oil Pump

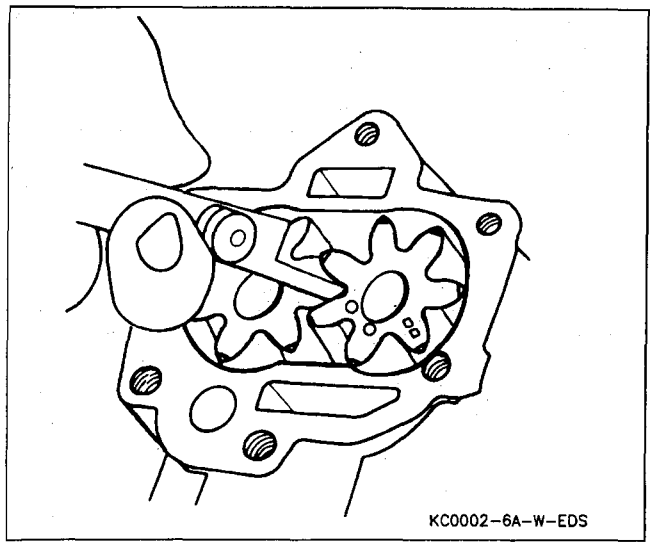


Figure 42 Measuring Oil Pump Gear Lash

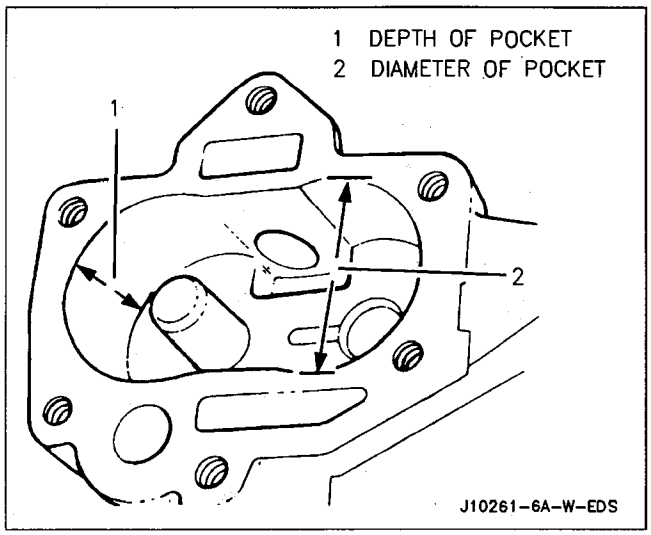


Figure 43 Measuring Oil Pump Gear Pocket

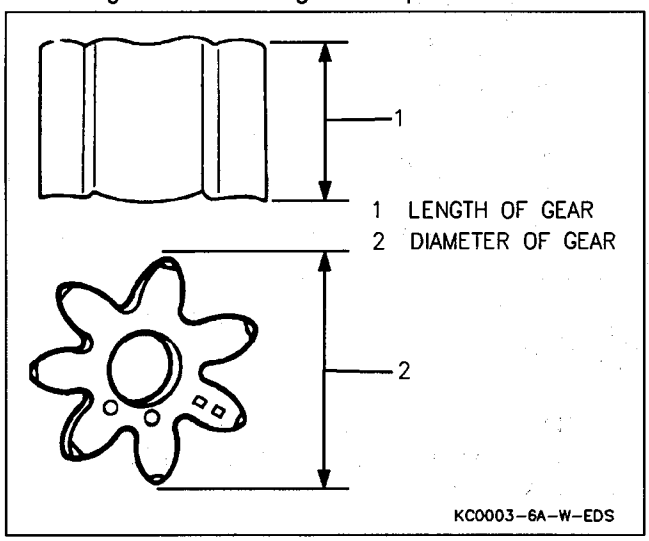


Figure 44 Measuring Oil Pump Gears

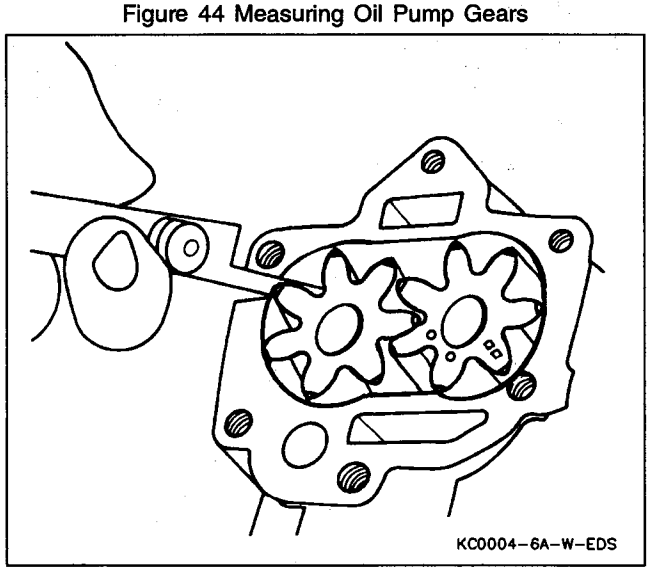


Figure 45 Measuring Gear Side Clearance

NOTICE: If the oil pressure does not build up almost immediately, remove the oil pan and check oil pump suction pipe attachment to the pump. Running the engine without measurable oil pressure will cause extensive damage.

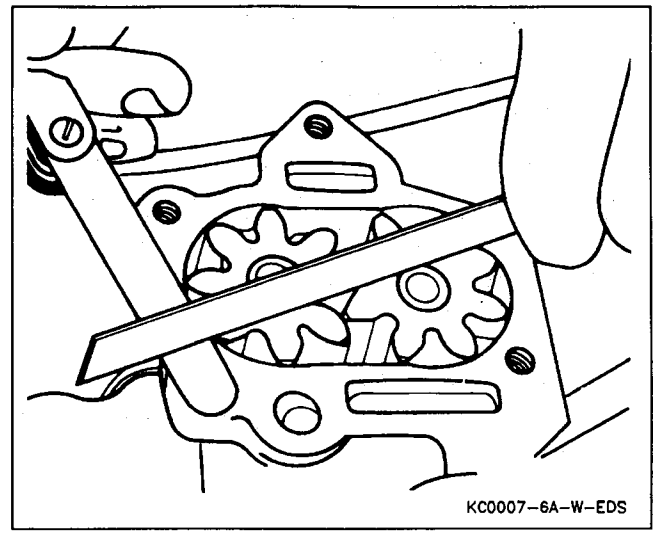


Figure 46 Measuring Oil Pump End Clearance

CYLINDER HEAD RECONDITIONING

Figures 47 through 54

Tools Required:
J 8001 Dial Indicator Set
J 8062 Valve Spring Compressor.
J 8101 Valve Guide Cleaner
J 9666 Valve Spring Tester
J 37377 Valve Guide Reamer 0.089 mm (0.003 inch) OS.
J 37378 Valve Guide Reamer 0.394 mm (0.015 inch) OS.
J 37379 Valve Guide Reamer 0.775 mm (0.030 inch) OS.

Important

- Before removing the cylinder head(s) from the engine and before disassembling the valve mechanism, perform a compression test and note the results.
- During disassembly of the cylinder head, be sure that the valve train components are kept together and identified so that they can be installed in their original locations.

Disassemble

1. Spark plugs (221).
2. Right cylinder head engine lift hook bolts (201).
3. Engine lift hook (200).
4. Intake manifold mounting stud (140).
5. Rocker cover studs (196).
6. Compress the valve springs (128 and 135) using J 8062.
7. Valve locks (131 and 139).
8. Valve caps (130 and 138).
9. Exhaust valve oil shedders (137).
10. Valve springs (128 and 135) and dampers (127 and 134).

11. Spring shims (133), if equipped.
12. Intake valve stem oil seals (126).
13. Valve stem O-rings (129 and 136).

NOTICE: Avoid damaging the valve guide. If the valve stem has mushroomed due to wear from the rocker arm, remove burrs by chamfering the valve stem with an oil stone. Do not remove the valve from the guide with a hammer and punch.

14. Valves (125 and 132).
15. Rocker arm studs (121) and pushrod guide plates.
16. Water jacket plugs.

Inspect

- Cylinder head gasket and mating surfaces for leaks, corrosion and blow-by. If the gasket has failed, determine the cause:
  - A. Improper installation.
  - B. Loose or warped cylinder head.
  - C. Missing, off location or not fully seated dowel pins.
  - D. Low torque on cylinder head bolts.
  - E. Warped case (block) surface.
  - F. Scratched surfaces.
  - G. Excessive inlet manifold torque.
  - H. Cracked engine block tapped holes.

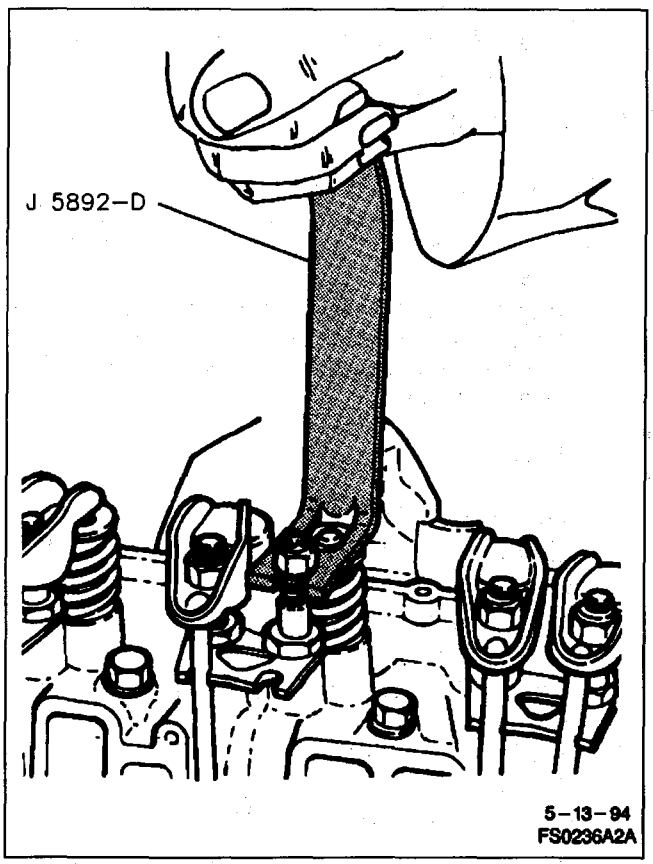


Figure 47 Compressing Valve Spring

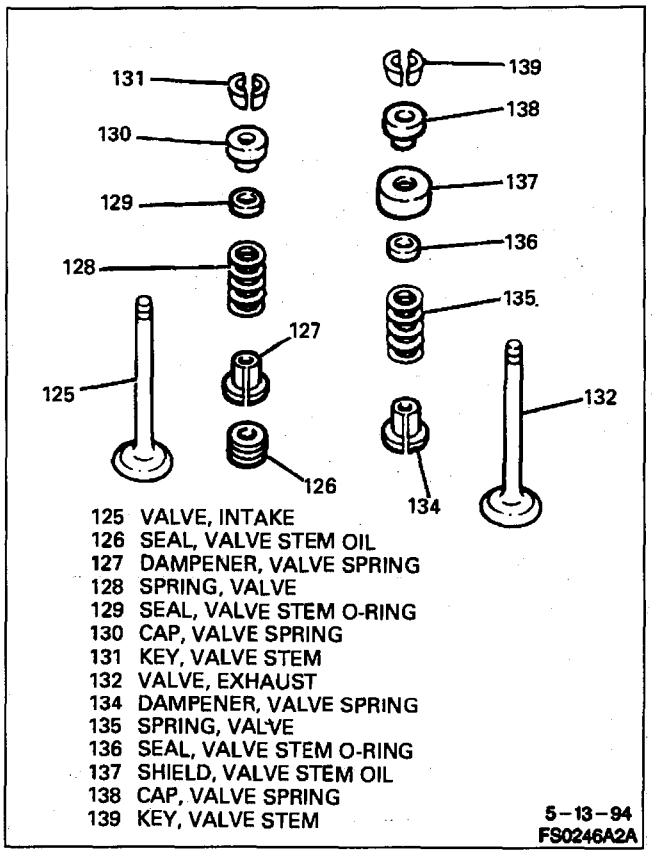


Figure 48 Valves and Components

Clean

CAUTION: Safety glasses must be worn when using a power wire brush to avoid damage to the eyes.

1. Cylinder head bolts (115).
2. Cylinder head (113). Carefully remove all varnish, soot and carbon to the bare metal. DO NOT use a motorized wire brush on any gasket sealing surface.
3. Valve guides as shown in Figure 49.

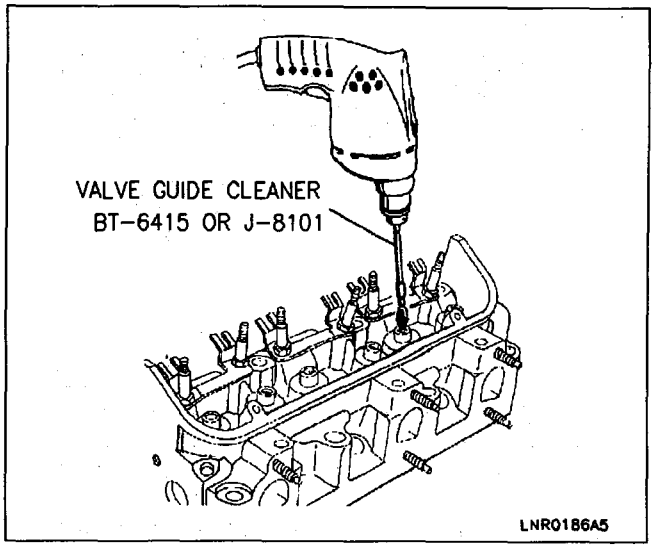


Figure 49 Cleaning Valve Guide

4. Valves (125 and 132) of carbon, oil and varnish.
   - Carbon can be removed with a wire brush.
   - Remove varnish by soaking in carburetor cleaning fluid.
   - Do not scratch the valve stem with the wire brush.
5. Threaded holes.
6. Remains of sealer from plug holes.

Inspect

1. Cylinder head bolts (115) for damaged threads or stretching, and damaged heads caused by improper use of tools.

Important

- Suspect bolts must be replaced.

2. Cylinder head (113) for cracks, especially between valve seats and in the exhaust ports.
3. Cylinder head deck for corrosion, sand particles in head, and porosity.

Important

- Do not attempt to weld the cylinder head, replace it.

4. Cylinder head deck, intake and exhaust manifold mating surfaces for flatness as shown in Figure 50. These surfaces may be re-conditioned by milling. If the surfaces are "out of flat" by more than 0.1mm (0.004 inch), the surface should be milled. If more than 0.25 mm (0.010 inch) of metal must be removed from the head, it should be replaced.
5. All threaded holes for damage. Threads may be reconditioned with thread inserts. Refer to "Thread Repair" in this section.
6. Cooling jacket plugs seating surfaces.
7. Valve seats for excessive wear and burned spots.
   - Since the valve guide serves to support and center the valve grinder, it is essential that the valve guide is cleaned properly. If the valve guide requires reaming, measure valve guide clearance to determine if an oversized valve will be required. This procedure must be performed before valve seats can be reconditioned.
   - If a burnt valve condition exists, it may be necessary to recondition the valve seat. At no time should there be less than 4 mm of valve seat material remaining after reconditioning.
   - Valve seats may be reconditioned by grinding. Follow the grinder manufacturer's instructions. Refer to "Engine Specifications" in this section for seat angles. If, after grinding, the new seat is too wide, it may be narrowed by using a 70° stone. The 70° stone will raise the seat.
8. Valve stem tip for wear.
9. Valve lock (131 and 139) and oil seal grooves for chipped or worn lands. Replace the valve if chipped or worn.
10. Valve face for burning or cracking. If pieces are broken off, inspect the corresponding piston and cylinder head area for damage.
11. Valve stem for burrs and scratches. Burrs and minor scratches may be removed with an oil stone.
12. Valve stem for straightness and valve head for bending or distortion. Use "V" blocks. Bent or distorted valves must be replaced.
13. Valve face for grooving. If the groove is so deep that refacing would result in a knife edge, the valve must be replaced.
14. The valve face may be ground to specifications if it is otherwise in good condition. If the valve face cannot be grounded within the limits given, it must be replaced. Refer to "Engine Specifications" in this section.
15. Valve spring dampers (127 and 134) for broken pieces or cracks. Replace if damaged.
16. Valve springs (128 and 135).
    - Free length.
    - Spring ends. If they are not parallel, the spring is bent and must be replaced.
    - Spring tension (load open and load closed). If below specification, replace.
    - For cracks or breaks.

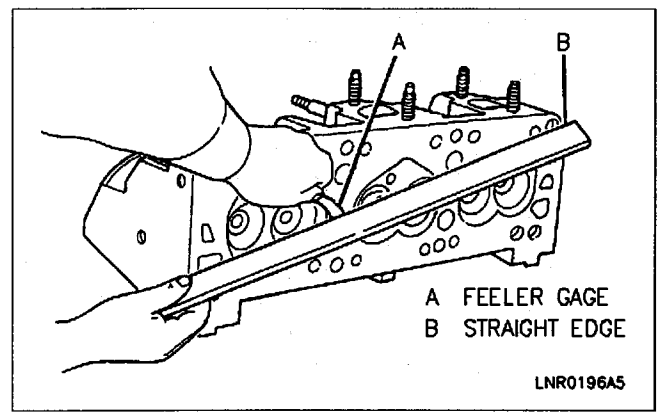


Figure 50 Checking Cylinder Head Flatness

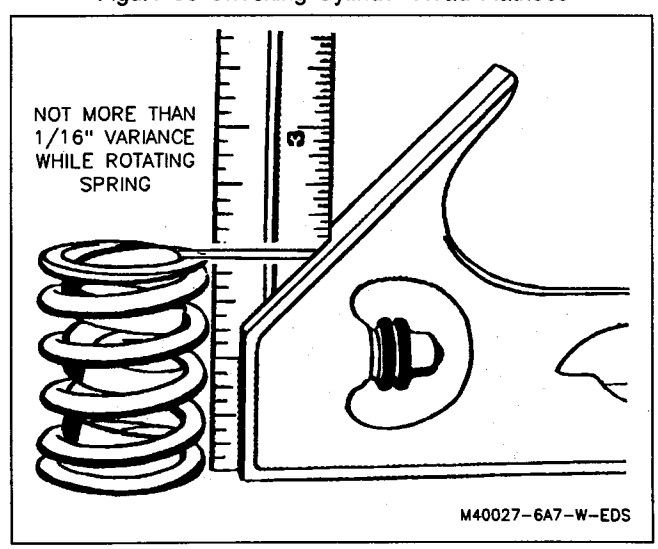


Figure 51 Checking Valve Springs

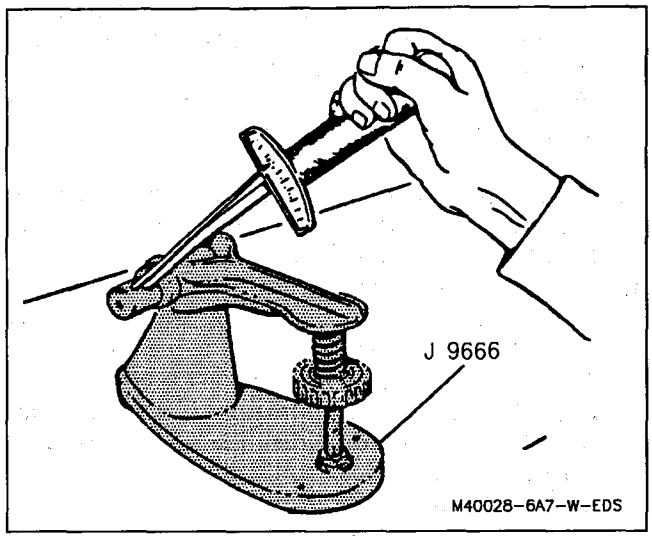


Figure 52 Checking Valve Spring Tension

17. Valve spring seating surface of the spring caps for wear, cracks or gouging. Replace as required.

Measure

1. Valve margin after grinding valves. If the margin is less than the minimum recommended margin, replace the valve.
2. Valve seat margin and runout. If the margin is less than the minimum recommended margin, replace the cylinder head.
3. Valve guide clearance.
   - Insert the valve into its guide. Lift it 2 mm (1/8 inch) off the seat and move it side to side, measuring the amount of movement with a dial indicator, or
   - With a hole gage, measure the valve guide ID, then measure the valve stem with a micrometer and compare the clearance.
   - Refer to "Engine Specifications" in this section for allowable clearances.

NOTICE: Avoid breaking reamer flutes or jamming the reamer into the valve guide due to packing of chips or carbon. Clean the valve guides before reaming.

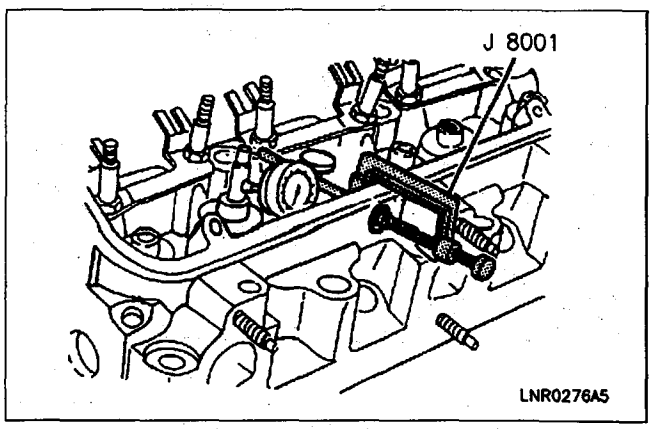


Figure 53 Measuring Valve Guide Clearance

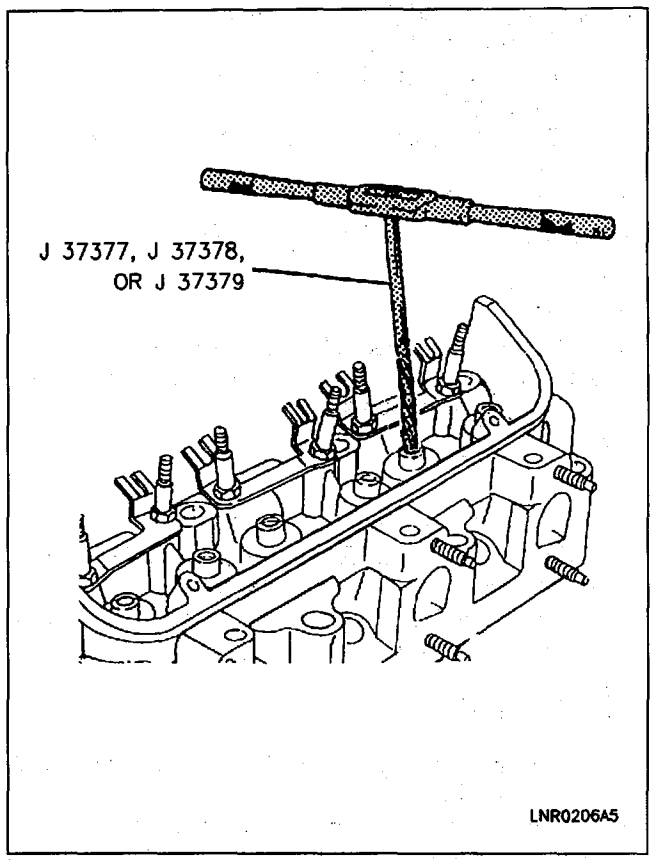


Figure 54 Reaming Valve Guide

- The valve guides may be reamed oversize and an oversized valve installed (Figure 54).

Assemble

1. Lightly lap the reconditioned valves into the valve seat.
2. Cooling jacket plugs. Coat plugs with sealer GM P/N 1050026 (or equivalent).

Tighten

- Plug to 21 N.m (15 lb. ft.).

3. Pushrod guide plates and rocker arm studs (121).

Tighten

- Studs (121) to 46 N.m (35 lb. ft.).

4. Valves (125 and 132).

Measure

- Valve run-out. Lift the valve off its seat and apply a dab of Prussian blue on the valve face. Seat the valve and carefully rotate it. The Prussian blue traces transferred to the valve seat are an indication of concentricity of the valve seat.
- Clean all traces of Prussian blue. Apply a dab of Prussian blue on the valve seat and repeat the check. The traces of Prussian blue transferred to the valve indicates valve run-out. Recondition valve seat/face or replace valves as required.

5. Intake valve stem oil seals (126).

Important

- Push the valve stem seals down as far as possible. If oversize valves have been installed, oversized valve stem must be used.

A. Use plastic sleeve provided.
B. Press over valve guide boss.

6. Spring shim (133), if required.
7. Valve stem O-rings (129 and 136).
8. Valve spring dampers (127 and 134) and springs (128 and 135).
9. Exhaust valve oil shedders (137).
10. Valve caps (123 and 138).
11. Compress the valve springs (128 and 135) using J 38606.
12. Valve locks (131 and 139).
    - If necessary, hold valve locks in place with grease.
13. Release valve springs (128 and 135).

Inspect

- Make sure valve locks are seated.

14. Rocker cover studs (196).

Tighten

- Studs (196) to 12 N.m (106 lb. in.).

15. Intake manifold mounting studs (140).

Tighten

- Studs (140) to 10 N.m (89 lb. in.).

16. Right cylinder head engine lift hook (200) and bolts (201).

Tighten

- Bolts (201) to 32 N.m (24 lb. ft.).

NOTICE: To avoid damage, install spark plugs (221) after the cylinder head has been installed on the engine block assembly.

CAMSHAFT INSPECTION

Figure 55

Tool Required:
J 26900-12 Dial Indicator
J 26900-13 Magnetic Base

Inspect

- Sprocket.
- Keyway and threads.
- Bearing surfaces and lobes for:
  — Wear.
  — Galling.
  — Gouges.
  — Overheating (Discoloration).

Important

- Do not attempt to repair the camshaft, replace it if damaged.
- If a new camshaft is installed, all valve lifters must be replaced.

Measure

1. Bearing journals.
   - With a micrometer, measure diameter and run-out. If out of specification, replace the camshaft.
2. Camshaft lift.

A. Lubricate the camshaft bearings with GM Camshaft and Lifter Prelube P/N 1052365 (or equivalent).
B. Carefully set the camshaft on "V" blocks or between camshaft centers.
C. Install J 26900-12 and J 26900-13.
D. Measure camshaft journal runout and lobe lift . If out of specification, replace the camshaft.

Important

- If a new camshaft is being installed, add Camshaft and Lifter Prelube GM P/N 1052365 (or equivalent) to the engine oil. Coat cam lobes with Camshaft and Lifter Prelube GM P/N 1052365 (or equivalent).

TIMING CHAIN AND SPROCKETS

Figure 68

Inspect

- Camshaft and crankshaft sprockets (98 and 26) for wear or nicks.
- Key and crankshaft keyway for wear or nicks.
- Timing chain (25) for wear or binding.

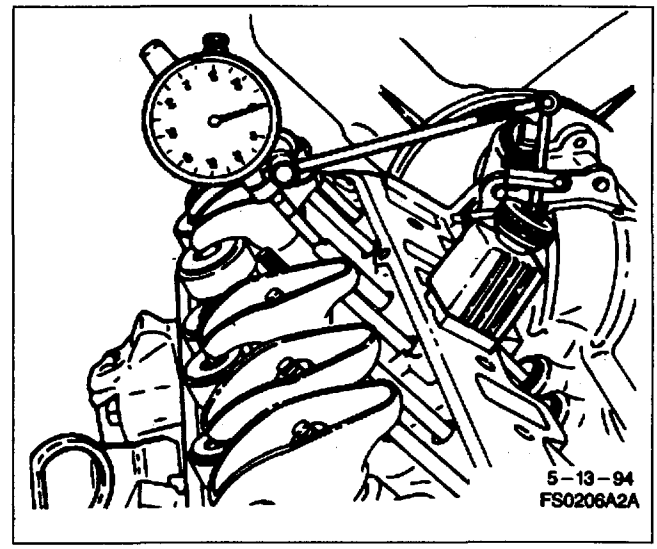


Figure 55 Measuring Camshaft Lobe Lift

ENGINE FRONT COVER

Figure 69

Tool Required:
J 34995 Oil Seal Installer

Disassemble

1. Crankshaft position sensor screws (56).
2. Crankshaft position sensor (57).
3. Front cover oil seal (58).
   - Pry out carefully with a suitable tool.

Clean

- Engine front cover mating surfaces.

Inspect

- Front cover oil seal (58) for damage.
- Cracks or nicks.

Assemble

1. Front cover oil seal (58) using J34995.
2. Crankshaft position sensor (57).
3. Crankshaft position sensor screws (56).

Tighten

- Sensor screws (56) to 10 N·m (89 lb. in.).

OIL PAN

Figure 17

Disassemble

1. Low oil level indicator (15).

Clean

- Oil pan (1) in solvent. Remove all sludge and varnish.
- Gasket surfaces.

Inspect

- Gasket flanges for bending or damage.
- Oil pan (1) for cracks or dents.

Assemble

1. Low oil level indicator (15).

Tighten

- Indicator (15) to 22 N·m (16 lb. ft.).

2. Oil drain plug (9) and washer (8).

Tighten

- Oil drain plug (9) to 25 N·m (18 lb. ft.).

COOLANT PUMP

Figure 69

Clean

- Coolant pump (54) mating surface.

Inspect

- Coolant pump shaft for looseness.

VALVE LIFTERS

Figure 56

Valve lifters should be kept in order so they may be installed in their original position.

If the lifters are removed, they must be installed in their original location. If replacement is necessary, use lifters with a narrow flat ground along the lower 3/4 of lifter. These flats provide additional oil to the cam lobe and lifter surfaces.

Inspect

- Lifter body for wear and scuffing.
- Lifter bore for wear.
- Lifter pushrod seat for wear.

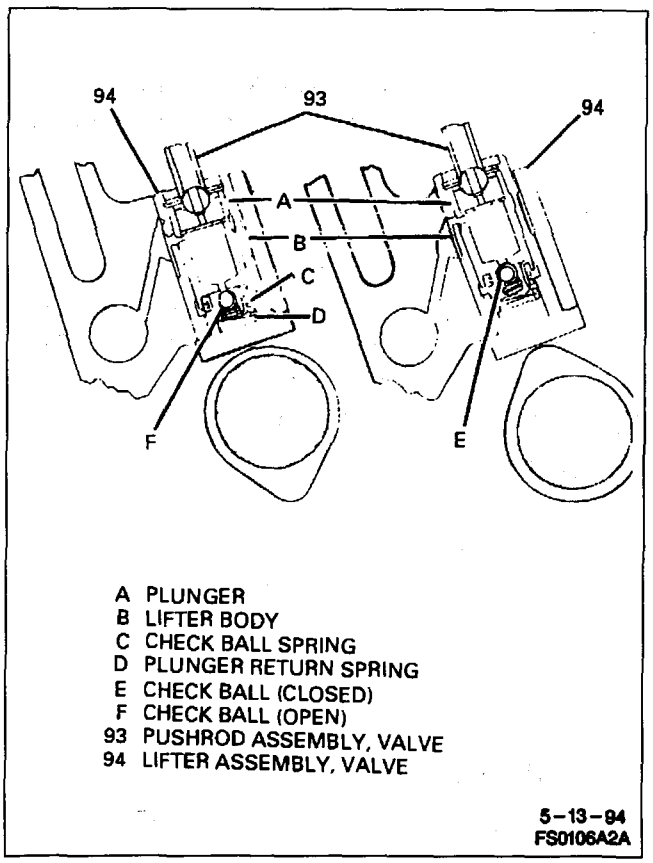


Figure 56 Valve Lifter Operation

Important

- Whenever new valve lifters are being installed, coat foot of valve lifters with camshaft and lifter prelube GM P/N 1052365 (or equivalent).

VALVE ROCKER ARMS AND PUSHRODS

Figure 13

Inspect

- Rocker arms (122) and balls (123) for wear at rotation surfaces.
- Pushrod (93) ends for wear.
- Pushrod (93) for bends.

VALVE ROCKER COVERS

Figure 12

Disassemble

1. Oil fill tube bolt (189) and oil fill tube (188).
2. Rubber grommets.

Clean

- Valve rocker cover gasket surfaces.

Inspect

- Gasket flanges for damage.
- Rubber grommets for deterioration.

Assemble

1. Rubber grommets.
2. Oil fill tube (188) and bolt (189).

Tighten

- Oil fill tube bolt (189) to 8 N.m (71 lb. in.).

UPPER INTAKE MANIFOLD

Figure 11

Disassemble

1. Throttle body bolts (165), throttle body (164) and gasket (163).
2. MAP sensor screws (160) and MAP sensor (158).
3. Canister purge solenoid (178).
4. Emission control vacuum harness assembly (172).
5. Vacuum tee.

Clean

- Gasket surfaces.
- Manifold bolts and studs.

Assemble

1. Vacuum tee.
2. Emission control vacuum harness assembly (172).
3. Canister purge solenoid (178).
4. MAP sensor screws (160) and MAP sensor (158).
5. Throttle body gasket (163), throttle body (164) and bolts (165).

Tighten

- Apply sealer GM P/N 1052080 to threads of throttle body bolts.
- Throttle body bolts (165) to 25 N.m (18 lb. ft.).

LOWER INTAKE MANIFOLD

Figure 14

Disassemble

1. Rocker cover studs (196).
2. Thermostat housing bolts (146).
3. Thermostat housing (147) and gasket.
4. Thermostat (148).
5. Engine coolant temperature sensor (145).
6. Heater inlet hose nipple (149).

Clean

- Intake manifold gasket surfaces.
- Injector bores.
- Intake manifold bolts and studs.

Assemble

1. Heater inlet hose nipple (149).

Tighten

- Apply Teflon sealant to threads of heater inlet hose nipple (149).
- Heater inlet hose nipple (149) to 30 N.m (22 lb. ft.).

2. Engine coolant temperature sensor (145).

Tighten

- Apply Teflon sealant GM P/N 1052080 to threads of sensor (145).
- Sensor (145) to 16 N.m (12 lb. ft.).

3. Thermostat (148).
4. Thermostat housing gasket and housing (147).
5. Thermostat housing bolts (146).

Tighten

- Thermostat housing bolts (146) to 21 N.m (15 lb. ft.).

6. Rocker cover studs (196).

Tighten

- Studs (196) to 12 N.m (106 lb. in.).

ASSEMBLY

CYLINDER BLOCK

Figure 1

Install or Connect

1. Oil gallery plugs (64 and 65).

Tighten

- Apply Teflon sealant GM P/N 1052080 to threads of plugs.
- Front and rear oil gallery plugs (79) to 33 N·m (24 lb. ft.).
- Front and rear oil gallery plugs (65 and 78) to 19 N·m (14 lb. ft.).
- Lifter valley oil gallery plugs (64) to 15 N·m (11 lb. ft.).

2. Coolant drain plugs (69 and 70).

Tighten

- Apply Teflon sealant GM P/N 1052080 to threads of plugs.
- Coolant drain plugs to 19 N·m (14 lb. ft.).

3. Coolant plugs (74).

- Apply sealant GM P/N 12345493 to outside edge of coolant expansion plugs (74).

4. Camshaft position sensor (96).
5. Camshaft position sensor retaining bolt (95).

Tighten

- Bolt (95) to 10 N·m (89 lb. in.).

6. Ignition timing sensor (67) and retaining bolt (66).

Tighten

- Bolt (66) to 10 N·m (89 lb. in.).

7. Knock sensor (68).

Tighten

- Apply sealer GM P/N 1052080 to threads of knock sensor.
- Knock sensor (68) to 19 N·m (14 lb. ft.).

8. Oil filter adapter (41) and gasket (40).
9. Oil filter adapter bolt (43).

Tighten

- Bolt (43) to 68 N·m (50 lb. ft.).

10. Oil filter (45).

Tighten

- Filter (45) to 13 N·m (115 lb. in.).

CAMSHAFT BEARINGS

Figure 57

Tool Required:
J 33049 Camshaft Bearing Remover/Installer

Install or Connect

1. New camshaft bearings (101).
   A. Select front, rear and intermediate camshaft bearings.
   B. Select the proper expander assembly and driving washer.
   C. Assemble J 33049.
   D. Place intermediate camshaft bearing onto J 33049 and index the oil hole at 4 o'clock when looking from the front of the engine block. Drive the intermediate camshaft bearings into place.
   E. Install #4 camshaft bearing with the oil hole indexed at 4 o'clock when looking from the front of the engine block, using J 33049.
   F. Install #1 camshaft bearing with the oil hole indexed at 4 and 7 o'clock when looking from the front of the engine block, using J 33049.

Inspect

- With a piece of 3/32 inch brass rod with a 90° bend at the end, probe the bearing oil holes and verify that they are properly aligned (Figure 57).

NOTICE: Proper alignment of the oil holes is critical. Restriction of the oil flow will cause severe engine damage.

2. Camshaft cover gasket (75), cover (76) and bolts (77).

Tighten

- Bolts (77) to 10 N·m (89 lb. in.).

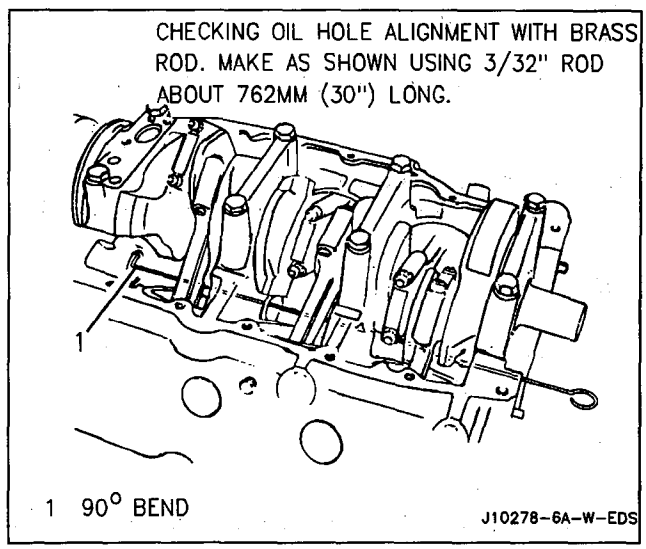


Figure 57 Checking Camshaft Bearing Oil Hole Alignment

CRANKSHAFT

Figures 22, 58 and 59

Install or Connect

NOTICE: Bearing inserts must not be shimmed, scraped or filed. Do not touch the bearing surface of the insert with the bare fingers. Skin oil and acids will etch the bearing surface.

Important

- Make sure the bearing cap bolt holes and the cap mating surfaces are clean and dry.

1. Dip bearing cap bolts (19) in clean engine oil.

NOTICE: Upper and lower inserts may be different. Do not obstruct any oil passages.

2. Place bearing inserts (23) into the bearing cap (20) and into the engine block (71). Refer to "Main Bearing and Connecting Rod Bearing Selection" in this section.

Important

- The inserts will project slightly when put into place. Make sure they project an equal distance on both sides. Make sure the insert tangs are engaged.

3. In the case of a thrust bearing type main bearing insert, coat the thrust surface with GM EOS P/N 1052368 (or equivalent).
4. Lubricate the bearing surface with clean engine oil.
5. Crankshaft (22).
6. Oil gallery O-ring (21) between the engine block and the rear main bearing cap (20).

NOTICE: In order to prevent the possibility of cylinder block and/or main bearing cap damage, the main bearing caps are to be tapped into their cylinder block cavity using a brass or leather mallet before attaching bolts are installed. Do not use attaching bolts to pull main bearing caps into their seats. Failure to observe this information may damage a cylinder block or bearing cap.

7. Bearing cap (20). Tap gently into place with a suitable tool.
   - Apply a small amount of sealer GM P/N 1052942 to the rear of rear bearing cap sealing surface.
8. With crankshaft bearing and bearing caps installed and cap bolts started, thrust crankshaft rearward to set and align bearing caps, then thrust crankshaft forward to align rear face of thrust main bearing (Figure 58).
9. Main bearing cap bolts (19).

Tighten

- Main bearing cap bolts (19) evenly to 50 N·m (37 lb. ft.).
- Turn main bearing cap bolts (19) evenly an additional 77° using J 36660.

Measure

- Crankshaft end play (Figure 59).

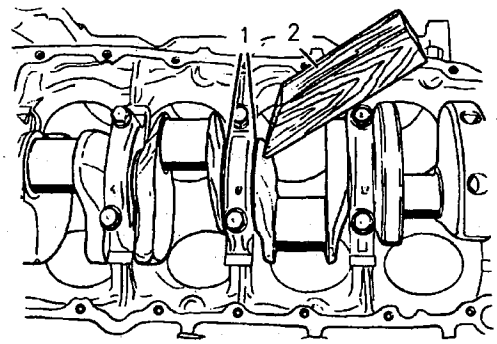
REAR MAIN OIL SEAL

Figures 60 and 61

Tool Required:
J 34686 Rear Main Oil Seal Installer

Install or Connect

1. Apply engine oil to ID and OD of new seal. Slide seal over mandrel until back of seal bottoms squarely against collar of tool (Figures 60 and 61).



1 CENTER MAIN BEARING THRUST FLANGES
2 WOOD BLOCK
BUMP SHAFT IN EACH DIRECTION TO ALIGN THRUST FLANGES OF CENTER MAIN BEARING

Figure 58 Seating the Crankshaft Thrust Bearing

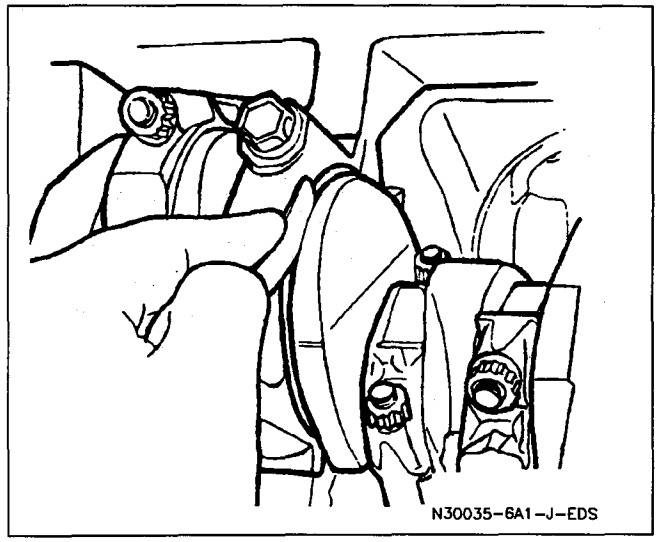


Figure 59 Measuring Crankshaft End Play

2. Rear main oil seal (32).
   A. Align dowel pin of J 34686 with dowel pin in crankshaft and attach J 34686 to crankshaft by hand or tighten attaching screws to 5 N.m (44 lb. in.).
   B. Turn "T" handle of J 34686 so the collar pushes the seal into the bore. Turn handle until the collar is tight against the cylinder case, this will ensure the seal is seated properly.
   C. Loosen the "T" handle of J 34686 until it comes to a stop.
   D. Remove J 34686 attaching screws.

Inspect

- Check to ensure seal is seated squarely in bore.

PISTONS AND CONNECTING RODS

Figures 21, 62 and 63

Tool Required:
J 8037 Piston Ring Compressor

Install or Connect

1. Lubricate cylinder wall and piston rings with clean engine oil.
2. Turn crankshaft to bottom dead center.
3. Connecting rod stud thread protector (Figure 21).
4. J 8037 Piston ring compressor (Figure 62).

NOTICE: Guide the lower connecting rod end carefully to avoid damaging the crankshaft journal.

5. Piston (86) and connecting rod (83) assembly.

Important

- Make sure that the arrow on top of the piston faces towards the front of the engine (Figure 65).

6. Remove thread protectors.

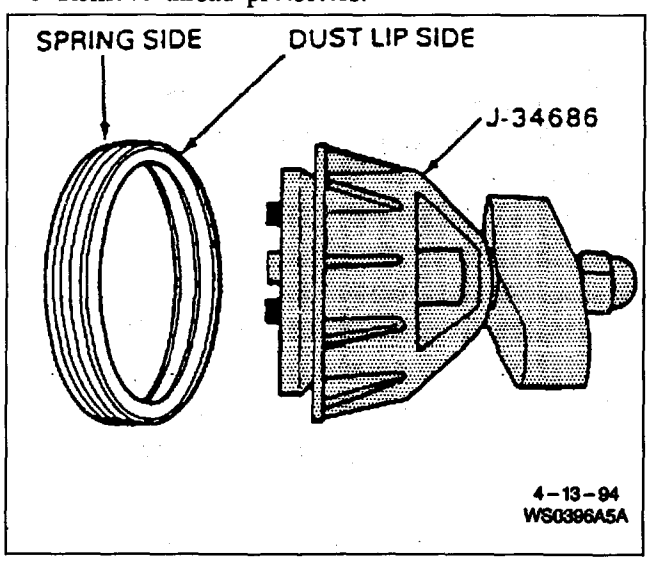


Figure 60 Rear Main Seal and Tool

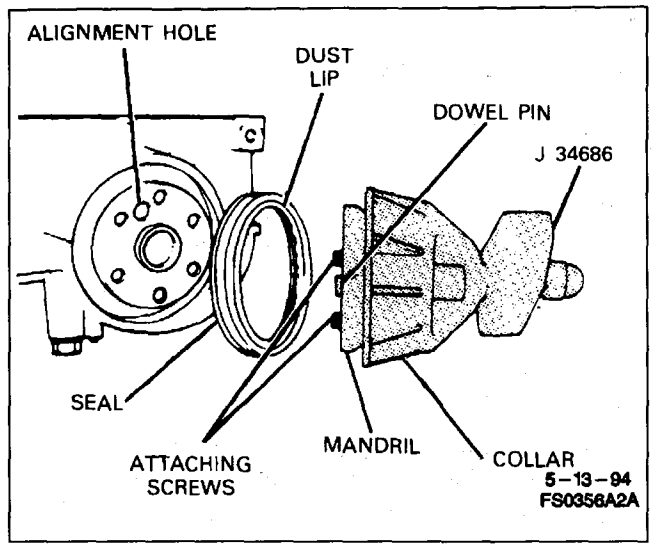


Figure 61 Installing Rear Main Seal

7. Connecting rod bearings (82). Refer to "Main Bearing and Connecting Rod Bearing Selection" in this section.

NOTICE: In order to prevent the possibility of rod bolt or bearing cap damage, the bearing caps may need to be tapped into position with a brass or leather mallet before attaching nuts are installed. Do not use attaching nuts to pull bearing caps onto rod. Failure to observe this information may damage a rod bolt or bearing cap.

8. Seat the bearing caps (81) by pushing on by hand or by carefully tapping it lightly with a suitable tool.
9. Bearing cap nuts (80).

Tighten

- Cap nuts (80) to 52 N.m (38 lb. ft.).

Inspect

- Pry the connecting rod back and forth with a suitable tool and check for binding. If necessary, loosen and retighten the bearing cap.

Measure

- Connecting rod side clearance (Figure 63).

OIL PUMP

Figure 20

Install or Connect

1. Oil pump (17) and drive rod (18).
2. Oil pump bolt (16).

Tighten

- Bolt (16) to 41 N.m (30 lb. ft.).

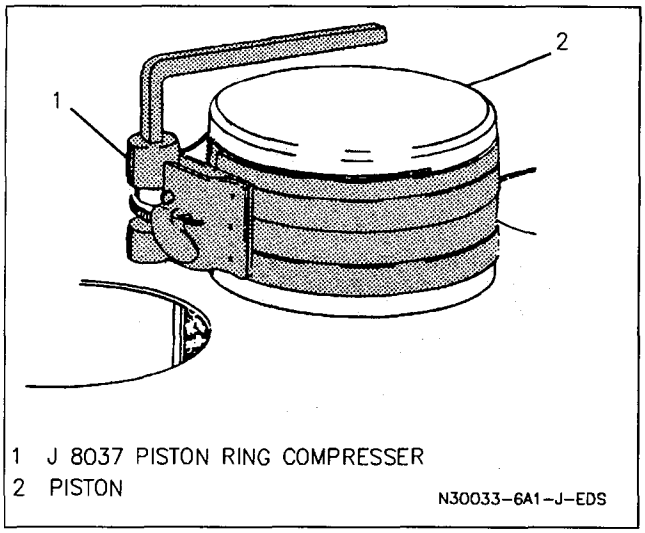


Figure 62 Piston Ring Compressor

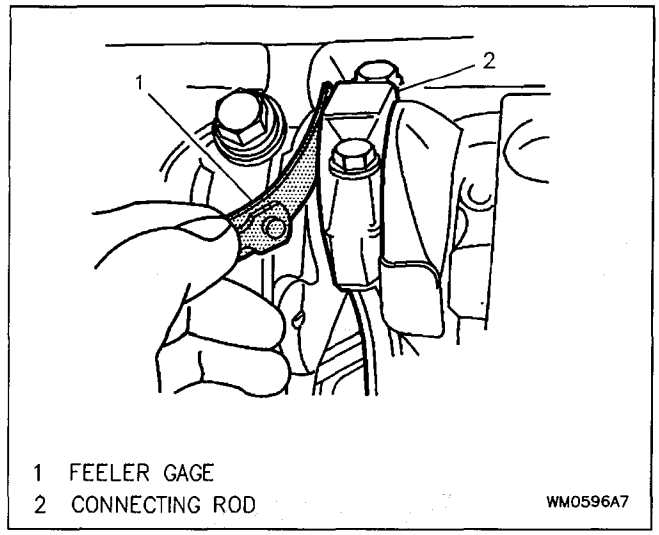


Figure 63 Measuring Connecting Rod Side Clearance

CYLINDER HEAD

Tool Required:
J 36660 Torque Angle Meter

Right

Figure 64

Install or Connect

1. Cylinder head gasket (112).
2. Cylinder head (113).
3. Cylinder head bolts (115).

Tighten

- Bolts (115) in sequence to 55 N.m (41 lb. ft.).
- Turn bolts (115) in sequence an additional 90° using J 36660. Refer to Figure 64.

4. Pencil brace bracket bolts.

Left

Figure 64

Install or Connect

1. Cylinder head gasket (112).
2. Cylinder head (113).
3. Cylinder head bolts (115).

Tighten

- Bolts (115) in sequence to 55 N.m (41 lb. ft.). Refer to Figure 64.
- Turn bolts (115) in sequence an additional 90° using J 36660. Refer to Figure 64.

4. Engine coolant temperature sensor (114).

Tighten

- Apply Teflon sealant GM P/N 1052080 to threads of sensor (114).
- Coolant temperature sensor (114) to 16 N.m (12 lb. ft.).

5. Engine lift bracket (200) and bolts (201).

Tighten

- Bolts (201) to 50 N.m (37 lb. ft.).

6. Oil level indicator tube nut (47).

Tighten

- Nut (47) to 21 N.m (15 lb. ft.).

7. Power steering pump bracket (38), nut (39) and bolt (37).

Tighten

- Bolt (37) to 25 N.m (18 lb. ft.).
- Nut (39) to 50 N.m (37 lb. ft.).

CAMSHAFT

Figure 65

Install or Connect

NOTICE: Camshaft journals are all the same diameter so care must be used when installing the camshaft to avoid bearing damage.

Important

- Coat camshaft journals with engine oil or its equivalent.
- Coat camshaft lobes with prelube GM P/N 1052365.

.list 0

1. Camshaft (100).
   A. Install three 4-inch bolts in the camshaft bolt holes.
   B. Carefully rotate and install the camshaft (100) into the camshaft bearings.
2. Oil pump driven gear assembly (90).
   - Lubricate driven gear with prelube GM P/N 1052365.
   - Lubricate assembly with engine oil for ease of installation.

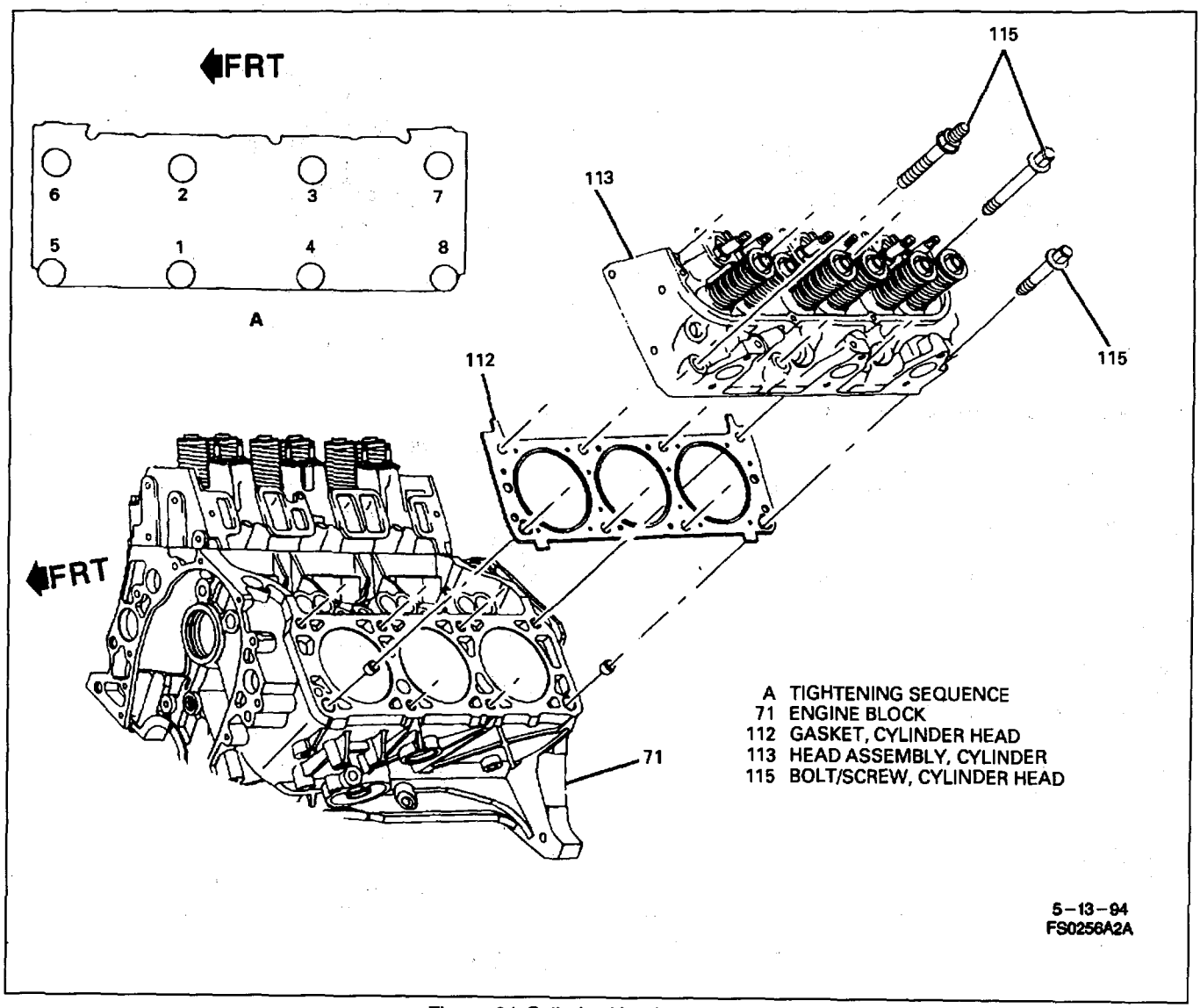


Figure 64 Cylinder Head Installation

3. Oil pump driven gear hold down clamp (92) and bolt (91).

Tighten

- Bolt (91) to 34 N·m (25 lb. ft.).

TIMING CHAIN AND SPROCKETS

Figure 66 through 68

Tool Required:
J 38612 Crankshaft Sprocket Installer

Install or Connect

1. Crankshaft sprocket (26) using J 38612.
2. Remove J 38612.
   - Coat crankshaft and camshaft sprocket teeth with engine oil.
   - Coat rear face of camshaft sprocket with engine oil.
3. Camshaft sprocket (98) and timing chain (25).
   - Align timing marks on crankshaft and camshaft sprockets with cast timing marks on engine block or timing marks on timing chain damper.
4. Camshaft sprocket bolts (97).

Tighten

- Bolts (97) to 25 N·m (18 lb. ft.).

5. Timing chain damper (63) and bolts (62).

Tighten

- Bolts (62) to 25 N·m (18 lb. ft.).

ENGINE FRONT COVER

Figure 69

Install or Connect

1. Front cover gasket (61).
   - Uniformly coat both sides of the lower tabs of the front cover gasket (61) with sealer GM P/N 1052080.

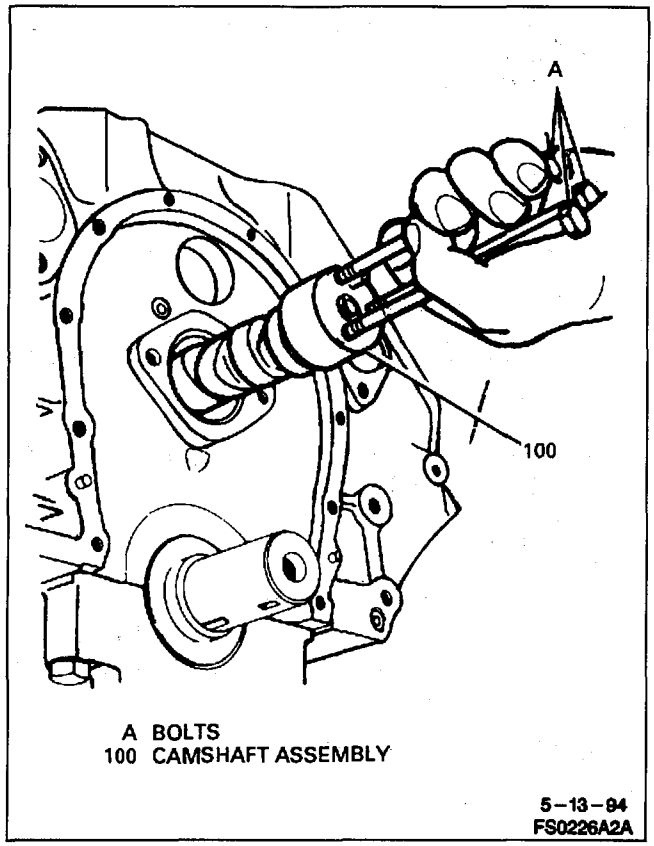


Figure 65 Installing Camshaft

2. Front cover (60).
3. Front cover bolts (59).

Tighten

- Bolts (59) to 21 N.m (15 lb. ft.).

COOLANT PUMP

Figure 69

Install or Connect

1. Coolant pump gasket (55).
   - Apply sealer GM P/N 1052080 to the threads of the coolant pump retaining bolts (51, 52 and 53).
2. Coolant pump (54) and retaining bolts (51, 52 and 53).

Tighten

- Large bolts (52) to 47 N.m (35 lb. ft.).
- Medium bolts (53) to 21 N.m (15 lb. ft.).
- Small bolts (51) to 10 N.m (89 lb. in.).

3. Coolant pump pulley (50) and retaining bolts (49).

Tighten

- Bolts (49) to 25 N.m (18 lb. ft.).

4. Power steering pump mounting bracket (227) and bolts (228).

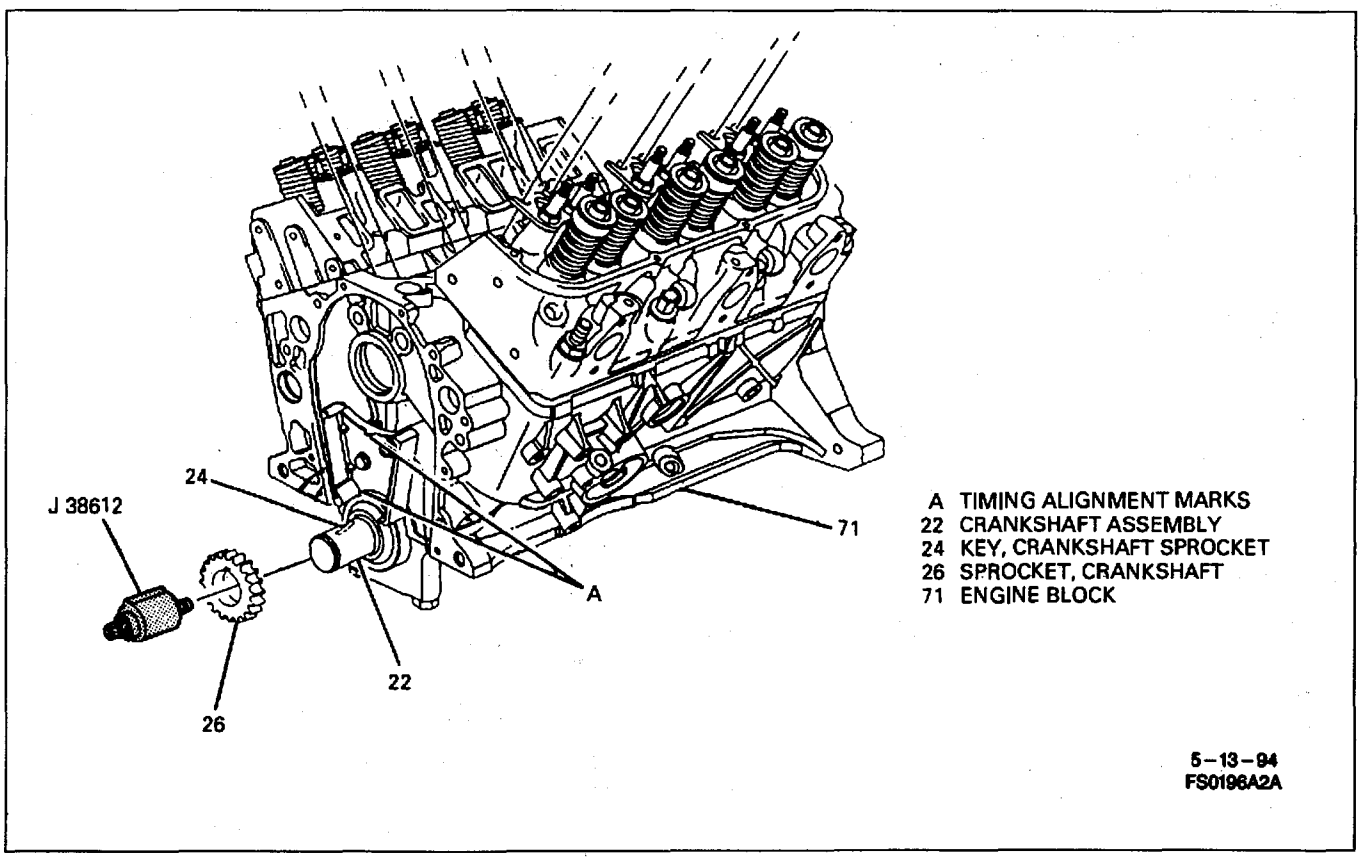


Figure 66 Crankshaft Sprocket Installation

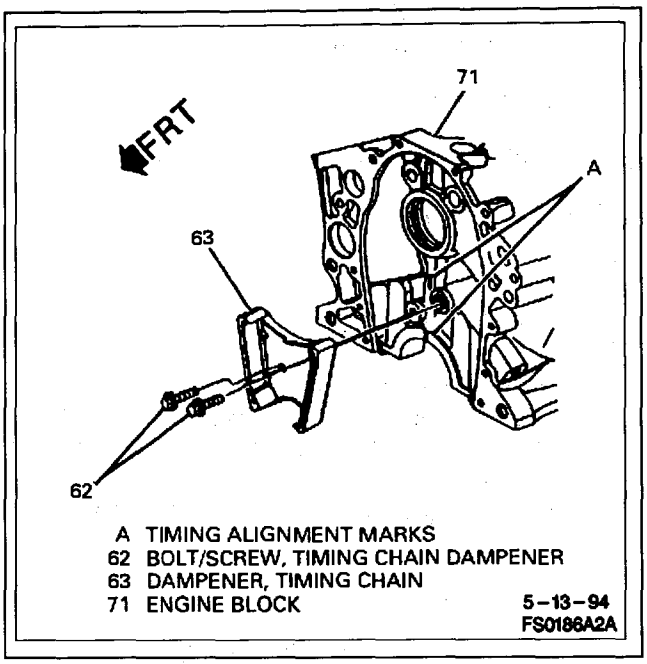


Figure 67 Timing Chain Damper

TORSIONAL DAMPER

Figure 70

Tool Required:
J 29113 Torsional Damper Installer

Install or Connect

1. Torsional damper (27) using J 29113.
   - Apply sealant GM P/N 12345739 to keyway of damper prior to installation.
2. Remove J 29113.
3. Crankshaft pulley (28) and retaining bolts (31).

Tighten

- Bolts (31) to 50 N.m (37 lb. ft.).

4. Torsional damper washer (29) and bolt (30).

Tighten

- Bolt (30) to 79 N.m (58 lb. ft.).

ELECTRONIC IGNITION MODULE

Tool Required:
J 25033-B Power Steering Pump Pulley Installer

Install or Connect

1. Electronic ignition module (222) and retaining nuts (226).

Tighten

- Nuts (226) to 10 N.m (89 lb. in.)

2. Power steering pump (225) and retaining bolts (228).
3. Power steering pump to rear bracket retaining bolts.
4. Power steering pump pulley (229) using J 25033-B.
   - Install pulley (229) until fully seated.

OIL PAN

Figure 17

Install or Connect

1. Oil pan gasket (1).
   - Apply sealant GM P/N 12345739 where the oil pan gasket tabs seat on rear main bearing cap groove.
2. Oil pan (1).
3. Oil pan reinforcements (10), nuts (11), bolts (12 and 14) and studs (13).

Tighten

- Nuts (11) to 10 N.m (89 lb. in.).
- Two rear bolts (14) to 25 N.m (18 lb. ft.).
- Remaining bolts and studs (12 and 13) to 10 N.m (89 lb. in.).

EXHAUST MANIFOLD

Figures 15 and 16

Transfer Parts

If replacing an exhaust manifold, transfer the following:

1. Oxygen sensor (111 and 217).

Tighten

- Oxygen sensor (110 and 218) to 42 N.m (31 lb. ft.).

2. Right manifold EGR adapter pipe (209) and studs (210).

Tighten

- Studs (210) to 31 N.m (23 lb. ft.).

3. Right manifold EGR gasket (208), EGR (206) and bolts (207).

Tighten

- Bolts (207) to 30 N.m (22 lb. ft.).

4. Right manifold EGR flexible adapter pipe gasket (211), EGR flexible adapter pipe (212) and bolts (214).

Tighten

- Bolts (214) to 26 N.m (19 lb. ft.).

Install or Connect

1. Exhaust manifold gasket (106 and 216).
2. Exhaust manifold (105 and 215) and heat shields (103, 104 and 205).

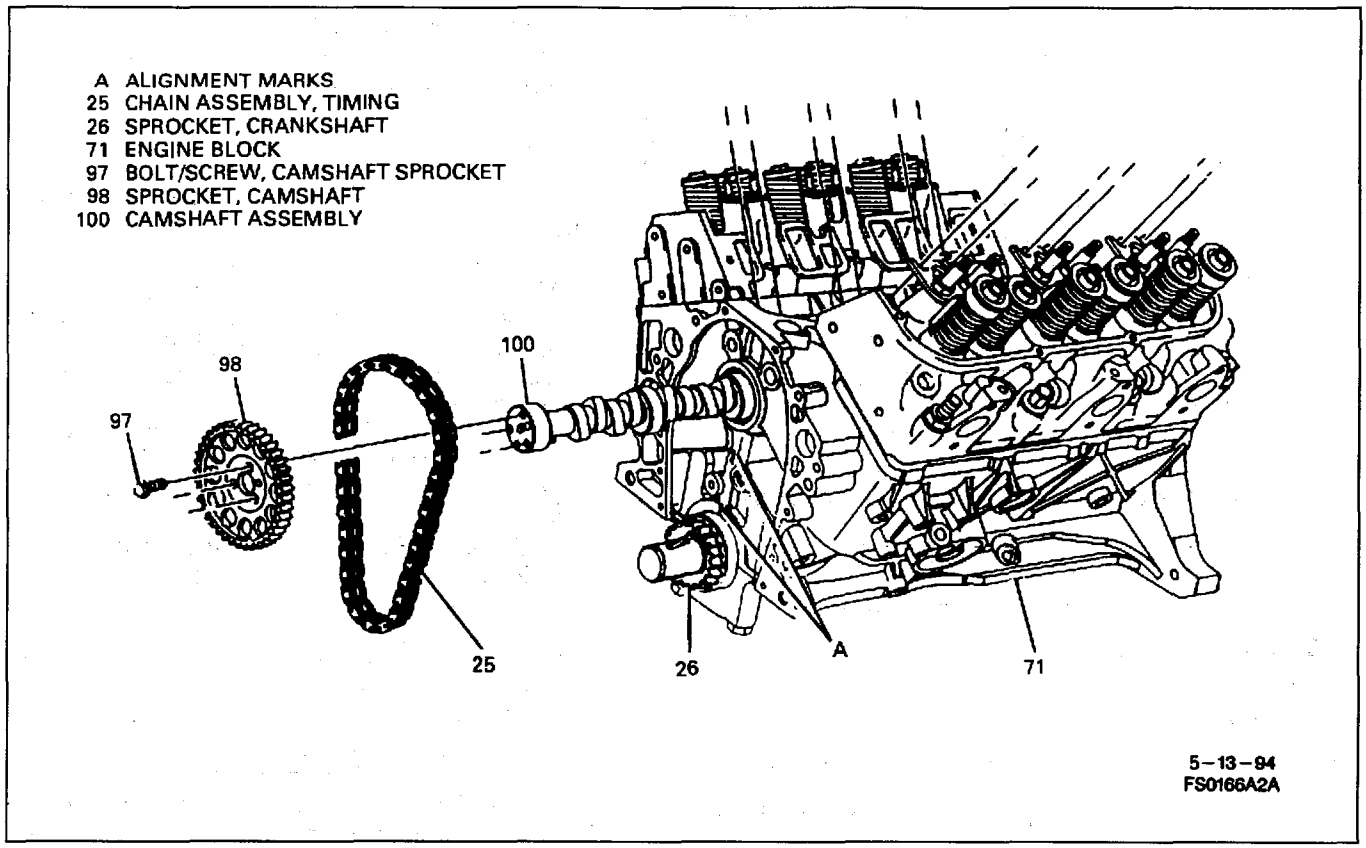


Figure 68 Camshaft Sprocket and Timing Chain Installation

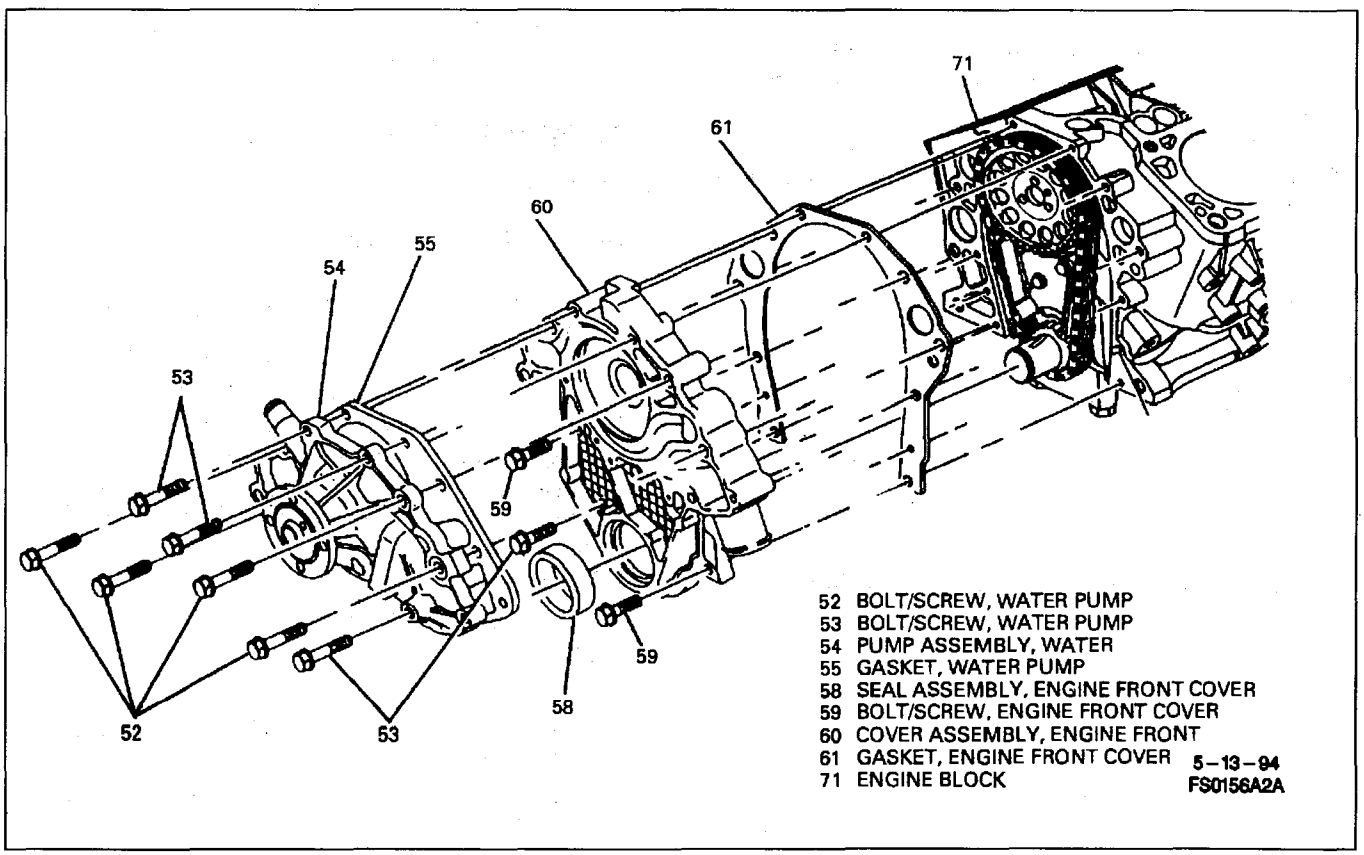


Figure 69 Engine Front Cover

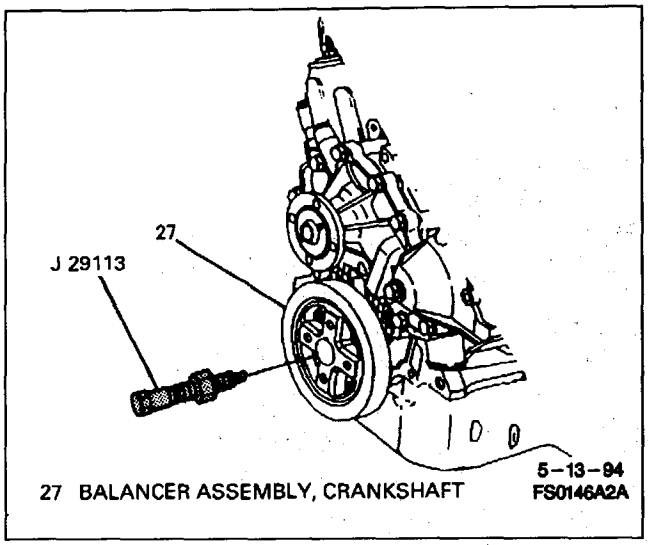


Figure 70 Torsional Damper Installation

3. Exhaust manifold retaining bolts (102 and 202).

Tighten

- Bolts (102 and 202) to 25 N.m (18 lb. ft.).

4. Secondary air injection pipe assembly, if equipped.
5. AIR pipe fitting to right exhaust manifold, if equipped.
6. AIR pipe retaining nut (184) and bolt (183), if equipped.
7. A/C compressor and generator mounting bracket.
8. A/C compressor and generator mounting bracket bolts.
9. Generator pencil brace bolts and braces.
10. Rear A/C compressor bracket mounting bolts and bracket.
11. Serpentine drive belt.

VALVE LIFTERS

Figure 13

Install or Connect

Install lifters in their original locations.

1. Coat lifters with prelube, GM P/N 1052365.
2. Valve lifters (94).

VALVE ROCKER ARM AND PUSHROD

Figure 13

Install or Connect

1. Pushrods (93).
   - Install pushrods in their original location.
   - Coat the ends of the pushrods with prelube GM P/N 1052365.
2. Rocker arms (122) and balls (123).
   - Install rocker arms and balls in their original location.
   - Coat rocker arm balls and friction surfaces of rocker arms with prelube GM P/N 1052365.
3. Rocker arm nuts (124).

Adjust

- Valves when lifter is on base circle of camshaft lobe:
  A. The engine should be in the #1 firing position. This may be determined by placing fingers on the #1 rocker arms as the engine assembly timing mark on the torsional damper aligns with the crankshaft position sensor bolt located on the front cover. If the valves are not moving, the engine is in the #1 firing position. If the valves move the engine is in #4 firing position and should be rotated one revolution to reach the #1 position.
  B. With the engine in the #1 firing position, the following valves should be adjusted:
     — Exhaust—1, 2, 3
     — Intake—1, 5, 6
  C. Tighten the adjusting nut until there is zero lash + 1-1/2 turns.
     — This can be determined by rotating pushrod while turning adjusting nut). When lash has been removed, turn adjusting nut in 1-1/2 additional turns (to center lifter plunger).
  D. Crank the engine one crankshaft revolution. This is the #4 firing position. With the engine in this position, the following valves should be adjusted to zero lash + 1-1/2 turns:
     — Exhaust—4, 5, 6
     — Intake—2, 3, 4

LOWER INTAKE MANIFOLD

Figure 14

Install or Connect

1. Cut lower manifold gasket where it says "Cut Out".
   - This will allow you to put the manifold gasket on with pushrods already installed.
2. Lower intake manifold gasket (141).
3. Apply sealant GM P/N 12345739 at both ends where the intake manifold mates the engine block. Bead should be 2.0-3.0 mm wide and 3.0-5.0 mm thick.
4. Lower intake manifold (142).
5. Retaining bolts (144) and nuts (143).

Tighten

- Bolts (144) and nuts (143) in sequence, refer to Figure 14.
- First, bolts (144) and nuts (143) in sequence, to 5 N.m (44 lb. in.).
- Then, bolts (144) and nuts (143) in sequence, to 20 N.m (15 lb. ft.).
- Finally, bolts (144) and nuts (143) in sequence, to 30 N.m (22 lb. ft.).

VALVE ROCKER COVER

Figure 12

Install or Connect

1. Valve rocker cover gasket (195) and cover (194).
   - Apply sealant GM P/N 12345739 at cylinder head to lower manifold joint.
2. Reinforcement (193) and nuts (192).

Tighten

- Nuts (192) to 10 N.m (89 lb. in.).

UPPER INTAKE MANIFOLD

Figure 10 and 11

Install or Connect

1. Upper intake manifold gasket (154) and manifold (155).
2. Upper intake manifold bolts (156).

Tighten

- Upper intake manifold bolts (156) to 25 N.m (18 lb. ft.).

3. MAP sensor electrical connector.
4. EGR flexible adapter pipe gasket (213), pipe and bolts (212) at upper manifold (155).

Tighten

- Apply Teflon sealant GM P/N 1052080 to threads of bolts (212).
- Gasket must be installed with text "tube side" facing the pipe.
- EGR flexible adapter pipe bolts to 26 N.m (19 lb. ft.).

5. PCV valve (190).

Important

- Do not press on the regulator cover or piedmont valve when installing fuel injector rail assembly.

6. Fuel injector rail assembly (166).
   A. Lightly lubricate fuel injector O-rings with engine oil.
   B. Install injectors of fuel rail assembly into bores of manifold.
   C. Carefully press on injector rail (166) with palms of both hands until injectors are fully seated.
7. Fuel rail stud (169).

Tighten

- Fuel rail stud (169) to 25 N.m (18 lb. ft.).

8. Coolant sensor electrical connector.
9. Fuel pressure regulator vacuum hose (173).
10. Fuel injection harness retaining nut.
11. Fuel lines (175) to fuel injection rail (166).
    - Slide fuel line hold down plate (168) over fuel lines.
12. Fuel line hold down plate bolt (167).

Tighten

- Apply Teflon sealant GM P/N 1052080 to threads of bolt (167).
- Bolt (167) to 25 N.m (18 lb. ft.).

13. Fuel line clamp bolts (176 and 177).

FLYWHEEL

Figure 9

Install or Connect

1. Flywheel (33).
2. Flywheel retaining bolts (36).

Tighten

- Bolts (36) to 83 N.m (61 lb. ft.).

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

AIR Check Valve Assembly	19 N.m (14 lb. ft.)
AIR Pipe Fitting to Manifold	25 N.m (18 lb. ft.)
AIR Pipe Assembly Nut	25 N.m (18 lb. ft.)
AIR Pipe Assembly Screw	50 N.m (37 lb. ft.)
Camshaft Rear Cover Bolts	10 N.m (89 lb. in.)
Camshaft Position Sensor Screw	10 N.m (89 lb. in.)
Camshaft Sprocket Bolt	25 N.m (18 lb. ft.)
Connecting Rod Cap Nut	50 N.m (37 lb. ft.)
Coolant Drain Plug	19 N.m (14 lb. ft.)
Coolant Pump Bolt—Large	47 N.m (35 lb. ft.)
Coolant Pump Bolt—Medium	21 N.m (15 lb. ft.)
Coolant Pump Bolt—Small	10 N.m (89 lb. in.)
Coolant Pump Pulley Bolt	25 N.m (18 lb. ft.)
Coolant Temperature Sensor	16 N.m (12 lb. ft.)
Coolant Temperature Gage Sensor	13 N.m (115 lb. in.)
Crankshaft Pulley Bolt	50 N.m (37 lb. ft.)
Crankshaft Position Sensor Screw	10 N.m (89 lb. in.)
Cylinder Head Bolt	55 N.m + 90° (41 lb. ft. + 90°)
Cylinder Head Bolt Tightening Sequence	Refer to A.
Cylinder Head Coolant Plug	23 N.m (17 lb. ft.)
Electronic Ignition Module Retaining Nut	10 N.m (89 lb. in.)
EGR Adapter Pipe to Exhaust Manifold Bolt	31 N.m (23 lb. ft.)
EGR Flexible Adapter Pipe to EGR Adapter Pipe Bolt	26 N.m (19 lb. ft.)
EGR Flexible Adapter Pipe to Upper Intake Manifold Bolt	26 N.m (19 lb. ft.)
EGR to Adapter Pipe Bolt	30 N.m (22 lb. ft.)
Engine Front Cover Bolt	21 N.m (15 lb. ft.)
Exhaust Manifold Bolt	25 N.m (18 lb. ft.)
Flywheel Bolt	83 N.m (61 lb. ft.)
Front Engine Lift Bracket Bolt	50 N.m (37 lb. ft.)
Fuel Injector Rail Bolt	25 N.m (18 lb. ft.)
Fuel Line Hold Down Plate Bolt	25 N.m (18 lb. ft.)
Heater Inlet Hose Nipple	30 N.m (22 lb. ft.)
Ignition Timing Sensor Screw	10 N.m (89 lb. ft.)
Knock Sensor	19 N.m (14 lb. ft.)
Lower Intake Manifold Mounting Stud	10 N.m (89 lb. in.)
Lower Intake Manifold Bolt	30 N.m (22 lb. ft.)
Lower Intake Manifold Tightening Sequence	Refer to B
Lower Intake Manifold Nut	30 N.m (22 lb. ft.)
Main Bearing Cap Bolts	50 N.m + 77° (37 lb. ft. + 77°)
Oil Drain Plug	25 N.m (18 lb. ft.)
Oil Gallery Plug—1/8 in	15 N.m (11 lb. ft.)
Oil Gallery Plug—1/4 in	19 N.m (14 lb. ft.)
Oil Gallery Plug—3/8 in	33 N.m (24 lb. ft.)
Oil Fill Tube Retaining Screw	8 N.m (71 lb. in.)
Oil Filter	13 N.m (115 lb. in.)
Oil Filter Adapter Bolt	68 N.m (50 lb. ft.)
Oil Level Indicator Nut	21 N.m (15 lb. ft.)
Oil Level Sensor	22 N.m (16 lb. ft.)
Oil Pan Bolt (2 Rear)	25 N.m (18 lb. ft.)
Oil Pan Bolt	10 N.m (89 lb. in.)
Oil Pan Nut	10 N.m (89 lb. in.)
Oil Pan Stud	6 N.m (53 lb. in.)
Oil Pressure Sensor	13 N.m (115 lb. in.)
Oil Pump Bolt	41 N.m (30 lb. ft.)
Oil Pump Cover Bolt	10 N.m (89 lb. in.)
Oil Pump Drive Assembly Bolt	34 N.m (25 lb. ft.)
Oxygen Sensor	42 N.m (31 lb. ft.)
Power Steering Pump Bracket Assembly Bolt	50 N.m (37 lb. ft.)
Power Steering Pump Rear Brace Nut	50 N.m (37 lb. ft.)

Power Steering Pump Rear Brace Stud	25 N.m (18 lb. ft.)
Pressure Plate Bolt	20 N.m + 45° (15 lb. ft. + 45°)
Rear Engine Lift Bracket Bolt	50 N.m (37 lb. ft.)
Rocker Cover Mounting Stud	8 N.m (71 lb. in.)
Rocker Cover Retaining Nut	10 N.m (89 lb. in.)
Rocker Arm Nut	Refer to C
Rocker Arm Stud	46 N.m (35 lb. ft.)
Spark Plug	31 N.m (23 lb. ft.)
Thermostat Housing Bolt	21 N.m (15 lb. ft.)
Throttle Body Retaining Bolt	25 N.m (18 lb. ft.)
Timing Chain Damper Bolt	25 N.m (18 lb. ft.)
Torsional Damper Bolt	79 N.m (58 lb. ft.)
Upper Intake Manifold Bolt	25 N.m (18 lb. ft.)

(A) Refer to "Cylinder Head" under Assembly in this section.
(B) Refer to "Lower Intake Manifold" under Assembly in this section.
(C) Refer to "Rocker Arms and Pushrods" under Assembly in this section.

ENGINE SPECIFICATIONS

General Specifications

Type	60°V-6
Displacement	204 Cu. In.
Liter (VIN)	3.4 (S)
RPO	L32
Bore	92 mm (3.622 inch)
Stroke	84 mm (3.3122 inch)
Compression Ratio	9.0:1
Firing Order	1—2—3—4—5—6
Oil Pressure @ Operating Temperature	103 kPa (15 psi) @ 1100 rpm - minimum

Cylinder Bore

Diameter	92.020 mm—92.038 mm (3.6228 in.-- 3.6235 in.)
Out-of-Round - Max	0.007 mm (0.0003 in.)

Piston

Diameter	91.977 mm-91.992 mm (3.6211 in.-3.6217 in.)
Clearance	0.028 mm-0.061 mm (0.0011 in.-0.0024 in.)

Piston Ring

Compression Groove Clearance 1st	0.05 mm-0.09 mm (0.002 in.-0.0035 in.)
2nd	0.05 mm-0.09 mm (0.002 in.-0.0035 in.)
Piston Ring Gap (at gage dia.) 1st	0.18 mm-0.41 mm (0.007 in.-0.016 in.)
2nd	0.48 mm-0.74 mm (0.019 in.-0.029 in.)
Oil Groove Clearance - Max	0.20 mm (0.008 in.)
Gap (Segment at gage dia.)	0.25 mm-0.76 mm (0.010 in.-0.030 in.)

Piston Pin

Diameter	22.9915 mm-22.9964 mm (.9052 in9054 in.)
Clearance	0.0116 mm-0.0218 mm (0.0005 in.-0.0009 in.)
Fit in Rod - Press	0.0165 mm-0.0464 mm (0.00065 in.-0.0018 in.)

Crankshaft

Main Journal Diameter - All	67.239 mm-67.257 mm (2.6473 in.-2.6483 in.)
Taper - Max	0.005 mm (0.0002 in.)
Out-of-Round - Max	0.005 mm (0.0002 in.)
Main Bearing Clearance	0.032 mm-0.077 mm (0.0012 in.-0.0030 in.)
Main Thrust Bearing Clearance	0.032 mm-0.077 mm (0.0012 in.-0.0030 in.)
Crankshaft End Play	0.06 mm-0.21 mm (0.0024 in.-0.0083 in.)

Crankpin

Diameter	50.768 mm-50.784 mm (1.9987 in.-1.9994 in.)
Taper - Max	0.005 mm (0.0002 in.)
Out-of-Round - Max	0.005 mm (0.0002 in.)
Rod Bearing Clearance	0.028 mm-0.082 mm (0.0011 in.-0.0032 in.)
Rod Side Clearance	0.18 mm-0.44 mm (0.007 in.-0.017 in.)

Camshaft

Lobe Lift Intake	6.67 mm (0.2626 in.)
Exhaust	6.94 mm (0.2732 in.)
Journal Diameter	47.44 mm-47.52 mm (1.868 in.-1.871 in.)
Bearing Inside Diameter	47.523 mm-47.549 mm (1.871 in.-1.872 in.)
Journal Clearance	0.026 mm-0.101 mm (0.001 in.-0.004 in.)

Valve System

Lifter	Hydraulic
Rocker Arm Ratio	1.50:1
Face Angle	45°
Seat Angle	46°
Seat Runout - Maxldr0.025 mm (0.001 in.) Seat Width Intake	1.55 mm-1.85 mm (0.061 in.-0.073 in.)
Seat Width Exhaust	1.70 mm-2.0 mm (0.067 in. -0.079 in.)
Stem ClearanceIntake	0.0356 mm-0.0686 mm (0.0014 in. -0.0027 in.)
Stem Clearance Exhaust	0.0381 mm-0.0737 mm (0.0015 in. -0.0029 in.)

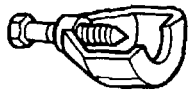
Valve Spring

Free Length	48.5 mm (1.91 in.)
Load - Closed	356 N @ 40.9 mm (80 Lbs. @ 1.61 in.)
Load - Open	841 N @ 30.5 mm (190 Lbs. @ 1.20 in.)
Installed Height	40.9 mm (1.61 in.)
Approx. # of Coils	4

Oil Pump

Gear Lash	0.094 mm-0.195 mm (0.0037 in.-0.0077 in.)
Gear Pocket Depth	30.53 mm-30.61 mm (1.202 in.-1.205 in.)
Gear Pocket Diameter	38.202 mm-38.252 mm (1.504 in.-1.506 in.)
Gear Length	30.45 mm-30.48 mm (1.199 in.-1.200 in.)
Gear Diameter	38.05 mm-38.10 mm (1.498 in.-1.500 in.)
Side Clearance	0.08 mm-0.10 mm (0.003 in.-0.004 in.)
End Clearance	0.05 mm-0.152 mm (0.002 in.-0.006 in.)
Valve to Bore Clearance	0.038 mm-0.089 mm (0.0015 in.-0.0035 in.)

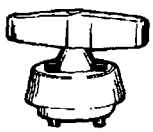
SPECIAL TOOLS

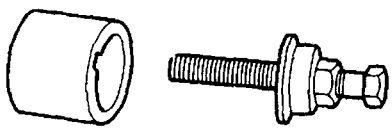
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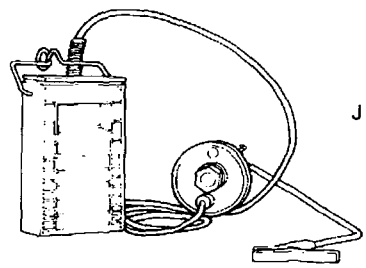
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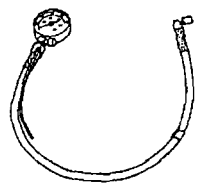
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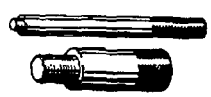
9.  J 23590

10.  J 23738-A

11.  J 36660

12.  J 34730-1

13.  J 8080

14.  J 5239

1. CRANKSHAFT SPROCKET REMOVER
2. TORSIONAL DAMPER INSTALLER
3. PISTON RING COMPRESSOR
4. TORSIONAL DAMPER REMOVER
5. REAR MAIN BEARING OIL SEAL INSTALLER
6. CRANKSHAFT SPROCKET INSTALLER
7. VALVE SPRING COMPRESSOR
8. CAM LOBE LIFT INDICATOR
9. SPARK PLUG PORT ADAPTER
10. VALVE STEM SEAL TESTER
11. TORQUE ANGLE METER
12. FUEL PRESSURE GAGE
13. MAIN BEARING SHELL REMOVER & INSTALLER
14. CONNECTING ROD BOLT GUIDE SET

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BLANK

SECTION 6A3A

5.7 LITER V8 ENGINE ON-VEHICLE SERVICE

RPO LT1 – VIN P

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J-B under "On-Vehicle Service" and the SIR Components and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or unneeded SIR system repairs.

CAUTION: Before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with "live" or "hot at all times" exposed electrical terminals, disconnect the battery negative cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "OFF" or "LOCK" position.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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ON-VEHICLE SERVICE

FUEL SYSTEM PRESSURE RELIEF

CAUTION:

- **To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing fuel system components.**
- **After relieving system pressure, a small amount of fuel may be released when servicing fuel lines or connections. In order to reduce the chance of personal injury, cover fuel pipe fittings with a shop towel before disconnecting, to catch any fuel that may leak out. Place the towel in an approved container when disconnect is completed.**

Tool Required:

J 34730-1 Fuel Pressure Gage

1. Disconnect battery negative cable assembly terminal to avoid possible fuel discharge if an additional attempt is made to start the engine.
2. Loosen fuel filler cap to relieve tank vapor pressure.
3. Connect gage J 34730-1 to fuel pressure connection. Wrap a shop towel around fitting while connecting gage to avoid spilling.
4. Install bleed hose into an approved container and open valve to bleed system pressure. Fuel connections are now safe for servicing.
5. Drain any fuel remaining in gage into an approved container.

SERPENTINE DRIVE BELT AND TENSIONER ASSEMBLY

Figures 1 and 2

NOTICE: Routine inspection of the belt may reveal cracks in the belt ribs. These cracks will not impair belt performance and therefore should not be considered a problem requiring belt replacement. However, the belt should be replaced if belt slip occurs or if sections of the belt ribs are missing.

A single serpentine drive belt is used to drive all engine accessories. All belt driven accessories are rigidly mounted with belt tension maintained by a spring loaded tensioner assembly.

The indicator on the movable portion of the tensioner assembly must be within the limits of the marks of the stationary portion of the tensioner assembly. Any reading outside of these limits indicates either a defective belt or tensioner assembly.

Drive Belt

Inspect

- Belt length scale on the drive belt tensioner assembly for the proper installed length. If the belt length scale does not indicate the proper installed length, install a new drive belt.

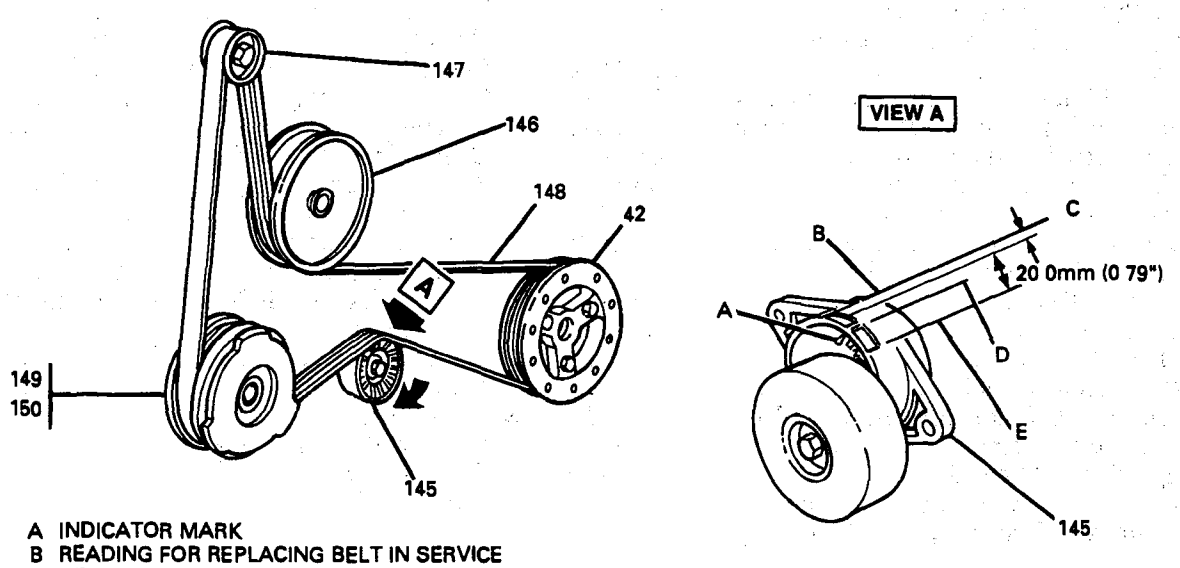
Remove or Disconnect

CAUTION: See "Caution" on page 6A3A-1 of this section.

1. Battery negative cable assembly.
2. Lift drive belt tensioner assembly (145) downward (clockwise) off drive belt (148) using a socket and handle on tensioner pulley bolt/screw.
3. Drive belt (148).

Install or Connect

1. Drive belt (148) over tensioner pulley by pushing down on drive belt tensioner assembly (145).
   - Be sure drive belt (148) is aligned into proper grooves of accessory drive pulleys.



A INDICATOR MARK
B READING FOR REPLACING BELT IN SERVICE
C DEFECTIVE PARTS CHECK RANGE
D MAXIMUM TOLERANCE BELT READING
E MINIMUM TOLERANCE BELT READING
42 BALANCER ASSEMBLY, CRANKSHAFT
145 TENSIONER ASSEMBLY, DRIVE BELT
146 PUMP ASSEMBLY, POWER STEERING
147 GENERATOR ASSEMBLY
148 BELT, SERPENTINE DRIVE
149 COMPRESSOR ASSEMBLY, AIR CONDITIONING
150 PULLEY, DRIVE BELT IDLER

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Figure 1 – Serpentine Drive Belt

2. Battery negative cable assembly.

Drive Belt Tensioner Assembly

Remove or Disconnect

1. Drive belt (148).
2. Drive belt tensioner bolts/screws (152).
3. Drive belt tensioner assembly (145).

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

1. Drive belt tensioner assembly (145).
2. Drive belt tensioner bolts/screws (152).

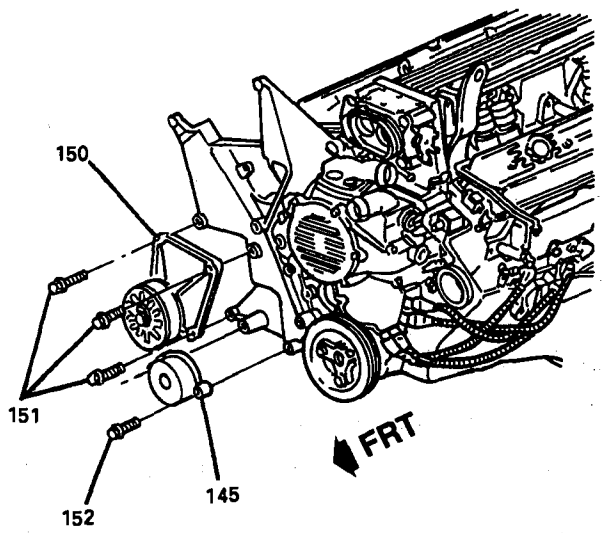
Tighten

- Drive belt tensioner bolts/screws (152) to 25 N•m (18 lb. ft.).

3. Drive belt (148).

Drive Belt Idler Pulley

The drive belt idler pulley is used in place of the A/C compressor when the vehicle is not equipped with air conditioning.



145 TENSIONER ASSEMBLY, DRIVE BELT
150 PULLEY, DRIVE BELT IDLER
151 BOLT/SCREW, DRIVE BELT IDLER PULLEY
152 BOLT/SCREW, DRIVE BELT TENSIONER

Figure 2 – Drive Belt Tensioner Assembly and Idler Pulley

Remove or Disconnect

1. Drive belt (148).
2. Idler pulley bolts/screws (151).
3. Drive belt idler pulley (150).

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

1. Drive belt idler pulley (150).
2. Idler pulley bolts/screws (151).

Tighten

- Idler pulley bolts/screws (151) to 50 N•m (37 lb. ft.).

3. Drive belt (148).

ENGINE MOUNT ASSEMBLIES AND BRACKETS

Figure 3

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, crankshaft pulley, or any sheet metal. Due to a small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen resulting in a damaged oil pickup unit.

Inspect

- Engine mounts for damage to the rubber portions of the mount.
  - Rubber surface covered with heat check cracks.
  - Rubber cushion separated from the plate of the mount.
  - Rubber cushion split through the center.

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Engine mount through-bolts/screws (130) and nuts (125).
3. Raise engine with a jacking fixture.
4. Engine mount bolts/screws (128) and engine mount assemblies (127).
5. Engine bracket bolts/screws (126) and engine brackets (124).

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

1. Engine brackets (124) and engine bracket bolts/screws (126).

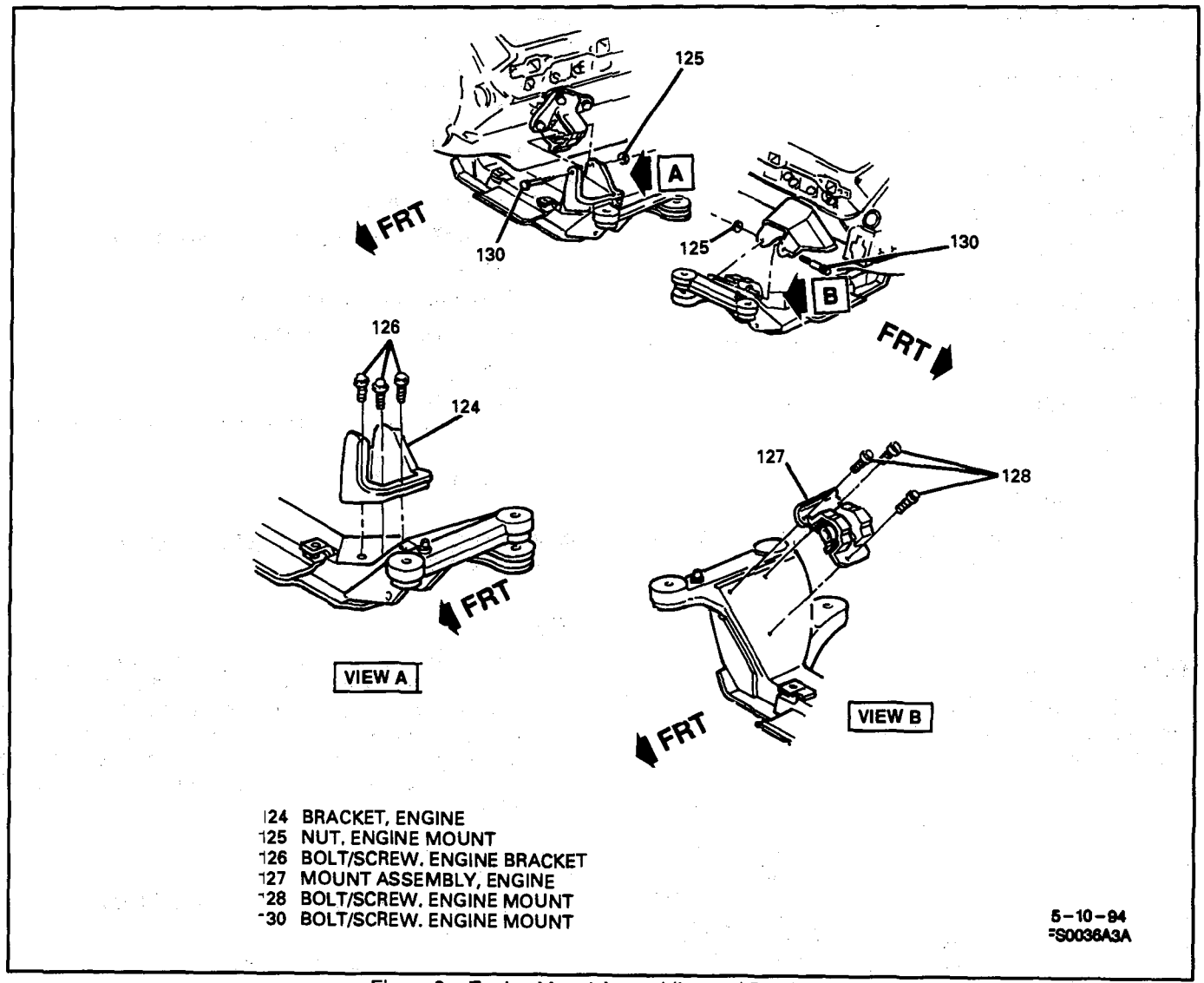


Figure 3 – Engine Mount Assemblies and Brackets

2. Engine mount assemblies (127) and engine mount bolts/screws (128).

Tighten

- Engine mount and bracket bolts/screws (126 and 128) to 58 N•m (43 lb. ft.).

3. Lower engine.
4. Engine mount through-bolts/screws (130) and nuts (125).

Tighten

- Engine mount through-bolt/screw nuts (125) to 80 N•m (59 lb. ft.).

-or-

- Engine mount through-bolts/screws (130) to 95 N•m (70 lb. ft.).

OIL LEVEL INDICATOR AND TUBE ASSEMBLIES

Remove or Disconnect

1. Nut securing tube bracket to right exhaust manifold stud bolt.
2. Level indicator and tube assemblies from engine block.

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

1. Clean tube assembly and apply sealant, GM P/N 12345493 or equivalent, around tube 12.7 mm (0.50 inch) below bead.
2. Tube assembly into engine block and rotate into position.
3. Nut securing tube bracket.

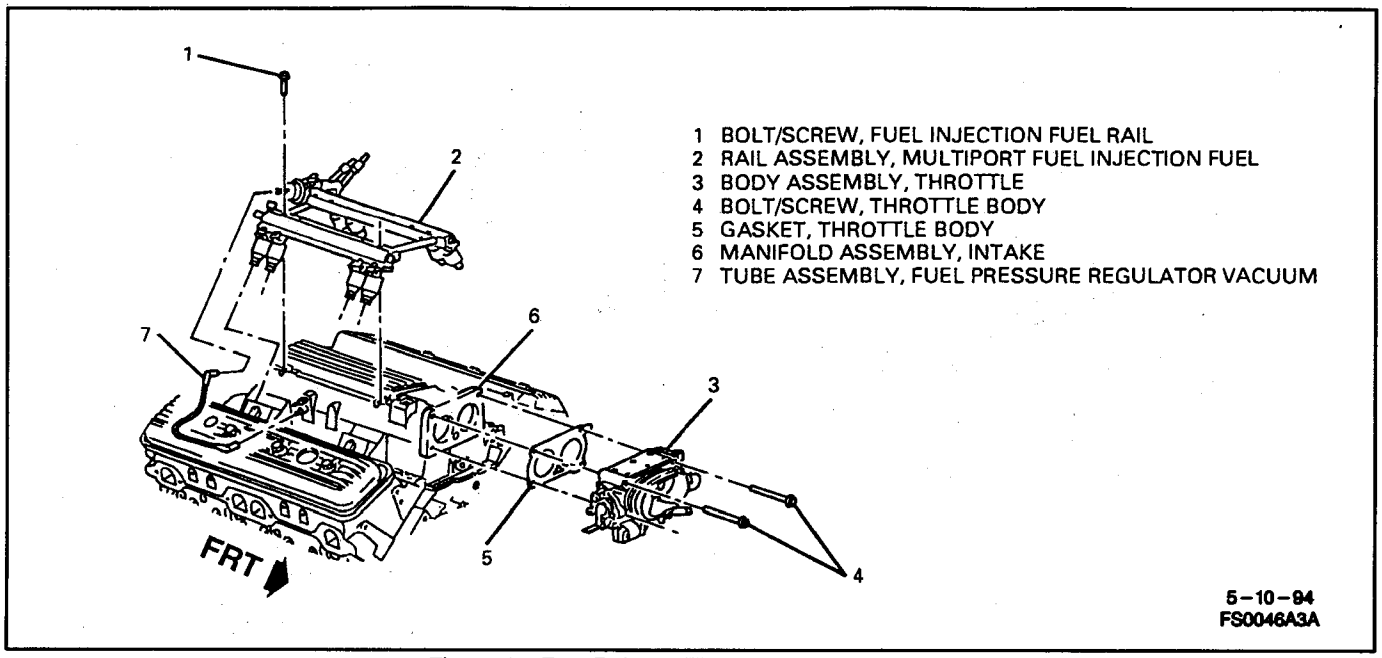


Figure 4 – Fuel Rail and Throttle Body Assemblies

Tighten

- Oil level indicator tube nut to 12 N•m (106 lb. ft.).

4. Level indicator.

INTAKE MANIFOLD ASSEMBLY

Figures 4 through 6

Remove or Disconnect

CAUTION: See "Caution" on page 6A3A-1 of this section.

1. Battery negative cable assembly.
2. Drain coolant. Refer to SECTION 6B.
3. Throttle body air duct.
4. Wiring harness connectors from fuel injectors.
5. Left and right wiring harnesses and lay aside.
6. Accelerator cable bracket bolts/screws, bracket and cables from throttle body assembly (3).
7. Accelerator control/cruise control servo cable adjuster assembly, if equipped. Refer to SECTION 5E2.
8. Relieve fuel system pressure. Refer to "Fuel System Pressure Relief" in this section.
9. Secondary air injection diverter valve hoses.
10. Fuel pipe connectors from fuel rail assembly (2).
11. Fuel rail bolts/screws (1).
12. Fuel pressure regulator vacuum tube assembly (7).
13. Fuel rail assembly (2) from intake manifold assembly (6) and lay aside.
14. Vacuum and crankcase vent hoses.
15. Exhaust gas recirculation (EGR) control valve relay nut and control valve relay.
16. Emission canister purge solenoid bracket nut and solenoid.
17. EGR valve nuts and valve assembly.
18. EGR valve pipe nuts and studs.
19. Secondary air injection pipe fitting, nuts and pipe assembly from intake and right exhaust manifold assemblies.
20. Generator rear brace. Refer to SECTION 6D3.
21. Coolant hoses from throttle body assembly (3).
22. Throttle body bolts/screws (4), throttle body assembly (3) and gasket (5).
23. Intake manifold bolts/screws (8) and studs (9).
24. Intake manifold assembly (6) and gaskets (10).
    - Discard gaskets (10).

Clean

- Intake manifold bolts/screws (8) and studs (9).
- Cylinder head assembly, engine block and intake manifold sealing surfaces.

Install or Connect

NOTICE: See "NOTICE" on page 6A3A-1 of this section.

1. Apply a 5 mm (3/16 inch) bead of RTV sealer, GM P/N 12346141 or equivalent, to the front and rear of the engine block. Extend the bead 13 mm (1/2 inch) up each cylinder head assembly to seal and retain the gaskets.
2. Intake manifold assembly (6) with new gaskets (10).
3. Intake manifold bolts/screws (8) and studs (9).

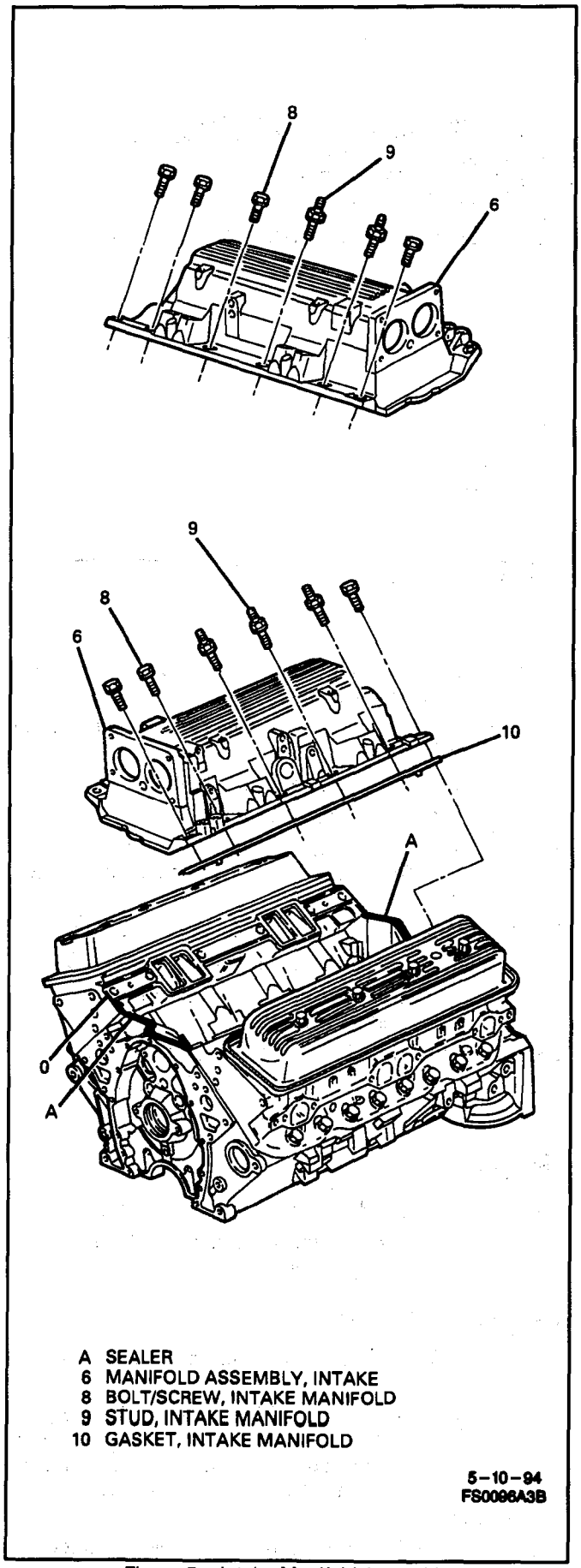


Figure 5 – Intake Manifold Assembly

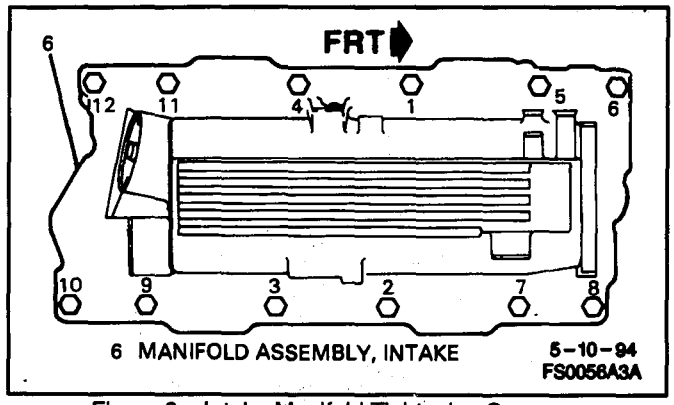


Figure 6 – Intake Manifold Tightening Sequence

Tighten

- Intake manifold bolts/screws (8) and studs (9) in a first pass to 8 N•m (71 lb. in.) in sequence as shown in Figure 6. Tighten in sequence in a second pass to final specifications of 48 N•m (35 lb. ft.).

4. Throttle body assembly (3), gasket (5) and throttle body bolts/screws (4).

Tighten

- Throttle body bolts/screws (4) to 26 N•m (18 lb. ft.).

5. Coolant hoses to throttle body assembly (3).
6. Generator rear brace. Refer to SECTION 6D3.
7. Accelerator control/cruise control servo cable adjuster assembly, if equipped. Refer to SECTION 5E2.
8. Accelerator cable bracket, bolts/screws and cables.

Tighten

- Accelerator cable bracket bolts/screws to 10 N•m (90 lb. in.).

9. Secondary air injection pipe assembly and nuts.

Tighten

- Secondary air injection pipe exhaust manifold fitting to 55 N•m (41 lb. ft.).

10 EGR valve pipe studs and nuts.

11. EGR valve assembly and nuts.
12. EGR control valve relay and nut.

Tighten

- EGR valve pipe studs to 6 N•m (53 lb. in.).
- EGR valve pipe nuts to 25 N•m (18 lb. ft.).
- EGR valve nuts to 25 N•m (18 lb. ft.).
- EGR control valve relay nut to 25 N•m (18 lb. ft.).

13. Emission canister purge solenoid and bracket bolt/screw.

Tighten

- Emission canister purge solenoid bracket bolt/screw to 6 N•m (53 lb. in.).

14 Vacuum and crankcase vent hoses.
15. Fuel rail assembly (2) to intake manifold assembly (6).
16. Fuel pressure regulator vacuum tube assembly (7).
17. Fuel rail bolts/screws (1).

Tighten

- Fuel rail bolts/screws (1) to 20 N•m (15 lb. ft.).

18. Fuel pipe connectors to fuel rail assembly (2).
19. Secondary air injection diverter valve hoses.
20. Left and right wiring harnesses.
21. Wiring harness connectors to fuel injectors.
22. Throttle body air duct.
23. Battery negative cable assembly.
24. Refill with coolant. Refer to SECTION 6B.

EGR VALVE PIPE ASSEMBLY

Figures 7

Remove or Disconnect

CAUTION: See "Caution" on page 6A3A-1 of this section.

1. Transmission fluid level indicator assembly.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Catalytic converter hanger assembly. Refer to SECTION 6F.
4. Support exhaust system assembly.
5. Exhaust crossover pipe assembly. Refer to SECTION 6F.
6. Transmission fluid filler tube assembly. Refer to SECTION 7A.
7. EGR pipe (12) to exhaust manifold mounting bolt/screw (229).
8. Lower vehicle..
9. EGR pipe nuts (14) and gasket (22) from intake manifold.
10. EGR pipe assembly 12 from vehicle.
    - Discard Gasket (22).

Clean

- Intake manifold sealing surface.

Install or Connect

NOTICE: See "NOTICE" on page 6A3A-1 of this section.

1. EGR pipe gasket (22), pipe (12) and nuts (14) to intake manifold fingertight.
2. Raise and suitable support vehicle. Refer to SECTION 0A.
3. EGR pipe (12) and EGR pipe assembly bolt/screw (229) to exhaust manifold.

Tighten

- EGR pipe bolt/screw (229) to 25 N•m (18 lb. ft.).

4. Transmission fluid filler tube assembly. Refer to SECTION 7A.
5. Exhaust crossover pipe assembly. Refer to SECTION 6F.
6. Remove exhaust system support.
7. Catalytic converter hanger assembly. Refer to SECTION 6F.
8. Lower vehicle.
9. Tighten EGR pipe nuts (14) at intake manifold.

Tighten

- EGR pipe nuts (14) to 25 N•m (18 lb. ft.)

10. Transmission fluid level indicator assembly.

EXHAUST MANIFOLD ASSEMBLIES

Figures 7 and 8

Right Exhaust Manifold Assembly

Remove or Disconnect

CAUTION: See "Caution" on page 6A3A-1 of this section.

1. Battery negative cable assembly.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Exhaust crossover pipe. Refer to SECTION 6F.
4. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
5. Oil level indicator and tube assemblies. Refer to "Oil Level Indicator and Tube Assemblies" in this section.
6. Oxygen sensor electrical connector.
7. Three rear exhaust manifold assembly bolts/screws (21).
8. Lower vehicle.
9. Secondary air injection pipe fitting from exhaust manifold assembly. Refer to SECTION 6E3.
10. EGR valve pipe assembly. Refer to SECTION 6E3.
11. Generator and rear lower brace. Refer to SECTION 6D3.
12. Remaining exhaust manifold studs (20) and bolt/screw (21).
13. Exhaust manifold assembly (19) and exhaust manifold gasket (18).

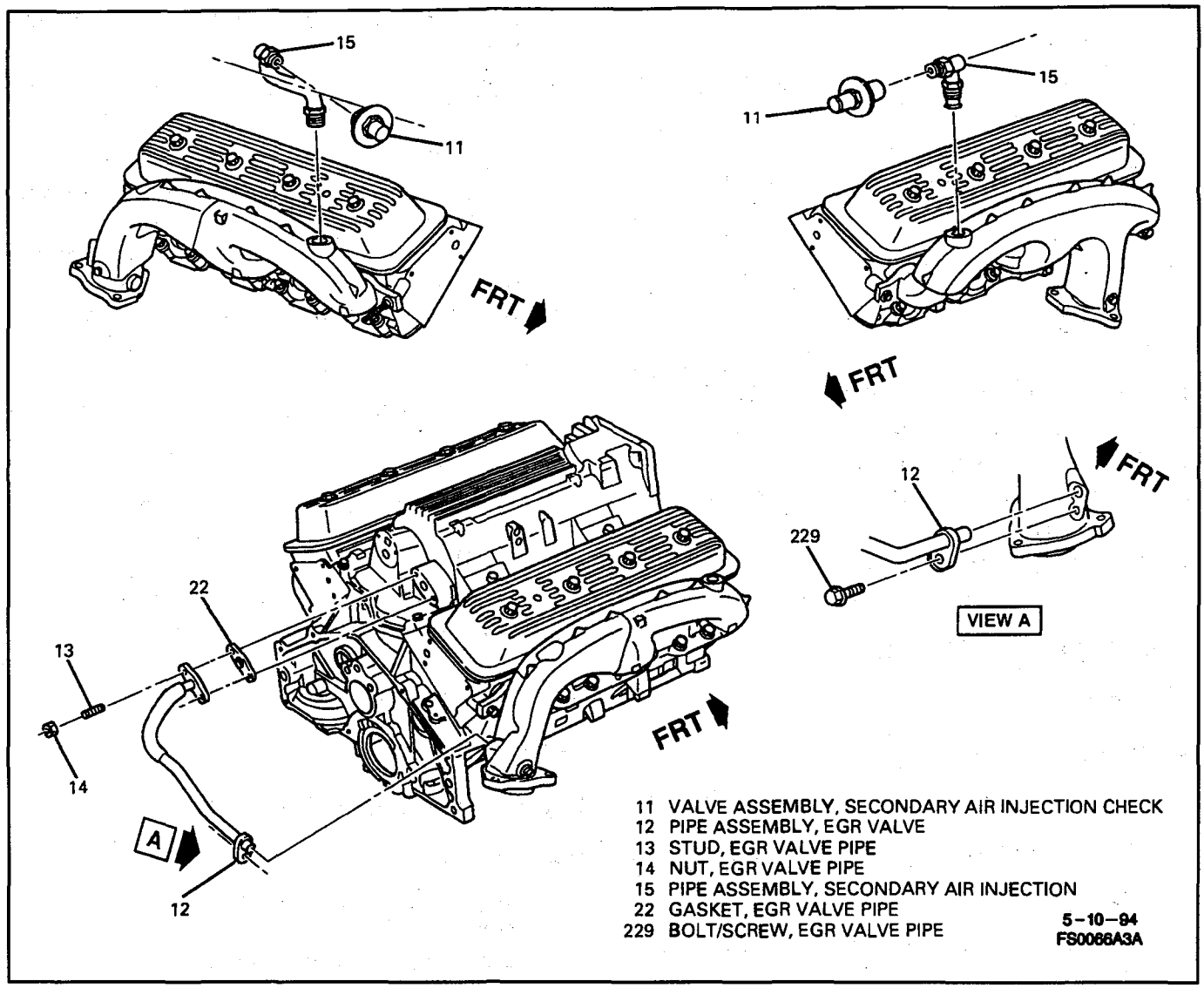


Figure 7 – Secondary Air Injection and EGR Valve Pipe Assemblies

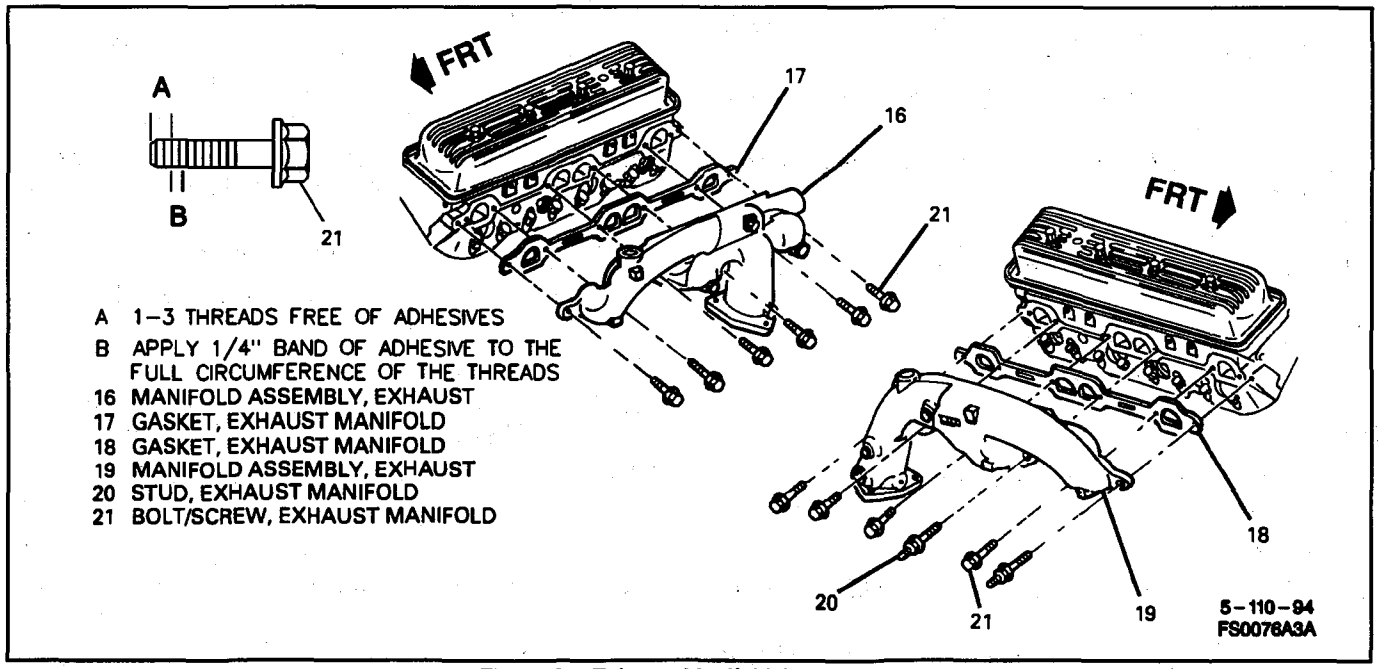


Figure 8 – Exhaust Manifold Assemblies

Clean

- Exhaust manifold and cylinder head sealing surfaces.

Important

1. Clean cylinder head exhuast manifold bolt/stud holes with a 3/8–16 Tap.
2. Clean bolt/stud hole with GM P/N 12345754 or equivalent..
3. Remove all old adhesive material from bolt/stud threads.
4. Apply 1/4″ band of GM P/N 12345493 adhesive to bolt/stud threads (Figure 8).

Install or Connect

NOTICE: See "NOTICE" on page 6A3A-1 of this section.

1. Exhaust manifold gasket (18) and exhaust manifold assembly (19).
2. Front three exhaust manifold studs (20) and bolt/screw (21).
3. Generator and rear lower brace. Refer to SECTION 6D3.
4. Raise and suitably support vehicle. Refer to SECTION 0A.
5. Remaining exhaust manifold bolts/screws (21).

Tighten

- Exhaust manifold studs (20) and bolts/screws (21) to 35 N•m (26 lb. ft.).

6. Oxygen sensor electrical connector.
7. Oil level indicator and tube assemblies. Refer to "Oil Level Indicator and Tube Assemblies" in this section.
8. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
9. Exhaust crossover pipe. Refer to SECTION 6F.
10. Lower vehicle.
11. EGR valve pipe assembly. Refer to SECTION 6E3.
12. Secondary air injection pipe assembly fitting to exhaust manifold assembly. Refer to SECTION 6E3.

Tighten

- Secondary air injection pipe assembly fitting to 55 N•m (41 lb. ft.).

13. Battery negative cable assembly.

Left Exhaust Manifold Assembly

Remove or Disconnect

CAUTION: See "Caution" on page 6A3A-1 of this section.

1. Battery negative cable assembly.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Crossover pipe from exhaust manifold assembly. Refer to SECTION 6F.
4. Lower vehicle.
5. Brake booster vacuum hose.
6. Secondary air injection pipe fitting from exhaust manifold assembly. Refer to SECTION 6E3.
7. Accelerator control/cruise control servo cable adjuster assembly, if equipped. Refer to SECTION 5E2.
8. Oxygen sensor electrical connector.
9. Exhaust manifold bolts/screws (21).
10. Exhaust manifold assembly (16) and exhaust manifold gasket (17).

Clean

- Exhaust manifold and cylinder head sealing surfaces.

Important

1. Clean cylinder head exhuast manifold bolt/stud holes with a 3/8–16 Tap.
2. Clean bolt/stud hole with GM P/N 12345754 or equivalent..
3. Remove all old adhesive material from bolt/stud threads.
4. Apply 1/4″ band of GM P/N 12345493 adhesive to bolt/stud threads (Figure 8).

Install or Connect

NOTICE: See "NOTICE" on page 6A3A-1 of this section.

1. Exhaust manifold gasket (17) and exhaust manifold assembly (16).
2. Exhaust manifold bolts/screws (21).

Tighten

- Exhaust manifold bolts/screws (21) to 35 N•m (26 lb. ft.).

3. Oxygen sensor electrical connector.
4. Accelerator control/cruise control servo cable adjuster assembly, if equipped. Refer to SECTION 5E2.
5. Secondary air injection pipe fitting from exhaust manifold assembly. Refer to SECTION 6E3.

Tighten

- Secondary air injection pipe fitting to 55 N•m (41 lb. ft.).

6. Brake booster vacuum hose.
7. Raise and suitably support vehicle. Refer to SECTION 0A.
8. Crossover pipe to exhaust manifold assembly. Refer to SECTION 6F.
9. Lower vehicle.

10. Battery negative cable assembly.

VALVE ROCKER ARM COVER ASSEMBLIES

Figure 9

Right Cover Assembly

Remove or Disconnect

CAUTION: See "Caution" on page 6A3A-1 of this section.

1. Battery negative cable assembly.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
4. Transmission fluid level indicator tube assembly bracket from transmission housing (automatic transmission only.)
5. Lower vehicle.
6. Crankcase vent hose.
7. Generator and rear generator brace. Refer to SECTION 6D3.
8. Secondary air injection pipe fitting from exhaust manifold assembly. Refer to SECTION 6D3.
9. Rocker arm cover bolts/screws (24).
10. Rocker arm cover assembly (23) and gasket (25).

Clean

- Rocker arm cover assembly and cylinder head gasket surfaces.

Install or Connect

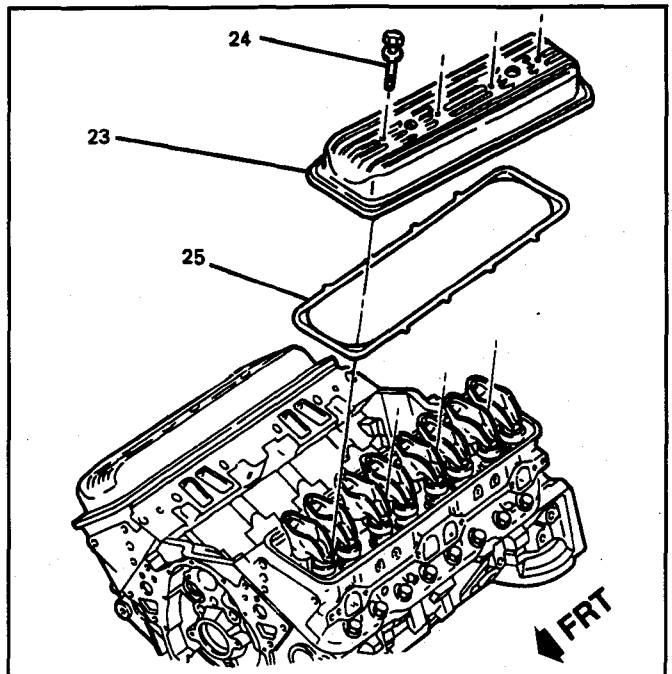
NOTICE: See "NOTICE" on page 6A3A-1 of this section.

1. Gasket (25) and rocker arm cover assembly (23).
2. Rocker arm cover bolts/screws (24).

Tighten

- Rocker arm cover bolts/screws (24) to 12 N•m (106 lb. in.).

3. Secondary air injection pipe fitting to exhaust manifold assembly. Refer to SECTION 6D3.
4. Generator and rear generator brace. Refer to SECTION 6D3.
5. Crankcase vent hose.
6. Raise and suitably support vehicle. Refer to SECTION 0A.
7. Transmission fluid level indicator tube assembly to transmission housing (automatic transmission only.)
8. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.



23 COVER ASSEMBLY, VALVE ROCKER ARM
24 BOLT/SCREW, VALVE ROCKER ARM COVER
25 GASKET, VALVE ROCKER ARM COVER

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Figure 9 – Valve Rocker Arm Cover Assemblies

9. Lower vehicle.
10. Battery negative cable assembly.

Left Cover Assembly

Remove or Disconnect

1. Brake booster vacuum hose.
2. Secondary air injection hose from pump to check valve assembly.
3. Secondary air injection pipe fitting from exhaust manifold assembly. Refer to SECTION 6E3.
4. Accelerator control/cruise control servo cable adjuster assembly, if equipped. Refer to SECTION 5E2.
5. Rocker arm cover bolts/screws (24).
6. Rocker arm cover assembly (23) and gasket (25).

Clean

- Rocker arm cover assembly and cylinder head gasket surfaces.

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

1. Gasket (25) and rocker arm cover assembly (23).
2. Rocker arm cover bolts/screws (24).

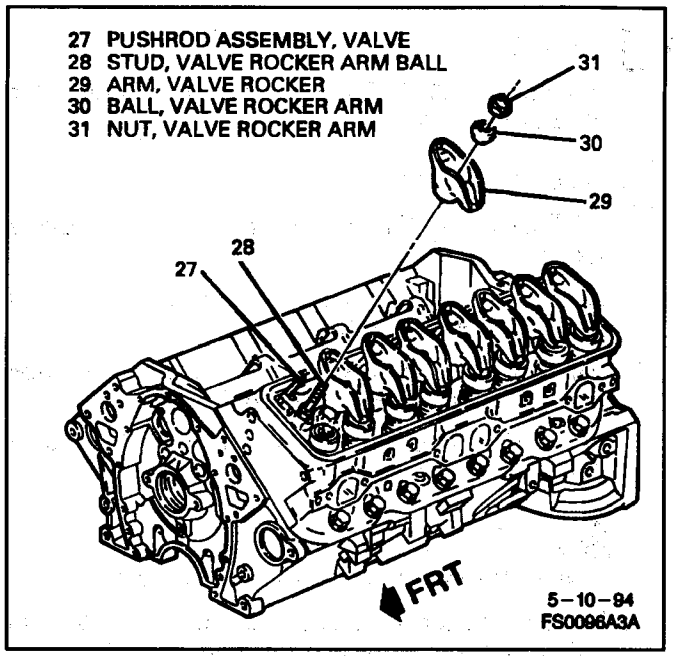


Figure 10 – Valve Rocker Arms and Pushrod Assemblies

Tighten

- Rocker arm cover bolts/screws (24) to 12 N•m (106 lb. in.).

3. Accelerator control/cruise control servo cable adjuster assembly, if equipped. Refer to SECTION 5E2.
4. Secondary air injection pipe fitting to exhaust manifold assembly. Refer to SECTION 6E3.
5. Secondary air injection hose to pump and check valve assembly.
6. Brake booster vacuum hose.

VALVE ROCKER ARMS AND PUSHROD ASSEMBLIES

Figure 10

Remove or Disconnect

1. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
2. Rocker arm nuts (31) and rocker arm balls (30).
3. Rocker arms (29) and pushrod assemblies (27).
   - Place the rocker arms (29), rocker arm balls (30) and pushrod assemblies (27) in a rack so that they can be reinstalled in the same locations from which they were removed.

Important

- Refer to SECTION 6A3B for inspection of the rocker arms, studs and pushrod assemblies.

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

Important

- When installing rocker arms (29) and rocker arm balls (30), coat their bearing surfaces with prelube, GM P/N 1052365 or equivalent. Install these components and the pushrod assemblies (27) in the locations from which they were removed.

1. Pushrod assemblies (27). Make sure pushrod assemblies (27) seat in lifter sockets.
2. Rocker arms (29).
3. Rocker arm balls (30) and rocker arm nuts (31).

Tighten

- Rocker arm nuts (31) until all lash is eliminated.

Adjust

1. Turn crankshaft assembly until cast arrow on crankshaft hub is in 12 o'clock position and number 1 cylinder is in firing position (top dead center).
   - Watch number 1 cylinder valves as crankshaft hub arrow approaches 12 o'clock position. If a valve moves as the arrow moves to position, the engine is in number 6 cylinder firing position. Crankshaft assembly must then be turned one more time to reach number 1 cylinder firing position.
2. With engine in number 1 cylinder firing position, the following valves can be adjusted:
   - Exhaust 1, 3, 4, 8
   - Intake 1, 2, 5, 7
3. Back off rocker arm nut (31) until lash is felt in pushrod assembly (27). Then tighten rocker arm nut (31) until all lash is removed. Zero lash can be felt by moving pushrod assembly (27) up and down using thumb and forefinger until there is no more movement.
4. When all free play has been removed, tighten rocker arm nut (31) one additional turn.
5. Turn crankshaft assembly one revolution until hub arrow is again at 12 o'clock position. This is number 6 cylinder firing position. The following valves can now be adjusted:
   - Exhaust 2, 5, 6, 7
   - Intake 3, 4, 6, 8
6. Install valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.

ROCKER ARM STUDS

Figure 10

Rocker arm studs that have damaged threads should be replaced with new studs.

Remove or Disconnect

1. Valve rocker arm cover assembly. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
2. Valve rocker arm. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
3. Rocker arm stud (28).

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

1. Apply sealer, GM P/N 1052080 or equivalent, to threads of new rocker arm stud.
2. Rocker arm stud (28).

Tighten

- Rocker arm stud (28) to 68 N•m (50 lb. ft.).

3. Valve rocker arms. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
4. Valve rocker arm cover assembly. Refer to "Valve Rocker Arm Cover Assemblies" in this section.

VALVE LIFTER ASSEMBLIES

Figure 11

Tools Required:

J 3049 Hydraulic Valve Lifter Remover (Plier Type)

J 9290-01 Hydraulic Valve Lifter Remover (Slide Hammer Type)

No service parts are available for valve lifter assemblies. They are replaced as a unit when worn and when a new camshaft assembly is installed.

Remove or Disconnect

1. Intake manifold assembly. Refer to "Intake Manifold Assembly" in this section.
2. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
3. Valve rocker arms and pushrod assemblies. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
4. Valve lifter guide retainer (33) and bolts/screws (32).
5. Valve lifter guide (35) and valve lifter assembly (36).
   - Some valve lifter assemblies (36) may be stuck in their bores because of gum or varnish deposits. These valve lifter assemblies (36) can be removed using J 3049 or J 9290-01.

Important

- Refer to SECTION 6A3B for inspection of the valve lifter assemblies.

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

1. Coat valve lifter rollers with prelube, GM P/N 1052365 or equivalent.
2. Valve lifter assemblies (36) in the same location from which they were removed.
3. Valve lifter guides (35), valve lifter guide retainer (33) and bolts/screws (32).

Tighten

- Bolts/screws (32) to 25 N•m (18 lb. ft.).

4. Valve rocker arms and pushrod assemblies. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
5. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
6. Intake manifold assembly. Refer to "Intake Manifold Assembly" in this section.

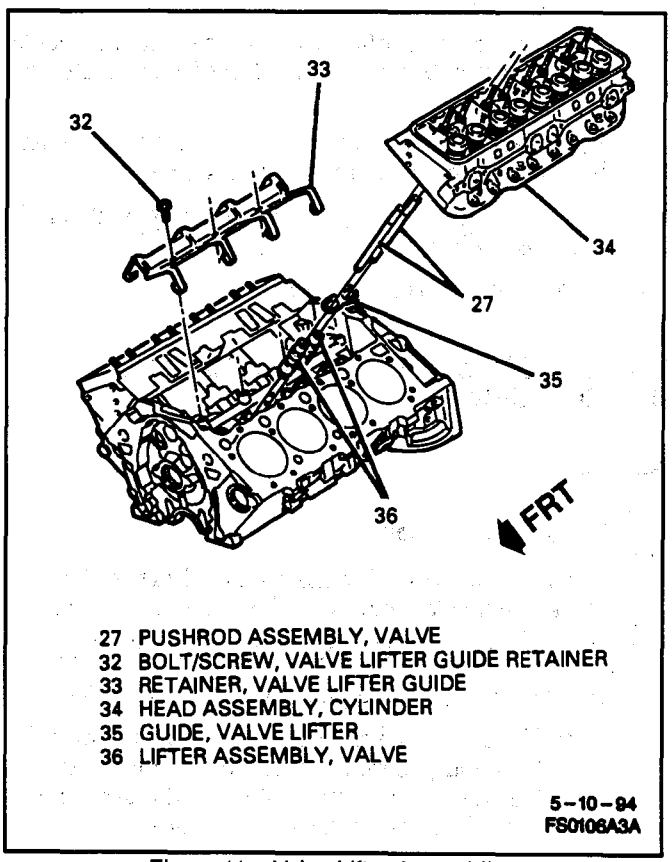


Figure 11 – Valve Lifter Assemblies

WATER PUMP ASSEMBLY

The water pump assembly is directly driven by the pump shaft which is coupled to a bearing, gear and shaft assembly driven by the camshaft sprocket. Refer to SECTION 6B for water pump assembly service procedures.

CRANKSHAFT BALANCER ASSEMBLY AND HUB

Figure 12

Tool Required:

J 39046 Crankshaft Hub Remover/Installer

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
3. Balancer bolts/screws (46) and balancer assembly (42).
4. Matchmark crankshaft hub (45) to engine front cover assembly.
   - Do not crank engine over after match-marking crankshaft hub and engine front cover assembly. Rotating crankshaft assembly will misalign installation of balancer assembly to crankshaft assembly possibly resulting in engine imbalance.
5. Crankshaft hub bolt/screw and washer.
6. Crankshaft hub (45) using J 39046.

The crankshaft hub (45) can be installed by a different procedure if the engine should accidentally be cranked over after matchmarking the hub and engine front cover assembly.

A. Set number 1 piston assembly to top dead center.

B. Install crankshaft hub (45) with cast arrow on hub in the 12 o'clock position.

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

1. Crankshaft hub (45) using J 39046.
2. Crankshaft hub washer and bolt/screw.
3. Crankshaft balancer assembly (42) and bolts/screws (46).

Important

- If balancer assembly is replaced, new balance weights of the same size must be installed on the new balancer assembly in the same hole locations as the old balancer assembly.

Tighten

- Crankshaft balancer hub bolt/screw to 100 N•m (74 lb. ft.).

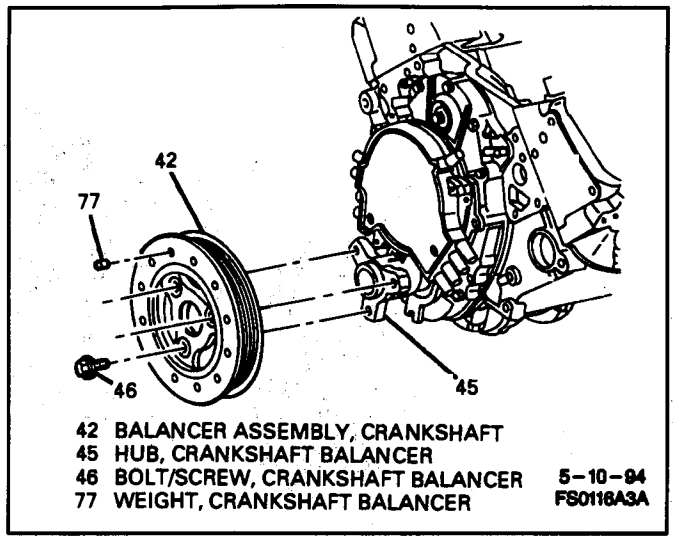


Figure 12 – Crankshaft Balancer Assembly and Hub

- Crankshaft balancer bolts/screws (46) to 85 N•m (63 lb. ft.).

4. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
5. Lower vehicle.

DISTRIBUTOR ASSEMBLY

The distributor assembly is mounted to the engine front cover assembly and driven by a pin connected to the camshaft sprocket. Refer to SECTION 6D4 for the distributor assembly service procedures.

ENGINE FRONT COVER ASSEMBLY

Figure 13

Tool Required:

J 39087 Driven Gear Shaft Front Cover Seal Protector

Remove or Disconnect

1. Throttle body air duct.
2. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
3. Water pump assembly. Refer to SECTION 6B.
4. Crankshaft balancer assembly and hub. Refer to "Crankshaft Balancer Assembly and Hub" in this section.
5. Distributor assembly. Refer to SECTION 6D4.
6. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
7. Engine front cover bolts/screws (52).
8. Engine front cover assembly (50) and gasket (51).

Clean

- Engine front cover and engine block gasket surfaces.

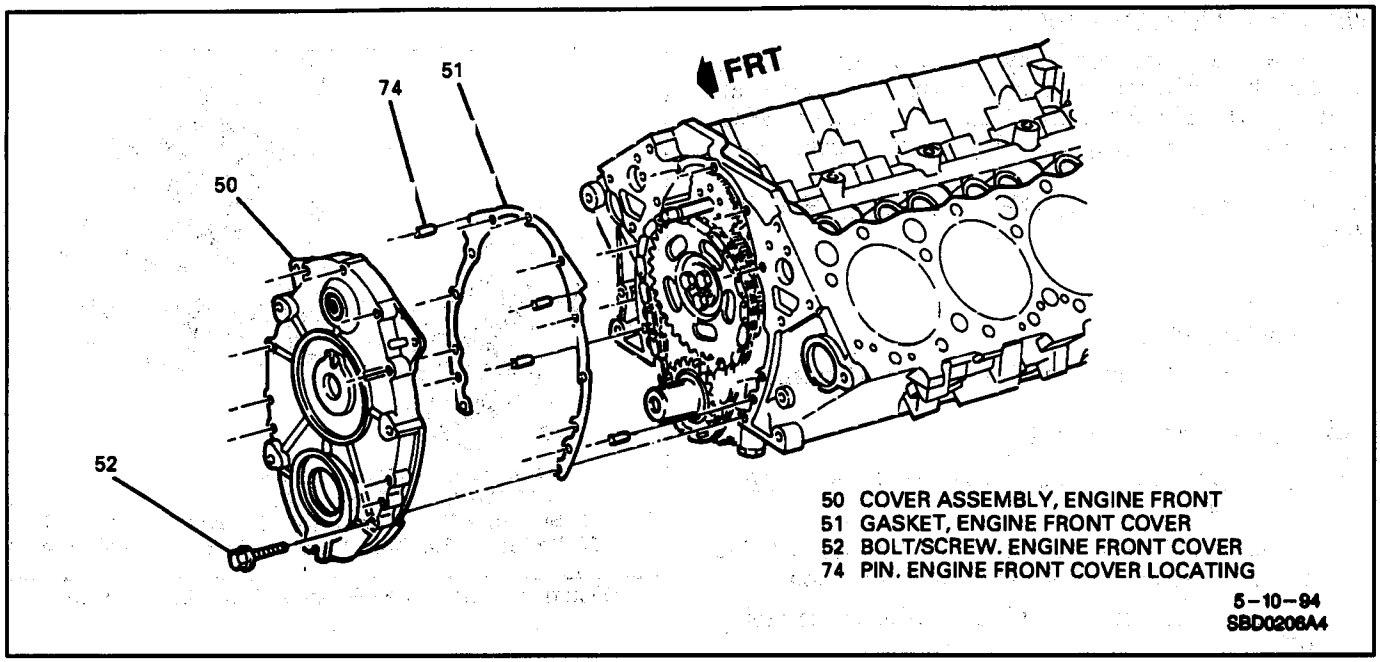


Figure 13 – Engine Front Cover Assembly

Inspect

- Engine front cover assembly (50) for damage to the seals or gasket surface. Refer to SECTION 6A3B to replace front cover seals if necessary.

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

NOTICE: Be careful not to damage the seal when installing the engine front cover assembly over the water pump driveshaft assembly.

1. Gasket (51) and engine front cover assembly (50) using J 39087 on water pump driveshaft assembly.
2. Engine front cover bolts/screws (52).

Tighten

- Engine front cover bolts/screws (52) to 11 N•m (97 lb. in.).

3. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
4. Distributor assembly. Refer to SECTION 6D4.
5. Crankshaft balancer assembly and hub. Refer to "Crankshaft Balancer Assembly and Hub" in this section.
6. Water pump assembly. Refer to SECTION 6B.
7. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
8. Throttle body air duct.

TIMING CHAIN ASSEMBLY, CRANKSHAFT AND CAMSHAFT SPROCKETS, AND WATER PUMP DRIVESHAFT ASSEMBLY

Figures 14 and 15

Tools Required:

- J 5825-A Crankshaft Gear Remover
- J 5590 Crankshaft Gear Installer
- J 39243 Driven Gear Assembly Remover
- J 39092 Driven Gear Assembly Installer
- J 39087 Driven Gear Shaft Front Cover Seal Protector
- J 39089 Driven Gear/Water Pump Shaft Seal Installer

Remove or Disconnect

1. Engine front cover assembly. Refer to "Engine Front Cover Assembly" in this section.
2. Rotate crankshaft assembly until timing marks punched on crankshaft sprocket (62) and camshaft sprocket (57) are aligned as shown in Figure 14.
3. Camshaft sprocket bolts/screws (56).
4. Camshaft sprocket (57) and timing chain assembly (61).

NOTICE: Do not turn the crankshaft assembly after the timing chain has been removed to prevent damage to piston assemblies or valves.

5. Water pump bearing retainer bolts/screws (64) and water pump driveshaft assembly (63) using J 39243.
   - Remove and discard O-ring from water pump driveshaft assembly (63).
6. Crankshaft sprocket (62) using J 5825-A.

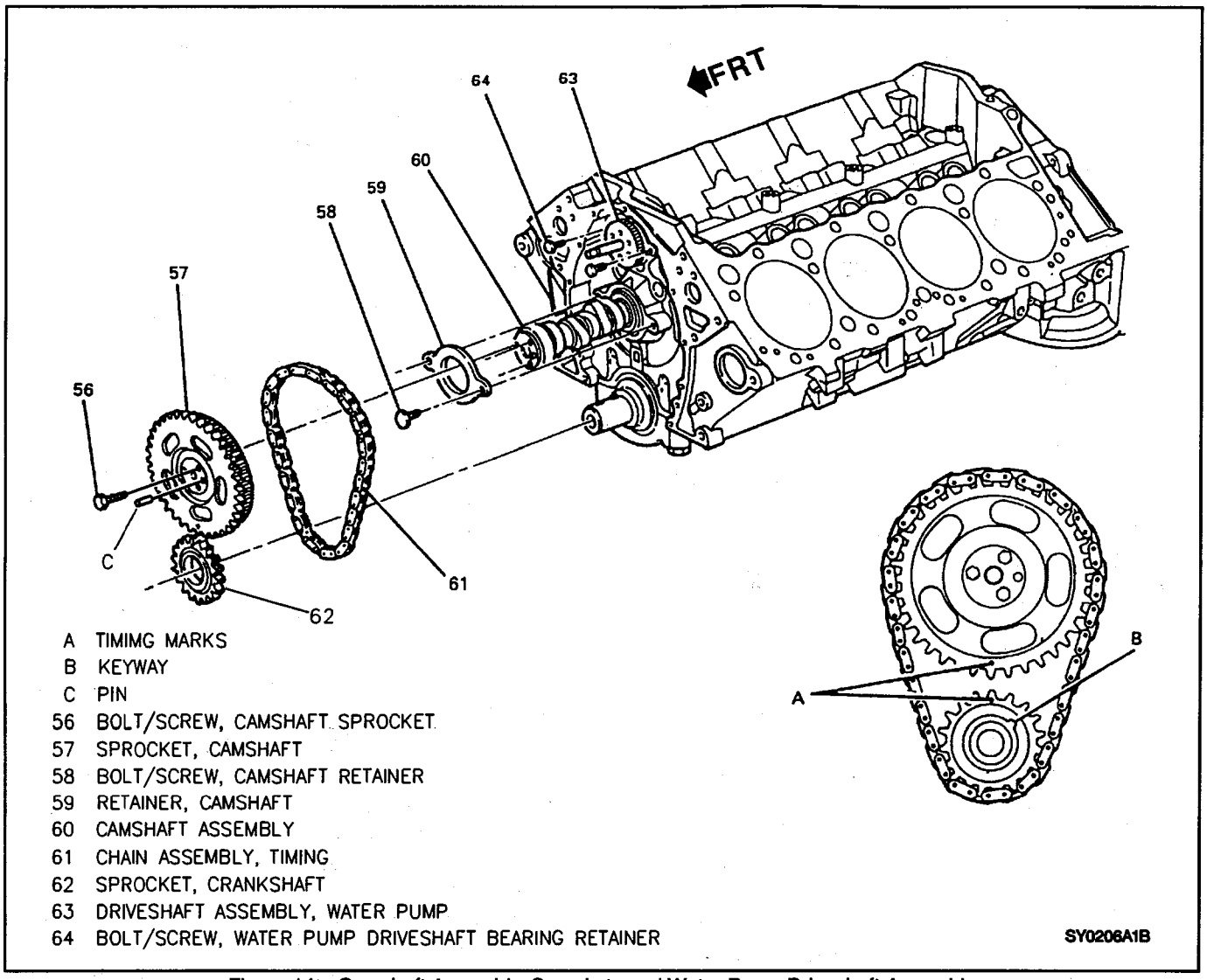


Figure 14 – Camshaft Assembly, Sprockets and Water Pump Driveshaft Assembly

7. Key, if necessary.

Inspect

- Refer to SECTION 6A3B for component inspection.

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

1. Key, if previously removed.
2. Crankshaft sprocket (62) using J 5590.
3. Water pump driveshaft assembly (63) using J 39092.
4. Water pump bearing retainer bolts/screws (64).

Tighten

- Water pump bearing retainer bolts/screws (64) to 12 N•m (105 lb. in.).

5. Camshaft sprocket (57) and timing chain assembly (61).
   - Camshaft sprocket and water pump driveshaft gears must mesh, or damage to camshaft retainer (59) could occur.
6. Camshaft sprocket bolts/screws (56).
   - Make sure that camshaft and crankshaft timing marks align as shown in Figure 14.

Tighten

- Camshaft sprocket bolts/screws (56) to 25 N•m (18 lb. ft.).

7. New O-ring to water pump driveshaft assembly using J 39089.
8. Engine front cover assembly. Refer to "Engine Front Cover Assembly" in this section.

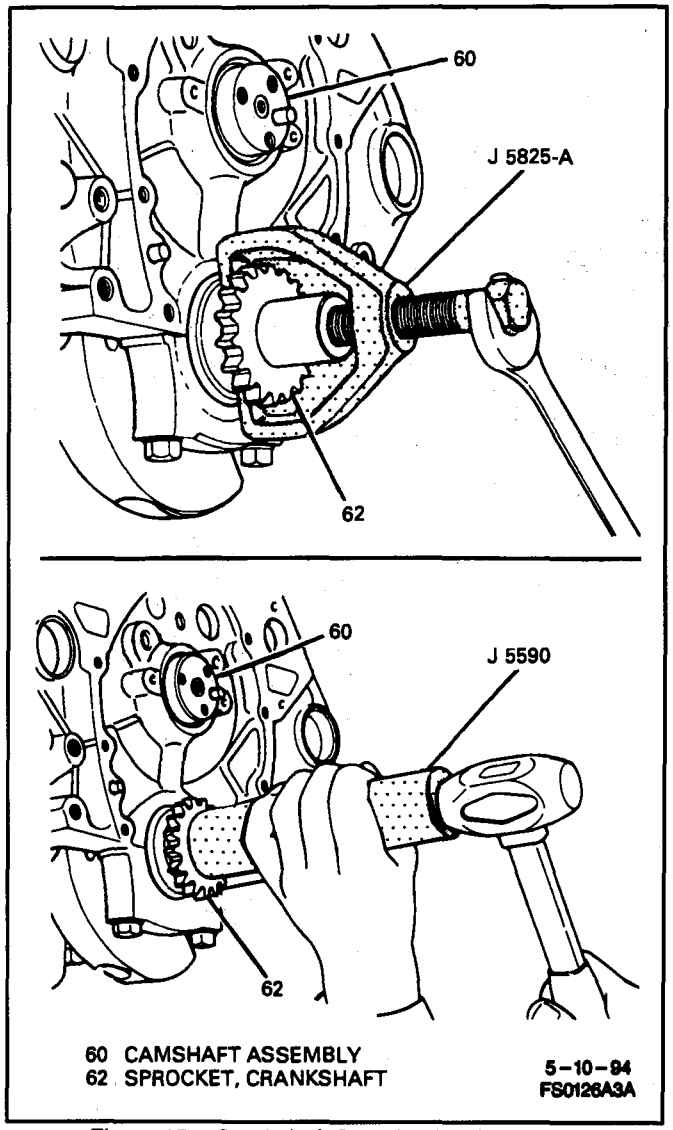


Figure 15 – Crankshaft Sprocket Replacement

CAMSHAFT ASSEMBLY

Figures 14, 16 and 17

Remove or Disconnect

1. Intake manifold assembly. Refer to "Intake Manifold Assembly" in this section.
2. Valve rocker arms and pushrod assemblies. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
3. Bolt/screw (66) and oil pump driveshaft assembly (65).
4. Engine front cover assembly. Refer to "Engine Front Cover Assembly" in this section.
5. Camshaft sprocket. Refer to "Timing Chain Assembly, Crankshaft and Camshaft Sprockets, and Water Pump Driveshaft Assembly" in this section.

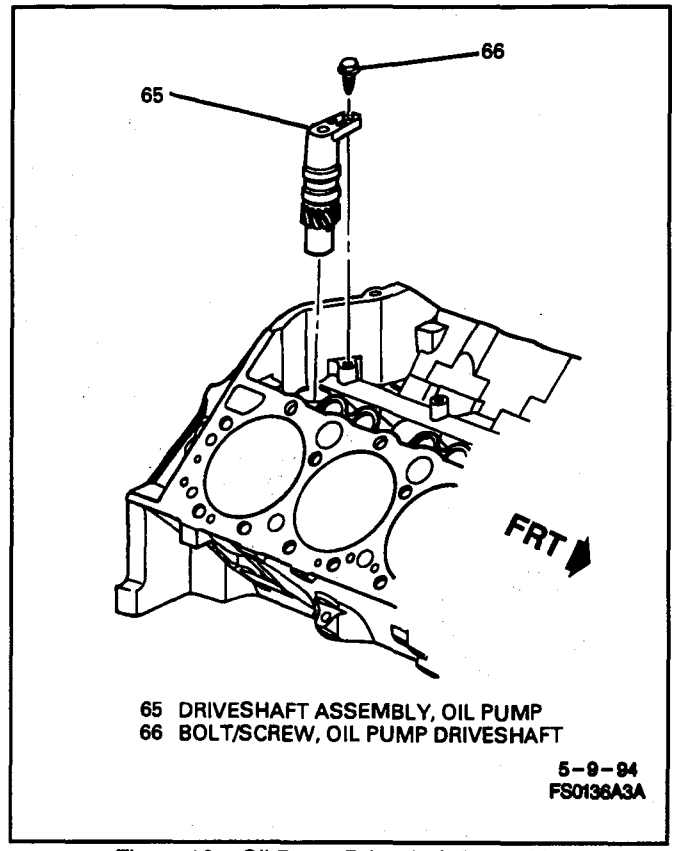


Figure 16 – Oil Pump Driveshaft Assembly

6. Valve lifter assemblies. Refer to "Valve Lifter Assemblies" in this section.
7. Discharge air conditioning system. Refer to SECTION 1B.
8. Air conditioning compressor and condenser hose from condenser.
9. Air conditioning receiver and dehydrator hose from condenser.
10. Radiator assembly with air conditioning condenser. Refer to SECTION 6B.
11. Air conditioning condenser support assembly.
12. Camshaft retainer bolts/screws (58) and camshaft retainer (59).

    NOTICE: All camshaft journals are the same diameter so care must be used in removing the camshaft to avoid damage to the bearings.
13. Camshaft assembly (60).
    A. Install three 5/16-18 x 4-inch bolts/screws in camshaft bolt holes.
    B. Carefully rotate and pull camshaft assembly out of bearings.

Important

- Refer to "Cleaning, Inspection and Repair" in SECTION 6A3B for inspection and measurement procedures for the camshaft assembly.
- Refer to "Valve Rocker Arms and Pushrod Assemblies" in SECTION 6A3B to measure camshaft lobe lift.

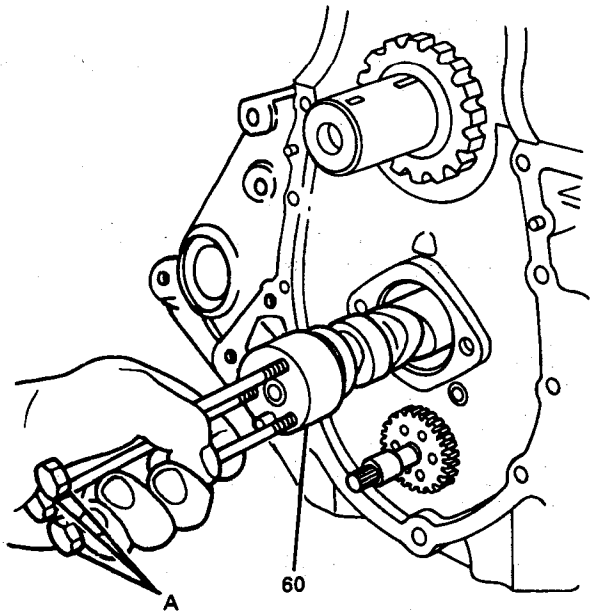


Figure 17 – Removing Camshaft Assembly

Inspect

- Camshaft bearings for scratches, pits, or loose fit in their bores. Replace the camshaft bearings, if necessary. Refer to SECTION 6A3B.

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

1. When installing a new camshaft assembly (60), coat camshaft lobes with "Molykote" or its equivalent.
2. When installing a new camshaft assembly (60), replace all valve lifter assemblies to ensure durability of the camshaft lobes and lifter rollers.
3. Lubricate all camshaft journals with engine oil.
4. Camshaft assembly (60).
5. Camshaft retainer (59) and camshaft retainer bolts/screws (58).

Tighten

- Camshaft retainer bolts/screws (58) to 12 N•m (105 lb. in.).

6. Air conditioning condenser support assembly.
7. Radiator assembly with air conditioning condenser. Refer to SECTION 6B.
8. Air conditioning receiver and dehydrator hose to condenser.
9. Air conditioning compressor and condenser hose to condenser.
10. Charge air conditioning system. Refer to SECTION 1B.
11. Valve lifter assemblies. Refer to "Valve Lifter Assemblies" in this section.
12. Camshaft sprocket. Refer to "Timing Chain Assembly, Crankshaft and Camshaft Sprockets, and Water Pump Driveshaft Assembly" in this section.
13. Engine front cover assembly. Refer to "Engine Front Cover Assembly" in this section.
14. Oil pump driveshaft assembly (65) and bolt/screw (66).

Tighten

- Bolt/screw (66) to 18 N•m (13 lb. ft.).

15. Valve rocker arms and pushrod assemblies. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
16. Intake manifold assembly. Refer to "Intake Manifold Assembly" in this section.

VALVE SPRING AND STEM SEAL

Figures 18, 19 and 20

Tools Required:

J 22794 Spark Plug Port Adapter

J 5892-C Valve Spring Compressor (Head-On)

Remove or Disconnect

1. Valve rocker arms and pushrod assemblies at cylinder to be serviced. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
2. Spark plug at cylinder to be serviced.
3. Install J 22794 to spark plug hole and apply compressed air to hold valves in place.
4. Compress valve spring (69) using J 5892-C (Figure 18).
5. Valve stem keys (72).
6. Valve spring cap (70).
7. Valve spring (69).
8. Valve stem oil seal (73).

Install or Connect

1. Valve stem oil seal (73) and seat seal against valve spring shim (76).
2. Valve spring (69).
3. Valve spring cap (70).
4. Compress valve spring (69) using J 5892-C.

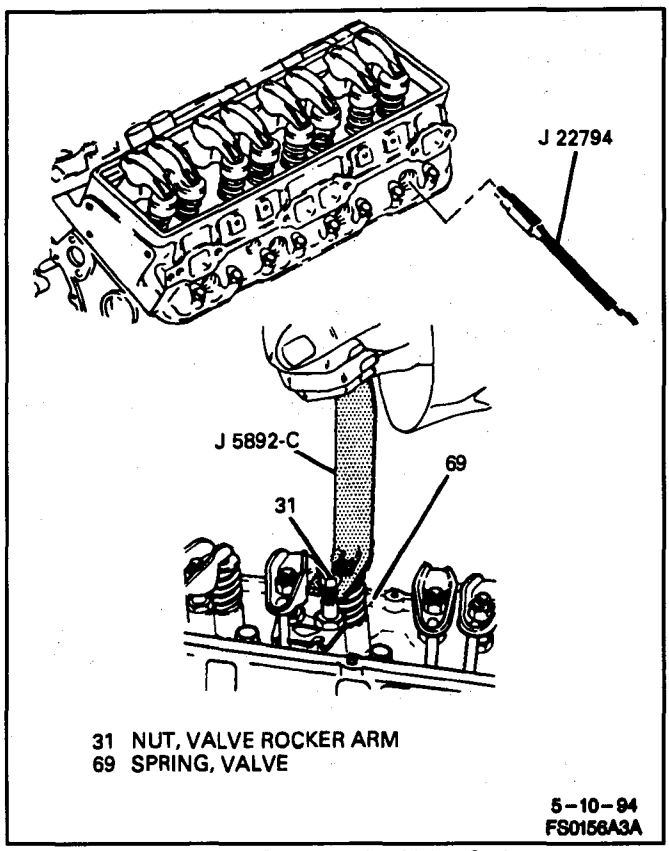


Figure 18 – Compressing Valve Spring

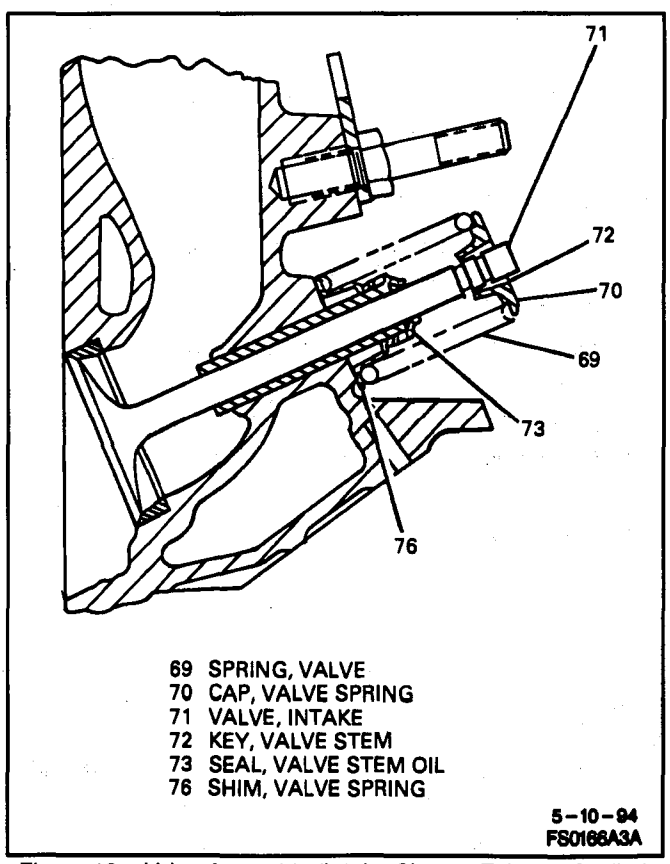


Figure 19 – Valve Assembly (Intake Shown, Exhaust Similar)

5. Valve stem keys (72).
   A. Use grease to hold keys in place while disconnecting J 5892-C.
   B. Remove J 22794.
   C. Make sure keys seat properly in upper groove of valve stem.
   D. Tap end of stem with plastic-faced hammer to seat keys, if necessary.
6. Spark plug.

Tighten

- Spark plug to 15 N•m (11 lb. ft.).

7. Valve rocker arms and pushrod assemblies. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.

CYLINDER HEAD ASSEMBLY AND GASKET

Figure 20

Left Cylinder Head Assembly

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Drain coolant. Refer to SECTION 6B.
3. Crossover pipe from exhaust manifold assembly. Refer to SECTION 6F.
4. Lower vehicle.
5. Intake manifold assembly. Refer to "Intake Manifold Assembly" in this section.
6. Secondary air injection hose from check valve assembly.
7. Coolant air bleed pipe bolt/screw from left cylinder head assembly using a backup wrench on pipe fitting.
8. Ignition coil bolts/screws and coil assembly. Refer to SECTION 6D4.
9. Left exhaust manifold assembly. Refer to"Exhaust Manifold Assemblies" in this section.
10. Spark plug wire harness assembly from clips.
11. Spark plug wire harness assembly from spark plugs.
12. Spark plugs.
13. Coolant temperature sensor connector.
14. Rocker arm cover bolts/screws and cover assembly. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
15. Rocker arm nuts, rocker arms, and pushrod assemblies. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
16. Cylinder head bolts/screws (81).
17. Cylinder head assembly (34) and cylinder head gasket (82).
    - Discard cylinder head gasket (82).

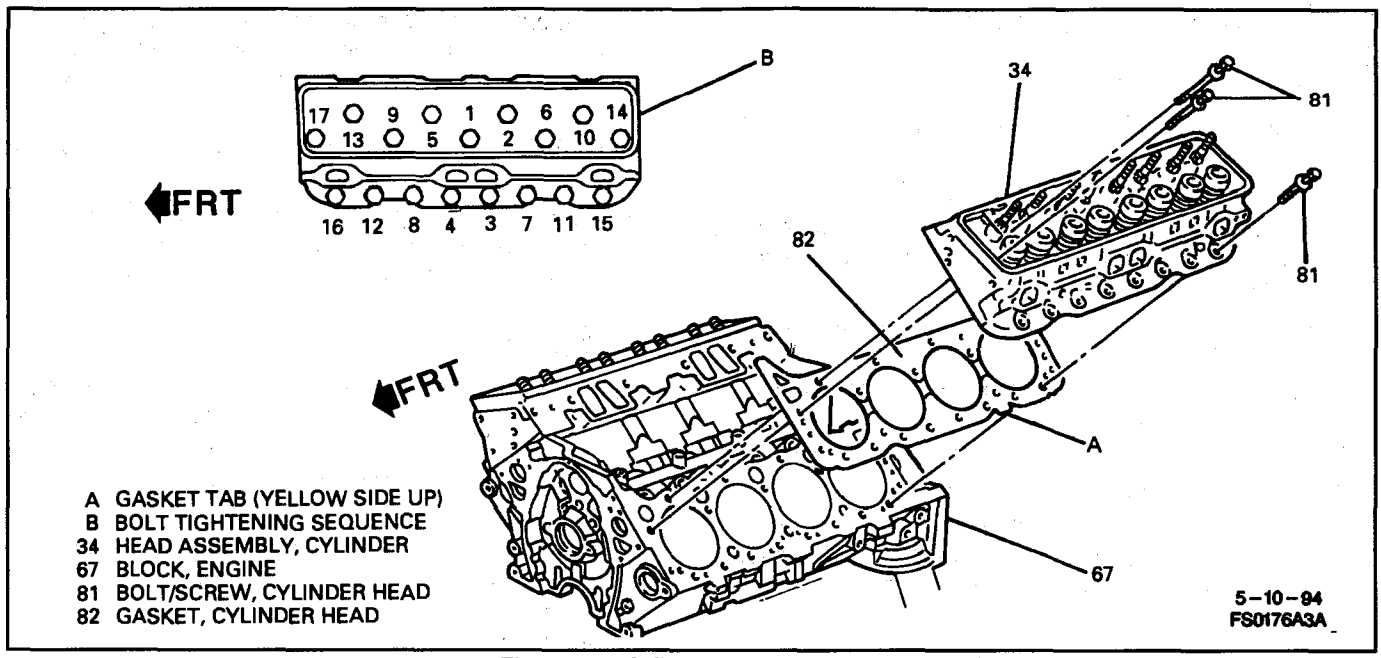


Figure 20 – Cylinder Head Assembly

Important

- Refer to SECTION 6A3B for cylinder head assembly cleaning, inspection and repair.

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

1. New cylinder head gasket (82) with yellow tab facing up.
2. Cylinder head assembly (34) over locator pins and cylinder head gasket (82).
3. Coat threads of cylinder head bolts/screws (81) with sealing compound, GM P/N 1052080 or equivalent.
4. Cylinder head bolts/screws (81) finger tight.

Tighten

- Cylinder head bolts/screws (81) in sequence and in three passes to 88 N•m (65 lb. ft.) (Figure 20).

5. Pushrod assemblies and valve rocker arms. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
6. Right valve rocker arm cover assembly and bolts/screws.

Tighten

- Valve rocker arm cover bolts/screws to 12 N•m (106 lb. in.).

7. Coolant temperature sensor connector.
8. Spark plugs.

Tighten

- Spark plugs to 15 N•m (11 lb. ft.).

9. Spark plug wire harness assembly to spark plugs.
10. Spark plug wire harness assembly to clips.
11. Left exhaust manifold assembly. Refer to "Exhaust Manifold Assemblies" in this section.
12. Ignition coil bolts/screws and coil assembly.

Tighten

- Ignition coil studs to 40 N•m (30 lb. ft.).

13. Engine coolant air bleed pipe and bolt/screw to left cylinder head assembly using a backup wrench on pipe fitting.

Tighten

- Engine coolant air bleed pipe bolt/screw to 40 N•m (30 lb. ft.).

14. Secondary air injection hose to check valve assembly.
15. Intake manifold assembly. Refer to "Intake Manifold Assembly" in this section.
16. Raise and suitably support vehicle. Refer to SECTION 0A.
17. Crossover pipe to exhaust manifold assembly. Refer to SECTION 6F.
18. Lower vehicle.
19. Refill with coolant. Refer to SECTION 6B.

Right Cylinder Head Assembly

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Drain coolant. Refer to SECTION 6B.
3. Serpentine drive belt and belt tensioner assembly. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
4. Transmission fluid level indicator tube assembly bracket from transmission housing.
5. Air conditioning compressor rear brace bolt/screw from engine block.
6. Air conditioning compressor electrical connector.
7. Air conditioning compressor front mounting bolts/screws and lay air conditioning compressor aside.
8. Right exhaust manifold assembly. Refer to "Exhaust Manifold Assemblies" in this section.
9. Lower vehicle.
10. Generator assembly. Refer to SECTION 6D3.
11. Right valve rocker arm cover assembly. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
12. Intake manifold assembly. Refer to "Intake Manifold Assembly" in this section.
13. Coolant air bleed pipe bolt/screw from left cylinder head assembly.
14. Lower radiator hose from water pump assembly and reposition.
15. Heater hose from water pump assembly and reposition.
16. Coolant air bleed pipe assembly hose from radiator.
17. Power steering pump assembly. Refer to SECTION 3B.
18. Generator bracket bolts/screws and generator and air conditioning compressor and power steering pump bracket assembly.
19. Spark plug wire harness assembly from spark plugs.
20. Spark plugs.
21. Valve rocker arms and pushrod assemblies. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
22. Cylinder head bolts/screws (81).
23. Cylinder head assembly (34) and gasket (82).
    - Discard gasket (82).
24. Coolant air bleed pipe bolt/screw and pipe assembly from cylinder head assembly.

Important

- Refer to SECTION 6A3B for cylinder head assembly cleaning, inspection and repair.

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

1. Coolant air bleed pipe assembly and bolt/screw to cylinder head assembly using backup wrench.
2. New cylinder head gasket (82) with yellow tab facing up.
3. Cylinder head assembly (34) over dowel pins and gasket (82).
4. Coat threads of cylinder head bolts/screws (81) with sealing compound, GM P/N 1052080 or equivalent.
5. Cylinder head bolts/screws (81) finger tight.

Tighten

- Cylinder head bolts/screws (81) in sequence and in three passes to 88 N•m (65 lb. ft.) (Figure 20).
- Engine coolant air bleed pipe bolt/screw to 40 N•m (30 lb. ft.).

6. Pushrod assemblies and valve rocker arms. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
7. Spark plugs.

Tighten

- Spark plugs to 15 N•m (11 lb. ft.).

8. Spark plug wire harness assembly to spark plugs.
9. Generator and air conditioning compressor and power steering pump bracket assembly and generator bracket bolts/screws.

Tighten

- Generator bracket bolts/screws to 40 N•m (30 lb. ft.).

10. Right valve rocker arm cover assembly. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
11. Generator assembly. Refer to SECTION 6D3.
12. Power steering pump assembly. Refer to SECTION 3B.
13. Coolant air bleed pipe assembly hose to radiator.
14. Heater hose to water pump assembly and reposition.
15. Lower radiator hose to water pump assembly.
16. Coolant air bleed pipe bolt/screw to left cylinder head assembly using backup wrench.

Tighten

- Engine coolant air bleed pipe bolt/screw to 40 N•m (30 lb. ft.).

17. Intake manifold assembly. Refer to "Intake Manifold Assembly" in this section.
18. Raise and suitably support vehicle. Refer to SECTION 0A.
19. Right exhaust manifold assembly. Refer to "Exhaust Manifold Assemblies" in this section.
20. Air conditioning compressor front mounting bolts/screws.
21. Air conditioning compressor electrical connector.

22. Air conditioning compressor rear brace bolt/screw to engine block.

Tighten

- Air conditioning compressor rear brace bolt/screw to 33 N•m (24 lb. ft.).

23. Transmission fluid level indicator tube assembly bracket to transmission housing.
24. Serpentine drive belt and belt tensioner assembly. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
25. Lower vehicle.
26. Refill with coolant. Refer to SECTION 6B.

ENGINE OIL COOLER AND HOSE ASSEMBLY

Figure 21

Remove or Disconnect

1. Drain coolant.
2. Drain engine oil.
3. Oil filter assembly (144).
4. Engine oil cooler bolt/screw (140) from engine oil cooler hose assembly manifold fitting and oil cooler assembly (141).
5. Nut from engine oil cooler hose bracket.
6. Engine oil cooler hose assembly clamps from radiator and water pump assemblies.
7. Engine oil cooler hose assembly (129).
8. Engine oil cooler through bolt/screw (153) and oil cooler assembly (141) from oil filter adapter assembly (142).

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

1. Engine oil cooler through bolt/screw (153) and oil cooler assembly (141) to oil filter adapter assembly (142).

Tighten

- Engine oil cooler through bolt/screw (153) to 35 N•m (26 lb. ft.).

2. Engine oil cooler hose assembly (129) and clamps to radiator and water pump assemblies.
3. Engine oil cooler bolt/screw (140) to engine oil cooler assembly (141).

Important

- When servicing engine oil cooler assembly components always discard old seals and replace with new seals.

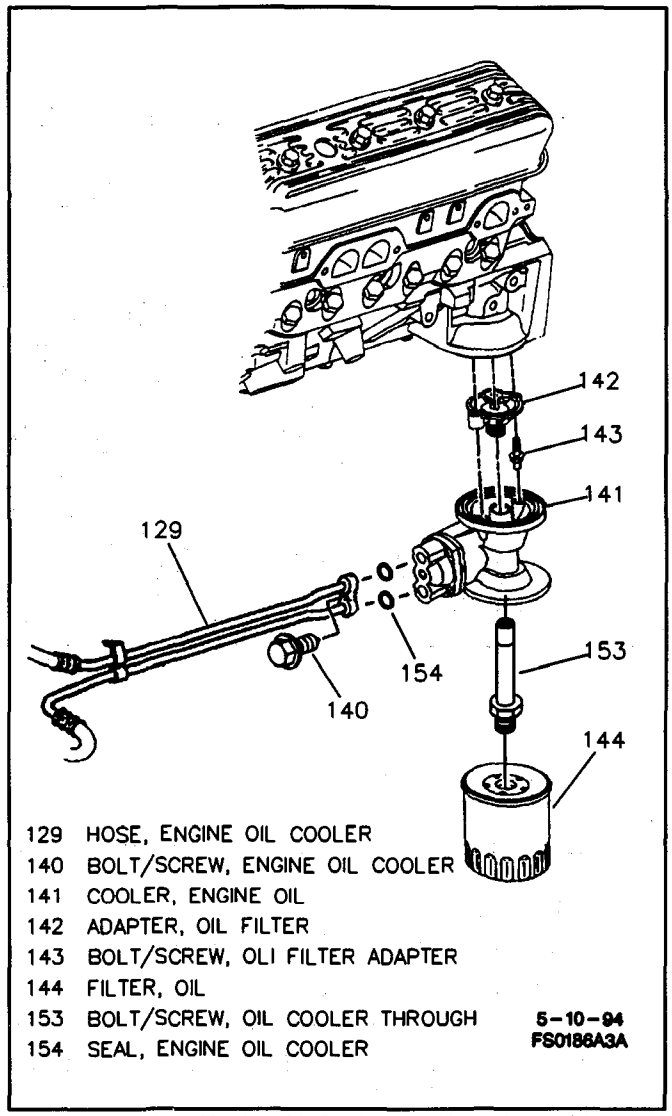


Figure 21 – Engine Oil Cooler and Hose Assembly

Tighten

- Engine oil cooler bolt/screw to 33 N•m (24 lb. ft.).

4. Engine oil cooler hose bracket nut.

Tighten

- Engine oil cooler hose bracket nut to 17 N•m (13 lb. ft.).

5. Oil filter assembly (144).
6. Refill engine with oil.
7. Refill coolant. Refer to SECTION 6B.

OIL PAN ASSEMBLY

Figures 22 and 23

Remove or Disconnect

CAUTION: See "Caution" on page 6A3A-1 of this section.

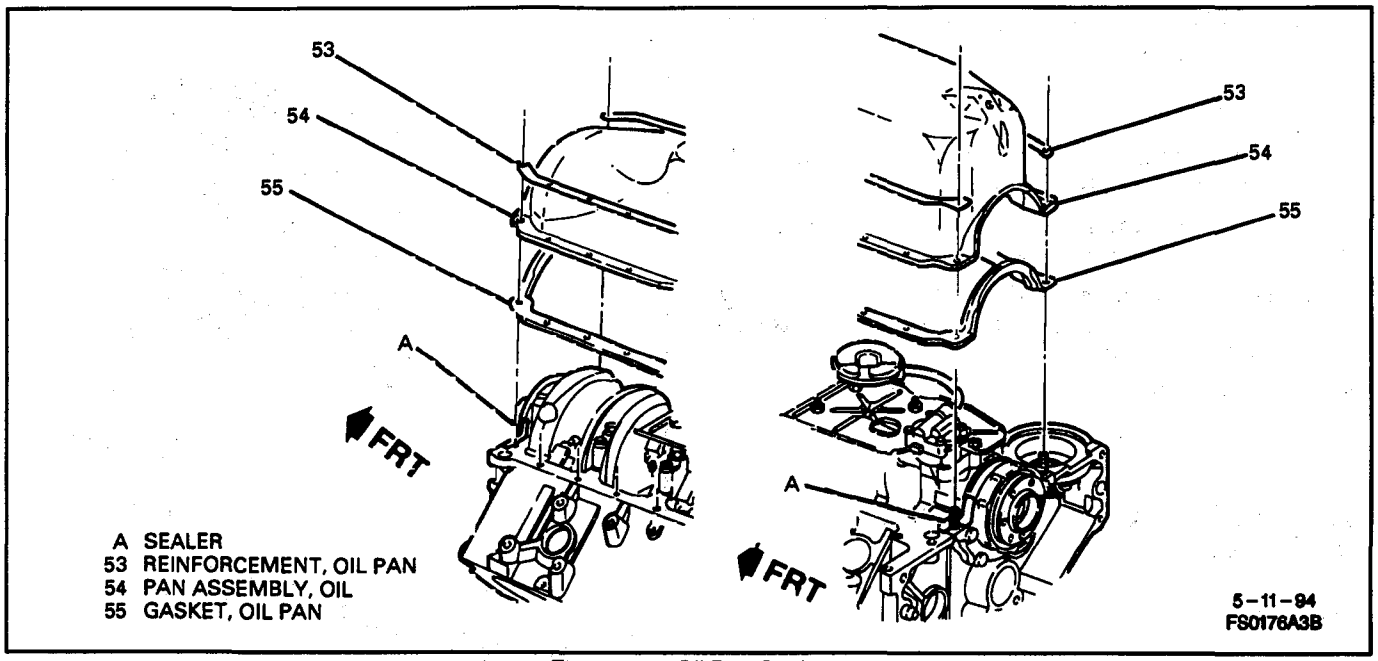


Figure 22 – Oil Pan Sealer

1. Battery negative cable assembly.
2. Air intake duct.
3. Raise and suitably support vehicle. Refer to SECTION 0A.
4. Drain engine oil.
5. Drain coolant. Refer to SECTION 6B.
6. Oil level sensor connector.
7. Oil level sensor assembly (178).
8. Exhaust crossover pipes from exhaust manifold assemblies. Refer to SECTION 6F.
9. Exhaust pipe hanger bolt/screw and reposition pipe.
10. Engine oil cooler hose bracket nut from oil pan assembly.
11. Engine oil cooler bolt/screw from engine oil cooler assembly and reposition engine oil cooler hose assembly.
12. Transmission fluid cooler lines from clip at oil pan assembly (automatic transmission).
13. Starter motor assembly. Refer to SECTION 6D2.
14. Converter cover bolts/screws and cover (automatic transmission).
15. Engine mount through-bolts/screws.
16. Raise engine with jacking fixture.
17. Oil pan bolts/screws (84), studs (83) and nuts (85).
18. Oil pan assembly (54), reinforcements (53) and gasket (55).
    - Rotate crankshaft assembly to reposition counterweights if necessary.

Clean

1. Oil pan and engine block gasket surfaces.
2. Apply a small amount of sealer, GM P/N 1052914 or equivalent, to the front cover assembly and engine block junction and to the rear oil seal housing and engine block junction. Apply sealer 25 mm (1 inch) in either direction of the radius cavity of these junctions. See Figure 22.

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

1. Oil pan gasket (55), oil pan assembly (54) and reinforcements (53).
2. Oil pan nuts (85), bolts/screws (84) and studs (83).

Tighten

- Corner oil pan bolts/screws (84) or stud (83), and nuts (85) to 20 N•m (15 lb. ft.).
- Remainder of oil pan bolts/screws (84) and studs (83) to 11 N•m (100 lb. in.).

3. Lower engine.
4. Engine mount through-bolts/screws.
5. Oil level sensor assembly (178).

Tighten

- Engine mount through-bolts/screws to 95 N•m (70 lb. ft.).
- Engine oil level sensor assembly (178) to 22 N•m (16 lb. ft.).

6. Converter cover and bolts/screws (automatic transmission).
7. Starter motor assembly. Refer to SECTION 6D2.
8. Transmission fluid cooler lines to clip at oil pan assembly (automatic transmission).

9. Engine oil cooler bolt/screw to engine oil cooler assembly.

Tighten

- Engine oil cooler bolt/screw to 33 N•m (24 lb. ft.).

10. Engine oil cooler hose bracket nut to oil pan assembly.
11. Exhaust pipe hanger bolt/screw.
12. Exhaust crossover pipes to exhaust manifold assemblies. Refer to SECTION 6F.
13. Oil level sensor connector.
14. Lower vehicle.
15. Air intake duct.
16. Battery negative cable assembly.
17. Refill engine with oil.
18. Refill with coolant. Refer to SECTION 6B.

OIL PUMP ASSEMBLY

Figure 24

Remove or Disconnect

1. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
2. Oil pan baffle nuts.
3. Bolt/screw (120) attaching oil pump assembly (118) to rear crankshaft bearing cap.
4. Oil pan baffle (119), oil pump assembly (118) and driveshaft (89) and retainer (95).

Important

- Refer to SECTION 6A3B for oil pump assembly cleaning, inspection and repair.

Install or Connect

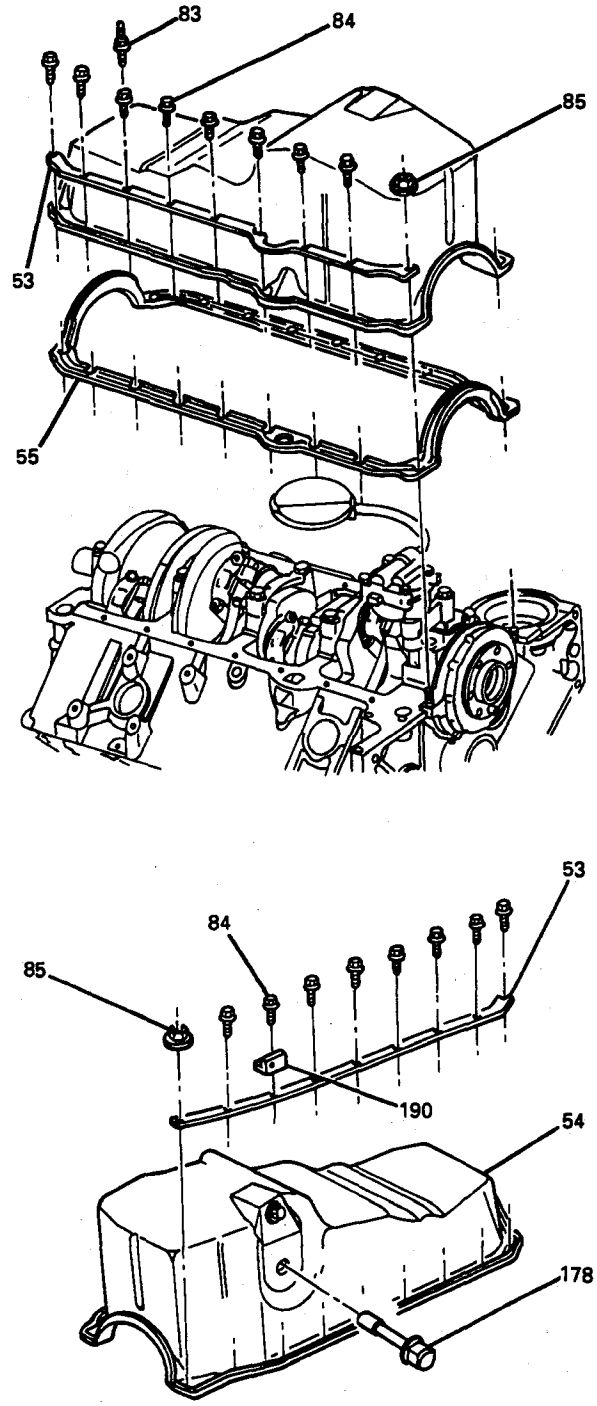
NOTICE: See "Notice" on page 6A3A-1 of this section.

1. Oil pump assembly (118), and driveshaft (89) with retainer (95).
   - Align slot on end of driveshaft (89) with drive tang on oil pump assembly (118).
2. Oil pan baffle (119).
3. Bolt/screw (120) attaching oil pump assembly (118) to rear crankshaft bearing cap.
4. Oil pan baffle nuts.

Tighten

- Bolt/screw (120) to 90 N•m (66 lb. ft.).
- Oil pan baffle nuts to 40 N•m (30 lb. ft.).

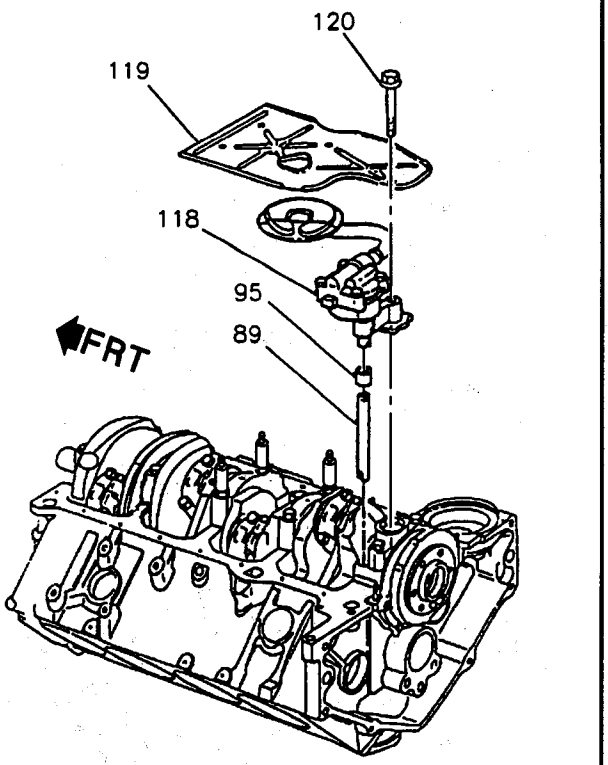
5. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.



53 REINFORCEMENT, OIL PAN
54 PAN ASSEMBLY, OIL
55 GASKET, OIL PAN
83 STUD, OIL PAN
84 BOLT/SCREW, OIL PAN
85 NUT, OIL PAN
178 SENSOR ASSEMBLY, ENGINE OIL LEVEL SWITCH
190 BRACKET, ENGINE WIRING HARNESS

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Figure 23 – Oil Pan Assembly



89 DRIVESHAFT, OIL PUMP
95 RETAINER, OIL PUMP DRIVESHAFT
118 PUMP ASSEMBLY, OIL
119 BAFFLE, OIL PAN
120 BOLT/SCREW, OIL PUMP

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Figure 24 – Oil Pump Assembly

CONNECTING ROD BEARINGS

Figure 25

Connecting rod bearings are the precision insert type and do not use shims for adjustment. Do not file connecting rods or rod caps. If clearances are found to be excessive, a new bearing will be required. Service bearings are available in standard size and 0.001 and 0.002-inch undersize for use with new and used standard size crankshafts, and in 0.010 and 0.020-inch undersize for use with reconditioned crankshafts.

When removing a connecting rod cap, you may find a 0.010-inch undersize bearing. These are used in manufacturing for selective fitting.

Remove or Disconnect

1. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
2. Oil pump assembly. Refer to "Oil Pump Assembly" in this section.

Important

- Place matchmarks or numbers on connecting rod assemblies (104) and connecting rod caps (99). Connecting rod caps (99) must be assembled to their original connecting rod assemblies (104).

3. Connecting rod nuts (100).
4. Connecting rod cap (99) and bearings (101).
   - Keep bearings (101) with their original connecting rod assembly (104) and connecting rod cap (99) for reassembly.
   - Wipe oil from bearings (101) and crankpins.

Inspect

- Bearings (101) for excessive wear or damage.

Measure

NOTICE: See "Notice" on page 6A3A-1 of this section.

1. Crankpin for out-of-round and taper with a micrometer. Refer measurements to "Specifications" in this section.
   - If not within specifications, replace or recondition crankshaft assembly (98).
   - If installing new bearings (101), determine new bearing size from maximum crankpin diameter.
2. Bearing clearances, using gaging plastic.
   A. Place piece of gaging plastic the full width of bearing (101), (parallel to crankshaft assembly) onto crankpin.
      - Plastic gage should be positioned in middle of bearing (101). Bearing (101) is thickest in center and bearing clearance must be measured at this location.
   B. Install connecting rod cap (99) with bearing (101) onto connecting rod assembly (104).
   C. Install connecting rod nuts (100).

Tighten

- Connecting rod nuts (100), evenly, to 27 N•m (20 lb. ft.), + additional 55 degrees.

NOTICE: Do not turn the crankshaft assembly with the gaging plastic installed or the accuracy of the measurement will be affected.

   D. Remove connecting rod nuts (100) and connecting rod cap (99). The gaging plastic will be found adhering to either the connecting rod cap (99) or crankshaft journal. Leave the gaging plastic in place to measure it.
   E. Measure gaging plastic at its widest, using scale provided with gaging plastic. Refer measurements to "Specifications" in this section.
      - If clearance is greater than specified, select an undersize bearing (101) and re-measure clearance.

- If clearance cannot be brought to specifications, regrind crankpin. If crankpin is already at maximum undersize, replace crankshaft assembly (98).

F. Remove gaging plastic.

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

1. Coat inside surface of bearings (101) with engine oil.
2. Connecting rod cap (99) and bearings (101).
3. Connecting rod nuts (100).

Tighten

- Connecting rod nuts (100), evenly, to 27 N•m (20 lb. ft.) + additional 55 degrees.

Measure

- Connecting rod side clearance.

A. When all connecting rod bearings (101) have been installed, tap each connecting rod assembly (104) lightly parallel to crankpin to make sure they have clearance.

B. Measure side clearance between connecting rod caps (99) using a feeler gage, or dial indicator.

C. Rod side clearance should be 0.16 to 0.35 mm (0.006 to 0.014 inch).

4. Oil pump assembly. Refer to "Oil Pump Assembly" in this section.
5. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.

PISTON AND CONNECTING ROD ASSEMBLIES

Figure 25

Remove or Disconnect

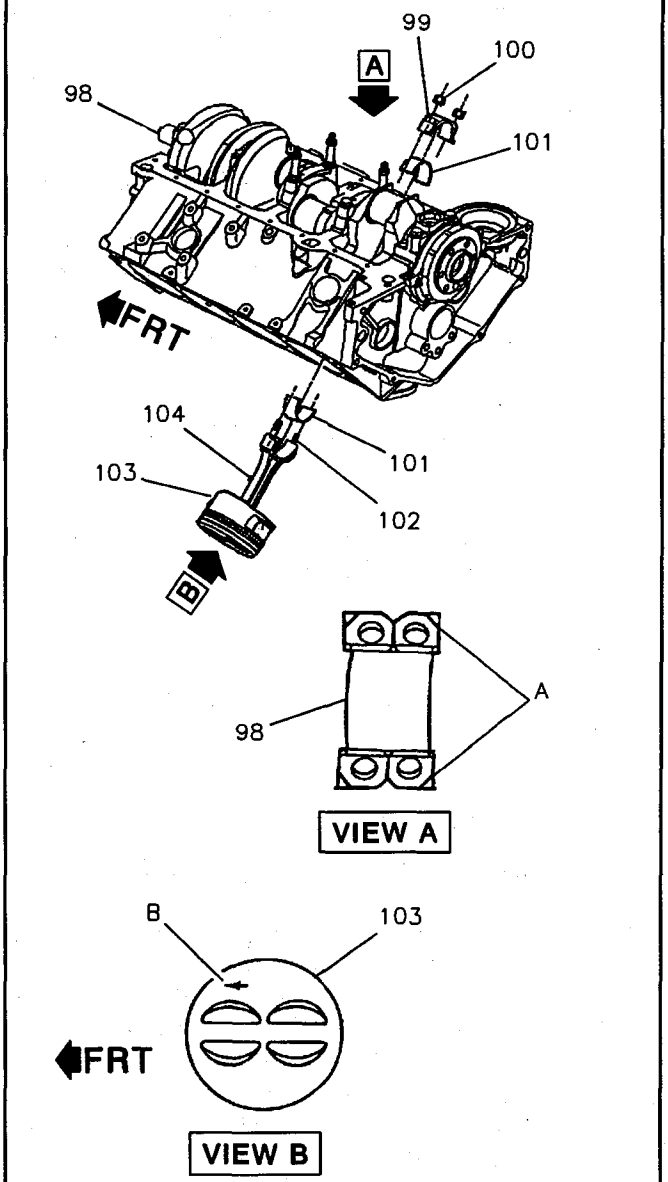
Tools Required:

J 8037 Piston Ring Compressor

J 5239 Connecting Rod Bolt Guide Set

1. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
2. Oil pump assembly. Refer to "Oil Pump Assembly" in this section.
3. Cylinder head assembly. Refer to "Cylinder Head Assembly and Gasket" in this section.
4. Ring ridge.

A. Turn crankshaft assembly (98) until piston assembly (103) is at bottom of its stroke.



A FLANGES OF CONNECTING RODS MUST FACE TO THE FRONT IN THE LEFT BANK AND TO THE REAR IN THE RIGHT BANK
B ARROW TO BE ORIENTED TO FRONT OF ENGINE
98 CRANKSHAFT ASSEMBLY
99 CAP, CONNECTING ROD
100 NUT, CONNECTING ROD
101 BEARING, CONNECTING ROD
102 BOLT/SCREW, CONNECTING ROD
103 PISTON ASSEMBLY
104 ROD ASSEMBLY, CONNECTING

SF0146A3B

Figure 25 – Piston and Connecting Rod Assemblies

B. Place a cloth on top of piston assembly (103).
C. Use a ridge reamer to remove ring ridge.
D. Turn crankshaft assembly (98) so piston assembly (103) is at top of its stroke.
E. Remove cloth and cutting debris.

Important

- Place matchmarks or numbers on connecting rod assemblies (104) and connecting rod caps (99). Connecting rod caps (99) must be assembled to their original connecting rod assemblies (104).

5. Connecting rod nuts (100) and connecting rod cap (99).
6. Connecting rod assembly (104) and piston assembly (103) out of top of engine block using J 5239.

Important

- Refer to SECTION 6A3B for cleaning, inspection and repair of the piston and connecting rod assembly.

Clean

1. Cylinder bores with hot water and detergent or with a light honing.
2. Swab bores with engine oil and a clean, dry cloth.

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

1. Coat piston assembly (103), piston rings, cylinder bore, and bearing surfaces with engine oil.
2. Piston assembly (103) into its original bore using J 5239 and J 8037 and lightly tapping top of piston assembly (103) with a wooden hammer handle.
   A. When installing piston assembly (103) and connecting rod assembly (104), stamped arrow on piston assembly (103) must point to front of engine while flange on connecting rod assembly (104) must face toward front of piston on left-hand assembly and face toward rear of piston on right-hand assembly. Refer to Figure 25.
   B. Hold J 8037 firmly against engine block until all piston rings have entered cylinder bore.
3. Connecting rod caps (99) onto their original connecting rod assemblies (104).
   - Align matchmarks or numbers which were placed on connecting rod assembly (104) and connecting rod cap (99) during removal.
4. Connecting rod nuts (100).

Tighten

- Connecting rod nuts (100), evenly, to 27 N•m (20 lb. ft.) + additional 55 degrees.

5. Cylinder head assembly. Refer to "Cylinder Head Assembly and Gasket" in this section.
6. Oil pump assembly. Refer to "Oil Pump Assembly" in this section.
7. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.

CRANKSHAFT BEARINGS

Figures 26 and 27

Tool Required:

J 8080 Main Bearing Shell Remover and Installer

Crankshaft bearings are of the precision insert type. If clearances are found to be excessive, a new bearing, both upper and lower halves, will be required. Service bearings are available in both standard size and undersize.

Selective fitting of both connecting rod and crankshaft bearing inserts is necessary in production in order to obtain close tolerances. For example, on a rear crankshaft bearing you may find one half of a standard insert with one half of a 0.001 inch undersize insert which will decrease the clearance 0.0005 inch from using a full standard bearing.

Important

- If replacing the rear crankshaft bearing, check for the correct part number. Some rear crankshaft bearings are 0.20 mm (0.008 inch) wider than standard. The crankshaft assembly will be identified by "0.008" stamped on the rear counterweight.

Remove or Disconnect

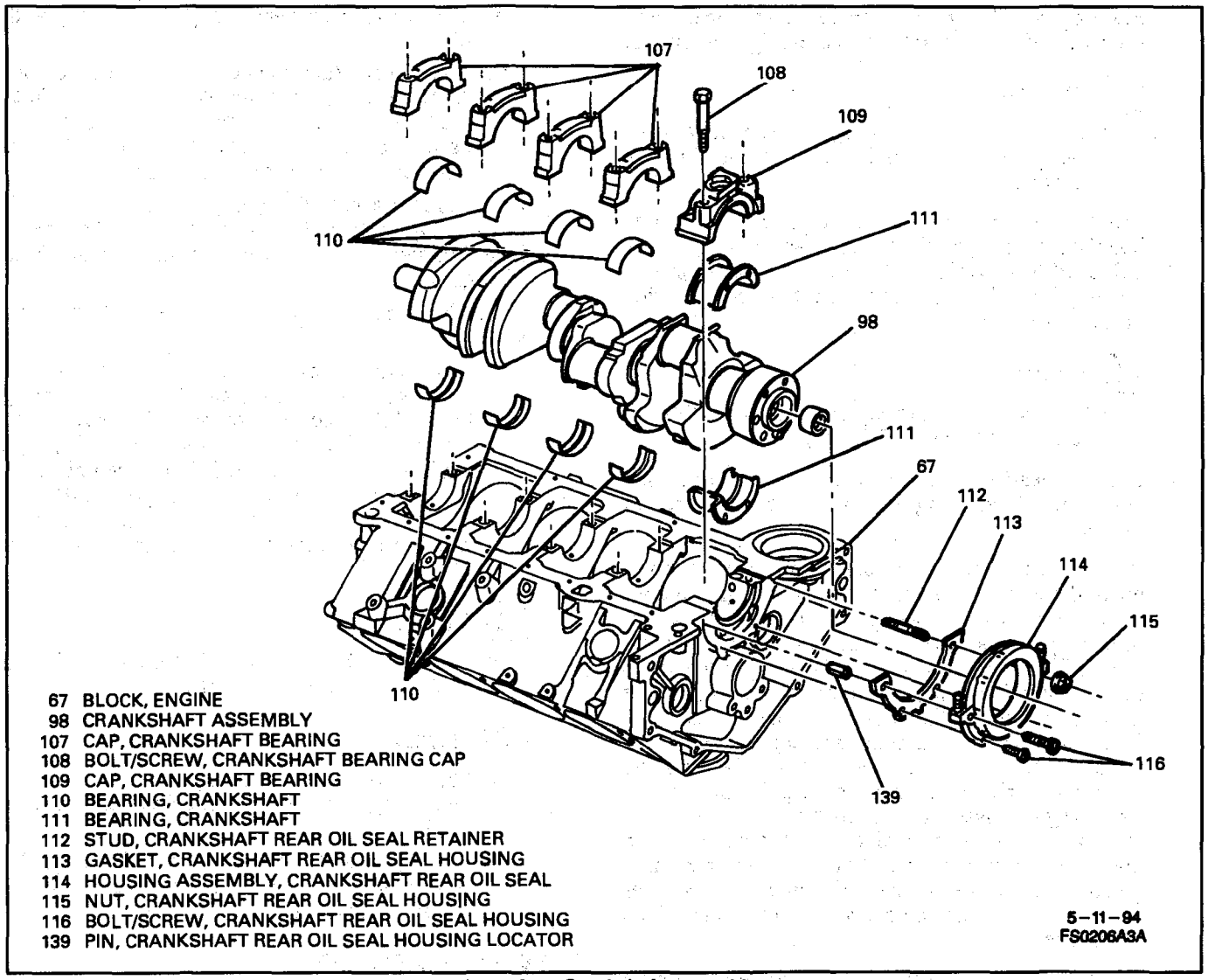
1. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
2. Oil pump assembly. Refer to "Oil Pump Assembly" in this section.
3. Spark plugs.
4. Cap (107 or 109) and lower bearing of crankshaft bearing (110 or 111) requiring replacement.
5. Insert J 8080 into oil hole in crankshaft journal.
6. Rotate crankshaft assembly (98) allowing J 8080 to push against insert's straight (unnotched) side. This will roll upper bearing out of block.
7. Remove J 8080 from crankshaft assembly (98).

Inspect

- In general, the lower half of the crankshaft bearing insert (except #1 bearing) shows a greater wear and the most distress from fatigue. If upon inspection the lower half is suitable for use, it can be assumed that the upper half is also satisfactory. If the lower half shows evidence of wear or damage, both upper and lower halves should be replaced. Never replace one half without replacing the other half.

Important

- To obtain the most accurate results when checking crankshaft bearing clearances, use gaging plastic.



67 BLOCK, ENGINE
98 CRANKSHAFT ASSEMBLY
107 CAP, CRANKSHAFT BEARING
108 BOLT/SCREW, CRANKSHAFT BEARING CAP
109 CAP, CRANKSHAFT BEARING
110 BEARING, CRANKSHAFT
111 BEARING, CRANKSHAFT
112 STUD, CRANKSHAFT REAR OIL SEAL RETAINER
113 GASKET, CRANKSHAFT REAR OIL SEAL HOUSING
114 HOUSING ASSEMBLY, CRANKSHAFT REAR OIL SEAL
115 NUT, CRANKSHAFT REAR OIL SEAL HOUSING
116 BOLT/SCREW, CRANKSHAFT REAR OIL SEAL HOUSING
139 PIN, CRANKSHAFT REAR OIL SEAL HOUSING LOCATOR

Figure 26 – Crankshaft Assembly

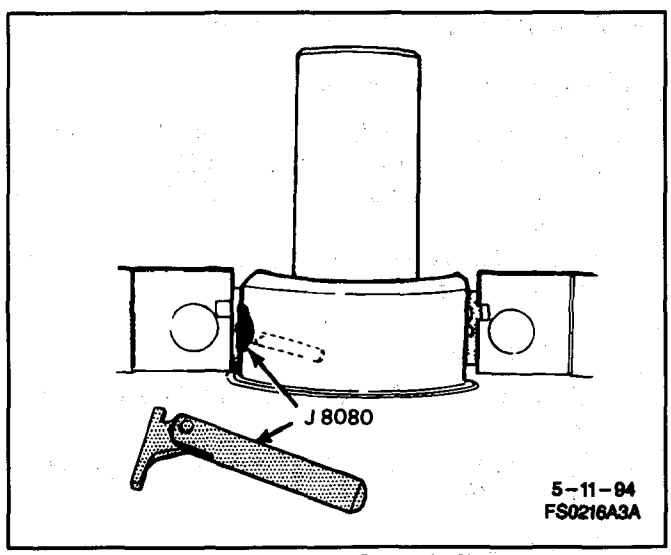


Figure 27 – Removing Crankshaft Bearing

- If the engine is out of the vehicle and upside down, the crankshaft assembly will rest on the upper bearings and the total clearance can be measured between the lower bearing and journal. If the engine is to remain in the vehicle, the crankshaft assembly must be supported upward to remove any clearance from the upper bearing. The total clearance can then be measured between the lower bearing and journal.
- To assure the proper seating of the crankshaft assembly, all bearing cap bolts/screws should be at their specified torque. In addition, prior to checking fit of bearings, the surface of the crankshaft journal and bearing should be wiped clean of oil.

Measure

1. With oil pan and oil pump assemblies removed, and starting with rear crankshaft bearing, remove bearing cap and wipe oil from journal and bearing cap. Note location of stud bolts/screws.

2. Place a piece of gaging plastic the full width of bearing (parallel to the crankshaft assembly) on journal.

Important

- Do not rotate the crankshaft assembly while the gaging plastic is between the bearing and journal.

3. Install bearing cap and evenly tighten retaining bolts/screws to specifications. Bearing cap must be tightened to specification in order to assure proper reading. Variations in torque affect the compression of the gaging plastic.

Tighten

- Crankshaft bearing cap bolts/screws (108) and studs to 105 N•m (77 lb. ft.).

4. Remove bearing caps. The flattened gaging plastic will be found adhering to either the bearing shell or journal.

5. Without removing gaging plastic, measure its compressed width (at the widest point) with graduations on gaging plastic envelope. Normally crankshaft bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal (0.001 inch maximum), be sure to fit to maximum diameter of journal: If bearing is fitted to minimum diameter, and journal is out-of-round 0.001 inch, interference between bearing and journal will result in rapid bearing failure. If flattened gaging plastic tapers toward middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of bearing or journal. Be sure to measure journal with a micrometer if flattened gaging plastic indicates more than 0.001 inch difference.

6. If bearing clearance is within specifications, bearing insert is satisfactory. If clearance is not within specifications, replace insert. Always replace both upper and lower inserts as a unit. When bearing cap is installed and clearance is less than 0.001 inch, inspect for burrs or nicks.

7. A standard, 0.001 inch or 0.002 inch undersize bearing may produce proper clearance. If not, it will be necessary to regrind crankshaft journal for use with next undersize bearing. After selecting new bearing, recheck clearance.

8. Proceed to next bearing. When checking #1 crankshaft bearing, loosen accessory drive belt so as to prevent tapered reading with gaging plastic. After all bearings have been checked, rotate crankshaft assembly to see that there is no excessive drag.

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

1. Crankshaft bearings (110 and 111) into engine block (67) and crankshaft bearing caps (107) and rear crankshaft bearing cap (109).
   A. Coat crankshaft bearings (110 and 111) with oil.
   B. Insert plain (unnotched) end between crankshaft assembly and indented or notched side of block. Rotate bearing into place using J 8080 as previously described, and remove J 8080 from oil hole in crankshaft journal.
2. Crankshaft bearing caps (107) and rear crankshaft bearing cap (109) with assembled crankshaft bearings (110 and 111) with arrows pointing toward front of engine.
3. Crankshaft bearing cap bolts/screws (108) and studs.
   - With crankshaft assembly (98), crankshaft bearings (110 and 111) and crankshaft bearing caps (107) and rear crankshaft bearing cap (109) installed and bolts/screws (108) and studs started, thrust crankshaft assembly (98) rearward to set and align bearing caps (107 and 109). Then thrust crankshaft assembly forward to align rear faces of rear crankshaft bearings (111).

Tighten

- Crankshaft bearing cap bolts/screws (108) and studs to 105 N•m (77 lb. ft.).

Measure

- Crankshaft end play, using a dial indicator or feeler gage. Refer to "Specifications" in this section.
- If using a feeler gage, measure between the front of the rear crankshaft bearing cap (109) and the crankshaft thrust surface.

FLYWHEEL ASSEMBLY

Figure 28

Flywheel Assembly Replacement

Remove or Disconnect

1. Transmission assembly. Refer to SECTION 7A for an automatic transmission or SECTION 7B for a manual transmission and SECTION 7C for the clutch.
2. Flywheel bolts/screws (136 or 138) and flywheel assembly (135 or 137).

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

1. Flywheel assembly (135 or 137) and flywheel bolts/screws (136 or 138).

Tighten

- Flywheel bolts/screws (136 or 138) to 100 N•m (74 lb. ft.).

2. Transmission assembly. Refer to SECTION 7A for an automatic transmission or SECTION 7B for a manual transmission and SECTION 7C for the clutch.

Flywheel Assembly Balancing

Figure 28

Inspect

- Flywheel assembly (135 or 137) for missing or loose converter-to-flywheel bolts/screws. Tighten or replace as necessary.
- Converter for damage or missing balance weights. If converter is damaged or balance weights are missing, replace converter. Refer to SECTION 7A.
- If flywheel assembly is replaced, new balance weights (134) of same size must be installed on new flywheel assembly in same hole locations as old flywheel assembly.

CRANKSHAFT REAR OIL SEAL ASSEMBLY

Figures 26, 29 and 30

Remove or Disconnect

Tool Required:

J 35621 Rear Main Seal Installer

1. Flywheel assembly. Refer to "Flywheel Assembly Replacement" under "Flywheel Assembly" in this section.
   - Care should be taken not to nick crankshaft sealing surface when removing seal.
2. Crankshaft rear oil seal assembly.
   - Using notches provided in crankshaft rear oil seal housing assembly (114), pry out seal assembly with a screwdriver.

Install or Connect

1. Coat new seal assembly entirely with engine oil.
2. Seal assembly onto J 35621.
3. J 35621 onto rear of crankshaft assembly (98). Tighten screws snugly to ensure seal assembly will be installed squarely over crankshaft assembly (98).
4. Crankshaft rear oil seal assembly to crankshaft assembly (98) and crankshaft rear oil seal housing (114).
5. Tighten wing nut on J 35621 until it bottoms.
6. Remove J 35621 from crankshaft rear oil seal housing assembly (114).
7. Flywheel assembly. Refer to "Flywheel Assembly Replacement" under "Flywheel Assembly" in this section.

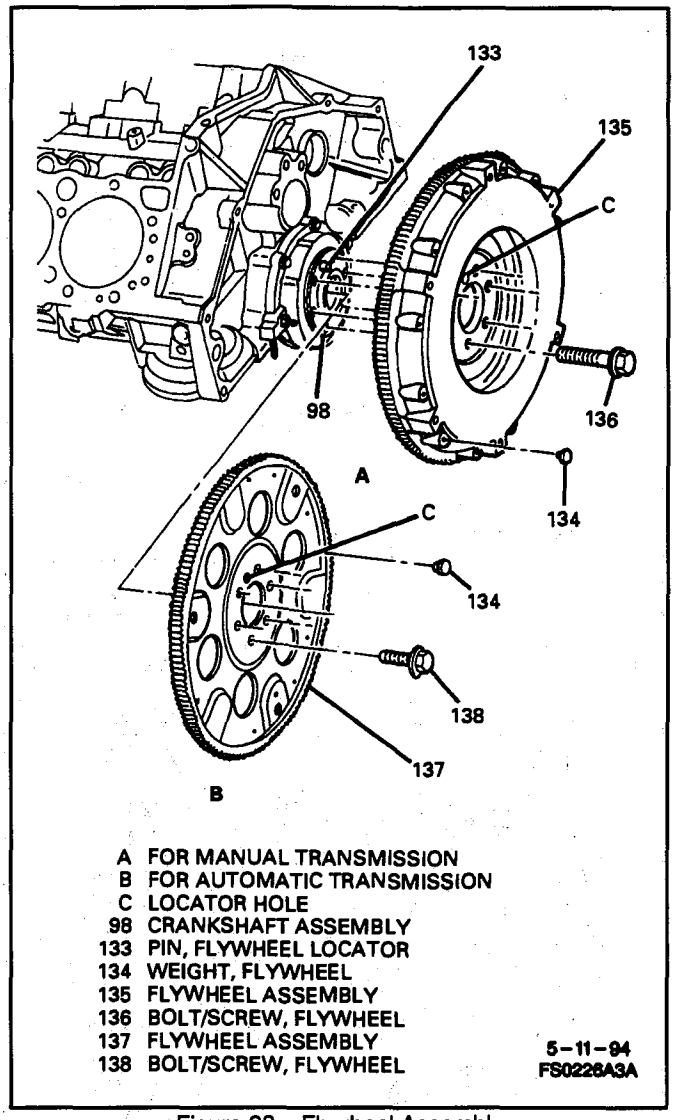


Figure 28 – Flywheel Assembly

CRANKSHAFT REAR OIL SEAL HOUSING ASSEMBLY AND GASKET

Figures 26 and 29

Remove or Disconnect

1. Flywheel assembly. Refer to "Flywheel Assembly Replacement" under "Flywheel Assembly" in this section.
2. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
3. Crankshaft rear oil seal housing nuts (115) and bolts/screws (116).
4. Crankshaft rear oil seal housing assembly (114) with the assembled seal, and gasket (113).
5. Crankshaft rear oil seal assembly from crankshaft rear oil seal housing assembly (114).

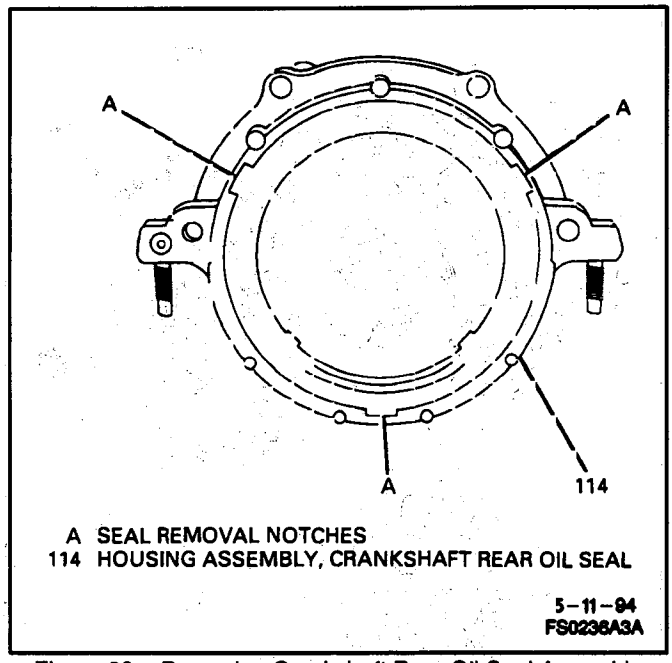


Figure 29 – Removing Crankshaft Rear Oil Seal Assembly

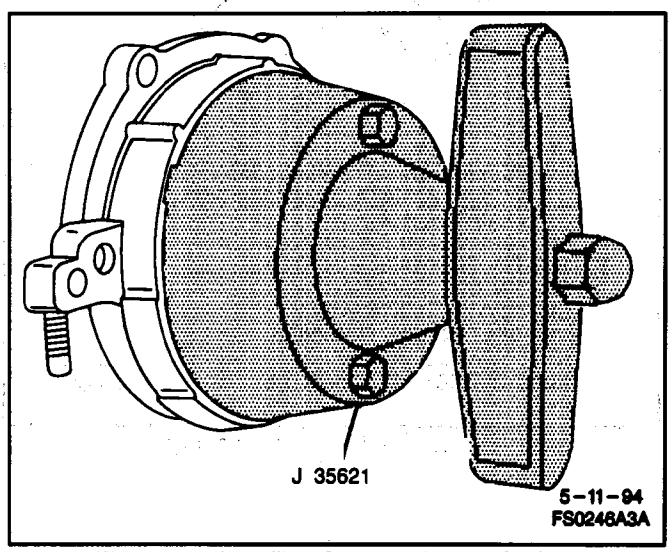


Figure 30 – Installing Crankshaft Rear Oil Seal

Clean

- Gasket surfaces.

Install or Connect

NOTICE: See "Notice" on page 6A3A-1 of this section.

Important

- Always use a new crankshaft rear oil seal assembly and a new oil seal housing gasket (113) during the installation of the crankshaft rear oil seal housing assembly (114).

1. New oil seal housing gasket (113) and crankshaft rear oil seal housing assembly (114) on studs (112).
   - It is not necessary to use any type of sealant to hold oil seal housing gasket (113) in place.
2. Crankshaft rear oil seal housing nuts (115) and bolts/screws (116).

Tighten

- Crankshaft rear oil seal housing nuts (115) and bolts/screws (116) to 15 N•m (11 lb. ft.).

Inspect

- Oil pan gasket for damage. Replace gasket if necessary.

3. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
4. New crankshaft rear oil seal assembly. Refer to "Crankshaft Rear Oil Seal Assembly" in this section.
5. Flywheel assembly. Refer to "Flywheel Assembly Replacement" under "Flywheel Assembly" in this section.

ENGINE ASSEMBLY

CAUTION: See "Caution" on page 6A2A-1 of this section.

Remove or Disconnect

1. Discharge air conditioning system. Refer to SECTION 1B.
2. Battery negative cable assembly.
3. Battery positive cable assembly.
4. Raise and suitably support vehicle. Refer to SECTION OA.
5. Front wheels and tires. Refer to SECTION 3E.
6. Drain coolant. Refer to SECTION 6B.
7. Drain engine oil.
8. Exhaust crossover pipe assembly from intermediate pipe. Refer to SECTION 6F.
9. Converter bolts/screws (automatic transmission). Refer to SECTION 7A.
10. Front fascia lower deflectors. Refer to SECTION 10-5.
11. Stabilizer bar bolts/screws. Refer to SECTION 3C.
12. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
13. Air conditioning hose assembly from condenser and compressor. Refer to SECTION 1B.
14. Transmission fluid cooler lines from radiator assembly (automatic transmission). Refer to SECTION 6B.
15. Lower radiator hose from radiator assembly. Refer to SECTION 6B.
16. Lower heater hose from water pump. Refer to SECTION 6B.
17. Electrical ground straps from right side of engine block.
18. Shift linkage from transmission assembly. Refer to SECTION 7A or SECTION 7B.
19. Propeller shaft assembly after matchmarking. Refer to SECTION 4A.

20. Torque arm from transmission assembly. Refer to SECTION 3D.
21. Intermediate steering shaft from rack and pinion assembly. Refer to SECTION 3F4.
22. Electrical ground straps from left side of frame rail.
23. Electrical connectors from wheel speed sensor assemblies.
24. Lower vehicle.
25. Air intake duct.
26. Fuel lines from fuel rail assembly. Refer to SECTION 6C.
27. Accelerator control/cruise control servo cable adjuster assembly, if equipped. Refer to SECTION 5E2.
28. Cruise and accelerator control cables from throttle body assembly.
29. Upper radiator hose from water pump assembly. Refer to SECTION 6B.
30. Lower radiator hose from water pump assembly. Refer to SECTION 6B.
31. Brake booster vacuum hose.
32. Upper heater hose from water pump assembly. Refer to SECTION 6B.
33. Coolant air bleed pipe hose from radiator assembly. Refer to SECTION 6B.
34. Air conditioning receiver and dehydrator hose from condenser. Refer to SECTION 1B.
35. Air conditioning hose from expansion tube. Refer to SECTION 1B.
36. Brake lines from antilock brake system (ABS) brake combination valve. Refer to SECTION 5.
37. Power steering reservoir and reposition. Refer to SECTION 1B.
38. Brake lines and clips from ABS hydraulic modulator assembly. Refer to SECTION 5.
39. Right-hand body hinge pillar trim panel assembly. Refer to SECTION 10-5.
40. Three engine wiring harness connectors (blue, black and white connectors) and evaporator temperature sensor connector.
41. Forward lamp wiring harness connectors.
42. Powertrain control module (PCM) and harness.
    - Place PCM and harness on top of engine.
43. Engine wire harness through front of dash.
    - Place harness on top of engine.
44. Positive lead at generator.
45. Positive lead at junction block.
46. Negative lead at mounting stud (located next to the junction block).
47. Lower shock attachment bolts/screws and nuts from lower control arm.
48. Upper control arm ball stud assembly from steering knuckle assembly. Refer to SECTION 3C.
49. Raise and suitably support vehicle. Refer to SECTION OA.
50. Position lift table under engine and engine frame assembly. Use Kent-Moore tool number 204-BX-75G or equivalent.
51. Engine frame and transmission support bolts/screws. Refer to SECTION 10-3.
52. Raise vehicle from engine, transmission and engine frame assemblies.
53. Secure strut assemblies to engine frame.
54. Transmission assembly. Refer to SECTION 7A or SECTION 7B.
55. Clutch housing and clutch assembly (manual transmission). Refer to SECTION 7C.
56. Power steering lines from power steering pump assembly. Refer to SECTION 3B.
57. Hose assemblies from air conditioning compressor. Refer to SECTION 1B.
58. Air conditioning compressor bolts/screws and compressor. Refer to SECTION 1B.
59. Engine mount through-bolts/screws. Refer to "Engine Mount Assemblies and Brackets" in this section.
60. Engine assembly from engine frame.

Important

- Refer to SECTION 6A3B for engine block cleaning, inspection and repair.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Engine assembly to engine frame.
2. Engine mount through-bolts/screws. Refer to "Engine Mount Assemblies and Brackets" in this section.
3. Power steering lines to power steering pump. Refer to SECTION 3B.
4. Air conditioning compressor and bolts/screws. Refer to SECTION 1B.
5. Hose assemblies to air conditioning compressor. Refer to SECTION 1B.
6. Clutch housing and clutch assembly. Refer to SECTION 7C.
7. Transmission assembly. Refer to SECTION 7A or SECTION 7B.
8. Position engine lift table and install engine, transmission and engine frame assemblies by lowering vehicle to crossmember assembly.
9. Engine frame and transmission support bolts/screws. Refer to SECTION 10-3.
10. Engine lift table.
11. Lower vehicle.
12. Upper control arm ball stud assembly to steering knuckle assembly. Refer to SECTION 3C.
13. Lower shock attachment bolts/screws and nuts to lower control arm.
14. Negative lead at mounting stud (located next to junction block).

15. Positive lead at generator.
16. Engine wire harness though front of dash.

Important

- When reinstalling engine wiring harness back through front of dash, the rubber grommet MUST BE INSTALLED PROPERLY to ensure correct sealing. If grommet is torn or damaged for any reason, it must be replaced.

17. PCM and harness.
18. Forward lamp wiring harness connectors.
19. Wiring harness connectors.
20. Right-hand body hinge pillar trim panel assembly. Refer to SECTION 10-5.
21. Brake lines and clips to ABS hydraulic modulator assembly. Refer to SECTION 5.
22. Brake lines to ABS brake combination valve. Refer to SECTION 5.
23. Air conditioning hose to expansion tube. Refer to SECTION 1B.
24. Air conditioning receiver and dehydrator hose to condenser. Refer to SECTION 1B.
25. Coolant air bleed pipe hose to radiator assembly. Refer to SECTION 6B.
26. Brake booster vacuum hose.
27. Lower radiator hose to water pump assembly. Refer to SECTION 6B.
28. Upper radiator hose to water pump assembly. Refer to SECTION 6B.
29. Accelerator control/cruise control servo cable adjuster assembly, if equipped. Refer to SECTION 5E2.
30. Cruise and accelerator control cables to throttle body assembly
31. Fuel lines to fuel rail assembly. Refer to SECTION 6B.
32. Raise and suitably support vehicle. Refer to SECTION OA.
33. Electrical connectors to wheel speed sensor assemblies.
34. Electrical ground straps to left side of frame rail.
35. Intermediate steering shaft to rack and pinion assembly. Refer to SECTION 3F4.
36. Torque arm to transmission assembly. Refer to SECTION 3D.
37. Propeller shaft assembly. Refer to SECTION 4A.
38. Shift linkage to transmission assembly. Refer to SECTION 7A or SECTION 7B.
39. Electrical ground straps to right side of engine block.
40. Lower heater hose to water pump. Refer to SECTION 6B.
41. Lower radiator hose to radiator assembly. Refer to SECTION 6B.
42. Transmission fluid cooler lines to radiator assembly (automatic transmission). Refer to SECTION 6B.
43. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in the section.
44. Air conditioning hose assembly to condenser and compressor. Refer to SECTION 1B.
45. Stabilizer bar bolts/screws. Refer to SECTION 3C.
46. Front fascia lower deflectors. Refer to SECTION 10-5.
47. Converter bolts/screws (automatic transmission). Refer to SECTION 7A.
48. Exhaust crossover pipe assembly from intermediate pipe. Refer to SECTION 6F.
49. Lower vehicle.
50. Refill with engine oil. Refer to SECTION OA.
51. Refill with engine coolant. Refer to SECTION 6B.
52. Front wheels and tires. Refer to SECTION 3E.
53. Battery positive cable assembly.
54. Battery negative cable assembly.
55. Bleed brake system. Refer to SECTION 5E1.
56. Bleed power steering system. Refer to SECTION 3B.
57. Charge air conditioning system. Refer to SECTION 1B.
58. Air intake duct.
59. Align wheels. Refer to SECTION 3A.

THREAD REPAIR

Figure 31

Damaged threads may be reconditioned by drilling out, re-threading and installing a suitable thread insert. General purpose thread repair kits are available commercially.

CAUTION: Wear safety glasses to avoid eye damage.

1. Determine size, pitch and depth of damaged thread. If necessary, adjust stop collars on cutting tool and tap to required depth.

Important

- Refer to kit manufacturer's instructions regarding size of drill and tap to be used.

2. Drill out damaged thread. Clean out chips.
3. Tap hole.
   A. Lubricate tap with light engine oil.
   B. Clean thread.

Important

- Avoid build-up of chips. Back out tap every few turns and remove chips.

4. Thread the thread insert onto mandrel of installer. Engage tang of insert onto end of mandrel.
5. Lubricate insert with light engine oil (except when installing in aluminum) and install.

Important

- When correctly installed, insert should be flush to one turn below surface.

6. If tang of insert does not break off when backing out installer, break tang off with drift pin.

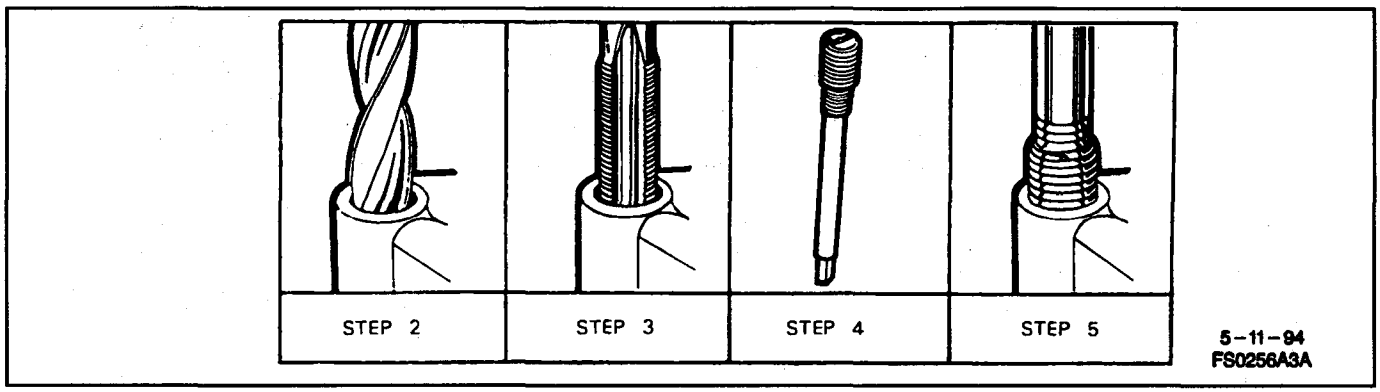


Figure 31 – Repairing Threaded Holes

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Accelerator Control Cable Bracket Bolt/Screw	12 N•m (106 lb. in.)
Air Conditioning Compressor Rear Brace-to-Engine Block Bolt/Screw	33 N•m (24 lb. ft.)
Camshaft Retainer Bolt/Screw	12 N•m (105 lb. in.)
Camshaft Sprocket Bolt/Screw	25 N•m (18 lb. ft.)
Catalytic Converter-to-Exhaust Manifold Nut	21 N•m (15 lb. ft.)
Connecting Rod Nut	27 N•m (20 lb. ft.) + additional 55°
Crankshaft Balancer Bolt/Screw	85 N•m (63 lb. ft.)
Crankshaft Balancer Hub Bolt/Screw	100 N•m (74 lb. ft.)
Crankshaft Bearing Cap Bolt/Screw	105 N•m (77 lb. ft.)
Crankshaft Rear Oil Seal Housing Nut and Bolt/Screw	15 N•m (11 lb. ft.)
Cylinder Head Bolt/Screw	88 N•m (65 lb. ft.)
Distributor Bolt/Screw	12 N•m (106 lb. in.)
Drive Belt Idler Pulley Bolt/Screw	50 N•m (37 lb. ft.)
Drive Belt Tensioner Bolt/Screw	25 N•m (18 lb. ft.)
EGR Control Valve Relay Nut	25 N•m (18 lb. ft.)
EGR Valve Nut	25 N•m (18 lb. ft.)
Engine Block Oil Gallery Plug	20 N•m (15 lb. ft.)
Engine Bracket Bolt/Screw	58 N•m (43 lb. ft.)
Engine Coolant Air Bleed Pipe Bolt/Screw	40 N•m (30 lb. ft.)
Engine Front Cover Bolt/Screw	11 N•m (100 lb. in.)
Engine Mount Through-Bolt Nut	80 N•m (59 lb. ft.)
Engine Mount Through-Bolt/Screw	95 N•m (70 lb. ft.)
Engine Mount-to-Frame or Engine Bolt/Screw	58 N•m (43 lb. ft.)
Engine Oil Cooler Bolt/Screw	33 N•m (24 lb. ft.)
Engine Oil Cooler Adapter Bolt/Screw	25 N•m (18 lb. ft.)
Engine Oil Cooler Hose Bracket Nut	17 N•m (13 lb. ft.)
Engine Oil Level Sensor Assembly	22 N•m (16 lb. ft.)
Evaporative Emission Canister Purge Solenoid Valve Bracket Bolt/Screw	6 N•m (53 lb. in.)
Exhaust Manifold Bolt/Screw and Stud	35 N•m (26 lb. ft.)
Flywheel Bolt/Screw	100 N•m (74 lb. ft.)
Fuel Injection Fuel Rail Bolt/Screw	10 N•m (90 lb. in.)
Fuel Pump Switch and Engine Oil Pressure Gage Sensor Assembly	12 N•m (105 lb. in.)
Generator Bracket Bolt/Screw	40 N•m (30 lb. ft.)
Ignition Coil Bolt/Screw	40 N•m (30 lb. ft.)
Intake Manifold Bolt/Screw and Stud	
First Pass	8 N•m (71 lb. in.)
Final Pass	48 N•m (35 lb. ft.)
Knock Sensor Assembly	20 N•m (15 lb. ft.)
Oil Filter Adapter Bolt/Screw	23 N•m (17 lb. ft.)
Oil Level Indicator Tube Nut	12 N•m (106 lb. in.)
Oil Pan	
Corner Bolt/Screw and Nut	20 N•m (15 lb. ft.)
Side Rail Bolt/Screw	12 N•m (106 lb. in.)
Oil Pan Baffle Nut	40 N•m (30 lb. ft.)
Oil Pan Drain Plug	20 N•m (16 lb. ft.)

Oil Pump Cover Bolt/Screw ..... 9 N•m (80 lb. in.)
Oil Pump Driveshaft Bolt/Screw ..... 18 N•m (13 lb. ft.)
Oil Pump-to-Rear Crankshaft Bearing Cap Bolt/Screw ..... 90 N•m (66 lb. ft.)
Oil Temperature Sensor Assembly ..... 12 N•m (108 lb. in.)
Secondary Air Injection Pump Bracket Bolt/Screw ..... 40 N•m (30 lb. ft.)
Secondary Air Injection Pipe Fitting-to-Exhaust Manifold Assembly ..... 55 N•m (41 lb. ft.)
Spark Plug Bracket Bolt/Screw ..... 12 N•m (105 lb. in.)
Starter Motor Bolt/Screw ..... 47 N•m (35 lb. ft.)
Throttle Body Bolt/Screw ..... 25 N•m (18 lb. ft.)
Valve Lifter Guide Retainer Bolt/Screw ..... 25 N•m (18 lb. ft.)
Valve Rocker Arm Cover Bolt/Screw ..... 12 N•m (106 lb. in.)
Valve Rocker Arm Stud ..... 68 N•m (50 lb. ft.)
Water Pump Driveshaft Bearing Retainer Bolt/Screw ..... 12 N•m (105 lb. in.)
Water Pump Bolt/Screw ..... 41 N•m (30 lb. ft.)

ENGINE ASSEMBLY SPECIFICATIONS 5.7L (LT1)

GENERAL

Type V8
Displacement ..... 5.7L (350 CID)
Bore ..... 101.60 mm (4.000″)
Stroke ..... 88.39 mm (3.480″)
Compression Ratio 10.5:1
Firing Order 1-8-4-3-6-5-7-2
Spark Plugs
  Type AC41-906
  Gap ..... 1.27 mm (0.050″)
  Torque ..... 15 N•m (11 lb. ft.)
Oil Pressure (Minimum) ..... 41.4 kPa (6.0 psig) at 1,000 engine rpm
124.1 kPa (18.0 psig) at 2,000 engine rpm
165.5 kPa (24.0 psig) at 4,000 engine rpm
Oil Filter Torque ..... 19 N•m (14 lb. ft.)

CYLINDER BORE

Out-of-Round
  Production ..... 0.02 mm (0.001″) MAX.
  Service Limit ..... 0.05 mm (0.002″) MAX.
Taper
  Production
    Thrust Side ..... 0.012 mm (0.0005″) MAX.
    Relief Side ..... 0.025 mm (0.0010″) MAX.
  Service Limit ..... 0.025 mm (0.0010″) MAX.

PISTON ASSEMBLY

Piston Bore Clearance
  Production ..... 0.025 - 0.068 mm (0.0010 - 0.0027″)
  Service Limit ..... 0.068 mm (0.0027″) MAX.

PISTON RINGS

Piston Compression Ring
  Groove Clearance
    Production Top ..... 0.030 - 0.081 mm (0.0012 - 0.0032″)
    Production 2nd ..... 0.030 - 0.081 mm (0.0012 - 0.0032″)
    Service Limit ..... 0.107 mm (0.0042″) MAX.
  Gap
    Production Upper ..... 0.25 - 0.50 mm (0.010 - 0.020″)
    Production Lower ..... 0.46 - 0.66 mm (0.018 - 0.026″) MAX.
    Service Limit ..... 0.88 mm (0.035″) MAX.
Piston Oil Ring
  Groove Clearance
    Production ..... 0.051 - 0.17 mm (0.002 - 0.007″)
    Service Limit ..... 0.20 mm (0.008″) MAX.
  Gap
    Production ..... 0.25 - 0.76 mm (0.010 - 0.030″)
    Service Limit ..... 1.65 mm (0.065″) MAX.

PISTON PIN

- Diameter ..... 23.546 - 23.548 mm (0.9270 - 0.9271″)
- Clearance in Piston Assembly
  - Production ..... 0.0127 - 0.0203 mm (0.0005 - 0.0008″)
  - Service Limit ..... 0.025 mm (0.001″) MAX.
- Fit In Connecting Rod Assembly ..... 0.021 - 0.040 mm (0.0008 - 0.0016″) Interference

CRANKSHAFT ASSEMBLY

- Main Journal
  - Diameter #1 ..... 62.189 - 62.212 mm (2.4484 - 2.4493″)
  - Diameter #2, #3, #4 ..... 62.182 - 62.205 mm (2.4481 - 2.4490″)
  - Diameter #5 ..... 62.177 - 62.120 mm (2.4481 - 2.4488″)
  - Taper
    - Production ..... 0.005 mm (0.0002″) MAX.
    - Service Limit ..... 0.025 mm (0.0010″) MAX.
  - Out-of-Round
    - Production ..... 0.005 mm (0.0002″) MAX.
    - Service Limit ..... 0.025 mm (0.0010″) MAX.
- Crankshaft Bearing Clearance
  - Production #1 ..... 0.020 - 0.051 mm (0.0008 - 0.0020″)
  - Production #2, #3, #4 ..... 0.028 - 0.051 mm (0.0011 - 0.0020″)
  - Production #5 ..... 0.043 - 0.081 mm (0.0017 - 0.0032″)
  - Service Limit #1 ..... 0.025 - 0.038 mm (0.0010 - 0.0015″)
  - Service Limit #2, #3, #4 ..... 0.025 - 0.064 mm (0.0010 - 0.0025″)
  - Service Limit #5 ..... 0.064 - 0.089 mm (0.0025 - 0.0035″)
- Crankshaft Assembly End Play ..... 0.03 - 0.17 mm (0.001 - 0.007″)

CONNECTING ROD ASSEMBLY

- Connecting Rod Journal
  - Diameter ..... 53.068 - 53.334 mm (2.0893 - 2.0998″)
  - Taper
    - Production ..... 0.013 mm (0.0005″) MAX.
    - Service Limit ..... 0.025 mm (0.0010″) MAX.
  - Out-of-Round
    - Production ..... 0.013 mm (0.0005″) MAX.
    - Service Limit ..... 0.025 mm (0.0010″) MAX.
- Rod Bearing Clearance
  - Production ..... 0.033 - 0.088 mm (0.0013 - 0.0035″)
  - Service Limit ..... 0.076 mm (0.0030″) MAX.
- Rod Side Clearance ..... 0.16 - 0.35 mm (0.006 - 0.014″)

CAMSHAFT ASSEMBLY

- Journal Diameter ..... 47.452 - 47.477 mm (1.8682 - 1.8692″)
- End Play ..... 0.11 - 0.30 mm (0.004 - 0.012″)
- Lobe Lift ± 0.050 mm (0.002″)
  - Intake ..... 7.62 mm (0.300″)
  - Exhaust ..... 7.62 mm (0.300″)

VALVE SYSTEM

- Lifter Assembly ..... Hydraulic
- Rocker Arm Ratio 1.50:1
- Valve Lash ..... 1 ± 1/4 turn down from zero lash
- Face Angle ..... 45°
- Seat Angle ..... 46°
- Seat Runout ..... 0.05 mm (0.002“) MAX.
- Seat Width
  - Intake ..... 0.76 - 1.27 mm (0.030 - 0.050″)
  - Exhaust ..... 1.52 - 2.03 mm (0.060 - 0.080″)
- Stem Clearance
  - Production
    - Intake ..... 0.027 - 0.069 mm (0.0011 - 0.0027″)
    - Exhaust ..... 0.027 - 0.069 mm (0.0011 - 0.0027″)
  - Service
    - Intake ..... 0.093 mm (0.0037″) MAX.
    - Exhaust ..... 0.119 mm (0.0047″) MAX.
- Valve Spring

Free Length	51.1 mm (2.01″)
Pressure	
Closed	360 - 395 N at 45.2 mm (81 - 89 lb. at 1.78″)
Open	1121 - 1208 N at 33.1 mm (252 - 272 lb. at 1.305″)
Installed Height	
Intake	45.2 mm (1.78″)
Exhaust	45.2 mm (1.78″)
Valve Lift	
Intake	11.43 mm (0.450″)
Exhaust	11.68 mm (0.460″)

SPECIAL TOOLS

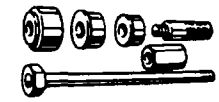
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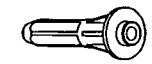
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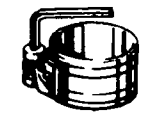
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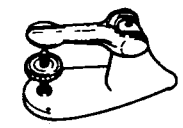
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5  J 39089

6  J 6098-01

7  J 39088

8  J 8037

9  J 9666 or J 8056

10  J 8062

1 CRANKSHAFT GEAR INSTALLER

2 DRIVEN GEAR SHAFT FRONT COVER SEAL PROTECTOR

3 CRANKSHAFT GEAR REMOVER

4 VALVE SPRING COMPRESSOR (HEAD-ON)

5 DRIVEN GEAR/WATER PUMP SHAFT SEAL INSTALLER

6 CAMSHAFT BEARING REMOVER AND INSTALLER

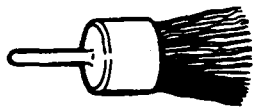
7 DRIVEN GEAR SHAFT FRONT COVER SEAL INSTALLER

8 PISTON RING COMPRESOR

9 VALVE SPRING TESTER

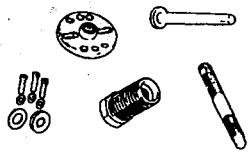
10 VALVE SPRING COMPRESSOR (HEAD-OFF)

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11  J 8358

12  J 8520

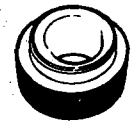
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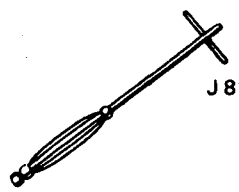
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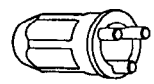
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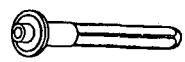
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18  J 35468

19  J 35621

20  J 8101

21  J 39092

22  J 39090

11 CARBON REMOVING BRUSH (ALUMINUM)

12 CAM LOBE LIFT INDICATOR

13 OIL SUCTION PIPE INSTALLER

14 CRANKSHAFT HUB REMOVER AND INSTALLER

15 SPARK PLUG PORT ADAPTOR (14 mm TAPERED SEAT)

16 VALVE STEM SEAL TESTER (MITY-VAC)

17 PISTON PIN REMOVER AND INSTALLER SET

18 FRONT COVER OIL SEAL INSTALLER

19 REAR MAIN SEAL INSTALLER

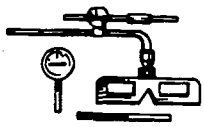
20 VALVE GUIDE CLEANER

21 DRIVEN GEAR ASSEMBLY INSTALLER

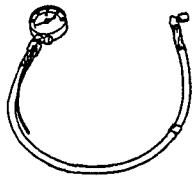
22 DISTRIBUTOR DRIVESHAFT FRONT COVER SEAL INSTALLER

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23  J 3049–A

24  J 7872

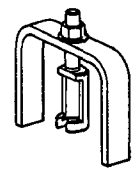
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26  J 34730–1

27  J 8080

28  J 5239

29  J 9290–01

30  J 39243

31  J 36660

23 HYDRAULIC VALVE LIFTER REMOVER (PLIER TYPE)
24 MAGNETIC BASE INDICATOR SET
25 DIAL INDICATOR SET
26 FUEL PRESSURE GAGE
27 MAIN BEARING SHELL REMOVER & INSTALLER
28 CONNECTING ROD BOLT GUIDE SET
29 HYDRAULIC VALVE LIFTER REMOVER (SLIDE HAMMER TYPE)
30 DRIVEN GEAR REMOVER
31 TORQUE ANGLE METER

BLANK

SECTION 6A3B
5.7 LITER V8 ENGINE UNIT REPAIR
RPO LT1 - VIN P

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

CONSTRUCTION

Figures 1 through 4

Engine Block

The engine block is made of cast iron and has eight cylinders arranged in a "V" shape with four cylinders in each bank. It is a one-piece casting with the cylinders encircled by coolant jackets.

Cylinder Head Assemblies

The cylinder head assemblies are cast aluminum and have powdered metal valve guides and valve seats pressed into the intake and exhaust ports. The spark plugs are located between the intake and exhaust ports.

Crankshaft Assembly

The crankshaft assembly is made of cast nodular iron. It is supported by five crankshaft bearings that are retained by bearing caps which are machined with the block for proper alignment and clearances. The bearing caps are retained by two bolt/screws each. The number five bearing at the rear of the engine assembly is the end thrust bearing. Four connecting rod journals (two rods per journal) are spaced 90 degrees apart.

Piston and Connecting Rod Assemblies

The pistons are cast aluminum that use two compression rings and one oil control ring assembly. The piston is a low-friction, lightweight design with a flat top and barrel-shaped skirt. The piston pins are chromium steel. They have a floating fit in the piston and are retained by a press fit in the connecting rod assembly.

The connecting rod assemblies are made out of powdered metal. They are machined with the rod cap installed for proper clearances and alignment.

Camshaft Assembly

A steel camshaft assembly is supported by five bearings pressed into the engine block. The timing sprocket mounted to the front of the camshaft assembly is driven by the crankshaft sprocket through a timing chain assembly.

The camshaft sprocket also has spur gear teeth which drive a geared shaft assembly to operate the water pump assembly.

A spiral gear machined into the camshaft assembly near the rear journal drives a shaft assembly which operates the oil pump assembly.

A pin on the camshaft mates with the distributor driveshaft. This provides net build timing, meaning that the ignition timing does not have to be adjusted.

Valve Train

The valve train is a ball pivot type. Motion is transmitted from the camshaft assembly through hydraulic roller lifter and tubular pushrod assemblies to the rocker arms. The rocker arm pivots on a ball to open the valve. The hydraulic lifter assemblies keep all parts of the valve train in constant contact.

The rocker arm ball is retained on the rocker arm stud with a locking nut. The rocker arm stud is threaded into the cylinder head assembly.

Intake Manifold Assembly

The intake manifold assembly is a one-piece cast aluminum unit. The intake manifold assembly has exhaust gas recirculation and crankcase vent passages cast into it but coolant crossover passages have been eliminated.

Exhaust Manifold Assemblies

The two cast-iron exhaust manifold assemblies direct exhaust gases from the combustion chambers to the exhaust system. The exhaust manifold assemblies each have a port for air injection system pipe fittings.

LUBRICATION

Figures 5 through 7

Engine assembly lubrication is supplied by a gear-type oil pump assembly. The oil pump assembly is driven by an intermediate shaft which is connected to a shaft assembly driven by the camshaft assembly. The pump gears rotate and draw oil from the oil pan sump through a pick-up screen and pipe. The oil is pressurized as passes through the pump and sent through engine block oil galleries.

Contained within the oil pump assembly is a pressure relief valve that maintains oil pressure within a specified range.

Pressurized oil is directed to the oil filter where harmful contaminants are removed. A bypass valve is also incorporated into the oil filter. The bypass allows oil to bypass the filter and flow to the engine assembly if the filter becomes clogged.

The oil is then pumped to the main oil gallery which is drilled through the length of the engine block just above the camshaft assembly. At the rear of the engine block, oil also flows into the right and left lifter oil galleries. From the main oil gallery, oil is pumped downward to the camshaft bearings, then to the crankshaft bearings. The crankshaft bearing upper inserts are grooved to align with oil passages drilled from the crankshaft bearing journal to the connecting rod journal. After lubricating the connecting rod bearings, the cylinder walls, rings and piston pins are lubricated by oil which is "slung" from the connecting rod bearing journals due to the rotation of the crankshaft assembly. This oil then returns to the oil pan sump. Oil that has entered the left and right lifter oil galleries pressurizes the hydraulic lifter assemblies and is then pumped up through the pushrod assemblies to lubricate the rocker arms and valve stems.

Oil returning to the oil pan assembly from the cylinder head assemblies and the front camshaft bearing, lubricates the timing chain assembly and crankshaft and camshaft sprockets.

DISASSEMBLY

When beginning the engine assembly unit repair, the belt tensioner, power steering pump and bracket, generator, air injection pump, A/C compressor, and generator and A/C compressor braces should already be removed. For removal procedures, refer to the specific section in the service manual for each component.

FLYWHEEL ASSEMBLY

Figure 8

Remove or Disconnect

1. Flywheel bolts/screws (136 or 138).
2. Flywheel assembly (135 or 137).

DRAINING THE ENGINE ASSEMBLY

Remove or Disconnect

1. Oil pan plug and drain engine oil.
2. Oil filter assembly.
3. Both knock sensor assemblies and allow coolant to drain.

INTAKE MANIFOLD ASSEMBLY

Figures 9 through 11

Remove or Disconnect

1. Fuel pressure regulator vacuum tube assembly (7).
2. Fuel rail bolts/screws (1).
3. Canister purge valve vacuum hose.
4. Fuel injectors and fuel rail assembly (2) from intake manifold assembly (6).
5. Exhaust gas recirculation (EGR) vacuum harness assembly and crankcase vent hoses.
6. EGR solenoid assembly and bracket.
7. Canister purge valve assembly and bracket.
8. Move wiring harness assemblies out of area.
9. Disconnect distributor wiring harness assembly, if necessary.
10. EGR valve nuts, valve assembly and gasket.
11. EGR valve pipe bolt/screw (229), nut (14), pipe assembly (12) and gasket (22).
12. Accelerator cable bracket bolt/screw and bracket.
13. Engine coolant air bleed pipe bolts/screws and pipe.
    - Use a backup wrench on pipe fitting when removing bolts/screws.
14. Manifold absolute pressure (MAP) sensor bolts/screws and MAP sensor.
15. Throttle body bolts/screws (4), throttle body assembly (3) and gasket (5).
16. Intake manifold bolts/screws (8) and studs (9).
17. Intake manifold assembly (6) and gaskets (10).

EXHAUST MANIFOLD ASSEMBLIES

Figures 11 and 12

Right Exhaust Manifold Assembly

Remove or Disconnect

1. Right cylinder bank spark plug wire harness assembly from spark plugs and supports.
2. Oil level indicator tube nut.
3. Oil level indicator and tube.
4. Right exhaust manifold air injection pipe assembly (15) and check valve (11).
5. Right exhaust manifold studs (20) and bolts/screws (21) and spacers (245).
6. Right heat shields, exhaust manifold assembly (19) and gasket (18).

Left Exhaust Manifold Assembly

Remove or Disconnect

1. Left exhaust manifold air injection pipe assembly (15) and check valve (11).
2. Left cylinder bank spark plug wire harness assembly from spark plugs and supports.
3. Left exhaust manifold bolts/screws (21) and spacers (245).
4. Left heat shields, exhaust manifold assembly (16) and gasket (17).

VALVE ROCKER ARM COVER ASSEMBLIES

Figure 13

Right Valve Rocker Arm Cover Assembly

Remove or Disconnect

1. Crankcase vent hose.
2. Right valve rocker arm cover bolts/screws (24).
3. Right valve rocker arm cover assembly (23) and gasket (25).

Left Valve Rocker Arm Cover Assembly

Remove or Disconnect

1. Left valve rocker arm cover bolts/screws (24).
2. Left valve rocker arm cover assembly (23) and gasket (25).

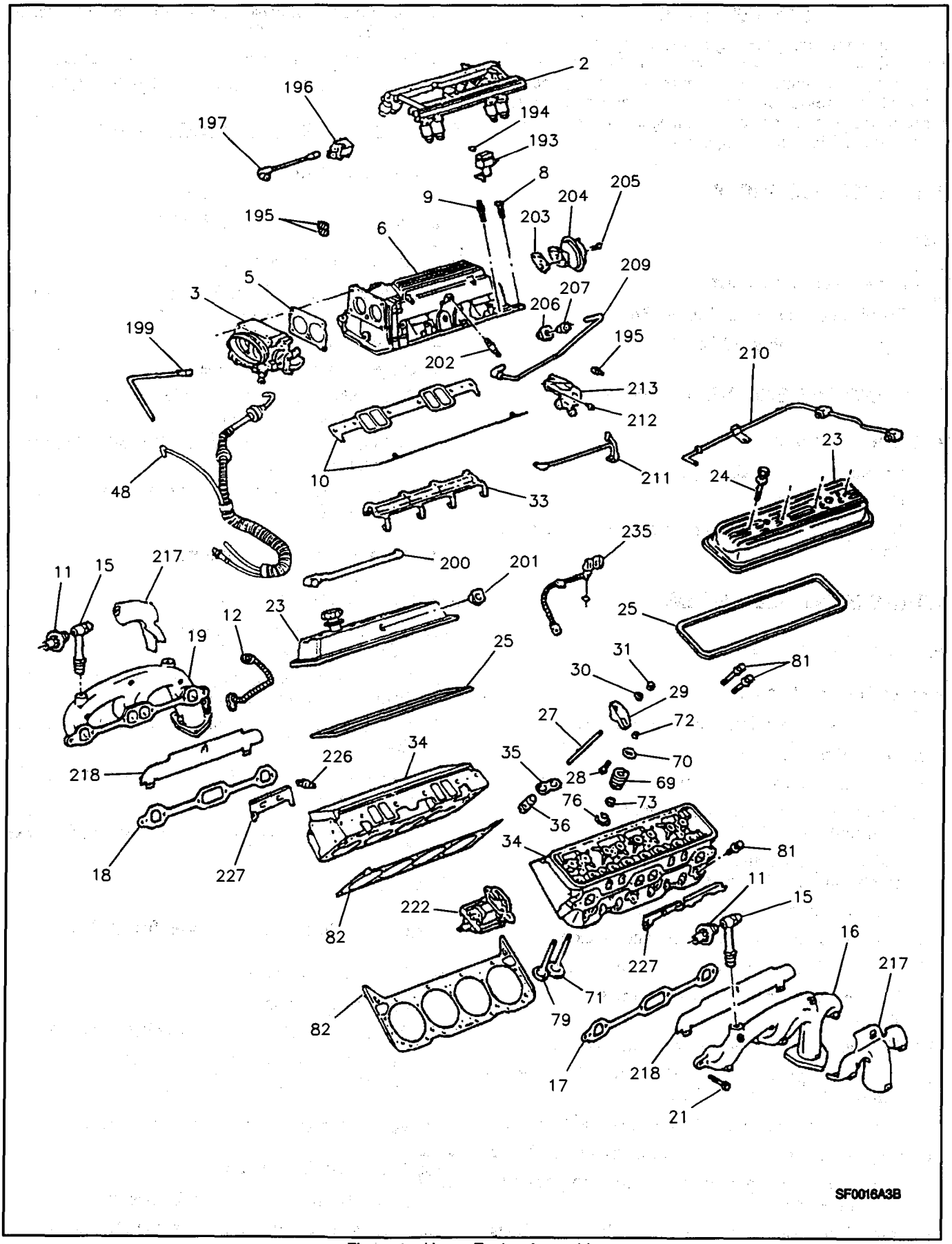


Figure 1 – Upper Engine Assembly

2 RAIL ASSEMBLY, MULTIPORT FUEL INJECTION
3 BODY ASSEMBLY, THROTTLE
5 GASKET, THROTTLE BODY
6 MANIFOLD ASSEMBLY, INTAKE
8 BOLT/SCREW, INTAKE MANIFOLD
9 STUD, INTAKE MANIFOLD
10 GASKET, INTAKE MANIFOLD
11 VALVE ASSEMBLY, SECONDARY AIR INJECTION CHECK
12 PIPE ASSEMBLY, SECONDARY AIR INJECTION
15 PIPE ASSEMBLY, SECONDARY AIR INJECTION
16 MANIFOLD ASSEMBLY, EXHAUST
17 GASKET, EXHAUST MANIFOLD
18 GASKET, EXHAUST MANIFOLD
19 MANIFOLD ASSEMBLY, EXHAUST
21 BOLT/SCREW, EXHAUST MANIFOLD
23 COVER ASSEMBLY, VALVE ROCKER ARM
24 BOLT/SCREW, VALVE ROCKER ARM COVER
25 GASKET, VALVE ROCKER ARM COVER
27 PUSHROD ASSEMBLY, VALVE
28 STUD, VALVE ROCKER ARM BALL
29 ARM, VALVE ROCKER
30 BALL, VALVE ROCKER ARM
31 NUT, VALVE ROCKER ARM
33 RETAINER, VALVE LIFTER GUIDE
34 HEAD ASSEMBLY, CYLINDER
35 GUIDE, VALVE LIFTER
36 LIFTER ASSEMBLY, VALVE
48 HARNESS ASSEMBLY, DISTRIBUTOR VACUUM
69 SPRING, VALVE
70 CAP, VALVE SPRING
71 VALVE, INTAKE
72 KEY, VALVE STEM
73 SEAL, VALVE STEM OIL
79 VALVE, EXHAUST
81 BOLT/SCREW, CYLINDER HEAD
82 GASKET, CYLINDER HEAD
193 SOLENOID ASSEMBLY, EGR CONTROL VALVE RELAY
194 NUT, EGR CONTROL VALVE RELAY
195 FITTING, INTAKE MANIFOLD VACUUM
196 VALVE ASSEMBLY, EVAPORATIVE EMISSION CANISTER PURGE SOLENOID
197 HOSE, EVAPORATIVE EMISSION CANISTER PURGE SOLENOID VALVE
199 PIPE ASSEMBLY, EVAPORATIVE EMISSION CANISTER PURGE SOLENOID VALVE
200 HOSE, CRANKCASE VENT VALVE
201 GROMMET, CRANKCASE VENT HOSE CONNECTOR
202 FITTING, POWER BRAKE BOOSTER VACUUM TUBE
203 GASKET, EGR VALVE
204 VALVE ASSEMBLY, EGR
205 BOLT/SCREW, EGR VALVE
206 GROMMET, CRANKCASE VENT VALVE
207 VALVE ASSEMBLY, CRANKCASE VENT
209 HOSE, CRANKCASE VENT VALVE
210 PIPE, ENGINE COOLANT AIR BLEED
211 HARNESS ASSEMBLY, EGR VALVE VACUUM
212 BOLT/SCREW, ACCELERATOR CONTROL CABLE BRACKET
213 BRACKET, ACCELERATOR CONTROL CABLE
217 SHIELD, EXHAUST MANIFOLD HEAT OUTER
218 SHIELD, EXHAUST MANIFOLD HEAT INNER
222 COIL ASSEMBLY, IGNITION
226 SPARK PLUG
227 SUPPORT, SPARK PLUG WIRE
235 HARNESS ASSEMBLY, IGNITION DISTRIBUTOR WIRING

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Figure 2 – Upper Engine Assembly – Legend

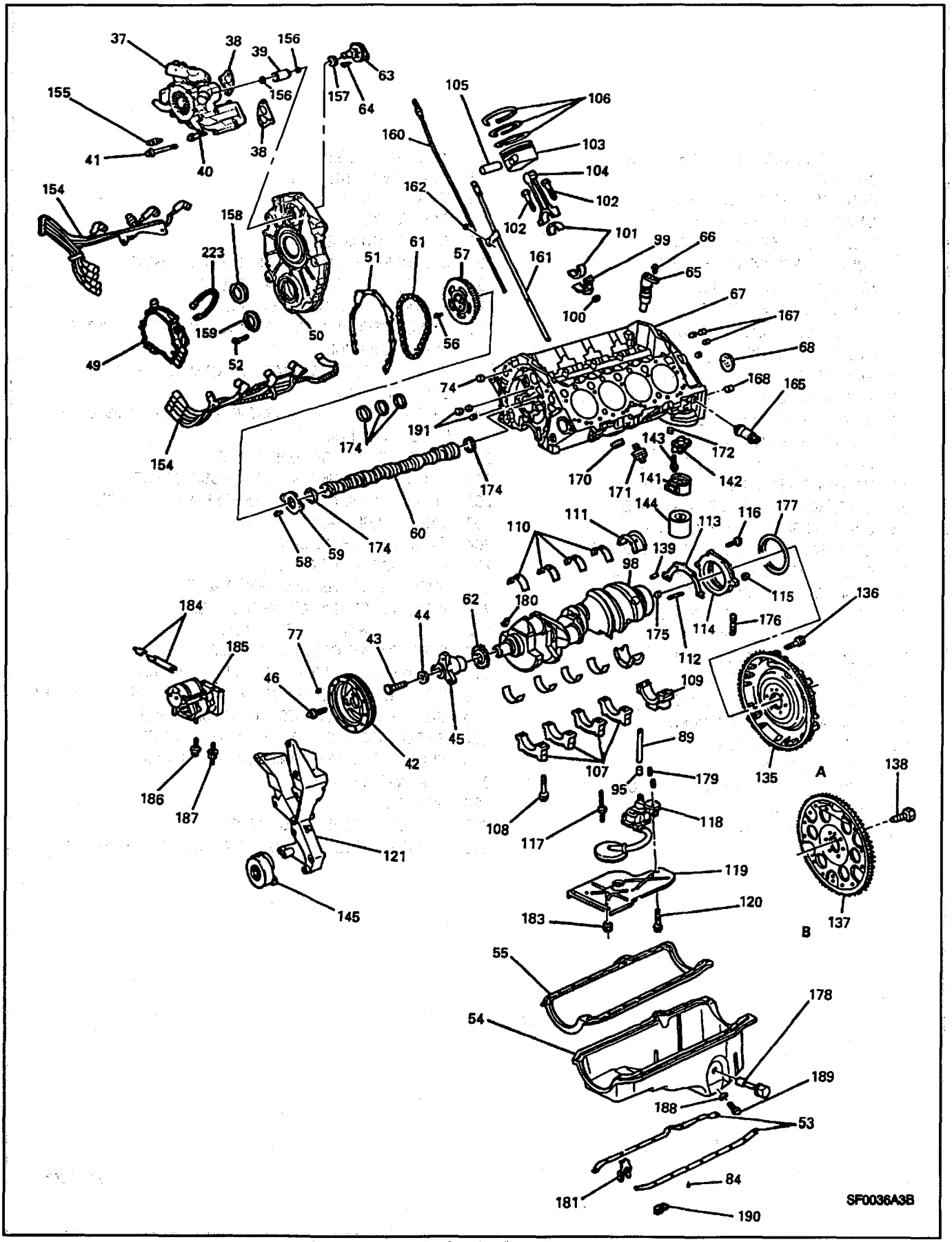
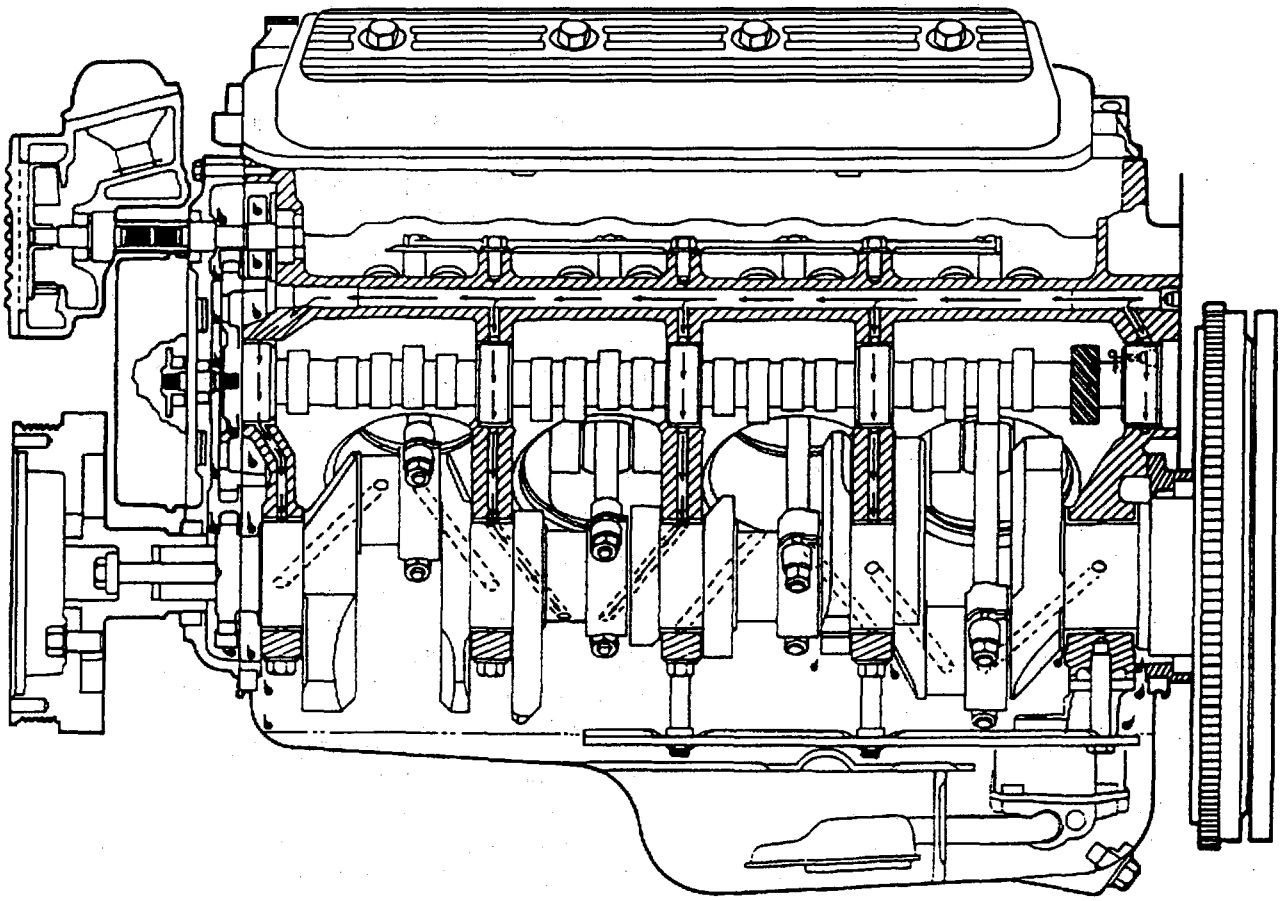


Figure 3 – Lower Engine Assembly

A FOR MANUAL TRANSMISSION
B FOR AUTOMATIC TRANSMISSION
37 PUMP ASSEMBLY, WATER
38 GASKET, WATER PUMP
39 COUPLING, WATER PUMP DRIVESHAFT
40 BOLT/SCREW WATER PUMP
41 BOLT/SCREW WATER PUMP
42 BALANCER ASSEMBLY, CRANKSHAFT
43 BOLT/SCREW, CRANKSHAFT BALANCER HUB
44 WASHER, CRANKSHAFT BALANCER HUB
45 HUB, CRANKSHAFT BALANCER
46 BOLT/SCREW, CRANKSHAFT BALANCER
49 DISTRIBUTOR ASSEMBLY
50 COVER, ASSEMBLY, ENGINE FRONT
51 GASKET, ENGINE FRONT COVER
52 BOLT/SCREW, ENGINE FRONT COVER
53 REINFORCEMENT, OIL PAN
54 PAN ASSEMBLY, OIL
55 GASKET, OIL PAN
56 BOLT/SCREW, CAMSHAFT SPROCKET
57 SPROCKET, CAMSHAFT
58 BOLT/SCREW, CAMSHAFT RETAINER
59 RETAINER, CAMSHAFT
60 CAMSHAFT ASSEMBLY
61 CHAIN ASSEMBLY, TIMING
62 SPROCKET, CAMSHAFT
63 DRIVESHAFT ASSEMBLY, WATER PUMP
64 BOLT/SCREW, WATER PUMP DRIVESHAFT BEARING RETAINER
65 DRIVESHAFT ASSEMBLY, OIL PUMP
66 BOLT/SCREW, OIL PUMP DRIVESHAFT
67 BLOCK, ENGINE
68 PLUG, CAMSHAFT REAR BEARING HOLE
74 PIN, ENGINE FRONT COVER LOCATING
77 WEIGHT, CRANKSHAFT BALANCER
84 BOLT/SCREW, OIL PAN
89 DRIVESHAFT, OIL PUMP
95 RETAINER, OIL PUMP DRIVESHAFT
98 CRANKSHAFT ASSEMBLY
99 CAP, CONNECTING ROD
100 NUT, CONNECTING ROD
101 BEARING, CONNECTING ROD
102 BOLT/SCREW, CONNECTING ROD
103 PISTON ASSEMBLY
104 ROD ASSEMBLY, CONNECTING
105 PIN, PISTON
106 RING, PISTON
107 CAP, CRANKSHAFT BEARING
108 BOLT/SCREW, CRANKSHAFT BEARING CAP
109 CAP, CRANKSHAFT BEARING
110 BEARING, CRANKSHAFT
111 BEARING, CRANKSHAFT
112 STUD, CRANKSHAFT REAR OIL SEAL RETAINER
113 GASKET, CRANKSHAFT REAR OIL SEAL HOUSING
114 HOUSING ASSEMBLY, CRANKSHAFT REAR OIL SEAL
115 NUT, CRANKSHAFT REAR OIL SEAL HOUSING
116 BOLT/SCREW, CRANKSHAFT REAR OIL SEAL HOUSING
117 STUD, CRANKSHAFT BEARING CAP
118 PUMP ASSEMBLY, OIL
119 BAFFLE, OIL PAN
120 BOLT/SCREW OIL PUMP
121 BRACKET ASSEMBLY, GENERATOR AND AIR CONDITIONING COMPRESSOR AND POWER STEERING PUMP
135 FLYWHEEL ASSEMBLY
136 BOLT/SCREW FLYWHEEL
137 FLYWHEEL ASSEMBLY
138 BOLT/SCREW FLYWHEEL
139 PIN, CRANKSHAFT REAR OIL SEAL HOUSING LOCATOR
141 COOLER ASSEMBLY, ENGINE OIL
142 ADAPTER ASSEMBLY, OIL FILTER
143 BOLT/SCREW, OIL FILTER ADAPTER
144 FILTER ASSEMBLY, OIL
145 TENSIONER ASSEMBLY, DRIVE BELT
154 HARNESS ASSEMBLY, SPARK PLUG WIRE
155 SENSOR ASSEMBLY, ENGINE COOLANT TEMPERATURE
156 SEAL, WATER PUMP DRIVESHAFT
157 SEAL ASSEMBLY, WATER PUMP BEARING
158 SEAL, DISTRIBUTOR
159 SEAL ASSEMBLY, CRANKSHAFT FRONT OIL
160 INDICATOR ASSEMBLY, OIL LEVEL
161 TUBE ASSEMBLY, OIL LEVEL INDICATOR
162 NUT, OIL LEVEL INDICATOR TUBE
165 SENSOR ASSEMBLY, FUEL PUMP AND ENGINE OIL PRESSURE INDICATOR SWITCH
167 PLUG, ENGINE BLOCK OIL GALLERY
168 PIN, TRANSMISSION
170 PLUG, ENGINE BLOCK CORE HOLE
171 SENSOR ASSEMBLY, KNOCK
172 PLUG, OIL FILTER ADAPTER HOLE
174 BEARING, CAMSHAFT
175 BEARING, CLUTCH PILOT
176 STUD, CRANKSHAFT REAR OIL SEAL RETAINER
177 SEAL ASSEMBLY, CRANKSHAFT REAR OIL
178 SENSOR ASSEMBLY, ENGINE OIL LEVEL SWITCH
179 PIN, OIL PUMP LOCATOR
180 KEY, CRANKSHAFT BALANCER
181 CLIP, TRANSMISSION OIL COOLER PIPE
183 NUT, CRANKSHAFT OIL DEFLECTOR
184 SHIM, STARTER MOTOR
185 MOTOR ASSEMBLY, STARTER
186 BOLT/SCREW, STARTER MOTOR
187 STUD, STARTER MOTOR
188 GASKET, OIL PAN DRAIN PLUG
189 PLUG, OIL PAN DRAIN
190 BRACKET, ENGINE WIRING HARNESS
191 PLUG, ENGINE BLOCK OIL GALLERY
223 HARNESS ASSEMBLY, IGNITION COIL WIRE

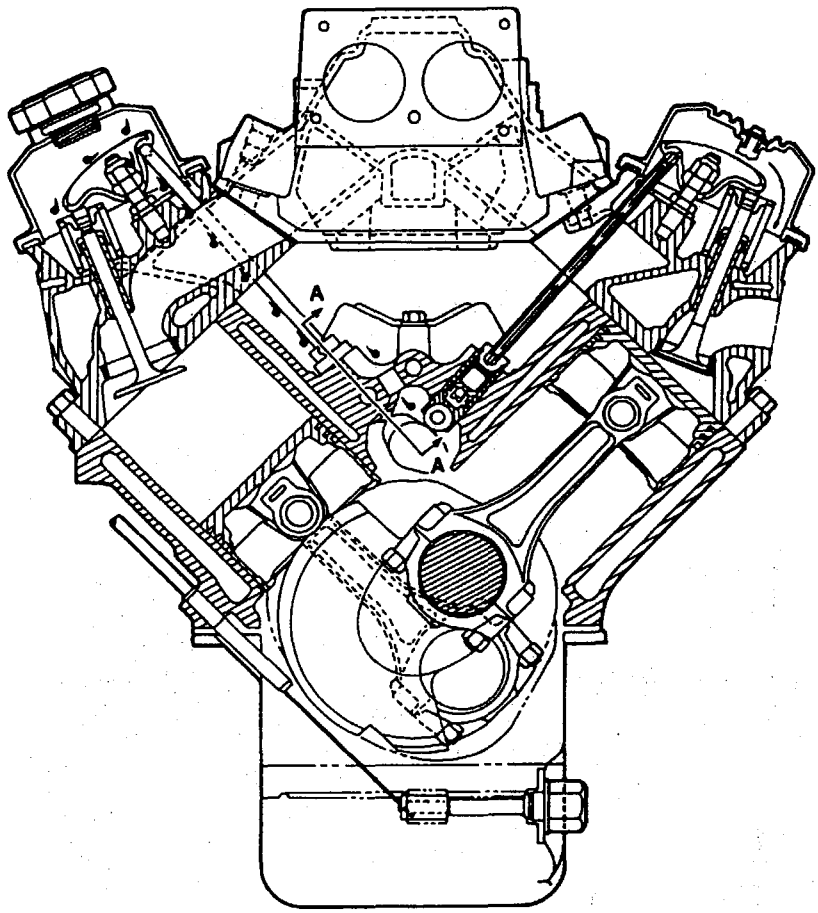
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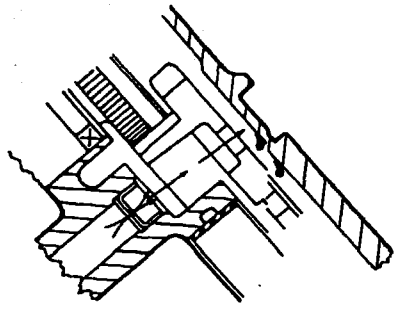
Figure 4 – Lower Engine Assembly – Legend



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Figure 5 – Engine Assembly Lubrication – Left Side View





SECTION A – A

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Figure 6 – Engine Assembly Lubrication - Front View

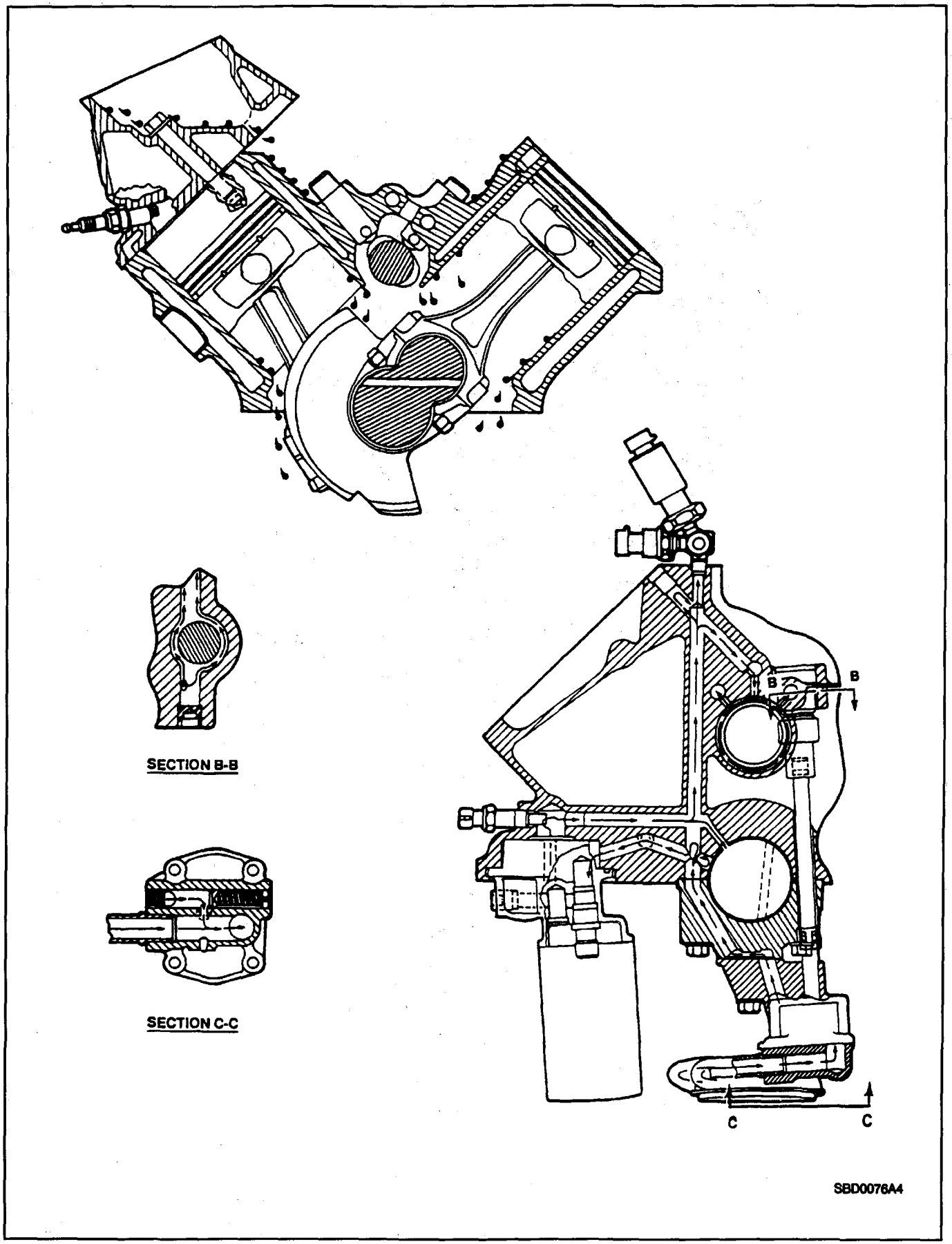
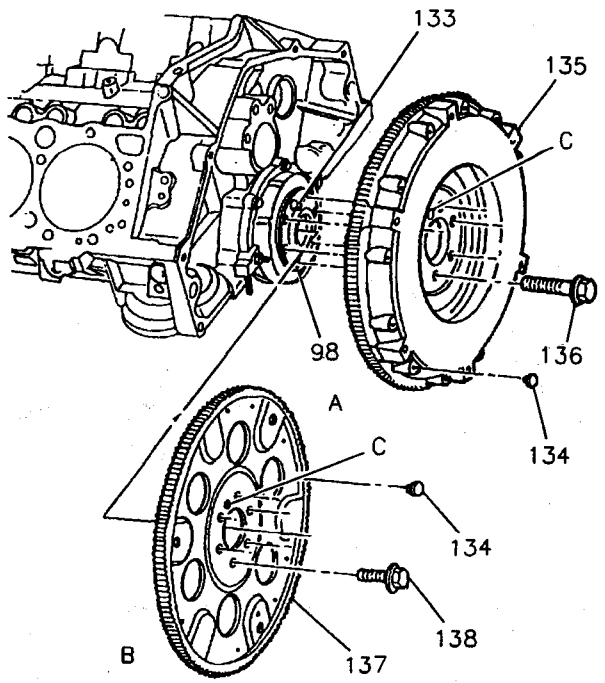


Figure 7 – Engine Assembly Lubrication – Rear Views



A FOR MANUAL TRANSMISSION
B FOR AUTOMATIC TRANSMISSION
C LOCATOR HOLE
98 CRANKSHAFT ASSEMBLY
133 PIN, FLYWHEEL LOCATOR
134 WEIGHT, FLYWHEEL
135 FLY WHEEL ASSEMBLY
136 BOLT/SCREW, FLYWHEEL
137 FLYWHEEL ASSEMBLY
138 BOLT/SCREW, FLYWHEEL
SF0076A3B

Figure 8 – Flywheel Assembly

VALVE ROCKER ARMS AND PUSHROD ASSEMBLIES

Figure 14

Remove or Disconnect

1. Rocker arm nuts (31) and balls (30).
2. Rocker arms (29) and pushrod assemblies (27).
   - Place rocker arms (29), rocker arm balls (30) and pushrod assemblies (27) in a rack so that they can be reinstalled in same locations from which they were removed.
3. Rocker arm ball stud (28).

VALVE LIFTER ASSEMBLIES

Figure 15

Remove or Disconnect

1. Valve lifter guide retainer bolts/screws (32) and retainer (33).
2. Valve lifter guides (35) and valve lifter assemblies (36).
   - Some valve lifter assemblies (36) may be stuck in their bores because of gum or varnish deposits. These lifter assemblies (36) can be removed using J 3049 or J 9290-01.

WATER PUMP ASSEMBLY

Figure 16

Remove or Disconnect

1. Air injector pump bracket bolt/screws and bracket.
2. Water pump bolts/screws (40 and 41).

Important

A. Keep ignition wires connected to distributor assembly until water pump is removed.
B. Make sure coolant is drained.

2. Water pump assembly (37), coupling (39) and gaskets (38).

CRANKSHAFT BALANCER ASSEMBLY AND HUB

Figure 17

Tool Required:
J 39046 Crankshaft Hub Remover/Installer

Remove or Disconnect

1. Crankshaft balancer bolts/screws (46) and balancer assembly (42).
2. Crankshaft balancer hub bolt/screw and washer.
3. Crankshaft balancer hub (45) using J 39046.

DISTRIBUTOR ASSEMBLY

Figure 18

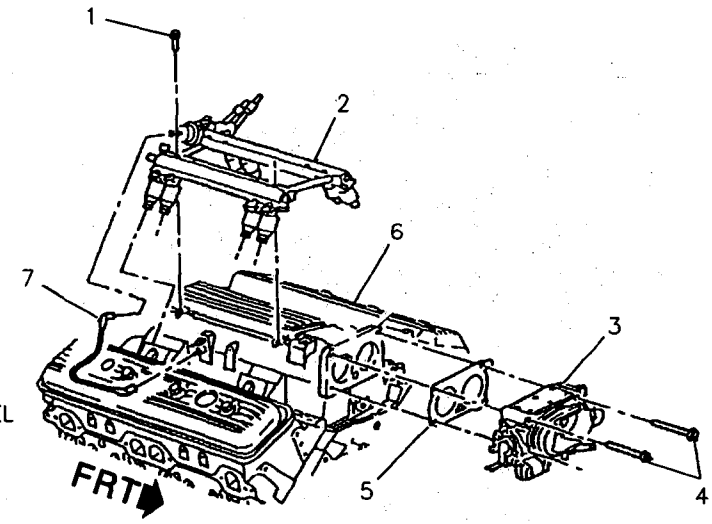
Remove or Disconnect

1. Spark plug and ignition harness assemblies from coil assembly and spark plugs.
2. Distributor vacuum harness assembly.

Important

- Do not allow foreign material to enter open vacuum lines.
- Cap ends as necessary.

3. Distributor bolts/screws (47) and distributor assembly (49).



1 BOLT/SCREW,FUEL INJECTION FUEL RAIL
2 RAIL ASSEMBLY, MULTIPORT FUEL INJECTION FUEL
3 BODY ASSEMBLY, THROTTLE
4 BOLT/SCREW, THROTTLE BODY
5 GASKET, THROTTLE BODY
6 MANIFOLD ASSEMBLY, INTAKE
7 TUBE ASSEMBLY, FUEL PRESSURE REGULATOR VACUUM

Figure 9 – Fuel Rail and Throttle Body Assemblies

OIL PAN ASSEMBLY

Remove or Disconnect

1. Oil level sensor assembly.
   - Oil level sensor assembly must be removed to prevent it from being damaged as oil pan assembly is removed.
2. Oil pan bolts/screws, nuts and studs.
3. Oil pan assembly, reinforcements and gasket.

ENGINE FRONT COVER ASSEMBLY

Figure 19

Remove or Disconnect

1. Front cover bolts/screws (52).
2. Front cover assembly (50) and gasket (51).

TIMING CHAIN ASSEMBLY, CRANKSHAFT AND CAMSHAFT SPROCKETS, AND WATER PUMP DRIVESHAFT ASSEMBLY

Figures 20 and 21

Tools Required:

J 39243 Driven Gear Assembly Remover
J 5825-A Crankshaft Gear Remover

Remove or Disconnect

1. Camshaft sprocket bolts/screws (56).
   NOTICE: To prevent damage to piston or valve assemblies, do not turn the crankshaft assembly after the timing chain assembly has been removed.
2. Camshaft sprocket (57) and timing chain assembly (61).
3. Water pump driveshaft bolts/screws (64) and driveshaft assembly (63) using J 39243.
4. Crankshaft sprocket (62) using J 5825-A.
5. Key, if necessary.

CAMSHAFT ASSEMBLY

Figures 20, 22 and 23

Remove or Disconnect

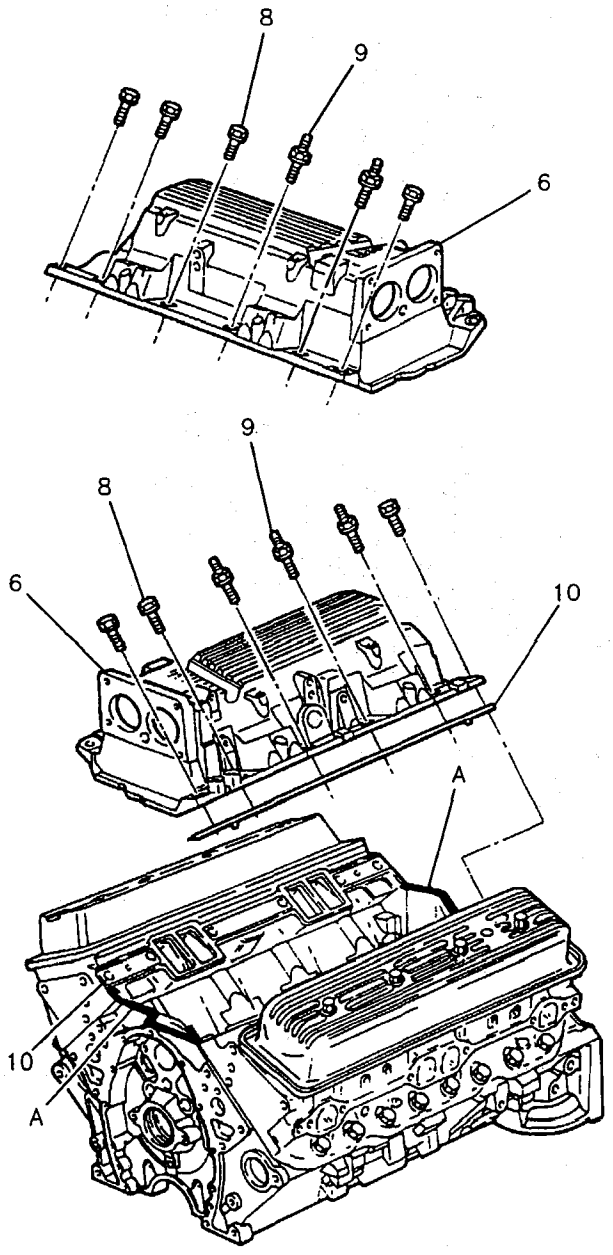
1. Bolt/screw (66) and oil pump driveshaft assembly (65).
2. Camshaft retainer bolts/screws (58) and retainer (59).
   NOTICE: All camshaft journals are the same diameter so care must be used in removing the camshaft assembly to avoid damage to the bearings.
3. Camshaft assembly (60).
   A. Install three 5/16-18 x 4-inch bolts in camshaft bolt holes.
   B. Carefully rotate and pull camshaft assembly (60) out of bearings.

CYLINDER HEAD ASSEMBLY

Figures 24 and 25

Remove or Disconnect

1. Engine coolant air bleed pipe bolts/screws and pipe.
   - Use a backup wrench on pipe fitting when removing bolts/screws.
2. Generator bracket bolts/screws (122 and 123) spark plug wire support (173) and bracket assembly (121) from right cylinder head assembly (34).



A SEALER
6 MANIFOLD ASSEMBLY, INTAKE
8 BOLT/SCREW, INTAKE MANIFOLD
9 STUD, INTAKE MANIFOLD
10 GASKET, INTAKE MANIFOLD

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Figure 10 – Intake Manifold Assembly

3. Cylinder head bolts/screws (81).

   NOTICE: After removal, place the cylinder head assembly on two wood blocks to prevent damage.

4. Cylinder head assembly (34) and gasket (82).
5. Ignition coil studs, coil and bracket assembly from left cylinder head assembly (34).

OIL PUMP ASSEMBLY

Figure 26

Remove or Disconnect

1. Oil pan baffle nuts.
2. Bolt/screw (120) attaching oil pump assembly (118) to rear crankshaft bearing cap.
3. Oil pan baffle (119), oil pump assembly (118), driveshaft (89) and retainer (95).

PISTON AND CONNECTING ROD ASSEMBLY

Figure 27

Tool Required:

J 5239 Connecting Rod Bolt Guide Set

Remove or Disconnect

1. Ring ridge.
   A. Turn crankshaft assembly (98) until piston assembly (103) is at bottom of its stroke.
   B. Place a cloth on top of piston assembly (103).
   C. Use a ridge reamer to remove ring ridge.
   D. Turn crankshaft assembly (98) so piston assembly (103) is at top of its stroke.
   E. Remove cloth and cutting debris.

Important

- Place matchmarks or numbers on connecting rod assemblies (104) and connecting rod caps (99). Connecting rod caps (99) must be assembled to their original connecting rod assemblies (104).

2. Connecting rod nuts (100).
3. Connecting rod cap (99) and bearings (101).
   - Keep bearings (101) with their original connecting rod assembly (104) and connecting rod cap (99) for reassembly if they are being reused.
   - Wipe oil from bearings (101) and crankpins.
4. Connecting rod assembly (104) and piston assembly (103) out of top of engine block using J 5239.

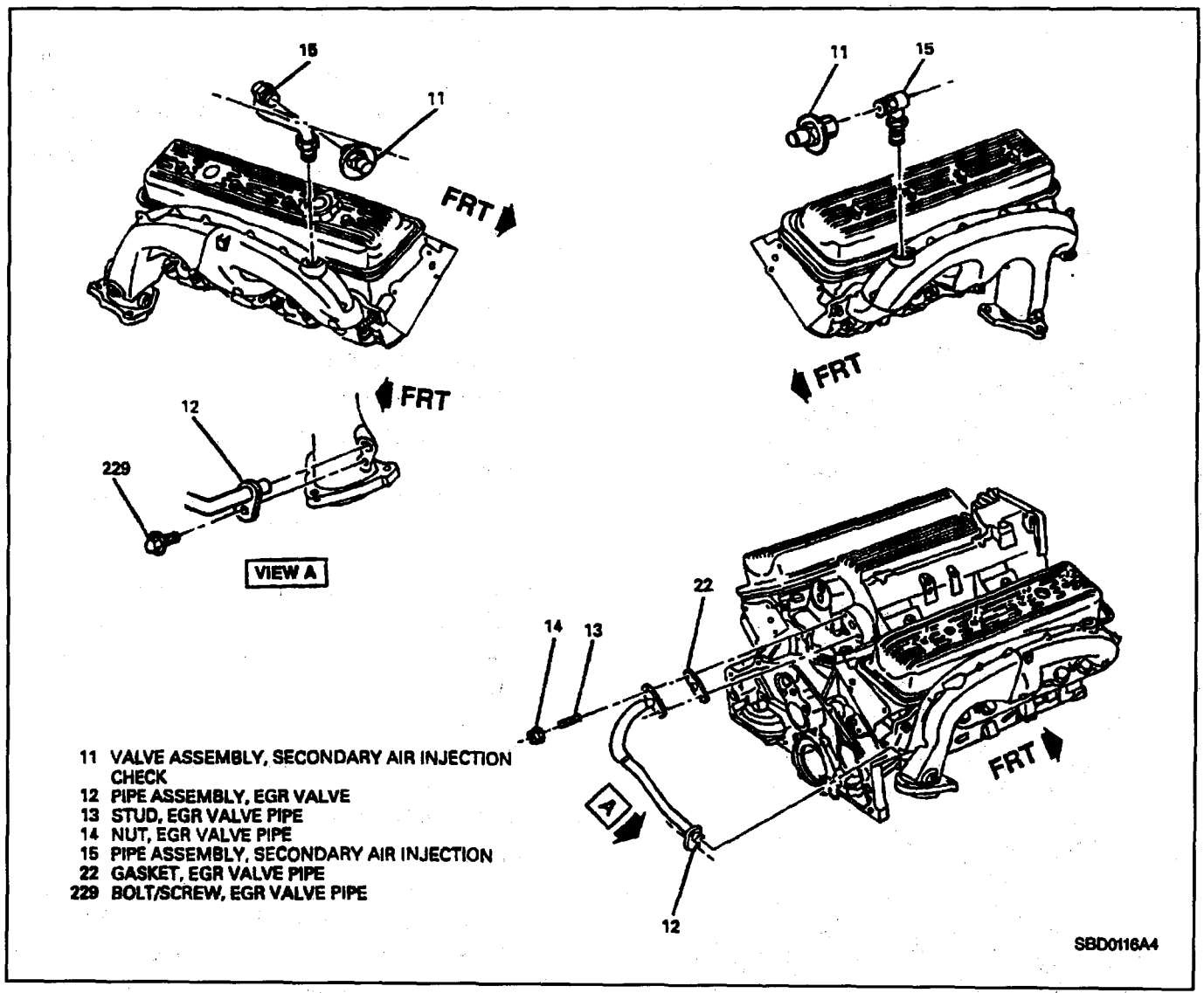


Figure 11 – Secondary Air Injection Components

CRANKSHAFT REAR OIL SEAL HOUSING AND CRANKSHAFT ASSEMBLY

Figures 28 and 29

Remove or Disconnect

1. Crankshaft rear oil seal housing nuts (115) and bolts/screws (116).
2. Crankshaft rear oil seal housing assembly (114) with assembled seal, and gasket (113).
3. Crankshaft rear oil seal from crankshaft rear oil seal housing assembly (114).
4. Crankshaft bearing cap bolts/screws (108) and studs (117).
5. Crankshaft bearing caps (107) and rear crankshaft bearing cap (109).
6. Crankshaft assembly (98).
7. Crankshaft bearings (110 and 111) from engine block (67).
8. Crankshaft bearings (110 and 111) from crankshaft bearing caps (107) and rear crankshaft bearing cap (109).

CAMSHAFT BEARINGS

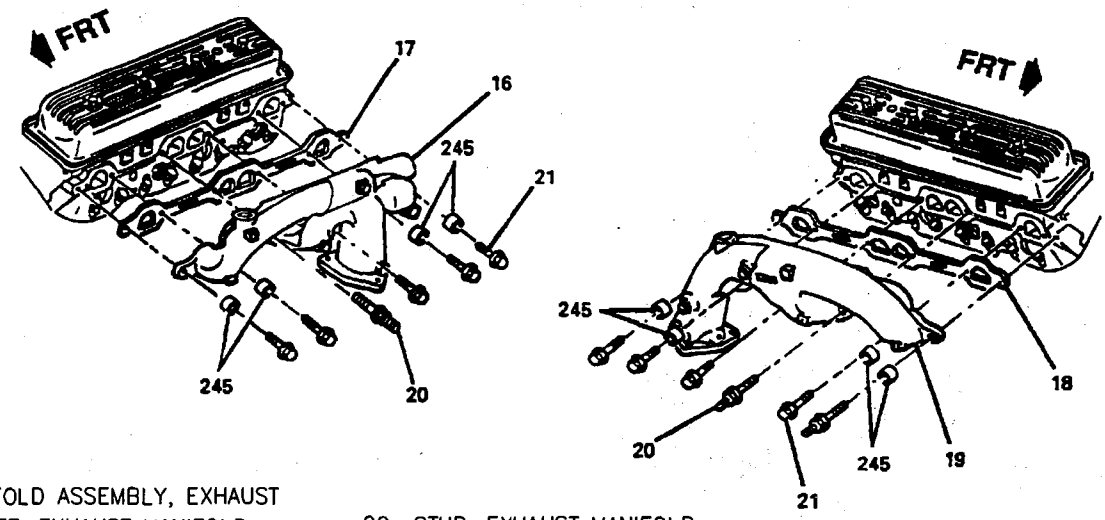
Figures 30 and 31

Tool Required:

J 6098-01 Camshaft Bearing Remover/Installer

Remove or Disconnect

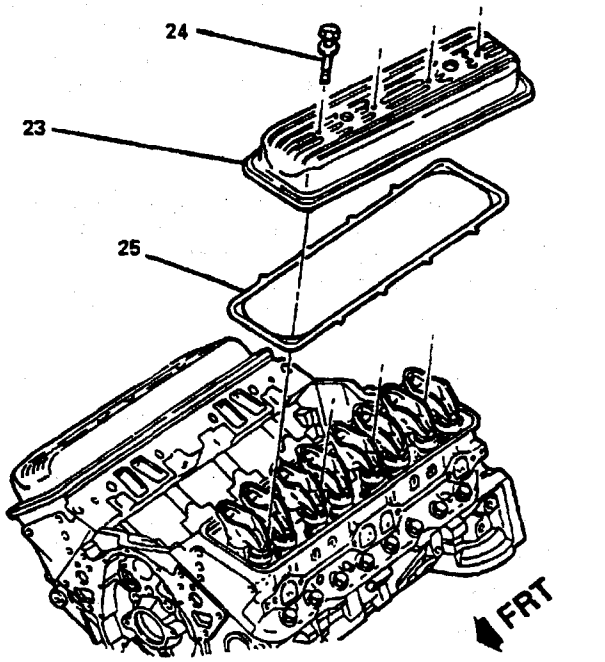
1. Camshaft rear bearing hole plug.
2. Inner camshaft bearings using J 6098-01.
   A. With nut and thrust washer installed to end of puller screw threads, index pilot in camshaft front bearing and install puller screw through pilot and bearing to be removed.



16 MANIFOLD ASSEMBLY, EXHAUST
17 GASKET, EXHAUST MANIFOLD
18 GASKET, EXHAUST MANIFOLD
19 MANIFOLD ASSEMBLY, EXHAUST
20 STUD, EXHAUST MANIFOLD
21 BOLT/SCREW, EXHAUST MANIFOLD
245 SPACER, EXHAUST MANIFOLD

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Figure 12 – Exhaust Manifold Assemblies



23 COVER ASSEMBLY, VALVE ROCKER ARM
24 BOLT/SCREW, VALVE ROCKER ARM COVER
25 GASKET, VALVE ROCKER ARM COVER

SBD0136A4

Figure 13 – Valve Rocker Arm Cover Assemblies

B. Install bearing tool with shoulder toward bearing. Make sure that enough threads are engaged.
C. Using two wrenches, hold puller screw while turning nut to draw bearing out of bore.
   - When bearing has been pulled from bore, remove bearing tool and bearing from puller screw.
D. Repeat above steps for remaining inner camshaft bearings.
   - Index pilot in rear camshaft bearing to remove rear inner bearing.

3. Front and rear camshaft bearings using J 6098-01.
   A. Assemble bearing tool to driver handle.
   B. Drive front and rear bearings out, toward center of engine block (67).

CLEANING, INSPECTION AND REPAIR

ENGINE BLOCK

Figure 31

Remove or Disconnect

1. Engine oil cooler assembly (141).
2. Oil filter adapter bolts/screws (143).
3. Oil filter assembly (142).
4. Front and rear oil gallery plugs.

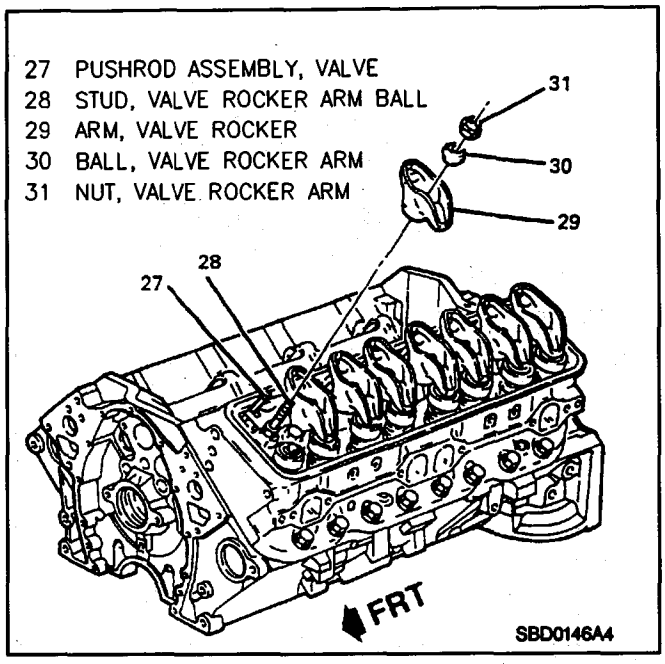


Figure 14 – Valve Rocker Arms and Pushrod Assemblies

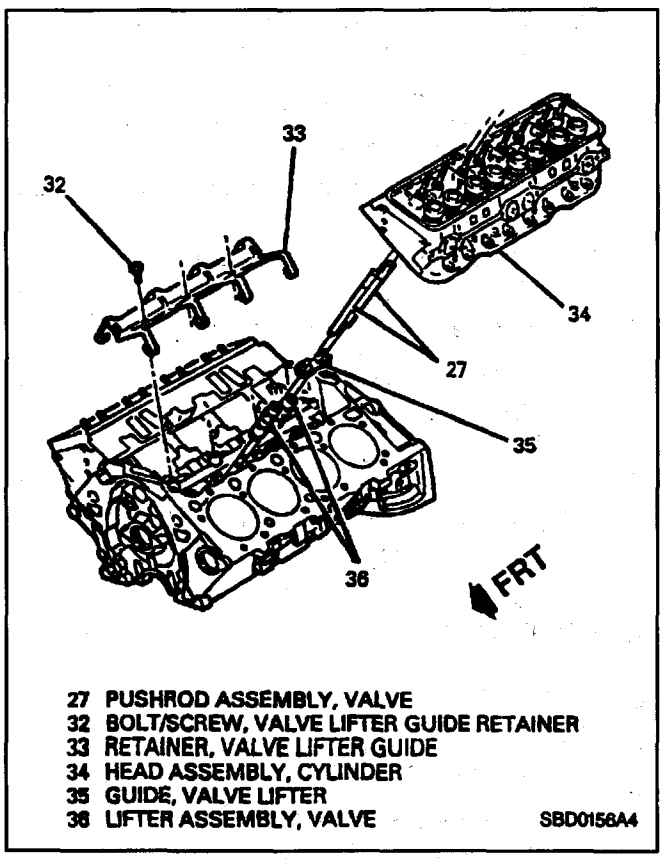


Figure 15 – Valve Lifter Assemblies

5. Fuel pump and oil pressure sensor assembly.
6. Starter motor assembly. Refer to SECTION 6D2.
7. Engine block core plugs.

Clean

- Engine block in solvent.
- Gasket surfaces.
- Coolant passages.
- Oil passages.

Inspect

- For cracks in cylinder walls, coolant jacket, valve lifter bores and crankshaft bearing webs.

Measure

- Cylinder bores for taper, out-of-round, or excessive ring ridge at top of ring travel. Use a dial indicator. Compare measurements to "Specifications" in this section.
  - Cylinders with less than 0.025 mm (0.0010 inch) of wear or taper may be reconditioned with a hone.
  - Cylinders with more than 0.025 mm (0.0010 inch) wear or taper must be bored and honed to smallest oversize piston assembly that will permit complete resurfacing of all cylinders.

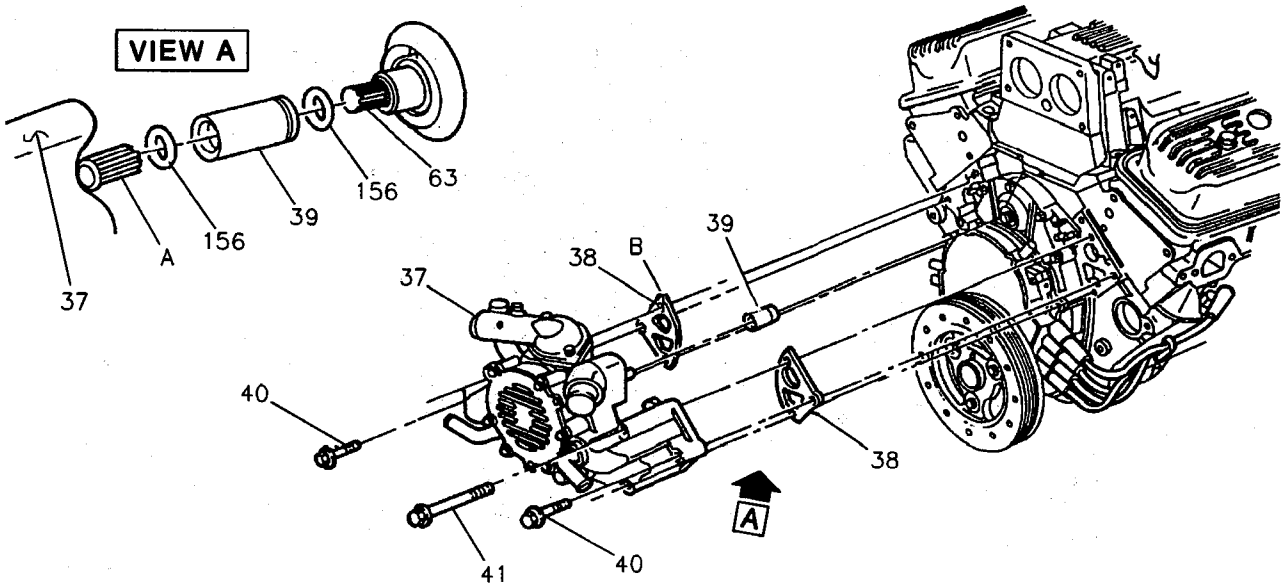
Boring

1. Draw a flat file across top of engine block several times to remove any burrs or gasket material. If engine block surface is not completely smooth and flat, boring bar may be tilted which would result in cylinder having an incorrect angle to crankshaft assembly.
2. Measure piston assembly to be installed 11.5 mm (0.45 inch) from bottom of piston skirt and at right angles to piston pin.
3. Bore cylinder to same diameter as piston assembly.
4. Hone cylinder as outlined below to provide specified clearance.
   - Follow instructions provided by manufacturer of boring equipment being used.

NOTICE: Handle piston assemblies with care. Do not attempt to force them into the cylinder. The piston assemblies may be easily distorted.

Honing

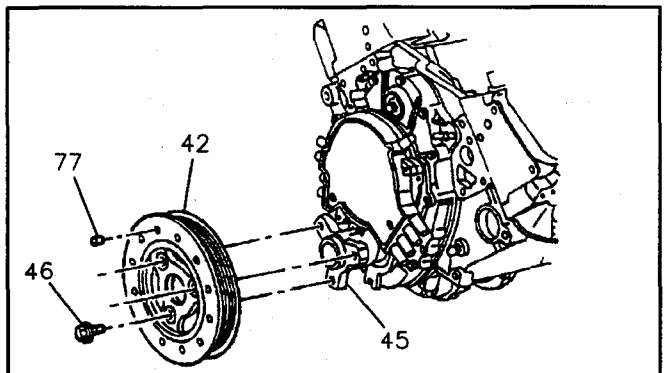
1. Follow instructions provided by manufacturer of honing equipment being used.
2. Occasionally during honing operation:
   A. Clean cylinder bore.
   B. Measure cylinder bore for proper piston fit.



A SHAFT, WATER PUMP
B TAB ON GASKET
37 PUMP ASSEMBLY, WATER
38 GASKET, WATER PUMP
39 COUPLING, WATER PUMP DRIVESHAFT
40 BOLT/SCREW, WATER PUMP
41 BOLT/SCREW, WATER PUMP
63 DRIVESHAFT ASSEMBLY, WATER PUMP
156 SEAL, WATER PUMP DRIVESHAFT

SF0106A3B

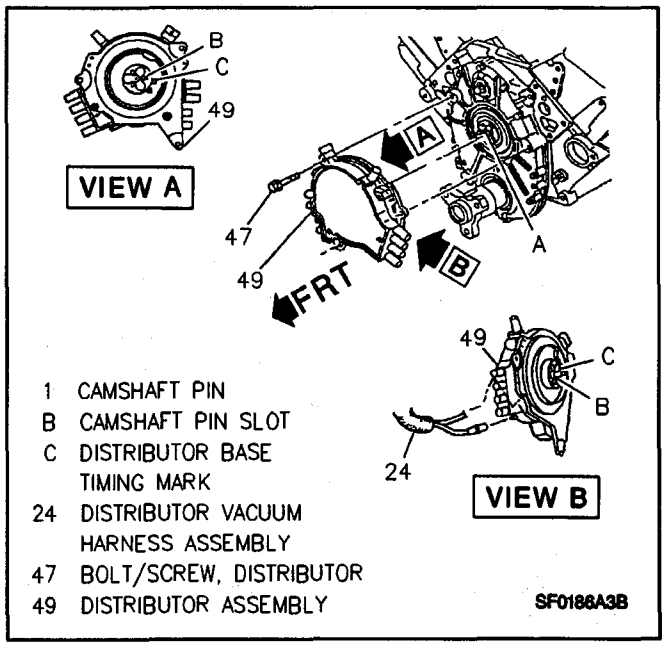
Figure 16 – Water Pump Assembly



42 BALANCER ASSEMBLY, CRANKSHAFT
45 HUB, CRANKSHAFT BALANCER
46 BOLT/SCREW, CRANKSHAFT BALANCER
77 WEIGHT, CRANKSHAFT BALANCER

SBD0176A4

Figure 17 - Crankshaft Balancer Assembly and Hub



1 CAMSHAFT PIN
B CAMSHAFT PIN SLOT
C DISTRIBUTOR BASE TIMING MARK
24 DISTRIBUTOR VACUUM HARNESS ASSEMBLY
47 BOLT/SCREW, DISTRIBUTOR
49 DISTRIBUTOR ASSEMBLY

SF0186A3B

Figure 18 – Distributor Assembly

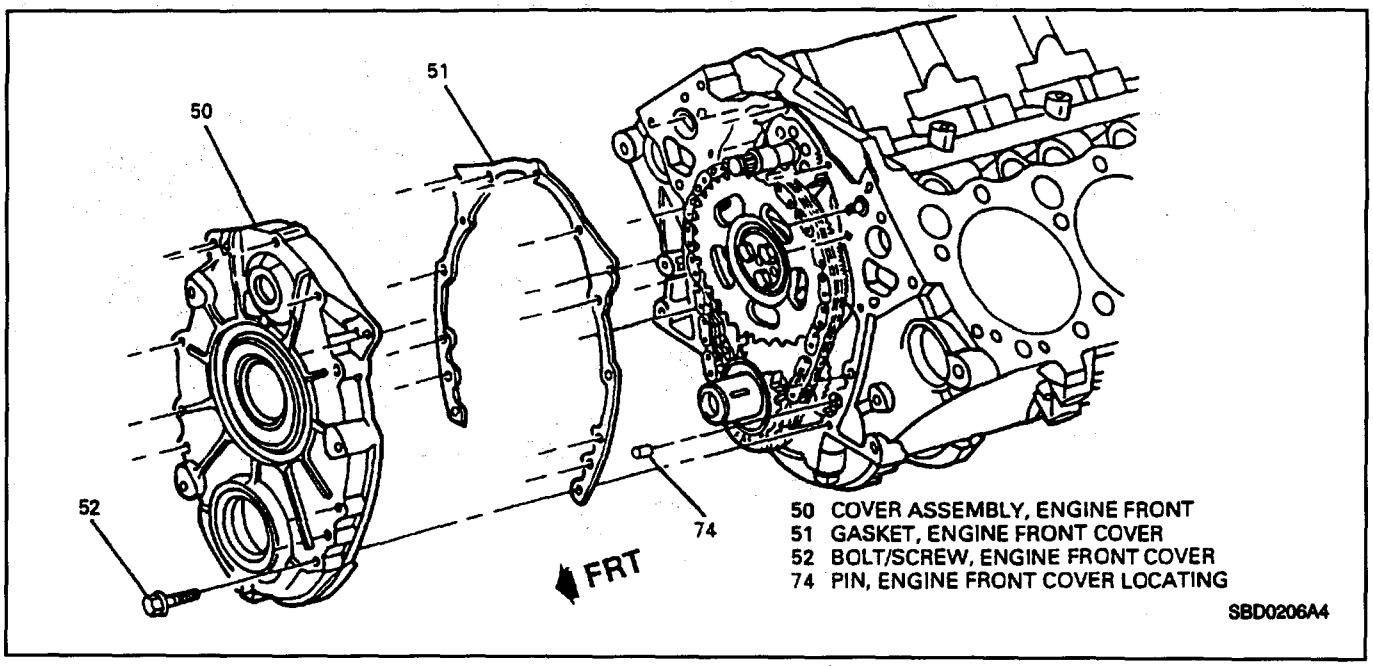


Figure 19 – Engine Front Cover Assembly

3. Finish operation with a 45 to 65 degree crosshatch pattern on cylinder walls.
   - Finish marks should be clean but not sharp, free from imbedded particles and torn or faded metal.
4. Place a permanent mark on each piston assembly to match it to its proper cylinder.

Clean

- Cylinder bores and block with hot water and detergent using a stiff bristle brush. Rinse thoroughly and dry with a clean cloth.
  - Any abrasive material left in cylinder bores will cause rapid wear of piston rings, bearings, and other engine assembly parts.
  - Do not use kerosene or gasoline for cleaning.
  - After cleaning, swab cylinder bores with light engine oil and a clean cloth. Then wipe them out with a clean dry cloth.

CRANKSHAFT BEARING FITTING

Figure 28

If replacing rear crankshaft bearing, check for correct part number. Some rear crankshaft bearings are 0.20 mm (0.008-inch) wider than standard. Crankshaft assembly will be identified by "0.008" stamped on rear counterweight.

It is necessary to measure clearance of each crankshaft bearing to determine proper sizes. Factory installed crankshaft bearings may not be same size for each journal.

Inspect

- Lower half of crankshaft bearing (110 or 111).
  - If lower half is worn or damaged, both upper and lower half should be replaced.
  - If lower half is suitable for use, upper half will also be suitable for use.

Measure

- Crankshaft bearing clearance using gaging plastic.

A. Place a piece of gaging plastic full width of crankshaft bearing (110 or 111) onto journal.

B. Measure all five bearing clearances at same time.

Important

- Do not rotate crankshaft assembly (98) while gaging plastic is between journal and crankshaft bearing (110 or 111).

C. Install crankshaft bearing caps (107) and rear crankshaft bearing cap (109) with arrows pointing toward front of engine block assembly.

D. Install bearing cap bolts/screws (108) and studs (117).

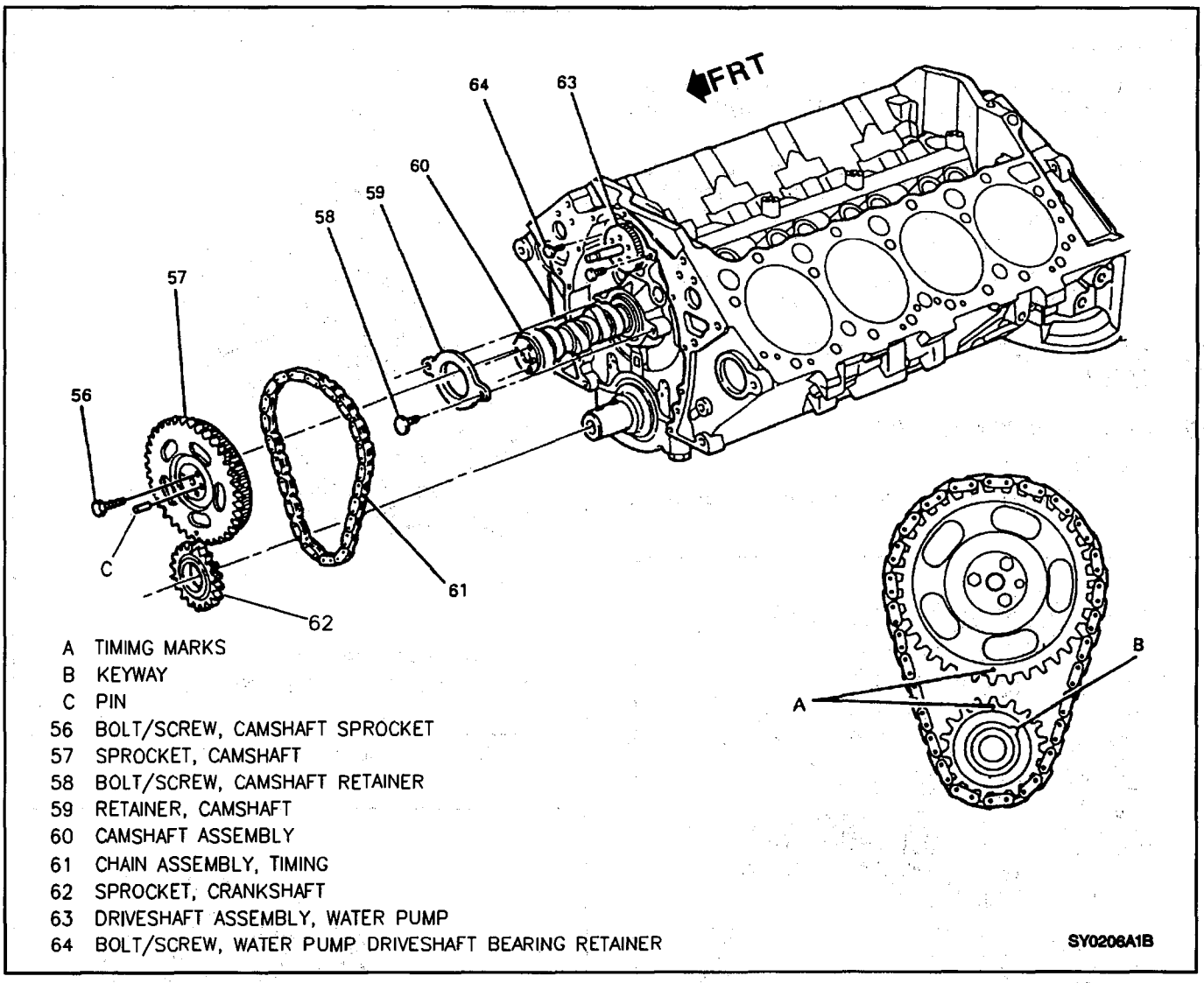


Figure 20 – Camshaft Assembly, Sprockets and Water Pump Driveshaft Assembly

Tighten

- In board bolts/screws (108) and studs (117) on four-bolt crankshaft bearing caps to N•m (105/77 lb. ft.).
- All other bolts/screws (108) to 92 N•m (68 lb. ft.).

E. Remove crankshaft bearing cap bolts/screws (108), studs (117), crankshaft bearing caps (107) and rear crankshaft bearing cap (109).

F. Measure gaging plastic at its widest using scale provided with gaging plastic. Refer measurements to "Specifications" in this section.

- If gaging plastic shows an irregularity in journal exceeding 0.025 mm (0.0010 inch), measure journal with a micrometer.
- If clearance is greater than specified, select an undersize bearing and re-measure clearance. Always replace both upper and lower crankshaft bearings (110 and 111) as a unit.
- If clearance cannot be brought to specifications using a standard undersize bearing, regrind crankshaft assembly (98) for use with next undersize bearing.

CRANKSHAFT ASSEMBLY

Figure 28

Clean

- Crankshaft assembly (98) in solvent and dry it with compressed air.

Measure

- Crankpins for out-of-round, taper, or undersize with a micrometer. Refer to "Specifications" in this section.
- Crankshaft run-out at front and rear intermediate journals with a dial indicator. Support crankshaft front and rear journals on V-blocks. Refer to "Specifications" in this section.
- Replace or recondition crankshaft assembly (98) if measurements are outside of specifications.

PISTON AND CONNECTING ROD ASSEMBLY

Figures 27 and 33 through 37

Tool Required:

J 24086-B Piston Pin Remover and Installer Set

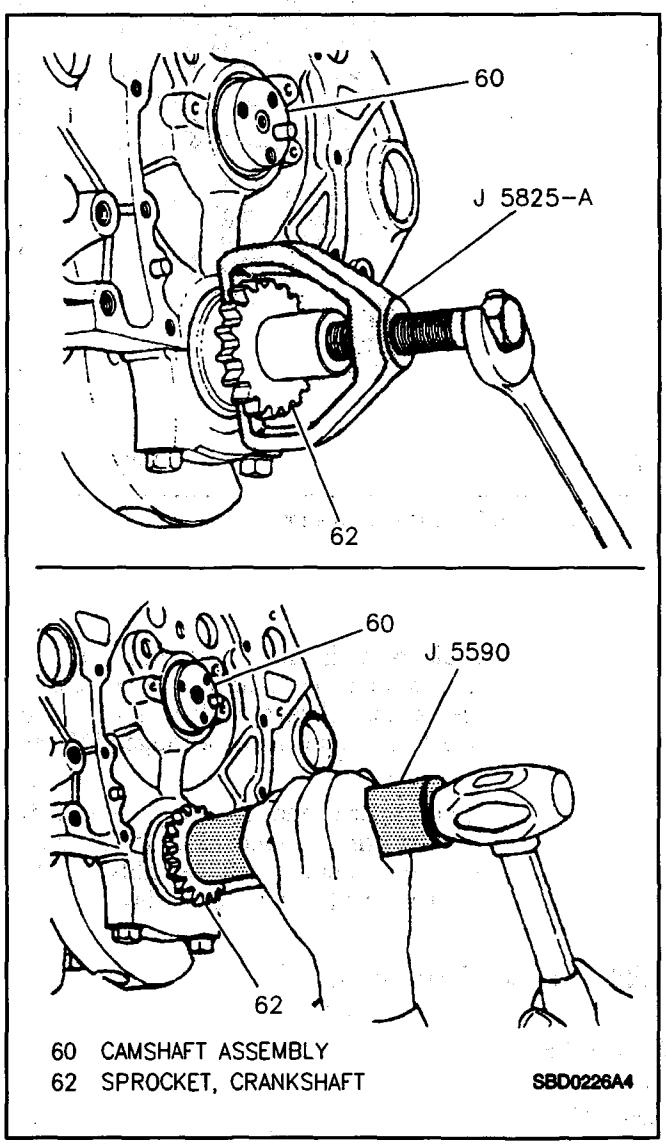


Figure 21 – Crankshaft Sprocket Replacement

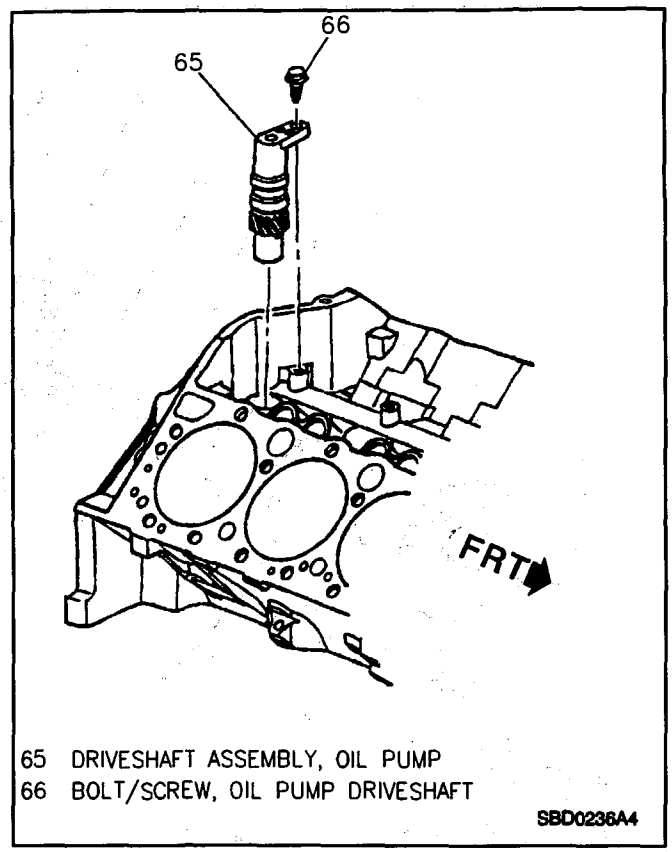


Figure 22 – Oil Pump Driveshaft Assembly

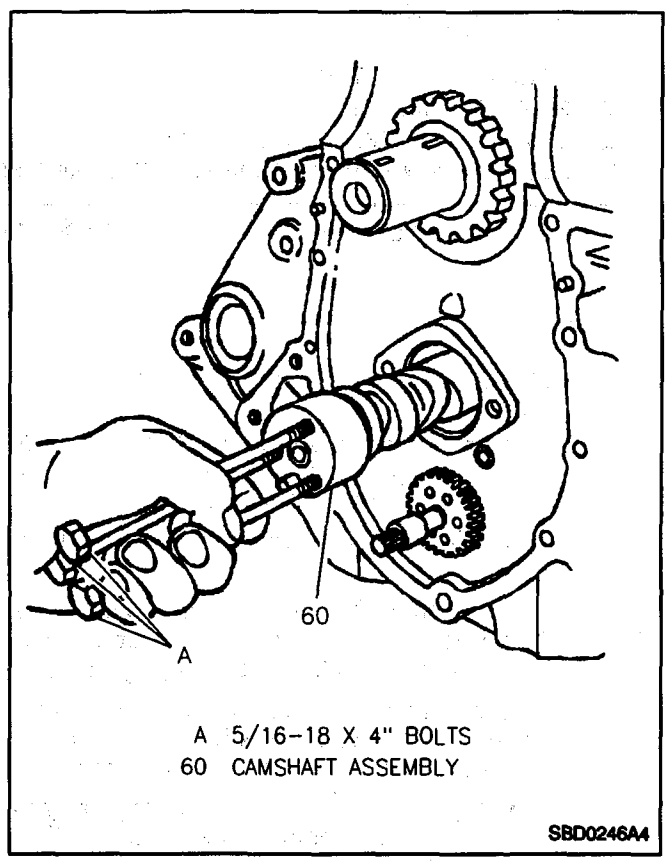


Figure 23 – Removing Camshaft Assembly

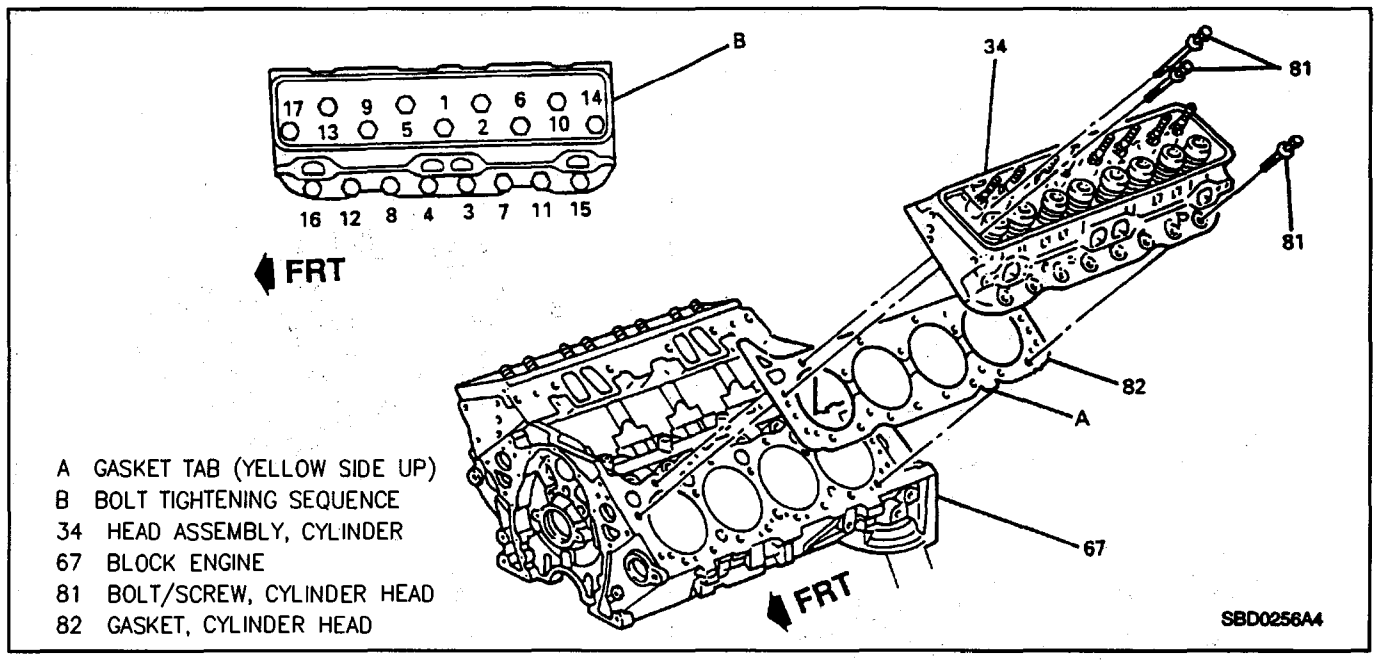


Figure 24 – Cylinder Head Assembly

Disassemble

1. Piston rings (106) from piston assembly (103).
2. Piston pin (105) from piston assembly (103) using J 24086-B (Figure 33).

Clean

1. Connecting rod assembly (104) in cleaning solvent.
2. Dry connecting rod assembly (104) with compressed air. Do not wire brush any part of piston assembly.
3. Varnish from piston skirts and pins with cleaning solvent.
4. Piston ring grooves with a groove cleaner.
5. Piston oil ring holes and slots.

Inspect

- Connecting rod assembly (104) for twisting, nicks and cracks. Replace any damaged connecting rod assemblies (104).
- Piston assemblies (103) for:
  - Cracked ring lands, skirts, or pin bosses.
  - Grooves for nicks or burrs that may cause binding.
  - Warped or worn ring lands.
  - Scuffed or damaged skirts.
  - Eroded areas at top of piston assembly (103).
  - Worn piston bores and piston pins (105).
  - Replace piston assemblies (103) that are damaged or show signs of excessive wear.

Measure

1. Piston pin bore-to-piston pin clearance.
   A. Piston pin bores and piston pins (105) must be free of varnish or scuffing when being measured.
   B. Use a micrometer to measure piston pin (105) and an inside micrometer to measure piston pin bore.
   C. If clearance is in excess of 0.025 mm (0.0010 inch), piston assembly (103) and piston pin (105) should be replaced. Piston assembly (103) and piston pin (105) are matched and are not serviced separately.
2. Piston compression ring end gap.

Important

- Fit each compression ring to cylinder in which it will be used.
  A. Place compression ring into cylinder bore.
  B. Push compression ring into cylinder bore to approximately 6.5 mm (1/4 inch) below ring travel. Ring must be square to cylinder wall.
  C. Measure end gap with a feeler gage. Refer to "Specifications" in this section for acceptable end gaps.
  D. If end gap exceeds specifications, select another size ring set.

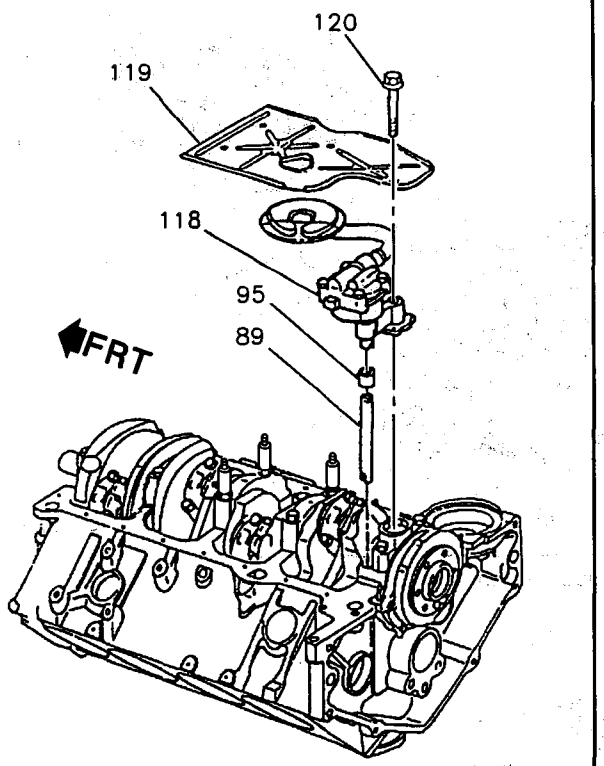


Figure 25 – Oil Pump Assembly

3. Piston ring side clearance.
   A. Roll piston ring (106) entirely around its ring groove on piston assembly (103).
   B. If any binding is caused by ring groove, dress groove with a fine cut file.
   C. If any binding is caused by a distorted piston ring (106), replace piston ring (106).
   D. Measure side clearance of piston ring (106) and groove with a feeler gage. For acceptable side clearances, refer to "Specifications" in this section.
   E. If side clearance is too small, try another piston ring (106).
4. Piston-to-cylinder bore clearance to determine suitability of a used piston assembly (103). Measure piston-to-cylinder bore clearance as follows:
   A. Measure cylinder bore diameter at a point 64 mm (2 1/2 inches) from top of cylinder bore using a bore gage.

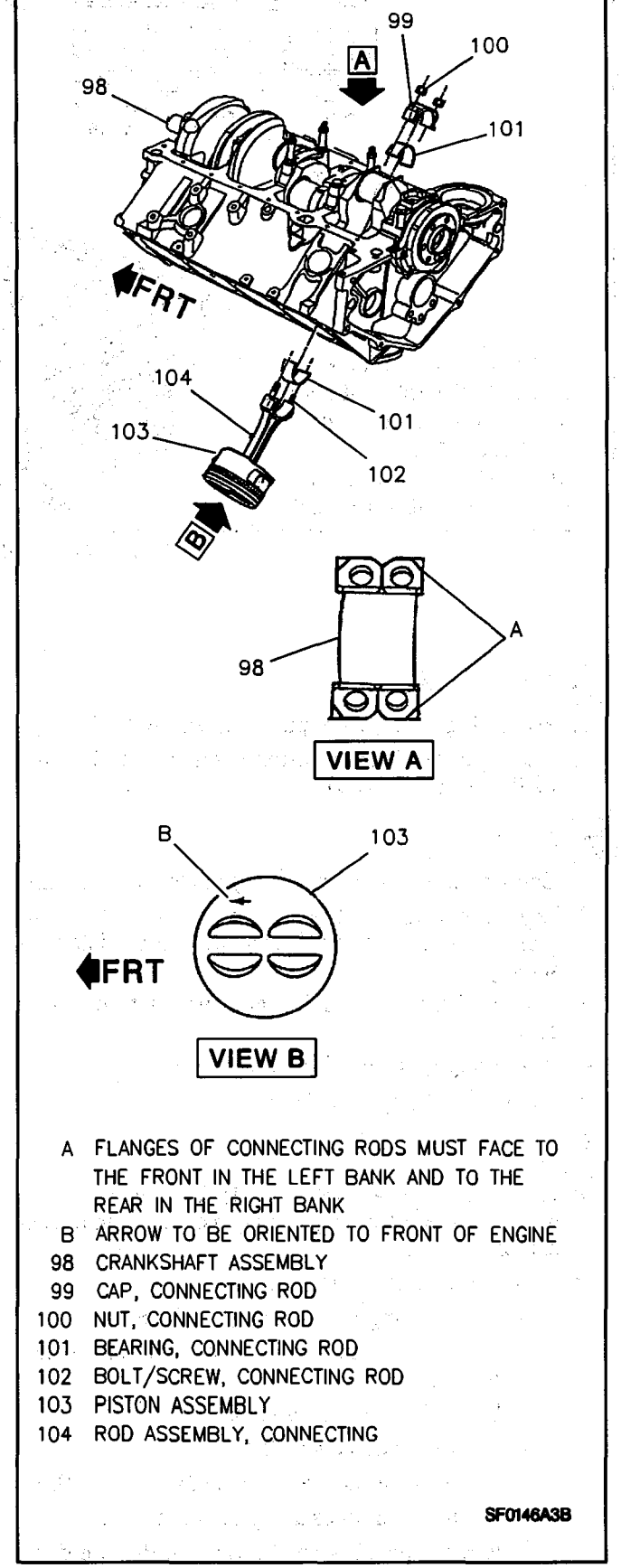
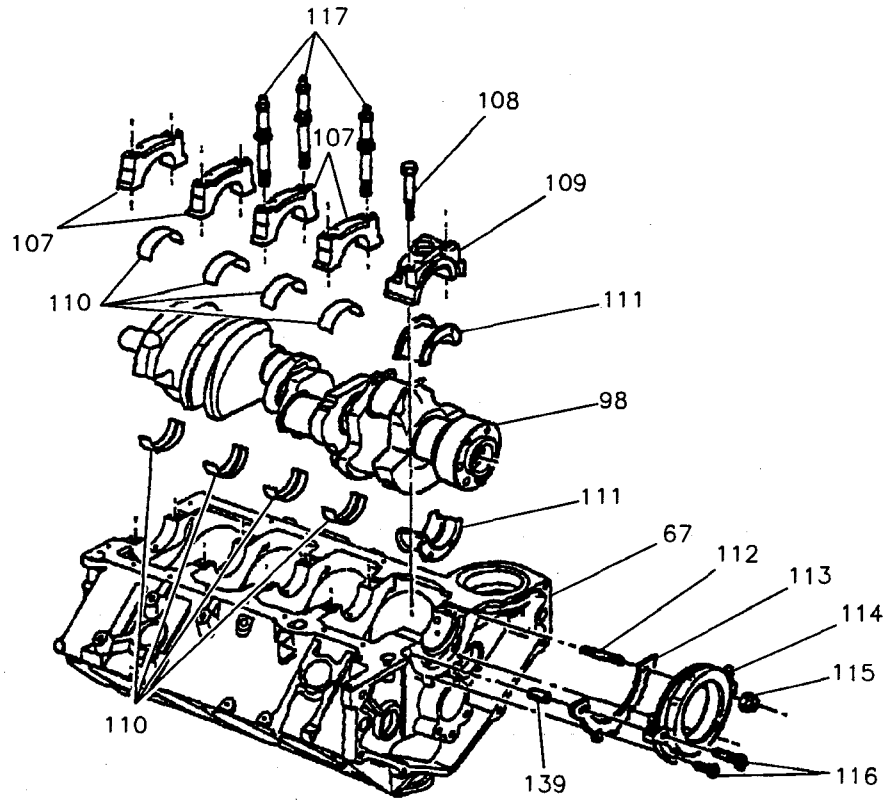


Figure 26 – Piston and Connecting Rod Assembly



67	BLOCK, ENGINE	112	STUD, CRANKSHAFT REAR OIL SEAL RETAINER
98	CRANKSHAFT ASSEMBLY	113	GASKET, CRANKSHAFT REAR OIL SEAL HOUSING
107	CAP, CRANKSHAFT BEARING	114	HOUSING ASSEMBLY, CRANKSHAFT REAR OIL SEAL
108	BOLTS/SCREW, CRANKSHAFT BEARING CAP	115	NUT, CRANKSHAFT REAR OIL SEAL HOUSING
109	CAP, CRANKSHAFT BEARING	116	BOLT/SCREW, CRANKSHAFT REAR OIL SEAL HOUSING
110	BEARING, CRANKSHAFT	117	STUD, CRANKSHAFT BEARING CAP
111	BEARING, CRANKSHAFT	139	PIN, CRANKSHAFT REAR OIL SEAL HOUSING LOCATOR

SBD0296A4

Figure 27 – Crankshaft Assembly

B. Measure piston assembly (103) 11.5 mm (0.45 inch) from bottom of skirt at right angles to piston pin (105) using a caliper or micrometer.
C. Subtract piston diameter from cylinder bore diameter. This will indicate piston-to-bore clearance.
D. Compare measurements to "Specifications" in this section.
E. If clearance exceeds specifications, subtract size of new piston assembly from cylinder bore diameter previously measured.
F. If clearance with new piston assembly is within specifications, mark that piston assembly to cylinder to which it is to be installed.
G. If clearance is within specifications, used piston assembly (103) may be reinstalled.

Assemble

Tool Required:

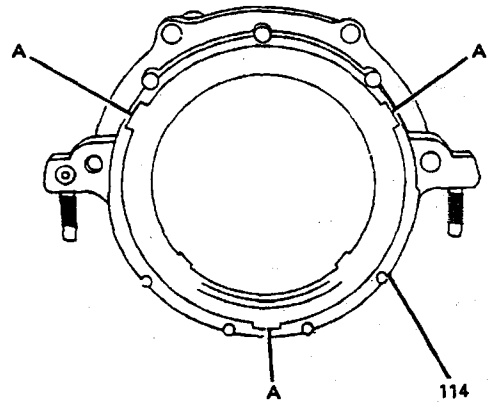
J 24086-B Piston Pin Remover and Installer Set

Important

- When assembling piston assembly (103) and connecting rod assembly (104), stamped arrow on piston assembly (103) must point to front of engine block assembly while flange on connecting rod assembly must face toward front of piston assembly on left hand assembly and face toward rear of piston assembly on right hand assembly. Refer to Figure 26.

NOTICE: After J 24086-B installer bottoms on support assembly, do not exceed 34 475 kPa (5000 psi) or the tool may be damaged.

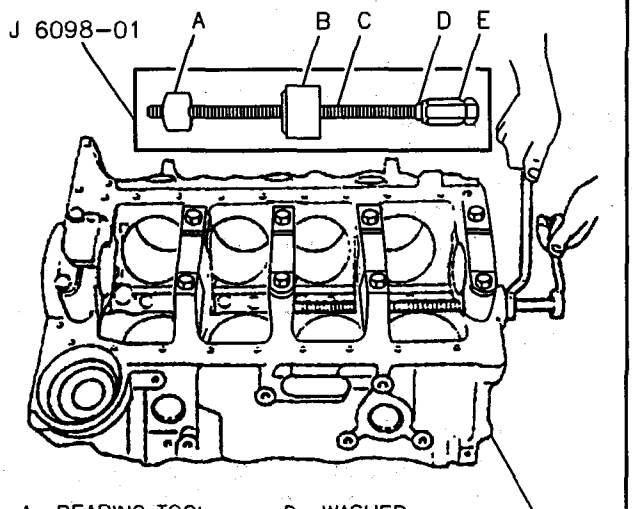
1. Piston assembly (103) and connecting rod assembly (104).
   A. Lubricate piston pin holes in both piston assembly (103) and connecting rod assembly (104).
   B. Press piston pin (105) into piston assembly (103) and connecting rod assembly (104) using J 24086-B (Figure 36).



A SEAL REMOVAL NOTCHES
114 HOUSING ASSEMBLY, CRANKSHAFT REAR OIL SEAL

SBD0306A4

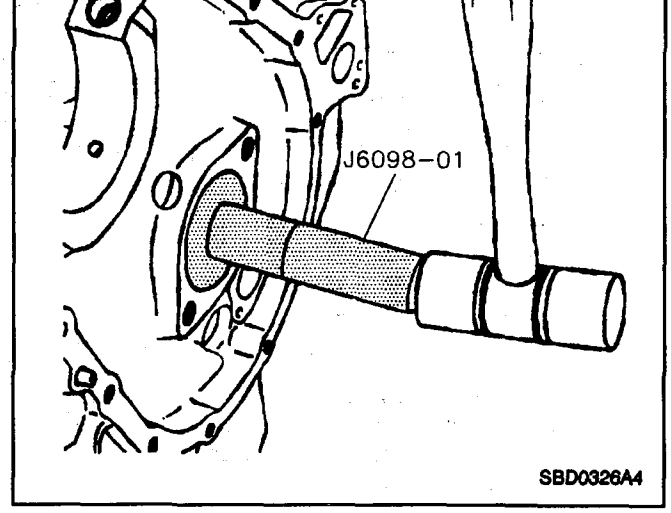
Figure 28 – Removing Crankshaft Rear Seal



A BEARING TOOL
B PILOT
C PULLER SCREW
D WASHER
E NUT
67 BLOCK, ENGINE

SF0156A3B

Figure 29 – Removing Camshaft Inner Bearing



SBD0326A4

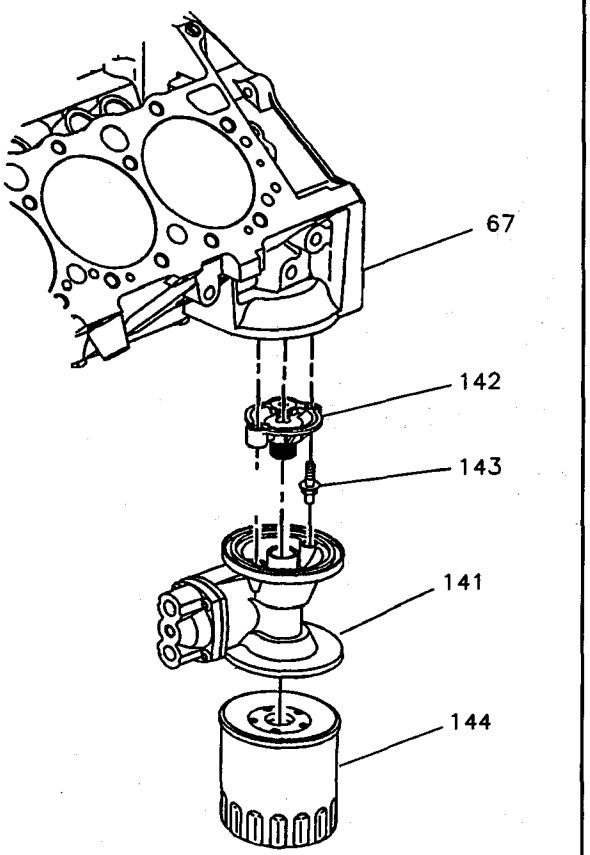
Figure 30 – Replacing Camshaft Front Bearing

Inspect

- For freedom of movement of piston assembly (103) on piston pin (105).

2. Piston rings (106) onto piston assembly (103).
   - Marked side of piston rings (106) must face toward top of piston assembly (103). Locate piston ring gaps as shown in Figure 37.

A. Install oil ring spacer in groove.
B. Hold spacer ends together and install lower oil ring rail with gap properly located.
C. Install upper oil ring rail with gap properly located.
D. Flex oil ring assembly to make sure rings are free.
E. Install lower compression ring with gap properly located.
F. Install upper compression ring with gap properly located.



67 BLOCK, ENGNE
141 COOLER, ENGINE OIL
142 ADAPTER, OIL FILTER
143 BOLT/SCREW, OIL FILTER ADAPTER
144 FILTER, OIL

SF0166A3B

Figure 31 – Oil Filter Adapter Assembly

CONNECTING ROD BEARINGS

Figure 27

Connecting rod bearings are the precision insert type and do not use shims for adjustment. Do not file connecting rod assemblies or rod caps. If clearances are found to be excessive, a new bearing will be required. Service bearings are available in standard size and 0.001 and 0.002-inch undersize for use with new and used standard size crankshaft assemblies, and in 0.010 and 0.020-inch undersize for use with reconditioned crankshaft assemblies.

When removing a connecting rod cap, you may find a 0.010-inch undersize bearing. These are used in manufacturing for selective fitting.

Inspect

- Bearings (101) for excessive wear or damage.

Measure

1. Crankpin for out-of-round and taper with a micrometer. Refer measurements to "Specifications" in this section.
   - If not within specifications, replace or recondition crankshaft assembly.
   - If installing new bearings (101), determine new bearing size from maximum crankpin diameter.
2. Bearing clearances using gaging plastic.
   A. Place a piece of gaging plastic full width of bearing (101), (parallel to crankshaft assembly) onto crankpin.
      - Plastic gage should be positioned in middle of bearing (101). Bearing (101) is thickest in center and bearing clearance must be measured at this location.
   B. Install connecting rod cap (99) with bearing (101) onto connecting rod assembly (104).
   C. Install connecting rod nuts (100).

Tighten

- Connecting rod nuts (100), evenly, to 27 N•m (20 lb. ft.) plus 55 degrees.

Important

- Do not turn crankshaft assembly with gaging plastic installed or accuracy of measurement will be affected.

   D. Remove connecting rod nuts (100) and cap.
   E. Measure gaging plastic at its widest using scale provided with gaging plastic. Refer measurements to "Specifications" in this section.
   F. If clearance is greater than specified, select an undersize bearing (101) and re-measure clearance.
   G. If clearance cannot be brought to specifications, regrind crankpin. If crankpin is already at maximum undersize, replace crankshaft assembly (98).

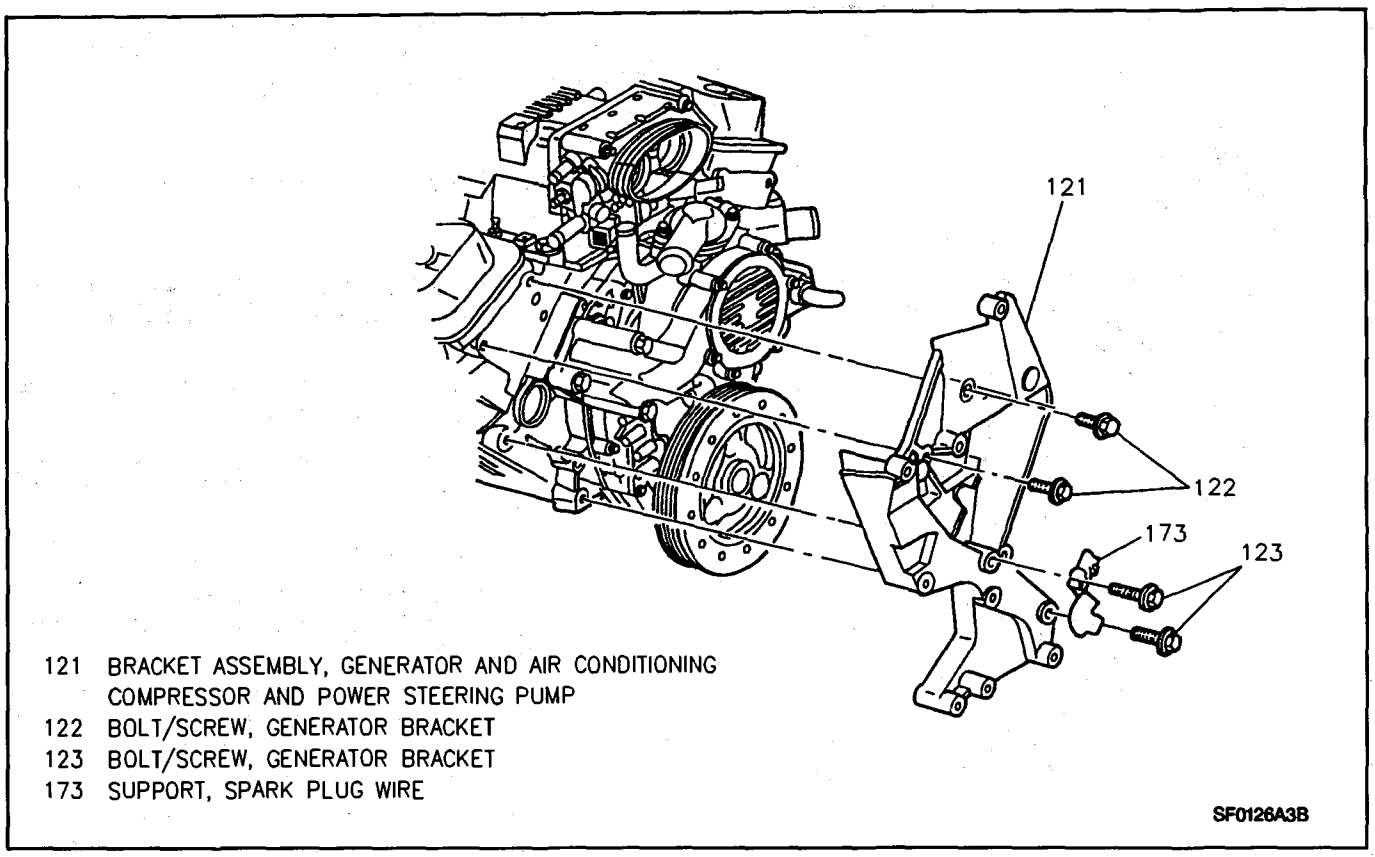


Figure 32 – Generator and Air Conditioning Compressor and Power Steering Pump Bracket Assembly

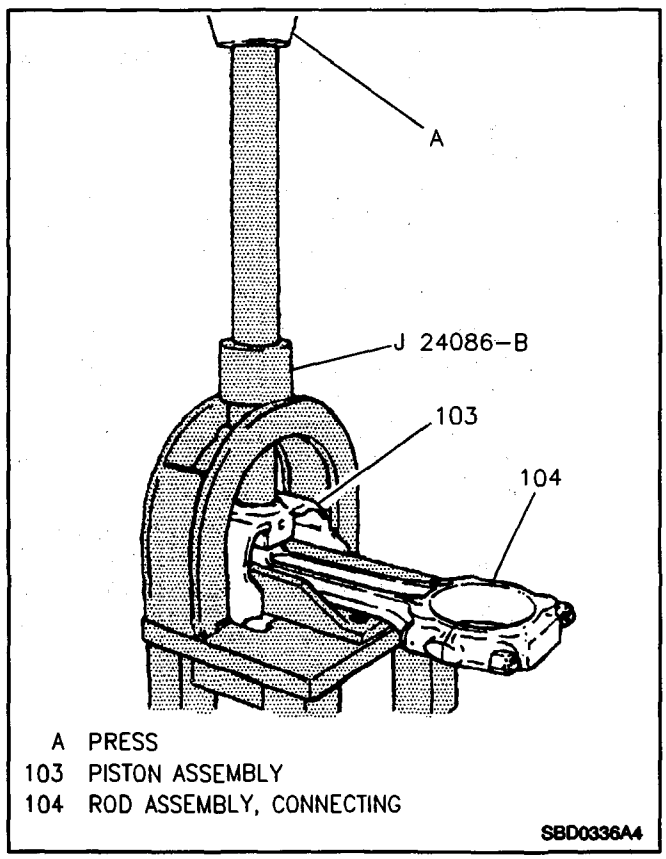


Figure 33 – Removing Piston Pin

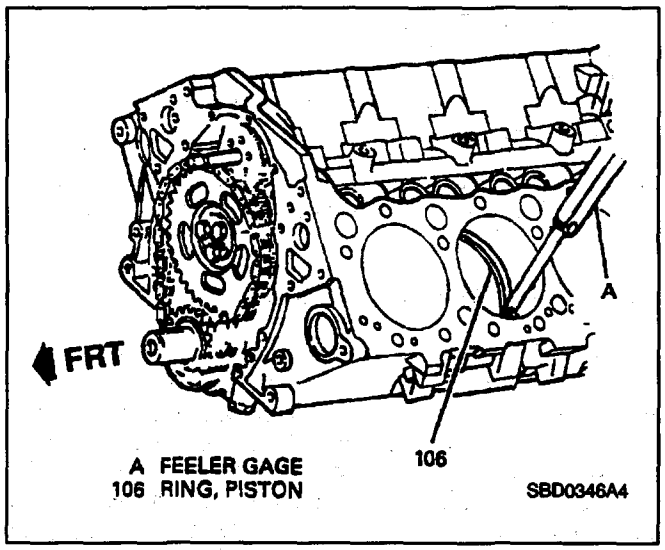
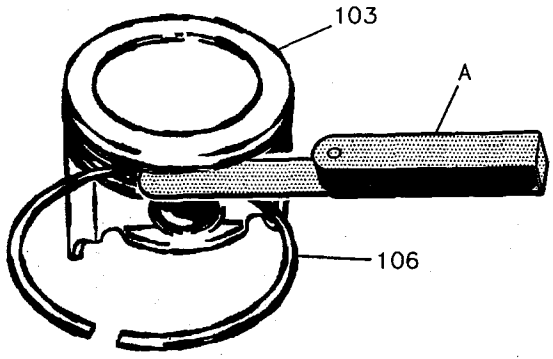
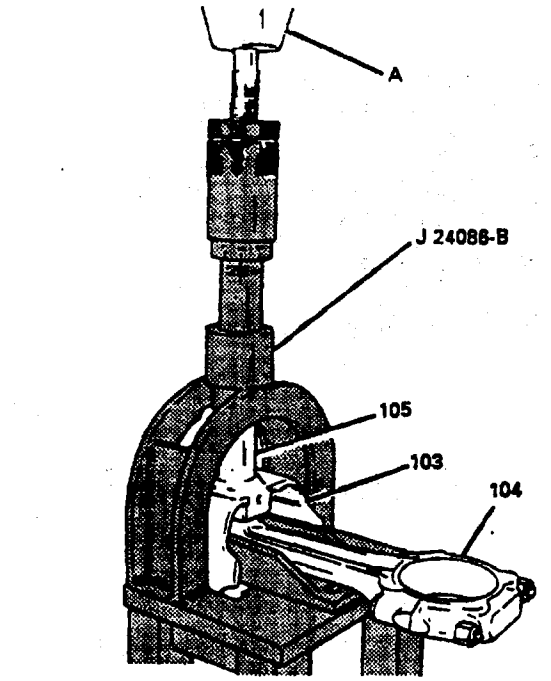


Figure 34 – Measuring Piston Ring End Gap



A FEELER GAGE
103 PISTON ASSEMBLY
106 RING, PISTON
SBD0356A4

Figure 35 – Measuring Piston Ring Side Clearance



A PRESS
103 PISTON ASSEMBLY
104 ROD ASSEMBLY, CONNECTING
105 PIN, PISTON
SBD03666A4

Figure 36 – Installing Piston Pin

OIL PUMP ASSEMBLY

Figure 38

Disassemble

1. Oil pump cover bolts/screws (97) and pump cover (96).
   - Matchmark gear teeth for reassembly.
2. Driven gear (86), drive gear (94), and driveshaft (89) and retainer (95) from housing assembly (87).
3. Oil pressure relief valve pin (90), relief valve (92), spring (91) and plug (93).
4. Screen assembly (88) from housing assembly (87), if replacement is necessary.
   - Mount housing assembly (87) in a soft-jaw vise and extract screen assembly (88).
   - Screen assembly (88) is serviced as a unit. Do not disturb pipe on screen.

Clean

1. All parts in cleaning solvent.
2. Dry parts with compressed air.

Inspect

- Housing assembly (87) and cover (96) for cracks, scoring, casting imperfections, and damaged threads.
- Drive gear shaft. If loose in housing assembly (87), replace oil pump.
  - Burrs may be removed with a fine oil stone.
- Relief valve spring (91) for loss of tension.
- Screen assembly (88) for broken wire mesh or screen, or looseness.
  - If pipe is loose or has been removed from screen, screen assembly (88) must be replaced.
- Gears for chipping, galling, and wear.
- Drive gear (94) and driveshaft (89) for looseness and wear.

Important

- If wear is noted, replace entire pump assembly.

Assemble

Tool Required:

J 21882 Oil Suction Pipe Installer

NOTICE: See "Notice" on page 6A3B-1 of this section.

Important

- Be careful not to twist, shear, or collapse screen assembly while installing it to oil pump assembly.

1. A new screen assembly (88), if previously disassembled, to housing assembly (87).
   A. Mount housing assembly (87) in a soft-jaw vise.
   B. Apply sealer to end of pipe.
   C. Tap pipe into place using J 21882 and a plastic-faced hammer.
2. Relief valve (92), spring (91), plug (93) and pin (90).
3. Drive gear (94), driveshaft (89) and retainer (95) to housing assembly (87).

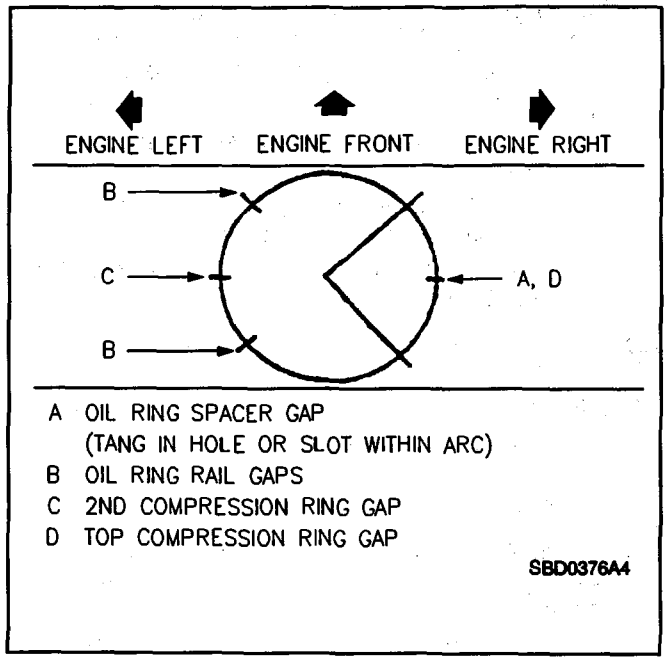


Figure 37 – Piston Ring Gap Locations

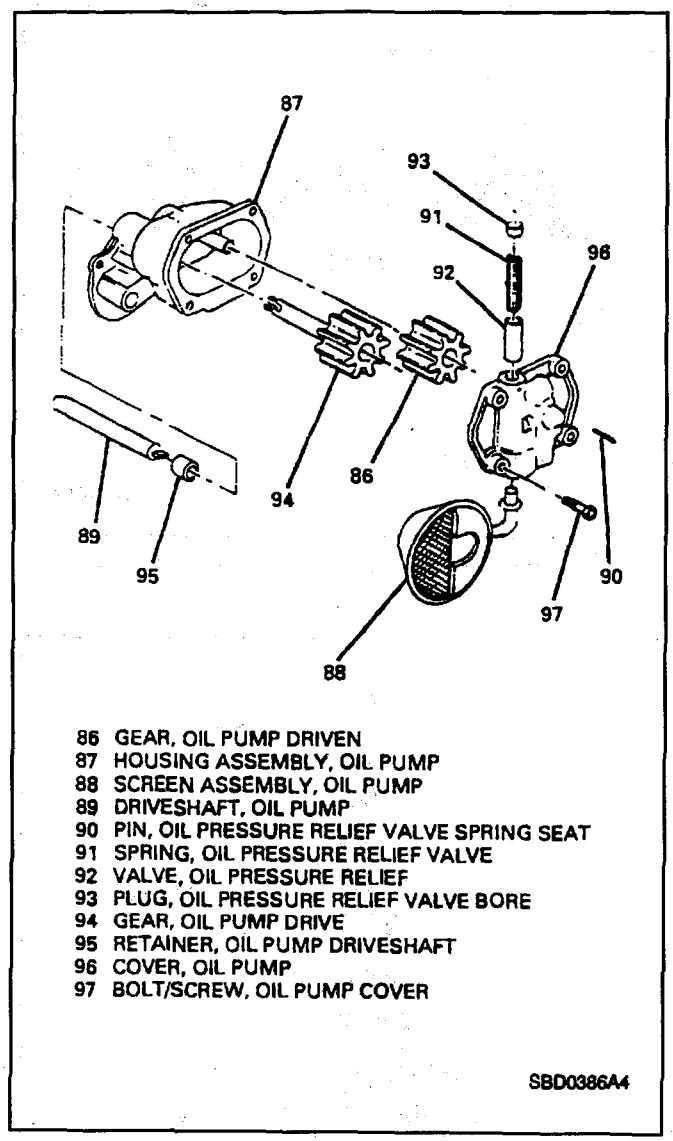


Figure 38 – Oil Pump Components

4. Driven gear (86) to housing assembly (87) with smooth side of gear toward pump cover (96).
5. Pump cover (96).
6. Oil pump cover bolts/screws (97).

Tighten

- Oil pump cover bolts/screws (97) to 9 N•m (80 lb. in.).

Inspect

- For smoothness of operation by turning pump driveshaft (89) by hand.

CYLINDER HEAD ASSEMBLY

Figures 24 and 39 through 45

Tools Required:

J 8001 Dial Indicator Set

J 9666 Valve Spring Tester

J 8062 Valve Spring Compressor

J 8358 Carbon Removing Brush

J 8101 Valve Guide Cleaner

Disassemble

1. Spark plugs from cylinder head assembly.
2. Compress valve springs (69) using J 8062.
3. Valve stem keys (72).
- Pressure relief valve (92) for scoring and sticking.
- Pressure relief valve (92) for scoring and sticking.
4. Cap (70) from valve.
5. Valve spring (69).
6. Valve seal (73).
7. Valve.
   - Place valves in a rack in proper sequence so they can be assembled in their original order.
8. Shim (76).

Clean

1. Carbon from combustion chambers and valve parts using J 8358.

   -Be careful not to scuff chamber
2. Valve guides using J 8101 (Figure 41).

3. Carbon and sludge from pushrod assemblies and rocker arms.
4. Valve stems and heads on a buffing wheel.
5. Cylinder head assembly and engine block gasket surfaces.
6. Bolt/screw hole threads in cylinder head assembly (34) and engine block.

Inspect

1. Cylinder head assembly (34) for cracks in exhaust ports, combustion chambers, or external cracks to water chamber.
2. Valves for burned heads, cracked faces, or damaged stems.
3. Valve springs (69) for squareness.

Measure

1. Valve spring tension using J 9666 (Figure 42).
   - If spring tension is less than 360 N (81 lb.) at 45.2 mm (1.78 inch), replace spring.
2. Valve stem-to-bore clearance.
   A. Excessive valve stem-to-bore clearance will cause excessive oil consumption and may cause a valve to break. Insufficient clearance will result in noisy and sticky functioning of valve and disturb engine assembly smoothness.
   B. Clamp J 8001 on exhaust port side of cylinder head assembly.
   C. Locate indicator so movement of valve stem from side to side (crosswise to cylinder head assembly) will cause a direct movement of indicator stem. Indicator stem must contact side of valve stem just above valve guide.
   D. Drop valve head about 1.6 mm (1/16 inch) off valve seat.
   E. Move stem of valve from side to side using light pressure to obtain a clearance reading. If clearance exceeds specifications, it will be necessary to ream valve guides for oversize valves. Refer to "Specifications" in this section.
   F. Service valves are available in standard, 0.003, 0.015, 0.030 inch oversize.

Recondition

1. Valves with oversize stems are available as outlined above. Ream valve guide bores for oversize valves as necessary.

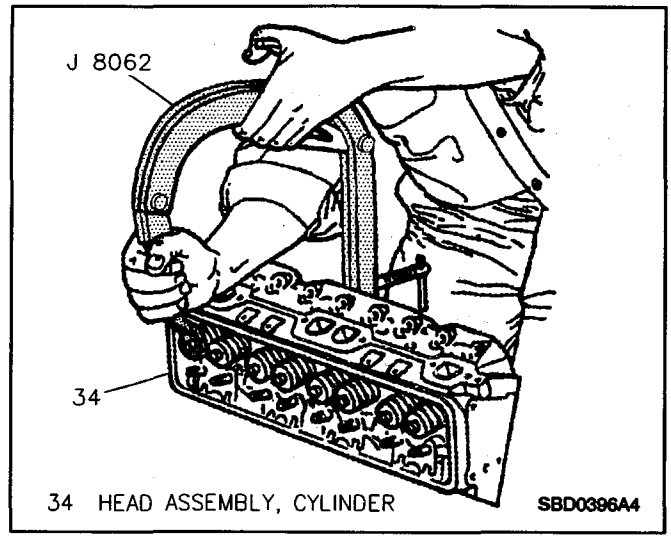


Figure 39 – Compressing Valve Spring

2. Reconditioning valve seats is very important. Valve seat reconditioning must be done after reaming valve guide bores or installing new valve guides.
   - Seating of valves must be perfect for engine assembly to deliver optimum power and performance.
   - Another important factor is cooling of valve heads. Good contact between each valve and its seat in cylinder head assembly is necessary to insure that heat in valve head will be properly carried away.
   - Several different types of equipment are available for reconditioning valve seats. Recommendations of manufacturer of equipment being used should be carefully followed to attain proper results.
   - Regardless of what type of equipment is used, it is essential that valve guide bores be free from carbon or dirt to ensure proper centering of pilot in guide. Valve seats should be concentric to within 0.05 mm (0.002 inch) total indicator reading.
3. Valves that are pitted can be refaced to proper angle, insuring correct relation between head and stem, on a valve refacing mechanism. Valve stems which show excessive wear, or valves that are warped excessively should be replaced. If edge of valve head is less than 0.79 mm (1/32 inch) thick after grinding, replace valve.
   - Several different types of equipment are available for refacing valves. Recommendation of manufacturer of equipment being used should be carefully followed to attain proper results.

Assemble

1. Shim (76) to cylinder head assembly.
2. Valve into proper port.
3. Valve seal (73) and seat seal (73) against shim (76).
4. Valve spring (69).

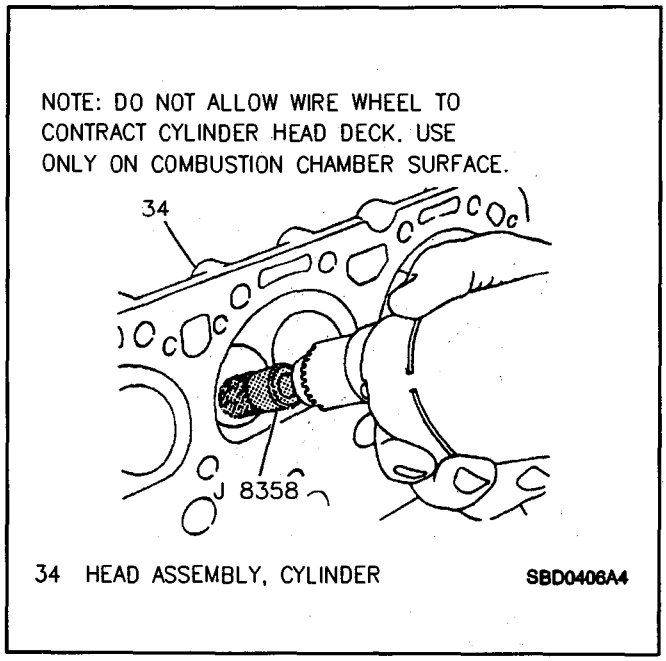


Figure 40 – Cleaning Combustion Chamber

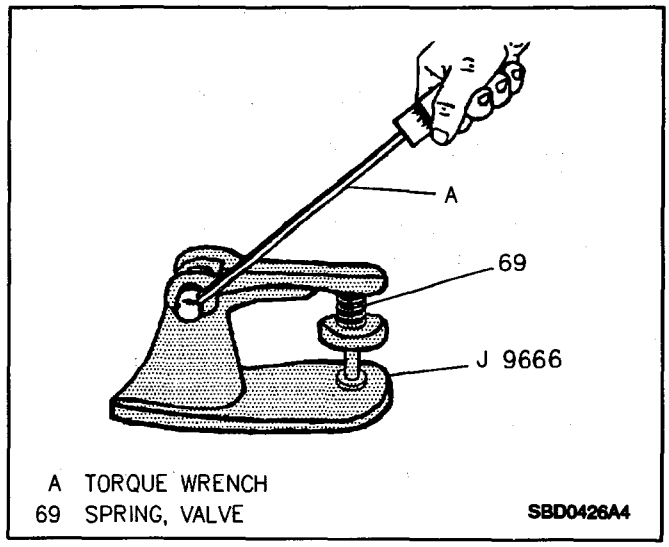


Figure 42 – Checking Valve Spring Tension

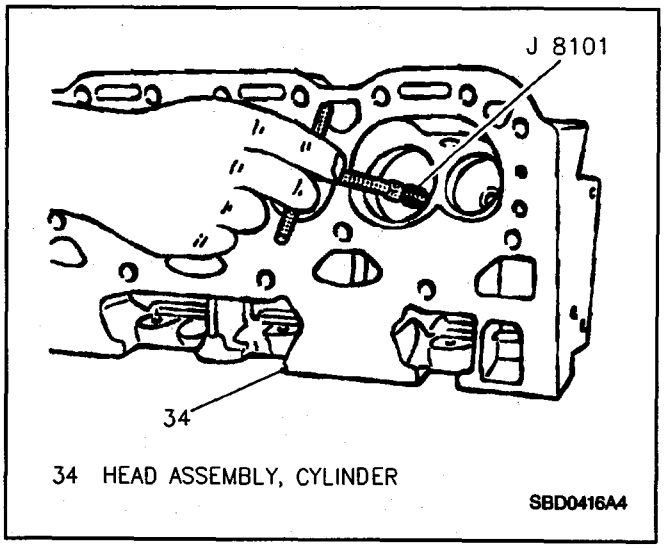


Figure 41 – Cleaning Valve Guide

5. Cap (70) on valve stem.
6. Compress valve spring (69) using J 8062 (Figure 39).
7. Valve stem keys (72).
   A. Use grease to hold keys (72) in place while disconnecting J 8062.
   B. Make sure keys (72) seat properly in upper groove of valve stem.
   C. Tap end of stem with a plastic-faced hammer to seat keys (72), if necessary.
8. Remaining valves.

Measure

- Valve spring installed height from valve spring seat to top of cap (Figure 45).
  - If installed height exceeds 45.2 mm (1.78 inch), install a valve spring seat shim approximately 1.6 mm (1/16 inch) thick.
  - Do not shim a valve spring to obtain a less than specified installed height.

CAMSHAFT ASSEMBLY

Figures 46 and 47

Tool Required:

J 7872 Magnetic Base Indicator Set

Measure

1. Camshaft journals with a micrometer.
   - If journals are more than 0.025 mm (0.0010 inch) out-of-round, replace with a new camshaft assembly.
2. Camshaft runout using J 7872.
   - Mount camshaft assembly in V-blocks or between centers. Using J 7872, check intermediate camshaft journal. If runout exceeds 0.038 mm (0.0015 inch) camshaft assembly is excessively bent and should be replaced.

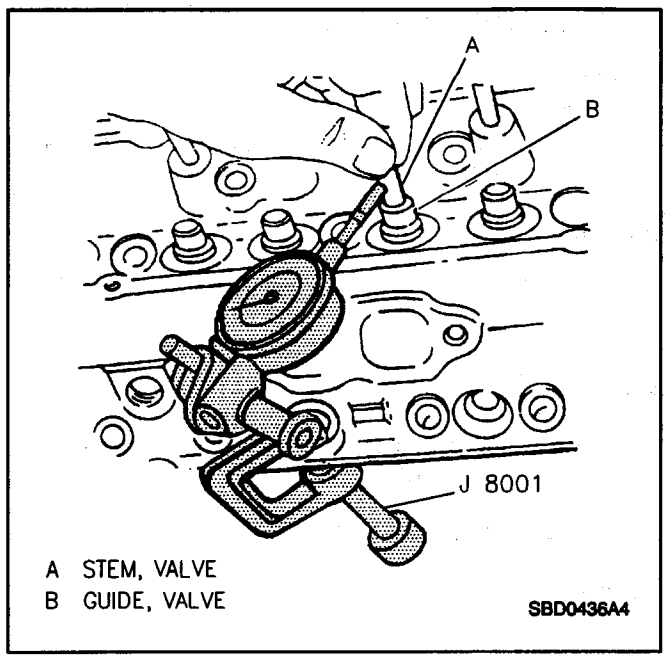


Figure 43 – Measuring Valve Stem Clearance

TIMING CHAIN ASSEMBLY, CRANKSHAFT AND CAMSHAFT SPROCKETS, AND WATER PUMP DRIVESHAFT ASSEMBLY

Figures 20 and 21

Inspect

- Camshaft and crankshaft sprockets (57 and 62) and water pump driveshaft assembly (63) for wear.
- One edge of teeth worn or teeth no longer concentric.
- Valley between teeth worn.
- Key and crankshaft keyway for wear.
- Timing chain assembly for binding.

ENGINE FRONT COVER ASSEMBLY

Figure 19

Tools Required:

J 35468 Front Cover Aligner and Oil Seal Installer

J 39937 Distributor Driveshaft Front Cover Seal Installer

J 39088 Driven Gear Shaft Front Cover Seal Installer

Clean

- Front cover assembly and engine block gasket surfaces.

Inspect

- Front cover assembly (50) for damage to seals or gasket surface.

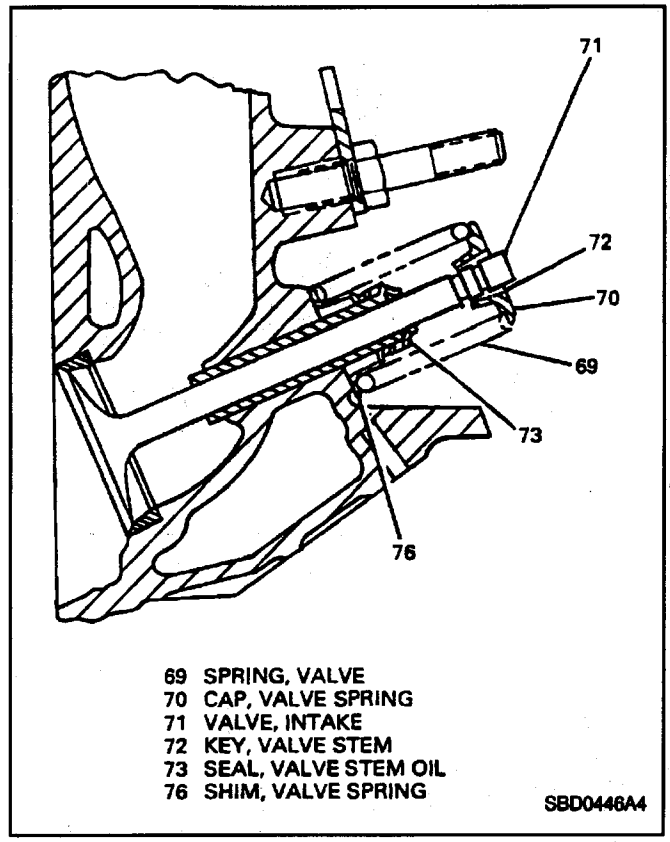


Figure 44 – Valve Assembly (Intake Shown, Exhaust Similar)

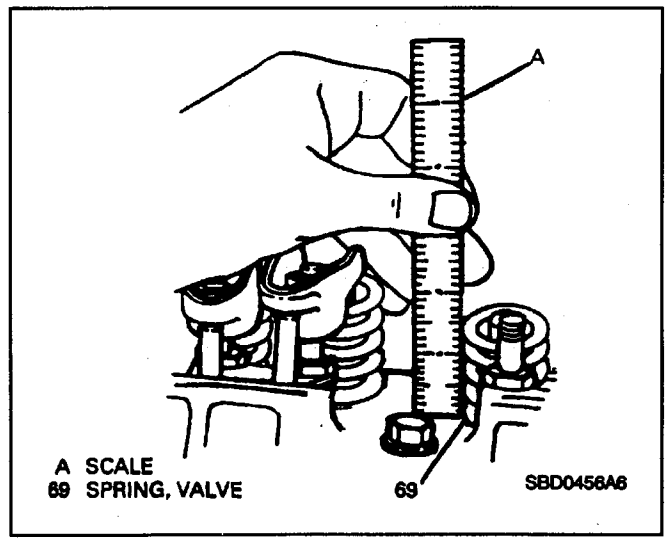


Figure 45 – Measuring Valve Spring Installation Height

ENGINE FRONT COVER OIL SEALS

Remove or Disconnect

- Front cover oil seals for crankshaft assembly, distributor shaft and water pump driveshaft assembly.

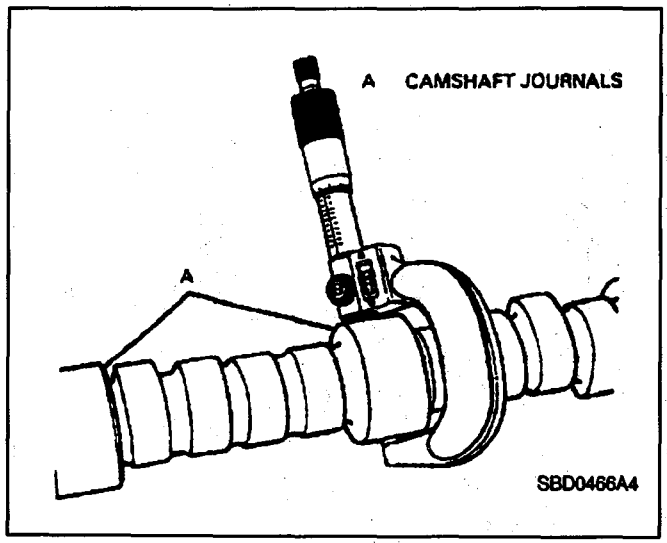


Figure 46 – Measuring Camshaft Journals

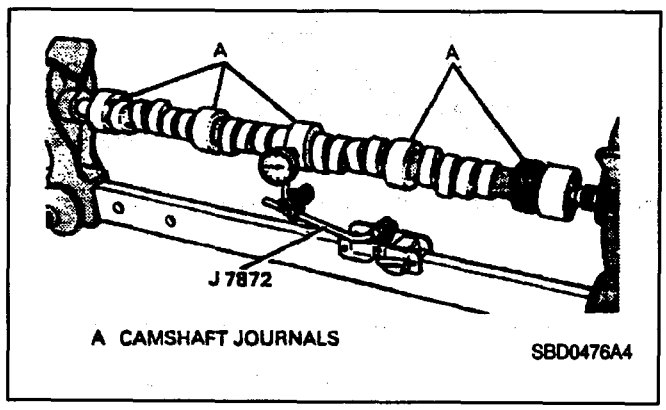


Figure 47 – Measuring Camshaft Runout

Install or Connect

1. Crankshaft seal using J 35468.
2. Distributor driveshaft seal using J 39937.
3. Water pump driveshaft seal using J 39088.

OIL PAN ASSEMBLY

Clean

- Oil pan assembly in solvent. Remove all sludge and varnish.
- Gasket surfaces.

Inspect

- Gasket flanges for bending or damage.
- Oil pan assembly for rock damage or cracks.
- Oil pan baffle for lack of fit.
- Drain plug threads for stripping.

WATER PUMP ASSEMBLY

Figure 16

Tool Required:

J 39089 Driven Gear/Water Pump Shaft Seal Installer

Clean

- Water pump assembly (37) and engine block gasket surfaces.

Inspect

- O-ring seals (156) on water pump driveshaft assembly (63) and water pump shaft. Replace seals (156), if necessary, using J 39089.

VALVE LIFTER ASSEMBLIES

Figure 15

Inspect

- Lifter body for wear and scuffing. Also inspect bore in engine block for scuffing.
- Lifter roller for:
  - Binding or roughness.
  - Excessive looseness in roller bearings.
  - Flat spots.
  - Pitting.
- Lifter pushrod seat and pushrod end for wear or scoring.

VALVE ROCKER ARMS AND PUSHROD ASSEMBLIES

Figure 14 and 15

Inspect

- Rocker arms (29) and balls (30) at their mating surfaces. These surfaces should be smooth and free of scoring or other damage.
- Rocker arm pushrod sockets and valve stem mating surfaces. These surfaces should be smooth with no scoring or exceptional wear.
- Pushrod assemblies (27) for scored ends or bends.

VALVE ROCKER ARM COVER ASSEMBLIES

Figure 13

Clean

- Valve rocker arm cover and cylinder head gasket surfaces.

Inspect

- Gasket flanges for damage.
- Rubber grommets for deterioration.

INTAKE MANIFOLD ASSEMBLY

Figure 10

Clean

- Intake manifold bolts/screws (8) and studs (9).
- Cylinder head assembly, engine block and intake manifold sealing surfaces.

ASSEMBLY

ENGINE BLOCK

Figure 32

Install or Connect

NOTICE: See "Notice" on page 6A3B-1 of this section.

1. Engine block core plugs.
2. Front and rear oil gallery plugs.

Tighten

- Rear engine block oil gallery plugs to 20 N•m (15 lb. ft.).

Inspect

- Oil filter adapter bypass valve and spring for operation.
- For cracked or broken bypass valve.
  - Oil filter adapter and bypass valve assembly must be replaced as a unit.

2. Oil filter adapter assembly (142).
3. Oil filter adapter bolts/screws (143).

Tighten

- Oil filter adapter bolts/screws (143) to 23 N•m (17 lb. ft.).

4. Oil filter adapter bolt/screws (143).
5. Engine oil cooler assembly (141).
6. Oil filter assembly (144).
7. Fuel pump and oil pressure sensor assembly.
8. Knock sensor assemblies.
9. Starter motor assembly and bolts/screws.

Tighten

- Knock sensor assemblies to 20 N•m (15 lb. ft.).
- Starter motor bolts/screws to 47 N•m (35 lb. ft.).
- Oil pressure fittings to 12 N•m (106 lb. in.).

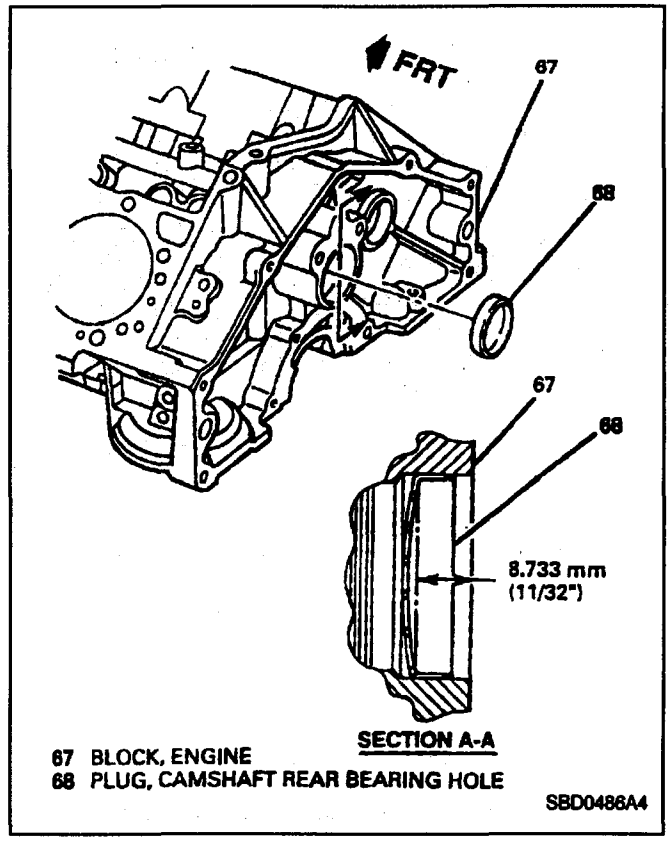


Figure 48 – Camshaft Rear Bearing Hole Plug

CAMSHAFT BEARINGS

Figures 30, 31 and 48

Tool Required:

J 6098-01 Camshaft Bearing Remover/Installer

Outer front and rear camshaft bearings must be installed first. These bearings serve as guides for tool pilot, and help center inner bearings during installation process.

Install or Connect

Important

- Align camshaft bearing oil holes properly during installation.
  - Number one (front) camshaft bearing oil holes must be positioned so that they are at 1 o'clock and 5 o'clock positions.
  - Number two through number four inner camshaft bearing oil holes must be positioned at 5 o'clock toward left side of engine block and even with bottom of cylinder bore.
  - Number five (rear) camshaft bearing oil hole must be positioned at 12 o'clock.

1. Front and rear camshaft bearings using J 6098-01.
   A. Assemble bearing tool to driver handle.

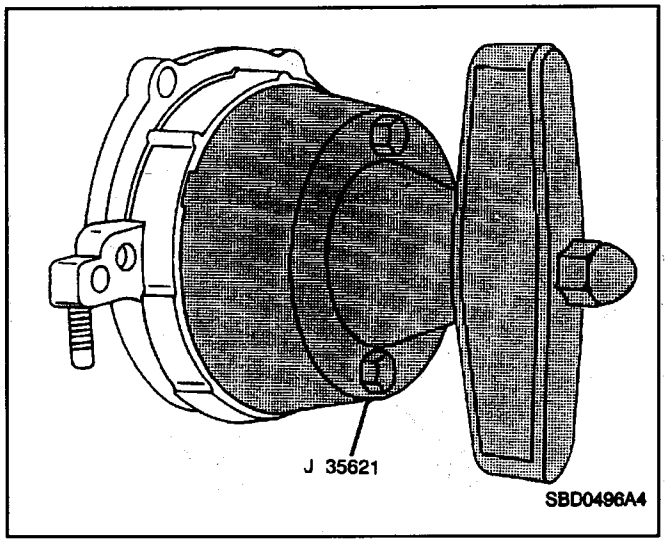


Figure 49 – Installing Crankshaft Rear Oil Seal

B. Align oil holes as outlined above.

C. Drive front and rear bearings in, toward center of engine block.

2. Inner camshaft bearings using J 6098-01.

A. With nut and thrust washer assembled to end of puller screw threads, index pilot in camshaft front bearing and install puller screw through pilot.

B. Index camshaft bearing in bore, aligning oil hole as outlined above.

C. Install puller screw through bearing bore and bearing to be installed and assemble bearing tool to puller screw with shoulder toward bearing. Make sure that enough threads are engaged.

D. Using two wrenches, hold puller screw while turning nut to draw bearing into bore.

- When bearing has been pulled into bore, remove bearing tool and puller screw and check alignment of bearing oil hole to bore oil hole.

E. Repeat above steps for remaining inner camshaft bearings.

- Index pilot in rear camshaft bearing to install rear inner bearing.

3. New camshaft rear bearing hole plug (68).

A. Coat plug outside diameter with GM P/N 1052080 sealant, or equivalent.

B. Install camshaft rear bearing hole plug (68) as shown in Figure 48.

CRANKSHAFT ASSEMBLY

Figure 28

Install or Connect

NOTICE: See "Notice" on page 6A3B-1 of this section.

1. Crankshaft bearings (110 and 111) into engine block (67) and crankshaft bearing caps (107) and rear crankshaft bearing cap (109).
   - Coat crankshaft bearings (110 and 111) with oil.
2. Crankshaft assembly (98).
3. Crankshaft bearing caps (107) and rear crankshaft bearing cap (109) with assembled crankshaft bearings (110 and 111) with arrows pointing toward front of engine block.
4. Crankshaft bearing cap bolts/screws (108) and studs.
   - With crankshaft assembly (98), crankshaft bearings (110 and 111) and crankshaft bearing caps (107) and rear crankshaft bearing cap (109) installed and bolts/screws (108) and studs started, thrust crankshaft assembly (98) rearward to set and align bearing caps (107 and 109). Then thrust crankshaft assembly forward to align rear faces of rear crankshaft bearings (111).

Tighten

- Crankshaft bearing cap bolts/screws (108) and studs to 105 N•m (77 lb. ft.).

Measure

- Crankshaft end play using a dial indicator or feeler gage. Refer to "Specifications" in this section.
  - If using a feeler gage, measure between front of rear crankshaft bearing cap (109) and crankshaft thrust surface.

CRANKSHAFT REAR OIL SEAL HOUSING

Figure 28

Clean

- Gasket surfaces.

Install or Connect

NOTICE: See "Notice" on page 6A3B-1 of this section.

Important

- Always use new crankshaft rear oil seal and new housing gasket (113) during installation of crankshaft rear oil seal housing (114).

1. New gasket (113) and crankshaft rear oil seal housing (114) on studs (112).
   - It is not necessary to use any type of sealant to hold gasket (113) in place.
2. Crankshaft rear oil seal housing nuts (115) and bolts/screws (116).

Tighten

- Crankshaft rear oil seal housing nuts (115) and bolts/screws (116) to 15 N•m (11 lb. ft.).

CRANKSHAFT REAR OIL SEAL

Figures 28 and 49

Tool Required:

J 35621 Rear Main Seal Installer

Install or Connect

1. Coat new seal entirely with engine oil.
2. Seal onto J 35621.
3. J 35621 onto rear of crankshaft assembly (98). Tighten screws snugly to ensure seal will be installed squarely over crankshaft assembly (98).
4. Crankshaft rear oil seal to crankshaft assembly (98) and crankshaft rear oil seal housing (114).
   - Tighten wing nut on J 35621 until it bottoms.
5. Remove J 35621 from crankshaft rear seal housing (114).

PISTON AND CONNECTING ROD ASSEMBLY

Figures 27 and 50

Install or Connect

Tool Required:

J 8037 Piston Ring Compressor

J 5239 Connecting Rod Bolt Guide Set

1. Coat piston assembly (103), piston rings, cylinder bore, and bearing surfaces with engine oil.
2. Piston assembly (103) with stamped arrow facing forward into its matched bore using J 8037 and J 5239 and lightly tapping top of piston assembly (103) with wooden hammer handle.
   - Hold J 8037 firmly against engine block until all piston rings have entered cylinder bore.
   - Guide connecting rod using J 5239.
3. Remove J 5239.

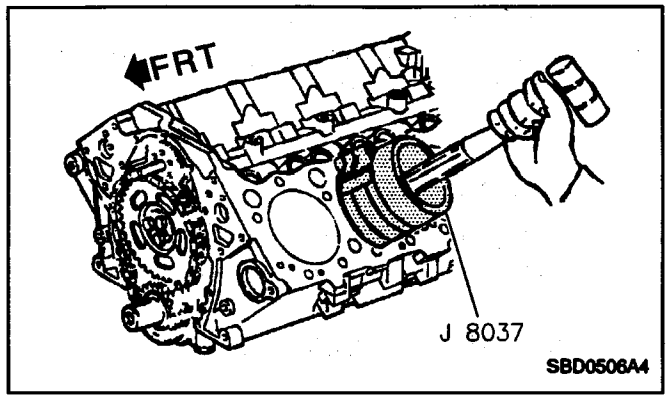


Figure 50 – Installing Piston Assembly

CONNECTING ROD BEARINGS

Figure 27

Install or Connect

NOTICE: See "Notice" on page 6A3B-1 of this section.

1. Coat inside surface of bearings (101) with engine oil.

Important

- When assembled, flanges on connecting rod assembly and cap should face to front in left bank and to rear in right bank.

2. Connecting rod cap (99) and bearings (101).
3. Connecting rod nuts (100).

Tighten

- Connecting rod nuts (100), evenly, to 27 N•m (20 lb. ft.) plus 55 degrees.

Measure

1. When all connecting rod bearings (101) have been installed, tap each connecting rod assembly lightly parallel to crankpin to make sure they have clearance.
2. Side clearance between connecting rod caps (99) using a feeler gage, or dial indicator.
   - Rod side clearance should be 0.16 to 0.35 mm (0.006 to 0.014 inch).

OIL PUMP ASSEMBLY

Figure 26

Install or Connect

NOTICE: See "Notice" on page 6A3B-1 of this section.

1. Oil pump assembly (118), and driveshaft (89).
   - Align slot on end of driveshaft (89) with drive tang on oil pump shaft.

2. Oil pan baffle (119).
3. Bolt/screw (120) attaching oil pump assembly (118) to rear crankshaft bearing cap.
4. Oil pan baffle nuts.

Tighten

- Oil pump bolt/screw (120) to 90 N•m (66 lb. ft.).
- Oil pan baffle nuts to 40 N•m (30 lb. ft.).

CYLINDER HEAD ASSEMBLY

Figures 24 and 51

Install or Connect

NOTICE: See "Notice" on page 6A3B-1 of this section.

1. New cylinder head gasket (82).
2. Gasket (82) over locating pins, with yellow side of tab on outboard side facing up.
3. Cylinder head assembly (34) over locating pins and gasket (82).
   - Coat threads of cylinder head bolts/screws (81) with sealing compound, (GM P/N 1052080 or equivalent).
4. Cylinder head bolts/screws (81) finger tight.

Tighten

- Cylinder head bolts/screws (81) in sequence and in three passes to 88 N•m (65 lb. ft.) (Figure 51).

5. Spark plugs.
6. Engine coolant air bleed pipe and bolts/screws.
   - Use a backup wrench on pipe fittings when installing bolts/screws.

Tighten

- Engine coolant air bleed pipe bolts/screws to 40 N•m (30 lb. ft.).
- Spark plugs to 27 N•m (20 lb. ft.).

CAMSHAFT ASSEMBLY

Figures 20, 22 and 23

When installing a new camshaft assembly coat camshaft lobes and journals with engine oil.

Inspect all valve lifter assemblies and replace as necessary to ensure durability of camshaft lobes and lifter rollers.

Install or Connect

NOTICE: See "Notice" on page 6A3B-1 of this section.

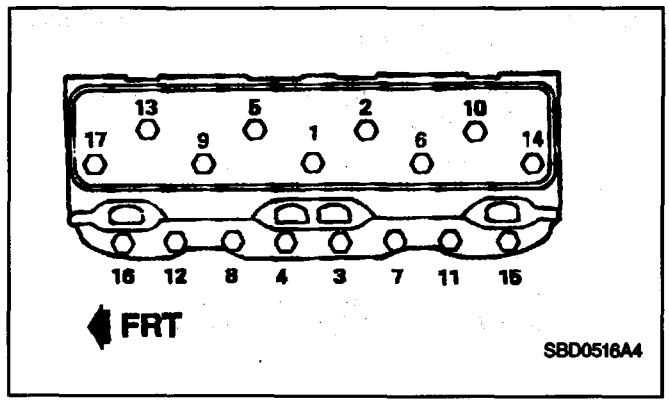


Figure 51 – Cylinder Head Tightening Sequence

1. Camshaft assembly (60).
2. Camshaft retainer (59) and camshaft retainer bolts/screws (58).

Tighten

- Camshaft retainer bolts/screws (58) to 12 N•m (106 lb. in.).

3. Oil pump driveshaft assembly (65) and bolt/screw (66).
   - Bolt/screw hole "ear" must be seated on boss before tightening bolt/screw.

Tighten

- Bolt/screw (66) to 18 N•m (13 lb. ft.).

TIMING CHAIN ASSEMBLY, CRANKSHAFT AND CAMSHAFT SPROCKETS, AND WATER PUMP DRIVESHAFT ASSEMBLY

Figures 20 and 21

Tools Required:

J 5590 Crankshaft Gear Installer

J 39089 Driven Gear/Water Pump Shaft Seal Installer

J 39092 Driven Gear Assembly Installer

Install or Connect

NOTICE: See "Notice" on page 6A3B-1 of this section.

1. Key, if previously removed.
2. Crankshaft sprocket (62) using J 5590.
3. Water pump driveshaft assembly (63) using J 39092.
4. Water pump driveshaft bearing retainer bolts/screws (64).

Tighten

- Water pump driveshaft bearing retainer bolts/screws (64) to 12 N•m (106 lb. in.).

5. Camshaft sprocket (57) and timing chain assembly (61).
   - Gears must mesh, or damage to camshaft retainer could occur.
6. Camshaft sprocket bolts/screws (56).
   - Make sure that camshaft and crankshaft timing marks align as shown in Figure 20.

Tighten

- Camshaft sprocket bolts/screws (56) to 25 N•m (18 lb. ft.).

7. New O-ring seal to water pump driveshaft assembly (63) using J 39089.

ENGINE FRONT COVER ASSEMBLY

Figure 19

Tool Required:

J 39087 Driven Gear Shaft Front Cover Seal Protector

Install or Connect

NOTICE: See "Notice" on page 6A3B-1 of this section.

NOTICE: Be careful not to damage seal when installing front cover assembly over water pump driveshaft assembly.

1. Gasket (51) and front cover assembly (50) using J 39087 on water pump driveshaft assembly.
2. Front cover bolts/screws (52).

Tighten

- Front cover bolts/screws (52) to 11 N•m (97 lb. in.).

DISTRIBUTOR ASSEMBLY

Figure 18

Important

- Distributor assembly (49) is driven by a camshaft pin that mates to one slot in the distributor driveshaft.
- Align distributor driveshaft slot with distributor base timing mark.
- Rotate engine crankshaft until number one piston is at top dead center (intake and exhaust valves closed). Camshaft pin will be at 9 o'clock position.

Install or Connect

NOTICE: See "Notice" on page 6A1B-1 of this section.

1. Distributor assembly (49).
   - Before inserting distributor bolt/screws (47), make sure distributor assembly (49) is fully seated to engine front cover. If it is difficult to seat, check alignment of distributor driveshaft slot, timing mark and camshaft pin.
2. Distributor bolts/screws (47).

Tighten

- Distributor bolts/screws (47) to 12 N•m (106 lb. in.).

3. Distributor bolts/screws (47).

Tighten

- Distributor bolts/screws (47) to 12 N•m (106 lb. in.).

4. Ignition coil and bracket assembly and studs.

Tighten

- Ignition coil studs to 34 N•m (25 lb. ft.).

5. Spark plug and ignition harness assemblies to distributor assembly (49) if removed.

OIL PAN ASSEMBLY

Figures 52 and 53

Install or Connect

1. Apply a small amount of sealer, GM P/N 1052914 or equivalent, to front cover assembly and engine block junction and to rear seal housing and engine block junction. Apply sealer 25 mm (1 inch) in either direction of radius cavity of junctions. See Figure 52.
2. Oil pan gasket (55), oil pan assembly (54) and reinforcements (53).
3. Oil pan nuts (85), bolts/screws (84) and studs (83).

Tighten

- Corner bolts/screws (84) or stud (83), and nuts (85) to 20 N•m (15 lb. ft.).
- Remainder of bolts/screws (84) and studs (83) to 11 N•m (97 lb. in.).

4. Oil level sensor assembly (178).

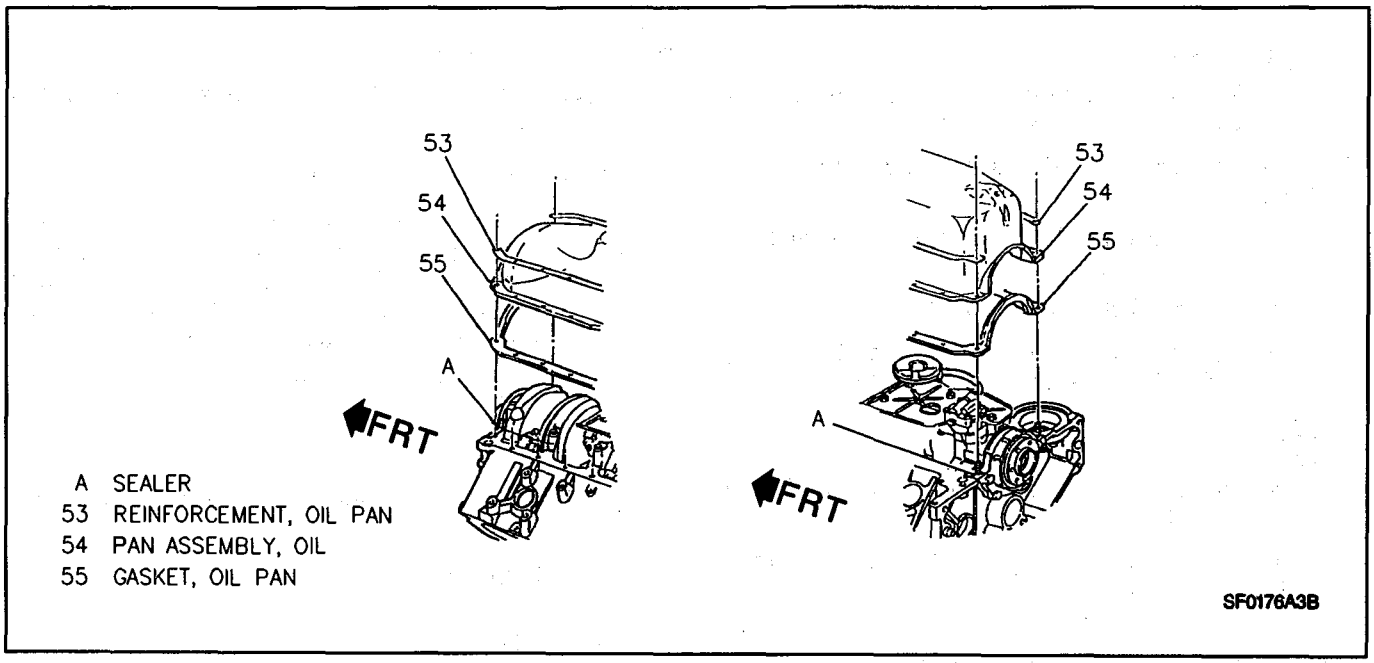


Figure 52 – Oil Pan Sealer

Tighten

- Oil level sensor assembly (178) to 35 N•m (26 lb. ft.).

CRANKSHAFT BALANCER ASSEMBLY AND HUB

Figure 17

Tool Required:

J 39046 Crankshaft Hub Remover/Installer

Install or Connect

NOTICE: See "Notice" on page 6A3B-1 of this section.

1. Crankshaft hub (45) must be installed by following procedure:
   A. Set number 1 piston assembly to top dead center.
   B. Install crankshaft hub with cast arrow on hub in 12 o'clock position.
2. Crankshaft hub (45) using J 39046.
3. Crankshaft hub washer (44) and bolt/screw (43).
4. Crankshaft balancer assembly (42) and bolts/screws (46).

Important

- If crankshaft balancer assembly is replaced, new balancer weights of same size must be installed on new balancer assembly in same location as old balancer assembly.
  A. Measure depth of empty balancer weight hole. Record measurement.
  B. Drive weights in old balancer to bottom of hole then measure depth of hole. Record measurement.
  C. Subtract measurement of hole with weight from measurement of empty hole. Difference will be the length of the balancer weight that must be installed in the new balancer assembly in the same location.

Tighten

- Crankshaft balancer hub bolt/screws (43) to 100 N•m (75 lb. ft.).
- Crankshaft balancer bolts/screws (46) to 85 N•m (63 lb. ft.).

WATER PUMP ASSEMBLY

Figure 16

Install or Connect

NOTICE: See "Notice" on page 6A3B-1 of this section.

1. Coupling (39) to water pump shaft with groove on coupling toward engine block.
   - Apply a light coat of grease to O-ring seals and grease to coupling.

2. Position water pump assembly (37) and gaskets (38), with tabs straight up, to engine block and rotate coupling (39), if necessary, to align it to water pump driveshaft splines and then seat water pump assembly (37).
3. Water pump bolts/screws (40 and 41).

Tighten

- Water pump bolts/screws (40 and 41) to 41 N•m (30 lb. ft.).

4. Air injection pump bracket bolt/screws to 40 N•m (30 lb. ft.).

VALVE LIFTER ASSEMBLIES

Figure 15

Install or Connect

NOTICE: See "Notice" on page 6A3B-1 of this section.

1. Coat valve lifter rollers with prelube, GM P/N 1052365 or equivalent.
2. Valve lifter assemblies (36) in same location from which they were removed.
3. Valve lifter guides (35), retainer (33) and bolts/screws (32).

Tighten

- Valve lifter guide retainer bolts/screws (32) to 25 N•m (18 lb. ft.).

VALVE ROCKER ARM BALL STUDS

Figure 14

Install or Connect

NOTICE: See "Notice" on page 6A3B-1 of this section.

1. Apply sealer, GM P/N 1052080 or equivalent, to threads of new rocker arm ball stud.
2. Rocker arm ball stud (28).

Tighten

- Valve rocker arm ball stud (28) to 68 N•m (50 lb. ft.).

VALVE ROCKER ARMS AND PUSHROD ASSEMBLIES

Figures 14 and 54

Tool Required:

J 8520 Cam Lobe Lift Indicator

Install or Connect

1. Coat rocker arm and rocker arm ball bearing surfaces with prelube, GM P/N 1052365 or equivalent, when installing. Install these components and pushrod assemblies (27) in locations from which they were removed.
2. Pushrod assemblies (27). Make sure pushrod assemblies (27) seat in lifter sockets.

Measure

- Camshaft lobe lift.

A. Position J 8520 with ball socket adapter on pushrod assembly. Make sure pushrod assembly is in lifter socket.

B. Rotate crankshaft assembly slowly in-direction of rotation until lifter roller is on heel of cam lobe. At this point, pushrod assembly will be in its lowest position.

C. Set J 8520 on zero.

D. Rotate crankshaft assembly slowly until pushrod assembly is in fully raised position.

E. Compare total lift shown on J 8520 with specifications. Refer to "Specifications" in this section.

F. Remove J 8520.

3. Rocker arms (29).
4. Rocker arm balls (30) and nuts (31).

Adjust

- Rocker arm nuts until all lash is eliminated.

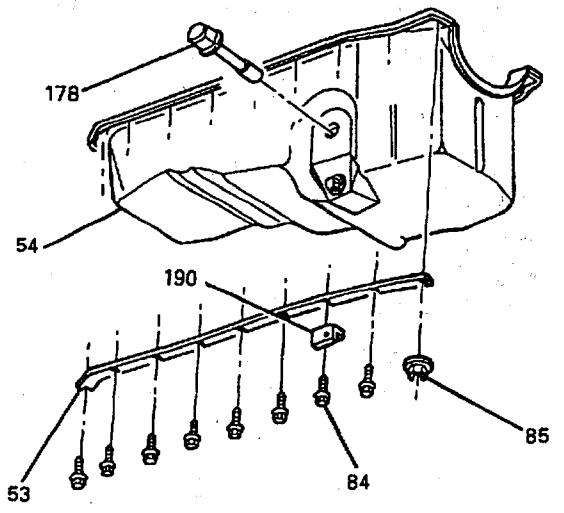
A. Turn crankshaft assembly until cast arrow on crankshaft balancer hub is in 12 o'clock position and number 1 cylinder is in firing position (top dead center).

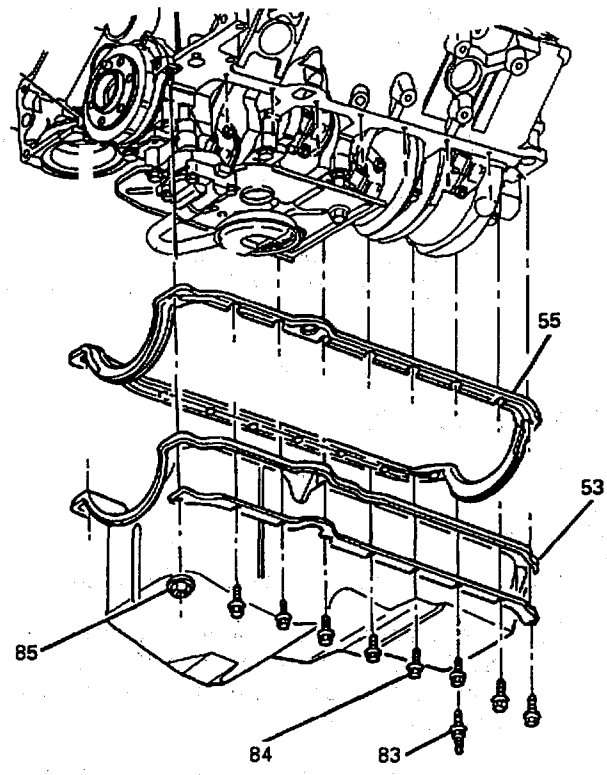
- Watch number 1 cylinder valves as crankshaft balancer hub arrow approaches 12 o'clock position. If a valve moves as arrow moves to position, engine assembly is in number 6 cylinder firing position. Crankshaft assembly must then be turned one more time to reach number 1 cylinder firing position.

B. With engine assembly in number 1 cylinder firing position, following valves can be adjusted:

Exhaust 1, 3, 4, 8

Intake 1, 2, 5, 7





53 REINFORCEMENT, OIL PAN
54 PAN ASSEMBLY, OIL
55 GASKET, OIL PAN
83 STUD, OIL PAN
84 BOLT/SCREW, OIL PAN
85 NUT, OIL PAN
178 SENSOR ASSEMBLY, ENGINE OIL LEVEL SWITCH
190 BRACKET, ENGINE WIRING HARNESS

SBD0536A4

Figure 53 – Oil Pan Assembly

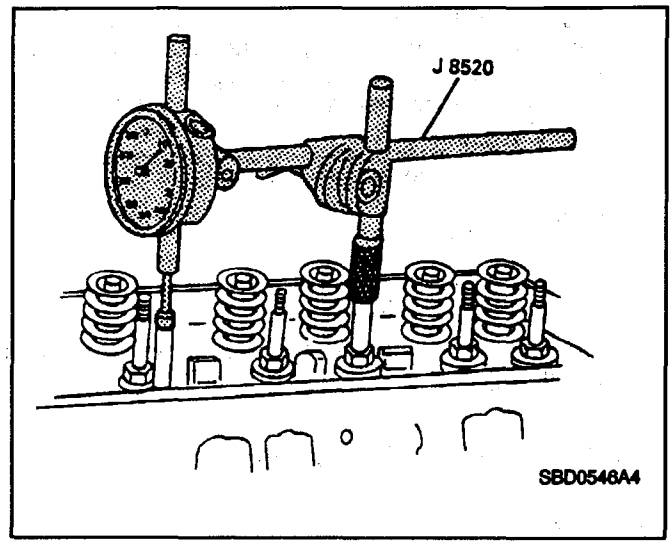


Figure 54 – Measuring Camshaft Lobe Lift

C. Back off rocker arm nut (31) until lash is felt in pushrod assembly (27). Then tighten rocker arm nut (31) until all lash is removed. Zero lash can be felt by rotating pushrod assembly (27) between thumb and forefinger until there is no free play but pushrod assembly (27) rotates with slight resistance.

D. When all free play has been removed, tighten rocker arm nut (31) one additional turn (360 degrees).

E. Turn crankshaft assembly one revolution until hub arrow is again at 12 o'clock position. This is number 6 cylinder firing position. Following valves can now be adjusted:

Exhaust 2, 5, 6, 7

Intake 3, 4, 6, 8

VALVE ROCKER ARM COVER ASSEMBLIES

Figure 13

Right Valve Rocker Arm Cover Assembly

Install or Connect

NOTICE: See "Notice" on page 6A3B-1 of this section.

1. Gasket (25) and valve rocker arm cover assembly (23).
2. Valve rocker arm cover bolts/screws (24).

Tighten

- Valve rocker arm cover bolts/screws (24) to 12 N•m (106 lb. in.).

3. Crankcase vent hose.

Left Valve Rocker Arm Cover Assembly

Install or Connect

1. Gasket (25) and valve rocker arm cover assembly (23).
2. Valve rocker arm cover bolts/screws (24).

Tighten

- Valve rocker arm cover bolts/screws (24) to 12 N•m (106 lb. in.).

INTAKE MANIFOLD ASSEMBLY

Figures 9, 10 and 55

Install or Connect

NOTICE: See "Notice" on page 6A3B-1 of this section.

1. Apply a 5 mm (3/16 inch) bead of RTV sealer, GM P/N 12346141 or equivalent, to front and rear of engine block. Extend bead 13 mm (1/2 inch) up each cylinder head assembly to seal and retain gaskets.
2. Intake manifold assembly (6) with new gaskets (10).
3. Intake manifold bolts/screws (8) and studs (9).

Tighten

- Intake manifold bolts/screws (8) and studs (9) in a first pass to 8 N•m (71 lb. in.) in sequence as shown in Figure 55. Tighten in sequence in a second pass to final specifications of 48 N•m (35 lb. ft.).

4. Throttle body assembly (3), gasket (5) and bolts screws (4).

Tighten

- Throttle body bolts/screws (4) to 25 N•m (18 lb. ft.).

5. Accelerator cable bracket.
6. Engine coolant air bleed pipe and bolts/screws.

Tighten

- Accelerator control cable bracket bolts/screws to 12 N•m (106 lb. in.).
- Engine coolant air bleed pipe bolts/screws to 40 N•m (30 lb. ft.).

  -Use a backup wrench when tightening engine coolant air bleed pipe bolts/screws.

7. EGR valve assembly and nuts.
8. EGR solenoid assembly and nut.

Tighten

- EGR valve nuts and EGR control valve relay nut to 25 N•m (18 lb. ft.).

9. Canister purge valve assembly bracket and bolt/screw.

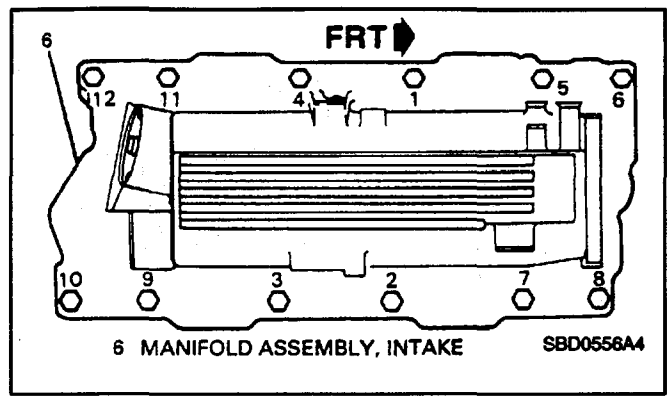


Figure 55 – Intake Manifold Bolt Tightening Sequence

Tighten

- Evaporative emission canister purge solenoid valve bracket bolt/screw to 6 N•m (53 lb. in.).

10. EGR vacuum harness assembly and crankcase vent hoses.
11. Generator bracket assembly, spark plug wire support and bolts/screws.

Tighten

- Generator bracket bolts/screws to 40 N•m (30 lb. ft.).

12. Canister purger valve vacuum hose.
13. Fuel injectors with fuel rail assembly (2) to intake manifold assembly (6).
14. Fuel pressure regulator vacuum tube assembly (7).
15. Fuel rail bolts/screws (1).

Tighten

- Fuel injection fuel rail bolts/screws (1) to 10 N•m (89 lb. ft.).

16. Wiring harness assemblies if moved or disconnected.
17. MAP sensor and bolts/screws.

Tighten

- Map sensor bolts/screws to 6 N•m (53 lb. in.).

EXHAUST MANIFOLD ASSEMBLIES

Figures 11 and 12

Right Exhaust Manifold Assembly

Important

1. Clean cylinder head exhaust manifold bolt/stud holes with a 3/8-16 tap.
2. Clean bolt/stud hole with GM 12345754.

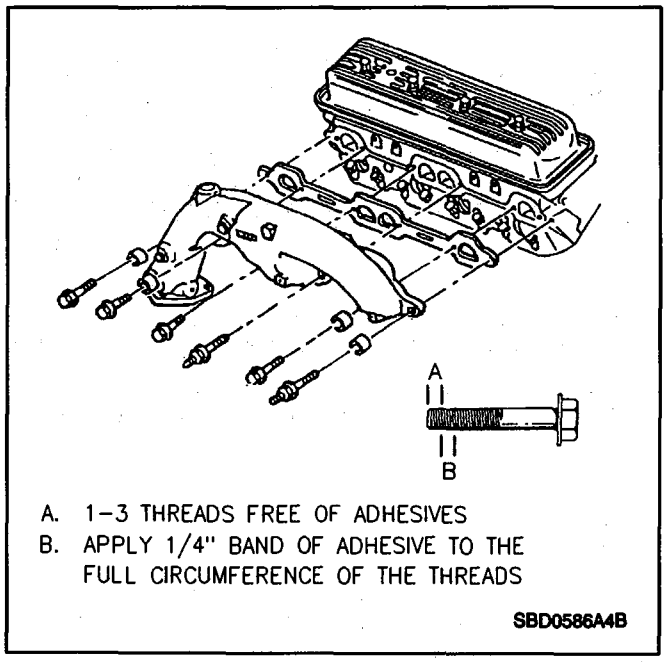


Figure 56 – Applying Adhesive to Bolt/Stud Threads

3. Remove all old adhesive material from bolt/stud threads.
4. Apply 1/4″ band of GM 12345493 adhesive to bolt/stud threads. Figure (56).

Install or Connect

NOTICE: See "Notice" on page 6A3B-1 of this section.

1. Exhaust manifold gasket (18), manifold assembly (19) and heat shields.
2. Exhaust manifold studs (20) and bolts/screws (21).

Tighten

- Exhaust manifold studs (20) and bolts/screws (21) to 35 N•m (26 lb. ft.).

3. Air injection pipe assembly (15) and check valve (11).

Tighten

- Secondary air injection pipe fitting-to-exhaust manifold assembly to 55 N•m (41 lb. ft.).

4. Apply sealer, GM P/N 1052080 or equivalent around oil level indicator tube 13 mm (1/2 inch) below bead.
5. Oil level indicator, tube and bolt/screw to engine block.

Tighten

- Oil level indicator bolt screw to 12 N•m (106 lb. in.).

6. Spark plug wire harness assembly.
7. EGR valve pipe gasket (22), pipe assembly (12), nut (14) and bolt/screw (229).

Tighten

- EGR valve pipe nuts (14) and bolt/screws (229) to 25 N•m (18 lb.ft.).

Left Exhaust Manifold Assembly

Important

1. Clean cylinder head exhaust manifold bolt/stud holds with a 3/8-16 tap.
2. Clean bolt/stud hole with GM 12345754.
3. Remove all old adhesive material from bolt/stud threads.
4. Apply 1/4 band of GM 12345493 adhesive to bolt/stud threads (figure 56).

Install or Connect

NOTICE: See "Notice" on page 6A3B-1 of this section.

1. Exhaust manifold gasket (17), manifold assembly (16) and heat shields.
2. Exhaust manifold studs (20) and bolts/screws (21) and spacers (245).

Tighten

- Exhaust manifold studs (20) and bolts/screws (21) to 35 N•m (26 lb. ft.).

3. Spark plug wire harness assembly.
4. Secondary air injection pipe assembly (15), and check valve (11).

Tighten

- Secondary air injection pipe fitting-to-exhaust manifold assembly to 55 N•m (41 lb. ft.).

FLYWHEEL ASSEMBLY

Figure 8

Install or Connect

1. Flywheel assembly (135 or 137) to crankshaft assembly.

- Align locator hole to pin (133).

2. Flywheel bolts/screws (136 or 138).

Tighten

- Flywheel bolts/screws (136 or 138) to 100 N•m (74 lb. ft.).

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Accelerator Control Cable Bracket Bolt/Screw	12 N•m (106 lb. in.)
Camshaft Retainer Bolt/Screw	12 N•m (106 lb. in.)
Camshaft Sprocket Bolt/Screw	25 N•m (18 lb. ft.)
Connecting Rod Nut	27 N•m (20 lb. ft.) + additional 55°
Coolant Air Bleed Pipe Bolt/Screw	40 N•m (30 lb. ft.)
Crankshaft Balancer Bolt/Screw	85 N•m (63 lb. ft.)
Crankshaft Balancer Hub Bolt/Screw	100 N•m (75 lb. ft.)
Crankshaft Bearing Cap Bolt/Screw and Stud	105 N•m (77 lb. ft.)
Crankshaft Rear Oil Seal Housing Nut/Bolt/Screw	15 N•m (11 lb. ft.)
Cylinder Head Bolt/Screw	88 N•m (65 lb. ft.)
Distributor Bolt/Screw	12 N•m (106 lb. in.)
Drain Plug	20 N•m (15 lb. in.)
EGR Control Valve Relay Nut	25 N•m (18 lb. ft.)
EGR Valve nut	25 N•m (18 lb. ft.)
EGR Valve Pipe Bolt/Screw and Nut	25 N•m (18 lb. ft.)
Engine Block Oil Gallery Plug	20 N•m (15 lb. ft.)
Engine Front Cover Bolt/Screw	11 N•m (97 lb. in.)
Engine Oil Level Sensor Assembly	35 N•m (26 lb. ft.)
Evaporative Emission Canister Purge Solenoid Valve Bracket Bolt/Screw	6 N•m (53 lb. ft.)
Exhaust Manifold Stud and Bolt/Screw	35 N•m (26 lb. ft.)
Flywheel Bolt/Screw	100 N•m (74 lb. ft.)
Fuel Injection Fuel Rail Bolt/Screw	10 N•m (89 lb. ft.)
Fuel Pump Switch and Oil Pressure Gage Sensor Assembly	12 N•m (106 lb. in.)
Generator Bracket Bolt/Screw	40 N•m (30 lb. ft.)
Ignition Coil Stud	40 N•m (30 lb. ft.)
Intake Manifold Bolt/Screw and Stud	
First Pass	8 N•m (71 lb. in.)
Final Pass	48 N•m (35 lb. ft.)
Knock Sensor Assembly	20 N•m (15 lb. ft.)
MAP Sensor Bolt/Screw	6 N•m (53 lb. ft.)
Oil Filter Adapter Bolt/Screw	23 N•m (17 lb. ft.)
Oil Level Indicator Tube Bolt/Screw	12 N•m (106 lb. in.)
Oil Pan Assembly	
Corner Nut/Bolt/Screw	20 N•m (15 lb. ft.)
Side Rail Bolt/Screw	11 N•m (97 lb. in.)
Oil Pan Baffle Nut	40 N•m (30 lb. ft.)
Oil Pan Drain Plug	20 N•m (15 lb. ft.)
Oil Pump Bolt/Screw-to-Rear Crankshaft Bearing Cap	90 N•m (66 lb. in.)
Oil Pump Cover Bolt/Screw	9 N•m (80 lb. in.)
Oil Pump Driveshaft Bolt/Screw	18 N•m (13 lb. ft.)
Secondary Air Injection Pipe-to-Exhaust Manifold Assembly	55 N•m (41 lb. ft.)
Secondary Air Injection Pump Bracket Bolt/Screw	40 N•m (30 lb. ft.)
Starter Motor Bolt/Screw	47 N•m (35 lb. ft.)
Throttle Body Bolt/Screw	25 N•m (18 lb. ft.)
Valve Lifter Guide Retainer Bolt/Screw	25 N•m (18 lb. ft.)
Valve Rocker Arm Ball Stud	68 N•m (50 lb. ft.)
Valve Rocker Arm Cover Bolt/Screw	12 N•m (106 lb. in.)
Water Pump Bolt/Screw and Stud	41 N•m (30 lb. ft.)
Water Pump Driveshaft Bearing Retainer Bolt/Screw	12 N•m (106 lb. in.)

ENGINE ASSEMBLY SPECIFICATIONS (5.7L LT1)

GENERAL

Type	V8
Displacement	5.7L (350 CID)
Bore	101.60 mm (4.000″)
Stroke	88.39 mm (3.480″)
Compression Ratio	10.5:1
Firing Order	1-8-4-3-6-5-7-2

- Spark Plugs
  - Type AC41-906
  - Gap ..... 1.27 mm (0.050″)
  - Torque ..... 27 N•m (20 lb. ft.)
- Oil Pressure (Minimum) ..... 41.4 kPa (6.0 psig) at 1,000 engine rpm
  124.1 kPa (18.0 psig) at 2,000 engine rpm
  165.5 kPa (24.0 psig) at 4,000 engine rpm
- Oil Filter Torque ..... 21 N•m (15 lb. ft.)

CYLINDER BORE

- Diameter ..... 101.618 - 101.643 mm (4.0007 - 4.0017″)
- Out-of-Round
  - Production ..... 0.02 mm (0.001″) MAX.
  - Service Limit ..... 0.05 mm (0.002″) MAX.
- Taper
  - Production
    - Thrust Side ..... 0.012 mm (0.0005″) MAX.
    - Relief Side ..... 0.025 mm (0.0010″) MAX.
  - Service Limit ..... 0.025 mm (0.0010″) MAX.

PISTON ASSEMBLY

- Piston Bore Clearance
  - Production ..... 0.025 - 0.068 mm (0.0010 - 0.0027″)
  - Service Limit ..... 0.068 mm (0.0027″) MAX.

PISTON RINGS

- Piston Compression Ring
  - Groove Clearance
    - Production Top ..... 0.030 - 0.068 mm (0.0012 - 0.0027″)
    - Production 2nd ..... 0.038 - 0.078 mm (0.0015 - 0.0031″)
    - Service Limit ..... 0.107 mm (0.0042″) MAX.
  - Gap
    - Production Upper ..... 0.25 - 0.50 mm (0.010 - 0.020″)
    - Production Lower ..... 0.46 - 0.66 mm (0.018 - 0.026″) MAX.
    - Service Limit ..... 0.88 mm (0.035″) MAX.
- Piston Oil Ring
  - Groove Clearance
    - Production ..... 0.051 - 0.17 mm (0.002 - 0.007″)
    - Service Limit ..... 0.20 mm (0.008″) MAX.
  - Gap
    - Production ..... 0.25 - 0.76 mm (0.010 - 0.030″)
    - Service Limit ..... 1.65 mm (0.065″) MAX.

PISTON PIN

- Diameter ..... 23.546 - 23.548 mm (0.9270 - 0.9271″)
- Clearance in Piston Assembly
  - Production ..... 0.0127 - 0.0203 mm (0.0005 - 0.0008″)
  - Service Limit ..... 0.025 mm (0.0010″) MAX.
- Fit In Connecting Rod Assembly ..... 0.013 - 0.050 mm (0.0005 - 0.0020″) Interference

CRANKSHAFT ASSEMBLY

- Main Journal
  - Diameter #1 ..... 62.189 - 62.212 mm (2.4484 - 2.4493″)
  - Diameter #2, #3, #4 ..... 62.182 - 62.205 mm (2.4481 - 2.4490″)
  - Diameter #5 ..... 62.177 - 62.120 mm (2.4479 - 2.4488″)
  - Taper
    - Production ..... 0.005 mm (0.0002″) MAX.
    - Serviced Limit ..... 0.025 mm (0.0010″) MAX.
  - Out-of-Round
    - Production ..... 0.005 mm (0.0002″) MAX.
    - Service Limit ..... 0.025 mm (0.0010″) MAX.
- Crankshaft Bearing Clearance
  - Production #1 ..... 0.020 - 0.051 mm (0.0008 - 0.0020″)
  - Production #2, #3, #4 ..... 0.028 - 0.051 mm (0.0011 - 0.0020″)
  - Production #5 ..... 0.043 - 0.081 mm (0.0017 - 0.0032″)
  - Service Limit #1 ..... 0.025 - 0.038 mm (0.0010 - 0.0015″)

- Service Limit #2, #3, #4 ..... 0.025 - 0.064 mm (0.0010 - 0.0025″)
- Service Limit #5 ..... 0.064 - 0.089 mm (0.0025 - 0.0035″)
- Crankshaft Assembly End Play ..... 0.03 - 0.17 mm (0.001 - 0.007″)
- Crankshaft Assembly Runout (at rear flange) ..... 0.038 mm (0.0015″)

CONNECTING ROD ASSEMBLY

- Connecting Rod Journal
  - Diameter ..... 53.284 - 53.334 mm (2.0978 - 2.0998″)
  - Taper
    - Production ..... 0.007 mm (0.0003″) MAX.
    - Service Limit ..... 0.025 mm (0.0010″) MAX.
  - Out-of-Round
    - Production ..... 0.007 mm (0.0003″) MAX.
    - Service Limit ..... 0.025 mm (0.0010″) MAX.
- Rod Bearing Clearance
  - Production ..... 0.033 - 0.088 mm (0.0013 - 0.0035″)
  - Service Limit ..... 0.076 mm (0.0030″) MAX.
- Rod Side Clearance ..... 0.16 - 0.35 mm (0.006 - 0.014″)

CAMSHAFT ASSEMBLY

- Journal Diameter ..... 47.440 - 47.490 mm (1.8677 - 1.8697″)
- End Play ..... 0.11 - 0.30 mm (0.004 - 0.012″)
- Lobe Lift ± 0.050 mm (0.002″)
  - Intake ..... 7.62 mm (0.300″)
  - Exhaust ..... 7.80 mm (0.307″)

VALVE SYSTEM

- Lifter Assembly ..... Hydraulic
- Rocker Arm Ratio 1.50:1
- Valve Lash ..... 1 ± 1/4 turn down from zero lash
- Face Angle ..... 45°
- Seat Angle ..... 46°
- Seat Runout ..... 0.05 mm (0.002″) MAX.
- Seat Width
  - Intake ..... 0.76 - 1.27 mm (0.030 - 0.050″)
  - Exhaust ..... 1.52 - 2.03 mm (0.060 - 0.080″)
- Stem Clearance
  - Production
    - Intake ..... 0.023 - 0.069 mm (0.0009 - 0.0027″)
    - Exhaust ..... 0.023 - 0.069 mm (0.0009 - 0.0027″)
  - Service
    - Intake ..... 0.093 mm (0.0037″) MAX.
    - Exhaust ..... 0.119 mm (0.0047″) MAX.
- Valve Spring
  - Free Length ..... 51.1 mm (2.01″)
  - Pressure
    - Closed ..... 360 - 395 N at 45.2 mm (81 - 89 lb. at 1.78″)
    - Open ..... 1121 - 1208 N at 33.1 mm (252 - 272 lb. at 1.305″)
  - Installed Height
    - Intake ..... 45.2 mm (1.78″)
    - Exhaust ..... 45.2 mm (1.78″)
- Valve Lift
  - Intake ..... 11.43 mm (0.450″)
  - Exhaust ..... 11.68 mm (0.460″)

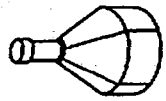
SPECIAL TOOLS



1
J 5590



2
J 39087



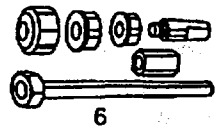
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J 5825-A



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J 3049



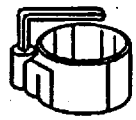
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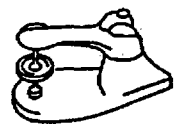
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J 6098-01



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J 39088



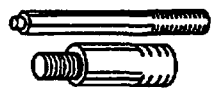
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J 8037



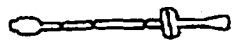
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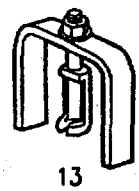
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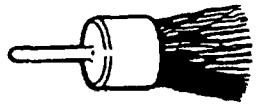


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1 CRANKSHAFT GEAR INSTALLER
2 DRIVEN GEAR SHAFT FRONT COVER SEAL PROTECTOR
3 CRANKSHAFT GEAR REMOVER
4 HYDRAULIC VALVE LIFTER REMOVER (PLIER TYPE)
5 DRIVE GEAR/WATER PUMP SHAFT SEAL INSTALLER
6 CAMSHAFT BEARING REMOVER AND INSTALLER
7 DRIVEN GEAR SHAFT FRONT COVER SEAL INSTALLER
8 PISTON RING COMPRESSOR
9 VALVE SPRING TESTER
10 VALVE SPRING COMPRESSOR (HEAD-OFF)
11 CONNECTING ROD BOLT GUIDE SET
12 HYDRAULIC VALVE LIFTER REMOVER (SLIDE-HAMMER TYPE)
13 DRIVEN GEAR ASSEMBLY REMOVER

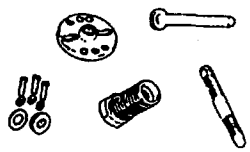
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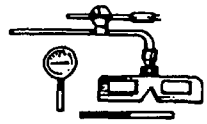
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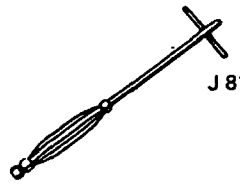
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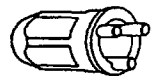
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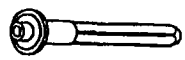
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23.  J 35621

24.  J 8101

25.  J 39092

26.  J 39937

27.  J 8001

14 TORQUE ANGLE METER
15 CARBON REMOVING BRUSH
16 CAM LOBE LIFT INDICATOR
17 OIL SUCTION PIPE INSTALLER
18 CRANKSHAFT HUB REMOVER AND INSTALLER
19 SPARK PLUG PORT ADAPTOR (14 mm TAPERED SEAT)
20 MAGNETIC BADE INDICATOR SET
21 PISTON PIN REMOVER AND INSTALLER SET
22 FRONT COVER ALIGNER AND OIL SEAL INSTALLER
23 REAR MAIN SEAL INSTALLER
24 VALVE GUIDE CLEANER
25 DRIVEN GEAR ASSEMBLY INSTALLER
26 DISTRIBUTOR DRIVESHAFT FRONT COVER SEAL INSTALLER
27 DIAL INDICATOR SET

SF0576A3B

BLANK

SECTION 6B

COOLING AND RADIATOR

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

The cooling system, which consists of a radiator assembly and coolant recovery subsystem, electric engine coolant fan assembly, engine coolant thermostat assembly and water pump assembly and serpentine drive belt, works to maintain engine temperature at an efficient level during all engine operating conditions.

On the 3.4L L32 engine, coolant is drawn from the radiator assembly by the water pump assembly and circulated through coolant jackets in the engine block assembly, intake manifold assembly, and cylinder head assemblies. It is then directed back to the radiator assembly.

On the 5.7L LT1 engine, coolant is drawn from the radiator assembly by the water pump assembly and circulated through coolant jackets in the cylinder heads, then

through coolant jackets in the engine block. It is then directed back to the radiator assembly.

The system directs some engine coolant through hose assemblies to the heater core to provide defrost and passenger compartment heat. A coolant recovery reservoir assembly is connected to the radiator assembly to recover engine coolant displaced by expansion. As the engine assembly cools, the engine coolant is drawn back into the radiator assembly by vacuum.

RADIATOR ASSEMBLY

Cross-Flow Radiator Core and Outlet and Inlet Tanks

A cross-flow radiator core is used on all models. Outlet and inlet tanks are located to the right and left of the cross-flow radiator core. All radiator assemblies used with automatic transmissions have transmission oil coolers and inlet and outlet fittings for transmission fluid circulation. Vehicles with manual transmission assemblies use radiator assemblies without transmission oil coolers.

An aluminum-plastic radiator assembly can be identified by a note on the outlet tank 127 mm (5 inches) below the filler neck which reads: "Important – for repair see Harrison Service Manual." Service procedures for the aluminum-plastic radiator assembly are described in that manual and in this section.

Transmission Oil Cooler Assembly

If equipped, the transmission oil cooler assembly is located in the outlet tank on the right side of the radiator assembly. For information on servicing the transmission oil cooler and pipe assemblies, refer to SECTION 7A.

Engine Oil Cooler Assembly

The 5.7L LT1 engine equipped with a GU5 axle require an engine oil cooler assembly which is located in the left end of the radiator assembly. Engine oil cooler pipes connect the radiator assembly to the engine block assembly through an adapter, located between the oil filter assembly and engine block.

Radiator Drain Cock Assembly

The radiator drain cock assembly includes the radiator drain cock and the radiator drain cock sealer; it is located on the inner right side of the radiator assembly, near the bottom.

RADIATOR FILLER CAP ASSEMBLY

Figure 1

A pressure-type radiator filler cap assembly is used with the cross-flow radiator assembly to allow a buildup of 124 kPa (18 psi) in the cooling system. This pressure raises the boiling point of engine coolant to approximately 125°C (257°F) at sea level.

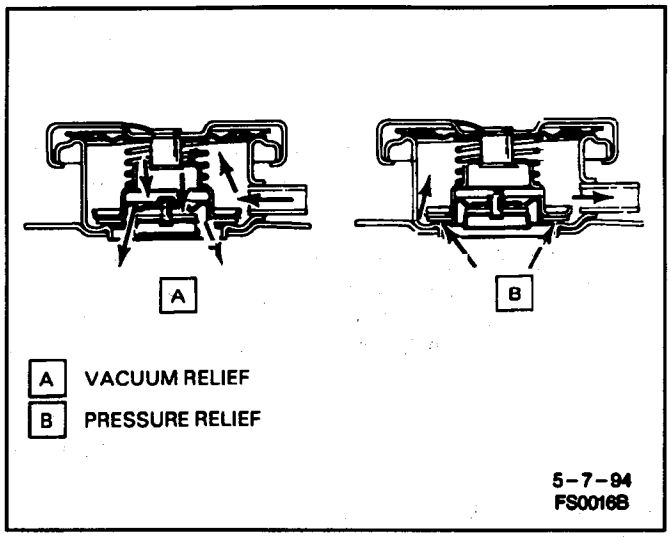


Figure 1 – Pressure-Type Radiator Filler Cap Assembly (Typical)

CAUTION: Do not remove radiator filler cap assembly to check engine coolant level; check engine coolant at the coolant recovery reservoir assembly. Engine coolant should be added only to the coolant recovery reservoir assembly, when the system cools.

CAUTION: As long as there is pressure in the cooling system, the temperature can be considerably higher than the boiling temperature of the solution. Removal of the radiator filler cap assembly while engine assembly is hot and pressure is high will cause the solution to boil instantaneously and possibly with explosive force, spewing the solution over engine assembly, fenders and person removing cap. If the solution contains flammable antifreeze, such as alcohol (not recommended for use at any time), there is also the possibility of causing a serious fire.

The pressure-type radiator filler cap assembly contains a blow-off (pressure) valve and a vacuum (atmospheric) valve. The pressure valve is held against its seat by a heavy spring. This spring protects the radiator assembly by relieving pressure exceeding 124 kPa (18 psi).

To prevent radiator assembly collapse caused by vacuum as the engine assembly cools, the vacuum valve prevents excessive pressure differences from occurring between the cooling system and the atmosphere.

The radiator filler cap assembly has been designed without finger grips to discourage inadvertent removal. To safely remove the radiator filler cap assembly, rotate the cap assembly slowly counter-clockwise (do not press down) to detent. Allow any pressure to be relieved. Next, press down on the cap assembly and continue to rotate cap assembly counterclockwise and lift off the cap assembly. Embossed on the cap assembly is a caution against opening it and arrows indicating the proper closed position.

ELECTRIC ENGINE COOLANT FAN ASSEMBLY

An electric engine coolant fan assembly aids air flow through the radiator assembly. There are five plastic blades on each fan blade assembly. The fan blade assembly is driven by a motor attached to the radiator support. The 5.7L LT1 engine assembly equipped with air conditioning has two engine coolant fan assemblies attached to the radiator support.

The fan motor is activated by an PCM controlled fan relay. If the vehicle is equipped with air conditioning, the fan motor also operates when the compressor assembly is operating.

CAUTION: If a fan blade assembly is bent or damaged in any way, no attempt should be made to repair or reuse the damaged part. A bent or damaged fan blade assembly should always be replaced. It is essential that fan blade assemblies remain in proper balance and proper balance cannot be assured once a fan blade assembly has been bent or damaged. A fan blade assembly that is not in proper balance could fail and fly apart during subsequent use, creating an extremely dangerous condition.

The fan blade assembly is designed to aid air flow through the radiator and air conditioning condenser.

ENGINE COOLANT TEMPERATURE GAGE SENSOR

This sensor controls a temperature gage in the instrument cluster assembly. The temperature gage indicates the operating temperature of the engine assembly. Refer to SECTION 8A for engine coolant temperature gage sensor diagnosis and location.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR

This sensor sends a signal to the powertrain control module (PCM) which completes the ground for the electric engine coolant fan relay, which operates the fan assembly when the engine coolant temperature exceeds 110°C (230°F). Refer to SECTION 6E3 for engine coolant temperature (ECT) sensor diagnosis and location.

ENGINE COOLANT THERMOSTAT ASSEMBLY

A pellet-type engine coolant thermostat assembly is used in the engine coolant outlet passage to control the flow of engine coolant to provide fast engine warm-up and to regulate engine temperatures. A wax pellet element in the thermostat assembly expands when heated and contracts when cooled. The pellet element is connected through a piston to a valve. The valve remains closed while the engine coolant is cold, preventing circulation of engine coolant through the radiator assembly and allowing the circulation of engine coolant only through the engine assembly.

As the engine assembly warms, the pellet element expands and the thermostat valve opens, permitting engine coolant to flow through the radiator assembly.

COOLANT RECOVERY SYSTEM

A plastic reservoir is connected to the radiator assembly by a hose. As the vehicle is driven, the engine coolant is heated and expands. The portion of the engine coolant displaced by this expansion flows from the radiator assembly into the reservoir assembly. When the engine assembly is stopped and the engine coolant cools and contracts, the displaced engine coolant is drawn back into the radiator assembly by vacuum. Thus, the radiator assembly is kept filled with engine coolant to the desired level at all times, resulting in increased cooling efficiency.

RADIATOR AIR BAFFLE ASSEMBLIES AND DEFLECTORS

Radiator air baffle assemblies and deflectors are located at the top and bottom of the radiator assembly to increase air flow through the radiator assembly.

SERPENTINE DRIVE BELT

The serpentine drive belt drives the water pump assembly (V6 only) and engine accessories. To check the condition of the serpentine drive belt and tensioner assembly, refer to SECTION 6A2A or SECTION 6A3A.

ENGINE BLOCK COOLANT DRAIN HOLE PLUG

The engine block coolant drain hole plug is on the left side of the engine block assembly. It must be removed during a complete drain and refill of the coolant system. The knock sensor on the right side of the engine block assembly must also be removed.

MAINTENANCE RECOMMENDATIONS

Regular maintenance of the cooling system will help keep it operating properly. Use the following procedures to check the cooling system at least once a year or 25 000 km (15,000 miles).

CHECKING ENGINE COOLANT

Check the engine coolant level in the reservoir assembly by removing the reservoir cap and checking the dipstick while the engine is cold. The level should be at or above the "FULL COLD" mark on the dipstick when the engine assembly is cold. At normal operating temperatures the engine coolant level should be at or above the "FULL HOT" mark on the dipstick.

Engine coolant should be added only to the reservoir assembly to raise the level to the appropriate mark. Use a 50/50 mixture of high quality ethylene glycol and water for engine coolant additions.

Every two years or 50 000 kilometers (30,000 miles), whichever comes first, the cooling system should be drained and refilled. Refer to "Draining and Refilling the Cooling System" in this section.

ENGINE COOLANT CONCENTRATION

The percentage of ethylene glycol in the engine coolant should be checked periodically and when the engine coolant level is adjusted or the system drained and refilled.

This test is done by using a refractometer engine coolant tester. Refractometers test for the amount of glycol in a coolant mixture by measuring the speed of light as it passes through the fluid and are not affected by the specific gravity of the glycol. Refer to "Engine Coolant Testing" in this section for the test procedures.

HOSE ASSEMBLIES AND CLAMPS INSPECTION

Inspect the condition of all hose assemblies and clamps. Hose assemblies should be flexible and show no signs of bulging, cracks, cuts, kinks or area of possible leaks. Inspect the brackets, supports, ties and clamps. Adjust and tighten as necessary.

WATER PUMP ASSEMBLY COOLANT WEEPAGE

A very slight amount of weepage may occur at the water pump vent hole during vehicle operation. Tracks of residue may occur from the lower vent hole. The water pump should be replaced only if coolant is dripping from the vent hole while the engine is in operation or while the cooling system is pressurized.

Minor water pump weepage and minor engine cooling system leaks may be corrected by adding two sealant pellets to the cooling system. The pellets are available from GMSPO in packages of six under GM P/N 3634621.

Two engine coolant supplement pellets should be added to the coolant system under the following conditions:

- Vehicle encountering water pump weepage or minor coolant leak/loss that cannot be corrected through normal service procedures.
- When cooling system is drained and coolant is replaced with new coolant due to engine repair work or at recommended coolant change intervals (two years or 30,000 miles).
- Whenever engine water pump is replaced. The addition of pellets provides a mild lapping of the new water pump seal that improves conformability of the mating surfaces. Water pump seal weepage is minimized by the addition of pellets.

CAUTION: To avoid the danger of being burned, do not remove the cap while the engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure.

NOTICE: Do not add pellets into non-pressurized coolant recovery bottles.

The two pellets should be installed into the radiator. Care should be exercised to avoid contamination of the pressure/radiator cap and mating sealing surfaces with pellet debris. The use of sealant pellets may cause a film to appear around the sides of non-pressurized coolant recovery bottles. The presence of this film is considered to be normal.

Following installation of the pellets, run the engine for approximately 15 minutes, then check for coolant leaks and proper cooling system operation.

Important

If pellets have been installed to correct an excessive water pump seal weepage condition, one to two weeks of normal vehicle operation may be required to lap in the mating seal surfaces. Some staining due to minor weepage may continue to occur. This is considered normal.

PRESSURE TESTING

Test the radiator filler cap assembly for the proper pressure holding capacity. Refer to "Pressure Test" in this section.

EXTERIOR RADIATOR ASSEMBLY CLEANING

Clearing away bugs, leaves and other debris from the small air passageways of the radiator assembly will improve the operation of the cooling system.

Use compressed air to blow through the radiator assembly from the rear towards the front of the vehicle.

NOTICE: The radiator fins are necessary for good heat transfer and should not be brushed. Brushing may damage the fins, reducing heat transfer.

DIAGNOSIS

COOLING SYSTEM OVERHEATING

Figure 2

1. If overheating occurs due to prolonged idling in gear, instruct operator on driving techniques which would reduce possibility of engine assembly overheating:
   - Idle in "NEUTRAL" as much as possible and raise engine rpm using accelerator pedal assembly.
   - Turn air conditioning "OFF" during extended idling.
2. If above does not apply, refer to diagnosis chart.

ENGINE COOLANT THERMOSTAT ASSEMBLY TEST

Figure 2

Tools Required:

J 24731-188 Tempil Stick

J 24731-206 Tempil Stick

Inspect

- Thermostat assembly opening temperature (Figure 2).

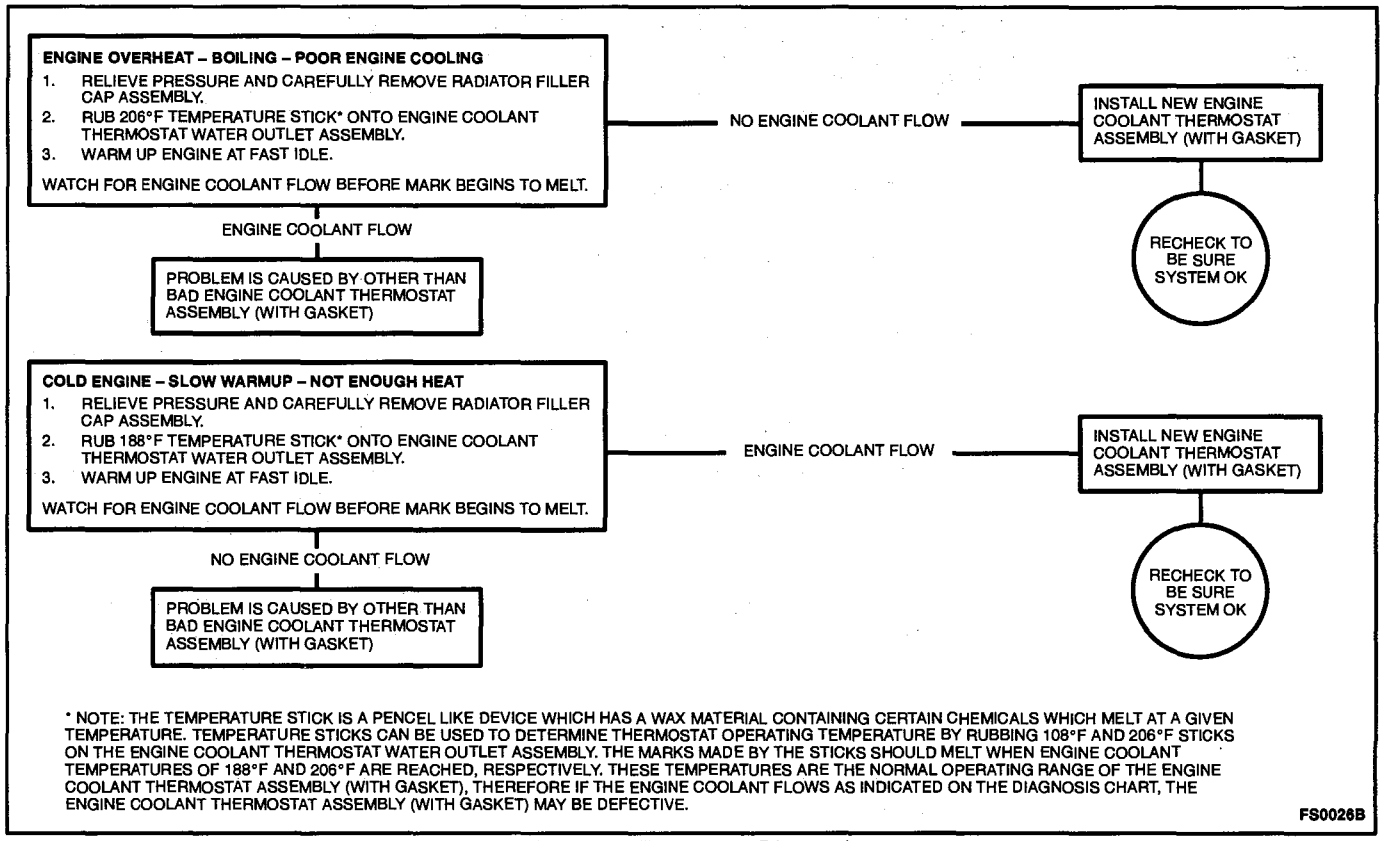


Figure 1 – Thermostat Diagnosis

RADIATOR FILLER CAP ASSEMBLY

Inspect

- Cap assembly for weak spring washer or damage to gasket. If spring washer is weak, replace cap assembly.
- Relief valve gasket in cap assembly and inner sealing surface of neck assembly for damage or debris.
- Hose fitting on neck assembly for cracks. If fitting is loose or cracked, replace radiator end tank.

Pressure Test

Tool Required:

J 24460-01 Cooling System Tester

1. Clean cap assembly.
2. Install cap assembly on J 24460-01.
3. Pump pressure tester slowly to obtain minimum holding pressure.
   A. If cap assembly fails to hold 83 kPa (12 psi), replace cap assembly.
   B. If installing new cap assembly, coat both gaskets with engine coolant.

SERPENTINE DRIVE BELT

Routine inspection of the serpentine drive belt may reveal cracks in the belt ribs. These cracks will not impair belt performance and are not a basis for belt replacement. For belt tensioning and replacement procedures, refer to SECTION 6A2A or SECTION 6A3A.

COOLING SYSTEM DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine overheats.	a. Loss of engine coolant.	a. Refer to next condition – "Loss of engine coolant."
	b. Loss of system pressure.	b. Perform radiator filler cap assembly pressure test.
	c. Weak engine coolant solution.	c. Test engine coolant for proper 50-50 mixture.
	d. Loose serpentine drive belt.	d. Check serpentine drive belt tension. Refer to SECTION 6A2A or SECTION 6A3A.
	e. Advanced/Retarded ignition timing.	e. Refer to SECTION 6E.
	f. Obstructed radiator fins.	f. Remove or relocate added-on parts that block air to radiator assembly. Clean away bugs, leaves, and other debris.
	g. Cooling system passages blocked by rust or scale.	g. Flush cooling system or flow check radiator assembly. Remove cylinder head assembly and inspect, if required.
	h. Kinked reservoir hose assembly.	h. Re-route reservoir hose assembly.
	i. Inoperative engine coolant temperature fan assembly.	i. Refer to SECTION 8A.
	j. Loose, damaged, and/or missing radiator upper and lower shrouds, air deflectors or baffle assemblies.	j. Repair or replace as required.
	k. Thermostat assembly.	k. Replace thermostat assembly stuck in closed position.
	l. Faulty water pump assembly.	l. Replace water pump assembly.
	m. Incorrect radiator assembly.	m. Determine proper radiator assembly for vehicle and replace radiator assembly if necessary.
	n. Incorrect or damaged fan blade assembly.	n. Check for correct part number. Replace fan blade assembly if required.
	o. Faulty emission system components. – PCV valve. – Catalytic converter plugged.	o. Refer to SECTION 6E or 6F.
	p. Engine oil overfill.	p. Check engine oil level.
	q. Incorrect Temperature gauge reading.	q. Faulty coolant sensor or circuit.

CONDITION	POSSIBLE CAUSE	CORRECTION
Loss of engine coolant.	a. Leaking radiator assembly.	a. Inspect radiator assembly. Repair as necessary.
	b. Radiator filler cap assembly faulty.	b. Perform cap assembly pressure test.
	c. Distorted neck assembly.	c. If radiator neck assembly upper sealing area is distorted, use wood block and mallet to reform neck assembly to fit cap assembly.
	d. Leaking reservoir or hose assembly.	d. Replace reservoir or hose assembly.
	e. Loose or damaged radiator or heater hose assemblies or connections.	e. Reseat hose assemblies. Replace hose assemblies or clamps.
	f. Water pump assembly seal leaking.	f. Replace water pump assembly.
	g. Water pump gasket leaking.	g. Replace water pump gasket.
	h. Improper cylinder head assembly torque.	h. Re-tighten cylinder head bolts/ screws to specifications. Replace cylinder head gasket if required.
	i. Leaking – intake manifold assembly (3.4L L32 engine). – cylinder head assembly gasket. – engine block coolant drain hole plug or knock sensor. – heater core. – heater water valve, if equipped.	i. Make repairs or replace components as necessary to correct leak.
Engine fails to reach normal operating temperature. Cool air from the heater.	a. Thermostat assembly stuck open or wrong type of thermostat assembly.	a. Install new thermostat assembly of correct type and heat range.
	b. Engine coolant is below the "FULL COLD" mark.	b. Add engine coolant.
	c. Blockage in coolant circuit.	c. Flush cooling system or flow check radiator.

ON-VEHICLE SERVICE

DRAINING AND REFILLING COOLING SYSTEM

CAUTION: To avoid the danger of being burned, do not remove the radiator filler cap assembly while the engine and radiator assembly are still hot. Scalding fluid and steam may be blown out under pressure.

NOTICE: See "Notice" on page 6B-1 of this section.

Important

- Dispose of used coolant in a proper fashion, i.e., in a used coolant holding tank. Never pour used coolant down the drain. Ethylene glycol antifreeze is a very toxic chemical; disposing of it into the sewer system or ground water is both illegal and ecologically unsound.

ENGINE COOLANT FLUSHING AND RECYCLING

Engine Coolant Flushing

Tool Required:

Non-Aqueous Coolant Exchanger such as Pro-Fill J 75010-KM (Available in the GM Dealer Equipment program)

If your state/local environmental enforcement group does not allow the discharge of coolant or if you do not desire to put used coolant into the environment there are various methods and equipment that can be used to flush the coolant system. If using special equipment such as back flusher, follow the manufacturer's instructions. However, the thermostat should be removed before flushing the system.

Engine Coolant Recycling

Tool Required:

GM approved Recycling System such as Pro Clean (Available in the GM Dealer Equipment program)

As the need arises to conduct cooling system maintenance or repairs, all of the used coolant must be removed and replaced with qualified new or recycled coolant. If only the radiator is drained, up to 50 percent of the used, contaminated coolant can remain in the cooling system. Removing used coolant (from the vehicle) can be accomplished by several methods:

- Utilize waterless coolant evacuation system available in the GM Dealer Equipment program (or equivalent) which removes the used coolant and replaces it with approved new or recycled coolant.
- Utilize a GM approved coolant recycling system available in the GM Dealer Equipment program (or equivalent) which recycles the coolant on the vehicle thereby eliminating the need for evacuation.
- Recover used coolant and store in a used coolant holding tank and submit the used coolant for recycling on a regular basis.

3.4L L32 Engine

1. Park vehicle on a level surface.
2. Remove, clean and reinstall reservoir assembly. Refer to "Battery Tray and Coolant Recovery Reservoir Assembly" in this section.
3. Remove pressure cap assembly.
   A. Turn pressure cap assembly slowly counterclockwise until it reaches the "stop." Do not press down while turning pressure cap assembly.
   B. Wait until any remaining pressure (indicated by hissing sound) is relieved.
   C. After all hissing ceases, press down on pressure cap assembly and continue to rotate pressure cap assembly counterclockwise.
4. Open drain cock assembly.
5. Remove drain hole plug and knock sensor, located on either side of engine block.
6. Allow system to drain completely.
7. Close drain cock assembly.
8. Install drain hole plug and knock sensor.

Tighten

- Drain hole plug to 18 N•m (13 lb. ft.).
- Knock sensor to 20 N•m (15 lb. ft.).
- Drain cock assembly to 1.5 N•m (13 lb. in.).

9. Add enough water to fill cooling system.
10. Run engine assembly until thermostat assembly opens.
11. Stop engine assembly. Repeat steps 2 through 10, until drained fluid is nearly colorless.
12. Remove, empty and reinstall reservoir assembly. Refer to "Battery Tray and Coolant Recovery Reservoir Assembly" in this section.

    NOTICE: Use new ethylene glycol antifreeze, meeting GM specification 1825M, to provide the required freezing and corrosion protection – at least 50 percent solution, at temperature of −37°C (−34°F).
13. Add enough water and new ethylene glycol antifreeze (meeting GM specification 1825M) to provide a solution that is at least 50 percent antifreeze, but no more than 70 percent antifreeze.
    A. Fill radiator assembly to below neck assembly.
    B. Fill reservoir assembly to "FULL COLD" mark.
    C. Add two cooling system sealer pellets.
    D. Install reservoir assembly cap.
14. Run engine assembly, with radiator cap assembly removed, until normal operating temperature is reached (radiator inlet hose assembly becomes hot).

    CAUTION: Under some conditions, ethylene glycol in engine coolant is flammable. To avoid being burned when adding engine coolant, do not spill it on the exhaust system or on hot engine parts.
15. With engine assembly idling, add engine coolant to radiator assembly until level reaches bottom of neck assembly.
16. Install cap assembly.
    - Arrows on cap assembly must line up with reservoir hose assembly.

5.7L LT1 Engine

1. Park vehicle on level surface.
2. Remove coolant recovery reservoir filler cap assembly.
   A. Slowly rotate cap counterclockwise about 1/4 turn and then stop.
   B. Wait until any remaining pressure (indicated by hissing sound) is relieved.
   C. After all hissing ceases, continue to rotate cap assembly counterclockwise until cap is removed.
3. Open radiator drain cock assembly.
4. Open heater air bleed vents located just above water pump assembly on the thermostat housing and heater outlet hose pipe. Air bleed vents should be open two or three turns.
   - Place a shop towel under the bleed valve to prevent coolant from splashing onto distributor assembly.
5. Remove drain hole plug and knock sensor, located on either side of engine block.
6. Allow system to drain completely.

Important

- Store used coolant in a proper fashion, i.e., in a used coolant holding tank. NEVER POUR USED COOLANT DOWN THE DRAIN! Ethylene Glycol antifreeze is a very toxic chemical; disposing of it into the sewer system or ground water is both illegal and ecologically unsound!

7. Close coolant drain cock valve.
8. Install ESC knock sensors and drain hole plug.

   NOTICE: Use Ethylene Glycol antifreeze meeting GM specification 2025-M to provide required freezing and corrosion protection – at least 50-percent solution, –37°C (–34°F).
9. Fill cooling system through the radiator neck.
10. Close air bleed vent when bubbles disappear and only coolant is visible.
11. Fill the coolant recovery reservoir assembly to the "COLD" fill mark. This will provide the extra coolant required to replace the air left in the system upon the first couple of thermocycles.
12. Coolant recovery reservoir assembly cap.

Important

- Block wheel assemblies, place transmission assembly in "PARK" or "NEUTRAL" and set parking brake.

13. Run engine with the coolant radiator pressure cap off until thermostat assembly opens.

Important

- With the engine running, add coolant to the radiator until the level reaches the bottom of the filler neck.

14. Fill the cooling system again after these procedures are completed.

    NOTICE: Use Ethylene Glycol antifreeze meeting GM specification 2025-M to provide required freezing and corrosion protection – at least 50-percent solution, –37°C (–34°F).

Important

- When refilling the engine cooling system, add two engine coolant supplemental sealant pellets GM P/N 3634621 or equivalent) and coolant antifreeze meeting GM specification 2025-M.

15. Install the radiator cap assembly.

Inspect

- For leaks, after running engine until normal operating temperature is reached.

NOTICE: "LOW COOLANT" warning/indicator lamp may come on after this procedure. After operating vehicle so engine heats up and cools down three times, if "LOW COOLANT" warning/indicator lamp does not go out, or fails to come on at ignition check and coolant is above "FULL COLD" mark in reservoir assembly, refer to SECTION 8A. If at any time the "TEMP" warning/indicator lamp comes on, immediate action is required. Turn off engine and allow vehicle to cool. Do not remove coolant recovery reservoir cap at this time.

16. Test coolant concentration. Refer to "Testing the Coolant Concentration" in this section.

ALUMINUM RADIATOR SERVICE

Figures 3 and 4

This radiator uses an aluminum core with plastic side tanks. The core and side tanks can be replaced separately. Core repair is easily made with the hot melt adhesive method. A transmission oil cooler may be located in one of the side tanks. The drain cock is located on the lower part of one of the tanks.

The following components are serviceable:

- Radiator core.
- Tanks and gaskets. (Tanks cannot be repaired if broken or cracked).
- Oil cooler and gaskets.
- Drain cock and gaskets.

Precautions

CAUTION: Failure to follow any one of these procedures could result in personal injury or components damage.

- Do not remove radiator cap while engine is at normal operating temperature. Cooling system will release scalding fluid and steam under pressure if cap is removed while engine and radiator are still hot.
- Do not use boil-out tanks or any tank that has been used for copper or brass radiators.
- Do not open hood if steam or coolant can be seen escaping from engine compartment.
- Do not remove cap on coolant recovery reservoir if an engine over temperature is suspected.

Diagnosis

Leak Testing

Some core leaks can be detected by adding water to the radiator. Clean the core so the damaged area is easier to find.

On-Vehicle Pressure Testing

Figure 5

Tool Required:

J 24460-01 Cooling System Tester

1. Ensure that radiator hose clamps and heater hose clamps are properly positioned and secured.
2. Inspect connections for leaks. Repair as required.

CAUTION: To avoid being burned, do not remove radiator cap assembly while engine assembly is at normal operating temperature. The cooling system will release scalding fluid and steam under pressure if radiator filler cap assembly is removed while engine assembly and radiator assembly are still hot.

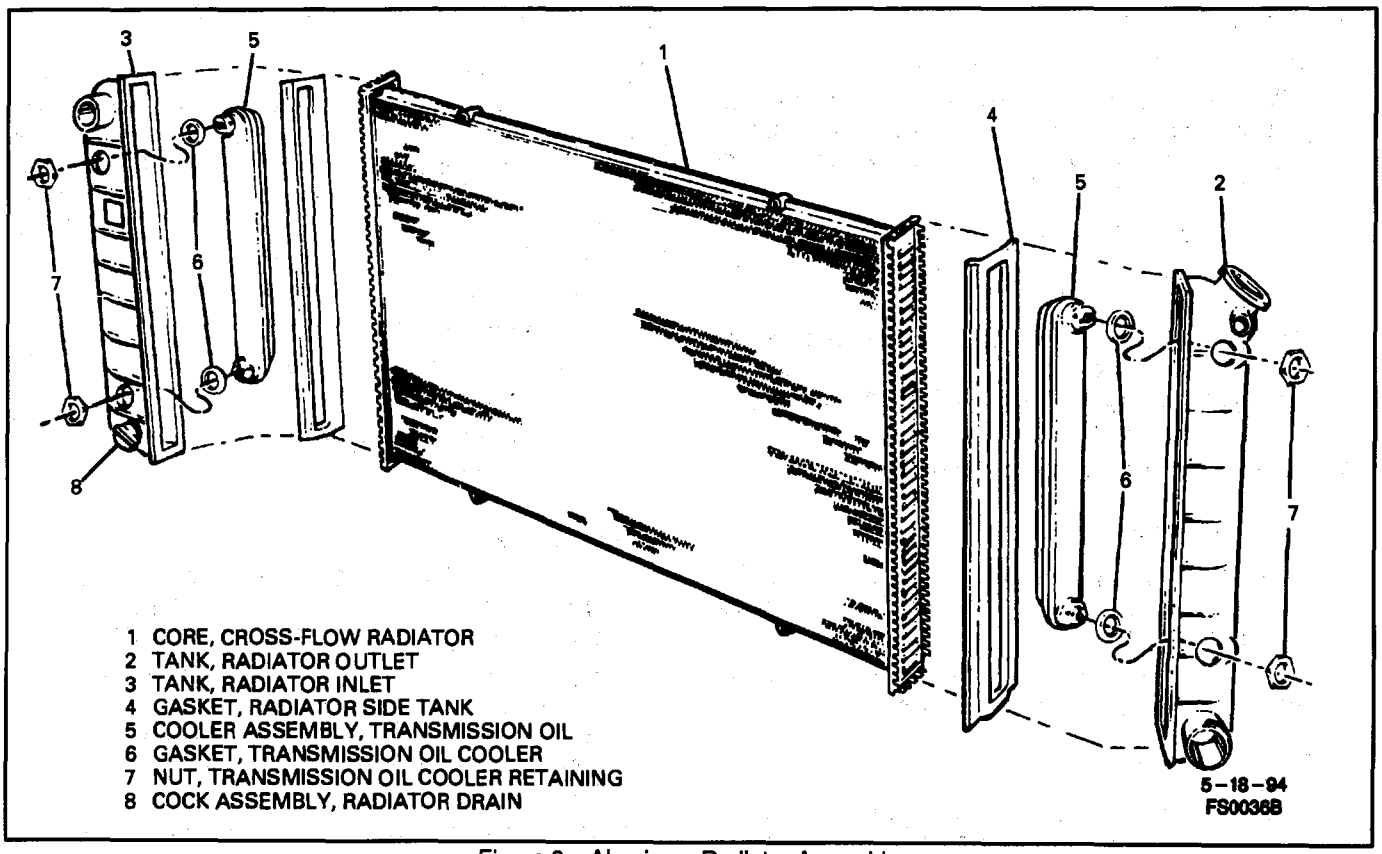


Figure 3 – Aluminum Radiator Assembly

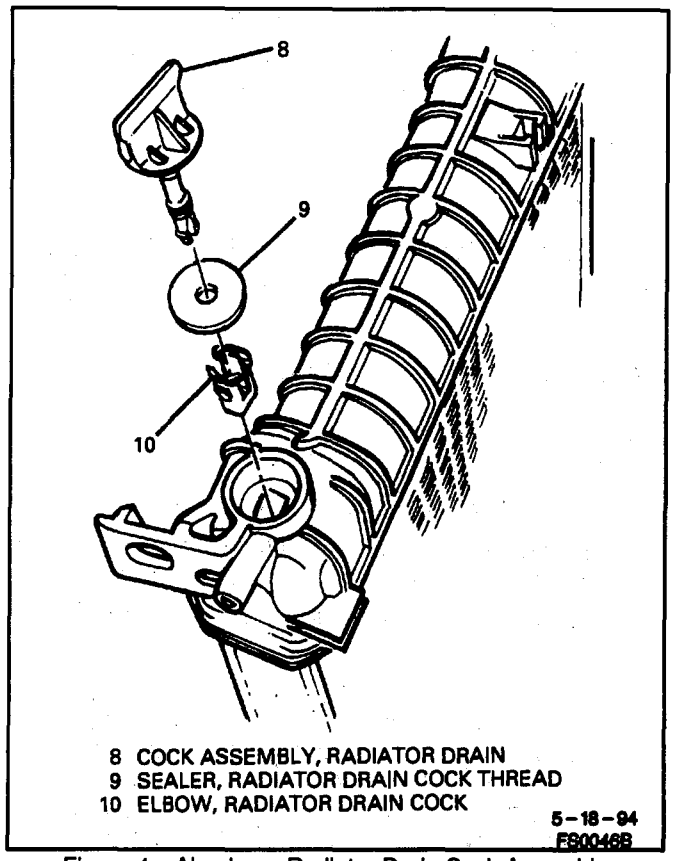


Figure 4 – Aluminum Radiator Drain Cock Assembly

3. Remove radiator filler cap assembly.
4. Fill cooling system to base of radiator assembly neck.
5. Attach J 24460-01 to radiator assembly neck.
   - Follow instructions supplied with J 24460-01.
6. Build up pressure to no more than 138 kPa (20 psi).
7. System should hold pressure for about two minutes.
   A. If a measurable amount of pressure drops in less than two minutes, check for leak.
   B. Mark leaking area and remove radiator assembly for repair. Refer to "Radiator Assembly" in this section.

Off-Vehicle Leak Testing

NOTICE: Do not use boil-out tanks or any tank that has been used for copper or brass radiator assemblies. The remaining solutions or chemicals in these tanks could cause radiator assembly failure.

Figures 6 and 7

Tool Required:

J 24460-01 Cooling System Tester

1. Plug radiator inlet and outlet tubes. Make sure drain cock is closed.
2. Attach J 24460-01 to radiator assembly.
3. Build up pressure to 138 kPa (20 psi).
4. Observe gage for any pressure loss.
5. Run water over repair area and look for any bubbles.
   - If a large tank is available, radiator assembly can be submerged to check for air bubbles.

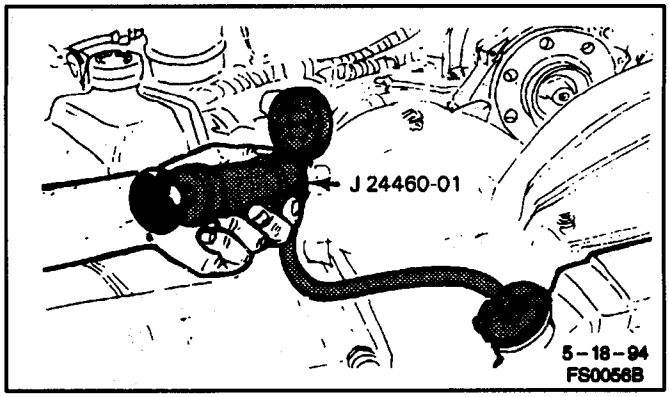


Figure 5 – Pressure Testing the Radiator Assembly

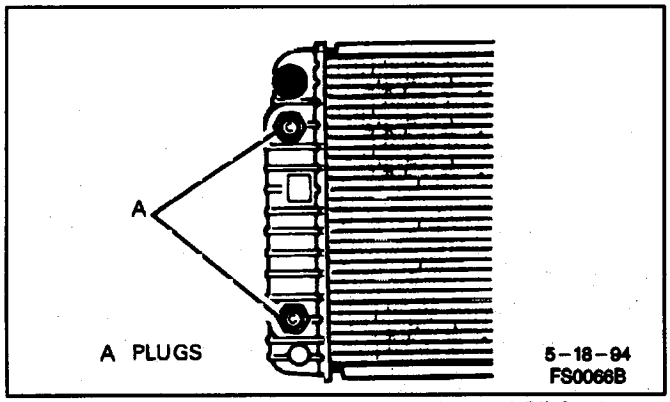


Figure 6 – Aluminum Radiator Assembly and Oil Cooler Plugs

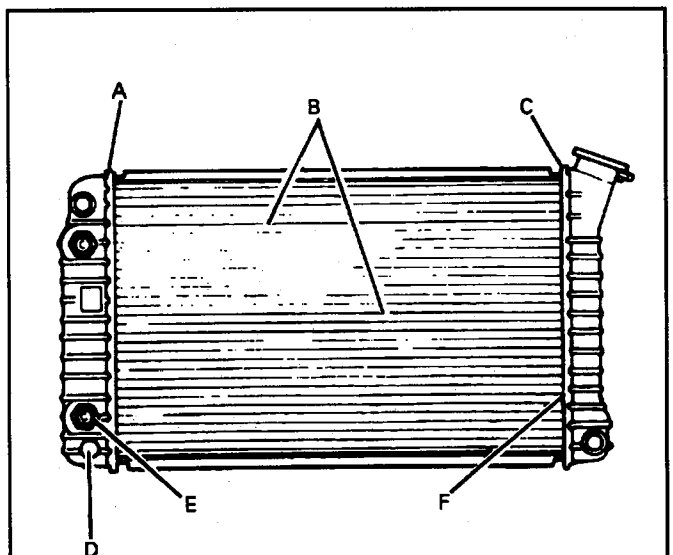


Figure 7 – Possible Leak Areas

Repairable Leaks

Core leaks and gasket leaks are the two types of leaks that can be repaired on the radiator assembly. Core leaks can occur in a tube or in the joints between the tubes and headers. Gasket leaks can occur between the oil cooler fittings and the tank. Some leaks can be repaired while the radiator assembly is on the vehicle; however, it is more practical to remove the radiator assembly from the vehicle.

Repair Methods

Figures 8 through 12

The hot melt adhesive is the most effective method of repairing the radiator core. The hot melt adhesive kit contains adhesive sticks, cotton swabs, wire brush and primer. The adhesive kit is reusable, has an indefinite shelf life and is waste free. The sticks must be stored in a sealed container to keep them dry.

Cooling Fin Removal

For damaged areas that are between the cooling fins, it may be necessary to remove some of the fins. Do not remove more fins than necessary. Usually removal of fins 6 mm (1/4 inch) beyond the leak or damage area is enough to make an accurate repair.

Tube Blocking

If a tube is severely damaged, it can be blocked off.

NOTICE: Do not block off more than two tubes in radiator assembly. Blocking off more than two tubes will reduce the cooling capability of the system.

The tube should be cut off 6 mm (1/4 inch) from the header and pinched shut before it is cleaned and sealed.

Header Repair

NOTICE: To prevent damage to the tank or gasket, the following procedures must be used when repairs are made on or near the header.

If the header or the tube near the header requires a repair, the side tank does not have to be removed. A damp cloth can be placed against the side tank where the repair has to be made. The side tank can also be submerged in a tank of water up to the header.

General Core Repair

Figures 13 through 16

If the leak area surface is not clean, the repair material will not stick to the surface.

1. Position core so repair area is accessible.
2. Apply wet cloth between core pipes and headers if working near plastic tanks or joints or submerge tank in water.
3. Heat repair area slightly with small torch or heat gun to be sure it is dry.
   - Do not use blow torch.

4. Brush area to be repaired with small steel brush that is supplied in kit and remove dust away from repair area.

   CAUTION: To help avoid personal injury when using the primer (which contains trichloroethane) the following precautions and steps should be followed:

   - **If primer is swallowed, seek medical attention.**
   - **If primer contacts the eyes, do not rub eyes. Splash the affected area with large quantities of cold water and seek medical attention.**
   - **If primer contacts the body, wash thoroughly with soap and water.**
   - **Do not mix the primer with water.**

5. Open tube of primer using spurred cap or pin and apply primer to repair area only. Use of primer produces stronger repair.
6. Scrub repair area with cotton swab until fresh swab stays clean.
   - Clear, yellow-brown coating does not have to be removed.
7. Heat repair area with heat gun or by moving small torch in circular pattern using soft, blue flame.
8. Withdraw small torch or heat gun and rub adhesive stick on repair area. Adhesive will flow at temperature of approximately 260°C (500°F).
   - If stick doesn't start to melt, remove it and reapply heat. Do not heat stick directly with flame. High heat will burn and char adhesive.
9. Continue heating until adhesive flows and wets entire repair area and fills joint. If a hole is in center of tube, heat tube and let hot surface melt and pull in adhesive. Force of flame or heat gun will also tend to guide adhesive toward hole. For leaks between tube and header, flow adhesive completely around tube and header joint with tank installed.
10. Heat repair area until adhesive is bubble free, smooth and has light yellow color. Curing is not required.
11. Test radiator assembly for leaks when cool. Refer to "Off-Vehicle Testing" in this section. If repair area still leaks, heat it gently to dry it. Heat and flow adhesive or apply more as necessary to repair leak.

Radiator Side Tank Gasket Leak Repair

Figures 17 through 20

Tool Required:

J 33419-A Radiator Core Remover/Installer

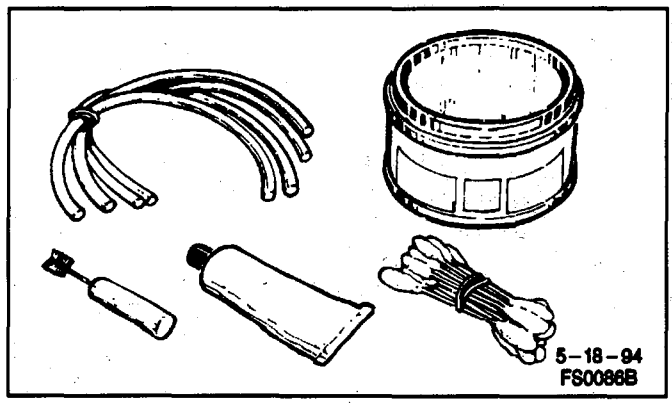


Figure 8 – Hot Melt Adhesive Repair Kit

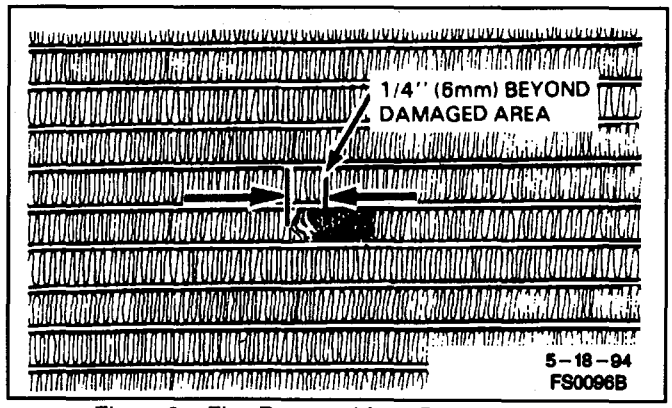


Figure 9 – Fins Removed from Damaged Area

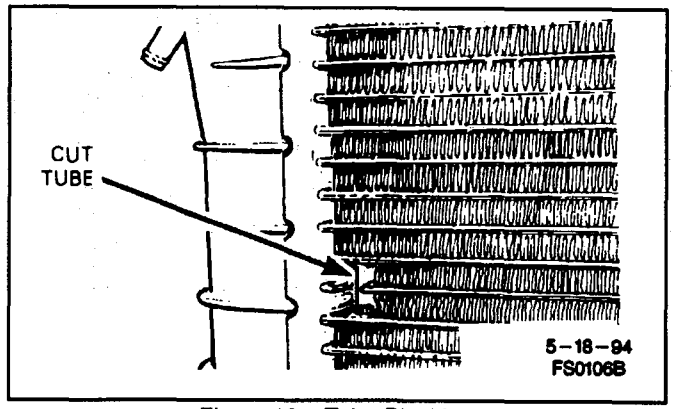


Figure 10 – Tube Blocking

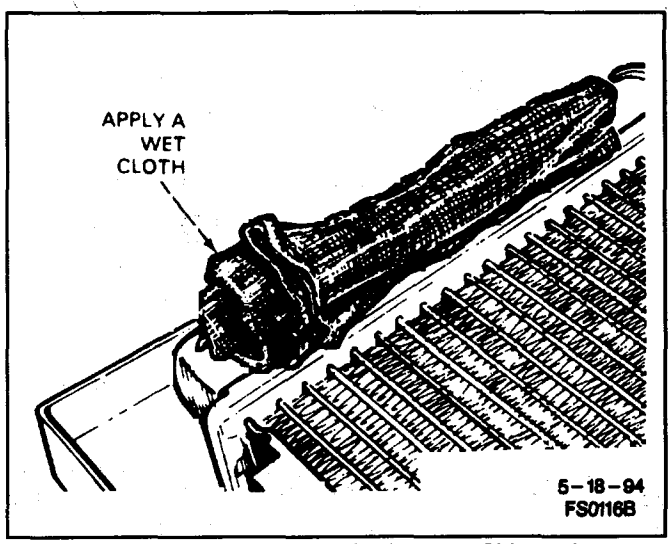


Figure 11 – Using a Wet Cloth on the Side Tank

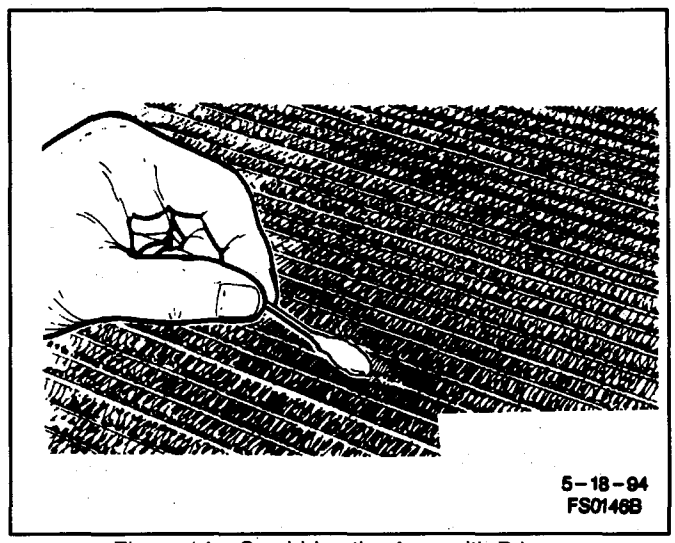


Figure 14 – Scrubbing the Area with Primer

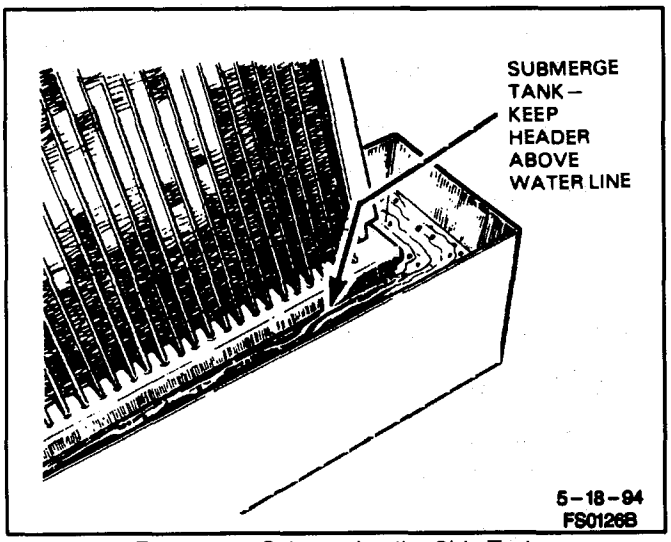


Figure 12 – Submerging the Side Tank

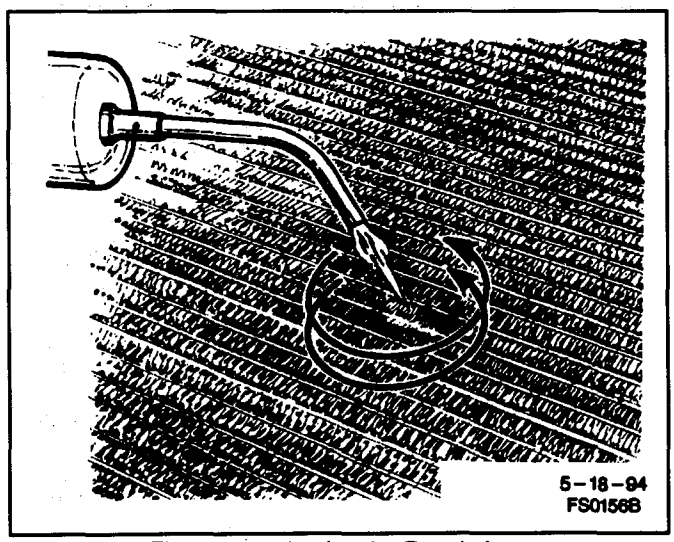


Figure 15 – Heating the Repair Area

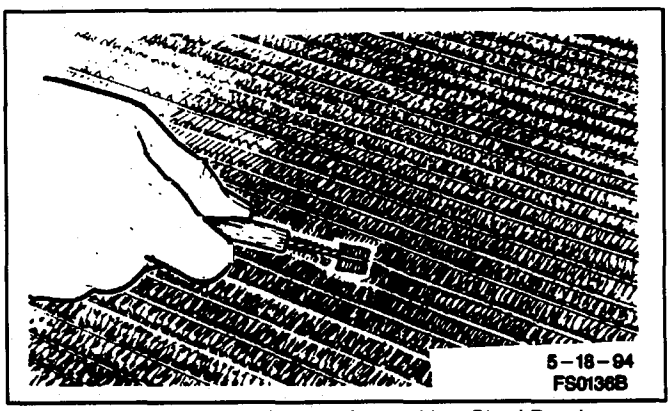


Figure 13 – Cleaning the Area with a Steel Brush

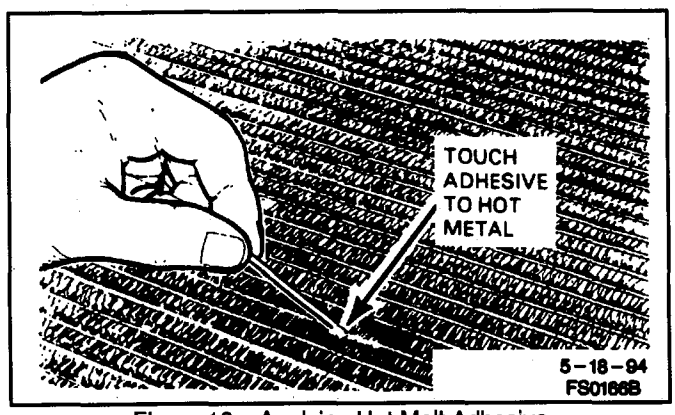


Figure 16 – Applying Hot Melt Adhesive

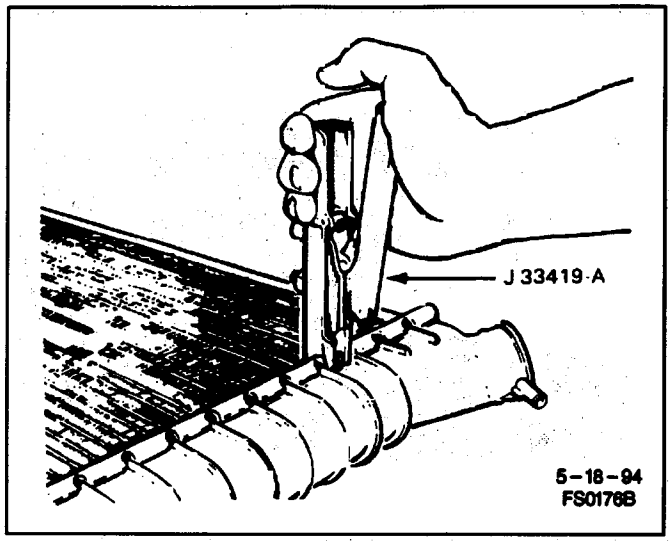


Figure 17 – Tightening the Clinch Tabs

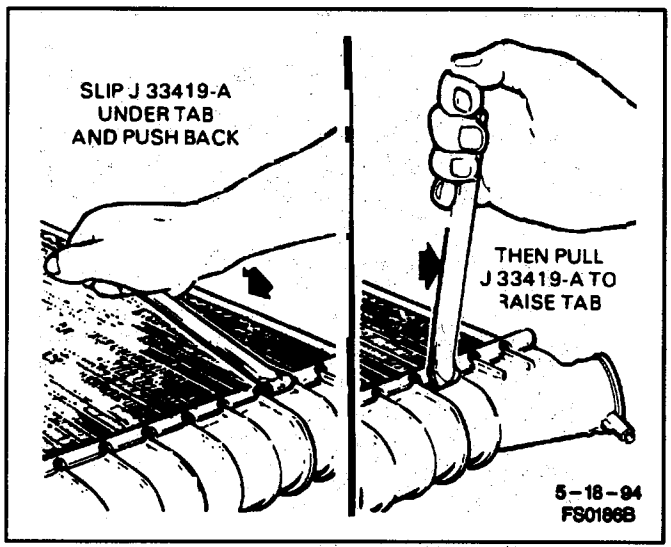


Figure 18 – Opening the Clinch Tabs

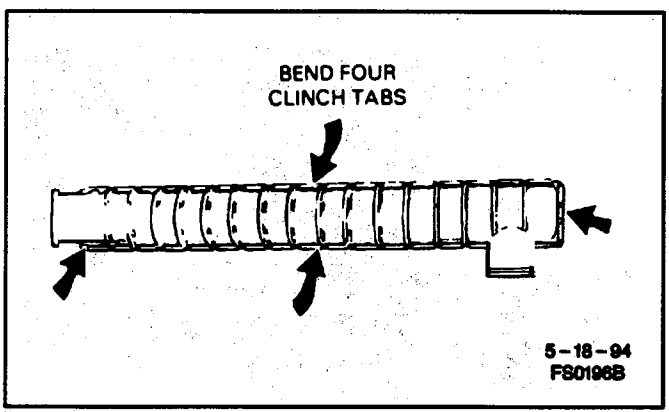


Figure 19 – Seating the Tank to the Core

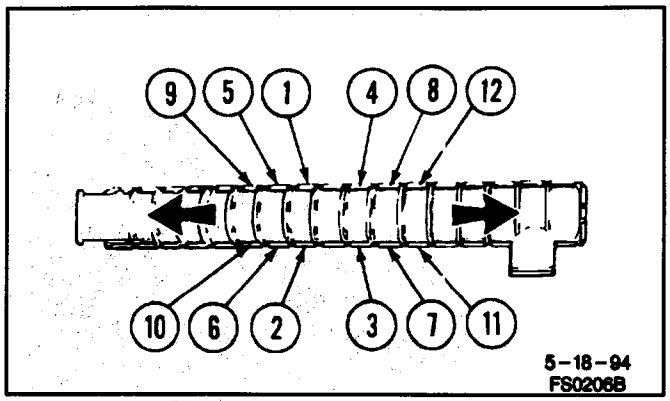


Figure 20 – Clinching Sequence

Radiator side tank gasket leaks can easily be mistaken for tank or header leaks. If a plastic tank leaks from the header joint gasket, tighten the clinch tabs with J 33419-A or locking-type pliers. If the tank still leaks, remove and repair it.

1. Pry open clinch tabs except those under inlet, outlet and radiator assembly neck, using J 33419-A or screwdriver.
   - Lift tabs only enough to allow removal.

   NOTICE: Do not overbend tabs. Overbending tabs could result in breaking tab. If more than three tabs are broken on one side of header or more than two adjacent tabs are broken, the core must be replaced.
2. Lift tank and slide it out from under remaining clinched tab.
   - Tapping tank with your hand may be required to dislodge gasket.
3. Lift remaining tab(s) with pliers.
4. Remove and discard gasket.

Clean

- Header gasket groove of dirt and old rubber.
- Sealing edge of plastic tank.

Inspect

- Header gasket surface and tank flange for evidence of leaks.
- Surfaces and remove dirt, burrs and bumps.

5. Remove transmission oil cooler, if equipped, and install it into new tank.
6. Dip or coat new gasket in engine coolant and position it on header surface.
7. Position tank and gasket to header. Clamp it in place and secure it by bending four clinch tabs.
8. Clamp remaining clinch tabs around header using J 33419-A or pliers.
   - Start at center and work towards end.
9. Replace core if there are more than three tabs broken on one side or if two adjacent tabs are broken.
10. Install radiator drain cock assembly, if removed.
11. Test radiator assembly for leaks. Refer to "Off-Vehicle Leak Testing" in this section.

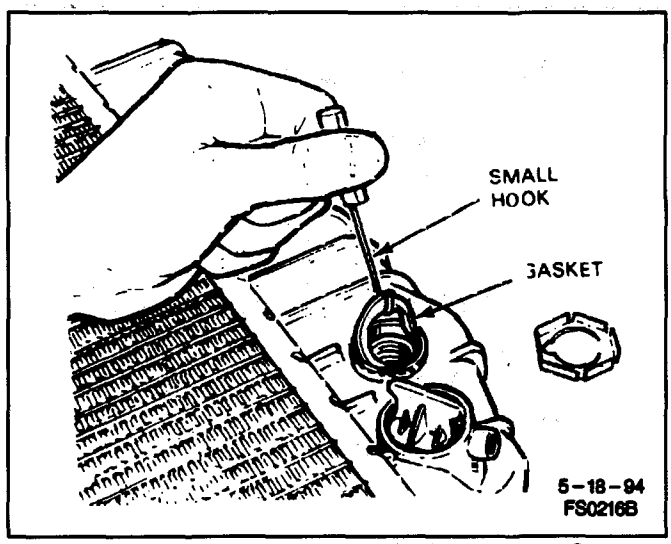


Figure 21 – Removing the Transmission Oil Cooler Gasket

TRANSMISSION OIL COOLER GASKET

Figure 21

The outlet tank must be removed to replace the transmission oil cooler but the transmission oil cooler gasket can be replaced without removing the outlet tank.

1. Remove radiator assembly. Refer to "Radiator Assembly" in this section.
   - Lay radiator assembly on flat surface.
2. Remove bottom transmission oil cooler pipe and loosen top pipe connection.
3. Press transmission oil cooler into hole and remove gasket using small hook.
4. Blow dry all surfaces on outlet tank and transmission oil cooler.
5. Install new transmission oil cooler gasket without lubrication.
   - Be sure gasket is properly seated inside lip of fitting.
6. Reach into inlet or outlet opening and push transmission oil cooler into position against outlet tank.

   NOTICE: See "Notice" on page 6B-1 of this section.
7. Install transmission oil cooler pipe loosely.
   - To replace other gasket, follow previous steps in order.

Tighten

   - Transmission oil cooler pipe connections to 27 N•m (20 lb. ft.).
     - Do not overtighten.
8. Leak test radiator assembly. Refer to "Off-Vehicle Leak Testing" in this section.
9. Install radiator assembly. Refer to "Radiator Assembly" in this section.

TRANSMISSION OIL COOLER

Figure 3

Remove or Disconnect

1. Radiator assembly. Refer to "Radiator Assembly" in this section.
2. Outlet tank.
3. Transmission oil cooler retaining nuts.
4. Transmission oil cooler gaskets.
5. Transmission oil cooler.

Clean

- Sealing surfaces.

Install or Connect

NOTICE: See "Notice" on page 6B-1 of this section.

1. New transmission oil cooler gaskets without lubrication.
2. Transmission oil cooler into outlet tank.
3. Transmission oil cooler retaining nuts.
4. Outlet tank.
   - Be careful not to loosen or misalign gaskets.
5. Radiator assembly. Refer to "Radiator Assembly" in this section.

RECORE

If the radiator core is damaged beyond repair and the other parts are serviceable, install the original inlet and outlet tanks, transmission oil cooler, radiator filler cap assembly and radiator drain cock assembly onto a new core and install new gaskets.

RADIATOR DRAIN COCK ASSEMBLY

Figure 4

If the drain cock assembly does not seal when tightened snugly, remove the radiator drain cock assembly, clean the drain and replace the radiator drain cock assembly. If the body of the radiator drain cock assembly is broken, remove the body from the tank by squeezing the sides together with needle nose pliers.

ENGINE COOLANT THERMOSTAT ASSEMBLY

Figures 22 and 23

Remove or Disconnect

NOTICE: See "Notice" on page 6B-1 of this section.

1. Open radiator drain cock assembly and drain engine coolant from radiator assembly to below level of engine coolant thermostat assembly.
2. Close radiator drain cock assembly.

Tighten

- Radiator drain cock assembly to 1.5 N•m (13 lb. in.).

3. Air cleaner assembly.
4. Inlet hose assembly and clamp from engine coolant thermostat assembly.
5. Water outlet bolt/screw (12 or 15).
6. Water outlet assembly (11 or 14).
7. Water outlet gasket (16), if equipped.
8. Engine coolant thermostat assembly (13 or 17).

Clean

- Gasket surfaces of water outlet assembly and intake manifold assembly or water pump assembly.

Install or Connect

NOTICE: See "Notice" on page 6B-1 of this section.

1. Engine coolant thermostat assembly into intake manifold assembly or water pump assembly.
2. New water outlet gasket (16), if equipped.
3. Water outlet assembly (11 or 14).
4. Water outlet bolt/screw (12 or 15).

Tighten

- Water outlet bolt/screw (12 or 15) to 28 N•m (21 lb. ft.).

5. Inlet hose assembly and clamp. Refer to SECTION 1A.
6. Air cleaner assembly.
7. Add engine coolant. Refer to "Draining and Refilling the Cooling System" in this section.

Inspect

- For leaks, after running engine assembly to normal operating temperature.

ELECTRIC ENGINE COOLANT FAN ASSEMBLY

Figures 24 and 25

CAUTION: Keep hands, tools, and clothing away from electric engine coolant fan(s) to help prevent personal injury. This/These fan is/are electric and can come on whether or not the engine is running. The fan(s) can start automatically in response to a heat sensor with the ignition in the "ON" position.

Remove or Disconnect

1. Air cleaner assembly.
2. Electrical connector and clips.
3. Radiator upper mounting panel.

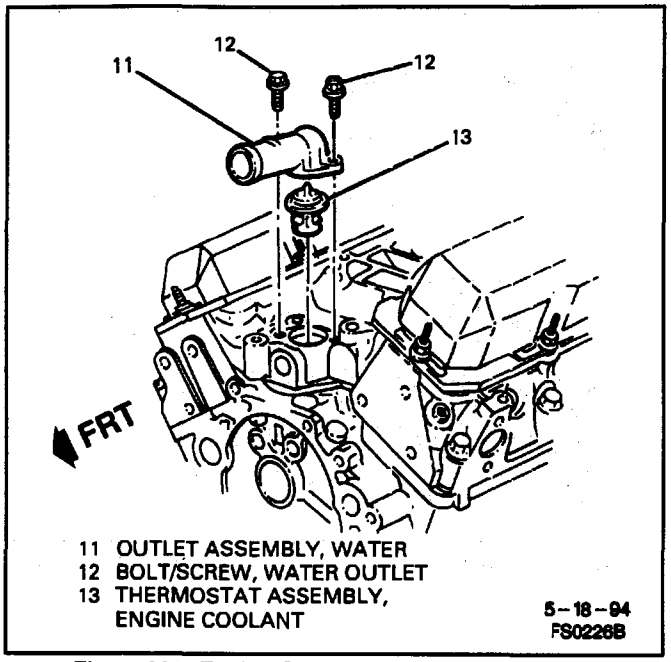


Figure 22 – Engine Coolant Thermostat Assembly (3.4L L32 Engine)

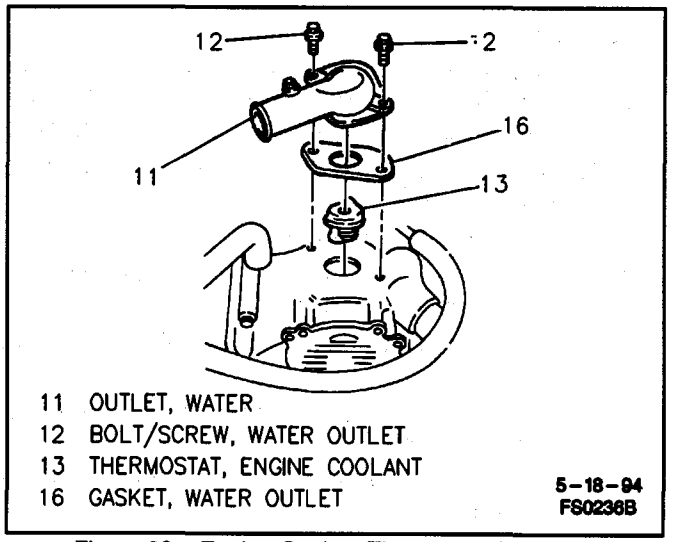


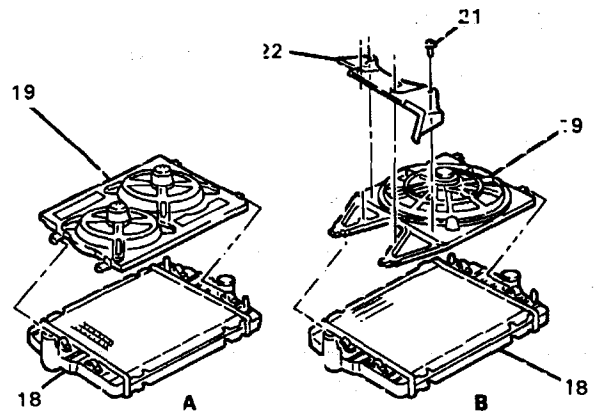
Figure 23 – Engine Coolant Thermostat Assembly (5.7L LT1 Engine)

4. Electric engine coolant fan assembly (19 or 20).
   - Electric engine coolant fan assembly (19 or 20) will slide out.
5. Fan blade nut (23).
6. Fan blade assembly (25).

Inspect

- For bent or cracked fan blades.
- Mating surfaces for smoothness. Remove burrs or other imperfections as necessary.

CAUTION: If a fan blade assembly is bent or damaged in any way, no attempt should be made to repair and/or reuse the damaged part. A bent or damaged fan blade assembly should always be replaced with a new fan blade assembly.



A ENGINE ASSEMBLY, LT1 5.7L
B ENGINE ASSEMBLY, L32 3.4L
18 RADIATOR ASSEMBLY
19 FAN ASSEMBLY, ENGINE COOLANT
21 RETAINER, RADIATOR AIR SIDE DEPRESSION (PUSH-IN)
22 DEFLECTOR, RADIATOR AIR SIDE

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Figure 24 – Engine Coolant Fan Assembly

CAUTION: It is essential that the fan blade assembly remain in proper balance. Balance cannot be assured once a fan blade assembly has been bent or damaged. A fan blade assembly that is not in proper balance could fail and fly apart during subsequent use, creating an extremely dangerous condition.

Install or Connect

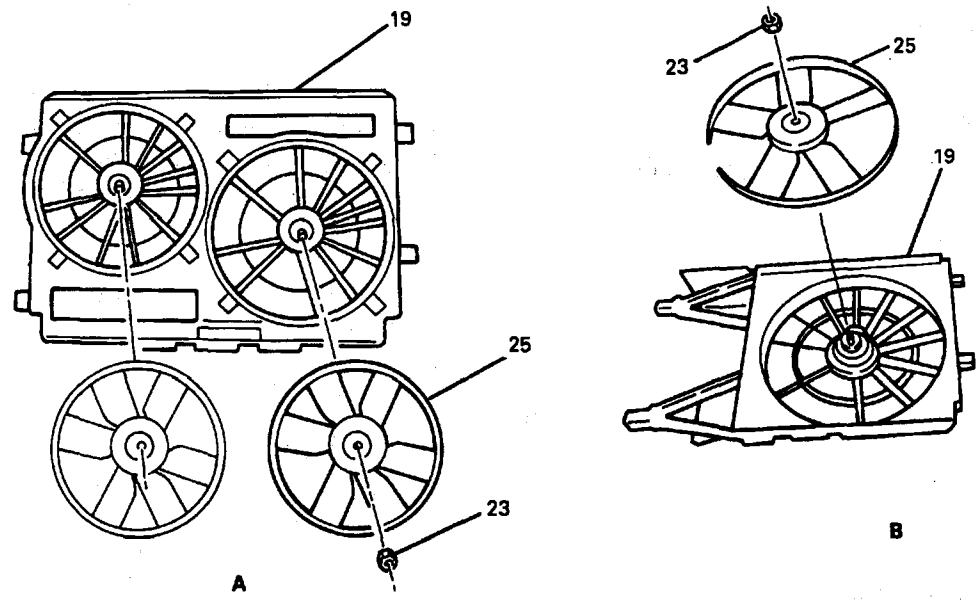
NOTICE: See "Notice" on page 6B-1 of this section.

1. Fan blade assembly (25 or 26).
2. Fan blade nut (23 or 24)
3. Electric engine coolant fan assembly (19 or 20).
   - Electric engine coolant fan assembly (19 or 20) will slide into place.
4. Radiator upper mounting panel.

Tighten

- Radiator upper panel mounting bolts/screws to 12 N•m (106 lb. in.).

5. Electrical connector and clips.
6. Air cleaner assembly.



A 5.7L LT1 ENGINE
B 3.4L L32 ENGINE
19 FAN ASSEMBLY, ENGINE COOLANT
23 NUT, FAN BLADE
25 BLADE ASSEMBLY, FAN

5-18-94
FS0256B

Figure 25 – Fan Blade Assembly

WATER PUMP ASSEMBLY

Figures 26, 27 and 28

Remove or Disconnect

3.4L L32 Engine

1. Drain radiator assembly. Refer to "Draining and Refilling Cooling System" in this section.
2. Air duct and electrical connector.
3. Top coil of coil pack.
4. Loosen tensioner pulley bolt/screw.
5. Heater hose from pump. Refer to SECTION 1A.
6. Loosen water pump pulley bolts/screws (27).
7. Power steering bracket bolts/screws. Refer to SECTION 3B.
8. Serpentine belt. Refer to SECTION 6A2A and SECTION 6A3A.
9. Water pump pulley (28).
10. Power steering pump bracket and pump. Refer to SECTION 3B.
11. Water pump bolts/screws (29).
12. Engine front cover bolts/screws (30).
13. Water pump cover bolts/screws (31).
14. Water pump assembly (32) and water pump gasket (33).

Clean

- All gasket surfaces.
- Water pump bolts/screws.

Install or Connect

NOTICE: See "Notice" on page 6B-1 of this section.

1. New water pump gasket (33).
2. Water pump assembly (32).
3. Water pump cover bolts/screws (31).

Tighten

- Water pump cover bolts/screws (31) to 45 N•m (33 lb. ft.).

4. Engine front cover bolts/screws (30).

Tighten

- Engine front cover bolts/screws (30) to 11 N•m (97 lb. in.).

5. Water pump bolt/screw (29).

Tighten

- Water pump bolts/screws (29) to 10 N•m (89 lb. in.).

6. Power steering pump and bracket. Refer to SECTION 3B.
7. Water pump pulley (28).
8. Serpentine belt. Refer to SECTION 6A2A or SECTION 6A3A.
9. Power steering pump bracket bolts/screws. Refer to SECTION 3B.

Tighten

- Power steering bracket bolts/screws to 40 N•m (30 lb. ft.).

10. Heater hose to pump. Refer to SECTION 1A.
11. Top coil of coil pack.

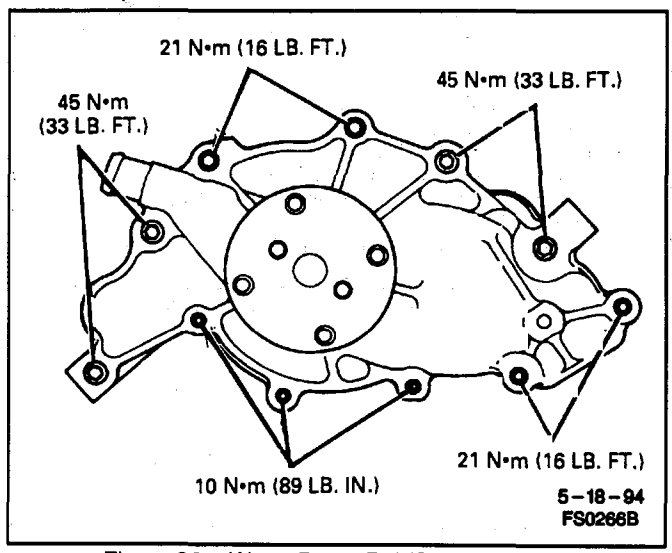


Figure 26 – Water Pump Bolt/Screw Torques (3.4L L32 Engine)

12. Electrical connector to alternator.
13. Air duct and electrical connector.
14. Add engine coolant. Refer to "Draining and Refilling the Cooling System" in this section.

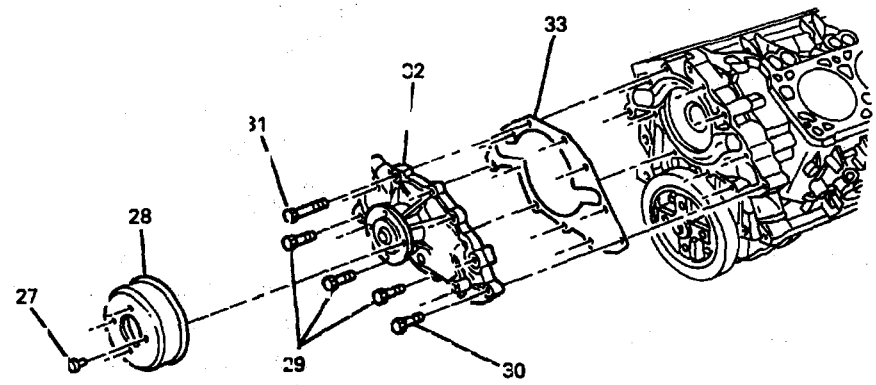
Inspect

- For leaks, after running engine to normal operating temperature.

Remove or Disconnect

5.7L LT1 Engine

1. Electrical connector from electric engine coolant fan assembly.
2. Right electric engine coolant fan assembly. Refer to "Electric Engine Coolant Fan Assembly" in this section.
3. Block drain plug and knock sensor.
4. Drain engine coolant. Refer to "Draining and Refilling the Cooling System" in this section.
5. Install drain plug and knock sensor.
6. Air intake duct.
7. Air cleaner assembly.
8. Upper and lower radiator hose assembly from water pump assembly.



27 BOLT/SCREW, WATER PUMP PULLEY
28 PULLEY, WATER PUMP
29 BOLT/SCREW, WATER PUMP
30 BOLT/SCREW, ENGINE FRONT COVER
31 BOLT/SCREW, WATER PUMP COVER
32 PUMP ASSEMBLY, WATER
33 GASKET, WATER PUMP

5-18-94
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Figure 27 – Water Pump Assembly (3.4L L32 Engine)

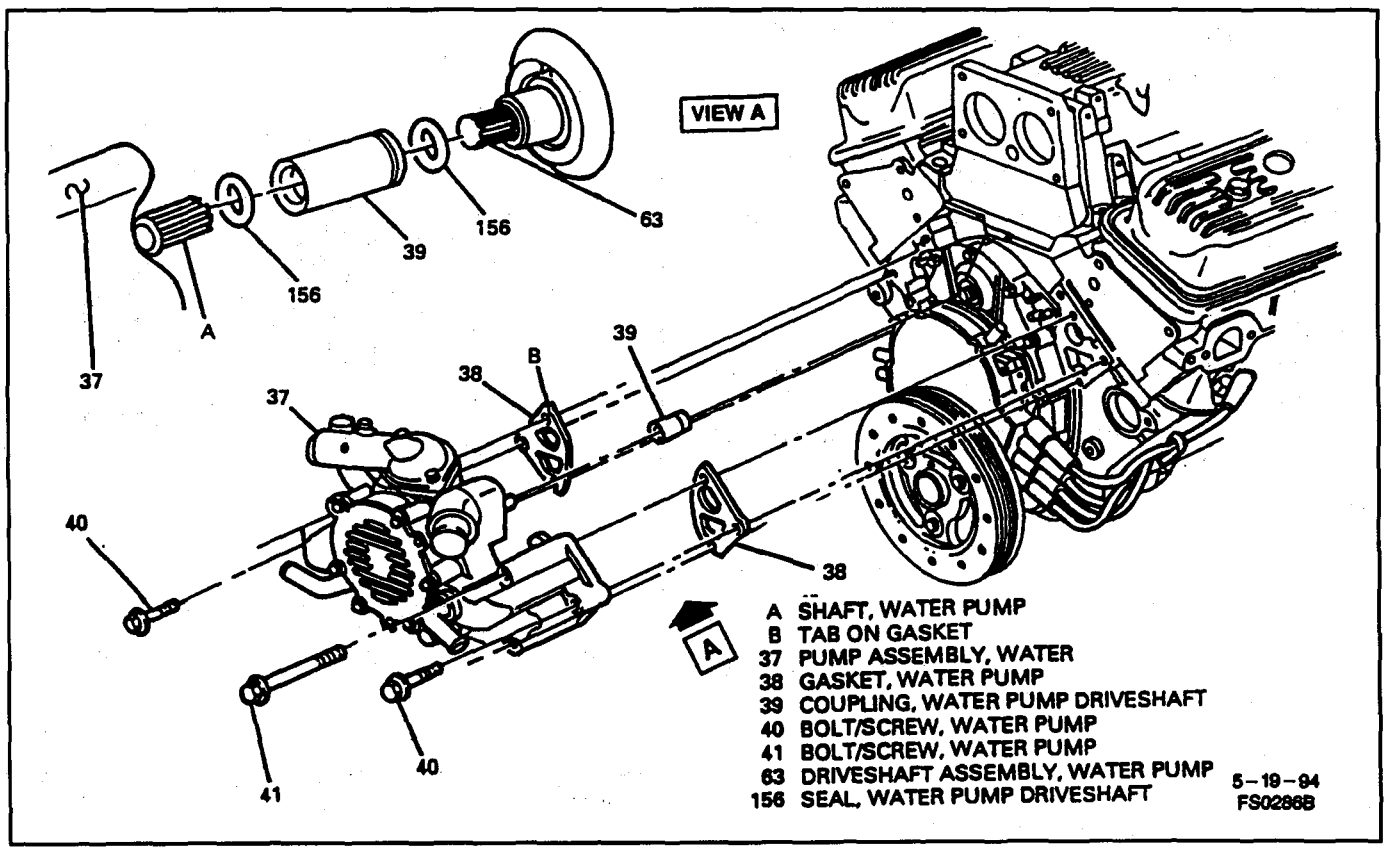


Figure 28 – Water Pump Assembly (5.7L LT1 Engine)

9. Heater hose assemblies from water pump assembly and throttle body. Refer to SECTION 1A.
10. Electrical connector from coolant sensor.
11. Reposition coil and bracket.
12. Air pump and bracket. Refer to SECTION 6E3.
13. Water pump bolts/screws (38).
14. Water pump cover bolt/screw (37).
15. Water pump assembly (34).
16. Water pump gaskets (35).
17. Shaft coupling (36), and water pump driveshaft seals (156).

Clean

- Water pump gasket surfaces.
- Water pump bolts/screws (38).

Install or Connect

1. Shaft coupling (36), and water pump driveshaft seals (156).
2. Water pump gaskets (35).
3. Water pump assembly (34).
4. Water pump cover bolt/screw (37).

Tighten

- Water pump cover bolt/screw (37) to 41 N•m (30 lb. ft.).

5. Water pump bolts/screws (38).

Tighten

- Water pump bolts/screws (38) to 41 N•m (30 lb. ft.).

6. Air pump and bracket. Refer to SECTION 6E3.
7. Reposition coil and bracket.
8. Electrical connector to coolant sensor.
9. Heater hose assemblies to water pump assembly and throttle body. Refer to SECTION 1A.
10. Upper and lower radiator hose assembly to water pump assembly.
11. Air cleaner assembly.
12. Air intake duct.
13. Refill cooling system. Refer to "Draining and Refilling the Cooling System" in this section.
14. Electrical connector to electric engine coolant fan assembly.

Inspect

- For leaks, after running engine assembly to normal operating temperature.

BATTERY TRAY AND COOLANT RECOVERY RESERVOIR ASSEMBLY

Figure 29

Remove or Disconnect

1. Battery. Refer to SECTION 6D1.
2. Coolant recovery hose assembly.
3. Bolt/screw (40).
4. Battery tray and reservoir assembly (39)

Clean

- Battery tray and reservoir assembly (39) with soap and water. Rinse thoroughly.

Install or Connect

NOTICE: See "Notice" on page 6B-1 of this section.

1. Battery tray and reservoir assembly (39).
2. Bolt/screw (40).

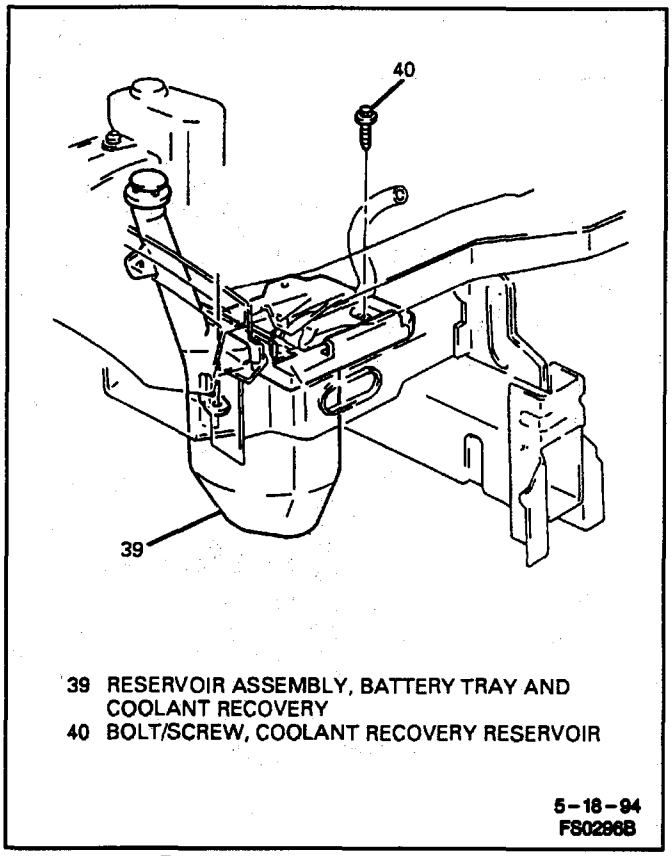
Tighten

- Bolt/screw (40) to 12 N•m (106 lb. in.).

3. Coolant recovery hose assembly.
4. Battery. Refer to SECTION 6D1.
5. Add engine coolant to "FULL COLD" mark on reservoir assembly.

ENGINE OIL COOLER INLET AND OUTLET HOSE ASSEMBLIES

Refer to SECTION 6A3A for service information on inlet and outlet hose assemblies.



39 RESERVOIR ASSEMBLY, BATTERY TRAY AND COOLANT RECOVERY
40 BOLT/SCREW, COOLANT RECOVERY RESERVOIR

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Figure 29 – Battery Tray and Coolant Recovery Reservoir Assembly

COOLANT LEVEL SENSOR (5.7L LT1 Engine Only)

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Drain engine coolant. Refer to "Draining and Refilling the Cooling System" in this section.

3. Lower vehicle.
4. Battery. Refer to SECTION 6D1.
5. Electrical connector at sensor.
6. Sensor.

Install or Connect

1. Sensor.
2. Electrical connector to sensor.
3 Battery. Refer to SECTION 6D1.
4. Add engine coolant. Refer to "Draining and Refilling the Cooling System" in this section.

RADIATOR ASSEMBLY

Figures 30 and 31

Remove or Disconnect

1. Air intake duct.
2. Air cleaner assembly.
3. Raise and suitably support vehicle. Refer to SECTION 0A.
4. Drain engine coolant. Refer to "Draining and Refilling the Cooling System" in this section.
5. Electrical connector(s) at electric engine coolant fan assembly.
6. Radiator upper mounting panel.
7. Electric engine coolant fan assembly. Refer to "Electric Engine Coolant Fan Assembly" in this section.
8. Transmission oil cooler lines. Refer to SECTION 7A.
9. Coolant level sensor, if equipped. Refer to "Coolant Level Sensor" in this section.
10. Lower vehicle.
11. Loosen receiver dehydrator bracket.
12. Lower radiator hose assembly at water pump assembly.
13. Upper radiator hose assembly.
14. Overflow tube.
15. Radiator from condenser.
16. Radiator assembly (18).

Install or Connect

NOTICE: See "Notice" on page 6B-1 of this section.

1. Radiator assembly (18).
   - Make sure radiator assembly is seated on radiator insulators (42 and 43).
2. Radiator assembly to condenser.
3. Overflow tube.
4. Upper radiator hose.
5. Lower radiator hose assembly to water pump assembly.
6. Tighten receiver dehydrator bracket.
7. Raise and suitably support vehicle. Refer to SECTION 0A.
8. Coolant level sensor, if equipped. Refer to "Coolant Level Sensor" in this section.
9. Transmission oil cooler lines. Refer to SECTION 7A.
10. Electric engine coolant fan assembly. Refer to "Electric Engine Coolant Fan Assembly" in this section.
11. Radiator upper mounting panel.

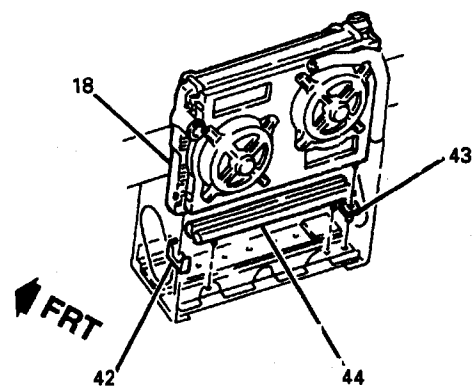
Tighten

- Radiator upper panel mounting bolts/screws to 12 N•m (106 lb. in.).

12. Electrical connector(s) to electric engine coolant fan assembly.
13. Add engine coolant. Refer to "Draining and Refilling the Cooling System" in this section.
14. Lower vehicle.
15. Air cleaner assembly.
16. Air intake duct.

Inspect

- For leaks, after running engine assembly until normal operating temperature is reached.



18 RADIATOR ASSEMBLY
42 INSULATOR, RADIATOR LOWER (LEFT HAND)
43 INSULATOR, RADIATOR LOWER (RIGHT HAND)
44 SEAL ASSEMBLY, RADIATOR AIR LOWER

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Figure 30 – Radiator Insulators and Seal Assembly

RADIATOR AIR BAFFLE ASSEMBLIES AND DEFLECTORS

Radiator Upper Mounting Panel

Figure 31

Remove or Disconnect

1. Bolts/screws (47).
2. Upper mounting panel (48).

Install or Connect

1. Upper mounting panel (48).
2. Bolts/screws (47).

Tighten

- Bolts/screws (47) to 12 N•m (106 lb. in.).

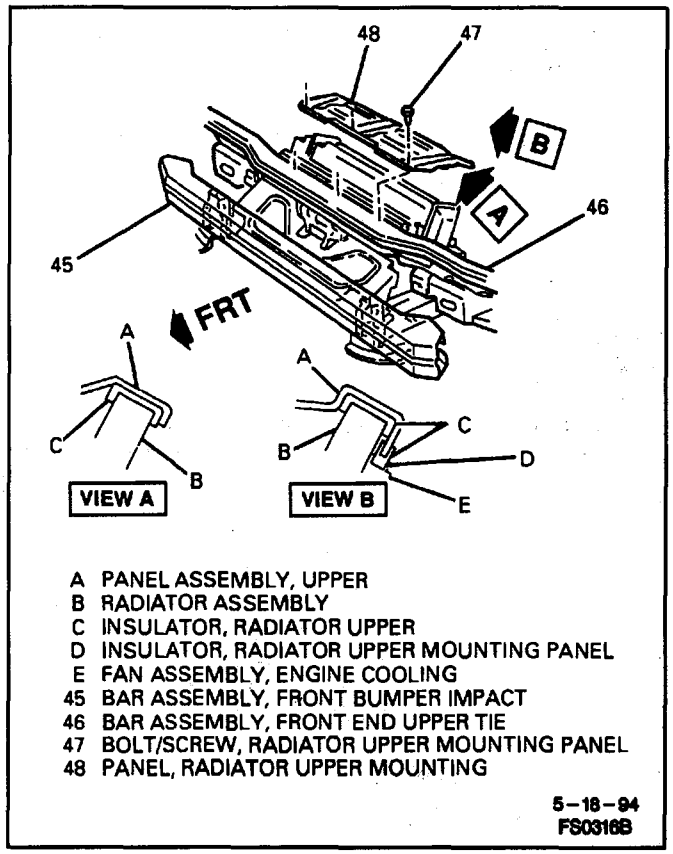


Figure 31 – Radiator Upper Mounting Panel Assembly

Radiator Air Lower Baffle Assembly and Deflector

Figure 32

Remove or Disconnect

1. Radiator air lower deflector bolt/screw (52).
2. Radiator air lower baffle retainers (500.
3. Radiator air lower baffle assembly (49).

Install or Connect

NOTICE: See "Notice" on page 6B-1 of this section.

1. Radiator air lower baffle assembly (49).
2. Radiator air lower baffle retainers (50).
3. Radiator air lower deflector bolt/screw (52).

Tighten

- Bolt/screw (52) to 1.5 N•m (13 lb. in.).

Radiator Air Upper Baffle Assembly

Figure 33

Remove or Disconnect

1. Radiator air upper baffle retainers (54).
2. Radiator air upper baffle assembly (53).

Install or Connect

NOTICE: See "Notice" on page 6B-1 of this section.

1. Radiator air upper baffle assembly (53) to radiator assembly (18).
2. Radiator air upper baffle retainers (54).

ENGINE COOLANT HOSE ASSEMBLIES

Remove or Disconnect

1. Drain radiator assembly so level of engine coolant is below hose assembly being removed.
2. Air cleaner assembly.
3. Inlet hose assembly from radiator assembly and engine coolant thermostat assembly.
4. Outlet hose assembly from radiator assembly and water pump assembly.

Install or Connect

NOTICE: See "Notice" on page 6B-1 of this section.

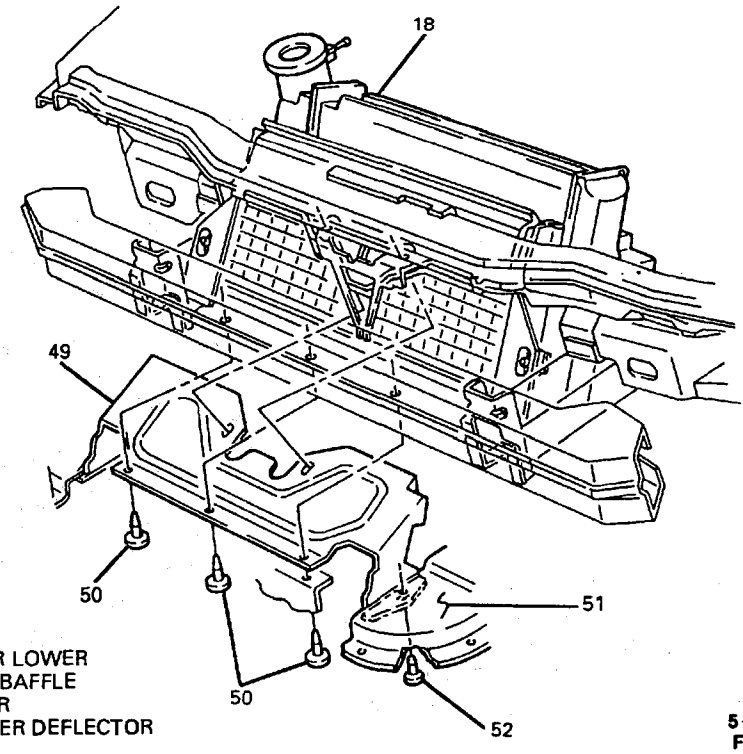
1. Outlet hose assembly and clamps to radiator assembly and water pump assembly.
2. Inlet hose assembly to radiator assembly and engine coolant thermostat assembly.
3. Add engine coolant. Refer to "Draining and Refilling Cooling System" in this section.
4. Air cleaner assembly.

COOLANT AIR BLEED PIPE ASSEMBLY

Figure 34

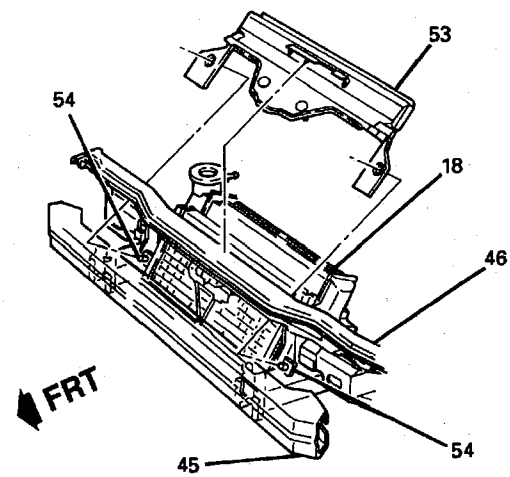
Remove or Disconnect

1. Drain coolant. Refer to "Draining and Refilling Cooling System" in this section.



18 RADIATOR ASSEMBLY
49 BAFFLE ASSEMBLY, RADIATOR AIR LOWER
50 RETAINER, RADIATOR AIR LOWER BAFFLE
51 DEFLECTOR, RADIATOR AIR LOWER
52 BOLT/SCREW, RADIATOR AIR LOWER DEFLECTOR

Figure 32 – Radiator Air Lower Baffle Assembly



18 RADIATOR ASSEMBLY
45 BAR ASSEMBLY, FRONT BUMPER IMPACT
46 BAR ASSEMBLY, FRONT END UPPER TIE
53 BAFFLE ASSEMBLY, RADIATOR AIR UPPER
54 RETAINER, RADIATOR AIR UPPER BAFFLE

Figure 33 – Radiator Air Upper Baffle Assembly

2. Transmission. Refer to SECTION 7A or SECTION 7B.
3. Left and right bleed pipe mounting (banjo) bolts.
   - Use a backup wrench.
4. Lower vehicle.
5. Upper alternator bracket. Refer to SECTION 6D3.
6. Electrical connectors and vacuum hoses, as necessary, to gain access to bleed pipe.
7. Air bleed pipe mounting nut at intake manifold.
8. Coolant hose at air bleed pipe.
9. Coolant air bleed pipe assembly.

Install or Connect

NOTICE: See "Notice" on page 6B-1 of this section.

1. Coolant air bleed pipe assembly.
2. Coolant hose at air bleed pipe.
3. Air bleed pipe mounting nut at intake manifold.

Tighten

- Mounting nut to 21 N•m (15 lb. ft.).

4. Electrical connectors and vacuum hoses, as necessary.
5. Upper alternator bracket. Refer to SECTION 6D3.
6. Raise and suitably support vehicle. Refer to SECTION 0A.
7. Left and right bleed pipe mounting (banjo) bolts.
   - Use a backup wrench.

Tighten

- Mounting bolts to 42 N•m (31 lb. ft.).

8. Transmission. Refer to SECTION 7A or SECTION 7B.
9. Refill cooling system. Refer to "Draining and Refilling Cooling System" in this section.

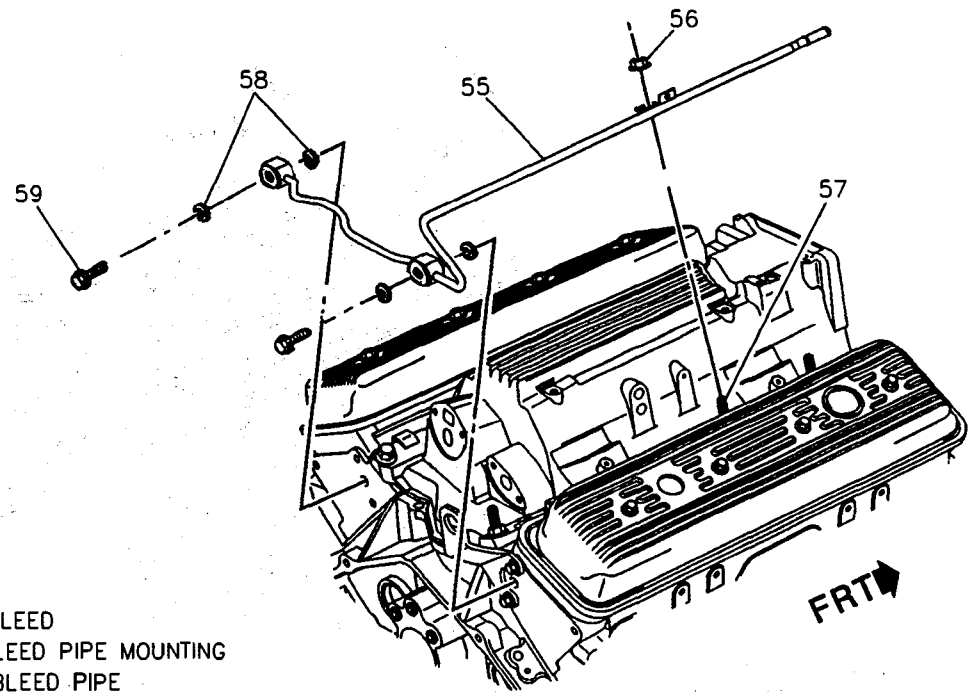


Figure 34 – Coolant Air Bleed Pipe Assembly

TESTING THE COOLANT CONCENTRATION

Figures 35 through 37

Tools Required:

J 23688-A or J 26568-A Coolant Tester

Important

- Both J 23688-A and J 26568-A automatically compensate for temperature.
- Make sure eyepiece of J 23688-A or J 26568-A is totally free of solution before looking through it. Refer to Figure 34.
- Before each use, swing plastic cover at slanted end of J 26568-A or J 23688-A exposing measuring window and bottom of plastic cover.
- Wipe dry both prism and bottom of sample cover with tissue or clean soft cloth. Refer to Figure 35.
- Close plastic cover.

1. Release tip of pump from J 23688-A or J 26568-A housing.
   - Do not remove clear plastic pump from J 23688-A or J 26568-A.

CAUTION: To avoid being burned, DO NOT remove coolant recovery reservoir cap while engine is at normal operating temperature. The cooling system will release scalding fluid and steam under pressure if cap is removed while engine and radiator are still hot. This could result in a large coolant loss and possible personal injury.

2. Remove coolant recovery reservoir cap.
3. Insert tube into coolant recovery reservoir assembly.
   - Make sure tube is below level of coolant.
4. Press and release bulb to get sample of coolant.
5. Bend tube around J 23688-A or J 23568-A so that tip can be inserted in cover plate opening.
6. Press bulb and allow a few drops to fall onto measuring surface.
   - Do not open plastic cover when taking readings because water evaporation can change readings.
7. Point J 23688-A or J 26568-A toward any light source and look into eyepiece.
   - Coolant protection reading is at point where dividing line between light and dark crosses scale on right.
   - Temperature scale is reversed from a standard thermometer scale. Below zero readings are on upper half of scale.
   - If readings are not clear, the measuring prism was not cleaned and dried or there was not enough fluid on measuring prism.

Calibrating Testers

J 23688-A and J 26568-A are factory calibrated and sealed and should not require adjustment. If adjustment is required, follow instructions below.

1. Make sure J 23688-A and J 26568-A is between 21 and 29°C (70 and 85°F).
2. Using distilled water, take a reading. If reading departs from a 0°C (32°F) reading on scale, a correction can be made by adjusting screw on bottom of J 23688-A and J 26568-A.
3. Remove sealant covering screw.

Important

- Do not remove screw from J 23688-A and J 26568-A.

4. Turn screw in direction necessary to adjust reading to 0°C (32°F) line.
5. Reseal the screw using a silicone sealant.

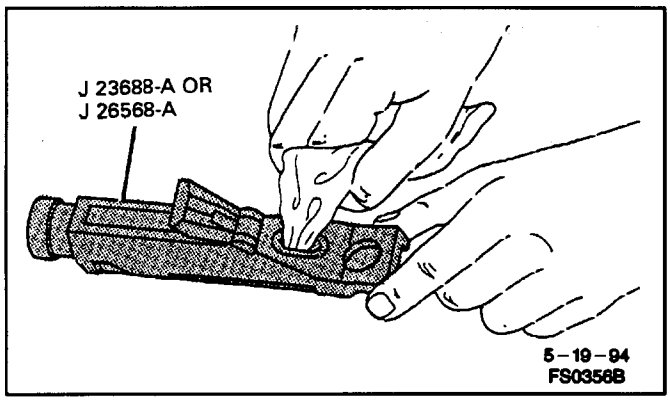


Figure 35 – Cleaning the Coolant Tester

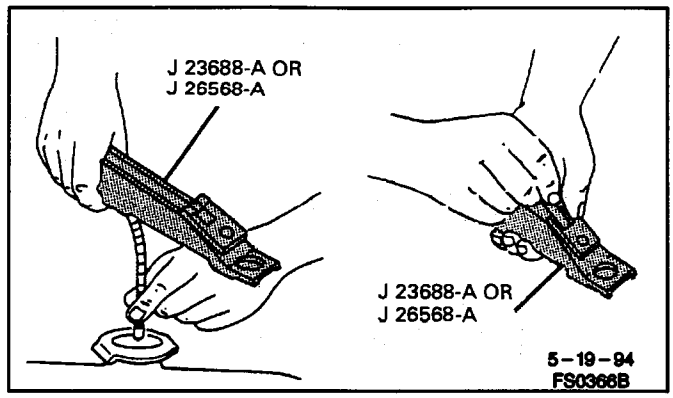


Figure 36 – Collecting the Coolant

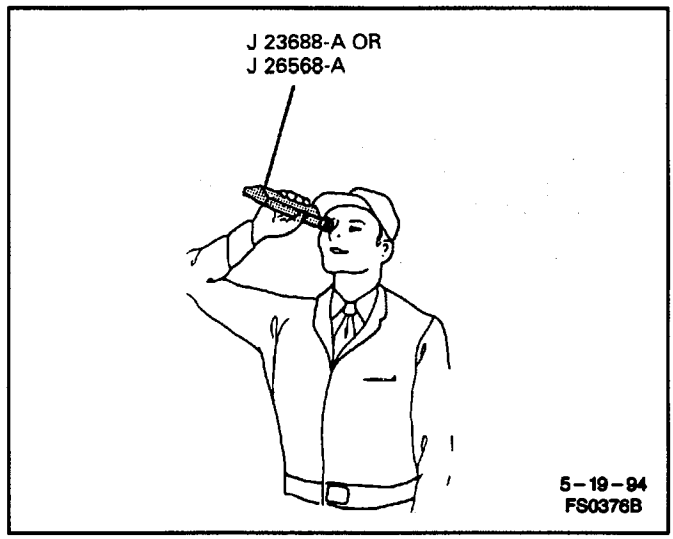


Figure 37 – Reading the Coolant Tester

SPECIFICATIONS

GENERAL SPECIFICATIONS

Cooling System Approximate Fluid Capacities

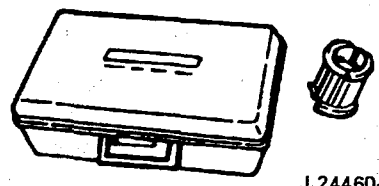
3.4L L32 Engine	
With Manual Transmission	11.8 liters (12.5 qt.)
With Automatic Transmission	11.6 liters (12.3 qt.)
5.7L LT1 Engine	
With Manual Transmission	14.5 liters (15.3 qt.)
With Automatic Transmission	14.3 liters (15.1 qt.)

FASTENER TIGHTENING SPECIFICATIONS

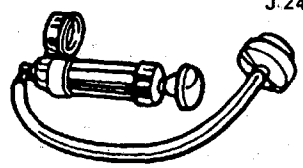
Air Bleed Pipe Mounting Bolts/Screws	40 N•m (30 lb. ft.)
Air Bleed Pipe Mounting Nut	17 N•m (13 lb. ft.)
Battery Tray and Coolant Recovery Reservoir Bolt/Screw	12 N•m (106 lb. in.)
Engine Block Coolant Drain Hole Plug	18 N•m (3 lb. ft.)
Engine Front Cover Bolt/Screw	11 N•m (97 lb. in.)
Knock Sensor	20 N•m (15 lb. ft.)
Oil Cooler Pipe Connections	27 N•m (20 lb. ft.)
Power Steering Bracket Bolt/Screw	40 N•m (30 lb. ft.)
Radiator Air Lower Deflector Bolt/Screw	1.5 N•m (13 lb. in.)
Radiator Drain Cock Assembly	1.5 N•m (13 lb. in.)
Radiator Upper Mounting Panel Bolt/Screw	12 N•m (106 lb. in.)
Water Outlet Bolt/Screw	28 N•m (21 lb. ft.)
Water Pump Bolt/Screw (3.4L L32 Engine)	10 N•m (89 lb. in.)
Water Pump Bolt/Screw (5.7L LT1 Engine)	41 N•m (30 lb. ft.)
Water Pump Cover Bolt/Screw	41 N•m (30 lb. ft.)

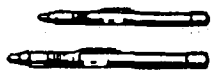
SPECIAL TOOLS

1.



J 24460-01





J 24731-188

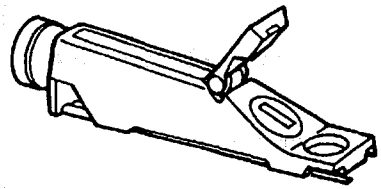
J 24731-206

2.



3.

J 33419-A



1. COOLING SYSTEM TESTER
2. TEMPIL STICKS
3. RADIATOR CORE REMOVER/INSTALLER
4. COOLANT TESTER

4. J 23688-A OR J 26568-A

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SECTION 6C

ENGINE FUEL

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread-locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

The fuel supply is stored in the fuel tank. An electric fuel pump, attached to the fuel sender assembly (inside the fuel tank) pumps fuel through an in-line filter to the fuel rail assembly. The pump is designed to provide fuel at a pressure above the regulated pressure needed by the injectors. A pressure regulator, an integral part of the fuel rail assembly, keeps fuel available to the injectors at a regulated pressure. Unused fuel is returned to the fuel tank by a separate pipe. For further information on the fuel injection system, refer to "Fuel Metering System" located in SECTION 6E3-C2.

Unleaded fuel must be used with all gasoline engines for proper emission control system operation. Using unleaded fuel will also decrease spark plug fouling and extend engine oil life. Leaded fuel can damage the emission control system, and its use can result in loss of emission warranty coverage.

All vehicles with gasoline engines are equipped with an evaporative emission system that minimizes the escape of fuel vapors to the atmosphere. Information on this system is located in SECTION 6E3-C3.

FUEL TANK VENT VALVE (REMOTE MOUNTED)

Figure 1

The fuel tank vent valve, located in the rear of the vehicle by the fuel tank, is a pressure/vacuum relief valve. When fuel tank pressure exceeds a specified pressure the valve will open allowing tank pressure to bleed off. When the fuel tank is in a vacuum condition, the vent valve will open when the vacuum is within a specified range allowing fresh air to be pulled in.

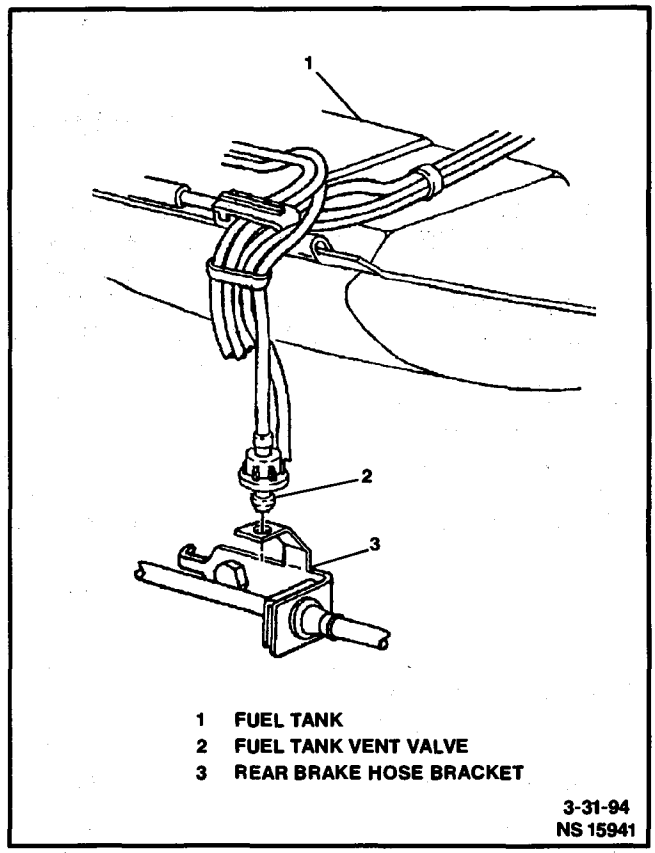


Figure 1 - Fuel Tank Vent Valve

FUEL TANK

The fuel tank is used to store fuel for the vehicle. The tank is located in the rear of the vehicle and is held in place by two metal straps that are attached to the frame. The fuel tank is made of steel and is coated internally with a special corrosion inhibiter.

Fuel Tank Filler Pipe

Figure 2

To prevent refueling with leaded fuel, the fuel filler pipe has a built-in restrictor and deflector.

Fuel Filler Cap

Figure 2

The fuel tank filler pipe is equipped with a non-vented threaded-type cap. The threaded part of the cap requires several turns counterclockwise to remove. A built-in torque-limiting device prevents over tightening. To install, turn the cap clockwise until a clicking noise is heard. This signals that the correct torque has been reached and the cap is fully seated.

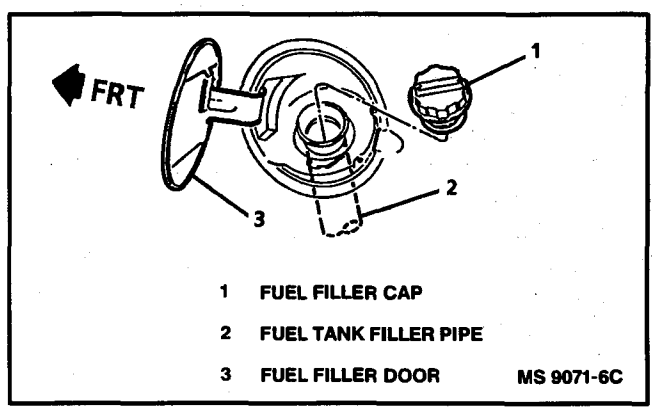


Figure 2 - Fuel Filler Cap

NOTICE: If a fuel filler cap requires replacement, use only a cap with the same features. Failure to use the correct cap can result in a serious malfunction of the system.

FUEL SENDER ASSEMBLY

Figure 3

The fuel sender assembly is located inside the fuel tank, and is attached to the top of the fuel tank.

The fuel sender assembly consists of the following major components: a fuel sender, fuel pump and reservoir assembly, and a fuel pump strainer.

Fuel Sender

Figure 3

The fuel sender consists of the float, wire float arm, sensor and roll-over valve. Fuel level is sensed by the position of the float arm, and a signal is sent to the display in the vehicle instrument cluster.

The roll-over valve is pressed into the EVAP pipe of the fuel sender and is not serviced separately. The roll-over valve prevents fuel spilling from the fuel sender EVAP pipe if the vehicle rolls over.

Fuel Pump and Reservoir Assembly

Figures 3 and 4

An electric high pressure roller vane fuel pump is mounted inside the fuel reservoir, which is located in the fuel tank. The fuel is pumped to the fuel rail assembly at a specified flow and pressure by the fuel pump. Excess fuel is returned to the fuel tank by the return pipe. The fuel pump delivers a constant flow of fuel to the engine even during low fuel conditions and aggressive vehicle maneuvers. As part of the fuel pump and reservoir assembly, three hoses are permanently attached. The fuel pump flex pipe has a quick-connect fitting, the fuel return hose has a square end and the fuel vapor hose is cut on an angle. The fuel pump flex pipe also acts to dampen fuel pulses and noise generated by the fuel pump.

The electric fuel pump operation is controlled by the Powertrain Control Module (PCM) through a fuel pump relay. Refer to SECTION 6E3-C2 and SECTION 8A of this manual for further description and a wiring diagram of the fuel pump relay.

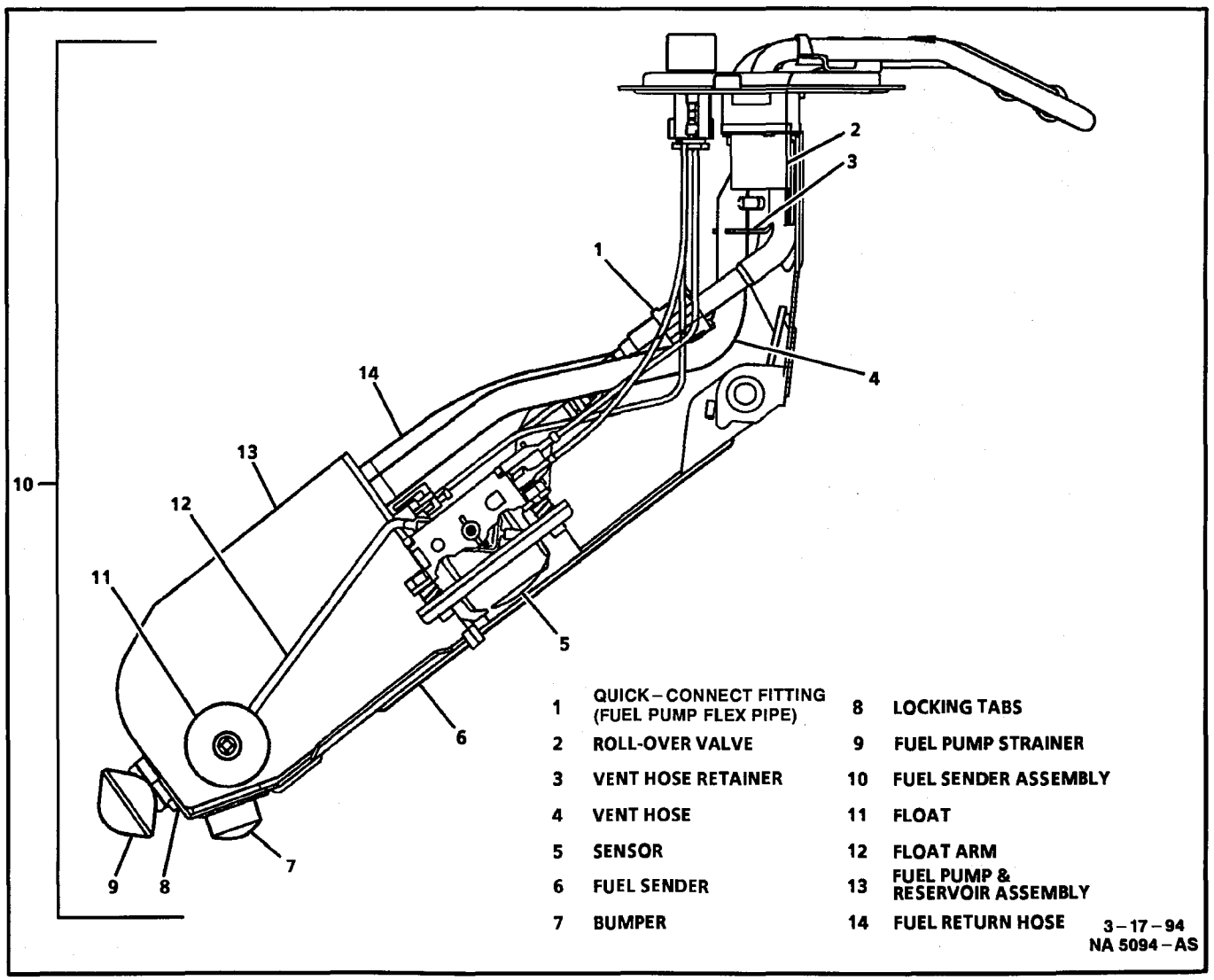


Figure 3 - Fuel Sender Assembly

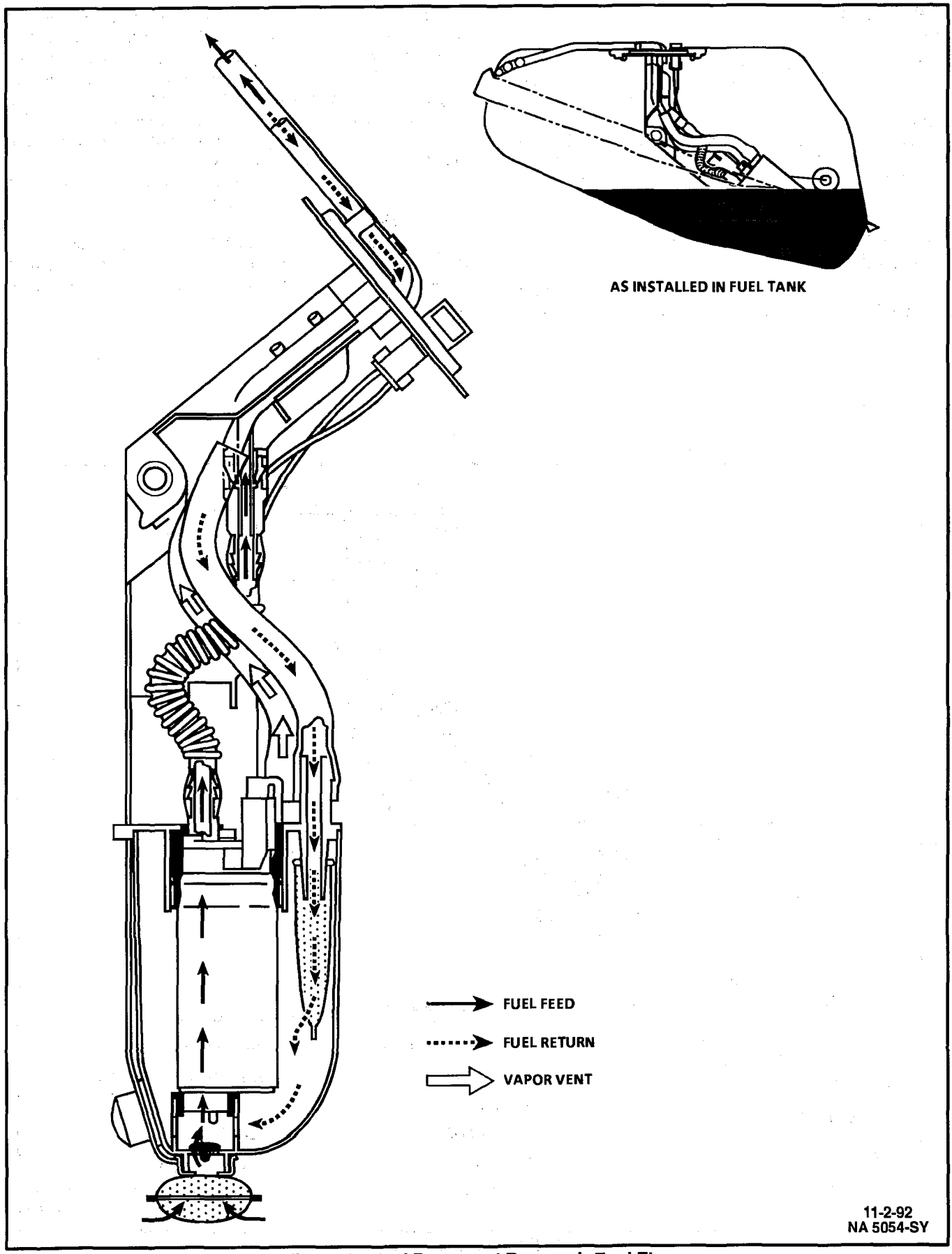


Figure 4 - Fuel Pump and Reservoir Fuel Flow

Fuel Pump Strainer
Figures 3 and 4

A woven plastic fuel pump strainer is attached to the lower end of the fuel pump and reservoir assembly in the fuel tank. The functions of the fuel pump strainer are to filter contaminants and to wick fuel.

The life of the fuel pump strainer is generally considered to be that of the fuel pump. The fuel pump strainer is self-cleaning and normally requires no maintenance. Fuel stoppage at this point indicates that the fuel tank contains an abnormal amount of sediment or water. In this case, the tank should be thoroughly cleaned. See "Fuel System Cleaning" in this section. If the fuel pump strainer is plugged, replace it with a new one.

IN-LINE FUEL FILTER
Figure 5

A steel in-line fuel filter is used in the fuel feed pipe ahead of the fuel injection system. The filter element is made of paper, and is designed to trap particles in the fuel that may damage the injection system. The filter housing is constructed to withstand maximum fuel system pressure, exposure to fuel additives, and changes in temperature. The filter has a quick-connect inlet and a threaded outlet fitting. The threaded fitting is sealed with an O-ring. There is no service interval for fuel filter replacement. Only replace the fuel filter if it is restricted.

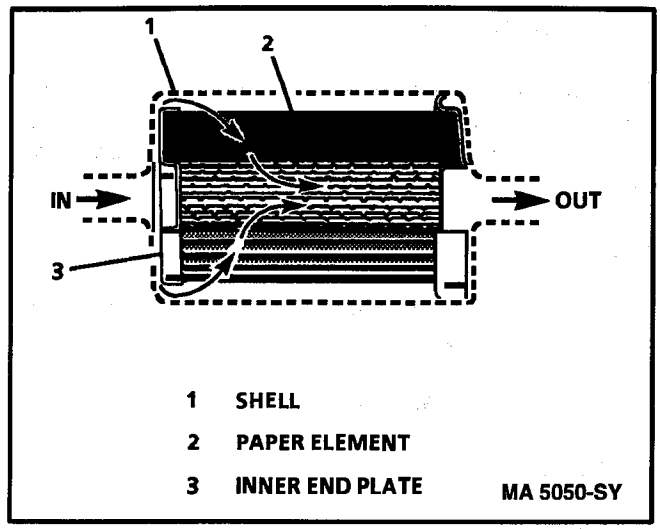


Figure 5 - In-Line Fuel Filter (Typical)

FUEL FEED AND RETURN PIPES

The fuel feed pipe carries fuel from the fuel tank to the fuel rail assembly. The fuel return pipe carries fuel from the fuel rail assembly back to the fuel tank. The fuel feed and return pipes consist of three sections:

- The rear fuel pipe assemblies are located from the top of the fuel tank to the chassis fuel pipes. The rear fuel pipes are constructed of nylon.
- The chassis fuel pipes are located under the vehicle and connect the rear fuel pipes to the engine compartment connecting fuel pipes. These pipes are constructed of steel.
- The engine compartment connecting fuel pipes connect the chassis pipes to the engine fuel rail. These fuel pipes are routed from the chassis fuel pipes under the vehicle and behind the front driver side wheel house liner to the engine compartment. These fuel pipes are constructed of nylon.

Nylon Fuel Pipes

Nylon fuel pipes are designed to perform the same job as the steel or flexible fuel pipes or hoses they replace. Nylon pipes are constructed to withstand maximum fuel system pressure, exposure to fuel additives, and changes in temperature. There are two sizes used: 3/8" ID for the fuel feed, and 5/16" ID for the fuel return.

The fuel feed and return pipes are assembled as a harness. Retaining clips hold the pipes together and provide a means for attaching the pipes to the vehicle. Sections of the pipes that are exposed to chafing, high temperature or vibration are protected with heat resistant rubber hose and/or corrugated plastic conduit.

Nylon fuel pipes are somewhat flexible and can be formed around gradual turns under the vehicle. However, if forced into sharp bends, nylon pipes will kink and restrict fuel flow. Also, once exposed to fuel, nylon pipes may become stiffer and are more likely to kink if bent too far. Special care should be taken when working on a vehicle with nylon fuel pipes:

CAUTION: To Reduce the Risk of Fire and Personal Injury:
• Always cover nylon fuel pipes with a wet towel before using a torch near them. Also, never expose the vehicle to temperatures higher than 115°C (239°F) for more than one hour, or more than 90°C (194°F) for any extended period.
• Take care not to nick or scratch the nylon fuel pipes. If damaged, they must be replaced.

Quick-Connect Fittings

Quick-connect type fittings provide a simplified means of installing and connecting fuel system components. Depending on the vehicle model, there are two types of quick-connect fittings, each used at different locations in the fuel system. Each type consists of a unique female connector and a compatible male pipe end. O-rings, located inside the female connector, provide the fuel seal. Integral locking tabs or fingers hold the fittings together.

Fuel Pipe O-Rings

The fuel feed pipe threaded connection at the fuel filter is sealed with an O-ring seal. Fuel system O-ring seals are made of special material, and should only be serviced with the correct service part.

EVAP PIPES AND HOSES

The EVAP pipe and hoses extend from the fuel sender assembly to the evaporative emission canister.

DIAGNOSIS

ALCOHOL-IN-FUEL

Alcohol-in-fuel can be detrimental to fuel system components and may cause driveability problems such as hesitation, lack of power, stall, no start, etc.

The problems may be due to fuel system corrosion and subsequent fuel filter plugging, deterioration of rubber components and/or air-fuel mixture leaning.

Various types and concentrations of alcohols are used in commercial fuel. Some alcohols are more detrimental to fuel system components than others. If an excessive amount of alcohol in the fuel is suspected as the cause of a driveability condition, the following procedure may be used to detect the presence of alcohol in the fuel.

Testing Procedure

The fuel sample should be drawn from the bottom of the tank so that any water present in the tank will be detected. The sample should be bright and clear. If the sample appears cloudy, or contaminated with water (as indicated by a water layer at the bottom of the sample), this procedure should not be used, and the fuel system should be cleaned. See "Fuel System Cleaning" in this section.

1. Using a 100 ml cylinder with 1 ml graduation marks, fill with fuel to the 90 ml mark.
2. Add 10 ml of water to bring the total fluid volume to 100 ml and install a stopper.
3. Shake vigorously for 10 to 15 seconds.
4. Carefully loosen the stopper to release pressure.
5. Close the stopper and shake vigorously again for 10 to 15 seconds.
6. Put the graduated cylinder on a level surface for approximately 5 minutes to allow adequate liquid separation.

If alcohol is present in the fuel, the volume of the lower layer (which would now contain both alcohol and water) will be greater than 10 ml. For example, if the volume of the lower layer is increased to 15 ml, it will indicate at least 5 percent alcohol in fuel. The actual amount of alcohol may be somewhat greater because this procedure does not extract all of the alcohol from the fuel.

FUEL TANK LEAK CHECK

Important

- Before attempting "Fuel Tank Leak Check" place a dry chemical (Class B) fire extinguisher near work area.
- Before removing the fuel tank for a suspected leak, make sure fuel pipes are not leaking onto the tank. Once removed, make sure fuel is not leaking around fuel sender assembly seal.
- This check requires a fuel sender assembly, fuel filler cap, and a fuel sender seal to be installed in the fuel tank.

1. Disconnect negative battery cable.
2. Relieve fuel system pressure (see "Fuel System Pressure Relief").
3. Drain fuel tank (see "Draining Fuel Tank").
4. Remove fuel tank (see "Fuel Tank Replacement").
5. Cap fuel feed pipe, fuel return pipe, and EVAP pipe on fuel sender assembly.
6. Connect a piece of hose to the vent pipe.
7. Submerge tank in water or apply soap solution to outside of tank.
8. Apply 7 to 10 kPa (1 to 1½ psi) air pressure to the piece of hose on the fuel tank vent pipe.
   - Air bubbles appearing from fuel tank indicate a leak. Replace fuel tank if it is leaking (see "Fuel Tank Replacement").

FUEL TANK VENT VALVE CHECK

The fuel tank vent valve, located in the rear of the vehicle by the fuel tank, is a pressure/vacuum relief valve. If the valve is not functioning properly it could cause excessive pressure or vacuum to build up in the tank. The result may be possible fuel discharge when removing cap or possible damage to the tank or fuel sender.

Checking procedure:

1. Loosen fuel filler cap to relieve tank pressure.
2. Remove tank vent valve from vehicle.
3. Wrap vent valve in shop towel and shake out any remaining fuel.
4. Using the appropriate adapters, connect vent valve to a radiator pressure check device.
5. Slowly apply pressure to vent valve. The valve should open at approximately 1 psi. If not, replace vent valve.
6. Disconnect vent valve from pressure tester.
7. Using the appropriate adapters, connect vent valve to a hand operated vacuum pump.
8. Slowly apply vacuum to the vent valve. The valve should open at approximately 1-2" Hg. If not, replace vent valve.

ON-VEHICLE SERVICE

Important

- Before attempting any "On-Vehicle Service" place a dry chemical (Class B) fire extinguisher near work area.

FUEL SYSTEM PRESSURE RELIEF

Tool Required:
J 34730-1, Fuel Pressure Gage

CAUTION:
• To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing fuel system components.
• After relieving system pressure, a small amount of fuel may be released when servicing fuel pipes or connections. In order to reduce the chance of personal injury, cover fuel pipe fittings with a shop towel before disconnecting, to catch any fuel that may leak out. Place the towel in an approved container when disconnect is completed.

1. Ignition "OFF."
2. Disconnect negative battery cable to avoid possible fuel discharge if an accidental attempt is made to start the engine.
3. Loosen fuel filler cap to relieve tank pressure. (Do not tighten until service has been completed.)
4. Connect J 34730-1 to fuel pressure connection. Wrap a shop towel around fitting while connecting gage to avoid spillage.
5. Install bleed hose into an approved container and open valve to bleed system pressure. Fuel connections are now safe for servicing.
6. Drain any fuel remaining in gage into an approved container.

SERVICING QUICK-CONNECT FITTINGS
Figure 6

Tools Required:
J 37088-A, tool set, Fuel Line Quick-Connect Separator

Remove or Disconnect

Important

- Relieve fuel system pressure before servicing any fuel system connection (see "Fuel System Pressure Relief").
- Slide dust covers from quick-connect fittings, if equipped.

1. Grasp both sides of fitting. Twist female connector ¼ turn in each direction to loosen any dirt within fitting.

CAUTION: Safety glasses must be worn when using compressed air, as flying dirt particles may cause eye injury.

2. Using compressed air, blow dirt out of fitting.

- For plastic (Hand Releasable) Fitting-

3. Squeeze plastic retainer release tabs.
4. Pull connection apart.

-OR-

- For Metal Fitting -

3. Choose correct tool from J 37088-A tool set for size of fitting. Insert tool into female connector, then push inward to release locking tabs.
4. Pull connection apart.

Clean and Inspect

NOTICE: If it is necessary to remove rust or burrs from fuel pipe: use emery cloth in a radial motion with the pipe end to prevent damage to O-ring sealing surface.

- Using a clean shop towel, wipe off male pipe end.
- Inspect both ends of fitting for dirt and burrs. Clean or replace components/assemblies as required.

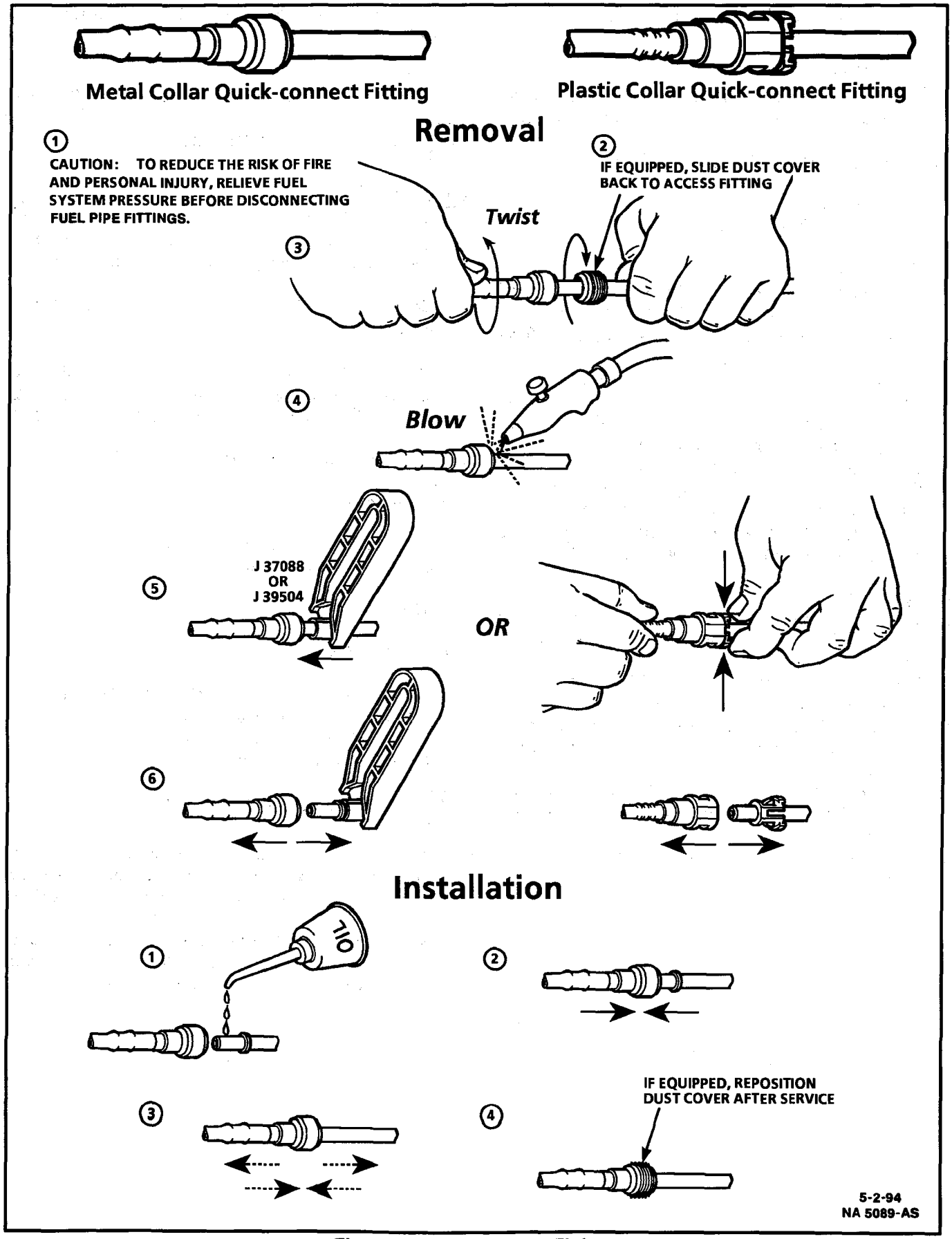


Figure 6 - Quick-Connect Fittings

Install or Connect

CAUTION: To Reduce the Risk of Fire and Personal Injury:
• Before connecting fitting, always apply a few drops of clean engine oil to the male pipe end. This will ensure proper reconnection and prevent a possible fuel leak. (During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.)

1. Apply a few drops of clean engine oil to the male pipe end.
2. Push both sides of fitting together to cause the retaining tabs/fingers to snap into place.
3. Once installed, pull on both sides of fitting to make sure connection is secure.
4. Reposition dust cover over quick-connect fitting, if equipped.

IN-LINE FUEL FILTER REPLACEMENT

Figure 7

Important

- There is no service interval for fuel filter replacement. Only replace fuel filter if it is restricted.
- If the in-line fuel filter is restricted, the fuel tank should be inspected internally and cleaned if necessary.

Remove or Disconnect

1. Negative battery cable.
2. Relieve fuel system pressure (see "Fuel System Pressure Relief").
3. Raise vehicle.

Clean

- Clean all in-line fuel filter connections and surrounding areas before disconnecting to avoid possible contamination of the fuel system.

4. Quick-connect fitting at fuel filter inlet (see "Servicing Quick-Connect Fittings").
5. Threaded fitting from fuel filter outlet.
6. Slide fuel filter from bracket.

Inspect

- Fuel pipe O-ring for cuts, nicks, swelling or distortion. Replace if necessary.

Install or Connect

1. Slide fuel filter into bracket.
2. Threaded fitting to fuel filter outlet.

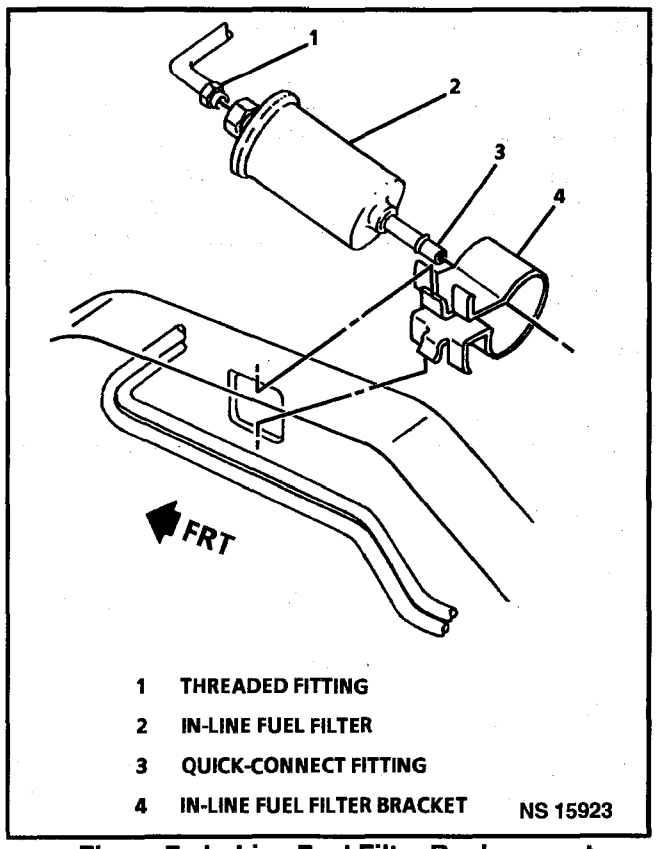


Figure 7 - In-Line Fuel Filter Replacement

Tighten

- In-line fuel filter fitting to 30 N·m (22 lb. ft.).

3. Quick-connect fitting to fuel filter inlet (see "Servicing Quick-Connect Fittings").
4. Lower vehicle.
5. Tighten fuel filler cap.
6. Negative battery cable.

Inspect

- Turn ignition switch to "ON" position for two seconds, then turn to "OFF" for ten seconds. Again turn to "ON" position and check for fuel leaks.

DRAINING FUEL TANK

CAUTION:
• Never drain or store fuel in an open container due to the possibility of fire or explosion.
• When draining fuel tank, slowly insert and do not force hand operated pump device in fuel tank. Forcing pump device can cause fuel pump to be dislocated from fuel sender assembly.

- Use a hand operated pump device to drain fuel through the fuel filler pipe. Remove fuel and install fuel filler cap.

FUEL TANK REPLACEMENT
Figure 8

CAUTION: To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle on the opposite end from which components are being removed. This will reduce the possibility of the vehicle falling off the hoist.

Remove or Disconnect
1. Negative battery cable.
2. Relieve fuel system pressure (see "Fuel System Pressure Relief").
3. Drain fuel tank (see "Draining Fuel Tank").
4. Raise vehicle.
5. Fuel filler pipe shield.
6. Exhaust system (pipe and muffler), refer to SECTION 6F.
7. Exhaust system heat shields.
8. Rear axle assembly, refer to SECTION 4B.

Clean
- Clean all fuel pipe and hose connections and surrounding areas before disconnecting to avoid possible contamination of the fuel system.

9. Fuel feed pipe, fuel return pipe, EVAP pipe and vent hose at fuel sender assembly (see "Servicing Quick-Connect Fittings").
10. Electrical connector.

NOTICE: Do Not bend fuel tank straps, as this may damage straps.

11. With aid of an assistant, support fuel tank, and remove fuel tank strap front attaching bolts, fuel tank straps and fuel tank.
    - Place fuel tank in a suitable work area.

Disassemble
1. Fuel tank insulator pads and tank strap insulator pads if damaged, otherwise leave on.
2. Fuel sender assembly from fuel tank (see "Fuel Sender Assembly Replacement").

Assemble
1. Fuel sender assembly to fuel tank (see "Fuel Sender Assembly Replacement").
2. Tank strap insulator pads and fuel tank insulator pads, if needed.
    - Peel off release paper on insulators and apply to tank and straps.

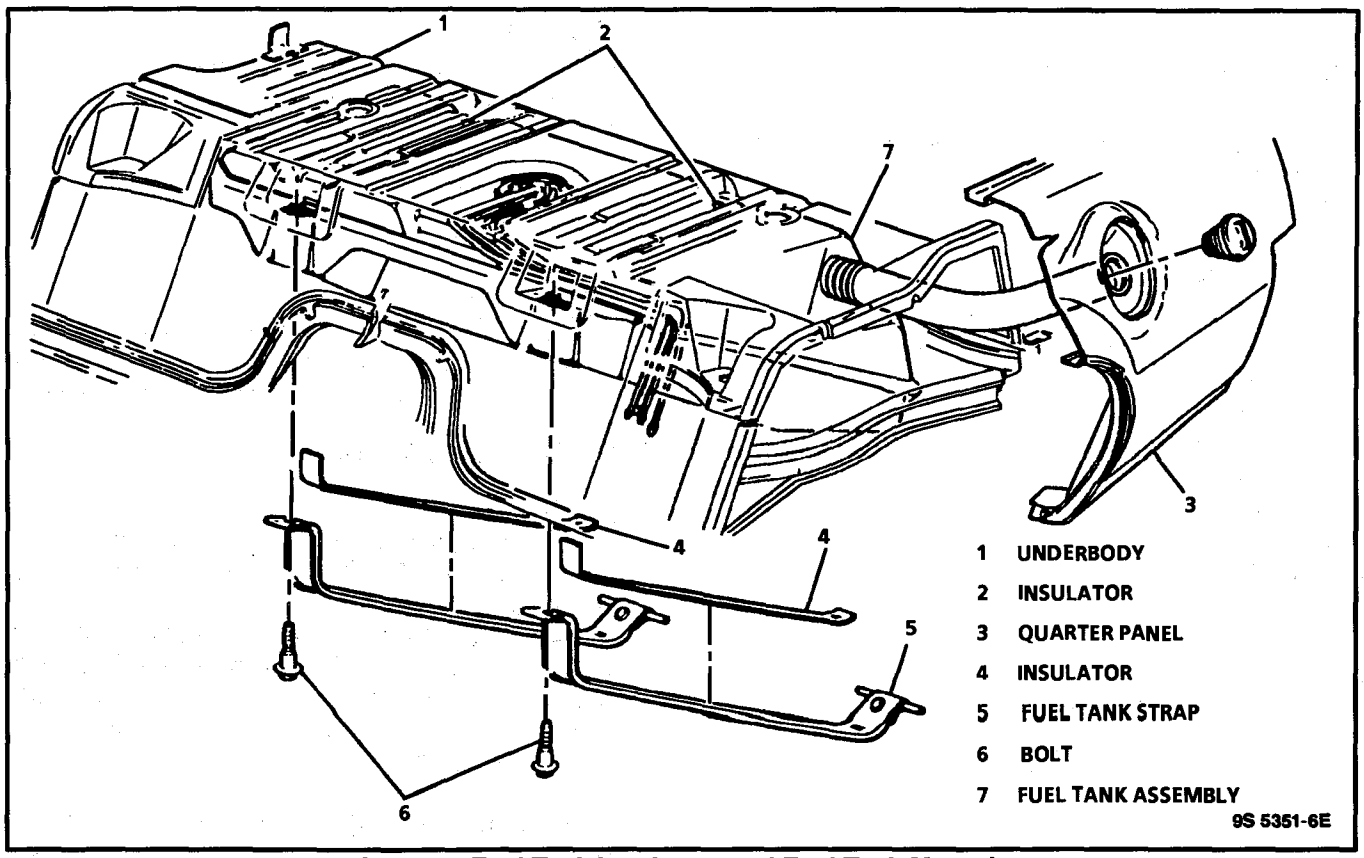


Figure 8 - Fuel Tank Insulators and Fuel Tank Mounting

Install or Connect

1. Hook rear end of fuel tank straps into underbody bracket.
2. With the aid of an assistant, position and support fuel tank. Position fuel tank straps and loosely install front fuel tank strap attaching bolts.

Tighten

- Front fuel tank strap attaching bolts to 33 N·m (24 lb. ft.).

3. Electrical connector.
4. Fuel return pipe, fuel feed pipe, EVAP pipe, and vent hose and clamps at fuel sender assembly (see "Servicing Quick-Connect Fittings").
5. Rear axle assembly, refer to SECTION 4B.
6. Exhaust system heat shields and attaching screws.
7. Exhaust system (pipe and muffler), refer to SECTION 6F.
8. Fuel filler pipe shield.
9. Lower vehicle.
10. Add fuel and install fuel filler cap.
11. Negative battery cable.

Inspect

- Turn ignition switch to "ON" position for two seconds, then turn to "OFF" for ten seconds. Again turn to "ON" position and check for fuel leaks.

FUEL TANK VENT VALVE

Remove or Disconnect

1. Negative battery cable.
2. Fuel filler cap.
3. Raise vehicle.
4. Fuel tank vent valve hose.
5. Fuel tank vent valve from rear brake hose bracket.

Install or Connect

1. Fuel tank vent valve to fuel tank vent valve hose.
2. Fuel tank vent valve to rear brake hose bracket.
3. Lower vehicle.
4. Fuel filler cap.
5. Negative battery cable.

FUEL SENDER ASSEMBLY REPLACEMENT *Figure 9*

Important

- Always replace fuel sender assembly seal when reinstalling fuel sender assembly.

NOTICE: Do Not handle the fuel sender assembly by the fuel sender pipes. Due to the length of the pipes, the amount of leverage generated by handling the pipes could damage the solder joints.

Remove or Disconnect

1. Negative battery cable.
2. Relieve fuel system pressure (see "Fuel System Pressure Relief").
3. Drain fuel tank (see "Draining Fuel Tank").
4. Fuel tank (see "Fuel Tank Replacement").
5. Fuel sender retaining nuts, retaining ring, fuel sender assembly and seal from fuel tank. Discard seal.

CAUTION: To reduce risk of fire and personal injury, drain fuel from fuel sender assembly into an approved container.

Clean

- Fuel sender assembly sealing surfaces.

Install or Connect

1. Position new fuel sender assembly seal on fuel tank.

Important

- Fuel pump strainer must be in a horizontal position. When installing the fuel sender assembly, assure that the fuel pump strainer does not block full travel of float arm.

2. Gently fold fuel strainer over itself.
   - Slowly position fuel sender assembly in fuel tank so that fuel strainer is not damaged or trapped by sump walls.
3. Fuel sender assembly into fuel tank.

Tighten

- Fuel sender assembly retaining nuts to 6.5 N·m (58 lb. in.).

4. Fuel tank (see "Fuel Tank Replacement").
5. Add fuel and install fuel filler cap.
6. Negative battery cable.

Inspect

- Turn ignition switch to "ON" position for two seconds, then turn to "OFF" for ten seconds. Again turn to "ON" position and check for fuel leaks.

FUEL SENDER ASSEMBLY SERVICE
Figure 10

Remove or Disconnect
1. Negative battery cable.
2. Relieve fuel system pressure (see "Fuel System Pressure Relief").
3. Drain fuel tank (see "Draining Fuel Tank").
4. Fuel tank (see "Fuel Tank Replacement").
5. Fuel sender assembly (see "Fuel Sender Assembly Replacement").

Disassemble
1. Note position of fuel stainer on fuel pump.
2. Support fuel sender assembly with one hand and grasp strainer with other hand.
   - Rotate strainer in one direction and pull off of pump. Discard strainer after inspection.

Inspect
- Fuel pump strainer. If strainer is contaminated, the fuel tank should be cleaned.
- Fuel pump inlet for dirt and debris. If found, fuel pump and reservoir should be replaced.

- If fuel pump and reservoir is being replaced, proceed to step 3. -

3. Vent hose and fuel return hose from under cover.
4. Quick-connect fitting on fuel pump flex pipe (see "Servicing Quick-Connect Fittings").
5. Electrical connector from fuel pump.
6. Pry locking tabs on bottom of fuel reservoir, lift reservoir to clear locking tabs and pull reservoir downward to clear guides on fuel sender.

Assemble
1. Align tabs on reservoir with guide on fuel sender, push upward to stop on top of reservoir and snap locking tabs over ramps on bottom of reservoir.
2. Fuel vent and return hose.
3. Quick-connect fitting on fuel pump flex pipe (see "Servicing Quick-Connect Fittings").
4. Electrical connector on fuel pump.

Important
- Always install a new pump strainer when replacing fuel pump.

5. New pump strainer in same position as noted during disassembly.
   - Push on outer edge of strainer ferrule until fully seated.

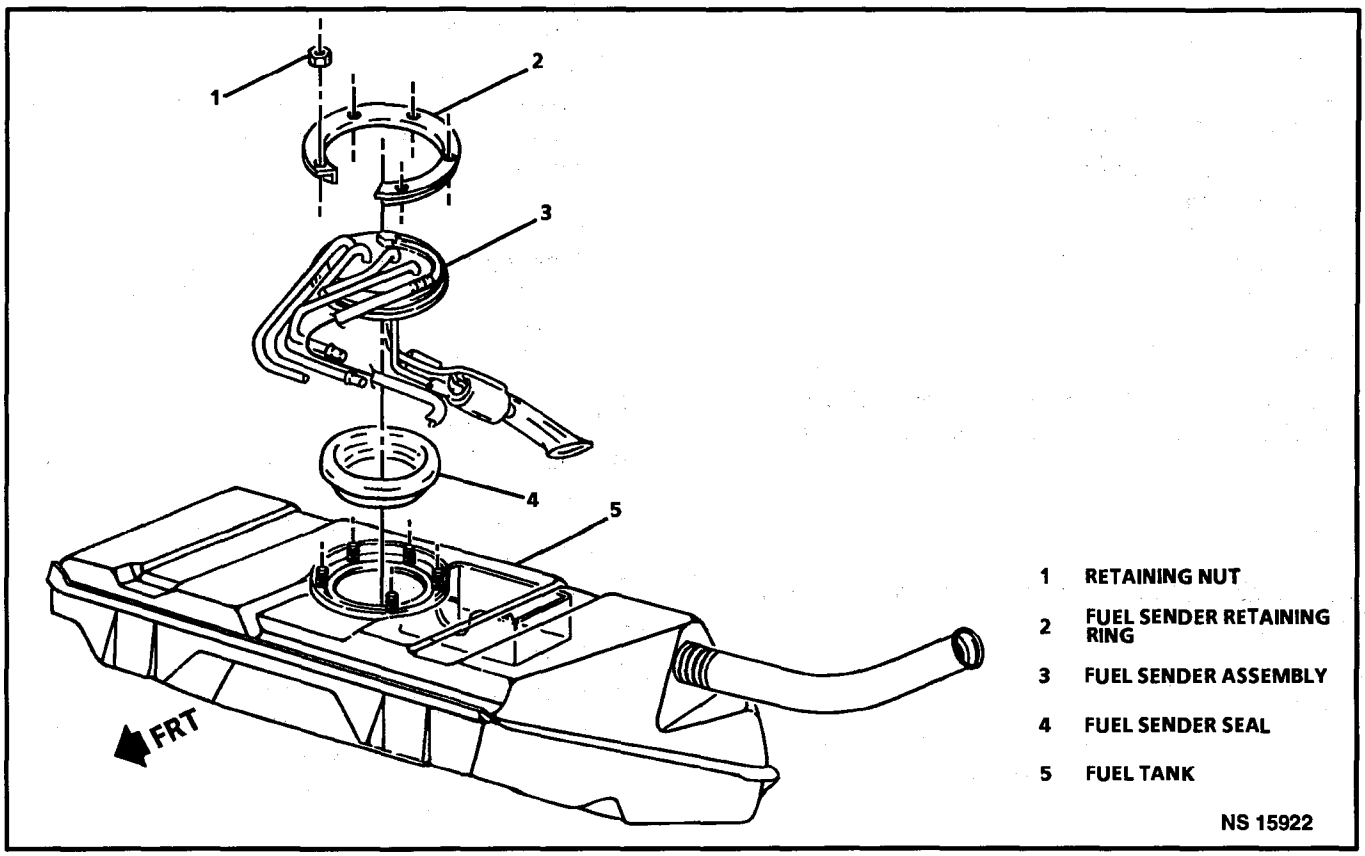


Figure 9 - Fuel Sender Assembly Replacement

Install or Connect

1. Fuel sender assembly (see "Fuel Sender Assembly Replacement").
2. Fuel tank (see "Fuel Tank Replacement").
3. Add fuel and install fuel filler cap.
4. Negative battery cable.

Inspect

- Turn ignition switch to "ON" position for two seconds, then turn to "OFF" for ten seconds. Again turn to "ON" position and check for fuel leaks.

FUEL SYSTEM CLEANING

Important

- Only use oil free compressed air to blow out fuel pipes.
- If the in-line fuel filter is plugged, the fuel tank should be inspected internally and cleaned if necessary.

Fuel Tank

Remove or Disconnect

1. Negative battery cable.
2. Relieve fuel system pressure (see "Fuel System Pressure Relief").
3. Drain fuel tank (see "Draining Fuel Tank").
4. Fuel tank (see "Fuel Tank Replacement").
5. Fuel sender assembly (see "Fuel Sender Assembly Replacement").

Inspect

- Fuel pump strainer. If contaminated, it must be replaced and the fuel pump must be inspected.
- Fuel pump inlet for dirt and debris. If found, fuel pump and reservoir should be replaced.

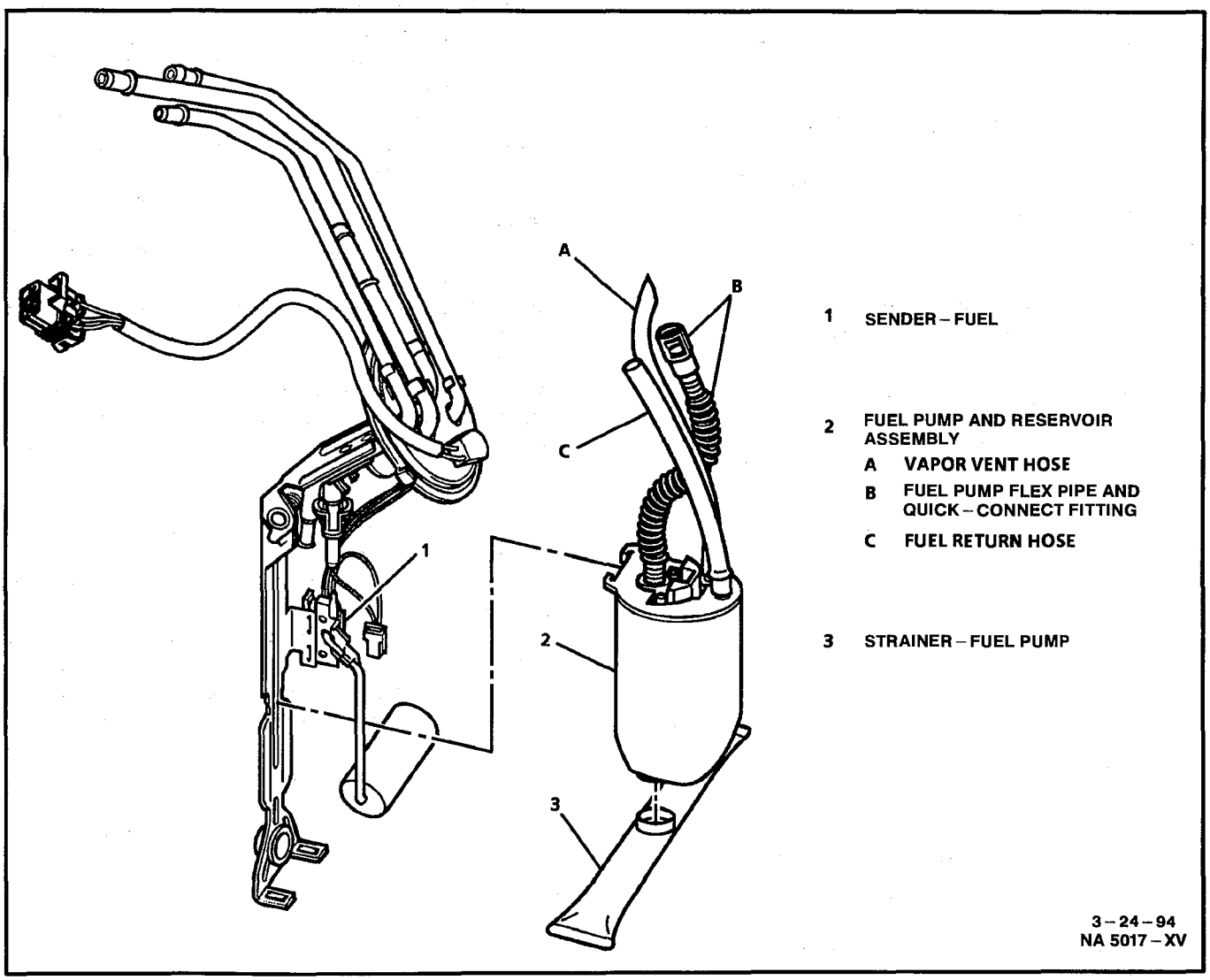


Figure 10 - Fuel Sender Assembly Disassembly

6. Flush fuel tank with hot water.

Important

- When flushing fuel tank, the fuel and water mixture needs to be treated as a hazardous material. The material needs to be handled in accordance with all applicable local, state, and federal laws and regulations.

7. Pour water out of fuel sender assembly opening.
   - Rock tank to be sure that removal of water from tank is complete.

Install or Connect

1. Fuel sender assembly (see "Fuel Sender Assembly Replacement").
2. Fuel tank (see "Fuel Tank Replacement").
3. Add fuel and install fuel filler cap.
4. Negative battery cable.

Inspect

- Turn ignition switch to "ON" position for two seconds, then turn to "OFF" for ten seconds. Again turn to "ON" position and check for fuel leaks.

FUEL FEED, RETURN, AND EVAP PIPES

Rear Fuel Feed, Return, and EVAP Pipe Replacement (Fuel Tank)

Figure 11

NOTICE: Do Not attempt to repair rear fuel feed, return, and EVAP pipes. If damaged, replace.

Remove or Disconnect

1. Negative battery cable.
2. Relieve fuel system pressure (see "Fuel System Pressure Relief").
3. Raise vehicle.

Clean

- Clean all fuel and EVAP pipe and hose connections and surrounding areas before disconnecting to avoid possible contamination of the fuel system.

4. Fuel tank (see "Fuel Tank Replacement").
5. Rear fuel feed and return pipes from chassis fuel pipe and fuel filter (see "Servicing Quick-Connect Fittings").
6. EVAP hoses from EVAP pressure control valve and EVAP canister.

Install or Connect

1. EVAP hoses to EVAP pressure control valve and EVAP canister.
2. Rear fuel feed and return pipes to chassis fuel pipe and fuel filter.
3. Fuel tank (see "Fuel Tank Replacement").
4. Lower vehicle.
5. Negative battery cable.
6. Tighten fuel filler cap.

Inspect

- Turn ignition switch to "ON" position for two seconds, then turn to "OFF" for ten seconds. Again turn to "ON" position and check for fuel leaks.

Chassis Fuel Feed, Return, and EVAP Pipe Repair/Replacement

Figure 12

NOTICE:

- When replacing fuel or EVAP pipes, always replace them with original equipment or parts that meet the GM specifications for those parts. The replacement pipes must have the same type of fittings as the original pipes to ensure the integrity of the connection.
- Do not use copper or aluminum tubing to replace steel tubing. Only tubing meeting the 124-M specification or its equivalent is capable of meeting all pressure, corrosion and vibration characteristics necessary to ensure the durability standard required.
- When repairing fuel or EVAP pipes with hoses, always replace them with original equipment or parts meeting GM specifications. Use only reinforced fuel-resistant hose which is identified with the word "Fluoroelastomer" or "GM 6163-M" on the hose. Inside hose diameter must match outside pipe diameter.
- Do not use rubber hose within 100 mm (4″) of any part of the exhaust system or within 254 mm (10″) of the catalytic converter.
- A minimum of 13 mm (½″) clearance must be maintained around sharp edges such as flanges, pinch welds, etc., to prevent contact and chaffing. A minimum of 19 mm (¾″) clearance must be maintained around all moving parts.
- If more than a 6 inch length of pipe is removed, use a combination of steel pipe and hose so that the total hose lengths, including the 100mm (4″) additional length will not be more than 254 mm (10″) long. Follow the same routing as the original pipe.
- Cut ends of pipe remaining on car square with a tube cutter. Using the first step of a double flaring tool, form a bead on the end of both pipe sections. If pipe is too corroded to withstand the beading operation without damage, the pipe should be replaced. If a new section of pipe is used, form a bead on both ends of it also.
- Use screw type hose clamps. Slide clamps onto pipe and push hose 51 mm (2″) onto each portion of fuel pipe.

Remove or Disconnect

1. Negative battery cable.
2. Relieve fuel system pressure (see "Fuel System Pressure Relief").

Clean

- Clean all fuel and EVAP pipe/hose connections and surrounding areas before disconnecting to avoid possible contamination of the fuel system.

3. Raise vehicle.
4. Engine compartment connecting fuel feed, return, and EVAP pipe assemblies from chassis fuel pipes (see "Servicing Quick-Connect Fittings").
5. Fuel feed pipe from outlet side of in-line fuel filter. Discard O-ring.
6. Fuel return and EVAP pipes from rear fuel pipes (see "Servicing Quick-Connect Fittings").
7. Fuel pipes and attaching hardware from under body.
   - Note position of fuel pipes for installation.

Inspect

- Pipes for bends, kinks and cracks. Repair or replace pipes as required.

Install or Connect

1. Position new or repaired fuel pipe or pipes in body clips as noted during removal and install with attaching hardware.
2. Position new O-ring on fuel feed pipe and connect to outlet side of in-line fuel filter.

Tighten

- Fuel feed pipe fitting to 30 N·m (22 lb. ft.).

3. Fuel return and EVAP pipes to rear fuel pipes (see "Servicing Quick-Connect Fittings").

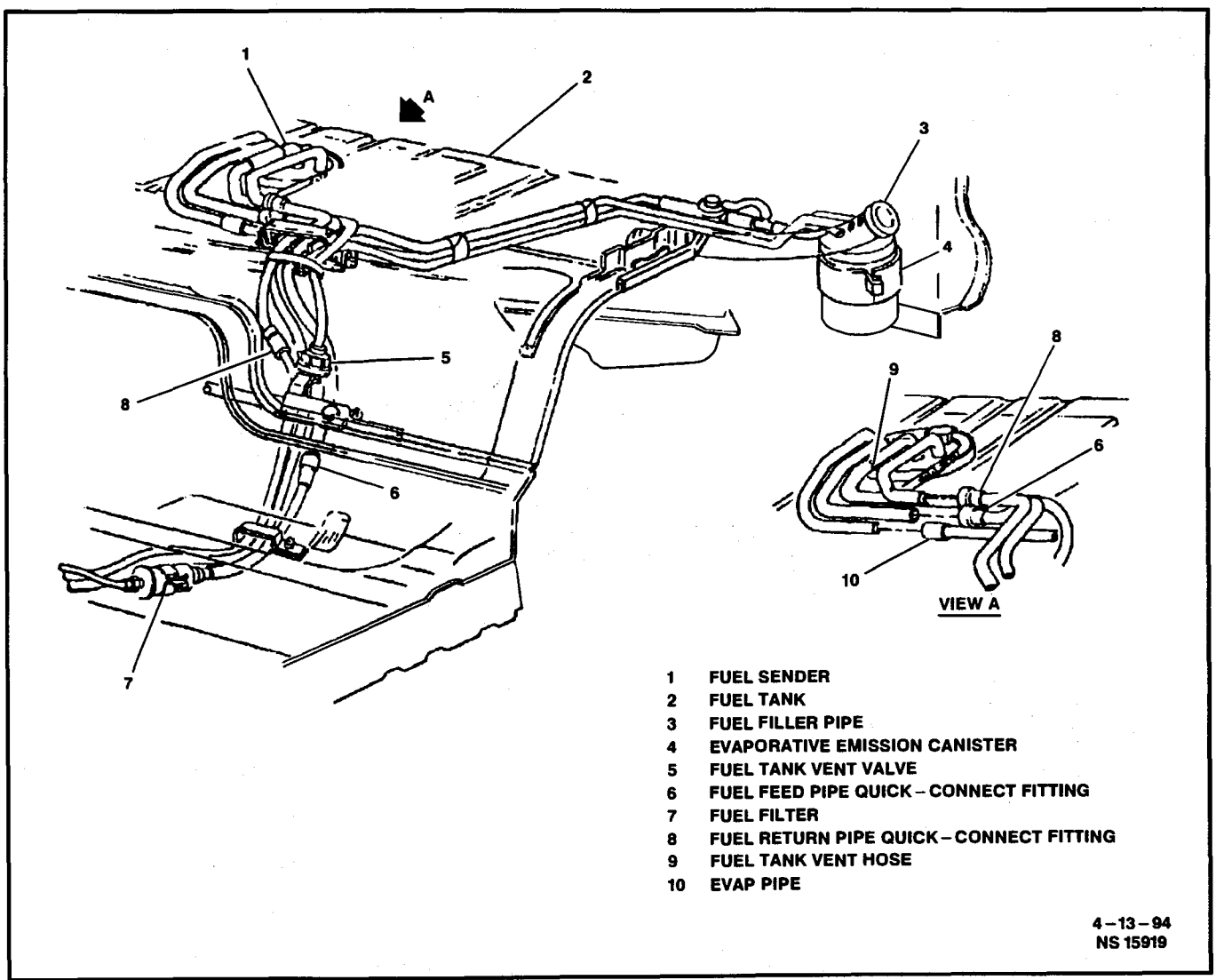


Figure 11 - Fuel and EVAP Pipe Replacement (Rear Pipes)

4. Chassis fuel pipes to engine compartment connecting fuel pipes (see "Servicing Quick-Connect Fittings").
5. Lower vehicle.
6. Tighten fuel filler cap.
7. Negative battery cable.

Inspect

- Turn ignition switch to "ON" position for two seconds, then turn to "OFF" for ten seconds. Again turn to "ON" position and check for fuel leaks.

Engine Compartment Connecting Fuel Feed, Return, and EVAP Pipe Replacement (Chassis to Engine)

Figure 13

NOTICE: Do Not attempt to repair sections of engine compartment connecting fuel and EVAP pipes. If damaged, replace.

Remove or Disconnect

1. Negative battery cable.
2. Relieve fuel system pressure (see "Fuel System Pressure Relief").

Clean

- Clean all engine compartment connecting fuel pipe connections and surrounding areas before disconnecting to avoid possible contamination of the fuel system.

3. Fuel feed, return and EVAP pipes at engine (see "Servicing Quick-Connect Fittings").
4. Fuel and EVAP pipes from routing clip.
5. Reposition grommet in wheelhouse.
6. Raise vehicle.
7. Reposition left front wheelhouse panel liner.
8. Fuel feed, return, and EVAP pipe protector.
9. Fuel and EVAP pipes at chassis fuel and EVAP pipes (see "Servicing Quick-Connect Fittings")
10. Fuel feed, return, and EVAP pipes from underbody retainer.

Install or Connect

1. Fuel and EVAP pipes through wheelhouse opening.
2. Fuel and EVAP pipes at chassis fuel and EVAP pipes.
3. Fuel feed, return, and EVAP pipes into underbody retainer.
4. Fuel and EVAP pipe protector.
5. Left front wheelhouse panel liner.
6. Lower vehicle.

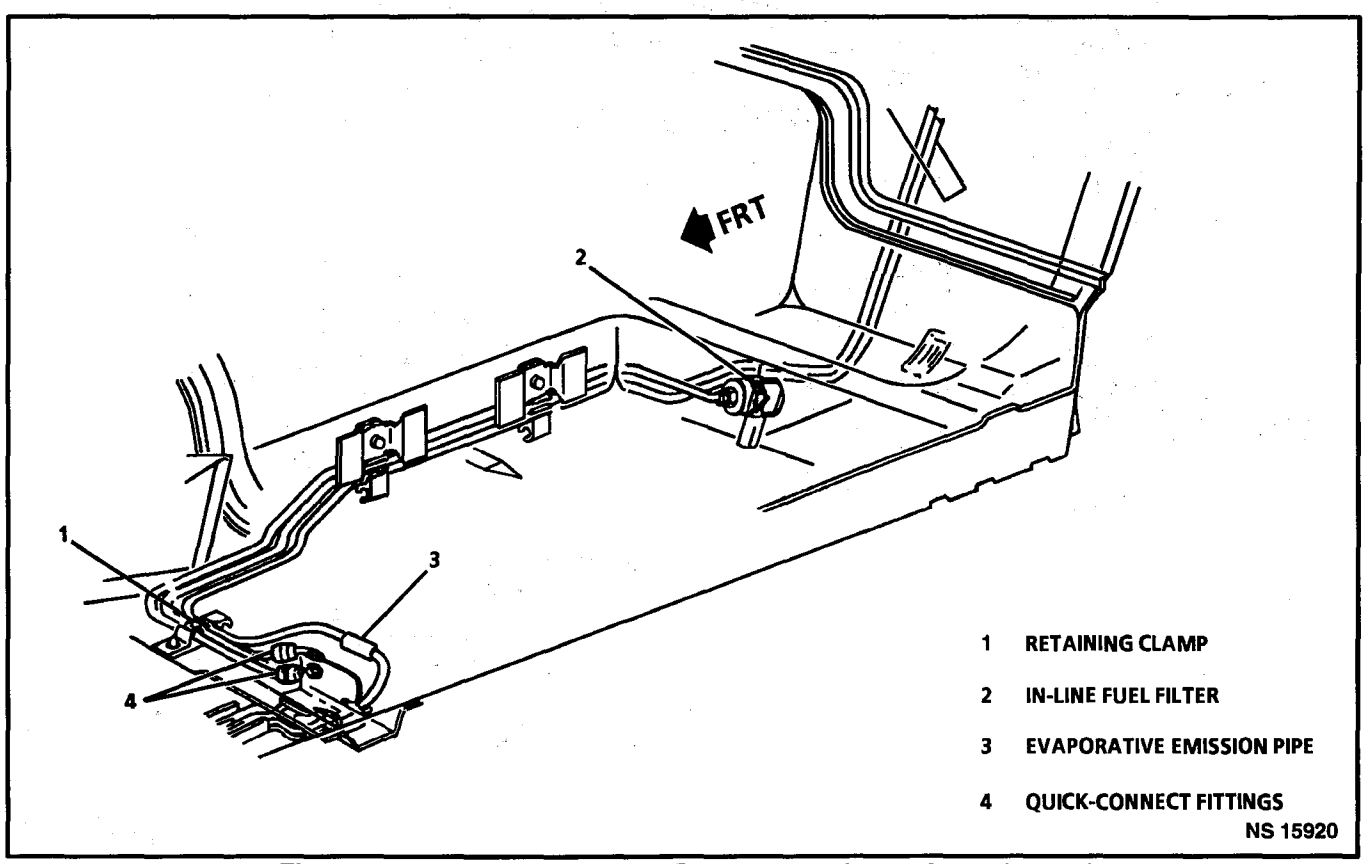
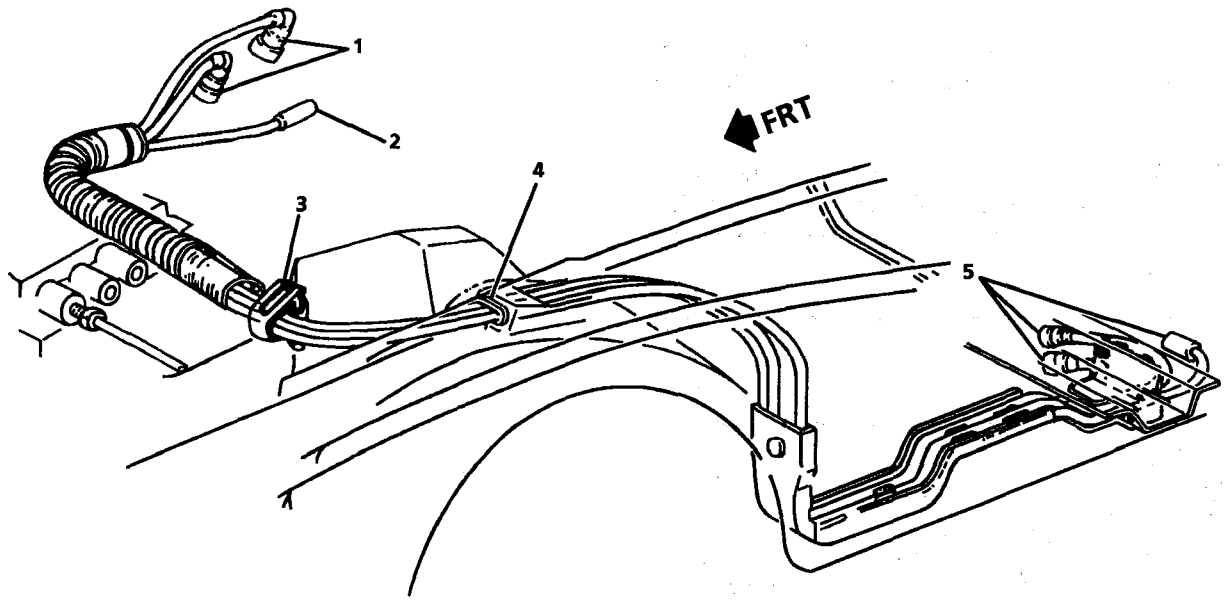


Figure 12 - Fuel and EVAP Pipe Replacement (Chassis Fuel Pipes)



1 ENGINE COMPARTMENT CONNECTING PIPES
2 EVAPORATIVE EMISSION PIPE
3 RETAINING CLAMP
4 GROMMET (WHEELHOUSE OPENING)
5 TO CHASSIS FUEL PIPES

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Figure 13 - Fuel and EVAP Pipe Replacement (Engine Compartment Connecting Fuel Pipes)

7. Fuel and EVAP pipes to routing clip.
8. Grommet in wheelhouse.
9. Fuel feed, return, and EVAP pipes at engine.
10. Tighten fuel filler cap.
11. Negative battery cable.

Inspect

- Turn ignition switch to "ON" position for two seconds, then turn to "OFF" for ten seconds. Again turn to "ON" position and check for fuel leaks.

SPECIFICATIONS

TORQUE SPECIFICATIONS

In-line Fuel Filter Fitting	30 N·m (22 lb. ft.)
Fuel Sender Assembly Retaining Nuts	6.5 N·m (58 lb. in.)
Fuel Tank Strap Attaching Bolts	33 N·m (24 lb. ft.)

FUEL SPECIFICATIONS

The fuel must meet ASTM Standard: D4814(U.S.), CGSB 3.5-M87 (Canada).

Octane Requirements

3.4L (VIN S)
3.8L (VIN K)
5.7L (VIN P)

Min. Octane Recommended: 87[(R+M)/2] (pump) octane where R= research octane number, and M= motor octane number.

Gasoline With Alcohol

NOTICE: Do Not spill fuel containing alcohol on the vehicle. Alcohol can cause damage to the paint finish and trim.

Methyl Tertiary-Butyl Ether (MTBE)

Fuel containing Methyl Tertiary-Butyl Ether (MTBE) may be used, providing there is no more than 15% MTBE by volume.

Ethanol

Fuel containing ethanol (ethyl) or grain alcohol may be used, providing that there is no more than 10% ethanol alcohol by volume.

Methanol

Fuel containing methanol (methyl) or wood alcohol may be used, providing that there is no more than 5% methanol by volume.

NOTICE: Do Not use fuel that contains more than 5% methanol. Use of a fuel (gasohol) that contains more than 5% of methanol can corrode metal fuel system components and damage plastic and rubber parts.

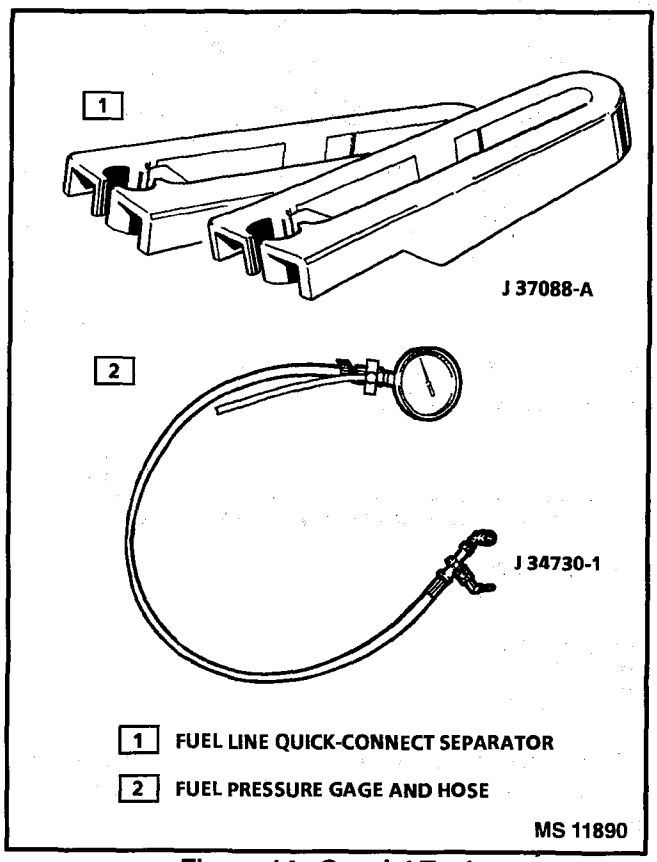


Figure 14 - Special Tools

SECTION 6D

ENGINE ELECTRICAL

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

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Battery 6D1
Cranking System 6D2
Charging System 6D3
Ignition System 6D4
Engine Wiring 6D5

GENERAL DESCRIPTION

The engine electrical system includes the storage battery assembly, ignition (primary and secondary), starter motor assembly (and related wiring) and the generator assembly (and related wiring). To diagnose and troubleshoot system faults, refer to SECTION 8A for wiring diagrams, component locations and system checks.

When a fault is traced to a particular component, refer to that component's section of the service manual.

BLANK

SECTION 6D1

BATTERY

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: Before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with "live" exposed electrical terminals, disconnect the battery negative cable assembly to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "OFF" or "LOCK" position.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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CAUTION: All battery assemblies generate hydrogen gas which is extremely flammable. If ignited by a spark or flame, the gas may explode violently, causing spraying of acid, fragmentation of the battery assembly and possible severe personal injuries. Wear approved eye protection. Battery assembly fluid is corrosive acid. Flush any contacted area with water immediately and thoroughly.

GENERAL DESCRIPTION

BATTERY ASSEMBLY

Figures 1 and 2

The maintenance-free battery assembly is standard on all vehicles. See "Specifications" in this section for battery assembly usage applications. There are no vent plugs in the cover. The battery assembly is completely sealed except for two small vent holes in the sides. These vent holes allow the small amount of gas produced in the battery assembly to escape.

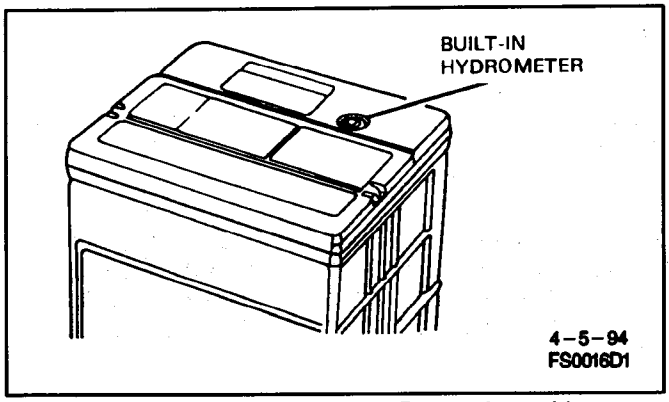


Figure 1 – Maintenance-Free Battery Assembly

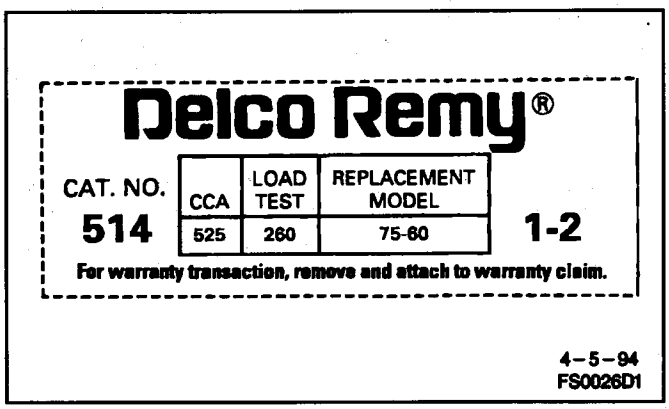


Figure 2 – Battery Assembly Label

The battery assembly has three major functions in the electrical system: first, it provides a source of energy for cranking the engine; second, it acts as a voltage stabilizer for the electrical system, and third, it provides energy for a limited time when the electrical load exceeds the output of the generator assembly.

The battery assembly specifications label contains important information for servicing the battery assembly. This information includes test rating and both original equipment and recommended replacement part numbers. Refer to "Specifications" at the end of this section.

BATTERY ASSEMBLY RATINGS

A battery assembly has two ratings: (1) a reserve capacity rating and (2) a cold cranking amperage rating at –18°C (0°F). When replacing the battery assembly, use these two ratings as a guide in selecting a replacement. For the catalog number of a replacement battery assembly with ratings similar to the original battery assembly, refer to "Specifications" at the end of this section.

Reserve Capacity

The "Reserve Capacity" is an estimate of the maximum length of time it is possible to travel at night with minimum electrical load and no generator assembly output.

Expressed in minutes, it is the approximate time the fully-charged battery assembly can support a 25-amp load without the battery assembly terminal voltage dropping below 10.5 volts at 27°C (80°F).

Cold Cranking Amps

The cold cranking amperage (CCA) test is expressed at a battery temperature of –18°C (0°F). The current rating is the minimum amperage which must be maintained by the battery assembly for 30 seconds, at the specified temperature, while meeting a minimum voltage requirement of 7.2 volts. This rating is a measure of cold cranking capacity.

COMMON CAUSES OF FAILURE

The battery assembly is not designed to last indefinitely; however, with proper care, it will provide many years of service.

If the battery assembly tests "good," but fails to perform satisfactorily in service for no apparent reason, the following are some of the more important factors that may point to the cause of trouble:

1. Vehicle accessories are left on overnight.
2. Slow average driving speeds for short periods.
3. The vehicle's electrical load being more than the generator assembly output, particularly with the addition of aftermarket equipment.
4. Conditions in the charging system such as electrical shorts, slipping serpentine belt, faulty generator assembly, or generator voltage regulator.
5. Battery assembly abuse, including failure to keep the battery assembly terminals clean and tight or loose battery assembly hold-down. See "Battery Assembly Replacement" in this section for torque specifications.
6. Mechanical conditions in the electrical system, such as shorted or punched wires.
7. Extended storage of vehicles.
8. Extended cranking periods due to plug fouling.
9. Incorrect interpretation of the hydrometer.
10. Insufficient ampere-hour charge rate for a discharged battery assembly.
11. Continuous current draw on the battery assembly through excessive parasitic drain.

ELECTROLYTE FREEZING

The freezing point of electrolyte depends on a specific gravity. Since freezing may ruin a battery assembly, it should be protected against freezing by keeping it in a charged condition.

As long as the green dot is visible in the hydrometer, the freezing point of the battery will be somewhere below –32°C (–25°F).

The higher the state of charge, the lower the freezing point. A fully charged battery will not freeze until the temperature gets below –65°C (–85°F).

BATTERY TRAY ASSEMBLY AND HOLD-DOWN RETAINER

The battery tray assembly and hold-down retainer should be clean and free from corrosion before installing the battery assembly.

The battery tray assembly should be in a sound condition so that it will hold the battery assembly securely

and keep it level. Make certain there are no parts in the battery tray assembly before installing battery assembly.

To prevent the battery assembly from shaking in its battery tray assembly, the hold-down retainers should be tight, but not overtight.

BATTERY ASSEMBLY PROTECTION DURING VEHICLE STORAGE

Today's vehicles have many high technology electronic devices which result in very small but continuous current drains on the battery assemblies, commonly referred to as "parasitic loads." Vehicles that are not used for an extended period of time may develop an extremely discharged and/or permanently damaged battery assembly resulting from parasitic loads.

Any battery assembly discharged by parasitic loading and then allowed to stand in this condition for a period of time may not accept recharge. However, if properly recharged, most battery assemblies will return to a good usable condition.

An extremely discharged battery assembly can freeze at temperatures as high as –7°C (20°F), causing permanent damage. Permanent damage to a discharged battery assembly can also be accelerated by high temperatures.

To prevent this condition, the battery negative cable assembly should be disconnected on vehicles which are not going to be in service within a 30-day period, beginning from the time the vehicle is shipped. If this is not possible, battery assemblies should be recharged periodically (every 20-45 days) until the green dot of the built-in hydrometer is visible.

BUILT-IN HYDROMETER

Figure 3

The maintenance-free battery assembly has a built-in temperature compensated hydrometer in the top of the battery assembly. This hydrometer is used with the following diagnostic procedure.

When observing the hydrometer, make sure that the battery assembly has a clean top. A light may be required in some poorly-lit areas. Tap the hydrometer lightly on top to dislodge any air bubbles that might cause a false indication.

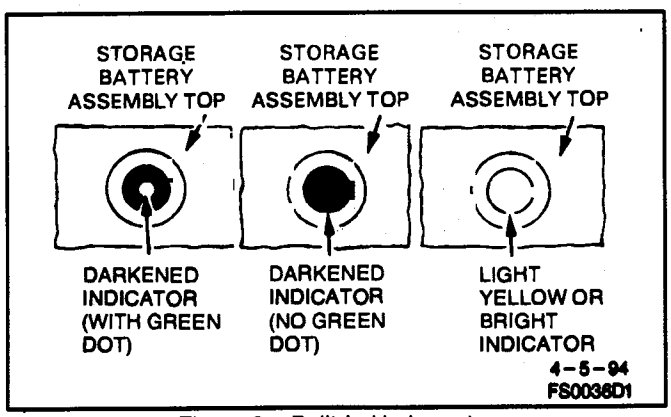


Figure 3 – Built-In Hydrometer

Under normal operation, two indications can be observed.

1. GREEN DOT VISIBLE
   Any green appearance is interpreted as a "green dot" and the battery assembly is ready for testing.
2. DARK; GREEN DOT NOT VISIBLE
   If there is cranking complaint, the battery assembly should be tested as described in the "Diagnosis" in this section. The charging and electrical systems should also be checked at this time.

   Occasionally, a third condition may appear:
3. CLEAR OR LIGHT YELLOW
   This means the fluid level is below the bottom of the hydrometer. This may have been caused by excessive or prolonged charging, a broken case, or excessive tipping. When finding a battery assembly in this condition it may indicate high charging voltages caused by a faulty charging system, therefore, the charging and electrical systems may need to be checked .If a cranking complaint exists and is caused by the battery assembly, the battery assembly should be replaced.

DIAGNOSIS

BATTERY ASSEMBLY TESTING

Figures 3, 4 and 5

The following procedure should be used for testing battery assemblies:

1. VISUAL INSPECTION
   Check for obvious damage, such as a cracked or broken case or cover that could permit loss of electrolyte. If obvious damage is noted, replace the battery assembly. Determine the cause of damage and correct as needed. If not, proceed to step 2.
2. HYDROMETER CHECK (Figure 3).
   - GREEN DOT VISIBLE – Go to step 3.
   - DARK; GREEN DOT NOT VISIBLE.
     Charge the battery assembly as outlined under "Charging Procedure" in this section and proceed to step 3.
3. LOAD TEST
   Load testing requires using battery assembly side terminal adapters to ensure good connection (Figure 4). Do not load test a frozen battery assembly
   A. Connect a voltmeter and a battery assembly load tester across the battery assembly terminals.
   B. Apply a 300-amp load for 15 seconds to remove surface charge from the battery assembly.
   C. Wait 15 seconds to let the battery assembly recover. Apply load specified on the battery assembly label or in "Specifications" at the end of this section. Read voltage after 15 seconds, then remove load.
   D. If voltage does not drop below the minimum listed in Figure 5, the battery assembly is good and should be returned to service. The battery assembly temperature must be estimated by feel and by the temperature the battery assembly has been exposed to for the past few hours.

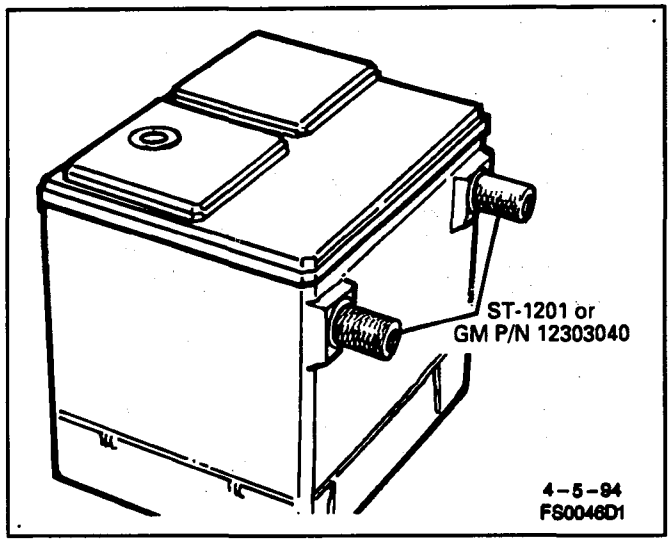


Figure 4 – Battery Assembly Side Terminal Adapters

ESTIMATED TEMPERATURE	MINIMUM VOLTAGE
21°C (70°F)	9.6
10°C (50°F)	9.4
0°C (32°F)	9.1
– 10°C (14°F)	8.8
– 18°C (0°F)	8.5
BELOW: – 18°C (0°F)	8.0

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Figure 5 – Battery Assembly Voltage Drop Temperature

E. If voltage drops below the minimum listed, replace the battery assembly.

BATTERY ASSEMBLY ELECTRICAL DRAIN

Battery assembly electrical drain is a small amount of current required by specific control modules that is needed to retain system memory and system monitoring. Too much electrical drain, however, can cause an extremely discharged and/or permanently damaged battery assembly. To test the battery assembly electrical drain, refer to "Parasitic Load Test" in this section.

Parasitic Load Test
Figures 6 and 7

Tool Required:

J 38758 Parasitic Draw Test Switch

If the battery assembly discharges while the vehicle sits for a few hours or days, the vehicle should be diagnosed for parasitic loads. Simple connection of an ammeter in series with the battery assembly may not find the cause as the condition may not show up when power is restored unless that particular component is repeatedly cycled. Parasitic loads can be diagnosed using either of the procedures below, but use of the special tool as described in the first procedure is recommended.

NOTICE: Parasitic draw test switch should never be turned to "OFF" position with engine running or damage could occur to attached ammeter or vehicle electrical system.

1. Turn test switch knob to "OFF" position.

   CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in Section 0A.

2. Remove battery negative cable assembly.
3. Install parasitic draw test switch male (cable) end to negative battery terminal.
4. Install battery negative cable assembly to female end of test switch tool.
5. Turn test switch tool knob to "ON" position.
6. Road test vehicle while activating all accessories (radio, A/C, etc.).
7. Turn ignition switch to "LOCK" position and remove ignition key.

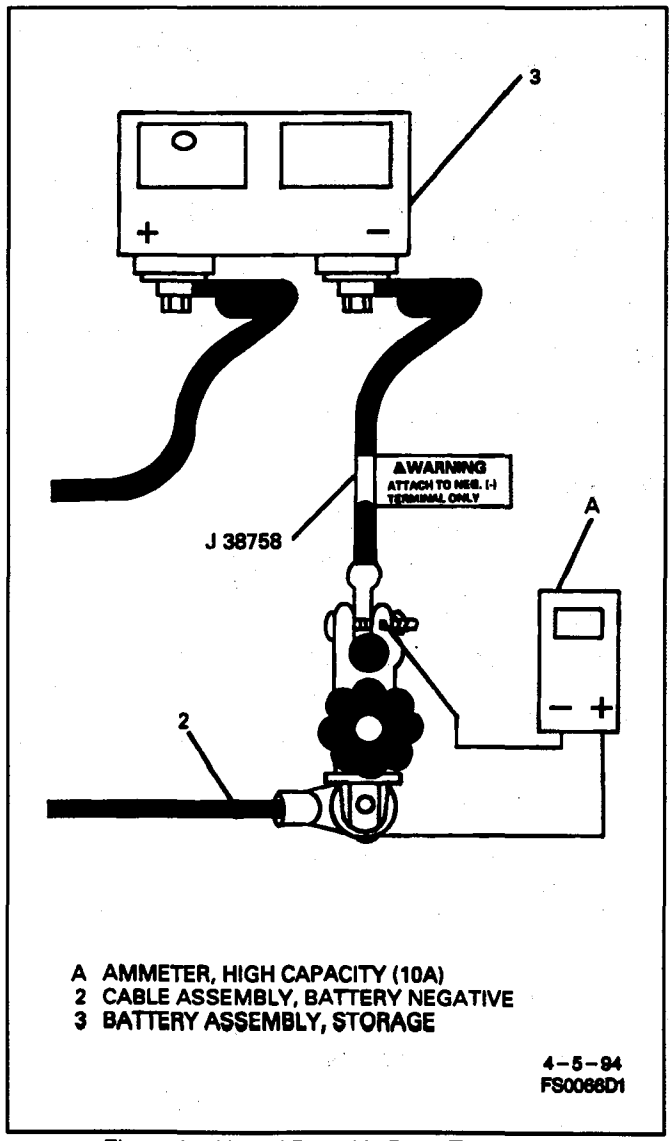


Figure 6 – Use of Parasitic Draw Test Switch

8. Set ammeter to 10-amp scale and connect to terminals on test switch tool with alligator clips. Use of 10-amp scale may prevent damage to meter.
9. Turn test switch tool knob to "OFF" position to allow current to flow through ammeter.
10. Check current reading. Allow time for reading to stabilize. Verify that retained accessory power (RAP) is off. If current reading is at or below two amps, turn test tool knob to "ON" position (to maintain continuity in electrical system) and switch to a lower scale for a more accurate reading, or install a more accurate meter, if necessary. Turn test tool knob to "OFF." If current reading is above 25 milliamps, refer to components parasitic load chart (Figure 7) for specific current loads and micro-processor "time-outs" for modules in "awake" and "asleep" states. Total reading below 20 milliamps is normal, and a reading below 25 milliamps is acceptable. A zero reading indicates a problem with meter, scale being used, or connection.
11. If current draw is above specifications listed in component parasitic load chart, remove system maxi-fuses and circuit breakers one at a time until current draw returns to a value less than or equal to specifications listed. This should be done while monitoring ammeter so that a disruption of drain will be evident. Perform steps 9 and 10 each time a fuse is removed. Refer to SECTION 8A for specific circuit schematics. Total readings in the hundreds of milliamps may suggest grounded wires, sticking relays, or small lamps remaining lit.

Important

- Always turn test switch tool knob to "ON" position before removing each fuse to maintain continuity in electrical system and to avoid damaging ammeter due to accidental overloading (i.e., opening door). Do not turn switch to "OFF" while engine is running.

12. When cause of excessive current draw has been located and repaired, repeat steps 9 and 10 to verify the repair. Then turn test tool to "OFF," remove tool, and reconnect battery negative cable assembly to battery assembly negative terminal.

Tighten

- Negative cable assembly to 15 N•m (11 lb. ft.).

Alternate Parasitic Load Test

Figures 4, 7, and 8

The following alternate procedure may be used when testing for parasitic load if J 38758 is not available.

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Disconnect battery negative cable assembly.
2. Install a battery side terminal adapter, AC Delco P/N ST-1201 or GM P/N 12303040 or equivalent, in negative terminal of battery (See Figure 4).
3. Install other battery side terminal adapter or a 3/8-inch nut with standard threads (16 UNC) on battery negative cable assembly to assure a good electrical contact with metal face on cable for testing (add a washer behind nut if nut does not contact firmly). Yellow or black finish nuts are generally non-conductive and should not be used.
4. With all lights, accessories, retained accessory power (RAP), and ignition switch off, connect a high capacity ammeter (at least 10 amps) from battery negative cable assembly to side terminal adapter. This high capacity ammeter is connected to verify whether or not a high current draw is occurring at a constant rate. It is this type of high current draw which will blow the fuse in lower capacity ammeters.

1995 COMPONENT PARASITIC LOADS (mA)

Component	Approximate Parasitic Draw
PASS-Key II*	2
Voltage Regulator in Generator Assembly	1
PCM	5-10
Radio Control Head	5

*After specified timeout period elapses, component switches from "AWAKE" to "ASLEEP" mode.

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Figure 7 – Component Parasitic Loads

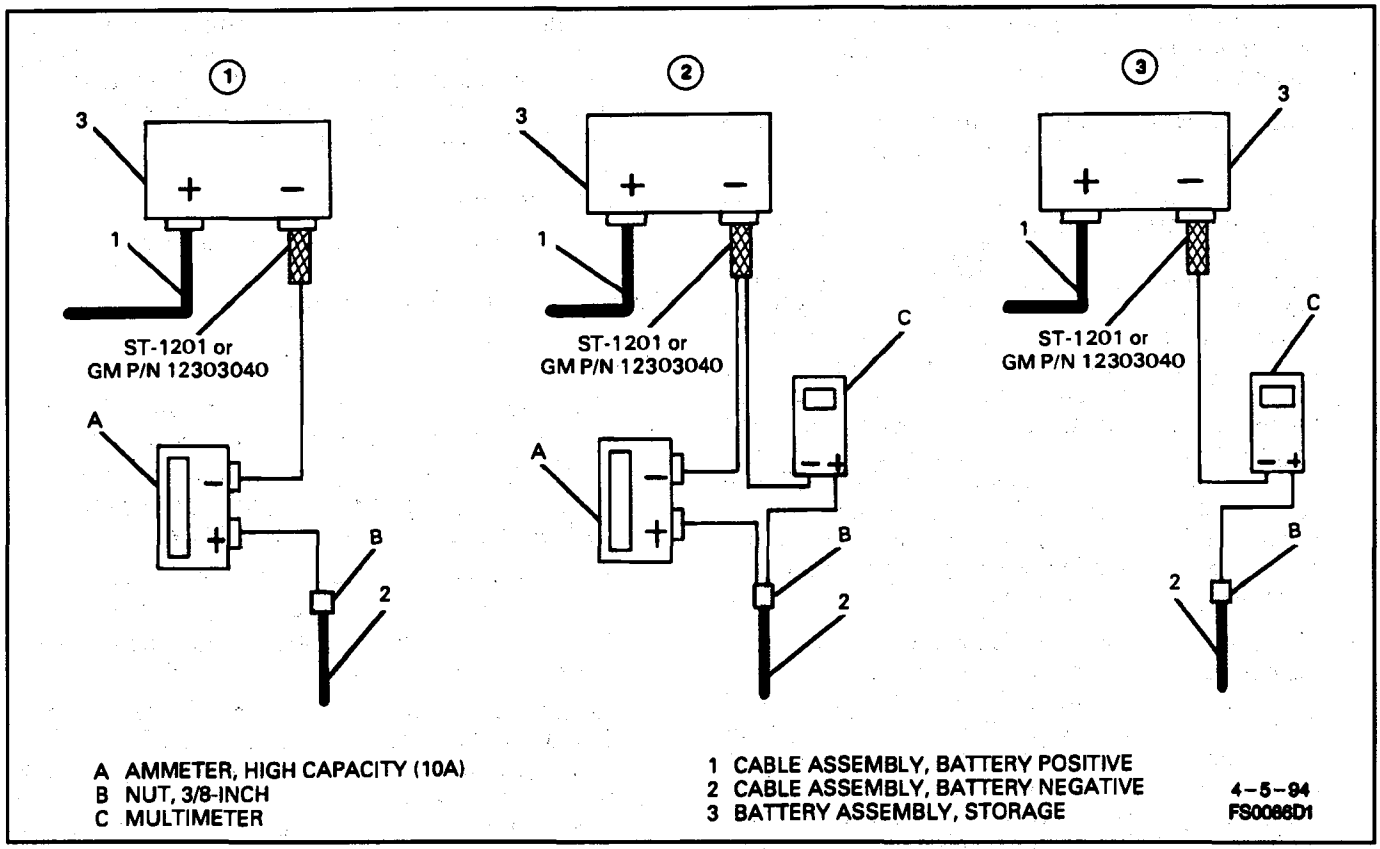


Figure 8 – Alternate Parasitic Load Diagnosis Procedure

NOTICE: If a high capacity ammeter is not available, install a section of heavy wire (preferably battery cable section) between existing battery negative cable assembly and side terminal adapter. Allow time for initial draw to occur or check for reduced current with and inductive ammeter (current clamp) and proceed to step 5.

5. With high capacity ammeter or battery cable section still connected, connect digital multimeter, set on 2000 mA dc range, in parallel with high reading ammeter.

6. Disconnect high capacity ammeter and take reading with digital multimeter.

   If current draw is above specifications listed in component parasitic load chart, remove system fuses and mini-breakers one at a time until current draw returns to a value less than or equal to specifications listed. This should be done while monitoring ammeter so that a disruption of drain will be evident. Refer to Figure 7 for approximate parasitic loads for various vehicle components. Set ammeter on maximum scale when pulling fuses to avoid damage. Refer to SECTION 8A for specific circuit schematics.

7. When cause of excessive draw has been located and repaired, repeat step 6 to verify the repair. Reconnect battery negative cable assembly to battery assembly negative terminal.

Tighten

- Negative cable assembly to 15 N•m (11 lb. ft.)

ON-VEHICLE SERVICE

BATTERY ASSEMBLY CHARGING

NOTICE: Always disconnect the negative cable assembly when charging a battery assembly or electronic components may be damaged.

When it is necessary to charge the battery assembly follow these basic rules:

1. Do not charge battery assembly if hydrometer is clear or light yellow. Replace battery assembly.
2. If the battery assembly feels hot (52°C (125°F) or higher), or if electrolyte violently gasses or spews through the vent holes, discontinue charging or reduce charging rate.
3. Do not charge a battery assembly if it seems to be frozen.

Charging Procedure

Tool Required:

A/C Delco P/N ST-1201 or GM P/N 12303040 Battery Side Terminal Adapters (Pair)

1. Battery assemblies with green hydrometer dot showing do not require charging unless they have just been discharged (such as in cranking vehicle).

2. When charging battery assembly with side terminals, install adapter kit (AC Delco P/N ST-1201 or GM P/N 12303040 or equivalent). Refer to Figure 4.

   The adapter should be snugged up against the battery assembly terminals to keep resistance between the adapter and the battery assembly terminal to a minimum. Recommended battery assembly side terminal adapter torque is 15 N•m (11 lb. ft.).
3. Make sure all battery charger connections are clean and tight.
4. For best results, battery assemblies should be charged while electrolyte and plates are at room temperature. A battery assembly that is extremely cold may not accept current for several hours after starting battery charger.
5. Charge battery assembly until green dot of built-in hydrometer appears. Refer to "Charging Time Required" in this section. Battery assembly should be checked every half-hour while charging. Tap the hydrometer lightly on top to dislodge any air bubbles that might cause a false indication.
6. After charging, battery assembly should be tested. Refer to "Diagnosis" in this section.

Charging Time Required

The time required to charge a battery assembly will vary depending on the following factors:

- **Size of Battery Assembly** – A completely discharged large heavy-duty battery assembly requires more than twice the recharging as a completely discharged small passenger vehicle battery assembly.
- **Temperature** – A longer time will be needed to charge any battery assembly at –18°C (0°F) than at 27°C (80°F). When a fast battery charger is connected to a cold battery assembly the current accepted by the battery assembly will be very low at first, then in time, the battery assembly will accept a higher rate as the battery assembly warms.
- **Battery Charger Capacity** – A battery charger which can supply only five amps will require a much longer period of charging than a battery charger that an supply 30 amps or more.
- **State-of-Charge** – A completely discharged battery assembly requires more than twice as much charge as a half-charged battery assembly. Because the electrolyte is nearly pure water and a poor conductor in a completely discharged battery assembly, the current accepted by the battery assembly is very low at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current will also increase.

CHARGING A VERY LOW OR COMPLETELY DISCHARGED BATTERY ASSEMBLY

The following procedure should be used to recharge a very low or completely discharged battery assembly.

Unless the procedure is properly followed, a perfectly good battery assembly may be needlessly replaced.

1. Measure voltage at battery assembly terminals with an accurate voltmeter. If below 11 volts, the charge current will be very low and it could take some time before it accepts a current in excess of a few milliamps. Such low current may be detectable on ammeter available in the field.
2. Set battery charger on high setting.
3. Some chargers feature polarity protection circuitry which prevents charging unless the battery charger leads are connected to the battery terminals correctly. A completely discharged battery assembly may not have enough voltage to activate this circuitry even though battery charger leads are connected properly, making it appear that the battery assembly will not accept charging current. Therefore, follow the specific charger manufacturer's instructions telling how to bypass or override the circuitry so that the charger will turn on and charge a low-voltage battery assembly.
4. Battery chargers vary in the amount of voltage and current they provide. the time required for the battery assembly to accept measurable charger current at various voltages may be as follows:

CHARGING VOLTAGE	HOURS
16.0 or more	Up to 4 Hours
14.0 – 15.9	Up to 8 Hours
13.0 or less	Up to 16 Hours

   If the charge current is still not measurable at the end of the above charging times, the battery assembly should be replaced.

   If the charge current is measurable during the charging time, the battery assembly is considered good and charging should be completed in the normal manner.
5. It is important to remember that a completely discharged battery assembly must be recharged for a sufficient number of ampere hours (AH) to restore it to a usable state. As a general rule of thumb, using the reserve capacity (RC) rating of the battery assembly as the number of ampere hours of charge will usually bring the green dot into view. For reserve capacity refer to "Specifications" in this section. If battery assembly is rated at 75 RC minutes, it would usually be completely recharged as follows:

   10 ampere charge × 7 1/2 hours = 75 AH

   or

   25 ampere charge × 3 hours = 75 AH, etc.
6. It is recommended that any battery assembly recharged by this procedure by LOAD TESTED to establish serviceability. Refer to "Battery Assembly Testing in this section.

JUMP STARTING IN CASE OF EMERGENCY WITH AUXILIARY (BOOSTER) BATTERY ASSEMBLY

NOTICE: Do not push or tow the vehicle to start. Damage to the emission system and/or to other parts of the vehicle may result.

Both auxiliary battery assembly and discharged battery assembly should be treated carefully when using jumper cables.

CAUTION: Departure from these conditions or the procedure below could result in: (1) serious personal injury

(particularly to eyes) or property damage from such causes as battery assembly explosion, battery assembly acid or electrical burns; and/or (2) damage to electronic components of either vehicle.

Never expose battery assembly to open flame or electric spark – battery assemblies generate a gas which is flammable and explosive. Remove rings, watches, and other jewelry. Wear approved eye protection.

Do not allow battery assembly fluid to contact eyes, skin, fabrics, or painted surfaces – battery assembly fluid is a corrosive acid. Flush any contacted area with water immediately and thoroughly. Be careful that metal tools or jumper cables do not contact the battery assembly positive terminal (or metal in contact with it) and any other metal on the vehicle, because a short circuit could occur.

1. Set parking brake lever assembly and place automatic transmission assembly in "PARK." Turn off the ignition, lamps and all other electrical loads.
2. Check the built-in hydrometer. If it is clear or light yellow, replace the battery assembly.

   NOTICE: Do not jump start a vehicle with charging equipment unless the equipment is specifically designed for jump starting. Using improper equipment can cause serious damage to the electrical system or electronic parts.
3. Attach the end of one jumper cable to the auxiliary battery assembly positive terminal and the other end of the same cable to the positive terminal of the junction block assembly.

   Do not permit vehicles to touch each other as this could cause a ground connection and counteract the benefits of this procedure.

   CAUTION: To prevent sparking and possibly explosion of battery gases, do not connect jumper cable directly to the battery negative terminal of the dead battery assembly.
4. Attach one end of the remaining negative cable to the auxiliary battery assembly negative terminal, and the other end to a solid engine ground (such as the compressor assembly bracket or power steering pump bracket assembly) at least 46 cm (18 inches from the battery assembly of the vehicle being started.
5. Start the engine of the vehicle that is providing the jump start and turn off electrical accessories. Then start the engine of the vehicle with the discharged battery assembly.
6. Reverse these directions exactly when removing the jumper cables. The negative cable must first be disconnected from the engine that was jump started.

BATTERY TRAY ASSEMBLY REPLACEMENT

The battery tray is part of the coolant recovery reservoir assembly. Refer to Section 6B for replacement.

BATTERY ASSEMBLY REPLACEMENT

Figure 9

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in Section 0A.

1. Negative cable assembly (2) from battery assembly negative terminal.
2. Positive cable assembly (1) from battery assembly positive terminal.
3. Battery hold-down retainer bolt/screw (5) and battery hold-down retainer (9).
4. Battery assembly (3).

Install or Connect

NOTICE: See "Notice" on page 6D1-1 of this section.

1. Battery assembly (3).
2. Battery hold-down retainer (9) and battery hold-down retainer bolt/screw (5).

   Tighten
   - Battery hold-down retainer bolt/screw (5) to 18 N•m (13 lb. ft.).
3. Positive cable assembly (1) to battery assembly positive terminal.

   Tighten
   - Positive cable assembly (1) to 15 N•m (11 lb. ft.).
4. Negative cable assembly (2) to battery assembly negative terminal.

   Tighten
   - Negative cable assembly (2) to 15 N•m (11 lb. ft.).

BATTERY CABLE ASSEMBLY REPLACEMENT AND ROUTING

Whenever battery cable assemblies are replaced, always be certain to use a replacement battery cable assembly that is the same type and length. Some positive table assemblies have additional feed wires attached to them and some negative cable assemblies have additional ground straps attached.

Always be certain when replacing a battery cable assembly to route it the same as the one being replaced.

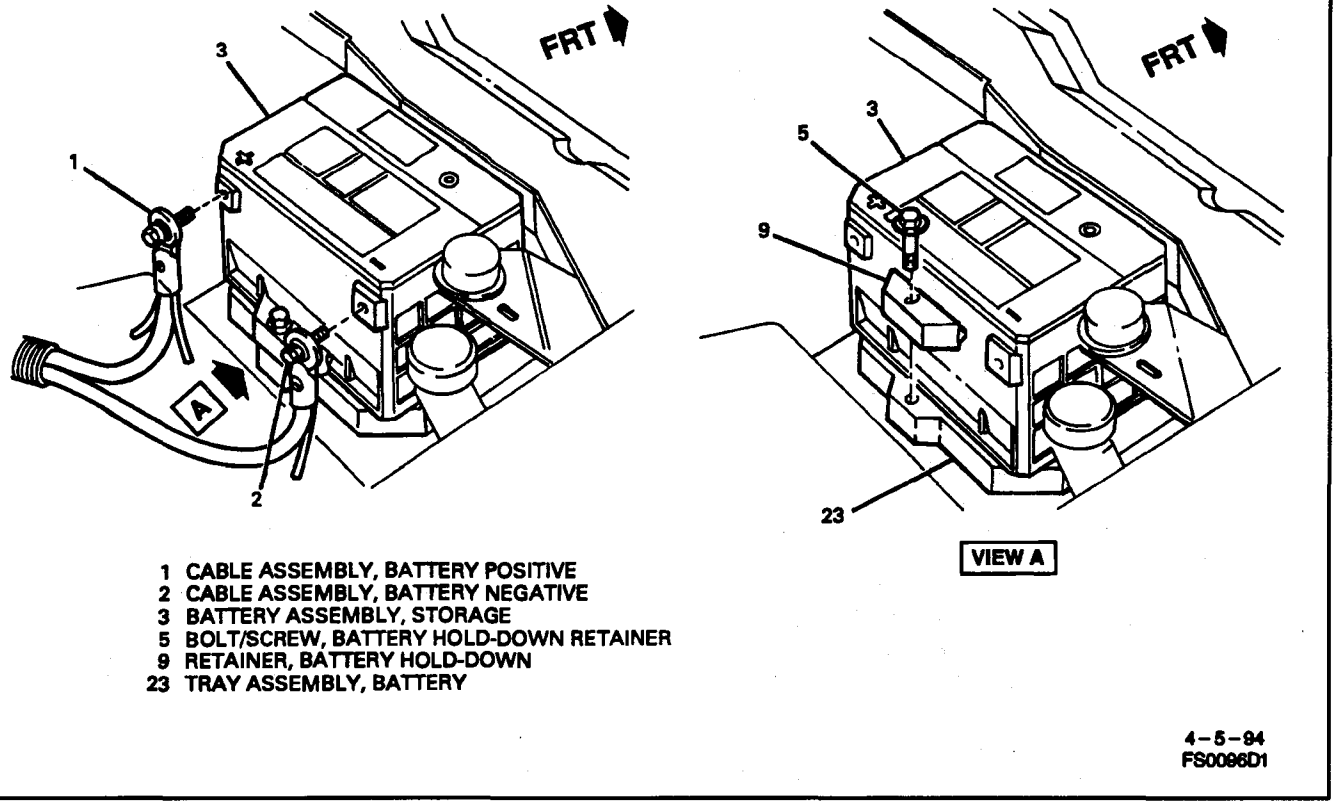


Figure 9 – Battery Assembly

Negative Cable Assembly

Figures 10 and 11

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in Section 0A.

1. Battery assembly. Refer to "Battery Assembly Replacement" in this section.
2. Nut (8) and negative cable assembly (2) from stud (7) on wheelhouse assembly.
3. Raise and suitably support vehicle. Refer to SECTION 0A.
4. Using a standard screwdriver, pop open cable assembly clip (16) and remove negative cable assembly (2).
5. Negative cable assembly (2) from engine block.
   - On 3.4L L32 engines, negative cable assembly (2) is connected to engine block by a stud threaded into engine block just behind crankshaft pulley assembly. Remove nut (10) and then remove negative cable assembly (2).
   - On 5.7L T1 engines, negative cable assembly (2) is connected to the engine block by either a stud (13) or nut (10) just behind the air conditioning compressor assembly. Remove stud (13) or nut (10) and negative cable assembly (2).

Install or Connect

NOTICE: See "Notice" on page 6D1-1 of this section

1. Negative cable assembly (2) to engine block.
   - On 3.4L L32 engines, connect negative cable assembly (2) and nut (10) to engine block stud just behind crankshaft pulley.
   - On 5.7L LT1 engines, connect negative cable assembly (2) and either stud (13) or nut (10) to engine block just behind air conditioning compressor assembly.

   Tighten
   - Nut (10) to 22 N•m (16 lb. ft.)

     or
   - Stud (13) to 33 N•m (24 lb. ft.).
2. Place negative cable assembly (2) back into cable assembly clip (16) and snap clip closed.
3. Lower vehicle.
4. Negative cable assembly (2) and nut (8) to stud (7) on wheelhouse assembly.

   Tighten
   - Nut (8) to 5.5 N•m (49 lb. in.).
5. Battery assembly. Refer to "Battery Assembly Replacement" in this section.

Positive Cable Assembly

Figures 10 and 11

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in Section 0A.

Remove or Disconnect

1. Battery assembly. Refer to "Battery Assembly Replacement" in this section.
2. Positive cable assembly (1) from junction block.
   A. Open junction block cover (4).
   B. Remove nut (6) from stud (14).
   C. Remove positive cable assembly (1) from stud (14).
3. Positive cable assembly (1) from generator assembly (21).
   A. Move boot covering connection and slide out of way.
   B. Remove positive cable assembly (1).
      - On 3.4L L32 engines, positive cable assembly (1) is connected to generator assembly (21) with nut (18). Remove nut (18) and positive cable assembly (1).
      - On 5.7L LT1 engines, positive cable assembly (1) is connected to generator assembly (21) with bolt/screw (20). Remove bolt/screw (20) and positive cable assembly (1).
4. Raise and suitably support vehicle. Refer to SECTION 0A.
5. Using a standard screwdriver, pop open cable assembly clip (16) and remove positive cable assembly (1).
6. Bolt/screw (11) securing positive cable assembly (1) and clip (17) to engine mount bracket.
7. Nut (12) and positive cable assembly (1) from starter solenoid switch (19).

NOTICE: Before installing positive cable assembly to starter solenoid switch, be sure solenoid terminal is secure in cap by tightening terminal nut next to cap. If terminal is not tight in solenoid cap, the cap may be damaged during installation of positive cable assembly and cause starter to fail later.

Install or Connect

NOTICE: See "Notice" on page 6D1-1 of this section.

1. Positive cable assembly (1) and nut (12) to starter solenoid switch (19).

Tighten

- Nut (12) to 9.5 N•m (84 lb. ft.).

2. Bolt/screw (11) and clip (17) securing positive cable assembly to engine mount bracket.

Tighten

- Bolt/screw (11) to 10 N•m (89 lb. in.).

3. Place positive cable assembly (1) back into cable assembly clip (16) and snap clip (16) closed.
4. Lower vehicle.
5. Positive cable assembly (1) to generator assembly (21).
   - On 3.4L L32 engines, positive cable assembly (1) is connected to the generator assembly (21) with nut (18).

Tighten

- Nut (18) to 10 N•m (89 lb. in.).

   - On 5.7L LT1 engines, positive cable assembly (1) is connected to generator assembly (21) with bolt/screw (20).

Tighten

- Bolt/screw (20) to 15 N•m (11 lb. ft.).

6. Carefully slide boot over positive cable assembly (1) and generator assembly (21) connection.
7. Positive cable assembly (1) to junction block.
   A. Place positive cable assembly (1) and nut (6) on stud (14).

Tighten

- Nut (6) to 2.0 N•m (18 lb. in.).

   B. Close junction block cover (4).
8. Battery assembly. Refer to "Battery Assembly Replacement" in this section.
   - Route positive cable assembly between heater hoses as shown in Figure 11.

GROUND STRAPS

Additional ground straps are used to connect the body and frame to the engine and transmission. Always connect all ground straps to ensure a good ground path to the battery assembly from all electrical components.

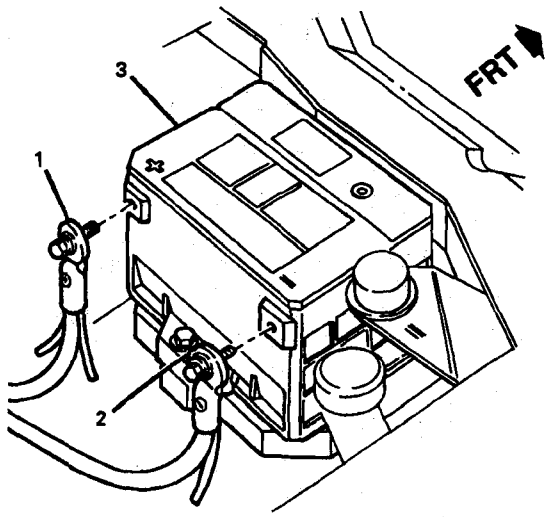
CHARGING EQUIPMENT

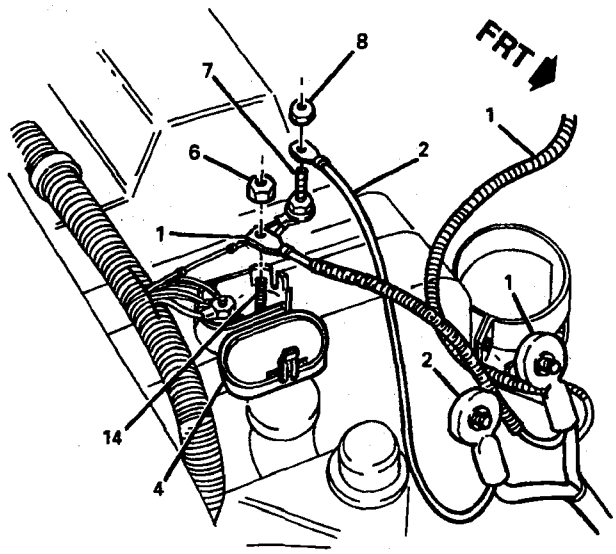
A battery charger that is considered sufficient is usually capable of a 16-volt output. When choosing a charger, the following items should be considered essential:

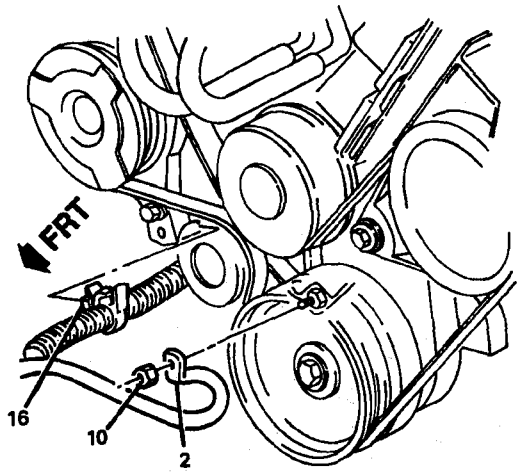
1. A 16-volt minimum output.
2. To prevent overcharging, the unit should have a timer (1 to 2 hours) or a voltage regulator that would regulate a maximum of 18 volts, or have an automatic shut-off feature at full charge.
3. Ammeter or charging rate meter.
4. An automatic polarity protector.

Some equipment that is available includes the AC Delco MP2101-07, Associated No. 6001, the Sun 720, or equivalent. Very few chargers have sensitive low-voltage meters, therefore, separate voltmeters may be necessary.

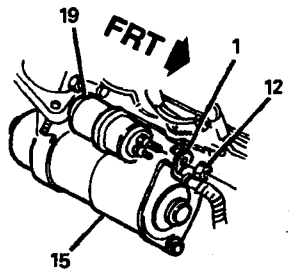
A suitable load tester such as the Sun VAT-40 (or equivalent) is available and is a very useful tool to properly diagnose battery assembly problems.



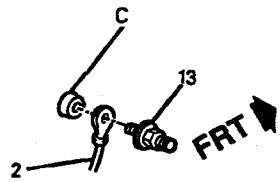




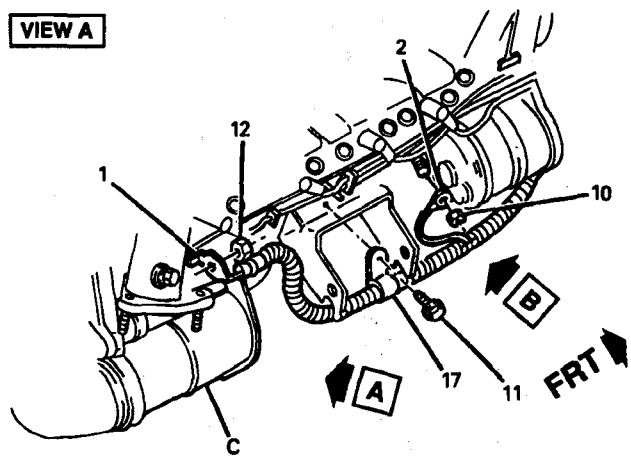
A



VIEW A



VIEW B

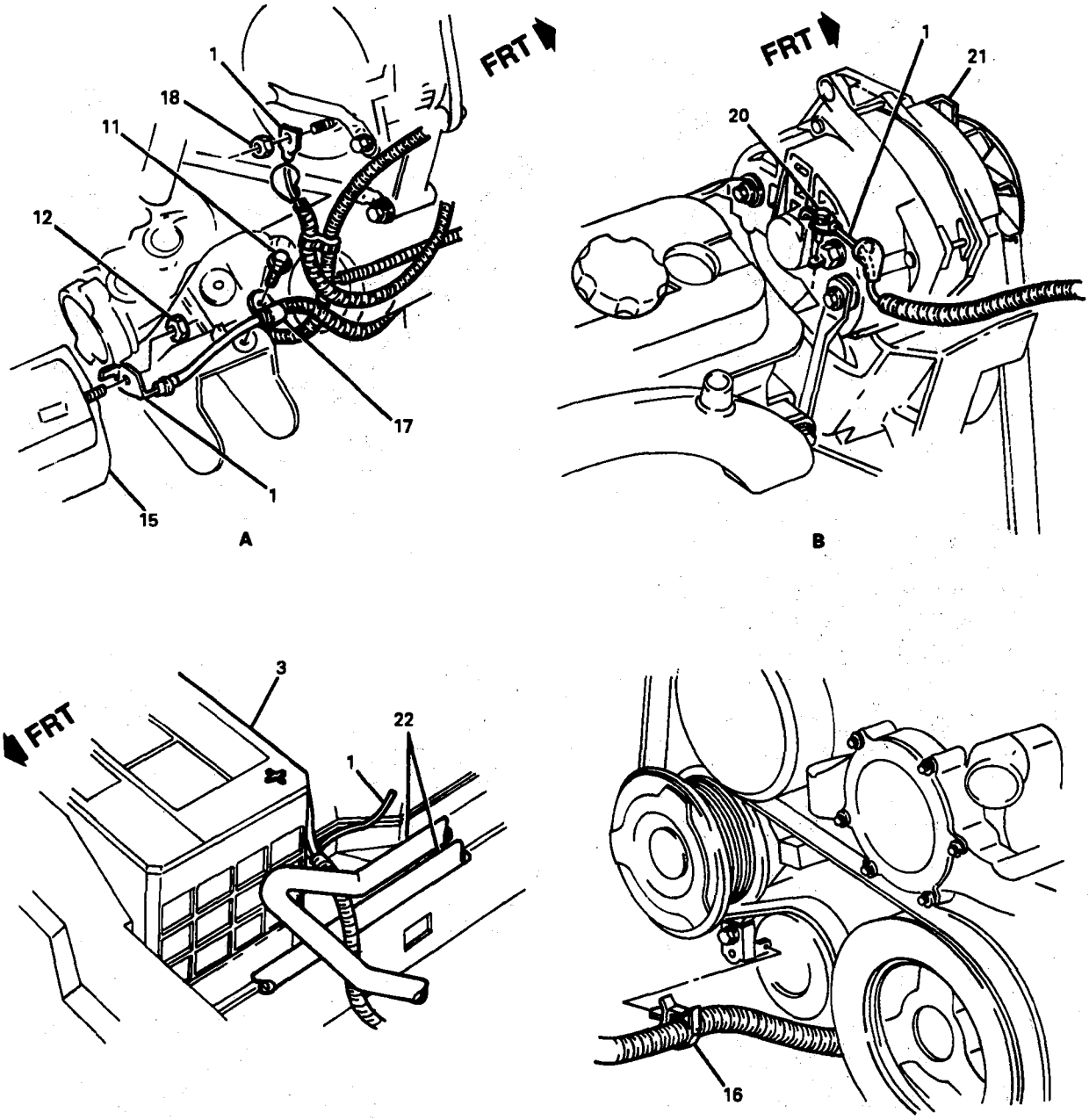


B

A 3.4L L32 ENGINE
B 5.7L LT1 ENGINE
C BLOCK, ENGINE
1 CABLE ASSEMBLY, BATTERY POSITIVE
2 CABLE ASSEMBLY, BATTERY NEGATIVE
3 BATTERY ASSEMBLY, STORAGE
4 COVER, JUNCTION BLOCK
6 NUT, BATTERY POSITIVE CABLE-TO-JUNCTION BLOCK
7 STUD, GROUND
8 NUT, BATTERY NEGATIVE CABLE GROUND,
10 NUT, BATTERY NEGATIVE CABLE-TO-ENGINE BLOCK GROUND
11 BOLT/SCREW, BATTERY POSITIVE AND NEGATIVE CABLE ASSEMBLY CLIP
12 NUT, BATTERY POSITIVE CABLE
13 STUD, BATTERY NEGATIVE CABLE-TO-ENGINE BLOCK GROUND
14 STUD, JUNCTION BLOCK POSITIVE TERMINAL
15 MOTOR ASSEMBLY, STARTER
16 CLIP, CABLE ASSEMBLY
17 CLIP, CABLE ASSEMBLY
19 SWITCH, STARTER SOLENOID

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Figure 10 – Battery Cable Assemblies Routing (1 of 2)



A 3.4L L32 ENGINE
B 5.7L LT1 ENGINE
1 CABLE ASSEMBLY, BATTERY POSITIVE
3 BATTERY ASSEMBLY, STORAGE
11 BOLT/SCREW, BATTERY POSITIVE AND NEGATIVE CABLE ASSEMBLY CLIP
12 NUT, BATTERY POSITIVE CABLE
15 MOTOR ASSEMBLY, STARTER
16 CLIP, CABLE ASSEMBLY
17 CLIP, CABLE ASSEMBLY
18 NUT, ENGINE WIRING HARNESS GENERATOR LEAD,
20 BOLT/SCREW, ENGINE WIRING HARNESS GENERATOR LEAD
21 GENERATOR ASSEMBLY
22 HOSE ASSEMBLY, HEATER INLET/OUTLET

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Figure 11 – Battery Cable Assemblies Routing (2 of 2)

SPECIFICATIONS

BATTERY ASSEMBLY USAGE

STORAGE BATTERY ASSEMBLY USAGE CHART

CATALOG NUMBER	TEST LOAD AMPS	COLD CRANKING AMPS*	RESERVE CAPACITY MINUTES**	REPLACEMENT NUMBER
514 (Std. LT1, L32)	260	525	90	75-60

* Cold Cranking = Amperage available for 30 seconds of engine cranking at −18C (0F).

** Reserve Capacity = The approximate time in minutes a storage battery assembly can support a 25 amp load without the terminal voltage dropping below 10.5 volts at 27C (80F) in the event of a charging system failure.

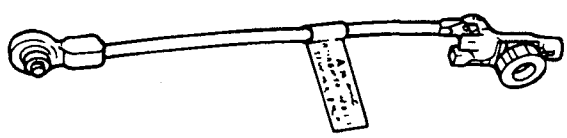
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FASTENER TIGHTENING SPECIFICATIONS

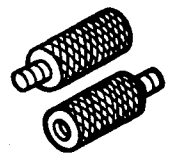
Battery Hold-Down Retainer Bolt/Screw	18 N•m (13 lb. ft.)
Battery Negative Cable Assembly-to-Battery Assembly	15 N•m (11 lb. ft.)
Battery Negative Cable Ground Body-to-Nut	5.5 N•m (49 lb. in.)
Battery Negative Cable-to-Engine Block Nut	22 N•m (16 lb. ft.)
Battery Negative Cable-to-Engine Block Stud	33 N•m (24 lb. ft.)
Battery Positive and Negative Cable Retainer Bolt/Screw	10 N•m (89 lb. in.)
Battery Positive Cable Assembly-to-Battery Assembly	15 N•m (11 lb. ft.)
Battery Positive Cable-to-Generator Bolt/Screw	15 N•m (11 lb. ft.)
Battery Positive Cable-to-Generator Nut	10 N•m (89 lb. in.)
Battery Positive Cable-to-Junction Block Nut	2.0 N•m (18 lb. in.)
Battery Positive Cable-to-Starter Solenoid Switch Nut	9.5 N•m (84 lb. in.)

SPECIAL TOOLS

1. J 38758



2. ST-1201



1. PARASITIC DRAW TEST SWITCH
2. BATTERY SIDE TERMINAL ADAPTERS (PAIR)

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BLANK

SECTION 6D2

CRANKING SYSTEM

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: Before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with "live" exposed electrical terminals, disconnect the battery negative cable assembly to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "OFF" or "LOCK" position.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

CRANKING CIRCUIT

The cranking circuit consists of the battery assembly, starter motor assembly, ignition switch, control circuits, starter enable relay and related electrical wiring; these components are connected electrically. Refer to SECTION 8A for a complete electromechanical schematic.

STARTER MOTOR ASSEMBLY

Figure 1

When the ignition switch is turned to the start position, battery voltage is applied to the PASS-Key II® decoder module and resistance is read at this time. If proper resistance is recognized and vehicle is in "PARK" or "NEUTRAL", then the PASS-KEY II® decoder module will energize the starter enable relay. The starter enable relay will send battery voltage to the starter solenoid switch. The starter solenoid switch will move the starter shift lever, causing the starter drive pinion to engage the flywheel ring gear. After engagement, the starter solenoid switch will close the main contacts, which results in cranking of the engine. When the engine starts, pinion overrun protects the armature from excessive speed until the switch is opened, at which time the solenoid switch plunger spring causes the pinion to disengage. To prevent excessive overrun, the ignition switch should be opened immediately when the engine starts.

DIAGNOSIS

Before removing any unit in a cranking circuit repair, perform the diagnostic procedures recommended in Figures 2, 3 and 4, and in SECTION 8A. Then check the following items:

Battery Assembly: Determine condition of battery assembly. Follow testing procedure outlined in SECTION 6D1.

Wiring: Inspect wiring for damage. Inspect all connections to starter motor assembly, solenoid switch, ignition switch, and battery assembly, including all ground connections. Clean and tighten all connections as required.

1 CONTACT, STARTER SOLENOID SWITCH
2 PLUNGER, STARTER SOLENOID SWITCH
3 SWITCH, STARTER SOLENOID
4 SPRING, STARTER SOLENOID SWITCH PLUNGER
5 LEVER, STARTER SHIFT
6 BUSHING, STARTER DRIVE
7 COLLAR, STARTER DRIVE STOP
8 DRIVE, STARTER
9 COIL, STARTER FIELD
10 ARMATURE, STARTER
11 BRUSH, STARTER
12 TERMINAL, STARTER SOLENOID

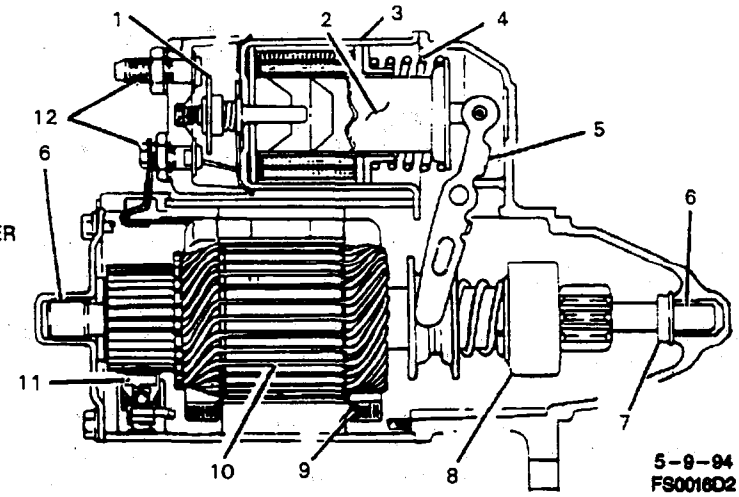


Figure 1- Starter Motor Assembly

Ignition Switch and Control Circuits: Inspect all switches and relays to determine condition.

Cranking or Slow Cranking: If engine assembly does not crank, or cranks slowly, follow diagnostic procedure in Figures 2, 3 and 4, and in SECTION 8A. If faulty starter motor assembly is diagnosed, remove starter motor assembly and follow test procedures.

Starter Motor Assembly Noise: Correct starter motor assembly noise using the following procedure:

1. Refer to Figure 4 to determine problem.
2. Shims are not installed during vehicle assembly. However if complaint is similar to problem 1 or 2 in Figure 4, correct "shimming" as follows:
   - For starter motor assembly noise during cranking, add one 0.38 mm (0.015 inch) single shim (13 or 18) to outer bolt/screw only. Refer to Figure 5.
   - For high-pitched whining after engine assembly fires, add 0.38 mm (0.015 inch) double shims (14 or 19) until noise disappears. Number of shims should not exceed 1.14 mm (0.045 inch).

Starter Motor Assembly: General diagnosis is part of starter motor assembly testing procedure. If battery assembly, wiring and switches are in satisfactory condition, engine assembly is functioning properly, and problem has been traced to starter motor assembly, remove starter motor assembly (refer to "Starter Motor Assembly Replacement" in this section) and proceed to "Unit Repair" in this section, if servicing the SD210 starter motor.

NOTICE: Never operate the starter motor assembly more than 30 seconds at a time without pausing to allow it to cool for at least two minutes. Overheating, caused by excessive cranking, will seriously damage the starter motor assembly.

ON-VEHICLE SERVICE

LUBRICATION

Starter motor assemblies do not require lubrication except during overhaul. When the starter motor assembly is taken apart for any reason, lubricate only as described under "SD210 Starter Motor Assembly" in this section.

STARTER MOTOR ASSEMBLY REPLACEMENT

Figures 5 and 6

Remove or Disconnect

Important

- This vehicle was designed for starter mounting without shims. However if single shims (13) or double shims (14) have been added to correct a noise or engagement condition, they should be reinstalled in their original location to ensure proper pinion-to-flywheel assembly engagement. Refer to figure 6.

CAUTION: See "Caution" on page 6D2-1 of this section.

1. Battery negative cable assembly.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Exhaust crossover pipe at the manifolds. Refer to SECTION 6F.
4. Two starter mounting bolts/screws (16) and lower starter motor assembly (15).

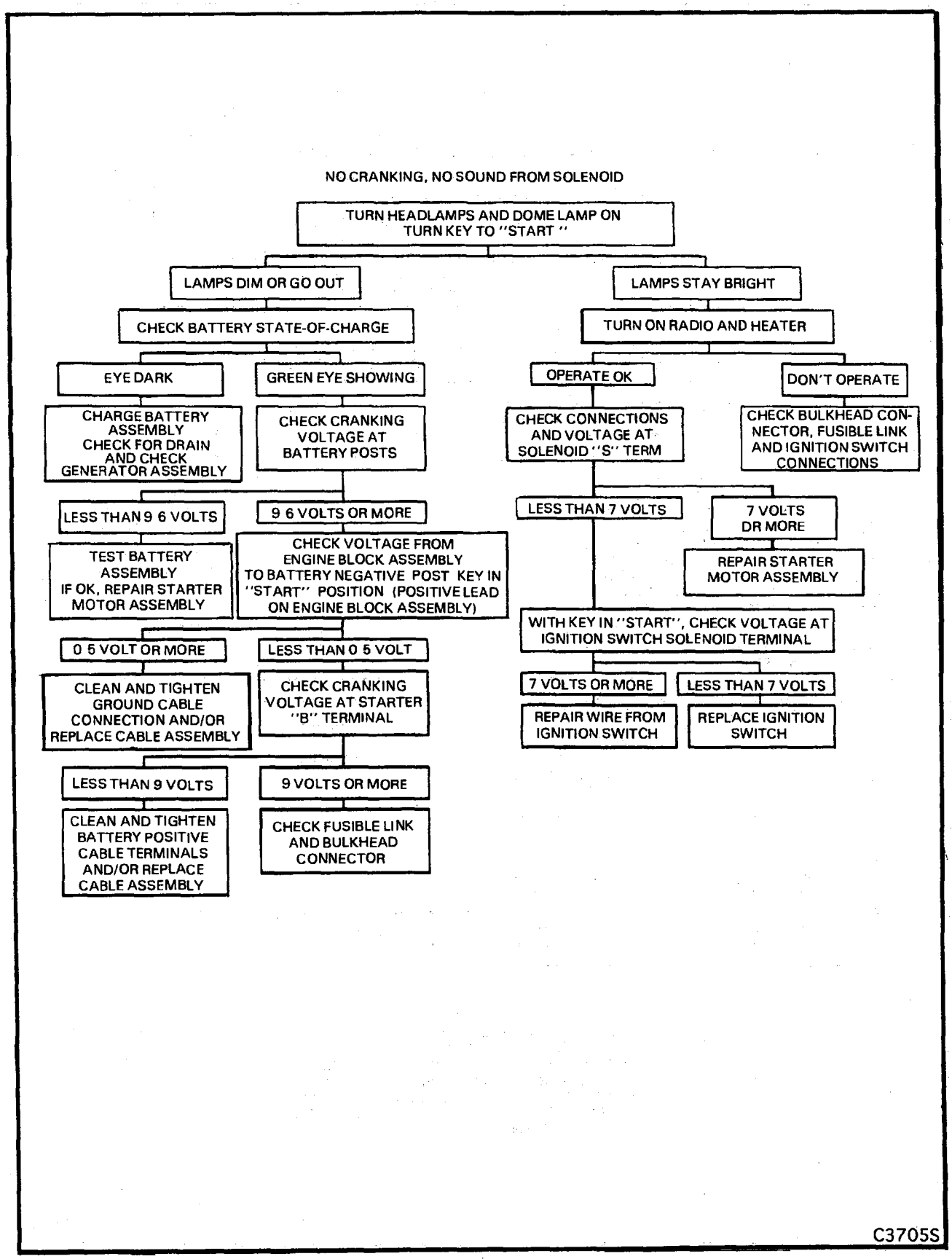


Figure 2 - Electrical System General Diagnosis (1 of 2)

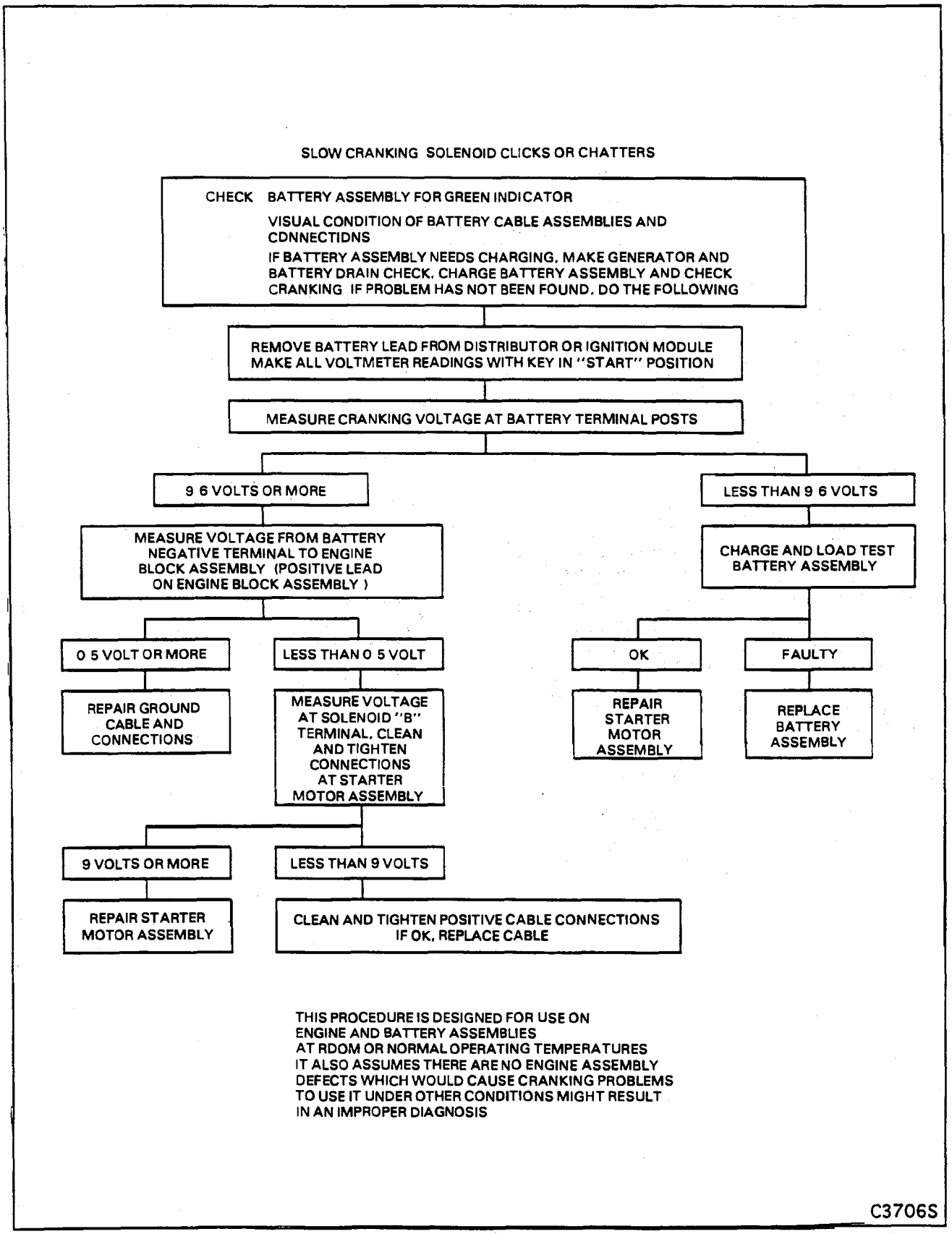


Figure 3 - Electrical System General Diagnosis (2 of 2)

	PROBLEM	CAUSE
1	HIGH PITCHED WHINE DURING CRANKING (BEFORE ENGINE FIRES) BUT ENGINE CRANKS AND FIRES OK	DISTANCE TOO GREAT BETWEEN STARTER DRIVE PINION AND FLYWHEEL ASSEMBLY
2	HIGH PITCHED "WHINE" AFTER ENGINE FIRES, AS IGNITION KEY IS BEING RELEASED ENGINE CRANKS AND FIRES OK THIS INTERMITTENT COMPLAINT IS OFTEN DIAGNOSED AS "STARTER HANG-IN" OR "SOLENDID WEAK "	DISTANCE TOO SMALL BETWEEN STARTER DRIVE PINION AND FLYWHEEL ASSEMBLY FLYWHEEL ASSEMBLY RUNOUT CONTRIBUTES TO THE INTERMITTENT NATURE
3	A LOUD "WHOOP" AFTER THE ENGINE FIRES BUT WHILE THE STARTER DRIVE PINION IS STILL HELD ENGAGED SOUNDS LIKE A SIREN IF THE ENGINE IS REVVED WHILE STARTER DRIVE PINION IS ENGAGED	A NEW STARTER DRIVE ASSEMBLY WILL OFTEN CORRECT THIS PROBLEM
4	A "RUMBLE," "GROWL" OR (IN SEVERE CASES) A "KNOCK" AS THE STARTER MOTOR ASSEMBLY IS COASTING DOWN TO A STOP AFTER STARTING THE ENGINE	MOST PROBABLE CAUSE IS A BENT OR UNBALANCED STARTER ARMATURE A NEW STARTER ARMATURE WILL OFTEN CORRECT THIS PROBLEM

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Figure 4 - Starter Motor Assembly Noise Diagnosis

5. Electrical leads from starter motor assembly (15).
   - Note position of wires before disconnecting.
6. Starter motor assembly (15).

Install or Connect

NOTICE: See "Notice" on page 6D2-1 of this section.

NOTICE: Before attaching electrical leads, tighten inner nuts on the solenoid terminals. If the nuts are not tight, solenoid cap may be damaged during installation of leads. Tighten inner nut of "BAT" terminal to 9 N.m (80 lb. in.) on both PG-260 and SD210 starter motor assemblies.

1. Electrical leads to starter motor assembly (15).

Tighten

- Starter solenoid switch "BAT" terminal outer nut to 9 N.m (80 lb. in.).
- Starter solenoid switch "S" terminal nut to 2.5 N.m (22 lb. in.).

2. Starter motor assembly (15) to engine assembly.
3. Bolts/screws (16).

Tighten

- Bolts/screws (16) to 47 N.m (35 lb. ft.).

Measure

- Pinion-to-flywheel clearance (see Figure 6). Add shims (13 or 14) if necessary.

4. Exhaust crossover pipe to the manifolds. Refer to SECTION 6F.
5. Lower vehicle.
6. Battery negative cable assembly.

Tighten

- Battery negative cable assembly to 15 N.m (11 lb. ft.).

UNIT REPAIR

STARTER SOLENOID SWITCH REPLACEMENT

3.4 L32 Engine

Figure 7

When a "no crank and no sound" starter motor assembly condition exists, check solenoid switch (56) before disassembling starter motor assembly. Solenoid switch (56) can be checked without removal. Refer to "Cleaning, Inspection and Testing" in this section. For removal and installation procedures, refer to "SD210 Starter Motor Assembly Disassembly" and "SD210 Starter Motor Assembly" in this section.

Remove or Disconnect

1. Starter solenoid switch nut (61).
2. Field lead from solenoid switch "M" terminal.
3. Nuts (62) and solenoid switch heat shield (71).
4. Starter solenoid switch clamp bolts/screws (63) and clamp (66).
5. Starter solenoid switch (56).

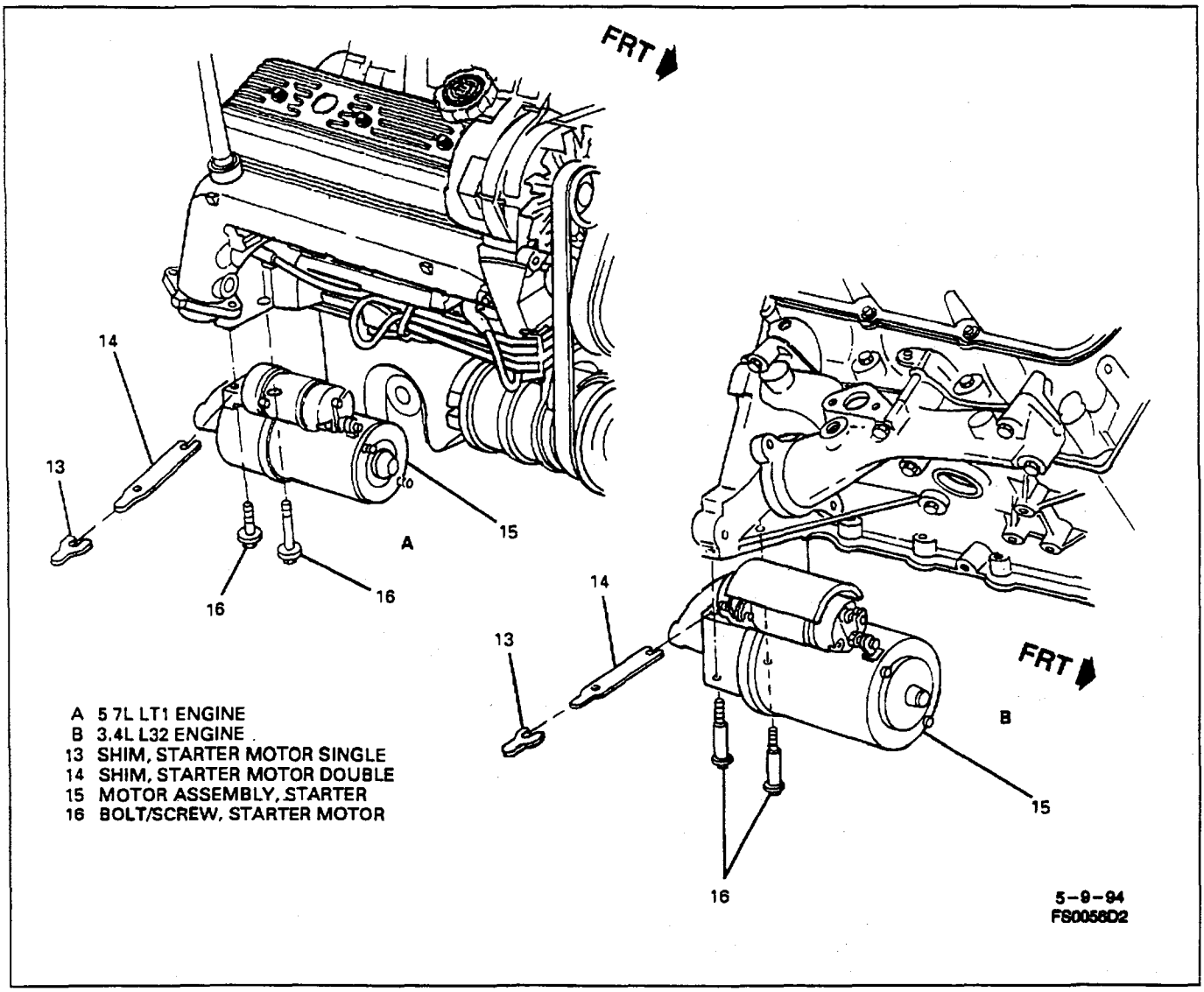


Figure 5 - Mounting Starter Motor Assembly

Install or Connect

NOTICE: See "Notice" on page 6D2-1 of this section.

1. Starter solenoid switch (56).
2. Clamp (66) and starter solenoid switch clamp bolts/screws (63).

Tighten

- Starter solenoid switch clamp bolts/screws (63) to 11 N.m (97 lb. in.)

3. Solenoid switch heat shield (71) and nuts (62).

Tighten

- Nut (62) to 12 N.m (106 lb. in.).

NOTICE: Before attaching field lead, tighten inner nut on the solenoid switch "M" terminal. If inner nut is not tight, solenoid cap may be damaged during installation of outer nut. Tighten inner nut on the solenoid switch "M" terminal to 9 N.m (80 lb. in.).

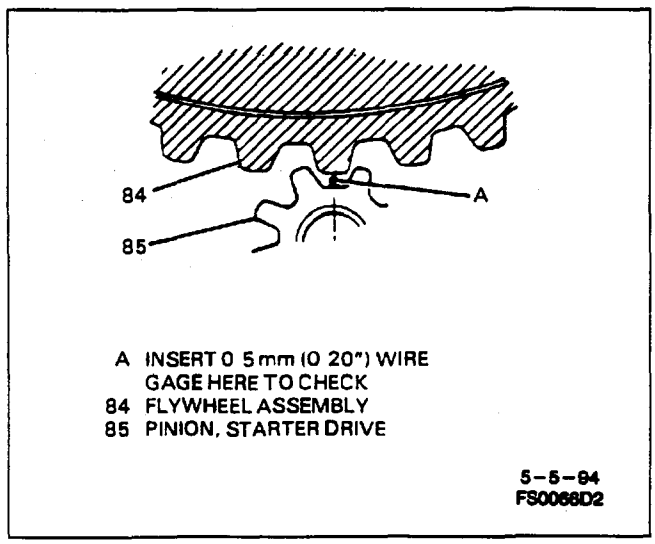
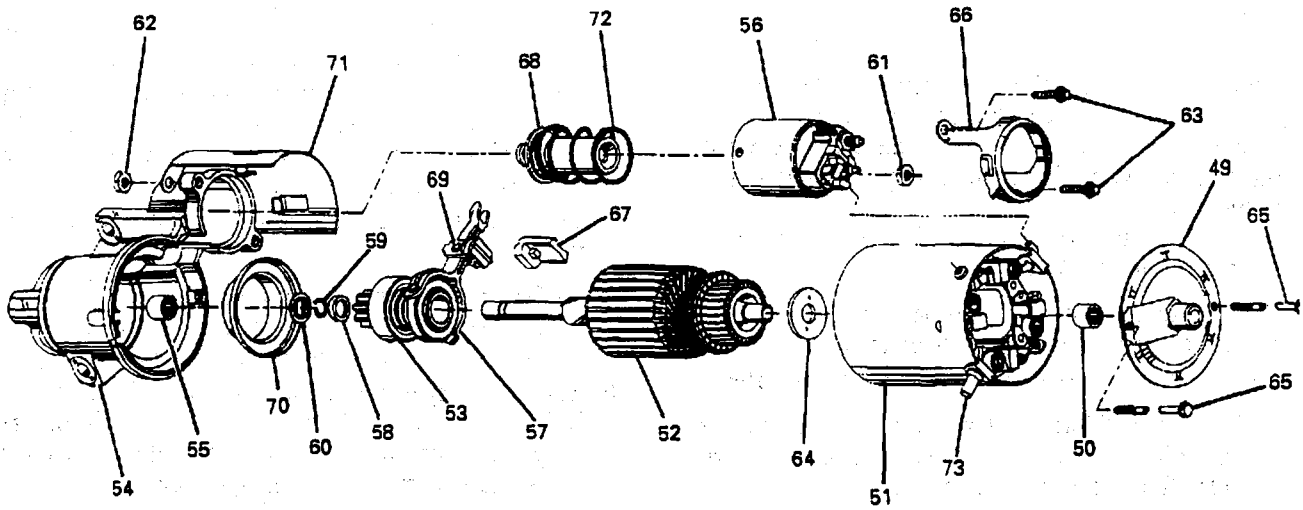


Figure 6 - Flywheel Assembly-to-Pinion Clearance



49 FRAME, STARTER COMMUTATOR END
50 BEARING, STARTER ARMATURE COMMUTATOR END
51 FRAME KIT, STARTER WITH FIELD
52 ARMATURE, STARTER
53 DRIVE ASSEMBLY, STARTER
54 HOUSING, STARTER DRIVE
55 BEARING, STARTER DRIVE SHAFT DRIVE END
56 SWITCH, STARTER SOLENOID
57 LEVER, STARTER SHIFT
58 COLLAR, STARTER DRIVE STOP
59 RETAINER, STARTER DRIVE STOP COLLAR
60 COLLAR, STARTER DRIVE THRUST
61 NUT, STARTER SOLENOID SWITCH OUTER,
62 NUT, STARTER MOTOR ASSEMBLY HEAT SHEILD,
63 BOLT/SCREW, STARTER SOLENOID SWITCH CLAMP,
64 WASHER, STARTER ARMATURE BRAKE COMMUTATOR END
65 BOLT/SCREW, COMMUTATOR END FRAME,
66 CLAMP, STARTER SOLENOID SWITCH
67 PLUG, STARTER SHIFT LEVER RETAINER
68 PLUNGER, STARTER SOLENOID SWITCH
69 RETAINER, STARTER SHIFT LEVER
70 SHIELD, STARTER DRIVE HOUSING
71 SHIELD, STARTER MOTOR ASSEMBLY HEAT
72 SPRING, STARTER SOLENOID SWITCH PLUNGER
73 TUBE, STARTER DRAIN

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Figure 7 - SD210 Starter Motor Assembly Disassembled View

4. Field lead to solenoid switch "M" terminal.
5. Starter solenoid switch outer nut (61).

Tighten

- Starter solenoid switch outer nut (61) to 10 N.m (89 lb. in.).

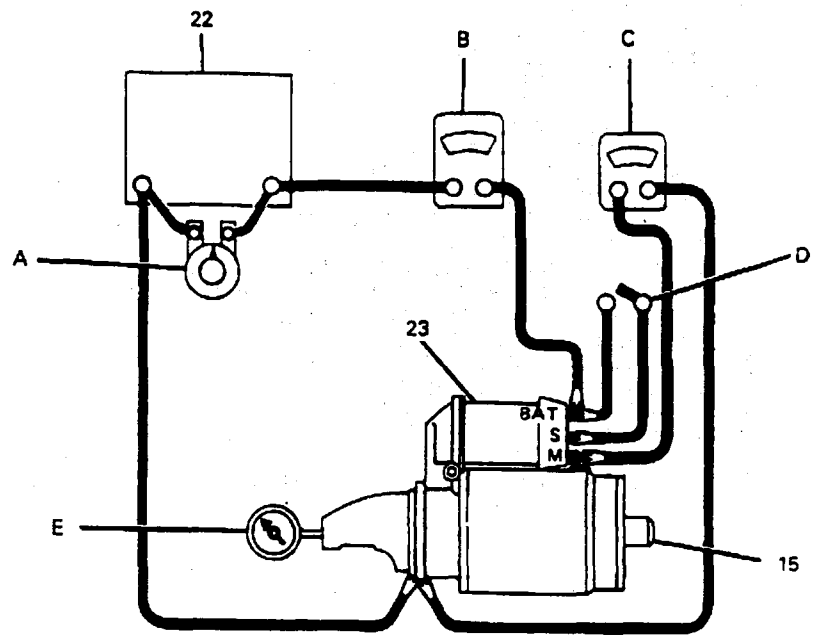
NO-LOAD TEST

Figure 8

With carbon pile "OFF", make connections as shown in Figure 8. Close the switch, adjust carbon pile to obtain 10 volts, and compare the RPM, current and voltage readings with "Specifications" listed at the end of this section.

Make disconnections only with the switch open. Use the test results as follows:

1. Rated current draw and no-load speed indicates normal starter motor assembly condition.
2. Low free speed and high current draw indicates:
   - Too much friction. This can be caused by tight, dirty or worn bearings, or bent armature shaft allowing armature to drag.
   - Shorted armature. This can be further checked on growler after disassembly.
   - Grounded armature or fields. Check further after disassembly.
3. Failure to operate with high current draw indicates:
   - Direct ground in terminal or fields.
   - "Frozen" bearings (this should have been determined by hand turning armature).
4. Failure to operate with no current draw indicates:
   - Open field circuit. After disassembly inspect internal connections and trace circuit with test lamp.
   - Open armature coils. Inspect commutator for badly burned bars after disassembly.
   - Broken brush springs, worn brushes, high insulation between commutator bars or other causes which would prevent good contact between brushes and commutator.
5. Low no-load speed and low current draw indicates:
   - High internal resistance due to poor connections, defective leads, dirty commutator and causes listed above under number 4.
6. High free speed and high current draw usually indicate shorted fields. If shorted fields are suspected, replace field coil assembly. Also check for shorted armature, using growler.



A CARBON PILE
B AMMETER
C VOLTMETER
D SWITCH
E RPM INDICATOR
15 MOTOR ASSEMBLY, STARTER
22 BATTERY ASSEMBLY, STORAGE
23 SWITCH, STARTER SOLENOID

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Figure 8 - No-Load Test

SD210 STARTER MOTOR ASSEMBLY DISASSEMBLY

Figure 7

Disassemble

1. Nuts (62) and heat shield (71), if equipped, from clamp bolts/screws (63).
2. Nut (61) and field lead from solenoid switch (56).
3. Clamp bolts/screws (63) and solenoid switch (56) with clamp (66) from drive housing (54).
4. Bolts/screws (65) from starter motor assembly.
5. Commutator end frame (49), brake washer (64), and frame kit (51) from armature (52) and drive housing (54).
6. Plug (67) from drive housing (54).
7. Armature (52) with starter drive assembly (53), shift lever (57), plunger (68), and return spring (72) from drive housing (54).
8. Return spring (72) from plunger (68).
9. Plunger (68) from shift lever (57).
10. Shift lever (57) from drive housing (54) by spreading lever arms slightly to disengage.
11. Thrust collar (60) from armature shaft.
12. Retainer (59) by pushing pinion stop collar (58) off of retainer (59) and sliding it off of armature shaft.
    - Discard retainer (59)
13. Pinion stop collar (58) and starter drive assembly (53) from armature shaft.

CLEANING, INSPECTION AND TESTING (SD210 STARTER MOTOR)

Figures 7 through 11

NOTICE: Do not use grease dissolving solvents for cleaning the overrunning clutch or armature. Solvents dissolve the grease packed in the clutch and damage armature and field coil insulation.

1. Clean all starter motor assembly parts. Wipe parts with a clean shop cloth.
2. Test drive starter assembly (53) action. Pinion should turn freely in overrunning direction. Check pinion teeth for chipping, cracking or excessive wear. Replace starter drive assembly (53) if necessary. Badly chipped pinion teeth may indicate chipped teeth on ring gear; replace if necessary.
3. Check starter drive assembly (53) for slipping by leaving starter drive assembly (53) with shop towel and clamp in vice. Using 12-point deep socket and torque wrench, put socket on pinion and turn counterclockwise. Drive should not slip up to 68 N.m (50 lb. ft.) of torque. If it does, replace starter drive assembly (53).
4. Starter drive assembly (53) requires no lubrication; however, drive assembly (53) should be wiped clean.

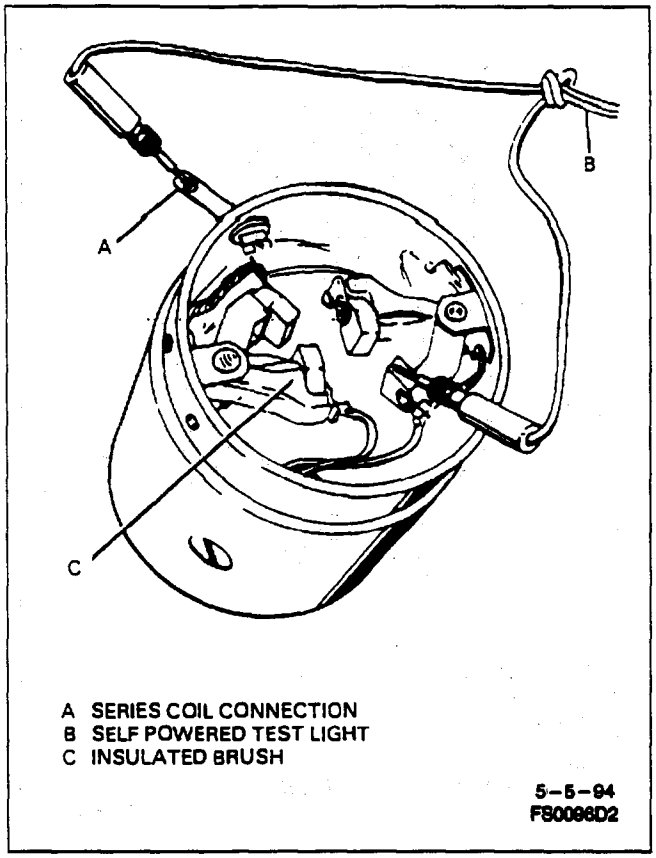


Figure 9 - Testing Series Coil for Open

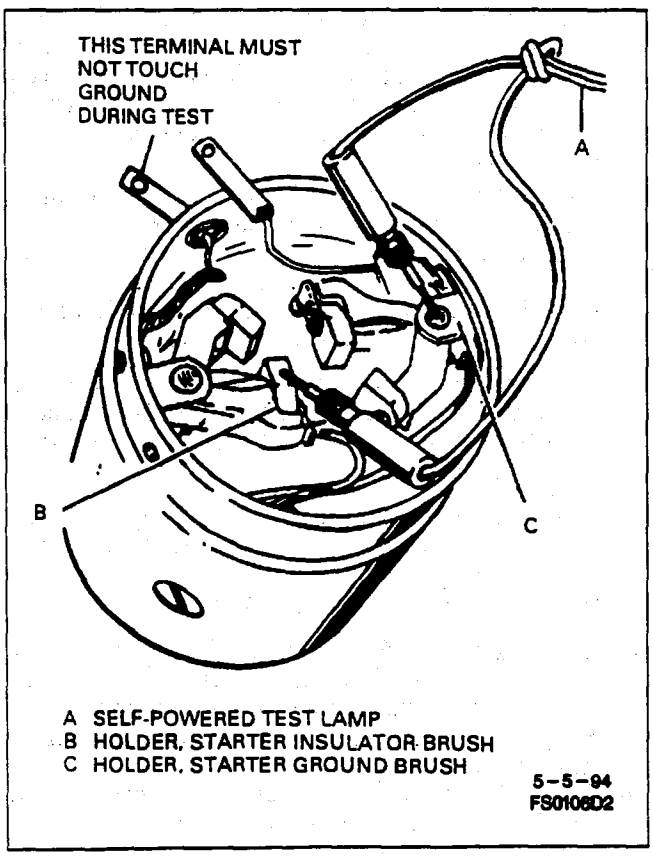


Figure 10 - Testing Series Coil for Ground

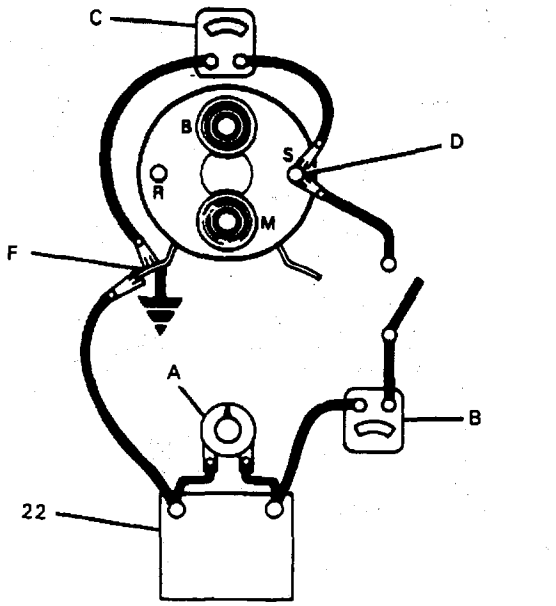


Figure 11 - Testing Solenoid Windings

5. Inspect armature commutator. If commutator is dirty, clean with 400 grit polishing cloth. If commutator is rough, replace armature (52) Do not undercut or turn commutators. Inspect points where armature conductors join commutator bars to make sure they have good connection. Burned commutator bar is usually evidence of poor connection.
6. Inspect brushes and brush holders.When brushes appear excessively worn when compared to new brushes they should be replaced. Make sure brush holders are clean and brushes are not binding in brush holder. Full brush surface should ride on the commutator to give proper performance.
   - Check to ensure that brush springs are giving firm contact between brushes and commutor. When brush springs are distorted or discolored, they should be replaced.
     — On SD210 starter motor assembly, all brush and brush holder parts are part of the frame kit (51).
7. If test equipment is a available:

A. Check armature (52) for short circuits by placing on growler and holding hacksaw blade over armature core while armature is rotated. If saw blade vibrates, armature (52) is shorted. Replace armature (52).
B. On SD210 starter motor assembly, check field windings by using self-powered test lamp. Place one lead on field lead terminal and other lead on one insulated brush. If lamp fails to light, series coil is open and will require repair or replacement. Perform this test for each insulated brush to check brush and lead continuity (Figure 12).
C. On SD210 starter motor assembly, using self-powered test lamp, place one lead on grounded brush holder assembly and other lead on either insulated brush. If lamp lights, grounded series coil is indicated and frame kit (51) must be replaced (Figure 13).
D. Check armature (52) for grounds using a self-powered test lamp. Place one lead on commutator and other lead on armature core or shaft. If lamp lights, armature (52) is grounded and must be replaced.
E. Check current draw of solenoid windings as follows:
   — If solenoid switch(56) is not removed from starter motor assembly, field lead must be removed from "M" terminal on solenoid switch (56) before making these tests. Complete tests in minimum of time to prevent overheating of solenoid switch (56).
   — To check hold-in winding, connect ammeter in series with 12-volt battery and "S" terminal on solenoid switch (56). Connect voltmeter to "S" terminal and to ground. Connect carbon pile across battery. Adjust voltage to 10 volts and note ammeter reading. Reading should be 10 to 20 amperes.
   — To check both windings, connect as for previous test. Ground solenoid "M" terminal. Adjust voltage to 10 volts and note ammeter reading. Reading should be 60 to 85 amperes.

Important

- Current will decrease as winding heat up.
- Current draw reading that are over specifications indicate shorted turns or a ground in the windings of the solenoid switch (56) and the solenoid switch (56) should be replaced. No or low current draw reading that are under specifications indicate excessive resistance. A zero reading indicates an open circuit. Check connections, then replace solenoid switch (56) if necessary.

8. On SD210 starter, solenoid switch h (56) is serviced as an assembly.

CHECKING PINION CLEARENCE (SD210 STARTER MOTOR)

Figure 12

NOTICE: When the starter motor assembly has been disassembled or the solenoid switch has been replaced, it is necessary to check the pinion clearance. Starter motor assembly may not engage properly if pinion clearance is incorrect.

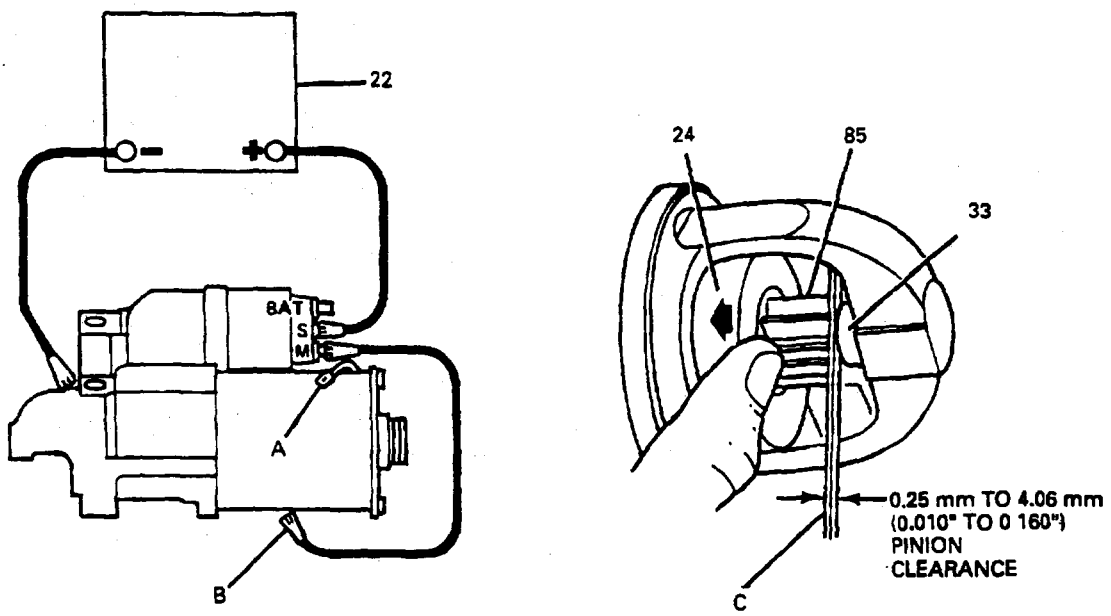


Figure 12 - Electrical Connections and Checking Pinion Clearence

Measure

Pinion clearance as follows:

CAUTION: Keep fingers, tools, and other objects away from opening in drive housing while making electrical connections during this procedure. The strong shifting action of the solenoid switch could cause personal injury or damage as the drive pinion moves into cranking position.

A. Secure starter motor assembly in vise or equivalent fixture so that opening in drive housing is accessible for measurement.
B. Disconnect file lead from solenoid switch "M" terminal and insulate it carefully.
C. Connect one 12-volt battery lead to solenoid switch "S" terminal and the other to starter frame.
D. Flash jumper lead momentarily from solenoid switch "M" terminal to starter frame. This will shift pinion into cranking position and it will remain so until battery is disconnected.
E. Push pinion back as far as possible to take up any movement, and check clearance with feeler gage. Clearance should be 0.5 mm to 4.06 mm (0.010 inch to 0.160 inch).
F. Means for adjusting pinion clearance is not provided on starter motor assembly. If clearance does not fall within limits, check for improper installation and replace all worn parts.

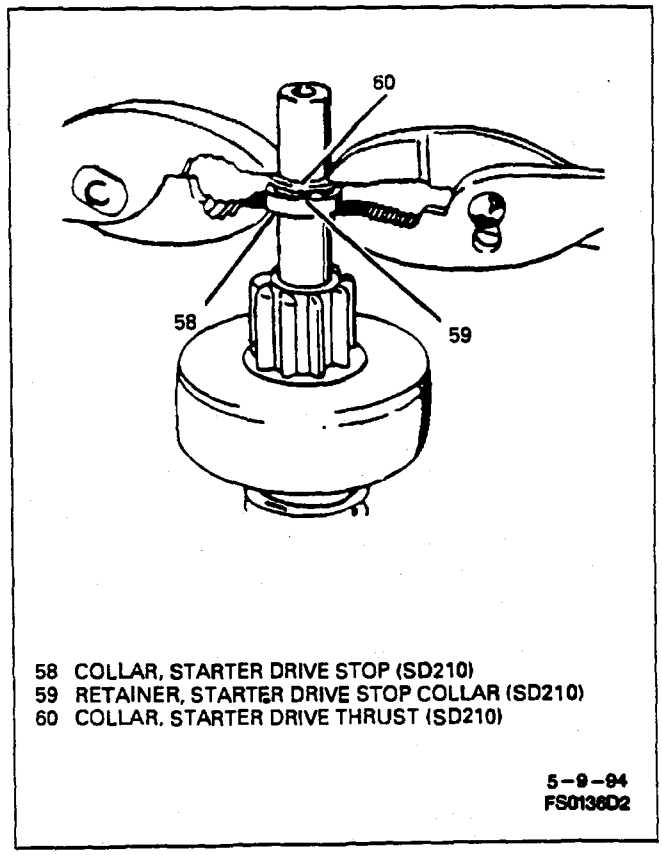


Figure 13 - Installing Pinion Stop Collar

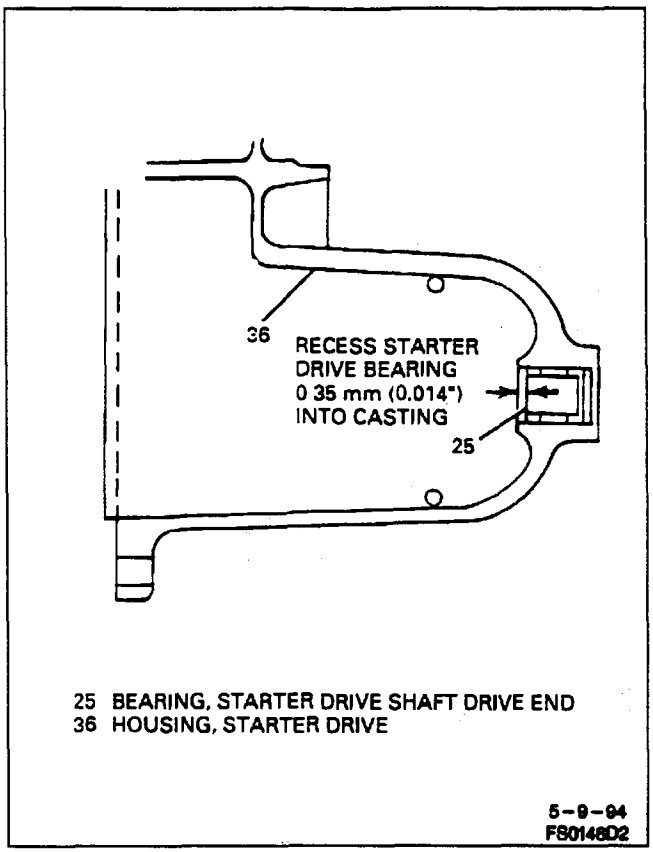


Figure 14 - Starter Dirve Shaft Drive End Bearing

G. Disconnect 12-volt battery leads from solenoid switch "S" terminal and starter frame.
H. Reconnect field lead.

SD210 STARTER MOTOR ASSEMBLY

Figures 7 and 13

Assemble

NOTICE: See "Notice" on page 6D2-1 of this section.

1. Starter drive assembly (53) onto armature shaft.
2. Pinion stop collar (58) onto armature shaft with flat side toward starter drive assembly (53).
3. New retainer (59) onto armature shaft and slide it down shaft until seated in shaft groove.
4. Thrust collar (60) onto armature shaft with flange toward retainer (59).
   - Use two sets of pliers and squeeze pinion stop collar (58) onto retainer (59).

Inspect

- End bearing (55). If bearing (55) has no lubrication visible or appears damaged, replace bearing (55).
- Press bearing (55) from drive housing (54) and then press in new bearing (55) until recessed 1.6 mm (1/16 inch) into drive housing casting. Bearing (55) is pre-lubricated and no additional lubrication is needed.

5. Shift lever (57) to starter drive assembly (53) by spreading arms slightly.
6. Plunger (68) to other end of shift lever (57) by snapping into place.
7. Armature shaft into end bearing (55) while sliding lever retainer (69) into slot in drive housing (54).
8. Plug (67) into slot in drive housing (54).
9. Return spring (72) over plunger (68).
10. Solenoid switch (56) with clamp (66) to drive housing (54).
    - Align motor terminal and solenoid switch (56) with field lead.
11. Clamp bolts/screws (63).

Tighten

- Clamp bolts/screws (63) to 11 N.m (97 lb. in.).

Clean

- Contact surface of frame kit brushes and armature commutator with soft cloth.

12. Frame kit (51) onto armature (52) and drive housing (54) by pushing in and holding brushes and aligning notch in frame kit (51) with locator on drive housing (54). When in place, release brushes and make sure they move freely and contact commutator.

Inspect

- Bearing (50) in commutator end frame (49). If bearing (50) has no visible lubrication or appears damaged, press in a new bearing (50) until recessed 2 mm (0.08 inch) into commutator end frame (49). Bearing (50) is pre-lubricated and no additional lubrication is needed.

13. Washer (64) onto armature shaft.
14. Commutator end frame (49) onto armature shaft and seat into frame kit (51).
15. Identification tag over bolt/screw hole in commutator end frame (49) with fluted end around bearing well.
16. Bolts/screws (65) to starter motor assembly.

Tighten

- Bolts/screws (65) to 8.5 N.m (75 lb. in.).

NOTICE: Before attaching electrical leads, tighten inner nuts on solenoid switch terminals. If nuts are not tight, solenoid cap may be damaged during installation of leads. Tighten inner nuts on "S" terminal to 2.5 N.m (22 lb.in.).Tighten inner nut at "BAT" terminal to 10 N.m (89 lb.in.)

17. Nut (61) to solenoid switch (56).

Tighten

- Nut (61) to 10 N.m (89 lb. in.).

18. Heat shield (71) and nuts (62) onto protruding ends of clamp bolts/screws (63).

Tighten

- Nut (62) to 12 N.m (106 lb.in.).

SPECIFICATIONS

STARTER MOTOR ASSEMBLY USAGE CHART

3.4L L32 Engine

Starter type	SD210
No-Load Test at 10 Volts	
Amps-Minimum	45
Amps-Maximum	75
RPM at Drive Pinion	
Minimum	6.000
Maximum	11,000
Starter Solenoid Switch	
Hold-in Windings at 10 Volts	10-20 Amps
Both Windings at 10 Volts	60-85 Amps

5.7L LT1 Engine

Starter Type	PG260
No-Load Test at 10 Volts	
Current	64-95 Amps
Starter Drive Pinion Speed	2825-3275 RPM
Starter Solenoid Switch	
Hold-in Windings at 10 Volts	10-20 Amps
Both Windings at 10 Volts	60-85 Amps

FASTENER TIGHTENING SPECIFICATIONS

Battery Negative Cable Assembly	15 N.m (11 lb.ft.)
Starter Motor Assembly Heat Shield Nut	12 N.m (106 lb.in.)
Starter Motor Bolt.Screw	47 N.m (35 lb.ft.)
Starter Motor Brush Holder Bolt/Screw (PG260)	6.5 N.m (58 lb.in.)
Starter Motor Commutator End Frame Bolt/Screw	8.5 N.m (75 lb.in.)
Starter Solenoid Switch "BAT" Terminal Inner Nut	9 N.m (80 lb.in.)
Starter Solenoid Switch "BAT" Terminal Outer Nut	9 N.m (80 lb.in.)
Starter Solenoid Switch Clamp Bolt/Screw	11 N.m (97 lb.in.)
Starter Solenoid Switch Inner Nut	9 N.m (80 lb.in.)
Starter Solenoid Switch Outer Nut (PG260)	8 N.m (71 lb.in.)
Starter Solenoid Switch Outer Nut (SD210)	10 N.m (89 lb.in.)
Starter Solenoid Switch "S" Terminal Nut	2.5 N.m (22 lb.in.)
Starter Through-Bolt/Screw (PG260)	8.5 N.m (75 lb.in.)

GENERAL SPECIFICATIONS

Pinion Clearance	0.25 mm to 4.06 mm (0.010: to 0.160")

BLANK

SECTION 6D3

CHARGING SYSTEM

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in SECTION 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: Before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with "live" exposed electrical terminals, disconnect the battery negative cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "OFF" or "LOCK" position.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

CHARGING CIRCUIT

Refer to SECTION 8A for operation and additional charging circuit diagnosis.

CS-130 AND CS-144 GENERATOR ASSEMBLIES

The charging system generator assemblies use a built-in voltage regulator with fault detection, a stator, rectifier bridge, and rotor with slip rings and brushes. A conventional pulley and fan is used to cool the slip ring end frame, rectifier bridge and voltage regulator.

These generator assemblies use only two connections – battery positive and "L" terminal, in addition to the ground path through the generator bracket. Use of "P," "I" and "S" terminals is optional. The "P" terminal is connected to the stator and may be connected externally to a tachometer or other device. The "I" terminal can be connected directly to battery voltage to power the generator assemblies instead of, or in addition to, the "L" terminal which must be stepped down. The "S" terminal may be connected to an external voltage source, such as voltage near the battery assembly, for voltage control. If the "S" terminal is not used, internal generator voltage is used for control.

The voltmeter reads battery voltage when the engine is not running and reads charging system voltage when the engine is running. The normal indication is between 11 volts and 16 volts.

The regulator voltage setting varies with temperature and limits system voltage by controlling rotor field current. While the field current is "on," this regulator actually switches rotor field current on and off at a fixed frequency of about 400 cycles per second to help control radio noise. By varying the overall on-off time, correct average field current for proper system voltage control can be obtained. At high speeds, the on-time may be 10 percent and the off-time 90 percent. At low speeds, with high electrical loads, on-off time may be 90 percent and 10 percent respectively.

DIAGNOSIS

CS GENERATOR ASSEMBLY ON-VEHICLE CHECK

Tool Required:

J 39200 Digital Multimeter

When the CS charging system is operating normally, the voltmeter will read between 11 volts and 16 volts when the engine is running. If the voltmeter operates abnormally, or if an undercharged or overcharged battery assembly condition occurs, the following procedure may be used to diagnose the charging system. Remember that an undercharged battery assembly is often caused by accessories being left on overnight, or by a hood or instrument panel compartment lamp that stays on.

Noise from a generator assembly may be caused by a loose drive pulley, loose mounting bolts/screws, worn or dirty bearings, faulty diode or faulty stator. A magnetic whining noise may be heard from vehicles equipped with the CS-130 alternator. This is a normal condition.

To avoid damage to the electrical equipment, always observe the following precautions:

- Do not reverse connections to generator assembly.
- Do not short across or ground any of the terminals in charging circuit, except as directed by instructions.
- NEVER disconnect generator "BAT" terminal with generator assembly operating.
- When connecting charger or booster battery assembly to battery assembly, refer to SECTION 6D1.
- In some vehicles, voltmeter may be used instead of indicator lamp. In this case, steps 1 through 4 pertaining to faulty indicator lamp operation, should be omitted from troubleshooting procedure.
- Do not attempt to disassemble CS-130 generator assembly. Damage to generator assembly could result.

Trouble in the charging system will show up as one or more of the following conditions:

- Faulty voltmeter operation.
- Undercharged battery assembly, as evidenced by slow cranking or dark hydrometer.
- Overcharged battery assembly, as evidenced by spewing of electrolyte from vents or a yellow hydrometer.

To diagnose the CS-130 or CS-144 charging system, use the following procedure:

Important

- Only the CS-144 generator assembly may be repaired.

1. Visually check serpentine drive belt and wiring.
2. Battery assembly undercharged or overcharged (voltage lower than 11 volts or higher than 16 volts).
   A. Detach wiring harness connector from generator assembly.
   B. With ignition switch "ON" and engine assembly not running, connect J 39200 as voltmeter from ground to "L" terminal in wiring harness connector. Connect to "F" or "I" terminal for gage equipped vehicles. At least one terminal should have battery voltage.
   C. Zero volts indicates open circuit between terminal and battery assembly. Correct as required.
   D. Reconnect harness connector to generator assembly.

CAUTION: Disconnect battery negative cable assembly before installing or removing a series-type ammeter at generator battery terminal.

CAUTION: See "Caution" on page 6D3-1 of this section.

   E. Install ammeter at generator output terminal. With load off, install carbon pile load test across battery terminals. Start engine assembly and run at 2500 rpm. Make sure this is done at ambient temperature.
   F. Measure voltage across battery assembly, using J 39200. If voltage is above 16 volts, replace or repair generator assembly.
   G. Turn on accessories and load battery assembly with carbon pile to obtain maximum generator assembly output. Maintain voltage at 13 volts or above. Use ammeter to check amperage. Compare output to ampere rating in "Specifications" at the end of this section.
      - If within 15 amps of rated output, generator assembly is OK.
      - If not within 15 amps of rated output, repair or replace generator assembly.

CS GENERATOR ASSEMBLY BENCH CHECK

Figure 1

Tool Required:

J 39200 Digital Multimeter

The following bench check may be used to simulate operation on a vehicle. Use the bench check to verify operation of a CS-144 generator assembly that has been repaired.

1. Mount generator assembly in suitable test stand according to test stand manufacturer's instructions. Test stand must be capable of driving generator assembly at 6,500 rpm.
2. Make connections as shown in Figure 1. Be sure carbon pile is turned off. Ground polarity of generator assembly and battery assembly must be same. Battery assembly must be fully charged. Use a 30-500 ohm resistor between battery assembly and "L" terminal of generator assembly.
3. Slowly increase generator assembly speed and observe voltage using J 39200.

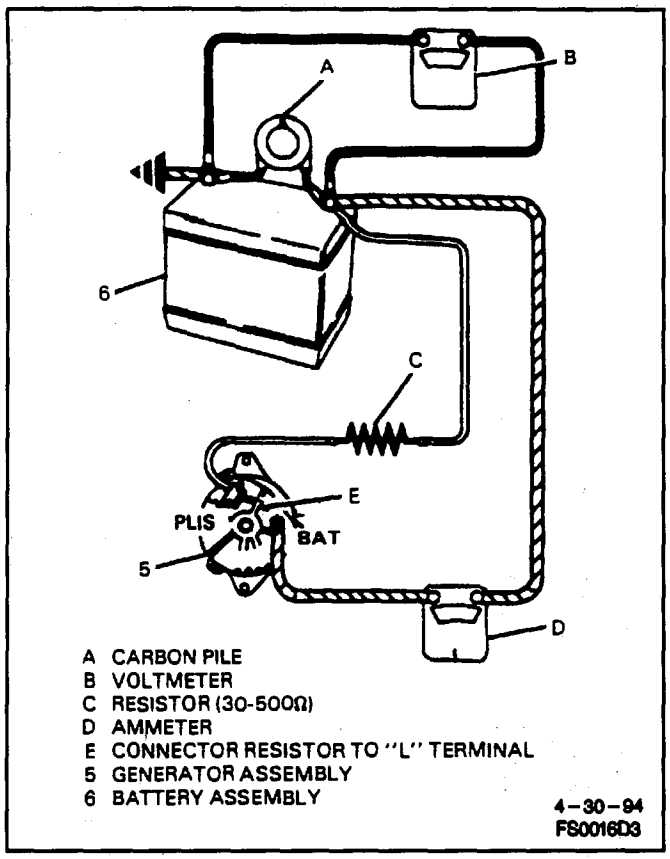


Figure 1 – Generator Assembly Bench Check

Important

- The battery assembly must be fully charged when making this test.
- The engine must be run at 2500 rpm and at ambient temperature.

4. If voltage is uncontrolled and increases above 16 volts, repair or replace generator assembly.
5. If voltage is below 16 volts, increase speed and connect and adjust carbon pile to obtain maximum amperage output. Maintain voltage above 13 volts.
6. Use ammeter to check amperage. If output is within 15 amps of rated output, generator assembly is good.
7. If output is not within 15 amps of rated output, repair or replace generator assembly.

Important

- Only the CS-144 generator assembly may be repaired.

ON-VEHICLE SERVICE

The CS generator assembly does not require periodic lubrication. The rotor shaft is mounted on permanently lubricated bearings. At periodic intervals, check mounting bolts/screws for tightness and check serpentine drive belt tension. Refer to SECTION 6A2A or 6A3A.

The charging system could be equipped with two different CS-144 generators. The reason for this is the CS-144 124-amp generator is being replaced by the CS-144 140-amp generator. The differences between the two are as follows:

- The CS-144 124-amp generator (part number 10480131) is equipped with a metal fan mounted at the front of the generator and a bolt used to attach the battery positive cable assembly to the generator "BAT" terminal.
- The CS-144 140-amp generator (part number 10480111) is equipped with a plastic and metal fan mounted at the front of the generator and uses a stud and nut to attach the battery positive cable assembly to the "BAT" terminal.

GENERATOR ASSEMBLY REPLACEMENT

CS-130 105-AMP Generator Assembly (3.4L L32 Engine)

Figure 2

Remove or Disconnect

CAUTION: See "Caution" on page 6D3-1 of this section.

1. Battery negative cable assembly from battery terminal.
2. Serpentine drive belt. Refer to SECTION 6A2A or 6A3A.
3. Battery positive cable assembly from generator "BAT" terminal.
4. Electrical connector from generator assembly (5).
5. Nuts (2 and 25) and bolt/screw (21).
6. Generator rear inner brace (1).
7. Bolts/screws (9 and 17).
8. Generator assembly (5) from accessory mounting bracket (7).

Install or Connect

NOTICE: See "Notice" on page 6D3-1 of this section.

1. Generator assembly (5) to accessory mounting bracket (7).
2. Bolts/screws (9 and 17).

Tighten

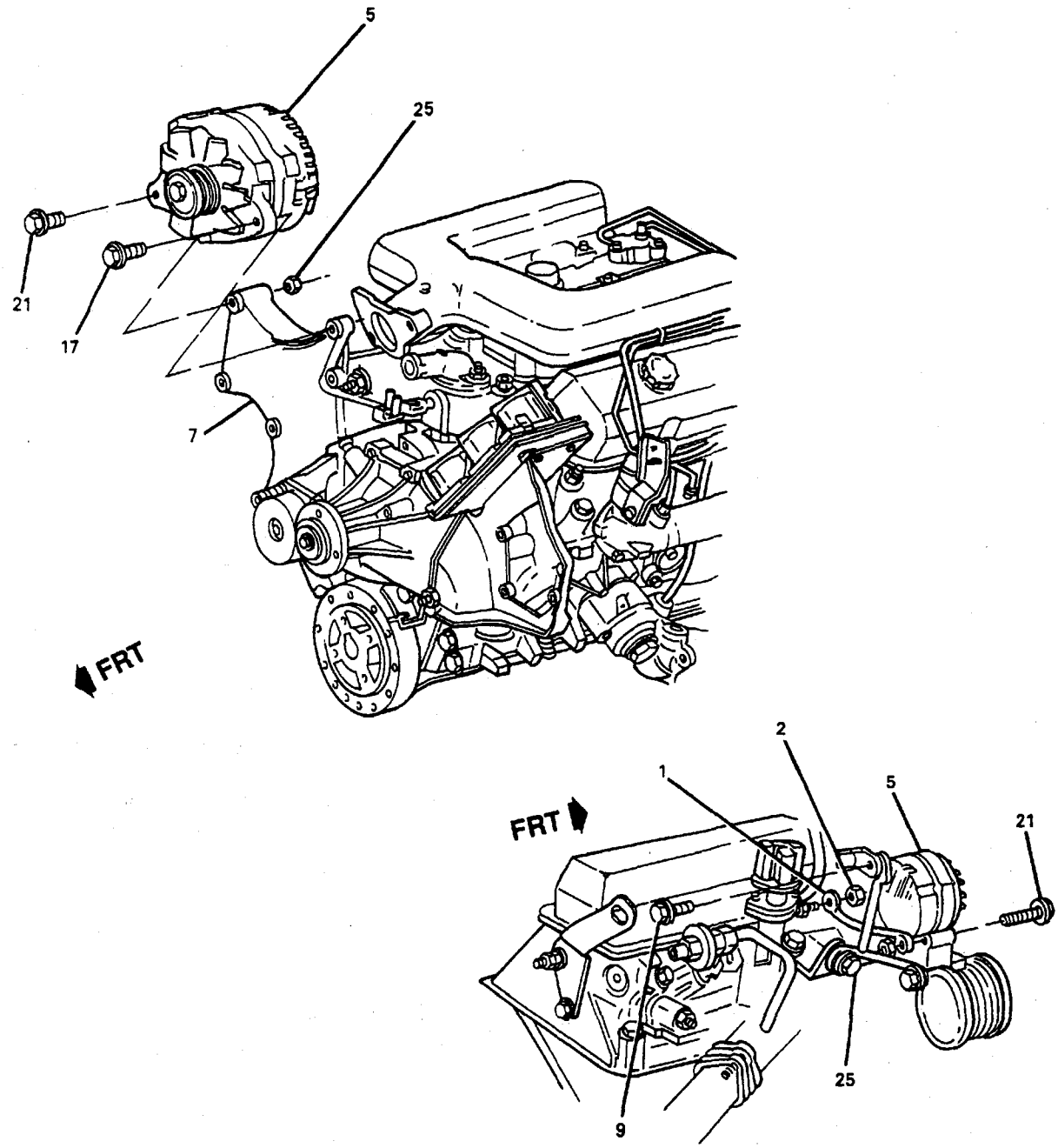
- Bolt/screw (9) to 50 N•m (37 lb. ft.).
- Bolt/screw (17) to 50 N•m (37 lb. ft.).

3. Generator rear inner brace (1).
4. Nuts (2 and 25) and bolt/screw (21).

Tighten

- Nut (2) to 25 N•m (18 lb. ft.).
- Nut (25) to 50 N•m (37 lb. ft.).
- Bolt/screw (21) to 50 N•m (37 lb. ft.).

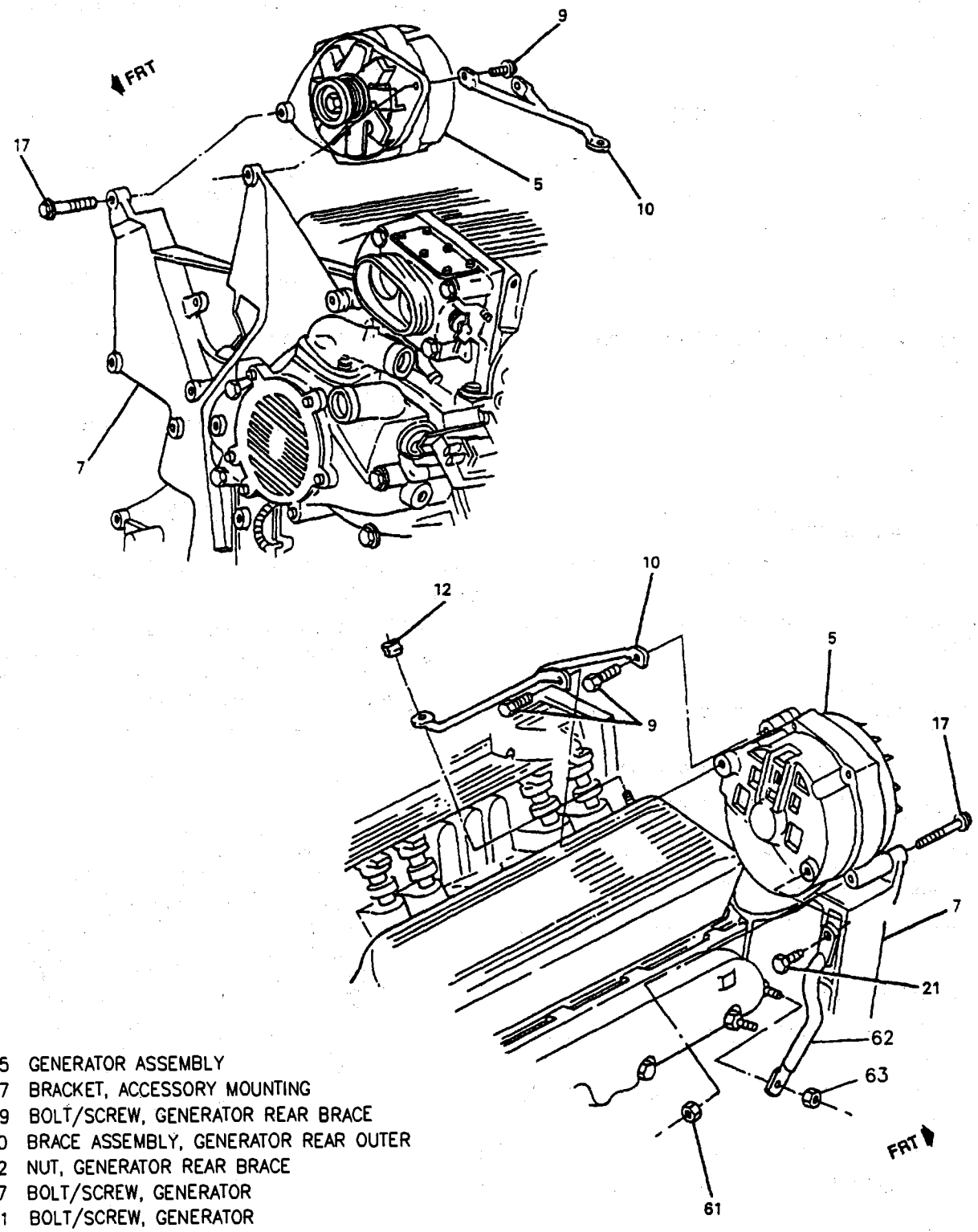
5. Electrical connector to generator assembly (5).



1 BRACE, GENERATOR REAR INNER
2 NUT, GENERATOR BRACE
5 GENERATOR ASSEMBLY
7 BRACKET, ACCESSORY MOUNTING
9 BOLT/SCREW, GENERATOR REAR BRACE
17 BOLT/SCREW, GENERATOR
21 BOLT/SCREW, GENERATOR
25 NUT, GENERATOR

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Figure 2 – CS-130 105-Amp Generator Assembly Mounting (3.4L L32 Engine)



5 GENERATOR ASSEMBLY
7 BRACKET, ACCESSORY MOUNTING
9 BOLT/SCREW, GENERATOR REAR BRACE
10 BRACE ASSEMBLY, GENERATOR REAR OUTER
12 NUT, GENERATOR REAR BRACE
17 BOLT/SCREW, GENERATOR
21 BOLT/SCREW, GENERATOR
61 NUT, GENERATOR ASSEMBLY
62 BRACE ASSEMBLY, GENERATOR REAR OUTER
63 NUT, GENERATOR OUTER BRACE MOUNTING

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Figure 3 – CS-144 Generator Assembly Mounting (5.7L LT1 Engine) (Typical)

6. Battery positive cable assembly to generator "BAT" terminal.

Tighten

- Cable nut to 10 N•m (89 lb. in.).

7. Serpentine drive belt. Refer to SECTION 6A2A or 6A3A.
8. Battery negative cable assembly to battery terminal.

Tighten

- Battery negative cable bolt/screw to 15 N•m (11 lb. ft.).

CS-144 124-Amp or 140-Amp Generator Assembly (5.7L LT1 Engine)

Figure 3

Remove or Disconnect

CAUTION: See "Caution" on page 6D3-1 of this section.

1. Battery negative cable assembly from battery terminal.
2. Serpentine drive belt. Refer to SECTION 6A2A or 6A3A.
3. Lower vehicle.
4. Battery positive cable assembly from generator "BAT" terminal.
5. Electrical connector from generator assembly (5).
6. Bolts/screws (9, 17 and 21) and nut (61) at generator assembly (5).
7. Nut (12) at generator rear inner brace (10).
8. Generator rear inner brace (10).
9. Generator assembly (5) from accessory mounting bracket (7).

Install or Connect

NOTICE: See "Notice" on page 6D3-1 of this section.

1. Generator assembly (5) to accessory mounting bracket (7).
2. Generator rear inner brace (10).
3. Nut (12) at generator rear inner brace (10).

Tighten

- Nut (12) to 33 N•m (24 lb. ft.).

4. Bolts/screws (9, 17 and 21) and nut (61) at generator assembly (5).

Tighten

- Bolts/screws (9 and 17) to 50 N•m (37 lb. ft.).
- Bolt/screw (21) to 25 N•m (18 lb. ft.).

5. Electrical connector to generator assembly (5).
6. Battery positive cable assembly to generator "BAT" terminal.

Tighten

- Cable bolt/screw to 10 N•m (89 lb. in.), if equipped with 124-amp alternator.
- Cable nut to 20 N•m (15 lb. ft.), if equipped with 140-amp alternator.

7. Raise and suitably support vehicle. Refer to SECTION 0A.
8. Serpentine drive belt. Refer to SECTION 6A2A or 6A3A.
9. Battery negative cable assembly to battery terminal.

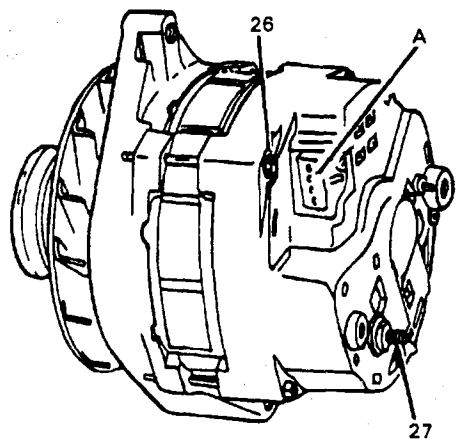
Tighten

- Battery negative cable bolt/screw to 15 N•m (11 lb. ft.).

UNIT REPAIR

CS-130 105-AMP GENERATOR ASSEMBLY (3.4L L32 Engine)

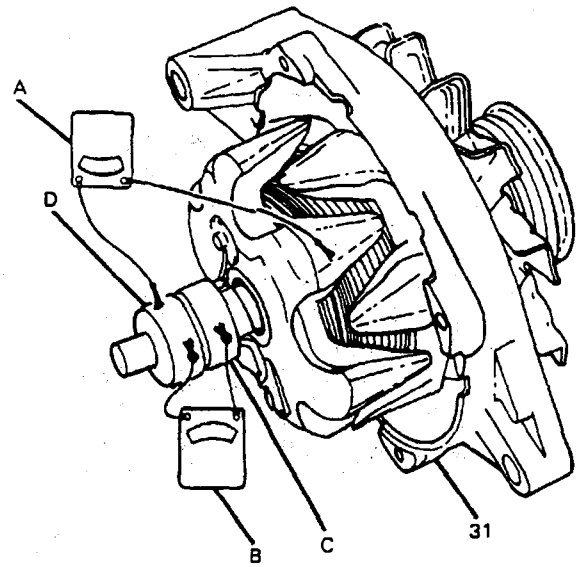
NOTICE: Do not attempt to disassemble a CS-130 generator assembly. Damage to the generator assembly could result. The CS-130 generator assembly is replaced as a complete assembly.



A "P" "L" "I" "S" TERMINALS
26 THROUGH-BOLT/SCREW, GENERATOR
27 TERMINAL, GENERATOR BATTERY

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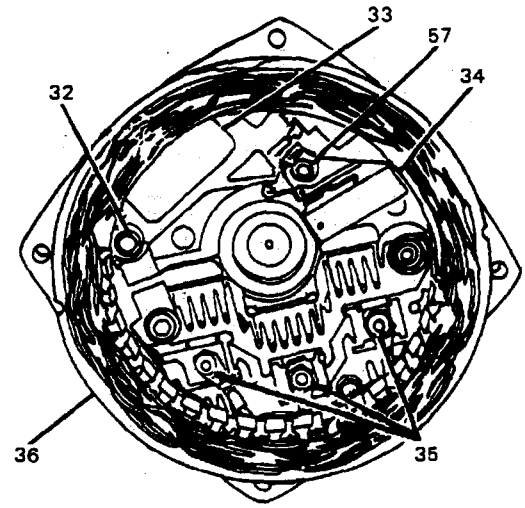
Figure 4 – Generator Through-Bolt/Screw Location



A OHMMETER CHECK FOR GROUNDS
B OHMMETER CHECK FOR SHORTS AND OPENS
C RING, SLIP
D RING, SLIP
31 ROTOR, GENERATOR

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Figure 5 – Testing Generator Rotor



32 BOLT/SCREW, REGULATOR ATTACHING
33 REGULATOR, GENERATOR VOLTAGE
34 HOLDER, GENERATOR BRUSH
35 NUT, STATOR LEAD ATTACHING
36 STATOR, GENERATOR
57 BOLT/SCREW, GENERATOR BRUSH HOLDER

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Figure 6 – Generator Slip Ring End Frame View

CS-144 124-AMP OR 140-AMP GENERATOR DISASSEMBLY, TEST AND REASSEMBLY (5.7L LT1 Engine)

Figures 4 through 12

Disassemble

1. Make scribe marks on slip ring end frame (43) and drive end frame (59) to ease reassembly.
2. Through-bolts/screws (26) and separate slip ring end frame (43) and drive end frame (59).
3. End frame bearing (28) from rotor shaft.

Measure

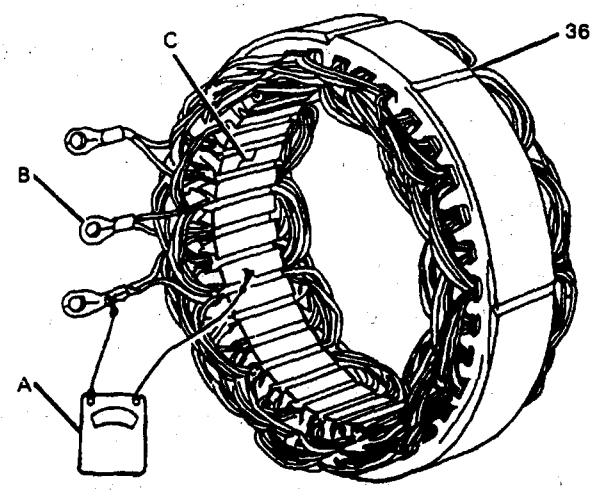
- Rotor (31) for grounds, opens and shorts (Figure 5).

Important

- Test should be performed at approximately 21°C (70°F). A different temperature may result in inaccurate ohmmeter readings.

A. Connect ohmmeter to slip ring and clean metal grounding surface on frame of rotor (31) to check for grounds.

- Ohmmeter should read infinity (open). If not, replace rotor (31).



A OHMMETER CHECK FOR GROUNDS
B TERMINAL, GENERATOR STATOR
C LAMINATIONS
36 STATOR, GENERATOR

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Figure 7 – Testing Generator Stator

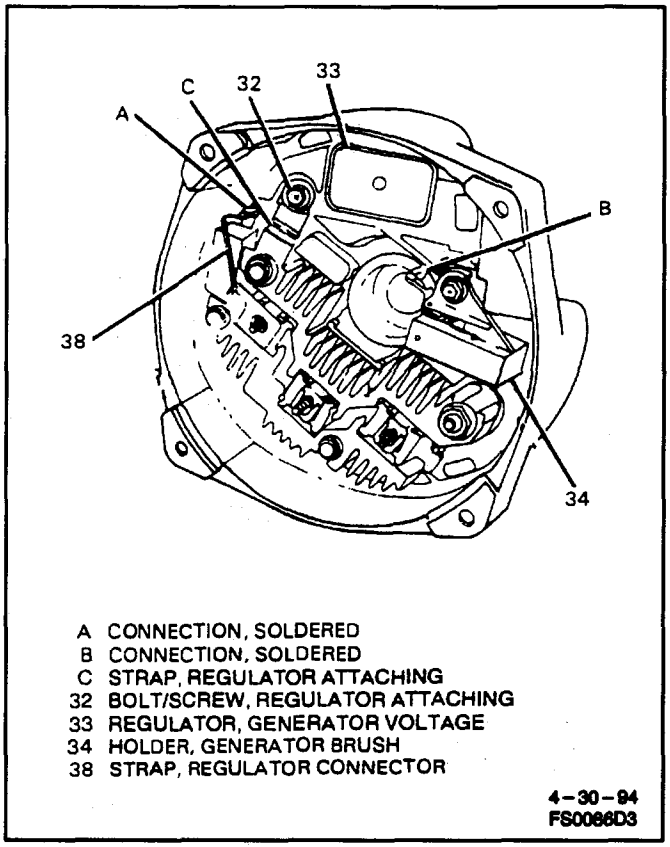


Figure 8 – Removing Generator Voltage Regulator and Generator Brush Holder

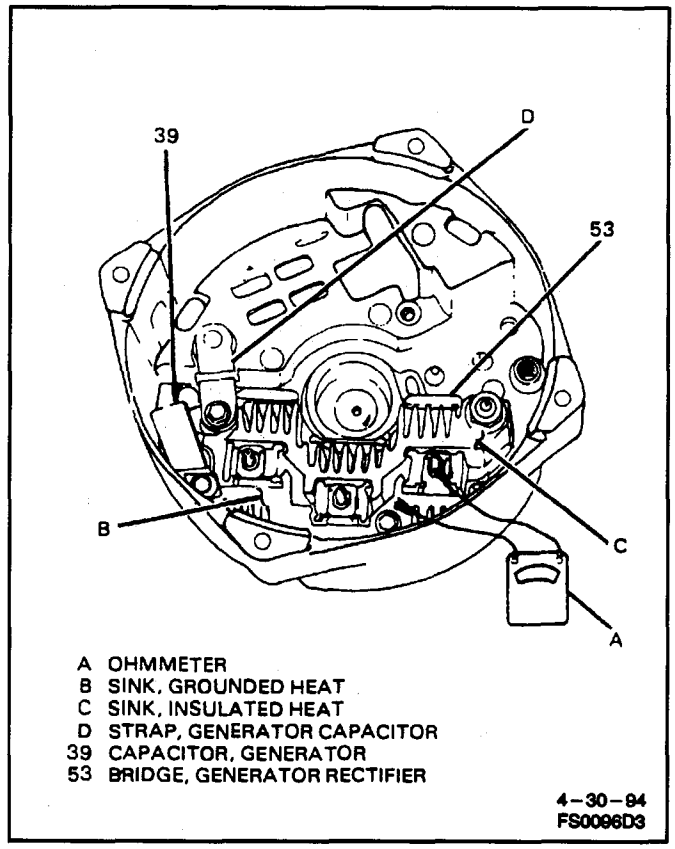


Figure 9 – Testing Generator Rectifier Bridge

B. Connect ohmmeter to both slip rings to check for shorts and opens.
   - Ohmmeter should read 1.7 to 2.1 ohms. If not, replace rotor (31).

4. Nuts (35).
5. Stator (36) from slip ring end frame (43).

Measure

- Stator (36) for grounds (Figure 7).
  A. Connect ohmmeter to stator terminal and to clean metal ground on laminations.
  B. If ohmmeter reading is low, replace stator (36). Stator (36) cannot be checked for opens and shorts with ohmmeter.

6. Unsolder connections at connector strap (38) and brush holder (34) to voltage regulator (33).
7. Bolt/screw (32) and bolt/screw (57).
8. Voltage regulator (33) and brush holder (34) with dust shield (60) from slip ring end frame (43).
   - Tap plastic retaining pin from dust shield retaining clip. Be sure to keep pin for reassembly.
9. Brushes (41) and dust shield (60) from brush holder (34).

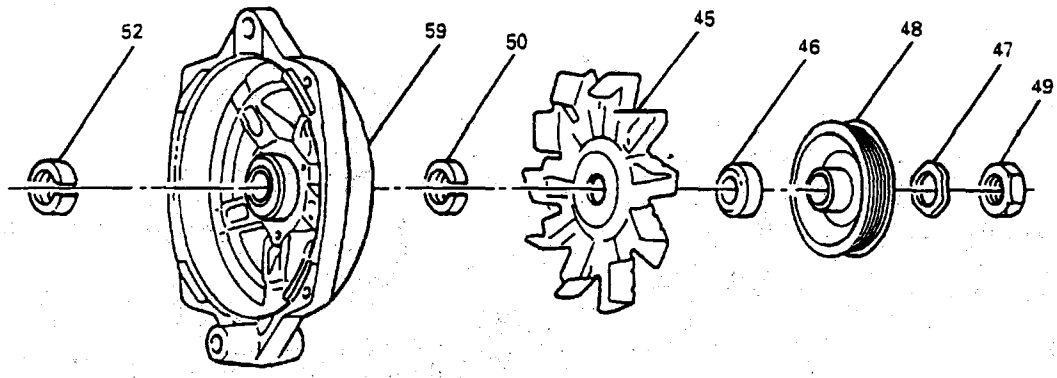
Clean

- Brushes (41) with soft, dry cloth.

Measure

- Rectifier bridge (53) for continuity (Figure 9).
  A. Connect ohmmeter to grounded heat sink and flat metal clip at rectifier bridge (53).
  B. Reverse leads. One reading should be high (open) and one low (continuity). If both readings are the same, replace rectifier bridge (53).
  C. Repeat test between grounded heat sink and clips at two other bridge terminals.
  D. Repeat test between insulated heat sink and at bridge terminals.

10. Capacitor (39) and rectifier bridge (53).
11. Washers (55) and bolts/screws (56 and 58).
12. Bearing (28) from slip ring end frame (43) by pushing through to inside.
13. Nut (49), using hex wrench to hold rotor shaft.
14. Washer (47), pulley (48), fan collar (46), fan (45) and outside collar (50).
15. Rotor (31) from drive end frame (59).
16. Inside collar (52) from rotor (31).



45 FAN, GENERATOR
46 COLLAR, GENERATOR ROTOR DRIVE END FAN
47 WASHER, GENERATOR ROTOR SHAFT DRIVE END
48 PULLEY, GENERATOR
49 NUT, GENERATOR ROTOR SHAFT DRIVE END,
50 COLLAR, GENERATOR ROTOR DRIVE END BEARING OUTSIDE
52 COLLAR, GENERATOR ROTOR DRIVE END BEARING INSIDE
59 FRAME, GENERATOR ROTOR DRIVE END BEARING

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Figure 10 – Generator Rotor Drive End Bearing

Assemble

NOTICE: See "Notice" on page 6D3-1 of this section.

1. Inside collar (52) onto rotor (31).
2. Rotor (31) to drive end frame (59).
3. Outside collar (50), fan (45), fan collar (46), pulley (48) and washer (47) onto rotor shaft.
4. Nut (49).

Tighten

- Nut (49) to 100 N•m (75 lb. ft.).

5. Bearing (28) into slip ring end frame (43) from outside, until flush with outside shoulder of slip ring end frame (43).
6. Slip ring end frame electrical components.

Important

- Installation of the slip ring end frame electrical components must be done in the following order to insure proper operation of the unit. Assembly in any other manner will result in either no output from generator assembly (5) or a direct internal ground in the generator assembly (5).

A. Rectifier bridge (53).
B. Capacitor (39).
C. Washers (55).
D. Bolts/screws (56 and 58).

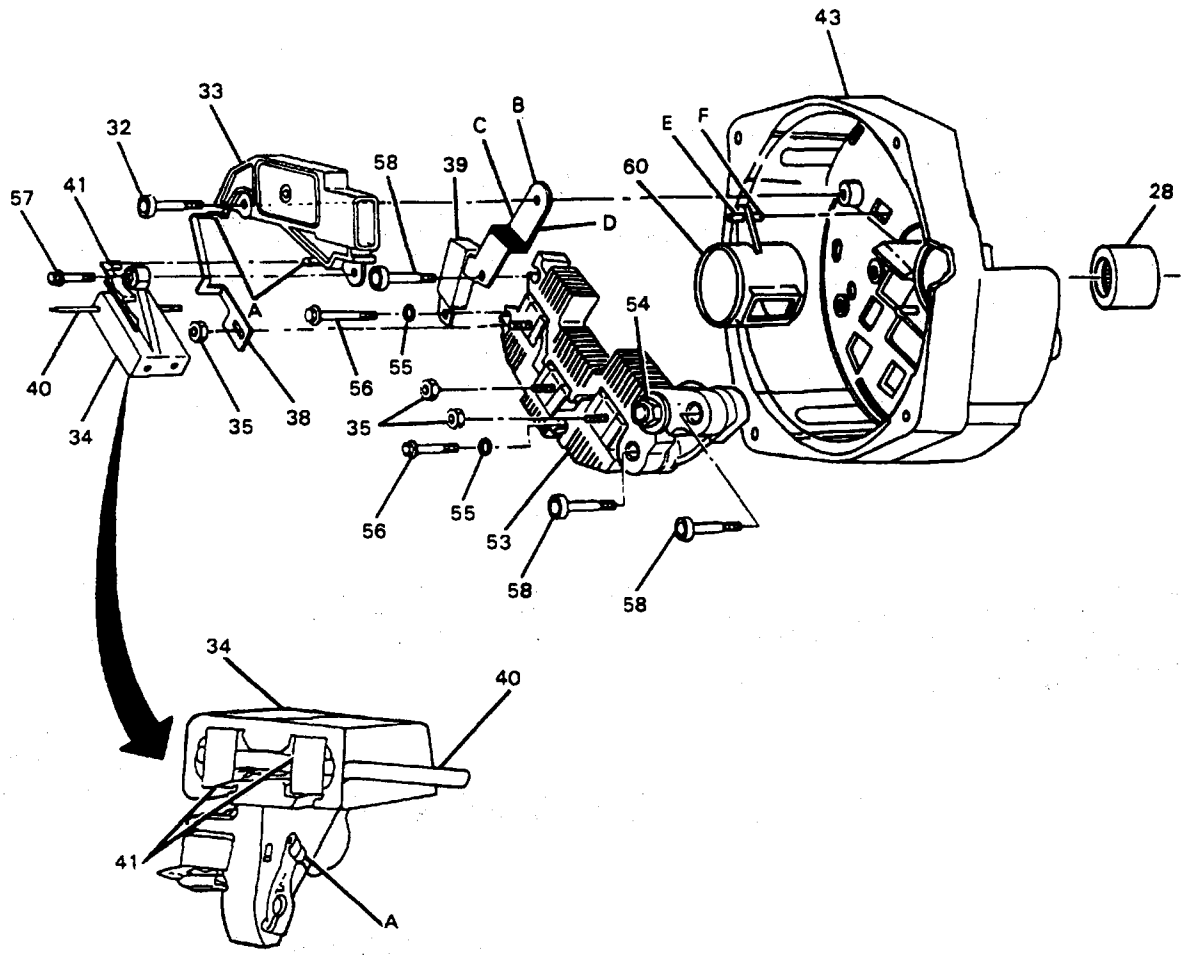
Important

- The capacitor (39) has an insulator material on one side which must rest against the drive end frame (59) (ground).
- The capacitor/rectifier bridge insulated attaching bolt/screw (58) must be installed in the proper hole, attaching the capacitor strap and rectifier bridge (53) to the slip ring end frame (43).

E. Brushes (41) into brush holder (34) with retaining pin (40).
F. Dust shield (60) onto brush holder (34).
G. Voltage regulator (33), and brush holder (34) with dust shield (60), brushes (41) and retaining pin (40) installed into slip ring end frame (43).

Important

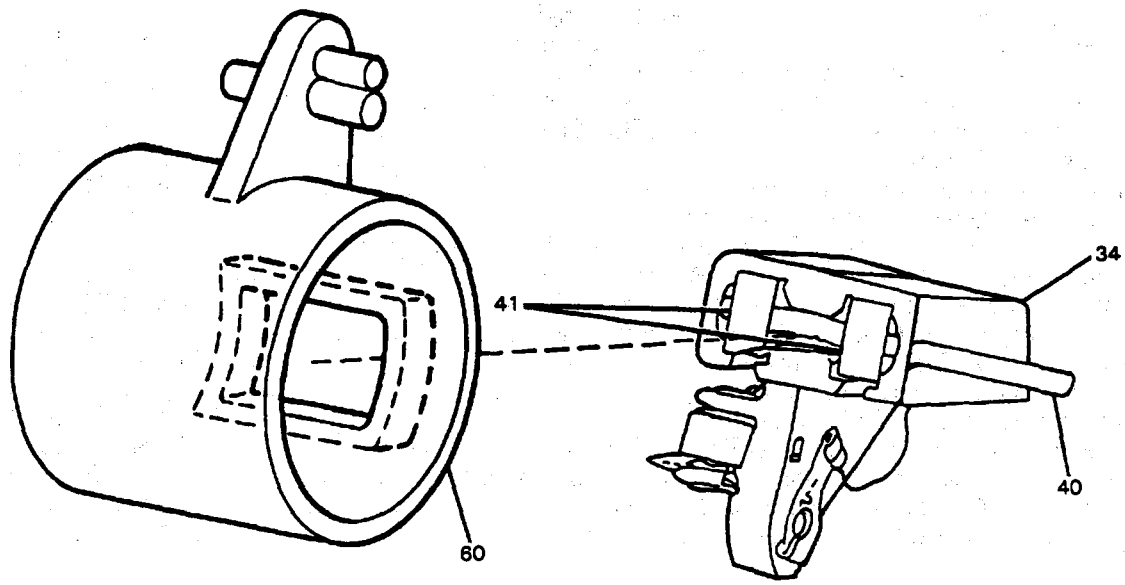
- The metal side of the capacitor strap must be against the regulator connection.



A CLIPS, SOLDER
B STRAP, GENERATOR CAPACITOR
C METAL SIDE
D INSULATED SIDE
E PIN, PLASTIC RETAINING
F CLIP, DUST SHIELD RETAINING
28 BEARING, GENERATOR ROTOR SLIP RING END FRAME
32 BOLT/SCREW, REGULATOR ATTACHING
33 REGULATOR, GENERATOR VOLTAGE
34 HOLDER, GENERATOR BRUSH
35 NUT, STATOR LEAD ATTACHING
38 STRAP, REGULATOR CONNECTOR
39 CAPACITOR, GENERATOR
40 PIN, BRUSH RETAINING
41 BRUSH, GENERATOR
43 FRAME, GENERATOR SLIP RING END
53 BRIDGE, GENERATOR RECTIFIER
54 NUT, GENERATOR BATTERY TERMINAL
55 WASHER, GENERATOR RECTIFIER BRIDGE
56 BOLT/SCREW, GENERATOR RECTIFIER BRIDGE
57 BOLT/SCREW, GENERATOR BRUSH HOLDER
58 BOLT/SCREW, GENERATOR CAPACITOR/RECTIFIER BRIDGE INSULATED ATTACHING
60 SHIELD, DUST

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Figure 11 – Generator Slip Ring End Frame Components



34 HOLDER, GENERATOR BRUSH
40 PIN, BRUSH RETAINING
41 BRUSH, GENERATOR
60 SHIELD, DUST

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Figure 12 – Generator Brushes Retained In Generator Brush Holder

H. Tap plastic retaining pin on dust shield (60) into retaining clip.
   - Be sure brush retaining pin (40) goes through access hole to outside of slip ring end frame (43) for removal after generator is assembled.

I. Bolt/screw (32) and bolt/screw (57).

J. Connector strap (38) to voltage regulator solder clip, and brush holder connection to other voltage regulator solder clip.
   - Crimp and solder voltage regulator solder clip connections.

NOTICE: Avoid excessive heat when soldering connections, as this can cause voltage regulator damage.

K. Stator (36), placing stator terminals over rectifier bridge terminals.

L. Nuts (35).

M. Slip ring end frame (43) and drive end frame (59), noting scribe marks.

N. Slip ring end bearing outer race into bearing well in slip ring end frame casting.

O. Through-bolts/screws (26).

P. Remove retaining pin (40) to release brushes (41) against slip rings.

SPECIFICATIONS

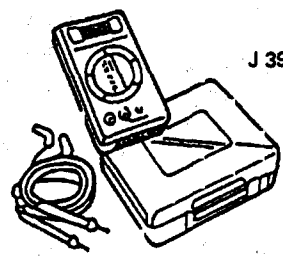
GENERATOR ASSEMBLY USAGE CHART

ENGINE	EQUIPMENT	MODEL	PART NUMBER	RATED AMPERES
3.4L L32	ALL	CS-130		105
5.7L LT1	ALL	CS-144	10480131	124
5.7L LT1	ALL	CS-144	10480111	140

FASTENER TIGHTENING SPECIFICATIONS

CS-130 105-Amp Generator Assembly (3.4L L32 Engine)	
Battery Negative Cable Assembly-to-Battery Terminal	15 N•m (11 lb. ft.)
Battery Positive Cable Assembly-to-Generator Nut	10 N•m (89 lb. in.)
Generator-to-Accessory Mounting Bracket Bolt/Screw (Lower)	50 N•m (37 lb. ft.)
Generator-to-Accessory Mounting Bracket Bolt/Screw (Upper)	50 N•m (37 lb. ft.)
Generator-to-Generator Brace Bolt/Screw	50 N•m (37 lb. ft.)
Generator-to-Generator Brace Nut (Lower)	50 N•m (37 lb. ft.)
Generator-to-Generator Brace Nut (Upper)	25 N•m (18 lb. ft.)
CS-144 124-Amp or 140-Amp Generator Assembly (5.7L LT1 Engine)	
Battery Negative Cable Assembly-to-Battery Terminal	15 N•m (11 lb. ft.)
Battery Positive Cable Assembly-to-Generator Bolt/Screw	10 N•m (89 lb. in.)
Battery Positive Cable Assembly-to-Generator Nut	20 N•m (15 lb. ft.)
Generator Inner Brace Mounting nut	33 N•m (24 lb. ft.)
Generator Outer Brace Mounting Nut	33 N•m (24 lb. ft.)
Generator Rotor Shaft Drive End Nut	100 N•m (75 lb. ft.)
Generator-to-Accessory Mounting Bracket Bolt/Screw (Lower)	50 N•m (37 lb. ft.)
Generator-to-Accessory Mounting Bracket Bolt/Screw (Upper)	50 N•m (37 lb. ft.)
Generator-to-Generator Lower Brace Bolt/Screw	25 N•m (18 lb. ft.)
Generator-to-Generator Upper Brace Bolt/Screw	50 N•m (37 lb. ft.)

SPECIAL TOOLS



1 DIGITAL MULTIMETER

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SECTION 6D4

IGNITION SYSTEM

CAUTION: Before removing or installing any electrical unit or when a tool or equipment could easily come in contact with "live" exposed electrical terminals, disconnect the negative battery cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "OFF" or "LOCK" position.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

The ignition system controls fuel combustion by providing a spark to ignite the compressed air/fuel mixture at the correct time. To provide improved engine performance, fuel economy, and control of exhaust emissions, the powertrain control module (PCM) controls distributor spark advance (timing) with an ignition control system.

IGNITION SYSTEM (5.7L LT1 ENGINE)

The 5.7L LT1 engine ignition system consists of a distributor assembly, control circuits for ignition timing in the powertrain control module (PCM), a separate ignition coil/ignition control module assembly, vacuum harness, primary and secondary wiring, and the spark plugs. All ignition timing is controlled by the PCM; there is no "bypass" mode built into the ignition control module as in other ignition systems.

The distributor assembly is mounted directly to the front cover behind the water pump assembly. It directs the spark from the ignition coil assembly to the proper spark plug secondary wire through a rotor. Spark plug secondary wire connectors in the distributor cap are arranged for convenience in routing spark plug wire harness assemblies. The corresponding cylinder number is molded into the distributor cap next to each spark plug secondary wire connector.

The distributor assembly also contains a signal disk and two optical camshaft position (CMP) sensor assemblies that provide signals to the PCM for timing control. One CMP sensor assembly senses 360 equally-spaced slots in the signal disk to provide 720 signals per camshaft revolution for high-resolution timing control. The other CMP sensor assembly senses eight disk slots of variable length, providing a low-resolution signal that tells the PCM which spark plug is being fired. Power for the opti-

cal CMP sensor assemblies, a system ground, and the two CMP sensor assembly signals are transferred between the PCM and the distributor assembly through a shielded harness connected to the four-terminal connector on the distributor.

The ignition system supplies two timing inputs to the PCM, a high resolution signal (360 pulses per one camshaft revolution) and a low resolution signal (eight pulses per one camshaft revolution). The PCM can determine if one of the timing inputs is not being received by comparing the two inputs. If the PCM detects one timing pulse without detecting the other timing pulse, diagnostic trouble code 16 or 36 will set.

The reference signals toggle between 0 and 5 volts as the camshaft assembly turns. Therefore, an open, a short to voltage, a short to ground, or a defective sensor inside the distributor assembly can prevent the voltage from pulsing at the PCM.

The ignition coil/ignition control module assembly provides spark to the distributor assembly, timed by signals from the PCM. Power (B+) for the ignition coil primary circuit and the ignition control module is supplied by the ignition switch. The PCM combines the camshaft position information supplied by the distributor with other system parameters and calculates the required spark advance and coil dwell. The PCM signals the ignition control module, which turns on the primary current to the ignition coil by grounding the primary circuit, and then turns it off by removing the ground. When the primary current flow stops, high voltage induced in the ignition coil secondary winding becomes the spark voltage for the spark plug. The spark voltage is delivered to the distributor assembly through the coil output (secondary) wire, and then directed to the proper spark plug connector by the distributor rotor.

IGNITION SYSTEM (3.4L L32 ENGINE)

The 3.4L L32 engine ignition system uses a "waste spark" method of spark distribution. Each cylinder is paired with its opposing cylinder in the firing order, so that one cylinder on compression fires simultaneously with its opposing cylinder on exhaust. Since the cylinder on the exhaust requires very little of the available voltage to fire its plug, most of the voltage is used to fire the cylinder on compression. The process reverses when the cylinders reverse roles. There are three coils for this electronic ignition (EI) system.

Components of the EI system include an ignition coil, ignition coil module, 3X signal crankshaft position sensor assembly, camshaft position sensor assembly, 24X signal crankshaft position sensor assembly, crankshaft reluctor ring, crankshaft balancer assembly with interrupter rings, and the PCM. The coil pack consists of three separate, interchangeable, ignition coils. The ignition coil module is located above the power steering pump assembly and is connected to the PCM. The ignition coil module controls the primary circuit to the coils, turning them on and off.

This system also uses a magnetic crankshaft position sensor assembly which protrudes into the engine block, within approximately 1.27 mm (0.050 inch) of the crankshaft reluctor. The reluctor is a special wheel cast on the crankshaft assembly that has seven machined slots, six of which are equally spaced (60 degrees apart). The seventh slot is spaced 10 degrees from one of the other slots. As the reluctor rotates with the crankshaft, the slots change the magnetic field of the crankshaft position sensor assembly, causing an induced voltage pulse.

By counting the time between pulses, the ignition control module can recognize the pulse of the seventh slot (sync pulse). Based on this sync pulse, the ignition control module sends the reference signal to the PCM to calculate crankshaft position (used to fire coils in correct sequence) and engine speed.

To properly control timing, the PCM relies on the following information:

- Engine load (manifold pressure or vacuum).
- Atmospheric (barometric) pressure.
- Engine temperature.
- Intake air temperature.
- Crankshaft position.
- Engine speed (rpm).

For further information refer to SECTION 6E3.

Camshaft Position Sensor Assembly (3.4L L32 Engine)

The camshaft position sensor assembly is located on the engine block behind the water pump assembly near the lower intake manifold assembly.

The camshaft position sensor assembly is used for timing the injectors for sequential injection. This sensor is a hall-effect type switch. Refer to SECTION 6E3 for more information.

24X Signal Crankshaft Position Sensor Assembly (3.4L L32 Engine)

The 24X signal crankshaft position sensor assembly is mounted to the engine front cover assembly and is partially behind the crankshaft balancer assembly. This sensor reads 24 notches in the crankshaft balancer assembly for crankshaft position and is used for ignition control during engine cranking and improved idle control. The ECM uses the 24X signal crankshaft position sensor assembly to improve spark accuracy at speeds below 1200 rpm, and influence fuel delivery at speeds below 2000 rpm. This is a hall-effect sensor. For additional information, refer to SECTION 6E3.

3X Signal Crankshaft Position Sensor Assembly (3.4L L32 Engine)

The 3X signal crankshaft position sensor assembly inserts through the right side of the engine block at mid-engine, near the crankshaft reluctor ring. Notches in the crankshaft reluctor ring trigger the magnetic pickup sensor to provide timing information to the PCM. This is also a hall-effect sensor. For additional information, refer to SECTION 6E3.

SPARK PLUG WIRE HARNESS ASSEMBLY

The spark plug wire harness assemblies used with both ignition systems use carbon impregnated cord conductors, encased in 8 mm (5/16-inch) diameter silicone jackets. The silicone jackets withstand very high tempera-

tures and also provide excellent insulation for the high voltage of the system. Silicone spark plug boots form a tight seal to the spark plugs.

SPARK PLUGS

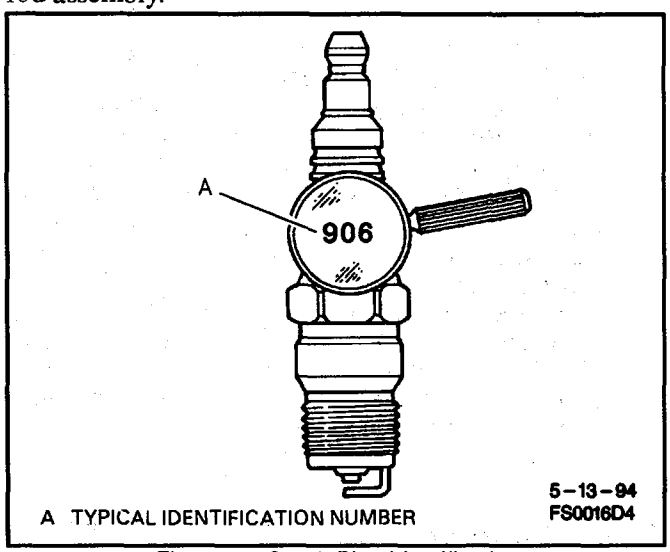
Figure 1

Resistor type, tapered seat spark plugs are used on all engine assemblies. No gasket is used on these tapered-seat spark plugs. Refer to SECTION 0B for spark plug type and gap size. When replacing spark plugs, use only the type specified.

Normal service is assumed to be a mixture of idling, slow speed, and high speed driving. Occasional or intermittent high-speed driving is needed for good spark plug performance. It gives increased combustion heat, burning away carbon or oxides that have built up from frequent idling, or continual stop-and-go driving.

IGNITION SWITCH

The mechanical key and lock cylinder ignition switch is located in the steering column assembly on the right-hand side, just below the steering wheel. The electrical switching portion of the assembly is separate from the key and lock cylinder. However, both are synchronized and work in conjunction through the action of the actuator rod assembly.



A TYPICAL IDENTIFICATION NUMBER

Figure 1 – Spark Plug Identification

For a complete explanation of the key and lock cylinder, and the actuator rod assembly, refer to SECTION 3F or SECTION 3F5B. For electrical switching information, refer to SECTION 8A.

KNOCK SENSOR SYSTEM

The knock sensor system retards the spark advance when detonation occurs. Further information is found in SECTION 6E3.

IGNITION TIMING

The base timing is preset when the engine is manufactured, no adjustment is possible. Timing advance and retard are accomplished through the PCM with ignition control and knock sensor systems.

DIAGNOSIS

IGNITION SYSTEM

Diagnosis for the ignition system is in SECTION 6E3.

SPARK PLUGS

Worn or dirty spark plugs may give satisfactory operation at idling speed, but frequently fail at higher rpm. Faulty spark plugs may cause poor fuel economy, power loss, loss of speed, hard starting and generally poor engine performance. Follow the scheduled maintenance services recommendations given in SECTION 0B, to assure satisfactory spark plug performance.

Normal spark plug operation will result in brown to grayish-tan deposits appearing on the portion of the spark plug that projects into the cylinder area. A small amount of red-brown, yellow, and white powdery material may also be present on the insulator tip around the center electrode. These deposits are normal combustion by-products of fuels and lubricating oils with additives. Some electrode wear will also occur.

Engine assemblies which are not running properly are often referred to as "misfiring." This means the ignition spark is not igniting the fuel/air mixture at the proper time. While other ignition and fuel system causes must also be considered, possible causes include ignition system conditions which allow the spark voltage to reach ground in some other manner than by jumping across the air gap at the tip of the spark plug, leaving the fuel/air mixture unburned. Refer to SECTION 6E3. Misfiring may also occur when the tip of the spark plug becomes overheated and ignites the mixture before the spark jumps. This is referred to as "pre-ignition."

Spark plug misfiring may be indicated in a number of ways: poor fuel economy, power loss, loss of speed, hard starting, and/or generally poor engine performance. Worn or dirty plugs may give satisfactory operation at idling speed, but will misfire under other operating conditions. Spark plugs may also misfire due to fouling, excessive gap, or a cracked or broken insulator. Should misfiring occur before the recommended replacement interval, locate and correct the cause.

Carbon fouling of the spark plug is indicated by dry, black carbon (soot) deposits on the portion of the spark plug in the cylinder. Excessive idling and slow speeds under light engine loads can keep the spark plug temperatures so low that these deposits are not burned off. Over-rich fuel mixtures or poor ignition system output may also be the cause. Refer to SECTION 6E for diagnosis.

Oil fouling of the spark plug is indicated by wet oily deposits on the portion of the spark plug in the cylinder, usually with little electrode wear. This may be caused by oil getting past worn piston rings. This condition also may occur during break-in of new or newly overhauled engine assemblies.

Deposit fouling of the spark plug occurs when the normal red-brown, yellow or white deposits of combustion by-products become sufficient to cause misfiring. In some cases, these deposits may melt and form a shiny glaze on the insulator around the center electrode. If the fouling is found in only one or two cylinders, valve stem clearances or intake valve seals may be allowing excess

lubricating oil to enter the cylinder, particularly if the deposits are heavier on the side of the spark plug that was facing the intake valve.

Excessive gap means that the air space between the center and side electrodes at the bottom of the spark plug is too wide for consistent firing. This may be due to improper gap adjustment or to excessive wear of the electrodes during use. A check of the gap size and comparison to the gap specified for the vehicle in SECTION 0B, will tell if the gap is too wide. Too small of a spark plug gap may cause an unstable idle condition. Excessive gap wear can be an indication of continuous operation at high speeds or with high engine loads, causing the spark plug to run too hot. Another possible cause is an excessively lean fuel mixture.

Low or high spark plug installation torque or improper seating can result in the spark plug running too hot and cause excessive gap wear. The plug and cylinder head seats must be in good contact for proper heat transfer and spark plug cooling. Dirty or damaged threads in the head or on the spark plug can keep it from seating even though the proper torque is applied. Once spark plugs are properly seated, tighten to torque shown under "Specifications" in this section. Low torque may result in poor contact of seats due to a loose spark plug. Over-tightening may cause spark plug shell to be stretched and also result in poor contact between seats. In extreme cases, exhaust blow-by and damage beyond simple gap wear may occur.

Cracked or broken insulators may be the result of improper installation, damage during spark plug regapping, or heat shock to the insulator material. Upper insulators can be broken when a poorly fitting tool is used during installation or removal, or when the spark plug is hit from the outside. Cracks in the upper insulator may be inside the shell and not visible. Also, the breakage may not cause problems until oil or moisture penetrates the crack later.

A broken or cracked lower insulator tip (around the center electrode) may result from damage during regapping or from "heat shock" (spark plug suddenly operating too hot).

Damage during regapping can happen if the gapping tool is pushed against the center electrode or the insulator around it, causing the insulator to crack. When regapping a spark plug, make the adjustment by only bending the ground side terminal, keeping the tool clear of other parts.

"Heat shock" breakage in the lower insulator tip generally occurs during severe engine operating conditions (high speeds or heavy loading) and may be caused by over-advanced timing or low grade fuels. Heat shock refers to a rapid increase in the tip temperature that causes the insulator material to crack.

Spark plugs with less than the recommended amount of service can sometimes be cleaned and regapped, then returned to service. However, if there is any doubt about the serviceability of a spark plug, replace it. Spark plugs with cracked or broken insulators should always be replaced.

SPARK PLUG WIRE HARNESS ASSEMBLY

Inspect spark plug wires visually first for any cuts, burns, or damage. While engine is running, inspect for any arcing to ground or other components. Use a spray bottle to lightly coat the spark plug wires with water while observing idle quality, if idle quality diminishes or engine stalls, spark plug wires should be replaced.

ON-VEHICLE SERVICE

SERVICE PRECAUTIONS

- Allow engine assembly to cool before removing spark plugs. Attempting to remove spark plugs from a hot engine assembly may cause spark plugs to seize, causing damage to cylinder head threads.
- Clean spark plug recess area before removing spark plug. Failure to do so can result in engine damage due to dirt or foreign material entering cylinder head assembly, or in contamination of cylinder head threads. Contaminated threads may prevent proper seating of new spark plug.
- Spark plug gap must be checked using a "wire type" gage before installing into engine. Refer to SECTION 0B, for spark plug usage information. Today's technology requires a specific spark plug heat range for each engine type. Installing spark plugs of any other heat range can severely damage the engine assembly.
- Check spark plug gap using a wire type gage before installing. If spark plug gaps are not adjusted correctly, engine idle quality may be seriously affected. A wire type gage must be used (as opposed to a flat feeler type gage) to insure an accurate reading. Refer to SECTION 0B for correct spark plug type and gap.
- The material used to construct spark plug wires is very soft. This wire will withstand more heat and carry a higher voltage, but chaffing and cutting become easier. The spark plug wires must be routed correctly to prevent chaffing or cutting. See "Spark Plug Wire Harness Assembly Replacement" in the following procedure, for routing. When removing a spark plug wire from a spark plug, twist the boot on the spark plug one-half turn while pulling on the boot.

SPARK PLUG WIRE HARNESS ASSEMBLY REPLACEMENT (5.7L LT1 ENGINE)

Figure 2

NOTICE: The boots should be twisted one-half turn while removing. Do not pull on the wires to remove them from the spark plugs. Pull on the boots, or use a tool designed for this purpose.

When replacing spark plug wire harness assemblies (secondary wiring), route the wires correctly and through the proper retainers. Failure to route the wires properly can lead to radio ignition noise and crossfiring of the spark plugs, or shorting of the leads to ground.

Remove or Disconnect

1. Be sure ignition switch is in "OFF" or "LOCK" position.

2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Power steering pump assembly. Refer to SECTION 3B.
4. Crossover pipe from exhaust manifold assemblies.
5. Lower radiator hose from water pump.
6. Spark plug wire harness from wire harness clips.
7. Spark plug wire harness from distributor.
8. Spark plug wire harness from spark plugs.
   - Note position of wires before removing.

Install or Connect

NOTICE: See "Notice" on page 6D4-1 of this section.

1. Spark plug wire harness to spark plugs.
2. Spark plug wire harness to distributor.
3. Spark plug wire harness to wire harness clips.
4. Lower radiator hose to water pump.
5. Crossover pipe to exhaust manifold assemblies.

Tighten

- Crossover pipe to exhaust manifold nuts to 35 N•m (26 lb. ft.).

6. Power steering pump assembly. Refer to SECTION 3B.
7. Lower vehicle.

SPARK PLUG WIRE HARNESS ASSEMBLY REPLACEMENT (3.4L L32 ENGINE)

Figure 3

NOTICE: The boots should be twisted one-half turn while removing. Do not pull on the wires to remove them from the spark plugs. Pull on the boots, or use a tool designed for this purpose.

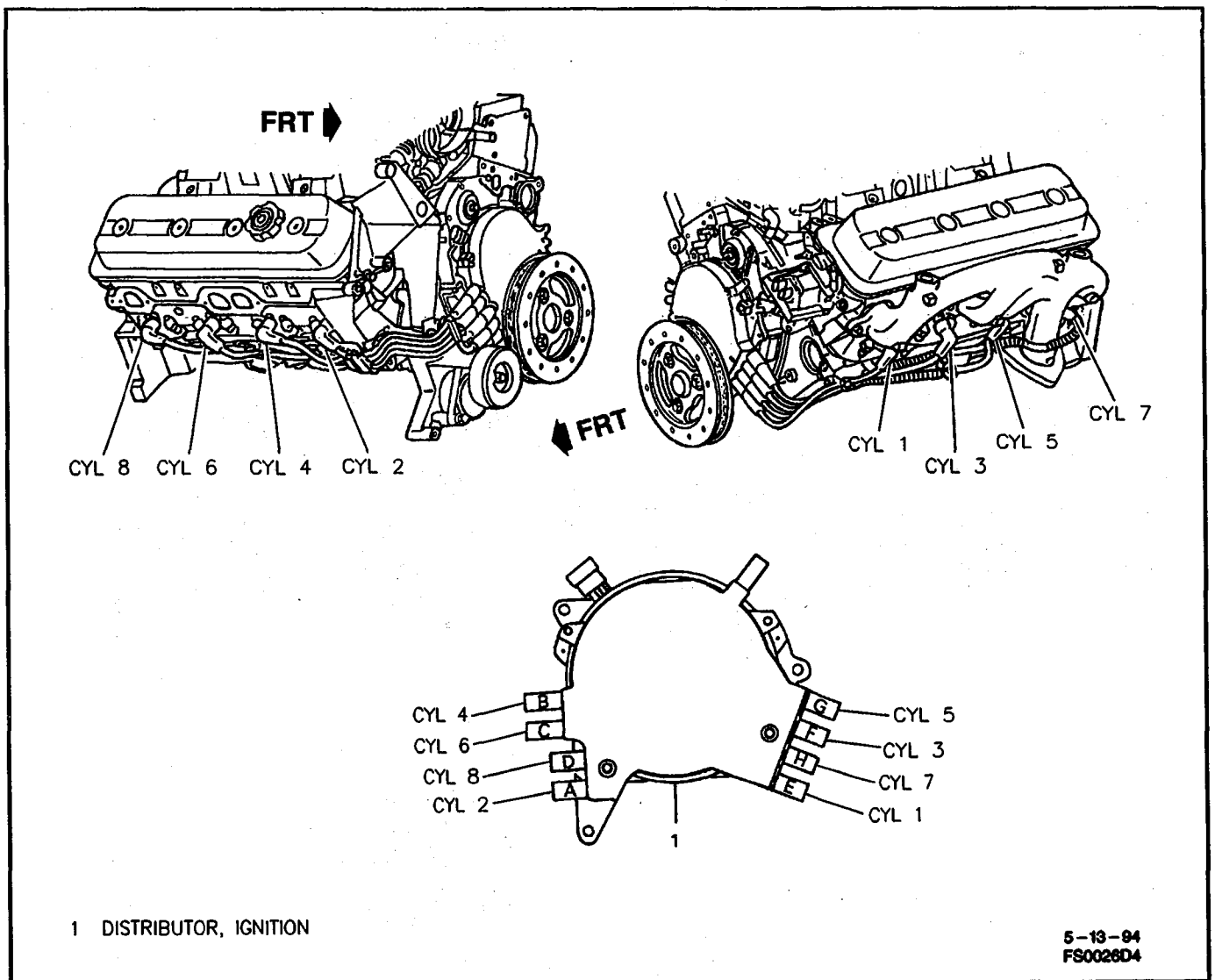


Figure 2 – Spark Plug Wire Harness Assembly Routing (5.7L LT1 Engine)

Remove or Disconnect

1. Be sure ignition switch is in "OFF" or "LOCK" position.
2. Accelerator cable cover from accelerator cable bracket.
3. Spark plug wire harness from wire harness clips.
4. Spark plug wire harness from coil.
5. Spark plug wire harness from spark plugs.
   - Note position of wires before removing.

Install or Connect

NOTICE: See "Notice" on page 6D4-1 of this section.

1. Spark plug wire harness to spark plugs.
2. Spark plug wire harness to coil.
3. Spark plug wire harness to wire harness clips.
4. Accelerator cable cover to accelerator cable bracket.

SPARK PLUGS

Figures 2 and 3

CAUTION: If you smoke while handling coated spark plugs, wear gloves to prevent transfer of the coating to cigarettes and subsequent burning of the coating. Wash hands after installing spark plugs.

Remove or Disconnect

1. Be sure ignition switch is in "OFF" or "LOCK" position.

   NOTICE: The boots should be twisted one-half turn while removing. Do not pull on the wires to remove them from the spark plugs. Pull on the boots, or use a tool designed for this purpose.
2. Spark plug wire harness assembly from spark plugs.
   - Note positions of wires before removing.

Important

- Clean dirt and debris from spark plug recess areas.

3. Spark plugs from cylinder head assemblies.

Install or Connect

NOTICE: Be sure spark plugs thread smoothly into cylinder head assemblies and are fully seated. Cross-threading or failing to fully seat spark plugs can cause overheating of spark plugs, exhaust blow-by, or thread damage. Follow recommended torque specifications carefully. Over or under-tightening can also cause severe damage to cylinder head assemblies or spark plugs.

1. Spark plugs to cylinder head assemblies.

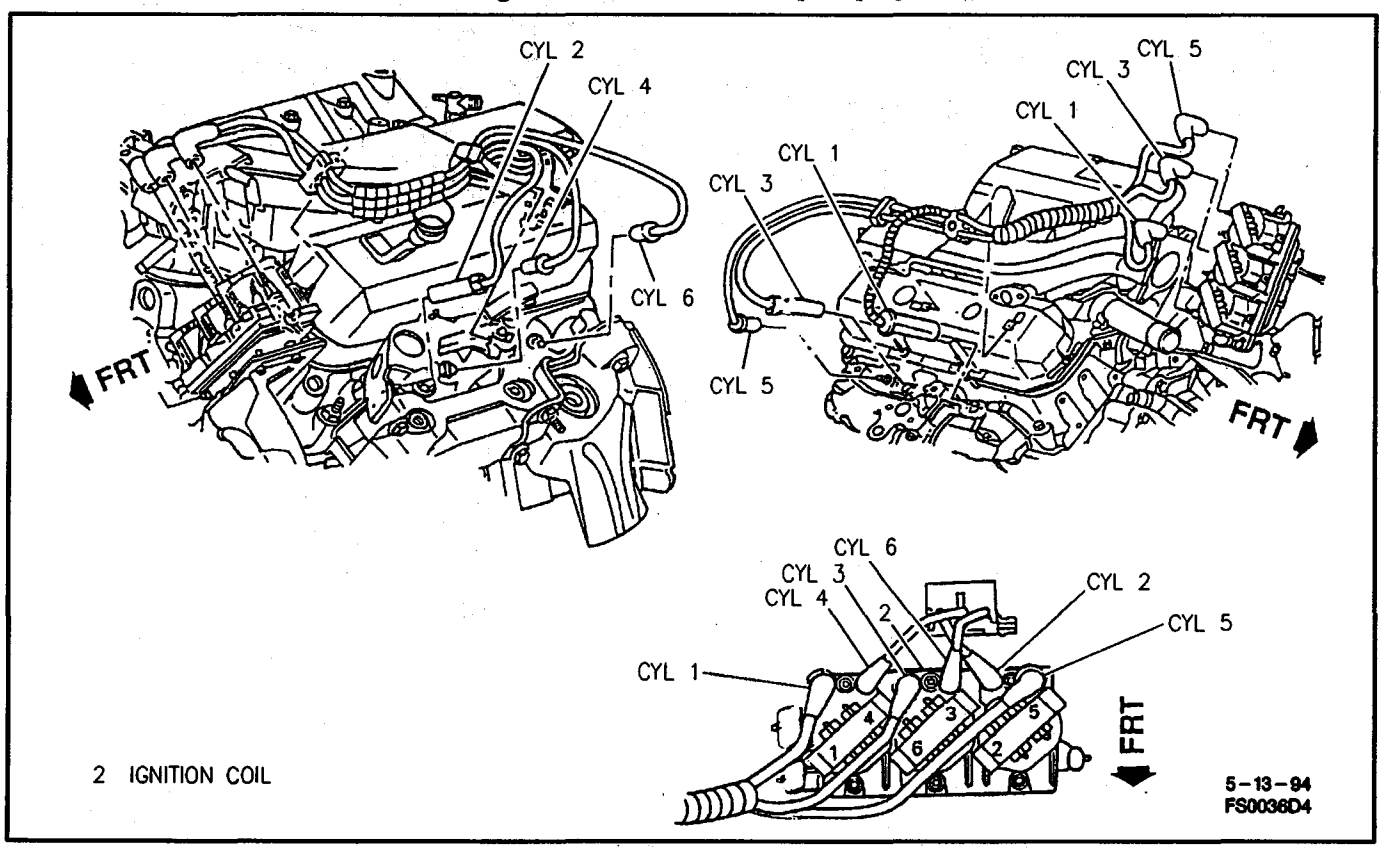


Figure 3 – Spark Plug Wire Harness Assembly Routing (3.4L L32 Engine)

Tighten

- Spark plugs to 15 N•m (11 lb. ft.).

2. Spark plug wire harness assemblies, routed properly as note during removal.

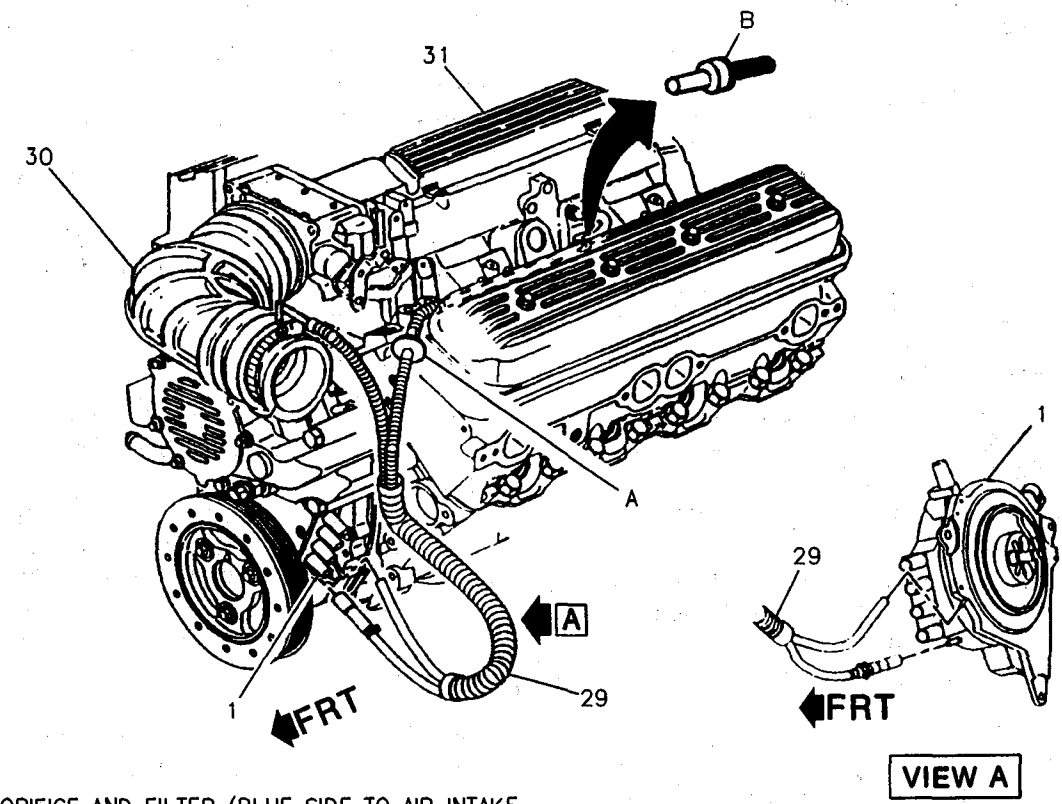
DISTRIBUTOR ASSEMBLY VENTILATION SYSTEM (5.7L LT1 Engine)

Figure 4

The ventilation system vacuum harness assembly (29), connected to the air intake duct (30), the distributor assembly (1) and the air intake manifold (31), provides ventilation to the distributor assembly (1), thus preventing moisture build-up and possible ignition system failure. A check valve at the air intake duct connection insures one-way flow through the distributor assembly (1) to the air intake manifold (31), refer to Figure 4 for correct orientation.

The ventilation system vacuum harness assembly (29) connects to the air intake duct (30) and the air intake manifold (31) with vacuum fittings. It attaches to the distributor assembly (1) at two places with separately sized connectors.

In the case of ignition system failure, check vacuum harness assembly (29) for proper hook-up and/or kinks. If OK, check the ventilation system for a possible restriction before removing the distributor assembly (1). Disconnect the vacuum harness assembly (29) at the air intake duct (30) and check for vacuum using a vacuum gage. The gage needle should slowly move towards manifold vacuum. If no vacuum is present, replace the vacuum harness assembly (29). Once is has been determined that the ventilation system vacuum harness assembly is functioning properly, disconnect the vacuum gage and reconnect the vacuum hose to the air intake duct. Running the engine with manifold vacuum present in the distributor may lead to engine misfire.



A ORIFICE AND FILTER (BLUE SIDE TO AIR INTAKE MANIFOLD)
B VACUUM CHECK VALVE ("VAC" SIDE TO AIR INTAKE MANIFOLD)
1 DISTRIBUTOR, INGITION
29 VACUUM HARNESS, DISTRIBUTOR VENTILATION SYSTEM
30 DUCT, AIR INTAKE
31 MANIFOLD, AIR INTAKE

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Figure 4 – Distributor Assembly Ventilation System (5.7L LT1 Engine)

Important

- Failure to connect all hoses of the ventilation system will eventually result in distributor assembly failure.

DISTRIBUTOR (5.7L LT1 ENGINE)

Figure 5

Remove or Disconnect

1. Check the distributor ventilation system for proper operation. Refer to "Distributor Assembly Ventilation System" in this section.
2. Be sure ignition switch is in "OFF" or "LOCK" position.

Important

- Do not allow foreign material to enter open vacuum lines, cap ends as necessary.

3. Water pump assembly. Refer to SECTION 6B.
4. Crankshaft balancer assembly. Refer to SECTION 6A3A.

Important

- Make sure all coolant has been wiped off distributor and surrounding area before disconnecting any electrical connectors or spark plug wire harness assemblies.

5. Spark plug wire harness assemblies from distributor assembly (1). Refer to "Spark Plug Wire Harness Assembly Replacement" in this section.
6. Four-terminal PCM connector from distributor assembly (1).
7. Vacuum harness assembly (29) from distributor assembly(1). Refer to "Distributor Assembly Ventilation System" in this section.
8. Distributor bolts/screws (3).
9. Distributor assembly (1).
   - Pull distributor assembly forward until driveshaft (4) disengages from end of camshaft assembly.

Install or Connect

NOTICE: See "Notice" on page 6D4-1 of this section.

1. Distributor assembly (1) into position with driveshaft (4) in end of camshaft assembly.
   A. Rotate distributor coupling until camshaft sprocket pin slot aligns with camshaft sprocket pin.
   B. Slide distributor (1) onto end of camshaft until fully seated on engine front cover.

Important

- Do not attempt to fully seat distributor (1) using bolts/screws (3). If distributor (1) will not seat by hand, it is not properly aligned with camshaft. Rotate crankshart until engine is at number 1 cylinder TDC (camshaft sprocket pin at the 9 o'clock position). Rotate the distributor coupling (4) until the camshaft sprocket pin slot aligns with the distributor base timing mark. Install distributor (1) using hand pressure to fully seat.

2. Distributor bolts/screws (3).

Tighten

- Bolts/screws (3) to 12 N•m (106 lb. in.).

3. Four-terminal PCM connector to distributor assembly (1).
4. Vacuum harness (29) to distributor (1). Refer to "Distributor Assembly Ventilation System" in this section.
5. Spark plug wire harness assemblies to distributor assembly (1).
6. Crankshaft balancer assembly. Refer to SECTION 6A3A.
7. Water pump assembly. Refer to SECTION 6B.

DISTRIBUTOR CAP, COVER, ROTOR AND BASE ASSEMBLY (5.7L LT1 Engine)

Figure 6

Tools Required:

J 39997 Ignition Distributor Cap Socket

J 39998 Ignition Distributor Rotor

NOTICE: The distributor and timing disk assembly must be kept clean and free of oil, dirt and engine coolant. Any contamination may lead to engine misfire and distributor assembly damage. Do not disassemble the distributor until all coolant has been cleaned from the distributor and surrounding area.

Remove or Disconnect

1. Remove the water pump and crankshaft balancer assembly. Refer to SECTION 6A4A.
2. Spark plug wire harness assemblies from distributor assembly.
3. Four-terminal PCM connector from distributor assembly.
4. Vacuum harness assembly from distributor assembly.

Important

- Do not allow foreign material to enter open vacuum lines, cap ends as necessary.

5. Distributor cap bolts/screws (29) using J 39997 or equivalent.
6. Distributor cap (30).

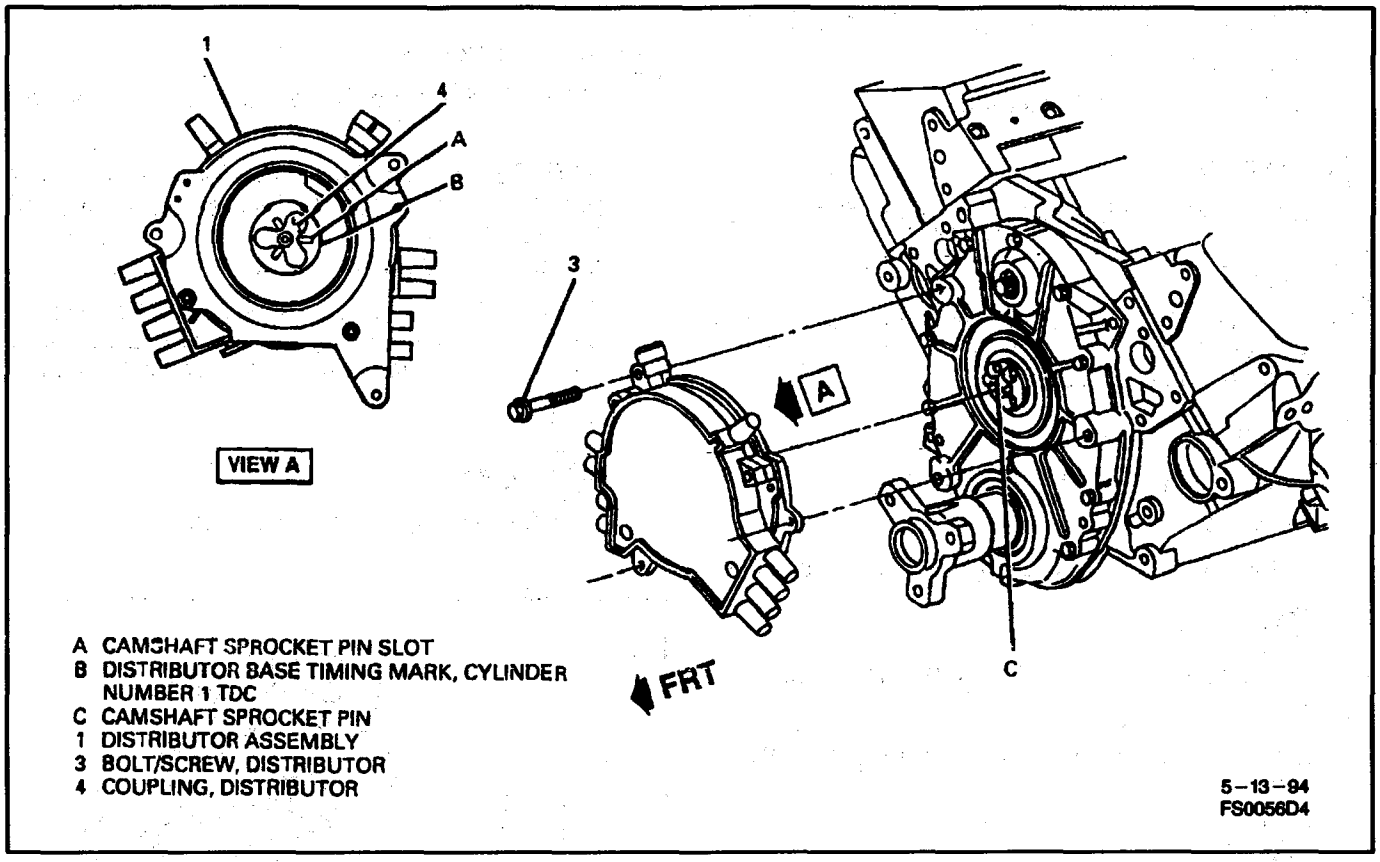


Figure 5 – Distributor Assembly (5.7L LT1 Engine)

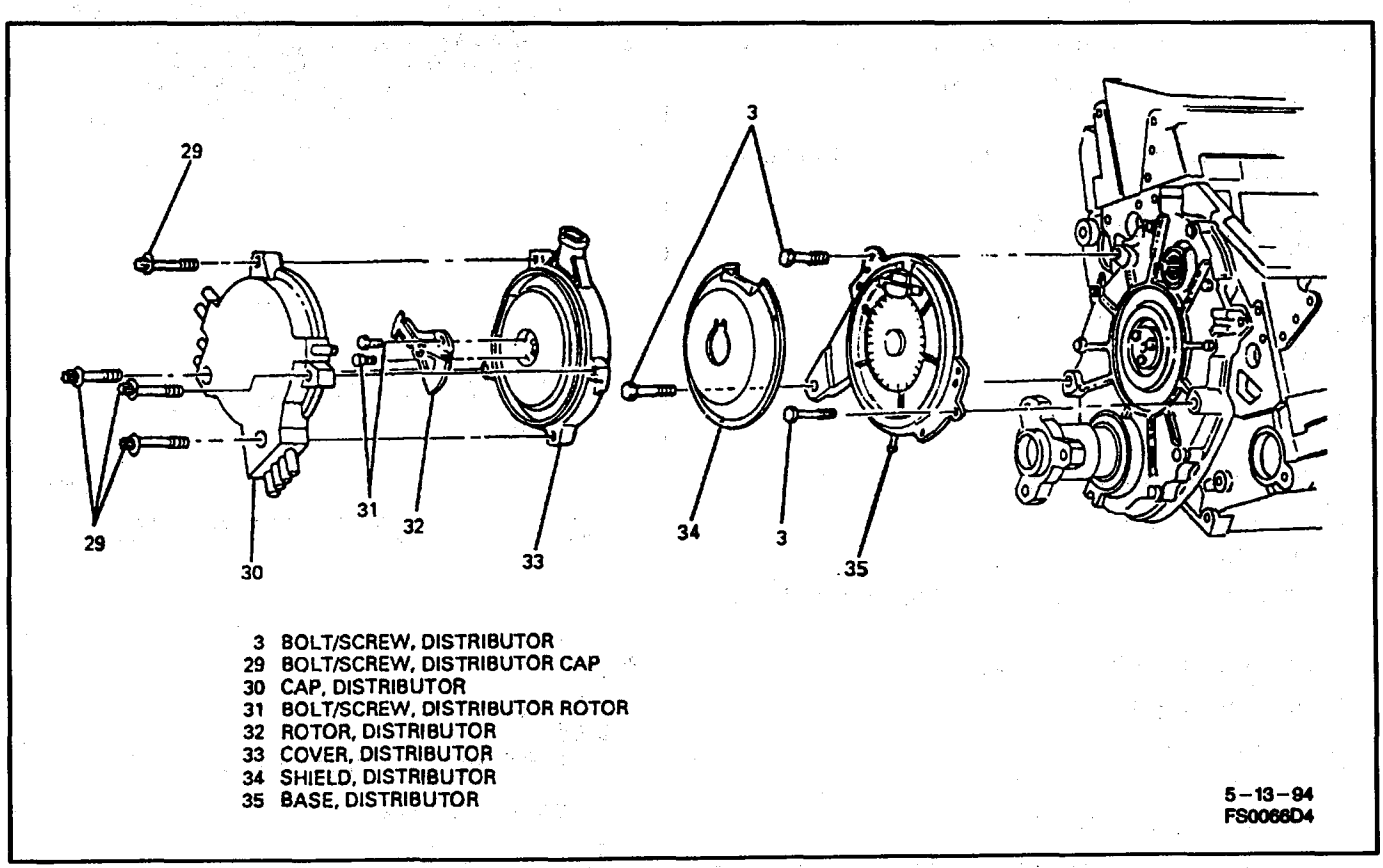


Figure 6 – Distributor Cap, Cover, Rotor and Base Assembly (5.7L LT1 Engine)

7. Rotor bolts/screws (31) using J 39998 or equivalent.
8. Rotor assembly (32).
9. Distributor cover (33) and shield (34).

Important

- Do not touch timing disk sensor or distributor base.

Inspect

- Distributor base and timing disk for damage, corrosion or plastic particles. If any are present, replace entire distributor assembly.

Install or Connect

1. Shield (34) and distributor cover (33).
2. Rotor (32).
3. Rotor bolts/screws (31) using J 39998 or equivalent.

Tighten

- Rotor bolts/screws (31) to 0.7 N•m (6 lb. in.).

4. Distributor cap (30).
5. Distributor cap bolts/screws (29) using J 39997 or equivalent.

Tighten

- Distributor cap bolts/screws (29) to 2.8 N•m (25 lb. in.).

6. Vacuum harness assembly to distributor assembly.
7. Connect four-terminal PCM connector to distributor.
8. Spark plug wire harness assemblies to distributor assembly.
9. Crankshaft balancer and water pump assemblies. Refer to SECTION 6A4A.

IGNITION COIL ASSEMBLY (5.7L LT1 ENGINE)

Figure 7

Remove or Disconnect

1. Be sure ignition switch is in "OFF" or "LOCK" position.
2. Four-terminal PCM connector at ignition coil module.
3. Ignition coil wiring connectors.
4. Ignition coil harness.
5. Bolt/screw (6).
6. Stud (5).
7. Ignition coil assembly (8).
   - Do not wipe silicone grease from bottom of ignition coil assembly (8) if it is to be reinstalled.

Install or Connect

NOTICE: See " Notice" on page 6D4-1 of this section.

NOTICE: If a new ignition coil assembly is to be installed, a package of silicone grease will be included in the box. This grease is necessary for ignition coil assembly cooling.

1. Spread silicone grease on metal mounting face of ignition coil bracket (14) if necessary, and position ignition coil assembly (8) to cylinder head assembly.
2. Stud (5).

Tighten

- Stud (5) to 25 N•m (18 lb. ft.).

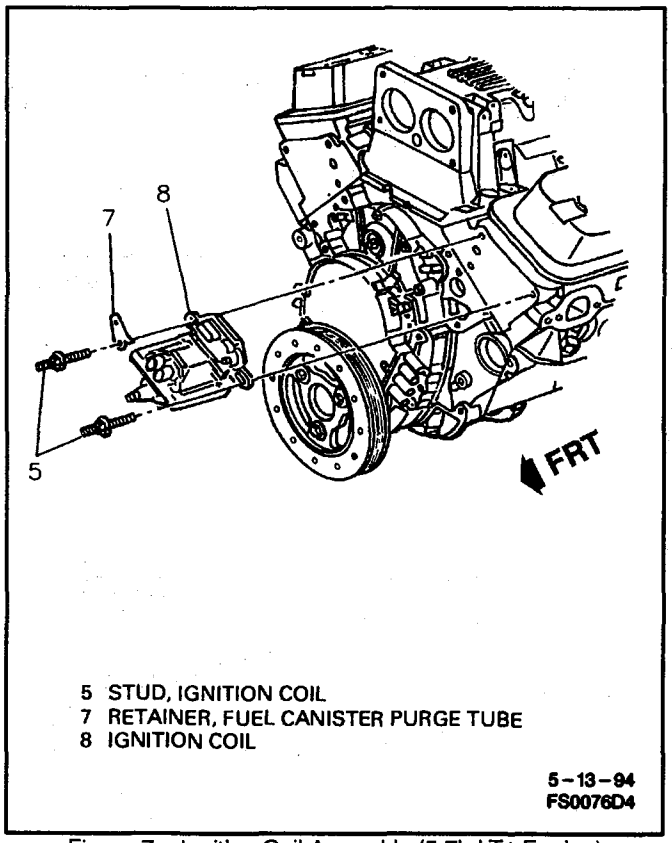


Figure 7 – Ignition Coil Assembly (5.7L LT1 Engine)

3. Bolt/screw (6).

Tighten

- Bolt/screw (6) to 25 N•m (18 lb. ft.).

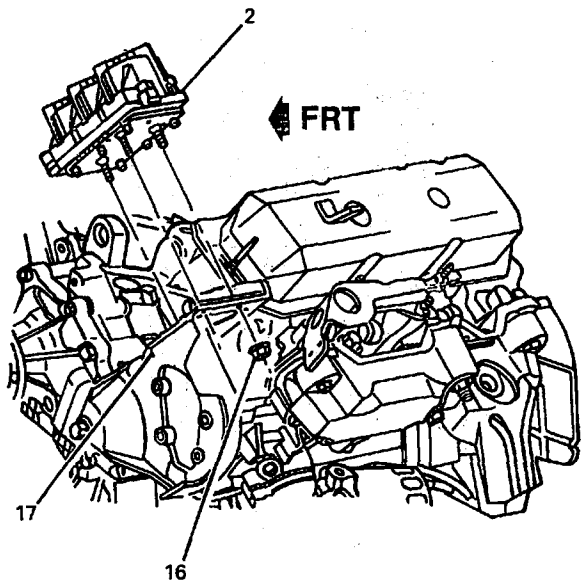
4. Ignition coil harness.
5. Ignition coil wiring connectors.
6. Four-terminal PCM connector to ignition coil module.

IGNITION COIL ASSEMBLY (3.4L L32 ENGINE)

Figure 8

Remove or Disconnect

1. Be sure ignition switch is in "OFF" or "LOCK" position.
2. Spark plug wire harness assembly from ignition coil assembly (2).
3. Electrical connectors.
4. Nuts (16).
5. Ignition coil assembly (2).



2 IGNITION COIL ASSEMBLY
16 NUT, IGNITION COIL ASSEMBLY
17 BRACKET, IGNITION COIL AND POWER STEERING PUMP

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Figure 8 – Ignition Coil Assembly (3.4L L32 Engine)

Install or Connect

NOTICE: See "Notice" on page 6D4-1 of this section.

1. Ignition coil assembly (2).
2. Nuts (16).

Tighten

- Nuts (16) to 10 N•m (89 lb. in.).

3. Electrical connectors.
4. Spark plug wire harness assembly.

3X SIGNAL CRANKSHAFT POSITION SENSOR ASSEMBLY (3.4L L32 ENGINE)

Figure 9

Remove or Disconnect

1. Be sure ignition switch is in "OFF" or "LOCK" position.
2. Sensor electrical connector.
3. Bolt/screw (26).
4. Sensor assembly (25) from engine block.

Inspect

- Sensor O-ring for wear, cracks or leakage. Replace if necessary.

Install or Connect

NOTICE: See "Notice" on page 6D4-1 of this section.

1. Lubricate sensor O-ring with engine oil.
2. Sensor assembly (25) to the engine block.
3. Bolt/screw (26).

Tighten

- Bolt/screw (26) to 10 N•m (89 lb. in.).

4. Sensor electrical connector.

24X SIGNAL CRANKSHAFT POSITION SENSOR ASSEMBLY (3.4L L32 ENGINE)

Figure 9

Remove or Disconnect

1. Be sure ignition switch is in "OFF" or "LOCK" position.
2. Crankshaft balancer assembly. Refer to SECTION 6A2A.
3. Bolts/screws (24).
4. Sensor (23).

Install or Connect

NOTICE: See "Notice" on page 6D4-1 of this section.

1. Sensor (23).
2. Bolts/screws (24).

Tighten

- Bolts/screws (24) to 1.9 N•m (17 lb. in.).

3. Crankshaft balancer assembly. Refer to SECTION 6A2A.

CAMSHAFT POSITION SENSOR ASSEMBLY (3.4L L32 ENGINE)

Figure 9

Remove or Disconnect

1. Be sure ignition switch is in "OFF" or "LOCK" position.
2. Electrical connector from sensor assembly (27).
3. Bolt/screw (28).

NOTICE: Be careful not to damage sensor assembly when prying at its base during removal.

4. Sensor assembly (27) using a small-bladed screwdriver to gently pry between sensor assembly (27) and engine block.
   - Pry from alternate sides to loosen sensor assembly (27) in its mounting boss.

Inspect

- Sensor O-rings for wear, cracks or leakage. Replace if necessary.

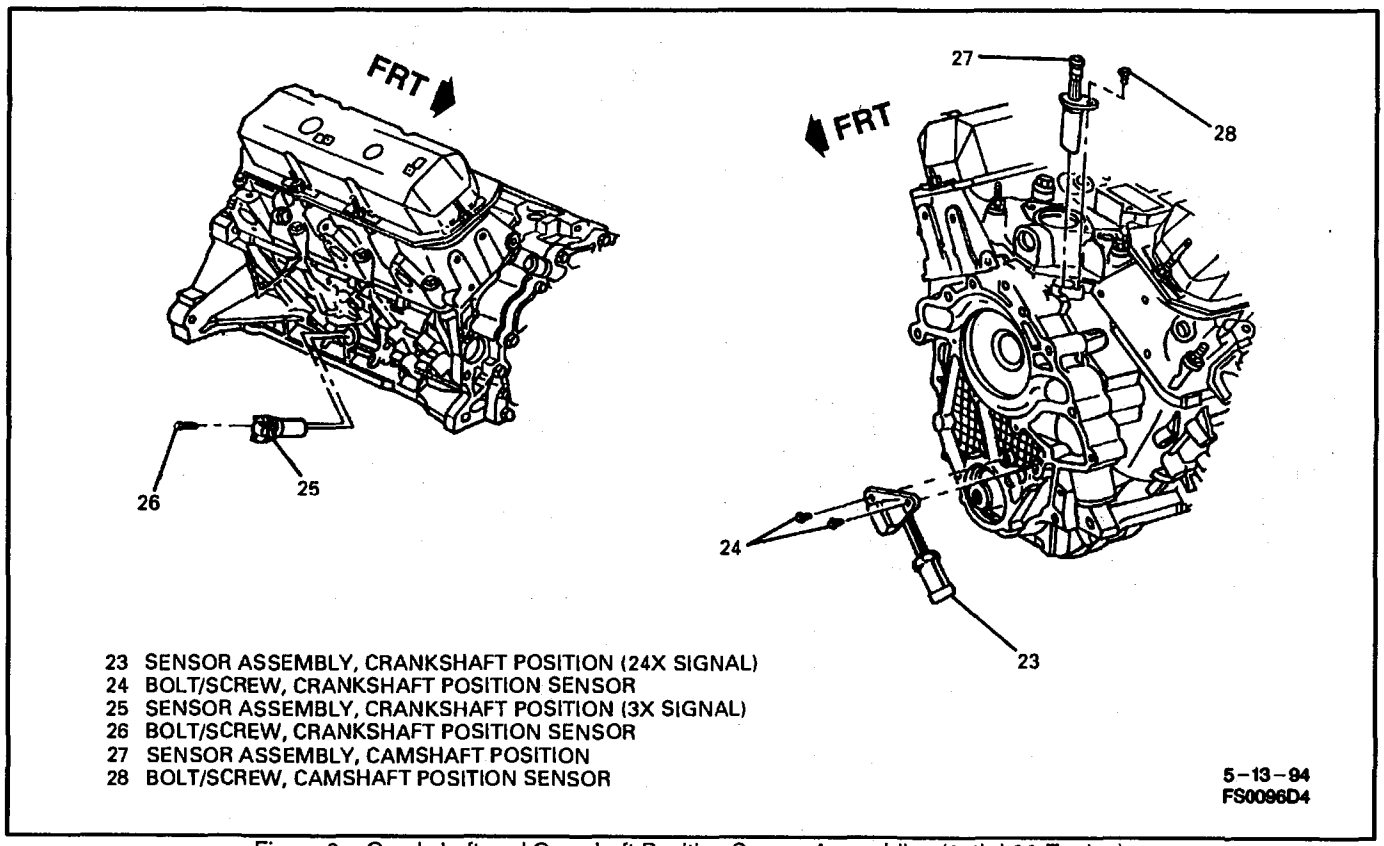


Figure 9 – Crankshaft and Camshaft Position Sensor Assemblies (3.4L L32 Engine)

Install or Connect

NOTICE: See "Notice" on page 6D4-1 of this section.

1. Lubricate sensor O-rings with engine oil.
2. Sensor (27) in engine block.
3. Bolt/screw (28).

Tighten

- Bolt/screw (28) to 1.9 N•m (17 lb. in.).

4. Sensor electrical connector.

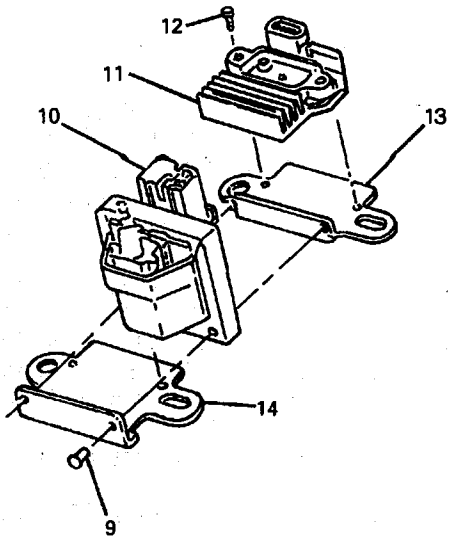
UNIT REPAIR

IGNITION COIL AND IGNITION COIL MODULE (5.7L LT1 ENGINE)

Figure 10

Disassemble

1. Coil (10) from brackets (13 and 14) by drilling out rivets (9).
2. Bolts/screws (12).
3. Ignition coil module (11).



9 RIVET, BRACKET ATTACHMENT
10 COIL, IGNITION
11 MODULE, IGNITION CONTROL
12 BOLT/SCREW, IGNITION CONTROL MODULE
13 BRACKET, IGNITION CONTROL
14 BRACKET, IGNITION COIL

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Figure 10 – Ignition Coil and Ignition Coil Module (5.7L LT1 Engine)

Assemble

NOTICE: See " Notice" on page 6D4-1 of this section.

NOTICE: A package of silicone grease is included with a new ignition control module. This grease is necessary for ignition control module cooling.

1. Spread silicone grease on metal face of ignition control module (11) and on bracket (13) where it seats, and position ignition control module (11) to bracket (13).
2. Bolts/screws (12).

Tighten

- Bolts/screws (12) to 1.7 N•m (15 lb. in.).

3. Coil (10) to brackets (13 and 14) using bolts/screws provided with replacement coil (10).

Tighten

- Bolts/screws to 2.8 N•m (25 lb. in.).

IGNITION COIL ASSEMBLY (3.4L L32 ENGINE)

Figure 11

Disassemble

1. Bolts/screws (22).
2. Ignition coils (18).
3. Seals (19).
4. Module (20) from bracket (21).

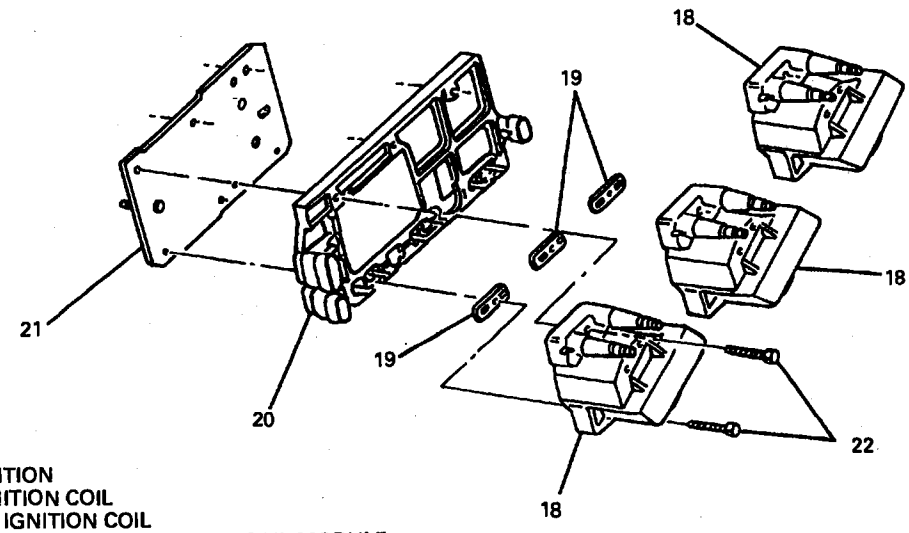
Assemble

NOTICE: See "Notice" on page 6D4-1 of this section.

1. Module (20) to bracket (21).
2. Seals (19).
3. Ignition coils (18).
4. Bolts/screws (22).

Tighten

- Bolts/screws (22) to 4.5 N•m (40 lb. in.).



18 COIL, IGNITION
19 SEAL, IGNITION COIL
20 MODULE, IGNITION COIL
21 BRACKET, ELECTRONIC IGNITION COIL MODULE
22 BOLT/SCREW, IGNITION COIL

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Figure 11 – Ignition Coils and Ignition Coil Module (3.4L L32 Engine)

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Camshaft Position Sensor Assembly Bolt/Screw (3.4L L32 Engine)	1.9 N•m (17 lb. in.)
Distributor Bolt/Screw (5.7L LT1 Engine)	12 N•m (106 lb. in.)
Distributor Cap Bolt/Screw	2.8 N•m (25 lb. in.)
Distributor Rotor Bolt/Screw	0.7 N•m (6 lb. in.)
Ignition Coil Assembly Bolt/Screw (3.4L L32 Engine)	4.5 N•m (40 lb. in.)
Ignition Coil Assembly Bolt/Screw (5.7L LT1 Engine)	25 N•m (18 lb. ft.)
Ignition Coil Assembly Nut (3.4L L32 Engine)	10 N•m (89 lb. in.)
Ignition Coil Assembly Stud (5.7L LT1 Engine)	40 N•m (30 lb. ft.)
Ignition Coil Bolt/Screw (5.7L LT1 Engine)	2.8 N•m (25 lb. in.)
Ignition Coil Module Bolt/Screw (5.7L LT1 Engine)	1.7 N•m (15 lb. in.)
Spark Plugs	27 N•m (20 lb. ft.)
3X Signal Crankshaft Position Sensor Assembly Bolt/Screw (3.4L L32 Engine)	10 N•m (89 lb. in.)
24X Signal Crankshaft Position Sensor Assembly Bolt/Screw (3.4L L32 Engine)	1.9 N•m (17 lb. in.)

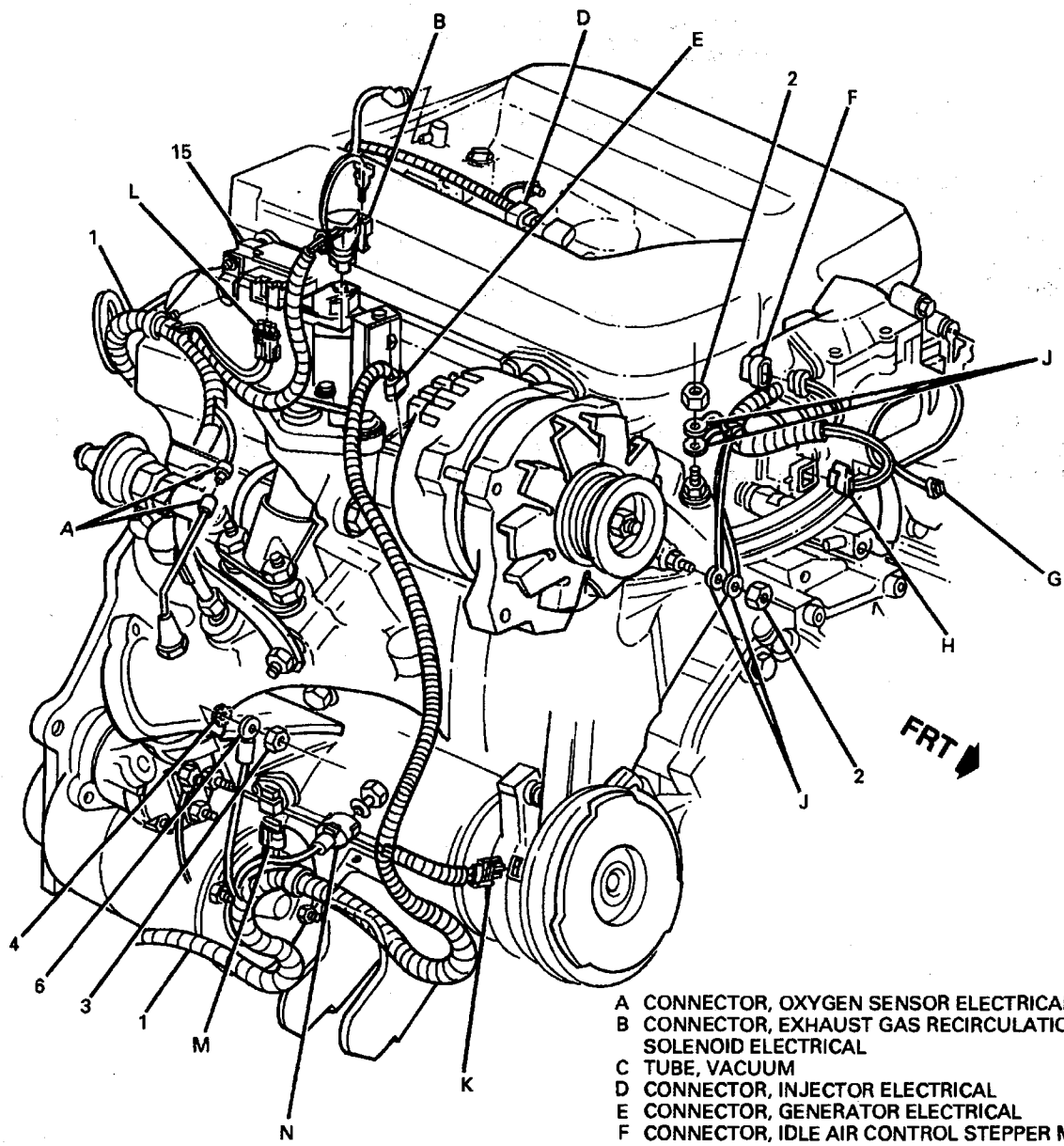
SECTION 6D5

ENGINE WIRING

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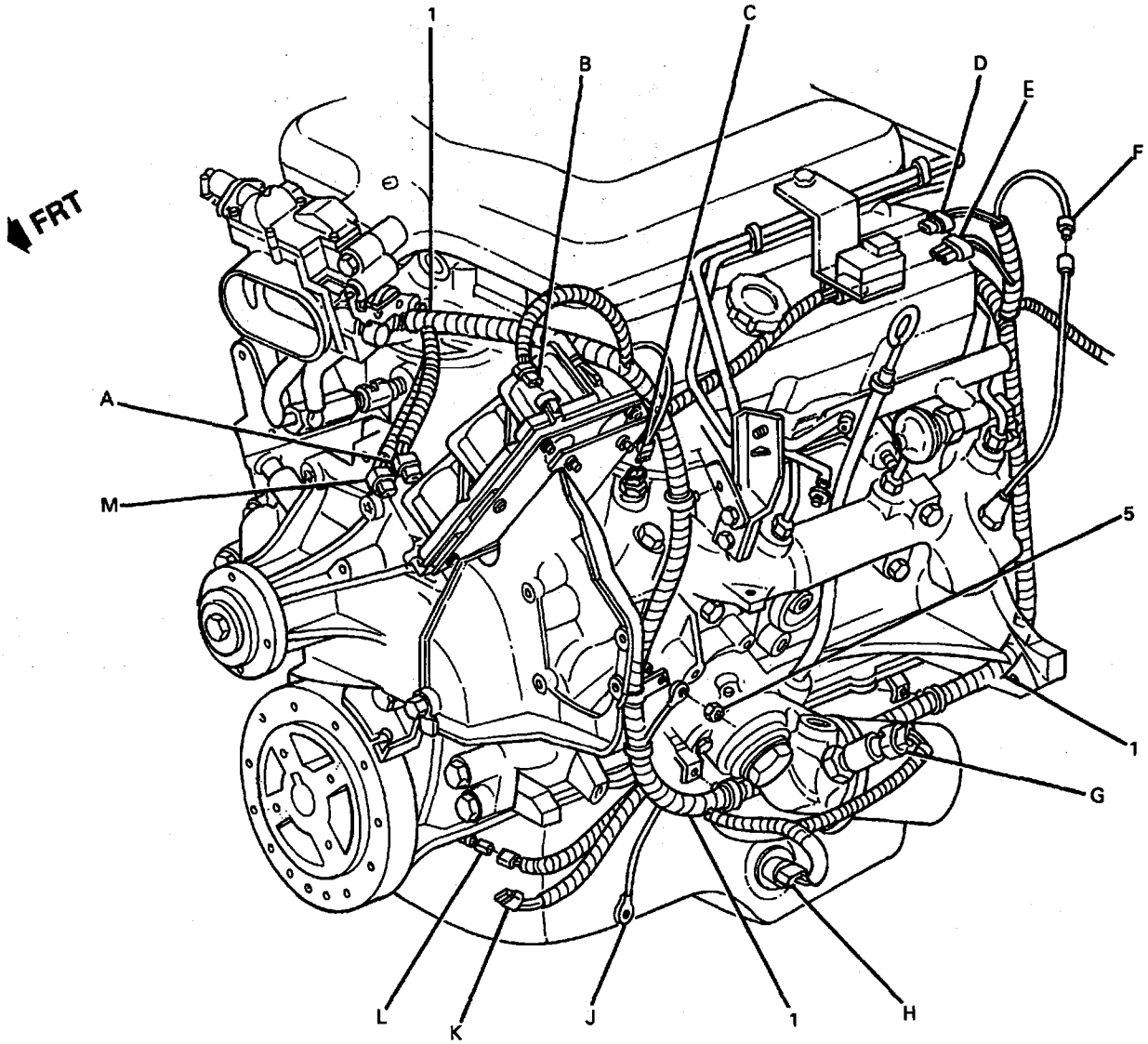
The following figures illustrate engine wiring harness routing and the various electrical/electronic components that have terminal connectors attached to them. In the illustration legends, the connectors are identified with the component name that completes their connection. Refer to SECTION 8A for detailed diagnostics.



A CONNECTOR, OXYGEN SENSOR ELECTRICAL
B CONNECTOR, EXHAUST GAS RECIRCULATION SOLENOID ELECTRICAL
C TUBE, VACUUM
D CONNECTOR, INJECTOR ELECTRICAL
E CONNECTOR, GENERATOR ELECTRICAL
F CONNECTOR, IDLE AIR CONTROL STEPPER MOTO ELECTRICAL
G CONNECTOR, IDLE AIR TEMPERATURE SENSOR ELECTRICAL
H CONNECTOR, THROTTLE POSITION SENSOR ELECTRICAL
J TERMINAL, ENGINE GROUND
K CONNECTOR, A/C COMPRESSOR CLUTCH ELECTR
L CONNECTOR, MANIFOLD ABSOLUTE PRESSURE SENSOR ELECTRICAL
M CONNECTOR, CRANKSHAFT SENSOR ELECTRICAL
N CONNECTOR, KNOCK SENSOR ELECTRICAL
1 HARNESS ASSEMBLY, ENGINE WIRING
2 NUT, ENGINE WIRING HARNESS GROUND
3 NUT, ENGINE WIRING HARNESS START LEAD
4 WASHER, ENGINE WIRING HARNESS START LEAD
6 LEAD, ENGINE WIRING HARNESS START
15 SENSOR ASSEMBLY, MANIFOLD ABSOLUTE PRESSURE

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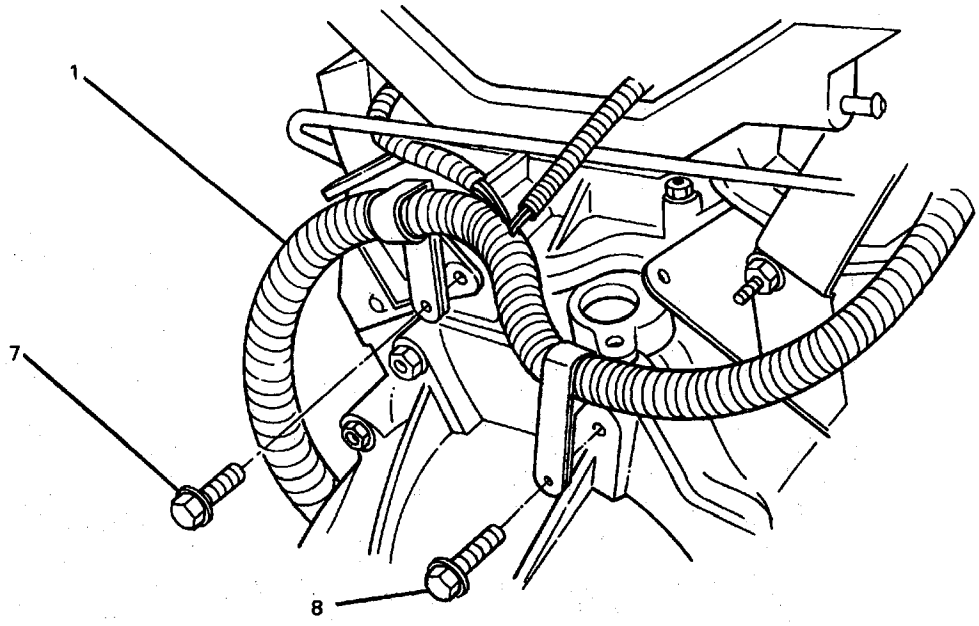
Figure 1 – Right-Hand Side Engine Wiring Harness Assembly (3.4L L32)



A CONNECTOR, DISTRIBUTOR SENSOR INPUT/OUTPUT ELECTRICAL
B CONNECTOR, DISTRIBUTOR POWER INPUT ELECTRICAL
C CONNECTOR, ENGINE COOLANT TEMPERATURE GAGE SENSOR ELECTRICAL
D CONNECTOR, CANISTER PURGE SOLENOID VALVE ELECTRICAL
E CONNECTOR, CAMSHAFT POSITION SENSOR ELECTRICAL
F CONNECTOR, OXYGEN SENSOR ELECTRICAL
G CONNECTOR, OIL PRESSURE SENSOR ELECTRICAL
H CONNECTOR, OIL LEVEL SENSOR ELECTRICAL
J STRAP, RIGHT FRONT GROUND
K CONNECTOR, POWER STEERING PRESSURE SWITCH ELECTRICAL
L CONNECTOR, CRANKSHAFT POSITION SENSOR ELECTRICAL
M CONNECTOR, CRANK SENSOR INPUT ELECTRICAL
1 HARNESS ASSEMBLY, ENGINE WIRING
5 NUT, ENGINE WIRING HARNESS CLAMP

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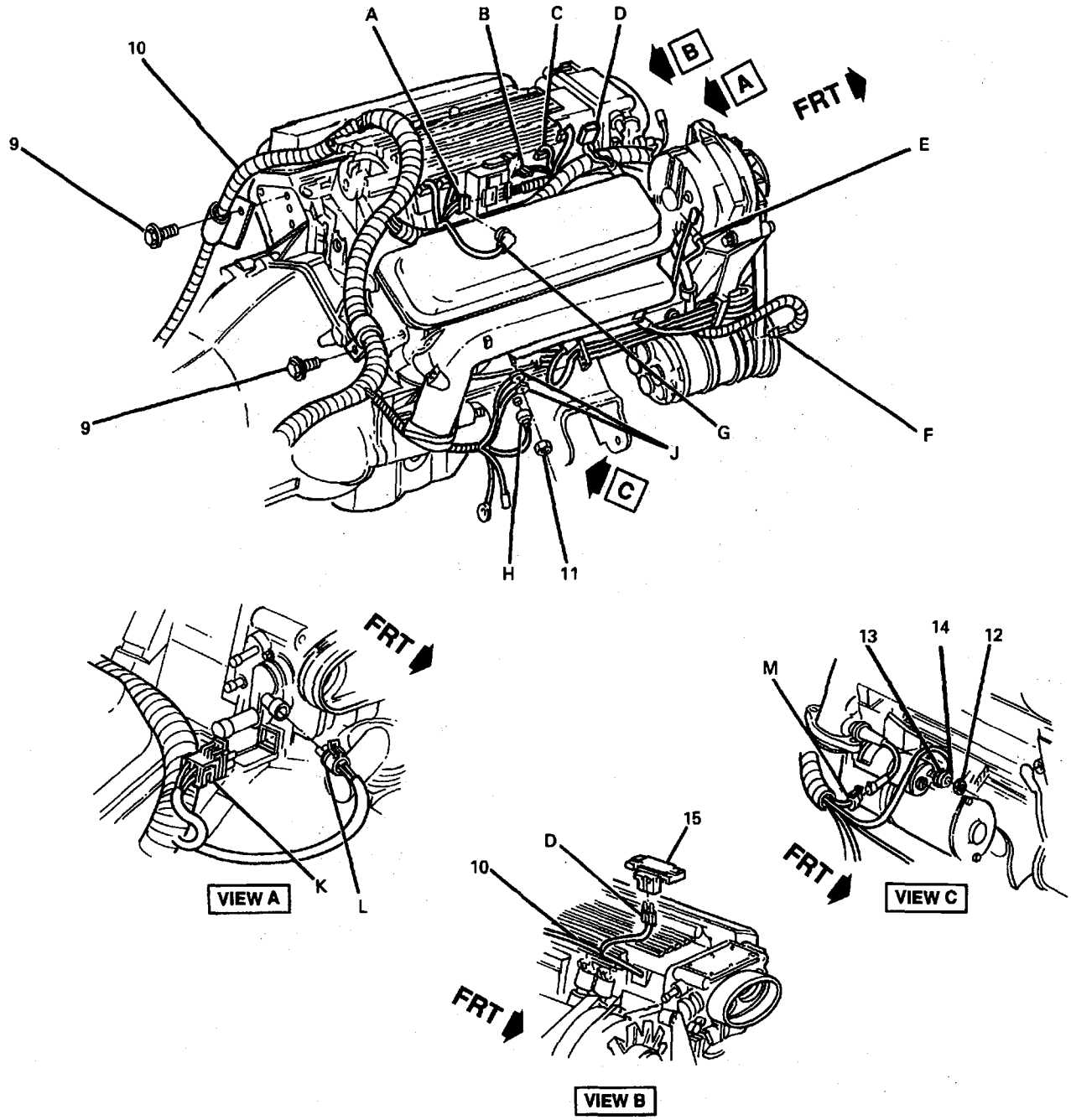
Figure 2 – Left-Hand Side Engine Wiring Harness Assembly (3.4L L32)



1 HARNESS ASSEMBLY, ENGINE WIRING
7 BOLT/SCREW, ENGINE WIRING HARNESS CLAMP
8 BOLT/SCREW, FLYWHEEL HOUSING

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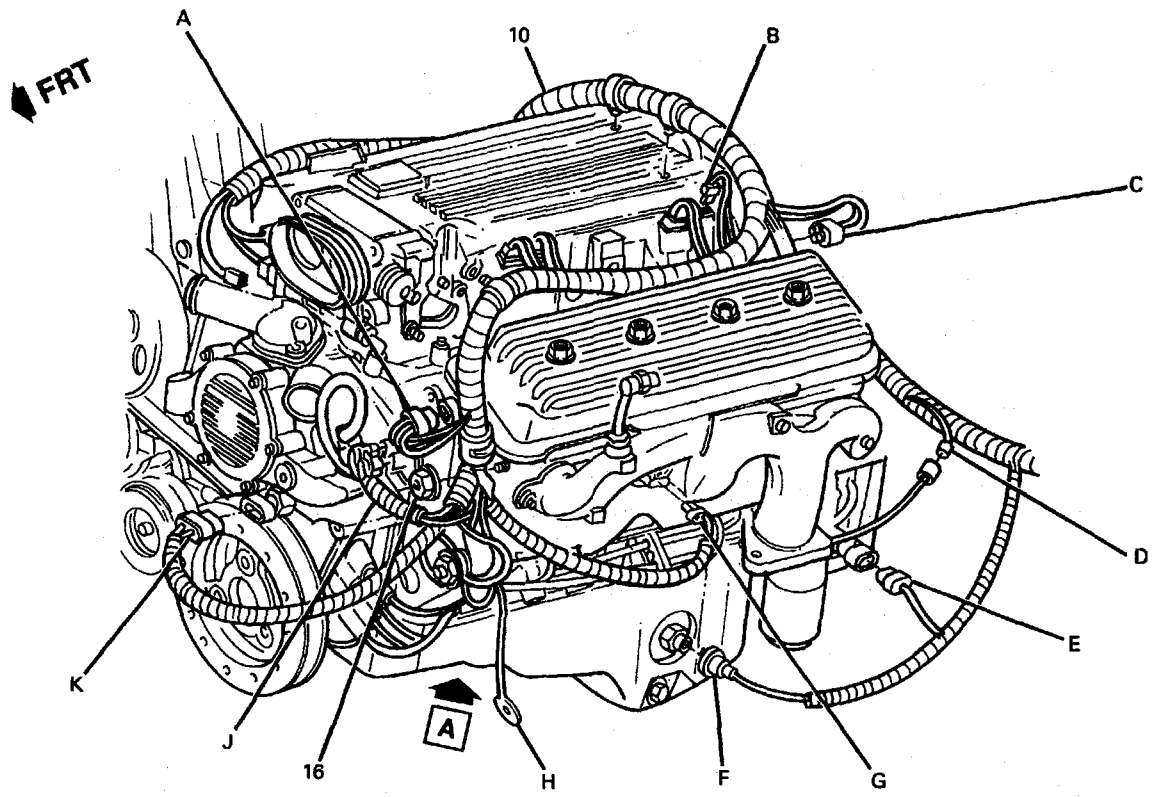
Figure 3 – Rear View Engine Wiring Harness Assembly (3.4L L32)

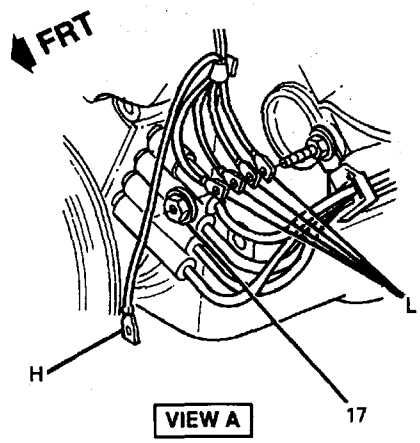


A CONNECTDR, IGNITION DISTRIBUTOR ELECTRICAL
B CONNECTOR, CANISTER PURGE SOLENOID VALVE ELECTRICAL
C CONNECTOR, INJECTOR ELECTRICAL
D CONNECTOR, MANIFOLD ABSOLUTE PRESSURE SENSOR ELECTRICAL
E CONNECTOR, GENERATOR ELECTRICAL
F CONNECTOR, A/C COMPRESSOR CLUTCH ELECTRICAL
G TUBE, VACUUM
H CONNECTOR, KNOCK SENSOR ELECTRICAL
J TERMINAL, ENGINE GROUND
K CONNECTOR, IDLE AIR CONTROL STEPPER MOTOR ELECTRICAL
L CONNECTOR, THROTTLE POSITION SENSOR ELECTRICAL
M CONNECTOR, OXYGEN SENSOR ELECTRICAL
9 BOLT/SCREW, ENGINE WIRING HARNESS CLAMP
10 HARNESS ASSEMBLY, ENGINE WIRING
11 NUT, ENGINE WIRING HARNESS GROUND
12 NUT, ENGINE WIRING HARNESS START LEAD
13 WASHER, ENGINE WIRING HARNESS START LEAD
14 LEAD, ENGINE WIRING HARNESS START
15 SENSOR ASSEMBLY, MANIFOLD ABSOLUTE PRESSURE

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Figure 4 – Right-Hand Side Engine Wiring Harness Assembly (5.7L LT1)

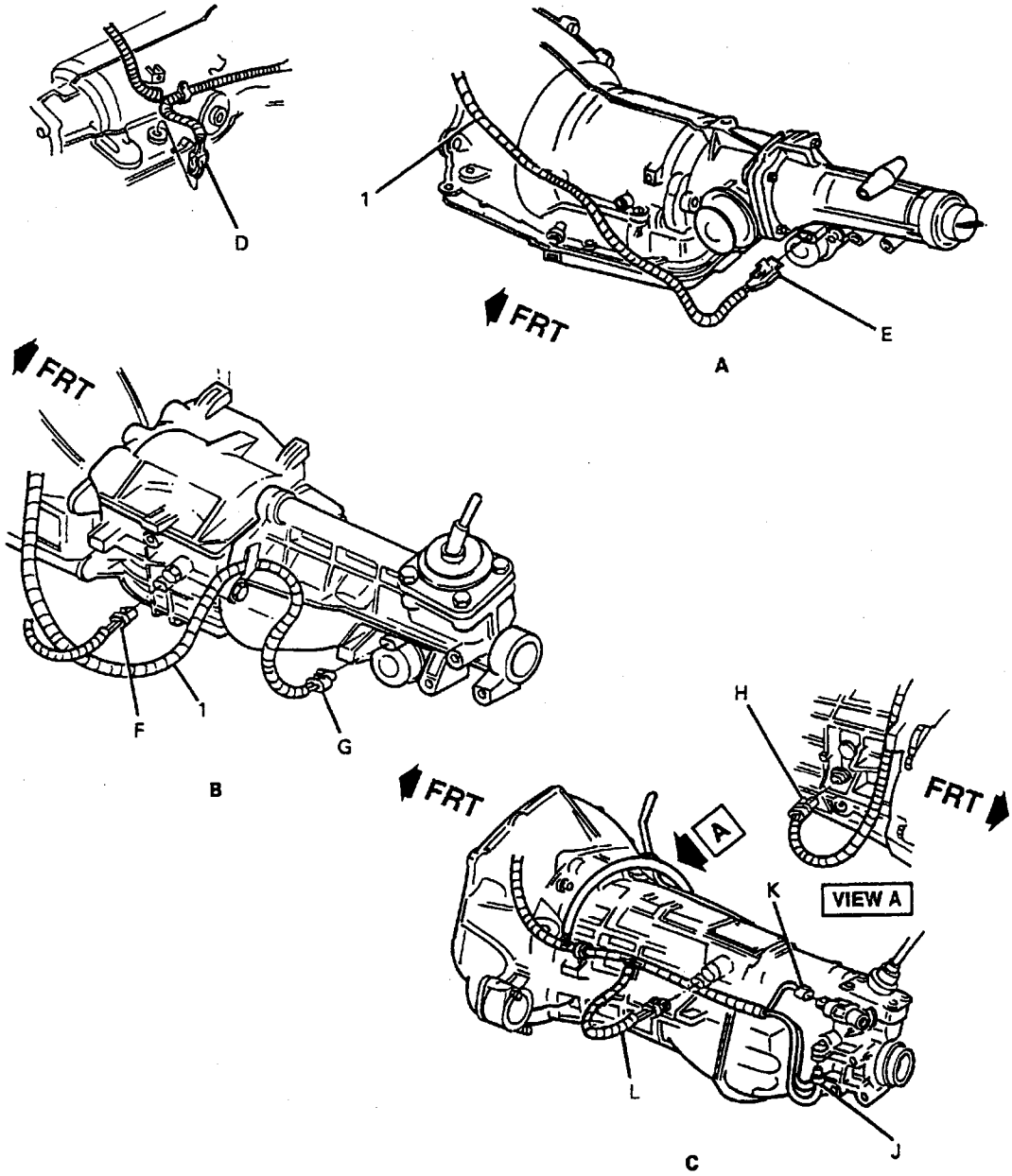




A CONNECTOR, IGNITION COIL DRIVER ELECTRICAL
B CONNECTOR, INJECTOR ELECTRICAL
C CONNECTOR, EXHAUST GAS RECIRCULATION SOLENOID VALVE ELECTRICAL
D CONNECTOR, OXYGEN SENSOR ELECTRICAL
E CONNECTOR, OIL PRESSURE SENSOR ELECTRICAL
F CONNECTOR, OIL LEVEL SENSOR ELECTRICAL
G CONNECTOR, ENGINE COOLANT TEMPERATURE GAGE SENSOR ELECTRICAL
H STRAP, RIGHT FRONT GROUND
J CONNECTOR, IGNITION COIL ELECTRICAL
K CONNECTOR, ENGINE COOLANT TEMPERATURE SENSOR ELECTRICAL
L TERMINAL, GROUND
10 HARNESS ASSEMBLY, ENGINE WIRING
16 NUT, ENGINE WIRING HARNESS CLAMP
17 NUT, ENGINE WIRING HARNESS GROUND

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Figure 5 – Left-Hand Side Engine Wiring Harness Assembly (5.7L LT1)



A TRANSMISSION ASSEMBLY, AUTOMATIC (M30)
B TRANSMISSION ASSEMBLY, MANUAL (5-SPEED M49)
C TRANSMISSION ASSEMBLY, MANUAL (6-SPEED MM6)
D CONNECTOR, ELECTRONIC SWITCH
E CONNECTOR, VEHICLE SPEED SENSOR ELECTRICAL
F CONNECTOR, BACKUP SWITCH ELECTRICAL
G CONNECTOR, VEHICLE SPEED SENSOR ELECTRICAL
H CONNECTOR, BACKUP SWITCH ELECTRICAL
J CONNECTOR, VEHICLE SPEED SENSOR ELECTRICAL
K CONNECTOR, REVERSE LOCKOUT SOLENOID ELECTRICAL
L CONNECTOR, SKIP SHIFT SOLENOID
1 HARNESS ASSEMBLY, ENGINE WIRING

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Figure 6 – Transmission Engine Wiring Harness Assembly (All)

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SECTION 6F

EXHAUST SYSTEM

NOTICE: All new GM vehicles are certified by the United States Environmental Protection Agency as conforming to the requirements of the regulations for the control of air pollution from new motor vehicles. This certification is contingent on certain adjustments being set to factory standards, thus, these adjustment points either have been permanently sealed and/or made inaccessible to prevent indiscriminate adjustment in the field. For this reason, the factory procedure for temporarily removing plugs, caps, etc., for the purpose of servicing the product must be strictly followed and, where practical, returned to the original intent of the design.

NOTICE: Exhaust system components must have enough clearance from the underbody to prevent overheating of the floor panel assembly and possible damage to the passenger compartment, insulation and trim materials.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

NOTICE: When inspecting or replacing exhaust system components, make sure there is adequate clearance from all points on the underbody to prevent overheating of the floor panel assembly and possible damage to the passenger compartment, insulation and trim materials.

Periodic maintenance of the exhaust system is not required. If the vehicle is raised for other service, it is advisable to check the condition of the complete exhaust system.

Check complete exhaust system, nearby body areas and rear compartment lid for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections or other deterioration that could permit exhaust fumes to seep into the rear compartment or passenger compartment. Dust or water in the rear compartment may indicate a problem in one of these areas. Any faulty areas should be corrected immediately. To help ensure continued integrity, the exhaust system pipe rearward of the exhaust muffler assembly must be replaced whenever a new exhaust muffler assembly is installed.

EXHAUST CROSSOVER PIPE ASSEMBLY

On the 3.4L L32 engine, the exhaust crossover pipe assembly can be removed from the catalytic converter assembly. On the 5.7L LT1 engine, the exhaust crossover pipe and catalytic converter assembly must be replaced a complete assembly.

CATALYTIC CONVERTER ASSEMBLY

Figure 1

CAUTION: Prolonged operation with a misfiring or flooded engine may cause the warmup three way catalytic converters to overheat. This could cause damage either to the catalyst itself or the operating vehicle and possible personal injury.

NOTICE: When jacking or lifting vehicle from frame side rails, be certain lift pads do not contact catalytic converter or damage to catalytic converter may result.

The catalytic converter assembly is an emission control devise added to the exhaust system to reduce pollutants from the exhaust gas stream.

NOTICE: The catalytic converter requires the use of unleaded fuel only, or damage to the catalyst may result.

A single bed monolith catalytic converter is used in combination with two different types of catalyst. These are oxidation catalyst and three-way (reduction/oxidation) catalyst.

The catalysts have coatings that contain platinum and palladium. The oxidation catalyst lowers the level of hydrocarbons (HC) and carbon monoxide (CO). The three-way catalyst lowers the levels of oxides of nitrogen (NO_3) as well as HC and CO.

EXHAUST MUFFLER ASSEMBLY

The muffler assembly is a tri-flow design. The muffler assembly has a slot in the inlet pipe. The slot indexes to a key (tab) welded on the exhaust pipe assembly to help maintain alignment.

HANGERS

Important

- The installation of exhaust system supports is very important, as improperly installed supports can cause annoying vibrations that can be difficult to diagnose.

Two types of hangers are used to support the exhaust system. One type is a conventional rubber strap. The second type is a "rubber block". The rubber block type provides a rigid hanger along with a feature that continues to support the exhaust system if a rubber insulator block is broken.

CLAMPS AND WELDED CONNECTIONS

CAUTION: Coat slip joints with exhaust system sealer before assembly to prevent exhaust from entering the vehicle and causing personal injury.

Two methods are used for connecting exhaust system slip joints: clamps and welds. When servicing a welded connection it should be cut and the new connection clamped when installing replacement parts.

Three types of clamps are used for connecting exhaust system slip joints: guillotine, saddle/U-bolt and single nut compression.

DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
Leaking Exhaust Gases	Leaks at pipe joints.	Tighten nuts/bolts at leaking joints to specifications.
Exhaust Noises	1. Exhaust pipes contacting heat shields, or loose heat shields. Inspect when cold and after warmup.	1. Tighten heat shield bolts/screws to 2.0 N•m (18 lb. in.). Align exhaust system if necessary. Refer to "Exhaust System Clearance Dimensions" in this section.
	2. Leaks at manifold assembly or pipe connections.	2. Tighten clamps at leaking connections to specifications.
	3. Burned or blown out muffler assembly.	3. Replace muffler assembly.
	4. Burned or rusted out exhaust pipe assembly.	4. Replace exhaust pipe assembly.
	5. Leaking exhaust crossover pipe assembly at manifold flange.	5. Tighten exhaust crossover pipe nuts to 35 N•m (26 lb. ft.).
	6. Cracked or broken manifold assembly.	6. Replace manifold assembly.
	7. Leak between manifold assembly. and cylinder head.	7. Tighten manifold-to-cylinder head stud nuts or bolts/screws to specifications. Refer to SECTION 6A2A or 6A3A.

Exhaust Vibrations	1. Transmission shims are between catalytic converter assembly and transmission support assembly.	1. Reposition shims so they are between transmission assembly and catalytic converter bracket.
	2. Inadequate clearance, less than 3 mm (1/8 inch), between transmission support assembly and floor panel assembly.	2. Replace transmission support assembly. Refer to SECTION 11
	3. Inadequate clearance, less than 3 mm (1/8 inch), between catalytic converter hanger assembly and transmission support assembly.	3. Loosen catalytic converter hanger bolts/screws and reposition catalytic converter hanger assembly.
Loss of Engine Power and/or Internal Rattles in Muffler Assembly	Dislodged turning tubes and/or baffles in muffler assembly, catalytic converter assembly or exhaust pipe assembly.	Replace muffler assembly, catalytic converter assembly or exhaust pipe assembly.

ON-VEHICLE SERVICE

COMPONENT REPLACEMENT

Exhaust system service includes replacement of the following items:

- Exhaust crossover pipe assembly (3.4L L32 engine)
- Catalytic converter assembly (with crossover pipe for 5.7L LT1 engine)
- Exhaust pipe assembly
- Exhaust muffler assembly (with tailpipe(s))
- Complete exhaust system
- Catalytic converter and exhaust muffler hanger assemblies
- Catalytic converter heat shield
- Exhaust heat shield
- Exhaust pipe heat shield assembly
- Exhaust muffler heat shield

EXHAUST CROSSOVER PIPE ASSEMBLY

3.4L L32 Engine

Figures 1 and 2

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Exhaust crossover pipe nuts (2).
3. Exhaust crossover pipe assembly (4) from studs on exhaust manifold assembly (1).
4. Lower exhaust system.
5. Exhaust crossover pipe seal (3) from exhaust manifold assembly (1).
6. Support catalytic converter assembly (7) and exhaust system.
7. Catalytic converter clamp assembly (8).
8. Catalytic converter assembly (7) from exhaust crossover pipe assembly (4).

Install or Connect

NOTICE: See "Notice" on page 6F-1 of this section.

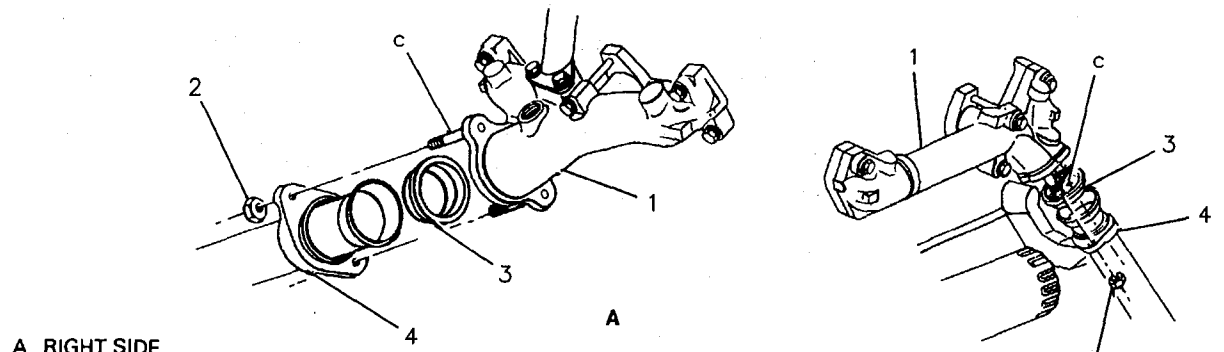
1. Exhaust crossover pipe assembly (4) to catalytic converter assembly (7).
2. Catalytic converter clamp assembly (8).

   Tighten

   - Catalytic converter clamp assembly (8) to 68 N•m (50 lb. ft.).
3. Exhaust crossover pipe seal (3).
4. Raise exhaust crossover pipe assembly (4).
5. Exhaust crossover pipe assembly (4) to studs on exhaust manifold assembly (1).
6. Exhaust crossover pipe nuts (2).

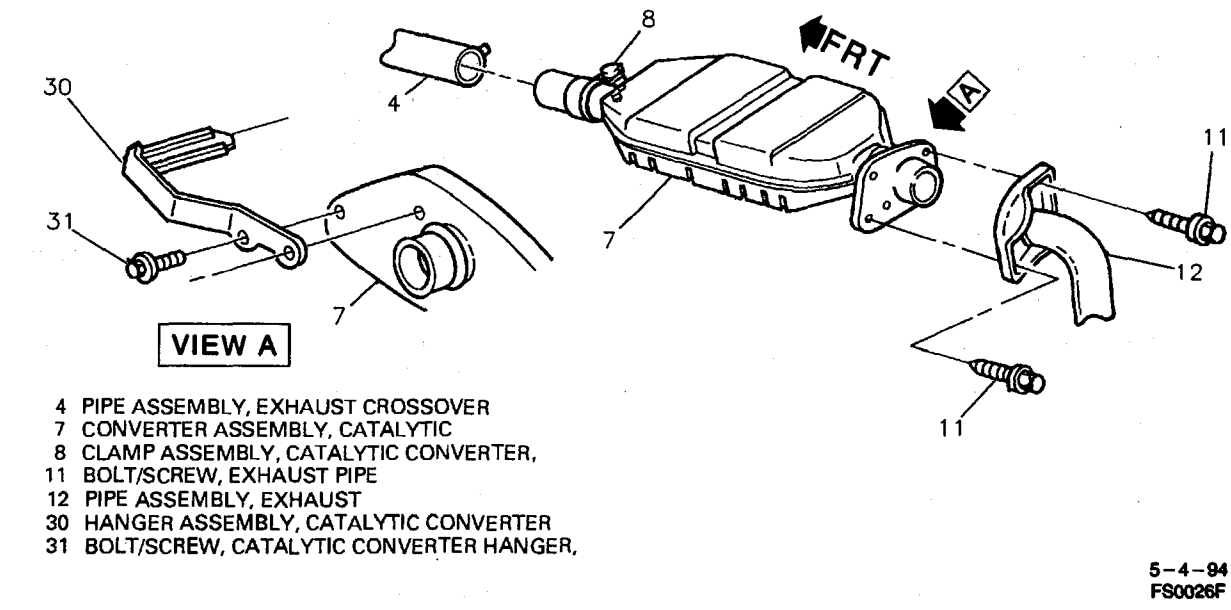
   Tighten

   - Exhaust crossover pipe nuts (2) evenly to 35 N•m (26 lb. ft.).
7. Lower vehicle.



A RIGHT SIDE
B LEFT SIDE
C STUD
1 MANIFOLD ASSEMBLY, EXHAUST
2 NUT, EXHAUST CROSSOVER PIPE
3 SEAL, EXHAUST CROSSOVER PIPE
4 PIPE ASSEMBLY, EXHAUST CROSSOVER

Figure 1 – Exhaust Manifold Attachments (3.4L L32 Engine)



4 PIPE ASSEMBLY, EXHAUST CROSSOVER
7 CONVERTER ASSEMBLY, CATALYTIC
8 CLAMP ASSEMBLY, CATALYTIC CONVERTER,
11 BOLT/SCREW, EXHAUST PIPE
12 PIPE ASSEMBLY, EXHAUST
30 HANGER ASSEMBLY, CATALYTIC CONVERTER
31 BOLT/SCREW, CATALYTIC CONVERTER HANGER,

Figure 2 – Catalytic Converter Assembly (3.4L L32 Engine)

5.7L LT1 Engine

The crossover pipe is welded to the catalytic converter assembly. The crossover pipe and catalytic converter assembly are replaced as a unit. Refer to "Catalytic Converter Assembly" in the following procedure.

CATALYTIC CONVERTER ASSEMBLY

3.4L L32 Engine

Figure 2

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Catalytic converter clamp assembly (8) at exhaust crossover pipe assembly (4).
3. Exhaust pipe bolts/screws (11).
4. Exhaust pipe assembly (12) from catalytic converter assembly (7).
5. Catalytic converter hanger bolts/screws (31).
6. Catalytic converter assembly (7).

Install or Connect

NOTICE: See "Notice" on page 6F-1 of this section.

1. Catalytic converter assembly (7) to catalytic converter hanger assembly (30).
2. Catalytic converter hanger bolts/screws (31).

Tighten

- Catalytic converter hanger bolts/screws (31) to 41 N•m (30 lb. ft.).

3. Exhaust pipe assembly (12) to catalytic converter assembly (7).
4. Exhaust pipe bolts/screws (11).

Tighten

- Exhaust pipe bolts/screws (11) to 20 N•m (15 lb. ft.).

5. Catalytic converter clamp assembly (8) at exhaust crossover pipe assembly (4).

Tighten

- Catalytic converter clamp assembly (8) to 68 N•m (50 lb. ft.).

6. Lower vehicle.

5.7L LT1 Engine

Figures 3 and 4

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Exhaust crossover pipe nuts (2).
3. Exhaust crossover pipe from studs on exhaust manifold assembly (5).
4. Exhaust pipe bolts/screws (13).
5. Catalytic converter assembly (10) from exhaust pipe assembly (14).
6. Catalytic converter hanger bolts/screws (40).
7. Catalytic converter assembly (10).

Install or Connect

NOTICE: See "Notice" on page 6F-1 of this section.

1. Catalytic converter assembly (10) to catalytic converter hanger assembly (35).
2. Catalytic converter hanger bolts/screws (40).

Tighten

- Catalytic converter hanger bolts/screws (40) to 41 N•m (30 lb. ft.).

3. Exhaust pipe assembly (14) to catalytic converter assembly (10).
4. Exhaust pipe bolts/screws (13).

Tighten

- Exhaust pipe bolts/screws (13) to 20 N•m (15 lb. ft.).

5. Exhaust crossover pipe to studs on exhaust manifold assembly (5).
6. Exhaust crossover pipe nuts (2).

Tighten

- Exhaust crossover pipe nuts (2) to 35 N•m (20 lb. ft.).

7. Lower vehicle.

EXHAUST PIPE ASSEMBLY

Figures 2 and 4 through 6

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Exhaust pipe bolts/screws (11 or 13) at catalytic converter assembly (7 and 10).
3. Exhaust pipe hanger nut (19 or 22).
4. Muffler clamp assembly (17 or 23).
5. Exhaust pipe assembly (12 or 14) from exhaust muffler assembly (15 or 20).
6. Exhaust pipe assembly (12 or 14), sliding it out of exhaust pipe hanger bracket assembly (18 or 21).

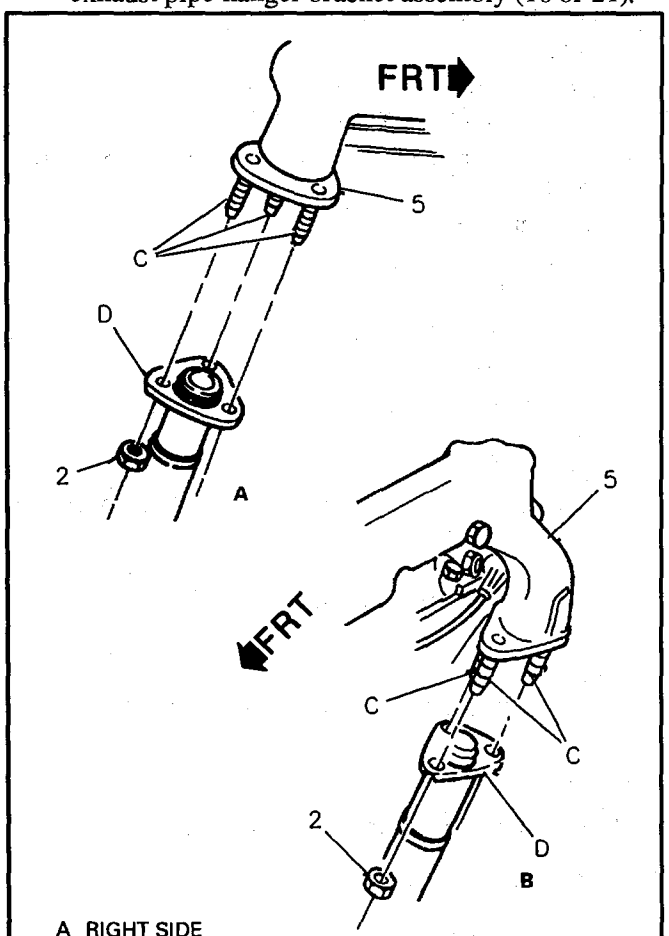


Figure 3 – Exhaust Manifold Attachments (5.7L LT1 Engine)

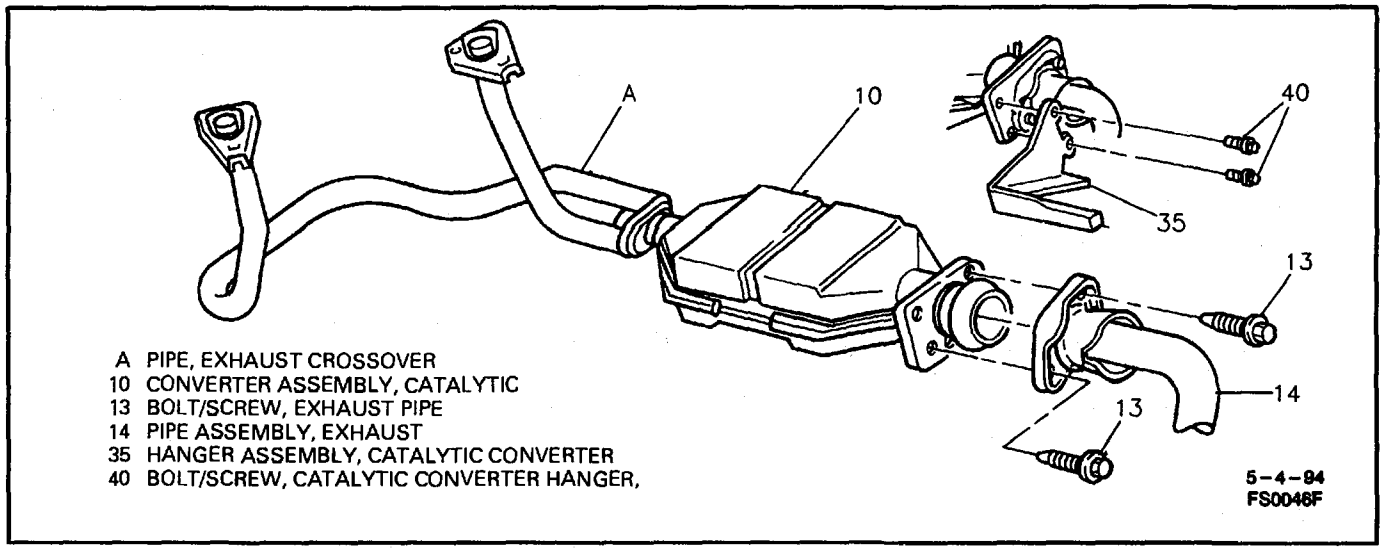


Figure 4 – Catalytic Converter Assembly (5.7L LT1 Engine)

Install or Connect

NOTICE: See "Notice" on page 6F-1 of this section.

1. Exhaust pipe assembly (12 or 14) to exhaust pipe hanger bracket assembly (18 or 21).
2. Exhaust pipe assembly (12 or 14) to exhaust muffler assembly (15 or 20).
3. Muffler clamp assembly (17 or 23).

   Tighten

   - Muffler clamp assembly (17 or 23) to 68 N•m (50 lb. ft.).
4. Exhaust pipe hanger nut (19 or 22).

   Tighten

   - Exhaust pipe hanger nut (19 or 22) to 25 N•m (18 lb. ft.).
5. Exhaust pipe bolts/screws (11 or 13) to catalytic converter assembly (7 or 10).

   Tighten

   - Exhaust pipe bolts/screws (11 or 13) to 20 N•m (15 lb. ft.).
6. Lower vehicle.

EXHAUST MUFFLER ASSEMBLY

Figures 5 and 6

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Exhaust muffler hanger nut (26), if equipped.
3. Muffler clamp assembly (17 or 23).
4. Exhaust pipe assembly (12 or 14) at exhaust muffler assembly (15 or 20).
5. Tailpipe from exhaust muffler hanger assembly (16 or 24).
6. Exhaust muffler assembly (15 or 20).

Install or Connect

NOTICE: See "Notice" on page 6F-1 of this section.

1. Exhaust muffler assembly (15 or 20).
2. Tailpipe to exhaust muffler hanger assembly (16 or 24).
3. Exhaust pipe assembly (12 or 14) at exhaust muffler assembly (15 or 20).
4. Muffler clamp assembly (17 or 23).

   Tighten

   - Muffler clamp assembly (17 or 23) to 68 N•m (50 lb. ft.).
5. Exhaust muffler hanger nut (26), if equipped.

   Tighten

   - Exhaust muffler hanger nut (26) to 25 N•m (18 lb. ft.).
6. Lower vehicle.

EXHAUST TAILPIPE EXTENSION ASSEMBLY (5.7L LT1 ENGINE)

Remove or Disconnect

1. Loosen exhaust tailpipe extension clamp assembly.
2. Exhaust tailpipe extension assembly from tailpipe.

Install or Connect

NOTICE: See "Notice" on page 6F-1 of this section.

1. Exhaust tailpipe extension assembly to tailpipe until stop position is reached.

2. Align exhaust tailpipe extension assembly to rear fascia assembly and tighten exhaust tailpipe extension clamp assembly.

Tighten

- Exhaust tailpipe extension clamp assembly to 70 N•m (52 lb. ft.).

CATALYTIC CONVERTER HANGER ASSEMBLY

Figures 7 and 8

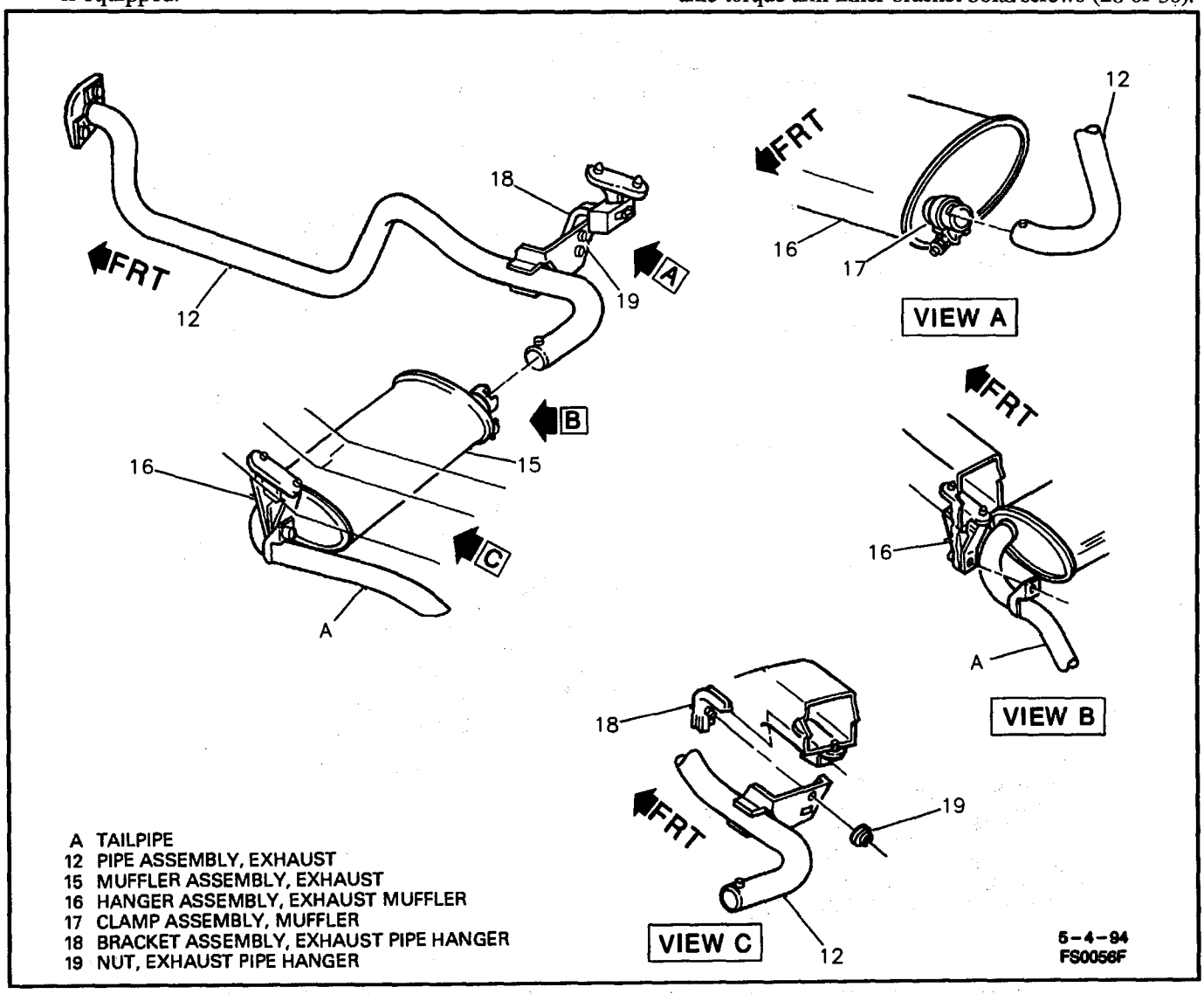
Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Support catalytic converter assembly (7 or 10).
3. Catalytic converter hanger bolts/screws (31 or 40).
4. Rear axle torque arm outer bracket bolt/screw (34), if equipped.
5. Rear axle torque arm bracket nuts (29 or 39) from rear axle torque arm inner bracket bolts/screws (28 or 36).
6. Catalytic converter hanger bracket assembly (32, 33 or 38) with catalytic converter hanger assembly (30 or 35) away from rear axle torque arm inner bracket assembly (27 or 37).
7. Catalytic converter hanger assembly (30 or 35) from catalytic converter hanger bracket assembly (32, 33 or 38).

Install or Connect

NOTICE: See "Notice" on page 6F-1 of this section.

1. Catalytic converter hanger assembly (30 or 35) to catalytic converter hanger bracket assembly (32, 33 or 38).
2. Catalytic converter hanger bracket assembly (32, 33 or 38) with catalytic converter hanger assembly (30 or 35) to rear axle torque arm inner bracket assembly (27 or 37).
3. Rear axle torque arm bracket nuts (29 or 39) to rear axle torque arm inner bracket bolts/screws (28 or 36).



A TAILPIPE
12 PIPE ASSEMBLY, EXHAUST
15 MUFFLER ASSEMBLY, EXHAUST
16 HANGER ASSEMBLY, EXHAUST MUFFLER
17 CLAMP ASSEMBLY, MUFFLER
18 BRACKET ASSEMBLY, EXHAUST PIPE HANGER
19 NUT, EXHAUST PIPE HANGER

Figure 5 – Exhaust Muffler Assembly (3.4L L32 Engine)

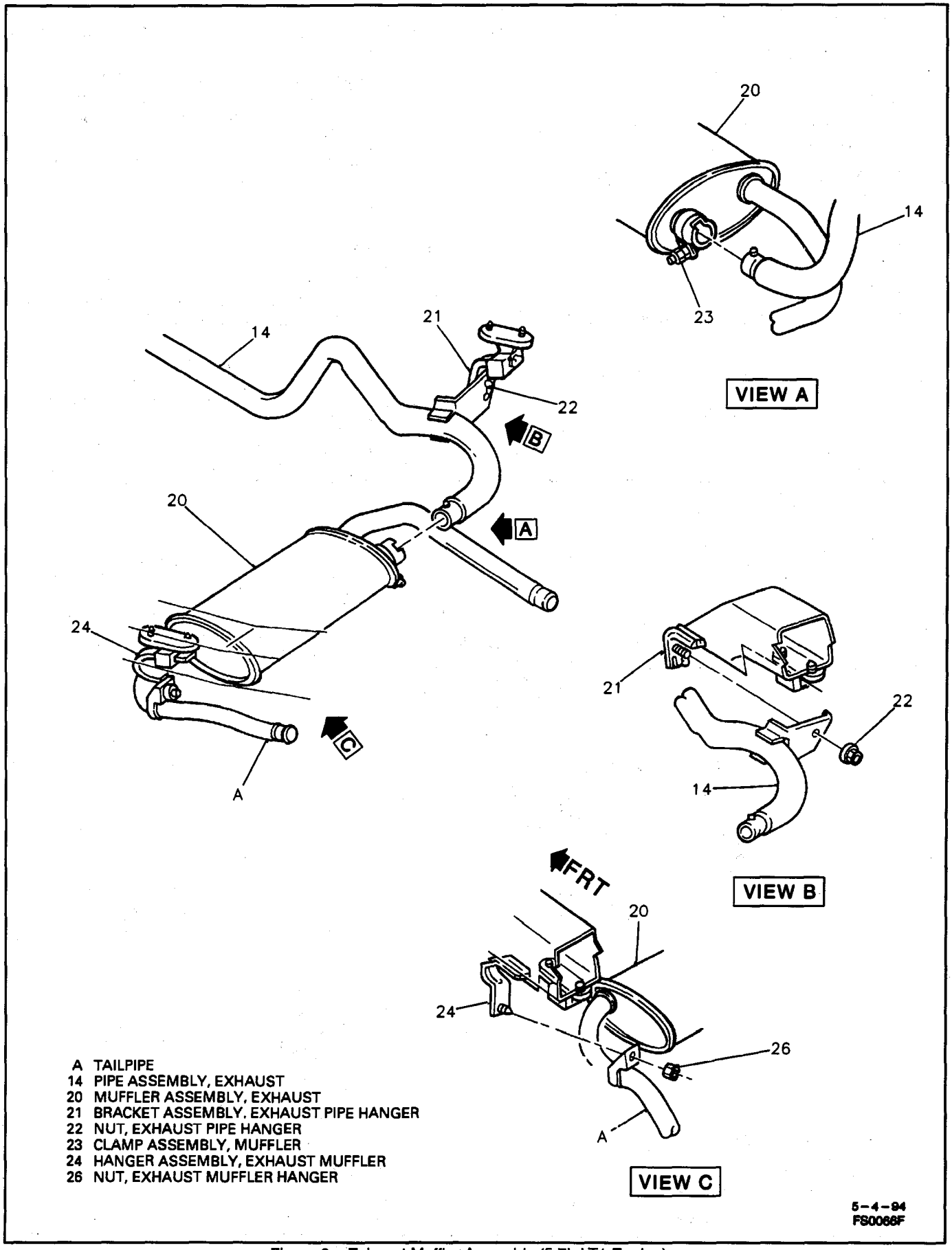


Figure 6 – Exhaust Muffler Assembly (5.7L LT1 Engine)

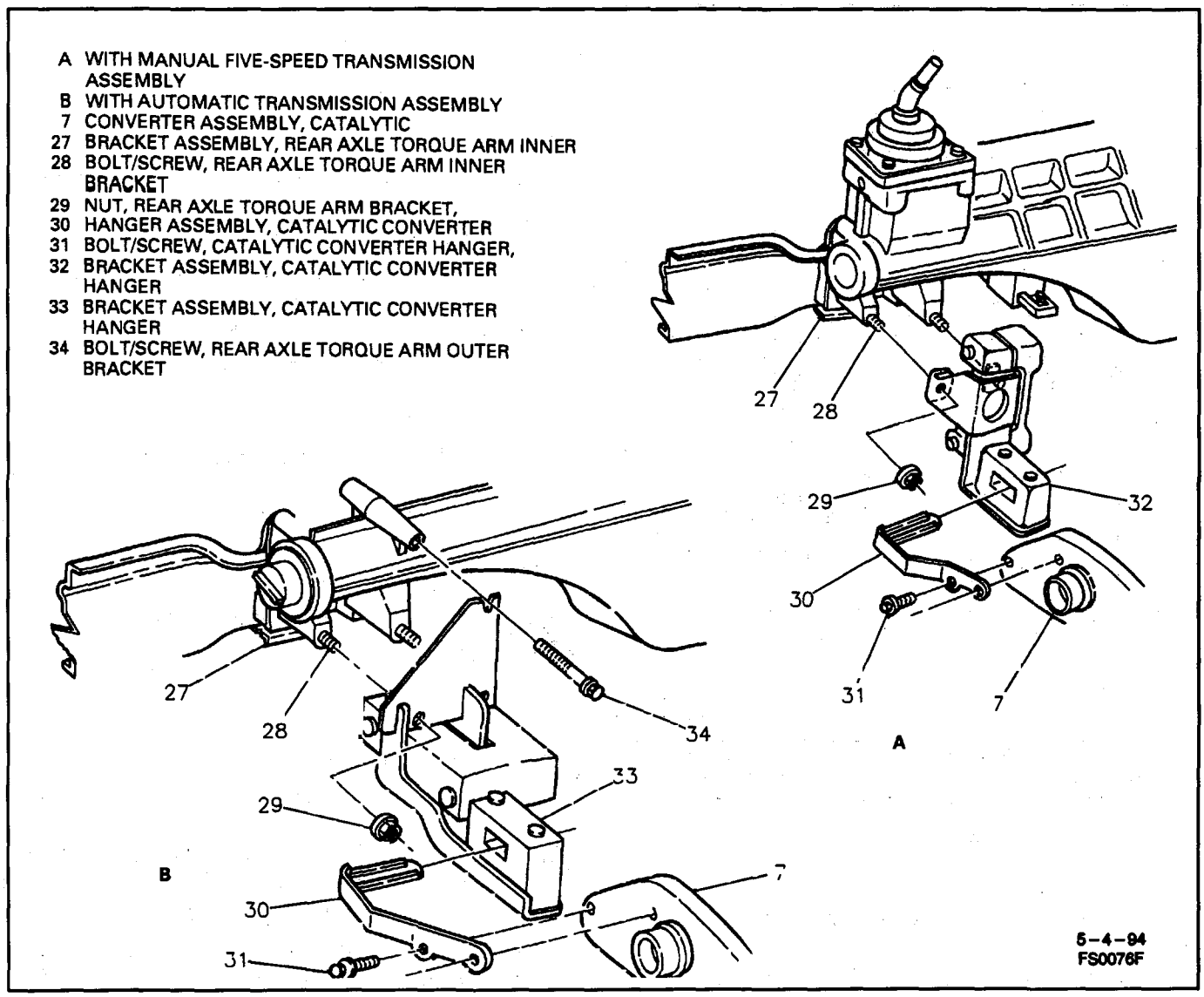


Figure 7 – Catalytic Converter Hanger Assembly to Transmission Assembly (3.4L L32 Engine)

Tighten

- Rear axle torque arm bracket nuts (29 or 39) to 41 N•m (20 lb. ft.).

4. Rear axle torque arm outer bracket bolt/screw (34), if equipped.

Tighten

- Rear axle torque arm outer bracket bolt/screw (34) to 27 N•m (20 lb. ft.).

5. Catalytic converter hanger bolts/screws (31 or 40).

Tighten

- Catalytic converter hanger bolts/screws (31 or 40) to 41 N•m (30 lb. ft.).

6. Remove support from catalytic converter assembly (7 or 10).
7. Lower vehicle.

EXHAUST MUFFLER HANGER ASSEMBLIES

3.4L L32 Engine

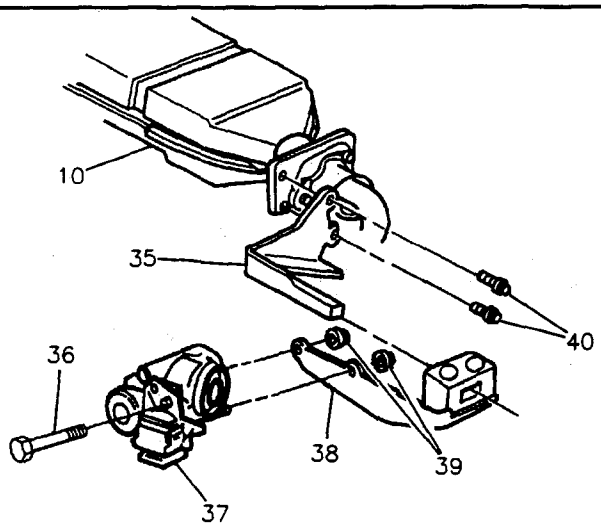
Figure 5, 6 and 9

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Support exhaust muffler assembly (15).
3. Exhaust muffler hanger bracket bolts/screws (42).
4. Exhaust muffler hanger assembly (16).

Install or Connect

NOTICE: See "Notice" on page 6F-1 of this section.



10 CONVERTER ASSEMBLY, CATALYTIC
35 HANGER ASSEMBLY, CATALYTIC CONVERTER
36 BOLT/SCREW, REAR AXLE TORQUE ARM INNER BRACKET
37 BRACKET ASSEMBLY, REAR AXLE TORQUE ARM INNER
38 BRACKET ASSEMBLY, CATALYTIC CONVERTER HANGER
39 NUT, REAR AXLE TORQUE ARM BRACKET
40 BOLT/SCREW, CATALYTIC CONVERTER HANGER

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Figure 8 – Catalytic Converter Assembly to Transmission Assembly (5.7L LT1 Engine – Manual Transmission Assembly Shown, Automatic Transmission Assembly Similar)

1. Exhaust muffler hanger assembly (16) to tailpipe and underbody.
2. Exhaust muffler hanger bracket bolts/screws (42).

Tighten

- Exhaust muffler hanger bracket bolts/screws (42) to 15 N•m (11 lb. ft.).
- Exhaust hanger assembly (16) bolt/screw to 15 N•m (11 lb. ft.).

3. Remove support from exhaust muffler assembly (15).
4. Lower vehicle.

5.7L LT1 Engine

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Support exhaust muffler assembly (20).
3. Exhaust muffler hanger nut (26).
4. Exhaust muffler hanger assembly (24).
5. Exhaust muffler hanger bracket bolts/screws (41).
6. Exhaust muffler hanger assembly (57).

Install or Connect

NOTICE: See "Notice" on page 6F-1 of this section.

1. Exhaust muffler hanger assembly (57).
2. Exhaust muffler hanger bracket bolts/screws (41).

Tighten

- Exhaust muffler hanger bracket bolts/screws (41) to 15 N•m (11 lb. ft.).

3. Exhaust muffler hanger assembly (24).
4. Exhaust muffler hanger nut (26).

Tighten

- Exhaust muffler hanger nut (26) to 25 N•m (18 lb. ft.).

5. Remove support from exhaust muffler assembly (20).
6. Lower vehicle.

EXHAUST MUFFLER INTERIOR BRACKET ASSEMBLY

Figures 5, 6 and 9

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Support exhaust muffler assembly (15 or 20) and exhaust pipe assembly (12 or 14).
3. Exhaust pipe hanger nut (19 or 22).
4. Exhaust pipe hanger bracket assembly (18 or 21).
5. Exhaust muffler interior hanger bolts/screws (44).
6. Exhaust muffler interior bracket assembly (43).

Install or Connect

NOTICE: See "Notice" on page 6F-1 of this section.

1. Exhaust muffler interior bracket assembly (43).
2. Exhaust muffler interior hanger bolts/screws (44).

Tighten

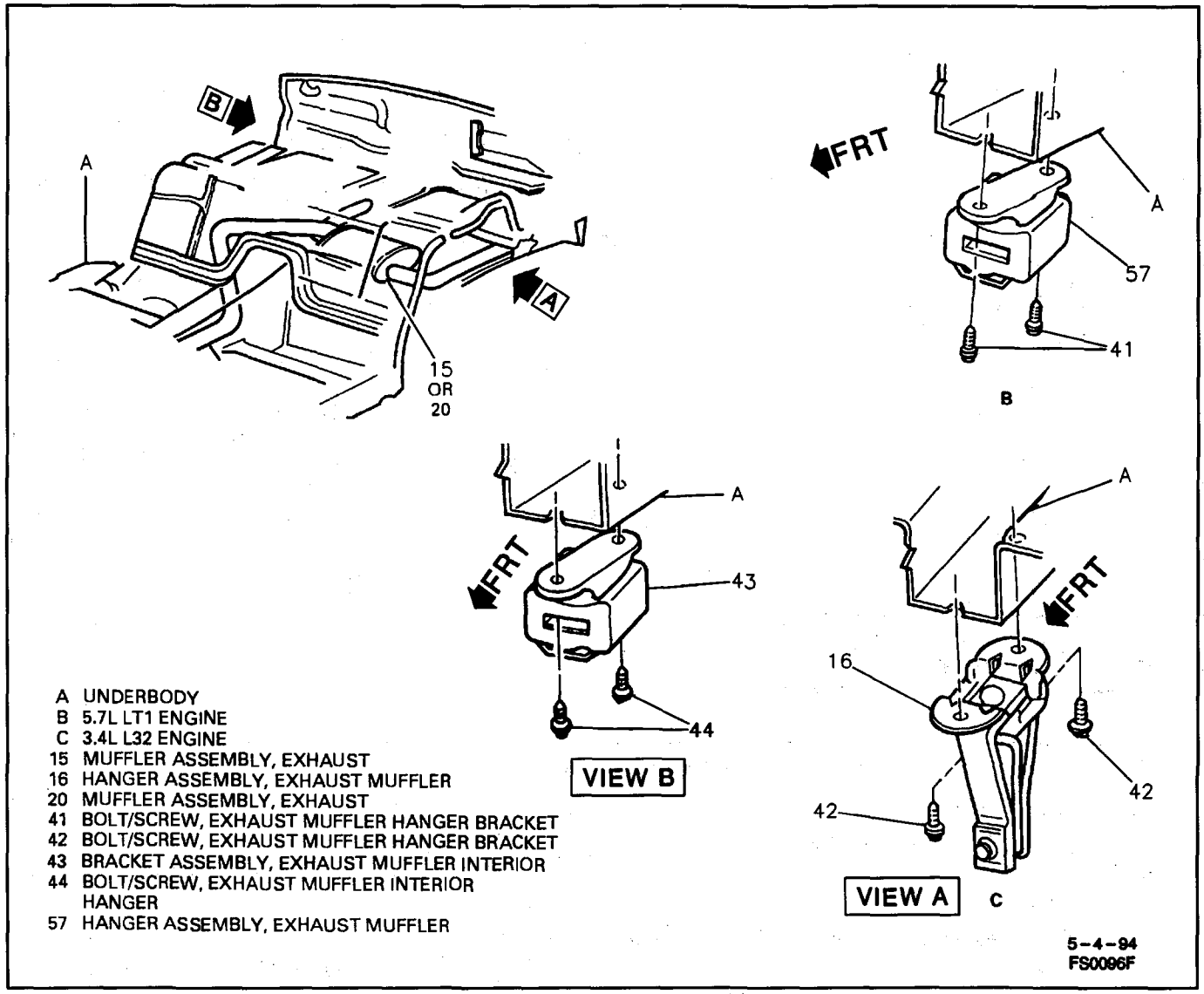
- Exhaust muffler interior hanger bolts/screws (44) to 15 N•m (11 lb. in.).

3. Exhaust pipe hanger bracket assembly (18 or 21).
4. Exhaust pipe hanger nut (19 or 22).

Tighten

- Exhaust pipe hanger nut (19 or 22) to 25 N•m (18 lb. in.).

5. Remove support from exhaust muffler assembly (15 or 20) and exhaust pipe assembly (12 or 14).
6. Lower vehicle.



A UNDERBODY
B 5.7L LT1 ENGINE
C 3.4L L32 ENGINE
15 MUFFLER ASSEMBLY, EXHAUST
16 HANGER ASSEMBLY, EXHAUST MUFFLER
20 MUFFLER ASSEMBLY, EXHAUST
41 BOLT/SCREW, EXHAUST MUFFLER HANGER BRACKET
42 BOLT/SCREW, EXHAUST MUFFLER HANGER BRACKET
43 BRACKET ASSEMBLY, EXHAUST MUFFLER INTERIOR
44 BOLT/SCREW, EXHAUST MUFFLER INTERIOR HANGER
57 HANGER ASSEMBLY, EXHAUST MUFFLER

Figure 9 – Installing Exhaust Muffler Hanger Assemblies to Underbody

CATALYTIC CONVERTER HEAT SHIELD

Figure 10

Remove or Disconnect

1. Catalytic converter assembly. Refer to "Catalytic Converter Assembly" under "On-Vehicle Service" in this section.
2. Catalytic converter heat shield bolts/screws (46).
3. Catalytic converter heat shield (45).

Install or Connect

NOTICE: See "Notice" on page 6F-1 of this section.

1. Catalytic converter heat shield (45).
2. Catalytic converter heat shield bolts/screws (46).

Tighten

- Catalytic converter heat shield bolts/screws (46) to 2.0 N•m (18 lb. in.).

3. Catalytic converter assembly. Refer to "Catalytic Converter Assembly" under "On-Vehicle Service" in this section.

EXHAUST HEAT SHIELD

Figure 10

Remove or Disconnect

1. Exhaust crossover pipe assembly (3.4L L32 engine). Refer to "Exhaust Crossover Pipe Assembly" under "On-Vehicle Service" in this section.
2. Catalytic converter assembly (5.7L LT1 engine). Refer to "Catalytic Converter Assembly" under "On-Vehicle Service" in this section.
3. Exhaust heat shield bolt/screw (48).
4. Exhaust heat shield (47).

Install or Connect

NOTICE: See "Notice" on page 6F-1 of this section.

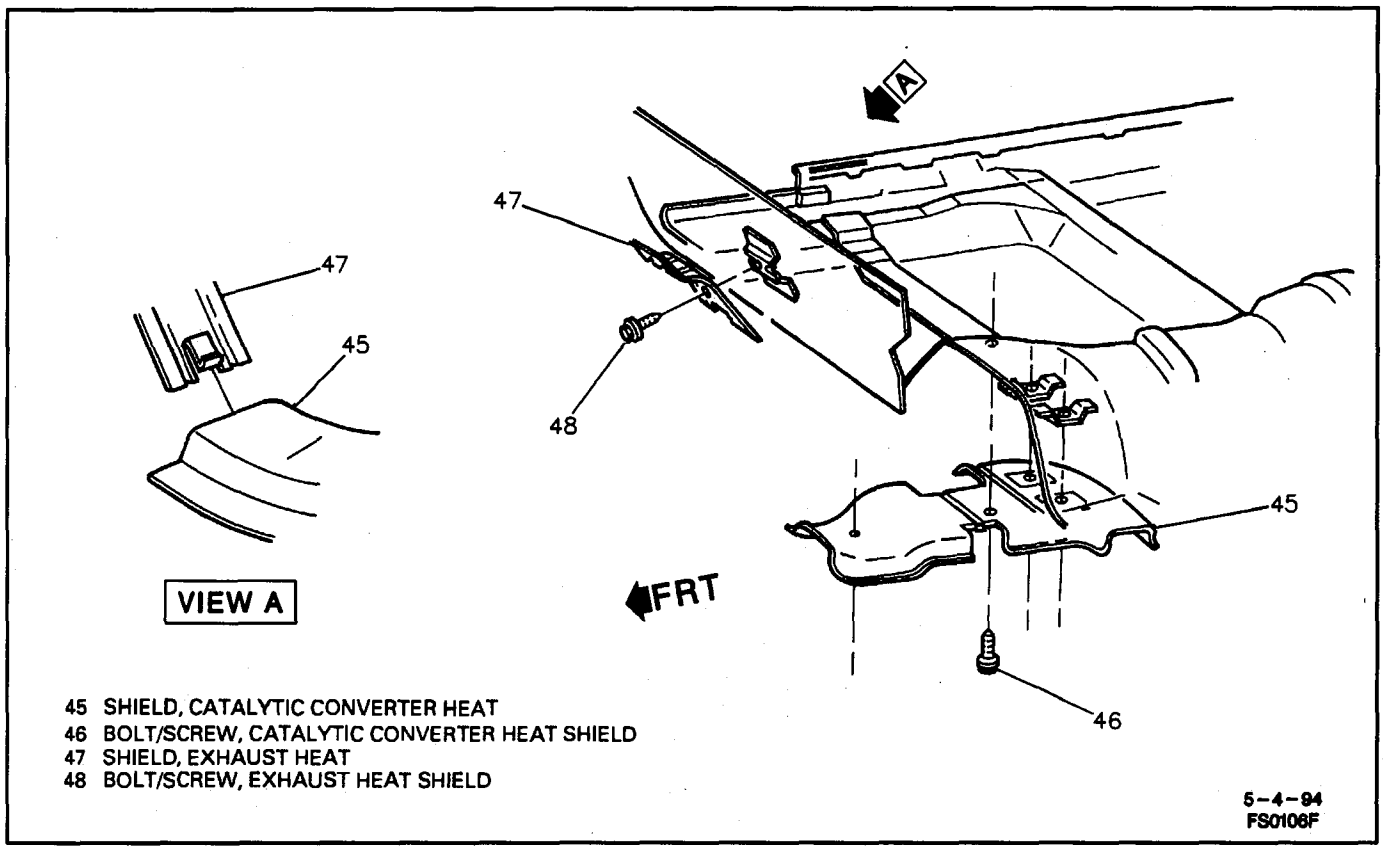


Figure 10 – Catalytic Converter and Exhaust Heat Shield

1. Exhaust heat shield (47).
2. Exhaust heat shield bolt/screw (48).

Tighten

- Exhaust heat shield bolt/screw (48) to 2.0 N•m (18 lb. in.).

3. Catalytic converter assembly (5.7L LT1 engine). Refer to "Catalytic Converter Assembly" under "On-Vehicle Service" in this section.
4. Exhaust crossover pipe assembly (3.4L L32 engine). Refer to "Exhaust Crossover Pipe Assembly" under "On-Vehicle Service" in this section.

EXHAUST PIPE HEAT SHIELD ASSEMBLY AND EXHAUST MUFFLER HEAT SHIELD

Remove or Disconnect

1. Exhaust muffler assembly. Refer to "Exhaust Muffler Assembly" under "On-Vehicle Service" in this section.
2. Exhaust pipe assembly. Refer to "Exhaust Pipe Assembly" in this section.
3. Exhaust pipe heat shield bolts/screws (50).
4. Exhaust pipe heat shield assembly (49).
5. Exhaust muffler heat shield bolts/screws (51).
6. Exhaust muffler heat shield (52).

Install or Connect

NOTICE: See "Notice" on page 6F-1 of this section.

1. Exhaust muffler heat shield (52).
2. Exhaust muffler heat shield bolts/screws (51).

Tighten

- Exhaust muffler heat shield bolts/screws (51) to 2.0 N•m (18 lb. in.).

3. Exhaust pipe heat shield assembly (49).
4. Exhaust pipe heat shield bolts/screws (50).

Tighten

- Exhaust pipe heat shield bolts/screws (50) to 2.0 N•m (18 lb. in.).

5. Exhaust pipe assembly. Refer to "Exhaust Pipe Assembly" in this section.
6. Exhaust muffler assembly. Refer to "Exhaust Muffler Assembly" under "On-Vehicle Service" in this section.

EXHAUST SYSTEM CLEARANCE DIMENSIONS

All checking dimensions are to be made on a cold exhaust system.

If dimensions cannot be met, it indicates a quality deficiency in a component part that must be corrected.

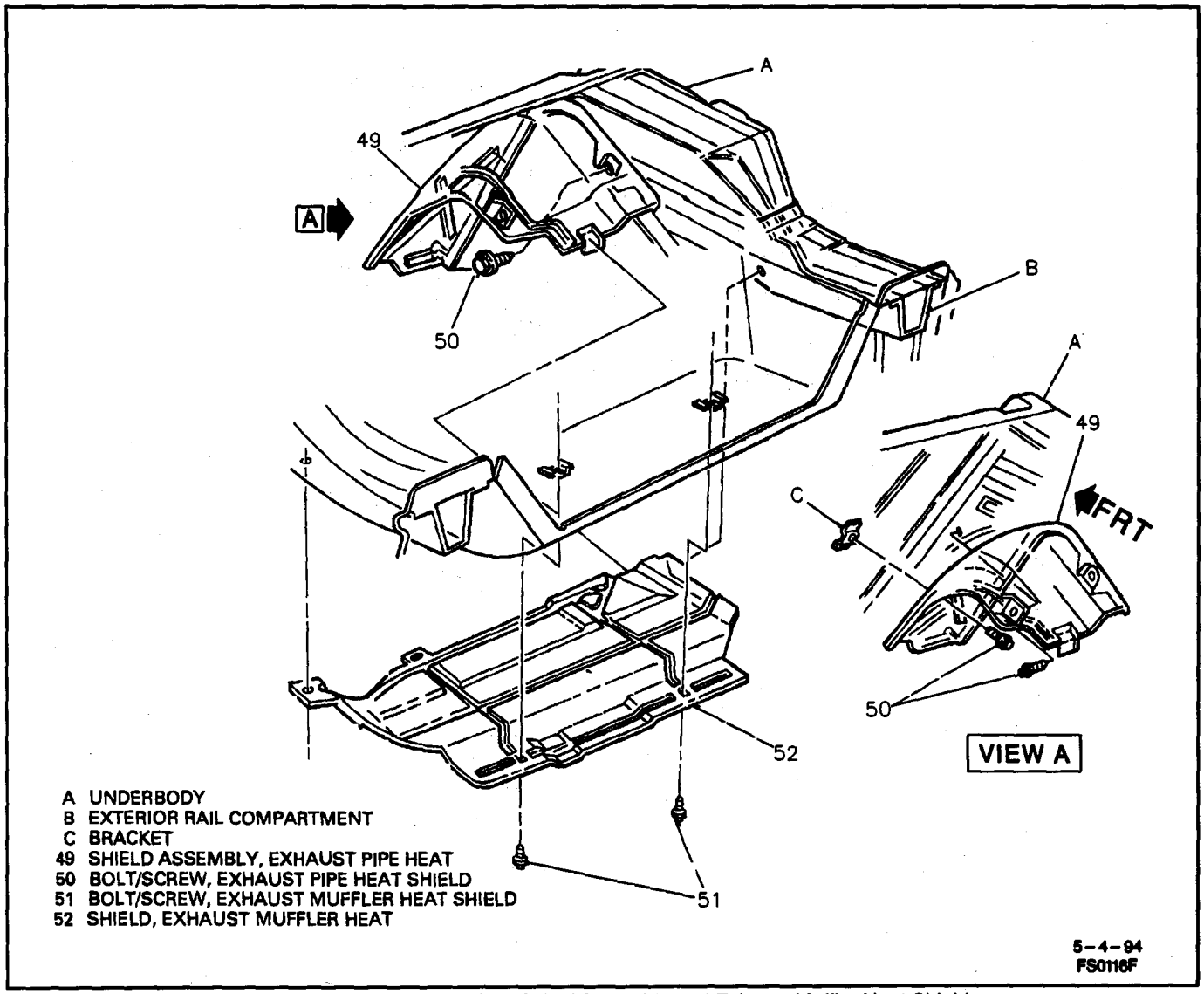
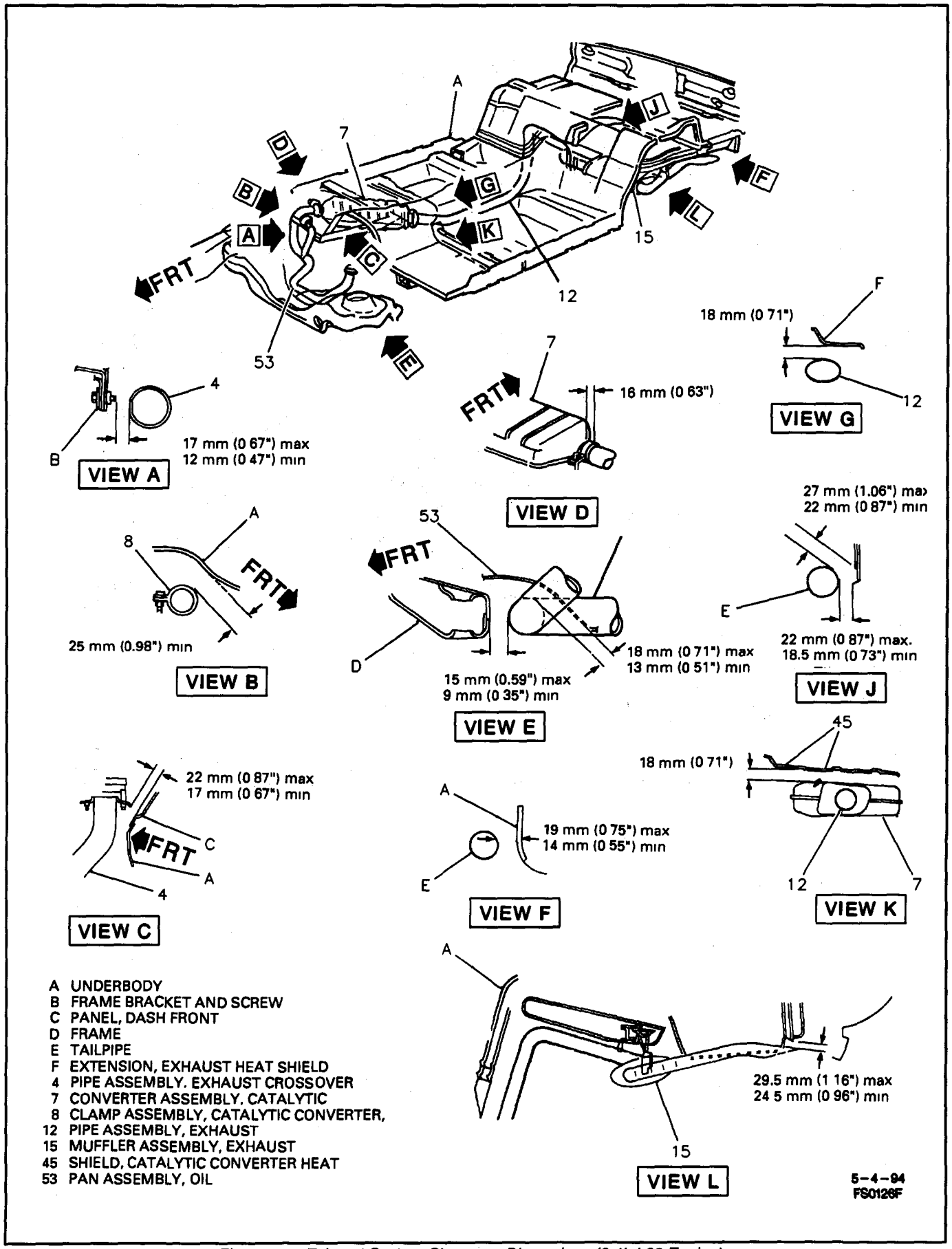


Figure 11 – Exhaust Pipe Heat Shield Assembly and Exhaust Muffler Heat Shield



A UNDERBODY
B FRAME BRACKET AND SCREW
C PANEL, DASH FRONT
D FRAME
E TAILPIPE
F EXTENSION, EXHAUST HEAT SHIELD
4 PIPE ASSEMBLY. EXHAUST CROSSOVER
7 CONVERTER ASSEMBLY. CATALYTIC
8 CLAMP ASSEMBLY, CATALYTIC CONVERTER,
12 PIPE ASSEMBLY, EXHAUST
15 MUFFLER ASSEMBLY, EXHAUST
45 SHIELD, CATALYTIC CONVERTER HEAT
53 PAN ASSEMBLY, OIL

Figure 12 – Exhaust System Clearance Dimensions (3.4L L32 Engine)

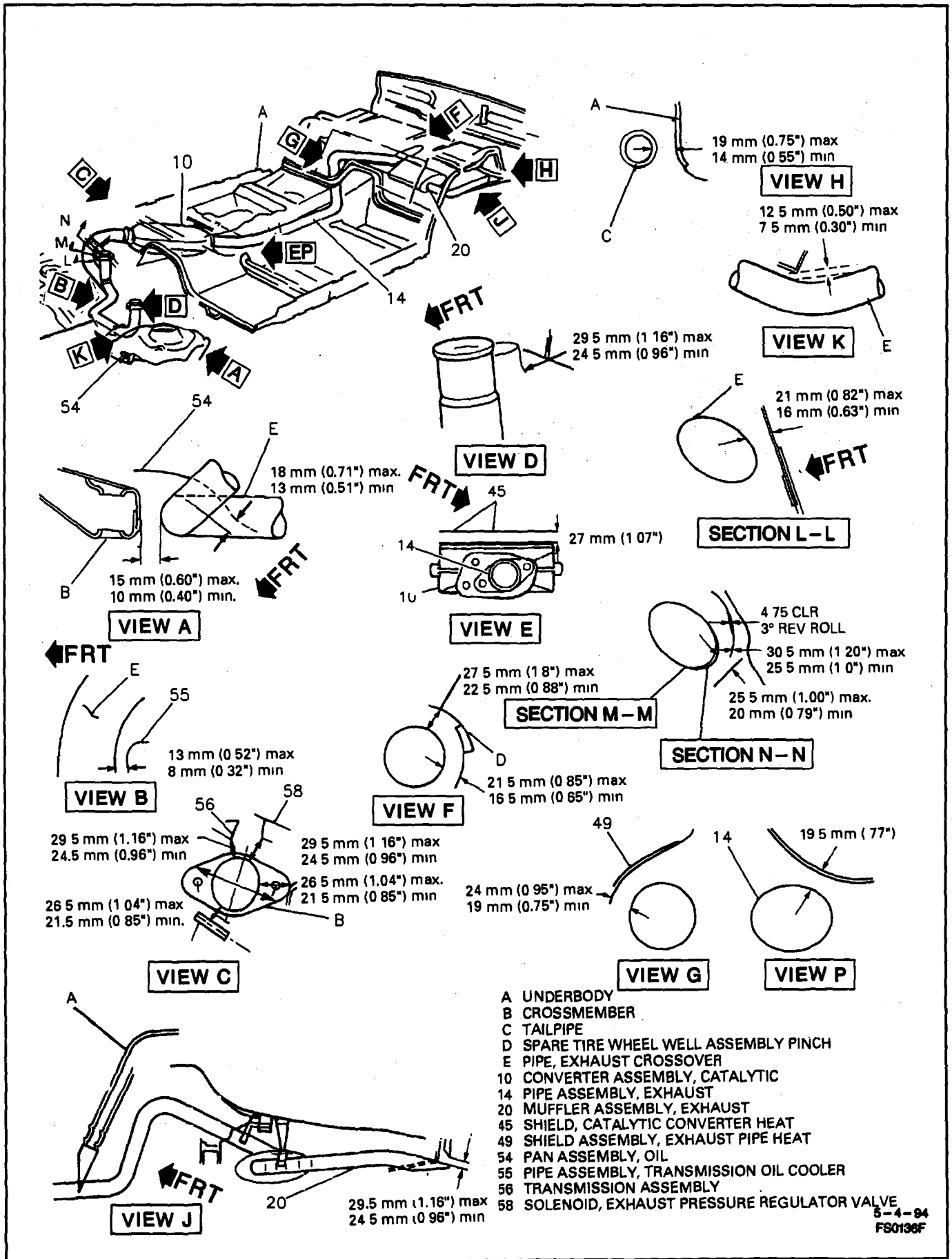


Figure 13 – Exhaust System Clearance Dimensions (5.7L LT1 Engine)

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Catalytic Converter Clamp Assembly	68 N•m (50 lb. ft.)
Catalytic Converter Hanger Bolt/Screw	41 N•m (30 lb. ft.)
Catalytic Converter Heat Shield Bolt/Screw	2.0 N•m (18 lb. in.)
Exhaust Crossover Pipe Nut	35 N•m (26 lb. ft.)
Exhaust Heat Shield Bolt/Screw	2.0 N•m (18 lb. in.)
Exhaust Muffler Hanger Assembly Bolt/Screw	15 N•m (11 lb. ft.)
Exhaust Muffler Hanger Bracket Bolt/Screw	10 N•m (89 lb. in.)
Exhaust Muffler Hanger Nut	25 N•m (18 lb. ft.)
Exhaust Muffler Heat Shield Bolt/Screw	2.0 N•m (18 lb. in.)
Exhaust Muffler Interior Hanger Bolt/Screw	10 N•m (89 lb. in.)
Exhaust Pipe Bolt/Screw	20 N•m (15 lb. ft.)
Exhaust Pipe Hanger Nut	15 N•m (11 lb. ft.)
Exhaust Pipe Heat Shield Bolt/Screw	2.0 N•m (18 lb. in.)
Exhaust Tailpipe Extension Clamp Assembly	68 N•m (50 lb. ft.)
Muffler Clamp Assembly	68 N•m (50 lb. ft.)
Rear Axle Torque Arm Bracket Nut	45 N•m (33 lb. ft.)
Rear Axle Torque Arm Inner Bracket Bolt/Screw	50 N•m (37 lb. ft.)
Rear Axle Torque Arm Outer Bracket Bolt/Screw	27 N•m (20 lb. ft.)

SECTION 7

AUTOMATIC AND MANUAL TRANSMISSION

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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Section 7C – Clutch 7-2

GENERAL DESCRIPTION

Section 7 contains both on-vehicle service and unit repair, as well as diagnosis procedures for the HYDRA-MATIC 4L60-E automatic transmission assembly, the Borg-Warner 5-speed manual transmission assembly and the Borg-Warner 6-speed manual transmission assembly.

DESCRIPTION OF SECTION 7

SECTION 7A – AUTOMATIC TRANSMISSION ON-VEHICLE SERVICE

This section contains information for automatic transmission assembly identification, automatic transmission fluid level checking procedures and specific information for servicing some components while the automatic transmission assembly is in the vehicle. This section also contains procedures for removing and installing the automatic transmission assembly.

SECTION 7A-14A – HYDRA-MATIC 4L60-E AUTOMATIC TRANSMISSION DIAGNOSIS (RPO M30)

This section contains information to assist in diagnosing automatic transmission operating conditions when the unit is in the vehicle. The diagnosis covers: road test procedures, diagnosis charts, fluid flow diagrams, electrical wiring diagrams, automatic transmission oil passage identification and torque converter clutch diagnosis.

SECTION 7A-14B – HYDRA-MATIC 4L60-E AUTOMATIC TRANSMISSION UNIT REPAIR (RPO M30)

This section contains the disassembly, inspection, overhaul and assembly procedures for the mechanical components on the automatic transmission. It also includes information on gaging certain components, proper use of special tools, and torque specifications required for assembly.

SECTION 7B – MANUAL TRANSMISSION ON-VEHICLE SERVICE (RPO M49 AND MM6)

This section contains information on the Borg-Warner 5-speed (RPO M49) manual transmission and Borg-Warner 6-speed (RPO MM6) manual transmission. It includes information on transmission identification, fluid level checking procedures and specifics on servicing some components while the transmission is in the vehicle. This section also contains procedures for the removal and installation of the transmission from the vehicle.

SECTION 7B-6B – BORG-WARNER (T5) 5-SPEED MANUAL TRANSMISSION UNIT REPAIR (RPO M49)

This section covers the disassembly, inspection, overhaul and assembly procedures for the Borg-Warner 5-speed manual transmission. Also included is information on the gaging of certain components, proper use of special tools, and torque specifications required for assembly.

SECTION 7B-10B – BORG-WARNER (T56) 6-SPEED MANUAL TRANSMISSION UNIT REPAIR (RPO MM6)

This section covers the disassembly, inspection, overhaul and assembly procedures for the Borg-Warner 6-speed manual transmission. Also included is information on the gaging of certain components, proper use of special tools, and torque specifications required for assembly.

SECTION 7C – CLUTCH

This section contains clutch assembly diagnosis, on-vehicle service of the hydraulic system, pressure plate/clutch disc removal and installation procedures, torque specifications and special tools required.

SECTION 7A

AUTOMATIC TRANSMISSION ON-VEHICLE SERVICE

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

NOTICE: The assembly of some components will require the use of an assembly lube. It is recommended that Transjel™ or petroleum jelly be used during assembly. Grease other than the recommended assembly lube will change transmission fluid characteristics and cause undesirable shift conditions and/or filter clogging.

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GENERAL INFORMATION

TRANSMISSION ASSEMBLY IDENTIFICATION INFORMATION

Figures 1 and 2

The HYDRA-MATIC 4L60-E transmission has the identification information stamped into the case pan rail. The location of this information is shown in Figure 1. This information will assist in the servicing and determination of replacement parts when ordered through a GM parts catalog.

Additional transmission identification is provided on the "Service Parts Identification" label shown in Figure 2. This label contains information on the Regular Production Options (RPO) as well as standard and mandatory options. This label is affixed to the inside of each vehicle at the assembly plant. Refer to SECTION 0A for additional information.

TRANSMISSION ASSEMBLY DEFINITIONS

The following definitions are provided to establish a common language and assist the user in describing transmission assembly related conditions. Some of these terms or conditions are used in the transmission assembly diagnosis section of this service manual.

Throttle Positions

Minimum Throttle – least amount of throttle opening required for an upshift.

Light Throttle – approximately 1/4 of accelerator pedal travel.

Medium Throttle – approximately 1/2 of accelerator pedal travel.

Heavy Throttle – approximately 3/4 of accelerator pedal travel.

Wide Open Throttle (WOT) – full travel of accelerator pedal.

Full Throttle Detent Downshift – quick application of accelerator pedal to its full travel, forcing a downshift.

Zero Throttle Coastdown – full release of accelerator pedal while vehicle is in motion in drive range.

Engine Braking – condition where engine is used to slow vehicle by manually downshifting during zero throttle coastdown.

Shift Conditions

Bump – sudden and forceful application of clutch or band.

Chuggle – bucking or jerking condition that may be engine related. May be most noticeable when the torque converter clutch is engaged. Similar to the feel of towing a trailer.

Delayed – condition where shift is expected but does not occur for a period of time. Examples of this condition could be described as clutch or band engagement that does not occur as quickly as expected during part throttle or wide open throttle application of accelerator, or when manually downshifting to lower range. Also defined as "late" or "extended."

Double Bump – two sudden and forceful applications of clutch or band. Also defined as "double feel."

Early – condition where shift occurs before vehicle has reached proper speed and tends to labor engine after upshift.

End Bump – firmer feel at end of shift as compared to feel at start of shift. Also defined as "end feel" or "slip bump."

Firm – noticeable quick application of clutch or band that is considered normal with medium to heavy throttle shift. Should not be confused with "harsh" or "rough."

Flare – quick increase in engine RPM accompanied with momentary loss of torque. This most generally occurs during a shift. Also defined as "slipping."

Harsh – more noticeable application of clutch or band as compared to "firm." This condition is considered undesirable at any throttle position. Also defined as "rough."

Hunting – repeating quick series of upshifts and downshifts causing noticeable change in engine RPM. An example could be described as a 4-3-4 shift pattern. Also defined as "busyness."

Initial Feel – distinct firmer feel at start of shift as compared to finish of shift.

Late – shift that occurs when engine is at higher than normal RPM for given amount of throttle.

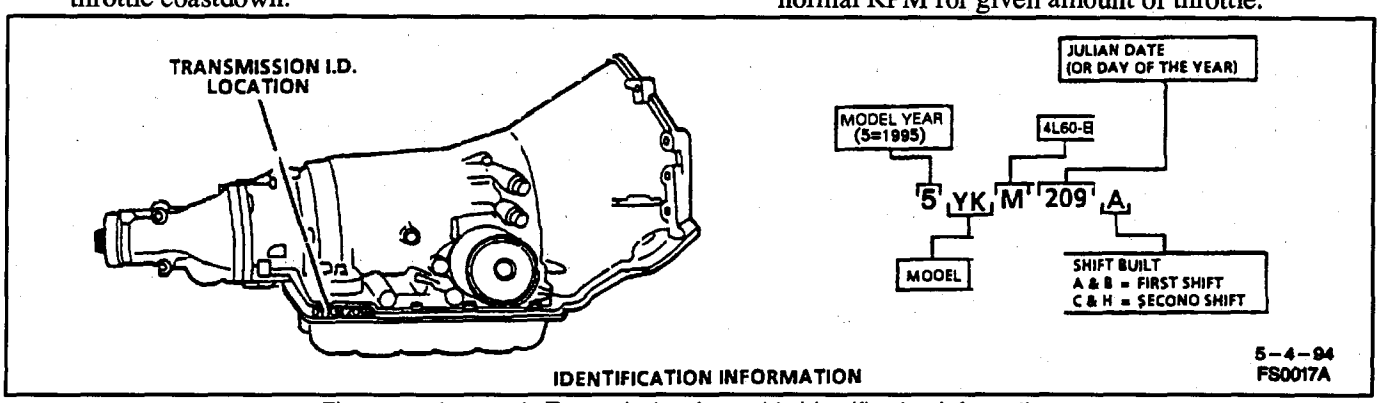


Figure 1 – Automatic Transmission Assembly Identification Information

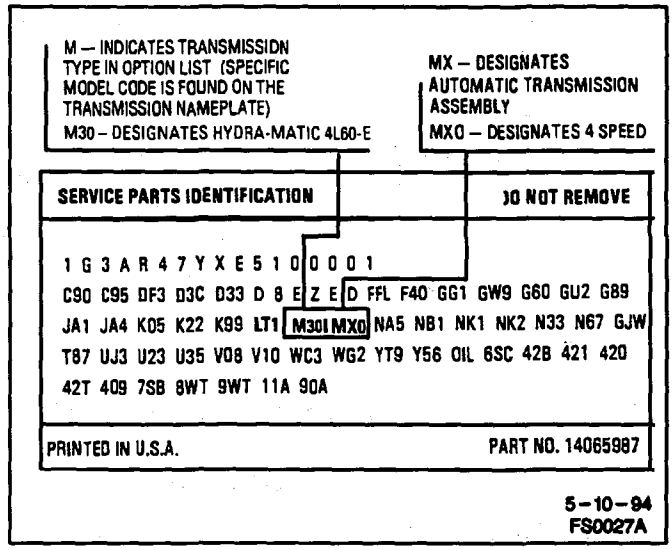


Figure 2 – Service Parts Identification Label

Shudder – repeating jerking sensation similar to "chuggle" but more severe and rapid in nature. This condition may be most noticeable during certain ranges of vehicle speed. May also be used to define the condition after torque converter clutch engagement.

Slipping – noticeable increase in engine RPM without vehicle speed increase. Slip usually occurs during or after initial clutch or band engagement.

Soft – slow, almost unnoticeable clutch application with very little shift feel.

Surge – repeating engine related feeling of acceleration and deceleration that is less intense than "chuggle."

Tie-Up – condition where two opposing clutches are attempting to apply at the same time causing the engine to labor with noticeable loss of engine RPM.

Noise Conditions

Gear Noise – whine, most noticeable in first gear and reverse that is related to vehicle speed. A gear noise condition may become less noticeable or go away after an upshift.

Pump Noise – high-pitched whine increasing in intensity with engine RPM. This condition may also be noticeable in "PARK" and "NEUTRAL" operating ranges with the vehicle stationary.

PRELIMINARY CHECKING PROCEDURE

Transmission assembly performance may be influenced by one or more of the following items. These items should be checked and corrected if necessary, before attempting transmission assembly diagnosis.

- High or low fluid level.
- Engine performance. Refer to SECTION 6 and SECTION 6E.
- Manual linkage adjustment.
- Internal fluid leaks. Refer to SECTION 7A-15A.
- Electrical system. Refer to SECTION 6D and SECTION 8A.
- Transmission assembly or other mechanical component. Refer to SECTION 7A-15A.

NOISE AND VIBRATION ANALYSIS

A noise or vibration noticeable when the vehicle is in motion, may not be caused by the transmission assembly.

If a noise or vibration is noticeable in "PARK" and "NEUTRAL" with engine at idle, but is less noticeable as RPM increases, the cause may be poor engine performance.

Inspect

- Tire and wheel assemblies for:
  - Uneven wear.
  - Imbalance.
  - Mixed sizes.
  - Mixed radial and bias ply. Refer to SECTION 3E.
- Suspension components for:
  - Alignment and wear.
  - Loose fasteners. Refer to SECTION 3C.
- Engine and transmission assembly mounts for:
  - Damage.
  - Loose bolts/screws.
- Transmission case mounting holes for:
  - Missing bolts/screws, nuts, studs.
  - Stripped threads.
  - Cracks.
- Flywheel assembly for:
  - Missing or loose bolts/screws.
  - Cracks.
  - Imbalance. Refer to SECTION 6A1.
- Torque converter clutch for:
  - Missing or loose bolts/screws or lugs.
  - Missing or loose balance weights.
  - Imbalance.

TRANSMISSION FLUID CHECKING AND FILLING PROCEDURES

Figure 3

Checking fluid level, color and condition at regular intervals will provide early diagnosis information about the transmission. This information may then be used to correct a condition that, if not detected early, could result in major transmission repair.

Refer to SECTION 0B for maintenance information and servicing intervals.

Important

- When new, automatic transmission fluid should be red. The red dye is added so the assembly plant can identify it as transmission fluid and distinguish it from engine oil or antifreeze. The red dye, which is not an indicator

of fluid quality, is not permanent. As the vehicle is driven the transmission fluid will begin to look darker. The color may eventually appear light brown.

- Wait at least 30 minutes before checking the transmission fluid level if you have been driving:
  - When outside temperatures are above 32°C (90°F).
  - At high speed for greater than 15 minutes.
  - In heavy traffic during hot weather.
  - While pulling a trailer.
- To get the right reading, the fluid should be at normal operating temperature, which is 80°C-93°C (180°F to 200°F).
- Hot check:
  - Get the vehicle warmed up by driving about 24 km (15 miles), when outside temperatures are above 10°C (50°F). If it's colder than 10°C (50°F), you may have to drive longer.
- Cold check:
  - A cold check can be made when the transmission temperature is between 24-29°C (75-85°F). Let the engine run at slow idle for 5 minutes if the outside temperature is 10°C (50°F) or more. If it's colder than 10°C (50°F), you may have to idle the engine longer.
- Fluid check procedure hot or cold:

A. Park the vehicle on a level surface.

B. Place the shift lever "PARK" with the parking brake applied.

C. With your foot on the brake pedal, move the shift lever through each gear range, pausing for about 3 seconds in each range. Then, position the shift lever in "PARK."

D. Let the engine idle for 3 minutes or more.

E. Then follow these steps to check the fluid level:

a. Pull out the dipstick and wipe it with a clean rag or paper towel.

b. Push it back in all the way, wait 3 seconds and then pull it back out again.

F. Check both sides of the dipstick, and read the lower level. The fluid level must be in the "COLD" area for a cold check or in the "HOT" area or cross-hatched area for a hot check.

G. If the fluid level is where it should be, push the dipstick back in all the way.

NOTICE: Do not overfill. Overfilling will cause foaming, loss of fluid and possible damage to the transmission.

H. If the fluid level is low, add only enough DEXRON®-III to bring the fluid level up to the "COLD" area for a cold check or the "HOT" area for a hot check. It doesn't take much fluid, generally less than a pint. DO NOT OVERFILL.

I. After adding fluid, recheck the fluid level as described above. When the correct fluid level is obtained, push the dipstick back in all the way.

- Fluid color.
  - Should be red when new.

GENERAL SERVICE PROCEDURES

NO AIR TOOL RECOMMENDATION

NOTICE: It is not recommended to use air powered tools to disassemble or assemble transmission assemblies. Improper bolt torques can contribute to transmission assembly repair conditions, and this information vital to diagnosis can only be detected when using hand tools.

PARTS CLEANING, INSPECTION AND REPLACEMENT

- Use appropriate safety equipment such as:
  - Safety glasses.
  - Safety shoes.
  - Gloves.
- Keep work areas and tools clean.
- Clean transmission assembly exterior before removing parts.
- Do not use wipe cloths or rags.
- Do not use solvents on:
  - Rubber seals.
  - Plastic/Teflon® thrust washers or spacers.
- Blow out all passages with compressed air.
- Clean out small passages with fine wire.
- Handle parts carefully to prevent damage.

NOTICE: The assembly of some components will require use of an assembly lube. It is recommended that J 36850 Transjel™, or equivalent, be used during assembly. Do not use any type of grease to retain parts during assembly of this unit. Lubricants other than the recommended assembly lube will change fluid characteristics and cause undesirable shift conditions and/or oil filter clogging.

- When installing bolts/screws or studs into aluminum, always dip the threads in Transjel™, or equivalent.
- Recondition damaged or stripped aluminum threads with thread inserts.
- Replace all gaskets and O-ring seals.
  - Do not use gasket cement or sealers.

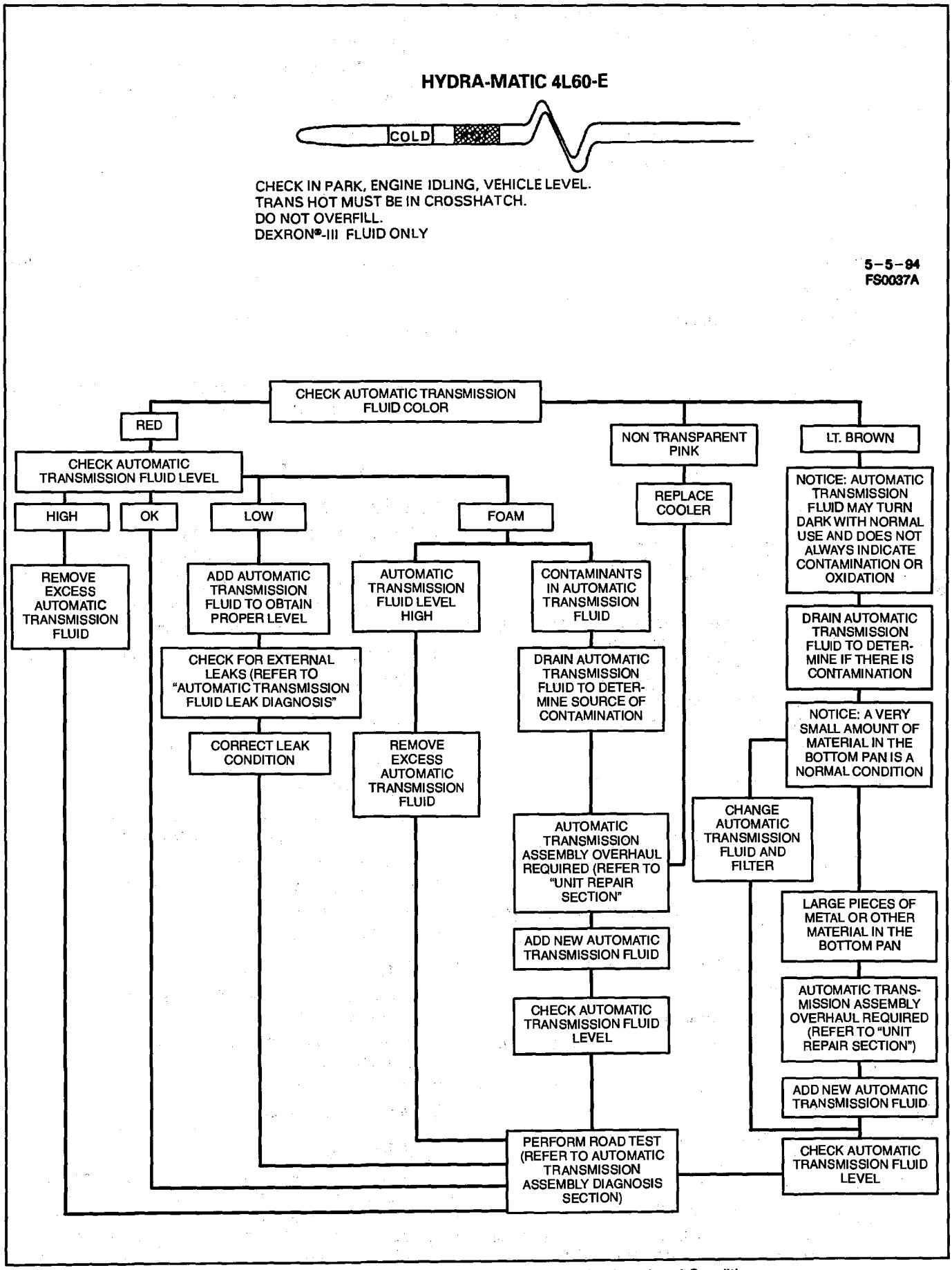


Figure 3 – Checking Automatic Transmission Fluid Color, Level and Condition

- Replace Teflon® and rubber lip seals only when necessary and install using the appropriate seal installer.

Inspect

- Manual linkage for:
  - Bent or broken links and rods.
- All seals, gaskets, O-ring seals and mating surfaces for:
  - Nicks.
  - Cuts.
  - Damage.
- Snap rings for:
  - Expansion or compression.
  - Distortion.
  - Nicks.
  - Proper ring-to-groove fit.
- Bearings and thrust surfaces for:
  - Wear.
  - Scoring.
  - Pitting.

FLYWHEEL ASSEMBLY/TORQUE CONVERTER CLUTCH VIBRATION TEST PROCEDURE

NOTICE: Some engine/transmission assembly combinations cannot be balanced in this manner due to limited clearances between the torque converter clutch bolts/screws and the engine. Be sure bolts/screws do not bottom out in lug nuts or the transmission converter cover could be dented and cause internal damage.

Remove or Disconnect

1. Start engine.
2. With engine at idle speed and transmission assembly in "PARK" or "NEUTRAL," observe vibration.
3. Shut off engine.
4. Raise and suitably support vehicle. Refer to SECTION 0A.
5. Transmission converter cover bolts/screws.
6. Flywheel bolts/screws.
   - Discard flywheel bolts/screws.
7. Rotate torque converter clutch 120 degrees (1/3 turn).

Install or Connect

NOTICE: See "Notice" on page 7A-1 of this section.

1. Flywheel bolts/screws.
   - Hand start flywheel bolts/screws.
     - Use new flywheel bolts/screws with retaining compound removed from first three threads.

Tighten

- Flywheel bolts/screws to 63 N•m (46 lb. ft.).

2. Transmission converter cover bolts/screws.

Tighten

- Transmission converter cover bolts/screws to 10 N•m (89 lb. in.).

3. Lower vehicle.
4. Start engine and check for vibration.
   - If vibration still exists repeat this procedure until best possible balance is obtained.

FLUID LEAK DIAGNOSIS

Figure 4

The cause of most external leaks generally can be located and repaired with the transmission assembly in the vehicle.

Methods for Locating Leak

General Method

1. Verify leak is transmission fluid.
2. Thoroughly clean suspected leak area.
3. Operate vehicle for about 24 km (15 miles) or until normal operating temperatures are reached.
4. Park vehicle over clean paper or cardboard.
5. Shut off engine and look for fluid spots on paper.
6. Make necessary repairs.

Powder Method

1. Thoroughly clean suspected leak area with solvent.
2. Apply aerosol type powder (foot powder) to suspected leak area.
3. Operate vehicle for about 24 km (15 miles) or until normal operating temperatures are reached.
4. Shut off engine.
5. Inspect suspected leak area and trace leak path through powder to find source.
6. Make necessary repairs.

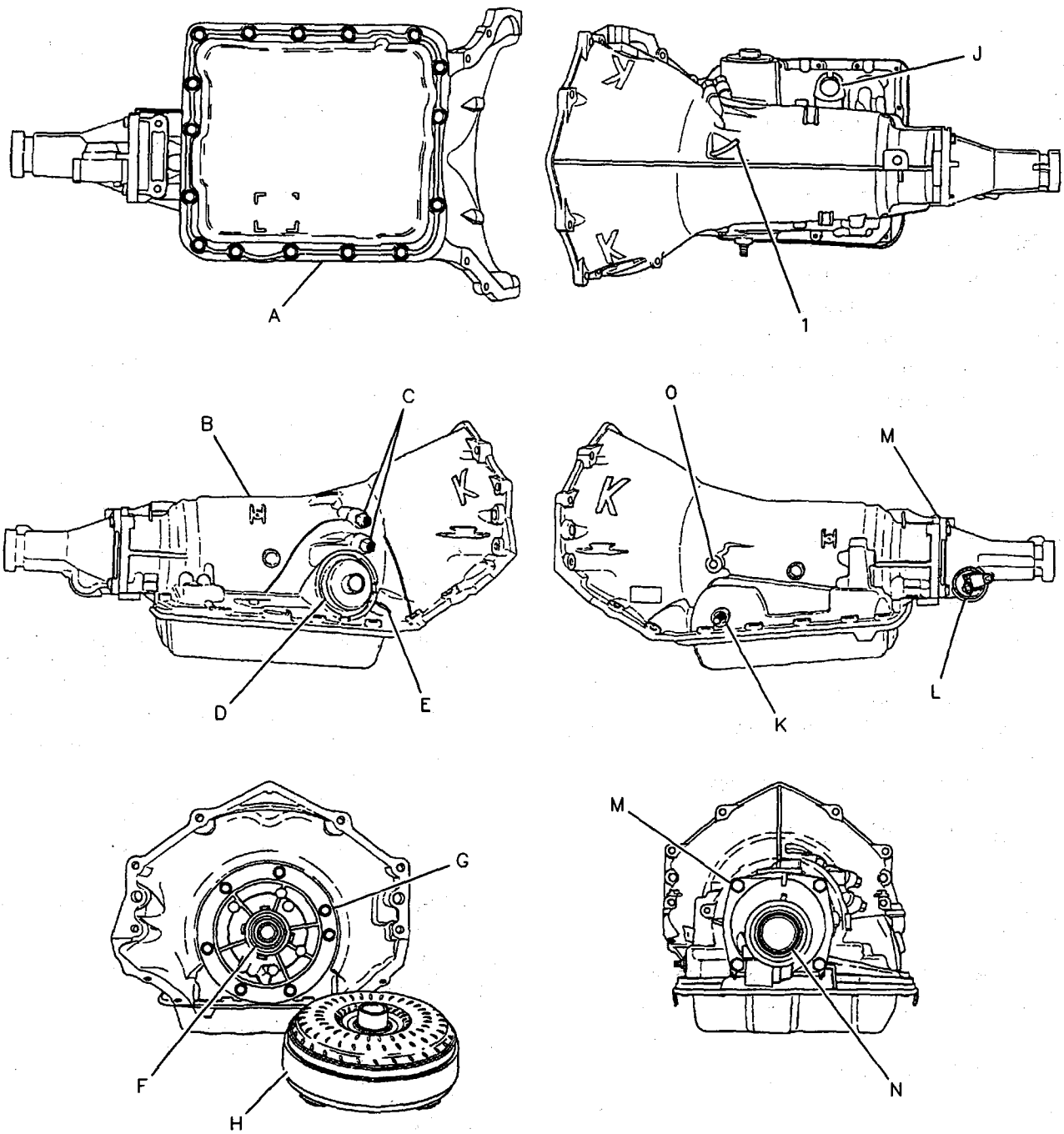
Dye and Black Light Method

A fluid dye and black light kit is available from various tool manufacturers.

1. Follow manufacturer's recommendations for amount of dye to use.
2. Detect leak with black light.
3. Make necessary repairs.

Repairing the Leak

Once the leak has been pinpointed and traced back to its source, the cause of the leak must be determined for it to be properly repaired. For example, if a gasket is replaced, but the sealing flange is bent, the new gasket will not repair the leak. The bent flange also must be repaired.



A BOTTOM PAN GASKET
B CASE
C COOLER CONNECTORS
D SERVO COVER SEAL
E OIL FILL TUBE SEAL
F OIL PUMP SEAL ASSEMBLY
G OIL PUMP TO CASE SEAL
H CONVERTER
I VENT
J ELECTRICAL CONNECTOR SEAL
K MANUAL SHAFT SEAL
L SPEED SENSOR SEAL
M EXTENSION TO CASE SEAL
N EXTENSION OIL SEAL ASSEMBLY
O LINE PRESSURE PLUG

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Figure 4 – Automatic Transmission Fluid Leak Points

The following conditions may cause a leak. Before attempting to repair a leak, these conditions should be checked and corrected if necessary.

Gaskets

Inspect

- Fluid level/pressure too high.
- Plugged vent or drain-back holes.
- Improperly torqued fasteners, dirty or damaged threads.
- Warped flanges or sealing surface.
- Scratches, burrs or other damage to sealing surface.
- Damaged or worn gasket.
- Cracking or porosity of component.
- Improper sealant used, where applicable.
- Incorrect gasket.

Seals

Inspect

- Fluid level/pressure too high.
- Plugged vent or drain-back holes.
- Damaged seal bore.
- Damaged or worn seal.
- Improper installation.
- Cracks in component.
- Scratched, nicked or damaged, manual or output shaft surface.
- Loose or worn bearing causing excess seal wear.

Possible Points of Fluid Leaks

Oil Pan

Inspect

- Incorrectly tightened oil pan bolts/screws.
- Improperly installed or damaged oil pan gasket.
- Damaged oil pan.
- Incorrect oil pan gasket.

Oil Case Leak

Inspect

- Damaged or missing transmission filler tube seal.
- Mislocated filler tube bracket.
- Damaged vehicle speed sensor seal.
- Damaged manual shaft seal.
- Loose or damaged oil cooler connector fittings.
- Worn or damaged propeller shaft oil seal.
- Loose parking pawl shaft cup plug, if equipped.
- Loose line pressure pipe plug.
- Porous casting.

Leak at Torque Converter End

Inspect

- Torque converter seal damaged.
  - Torque converter seal lip cut. Check torque converter hub for damage.
  - Bushing moved forward and damaged.
  - Garter spring missing from seal.
- Torque converter leak in weld area.
- Porous casting of transmission case or oil pump.

Leak at Vent Pipe of Fluid Filler Tube Assembly

Inspect

- Over-filled system.
- Water or coolant in fluid. Fluid will appear milky.
- Transmission case porous.
- Incorrect fluid level indicator assembly.
- Plugged vent.
- Plugged drain-back holes.
- Mispositioned oil pump-to-case gasket, if equipped.

Transmission Case Porosity Repair

1. Clean leak area with solvent and air dry.
   CAUTION: Epoxy cement may cause skin irritations and eye damage. Read and follow all information on container label as provided by manufacturer.
2. Mix sufficient amount of epoxy cement, GM P/N 1052533, or equivalent, following manufacturers' recommendations.
3. While transmission case is hot, apply epoxy cement with clean, dry soldering acid brush.
4. Allow epoxy cement to cure for three hours before starting engine.
5. Repeat fluid leak diagnosis procedures to determine if leak is fixed.

TORQUE CONVERTER CLUTCH ELECTRICAL CONTROLS

The torque converter clutch (TCC) system uses controls that are both internal and external to the transmission assembly. For internal control components of the TCC system, refer to SECTION 7A-15A for wiring diagrams and switch locations.

The external control components of the TCC system include:

Cruise Control Release Switch Assembly – To avoid stalling the engine when braking, the TCC is released any time the brake pedal assembly is applied.

Powertrain Control Module (PCM) – Receives input signals and grounds TCC solenoid to apply clutch when proper operating conditions are met.

Throttle Position Sensor – Sends throttle position information to PCM.

Manifold Absolute Pressure (MAP) Sensor – Sends engine vacuum (load) information to PCM.

Vehicle Speed Sensor (VSS) – Sends vehicle speed information to PCM.

Engine Coolant Temperature Sensor – Sends engine coolant temperature information to PCM.

TORQUE CONVERTER CLUTCH DIAGNOSIS

To properly diagnose the torque converter clutch (TCC) system, perform all electrical testing first and then hydraulic testing. Refer to SECTION 6E3 and SECTION 7A-15A for additional TCC information.

ON-VEHICLE SERVICE

AUTOMATIC TRANSMISSION RANGE SELECTOR LEVER CABLE ASSEMBLY

Figure 5

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Cable assembly (806) from bracket (800).
4. Cable assembly (806) from lever assembly (809).
5. Lower vehicle.
6. Front floor console trim plate assembly. Refer to SECTION 8C.
7. Cable assembly (806) from control assembly (805).
8. Grommet on cable assembly (806) from base of control assembly (805), pulling cable assembly (806) through hole in front compartment floor pan assembly.

Install or Connect

NOTICE: See "Notice" on page 7A-1 of this section.

1. Grommet on cable assembly (806) to base of control assembly (805) by feeding cable assembly (806) through hole in front compartment floor pan assembly.
2. Cable assembly (806) to control assembly (805).
3. Front floor console trim plate assembly. Refer to SECTION 8C.
4. Place control assembly (805) in "NEUTRAL" position.

Important

- Control assembly must remain in "NEUTRAL" position until cable assembly installation is completed.

5. Raise and suitably support vehicle. Refer to SECTION 0A.

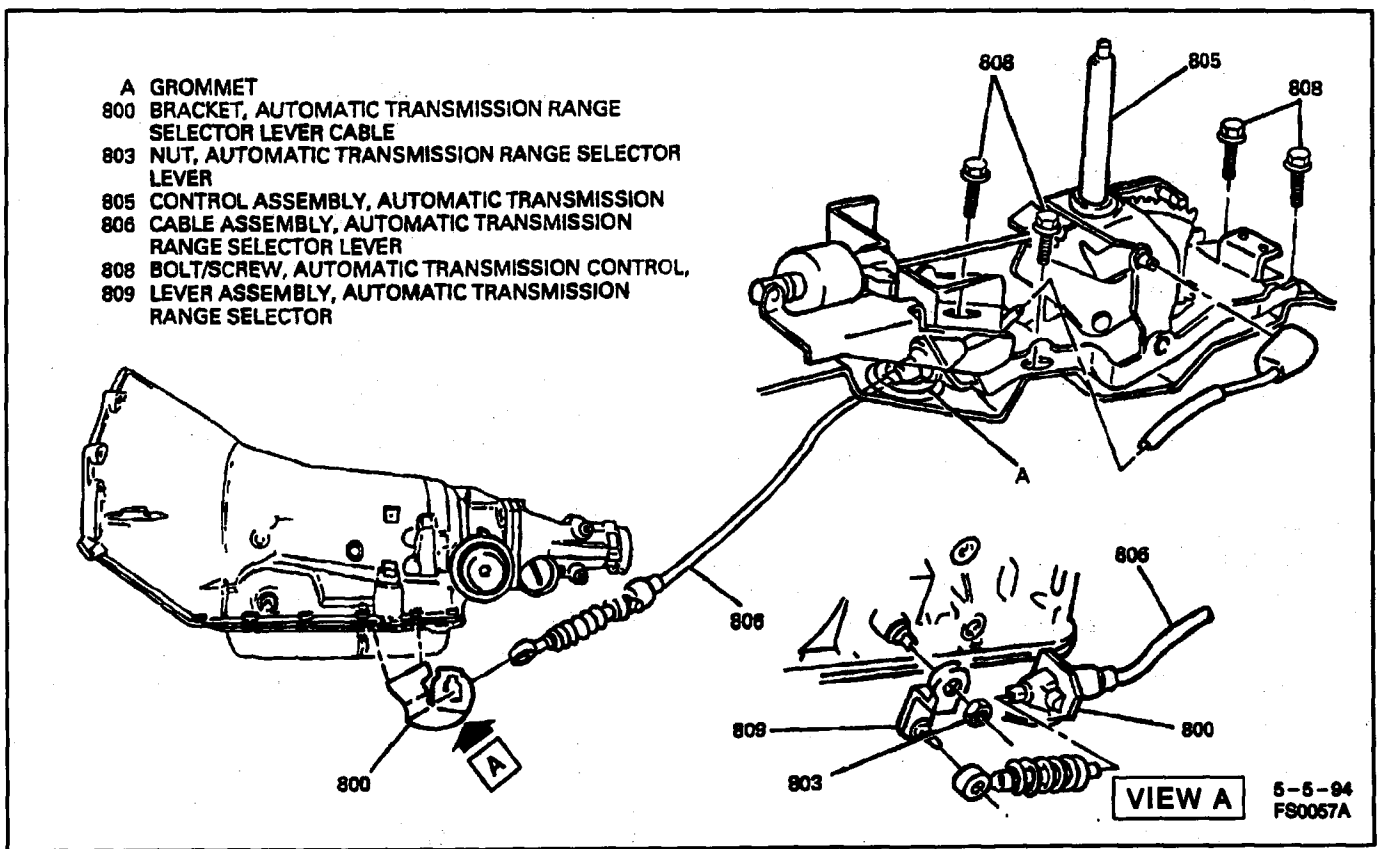


Figure 5 – Automatic Transmission Range Selector Lever Cable Assembly

6. Cable assembly (806) to bracket (800) with adjustment button unlocked.
7. Place lever assembly (809) in "NEUTRAL" position by rotating lever assembly counterclockwise from "PARK" through "REVERSE" and into "NEUTRAL."
8. Cable assembly (806) to lever assembly (809).
9. Lock adjustment button on cable assembly (806) to bracket (800) by turning counterclockwise.
10. Lower vehicle.
11. Battery negative cable assembly.

AUTOMATIC TRANSMISSION CONTROL ASSEMBLY

Figures 5 and 6

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Automatic transmission range selector lever cable assembly. Refer to "Automatic Transmission Range Selector Lever Cable Assembly" in this section.
3. Park/neutral position switch assembly. Refer to "Park/Neutral Position Switch Assembly" in this section.
4. Bolts/screws (808).
5. Control assembly (805).

Install or Connect

NOTICE: See "Notice" on page 7A-1 of this section.

1. Control assembly (805).
2. Bolts/screws (808).

Tighten

- Bolts/screws (808) to 4.5 N•m (40 lb. in.).

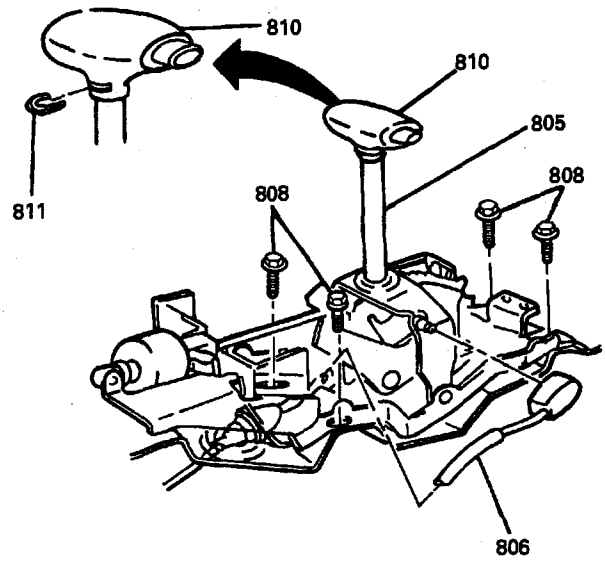
3. Park/neutral position switch assembly. Refer to "Park/Neutral Position Switch Assembly" in this section.
4. Automatic transmission range selector lever cable assembly. Refer to "Automatic Transmission Range Selector Lever Cable Assembly" in this section.
5. Battery negative cable assembly.

AUTOMATIC TRANSMISSION PARK LOCK CABLE ASSEMBLY

Figure 7

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.



805 CONTROL ASSEMBLY, AUTOMATIC TRANSMISSION
806 CABLE ASSEMBLY, AUTOMATIC TRANSMISSION RANGE SELECTOR LEVER
808 BOLT/SCREW, AUTOMATIC TRANSMISSION CONTROL,
810 KNOB/HANDLE, AUTOMATIC TRANSMISSION CONTROL LEVER
811 RETAINER, AUTOMATIC TRANSMISSION CONTROL LEVER HANDLE

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Figure 6 – Automatic Transmission Control Assembly (Typical)

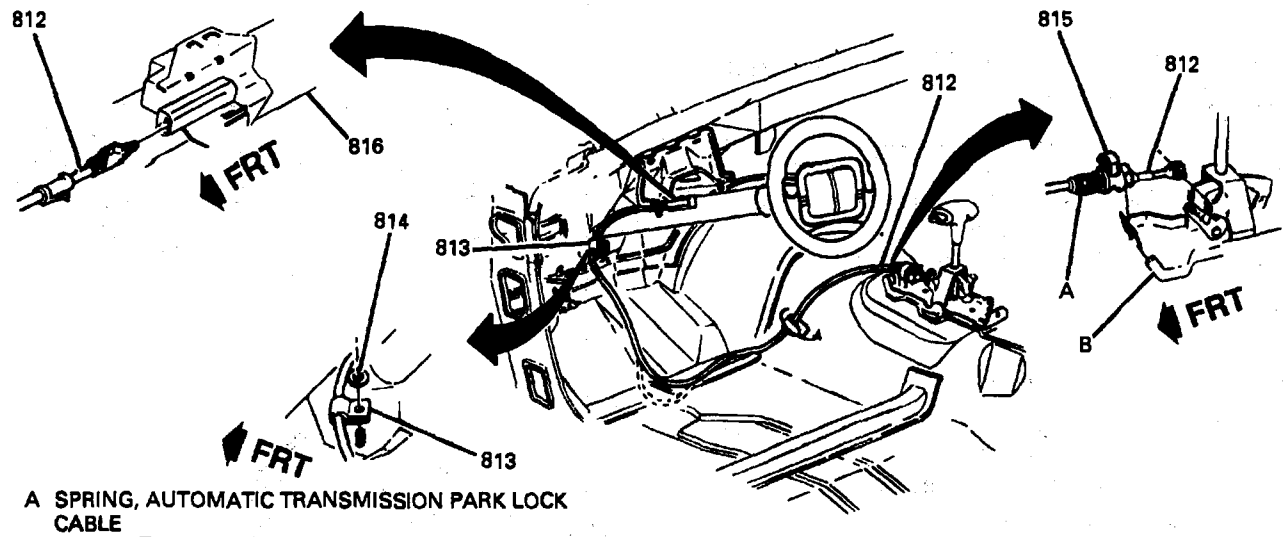
1. Battery negative cable assembly.

CAUTION: Refer to "Caution" on page 7A-1 of this section.

2. Disable the SIR system. Refer to SECTION 9J.
3. Place automatic transmission control assembly in "PARK."
4. Turn ignition key to "RUN" position.
   - Do not proceed to next step with ignition key in any other position.
5. Left-hand instrument panel sound insulator assembly, instrument panel driver knee bolster assembly, and instrument panel driver knee bolster deflector. Refer to SECTION 8C.
6. Front floor console assembly. Refer to SECTION 8C.
7. Nut (814).
8. Clip (813).
9. Cable assembly (812) from bracket.
10. Move button (815) to "UP" position.
11. Unsnap cable terminal from park lock lever pin.
12. Lower steering column assembly. Refer to SECTION 3F.
13. Unsnap cable assembly (812) from steering column assembly (816).

Install or Connect

1. Make sure ignition key is in "RUN" position and automatic transmission control assembly is in "PARK."



A SPRING, AUTOMATIC TRANSMISSION PARK LOCK CABLE
B BRACKET, AUTOMATIC TRANSMISSION PARK LOCK CABLE
812 CABLE ASSEMBLY, AUTOMATIC TRANSMISSION PARK LOCK
813 CLIP, AUTOMATIC TRANSMISSION PARK LOCK CABLE
814 NUT, AUTOMATIC TRANSMISSION PARK LOCK CABLE
815 BUTTON, AUTOMATIC TRANSMISSION PARK LOCK CABLE LOCK
816 COLUMN ASSEMBLY, STEERING

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Figure 7 – Automatic Transmission Park Lock Cable Assembly (Typical)

- Do not proceed to next step with ignition key in any other position.

2. Snap cable terminal to park lock lever pin.
3. Push cable connector forward to remove slack.
4. With no load applied to connector, press button (815) down.
5. Cable assembly (812) to bracket.
   A. Push bracket housing against adjusting spring.
   B. Drop cable assembly (812) through slot in bracket and seat housing to automatic transmission control assembly.
6. Push button (815) down.
7. Snap cable assembly (812) into steering column assembly (816).
8. Raise steering column assembly. Refer to SECTION 3F.
9. Clip (813).
10. Nut (814).
11. Front floor console assembly. Refer to SECTION 8C.
12. Left-hand instrument panel sound insulator assembly, instrument panel driver knee bolster assembly, and instrument panel driver knee bolster deflector. Refer to SECTION 8C.
13. Turn ignition key to "OFF" position.
14. Battery negative cable assembly.
15. Enable the SIR system. Refer to SECTION 9J.

Inspect

- Functional operation.
  A. With automatic transmission control assembly in "PARK" and the ignition key in "LOCK" position, make sure control assembly cannot be moved to different position. Ignition key should be removable from steering column assembly.
  B. With ignition key in "RUN" and automatic transmission control assembly in "NEUTRAL," make sure key cannot be turned to "LOCK."
  C. If above conditions are met, system is properly adjusted. Proceed to step E.
  D. If above conditions are not met, put button (815) back to "UP" position, and readjust as above. Then push button (815) down and recheck operation.
  E. If key cannot be removed in "PARK" position, move button (815) to "UP" position and move cable connector nose rearward until ignition key can be removed.
  F. Snap button (815) down.

G. Reinstall cable assembly (812) into clip (813) to ensure correct routing.

AUTOMATIC TRANSMISSION CONTROL LEVER SOLENOID

The automatic transmission control lever solenoid is part of the brake transmission shift interlock system (BTSI). The solenoid prevents the operator from shifting the automatic transmission control assembly out of "PARK" unless the brake pedal is depressed.

Figure 8

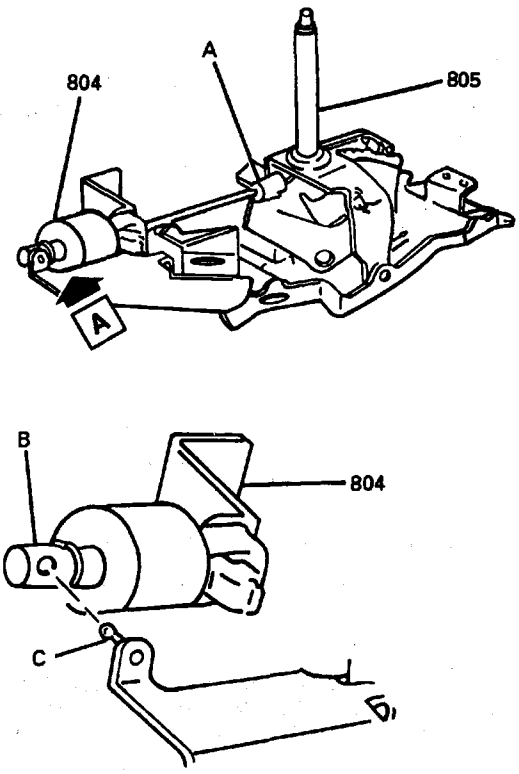
Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in section 0A.

1. Battery negative cable assembly.
2. Front floor console trim plate assembly. Refer to SECTION 8C.
3. Wiring harness electrical connector from automatic transmission control lever solenoid (804).
4. Automatic transmission control lever solenoid (804) by unsnapping retainers.

Install or Connect

1. Automatic transmission control lever solenoid (804) by snapping retainers into place.
2. Wiring harness electrical connector to automatic transmission control lever solenoid (804).
3. Front floor console trim plate assembly. Refer to SECTION 8C.
4. Battery negative cable assembly.



A CONNECTOR, ELECTRICAL
B RETAINER, PLASTIC
C STUD
804 SOLENOID, AUTOMATIC TRANSMISSION CONTROL LEVER
805 CONTROL ASSEMBLY, AUTOMATIC TRANSMISSION

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Figure 8 – Automatic Transmission Control Lever Solenoid (Typical)

PARK/NEUTRAL POSITION SWITCH ASSEMBLY

The park/neutral position switch assembly prevents starter motor operation when the automatic transmission control assembly is in any gear by breaking the starter motor circuit. When the automatic transmission control assembly is in reverse (engine running), the park/neutral position switch completes the backup lamp circuit, lighting the backup lamps.

Figure 9

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Front floor console assembly. Refer to SECTION 8C.
3. Bolts/screws (819).
4. Switch assembly (817).

Park/Neutral Position Switch Assembly Adjustment Using Old Switch Assembly

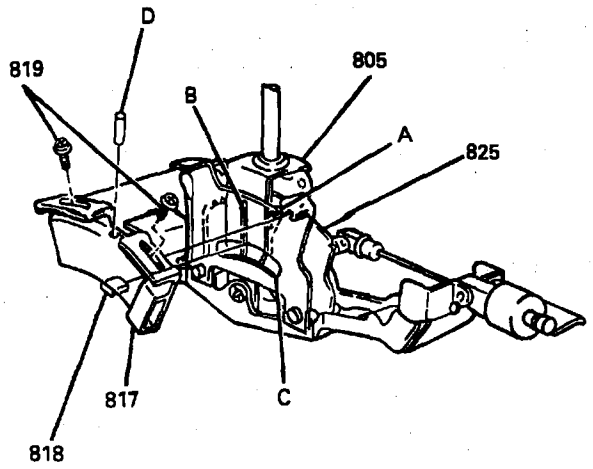
Install or Connect

NOTICE: See "Notice" on page 7A-1 of this section.

1. Place automatic transmission control assembly (805) in "NEUTRAL."
2. Tang (818) on switch assembly (817) into slot on automatic transmission control assembly (805).
3. Bolts/screws (819) to automatic transmission case, loosely.
4. Insert 2.34 mm (3/32-inch) gage pin into service adjustment hole, and rotate switch assembly (817) until gage pin drops to 15 mm (19/32-inch) depth.

Tighten

- Bolts/screws (819) to 2.2 N•m (19 lb. in.).



A NEUTRAL NOTCH
B PARK NOTCH
C TANG SLOT
D PIN, GAGE
805 CONTROL ASSEMBLY, AUTOMATIC TRANSMISSION
817 SWITCH ASSEMBLY, PARK/NEUTRAL POSITION
818 TANG, PARK/NEUTRAL POSITION SWITCH CARRIER
819 BOLT/SCREW, PARK/NEUTRAL POSITION SWITCH,
825 DETENT PLATE, PARK/NEUTRAL POSITION SWITCH

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Figure 9 – Park/Neutral Position Switch Assembly

5. Front floor console assembly. Refer to SECTION 8C.
6. Battery negative cable assembly.

Important

- After park/neutral position switch assembly adjustment, verify engine will only start with ignition key in "PARK" or "NEUTRAL." If engine will start with ignition key in any other position, readjust park/neutral position switch assembly.

Park/Neutral Position Switch Assembly Adjustment Using New Switch Assembly

Install or Connect

1. Place automatic transmission control assembly (805) in "NEUTRAL."
2. Tang (818) on switch assembly (817) into slot on automatic transmission control assembly (805).
3. Bolts/screws (819) to automatic transmission case.

Tighten

- Bolts/screws (819) to 2.2 N•m (19 lb. in.).

Important

- If park/neutral position switch bolt/screw holes will not align with automatic transmission control assembly, verify automatic transmission control assembly is in "NEUTRAL" position. Do not rotate park/neutral position switch assembly. If switch assembly has been rotated and the pin is broken, the switch assembly can be adjusted using the procedure under "Park/Neutral Position Switch Assembly Adjustment Using Old Switch Assembly" in this section.

4. Front floor console assembly. Refer to SECTION 8C.
5. Battery negative cable assembly.

CHANGING TRANSMISSION FLUID AND AUTOMATIC TRANSMISSION OIL FILTER ASSEMBLY

Figures 3, 10 and 11

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Place drain pan under oil pan (73).
3. Bolts/screws (74) from front and sides only.
4. Loosen rear bolts/screws (74) approximately four turns.

   NOTICE: When removing automatic transmission oil pan bolts/screws, use caution in order not to damage the automatic transmission case or automatic transmission oil pan sealing surfaces.

5. Lightly tap oil pan (73) with rubber mallet or pry to allow fluid to drain.

Inspect

- Fluid color and condition. Refer to Figure 3.
- Filter. Open filter by prying the metal crimping away from the top of the filter (black) and pulling apart. The filter may contain evidence for root cause diagnosis.
  - Clutch material.
  - Bronze slivers indicating bushing wear.
  - Steel particles.

6. Remaining bolts/screws (74), oil pan (73) and gasket (72).
7. Filter assembly (71) and seal (70).
   - Seal (70) may be stuck in automatic transmission case.

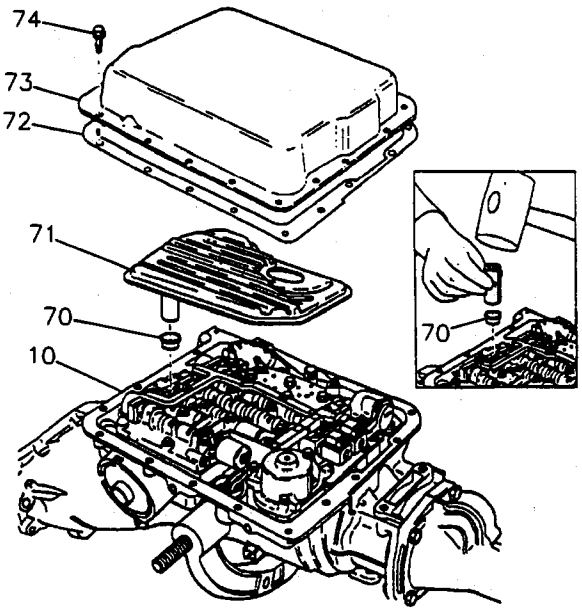
Clean

- Automatic transmission case and gasket surfaces with solvent, and air dry. All traces of gasket material must be removed.

Install or Connect

NOTICE: See "Notice" on page 7A-1 of this section.

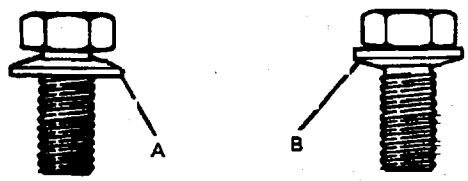
1. Filter seal (70) into the pump.



10 CASE, TRANSMISSION
70 SEAL, FILTER
71 FILTER, TRANSMISSION OIL
72 GASKET, TRANSMISSION OIL PAN
73 PAN, TRANSMISSION OIL
74 BOLT/SCREW, TRANSMISSION OIL PAN

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Figure 10 – Automatic Transmission Oil Pan and Oil Filter Assembly



A AUTOMATIC TRANSMISSION OIL PAN BOLT/SCREW AND CONICAL WASHER ASSEMBLY IS REUSABLE
B AUTOMATIC TRANSMISSION OIL PAN BOLT/SCREW AND CONICAL WASHER ASSEMBLY IS NOT REUSABLE

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Figure 11 – Automatic Transmission Oil Pan Bolt/Screw and Conical Washer Assembly

2. Oil filter (71).
3. Oil pan gasket (72).
4. Chip magnet (74) onto oil pan (73).
5. New gasket (72), oil pan (73) and bolts/screws (74).

NOTICE: Automatic transmission oil pan bolt/screw and washer assembly must not be reused if conical washer is reversed. Failure to replace the bolt/screw and washer may result in improper fastening of system components.

Tighten

- Bolts/screws (74) to 12 N•m (9 lb. ft.).

6. Lower vehicle.

NOTICE: Do not overfill. Overfilling will cause foaming, loss of fluid and possible damage to the transmission.

7. Fill automatic transmission fluid to proper level.
8. Check "COLD" fluid level reading for initial fill only. Refer to "Transmission Fluid Checking Procedures" in this section.
   - Do not overfill.

Inspect

- Gasket (72) for leaks.

AUTOMATIC TRANSMISSION OIL COOLER UPPER PIPE AND UPPER AND LOWER HOSE ASSEMBLIES

Figure 12

If replacement of automatic transmission oil cooler pipe and hose assemblies is required, use only double-wrapped and brazed steel tubing meeting GM specification 123 M or equivalent. Tubing should be double flared.

NOTICE: Allow sufficient clearance to transmission oil cooler pipe and hose assemblies to prevent damage or wear which may cause fluid loss.

Remove or Disconnect

1. Fitting on radiator end of oil cooler upper hose assembly (860).
2. Fitting on radiator end of oil cooler lower hose assembly (857).
3. Raise and suitably support vehicle. Refer to SECTION 0A.
4. Propeller shaft assembly. Refer to SECTION 4A.
5. Rear axle torque arm assembly. Refer to SECTION 3D.
6. Catalytic converter hanger assembly. Refer to SECTION 6F.
7. Support automatic transmission assembly with a transmission stand.
8. Transmission support member assembly. Refer to SECTION 10-3.
9. Lower the transmission stand slightly, to allow access to oil cooler fittings at the transmission assembly.
10. Fitting on transmission assembly end of upper pipe assembly (856).
11. Fitting on transmission assembly end of lower hose assembly (857).
12. Upper pipe assembly (856) and lower hose assembly (857) from engine clip (858) and pipe clip (859).

Install or Connect

NOTICE: See "NOTICE" on page 7A-1 of this section.

1. Upper pipe assembly (856) and lower hose assembly (857) to engine clip (858) and pipe clip (859).
2. Fitting on transmission assembly end of lower hose assembly (857).

Tighten

- Fitting on transmission assembly end of lower hose assembly (857) to 27 N•m (20 lb. ft.).

3. Fitting on transmission assembly end of upper pipe assembly (856).

Tighten

- Fitting on transmission assembly end of upper pipe assembly (856) to 27 N•m (20 lb. ft.).

4. Raise the transmission assembly.
5. Transmission support member assembly. Refer to SECTION 10-3.
6. Remove transmission stand.
7. Catalytic converter hanger assembly. Refer to SECTION 6F.
8. Rear axle torque arm assembly. Refer to SECTION 3D.
9. Propeller shaft assembly. Refer to SECTION 4A.
10. Lower vehicle.
11. Fitting on radiator end of oil cooler lower hose assembly (857).

Tighten

- Fitting on radiator end of oil cooler lower hose assembly (857) to 27 N•m (20 lb. ft.).

12. Fitting on radiator end of oil cooler upper hose assembly (860).

Tighten

- Fitting on radiator end of oil cooler upper hose assembly (860) to 27 N•m (20 lb. ft.).

OIL COOLER FLUSHING PROCEDURE

Figure 12

Tools Required:

J 35944 "Transmission" Oil Cooler and Line Flusher

J 35944-20 Cooler Flushing Fluid

NOTICE: The automatic transmission oil cooler flushing procedure must be performed whenever a transmission assembly is removed for service to remove existing oil which may be contaminated and to prevent contamination of new oil. The flushing procedure must be performed before installation of the overhauled or replacement transmission assembly.

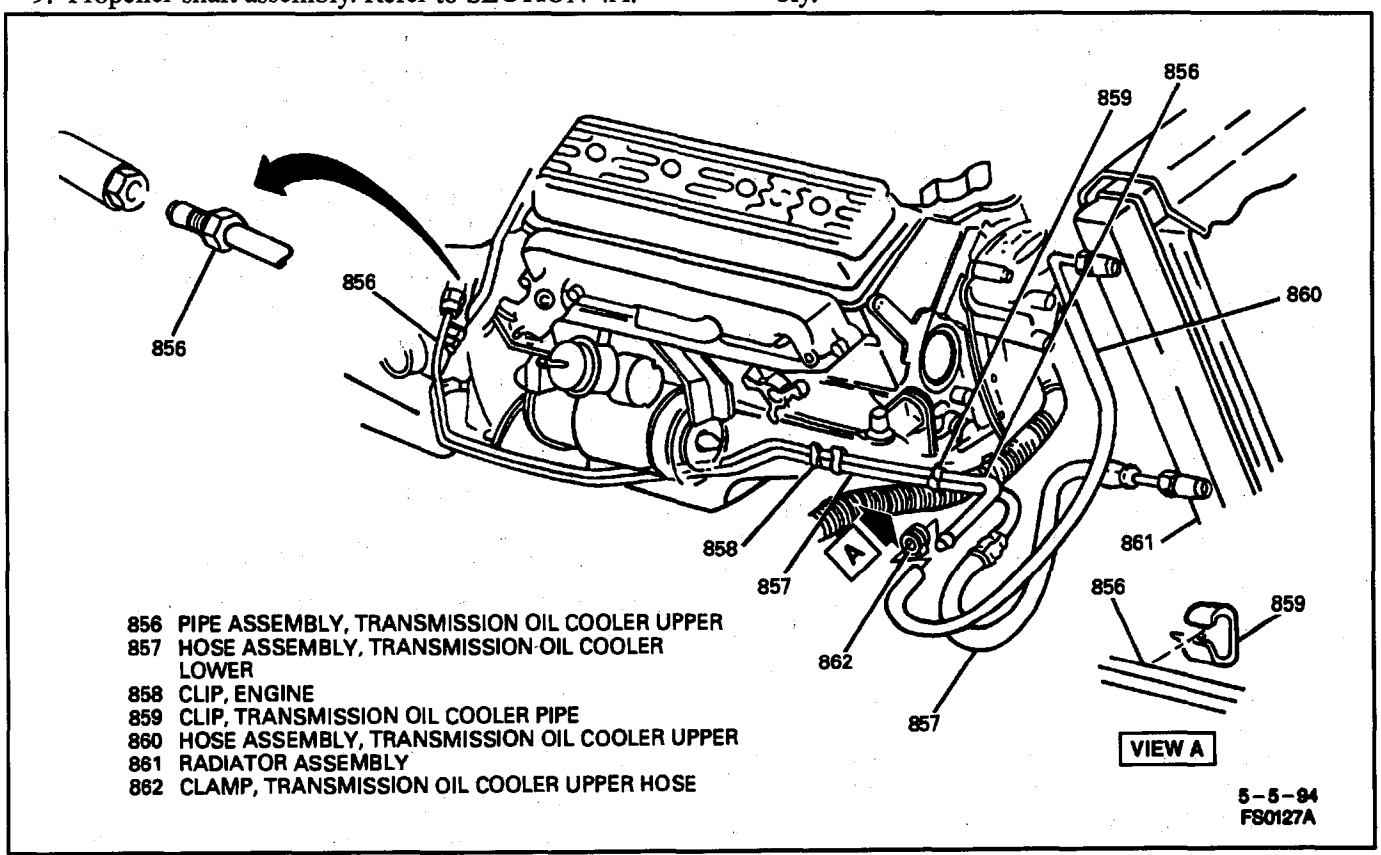


Figure 12 – Transmission Oil Cooler Pipe and Hose Assemblies

NOTICE: Flushing tool is designed for use with only J 35944-20 flushing fluid. Use of any other fluid can result in damage to the tool, automatic transmission oil cooler components or improper flushing of the cooler.

1. Remove fill cap on J 35944 and fill with 0.6 liters (20 to 21 ounces) of J 35944-20.
   - Do not overfill tool.
   - Follow manufacturer's suggested procedures for handling fluid.
2. Replace cap on J 35944 and pressurize to 550 to 700 kPa (80 to 100 psi).

   NOTICE: Shop air supply must be equipped with a water/oil filter and pressure should not exceed 825 kPa (120 psi). Failure to use a water/oil filter can allow residual moisture to cause corrosion of components. Excessive air pressure can cause damage to components.
3. Install J 35944 to undercarriage of vehicle with hook provided, and attach hose from flushing tool to upper pipe assembly (856) attaching to **top** fitting at transmission assembly end of oil cooler.
4. Install discharge hose to lower hose assembly (857) attaching to **bottom** fitting at transmission assembly end of oil cooler. Clip opposite end of discharge hose to oil drain container.
5. With water valve on tool in "OFF" position, attach water supply to J 35944.
6. Turn water supply on at faucet.
7. Flush transmission fluid by opening water valve on tool to "ON" position for about 10 seconds.
   - If water does not flow through cooler (system is completely plugged), do not complete flushing procedure. Turn water off immediately and inspect oil cooler and pipes for restriction. Replace cooler and/or pipes as required.
8. Turn water valve on tool to "OFF" position and clip discharge hose to 5-gallon pail. Cover pail with shop cloth to prevent splash.
9. Turn water valve on tool to "ON" position and depress trigger to mix flushing fluid into water flow.
   - Use bale clip to hold trigger down.
10. Flush oil cooler with water and fluid for two minutes.
    - Every 15 to 20 seconds during flushing procedure, attach air supply to air valve on J 35944 and leave in place for 3 to 5 seconds to create surging action for complete cleaning.
11. Release trigger and turn water valve on tool to "OFF" position.
12. Disconnect discharge hose from lower hose assembly (857).
13. Install hose from J 35944 to lower hose assembly (857) attaching to **bottom** fitting of oil cooler.
14. Connect discharge hose to upper pipe assembly (856) attaching to **top** fitting of oil cooler.
    - Reversing hoses creates back-flush.
15. Repeat steps 9 and 10.
16. Release trigger and allow water only to rinse the oil cooler for one minute.
17. Turn water valve on tool to "OFF" position and turn water supply off at faucet.
18. Attach air supply to air valve on J 35944 and dry system out with dry compressed air for at least two minutes. Be sure no moisture can be seen leaving hose.
19. Remove J 35944 and discharge hose from oil cooler/hoses.
20. Connect oil cooler feed hose to automatic transmission assembly.
    - Feed hose is lower hose assembly (857) attached to **bottom** connection at transmission end of system.
21. Attach discharge hose to oil cooler return pipe.
    - Return pipe is upper pipe assembly (856) attached to **top** connection at transmission end of system.
22. Attach opposite end of discharge hose to oil drain container.
23. Fill automatic transmission assembly with fluid.
24. Start engine and run for 30 seconds to remove any residual moisture from cooler.

Inspect

A. Fluid flow through cooler feed lines during 30 second running period. Minimum of 1.8 liters (2 quarts) of fluid should flow during this time.
B. If fluid flow is insufficient, check flow by disconnecting feed line at cooler and observe flow with engine running at idle.
   - Insufficient Flow: Inspect transmission for causes.
   - Sufficient Flow: Inspect cooler pipes, hoses and fittings and repeat cooler flushing procedure. If the flow through cooler is still insufficient after second flushing procedure, replace cooler.

25. Disconnect discharge hose.
26. Connect oil cooler return pipe to fitting.

Adjust

- Transmission fluid level.

SERVICEABLE COMPONENTS

TRANSMISSION FLUID FILLER TUBE ASSEMBLY

Figure 13

Remove or Disconnect

1. Indicator assembly (837).
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Bolt/screw (835) retaining tube assembly (836) to transmission assembly (838).

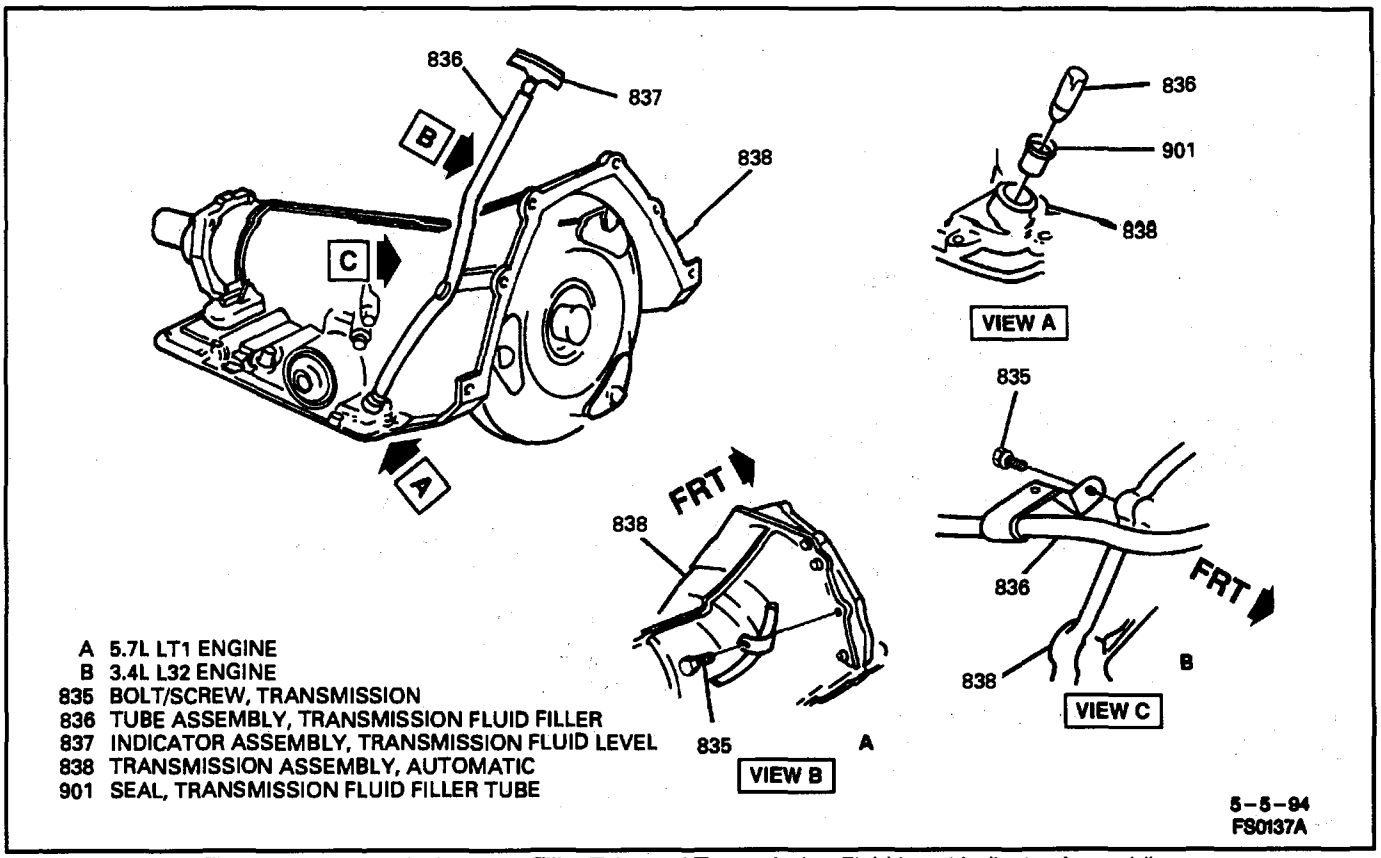


Figure 13 – Transmission Fluid Filler Tube and Transmission Fluid Level Indicator Assemblies

4. Loosen tube assembly (836) from transmission assembly (838).
5. Place drain pan under transmission assembly (838).
6. Lower vehicle.
7. Tube assembly (836) and seal (901) from vehicle by pulling out from top.

Install or Connect

NOTICE: See "Notice" on page 7A-1 of this section.

1. Seal (901) and tube assembly (836) through top of vehicle.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Insert seal (901) into automatic transmission case hole.
4. Tube assembly (836) to transmission assembly (838).
5. Bolt/screw (835) attaching tube assembly (836) to transmission assembly (838).

Tighten

- Bolt/screw (835) to 95 N•m (70 lb. ft.) on 3.4L L32 engines.
- Bolt/screw (835) to 47 N•m (35 lb. ft.) on 5.7L LT1 engines.

6. Lower vehicle.
7. Indicator assembly (837).

Vehicle Speed Sensor (VSS)

Figure 14

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Speed sensor electrical connector.
3. Speed sensor bolt (100).
4. Speed sensor (99) and O-ring seal (42).
   - Use suitable container to catch transmission fluid.

Install or Connect

NOTICE: See "Notice on page 7A-1 of this section.

1. Speed sensor (99) with new O-ring seal (42).
2. Speed sensor bolt (100).

Tighten

- Speed sensor bolt (100) to 11 N•m (97 lb. in.).

3. Speed sensor electrical connector.
4. Lower vehicle.

NOTICE: Do not overfill. Overfilling will cause foaming, loss of fluid and possible damage to the transmission.

- Refill with transmission fluid as required.

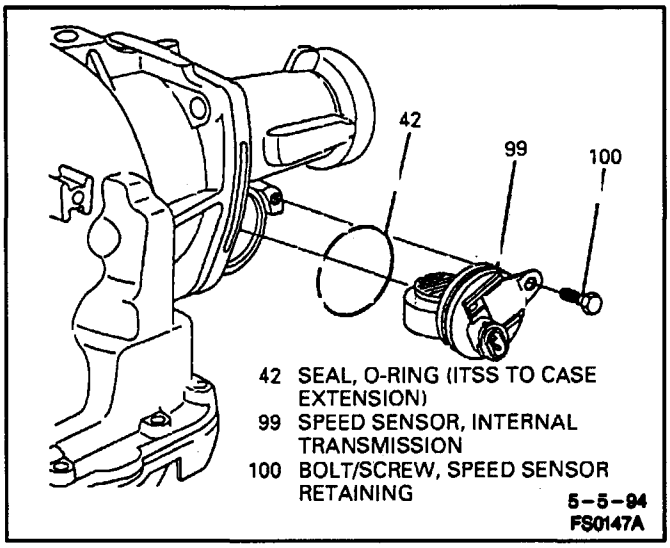


Figure 14 – Vehicle Speed Sensor

AUTOMATIC TRANSMISSION CASE EXTENSION

Figure 15

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Propeller shaft assembly. Refer to SECTION 4A.
3. Rear axle torque arm assembly. Refer to SECTION 3D.
4. Catalytic converter hanger assembly. Refer to SECTION 6F.
5. Bolts/screws (37).
6. Extension (36), with seal (35). Discard seal (35).
7. Sleeve (690) and seal (691), if necessary.

Install or Connect

NOTICE: See "Notice" on page 7A-1 of this section.

1. Sleeve (690) and seal (691), if removed.
2. New seal (35) and extension (36).
3. Bolts/screws (37).

Tighten

- Bolts/screws (37) to 35 N•m (26 lb. ft.).

4. Rear axle torque arm assembly. Refer to SECTION 3D.
5. Propeller shaft assembly. Refer to SECTION 4A.
6. Catalytic converter hanger assembly. Refer to SECTION 6F.
7. Lower vehicle.

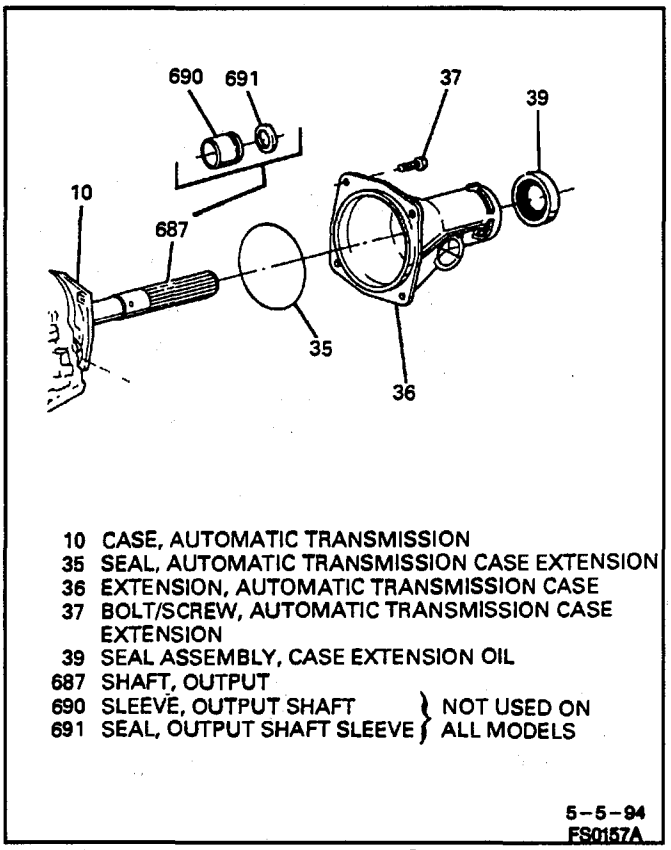


Figure 15 – Speedometer Drive Gear and Automatic Transmission Case Extension

ACCUMULATOR ASSEMBLIES

Figure 16

Remove or Disconnect

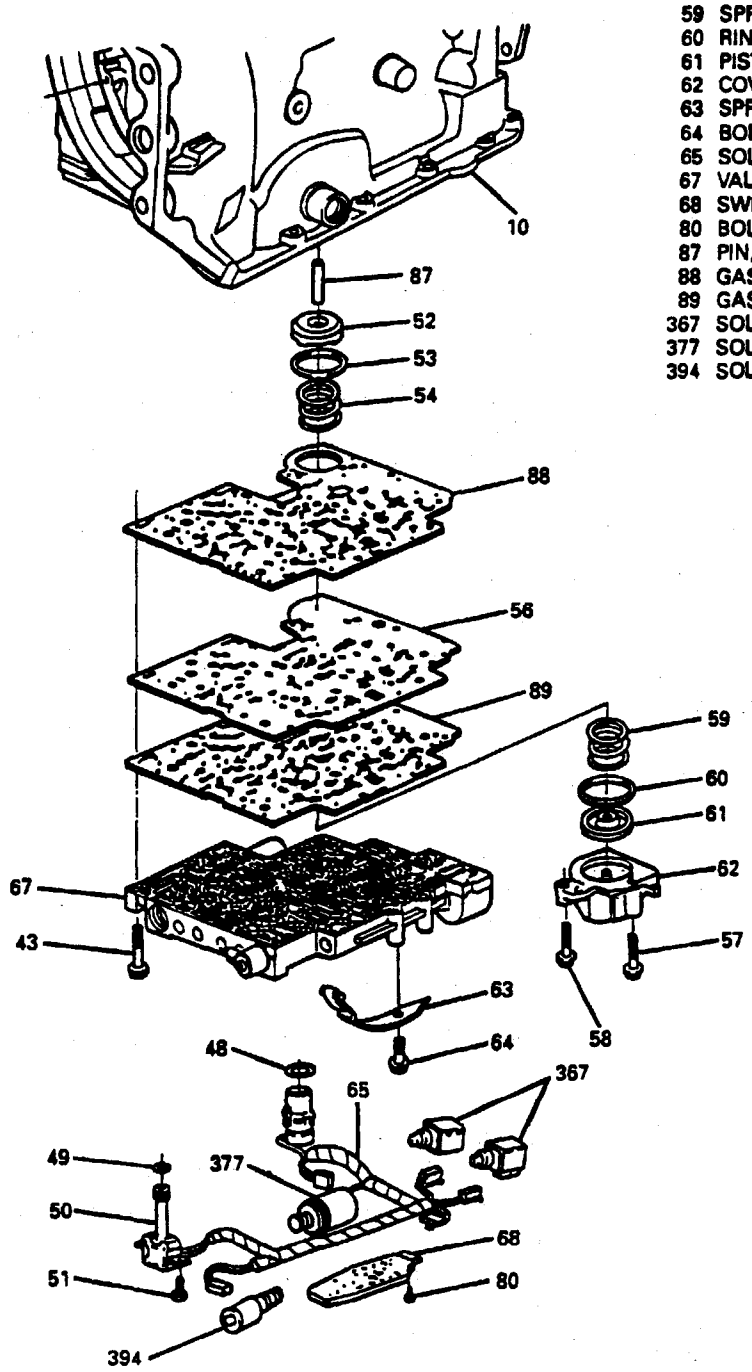
1. Oil pan and filter assembly. Refer to "Changing Fluid and Oil Filter Assembly" in this section.
2. Bolts/screws (57 and 58) attaching cover and pin assembly (62) to transmission case.
3. Cover and pin assembly (62).
4. Piston (61), ring (60), and spring (59).
   - Piston (61) and ring (60) may remain inside cover and pin assembly (62).
5. Control valve assembly, if replacing 3-4 accumulator assembly. Refer to "Control Valve Body and Pressure Switch" in this section.
6. Piston (52), ring (53) and pin (87).

Inspect

- Accumulator assemblies. Refer to SECTION 7A-14B for disassembly and inspection procedures.

Install or Connect

1. Piston (52), ring (53) and pin (87).
2. Control valve assembly, if removed. Refer to "Control Valve Body and Pressure Switch" in this section.



10 CASE, TRANSMISSION
43 BOLT/SCREW, VALVE BODY
48 SEAL, WIRE HARNESS PASS-THROUGH CONNECTOR O-RING
49 SEAL, CONVERTER CLUTCH SOLENOID VALVE
50 SOLENOID VALVE, TORQUE CONVERTER CLUTCH
51 BOLT/SCREW, CONVERTER CLUTCH SOLENOID VALVE,
52 PISTON, 3-4 ACCUMULATOR
53 RING, OIL SEAL (3-4 ACCUMULATOR PISTON)
54 SPRING, 3-4 ACCUMULATOR
56 PLATE, VALVE BODY SPACER
57 BOLT/SCREW, 1-2 ACCUMULATOR COVER,
58 BOLT/SCREW, 1-2 ACCUMULATOR COVER,
59 SPRING, 1-2 ACCUMULATOR
60 RING, OIL SEAL
61 PISTON, 1-2 ACCUMULATOR
62 COVER AND PIN ASSEMBLY, 1-2 ACCUMULATOR
63 SPRING ASSEMBLY, MANUAL DETENT
64 BOLT/SCREW, MANUAL DETENT SPRING,
65 SOLENOID ASSEMBLY, WIRING HARNESS AND
67 VALVE ASSEMBLY, CONTROL BODY
68 SWITCH ASSEMBLY, TRANSMISSION PRESSURE
80 BOLT/SCREW, PRESSURE SWITCH ASSEMBLY,
87 PIN, ACCUMULATOR PISTON
88 GASKET, SPACER PLATE TO CASE
89 GASKET, SPACER PLATE TO VALVE BODY
367 SOLENOID, 1-2 AND 2-3 SHIFT
377 SOLENOID, PRESSURE CONTROL
394 SOLENOID, 3-2 CONTROL

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Figure 16 – Wiring Harness, Pressure Switch, Control Valve and Accumulator Assemblies

3. Spring (59), ring (60), and piston (61).
   - If spring (59) is conical in shape, larger end is installed in piston (61).
4. Cover and pin assembly (62).
5. Bolts/screws (57 and 58) attaching cover and pin assembly (62) to transmission case.

Tighten

- Bolts/screws (57 and 58) to 11 N•m (97 lb. in.).

6. Oil pan and filter assembly. Refer to "Changing Fluid and Oil Filter Assembly" in this section.

2-4 BAND SERVO ASSEMBLY

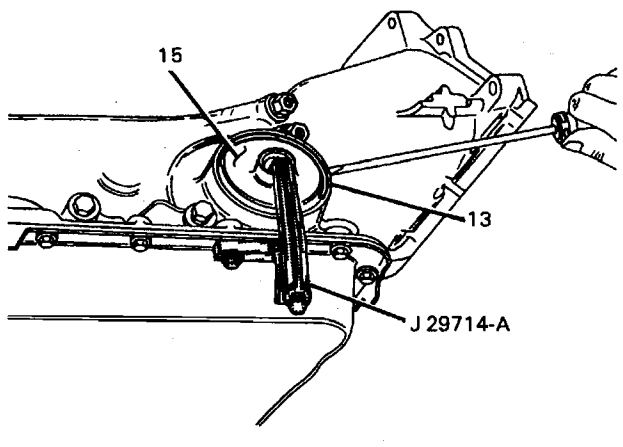
Figures 17 and 18

Remove or Disconnect

Tool Required:

J 29714-A Servo Cover Depressor

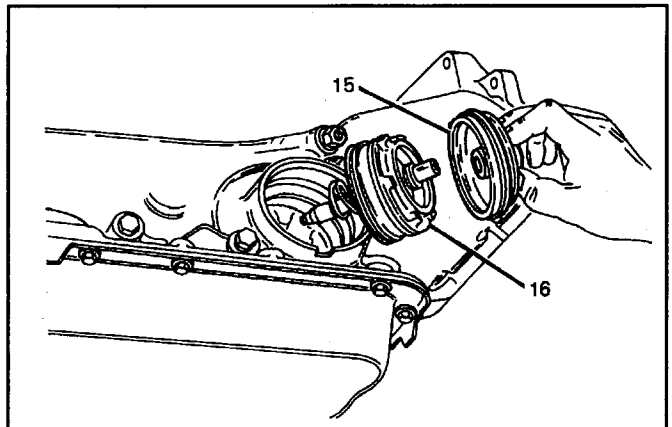
1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Exhaust crossover pipe assembly and catalytic converter hanger assembly. Refer to SECTION 6F.
3. Propeller shaft assembly. Refer to SECTION 4A.
4. Rear axle torque arm assembly. Refer to SECTION 3D.
5. Support automatic transmission assembly with transmission stand.
6. Transmission support. Refer to SECTION 10-3.
7. Catalytic converter heat shield. Refer to SECTION 6F.



13 RING, 2-4 BAND SERVO COVER RETAINING
15 COVER, 2-4 BAND SERVO

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Figure 17 – 2-4 Band Servo Cover



15 COVER, 2-4 BAND SERVO
16 SERVO ASSEMBLY, 2-4 BAND

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Figure 18 – 2-4 Band Servo Assembly

8. Lower automatic transmission assembly.
9. Two automatic transmission oil pan bolts/screws from below servo cover (15).
10. Install J 29714-A on automatic transmission oil pan rail.
11. Reinstall automatic transmission oil pan bolts/screws.
12. Depress servo cover (15) and remove retaining ring (13).
13. J 29714-A.
14. Servo cover (15).
    - If unable to remove by hand, use slip joint pliers.
    - O-ring seal may remain in automatic transmission case.
15. 2-4 band servo assembly (16).

Inspect

- 2-4 band servo assembly. Refer to SECTION 7A-15B for disassembly and inspection procedures.

Install or Connect

NOTICE: See "Notice" on page 7A-1 of this section.

1. 2-4 band servo assembly (16).
2. Servo cover (15).
   - Replace O-ring seal on servo cover (15).
3. Install J 29714-A on automatic transmission oil pan rail.
4. Depress servo cover (15).
5. Retaining ring (13).
6. Remove J 29714-A.

Tighten

- Automatic transmission oil pan bolts/screws to 16 N•m (12 lb. ft.).

7. Raise automatic transmission assembly.
8. Catalytic converter heat shield. Refer to SECTION 6F.
9. Transmission support. Refer to SECTION 10-3.
10. Remove tool supporting automatic transmission assembly.
11. Rear axle torque arm assembly. Refer to SECTION 3D.
12. Propeller shaft assembly. Refer to SECTION 4A.
13. Exhaust crossover pipe assembly and catalytic converter hanger assembly. Refer to SECTION 6F.
14. Lower vehicle.

TRANSMISSION CONVERTER COVER

Figure 19

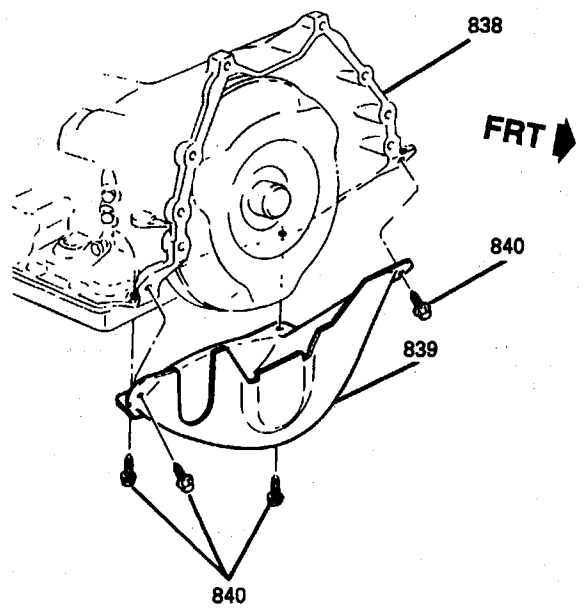
Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION OA.
2. Converter cover bolts/screws (840).
3. Converter cover (839) from automatic transmission assembly (838).

Install or Connect

NOTICE: See "Notice" on page 7A-1 of this section.

1. Converter cover (839) to automatic transmission assembly (838).



838 TRANSMISSION, AUTOMATIC
839 COVER, TRANSMISSION CONVERTER
840 BOLT/SCREW, TRANSMISSION CONVERTER COVER

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Figure 19 – Transmission Converter Cover

2. Converter cover bolts/screws (840).

Tighten

- Transmission converter cover bolts/screws (840) to 10 N•m (89 lb. in.).

3. Lower vehicle.

PRESSURE REGULATOR VALVE

Figure 20

Remove or Disconnect

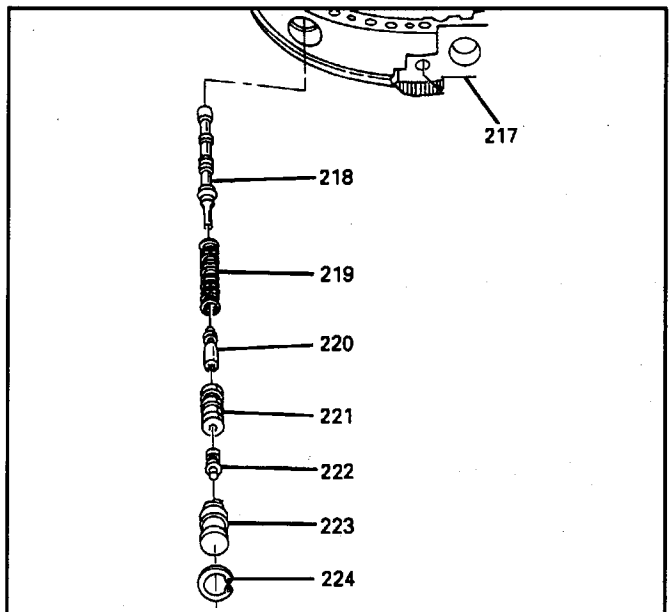
1. Automatic transmission oil pan. Refer to "Changing Transmission Fluid and Automatic Transmission Oil Filter Assembly" in this section.
2. Compress TV (throttle valve) boost valve bushing and related components (223 through 218) with small screwdriver.
3. Retainer ring (224).
4. Slowly release spring pressure.
5. Regulator valve (218).
6. Spring (219).
7. Reverse boost valve (220) and bushing (221).
8. TV boost valve (222) and bushing (223).

Inspect

- Pressure regulator valve assembly. Refer to SECTION 7A-15B for disassembly and inspection procedures.

Install or Connect

1. Regulator valve (218) into pump cover bore.
2. Spring (219).
3. Reverse boost valve (220) into bushing (221).
   - Small end first. Retain with Transjel™, or equivalent.
4. Bushing (221) with reverse boost valve (220) into pump cover bore.
5. TV boost valve (222) into bushing (223).
   - Insert long land of TV boost valve (222) into largest hole of bushing (223). Retain with Transjel™, or equivalent.
6. Bushing (223) with TV boost valve (222) into pump cover bore.
7. Compress TV boost valve bushing and related components (223 through 218).
8. Retainer ring (224).
9. Automatic transmission oil pan. Refer to "Changing Transmission Fluid and Automatic Transmission Oil Filter Assembly" in this section.



217 PUMP ASSEMBLY, AUTOMATIC TRANSMISSION OIL
218 VALVE, PRESSURE REGULATOR
219 SPRING, PRESSURE REGULATOR VALVE
220 VALVE, REVERSE BOOST
221 BUSHING, REVERSE BOOST VALVE
222 VALVE, TV BOOST
223 BUSHING, TV BOOST VALVE
224 RING, TV BOOST VALVE BUSHING RETAINER

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Figure 20 – Pressure Regulator Valve Assembly

CONTROL VALVE BODY AND PRESSURE SWITCH

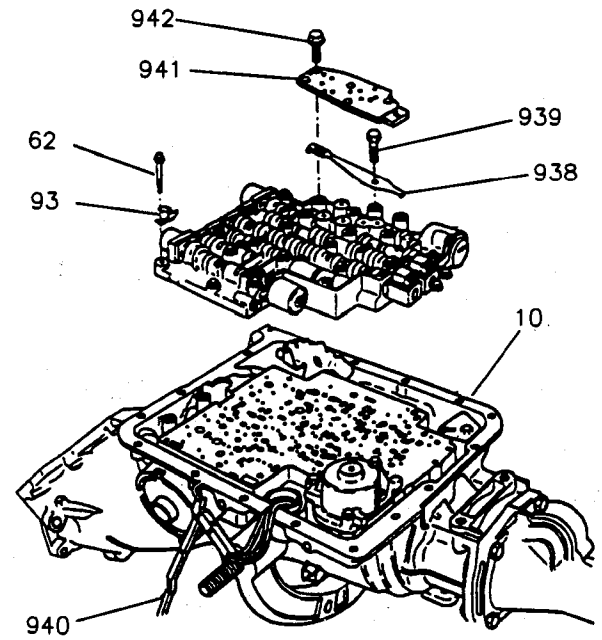
Figures 10, 21, 22 through 24

Remove or Disconnect

1. Oil pan. Refer to "Changing Transmission Fluid and Automatic Transmission Oil Filter Assembly" in this section.
2. Oil filter and filter seal.
3. Electrical connectors from control valve body components.
4. Torque converter clutch (TCC) solenoid bolts/screws and solenoid assembly with O-ring seal.
5. Wiring harness bolts/screws and lay wiring harness aside.
6. Bolts/screws (942) and pressure switch assembly (941).
7. Bolt/screw (939) and manual detent spring assembly (938).
8. Remaining control valve body bolts/screws.
9. Manual valve link (705).
10. Control valve body (937).

Inspect

- Control valve body (937). Refer to SECTION 7A-14B for cleaning, inspection and repair of the control valve body.



10 CASE, TRANSMISSION
62 BOLT/SCREW, VALVE BODY
93 BRACKET, DIPSTICK TUBE
937 VALVE, CONTROL BODY
938 SPRING, MANUAL DETENT
939 BOLT/SCREW, MANUAL DETENT SPRING
940 WIRE HARNESS, SOLENOID
941 SWITCH, TRANSMISSION PRESSURE
942 BOLT/SCREW, PRESSURE SWITCH

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Figure 21 – Control Valve and Pressure Switch Assembly

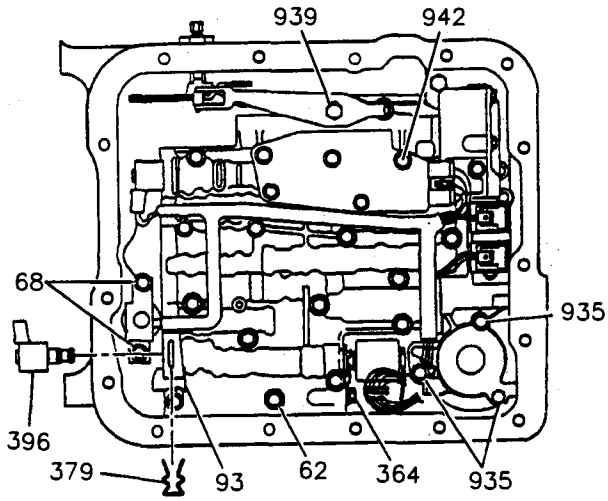
Install or Connect

NOTICE: Install all valve body bolts/screws then torque in a spiral pattern starting from the center (see Figure 22). If bolts/screws are torqued at random, valve bores may be distorted and inhibit valve operation.

1. Control valve body (937) and manual valve link (705) to transmission case (10).
2. Control valve body bolts/screws.
3. Manual detent spring assembly (938) and bolt/screw (939).
4. Pressure switch assembly (941) and bolts/screws (942).
5. Wiring harness and wiring harness bolts/screws.
6. TCC solenoid, O-ring seal and bolts/screws.
7. Electrical connectors.

Tighten

- All bolts/screws in the pattern shown in Figure 22 to 11 N•m (97 lb. in.).



62 BOLT/SCREW, VAVLE BODY
68 BOLT/SCREW, HEX WASHER HEAD (SOLENOID)
93 BRACKET, DIPSTICK STOP
364 BOLT/SCREW, FORWARD ACCULUMINATOR COVER
379 RETAINER, SOLENOID
396 TCC PWM SOLENOID
935 BOLT/SCREW, ACCUMULATOR COVER
939 BOLT/SCREW, MANUAL DETENT SPRING
942 BOLT/SCREW, PRESSURE SWITCH

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Figure 22 – Valve Body Bolt Locations

8. Oil filter and filter seal.
9. Oil pan. Refer to "Changing Transmission Fluid and Automatic Transmission Oil Filter Assembly" in this section.

CONTROL AND SHIFT SOLENOIDS

Figures 10, 16, 22 and 23

Remove or Disconnect

1. Oil pan. Refer to "Changing Transmission Fluid and Automatic Transmission Oil Filter Assembly" in this section.
2. Oil filter and filter seal.
3. Accumulator cover bolts/screws (935).
4. 1-2 accumulator cover, piston and spring (934, 933 and 932).
5. Component electrical connectors.
6. TCC PWM Solenoid Retainer Clip (379) and Solenoid (396).
7. TCC Solenoid bolts and solenoid assembly with O-ring seal and wiring harness.
8. Pressure control solenoid retainer bolt/screw, retainer and solenoid.
9. Shift solenoid retainers and shift solenoids.
10. 3-2 control solenoid retainer and control solenoid.
11. Dipstick stop bracket (93).

Install or Connect

1. Dipstick stop bracket (93).
2. 3-2 control solenoid and retainer.
3. Shift solenoids and retainers.
4. Pressure control solenoid, retainer and retainer bolt/screw.
   - Position pressure control solenoid with the electrical tabs facing outboard.
5. TCC Solenoid bolts and solenoid assembly with O-ring seal and wiring harness.
6. TCC PWM Solenoid Retainer Clip (379) and Solenoid (396).
7. Component electrical connectors.
8. 1-2 accumulator piston to the accumulator cover.
   - Piston legs must face toward the case when installed.
9. 1-2 accumulator spring onto piston (932 and 933).
10. 1-2 accumulator cover (934) and accumulator cover-bolts/screws (935).

Tighten

- Bolts/screws (935) to 11 N•m (97 lb. in.).

11. Oil filter and filter seal.
12. Oil pan. Refer to "Changing Transmission Fluid and Automatic Transmission Oil Filter Assembly" in this section.

TCC SOLENOID AND WIRING HARNESS REPLACEMENT

Figures 16 and 23

Tool Required:

J 28458 Power Piston Seal Protector and Diaphragm Retainer Installer

Remove or Disconnect

1. Exhaust system. Refer to SECTION 6F.
2. Oil pan. Refer to "Changing Transmission Fluid and Automatic Transmission Oil Filter Assembly" in this section.
3. Oil filter and seal.
4. External wiring harness connector from transmission pass-through connector.
   - Squeeze fore and aft. flats on connector to release locking tabs and pull connector.
5. Accumulator cover bolts/screws (935).
6. 1-2 accumulator cover, piston and spring (934, 933 and 932).

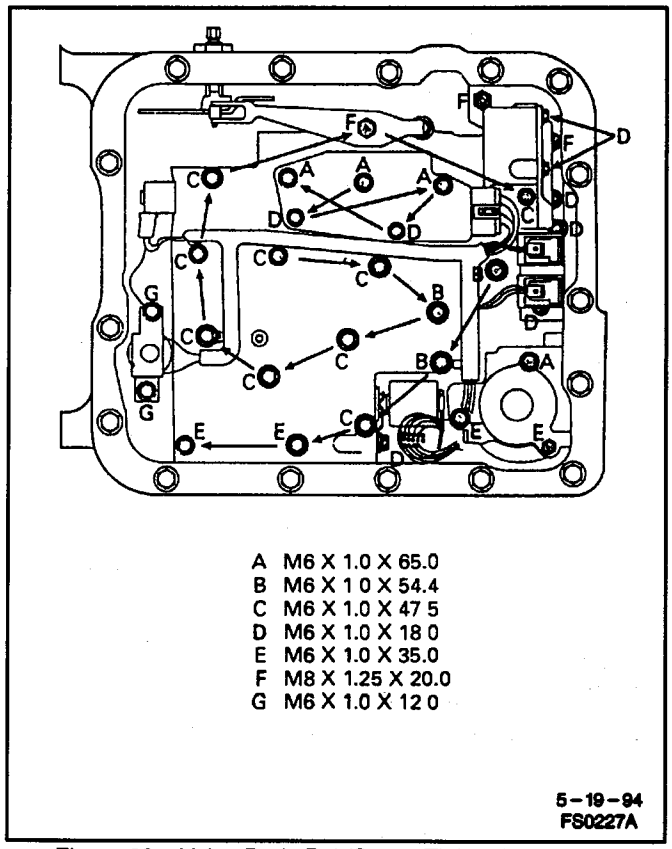


Figure 23 – Valve Body Bolt/Screw Tightening Pattern

7. Component electrical connectors.
8. Pressure control solenoid retainer bolt/screw, retainer and solenoid.
9. TCC solenoid bolts/screws.
10. Pass-through electrical connector from transmission case.
    - Use small end of J 28458 over top of connector and twist to release four tabs while at the same time pulling harness connector from the transmission case.
11. TCC solenoid with wiring harness from transmission case.

Install or Connect

1. TCC solenoid with wiring harness to transmission case.
2. Pass-through electrical connector to transmission case.
3. TCC solenoid bolts/screws.
4. Pressure control solenoid, retainer and bolt/screw.

Tighten

- TCC solenoid bolts/screws to 11 N•m (97 lb. in.).
- Pressure control solenoid bolt/screw to 11 N•m (97 lb. in.).

5. Component electrical connectors.
6. 1-2 accumulator piston (933) to 1-2 accumulator cover (934).
    - Piston legs must face toward the case when installed.
7. 1-2 accumulator spring onto piston (932)/(933).
8. 1-2 accumulator cover (934) and accumulator cover bolts/screws (935).

Tighten

- Bolts/screws to 11 N•m (97 lb. in.).

9. Wiring harness connector to transmission pass-through connector.
10. Oil filter and seal.
11. Oil pan. Refer to "Changing Transmission Fluid and Automatic Transmission Oil Filter Assembly" in this section.
12. Exhaust system. Refer to SECTION 6F.

ELECTRICAL CONNECTOR AND SEAL

Figure 23

Remove or Disconnect

1. Oil pan and automatic transmission oil filter assembly. Refer to "Changing Transmission Fluid and Automatic Transmission Oil Filter Assembly" in this section.
2. Internal and external electrical wires from electrical connections.
3. Electrical connector and seal from automatic transmission assembly.
4. Seal from electrical connector.
    - Discard old seal.

Inspect

- Automatic transmission sealing surface for damage or corrosion.

Install or Connect

1. New seal to electrical connector.
2. Electrical connector and new seal to automatic transmission assembly.
3. Internal and external electrical wires to electrical connectors.
4. Oil pan and automatic transmission oil filter assembly. Refer to "Changing Transmission Fluid and Automatic Transmission Oil Filter Assembly" in this section.

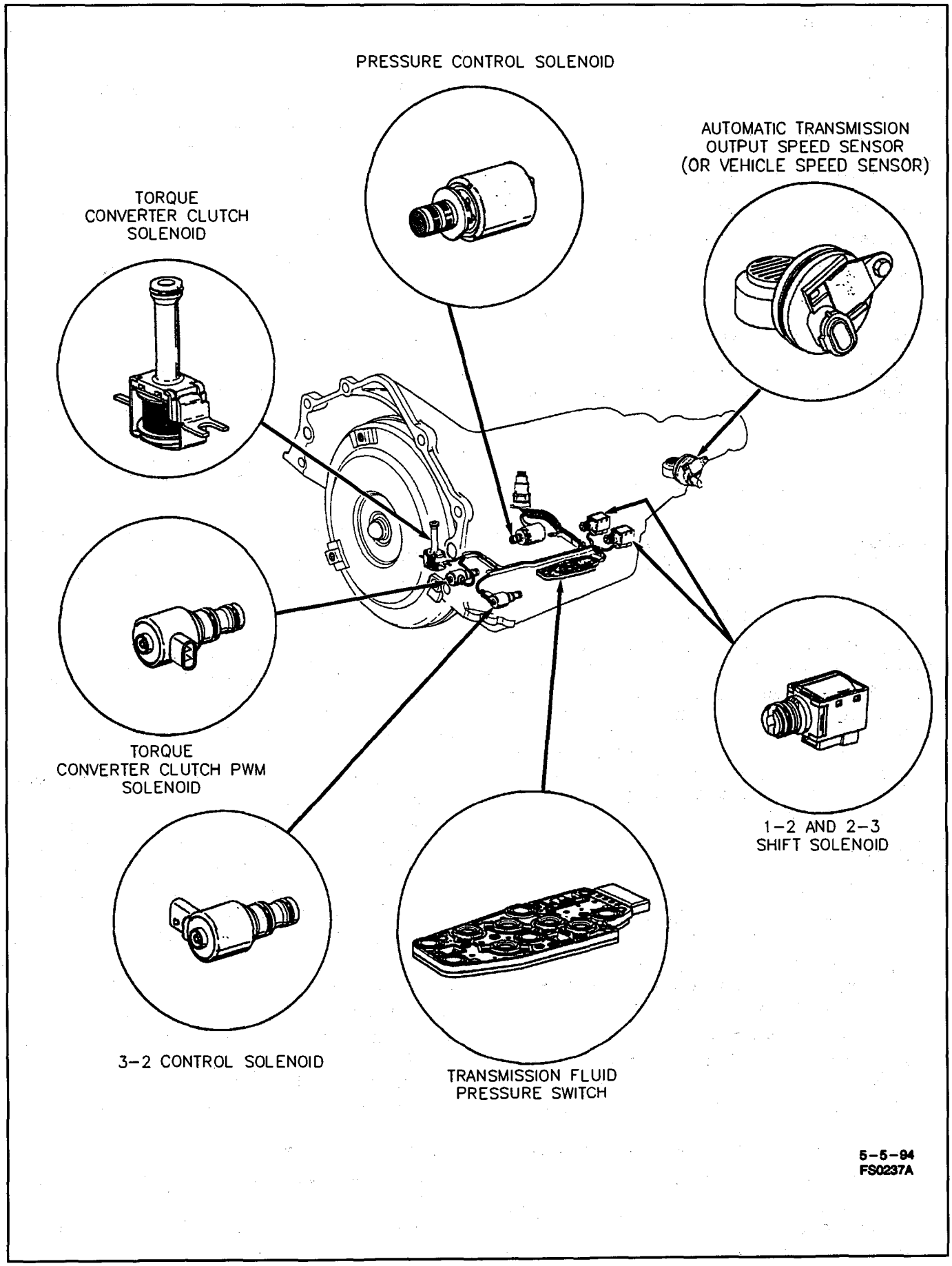


Figure 24 – Electronic Component Location Views

CASE EXTENSION OIL SEAL ASSEMBLY

Figure 15

Tool Required:

J 21426 Case Extension Oil Seal Installer

Remove or Disconnect

1. Propeller shaft assembly. Refer to SECTION 4A.
2. Oil seal assembly (39) with screwdriver.

Install or Connect

1. Oil seal assembly (39). Tap into place with J 21426.
2. Propeller shaft assembly. Refer to SECTION 4A.

NOTICE: Do not overfill. Overfilling will cause foaming, loss of fluid and possible damage to the transmission.

Adjust

- Automatic transmission fluid level.

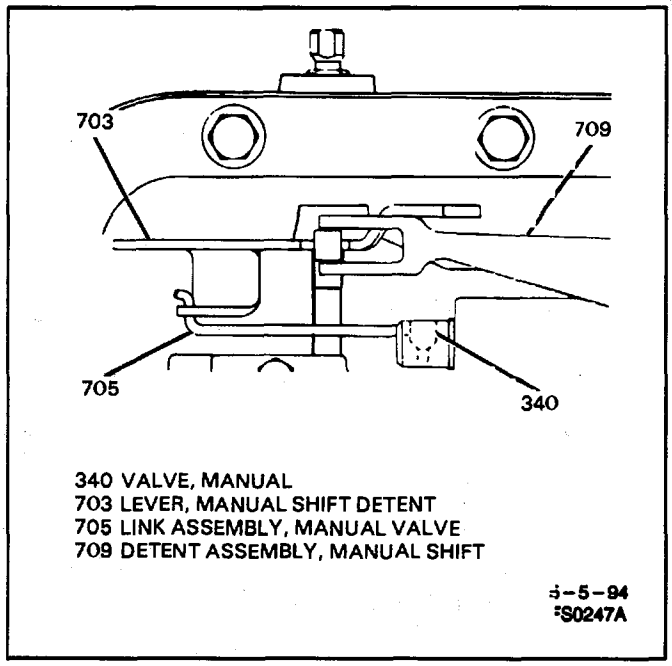


Figure 25 – Manual Shift Detent Assembly

AUTOMATIC TRANSMISSION ASSEMBLY REMOVAL AND INSTALLATION

Figures 19 and 25 through 28

A pressure test should be performed before automatic transmission assembly removal to aid in diagnosis.

NOTICE: Transmission oil cooler flushing must be performed when an automatic transmission assembly is removed for service. The flushing procedure should be performed after the installation of the overhauled or replacement assembly. Failure to flush the system may cause damage to the system and its components.

Remove or Disconnect

Tool Required:

J 21426 Output Shaft Sleeve and Case Extension Oil Seal Installer

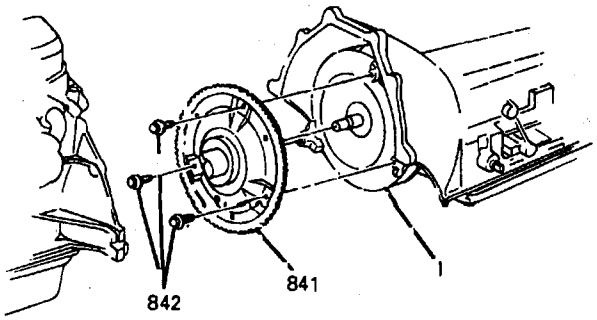
CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Mark position of propeller shaft assembly to pinion yoke.
4. Propeller shaft assembly. Refer to SECTION 4A.
5. Support transmission assembly (838).
6. Washer (853) and nut (852) from support (850) and transmission assembly (838).
7. Bolts/screws (854) from support (850) and rail assembly (846).
8. Support (850) from transmission assembly (838) and rail assembly (846).
9. Rear axle torque arm. Refer to SECTION 3D.
10. Catalytic converter hanger assembly. Refer to SECTION 6F.
11. Bolts/screws (840) from cover (839).
12. Cover (839) from transmission assembly (838).
13. Bolts/screws (842) from converter assembly (1).
14. Flywheel assembly (841) from converter assembly (1).
15. Move catalytic converter heat shield as necessary. Refer to SECTION 6F.
16. Automatic transmission range selector lever cable assembly. Refer to "Automatic Transmission Range Selector Lever Cable Assembly" in this section.
17. Transmission oil cooler pipe assemblies from transmission oil cooler pipe clips.
18. Electrical connectors at transmission assembly (838).
19. Bolts/screws (843 or 845).
20. Transmission fluid level indicator assembly.
21. Separate transmission assembly (838) from engine block.
22. Transmission oil cooler lines.
23. Lower transmission assembly (838) from vehicle.

Install or Connect

NOTICE: See "Notice" on page 7A-1 of this section.

1. Raise transmission assembly (838) into vehicle.
2. Transmission oil cooler lines.
3. Align transmission assembly (838) to engine block.



1 CONVERTER ASSEMBLY, TORQUE
841 FLYWHEEL ASSEMBLY
842 BOLT/SCREW, TRANSMISSION TORQUE CONVERTER,

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Figure 26 – Torque Converter Assembly-to-Flywheel Assembly

4. Transmission fluid level indicator assembly.
5. Bolts/screws (843 or 845).

Tighten

- Bolts/screws (843) to 47 N•m (35 lb. ft.).
- Bolts/screws (845) to 95 N•m (70 lb. ft.).

6. Electrical connectors to transmission assembly (838).
7. Transmission oil cooler pipe and hose assemblies to transmission oil cooler pipe clips.
8. Automatic transmission range selector lever cable assembly. Refer to "Automatic Transmission Range Selector Lever Cable Assembly" in this section.
9. Reposition catalytic converter heat shield. Refer to SECTION 6F.
10. Flywheel assembly (841) to converter assembly (1).
11. Bolts/screws (842) to converter assembly (1).

Tighten

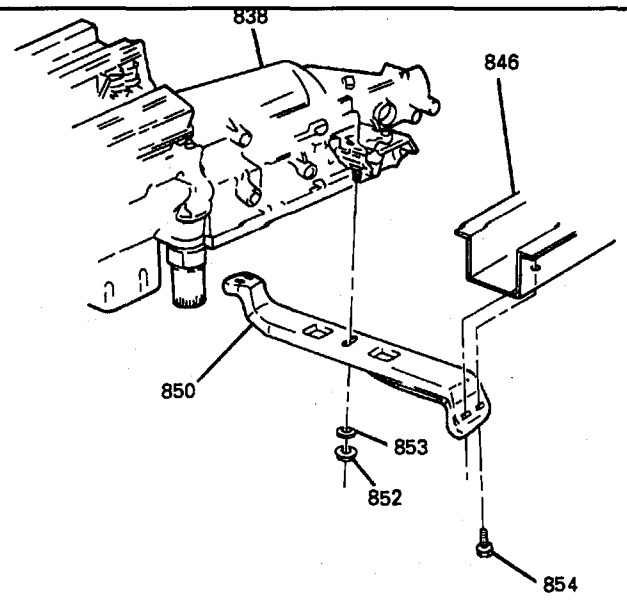
- Bolts/screws (842) to 63 N•m (46 lb. ft.).

12. Converter cover (839) to transmission assembly (838).
13. Bolts/screws (840) to cover (839).

Tighten

- Bolts/screws (840) to 10 N•m (89 lb. in.).

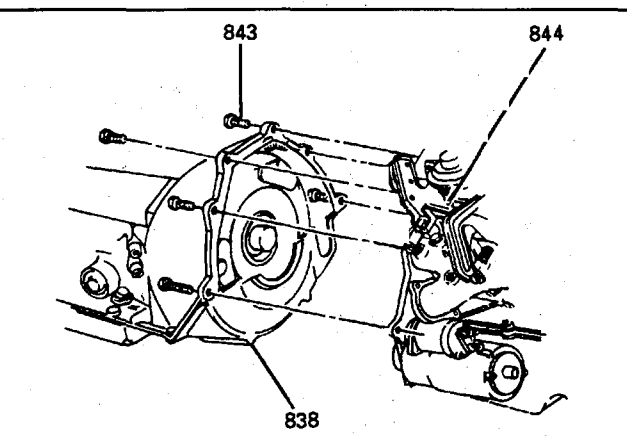
14. Catalytic converter hanger assembly. Refer to SECTION 6F.
15. Rear axle torque arm. Refer to SECTION 3D.
16. Support (850) to transmission assembly (838) and rail assembly (846).
17. Bolts/screws (854) to support (850) and rail assembly (846).
18. Washer (853) and nut (852) to support (850) and transmission assembly (838).



838 TRANSMISSION ASSEMBLY, AUTOMATIC
846 RAIL ASSEMBLY, ENGINE COMPARTMENT INNER SIDE
850 SUPPORT, TRANSMISSION
852 NUT, TRANSMISSION MOUNT
853 WASHER, TRANSMISSION MOUNT
854 BOLT/SCREW, TRANSMISSION SUPPORT

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Figure 27 – Automatic Transmission Assembly Mounting



838 TRANSMISSION ASSEMBLY, AUTOMATIC
843 BOLT/SCREW, TRANSMISSION
844 ENGINE ASSEMBLY

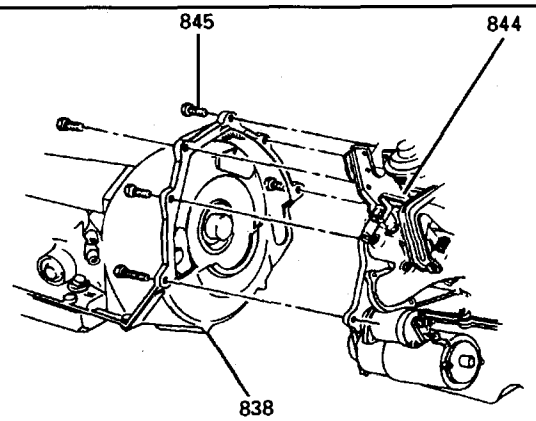
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Figure 28 – Automatic Transmission Assembly-to-Engine Assembly (5.7 LT1 Engine)

Tighten

- Nut (852) to 47 N•m (35 lb. ft.).

19. Remove support from transmission assembly (838).
20. Propeller shaft assembly, using marks made during removal. Refer to SECTION 4A.



838 TRANSMISSION ASSEMBLY, AUTOMATIC
844 ENGINE ASSEMBLY
845 BOLT/SCREW, TRANSMISSION

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Figure 29 – Automatic Transmission Assembly-to-Engine Assembly (3.4L L32 Engine)

21. Lower vehicle.
22. Battery negative cable assembly.

Clean

NOTICE: Transmission oil cooler flushing must be performed when a transmission assembly is removed for service. The flushing procedure should be performed after the installation of the overhauled or replacement assembly. Failure to flush the system may cause damage to the system and its components.

- Transmission oil cooler and oil cooler pipe and hose assemblies. Refer to "Oil Cooler Flushing Procedure" in this section.

Adjust

- Automatic transmission shift control lever cable assembly. Refer to "Automatic Transmission Range Selector Lever Cable Assembly" in this section.

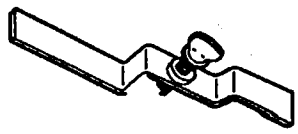
  NOTICE: Do not overfill. Overfilling will cause foaming, loss of fluid and possible damage to the transmission.
- Transmission fluid level.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Accumulator Cover Bolt/Screw	11 N•m (97 lb. in.)
Automatic Transmission Case Extension Bolt/Screw	35 N•m (26 lb. ft.)
Automatic Transmission Control Bolt/Screw	4.5 N•m (40 lb. in.)
Automatic Transmission Oil Cooler Pipe and Hose Assembly Fittings	27 N•m (20 lb. ft.)
Automatic Transmission Oil Pan Bolt/Screw	12 N•m (9 lb. ft.)
Automatic Transmission Range Selector Lever Cable Bracket Bolt/Screw	24 N•m (18 lb. ft.)
Automatic Transmission Range Selector Lever Nut	20 N•m (15 lb. ft.)
Control Valve Body Bolt/Screw	11 N•m (97 lb. in.)
Manual Shift Detent Bolt/Screw	22 N•m (16 lb. ft.)
Park/Neutral Position Switch Bolt/Screw	2.2 N•m (19 lb. in.)
Pressure Control Solenoid Retainer Bolt/Screw	11 N•m (97 lb. in.)
Spacer Plate Support Bolt/Screw	11 N•m (97 lb. in.)
Special Hex Washer Head Bolt (M6X1X16)	11 N•m (97 lb. in.)
TCC Solenoid Valve Bolt/Screw	11 N•m (97 lb. in.)
Transmission Bolt/Screw (3.4L L32 Engine)	95 N•m (70 lb. ft.)
Transmission Bolt/Screw (5.7L LT1 Engine)	47 N•m (35 lb. ft.)
Transmission Converter Cover Bolt/Screw	10 N•m (89 lb. in.)
Transmission Mount Nut	47 N•m (35 lb. ft.)
Transmission Torque Converter Bolt/Screw	63 N•m (46 lb. ft.)
Vehicle Speed Sensor Bolt/Screw	11 N•m (97 lb. in.)
Vehicle Speed Sensor Retaining Bolt/Screw	10 N•m (89 lb. in.)

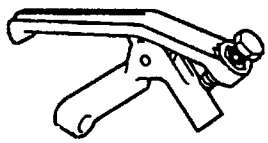
SPECIAL TOOLS



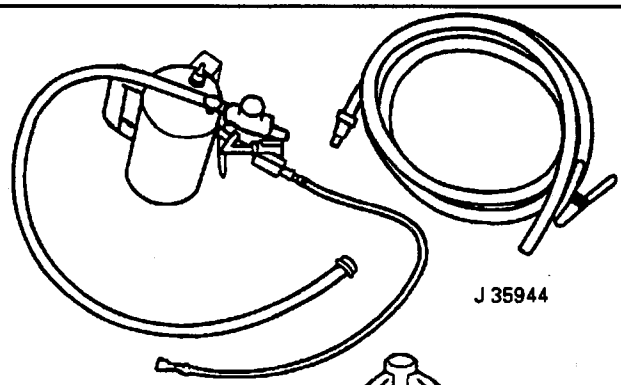
1 J 21366



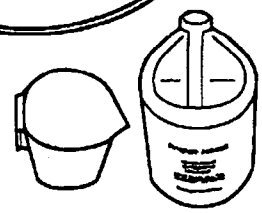
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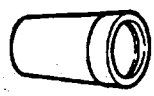
3 J 29714-A



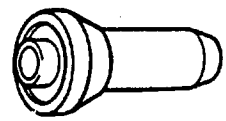
4 J 35944



5 J 35944-20



6 J 28458



7 J 21426

1 CONVERTER HOLDING STRAP
2 TRANSMISSION ASSEMBLY LUBRICANT (TRANSJEL®)
3 SERVO COVER DEPRESSOR
4 OIL COOLER AND LINE FLUSHER
5 COOLER FLUSHING FLUID (1 GALLON)
6 POWER PISTON SEAL PROTECTOR AND DIAPHRAGM RETAINER INSTALLER
7 CASE EXTENSION OIL SEAL INSTALLER

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SECTION 7A-14A
HYDRA-MATIC 4L60-E
AUTOMATIC TRANSMISSION DIAGNOSIS
RPO M30

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GENERAL INFORMATION

HOW TO USE THIS SECTION

This section provides general information on transmissions, a detailed description of the operation of the HYDRA-MATIC 4L60-E and procedures for diagnosing the HYDRA-MATIC 4L60-E. When diagnosing any condition on the HYDRA-MATIC 4L60-E, begin with the "HYDRA-MATIC 4L60-E Functional Test Procedure" in this section. After the cause of a condition is determined, refer to SECTION 7A-14B, "ON-VEHICLE SERVICE" for repair procedures.

TRANSMISSION DEFINITIONS AND ABBREVIATIONS

The following definitions and abbreviations are provided to establish a common language for describing transmission related conditions. These terms are used in SECTION 7A-14B.

Throttle Positions

- Minimum Throttle – the least amount of throttle opening required for an upshift.
- Light Throttle – approximately 1/4 of accelerator pedal travel. (25% Throttle Position)
- Medium Throttle – approximately 1/2 of accelerator pedal travel. (50% Throttle Position)
- Heavy Throttle – approximately 3/4 of accelerator pedal travel. (75% Throttle Position)
- Wide Open Throttle (WOT) – full travel of the accelerator pedal. (100% Throttle Position)
- Full Throttle Detent Downshift – a quick apply of the accelerator pedal to its full travel, forcing a downshift.
- Zero Throttle Coastdown – a full release of the accelerator pedal while the car is in motion and in drive range.
- Engine Braking – a condition where the engine is used to slow the car by manually downshifting during a zero throttle coastdown.

Shift Conditions

- Bump – a sudden and forceful apply of a clutch or band.
- Chuggle – a bucking or jerking may be most noticeable when the converter clutch is engaged; similar to the feel of towing a trailer.

- Delayed – a condition where a shift is expected but does not occur for a period of time. Samples of this could be described as clutch or band engagement that does not occur as quickly as expected during a part throttle or wide open throttle apply of the accelerator or, when manually downshifting to a lower range. Also defined as "LATE" or "EXTENDED".
- Double Bump (Double Feel) – two sudden and forceful applies of a clutch or band.
- Early – a condition where the shift occurs before the car has reached proper speed. Tends to labor the engine after the upshift.
- End Bump – a firmer feel at the end of a shift as compared to the feel at the start of the shift. Also defined as "END FEEL" or "SLIP BUMP".
- Firm – a noticeably quick apply of a clutch or band that is considered normal with a medium to heavy throttle. Should not be confused with "HARSH" or "ROUGH".
- Flare – a quick increase in engine rpm along with a momentary loss of torque. This most generally occurs during a shift. Also defined as "SLIPPING".
- Harsh (Rough) – a more noticeable apply of a clutch or band as compared with "FIRM". This condition is considered undesirable at any throttle position.
- Hunting – a repeating quick series of upshifts and downshifts that causes a noticeable change in engine rpm. An example could be described as a 4-3-4 shift pattern. Also defined as "BUSYNESS".
- Initial Feel – a distinct firmer feel at the start of a shift as compared to the finish of the shift.
- Late – a shift that occurs when the engine is at a higher than normal rpm for a given amount of throttle.
- Shudder – a repeating jerking condition similar to "CHUGGLE" but more severe and rapid. This condition may be most noticeable during certain ranges of car speed.
- Slipping – a noticeable increase in engine rpm without a car speed increase. A slip usually occurs during or after initial clutch or band apply.
- Soft – a slow, almost unnoticeable clutch or band apply with very little shift feel.
- Surge – a repeating engine related condition of acceleration and deceleration that is less intense than "CHUGGLE".
- Tie-Up – a condition where two opposing clutches and/or bands are attempting to apply at the same time causing the engine to labor with a noticeable loss of engine rpm.

Noise Conditions

- Planetary Gear Noise – a whine related to car speed most noticeable in first gear or reverse. Becomes less noticeable after an upshift.
- Pump Noise – a high pitch whine that increases with engine rpm.

Abbreviations

- PCM – Powertrain Control Module.
- TCC – Torque Converter Clutch.
- TP Sensor – Throttle Position Sensor.
- ECT Sensor – Engine Coolant Temperature Sensor.
- VS Sensor – Vehicle Speed Sensor.
- RWD – Rear Wheel Drive.
- 2WD – 2 Wheel Drive.
- 4WD – 4 Wheel Drive.
- PSA – Transmission Fluid Pressure Switch Assembly.
- TTS – Transmission Temperature Sensor

TRANSMISSION GENERAL DESCRIPTION

The HYDRA-MATIC 4L60-E is a fully automatic rear wheel drive electronically controlled transmission. It provides four forward ranges including overdrive, and reverse. Shift points are controlled by the PCM via two shift solenoids. Oil pressure is supplied by a vane type oil pump, and regulated by the PCM with a transmission pressure control solenoid (force motor). Shift schedules and TCC apply rates are also controlled by the PCM and are influenced by transmission temperature.

The transmission can be operated in any one of the following seven modes:

P – Park position prevents the vehicle from rolling either forward or backward. (For safety reasons the parking brake should be used in addition to the park position.)

R – Reverse allows the vehicle to be operated in a rearward direction.

N – Neutral allows the engine to be started and operated while driving the vehicle. If necessary this position may be selected if the engine must be restarted with the vehicle moving.

Ⓓ – Overdrive is used for all normal driving conditions. It provides four gear ratios plus converter clutch operation. Downshifts are available for safe passing by depressing the accelerator.

D – Drive position is used for city traffic and hilly terrain. It provides three gear ranges. Again, downshifts are available by depressing the accelerator.

2 – Manual second is used to provide acceleration, engine braking, or greater traction from a stop. When manual second is chosen, the vehicle will start out and remain in second gear. This range may be selected at any vehicle speed.

1 – Manual Lo is used to provide maximum engine braking. This range may also be selected at any vehicle speed.

TRANSMISSION COMPONENT AND SYSTEM DESCRIPTIONS

The mechanical components of this unit are:

- Torque converter with converter clutch (TCC)
- Vane type oil pump
- Five multiple disc clutches
- 2-4 band assembly
- Two planetary gear sets
- One sprag clutch
- One roller clutch
- Control valve assembly

The electrical components of this unit are:

- Two shift solenoids
- 3-2 downshift solenoid
- Transmission pressure control solenoid (force motor)
- Torque converter clutch solenoid and wiring harness assembly
- Transmission fluid temperature sensor
- Fluid pressure switch assembly
- Vehicle speed sensor (2WD only)

Refer to Figure 1 for component locations. Refer to Range Reference Chart Figure 7 for component operation in all seven modes of transmission operation. Refer to Figures 2-6 for detailed descriptions of electrical components.

Transmission Adapt Function

The HYDRA-MATIC 4L60-E uses a line pressure control system which has the ability to adapt the system's line pressure to compensate for normal wear of clutch fiber plates, seals, springs, etc. This "learning" feature is similar to what is used for fuel control (integrator/block learn).

The HYDRA-MATIC 4L60-E transmission only uses the adapt function for the 1-2 upshift. The PCM monitors engine speed to determine if the shift is occurring too fast (harsh) or too slow (soft) and adjusts the pressure control solenoid to maintain the correct shift feel. The line pressure can adapt to values ranging from 5 psi below, to 10 psi above normal line pressure.

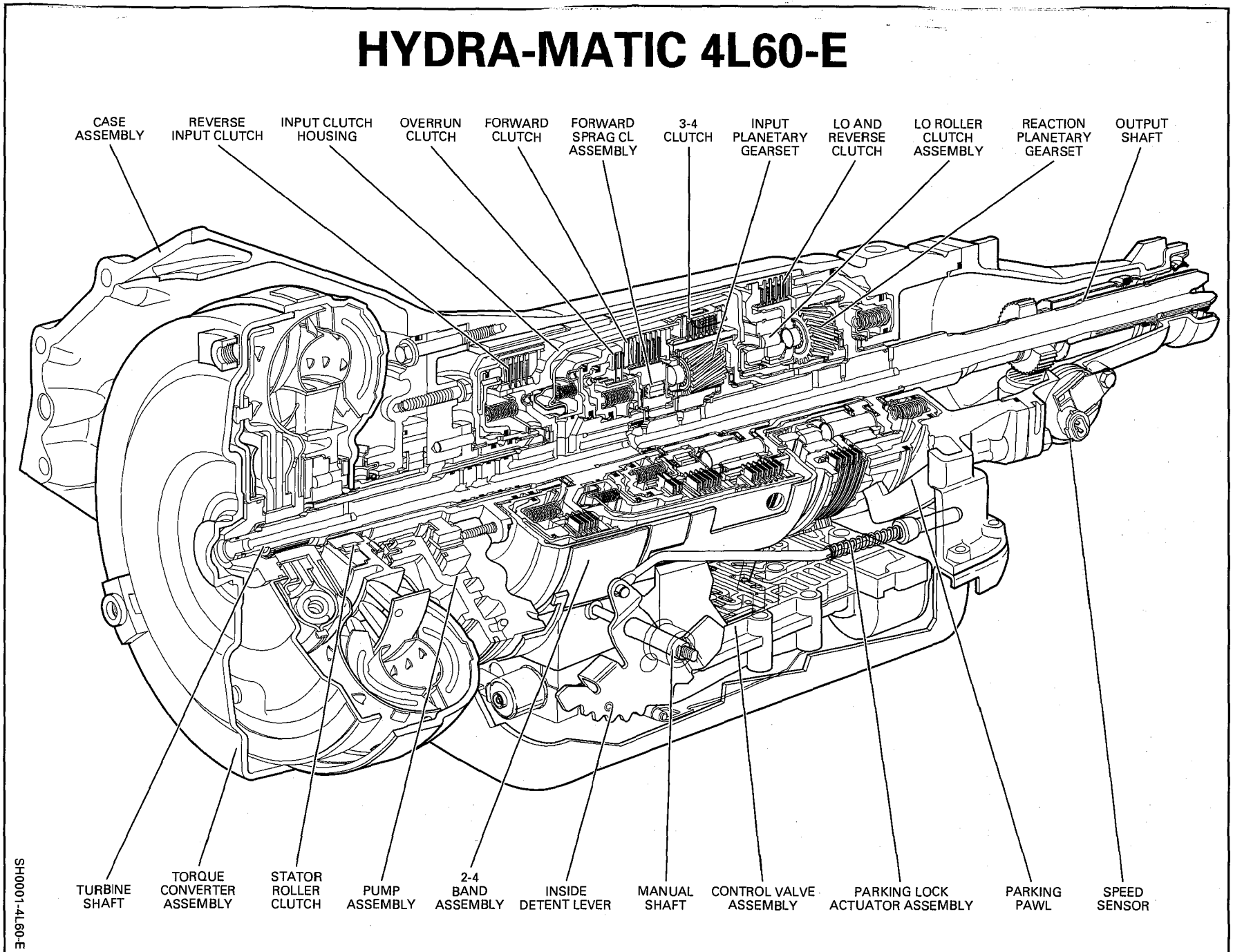


Figure 1 HYDRA-MATIC 4L60-E Transmission

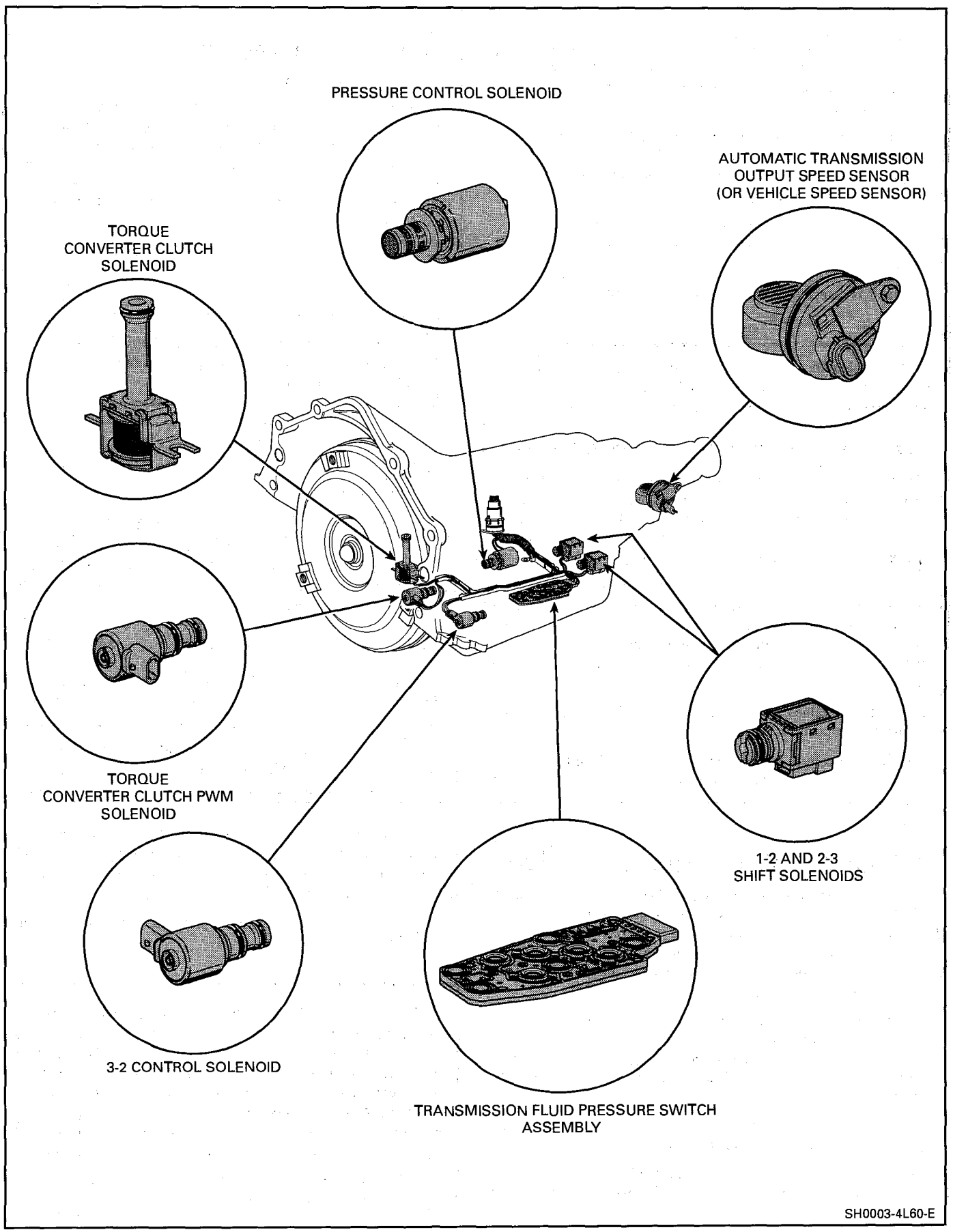
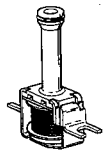


Figure 2 Electronic Component Location Views

Torque Converter Clutch Solenoid



The torque converter clutch solenoid is a normally open exhaust valve that is used to control torque converter clutch apply and release.

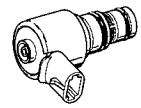
When grounded (energized) by the PCM, the TCC solenoid stops converter signal oil from exhausting. This causes converter signal oil pressure to increase and shift the TCC valve to shift into the apply position

The brake switch is an input to the PCM, and the PCM directly controls TCC apply based on the brake switch status.

If a fault is detected in the TCC circuit, code 067 or 069 will set.

TCC solenoid resistance should be 20-40 ohms minimum when measured at 20°C (68°F).

Torque Converter Clutch PWM Solenoid

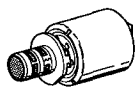


The torque converter clutch PWM solenoid is used to control fluid acting on the converter clutch valve, which then controls TCC apply and release. This solenoid is attached to the control valve body assembly within the transmission. The TCC PWM solenoid is used to provide smooth engagement of the torque converter clutch by operating on a negative duty cycle percent of "ON" time.

If a fault is detected in the TCC PWM circuit, code 083 will set.

TCC PWM solenoid resistance should be 10-11 ohms when measured at 20°C (68°F), and 3-15 ohms when measured at 100°C (212°F).

Transmission Pressure Control Solenoid



The transmission pressure control solenoid (or force motor) is an electronic pressure regulator that controls pressure based on current flow through its coil winding. The magnetic field produced by the coil moves the solenoid's internal valve which varies pressure to the pressure regulator valve.

The PCM controls the pressure control solenoid by commanding current between 0 and 1.1 amps. This changes the duty cycle of the solenoid, which can range between 0 % and 60 %. 1.1 amps corresponds to minimum line pressure, and 0 amps is maximum line pressure (if solenoid loses power, transmission will still have maximum line pressure).

Line pressure values are calculated by the PCM using inputs such as the throttle position sensor.

The pressure control solenoid takes the place of the throttle valve that was used on past model transmissions.

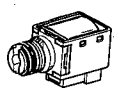
If there is a difference between the amperage commanded by the PCM and the actual amperage, diagnostic trouble code 073 will set.

Unlike the pressure control solenoid on the HYDRA-MATIC 4L80-E, the 4L60-E pressure control solenoid does not pulse every 10 seconds for a cleaning cycle.

Force High	Force Low	Line Pressure
+ 0% Duty Cycle	0 Amps	Maximum
+ 60% Duty Cycle	1.1 Amps @ 4-5 V	Minimum

Transmission Pressure Control Solenoid resistance should measure 3.5 - 8 ohm when measured at 20°C (68°F).

1-2 and 2-3 Shift Solenoids



The 1-2 and 2-3 shift solenoids (also called A and B solenoids) are identical solenoid devices that control the movement of the 1-2 and 2-3 shift valves (the 3-4 shift valve is not directly controlled by a shift solenoid). The solenoids are normally open exhaust valves that work in four combinations to shift the transmission into different gears (see chart).

The PCM energizes each solenoid by grounding it through an internal quad driver. This sends current through the coil winding in the solenoid and moves the internal plunger out of the exhaust position. When 'ON', the solenoid redirects fluid to move a shift valve.

PCM controlled shift solenoids eliminate the need for TV and governor pressures to control shift valve operation.

Note: The manual valve can hydraulically override the shift solenoids. Only in D4 are the shift solenoid states totally determining what gear the transmission is in. In the other manual valve positions, the transmission shifts hydraulically and the shift solenoid states 'catch up' when throttle position and vehicle speed fall into the correct ranges.

Diagnostic trouble codes 081 and 082 indicate shift solenoid circuit voltage faults.

Shift solenoid resistance should measure 20-40 ohms minimum when measured at 20°C (68°F). Shift solenoid current flow should not exceed 0.75 amps. The shift solenoid should energize at a voltage of 7.5 volts or more (measured across the terminals). The shift solenoid should de-energize when voltage is one volt or less.

If both solenoids lose power, third gear only will result.

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Figure 3 Electronic Component Descriptions

Transmission Fluid Pressure Switch Assembly



The transmission fluid pressure switch assembly (PSA) is a set of five pressure switches on the valve body that sense whether fluid pressure is present in five different valve body passages. The combination of which switches are open and closed is used by the PCM to determine actual manual valve position. The PSA assembly however cannot distinguish between Park and Neutral because the monitored valve body pressures are identical in both cases.

The switches are wired to provide three signal lines that are monitored by the PCM. These inputs are used to help control line pressure, torque converter clutch apply and shift solenoid operation. Voltage at each of the signal lines will be either zero or twelve volts.

To monitor PSA assembly operation, the PCM compares the actual voltage combination of the switches to a PSA combination chart stored in the its memory. If the PCM sees one of two 'illegal' voltage combinations (see chart) a code 028 will result. A Code 28 indicates a short circuit condition in either the range signal "A" or range signal "C" circuits.

PSA assembly signal voltage can be measured from each pin to ground, and compared to the combination chart. On the transmission wiring harness, pin N is 'range signal A', pin R is 'range signal B', and pin P is 'range signal C'. With the wiring harness connected and engine running, a voltage measurement of these three lines will indicate a 'high' reading (near 12 volts) when a circuit is open, and a low (zero volts) when the circuit is switched to ground.

The transmission temperature sensor is part of the transmission fluid pressure switch assembly.

Seven valid combination and two invalid combinations are available from the PSA: Valid combinations for Circuits A, B and C are shown below. Invalid combinations are A=0V, B=0V AND C=0V; OR A=0V, B=12V AND C=0V.

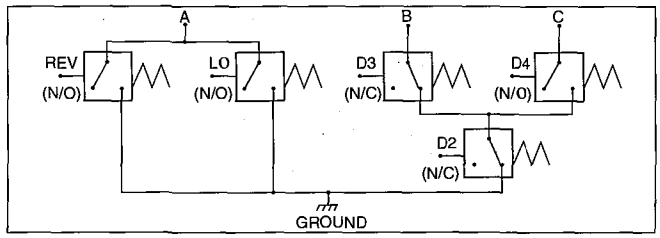
RANGE INDICATOR	OIL PRESSURE				
	REV	D4	D3	D2	LO
PARK					
REVERSE	■				
NEUTRAL					
D4		■			
D3		■	■		
D2		■	■	■	
D1		■	■	■	■

■ OIL PRESSURE PRESENT

VALID PSA COMBINATION CHART

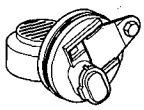
	"A"	"B"	"C"
PARK	12	0	12
REVERSE	0	0	12
NEUTRAL	12	0	12
D4	12	0	0
D3	12	12	0
D2	12	12	12
D1	0	12	12
ILLEGAL	0	12	0
ILLEGAL	0	0	0

EXPECTED VOLTAGE READINGS



SWITCH LOGIC (N/O)- NORMALLY OPEN (N/C)- NORMALLY CLOSED

Vehicle Speed Sensor



The vehicle speed sensor (or transmission output speed sensor) is used to control shift points and calculate TCC slip.

The speed sensor contains a coil that gives off a continuous magnetic field. A rotor rotates past the sensor, and the rotor teeth break the magnetic field. Each break in the field sends a pulse to the VSSB (Vehicle Speed Sensor Buffer). The VSSB sends two signals to the PCM, the first is a 2002 pulse per mile (PPM) signal used by the engine. The second is the transmission/transfer case 40 pulse per revolution (PPR) signal used to control the transmission.

In two wheel drive (2WD) applications, the vehicle speed sensor is located on the transmission extension housing.

Sensor resistance should be 1260-1540 ohms when measured at 20°C (68°F). Output voltage will vary with speed from a minimum of 0.5 Volts AC at 100 RPM, to more than 100 Volts AC at 8000 RPM.

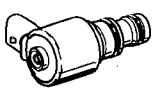
Four wheel drive (4WD) applications use a vehicle speed sensor located on the transfer case.

In 2WD or 4WD Hi, trans output speed = transfer case speed

In 4WD Lo, trans output speed = transfer case speed x constant

Codes 024 or 072 will set if a fault exists in the vehicle speed sensor circuit 40 PPR line.

3-2 Control Solenoid



The 3-2 control solenoid is a pulse width modulated solenoid used to improve the 3-2 downshift. The solenoid regulates the release of the 3-4 clutch and 2-4 band apply.

The solenoid uses duty cycle to regulate pressures that smoothly release the clutch and apply the band. Duty cycle is normally about 0% in first gear, 90% in all other drive gears and drops during the 3-2 downshift. Throttle position, vehicle speed and the commanded gear are used to determine duty cycle.

3-2 Control solenoid resistance should be a minimum of 9-14 ohms at 20°C (68°F). It is operated using pulse width modulation at a frequency of 50 Hz.

If a voltage fault is detected in the 3-2 control solenoid circuit, diagnostic trouble code 066 will set.

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Figure 4 Electronic Component Descriptions

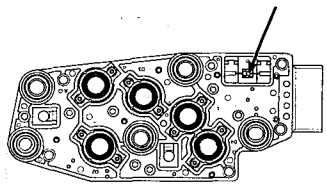
Transmission Fluid Temperature Sensor

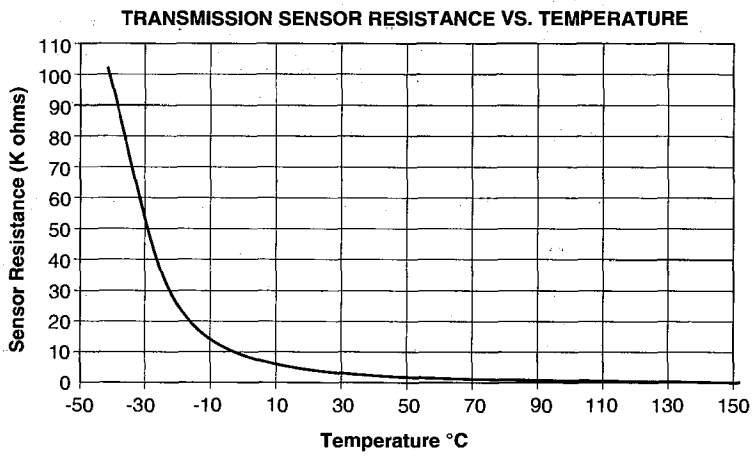
The transmission fluid temperature sensor is part of the transmission fluid pressure switch assembly and is used to help control torque converter clutch apply and shift quality.

The temperature sensor is a resistor (thermister) which changes value based on temperature. At low temperatures the resistance is high, and at high temperatures the resistance is low.

The PCM sends a 5 volt signal to the temperature sensor and measures the voltage drop in the circuit. This means you will measure a high voltage when the transmission is cold, and a low voltage when the transmission is hot.

If the temperature sensor circuit has a fault, code 058 or 059 will set. A code 58 indicates a short circuit condition while a code 59 indicates an open circiut condition. Code 079 will set if the transmission is operating at a high temperature for a period of time.





TRANSMISSION SENSOR – TEMPERATURE TO RESISTANCE TO VOLTAGE (approximate)

°C	R low (ohms)	R high (ohms)
-40	73556.4	127857.6
-35	54156.0	90760.0
-30	40171.0	65197.0
-25	30074.1	47301.9
-20	22677.4	34676.6
-15	17244.9	25651.1
-10	13199.0	19153.0
-5	10184.3	14413.7
0	7902.2	10943.8
5	6192.6	8379.4
10	4875.8	6466.2
15	3869.6	5028.4
20	3088.6	3941.4
25	2481.3	3108.7
30	1992.6	2481.4
35	1610.1	1991.9
40	1308.4	1609.6
45	1068.6	1307.4
50	875.7	1070.0
55	723.6	884.0
60	600.3	734.0
65	501.3	613.0
70	420.3	514.0
75	353.7	432.0
80	298.8	365.0
85	253.8	310.0
90	216.9	266.0
95	185.4	229.0
100	159.3	198.0
105	136.8	172.0
110	118.8	150.0
115	103.5	132.0
120	89.9	116.0
125	78.7	102.0
130	69.1	90.1
135	60.9	79.8
140	53.8	70.9
145	47.8	63.2
150	42.5	56.6

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Figure 5 Electronic Component DescriptionsWiring Diagram

TRANSMISSION ELECTRICAL CONNECTOR

The transmission electrical connector is a very important part of the transmission operating system. Any interference with the electrical connection can cause the transmission to set Diagnostic Trouble Codes (DTCs) and/or affect proper operation.

The following items can affect the electrical connection:

- Bent pins in the connector from rough handling during connection and disconnection.
- Wires backing away from the pins or coming uncrimped (in either internal or external wiring harness).
- Dirt contamination entering the connector when disconnected.
- Pins in the internal wiring connector backing out of the connector or pushed out during reconnection.
- Excessive transmission fluid leaking into the connector, wicking up into the external wiring harness, and degrading the wire insulation. *
- Water/moisture intrusion in the connector.
- Low pin retention in the external connector from excessive connection and disconnection of the wiring connector assembly.
- Pin corrosion from contamination.
- Broken/cracked connector assembly.

Points to remember when working with the transmission wiring connector assembly:

- To remove the connector, squeeze the two tabs towards each other and pull straight up (Refer to the illustration).
- Carefully limit twisting or wiggling the connector during removal. Bent pins can occur.
- **DO NOT** pry the connector off with a screwdriver or other tool.
- To reinstall the external wiring connector, first orient the pins by lining up the arrows on each half of the connector. Push the connector straight down into the transmission without twisting or angling the mating parts.
- The connector should click into place with a positive feel and/or noise.
- Whenever the transmission external wiring connector is disconnected from the internal harness and the engine is operating DTC(s) will set. Clear these DTC(s) after reconnecting the external connector.

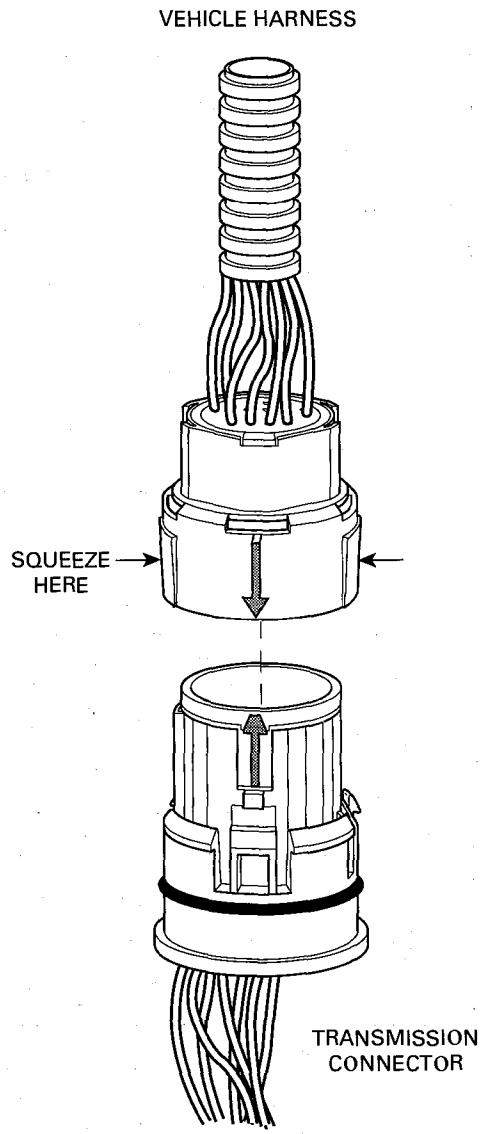
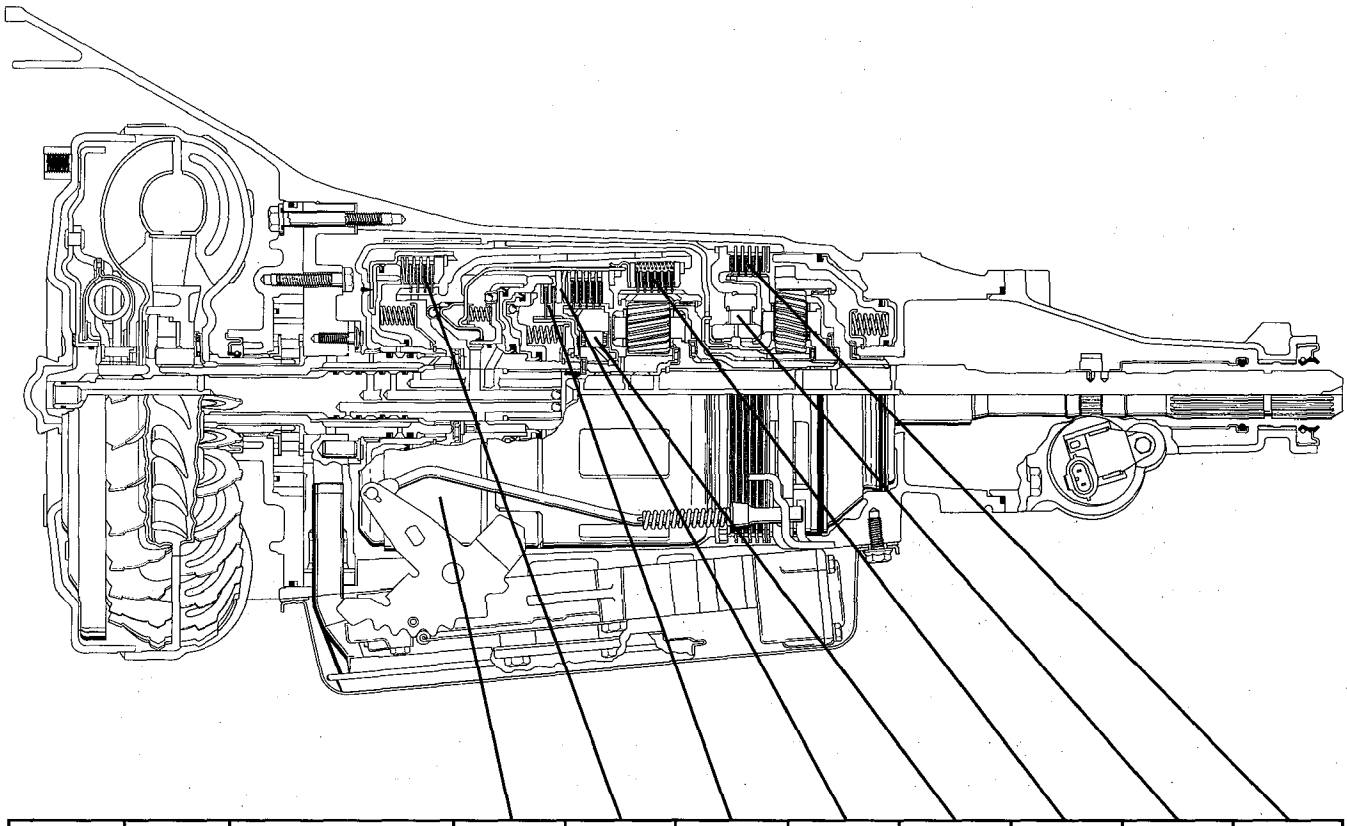


Figure 6 Transmission Electrical Connector



RANGE	GEAR	SHIFT SOLENOID		2-4 BAND	REVERSE INPUT CLUTCH	OVERRUN CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CL. ASSEMBLY	3-4 CLUTCH	LO/ROLLER CLUTCH	LO/REV. CLUTCH
		1-2	2-3								
PARK		ON*	ON*								APPLIED
REVERSE		ON*	ON*		APPLIED						APPLIED
NEUTRAL		ON*	ON*								
(D)	1st	ON	ON				APPLIED	HOLDING		HOLDING	
	2nd	OFF	ON	APPLIED			APPLIED	HOLDING			
	3rd	OFF	OFF				APPLIED	HOLDING	APPLIED		
	4th	ON	OFF	APPLIED			APPLIED		APPLIED		
D	1st	ON	ON				APPLIED	HOLDING		HOLDING	
	2nd	OFF	ON	APPLIED			APPLIED	HOLDING			
	3rd	OFF	OFF			APPLIED	APPLIED	HOLDING	APPLIED		
2	1st**	ON	ON			APPLIED	APPLIED	HOLDING		HOLDING	
	2nd	OFF	ON	APPLIED		APPLIED	APPLIED	HOLDING			
1	1st	ON	ON			APPLIED	APPLIED	HOLDING		HOLDING	APPLIED
	2nd***	OFF	ON	APPLIED		APPLIED	APPLIED	HOLDING			

* SHIFT SOLENOID STATE IS A FUNCTION OF VEHICLE SPEED AND MAY CHANGE IF VEHICLE SPEED INCREASES SUFFICIENTLY IN PARK, REVERSE OR NEUTRAL. HOWEVER, THIS DOES NOT AFFECT TRANSMISSION OPERATION.

** MANUAL SECOND – FIRST GEAR IS ELECTRONICALLY PREVENTED UNDER NORMAL OPERATING CONDITIONS.

*** MANUAL FIRST – SECOND GEAR IS ONLY AVAILABLE ABOVE APPROXIMATELY 48 TO 56 KM/H (30 TO 35 MPH).

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Figure 7 Range Reference Chart

DIAGNOSIS

NOTICE: If a wire is probed with a sharp instrument and not properly sealed afterward, the wire will corrode and an open circuit will result.

Diagnostic test probes are now available that allow you to probe individual wires without leaving the wire open to the environment. These probe devices are inexpensive and easy to install, and they permanently seal the wire from corrosion.

BASIC KNOWLEDGE REQUIRED (Refer to 6E)

You must be familiar with some basic electronics to use this section of the Service Manual. They will help you to follow diagnostic procedures.

NOTICE: Lack of basic knowledge of this powertrain when performing diagnostic procedures could result in incorrect diagnostic performance or damage to powertrain components. Do not, under any circumstances, attempt to diagnose a powertrain problem without this basic knowledge.

Special Tools

You should be able to use a Digital Volt Meter (DVM), a circuit tester, jumper wires or leads and a line pressure gage set. The functional test procedures given in Figures 8 and 9 are designed to verify the correct operation of electronic components in the transmission. This will eliminate the unnecessary removal of transmission components.

QUICK CHECK PROCEDURE

When diagnosing any HYDRA-MATIC 4L60-E related condition, always begin with the functional test procedure in this section. The functional test procedure will indicate the proper path of diagnosing the transmission by describing the basic checks and then referencing the locations of specific checks. Refer to Figures 8 and 9.

TRANSMISSION FLUID CHECKING PROCEDURE

Whenever checking HYDRA-MATIC 4L60-E transmission fluid refer to Figure 12.

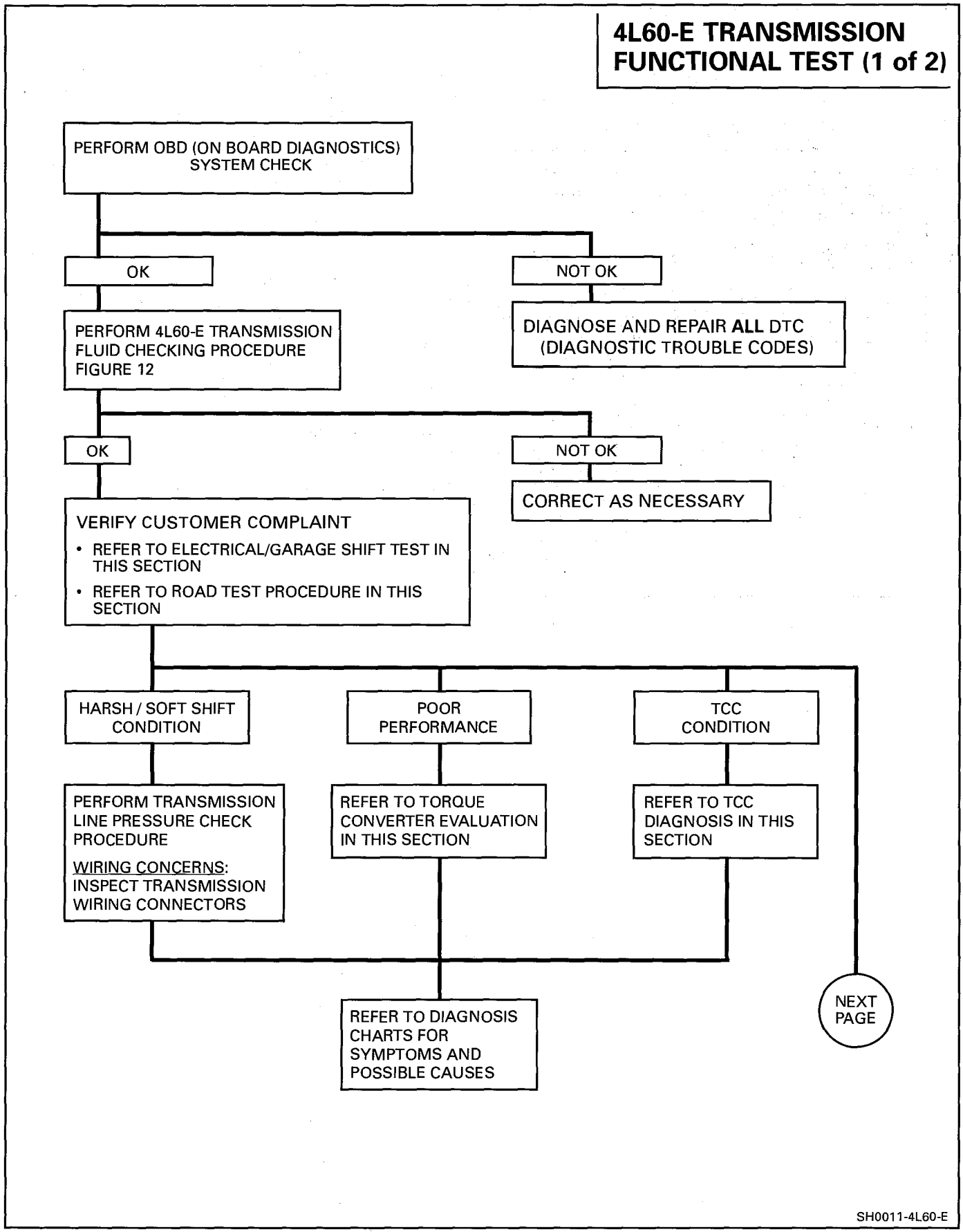


Figure 8 Transmission Functional Test (1 of 2)

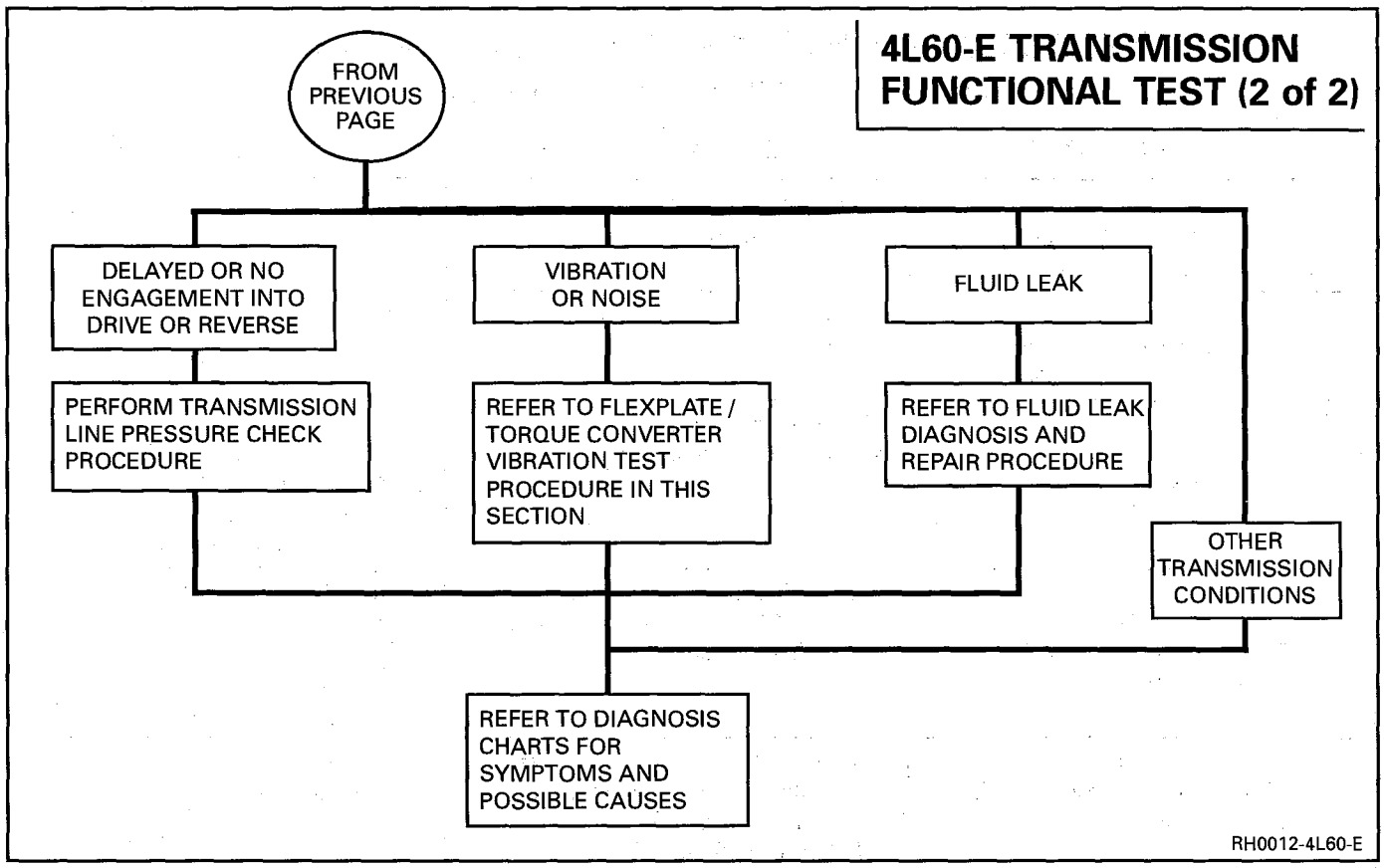


Figure 9 Transmission Functional Test (2 of 2)

DIAGNOSTIC TROUBLE CODES AND DEFAULT ACTIONS

Refer to Section 6E3 to Diagnose Trouble Codes.

TROUBLE CODE	CODE PARAMETERS	DEFAULT ACTION
14 Engine Coolant Temp Sensor Circuit (High)	Engine coolant temp over 151°C (306°F) for 1/2 second.	• TCC apply cold.
15 Engine Coolant Temp Sensor Circuit (Low)	Engine coolant temp less than -40°C (-40°F) for 1/2 second.	• TCC apply cold.
21 Throttle Position Sensor Circuit (High)	TP voltage greater than 4.88 volts for four seconds.	• No TCC. • Fixed shift points. • Harsh shifts. • Maximum line pressure. • No fourth gear in hot mode.
22 Throttle Position Sensor Circuit (Low)	With engine running, TP voltage less than .06 volts for four seconds. (Diesel is less than .16 volts.)	• No TCC. • Fixed shift points. • Harsh shifts. • Maximum line pressure. • No fourth gear in hot mode.
24 Vehicle Speed Sensor Circuit No Signal	In Drive or Reverse with engine speed greater than 3000 rpm, output speed is less than 250 rpm for three seconds. (MAP is 100-255 kPa, TP is 10-100%)	• Maximum line pressure. • Third gear only.
28 Trans. Range Pressure Switch Circuit Error	PCM detects one of two "invalid" combinations of PSM signals for five seconds.	• No TCC. • Harsh shifts. • No fourth gear in hot mode. • No 2nd gear in D2.
37 Brake Switch Stuck "ON" (1) TCC Brake Switch Error (2)	With brake on, vehicle speed is 5-20 mph for six seconds, then vehicle speed is >20 mph for six seconds. After vehicle speed is < 5 mph. This must happen seven times.	• No TCC. • No fourth gear in hot mode.
38 (1) Brake Switch Stuck "OFF"	With brake off, vehicle speed is >20 mph for six seconds, then vehicle speed is 5-20 mph for six seconds. After vehicle speed is < 5 mph. This must happen seven times.	• No TCC. • No fourth gear in hot mode.
53 System Voltage Overcharged	Generator voltage is greater than 19.5 volts for two seconds.	• No TCC. • Maximum line pressure. • Third gear only.
58 Transmission Fluid Temp Sensor Circuit (High)	Transmission fluid temperature is greater than 151°C (306°F) for one second.	• No default action.
59 Transmission Fluid Temp Sensor Circuit (Low)	Transmission fluid temperature is below -40°C (-40°F) for one second.	• No default action.

(1) Not used on 3.4L F-Cars.
(2) Used on 3.4L F-Cars only.

SH0026-4L60-E-C

Figure 10 Trouble Chart Diagnosis Chart A

DIAGNOSTIC TROUBLE CODES AND DEFAULT ACTIONS

Refer to Section 6E3 to Diagnose Trouble Codes.

TROUBLE CODE	CODE PARAMETERS	DEFAULT ACTION
72 Vehicle Speed Sensor Error	Two successive speed readings have a difference of more then 1000 RPM. (Difference must be more than 1500 RPM in P and N.)	• Maximum line pressure. • Soft landing third gear only. • No TCC.
73 (1) Pressure Control Solenoid Current **93** (2)	Pressure control solenoid return amperage varies more than .16 amp from commanded amperage for one second.	• Harsh shifts. • Maximum line pressure.
74 (1) TCS/ASR Circuit Low	ASR active for five seconds.	• Inhibit TCC operation. • Inhibit 4th gear, if in Hot mode.
75 (1) System Voltage Low **96** (2)	System voltage is less than 7.3 V at low temps and less than 11.7 V at high temps for four seconds.	• No TCC. • Maximum line pressure. • Third gear only.
79 Transmission Fluid Overtemp	Transmission temp is higher than 146°C (302°F) for 30 minutes.	• No default action.
80 (2) Trans Component Slipping	Slip > 100 RPM, TCC Mode = Locked, Gear = 2, 3, or 4, Gear selector in D3 or D4, No code 28; 0 < TPS < 35% Transmission temp is between 60-100°C. This must happen for at least 10 seconds.	• Inhibit TCC Operation. • Maximum line pressure. • Inhibit 4th gear if in Hot mode.
81 (1) 2-3 Shift Solenoid Circuit Fault	2-3 Shift Solenoid is commanded "ON" by PCM but circuit voltage is high for two seconds OR 2-3 Shift Solenoid is commanded "OFF" by PCM but circuit voltage is low for two seconds.	• No TCC. • Maximum line pressure. • Second or third gear only.
82 (1) 1-2 Shift Solenoid Circuit Fault	1-2 Shift Solenoid is commanded "ON" by PCM but circuit voltage is high for two seconds OR 1-2 Shift Solenoid is commanded "OFF" by PCM but circuit voltage is low for two seconds.	• Maximum line pressure. • Second or third gear only OR • First and fourth gears only.
83 (1) TCC PWM Solenoid Circuit Fault	The PCM commands the solenoid "ON" and voltage remains high (B+) for two seconds OR The PCM commands the solenoid "OFF" and voltage remains low (zero volts) for two seconds.	• Inhibit TCC operation • Inhibit 4th gear operation
84 (1) 3-2 Control Solenoid Circuit Fault	At high duty cycle, the circuit voltage high -OR- at low duty cycle the circuit voltage is low for four seconds.	• Third gear only. • Soft landing to 3rd gear.
85 (1) TCC Stuck "ON" **90** (2) TCC Circuit Error	With gear selector in a drive range, transmission in 2nd, 3rd or 4th, TP Sensor greater than 25% and TCC unlocked - slip is between -20 and 20 RPM.	• TCC "ON" in all gears. • Early shifts.
90 (1) TCC Solenoid Circuit Fault	TCC is commanded on, but circuit is high -OR- TCC is commanded off but circuit voltage is low for two seconds.	• No TCC. • No fourth gear in hot mode.

(1) Not used on 3.4L F-Cars. (2) Used on 3.4L F-Cars only. SH0027-4L60-E-C

Figure 11 Trouble Code Diagnosis Chart B

4L60-E TRANSMISSION FLUID CHECKING PROCEDURE

1. Warm the transmission to operating temperature by driving the vehicle about 15 miles (24 km). Operating temperature is 180-200°F (82-94°C).
2. Park vehicle on a level surface, place shift lever in "P" park and apply the parking brake.
3. Check fluid level on the dipstick (read the lower level).
4. If fluid level is low, DEXRON®-III Automatic Transmissions Fluid is preferred, if unavailable DEXRON®-IIE is acceptable, add only enough to bring the fluid level into the hot area.

* It is important to check fluid level when the transmission has reached operating temperature. The hot range is calibrated to correspond to the correct fluid level range for fluid between 180 and 200°F (82-94°C).

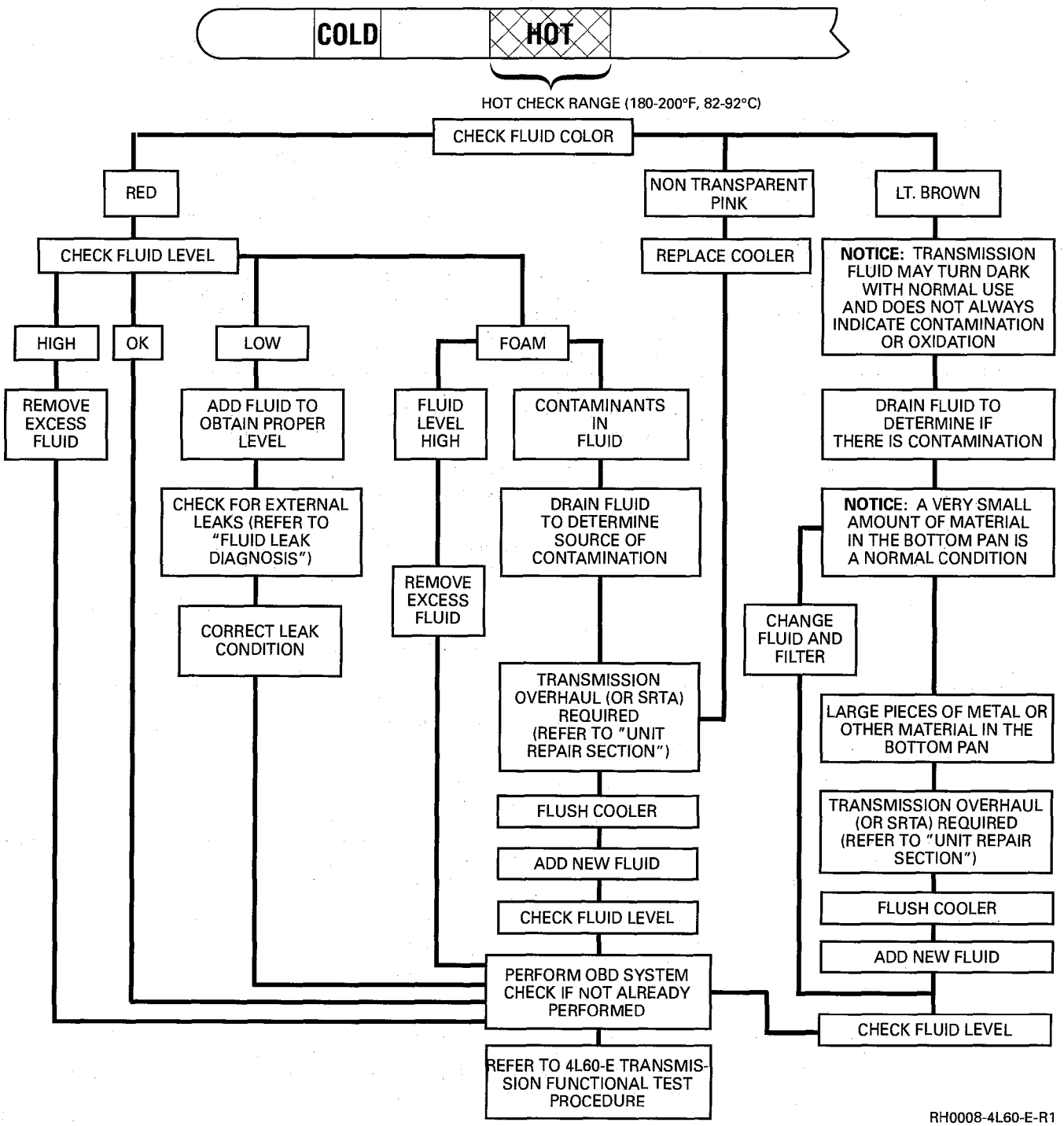


Figure 12 Fluid Checking Procedure

HYDRA-MATIC 4L60-E LINE PRESSURE CHECK PROCEDURE

Line pressures are calibrated for two sets of gear ranges – Drive-Park-Neutral and Reverse. This allows the transmission line pressure to be appropriate for different pressure needs in different gear ranges:

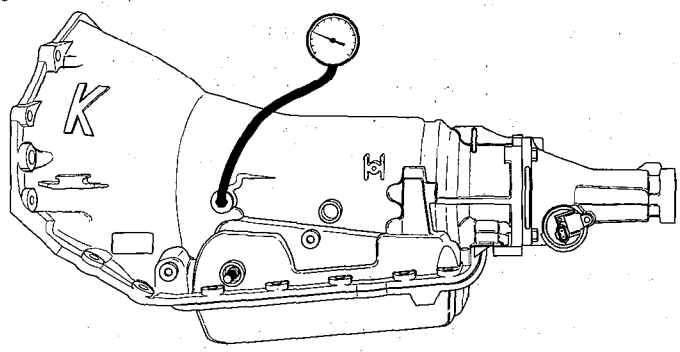
Gear Range	Line Pressure Range
Drive, Park or Neutral	55 - 189 PSI
Reverse	64 - 324 PSI

Before performing a line pressure check, verify that the pressure control solenoid is receiving the correct electrical signal from the PCM:

1. Install a scan tool.
2. Start the engine and set parking brake.
3. Check for a stored pressure control solenoid diagnostic trouble code, and other diagnostic trouble codes.
4. Repair vehicle if necessary.

   Inspect
   - Fluid level (see Section 7A)
   - Manual linkage

   Install or Connect
   - TECH 1 Scan tool
   - Oil pressure gage at line pressure tap



5. Put gear selector in Park and set the parking brake.
6. Start engine and allow it to warm up at idle.
7. Access the "PCS Control" test on the TECH 1 scan tool.
8. Increase DESIRED PCS in 0.1 Amp increments and read the corresponding line pressure on the pressure gage. (Allow pressure to stabilize for 5 seconds after each current change.)
9. Compare data to the Drive-Park-Neutral line pressure chart below.

***NOTICE** Total test running time should not exceed 2 minutes, or transmission damage could occur.

CAUTION Brakes must be applied at all times to prevent unexpected vehicle motion.

If pressure readings differ greatly from the line pressure chart, refer to the Diagnosis Charts contained in this section.

The TECH 1 scan tool is only able to control the pressure control solenoid in Park and Neutral with the vehicle stopped. This protects the clutches from extremely high or low pressures in Drive or Reverse ranges.

Pressure Control Solenoid Current (Amp)	Line Pressure (PSI)
0.02	170 - 190
0.10	165 - 185
0.20	160 - 180
0.30	155 - 175
0.40	148 - 168
0.50	140 - 160
0.60	130 - 145
0.70	110 - 130
0.80	90 - 115
0.90	65 - 90
0.98	55 - 65

Pressures at 1500 RPM and 66°C (150°F). Line pressure drops as temperature increases.

SH0010-4L60-E

Figure 13 Line Pressure Check Procedure

LINE PRESSURE CHECK PROCEDURE

This test can be performed during the hoist or road test. It is easier to check pressures during the hoist test because the tubing and pressure gage can remain outside of the vehicle, and won't be damaged by road conditions or debris. The technician can diagnose more quickly on the hoist since the driver doesn't have to watch the road.

The HYDRA-MATIC 4L60-E uses a vane type oil pump to produce hydraulic pressure, and a transmission pressure control solenoid (force motor) to control that pressure at the pressure regulator valve, after it leaves the pump. The transmission pressure control solenoid is controlled by an electrical signal that ranges from 0 to 1 amp. One amp corresponds to minimum line pressure (approx. 50 to 55 PSI not 0 PSI) and 0 amps corresponds to a maximum line pressure (approx. 265 to 290 PSI) in D. Refer to Figure 13 to perform line pressure test.

ELECTRICAL/GARAGE SHIFT TEST

This preliminary test should be performed before a hoist or road test to make sure electronic control inputs are connected and operating. If the inputs are not checked before operating the transmission, a simple electrical condition could be misdiagnosed as a major transmission condition.

A scan tool provides valuable information and must be used on the HYDRA-MATIC 4L60-E transmission for accurate diagnosis.

1. Move gear selector to "Park" (P) and set the parking brake.
2. Connect scan tool to DLC terminal.
3. Start engine.
4. Connect power to scan tool.
5. Verify that the following signals are present:
   - ENGINE SPEED
   - TRANS OUTPUT SPEED
   - VEHICLE SPEED
   - A/B/C RNG
   - PRNDL SELECT
   - DESIRED PCS
   - ACTUAL PCS
   - PCS DUTY CYCLE
   - BRAKE SWITCH
   - 4 WD LOW SWITCH (4WD Only)
   - ENG COOLANT TEMP
   - TRANS FLUID TEMP
   - THROTTLE ANGLE
   - SYSTEM VOLTS
6. Monitor the BRAKE SWITCH signal while tapping the brake pedal with your foot.
   - The BRAKE SWITCH should be on when the pedal is depressed, and come off when the brake pedal is released.
7. Monitor the PRNDL SELECT signal and move the gear selector through all the ranges.
   - Verify that the PRNDL SELECT value matches the gear range indicated on the instrument panel or console.
   - Gear selections should be immediate and not harsh.
8. Move gear selector to neutral and monitor the THROTTLE ANGLE signal while increasing and decreasing engine RPM with the accelerator pedal.
   - THROTTLE ANGLE should increase with engine RPM.

Upshift Control and Torque Converter Clutch (TCC) Apply

The PCM calculates upshift points based primarily on two inputs: THROTTLE ANGLE and VEHICLE SPEED. When the PCM says a shift should occur, an electrical signal is sent to the shift solenoids which in turn moves the valves to perform the upshift.

The shift speed charts reference THROTTLE ANGLE instead of "min throttle" or "wot" to make shift speed measurement more uniform and accurate. A scan tool should be used to monitor THROTTLE ANGLE. Some scan tools have been programmed to record shift point information. Check the instruction manual to see if this test is available.

With gear selector in D4:

1. Look at the shift speed chart contained in this section and choose a percent throttle angle of 15 or 20. (Figure 15.)
2. Set up the scan tool to monitor THROTTLE ANGLE and VEHICLE SPEED.
3. Accelerate to the chosen throttle angle and hold the throttle steady.
4. As the transmission upshifts, note the shift speed and commanded gear changes for:
   - 2nd gear.
   - 3rd gear.
   - 4th gear.

Important

- Shift speeds may vary due to slight hydraulic delays responding to electronic controls. A change from the original equipment tire size also affects shift speeds.

  Note when TCC applies. This should occur in third or fourth gear. If the apply is not noticed by an RPM drop, refer to the "Preliminary Torque Converter Clutch Diagnosis" information contained in this section.

  The TCC should not apply unless the **transmission** has reached a minimum operating temperature of 18°C TRAN TEMP and engine coolant temp of 60°C.

5. Repeat steps 1-4 using several different throttle angles.

Part Throttle Detent Downshift

At vehicle speeds of 64 to 88 km/h (40 to 55 mph) in fourth gear, quickly increase throttle angle.

Verify that:

- TCC releases.
- Transmission downshifts to 3rd gear immediately.
- 1-2 Shift Solenoid turns off.

Full Throttle Detent Downshift

At vehicle speeds of 64 to 88 km/h (40 to 55 mph) in fourth gear, quickly increase throttle angle to its maximum position.

Verify that:

- TCC releases.
- Transmission downshifts to 2nd gear immediately.
- 1-2 Shift Solenoid is off, 2-3 Shift Solenoid is on.

Manual Downshifts

The shift solenoids do not control the initial downshift during 4-3 and 3-2 manual downshifts. All manual downshifts are hydraulic except the 2-1. The solenoid states will change during, or shortly after a manual downshift is selected.

1. At vehicle speeds of 64 to 88 km/h (40 to 55 mph) in fourth gear, release the accelerator pedal while moving the gear selector to D3. Observe that:
   - TCC releases.
   - Transmission downshifts to 3rd gear immediately.
   - Engine slows vehicle down.
2. Move gear selector back to D4 and accelerate to 64 to 72 km/h (40 to 45 mph). Release the accelerator while moving the gear selector to D2 and observe that:
   - TCC releases.
   - Transmission downshifts to 2nd gear immediately.
   - Engine slows vehicle down.
3. Move gear selector back to D4 and accelerate to 48 km/h (30 mph). Release the accelerator pedal while moving the gear selector to D1 and observe that:
   - TCC releases.
   - Transmission downshifts to 1st gear immediately.
   - Engine slows vehicle down.

Coasting Downshifts

1. With the gear selector in D4, accelerate to 4th gear with TCC applied.
2. Release the accelerator pedal and lightly apply the brakes, and observe that:
   - TCC releases.
   - Downshifts occur at speeds shown on the shift speed chart.

Manual Gear Range Selection

Upshifts in the manual gear ranges are controlled by the shift solenoids.

Perform the following tests by accelerating at 10-15 degrees TP Sensor.

Manual Third (D3)

- With vehicle stopped, move the gear selector to D3 and accelerate to observe:
  - 1-2 shift.
  - 2-3 shift.

Manual Second (D2)

1. With vehicle stopped, move gear selector to D2 and accelerate to observe:
   - Transmission starts and remains in second gear.
2. Accelerate to 40 km/h (35 mph) and observe:
   - 2-3 shift does not occur.
   - TCC does not apply.

Manual First (D1)

- With vehicle stopped, move gear selector to D1. Accelerate to 32 km/h (20 mph) and observe:
  - No upshifts occur.
  - TCC does not apply.
  - Can upshift out of first at fuel cut-off.

Reverse (R)

- With vehicle stopped, move gear selector to R and slowly accelerate to observe:
  - 1-2 and 2-3 Shift Solenoids are on.

Use a scan tool to see if any transmission trouble codes have been set. Refer to "Trouble Code Diagnosis" in this section and repair the vehicle as directed. After repairing the vehicle, perform the hoist test and verify that the code has not set again.

If the transmission is not performing well and no trouble codes have been set, there may be an intermittent condition. Check all electrical connections for damage or a loose fit. Some scan tools have a snapshot test which can help catch an intermittent condition that doesn't occur long enough to set a code.

You may want to read "Electronic Component Diagnosis" in this section to become familiar with transmission conditions caused by transmission electrical malfunctions.

If no trouble codes have been set and the condition is suspected to be hydraulic, take the vehicle on a road test.

ROAD TEST PROCEDURE

- Perform the road test using a scan tool.
- This test should be performed when traffic and road conditions permit.
- Observe all traffic safety regulations.

1. Start engine.
2. Depress brake pedal.
3. Move gear selector from:
   - Park to Reverse.
   - Reverse to Neutral.
   - Neutral to D4.

Important

- Gear selections should be immediate and not harsh.

4. Perform the same test procedure as instructed previously in the road test:
   - Upshifts and TCC apply.
   - Part Throttle Detent Downshift.
   - Full Throttle Detent Downshift.
   - Manual Downshifts.
   - Coasting Downshifts.
   - Manual Gear Range Selection.

Use a scan tool to see if any transmission malfunction codes have been set. If so, perform transmission functional test. (Figure 8.) After repairing the vehicle, perform the road test and verify that no codes have been set again.

If no codes have been set and the condition remains, refer to the "Diagnosis Charts" contained in this section. If the condition is suspected to originate in the torque converter, refer to "Torque Converter Clutch (TCC) Diagnosis" later in this section.

TORQUE CONVERTER CLUTCH (TCC) DIAGNOSIS

To properly diagnose the Torque Converter Clutch (TCC) system, perform all electrical testing first and then the hydraulic testing.

The TCC is applied by fluid pressure which is controlled by a solenoid located inside the Automatic Transmission assembly. The solenoid is energized by completing an electrical circuit through a combination of switches and sensors.

Functional Check Procedure

Inspect

1. Install a tachometer or scan tool.
2. Operate the vehicle until proper operating temperature is reached.
3. Drive vehicle at 80 to 88 km/h (50 to 55 mph) with light throttle (road load).
4. Maintaining throttle, lightly touch the brake pedal and check for release of the TCC and a slight increase in engine speed (RPM).
5. Release the brake, slowly accelerate and check for a re-apply of the converter clutch and a slight decrease in engine speed (RPM).

TORQUE CONVERTER EVALUATION

Torque Converter Stator

The torque converter stator roller clutch can have one of two different type **malfunctions**:

A. Stator assembly freewheels in both directions.
B. Stator assembly remains locked up at all times.

Condition A-Poor Acceleration Low Speed

The car tends to have poor acceleration from a standstill. At speeds above 50 to 55 km/h (30 to 35 mph), the car may act normal. If poor acceleration is noted, it should first be determined that the exhaust system is not blocked, and the transmission is in first (1st) gear when starting out.

If the engine freely accelerates to high RPM in "NEUTRAL" (N), it can be assumed that the engine and exhaust system are normal. Checking for poor performance in "Drive" and "Reverse" will help determine if the stator is freewheeling at all times.

Condition B-Poor Acceleration High Speed

Engine RPM and car speed limited or restricted at high speeds. Performance when accelerating from a standstill is normal. Engine may over-heat. Visual examination of the converter may reveal a blue color from over-heating.

If the converter has been removed, the stator roller clutch can be checked by inserting two fingers into the splined inner race of the roller clutch and trying to turn the race in both directions. The inner race should turn freely clockwise, but not turn or be very difficult to turn counterclockwise.

Noise

Torque converter whine is usually noticed when the vehicle is stopped and the transmission is in "Drive" or "Reverse". The noise will increase when engine RPM is increased. The noise will stop when the vehicle is moving or when the torque converter clutch is applied because both halves of the converter are turning at the same speed.

Perform a stall test to make sure the noise is actually coming from the converter:

1. Place foot on brake.
2. Put gear selector in "Drive".
3. Depress accelerator to approximately 1200 RPM for no more than six seconds.

NOTICE: If the accelerator is depressed for more than six seconds, damage to the transmission may occur.

A torque converter noise will increase under this load.

Important

- This noise should not be confused with pump whine noise which is usually noticeable in "Park", "Neutral" and all other gear ranges. Pump whine will vary with pressure ranges.

The torque converter should be replaced under any of the following conditions:

- External leaks in the hub weld area.
- Converter hub is scored or damaged.
- Converter pilot is broken, damaged or fits poorly into crankshaft.
- Steel particles are found after flushing the cooler and cooler lines.
- Pump is damaged or steel particles are found in the converter.
- Vehicle has TCC shudder and/or no TCC apply. Replace only after all hydraulic and electrical diagnoses have been made. (Converter clutch material may be glazed.)
- Converter has an imbalance which cannot be corrected. (Refer to Converter Vibration Test Procedure.)
- Converter is contaminated with engine coolant containing antifreeze.
- Internal failure of stator roller clutch.
- Excess end play.
- Heavy clutch debris due to overheating (blue converter).
- Steel particles or clutch lining material found in fluid filter or on magnet when no internal parts in unit are worn or damaged – indicates that lining material came from converter.

The Torque Converter Should Not Be Replaced If:

- The oil has an odor, is discolored, and there is no evidence of metal or clutch facing particles.
- The threads in one or more of the converter bolt holes are damaged.
  - Correct with thread insert. (Refer to SECTION 6A.)
- Transmission failure did not display evidence of damage or worn internal parts, steel particles or clutch plate lining material in unit and inside the fluid filter.
- Vehicle has been exposed to high mileage (only). The exception may be where the torque converter clutch damper plate lining has seen excess wear by vehicles operated in heavy and/or constant traffic, such as taxi, delivery or police use.

TCC SHUDDER

The key to diagnosing Torque Converter Clutch (TCC) shudder is to note when it happens and under what conditions.

TCC Shudder should only occur during the APPLY and/or RELEASE of the converter clutch; SELDOM after the TCC plate is fully applied.

While TCC Is Applying Or Releasing:

If the shudder occurs while TCC is applying, the problem can be within the transmission or torque converter. Something is not allowing the clutch to become fully engaged, not allowing clutch to release, or is trying to release and apply the clutch at the same time. This could be caused by leaking turbine shaft seals, a restricted release orifice, a distorted clutch or housing surface due to long converter bolts, or defective friction material on the TCC plate.

Shudder Occurs After TCC Has Applied:

In this case, most of the time there is nothing wrong with the transmission! As mentioned above, once the TCC has been applied, it is very unlikely that it will slip. Engine problems may go unnoticed under light throttle and load, but become noticeable after TCC apply when going up a hill or accelerating, due to the mechanical coupling between engine and transmission.

REMEMBER: Once TCC is applied there is no torque converter (fluid coupling) assistance. Engine or driveline vibrations could be unnoticeable before TCC engagement.

Inspect the following components to avoid misdiagnosis of TCC Shudder and possibly disassembling a transmission and/or replacing a torque converter unnecessarily:

- Spark plugs – Inspect for cracks, high resistance or broken insulator.
- Plug wires – Look in each end. If there is red dust (ozone) or black substance (carbon) present, then the wires are bad. Also look for a white discoloration of the wire indicating arcing during hard acceleration.
- Distributor cap and rotor – Look for broken or uncrimped parts.
- Coil – Look for black on bottom indication arcing while engine is misfiring.
- Fuel injector – Filter may be plugged.
- Vacuum leak – Engine won't get correct amount of fuel. May run rich or lean depending on where the leak is.
- EGR valve – Valve may let in too much unburnable exhaust gas and cause engine to run lean.
- MAP/MAF sensor – Like vacuum leak, engine won't get correct amount of fuel for proper engine operation.
- Carbon on intake valves – Restricts proper flow or air/fuel mixture into cylinders.
- Flat cam – Valves don't open enough to let proper fuel/air mixture into cylinders.
- Oxygen sensor – May command engine too rich or too lean for too long.
- Fuel pressure – May be too low.
- Engine mounts – Vibration of mounts can be multiplied by TCC engagement.
- Axle joints – Check for vibration.
- TPS – TCC apply and release depends on TPS in many engines. If TPS is out of specification, TCC may remain applied during initial engine crowd.
- Cylinder balance – Bad piston rings or poorly sealing valves can cause low power in a cylinder.
- Fuel contamination – Causes poor engine performance.

FLEXPLATE/TORQUE CONVERTER VIBRATION TEST PROCEDURE

- Start engine.
- With engine at idle speed and transmission in "Park" (P) or "Neutral" (N), observe vibration.
- Key off.

Remove or Disconnect

1. Flexplate shield attaching bolts.
2. Flexplate to torque converter attaching bolts.
3. Rotate torque converter 120 degrees (1/3 turn).

Install or Connect

1. Flexplate to torque converter attaching bolts.

   Tighten

   - Bolts to 62 N•m (46 lb. ft.)
2. Flexplate shield attaching bolts.

- Start engine and check for vibration. Repeat procedure until best possible balance is obtained.

TECH 1 PARAMETER	IN PARK AT IDLE	
ENGINE SPEED	550-750 RPM	
TRANS OUTPUT SPD	0 RPM	(1)
ENG COOL TEMP	85°C - 105°C	(5)
TRANS FLUID TEMP	30°C - 130°C	(5)
THROT POSITION	.4 - .6 V	
THROTTLE ANGLE	0%	
A/B/C RNG	OFF ON OFF	
TRANS RANGE SW.	Park/Neutral	
COMMANDED GEAR	1	
ADAPTABLE SHIFT	NO	(3)
1-2 SOL / 2-3 SOL	ON ON	
CTR FDBK 1/2 2/3	ON ON	(4)
3-2 CONTROL SOL	0%	
3-2 CONTROL FDBK	OFF	
HOT MODE	NO	
TCC SLIP RPM	600-750	
TCC SOLENOID	OFF	
CTR FDBK TCC	OFF	(4)
DESIRED PCS	1.01	
ACTUAL PCS	1.01	
PCS DUTY CYCLE	40 - 60%	
VEHICLE SPEED	0	
4WD LOW SWITCH	OFF	
CRUISE ENGAGED	OFF	
TCC BRAKE SWITCH	Released	
KICKDOWN ENABLED	NO	
1-2 SHIFT TIME	.3 - 1.35 Sec.	(2)(3)
1-2 SHIFT ERROR	0 - 6.25 Sec.	(2)(3)
2-3 SHIFT TIME	.3 - 1.35 Sec.	(2)(3)
CURR. ADAPT CELL	N/A < 25% TP	
TRANS CALIB ID	Internal ID Only	
SYSTEM VOLTS	13.6	
PRESS ADAPT 25% TP	–5 - 10	
PRESS ADPT 40% TP	–5 - 10	
PRESS ADPT 70% TP	–5 - 10	
CURR. ADAPT PSI	-5 - 10	

1. There may be a small speed reading due to vehicle vibration.
2. Zero until a shift occurs.
3. 'Yes' means the shift time is an accurate and valid number. (If shift was adaptable.)
   If shift was adaptable, 'No' indicates the shift time is not accurate for one or more of the following reasons:
   - Transmission is in D2 or D1
   - There is a long shift delay
   - There is a long shift time
   - There has been a significant throttle angle change
   - Transmission is in hot mode
   - A shift starts too soon after the solenoids change states
   - Diagnostic codes are set (21, 22, 24, 28, 53, 58, 59, 72, 73, 75, 79, 81 or 82)
   - There has been a significant vehicle speed change
   - 4WD lo switch is on
4. Should match commanded solenoid state.
5. Normal operating temperature.

RH0065-4L60-E

Figure 14 Typical TECH 1 Data Values

1995 HYDRA-MATIC 4L60-E SHIFT SPEED CHART

ENGINE	BODY	AXLE RATIO	1-2 SHIFT +/- 250 RPM TPS			2-3 SHIFT +/- 200 RPM TPS			3-4 SHIFT +/- 150 RPM TPS			3-2 +/- 100 RPM	2-1 +/- 100 RPM	1-2 WOT	2-3 WOT
2.2L			10	25	50	10	25	50	10	25	50				
(LM2)	S	4.10	596	795	1143	1043	1441	2137	1491	1988	3280	3081	1491	1689	3230

ENGINE	BODY	AXLE RATIO	1-2 SHIFT +/- 250 RPM TPS			2-3 SHIFT +/- 200 RPM TPS			3-4 SHIFT +/- 150 RPM TPS			3-2 +/- 100 RPM	2-1 +/- 100 RPM	1-2 WOT	2-3 WOT
			10	25	50	10	25	50	10	25	50				
4.3L (L35)	S/T	3.08/3.42	566	828	915	1090	1526	1787	1438	1918	2659	2441	1220	1526	2921
	M/L	3.42/3.73	566	828	915	1090	1526	1787	1438	1918	2659	2441	1220	1526	2921
4.3L (LB4)	G	3.42/3.73	479	654	959	872	1264	1918	1395	1831	2572	2267	1220	1351	2528
	C/K	3.08/3.42	479	654	959	959	1264	1918	1395	1831	2572	2267	1220	1351	2528
	C/K	3.73/4.10	523	697	784	1002	1351	1613	1395	1831	2572	2049	1220	1351	2528
	M	3.23	479	654	959	959	1526	1918	1395	1831	2572	2267	1220	1351	2528
	M	3.42	523	784	1046	915	1438	1962	1395	1918	2659	2049	1220	1351	2528
	S/T	3.08/3.42	479	654	959	915	1526	1918	1395	1831	2572	2267	1220	1351	2528

ENGINE	BODY	AXLE RATIO	1-2 SHIFT +/- 250 RPM TPS			2-3 SHIFT +/- 200 RPM TPS			3-4 SHIFT +/- 150 RPM TPS			3-2 +/- 100 RPM	2-1 +/- 100 RPM	1-2 WOT	2-3 WOT
			10	25	50	10	25	50	10	25	50				
5.0L (L03)	C10/G10/G20	3.08	481	666	851	777	1184	1591	1184	1665	2479	2035	962	1258	2368
	C20/K10/K20	3.42													
	C10/G10/G20	3.42	529	773	936	814	1302	1750	1221	1668	2482	2035	976	1261	2360
	C20/K10/K20	3.73													
	G20	3.73	536	849	938	894	1385	1788	1251	1698	2503	2011	983	1251	2369
	C20/K10/K20	4.10													

ENGINE	BODY	AXLE RATIO	1-2 SHIFT +/- 250 RPM TPS			2-3 SHIFT +/- 200 RPM TPS			3-4 SHIFT +/- 150 RPM TPS			3-2 +/- 100 RPM	2-1 +/- 100 RPM	1-2 WOT	2-3 WOT
			10	25	50	10	25	50	10	25	50				
5.7L (L05)	C10/G10/G20	3.08	444	629	851	777	1184	1591	1184	1628	2479	2035	962	1295	2368
	C20/K10/K20	3.42													
	C10/G10/G20	3.42	447	691	936	814	1302	1709	1221	1668	2482	2035	976	1261	2360
	C20/K10/K20	3.73													
	C10/G20	3.73	491	759	938	894	1385	1788	1251	1698	2503	2011	983	1251	2369
	C20/K20	4.10													

ENGINE	BODY	AXLE RATIO	1-2 SHIFT +/- 250 RPM TPS			2-3 SHIFT +/- 200 RPM TPS			3-4 SHIFT +/- 150 RPM TPS			3-2 +/- 100 RPM	2-1 +/- 100 RPM	1-2 WOT	2-3 WOT
		TPS	10	25	50	10	25	50	10	25	50				
6.5L (DIESEL)	G	3.42	370	534	822	698	1068	1644	1315	1561	2096	1767	945	1191	1931
	G	3.08	370	518	814	703	1073	1665	1295	1554	2109	1776	962	1147	1924
	C10	3.42	370	534	822	698	1068	1644	1315	1561	2096	2013	945	1191	2260
	C20/K	3.73													
	C10	3.08	370	518	814	703	1036	1665	1295	1517	2109	2035	962	1147	2257
	C20/K	3.42													
	G	3.73	358	537	806	716	1075	1657	1299	1568	2105	1792	940	1164	1926

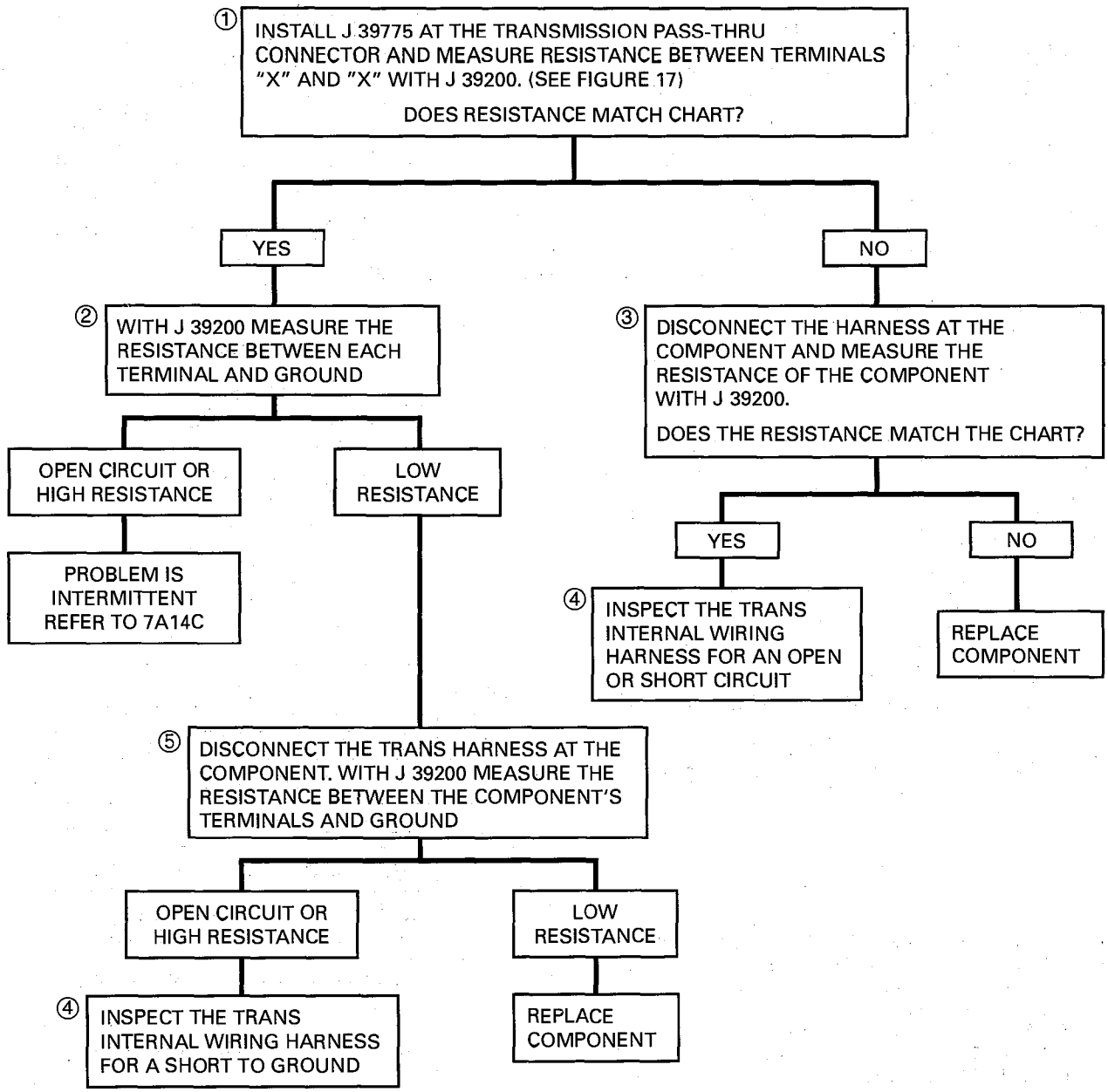
1. ALL SPEEDS ARE GIVEN IN TRANSMISSION OUTPUT SHAFT RPM
2. SPEEDS ARE BASED ON PERCENT THROTTLE POSITION SENSOR (TPS) DATA
3. USE A TECH 1 OR OTHER SCAN TOOL TO MONITOR THIS DATA
4. ALL SHIFT SPEEDS ARE APPROXIMATE

SH0009-4L60-E

Figure 15 1995 4L60-E Shift Speed Chart

NOTE: This procedure cannot be used on the pressure switch assembly. See figure 19.

4L60-E TRANSMISSION INTERNAL WIRING HARNESS CHECK



① This test measures the resistance of the component at the transmission pass-thru connector.

② This test checks for a short to ground in the internal wiring harness or component.

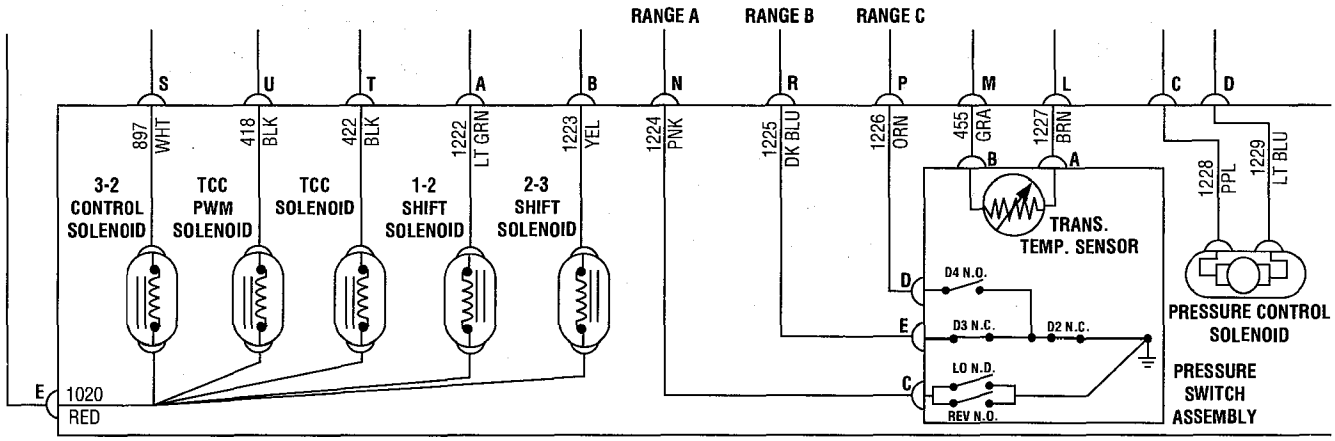
③ This test measures the resistance of the component.

④ Check the internal wiring harness for continuity, pinched wires and corrosion.

⑤ This test checks for a short to ground in the component (cannot be used on TCC solenoid).

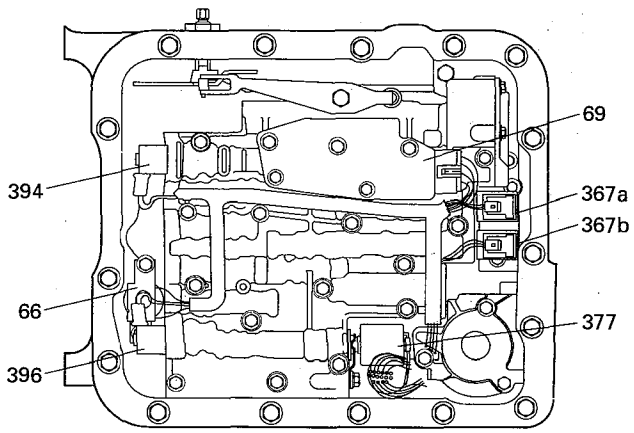
SH0217-4L60-E

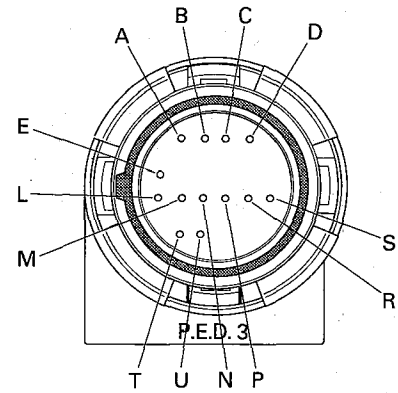
Figure 16 Internal Wiring Harness Check



INTERNAL TRANSMISSION WIRING HARNESS

N.C. = NORMALLY CLOSED SWITCH
N.O. = NORMALLY OPEN SWITCH





CAVITY	FUNCTION
A	1-2 SHIFT SOLENOID (LOW)
B	2-3 SHIFT SOLENOID (LOW)
C	PRESSURE CONTROL SOLENOID (HIGH)
D	PRESSURE CONTROL SOLENOID (LOW)
E	BOTH SHIFT SOLENOIDS, TCC SOLENOID, AND 3-2 CONTROL SOLENOID (HIGH)
L	TRANSMISSION FLUID TEMPERATURE (HIGH)
M	TRANSMISSION FLUID TEMPERATURE (LOW)
N	RANGE SIGNAL "A"
P	RANGE SIGNAL "C"
R	RANGE SIGNAL "B"
S	3-2 CONTROL SOLENOID (LOW)
T	TCC SOLENOID (LOW)
U	TCC PWM SOLENOID

66 SOLENOID ASSEMBLY, WIRING HARNESS AND
69 SWITCH ASSEMBLY, TRANSMISSION PRESSURE
367a 1-2 SHIFT SOLENOID
367b 2-3 SHIFT SOLENOID
377 PRESSURE CONTROL SOLENOID
394 3-2 CONTROL SOLENOID
396 TCC CONTROL SOLENOID

SH0028-4L60-E

Figure 17 Wiring Diagram

4L60-E COMPONENT RESISTANCE CHART

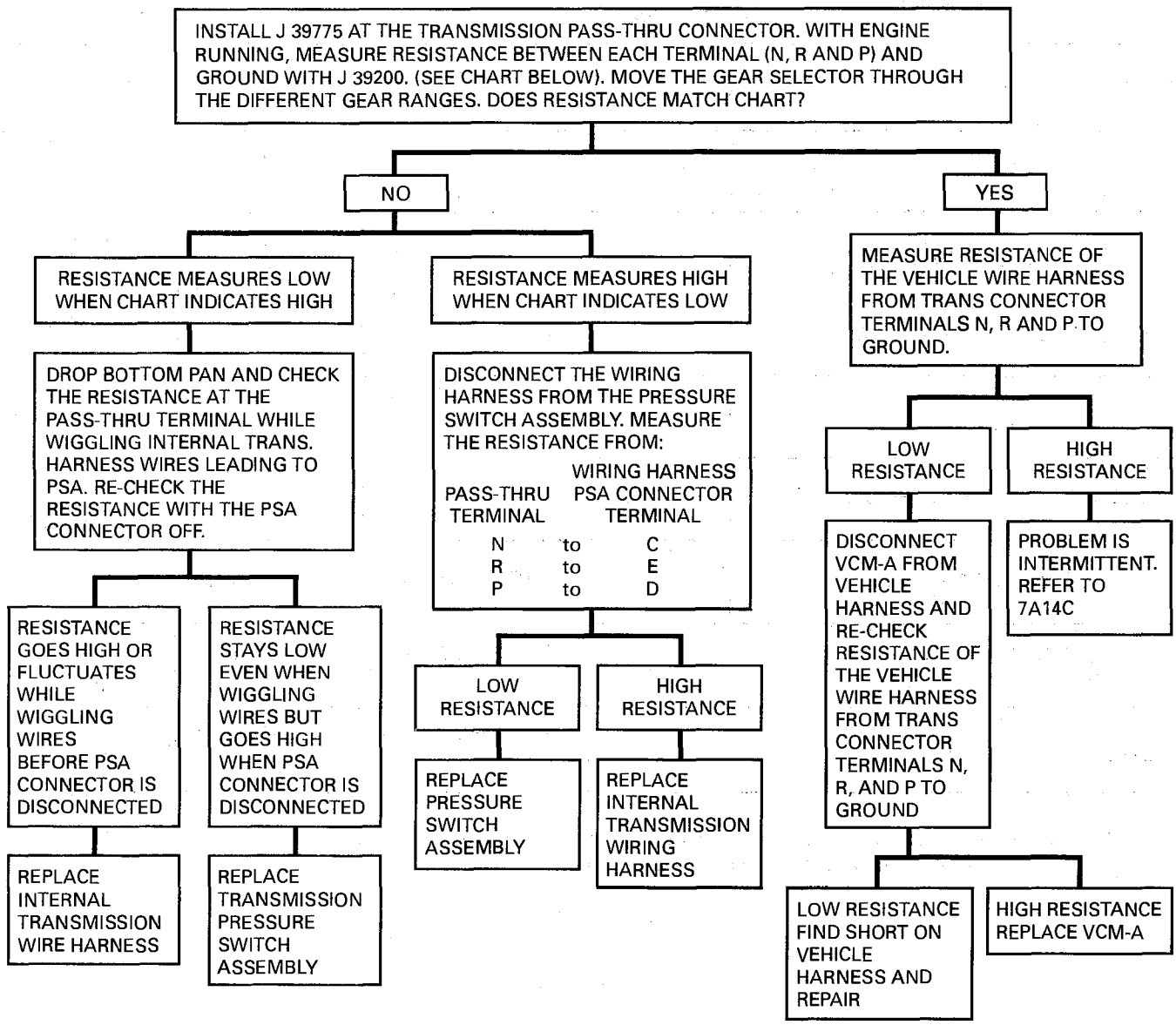
COMPONENT	PASS THRU PINS	RES 20° C	RES 100° C	RES TO GND (CASE)
SHIFT SOLENOID A	A, E	19-24 Ω	24-31 Ω	Less than 250 K Ω
SHIFT SOLENOID B	B, E	19-24 Ω	24-31 Ω	Less than 250 K Ω
TCC ENABLE SOLENOID (ON/OFF)	T, E	21-26 Ω	26-33 Ω	Less than 250 K Ω
TCC CONTROL PWM SOLENOID	U, E	10-11 Ω	3-15 Ω	Less than 250 K Ω
3-2 CONTROL PWM SOLENOID	S, E	10-11 Ω	13-15 Ω	Less than 250 K Ω
PRESSURE CONTROL SOLENOID	C, D	3-5 Ω	4-7 Ω	Less than 250 K Ω
PRESSURE SWITCH ASSEMBLY	**SEE PSA DIAGNOSTIC CHECK**			
* TRANSMISSION FLUID TEMPERATURE SENSOR	M, L	3088-3942 Ω	159.3-198 Ω	Less than 10 M Ω
VEHICLE SPEED SENSOR	A, B VSS CONN	1150-1250 Ω	1725-1825 Ω	Less than 10 M Ω

* NOTE: The resistance of this device is necessarily temperature dependant and will therefore vary far more than any other device.

SH0218-4L60-E

Figure 18 Component Resistance Chart

4L60-E TRANSMISSION PRESSURE SWITCH ASSEMBLY RESISTANCE CHECK



Pressure Switch Assembly (PSA) Resistance Chart
NOTE:Engine must be running

Gear Selector Position	Range		
	A	B	C
PARK	H	L	H
REVERSE	L	L	H
NEUTRAL	H	L	H
D4	H	L	L
D3	H	H	L
D2	H	H	H
D1	L	H	H

When range "X" is measured for resistance to ground,
H = High resistance (over 50K Ohms) - open circuit
L = Low resistance (under 200 Ohms) - grounded circuit

IMPORTANT:

Whenever the transmission pass-thru connector is disconnected from the vehicle harness and the engine is running, multiple transmission Diagnostic Trouble Codes will set. Be sure to clear these codes when finished with this procedure.

SH0219-4L60-E

Figure 19 Pressure Switch Assembly Resistance Check

HYDRA-MATIC 4L60-E ELECTRONIC COMPONENT MALFUNCTIONS

This chart gives some general information about electronic component malfunctions. Use this information to become familiar with possible conditions caused by transmission/vehicle electrical components. Refer to the diagnosis charts for more specific information.

COMPONENT/SYSTEM	CAN EFFECT
Throttle Position Sensor	– Shift pattern (erratic). – Shift quality (firm or soft). – Engine (rough).
Output Speed Sensor	– Shift pattern (erratic). – TCC apply (at wrong time). – Shift quality (harsh or soft).
Pressure Switch Assembly	– TCC apply (no apply if diagnostic code is set). – Shift pattern (no fourth gear in hot mode). – Shift quality (harsh). – Line pressure (high). – Manual downshift (erratic).
Transmission Fluid Temperature Sensor	– TCC control (on or off). – Shift quality (harsh or soft).
Engine Coolant Temperature Sensor	– TCC control (no apply). – Shift quality (harsh).
Shift Solenoids	– Gear application (wrong gear, only two gears, no shift).
Brake Switch	– TCC apply (no apply). – No 4th gear if in hot mode.
System Voltage	– Line pressure (high). – Gear application (third gear only). – TCC control (no apply). – No 4th gear if in hot mode.
3-2 Control Solenoid	– Gear application (third gear only). – 3-2 downshifts (flare or tie-up).
Pressure Control Solenoid	– Line pressure (high or low). – Shift quality (harsh or soft).
TCC Solenoid	– TCC apply (no apply). – No 4th gear if in hot mode.
4WD Low Switch	– Incorrect shift pattern.

SH0007-4L60-E

Figure 20 Component Malfunctions

HYDRA-MATIC 4L60-E ELECTRONIC COMPONENT MALFUNCTIONS (continued)

COMPONENT/SYSTEM	CAN EFFECT
Cruise Control	– Delays 3-4 upshift and TCC apply during heavy throttle
Acceleration Slip Regulation (ASR) (Y-car only)	– Downshift
2nd Gear Start Switch (Second) (V6 Pontiac F-car only)	– 2nd Gear starts
Manual Switch (V8 Pontiac F-car only)	– Shift pattern
Performance Switch (V8 Pontiac F-car only)	– Shift quality – Shift pattern

RH0221-4L60-E

Figure 21 Component Malfunctions

CONDITION	INSPECT COMPONENT	FOR CAUSE
OIL PRESSURE HIGH OR LOW (Verify With Gage – Refer To Line Pressure Check Procedure)	• Oil Pump Assembly (4)	– Pressure regulator valve (216) stuck. – Pressure regulator valve spring (217). – Rotor guide (211) omitted or misassembled. – Rotor (212) cracked or broken. – Reverse boost valve (219) or sleeve (220) stuck, damaged or incorrectly assembled. – Orifice hole in pressure regulator valve (217) plugged. – Sticking slide (203) or excessive rotor clearance. – Pressure relief ball (228) not seated or damaged. – Porosity in pump cover or body. – Wrong pump cover. – Pump faces not flat. – Excessive rotor clearance.
	• Oil Filter (72)	– Intake pipe restricted by casting flash. – Cracks in filter body or intake pipe. – O-ring seal (71) missing, cut or damaged. – Wrong grease used on rebuild.
	• Valve Body (60)	– Manual valve (340) scored or damaged. – Spacer plate (48) or gaskets (47 and 52) incorrect, misassembled or damaged. – Face not flat. – 2-3 Shift valve (369) stuck. – Checkballs omitted or misassembled.
	• Pressure Control Solenoid (377)	– Damage to pins.
	• System Voltage	
	• Pressure Switch Assembly (69)	– Contamination. – Damaged seals.
	• Case (8)	– Case to valve body face not flat.
	• Possible Codes: - 24 Vehicle Speed Sensor Signal Low - 52 Long System Voltage High - 53 System Voltage High - 72 Vehicle Speed Sensor Loss - 73 Pressure Control Solenoid Current - 75 System Voltage Low - 81 2-3 Shift Solenoid Circuit Fault - 82 1-2 Shift Solenoid Circuit Fault	
HARSH SHIFTS	• Possible Codes: - 21 Throttle Position Sensor Circuit (High) - 22 Throttle Position Sensor Circuit (Low) - 73 Pressure Control Solenoid Current	

ALL ILLUSTRATION NUMBERS REFERENCE HYDRA-MATIC 4L60-E UNIT REPAIR SECTION

SH0013-4L60-E

Figure 22 Diagnosis Chart A

CONDITION	INSPECT COMPONENT	FOR CAUSE
HARSH SHIFTS (Continued)	• Throttle Position Sensor	– Open or shorted circuit.
	• Vehicle Speed Sensor (36)	– Open or shorted circuit.
	• Pressure Switch Assembly (69)	– Contamination. – Damaged seals.
	• Trans Fluid Temperature Sensor (69)	– Open or shorted circuit.
	• Engine Coolant Temperature Sensor	– Open or shorted circuit.
	• Pressure Control Solenoid (377)	– Damage to pins. – Contamination.
INACCURATE SHIFT POINTS	• Oil Pump Assembly (4)	– Stuck pressure regulator valve (216). – Sticking pump slide (203).
	• Valve Body Assembly (60)	– Spacer plate (48) or gaskets (47 and 52) misassembled, damaged or incorrect.
	• Case (8)	– Porous or damaged valve body pad. – 2-4 Servo Assembly (12-29) a. 2-4 accumulator porosity. b. Damaged servo piston seals. c. Apply pin damaged or improper length. – 2-4 Band Assembly (602). a. Burned. b. Anchor pin not engaged.
	• Throttle Position Sensor	– Disconnected. – Damage.
	• Vehicle Speed Sensor (36)	– Disconnected. – Damaged. – Bolt not tightened.
	• 4WD Low Switch	– Disconnected. – Damaged.
EARLY SHIFTS	• Possible Codes: - 69 TCC Stuck "ON"	
FIXED SHIFT POINTS	• Possible Codes: - 21 Throttle Position Sensor Circuit (High) - 22 Throttle Position Sensor Circuit (Low)	
1ST GEAR RANGE ONLY – NO UPSHIFT	• Valve Body (60)	– 1-2 Shift valve (366) sticking. – Spacer plate (48) or gaskets (47 and 52) mispositioned or damaged.
	• Case (8)	– Case to valve body face not flat or damaged.
	• Shift Solenoids (379)	– Stuck or damaged. – Electrical connection.
	• 2-4 Servo Assembly (12-29)	– Restricted or blocked apply passages case. – Nicks or burrs on servo pin (13) or pin bore in case – 4th Servo piston (25) in backwards.

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SH0014-4L60-E

Figure 23 Diagnosis Chart B

CONDITION	INSPECT COMPONENT	FOR CAUSE
1ST GEAR RANGE ONLY – NO UPSHIFTS (Continued)	• 2-4 Band Assembly (602)	– 2-4 Band (602) worn or damaged. – Band anchor pin not engaged.
SLIPS IN 1ST GEAR	• Forward Clutch Assembly	– Clutch plates (649) worn. – Porosity or damage in forward clutch piston (630). – Forward clutch piston inner and outer seals (629) missing, cut or damaged. – Input housing to forward clutch housing O-ring seal (622) missing, cut or damaged. – Damaged forward clutch housing (628). – Forward clutch housing retainer and ball assembly (627) not sealing or damaged.
	• Forward Clutch Accumulator	– Piston seal (353) missing, cut or damaged. – Piston (354) out of its bore. – Porosity in the piston or valve body (350). – Stuck abuse valve (357).
	• Input Housing and Shaft Assembly (621)	– Turbine shaft seals (619) missing, cut or damaged.
	• Valve Body (60)	– 1-2 Accumulator valve (371) stuck. – Face not flat, damaged lands or interconnected passages. – Spacer plate (48) or gaskets (47 and 52) incorrect, mispositioned or damaged.
	• Low Roller Clutch (678)	– Damage to lugs or inner ramps. – Rollers not free moving. – Inadequate spring tension. – Damage to inner splines. – Lube passage plugged.
	• Torque Converter (1)	– Stator roller clutch not holding.
	• 1-2 Accumulator Assembly (54-59)	– Porosity in piston (56) or 1-2 Accumulator cover and pin assembly (57). – Damaged ring grooves on piston. – Piston seal (55) missing, cut or damaged. – Valve body to spacer plate gasket (52) at 1-2 Accumulator cover, missing or damaged. – Leak between piston and pin. – Broken 1-2 Accumulator spring (54).
	• Line Pressure	– (See Causes of High or Low Oil Pressure.)
	• 2-4 Servo Assembly (12-29)	– 4th Servo piston (25) in backwards.

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PH0015-4L60-E

Figure 24 Diagnosis Chart C

CONDITION	INSPECT COMPONENT	FOR CAUSE
SLIPPING OR ROUGH 1-2 SHIFT	• Valve Body Assembly (60)	– 1-2 Shift valve train (365-366) stuck. – Gaskets (47 and 52) or spacer plate (48) incorrect, mispositioned or damaged. – 1-2 Accumulator valve (371) stuck. – Face not flat.
	• 2-4 Servo Assembly (12-29)	– Apply pin (13) too long or too short. – 2nd servo apply piston seal missing, cut or damaged. – Restricted or missing oil passages. – Servo bore in case damaged.
	• 2nd Accumulator (54-59)	– Porosity in 1-2 accumulator housing (57) or piston (56). – Piston seal or groove damaged. – Nicks or burrs in 1-2 accumulator housing. – Missing or restricted oil passage.
	• 2-4 Band (602)	– Worn or mispositioned.
	• Oil Pump Assembly (4) or Case (8)	– Faces not flat.
NO 2-3 SHIFT OR 2-3 SHIFT SLIPPING, ROUGH OR HUNTING	• Converter (1)	– Internal damage.
	• Oil Pump (4)	– Stator shaft (214) sleeve scored or off location.
	• Valve Body (60)	– 2-3 Valve train (268-269) stuck. – Accumulator valve (371) stuck. – Spacer plate (48) or gaskets (47 and 52) incorrect, mispositioned or damaged.
	• Input Housing Assembly (621)	– Clutch plates worn [3-4 (654) or forward (649)]. – Excessive clutch plate travel. – Cut or damaged piston seals [3-4 (624) or forward (629)]. – Porosity in input clutch housing (621) or piston (623). – 3-4 Piston checkball (620) stuck, damaged or not sealing. – Restricted apply passages. – Forward clutch piston retainer and ball assembly (627) not seating. – Sealing balls loose or missing.
	• Case (8)	– 3rd Accumulator retainer and ball assembly not seating.
	• 2-4 Servo Assembly (12-29)	– 2nd Apply piston seals (18 and 19) missing, cut or damaged.
	• Possible Codes: - 24 Vehicle Speed Sensor Signal Low - 72 Vehicle Speed Sensor Loss	

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PH0016-4L60-E

Figure 25 Diagnosis Chart D

CONDITION	INSPECT COMPONENT	FOR CAUSE
2ND AND 3RD GEARS ONLY OR 1ST AND 4TH GEARS ONLY	• Possible Codes: - 82 1-2 Shift Solenoid Circuit Fault	
	• Shift Solenoids (379)	– Sediment. – Electrical Connection. – Damaged seal.
THIRD GEAR ONLY	• Possible Codes: - 52 Long System Voltage High - 53 System Voltage High - 66 3-2 Control Solenoid Circuit Fault - 75 System Voltage Low - 81 2-3 Shift Solenoid Circuit Fault	
	• System Voltage	
	• 3-2 Control Solenoid (394)	
3-2 FLARE OR TIE-UP	• 3-2 Control Solenoid (394)	– Shorted or damaged. – Contamination. – Damaged seal.
NO 3-4 SHIFT/SLIPPING OR ROUGH 3-4 SHIFT	• Oil Pump Assembly (4)	Faces not flat. – Pump cover retainer and ball assembly omitted or damaged.
	• Valve Body Assembly (60)	– Valves stuck. • 2-3 Shift valve (368-369) train. • Accumulator valve (371). • 1-2 Shift valve train (365-366). • 3-2 Control valve (391). – Spacer plate (48) or gaskets (47 and 52) incorrect, mispositioned or damaged.
	• 2-4 Servo Assembly (12-29)	– Incorrect band apply pin (13). – Missing or damaged servo seals (26 and 27). – Porosity in pistons, cover or case. – Damaged piston seal grooves. – Plugged or missing orifice cup plug (11).
	• Case (8)	– 3rd Accumulator retainer and ball assembly leaking. – Porosity in 3-4 accumulator piston (44) or bore. – 3-4 Accumulator piston seal (45) or seal grooves damaged. – Plugged or missing orifice cup plug. – Restricted oil passage.
	• Input Housing Assembly (621)	– Refer to Slipping 2-3 Shift.
	• 2-4 Band Assembly (602)	– Worn or misassembled.

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PH0017-4L60-E-R1

Figure 26 Diagnosis Chart E

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO 3-4 SHIFT/SLIPPING OR ROUGH 3-4 SHIFT (Continued)	• Possible Codes: - 21 Throttle Position Sensor Circuit (High) - 22 Throttle Position Sensor Circuit (Low) - 28 Fluid Pressure Switch Assembly Fault - 37 Brake Switch Stuck "ON" - 38 Brake Switch Stuck "OFF" - 67 TCC Solenoid Circuit Fault	
[R] NO REVERSE OR SLIPS IN REVERSE	• Input Housing Assembly (621)	– 3-4 Apply ring (625) stuck in applied position. – Forward clutch not releasing. – Turbine shaft seals (619) missing, cut or damaged.
	• Manual Valve Link (705)	– Disconnected.
	• Oil Pump Assembly (4)	– Retainer and ball assembly missing or damaged. – Stator shaft seal rings (230) or ring grooves damaged. – Stator shaft sleeve scored or damaged. – Reverse boost valve (219) stuck, damaged or misassembled. – Cup plug missing. – Restricted oil passage. – Faces not flat. – Converter clutch valve (224) stuck.
	• Valve Body Assembly (60)	– 2-3 Shift valve (369) stuck. – Manual linkage (705) not adjusted. – Spacer plate (48) and gaskets (47 and 52) incorrect, mispositioned or damaged. – Lo overrun valve (361) stuck. – Orificed cup plug restricted, missing or damaged.
	• Reverse Input Clutch Assembly (605)	– Clutch plate (612) worn. – Reverse input housing and drum assembly (605) cracked at weld. – Clutch plate retaining ring out of groove. – Return spring assembly retaining ring (610) out of groove. – Seals (608) cut or damaged. – Restricted apply passage. – Porosity in piston (607). – Belleville plate (611) installed incorrectly. – Excessive clutch plate travel. – Oversized housing.
	• Lo And Reverse Clutch	– Clutch plates (682) worn. – Porosity in piston (695). – Seals (696) damaged. – Return spring assembly retaining ring (693) mispositioned. – Restricted apply passage.

ALL ILLUSTRATION NUMBERS REFERENCE HYDRA-MATIC 4L60-E UNIT REPAIR SECTION

PH0018-4L60-E

Figure 27 Diagnosis Chart F

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO PART THROTTLE OR DELAYED DOWNSHIFTS	• 2-4 Servo Assembly (12-29)	– Servo cover retaining ring (29) omitted or misassembled. – 4th Apply piston (25) damaged or misassembled. – Servo inner housing (20) damaged or misassembled.
	• Valve Body Assembly (60)	– 3-2 Downshift valve (389) stuck. – 4-3 Sequence valve body channel blocked.
HARSH GARAGE SHIFT	• Valve Body Assembly (60)	– Orifice cup plug missing. – Checkball missing.
NO OVERRUN BRAKING – MANUAL 3-2-1	• External Linkage	– Not adjusted properly.
	• Valve Body Assembly (60)	– 4-3 Sequence valve (382) stuck. – Checkball mispositioned. – Spacer plate (48) and gaskets (47 and 52) incorrect, damaged or mispositoned.
	• Input Clutch Assembly (621)	– Turbine shaft oil passages plugged or not drilled. – Turbine shaft seal rings (619) damaged. – Turbine shaft sealing balls loose or missing. – Porosity in forward (630) or overrun clutch piston (632). – Overrun piston seals (631) cut or damaged. – Overrun piston checkball (633) not sealing.
NO TORQUE CONVERTER CLUTCH APPLY	• Electrical	– 12 Volts not supplied to transmission. – Outside electrical connector damaged. – Inside electrical connector, wiring harness or solenoid damaged. – Electrical short (pinched solenoid wire). – Solenoid not grounded.
	• TCC Solenoid	
	• Engine Speed Sensor	
	• Converter (1)	– Internal damage.
	• Engine Coolant Temperature Sensor	
	• Oil Pump Assembly (4)	– Converter clutch valve (224) stuck or assembled backwards. – Converter clutch valve retaining ring (222) mispositioned. – Pump to case gasket (6) mispositioned. – Orifice cup plug restricted or damaged. – Solenoid O-ring seal (67) cut or damaged. – High or uneven bolt torque (pump body to cover).

ALL ILLUSTRATION NUMBERS REFERENCE HYDRA-MATIC 4L60-E UNIT REPAIR SECTION

PH0019-4L60-E

Figure 28 Diagnosis Chart G

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO TORQUE CONVERTER CLUTCH APPLY (Continued)	• Trans Fluid Temperature Sensor (69)	
	• Input Housing and Shaft (621)	– Turbine shaft O-ring seal (618) cut or damaged. – Turbine shaft retainer and ball assembly (617) restricted or damaged.
	• Brake Switch	
	• Pressure Switch Assembly (69)	– Contamination. – Damaged seals.
	• Valve Body Assembly (60)	– TCC signal valve (380) stuck. – Solenoid O-ring leaking.
	• Solenoid Screen	– Blocked.
	• Possible Codes: - 21 Throttle Position Sensor Circuit (High) - 22 Throttle Position Sensor Circuit (Low) - 28 Fluid Pressure Switch Assembly Fault - 37 Brake Switch Stuck "ON" - 38 Brake Switch Stuck "OFF" - 52 Long System Voltage High - 53 System Voltage High - 67 TCC Solenoid Circuit Fault - 75 System Voltage Low - 81 2-3 Shift Solenoid Circuit Fault	
TORQUE CONVERTER CLUTCH SHUDDER	• Torque Converter Assembly (1)	– Internal damage.
	• Oil Pump Assembly (4)	– Converter clutch valve (224) stuck. – Restricted oil passage.
	• Oil Filter (72)	– Crack in filter body. – Flash restricting filter neck. – O-ring seal (71) cut or damaged.
	• Miscellaneous	– Low oil pressure. – Engine not tuned properly.
	• Input Housing and Shaft Assembly (621)	– Turbine shaft O-ring (618) cut or damaged. – Turbine shaft retainer and ball assembly (617) restricted or damaged.
TCC APPLY WITH A COLD ENGINE	• Possible Codes: - 14 Engine Coolant Temp Sensor Circuit (High) - 15 Engine Coolant Temp Sensor Circuit (Low)	

ALL ILLUSTRATION NUMBERS REFERENCE HYDRA-MATIC 4L60-E UNIT REPAIR SECTION

PH0020-4L60-E

Figure 29 Diagnosis Chart H

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO TORQUE CONVERTER CLUTCH RELEASE	• TCC Solenoid	– External ground. – Clogged exhaust orifice.
	• Converter (1)	– Internal damage.
	• Valve Body Assembly (60)	– Converter clutch apply valve stuck in apply position.
	• Oil Pump Assembly (4)	– Converter clutch valve (224) stuck.
	• PCM	– External ground.
TCC ON IN ALL GEARS	• Possible Codes: - 69 TCC Stuck "On"	
DRIVES IN NEUTRAL	• Forward Clutch	– Not releasing.
	• Manual Valve Link (705)	– Disconnected.
	• Case (8)	– Face not flat. – Internal leakage.
2ND GEAR START (DRIVE RANGE)	• Forward Clutch Sprag Assembly (642)	– Sprag assembly installed backwards.
NO PARK	• Parking Linkage (63, 79-90)	– Actuator rod assembly (85) bent or damaged. – Actuator rod spring binding or improperly crimped. – Actuator rod not attached to inside detent lever (788). – Parking lock bracket (86) damaged or not torqued properly. – Inside detent lever (88) not torqued properly. – Detent roller and spring assembly (63) mispositioned or not torqued properly. – Parking pawl (81) binding or damaged.
RATCHETING NOISE	• Parking Pawl (81)	– Parking pawl return spring (80) weak, damaged or misassembled.
OIL OUT THE VENT	• Oil Pump (4)	– Chamfer in pump body rotor pocket too large.
	• Miscellaneous	– Fluid level - overfilled.

ALL ILLUSTRATION NUMBERS REFERENCE HYDRA-MATIC 4L60-E UNIT REPAIR SECTION

PH0021-4L60-E

Figure 30 Diagnosis Chart I

CONDITION	INSPECT COMPONENT	FOR CAUSE
VIBRATION IN REVERSE AND WHINING NOISE IN PARK	• Oil Pump (4)	– Broken vane rings (210).
NO DRIVE IN ALL RANGES	• Torque Converter (1)	– Converter to flex plate bolts missing.
NO DRIVE IN DRIVE RANGE	• Torque Converter (1)	– Stator roller clutch not holding. – Converter not bolted to flex plate.
FRONT OIL LEAK	• Torque Converter (1)	– Welded seam leaking. – Damaged converter hub.
	• Torque Converter Seal (243)	– Damaged seal assembly. – Missing garter spring.
DELAY IN DRIVE AND REVERSE	• Torque Converter (1)	– Converter drainback.

ALL ILLUSTRATION NUMBERS REFERENCE HYDRA-MATIC 4L60-E UNIT REPAIR SECTION

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Figure 31 Diagnosis Chart J

FLUID LEAK DIAGNOSIS AND REPAIR

The cause of most external leaks can generally be located and repaired with the transmission in the vehicle.

METHODS FOR LOCATING LEAKS

General Method

1. Verify that the leak is transmission fluid.
2. Thoroughly clean the suspected leak area.
3. Operate the vehicle for about 15 miles or until normal operating temperatures are reached.
4. Park the vehicle over clean paper or cardboard.
5. Shut the engine off and look for fluid spots on the paper.
6. Make necessary repairs.

Powder Method

1. Thoroughly clean the suspected leak area with solvent.
2. Apply an aerosol type powder (foot powder) to the suspected leak area.
3. Operate the vehicle for about 15 miles or until normal operating temperatures are reached.
4. Shut the engine off.
5. Inspect the suspected leak area and trace the leak path through the powder to find the source.
6. Make necessary repairs.

Dye and Black Light Method

1. Follow the manufacturer's recommendation for the amount of dye to be used.
2. Find the leak with a black light.
3. Make necessary repairs.

REPAIRING THE LEAK

Once the leak has been pinpointed and traced back to its source, the cause of the leak must be determined in order for it to be repaired properly. If a gasket is replaced, but the sealing flange is bent, the new gasket will not repair the leak. The bent flange must be repaired also. Before attempting to repair a leak, check to be sure that the following conditions are correct as they may cause a leak.

Gaskets

- Fluid level or pressure is too high.
- Plugged vent or drain-back holes.
- Improperly torqued fasteners or dirty/ damaged threads.
- Warped flanges or sealing surface.
- Scratches, burrs, or other damage to the sealing surface.
- Damaged or worn gasket.
- Cracking or porosity of the component.
- Improper sealant used (where applicable).
- Porosity.

Seals

- Fluid level or pressure is too high.
- Plugged vent or drain-back holes.
- Damaged seal bore (scratched, burred or nicked).
- Damaged or worn seal.
- Improper installation.
- Cracks in component.
- Manual or output shaft surface scratched, nicked, or missing.
- Loose or worn bearing causing excess seal wear.

POSSIBLE POINTS OF OIL LEAKS

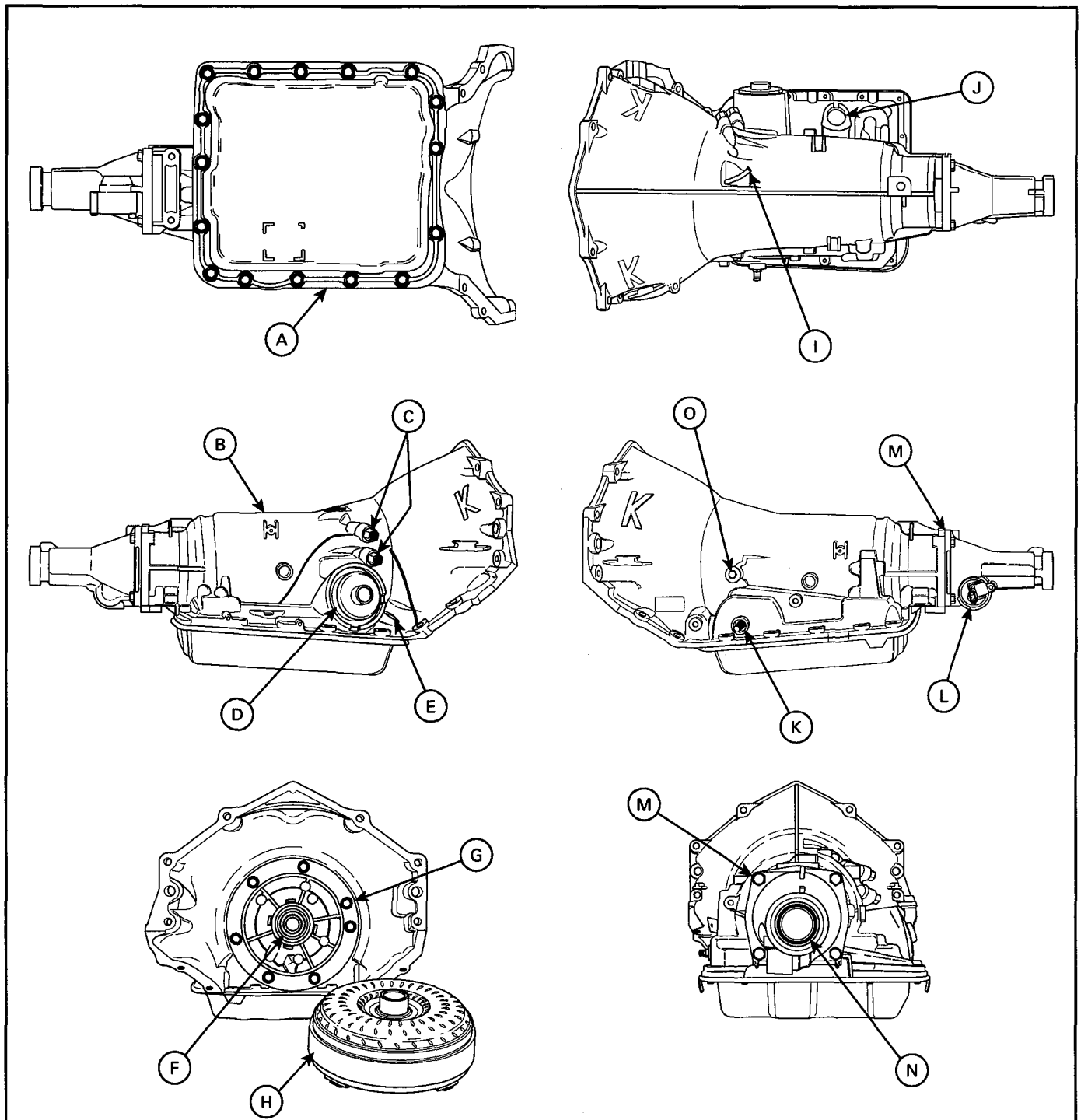
1. Transmission and transmission oil pan:
   - Attaching bolts not torqued correctly.
   - Improperly installed or damaged gasket.
   - Oil pan or mounting face not flat.
2. Case Leak:
   - Filler tube multi-lip seal damaged or missing.
   - Filler tube bracket misaligned.
   - Speed sensor seal damaged.
   - Manual shaft seal damaged.
   - Oil cooler connector fittings loose or damaged.
   - Propeller shaft oil seal worn or damaged.
   - Line pressure pipe plug loose.
   - Porous casting.
3. Leak at converter end:
   - Converter seal damaged.
     - Seal lip cut (check converter hub for damage).
     - Bushing moved forward and damaged.
     - Garter spring missing from seal.
   - Converter leak in weld area.
   - Porous casting (case or pump).
4. Fluid comes out vent pipe or fill tube:
   - Overfilled.
   - Water or coolant in fluid (fluid will appear milky).
   - Case porous.
   - Incorrect fluid level indicator.
   - Plugged vent.
   - Drain back holes plugged.
   - The alignment of the oil pump to case gasket (if equipped).

CASE POROSITY REPAIR

1. Clean the leak area with solvent and air dry.

   CAUTION: Epoxy adhesive may cause skin irritations and eye damage. Read and follow all information on the container label as provided by the manufacturer.

2. Mix a sufficient amount of epoxy adhesive (GM P/N 1052533 or equivalent) following the manufacturer's recommendations.
3. While the transmission case is hot, apply epoxy adhesive with a clean, dry soldering acid brush.
4. Allow the epoxy adhesive to cure for three hours before starting the engine.
5. Repeat fluid leak diagnosis procedures.



A BOTTOM PAN GASKET
B CASE
C COOLER CONNECTORS
D SERVO COVER SEAL
E OIL FILL TUBE SEAL
F OIL PUMP SEAL ASSEMBLY
G OIL PUMP TO CASE SEAL
H CONVERTER
I VENT
J ELECTRICAL CONNECTOR SEAL
K MANUAL SHAFT SEAL
L SPEED SENSOR SEAL
M EXTENSION TO CASE SEAL
N EXTENSION OIL SEAL ASSEMBLY
O LINE PRESSURE PLUG

SH0029-4L60-E

Figure 32 Leak Inspection Points

4L60-E TRANSMISSION FLUID FLOW AND CIRCUIT DESCRIPTIONS

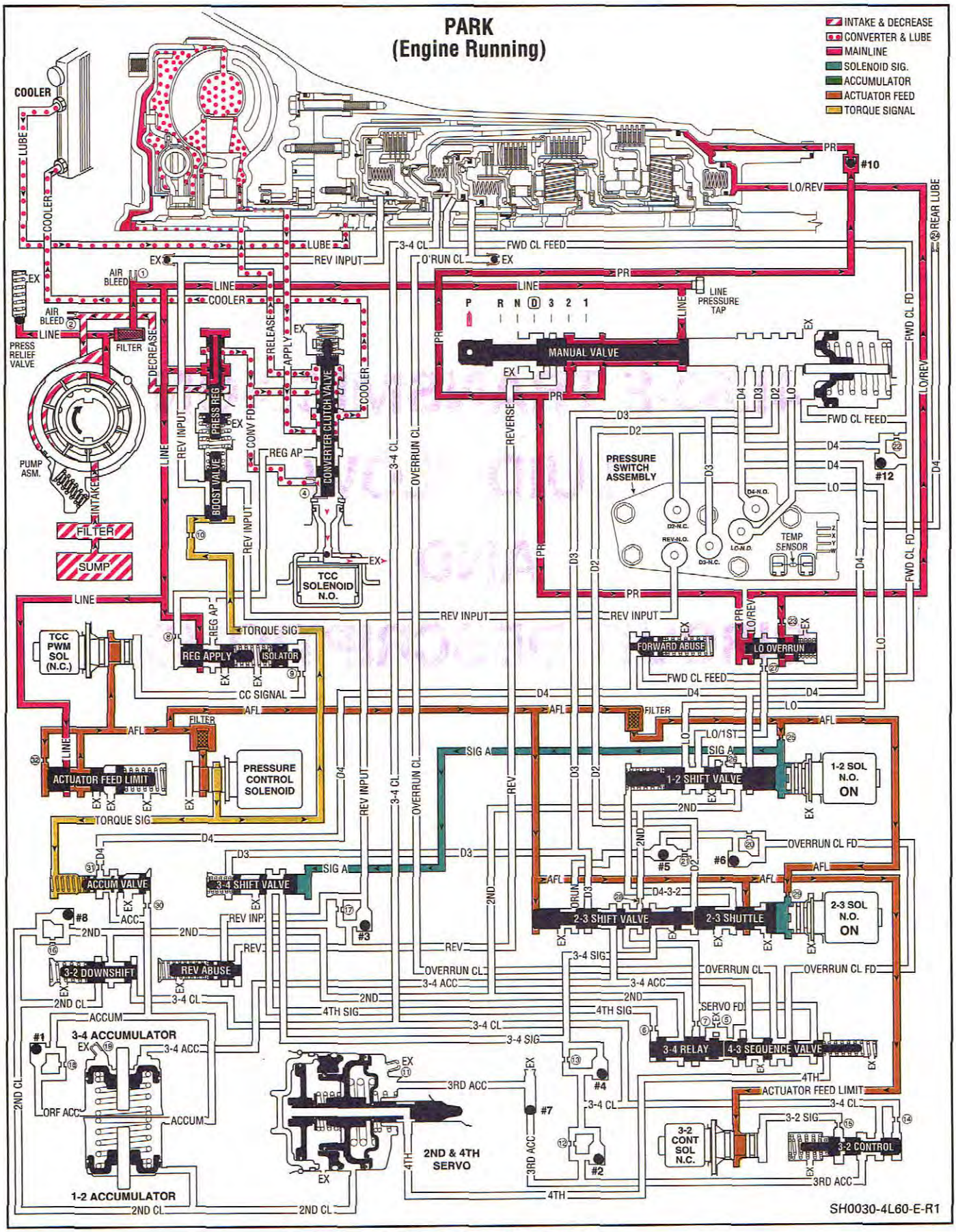


Figure 33 Park - Engine Running

PARK - (Engine Running)

With the gear selector lever in the Park (P) position and the engine running, line pressure from the oil pump assembly is directed to various components in the valve body and oil pump.

PRESSURE REGULATION

Pressure Regulator Valve: Regulates oil pump output (line pressure) in response to torque signal fluid pressure, spring force and line pressure acting on the end of the valve. Line pressure is routed through the valve and into both the converter feed and decrease fluid circuits. Regulated line pressure is also directed to the manual valve, converter clutch signal valve and actuator feed limit valve.

Pressure Relief Valve: Controlled by spring force, this checkball limits the maximum value of line pressure. When line pressure reaches this limiting value, fluid is exhausted past the ball and returns to the sump.

Line Pressure Tap: Provides a location to measure line pressure with a fluid pressure gage.

Actuator Feed Limit (AFL) Valve: Biased by spring force and orificed AFL fluid, it limits the maximum value of line pressure entering the AFL fluid circuit. Below this limiting value, AFL fluid pressure equals line pressure. AFL fluid is routed to the pressure control solenoid, 3-2 control solenoid, 1-2 and 2-3 shift solenoids, and the 2-3 shift valve train.

Pressure Control Solenoid: Controlled by the Powertrain Control Module (PCM), it regulates filtered AFL fluid into torque signal fluid pressure. This regulation is controlled by varying the current value to the solenoid in relation to throttle position and other vehicle operating conditions.

TORQUE CONVERTER CLUTCH (TCC)

Torque Converter Clutch Signal Valve: The valve may be in a position to allow line pressure to enter the converter clutch (CC) signal fluid circuit. If this occurs with the 2nd clutch fluid circuit empty, CC signal fluid pressure orificed to the end of the CC signal valve will close the valve and block line pressure. Any fluid in the CC signal fluid circuit will exhaust through the normally open and closed TCC solenoid.

Converter Clutch Apply Valve: Held in the release position by spring force, it directs converter feed fluid into the release fluid circuit. Also, fluid returning from the converter in the apply fluid circuit is routed through the valve and into the cooler fluid circuit.

Torque Converter: Release fluid pressure unseats the TCC apply checkball (#9), keeps the pressure plate released from the converter cover and fills the converter with fluid. Fluid exits the converter between the converter hub and stator shaft in the apply fluid circuit.

Cooler and Lubrication System: Cooler fluid from the converter clutch apply valve is routed through the transmission fluid cooler and into the lubrication fluid circuits.

Manual Valve: Controlled by the selector lever and manual shaft, the manual valve is in the Park (P) position and directs line pressure into the PR (Park/Reverse) fluid circuit. Line pressure is blocked from entering any other fluid circuit at the manual valve.

LO AND REVERSE CLUTCH APPLIES

Lo and Reverse Clutch Piston: PR fluid seats the lo/reverse clutch checkball (#10) and is orificed to the outer area of the piston. Orificing PR fluid around the #10 checkball helps control the lo and reverse clutch apply. Also, lo/reverse fluid pressure from the lo overrun valve acts on the inner area of the lo and reverse clutch piston to increase the clutch holding capacity.

Lo Overrun Valve: PR fluid pressure moves the valve against spring force and fills the lo/reverse fluid circuit. Lo/reverse fluid is orificed (#23) back to the lo/overrun valve to assist PR fluid in moving the valve against spring force. Spring force provides a time delay for PR fluid filling the lo/reverse fluid circuit. Lo/reverse fluid is routed to the inner area of the lo and reverse clutch piston to increase the holding capacity of the clutch.

Pressure Switch Assembly (PSA): The PSA consists of five fluid pressure switches: D2 and D3 are normally closed and D4, Lo and Rev are normally open. All fluid circuits routed to the assembly are empty and the PSA signals the PCM that the transmission is in either Park or Neutral.

Shift Solenoids (1-2 and 2-3): Both shift solenoids, which are normally open, are energized by the PCM and block fluid from exhausting. This maintains AFL fluid pressure at solenoid "B" and signal "A" fluid pressure at the 1-2 solenoid.

Shift Valves (1-2, 2-3 and 3-4): Signal "A" fluid pressure holds the 1-2 shift valve in the downshifted position and the 3-4 shift valve in the upshifted (First and Fourth gear) position. AFL fluid pressure from 2-3 shift solenoid holds the 2-3 shift valve train in the downshifted position.

SUMMARY

SHIFT SOLENOID		2-4 BAND	REVERSE INPUT CLUTCH	OVERRUN CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CL. ASSEMBLY	3-4 CLUTCH	LO/ROLLER CLUTCH	LO/REV. CLUTCH
1-2	2-3								
ON*	ON*								APPLIED

* SHIFT SOLENOID STATE IS A FUNCTION OF VEHICLE SPEED AND MAY CHANGE IF VEHICLE SPEED INCREASES SUFFICIENTLY IN PARK, REVERSE OR NEUTRAL. HOWEVER, THIS DOES NOT AFFECT TRANSMISSION OPERATION.

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Figure 34 Park - Engine Running (Legend)

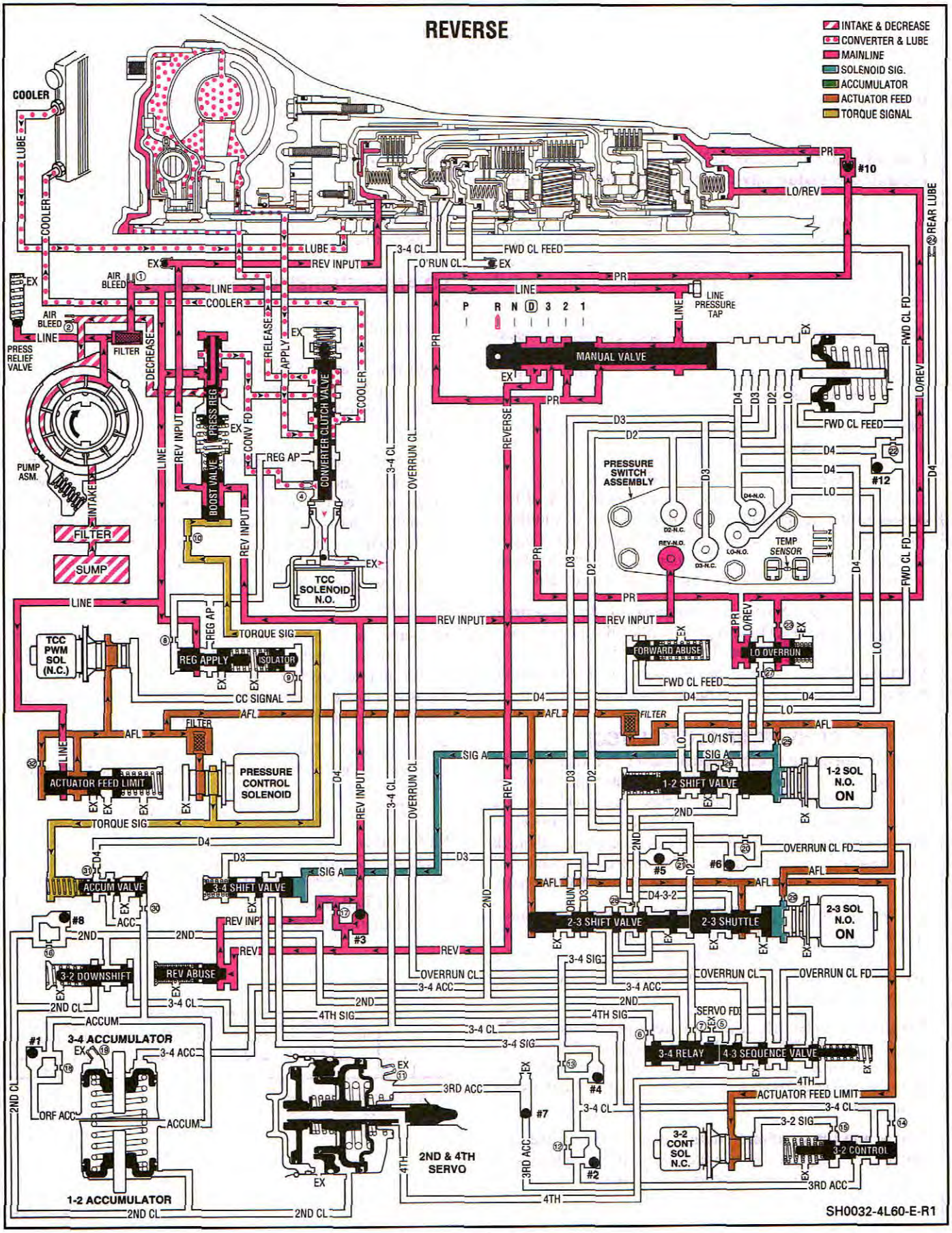


Figure 35 Reverse

REVERSE

When the gear selector lever is moved to the Reverse (R) position (from the Park position), the following changes occur to the transmissions hydraulic and electrical systems:

Manual Valve: The manual valve moves to the Reverse position and line pressure enters the reverse fluid circuit. As in Park, line pressure also fills the PR (Park/Reverse) fluid circuit. All other fluid circuits are blocked by the manual valve.

Lo and Reverse Clutch: As in Park, PR fluid pressure acts on the outer area of the lo and reverse clutch piston to apply the lo and reverse clutch. Also, lo/reverse fluid from the lo overrun valve acts on the inner area of the piston to increase the holding capacity of the clutch (see Note Below).

REVERSE INPUT CLUTCH APPLIES

Reverse Input Checkball (#3): Reverse fluid pressure seats the #3 checkball, flows through orifice #17 and fills the reverse input fluid circuit. This orifice helps control the reverse input clutch apply rate when engine speed is at idle.

Reverse Abuse Valve: Reverse fluid pressure acts on the end of the valve opposite of spring force. At engine speeds above idle, reverse fluid pressure, which is fed by line pressure, increases and moves the valve against spring force (as shown). Reverse fluid can then fill the reverse input fluid circuit through the reverse abuse valve. This bypasses the control of orifice #17 and provides a faster clutch apply.

Boost Valve: Reverse input fluid pressure moves the boost valve against the pressure regulator valve spring. The spring acts on the pressure regulator valve to increase the operating range of line pressure in Reverse. Reverse input fluid also flows through the valve and to the reverse input clutch piston. Remember that torque signal fluid pressure continually acts on the boost valve to control line pressure in response to vehicle operating conditions.

Reverse Input Clutch Piston: Reverse input fluid pressure moves the piston to apply the reverse input clutch plates and obtain Reverse.

Reverse Input Air Bleed Checkball: This ball and capsule is located in the reverse input fluid circuit in the oil pump to provide an air escape when the fluid pressure increases. It also allows air into the circuit to displace the fluid when the clutch releases.

Pressure Switch Assembly (PSA): Reverse input fluid pressure closes the normally open reverse switch in the PSA. This signals the PCM that the manual valve is in the Reverse (R) position.

Shift Solenoids (1-2 and 2-3): Both solenoids are energized as in Park range. Signal "A" and actuator feed limit (AFL) fluids are blocked from exhausting through the shift solenoids to maintain fluid pressure in these circuits at the end of the shift valves.

Shift Valves (1-2, 2-3 and 3-4): Signal "A" fluid pressure holds the 1-2 shift valve in the downshifted position and the 3-4 shift valve in the upshifted (First and Fourth gear) position. AFL fluid pressure from shift the 2-3 solenoid holds the 2-3 shift valve train in the downshifted position.

Pressure Control Solenoid: It continues to regulate AFL fluid into torque signal fluid pressure. The PCM varies the current at the solenoid to regulate torque signal fluid pressure in response to throttle position and other PCM input signals. Torque signal fluid pressure is used to control line pressure at the boost and pressure regulator valves.

Note: The explanation in each gear range is, for the most part, limited to what changes from the range on the previous page. However, some component descriptions are repeated for clarity and continuity. Also, refer to the appropriate General Motors Service Manual for specific fluid pressure information.

SUMMARY

SHIFT SOLENOID		2-4 BAND	REVERSE INPUT CLUTCH	OVERRUN CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CL. ASSEMBLY	3-4 CLUTCH	LO/ROLLER CLUTCH	LO/REV. CLUTCH
1-2	2-3								
ON*	ON*		APPLIED						APPLIED

* SHIFT SOLENOID STATE IS A FUNCTION OF VEHICLE SPEED AND MAY CHANGE IF VEHICLE SPEED INCREASES SUFFICIENTLY IN PARK, REVERSE OR NEUTRAL. HOWEVER, THIS DOES NOT AFFECT TRANSMISSION OPERATION.

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Figure 36 Reverse (Legend)

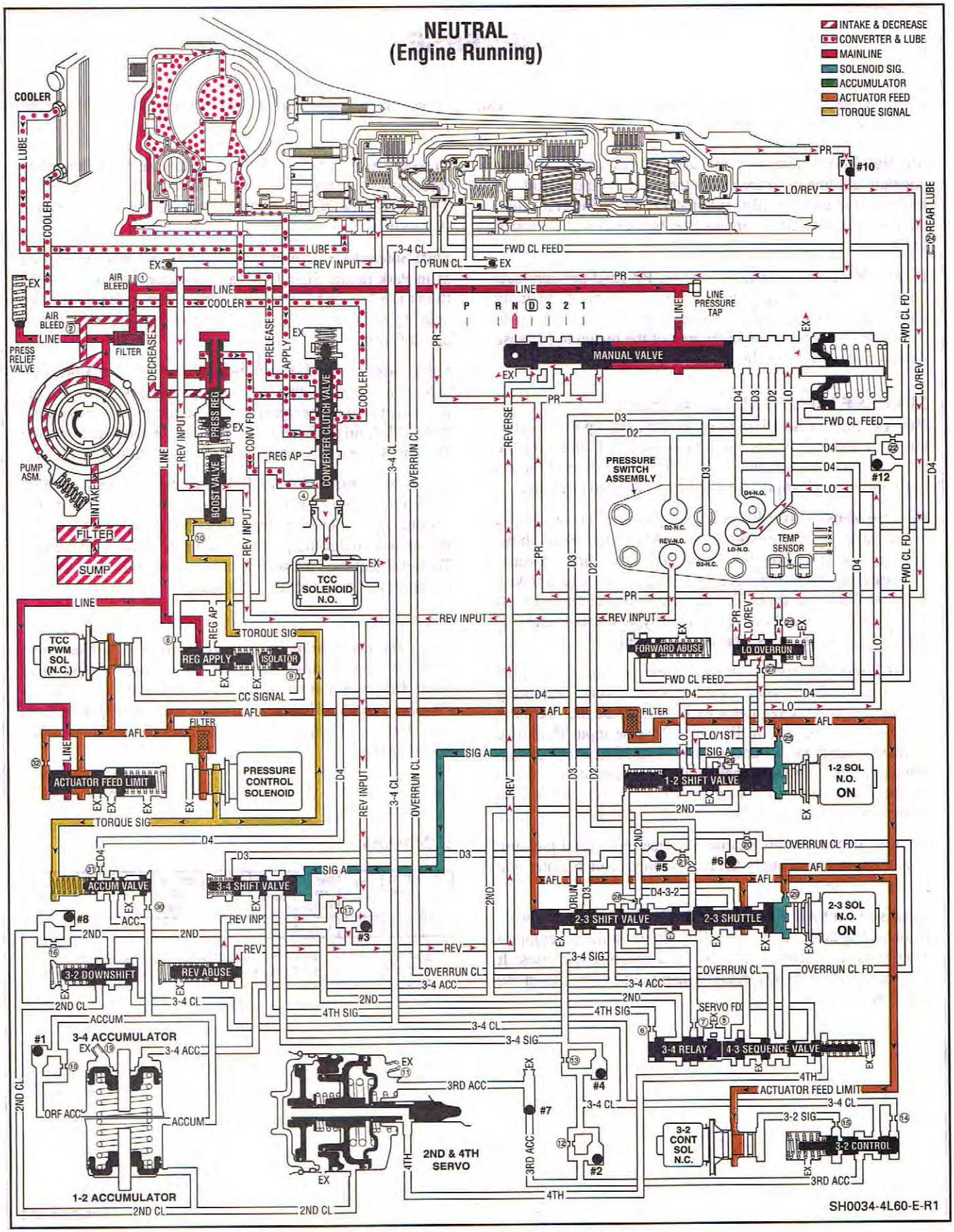


Figure 37 Neutral - Engine Running

NEUTRAL - (Engine Running)

When the gear selector lever is moved to the Neutral position (N), from the Reverse position, the following changes occur to the transmissions hydraulic and electrical systems:

Manual Valve: In the Neutral position, the manual valve blocks line pressure from entering any other fluid circuits. Reverse and PR fluids exhaust past the manual valve.

LO and REVERSE CLUTCH RELEASES

Lo and Reverse Clutch Piston: PR and lo/reverse fluids exhaust from the piston, thereby releasing the lo and reverse clutch plates. Exhausting PR fluid unseats the lo/reverse checkball (#10) for a quick exhaust.

Lo Overrun Valve: Spring force closes the valve when PR fluid pressure exhausts. Lo/reverse fluid exhausts through the valve, into the lo/1st fluid circuit, past the 1-2 shift valve, into the lo fluid circuit and through an exhaust port at the manual valve.

REVERSE INPUT CLUTCH RELEASES

Reverse Input Clutch Piston: Reverse input fluid pressure exhausts from the piston, through the boost valve, past the #3 checkball and to the manual valve. With reverse input fluid exhausted, the reverse input clutch plates are released and the transmission is in Neutral.

Reverse Abuse Valve: Reverse fluid pressure exhausts and spring force closes the valve.

Boost Valve: Reverse input fluid pressure exhausts and line pressure returns to the normal operating range as in the Park and Overdrive positions.

Reverse Input Checkball (#3): Exhausting reverse input fluid unseats the ball for a quick exhaust through the reverse fluid circuit and past the manual valve.

Pressure Switch Assembly (PSA): Reverse input fluid exhausts from the PSA. With no other fluid routed to it, the PSA signals the PCM that the transmission is operating in either Park or Neutral.

Note: In Park, Reverse, and Neutral the shift solenoids are shown energized. This is the normal operating state when the vehicle is stationary or at low vehicle speeds. However, the PCM will change the shift solenoid states depending on vehicle speed. For example, if Neutral is selected when the transmission is operating in Second Gear, the shift solenoids will remain in a Second Gear state. However, with the manual valve blocking line pressure, the shift solenoid states do not affect transmission operation in Park, Reverse and Neutral.

SUMMARY

SHIFT SOLENOID		2-4 BAND	REVERSE INPUT CLUTCH	OVERRUN CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CL. ASSEMBLY	3-4 CLUTCH	LO/ROLLER CLUTCH	LO/REV. CLUTCH
1-2	2-3								
ON*	ON*								

* SHIFT SOLENOID STATE IS A FUNCTION OF VEHICLE SPEED AND MAY CHANGE IF VEHICLE SPEED INCREASES SUFFICIENTLY IN PARK, REVERSE OR NEUTRAL. HOWEVER, THIS DOES NOT AFFECT TRANSMISSION OPERATION.

RH0035-4L60-E

Figure 38 Neutral - Engine Running (Legend)

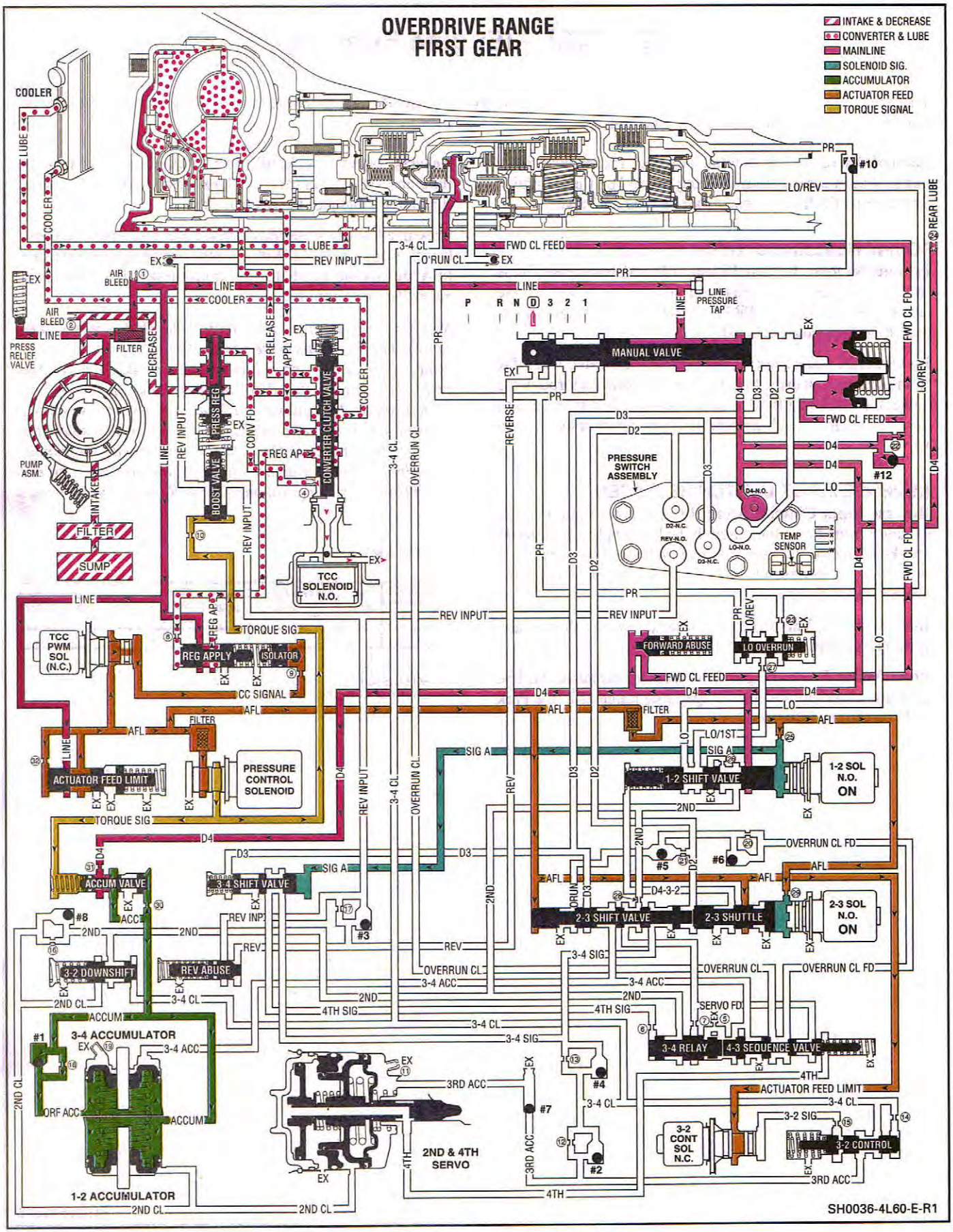


Figure 39 Overdrive Range - First Gear

OVERDRIVE RANGE - FIRST GEAR

When the gear selector lever is moved to the Overdrive ((D)) position, from the Neutral position, the following changes occur to the transmissions hydraulic and electrical systems:

Manual Valve: Line pressure flows through the manual valve and fills the D4 fluid circuit. All other fluid circuits remain empty with the manual valve in the Overdrive position.

FORWARD CLUTCH APPLIES

Forward Clutch Accumulator Checkball (#12): D4 fluid pressure seats the ball and is orificed (#22) into the forward clutch feed fluid circuit. This orifice helps control the forward clutch apply rate.

Forward Clutch Piston: Forward clutch feed fluid pressure moves the piston to apply the forward clutch plates and obtain First gear.

Forward Clutch Accumulator Piston: Forward clutch feed fluid pressure moves the piston against spring force. This action absorbs some of the initial increase of forward clutch feed fluid pressure to cushion the forward clutch apply.

Forward Clutch Abuse Valve: D4 fluid pressure acts on the valve opposite of spring force. At engine speeds greater than idle, D4 fluid pressure increases and moves the valve against spring force (as shown). D4 fluid can then quickly fill the forward clutch feed fluid circuit, thereby bypassing the control of orifice #22 and providing a faster apply of the forward clutch. Otherwise, with increased throttle opening and engine torque, the clutch may slip during apply.

Pressure Switch Assembly (PSA): D4 fluid pressure is routed to the PSA and closes the normally open D4 fluid pressure switch. This signals the PCM that the transmission is operating in Overdrive range.

1-2 Shift Solenoid: Energized (ON) as in Neutral, the normally open solenoid is closed and blocks signal "A" fluid from exhausting through the solenoid. This maintains pressure in the signal "A" fluid circuit.

2-3 Shift Solenoid: Energized (ON) as in Neutral, the normally open solenoid is closed and blocks actuator feed limit (AFL) fluid from exhausting through the solenoid. This maintains AFL fluid pressure at the solenoid end of the 2-3 shift valve.

2-3 Shift Valve Train: AFL fluid pressure at the solenoid end of the 2-3 shift valve holds the valve train in the downshifted position against AFL fluid pressure acting on the 2-3 shuttle valve. In this position, the 2-3 shift valve blocks AFL fluid from entering the D432 fluid circuit. The D432 fluid circuit is open to an exhaust port past the valve.

1-2 Shift Valve: Signal "A" fluid pressure holds the valve in the downshifted position against spring force. In the First gear position the valve blocks D4 fluid from entering the 2nd fluid circuit.

Accumulator Valve: Biased by torque signal fluid pressure, spring force and orificed accumulator fluid pressure at the end of the valve, the accumulator valve regulates D4 fluid into accumulator fluid pressure. Accumulator fluid is routed to both the 1-2 and 3-4 accumulator assemblies in preparation for the 1-2 and 3-4 upshifts respectively.

Rear Lube: D4 fluid is routed through an orifice cup plug (#24) in the rear of the transmission case to feed the rear lube fluid circuit.

Pressure Control Solenoid: Remember that the pressure control solenoid continually varies torque signal fluid pressure in relation to throttle position and vehicle operating conditions. This provides a precise control of line pressure.

3-2 Control Solenoid: The PCM keeps the solenoid OFF in First gear and the normally closed solenoid blocks AFL fluid from entering the 3-2 signal fluid circuit.

SUMMARY

SHIFT SOLENOID		2-4 BAND	REVERSE INPUT CLUTCH	OVERRUN CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CL. ASSEMBLY	3-4 CLUTCH	LO/ROLLER CLUTCH	LO/REV. CLUTCH
1-2	2-3								
ON	ON				APPLIED	HOLDING		HOLDING	

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Figure 40 Overdrive Range - First Gear (Legend)

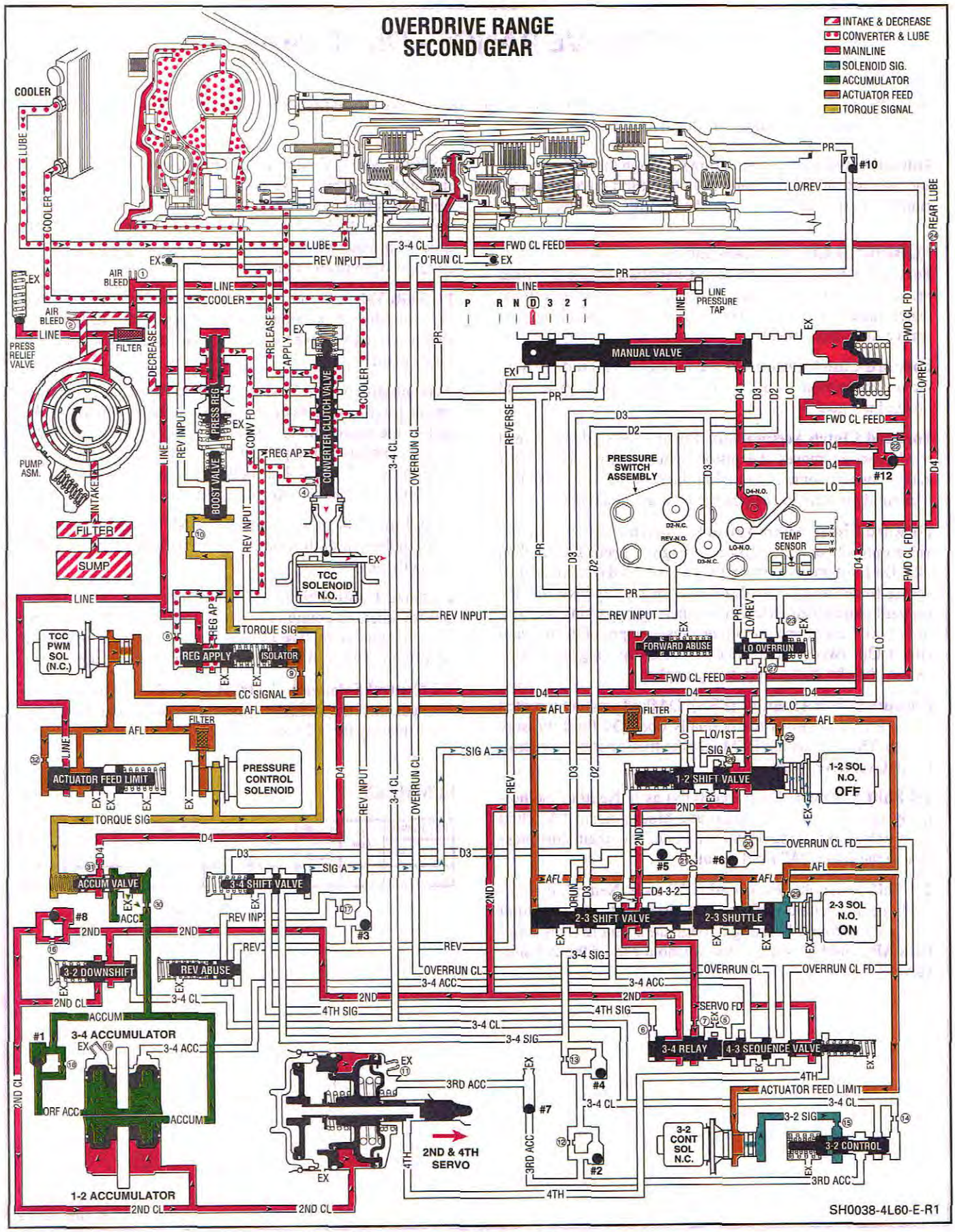


Figure 41 Overdrive Range - Second Gear

OVERDRIVE RANGE - SECOND GEAR

As vehicle speed increases, and other operating conditions are appropriate, the PCM de-energizes the 1-2 shift solenoid to shift the transmission into Second gear.

1-2 Shift Solenoid: De-energized (turned OFF) by the PCM, the normally open solenoid opens and signal "A" fluid exhausts through the solenoid.

Note: Actuator feed limit (AFL) fluid continues to feed the signal "A" fluid circuit through orifice #25. However, the exhaust port through the solenoid is larger than orifice #25 to prevent a pressure buildup in the signal "A" fluid circuit. Exhausting signal "A" fluid is represented by the blue arrows.

2-3 Shift Solenoid: Energized (ON) as in First gear, it blocks AFL fluid from exhausting through the solenoid. This maintains AFL fluid pressure at the solenoid end of the 2-3 shift valve.

2-4 BAND APPLIES

1-2 Shift Valve: Without signal "A" fluid pressure, spring force moves the valve into the upshifted position. D4 fluid is routed through the valve and fills the 2nd fluid circuit.

1-2 Shift Checkball (#8): 2nd fluid pressure seats the #8 checkball, flows through orifice #16 and fills the 2nd clutch fluid circuit. This orifice helps control the 2-4 band apply rate.

2-4 Servo Assembly: 2nd clutch fluid pressure moves the 2nd apply piston against servo cushion and servo return spring forces. The apply piston moves the band apply pin to apply the 2-4 band. These spring forces help control the 2-4 band apply rate.

1-2 Accumulator: 2nd clutch fluid pressure also moves the 1-2 accumulator piston against spring force and accumulator fluid pressure. This action absorbs initial 2nd clutch fluid pressure to cushion the 2-4 band apply rate. Also, the movement of the 1-2 accumulator piston forces some accumulator fluid out of the accumulator assembly. This accumulator fluid is routed back to the accumulator valve.

Accumulator Valve: Accumulator fluid forced out of the 1-2 accumulator is orificed (#30) to the end of the accumulator valve. This pressure moves the valve against spring force and torque signal fluid pressure to regulate the exhaust of excess accumulator fluid. This regulation provides additional control for the 2-4 band apply rate. The oil circuit shows the exhaust of accumulator fluid during the shift by the arrow directions in the accumulator fluid circuit.

2-3 Shift Valve Train: AFL fluid pressure from the 2-3 shift solenoid holds the valve train in the downshifted position. 2nd fluid is routed through the 2-3 shuttle valve and fills the servo feed fluid circuit.

3-4 Relay Valve and 4-3 Sequence Valve: Spring force holds these valves in the downshifted position (First, Second and Third gear position). 2nd fluid is blocked by the 3-4 relay valve and servo feed fluid is blocked by both valves in preparation for a 3-4 upshift.

3-2 Downshift Valve: Spring force holds the valve closed, blocking 2nd fluid and 2nd clutch fluid. This valve is used to help control the 3-2 downshift.

3-2 Control Solenoid: In Second gear, the PCM operates the normally closed solenoid at approximately a 90% duty cycle. This opens the AFL fluid circuit to fill the 3-2 signal fluid circuit (at 100% duty cycle the AFL fluid circuit is completely open).

3-2 Control Valve: 3-2 signal fluid pressure moves the valve against spring force. This action does not affect the transmission operation in Second gear.

3-4 Shift Valve: Signal "A" fluid pressure exhausts and spring force moves the valve into the downshift position (Second and Third gear position).

TORQUE CONVERTER CLUTCH

Converter Clutch Signal Valve: 2nd clutch fluid pressure opens the valve and line pressure feeds the converter clutch (CC) signal fluid circuit. CC signal fluid is orificed (#8) to the end of the CC signal valve and opposes 2nd clutch fluid pressure. CC signal fluid is routed through a filter and orificed (#4) to the TCC solenoid.

TCC Solenoid: Under normal operating conditions in Second gear the PCM keeps the normally open TCC solenoid de-energized (OFF). CC signal fluid exhausts through the open solenoid and spring force keeps the converter clutch apply valve in the release position.

Note: The orifice cup plug (#4) in the CC signal fluid circuit is smaller than the exhaust through the TCC solenoid. Therefore, fluid pressure does not build up at the end of the converter clutch apply valve.

SUMMARY

SHIFT SOLENOID		2-4 BAND	REVERSE INPUT CLUTCH	OVERRUN CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CL. ASSEMBLY	3-4 CLUTCH	LO/ROLLER CLUTCH	LO/REV. CLUTCH
1-2	2-3								
OFF	ON	APPLIED			APPLIED	HOLDING			

RH0039-4L60-E

Figure 42 Overdrive Range - Second Gear (Legend)

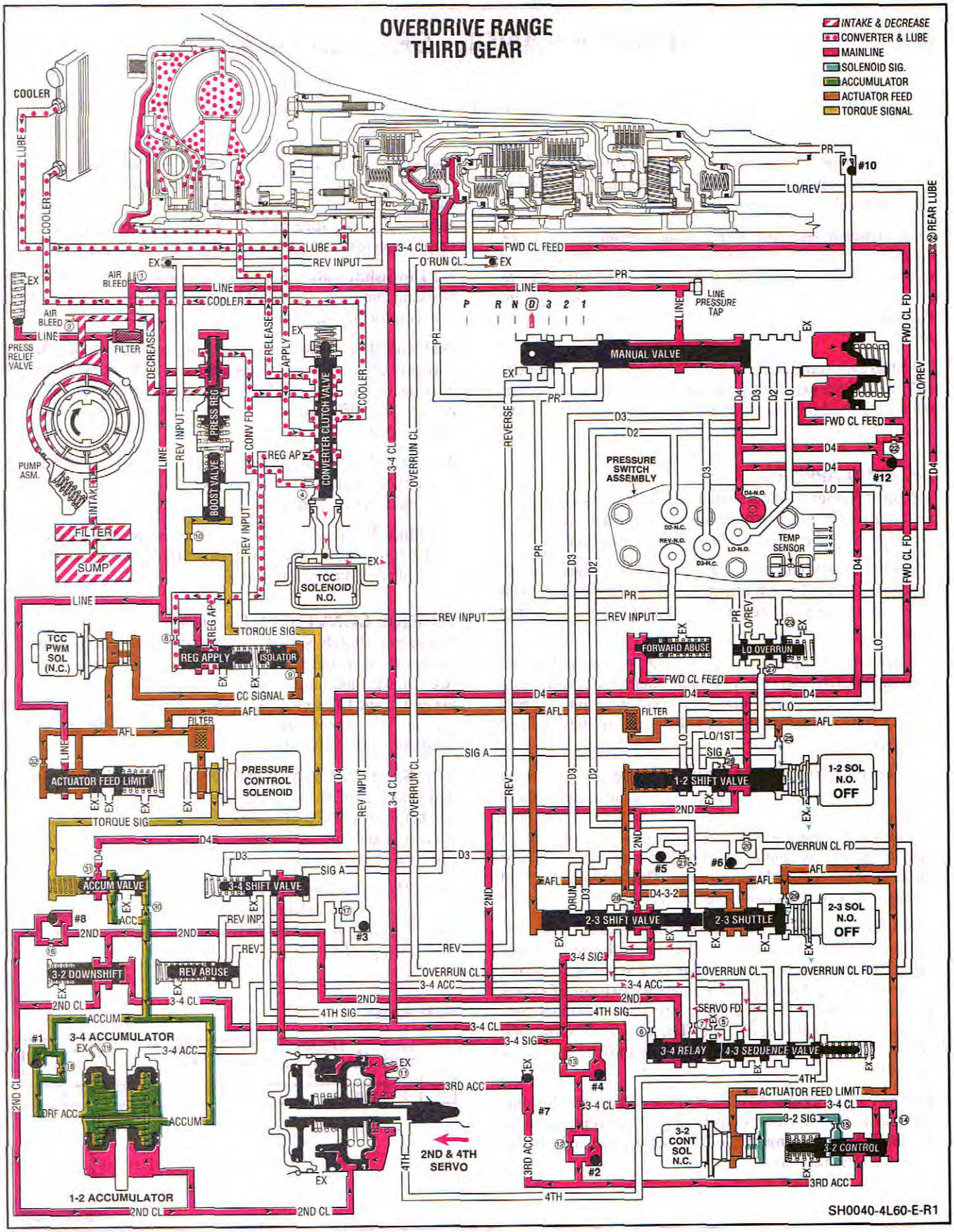


Figure 43 Overdrive Range - Third Gear

OVERDRIVE RANGE - THIRD GEAR

As vehicle speed increases further, and other vehicle operating conditions are appropriate, the PCM de-energizes the normally open the 2-3 shift solenoid to shift the transmission into Third gear.

2-3 Shift Solenoid: De-energized (turned OFF) by the PCM, the solenoid opens and actuator feed limit (AFL) fluid exhausts through the solenoid.

Note: AFL fluid continues to feed the solenoid through orifice #29. However, the exhaust port through the solenoid is larger than orifice #29 to prevent a buildup of pressure in the AFL fluid circuit at the solenoid end of the 2-3 shift valve. Exhausting AFL fluid is represented by the arrows through the solenoid.

3-4 CLUTCH APPLIES

2-3 Shift Valve Train: AFL fluid pressure at the 2-3 shuttle valve moves the valve train toward the solenoid. In the upshifted position the following changes occur:

- AFL fluid is routed through the 2-3 shift valve and fills the D432 fluid circuit.
- 2nd fluid is blocked from entering the servo feed fluid circuit and is orificed (#28) into the 3-4 signal fluid circuit. This orifice helps control the 3-4 clutch apply rate.
- Servo feed fluid exhausts past the valve, into the 3-4 accumulator fluid circuit and through an exhaust port at the 3-4 relay valve.

3-4 Clutch Exhaust Checkball (#4): 3-4 signal fluid unseats the ball and enters the 3-4 clutch fluid circuit.

3-4 Clutch Piston: 3-4 clutch fluid pressure moves the piston to apply the 3-4 clutch plates and obtain 3rd gear. However, the 2-4 band must release as the 3-4 clutch applies.

2-4 BAND RELEASES and 3-4 CLUTCH ACCUMULATION

3rd Accumulator Checkball (#2): 3-4 clutch fluid pressure unseats the ball and fills the 3rd accumulator fluid circuit.

3rd Accumulator Exhaust Checkball (#7): 3rd accumulator fluid seats the ball against the orificed exhaust and is routed to the release side of the 2nd apply piston. Before the #7 checkball seats, air in the 3rd accumulator fluid circuit is exhausted through the orifice.

2-4 Servo Assembly: 3rd accumulator fluid pressure acts on the release side of the 2nd apply piston and assists servo return spring force. The surface area on the release side of the piston is greater than the surface area on the apply side. Therefore, 3rd accumulator fluid pressure and servo return spring force move the 2nd apply piston against 2nd clutch fluid pressure. This action serves two functions:

1. Move the apply pin to release the 2-4 band.
2. Act as an accumulator by absorbing initial 3-4 clutch fluid to cushion the 3-4 clutch apply rate. Remember that the 3rd accumulator fluid circuit is fed by 3-4 clutch fluid.

3-2 Downshift Valve: 3-4 clutch fluid pressure moves the valve against spring force. This opens the valve and allows 2nd fluid to feed the 2nd clutch fluid circuit through the valve.

3-2 Control Solenoid and 3-2 Control Valve: The solenoid remains at approximately 90% duty cycle and routes AFL fluid into the 3-2 signal fluid circuit. 3-2 signal fluid pressure holds the 3-2 control valve against spring force, thereby blocking the 3rd accumulator and 3-4 clutch fluid circuits.

1-2 Shift Solenoid and 1-2 Shift Valve: The 1-2 shift solenoid remains de-energized and signal "A" fluid is exhausted through the solenoid. Also, D432 fluid pressure from the 2-3 shift valve assists spring force to hold the 1-2 shift valve in the upshifted position.

3-4 Shift Valve: Spring force holds the valve in the downshifted position, blocking 3-4 clutch fluid in preparation for a 3-4 upshift.

TORQUE CONVERTER CLUTCH

TCC Solenoid: Under normal operating conditions in Overdrive Range - Third Gear the PCM keeps the normally open TCC solenoid de-energized. CC signal fluid exhausts through the open solenoid and spring force keeps the converter clutch apply valve in the release position. However, at speeds above approximately 121 km/h (75 mph) the PCM will command TCC apply in Third gear.

SUMMARY

SHIFT SOLENOID		2-4 BAND	REVERSE INPUT CLUTCH	OVERRUN CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CL. ASSEMBLY	3-4 CLUTCH	LO/ROLLER CLUTCH	LO/REV. CLUTCH
1-2	2-3								
OFF	OFF				APPLIED	HOLDING	APPLIED		

RH0041-4L60-E

Figure 44 Overdrive Range - Third Gear (Legend)

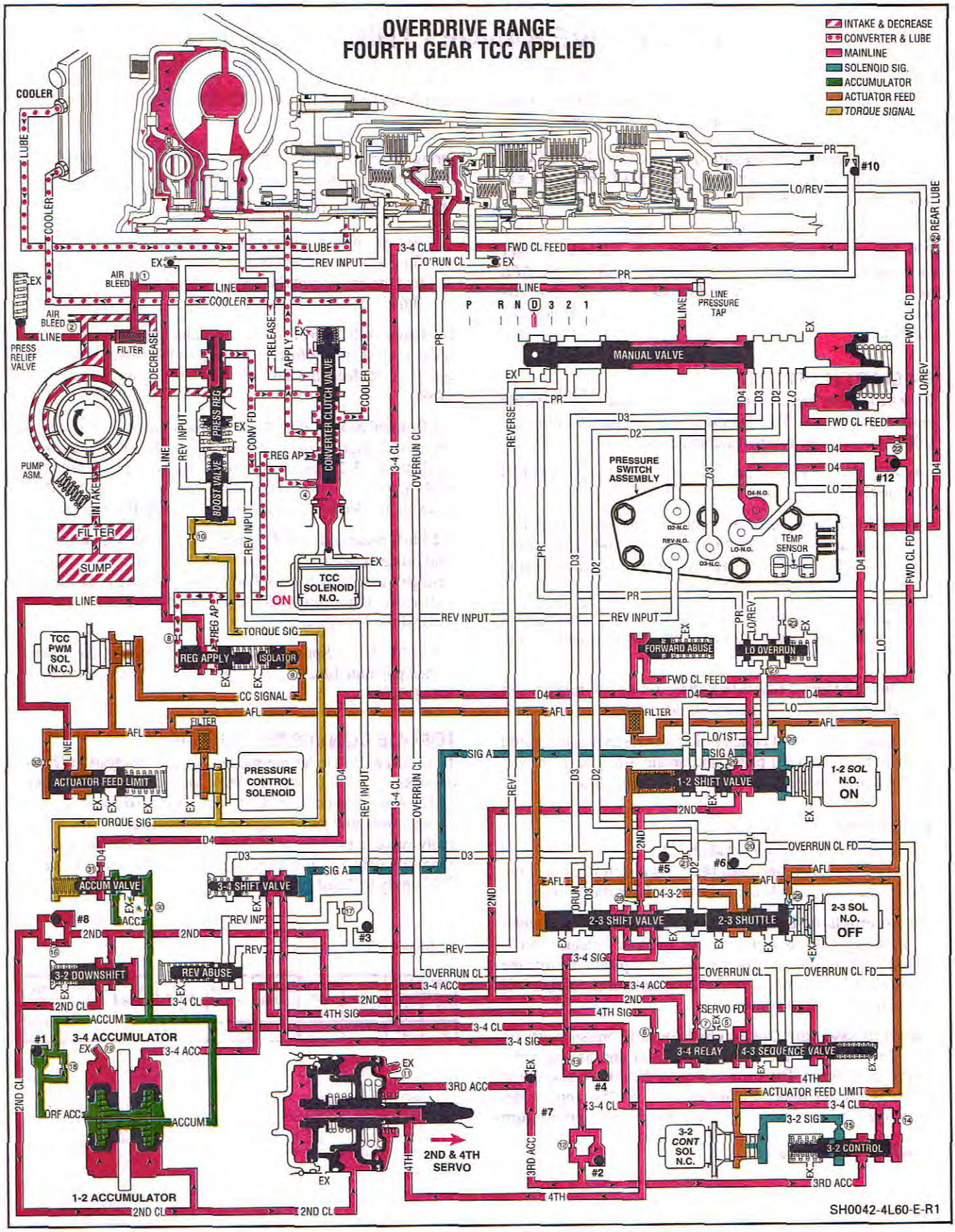


Figure 45 Overdrive Range - Fourth Gear – Converter Clutch Applied

OVERDRIVE RANGE - FOURTH GEAR
Converter Clutch Applied

At higher vehicle speeds, the Hydra-matic 4L60-E transmission uses an Overdrive gear ratio (Fourth gear) to increase fuel economy and maximize engine performance. When vehicle operating conditions are appropriate, the PCM energizes the 1-2 shift solenoid to shift the transmission into Fourth gear.

1-2 Shift Solenoid: Energized (turned ON) by the PCM, the normally open solenoid closes and blocks signal "A" fluid from exhausting through the solenoid. This creates pressure in the signal "A" fluid circuit.

2-3 Shift Solenoid: De-energized (OFF) as in Third gear, it exhausts actuator feed limit (AFL) fluid through the solenoid.

1-2 Shift Valve: D432 fluid pressure from the 2-3 shift valve and spring force hold the valve in the upshifted position against signal "A" fluid pressure.

2-4 BAND APPLIES

3-4 Shift Valve: Signal "A" fluid pressure moves the valve into the upshifted position against spring force. In this position, the valve routes 3-4 signal fluid into the 4th signal fluid circuit.

3-4 Relay Valve and 4-3 Sequence Valve: 4th signal fluid pressure moves both valves into the upshifted (Fourth gear) position against spring force acting on the 4-3 sequence valve. This causes the following changes:

- Orificed (#7) 2nd fluid is routed through the 3-4 relay valve and into the servo feed fluid circuit.
- Servo feed fluid is routed through the 4-3 sequence valve and into the 4th fluid circuit.
- 3-4 accumulator fluid routed from the 2-3 shuttle valve is blocked by both valves.

2-4 Servo Assembly: 4th fluid is routed through the center of the servo pin and acts on the apply side of the 4th apply piston. 4th fluid pressure moves the 4th apply piston against the apply pin spring force acting on the release side of the 4th apply piston. This action moves the apply pin and applies the 2-4 band to obtain Fourth gear.

2-4 BAND APPLY ACCUMULATION

2-3 Shift Valve Train: The valve train remains in the upshifted position with AFL fluid pressure acting on the 2-3 shuttle valve. In addition to its operation in Third gear, the 2-3 shift valve directs servo feed fluid into the 3-4 accumulator fluid circuit.

3-4 Accumulator Assembly: 3-4 accumulator fluid pressure moves the 3-4 accumulator piston against spring force and orificed accumulator fluid pressure. This action absorbs initial 4th clutch apply fluid pressure to cushion the 2-4 band apply. Remember that both the 3-4 accumulator and 4th fluid circuits are fed by servo feed fluid. As 3-4 accumulator fluid fills the accumulator, any air in the system will exhaust through orifice #19. The piston movement forces some orificed accumulator fluid out of the 3-4 accumulator assembly.

3-4 Accumulator Checkball (#1): The accumulator fluid forced from the accumulator unseats the #1 checkball and enters the accumulator fluid circuit. This fluid is routed to the accumulator valve. This is shown by the arrow directions in the oil circuit.

Accumulator Valve: Accumulator fluid forced from the 3-4 accumulator is orificed to the end of the accumulator valve. This fluid pressure, in addition to spring force and torque signal fluid pressure, regulates the exhaust of excess accumulator fluid pressure through the middle of the valve. This regulation helps control the 2-4 band apply feel.

3-2 Control Solenoid and 3-2 Control Valve: Similar to Third gear, the PCM operates the solenoid at approximately a 90% duty cycle, AFL fluid fills the 3-2 signal fluid circuit and 3-2 signal fluid pressure holds the 3-2 control valve against spring force.

TORQUE CONVERTER CLUTCH APPLIES

TCC Solenoid: When operating conditions are appropriate, the PCM energizes the normally open TCC solenoid. This closes the solenoid, blocks converter clutch signal fluid from exhausting and creates pressure in the converter clutch signal fluid circuit.

Converter Clutch Apply Valve: Converter clutch signal fluid pressure moves the valve against spring force and into the apply position. In this position, release fluid is open to an exhaust port and converter feed fluid fills the apply fluid circuit. Converter feed fluid also feeds the cooler fluid circuit through orifice #3.

Torque Converter: Release fluid from behind the pressure plate exhausts through the end of the turbine shaft. Apply fluid pressure is routed between the converter hub and stator shaft where it enters the torque converter. This fluid applies the converter clutch against the converter cover and keeps the converter filled with fluid.

TCC Apply Checkball (#9): Release fluid exhausting from the converter seats the #9 checkball, located in the end of the turbine shaft, and is orificed around the ball. Orificing the exhausting release fluid controls the converter clutch apply rate.

SUMMARY

SHIFT SOLENOID		2-4 BAND	REVERSE INPUT CLUTCH	OVERRUN CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CL. ASSEMBLY	3-4 CLUTCH	LO/ROLLER CLUTCH	LO/REV. CLUTCH
1-2	2-3								
ON	OFF	APPLIED			APPLIED		APPLIED		

RH0043-4L60-E

Figure 46 Overdrive Range - Fourth Gear – Converter Clutch Applied (Legend)

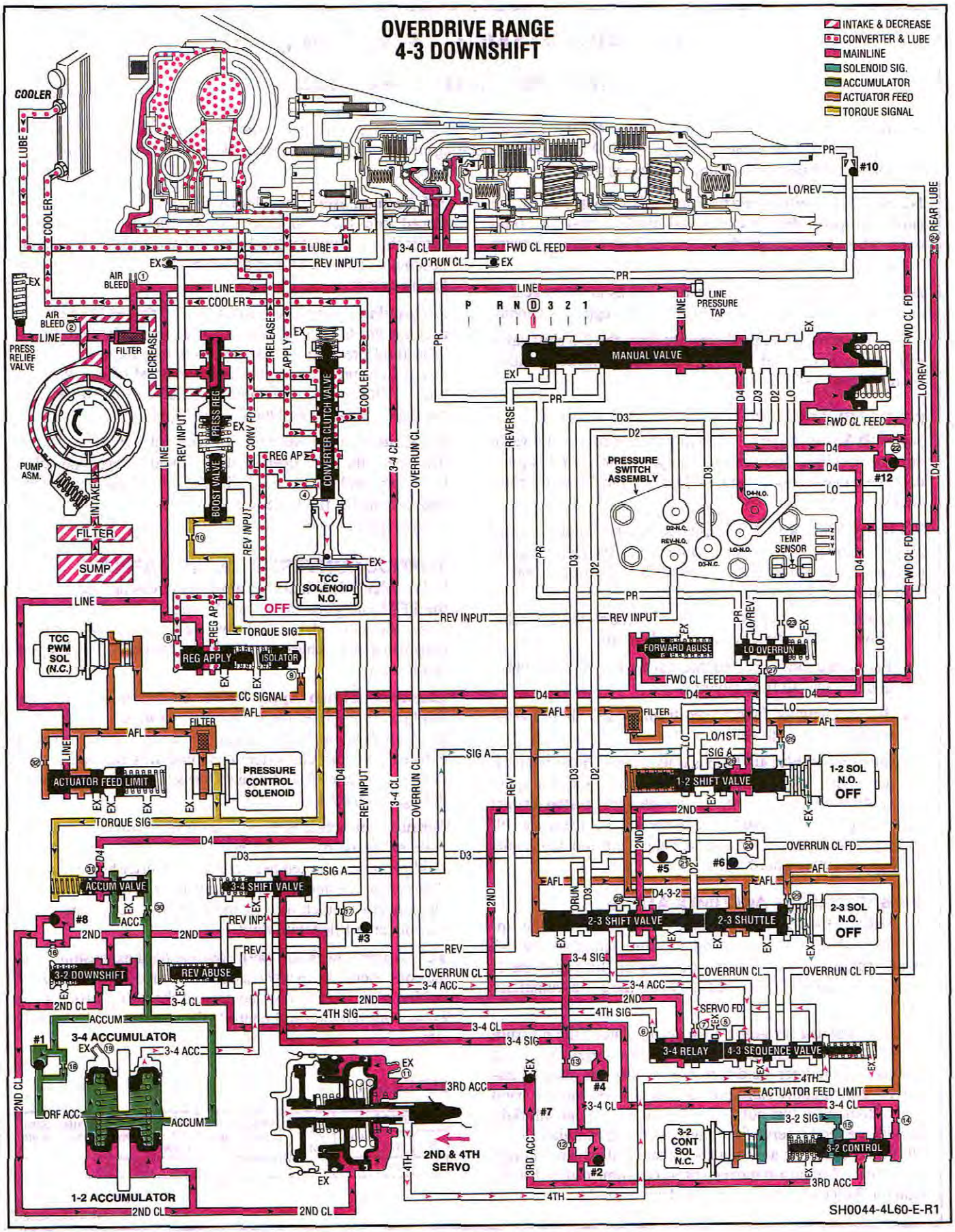


Figure 47 Overdrive Range – 4-3 Downshift

OVERDRIVE RANGE: 4-3 DOWNSHIFT

When the transmission is operating in Fourth gear, a forced 4-3 downshift will occur if there is a significant increase in throttle position. At minimum throttle, vehicle speed will decrease gradually (coastdown) and the PCM will command a 4-3 downshift. The PCM will also initiate a forced 4-3 downshift when throttle position remains constant but engine load is increased, such as driving up a steep incline. To achieve a 4-3 downshift, the PCM de-energizes the 1-2 shift solenoid and the following changes occur to the transmissions electrical and hydraulic systems:

1-2 Shift Solenoid: De-energized by PCM, the normally open solenoid opens and signal "A" fluid exhausts through the solenoid.

1-2 Shift Valve: As in Fourth gear, D432 fluid pressure and spring force hold the valve in the upshifted position.

2-4 BAND RELEASES

3-4 Shift Valve: With signal "A" fluid pressure exhausted, spring force moves the valve into the downshifted position. In this position, the valve blocks 3-4 signal fluid and 4th signal fluid exhausts past the valve.

3-4 Relay Valve and 4-3 Sequence Valve: These valves control the timing of the 2-4 band release. With 4th signal fluid pressure exhausted, 3-4 accumulator fluid pressure moves the 3-4 relay valve into the Third gear position. This opens 3-4 accumulator fluid to an orificed exhaust (#5) past the 3-4 relay valve (shown by red arrows). Because the exhaust is orificed, 3-4 accumulator fluid pressure momentarily holds the 4-3 sequence valve against spring force before completely exhausting.

When exhausting 3-4 accumulator fluid pressure decreases sufficiently, spring force will move the 4-3 sequence valve into the Third gear position as shown. This opens both the 3-4 accumulator and 4th fluid circuits to a quick exhaust past the 4-3 sequence valve. In this position the valve blocks 2nd fluid from entering the servo feed fluid circuit.

2-4 Servo Assembly: 4th fluid exhausts from the 4th apply piston in the servo assembly. The apply pin spring moves the 4th apply piston and apply pin to release the band from the reverse input drum and shift the transmission into Third gear.

3-4 Accumulator Assembly: 3-4 accumulator fluid exhausts from the 3-4 accumulator piston. Orificed accumulator fluid pressure and spring force move the piston to a Third gear position.

3-4 Accumulator Checkball (#1): As accumulator fluid fills the 3-4 accumulator it seats the #1 checkball and is forced through orifice #18. This orifice controls the rate at which accumulator fluid pressure fills the 3-4 accumulator and 3-4 accumulator fluid exhausts from the accumulator assembly.

Accumulator Valve: Biased by torque signal fluid pressure and spring force, the accumulator valve regulates drive fluid into the accumulator fluid circuit.

2-3 Shift Solenoid: This solenoid remains de-energized as in Fourth gear and AFL fluid exhausts through the solenoid.

2-3 Shift Valve Train: AFL fluid pressure at the 2-3 shuttle valve holds the valves in the upshifted position. This allows servo feed fluid to exhaust through the valve, into the 3-4 accumulator fluid circuit and past the 4-3 sequence valve.

Torque Converter Clutch: The PCM releases the converter clutch prior to initiating the 4-3 downshift. However, if vehicle speed is above approximately 121 km/h (75 mph), the PCM will command TCC apply in Third gear.

Pressure Control Solenoid: Remember that the force motor continually adjusts torque signal fluid pressure in relation to the various PCM input signals (mainly throttle position).

SUMMARY

SHIFT SOLENOID		2-4 BAND	REVERSE INPUT CLUTCH	OVERRUN CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CL. ASSEMBLY	3-4 CLUTCH	LO/ROLLER CLUTCH	LO/REV. CLUTCH
1-2	2-3								
OFF	OFF				APPLIED	HOLDING	APPLIED		

RH0045-4L60-E

Figure 48 Overdrive Range – 4-3 Downshift (Legend)

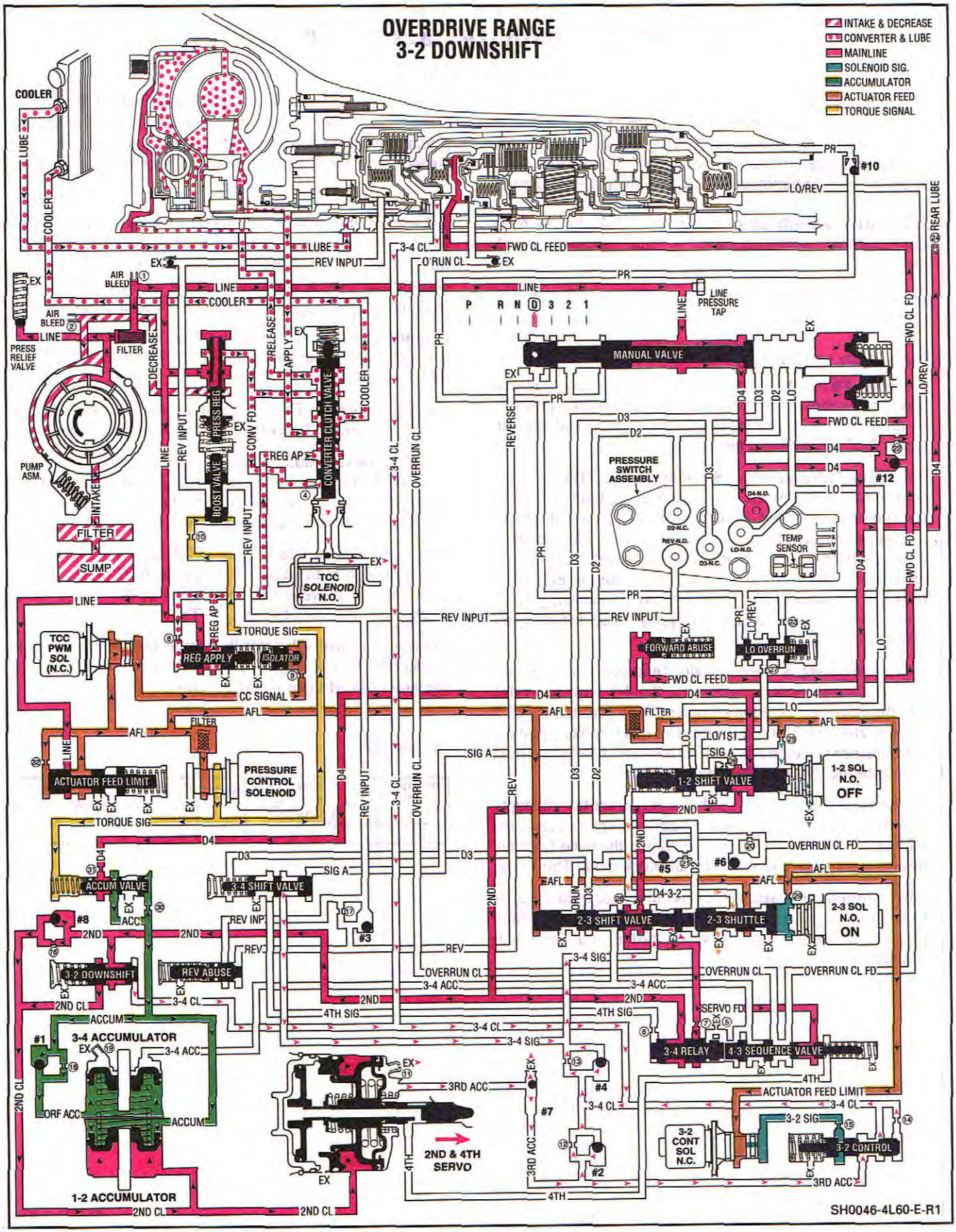


Figure 49 Overdrive Range – 3-2 Downshift

OVERDRIVE RANGE: 3-2 DOWNSHIFT

Similar to a forced 4-3 downshift, a forced 3-2 downshift can occur due to minimum throttle (coastdown conditions), heavy throttle or increased engine load. To achieve a forced 3-2 downshift, the PCM energizes the 2-3 shift solenoid and the following changes occur:

2-3 Shift Solenoid: Energized by the PCM, the normally open solenoid closes and blocks actuator feed limit (AFL) fluid from exhausting through the solenoid. This creates pressure in the AFL fluid circuit at the solenoid end of the 2-3 shift valve.

2-3 Shift Valve Train: AFL fluid pressure from the shift solenoid moves both valves to the downshifted position against AFL fluid pressure acting on the 2-3 shuttle valve. This causes the following changes:

- AFL fluid is blocked from the D432 fluid circuit and D432 fluid exhausts past the 2-3 shift valve.
- 2nd fluid is blocked from feeding the 3-4 signal fluid circuit and 2nd fluid is routed into the servo feed fluid circuit.
- 3-4 signal fluid is exhausted past the valve. 3-4 clutch fluid and 3rd accumulator fluid, which were fed by 3-4 signal fluid, also exhaust.

3-4 CLUTCH RELEASES and 2-4 BAND APPLIES

3-4 Clutch Piston: 3-4 clutch fluid exhausts from the piston and the 3-4 clutch plates are released.

3-4 Clutch Exhaust Checkball (#4): Exhausting 3-4 clutch fluid seats the #4 checkball and is forced through orifice #13. This orifice controls 3-4 clutch fluid exhaust and the 3-4 clutch release rate.

2-4 Servo Assembly: 3rd accumulator fluid exhausts from the servo assembly. 2nd clutch fluid pressure moves the 2nd apply piston against servo return spring force to move the apply pin and apply the 2-4 band.

3-2 Downshift Valve and 1-2 Upshift Checkball (#8): 3-4 clutch fluid exhausts from the valve and spring force moves the valve into the Second gear position. However, before spring force overcomes exhausting 3-4 clutch fluid pressure, 2nd fluid feeds the 2nd clutch fluid circuit through the valve. This bypasses the control of orifice #16 at the #8 checkball and provides a faster 2-4 band apply. Remember that the #8 checkball and orifice #16 are used to help control the 2-4 band apply during a 1-2 upshift.

DOWNSHIFT TIMING and CONTROL

At higher vehicle speeds the 2-4 band apply must be delayed to allow engine speed RPM to increase sufficiently for a smooth transfer of engine load to the 2-4 band. Therefore, exhaust of 3rd accumulator fluid must be delayed. However, at lower speeds the band must be applied quickly. To provide for the varying requirements for the 2-4 band apply rate, exhausting 3rd accumulator fluid is routed to both the 3rd accumulator checkball (#2) and the 3-2 control valve.

3rd Accumulator Checkball (#2): Exhausting 3rd accumulator fluid seats the #2 ball and is forced through orifice #12. This fluid exhausts through the 3-4 clutch and 3-4 signal fluid circuits and past the 2-3 shuttle valve. Orifice #12 slows the exhaust of 3rd accumulator fluid and delays the 2-4 band apply rate.

Note: The #12 orifice is not used on some models. For these models, all of the exhausting 3rd accumulator fluid is routed to the 3-2 control valve when the #2 checkball seats.

3-2 Control Solenoid and 3-2 Control Valve: These components are used to increase the exhaust rate of 3rd accumulator fluid; as needed depending on vehicle speed. The normally closed 3-2 control solenoid is Pulse Width Modulated (PWM) and controlled by the PCM through a duty cycle operation. The PCM decreases the solenoid's duty cycle during a 3-2 downshift from approximately 90% to as low as 10%. Once the shift is complete the solenoid returns to a 90% duty cycle. The duty cycle value during the shift controls the 2-4 band apply rate.

- At lower vehicle speed the PCM operates the 3-2 control solenoid at a lower duty cycle during the shift.
- At a lower duty cycle the solenoid regulates 3-2 signal fluid to a lower pressure.
- With lower 3-2 signal fluid pressure, 3-2 control valve spring force opens the valve farther to regulate a faster exhaust of 3rd accumulator fluid into the 3-4 clutch fluid circuit (as shown).
- A faster exhaust of 3rd accumulator exhaust provides a faster apply of the 2-4 band, as needed at lower speeds.

3rd Accumulator Exhaust Checkball (#7): After the downshift is completed, the #7 checkball unseats and allows residual fluid in the 3rd accumulator fluid circuit to exhaust.

Pressure Control Solenoid: Remember that the pressure control solenoid continually adjusts torque signal fluid in relation to the various PCM input signals (mainly throttle position).

SUMMARY

SHIFT SOLENOID		2-4 BAND	REVERSE INPUT CLUTCH	OVERRUN CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CL. ASSEMBLY	3-4 CLUTCH	LO/ROLLER CLUTCH	LO/REV. CLUTCH
1-2	2-3								
OFF	ON	APPLIED			APPLIED	HOLDING			

RH0047-4L60-E

Figure 50 Overdrive Range – 3-2 Downshift (Legend)

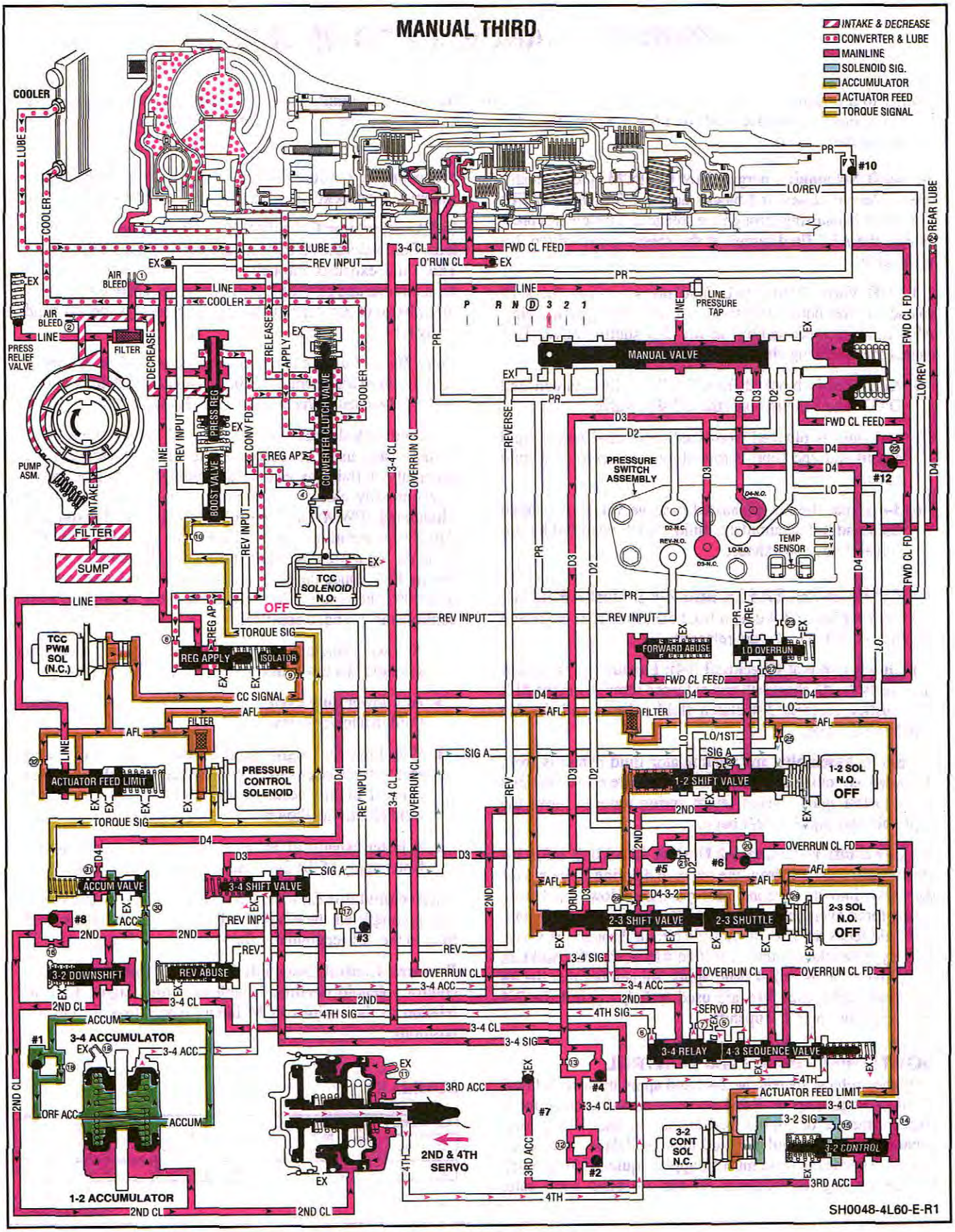


Figure 51 Manual Third

DRIVE RANGE - MANUAL THIRD
(from Overdrive Range - Fourth Gear)

A manual 4-3 downshift is available to increase vehicle performance when the use of only three gear ratios is desired. Manual Third gear range also provides engine braking in Third gear when the throttle is released. A manual 4-3 downshift is accomplished by moving the selector lever into the Manual Third (D) position. This moves the manual valve and immediately downshifts the transmission into Third gear. Refer to *Overdrive Range: 4-3 Downshift* for a complete description of a 4-3 downshift. In Manual Third, the transmission is prevented, both hydraulically and electronically, from shifting into Fourth gear. The following information explains the additional changes during a manual 4-3 downshift as compared to a forced 4-3 downshift.

Manual Valve: The selector lever moves the manual shaft and manual valve into the Manual Third position (D). This allows line pressure to enter the D3 fluid circuit.

Pressure Switch Assembly (PSA): D3 fluid is routed to the PSA and opens the normally closed D3 fluid pressure switch. The combination of the opened D3 switch and the closed D4 switch signals the PCM that the transmission is operating in Manual Third.

FOURTH GEAR PREVENTED

1-2 Shift Solenoid: When Manual Third is selected, the PCM de-energizes the 1-2 shift solenoid to immediately downshift the transmission into Third gear. This electronically prevents Fourth gear.

3-4 Shift Valve: D3 fluid pressure assists spring force to keep the valve in the downshifted position against the signal "A" fluid circuit. In this position the valve blocks 3-4 signal fluid and the 4th signal fluid circuit is open to an exhaust port past the valve. Therefore, with D3 fluid pressure assisting spring force, Fourth gear is hydraulically prevented.

OVERRUN CLUTCH APPLIED

2-3 Shift Valve Train: With the 2-3 shift solenoid de-energized and open, actuator feed limit (AFL) fluid acting on the 2-3 shuttle valve holds both valves in the upshifted position. This allows D3 fluid to feed the overrun fluid circuit through the 2-3 shuttle valve.

Overrun Clutch Feed Checkball (#5): Overrun fluid pressure seats the ball against the empty D2 fluid circuit.

Overrun Clutch Control Checkball (#6): Overrun fluid pressure seats the #6 checkball and is orificed (#20) to fill the overrun clutch feed fluid circuit. This orifice controls the overrun clutch apply rate.

3-4 Relay Valve and 4-3 Sequence Valve: 4th signal fluid pressure is exhausted from the end of the 3-4 relay valve. Overrun clutch feed fluid pressure assists spring force and closes both valves. This allows overrun clutch feed fluid to flow through the 4-3 sequence valve and fill the overrun clutch fluid circuit.

Overrun Clutch Piston: Overrun clutch fluid pressure moves the piston to apply the overrun clutch plates. The overrun clutch plates provide engine compression braking in Manual Third - Third Gear.

Overrun Clutch Air Bleed Checkball: This ball and capsule is located in the overrun clutch fluid circuit in the oil pump. It allows air to exhaust from the circuit as fluid pressure increases and also allows air into the circuit to displace the fluid when the clutch releases.

Torque Converter Clutch: The PCM de-energizes the TCC solenoid to release the converter clutch prior to downshifting (assuming the converter clutch is applied in Overdrive Range - Fourth Gear when Manual Third is selected). The PCM will re-apply the converter clutch in Manual Third - Third Gear only when vehicle speed is above approximately 121 km/h (75 mph).

Pressure Control Solenoid: The pressure control solenoid operates in the same manner as Overdrive Range, regulating in response to throttle position and other vehicle operating conditions.

MANUAL THIRD - FIRST and SECOND GEARS: OVERRUN CLUTCH RELEASED

In Manual Third the transmission upshifts and downshifts normally between First, Second and Third gears. However, in First and Second gears, the 2-3 shift solenoid is energized and the 2-3 shift valve train is in the downshifted position. The 2-3 shuttle valve blocks D3 fluid from entering the overrun fluid circuit and opens the overrun fluid circuit to an exhaust port at the valve. This prevents overrun clutch apply and engine compression braking in Manual Third - First and Second Gears.

SUMMARY

SHIFT SOLENOID		2-4 BAND	REVERSE INPUT CLUTCH	OVERRUN CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CL. ASSEMBLY	3-4 CLUTCH	LO/ROLLER CLUTCH	LO/REV. CLUTCH
1-2	2-3								
OFF	OFF			APPLIED	APPLIED	HOLDING	APPLIED		

RH0049-4L60-E

Figure 52 Manual Third (Legend)

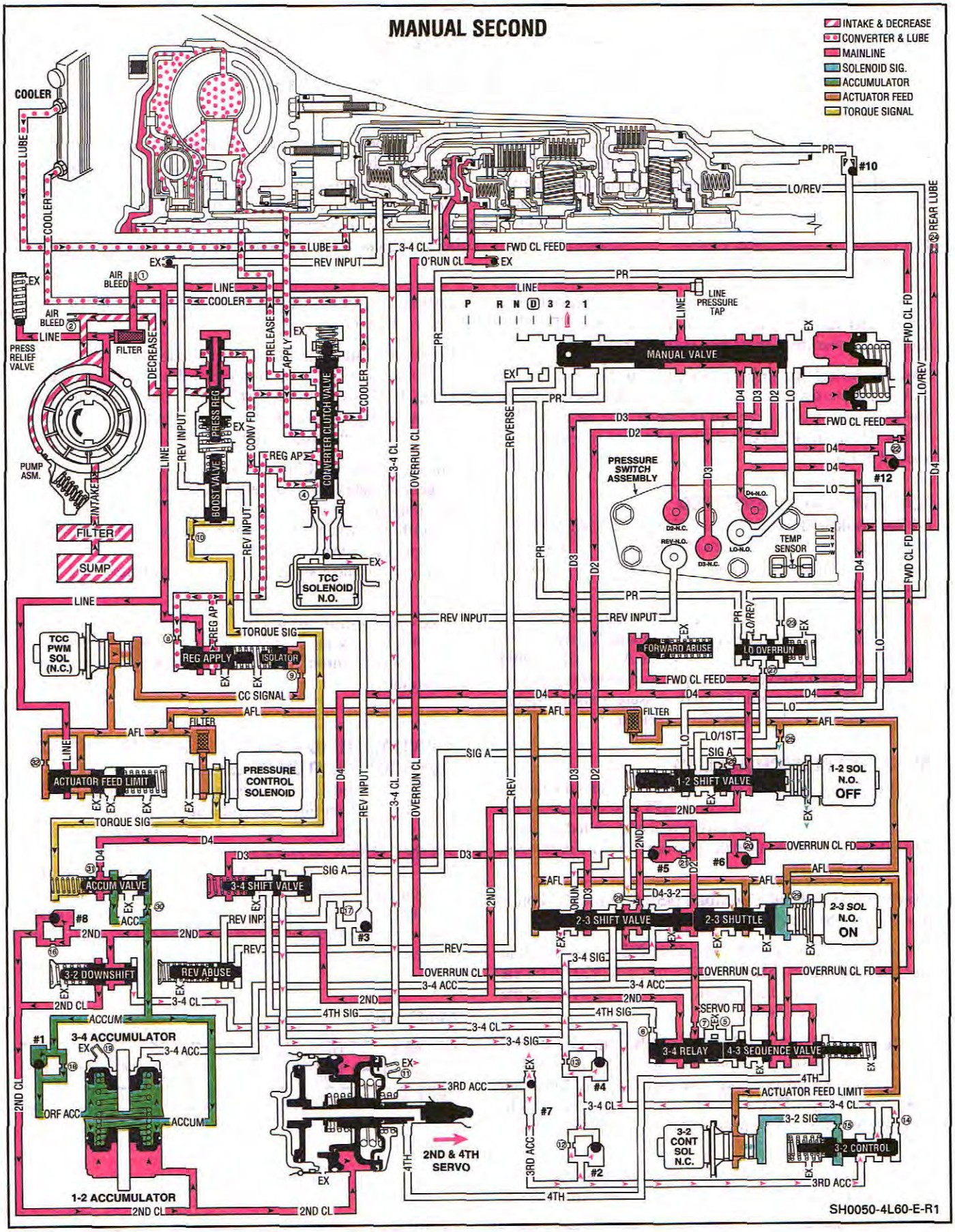


Figure 53 Manual Second

MANUAL SECOND - SECOND GEAR (from Manual Third - Third Gear)

A manual 3-2 downshift can be accomplished by moving the gear selector lever into the Manual Second (2) position when the transmission is operating in Third gear. This causes the transmission to shift immediately into Second gear regardless of vehicle operating conditions. Refer to *Overdrive Range: 3-2 Downshift* for a complete description of a 3-2 downshift. Also, the transmission is prevented from operating in any other gear, First, Third or Fourth. The following information explains the additional changes during a manual 3-2 downshift as compared to a forced 3-2 downshift.

Manual Valve: The selector lever moves the manual shaft and manual valve into the Manual Second (2) position. This allows line pressure to enter the D2 fluid circuit.

Pressure Switch Assembly (PSA): D2 fluid is routed to the PSA where it opens the normally closed D2 fluid pressure switch. With the D2, and D3 pressure switches closed and the D4 pressure switch open, the PSA signals the PCM that the transmission is operating in Manual Second.

THIRD and FOURTH GEARS PREVENTED

2-3 Shift Solenoid: The PCM energizes the 2-3 shift solenoid and AFL fluid pressure holds the 2-3 shift valve in the downshifted position. This electronically prevents Third and Fourth gears.

2-3 Shift Valve Train: D2 fluid is routed between the 2-3 shuttle and 2-3 shift valves and causes the following:

- Regardless of operating conditions, D2 fluid pressure holds the 2-3 shuttle valve in the downshifted position against AFL fluid pressure.
- 2nd fluid is blocked from entering the 3-4 signal fluid circuit and the 3-4 signal fluid circuit is open to an exhaust port at the valve.
- The 3-4 clutch cannot apply with 3-4 signal fluid exhausted. Therefore, Third and Fourth gears are hydraulically prevented.
- *2nd fluid feeds the servo feed fluid circuit but has no* function in Manual Second.
- AFL fluid is blocked by the 2-3 shift valve and the D432 fluid circuit is exhausted through the valve.
- Overrun fluid is exhausted through the 2-3 shuttle valve.

1-2 Shift Valve: *The 1-2 solenoid is OFF, signal "A" fluid* exhausts through the solenoid and spring force holds the valve in the upshifted position.

FIRST GEAR PREVENTED

The prevention of First gear in controlled electronically by the PCM through the 1-2 shift solenoid. The PCM keeps the 1-2 shift solenoid de-energized regardless of vehicle operating conditions when the PSA signals Manual Second gear range. This keeps signal "A" fluid exhausted and spring force holds the 1-2 shift valve in the upshifted position.

OVERRUN CLUTCH REMAINS APPLIED

Overrun Clutch Feed Checkball (#5): Orificed D2 fluid pressure seats the #5 checkball against the empty overrun clutch fluid circuit. This is done simultaneously with overrun clutch fluid exhausting such that there is a continuous fluid supply to the overrun clutch feed fluid circuit.

Overrun Clutch Piston: A continuous supply of fluid pressure is routed to the piston to keep the overrun clutch plates applied.

Torque Converter Clutch: The converter clutch is released prior to downshifting into Manual Second - Second Gear. Under normal operating conditions the TCC will not apply in Second gear.

Pressure Control Solenoid: The PCM output signal to the force motor increases the operating range of torque signal fluid pressure in Manual Second. This provides increased line pressure for the additional torque requirements during engine compression braking and increased engine loads.

SUMMARY

SHIFT SOLENOID		2-4 BAND	REVERSE INPUT CLUTCH	OVERRUN CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CL. ASSEMBLY	3-4 CLUTCH	LO/ROLLER CLUTCH	LO/REV. CLUTCH
1-2	2-3								
OFF	ON	APPLIED		APPLIED	APPLIED	HOLDING			

RH0051-4L60-E

Figure 54 Manual Second (Legend)

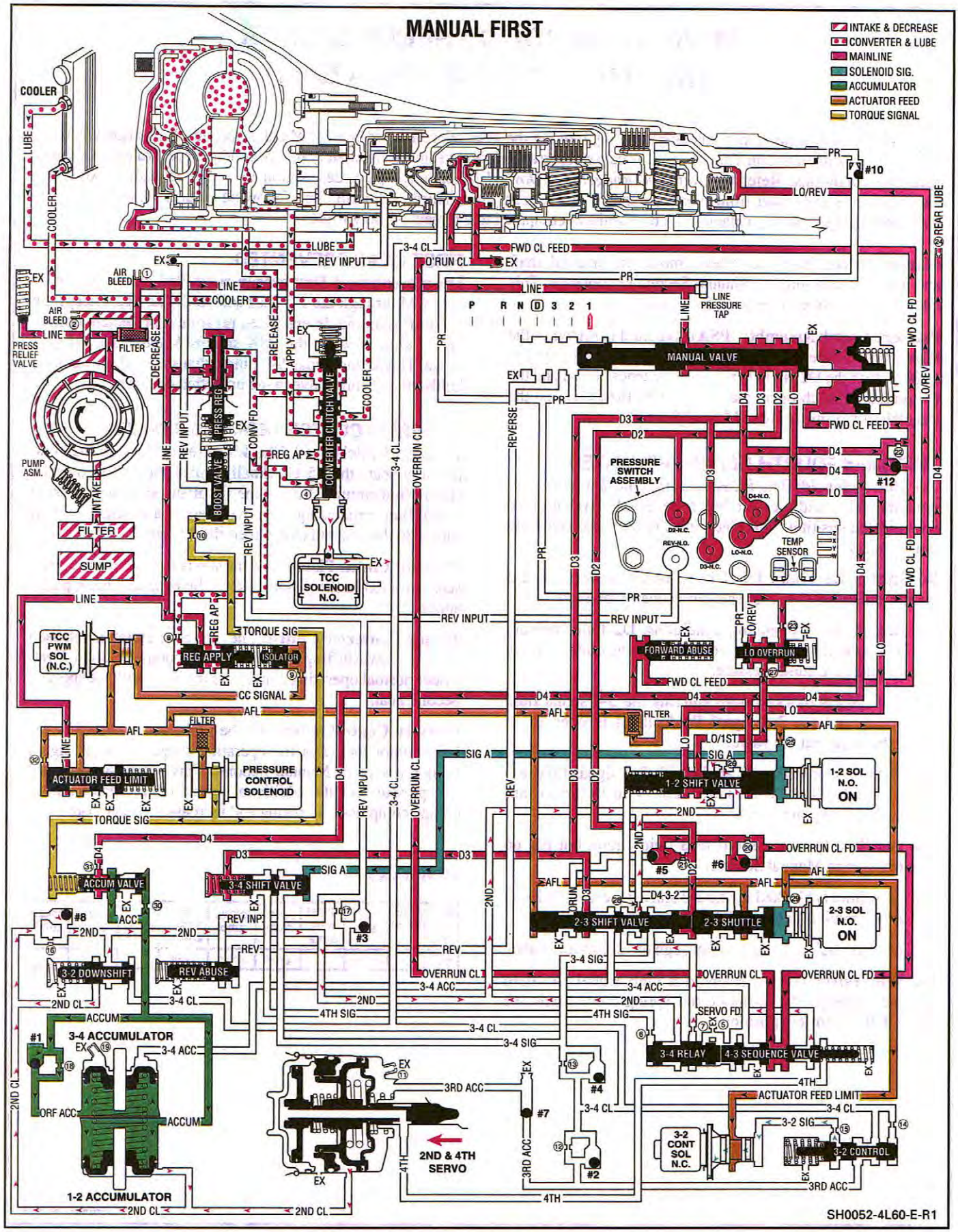


Figure 55 Manual First

MANUAL FIRST - FIRST GEAR
(from Manual Second - Second Gear)

A manual 2-1 downshift can be accomplished by moving the gear selector lever into the Manual First (1) position when the transmission is operating in Second gear. The downshift to First gear is controlled electronically by the PCM. The PCM will not energize the 1-2 shift solenoid to initiate the downshift until vehicle speed is below approximately 48 to 56 km/h (30 to 35 mph). Above this speed, the transmission will operate in a Manual First - Second Gear state. The following text explains the manual 2-1 downshift.

Manual Valve: The selector lever moves the manual shaft and manual valve into the Manual First (1) position. This allows line pressure to enter the lo fluid circuit.

Pressure Switch Assembly (PSA): Lo fluid is routed to the PSA where it closes the normally open lo pressure switch. The addition of the lo pressure switch being closed signals the PCM that Manual First is selected.

2-3 Shift Solenoid: In both First and Second gears this solenoid is energized and maintaining actuator feed limit (AFL) fluid pressure at the solenoid end of the 2-3 shift valve train.

2-3 Shift Valve Train: Held in the downshifted position by AFL fluid pressure from the solenoid, the valve train blocks AFL fluid from entering the D432 fluid circuit. The D432 fluid circuit is open to an exhaust past the valve.

1-2 Shift Solenoid: Below approximately 48 to 56 km/h (30 to 35 mph) the PCM energizes the normally open solenoid. This blocks signal "A" fluid pressure from exhausting through the solenoid and creates pressure in the signal "A" fluid circuit. Above this speed, the PCM keeps the solenoid de-energized and the transmission operates in Manual First - Second Gear.

1-2 Shift Valve: Signal "A" fluid pressure moves the valve against spring force and into the downshifted position. In this position, lo fluid from the manual valve is routed into the lo-1st fluid circuit and D4 fluid is blocked from entering the 2nd fluid circuit. 2nd fluid exhausts through an orifice and an annulus exhaust port past the valve. This orifice (#26) helps control the 2-4 band release during a 2-1 downshift.

2-4 BAND RELEASES

2-4 Servo Assembly: 2nd clutch fluid, which was fed by 2nd fluid, exhausts from the servo. This allows spring force from the servo cushion and servo return springs to move the 2nd apply piston and apply pin to release the 2-4 band. These spring forces help control the 2-4 band release.

1-2 Accumulator Assembly: 2nd clutch fluid also exhausts from the 1-2 accumulator assembly. Spring force and accumulator fluid pressure move the accumulator piston to assist 2nd clutch fluid exhaust.

Accumulator Valve: As accumulator fluid is filling the 1-2 accumulator assembly, the accumulator valve regulates D4 fluid into the accumulator fluid circuit. This regulation, biased by torque signal fluid pressure and spring force, helps control the movement of the 1-2 accumulator piston, 2nd clutch fluid exhaust and the 2-4 band release.

1-2 Upshift Checkball (#8): Exhausting 2nd clutch fluid pressure unseats the ball and is routed through the 2nd fluid circuit.

Converter Clutch Signal Valve: 2nd fluid exhausts from the converter clutch signal valve. Refer to Park range on for a description of the TCC signal valve operation in First gear.

LO and REVERSE CLUTCH APPLIES

Lo Overrun Valve: Lo 1st fluid is regulated through the lo overrun valve and into the lo/reverse fluid circuit to control the lo/reverse clutch apply.

Lo/Reverse Piston: Lo/reverse fluid pressure acts on the inner area of the piston to move the piston and apply the lo/reverse clutch plates.

OVERRUN CLUTCH APPLIED

The overrun clutch remains applied in Manual First to provide engine compression braking.

Pressure Control Solenoid: Similar to Manual Second, the PCM output signal to the force motor increases the operating range of torque signal fluid pressure. This provides increased line pressure for the additional torque requirements during engine compression braking and increased engine loads.

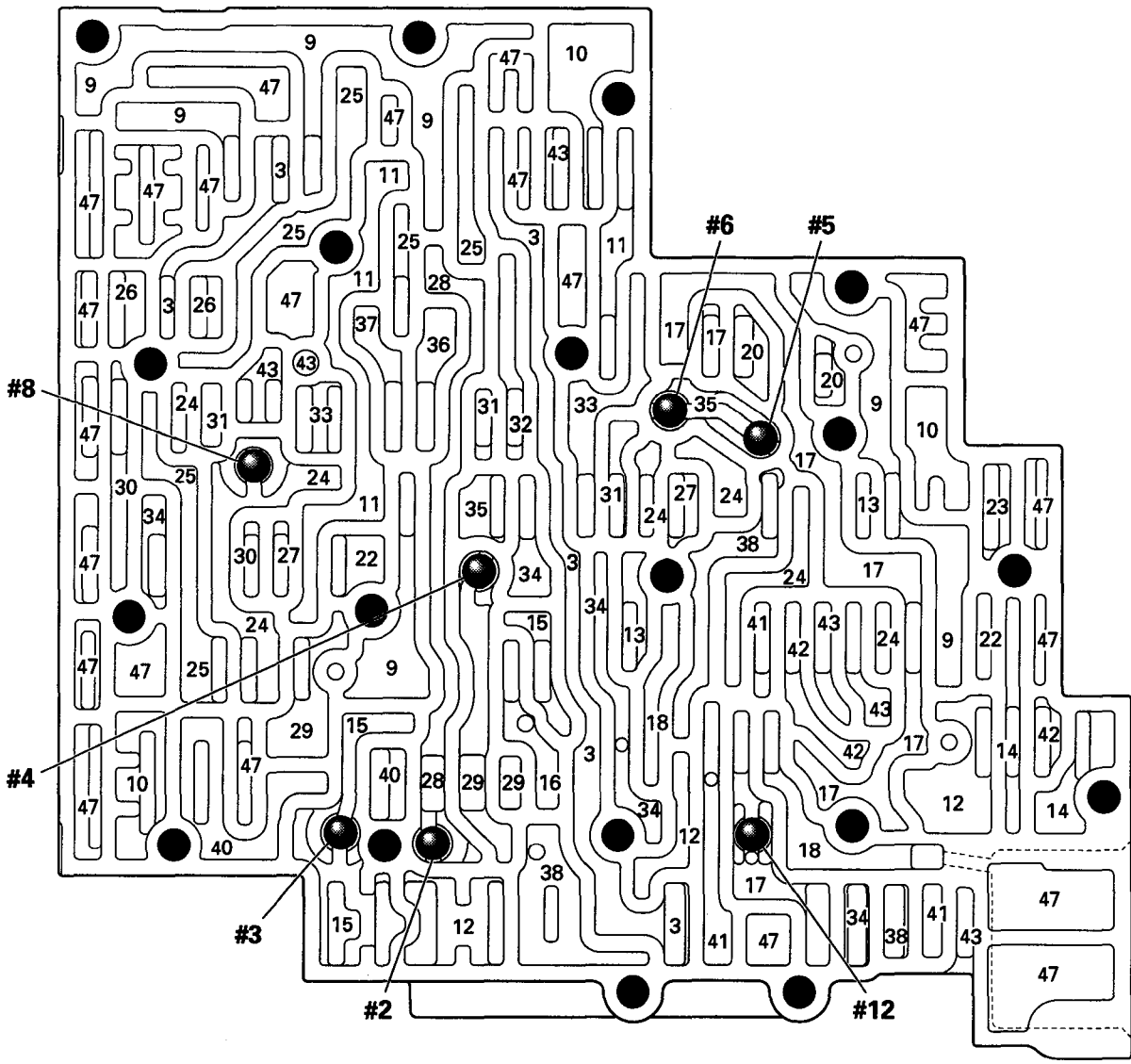
3-2 Downshift Control Solenoid and 3-2 Control Valve: In First gear the solenoid is OFF, AFL fluid is blocked by the solenoid, 3-2 signal fluid exhausts through the solenoid and spring force opens the 3-2 control valve.

SUMMARY

SHIFT SOLENOID		2-4 BAND	REVERSE INPUT CLUTCH	OVERRUN CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CL. ASSEMBLY	3-4 CLUTCH	LO/ROLLER CLUTCH	LO/REV. CLUTCH
1-2	2-3								
ON	ON			APPLIED	APPLIED	HOLDING		HOLDING	APPLIED

RH0053-4L60-E

Figure 56 Manual First (Legend)

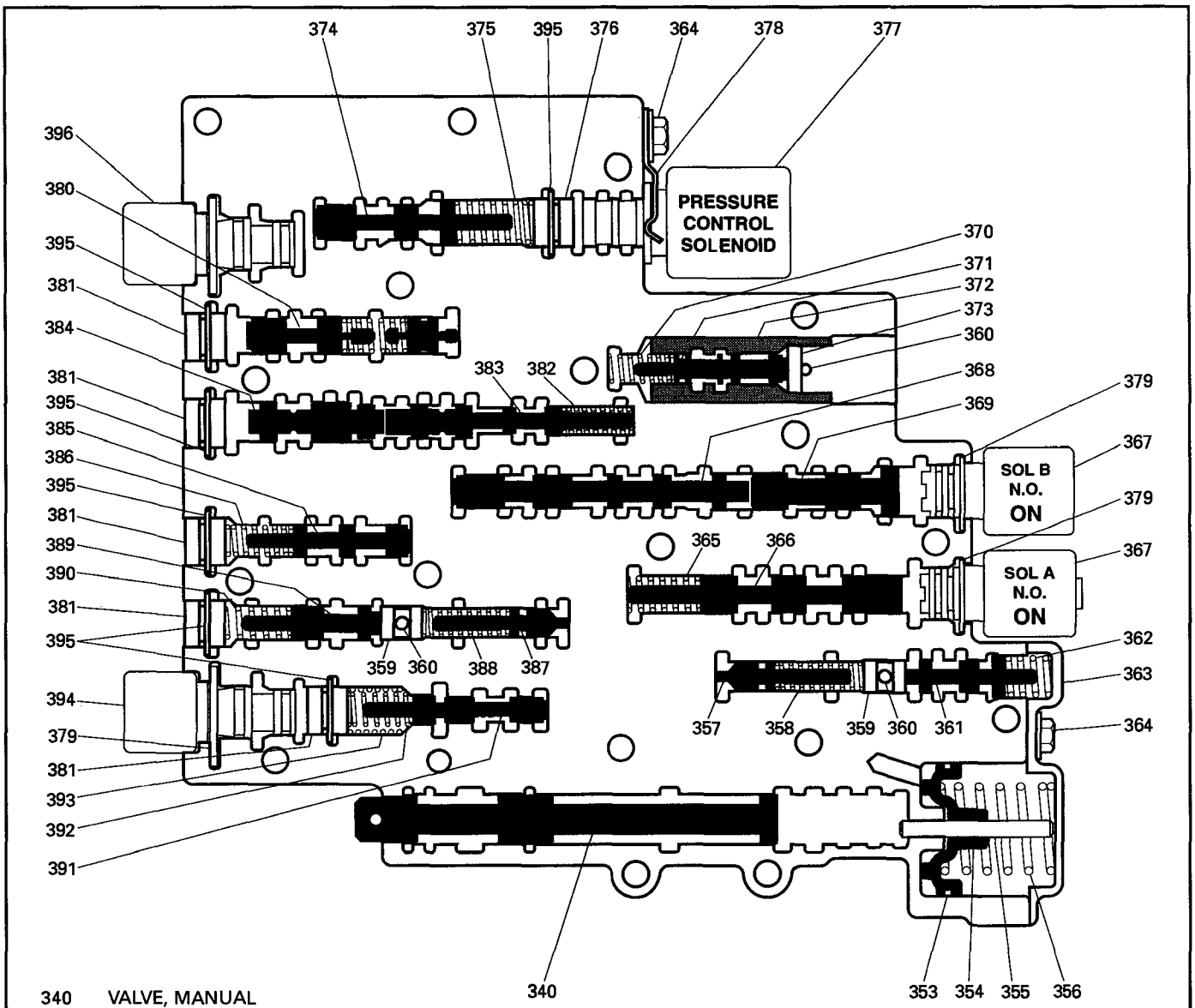


PASSAGES

1	SUCTION (INTAKE)	18	FORWARD CLUTCH FEED	35	OVERRUN
2	DECREASE	19	REAR LUBE	36	OVERRUN CLUTCH FEED
3	LINE	20	ACCUMULATOR	37	OVERRUN CLUTCH
4	CONVERTER FEED	21	ORIFICIED ACCUMULATOR	38	D2
5	RELEASE	22	SIGNAL A	39	ORIFICED D2
6	APPLY (REG APPLY)	23	SIGNAL B	40	3-2 SIGNAL
7	TO COOLER	24	2ND	41	LO
8	LUBE FROM COOLER	25	2ND CLUTCH	42	LO/1ST
9	ACTUATOR FEED LIMIT	26	C.C. SIGNAL	43	EXHAUST
10	FILTERED ACTUATOR FEED	27	3-4 SIGNAL	44	ORIFICED EXHAUST
11	TORQUE SIGNAL	28	3RD ACCUM	45	VENT
12	PR	29	3-4 CLUTCH	46	SEAL DRAIN
13	D4-3-2	30	4TH SIGNAL	47	VOID
14	LO/REVERSE	31	SERVO FEED		
15	REVERSE	32	4TH		
16	REVERSE INPUT (REV. CL.)	33	3-4 ACCUM		
17	D4	34	D3		

RH0054-4L60-E

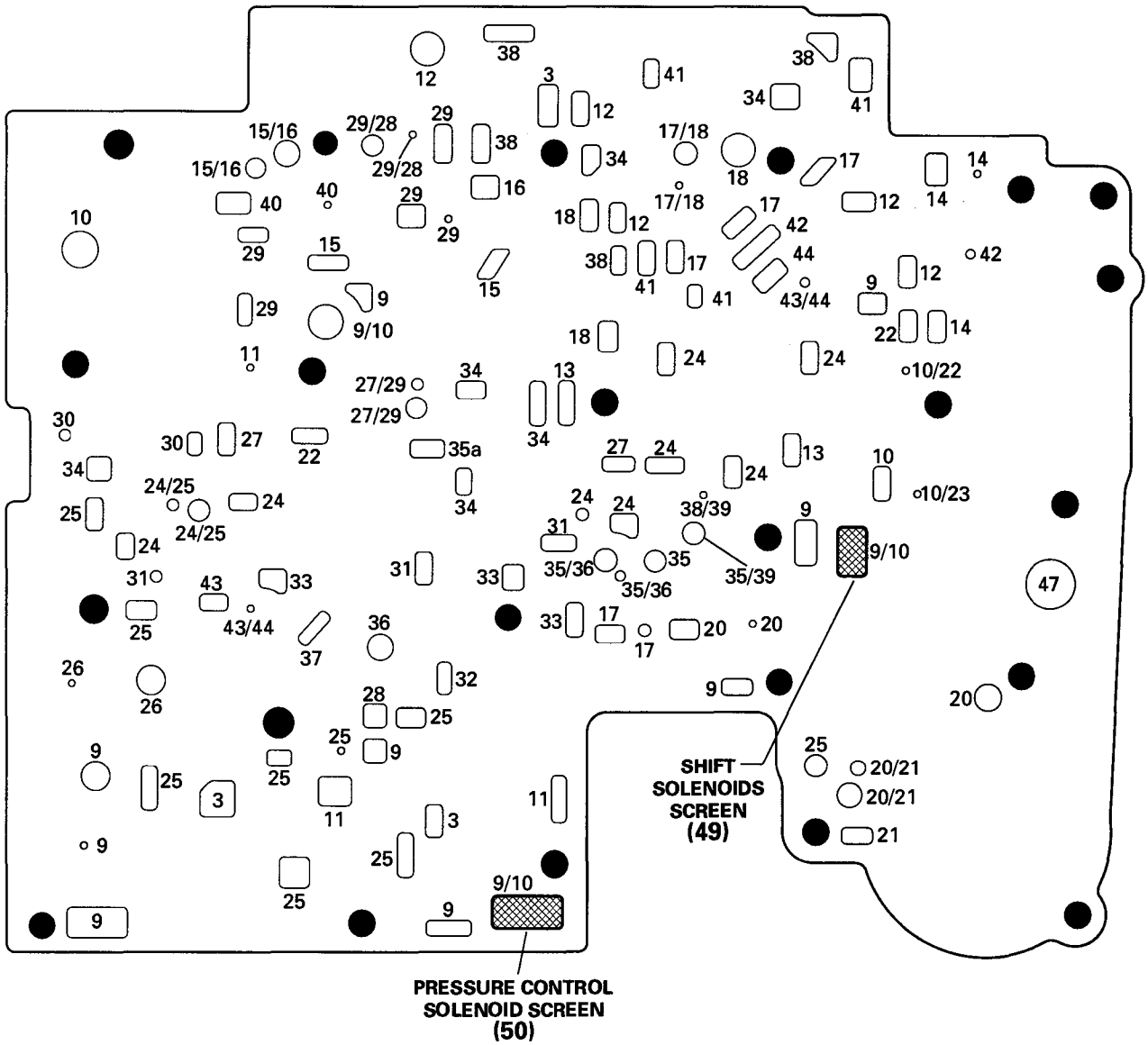
Figure 57 Valve Body Passages And Checkball Locations



340	VALVE, MANUAL
353	SEAL, FORWARD ACCUMULATOR OIL
354	PISTON, FORWARD ACCUMULATOR
355	PIN, FORWARD ACCUMULATOR
356	SPRING, FORWARD ACCUMULATOR
357	VALVE, FORWARD ABUSE
358	SPRING, FORWARD ABUSE VALVE
359	PLUG, BORE
360	PIN, COILED SPRING
361	VALVE, LOW OVERRUN
362	SPRING, LOW OVERRUN VALVE
363	COVER, FORWARD ACCUMULATOR
364	BOLT, FORWARD ACCUMULATOR COVER
365	SPRING, 1-2 SHIFT VALVE
366	VALVE, 1-2 SHIFT
367-A	1-2 SHIFT SOLENOID (A)
367-B	2-3 SHIFT SOLENOID (B)
368	VALVE, 2-3 SHIFT
369	VALVE, 2-3 SHUTTLE
370	SPRING, 1-2 ACCUMULATOR VALVE
371	VALVE, 1-2 ACCUMULATOR
372	SLEEVE, 1-2 ACCUMULATOR VALVE
373	PLUG, BORE
374	VALVE, ACTUATOR FEED LIMIT
375	SPRING, ACTUATOR FEED LIMIT VALVE
376	PLUG, BORE
377	PRESSURE CONTROL SOLENOID
378	RETAINER, PRESSURE CONTROL SOLENOID
379	RETAINER, SOLENOID
380	VALVE, CONVERTER CLUTCH SIGNAL
381	PLUG, BORE
382	SPRING, 4-3 SEQUENCE VALVE
383	VALVE, 4-3 SEQUENCE
384	VALVE, 3-4 RELAY
385	VALVE, 3-4 SHIFT
386	SPRING, 3-4 SHIFT VALVE
387	VALVE, REVERSE ABUSE
388	SPRING, REVERSE ABUSE VALVE
389	VALVE, 3-2 DOWNSHIFT
390	SPRING, 3-2 DOWNSHIFT VALVE
391	VALVE, 3-2 CONTROL
392	SPRING, 3-2 CONTROL VALVE
393	SPRING, BORE PLUG
394	3-2 CONTROL SOLENOID
395	RETAINER, BORE PLUG
396	TCC CONTROL SOLENOID

SH0055-4L60-E

Figure 58 Valve Trains

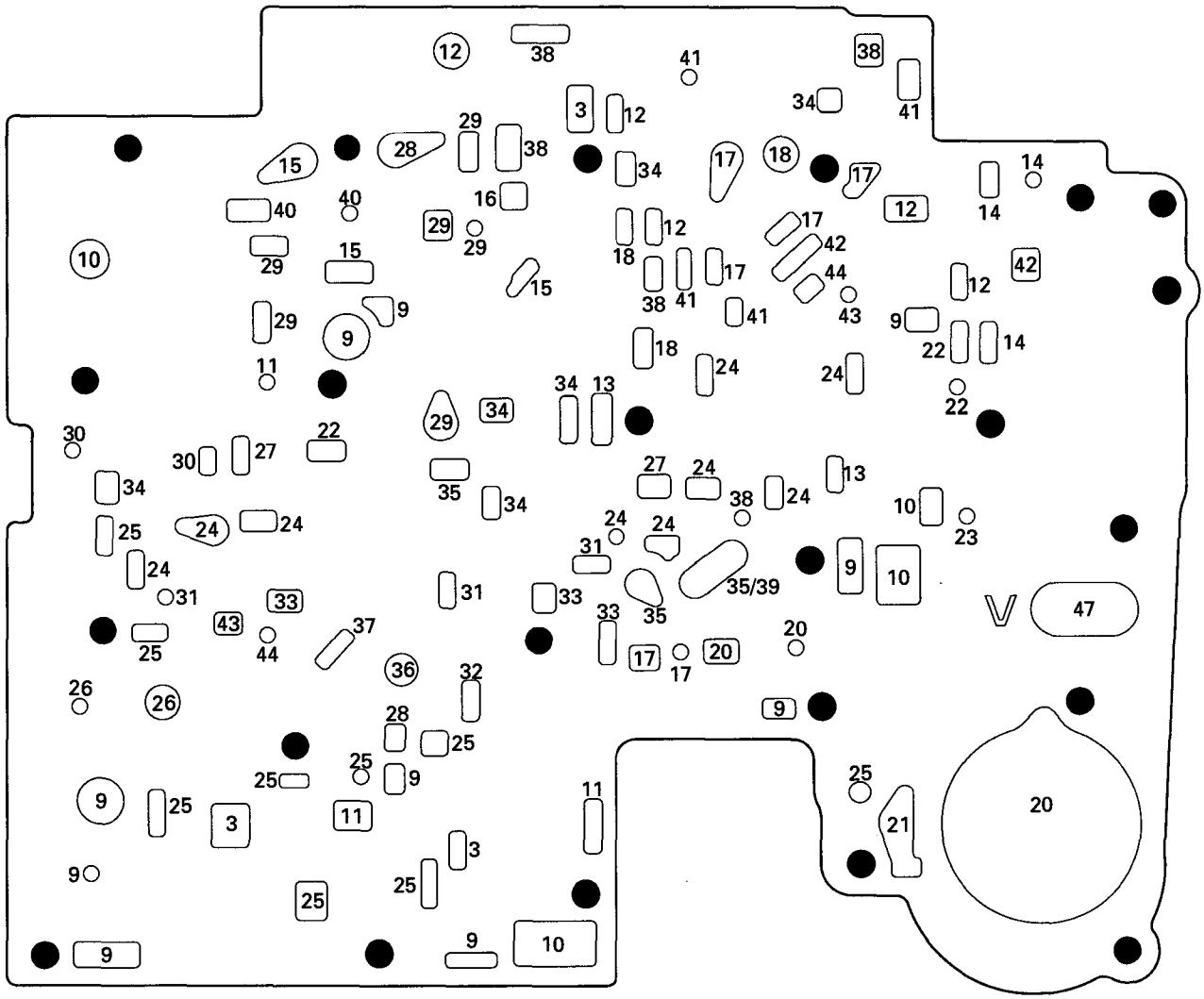


PASSAGES

1	SUCTION (INTAKE)	18	FORWARD CLUTCH FEED	35	OVERRUN
2	DECREASE	19	REAR LUBE	36	OVERRUN CLUTCH FEED
3	LINE	20	ACCUMULATOR	37	OVERRUN CLUTCH
4	CONVERTER FEED	21	ORIFICIED ACCUMULATOR	38	D2
5	RELEASE	22	SIGNAL A	39	ORIFICED D2
6	APPLY (REG APPLY)	23	SIGNAL B	40	3-2 SIGNAL
7	TO COOLER	24	2ND	41	LO
8	LUBE FROM COOLER	25	2ND CLUTCH	42	LO/1ST
9	ACTUATOR FEED LIMIT	26	C.C. SIGNAL	43	EXHAUST
10	FILTERED ACTUATOR FEED	27	3-4 SIGNAL	44	ORIFICED EXHAUST
11	TORQUE SIGNAL	28	3RD ACCUM	45	VENT
12	PR	29	3-4 CLUTCH	46	SEAL DRAIN
13	D4-3-2	30	4TH SIGNAL	47	VOID
14	LO/REVERSE	31	SERVO FEED		
15	REVERSE	32	4TH		
16	REVERSE INPUT (REV. CL.)	33	3-4 ACCUM		
17	D4	34	D3		

SH0056-4L60-E

Figure 59 Spacer Plate Passages

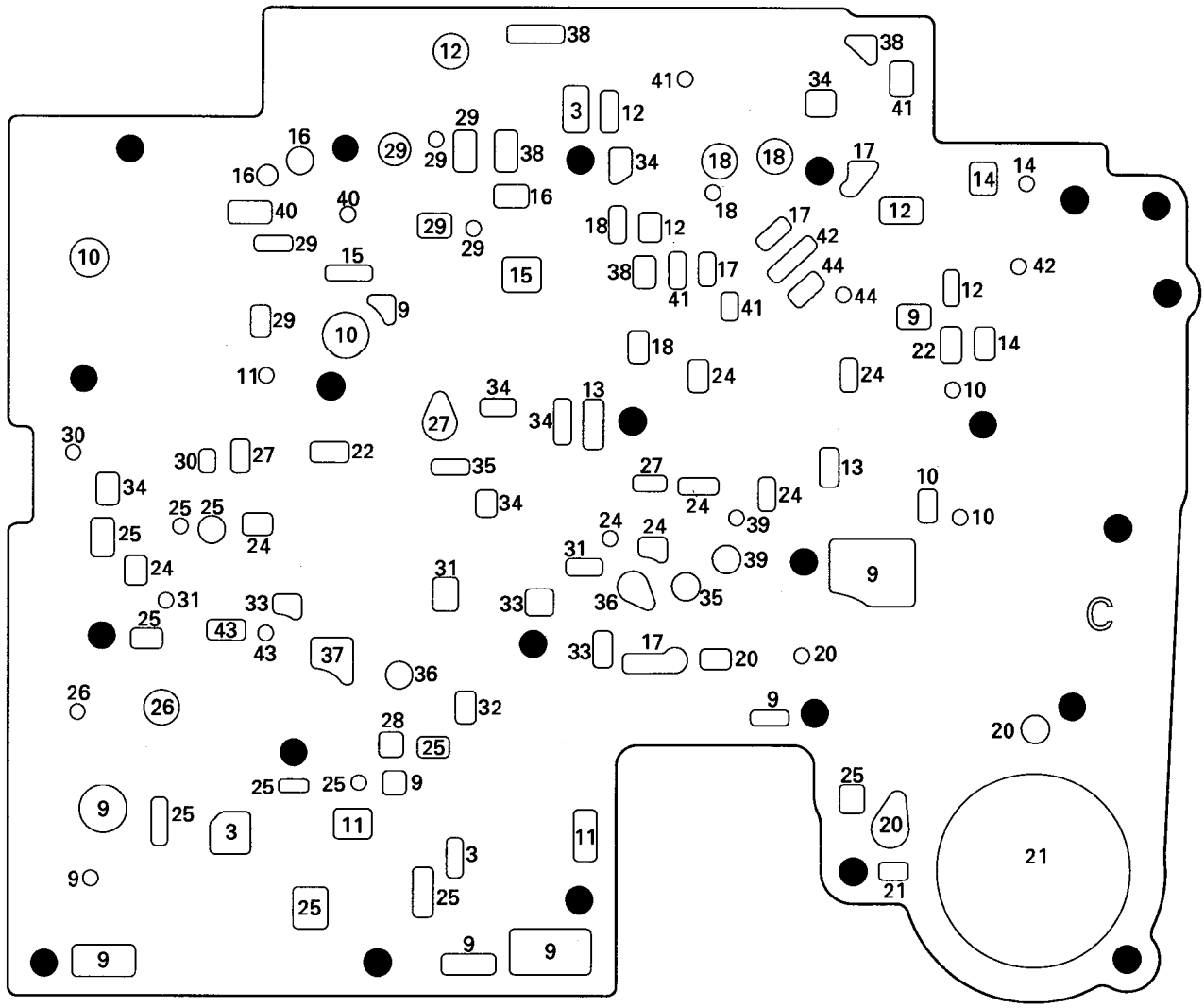


PASSAGES

1	SUCTION (INTAKE)	18	FORWARD CLUTCH FEED	35	OVERRUN
2	DECREASE	19	REAR LUBE	36	OVERRUN CLUTCH FEED
3	LINE	20	ACCUMULATOR	37	OVERRUN CLUTCH
4	CONVERTER FEED	21	ORIFICIED ACCUMULATOR	38	D2
5	RELEASE	22	SIGNAL A	39	ORIFICED D2
6	APPLY (REG APPLY)	23	SIGNAL B	40	3-2 SIGNAL
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10	FILTERED ACTUATOR FEED	27	3-4 SIGNAL	44	ORIFICED EXHAUST
11	TORQUE SIGNAL	28	3RD ACCUM	45	VENT
12	PR	29	3-4 CLUTCH	46	SEAL DRAIN
13	D4-3-2	30	4TH SIGNAL	47	VOID
14	LO/REVERSE	31	SERVO FEED		
15	REVERSE	32	4TH		
16	REVERSE INPUT (REV. CL.)	33	3-4 ACCUM		
17	D4	34	D3		

SH0057-4L60-E

Figure 60 Spacer Plate to Valve Body Gasket

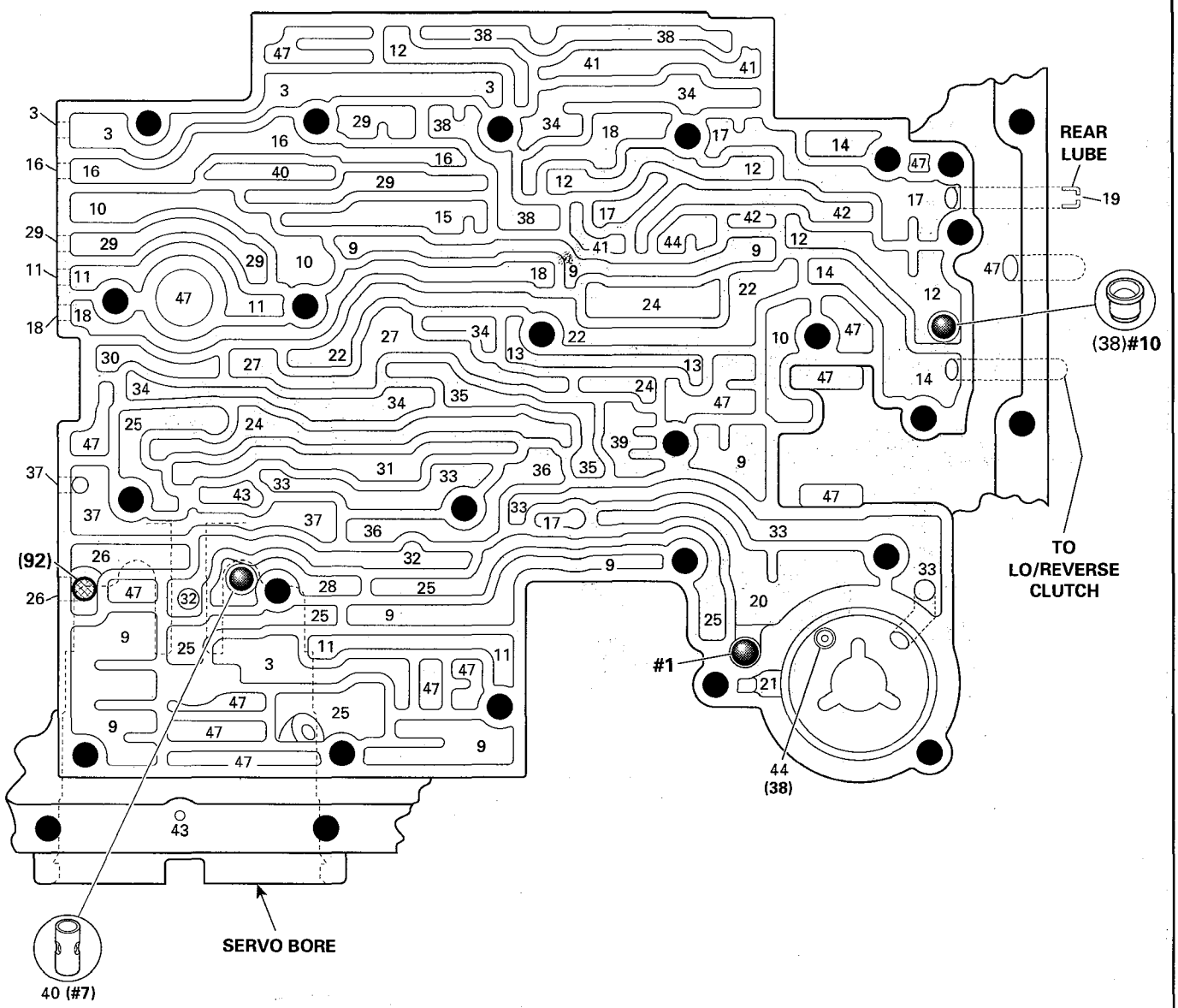


PASSAGES

1	SUCTION (INTAKE)	18	FORWARD CLUTCH FEED	35	OVERRUN
2	DECREASE	19	REAR LUBE	36	OVERRUN CLUTCH FEED
3	LINE	20	ACCUMULATOR	37	OVERRUN CLUTCH
4	CONVERTER FEED	21	ORIFICIED ACCUMULATOR	38	D2
5	RELEASE	22	SIGNAL A	39	ORIFICED D2
6	APPLY (REG APPLY)	23	SIGNAL B	40	3-2 SIGNAL
7	TO COOLER	24	2ND	41	LO
8	LUBE FROM COOLER	25	2ND CLUTCH	42	LO/1ST
9	ACTUATOR FEED LIMIT	26	C.C. SIGNAL	43	EXHAUST
10	FILTERED ACTUATOR FEED	27	3-4 SIGNAL	44	ORIFICED EXHAUST
11	TORQUE SIGNAL	28	3RD ACCUM	45	VENT
12	PR	29	3-4 CLUTCH	46	SEAL DRAIN
13	D4-3-2	30	4TH SIGNAL	47	VOID
14	LO/REVERSE	31	SERVO FEED		
15	REVERSE	32	4TH		
16	REVERSE INPUT (REV. CL.)	33	3-4 ACCUM		
17	D4	34	D3		

RH0058-4L60-E

Figure 61 Spacer Plate to Case Gasket



PASSAGES

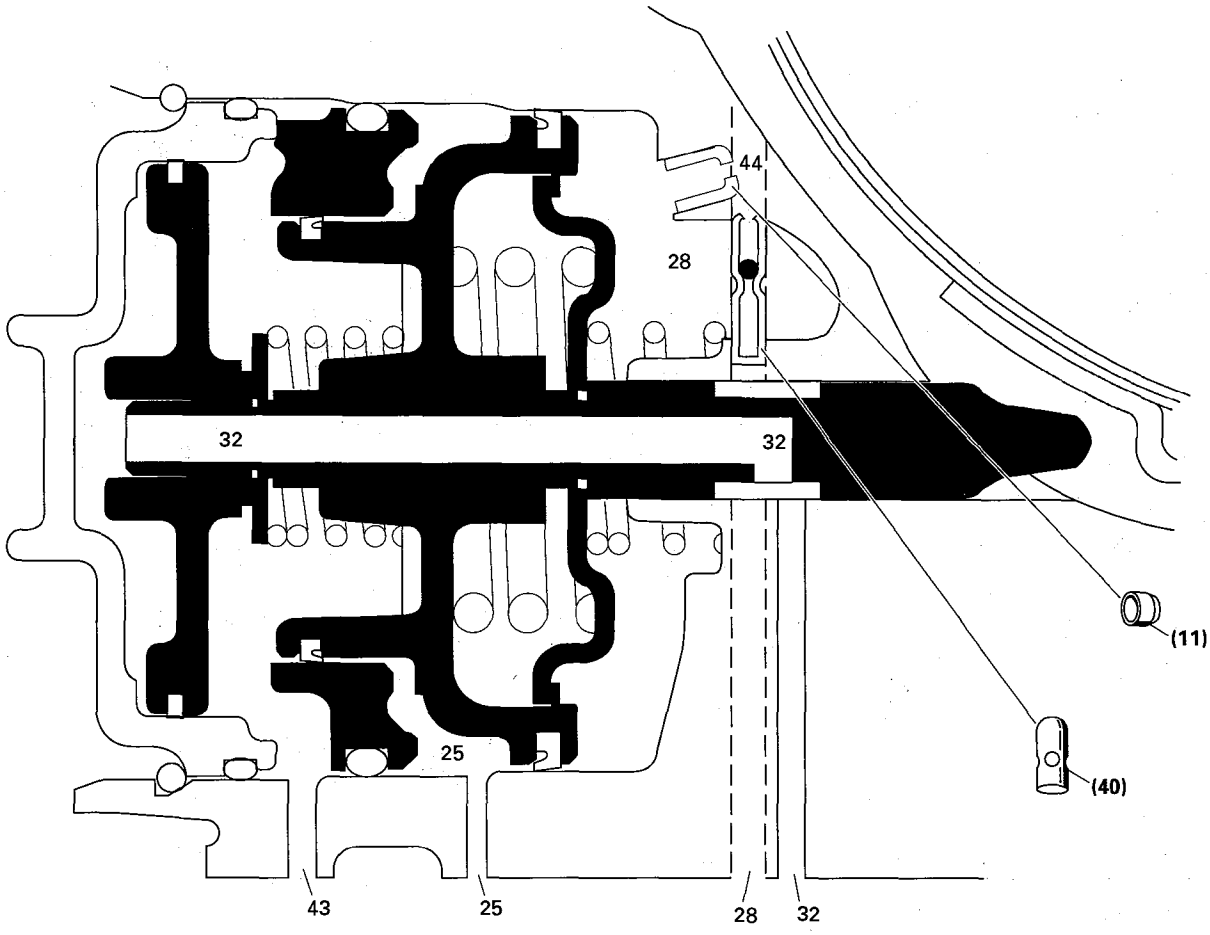
1 SUCTION (INTAKE)
2 DECREASE
3 LINE
4 CONVERTER FEED
5 RELEASE
6 APPLY (REG APPLY)
7 TO COOLER
8 LUBE FROM COOLER
9 ACTUATOR FEED LIMIT
10 FILTERED ACTUATOR FEED
11 TORQUE SIGNAL
12 PR
13 D4-3-2
14 LO/REVERSE
15 REVERSE
16 REVERSE INPUT (REV. CL.)
17 D4
18 FORWARD CLUTCH FEED
19 REAR LUBE
20 ACCUMULATOR
21 ORIFICIED ACCUMULATOR
22 SIGNAL A
23 SIGNAL B
24 2ND
25 2ND CLUTCH
26 C.C. SIGNAL
27 3-4 SIGNAL
28 3RD ACCUM
29 3-4 CLUTCH
30 4TH SIGNAL
31 SERVO FEED
32 4TH
33 3-4 ACCUM
34 D3
35 OVERRUN
36 OVERRUN CLUTCH FEED
37 OVERRUN CLUTCH
38 D2
39 ORIFICED D2
40 3-2 SIGNAL
41 LO
42 LO/1ST
43 EXHAUST
44 ORIFICED EXHAUST
45 VENT
46 SEAL DRAIN
47 VOID

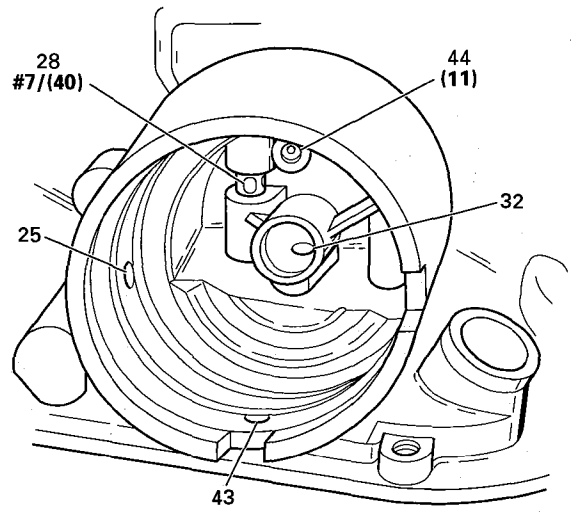
COMPONENTS ( )

(38) ACCUMULATOR BLEED PLUG
(40) 3RD ACCUM. RETAINER AND
(92) TCC SCREEN

RH0059-4L60-E

Figure 62 Case Passages and Checkball Locations





PASSAGES

25 2ND CLUTCH
28 3RD ACCUMULATOR
32 4TH
43 EXHAUST
44 ORIFICED EXHAUST

COMPONENTS ( )

(11) CASE SERVO ORIFICED PLUG
(40) 3RD ACCUM. RETAINER AND BALL ASSEMBLY (#7)

RH0062-4L60-E

Figure 63 2-4 Servo Passages

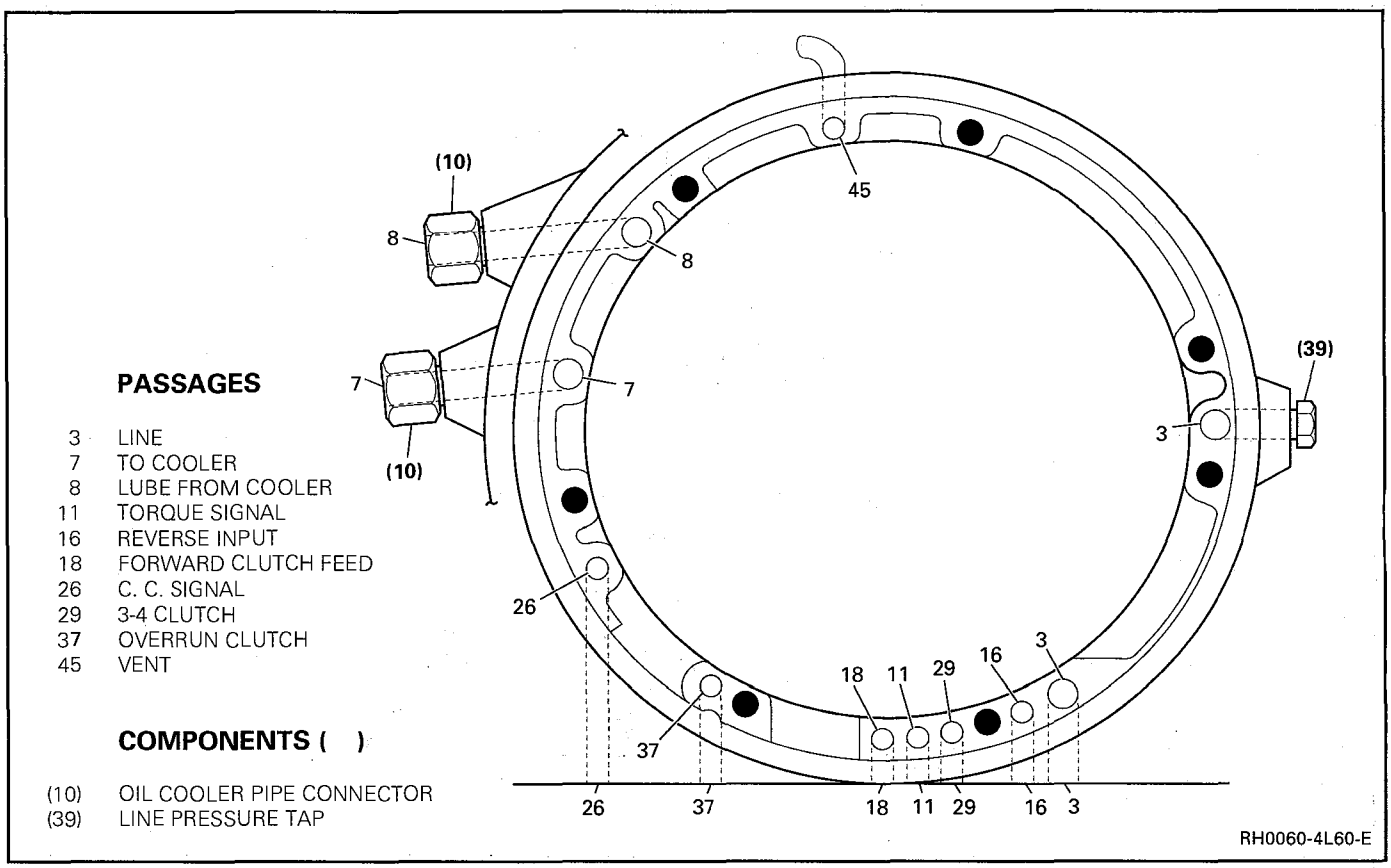


Figure 64 Pump to Case Passages

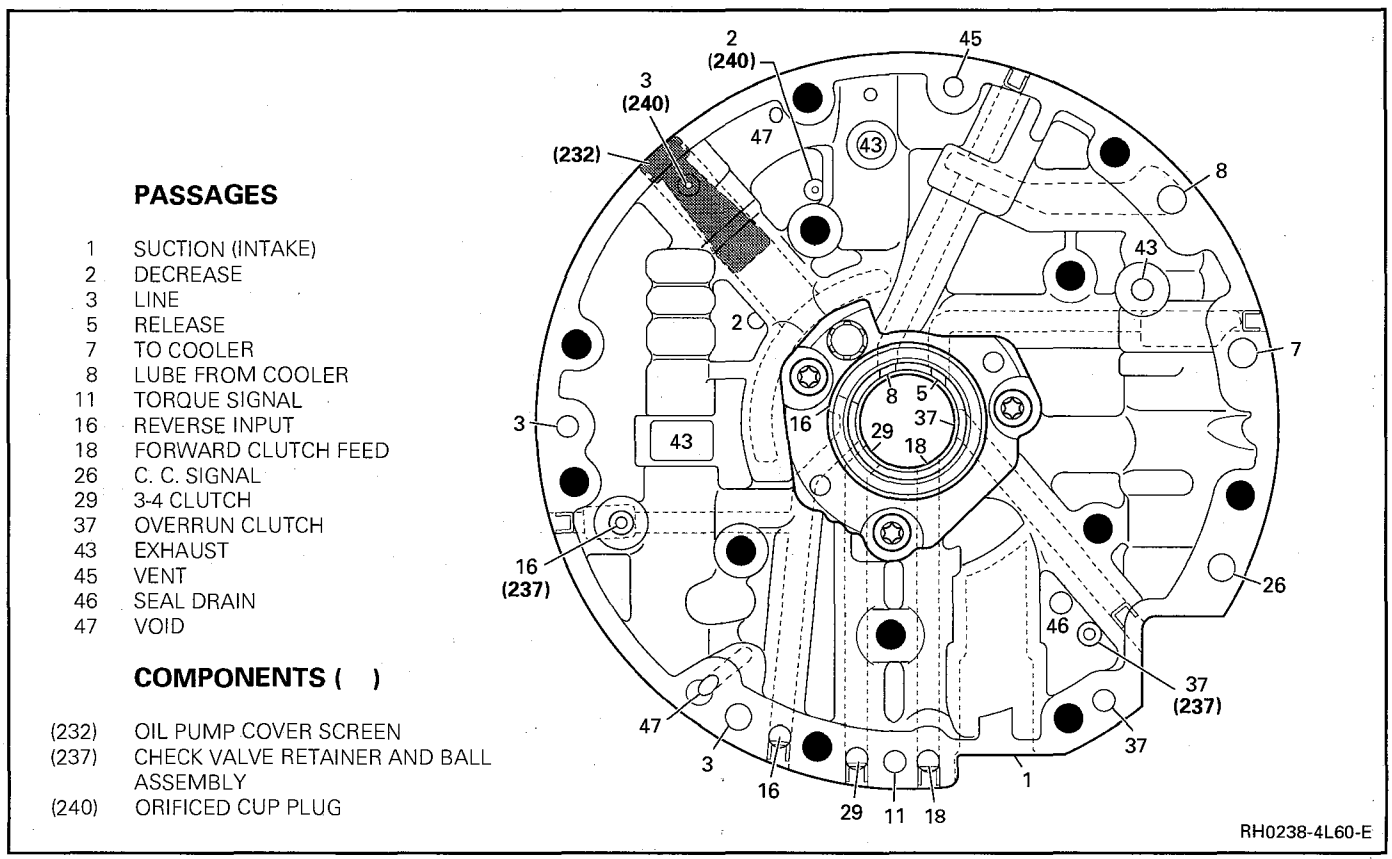


Figure 65 Pump Cover Passages (Case Side)

PASSAGES

1	SUCTION (INTAKE)
2	DECREASE
3	LINE
4	CONVERTER FEED
5	RELEASE
6	APPLY
7	TO COOLER
8	LUBE FROM COOLER
11	TORQUE SIGNAL
16	REVERSE INPUT
18	FORWARD CLUTCH FEED
26	C. C. SIGNAL
29	3-4 CLUTCH
37	OVERRUN CLUTCH
43	EXHAUST
45	VENT
47	VOID

COMPONENTS ( )

(232)	OIL PUMP COVER SCREEN
(237)	CHECK VALVE RETAINER AND BALL ASSEMBLY
(238)	CONVERTER CLUTCH SIGNAL ORIFICED CUP PLUG
(240)	ORIFICED CUP PLUG

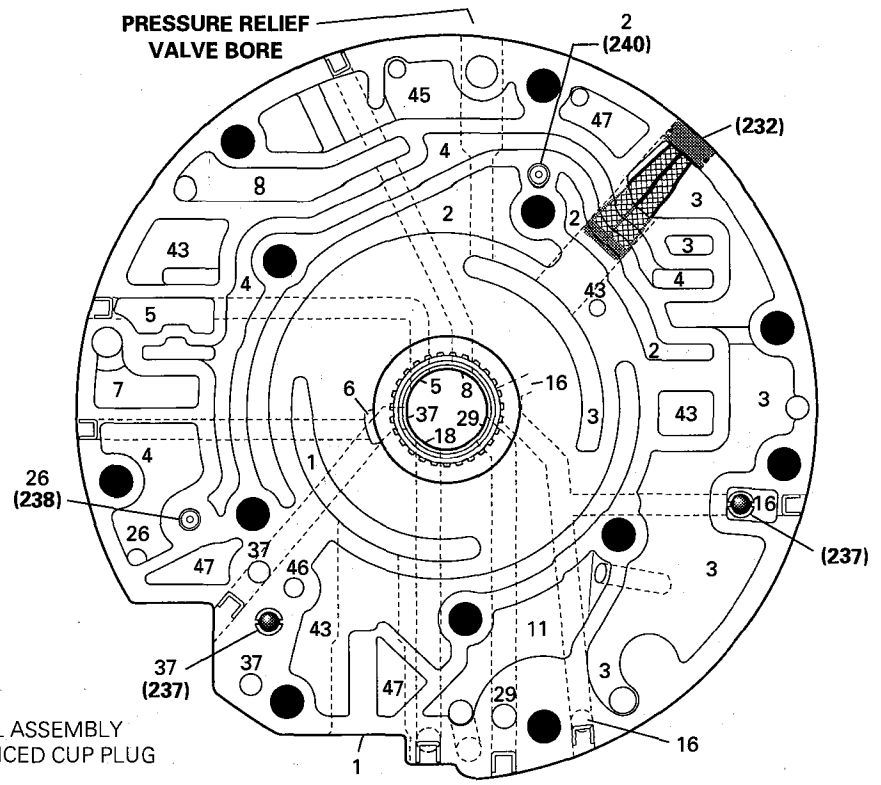


Figure 66 Pump Cover Passages

PASSAGES

1	SUCTION (INTAKE)
2	DECREASE
3	LINE
4	CONVERTER FEED
5	RELEASE
7	TO COOLER
11	TORQUE SIGNAL
16	REVERSE INPUT
26	C. C. SIGNAL
29	3-4 CLUTCH
37	OVERRUN CLUTCH
43	EXHAUST
45	VENT
46	SEAL DRAIN
47	VOID

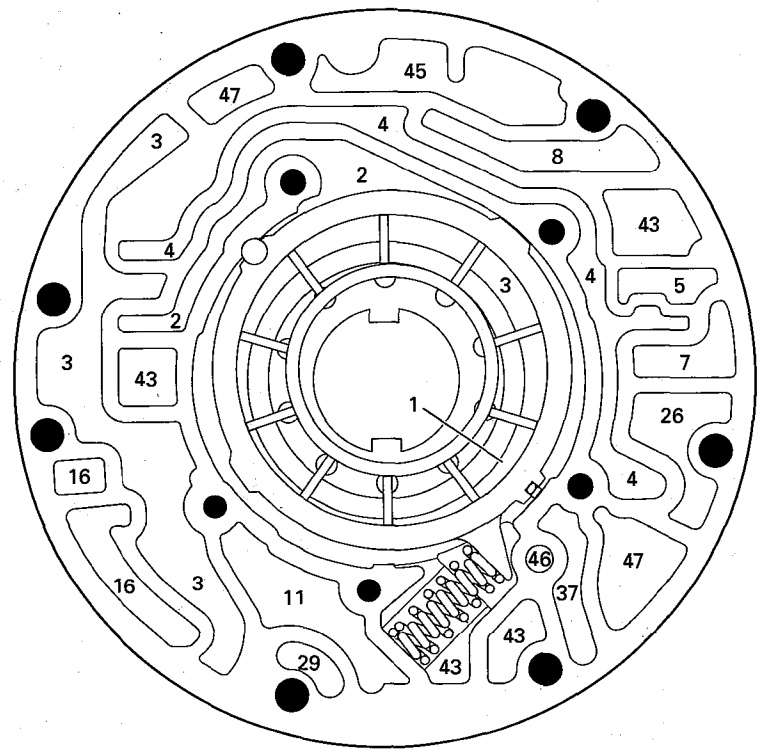
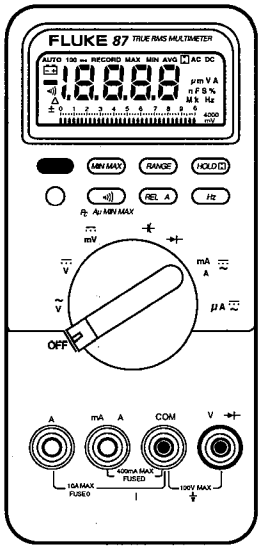


Figure 67 Pump Body Passages



FLUKE 87 TRUE RMS MUTIMETER
J 39200

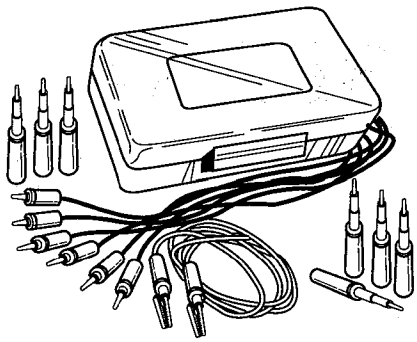
VOLTMETER – Voltage position measures magnitude of voltage when connected in parallel to an existing circuit. A digital voltmeter with a 10 meg ohm input impendance is used because this type of meter will not load down the circuit and result in faulty readings. Some circuits require accurate low voltage readings because they have a very high resistance.

AMMETER – When used as an ammeter, this meter accurately measures extremely low current flow. Refer to meter instructions for more information.

- Selector must be set properly for both function and range. DCis used for most automotive measurements.

OHMMETER – Measures resistance of circuit directly in ohms. Refer to meter instructions for more information.

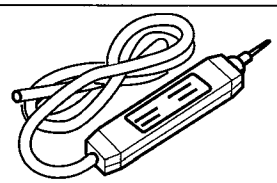
- OL display in all ranges indicates open circuit.
- Zero display in all ranges indicates a short circuit.
- An interrmittent connection in a circuit may be indicated by a digital reading that will not stabilize on the circuit.
- Autoranges to the 400 Ω, 4 kΩ, 40 kΩ, 400 kΩ, 4 MΩ, or 40 MΩ resistance range.



J 35616-A

CONNECTOR TEST ADAPTER KIT

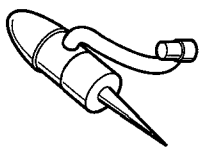
Assortment of flexable connectors to adapt a multimeter or jumper cords to connectors.



J 34636

CIRCUIT TESTER

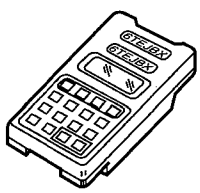
Used for checking all relays and solenoids before connecting them to a new ECM. Measures the circuit resistance and indicates pass or fail via green or red LED. Amber LED indicates current polarity. Can also be used as a non-powered continuity checker.



J 34142-A

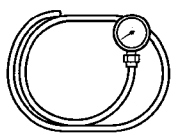
UNPOWERED TEST LIGHT

Used for checking wiring for complete circuit, short to ground, or voltage.



TECH 1 TESTER

Used to check solenoids and other electronic components. Can record vehicle data during dynamic testing, and turn some electronic components on and off.



J 21867

UNIVERSAL PRESSURE GAUGE SET

(9 Ft. Hose; 0-300 PSI)

Used for checking line pressure, pump output (min., max.) in all gear ranges.

RH0239-4L60-E

Figure 68 Electrical Diagnosis Tools

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SECTION 7A-14B
HYDRA-MATIC 4L60-E
AUTOMATIC TRANSMISSION UNIT REPAIR
RPO M30

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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TRANSMISSION DISASSEMBLY

General Service Information

Figure 1

Tool Required:

J 8763-02 Holding Fixture and Base

NOTICE: It is not recommended to use air powered tools to disassemble or assemble transmissions/transaxles. Improper bolt torques can contribute to transmission repair conditions and this information, vital to diagnosis, can only be detected when using hand tools.

- Teflon Oil Seal Rings
  If any seal rings are damaged, cut, or do not rotate freely in their groove be certain to check the ring groove for debris, burrs, or damage.
- Thrust Washer Surfaces
  The thrust washer and thrust bearing surfaces may appear to be polished. This is a normal condition and should not be considered damage.

Clean

- Thoroughly clean the exterior of the transmission.

Remove or Disconnect

- Torque Converter (1).

Install or Connect

1. J 8763-02 onto the transmission case.
2. Holding fixture into the base.

Remove or Disconnect

- Drain the transmission fluid out case extension by rotating transmission so bell housing is up.

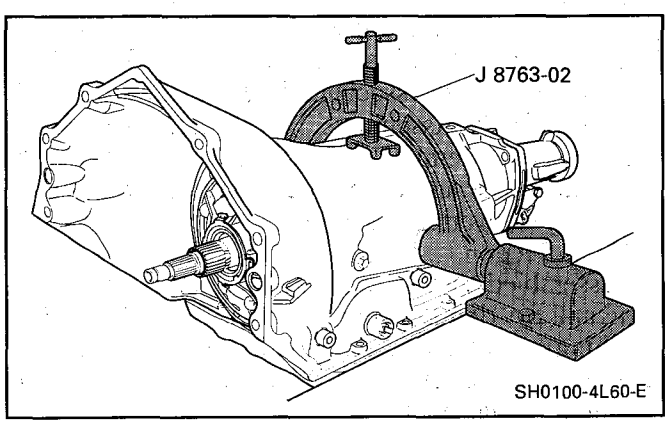


Figure 1 Holding Fixture

2-4 Servo Assembly

Figures 2 and 3

Tool Required:

J 29714 Servo Cover Compressor

Remove or Disconnect

1. Install J 29714.
2. Servo cover retaining ring (29).
3. Servo cover and O-ring seal (28 and 27).
   - If the servo cover seems to be hung up on the seal, cut and remove the O-ring seal before removing the cover.
4. 2-4 servo assembly (12-26).

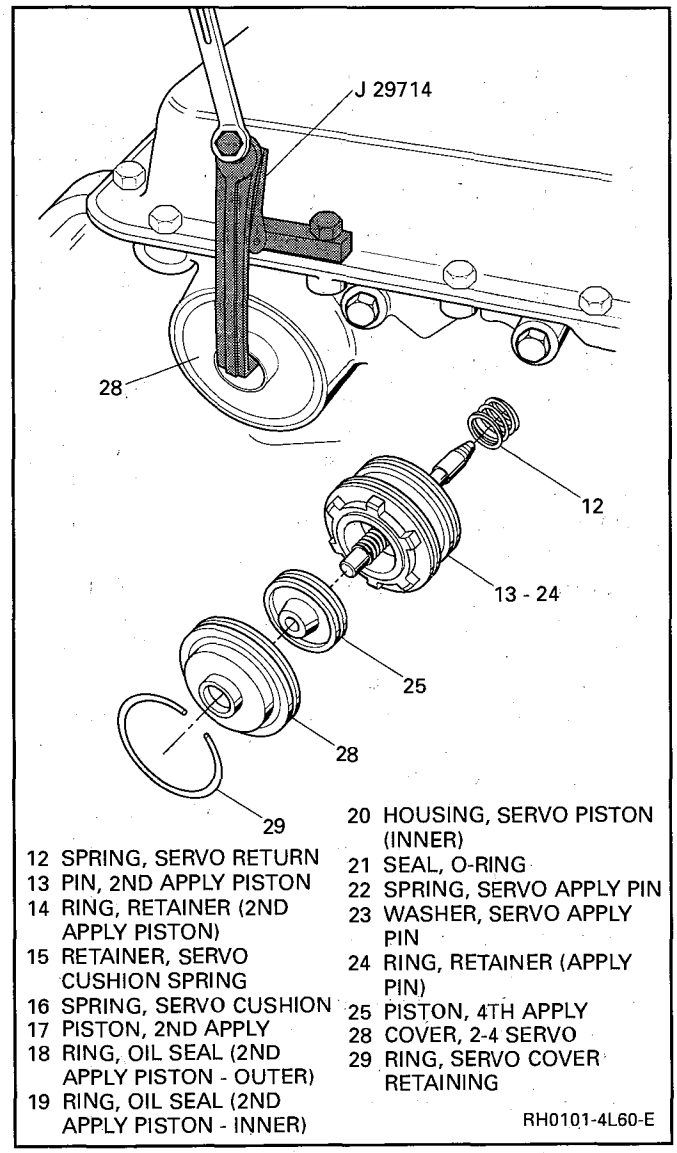


Figure 2 Servo Cover Removal

Servo Pin Length

Figures 3, 4 and 5

Tools Required:

J 33037 Band Apply Pin Tool

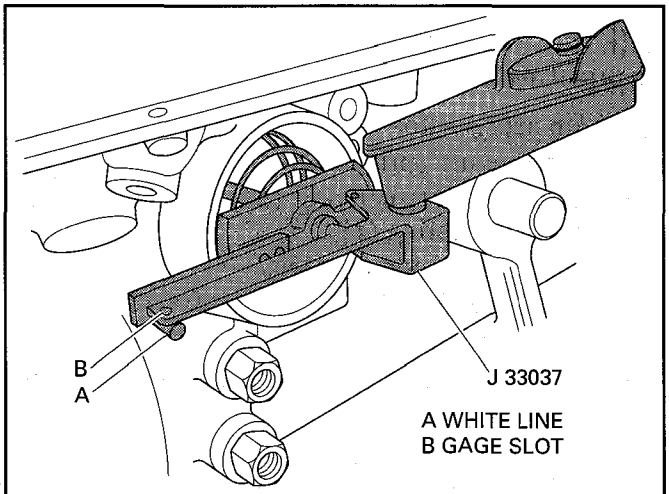
J 22269-01 Piston Compressor

As a diagnostic aid, the servo pin length should now be checked. If the pin length is too short or too long, be certain to inspect the 2-4 band and reverse input drum for damage or wear when disassembled.

Measure

Figure 3

1. Install J 33037 as shown with apply pin (13).
2. Install servo cover retaining ring (29) to secure tool.
3. Apply 11 N•m (98 lb. in.) torque.
4. If white line "A" appears in gage slot "B" pin length is correct.
5. Use pin selection chart to determine correct pin length if new pin is needed.



PIN IS PRESET AT FACTORY AND MUST NOT BE READJUSTED

2-4 SERVO PIN SELECTION

PIN LENGTH		PIN I.D.
MM	INCH	
65.82-66.12	2.59-2.60	1 GROOVE
67.23-67.53	2.65-2.66	2 GROOVES
68.64-68.94	2.70-2.71	NO GROOVE

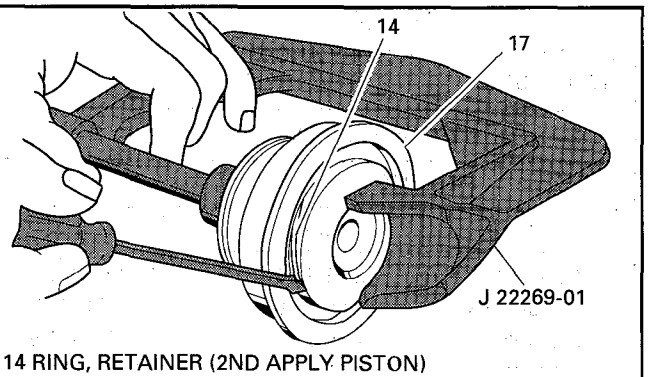
RH0102-4L60-E

Figure 3 Servo Pin Length

Remove or Disconnect

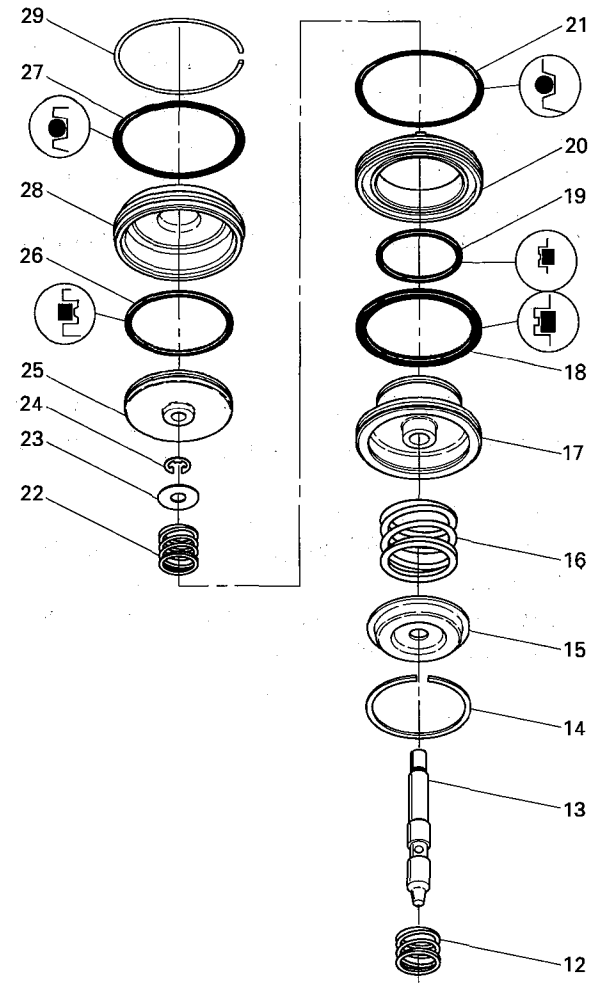
Figures 4 and 5

1. 4th apply piston (25).
2. Servo return spring (12).
3. Servo pin retainer ring (24), washer (23) and apply pin spring (22).
4. 2nd apply piston pin (13).
5. Install J 22269-01.
6. Retainer ring (14).
7. Cushion spring retainer (15) and cushion spring (16).



14 RING, RETAINER (2ND APPLY PISTON)
17 SECOND APPLY PISTON
RH0103-4L60-E

Figure 4 Second Servo Piston Retaining Ring Removal



ILL. NO.	DESCRIPTION
12	SPRING, SERVO RETURN
13	PIN, 2ND APPLY PISTON
14	RING, RETAINER (2ND APPLY PISTON)
15	RETAINER, SERVO CUSHION SPRING
16	SPRING, SERVO CUSHION
17	PISTON, 2ND APPLY
18	RING, OIL SEAL (2ND APPLY PISTON - OUTER)
19	RING, OIL SEAL (2ND APPLY PISTON - INNER)
20	HOUSING, SERVO PISTON (INNER)
21	SEAL, O-RING
22	SPRING, SERVO APPLY PIN
23	WASHER, SERVO APPLY PIN
24	RING, RETAINER (APPLY PIN)
25	PISTON, 4TH APPLY
26	RING, OIL SEAL (4TH APPLY PISTON - OUTER)
27	SEAL, O-RING (2-4 SERVO COVER)
28	COVER, 2-4 SERVO
29	RING, SERVO COVER RETAINING

RH0104-4L60-E

Figure 5 Servo Assembly

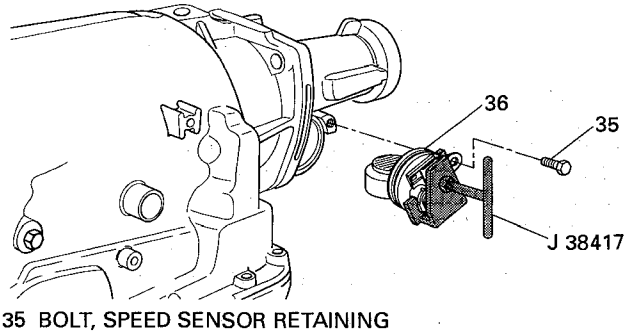
Speed Sensor and Case Extension

Figures 6 and 7

Tool Required:

J 38417 Speed Sensor Remover and Installer

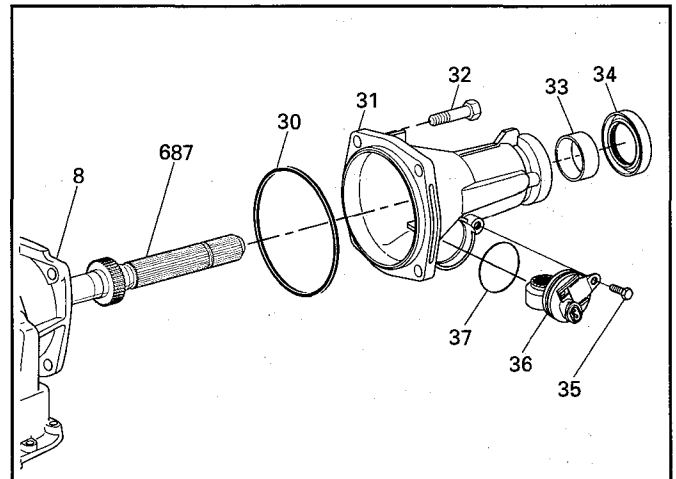
1. Speed sensor retaining bolt (35).
2. Speed sensor assembly (36) and O-ring seal (37) with J 38417.
3. Case extension bolts (32), case extension (31) and extension seal ring (30).
4. Output shaft sleeve (690) and output shaft O-ring seal (691).
   - Not all models use an output shaft sleeve and seal.



35 BOLT, SPEED SENSOR RETAINING
36 SPEED SENSOR, INTERNAL TRANSMISSION

SH0105-4L60-E

Figure 6 Speed Sensor Removal



ILL. NO.	DESCRIPTION
8	CASE, TRANSMISSION
30	SEAL, CASE EXTENSION TO CASE
31	EXTENSION, CASE
32	BOLT, CASE EXTENSION TO CASE
33	BUSHING, CASE EXTENSION
34	SEAL ASSEMBLY, CASE EXTENSION OIL
35	BOLT, SPEED SENSOR RETAINING
36	SPEED SENSOR, INTERNAL TRANSMISSION
37	SEAL, O-RING (ITSS TO CASE EXTENSION)
687	SHAFT, OUTPUT

RH0106-4L60-E

Figure 7 Extension and Associated Parts

Pan And Filter Assembly

Figure 8

Clean

- Exposed ends of bottom pan screws and spray with penetrating oil.

Remove or Disconnect

1. Screws (76), oil pan (75) and gasket (73).
2. Oil filter (72) and filter seal (71).
   - Filter seal may be stuck in the pump.

Inspect

- Filter (72), open filter by prying the metal crimping away from the top of the filter (black) and pull apart. The filter may contain evidence for root cause diagnosis.
  - Clutch material.
  - Bronze slivers indicating bushing wear.
  - Steel particles.

Valve Body And Wiring Harness

Figures 9 through 14

Remove or Disconnect

Figures 9 and 10

1. Electrical connections from components.
2. TCC PWM Solenoid Retainer Clip (379) and Solenoid (396).
3. TCC Solenoid bolts (68) and solenoid assembly (66) with O-ring seal (65) and wiring harness.
4. Pressure switch assembly bolts (70) and pressure switch assembly (69).
5. Accumulator cover bolts (58 and 59) and 1-2 accumulator cover and pin assembly (57).
6. 1-2 accumulator piston (56) and seal (55).
7. Spring (54).
8. Dipstick stop bracket (93).

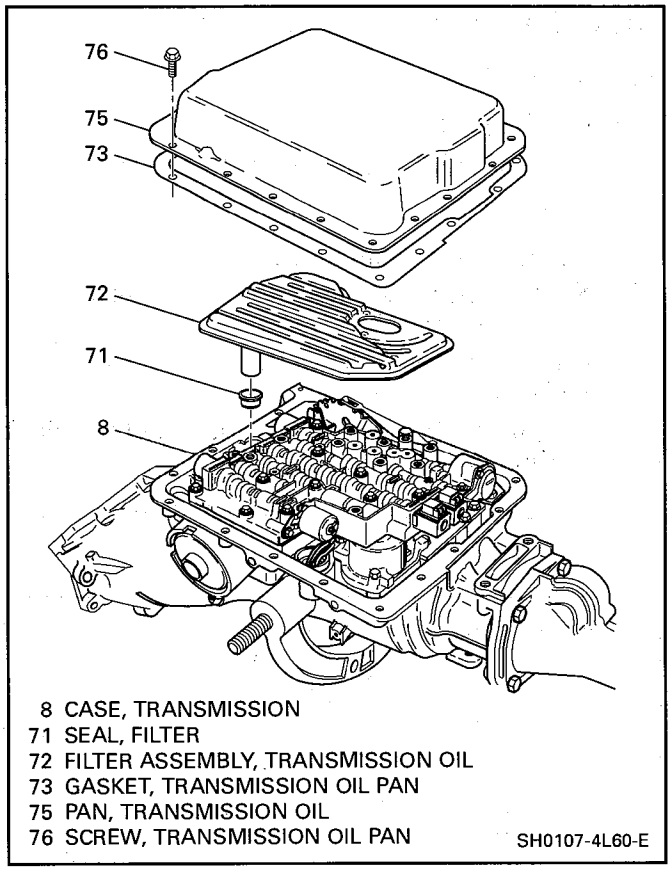


Figure 8 Pan, Filter and Seal Removal

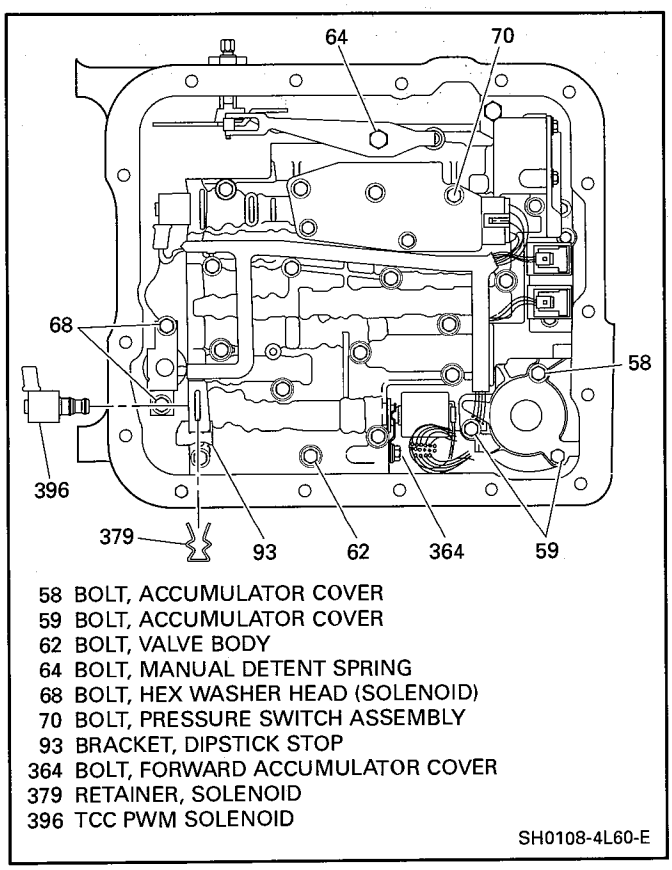
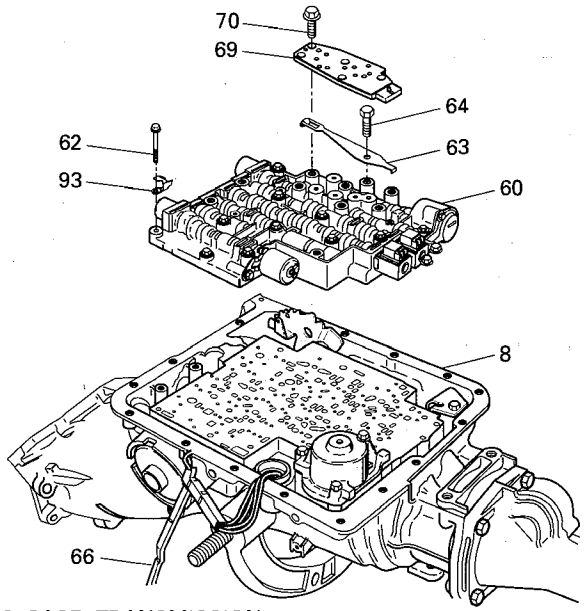


Figure 9 Valve Body Bolt Locations



8 CASE, TRANSMISSION
60 VALVE ASSEMBLY, CONTROL BODY
62 BOLT, VALVE BODY
63 SPRING ASSEMBLY, MANUAL DETENT
64 BOLT, MANUAL DETENT SPRING
66 SOLENOID ASSEMBLY, WIRING HARNESS AND
69 SWITCH ASSEMBLY, TRANSMISSION PRESSURE
70 BOLT, PRESSURE SWITCH ASSEMBLY
93 BRACKET, DIPSTICK STOP
SH0109-4L60-E

Figure 10 Control Valve and Pressure Switch Assembly

Remove or Disconnect

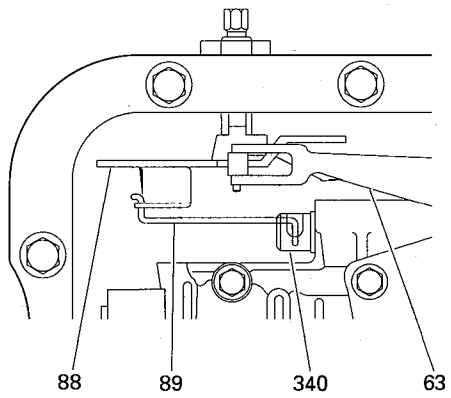
Figures 9, 11 and 12

1. Bolt (64) and manual detent spring assembly (63).
2. Wiring harness retaining bolts.

Remove or Disconnect

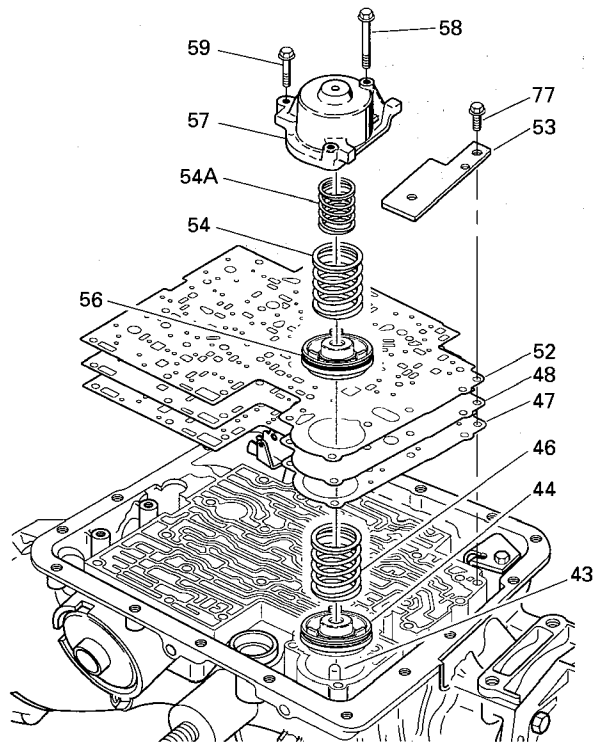
Figures 11 through 14

1. Remaining valve body bolts (62).
2. Manual valve link (89).
3. Control valve assembly (60).
4. Bolts (58 and 59), accumulator cover (57), piston (56, spring (54) and spring (54A).
5. Bolts (77) and plate (53).
6. Spacer plate (48) and spacer plate gaskets (47 and 52).
7. Spring (46), piston (44), and pin (43).
   - Seven checkballs are located under the valve body and one is located in the case. The large copper flash colored ball is #1 checkball (91).



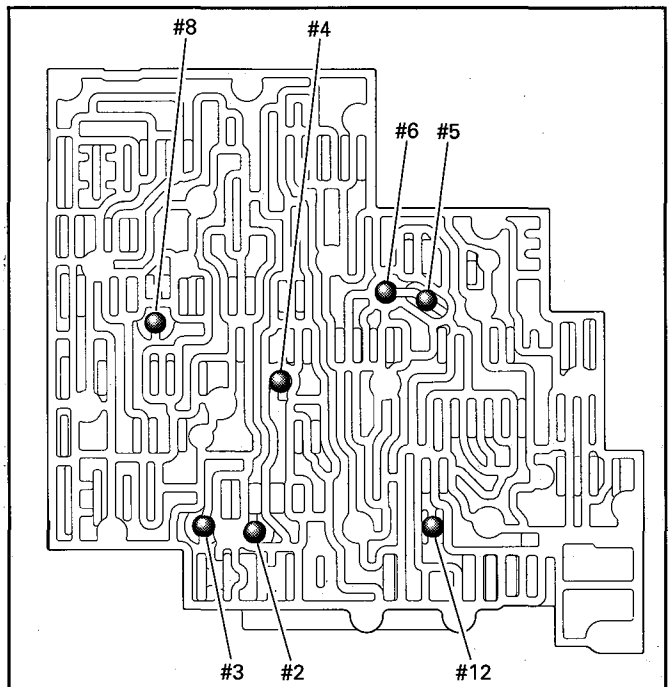
63 SPRING ASSEMBLY, MANUAL DETENT
88 LEVER, INSIDE DETENT
89 LINK, MANUAL VALVE
340 VALVE, MANUAL
RH0110-4L60-E

Figure 11 Manual Valve Link



43 PIN, ACCUMULATOR PISTON
44 PISTON, 3-4 ACCUMULATOR
46 SPRING, 3-4 ACCUMULATOR
47 GASKET, SPACER PLATE TO CASE
48 PLATE, VALVE BODY SPACER
52 GASKET, SPACER PLATE TO VALVE BODY
53 PLATE, SPACER PLATE SUPPORT
54 SPRING, 1-2 ACCUMULATOR
54A SPRING, 1-2 ACCUMULATOR (INNER)
56 PISTON, 1-2 ACCUMULATOR
57 COVER AND PIN ASSEMBLY, 1-2 ACCUMULATOR
58 BOLT, ACCUMULATOR COVER
59 BOLT, ACCUMULATOR COVER
77 BOLT, SPACER PLATE SUPPORT
RH0111-4L60-E-R1

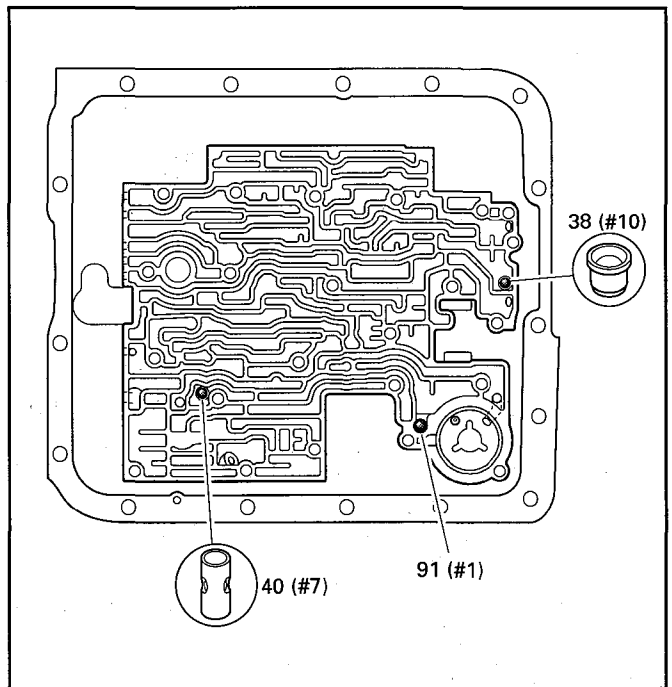
Figure 12 Accumulator Assembly, Spacer Plate and Gaskets



2 3RD ACCUMULATOR
3 REVERSE INPUT
4 3-4 CLUTCH EXHAUST
5 OVERRUN CLUTCH FEED
6 OVERRUN CLUTCH CONTROL
8 1-2 UPSHIFT
12 FORWARD CLUTCH ACCUM.

RH0112-4L60-E

Figure 13 Valve Body Checkballs



38 PLUG, TRANSMISSION CASE (ACCUM. BLEED)
40 RETAINER AND BALL ASSEMBLY, 3RD ACCUM.
91 NO. 1 CHECKBALL

SH0113-4L60-E

Figure 14 Case Checkballs and Filters

Transmission End Play Check

Figures 15 and 16

Tools Required:

J 24773-A Oil Pump Remover
J 25022-A End Play Adaptor (245 mm)
J 34725 End Play Adaptor (298 mm)
J 25025-7A Post
Dial indicator

As a diagnostic aid, transmission end play should be checked prior to removing the internal parts. If the end play is not within specifications, you should watch for possible worn or misassembled parts during disassembly.

Measure

1. Remove an oil pump bolt (2) and install a 278 mm (11 inch) bolt and locknut or J 25025-7A.
2. Install J 25022-A or J 34725 as shown.
3. Install J 24773-A as shown.
4. Install dial indicator.
   A. Set to zero.
   B. Pull up on J 24773-A.
   C. End play should be 0.13 to 0.92 mm (0.005 to 0.036 inch).

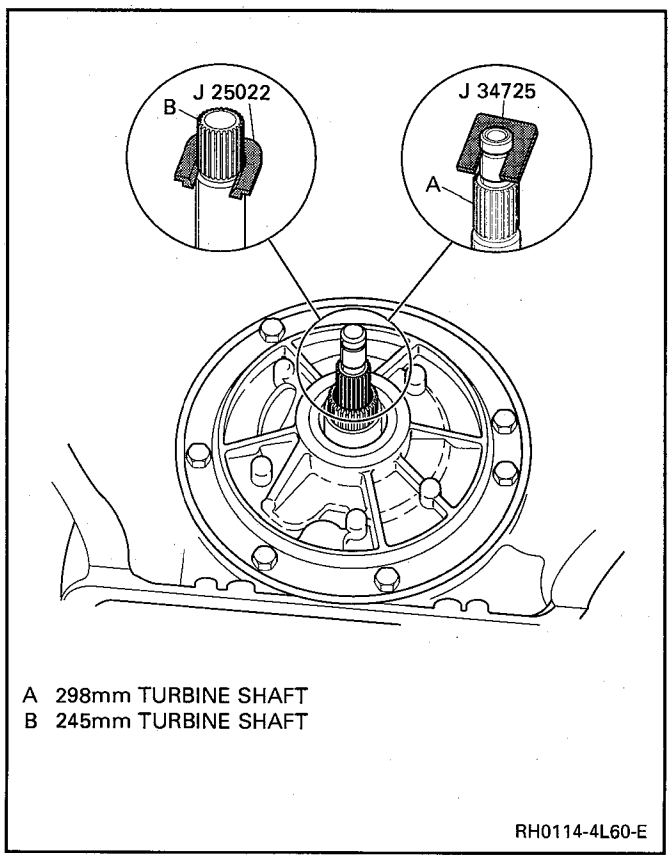


Figure 15 End Play Tool

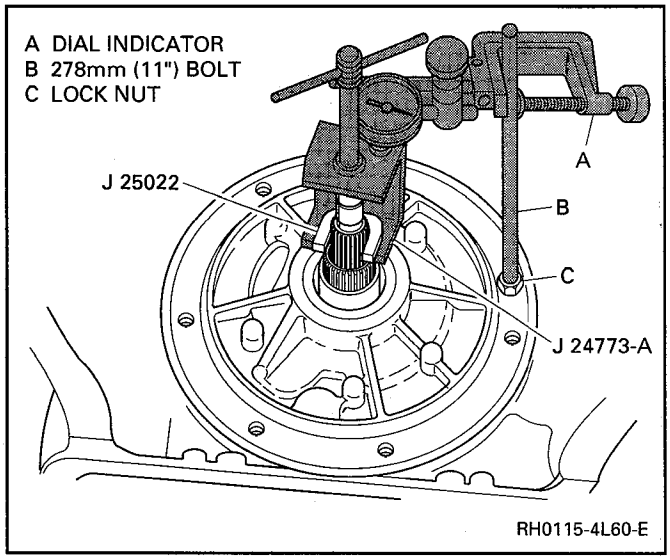


Figure 16 End Play Check

Oil Pump Assembly

Figures 17 and 18

Tools Required:

J 37789-A Oil Pump Remover and Installer
J 39119 Adapter

Remove or Disconnect

1. O-ring seal (618).
2. All oil pump bolts (2) and O-rings (3).
3. Slide J 39119 over stator shaft until it locks under splines.
4. Oil pump assembly (4) with J 37789-A.
5. Oil pump to case seal (5) and gasket (6).
6. Reverse input clutch to oil pump thrust washer (601).

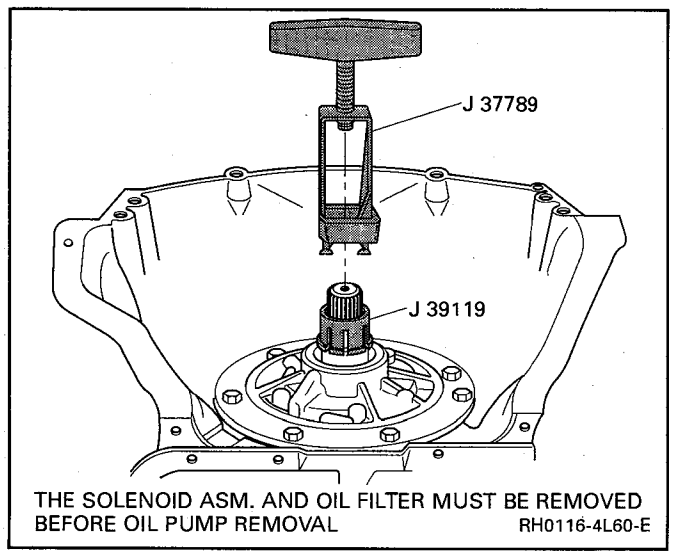
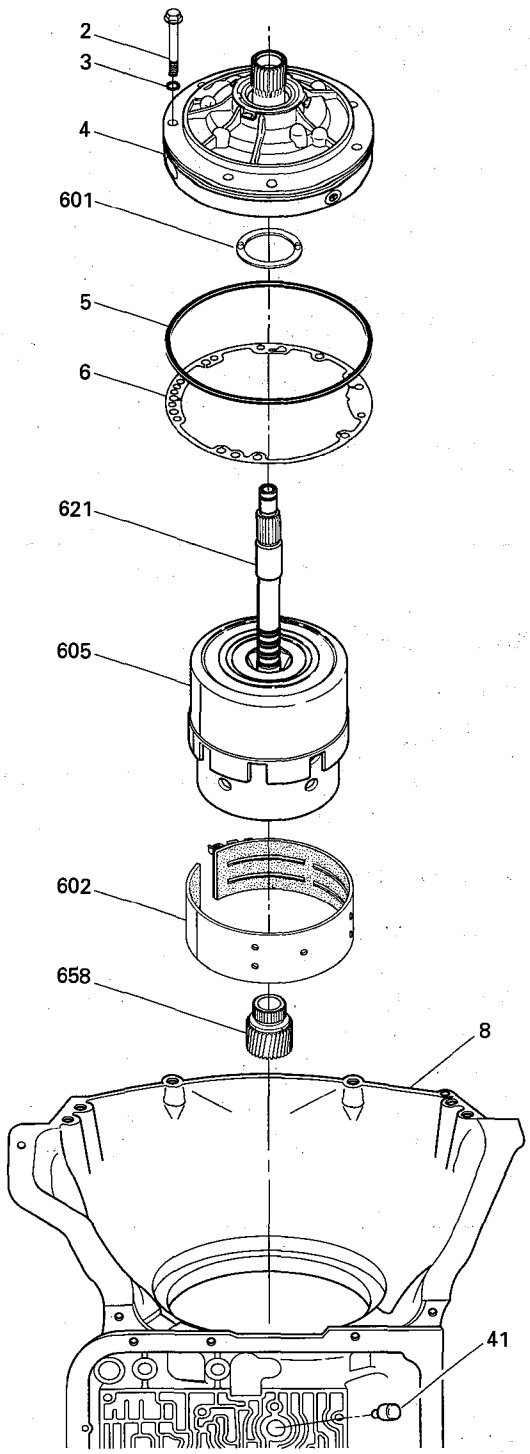


Figure 17 Oil Pump Removal



2 BOLT, PUMP TO CASE
3 O-RING, PUMP TO CASE BOLT
4 PUMP ASSEMBLY, OIL
5 SEAL, OIL (PUMP TO CASE)
6 GASKET, PUMP COVER TO CASE
8 CASE, TRANSMISSION
41 PIN, BAND ANCHOR
601 WASHER, THRUST (PUMP TO DRUM)
602 BAND ASSEMBLY, 2-4
605 HOUSING AND DRUM ASSEMBLY, REVERSE INPUT CLUTCH
621 HOUSING AND SHAFT ASSEMBLY, INPUT
658 GEAR, INPUT SUN
RH0117-4L60-E

Figure 18 Input Clutch Removal

2-4 Band, Reverse Input Clutch, Input Clutch And Input Gear Set

Figures 18 through 20

Tools Required:

J 29837 Output Shaft Support Fixture

J 34627 Snap Ring Pliers

Remove or Disconnect

Figures 18 and 20

1. Reverse input clutch (605) and input clutch (621) together.
   - Grasp the turbine shaft and lift.
2. Band anchor pin (41).
3. The 2-4 band assembly (602).
4. Input sun gear (658).

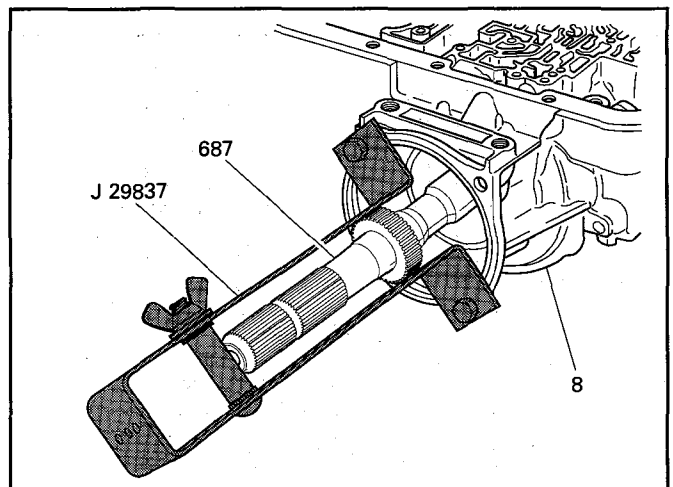
Install or Connect

Figures 19 and 20

- J 29837 as shown.

Important

- Output shaft (687) may fall free when retaining ring (661) is removed if J 29837 is not used.



8 CASE, TRANSMISSION
687 SHAFT, OUTPUT
SH0118-4L60-E

Figure 19 Output Shaft Support Fixture

Remove or Disconnect

Figure 20

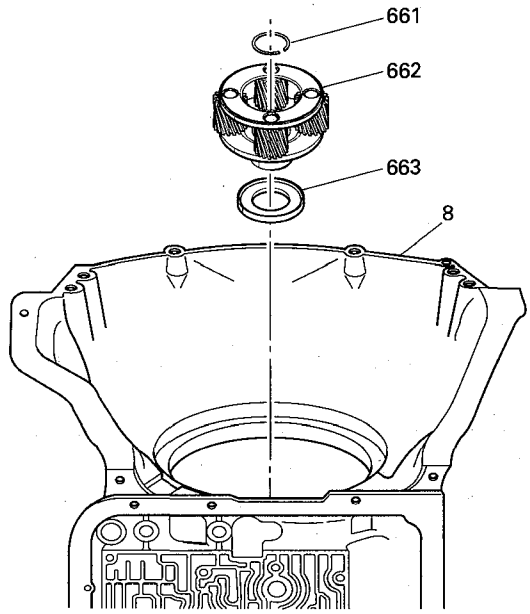
1. Retaining ring (661) with J 34627. Do not overexpand the ring.
2. Input carrier assembly (662).

3. J 29837 and output shaft (687).

Important

- The manufacturer assembles the output shaft and reaction internal gear with adhesive for ease of assembly. If these parts have not become separated during use, the output shaft will come out later along with the reaction internal gear.

4. Thrust bearing assembly (663).



8 CASE, TRANSMISSION
661 RET., OUTPUT SHAFT TO INPUT CARRIER
662 CARRIER ASSEMBLY, INPUT (COMPLETE)
663 BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)

RH0119-4L60-E

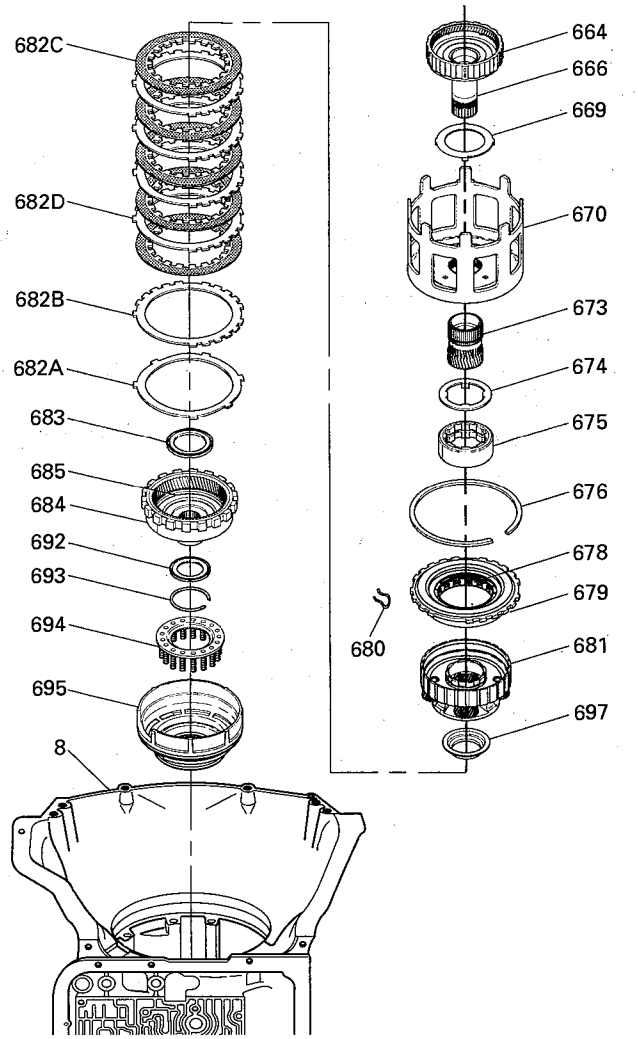
Figure 20 Input Carrier Removal

Reaction Gear Set

Figure 21

Remove or Disconnect

1. Input internal gear (664) and reaction carrier (666).
2. Reaction sun shell (670) and thrust washer (669).
3. Reaction sun shell to inner race thrust washer (674).
4. Lo and reverse support to case retainer ring (676).
5. Lo and reverse clutch support retainer spring (680).
6. Reaction sun gear (673).
7. Lo and reverse inner race (675), roller assembly (678), support assembly (679) and reaction carrier assembly (681).
8. Lo and reverse clutch plates (682).
9. Reaction internal gear (684) and thrust bearing assembly (683).
10. Reaction gear support to case bearing (692).



8 CASE, TRANSMISSION
664 GEAR, INPUT INTERNAL
666 SHAFT, REACTION CARRIER
669 WASHER, THRUST (REACTION SHAFT/SHELL)
670 SHELL, REACTION SUN
673 GEAR, REACTION SUN
674 WASHER, THRUST (RACE/REACTION SHELL)
675 RACE, LO AND REVERSE ROLLER CLUTCH
676 RING, LO AND REVERSE SUPPORT TO CASE RETAINER
678 CLUTCH ASSEMBLY, LO AND REVERSE ROLLER
679 SUPPORT ASM., LO AND REVERSE CLUTCH
680 SPRING, TRANSMISSION (LO AND REVERSE CLUTCH SUPPORT RETAINER)
681 CARRIER ASSEMBLY, REACTION
682A PLATE, LO AND REVERSE CLUTCH (WAVED)
682B PLATE, SPACER LO AND REVERSE CLUTCH (SELECTIVE)
682C PLATE ASSEMBLY, LO AND REVERSE CLUTCH (FIBER)
682D PLATE, LO AND REVERSE CLUTCH (STEEL)
683 BEARING ASSEMBLY, THRUST (REACTION CARRIER/ SUPPORT)
684 GEAR, INTERNAL REACTION
685 SUPPORT, INTERNAL REACTION GEAR
692 BRG., REACTION GEAR SUPPORT TO CASE
693 RING, LO AND REVERSE CLUTCH RETAINER
694 SPRING ASSEMBLY, LO AND REVERSE CLUTCH
695 PISTON, LO AND REVERSE CLUTCH
697 DEFLECTOR, OIL (HIGH OUTPUT MODELS ONLY)

RH0120-4L60-E

Figure 21 Reaction Gear Set Removal

Lo And Reverse Clutch Parts

Figures 22, 23 and 25

Tools Required:

J 34627 Snap Ring Remover/Installer

J 23327 Clutch Spring Compressor

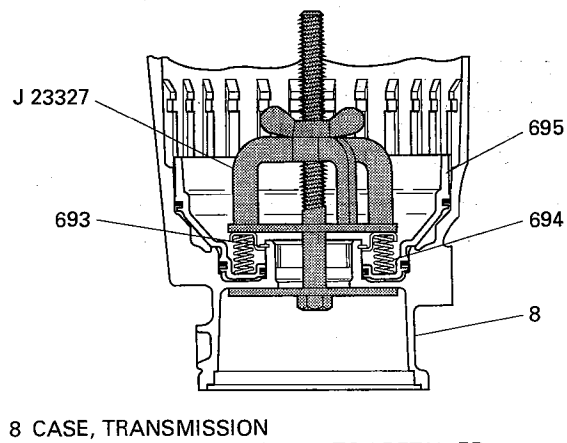
Remove or Disconnect

1. Bolts (715) and parking lock bracket (710).

Important

- Due to interference, the parking pawl may have to be removed before removing or installing the low and reverse piston.
  - A. Parking pawl shaft plug (78) with a #4 screw extractor.
  - B. Parking pawl pivot shaft (79) with a magnet.
  - C. Parking pawl (81) and return spring (80).

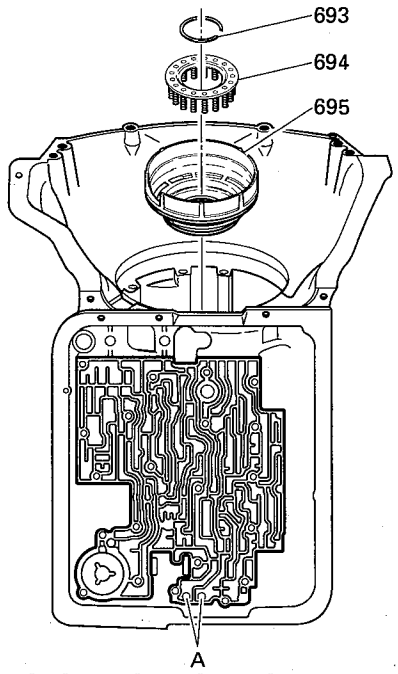
2. Install tool J 23327.
3. Lo and reverse clutch retainer ring (693) with J 34627.
4. Lo and reverse clutch spring assembly (694).
5. Lo and reverse clutch piston (695).
   - Apply air pressure in the case apply passage.



8 CASE, TRANSMISSION
693 RING, LO AND REVERSE CLUTCH RETAINER
694 SPRING ASSEMBLY, LO AND REVERSE CLUTCH
695 PISTON, LO AND REVERSE CLUTCH

RH0121-4L60-E

Figure 22 Lo and Reverse Snap Ring Removal



A APPLY AIR PRESSURE HERE TO REMOVE LO AND REVERSE PISTON FROM THE CASE
693 RING, LO AND REVERSE CLUTCH RETAINER
694 SPRING ASSEMBLY, LO AND REVERSE CLUTCH
695 PISTON, LO AND REVERSE CLUTCH

RH0122-4L60-E

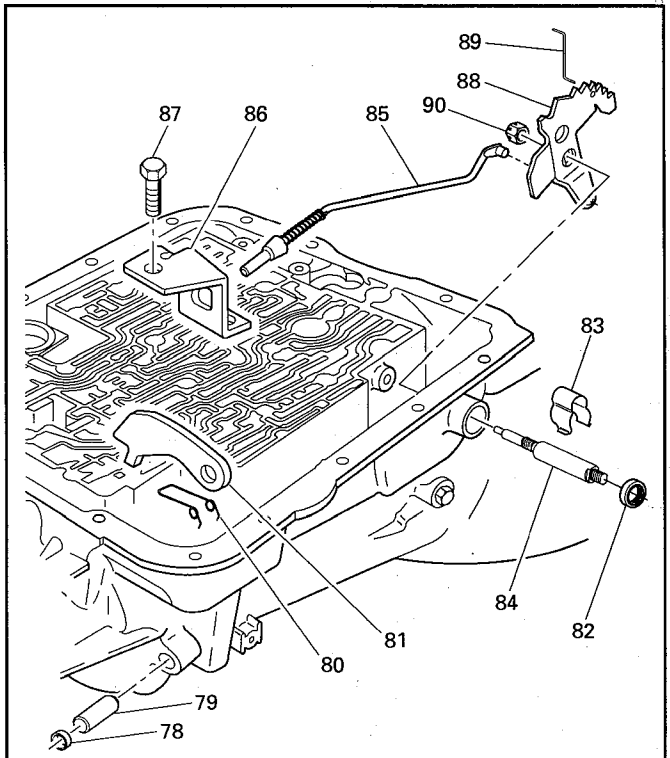
Figure 23 Lo and Reverse Piston Removal

Inner Manual Linkage

Figure 24

Remove or Disconnect

1. Inside manual shaft nut (90).
2. Manual shaft (84) and manual shaft retainer (83).
3. Parking lock actuator assembly (85) and inside detent lever (88).



78 PLUG, STEEL CUP
79 SHAFT, PARKING BRAKE PAWL
80 SPRING, PARKING PAWL RETURN
81 PAWL, PARKING BRAKE
82 SEAL, MANUAL SHAFT
83 RETAINER, MANUAL SHAFT
84 SHAFT, MANUAL
85 ACTUATOR ASSEMBLY, PARKING LOCK
86 BRACKET, PARKING LOCK
87 BOLT, PARKING LOCK BRACKET
88 LEVER, INSIDE DETENT
89 LINK, MANUAL VALVE
90 NUT, HEX HEAD

RH0123-4L60-E

Figure 24 Parking Linkage

Manual Shaft Seal Replacement

Figure 25

Remove or Disconnect

- Manual shaft seal (82).
  - Pry out with a screwdriver.

Install or Connect

- New manual shaft seal (82).
  - Tap into place using a 14 mm socket.

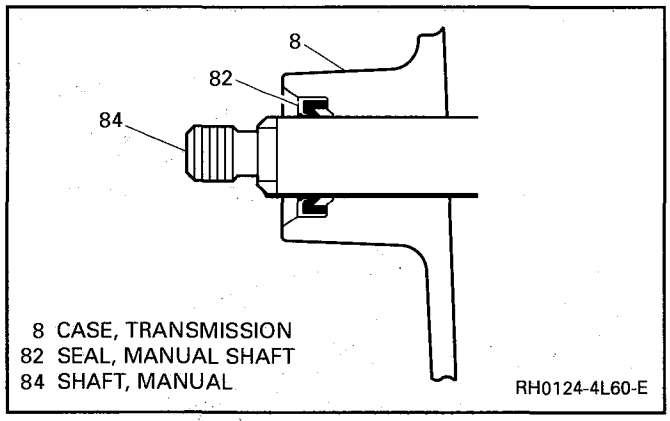


Figure 25 Manual Shaft Seal

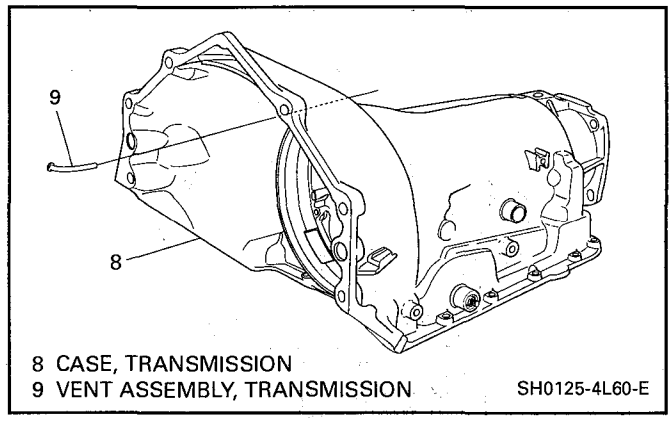


Figure 26 Case Vent Assembly

Inspect

Figure 24

- Actuator rod (85) for damage.
- Inside detent lever (88) for damage or cracks.
- Manual shaft (84) for damage or burrs.
- Manual detent spring assembly (63) for roller freeness or damage.

Install or Connect

Figure 24

- Parking lock actuator (85) onto inside detent lever (88).
- Manual shaft (84) into case (8) and inside detent lever (88).
- Inside manual shaft nut (90) onto manual shaft (84).

  Tighten

  - Nut (90) to 31 N•m (23 lb. ft.)
- Manual shaft retainer (83) onto manual shaft (84).

COMPONENT REPAIR AND TRANSMISSION REASSEMBLY

The assembly of some components will require use of an assembly lube. It is recommended that Transjel™ J 36850 or equivalent be used during assembly.

NOTICE: Do not use any type of grease to retain parts during assembly of this unit. Greases other than the recommended assembly lube will change transmission fluid characteristics and cause undesirable shift conditions and/or filter clogging.

Case Assembly

Clean

- Thoroughly with solvent.
- Air dry.
  - Do not wipe with cloth.

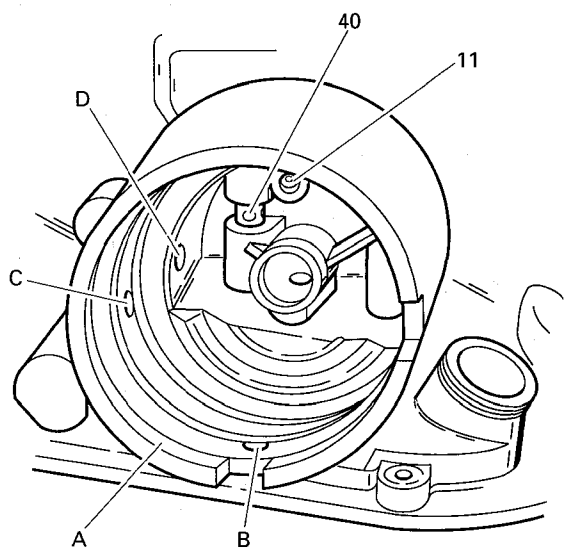
Case

Figures 26, 27 and 28

Inspect

- Case (8) exterior for cracks or porosity.
- Case to valve body face for damage, interconnected oil passages and flatness.
  - Face flatness can be checked by inspecting the spacer plate to case gasket for proper land impressions.
- Vent assembly (9) for damage.
- Air check all oil passages.
  - See diagnosis section for oil passage identification.
- 2-4 servo bore for:
  - Damage, porosity, or burrs.
  - Any sharp edges (i.e. – oil passages, slots for retaining ring removal – remove if found).
- Orifice cup plug (11) in servo bore for debris or damage.
- Third accumulator bore for:
  - Porosity, damage, or burrs.
  - Pin damage (43).
  - Orifice cup plug (42) damaged or plugged.
- Speed sensor bore for:
  - Damage.
  - Sharp edges.
  - Porosity.
- All bolt holes for thread damage
  - Heli-coil to repair.
- Cooler connectors (10) for:
  - Damage.
  - Proper torque 38 N•m (28 lb. ft.).

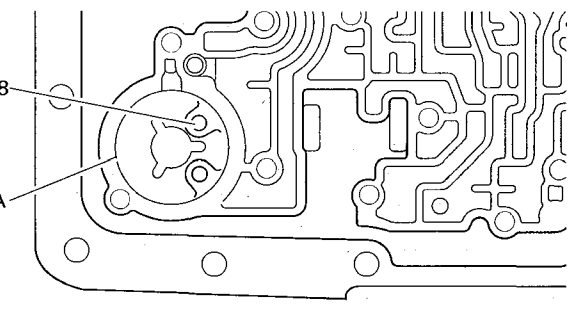
- Case interior for:
  - Damaged ring grooves or casting flash.
  - Clutch plate lugs worn or damaged.
  - Bushing (33) scored, worn, or damaged (see Bushing Replacement).



A 2-4 SERVO BORE
B SERVO EXHAUST HOLE
C 2ND 7 4TH BAND APPLY PASSAGE
D 3RD ACCUM. PRESSURE TAP PASSAGE
11 PLUG, CASE SERVO
40 RETAINER AND BALL ASSEMBLY, 3RD ACCUM.

RH0061-4L60-E

Figure 27 2-4 Servo Bore



A 3-4 ACCUMULATOR BORE
38 PLUG, TRANSMISSION CASE (ACCUM. BLEED)

RH0126-4L60-E

Figure 28 Third Accumulator Bore

Third Accumulator Retainer and Ball Assembly

Figure 29

Inspect

- Ball for:
  - Presence.
  - Sticking or leaking.
- Retainer for:
  - Presence.
  - Loose.
  - Incorrect seating.
  - Restricted feed slots.

Retainer and Ball Assembly Leak Check Procedure

Figure 29

1. Install the servo assembly (12-26) into the servo bore.
2. Install the servo cover (28) and retainer (29).
3. Pour a suitable solvent into the accumulator bore.

Inspect

- Watch for leakage inside the case.
- If leakage is observed, replace the third accumulator retainer and ball assembly.

Replacement Procedure – Third Accumulator Retainer and Ball Assembly

Figures 29 and 30

Tools Required:

6.3 mm (#4) Screw Extractor

9.5 mm (3/8 inch) diameter metal rod

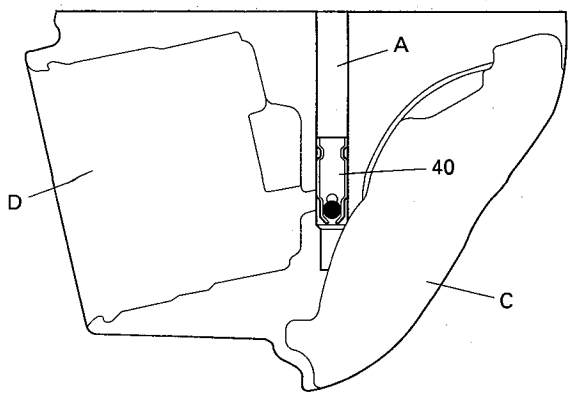
Remove or Disconnect

- Third accumulator retainer and ball assembly (40).
  - Use 6.3 mm (#4) screw extractor.

Install or Connect

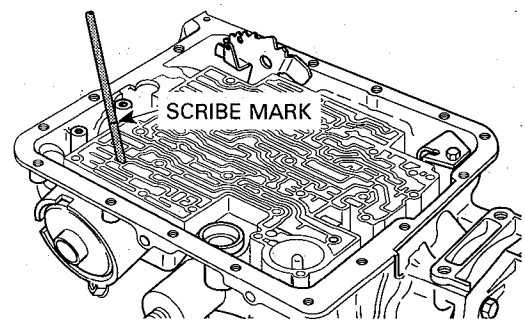
Figures 29 and 30

- A new third accumulator retainer and ball assembly.
  - Oil feed slots in the retainer must line up with oil passage in the servo bore. To be certain of correct installation depth, scribe a mark at 42.0 mm (1.653 inch) on the 9.5 mm (3/8 inch) diameter metal rod. Use it to seat the third accumulator and ball assembly as shown. When the scribed line is flush with the case face, installation depth is correct.



A 3RD ACCUMULATOR BORE
C CASE INTERIOR
D 2-4 SERVO BORE
40 RETAINER & BALL ASSEMBLY, 3RD ACCUM.
RH0127-4L60-E

Figure 29 Leak Check – 3rd Accumulator



DRIVE UNTIL SCRIBE MARK
IS FLUSH WITH CASE
RH0128-4L60-E

Figure 30 Third Accumulator Retainer and Ball Asm. – Installation

Lo and Reverse Clutch Piston

Figures 31 and 32

Tools Required:

J 34627 Snap Ring Remover/Installer

J 23327 Clutch Spring Compressor

Inspect

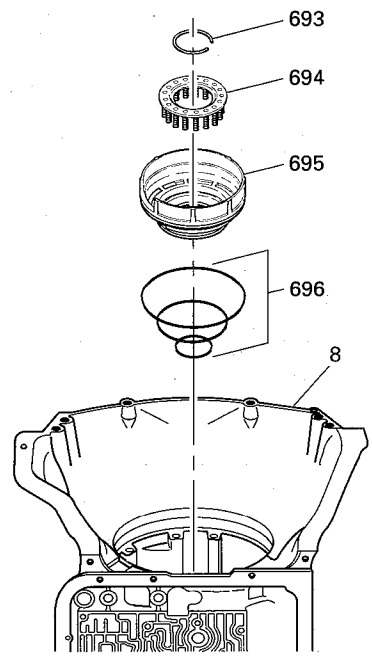
Figure 31

- Lo and reverse piston (695) for:
  - Porosity or damage.
  - Ring groove damage.
- Piston seals (696) for nicks or cuts.
- Spring assembly (694) for damage.
- Retainer ring (693) overstressed.

Install or Connect

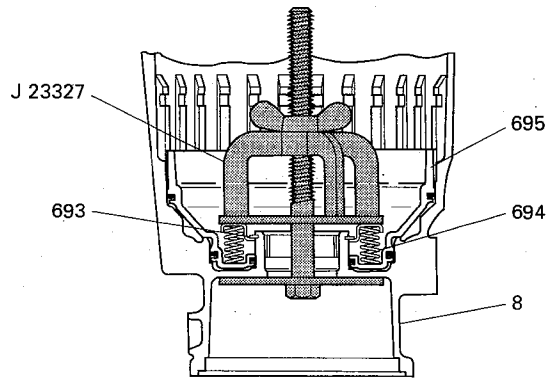
Figure 32

1. Piston seals (696) onto the piston (695).
   - Lubricate with Transjel™ J 36850 or equivalent.
2. Piston (695) into the case.
   - Index the piston with the notch in the bottom of the case.
3. Spring assembly (694) onto the piston.
   - Flat side of the retainer upward.
4. J 23327 over the spring assembly.
   - Compress the spring assembly past the ring groove in the case hub.
5. Retainer ring (693) into the case hub ring groove with J 34627.



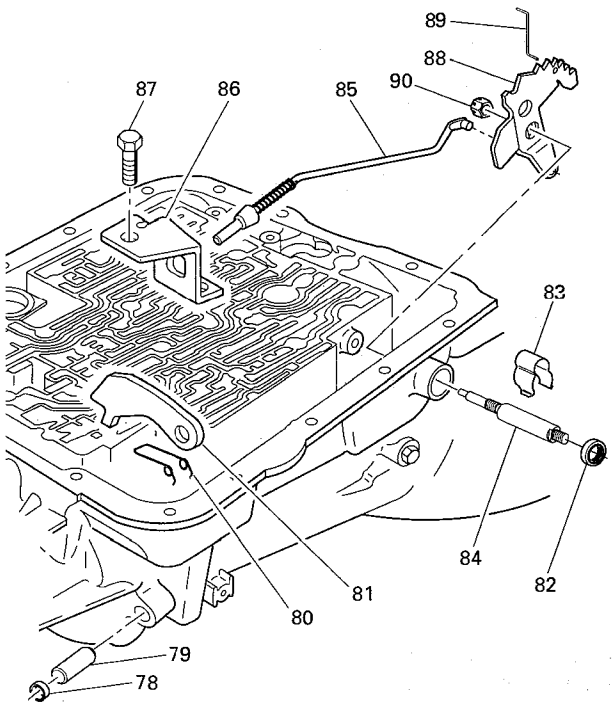
8 CASE, TRANSMISSION
693 RING, LO AND REVERSE CLUTCH RETAINER
694 SPRING ASSEMBLY, LO AND REVERSE CLUTCH
695 PISTON, LO AND REVERSE CLUTCH
696 SEAL, TRANSMISSION (LO AND REVERSE CLUTCH – OUTER, CENTER, INNER)
RH0129-4L60-E

Figure 31 Lo and Reverse Piston



8 CASE, TRANSMISSION
693 RING, LO AND REVERSE CLUTCH RETAINER
694 SPRING ASSEMBLY, LO AND REVERSE CLUTCH
695 PISTON, LO AND REVERSE CLUTCH
RH0121-4L60-E

Figure 32 Installing Lo and Reverse Snap Ring



78 PLUG, STEEL CUP
79 SHAFT, PARKING BRAKE PAWL
80 SPRING, PARKING PAWL RETURN
81 PAWL, PARKING BRAKE
82 SEAL, MANUAL SHAFT
83 RETAINER, MANUAL SHAFT
84 SHAFT, MANUAL
85 ACTUATOR ASSEMBLY, PARKING LOCK
86 BRACKET, PARKING LOCK
87 BOLT, PARKING LOCK BRACKET
88 LEVER, INSIDE DETENT
89 LINK, MANUAL VALVE
90 NUT, HEX HEAD
RH0123-4L60-E

Figure 33 Parking Pawl Installation

Parking Pawl

Figure 33

Inspect

- Parking pawl (81) for cracks, burrs, or damage.
- Parking pawl return spring (80) for distortion or damage.
- Parking pawl pivot shaft (79) for damage and freeness of fit with the parking pawl.

Install or Connect

Figure 33

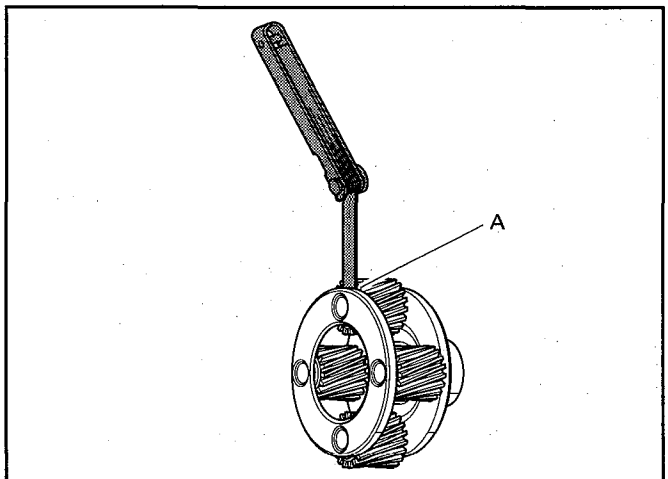
1. Parking pawl (81) and parking pawl return spring (80) into the case.
2. Parking pawl pivot shaft (79) into the parking pawl (81) and the case.
   - Check for proper operation.
3. Retaining plug (78) into the case.
   - Coat the plug with Loctite® sealant or equivalent and install it with a hammer and punch.

Reaction Internal Gear and Carrier Assembly

Figures 34, 35 and 36

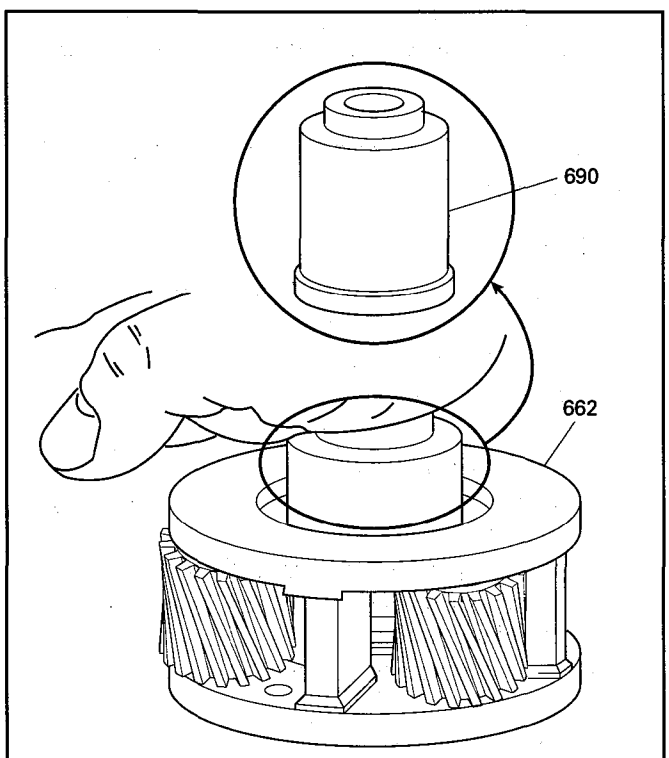
Inspect

- Reaction internal gear (684) and support (685) for:
  - Proper assembly.
  - Stripped splines.
  - Cracks.
  - Teeth or lug damage.
  - Thrust bearing assemblies (683 and 692) for damage.
- Lo and reverse clutch plates (682) for:
  - Composition material wear, heat damage, or delamination.
  - Heat damage or surface finish damage to steel plates.
- Reaction carrier assembly (681) for:
  - Pinion gear damage.
  - Excessive pinion washer wear.
  - End play exceeding 0.61 mm (0.024 inch).
  - Proper pinion staking.
  - Keystoned pinion gears (pinions must turn freely).
  - Damaged or worn thrust bearing.
  - To check the captive thrust bearing in the carrier for wear, place a bushing or an output shaft sleeve on the bearing race (do not contact the pinion gears) and turn it with the palm of your hand. Any imperfections will be felt through the bushing.



A PINION GEAR END PLAY – .20mm/.60mm (.008"/.024")
RH0131-4L60-E

Figure 34 Pinion End Play Check



662 CARRIER ASSEMBLY, INPUT (COMPLETE)
690 SLEEVE, OUTPUT SHAFT
RH0132-4L60-E

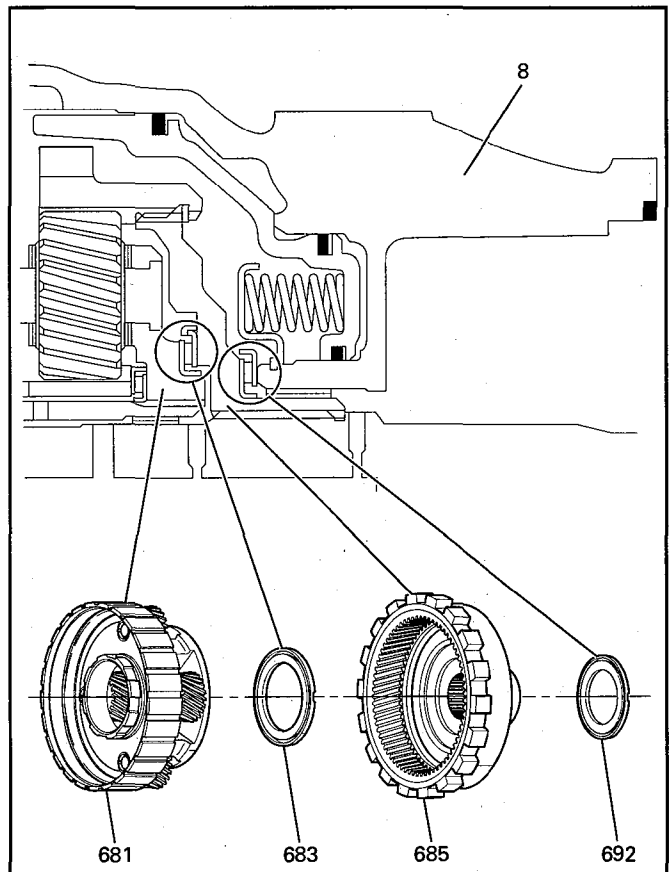
Figure 35 Captive Thrust Bearing Check

Reaction Internal Gear and Support

Figure 41

Install or Connect

1. Reaction gear support to case bearing (692) onto the case hub as shown.
   - Outside bearing race goes toward case hub.
   - Retain with Transjel™ J 36850 or equivalent.
2. Reaction internal gear and support (684 and 685) onto the bearing as shown.
3. Reaction carrier to support thrust bearing assembly (683) onto the support (685).
   - Outer bearing race goes toward the support.
4. Reaction carrier (681) onto the thrust bearing.



8 CASE, TRANSMISSION
681 CARRIER ASSEMBLY, REACTION
683 BEARING ASSEMBLY, THRUST (REACTION CARRIER/ SUPPORT)
685 SUPPORT, INTERNAL REACTION GEAR
692 BRG., REACTION GEAR SUPPORT TO CASE
SH0133-4L60-E

Figure 36 Reaction Internal Gear and Carrier Bearing Locations

Lo and Reverse Clutch Spacer Plate Selection

Figures 37 through 40

Tools Required:

Scale

Straight edge

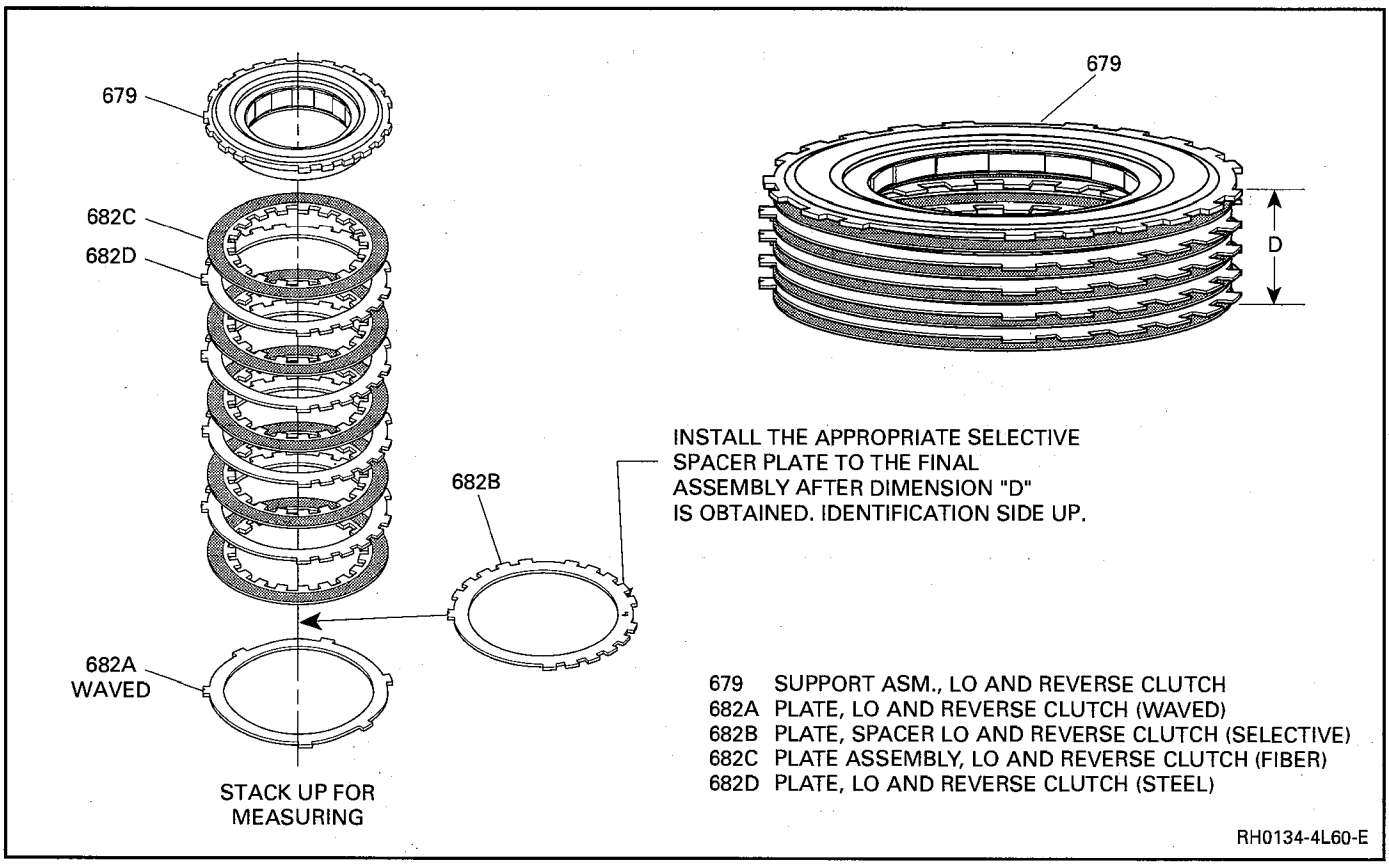


Figure 37 Measuring For Spacer Plate Selection

Measure

Figures 37, 38 and 39

1. To measure for proper selective spacer plate, stack the lo and reverse assembly on a flat surface in the following order:
   A. One waved plate (682B).
   B. Five composition and four steel plates (682), starting with one composition plate and alternating with steel.
   C. Lo and reverse clutch support (679).
2. Apply an evenly distributed load to the top of the lo and reverse support assembly (679). Light pressure (approximately 22 N or 5 lbs.) on the lo and reverse support assembly (679) will provide the correct dimension for measurement.

NOTICE: Excessive pressure will start to flatten the wave plate resulting in an inaccurate measurement.

3. Measure the height of the clutch pack from the work surface to the top of the lo and reverse clutch support (dimension D).
4. Use dimension D to select the proper thickness of the selective spacer plate for assembly.
5. Install the proper selective spacer plate between the wave plate and the first composition clutch plate with the identification side up.
6. The overall height for dimension D with the selective spacer plate included should be 29.22 to 29.90 mm (1.20 to 1.24 inch).

LO AND REVERSE CLUTCH		
	QTY.	THICKNESS
PLATE – WAVED	1	2.42mm (.096")
PLATE – SELECTIVE	1	SEE FIG. 39
PLATE – COMP. FACED	5	2.25mm (.088")
PLATE – FLAT STEEL	5	1.75mm (.069")

RH0135-4L60-E

Figure 38 Lo and Reverse Clutch Plate Chart

LO AND REVERSE CLUTCH SPACER PLATE SELECTION CHART				
IF GAGE DIMENSION "D" IS		USE THIS SELECTIVE PLATE		
FROM	TO	IDENTIFICATION	PLATE THICKNESS	
28.065mm (1.102")	27.545mm (1.081")	NONE	1.684mm (.066")	1.829mm (.072")
28.586mm (1.122")	28.066mm (1.102")	0	1.314mm (.052")	1.168mm (.046")
27.544mm (1.081")	27.026mm (1.061")	1	2.198mm (.087")	2.344mm (.092")

RH0136-4L60-E

Figure 39 Lo and Reverse Spacer Plate Selection Chart

Install or Connect

Figures 38 and 40

1. Waved plate (682A).
2. Correct selective spacer plate (682B), from selection procedure.
3. Lo and reverse clutch plates (682) into case lugs.
   - Start with a composition plate and alternate with steel.
   - Index with the splines of the reaction carrier and the case as shown.

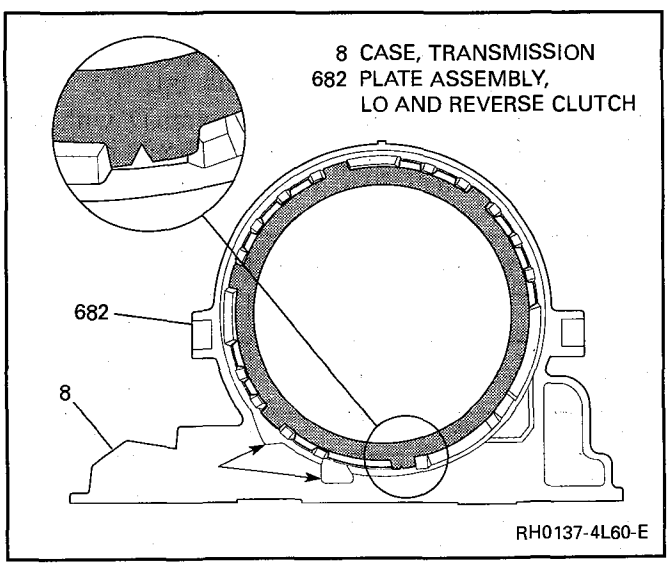


Figure 40 Lo and Reverse Clutch Plates Properly Installed

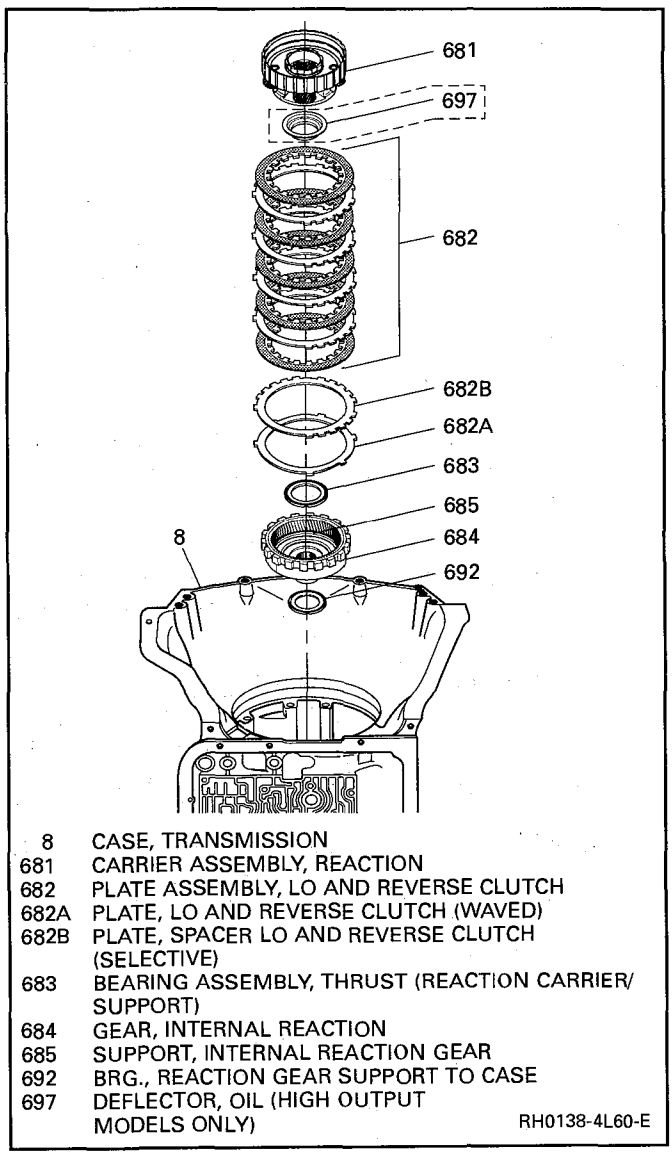


Figure 41 Reaction Internal Gear and Carrier Assembly Installation

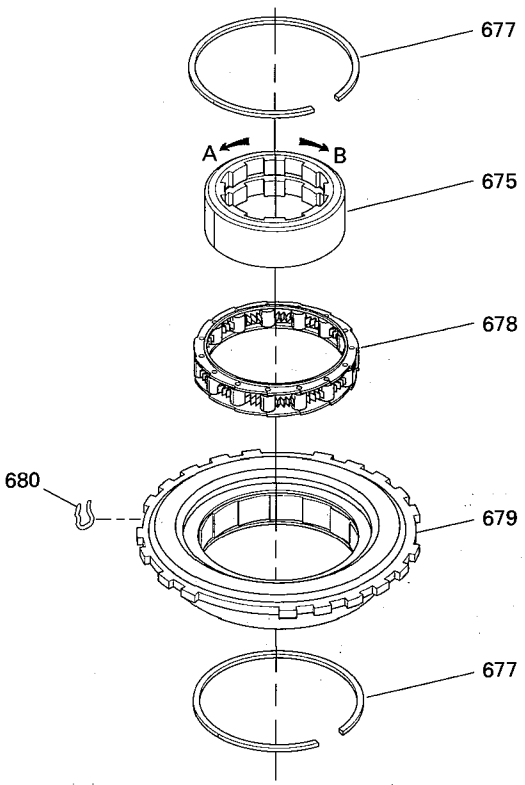
Lo and Reverse Clutch Support Assembly

Figures 42, 43 and 44

Remove or Disconnect

Figure 42

1. Inner race (675) from the support assembly.
2. One retainer ring (677).
3. Roller clutch assembly (678).



A LOCKED UP
B FREE WHEELS
675 RACE, LO AND REVERSE ROLLER CLUTCH
677 RING, LO AND REVERSE RETAINER (ROLLER ASSEMBLY/CAM)
678 CLUTCH ASSEMBLY, LO AND REVERSE ROLLER
679 SUPPORT ASM., LO AND REVERSE CLUTCH
680 SPRING, TRANSMISSION (LO AND REVERSE CLUTCH SUPPORT RETAINER)

RH0139-4L60-E

Figure 42 Lo and Reverse Clutch Support Assembly

Inspect

Figure 42

- Inner race (675) for damage and surface finish.
- Roller clutch assembly (678) for:
  - Damaged rollers.
  - Broken springs.
- Cam for:
  - Loose cam.
  - Surface finish.
- Support assembly for:
  - Cracks or damaged lugs.

Install or Connect

Figures 42, 43 and 44

1. Roller clutch assembly (678) into the cam and support assembly (679).
2. Support and roller assembly into the case with the hub down.
3. Inner race (675) into the roller assembly.
   - Turn inner race (675) while inserting.
     A. Push down for full engagement.
     B. Bottom tangs will be flush with carrier hub when properly installed.
     C. Check for proper operation by rotating the inner race as shown in Figure 42.
4. Support retainer spring (680) into the case.
   - Insert between the case lug and the one open notch in the support.

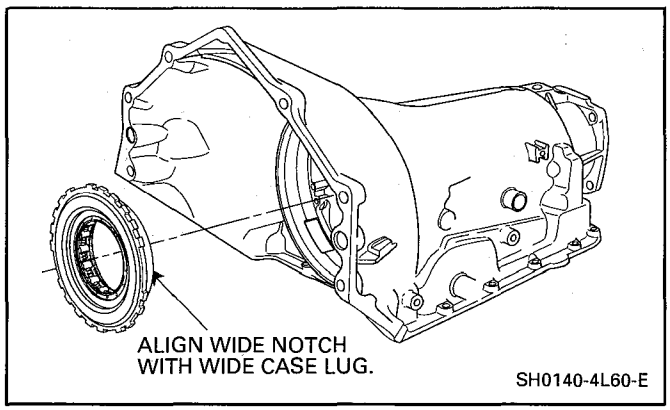
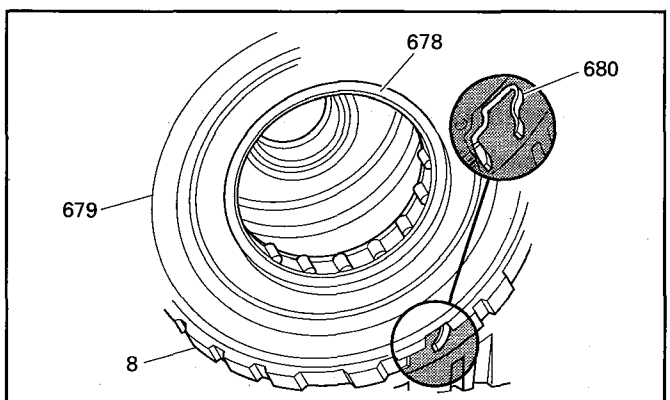


Figure 43 Lo and Reverse Support and Roller Asm. Installation



8 CASE, TRANSMISSION
678 CLUTCH ASSEMBLY, LO AND REVERSE ROLLER
679 SUPPORT ASM., LO AND REVERSE CLUTCH
680 SPRING, TRANSMISSION (LO AND REVERSE CLUTCH SUPPORT RETAINER)

RH0141-4L60-E

Figure 44 Support Spring – Installed

Reaction Sun Gear and Shell

Figure 45

Inspect

- Reaction sun gear (673) for:
  - Nicked, scored, or worn bushing (See Bushing Replacement).
  - Damaged spline or teeth.
  - Loose or weak retaining ring (do not remove this ring, except to replace it.).
- Reaction sun shell (670) for:
  - Stripped or worn splines.
  - Broken hub.
  - Bent tangs.
- Lo and reverse inner race to reaction sun gear shell thrust washer (674) for wear or damage.
- Reaction shaft to reaction sun gear shell bronze thrust washer (669) for wear or damage.

Install or Connect

Figure 45

1. Reaction sun gear retainer ring (671) onto the reaction sun gear, if previously removed.
2. Reaction sun gear (673) into the reaction carrier.
   - Index the teeth with the pinion gears.
3. Thrust washer (674) onto the lo and reverse support inner race.
   - Index the four locating ears into the inner race.
4. Reaction sun gear shell (670) onto the reaction sun gear.
5. Bronze thrust washer (669) onto the reaction sun gear shell.
   - Index tangs into the shell.

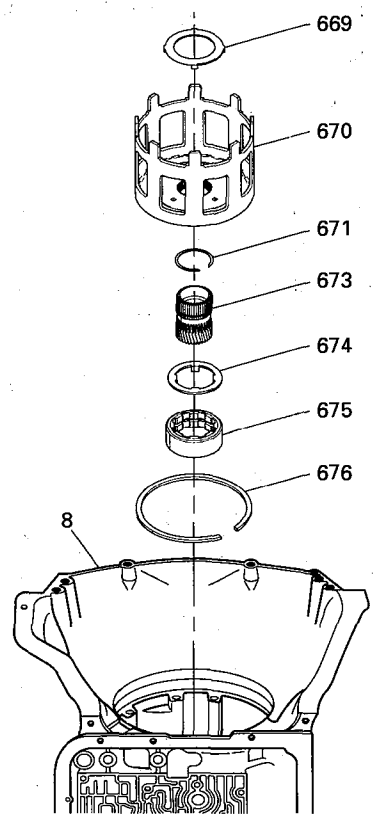
Input Internal Gear and Reaction Shaft

Figures 46 and 47

Remove or Disconnect

Figure 46

1. Retainer ring (668) from input internal gear (664).
2. Reaction carrier shaft (666) from the input internal gear.



8 CAST, TRANSMISSION
669 WASHER, THRUST (REACTION SHAFT/SHELL)
670 SHELL, REACTION SUN
671 RING, REACTION SUN GEAR RETAINER
673 GEAR, REACTION SUN
674 WASHER, THRUST (RACE/REACTION SHELL)
675 RACE, LO AND REVERSE ROLLER CLUTCH
676 RING, LO AND REVERSE SUPPORT TO CASE RETAINER

RH0142-4L60-E

Figure 45 Reaction Sun Gear and Shell Installation

Inspect

Figures 46 and 47

- Reaction carrier shaft (666) for:
  - Scored, damaged, or worn bushings (see Bushing Replacement).
  - Cracked shaft.
  - Damaged spline or gear teeth.
  - Under cut around the shaft from interference with the sun gear.

- Input internal gear (664) for:
  - Cracks.
  - Damaged spline or gear teeth.
- Input carrier to reaction shaft thrust bearing (663) for wear or damage.
- Output shaft (687) for:
  - Plugged or restricted lube passages.
  - Damaged splines or ring groove.
  - Damaged governor drive gear teeth.
  - Burrs or damage to the front of the shaft at seal area. (Polish with crocus cloth if necessary).
  - Burrs or damage to bearing journals.

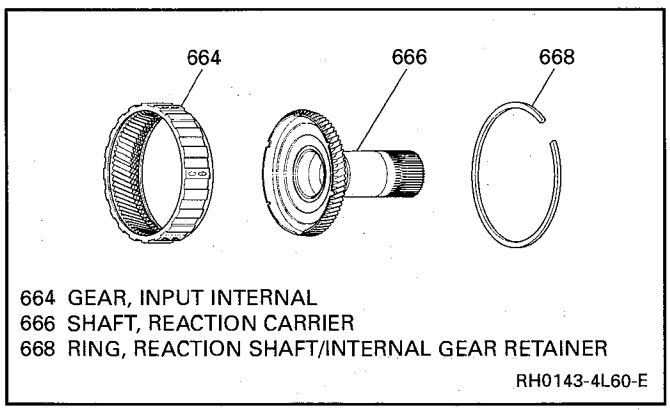


Figure 46 Input Internal Gear and Reaction Shaft

Transmission Output Speed Sensor Rotor

Figure 47

Tools Required:

J 21427-01 Speedometer Gear Puller Adapter

J 8433 Speedometer Gear Puller

J 36352-6 "C" Washer

J 36352-4 Rotor Installer

Mechanical press

Inspect

Figure 47

- Speed sensor rotor on output shaft for tooth damage.

Important

- If rotor is damaged, replace it. Do not reuse a rotor that has been removed.

Remove or Disconnect

Figure 47

- Install J 21427 with J 8433 and remove rotor.

Install or Connect

Figure 47

1. Place new rotor over output shaft.
2. Place J 36352-4 in groove on output shaft.
3. Place J 36352-6 on shaft and press to make contact with J 36352-4.

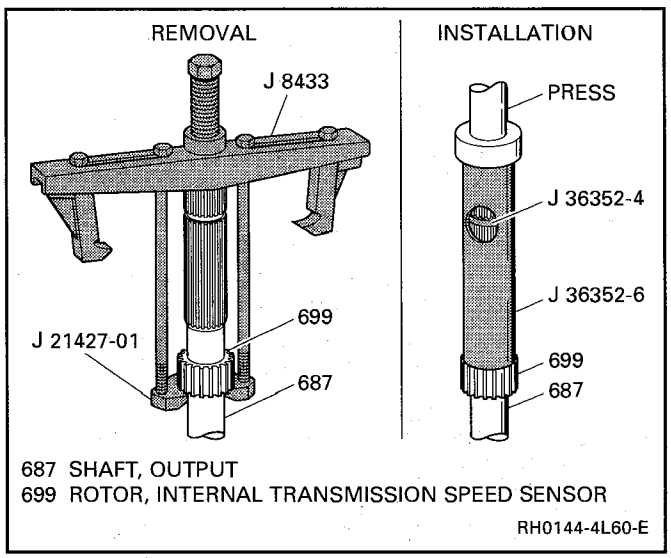


Figure 47 Transmission Output Speed Sensor Rotor

Input Internal Gear and Output Shaft

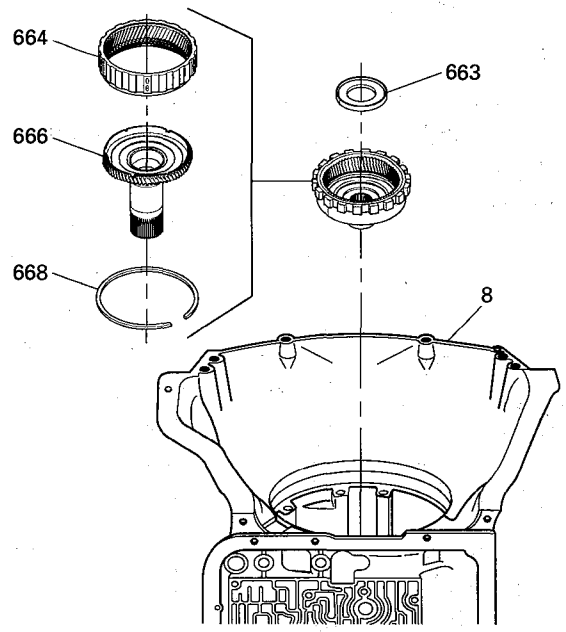
Figures 48 and 49

Tool Required:

J 29837 Output Shaft Support Fixture

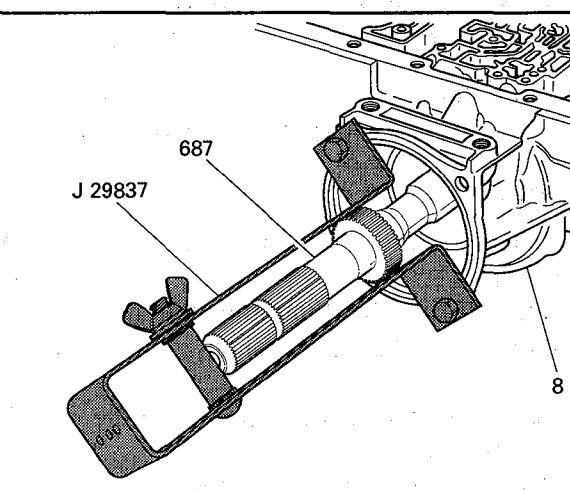
Install or Connect

1. Reaction shaft (666) into the input internal gear (664).
2. Retainer ring (668) into the input internal gear.
3. Input internal gear and shaft assembly into the sun gear shell.
   - Index the shaft spline into the reaction carrier.
4. Thrust bearing (663) onto the reaction carrier shaft.
   - Outer race goes toward the reaction carrier shaft.
5. Output shaft (687) into the transmission.
   - Index the splines with the mating parts.
6. J 29837 onto the case.
   - Position upwards as far as possible to support the output shaft.



8 CASE, TRANSMISSION
663 BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)
664 GEAR, INPUT INTERNAL
666 SHAFT, REACTION CARRIER
668 RING, REACTION SHAFT/INTERNAL GEAR RETAINER
RH0145-4L60-E

Figure 48 Input Internal Gear Installation



8 CASE, TRANSMISSION
687 SHAFT, OUTPUT
SH0118-4L60-E

Figure 49 Output Shaft – Installation

Input Carrier and Sun Gear

Figure 50

Tool Required:

J 34627 Snap Ring Pliers

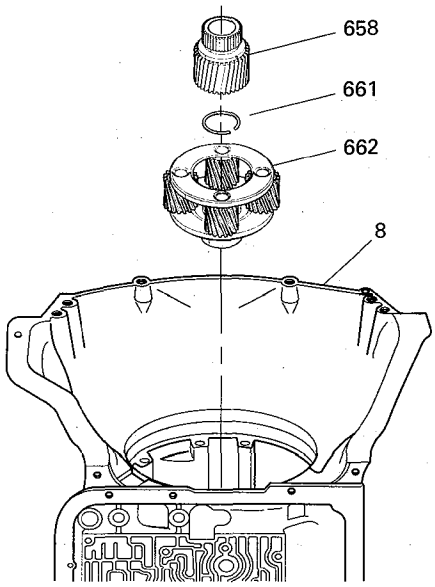
Inspect

- Input carrier assembly (662) for:
  - Pinion gear damage.
  - Excessive pinion washer wear – end play should be 0.20 to 0.61 mm (0.008 to 0.024 inch).
  - Proper pin stake.
  - Keystoned pinion gears (pinion gears must rotate freely).
  - Damaged or worn thrust bearing.
    - To check the captive thrust bearing in the carrier for wear, place a bushing or an output shaft sleeve on the bearing race (do not contact the pinion gears) and turn it with the palm of your hand. Any imperfections will be felt through the bushing.
- Input sun gear (658) for:
  - Bushing damage or wear (see Bushing Replacement Procedure).
  - Cracks.
  - Damaged spline or gear teeth.

Install or Connect

Figure 50

1. Input carrier assembly (662) onto the output shaft.
2. Retainer ring (661) into the output shaft ring groove.
   - Use care not to overexpand the ring during installation.
   - Do not reuse the old retainer ring if it has been overexpanded.
3. Remove J 29837.
4. Input sun gear (658) into the input carrier.
   - Rotate the sun gear teeth into the pinion gear teeth.



8 CASE, TRANSMISSION
658 GEAR, INPUT SUN
661 RET., OUTPUT SHAFT TO INPUT CARRIER
662 CARRIER ASSEMBLY, INPUT (COMPLETE)
RH0146-4L60-E

Figure 50 Input Carrier and Sun Gear – Installation

Input Clutch Assembly

Figures 51 through 55

Tools Required:

J 23456 Clutch Spring Compressor Press

J 23327-1 Clutch Spring Compressor

J 25018-A Clutch Spring Compressor Adaptor

Remove or Disconnect

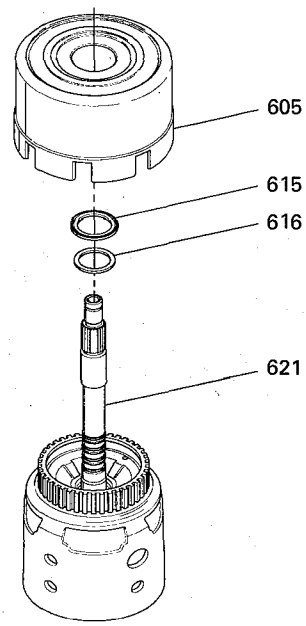
Figures 51 and 53

- Reverse input clutch assembly (605) from the input clutch assembly (621).
- Oil pump to selective washer thrust bearing (615).
- Selective washer (616).

Disassemble

Figures 52 and 53

1. Place the input clutch assembly (621) on the bench with the turbine shaft through the bench hole.
2. The 3-4 clutch plate retainer ring (656) and the backing plate (655).
3. The 3-4 clutch plates (654).
4. Five 3-4 clutch boost spring assemblies (600).
5. The 3-4 clutch apply plate (653).
6. The 3-4 clutch ring retainer plate (652).
7. Forward clutch backing plate retainer ring (651) and backing plate (650).
8. Forward clutch sprag assembly (638-648).



605 HOUSING AND DRUM ASSEMBLY, REVERSE INPUT CLUTCH
615 BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616 WASHER, THRUST (SELECTIVE)
621 HOUSING AND SHAFT ASSEMBLY, INPUT
RH0147-4L60-E

Figure 51 Reverse Input and Input Clutches

Disassemble

Figure 53

1. Input sun gear bearing assembly (637).
2. Input housing to output shaft lip seal (636).
3. Forward clutch plates (649).
4. Forward wave plate (648).
5. Forward clutch apply plate (646).
6. Overrun clutch plates (645).

Disassemble

Figure 53

1. Install J 23456 and J 23327-1 with J 25018-A.
   - Compress overrun clutch spring assembly (634).
2. Overrun clutch retainer ring (635).

3. Overrun clutch spring assembly (634).
4. Overrun clutch piston (632).
   - Inner and outer lip seals (631).
5. Forward clutch piston assembly (630).
   - Inner and outer lip seals (629).
6. Forward clutch housing (628).
7. The 3-4 clutch spring assembly (626).
8. The 3-4 clutch apply ring (625) and piston (623).
   - Inner and outer lip seals (624) from piston.
9. Forward clutch to input housing O-ring seal (622).
10. Four turbine shaft oil seal rings (619).

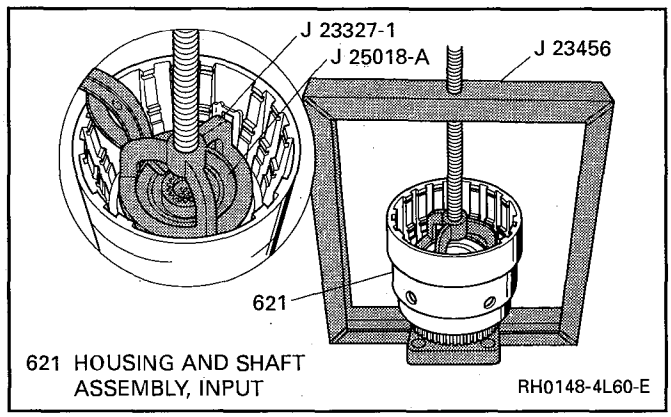


Figure 52 Overrun Clutch Retainer Ring – Removal

Inspect

Figures 53 and 54

- Input housing for porosity or damage
- Input housing and shaft assembly (621) for:
  - Spline wear or damage.
  - Three turbine shaft checkballs.
    A. The balls must **not** be loose or leaking.
    B. The open hole is the lube oil passage which feeds the output shaft.
- Presence of orificed cup plug (698).
- Cracks at lube holes.
- Four turbine shaft oil seal ring grooves for damage or burrs.
  - Seals must fit freely into the ring grooves.
- Feed passages for:
  - Obstructions – blow air through passages.

Check Valve Retainer and Ball Assembly – Replacement Procedure

Figures 53 through 63

Tools Required:

6.35 mm (1/4 inch) diameter rod or drift hammer

J 23456 Clutch Spring Compressor Press

J 23327-1 Clutch Spring Compressor

J 25018-A Clutch Spring Compressor Adaptor

J 29882 Overrun Clutch Inner Seal Protector

J 29883 Forward Clutch Inner Seal Protector

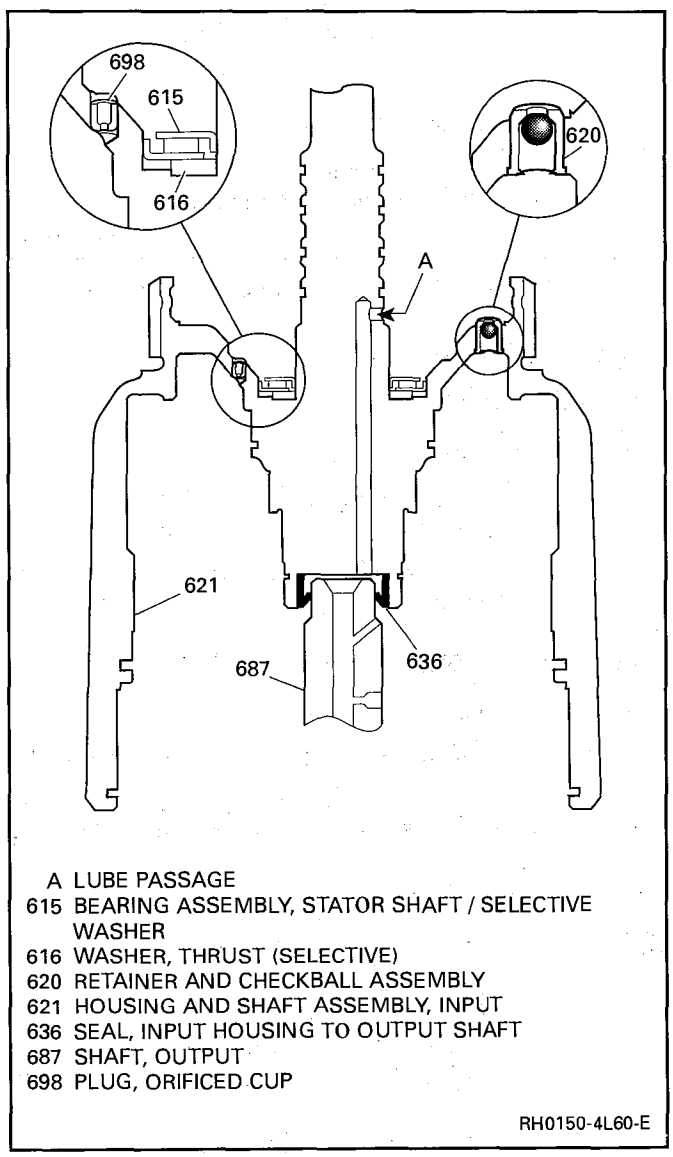
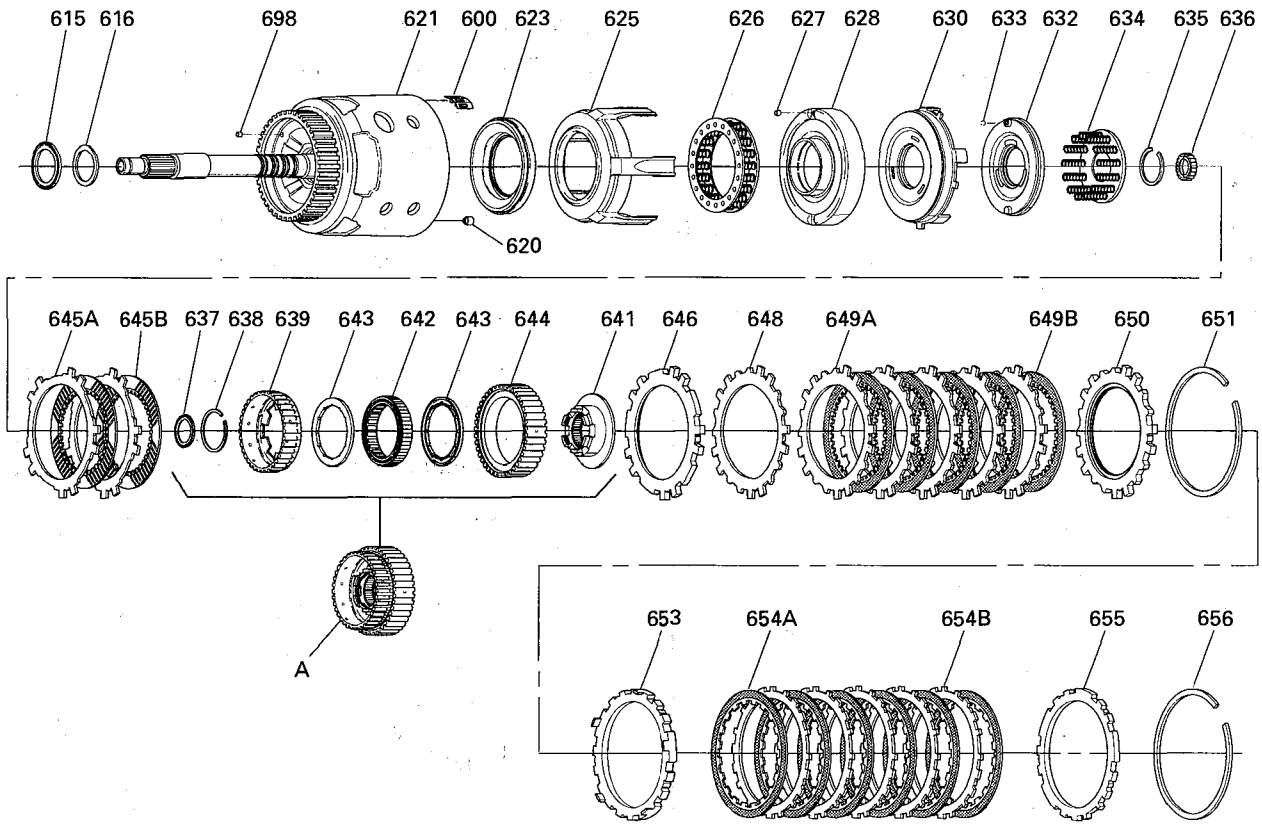


Figure 53 Input Housing Check Valve Ball



ILL. NO.	DESCRIPTION
600	SPRING ASM., 3-4 CLUTCH BOOST (5)
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
620	RETAINER AND CHECKBALL ASSEMBLY
621	HOUSING AND SHAFT ASSEMBLY, INPUT
623	PISTON, 3RD AND 4TH CLUTCH
625	RING, 3RD AND 4TH CLUTCH (APPLY)
626	SPRING ASSEMBLY, 3RD AND 4TH CLUTCH
627	RETAINER AND BALL ASSEMBLY, FORWARD CLUTCH HOUSING
628	HOUSING, FORWARD CLUTCH
630	PISTON, FORWARD CLUTCH
632	PISTON, OVERRUN CLUTCH
633	BALL, OVERRUN CLUTCH
634	SPRING ASSEMBLY, OVERRUN CLUTCH
635	SNAP RING, OVERRUN CLUTCH SPRING RETAINER
636	SEAL, INPUT HOUSING TO OUTPUT SHAFT
645A	PLATE ASSEMBLY, OVERRUN CLUTCH (STEEL)
645B	PLATE, OVERRUN CLUTCH (FIBER)
A	FORWARD CLUTCH SPRAG ASSEMBLY
637	BEARING ASSEMBLY, INPUT SUN GEAR
638	SNAP RING, OVERRUN CL. HUB RETAINING
639	HUB, OVERRUN CLUTCH
641	RETAINER AND RACE ASSEMBLY, SPRAG
642	FORWARD SPRAG ASSEMBLY
643	RETAINER RINGS, SPRAG ASSEMBLY
644	RACE, FORWARD CLUTCH (OUTER)

ILL. NO.	DESCRIPTION
646	PLATE, FORWARD CLUTCH (APPLY)
648	PLATE, FORWARD CLUTCH (WAVED)
649A	PLATE ASSEMBLY, FORWARD CLUTCH (STEEL)
649B	PLATE, FORWARD CLUTCH (FIBER)
650	PLATE, FORWARD CLUTCH BACKING (SEL.)
651	RING, FORWARD CLUTCH BACKING PLATE RETAINER
653	PLATE, 3RD AND 4TH CLUTCH APPLY (STEPPED)
654A	PLATE ASSEMBLY, 3RD AND 4TH CLUTCH (FIBER)
654B	PLATE, 3RD AND 4TH CLUTCH (STEEL)
655	PLATE, 3RD AND 4TH CLUTCH BACKING (SEL.)
656	RING, 3RD AND 4TH CLUTCH BACKING PLATE RETAINER
698	PLUG, ORIFICED CUP

SH0149-4L60-E-R1

Figure 54 Input Clutch Assembly

Remove or Disconnect

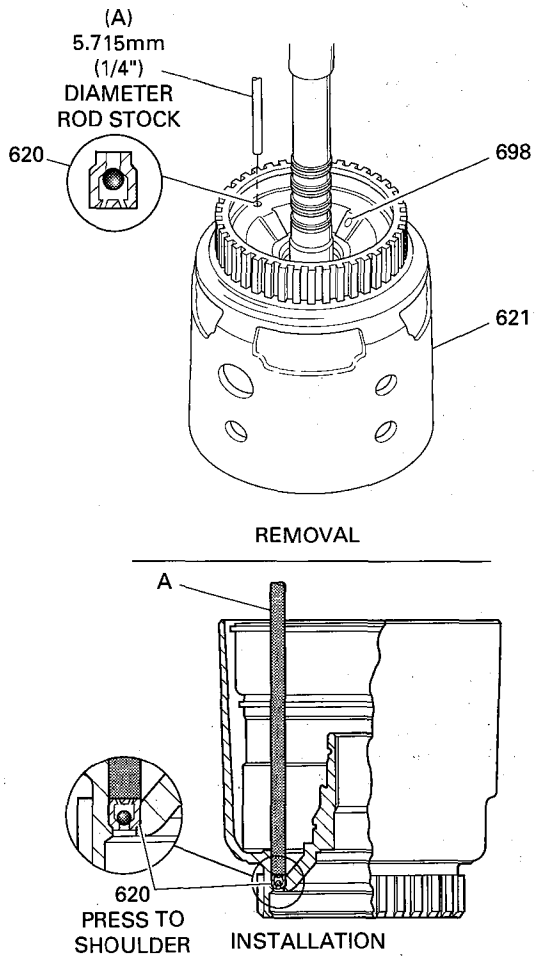
Figure 55

- Tap out retainer and ball assembly.

Install or Connect

Figures 55

- Using same tools, tap in retainer and ball assembly until shoulder is seated in housing.



A ROD STOCK/DRIFT, 5.715mm (1/4") DIA.
620 RETAINER AND CHECKBALL ASSEMBLY
621 HOUSING AND SHAFT ASSEMBLY, INPUT
698 PLUG, ORIFICED CUP

RH0153-4L60-E

Figure 55 Retainer and Checkball Removal/Installation

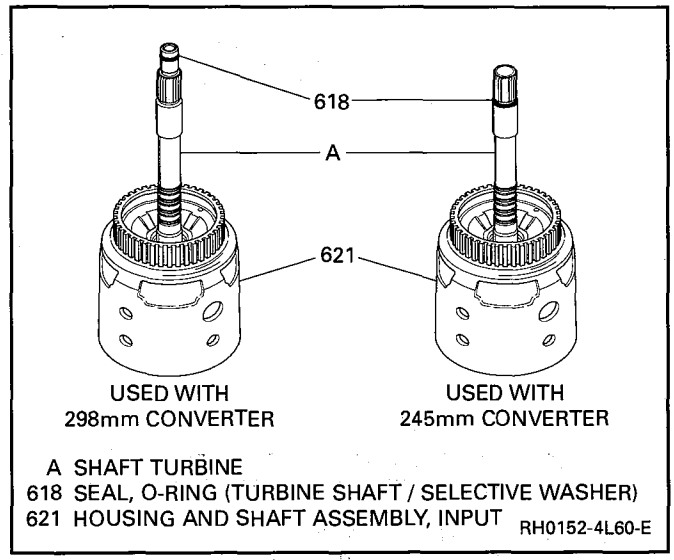
Inspect

Figures 53 and 56

- Turbine shaft O-ring seal (618) for:
  - Damage.
  - Nicks or cuts.
- Input housing check valve ball (620):
  - The ball must move freely.
  - Leak check the ball with solvent.

Important

- If the 3-4 clutch plates are burned or worn and a cause is not found during diagnosis or disassembly, replacement of the retainer and checkball assembly may be required (Figure 55).



A SHAFT TURBINE
618 SEAL, O-RING (TURBINE SHAFT / SELECTIVE WASHER)
621 HOUSING AND SHAFT ASSEMBLY, INPUT

RH0152-4L60-E

Figure 56 Views of the Input Housing

Inspect

Figure 54

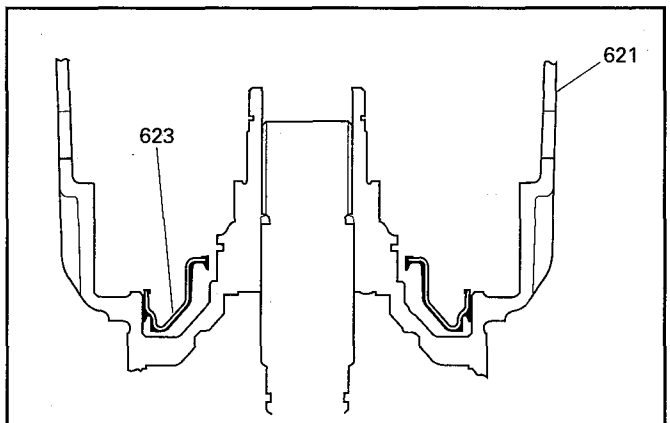
- The 3-4 clutch piston (623) for damage or porosity.
- The 3-4 clutch apply ring (625) for:
  - Bent tangs.
- The 3-4 clutch spring assembly (626) for damage or distortion.
- The 3-4 clutch boost spring assemblies (600) for damage or distortion.

Assemble

Figure 57

Position the input housing and shaft assembly on the bench with the turbine shaft through a bench hole.

1. Inner and outer 3-4 clutch lip seals (624) on the 3-4 clutch piston.
   - Seal lips must face away from the piston hub.
   - Lubricate the seals with Transjel™ J 36850 or equivalent.
2. The 3-4 clutch piston (623) into the input housing as shown.
   - Use care not to damage the seals.



621 HOUSING AND SHAFT ASSEMBLY, INPUT
623 PISTON, 3RD AND 4TH CLUTCH

SH0154-4L60-E

Figure 57 Input Housing and 3-4 Piston

Inspect

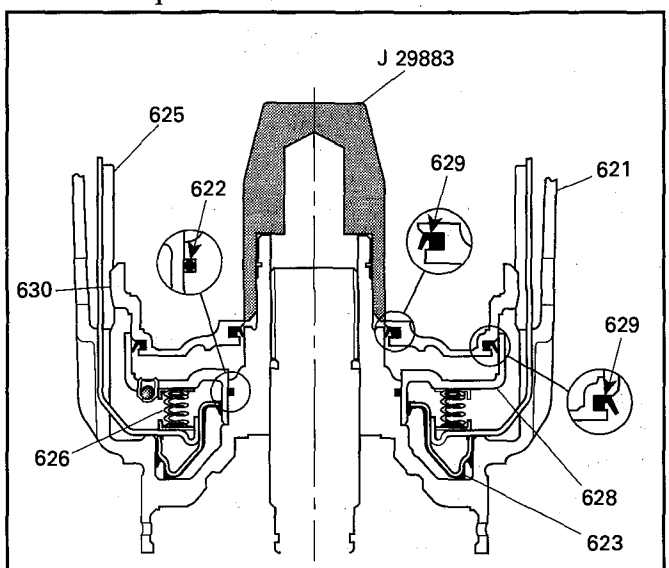
Figures 58 and 59

- Forward clutch housing (628) for:
  - Proper checkball operation.
  - Damage or distortion.
  - Burrs in seal areas.
  - Cracks.
- Forward clutch piston (630) and overrun clutch piston (632) for:
  - Porosity or damage.
  - Ring groove damage.
  - Apply leg damage.
- Overrun spring assembly (634) for damage or distortion.
- Input housing to output shaft lip seal (636) for damage or wear.

Assemble

Figures 58 and 59

1. Forward clutch housing to input clutch housing O-ring seal (622) as shown.
   - Lubricate with Transjel™ J 36850 or equivalent.

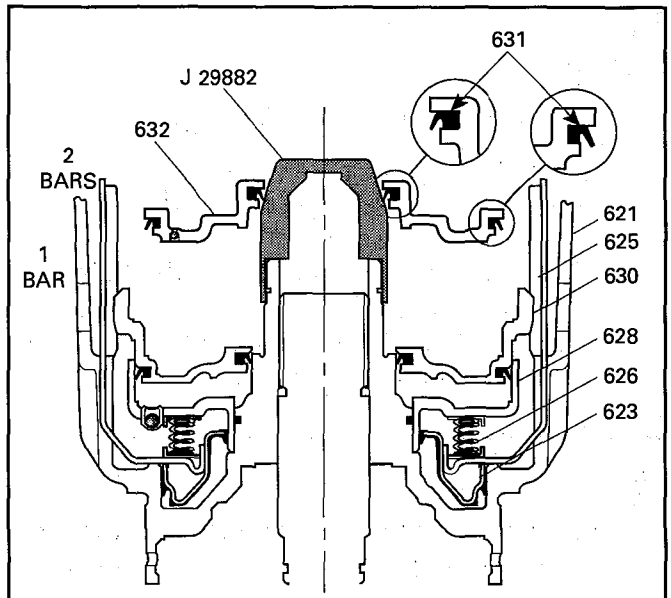


621 HOUSING AND SHAFT ASSEMBLY, INPUT
622 SEAL, O-RING INPUT TO FORWARD HSG.
623 PISTON, 3RD AND 4TH CLUTCH
625 RING, 3RD AND 4TH CLUTCH (APPLY)
626 SPRING ASSEMBLY, 3RD AND 4TH CLUTCH
628 HOUSING, FORWARD CLUTCH
629 SEAL, FORWARD CLUTCH (INNER AND OUTER)
630 PISTON, FORWARD CLUTCH

SH0155-4L60-E

Figure 58 Forward Clutch and 3-4 Apply Ring – Installed

2. Inner and outer seals (629) on forward clutch piston.
   - Seal lips must face away from the piston tangs as shown.
   - Lubricate with Transjel™ J 36850 or equivalent.
3. Forward clutch piston (630) into the forward clutch housing.
   - Use care not to damage the outer lip seal.
4. The 3-4 clutch spring assembly (626) onto the 3-4 clutch apply ring.
5. Forward clutch assembly onto the 3-4 clutch spring assembly.
   - The forward clutch piston apply legs must be indexed with the 3-4 clutch apply ring legs.
6. J 29883 on the input housing as shown.



621 HOUSING AND SHAFT ASSEMBLY, INPUT
623 PISTON, 3RD AND 4TH CLUTCH
625 RING, 3RD AND 4TH CLUTCH (APPLY)
626 SPRING ASSEMBLY, 3RD AND 4TH CLUTCH
628 HOUSING, FORWARD CLUTCH
630 PISTON, FORWARD CLUTCH
631 SEAL, OVERRUN CLUTCH (INNER AND OUTER)
632 PISTON, OVERRUN CLUTCH

SH0156-4L60-E

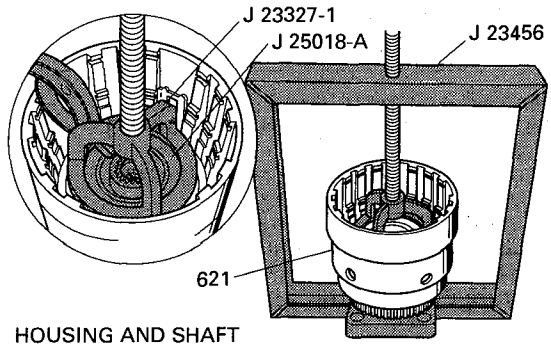
Figure 59 Overrun Piston – Installed

7. Apply ring and forward clutch assembly into the input housing as shown.
   A. Hold the assembly by the apply ring legs during installation.
   B. Do not let the forward clutch piston separate from the housing.
   C. Firmly seat the assembly.
8. J 29882 on the input housing as shown.
9. Overrun clutch piston (632).
   - Hub facing upward as shown.
   - If all parts are properly seated to this point, the overrun piston hub will be approximately 4.7 mm (3/16 in.) below the top of the snap ring groove in the input housing hub.

Assemble

Figures 60 and 61

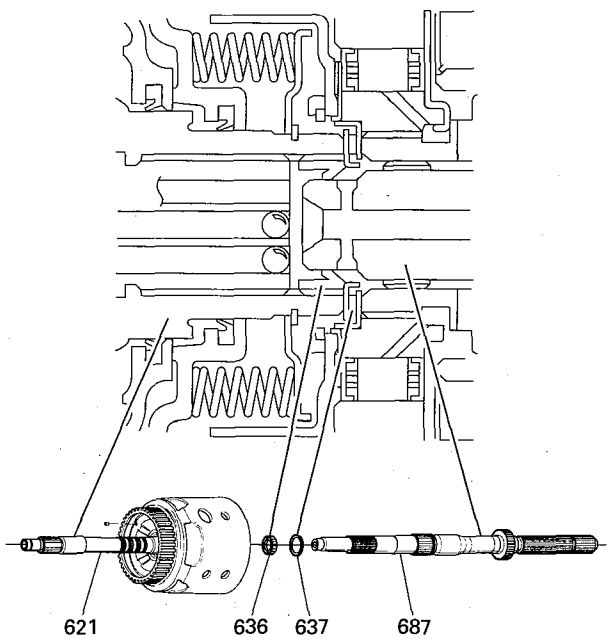
1. Overrun clutch spring assembly (634) onto the overrun clutch piston.
   - Locate the springs on the piston tabs.
2. J 23456 and J 23327-1 with J 25018-A onto the overrun spring assembly.
   - Compress springs (Do not over-compress).
3. Retainer snap ring (635) into the snap ring groove.
4. Input housing to output shaft lip seal (636).



621 HOUSING AND SHAFT ASSEMBLY, INPUT

RH0148-4L60-E

Figure 60 Overrun Clutch Retaining Ring – Installed



621 HOUSING AND SHAFT ASSEMBLY, INPUT
636 SEAL, INPUT HOUSING TO OUTPUT SHAFT
637 BEARING ASSEMBLY, INPUT SUN GEAR
687 SHAFT, OUTPUT

SH0157-4L60-E

Figure 61 Input Hsg. to Output Shaft Lip Seal

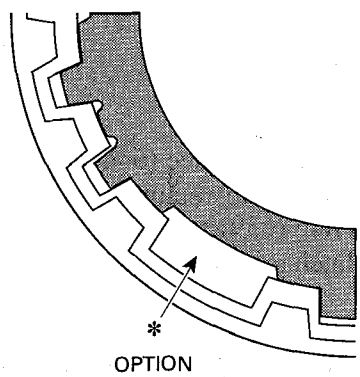
Inspect

- Overrun clutch plates (645) for:
  - Composition plate damaged tangs, delamination, or excessive wear.
  - Steel plate damaged tangs, wear, or heat damage.
- Input sun gear bearing assembly (637) for:
  - Wear.
  - Flatness.
  - Damaged.

Assemble

Figures 62 and 63

1. Overrun clutch plates (645) into the input housing.
   - Overrun clutch plates are the smallest of the three sets of plates in the input housing.
   - Index the plates as shown starting with a steel plate and alternate with composition.
2. Thrust bearing assembly (637) onto the input clutch hub.
   - The inside race must face the input housing hub.
   - Retain with Transjel™ J 36850 or equivalent.
3. Align the tangs on the two composition overrun clutch plates.



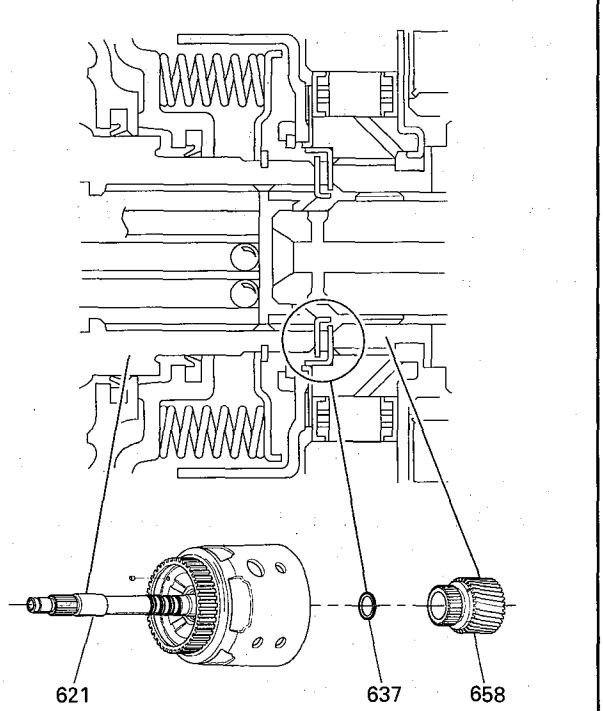
* ALIGN WIDE NOTCHES TO CASE LUGS

OVERRUN CLUTCH

MODEL	FLAT STEEL		COMP. FACED	
	NO.	THICK-NESS	NO.	THICK-NESS
ALL MODELS	2	2.248mm - 2.400mm (.089" - .094")	2	2.03mm (.079")

RH0158-4L60-E

Figure 62 Overrun Clutch Plate Chart



621 HOUSING AND SHAFT ASSEMBLY, INPUT
637 BEARING ASSEMBLY, INPUT SUN GEAR
658 GEAR, INPUT SUN
RH0159-4L60-E

Figure 63 Input Sun Gear Thrust Bearing

Forward Clutch Sprag Assembly

Figures 64 through 70

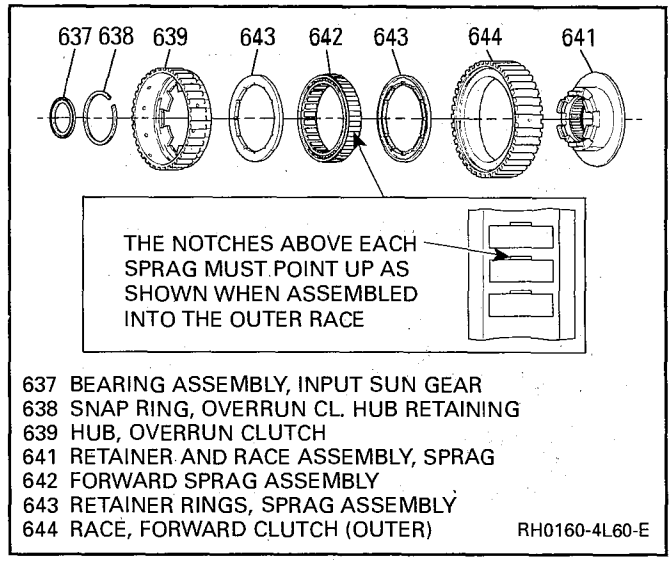
Disassemble

Figure 64

1. Forward sprag outer race (644).
2. Overrun clutch hub retaining snap ring (638) and clutch hub (639).
3. Forward clutch retainer and race assembly (641).

Inspect

- Forward clutch sprag assembly (642) for:
  - Wear or damage.
  - Weak or broken springs.
  - Damaged or missing retainer caps (brass).
- Overrun clutch hub (639) for:
  - Spline damage.
  - Plugged lubrication holes.
  - Damaged tangs.
  - Cracks.
- Forward clutch retainer and race assembly (641) for:
  - Spline damage.
  - Ring groove damage.
  - Surface finish damage.
  - Loose retainer.
- Forward sprag outer race (644) for:
  - Spline damage.
  - Surface finish damage.
  - Plugged lubrication holes.



637 BEARING ASSEMBLY, INPUT SUN GEAR
638 SNAP RING, OVERRUN CL. HUB RETAINING
639 HUB, OVERRUN CLUTCH
641 RETAINER AND RACE ASSEMBLY, SPRAG
642 FORWARD SPRAG ASSEMBLY
643 RETAINER RINGS, SPRAG ASSEMBLY
644 RACE, FORWARD CLUTCH (OUTER)
RH0160-4L60-E

Figure 64 Forward Clutch Sprag Assembly

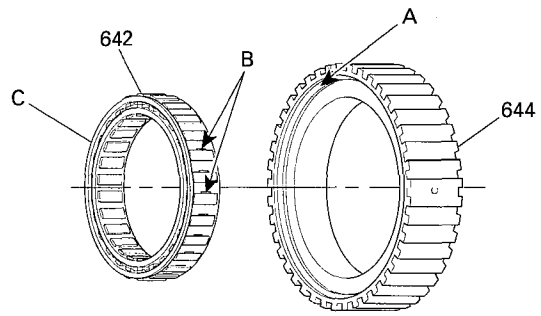
Assemble

Figures 65, 66 and 67

1. Forward clutch sprag assembly (642) into the outer race.
   - To correctly install, the notches in the sprag cage must face upward as shown.
2. One sprag retainer ring (643) onto the race and retainer assembly.
   - The flange on the retainer ring must face away from the retainer.
3. Race and retainer assembly into the sprag assembly.
   A. To assemble, hold the outer race in your left hand with your fingers supporting the sprag at the recessed side of the outer race.
   B. Insert the race and retainer assembly by pushing in and turning to the left.
4. The remaining retainer ring onto the sprag assembly.
5. Overrun clutch hub (639).
6. Overrun clutch hub retaining snap ring (638) into the snap ring groove of the race and retainer assembly.
7. Test the assembly for proper operation as shown (Figure 67).

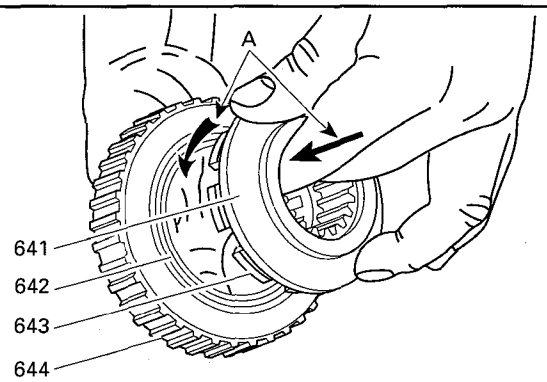
Important

- If the assembly operates backwards, you have installed the sprag backwards. Reassemble correctly.



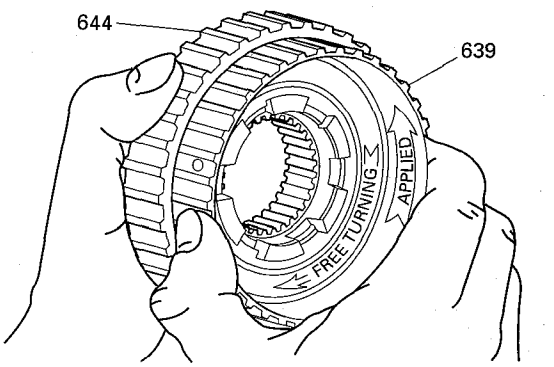
A RECESSED FACE
B NOTCHES POINT UPWARD AS SHOWN
C LIPPED EDGE
642 FORWARD SPRAG ASSEMBLY
644 RACE, FORWARD CLUTCH (OUTER)
RH0161-4L60-E

Figure 65 Sprag Assembly Procedure



A PUSH IN AND TURN COUNTERCLOCKWISE TO INSTALL
641 RETAINER AND RACE ASSEMBLY, SPRAG
642 FORWARD SPRAG ASSEMBLY
643 RETAINER RINGS, SPRAG ASSEMBLY
644 RACE, FORWARD CLUTCH (OUTER)
RH0162-4L60-E

Figure 66 Sprag Race and Retainer Assembly Procedure



THE OVERRUN CLUTCH HUB MUST TURN CLOCKWISE, BUT NOT COUNTERCLOCKWISE

639 HUB, OVERRUN CLUTCH
644 RACE, FORWARD CLUTCH (OUTER)
RH0163-4L60-E

Figure 67 Sprag Operation Check

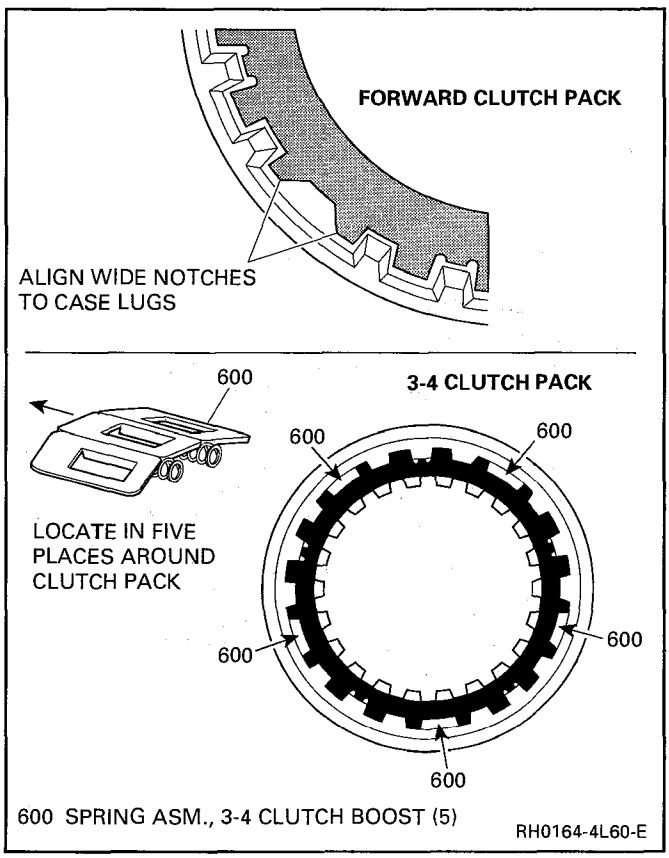
Assemble

- Forward clutch sprag assembly into the input clutch housing.
  - Index the overrun clutch hub into the overrun clutch plates.

Inspect

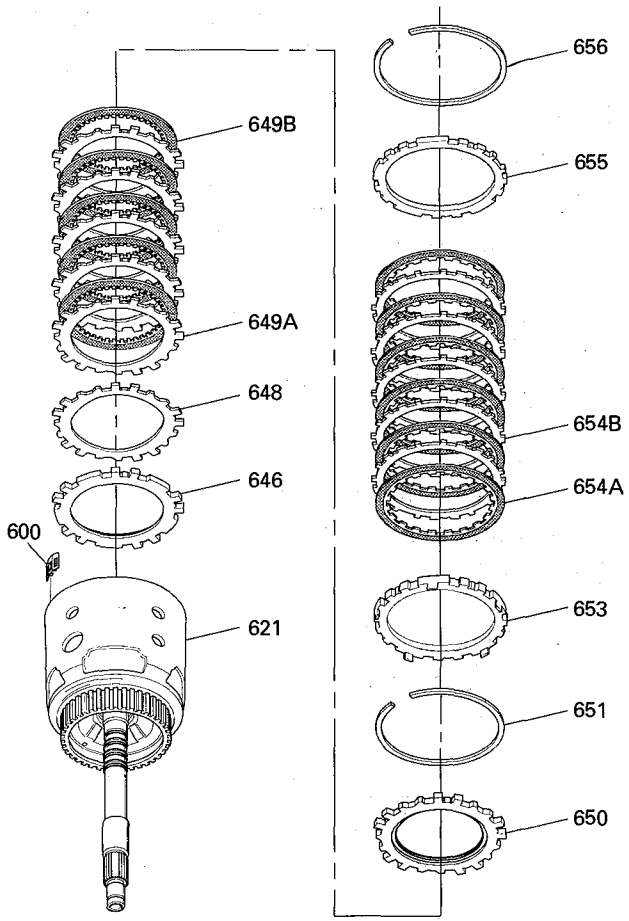
Figures 68 and 69

- Forward (649) and 3-4 clutch plates (654) for:
  - Composition plate damaged tangs, delamination, or wear.
  - Steel plate damaged tangs, wear, or heat damage.
- Forward (650) and 3-4 clutch backing plates (655) for:
  - Flatness.
  - Surface finish damage.
  - Burrs or nicks.
- Forward clutch apply plate (646) and spacer plate (647) for:
  - Flatness.
  - Surface finish damage.
  - Burrs or nicks.



600 SPRING ASM., 3-4 CLUTCH BOOST (5)
RH0164-4L60-E

Figure 68 Forward and 3-4 Clutch Plates – Installed



ILL. NO.	DESCRIPTION
600	SPRING ASM., 3-4 CLUTCH BOOST (5)
621	HOUSING AND SHAFT ASSEMBLY, INPUT
646	PLATE, FORWARD CLUTCH (APPLY)
648	PLATE, FORWARD CLUTCH (WAVED)
649A	PLATE ASSEMBLY, FORWARD CLUTCH (STEEL)
649B	PLATE, FORWARD CLUTCH (FIBER)
650	PLATE, FORWARD CLUTCH BACKING (SEL.)
651	RING, FORWARD CLUTCH BACKING PLATE RETAINER
653	PLATE, 3RD AND 4TH CLUTCH APPLY (STEPPED)
654A	PLATE ASSEMBLY, 3RD AND 4TH CLUTCH (FIBER)
654B	PLATE, 3RD AND 4TH CLUTCH (STEEL)
655	PLATE, 3RD AND 4TH CLUTCH BACKING (SEL.)
656	RING, 3RD AND 4TH CLUTCH BACKING PLATE RETAINER

RH0165-4L60-E-R1

Figure 69 Input Housing with Forward and 3-4 Clutch Plates

- The 3-4 clutch apply plate (653) for:
  - Flatness.
  - Bent tangs.
  - Surface finish damage.

Assemble

Figures 68 through 71

1. Forward clutch apply plate (646) into the input clutch housing.
   - Index as shown.
2. Waved steel forward clutch plate (648) into the input clutch housing.
   - Index as shown.
3. The remaining forward clutch plates (649) into the input clutch housing.
   - Start with a steel plate and alternate with composition.
4. Forward clutch selective backing plate (650).
5. Forward clutch retaining ring (651).

Forward Clutch Piston Travel Check

Figure 71

Measure

1. With the overrun clutch and forward clutch fully assembled in the Input Housing, check the end clearance between the backing plate (650) and the retaining ring (651) with two feeler gages.
2. Proper forward clutch backing plate travel should be 0.75 to 1.60 mm (0.030 to 0.063 inch).
3. Select the proper backing plate from the chart to obtain the correct clearance.

FORWARD CLUTCH INFORMATION CHART

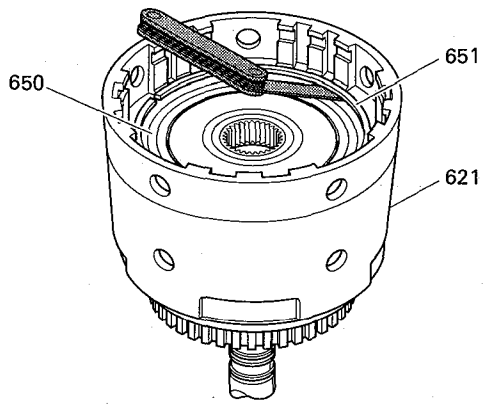
PLATE TYPE	THICKNESS	QUANTITY REQUIRED ALL MODELS
APPLY PLATE	4.30mm (.169")	1
WAVED STEEL CLUTCH PLATE	1.79mm (.070")	1
FLAT STEEL CLUTCH PLATE	2.29mm (.090")	5
COMPOSITION FACED CLUTCH PLATES	1.78mm (0.70")	5
BACKING PLATE	SELECTIVE	1

RH0166-4L60-E

Figure 70 Forward Clutch Plate Chart

FORWARD CLUTCH BACKING PLATE SELECTION

ALL MODELS	
BACKING PLATE TRAVEL = .75mm - 1.60mm (.030" - .063")	
PLATE THICKNESS	**IDENTIFICATION**
6.97mm - 7.07mm (.274" - .278")	A
6.38mm - 6.48mm (.250" - .255")	B
5.79mm - 5.89mm (.227" - .232")	C
5.20mm - 5.30mm (.205" - .208")	D
4.61mm - 4.71mm (.180" - .185")	E



621 HOUSING AND SHAFT ASSEMBLY, INPUT
650 PLATE, FORWARD CLUTCH BACKING (SEL.)
651 RING, FORWARD CLUTCH BACKING PLATE RETAINER

RH0167-4L60-E

Figure 71 Forward Clutch Backing Plate Travel

3-4 Clutch Assembly

Figures 72 and 76

Assemble

1. The 3-4 clutch apply plate (653).
   - Index each leg into the apply ring legs.
2. The 3-4 clutch plates (654).
   - Start with steel and alternate with composition as shown in (Figure 77).
   - First steel plate has the same spline configuration as apply plate.
3. The 3-4 boost springs (600).
4. The 3-4 clutch backing plate (655) and retainer ring (656).
   - Chamfered side up.

3-4 CLUTCH INFORMATION CHART

PLATE TYPE	THICKNESS	QUANTITY REQUIRED
		ALL MODELS
STEPPED APPLY PLATE	5.60mm (.220")	1
† FLAT STEEL CLUTCH PLATES	1.78mm (.070")	1
FLAT STEEL CLUTCH PLATE	2.71mm (.107")	5
COMPOSITION FACED CLUTCH PLATES	2.03mm (0.79")	6
BACKING PLATE	SELECTIVE	1

† SAME SPLINE CONFIGURATION AS APPLY PLATE

RH0168-4L60-E-R1

Figure 72 3-4 Clutch Plate Chart

3-4 Clutch Piston Travel Check

Figure 73

Measure

- Check the end clearance between the backing plate (655) and the first composition plate with a feeler gage.
- Select the proper backing plate from the chart to obtain the correct clearance for model you are working on.

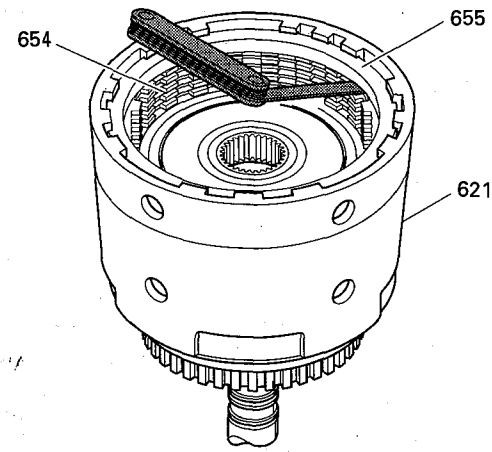
Clutch Air Check

Figure 74

Air check the 3-4, forward and overrun clutches by applying air pressure at the feed holes in the turbine shaft. (When the overrun clutch is checked, the air will blow by the forward clutch piston lip seals and exit out the forward clutch feed hole in the turbine shaft.)

3-4 BACKING PLATE SELECTION

MODEL	BACKING PLATE TRAVEL	*BACKING PLATE	
		Use Backing Plate Which Gives Correct Travel	
		DIM.	I.D.
ALL	2.10mm - .90mm (.083" - .035")	5.88mm - 5.68mm (.231" - .224")	A
		4.99mm - 4.76mm (.196" - .187")	B
		4.10mm - 3.90mm (.161" - .154")	C



621 HOUSING AND SHAFT ASSEMBLY, INPUT
654 PLATE ASSEMBLY, 3RD AND 4TH CLUTCH
655 PLATE, 3RD AND 4TH CLUTCH BACKING (SEL.)

RH0169-4L60-E-R1

Figure 73 3-4 Backing Plate Selection Chart

Turbine Shaft Seals

Figure 75

Tools Required:

J 36418-1 Seal Installer

J 36418-2A Seal Sizer

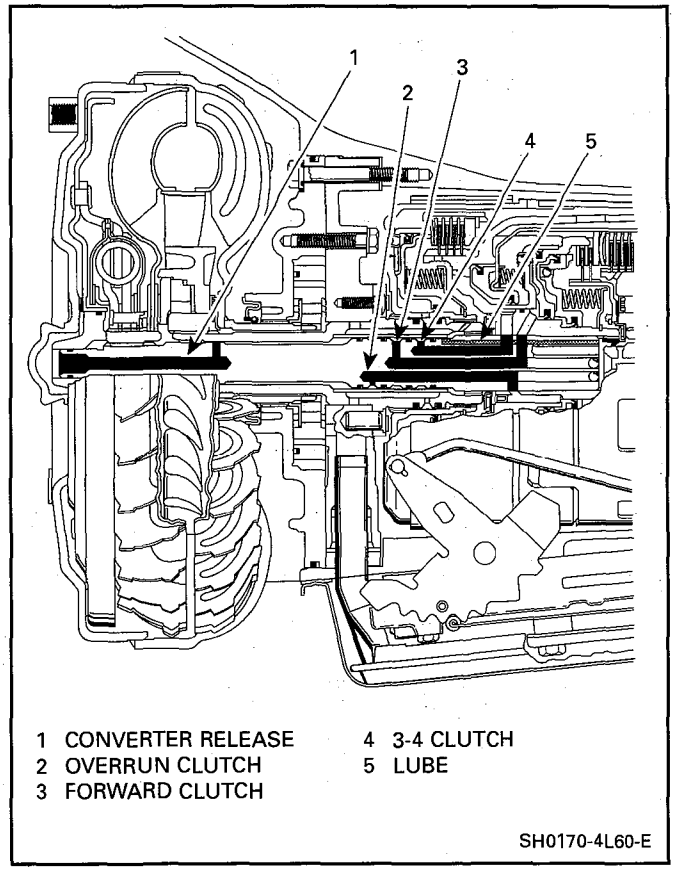
Assemble

1. Install four turbine shaft oil seal rings (619) using J-36418-1.

Adjust

- Adjust screw to obtain proper height.

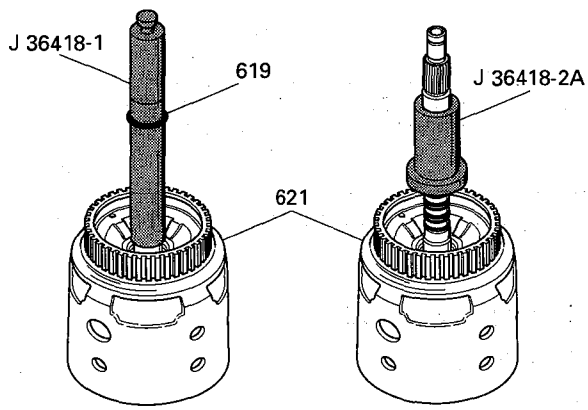
2. Use J 36418-2A to size the seals after installation.



1 CONVERTER RELEASE
2 OVERRUN CLUTCH
3 FORWARD CLUTCH
4 3-4 CLUTCH
5 LUBE

SH0170-4L60-E

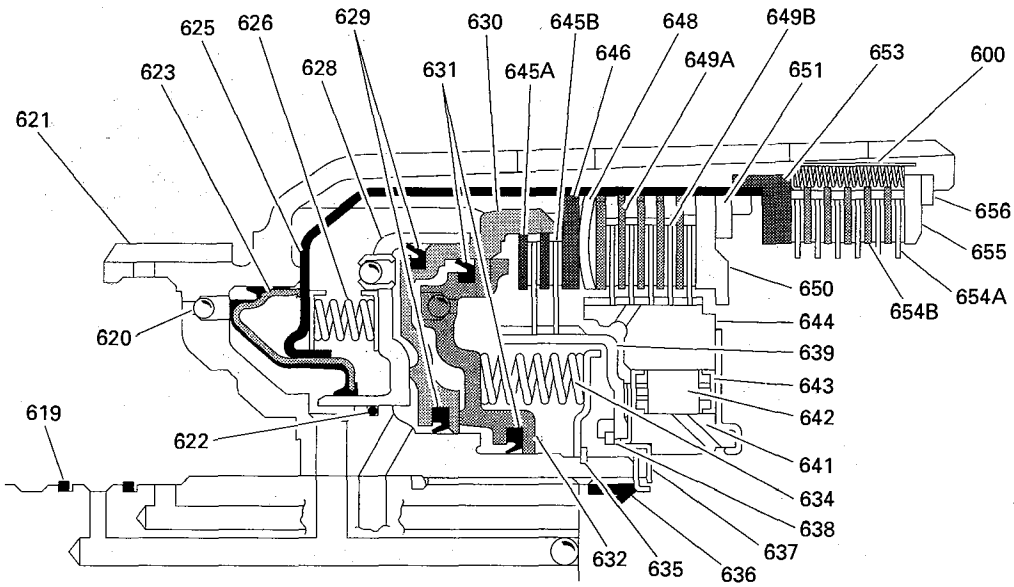
Figure 74 Turbine Shaft Fluid Passages



619 RING, OIL SEAL (SOLID)
621 HOUSING AND SHAFT ASSEMBLY, INPUT

RH0171-4L60-E

Figure 75 Turbine Shaft Oil Seal Rings



600 SPRING ASM., 3-4 CLUTCH BOOST (5)
619 RING, OIL SEAL (SOLID)
620 RETAINER AND CHECKBALL ASSEMBLY
621 HOUSING AND SHAFT ASSEMBLY, INPUT
622 SEAL, O-RING INPUT TO FORWARD HSG.
623 PISTON, 3RD AND 4TH CLUTCH
625 RING, 3RD AND 4TH CLUTCH (APPLY)
626 SPRING ASSEMBLY, 3RD AND 4TH CLUTCH
628 HOUSING, FORWARD CLUTCH
629 SEAL, FORWARD CLUTCH (INNER AND OUTER)
630 PISTON, FORWARD CLUTCH
631 SEAL, OVERRUN CLUTCH (INNER AND OUTER)
632 PISTON, OVERRUN CLUTCH
634 SPRING ASSEMBLY, OVERRUN CLUTCH
635 SNAP RING, OVERRUN CLUTCH SPRING RETAINER
636 SEAL, INPUT HOUSING TO OUTPUT SHAFT
637 BEARING ASSEMBLY, INPUT SUN GEAR
638 SNAP RING, OVERRUN CL. HUB RETAINING
639 HUB, OVERRUN CLUTCH
641 RETAINER AND RACE ASSEMBLY, SPRAG
642 FORWARD SPRAG ASSEMBLY
643 RETAINER RINGS, SPRAG ASSEMBLY
644 RACE, FORWARD CLUTCH (OUTER)
645A PLATE ASSEMBLY, OVERRUN CLUTCH (STEEL)
645B PLATE, OVERRUN CLUTCH (FIBER)
646 PLATE, FORWARD CLUTCH (APPLY)
648 PLATE, FORWARD CLUTCH (WAVED)
649A PLATE ASSEMBLY, FORWARD CLUTCH (STEEL)
649B PLATE, FORWARD CLUTCH (FIBER)
650 PLATE, FORWARD CLUTCH BACKING (SEL.)
651 RING, FORWARD CLUTCH BACKING PLATE RETAINER
653 PLATE, 3RD AND 4TH CLUTCH APPLY (STEPPED)
654A PLATE ASSEMBLY, 3RD AND 4TH CLUTCH (FIBER)
654B PLATE, 3RD AND 4TH CLUTCH (STEEL)
655 PLATE, 3RD AND 4TH CLUTCH BACKING (SEL.)
656 RING, 3RD AND 4TH CLUTCH BACKING PLATE RETAINER

SH0172-4L60-E

Figure 76 Input Clutch Assembly

Reverse Input Clutch Assembly

Figures 77 through 82

Tools Required:

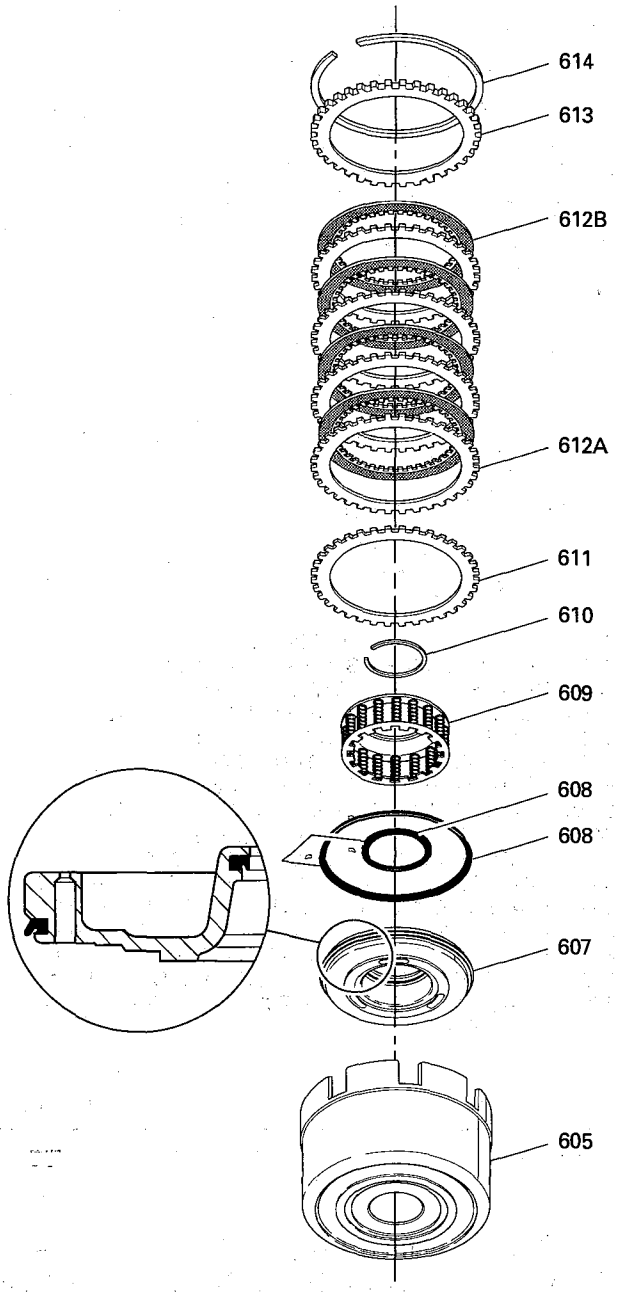
J 23327-1 Clutch Spring Compressor

J 25018-A Clutch Spring Compressor Adaptor

Disassemble

Figures 77 and 78

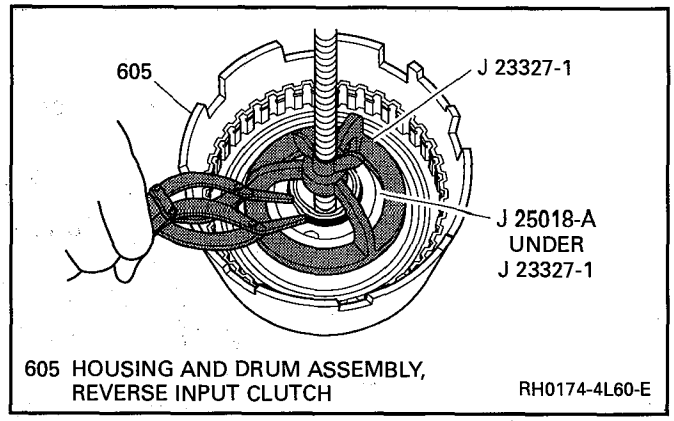
1. Retaining ring (614) from reverse input housing.
2. Backing plate (613).
3. Clutch plates (612) and Belleville steel plate (611).
4. Install J 23327-1 and J 25018-A.
   - Compress the spring assembly.
5. Spring assembly retainer ring (610) and spring assembly (609).
6. Reverse input clutch piston (607).
   - Inner and outer lip seals (608).



ILL. NO.	DESCRIPTION
605	HOUSING AND DRUM ASSEMBLY, REVERSE INPUT CLUTCH
607	PISTON ASM., REVERSE INPUT CLUTCH
608	SEALS, REVERSE INPUT CLUTCH (INNER AND OUTER)
609	SPRING ASM., REVERSE INPUT CLUTCH
610	RING, REVERSE INPUT CLUTCH SPRING RETAINER
611	PLATE, REVERSE INPUT CLUTCH (BELLEVILLE)
612A	PLATE ASM., REVERSE INPUT CLUTCH (STEEL)
612B	PLATE, REVERSE INPUT CLUTCH (FIBER)
613	PLATE, REVERSE INPUT CLUTCH BACKING (SELECTIVE)
614	RING, REVERSE INPUT CL. RETAINING

RH0173-4L60-E

Figure 77 Reverse Input Clutch Assembly



605 HOUSING AND DRUM ASSEMBLY, REVERSE INPUT CLUTCH

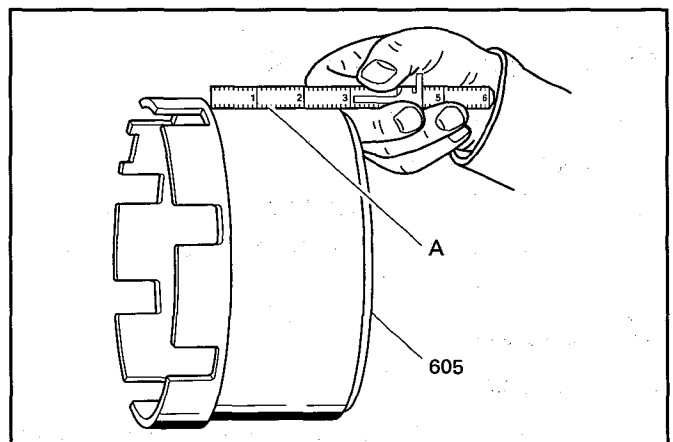
RH0174-4L60-E

Figure 78 Reverse Input Retainer Ring – Removal

Inspect

Figures 77 and 79

- Backing plate (613) for:
  - Damage.
  - Distortion or flatness.
  - Burrs or surface finish damage.
- Clutch Plates (612) for:
  - Composition plate tang damage, delamination, or wear.
  - Steel plate tang damage, wear, or heat damage.
- Spring assembly (609) for distortion or damage.
- Piston (607) for:
  - Damage or porosity.
  - Ring groove damage.
- Housing and drum assembly (605) for:
  - Damaged or worn bushings (603 and 606).
  - Surface on the hub and outer housing.
  - Leak at the weld.



A CHECK FOR DISHING AT THIS POINT
605 HOUSING AND DRUM ASSEMBLY, REVERSE INPUT CLUTCH

RH0175-4L60-E

Figure 79 Check Reverse Input Housing For Dishing

Assemble

Figures 77, 78, 80, 81 and 82

1. Inner and outer seals (608) on the piston.
   - Lips must face away from the hub as shown.
   - Lubricate with transmission fluid.
2. Piston (607) into the housing and drum assembly.
   - Use an 8 mm feeler gage to position the lip seals.
   - Use care not to damage the seals.
3. Spring assembly (609).
   - Large opening in the assembly goes towards the piston.
4. Install J 23327-1 and J 25018-A.
   A. Compress the spring assembly.
   B. Install the retainer ring (610).
5. Belleville steel clutch plate (611).
6. Clutch plates (612). (4 steel and 4 composition plates required).
   - Start with a steel and alternate with composition.

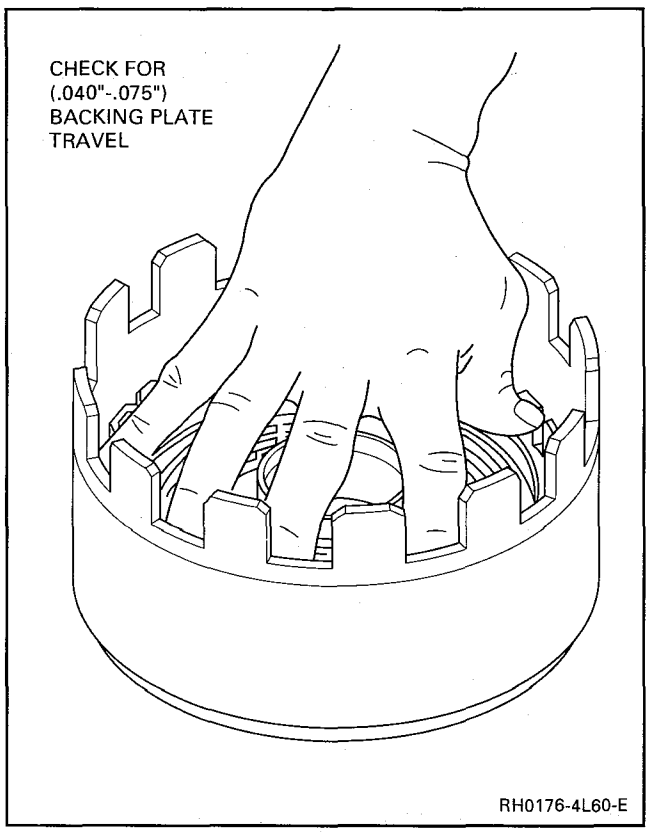


Figure 80 Reverse Input Backing Plate Selection

7. Backing plate (613).
   - Chamfered side up
8. Retaining ring (614).

Reverse Input Clutch Backing Plate Selection

Figures 80, 81 and 82

Measure

1. With the reverse input clutch fully assembled, apply an evenly distributed load to the clutch pack in the direction shown in Figure 81. Medium pressure (approximately 89 N or 20 lbs.) on the backing plate applied by hand on five evenly distributed points will obtain the backing plate travel for measurement.

NOTICE: Excessive pressure will distort the Belleville plate resulting in an inaccurate measurement.

2. Using a feeler gage, measure between the snap ring and the backing plate. Backing plate travel should be 1.02 to 1.94 mm (0.040 to 0.076 inch).
3. Select the proper backing plate to obtain the specified travel.

REVERSE INPUT CLUTCH		
	NO.	THICKNESS
BELLEVILLE PLATE	1	2.311mm (.091") 2.210mm (.087")
FLAT STEEL CLUTCH PLATE	4	2.045mm (0.81") 1.892mm (0.75")
COMPOSITION FACED CLUTCH PLATE	4	1.880mm (.074") 1.730mm (.068")
BACKING PLATE	1	SELECTIVE

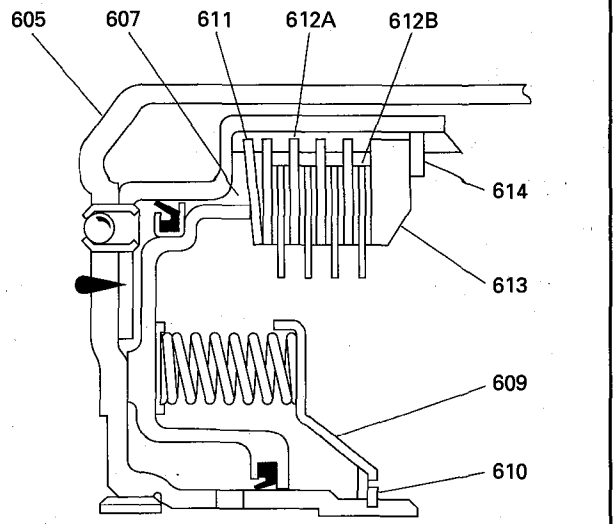
RH0177-4L60-E

Figure 81 Reverse Input Clutch Plate Chart

REVERSE INPUT CLUTCH BACKING PLATE SELECTION	
ALL MODELS	
BACKING PLATE TRAVEL =	1.02mm - 1.94mm (0.40" - .076")
PLATE THICKNESS	**IDENTIFICATION**
7.249mm - 7.409mm (.285" - .292")	2
6.678mm - 6.519mm (.263" - .257")	3
5.947mm - 5.787mm (.234" - .228")	4

RH0178-4L60-E

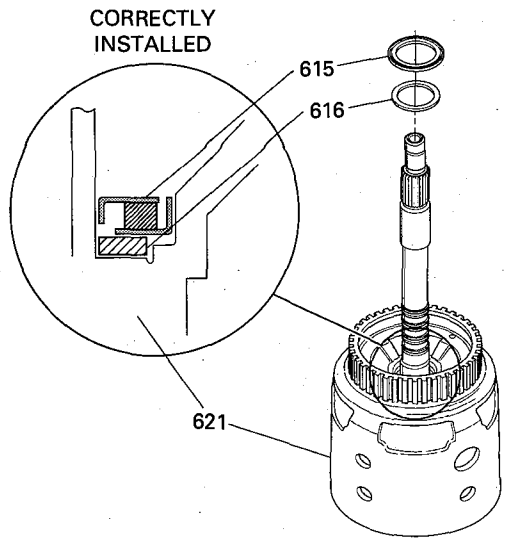
Figure 82 Reverse Input Backing Plate Selection Chart



605 HOUSING AND DRUM ASSEMBLY, REVERSE INPUT CLUTCH
607 PISTON ASM., REVERSE INPUT CLUTCH
609 SPRING ASM., REVERSE INPUT CLUTCH
610 RING, REVERSE INPUT CLUTCH SPRING RETAINER
611 PLATE, REVERSE INPUT CLUTCH (BELLEVILLE)
612A PLATE ASM., REVERSE INPUT CLUTCH (FIBER)
612B PLATE, REVERSE INPUT CLUTCH (STEEL)
613 PLATE, REVERSE INPUT CLUTCH BACKING (SELECTIVE)
614 RING, REVERSE INPUT CL. RETAINING

RH0179-4L60-E

Figure 83 Reverse Input Clutch



615 BEARING ASSEMBLY, STATOR SHAFT / SELECTIVE WASHER
616 WASHER, THRUST (SELECTIVE)
621 HOUSING AND SHAFT ASSEMBLY, INPUT

RH0180-4L60-E

Figure 84 Thrust Bearing and Selective Washer Location

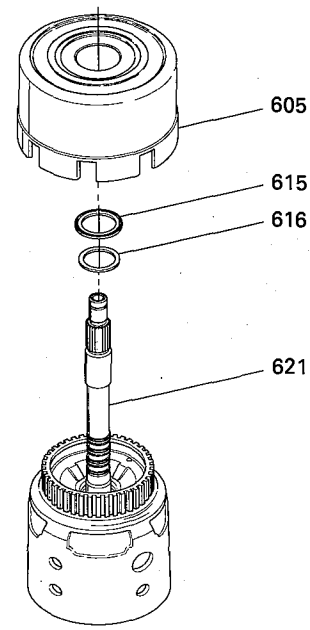
Reverse Input and Input Clutches

Figures 84, 85 and 86

Assemble

Figures 84 and 85

1. Selective thrust washer (616) onto the input housing.
2. Bearing assembly (615).
   - Inside (black race) goes toward the oil pump.
3. Reverse input clutch assembly (605) onto the input clutch assembly.
   - Index the reverse input clutch plates with the input clutch hub.
   - Make certain all clutch plates are fully engaged.



605 HOUSING AND DRUM ASSEMBLY, REVERSE INPUT CLUTCH
615 BEARING ASSEMBLY, STATOR SHAFT / SELECTIVE WASHER
616 WASHER, THRUST (SELECTIVE)
621 HOUSING AND SHAFT ASSEMBLY, INPUT

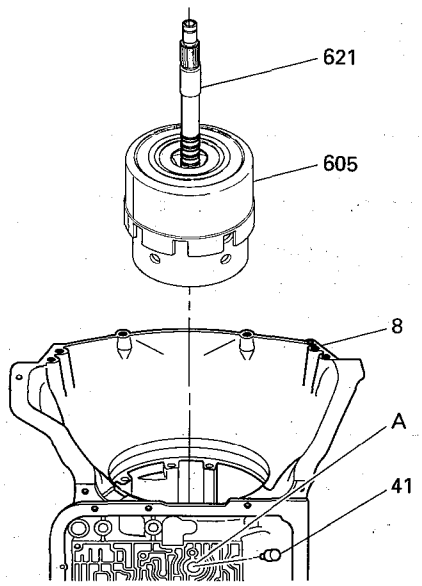
RH0147-4L60-E

Figure 85 Reverse Input and Input Clutches

Assemble

Figure 86

- Reverse input and input clutch assembly into the transmission case.
  - A. Index the 3-4 clutch plates with the input internal gear.
  - B. Make sure all clutch plates are fully engaged.
  - C. When properly assembled, the reverse input clutch housing will be located just below the case oil pump face.



A BAND ANCHOR PIN LOCATION
8 CASE, TRANSMISSION
41 PIN, BAND ANCHOR
605 HOUSING AND DRUM ASSEMBLY, REVERSE INPUT CLUTCH
621 HOUSING AND SHAFT ASSEMBLY, INPUT

RH0181-4L60-E

Figure 86 Installing Input Clutch

2-4 Band Assembly

Figures 86 and 87

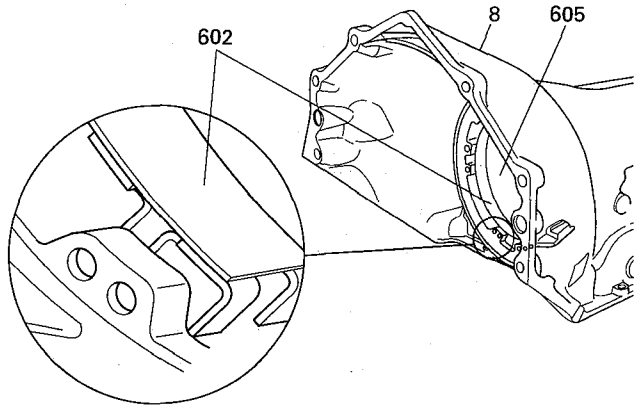
Inspect

- 2-4 band assembly (602) for damage or wear.

Assemble

Figures 86 and 87

1. Align the band anchor pin end with the case pin hole.
2. Band anchor pin (41) into the case.
   - Index the pin into the 2-4 band.



8 CASE, TRANSMISSION
602 BAND ASSEMBLY, 2-4
605 HOUSING AND DRUM ASSEMBLY, REVERSE INPUT CLUTCH

RH0182-4L60-E

Figure 87 2-4 Band Assembly – Installed

Oil Pump Assembly

Figures 88 and 90

Remove or Disconnect

1. Thrust washer (601).
2. Pump cover to case gasket (6).
3. Pump to case oil seal (5).
4. Pump cover bolts (233).
5. Pump cover (215) from pump body (200).

Oil Pump Body

Figure 90

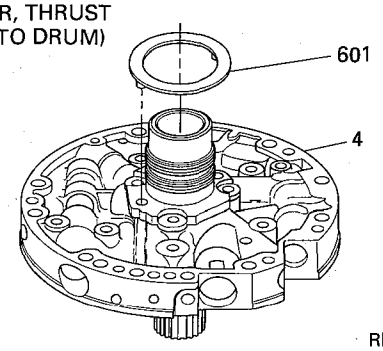
Disassemble

1. Pump slide springs (206 and 207).

CAUTION: Springs are under very high pressure. Place covering over spring to prevent possible injury.

- A. Compress with needle nose pliers.
- B. Pull straight out.

4 PUMP ASSEMBLY, OIL
601 WASHER, THRUST (PUMP TO DRUM)



RH0183-4L60-E

Figure 88 Oil Pump Thrust Washer Location

2. From the pump pocket:
   - Pump guide rings (210)
   - Pump vanes (213)
   - Pump rotor (212)
   - Pump guide (211)
   - Slide (209)
   - Slide seal (201)
   - Seal support (208)
   - Pivot slide pin (205) and spring (204)
   - Slide seal ring (201) and slide back up seal (202)
3. Retainer (94), oil seal assembly (2).
   - Pry out with a screwdriver.

Oil Pump Cover

Figures 89, 90 and 93

Tool Required:

One inch micrometer

Disassemble

Figures 90 and 93

1. Converter clutch apply valve train.
   A. Compress converter clutch stop valve (223) with a screwdriver.
   B. Remove retaining ring (222).
   C. Slowly release the spring tension.
   D. Stop valve (223), converter clutch apply valve (224) and two converter clutch valve springs.
2. Pressure relief ball (228).
   - Ball is under strong spring pressure.
   - Cover the ball with a cloth when removed.
3. Pressure regulator assembly (216-221).
   - Follow the same procedure used to remove the converter clutch valve.

Inspect

Figure 90

- Pressure regulator valve assembly (216-221) and converter clutch apply valve assembly (222-226) for:
  - Chips, burrs, distortion, plugged oil passage and free movement in bore.
  - Remove burrs with lapping compound.
- Pressure relief assembly (227-229) for damage or distortion.
- Pump cover (215) and pump body (200) for:
  - Worn or damaged bushings (see Bushing Replacement Procedure).
  - Foreign material or debris.
  - Porosity.
  - Scored or irregular mating faces.
  - Cross channel leaks.
  - Ring groove damage.
- Rotor (212) and slide (203) for cracks.
- Oil seal assembly for damage or wear.

Clean

- Wash and air dry all parts.

Important

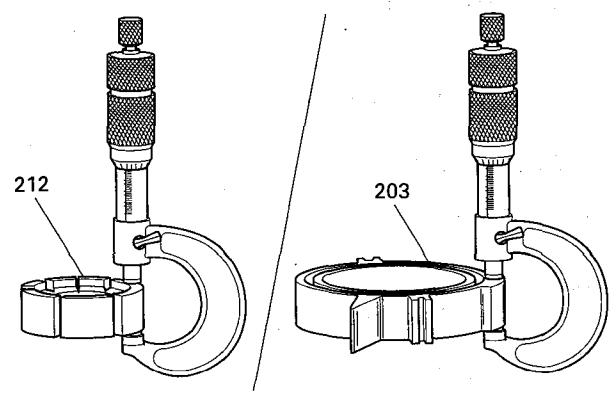
- Do not wipe dry with a cloth.

OIL PUMP ROTOR SELECTION CHART

THICKNESS (mm)	THICKNESS (in.)
17.948 - 17.961	0.7066 - 0.7071
17.961 - 17.974	0.7071 - 0.7076
17.974 - 17.987	0.7076 - 0.7081
17.987 - 18.000	0.7081 - 0.7086
18.000 - 18.013	0.7086 - 0.7091

OIL PUMP SLIDE SELECTION CHART

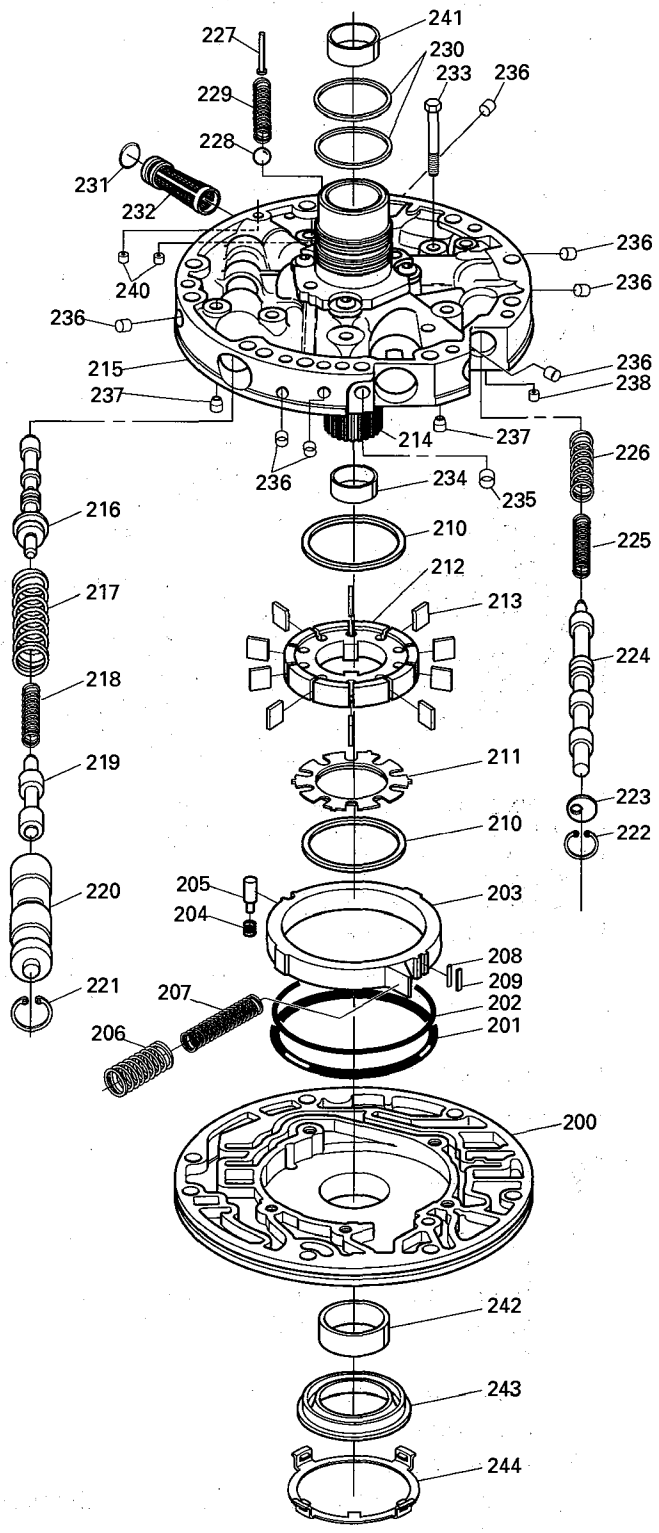
THICKNESS (mm)	THICKNESS (in.)
17.948 - 17.961	0.7066 - 0.7071
17.961 - 17.974	0.7071 - 0.7076
17.974 - 17.987	0.7076 - 0.7081
17.987 - 18.000	0.7081 - 0.7086
18.000 - 18.013	0.7086 - 0.7091



203 SLIDE, PUMP
212 ROTOR, OIL PUMP

RH0184-4L60-E

Figure 89 Oil Pump Rotor and Slide Selection



ILL. NO.	DESCRIPTION
200	BODY, PUMP
201	RING, OIL SEAL (SLIDE TO WEAR PLATE)
202	SEAL, O-RING (SLIDE SEAL BACK-UP)
203	SLIDE, PUMP
204	SPRING, PIVOT PIN
205	PIN, PIVOT SLIDE
206	SPRING, PUMP SLIDE (OUTER)
207	SPRING, PUMP SLIDE (INNER)
208	SUPPORT, PUMP SLIDE SEAL
209	SEAL, PUMP SLIDE
210	RING, PUMP VANE
211	GUIDE, ROTOR
212	ROTOR, OIL PUMP
213	VANE, PUMP
214	SHAFT, STATOR
215	COVER, PUMP
216	VALVE, PRESSURE REGULATOR
217	SPRING, PRESSURE REGULATOR VALVE
218	SPRING, PRESSURE REGULATOR ISOLATOR
219	VALVE, REVERSE BOOST
220	SLEEVE, REVERSE BOOST VALVE
221	RING, OIL PUMP REVERSE BOOST VALVE RETAINING
222	RING, OIL PUMP CONVERTER CLUTCH VALVE RETAINING
223	VALVE, STOP
224	VALVE, CONVERTER CLUTCH
225	SPRING, CONVERTER CLUTCH VALVE (INNER)
226	SPRING, CONVERTER CLUTCH VALVE (OUTER)
227	RIVET, PRESSURE RELIEF BOLT
228	BALL, PRESSURE RELIEF
229	SPRING PRESSURE RELIEF
230	RING, OIL SEAL (STATOR SHAFT)
231	SEAL, OIL PUMP COVER SCREEN
232	SCREEN, OIL PUMP COVER
233	BOLT, M8 X 1.25 X 40 (COVER TO BODY)
234	BUSHING, STATOR SHAFT (FRONT)
235	PLUG, OIL PUMP COVER (FWD CLUTCH FEED)
236	PLUG, OIL PUMP COVER
237	RETAINER AND BALL ASSEMBLY, CHECK VALVE
238	ORIFICE, CONVERTER CLUTCH SIGNAL (CUP PLUG)
240	PLUG, CUP ORIFICE
241	BUSHING, STATOR SHAFT (REAR)
242	BUSHING, PUMP BODY
243	SEAL ASSEMBLY, OIL
244	RETAINER, FRONT HELIX

SH0185-4L60-E

Figure 90 Oil Pump Assembly

Measure

Figure 89

- Oil pump rotor (212) thickness.
- Oil pump slide (203) thickness.

Important

- Measurement of rotor/slide must be made on undamaged surfaces. Select similar size replacements. Lightly hone both sides of replacement rotor or slide to remove any nicks or burrs.

Oil Pump Body

Figures 90, 91 and 92

Tool Required:

J 25016 Seal Installer

Assemble

1. O-ring seal (202) and oil seal ring (201) into the groove on the back side of the slide.
   - Retain with Transjel™ J 36850 or equivalent.
2. Pivot pin spring (204) and pivot pin (205) into the pump body.
3. Slide (203).
   - Index the notch in the slide with the pivot pin.
   - The oil seal ring must face downward into the pump pocket.
4. Slide seal (209) and support (208).
5. Vane guide ring (210).
6. Rotor guide (211) onto the rotor.
   - Retain with Transjel™ J 36850 or equivalent.
7. Rotor (212).
   - With guide toward the pump pocket.

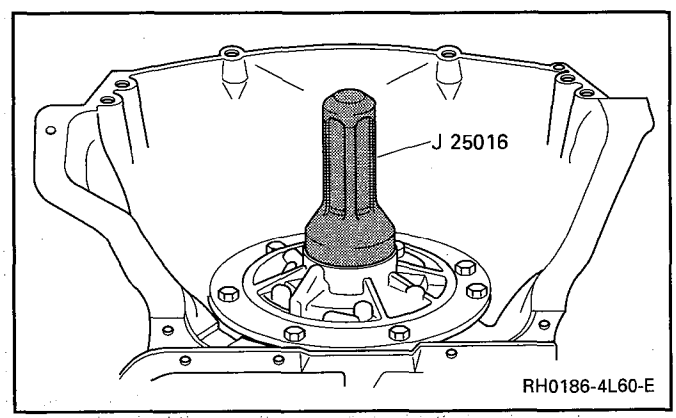


Figure 91 HYDRA-MATIC 4L60-E - Oil Pump Seal

8. Vanes (213).
9. Vane guide ring (210).
10. Pump slide spring (206 and 207).
11. Oil seal assembly (2), retainer (94).
    - Use J 25016.

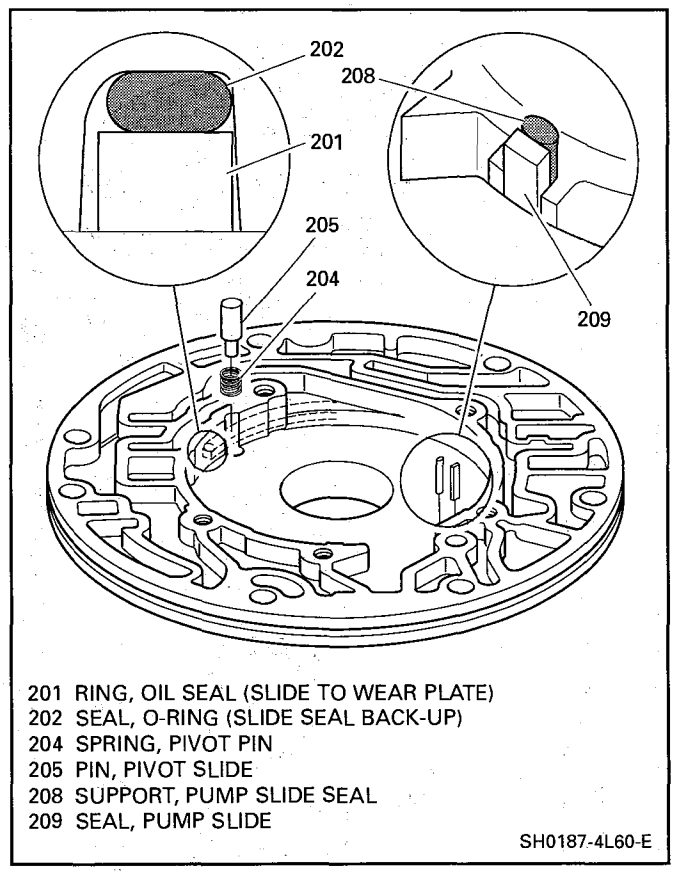


Figure 92 Slide Back Up and Slide Seal

Oil Pump Cover

Figure 90

Assemble

1. Pressure relief ball (228), spring (229) and rivet (227).
2. Inner (225) and outer (226) converter clutch valve springs into the converter clutch valve bore.
3. Converter clutch valve (224).
4. Stop valve (223).
5. Retaining ring (222).
6. Pressure regulator valve (216) into the pressure regulator bore.
7. Pressure regulator valve spring (217).

8. Reverse boost valve (219) into the reverse boost valve sleeve.
   - Small end of the valve first
   - Retain with Transjel™ J 36850 or equivalent.
9. Reverse boost valve sleeve (220) into the pressure regulator bore.
10. Retainer ring (221).

Oil Pump Cover and Body

Figures 90 and 94 through 97

Tools Required:

J 21368 Oil Pump Body and Cover Alignment Band

J 25025-1 Alignment Pins

Assemble

Figures 90, 94, 95 and 96

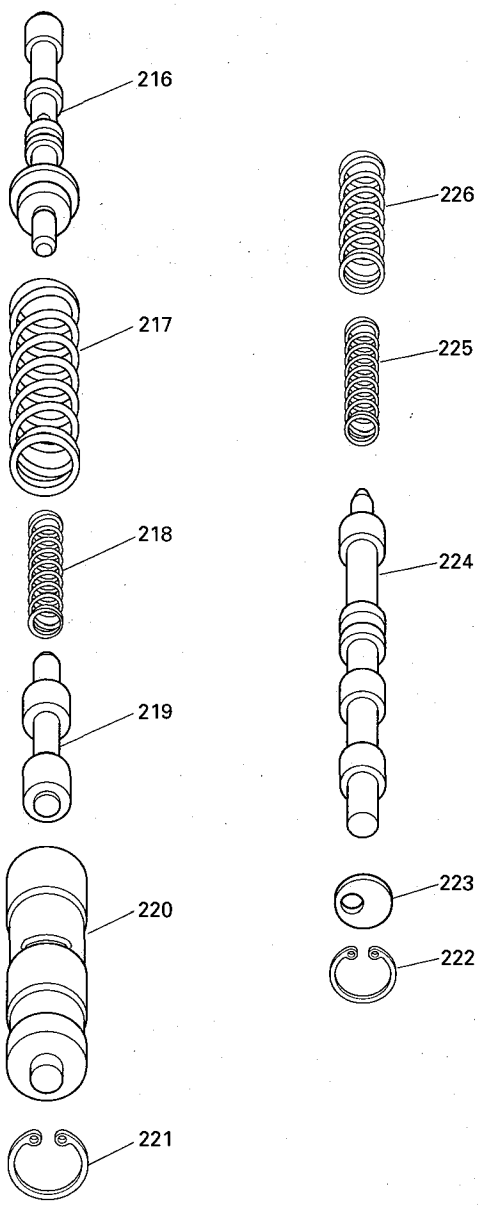
1. Oil pump cover (215) onto oil pump body.
   - Stator shaft through a bench hole
2. Pump cover bolts (233).
   - Leave finger tight.
3. Align pump cover and pump body with J 21368.
   - Place a screwdriver through a bolt hole and into a hole in the bench.

Tighten

   - Attaching bolts to 24 N•m (18 lb. ft.).
   - Retain with Transjel™ J 36850 or equivalent.
4. Install two oil seal rings (233) using J38735-3 and J 39855-1.

Adjust

   - Adjust screw to obtain proper height.
5. Use J 39855-2 to size seals after installation.



216 VALVE, PRESSURE REGULATOR
217 SPRING, PRESSURE REGULATOR VALVE
218 SPRING, PRESSURE REGULATOR ISOLATOR
219 VALVE, REVERSE BOOST
220 SLEEVE, REVERSE BOOST VALVE
221 RING, OIL PUMP REVERSE BOOST VALVE RETAINING
222 RING, OIL PUMP CONVERTER CLUTCH VALVE RETAINING
223 VALVE, STOP
224 VALVE, CONVERTER CLUTCH
225 SPRING, CONVERTER CLUTCH VALVE (INNER)
226 SPRING, CONVERTER CLUTCH VALVE (OUTER)

RH0188-4L60-E

Figure 93 Pressure Regulator and Converter Clutch Apply Valve Trains

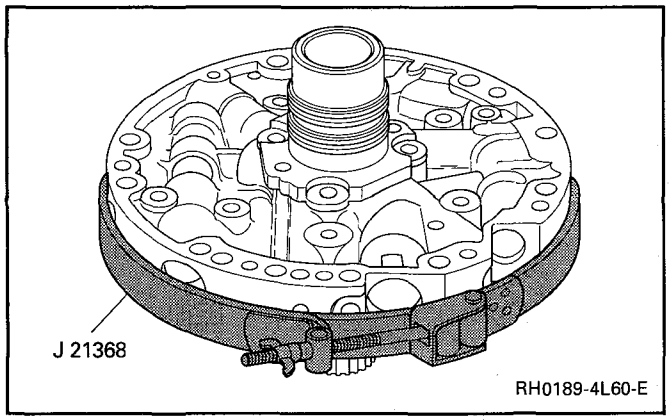


Figure 94 Oil Pump Alignment Band

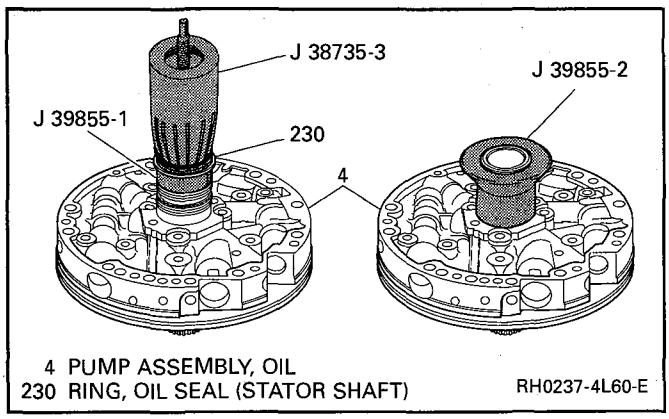


Figure 95 Install and Size Oil Seal Rings

Install or Connect

Figure 97

1. Thrust washer (601).
2. J 25025-1 into the case as shown.
3. Oil pump assembly into the case.
   - Align all holes properly.
4. Bolts and O-rings (2 and 3).

Tighten

- Bolts to 24 N•m (18 lb. ft.).

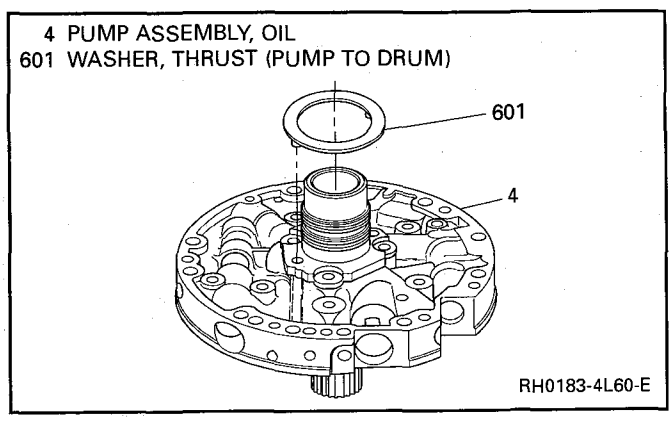


Figure 96 Oil Pump Thrust Washer

Important

- Rotate the transmission to a horizontal position. If the transmission is assembled properly the turbine shaft should turn by hand. If not identify and correct the misassembly now.

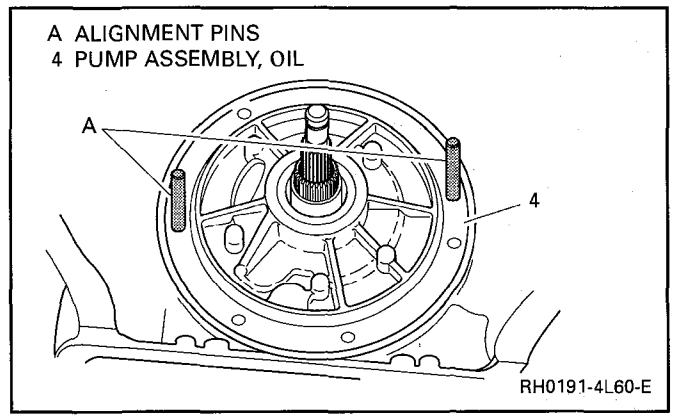


Figure 97 Oil Pump and Case

Transmission End Play Check

Figures 98 through 102 and 105, 106 and 107

Tools Required:

J 24773-A End Play Checking Fixture

J 25022 End Play Checking Fixture Adaptor (245 mm)

J 34725 End Play Checking Fixture Adaptor (298 mm)

J 25025-7A Post or 278 mm (11 inch) Bolt and Nut

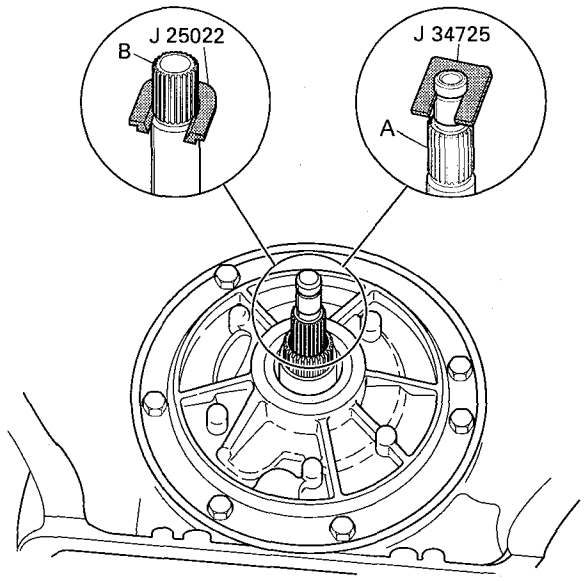
Dial indicator

Measure

Figures 98 through 101

1. Remove an oil pump to case bolt and install a 278 mm (11 inch) bolt and lock nut or J 25025-7A.
2. Install J 25022-A or J 34725 as shown.
3. Install J 24773-A as shown.
4. Install a dial indicator.
   - Set to zero.
5. Pull up on J 24773-A.
   - End play should be 0.13 to 0.92 mm (0.005 to 0.036 inch).

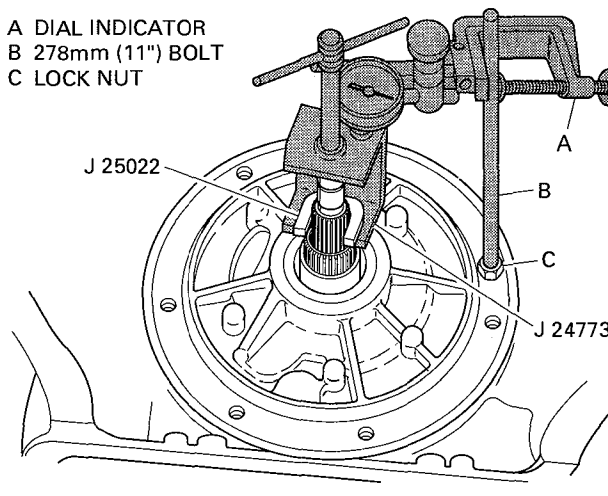
The selective washer which controls end play is located between the input housing and the thrust bearing on the oil pump hub. If more or less end play is required, select the proper washer from the chart and install. If dial indicator shows no end play, the selective washer and thrust bearing have been misassembled.



A 298mm TURBINE SHAFT
B 245mm TURBINE SHAFT

RH0114-4L60-E

Figure 98 End Play Tool



RH0115-4L60-E

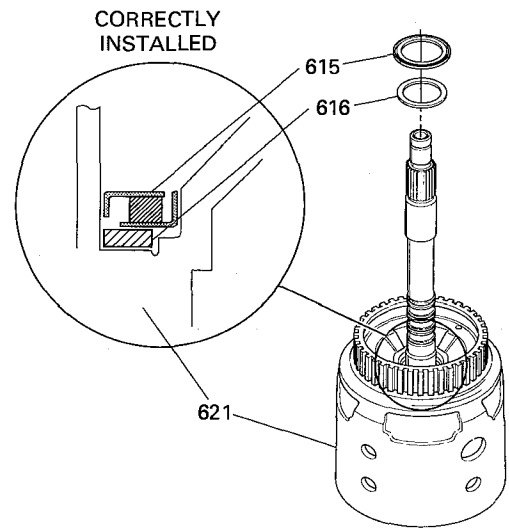
Figure 99 J 25022-A Installed

TRANSMISSION END PLAY WASHER SELECTION CHART

WASHER THICKNESS		I.D.
1.87 - 1.97 mm	(.074" - .078")	67
2.04 - 2.14 mm	(.080" - .084")	68
2.21 - 2.31 mm	(.087" - .091")	69
2.38 - 2.48 mm	(.094" - .098")	70
2.55 - 2.65 mm	(.100" - .104")	71
2.72 - 2.82 mm	(.107" - .111")	72
2.89 - 2.99 mm	(.113" - .118")	73
3.06 - 3.16 mm	(.120" - .124")	74

RH0192-4L60-E

Figure 100 End Play Chart



615 BEARING ASSEMBLY, STATOR SHAFT / SELECTIVE WASHER
616 WASHER, THRUST (SELECTIVE)
621 HOUSING AND SHAFT ASSEMBLY, INPUT

RH0180-4L60-E

Figure 101 Selective Washer and Thrust Bearing Properly Installed

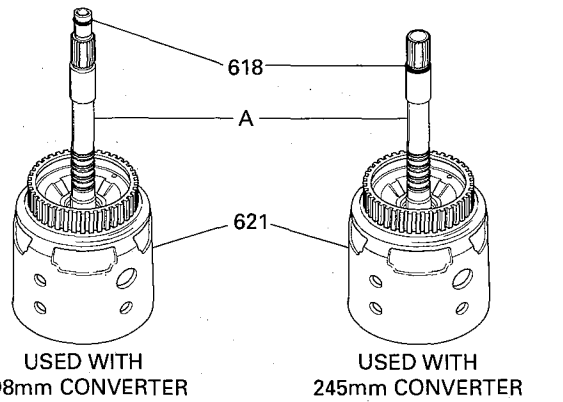
Assemble

Figure 102

- O-ring seal (618) into the groove in the end of the turbine shaft.

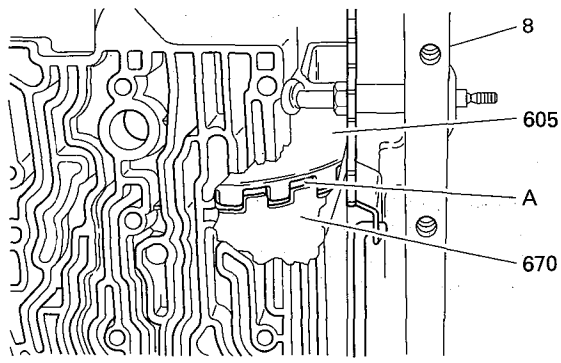
Important

- There should be clearance between the reverse input clutch and the reaction sun gear shell. This clearance can be observed at the point shown in Figure 105. **Do not** try to shim the internal parts because of this clearance (Figure 103).



A SHAFT, TURBINE
618 SEAL, O-RING (TURBINE SHAFT/ SELECTIVE WASHER)
621 HOUSING AND SHAFT ASSEMBLY, INPUT
RH0152-4L60-E

Figure 102 Turbine Shaft O-Ring Seal



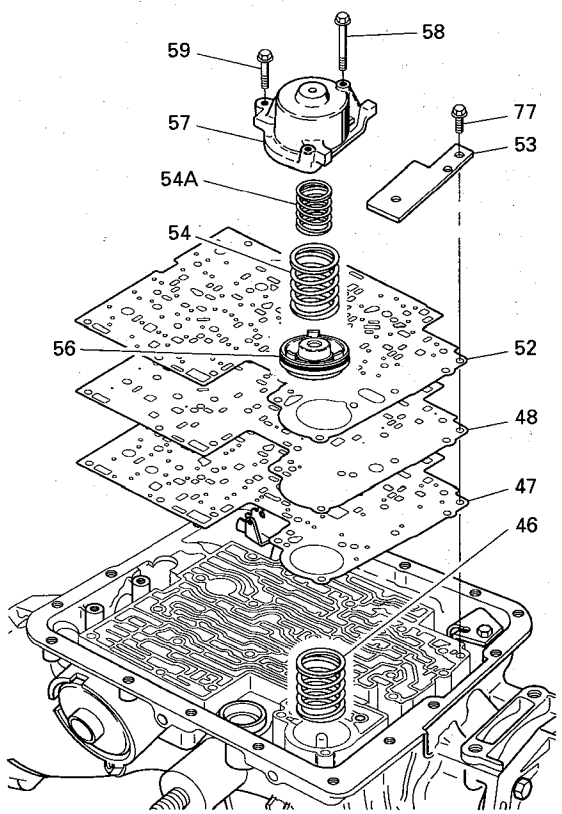
A AS INSTALLED THESE TWO PARTS HAVE A NORMAL END CLEARANCE OF APPROX. 3.8mm (.150")
8 CASE TRANSMISSION
605 HOUSING AND DRUM ASSEMBLY, REVERSE INPUT CLUTCH
670 SHELL, REACTION SUN
RH0193-4L60-E

Figure 103 Clearance Between Reverse Input Clutch and Sun Gear Shell

Inspect

Figures 104, 105 and 106

- The 1-2 accumulator cover and pin assembly (57) for:
  - Porosity or damage.
  - Scored piston wall.
  - Plugged oil passage.
- 1-2 accumulator piston (56) and the 3-4 accumulator piston (44) for:
  - Porosity.
  - Ring groove damage.
  - Pin hole damage.
- 1-2 accumulator spring (54) and 3-4 accumulator spring (46) for distortion or damage.
- Spacer plate (48) and gaskets (47 and 52) for damage.
- Checkballs (61) for damage.
- Manual detent spring (63) for damage.
- Oil filter (72) for:
  - Cut or damaged filter seal (71).
  - Cracks in the neck or body.
  - Casting flash in the neck.
- Solenoid assembly (66) for:
  - Damage.
  - Cut or pinched wires.
  - Damaged connectors.
  - Cut or damaged O-ring (65).



46 SPRING, 3-4 ACCUMULATOR
47 GASKET, SPACER PLATE TO CASE
48 PLATE, VALVE BODY SPACER
52 GASKET, SPACER PLATE TO VALVE BODY
53 PLATE, SPACER PLATE SUPPORT
54 SPRING, 1-2 ACCUMULATOR
54A SPRING, 1-2 ACCUMULATOR (INNER)
57 COVER AND PIN ASSEMBLY, 1-2 ACCUMULATOR
58 BOLT, ACCUMULATOR COVER
59 BOLT, ACCUMULATOR COVER
77 BOLT, SPACER PLATE SUPPORT RH0233-4L60-E-R1

Figure 104 Accumulator Assembly, Spacer Plate and Gaskets

Valve Body and Associated Parts

Figures 104 and 106

Tool Required:

J 25025-5 Guide Pins

NOTICE: The use of a honing stone, fine sandpaper or crocus cloth is not recommended for servicing stuck valves. All valve lands have sharply machined corners that are necessary for "cleaning" the bore. If these corners are rounded, foreign material could wedge between the valve and bore causing the valve to stick.

If it is found necessary to clean a valve, "micro fine" lapping compound 900 grit or finer should be used.

Too much "lapping" of a valve will cause excessive clearances and increase the chance of a valve not operating.

1-2 ACCUMULATOR SPRING COLOR		
1994 MODELS	INNER	OUTER
CA, CB, CH, CJ, CP, FD, KA, KC, MD, MJ, MN, MS, SF, SH, TA, TB, TL, TW	NO PAINT	YELLOW
CC, CF, CM, CU, KB, KP	PINK	YELLOW
HD, SA	NO PAINT	VIOLET
HB	WHITE	VIOLET
BB, BC	ORANGE	VIOLET
AH, BF, BW	ORANGE	YELLOW
FF, YD	WHITE	DK GREEN

3-4 ACCUMULATOR SPRING COLOR	
1994 MODELS	COLOR
CA, CB, FD, FF, HB, HD, KA, MD, MJ, MM, MS, SF, SH, TA, TB, TL, TW, YD	LT BLUE
CM, CU, KP	RED
BB, BC	DK GREEN
AH, BF, BW	VIOLET
CC, CF, CH, CJ, CP, KB, KC, SA	NOT USED

RH0194-4L60-E-R1

Figure 105 1-2 and 3-4 Accumulator Spring Chart

Install or Connect

1. The wiring harness pass-thru connector into the case.
2. The 3-4 accumulator pin (43) into the case.
3. The 3-4 accumulator piston seal (45) onto the 3-4 accumulator piston.
4. The 3-4 accumulator piston (44) onto the pin.
   - The end with three legs must face the valve body.
5. The 3-4 accumulator piston spring (46).

Install or Connect

1. Checkball (91) into case as shown.
   - Retain with Transjel™ J 36850 or equivalent.
2. J 25025-5 into the case.
3. Screens onto spacer plate as shown.
4. Spacer plate to case gasket (47) and spacer plate to valve body gasket (52) onto the spacer plate (48).
   - Gasket (47) identified by a "C".
     Gasket (52) identified by a "V".
   - Retain with Transjel™ J 36850 or equivalent.

5. Spacer plate and gaskets onto the case.

Important

- Be careful not to damage screens when installing the spacer plate and gaskets.

6. Spacer plate support (53) and bolts (77).

Tighten

- Bolts to 11 N•m (8 lb. ft.)

Control Valve Body

Clean

- Control valve assembly thoroughly in clean solvent.
  A. Move the valves with a pick or small screwdriver to dislodge any dirt or debris that may have accumulated.
  B. Air dry

Remove or Disconnect

Important

- Some valves are under pressure - cover the bores while removing roll pins and retainer clips.
- Valves, springs and bushings must be laid out on a clean surface in the exact sequence they are removed.

1. Pressure control solenoid retainer bolt (364) retainer (378) and solenoid.
2. Bore plug retainer clip (395), bore plug (376) and valve train (374 and 375).
3. 2-3 shift solenoid retainer (379), solenoid (367) and valve train (368 and 369).
4. 1-2 shift solenoid retainer (379), solenoid (367) and valve train (365 and 366).
5. Accumulator valve train retainer pin (360), bore plug (373) and valve train (370 and 371).
6. Forward accumulator cover bolts (364) and cover (363).
7. Forward accumulator spring (356), piston (354) and pin (355).
8. Lo overrun valve spring (362) and valve (361).
9. Retainer pin (360), bore plug (359) and forward abuse valve train (357 and 358).
10. Manual valve (340).
11. 3-2 control solenoid retainer clip (379) and solenoid (394).
12. Bore plug retainer (395), bore plug (381) and 3-2 control valve train (391 – 393).
13. 3-2 downshift bore plug retainer (395), bore plug (381) and valve train (389 – 390).
14. Reverse abuse bore plug retainer pin (360), bore plug (359) and valve train (387 – 388).
15. 3-4 shift valve bore plug retainer (395), bore plug (381) and valve train (385 – 386).
16. 3-4 relay bore plug retainer (395), bore plug (381) and valve train (382 – 384).
17. Torque converter clutch signal valve bore plug retainer (395), bore plug (381) and valve (380).

Clean

- All valves, springs, bushings and control valve body in clean solvent.
- Dry using compressed air

Inspect

- All valves and bushings for:
  - Porosity
  - Scoring
  - Nicks
  - Scratches
- Springs for damaged or distorted coils.
- Valve body casting for:
  - Porosity
  - Cracks
  - Interconnected oil passages
  - Damaged machined surfaces

Assemble

- Control valve assembly (350) exactly as shown.
  - Notice the position of the valve lands and bushing passages.
  - Position the pressure control solenoid so the connector tabs face outward.

NOTICE: TCC PWM solenoid (396) cannot be installed until TCC solenoid has been installed and torqued to proper specifications.

Install or Connect

1. Checkballs into the valve body assembly (350).
   - Retain with Transjel™ J 36850 or equivalent.
2. Valve body assembly (350).
   - Connect the manual valve link (89) to the inside detent lever (88).

- Be careful not to damage screens when installing the valve body assembly.

3. Wiring harness (66), manual spring assembly (63), pressure switch assembly (69), dipstick stop bracket (93) and all remaining valve body bolts.

NOTICE: Torque valve body bolts in a spiral pattern starting from the center. If bolts are torqued at random, valve bores may be distorted and inhibit valve operation.

4. TCC solenoid (66) and bolts (68).

Tighten

- Bolts to 11 N•m (8 lb. ft.)

5. TCC PWM solenoid (396), and retainer clip (379).

Install or Connect

- Wiring harness connections to electrical components.

To correctly hook up the wires, see the wiring diagram in the HYDRA-MATIC 4L60-E Diagnosis Section.

The pressure control solenoid (377) has two different colored connectors. The black connector should be installed on the tab farthest from the valve body.

Install or Connect

1. Parking bracket (86).

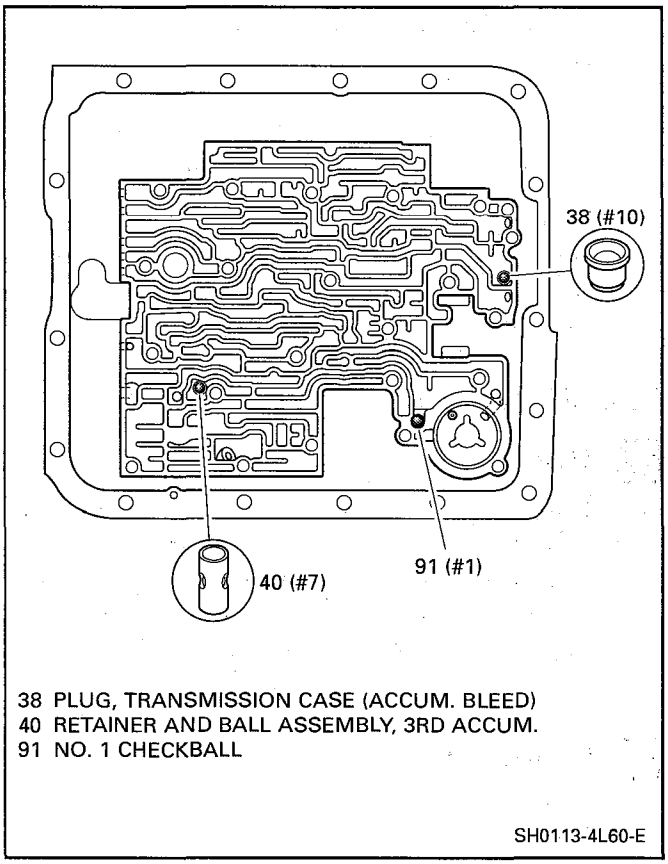
Tighten

- Bolts to 31 N•m (23 lb. ft.)

2. The 1-2 accumulator piston seal (55) onto the 1-2 accumulator piston (56).
3. The 1-2 accumulator piston (56) into the 1-2 accumulator cover and pin assembly (57).
   - The three legs on the piston must face toward the case when installed.
4. The 1-2 accumulator spring (54) and 1-2 accumulator inner spring (54A) onto the piston (56).
5. The 1-2 accumulator cover and pin assembly (57) onto the case.

Tighten

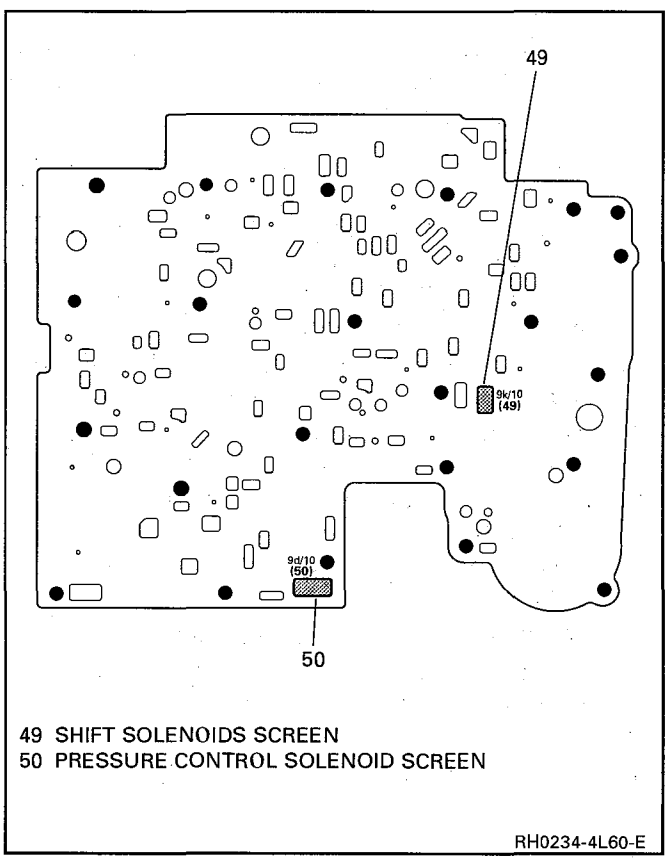
- Torque to 11 N•m (8 lb. ft.)



38 PLUG, TRANSMISSION CASE (ACCUM. BLEED)
40 RETAINER AND BALL ASSEMBLY, 3RD ACCUM.
91 NO. 1 CHECKBALL

SH0113-4L60-E

Figure 106 Case Checkballs and Oil Screens – Location



49 SHIFT SOLENOIDS SCREEN
50 PRESSURE CONTROL SOLENOID SCREEN

RH0234-4L60-E

Figure 107 Filter Screen – Locations

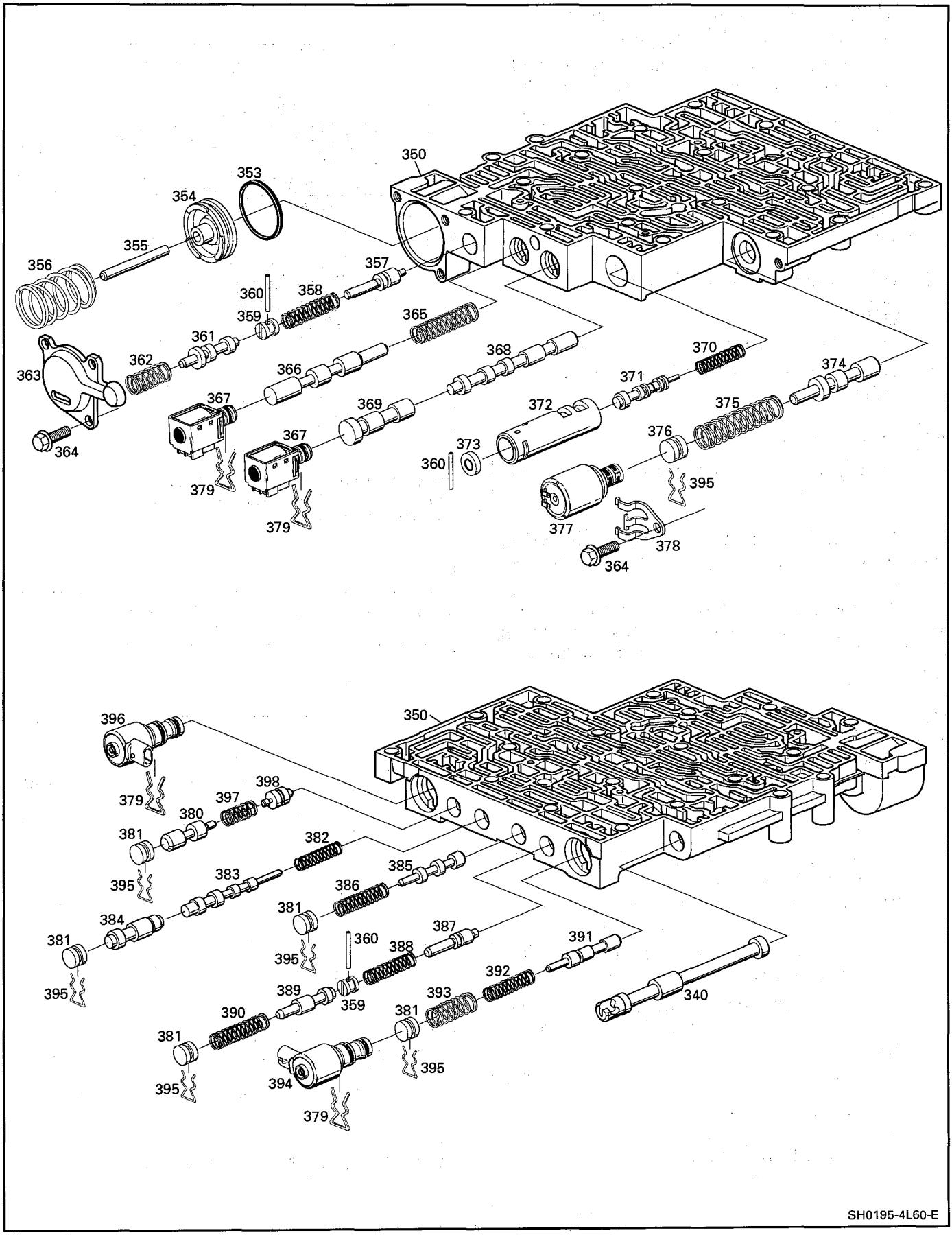
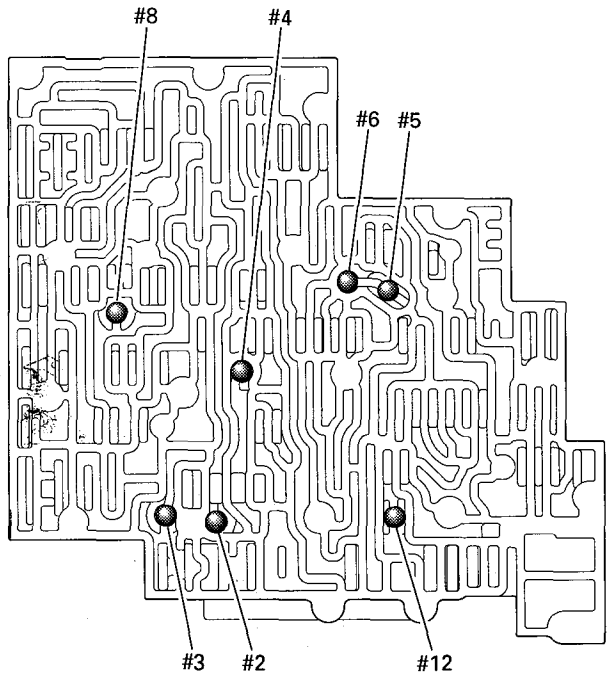


Figure 108 Control Valve Assembly

340 VALVE, MANUAL
350 VALVE ASSEMBLY, CONTROL BODY
353 SEAL, FORWARD ACCUMULATOR OIL
354 PISTON, FORWARD ACCUMULATOR
355 PIN, FORWARD ACCUMULATOR
356 SPRING, FORWARD ACCUMULATOR
357 VALVE, FORWARD ABUSE
358 SPRING, FORWARD ABUSE VALVE
359 PLUG, BORE
360 PIN, COILED SPRING
361 VALVE, LOW OVERRUN
362 SPRING, LOW OVERRUN VALVE
363 COVER, FORWARD ACCUMULATOR
364 BOLT, FORWARD ACCUMULATOR COVER
365 SPRING, 1-2 SHIFT VALVE
366 VALVE, 1-2 SHIFT
367A 1-2 SHIFT SOLENOID (A)
367B 2-3 SHIFT SOLENOID (B)
368 VALVE, 2-3 SHIFT
369 VALVE, 2-3 SHUTTLE
370 SPRING, 1-2 ACCUMULATOR VALVE
371 VALVE, 1-2 ACCUMULATOR
372 SLEEVE, 1-2 ACCUMULATOR VALVE
373 PLUG, BORE
374 VALVE, ACTUATOR FEED LIMIT
375 SPRING, ACTUATOR FEED LIMIT VALVE
376 PLUG, BORE
377 PRESSURE CONTROL SOLENOID
378 RETAINER, PRESSURE CONTROL SOLENOID
379 RETAINER, SOLENOID
380 VALVE, REGULATOR APPLY
381 PLUG, BORE
382 SPRING, 4-3 SEQUENCE VALVE
383 VALVE, 4-3 SEQUENCE
384 VALVE, 3-4 RELAY
385 VALVE, 3-4 SHIFT
386 SPRING, 3-4 SHIFT VALVE
387 VALVE, REVERSE ABUSE
388 SPRING, REVERSE ABUSE VALVE
389 VALVE, 3-2 DOWNSHIFT
390 SPRING, 3-2 DOWNSHIFT VALVE
391 VALVE, 3-2 CONTROL
392 SPRING, 3-2 CONTROL VALVE
393 SPRING, BORE PLUG
394 3-2 CONTROL SOLENOID
395 RETAINER, BORE PLUG
396 TCC PWM SOLENOID
397 SPRING, REGULATOR APPLY
398 VALVE, ISOLATOR

SH0196-4L60-E

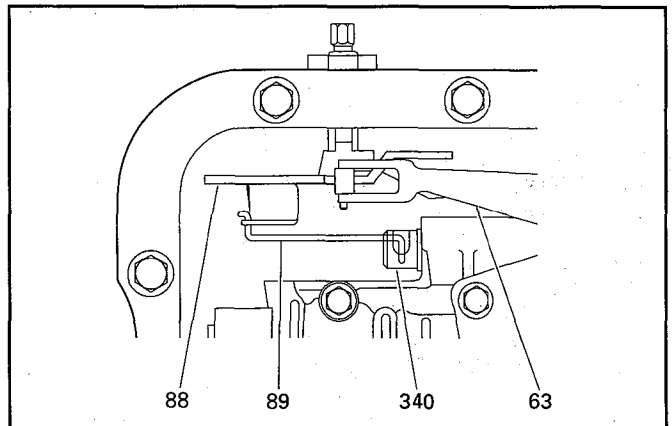
Figure 109 Control Valve Assembly – Legend



2 3RD ACCUMULATOR
3 REVERSE INPUT
4 3-4 CLUTCH EXHAUST
5 OVERRUN CLUTCH FEED
6 OVERRUN CLUTCH CONTROL
8 1-2 UPSHIFT
12 FORWARD CLUTCH ACCUM.

RH0112-4L60-E

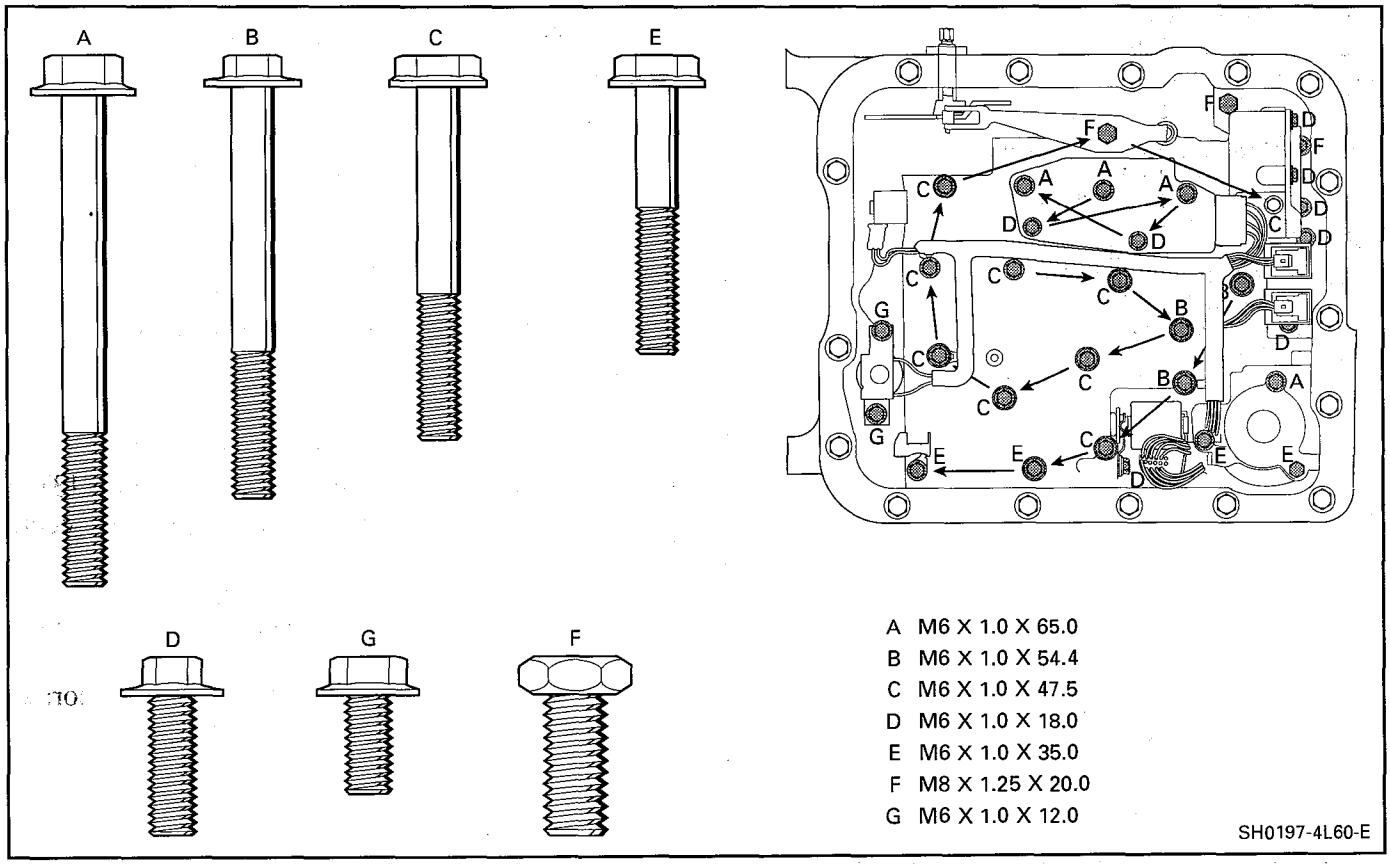
Figure 110 Valve Body Checkball Locations



63 SPRING ASSEMBLY, MANUAL DETENT
88 LEVER, INSIDE DETENT
89 LINK, MANUAL VALVE
340 VALVE, MANUAL

RH0110-4L60-E

Figure 111 Manual Valve Link



A M6 X 1.0 X 65.0
B M6 X 1.0 X 54.4
C M6 X 1.0 X 47.5
D M6 X 1.0 X 18.0
E M6 X 1.0 X 35.0
F M8 X 1.25 X 20.0
G M6 X 1.0 X 12.0

SH0197-4L60-E

Figure 112 Valve Body Bolt Locations

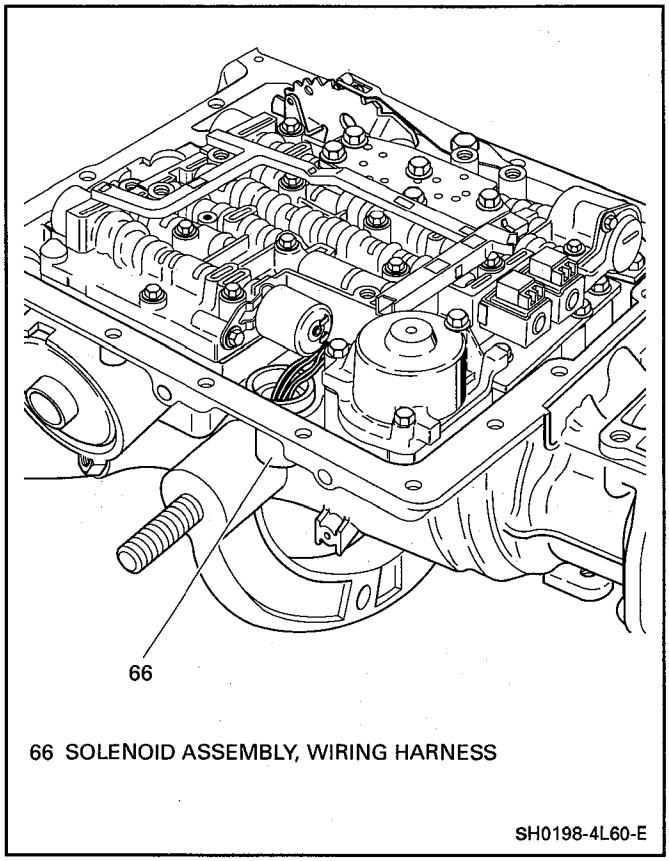


Figure 113 Outside Electrical Connector

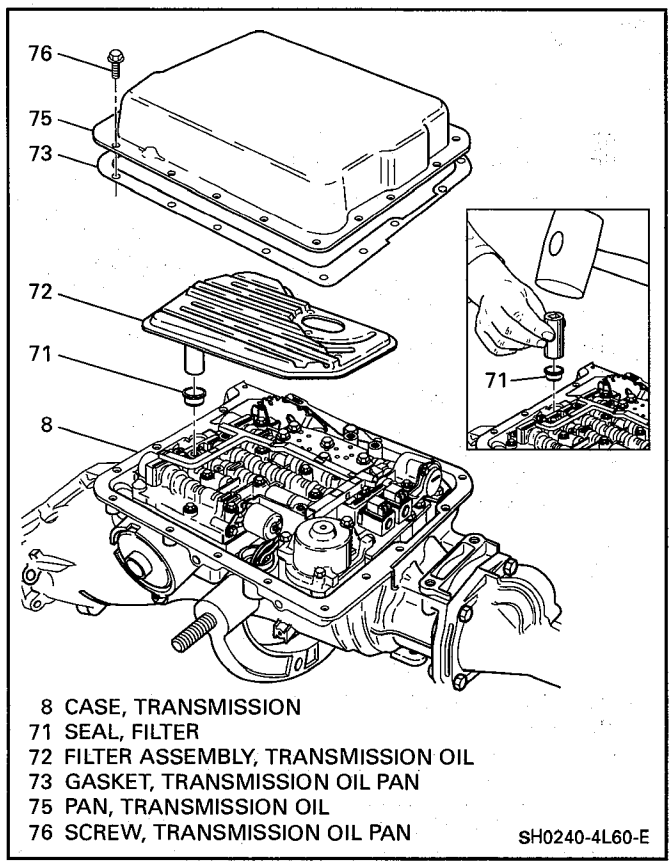


Figure 114 Case, Pan and Filter Assembly

Install or Connect

Figure 114

1. Filter seal (71) into the pump.
2. Oil filter (72).
3. Oil pan gasket (73).
4. Chip magnet (74) onto oil pan (75).
5. Oil pan (75) and bolts (76).

Tighten

- Torque to 12 N•m (9 lb. ft.)

2-4 Servo Assembly

Figures 115 through 119

Tools Required:

J 33037 Band Apply Pin Tool
Vernier calipers
Scale
J 22269-01 Piston Compressor
J 29714 Servo Cover Compressor

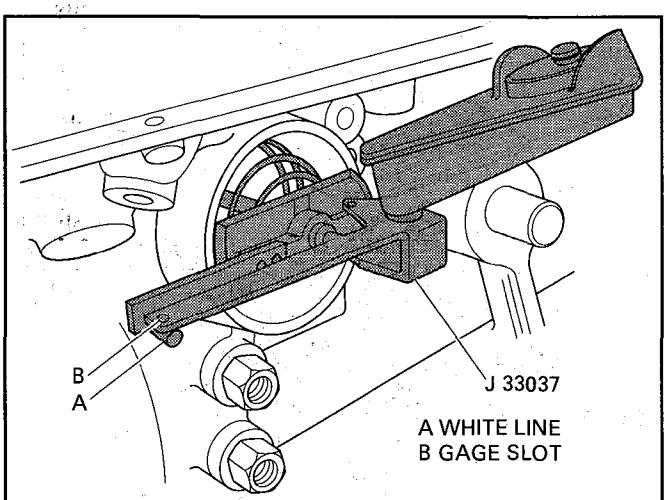
Measure

Figure 115

1. Install J 33037 as shown with apply pin (13).
2. Install servo cover retaining ring (29) to secure tool.
3. Apply 11 N•m (98 lb. in.) torque.
4. If white line "A" appears in the gage slot "B", pin length is correct.
5. Use pin selection chart to determine the correct pin length if new pin is needed.

Inspect

- Pistons for:
  - Porosity or damage.
  - Ring groove damage.



PIN IS PRESET AT FACTORY AND MUST NOT BE READJUSTED

2-4 SERVO PIN SELECTION

PIN LENGTH		PIN I.D.
MM	INCH	
65.82-66.12	2.59-2.60	1 GROOVE
67.23-67.53	2.65-2.66	2 GROOVES
68.64-68.94	2.70-2.71	NO GROOVE

RH0102-4L60-E

Figure 115 Servo Pin Length

- Cover (28) for porosity or damage.
- Seals for:
  - Nicks or cuts.
  - Freeness in the seal groove.
- Springs for distortion.
- Pin for wear or burrs.

Important

- Check servo bore in the case for any wear which may cut the servo seals.

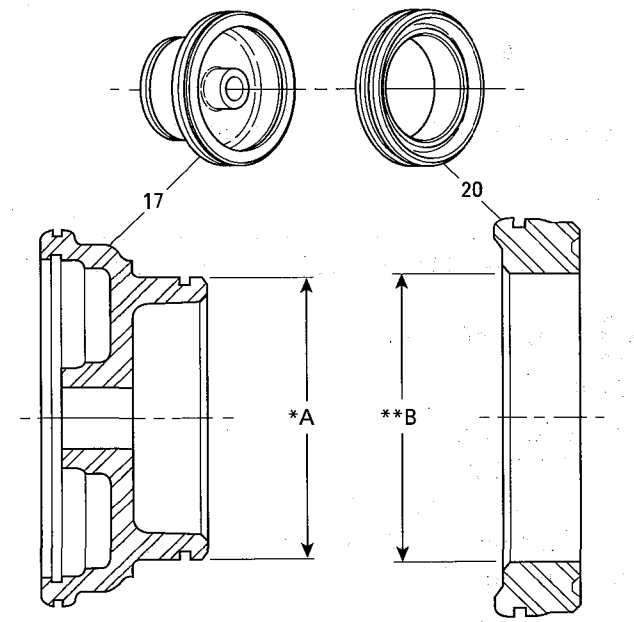
Measure

Figure 116

1. Measure piston (17) dimension *A.
2. Measure housing (20) dimension **B.
3. Check model application.

2ND APPLY PISTON AND HOUSING APPLICATION

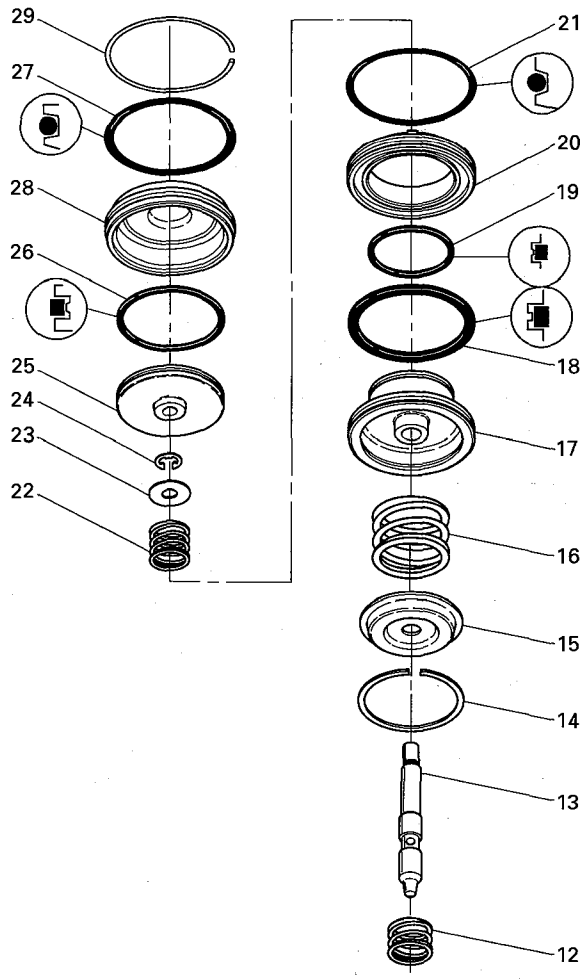
MODEL	PISTON DIMENSION *A	HOUSING DIMENSION **B
CHD, CJD, CKD, CLD, KCD, KDD	44.64mm (1.78")	45.54mm (1.79")
CAD, CBD, CCD, CFD, KAD, KBD, MJD, MDD, MND, MSD, SHD, TAM, TBM, TLD	57.85mm (2.28")	58.74mm (2.31")



17 PISTON, 2ND APPLY
20 HOUSING, SERVO PISTON (INNER)

RH0199-4L60-E

Figure 116 2nd Apply Piston and Housing Measurement



ILL. NO.	DESCRIPTION
12	SPRING, SERVO RETURN
13	PIN, 2ND APPLY PISTON
14	RING, RETAINER (2ND APPLY PISTON)
15	RETAINER, SERVO CUSHION SPRING
16	SPRING, SERVO CUSHION
17	PISTON, 2ND APPLY
18	RING, OIL SEAL (2ND APPLY PISTON - OUTER)
19	RING, OIL SEAL (2ND APPLY PISTON - INNER)
20	HOUSING, SERVO PISTON (INNER)
21	SEAL, O-RING
22	SPRING, SERVO APPLY PIN
23	WASHER, SERVO APPLY PIN
24	RING, RETAINER (APPLY PIN)
25	PISTON, 4TH APPLY
26	RING, OIL SEAL (4TH APPLY PISTON - OUTER)
27	SEAL, O-RING (2-4 SERVO COVER)
28	COVER, 2-4 SERVO
29	RING, SERVO COVER RETAINING

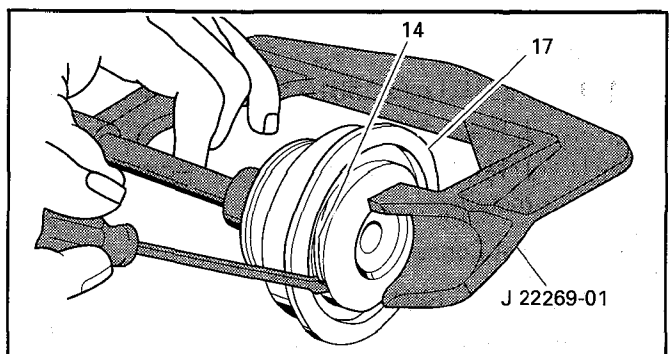
RH0104-4L60-E

Figure 117 2-4 Servo Assembly

Assemble

Figures 117 through 119

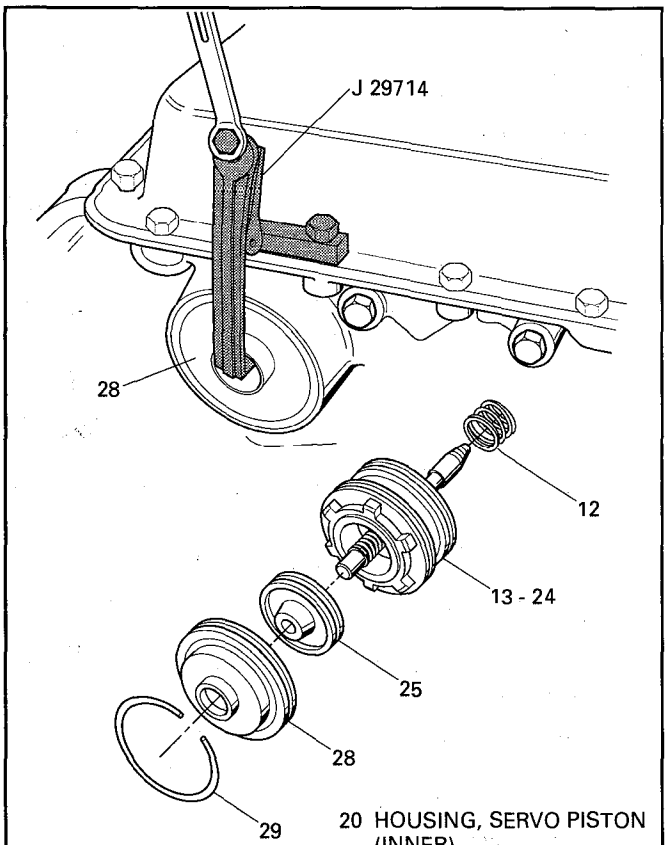
1. Cushion spring (16) into the 2nd apply piston (17).
2. Cushion spring retainer (15) on the cushion spring.
3. Install J 22269-01.
   A. Compress the retainer past the snap ring groove in the 2nd apply piston.
   B. Install the retainer ring (14).
4. The 2nd apply piston (17) onto the apply pin (13)
   - Retainer goes toward the shoulder of the pin.
5. Servo apply pin spring (22) on the pin.
6. Servo apply pin washer (23) and retaining clip (24).
7. Inner (19) and outer (18) seals on the 2nd apply piston (17).
   - Retain with Transjel™ J 36850 or equivalent.
8. O-ring seal (21) on servo piston housing.
9. Servo piston inner housing (20) on the 2nd apply piston.
10. Seal ring (26) onto the 4th apply piston.
11. The 4th apply piston (25) onto the apply pin.
12. Return spring (12) on the pin.
13. Servo piston assembly into the servo bore.
14. O-ring seal (21) on the servo cover.
    - Lubricate the seal with Transjel™ J 36850 or equivalent.
15. Servo cover (28) into the servo bore.
16. Install J 29714.
    A. Compress the servo cover.
    B. Install the retainer ring (29).



14 RING, RETAINER (2ND APPLY PISTON)
17 SECOND APPLY PISTON

RH0103-4L60-E

Figure 118 2nd Servo Piston – Assembly



12 SPRING, SERVO RETURN
13 PIN, 2ND APPLY PISTON
14 RING, RETAINER (2ND APPLY PISTON)
15 RETAINER, SERVO CUSHION SPRING
16 SPRING, SERVO CUSHION
17 PISTON, 2ND APPLY
18 RING, OIL SEAL (2ND APPLY PISTON - OUTER)
19 RING, OIL SEAL (2ND APPLY PISTON - INNER)
20 HOUSING, SERVO PISTON (INNER)
21 SEAL, O-RING
22 SPRING, SERVO APPLY PIN
23 WASHER, SERVO APPLY PIN
24 RING, RETAINER (APPLY PIN)
25 PISTON, 4TH APPLY
28 COVER, 2-4 SERVO
29 RING, SERVO COVER RETAINING

RH0101-4L60-E

Figure 119 2-4 Servo Bore

Speed Sensor and Case Extension

Figures 122

Tools Required:

J 23103 or J 25016 Seal Installer

J 21426 Seal Installer

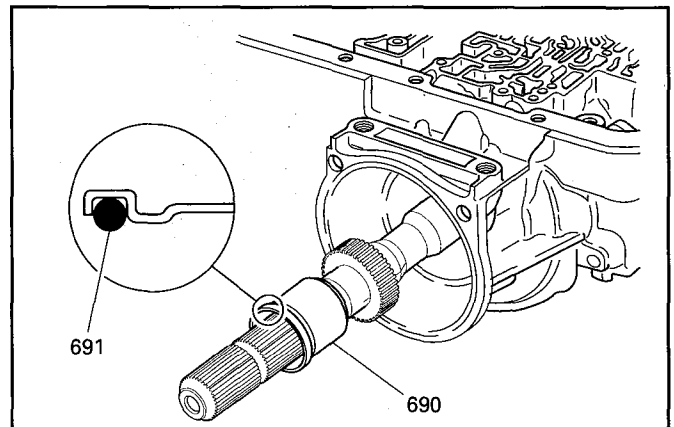
J 38417 Speed Sensor Remover and Installer

Install or Connect

1. O-ring seal (691) on the output shaft sleeve.
2. Output shaft sleeve (690) on the output shaft.
   - Use J 25016 or J 23103.
   - Do not push the sleeve past the machined surface on the output shaft.
3. Seal ring (37) on the case extension.
4. Case extension (31) and bolts (32).
   - Position extension so the speed sensor bore is on the gear selector lever side of the case.

Tighten

   - Torque to 35 N•m (26 lb. ft.).
5. Remove case extension oil seal (34).
   A. Pry out with a screwdriver.
   B. Install new seal with J 21426.
6. Speed sensor (36) with J 38417.
7. Retainer, bolt and washer (34).
8. Outside electrical connector, gear selector lever and nut.



690 SLEEVE, OUTPUT SHAFT
691 SEAL, OUTPUT SHAFT

SH0200-4L60-E

Figure 120 Output Shaft Sleeve and Seal

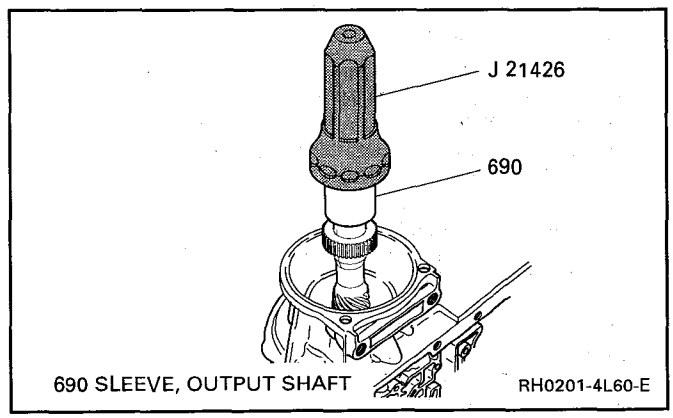


Figure 121 Output Shaft Sleeve – Installation

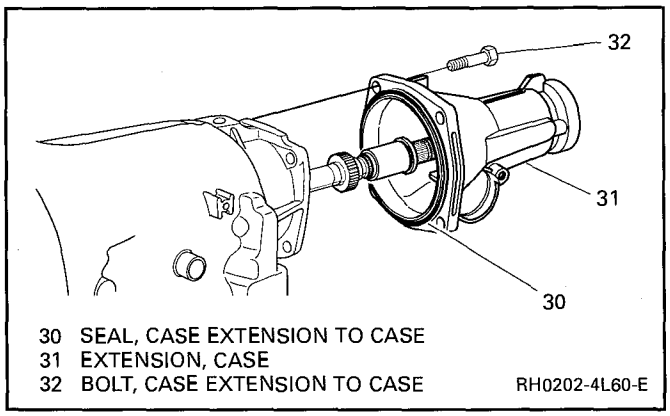


Figure 122 Case Extension and Seal

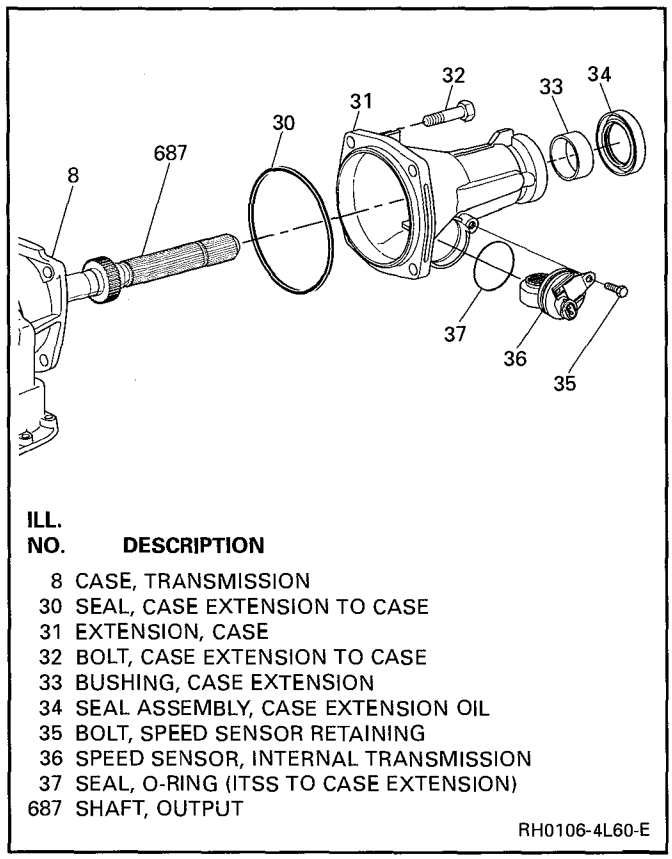


Figure 123 Case Extension and Associated Parts

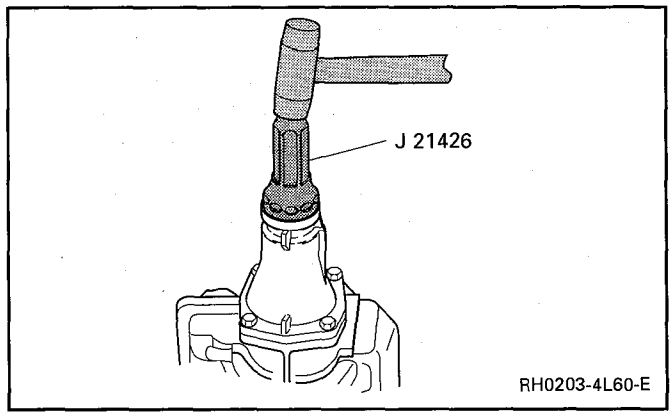


Figure 124 Case Extension Oil Seal Assembly

Torque Converter Assembly

Figure 125

Tool Required:

J 35138 Torque Converter End Play Checking Tool

Inspect

The torque converter assembly must be replaced for any of the following conditions:

- Evidence of damage to the pump assembly.
- Metal particles are found after flushing the cooler and cooler lines.
- External leaks in hub weld area.
- Converter pilot is broken, damaged or poor fit into crankshaft.
- Converter hub is scored or damaged.
- Internal damage to stator.
- Contamination from engine coolant.
- Excess end play.

Measure

Figure 125

- Install J 35138 and measure end play.
  - 0 to 0.5 mm (0.000 to 0.020 inch) for 245 mm torque converters.
  - 0 to 0.6 mm (0.000 to 0.024 inch) for 298 mm torque converters.

The Torque Converter should not be replaced If:

- The fluid has an odor, discoloration or no evidence of metal or clutch plate material.
  A. Drain out as much fluid as possible.
  B. Replace the oil filter and pan gasket.
  C. Fill to proper level (Refer to Section 7A).
- The converter bolt hole threads are damaged.
  – Correct with thread insert (Refer to Section 6A).

Important

- Flushing the torque converter is not recommended.

Install or Connect

1. Torque converter.
2. J 21366 converter holding strap.
3. Remove transmission from holding fixture.

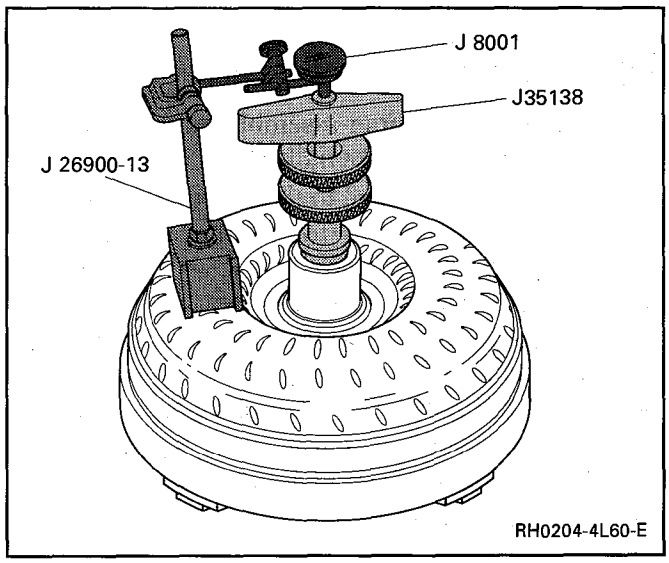


Figure 125 Checking Torque Converter End Play

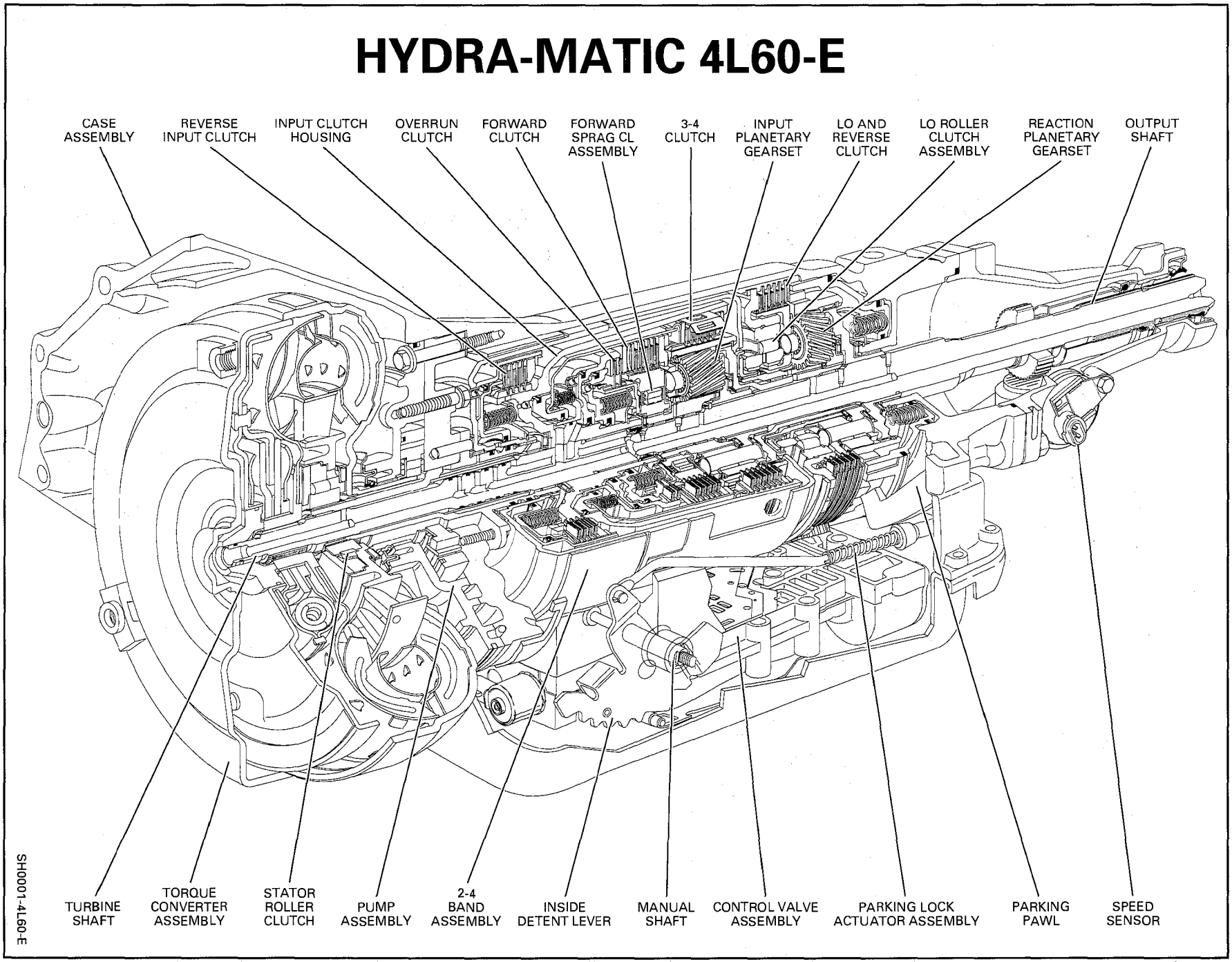


Figure 126 HYDRA-MATIC 4L60-E Transmission

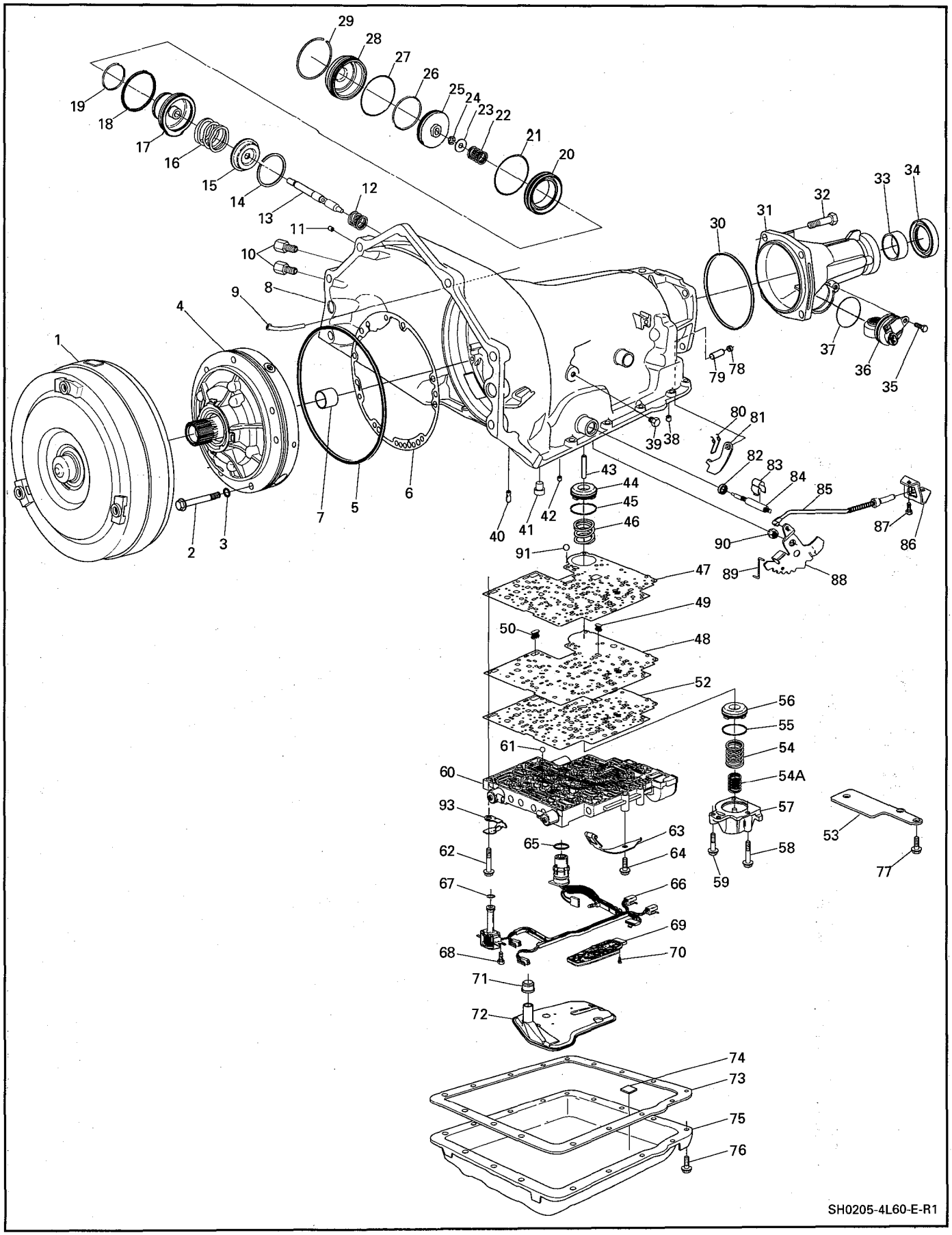


Figure 127 Case and Associated Parts

ILL. NO.	DESCRIPTION
1	TORQUE CONVERTER ASSEMBLY
2	BOLT, PUMP TO CASE
3	O-RING, PUMP TO CASE BOLT
4	PUMP ASSEMBLY, OIL
5	SEAL, OIL (PUMP TO CASE)
6	GASKET, PUMP COVER TO CASE
7	BUSHING, CASE
8	CASE, TRANSMISSION
9	VENT ASSEMBLY, TRANSMISSION
10	CONNECTOR, OIL COOLER PIPE
11	PLUG, CASE SERVO
12	SPRING, SERVO RETURN
13	PIN, 2ND APPLY PISTON
14	RING, RETAINER (2ND APPLY PISTON)
15	RETAINER, SERVO CUSHION SPRING
16	SPRING, SERVO CUSHION
17	PISTON, 2ND APPLY
18	RING, OIL SEAL (2ND APPLY PISTON - OUTER)
19	RING, OIL SEAL (2ND APPLY PISTON - INNER)
20	HOUSING, SERVO PISTON (INNER)
21	SEAL, O-RING
22	SPRING, SERVO APPLY PIN
23	WASHER, SERVO APPLY PIN
24	RING, RETAINER (APPLY PIN)
25	PISTON, 4TH APPLY
26	RING, OIL SEAL (4TH APPLY PISTON - OUTER)
27	SEAL, O-RING (2-4 SERVO COVER)
28	COVER, 2-4 SERVO
29	RING, SERVO COVER RETAINING
30	SEAL, CASE EXTENSION TO CASE
31	EXTENSION, CASE
32	BOLT, CASE EXTENSION TO CASE
33	BUSHING, CASE EXTENSION
34	SEAL ASSEMBLY, CASE EXTENSION OIL
35	BOLT, SPEED SENSOR RETAINING
36	SPEED SENSOR, INTERNAL TRANSMISSION
37	SEAL, O-RING (ITSS TO CASE EXTENSION)
38	PLUG, TRANSMISSION CASE (ACCUM. BLEED)
39	PLUG, PRESSURE
40	RETAINER AND BALL ASSEMBLY, 3RD ACCUM.
41	PIN, BAND ANCHOR
42	RETAINER AND BALL ASM. (DOUBLE ORIFICE)
43	PIN, ACCUMULATOR PISTON
44	PISTON, 3-4 ACCUMULATOR
45	RING, OIL SEAL (3-4 ACCUMULATOR PISTON)
46	SPRING, 3-4 ACCUMULATOR
47	GASKET, SPACER PLATE TO CASE
48	PLATE, VALVE BODY SPACER
49	SCREEN, SHIFT SOLENOIDS
50	SCREEN, PRESSURE CONTROL SOLENOID
52	GASKET, SPACER PLATE TO VALVE BODY
53	PLATE, SPACER PLATE SUPPORT
54	SPRING, 1-2 ACCUMULATOR
54A	SPRING, 1-2 ACCUMULATOR (INNER)
55	RING, OIL SEAL (1-2 ACCUMULATOR)
56	PISTON, 1-2 ACCUMULATOR
57	COVER AND PIN ASSEMBLY, 1-2 ACCUMULATOR
58	BOLT, ACCUMULATOR COVER
59	BOLT, ACCUMULATOR COVER
60	VALVE ASSEMBLY, CONTROL BODY
61	CHECKBALL
62	BOLT, VALVE BODY
63	SPRING ASSEMBLY, MANUAL DETENT
64	BOLT, MANUAL DETENT SPRING
65	SEAL, WIRING HARNESS PASS-THRU CONNECTOR O-RING
66	SOLENOID ASSEMBLY, WIRING HARNESS
67	SEAL, O-RING (SOLENOID)
68	BOLT, HEX WASHER HEAD (SOLENOID)
69	SWITCH ASSEMBLY, TRANSMISSION PRESSURE
70	BOLT, PRESSURE SWITCH ASSEMBLY
71	SEAL, FILTER
72	FILTER ASSEMBLY, TRANSMISSION OIL
73	GASKET, TRANSMISSION OIL PAN
74	MAGNET, CHIP COLLECTOR
75	PAN, TRANSMISSION OIL
76	SCREW, TRANSMISSION OIL PAN
77	BOLT, SPACER PLATE SUPPORT
78	PLUG, STEEL CUP
79	SHAFT, PARKING BRAKE PAWL
80	SPRING, PARKING PAWL RETURN
81	PAWL, PARKING BRAKE
82	SEAL, MANUAL SHAFT
83	RETAINER, MANUAL SHAFT
84	SHAFT, MANUAL
85	ACTUATOR ASSEMBLY, PARKING LOCK
86	BRACKET, PARKING LOCK
87	BOLT, PARKING LOCK BRACKET
88	LEVER, INSIDE DETENT
89	LINK, MANUAL VALVE
90	NUT, HEX HEAD
91	NO. 10 CHECKBALL
93	BRACKET, DIPSTICK STOP

SH0206-4L60-E

Figure 128 Case and Associated Parts – Legend

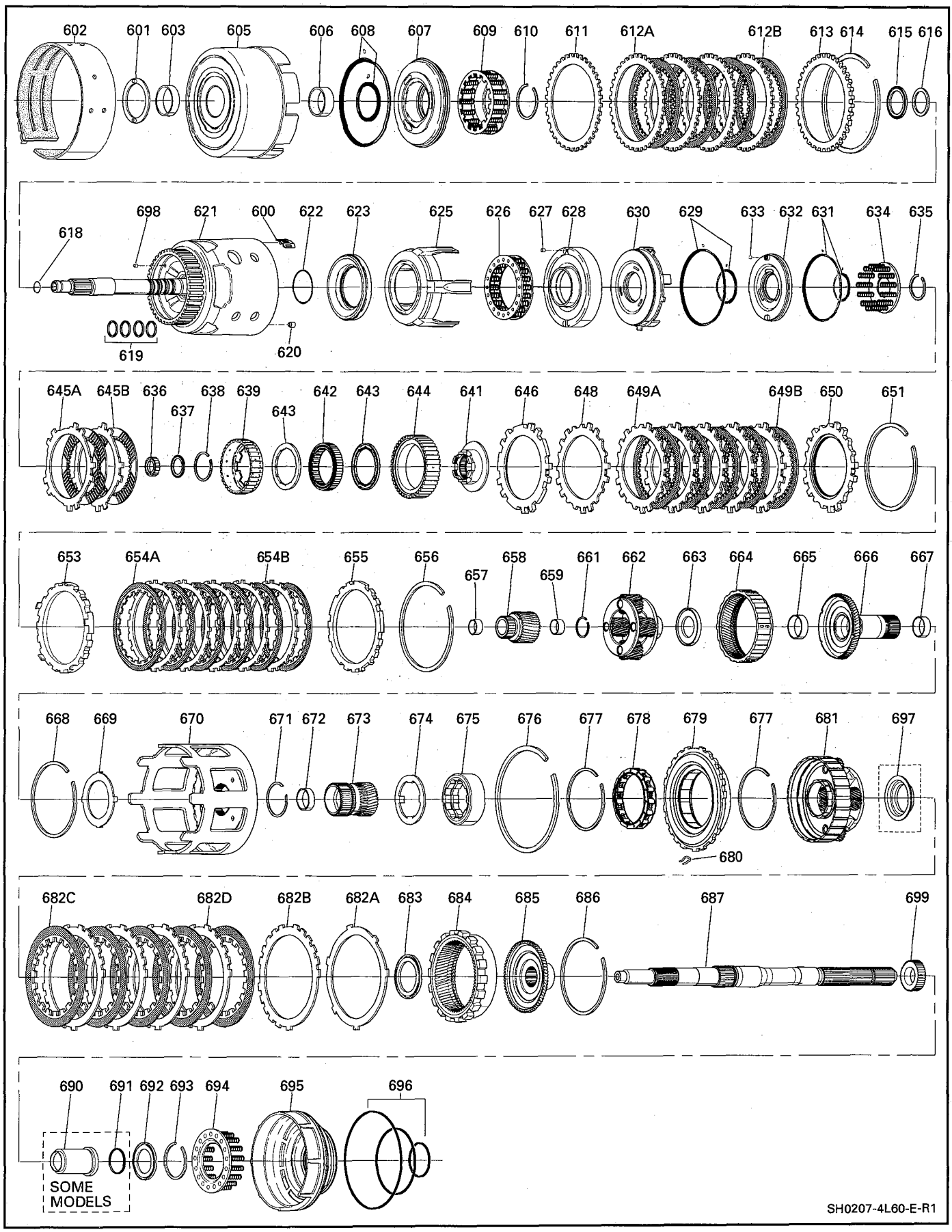


Figure 129 Transmission Internal Parts

ILL. NO.	DESCRIPTION
600	SPRING ASM., 3-4 CLUTCH BOOST (5)
601	WASHER, THRUST (PUMP TO DRUM)
602	BAND ASSEMBLY, 2-4
603	BUSHING, REVERSE INPUT CL. (FRONT)
605	HOUSING AND DRUM ASSEMBLY, REVERSE INPUT CLUTCH
606	BUSHING, REVERSE INPUT CLUTCH (REAR)
607	PISTON ASM., REVERSE INPUT CLUTCH
608	SEALS, REVERSE INPUT CLUTCH (INNER AND OUTER)
609	SPRING ASM., REVERSE INPUT CLUTCH
610	RING, REVERSE INPUT CLUTCH SPRING RETAINER
611	PLATE, REVERSE INPUT CLUTCH (BELLEVILLE)
612A	PLATE ASM., REVERSE INPUT CLUTCH (STEEL)
612B	PLATE, REVERSE INPUT CLUTCH (FIBER)
613	PLATE, REVERSE INPUT CLUTCH BACKING (SELECTIVE)
614	RING, REVERSE INPUT CL. RETAINING
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
618	SEAL, O-RING (TURBINE SHAFT/ SELECTIVE WASHER)
619	RING, OIL SEAL (SOLID)
620	RETAINER AND CHECKBALL ASSEMBLY
621	HOUSING AND SHAFT ASSEMBLY, INPUT
622	SEAL, O-RING INPUT TO FORWARD HSG.
623	PISTON, 3RD AND 4TH CLUTCH
625	RING, 3RD AND 4TH CLUTCH (APPLY)
626	SPRING ASSEMBLY, 3RD AND 4TH CLUTCH
627	RETAINER AND BALL ASSEMBLY, FORWARD CLUTCH HOUSING
628	HOUSING, FORWARD CLUTCH
629	SEAL, FORWARD CLUTCH (INNER AND OUTER)
630	PISTON, FORWARD CLUTCH
631	SEAL, OVERRUN CLUTCH (INNER AND OUTER)
632	PISTON, OVERRUN CLUTCH
633	BALL, OVERRUN CLUTCH
634	SPRING ASSEMBLY, OVERRUN CLUTCH
635	SNAP RING, OVERRUN CLUTCH SPRING RETAINER
636	SEAL, INPUT HOUSING TO OUTPUT SHAFT
637	BEARING ASSEMBLY, INPUT SUN GEAR
638	SNAP RING, OVERRUN CL. HUB RETAINING
639	HUB, OVERRUN CLUTCH
641	RETAINER AND RACE ASSEMBLY, SPRAG
642	FORWARD SPRAG ASSEMBLY
643	RETAINER RINGS, SPRAG ASSEMBLY
644	RACE, FORWARD CLUTCH (OUTER)
645A	PLATE ASSEMBLY, OVERRUN CLUTCH (STEEL)
645B	PLATE, OVERRUN CLUTCH (FIBER)
646	PLATE, FORWARD CLUTCH (APPLY)
648	PLATE, FORWARD CLUTCH (WAVED)
649A	PLATE ASSEMBLY, FORWARD CLUTCH (STEEL)
649B	PLATE, FORWARD CLUTCH (FIBER)
650	PLATE, FORWARD CLUTCH BACKING (SEL.)
651	RING, FORWARD CLUTCH BACKING PLATE RETAINER
653	PLATE, 3RD AND 4TH CLUTCH APPLY (STEPPED)
654A	PLATE ASSEMBLY, 3RD AND 4TH CLUTCH (FIBER)
654B	PLATE, 3RD AND 4TH CLUTCH (STEEL)
655	PLATE, 3RD AND 4TH CLUTCH BACKING (SEL.)
656	RING, 3RD AND 4TH CLUTCH BACKING PLATE RETAINER
657	BUSHING, INPUT SUN GEAR (FRONT)
658	GEAR, INPUT SUN
659	BUSHING, INPUT SUN GEAR (REAR)
661	RET., OUTPUT SHAFT TO INPUT CARRIER
662	CARRIER ASSEMBLY, INPUT (COMPLETE)
663	BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)
664	GEAR, INPUT INTERNAL
665	BUSHING, REACTION CARRIER SHAFT (FRONT)
666	SHAFT, REACTION CARRIER
667	BUSHING, REACTION CARRIER SHAFT (REAR)
668	RING, REACTION SHAFT/INTERNAL GEAR RETAINER
669	WASHER, THRUST (REACTION SHAFT/SHELL)
670	SHELL, REACTION SUN
671	RING, REACTION SUN GEAR RETAINER
672	BUSHING, REACTION SUN
673	GEAR, REACTION SUN
674	WASHER, THRUST (RACE/REACTION SHELL)
675	RACE, LO AND REVERSE ROLLER CLUTCH
676	RING, LO AND REVERSE SUPPORT TO CASE RETAINER
677	RING, LO AND REVERSE RETAINER (ROLLER ASSEMBLY/CAM)
678	CLUTCH ASSEMBLY, LO AND REVERSE ROLLER
679	SUPPORT ASM., LO AND REVERSE CLUTCH
680	SPRING, TRANSMISSION (LO AND REVERSE CLUTCH SUPPORT RETAINER)
681	CARRIER ASSEMBLY, REACTION
682A	PLATE, LO AND REVERSE CLUTCH (WAVED)
682B	PLATE, SPACER LO AND REVERSE CLUTCH (SELECTIVE)
682C	PLATE ASSEMBLY, LO AND REVERSE CLUTCH (FIBER)
682D	PLATE, LO AND REVERSE CLUTCH (STEEL)
683	BEARING ASSEMBLY, THRUST (REACTION CARRIER/ SUPPORT)
684	GEAR, INTERNAL REACTION
685	SUPPORT, INTERNAL REACTION GEAR
686	RING, REACTION GEAR/SUPPORT RETAINER
687	SHAFT, OUTPUT
690	SLEEVE, OUTPUT SHAFT
691	SEAL, OUTPUT SHAFT
692	BRG., REACTION GEAR SUPPORT TO CASE
693	RING, LO AND REVERSE CLUTCH RETAINER
694	SPRING ASSEMBLY, LO AND REVERSE CLUTCH
695	PISTON, LO AND REVERSE CLUTCH
696	SEAL, TRANSMISSION (LO AND REVERSE CLUTCH – OUTER, CENTER, INNER)
697	DEFLECTOR, OIL (HIGH OUTPUT MODELS ONLY)
698	PLUG, ORIFICED CUP
699	ROTOR, INTERNAL TRANSMISSION SPEED SENSOR

SH0208-4L60-E-R1

Figure 130 Transmission Internal Parts – Legend

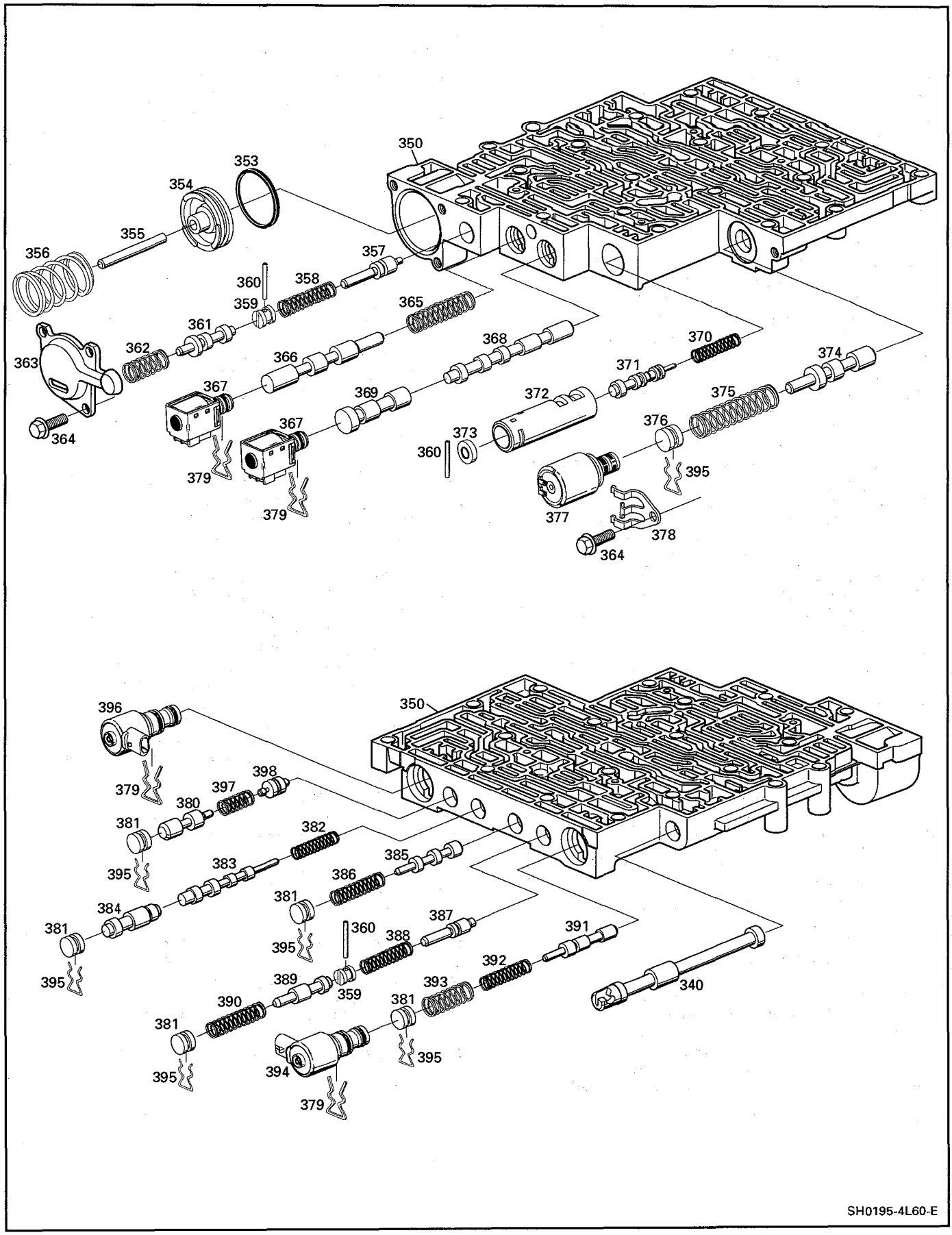


Figure 131 Control Valve Assembly

340 VALVE, MANUAL
350 VALVE ASSEMBLY, CONTROL BODY
353 SEAL, FORWARD ACCUMULATOR OIL
354 PISTON, FORWARD ACCUMULATOR
355 PIN, FORWARD ACCUMULATOR
356 SPRING, FORWARD ACCUMULATOR
357 VALVE, FORWARD ABUSE
358 SPRING, FORWARD ABUSE VALVE
359 PLUG, BORE
360 PIN, COILED SPRING
361 VALVE, LOW OVERRUN
362 SPRING, LOW OVERRUN VALVE
363 COVER, FORWARD ACCUMULATOR
364 BOLT, FORWARD ACCUMULATOR COVER
365 SPRING, 1-2 SHIFT VALVE
366 VALVE, 1-2 SHIFT
367A 1-2 SHIFT SOLENOID (A)
367B 2-3 SHIFT SOLENOID (B)
368 VALVE, 2-3 SHIFT
369 VALVE, 2-3 SHUTTLE
370 SPRING, 1-2 ACCUMULATOR VALVE
371 VALVE, 1-2 ACCUMULATOR
372 SLEEVE, 1-2 ACCUMULATOR VALVE
373 PLUG, BORE
374 VALVE, ACTUATOR FEED LIMIT
375 SPRING, ACTUATOR FEED LIMIT VALVE
376 PLUG, BORE
377 PRESSURE CONTROL SOLENOID
378 RETAINER, PRESSURE CONTROL SOLENOID
379 RETAINER, SOLENOID
380 VALVE, REGULATOR APPLY
381 PLUG, BORE
382 SPRING, 4-3 SEQUENCE VALVE
383 VALVE, 4-3 SEQUENCE
384 VALVE, 3-4 RELAY
385 VALVE, 3-4 SHIFT
386 SPRING, 3-4 SHIFT VALVE
387 VALVE, REVERSE ABUSE
388 SPRING, REVERSE ABUSE VALVE
389 VALVE, 3-2 DOWNSHIFT
390 SPRING, 3-2 DOWNSHIFT VALVE
391 VALVE, 3-2 CONTROL
392 SPRING, 3-2 CONTROL VALVE
393 SPRING, BORE PLUG
394 3-2 CONTROL SOLENOID
395 RETAINER, BORE PLUG
396 TCC PWM SOLENOID
397 SPRING, REGULATOR APPLY
398 VALVE, ISOLATOR

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Figure 132 Control Valve Assembly – Legend

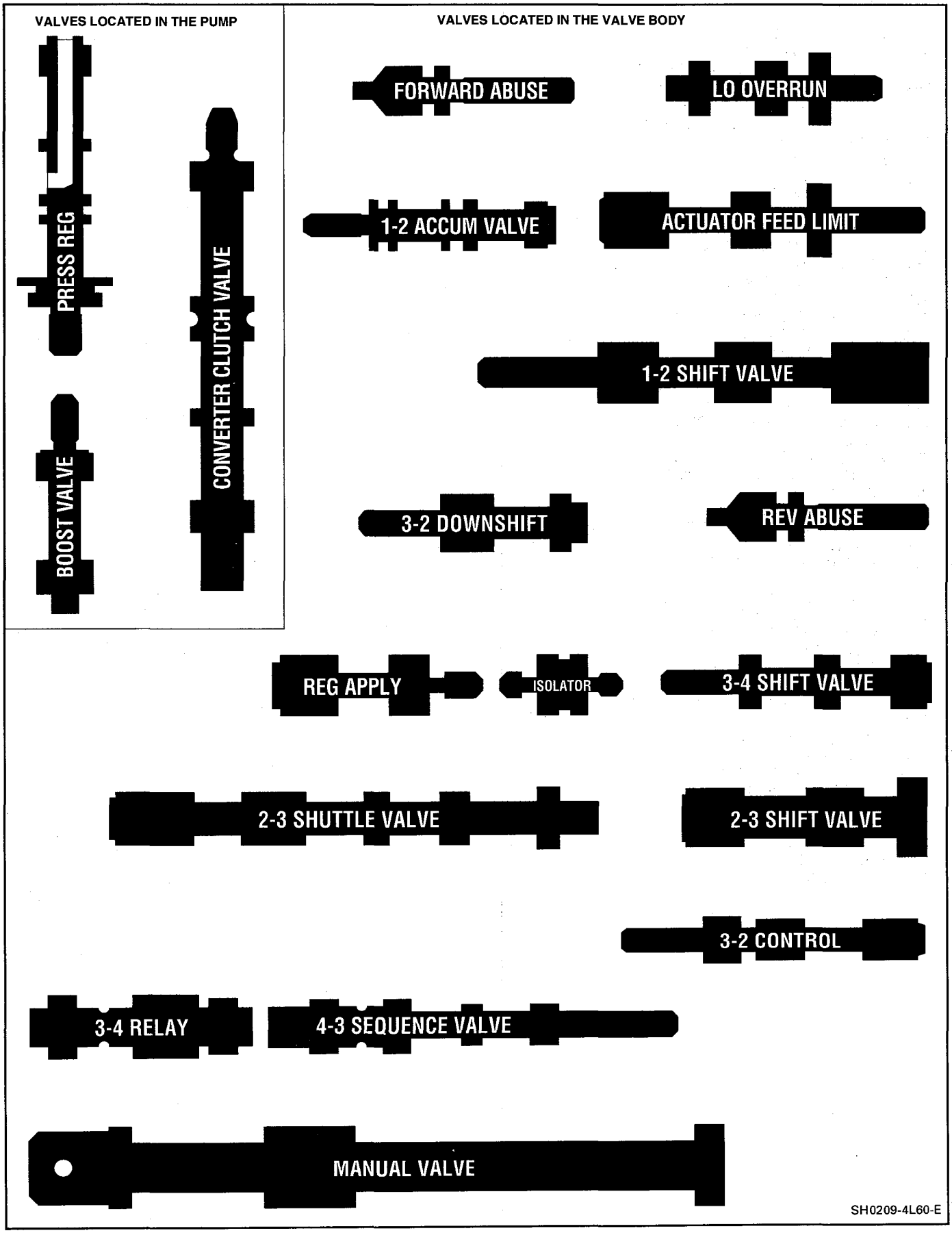


Figure 133 Control Valve Identification

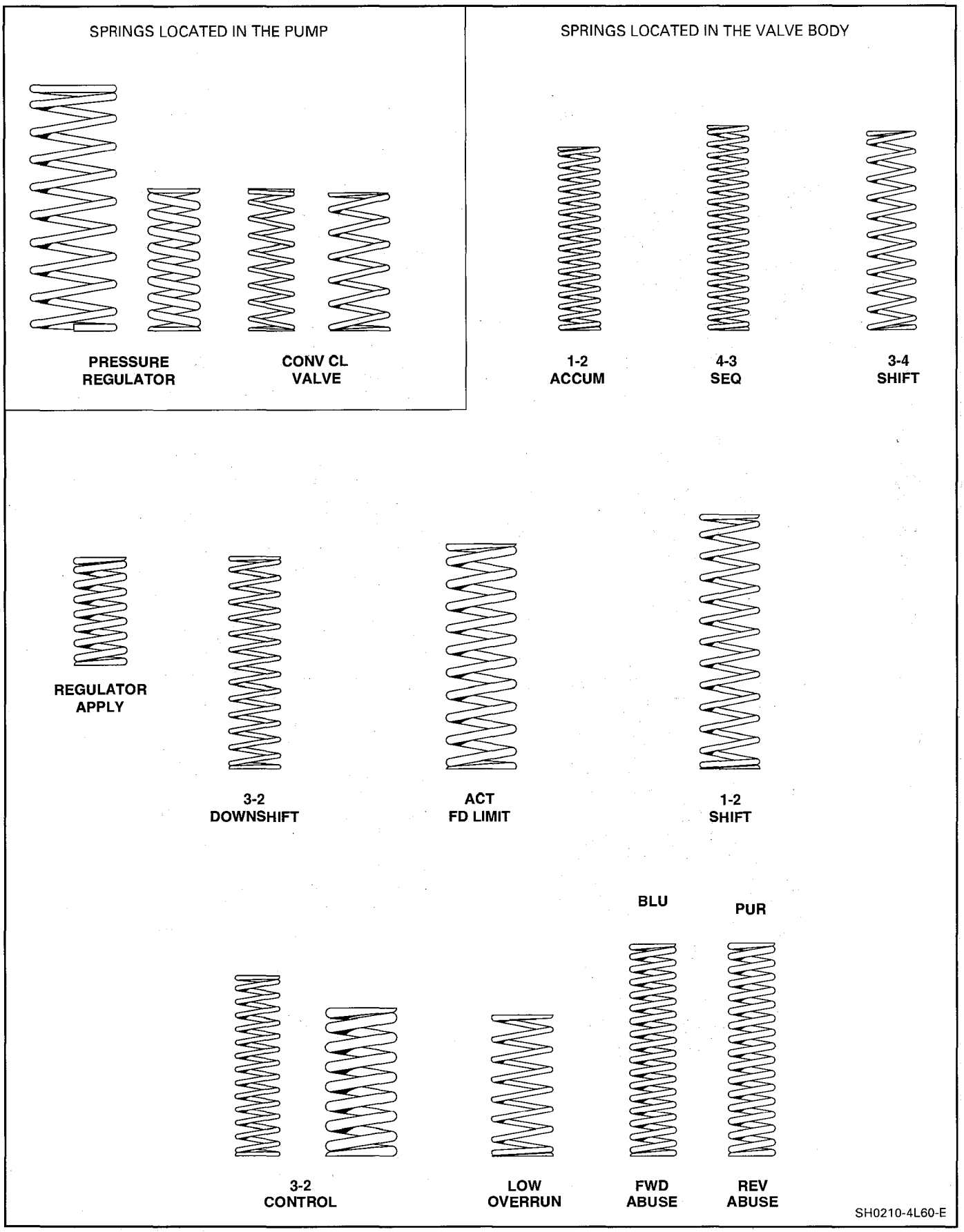
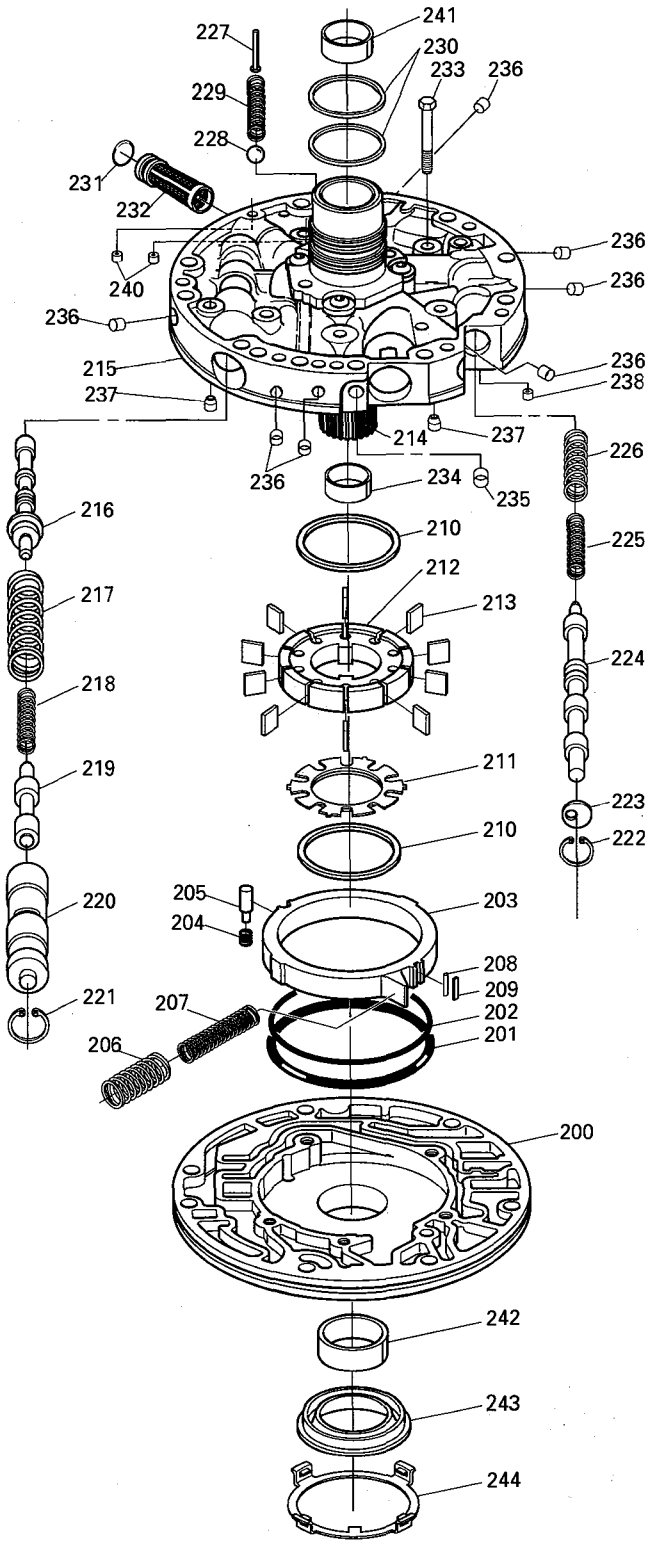


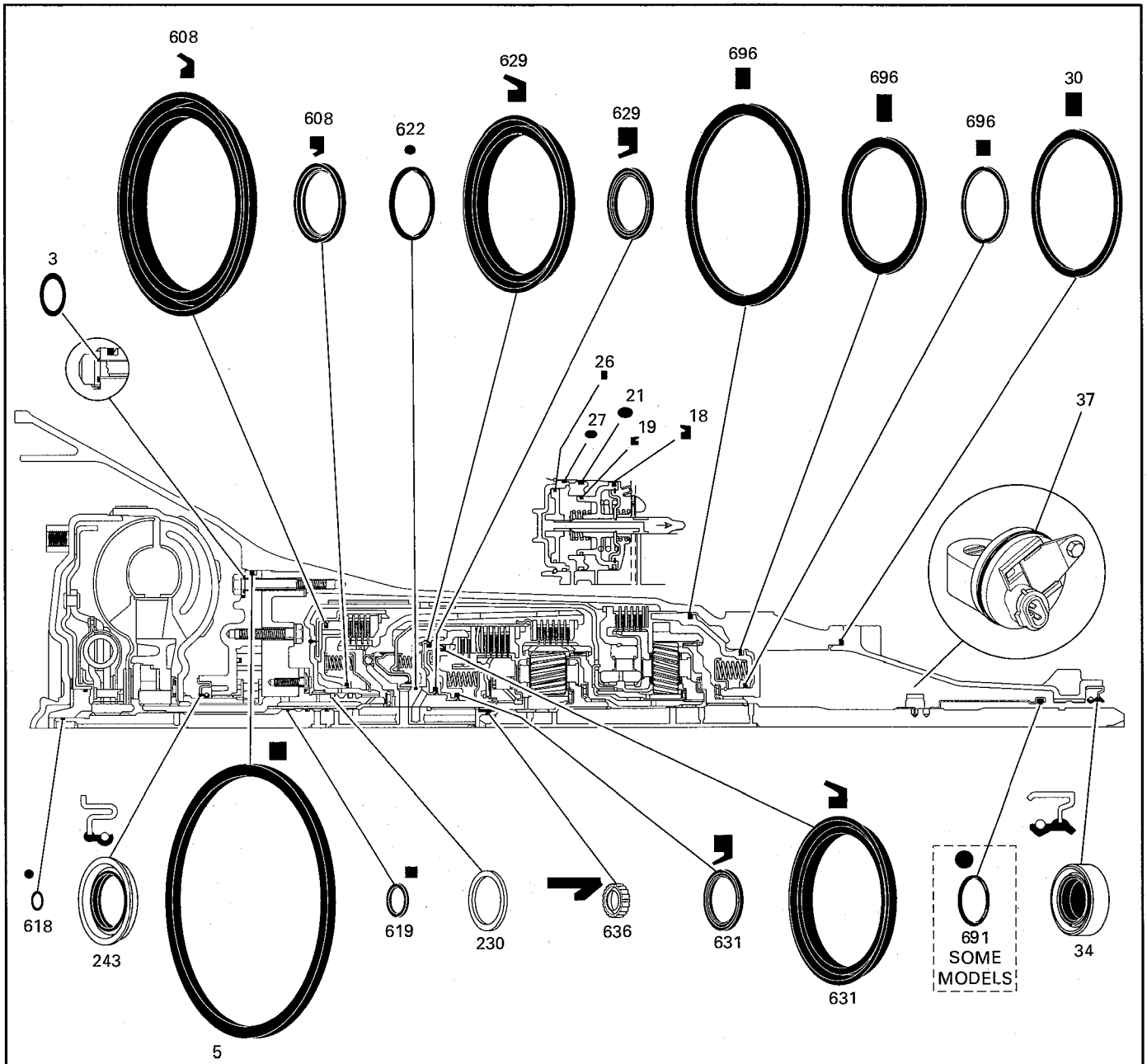
Figure 134 Control Valve Spring Identification



ILL. NO.	DESCRIPTION
200	BODY, PUMP
201	RING, OIL SEAL (SLIDE TO WEAR PLATE)
202	SEAL, O-RING (SLIDE SEAL BACK-UP)
203	SLIDE, PUMP
204	SPRING, PIVOT PIN
205	PIN, PIVOT SLIDE
206	SPRING, PUMP SLIDE (OUTER)
207	SPRING, PUMP SLIDE (INNER)
208	SUPPORT, PUMP SLIDE SEAL
209	SEAL, PUMP SLIDE
210	RING, PUMP VANE
211	GUIDE, ROTOR
212	ROTOR, OIL PUMP
213	VANE, PUMP
214	SHAFT, STATOR
215	COVER, PUMP
216	VALVE, PRESSURE REGULATOR
217	SPRING, PRESSURE REGULATOR VALVE
218	SPRING, PRESSURE REGULATOR ISOLATOR
219	VALVE, REVERSE BOOST
220	SLEEVE, REVERSE BOOST VALVE
221	RING, OIL PUMP REVERSE BOOST VALVE RETAINING
222	RING, OIL PUMP CONVERTER CLUTCH VALVE RETAINING
223	VALVE, STOP
224	VALVE, CONVERTER CLUTCH
225	SPRING, CONVERTER CLUTCH VALVE (INNER)
226	SPRING, CONVERTER CLUTCH VALVE (OUTER)
227	RIVET, PRESSURE RELIEF BOLT
228	BALL, PRESSURE RELIEF
229	SPRING PRESSURE RELIEF
230	RING, OIL SEAL (STATOR SHAFT)
231	SEAL, OIL PUMP COVER SCREEN
232	SCREEN, OIL PUMP COVER
233	BOLT, M8 X 1.25 X 40 (COVER TO BODY)
234	BUSHING, STATOR SHAFT (FRONT)
235	PLUG, OIL PUMP COVER (FWD CLUTCH FEED)
236	PLUG, OIL PUMP COVER
237	RETAINER AND BALL ASSEMBLY, CHECK VALVE
238	ORIFICE, CONVERTER CLUTCH SIGNAL (CUP PLUG)
239	ORIFICE, OIL COOLER (CUP PLUG)
240	PLUG, CUP ORIFICE
241	BUSHING, STATOR SHAFT (REAR)
242	BUSHING, PUMP BODY
243	SEAL ASSEMBLY, OIL
244	RETAINER, FRONT HELIX

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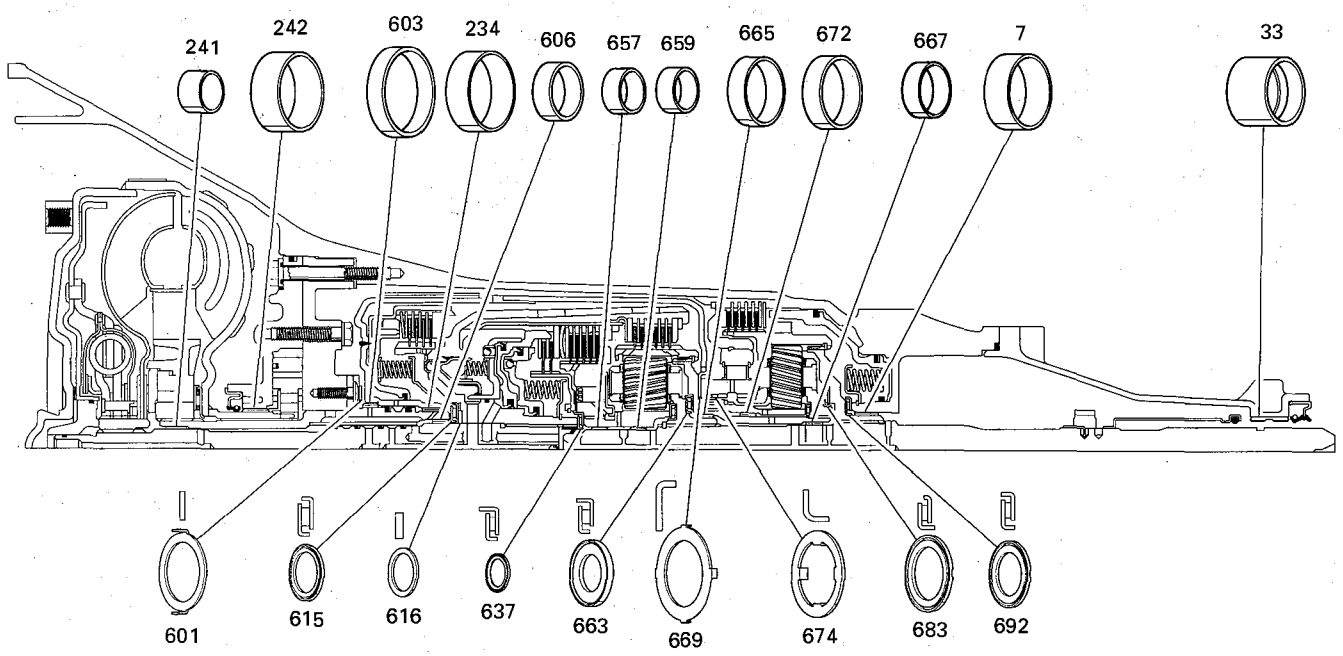
Figure 135 Oil Pump Assembly



3 O-RING, PUMP TO CASE BOLT
5 SEAL, OIL (PUMP TO CASE)
18 RING, OIL SEAL (2ND APPLY PISTON - OUTER)
19 RING, OIL SEAL (2ND APPLY PISTON - INNER)
21 SEAL, O-RING
26 RING, OIL SEAL (4TH APPLY PISTON - OUTER)
27 SEAL, O-RING (2-4 SERVO COVER)
30 SEAL, CASE EXTENSION TO CASE
34 SEAL ASSEMBLY, CASE EXTENSION OIL
37 SEAL, O-RING (ITSS TO CASE EXTENSION)
230 RING, OIL SEAL (STATOR SHAFT)
243 SEAL ASSEMBLY, OIL
608 SEALS, REVERSE INPUT CLUTCH (INNER AND OUTER)
618 SEAL, O-RING (TURBINE SHAFT/ SELECTIVE WASHER)
619 RING, OIL SEAL (SOLID)
622 SEAL, O-RING INPUT TO FORWARD HSG.
629 SEAL, FORWARD CLUTCH (INNER AND OUTER)
631 SEAL, OVERRUN CLUTCH (INNER AND OUTER)
636 SEAL, INPUT HOUSING TO OUTPUT SHAFT
691 SEAL, OUTPUT SHAFT
696 SEAL, TRANSMISSION (LO AND REVERSE CLUTCH –OUTER, CENTER, INNER)

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Figure 136 Seal Locations



7	BUSHING, CASE
33	BUSHING, CASE EXTENSION
234	BUSHING, STATOR SHAFT (FRONT)
241	BUSHING, STATOR SHAFT (REAR)
242	BUSHING, OIL PUMP BODY
601	WASHER, THRUST (PUMP TO DRUM)
603	BUSHING, REVERSE INPUT CL. (FRONT)
606	BUSHING, REVERSE INPUT CLUTCH (REAR)
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
637	BEARING ASSEMBLY, INPUT SUN GEAR
657	BUSHING, INPUT SUN GEAR (FRONT)
659	BUSHING, INPUT SUN GEAR (REAR)
663	BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)
665	BUSHING, REACTION CARRIER SHAFT (FRONT)
667	BUSHING, REACTION CARRIER SHAFT (REAR)
669	WASHER, THRUST (REACTION SHAFT/SHELL)
672	BUSHING, REACTION SUN
674	WASHER, THRUST (RACE/REACTION SHELL)
683	BEARING ASSEMBLY, THRUST (REACTION CARRIER/ SUPPORT)
692	BEARING., REACTION GEAR SUPPORT TO CASE

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Figure 137 Bushing and Bearing Locations

TORQUE SPECIFICATIONS

LOCATION	QTY.	SIZE	TORQUE	LOCATION	QTY.	SIZE	TORQUE
ACCUMULATOR COVER TO CASE	2	M6 1.0 x 35.0	11 N•m (8 LB.-FT.)	PARK BRAKE BRACKET TO CASE	2	M8 1.25 X 20.0	31 N•m (23 LB.-FT.)
ACCUMULATOR COVER TO CASE	1	M6 1.0 x 65.0	11 N•m (8 LB.-FT.)	PUMP COVER TO BODY	5	M8 1.25 X 40.0	24 N•m (18 LB.-FT.)
DETENT SPRING TO VALVE BODY	1	M8 1.25 x 20.0	24 N•m (18 LB.-FT.)	PUMP ASSEMBLY TO CASE	7	M8 1.25 X 60.0	24 N•m (18 LB.-FT.)
FWD ACCUM. COVER TO VALVE BODY	3	M6 1.0 x 17.7	11 N•m (8 LB.-FT.)	CASE EXTENSION TO CASE	4	M10 1.50 X 30.0	35 N•m (26 LB.-FT.)
SOLENOID ASSEMBLY TO CASE	2	M6 1.0 x 12.0	11 N•m (8 LB.-FT.)	MANUAL SHAFT TO INSIDE DETENT LEVER	1	M10 1.50 NUT	31 N•m (23 LB.-FT.)
TRANSMISSION OIL PAN TO CASE	16	M8 1.25 x 19.3	11 N•m (8 LB.-FT.)	LINE PRESSURE PLUG	1	1/8 - 27	11 N•m (8 LB.-FT.)
VALVE BODY TO CASE	2	M6 1.0 X 35.0	11 N•m (8 LB.-FT.)	CONNECTOR COOLER PIPE	2	1/4 - 18	38 N•m (28 LB.-FT.)
VALVE BODY TO CASE	9	M6 1.0 x 47.5	11 N•m (8 LB.-FT.)	PRESSURE SWITCH ASM. TO VALVE BODY	2	M6 1.0 X 17.7	11 N•m (8 LB.-FT.)
VALVE BODY TO CASE	3	M6 1.0 x 54.4	11 N•m (8 LB.-FT.)	VEHICLE SPEED SENSOR RETAINER	1	M6 1.0 X 21.7	11 N•m (8 LB.-FT.)
VALVE BODY TO CASE	3	M6 1.0 x 65.0	11 N•m (8 LB.-FT.)	SPACER PLATE SUPPORT TO CASE	3	M6 1.0 X 17.7	11 N•m (8 LB.-FT.)
PRESSURE CONTROL SOLENOID TO VALVE BODY	1	M6 1.0 X 17.7	11 N•m (8 LB.-FT.)				

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Figure 138 Torque Specifications

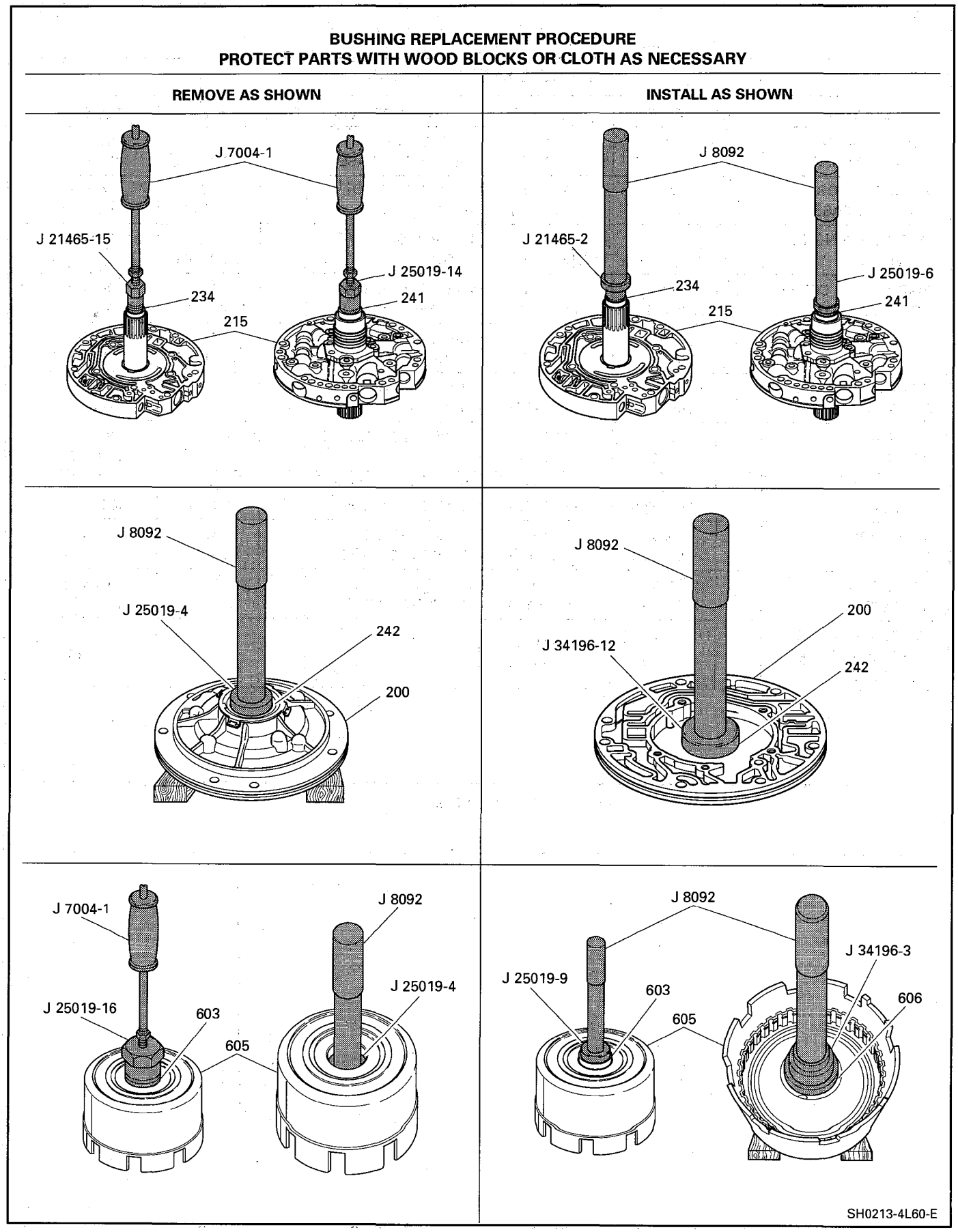
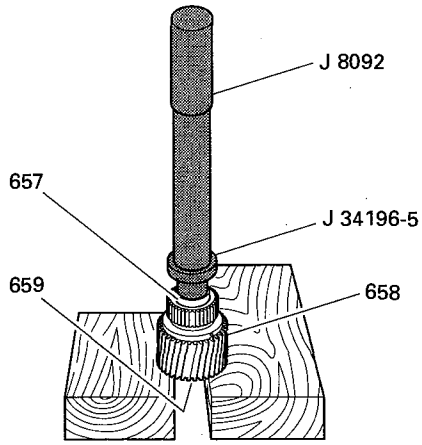
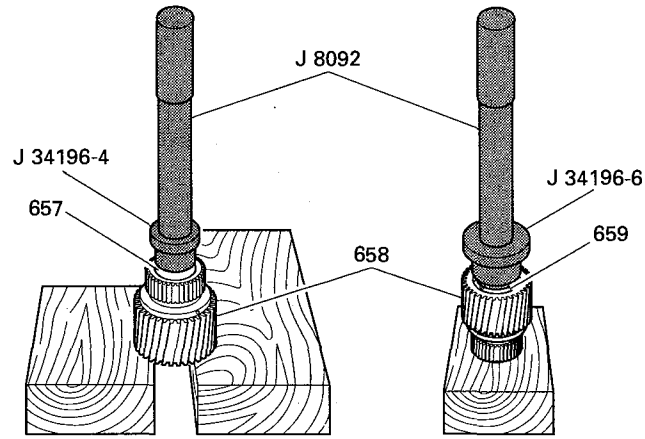
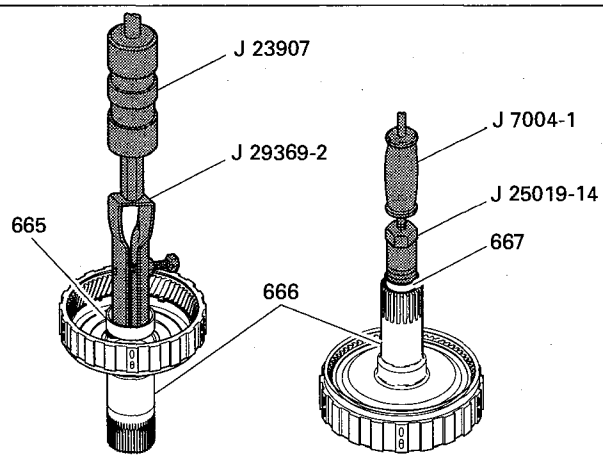
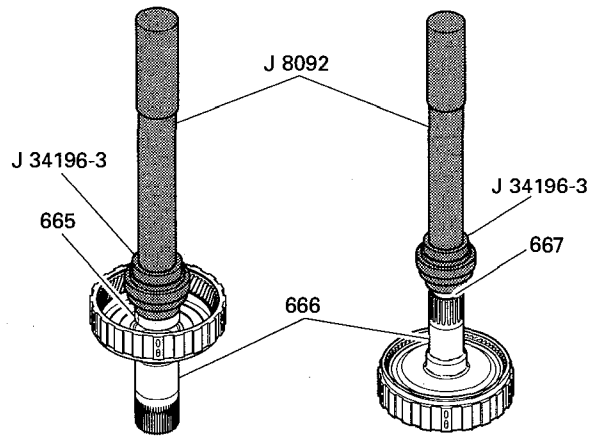
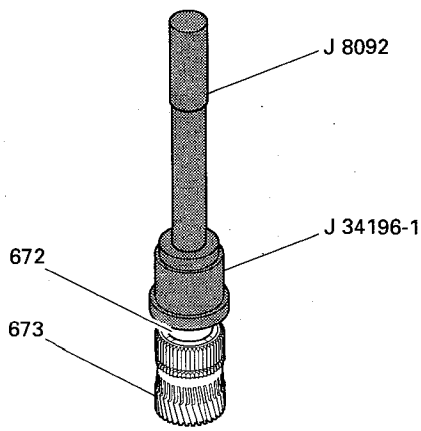
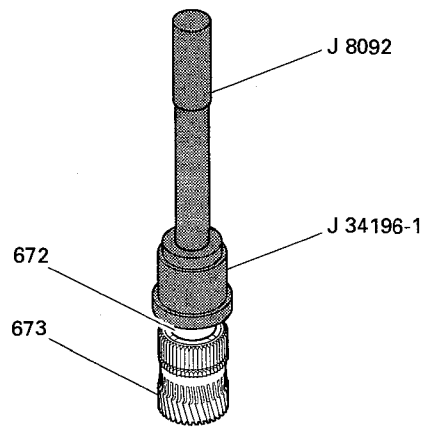


Figure 139 Bushing Replacement Procedure

BUSHING REPLACEMENT PROCEDURE
PROTECT PARTS WITH WOOD BLOCKS OR CLOTH AS NECESSARY

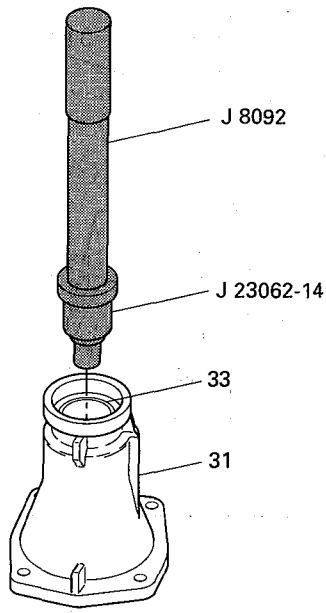
REMOVE AS SHOWN	INSTALL AS SHOWN
	
	
	

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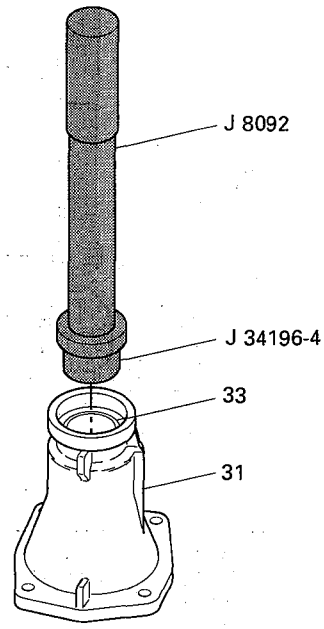
Figure 140 Bushing Replacement Procedure

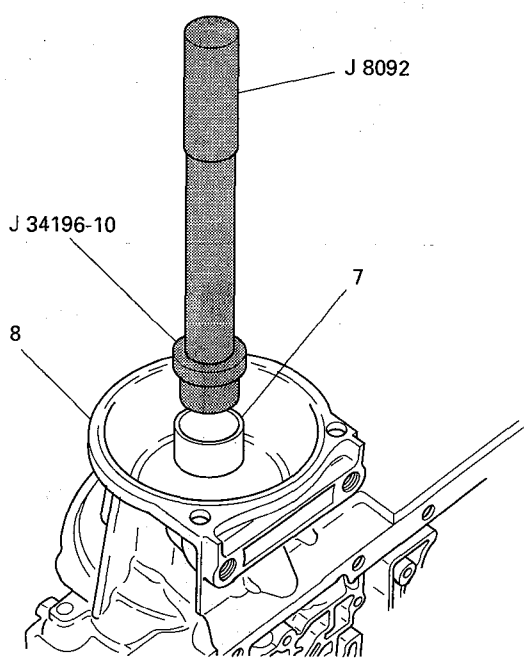
BUSHING REPLACEMENT PROCEDURE
PROTECT PARTS WITH WOOD BLOCKS OR CLOTH AS NECESSARY

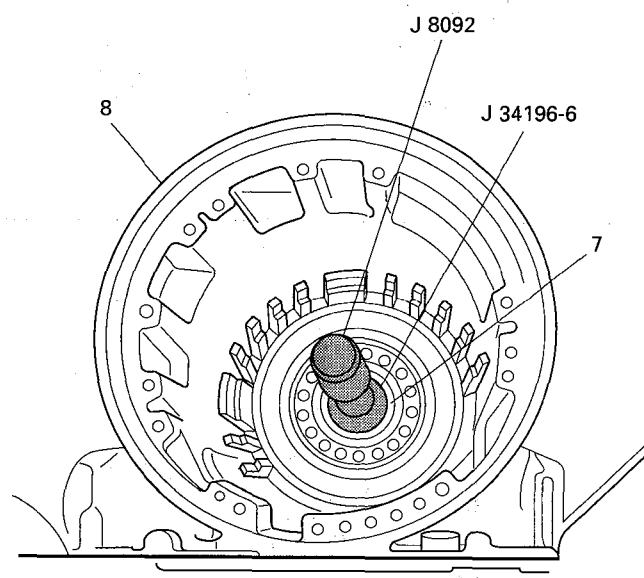
REMOVE AS SHOWN



INSTALL AS SHOWN







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Figure 141 Bushing Replacement Procedure

SPECIAL TOOLS

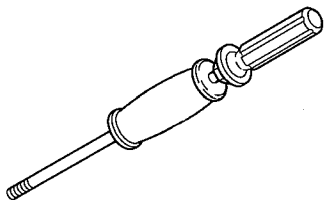
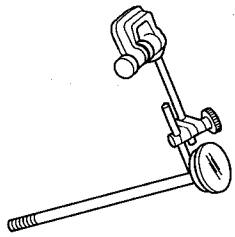
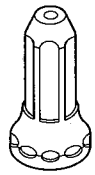
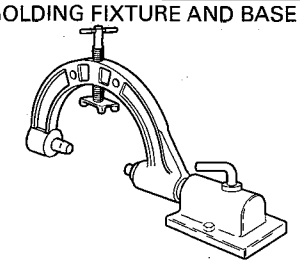
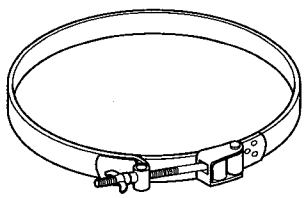
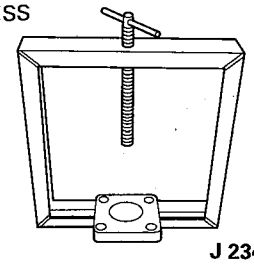
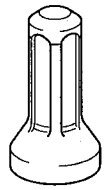
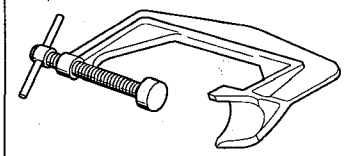
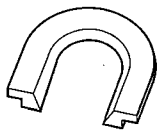
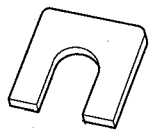
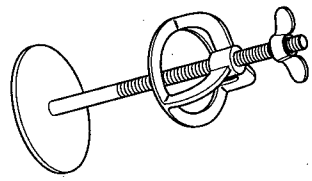
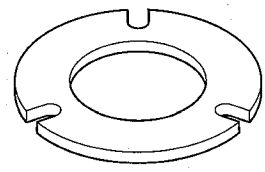
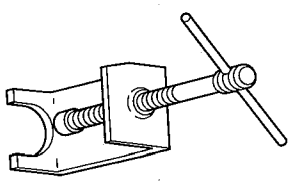
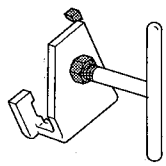
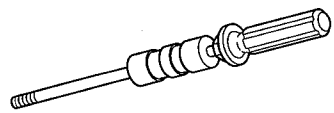
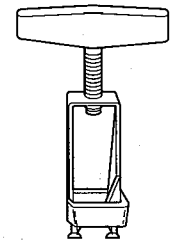
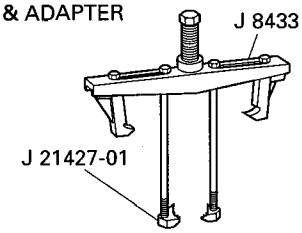
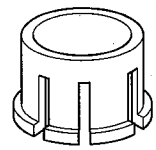
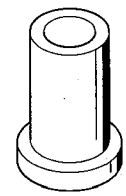
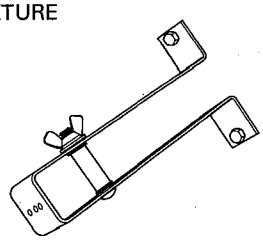
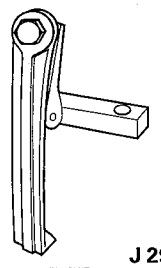
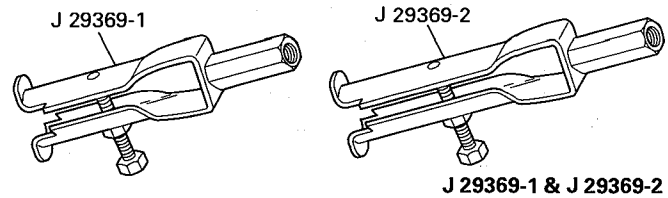
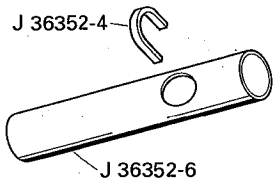
UNIVERSAL REMOVER  J 7004-1	DIAL INDICATOR SET  J 8001	REAR SEAL INSTALLER  J 21426	HOLDING FIXTURE AND BASE  J 8763-02
OIL PUMP BODY & COVER ALIGNMENT BAND  J 21368	CLUTCH SPRING COMPRESSOR PRESS  J 23456	PUMP OIL SEAL INSTALLER  J 25016	PISTON COMPRESSOR  J 22269-01
END PLAY CHECKING FIXTURE  J 25022	END PLAY FIXTURE ADAPTER  J 34725	CLUTCH SPRING COMPRESSOR  J 23327	CLUTCH SPRING COMPRESSOR ADAPTER  J 25018-A
OIL PUMP REMOVER & END PLAY CHECKING FIXTURE  J 24773-A	SPEED SENSOR REMOVER  J 38417	UNIVERSAL REMOVER  J 23907	PUMP REMOVER & INSTALLER  J 37789
SPEEDOMETER GEAR PULLER & ADAPTER  J 21427-01 & J 8433	TURBINE SHAFT SEAL INSTALLER  J 36418-1	ADAPTER  J 39119	TURBINE SHAFT SEAL SIZER  J 36418-2A
OUTPUT SHAFT SUPPORT FIXTURE  J 29837	SERVO COVER COMPRESSOR  J 29714	BUSHING & UNIVERSAL REMOVER SET  J 29369-1 & J 29369-2 RH0216-4L60-E	

Figure 142 Special Tools

SPECIAL TOOLS

SPEED SENSOR ROTER INSTALLER



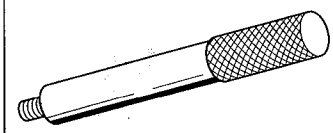
J 36352-4 & J 36352-6

SPEEDOMETER GEAR INSTALLER



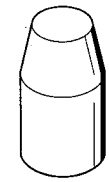
J 5590

HANDLE



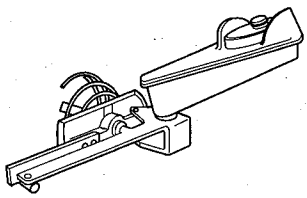
J 8092

INNER FORWARD CLUTCH SEAL PROTECTOR



J 29883

2-4 BAND APPLY PIN TOOL



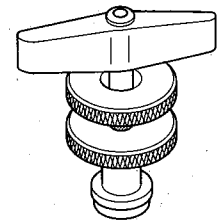
J 33037

DIAL INDICATOR POST



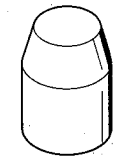
J 26900-13

END PLAY CHECKING TOOL



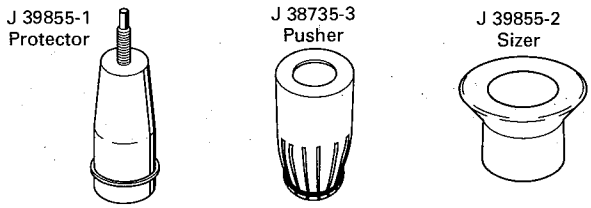
J 35138

INNER OVERRUN CLUTCH SEAL PROTECTOR



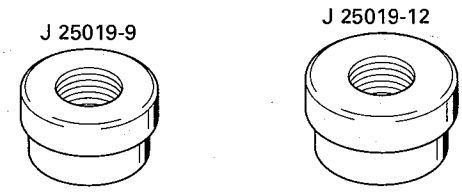
J 29882

STATOR SHAFT SEALS INSTILLATION AND SIZING TOOLS



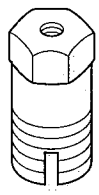
J 39855-1 & J 38735-3 & J 39855-2

BUSHING INSTALLERS



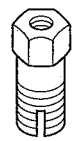
J 25019-9 & J 25019-12

BUSHING REMOVER



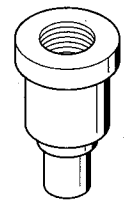
J 25019-14

BUSHING REMOVER



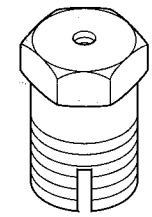
J 24036

BUSHING REMOVER



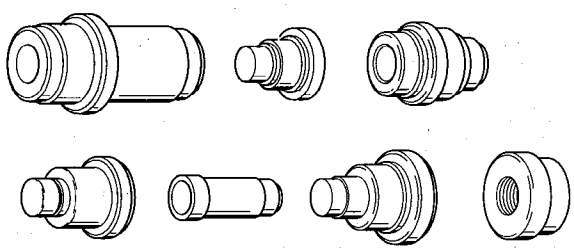
J 23062-14

BUSHING REMOVER



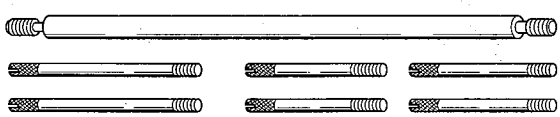
J 25019-16

BUSHING SET



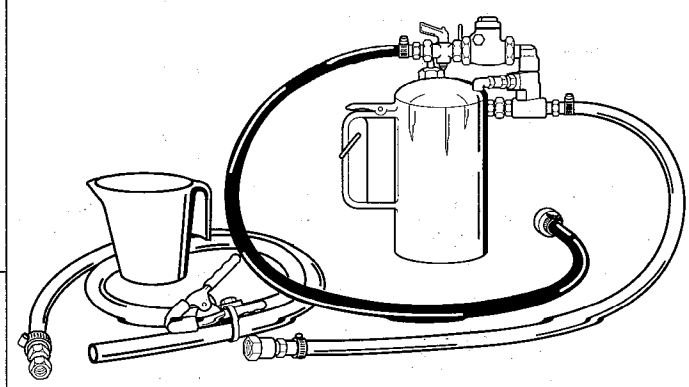
J 34196

DIAL INDICATOR STAND & GUIDE PIN SET



J 25025-B

COOLER FLUSHER



J 35944

RH0236-4L60-E

Figure 143 Special Tools

SECTION 7B

MANUAL TRANSMISSION ON-VEHICLE SERVICE

RPO MM6 AND M49

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

The 5-speed manual transmission assembly (RPO M49) is the only manual transmission assembly available for the 3.4L L32 V6 engine assembly. The 6-speed manual transmission assembly (RPO MM6) is available for the 5.7L LT1 V8 engine assembly. Manual transmission assemblies are identified by the number of forward gears and the measured distance between the centerline of the output shaft and the counter gear.

5-SPEED MANUAL TRANSMISSION ASSEMBLY (RPO M49)

The 5-speed 77 mm manual transmission assembly is a fully synchronized unit with blocker ring synchronizers and a sliding mesh reverse gear. First and second gears have three-piece synchronizer rings, consisting of steel inner and outer cones and a tapered metal ring that is lined on both sides with friction material similar to automatic transmission friction plates. The cones are independent of the gears and can be replaced separately. Third and fourth gear blocker rings are more conventional in appearance, but are also lined with friction material. The fifth gear blocker ring is brass.

NOTICE: No lubricant other than DEXRON®-II GM P/N 1051855 should be used in this manual transmission assembly. Other lubricants or additives may damage the blocker ring friction material or its adhesive.

The mainshaft and countershaft are supported on tapered roller bearings and must be shimmed for proper end play. First through fourth speed mainshaft gears ride on caged roller bearings. An aluminum transmission case houses the various gears and bearings. The manual transmission control assembly is mounted on top of the extension housing. The manual transmission control assembly cannot be adjusted and can be serviced independently of the manual transmission assembly.

6-SPEED MANUAL TRANSMISSION ASSEMBLY (RPO MM6)

The 6-speed 85 mm manual transmission assembly is a fully synchronized unit with blocker ring synchronizers and sliding mesh reverse gears.

NOTICE: No lubricant other than DEXRON®-II GM P/N 1051855 should be used in this manual transmission assembly. Other lubricants or additives may damage the blocker ring friction material or its adhesive.

The 6-speed manual transmission assembly has a reverse lockout solenoid, which operates a reverse lockout assembly to prevent the operator from accidently shifting into reverse when the vehicle is moving forward at a speed of 5 km/h (3 mph) or more.

The 6-speed manual transmission assembly is equipped with a skip shift solenoid. This is to ensure good fuel economy and compliance with federal fuel economy standards. When shifting out of first gear, second and third gears are inhibited by the use of an electric solenoid. The following conditions must be present for this to occur:

- Coolant temperature is above 77°C (162°F).
- Vehicle speed is between 24 and 29 km/h (15 and 21 mph).
- Throttle is opened 35 percent or less.

The 6-speed manual transmission assembly also utilizes an electronic speed sensor.

Each forward gear synchronizer assembly is made up of a splined hub with three synchronizer keys, a sleeve, and two synchronizer springs. The reverse synchronizer has a splined hub with three synchronizer keys, a sleeve, two synchronizer springs, and a reverse synchronizer retainer.

The mainshaft and countershaft are supported on tapered roller bearings. All speed gears ride on caged roller bearings. An aluminum transmission case houses the various gears and bearings.

Like the 5-speed manual transmission assembly, the 6-speed manual transmission control assembly is mounted on top of the extension housing, and can be serviced independently of the manual transmission assembly. The manual transmission control assembly cannot be adjusted. Unlike the 5-speed manual transmission assembly, the manual transmission control lever handle assembly on the 6-speed manual transmission assembly can be removed from the manual transmission control assembly. This allows for removal of the 6-speed manual transmission assembly with the manual transmission control assembly intact.

DIAGNOSIS

For diagnosis of the 5-speed 77 mm manual transmission assembly or the 6-speed 85 mm manual transmission assembly refer to the following diagnosis chart.

CONDITION	POSSIBLE CAUSE	CORRECTION
Transmission Assembly Shifts Hard	1. Incorrect clutch travel.	1. Refer to SECTION 7C.
	2. Misaligned clutch housing bore to crankshaft pilot.	2. Check alignment as necessary.
	3. Binding shift rail.	3. 5-Speed Manual Transmission Assembly – remove transmission cover and check for mispositioned selector arm roll pin, loose cover bolts, worn shift rail bores, worn shift rail, distorted oil seal, or extension housing not aligned with case. Replace worn or damaged components as necessary. 6-Speed Manual Transmission Assembly – remove, disassemble and inspect transmission. Check for worn shift bores, worn shift rail or worn shift rail bushings. Replace worn or damaged components as necessary.
	4. Internal bind in transmission assembly caused by shift forks, selector plates, or synchronizer assemblies.	4. Remove, disassemble and inspect manual transmission assembly. Replace worn or damaged components as necessary.
	5. Incorrect lubricant.	5. Drain and refill manual transmission assembly.

CONDITION	POSSIBLE CAUSE	CORRECTION
Manual Transmission Assembly Shifts Hard Into Reverse or Does Not Shift Into Reverse (6-Speed Manual Transmission Assembly)	1. No power to reverse lockout solenoid.	1. Turn ignition switch to "RUN" position and check for voltage (12 volts) at the reverse lockout.
	2. Damaged reverse lockout solenoid. Worn or broken reverse lockout mechanism.	2. Remove and check function of reverse lockout assembly. Replace worn or damaged parts as necessary.
	3. Worn or broken shift linkage components. Worn or damaged synchronizer sleeve or hub.	3. Remove, disassemble, and inspect manual transmission assembly. Replace worn or damaged components as necessary.
Gear Clash When Shifting From One Gear to Another	1. Incorrect clutch travel.	1. Refer to SECTION 7C.
	2. Low lubricant level or incorrect lubricant.	2. Drain and refill manual transmission assembly. If lubricant level was low, check for leaks and repair as necessary.
	3. Worn or damaged control or synchronizer assemblies.	3. Remove, disassemble and inspect manual transmission assembly. Replace worn or damaged components as necessary.
Noisy Transmission	1. Low lubricant level or incorrect lubricant.	1. Drain and refill manual transmission assembly. If lubricant level was low, check for leaks and repair as necessary.
	2. Loose clutch housing-to-engine, or transmission-to-clutch, housing bolts.	2. Check for correct bolt torque and torque as necessary.
	3. Misaligned clutch housing bore to crankshaft pilot.	3. Check alignment.
	4. Worn or damaged control assembly, transmission gears, or bearing components.	4. Remove, disassemble and inspect manual transmission assembly. Replace worn or damaged components as necessary.
Jumps Out of Gear	1. Worn offset lever plastic insert or loose lever.	1. Remove control assembly and check for loose offset lever or worn insert. Replace worn or damaged components as necessary.
	2. Worn or damaged control assembly, shift forks, selector plates, interlock plate, selector arm, shift rail, springs or shift cover.	2. Remove, disassemble, and inspect manual transmission assembly. Replace worn or damaged components as necessary.
	3. Worn or tapered gear teeth, worn or damaged synchronizer assemblies, excessive end play caused by worn thrust washers or output shaft gears.	3. Remove, disassemble and inspect manual transmission assembly. Replace worn or damaged components as necessary.
Will Not Shift Into One Gear	1. Worn, damaged, or incorrectly assembled control assembly, selector plates, interlock plate, or selector arm.	1. Remove, disassemble, and inspect manual transmission assembly. Replace worn or damaged components as necessary.
	2. Damaged or worn synchronizer sleeves or hubs.	2. Remove, disassemble, and inspect manual transmission assembly. Replace worn or damaged components as necessary.

CONDITION	POSSIBLE CAUSE	CORRECTION
Locked In One Gear, Cannot Be Shifted Out	1. Worn or broken shift rail(s). Bent or damaged shift fork.	1. Remove, disassemble, and inspect manual transmission assembly.
	2. Worn control assembly. Incorrectly assembled or broken shift mechanism. Worn or damaged gear train components.	2. Remove, disassemble, and inspect manual transmission assembly. Replace worn or damaged parts or assemble correctly.

ON-VEHICLE SERVICE

CHECKING MANUAL TRANSMISSION ASSEMBLY FLUID LEVEL

Figure 1

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.

Clean

- All dirt and oil from around fill plug (10 or 11).
  - Fill plug (11) is located on right side of 5-speed manual transmission assembly.
  - Fill plug (10) is located on left side of 6-speed manual transmission assembly.

2. Fill plug (10 or 11).
3. Fluid level should be even with bottom of fill plug hole.

Install or Connect

NOTICE: No lubricant other than DEXRON®-II GM P/N 1051855, should be used in this manual transmission assembly. Other lubricants or additives may damage the blocker ring friction material or its adhesive.

NOTICE: See "Notice" on page 7B-1 of this section.

1. Lubricant, if required.
2. Fill plug (10 or 11).

Tighten

- Fill plug (11) on 5-speed manual transmission assembly to 27 N•m (20 lb. ft.).
- Fill plug (10) on 6-speed manual transmission assembly to 27 N•m (20 lb. ft.).

3. Lower vehicle.

TRANSMISSION SUPPORT AND TRANSMISSION MOUNT ASSEMBLY

Figure 2

The transmission mount assembly for the 5-speed manual transmission assembly is similar to the transmission mount assembly for the 6-speed manual transmission assembly. The difference between the two mount assemblies is the shape. The removal and installation procedure for the two different mount assemblies will be the same.

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Support manual transmission assembly (1 or 2) with transmission stand.
4. Transmission mount nut (16) and washer (17) from transmission mount assembly (13).
5. Transmission support bolts/screws (15) from rail assembly.
6. Transmission support (14).
7. Transmission mount bolts/screws (18) from manual transmission assembly (1 or 2).
8. Transmission mount assembly (13).

Install or Connect

NOTICE: See "Notice" on page 7B-1 of this section.

1. Transmission mount assembly (13) to manual transmission assembly (1 or 2).
2. Transmission mount bolts/screws (18).

Tighten

- Transmission mount bolts/screws (18) to 48 N•m (36 lb. ft.).

3. Transmission support (14) to rail assemblies.
4. Transmission support bolts/screws (15).

Tighten

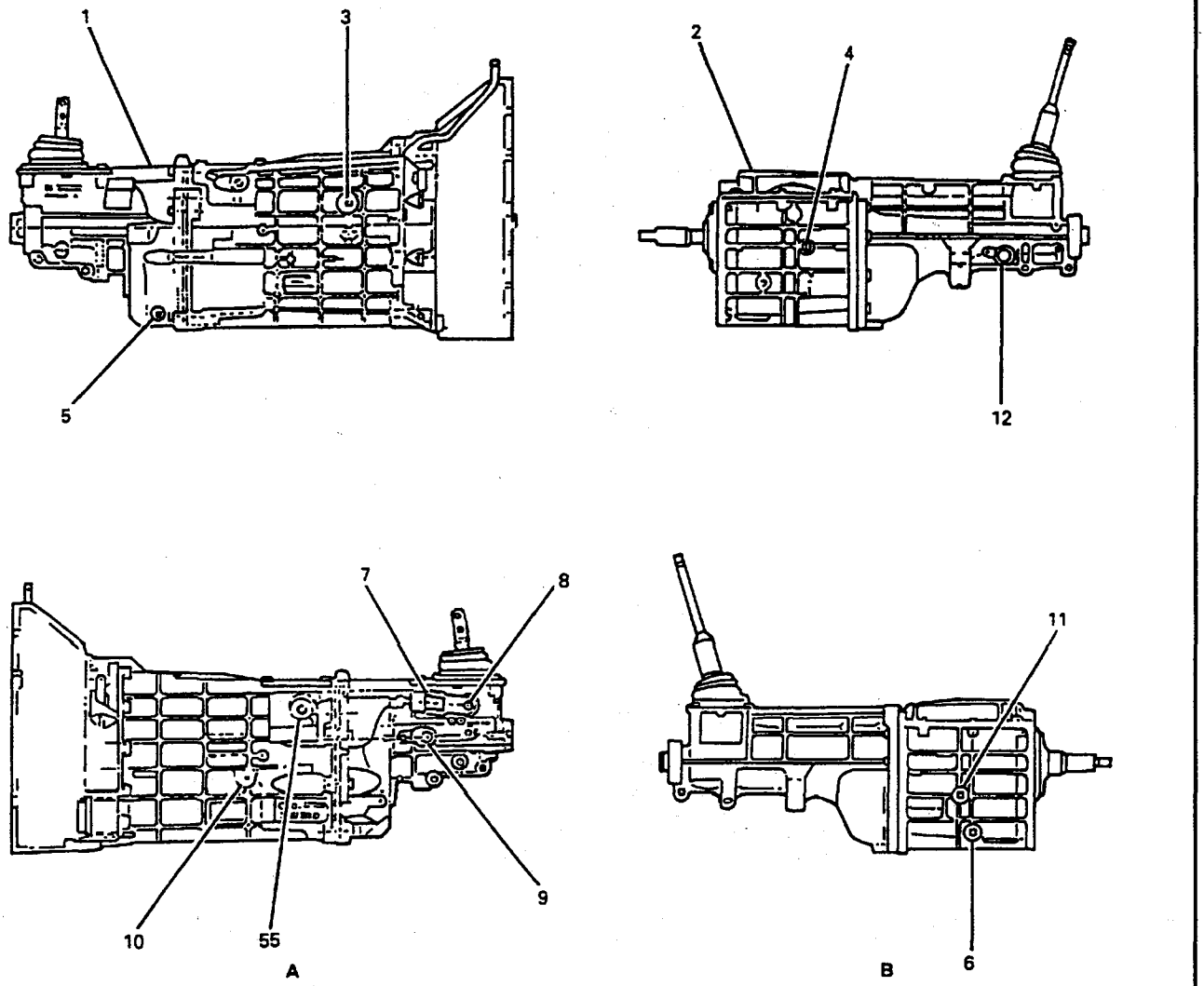
- Transmission support bolts/screws (15) to 57 N•m (43 lb. ft.).

5. Transmission mount washer (17) and nut (16).

Tighten

- Transmission mount nut (16) to 57 N•m (43 lb. ft.).

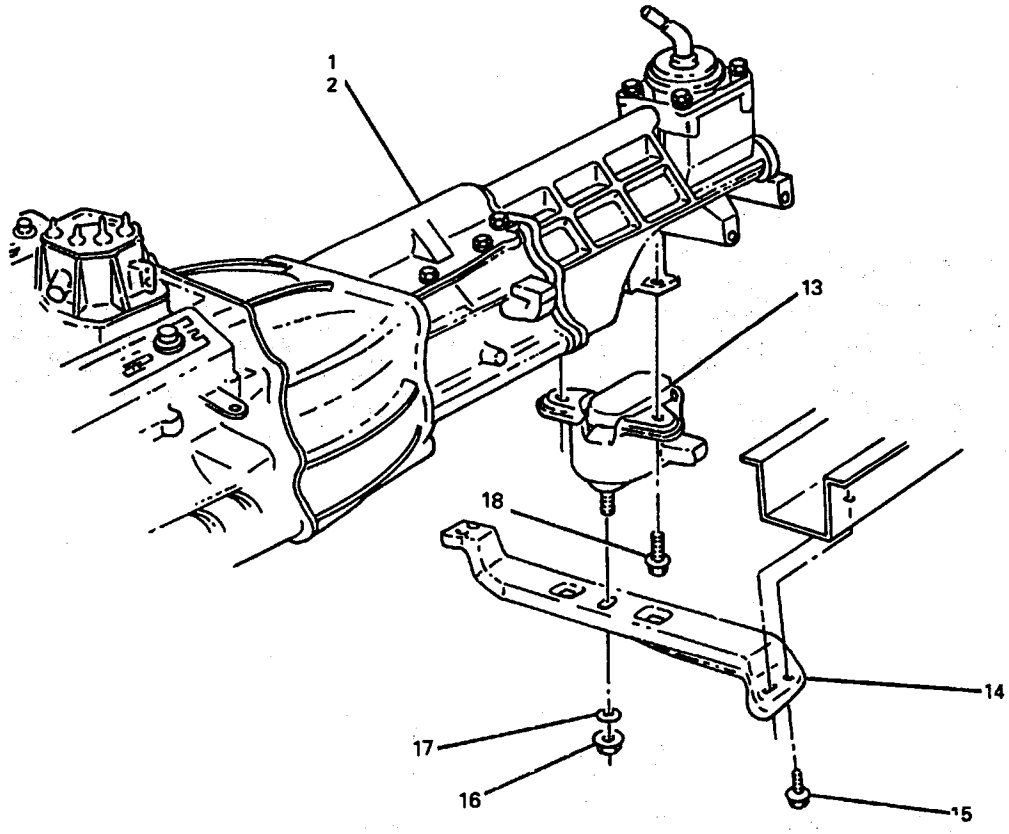
6. Remove transmission stand supporting manual transmission assembly (1 or 2).



A 6-SPEED MANUAL TRANSMISSION COMPONENT LOCATIONS
B 5-SPEED MANUAL TRANSMISSION COMPONENT LOCATIONS
1 TRANSMISSION ASSEMBLY, 6-SPEED MANUAL
2 TRANSMISSION ASSEMBLY, 5-SPEED MANUAL
3 SWITCH ASSEMBLY, BACKUP LAMP (6-SPEED)
4 SWITCH ASSEMBLY, BACKUP LAMP (5-SPEED)
5 PLUG, TRANSMISSION OIL DRAIN (6-SPEED)
6 PLUG, TRANSMISSION OIL DRAIN (5-SPEED)
7 SOLENOID, REVERSE LOCKOUT (6-SPEED)
8 LOCKOUT ASSEMBLY, REVERSE (6-SPEED)
9 SENSOR, ELECTRONIC SPEED (6-SPEED)
10 PLUG, TRANSMISSION OIL FILL (6-SPEED)
11 PLUG, TRANSMISSION OIL FILL (5-SPEED)
12 SENSOR ASSEMBLY, SPEED (5-SPEED)
55 SOLENOID, SKIP SHIFT (6-SPEED)

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Figure 1 – Manual Transmission Assembly Component Locations



1 TRANSMISSION ASSEMBLY, 6-SPEED MANUAL
2 TRANSMISSION ASSEMBLY, 5-SPEED MANUAL
13 MOUNT ASSEMBLY, TRANSMISSION
14 SUPPORT, TRANSMISSION
15 BOLT/SCREW, TRANSMISSION SUPPORT
16 NUT, TRANSMISSION MOUNT
17 WASHER, TRANSMISSION MOUNT
18 BOLT/SCREW, TRANSMISSION MOUNT

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Figure 2 – Transmission Support and Transmission Mount Assembly (Typical)

7. Lower vehicle.
8. Battery negative cable assembly.

MANUAL TRANSMISSION CONTROL LEVER BOOT ASSEMBLY

Figures 3 and 4

Remove or Disconnect

1. Front floor console trim plate assembly. Refer to SECTION 8C.
2. Handle bolts/screws (27), for 6-speed manual transmission assembly.
3. Handle assembly (26), for 6-speed manual transmission assembly.
4. Boot bolts/screws (22 or 23).
5. Boot assembly (24 or 25) from front compartment floor pan assembly (44 or 51).

Install or Connect

NOTICE: See "Notice" on page 7B-1 of this section.

1. Boot assembly (24 or 25) to front compartment floor pan assembly (44 or 51).
2. Boot bolts/screws (22 or 23).

Tighten

- Boot bolts/screws (22 or 23) to 1.7 N•m (15 lb. in.).

3. Handle assembly (26) to control assembly (20).
4. Handle bolts/screws (27).

Tighten

- Handle bolts/screws (27) to 25 N•m (18 lb. ft.).

5. Front floor console trim plate assembly. Refer to SECTION 8C.

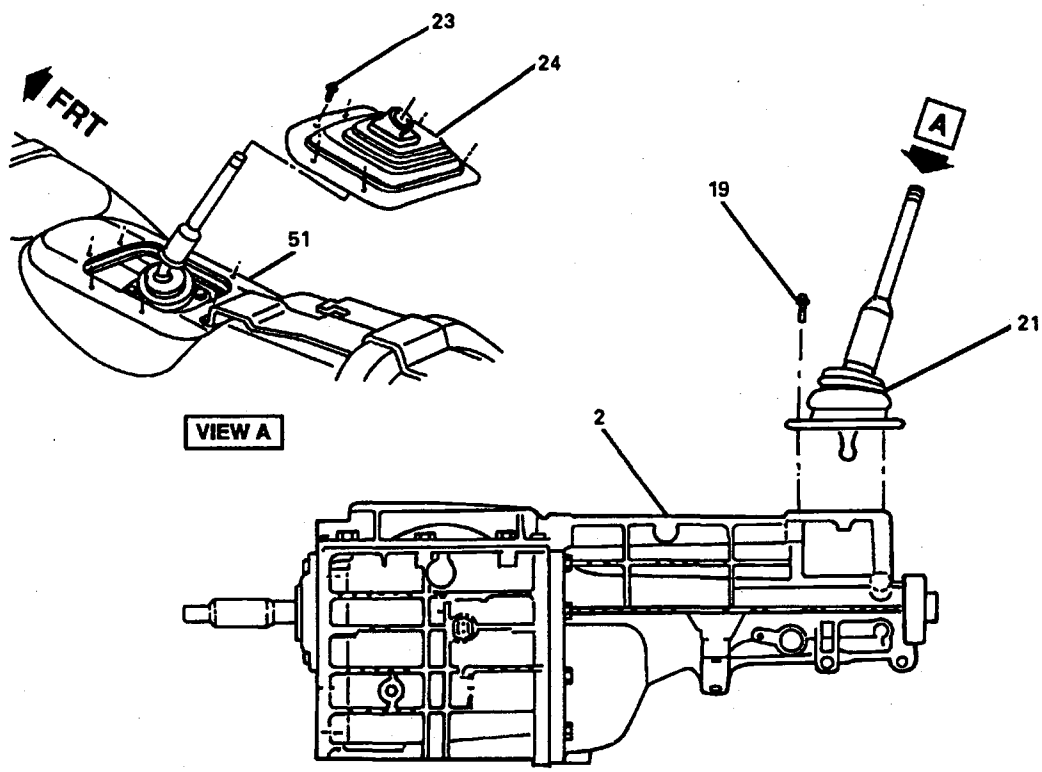


Figure 3 – Manual Transmission Control Lever Boot Assembly (5-Speed)

MANUAL TRANSMISSION CONTROL ASSEMBLY (5-SPEED)

Figure 3

Remove or Disconnect

1. Front floor console trim plate assembly. Refer to SECTION 8C.
2. Boot bolts/screws (23).
3. Boot assembly (24).
4. Transmission control bolts/screws (19).
5. Control assembly (21).

NOTICE: The upper and lower transmission control levers are bonded together. Separation of the levers will cause damage, requiring replacement of the transmission control assembly.

Install or Connect

NOTICE: See "Notice" on page 7B-1 of this section.

Clean

- Sealant from manual transmission extension housing.
- Sealant from control assembly (21), if reinstalling.

1. Apply a continuous 3 mm (1/8-inch) bead of RTV Sealant GM P/N 12345739, or equivalent to manual transmission extension housing-to-control assembly sealing surface.
2. Control assembly (21).
3. Transmission control bolts/screws (19).

Tighten

- Transmission control bolts/screws (19) to 17 N•m (13 lb. ft.).

4. Boot assembly (24).
5. Boot bolts/screws (23).

Tighten

- Boot bolts/screws (23) to 1.7 N•m (15 lb. in.).

6. Front floor console trim plate assembly. Refer to SECTION 8C.

MANUAL TRANSMISSION CONTROL LEVER HANDLE ASSEMBLY (6-SPEED)

Figure 4

Remove or Disconnect

1. Front floor console trim plate assembly. Refer to SECTION 8C.
2. Control lever handle bolts/screws (27).
3. Control lever handle assembly (26).

Install or Connect

NOTICE: See "Notice" on page 7B-1 of this section.

1. Control lever handle assembly (26).
2. Control lever handle bolts/screws (27).

Tighten

- Control lever handle bolts/screws (27) to 25 N•m (18 lb. ft.).

3. Front floor console trim plate assembly. Refer to SECTION 8C.

MANUAL TRANSMISSION CONTROL ASSEMBLY (6-SPEED)

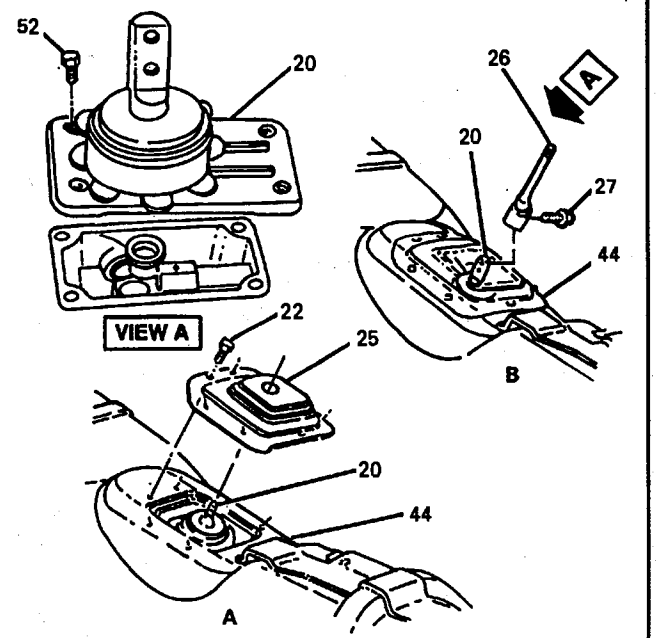
Figure 4

Remove or Disconnect

1. Front floor console trim plate assembly. Refer to SECTION 8C.
2. Handle bolts/screws (27).
3. Handle assembly (26).
4. Boot bolts/screws (22).
5. Boot assembly (25).
6. Transmission control bolts/screws (52).
7. Control assembly (20).

Install or Connect

NOTICE: See "Notice" on page 7B-1 of this section.



A REMOVAL OF 6-SPEED MANUAL TRANSMISSION CONTROL LEVER BOOT ASSEMBLY
B REMOVAL OF 6-SPEED MANUAL TRANSMISSION CONTROL LEVER HANDLE ASSEMBLY
20 CONTROL ASSEMBLY, MANUAL TRANSMISSION (6-SPEED)
22 BOLT/SCREW, MANUAL TRANSMISSION CONTROL LEVER BOOT
25 BOOT ASSEMBLY, MANUAL TRANSMISSION CONTROL LEVER
26 HANDLE ASSEMBLY, MANUAL TRANSMISSION CONTROL LEVER
27 BOLT/SCREW, MANUAL TRANSMISSION CONTROL LEVER HANDLE
44 PAN ASSEMBLY, FRONT COMPARTMENT FLOOR
52 BOLT/SCREW, TRANSMISSION CONTROL

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Figure 4 – Manual Transmission Control, Handle, and Boot Assemblies (6-Speed)

Clean

- Sealant from manual transmission extension housing.
- Sealant from control assembly (20), if reinstalling.

1. Apply a continuous 3 mm (1/8-inch) bead of RTV Sealant GM P/N 12345739, or equivalent to manual transmission extension housing-to-control assembly sealing surface.
2. Control assembly (20).
3. Transmission control bolts/screws (52).

Tighten

- Transmission control bolts/screws (52) to 18 N•m (13 lb. ft.).

4. Boot assembly (25).
5. Boot bolts/screws (22).

Tighten

- Boot bolts/screws (22) to 1.7 N•m (15 lb. in.).

6. Handle assembly (26) to control assembly (20).
7. Handle bolts/screws (27).

Tighten

- Handle bolts/screws (27) to 25 N•m (18 lb. ft.)

8. Front floor console trim plate assembly. Refer to SECTION 8C.

OUTPUT SHAFT SEAL

The output shaft seal for the 5-speed manual transmission assembly is similar to the output shaft seal for the 6-speed manual transmission assembly. While there are differences in the design, the removal and installation procedures for the two different output shaft seals is essentially the same. The only difference is the installation tool used to install the different seals.

Figures 5 and 6

Tools Required:

J 23907 Slide Hammer

J 26941 Extension Housing Seal Remover

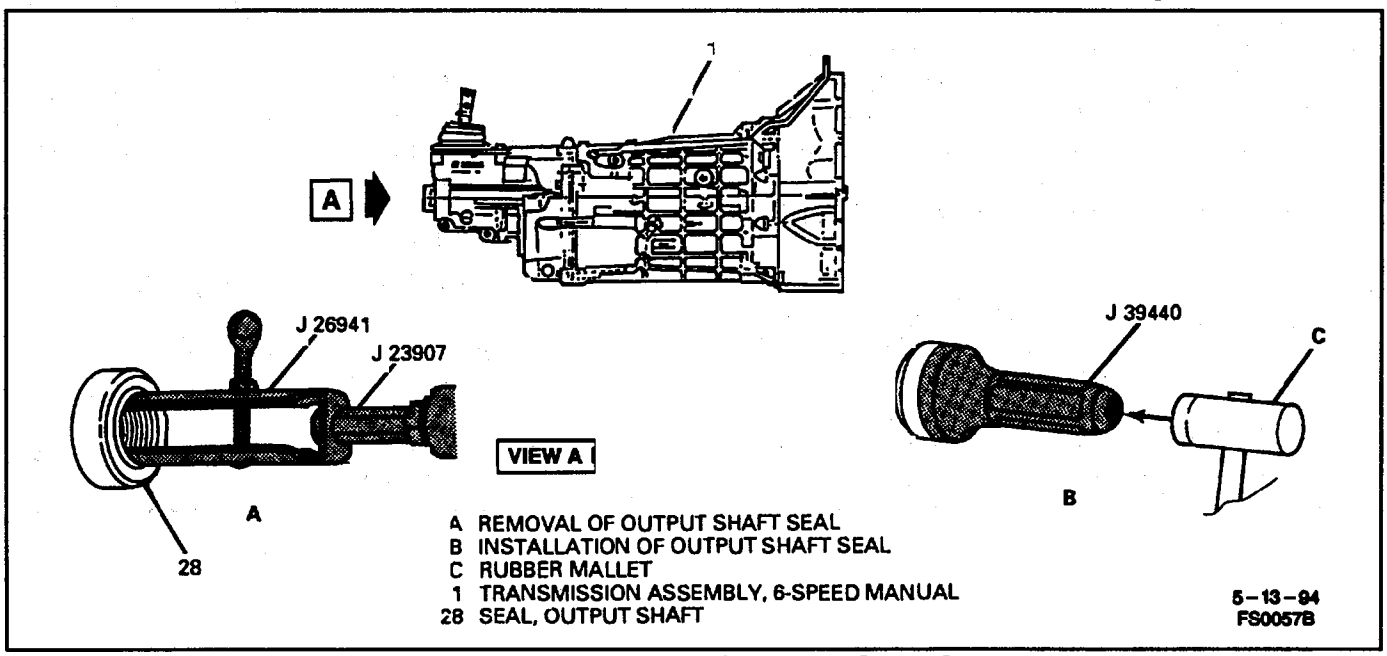


Figure 5 – Manual Transmission Output Shaft Seal (6-Speed)

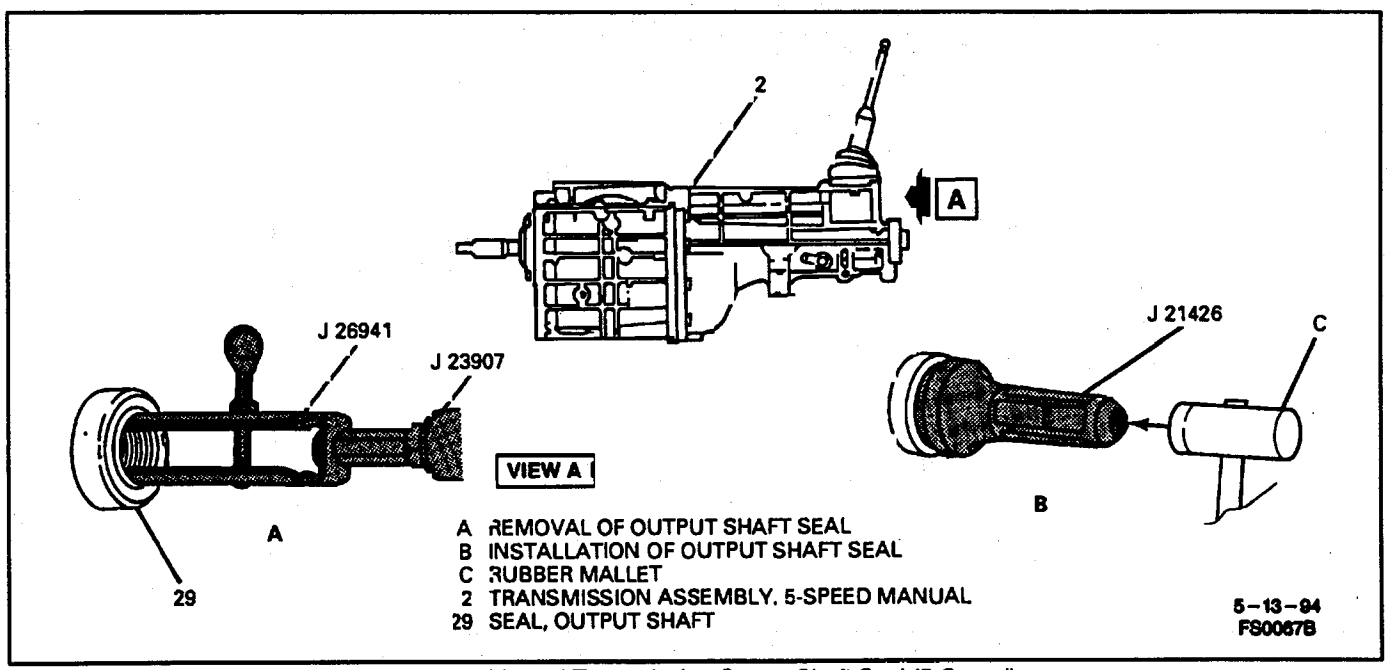


Figure 6 – Manual Transmission Output Shaft Seal (5-Speed)

J 21426 Extension Housing Seal Installer, 5-Speed Manual Transmission Assembly

J 39440 Extension Housing Seal Installer, 6-Speed Manual Transmission Assembly

Remove or Disconnect

1. Propeller shaft assembly. Refer to SECTION 4A.
2. Output shaft seal (28 or 29) using J 26941 with J 23907.

Install or Connect

NOTICE: See "Notice" on page 7B-1 of this section.

1. Output shaft seal (28 or 29), using J 21426 for 5-speed manual transmission assembly, or J 39440 for 6-speed manual transmission assembly.
2. Lubricate inside diameter of output shaft seal (28 or 29) with transmission fluid.
3. Propeller shaft assembly. Refer to SECTION 4A.

Inspect

- Manual transmission assembly fluid level. Refer to "Checking Manual Transmission Assembly Fluid Level" in this section.

BACKUP LAMP SWITCH ASSEMBLY

The backup lamp switch assembly is located on the left-hand side of the 5-speed manual transmission assembly, while the backup lamp switch assembly on the 6-speed manual transmission assembly is located on the right-hand side.

Figures 7 and 8

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Electrical connector from backup lamp switch assembly (3 or 4).
4. Backup lamp switch assembly (3 or 4) from manual transmission assembly (1 or 2).

Install or Connect

NOTICE: See "Notice" on page 7B-1 of this section.

1. Apply thin coating of teflon sealant, GM P/N 1052080 or equivalent to threads of backup lamp switch assembly (3 or 4).
2. Backup lamp switch assembly (3 or 4) to manual transmission assembly (1 or 2).

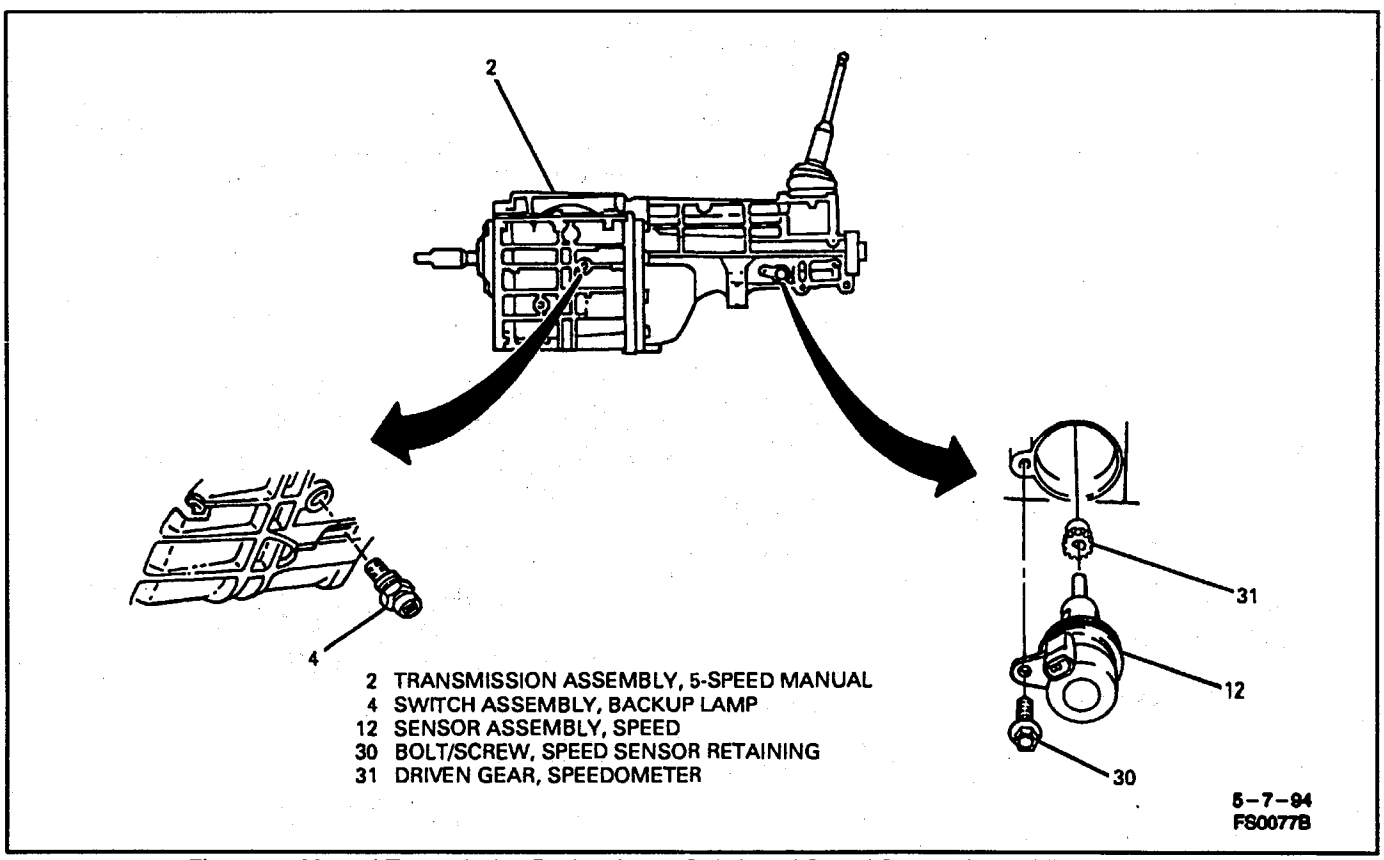


Figure 7 – Manual Transmission Backup Lamp Switch and Speed Sensor Assemblies (5-Speed)

Tighten

- Backup lamp switch assembly (4) 38 N•m (28 lb. ft.) for 5-speed manual transmission assembly.
- Backup lamp switch assembly (3) to 20 N•m (15 lb. ft.) for 6-speed manual transmission assembly.

3. Electrical connector to backup lamp switch assembly (3 or 4).
4. Lower vehicle.
5. Battery negative cable assembly.

SPEED SENSOR ASSEMBLY (5-SPEED)

Figure 7

Install or Connect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Electrical connector from speed sensor assembly (12).
4. Speed sensor retaining bolt/screw (30) from 5-speed manual transmission assembly (2).
5. Speed sensor assembly (12) and speedometer driven gear (31) from 5-speed manual transmission assembly (2).

Install or Connect

NOTICE: See "Notice" on page 7B-1 of this section.

1. Speedometer driven gear (31) and speed sensor assembly (12) to 5-speed manual transmission assembly (2).
2. Speed sensor retaining bolt/screw (30) to 5-speed manual transmission assembly (2).

Tighten

- Speed sensor retaining bolt/screw (30) to 10 N•m (89 lb. in.).

3. Electrical connector to speed sensor assembly (12).
4. Lower vehicle.
5. Battery negative cable assembly.

ELECTRONIC SPEED SENSOR (6-SPEED)

Figure 8

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Electrical connector from electronic speed sensor (9).
4. Electronic speed sensor retaining bolt/screw (32) from 6-speed manual transmission assembly (1).
5. Electronic speed sensor (9) from 6-speed manual transmission assembly (1).

Install or Connect

NOTICE: See "Notice" on page 7B-1 of this section.

1. Electronic speed sensor (9) to 6-speed manual transmission assembly (1).
2. Electronic speed sensor retaining bolt/screw (32) to 6-speed manual transmission assembly (1).

Tighten

- Electronic speed sensor retaining bolt/screw (32) to 10 N•m (89 lb. in.).

3. Electrical connector to electronic speed sensor (9).
4. Lower vehicle.
5. Battery negative cable assembly.

REVERSE LOCKOUT SOLENOID (6-SPEED)

Figures 8 and 9

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Electrical connector from reverse lockout solenoid (7).
4. Reverse lockout bolt/screw (40).
5. Reverse lockout assembly (8).
6. Reverse lockout solenoid (7) from reverse lockout assembly (8).

Install or Connect

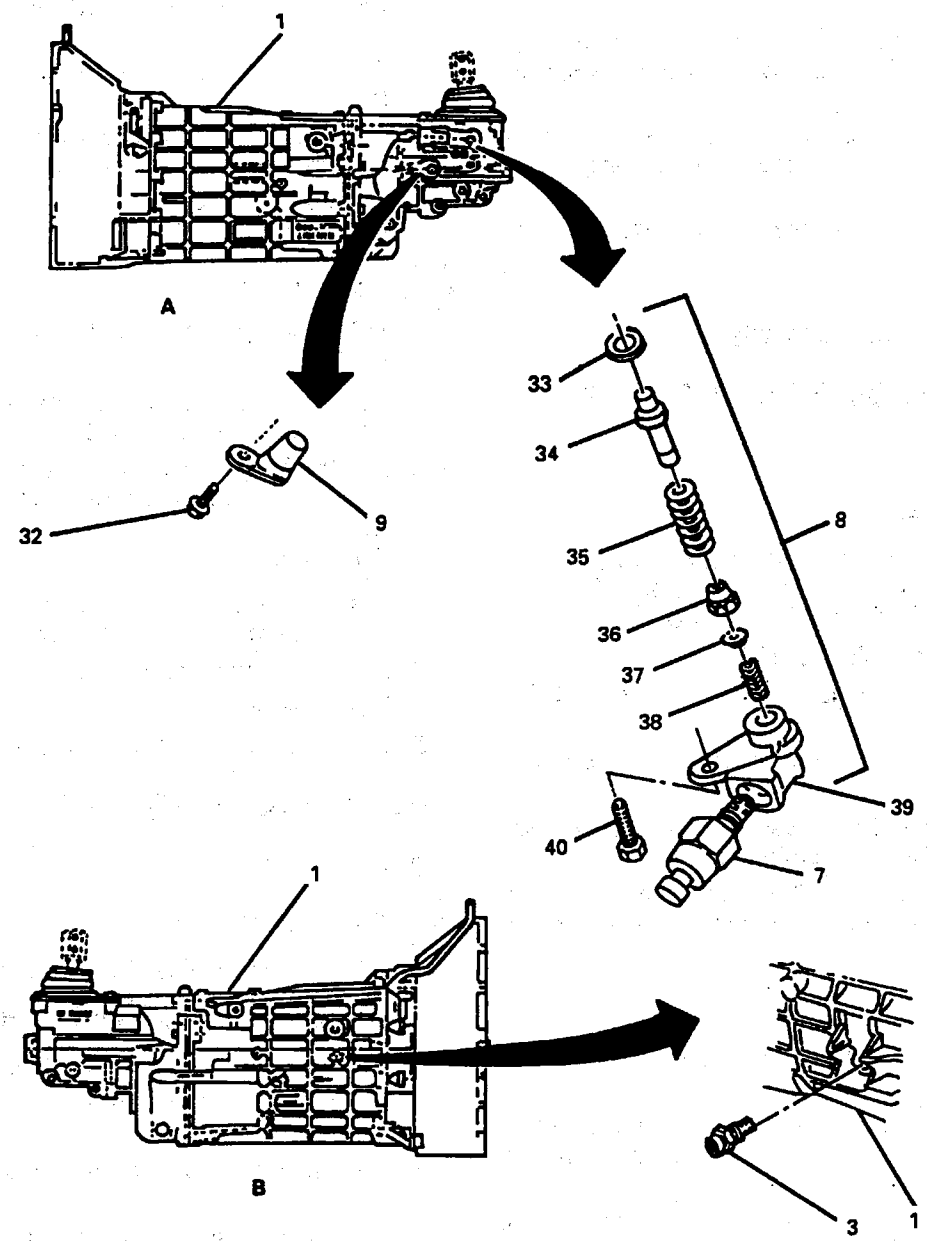
NOTICE: See "Notice" on page 7B-1 of this section.

1. Reverse lockout solenoid (7) to reverse lockout assembly (8).

Tighten

- Reverse lockout solenoid (7) to 40 N•m (30 lb. ft.).

2. Reverse lockout assembly (8) to 6-speed manual transmission assembly (1).
3. Reverse lockout bolt/screw (40).



A LEFT-HAND SIDE
B RIGHT-HAND SIDE
1 TRANSMISSION ASSEMBLY, 6-SPEED MANUAL
3 SWITCH ASSEMBLY, BACKUP LAMP
7 SOLENOID, REVERSE LOCKOUT
8 LOCKOUT ASSEMBLY, REVERSE
9 SENSOR, ELECTRONIC SPEED
32 BOLT/SCREW, ELECTRONIC SPEED SENSOR RETAINING
33 RING, REVERSE LOCKOUT SNAP
34 PLUNGER, REVERSE LOCKOUT
35 SPRING, REVERSE LOCKOUT OUTER
36 SEAT, REVERSE LOCKOUT
37 RETAINING RING, REVERSE LOCKOUT
38 SPRING, REVERSE LOCKOUT INNER
39 BODY, REVERSE LOCKOUT
40 BOLT/SCREW, REVERSE LOCKOUT

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Figure 8 – Manual Transmission Backup Lamp Switch, Electronic Speed Sensor, Reverse Lockout Solenoid, and Reverse Lockout Assembly (6-Speed)

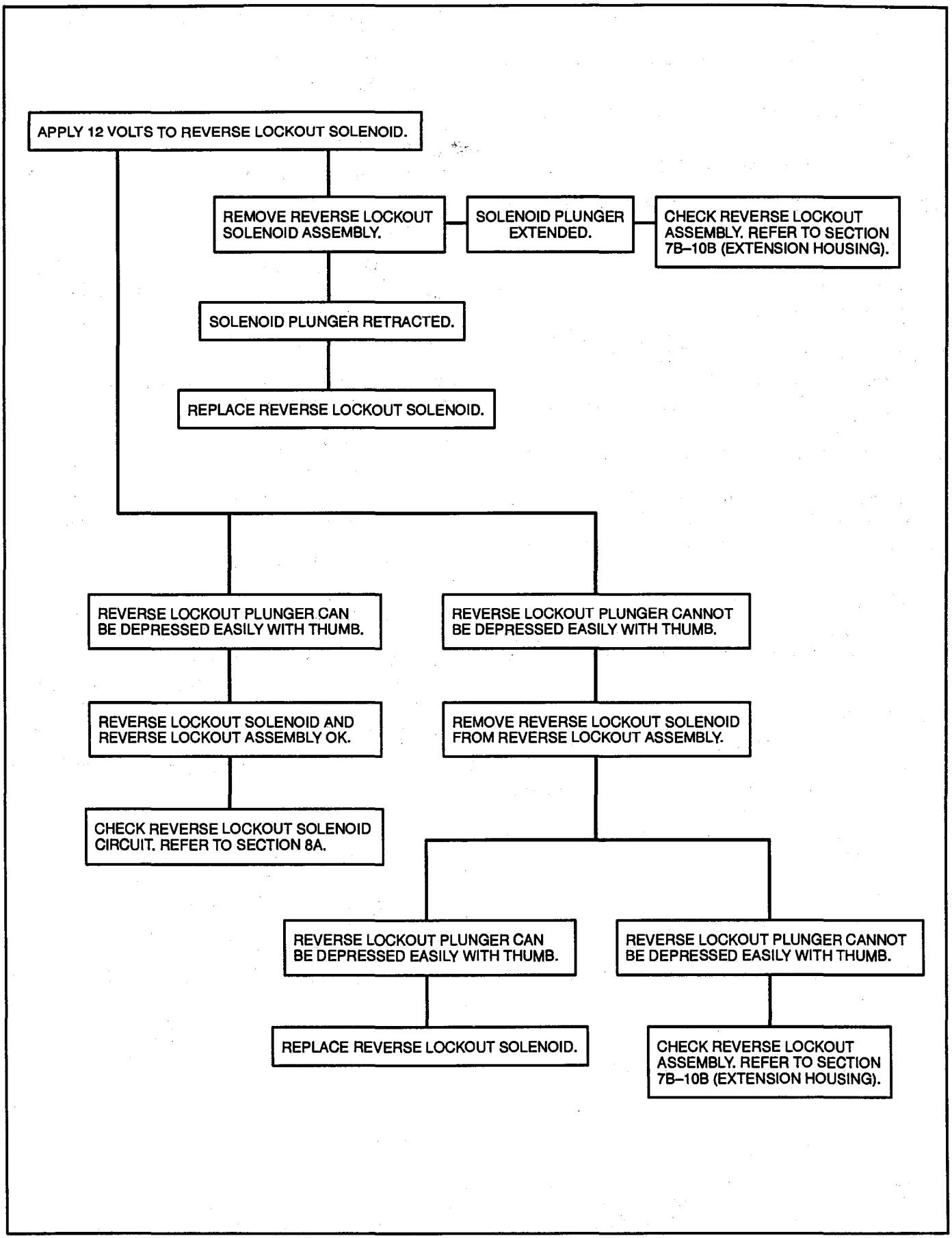


Figure 9 – Reverse Lockout Assembly Bench Check

Tighten

- Reverse lockout bolt/screw (40) to 18 N•m (13 lb. ft.).

4. Electrical connector to reverse lockout solenoid (7).
5. Lower vehicle.
6. Battery negative cable assembly.

REVERSE LOCKOUT ASSEMBLY (6-SPEED)

Figures 8 and 9

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Electrical connector from reverse lockout solenoid (7).
4. Reverse lockout bolt/screw (40) from 6-speed manual transmission assembly (1).
5. Reverse lockout assembly (8) from 6-speed manual transmission assembly (1).

Inspect

- Reverse lockout assembly. Refer to SECTION 7B-10B for inspection and disassembly procedures.

Install or Connect

NOTICE: See "Notice" on page 7B-1 of this section.

1. Reverse lockout assembly (8) to 6-speed manual transmission assembly (1).
2. Reverse lockout bolt/screw (40) to 6-speed manual transmission assembly (1).

Tighten

- Reverse lockout bolt/screw (40) to 18 N•m (13 lb. ft.).

3. Electrical connector to reverse lockout solenoid (7).
4. Lower vehicle.
5. Battery negative cable assembly.

SKIP SHIFT SOLENOID (6-SPEED)

Figure 10

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Electrical connector from skip shift solenoid (55).
4. Skip shift solenoid (55) from transmission assembly (1).

Install or Connect

1. Skip shift solenoid (55) to transmission assembly (1).

Tighten

- Skip shift solenoid (55) to 40 N•m (30 lb. ft.).

2. Electrical connector to skip shift solenoid (55).
3. Lower vehicle.
4. Battery negative cable assembly.

5-SPEED MANUAL TRANSMISSION ASSEMBLY (RPO M49)

Figures 1,2,3 and 11

Tools Required:

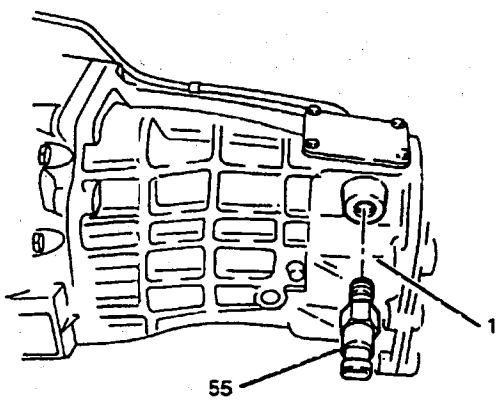
J 36842 Transmission Holding Fixture

J 3289-20 Bench Mount Holding Fixture Base

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Front floor console trim plate assembly. Refer to SECTION 8C.
3. Raise and suitably support vehicle. Refer to SECTION 0A.



1 TRANSMISSION ASSEMBLY
55 SOLENOID, SKIP SHIFT

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Figure 10 – Skip Shift Solenoid (6-Speed)

4. Drain fluid from 5-speed manual transmission assembly (2).
5. Propeller shaft assembly. Refer to SECTION 4A.
6. Support rear axle assembly with jack stand.
7. Rear axle torque arm assembly. Refer to SECTION 3D.
8. Catalytic converter hanger assembly. Refer to SECTION 6F.
9. Wiring harness connector from backup lamp switch assembly (4).
10. Wiring harness connector from speed sensor assembly (12).
11. Support engine assembly with a jack stand.
12. Support 5-speed manual transmission assembly (2) with jack stand.
13. Transmission support and transmission mount assembly. Refer to "Transmission Support and Transmission Mount Assembly" in this section.
14. Lower 5-speed manual transmission assembly (2), enough to reach transmission control bolts/screws (19), with aid of helper.
15. Transmission control bolts/screws (19).

    NOTICE: Manual transmission control assembly must be held when lowering manual transmission assembly, as control assembly is not retained in vehicle. If control assembly is not held it could drop causing damage to the component.
16. Lower 5-speed manual transmission assembly (2).
17. Manual transmission control assembly (21).
18. Transmission bolts/screws (41).
19. 5-speed manual transmission assembly (2) to flywheel housing assembly (45) with aid of helper.
20. Place 5-speed manual transmission assembly (2) in J 36842.

Install or Connect

NOTICE: See "Notice" on page 7B-1 of this section.

Clean

- Sealant from manual transmission extension housing.
- Sealant from control assembly (21), if reinstalling.

1. Control assembly (21) to installed position on vehicle.
2. 5-speed manual transmission assembly (2) to flywheel housing assembly (45), with aid of helper.
   - Pilot splined input shaft assembly (53) into clutch disc hub assembly and pilot bearing.
3. Support 5-speed manual transmission assembly (2) with jack stand.
4. Transmission bolts/screws (41).

Tighten

- Transmission bolts/screws (41) to 75 N•m (55 lb. ft.).

5. Apply a continuous 3 mm (1/8-inch) bead of RTV Sealant GM P/N 12345739, or equivalent to manual transmission extension housing-to-control assembly sealing surface.
6. Raise 5-speed manual transmission assembly (2) up engaging manual transmission control assembly (21).
7. Transmission control bolts/screws (19).

Tighten

- Transmission control bolts/screws (19) to 20 N•m (15 lb. ft.).

8. Raise 5-speed manual transmission assembly (2) to installed position.

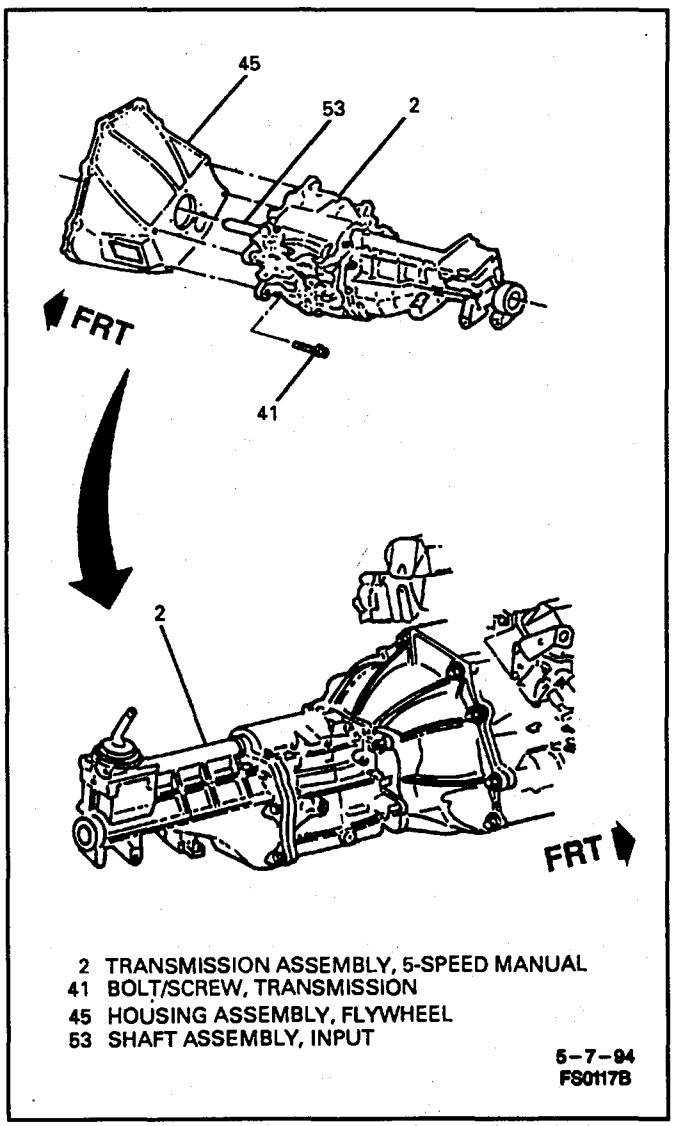


Figure 11 – Manual Transmission Assembly to Engine Assembly (5-Speed)

9. Transmission support and transmission mount assembly. Refer to "Transmission Support and Transmission Mount Assembly" in this section.
10. Remove jack stands from transmission and engine assemblies.
11. Wiring harness connector to speed sensor assembly (12).
12. Wiring harness connector to backup lamp switch assembly (4).
13. Catalytic converter hanger assembly. Refer to SECTION 6F.
14. Rear axle torque arm assembly. Refer to SECTION 3D.
15. Remove support from rear axle assembly.
16. Propeller shaft assembly. Refer to SECTION 4A.
17. Check and fill manual transmission assembly with fluid. Refer to "Checking Manual Transmission Assembly Fluid Level" in this section.
18. Lower vehicle.
19. Front floor console trim plate assembly. Refer to SECTION 8C.

6-SPEED MANUAL TRANSMISSION ASSEMBLY (RPO MM6)

Figures 1,2,4 and 12

Tool Required:

J 39430 Transmission Holding Fixture

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Front floor console trim plate assembly. Refer to SECTION 8C.
3. Manual transmission control lever handle bolts/screws (27).
4. Handle assembly (26).
5. Raise and suitably support vehicle. Refer to SECTION 0A.
6. Drain fluid from 6-speed manual transmission assembly (1).
7. Support rear axle assembly with jack stand.
8. Propeller shaft assembly. Refer to SECTION 4A.
9. Rear axle torque arm. Refer to SECTION 3D.
10. Catalytic converter hanger assembly. Refer to SECTION 6F.
11. Wiring harness connector from reverse lockout solenoid (7).
12. Wiring harness connector from skip shift solenoid (55).
13. Wiring harness connector from backup lamp switch assembly (3).
14. Actuator cylinder nuts (50).

NOTICE: Disconnect the clutch master cylinder pushrod before removing the actuator cylinder assembly. If not disconnected, permanent damage to the actuator cylinder will occur if the clutch pedal is depressed while the actuator is disconnected.

Important

- Do not let the actuator cylinder hang by hydraulic line.

15. Clutch actuator cylinder and retain with mechanic's wire.
16. Actuator spacer (46).
17. Pull clutch fork assembly (47) down to disengage from release bearing.
18. Wiring harness connector from electronic speed sensor (9).
19. Support engine assembly with jack stand.
20. Support 6-speed manual transmission assembly (1) with jack stand.
21. Transmission support and transmission mount assembly. Refer to "Transmission Support and Transmission Mount Assembly" in this section.

    NOTICE: The clutch fork assembly (47) must be disengaged from the release bearing assembly to prevent damage to the clutch system.
22. Transmission bolts/screws (43).
23. Six-speed manual transmission assembly (1) with aid of helper.
24. Place 6-speed manual transmission assembly (1) in J 39430.

Install or Connect

NOTICE: See "Notice" on page 7B-1 of this section.

1. Six-speed manual transmission assembly (1) with aid of helper.
   - Pilot transmission input shaft through the release bearing, the clutch driven plate splines and into the clutch pilot bearing.
2. Support 6-speed manual transmission assembly (1) with jack stand.
3. Transmission bolts/screws (43).

Tighten

- Transmission bolts/screws (43) to 35 N•m (26 lb. ft.).

4. Transmission support and transmission mount assembly. Refer to "Transmission Support and Transmission Mount Assembly" in this section.
5. Remove jack stands from transmission and engine assemblies.
6. Push clutch fork assembly (47) up to engage release bearing.
7. Actuator spacer (46).
8. Actuator cylinder.
9. Actuator cylinder nuts (50).

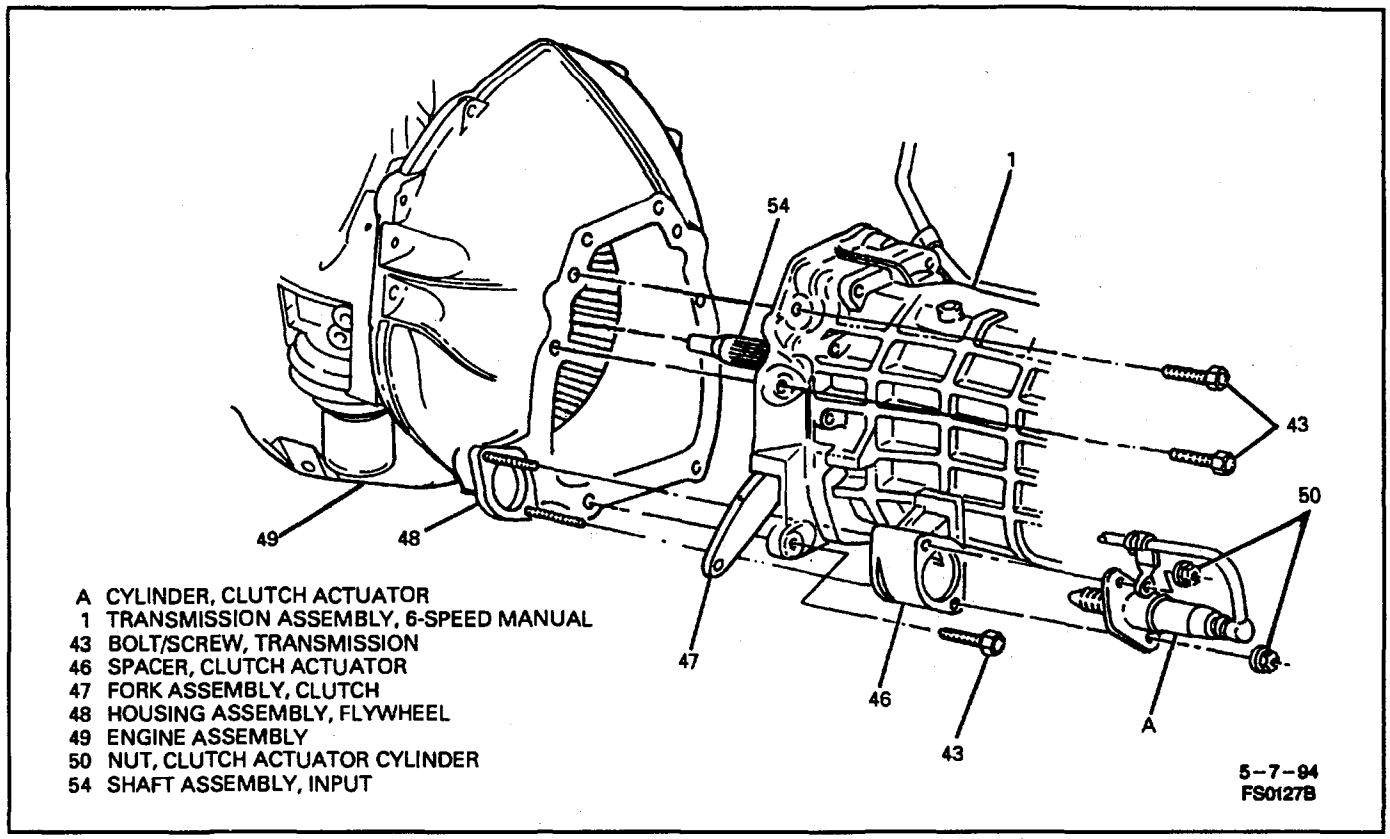


Figure 12 – Manual Transmission Assembly to Engine Assembly (6-Speed)

Tighten

- Actuator cylinder nuts (50) to 20 N•m (15 lb. ft.).

10. Wiring harness connector to electronic speed sensor (9).
11. Wiring harness connector to backup lamp switch assembly (3).
12. Wiring harness connector to skip shift solenoid (55).
13. Wiring harness connector to reverse lockout solenoid (7).
14. Catalytic converter hanger assembly. Refer to SECTION 6F.
15. Rear axle torque arm. Refer to SECTION 3D.
16. Propeller shaft assembly. Refer to SECTION 4A.
17. Remove support from rear axle assembly.
18. Fill transmission assembly with fluid. Refer to "Checking Manual Transmission Assembly Fluid Level" in this section.
19. Lower vehicle.
20. Clutch master cylinder pushrod. Refer to SECTION 7C.
21. Manual transmission control lever handle assembly (26).
22. Manual transmission control lever handle bolts/screws (27).

Tighten

- Manual transmission control lever handle bolts/screws (27) to 25 N•m (18 lb. ft.).

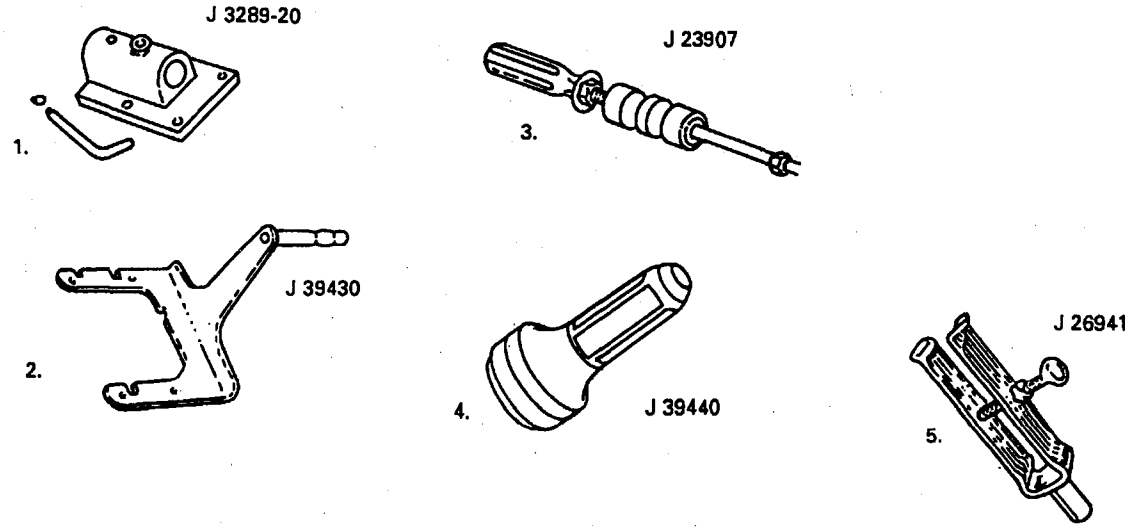
23. Front floor console trim plate assembly. Refer to SECTION 8C.
24. Battery negative cable assembly.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Backup Lamp Switch Assembly (5-Speed)	27 N•m (20 lb. ft.)
Backup Lamp Switch Assembly (6-Speed)	27 N•m (20 lb. ft.)
Clutch Actuator Cylinder Nut	20 N•m (15 lb. ft.)
Electronic Speed Sensor Retaining Bolt/Screw	10 N•m (89 lb. in.)
Manual Transmission Control Lever Boot Bolt/Screw (5-Speed)	1.7 N•m (15 lb. in.)
Manual Transmission Control Lever Boot Bolt/Screw (6-Speed)	1.7 N•m (15 lb. in.)
Manual Transmission Control Lever Handle Bolt/Screw	25 N•m (18 lb. ft.)
Reverse Lockout Bolt/Screw	18 N•m (13 lb. ft.)
Reverse Lockout Solenoid	40 N•m (30 lb. ft.)
Skip Shift Solenoid (6-Speed)	40 N•m (30 lb. ft.)
Speed Sensor Retaining Bolt/Screw	10 N•m (89 lb. in.)
Transmission Bolt/Screw (5-Speed)	75 N•m (55 lb. ft.)
Transmission Bolt/Screw (6-Speed)	35 N•m (26 lb. ft.)
Transmission Control Bolt/Screw (5-Speed)	20 N•m (15 lb. ft.)
Transmission Control Bolt/Screw (6-Speed)	20 N•m (15 lb. ft.)
Transmission Mount Bolt/Screw	48 N•m (36 lb. ft.)
Transmission Mount Nut	57 N•m (43 lb. ft.)
Transmission Oil Fill Plug (5-Speed)	27 N•m (20 lb. ft.)
Transmission Oil Fill Plug (6-Speed)	27 N•m (20 lb. ft.)
Transmission Support Bolt/Screw	57 N•m (43 lb. ft.)

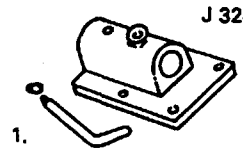
SPECIAL TOOLS

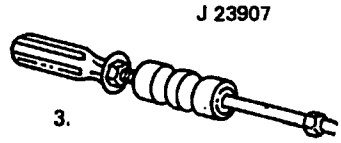


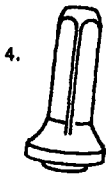
6-SPEED MANUAL TRANSMISSION ASSSEMBLY

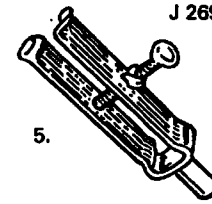
1. BENCH MOUNT HOLDING FIXTURE BASE
2. TRANSMISSION HOLDING FIXTURE
3. SLIDE HAMMER
4. EXTENSION HOUSING SEAL INSTALLER
5. EXTENSION HOUSING SEAL REMOVER

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5-SPEED MANUAL TRANSMISSION ASSEMBLY

1. BENCH MOUNT HOLDING FIXTURE BASE
2. TRANSMISSION HOLDING FIXTURE
3. SLIDE HAMMER
4. EXTENSION HOUSING SEAL INSTALLER
5. EXTENSION HOUSING SEAL REMOVER

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BLANK

SECTION 7B-6B

BORG-WARNER (T5) UNIT REPAIR

RPO M49

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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UNIT DISASSEMBLY

TRANSMISSION DISASSEMBLY

Figures 1 through 18

Clean

- Exterior of the transmission assembly thoroughly with appropriate solvent.

Disassemble

Tools Required:

J 37359 Countershaft Bearing Remover
J 22912-01 Bearing and Gear Puller

- Remove drain bolt on transmission case and drain lubricant.

NOTICE: Removal of offset lever in position other than neutral (centered) may result in driving the roll pin into the detent plate without releasing lever, making further disassembly extremely difficult.

- Position offset lever in neutral gate (centered).

1. Roll pin attaching offset lever to shift rail (Figure 3).
2. Extension housing-to-transmission case bolts.

NOTICE: Do not attempt to remove the offset lever while the extension housing is still bolted in place. The lever has a positioning lug engaged in the housing detent plate, which prevents moving the lever far enough for removal.

3. Housing and offset lever as an assembly (Figure 4).
4. Detent ball and spring from offset lever (Figure 5).
5. Roll pin from extension housing or offset lever.
6. Oiling funnel from rear of countershaft (Figure 6).
7. Bolts attaching transmission cover and shift fork assembly to case.
   - Two of the transmission cover attaching bolts are alignment-type dowel bolts. Note the location of these bolts for assembly reference.
8. Cover (Figure 7).
9. Reverse lever spring clip, pivot bolt and shift lever (Figure 8).
10. Backup lamp switch.
11. Fifth gear synchronizer snap ring and retainer from rear of countershaft (Figure 9).
12. Unhook reverse lock spring from front of transmission case (Figure 10).

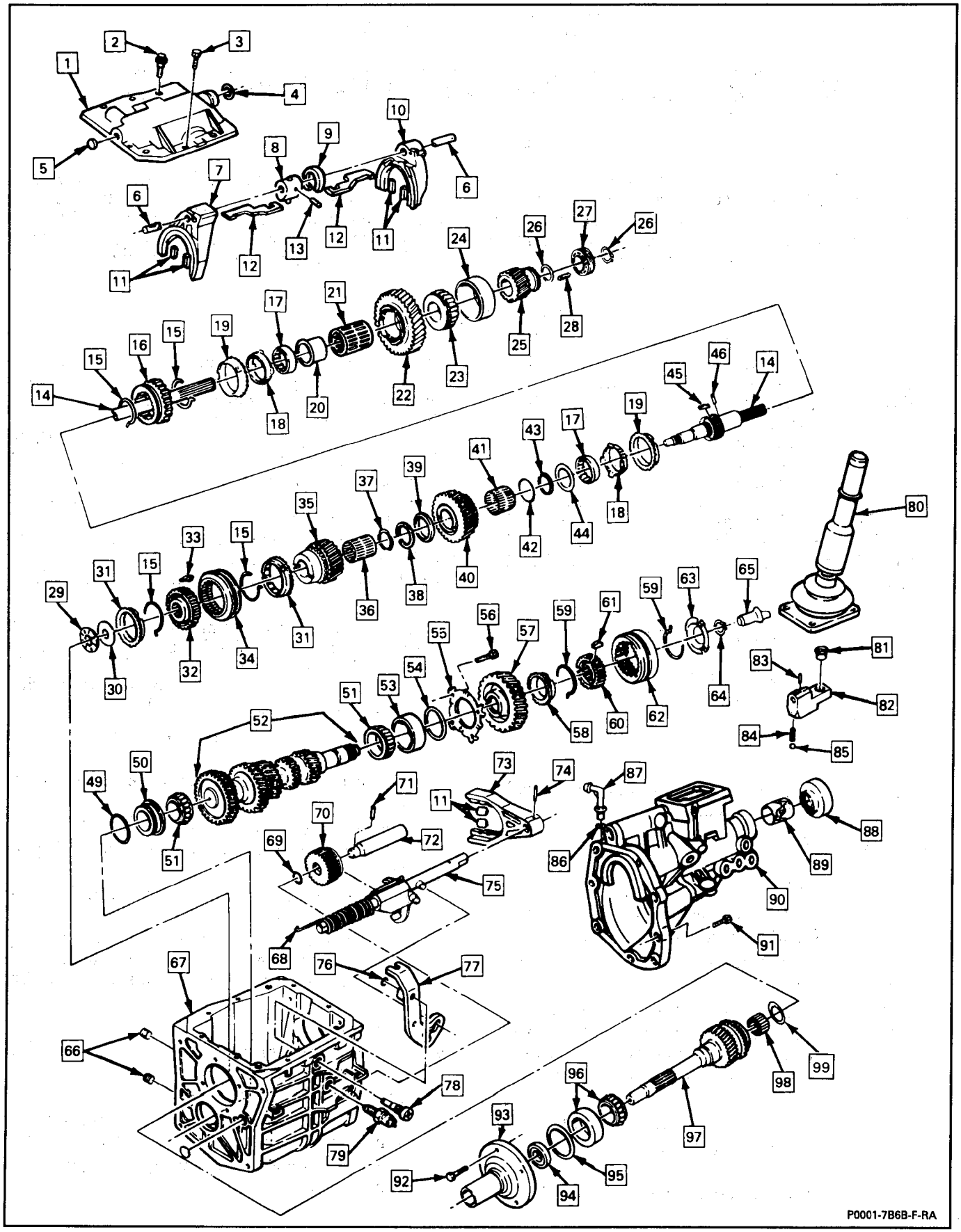


Figure 1 Disassembled View

1. COVER, TRANSMISSION
2. BOLT, ALIGNMENT DOWEL
3. BOLT
4. SEAL, O-RING
5. PLUG, SHIFT RAIL
6. RAIL, SHIFT
7. FORK, 3RD AND 4TH SHIFT
8. ARM, SELECTOR
9. PLATE, GEAR SELECT INTERLOCK
10. FORK, 1ST AND 2ND SHIFT
11. INSERT, SHIFT FORK
12. PLATE, SHIFT FORK
13. PIN, ROLL – SELECTOR ARM
14. SHAFT, MAIN WITH 1ST AND 2ND SYNCHRONIZER HUB
15. SPRING, SYNCHRONIZER
16. GEAR, REVERSE SLIDING
17. CONE, INNER – 1ST AND 2ND SYNCHRONIZER
18. CONE, OUTER – 1ST AND 2ND SYNCHRONIZER
19. RING, BLOCKER – 1ST AND 2ND SYNCHRONIZER
20. SLEEVE, 1ST GEAR BEARING
21. BEARING, 1ST GEAR
22. GEAR, 1ST SPEED
23. BEARING, MAINSHAFT REAR
24. RACE, MAINSHAFT REAR BEARING
25. GEAR, 5TH SPEED DRIVEN
26. RING, SNAP
27. GEAR, SPEEDOMETER DRIVE
28. CLIP, SPEEDOMETER DRIVE GEAR
29. BEARING, MAIN DRIVE-GEAR THRUST
30. RACE, MAIN DRIVE GEAR THRUST BEARING
31. RING, BLOCKER – 3RD AND 4TH SYNCHRONIZER
32. HUB, 3RD AND 4TH SYNCHRONIZER
33. KEY, SYNCHRONIZER
34. SLEEVE, 3RD AND 4TH SYNCHRONIZER
35. GEAR, 3RD SPEED
36. BEARING, 3RD GEAR
37. SPACER, 3RD GEAR BEARING
38. RING, SNAP 2ND GEAR THRUST WASHER
39. WASHER, THRUST – 2ND GEAR
40. GEAR, 2ND SPEED
41. BEARING, 2ND GEAR
42. SPACER, 2ND GEAR BEARING
43. RING, SPIRAL RETAINING – 2ND SYNCHRONIZER
44. WASHER, THRUST – 2ND SYNCHRONIZER
45. KEY, 1ST-2ND SYNCHRONIZER
46. PIN, LOCATING – 1ST SPEED BEARING SLEEVE
49. O-RING, BEARING RACE
50. RACE, FRONT COUNTERSHAFT BEARING
51. BEARING, COUNTERSHAFT
52. GEAR CLUSTER, COUNTERSHAFT
53. RACE, REAR COUNTERSHAFT
54. SHIM, COUNTERSHAFT BEARING ADJUSTMENT
55. RETAINER, COUNTERSHAFT
56. BOLT, COUNTERSHAFT RETAINER
57. GEAR, 5TH SPEED DRIVE
58. RING, BLOCKER – 5TH SYNCHRONIZER
59. SPRING, 5TH SYNCHRONIZER
60. HUB, 5TH SYNCHRONIZER
61. KEY, 5TH SYNCHRONIZER
62. SLEEVE, 5TH SYNCHRONIZER
63. RETAINER, 5TH SYNCHRONIZER
64. RING, SNAP – 5TH SYNCHRONIZER RETAINER
65. FUNNEL, TRANSMISSION OILING
66. PLUG, FILL AND DRAIN
67. CASE, TRANSMISSION
68. SPRING, REVERSE LOCK
69. O-RING, REVERSE IDLER
70. GEAR, REVERSE IDLER
71. PIN, ROLL – REVERSE IDLER
72. SHAFT, REVERSE IDLER
73. FORK, 5TH SHIFT
74. PIN, ROLL – SHIFT FORK
75. RAIL, 5TH AND REVERSE SHIFT
76. CLIP, SPRING – 5TH AND REVERSE LEVER
77. LEVER, 5TH AND REVERSE SHIFT
78. BOLT, 5TH AND REVERSE SHIFT LEVER PIVOT
79. SWITCH, REVERSE LAMP
80. CONTROL, TRANSMISSION SHIFT LEVER AND HOUSING
81. SLEEVE, SHIFT LEVER DAMPER
82. LEVER, OFFSET SHIFT
83. PIN, ROLL – OFFSET LEVER
84. SPRING, DETENT
85. BALL, DETENT
86. O-RING, EXTENSION HOUSING VENT
87. VENT, EXTENSION HOUSING
88. SEAL, EXTENSION HOUSING REAR OIL
89. BUSHING, EXTENSION HOUSING
90. HOUSING, EXTENSION
91. BOLT, EXTENSION HOUSING
92. BOLT, DRIVE GEAR BEARING RETAINER
93. RETAINER, DRIVE GEAR BEARING
94. SEAL, DRIVE GEAR BEARING RETAINER OIL
95. SHIM, MAINSHAFT BEARING ADJUSTMENT
96. RACE, MAIN DRIVE GEAR FRONT BEARING
97. GEAR, MAIN DRIVE
98. BEARINGS, ROLLER – MAIN DRIVE GEAR PILOT
99. SPACER

MC0002-7B-F-RP

Figure 2 Disassembled View – Legend

13. Fifth gear, synchronizer, shift fork and shift rail as an assembly. If necessary, rotate rail to disengage from reverse lever assembly (Figure 11).
14. Circlip, speedometer gear and retaining clip.
15. Snap ring from fifth speed driven gear (Figure 12).
16. Front bearing retainer bolts.
17. Front bearing retainer.
18. Front bearing race and end play shims from front bearing retainer (Figure 13).
19. Rotate drive gear until flat surface faces countershaft and remove drive gear from the transmission case.
    - Be careful not to drop the 15 roller bearings, thrust bearing, or race from the rear of drive gear (Figure 14).
20. Fourth gear blocker ring from third/fourth synchronizer.
21. Mainshaft rear bearing race.
    - If the race sticks, it is probably misaligned in the case bore. To free the race, work the shaft back and fourth in the case.
    - Tilt mainshaft upward and remove assembly from transmission case (Figure 15).
22. Reverse fork assembly from transmission case.
23. Countershaft retainer and shims (Figure 16).
24. Roll pin from forward end of reverse idler shaft.
25. Remove reverse idler shaft, rubber O-ring and gear from the transmission case (Figure 17).
26. Rear countershaft bearing race.
27. Countershaft bearing using appropriate pullers (Figure 18).
    - Move countershaft assembly rearward, tilt countershaft upward and remove from case.
28. Rear countershaft bearing from shaft using J 37359 with J 22912-01.

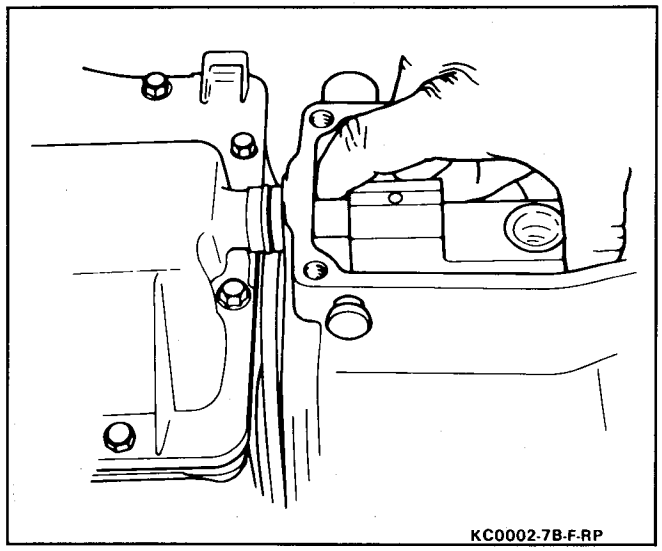


Figure 4 Extension Housing to Transmission Case

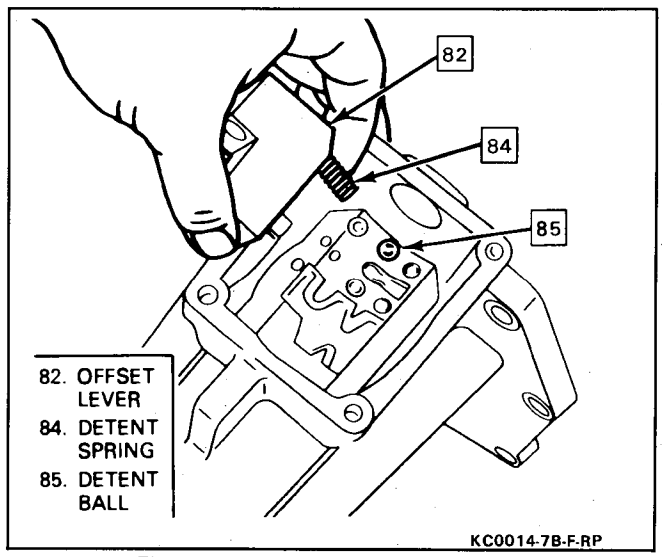


Figure 5 Detent and Offset Lever

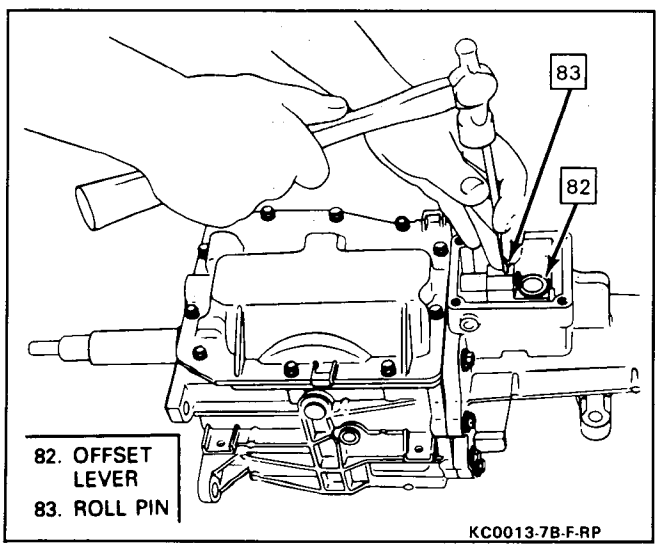


Figure 3 Offset Lever

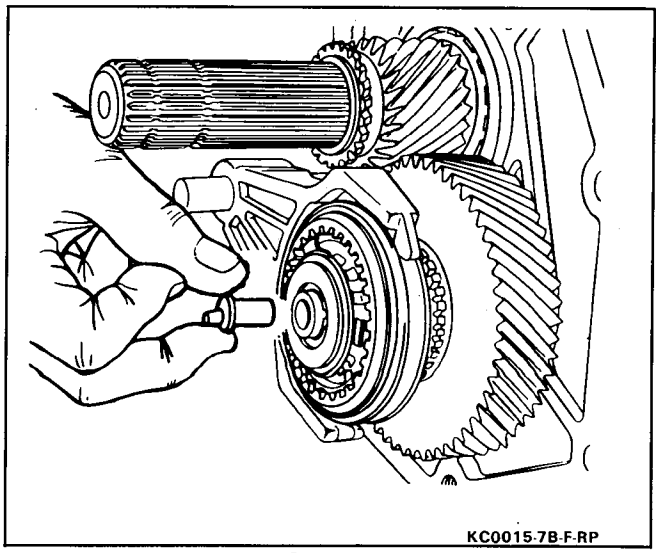


Figure 6 Oiling Funnel

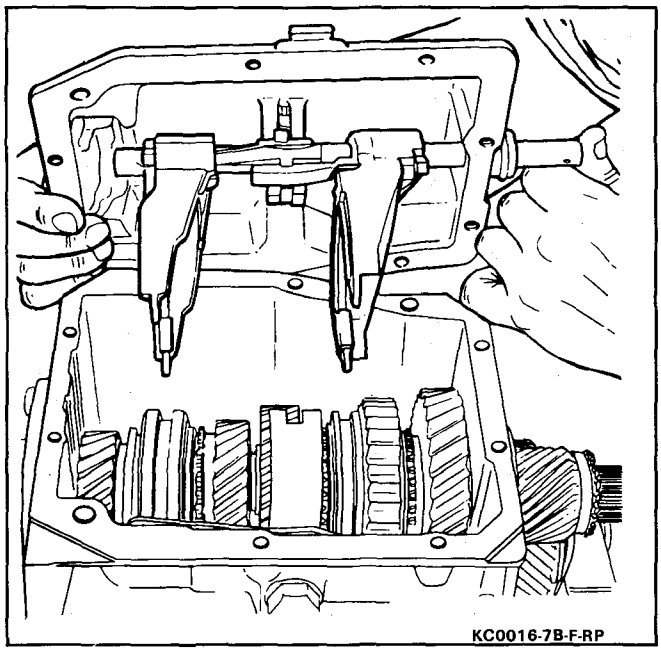


Figure 7 Transmission Cover

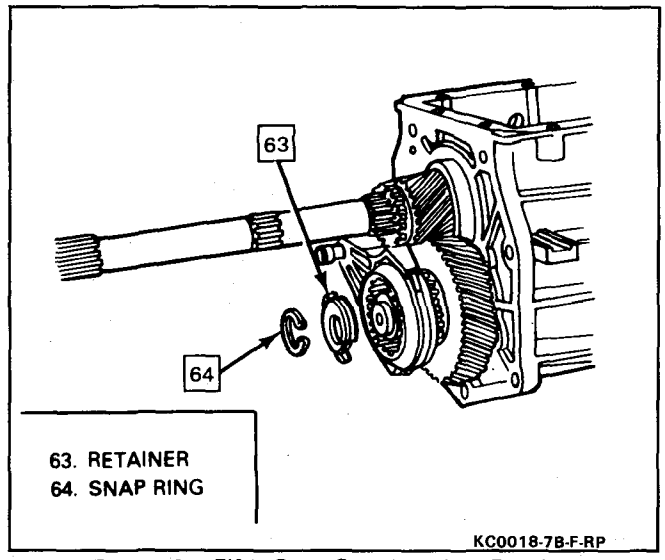


Figure 9 Fifth Gear Synchronizer Retainer

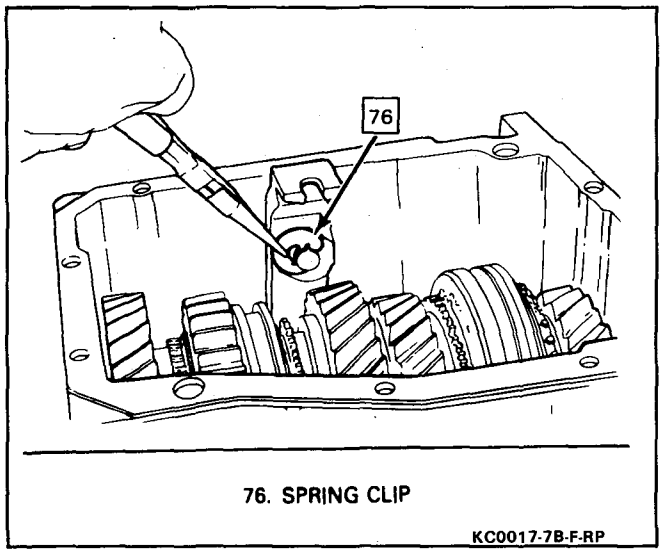


Figure 8 Reverse Lever Spring Clip

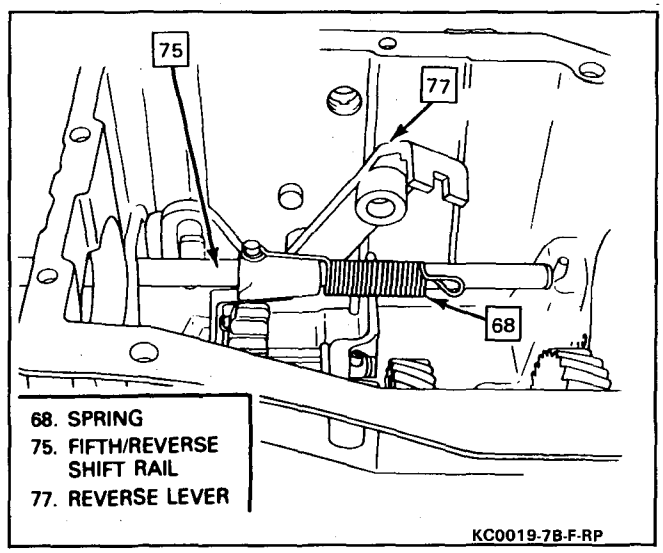


Figure 10 Reverse Lock Spring

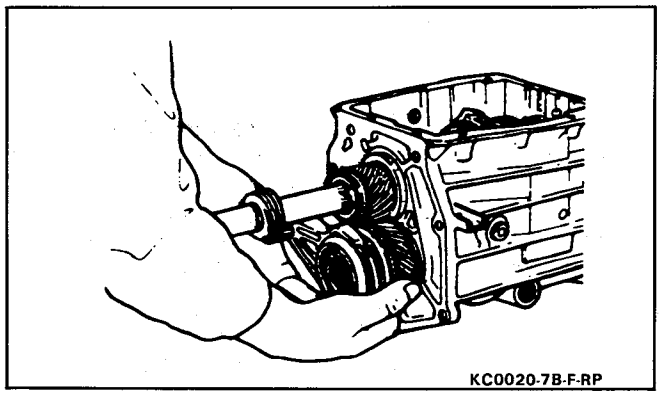


Figure 11 Fifth Gear Synchronizer

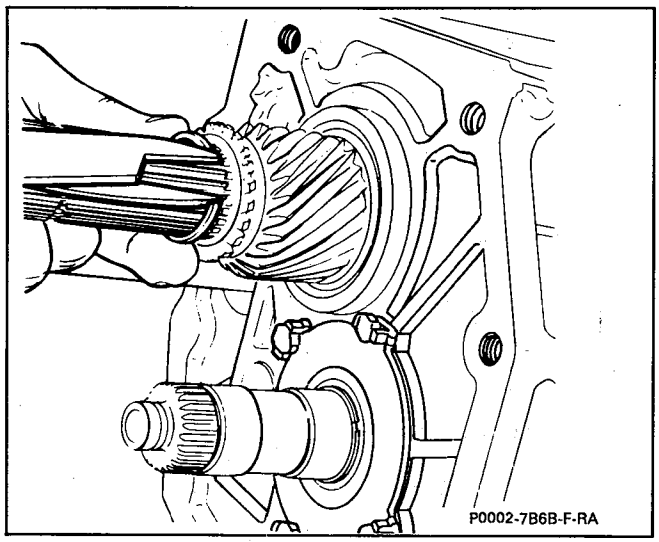


Figure 12 Fifth Gear Snap Ring

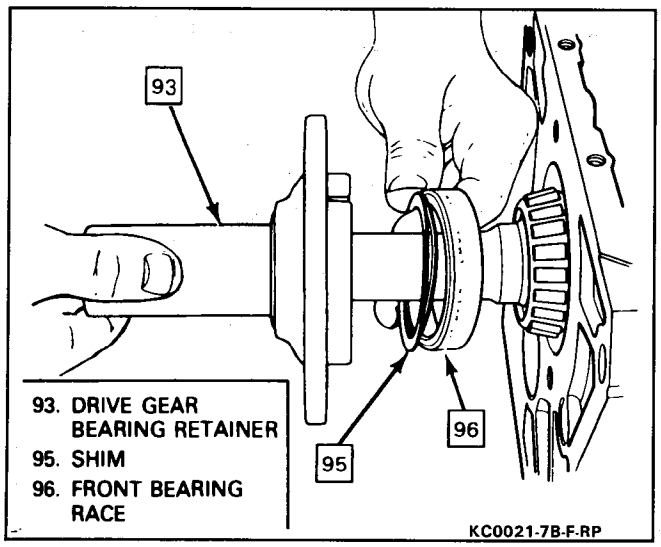


Figure 13 Bearing Retainer and Shims

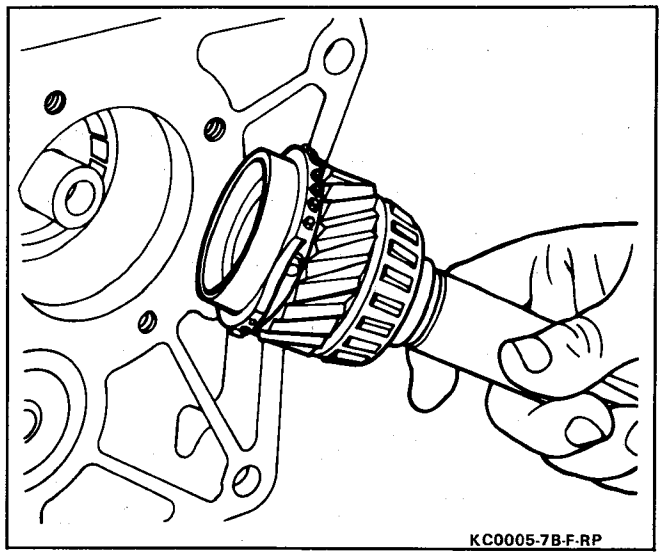


Figure 14 Drive Gear

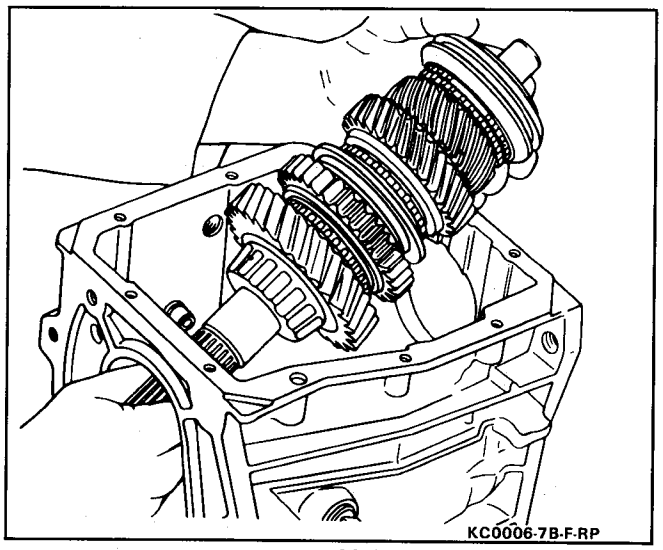


Figure 15 Mainshaft

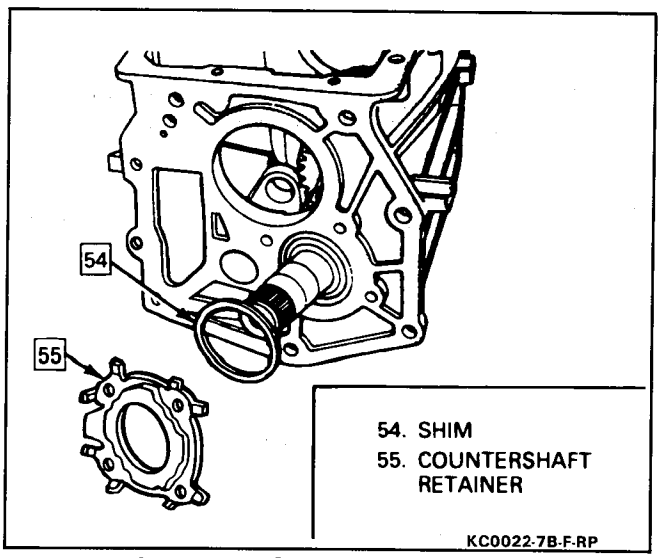


Figure 16 Countershaft Retainer

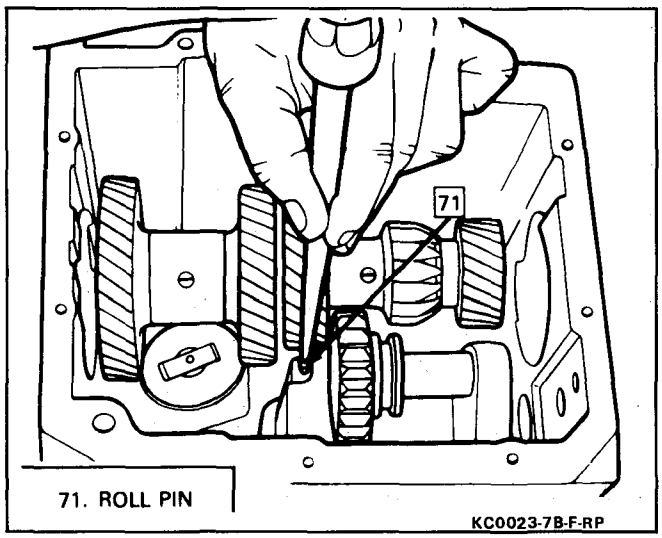


Figure 17 Removing Reverse Idler Shaft Roll Pin

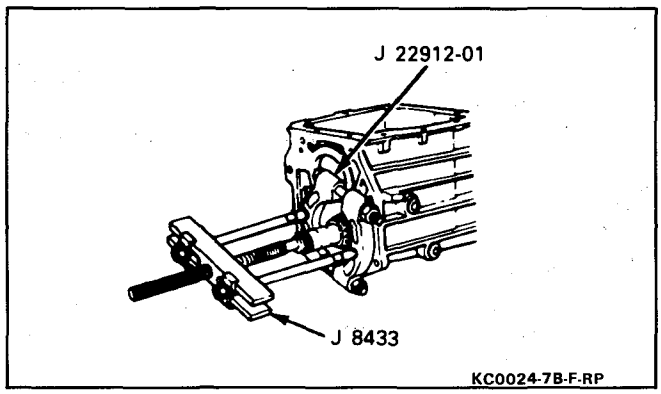


Figure 18 Removing Countershaft Bearing

MAINSHAFT DISASSEMBLY

Figures 19 through 21

Disassemble

Tool Required:

J 22912-01 Bearing and Gear Puller

1. Thrust bearing and race from front end of mainshaft.

- Scribe reference mark on third-fourth synchronizer hub and sleeve for reassembly.

2. Third-fourth synchronizer, third blocker ring, sleeve, hub and third gear as an assembly from mainshaft, using J 22912-01 and press.
3. Needle bearing assembly and spacer.
4. Second gear snap ring and thrust washer.
5. Second gear, spacer and needle bearing.
6. Spiral snap ring.
7. Thrust washer.
8. Three-piece second gear blocker ring assembly.

- Scribe reference mark on first-second synchronizer hub and sleeve for reassembly.

9. First/second synchronizer spring and keys from first-reverse sliding gear.
10. Sleeve from mainshaft hub.

NOTICE: Do not attempt to remove the first-second-reverse hub from mainshaft. The hub and shaft are permanently assembled and machined as a matched set.

11. Fifth gear, using J 22912-01 and press.
12. Mainshaft rear bearing assembly.
13. First gear.
14. Needle bearing and sleeve.
15. Locating pin.
16. Three-piece first gear blocker ring assembly.

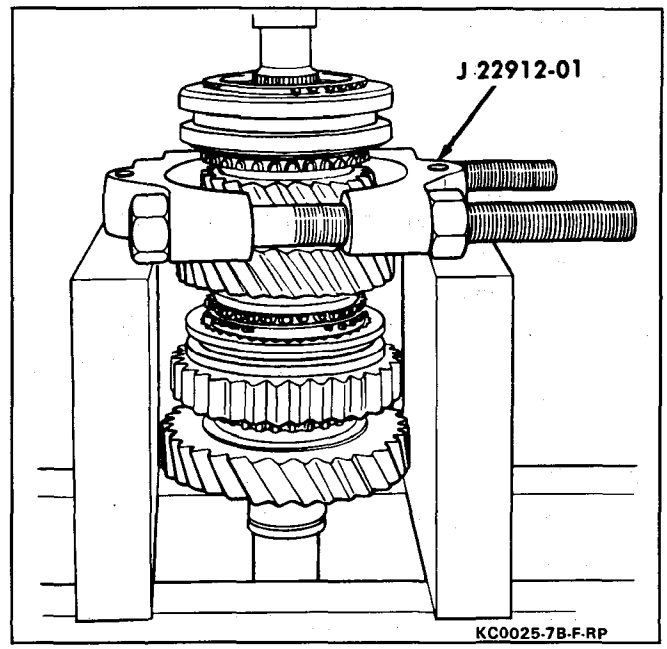


Figure 19 Removing Third-Fourth Synchronizer

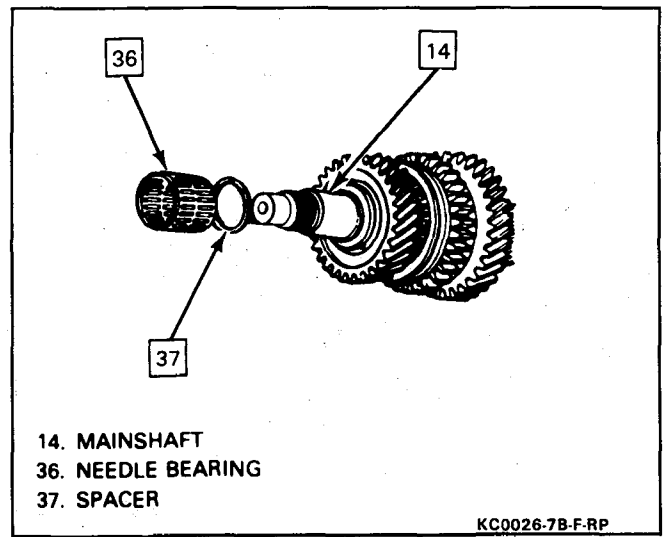


Figure 20 Needle Bearing and Spacer

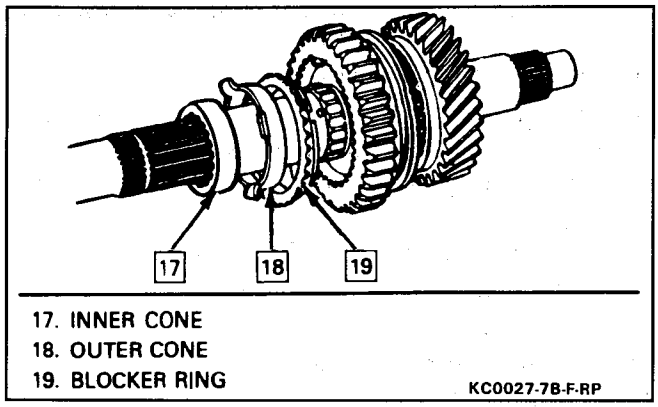


Figure 21 Three-Piece Blocker Ring

DRIVE GEAR DISASSEMBLY

Figures 22 and 23

Disassemble

Tool Required:

J 22912-01 Bearing and Gear Puller

1. Bearing race.
2. Thrust bearing.
3. Roller bearings from cavity of drive gear.
4. Remove bearing from drive gear using J 22912-01 and a press.

Clean

- Parts in appropriate solvent.

Inspect

- Gear teeth and shaft pilot for wear.

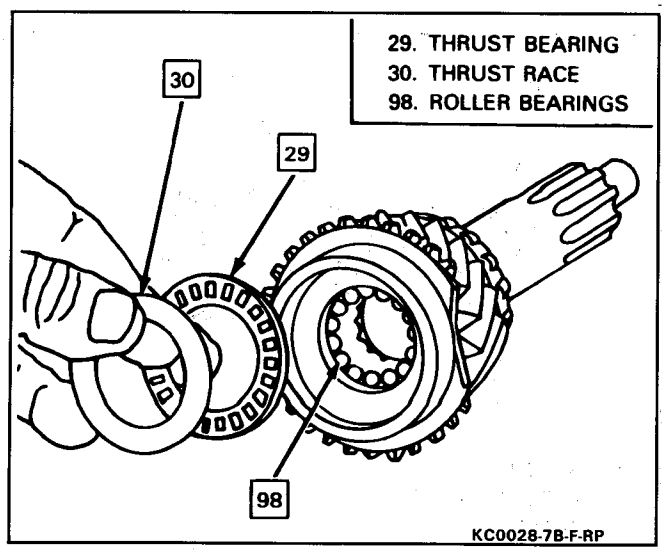


Figure 22 Drive Gear Bearings

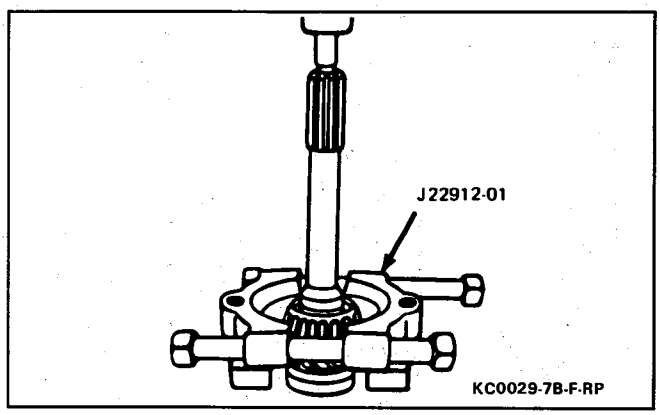


Figure 23 Removing Drive Gear Bearing

CLEANING AND INSPECTION

Transmission Case

Clean

1. Transmission case thoroughly inside and outside with appropriate solvent.
2. Magnetic disk at the bottom of the transmission case.

Inspect

1. Case for cracks.
2. Front and rear faces of the transmission case for burrs, and if present, dress them off with a fine mill file.

Bearing Rollers and Spacers

Inspect

- Drive gear bearing rollers.
- Reverse idler shaft.
- Spacers.

Gears

Inspect

- Drive gear bearing rollers for chips, cracks, or excessive wear and replace if necessary.
- Clutch sleeves to insure that they slide freely on their hubs.

Front and Rear Bearings

Clean

- Front and rear bearings thoroughly with appropriate solvent.

NOTICE: Do not allow the bearings to spin. Turn them slowly by hand. Spinning bearings may damage the race and rollers.

- Blow out bearings with compressed air.
- Lubricate bearings with transmission lubricant.

Inspect

- Bearings for roughness by slowly turning race by hand.

Synchronizer Blocker Rings

Figure 24

First/second synchronizer outer cone and third/fourth blocker ring are lined with friction material and cannot be checked visually for wear. Replacement is necessary when gap between blocker teeth and adjacent clutch teeth is significantly less than specified. Fifth gear blocker ring is brass and can be checked visually for wear and damage.

NOTICE: Make certain the blocker rings are correctly identified before assembly. First/second synchronizer blocker ring does not have friction material. The third/fourth synchronizer blocker ring has friction material. Assembling one in place of the other will result in serious damage to the transmission.

Inspect

- Fifth gear blocker ring for wear and damage.

Third/Fourth Blocker Rings

Figure 24

Assemble

1. Third gear blocker ring to third gear with twisting motion to fully seat.
2. Fourth gear blocker ring to main drive gear with twisting motion to fully seat.

Measure

- Gap between vertical faces of blocker teeth and clutch teeth. Nominal gap is 0.88-1.50 mm (0.035-0.059 inch) for new blocker rings (Figure 28).

First/Second Blocker Rings

Figure 24

Assemble

1. Three-piece first gear blocker ring assembly, using a twisting motion to fully seat.
2. Three-piece first gear blocker ring assembly, with needle bearing and bearing sleeve, to first gear.
3. Three-piece second gear blocker ring assembly, using a twisting motion to fully seat.
4. Three-piece second gear blocker ring assembly, with thrust washer, to second gear.

Measure

- Gap between vertical faces of blocker teeth and clutch teeth. Nominal gap is 0.81-1.40 mm (0.032-0.055 inch) for new blocker ring assemblies (Figure 28).

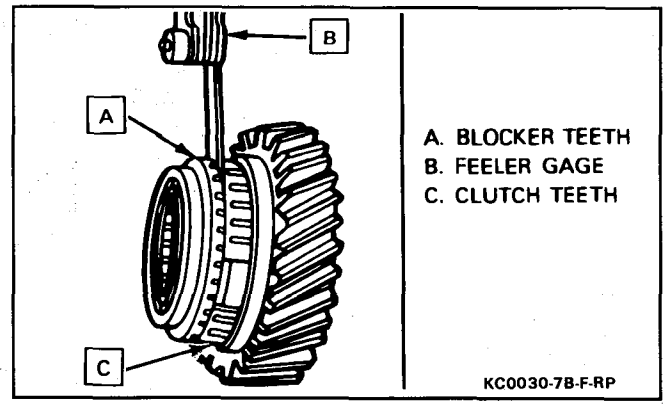


Figure 24 Measuring Blocker Ring Wear

SYNCHRONIZER KEYS AND SPRINGS

Figures 25 through 27

NOTICE: The synchronizer hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the keys and springs may be replaced if worn or broken.

Remove or Disconnect

- Keys and springs.
  - If relation of hub and sleeve are not already marked, mark for assembly purposes.
  - Push the sliding sleeve from the hub. The keys will fall free and the springs may be easily removed.

Install or Connect

- Keys and springs.
  - Place a blocker ring on side of the hub and sleeve and install keys and retain with a spring.
  - Place a blocker ring on opposite side of the hub and sleeve and install remaining spring.

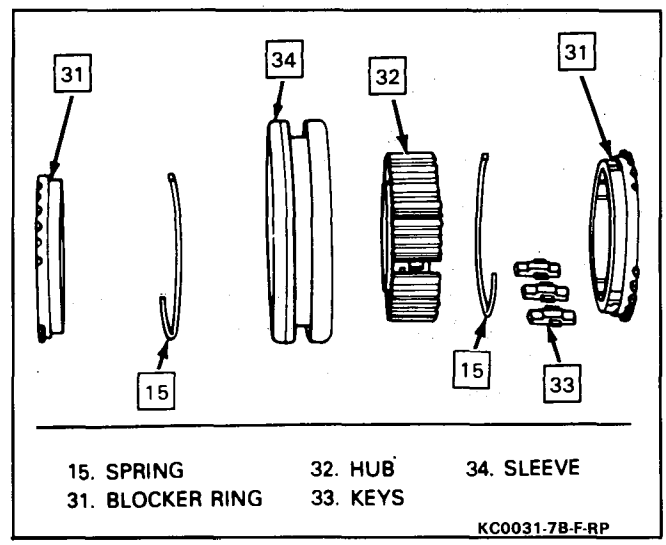


Figure 25 Third-Fourth Synchronizer Assembly

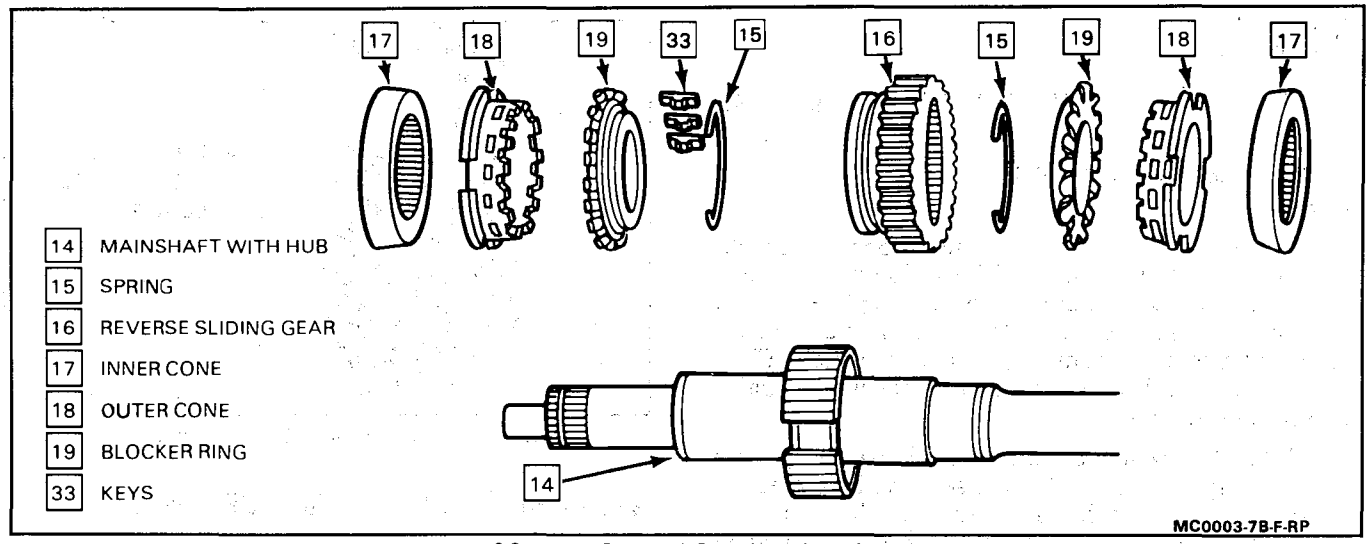


Figure 26 First-Second Synchronizer Assembly

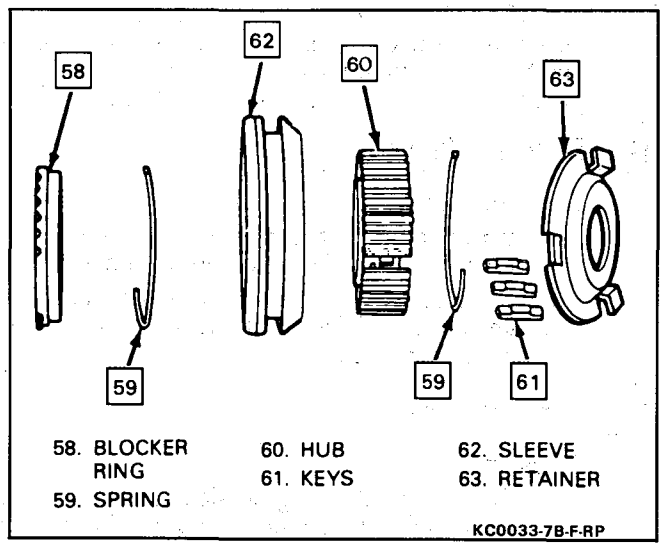


Figure 27 Fifth Gear Synchronizer Assembly

EXTENSION HOUSING OIL SEAL

Remove or Disconnect

- Oil seal out of extension housing, using a screwdriver or small chisel.

Install or Connect

Tool Required:

J 21426 Extension Housing Seal Installer

- New oil seal into extension housing using J 21426.
- Lubricate inside diameter of seal with transmission lubricant.

EXTENSION HOUSING BUSHING

Figure 28

Remove or Disconnect

Tools Required:

J 8092 Universal Driver Handle

J 23062-14 Extension Housing Bushing Remover and Installer

1. Oil seal out of extension housing, using a screwdriver or small chisel.
2. Bushing out of housing, using J 8092 with J 23062-14.

Install or Connect

Tools Required:

J 8092 Universal Driver Handle

J 23062-14 Extension Housing Bushing Remover and Installer

J 21426 Extension Housing Seal Installer

1. Bushing in housing, using J 8092 with J 23062-14.
2. New oil seal into extension housing using J 21426.

- Lubricate inside diameter of seal with transmission lubricant.

DRIVE GEAR BEARING RETAINER OIL SEAL

Figure 29

Remove or Disconnect

- Oil seal, using a screwdriver or small chisel.

Install or Connect

Tool Required:

J 37375 Drive Gear Bearing Retainer Seal Installer

- New seal into retainer using J 37375 until it bottoms in bore.
- Lubricate inside diameter of seal with transmission lubricant.

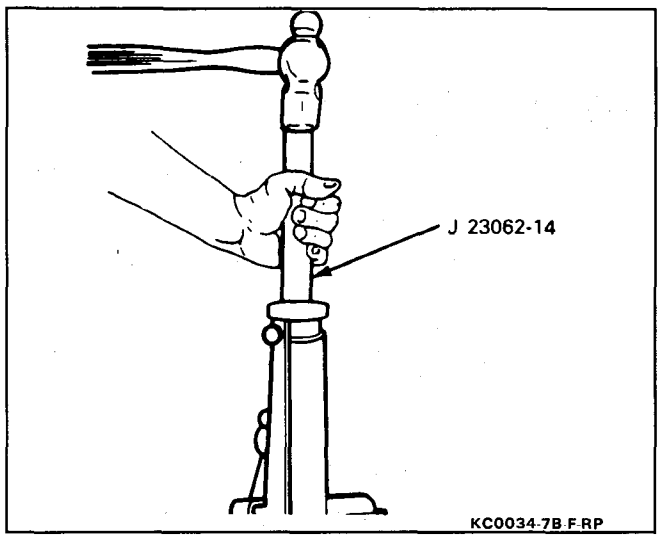


Figure 28 Installing Extension Housing Bushing

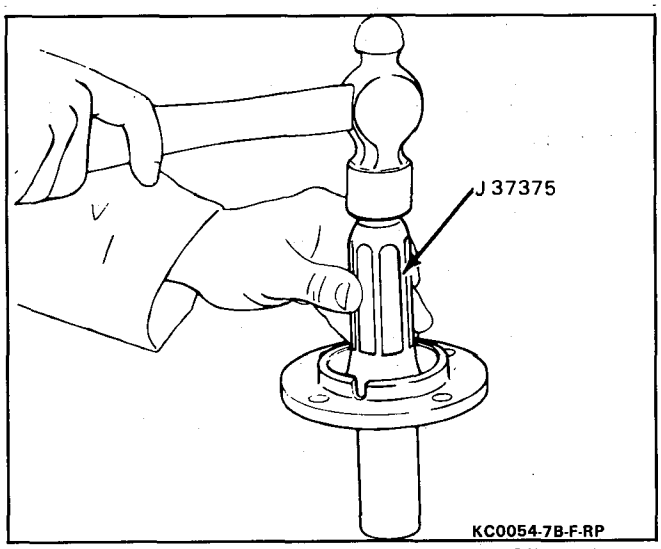


Figure 29 Installing Bearing Retainer Oil Seal

TRANSMISSION COVER

Figures 30 and 31

Disassemble

- Place selector arm plates and shift rail in neutral position (centered).
- Rotate shift rail until selector arm disengages from selector arm plates and roll pin is accessible.

1. Selector arm roll pin using a pin punch and hammer (Figure 31).
2. Shift rail, shift forks, shift fork plates, selector arm, interlock plate and roll pin.
3. Transmission cover to extension housing O-ring seal using a screwdriver.
4. Nylon inserts and shift fork plates from shift forks.
   - Note position of inserts and plates for assembly reference.

Assemble

1. Nylon inserts and shift fork plates in shift forks.
   - If removed, coat edges of shift rail plug with sealer GM p/n 1052624, or equivalent, before installing.
   - Coat shift rail and rail bores with transmission lubricant.
2. Shift rail in cover until flush with inside edge of cover.
3. Place first-second shift fork in cover with fork offset facing rear of cover and push shift rail through fork.
   - The first-second shift fork is the larger of the two forks.
4. Selector arm and C-shaped interlock plate in cover and insert shift rail through arm.
   - Widest part of interlock plate must face away from cover, and selector arm roll pin hole must face downward and toward rear of cover.
5. Third-fourth shift fork in cover with fork offset facing rear of cover.
   - Third-fourth shift fork plate must be under first-second shift fork plate.
6. Shift rail through third-fourth shift fork and into front bore in cover.
   - Rotate shift rail until shift fork plate at forward end of rail faces away from, but is parallel to cover.
   - Align roll pin holes in selector arm and shift rail and install roll pin.
     - Roll pin must be flush with surface of selector arm to prevent pin from contacting shift fork plates during shifts.
7. New transmission cover to extension housing O-ring seal.
   - Coat O-ring seal with transmission lubricant.

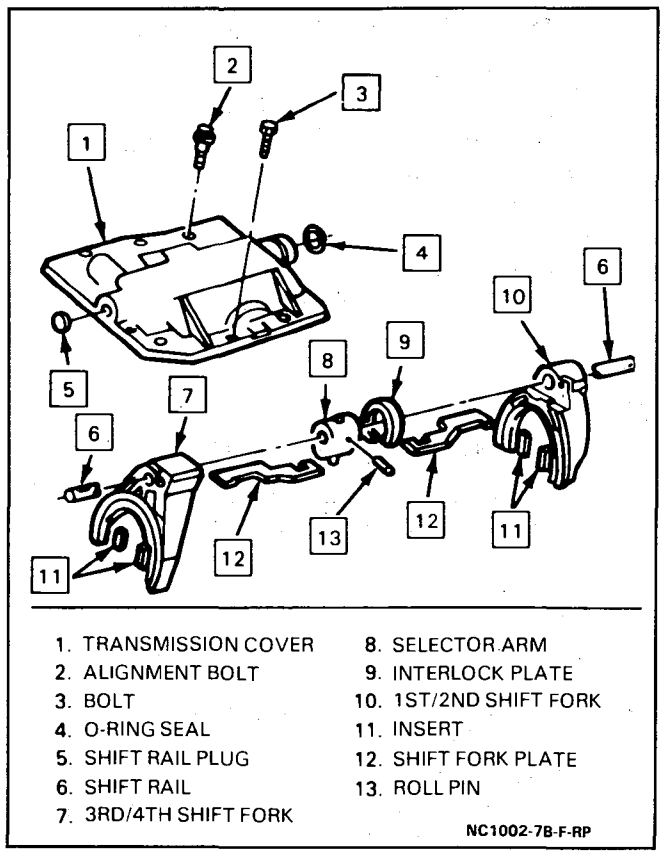


Figure 30 Transmission Cover

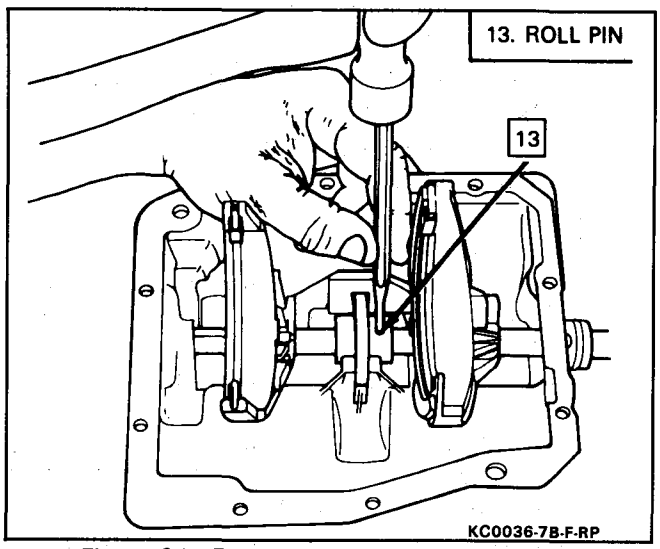


Figure 31 Removing Selector Arm Roll Pin

FRONT COUNTERSHAFT BEARING

Figures 32 through 35

Remove or Disconnect

Tools Required:

J 37358-1, -2 Bearing Race Receiver and Case Support
J 22912-01 Bearing and Gear Puller
J 37359 Countershaft Bearing Remover
J 8092 Universal Driver Handle

NOTICE: Failure to support the case properly will result in permanent distortion of the case during bearing race removal.

1. Countershaft front bearing race and O-ring from the transmission case, using J 37358-1 with J 37358-2 and a press.
   - Remove the front countershaft bearing race only if it is worn or damaged.
2. Countershaft front bearing from the countershaft, using J 22912-01 with J 37359, J 8092 and a press.

Install or Connect

Tools Required:

J 37357 Countershaft Bearing and Race Remover and Installer
J 22912-01 Bearing and Gear Puller
J 8092 Universal Driver Handle

1. Countershaft front bearing onto the countershaft, using J 37357 with J 22912-01, J 8092 and a press.
2. New O-ring onto the countershaft front bearing race.
   - Lubricate the O-ring.
3. Countershaft front bearing race into the transmission case, using J 37357 with J 8092 and a press.
   - Lightly tap the race into its bore until the O-ring is compressed.
   - Use a press to install the race until its shoulder rests on the inside of the case.

DRIVE GEAR ASSEMBLY

Assemble

Tools Required:

J 22912-01 Bearing and Gear Puller
J 6133-01 Installer

1. Bearing onto the drive gear, using J 22912-01 with J 6133-01 and a press.
   - Coat roller bearings and drive gear bearing bore with lightweight grease.
2. Roller bearings into the bore of the drive gear.
3. Thrust bearing and race into the drive gear.

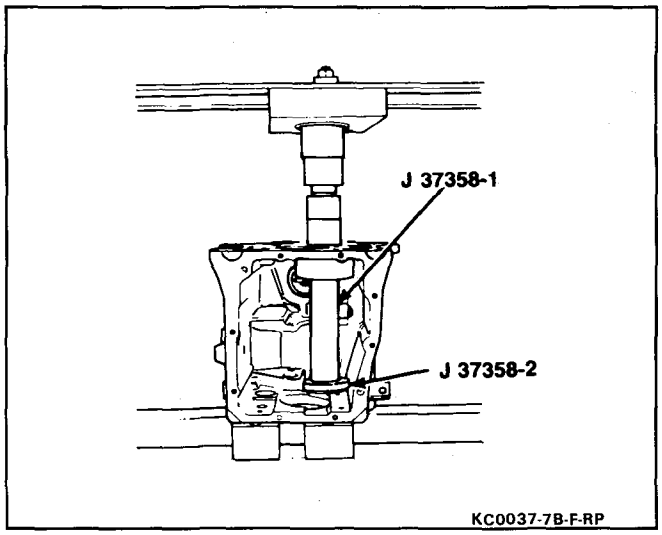


Figure 32 Removing Bearing Race from Case

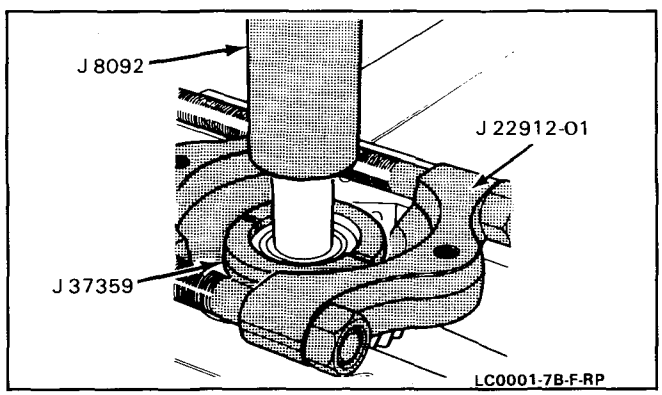


Figure 33 Removing Bearing from Countershaft

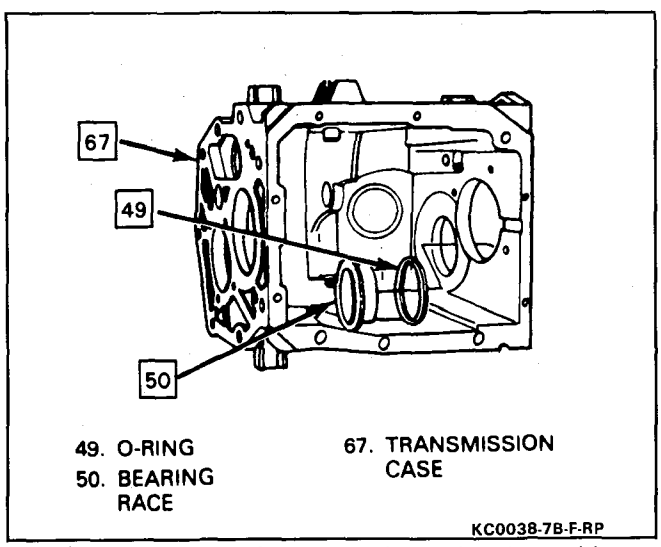


Figure 34 Front Countershaft Bearing Assembly

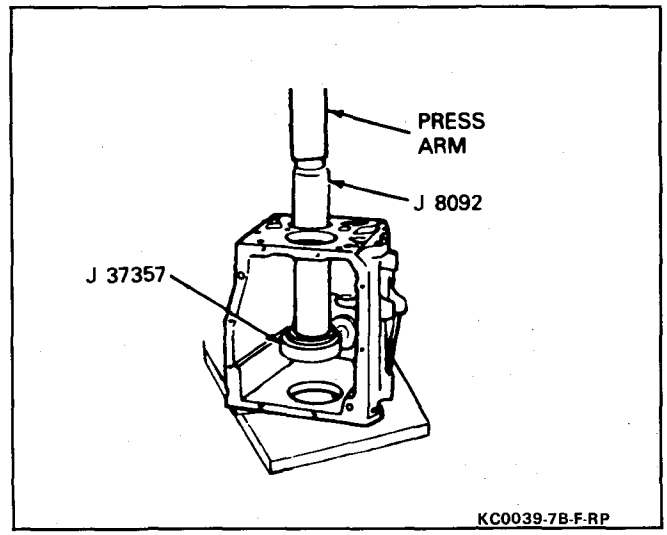


Figure 35 Installing Bearing Race to Case

MAINSHAFT ASSEMBLY

Figures 19, 20, 21 and 36

Assemble

Tools Required:

J 25234 Front and Rear Bearing Installer
J 37360 Spiral Snap Ring Installer
J 37372 Synchronizer and Gear Installer

NOTICE: If replacing first/second or third/fourth synchronizer blocker rings, soak new blocker ring assemblies for 10 minutes in Dexron®-IIE or equivalent before assembly on mainshaft.

- Coat mainshaft and gear bores with transmission lubricant.

1. First-second synchronizer sleeve on mainshaft hub aligning marks made at disassembly.

NOTICE: Use care in synchronizer spring placement. If synchronizer is assembled with improper spring replacement, hard shifting will result.

2. First-second synchronizer keys and springs.
   - Engage tang end of each spring in same synchronizer key, but position open end of springs opposite of each other.
3. Three-piece first gear blocker ring assembly.
4. Locating pin into mainshaft.
5. Sleeve and needle bearing onto mainshaft, aligning notch in sleeve with locating pin.
6. First gear, aligning slots in first gear with tabs on blocker ring assembly.
7. Rear mainshaft bearing with taper facing rear of shaft.

- Lubricate fifth gear splines with petroleum jelly.

NOTICE: Carefully align the mainshaft and gear splines. If splines are improperly aligned, damage could occur when the gear is pressed onto the mainshaft.

8. Fifth gear onto mainshaft, using J 25234 and a press.
9. Fifth gear snap ring.
10. Three-piece second gear blocker ring assembly and thrust washer.
11. Spiral snap ring, using J 37360.
12. Second gear spacer, needle bearing and gear, aligning slots in second gear with tabs on blocker ring assembly.
13. Second gear thrust washer and snap ring.
14. Third gear spacer and needle bearing assembly.
    - Make sure the bearing spacer is not trapped between the gear face and snap ring. The spacer runs inside the gear bore.
15. Third-fourth synchronizer, third blocker ring, sleeve, hub and third gear as an assembly, using J 37372 and a press.
16. Thrust bearing and race to front end of mainshaft.

Important

- Before pressing components together, make sure the synchronizer hub faces the short end of the mainshaft. Hold third gear against the synchronizer to maintain blocker ring alignment with keys.

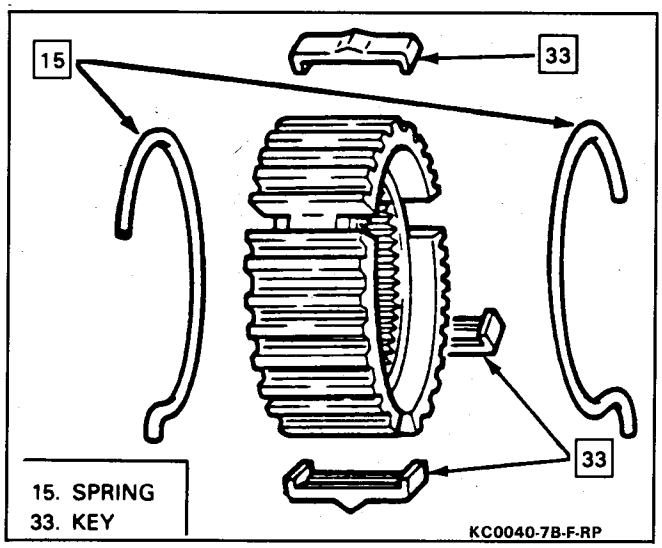


Figure 36 Synchronizer Springs

TRANSMISSION ASSEMBLY

Figures 1 through 18 and 37 through 39

Assemble

Tools Required:

J 37357 Countershaft Bearing and Race Remover and Installer
J 8092 Universal Driver Handle
J 37372 Synchronizer and Gear Installer
J 8001 Dial Indicator

1. Front countershaft bearing onto countershaft using J 37357 with J 8092 and a press.
2. Countershaft in case.
3. Rear countershaft bearing to countershaft using J 37372 and a press (Figure 37).

NOTICE: Failure to properly support the countershaft may result in permanent distortion of the case during installation.

- Support the countershaft with J 37357.

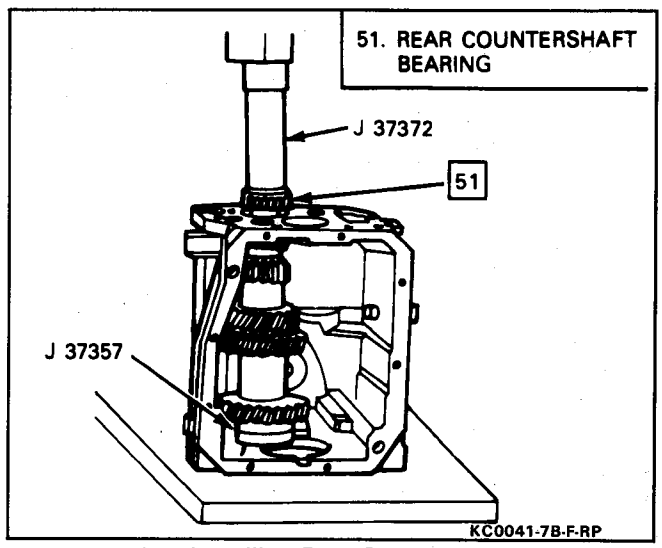


Figure 37 Installing Rear Countershaft Bearing

4. Rear countershaft bearing race.
5. Rubber O-ring and reverse idler gear in case with shift lever groove facing rear of case.
6. Reverse idler shaft from rear of case.
7. Roll pin in idler shaft.

8. Countershaft retainer (without shims) to transmission housing.

Tighten

- Countershaft retainer bolts to 20 N·m (15 lb. ft.).

Measure

- Countershaft end play using dial indicator J 8001.

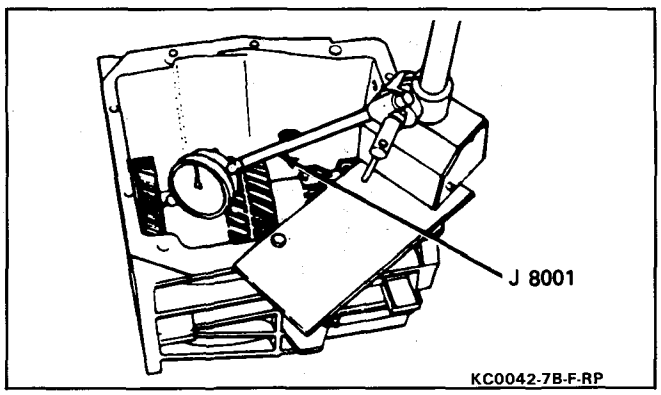


Figure 38 Measuring Countershaft End Play

- Remove retainer and install shim(s) as necessary to provide proper end play. Zero end play with no preload is ideal, but up to 0.10 mm (0.004 inch) end play is allowable. Do not preload bearing with shim(s) larger than original end play measurement. Refer to "Specifications" in this section.

- Reinstall retainer and bolts.

Tighten

- Bolts to 20 N·m (15 lb. ft.).

- Bend tabs over the four attaching bolts.

9. Reverse shift fork in case.
10. Assembled mainshaft in transmission case.
11. Rear mainshaft bearing race in case.
12. Drive gear in case (make sure rollers, thrust bearing and washer are in place), and engage in third-fourth synchronizer sleeve and blocker ring.
13. Front bearing race in front bearing retainer.
    - Do not install shims in front bearing retainer at this time.
    - Temporarily install front bearing retainer.
14. Fifth gear on countershaft.
    - Slide shift rail/fifth gear shift fork assembly into case. As shift rail enters case, align reverse shift fork and slide rail through fork. Position lever return spring in case with long end of spring to rear, and slide rail through spring (Figure 10).
15. Blocker ring and fifth gear synchronizer in fifth gear shift fork.
    - Slide fork rail assembly and synchronizer into position.
16. Fifth gear synchronizer retainer and snap ring (Figure 9).
17. Oiling funnel into rear of countershaft (Figure 6).
18. Fifth/reverse shift lever in case.
19. Lever return spring to front of case.
    - Make sure reverse shift fork pin and fifth gear shift rail pin are engaged with shift lever.
20. Fifth gear/reverse lever pivot bolts and retaining clip.
    - Coat pivot bolt threads with pipe thread sealant GM p/n 1052080.

Tighten

- Pivot bolt to 27 N·m (20 lb. ft.).

21. Backup lamp switch.
    - Coat threads with pipe thread sealant GM p/n 1052080.
22. Speedometer gear and retaining clip.
23. Circlip.
    - Apply 3 mm (1/8-inch) bead of RTV Sealant GM p/n 12345739 to transmission cover assembly.
    - Make sure all synchronizers are in the neutral position and that the shift forks in the cover are in the neutral (center) position.
    - Lower cover onto case while aligning shift forks and synchronizer sleeves.
24. Cover and install two dowel bolts.
25. Remaining cover bolts.

Tighten

- Cover bolts to 13 N·m (115 lb. in.).

    - Apply 3 mm (1/8-inch) bead of RTV Sealant GM p/n 12345739 to extension housing mating surface.
    - Coat detent spring with petroleum jelly and insert in offset lever.
    - Lubricate detent plate and install detent ball in neutral position on plate.
    - Position offset lever in extension housing with spring over detent ball. Slide lever and extension into position as an assembly.
26. Extension housing vent.
    - Press downward on offset lever to compress detent spring and push lever and housing into position.
27. Extension housing bolts.
    - Apply pipe thread sealant GM p/n 1052080 to threads of bolts.

Tighten

- Extension housing bolts to 30 N·m (22 lb. ft.).

28. Roll pin in offset lever and shift rail.
29. Damper sleeve in offset lever.
- Turn transmission case on end, and mount a dial indicator on extension housing with indicator on the end of mainshaft (Figure 39).

Measure

- Mainshaft end play.
  - Rotate mainshaft and zero dial indicator. Pull upward on mainshaft until end play is removed and record reading.
  - Ideal mainshaft end play is zero with plus or minus 0.02 mm (0.001 inch) allowable.
  - To set preload, select a shim pack equal to the dial indicator reading recorded.

- Remove front bearing retainer and front bearing race.
- Install necessary shims and reinstall bearing race. Refer to "Specifications" in this section.
- Apply a 3 mm diameter (1/8-inch) bead of RTV Sealant GM p/n 12345739 on case mating surface of front bearing retainer.

30. Bearing retainer.
- Apply pipe thread sealant GM p/n 1052080 to the threads of the retainer bolts.

31. Retainer bolts.

Tighten

- Retainer bolts to 20 N·m (15 lb. ft.).
- Apply pipe thread sealant GM p/n 1052080 to the threads of the drain and fill plugs.

32. Drain plug.

Tighten

- Drain plug to 27 N·m (20 lb. ft.).
- Fill the transmission to its proper level with Dexron®-IIE.

33. Fill plug.

Tighten

- Fill plug to 27 N·m (20 lb. ft.).

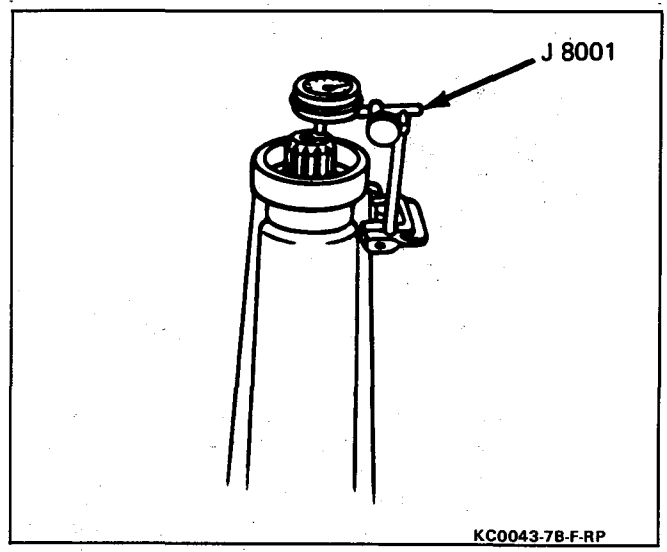


Figure 39 Measuring Mainshaft End Play

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Catalytic Converter-to-Transmission Nut	52 N·m (38 lb. ft.)
Transmission-to-Flywheel Housing Bolt	75 N·m (55 lb. ft.)
Extension Housing Bolt	30 N·m (22 lb. ft.)
Transmission Cover-to-Case Bolt	13 N·m (115 lb. in.)
Front Bearing Retainer Bolt	20 N·m (15 lb. ft.)
Countershaft Retainer Bolt	20 N·m (15 lb. ft.)
Reverse Pivot Bolt	27 N·m (20 lb. ft.)
Fill Plug	27 N·m (20 lb. ft.)
Drain Plug	27 N·m (20 lb. ft.)
Support-to-Rail Bolt	54 N·m (40 lb. ft.)
Transmission Mount-to-Transmission Bolt	54 N·m (40 lb. ft.)
Transmission Mount-to-Support Nut	47 N·m (35 lb. ft.)
Transmission Mount-to-Support Bolt	54 N·m (40 lb. ft.)
Speed Sensor Retainer Bolt	10 N·m (89 lb. in)
Shift Control Assembly Boot Screw	6 N·m (53 lb. in)
Shift Control Assembly Bolt	17 N·m (13 lb. ft.)
Vehicle Speed Sensor Retainer Bolt	10 N·m (89 lb. in.)
Torque Arm Outer Bracket Nut	41 N·m (30 lb. ft.)
Torque Arm-to-Rear Axle Differential Nut	133 N·m (98 lb. ft.)

LUBRICANT SPECIFICATIONS

Lubricant Capacity (approximate)	2.8 Liters (2.96 quarts)
Lubricant Recommended	Dexron®-IIE

SPEEDOMETER GEAR CHART

SPEEDOMETER GEAR CHART

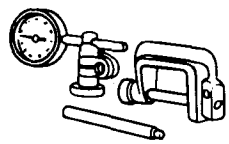
TIRE SIZE	AXLE RATIO	TRANSMISSION	DRIVE GEAR		DRIVEN GEAR	
			COLOR	TEETH	COLOR	TEETH
P215/65R15 P235/55R16 P245/50ZR16	3.08	M39	RED	9	GREY	22
P215/65R15	3.42	MB1	PURPLE	7	WHITE	19
P245/50ZR16		MK6				

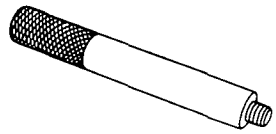
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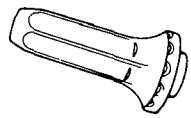
SHIM SPECIFICATIONS

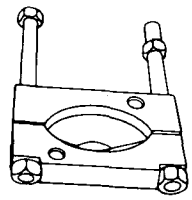
Input/Mainshaft		Countershaft	
Thickness (inches)	GM P/N	Thickness (inches)	GM P/N
0.012	14050783	0.1005	10117781
0.014	14050780	0.102	10117782
0.016	14050781	0.1035	10117783
0.018	14050782	0.105	10117784
0.020	14050784	0.1065	10117785
0.022	14050786	0.108	10117786
0.023	14050787	0.1095	10117787
0.024	14069868	0.111	10117788
0.025	14069869	0.1125	10117789
0.026	14069870	0.114	10117790
0.027	14069871	0.1155	10117791
0.028	14069872	0.117	10117792
0.029	14069873	0.1185	10117793
0.030	14069874	0.120	10117794
0.031	14069875	0.1215	10117795
0.032	14069876	0.123	10117796
0.033	14069877	0.1245	10117797
0.034	14069878	0.126	10117798
0.035	14069879	0.1275	10117799
0.036	14050785	0.129	10117800
0.037	14069880	0.1305	10117801
0.038	14069881	0.132	10117802
0.039	14069882	0.1335	10117803
0.040	14069883	0.135	10117804
0.041	14069884	0.1365	10117805
0.042	14069885	0.138	10117806
0.043	14069886	0.1395	10117807
0.044	14069887	0.141	10117808
		0.1425	10117809
		0.144	10117810
		0.1455	10117811
		0.147	10117812
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		0.150	10117814
		0.1515	10117815
		0.1530	10117816

SPECIAL TOOLS

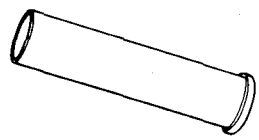
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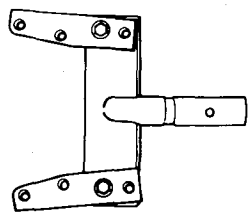
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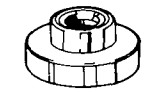
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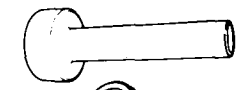
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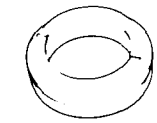
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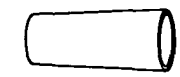
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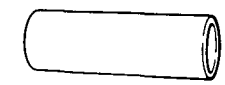
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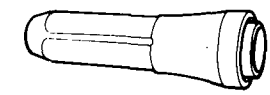
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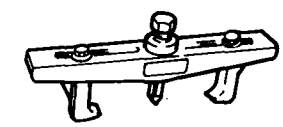
 J 37358-2

11  J 37359

12  J 37360

13  J 37372

14  J 37375

15  J 8433

1 DIAL INDICATOR
2 UNIVERSAL DRIVER HANDLE
3 EXTENSION HOUSING SEAL INSTALLER
4 BEARING AND GEAR PULLER
5 EXTENSION HOUSING BUSHING REMOVER AND INSTALLER
6 FRONT AND REAR BEARING INSTALLER
7 HOLDING FIXTURE
8 INSTALLER
9 COUNTERSHAFT BEARING AND RACE REMOVER AND INSTALLER
10 BEARING RACE RECEIVER AND CASE SUPPORT
11 COUNTERSHAFT BEARING REMOVER
12 SPIRAL SNAP RING INSTALLER
13 SYNCHRONIZER AND GEAR INSTALLER
14 DRIVE GEAR BEARING RETAINER SEAL INSTALLER
15 HEAVY DUTY PULLEY PULLER

NC1001 7B-F RP

BLANK

SECTION 7B-10B

BORG-WARNER (T56) UNIT REPAIR

RPO MM6

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

To ensure good fuel economy and compliance with federal fuel economy standards, 2nd and 3rd gears are inhibited when shifting out of 1st gear under the following conditions:

- Coolant temperature is above 77°C (161°F).
- Throttle is opened 35% or less.
- Vehicle speed is between 24 and 34 kmh (15 and 21 mph).
- Reset at less than 2 kmh (1 mph).

UNIT DISASSEMBLY

A complete disassembled view is shown on page 2.

SHIFTER

Figures 3 and 4

Tools Required:

J 3289-20 Holding Fixture Bench Mount
J 39430 Transmission Support Fixture

Remove or Disconnect

1. Vent tube (161).
2. Clutch housing bolts (163).
3. Clutch housing (162).
4. Clutch fork bolt (166).
5. Clutch fork (164) and T-handle (165).
6. Install transmission to J 39430 and J 3289-20.
   - Use bolts (163) to secure transmission to J 39430.

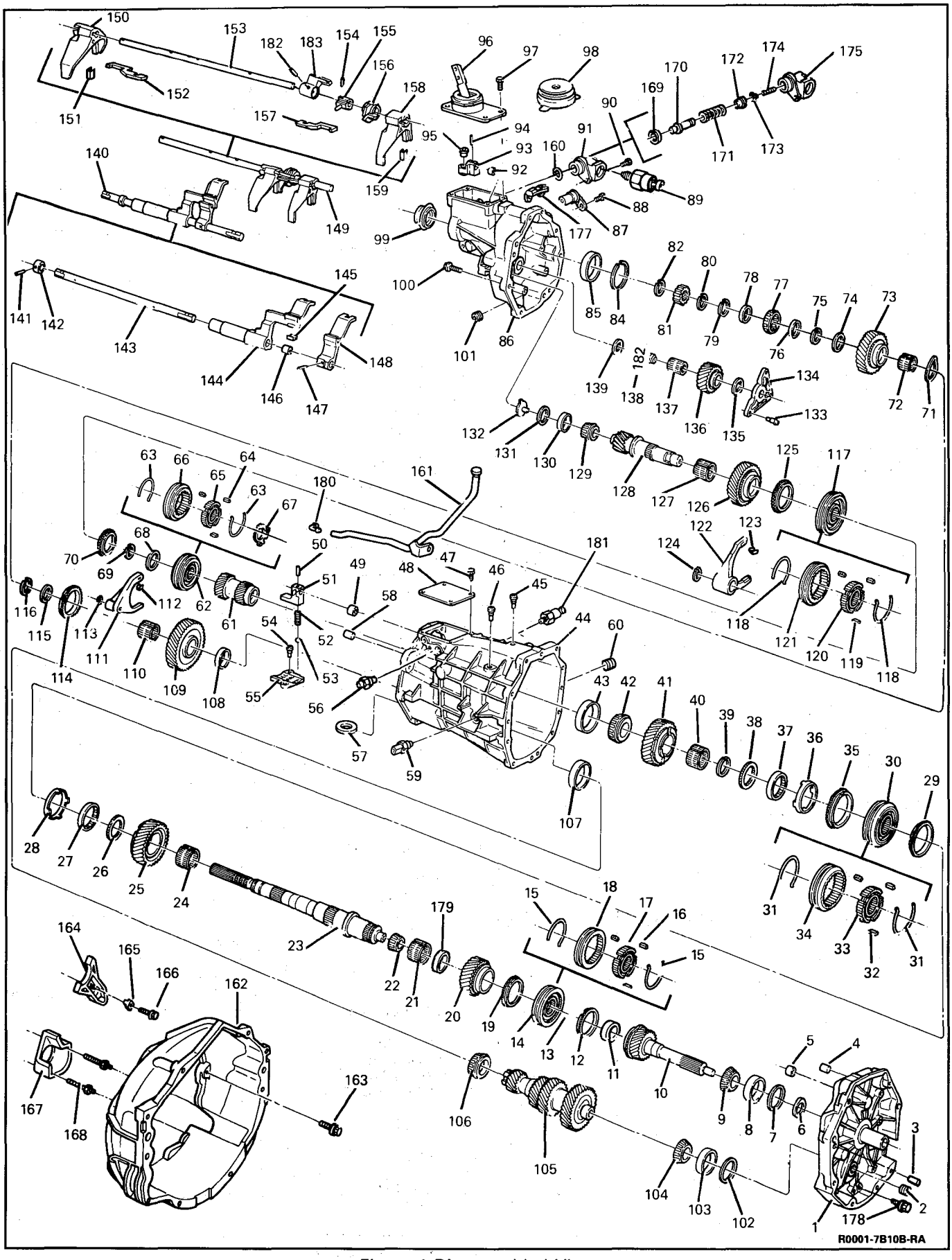


Figure 1 Disassembled View

1 PLATE, TRANSMISSION ADAPTER
2 PLUG
3 PIN, DOWEL
4 PIN, DOWEL
5 BUSHING, SHIFT RAIL
6 SEAL, INPUT SHAFT
7 SHIM, INPUT SHAFT
8 RACE, INPUT SHAFT BEARING
9 BEARING, INPUT SHAFT TAPERED
10 SHAFT, INPUT
11 RACE, INPUT SHAFT BEARING
12 RING, 4TH GEAR BLOCKER
13 RING, SNAP
14 SYNCHRONIZER ASSEMBLY, 3RD/4TH
15 SPRING, 3RD/4TH SYNCHRONIZER
16 KEY, 3RD/4TH SYNCRONIZER
17 HUB, 3RD/4TH SYNCHRONIZER
18 SLEEVE, 3RD/4TH SYNCHRONIZER
19 RING, 3RD GEAR BLOCKER
20 GEAR, 3RD SPEED
21 BEARING, 3RD GEAR NEEDLE
22 BEARING, MAINSHAFT SMALL TAPERED
23 MAINSHAFT
24 BEARING, 2ND GEAR NEEDLE
25 GEAR, 2ND SPEED
26 WASHER, THRUST
27 CONE, INNER
28 CONE, FRICTION
29 RING, 2ND GEAR BLOCKER
30 SYNCHRONIZER ASSEMBLY, 1ST/2ND
31 SPRING, 1ST/2ND SYNCHRONIZER
32 KEY, 1ST/2ND SYNCHRONIZER
33 HUB, 1ST/2ND SYNCHRONIZER
34 SLEEVE, 1ST/2ND SYNCHRONIZER
35 RING, 1ST GEAR BLOCKER
36 CONE, FRICTION
37 CONE, INNER
38 WASHER, THRUST
39 RING, SNAP
40 BEARING, 1ST GEAR NEEDLE
41 GEAR, 1ST SPEED
42 BEARING, MAINSHAFT LARGE TAPERED
43 RACE, MAINSHAFT BEARING
44 CASE, TRANSMISSION
45 BOLT, SHIFT LEVER GUIDE
46 BOLT, SHIFT LEVER GUIDE
47 BOLT, SHIFT DETENT COVER
48 COVER, SHIFT DETENT
49 BUSHING, SHIFT RAIL
50 PIN, FRONT OFFSET LEVER ROLL
51 LEVER, FRONT OFFSET
52 SPRING, SHIFT DETENT
53 BALL, SHIFT DETENT
54 BOLT, SHIFT GUIDEPLATE
55 PLATE, SHIFT GUIDE
56 DETENT ASSEMBLY, SHIFT
57 MAGNET
58 PIN, DOWEL
59 SWITCH, BACK-UP LAMP
60 PLUG, FILL
61 GEAR, 5TH/6TH DRIVEN
62 SYNCHRONIZER ASSEMBLY, REVERSE
63 SPRING, REVERSE SYNCHRONIZER
64 KEY, REVERSE SYNCHRONIZER
65 HUB, REVERSE SYNCHRONIZER
66 SLEEVE, REVERSE SYNCHRONIZER
67 RETAINER, REVERSE SYNCHRONIZER KEY
68 WASHER, THRUST
69 RING, SNAP
70 RING, REVERSE GEAR BLOCKER
71 WASHER, WAVE
72 BEARING, REVERSE GEAR NEEDLE
73 GEAR, REVERSE
74 WASHER, THRUST
75 RING, SNAP
76 SPACER
77 BEARING, REAR MAINSHAFT
78 SPACER
79 RING, SNAP
80 RING, SNAP
81 GEAR, SPEEDOMETER (ELECTRONIC)
82 RING, SNAP
84 RING, SNAP
85 RACE, MAINSHAFT BEARING
86 HOUSING, TRANSMISSION EXTENSION
87 SENSOR, ELECTRONIC SPEED
88 BOLT, SPEED SENSOR
89 SOLENOID, REVERSE LOCKOUT
90 BOLT, REVERSE LOCKOUT ASSEMBLY
91 BODY ASSEMBLY, REVERSE LOCKOUT
92 BUSHING, SHIFT RAIL
93 LEVER, REAR OFFSET SHIFT
94 PIN, REAR OFFSET SHIFT LEVER ROLL
95 CUP, ISOLATOR
96 SHIFTER ASSEMBLY
97 BOLT, SHIFTER ASSEMBLY
98 BOOT, SHIFTER
99 SEAL AND BOOT, REAR OUTPUT
100 BOLT, TRANSMISSION EXTENSION HOUSING
101 PLUG, DRAIN
102 SHIM, COUNTERSHAFT
103 RACE, COUNTERSHAFT BEARING
104 BEARING, COUNTERSHAFT TAPERED
105 COUNTERSHAFT
106 BEARING, COUNTERSHAFT TAPERED
107 RACE, COUNTERSHAFT BEARING
108 WASHER, THRUST
109 GEAR, 6TH DRIVE
110 BEARING, 6TH GEAR NEEDLE
111 FORK, REVERSE SHIFT
112 PAD, REVERSE SHIFT FORK
113 RING, SNAP
114 RING, 6TH GEAR BLOCKER
115 SPACER
116 RING, SNAP
117 SYNCHRONIZER ASSEMBLY, 5TH/6TH
118 SPRING, 5TH/6TH SYNCHRONIZER
119 KEY, 5TH/6TH SYNCHRONIZER
120 HUB, 5TH/6TH SYNCHRONIZER
121 SLEEVE, 5TH/6TH SYNCHRONIZER
122 FORK, 5TH/6TH SHIFT
123 PAD, 5TH/6TH SHIFT FORK
124 RING, SNAP
125 RING, 5TH GEAR BLOCKER
126 GEAR, 5TH DRIVE
127 BEARING, 5TH GEAR NEEDLE
128 EXTENSION, COUNTERSHAFT
129 BEARING, COUNTERSHAFT EXTENSION TAPERED
130 RACE, COUNTERSHAFT EXTENSION BEARING
131 SHIM, COUNTERSHAFT EXTENSION
132 FUNNEL, OIL
133 BOLT, REVERSE IDLER SHAFT BRACKET
134 BRACKET, REVERSE IDLER SHAFT
135 WASHER, REVERSE IDLER GEAR THRUST
136 GEAR, REVERSE IDLER
137 BEARING, REVERSE IDLER GEAR ROLLER
138 SHAFT, REVERSE IDLER GEAR
139 WASHER, REVERSE IDLER GEAR THRUST
140 RAIL ASSEMBLY, 5TH/6TH SHIFT
141 PIN, ROLL
142 COLLAR
143 RAIL, SHIFT
144 LEVER, 5TH/6TH SHIFT RAIL
145 PAD, 5TH/6TH SHIFT RAIL LEVER
146 BUSHING, 5TH/6TH SHIFT RAIL LEVER
147 PIN, ROLL
148 LEVER, REVERSE SHIFT RAIL
149 RAIL ASSEMBLY, 1ST/2ND 3RD/4TH SHIFT
150 FORK, 1ST/2ND SHIFT
151 PAD, 1ST/2ND SHIFT FORK
152 LINK, SHIFT
153 RAIL ASSEMBLY, 1ST/2ND 3RD/4TH SHIFT
154 PIN, ROLL
155 PIN, SELECTOR
156 PLATE, INTERLOCK
157 LINK, SHIFT
158 FORK, 3RD/4TH SHIFT
159 PAD, 3RD/4TH SHIFT FORK
160 O-RING, REVERSE LOCKOUT ASSEMBLY
161 TUBE, VENT
162 HOUSING, CLUTCH ADAPTER
163 BOLT, CLUTCH ADAPTER HOUSING
164 FORK, CLUTCH
165 T-HANDLE, CLUTCH FORK PIVOT
166 BOLT, CLUTCH FORK PIVOT
167 HOUSING, CLUTCH ACTUATOR ADAPTER
168 BOLT, CLUTCH ACTUATOR ADAPTER HOUSING
169 RING, SNAP
170 PLUNGER, REVERSE LOCKOUT
171 SPRING, REVERSE LOCKOUT OUTER
172 COLLAR, REVERSE LOCKOUT
173 RING, SNAP
174 SPRING, REVERSE LOCKOUT INNER
175 BODY, REVERSE LOCKOUT
176 BODY, REVERSE LOCKOUT
177 BUMPER, TRANSMISSION
178 BOLT, TRANSMISSION ADAPTER PLATE
179 SPACER
180 FITTING, VENT TUBE
181 SOLENOID, COMPUTER AIDED GEAR SELECT
182 PIN, ROLL .
183 LEVER, COMPUTER AIDED GEAR SELECT SOLENOID

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Figure 2 Disassembled View — Legend

7. Rotate transmission in horizontal position, shifter up.
8. Plug (101) and drain transmission fluid.
9. Put transmission in 3rd/4th neutral position.
10. Shifter bolts (97).
11. Shifter (96).

Inspect

- Isolator cup (95) for wear. Replace rear offset shift lever (93) if wear is excessive or isolator cup (95) is loose.

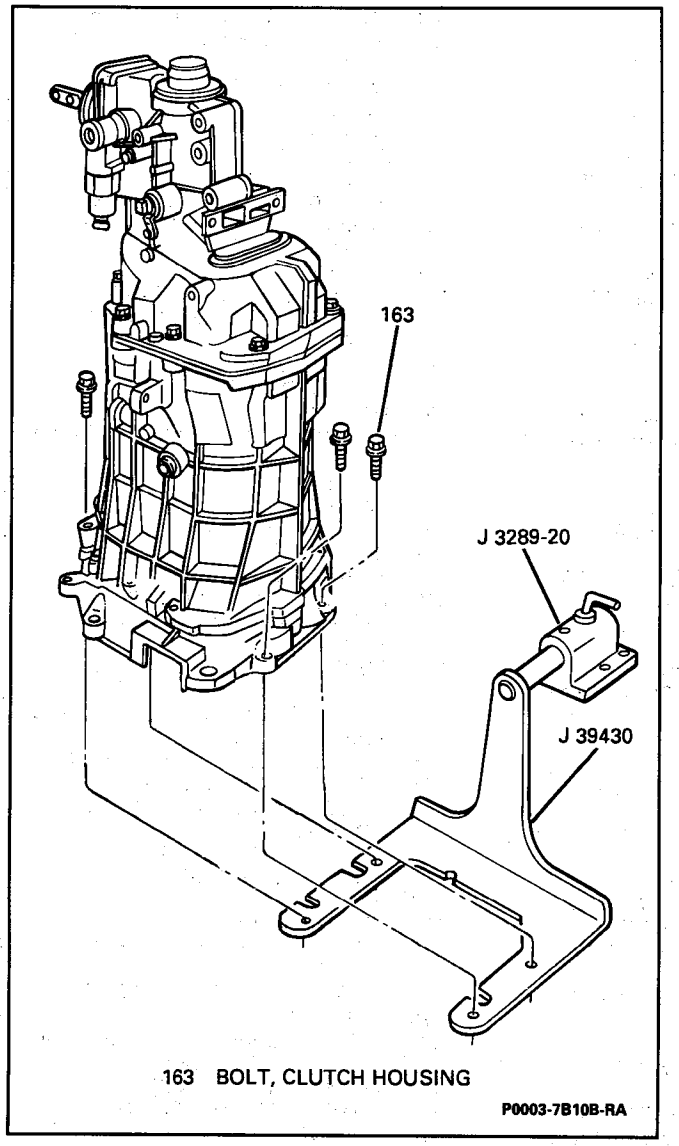


Figure 3 Transmission Support Fixture

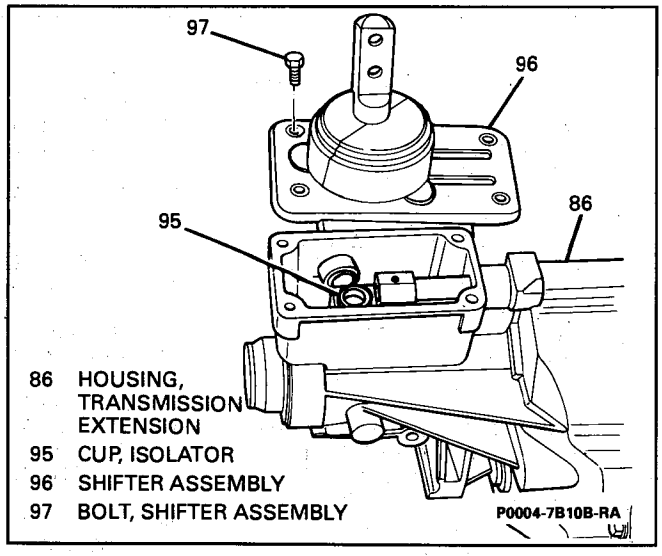


Figure 4 Shifter

EXTENSION HOUSING

Figure 5

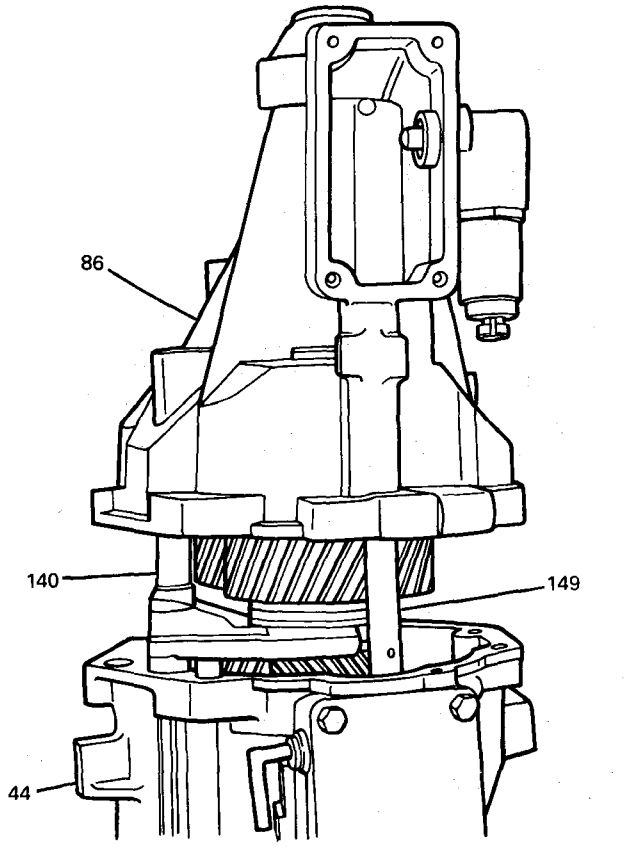
Remove or Disconnect

1. Rear offset shift lever roll pin (94).

Important

- If isolator cup (95) is not fully retained in rear offset lever with adhesive, replace rear offset lever assembly (93).

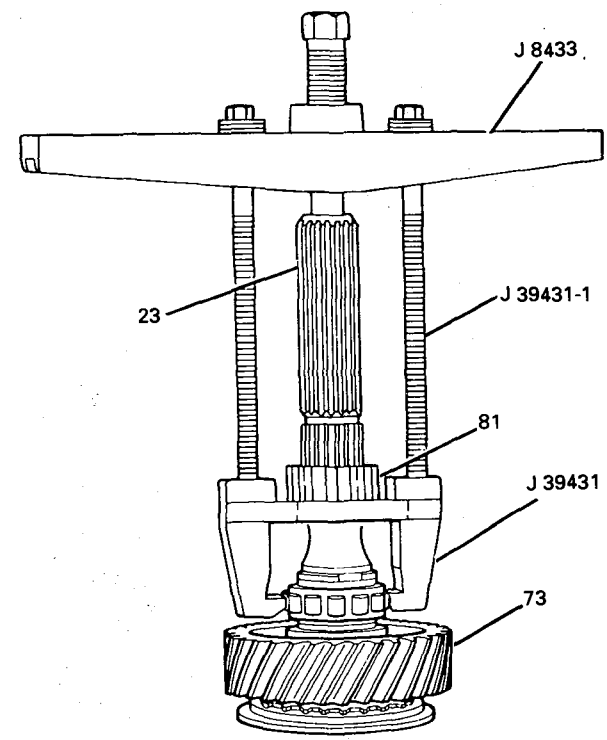
2. Rear offset shift lever (93) and isolator cup (95) assembly.
3. Extension housing bolts (100).
4. Extension housing (86).
   - With transmission in horizontal position, slide extension housing (86) off shift rails (140 and 149).



44 CASE, TRANSMISSION
86 HOUSING, TRANSMISSION EXTENSION
140 RAIL ASSEMBLY, 5TH/6TH SHIFT
149 RAIL ASSEMBLY, 1ST/2ND 3RD/4TH SHIFT

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Figure 5 Extension Housing



23 MAINSHAFT
73 GEAR, REVERSE
81 GEAR, SPEEDOMETER (ELECTRONIC)

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Figure 6 Speedometer Gear

SPEEDOMETER GEAR

Figure 6

Tools Required:

J 8433 Universal Bridge Puller
J 39431 Gear Remover
J 39431-1 Gear Remover Bolts

Remove or Disconnect

1. Rotate transmission in vertical position.
2. Sealing ring.
3. Speedometer gear snap ring (82).
4. Speedometer gear (81) using J 8433, J 39431 and J 39431-1.
   A. Set J 8433 onto nose of main shaft (23).
   B. Slide J 39431 under speedometer gear.
   C. Install bolts J 39431-1 to J 39431.
   D. Speedometer gear (81) using J 8433, J 39431 and J 39431-1.
5. Speedometer gear snap ring (80).

REVERSE SPEED GEAR

Figure 7

Remove or Disconnect

1. Roller bearing snap ring (79).
2. Spacer (78).
3. Roller bearing (77).
4. Spacer (76).
5. Snap ring (75).
6. Thrust washer (74).
7. Reverse speed gear (73).
8. Caged needle bearing (72).
9. Wave washer (71).
10. Blocker ring (70).

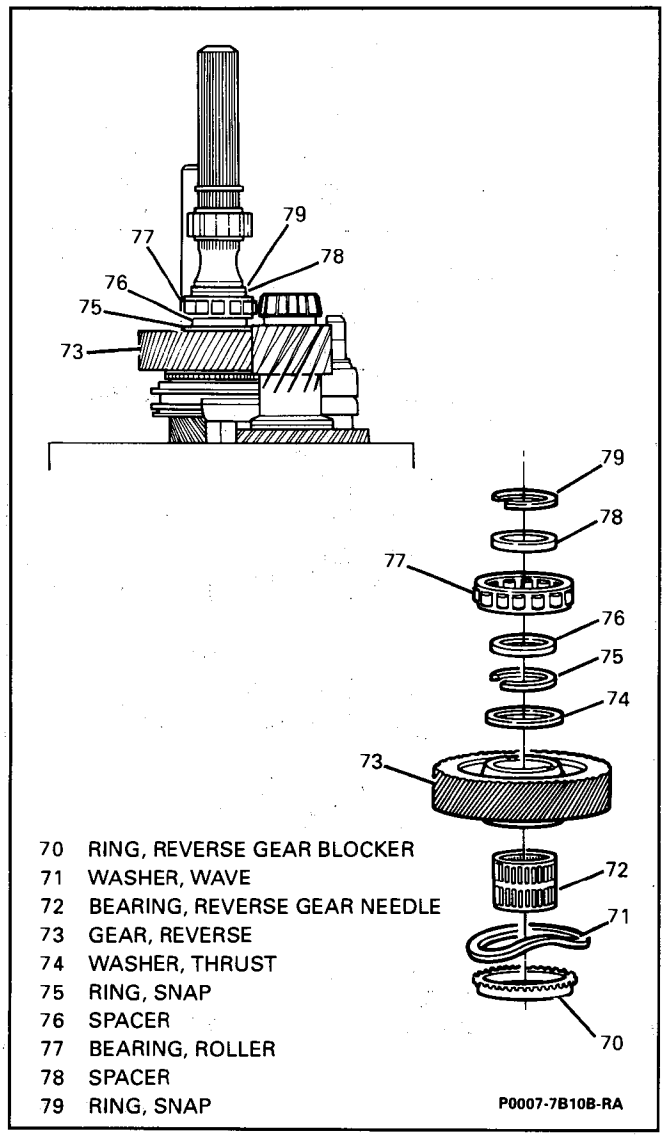


Figure 7 Reverse Speed Gear

REVERSE SHIFT FORK

Figure 8

Remove or Disconnect

1. Reverse synchronizer snap ring (69).
2. Reverse shift fork snap ring (113) and discard.
3. Reverse shift fork (111), synchronizer (62) and thrust washer (68) at the same time.

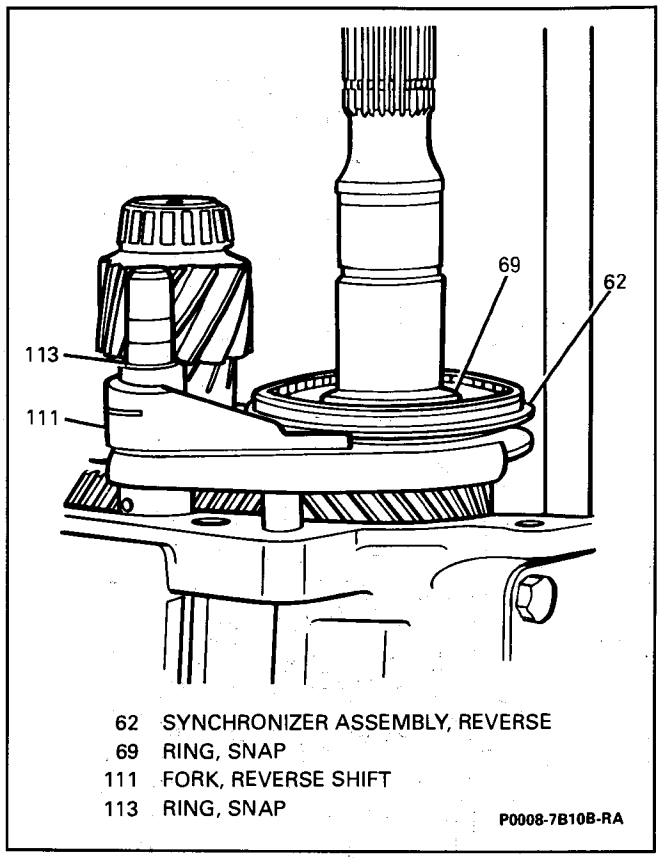


Figure 8 Reverse Shift Fork

5th/6th DRIVEN GEAR

Figure 9

Tools Required:

- J 8433 Universal Bridge Puller
- J 39431 Gear Remover
- J 39431-2 Gear Remover Bolts

Remove or Disconnect

1. 5th/6th driven gear (61) using J 8433, J 39431 and J 39431-2.
   - A. Set J 8433 onto nose of main shaft (23).
   - B. Slide J 39431 under 5th/6th driven gear.
   - C. Install bolts J 39431-2 to J 39431.
   - D. 5th/6th driven gear (61) using J 8433, J 39431 and J 39431-2.

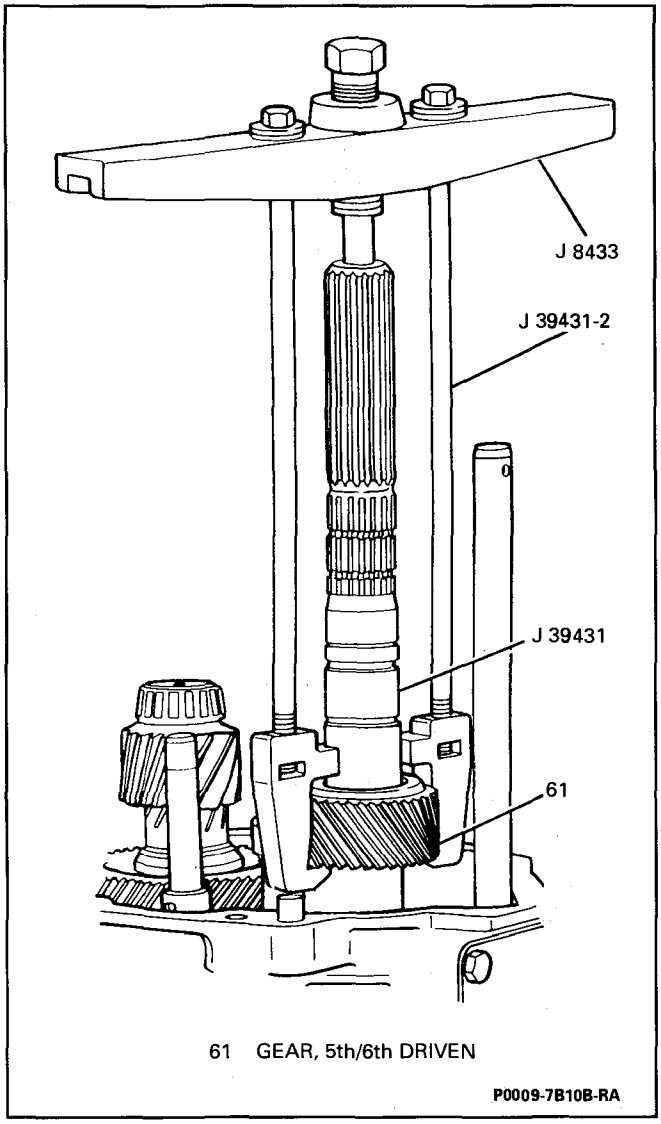


Figure 9 5th/6th Driven Gear

COUNTERSHAFT EXTENSION ASSEMBLY

Figure 10

Remove or Disconnect

1. 5th/6th shift fork snap ring (124).
2. Rotate transmission in horizontal position, guide plate up.
3. Countershaft extension assembly with 5th/6th shift fork (122).

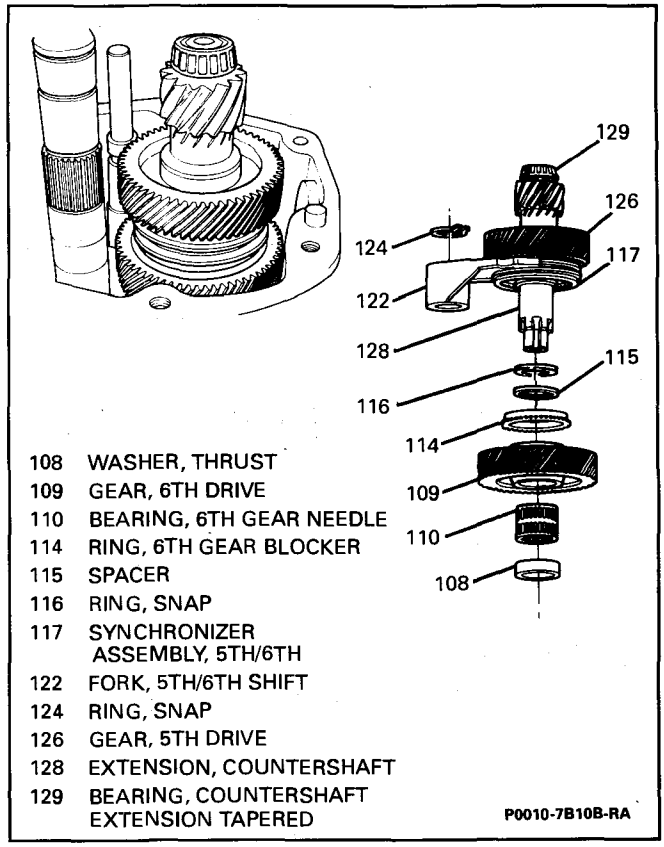


Figure 10 Countershaft Extension Assembly

TRANSMISSION CASE

Figures 11 and 12

Remove or Disconnect

1. Computer aided gear select solenoid (181).
2. Cover plate bolts (47).
3. Cover plate (48).
4. Shift detent assembly (56).
5. Roll pin (182).
6. Front offset lever rollpin (50).
7. 8 of the 10 adapter plate to transmission case bolts (178) .
8. Rotate transmission into vertical position.
9. Last 2 adapter plate to transmission case bolts (178).
10. Shift lever guide bolts (45 and 46).
11. Magnets (57).

12. Transmission case (44) and front offset lever (51).
    - Slide transmission case (44) up off of gear clusters and shift rail components.
    - Hold offset lever (51) against guideplate (55) to prevent release of detent ball (53) and spring (52).
    - Note that the loose detent ball (53) and spring (52) will come out.
    - Remove solenoid lever (183).

Clean

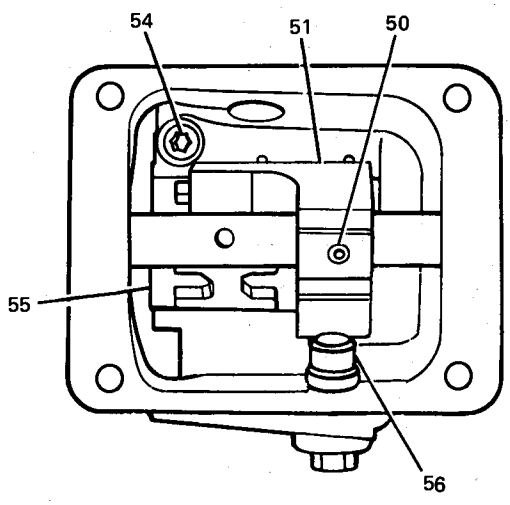
- Shift lever guide bolt threads (45 and 46).
- Case (44) and magnets (57) with solvent and dry with compressed air.

GUIDE PLATE

Figure 11

Remove or Disconnect

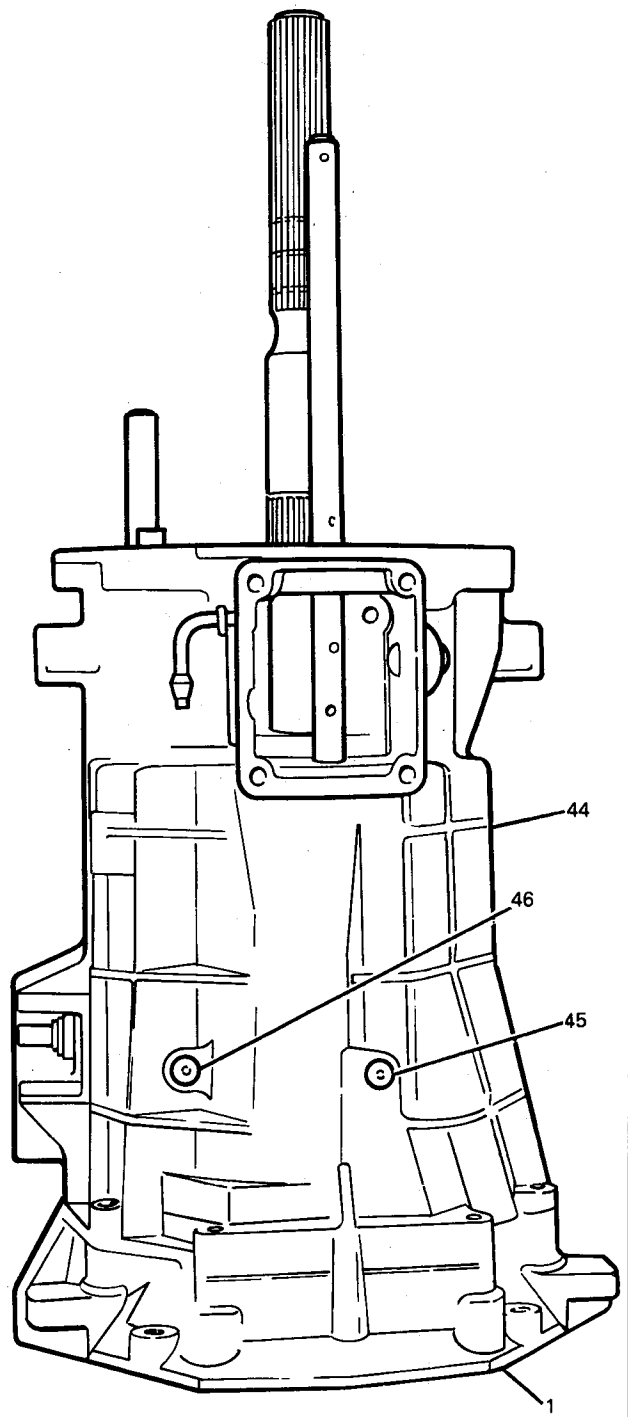
1. Shift guide plate bolts (54).
2. Guide plate (55).



50 PIN, FRONT OFFSET LEVER ROLL
51 LEVER, FRONT OFFSET
54 BOLT, SHIFT GUIDE PLATE
55 PLATE, SHIFT GUIDE
56 ENHANCER, SHIFT

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Figure 11 Shift Detent Assembly



1 PLATE, TRANSMISSION ADAPTER
44 CASE, TRANSMISSION
45 BOLT, SHIFT LEVER GUIDE
46 BOLT, SHIFT LEVER GUIDE

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Figure 12 Transmission Case

SHIFT RAIL ASSEMBLIES AND GEAR CLUSTERS

Figure 13

Remove or Disconnect

1. Rotate 5th/6th and reverse shift rail levers (140) off shift interlock plate (156).
2. 5th/6th and reverse shift rail assembly (140).
3. Countershaft (105).
   - Lift up mainshaft (23) enough to remove countershaft (105).
4. Mainshaft (23) and shift rail assembly (149).
   - Remove components as an assembly.
5. Shift rail assembly (149) from mainshaft (23).
6. 4th gear blocker ring (12).
7. Input shaft (10).

UNIT SUBASSEMBLY REPAIR AND INSPECTION

INPUT SHAFT

Figure 14

Tools Required:

J 5590 Press Tube
J 22912-01 Split Plate
J 23907 Slide Hammer
J 28537-17 Race Installer
J 39594 Race Remover
Hydraulic Press

Disassemble

Important

- Do not replace tapered bearing (9) or race (11) unless inspection shows bearing or race damage.

1. Input shaft tapered bearing (9) from input shaft (10) using J 22912-01 and hydraulic press.
2. Input shaft bearing race (11) using J 23907 and J 39594.

Clean

- Input shaft components with solvent and dry with compressed air.

Inspect

- Input shaft components.
  - Shaft (10) and spline for excessive wear or cracks. Replace if these conditions exist.
  - Gear teeth for excessive wear, pitting, scoring, spalling or fractures.
  - Bearing (9) for roughness of rotation, burred or pitted conditions. Replace if these conditions exist.

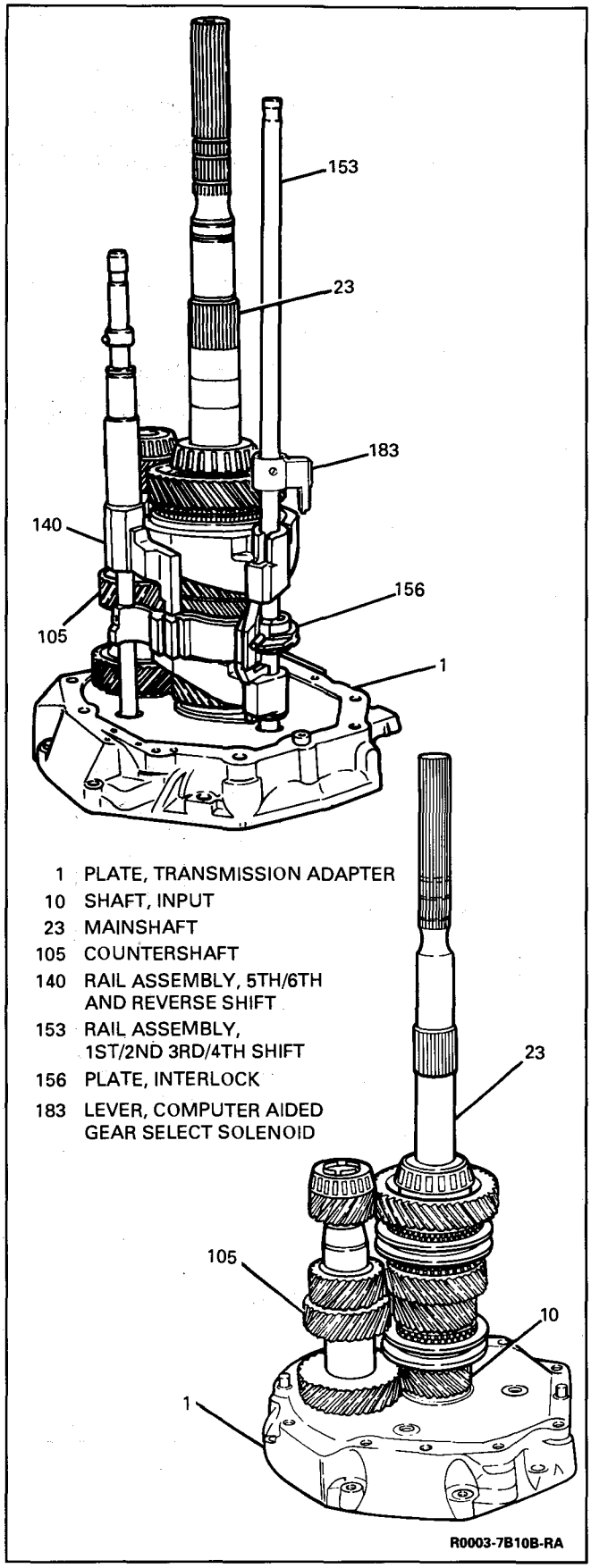


Figure 13 Shift Rail Assemblies and Gear Clusters

- If scuffed, nicked, burred or scoring conditions cannot be reconditioned by hand with a soft stone or crocus cloth, replace the component.
- When replacing bearing (9) also replace bearing race (8).
- When replacing bearing race (11) also replace bearing (22).

Assemble

1. New bearing race (11) to input shaft (10) using J 28537-17 hydraulic press.
2. New input shaft tapered bearing (9) to input shaft (10) using J 5590 and hydraulic press.

MAINSHAFT

Figure 15

Tools Required:

J 36183 Press Tube
J 36184 Press Tube Adapter
J 36513 Split Plate
J 39371 1st/2nd Synchronizer Installer
J 39442 Press Adapter
J 39443 Split plate
J 39473 Bearing Installer/Press Adapter
Hydraulic Press
V-Blocks

Disassemble

Important

- Identify and mark blocker rings. DO NOT MIX.

1. Mainshaft large tapered bearing (42) and O-ring.
2. 1st speed gear (41).
3. 1st speed gear caged needle bearing (40).
4. Snap ring (39).
5. 1st speed gear blocker ring assembly.
   A. Thrust washer (38).
   B. Inner cone (37).
   C. Friction cone (36).
   D. Blocker ring (35).
6. 2nd speed gear (25) using J 36513 and hydraulic press.
   - 1st/2nd synchronizer assembly (30), 2nd speed gear blocker ring (29), friction cone (28), 2nd speed gear inner cone (27), and thrust washer (26), will press off with 2nd speed gear (25).
7. 2nd speed gear caged needle bearing (24).
8. 3rd/4th synchronizer snap ring (13).
9. 3rd speed gear (20) using J 39473, V-blocks and hydraulic press.
   - 3rd/4th synchronizer assembly (14) and 3rd speed gear blocker ring (19) will press off with 3rd speed gear (20).
10. Spacer (179).
11. 3rd speed gear caged needle bearing (21).

Important

- Do not replace tapered bearing (22) unless inspection shows bearing damage.

12. Mainshaft small tapered bearing (22) using J 39442, J 39443 and hydraulic press.
    - Discard small tapered bearing (22).

Clean

- Mainshaft components with solvent and dry with compressed air.

Inspect

- Mainshaft components.
  - Shaft (23) and spline for excessive wear or cracks. Replace if these conditions exist.
  - Gear teeth (20, 25 and 41) for excessive wear, pitting, scoring, spalling or fractures.
  - Bearings (22 and 42) for roughness of rotation, burred or pitted conditions. Replace if these conditions exist.
  - Synchronizers (14 and 30). Refer to "Synchronizers" in this section.
- When replacing bearings (22 or 42) also replace bearing races (11 or 43).
- If scuffed, nicked, burred or scoring conditions cannot be reconditioned by hand with a soft stone or crocus cloth, replace the component.

Assemble

1. New mainshaft small tapered bearing (22) using J 39473, V-blocks and hydraulic press.
2. 3rd speed gear caged needle bearing (21).
3. Spacer (179).
4. 3rd speed gear (20).
5. 3rd speed gear blocker ring (19).

Important

- When pressing the 3rd/4th synchronizer assembly (14):
  A. Start press operation. STOP before keys engage blocker ring slots.
  B. Lift and rotate 3rd speed gear (20) to engage keys with blocker ring.
  C. Continue to press until seated.

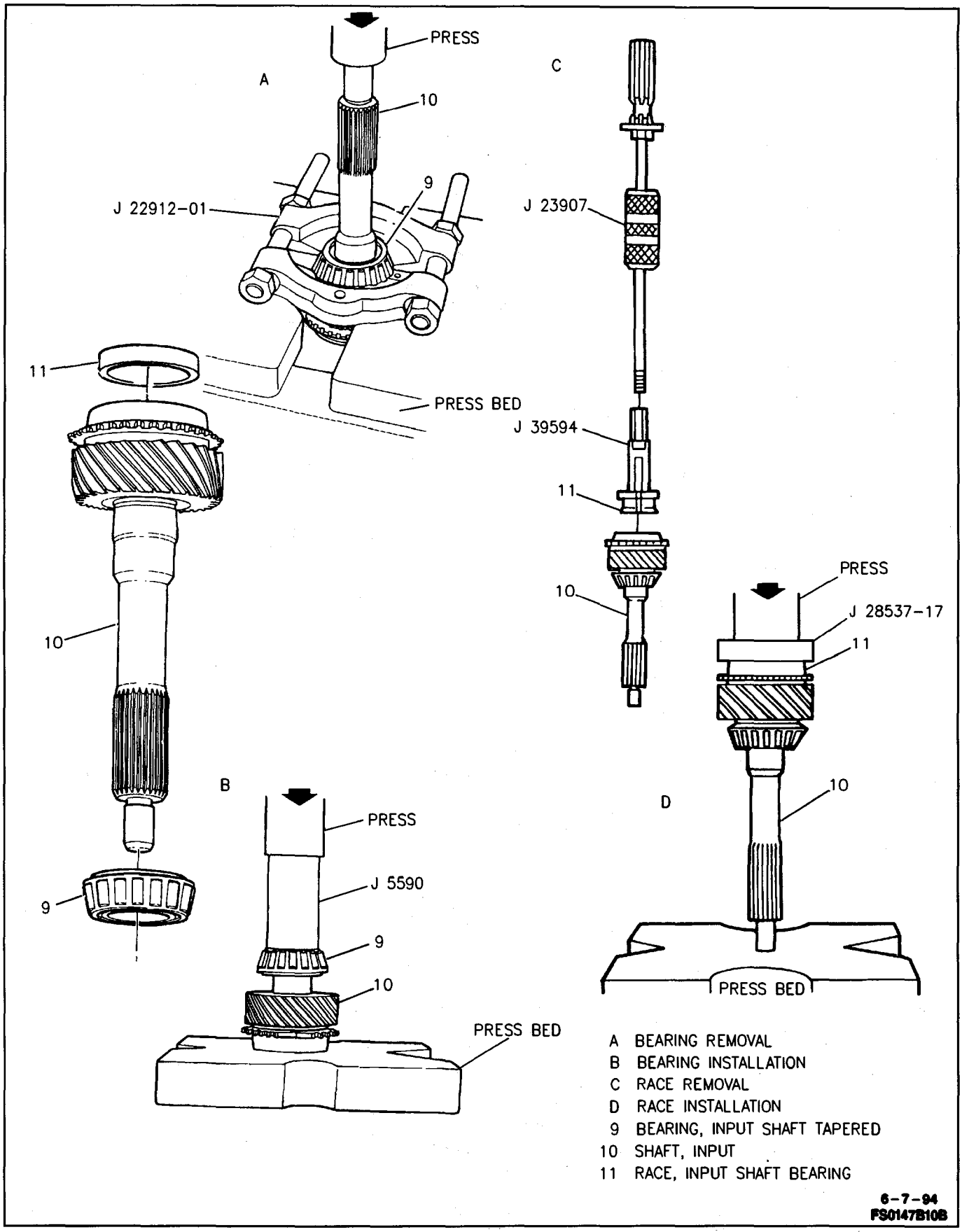
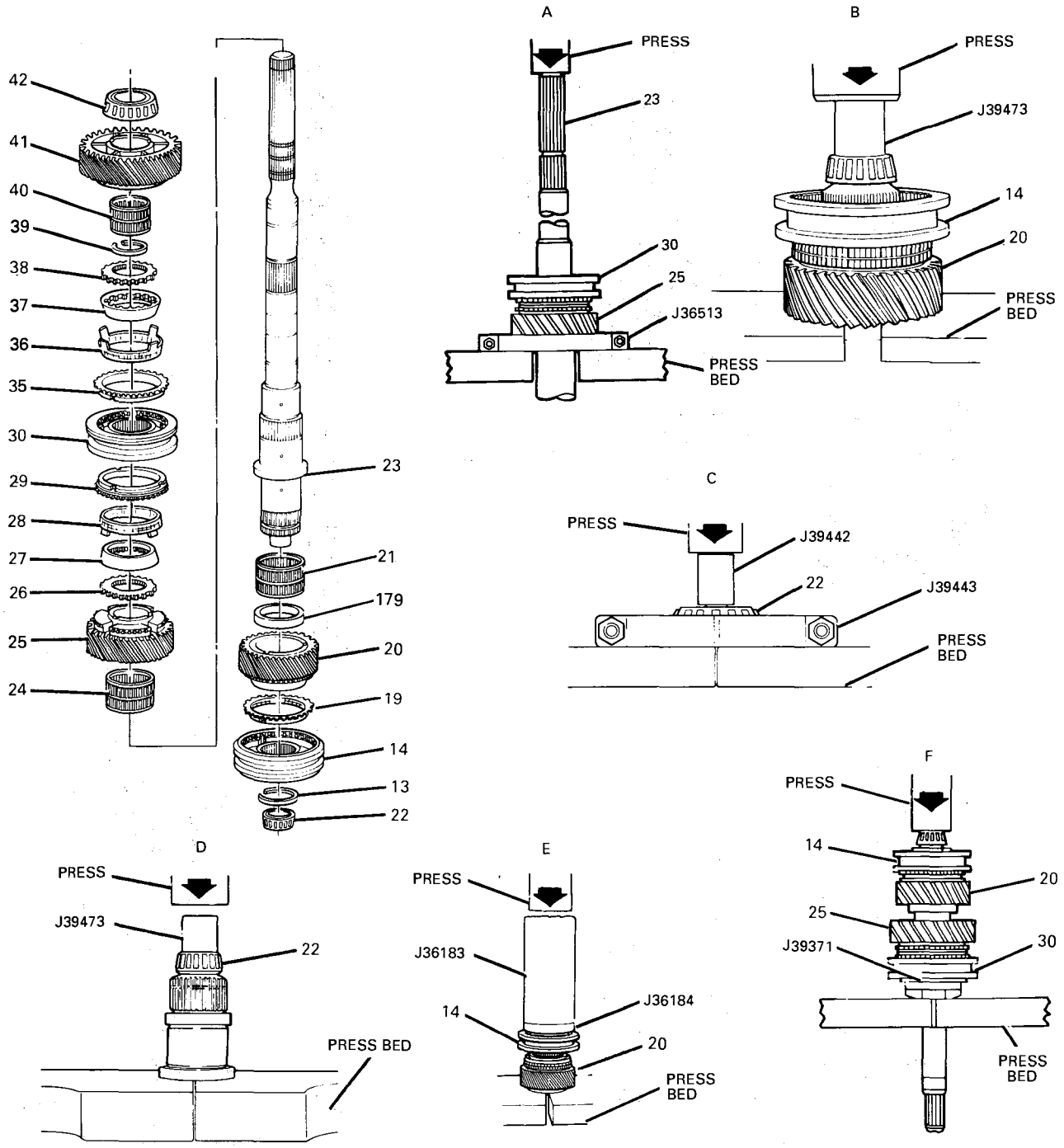


Figure 14 Input Shaft



A	2ND GEAR REMOVAL	22	BEARING, MAINSHAFT SMALL TAPER	37	CONE, INNER
B	3RD GEAR REMOVAL	23	MAINSHAFT	38	WASHER, THRUST
C	BEARING REMOVAL	24	BEARING, 2ND GEAR NEEDLE	39	RING, SNAP
D	BEARING INSTALLATION	25	GEAR, 2ND SPEED	40	BEARING, 1ST GEAR NEEDLE
E	3RD/4TH SYNCHRONIZER INSTALLATION	26	WASHER, THRUST	41	GEAR, 1ST SPEED
F	1ST/2ND SYNCHRONIZER INSTALLATION	27	CONE INNER	42	BEARING, MAINSHAFT LARGE TAPERED
13	RING, SNAP	28	CONE, FRICTION		
14	SYNCHRONIZER ASSEMBLY, 3RD/4TH	29	RING, 2ND GEAR BLOCKER	179	SPACER
19	RING, 3RD GEAR BLOCKER	30	SYNCHRONIZER ASSEMBLY, 1ST/2ND		
20	GEAR, 3RD SPEED	35	RING, 1ST GEAR BLOCKER		
21	BEARING, 3RD GEAR NEEDLE	36	CONE, FRICTION		

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Figure 15 Mainshaft

6. 3rd/4th synchronizer assembly (14) using J 36183, J 36184 and hydraulic press.
   - Install 3rd/4th synchronizer so ID groove on sleeve faces 3rd gear.
7. 3rd/4th synchronizer snap ring (13).
8. 2nd speed gear caged needle bearing (24).
9. 2nd speed gear (25).
10. Thrust washer (26).
11. 2nd speed gear inner cone (27).
12. Friction cone (28).
13. 2nd speed gear blocker ring (29).

Important

- When pressing the 1st/2nd synchronizer assembly (30):
  A. Start press operation. STOP before keys engage blocker ring slots.
  B. Lift and rotate 2nd speed gear (25) to engage keys with blocker ring.
  C. Continue to press until seated.

14. 1st/2nd synchronizer assembly (30) using J 39371 and hydraulic press.
    - Install 1st/2nd synchronizer so ID groove on sleeve faces 1st gear.
15. 1st speed gear blocker ring assembly.
    A. Blocker ring (35).
    B. Friction cone (36).
    C. Inner cone (37).
    D. Thrust washer (38).
16. Snap ring (39).
17. 1st speed gear caged needle bearing (40).
18. 1st speed gear (41).
19. Mainshaft large tapered bearing (42) and O-ring.

COUNTERSHAFT

Figure 16

Tools Required:

J 5590 Press Tube
J 22912-01 Split Plate
J 39438 Large Countershaft Bearing Installer
J 39473 Press Adapter
J 39511 Split Plate
J 39547 Press Adapter
Hydraulic Press
V-Blocks

Disassemble

Important

- Do not replace tapered bearings (104 and 106) unless inspection shows bearing damage.

1. Small tapered bearing (104) using J 22912-01, J 39473 and hydraulic press.
   - Discard tapered bearing (104).
2. Large tapered bearing (106) using J 39511, J 39547 and hydraulic press.
   - Discard tapered bearing (106).

Clean

- Countershaft with solvent and dry with compressed air.

Inspect

- Countershaft components.
  - Shaft (105) for excessive wear or cracks. Replace if these conditions exist.
  - Gear teeth for excessive wear, pitting, scoring, spalling or fractures.
  - Bearings (104 and 106) for roughness of rotation, burred or pitted conditions. Replace if these conditions exist.
- When replacing bearings (104 or 106) also replace bearing races (103 or 107).
- If scuffed, nicked, burred or scoring conditions cannot be reconditioned by hand with a soft stone or crocus cloth, replace the component.

Assemble

1. New large tapered bearing (106) using J 39438 and hydraulic press.
2. New small tapered bearing (104) using J 5590 and hydraulic press.

COUNTERSHAFT EXTENSION ASSEMBLY

Figure 17

Tools Required:

J 5590 Press Tube
J 22910-01 Split Plate
J 39442 Press Adapter
J 39443 Split Plate
J 39473 Bearing Installer
Hydraulic Press
V-Blocks

Disassemble

1. 5th/6th shift fork (122).
2. Thrust washer (108).
3. 6th drive gear (109).
4. Caged needle bearing (110).
5. Spacer (115).
6. 6th drive gear blocker ring (114).

7. 5th/6th synchronizer snap ring (116) and discard.
8. 5th drive gear (126) using J 22910-01 and hydraulic press.
   - 5th/6th synchronizer assembly (117) and 5th drive gear blocker ring (125) will press off with 5th drive gear (126).
9. 5th drive gear caged needle bearing (127).

Important

- Do not replace small tapered bearing (129) unless inspection shows bearing damage.

10. Small tapered bearing (129) using J 39442, J 39443 and hydraulic press.

Clean

- Countershaft extension components with solvent and dry with compressed air.

Inspect

- Countershaft extension components.
  - Shaft (128) and spline for excessive wear or cracks. Replace if these conditions exist.
  - Gear teeth (109 and 126) for excessive wear, pitting, scoring, spalling or fractures.
  - Bearing (129) for roughness of rotation, burred or pitted conditions. Replace if these conditions exist.
  - Synchronizer (117). Refer to "Synchronizers" in this section.
- When replacing bearing (129) also replace bearing race (130).
- If scuffed, nicked, burred or scoring conditions cannot be reconditioned by hand with a soft stone or crocus cloth, replace the component.

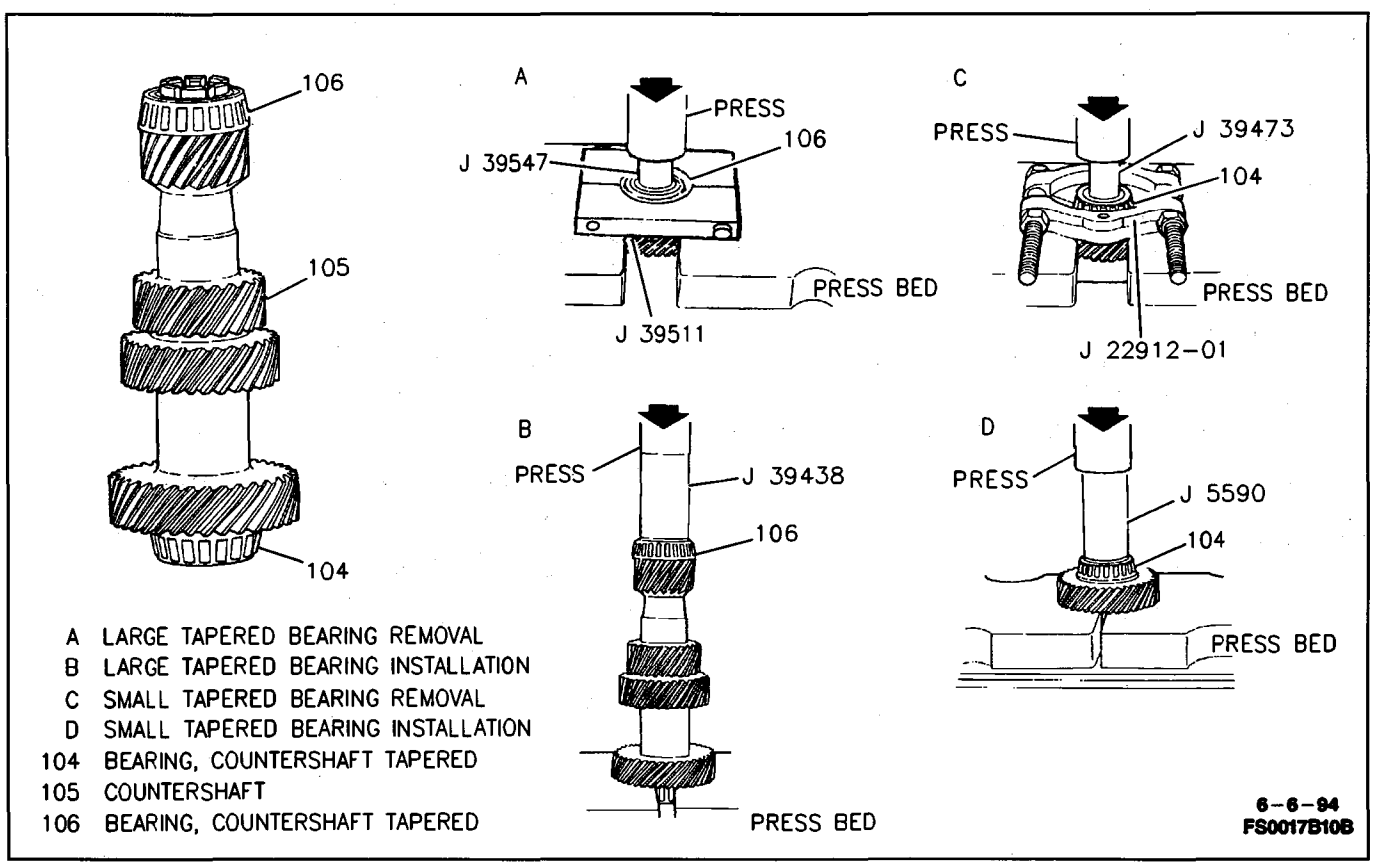


Figure 16 Countershaft

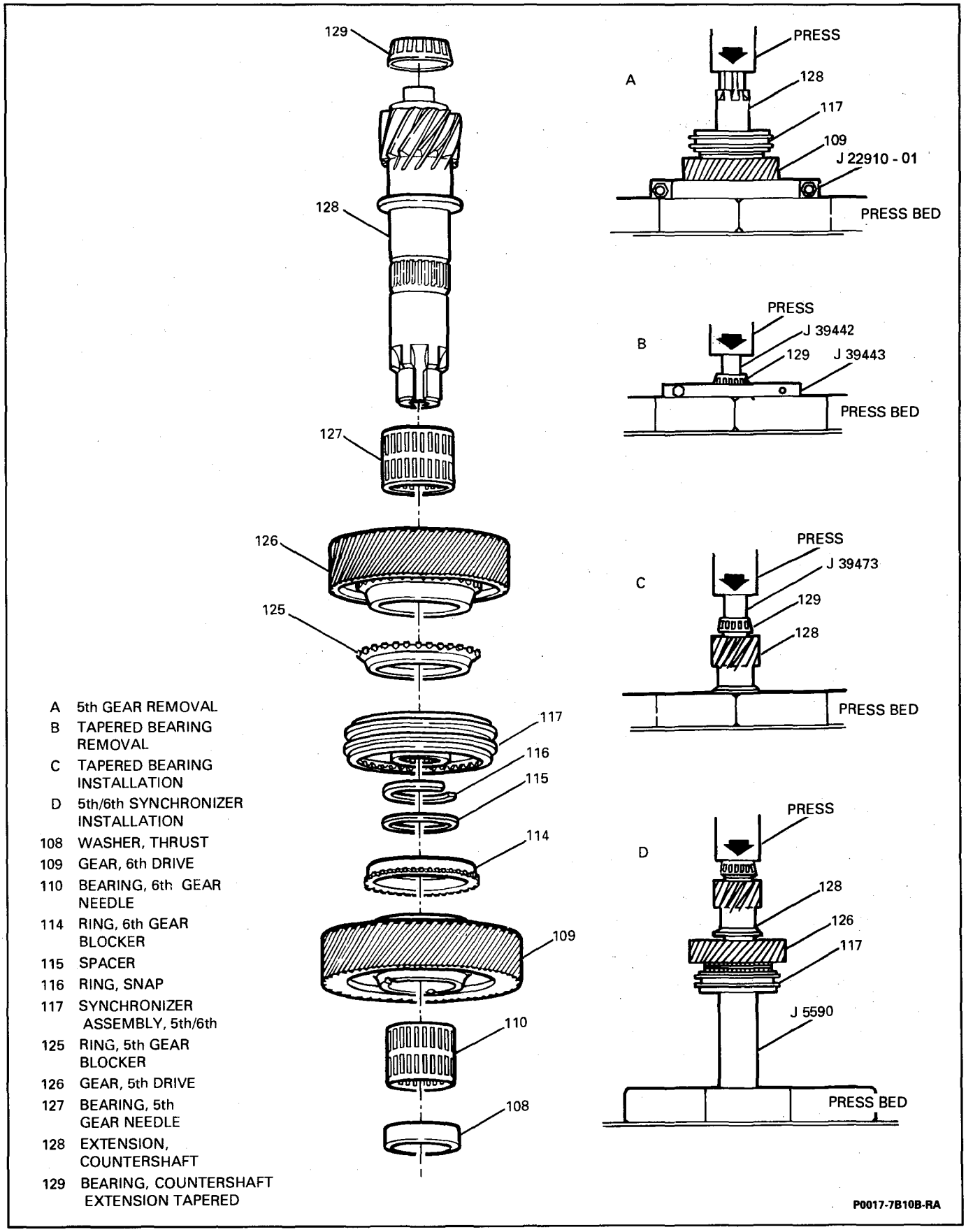


Figure 17 Countershaft Extension

Assemble

1. New small tapered bearing (129) using J 39473, V-blocks and hydraulic press.
2. 5th drive gear caged needle bearing (127).
3. 5th drive gear (126).
4. 5th drive gear blocker ring (125).

Important

- When pressing the 5th/6th synchronizer assembly (117):
  - A. Start press operation. STOP before keys engage blocker ring slots.
  - B. Lift and rotate 5th drive gear (126) to engage keys with blocker ring.
  - C. Continue to press until seated.

5. 5th/6th synchronizer assembly (117) using J 5590 and hydraulic press.
   - Install 5th/6th synchronizer so ID groove on sleeve faces 5th gear.
6. New 5th/6th synchronizer snap ring (116).
7. 6th drive gear blocker ring (114).
8. 6th drive gear spacer (115).
9. 6th drive gear caged needle bearing (110).
10. 6th drive gear (109).
11. 6th drive gear thrust washer (108).
12. 5th/6th shift fork (122).

SYNCHRONIZERS

1st/2nd, 3rd/4th, 5th/6th Synchronizers

Figures 18, 19, 20 and 22

Important

- Synchronizer components are not interchangeable. Keep synchronizer components separate.
- Synchronizer hubs and sleeves are a selected assembly and should be kept together as originally assembled.

Disassemble

1. Synchronizer spring (15), (31), (118) using a small-bladed screwdriver.
2. Turn synchronizer assembly (14), (30), (117) over.
3. Synchronizer spring (15), (31), (118) using a small-bladed screwdriver.
4. Keys (16), (32), (119).
5. Synchronizer sleeve (18), (34), (121) from hub (17), (33), (120).

Clean

- Synchronizer components with solvent and dry with compressed air.

Inspect

- Synchronizer components.
  - – Teeth for wear, nicked, burred or broken teeth. Replace hub and sleeve if excessive wear exists.
  - – Keys for wear or distortion. Replace if these conditions exist.
  - – Springs for distortion, cracks or wear. Replace if these conditions exist.
- If scuffed, nicked or burred conditions cannot be corrected by hand with a soft stone or crocus cloth, replace the component.

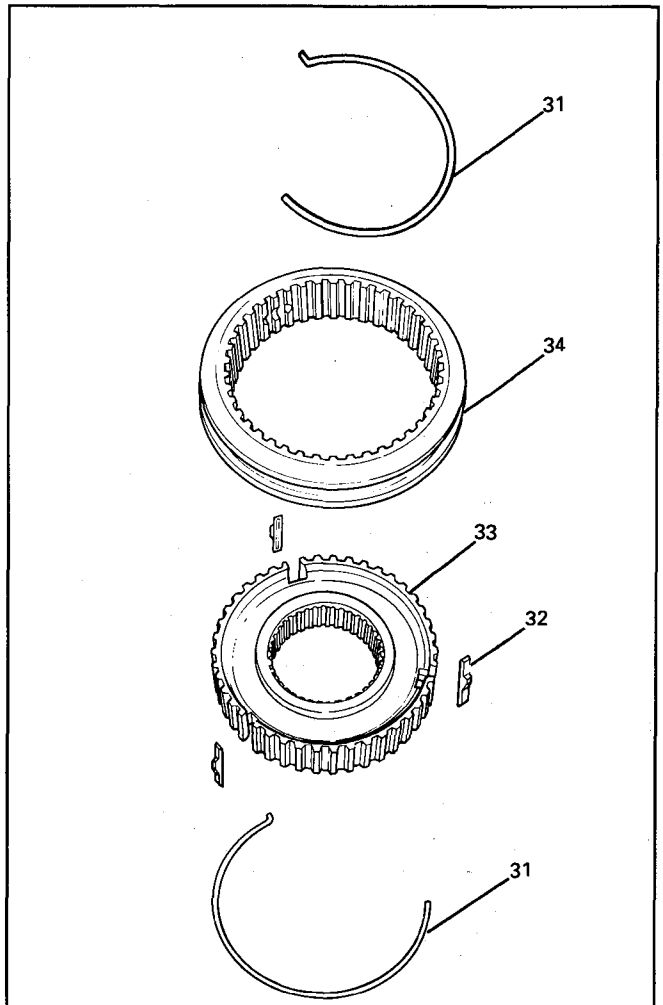


Figure 18 1st/2nd Synchronizer

Assemble

1. Synchronizer sleeve (18), (34), (121) to hub (17), (33), (120).
   - Align key openings in hub (17), (33), (120) with cuts in synchronizer sleeve (18), (34), (121).
2. Keys (16), (32), (119) with slots facing hub (17), (33), (120).
3. Synchronizer spring (15), (31), (118) using a small-bladed screwdriver.
   - Locate spring tang to one of the key slots.
4. Turn synchronizer assembly (14), (30), (117) over.
5. Synchronizer spring (15), (31), (118) using a small-bladed screwdriver.
   - Locate spring tang on same key but wind in opposite direction.

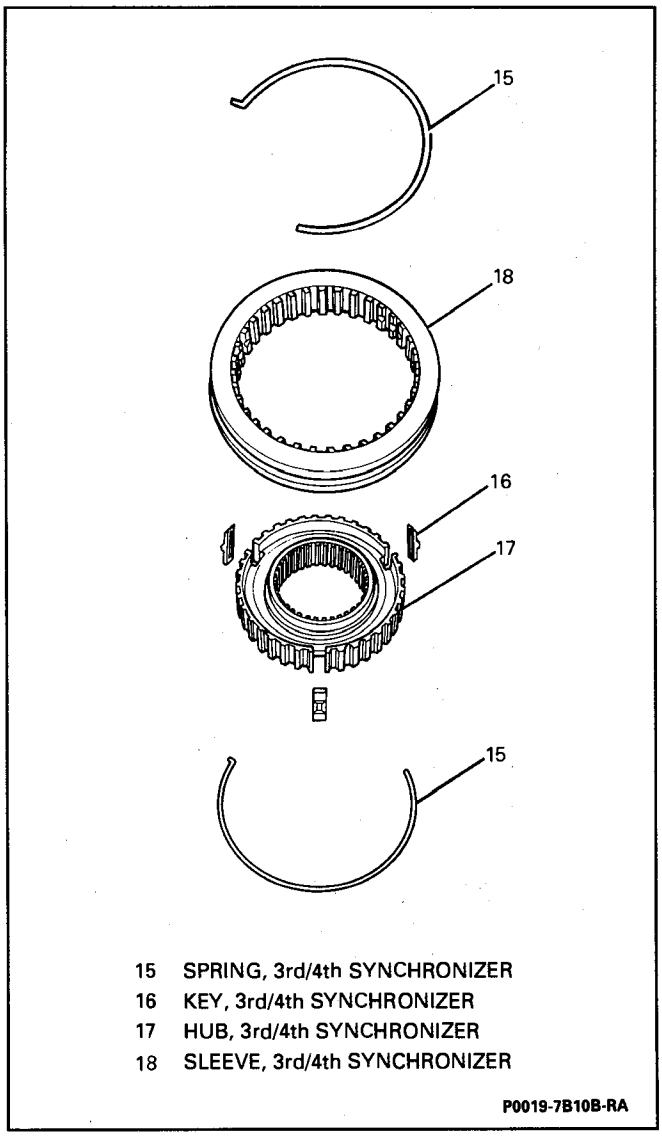


Figure 19 3rd/4th Synchronizer

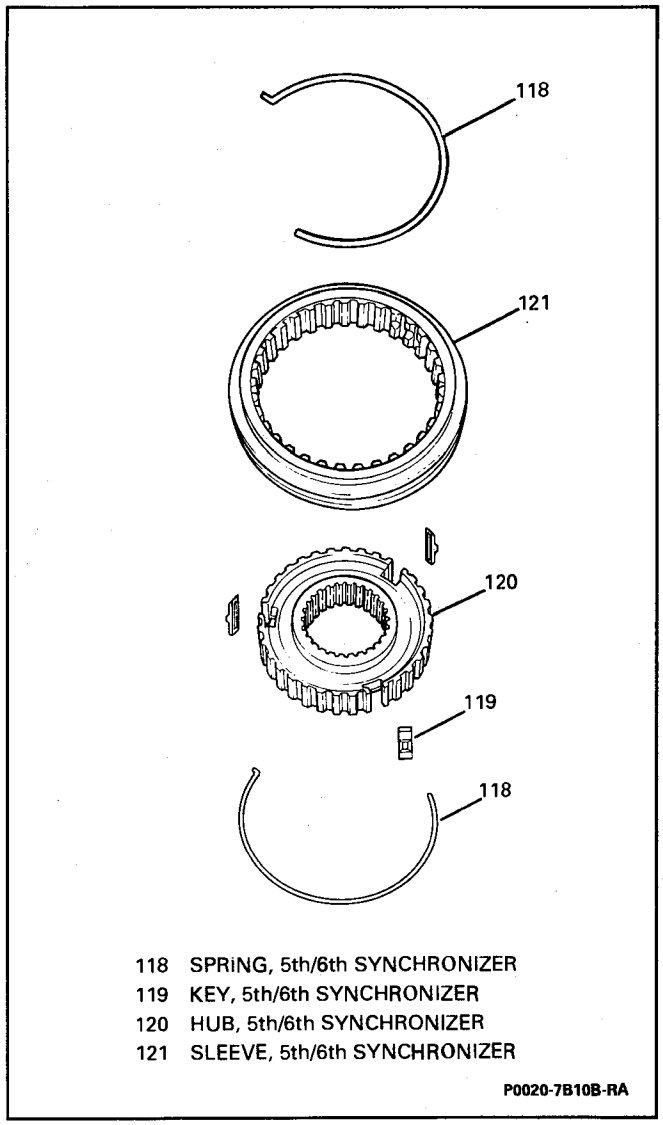


Figure 20 5th/6th Synchronizer

Reverse Synchronizer

Figure 21

Disassemble

1. Synchronizer spring (63) using a small-bladed screwdriver.
2. Synchronizer sleeve (66) from hub (65) by pressing against inner hub (65).
3. Turn hub (65) over.
   - Keys (64) will slide out from hub (65).
4. Synchronizer key retainer (67) using a small-bladed screwdriver through key slots of hub (65) and discard retainer (67).
5. Synchronizer spring (63) using a small-bladed screwdriver.

Clean

- Synchronizer components with solvent and dry with compressed air.

Inspect

- Synchronizer components.
  - Teeth for wear, nicked, burred or broken teeth. Replace hub and sleeve if excessive wear exists.
  - Keys for wear or distortion. Replace if these conditions exist.
  - Springs for distortion, cracks or wear. Replace if these conditions exist.
  - Retainer for distortion. Replace if this condition exists.
- If scuffed, nicked or burred conditions cannot be corrected by hand with a soft stone or crocus cloth, replace the component.

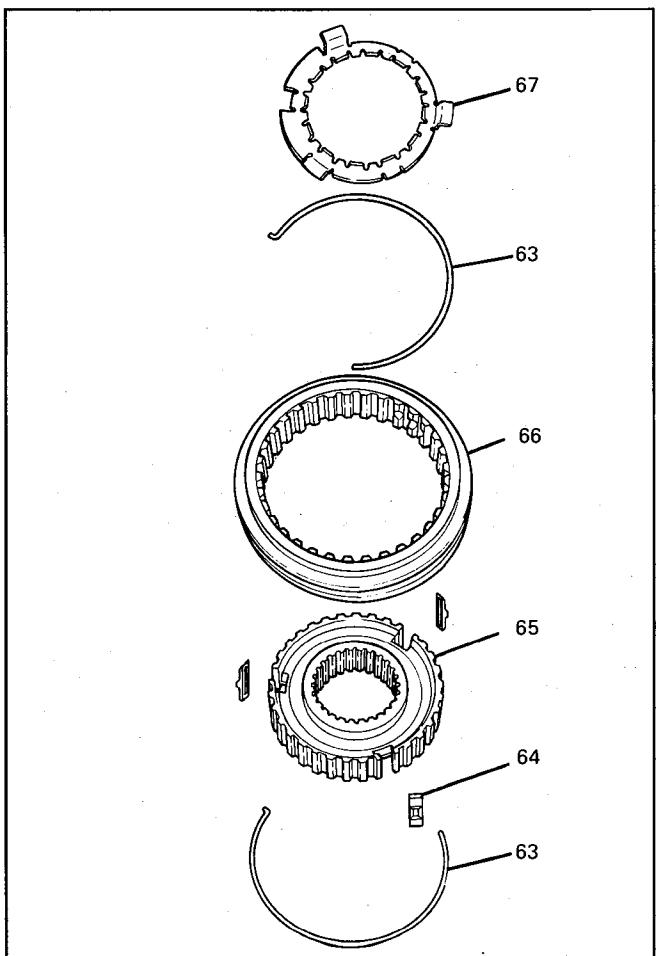


Figure 21 Reverse Synchronizer

Assemble

1. Synchronizer sleeve (66) to hub (65).
   - Align key openings in hub (65) with cuts in synchronizer sleeve (66).
2. Keys (64) with slots facing hub (65).
3. Synchronizer spring (63) using a small-bladed screwdriver.
   - Locate spring tang to one of the key slots.
4. Turn synchronizer assembly (62) over.
5. Synchronizer spring (63) using a small-bladed screwdriver.
   - Locate spring tang on same key but wind in opposite direction.
6. New synchronizer key retainer (67).
   - Locate key retainer tangs over synchronizer keys (64).

Synchronizer Blocker Ring Inspection

Figure 22

- Inspect the gear cones, clutch teeth and blocker rings for excessive wear.
- Inspect the synchronizer sleeve and gear clutch teeth for evidence of gear clash or cause of hop-out.
- Measure the gap between the blocker ring and the speed gear. Make sure the correct blocker ring is measured with the correct gear and the blocker ring is fully seated on the gear.
- Replace blocker rings for 1st, 2nd, 3rd, 4th, 5th and 6th gears if the wear gap is less than 0.38 mm (0.015 in.).
- Replace the reverse blocker ring if the wear gap is less than 0.75 mm (0.030 in.), when measured without the wave washer (71) in between the blocker ring and reverse gear.

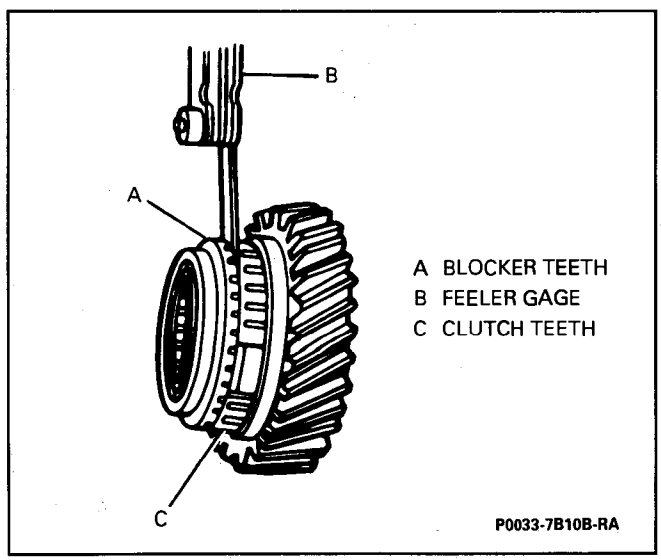


Figure 22 Measuring Blocker Ring Wear

SHIFT RAIL AND FORK ASSEMBLIES

1st/2nd, 3rd/4th Shift Rail Assembly

Figure 23

Disassemble

1. Rotate selector pin (155) until opposite shift links (152 and 157).
2. 3rd/4th shift fork (158) with shift link (157) from rail (153).
3. 1st/2nd shift fork (150) with shift link (152) from rail (153).
4. Roll pin (182) and computer aided gear select solenoid lever (183) from rail (153).
5. Interlock plate (156) from rail (153).
6. Selector pin roll pin (154).
7. Selector pin (155).

Clean

- Shift rail and fork assembly components with solvent and dry with compressed air.

Inspect

- Shift rail and fork assembly components.
  - Rail (153) for excessive wear or burrs. Replace if these conditions exist.
  - Shift forks (150 and 158) for excessive wear, fracture or distortion. Replace if these conditions exist.
  - Shift links (152 and 157) for excessive wear, fracture or distortion. Replace if these conditions exist.
  - Shift fork nylon inserts (151 and 159) for excessive wear. Replace if this condition exists.

Assemble

1. Selector pin (155).
2. Selector pin roll pin (154).
3. Interlock plate (156) to rail (153).
4. 1st/2nd shift fork (150) with shift link (152) to rail (153).
5. Computer aided gear select solenoid lever (183) to rail (153).
6. Roll pin (182) to lever (183).
7. 3rd/4th shift fork (158) with shift link (157) to rail (153).
8. Align selector pin (155) with slots in shift links (152 and 157).

5th/6th, Reverse Shift Rail Assembly

Figure 23

Tool Required:

J 23907 Slide Hammer
J 36800 Bushing Remover
J 39437 Bushing Installer

Disassemble

1. Collar roll pin (141).
2. Collar (142).
3. 5th/6th shift rail lever (144) from rail (143).

Important

- Do not replace bushings (146) unless inspection shows bushing damage.

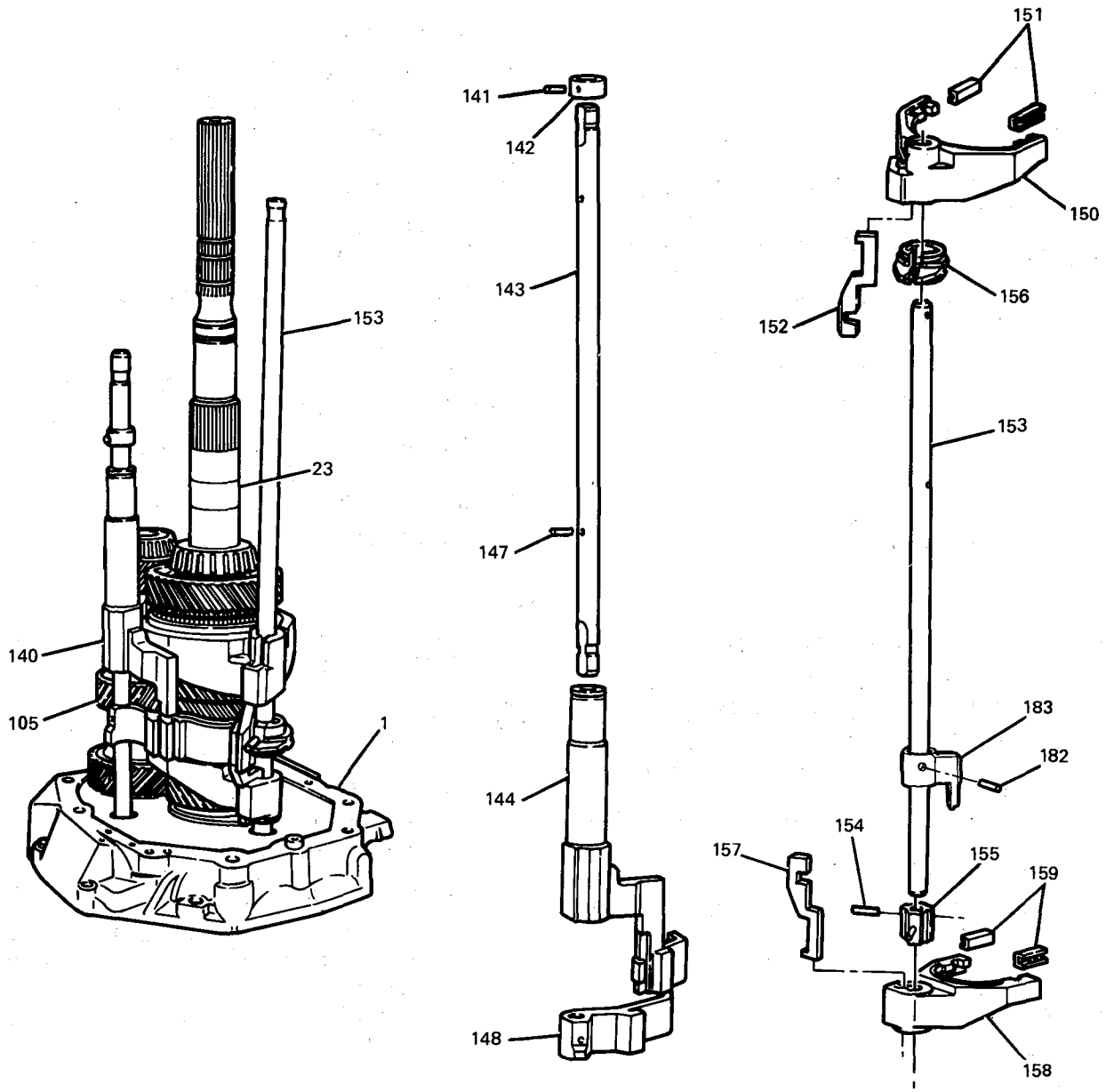
4. 5th/6th shift rail lever bushings (146) using J 23907 and J 36800.
5. Reverse shift rail lever roll pin (147).
6. Reverse shift rail lever (148) from rail (143).

Clean

- Shift rail assembly components with solvent and dry with compressed air.

Inspect

- Shift rail assembly components.
  - Rail (143) for excessive wear or burrs. Replace if these conditions exist.
  - Shift rail levers (144 and 148) for excessive wear, fracture or distortion. Replace if these conditions exist.
  - Shift rail lever nylon insert for excessive wear. Replace if this condition exists.
  - Shift rail lever bushings (146) for excessive wear. Replace if this condition exists.



1	PLATE, TRANSMISSION ADAPTER
23	MAINSHAFT
105	COUNTERSHAFT
140	RAIL ASSEMBLY, 5TH/6TH AND REVERSE SHIFT
141	PIN, ROLL
142	COLLAR
143	RAIL, SHIFT
144	LEVER, 5TH/6TH SHIFT RAIL
147	PIN, ROLL
148	LEVER, REVERSE SHIFT RAIL
150	FORK, 1ST/2ND SHIFT
151	PAD, 1ST/2ND SHIFT FORK
152	LINK, SHIFT
153	RAIL ASSEMBLY, 1ST/2ND 3RD/4TH SHIFT
154	PIN, ROLL
155	PIN, SELECTOR
156	PLATE, INTERLOCK
157	LINK, SHIFT
158	FORK, 3RD/4TH SHIFT
159	PAD, 3RD/4TH SHIFT FORK
182	PIN, ROLL
183	LEVER, COMPUTER AIDED GEAR SELECT SOLENOID

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Figure 23 Shift Rail and Fork Assemblies

Assemble

1. Reverse shift rail lever (148) to rail (143).
   - Locate reverse shift rail lever (148) to roll pin hole at opposite end of rail (143) from snap ring groove.
     - Notched edge of reverse shift rail lever should face towards other roll pin hole.
2. Reverse shift rail lever roll pin (147).
3. 5th/6th shift rail lever bushings (146) using J 39437.
4. 5th/6th shift rail lever (144) to rail (143).
5. Collar (142).
6. Collar roll pin (141).

TRANSMISSION ADAPTER PLATE

Figure 24

Tools Required:
- J 23907 Slide Hammer
- J 39439-2 Bushing Remover
- J 39433 Input Shaft Seal Installer
- J 39437 Bushing Installer

Disassemble

1. Input shaft bearing race (8) and shim (7).
2. Countershaft bearing race (103) and shim (102).
3. Adapter plate plug (2).
4. Input shaft seal (6).

Important
- Do not replace bushing (5) unless inspection shows bushing damage.

5. 1st/2nd, 3rd/4th shift rail bushing (5) using J 23907 and J 39439-2 .
6. Dowel pins (3 and 4).

Clean
- Adapter plate components with solvent and dry with compressed air.

Inspect
- Adapter plate components.
  - Bearing races (8 and 103) and bores for wear, scratches or grooves.
  - Bushing (5) for excessive wear or burrs. Replace if this condition exists.
  - Case for cracks, sealing surfaces for nicks, burrs or scratches. If case is cracked, it must be replaced.
- If scratches, grooves or nicks cannot be removed by hand with a soft stone or crocus cloth, replace the components.

Assemble

1. Dowel pins (3 and 4).
2. 1st/2nd, 3rd/4th shift rail bushing (5) using J 39437.
3. Input shaft seal (6) using J 39433.

Important
- Do not install shims (102 and 7) until after performing "Shimming Procedures" later in this section.

4. Countershaft bearing race (103).
5. Input shaft bearing race (8).

TRANSMISSION CASE

Figure 25

Tools Required
- J 8092 Drive Handle
- J 36190 Drive Handle
- J 39435 Mainshaft and Countershaft Bearing Race Installer
- J 23907 Slide Hammer
- J 39439-4 Bushing Installer
- J 39439-3 Bushing Installer
- J 39439-2 Bushing Remover
- J 39790 Mainshaft Bearing Race Remover
- J 39791 Countershaft Bearing Race Remover

Disassemble

1. Guide plate bolts (54) and guide plate (55).
2. Fill plug (60).
3. Backup lamp switch (59).
4. Computer aided gear select solenoid (185).
5. Dowel pins (58).

Important
- Do not replace bearing races (107 and 43) unless inspection shows bearing race damage.

6. Countershaft bearing race (107) using J 8092 and J 39791.
7. Mainshaft bearing race (43) using J 8092 and J 39790.
8. 1st/2nd, 3rd/4th shift rail bushings (49) using J 23907 and J 39439-2.

Clean
- Transmission case components with solvent and dry with compressed air.

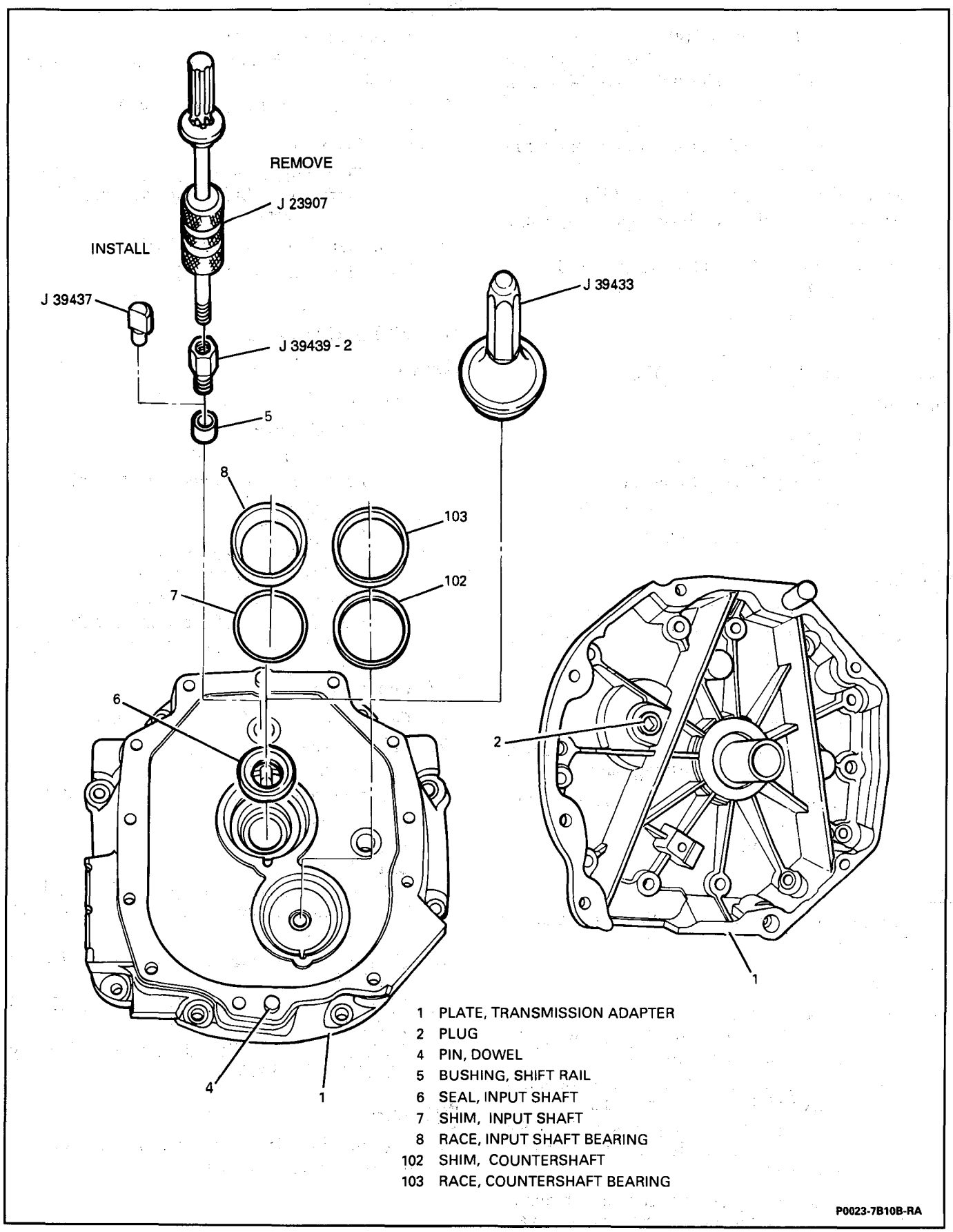


Figure 24 Transmission Adapter Plate

Inspect

- Transmission case components.
  - Bearing races (43 and 107) and bores for wear, scratches or grooves.
  - Bushing (49) for excessive wear. Replace if this condition exists.
  - Case (44) for cracks, threaded openings for damaged threads, sealing surfaces for nicks, burrs or scratches. If case is cracked, it must be replaced.
- If scratches, grooves or scoring cannot be removed by hand with a soft stone or crocus cloth, replace the component.

Assemble

1. 1st/2nd, 3rd/4th shift rail bushings (49) using J 36190, J 39439, and J 39439-3
2. Mainshaft bearing race (43) using J 8092 and J 39435.
3. Countershaft bearing race (107) using J 8092 and J 39435 .
4. Dowel pins (58).
5. Computer aided gear select solenoid (185).
6. Backup lamp switch (59).

Tighten

- Switch (59) to 27 N·m (20 lb. ft.)

7. Fill plug (60) with sealant GM p/n 1052080.

Tighten

- Fill plug (60) to 18 N·m (13 lb. ft.).

8. Guide plate (55) and guide plate bolts (54).

Tighten

- Bolts (54) to 22 N·m (16 lb. ft.).

EXTENSION HOUSING

Figure 26

Tools Required:

J 8092 Drive Handle
J 39439-1 Bushing Remover
J 39440 Rear Boot and Seal Installer
J 39546 Bearing Race Installer
J 39789 Bearing Race Remover
J 39437 Bushing Installer
J 41099 Reverse Solenoid Socket

Disassemble

1. Reverse idler shaft bracket bolts (133).
2. Reverse idler shaft bracket (134).
3. Reverse idler gear thrust washer (135).
4. Reverse idler gear (136).
5. Roller bearing (137).
6. Thrust washer (139).
7. Reverse idler shaft (138).
8. Countershaft extension bearing race (130).
9. Shim (131).
10. Funnel (132).
11. Plug (101).
12. Reverse lockout assembly bolt (90).

CAUTION: The reverse lockout assembly is under spring pressure. Exercise caution when removing snap ring (173), as bodily injury may result.

13. Reverse lockout assembly (91).
    A. Reverse lockout solenoid (89) from reverse lockout body (175) using J 41099.
    B. O-ring (160) from body (175).
    C. Snap ring (169) from body (175).
    D. Reverse lockout inner spring (174).
    E. Compress reverse lockout plunger (170) and collar (172) in vise and remove snap ring (173).
    F. Reverse lockout plunger (170).
    G. Reverse lockout outer spring (171).
    H. Reverse lockout collar (172).
14. Vehicle speed sensor bolt (88).
15. Vehicle speed sensor (87) and clamp.
    - O-ring seal from vehicle speed sensor (87).
16. Rear seal and boot (99).
    - Pry out seal and boot (99) with suitable tool.
17. Mainshaft bearing race snap ring (84).

Important

- Do not replace bearing race (85) unless inspection shows bearing race damage.

18. Mainshaft bearing race (85) using J 8092 and J 39789.

Important

- Do not replace bushing (92) unless inspection shows bushing damage.

19. Shift rail bushing (92) using J 36190 and J 39439-1

Clean

- Extension housing components with solvent and dry with compressed air.

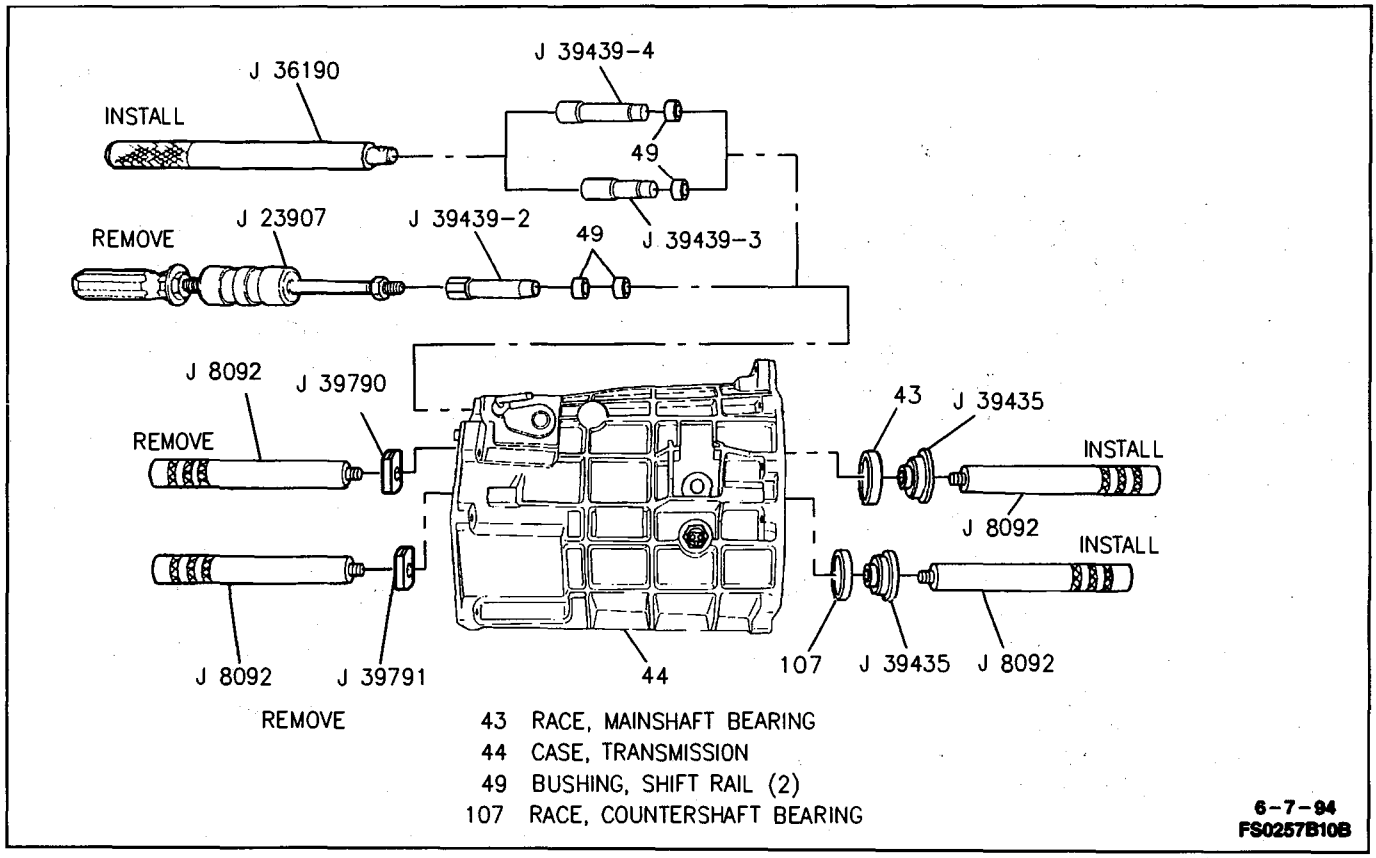


Figure 25 Transmission Case

Inspect

- Extension housing components.
  - Bearing races (85 and 130) and bores for wear, scratches or grooves.
  - Bushing (92) for excessive wear or burrs. Replace if this condition exists.
  - Case (86) for cracks, sealing surfaces for nicks, burrs or scratches. If case is cracked, it must be replaced.
- If scratches, grooves or nicks cannot be removed by hand with a soft stone or crocus cloth, replace the component.

Assemble

1. Shift rail bushing (92) using J 39437 .
2. Mainshaft bearing race (85) using J 8092 and J 39546.
3. Mainshaft bearing race snap ring (84).
4. Rear seal and boot (99) using J 39440
   - Locate drain hole in rear seal and boot (99) down.
5. O-ring seal to vehicle speed sensor (87).
6. Vehicle speed sensor (87) and clamp.
7. Vehicle speed sensor bolt (88).

   Tighten
   - Bolt (88) to 10 N·m (84 lb. in.)

   CAUTION: The reverse lockout assembly is under spring pressure. Exercise caution when installing snap ring (173), as bodily injury may result.

8. Assemble reverse lockout body assembly.
   A. Reverse lockout plunger (170).
   B. Reverse lockout outer spring (171).
   C. Reverse lockout collar (172).
   D. Compress reverse lockout plunger (170), collar (172) and outer spring (171) in vise and install snap ring (173).
   E. Reverse lockout inner spring (174).
   F. Install reverse lockout components in lockout body (175) and install snap ring (169).
   G. Reverse lockout solenoid (89) to reverse lockout body assembly (91) using J 41099.

      Tighten
      - Solenoid (89) to 40 N·m (30 lb. ft.).

   H. O-ring (160) to body assembly (91).

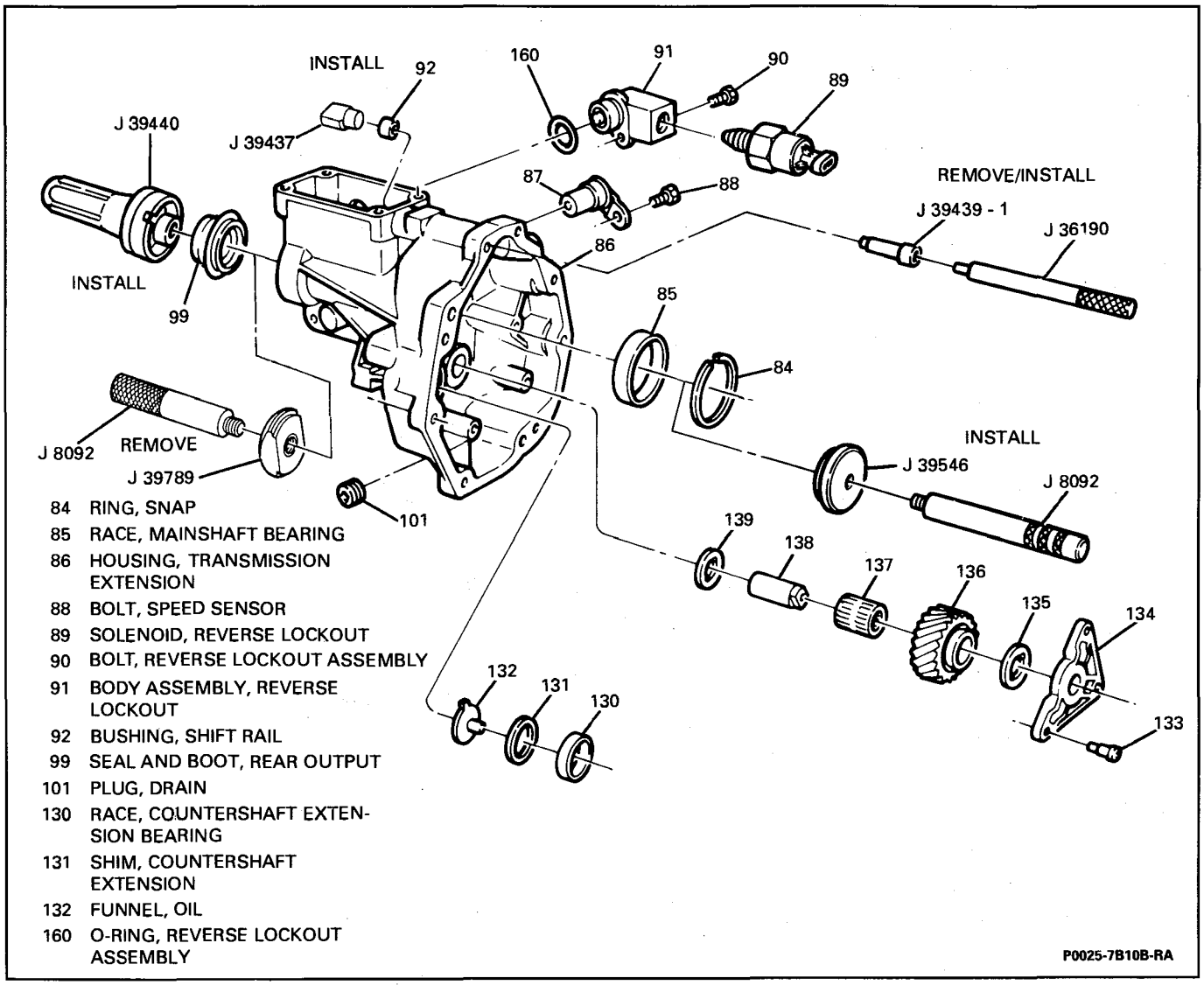


Figure 26 Transmission Extension Housing

10. Reverse lockout assembly.
11. Reverse lockout assembly bolt (90).

Tighten

- Bolt (90) to 18 N·m (13 lb. ft.).

12. Plug (101) with sealant GM p/n 1052080.

Tighten

- Plug (101) to 18 N·m (13 lb. ft.).

13. Countershaft extension bearing race (130).

Important

- Do not install shim (131) until after performing "Shimming Procedures" later in this section.

UNIT ASSEMBLY

SHIFT RAIL ASSEMBLIES AND GEAR CLUSTERS

Figure 27

Tool Required:

J 36850 Transmission Assembly Lube

Install or Connect

- Lubricate all components as assembly progresses. Use J 36850 Transmission Assembly Lube or equivalent.

1. Selective shims (7 and 102). Refer to "Input Shaft/Mainshaft and Countershaft" under "Shimming Procedures" in this section.
2. Input shaft bearing race (8).
3. Countershaft bearing race (103).
4. Input shaft (10) and 4th gear blocker ring (12).
5. Shift rail assembly (149) to mainshaft assembly.
6. Mainshaft assembly with shift rail assembly (149).
7. Countershaft assembly.
   A. Lift up mainshaft assembly enough to install countershaft assembly.
   B. Countershaft assembly.
   C. Lift mainshaft assembly enough to rotate input shaft (10) to engage synchronizer keys (16) with 4th gear blocker ring (12).
8. 5th/6th and reverse shift rail (140).
   - Align slots of shift rail levers with interlock plate (156).

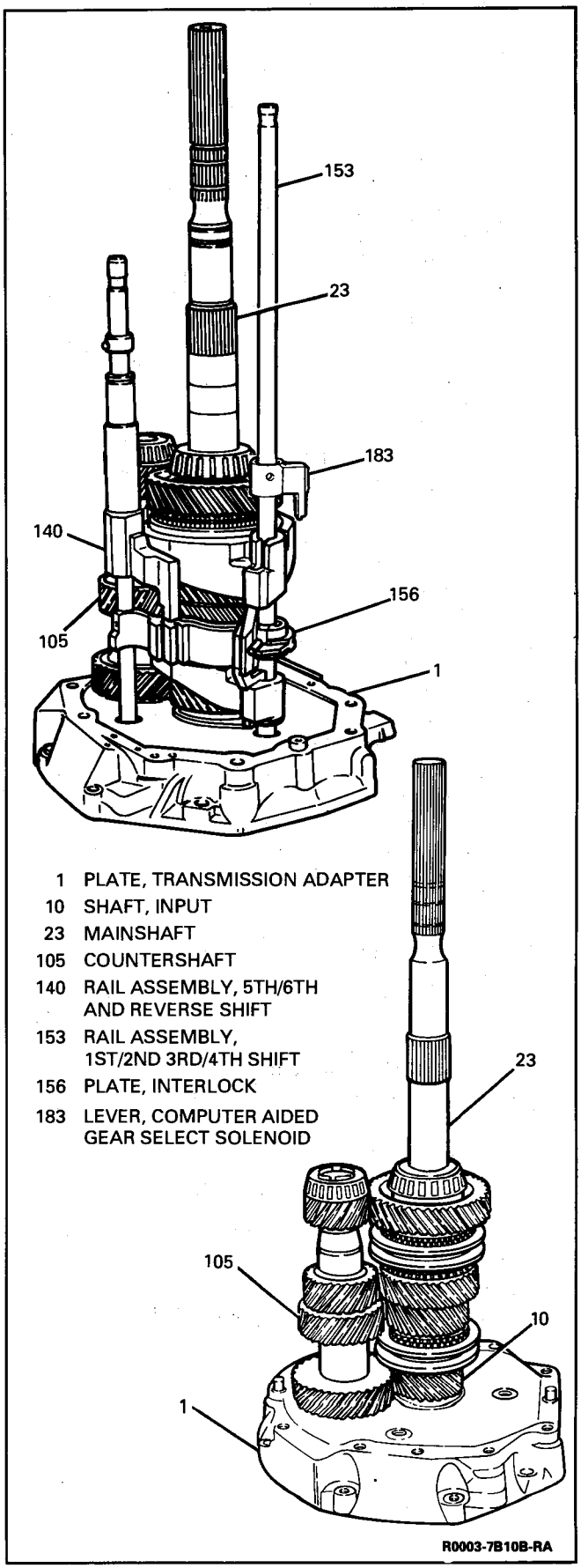


Figure 27 Shift Rail Assemblies and Gear Clusters

GUIDE PLATE

Figure 28

Tool Required:

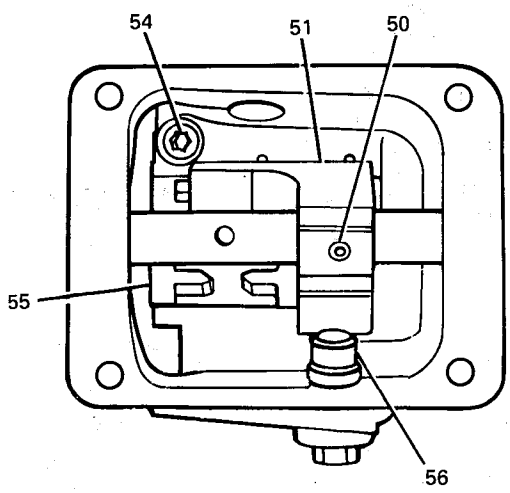
J 36850 Transmission Assembly Lube

Install or Connect

1. Guide plate (55).
2. Shift guide plate bolts (54).

Tighten

- Bolts (54) to 22 N·m (16 lb. ft.).



50 PIN, FRONT OFFSET LEVER ROLL
51 LEVER, FRONT OFFSET
54 BOLT, SHIFT GUIDE PLATE
55 PLATE, SHIFT GUIDE
56 ENHANCER, SHIFT

P0011-7B10B-RA

Figure 28 Shift Detent Assembly

TRANSMISSION CASE

Figures 28 and 29

Tool Required:

J 36850 Transmission Assembly Lube

Install or Connect

- Lubricate all components as assembly progresses. Use J 36850 Transmission Assembly Lube.

1. Sealant GM p/n 12345739 at transmission case to adapter plate mating surface.
   - Assemble ball detent in offset lever.
2. Transmission case (44) and front offset lever (51).

Important

- Make sure transmission is in NEUTRAL to keep 3rd/4th shift rail from engaging.
- Install solenoid lever (183).
- Compress front offset lever (51) together while sliding onto shift rail (149) to prevent spring release of inner components.
- Slide transmission case (44) onto gear clusters and shift rail components.

3. Shift lever guide bolts (45 and 46).
   - Apply anaerobic threadlocker GM p/n 12345382 to threads of shift lever guide bolts (45 and 46).
   - Pull up on 5th/6th and reverse shift rail assembly (140) enough to align the slot of the shift interlock plate (156) with guide bolt hole.

Tighten

- Bolts (45 and 46) to 27 N·m (20 lb. ft.).

4. Adapter plate to transmission case bolts (178).

Tighten

- Bolts (178) to 35 N·m (26 lb. ft.).

5. Front offset lever roll pin (50).
6. Roll pin (182).
7. Shift detent assembly (56).

Tighten

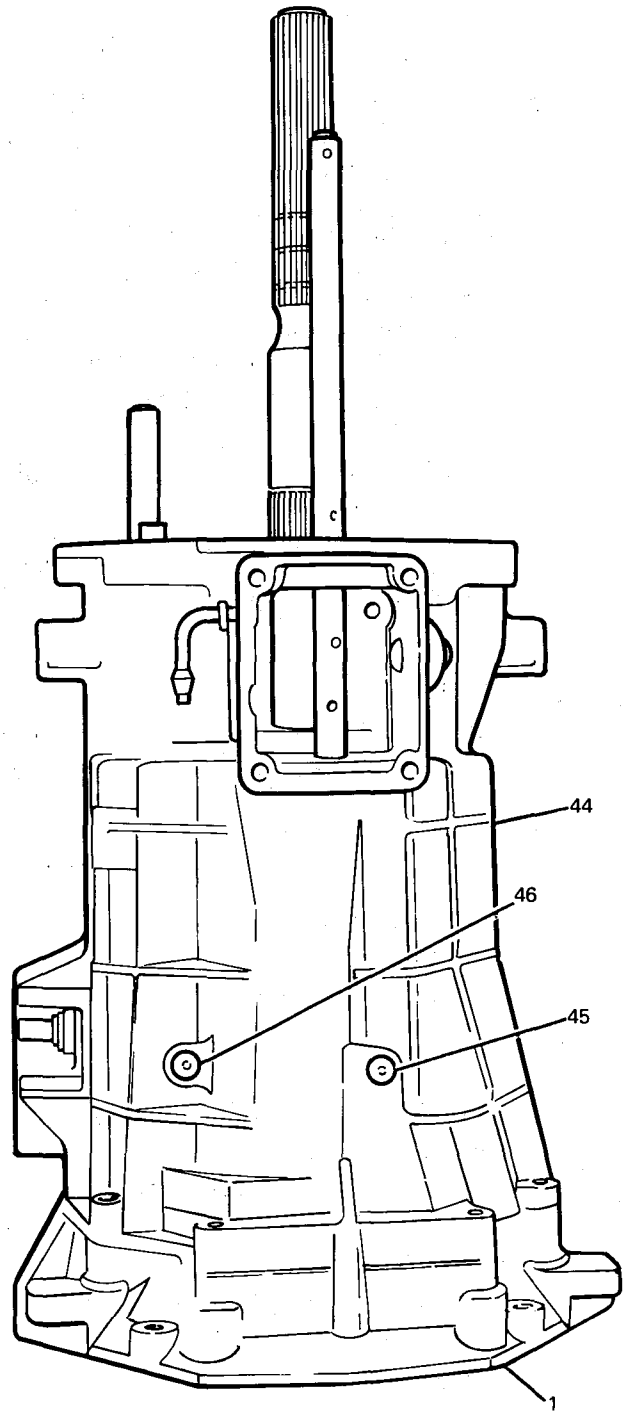
- Apply anaerobic threadlocker GM p/n 12345382 to threads of shift detent assembly (56).
- Shift detent assembly (56) to 40 N·m (30 lb. ft.).

8. Cover plate (48).
   - Apply sealant GM p/n 12345739 to mating surface of cover plate (48).
9. Cover plate bolts (47).

Tighten

- Bolts (47) to 20 N·m (15 lb. ft.).

10. Computer aided gear select solenoid (181).



1 PLATE, TRANSMISSION ADAPTER
44 CASE, TRANSMISSION
45 BOLT, SHIFT LEVER GUIDE
46 BOLT, SHIFT LEVER GUIDE

P0012-7B10B-RA

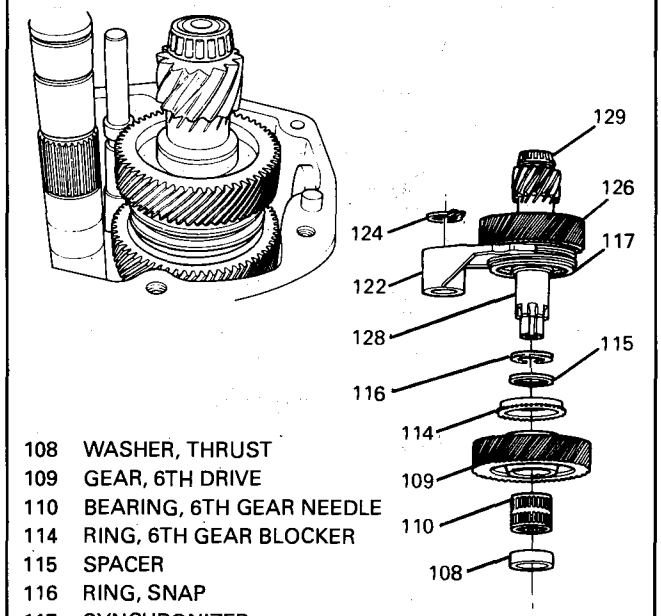
Figure 29 Transmission Case

COUNTERSHAFT EXTENSION ASSEMBLY

Figure 30

Install or Connect

1. Countershaft extension assembly and 5th/6th shift fork (122) with transmission in horizontal position.
   - Ensure splines of countershaft extension (128) engage splines of countershaft (105).
2. 5th/6th shift fork snap ring (124).



108 WASHER, THRUST
109 GEAR, 6TH DRIVE
110 BEARING, 6TH GEAR NEEDLE
114 RING, 6TH GEAR BLOCKER
115 SPACER
116 RING, SNAP
117 SYNCHRONIZER ASSEMBLY, 5TH/6TH
122 FORK, 5TH/6TH SHIFT
124 RING, SNAP
126 GEAR, 5TH DRIVE
128 EXTENSION, COUNTERSHAFT
129 BEARING, COUNTERSHAFT EXTENSION TAPERED

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Figure 30 Countershaft Extension Assembly

5th/6th DRIVEN GEAR

Figure 31

Tool Required:

J 39441 Gear Installer
J 39441-1 Gear Installer Bolts

Install or Connect

- 5th/6th driven gear (61) using J 39441.
  - Smaller OD gear down.
  - Engage splines of 5th/6th driven gear (61) to shaft splines (23) before pressing gear onto shaft.

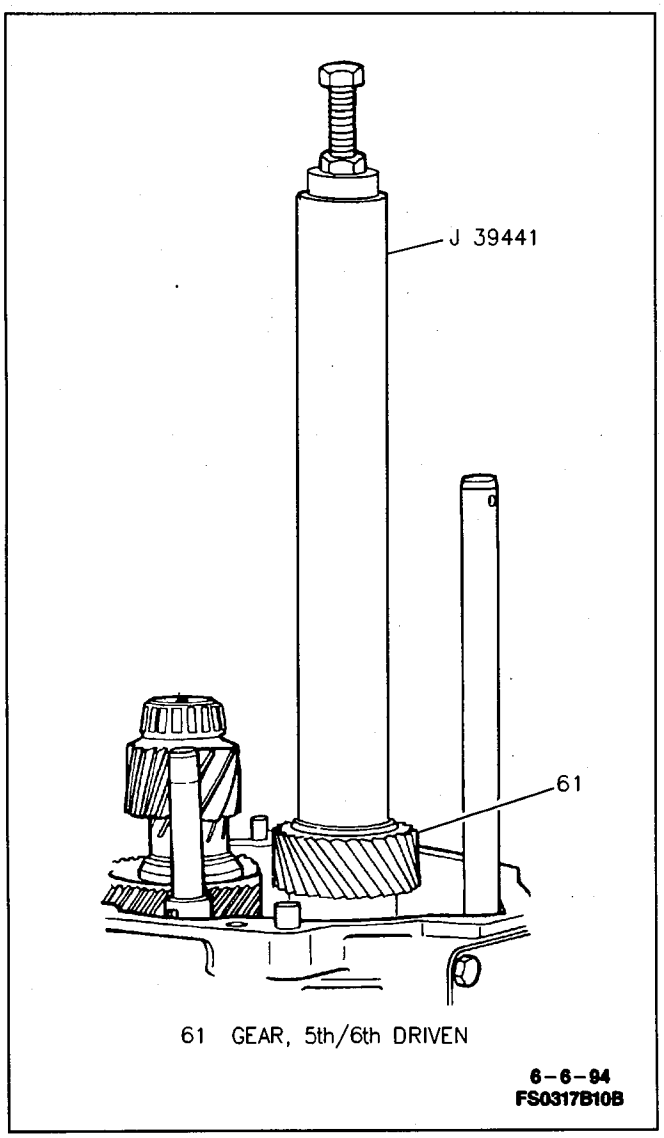


Figure 31 5th/6th Driven Gear

REVERSE SHIFT FORK

Figure 32

Install or Connect

1. Reverse shift fork (111), synchronizer (62) and thrust washer (68) at the same time.
2. New reverse shift fork snap ring (113).
3. Reverse synchronizer snap ring (69).

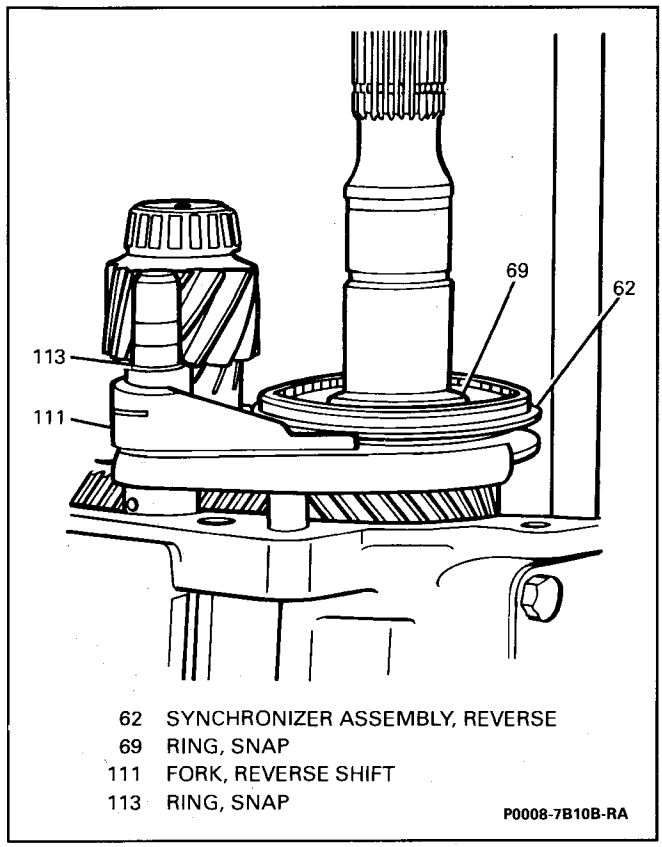


Figure 32 Reverse Shift Fork

REVERSE SPEED GEAR

Figure 33

Install or Connect

1. Blocker ring (70).
2. Wave washer (71).
   - Install wave washer (71) so concave side faces blocker ring (70).
3. Needle bearing (72).
4. Reverse speed gear (73).
5. Thrust washer (74).

6. Snap ring (75).
7. Spacer (76).
8. Roller bearing (77).
9. Spacer (78).
10. Roller bearing snap ring (79).

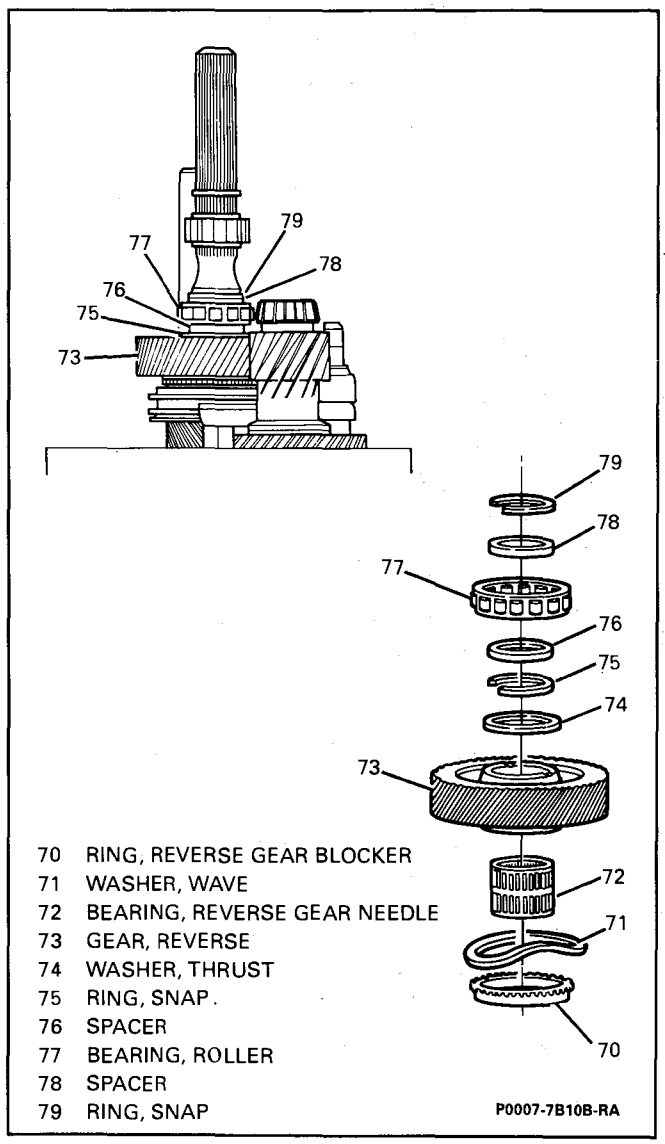


Figure 33 Reverse Speed Gear

SPEEDOMETER GEAR

Figure 34

Tool Required:

J 39441 Gear Installer
J 39441-2 Gear Installer Bolts

Install or Connect

1. Speedometer gear snap ring (80).
2. Speedometer gear (81) using J 39441 and J 39441-2.
3. Speedometer gear snap ring (82).
4. Sealing ring.

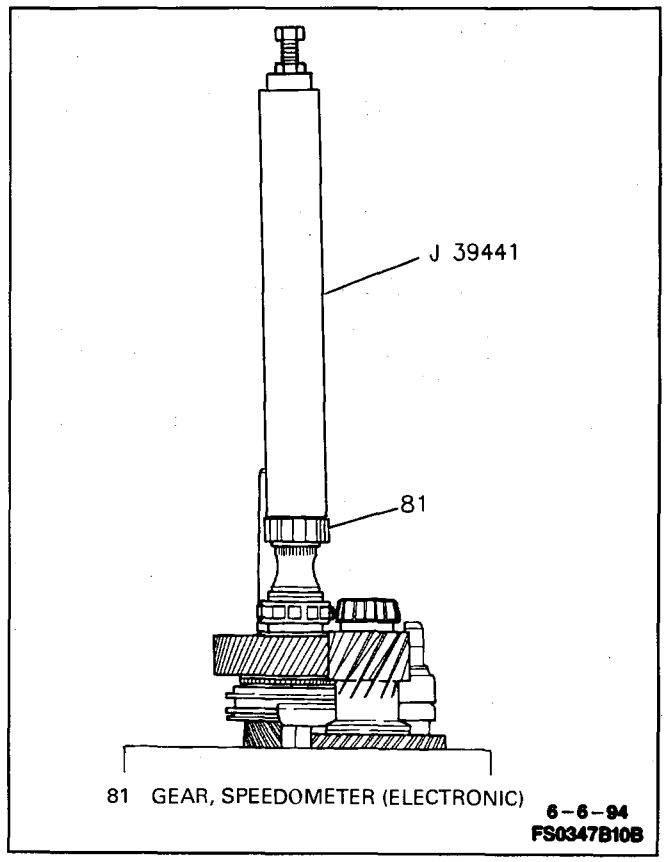


Figure 34 Speedometer Gear

EXTENSION HOUSING

Figure 35

Install or Connect

1. Funnel (132).
2. Selective shim (131). Refer to "Countershaft Extension" under "Shimming Procedures" in this section.
3. Countershaft extension bearing race (130).
4. Reverse idler shaft (138).
5. Thrust washer (139).
6. Roller bearing (137).
7. Reverse idler gear (136).
8. Reverse idler gear thrust washer (135).
9. Reverse idler shaft bracket (134).
10. Reverse idler shaft bracket bolts (133).
    - Apply sealant GM p/n 12345382 to threads of bolts (133).

Tighten

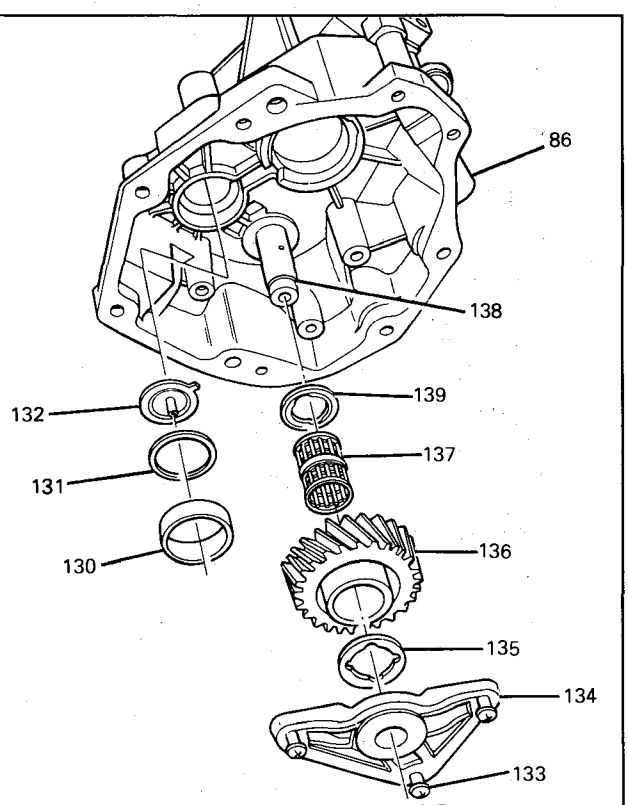
- Bolts (133) to 25 N·m (18 lb. ft.).

11. Extension housing (86).
    - Apply sealant GM p/n 12345739 at extension housing to transmission case mating surface.
    - Align 5th/6th and reverse shift rail (140) with extension housing bore.
12. Extension housing bolts (100) and transmission bumper (177).

Tighten

- Apply sealant GM p/n 1052080 to threads of bolts retaining transmission bumper.
- Bolts (100) to 35 N·m (26 lb. ft.).

13. Rear offset shift lever (93) and isolator cup (95).
14. Rear offset shift lever roll pin (94).



86 HOUSING, TRANSMISSION EXTENSION
130 RACE, COUNTERSHAFT EXTENSION BEARING
131 SHIM, COUNTERSHAFT EXTENSION
132 FUNNEL, OIL
133 BOLT, REVERSE IDLER SHAFT BRACKET
134 BRACKET, REVERSE IDLER SHAFT
135 WASHER, REVERSE IDLER GEAR THRUST
136 GEAR, REVERSE IDLER
137 BEARING, REVERSE IDLER GEAR ROLLER
138 SHAFT, REVERSE IDLER GEAR
139 WASHER, REVERSE IDLER GEAR THRUST

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Figure 35 Extension Housing

SHIFTER

Figure 36

Install or Connect

1. Shifter (96).
    - Apply sealant GM p/n 12345739 at extension housing to shifter mating surface.
2. Bolts (97).

Tighten

- Bolts (97) to 20 N·m (15 lb. ft.).

3. Remove transmission from J 39430 and J 3289-20.
4. Clutch fork (164) and T-handle (165).
5. Clutch fork bolt (166).

Tighten

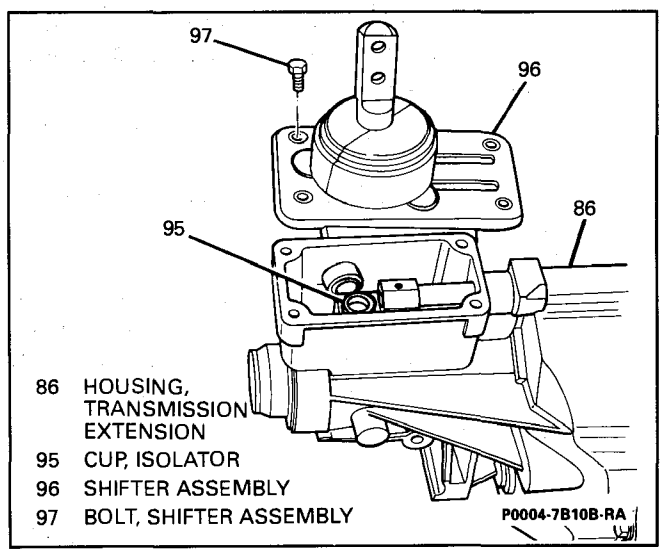
- Apply sealant GM p/n 12345382 to threads of clutch fork bolt (166).
- Bolt (166) to 25 N·m (18 lb. ft.).

6. Clutch housing (162).
7. Clutch housing bolts (163).

Tighten

- Bolts (163) to 35 N·m (26 lb. ft.).

8. Vent tube (161).



86 HOUSING, TRANSMISSION EXTENSION
95 CUP, ISOLATOR
96 SHIFTER ASSEMBLY
97 BOLT, SHIFTER ASSEMBLY

P0004-7B10B-RA

Figure 36 Shifter

SHIMMING PROCEDURES

INPUT SHAFT/MAINSHAFT AND COUNTERSHAFT

Figure 37

Tools Required:

J 8001 Dial Indicator Set

J 39444-1 Countershaft End Play Measuring Tool

Install or Connect

1. Position transmission in vertical position.
2. Input shaft (10) to adapter plate (1).
3. Mainshaft (23) to input shaft (10).
4. Countershaft (105).
   A. Lift up mainshaft (23) enough to install countershaft (105).
   B. Countershaft (105).
5. Transmission case (44).
6. Adapter plate to transmission case bolts (178).

Tighten

- Bolts (178) to 35 N·m (26 lb. ft.).

7. Place tip of J 8001 on end of mainshaft (23).

Measure

   A. Input shaft/mainshaft end play by moving input shaft (10) up and down.
   B. Select shim (6) to achieve 0.000 to 0.002 inch (0.00 to 0.05 mm) preload.

8. Remove J 8001.
9. Place tip of J 8001 on end of countershaft (105).
10. J 39444-1 through adapter plate plug hole.

Measure

   A. Countershaft end play using J 39444-1 to move countershaft (105) up and down.
   B. Select shim (102) to achieve 0.000 to 0.002 inch (0.00 to 0.05 mm) preload.

11. Remove J 39444-1 and J 8001.

Remove or Disconnect

1. Adapter plate to transmission case bolts (167).
2. Transmission case (44).
3. Countershaft (105).
   A. Lift up mainshaft (23) enough to remove countershaft (105).
   B. Countershaft (105).
4. Mainshaft (23).
5. Input shaft (10) from adapter plate (1).
6. Input shaft bearing race (8).
7. Countershaft bearing race (103).

COUNTERSHAFT EXTENSION

Figure 38

Tools Required:

J 8001 Dial Indicator Set

J 39444-2 Countershaft Extension End Play Measuring Rod

Install or Connect

Important

- This procedure cannot be performed accurately until the "Countershaft Shimming Procedure" has been completed and the transmission has been assembled to the point of installing the countershaft extension.

1. Position transmission in horizontal position.
2. Countershaft extension (128) to countershaft (105) making sure splines fully engage.
3. Extension housing (86).
4. Extension housing bolts (100).

Tighten

- Bolts (100) to 35 N·m (26 lb. ft.).

5. J 39444-2 through adapter plate plug hole and screw J 39444-2 into countershaft extension.
7. J 8001 so tip is on end of J 39444-2.

Measure

   A. Position transmission in vertical position.
   B. Countershaft extension end play using J 39444-2 to move countershaft extension (128) up and down.
   C. Select shim (131) to achieve 0.002 to 0.005 inch (0.05 to 0.13 mm) axial play.

8. Remove J 8001 and J 39444-2.
9. Install adapter plate plug (2).

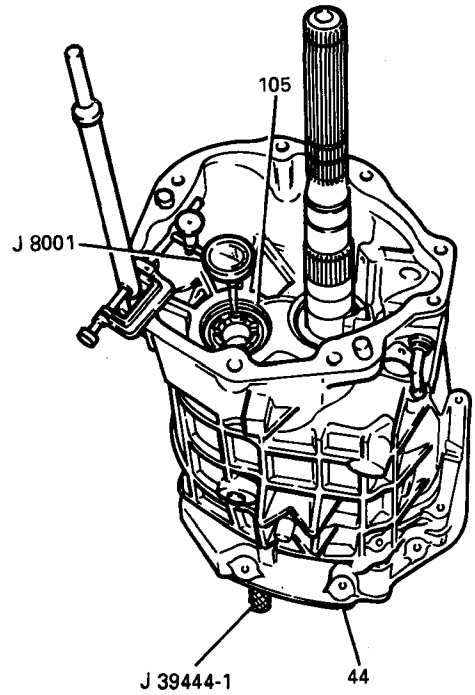
- Apply sealant GM p/n 1052080 to plug threads (2).

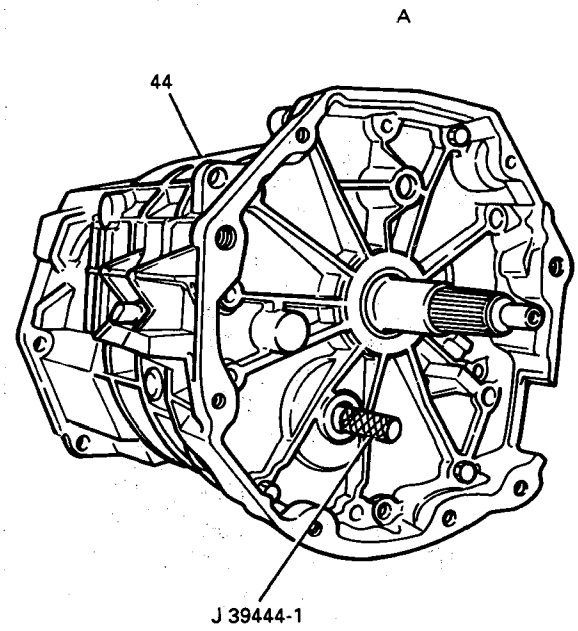
Tighten

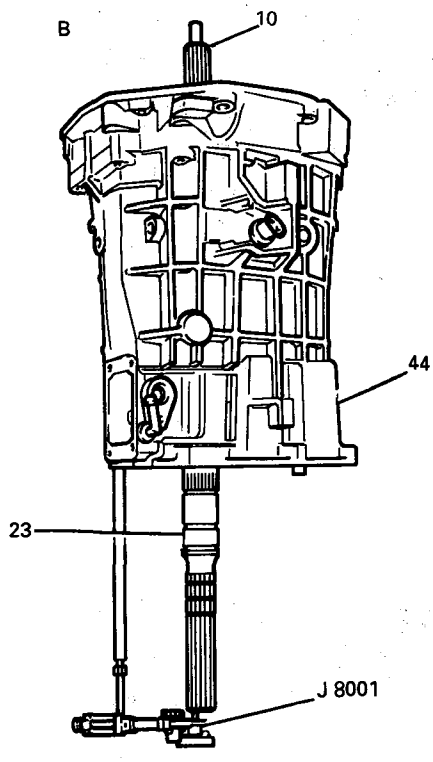
- Plug (2) to 27 N·m (20 lb. ft.).

Remove or Disconnect

1. Extension housing bolts (100).
2. Extension housing (86).
3. Countershaft extension (128).
4. Countershaft extension bearing race (130).



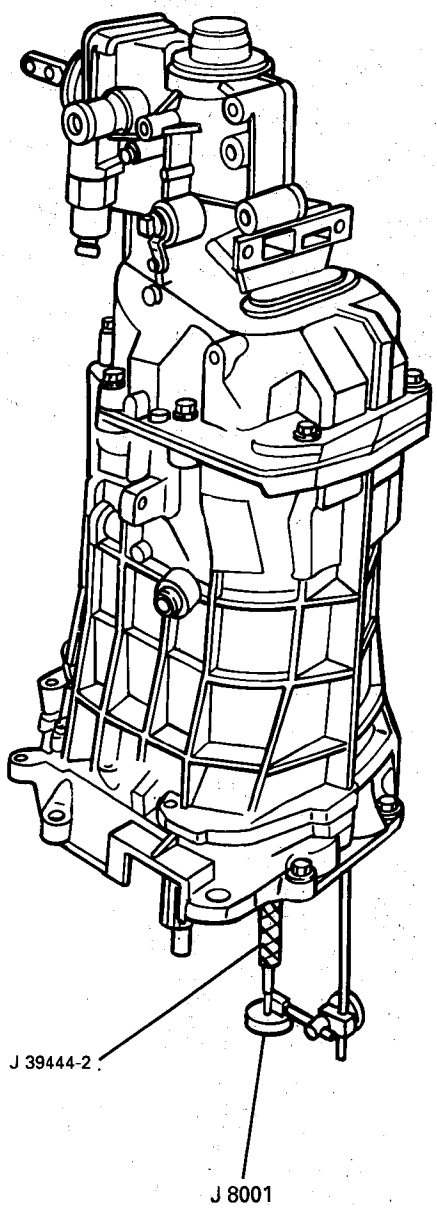




A COUNTERSHAFT SHIMMING PROCEDURE
B INPUT SHAFT/MAINSHAFT SHIMMING PROCEDURE
10 SHAFT, INPUT
23 MAINSHAFT
44 CASE, TRANSMISSION
105 COUNTERSHAFT

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Figure 37 Input Shaft/Mainshaft and Countershaft



NOTE: COUNTERSHAFT SHIMMING PROCEDURE MUST BE PERFORMED FIRST. COUNTERSHAFT AND CORRECT SHIM MUST BE INSTALLED DURING THIS PROCEDURE

P0029-7B10B-RA

Figure 38 Countershaft Extension

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

NO.*	DESCRIPTION	TORQUE
2	Adapter Plate Plug	27 N•m (20 lb. ft.)
178	Adapter Plate to Transmission Case Bolts	35 N•m (26 lb. ft.)
59	Backup Lamp Switch	27 N•m (20 lb. ft.)
166	Clutch Fork Bolt	25 N•m (18 lb. ft.)
163	Clutch Housing to Adapter Plate Bolt	35 N•m (26 lb. ft.)
48	Cover Plate Bolts	20 N•m (15 lb. ft.)
101	Extension Housing Plug	27 N•m (20 lb. ft.)
100	Extension Housing to Transmission Case Bolts	35 N•m (26 lb. ft.)
133	Reverse Idler Shaft Bracket Bolts	25 N•m (18 lb. ft.)
90	Reverse Lockout Assembly Bolt	18 N•m (13 lb. ft.)
89	Reverse Lockout Solenoid	40 N•m (30 lb. ft.)
97	Shifter Bolts	20 N•m (15 lb. ft.)
56	Shift Detent Assembly	40 N•m (30 lb. ft.)
45, 46	Shift Lever Guide Bolts	27 N•m (20 lb. ft.)
54	Shift Guide Plate Bolts	22 N•m (16 lb. ft.)
60	Transmission Case Fill Plug	27 N•m (20 lb. ft.)
88	Vehicle Speed Sensor Bolt	10 N•m (89 lb. in.)
*Disassembled Parts Illustration, Figure 1		RCPC1-7B1-T56

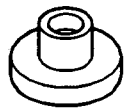
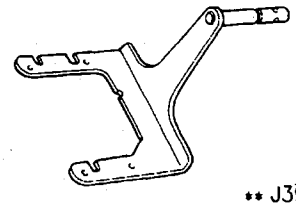
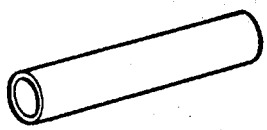
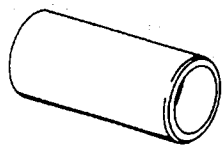
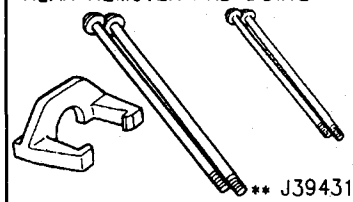
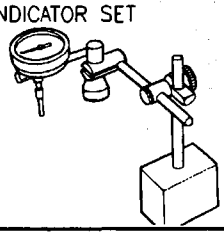
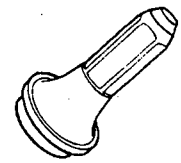
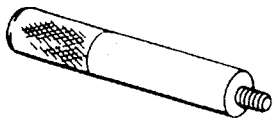
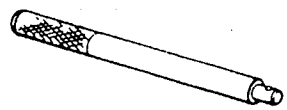
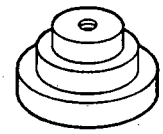
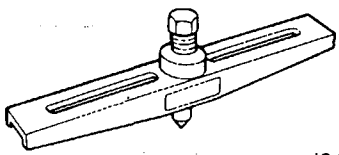
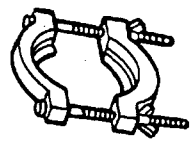
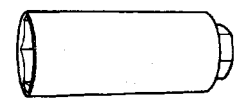
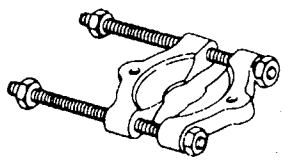
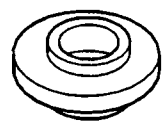
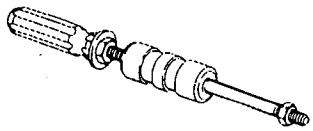
SHIMMING SPECIFICATIONS

SHIM NO.*	DESCRIPTION	SHIM TO ATTAIN
7	Input Shaft/Mainshaft Shim	Preload of 0.0-0.002 inch (0.0 to 0.05 mm)
102	Countershaft Shim	Preload of 0.0-0.002 inch (0.0 to 0.05 mm)
131	Countershaft Extension Shim	Axial Play of 0.002-0.005 inch (0.05 to 0.13 mm)
*Disassembled Parts Illustration, Figure 1		RCPC2-7B1-T56

LUBRICANT SPECIFICATIONS

Lube Capacity (Approximate) .....3.9 Liters (4.1 Quarts)
After refill, fluid level must be checked as outlined under On-Vehicle Service in Section 7B.
Recommended Lube .....Dexron®-III, -IIE

SPECIAL TOOLS

HOLDING FIXTURE  *** J3289-20	BEARING RACE INSTALLER  ** J28537-17	TRANSMISSION HOLDING FIXTURE  ** J39430
PRESS TUBE  *** J5590	PRESS TUBE  *** J36183	REAR REMOVER AND BOLTS  ** J39431,-1,-2
DIAL INDICATOR SET  *** J8001	PRESS TUBE ADAPTER  *** J36184	SEAL INSTALLER  * J39433
UNIVERSAL DRIVE HANDLE  *** J8092	DRIVE HANDLE  *** J36190	BEARING RACE INSTALLER  ** J39435
UNIVERSAL BRIDGE PULLER  *** J8433	SPLIT PLATE  *** J22910-01	SOLINOID SOCKET  * J41099
SPLIT PLATE  *** J22912-01	1ST/2ND SYNCHRONIZER INSTALLER  * J39371	BUSHING INSTALLER  ** J39437
SLIDE HAMMER  *** J23907		* T56 SPECIFIC, REQUIRED ** T56 SPECIFIC, AVAILABLE *** EXISTING TOOL **6-7-94** **FS0397B10B**

SPECIAL TOOLS (CONT.)

BEARING INSTALLER



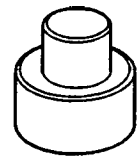
** J39438

COUNTERSHAFT END PLAY ROD



** J39444-1

PRESS ADAPTER



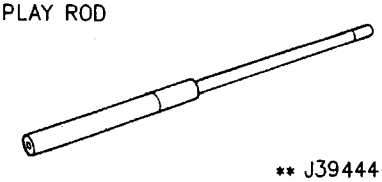
** J39547

PRESS ADAPTER



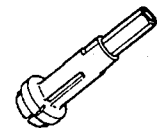
**J39442

COUNTERSHAFT EXTENSION END PLAY ROD



** J39444-2

BEARING RACE REMOVER



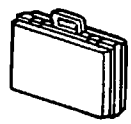
* J39594

REAR SEAL AND BOOT INSTALLER



* J39440

STORAGE CASE



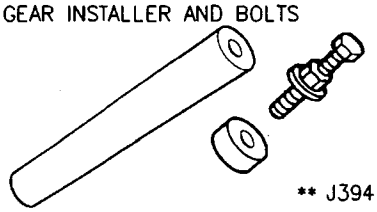
* J39445

BEARING RACE REMOVER



* J39789

GEAR INSTALLER AND BOLTS



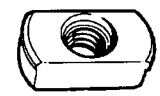
** J39441

BEARING INSTALLER/ADAPTER



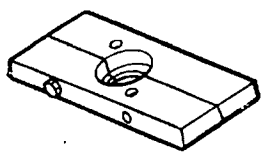
** J39473

BEARING RACE REMOVER



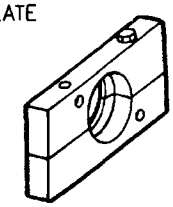
** J39790

SPLIT PLATE



* J39443

SPLIT PLATE



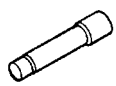
** J39511

BEARING RACE REMOVER



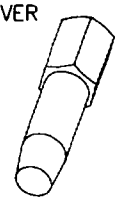
** J39791

BUSHING REMOVER/INSTALLER



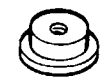
**J39439-1

BUSHING REMOVER



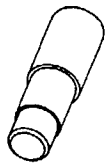
** J39439-2

BEARING RACE INSTALLER



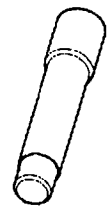
** J39546

BUSHING INSTALLER



** J39439-3

BUSHING INSTALLER



** J39439-4

* T56 SPECIFIC, REQUIRED
** T56 SPECIFIC, AVAILABLE
*** EXISTING TOOL

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BLANK

SECTION 7C

CLUTCH

CAUTION: When servicing the clutch system, do not create dust by cleaning components with compressed air. While not containing asbestos fibers, the clutch disc does contain fiberglass fibers which could cause bodily harm if inhaled. Any residue should also be washed from the skin as it could cause irritation.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread-locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

PRINCIPAL COMPONENTS

The principal components of the clutch system are the driving members, attached to the engine assembly and turning with the engine assembly; the driven member, attached to the transmission assembly and turning with the transmission assembly; and the operating members. The operating members include the clutch master cylinder and actuator assembly, the clutch release bearing assembly, the clutch pedal assembly, and the clutch pilot bearing.

Driving Members

The driving members of the clutch consist of two flat surfaced iron plates machined to a smooth finish. One of these surfaces is the rear face of the engine flywheel assembly and the other is the clutch pressure plate assembly (with cover). The 3.4L L32 engine uses a push-type clutch release system, while the 5.7L LT1 engine utilizes a pull-type clutch release system.

Driven Member

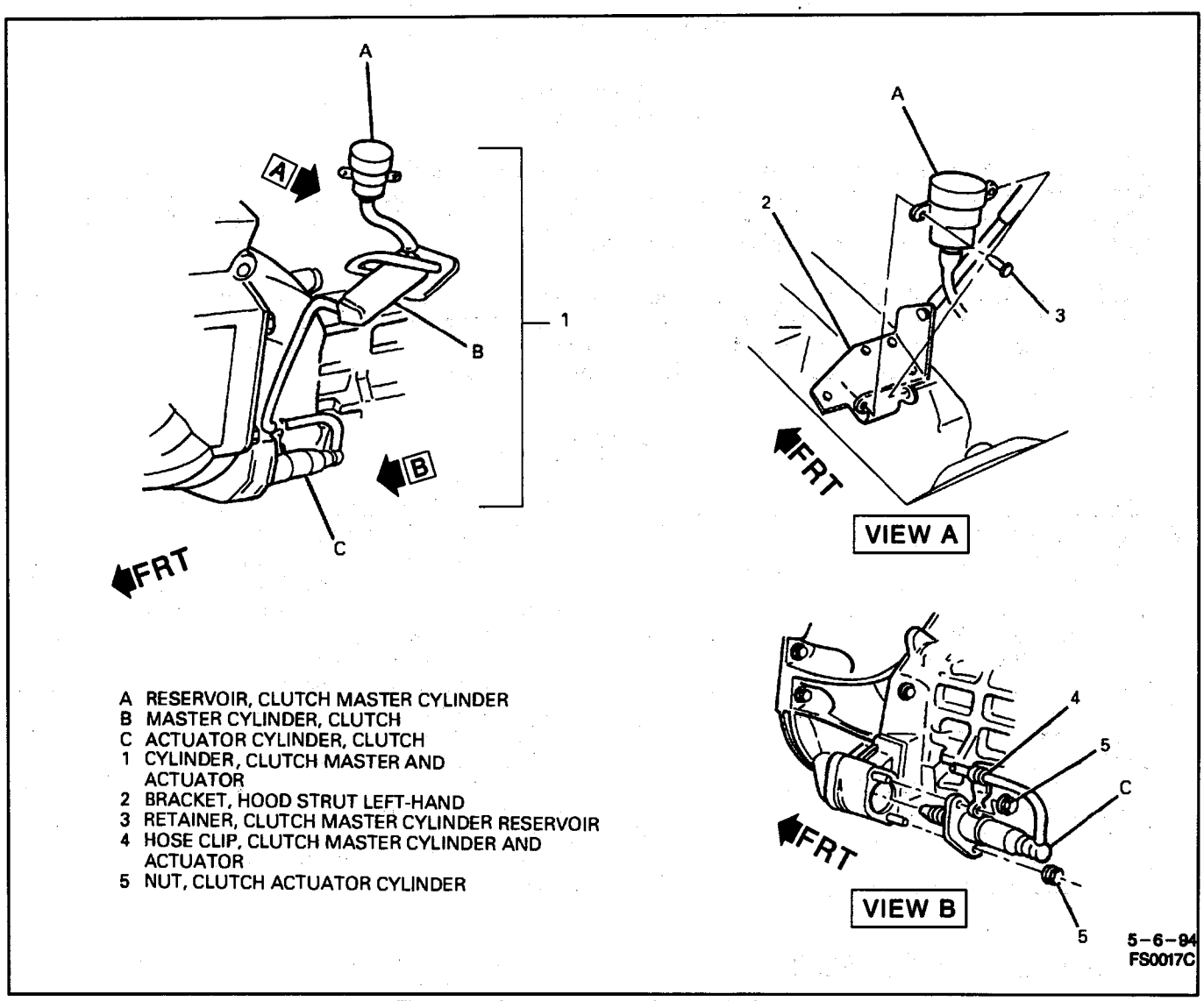
The driven member is the clutch driven plate assembly. This clutch driven plate assembly has a splined hub which meshes with the splines of the input shaft and drives the input shaft.

The driving and driven members are held in contact by spring pressure. This pressure is exerted by a diaphragm spring in the clutch pressure plate assembly (with cover).

Hydraulic Clutch

A hydraulic clutch operating mechanism is used to engage and disengage the clutch system. The mechanism consists of a remote master cylinder reservoir, a clutch master cylinder and a clutch actuator cylinder. The remote master cylinder reservoir is mounted to the left-hand hood strut bracket using a push-on retainer. The clutch master cylinder is mounted on the front of dash with a U-bolt fastener. The clutch actuator cylinder is mounted on the flywheel housing assembly on the 3.4L L32 engine and to the clutch actuator cylinder spacer on the flywheel housing assembly with the 5.7L LT1 engine. The clutch master cylinder is operated directly by the clutch pedal assembly.

When the clutch pedal assembly is pressed down, hydraulic fluid under pressure from the clutch master cylinder flows into the clutch actuator. On the 3.4L L32 engine the actuator piston engages the clutch fork assembly, which moves the release bearing assembly, pressing the diaphragm spring fingers to disengage the clutch.



A RESERVOIR, CLUTCH MASTER CYLINDER
B MASTER CYLINDER, CLUTCH
C ACTUATOR CYLINDER, CLUTCH
1 CYLINDER, CLUTCH MASTER AND ACTUATOR
2 BRACKET, HOOD STRUT LEFT-HAND
3 RETAINER, CLUTCH MASTER CYLINDER RESERVOIR
4 HOSE CLIP, CLUTCH MASTER CYLINDER AND ACTUATOR
5 NUT, CLUTCH ACTUATOR CYLINDER

Figure 1 – Clutch Hydraulic System (6-Speed)

On the 5.7L LT1 engine the actuator piston engages the clutch fork assembly which moves the release bearing assembly pulling the diaphragm spring fingers to disengage the clutch.

The hydraulic clutch system sets the clutch pedal height and provides automatic clutch adjustment. No adjustment of the clutch or clutch pedal assembly position is required.

Hydraulic Clutch Fluid

When adding fluid to or refilling the system after service operations use GM Delco-Supreme II ® brake fluid or an equivalent fluid that meets DOT 3 specifications.

NOTICE: Do not use silicon, mineral or paraffin based oil in the clutch hydraulic system. These fluids will damage the rubber parts in the cylinders.

Clutch Pilot Bearing

The clutch pilot bearing is an oil–impregnated bearing pressed into the crankshaft. The clutch pilot bearing should be cleaned and inspected for excessive wear or damage and replaced if necessary.

DIAGNOSIS

PRELIMINARY CHECKS

Before attempting to repair the clutch, transmission assembly or related hydraulic components or for any reasons other than an obvious failure, the problem and probable cause should be identified. A large percentage of clutch and manual transmission assembly problems show up as shifting difficulties, such as high shift effort, gear clash and grinding, or transmission assembly blockout. When any of these conditions occur, a careful analysis of these difficulties should be performed before removing the clutch or manual transmission assembly for repairs. Refer to "Clutch System Diagnosis" in this section for conditions, causes and corrections.

Before removal of the clutch hydraulic system, verify the malfunction by removing the flywheel housing cover and measure the travel of the clutch actuator pushrod. With the clutch pedal pushed fully to the floor, the clutch actuator pushrod should extend a minimum of 11 mm (0.43 inch) against the clutch fork assembly. Do not replace the hydraulic system if pushrod travel exceeds this distance.

If the clutch actuator pushrod does not meet the travel requirements, check the clutch master cylinder reservoir fluid level.

- The clutch actuator cylinder must be in place when checking the fluid level.
- The proper level is indicated by a step on the clutch master cylinder reservoir. Fill to specified level with GM Delco-Supreme II ® brake fluid or an equivalent fluid that meets DOT 3 specifications.
- Do not overfill. The upper portion of the clutch master cylinder reservoir must accept fluid that is displaced from the clutch actuator cylinder as the clutch wears.

NOTICE: Carefully clean the top and sides of the clutch master cylinder reservoir before opening to prevent contamination of the system with dirt, water or other foreign material. Remove the clutch master cylinder reservoir diaphragm before adding fluid. Carefully replace the diaphragm, cover gasket and cover after filling.

If the clutch master cylinder reservoir requires any fluid, check the clutch hydraulic system components for leakage. Remove rubber boots from the clutch master cylinder and check for leakage past the pistons. A slight wetting of the surfaces is acceptable. Replace the clutch hydraulic system if excessive leakage is evident.

CLUTCH SYSTEM DIAGNOSIS

For diagnosis of either the 5-speed manual transmission clutch system or the 6-speed manual transmission clutch system refer to the following chart.

CONDITION	PROBABLE CAUSE	CORRECTION
Fails to Release (Pedal assembly pressed to floor, shift lever does not move freely in and out of reverse gear)	1. Faulty clutch pilot bearing. 2. Faulty driven plate assembly. 3. Fork assembly off of clutch fork ball stud or ball stud loose on 5-speed (called T-stud on 6-speed. 4. Driven plate assembly hub binding on input shaft assembly splines. 5. Driven plate assembly hub binding on input shaft assembly splines. 6. Air in clutch hydraulic system. 7. Pedal assembly misaligned to the cowl.	1. Replace clutch pilot bearing. 2. Replace clutch driven plate assembly. 3. Install properly and lightly lubricate fingers at clutch release bearing and clutch fork ball stud. 4. Repair or replace input shaft assembly and/or driven plate assembly. 5. Replace driven plate assembly. Runout should not exceed 0.5 mm (0.020 inch). 6. Bleed Clutch hydraulic system. 7. Loosen pedal assembly mounting bolts and realign pedal assembly.
Slipping	1. Oil-soaked driven plate assembly. 2. Worn facing or facing torn from driven plate assembly. 3. Warped pressure plate assembly or flywheel assembly. 4. Weak diaphragm spring. 5. Clutch driven plate assembly not seated in. 6. Clutch driven plate assembly overheated.	1. Install new clutch driven plate assembly and correct leak at source. 2. Replace clutch driven plate assembly. 3. Replace pressure plate assembly or flywheel assembly. 4. Replace pressure plate assembly. 5. Make 30 to 40 normal starts. Do not overheat. 6. Allow to cool.

CONDITION	PROBABLE CAUSE	CORRECTION
Grabbing (Chattering)	1. Oil on clutch pressure plate assembly facing or burned or glazed facing. 2. Worn splines on input shaft assembly. 3. Warped pressure plate assembly or flywheel assembly. 4. Burned or smeared resin on flywheel or pressure plate assemblies.	1. Install new clutch driven plate assembly and correct leak at source. 2. Replace input shaft assembly. 3. Replace pressure plate assembly or flywheel assembly. 4. Sand off if superficial. Replace burned or heat checked parts.
Release Bearing Assembly Noise with Clutch Fully Engaged	1. Release bearing binding on transmission bearing retainer. 2. Fork assembly improperly installed.	1. Clean, lubricate, check for burrs, nicks, and other wear. 2. Install properly.
Noisy	1. Worn release bearing. 2. Fork assembly off ball stud on 5-speed (called T-stud on 6-speed) (heavy clicking).	1. Replace bearing assembly. 2. Install properly and lubricate fork assembly fingers and bearing assembly.
Clutch Pedal Assembly Stays on Floor when Disengaged	1. Bind in release bearing assembly. 2. Master cylinder pushrod fell off pedal.	1. Lubricate and free-up release bearing assembly. 2. Install correctly.
Excessive Pedal Pressure	1. Linkage needs lubrication. 2. Pressure plate assembly release fingers binding. 3. Linkage misaligned. 4. Release bearing assembly sleeve binding on transmission bearing retainer. 5. Sticking linkage, master cylinder or actuator cylinder.	1. Lubricate linkage. 2. Free and lubricate. 3. Align linkage. 4. Free and lubricate. 5. Clean or replace as needed.
Rapid Clutch Driven Plate Assembly Wear 	1. Scored flywheel assembly or pressure plate assembly. 2. Driver rides the clutch (rests left foot on clutch while driving). 3. Driver races engine and slips clutch excessively during starting. 4. Driver holds vehicle on hill by slipping clutch. 5. Weak pressure plate assembly springs.	1. Grind or replace. 2. Instruct driver. 3. Instruct driver. 4. Instruct driver. 5. Rebuild or replace pressure plate assembly.

ON-VEHICLE SERVICE

BLEEDING HYDRAULIC SYSTEM

Figure 1, 2 and 3

Bleeding is necessary whenever the level of fluid in the reservoir has been allowed to fall so low that air has been drawn into the master cylinder.

NOTICE: Never, under any circumstances, use fluid which has been bled from a system to fill the clutch master cylinder reservoir as it may be aerated, have too much moisture content and possibly be contaminated.

NOTICE: See "Notice" on page 7C-1 of this section.

1. Loosen clutch master cylinder nuts (23 and 24) to end of threads on U-bolt (25).
2. Clean dirt and grease from the reservoir cap to ensure no foreign substances will enter the system.
3. Remove the reservoir cap and diaphragm.
4. Wrap a piece of mechanics wire around left-hand hood strut bracket (2 or 8) making sure wire is accessible from underside of vehicle.
5. Raise and suitably support vehicle. Refer to SECTION 0A.
6. Remove actuator cylinder nuts (5 or 10).
7. Remove actuator cylinder.
   - Retain actuator cylinder in engine compartment using mechanics wire previously installed.
8. Lower vehicle.
9. Grasp actuator cylinder and depress hydraulic actuator cylinder pushrod approximately 20.0 mm (0.787 inch) into actuator cylinder bore and hold.
10. Install diaphragm and reservoir cap while holding in actuator cylinder pushrod.
11. Release actuator cylinder pushrod.
12. Hold actuator cylinder vertically with the pushrod end facing down.

Important

- Actuator cylinder should be lower than the master cylinder.

13. Press pushrod into actuator cylinder bore with short 10.0 mm (0.390 inch) strokes.

Inspect

- Master cylinder reservoir for air bubbles.

14. Continue until air bubbles are not longer entering reservoir.
15. Raise and suitably support vehicle. Refer to SECTION 0A.
16. Remove actuator cylinder from mechanics wire.
17. Install actuator cylinder.
18. Install actuator cylinder nuts (5 or 10).

Tighten

- Clutch actuator cylinder nuts (5 or 10) to 20 N•m (15 lb. ft.).

19. Lower vehicle.
20. Remove mechanics wire from left-hand hood strut bracket (2 or 8).
21. Install clutch master cylinder nuts (23 and 24).

Tighten

- Clutch actuator cylinder nuts (23) to 2 N•m (20 lb. ft.).

Inspect

- Fluid level in clutch master cylinder reservoir. Fill clutch master cylinder reservoir with Delco-Supreme II ® fluid or equivalent DOT 3 fluid.

CLUTCH MASTER AND ACTUATOR CYLINDER ASSEMBLY

Figures 1, 2 and 3

Remove or Disconnect

CAUTION; Refer to "CAUTION" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Instrument panel driver knee bolster assembly. Refer to SECTION 8C.
3. Clutch master cylinder pushrod from clutch pedal assembly (10).
4. Clutch master cylinder nuts (23 and 24) from dash panel assembly.
5. Clutch master cylinder U-bolt (25) from dash panel assembly.
6. Clutch master cylinder from dash panel assembly.
7. Clutch master cylinder reservoir retainer (3 or 7).
8. Clutch master cylinder reservoir from left-hand hood strut bracket (2 or 8).
9. Raise and suitably support vehicle. Refer to SECTION 0A.
10. Clutch actuator cylinder nuts (5 or 10).
11. Clutch actuator cylinder from clutch housing.
12. Clutch master and actuator cylinder assembly (1 or 6) from vehicle.

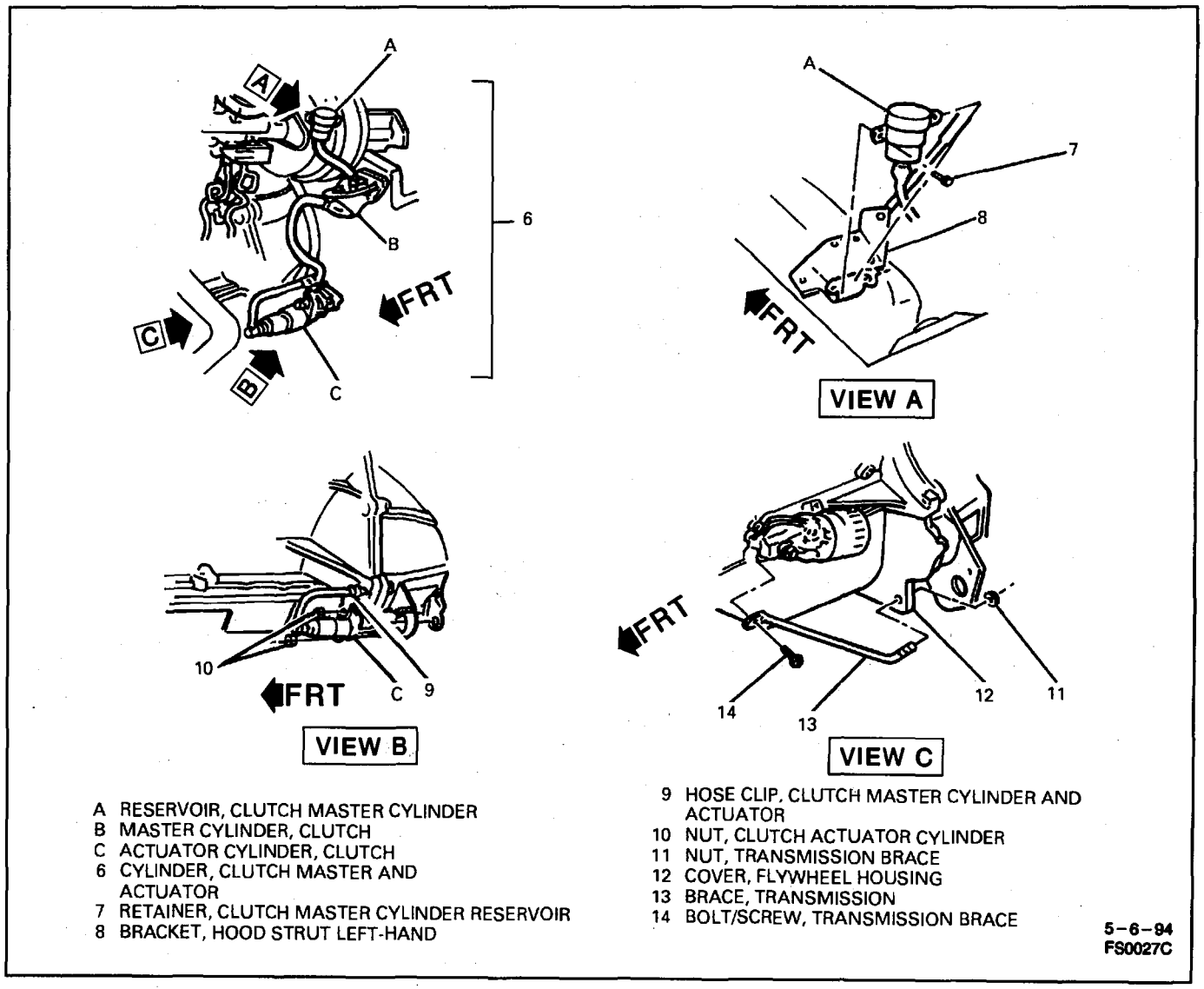


Figure 2 – Clutch Hydraulic System (5-Speed)

Install or Connect

NOTICE: See "Notice" on page 7B-1 of this section.

1. Clutch actuator cylinder.
2. Clutch actuator cylinder nuts (5 or 10).

Tighten

- Clutch actuator cylinder nuts (5 or 10) to 20 N•m (15 lb. ft.).

3. Lower vehicle.
4. Clutch master cylinder to dash panel assembly.
5. Clutch master cylinder U-bolt (25) to dash panel assembly.
6. Clutch master cylinder nuts (23 and 24).

Tighten

- Clutch master cylinder nuts (23) to 27 N•m (20 lb. ft.).

7. Clutch master cylinder reservoir to left-hand hood strut bracket (2 or 8).
8. Clutch master cylinder reservoir retainer (3 or 7).
9. Clutch master cylinder pushrod to clutch pedal assembly (19).
10. Instrument panel driver knee bolster assembly. Refer to Section 8C.
11. Battery negative cable assembly.

CLUTCH PEDAL ASSEMBLY

Figure 3

Remove or Disconnect

1. Brake and accelerator and clutch pedal assembly (with bracket). Refer to SECTION 5.
2. Brake pedal pivot nut (17) and bolt/screw (21).
3. Clutch pedal assembly (10) with pivot bushings (18).

Install or Connect

NOTICE: See "Notice" on page 7C-1 of this section.

1. Clutch pedal assembly (19) with pivot bushings (18).
2. Brake pedal pivot bolt/screw (21) and nut (17).

Tighten

- Brake pedal pivot (17) to 54 N•m (40 lb. ft.).

3. Brake and accelerator and clutch pedal assembly (with bracket). Refer to SECTION 5.

CLUTCH ANTICIPATE SWITCH ASSEMBLY

Figure 3

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Instrument panel driver knee bolster assembly. Refer to SECTION 8C.
3. Clutch anticipate switch harness electrical connector from clutch anticipate switch assembly (26 or 27).
4. Clutch anticipate switch assembly (26 or 27 from brake and accelerator and clutch pedal assembly (with bracket) (16).

Install or Connect

1. Clutch anticipate switch assembly (26 or 27) to brake and accelerator and clutch pedal assembly (with bracket) (16).
2. Clutch anticipate switch harness electrical connector to clutch anticipate switch assembly (26 or 27).
3. Instrument panel driver knee bolster assembly. Refer to SECTION 8C.
4. Battery negative cable assembly.

CLUTCH PEDAL POSITION SWITCH ASSEMBLY (CLUTCH START SWITCH ASSEMBLY)

Figure 3

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Instrument panel driver knee bolster assembly. Refer to SECTION 8C.
3. Clutch pedal position switch harness electrical connector from clutch pedal position switch assembly (28).
4. Clutch pedal position switch assembly (28) from brake and accelerator and clutch pedal assembly (with bracket) (16).

Install or Connect

1. Clutch pedal position switch assembly (28) to brake and accelerator and clutch pedal assembly (with bracket) (16).
2. Clutch pedal position switch harness electrical connector to clutch pedal position switch assembly (28).
3. Instrument panel driver knee bolster assembly. Refer to SECTION 8C.
4. Battery negative cable assembly.

CLUTCH DRIVEN PLATE ASSEMBLY (5-SPEED)

Figures 2, 3, 4 and 5

Tool Required:

J 33169 Clutch Alignment Arbor

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

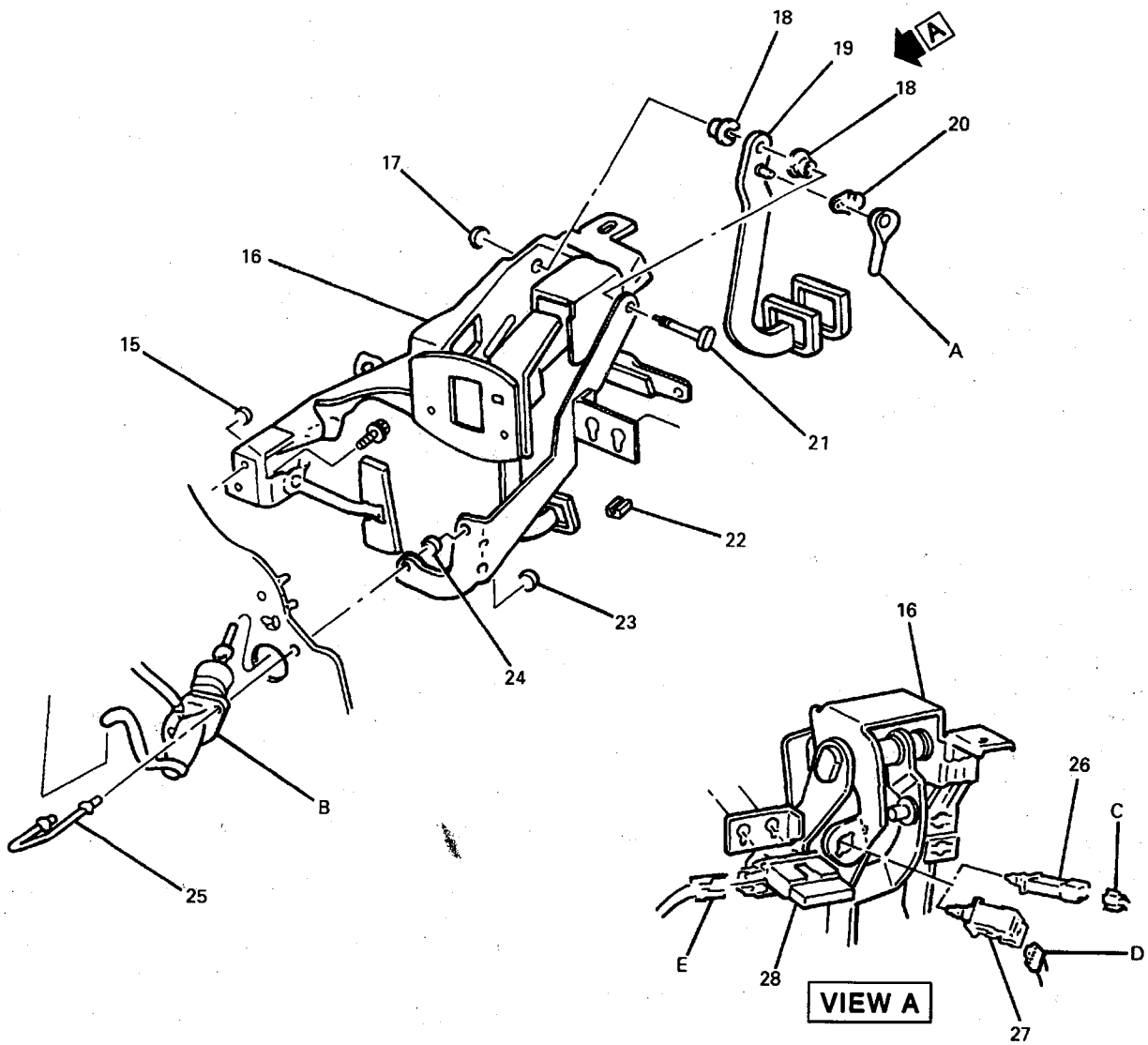
1. Battery negative cable assembly.
2. Instrument panel driver knee bolster assembly. Refer to SECTION 8C.
3. Clutch master cylinder pushrod from clutch pedal assembly (19).
4. Raise and suitably support vehicle. Refer to SECTION 0A.
5. 5-Speed manual transmission assembly. Refer to SECTION 0A.
6. Clutch actuator cylinder nuts (10).

   NOTICE: Do not allow clutch actuator cylinder to hang by hydraulic lines as this could cause damage to clutch hydraulic lines.

7. Clutch actuator cylinder and retain with mechanics wire.
8. Transmission brace nut (11) and bolt/screw (14).
9. Transmission brace (13).
10. Flywheel housing cover bolts/screws (53).
11. Flywheel housing cover (12).
12. Flywheel housing bolts/screws (65).
13. Flywheel housing assembly (34).
14. Clutch pressure plate and cover bolts/screws (51).
15. Clutch pressure plate assembly (with cover) (30) and clutch driven plate assembly (37).

Inspect

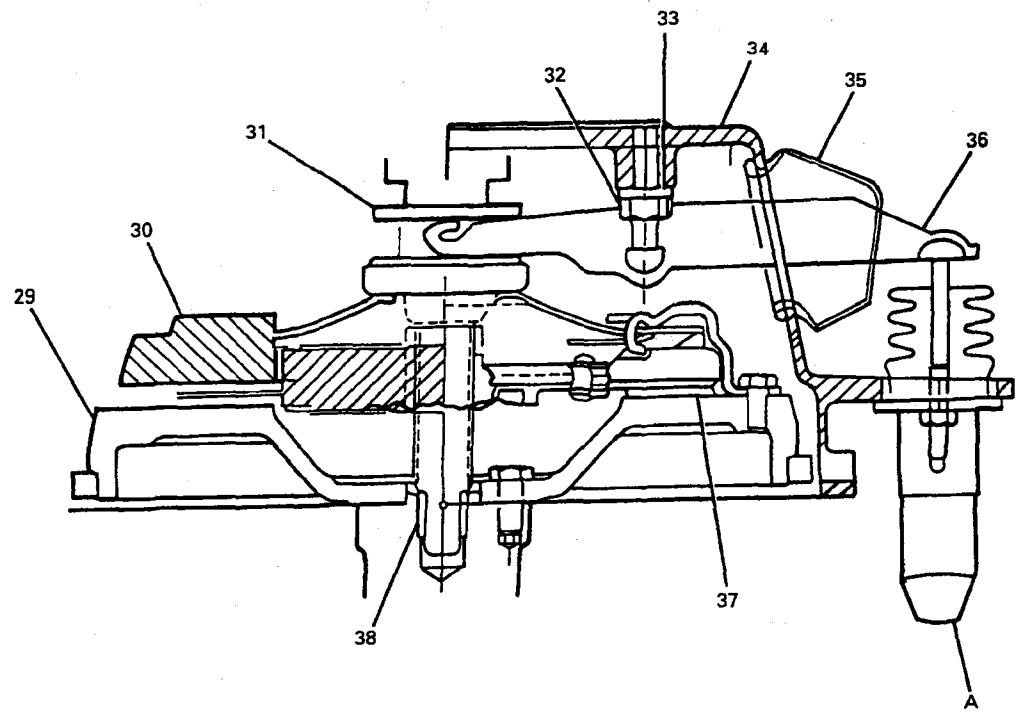
- Clutch pressure plate assembly (with cover) (30) for wear or damage. Repair or replace as necessary.



A PUSHROD, CLUTCH MASTER CYLINDER
B MASTER CYLINDER, CLUTCH
C CONNECTOR, CLUTCH ANTICIPATE SWITCH HARNESS ELECTRICAL
D CONNECTOR, CLUTCH ANTICIPATE SWITCH HARNESS ELECTRICAL
E CONNECTOR, CLUTCH PEDAL POSITION SWITCH HARNESS ELECTRICAL
15 NUT, BRAKE PEDAL
16 PEDAL, BRAKE AND ACCELERATOR AND CLUTCH (WITH BRACKET)
17 NUT, BRAKE PEDAL PIVOT
18 BUSHING, CLUTCH PEDAL PIVOT
19 PEDAL, CLUTCH
20 RETAINER, CLUTCH PEDAL LEVER PIN
21 BOLT/SCREW, BRAKE PEDAL PIVOT
22 BUMPER, CLUTCH PEDAL
23 NUT, CLUTCH MASTER CYLINDER
24 NUT, CLUTCH MASTER CYLINDER (PUSH-ON)
25 U-BOLT, CLUTCH MASTER CYLINDER
26 SWITCH, CLUTCH ANTICIPATE (WITH 3.4L L32 ENGINE)
27 SWITCH, CLUTCH ANTICIPATE (WITH 5.7L L1 ENGINE)
28 SWITCH, CLUTCH PEDAL POSITION (SWITCH, CLUTCH START)

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Figure 3 – Clutch Pedal Assembly and Switches



A ACTUATOR CYLINDER, CLUTCH
29 FLYWHEEL ASSEMBLY, ENGINE
30 PLATE ASSEMBLY, CLUTCH PRESSURE (WITH COVER)
31 BEARING ASSEMBLY, CLUTCH RELEASE
32 STUD, CLUTCH FORK BALL
33 WASHER, CLUTCH FORK BALL STUD
34 HOUSING ASSEMBLY, FLYWHEEL
35 BOOT, CLUTCH FORK
36 FORK ASSEMBLY, CLUTCH
37 PLATE ASSEMBLY, CLUTCH DRIVEN
38 BEARING, CLUTCH PILOT

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Figure 4 – Clutch System Cross Section (5-Speed)

- Clutch driven plate assembly (37) for wear or damage. Replace as necessary.
- Engine flywheel assembly. Refer to SECTION 6A2A.

Install or Connect

NOTICE: See "Notice" on page 7C-1 of this section.

1. Clutch driven plate assembly (37) to engine flywheel assembly (29).
2. Clutch pressure plate assembly (with cover) (30).
3. Clutch pressure plate and cover bolts/screws (51).

Tighten

- Clutch pressure plate and cover bolts/screws (51) finger tight.

4. Align clutch driven plate assembly (37) with pilot bearing assembly (38) and clutch pressure plate assembly (with cover) (30) using J 33169.

Tighten

- Clutch pressure plate and cover bolts/screws (51) to 20 N•m (15 lb. ft.) plus 30 degrees.

5. Flywheel housing assembly (34).
6. Flywheel housing bolts/screws (65).

Tighten

- Flywheel housing bolts/screws (65) to 75 N•m (55 lb. ft.).

Important

- Check for proper clutch fork assembly (36) to clutch release bearing assembly (31) engagement.

7. Flywheel housing cover (12).
8. Flywheel housing cover bolts/screws (53).

Tighten

- Flywheel housing cover bolts/screws (35) to 8.5 N•m (75 lb. ft.).

9. Transmission brace (13).
10. Transmission brace nut (11) and bolt/screw (14).

Tighten

- Transmission brace nut (11) and bolt/screw (14) to 50 N•m (37 lb. ft.).

11. Clutch actuator cylinder.
12. Clutch actuator cylinder nuts (10).

Tighten

- Clutch actuator cylinder nuts (10) to 20 N•m (15 lb. ft.).

13. 5-Speed manual transmission assembly. Refer to SECTION 7B.
14. Lower vehicle.
15. Clutch master cylinder pushrod to clutch pedal assembly (19).
16. Instrument panel driver knee bolster assembly. Refer to SECTION 8C.
17. Battery negative cable assembly.

CLUTCH DRIVEN PLATE ASSEMBLY (6-SPEED)

Figures 3, 6 and 7

Remove or Disconnect

Tool Required:

J 38836 Clutch Alignment Arbor

1. Instrument panel driver knee bolster assembly. Refer to SECTION 8C.
2. Clutch master cylinder pushrod from clutch pedal assembly (19).
3. Raise and suitably support vehicle. Refer to SECTION 0A.
4. 6-Speed manual transmission assembly. Refer to SECTION 7B.

   NOTICE: Do not allow clutch actuator cylinder to hang by hydraulic lines as this could cause damage to clutch hydraulic lines.

5. Flywheel housing cover bolts/screws (61).
6. Flywheel housing cover (56).
7. Flywheel housing cover bolts/screws (62).
8. Flywheel housing assembly (44).
9. Clutch pressure plate and cover bolts/screws (57).
10. Clutch pressure plate assembly (with cover) (39).

Inspect

- Clutch pressure plate assembly (with cover) (39) for wear or damage. Repair or replace as necessary.
- Clutch driven plate assembly (47) for wear or damage. Replace as necessary.
- Engine flywheel assembly. Refer to SECTION 6A3A.

Install or Connect

NOTICE: See "Notice" on page 7C-1 of this section.

1. Clutch driven plage assembly (47) to engine flywheel assembly (46)
2. Clutch pressure plate assembly (with cover) (39).
3. Clutch pressure plate and cover bolts/screws (57).

Tighten

- Clutch pressure plate and cover bolts/screws (57) finger tight.

4. Align clutch driven plate assembly (47) with clutch pilot bearing (48) and clutch pressure plate assembly (with cover) (39) using J 38836.

Tighten

- Clutch pressure plate and cover bolts/screws (57) to 30 N•m (22 lb. ft.).

5. Flywheel housing assembly (44).
6. Flywheel housing bolts/screws (62).

Tighten

- Flywheel housing bolts/screws (62) to 47 N•m (35 lb. ft.).

7. Flywheel housing cover (56).
8. Flywheel housing cover bolts/screws (61).

Tighten

- Flywheel housing cover bolts/screws (61) to 8.5 N•m (75 lb. ft.).

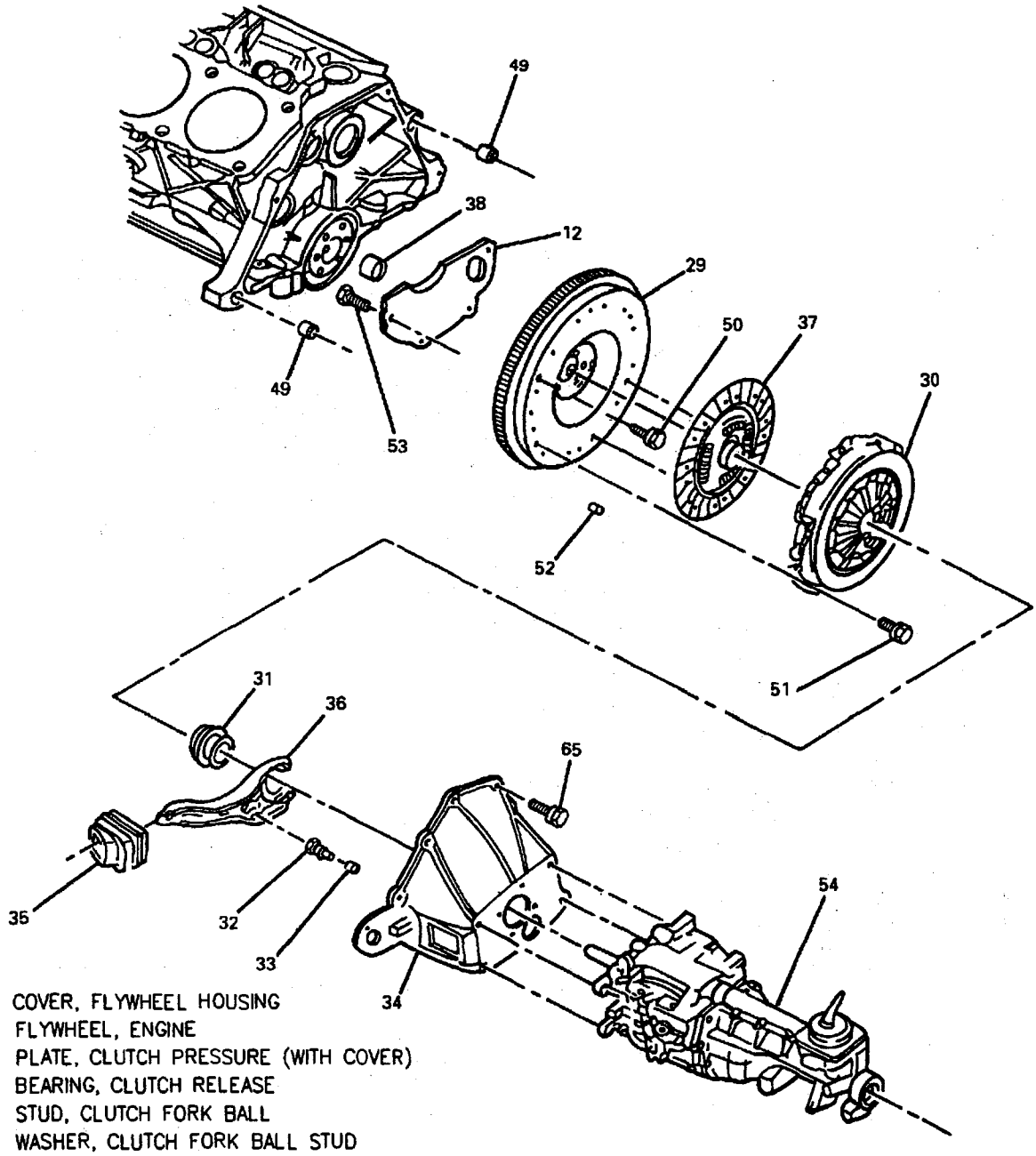
9. 6-Speed manual transmission assembly. Refer to SECTION 7B.
10. Lower vehicle.
11. Clutch master cylinder pushrod to clutch pedal assembly (19).
12. Instrument panel driver knee bolster assembly. Refer to SECTION 8C.

CLUTCH FORK ASSEMBLY AND CLUTCH RELEASE BEARING ASSEMBLY (5-SPEED)

Figures 2, 4 and 5

Remove or Disconnect

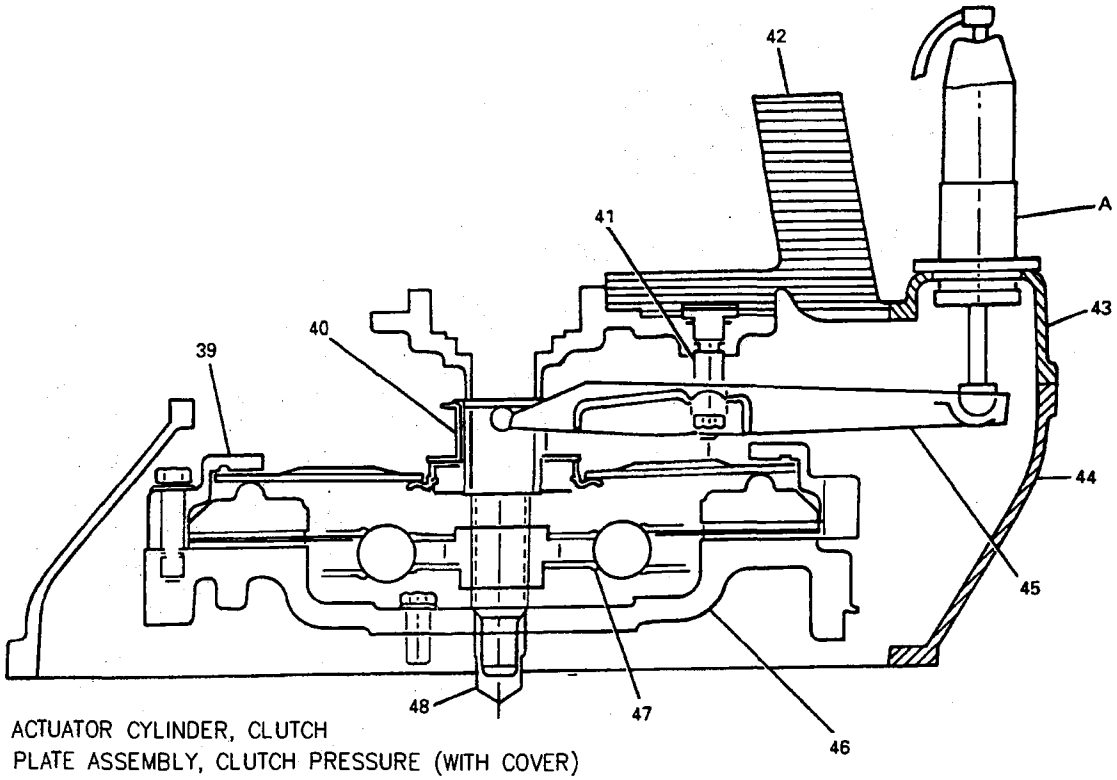
1. Instrument panel driver knee bolster assembly.
2. Clutch master cylinder pushrod from clutch pedal assembly (19).



12 COVER, FLYWHEEL HOUSING
29 FLYWHEEL, ENGINE
30 PLATE, CLUTCH PRESSURE (WITH COVER)
31 BEARING, CLUTCH RELEASE
32 STUD, CLUTCH FORK BALL
33 WASHER, CLUTCH FORK BALL STUD
34 HOUSING, FLYWHEEL
35 BOOT, CLUTCH FORK
36 FORK, CLUTCH
37 PLATE, CLUTCH DRIVEN
38 BEARING, CLUTCH PILOT
49 PIN, FLYWHEEL HOUSING LOCATOR
50 BOLT/SCREW, FLYWHEEL
51 BOLT/SCREW, CLUTCH PRESSURE PLATE AND COVER
52 PIN, FLYWHEEL GROOVE
53 BOLT/SCREW, FLYWHEEL HOUSING COVER
54 TRANSMISSION, MANUAL (5-SPEED)
65 BOLT/SCREW, FLYWHEEL HOUSING

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Figure 5 – Clutch System (5-Speed)



A ACTUATOR CYLINDER, CLUTCH
39 PLATE ASSEMBLY, CLUTCH PRESSURE (WITH COVER)
40 BEARING ASSEMBLY, CLUTCH RELEASE
41 T–STUD, CLUTCH FORK
42 TRANSMISSION ASSEMBLY, MANUAL (6–SPEED)
43 SPACER, CLUTCH ACTUATOR CYLINDER
44 HOUSING ASSEMBLY, FLYWHEEL
45 FORK ASSEMBLY CLUTCH
46 FLYWHEEL ASSEMBLY, ENGINE
47 PLATE ASSEMBLY, CLUTCH DRIVEN
48 BEARING, CLUTCH PILOT

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Figure 6 – Clutch System Cross Section (6-Speed)

3. Raise and suitably support vehicle. Refer to SECTION 0A.
4. 5-Speed manual transmission assembly. Refer to SECTION 7B.
5. Clutch actuator cylinder nuts (10).

   NOTICE: Do not allow clutch actuator cylinder to hang by hydraulic lines as this could cause damage to clutch hydraulic lines.
6. Clutch actuator cylinder and retain with mechanics wire.
7. Transmission brace nut (11) and bolt/screw (14).
8. Transmission brace (13).
9. Flywheel housing cover bolts/screws (53).
10. Flywheel housing cover (12).
11. Flywheel housing bolts/screws (65).
12. Flywheel housing assembly (34).
13. Clutch release bearing assembly (31).
14. Clutch fork assembly (36).
15. Clutch fork ball stud (32) and washer (33).

Inspect

- Clutch release bearing assembly, clutch fork assembly, and clutch fork ball stud for wear or damage. Replace as necessary.

Install or Connect

NOTICE: See "Notice" on page 7C-1 of this section.

1. Clutch fork ball stud (32) and washer (33).
2. Lubricate clutch ball stud (32) using wheel bearing lubricant GM P/N 1051344, or equivalent.
3. Clutch fork assembly (36) onto clutch ball stud (32).
4. Lubricant recess on inside diameter of clutch release bearing assembly (31) and the clutch fork groove using wheel bearing lubricant GM P/N 1051344, or equivalent.
5. Clutch release bearing assembly (31) to clutch fork assembly (36).
6. Flywheel housing assembly (34).

7. Flywheel housing bolts/screws (65).

Tighten

- Flywheel housing bolts/screws (65) to 75 N•m (55 lb. ft.).

8. Flywheel housing cover (12).
9. Flywheel housing cover bolts/screws (53).

Tighten

- Flywheel housing cover bolts/screws (53) to 8.5 N•m (75 lb. ft.).

10. Transmission brace (13).
11. Transmission brace nut (11) and bolt/screw (14).

Tighten

- Transmission brace nut (11) and bolt/screw (14) to 50 N•m (37 lb. ft.).

12. Clutch actuator cylinder.
13. Clutch actuator cylinder nuts (10).

Tighten

- Clutch actuator cylinder nuts (10) to 20 N•m (15 lb. ft.).

14. 5-Speed manual transmission assembly. Refer to SECTION 7B.
15. Lower vehicle.
16. Clutch master cylinder pushrod to clutch pedal assembly (19).
17. Instrument panel driver knee bolster assembly. Refer to SECTION 8C.

CLUTCH FORK ASSEMBLY AND CLUTCH RELEASE BEARING ASSEMBLY (6-SPEED)

Figures 3, 6 and 7

Tool Required:

J 33169 Clutch Alignment Arbor

Remove or Disconnect

1. Instrument panel driver knee bolster assembly. Refer to SECTION 8C.
2. Clutch master cylinder pushrod from clutch pedal assembly (19).
3. Raise and suitably support vehicle. Refer to SECTION 0A.
4. 6-Speed manual transmission assembly. Refer to SECTION 7B.
5. Flywheel housing cover bolts/screws (61).
6. Flywheel housing cover (56).
7. Flywheel housing bolts/screws (62).
8. Flywheel housing assembly (44).
9. Clutch pressure plate and cover bolts/screws (57).
10. Clutch pressure plate assembly (with cover) (39) and clutch driven plate assembly (47).
11. Clutch release bearing retainer (58).
12. Clutch release bearing assembly (40).
13. Clutch fork assembly (45) from 6-Speed manual transmission assembly (42).
14. Bolt/screw (63) and clutch fork T-stud (41) from 6-Speed manual transmission assembly (42).

Inspect

- Clutch release bearing assembly (40), clutch fork assembly (45), and clutch fork T-stud (41) for wear or damage. Replace as necessary.

Install or Connect

NOTICE: See "Notice" on page 7C-1 of this section.

1. Clutch fork T-stud (41) and bolt/screw (63).

Tighten

- Clutch fork T-stud bolt/screw (63) to 24 N•m (18 lb. ft.).

2. Lubricate clutch fork T-stud (41) using wheel bearing lubricant GM P/N 1051344, or equivalent.
3. Clutch fork assembly (45) on clutch fork T-stud (41) at first detent position.
   - Do not fully seat clutch fork assembly (45) on clutch fork T-stud (41) until after installation of 6-Speed manual transmission assembly (42). It will fully seat itself when transmission assembly (42) is installed.
4. Clutch release bearing assembly (40) to clutch pressure plate assembly (with cover) (39).
5. Clutch release bearing retainer (58).
6. Clutch driven plate assembly (47) to engine flywheel assembly (46).
7. Clutch pressure plate assembly (with cover) (39).
8. Clutch pressure plate and cover bolts/screws (57).

Tighten

- Clutch pressure plate and cover bolts/screws (57) finger tight.

9. Align clutch driven plate assembly (47) with clutch pilot bearing (48) and clutch pressure plate assembly (with cover) (39) using J 38836.

Tighten

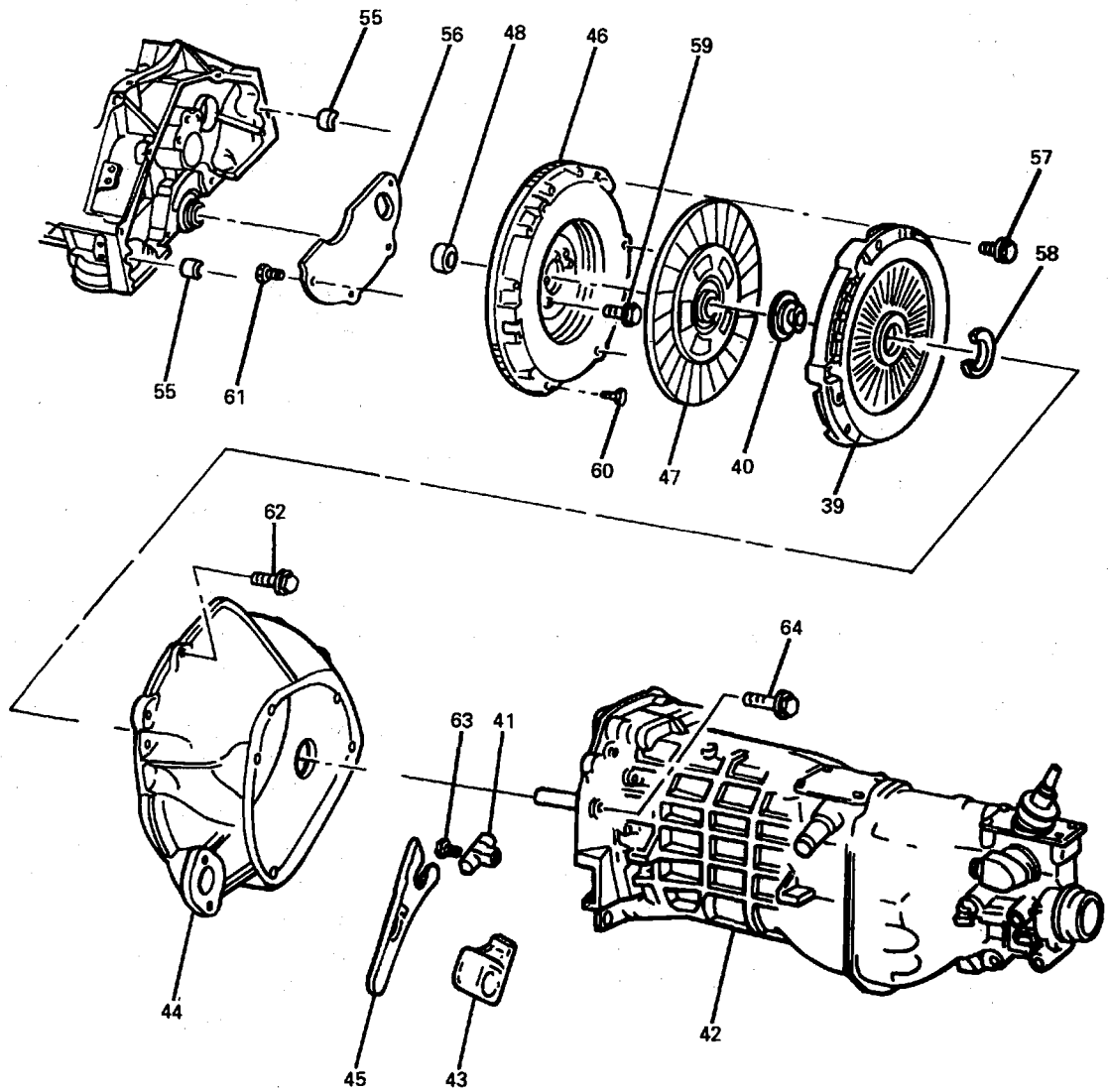
- Clutch pressure plate and cover bolts/screws (57) to 30 N•m (22 lb. ft.).

10. Flywheel housing assembly (44).
11. Flywheel housing assembly bolts/screws (62).

Tighten

- Flywheel housing bolts/screws (62) to 47 N•m (35 lb. ft.).

12. Flywheel housing cover (56).
13. Flywheel housing cover bolts/screws (61).



39 PLATE, CLUTCH PRESSURE (WITH COVER)
40 BEARING, CLUTCH RELEASE
41 T-STUD, CLUTCH FORK
42 TRANSMISSION, MANUAL (6-SPEED)
43 SPACER, CLUTCH ACTUATOR CYLINDER
44 HOUSING, FLYWHEEL
45 FORK, CLUTCH
46 FLYWHEEL, ENGINE
47 PLATE, CLUTCH DRIVEN
48 BEARING, CLUTCH PILOT
55 PIN, FLYWHEEL HOUSING LOCATOR
56 COVER, FLYWHEEL HOUSING
57 BOLT/SCREW, CLUTCH PRESSURE PLATE AND COVER
58 RETAINER, CLUTCH RELEASE BEARING
59 BOLT/SCREW, FLYWHEEL
60 PIN, FLYWHEEL GROOVE
61 BOLT/SCREW, FLYWHEEL HOUSING COVER
62 BOLT/SCREW, FLYWHEEL HOUSING
63 BOLT/SCREW, CLUTCH FORK T-STUD
64 BOLT/SCREW, TRANSMISSION

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Figure 7 – Clutch System (6-Speed)

Tighten

- Flywheel housing cover bolts/screws (61) to 8.5 N•m (75 lb. ft.).

14. 6-Speed manual transmission assembly. Refer to SECTION 7B.
15. Lower vehicle.
16. Clutch master cylinder pushrod to clutch pedal assembly (19).
17. Instrument panel driver knee bolster assembly. Refer to SECTION 8C.

CLUTCH PILOT BEARING

Figures 5 through 7

Tool Required:

J 23907 Clutch Pilot Bearing Remover

Remove or Disconnect

1. Clutch driven plate assembly. Refer to "Clutch Driven Plate Assembly (5-Speed)" or "Clutch Driven Plate Assembly (6-Speed)" in this section.
2. Engine flywheel assembly. Refer to SECTION 6A2A or 6A3A.
3. Clutch pilot bearing (38 or 48) using J 23907.

Install or Connect

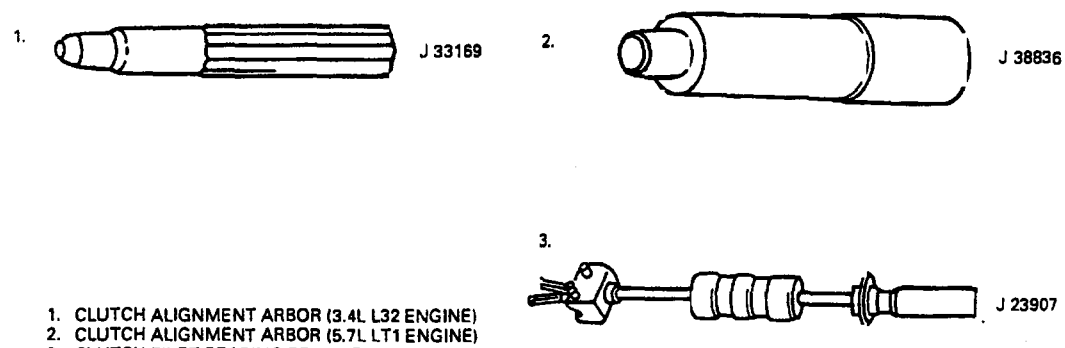
1. Clutch pilot bearing (38 or 48).
2. Engine flywheel assembly. Refer to SECTION 6A2A or 6A3A.
3. Clutch driven plate assembly. Refer to "Clutch Driven Plate Assembly (5-Speed)" or "Clutch Driven Plate Assembly (6-Speed" in this section.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Brake Pedal Nut	25 N•m (18 lb. ft.)
Brake Pedal Pivot Nut	54 N•m (40 lb. ft.)
Clutch Actuator Cylinder Nut	20 N•m (15 lb. ft.)
Clutch Fork T-Stud Bolt/Screw	24 N•m (18 lb. ft.)
Clutch Master Cylinder Nut	27 N•m (20 lb. ft.)
Clutch Pressure Plate and Cover Bolt/Screw (6-Speed)	30 N•m (22 lb. ft.)
Clutch Pressure Plate and Cover Bolt/Screw (5-Speed)	20 N•m (15 lb. ft.) Plus 45 Degrees
Flywheel Bolt/Screw (5-Speed)	83 N•m (61 lb. ft.)
Flywheel Bolt/Screw (6-Speed)	100 N•m (74 lb. ft.)
Flywheel Housing Cover Bolt/Screw	8.5 N•m (75 lb. in.)
Flywheel Housing Bolt/Screw (5-Speed)	75 N•m (55 lb. ft.)
Flywheel Housing Bolt/Screw (6-Speed)	47 N•m (35 lb. in.)
Transmission Brace Bolt/Screw	50 N•m (37 lb. in.)
Transmission Brace Nut	50 N•m (37 lb. ft.)
Transmission Bolt/Screw	35 N•m (26 lb. in.)

SPECIAL TOOLS



1. CLUTCH ALIGNMENT ARBOR (3.4L L32 ENGINE)
2. CLUTCH ALIGNMENT ARBOR (5.7L LT1 ENGINE)
3. CLUTCH PILOT BEARING REMOVER

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SECTION 8

ELECTRICAL BODY AND CHASSIS

CONTENTS

Electrical Diagnosis ..... Section 8A
Lighting Systems and Horns ..... Section 8B
Instrument Panel, Gages and Console ..... Section 8C
Windshield Wiper/Washer System ..... Section 8E

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SECTION 8B

LIGHTING SYSTEMS AND HORNS

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

HALOGEN BULBS

Some bulbs in this vehicle may contain halogen gas.

CAUTION: Halogen bulbs contain a gas under pressure. Handling a bulb improperly could cause it to shatter into flying glass fragments. To help avoid personal injury:

- **Turn off lamp assembly and allow bulb to cool before changing bulbs. Leave switch assembly off until bulb change is complete.**
- **Always wear eye protection when changing a halogen bulb.**
- **Handle bulb only by its base. Avoid touching glass.**
- **Do not drop or scratch bulb. Keep moisture away.**
- **Place used bulb in new bulb's carton and dispose of it properly. Keep halogen bulbs out of the reach of children.**

EXTERIOR LIGHTING

Backup Lamps

The backup lamps are part of the taillamp assemblies. They are located on the innermost side of the taillamp assembly next to the taillamp filler. They will come on when the transmission is shifted into "REVERSE." On vehicles with an automatic transmission assembly, the backup lamps are activated by the park/neutral position switch assembly. On vehicles with a manual transmission, they are activated by a backup lamp switch which is part of the transmission assembly. For more information, refer to SECTION 7A or 7B.

Daytime Running Lamps (Canadian Only)

All Canadian vehicles are equipped with daytime running lamps. The daytime running lamp system includes a solid state module, a relay and a light sensor. The system lights low-beam headlamps at reduced intensity when the ignition switch is in the "RUN" position during daylight. The daytime running lamp system is designed to light the low-beam headlamps at full intensity, and the parking and taillamps when low light conditions are present.

Front Fog Lamp Assemblies

The fog lamp switch assembly is below the headlamp and instrument panel lamp dimmer switch assembly to the left of the steering column assembly. To use the front fog lamp assemblies, first turn on the headlamps or parking lamps. Then push the right side of the fog lamp switch to turn on the front fog lamp assemblies. Push the left side of the switch to turn off the front fog lamp assemblies.

The front fog lamp assemblies should not be used as a substitute for the headlamps.

Switching to high-beam headlamps will turn off the front fog lamp assemblies. Switching back to low-beam headlamps will turn the front fog lamp assemblies on again.

The front fog lamp assemblies must be aimed for proper illumination of the road. Fog lamp aim should be checked when a new bulb is installed or if service or repairs in the front end area may have disturbed the fog lamp mountings.

Front Sidemarker Lamps

The front sidemarker lamps are housed within the parking and turn signal lamp assembly. They will come on when the headlamps or parking lamps are on. The front sidemarker lamps also have reflectors that will shine when struck by light whether or not the vehicle's lamps are on.

If the headlamps or parking lamps are off when a turn is signalled, the appropriate front sidemarker lamps will flash in unison with the front turn signal lamp on the same side. If the headlamps or parking lamps are on when a turn is signalled, the front sidemarker lamp and front turn signal lamp will flash alternately.

Hazard Lamp Flasher Assembly

The hazard warning flashers are part of the turn signal circuit. The hazard warning switch is on the right side of the steering column assembly. Pressing in on the hazard warning switch button causes the front and rear turn signal lamps and front sidemarker lamps to flash. Pulling on the hazard warning switch knob will turn off the hazard warning flashers.

The hazard warning flashers will work with the ignition switch in any position. When the hazard warning flashers are "ON," the turn signals do not work. The hazard lamp flasher assembly is in the convenience center behind the instrument panel assembly on the knee bolster bracket. For more information on the hazard warning switch assembly, refer to SECTION 3F.

Headlamp Capsule Assemblies and Headlamp Assemblies

The headlamp capsule assemblies (Chevrolet) and headlamp assemblies (Pontiac) are controlled by the headlamp switch located on the headlamp and instrument panel lamp dimmer switch assembly to the left of the steering column assembly. They will come on with the ignition switch in any position. Turning the headlamp switch all the way to the right turns on the headlamps. Turning the headlamp switch all the way to the left turns off the headlamps.

Headlamp low beam and high beam are controlled by the headlamp dimmer switch lever assembly on the left side of the steering column assembly. When the headlamps are on, pulling the lever assembly toward the driver until the switch clicks changes the lamp from low beam to high beam, or from high beam to low beam. An indicator lamp on the instrument cluster assembly will come on when the high-beam headlamps are on.

The headlamps must be aimed for proper illumination of the road. Headlamp aim should be checked whenever a new headlamp assembly is installed or service

repairs to the front end area may have disturbed the headlamp assembly or its mountings.

Important

- Some state and local laws specify requirements for headlamp aim. These laws must be followed.

High-Mount Stoplamp Assembly

The high-mount stoplamp assembly is in the center of the rear end spoiler assembly. It will illuminate whenever the brake pedal assembly is pushed down. The lamp is powered separately from the taillamp assemblies through a circuit in the stoplamp switch assembly.

Parking and Turn Signal Lamp Assemblies

The parking lamps can be turned on by turning the headlamp switch to the first position on the right. The parking lamps can be turned off by turning the headlamp switch to the left. If the parking lamps are on and the ignition switch is off, a warning tone will sound as a reminder to turn the lamps off.

When the turn signals are activated, the appropriate front parking lamps flash to signal a turn. The turn signal works only when the ignition switch is on and the hazard lamp flashers are turned off.

The turn signals are controlled by the turn signal lever assembly on the left side of the steering column assembly. Moving the lever all the way up or down (past the detent) will turn on the turn signals. When the turn is completed, the lever assembly will return to horizontal and the turn signals will stop flashing.

For changing lanes or shallow turns where the steering wheel assembly does not turn far enough to cancel the signal, move the signal only to the first detent and hold it there. When the lever assembly is released, it will return to horizontal and the turn signal will cancel. For more information, refer to SECTION 8A.

Rear License Lamp Assembly

The rear license lamp assembly will come on when the headlamps or parking lamps are on. The rear license lamp assembly is mounted on the rear bumper fascia above the license plate.

Rear Sidemarker Lamp Assemblies

The rear sidemarker lamp assemblies are mounted on the rear bumper fascia.

The rear sidemarker lamp assemblies will come on when the headlamps or parking lamps are on. The rear sidemarker lamp assemblies also have reflectors that will shine when struck by light whether or not the vehicle's lamps are on.

Taillamp Assemblies

The taillamps, backup lamps and turn signal lamps are part of the taillamp assembly.

Turning on either the headlamps or parking lamps will turn on the taillamps. When the brake pedal is pushed down, the taillamps glow brighter to serve as stoplamps.

The turn signals are controlled by the turn signal lever assembly on the left side of the steering column assembly. Moving the lever all the way up or down (past the detent) will turn on the turn signals. When the turn is completed, the lever assembly will return to neutral and the turn signals will stop flashing. If the brake pedal is held down when a turn is signalled, one side will flash and the other will stay on brightly.

For changing lanes or shallow turns where the steering wheel assembly does not turn far enough to cancel the signal, move the lever assembly only to the first detent. When the lever assembly is released, it will return to neutral and the turn signals will cancel.

Turn Signal Lamp Flasher Assembly

The turn signal lamp flasher assembly is mounted behind the instrument panel assembly on the driver knee bolster bracket.

INTERIOR LIGHTING

For information on the warning/indicator lamps, cluster lamps, etc., refer to SECTION 8C. For circuit information, refer to SECTION 8A.

Ashtray Lamp

An ashtray lamp is available on vehicles with a manual transmission. It is mounted beneath the ashtray and it will come on when the parking lamps or headlamps are turned on.

Automatic Transmission Indicator Lamp

The automatic transmission indicator lamp will illuminate the automatic transmission control indicator located on the front floor console assembly on vehicles equipped with an automatic transmission. It will come on when the parking lamps or headlamps are turned on.

Console Lamp

The console lamp is mounted on the front floor console assembly. It lights when the console compartment door is opened.

Dome and Reading Lamps

The dome lamp (not available on convertible models) is located on the roof above the rear seat assembly. It will come on when a door is opened or when the inside lamp is turned on. To turn on the interior lamps, rotate the interior lights thumbwheel switch, located to the left of the headlamp switch, full up.

The front reading lamps are part of the inside rearview mirror assembly. Use the switch to turn a reading lamp on or off when the doors are closed. With the doors open, the reading lamps are always on.

For more information on the dome and reading lamps, refer to SECTION 10-9 and SECTION 10-2.

Front Side Door Courtesy Lamps

The front side door courtesy lamps are mounted behind the front side door inside handle bezel assemblies. They come on when the parking lamps or headlamps are turned on to illuminate the door handles and controls.

Heater and Air Conditioning Control Lamp

The heater and air conditioning control lamp is mounted on the back of the heater and air conditioning control assembly. It will come on when the parking lamps or headlamps are turned on to illuminate the heater and air conditioning controls.

Instrument Panel Compartment Lamp

The instrument panel compartment lamp lights when the instrument panel compartment door is opened.

Rear Quarter Courtesy Lamps

The rear quarter courtesy lamps are mounted in the right and left quarter inner rear trim finishing panel assemblies. They will come on when a door is opened or when the interior lamps are turned on. For more information on the rear quarter courtesy lamps, refer to SECTION 10-7.

Rear Compartment Lamp

The rear compartment lamp is located in the rear compartment below the rear compartment lid latch assembly. It will come on when the rear compartment lid is opened. For more information on the rear compartment lamp, refer to SECTION 10-8.

HORN ASSEMBLIES

Pushing the pads on the left-hand or right-hand center of the steering wheel assembly sounds the horn assemblies by closing the horn relay. For wiring and circuit information, refer to SECTION 8A.

DIAGNOSIS

For wiring diagrams and other diagnosis information on properly repairing wiring harnesses, connectors, etc., refer to SECTION 8A.

LIGHTING SYSTEM TROUBLESHOOTING

Most lighting problems are caused by loose connectors, open or shorted wiring, burned-out bulbs, bad switch assemblies, an inadequate ground or blown fuses. Check these items first and then refer to SECTION 8A.

HORN ASSEMBLIES

If the horn assemblies do not blow, or blow constantly, follow the diagnostic procedures in SECTION 8A.

Horn Tone Poor

1. Horn tone poor – tighten horn bolts/screws in mounting area, or correct poor connections or ground.
2. Low-pitched moan – sounds like "mooing." Caused by current too high. Adjust current. Refer to "Horns" under "On-Vehicle Service" in this section.
3. Weak tone – current too low. Correct poor connections or ground, or adjust current. Refer to "Horns" under "On-Vehicle Service" in this section.
4. Weak, strained tone – remove foreign object in horn.
5. Harsh vibration – bend bracket so horn assembly is not touching sheet metal.

ON-VEHICLE SERVICE

When replacing a part that requires a special procedure (such as a lens and housing assembly sealed together), follow the instructions normally included in the replacement parts package.

When removing a part that requires special sealing items (such as sealing washers), be sure to reinstall those items when replacing the part. Also, if any body sealing items (grommets, etc.) are disturbed, be sure to repair them so the passenger compartment remains properly sealed.

Take care to prevent waterleaks if sealing surfaces are disturbed. Damaged gaskets must be replaced. If necessary, use sealer (body caulking compound or equivalent) in critical areas or any area where the gasket doesn't seal properly.

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

EXTERIOR LIGHTING

Backup Lamps

To replace a backup lamp bulb, refer to "Taillamp Assemblies" under "On-Vehicle Service" in this section.

Front Fog Lamp Assemblies

Figure 1

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Front bumper fascia lower deflector. Refer to SECTION 10-4.
3. Bolts/screws (3) attaching front fog lamp assembly (1) to front bumper impact bar (4).
4. Front fog lamp assembly (1) from front bumper impact bar (4).
5. Nuts (2) from front bumper impact bar (4), if necessary.

Install or Connect

NOTICE: See "Notice" on page 8B-1 of this section.

1. Nuts (2) to front bumper impact bar (4), if removed.

Tighten

- Nuts (2) to 10 N•m (89 lb. in.).

2. Front fog lamp assembly (1) to front bumper impact bar (4).
3. Bolts/screws (3) attaching front fog lamp assembly (1) to front bumper impact bar (4).

Tighten

- Bolts/screws (3) to 15 N•m (11 lb. ft.).

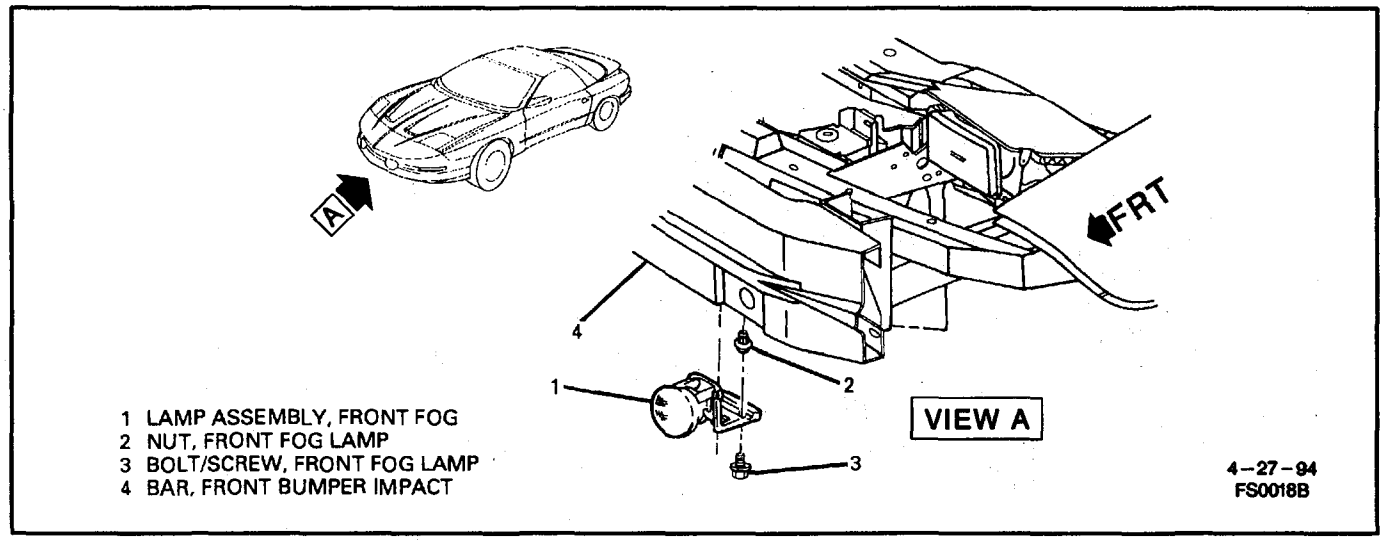


Figure 1 – Front Fog Lamp Assemblies (Typical)

4. Front bumper fascia lower deflector. Refer to SECTION 10-4.
5. Lower vehicle.

Front Fog Lamp Aiming Procedure

Horizontal aim is not adjustable on this vehicle. Vertical aim is done by an adjusting screw located at the top center of the front fog lamp assembly.

- Prepare vehicle:
  - A. Make sure all components are in place, if other service has been performed on vehicle.
  - B. Make sure vehicle has 1/2 tank of fuel or less.
  - C. Move vehicle to level area and park 7.6 m (25 feet) away from target screen.
  - D. Measure from center of front fog lamp assembly to ground line.
  - E. Turn front fog lamp assemblies on. Top edge of high intensity zone to be 102 mm (4 inches) below centerline of front fog lamp assembly.
  - F. Adjust front fog lamp assembly as required, using adjusting screw at top center of front fog lamp assembly.

Front Sidemarker Lamp

For replacement of front sidemarker lamp bulb, refer to "Parking and Turn Signal Lamp Assemblies" under "On-Vehicle Service" in this section.

Hazard Lamp Flasher Assembly

Figure 2

Remove or Disconnect

- Hazard lamp flasher assembly (6) by pulling from convenience center.

Install or Connect

- Hazard lamp flasher assembly (6) to convenience center.

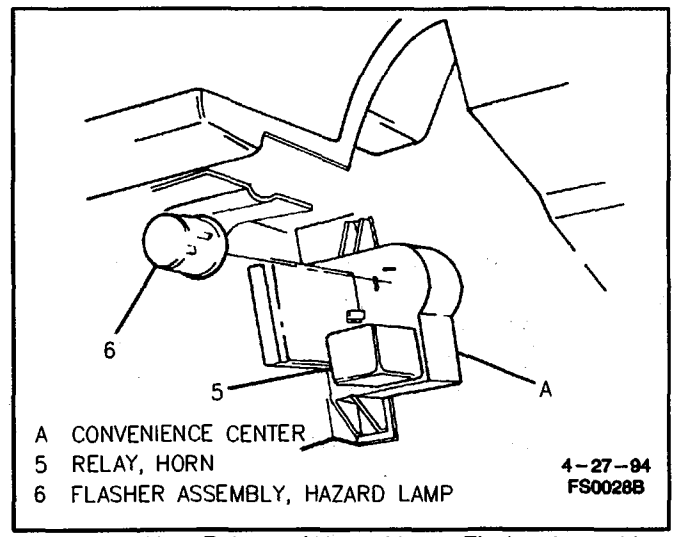


Figure 2 – Horn Relay and Hazard Lamp Flasher Assembly

Headlamp Capsule Assemblies

Chevrolet

Figure 3

Remove or Disconnect

1. Open hood assembly.
2. Bolts/screws (7).
3. Headlamp mounting ring (8).
4. Electrical connector.
5. Headlamp capsule assembly (9).

Install or Connect

NOTICE: See "Notice" on page 8B-1 of this section.

1. Headlamp capsule assembly (9).
2. Electrical connector.
3. Headlamp mounting ring (8).
   - If replacing headlamp mounting ring (8), transfer undamaged vertical level indicator to new headlamp mounting ring (8).

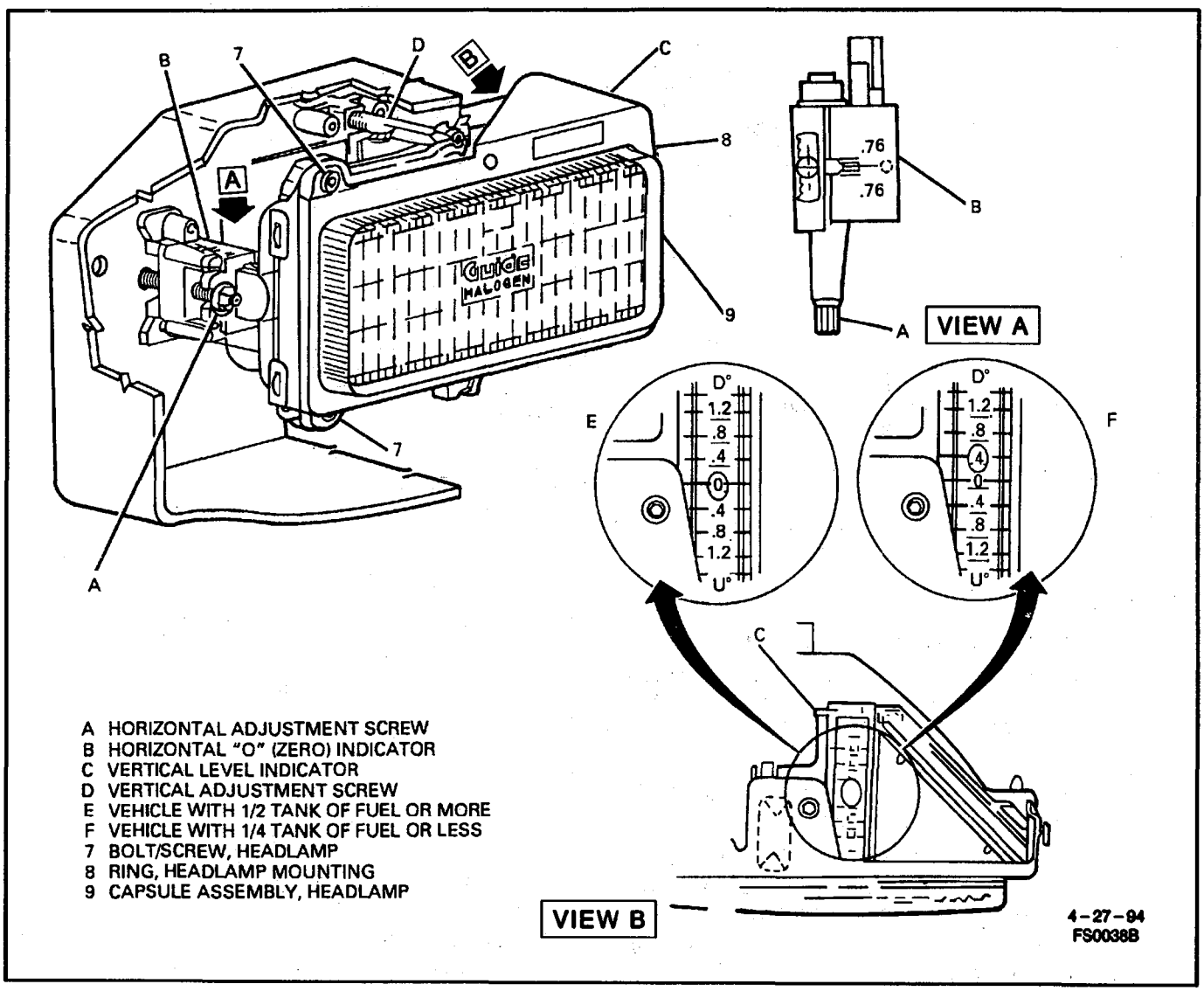


Figure 3 – Headlamp Capsule Assemblies – (Chevrolet)

4. Bolts/screws (7).
   - Tighten securely.
5. Close hood assembly.

Headlamp Assemblies

Pontiac

Headlamp Bulb Replacement

Figure 4

Remove or Disconnect

1. Open hood assembly.
2. Bolts/screws (44).
3. Headlamp bezel (43).
4. Headlamp bolts/screws attaching mounting ring to headlamp opening housing assembly (49).
5. Headlamp mounting ring.
6. Electrical connector.
7. Sealed-beam headlamp assembly.

Install or Connect

NOTICE: See "Notice" on page 8B-1 of this section.

1. Sealed-beam headlamp assembly.
2. Electrical connector.
3. Headlamp mounting ring.
4. Headlamp bolts/screws attaching mounting ring to headlamp opening housing assembly (49).
   - Tighten securely.
5. Headlamp bezel (43).
   - Top of headlamp bezel (43) must be flush to inner surface of headlamp opening door (42).
6. Bolts/screws (44).

Tighten

- Bolts/screws (44) to 1.7 N•m (15 lb. in.).

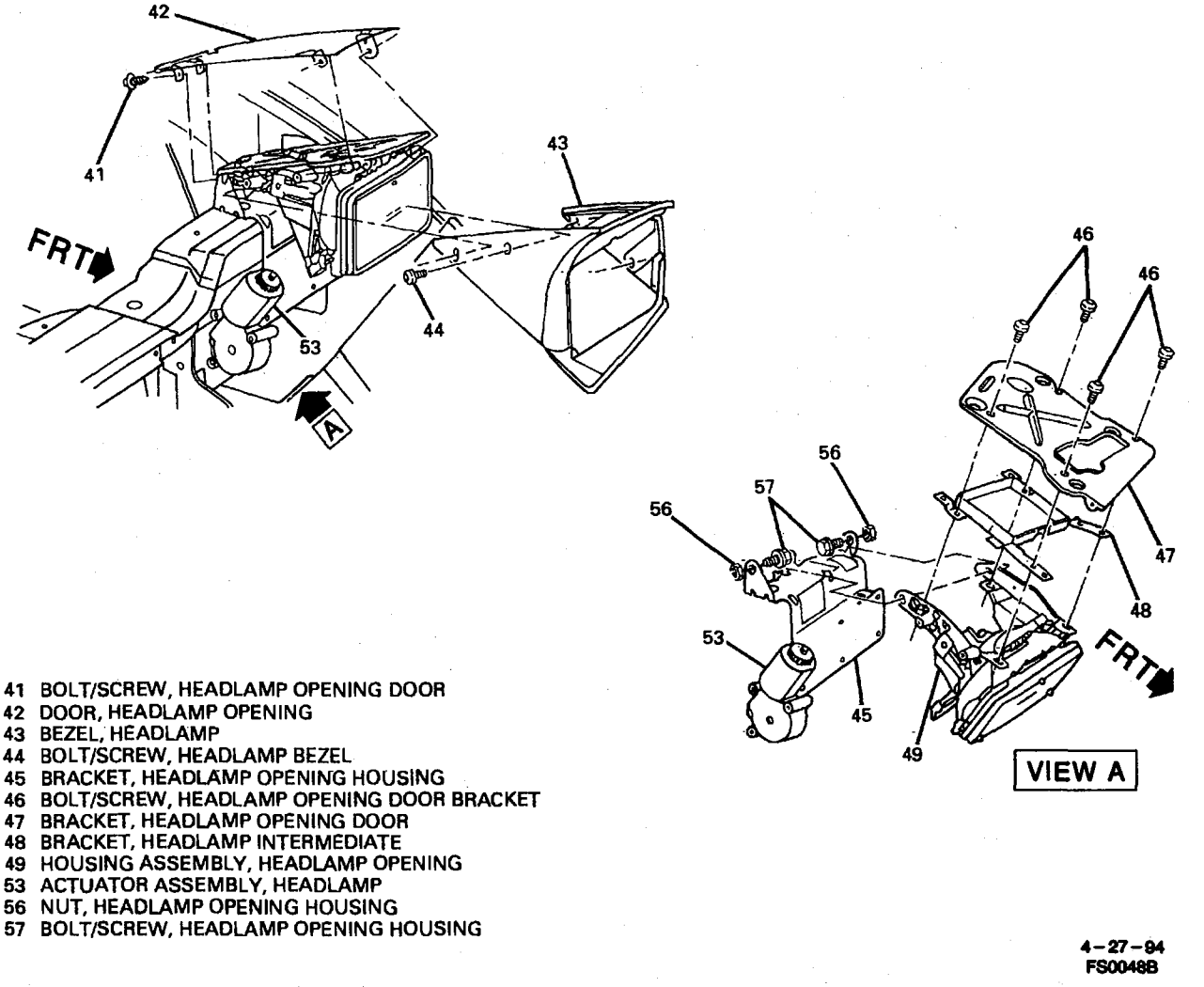


Figure 4 – Headlamp Assemblies – (Pontiac)

7. Close hood assembly.

Headlamp Opening Housing Assembly and Door Replacement

Pontiac

Figure 4

Remove or Disconnect

1. Raise headlamp manually by turning knob on headlamp actuator assembly (53).
2. Bolts/screws (44).
3. Headlamp bezel (43).
4. Bolts/screws (41).
5. Headlamp opening door (42).
6. Nuts (56) and bolts/screws (57) attaching headlamp opening housing assembly (49) to headlamp opening housing bracket (45).
7. Headlamp opening housing assembly (49) from headlamp opening housing bracket (45).
8. Bolts/screws (46).
9. Opening door bracket (47).
10. Intermediate bracket (48).
11. Headlamp actuator assembly cap (58).
12. Actuator assembly (53) from headlamp opening housing bracket (45), if necessary, by removing attaching nut and bolts/screws.

Install or Connect

NOTICE: See "Notice" on page 8B-1 of this section.

1. Actuator assembly (53) to headlamp opening housing bracket (45), if removed, by installing attaching nut and bolts/screws.
2. Headlamp actuator assembly cap (58).
3. Intermediate bracket (48) to headlamp opening housing assembly (49).
4. Opening door bracket (47) on top of intermediate bracket (48).
5. Bolts/screws (46).

Adjust

- Gaps and flushness of headlamp opening door (42) to surrounding area using bolts/screws (46).
- Tighten securely.

6. Headlamp opening housing assembly (49) to headlamp opening housing bracket (45).

Adjust

- Gaps on headlamp opening housing assembly (49) to surrounding area using the forward and rearward adjustment bolts/screws (60), or side-to-side adjustment bolts/screws (59).
- Tighten securely.

7. Bolts/screws (57) and nuts (56) attaching headlamp opening housing assembly (49) to headlamp opening housing bracket (45).
   - Tighten securely.
8. Headlamp opening door (42).
9. Bolts/screws (41).

Tighten

- Bolts/screws (41) to 1.7 N•m (15 lb. in.).

10. Headlamp bezel (43).
11. Bolts/screws (44).

Tighten

- Bolts/screws (44) to 1.7 N•m (15 lb. in.).

12. Lower headlamp.

Headlamp Opening Door Actuator Control Module Assembly

Pontiac

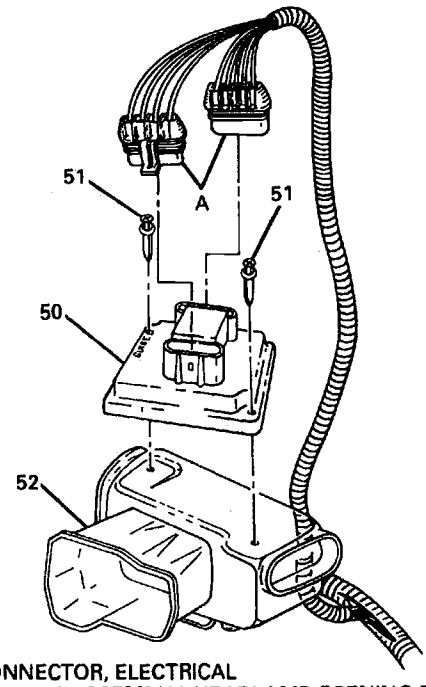
Figure 5

Remove or Disconnect

1. Front air intake duct. Refer to SECTION 6E3.
2. Bolts/screws (51).
3. Door actuator module assembly (50) from air intake duct (52).
4. Electrical connectors.

Install or Connect

1. Electrical connectors.
2. Door actuator module assembly (50) to air intake duct (52).



A CONNECTOR, ELECTRICAL
50 MODULE ASSEMBLY, HEADLAMP OPENING DOOR ACTUATOR CONTROL
51 BOLT/SCREW, HEADLAMP AUTOMATIC CONTROL MODULE
52 DUCT, FRONT AIR INTAKE

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Figure 5 – Headlamp Opening Door Actuator Control Module Assembly – (Pontiac)

3. Bolts/screws (51).
4. Front air intake duct. Refer to SECTION 6E3.

Headlamp Aiming by Screen Method

Figures 6, 7 and 8

Horizontal aim is corrected by an adjusting screw on the outer side of the headlamp capsule assembly (Chevrolet) or headlamp assembly (Pontiac). Vertical aim is corrected by an adjusting screw in the top center of the assembly.

It is desirable to have a specific aiming area in a darkened location. This area should be large enough to accommodate the vehicle, plus an additional 25 feet measured from the face of the headlamp capsule assemblies to the front of the visual screen.

- The floor on which the vehicle rests must be flat with the bottom of the screen. If the floor is not level, then compensation must be made.
- The aiming screen should be 5 feet high by 12 feet wide with a matte white surface, well shaded from outside light, and properly adjusted to the floor on which the vehicle stands. The screen must be provided with a vertical center line, two laterally adjustable vertical tapes, and a vertically adjustable horizontal tape.

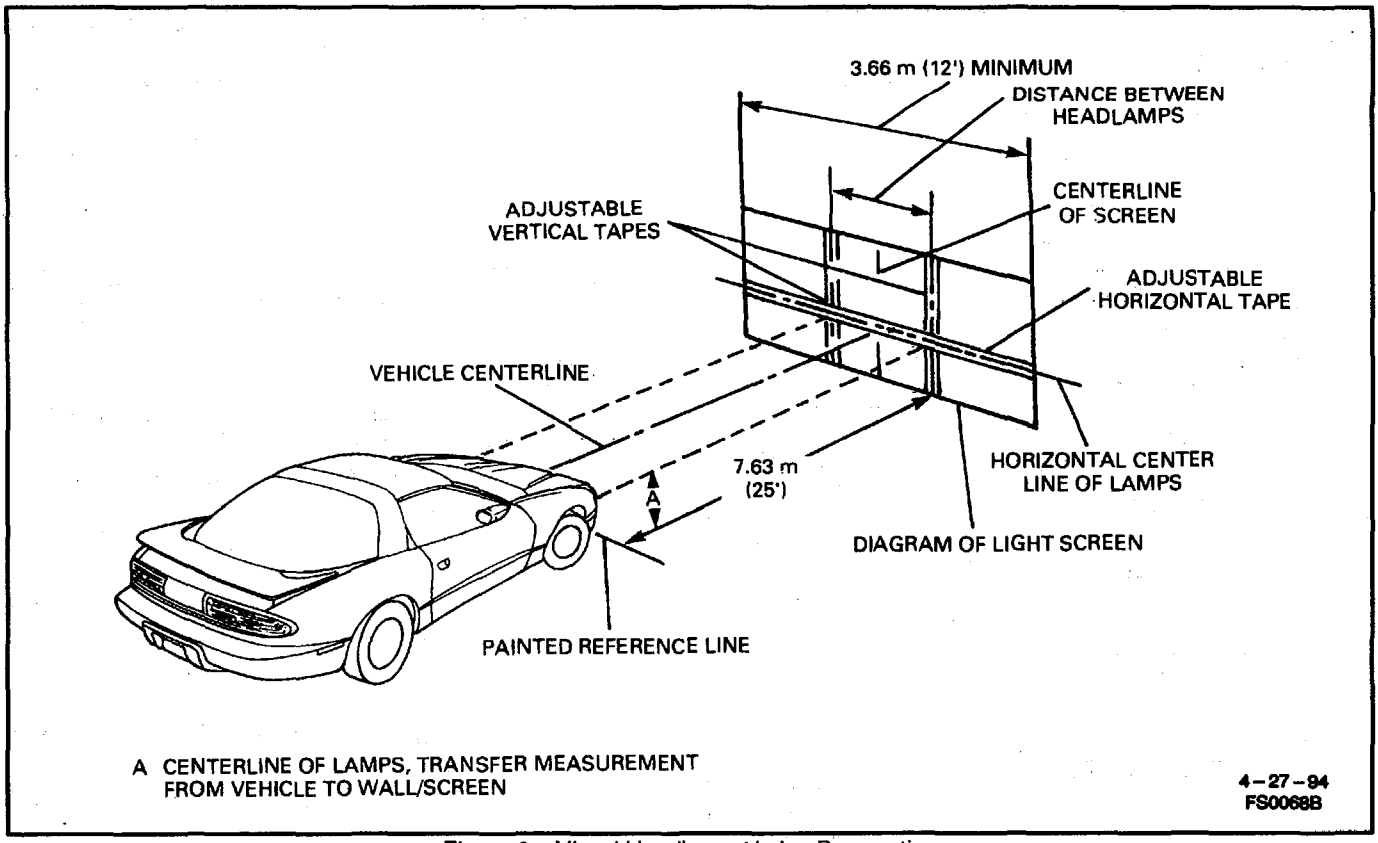


Figure 6 – Visual Headlamp Aiming Preparation

Important

- For each vehicle checked, the horizontal lines or tape on the screen must be adjusted. Vehicles of the same model and year will have different standing height for the headlamp capsule assemblies.

- Provisions should be made for moving the screen, so that it can be aligned parallel with the rear axle. This will allow for a horizontal line drawn perpendicular from the center line of the screen to pass through the center point between the two capsule assemblies.
- Once the screen has been set up in a permanent location, a reference line is to be painted on the floor to identify the proper location of the headlamp capsule assemblies (Chevrolet) or headlamp assemblies (Pontiac) when they are being aimed (Figure 6).
  - If a regular commercial aiming screen is not available, the screen may consist of a vertical wall having a clear uninterrupted area approximately 6 feet high by 12 feet wide, finished with a washable non-gloss white paint.

1. Prepare vehicle for checking beam aim as follows:
   A. Completely assemble all components on vehicle.
   B. Fuel load to be 1/2 tank or less.
      - Only other load in vehicle is the driver.

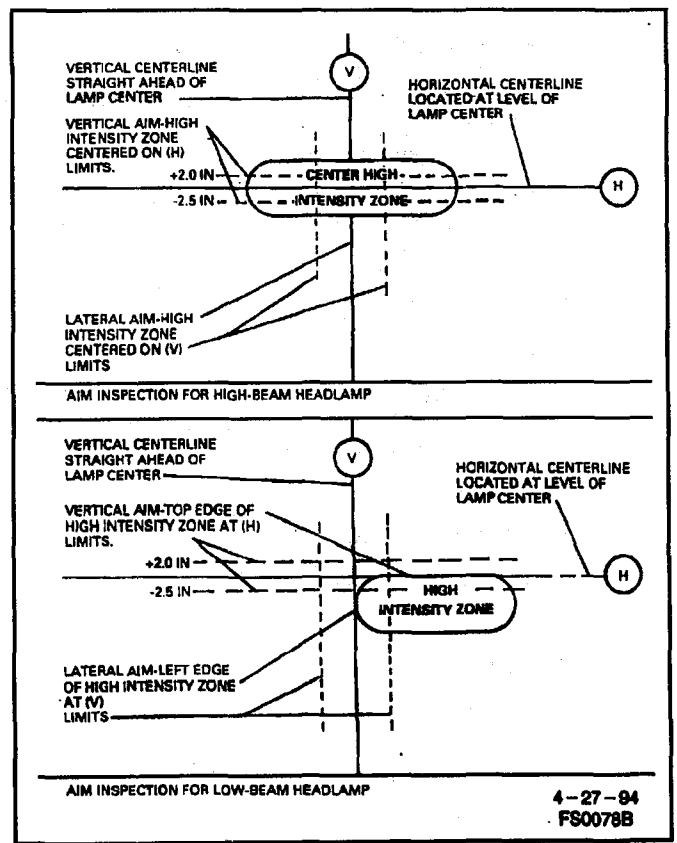


Figure 7 – Visual Headlamp Aim Limits – (Pontiac)

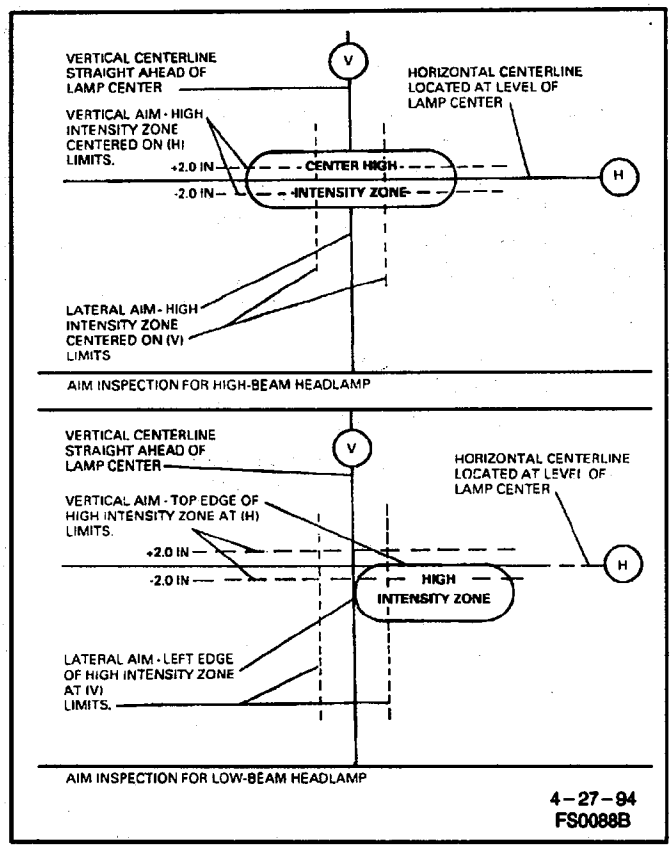


Figure 8 – Visual Headlamp Aim Limits – (Chevrolet)

C. Position vehicle so it is square with aiming screen, and with the headlamp capsule assemblies (Chevrolet) or headlamp assemblies (Pontiac) directly over reference line which has been painted on floor.

D. Locate vertical line on aiming screen so that it is in line with center of rear window and over hood (Figure 6).

E. Mark center of front and rear windows with narrow tape. Use these "sights" to locate center of vehicle.

- Move the vehicle or the screen until the center line of the screen comes into alignment with the two points.

F. Close doors.

G. Rock vehicle sideways to stabilize suspension.

2. With headlamps on high beam, observe center of high intensity zone on screen.

Adjust

- Horizontal aim using horizontal adjusting screw if center is more than:
  - 102 mm (4 inches) RIGHT of straight ahead.
  - 102 mm (4 inches) LEFT of straight ahead.
- Vertical aim using vertical adjusting screw if center is more than:
  - 51 mm (2 inches) ABOVE the horizontal line.
  - 51 mm (2 inches) BELOW the horizontal line (Chevrolet).
  - 64 mm (2.5 inches) BELOW the horizontal line (Pontiac).

3. Switch headlamps on to low beam, and observe left and top edges of high intensity zone on screen.

Adjust

- Horizontal aim using horizontal adjusting screw if left edge is more than:
  - 102 mm (4 inches) RIGHT of straight ahead.
  - 102 mm (4 inches) LEFT of straight ahead.
- Vertical aim using vertical adjusting screw if top edge is more than:
  - 51 mm (2 inches) ABOVE the horizontal line.
  - 51 mm (2 inches) BELOW the horizontal line (Chevrolet).
  - 64 mm (2.5 inches) BELOW the horizontal line (Pontiac).

Headlamp Aiming Alternate Procedure

Chevrolet

Figure 3

1. Prepare vehicle for checking beam aim as follows:
   A. Completely assemble all components on vehicle.
   B. Place vehicle on level surface.
      - Vehicle must be level. If necessary, pads may be used on uneven floors.
   C. Stop all other work on vehicle.
   D. Close doors.
   E. Rock vehicle sideways to stabilize suspension.

NOTICE: Horizontal aim of headlamp capsule assembly must be done first. Adjusting vertical aim first will result in incorrect headlamp aim.

2. Assure horizontal adjuster is set to "0" (zero) mark:
   A. If vehicle has been damaged, refer to "Headlamp Aiming After a Collision" in the following procedure.
   B. If horizontal pointer is not set at "0" (zero), turn horizontal aiming adjustment screw until pointer is lined up with "0" (zero).
3. Adjust vertical aim by turning vertical aiming screw until bubble in level is centered at "0" (zero).
   - If fuel tank is near empty to 1/4 full, adjust aim to center bubble at –0.4 degrees. This will reduce the chance of raising the headlamp capsule assemblies into oncoming driver's eyes when the fuel tank is filled.

Pontiac

If a headlamp testing machine is used, it should give results equivalent to those obtained using the screen method. It should be in good repair and adjustment, and should be used in accordance with the manufacturer's instructions. The machine using a photoelectric cell or cells to determine aim should also have a visual screen upon which the beam pattern is projected proportional to its appearance and aim on a screen at 25 feet. Such visual screen should be plainly visible to the operator and should have horizontal and vertical reference lines to permit visual appraisal of the lamp beam.

Tool Required:

J 25300-E Headlamp Aimer

1. Prepare vehicle for checking beam aim as follows:
   A. Completely assemble all components on vehicle.
   B. Place vehicle on level surface.
      - Vehicle must be level. If necessary, pads may be used on uneven floors.
   C. Stop all other work on vehicle.
   D. Close doors.
   E. Rock vehicle sideways to stabilize suspension.
2. Install headlamp aimer J 25300-E to headlamp assembly.
3. Calibrate mechanical aimers (conforming to SAE J602):
   A. Set master fixture to "0" U/D and "0" R/L.
   B. Calibrate aimers on master fixture to read "0" and "0" R/L.

Adjust

- Horizontal aim using horizontal adjusting screw.
  - 102 mm (4 inches) left to 102 mm (4 inches) right.
- Vertical aim using vertical adjusting screw.
  - 51 mm (2 inches) up to 64 mm (2.5 inches) down.

Important

- Aim-adjusting tools should be carefully selected since one full turn of an adjusting screw will move the aim approximately 89 mm (3.5 inches) when measured at 25 feet.

Headlamp Aiming After a Collision

1. Prepare vehicle for checking beam aim as follows:
   A. Completely assemble all components on vehicle.
   B. Place vehicle on level surface.
      - Vehicle must be level. If necessary, pads may be used on uneven floors.
   C. Stop all other work on vehicle.
   D. Close doors.
   E. Rock vehicle sideways to stabilize suspension.

NOTICE: Horizontal aim of headlamp capsule assembly (Chevrolet) or headlamp assembly (Pontiac) must be done first. Adjusting vertical aim first will result in incorrect headlamp aim.

2. Headlamp aim may be accomplished using a wall and visual aiming. Refer to "Headlamp Aiming by Screen Method" in this section.
3. It may be necessary to recalibrate horizontal adjuster after a collision. This is done after completion of the screen aiming procedure. Use a T-15 TORX® screwdriver to reset horizontal indicator to "0" (zero) (Chevrolet only).

High-Mount Stoplamp Assembly

Figure 9

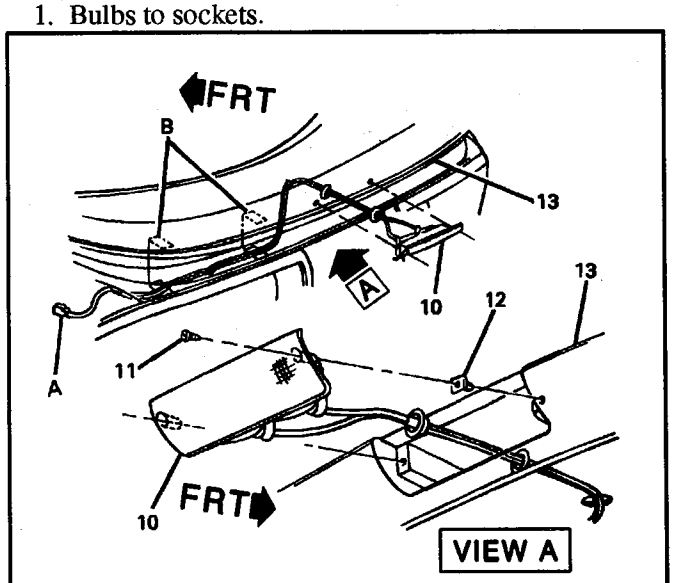
Remove or Disconnect

1. Bolts/screws (11) from stoplamp assembly (10).
2. Stoplamp assembly (10) from rear end spoiler assembly (13).
3. Nut (12), if necessary.
4. Electrical connector.
5. Bulbs and sockets from stoplamp assembly (10).
6. Bulbs from sockets.

Install or Connect

NOTICE: See "Notice" on page 8B-1 of this section.

1. Bulbs to sockets.



A CONNECTOR, ELECTRICAL
B TAPE
10 STOPLAMP ASSEMBLY, HIGH-MOUNT
11 BOLT/SCREW, HIGH-MOUNT STOPLAMP,
12 NUT, HIGH-MOUNT STOPLAMP
13 SPOILER ASSEMBLY, REAR END

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Figure 9 – High-Mount Stoplamp Assembly (Typical)

2. Bulbs and sockets to stoplamp assembly (10).
3. Electrical connector.
4. Nut (12), if removed.
5. Stoplamp assembly (10) to rear end spoiler assembly (13).
6. Bolts/screws (11) to stoplamp assembly (10).

Tighten

- Bolts/screws (11) to 1.7 N•m (15 lb. in.).

Parking and Turn Signal Lamp Assemblies

Figure 10

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Front bumper fascia lower deflector. Refer to SECTION 10-4.
3. Bolts/screws (15) from parking and turn signal lamp assembly (14).
4. Parking and turn signal lamp assembly (14) from shelf on front bumper fascia.
5. Front sidemarker lamp bulb (17), parking and turn signal lamp bulb (16) and sockets from front parking and turn signal lamp assembly (14).
6. Front sidemarker lamp bulb (17) and parking and turn signal lamp bulb (16) from sockets.

Install or Connect

NOTICE: See "Notice" on page 8B-1 of this section.

1. Front sidemarker lamp bulb (17) and parking and turn signal lamp bulb (16) to sockets.
2. Front sidemarker lamp bulb (17), parking and turn signal lamp bulb (16) and sockets to parking and turn signal lamp assembly (14).
3. Parking and turn signal lamp assembly (14) to shelf on front bumper fascia.
4. Bolts/screws (15) to parking and turn signal lamp assembly (14).

Tighten

- Bolts/screws (15) to 2.5 N•m (22 lb. in.).

5. Front bumper fascia lower deflector. Refer to SECTION 10-4.
6. Lower vehicle.

Rear License Lamp Assembly

Figure 11

Remove or Disconnect

1. Bolts/screws (18) from rear license lamp assembly (20).
2. Rear license lamp assembly (20) from rear bumper fascia (25).
3. Bulb (19) and socket from rear license lamp assembly (20).
4. Bulb (19) from socket.

Install or Connect

NOTICE: See "Notice" on page 8B-1 of this section.

1. Bulb (19) to socket.
2. Bulb (19) and socket to rear license lamp assembly (20).
3. Rear license lamp assembly (20) to rear bumper fascia (25).
4. Bolts/screws (18) to rear license lamp assembly (20).

Tighten

- Bolts/screws (18) to 1.9 N•m (17 lb. in.).

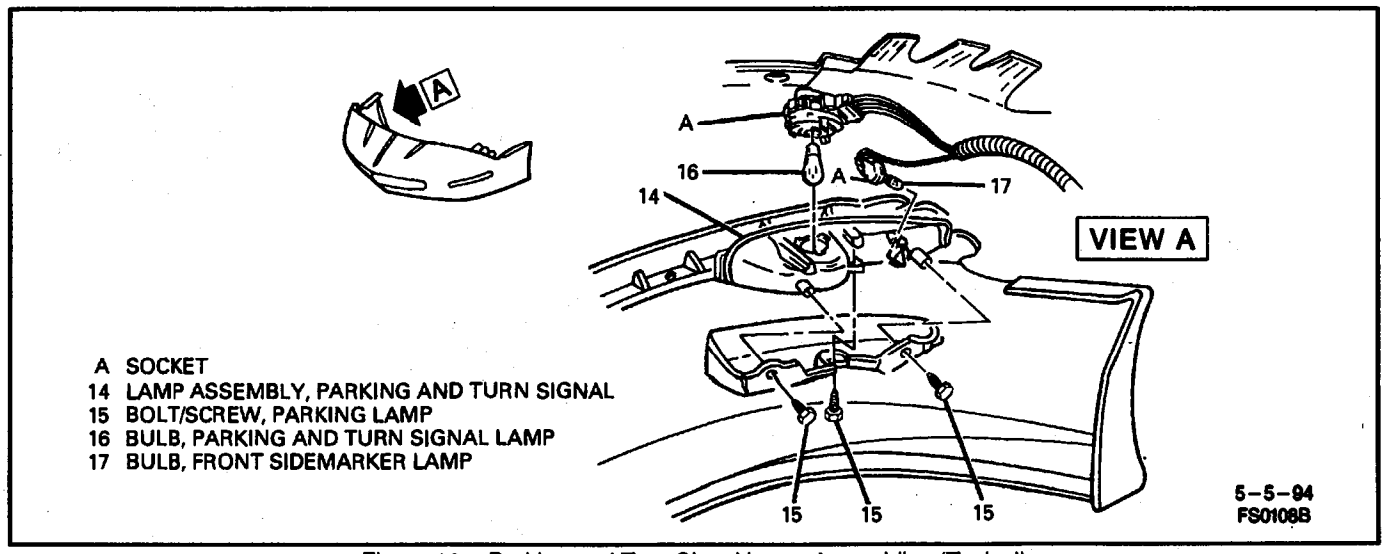
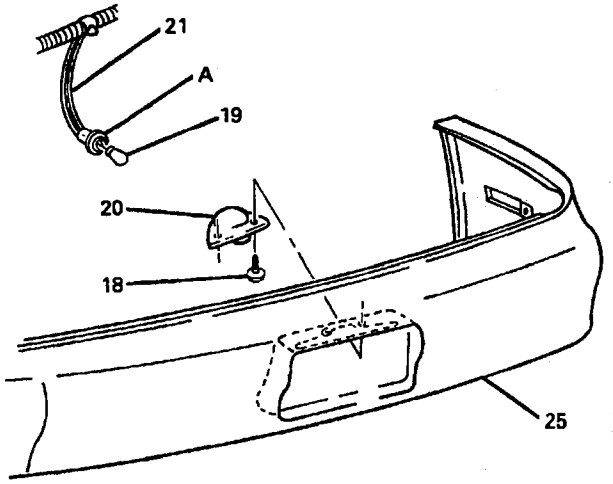


Figure 10 – Parking and Turn Signal Lamp Assemblies (Typical)



A SOCKET
18 BOLT/SCREW, REAR LICENSE LAMP
19 BULB, REAR LICENSE LAMP
20 LAMP ASSEMBLY, REAR LICENSE
21 HARNESS ASSEMBLY, REAR LICENSE AND REAR SIDEMARKER LAMP WIRING
25 FASCIA, REAR BUMPER

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Figure 11 – Rear License Lamp Assembly (Typical)

Rear Sidemarker Lamp Assemblies

Figure 12

Remove or Disconnect

1. Bolts/screws (22) from rear sidemarker lamp assembly (23).
2. Rear sidemarker lamp assembly (23) from rear bumper fascia (25).
3. Bulb (24) and socket from rear sidemarker lamp assembly (23).
4. Bulb (24) from socket.

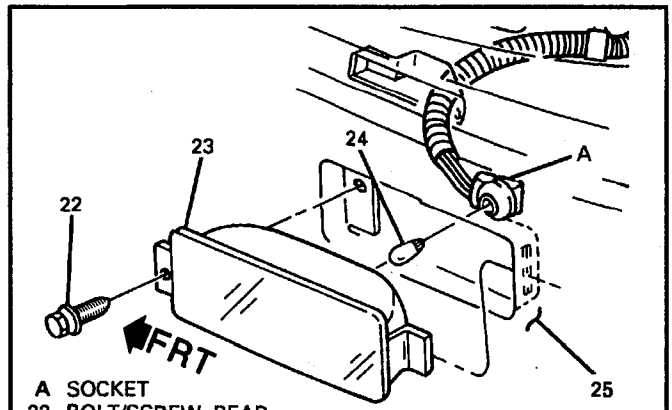
Install or Connect

NOTICE: See "Notice" on page 8B-1 of this section.

1. Bulb (24) to socket.
2. Bulb (24) and socket to rear sidemarker lamp assembly (23).
3. Rear sidemarker lamp assembly (23) to rear bumper fascia (25).
4. Bolts/screws (22) to rear sidemarker lamp assembly (23).

Tighten

- Bolts/screws (22) to 1.4 N•m (12 lb. in.).



A SOCKET
22 BOLT/SCREW, REAR SIDEMARKER LAMP
23 LAMP ASSEMBLY, REAR SIDEMARKER
24 BULB, REAR SIDEMARKER LAMP
25 FASCIA, REAR BUMPER

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Figure 12 – Rear Sidemarker Lamp Assemblies

Taillamp Assemblies

Chevrolet

Figure 13

Remove or Disconnect

1. Reposition rear compartment trim assembly.
2. Nuts (131) attaching taillamp assembly (126) to rear end finishing panel assembly.
3. Taillamp assembly (126) from rear end finishing panel assembly.
4. Taillamp, turn signal and backup lamp bulbs (127, 128, 129 and 130) and sockets from taillamp assembly (126).
5. Taillamp, turn signal and backup lamp bulbs (127, 128, 129 and 130) from sockets.

Install or Connect

NOTICE: See "Notice" on page 8B-1 of this section.

1. Taillamp, turn signal and backup lamp bulbs (127, 128, 129 and 130) to sockets.
2. Taillamp, turn signal and backup lamp bulbs (127, 128, 129 and 130) and sockets to taillamp assembly (126).
   - Rotate socket 90 degrees in taillamp assembly (126) to lock and secure.
3. Taillamp assembly (126) to rear end finishing panel assembly.
4. Nuts (131) attaching taillamp assembly (126) to rear end finishing panel assembly.

Tighten

- Nuts (131) to 3 N•m (27 lb. in.).

5. Position rear compartment trim assembly.

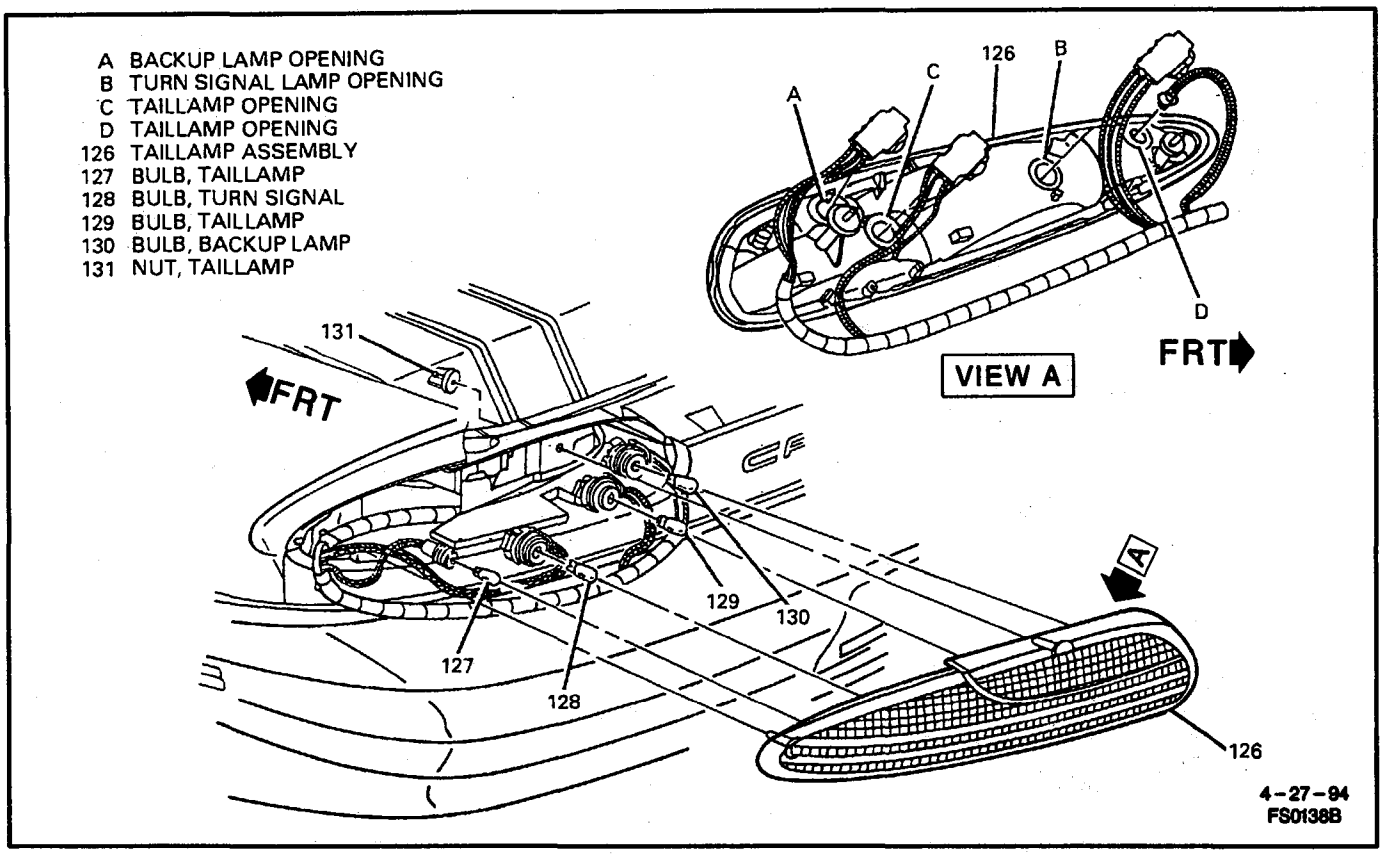


Figure 13 – Taillamp Assemblies – (Chevrolet)

Pontiac

Figure 14

Remove or Disconnect

1. Reposition rear compartment trim assembly.
2. Nuts (31) attaching taillamp assembly (26) to rear end panel assembly.
3. Taillamp assembly (26) from rear end panel assembly.
4. Taillamp filler (40), if necessary.
   - Both taillamp assemblies (26) must be removed to replace taillamp filler (40).
5. Taillamp, turn signal and backup lamp bulbs (27, 28 and 30) and sockets from taillamp assembly (26).
6. Taillamp, turn signal and backup lamp bulbs (27, 28 and 30) from sockets.

Install or Connect

NOTICE: See "Notice" on page 8B-1 of this section.

1. Taillamp, turn signal and backup lamp bulbs (27, 28 and 30) to sockets.
2. Taillamp, turn signal and backup lamp bulbs (27, 28 and 30) and sockets to taillamp assembly (26).
   - Rotate socket 90 degrees in taillamp assembly (26) to lock and secure.
3. Taillamp filler (40), if removed.
4. Taillamp assembly (26) to rear end panel assembly.
5. Nuts (31) attaching taillamp assembly (26) to rear end panel assembly.

Tighten

- Nuts (31) to 3 N•m (27 lb. in.).

6. Position rear compartment trim assembly.

Turn Signal Lamp Flasher Assembly

Figure 15

Remove or Disconnect

1. Clip (33) from driver knee bolster bracket.
2. Electrical connector.
3. Flasher assembly (32) from clip (33), if necessary.

Install or Connect

1. Flasher assembly (32) to clip (33), if removed.
2. Electrical connector.
3. Clip (33) to driver knee bolster bracket.

INTERIOR LIGHTING

For information on warning/indicator lamps, instrument cluster lamps, etc., refer to SECTION 8C. For circuit information, refer to SECTION 8A.

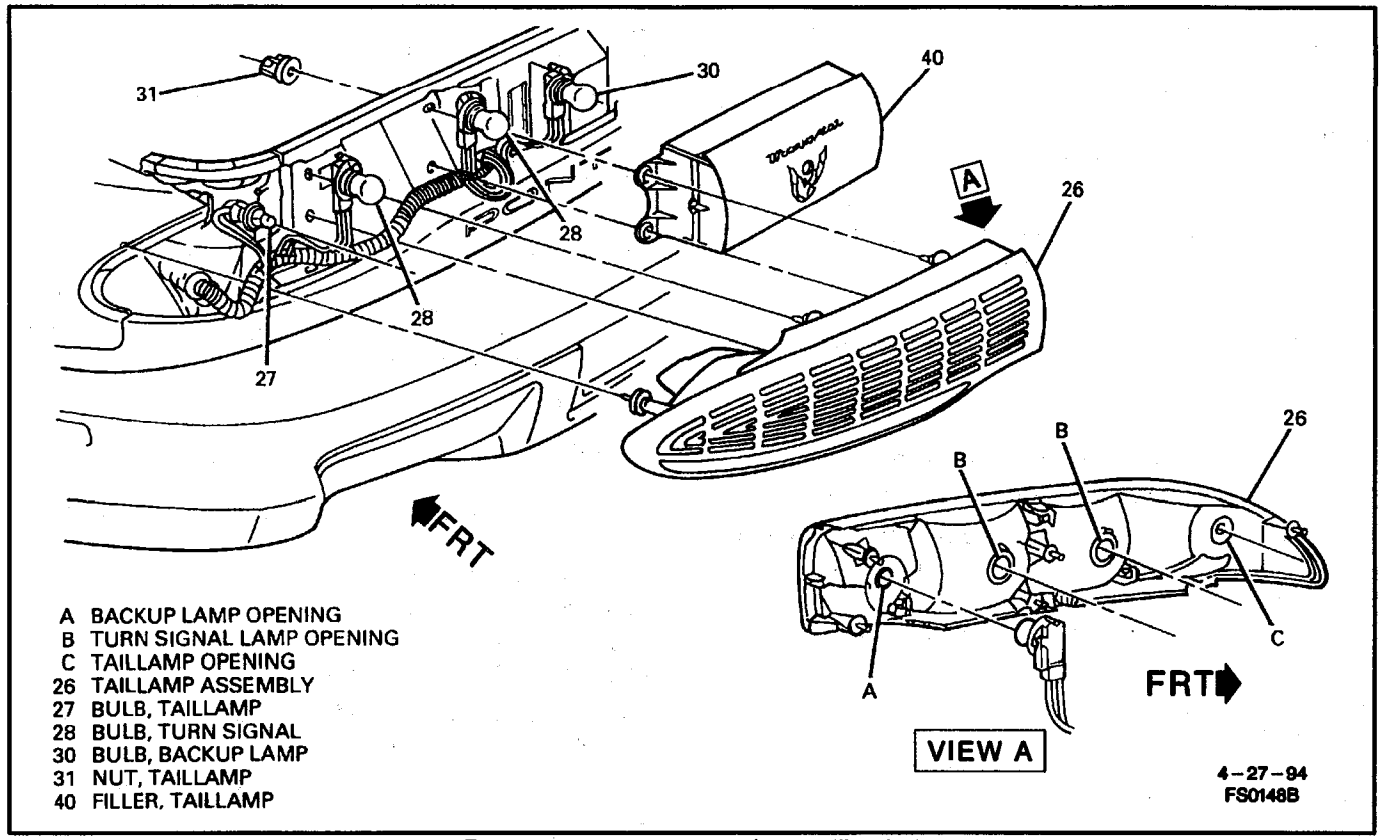


Figure 14 – Taillamp Assemblies – (Pontiac)

Ashtray Lamp

Bulb Replacement

Remove or Disconnect

1. Open ashtray opening cover.
2. Ashtray.
3. Pull bulb, socket and shield through opening in front floor console assembly.
4. Bulb and socket from shield.
5. Bulb from socket.

Install or Connect

1. Bulb to socket.
2. Shield to bulb and socket.
3. Bulb, socket and shield to opening in front floor console assembly.
4. Ashtray.
5. Close ashtray opening cover.

Automatic Transmission Indicator Lamp

Bulb Replacement

Remove or Disconnect

1. Front floor console transmission opening trim plate assembly.
2. Bulb and socket from front floor console transmission opening trim plate assembly.
3. Bulb from socket.

Install or Connect

1. Bulb to socket.
2. Bulb and socket to front floor console transmission opening trim plate assembly.
3. Front floor console transmission opening trim plate assembly.
   - Snap in place to secure.

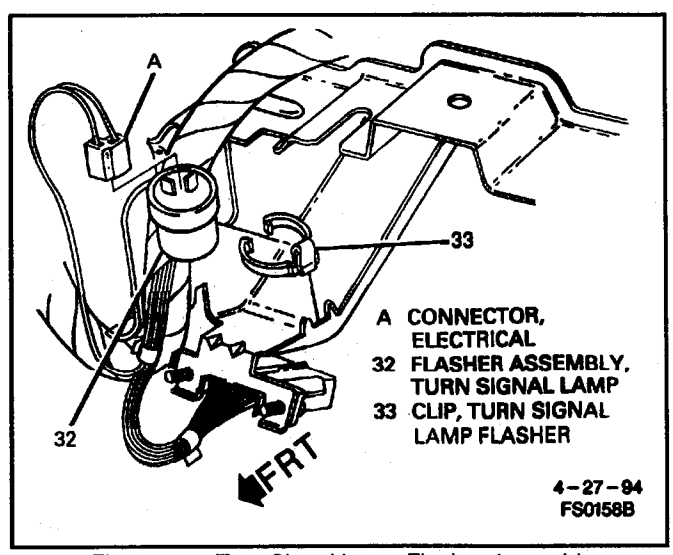


Figure 15 – Turn Signal Lamp Flasher Assembly

Console Lamp

Bulb Replacement

Remove or Disconnect

1. Open front floor console compartment door.
2. Console lamp and retainer from front floor console transmission shift opening trim plate assembly.
3. Bulb from socket.
4. Retainer from console lamp, if necessary.

Install or Connect

1. Retainer to console lamp, if removed.
2. Bulb to socket.
3. Lamp and retainer to opening in front floor console transmission shift opening trim plate assembly until retainer is seated.
4. Close front floor console compartment door.

Dome Lamp

Figure 16

Remove or Disconnect

1. Bolts/screws (35).
   - Loosen enough to pull dome lamp housing assembly (34) from headlining trim finish panel assembly.
2. Dome lamp housing assembly (34) by pulling from headlining trim finish panel assembly.
3. Electrical connector.
4. Bulb (36) from dome lamp housing assembly (34).

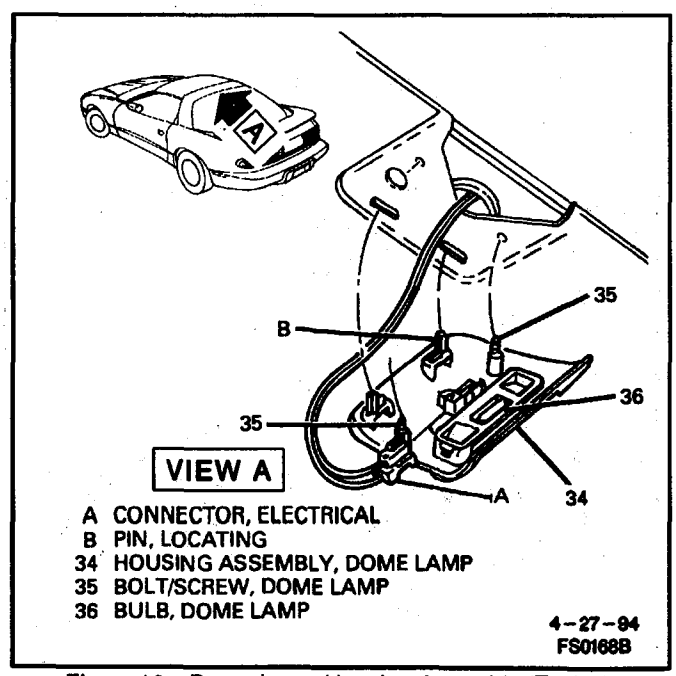


Figure 16 – Dome Lamp Housing Assembly (Typical)

Install or Connect

NOTICE: See "Notice" on page 8B-1 of this section.

1. Bulb (36) to dome lamp housing assembly (34).
2. Electrical connector.
3. Dome lamp housing assembly (34).
   - Use locating pins to position dome lamp housing assembly (34) to headlining trim finish panel assembly.
4. Bolts/screws (35).

Tighten

- Bolts/screws (35) to 1.7 N•m (15 lb. in.).

Front Reading Lamps

Bulb Replacement

Remove or Disconnect

1. Lamp lens from inside rearview mirror assembly, using a flat-bladed tool.
2. Bulb from socket, using a flat-bladed tool.

Install or Connect

1. Bulb into socket.
2. Lens to inside rearview mirror assembly by snapping into place.

Front Side Door Courtesy Lamps

Bulb Replacement

Remove or Disconnect

1. Front side door inside handle bezel bolt/screw.
2. Front side door inside handle bezel assembly.
3. Bulb and socket from front side door inside handle bezel assembly.
4. Bulb from socket.

Install or Connect

NOTICE: See "Notice" on page 8B-1 of this section.

1. Bulb to socket.
2. Bulb and socket to front side door inside handle bezel assembly.
3. Front side door inside handle bezel assembly.
4. Front side door inside handle bezel bolt/screw.

Tighten

- Front side door inside handle bezel bolt/screw to 1.4 N•m (12 lb. in.).

Heater and Air Conditioning Control Lamp

Bulb Replacement

Remove or Disconnect

1. Instrument panel cluster trim plate bezel assembly. Refer to SECTION 8C.
2. Heater and air conditioning control bolts/screws.
3. Heater and air conditioning control assembly.
4. Electrical connectors.
5. Bulbs and sockets from heater and air conditioning control assembly.
6. Bulbs from sockets.

Install or Connect

NOTICE: See "Notice" on page 8B-1 of this section.

1. Bulbs to sockets.
2. Bulbs and sockets to heater and air conditioning control assembly.
3. Electrical connectors.
4. Heater and air conditioning control assembly.
5. Heater and air conditioning control bolts/screws.

Tighten

- Heater and air conditioning control bolts/screws to 1.9 N•m (17 lb. in.).

6. Instrument panel cluster trim plate bezel assembly. Refer to SECTION 8C.

Instrument Panel Compartment Lamp

Bulb Replacement

Remove or Disconnect

1. Open instrument panel compartment door.
2. Instrument panel compartment lamp and retainer from instrument panel assembly.
3. Bulb from socket.
4. Retainer from instrument panel compartment lamp, if necessary.

Install or Connect

1. Retainer to instrument panel compartment lamp, if removed.
2. Bulb to socket.
3. Lamp and retainer to opening in instrument panel assembly until retainer is seated.
4. Close instrument panel compartment door.

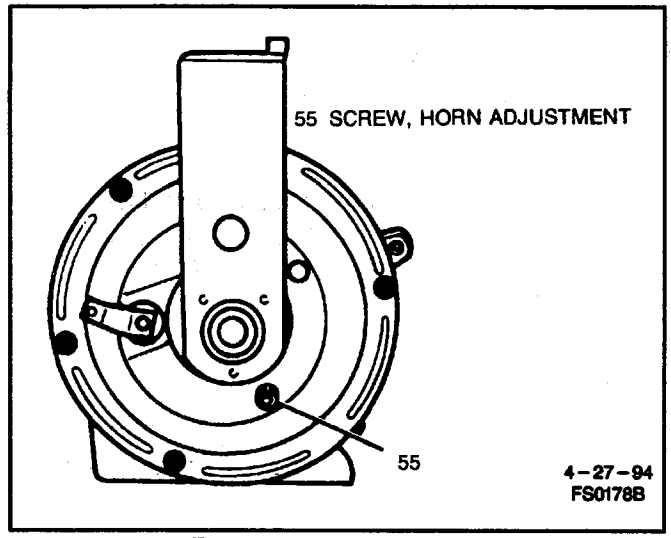


Figure 17 – Horn Adjustment

HORNS

Current Adjustment

Figure 17

Current draw for a horn assembly while operating should be 4.5 to 5.5 amperes at 11.5 to 12.5 volts. High current (more than 20 amperes) indicates an overheated winding or shorted horn assembly: replace the horn assembly. A current reading of about 18 amperes means contacting points are not open: adjust horn current.

No current reading indicates a broken connection or an open circuit due to a broken lead or overheated horn assembly. An overheated horn assembly must be replaced. No current reading may also mean contact points are open: adjust horn assembly.

Adjust

1. Increase current – turn adjustment screw (55) clockwise.
2. Decrease current – turn adjustment screw (55) counterclockwise.
3. Current adjustments should be made 1/4 turn (90 degrees) at a time.

Horn Assemblies

Figure 18

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Front bumper fascia lower deflector. Refer to SECTION 10-4.
4. Bolt/screw (39) from horn assembly (37 or 38).
5. Horn assembly (37 or 38) from right-hand engine compartment side outer rail assembly.
6. Electrical connector.

Install or Connect

NOTICE: See "Notice" on page 8B-1 of this section.

1. Electrical connector.
2. Horn assembly (37 or 38) to right-hand engine compartment side outer rail assembly.
   - Use "F" and "A" designations on inboard side of horn assembly (37 or 38).
3. Bolt/screw (39) to horn assembly (37 or 38).

Tighten

- Bolt/screw (39) to 27 N•m (20 lb. ft.).

4. Front bumper fascia lower deflector. Refer to SECTION 10-4.

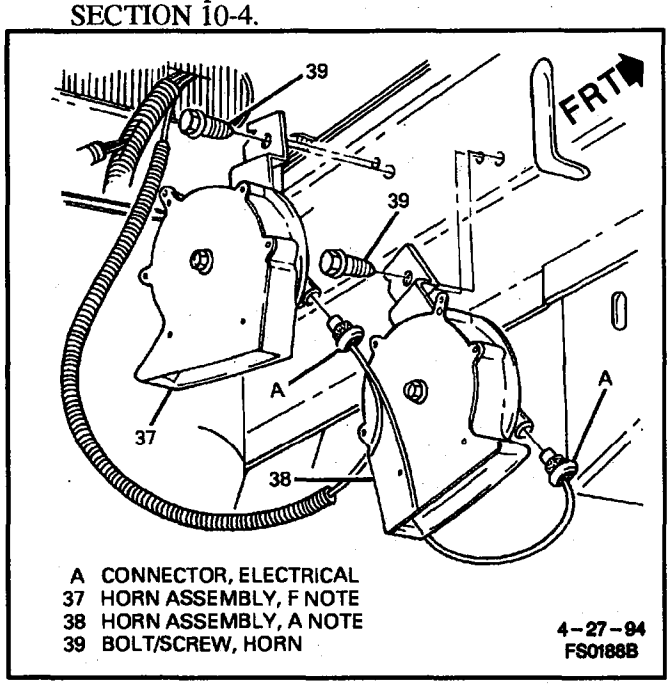


Figure 18 – Horn Assemblies

5. Lower vehicle.
6. Battery negative cable assembly.

Horn Relay

Figure 2

The horn relay (5) is in the convenience center, behind the instrument panel assembly on the driver knee bolster bracket.

Remove or Disconnect

- Horn relay (5) from convenience center.

Install or Connect

- Horn relay (5) to convenience center.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

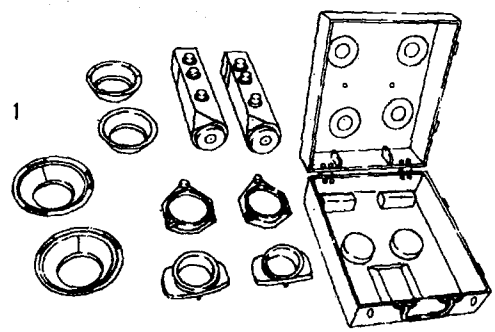
Dome Lamp Bolt/Screw	1.7 N•m (15 lb. in.)
Front Fog Lamp Bolt/Screw	15 N•m (11 lb. ft.)
Front Fog Lamp Nut	10 N•m (89 lb. in.)
Front Side Door Inside Handle Bezel Bolt/Screw	1.4 N•m (12 lb. in.)
Headlamp Bezel Bolt/Screw (Pontiac Only)	1.7 N•m (15 lb. in.)
Headlamp Opening Door Bolt/Screw (Pontiac Only)	1.7 N•m (15 lb. in.)
Heater and Air Conditioning Control Bolt/Screw	1.9 N•m (17 lb. in.)
High-Mount Stoplamp Bolt/Screw	1.7 N•m (15 lb. in.)
Horn Bolt/Screw	27 N•m (20 lb. ft.)
Parking Lamp Bolt/Screw	2.5 N•m (22 lb. in.)
Rear License Lamp Bolt/Screw	1.9 N•m (17 lb. in.)
Rear Sidemarker Lamp Bolt/Screw	1.4 N•m (12 lb. in.)
Taillamp Nut	3 N•m (27 lb. in.)

BULB USAGE CHART

Exterior Lamps	Trade No.	Interior Lamps	Trade No.
Backup (Chevrolet)	1151	Ashtray*	194
Backup (Pontiac)	1156	Automatic Transmission Indicator (PRNDL)	73
Front Fog	885	Cluster Illumination	161
Front Sidemarker	194	Console	194
Headlamp (Chevrolet)		Dome	906
Low Beam	H-4351	Front Reading	212-2
High Beam	H-4352	Front Side Door Courtesy	74
Headlamp (Pontiac)	H6545	Heater and Air Conditioning Control	37
High-Mount Stoplamp	921	Instrument Panel Compartment	194
Parking and Turn Signal	2397	Rear Compartment (Convertible Only)	562
Rear License	194	Rear Courtesy (Convertible Only)	562
Rear Sidemarker	194	Turn Signal Indicator	161
Taillamp	194	Warning/Indicator (Chevrolet)	161
Turn Signal	2057	Warning/Indicator (excluding Turn Signal Indicator) (Pontiac)	PC74

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FS0198B

SPECIAL TOOLS



J 25300-E

1 HEADLAMP AIMER

4-27-94
FS0208B

BLANK

SECTION 8C

INSTRUMENT PANEL, GAGES AND CONSOLE

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repair.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

AUXILIARY FUSE BLOCK

The fuse block is a part of the body wiring harness assembly. It is attached by a bracket on the left front hinge pillar and is accessed through a removable panel on the instrument panel carrier.

For diagnosis, refer to SECTION 8A.

CONVENIENCE CENTER

The convenience center is part of the body wiring harness assembly. It is attached to a bracket located on the cowl below the instrument panel carrier to the left of the steering column assembly.

The audio alarm assembly, vehicle speed sensor (VSS) buffer, and hazard lamp flasher are attached to the convenience center. The turn signal lamp flasher is opposite the convenience center to the right of the steering column assembly and the knee bolster bracket.

For diagnosis of the convenience center and components, refer to SECTION 8A.

DAYTIME RUNNING LAMPS (DRL) (CANADIAN ONLY)

All Canadian vehicles are equipped with daytime running lamps. The daytime running lamp system includes a solid state module and a light sensor. The system lights the park lamps when the ignition switch is in the "RUN" position during daylight. The daytime running lamp system is designed to light the low-beam headlamps at full intensity, and the parking and taillamps when low light conditions are present.

EXPRESS DOWN

Express Down fully lowers the driver's front side door window when the side window switch is pressed quickly and released.

RETAINED ACCESSORY POWER (RAP)

If the vehicle is equipped with Power door locks, the vehicle has a feature called Retained Accessory Power (RAP). With RAP the power door locks, electric mirrors, power windows, audio system and remote hatch release will continue to work up to 10 minutes after the ignition key is turned to "Off" and neither door is opened.

If a door is opened, the audio system and power windows will shut off. The power door locks, electric mirrors and remote hatch release will work until you shut the door. Once you have shut the door, these accessories will continue to work for approximately 35 seconds. After this time you will not be able to use these accessories until the next time you open a door or turn on the ignition.

FRONT FLOOR CONSOLE ASSEMBLY

The console assembly fits over the tunnel in the floor of the vehicle and extends from under the center of the instrument panel assembly to the rear seat area. The console assembly consists of two major assemblies. The lower console assembly forms the side and rear walls of the complete console structure, while the upper console assembly forms the top of the structure.

The upper console assembly has a cigarette lighter and an ashtray with a coinholder and mat, or a cassette holder. The upper console assembly also houses the transmission shift lever. For vehicles without the cassette holder in the upper console area, the cigarette lighter and ashtray are set just below the transmission shift lever in the center of the console assembly. The parking brake is in a recess in the right side of the console assembly.

Below the transmission shift lever, toward the rear of the vehicle, is a cupholder with a mat. In the rear of the console assembly is a storage compartment. The storage compartment contains a tray for cassette tapes or compact discs. The storage compartment has a padded door that serves as a front seat center armrest.

INSTRUMENT CLUSTER ASSEMBLY

The instrument cluster assembly is centered above the steering column assembly in the instrument panel and is removable from the rear of the panel (toward the steering wheel assembly). The instrument cluster assembly contains instruments that provide the driver with vehicle performance information.

The headlamp switch assembly, remote hatch release and the optional foglamp switch assembly are located on the left side of the cluster assembly.

Gages in the instrument cluster assembly include a fuel gage, an engine coolant temperature gage, and a voltmeter. A speedometer with an odometer and a trip odometer is included, along with a tachometer.

The instrument cluster assembly has indicator lamps for the headlamp high beam symbol, fasten seat belt assembly, turn signal directional arrows and five lamps for illumination.

The cluster assembly also contains warning indicator lamps for "ABS INOP," "AIR BAG," "ASR" (Acceleration Slip Regulation – Chevrolet V8 only), "BRAKE," "CHECK GAUGES," "LOW COOLANT" (V8 only), "LOW OIL," "LOW TRAC" (with ASR or TCS systems), "SECURITY," "SERVICE ENGINE SOON," "SKIP SHIFT" (V8 manual only) and "TCS OFF" (Traction Control System – Pontiac V8 only).

Electric power is directed to the appropriate lamps and gages of the instrument cluster assembly by a flexible printed circuit attached to the back of the instrument cluster case. Two multiple connectors and the snap-in bulb sockets help to hold the printed circuit to the back of the instrument cluster assembly.

The instrument cluster assembly is non-serviceable, except as noted in this section, and must be replaced as a unit.

When an instrument cluster assembly is replaced, the law requires the odometer reading of the replacement unit to be set to register the same mileage as the prior odometer. If the same mileage cannot be set, the law requires the replacement odometer to be set at zero and a label be installed on the driver's door frame to show the previous odometer reading and the date of replacement. Refer to "Odometer Repair Notice Label" in this section.

Gages

Engine Coolant Temperature Gage

The coolant temperature sending unit is mounted to the engine at a point where it is exposed to the coolant being circulated through the engine cooling passages. The sending unit contains a temperature-sensitive variable resistor that senses and reacts to coolant temperature. Resistance decreases as temperature increases.

When electric power is supplied to the engine coolant temperature gage, a current flows through the gage to the variable resistor and then to a ground at the engine. The position of the gage pointer is determined by the strength of the current flowing through the gage. When the engine coolant is cold, resistance is high, the current flow is low, and the pointer indicates a cold reading. As coolant temperature increases, the resistance of the sending unit resistor decreases and the pointer moves toward the center of the gage. Prolonged driving or idling in very hot weather may cause the pointer to move beyond this point. An overheat condition exists if the pointer goes into the red zone at the upper limit of the scale.

Dial calibrations go far above the normal boiling point of water – 100°C (212°F) – because the cooling system is pressurized. The increase in pressure also increases the boiling temperature of the coolant, permitting it to reach temperatures above those possible with a non-pressurized system without boiling. The higher operating temperature of the cooling system that results gives greater cooling efficiency and other benefits.

Fuel Gage

The fuel gage sending unit is mounted on the top surface of the fuel tank. The fuel level sender itself consists of a float that rides on the surface of the fuel in the tank, and a variable resistor controlled by the float arm. When electric power is supplied to the fuel gage, current flows through the gage to the variable resistor and then to ground. The position of the gage pointer is determined by the strength of the current flowing through the gage.

If the tank is full, the resistance of the variable resistor is high (90 ohms) and the current flow through the gage is at a minimum. This causes the pointer to indicate the "F" mark on the gage dial.

If the fuel level is low, the resistance of the variable resistor is also low and current flow through the gage is high. This causes the pointer to show a low fuel level reading. Intermediate fuel levels cause the pointer to indicate the corresponding position between "F" and "E."

Oil Pressure Gage

The oil pressure gage indicates the pressure of the lubricating oil flow provided by the engine oil pump. The oil pressure gage sending unit is a variable resistor mounted to the engine block so it will sense the oil pressure in a main oil passage just downstream from the engine oil pump. When electric power is supplied to the gage, current flows through the gage to the resistor in the sending unit and then to ground at the engine block. The position of the oil pressure gage pointer is determined by the strength of the current flowing through the gage.

When oil pressure is low, the resistance of the sending unit also is low and current flow through the gage is high. This causes the gage indicator needle to show a low pressure reading. As oil pressure increases, the resistance of the sending unit resistor also increases and current flow through the gage is reduced. Under normal conditions, the oil pressure reading should be between 138 and 414 kPa (20 and 60 psi). Engine oil pressure never should fall below a reading of 28 kPa (4 psi), even at idle.

Speedometer

The electric speedometer does not have a speedometer cable. The source of speed information is a small permanent magnet alternating current generator called a vehicle speed sensor (VSS), mounted on the transmission assembly. The shaft of the VSS fits into rotor teeth on the transmission output shaft in the same manner as the speedometer cable of a mechanical speedometer system. The transmission output shaft rotates and turns the rotor teeth near a magnetic pick-up within the vehicle speed

sensor. This generates an alternating current in the coil with a frequency that is proportional to the speed of the vehicle.

The alternating current from the VSS is sent to the Powertrain Control Module (PCM).

The PCM modifies the current to a series of direct current pulses at a frequency proportional to the speed of the vehicle. These pulses form a vehicle speed signal that is transmitted to the speedometer.

At the speedometer, a solid state circuit uses the speed signal to regulate the distribution of current from the fuse block to two electromagnetic coils at right angles to each other near the base of the speedometer pointer pivot. At the base of the speedometer pointer pivot is a magnet that is acted upon by the magnetic fields of the two coils. The relative strength of the two magnetic fields determines the position of the magnet and accordingly, the position of the speedometer pointer.

Pulses from the solid state circuit also are used to drive a small electric stepper motor. The stepper motor turns the numbered wheels of the odometer and the trip odometer. The numbered wheels are geared so when any one wheel completes a revolution, the next wheel to the left is turned one-tenth of a revolution. Every tenth of a revolution advances the displayed number by one unit. The trip odometer can be reset to zero at any time so the driver can record the distance traveled from any selected starting point.

Tachometer

The tachometer signal comes from the PCM.

Voltmeter

The voltmeter is an instrument that shows the voltage of the vehicle electrical system and indicates the ability of the charging system to keep the storage battery assembly charged. The voltmeter is wired in parallel with other circuits in the vehicle.

When the engine is running, the voltmeter indicates charging system voltage. If the engine is not running and the ignition switch is in the "RUN" or "START" position, the voltmeter will show battery voltage. The voltmeter can be used as a first step in diagnosing many electrical problems. Battery voltage drop can be seen while the engine is cranking. After the engine is running, generator output voltage is indicated.

It is normal for the voltmeter to read between 11 and 13 volts during extended idle or just after starting. As the electrical load is increased, or in stop-and-go driving, the pointer may rotate temporarily to the bottom of the scale. A voltmeter reading continuously below 11 volts or above 16 volts indicates an electrical system problem.

INSTRUMENT PANEL

The instrument panel and related parts form a rigid structure that encloses and supports many components on or near the passenger compartment side of the cowl. The top of the instrument panel is attached to the cowl next to the base of the windshield near both outboard ends by bolts/screws, and at the center by a support bracket. The bottom of the instrument panel is attached to a stamped metal tie bar that adds to the rigidity of the structure. A sound insulator panel is attached to the support bracket and the cowl on the passenger side of the panel to conceal the components under the instrument panel and provide a finished appearance.

The steering column assembly is clamped in place at the left side of the instrument panel. Below and to both sides of the steering column assembly is an instrument panel driver knee bolster assembly. An impact-absorbing pad covers the top of the instrument panel. Trim covers and trim plates accent the appearance of the exposed rear face of the instrument panel.

The air conditioning module case is attached to the cowl. Air ducts connect the case outlets to floor outlets, windshield defroster outlets, side window defogger outlets and a high level outlet in the center of the instrument panel. A high level air outlet is provided at each end of the instrument panel. The air conditioning module and ducts are concealed within the instrument panel structure.

Canadian vehicles equipped with daytime running lamps have a headlamp automatic control ambient light sensor assembly installed flush with the top surface of the instrument panel upper trim panel assembly under the windshield defroster nozzle grille assembly.

To the left of the steering column assembly, mounted on the cowl, is the convenience center with the hazard flasher unit, horn relay, audio alarm and turn signal flasher unit.

A headlamp switch with a thumbwheel dimmer control and an optional foglamp switch are mounted in the instrument panel to the left of the instrument cluster assembly. The headlamp switch controls headlamps, parking and sidemarker lamps, taillamps, interior lamps and instrument panel lamps. The dimmer control regulates the intensity of instrument panel illumination.

The instrument panel wiring harness assembly is installed within the instrument panel area.

INSTRUMENT PANEL SWITCHES

Headlamp and Instrument Panel Lamp Dimmer Switch Assembly

The headlamp and instrument panel lamp dimmer switch assembly may also contain a twilight sentinel switch and a headlamp switch indicator lamp, if the vehicle is equipped with a twilight sentinel option.

For more information, refer to SECTION 8B or SECTION 9C.

Lid Release Switch Assembly

The lid release switch assembly releases the rear lid of the vehicle automatically. The lid release switch assembly is located on the left-hand side of the instrument panel below the headlamp controls and foglamp switch assembly.

SENSORS

Daytime Running Lamp (DRL) Ambient Light Sensor (Canadian Only)

The headlamp automatic control ambient light (daylight) sensor assembly is located to the right of the heat

and air conditioning duct in the center of the instrument panel.

As the intensity of light reaching the sensor assembly increases, the electrical resistance of the sensor assembly decreases. When the DRL control module assembly senses a low resistance in the sensor assembly, the module assembly allows voltage to be applied to the DRL diode assembly and then to the headlamps. Due to the voltage drop across the diode assembly, the headlamps are on a reduced intensity.

As the intensity of light reaching the sensor assembly decreases, the electrical resistance of the sensor assembly increases. When the DRL module assembly senses a high resistance in the sensor assembly, the module assembly closes an internal relay and allows the headlamps to come to full intensity.

CLUSTER WARNING/INDICATOR LAMPS

"FASTEN SAFETY BELTS" Indicator Lamp

The "FASTEN SAFETY BELTS" indicator lamp will always go on whenever the ignition switch is in "RUN," "BULB TEST," or "START," if the driver's seat belt assembly is unbuckled. It will remain on until the driver's seat belt assembly is buckled.

For more information, refer to "Warning/Reminder Chimes" in this section or SECTION 10-11.

"TURN SIGNAL" Indicator Lamps

The left or right turn indicator lamp will illuminate when the multifunction lever on the left side of the steering column assembly is moved to signal a turn. The turn/hazard switch in the steering column assembly receives an on-and-off flashing current from the fuse block and the turn signal flasher unit in the convenience center when the ignition switch is in the "RUN," "START" or "BULB TEST" position. The turn/hazard switch routes the current to circuits that feed the left or right front turn signal lamp, left or right rear tail/stop/turn signal lamps when the multifunction lever is moved. The circuit to the left or right front turn signal lamp, and cornering and sidemarker lamps has a branch that feeds the appropriate turn indicator lamp in the instrument cluster assembly, causing it to flash when the exterior lamps are indicating a turn.

When the hazard warning button on the right side of the steering column assembly is pressed in, the left and right front turn signal lamps, cornering and sidemarker lamps, and rear tail/stop/turn signal lamps all flash, and both turn signal indicator lamps in the instrument cluster flash. Power for the hazard warning system reaches the turn/hazard switch from the fuse block and the hazard flasher in the convenience center. Power is supplied with the ignition switch in any position. When the hazard warning system is flashing, the turn signal circuits are inoperative.

"AIR BAG" Indicator Lamp

The "AIR BAG" indicator lamp will light to warn the driver of a potential supplemental inflatable restraint (SIR) system problem that could prevent the proper deployment of the air bag in an accident. When the ignition switch is first turned on, the lamp will flash seven times to verify proper operation of the lamp circuit and the diagnostic/energy reserve module (DERM). A Scan Tool can be used to read diagnostic trouble codes (DTCs) in the DERM and to clear all DTCs after repair. For additional information, including service precautions, refer to SECTION 9J.

"SERVICE ENGINE SOON" Indicator Lamp

The "SERVICE ENGINE SOON" indicator lamp in the instrument cluster will come on when turning the ignition on or the engine off to serve as a bulb and system check. It should go off after the engine starts unless a problem has been detected by the system.

The powertrain control module (PCM) performs a continual self-diagnosis of certain control functions and causes the "SERVICE ENGINE SOON" lamp to remain on when the engine is running if a problem is detected. In any event, the PCM will store in memory a 2-digit trouble code if a problem is detected. When the data link connector (DLC) test connection is grounded, the PCM will enable most outputs with the engine operating and terminal "B" grounded at the DLC. When turning the ignition on or the engine off, the "SERVICE ENGINE SOON" lamp will flash "FIELD SERVICE" which indicates an open/closed loop. The PCM will not flash DTCs. Tech 1 must be used to retrieve DTCs.

"LOW COOLANT" Indicator (V8 Only)

With a low coolant level, the circuit made by the low coolant probe has very high resistance (over 50,000 ohms). The low engine coolant indicator module assembly senses the voltage change at the low coolant level input and provides ground to the "LOW COOLANT" indicator and the indicator lights up. The "LOW COOLANT" indicator is grounded for 1.5 seconds when the ignition switch is initially turned "ON," causing the "LOW COOLANT" indicator to light.

"LOW OIL" Indicator

The "LOW OIL" indicator ground is controlled by the engine oil level indicator control module assembly. To check for a low oil condition, the low oil module looks for a ground through the oil level switch after the ignition switch has been turned to "OFF" or "LOCK."

The low oil module assembly checks for a low oil condition 32 minutes after the ignition switch is turned to "OFF" or "LOCK," if the previous ignition cycle was less than 12 minutes. If the previous ignition cycle was longer than 12 minutes, the low oil module assembly checks for a low oil condition 3 minutes after the ignition switch is turned to "OFF" or "LOCK."

When the low oil module assembly loses the ground through the oil level switch (oil level switch open indicating low oil level), the low oil assembly module grounds the "LOW OIL" indicator for the duration of the next ignition cycle.

When the low oil module assembly is grounded through the oil level switch, the low oil module assembly grounds the "LOW OIL" indicator for a bulb test when the ignition switch is turned to "RUN" during the next ignition cycle. The bulb test takes four to five seconds.

"BRAKE" Warning Lamp

When the ignition switch is turned to "RUN," the "BRAKE" warning lamp will come on for approximately 3 seconds. If the parking brake is set, the lamp will remain on. The lamp may also be illuminated by information from the Electronic Brake Control Module (EBCM) or Electronic Brake/Traction Control Module (EBTCM).

Additionally, with the ignition switch turned to "RUN," "BULB TEST," or "START, " the lamp may be activated by the brake combo valve. For more information, refer to SECTION 8A-41 and SECTION 5E1.

"ABS INOP" Indicator Lamp

The "ABS INOP" indicator lamp is part of the antilock brake system. When the ignition switch is turned to the "RUN" position, the "ABS INOP" lamp will turn on for approximately 3 seconds and then turn off if no ABS malfunction is detected. If a malfunction is detected, the lamp will remain on.

If the "ABS INOP" indicator lamp comes on while driving, there is a malfunction in the antilock brake system. For more information, refer to SECTION 5E1.

"ASR" Indicator Lamp

Chevrolet V8 Only

The Accelerated Slip Regulation (ASR) system limits wheel spin if it senses that one or both of the rear wheels are beginning to lose traction. When this happens, the ASR system works the rear brakes and reduces engine power to limit wheel spin.

The "ASR" indicator lamp will come on if there is a system failure, if the system has been turned off by the driver, or momentarily when starting the engine.

When the ignition switch is turned to the crank position, the "ABS INOP," "ASR," and "TCS OFF" lamps will come on. They will remain on if the switch is held in the crank position.

"CHECK GAUGES" Indicator Lamp

The "CHECK GAUGES" indicator lamp alerts the driver to check instrument cluster gages when any of the following abnormalities are detected: coolant temperature too high, generator voltage too high or too low, oil pressure too low.

The indicator lamp also comes on for about one second after ignition "ON" as a bulb test.

"LOW TRAC" Indicator Lamp (with ASR or TCS Systems)

On vehicles equipped with Accelerated Slip Regulation (ASR) or Traction Control Systems (TCS), the "LOW TRAC" indicator lamp comes on to indicate that the system is active and is limiting wheel spin.

The "LOW TRAC" lamp will turn on during ABS initialization, an ABS stop or a TCS event. It will remain on for approximately 3 seconds and then turn off.

The "LOW TRAC" indicator lamp also comes on when the Antilock Brake System (ABS) is adjusting brake pressure to help avoid a skid.

"SECURITY" Indicator Lamp

The "SECURITY" indicator lamp is part of the theft deterrent system. It will come on when the theft deterrent module assembly is preventing the engine from starting, or if the theft deterrent module assembly is not properly programmed. It also comes on for about five seconds during "BULB TEST."

"SKIP SHIFT" Indicator Lamp (V8 Manual Only)

When the "SKIP SHIFT" indicator lamp is on, the manual transmission can only be shifted from first to fourth gear. For more information on skip shift, refer to SECTION 6E3-C8.

"TCS OFF" Indicator Lamp

Pontiac V8 Only

The Traction Control System (TCS), if equipped, limits wheel spin if it senses that one or both of the rear wheels are beginning to lose traction. When this happens, the TCS works the rear brakes and reduces engine power to limit wheel spin.

The "TCS OFF" indicator lamp will come on if there is a system failure, if the system has been turned off by the driver, or momentarily when starting the engine.

When the ignition switch is turned to the crank position, the "ABS INOP," "ASR," and "TCS OFF" lamps will come on. They will remain on if the switch is held in the crank position.

WARNING/REMINDER CHIMES

The audio alarm module sounds a chime to bring attention to one or more of several conditions. These conditions are: 1) the lights are on and the ignition switch is not in "RUN," "BULB TEST," or "START;" 2) the ignition key is in the ignition switch when the driver's door is open; 3) the seatbelt assembly is unbuckled when the ignition switch is in "RUN," "BULB TEST," or "START" and 4) the turn signal has been on for more than a half mile. Voltage is applied at all times through the fuse block to power the solid state audio alarm module.

Ignition Key Warning

Whenever the key is in the ignition switch and the driver's door is open, the module is grounded. This sounds the alarm.

Fasten Seat Belt Assembly Warning

With the ignition switch in "RUN," "BULB TEST," or "START," voltage is applied through the fuse block to the audio alarm module. With the driver's seat belt assembly unbuckled, the module is grounded through the seat belt switch and the alarm sounds. When the driver's seat belt assembly is buckled, the alarm shuts off. If the driver's seat belt assembly remains unbuckled, the alarm times out after 4 to 8 seconds.

Lights-On Warning

When the headlamp switch is in "HEAD" or "PARK," voltage is applied to the audio alarm module. When the ignition switch is in "RUN," "BULB TEST," or "START," voltage is applied through the fuse block to the

module. These two voltages are sensed and the alarm assembly is not sounded.

When the ignition switch is not in "RUN," "BULB TEST" or "START," the module loses voltage. The audio alarm module senses change. If voltage is still available, it is applied to sound the alarm. The alarm can be turned off by turning the headlamp switch to "OFF." The module no longer senses voltage from the headlamp switch, so the alarm assembly does not sound.

DIAGNOSIS

For diagnosis of instrument panel, cluster, electrical system (including individual wire color information and applicable precautions for testing solid state electronic devices and systems), refer to SECTION 8A.

ON-VEHICLE SERVICE

It may be necessary to color coat some replacement components before installing them in the vehicle. For information regarding this procedure, refer to SECTION 10-1.

SERVICE PRECAUTIONS

CAUTION: When performing service on or around SIR components or SIR wiring, follow the procedures listed below to temporarily disable the SIR system. Failure to follow procedures could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

The DERM in all Driver-Passenger SIR systems can maintain sufficient voltage to cause a deployment for up to 2 minutes after the ignition switch is turned "OFF," the battery is disconnected, or the fuse powering the DERM is removed.

Disabling the SIR System

Remove or Disconnect

- Turn the steering wheel so that the vehicle's wheels are pointing straight ahead.
- Turn ignition switch to "LOCK" and remove key.

1. "AIR BAG" fuse from I/P fuse block.
2. Lower sound insulator panel - left side, refer to SECTION 8C.
3. Connector Position Assurance (CPA) and yellow 2-way connector located near the base of the steering column.
4. I/P compartment door assembly, refer to SECTION 8C.
5. CPA and yellow 2-way connector from passenger inflator module.

Important

- With the "AIR BAG" fuse removed and ignition switch "ON," the "AIR BAG" warning lamp will be "ON." This is normal operation and does not indicate a SIR system malfunction.

Enabling the SIR System

Install or Connect

- Turn ignition switch to "LOCK" and remove key.

1. Yellow 2-way connector and CPA passenger inflator module.
2. I/P compartment door assembly, refer to SECTION 8C.
3. Yellow 2-way connector and CPA near base of steering column.
4. Lower sound insulator panel - left side, refer to SECTION 8C.
5. "AIR BAG" fuse to I/P fuse block.

- Turn ignition switch to "RUN" and verify that the "AIR BAG" warning lamp flashes seven times and then turns "OFF." If it does not operate as described, perform the "SIR Diagnostic System Check" in SECTION 9J-A.

NOTICE: The instrument panel and cluster contain electrostatic discharge (ESD) sensitive parts. When handling an electronic part that is identified as being ESD sensitive, the service technician should follow the guidelines in SECTION 0A. Following these guidelines will reduce any possible electrostatic charge buildup on the service technician's body and the electronic part.

HANDLING ELECTROSTATIC DISCHARGE (ESD) SENSITIVE PARTS

NOTICE: When handling an electronic part that has an ESD-sensitive sticker, refer to SECTION 0A. Follow these guidelines to reduce any possible build-up of electrostatic charge:

- Do not open package until time when part is to be installed.
- Avoid touching electrical terminals of part.
- Before removing part from its package, ground package to known good ground on vehicle.
- Always touch known good ground before handling part. This should be repeated while handling part. Do it more often after sliding across seat, sitting down from standing position, or walking a distance.

Not all parts that can be damaged by ESD have an ESD label. Components that can be damaged by ESD are:

AM/FM stereo radio assembly/radio control

Antilock brake system EBCM assembly

Automatic day/night mirror

CalPak

Chime module

Cruise control module

Electronic automatic air conditioning control assembly

Electronic spark control module

MEM-CAL (memory and calibration unit)

PROM (programmable read only memory) calibrator

Supplemental inflatable restraint (SIR) DERM

Twilight sentinel amplifier

CONTROLS

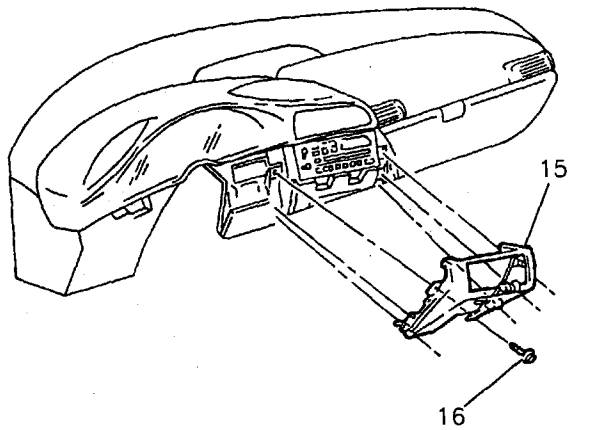
AM/FM Stereo and Clock Radio Assembly

Chevrolet

Figures 1 and 2

Remove or Disconnect

1. Driver knee bolster assembly. Refer to "Driver Knee Bolster Assembly and Deflector" in this section.
2. Trim plate assembly (15) and bolts/screws (16) from instrument panel assembly.



15 PLATE ASSEMBLY, INSTRUMENT PANEL ACCESSORY TRIM
16 BOLT/SCREW, INSTRUMENT PANEL ACCESSORY TRIM PLATE

5-06-94
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Figure 1 – Instrument Panel Accessory Trim Plate Assembly – (Chevrolet)

3. Bolts/screws (67) attaching brackets (68) to instrument panel carrier.
4. Brackets (68) and attached radio assembly (66) from instrument panel carrier.
5. Instrument panel wiring harness electrical connectors from radio assembly (66).
6. Bolts/screws (65) and nuts (64) attaching radio assembly (66) to brackets (68), if necessary.
7. Radio assembly (66) from brackets (68), if necessary.

Install or Connect

NOTICE: See "Notice" on page 8C-1 of this section.

1. Brackets (68) to radio assembly (66), if removed.
2. Bolts/screws (65) and nuts (64) attaching brackets (68) to radio assembly (66), if removed.

Tighten

- Nuts (64) to 2.8 N•m (25 lb. in.).

3. Instrument panel wiring harness electrical connectors to radio assembly (66).
4. Brackets (68) and attached radio assembly (66) to instrument panel carrier.
5. Bolts/screws (67) attaching brackets (68) to instrument panel carrier.

Tighten

- Bolts/screws (67) to 1.8 N•m (16 lb. in.).

6. Bolts/screws (16) attaching trim plate assembly (15) to instrument panel assembly.

Tighten

- Bolt/screw (16) to 1.9 N•m (17 lb. in.).

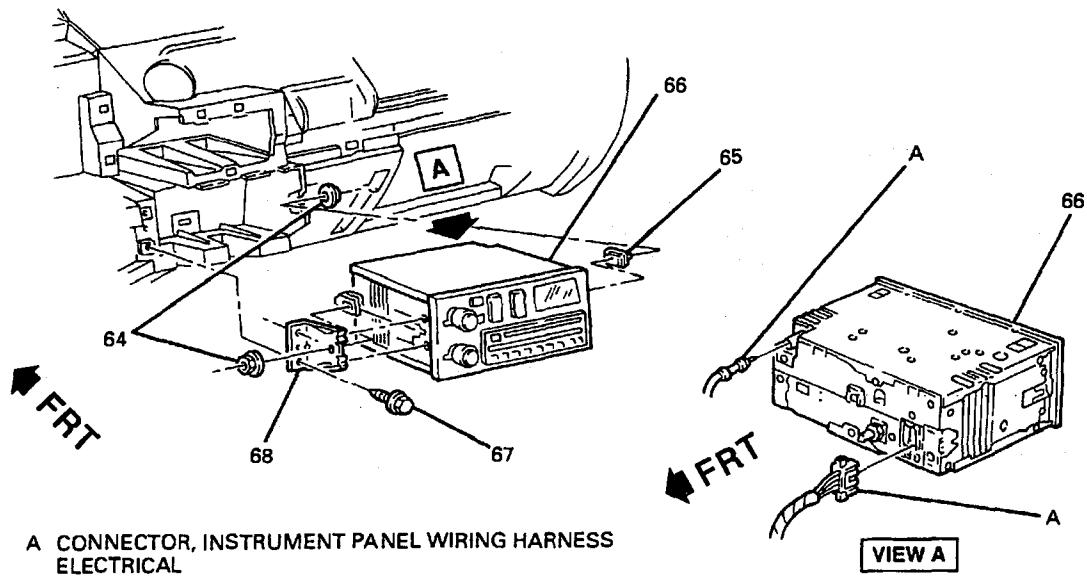
7. Driver knee bolster assembly. Refer to "Driver Knee Bolster Assembly and Deflector" in this section.

Pontiac

Figures 3 and 4

Remove or Disconnect

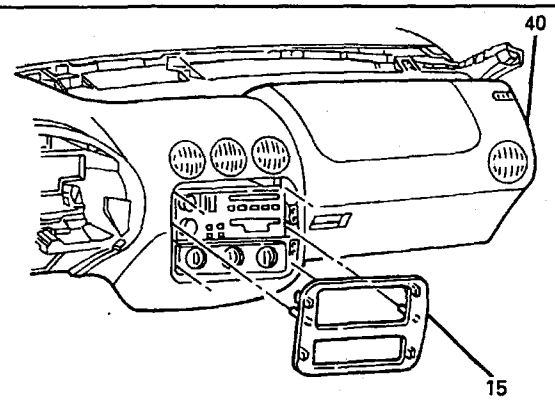
1. Driver knee bolster assembly. Refer to "Driver Knee Bolster Assembly and Deflector" in this section.
2. Trim plate assembly (15) from instrument panel assembly (40).
3. Bolt/screw (63) from instrument panel tie bar assembly, if necessary.
4. Retainer (62) and bolt/screw (65) from bracket (27).
5. Radio assembly (66).
6. Bolts/screws (67) attaching brackets (68) to instrument panel carrier.
7. Brackets (68) and attached radio assembly (66) from instrument panel carrier.
8. Instrument panel wiring harness electrical connectors from radio assembly (66).



A CONNECTOR, INSTRUMENT PANEL WIRING HARNESS ELECTRICAL
64 NUT, RADIO BRACKET
65 BOLT/SCREW, RADIO
66 RADIO ASSEMBLY, AM/FM STEREO AND CLOCK
67 BOLT/SCREW, RADIO BRACKET
68 BRACKET, RADIO

5-06-94
FS0028C

Figure 2 – AM/FM Stereo and Clock Radio Assembly – (Chevrolet)



15 PLATE ASSEMBLY, INSTRUMENT PANEL ACCESSORY TRIM
40 PANEL ASSEMBLY, INSTRUMENT

5-06-94
FS0038C

Figure 3 – Instrument Panel Accessory Trim Plate Assembly – (Pontiac)

9. Bolts/screws (65) and nuts (64) attaching radio assembly (66) to brackets (68), if necessary.
10. Radio assembly (66) from brackets (68), if necessary.

Install or Connect

NOTICE: See "Notice" on page 8C-1 of this section.

1. Brackets (68) to radio assembly (66), if removed.
2. Bolts/screws (65) and nuts (64) attaching brackets (68) to radio assembly (66), if removed.

Tighten

- Nuts (64) to 2.8 N•m (25 lb. in.).

3. Instrument panel wiring harness electrical connectors to radio assembly (66).
4. Brackets (68) and attached radio assembly (66) to instrument panel carrier.
5. Bolts/screws (67) attaching brackets (68) to instrument panel carrier.

Tighten

- Bolts/screws (67) to 1.8 N•m (16 lb. in.).

6. Radio assembly (66) to instrument panel assembly (40).
7. Retainer (62) and bolt/screw (65) to bracket (27).
8. Bolt/screw (63) to instrument panel tie bar assembly, if removed.

Tighten

- Bolt/screw (63) to 1.9 N•m (17 lb. in.).

9. Trim plate assembly (15) to instrument panel assembly (40).
10. Driver knee bolster assembly. Refer to "Driver Knee Bolster Assembly and Deflector" in this section.

Heater and Air Conditioning Control Assembly

Figure 5

Remove or Disconnect

1. Bezel assembly. Refer to "Instrument Panel Cluster Trim Plate Bezel Assembly" in this section.
2. Temperature control cable electrical connector and vacuum wiring harness electrical connector from over reinforcement (85).
3. Bolts/screws (81) attaching control assembly (82) to panel assembly (40).
4. Control assembly (82).

Install or Connect

NOTICE: See "Notice" on page 8C-1 of this section.

1. Control assembly (82) to panel assembly (40).
2. Bolts/screws (81).

Tighten

- Bolts/screws (81) to 1.9 N•m (17 lb. in.).

3. Temperature control cable electrical connector and vacuum wiring harness electrical connector through hole in panel assembly (40) and over reinforcement (85).
4. Bezel assembly. Refer to "Instrument Panel Cluster Trim Plate Bezel Assembly" in this section.

DATA LINK CONNECTOR (DLC)

Figure 6

The data link connector (DLC) is part of the instrument panel wiring harness assembly. Refer to SECTION 8A.

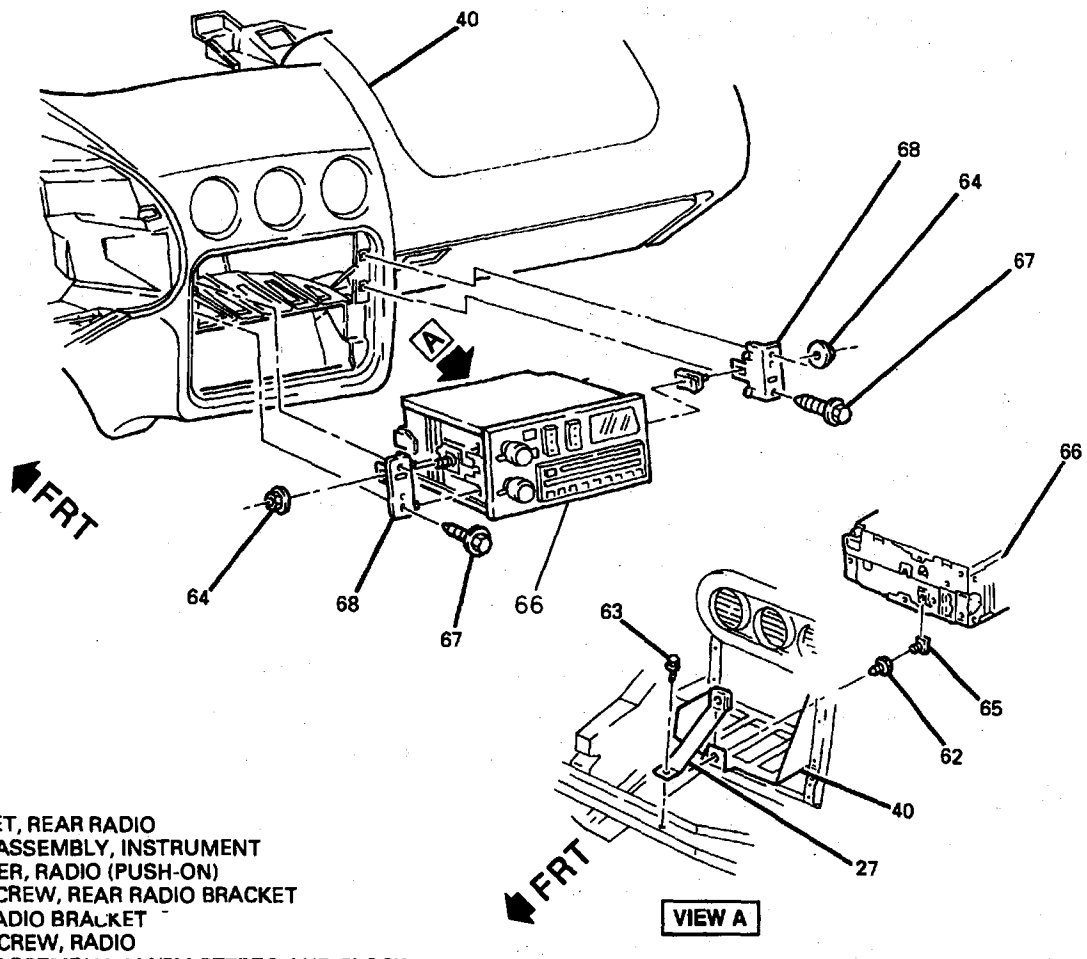


Figure 4 – AM/FM Stereo and Clock Radio Assembly – (Pontiac)

Remove or Disconnect

1. Two bolts/screws (61) attaching DLC to bracket (60).
2. Three instrument panel bolts/screws attaching bracket (60) to instrument panel carrier, if necessary.

Install or Connect

NOTICE: See "Notice" on page 8C-1 of this section.

1. Three instrument panel bolts/screws attaching bracket (60) to instrument panel carrier, if removed.

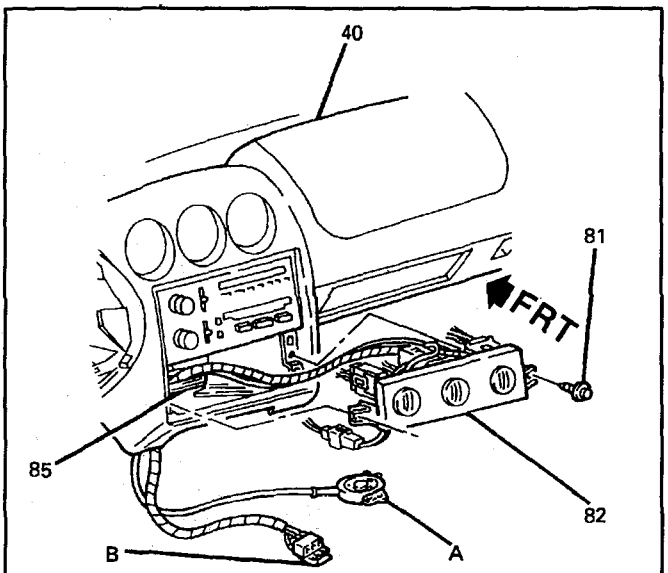
Tighten

- Instrument panel bolts/screws to 1.9 N•m (17 lb. in.).

2. Two bolts/screws (61) attaching DLC to bracket (60).

Tighten

- Bolts/screws (61) to 1.5 N•m (13 lb. in.).



A CONNECTOR, TEMPERATURE CONTROL CABLE ELECTRICAL
B CONNECTOR, VACUUM WIRING HARNESS ELECTRICAL
40 PANEL ASSEMBLY, INSTRUMENT
81 BOLT/SCREW, HEATER AND AIR CONDITIONING CONTROL,
82 CONTROL ASSEMBLY, HEATER AND AIR CONDITIONING
85 REINFORCEMENT, INSTRUMENT PANEL

5-06-94
FS0058C

Figure 5 – Heater and Air Conditioning Control Assembly (Typical)

DAYTIME RUNNING LAMP (DRL) COMPONENTS (CANADIAN ONLY)

Daytime Running Lamp Ambient Light Sensor Assembly

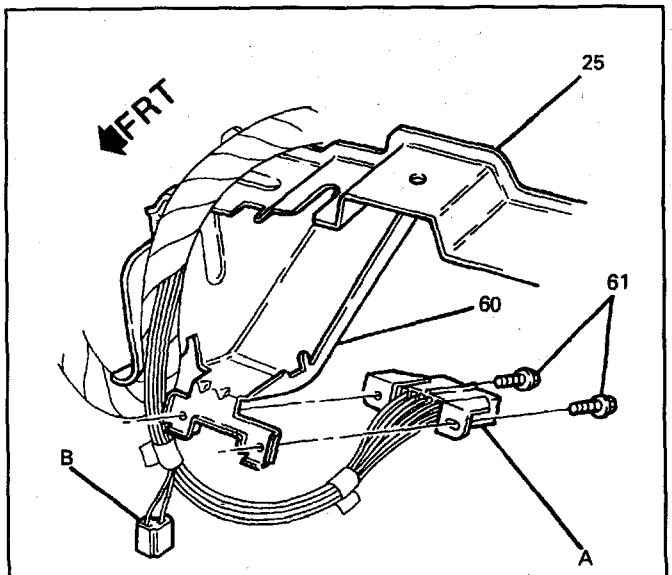
Figure 7

Remove or Disconnect

1. Grille (70) from instrument panel upper trim panel assembly.
   - Gently unsnap grille (70).
2. Sensor assembly (88) from grille (70).
   - Twist counterclockwise.
3. Sensor assembly (88) from instrument panel wiring harness grille electrical connector.

Install or Connect

1. Sensor assembly (88) to instrument panel wiring harness grille electrical connector.
2. Sensor assembly (88) to grille (70).
   - Twist clockwise.
3. Grille (70) to instrument panel upper trim panel assembly.
   - Snap into place.



A CONNECTOR, INSTRUMENT PANEL WIRING HARNESS ENGINE CONTROL MODULE DATA LINK ELECTRICAL
B CONNECTOR, INSTRUMENT CLUSTER TURN SIGNAL FLASHER ELECTRICAL
25 BAR ASSEMBLY, INSTRUMENT PANEL TIE
60 BRACKET, INSTRUMENT PANEL KNEE BOLSTER
61 BOLT/SCREW, INSTRUMENT PANEL WIRING HARNESS ENGINE CONTROL MODULE DATA LINK CONNECTOR

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Figure 6 – Data Link Connector (DLC)

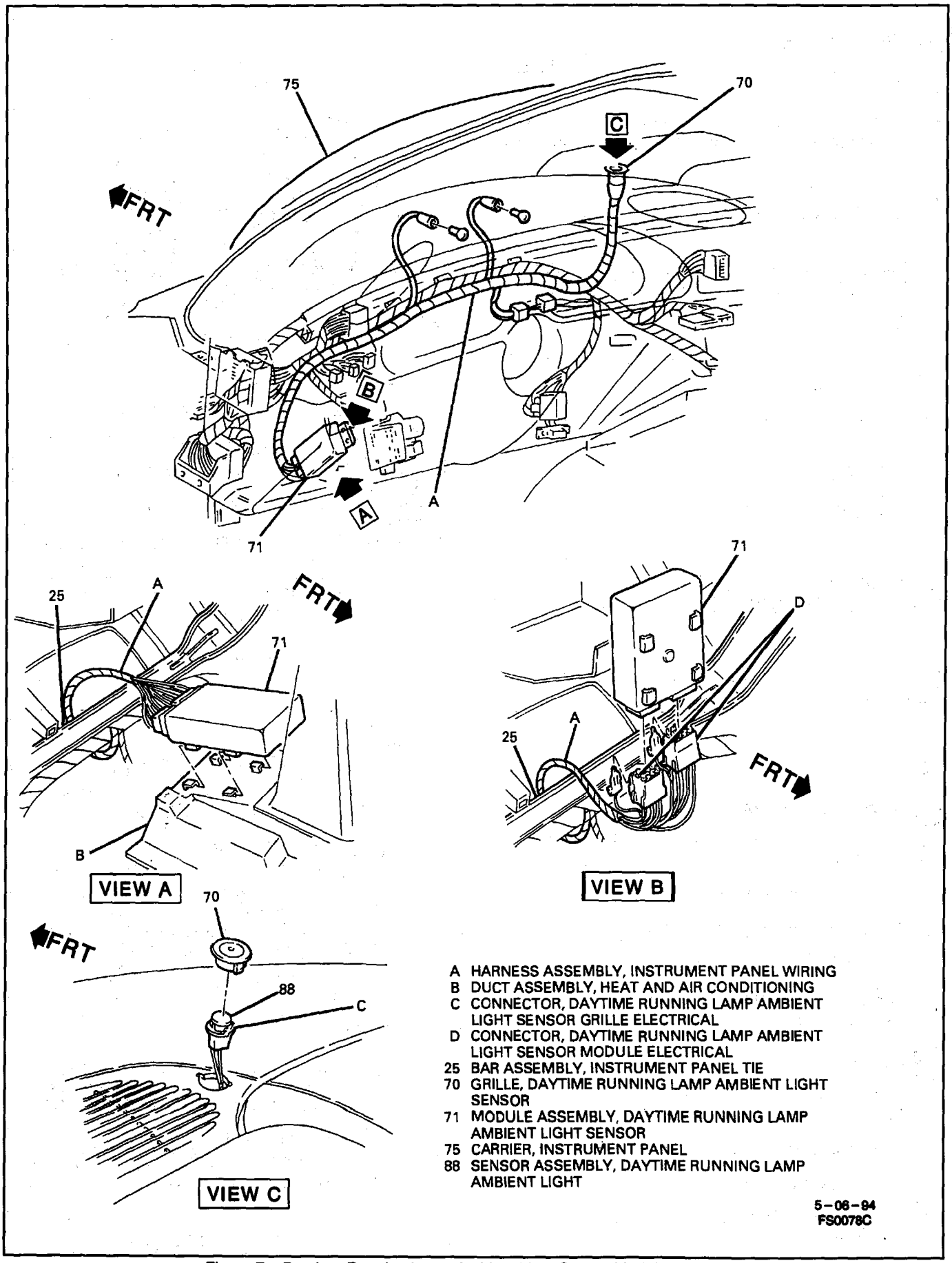


Figure 7 – Daytime Running Lamp Ambient Light Sensor Module Assembly

Daytime Running Lamp Ambient Light Sensor Module Assembly

Figure 7

Remove or Disconnect

1. Module assembly (71) from heat and air conditioning duct assembly.
2. Instrument panel wiring harness electrical connectors from module assembly (71) by depressing lock retainers on daytime running lamp ambient light sensor module electrical connectors.
3. Instrument panel wiring harness assembly from under and behind bar assembly (25).

Install or Connect

1. Route instrument panel wiring harness assembly behind and under bar assembly (25).
2. Daytime running lamp ambient light sensor module electrical connectors to module assembly (71).
   - When connecting, push, click, then tug on daytime running lamp ambient light sensor electrical connector, not wire.
3. Slide module assembly (71) onto heat and air conditioning duct assembly.

DRIVER KNEE BOLSTER ASSEMBLY AND DEFLECTOR

Chevrolet

Figure 8

Remove or Disconnect

1. Bolts/screws (4) from bolster assembly (3) at deflector (49) and instrument panel tie bar assembly.
2. Nuts (48) from studs (74).
3. Deflector (49) from studs (74).
   - Bolts/screws (4) to 1.9 N•m (17 lb. in.).

Install or Connect

NOTICE: See "Notice" on page 8C-1 of this section.

1. Deflector (49) to studs (74).
2. Nuts (48) to studs (74).
3. Bolts/screws (4) to bolster assembly (3) at deflector (49) and instrument panel tie bar assembly.

Tighten

- Bolts/screws (4) to 1.9 N•m (17 lb. in.).

Pontiac

Figure 9

Remove or Disconnect

1. Bolts/screws (4) from bolster assembly (3) at deflector (49) and instrument panel tie bar assembly.
2. Bolster assembly (3) from dual lock retainers on instrument panel carrier.
3. Nuts (48) from studs (74).
4. Deflector (49) from studs (74).

Install or Connect

NOTICE: See "Notice" on page 8C-1 of this section.

1. Deflector (49) to studs (74).
2. Nuts (48) to studs (74).
3. Bolster assembly (3) to dual lock retainers on instrument panel carrier.
   - Position bolster assembly (3) for best fit and apply pressure on retainers to secure.
4. Bolts/screws (4) to bolster assembly (3) at deflector (49) and instrument panel tie bar assembly.

Tighten

- Bolts/screws (4) to 1.9 N•m (17 lb. in.).

FRONT FLOOR CONSOLE ASSEMBLY

Figure 10

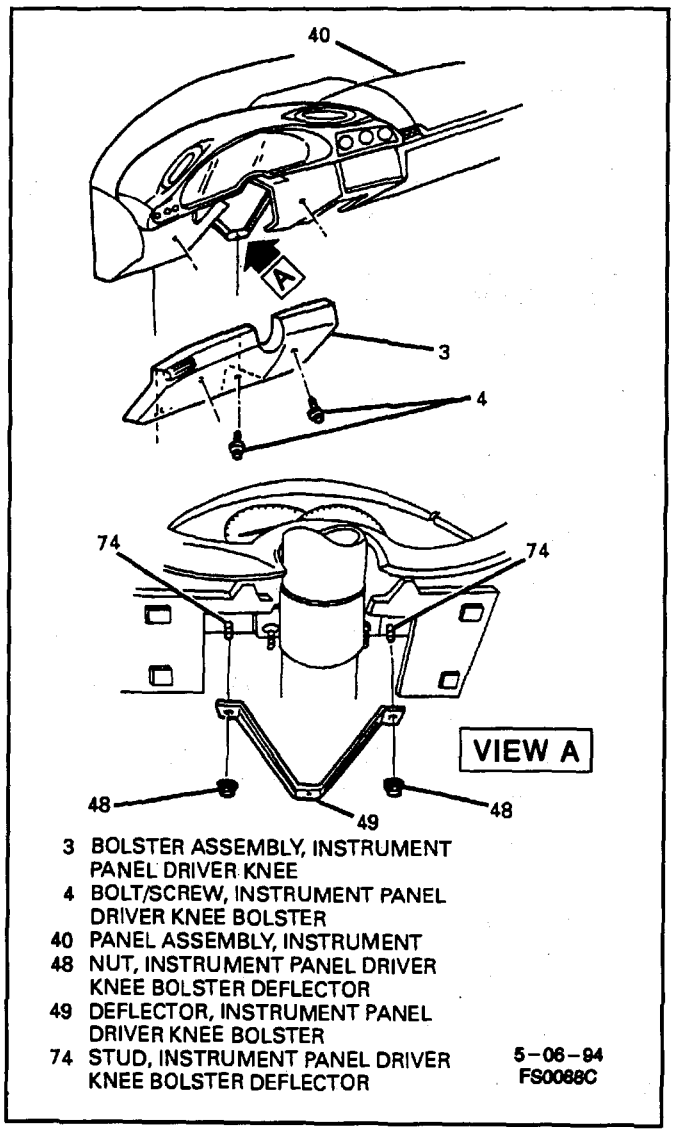
Remove or Disconnect

1. Bolts/screws (34) attaching console assembly (33) to instrument panel center support bracket and manual floor console bracket.
2. Bolt/screw (35) attaching console assembly (33) to instrument panel assembly.
3. Bolts/screws (36) attaching console assembly (33) to bracket (37).
4. Console assembly (33).

Install or Connect

NOTICE: See "Notice" on page 8C-1 of this section.

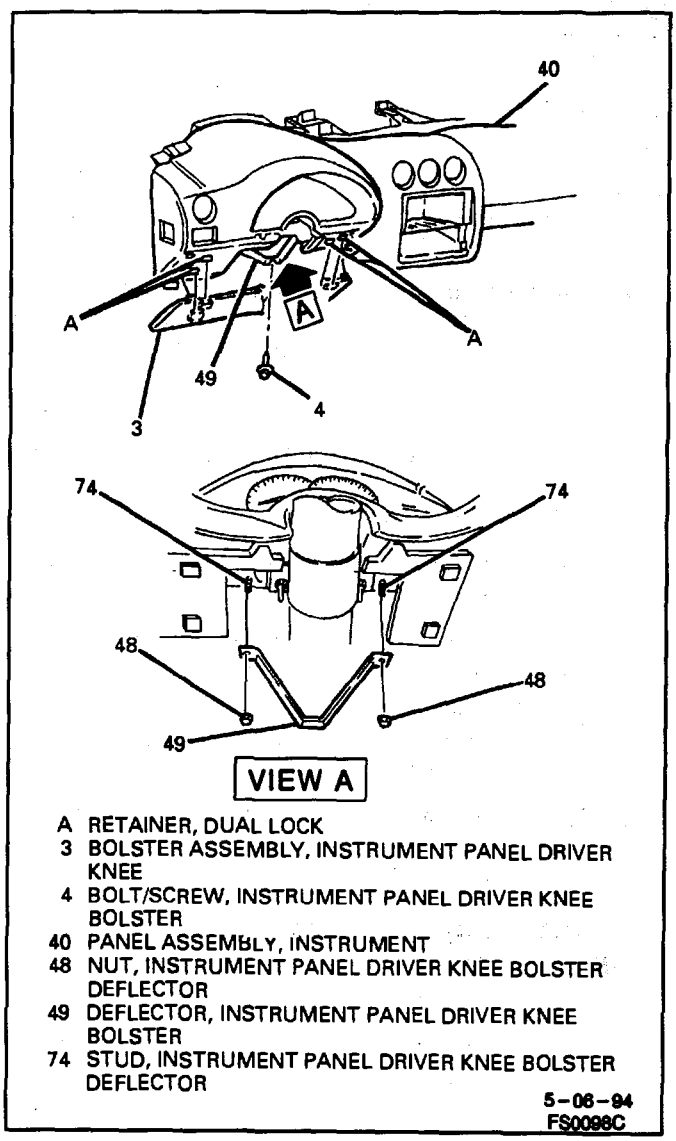
1. Console assembly (33).
   A. Route wiring connectors through appropriate openings.



3 BOLSTER ASSEMBLY, INSTRUMENT PANEL DRIVER KNEE
4 BOLT/SCREW, INSTRUMENT PANEL DRIVER KNEE BOLSTER
40 PANEL ASSEMBLY, INSTRUMENT
48 NUT, INSTRUMENT PANEL DRIVER KNEE BOLSTER DEFLECTOR
49 DEFLECTOR, INSTRUMENT PANEL DRIVER KNEE BOLSTER
74 STUD, INSTRUMENT PANEL DRIVER KNEE BOLSTER DEFLECTOR

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Figure 8 – Driver Knee Bolster Assembly and Deflector – (Chevrolet)



A RETAINER, DUAL LOCK
3 BOLSTER ASSEMBLY, INSTRUMENT PANEL DRIVER KNEE
4 BOLT/SCREW, INSTRUMENT PANEL DRIVER KNEE BOLSTER
40 PANEL ASSEMBLY, INSTRUMENT
48 NUT, INSTRUMENT PANEL DRIVER KNEE BOLSTER DEFLECTOR
49 DEFLECTOR, INSTRUMENT PANEL DRIVER KNEE BOLSTER
74 STUD, INSTRUMENT PANEL DRIVER KNEE BOLSTER DEFLECTOR

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Figure 9 – Driver Knee Bolster Assembly and Deflector – (Pontiac)

B. Insert parking brake assembly through appropriate opening.
C. Locating pin on console assembly (33) into hole in shifter bracket drive.
D. Position console assembly (33) to floor of vehicle.

2. Bolts/screws (36) attaching console assembly (33) to bracket (37).

Tighten

- Bolts/screws (36) to 8 N•m (71 lb. in.).

3. Bolt/screw (35) attaching console assembly (33) to instrument panel assembly.

Tighten

- Bolt/screw (35) to 5.5 N•m (49 lb. in.).

4. Bolts/screws (34) attaching console assembly (33) to instrument panel center support bracket and manual floor console bracket.

Tighten

- Bolts/screws (34) to 8 N•m (71 lb. in.).

Cigarette Lighter Assembly

Chevrolet (without Switches)

Figure 11

Remove or Disconnect

1. Cigarette lighter assembly from console assembly (33).
2. Bezel assembly (32) from cigarette lighter bezel wiring harness electrical connector.

Install or Connect

1. Bezel assembly (32) to cigarette lighter bezel wiring harness electrical connector.
2. Cigarette lighter assembly to appropriate opening in console assembly (33).
   - Snap into place.

Chevrolet (with Switches)

Figure 11

Remove or Disconnect

1. Switch assembly with cigarette lighter (98) from console assembly (33).
2. Wiring harness electrical connector from cigarette lighter assembly.
3. Cigarette lighter assembly from switch assembly with cigarette lighter (98).

Install or Connect

1. Cigarette lighter assembly to switch assembly with cigarette lighter (98).
2. Wiring harness electrical connector to cigarette lighter assembly.
3. Switch assembly with cigarette lighter (98) to console assembly (33).

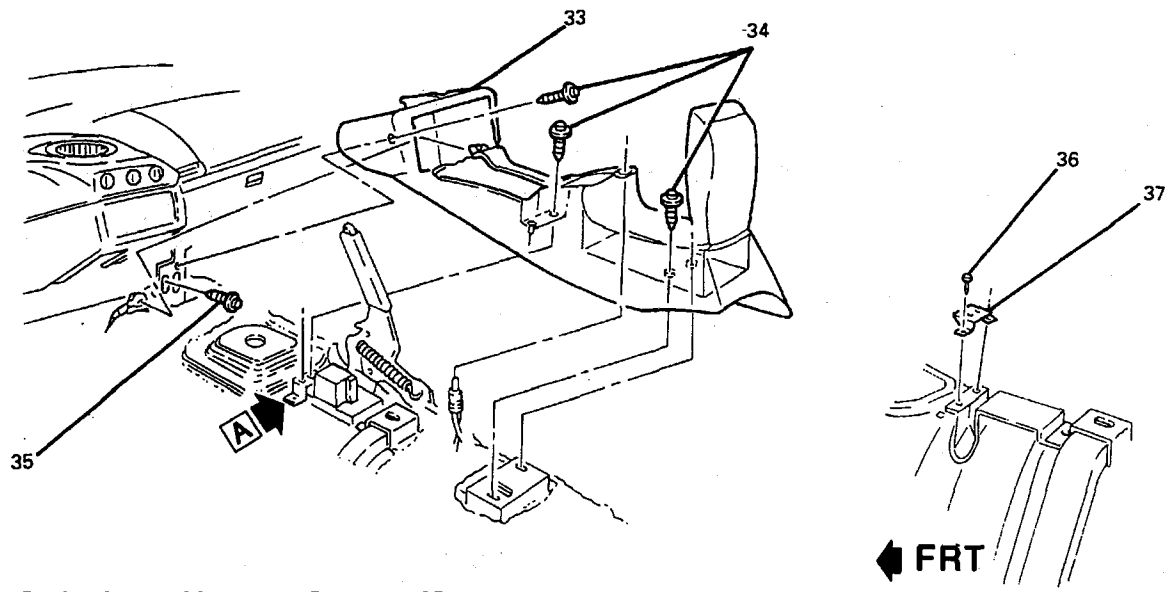
Pontiac

Remove or Disconnect

1. Front floor console assembly. Refer to "Front Floor Console Assembly" under "On-Vehicle Service" in this section.
2. Cigarette lighter electrical connector from cigarette lighter assembly.
3. Cigarette lighter assembly from front floor console assembly.

Install or Connect

1. Cigarette lighter assembly to front floor console assembly.
2. Cigarette lighter electrical connector to cigarette lighter assembly.
3. Front floor console assembly. Refer to "Front Floor Console Assembly" under "On-Vehicle Service" in this section.



33 CONSOLE ASSEMBLY, FRONT FLOOR
34 BOLT/SCREW, FRONT FLOOR CONSOLE
35 BOLT/SCREW, INSTRUMENT PANEL, LOWER
36 BOLT/SCREW, FRONT FLOOR CONSOLE BRACKET
37 BRACKET, FRONT FLOOR CONSOLE

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Figure 10 – Front Floor Console Assembly (Typical)

Convertible Top Switch

Chevrolet

Figure 11

Remove or Disconnect

1. Folding top switch assembly (98) from console assembly (33).
2. Convertible top switch connector from folding top switch assembly (98).
3. Cigarette lighter electrical connector from cigarette lighter assembly, if equipped.
4. Cigarette lighter assembly, if equipped, to folding top switch assembly (98).

Install or Connect

1. Cigarette lighter assembly, if equipped, to folding top switch assembly (98).
2. Cigarette lighter electrical connector to cigarette lighter assembly, if equipped.
3. Convertible top switch connector to folding top switch assembly (98).
4. Folding top switch assembly (98) to console assembly (33).

Pontiac

Figure 12

Remove or Disconnect

1. Folding top switch assembly (99) from console assembly (33).
2. Convertible top switch connector from folding top switch assembly (99).

Install or Connect

1. Convertible top switch connector to folding top switch assembly (99).
2. Folding top switch assembly (99) to console assembly (33).

Compartment Lamp Switch

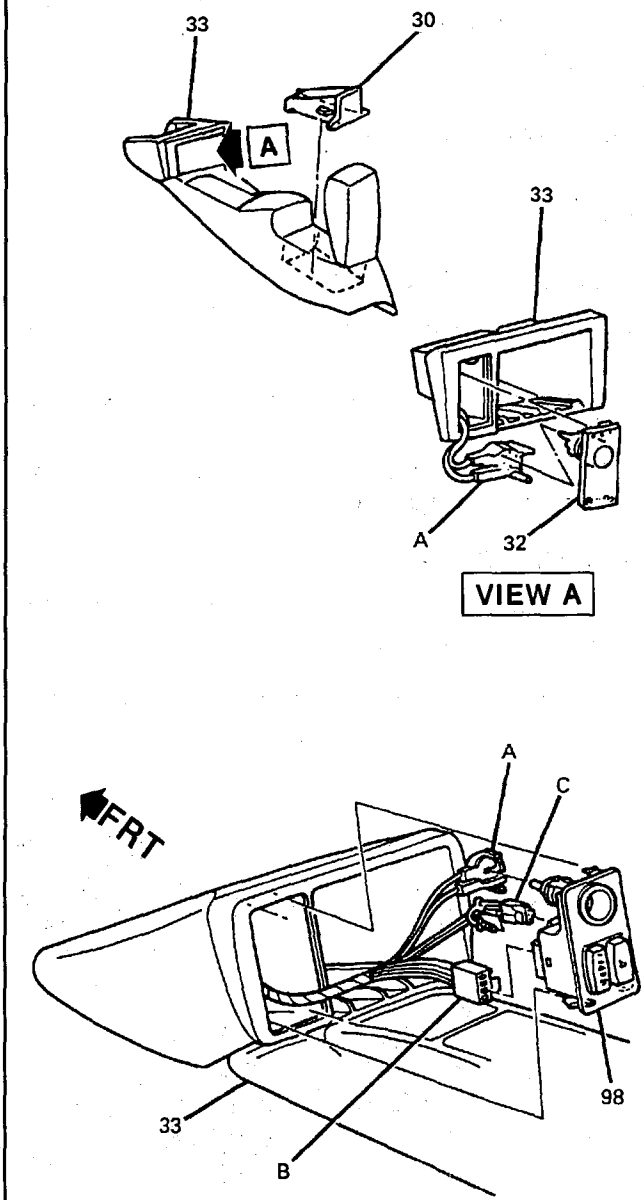
Figure 13

Remove or Disconnect

1. Switch (93) and retainer (94) from opening in console assembly (33).
2. Retainer (94) from switch (93).

Install or Connect

1. Retainer (94) to switch (93).
2. Switch (93) and retainer (94) down through opening in console assembly (33).
   - Be sure retainer (94) is seated in console assembly (33).



A CIGARETTE LIGHTER ELECTRICAL CONNECTOR
B CONVERTIBLE TOP SWITCH ELECTRICAL CONNECTOR
C TRACTION CONTROL SWITCH ELECTRICAL CONNECTOR
30 TRAY, FRONT FLOOR CONSOLE TAPE/DISC STORAGE
32 BEZEL ASSEMBLY, CIGARETTE LIGHTER
33 CONSOLE ASSEMBLY, FRONT FLOOR
98 SWITCH ASSEMBLY, ELECTRONIC TRACTION CONTROL AND FOLDING TOP (WITH CIGARETTE LIGHTER)

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Figure 11 – Cigarette Lighter, Traction Control Switch and Convertible Top Switch – (Chevrolet)

Performance Switch (V8 Automatic) Second Gear Start Switch (V6 Automatic)

Pontiac Only

Figure 12

Remove or Disconnect

1. Automatic transmission shift program switch (100) from console assembly (33).
2. Performance switch electrical connector from automatic transmission shift program switch (100).

Install or Connect

1. Performance switch electrical connector to automatic transmission shift program switch (100).
2. Automatic transmission shift program switch (100) to console assembly (33).

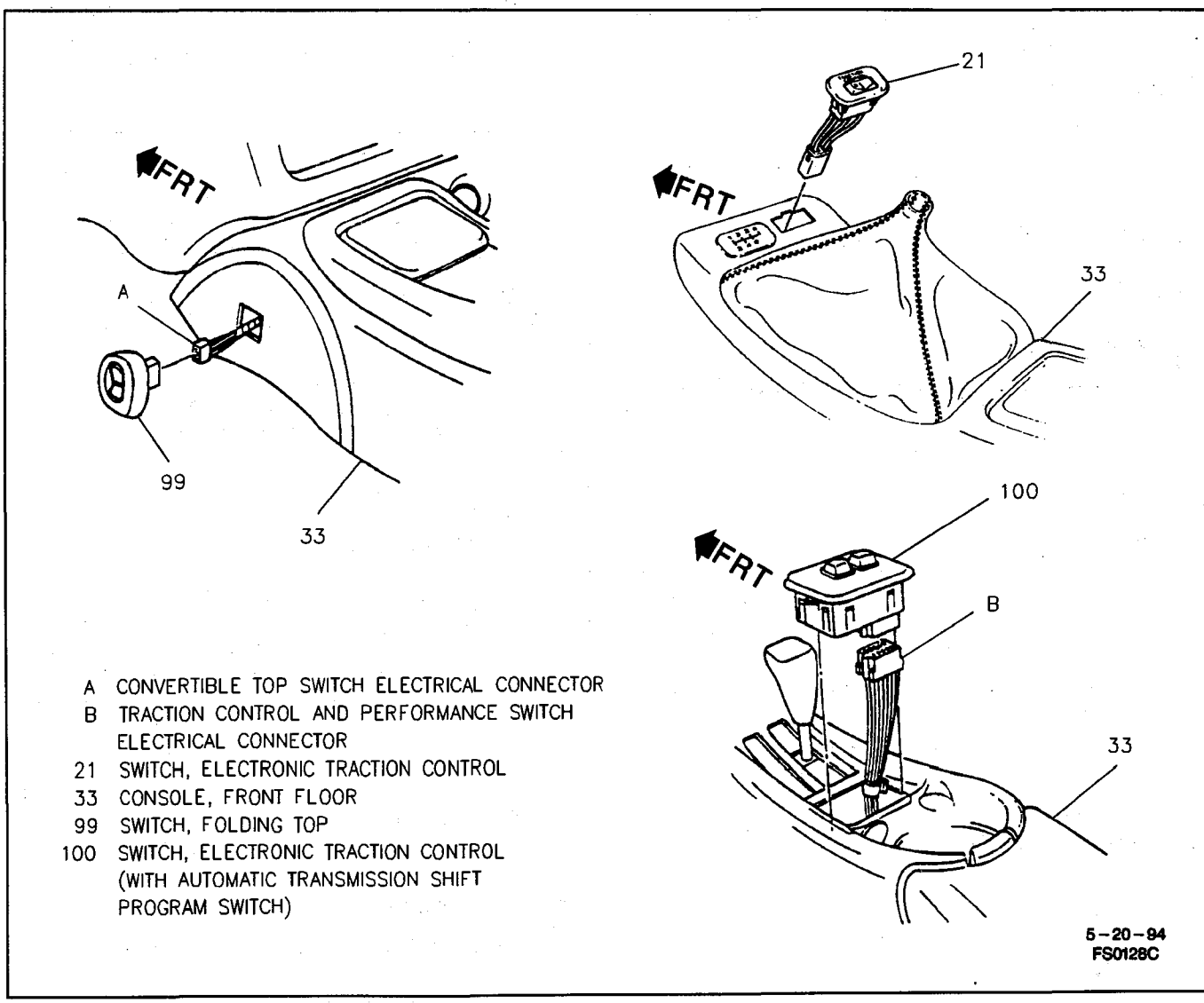
Traction Control Switches

ASR Switch – Chevrolet (V8) TCS Switch – Pontiac (V8)

Figures 11 and 12

Remove or Disconnect

1. Electronic traction control switch assembly (98 or 99) from console assembly (33).
2. Traction control switch electrical connector from electronic traction control switch assembly (98 or 99).
3. Cigarette lighter electrical connector from cigarette lighter assembly, if equipped (Chevrolet only).
4. Cigarette lighter assembly, if equipped, from traction control switch assembly (98) (Chevrolet only).



A CONVERTIBLE TOP SWITCH ELECTRICAL CONNECTOR
B TRACTION CONTROL AND PERFORMANCE SWITCH ELECTRICAL CONNECTOR
21 SWITCH, ELECTRONIC TRACTION CONTROL
33 CONSOLE, FRONT FLOOR
99 SWITCH, FOLDING TOP
100 SWITCH, ELECTRONIC TRACTION CONTROL (WITH AUTOMATIC TRANSMISSION SHIFT PROGRAM SWITCH)

Figure 12 – Convertible Top, Traction Control and Performance Switches – (Pontiac)

Install or Connect

1. Cigarette lighter assembly, if equipped, to traction control switch assembly (98) (Chevrolet only).
2. Cigarette lighter electrical connector to cigarette lighter assembly, if equipped (Chevrolet only).
3. Traction control switch electrical connector to electronic traction control switch assembly (98 or 99).
4. Electronic traction control switch assembly (98 or 99) to console assembly (33).

Storage Tray

Figure 11

Remove or Disconnect

- Tray (30) from console storage area.
  - Depress dual lock fasteners on either side of tray (30).

Install or Connect

- Tray (30) into console storage area.
  - Apply pressure to secure dual lock fasteners.

Transmission Plate Assembly

Figure 14

Remove or Disconnect

1. Retainers attaching plate assembly (28 or 29) to console assembly (33).
2. Plate assembly (28 or 29).

Install or Connect

1. Plate assembly (28 or 29) to console assembly (33).
   - Position plate assembly (28 or 29) over shifter stem, initially inserting forward end of plate assembly (28 or 29) into console assembly (33).
2. Retainers attaching plate assembly (28 or 29) to console assembly (33).
   - Apply pressure, snap into place and secure.

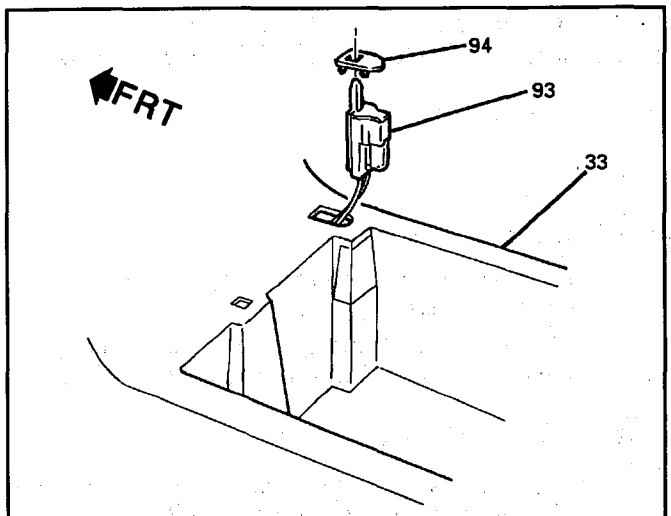
HEAT, VENTILATION AND AIR CONDITIONING DUCTS

Air Distributor Assembly

Figures 15 and 16

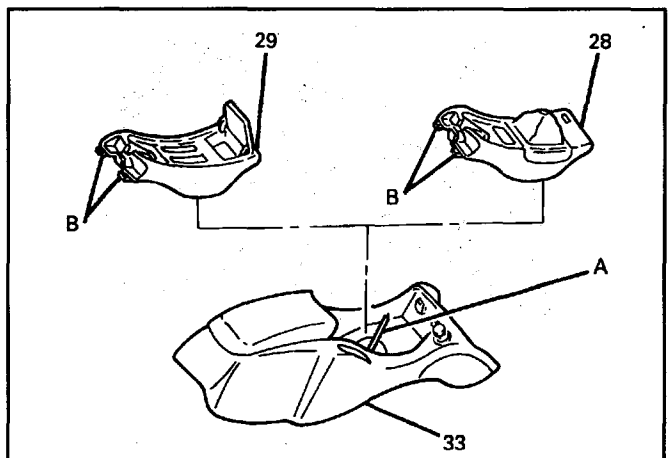
Remove or Disconnect

1. Instrument panel carrier. Refer to "Instrument Panel Carrier" in this section.



33 CONSOLE ASSEMBLY, FRONT FLOOR
93 SWITCH, INSTRUMENT PANEL COMPARTMENT LAMP
94 RETAINER, INSTRUMENT PANEL COMPARTMENT LAMP SWITCH
5-06-94 FS0138C

Figure 13 – Compartment Lamp Switch



A STEM, SHIFTER
B RETAINER
28 PLATE ASSEMBLY, FRONT FLOOR CONSOLE TRANSMISSION (MANUAL)
29 PLATE ASSEMBLY, FRONT FLOOR CONSOLE TRANSMISSION (AUTOMATIC)
33 CONSOLE ASSEMBLY, FRONT FLOOR
5-06-94 FS0148C

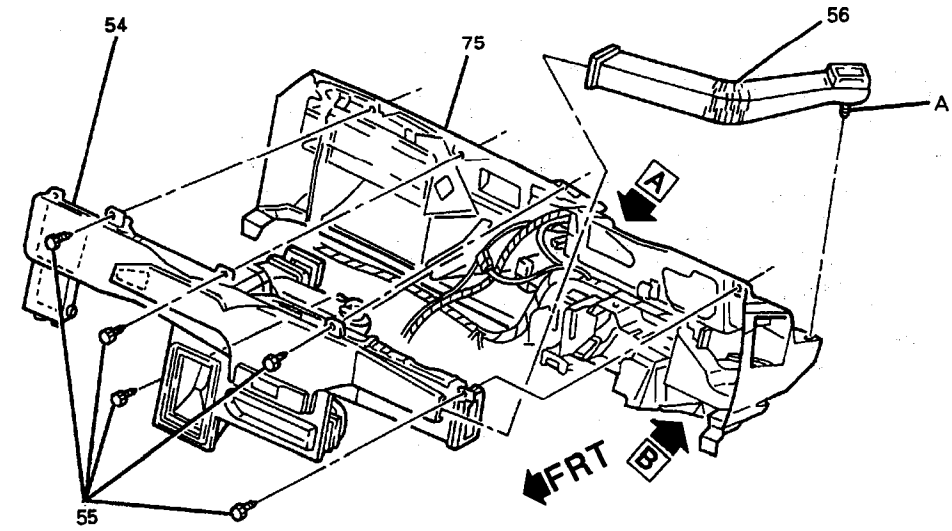
Figure 14 – Transmission Plate Assembly

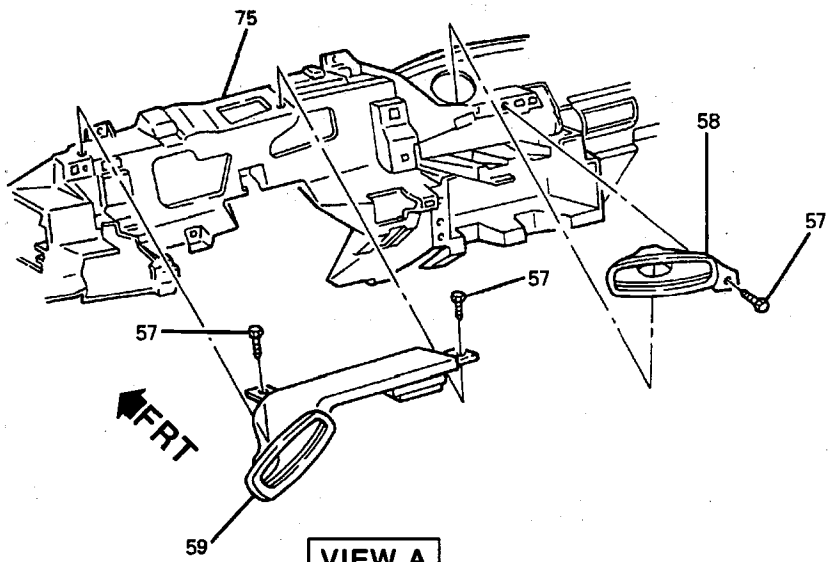
2. Bolts/screws (55) attaching distributor assembly (54) to carrier (75).
3. Distributor assembly (54) from carrier (75).

Install or Connect

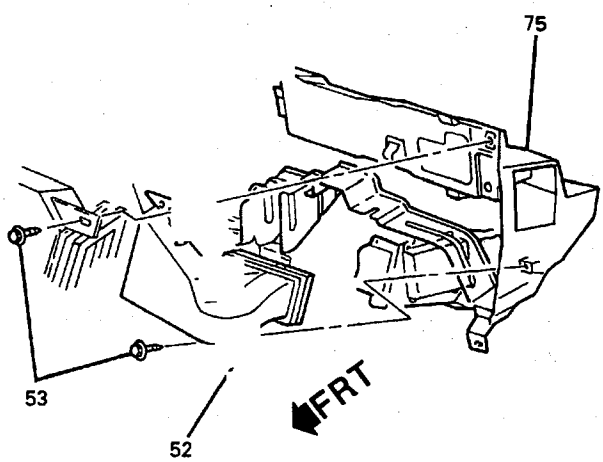
NOTICE: See "NOTICE" on page 8C-1 of this section.

1. Distributor assembly (54) to carrier (75).
2. Route heater control cable assembly and vacuum wiring harness assembly over reinforcement in carrier (75).





VIEW A



VIEW B

A PIN, LOCATOR
52 DUCT ASSEMBLY, INSTRUMENT PANEL OUTER AIR OUTLET
53 BOLT/SCREW, INSTRUMENT PANEL OUTER AIR OUTLET
54 DISTRIBUTOR ASSEMBLY, WINDSHIELD DEFROSTER NOZZLE AND AIR
55 BOLT/SCREW, AIR DISTRIBUTOR DUCT
56 DUCT ASSEMBLY, SIDE WINDOW DEFOGGER OUTLET
57 BOLT/SCREW, INSTRUMENT PANEL CENTER AIR OUTLET DUCT
58 DUCT ASSEMBLY, INSTRUMENT PANEL CENTER AIR OUTLET
59 DUCT ASSEMBLY, INSTRUMENT PANEL CENTER AIR OUTLET
75 CARRIER, INSTRUMENT PANEL

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Figure 15 – Heat, Ventilation and Air Conditioning Ducts – (Chevrolet)

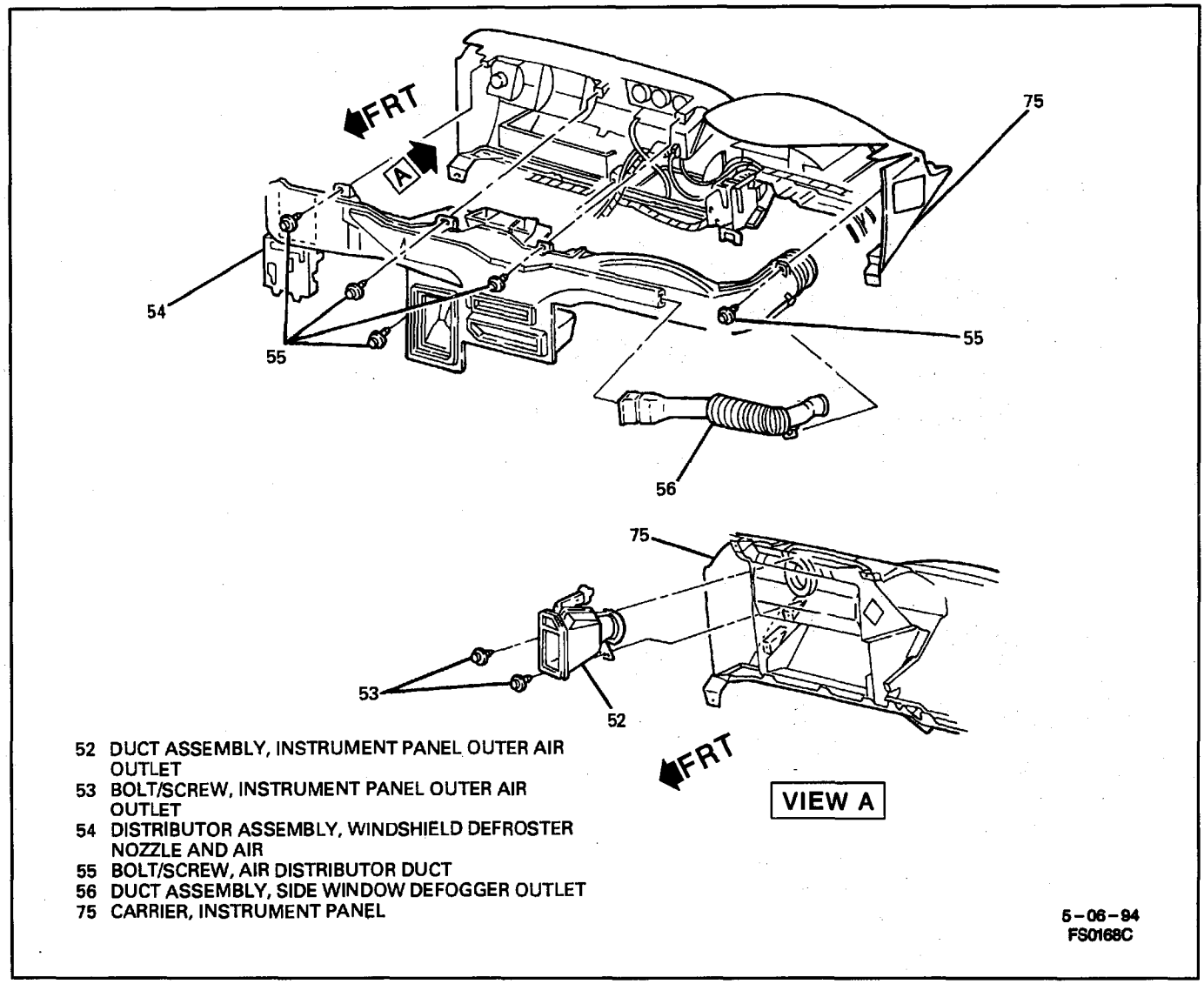


Figure 16 – Heat, Ventilation and Air Conditioning Ducts – (Pontiac)

- Align cable and wire assemblies with depression in distributor assembly (54).

3. Bolts/screws (55) attaching distributor assembly (54) to carrier (75).

Tighten

- Bolts/screws (55) to 1.9 N•m (17 lb. in.).

4. Instrument panel carrier (75). Refer to "Instrument Panel Carrier" in this section.

Center Air Outlet Duct Assemblies

Chevrolet Only

Figure 15

Remove or Disconnect

1. Bolts/screws (57) attaching duct assembly (58 or 59) to carrier (75).
2. Duct assembly (58 or 59).

Install or Connect

NOTICE: See "Notice" on page 8C-1 of this section.

1. Duct assembly (58 or 59) to carrier (75).
2. Bolts/screws (57) attaching duct assembly (58 or 59) to carrier (75).

Tighten

- Bolts/screws (57) to 1.9 N•m (17 lb. in.).

Defogger Outlet Duct Assembly

Figures 15 and 16

Remove or Disconnect

1. Duct assembly (56) from distributor assembly (54).
2. Duct assembly (56) from carrier (75).

Install or Connect

NOTICE: See "Notice" on page 8C-1 of this section.

1. Duct assembly (56) to carrier (75).
2. Duct assembly (56) to distributor assembly (54).

Floor Air Outlet Duct Assembly

Remove or Disconnect

1. Bolts/screws attaching duct assembly to module assembly.
2. Duct assembly.

Install or Connect

NOTICE: See "Notice" on page 8C-1 of this section.

1. Duct assembly to module assembly.
2. Bolts/screws attaching duct assembly to module assembly.

Tighten

- Bolts/screws 1.9 N•m (17 lb. in.).

Outer Air Outlet Duct Assemblies

Figures 16 and 17

Remove or Disconnect

1. Bolts/screws (53) attaching duct assembly (52) to carrier (75).
2. Duct assembly (52).

Install or Connect

NOTICE: See "Notice" on page 8C-1 of this section.

1. Duct assembly (52) to carrier (75).
2. Bolts/screws (53) attaching duct assembly (52) to carrier (75).

Tighten

- Bolts/screws (53) to 1.9 N•m (17 lb. in.).

INSTRUMENT CLUSTER ASSEMBLY

Figure 18

Remove or Disconnect

1. Instrument panel upper trim panel assembly. Refer to "Instrument Panel Upper Trim Panel Assembly" in this section.
2. Bolts/screws (79) attaching cluster assembly (78) to carrier (75).
3. Cluster assembly (78) from carrier (75).
4. Instrument cluster wiring harness electrical connector from cluster assembly (78).

Install or Connect

NOTICE: See "Notice" on page 8C-1 of this section.

1. Instrument cluster wiring harness electrical connector to cluster assembly (78).
   - When connecting, push, click, then tug on electrical connector, not wire.
2. Cluster assembly (78) to carrier (75).
3. Bolts/screws (79) attaching cluster assembly (78) to carrier (75).

Tighten

- Bolts/screws (79) to 2.2 N•m (20 lb. in.).

4. Instrument panel upper trim panel assembly. Refer to "Instrument Panel Upper Trim Panel Assembly" in this section.

INSTRUMENT PANEL CARRIER

Figure 19

Remove or Disconnect

CAUTION: See "Caution" on page 8C-1 of this section.

1. Sound insulator assembly from both sides of vehicle. Refer to "Sound Insulator Assembly" in this section.
2. Removable top assembly. Refer to SECTION 10-9.
3. Window rail trim panel assembly. Refer to SECTION 10-6.
4. Knee bolster assembly and deflector. Refer to "Driver Knee Bolster Assembly and Deflector" in this section.
5. Disable SIR. Refer to "Disabling the SIR System" in this section.

   NOTICE: Remove stoplamp switch before fully lowering the steering column assembly. Failure to do so may cause the stoplamp switch to become damaged or thrown out of adjustment resulting in a malfunctioning stoplamp switch or premature brake wear.
6. Stoplamp switch. Refer to SECTION 5.
7. Steering column assembly. Refer to SECTION 3F.
   - Gently lower steering column assembly.
8. Trim panel assembly. Refer to "Instrument Panel Upper Trim Panel Assembly" in this section.
9. Trim plate assembly. Refer to "AM/FM Stereo and Clock Radio Assembly" under "On-Vehicle Service" in this section.
10. Bezel assembly. Refer to "Instrument Panel Cluster Trim Plate Bezel Assembly" in this section.
11. Instrument cluster assembly. Refer to "Instrument Cluster Assembly" under "On-Vehicle Service" in this section.

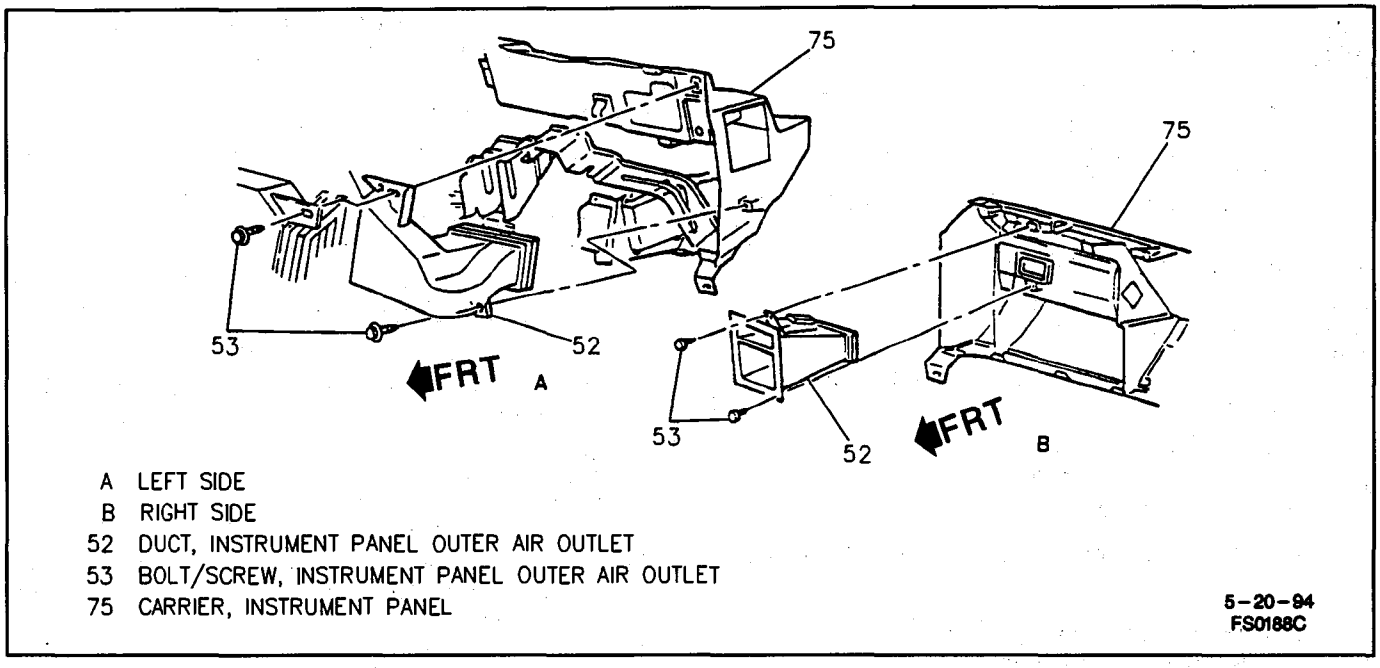


Figure 17 – Outer Air Outlet Duct Assemblies – (Chevrolet)

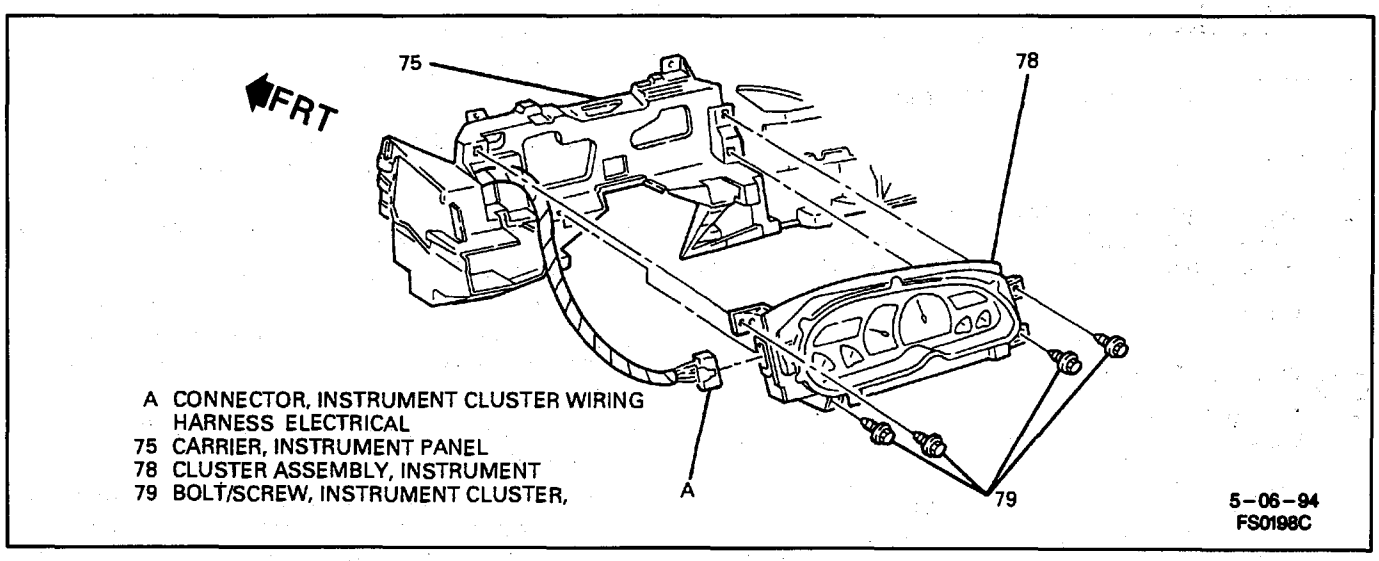


Figure 18 – Instrument Cluster Assembly (Typical)

12. Radio assembly. Refer to "AM/FM Stereo and Clock Radio Assembly" under "On-Vehicle Service" in this section.
13. Temperature control assembly. Refer to "Heater and Air Conditioning Control Assembly" under "On-Vehicle Service" in this section.
14. Left side duct assemblies. Refer to "Heat, Ventilation, and Air Conditioning Ducts" in this section.
15. Transmission gear shift knob, cover and console assemblies. Refer to "Front Floor Console Assembly" under "On-Vehicle Service" in this section.
16. Fuse block. Refer to "Auxiliary Fuse Block" under "Instrument Panel Wiring Harness Assembly" in this section.
17. Assembly line data link connector. Refer to "Instrument Panel Wiring Harness Assembly" in this section.
18. Hazard and chime assembly. Refer to "Warning/Reminder Chimes" under "On-Vehicle Service" in this section.
19. Upper bolts/screws (9).
20. Lower nuts (8).
21. Reposition carrier (75).
22. Air duct assembly. Refer to "Heat, Ventilation and Air Conditioning Ducts" in this section.
23. Audio alarm assembly. Refer to "Alarm Assembly" in this section.

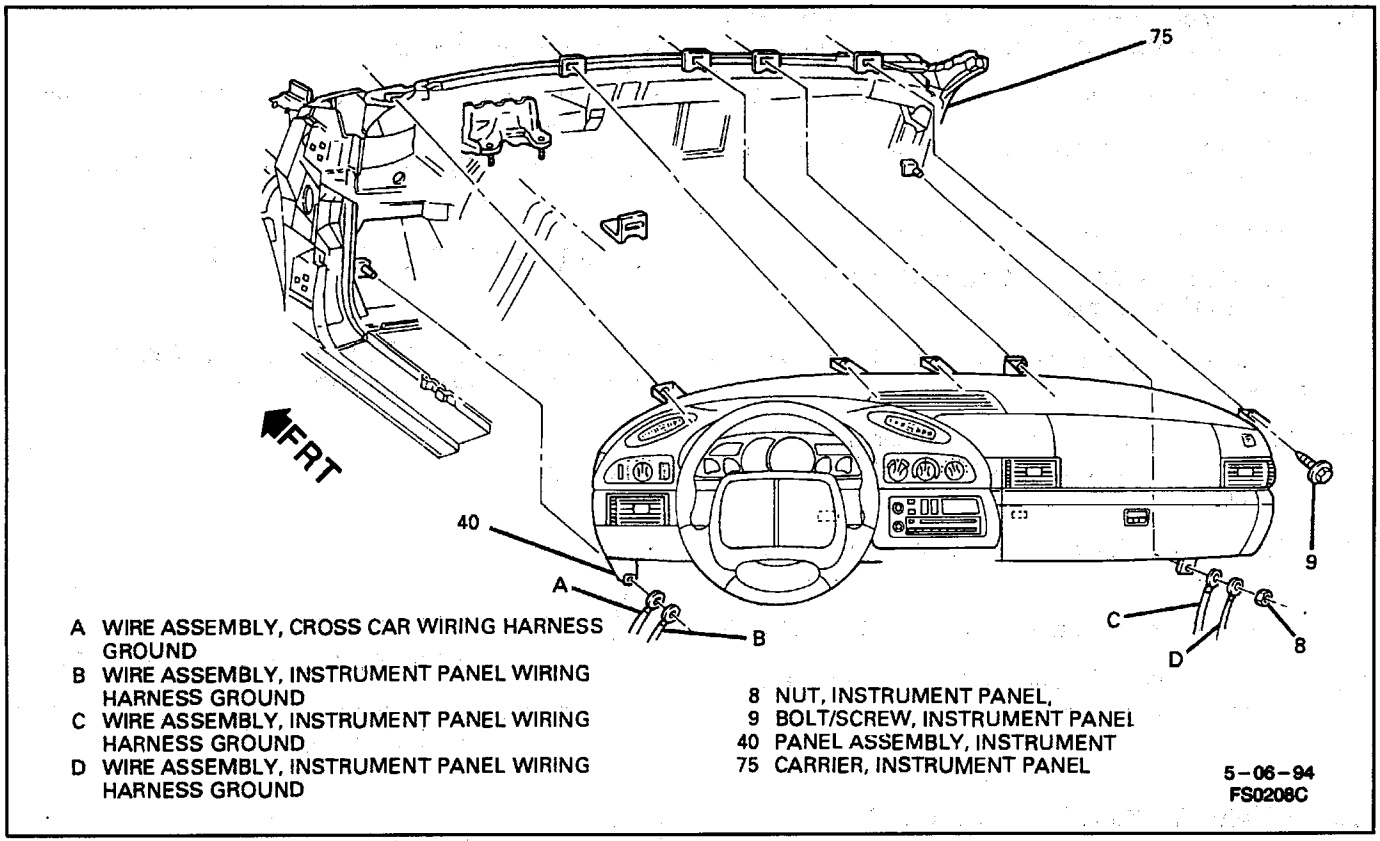


Figure 19 – Instrument Panel Assembly Mounting (Typical)

24. Wiring harness assembly from carrier (75). Refer to "Instrument Panel Wiring Harness Assembly" in this section.
25. Carrier (75).

Install or Connect

NOTICE: See "Notice" on page 8C-1 of this section.

1. Carrier (75).
2. Wiring harness assembly to carrier (75). Refer to "Instrument Panel Wiring Harness Assembly" in this section.
3. Audio alarm assembly. Refer to "Alarm Assembly" in this section.
4. Air duct assembly. Refer to "Heat, Ventilation and Air Conditioning Ducts" in this section.
5. Position carrier (75)
6. Lower nuts (8).

Tighten

- Lower nuts (8) to 25 N•m (18 lb. ft.).

7. Upper bolts/screws (9).

Tighten

- Upper bolts/screws (9) to 1.9 N•m (17 lb. in.).

8. Hazard and chime assembly. Refer to "Warning/Reminder Chimes" under "On-Vehicle Service" in this section.
9. Assembly line data link connector. Refer to "Instrument Panel Wiring Harness Assembly" in this section.
10. Fuse block. Refer to "Auxiliary Fuse Block" under "Instrument Panel Wiring Harness Assembly" in this section.
11. Transmission gear shift knob, cover and console assemblies. Refer to "Front Floor Console Assembly" under "On-Vehicle Service" in this section.
12. Left side duct assemblies. Refer to "Heat, Ventilation and Air Conditioning Ducts" in this section.
13. Temperature control assembly. Refer to "Heater and Air Conditioning Control Assembly" under "On-Vehicle Service" in this section.
14. Radio assembly. Refer to "AM/FM Stereo and Clock Radio Assembly" under "On-Vehicle Service" in this section.
15. Instrument cluster assembly. Refer to "Instrument Cluster Assembly" under "On-Vehicle Service" in this section.
16. Bezel assembly. Refer to "Instrument Panel Cluster Trim Plate Bezel Assembly" in this section.
17. Trim plate assembly. Refer to "AM/FM Stereo and Clock Radio Assembly" under "On-Vehicle Service" in this section.

18. Trim panel assembly. Refer to "Instrument Panel Upper Trim Panel Assembly" in this section.
19. Steering column assembly. Refer to SECTION 3F.
    - Gently raise steering column assembly into place.
20. Stoplamp switch. Refer to SECTION 5.

CAUTION: Refer to "Caution" on page 8C-1 of this section.

21. Enable SIR. Refer to "Enabling the SIR System" in this section.
22. Knee bolster assembly and deflector. Refer to "Driver Knee Bolster Assembly and Deflector" in this section.
23. Window rail trim panel assembly. Refer to SECTION 10-6.
24. Removable top assembly. Refer to SECTION 10-9.
25. Sound insulator assembly. Refer to "Sound Insulator Assembly" in this section.

INSTRUMENT PANEL INSULATOR

Figure 20

Remove or Disconnect

1. Retainers (7) attaching insulator (26) to carrier (75).
2. Insulator (26) from tape (24) that is attached to carrier (75).

Install or Connect

1. Insulator (26) to tape (24) that is attached to carrier (75).
2. Retainers (7) attaching insulator (26) to carrier (75).

INSTRUMENT PANEL SWITCHES

Headlamp and Instrument Panel Lamp Dimmer Switch Assembly

Chevrolet

Figure 21

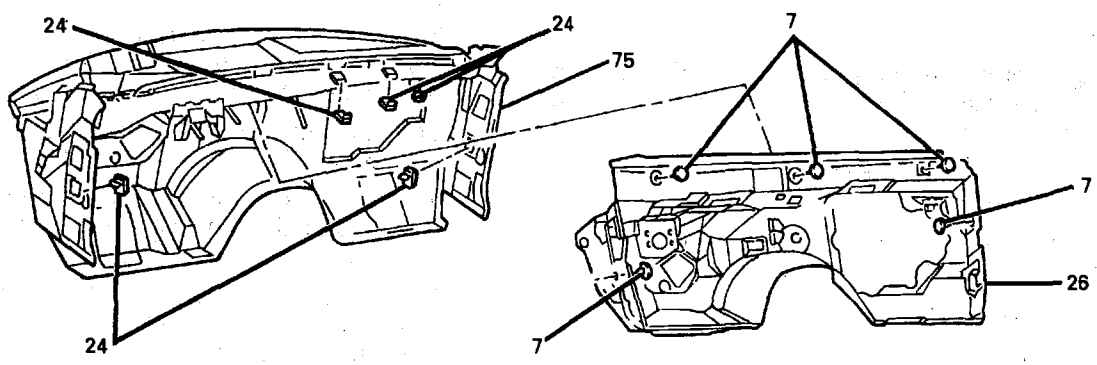
Remove or Disconnect

1. Switch assembly (83) from bezel assembly (5).
2. Instrument panel wiring harness electrical connectors from switch assembly (83).

Install or Connect

NOTICE: When installing switch assembly, do not put pressure on switch knob or dimmer thumbwheel. Failure to follow these instructions may result in damage to the switch assembly.

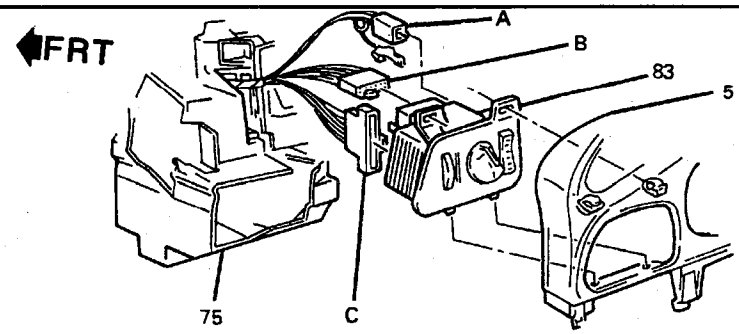
1. Switch assembly (83) to instrument panel wiring harness electrical connectors.
2. Switch assembly (83) to bezel assembly (5).



7 RETAINER, INSTRUMENT PANEL INSULATOR
24 TAPE, INSTRUMENT PANEL INSULATOR FASTENER
26 INSULATOR, INSTRUMENT PANEL
75 CARRIER, INSTRUMENT PANEL

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Figure 20 – Instrument Panel Insulator



A CONNECTOR, INSTRUMENT PANEL WIRING HARNESS FOG LAMP ELECTRICAL
B CONNECTOR, INSTRUMENT PANEL WIRING HARNESS ELECTRICAL
C CONNECTOR, INSTRUMENT PANEL WIRING HARNESS DIMMER SWITCH ELECTRICAL
5 BEZEL ASSEMBLY, INSTRUMENT PANEL CLUSTER TRIM PLATE
75 CARRIER, INSTRUMENT PANEL
83 SWITCH ASSEMBLY, HEADLAMP AND INSTRUMENT PANEL LAMP DIMMER

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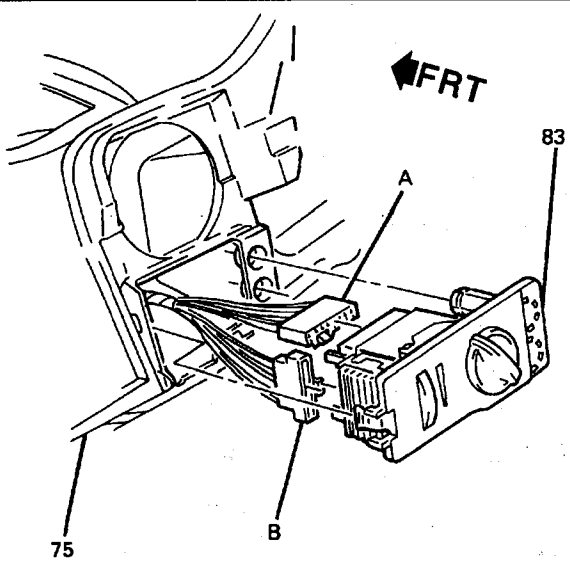
Figure 21 – Headlamp and Instrument Panel Lamp Dimmer Switch Assembly – (Chevrolet)

Pontiac

Figure 22

Remove or Disconnect

1. Switch assembly (83) from carrier (75).
2. Instrument panel wiring harness electrical connectors from switch assembly (83).



A CONNECTOR, INSTRUMENT PANEL WIRING HARNESS ELECTRICAL
B CONNECTOR, INSTRUMENT PANEL WIRING HARNESS ELECTRICAL
75 CARRIER, INSTRUMENT PANEL
83 SWITCH ASSEMBLY, HEADLAMP AND INSTRUMENT PANEL LAMP DIMMER

5-06-94
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Figure 22 – Headlamp and Instrument Panel Lamp Dimmer Switch Assembly – (Pontiac)

Install or Connect

NOTICE: When installing switch assembly, do not put pressure on switch knob or dimmer thumbwheel. Failure to follow these instructions may result in damage to the switch assembly.

1. Switch assembly (83) to instrument panel wiring harness electrical connectors.
2. Switch assembly (83) to carrier (75).

Lid Release Switch Assembly

Chevrolet

Figure 23

Remove or Disconnect

1. Switch assembly (31) from instrument panel carrier (75) inside instrument panel compartment door.
2. Instrument panel wiring harness electrical connector from switch assembly (31).

Install or Connect

1. Instrument panel wiring harness electrical connector to switch assembly (31).
2. Switch assembly (31) to instrument panel carrier (75) inside instrument panel compartment door.

Pontiac

Figure 24

Remove or Disconnect

1. Driver knee bolster assembly. Refer to "Driver Knee Bolster Assembly and Deflector" in this section.
2. Switch assembly (31) from instrument panel wiring harness electrical connector.

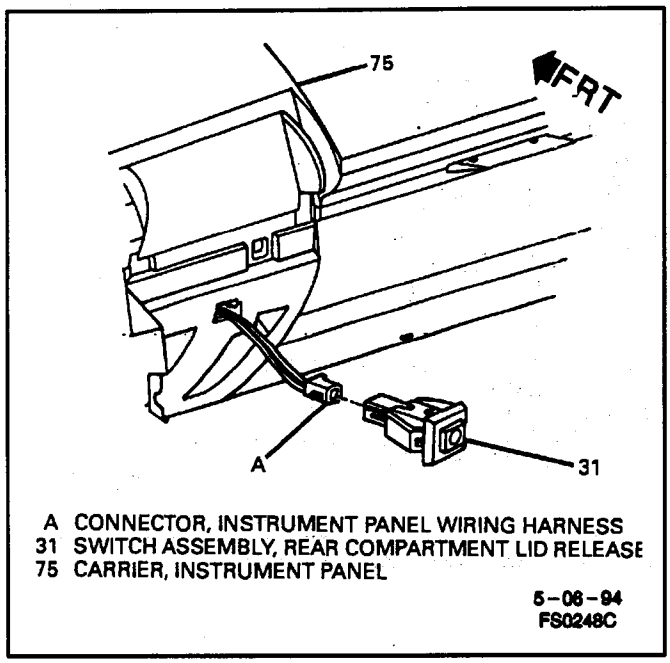


Figure 23 – Lid Release Switch Assembly – (Chevrolet)

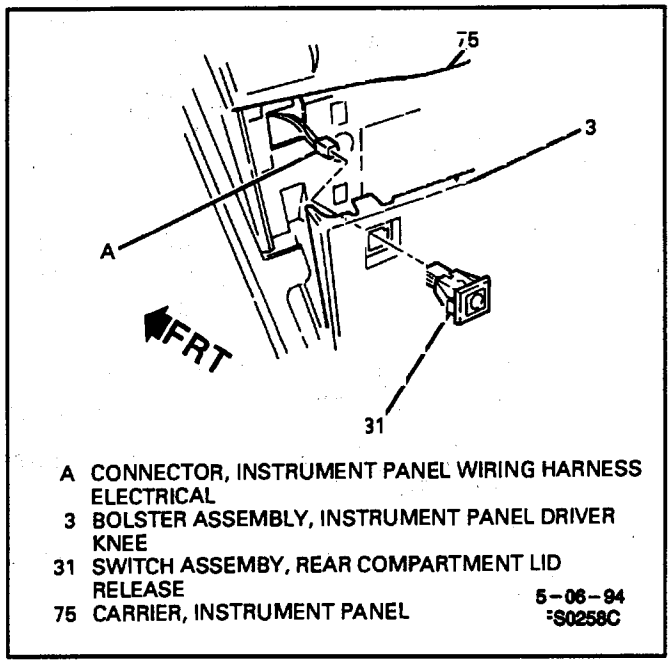


Figure 24 – Lid Release Switch Assembly – (Pontiac)

3. Switch assembly (31) from bolster assembly (3).

Install or Connect

1. Switch assembly (31) to bolster assembly (3).
2. Switch assembly (31) to instrument panel wiring harness electrical connector.
3. Driver knee bolster assembly. Refer to "Driver Knee Bolster Assembly and Deflector" in this section.

INSTRUMENT PANEL WIRING HARNESS ASSEMBLY

Refer to Figures 25 and 26 for instrument panel wiring harness assembly routing.

Auxiliary Fuse Block

Figure 27

Remove or Disconnect

1. Bolt/screw (86) connecting auxiliary fuse block to carrier (75).
2. Auxiliary fuse block.

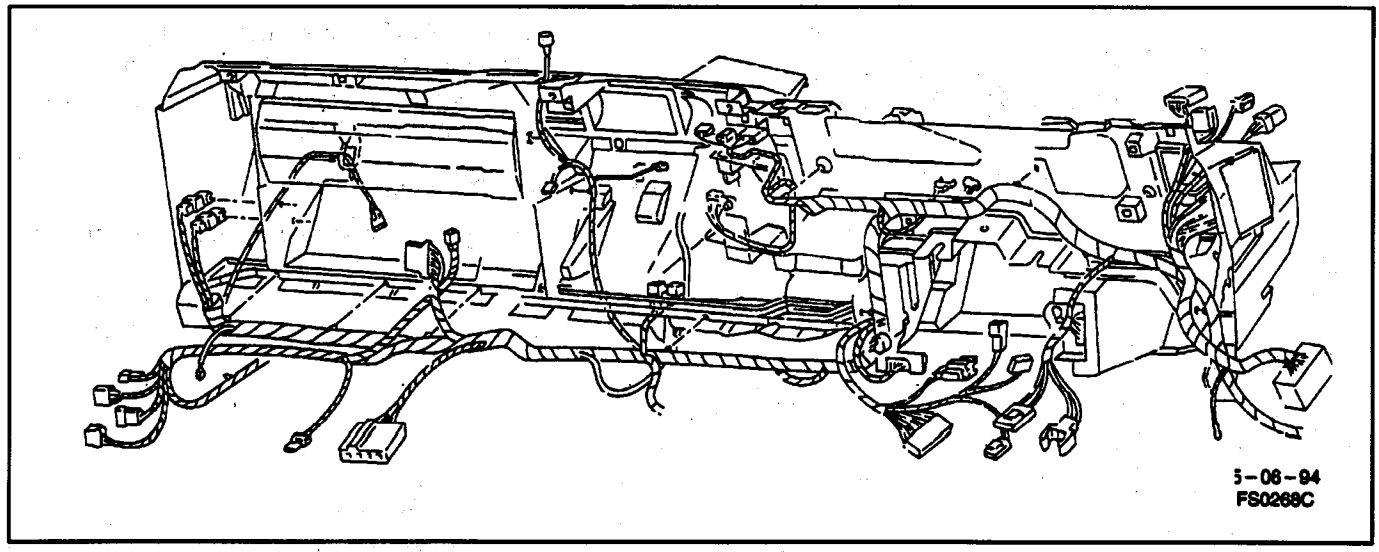


Figure 25 – Instrument Panel Wiring Harness Routing – (Chevrolet)

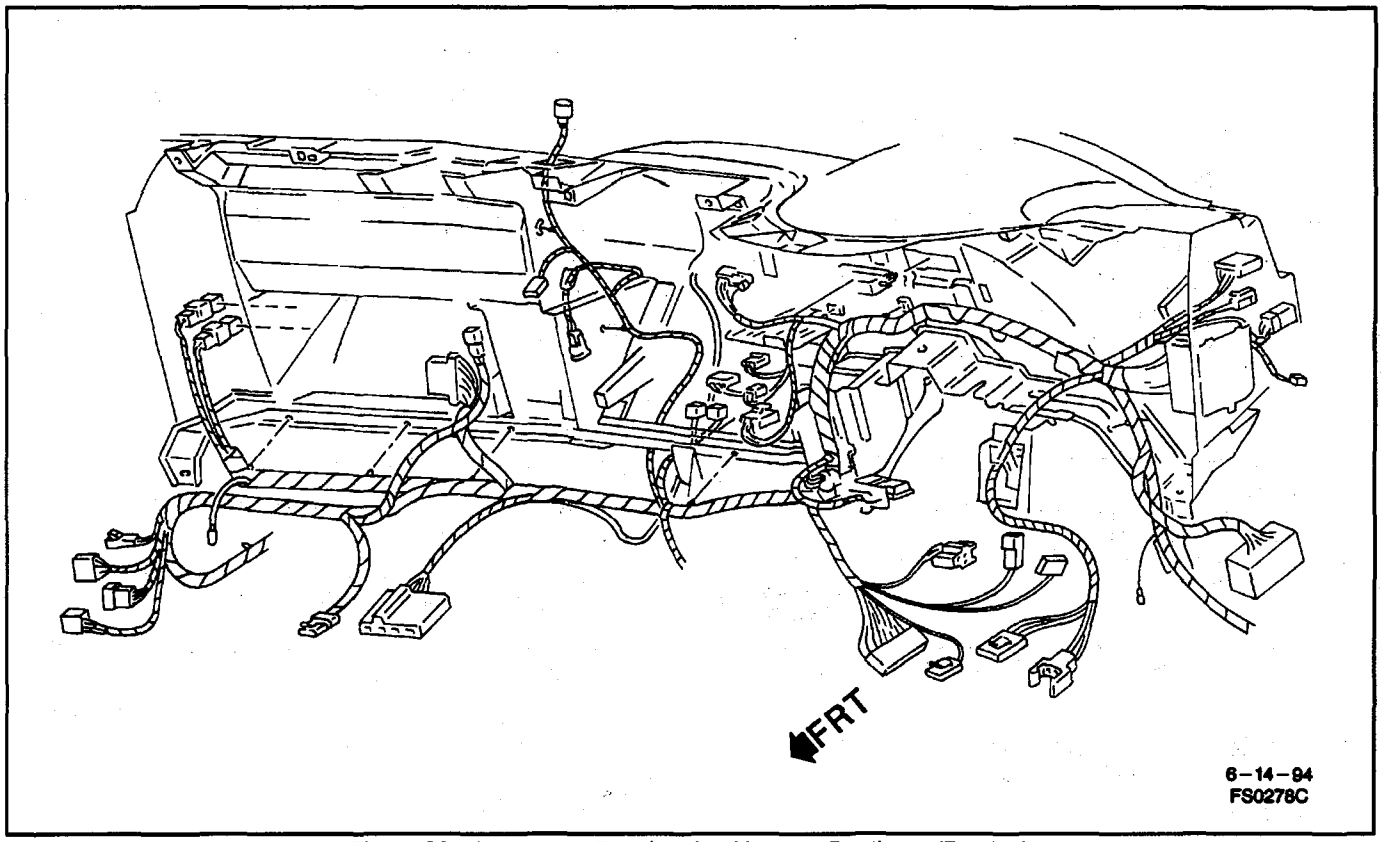


Figure 26 – Instrument Panel Wiring Harness Routing – (Pontiac)

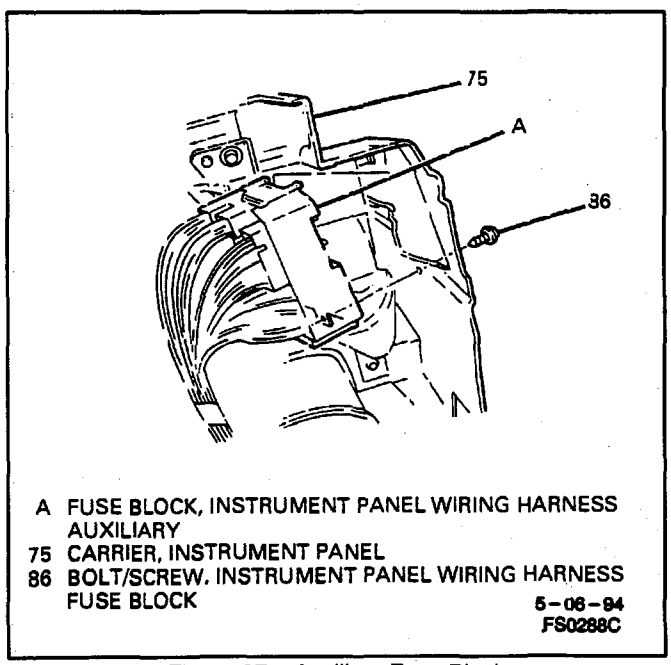


Figure 27 – Auxiliary Fuse Block

Install or Connect

NOTICE: See "Notice" on page 8C-1 of this section.

1. Auxiliary fuse block to carrier (75).
2. Bolt/screw (86).

Tighten

- Bolt/screw (86) to 1.5 N•m (13 lb. in.).

Convenience Center

Figure 28

Remove or Disconnect

1. Bolts/screws (87) attaching convenience center to tie bar assembly (25).
2. Convenience center.

Install or Connect

NOTICE: See "Notice" on page 8C-1 of this section.

1. Convenience center to tie bar assembly (25).
2. Bolts/screws (87).

Tighten

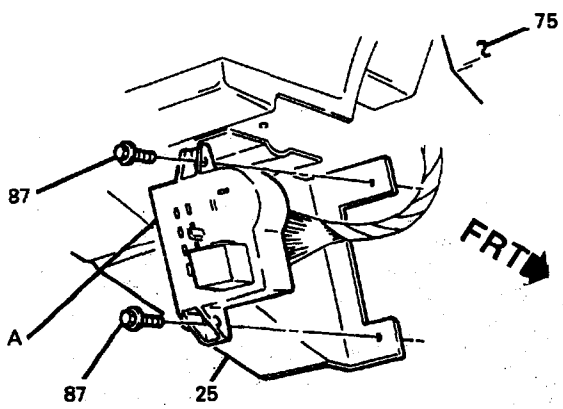
- Bolts/screws (87) to 1.9 N•m (17 lb. in.).

EXPRESS DOWN MODULE

Figure 29

Remove or Disconnect

CAUTION: See "Caution" on page 8C-1 of this section.



A CONVENIENCE CENTER, INSTRUMENT PANEL WIRING HARNESS
25 BAR ASSEMBLY, INSTRUMENT PANEL TIE
75 CARRIER, INSTRUMENT PANEL
87 BOLT/SCREW, INSTRUMENT PANEL WIRING HARNESS CONVENIENCE CENTER

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Figure 28 – Convenience Center

1. Left side sound insulator panel. Refer to "Sound Insulator Assembly" in this section.
2. Express down module.
3. Wiring harness electrical connector from express down module.

Install or Connect

1. Wiring harness electrical connector to express down module.
2. Express down module.
3. Left side sound insulator panel Refer to "Sound Insulator Assembly" in this section.

RETAINED ACCESSORY POWER (RAP) MODULE

Figure 29

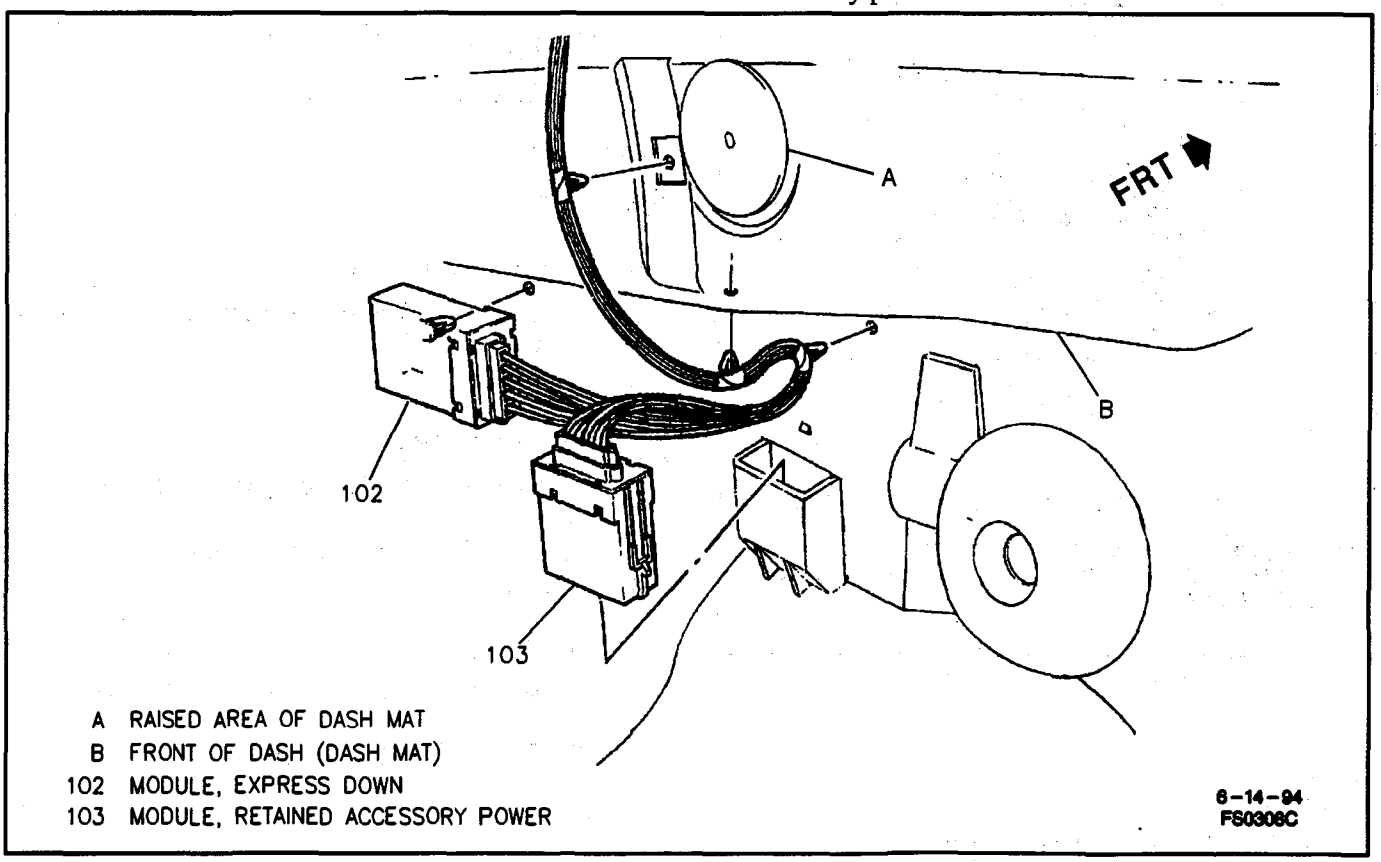
Remove or Disconnect

CAUTION: See "Caution" on page 8C-1 of this section.

1. Left side sound insulator panel. Refer to "Sound Insulator Assembly" in this section.
2. Retained accessory power module from pocket molded in dash mat.
3. Wiring harness electrical connector from retained accessory power module.

Install or Connect

1. Wiring harness electrical connector to retained accessory power module.



A RAISED AREA OF DASH MAT
B FRONT OF DASH (DASH MAT)
102 MODULE, EXPRESS DOWN
103 MODULE, RETAINED ACCESSORY POWER

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Figure 29 – Express Down and Retained Accessory Power (RAP) Modules

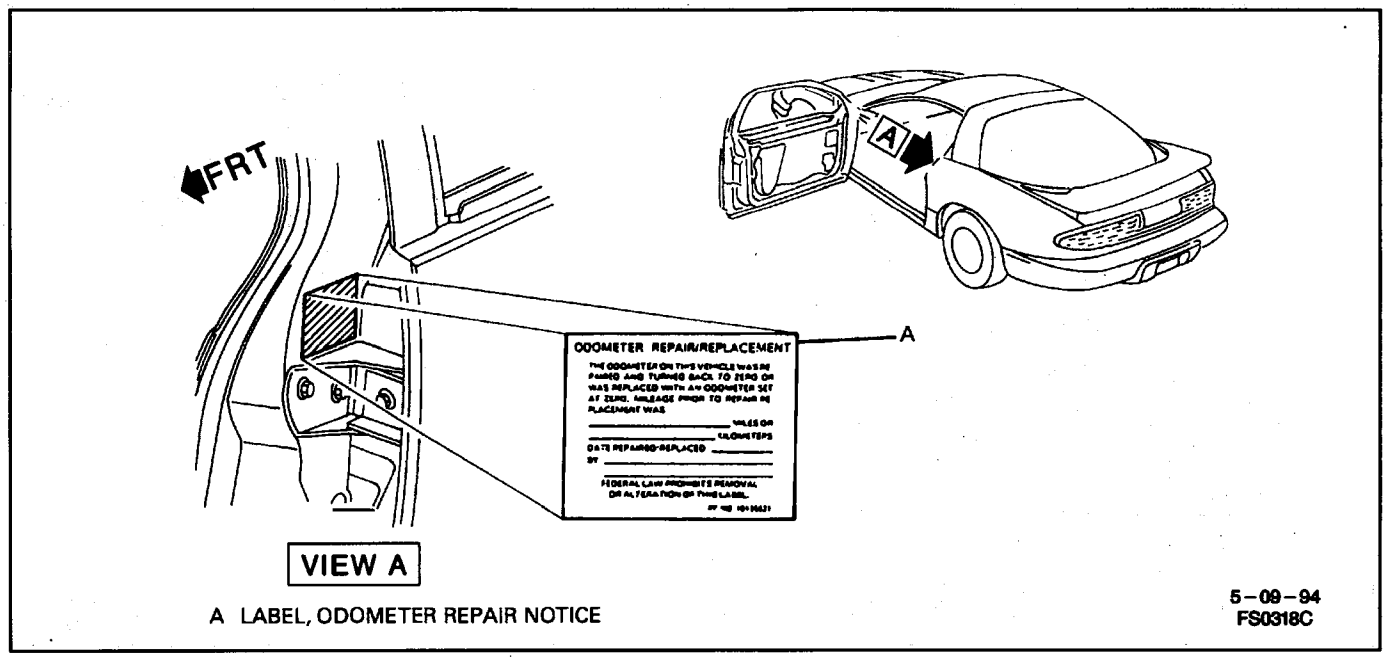


Figure 30 – Odometer Repair Notice Label

2. Retained accessory power module to pocket molded in dash mat.
3. Left side sound insulator panel. Refer to "Sound Insulator Assembly" in this section.

ODOMETER REPAIR NOTICE LABEL

Figure 30

Important

- When repairing an instrument cluster assembly, the law requires the odometer reading of the replacement unit to be set to register the same mileage as the prior odometer. If the same mileage cannot be set, the law requires that the replacement odometer be set to zero and a label be installed on the driver's door frame to show the previous reading and the date of replacement.
- A copy of the label must be retained in compliance with the retention requirements specified in the "Guidelines for General Motors Odometer Policy."

Install or Connect

1. Clean area around left B-pillar where odometer repair notice label is to be attached.
   - Label area is to be clean and free from plastisol or any foreign material that could affect adhesion of odometer repair notice label.
2. Properly fill out all necessary information on odometer repair notice label.
   - Sign and date odometer repair notice label.
3. Remove backing and attach odometer repair notice label to left B-pillar.

SOUND INSULATOR ASSEMBLY

Figure 31

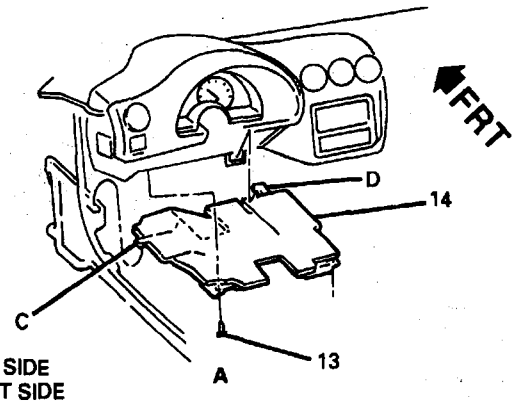
Left Side

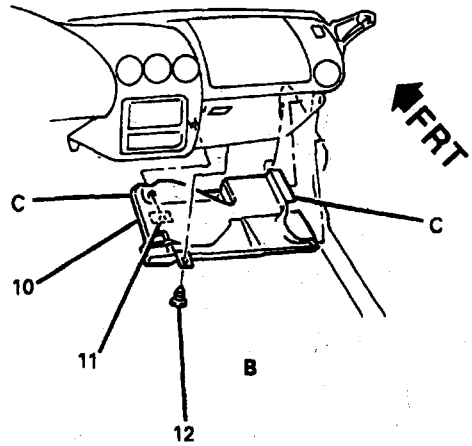
Remove or Disconnect

1. Retainer (13) from instrument panel carrier.
2. Insulator assembly (14) from instrument panel carrier.
   A. Unhook flange on insulator assembly (14) from side kick panel assembly.
   B. Detach tab on insulator assembly (14) from retainer on instrument panel carrier.

Install or Connect

1. Insulator assembly (14) to instrument panel carrier.
   A. Attach tab on insulator assembly (14) to retainer on instrument panel carrier.
   B. Hook flange on insulator assembly (14) to side kick panel assembly.
2. Retainer (13) to instrument panel carrier.

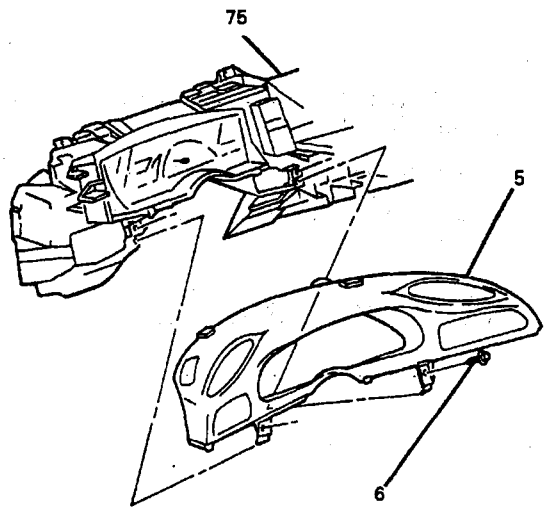




A LEFT SIDE
B RIGHT SIDE
C FLANGE
D TAB
10 INSULATOR ASSEMBLY, INSTRUMENT PANEL SOUND
11 RETAINER, INSTRUMENT PANEL SOUND INSULATOR
12 RETAINER, INSTRUMENT PANEL SOUND INSULATOR
13 RETAINER, INSTRUMENT PANEL SOUND INSULATOR
14 INSULATOR ASSEMBLY, INSTRUMENT PANEL SOUND

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Figure 31 – Sound Insulator Assembly (Typical)



5 BEZEL, INSTRUMENT PANEL CLUSTER TRIM PLATE
6 BOLT/SCREW, INSTRUMENT PANEL CLUSTER TRIM PLATE,
75 CARRIER, INSTRUMENT PANEL

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Figure 32 – Instrument Panel Cluster Trim Plate Bezel Assembly – (Chevrolet)

Right Side

Remove or Disconnect

1. Retainer (11) from boss on heater and air conditioning module assembly.
2. Retainer (12) from insulator assembly (10).
3. Insulator assembly (10) from instrument panel carrier.
   A. Detach forward flange on insulator assembly (10) from boss on heater and air conditioning module assembly.
   B. Unhook flange on insulator assembly (10) from under side kick panel assembly.

Install or Connect

1. Insulator assembly (10) to instrument panel carrier.
   A. Hook flange on insulator assembly (10) over side kick panel assembly.
   B. Attach forward flange on insulator assembly (10) to boss on heater and air conditioning module assembly.
2. Retainer (12) to insulator assembly (10).
3. Retainer (11) to boss on heater and air conditioning module assembly.

TRIM PANEL CLUSTER BEZEL ASSEMBLY, UPPER TRIM PANEL ASSEMBLY AND COMPARTMENTS

Instrument Panel Cluster Trim Plate Bezel Assembly

Chevrolet

Figure 32

Remove or Disconnect

1. Four bolts/screws (6) attaching bezel assembly (5) to carrier (75).
2. Bezel assembly (5) from carrier (75).

Install or Connect

NOTICE: See "Notice" on page 8C-1 of this section.

1. Bezel assembly (5) onto carrier (75).
   A. Position bezel assembly (5) over instrument cluster assembly.
   B. Align holes on bezel assembly (5) with holes on carrier (75).
2. Four bolts/screws (6) attaching bezel assembly (5) to carrier (75).

Tighten

- Bolts/screws (6) to 2.8 N•m (25 lb. in.).

Pontiac

Figure 33

Remove or Disconnect

1. Locator pins attaching bezel assembly (5) to carrier (75).
2. Bezel assembly (5) from carrier (75).

Install or Connect

1. Bezel assembly (5) onto carrier (75).
2. Locator pins attaching bezel assembly (5) to carrier (75).

Instrument Panel Compartment

The instrument panel compartment is part of the instrument panel carrier. The door, lock assembly and lamp are serviceable. The lamp switch is part of the body wiring harness assembly. For further information, refer to SECTION 8B.

Instrument Panel Compartment Door Assembly

Figure 34

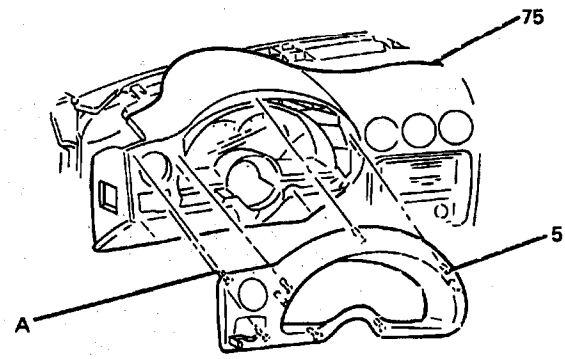
Remove or Disconnect

1. Bolts/screws (20 and 90) attaching hinge to instrument panel carrier.
2. Open door assembly (89).
3. Door assembly (89) from instrument panel carrier.

Install or Connect

NOTICE: See "Notice" on page 8C-1 of this section.

1. Door assembly (89) onto instrument panel carrier.
2. Close door assembly (89).
3. Bolts/screws (20 and 90) attaching hinge to instrument panel carrier.
   - Align hinge.



A PIN, LOCATOR
5 BEZEL ASSEMBLY, INSTRUMENT PANEL CLUSTER TRIM PLATE
75 CARRIER, INSTRUMENT PANEL

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Figure 33 – Instrument Panel Cluster Trim Plate Bezel Assembly – (Pontiac)

Tighten

- Bolts/screws (20 and 90) to 2.8 N•m (25 lb. in.).

Instrument Panel Compartment Door Lock Assembly

Figure 34

Remove or Disconnect

1. Open door assembly (89).
2. Three bolts/screws (92) attaching lock assembly (91) to door assembly (89).
3. Lock assembly (91) from door assembly (89).

Install or Connect

1. Lock assembly (91) to door assembly (89).
2. Three bolts/screws (92) attaching lock assembly (91) to door assembly (89).
   - Align and tighten bolts/screws (92).
3. Close door assembly (89).

Instrument Panel Compartment Door Lock Cylinder Assembly

Figure 34

Remove or Disconnect

1. Door lock assembly. Refer to "Instrument Panel Compartment Door Lock Assembly" in this section.
2. Insert key in lock cylinder (101) and rotate to locked position.
3. Remove key from lock cylinder (101).

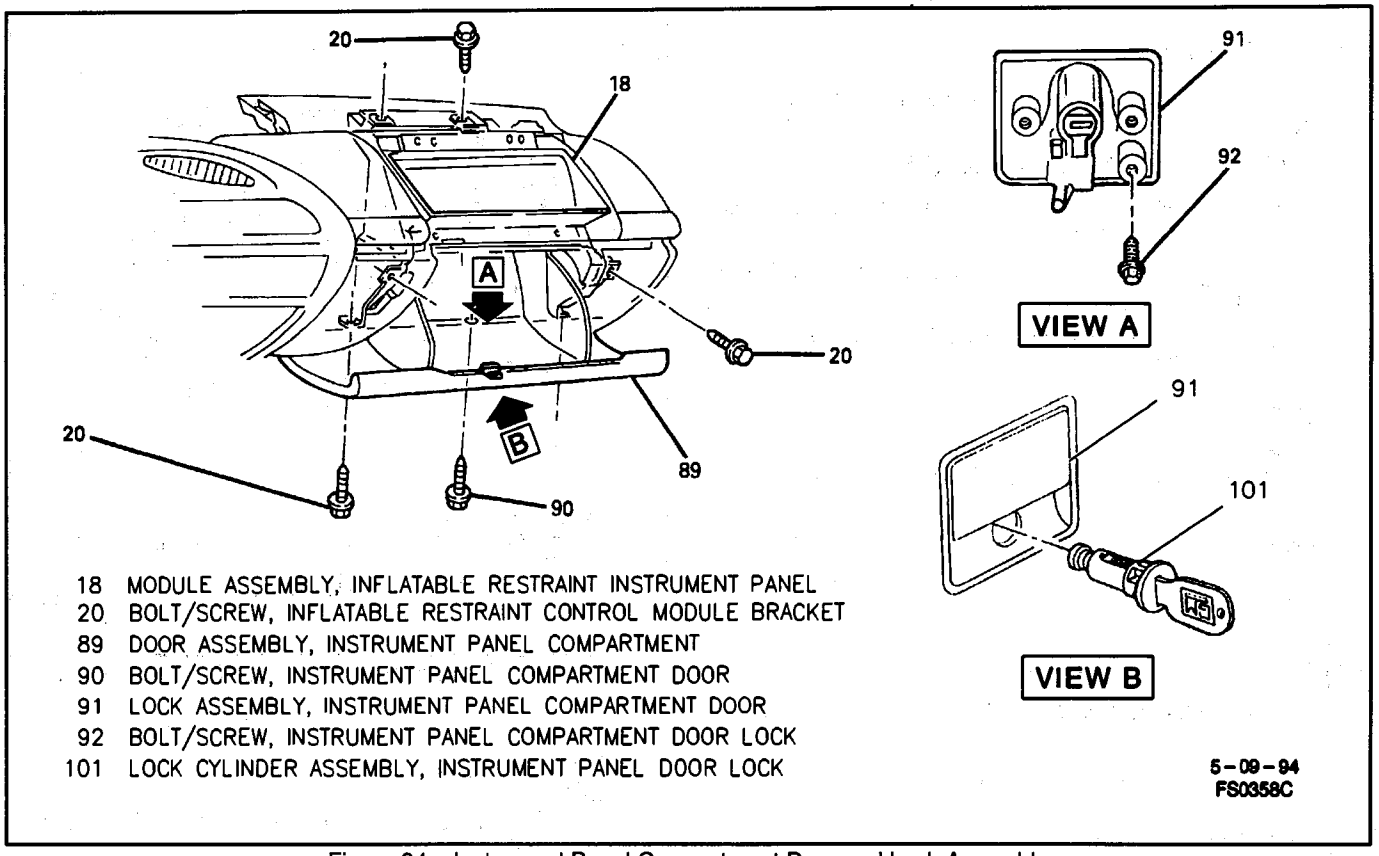


Figure 34 – Instrument Panel Compartment Door and Lock Assembly

4. Depress silver key tumbler using small bladed screwdriver.
5. Reinsert key into lock cylinder (101) while depressing key tumbler.
6. Rotate the cylinder clockwise and remove lock cylinder (101) and key.

Install or Connect

1. Depress silver key tumbler and insert key into the lock cylinder (101).
2. Lock cylinder assembly (101) and key into the lock assembly.

Important

- The lock handle must be opened to allow for installation.

3. Relock the lock (rotor) and rotate the key to the unlock position.
4. Remove key from the lock cylinder (101).
5. Door lock assembly. Refer to "Instrument Panel Compartment Door Lock Assembly" in this section.

Instrument Panel Compartment Lamp Switch

Figure 35

Remove or Disconnect

1. Switch (96) and retainer (95) from carrier (75).
2. Retainer (95) from switch (96).

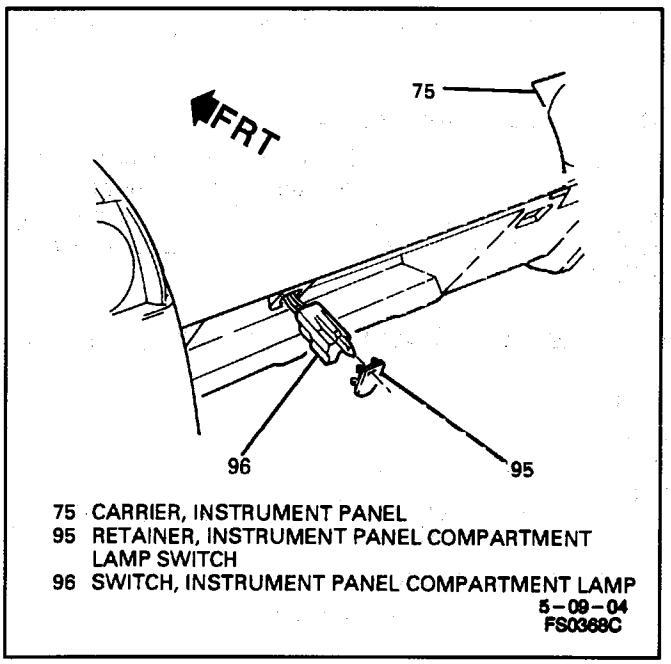
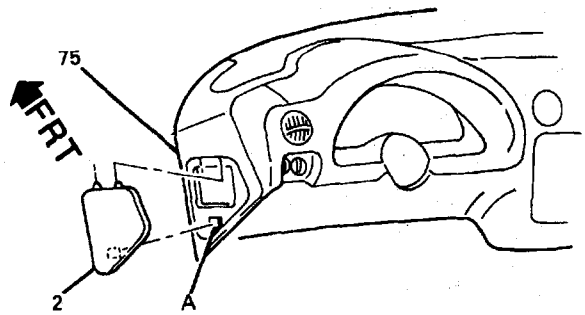


Figure 35 – Instrument Panel Compartment Lamp Switch (Typical)

Install or Connect

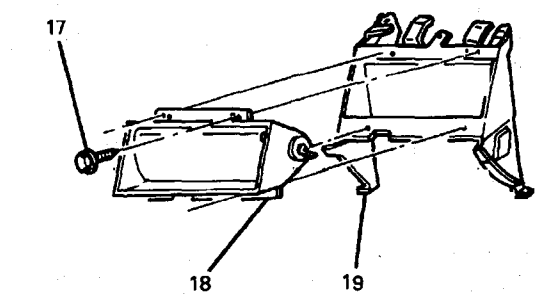
1. Retainer (95) to switch (96).
2. Switch (96) and retainer (95) down through opening in carrier (75).
   - Be sure retainer (95) is seated into carrier (75).



A LOCK ASSEMBLY, DUAL
2 DOOR ASSEMBLY, INSTRUMENT PANEL FUSE BLOCK ACCESS
75 CARRIER, INSTRUMENT PANEL

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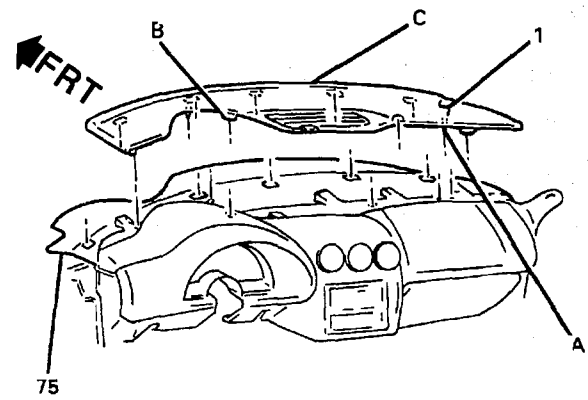
Figure 36 – Instrument Panel Fuse Block Access Door Assembly (Typical)



17 BOLT/SCREW, INFLATABLE RESTRAINT INSTRUMENT PANEL MODULE
18 MODULE ASSEMBLY, INFLATABLE RESTRAINT INSTRUMENT PANEL
19 BRACKET ASSEMBLY, INFLATABLE RESTRAINT INSTRUMENT PANEL MODULE

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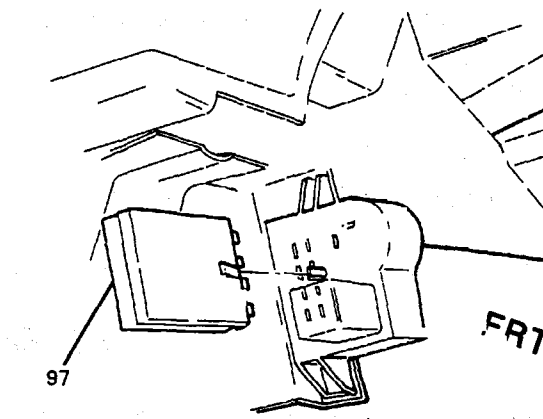
Figure 38 – Passenger Side Inflator Module Assembly



A PIN, LOCATOR
B FASTENER, DUAL LOCK
C SUPPORT, LOWER WINDSHIELD
1 PANEL ASSEMBLY, INSTRUMENT PANEL UPPER TRIM
75 CARRIER, INSTRUMENT PANEL

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Figure 37 – Instrument Panel Upper Trim Panel Assembly (Typical)



A CONVENIENCE CENTER, INSTRUMENT PANEL WIRING HARNESS
75 CARRIER, INSTRUMENT PANEL
97 ALARM ASSEMBLY, SEAT BELT AND IGNITION KEY

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Figure 39 – Seat Belt and Ignition Key and Alarm Assembly

Instrument Panel Fuse Block Access Door Assembly

Figure 36

Remove or Disconnect

- Door assembly (2) from carrier (75).

Install or Connect

- Door assembly (2) to carrier (75).
  - A. Align tabs on door assembly (2) with front edge of carrier (75).
  - B. Align locator pins on door assembly (2) with holes on carrier (75) and apply pressure.

Instrument Panel Upper Trim Panel Assembly

Figure 37

Remove or Disconnect

1. Panel assembly (1) from lower windshield support.
2. Panel assembly (1) from carrier (75).

Install or Connect

1. Panel assembly (1) to carrier (75).
   - A. Align panel assembly (1), using locator pins.
   - B. Apply pressure to rear of panel assembly (1), engaging dual lock fasteners with mating surface.

2. Panel assembly (1) to lower windshield support.
   - Engage dual lock fasteners with mating surface.

PASSENGER SIDE INFLATOR MODULE ASSEMBLY

Figures 34 and 38

CAUTION: See "Caution" on page 8C-1 of this section.

Remove or Disconnect

1. Disable SIR system. Refer to "Disabling the SIR System" in this section.
2. Bolts/screws (20) attaching bracket assembly (19) to instrument panel carrier.
3. Bracket assembly (19) from instrument panel carrier.
4. Bolts/screws (17) attaching module assembly (18) to bracket assembly (19).
5. Module assembly (18).

Install or Connect

NOTICE: See "Notice" on page 8C-1 of this section.

1. Module assembly (18) into bracket assembly (19).
2. Bolts/screws (17) attaching module assembly (18) to bracket assembly (19).

Tighten

- Bolts/screws (17) to 3.2 N•m (28 lb. in.).

3. Bracket assembly (19) to instrument panel carrier.
4. Bolts/screws (20) attaching bracket assembly (19) to instrument panel carrier.

Tighten

- Bolts/screws (20) to 3.2 N•m (28 lb. in.).

5. Enable the SIR system. Refer to "Enabling the SIR System" in this section.

WARNING/REMINDER CHIMES

Alarm Assembly

Figure 39

Remove or Disconnect

- Alarm assembly (97) from convenience center.

Install or Connect

- Alarm assembly (97) to convenience center.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Air Distributor Duct Bolt/Screw	1.9 N•m (17 lb. in.)
Floor Air Outlet Duct Bolt/Screw	1.9 N•m (17 lb. in.)
Front Floor Console Bolt/Screw	8 N•m (71 lb. in.)
Front Floor Console Bracket Bolt/Screw	8 N•m (71 lb. in.)
Heater and Air Conditioning Control Bolt/Screw	1.9 N•m (17 lb. in.)
Heater and Air Conditioning Evaporator and Blower Module Bolt/Screw	10 N•m (89 lb. in.)
Inflatable Restraint Control Module Bracket Bolt/Screw	3.2 N•m (28 lb. in.)
Inflatable Restraint Instrument Panel Module Bolt/Screw	3.2 N•m (28 lb. in.)
Instrument Cluster Bolt/Screw	2.2 N•m (20 lb. in.)
Instrument Panel Bolt/Screw (Upper)	1.9 N•m (17 lb. in.)
Instrument Panel Bolt/Screw (Lower)	5.5 N•m (49 lb. in.)
Instrument Panel Accessory Trim Plate Bolt/Screw	1.9 N•m (17 lb. in.)
Instrument Panel Center Air Outlet Duct Bolt/Screw	1.9 N•m (17 lb. in.)
Instrument Panel Cluster Trim Plate Bolt/Screw	2.8 N•m (25 lb. in.)
Instrument Panel Compartment Door Bolt/Screw	2.8 N•m (25 lb. in.)
Instrument Panel Driver Knee Bolster Deflector Nut	1.9 N•m (17 lb. in.)
Instrument Panel Driver Knee Bolster Bolt/Screw	1.9 N•m (17 lb. in.)
Instrument Panel Nut	25 N•m (18 lb. ft.)
Instrument Panel Outer Air Outlet Bolt/Screw	1.9 N•m (17 lb. in.)
Instrument Panel Wiring Harness Convenience Center Bolt/Screw	1.9 N•m (17 lb. in.)
Instrument Panel Wiring Harness Engine Control Module Data Link Connector Bolt/Screw	1.5 N•m (13 lb. in.)
Instrument Panel Wiring Harness Fuse Block Bolt/Screw	1.5 N•m (13 lb. in.)
Radio Bracket Bolt/Screw	1.8 N•m (16 lb. in.)
Radio Bracket Nut	2.8 N•m (25 lb. in.)
Rear Radio Bracket Bolt/Screw	1.9 N•m (17 lb. in.)

SECTION 8E

WINDSHIELD WIPER/WASHER SYSTEM

NOTICE: Refer to Battery Disconnect Caution in Section 0A.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

Figure 1

The windshield wiper/washer system consists of a permanent magnet depressed park wiper motor assembly, wiper linkage assemblies, wiper arm and blade assemblies, a washer pump mounted on a washer fluid reservoir and a wiper/washer switch assembly (Figure 1).

Pulse and timing functions, along with the demand wash function, are controlled by a printed circuit board in the wiper motor cover assembly. The wiper motor also is equipped with RFI (radio frequency interference) suppression.

Depressed park positioning is accomplished by an external drive mechanism on the wiper motor assembly.

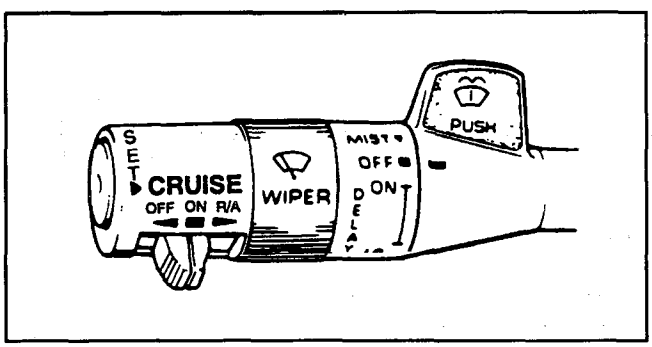


Figure 1 — Wiper/Washer Switch Assembly

CIRCUIT OPERATION

Figure 2

Wiper Operation

In addition to the features of a conventional (non-pulse) wiper system (mist, low and high speeds), the pulse type windshield wiper/washer system includes an operating mode in which the wipers make single sweeps with an adjustable time interval between sweeps. The time interval is controlled by a solid state timer in the wiper motor cover assembly. The duration of the delay interval is determined by the delay resistor in the wiper/washer switch assembly.

When the wiper switch is turned OFF, the wiper motor returns the wipers to end of sweep (inner wipe) position, the wiper motor reverses and activates its external depressed park mechanism to lower the wipers to park position.

Pulse Operation

With the wiper switch in DELAY (pulse), battery voltage is applied to the wiper motor connector at terminal "B" through CKT 143. Voltage also is applied to terminal "D" through CKT 113 and terminal "E" through CKT 112.

The length of delay time between sweeps is controlled by the variable pulse delay resistor. The delay is adjustable from 1 to 22 seconds, nominally.

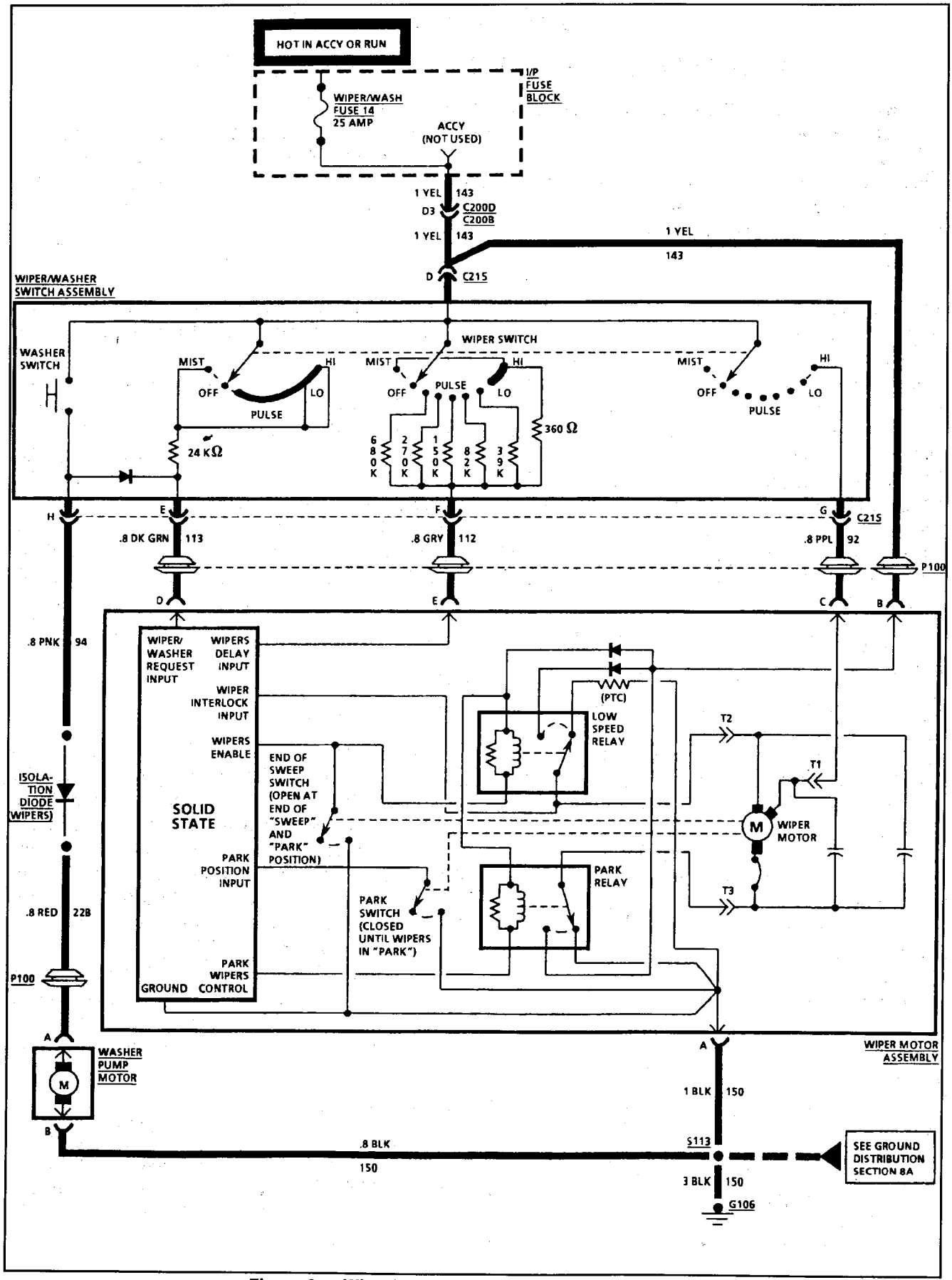


Figure 2 — Wiper/Washer System Electrical Schematic

Low Speed Operation

In the "LO" position of the wiper switch, battery voltage is applied to the wiper motor connector at terminal "B" through CKT 143 and terminal "E" through CKT 112, with voltage applied to terminal "D" through CKT 113.

High Speed Operation

In the "HI" position of the wiper switch, battery voltage is applied at terminals "B", "C" and "E" of the wiper motor assembly through CKTs 143, 92 and 112. Voltage also is applied to terminal "D" through CKT 113.

Park Position Operation

When turned "OFF" from any position, the wipers complete the last sweep and park. When the wiper switch is in "OFF", the wiper motor assembly has battery voltage applied to terminal "B" only, from CKT 143. When the end of sweep switch opens, the control circuit reverses the wiper motor which activates the external depressed park mechanism. The wiper motor continues to run until the park switch opens.

Washer Operation

When the switch is turned to "ON", battery voltage is applied to terminal "D" of the wiper motor assembly through CKT 113. The washer switch also applies voltage to terminal "A" which turns "ON" the washer pump through CKTs 94 and 228. The wiper motor has voltage applied through the low speed relay and operates at low speed for 2 to 4 wipes.

When the washer switch is held "ON", the wiper motor circuit board will keep the washer pump "ON" only as long as the washer switch is held "ON".

If the wipers had been in "DELAY", "LO" or "HI", they would return to that operation after the wash cycle. If in "OFF", they then return to park position after 2 to 4 wipes.

Mist Operation

When the wiper switch is turned to "MIST" and released, the wipers make one sweep at low speed and return to park position. If the wiper switch is held in "MIST", the wipers will continue to operate until the switch is released. The circuit operation is the same as that of "LO."

DIAGNOSIS

COMPONENT LOCATIONS

- Refer to Figure 4 for a list of component locations.

TROUBLESHOOTING HINTS

Figure 2

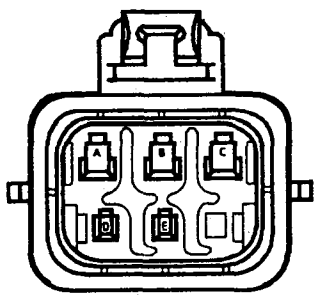
- Make the following checks before beginning System Diagnosis.

1. Check wiper fuse 14. If open, check for short to ground through CKT 143 and replace fuse.
2. Check that all system electrical connectors are mated correctly.
3. If washer does not operate, check that:
   —Washer reservoir is filled.
   —Hoses are correctly attached.
   —Hoses are not cut, pinched or kinked.
   —Nozzles are not clogged.
   —Connector seal at washer pump is not damaged or missing.
4. Check for binding or broken wiper arm linkage.

- Refer to system Diagnosis.

SYSTEM DIAGNOSIS

- Perform the System check (Figure 5), then refer to the Symptom Table (Figure 6) for the appropriate diagnostic procedures.



A BLK
B YEL
C PPL
D DK GRN
E GRY

Figure 3 — Wiper Motor Wiring Harness Connector

COMPONENT	LOCATION	SECTION 8A-201-PG	FIG.
I/P Fuse Block	LH side of I/P carrier, on the side	8	15
Isolation Diode (Wipers)	Approx. 20 cm (8 in.) from C215	35	64
Washer Pump	Front of vehicle, below engine hood latch	25	46
Wiper Motor Assembly	Rear of LH shock tower, mounted to dash panel below LH wiper mount	10	18
Wiper/Washer Switch Assembly	In left side of steering column, actuated by multi-function lever	3	5
C200B (18 cavities)	Part of forward lamp harness, between LH kick panel and steering column	25	49
C200D (48 cavities)	Part of lip harness, between LH kick panel and steering column	25	49
C215 (11 cavities)	Near base of steering column	35	64
G106	Near top LH side of radiator, in top of T-bar	19	35
P100	Left side in dash panel, engine to passenger compartment	19	36
S113	Forward lamp harness, approx. 13 cm (5 in.) from electrical center breakout		

Figure 4 — Component Locations

SYSTEM CHECK

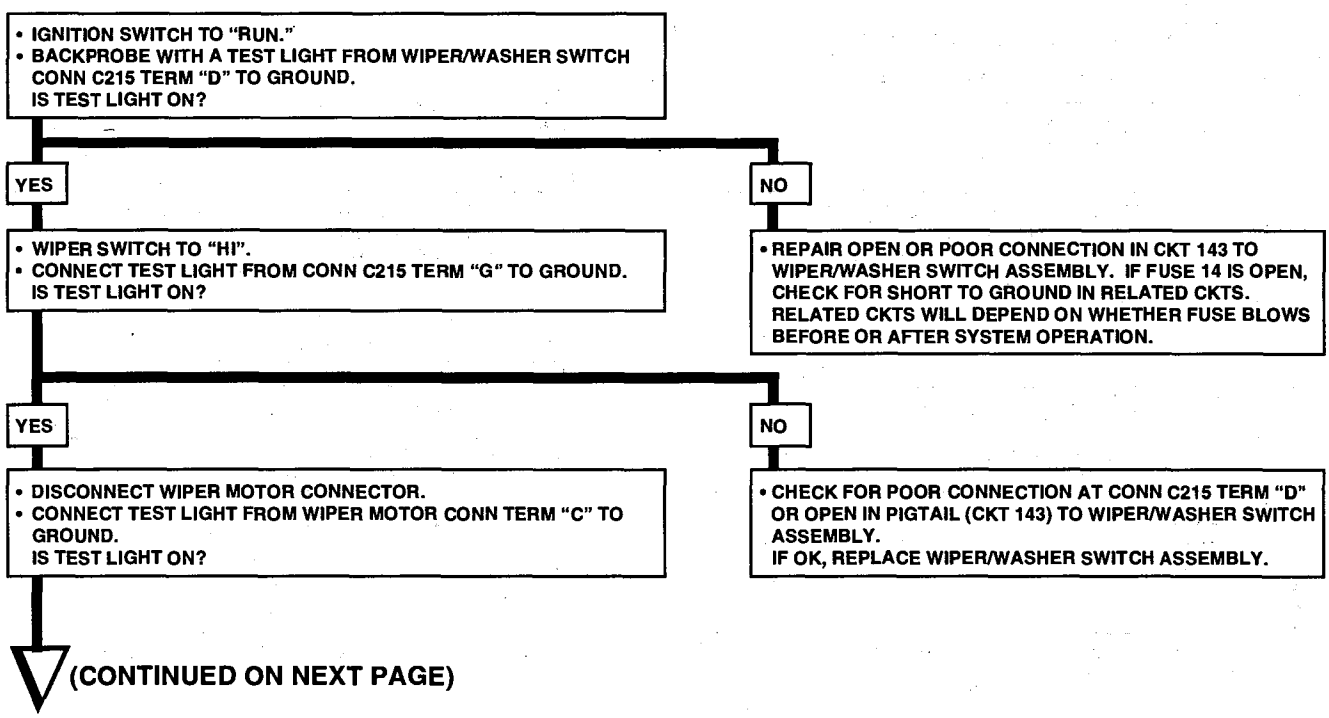
ACTION	NORMAL OPERATION
[1] • Turn ignition switch to RUN. • Press washer switch to ON.	Wipers operate at LO speed. Washer sprays windshield as long as washer switch is held in ON position. After releasing switch, washer stops and wipers return to park position after 2 to 4 sweeps.
[2] • Turn wiper switch to DELAY (pulse mode).	Wipers make one complete sweep, then pause for 1 to 22 seconds before making next sweep. The pause time is adjusted by turning the wiper switch through the delay range.
[3] • Wiper switch in DELAY. • Press washer switch ON.	Washer sprays windshield as long as washer switch is held ON. Wipers run at low speed while spraying and continue for 2 to 4 sweeps after washer switch is released. Wipers then return to pulse operation.
[4] • Turn wiper switch to LO.	Wipers run continuously at low speed.
[5] • Turn wiper switch to HI.	Wipers run continuously at faster speed.
[6] • Turn wiper switch to OFF.	Wipers return to park position at low speed.
[7] • Turn wiper switch to MIST, then release.	Wipers make one complete sweep, then return to park position.

Figure 5 — Wiper/Washer System Check

SYMPTOM	PROCEDURE	PAGE
Wipers do not operate in any mode.	Chart 1	8E-5
Wipers run when switch is "OFF."	Chart 2	8E-6
No low speed mode.	Replace wiper/washer switch assembly.	
No high speed mode.	Chart 3	8E-7
Wipers operate only when switch is in HI position, but run at low speed.	Check for open or poor connection in CKT 143 between wiper/washer switch CONN C215 TERM "D" and wiper motor CONN TERM "B". If OK, replace wiper motor assembly.	—
Low speed, pulse delay and mist modes inoperative (high speed mode OK).	Chart 4	8E-7
Pulse delay operates incorrectly or not at all.	Chart 5	8E-8
Wipers stop randomly and do not park when switch is moved to "OFF."	Chart 6	8E-8
Wipers do not operate when washer switch is activated.	Chart 7	8E-9
Washer does not operate.	Chart 8	8E-9

Figure 6 — Symptom Table

CHART 1
WIPERS DO NOT OPERATE IN ANY MODE



(CONTINUED ON NEXT PAGE)

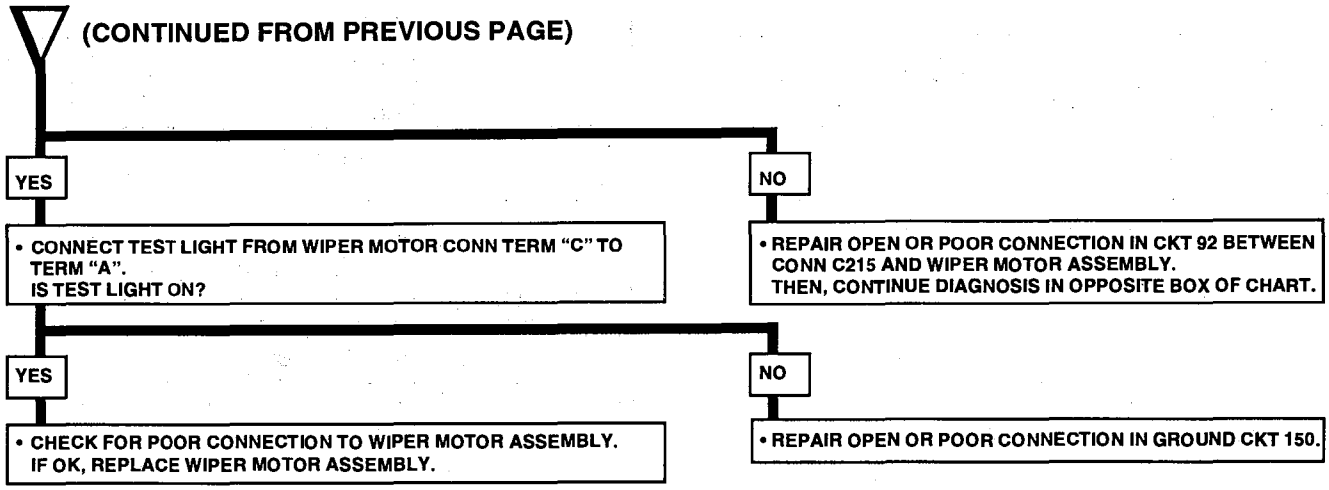


CHART 2
WIPERS RUN WHEN SWITCH IS "OFF"

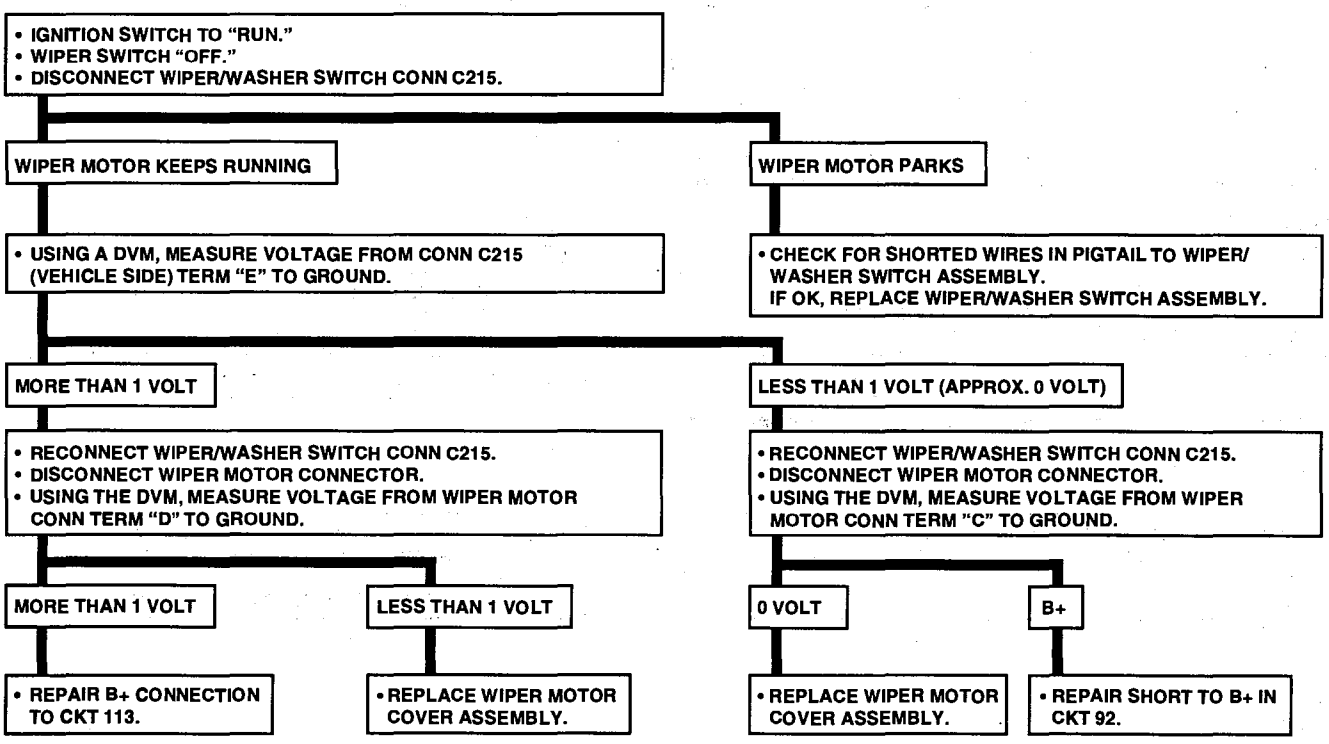


CHART 3
NO HIGH SPEED MODE

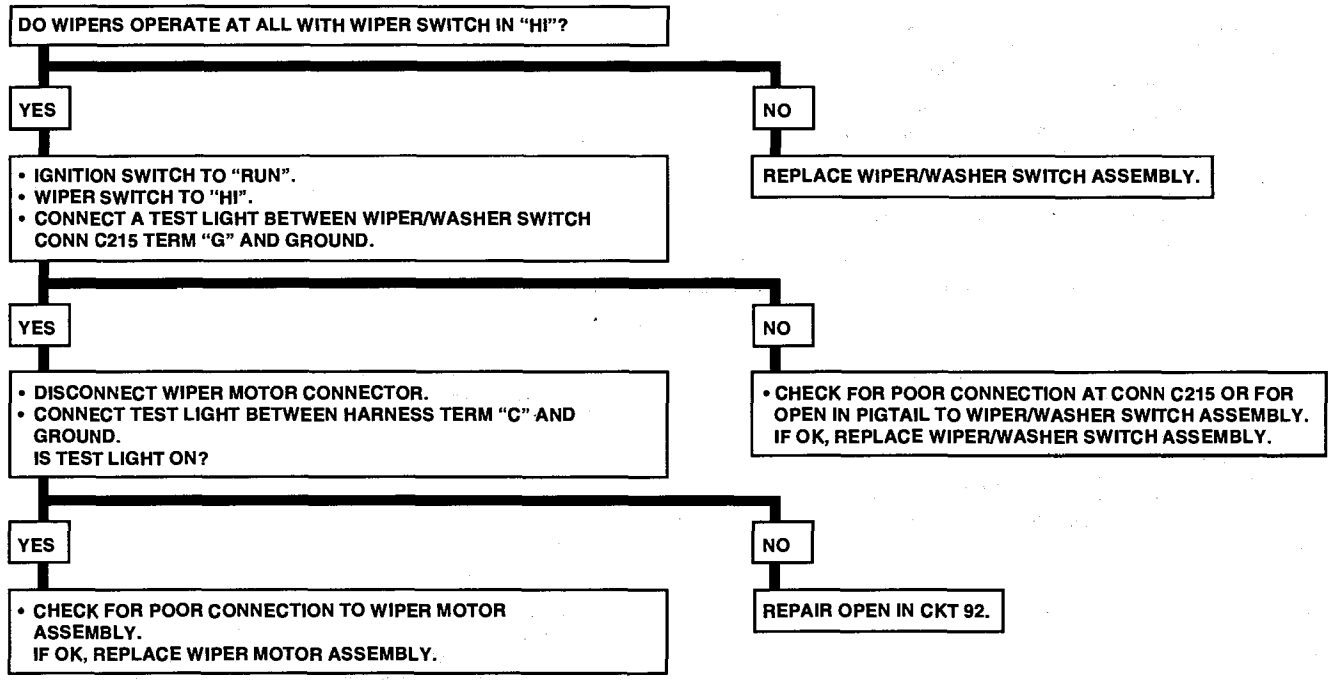


CHART 4
LOW SPEED, PULSE DELAY AND MIST MODES INOPERATIVE (HIGH SPEED MODE OK)

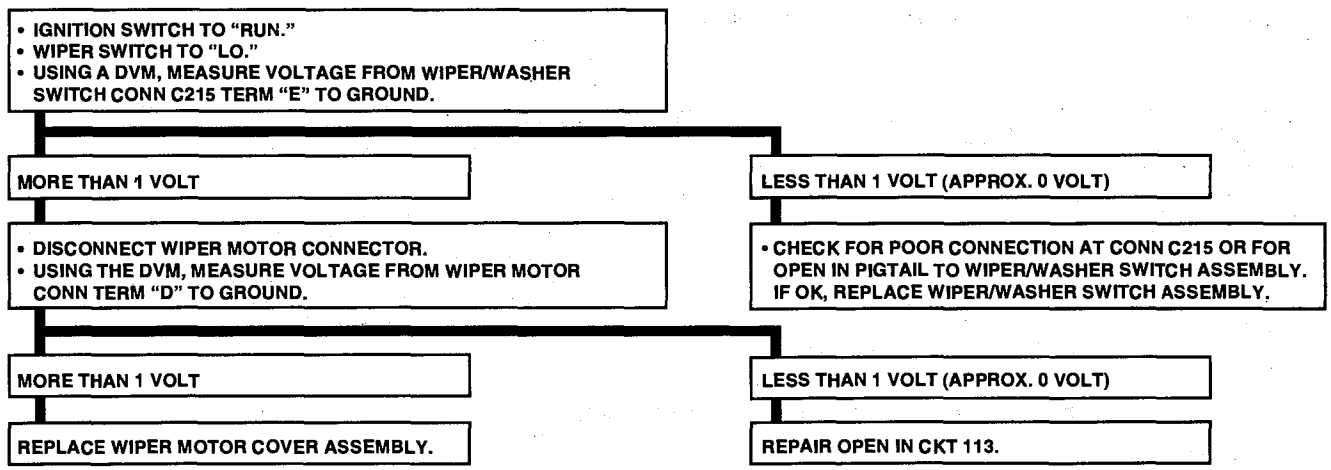


CHART 5
PULSE DELAY OPERATES INCORRECTLY OR NOT AT ALL

- IGNITION SWITCH TO "OFF".
- DISCONNECT WIPER/WASHER SWITCH CONN C215.
- WIPER SWITCH TO "DELAY".
- WITH A DIGITAL MULTIMETER SET TO OHMS SCALE, MEASURE RESISTANCE THROUGH WIPER/WASHER SWITCH ASSEMBLY FROM CONN C215 TERM "D" TO TERM "F".
- MOVE WIPER SWITCH THROUGH ENTIRE DELAY RANGE, ONE NOTCH AT A TIME.

DOES RESISTANCE VARY FROM APPROXIMATELY 39 kΩ TO 680 kΩ? (SEE FIGURE 2.)

YES

- RECONNECT WIPER/WASHER SWITCH CONN C215.
- DISCONNECT WIPER MOTOR CONNECTOR.
- IGNITION SWITCH TO "RUN".
- USING A DVM, MEASURE VOLTAGE FROM WIPER MOTOR CONN TERM "E" TO GROUND.

B+

REPLACE WIPER MOTOR COVER ASSEMBLY.

NO

REPLACE WIPER/WASHER SWITCH ASSEMBLY.

APPROX. 0 VOLT

- CHECK CKT 112 FOR OPEN OR POOR CONNECTION. IF OK, REPLACE WIPER MOTOR COVER ASSEMBLY.

CHART 6
WIPERS STOP RANDOMLY AND DO NOT PARK WHEN SWITCH IS MOVED TO "OFF"

- IGNITION SWITCH TO "RUN".
- WIPER SWITCH "OFF."
- DISCONNECT WIPER/WASHER SWITCH CONN C215.

DO WIPERS PARK?

NO

- USING A DVM, MEASURE VOLTAGE FROM CONN C215 (VEHICLE SIDE) TERM "E" TO GROUND.

MORE THAN 1 VOLT

- RECONNECT WIPER/WASHER SWITCH CONN C215.
- DISCONNECT WIPER MOTOR CONNECTOR.
- USING THE DVM, MEASURE VOLTAGE FROM CONN TERM "D" TO GROUND.

MORE THAN 1 VOLT

REPAIR SHORT TO B+ IN CKT 113.

LESS THAN 1 VOLT

REPLACE WIPER MOTOR COVER ASSEMBLY.

YES

REPLACE WIPER/WASHER SWITCH ASSEMBLY.

LESS THAN 1 VOLT (APPROX. 0 VOLT)

REPLACE WIPER MOTOR COVER ASSEMBLY.

CHART 7
WIPERS DO NOT OPERATE WHEN WASHER SWITCH IS ACTIVATED

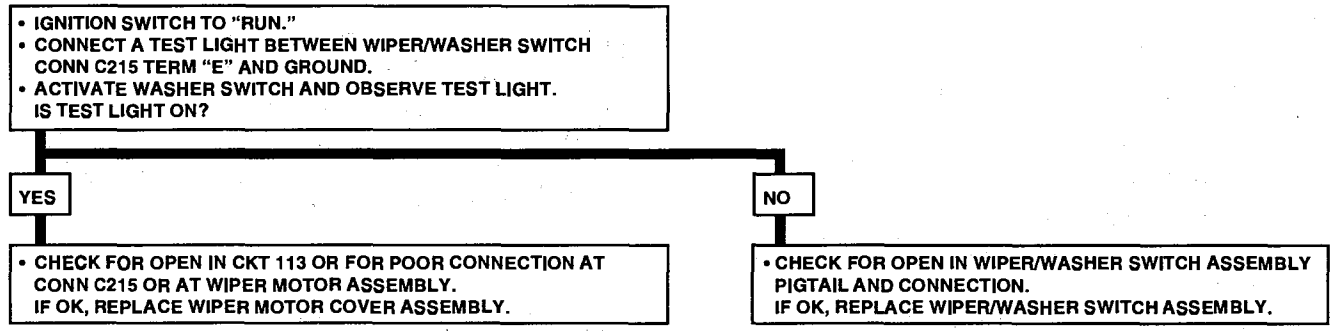
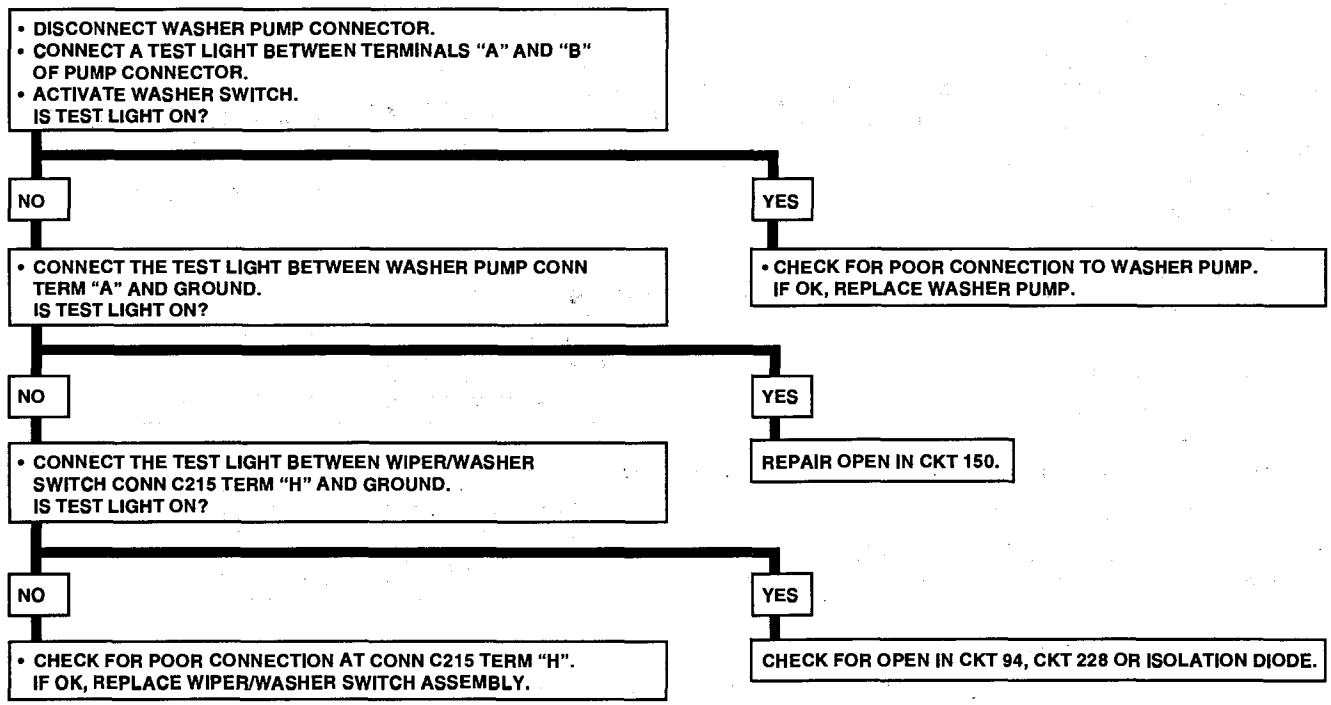


CHART 8
WASHER DOES NOT OPERATE



ON-VEHICLE SERVICE

WASHER PUMP REPLACEMENT

Figure 8

Remove or Disconnect

1. Negative battery cable.
2. Electrical connector (3).
3. Place drain pan under vehicle.
4. Washer pump (4) from reservoir (2) using suitable pliers.
5. Washer hose assembly (5) from pump.

Install or Connect

1. Washer hose assembly (5).
2. Washer pump (4) in washer reservoir (2) using pliers.

Important

- Make sure washer pump is pushed all the way into washer reservoir seal.

3. Electrical connector (3).
4. Refill washer reservoir.
5. Negative battery cable.

WASHER RESERVOIR REPLACEMENT

Figures 7 and 8

Remove or Disconnect

1. Washer fluid.
2. Two scrivets (1, Figure 7) from top of washer reservoir (2).
3. Drive vehicle onto rack.
4. Negative battery cable.
5. Raise vehicle on rack.
6. Splash guard and mounting screws.
7. Two scrivets (1) from bottom of washer reservoir.
8. Washer reservoir and pump (4, Figure 8).
9. Electrical connector (3) and washer hose assembly (5).
10. Washer pump from reservoir.

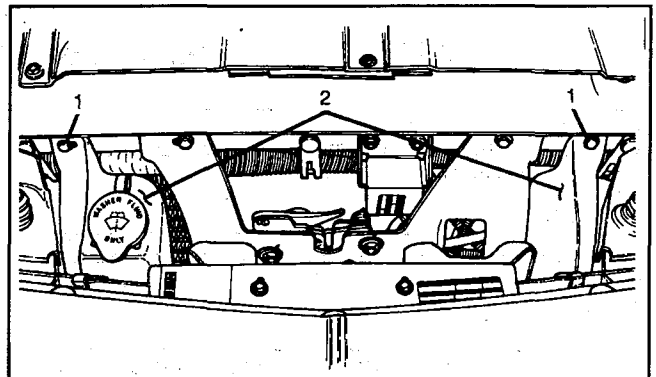
Install or Connect

NOTICE: See "Notice" on page 8E-1 of this section.

1. Washer pump (4, Figure 8) in washer reservoir (2).

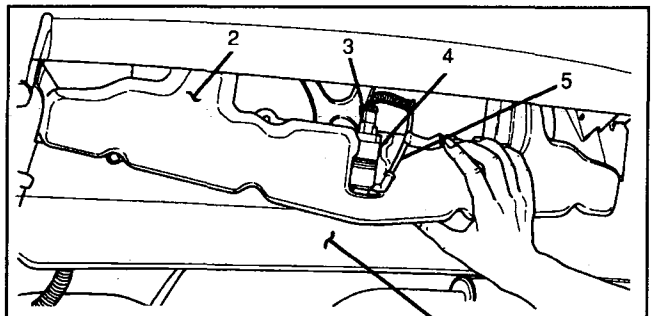
Important

- Make sure washer pump is pushed all the way into washer reservoir seal.



1 SCRIVET (4) 2 RESERVOIR, WASHER

Figure 7 — Washer Reservoir (Top Front View)



A GUARD, SPLASH
2 RESERVOIR, WASHER
3 CONNECTOR, ELECTRICAL
4 PUMP, WASHER
5 HOSE ASSEMBLY, WASHER

Figure 8 — Washer Reservoir Removal

2. Washer hose assembly (5) and electrical connector (3).
3. Washer reservoir with 2 scrivets (1, Figure 7) at bottom of reservoir.
4. Splash guard with mounting screws.
5. Lower vehicle on rack.
6. Negative battery cable, then drive vehicle off rack.
7. Two scrivets (1) at top of washer reservoir.
8. Washer fluid.

WIPER ARM REPLACEMENT

Figures 9 through 11

Remove or Disconnect

Tool Required:
J 39637 Wiper Arm Puller

1. Operate wipers at lowest DELAY setting, then shut off wipers at inner wipe (end of sweep) position. At tip of blade assembly, mark windshield to aid at installation. See Figure 11 for wipe pattern and inner wipe positions.
2. Raise hood (chev only).
3. Lift wiper arm nut cover and remove nut (7, Figure 9).

Important

- Do not grasp plastic spoiler of wiper arm.

4. Wiper arm (6, Figure 10) from linkage drive shaft using J 39637.
5. Wiper blade assembly, if required. See "Wiper Blade Assembly Replacement."

Install or Connect

NOTICE:: See "Notice" on page 8E-1 of this section.

1. Wiper blade assembly, if removed. See "Wiper Blade Assembly Replacement."
2. Wiper arm (6) on linkage drive shaft, with tip of blade assembly aligned with mark made at removal.

Important

- If wipers could not be stopped at inner wipe position for wiper arm removal, position blade tip(s) according to dimensions given in Figure 11.

3. Nut (7, Figure 9) on linkage drive shaft.

Important

- It may be necessary to allow for some movement of a wiper arm when its nut is being tightened. If wiper arm moves away from desired alignment mark, loosen nut (7) and reposition wiper arm.

Tighten

- Nut (7) to 32 N·m (24 lb. ft.) while holding wiper arm.

4. Close nut cover.
5. Close hood.

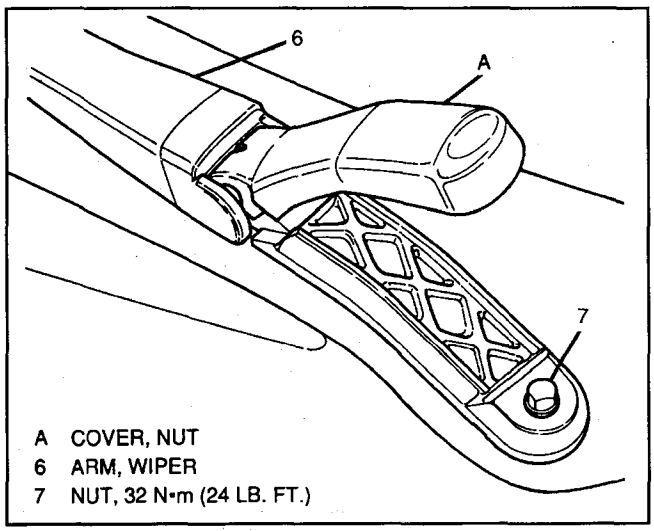


Figure 9 — Wiper Arm Nut Removal

Inspect

- Run wipers and check for proper wipe pattern (Figure 11).
- Shut off wipers and check for correct park position.

WIPER BLADE ASSEMBLY REPLACEMENT

Figures 12 and 13

Remove or Disconnect

Important

- Do not grasp plastic spoiler of wiper arm.

1. If wiper arms have not been removed, lift wiper arm (6, Figure 12) until it locks into service-up position.

Important

- Use care when removing or installing a blade assembly (8). Inadvertent bumping can cause the wiper arm to toggle back and strike the windshield.

2. Press down on locking tab of blade pivot, then pull blade assembly downward to disengage it from hook of wiper arm.

Install or Connect

1. Position pivot of blade assembly (8, Figure 13) in hook of wiper arm (6), then pull blade assembly upward until locking tab of blade pivot engages slot in arm hook.
2. Carefully lower wiper arm and blade assembly onto windshield.

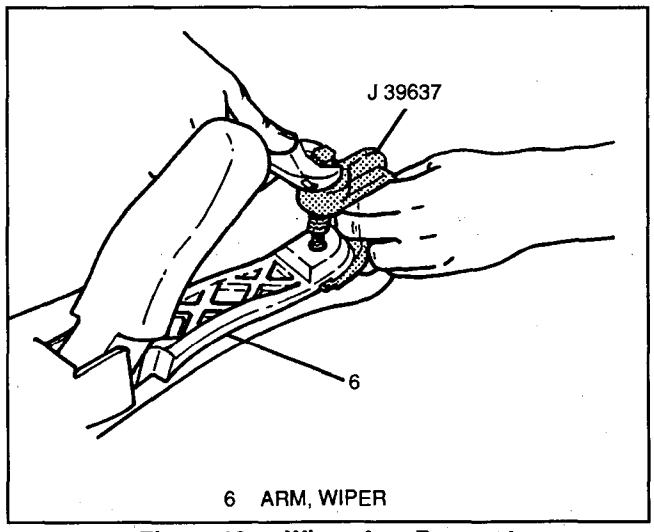
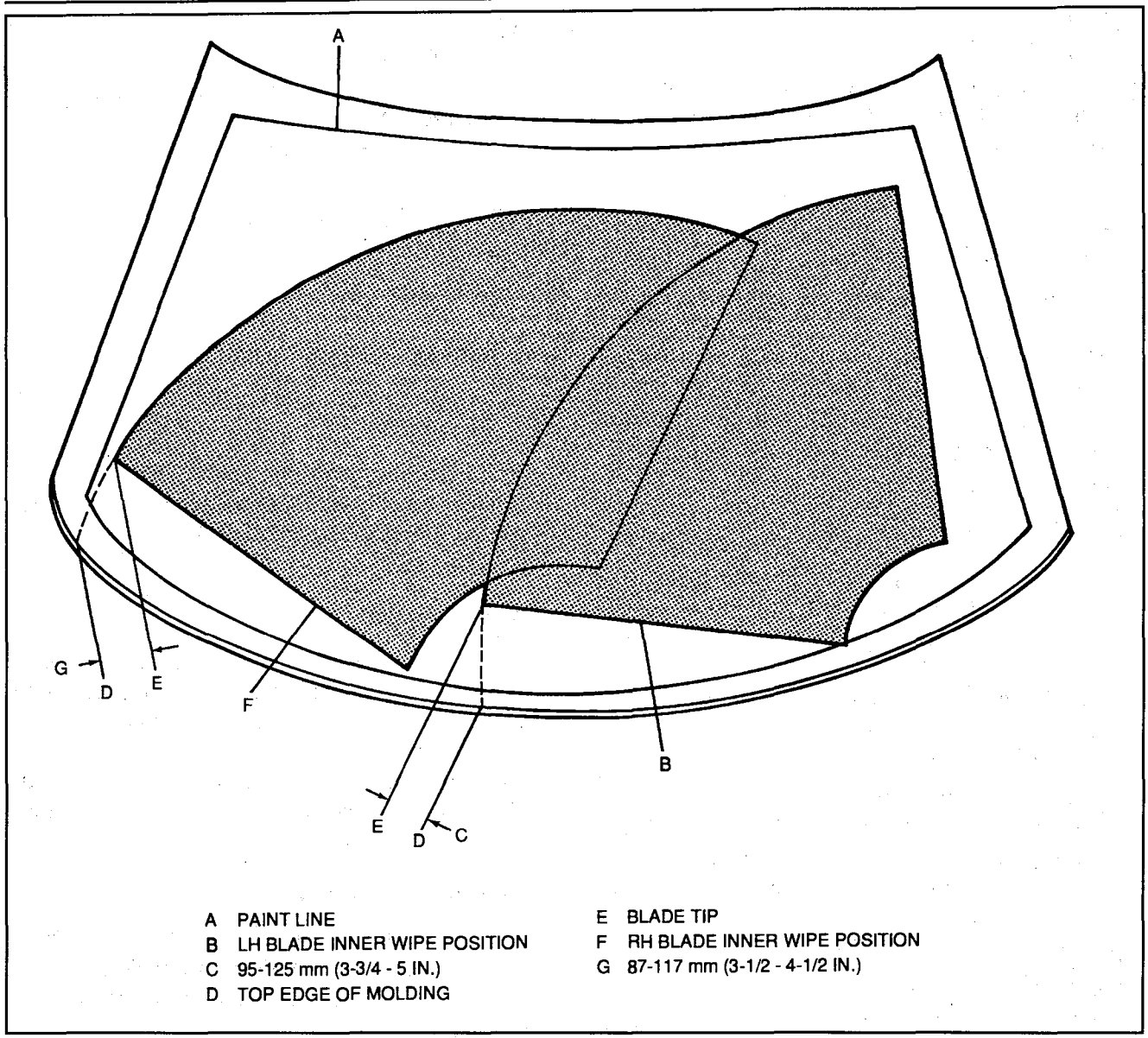


Figure 10 — Wiper Arm Removal



A PAINT LINE
B LH BLADE INNER WIPE POSITION
C 95-125 mm (3-3/4 - 5 IN.)
D TOP EDGE OF MOLDING
E BLADE TIP
F RH BLADE INNER WIPE POSITION
G 87-117 mm (3-1/2 - 4-1/2 IN.)

Figure 11 — Wipe Pattern and Inner Wipe Positions

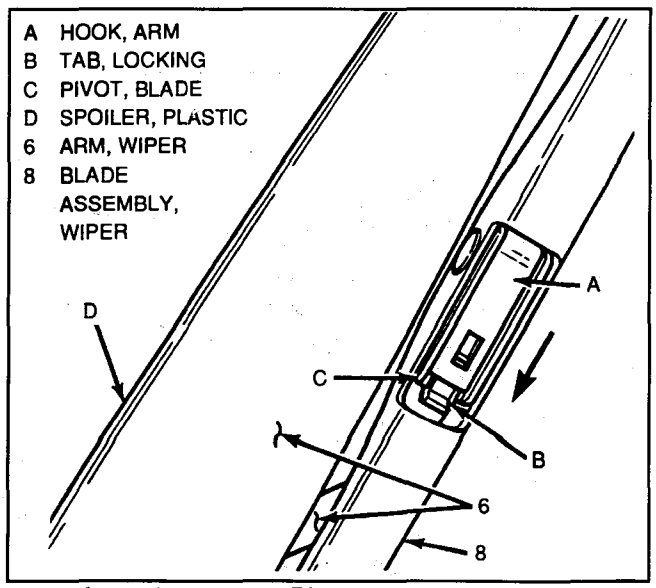


Figure 12 — Wiper Blade Assembly Removal

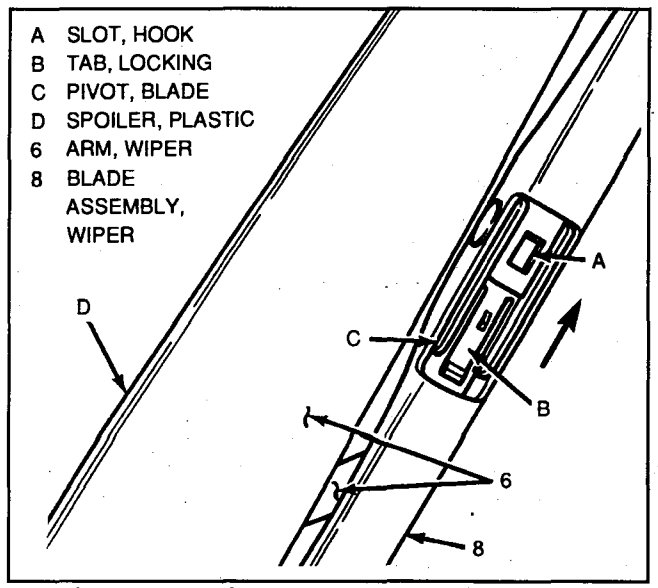


Figure 13 — Wiper Blade Assembly Installation

WIPER BLADE ELEMENT REPLACEMENT

Figures 14 and 15

Remove or Disconnect

1. Wiper blade assembly from wiper arm. See "Wiper Blade Assembly Replacement."
2. Blade element (9, Figure 14) has two notches at one end which are engaged by the bottom claw set of blade assembly. At notched end, pull blade element from blade assembly.

Install or Connect

NOTICE:: The heel end of the wiper blade assembly is the end nearest to the base of the wiper arm.

Important

- Replacement blade elements have three plastic caps which retain the two metal flexor strips. Do not remove these caps before the element is installed.

1. At heel end of blade assembly, slide blade element (9, Figure 15), notched end last, into blade claw sets. The plastic retainer caps will be forced off as element is fully inserted.
2. Be certain that the two element notches are engaged by last claw set and that all other claws are properly engaged in slots of element on both sides.
3. Wiper blade assembly on wiper arm. See "Wiper Blade Assembly Replacement."

WINDSHIELD WASHER

Figures 11 and 16

A correctly operating windshield wiper/washer system has a spray pattern that cleans 75% of the wipe pattern (Figure 11) within ten wiper cycles.

If a washer nozzle (10, Figure 16) becomes plugged, apply air pressure. If a nozzle remains plugged, the nozzle must be replaced.

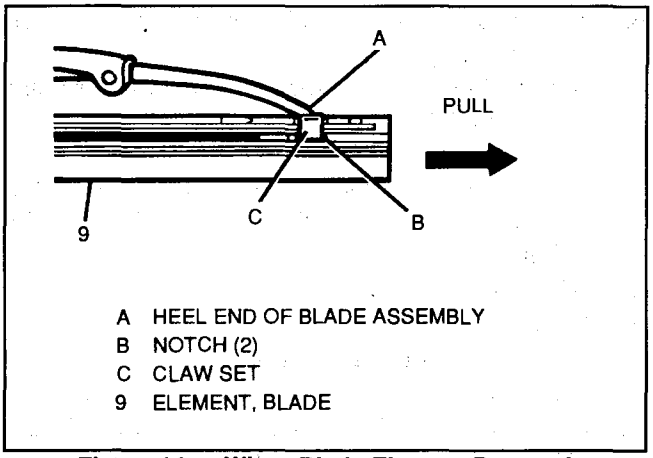
WIPER MOTOR ASSEMBLY REPLACEMENT

Figures 16 through 19

Remove or Disconnect

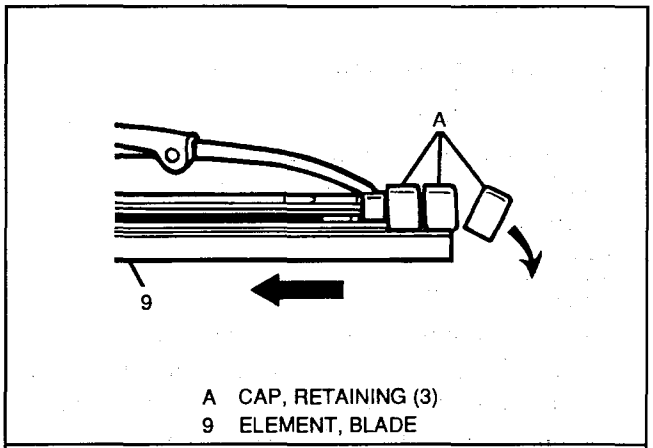
Tool Required:
J 39232 Wiper Linkage Separator

1. Wiper arm and blade assemblies. See "Wiper Arm Replacement."
2. Negative battery cable.
3. LH cowl panel and hood seal.

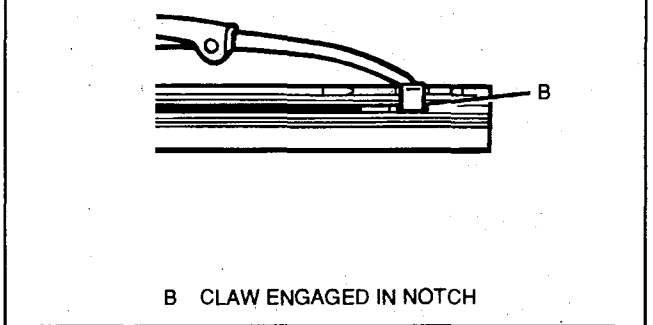


A HEEL END OF BLADE ASSEMBLY
B NOTCH (2)
C CLAW SET
9 ELEMENT, BLADE

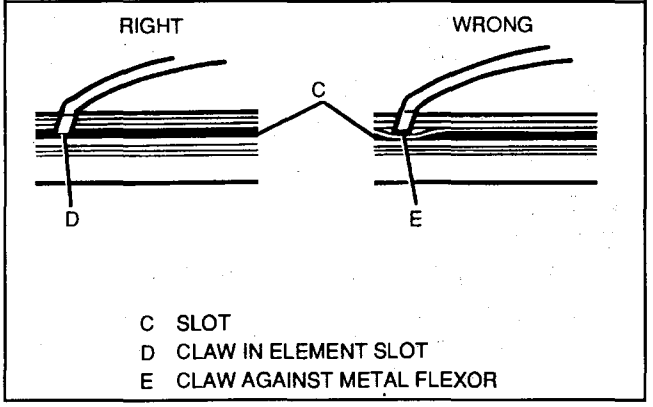
Figure 14 — Wiper Blade Element Removal



A CAP, RETAINING (3)
9 ELEMENT, BLADE



B CLAW ENGAGED IN NOTCH



C SLOT
D CLAW IN ELEMENT SLOT
E CLAW AGAINST METAL FLEXOR

Figure 15 — Wiper Blade Element Installation

4. Washer hose assembly (11, Figure 16) from LH cowl panel.
5. Electrical connector from wiper motor assembly (17, Figure 17).
6. Screw (14) and nut (20).
7. Socket of RH linkage assembly (13) from ball of LH linkage assembly (15) using J 39232 (see Figure 18).
8. LH linkage assembly.
9. Screw (19, Figure 17).
10. Pull wiper motor assembly free from slots of bracket (16).
11. Socket of RH linkage assembly from crank arm ball of wiper motor assembly using J 39232 (see Figure 18).

Install or Connect

Tool Required:
J 39529 Wiper Linkage Installer

NOTICE:: See "Notice" on page 8E-1 of this section.

Important

- When installing wiper motor assembly, make certain that the crank arm is in inner wipe position as shown in Figure 17. The crank arm drive pin must be engaged in the cam pocket.

1. Press socket of RH linkage assembly (13) into engagement with crank arm ball of wiper motor assembly (17) using J 39529 (see Figure 19).
2. Wiper motor assembly (17, Figure 17) with two locator pads (18) pressed fully into slots of bracket (16).
3. Screw (19).

Tighten

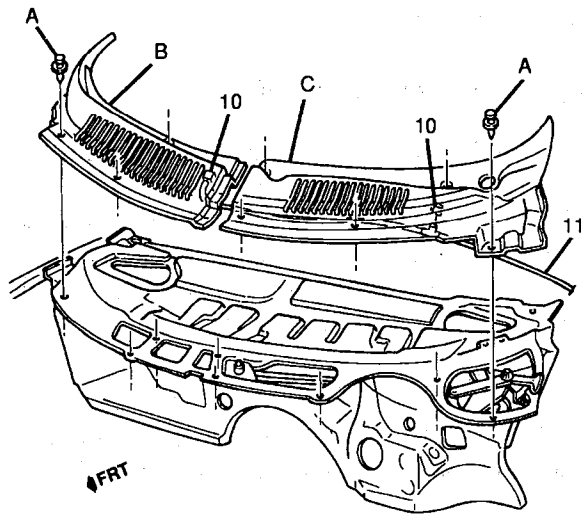
- Screw (19) to 10 N•m (7.5 lb. ft.).

4. LH linkage assembly (15) without attaching parts.
5. Press socket of RH linkage assembly into engagement with ball of LH linkage assembly using J 39529 (see Figure 19).
6. Attach LH linkage assembly with screw (14, Figure 17) and nut (20).

Tighten

- Screw (14) and nut (20) to 10 N•m (7.5 lb. ft.).

7. Electrical connector to wiper motor assembly.
8. Washer hose assembly (11, Figure 16) to LH cowl panel and washer nozzle (10).
9. LH cowl panel and hood seal.
10. Negative battery cable.
11. Wiper arm and blade assemblies. See "Wiper Arm Replacement."



A SCRIVET (8)
B PANEL, RH COWL
C PANEL, LH COWL
10 NOZZLE, WASHER (2)
11 HOSE ASSESMBLY, WASHER

Figure 16 — Cowl Panels and Washer Components

WIPER LINKAGE ASSEMBLY REPLACEMENT

Figures 16 through 19

Remove or Disconnect

Tool Required:
J 39232 Wiper Linkage Separator

1. Wiper arm and blade assemblies. See "Wiper Arm Replacement."
2. LH cowl panel and hood seal.
3. Washer hose assembly (11, Figure 16) from LH cowl panel.
4. Screw (14, Figure 17) and nut (20).
5. Socket of RH linkage assembly (13) from ball of LH linkage assembly (15) using J 39232 (see Figure 18).
6. LH linkage assembly.
7. Three screws (12, Figure 17).
8. Socket of RH linkage assembly from crank arm ball of wiper motor assembly (17) using J 39232 (see Figure 18).
9. RH linkage assembly from slotted plenum access hole.

Install or Connect

Tool Required:
J 39529 Wiper Linkage installer

NOTICE: See "Notice" on page 8E-1 of this section.

1. RH linkage assembly (13, Figure 17) through slotted plenum access hole.
2. Three screws (12) finger tight.
3. Align RH linkage assembly.
4. Press socket of RH linkage assembly into engagement with crank arm ball of wiper motor assembly (17) using J 39529 (see Figure 19).
5. LH linkage assembly (15, Figure 17) without attaching parts.
6. Press socket of RH linkage assembly into engagement with ball of LH linkage assembly using J 39529 (see Figure 19).
7. Screw (14, Figure 17) and nut (20).

Tighten

- Screw (14), nut (20) and three screws (12) to 10 N•m (7.5 lb. ft.).

8. Washer hose assembly to LH cowl panel and washer nozzle (10).
9. LH cowl panel and hood seal.
10. Wiper arm and blade assemblies. See "Wiper Arm Replacement."

OFF-VEHICLE SERVICE

WIPER MOTOR COVER ASSEMBLY REPLACEMENT

Figures 20 and 21

Remove or Disconnect

1. Three screws (21, Figure 20) using Torx screwdriver.
2. Cover assembly (22).

Install or Connect

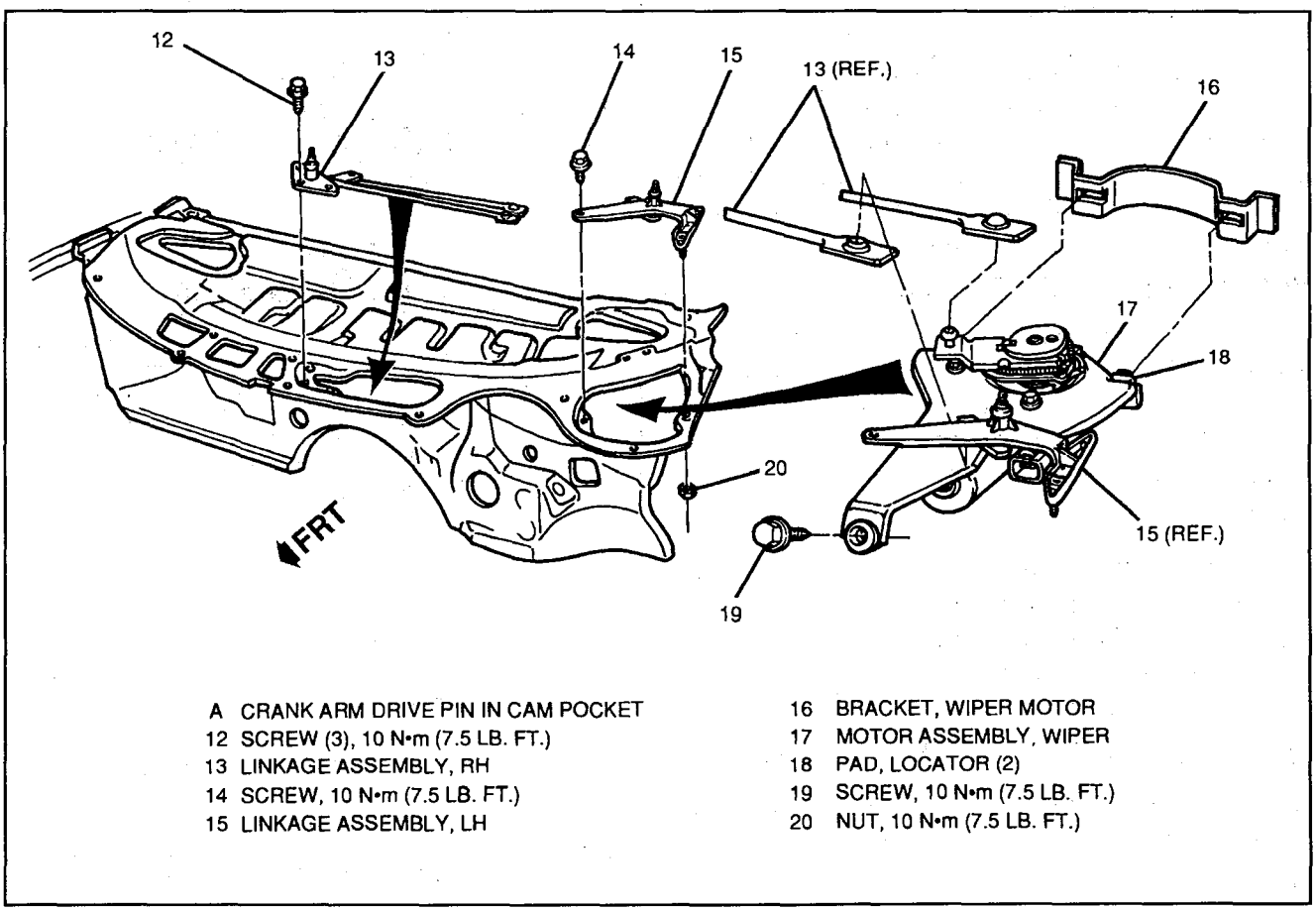
NOTICE:: See "Notice" on page 8E-1 of this section.

1. Cover assembly (22, Figure 20).

Important

- Before installing the cover assembly, make certain that the inner wipe cam is positioned as shown in Figure 21.

2. Three screws (21, Figure 20).



A CRANK ARM DRIVE PIN IN CAM POCKET
12 SCREW (3), 10 N•m (7.5 LB. FT.)
13 LINKAGE ASSEMBLY, RH
14 SCREW, 10 N•m (7.5 LB. FT.)
15 LINKAGE ASSEMBLY, LH
16 BRACKET, WIPER MOTOR
17 MOTOR ASSEMBLY, WIPER
18 PAD, LOCATOR (2)
19 SCREW, 10 N•m (7.5 LB. FT.)
20 NUT, 10 N•m (7.5 LB. FT.)

Figure 17 — Linkage and Wiper Motor Assemblies

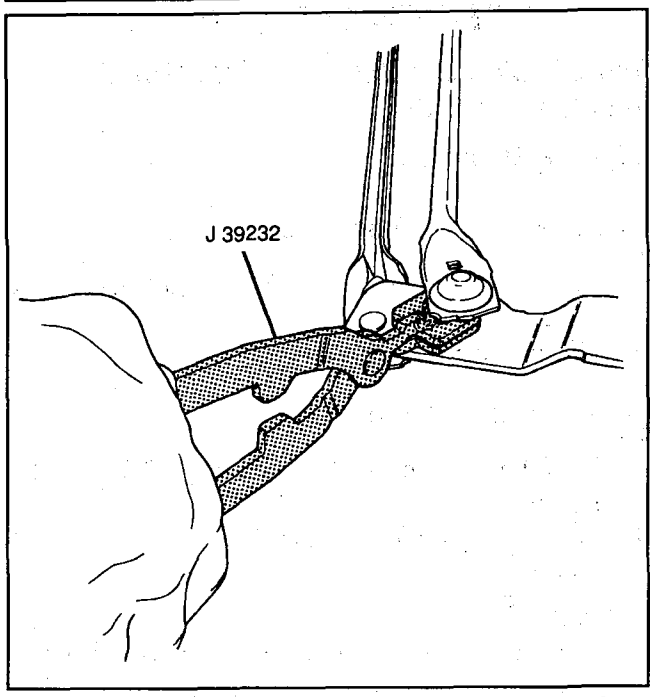


Figure 18 — J 39232 Wiper Linkage Separator (Typical Usage)

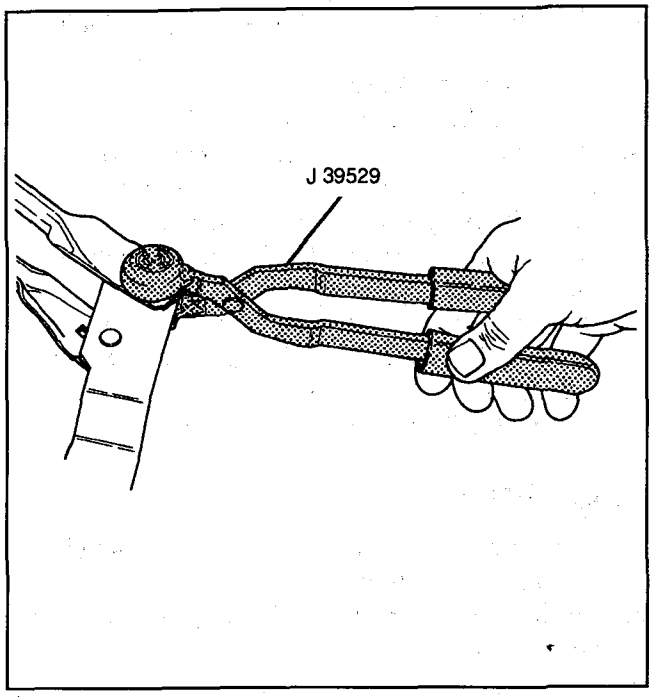


Figure 19 — J 39529 Wiper Linkage Installer (Typical Usage)

Tighten

- Screws (21) to 2 N•m (18 lb. in.).

WIPER CHATTER REPAIR

Some vehicles may exhibit a condition where the windshield wipers chatter and/or wipe unevenly. Several items may contribute to this condition. To completely repair this condition ALL items listed should be checked and repaired as necessary.

WINDSHIELD GLASS CLEANING

Clean windshield with windshield cleaner, GM PN 1050011 or equivalent. The cleaner used should be one which will not harm paint finish or scratch glass. The glass is clean when water no longer "beads", but "sheets" across entire glass surface.

BLADE ELEMENT CLEANING

Lift each blade assembly off windshield and clean element with a cloth saturated in full strength washer solution. Rinse blade assemblies with water.

CAUTION: Avoid prolonged skin contact with washer solution.

WIPER ARM TIP PRESSURE CHECK

1. Run wipers at lowest DELAY setting, then shut wipers off at inner wiper (end of sweep) position.

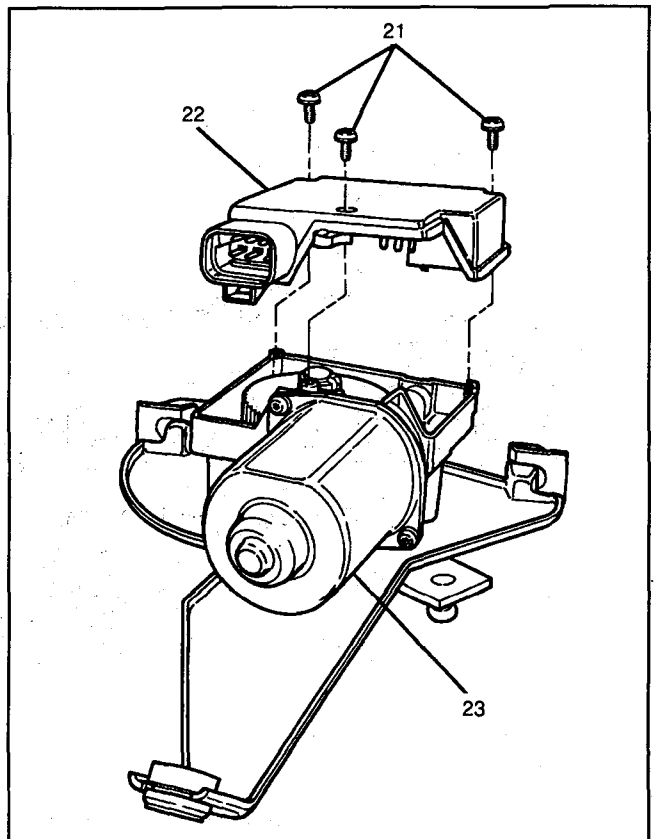


Figure 20 — Wiper Motor Cover Assembly Replacement

2. Remove blade assemblies from wiper arms, providing protection for windshield surface.
3. Attach a scale to wiper arm hook and measure the force required to lift wiper arm perpendicular to windshield to normal working height (height with blade assembly attached).
4. If the force required is not within the specifications given below, the wiper arm should be replaced.
   Tip Pressure — RH Wiper Arm – 9-11 N (32.5-39.5 oz.)
   LH Wiper Arm – 10-12 N (36.0-43.0 oz.)

BLADE ELEMENT SET CHECK

Figure 22

Remove wiper blade assemblies from wiper arms. Look down the length of the blade element. The rubber element which contacts the glass must be on the center line of the blade assembly ±15 degrees. Replace the element if necessary.

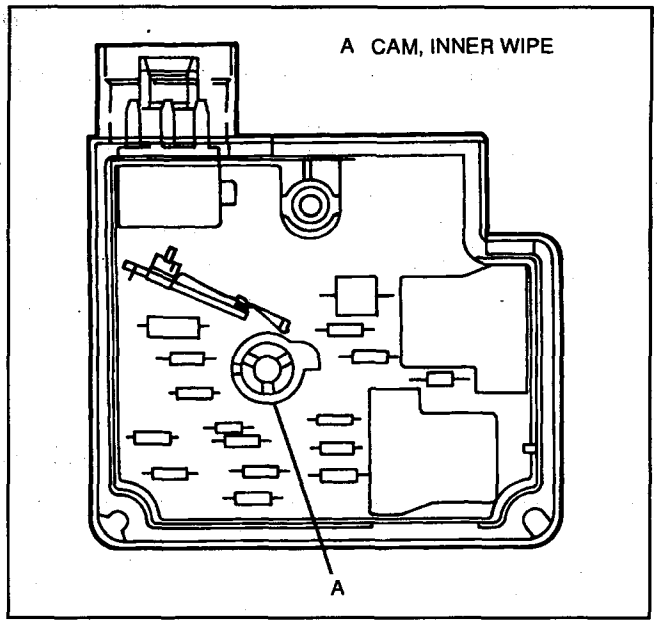


Figure 21 — Inner Wipe Cam Position for Cover Assembly Installation

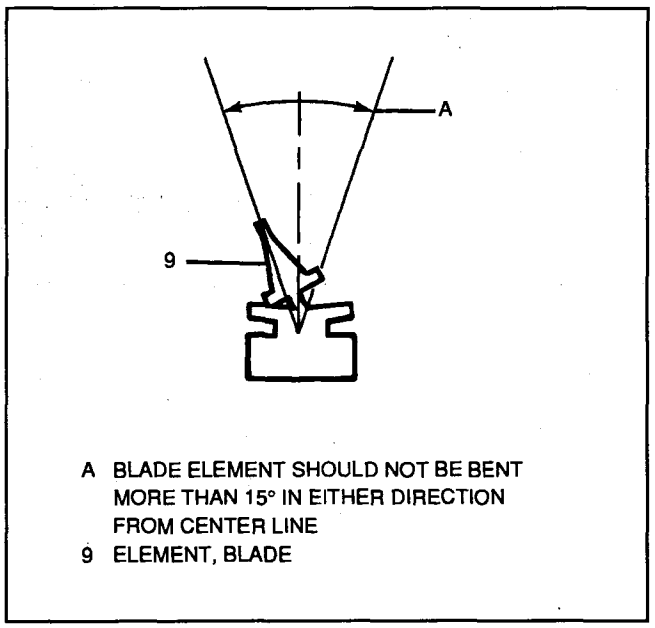


Figure 22 — Blade Element Set Check

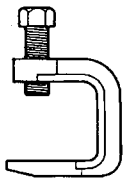
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Linkage Assembly Nut (20)	10 N•m (7.5 lb. ft.)
Linkage Assembly Screws (12 and 14)	10 N•m (7.5 lb. ft.)
Wiper Arm Nuts (7)	32 N•m (24 lb. ft.)
Wiper Motor Assembly Screw (19)	10 N•m (7.5 lb. ft.)
Wiper Motor Cover Assembly Screws (21)	2 N•m (18 lb. in.)

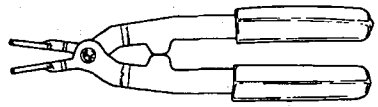
SPECIAL TOOLS

1.



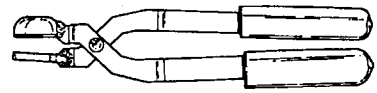
J 39637

2.



J 39232

3.



J 39529

1. WIPER ARM PULLER
2. WIPER LINKAGE SEPARATOR
3. WIPER LINKAGE INSTALLER

SECTION 9

ACCESSORIES

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Audio Systems ..... Section 9A
Cruise Control ..... Section 9B
Theft Deterrent Systems ..... Section 9D
Engine Coolant Heater ..... Section 9E
Supplemental Inflatable Restraint (SIR) System ..... Section 9J
Remote Keyless Entry ..... Section 9K

BLANK

SECTION 9A

AUDIO SYSTEMS

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury or otherwise unneeded SIR system repairs.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

All radio assemblies have electronic memory for preselected station function.

SPEAKER SYSTEMS

Base Audio System (UQ0)

There are two front speaker assemblies, one in each front side door, and two rear speaker assemblies mounted in the rear panel. These speaker locations allow for a full, high fidelity sound.

Standard radio front side door speaker assemblies are 6 inches round and 4 ohms. Radio rear speaker assemblies are 6 inches round and 10 ohms.

High performance extended range speaker assemblies are standard with full electronically tuned receiver (ETR) system.

Chevrolet convertibles are equipped with (U62) sound systems which include two door coax speakers and two "B" pillar coax speakers.

Delco®-GM/Bose® Music Systems

Chevrolet

The speaker system for the Delco®-GM/Bose® Music Systems (UU8 and U1T) includes five speaker assemblies. There are two front speaker assemblies, one in each front side door, two "B" pillar subwoofer speakers, and one rear speaker assembly, mounted in the left rear cargo compartment trim. Amplifiers for all rear speakers are housed in the rear Bose® speaker assembly.

Optional Audio System

Pontiac

The premium speaker system is available on the UT6 and UP3 radio assemblies. It consists of four front speaker assemblies, two in each front side door, and six rear speaker assemblies, two mounted in the rear sail panel, and four mounted in the rear compartment trim panel assembly. The amplifier is located under the right rear armrest assembly.

Pontiac convertibles are equipped with (U62-base) sound system which includes two door coax speakers and two "B" pillar coax speakers. Pontiac convertibles also can be equipped with (UW6-uplevel), a sound system which includes two door high-sensitivity speakers, two door dome tweeters and two "B" pillar coax speakers.

RADIO FIXED ANTENNA ASSEMBLY

The fixed antenna assembly is designed to provide good radio omni-directional reception in moderate fringe areas.

RADIO POWER ANTENNA ASSEMBLY

The electrically operated, rear-mounted, telescoping rod-type antenna extends fully whenever the radio assembly is in use and retracts whenever the radio assembly or ignition switch is turned to "OFF" and retained accessory power is not active.

The antenna mast is attached to a plastic cable that is driven up and down by an electric motor. The motor is automatically shut off by limit switches when the antenna reaches the full-up or full-down position.

RADIO ASSEMBLIES

All 2000 (Chevrolet UN6 and UU8), and CDM Chevrolet U2T and U1C), 2001 (Pontiac) series radio assemblies feature ETR tuning, vacuum fluorescent display, AM-FM stereo, seek tuning, and digital clock display. Eight radio assemblies are available.

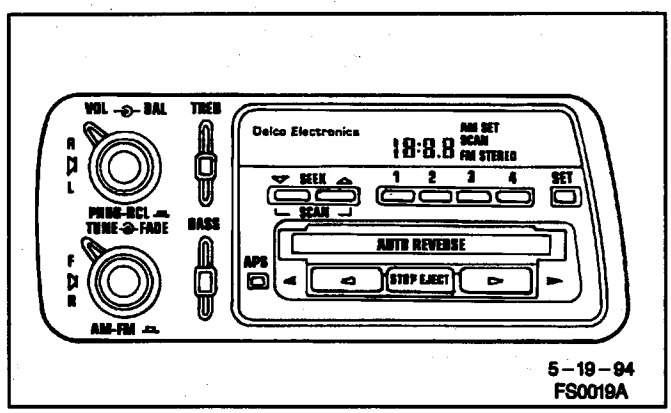


Figure 1 – UN6 Radio – (Chevrolet)

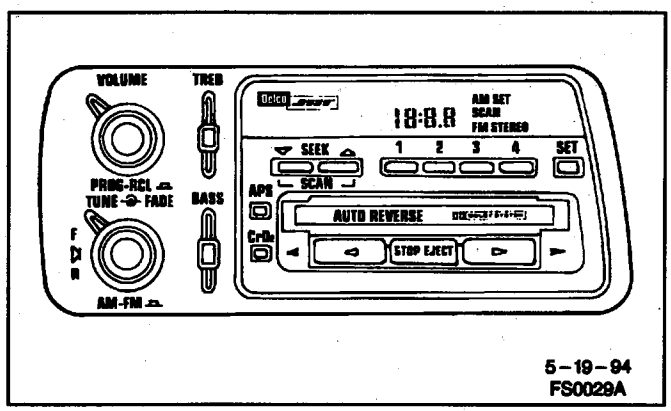


Figure 2 – UU8 Radio – (Chevrolet)

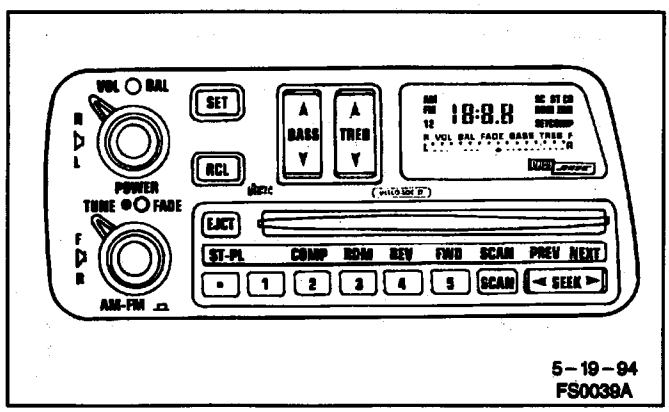


Figure 3 – U1T Radio – (Chevrolet)

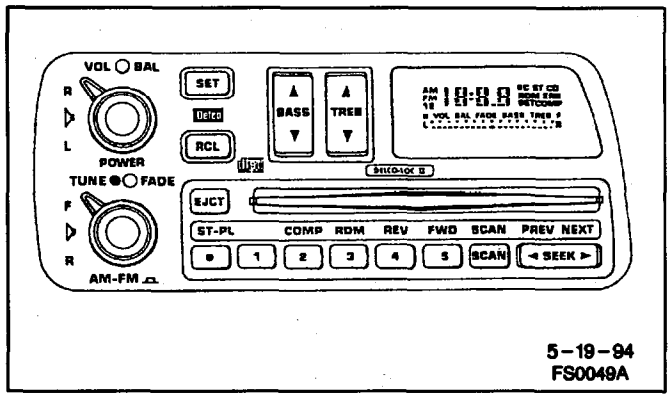


Figure 4 – U1C Radio – (Chevrolet Convertible)

Chevrolet

Figures 1 through 4

- AM/FM Stereo/Cassette (UN6) with dynamic noise reduction and Automatic Program Search.
- Delco®-GM/Bose® Music System with Cassette Tape Player (UU8), dynamic noise reduction and Automatic Program Search.
- Delco®-GM/Bose® Music System with Compact Disc Player (U1T) and Delco®-Loc II.
- AM/FM Stereo/Compact Disc (U1C) with scan and directional seek and Delco®-Loc II (convertible).

All Chevrolet radios are equipped with scan and dual directional seek.

Pontiac

Figures 5 through 8

- AM/FM Stereo/Cassette (UN6) with Theftlock.
- AM/FM Stereo/Cassette Equalizer (UT6) with Steering Wheel Radio Controls with Theftlock.
- AM/FM Stereo/Compact Disc Player (U1C) with Theftlock.
- AM/FM Stereo/Compact Disc/Equalizer (UP3) with Steering Wheel Radio Controls.

All Pontiac radios are equipped with dual directional seek. UN6 and UT6 radios are equipped with Dolby ®.

Pontiac Firebird models have a new family of radio assemblies (2001 series) available featuring new styling (flush front design) and steering wheel controls on up-level radios. Some assemblies are available with or without a graphic equalizer.

The Pontiac optional audio system (UT6 and UP3) uses ten speakers and an amplifier: four speaker assemblies mounted in the front side doors, two speaker assemblies in the rear sail panel and four speaker assemblies in the rear compartment trim panel assembly. The amplifier is under the right rear armrest assembly.

FM Stereo

All factory-equipped sound systems with an FM stereo radio assembly will switch to stereo operation whenever an FM stereo broadcast is being received, and an indicator in the dial will light. Stereo operation means the radio is separating a stereo broadcast back into the original two channels, called "left" and "right." Stereo sound is noticeably more realistic to the ear.

Although FM is normally static-free, reception can be limited by terrain, atmospheric conditions, station strength and distance from the transmitter. Buildings or other obstructions can cause momentary static, flutter or station swapping. If reception is poor, tuning to a stronger station will bring improvement.

AMAX Stereo Certification

All optional radio assemblies are AMAX certified. These receivers can reproduce the fidelity sound now transmitted by all AM stations but not received on all AM radio assemblies.

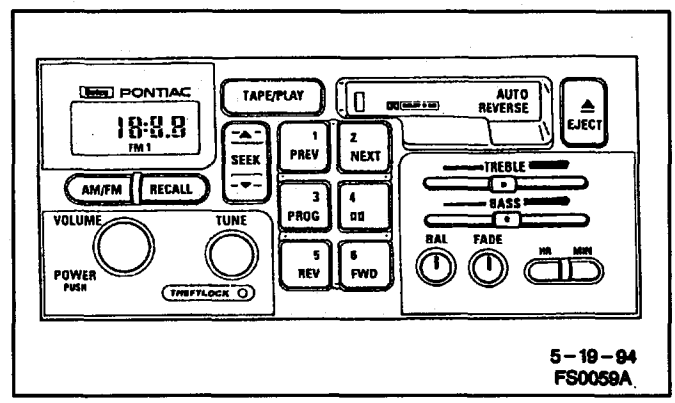


Figure 5 – UN6 Radio – (Pontiac)

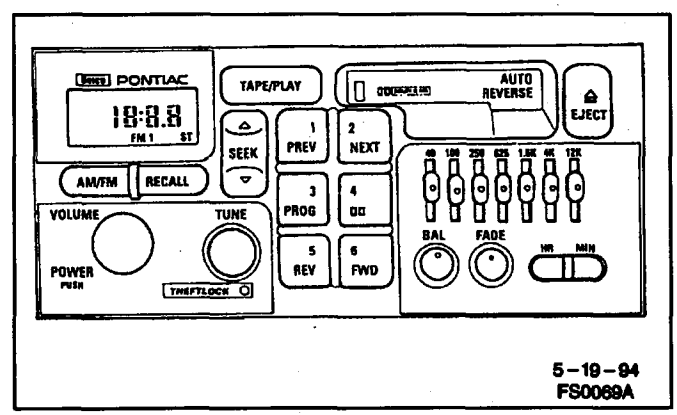


Figure 6 – UT6 Radio – (Pontiac)

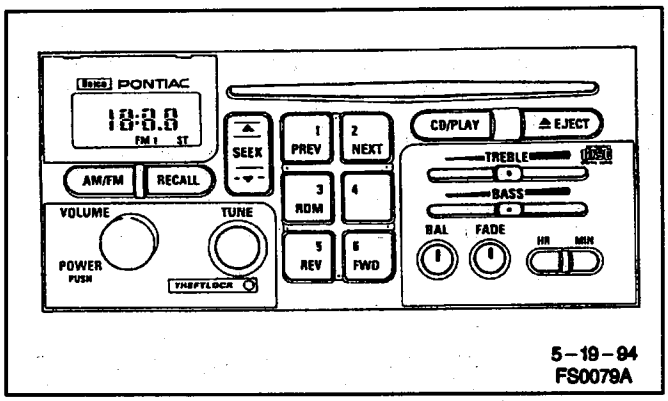


Figure 7 – U1C Radio – (Pontiac)

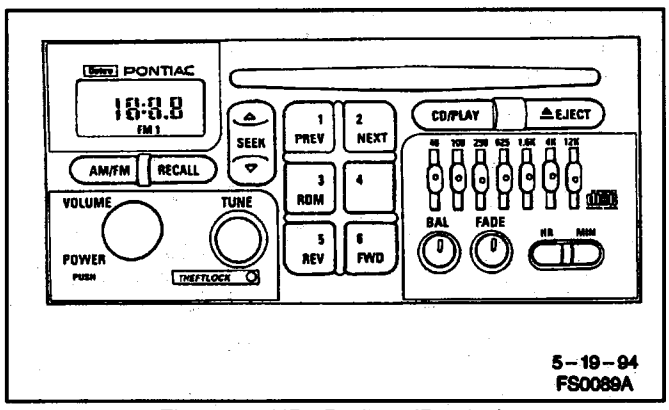


Figure 8 – UP3 Radio – (Pontiac)

Some improvements are high fidelity, adjustable receiver band width (wide for high fidelity or narrow to cut out any interference), noise cancellation, full stereo sound, new frequencies received and external antenna assembly capability.

The range of most AM stations is greater than FM, especially at night. The longer range, however, can cause stations to interfere with each other. AM is also subject to noise pick-up from storms, power lines, etc. AMAX certification reduces many of these problems.

RADIO ASSEMBLY CONTROLS

When the radio assembly is first turned on, the frequency will appear on the display for five seconds, and then the display will return to the time display. To recall the frequency, simply push in the upper knob (Chevrolet) or the "Recall" button (Pontiac) while the radio assembly is turned on. The frequency will appear on the display for five seconds. When the ignition lock cylinder is in the "LOCK" or "OFF" position, the radio display is blank. To display the time when the ignition lock cylinder is in the "OFF" or "LOCK" position, simply push the upper knob or the "Recall" button. The time will display for five seconds. Then the display will turn blank.

ETR AM/FM STEREO/CASSETTE (UN6)

Chevrolet

Figure 1

Radio Assembly Operation

Upper Knob

This knob turns the radio assembly on and off. Rotate knob to control volume. The control ring behind the knob is the balance control.

Turn the ring clockwise to move speaker balance to the right and counterclockwise to move speaker balance to the left. Press the knob to select the other side of the tape when playing a cassette.

Lower Knob

Turn the knob to manually select radio stations. When the radio assembly is on and the tape player is off, press the knob to choose either the AM or the FM band.

The control ring behind the lower knob fades the sound between the front and rear speaker assemblies.

Bass and Treble Controls

Slide the "TREB" lever up to increase treble and down to decrease treble. Slide the "BASS" lever up to increase bass and down to decrease bass.

If a station is weak and noisy, move the "TREB" lever down to reduce the noise.

Push Buttons

To preset four AM stations and four FM stations:

1. Tune in desired station.
2. Press "SET." Within five seconds, press a station button.

To preset three additional AM stations and three additional FM stations:

1. Tune in desired station.
2. Press "SET." Within five seconds, press any two adjacent buttons simultaneously.

The radio will tune to the preselected station when the push button or button pair is pressed.

Button pairing allows for seven AM and seven FM stations to be preset for a total of fourteen preset stations.

If electrical power is interrupted by a blown fuse or a discharged battery, the stations must be reset.

Clock

To set the clock display on a 2000 series radio assembly, the ignition lock cylinder must be in the "ACCESSORY" or "RUN" position and the radio assembly must be off. To set the clock:

1. Push "SET."
2. Within five seconds, push and hold "SEEK ▼" until the correct hour appears.
3. Then press and hold "SEEK ▲" until the correct minute appears.

Seek and Scan Feature

The 2000 series radio assemblies have "SEEK" and "SCAN" features for electronic station tuning up and down the band.

Push the "SEEK ▲ or ▼ " and the radio will tune to next higher or lower station with enough signal strength to be heard clearly, and stay there.

"SCAN" is a two-button sequence. To "SCAN" to the next higher station, press "SEEK ▲" and hold it there while you press "SEEK ▼." To "SCAN" to the next lower station, press "SEEK ▼ " and hold it there while you press "SEEK ▲ ." The radio will move to the next strong station. It will pause there a few seconds, then move to the next strong station. When the radio reaches the end of the band, it will return to the other end of the band and continue to "SCAN." This will continue until the "SCAN" mode is terminated. To terminate the "SCAN" mode, press either seek up, seek down, both buttons again, or press the upper knob.

Cassette Tape Player

To play a tape, the ignition lock cylinder must be in the "ACCESSORY" or "RUN" position and the receiver/tape player must be turned on. Insert the cassette squarely through the door, exposed tape side of the cassette first. When the tape is fully inserted, the radio will turn off and the tape will begin playing.

To advance the tape, press the " ▶" (forward) button. To reverse the tape, press the "◀ " (reverse) button. To resume tape play from fast forward or reverse, press the "STOP-EJECT" button lightly. When the tape reaches the end of a side, it will automatically reverse and play the other side of the tape. To resume listening to the radio or to eject the tape, push the "STOP-EJECT" button.

The cassette player is turned off by ejecting the tape, turning the power knob (upper knob) or rotating the ignition lock cylinder to "LOCK," "OFF" or "START." When this occurs, the tape player will either eject the cassette automatically or the internal tape drive and roller will retract automatically. This is to protect the tape player and cassette tape.

For the best operation of the cassette player do not use cassette tapes longer than 60 minutes per side.

Tape Direction Indicators

The direction the tape is being played is indicated by indicator arrows. When the indicator arrow on the left side is on, the tape direction is to the left. When the indicator arrow on the right side is on, the tape direction is to the right.

Reversing Sides

Press the upper knob to play the other side of the tape. When the end of tape is reached, it automatically reverses direction and plays the other side.

"APS" (Automatic Program Search)

Push "APS" to go to the beginning of a new selection.

To go forward to the beginning of the next selection, push" ▶." To go back to the beginning of the current selection, push "◀. " Push "◀ " again to go to the beginning of the previous selection.

Tape Eject Button

Press "STOP-EJECT" to eject tape or stop tape and switch to radio.

DELCO®-GM/BOSE® MUSIC SYSTEM/CASSETTE (UU8)

Chevrolet

Figure 2

Radio Assembly Operation

Upper Knob

This knob turns the radio assembly on and off. Rotate knob to control volume. Press the knob to select the other side of the tape when playing a cassette.

Lower Knob

Turn the knob to manually select radio stations. When the radio assembly is on and the tape player is off, press the knob to choose either the AM or the FM band.

The control ring behind the lower knob fades the sound between the front and rear speaker assemblies.

Bass and Treble Controls

Slide the "TREB" lever up to increase treble and down to decrease treble. Slide the "BASS" lever up to increase bass and down to decrease bass.

If a station is weak and noisy, move the "TREB" lever down to reduce the noise.

Balance

The speaker assemblies are electronically balanced on the Delco®-GM/Bose® Music System.

Push Buttons

To preset four AM stations and four FM stations:

1. Tune in desired station.
2. Press "SET." Within five seconds, press a station button.

To preset three additional AM stations and three additional FM stations:

1. Tune in desired station.
2. Press "SET." Within five seconds, press any two adjacent buttons simultaneously.

The radio will tune to the preselected station when the push button or button pair is pressed.

Button pairing allows for seven AM and seven FM stations to be preset for a total of fourteen preset stations.

If electrical power is interrupted by a blown fuse or a discharged battery, the stations must be reset.

Clock

To set the clock display on a 2000 series radio assembly, the ignition lock cylinder must be in the "ACCESSORY" or "RUN" position and the radio assembly must be off. To set the clock:

1. Push "SET."
2. Within five seconds, push and hold "SEEK ▼" until the correct hour appears.
3. Then press and hold "SEEK ▲" until the correct minute appears.

Seek and Scan Feature

The 2000 series radio assemblies have "SEEK" and "SCAN" features for electronic station tuning up and down the band.

Push the "SEEK ▲ or ▼" and the radio will tune to next higher or lower station with enough signal strength to be heard clearly, and stay there.

"SCAN" is a two-button sequence. To "SCAN" to the next higher station, press "SEEK ▲" and hold it there while you press "SEEK ▼." To "SCAN" to the next lower station, press "SEEK ▼" and hold it there while you press "SEEK ▲." The radio will move to the next strong station. It will pause there a few seconds, then move to the next strong station. When the radio reaches the end of the band, it will return to the other end of the band and continue to "SCAN." This will continue until the "SCAN" mode is terminated. To terminate the "SCAN" mode, press either seek up, seek down, both buttons again, or press the upper knob.

Cassette Tape Player

To play a tape, the ignition lock cylinder must be in the "ACCESSORY" or "RUN" position and the receiver/tape player must be turned on. Insert the cassette squarely through the door, exposed tape side of the cassette first. When the tape is fully inserted, the radio will turn off and the tape will begin playing.

To advance the tape, press the "▶" (forward) button. To reverse the tape, press the "◀" (reverse) button. To resume tape play from fast forward or reverse, press the "STOP-EJECT" button lightly. When the tape reaches the end of a side, it will automatically reverse and play the other side of the tape. To resume listening to the radio or to eject the tape, push the "STOP-EJECT" button.

The cassette player is turned off by ejecting the tape, turning the power knob (upper knob) or rotating the ignition lock cylinder to "LOCK," "OFF" or "START." When this occurs, the tape player will either eject the cassette automatically or the internal tape drive and roller will retract automatically. This is to protect the tape player and cassette tape.

For the best operation of the cassette player do not use cassette tapes longer than 60 minutes per side.

Tape Direction Indicators

The direction the tape is being played is indicated by indicator arrows. When the indicator arrow on the left side is on, the tape direction is to the left. When the indicator arrow on the right side is on, the tape direction is to the right.

Reversing Sides

Press the upper knob to play the other side of the tape. When the end of tape is reached, it automatically reverses direction and plays the other side.

"APS" (Automatic Program Search)

Push "APS" to go to the beginning of a new selection.

To go forward to the beginning of the next selection, push "▶." To go back to the beginning of the current selection, push "◀." Push "◀" again to go to the beginning of the previous selection.

Tape Eject Button

Press "STOP-EJECT" to eject tape or stop tape and switch to radio.

Tape Equalization Button

Select the 70 μsec (chrome or metal) tape by pressing "CrO_2" button in, or 120 μsec (standard) by leaving "CrO_2" button out.

DELCO®-GM/BOSE® MUSIC SYSTEM/COMPACT DISC (U1T)

Chevrolet

Figure 3

Radio Assembly Operation

Upper Knob

This knob turns the radio assembly on and off. Rotate knob to control volume. Press knob to silence the sound. The control ring behind the knob is the balance control. Turn the ring clockwise to move speaker balance to the right and counterclockwise to move speaker balance to the left.

Lower Knob

Rotate knob to tune radio stations manually. Press knob to alternately select AM or FM (FM1 or FM2) band. Rotate control behind lower knob to adjust the sound between front and rear speaker assemblies.

Bass and Treble Controls

Push "BASS ▲" to hear more bass and "BASS ▼" to hear less bass.

Push "TREB ▲" to hear more treble and "TREB ▼" to hear less treble.

For the clearest sound, keep both of these adjusted all the way up.

If a station is weak and noisy, push "TREB ▼" to reduce the noise.

Push Buttons

To preset five AM stations, five FM1 stations and five FM2 stations, use the following procedure:

1. Tune in desired station.
2. Push "SET." Within five seconds, push one of the five push buttons.
3. Repeat these steps for each push button.

Clock

To set the clock display, the ignition lock cylinder must be in the "ACCESSORY" or "RUN" position and the radio assembly must be off. To set the clock:

1. Press the lower knob to select AM, FM1, or FM2.
2. Push "SET."
3. Within five seconds, push and hold "SCAN" until the correct hour appears.
4. Then push and hold "SEEK ▶ or ◀" until the correct minute appears.

"SEEK"

Press "SEEK ▶ or ◀" and the radio will tune to the next higher or lower station with enough signal strength to be heard clearly, and stay there.

"SCAN"

Push "SCAN" to hear each station for a few seconds. To stop scanning, push "SCAN" again or the upper knob.

Compact Disc Player

With the radio assembly on, insert disc into slot, label side up (player pulls it in). "CD" will appear on the display and track 1 will begin to play. If disc comes back out and "ERR" appears on display, check to see if:

- Disc is upside down.
- Disc is dirty, scratched or wet.
- Too much moisture is in the air.
- Temperature is too hot or too cold.

"RCL" (Recall)

Press "RCL" to see current track number. Press "RCL" again within five seconds to see time elapsed in current track on the display.

"PREV" (Previous)

Press "PREV" to play track again. If held or pressed more than once, the disc will return to previous track. If "PREV" is pressed within eight seconds from start of track, the disc will go to the beginning of the previous track and begin to play. If "PREV" button is pressed after eight seconds into the track, the disc will go to the beginning of the current track and begin to play.

"NEXT"

Press "NEXT" when you want to hear the next track now (before the present track is finished). If "NEXT" is held or pressed more than once, the disc will advance farther.

"FWD" (Forward)

Press and hold "FWD" to quickly advance within a track. Release it to resume playing.

"REV" (Reverse)

Press and hold "REV" to return quickly to a favorite passage on the disc. Release it to resume playing.

"SCAN"

Press "SCAN" to listen to each track for about 10 seconds. To stop scanning, push "RDM" or "SCAN."

"RDM" (Random)

Press this button and the player chooses a random order of tracks to play. When the final random track has been played, the disc will play the same random selection again. Press "RDM" again for a different selection of tracks.

"COMP" (Compression)

Push "COMP" to make loud and soft passages more nearly equal in volume.

"ST-PL" (Stop/Play)

Press "ST-PL" to stop disc from playing. The radio will resume playing. "ST-PL" will also restart the disc. The disc will resume playing at the point where it stopped.

"EJCT" (Eject)

Push "EJCT" to eject disc and resume radio play.

ETR AM/FM STEREO/COMPACT DISC PLAYER (U1C)

Chevrolet Convertible

Figure 4

Radio Assembly Operation

Upper Knob

This knob turns the radio assembly on and off. Rotate knob to control volume. Press knob to silence the sound. The control ring behind the knob is the balance control. Turn the ring clockwise to move speaker balance to the right and counterclockwise to move speaker balance to the left.

Lower Knob

Rotate knob to tune radio stations manually. Press knob to alternately select AM or FM (FM1 or FM2) band. Rotate control behind lower knob to adjust the sound between front and rear speaker assemblies.

Bass and Treble Controls

Push "BASS ▲" to hear more bass and "BASS ▼" to hear less bass.

Push "TREB ▲" to hear more treble and "TREB ▼" to hear less treble.

For the clearest sound, keep both of these adjusted all the way up.

If a station is weak and noisy, push "TREB ▼" to reduce the noise.

Push Buttons

To preset five AM stations, five FM1 stations and five FM2 stations, use the following procedure:

1. Press the lower knob to select AM, FM1, or FM2.
2. Tune in desired station.
3. Push "SET." Within five seconds, push one of the five push buttons.
4. Repeat these steps for each push button.

Clock

To set the clock display, the ignition lock cylinder must be in the "ACCESSORY" or "RUN" position and the radio assembly must be off. To set the clock:

1. Push "SET."
2. Within five seconds, push and hold "SCAN ◀" until the correct hour appears.
3. Then push and hold "SEEK ▶ or ◀" until the correct minute appears.

"SEEK"

Press "SEEK ▶ or ◀" and the radio will tune to the next higher or lower station with enough signal strength to be heard clearly, and stay there.

"SCAN"

Push "SCAN" to hear each station for a few seconds. To stop scanning, push "SCAN" again or the upper knob.

Compact Disc Player

With the radio assembly on, insert disc into slot, label side up (player pulls it in). "CD" will appear on the display and track 1 will begin to play. If disc comes back out and "ERR" appears on display, check to see if:

- Disc is upside down.
- Disc is dirty, scratched or wet.
- Too much moisture is in the air.
- Temperature is too hot or too cold.

"RCL" (Recall)

Press "RCL" to see current track number. Press "RCL" again within five seconds to see time elapsed in current track on the display.

"PREV" (Previous)

Press the "PREV" to play track again. If held or pressed more than once, the disc will return to previous track. If "PREV" is pressed within eight seconds from start of track, the disc will go to the beginning of the previous track and begin to play. If "PREV" button is pressed after eight seconds into the track, the disc will go to the beginning of the current track and begin to play.

"NEXT"

Press "NEXT" when you want to hear the next track now (before the present track is finished). If "NEXT" is held or pressed more than once, the disc will advance farther.

"FWD" (Forward)

Press and hold "FWD" to quickly advance within a track. Release it to resume playing.

"REV" (Reverse)

Press and hold "REV" to return quickly to a favorite passage on the disc. Release it to resume playing.

"SCAN"

Press "SCAN" to listen to each track for about 10 seconds. To stop scanning, push "RDM" or "SCAN."

"RDM" (Random)

Press this button and the player chooses a random order to tracks to play. When the final random track has been played, the disc will play the same random selection again. Press "RDM" again for a different selection of tracks.

"COMP" (Compression)

Push "COMP" to make loud and soft passages more equal in volume.

"ST-PL" (Stop/Play)

Press "ST-PL" to stop disc from playing. The radio will resume playing. "ST-PL" will also restart the disc. The disc will resume playing at the point where it stopped.

"EJCT" (Eject)

Push "EJCT" to eject disc and resume radio play.

ETR AM/FM STEREO/CASSETTE TAPE PLAYER (UN6)

Pontiac

Figure 5

Radio Assembly Operation

Volume Knob

Push the "VOLUME" knob to turn the radio on or off. Rotate the knob to adjust sound.

"AM/FM"

Press "AM/FM" to receive either AM/FM1 or FM2. The lighted display shows the selection.

Tune Knob

Press the "TUNE" knob to release the knob. Turn the knob to choose desired radio stations. Push the "TUNE" knob back in to store it when not in use.

"RECALL"

Press "RECALL" to recall the station being played or the clock display. Press "RECALL" also to display the time when the ignition is off.

"SEEK"

Press "SEEK ▼" or "▲" and the radio will tune to the next lower or higher station and stay there.

Bass and Treble Controls

Slide the "TREBLE" lever to the right to increase treble and to the left to decrease treble. Slide the "BASS"

lever to the right to increase bass and to the left to decrease bass.

If a station is weak and noisy, move the "TREBLE" lever to the left to reduce the noise.

AMAX Stereo Certification

With an AMAX-certified receiver, the radio can produce quality AM sound comparable to FM stereo. AMAX reduces noise without reducing the high frequencies needed for the best sound. In addition to improved sound quality, AMAX includes more stations on the AM band. You don't have to do anything to a Delco® GM radio because AMAX is automatic.

Clock

To set the clock display on the radio assembly, the ignition may be off. To set the clock:

1. Press and hold "HR" (hour) until the correct hour appears.
2. Press and hold "MIN" (minute) until the correct minute appears.

There will be a two-second delay before the clock goes into the time-set mode.

Push Buttons

To preset six AM stations and six FM1 stations or six FM2 stations:

1. Press theAM/FM button to select AM, FM1, or FM2.
2. Tune in desired station.
3. Press and hold one of the six push buttons until the display shows "SET." Whenever that button is pressed, the preset station will return.

   Repeat these steps for each push button.

Speaker Adjustment

Balance Knob: Press "BAL" knob to release knob. Turn the knob to move the sound between the right and left speakers. Push "BAL" knob back in to store it when not adjusting.

Fade Knob: Press "FADE" knob to release the knob. Turn the knob to move the sound between the front and rear speakers. Push "FADE" knob back in to store it when not adjusting.

Cassette Tape Player

If "Cln" (Clean) appears on the display when you insert your cassette tape, your cassette player needs to be cleaned. It will still play cassette tapes, but it should be cleaned to prevent damage to your cassette tape and player. See "Tape Player and Cassette Care" later in this section.

After you have cleaned the cassette tape player, press and hold "EJECT" for five seconds to reset the "Cln" indicator. The radio will display "---" to show that the clean feature has been reset.

The tape player is built to work best with tapes that are 30 minutes long on each side. Tapes longer than that are so thin they may not work well in this player.

To play a tape, the ignition lock cylinder must be in the "ACCESSORY" or "RUN" position and the receiver/tape player must be turned on. Insert the cassette squarely through the door, exposed tape side of the cassette first. If you hear nothing or hear just garbled sound, it may not be in squarely. Press "EJECT" to remove the tape and start over. A cassette symbol will appear in the upper left hand corner of the display whenever a tape is inserted. When the tape is fully inserted, the radio will turn off and the tape will begin playing.

Once the tape is playing, use "VOLUME," "BAL," "FADE," "TREBLE" and "BASS" just as for the radio. The arrow shows which side of the tape is playing.

To rapidly advance the tape, press "FWD" (forward). Press "PROG" (program) or "REV" (reverse) to stop this process. The radio will play during this operation. To rapidly reverse the tape, press "REV" (reverse). Press "PROG" (program) or "REV" (reverse) again to stop this process. The radio will play during this operation.

To play the next selection, press "NEXT" or "SEEK ▲" (instead of waiting until the current selection is finished). For "NEXT" to work properly, your tape must have at least three seconds of silence between each selection. The radio will not play during this operation.

To replay the current selection, press "PREV" or "SEEK ▼." For "PREV" to work properly, your tape must have at least three seconds of silence between each selection. The radio will not play during this operation.

To switch from one side of the tape to the other or to stop the tape from searching, press the "PROG" (program) knob.

To reduce tape noise, press [Dolby®] symbol. This symbol will appear in the display.

To stop the tape player do any of the following:

- Turn the power off or turn the ignition key off. The cassette stays in the player and will resume playing at the point where it stopped.
- Press AM/FM to stop playing the cassette and switch to radio. Press "TAPE/PLAY" to restart the cassette at the point where it stopped.
- Press "EJECT" to remove the cassette or stop the cassette and switch to radio. "EJECT" will work with the ignition on or off.

Diagnostic Tape Error Indicator

When the cassette player detects a problem with the tape either just after it is loaded or while it is playing, it will attempt to work around the error. If the cassette player cannot continue to play the tape, it will eject it and switch to the radio mode.

If a problem is detected, the radio will display: the error message, the radio frequency that is playing, and the time. Each message will appear for five seconds. These error messages and their meanings are as follows: E10 - cassette too tight; E11 - cassette broken; E13 - communication problem.

This error indicator feature may not work with certain types of adapters for add-on CD players. If there is not tension on the reels of the cassette player, it will interpret the adapter as a broken tape and eject it.

ETR AM/FM STEREO/CASSETTE TAPE PLAYER WITH GRAPHIC EQUALIZER (UT6)

Pontiac

Figure 6

Radio Assembly Operation

Volume Knob

Push the "VOLUME" knob to turn the radio on or off. Rotate the knob to adjust sound.

"AM/FM"

Press "AM/FM" to receive either AM/FM1 or FM2. The lighted display shows the selection.

Tune Knob

Press the "TUNE" knob to release the knob. Turn the knob to choose desired radio stations. Push the "TUNE" knob back in to store it when not in use.

"RECALL"

Press "RECALL" to recall the station being played or the clock display. Press "RECALL" also to display the time when the ignition is off.

"SEEK"

Press "SEEK ▼" or "▲" and the radio will tune to the next lower or higher station and stay there.

AMAX Stereo Certification

With an AMAX-certified receiver, the radio can produce quality AM sound comparable to FM stereo. AMAX reduces noise without reducing the high frequencies needed for the best sound. In addition to improved sound quality, AMAX includes more stations on the AM band. You don't have to do anything to a Delco® GM radio because AMAX is automatic.

Clock

To set the clock display on the radio assembly, the ignition may be off. To set the clock:

1. Press and hold "HR" (hour) until the correct hour appears.
2. Press and hold "MIN" (minute) until the correct minute appears.

There will be a two-second delay before the clock goes into the time-set mode.

Push Buttons

To preset six AM stations and six FM1 stations or six FM2 stations:

1. Press the AM/FM button to select AM, FM1, or FM2.
2. Tune in desired station.
3. Press and hold one of the six push buttons until the display shows "SET." Whenever pressing that button, the preset station will return.

Repeat these steps for each push button.

Speaker Adjustment

Balance Knob: Press "BAL" knob to release the knob. Turn the knob to move the sound between the right and left speakers. Push "BAL" knob back in to store it when not adjusting.

Fade Knob: Press "FADE" knob to release the knob. Turn the knob to move the sound between the front and rear speakers. Push "FADE" knob back in to store it when not adjusting.

Steering Wheel Controls

Vehicles equipped with this radio have steering wheel controls for the audio system. With steering wheel controls, use the buttons on the steering wheel to:

1. Play the cassette tape player.
2. Adjust the volume.
3. Choose AM, FM1 or FM2.
4. Use the "SEEK" and "MUTE" functions.
5. Choose one of the preset stations.

Setting the Graphic Equalizer

Use the levers to set the bass, midrange and treble until you get the sound you want. The 40, 100, 250 and 625 levers adjust the bass; 1.6K is midrange, and 4K and 12K control the treble. The 1.6K lever may be set in the middle position and then the other levers may be moved up or down until a satisfactory amount of bass and treble is achieved.

Cassette Tape Player

If "Cln" (Clean) appears on the display when you insert your cassette tape, your cassette player needs to be cleaned. It will still play cassette tapes, but it should be cleaned to prevent damage to your cassette tape and player. See "Tape Player and Cassette Care" later in this section.

After you have cleaned the cassette tape player, press and hold "EJECT" for five seconds to reset the "Cln" indicator. The radio will display "---" to show that the clean feature has been reset.

The tape player is built to work best with tapes that are 30 to 45 minutes long on each side. Tapes longer than that are so thin they may not work well in this player.

To play a tape, the ignition lock cylinder must be in the "ACCESSORY" or "RUN" position and the receiver/tape player must be turned on. Insert the cassette squarely through the door, exposed tape side of the cassette first. If you hear nothing or hear just garbled sound, it may not be in squarely. Press "EJECT" to remove the tape and start over. A cassette symbol will appear in the upper left hand corner of the display whenever a tape is inserted. When the tape is fully inserted, the radio will turn off and the tape will begin playing.

Once the tape is playing, use "VOLUME," "BAL," "FADE," "TREBLE" and "BASS" just as for the radio. The arrow shows which side of the tape is playing.

To rapidly advance the tape, press "FWD" (forward). Press "PROG" (program) or "REV" (reverse) to stop this process. The radio will play during this operation. To rapidly reverse the tape, press "REV" (reverse). Press "PROG" (program) or "REV" (reverse) again to

stop this process. The radio will play during this operation.

To play the next selection, press "NEXT" or "SEEK ▲" (instead of waiting until the current selection is finished). For "NEXT" to work properly, your tape must have at least three seconds of silence between each selection. The radio will not play during this operation.

To replay the current selection, press "PREV" or "SEEK ▼." For "PREV" to work properly, your tape must have at least three seconds of silence between each selection. The radio will not play during this operation.

To switch from one side of the tape to the other or to stop the tape from searching press the "PROG" (program) knob.

To reduce tape noise, press [Dolby®] symbol. This symbol will appear in the display.

To stop the tape player do any of the following:

- Turn the power off or turn the ignition key off. The cassette stays in the player and will resume playing at the point where it stopped.
- Press AM/FM to stop playing the cassette and switch to radio. Press "TAPE/PLAY" to restart the cassette at the point where it stopped.
- Press "EJECT" to remove the cassette or stop the cassette and switch to radio. "EJECT" will work with the ignition or radio off.

Diagnostic Tape Error Indicator

When the cassette player detects a problem with the tape either just after it is loaded or while it is playing, it will attempt to work around the error. If the cassette player cannot continue to play the tape, it will eject it and switch to the radio mode.

If a problem is detected, the radio will display: the error message, the radio frequency that is playing, and the time. Each message will appear for five seconds. These error messages and their meanings are as follows: E10 - cassette too tight; E11 - cassette broken; E13 - communication problem.

This error indicator feature may not work with certain types of adapters for add-on CD players. If there is not tension on the reels of the cassette player, it will interpret the adapter as a broken tape and eject it.

ETR AM/FM STEREO/COMPACT DISC PLAYER (U1C)

Pontiac

Figure 7

Radio Assembly Operation

Volume Knob

Push the "VOLUME" knob to turn the radio on or off. Rotate the knob to adjust sound.

"AM/FM"

Press "AM/FM" to receive either AM/FM1 or FM2. The lighted display shows the selection.

Tune Knob

Press the "TUNE" knob to release the knob. Turn the knob to choose desired radio stations. Push the "TUNE" knob back in to store it when not in use.

"RECALL"

Press "RECALL" to recall the station being played or the clock display. Press "RECALL" also to display the time when the ignition is off.

"SEEK"

Press "SEEK ▼" or "▲" and the radio will tune to the next lower or higher station and stay there.

AMAX Stereo Certification

With an AMAX-certified receiver, the radio can produce quality AM sound comparable to FM stereo. AMAX reduces noise without reducing the high frequencies needed for the best sound. In addition to improved sound quality, AMAX includes more stations on the AM band. You don't have to do anything to a Delco® GM radio because AMAX is automatic.

Bass and Treble Controls

Slide the "TREBLE" lever to the right to increase treble and to the left to decrease treble. Slide the "BASS" lever to the right to increase bass and to the left to decrease bass.

If a station is weak and noisy, move the "TREBLE" lever to the left to reduce the noise.

Clock

To set the clock display on the radio assembly, the ignition may be off. To set the clock:

1. Press and hold "HR" (hour) until the correct hour appears.
2. Press and hold "MIN" (minute) until the correct minute appears.

There will be a two-second delay before the clock goes into the time-set mode.

Push Buttons

To preset six AM stations and six FM1 stations or six FM2 stations:

1. Press the AM/FM button to select AM, FM1, or FM2.
2. Tune in desired station.
3. Press and hold one of the six push buttons until display shows "SET." Whenever pressing that button, the preset station will return.

Repeat these steps for each push button.

Speaker Adjustment

Balance Knob: Press "BAL" knob to release the knob. Turn the knob to move the sound between the right and left speakers. Push "BAL" knob back in to store it when not adjusting.

Fade Knob: Press "FADE" knob to release the knob. Turn the knob to move the sound between the front and rear speakers. Push "FADE" knob back in to store it when not adjusting.

Compact Disc Player

With the radio assembly on, insert the disc into the slot, label side up (player pulls it in). "CD" will appear on the display and track 1 will begin to play. If the disc comes back out and "ERR" appears on display, check to see if:

- Disc is upside down.
- Disc is dirty, scratched or wet.
- Too much moisture is in the air.
- Temperature is too hot or too cold.

"RECALL"

Press "RECALL" to see current track number. Press "RECALL" again within five seconds to see time elapsed in current track on the display. The track number also appears when the disc is inserted.

"PREV" (Previous)

Press "PREV" to play track again. If held or pressed more than once, the disc will return to previous track. If "PREV" is pressed within eight seconds from start of track, the disc will go to the beginning of the previous track and begin to play. If "PREV" button is pressed after eight seconds into the track, the disc will go to the beginning of the current track and begin to play.

To Play Next Selection

Press "NEXT" or "SEEK ▲" when you want to hear the next track now (before the present track is finished). If "NEXT" or "SEEK ▲" is held or pressed more than once, the disc will advance farther.

To Replay Current Selection

Press "PREV" or "SEEK ▼" to play a track again. If you press and hold these buttons or press more than once, the disc will return to previous tracks.

"FWD" (Forward)

Press and hold "FWD" to advance quickly within a track. Release it to resume playing. The radio will play during this operation.

"REV" (Reverse)

Push "REV" and hold it to return quickly to a favorite passage on the disc. Release it to resume playing.

"RDM" (Random)

Press this button and the player chooses a random order of tracks to play. When the final random track has been played, the disc will play the same random selection again. Press "RDM" again for a different selection of tracks.

To Stop Disc Player

Any of the following steps will stop the disc player:

- Turn the power off or turn the ignition key off. The disc stays in the player and will resume playing at the point where it stopped.
- Press "AM/FM" to stop playing the disc and switch to the radio. Press "CD/PLAY" to restart the disc at the point where it stopped.
- Press "EJECT" to eject the disc or stop the disc and switch to radio. "EJECT" will work with the ignition or radio off.

ETR AM/FM STEREO/COMPACT DISC PLAYER WITH GRAPHIC EQUALIZER (UP3)

Pontiac

Figure 8

Radio Assembly Operation

Volume Knob

Push the "VOLUME" knob to turn the radio on or off. Rotate the knob to adjust sound.

"AM/FM"

Press "AM/FM" to receive either AM/FM1 or FM2. The lighted display shows the selection.

Tune Knob

Press the "TUNE" knob to release the knob. Turn the knob to choose desired radio stations. Push the "TUNE" knob back in to store it when not in use.

"RECALL"

Press "RECALL" to recall the station being played or the clock display. Press "RECALL" also to display the time when the ignition is off.

"SEEK"

Press "SEEK ▼" or "▲" and the radio will tune to the next lower or higher station and stay there.

AMAX Stereo Certification

With an AMAX-certified receiver, the radio can produce quality AM sound comparable to FM stereo. AMAX reduces noise without reducing the high frequencies needed for the best sound. In addition to improved sound quality, AMAX includes more stations on the AM band. You don't have to do anything to a Delco® GM radio because AMAX is automatic.

Clock

To set the clock display on the radio assembly, the ignition may be off. To set the clock:

1. Press and hold "HR" (hour) until the correct hour appears.
2. Press and hold "MIN" (minute) until the correct minute appears.

There will be a two-second delay before the clock goes into the time-set mode.

Push Buttons

To preset six AM stations and six FM1 stations or six FM2 stations:

1. Press the AM/FM button to select AM, FM1, or FM2.
2. Tune in desired station.
3. Press and hold one of the six push buttons until display shows "SET." Whenever pressing that button, the preset station will return.

Repeat these steps for each push button.

Speaker Adjustment

Balance Knob: Press "BAL" knob to release the knob. Turn the knob to move the sound between the right and left speakers. Push "BAL" knob back in to store it when not adjusting.

Fade Knob: Press "FADE" knob to release the knob. Turn the knob to move the sound between the front and rear speakers. Push "FADE" knob back in to store it when not adjusting.

Steering Wheel Controls

Vehicles equipped with this radio have steering wheel controls for the audio system. With steering wheel controls, use the buttons on the steering wheel to:

1. Play the compact disc player.
2. Adjust the volume.
3. Choose AM, FM1 or FM2.
4. Use the "SEEK" and "MUTE" functions.
5. Choose one of the preset stations.

Setting the Graphic Equalizer

Use the levers to set the bass, midrange and treble until you get the sound you want. The 40, 100, 250 and 625 levers adjust the bass; 1.6K is midrange, and 4K and 12K control the treble. The 1.6K lever may be set in the middle position and then the other levers may be moved up or down until a satisfactory amount of bass and treble is achieved.

Compact Disc Player

With the radio assembly on, insert the disc into the slot, label side up (player pulls it in). "CD" will appear on the display and track 1 will begin to play. If the disc comes back out and "ERR" appears on display, check to see if:

- Disc is upside down.
- Disc is dirty, scratched or wet.
- Too much moisture is in the air.
- Temperature is too hot or too cold.

"RECALL"

Press "RECALL" to see current track number. Press "RECALL" again within five seconds to see time elapsed in current track on the display. The track number also appears when the disc is inserted.

"PREV" (Previous)

Press "PREV" to play track again. If held or pressed more than once, the disc will return to previous track. If "PREV" is pressed within eight seconds from start of track, the disc will go to the beginning of the previous track and begin to play. If "PREV" button is pressed after eight seconds into the track, the disc will go to the beginning of the current track and begin to play.

To Play Next Selection

Press "NEXT" or "SEEK ▲" when you want to hear the next track now (before the present track is finished). If "NEXT" or "SEEK ▲" is held or pressed more than once, the disc will advance farther.

To Replay Current Selection

Press "PREV" or "SEEK ▼" to play a track again. If you press and hold these buttons or press more than once, the disc will return to previous tracks.

"FWD" (Forward)

Press and hold "FWD" to advance quickly within a track. Release it to resume playing. The radio will play during this operation.

"REV" (Reverse)

Push "REV" and hold it to return quickly to a favorite passage on the disc. Release it to resume playing.

"RDM" (Random)

Press this button and the player chooses a random order of tracks to play. When the final random track has been played, the disc will play the same random selection again. Press "RDM" again for a different selection of tracks.

To Stop Disc Player

Any of the following steps will stop the disc player:

- Turn the power off or turn the ignition key off. The disc stays in the player and will resume playing at the point where it stopped.
- Press "AM/FM" to stop playing the disc and switch to the radio. Press "CD/PLAY" to restart the disc at the point where it stopped.
- Press "EJECT" to eject the disc or stop the disc and switch to radio. "EJECT" will work with the ignition or radio off. Press "EJECT" to load a disc when the radio is off.

SETTING RADIO ANTI-THEFT FEATURE

Delco®-Loc II and Theftlock is a security feature which can be used or ignored. If ignored, the radio assembly will play normally. If used, the radio assembly will be useless if stolen because it won't turn on.

This is how to enter a secret code into the radio assembly. If battery power is lost for any reason, the secret code must be entered again before the radio assembly will turn on.

Delco®-Loc II

Chevrolet

1. Write down any 6-digit number and keep in safe place.
2. Turn ignition to "ACCESSORY" or "RUN" position.
3. Turn the volume control knob to the left to turn radio assembly off.
4. Press buttons "1" and "4" together and hold until "---" shows on display.
5. Do not wait more than 15 seconds between each step.
6. Press "SET" and "000" appears on the display.

7. Press "SCAN" and hold until first digit of code appears.
8. Press "SEEK ◀ or ▶" to make second and third digits appear.
9. Press the lower knob (tune knob) ("000" appears).
10. Press "SCAN" and hold until fourth digit of code appears.
11. Press "SEEK ◀ or ▶" to make last two digits of code appear.
12. Press the lower knob (tune knob) ("rEP" appears for 5 seconds, then "000" appears).
13. For verification, repeat steps 7 through 11. Next, press the lower knob (tune knob). "SEC" will then be seen on display, meaning radio assembly is secured. If the display shows "---", the verification steps were not successful and the entire sequence must be repeated from step 6.

Theftlock

Pontiac

The instructions below explain how to enter a security code into the system. If the vehicle loses battery power for any reason, the security code must be entered again before the system will turn on.

1. Write down any number from 000 to 1999 and keep it in a safe place.
2. Turn ignition switch to the "ACCESSORY" or "RUN" position.
3. Turn audio system off.
4. Press and hold pushbuttons "1" and "4" together until "---" shows on the display.

You are now ready to enter the security code, pausing no more than 15 seconds between steps.

5. Press "MIN" and "000" will appear on the display.
6. Press "MIN" again and hold until the last two digits of the code appear. Release button.
7. Press "HR" until the first one or two digits of the code appear.
8. Press "AM/FM;" "rEP" will appear on the display.
9. Repeat steps 5 through 7.
10. Press "AM/FM," "SEC" will appear on the display. This means that the audio system is secured.

The indicator light will also flash when the ignition is off. If the display shows "---", the verification steps were not successful and the entire sequence must be done over.

UNLOCKING SECURED RADIO ASSEMBLY

Theftlock

Pontiac

If the audio system is secured ("SEC" shows on the display) and you wish to disable it, enter the security code as follows, pausing no more than 15 seconds between steps:

1. Turn ignition on. Make sure audio system is off. The time will show on the display.
2. Press pushbuttons "1" and "4" together until "SEC" shows on the display.
3. Press "MIN" and "000" will appear on the display.
4. Press "MIN" again and hold until the last two digits of the code appear. Release the button.
5. Press "HR" until the first one or two digits appear.
6. Press "AM/FM." If "---" shows, you have shut off the theft-deterrent feature. If "SEC" shows, the audio system is still secured.

Important

- If the security code is lost or forgotten, contact the dealer for assistance.

UNLOCKING SECURED RADIO ASSEMBLY AFTER POWER LOSS

When battery power is reapplied to a secured radio assembly, the radio assembly won't turn on and "LOC" appears on the display. Enter the secret customer or factory backup code as follows (do not pause more than 15 seconds between steps):

Delco®-Loc II

Chevrolet

1. Turn ignition to "ACCESSORY" or "RUN" position.
2. Press "SET" and "000" appears on display.
3. Press "SCAN" and hold until first digit of secret code appears.
4. Press "SEEK ◀ or ▶" to make second and third digits of code appear.
5. Press the lower knob (tune knob) and "000" appears on display.
6. Press "SCAN" and hold until fourth digit of secret code appears.
7. Press "SEEK ◀ or ▶" to make fifth and sixth digits of code appear.
8. Press the lower knob (tune knob). If the unlock sequence was successful, the display will show the "Time of Day (CLOCK)," indicating the radio is operational and in the SECURED mode. If "LOC" shows, the numbers did not match and the unit is still locked. Repeat steps 2 through 8.

Theftlock

Pontiac

If power is disrupted to the audio system while in the "SEC" mode, the unit will not work and "LOC" will show on the display whenever the ignition is on. To unlock the unit (with the ignition in "ACC" or "RUN" position and radio off):

1. Press "MIN" and "000" will appear on the display.
2. Press "MIN" again and hold until last two digits of the code appear. Release the button.

3. Press "HR" until the first one or two digits appear.
4. Press "AM/FM" and "SEC" will appear and the unit will work. If "LOC" shows, the numbers did not match and the unit is still locked.

DETERMINING FACTORY BACKUP UNLOCKING CODE FOR SECURED RADIO ASSEMBLY

If the security is activated and the radio assembly is disconnected from battery power, the radio assembly will display "LOC." The radio assembly will not turn on until the correct unlocking code is entered. If the customer code is lost or unavailable, use the following procedures to determine the factory backup code. This procedure requires a tone dialing telephone.

Delco®-Loc II

Chevrolet

1. Turn ignition to "ACCESSORY" or "RUN" position.
2. Press and hold "COMP" and "RDM" (push buttons 2 and 3). After three seconds, digits 1 through 3 of radio identification number will be displayed. Write them down.
3. Press lower knob (tune knob). Digits 4 through 6 of radio identification number will be displayed. Write them down.
4. Using tone dialing telephone, call 1-800-537-5140 (U.S. and Canada) or (317) 451-8965.
5. When computer advises, enter dealer code or radio shop account number using telephone keypad, then press "*".
6. When advised, enter six-digit radio identification number obtained in steps 2 and 3, then press "*". Computer will respond with unlocking code. Write it down.
7. To unlock secured radio, refer to "Unlocking Secured Radio Assembly after Power Loss" in this section.

Theftlock

Pontiac

1. Turn ignition to "ACCESSORY" or "RUN" position and turn radio off.
2. If the unit is in the locked condition ("LOC" is displayed), skip this step. Otherwise, depress preset buttons 1 ("PREV") and 4 for five seconds. The display will show either "---" (unsecured state) or "SEC" (secured state).
3. Depress preset buttons 2 ("NEXT") and 3 for five seconds. Display will show first three digits of factory code. Write them down.
4. Depress "AM/FM" button. Display will show second three digits of factory code. Write them down.
5. Depress "AM/FM" button. Unit will display either "LOC," "SEC" or "---" depending on state unit is in. Unit will revert to initial display prior to code retrieval sequence after 15 seconds or any operator interaction.
6. Using tone dialing telephone, call 1-800-537-5140 (U.S. and Canada) or (317) 451-8965.
7. When computer advises, enter dealer code or radio shop account number using telephone keypad, then press "*"
8. When advised, enter six-digit radio identification number obtained in steps 2 and 3, then press "*". Computer will respond with unlocking code. Write it down.
9. To unlock secured radio, refer to "Unlocking Secured Radio Assembly after Power Loss" in this section.

DIAGNOSIS

AUDIO SYSTEM DIAGNOSIS

For information on audio system diagnosis, refer to SECTION 8A.

- Check for proper torque at antenna base to ensure proper ground.

RADIO FIXED ANTENNA ASSEMBLY DIAGNOSIS

Unplug antenna lead-in at back of radio assembly and plug a test antenna into the radio assembly. Make sure test antenna base is grounded to the vehicle chassis and keep hands off of antenna. Check radio reception in an area away from electrical interferences. These include tall buildings, metal structures, power lines, fluorescent lighting and power tools. Tune to high and low ends of the dial on both AM and FM, checking weak and strong station reception. If reception is OK, problem exists with antenna assembly and/or its lead-in cable. If reception is still poor, refer to SECTION 8A.

RADIO POWER ANTENNA ASSEMBLY MOUNTING AND CONNECTIONS

Poor grounding of the radio power antenna assembly, either at the antenna assembly mounting or at any other connection in the antenna/lead-in system, can result in seriously reduced radio assembly performance. A poor ground can cause excess ignition noise in AM reception and erratic audio.

To check for a poor ground of the radio power antenna mast, perform the following:

1. Fully lower antenna assembly.
2. Disconnect antenna motor electrical connector.
3. Remove escutcheon from fender assembly.
4. Attach alligator clips to upper end of mast to act as antenna. Leave other end of clip unattached.
5. Tune radio assembly for weak AM station or signal which is dependent on clip, i.e., clip attached, station is present; clip removed, no station.
6. Remove clip.
7. Ground upper end of mast to body.
8. If radio station is not received, then antenna grounds are good. If station is still present or stronger, a poor ground or no ground connection is preset in system.

Possible ground loss points are:

- Antenna assembly upper mounting (bolts/screws loose, paint overspray).
- Coaxial connector at antenna assembly (if applicable) loose or corroded. Remove to inspect inside connector for corrosion.
- Coaxial connector at extension cable (if applicable) loose.
- Coaxial connector at radio assembly loose or corroded.
- Antenna harness connector corroded.

RADIO POWER ANTENNA LEAD-IN CABLE CHECK

Figure 9

Usually, symptoms of a broken center conductor of the lead-in cable will result in no AM and weak FM. In case of continued reception or noise complaints, always check the lead-in with a multimeter. The chart and diagram in Figure 9 show accurate readings. When checking resistance, cautiously wiggle the lead-in tip and cable. If the readings shown in Figure 9 are not obtained, some portion of the lead-in is intermittent and the lead-in should be replaced.

RADIO POWER ANTENNA ASSEMBLY CHECK

Figure 10

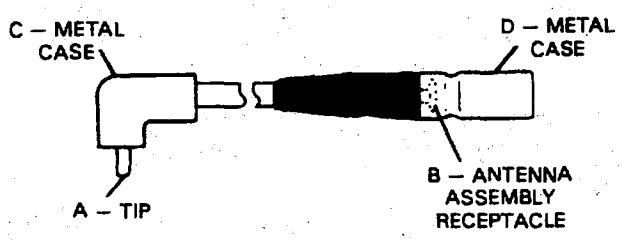
Improperly grounded antenna assemblies are usually the cause of poor reception or noise complaints. To assure a good ground, a braided ground strap should be connected from the housing case to chassis ground.

After checking and repairing the antenna assembly, always make sure lead-in connector(s) are dirt and corrosion free, and are tightly fastened.

The antenna assembly can be checked by using a multimeter. With the probes fastened to each point as shown in Figure 10, wiggle the separate antenna assembly sections and antenna housing case. With a properly grounded antenna assembly, the readings shown should always be obtained. If not, replace the antenna assembly. Refer to "Radio Power Antenna Assembly" under "On-Vehicle Service" in this section.

Moisture in Radio Power Antenna Assembly Tube

Weak reception or fading may be caused by moisture in the support tube, due to condensation or leakage through the insulation bushings. If trouble has been traced to moisture in the tube, the antenna assembly must be removed, disassembled, and thoroughly cleaned. All moisture can be removed by blowing out with compressed air, then pushing a clean dry cloth through the support tube as far as possible Before assembling antenna assembly, check drain holes in motor housing to be sure they are not obstructed.



OHMMETER PROBES AT POINTS:	RESISTANCE MEASURED IN OHMS
A AND B	LESS THAN 0.5*
C AND D	LESS THAN 0.5
A AND D	INFINITE
C AND B	INFINITE
A AND C	INFINITE
B AND D	INFINITE

*ON SOME LONG LENGTHS OF LEAD-INS, SUCH AS RADIO POWER ANTENNA ASSEMBLIES, CAPACITANCE IS ADDED IN THE TIP. THIS RESULTS IN A RESISTANCE READING OF APPROXIMATELY 100,000 OHMS.

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Figure 9 – Lead-In Cable Diagnosis

RADIO SPEAKER DIAGNOSIS (CASSETTE ONLY)

Tools required:
J 39916 Speaker Diagnostic Test Tape Kit

Important

- Always compare the front speakers to front, and rear speakers to rear. Do not compare front speaker to rear speaker because they could be different speakers or their mounting environment could cause them to sound different.

Tones are used to test and evaluate coaxial speakers or other complex speaker systems. There are three basic tones used, 50 Hz tone, 500 Hz warble tone, and 9k Hz spectral tone. The combination tone is a blend of the above three tones.

Bass/Sub-woofer Test (50 Hz sine tone)

The 50 Hz tone is used to evaluate the bass response of an audio system. This tone is also helpful in evaluating audio systems which have separate subwoofer amplifiers and speakers.

Midrange Speaker Test (500 Hz warble tone)

The 500 Hz warble tone is used for the evaluation of midrange speaker response. This tone is qualified as a warble tone because it has different audio characteristics than a sine tone. This tone produces a warble sound. At these tone midrange frequencies, it is better to use a warble tone than a sine wave because the location of a

warble tone source, such as a speaker, is easier to identify. A normal sine tone can set up a standing wave within a vehicle which can make it difficult to determine its source location.

Tweeter Test (9k Hz spectral tone)

The 9k Hz spectral tone is used for tweeter or high frequency evaluation. This tone is a section of frequencies of equal amplitudes ranging from 8.5k Hz - 9.5k Hz. This sounds like a group of crickets chirping. This type of tone is used for two reasons. One, much like a warble tone, it is easy to locate its source, and two, this type of tone is easier to identify for those people with high end hearing loss problems.

All Speaker Test

The combination tone can be used for numerous audio problems such as distorted or no sound from speaker(s). When using the combination tone, comparative AC voltage measurements can be made on the speaker terminals, provided the fade and balance controls are in the detent position. With these voltage measurements, a determination can be made in the diagnosis of speaker or amplifier.

Speaker/Grill Rattle Test (50 Hz to 8k Hz swept sine)

The next portion of the tape can be used to diagnose speaker and grill rattles. The first test is two tones played back to back. The second test is a variable frequency tone, but frequency change is at a much slower rate. Both tests can be used to repair a speaker rattle or buzz. If the problem has already been isolated, the fade and balance controls can be set to the proper location and the test tones can be played in the specific problem area.

Motor Speed Test

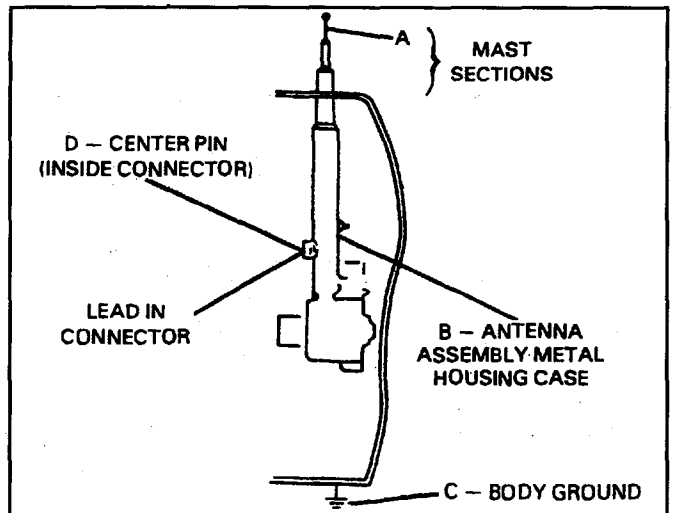
There is a two minute time period marked in this section of tape for the purpose of checking the cassette tape motor speed. This portion of the diagnostic tape can be used to verify complaints of abnormal sound from the cassette tape player. In some cases, improper tape motor speed can cause audio abnormalities. If the time taken for this is between one minute and fifty-six seconds to two minutes and one second, the tape motor speed is within tolerance.

Tape Cleaning Procedures

The recommended time for cleaning is every fifteen hours for best performance and every fifty hours to prevent damage to the tape head. The preferred tape cleaner is available as a part of the Audio System Kit P/N J 39916.

Noise Diagnosis (Dead Space)

This portion can be used for noise diagnosis such as alternator whine, switch pops, etc. which can be more easily detected during dead space (blank space in between songs). This portion of the diagnostic tape may be used in conjunction with noise diagnosis in Section 8A.



OHMMETER PROBES AT POINTS:	RESISTANCE MEASURED IN OHMS*
A AND D	LESS THAN 0.5
B AND C	LESS THAN 1.0
A AND C	INFINITE

*FOR BEST RESULTS, USE A DIGITAL OHMMETER.

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Figure 10 – Antenna Assembly Diagnosis (Typical)

ON-VEHICLE SERVICE

TAPE PLAYER AND CASSETTE CARE

Tape Head and Capstan Cleaning

Figure 11

Two parts should be cleaned on the tape player, the head and the capstan. Since they can be reached through the tape door, leave the tape player in the vehicle. This service should be performed every 50 hours of cassette operation.

To clean the head and capstan, use a cotton swab dipped in rubbing alcohol.

A cassette cleaning kit may also be used to clean the head and capstan. Follow instructions on the kit to clean the tape player.

Do not contact the tape head with magnetized tools. If the head becomes magnetized, it will degrade every cassette played in the player.

The Pontiac tape deck has an added function that helps prevent damage if the cassette tape would break or become jammed. This tape deck may eject the scrubbing-type cleaning cartridge after about five seconds. Therefore, it may be necessary to insert the scrubbing-type cleaner at least three times to thoroughly clean the deck.

A non-scrubbing, wet type tape cleaner could be used in replace of the scrubbing-type. This type uses a fabric belt in place of the tape and will not eject after five seconds. However, it may not provide as thorough a cleaning as the scrubbing-type cleaner.

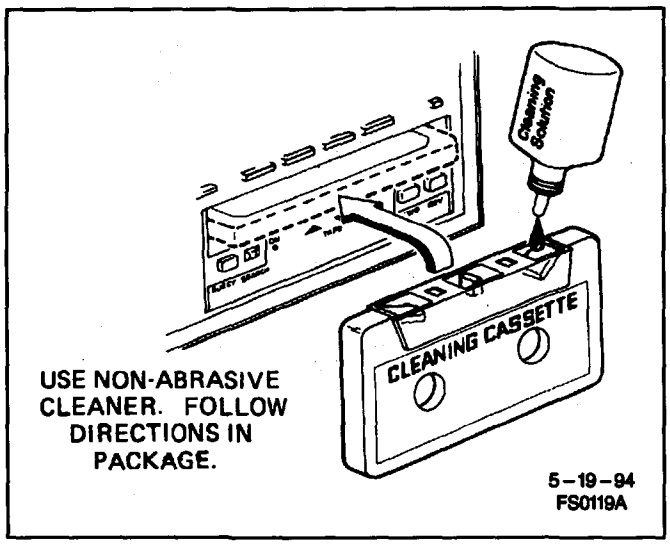


Figure 11 – Cleaning Cassette Player

No service is performed on the cassettes. The cassette manufacturer handles warranties of cassettes. The test cassette used by the dealer should be stored in its container to keep the tape clean. Store cassette away from extreme heat and direct sunlight.

RADIO POWER ANTENNA ASSEMBLY CARE

Periodic cleaning may be necessary to assure proper radio power antenna assembly operation.

Cleaning the radio power antenna assembly:

1. Actuate antenna assembly to full extension.
2. Dampen clean cloth with mineral spirits.
3. Wipe cloth over antenna sections removing any dirt.
4. Actuate antenna assembly through one complete cycle (retract and extend).
5. Repeat steps 1 through 4 at least two more times.

COMPACT DISC CARE

Handle discs carefully. Store in protective case away from sun, heat and dust. If surface is soiled, dampen a clean, soft cloth in a solution of mild neutral detergent and wipe clean. Mini discs called "singles" (about 3 inches in diameter) will not eject and should not be used.

RADIO ASSEMBLY

Refer to SECTION 8C for removal and installation procedures.

SPEAKER ASSEMBLIES

For removal and installation of radio front side door speakers, refer to SECTION 10-6. For removal and installation of rear speaker assemblies (including the Bose amplifier), refer to SECTION 10-7.

Important

- All Delco® sound systems have ungrounded speakers. Installing add-on tape players, CBs or other units which use the vehicle speakers may damage your Delco® sound system, and is not recommended.

RADIO SUPPRESSION EQUIPMENT

When installing a new radio assembly, or when noise is a problem, ensure that radio suppression equipment is present and properly installed. Refer to "Noise Diagnostic Charts" in SECTION 8A for determining locations.

RADIO FIXED ANTENNA ASSEMBLY

Figure 12

Tool Required:

J 38536-A Antenna Bezel Socket

Remove or Disconnect

1. Using J 38536-A loosen nut (2).
2. Antenna base (3) from spare tire bracket.
3. Nut (2) and bezel (1).
4. Top of antenna base (3) from rear quarter panel
5. Cable (4) from antenna base (3).

Install or Connect

CAUTION; If substituting an antenna or cable, be sure to use a barbless-type connector. Incorrect connectors may cause poor reception or damage to connectors.

NOTICE: See "Notice" on page 9A-1 of this section.

1. Cable (4) into antenna base (3).
2. Top of antenna base (3) into hole in rear quarter panel.
3. Bezel (1) to antenna base (3) and secure with nut (2) (finger tighten only).

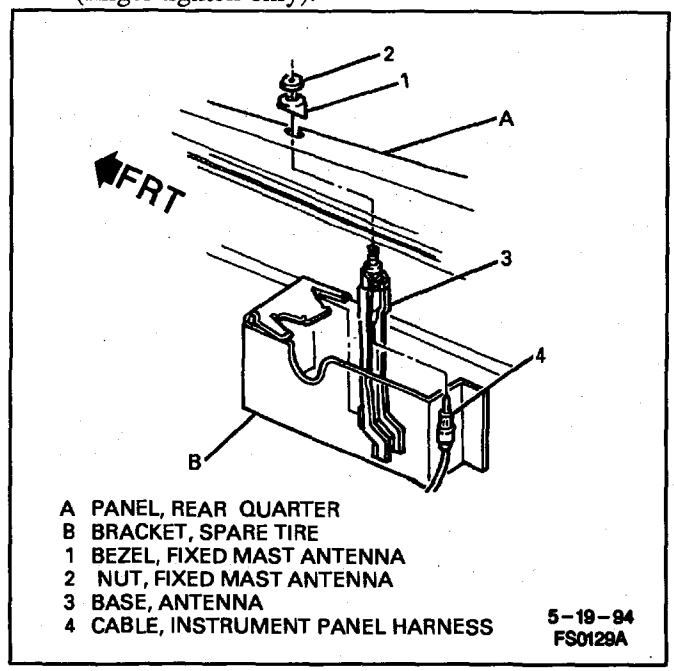


Figure 12 – Radio Fixed Antenna Mounting

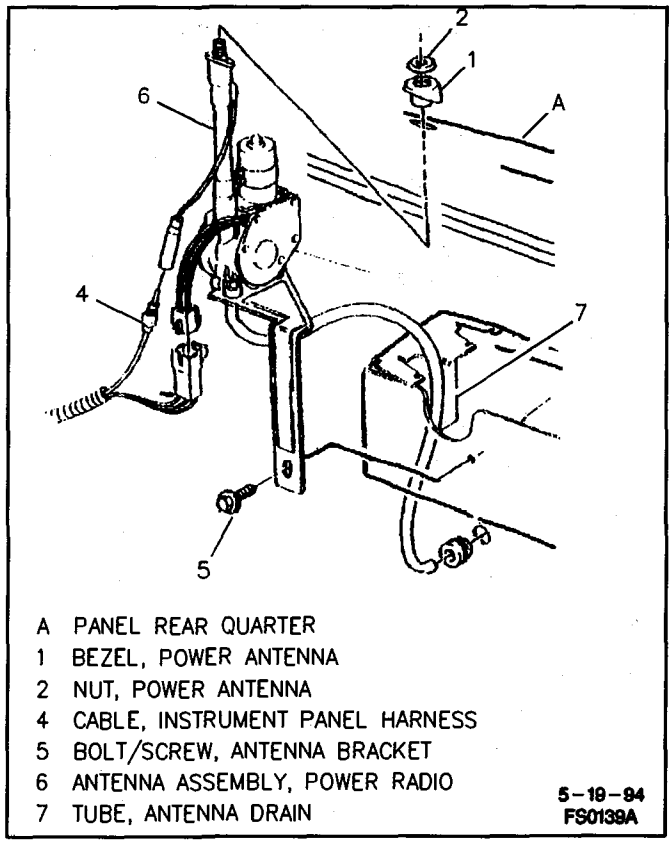


Figure 13 – Radio Power Antenna Mounting (Chevrolet Shown – Pontiac Similar)

4. Bottom of antenna base (3) into spare tire bracket.

Tighten

- Nut (2) to 3 N•m (34 lb. in.) using J 38536-A.

RADIO POWER ANTENNA ASSEMBLY

Pontiac

Figure 13

Tool Required:

J 38536 Antenna Bezel Socket

Remove or Disconnect

1. Quarter inner rear trim finishing panel assembly. Refer to SECTION 10-7.
2. Jack and spare tire assembly. Refer to SECTION 3E.
3. Cable (4) from antenna cable connector.
4. Electrical connector from power antenna assembly (6).
5. Nut (2) from power antenna assembly (6) using J 38536.
6. Bezel (1) from power antenna assembly (6).
7. Drain tube and grommet (7) from rear quarter panel.
8. Bolt/screw (5) from power antenna assembly (6) and spare tire bracket.
9. Power antenna assembly (6).

Install or Connect

NOTICE: See "Notice" on page 9A-1 of this section.

1. Power antenna assembly (6).
2. Bolt/screw (5) to power antenna assembly (6) and spare tire bracket.

Tighten

- Bolt/screw (5) to 5 N•m (44 lb. in.)

3. Drain tube and grommet (7) to rear quarter panel.
4. Bezel (1) to power antenna assembly (6).
5. Nut (2) to power antenna assembly (6) using J 38536.

Tighten

- Nut (3) to 3 N•m (34 lb. in.).

6. Electrical connector to power antenna assembly (6).
7. Cable (4) to antenna cable connector.
8. Jack and spare tire assembly. Refer to SECTION 3E.
9. Quarter inner rear trim finishing panel assembly. Refer to SECTION 10-7.

RADIO POWER ANTENNA ASSEMBLY MAST

Pontiac

Figures 14 and 15

Tool Required:

J 38536 Antenna Bezel Socket

Remove or Disconnect

1. Antenna nut (2) using J 38536.

Important

- Do not pull antenna mast (10) by hand to remove it.

2. Antenna mast (10).
   A. Turn on ignition switch and radio assembly.
   B. Remove antenna mast (10) and contact spring (9).
      - Note orientation of serrated side of plastic cable for proper placement during installation.

Clean

- Contact spring (9) with contact cleaner.

Install or Connect

NOTICE: See "Notice" on page 9A-1 of this section.

NOTICE: Serrated side of plastic cable must face antenna motor. Plastic cable could be damaged if not properly oriented.

1. New antenna mast (10) into antenna housing.

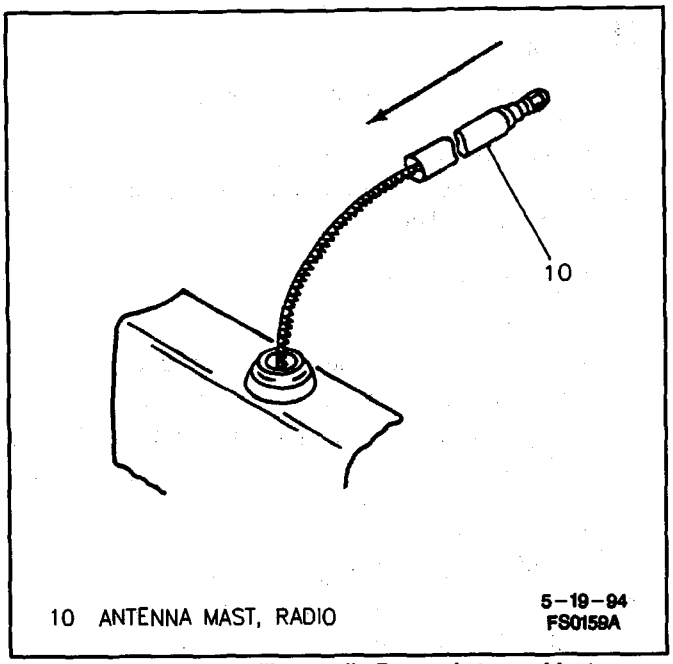


Figure 15 – Installing Radio Power Antenna Mast

A. Insert plastic cable into housing oriented as noted during removal, and stop when resistance is felt (approximately 30 cm [12 inches]).

B. Turn ignition switch to "OFF" position so that plastic cable retracts into housing and catches onto gear mechanism of drum housing.

C. If plastic cable does not retract into housing, rotate cable clockwise and/or counterclockwise until cable retracts into housing with motor operating.

2. Contact spring (9) onto antenna mast (10).
   - Make certain flanged end of contact spring (9) faces upward.
3. Antenna nut (3) using J 38536.

Tighten

- Antenna nut (2) to 3 N•m (34 lb. in.).

Inspect

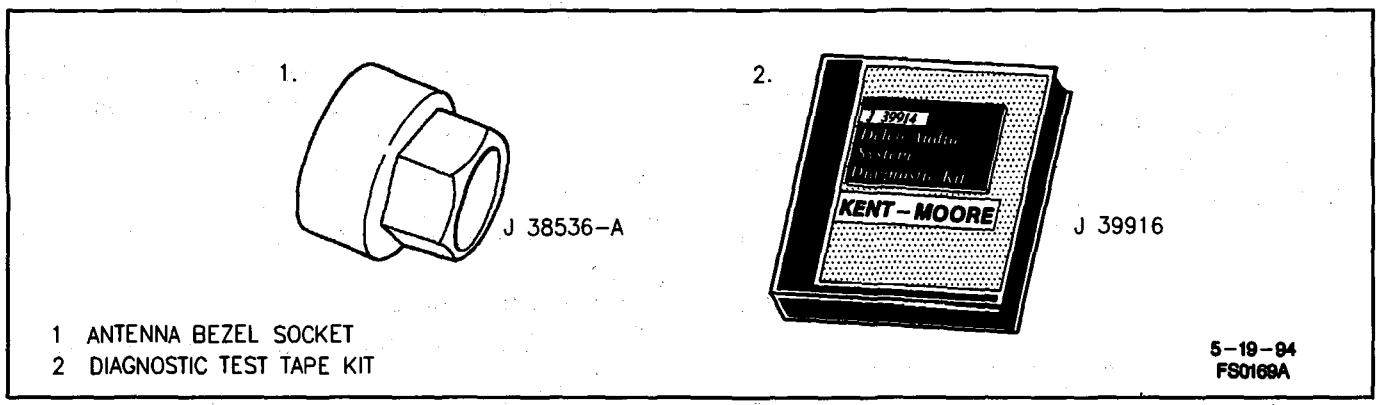
- Antenna assembly operation.
  - Cycle antenna assembly several times. Antenna mast (10) may only extend or retract halfway. Continue to operate antenna assembly until antenna mast (10) will fully extend and retract.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Radio Antenna Nut	3 N•m (34 lb. in.)
Radio Antenna Bracket Bolt/Screw	5 N•m (44 lb. in.)

SPECIAL TOOLS



SECTION 9B

CRUISE CONTROL

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

Cruise control is a speed control system that maintains a desired vehicle speed under normal driving conditions. However, steep grades up or down may cause variations in the selected speeds. The electronic cruise control system has the capability to cruise, coast, resume speed, accelerate, and raise "tap-up" or lower "tap-down." Set speed in increments of 1.6 km/h (1 mph) when tapping-up or tapping-down.

The main parts of the cruise control system are the functional control switches, cruise control module assembly, vehicle speed sensor assembly, cruise control release switch, stoplamp and torque converter clutch (TCC) switch, and clutch (5.7L LT1 engine) or clutch anticipate (3.4L L32 engine) switch assemblies.

The cruise control system uses a cruise control module assembly to obtain the desired vehicle cruise operation. Two important components in the module assembly help to do this. One is an electronic controller and the second is an electric stepper motor. The controller monitors vehicle speed and operates the electric stepper motor. The motor moves a ribbon and throttle linkage, in response to the controller, to maintain the desired cruise speed. The cruise control module assembly contains a low speed limit which will prevent system engagement below a minimum speed of 40 km/h (25 mph). The operation of the controller is controlled by functional control switches located on the turn signal and headlamp dimmer switch and cruise control actuator and windshield wiper and windshield washer lever assembly.

Cruise control release switch, stoplamp and TCC switch, and clutch or clutch anticipate switch assemblies are provided to disengage the cruise system. The switch assemblies are mounted on the brake and accelerator and clutch pedal bracket. When the brake pedal or clutch pedal is depressed, the cruise control system is electrically disengaged and the throttle is returned to the idle position.

NOTICE: If vehicle is equipped with traction control (acceleration slip regulation), in a low tract situation the cruise control will disengage.

CRUISE CONTROL MODULE ASSEMBLY

The cruise control module assembly is mounted on the left engine compartment inner side rail assembly. The module assembly has an electronic controller and an electric stepper motor to vary the throttle with each different cruise control mode. The module assembly is not serviceable.

CRUISE CONTROL SWITCH ASSEMBLIES

The cruise control release switch, stoplamp and TCC switch, and clutch or clutch anticipate switch assemblies are used to disengage the cruise control system. A release switch assembly, a stoplamp and TCC switch assembly, and a clutch or clutch anticipate switch assembly mounted on the brake pedal bracket assembly disengage the system electrically when the brake pedal or clutch pedal is depressed. This is done by activating the brake cut-out input to the cruise control module assembly. The speed of the vehicle at brake actuation will be stored in the memory of the system. The stoplamp and TCC switch assembly has a three-wire stoplamp connector and a two-wire TCC connector on automatic transmission only. The cruise control release switch assembly has a two-wire cruise control disable connector. The clutch switch assembly (5.7L LT1 engine) has a two-wire cruise control disable connector and the clutch anticipate switch assembly (3.4L L32 engine) has a four-wire cruise control disable connector.

SPEED SENSOR

Vehicle Speed Sensor (VSS) Assembly

The vehicle speed sensor (VSS) assembly is mounted to the automatic or manual transmission assembly and produces an alternating current (ac) signal. The frequency of this signal is proportional to the speed at which the automatic transmission assembly output shaft rotates, which in turn, is proportional to the speed of the vehicle.

The ac signal produced by the VSS assembly is supplied to the powertrain control module (PCM).

The PCM internally converts the number of pulses per mile per second to determine vehicle speed. It then delivers the signal to the cruise control module and speedometer assembly at a rate of 4,000 pulses per mile.

For removal procedure, refer to SECTION 7A or to SECTION 8A for diagnostic information.

FUNCTIONAL CONTROL SWITCHES

Off-On-Resume/Accelerate Switch

Figure 1

Important

- Vehicle is equipped with a "Set To Get Cruise" feature requiring operator to set an initial speed by using "SET/COAST" button before "RESUME/ ACCEL" slider switch will activate.

The "OFF-ON-R/A" switch (2) has three positions. This switch turns the cruise control system "ON" and "OFF" and also returns cruise control operation to the last speed setting when momentarily moved toward the "R/A" (RESUME/ACCELERATE) position after braking. Do not hold the "OFF-ON-R/A" switch (2) in the "R/A" position. Release it immediately. If the "OFF-ON-R/A" switch (2) is held in the "R/A" position for more than one second, the system goes into the acceleration mode. To accelerate the vehicle, move the "OFF-ON-R/A" switch (2) to the"R/A" position and hold it there until the vehicle reaches the desired speed. When the "OFF-ON-R/A" switch (2) is released, the system will maintain the new cruise speed. In order to use the acceleration mode, the "OFF-ON-R/A" switch (2) must be in the "ON" position and the vehicle must be above the low speed limit of 40 km/h (25 mph), with a set speed already in memory.

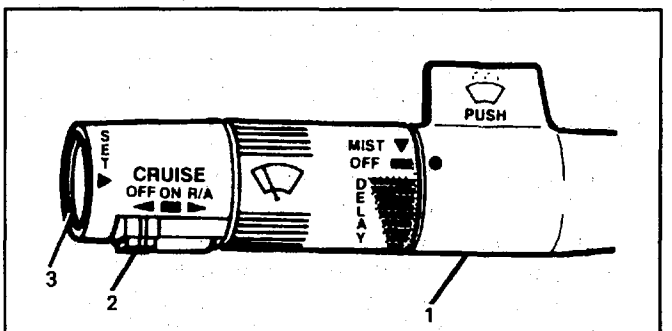
The "OFF-ON-R/A" switch (2) can also be used to raise "tap-up" vehicle speed. In order to do this the cruise control system must be engaged and operating. "Tapping-up" is done by quickly pressing the "OFF-ON-R/A" switch (2) toward the "R/A" position and quickly releasing it, or "tapping" the "OFF-ON-R/A" switch (2). Do not hold the "OFF-ON-R/A" switch (2) in the "R/A" position, or the system will go into the acceleration mode. "Tap-up" is a function in which cruise speed can be increased by 1.6 km/h (1 mph) increments (one tap = 1.6 km/h (1 mph) increase).

Set/Coast Button Switch

Figure 1

The cruise control "SET/COAST" button switch (3) (located in the end of the turn signal and headlamp dimmer switch and cruise control actuator and windshield wiper and windshield washer lever assembly) has two positions - "NORMAL" and "DEPRESSED."

- **The Set Position** - With the "SET/COAST" button switch depressed and then released (vehicle speed must exceed the low speed limit point, and the "OFF-ON-R/A" switch (2) must be in the "ON" position), the cruise speed will be set at the speed the vehicle was going when the "SET/COAST" button switch (3) was released. Vehicle cruise speed will be within ± 1.6 km/h (1 mph) of the actual speed at engaged speed. The system will cruise until either the "OFF-ON-R/A" switch (2) is moved to "OFF," the ignition switch is turned "OFF," and/or the "SET/COAST" button switch (3) is pushed in fully and held. Pushing the brake pedal assembly releases the "SET/COAST" button switch (3) but not the resume capability.
- **The Coast Position** – With the "SET/COAST" button switch (3) fully depressed, the driver can raise or lower vehicle speed. To increase speed, the driver can accelerate to a new speed, fully depress the "SET/COAST" button switch (3) and release the button. The cruise control module assembly "forgets" the previously set speed. An increased control speed can be more easily set with the "OFF-ON-R/A" switch (2) as previously described. To decrease cruise speed, the "SET/COAST" button switch (3) is held in, disengaging the cruise system, which allows the throttle to return to the idle position. When the vehicle has slowed to the desired cruise speed, releasing the "SET/COAST" button switch (3) will re-engage the system at the new selected speed.



1 LEVER ASSEMBLY, TURN SIGNAL AND HEADLAMP DIMMER SWITCH AND CRUISE CONTROL ACTUATOR AND WINDSHIELD WIPER AND WINDSHIELD WASHER
2 SWITCH, OFF-ON-RESUME/ACCELERATE
3 SWITCH, SET/COAST BUTTON

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Figure 1 – Cruise Control Actuator Lever Assembly (Typical)

- **The "Tap Down" Position** – To lower "tap down" the cruise must be engaged and operating. "Tapping-down" is done by quickly pressing and releasing the "SET/COAST" button switch (3), or "tapping" the "SET/COAST" button switch (3). Do not hold the "SET/COAST" button switch (3) in the depressed position or the system will go into the coast mode. "Tap-down" is a function in which cruise speed can be decreased by 1.6 km/h (1 mph)

increments (one tap = 1.6 km/h (1 mph) decrease). The accelerator pedal assembly may be depressed at any time to override the cruise system. Release of the accelerator pedal assembly will return the vehicle to the previously set cruise speed.

CAUTION: To keep the vehicle under control, and to prevent possible personal injury and vehicle damage, the cruise control should not be used on slippery or winding roads or in traffic of heavy or varying volume. When traveling down a steeply graded hill, the cruise control should be disengaged by depressing the brake pedal assembly lightly. The automatic transmission assembly can then be shifted into a lower gear range to help control vehicle speed.

ON-VEHICLE SERVICE

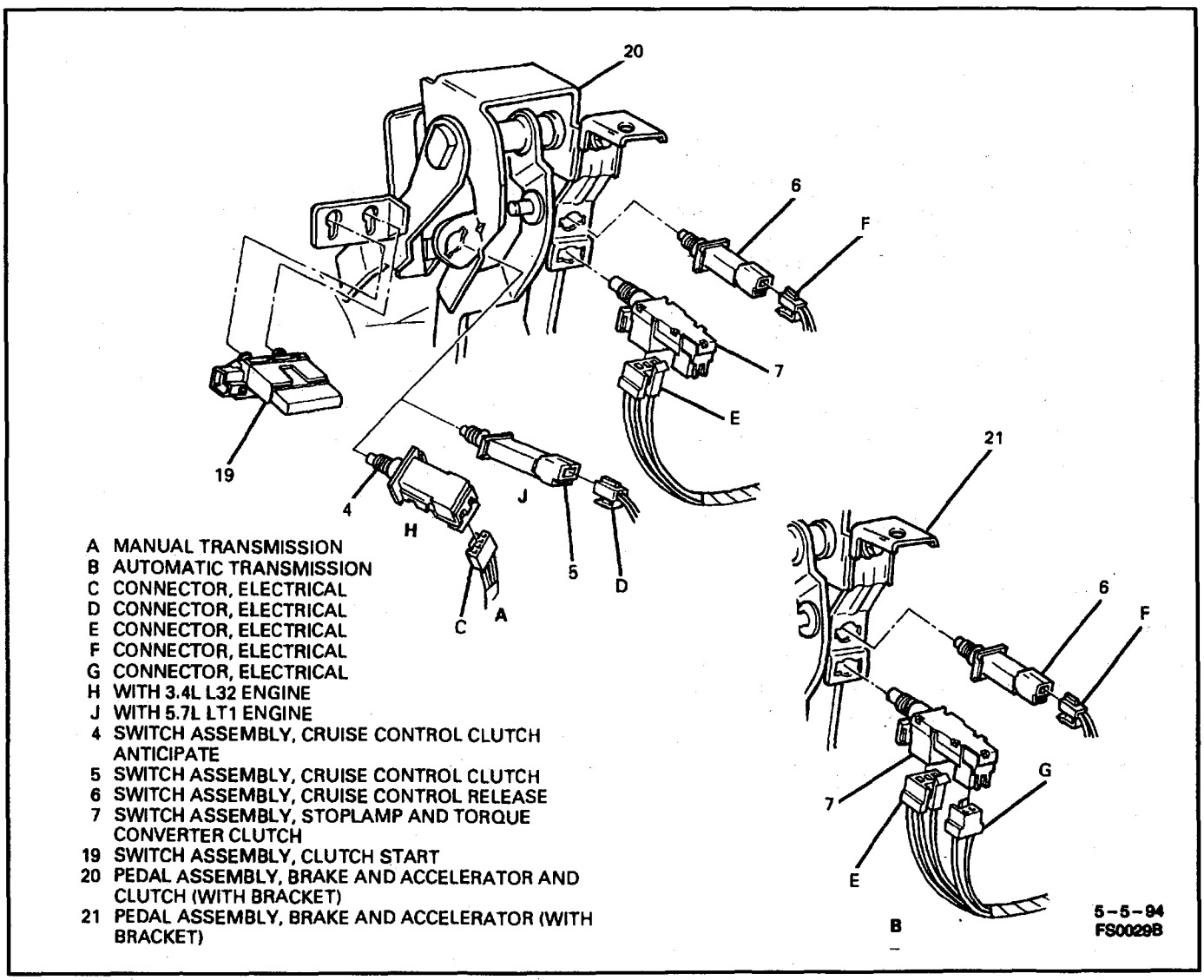
CRUISE CONTROL SWITCH ASSEMBLIES

Figure 2

Adjustment

The release switch assembly (6) must be adjusted at the same time the stoplamp and torque converter clutch (TCC) switch is adjusted. The clutch switch assembly (5) or clutch anticipate switch assembly (4) cannot be adjusted until after clutch pedal assembly (20) is installed.

NOTICE: Proper stoplamp switch assembly adjustment is essential. Improper stoplamp switch assembly adjustment will cause brake drag and excessive brake lining wear.



A MANUAL TRANSMISSION
B AUTOMATIC TRANSMISSION
C CONNECTOR, ELECTRICAL
D CONNECTOR, ELECTRICAL
E CONNECTOR, ELECTRICAL
F CONNECTOR, ELECTRICAL
G CONNECTOR, ELECTRICAL
H WITH 3.4L L32 ENGINE
J WITH 5.7L LT1 ENGINE
4 SWITCH ASSEMBLY, CRUISE CONTROL CLUTCH ANTICIPATE
5 SWITCH ASSEMBLY, CRUISE CONTROL CLUTCH
6 SWITCH ASSEMBLY, CRUISE CONTROL RELEASE
7 SWITCH ASSEMBLY, STOPLAMP AND TORQUE CONVERTER CLUTCH
19 SWITCH ASSEMBLY, CLUTCH START
20 PEDAL ASSEMBLY, BRAKE AND ACCELERATOR AND CLUTCH (WITH BRACKET)
21 PEDAL ASSEMBLY, BRAKE AND ACCELERATOR (WITH BRACKET)

Figure 2 - Cruise Control Switch Assemblies

Adjust

1. To adjust, depress brake pedal assembly or clutch pedal assembly and insert release switch assembly (6), stoplamp and TCC switch assembly (7), and clutch switch assembly (5) or clutch anticipate switch assembly (4) into pedal assembly with bracket (20 or 21) until retainer on release switch assembly (6), stoplamp and TCC switch assembly (7), or clutch switch assembly (5) or clutch anticipate assembly (4) is fully seated.

   NOTICE: Make sure to apply the proper amount of force to the brake pedal assembly during adjustment. Too much force could damage the vacuum booster assembly. Too little could cause dragging brakes.

2. Slowly pull brake or clutch pedal assembly rearward with a force of 222 N (50 pounds) until "click" sounds can no longer be heard. At this point, release switch assembly (6), stoplamp and TCC switch assembly (7), and clutch switch assembly (5) or clutch anticipate assembly (4) will have moved retainers to their original position.

Measure

- The release switch assembly and stoplamp and TCC switch assembly contacts should be open at 25.4 mm (1 inch) or less of pedal assembly travel, and occur at the same time or before the onset of braking. The brake pedal assembly travel can be up to 25.4 mm (1 inch) before the cruise control system disengages.

Replacement

Remove or Disconnect

1. Left-hand instrument panel sound insulator assembly.
2. Electrical connectors.
3. Release switch assembly (6), stoplamp and TCC switch assembly (7), and clutch switch assembly (5) or clutch anticipate switch assembly (4), if equipped, from pedal assembly with bracket (20 or 21).

Install or Connect

1. Release switch assembly (6), stoplamp and TCC switch assembly (7), and clutch switch assembly (5) or clutch anticipate switch assembly (4), if equipped, to pedal assembly with bracket (20 or 21).
2. Electrical connectors.
3. Left-hand instrument panel sound insulator assembly.

Adjust

- Release switch assembly (6), stoplamp and TCC switch assembly (7), and clutch switch assembly (5) or clutch anticipate switch assembly (4) as outlined above.

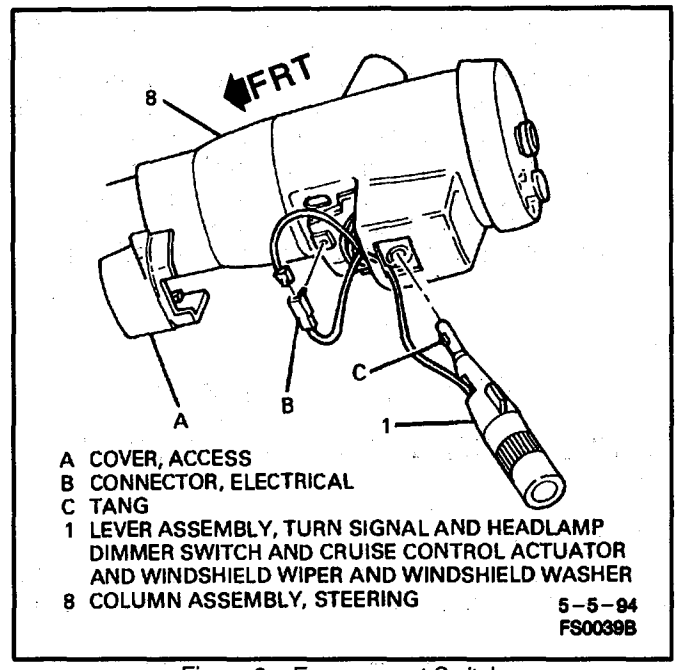


Figure 3 – Engagement Switch

ENGAGEMENT SWITCH

Figure 3

The multi-function lever cannot be serviced. The complete multi-function lever assembly must be replaced as an assembly.

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Steering column access cover.
3. Electrical connector.
   - Make sure windshield wiper switch is in the "OFF" position.
4. Lever assembly (1) by pulling it straight out.

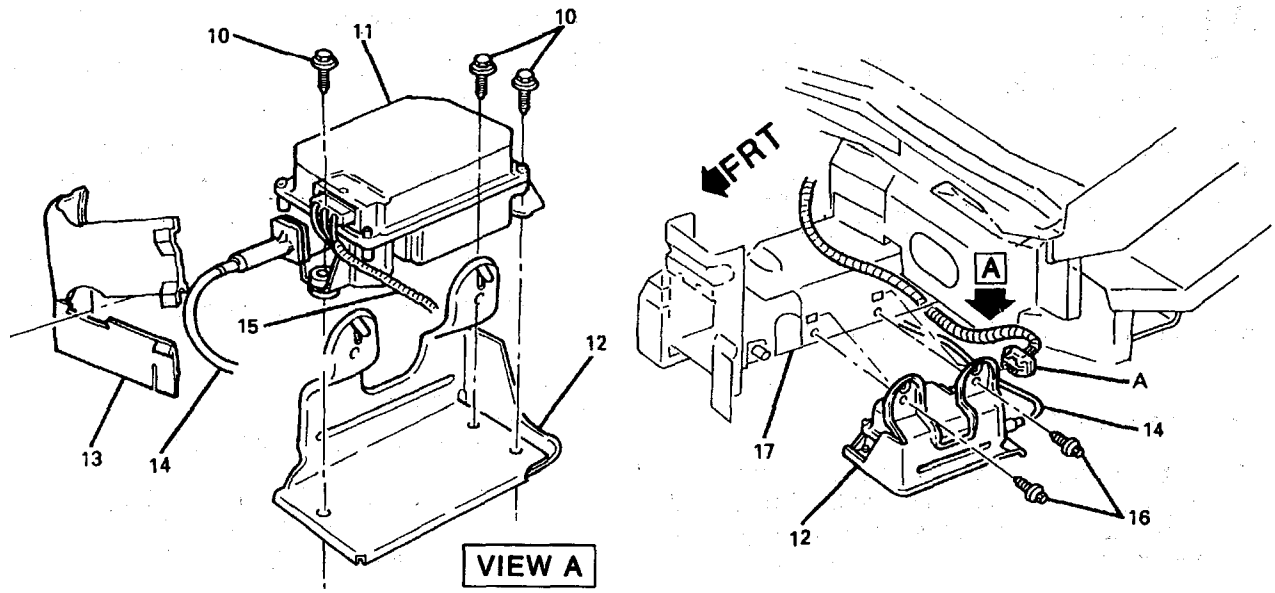
Install or Connect

1. Lever assembly (1).
   - Align tang on lever assembly (1) to notch on column assembly (8) and push in until fully seated.
2. Electrical connector.
3. Steering column access cover.
4. Battery negative cable assembly

CRUISE CONTROL MODULE ASSEMBLY

Figure 4

The cruise control module assembly (11) is mounted on the left engine compartment inner side rail assembly using two cruise control module bracket bolts/screws (16).



A CONNECTOR, ELECTRICAL
10 BOLT/SCREW, CRUISE CONTROL, 6 N•m (53 LB. IN.)
11 MODULE ASSEMBLY, CRUISE CONTROL
12 BRACKET ASSEMBLY, CRUISE CONTROL MODULE
13 COVER, CRUISE CONTROL
14 CABLE ASSEMBLY, CRUISE CONTROL
15 HARNESS ASSEMBLY, FORWARD LAMP WIRING
16 BOLT/SCREW, CRUISE CONTROL MODULE BRACKET, 10 N•m (89 LB. IN.)
17 RAIL ASSEMBLY, ENGINE COMPARTMENT INNER SIDE

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Figure 4 – Cruise Control Module Assembly

Remove or Disconnect

1. Accelerator control cable splash shield bolts/screws from throttle body.
2. Accelerator control cable splash shield from throttle body.
3. Left-hand front bumper fascia lower deflector. Refer to SECTION 10-4.
4. Cruise control cover (13) to access connectors.
5. Electrical connector from cruise control module assembly (11).
6. Cruise control cable assembly from cruise control module assembly. Refer to "Cable Assembly Replacement" in this section.
7. Bolts/screws (16).
8. Cruise control module assembly (11) with bracket assembly (12) from left engine compartment inner side rail assembly.
9. Bolts/screws (10) attaching cruise control module assembly (11) to bracket assembly (12).
10. Cruise control module assembly (11) from bracket assembly (12).

Install or Connect

NOTICE: See "Notice" on page 9B-1 of this section.

1. Cruise control module assembly (11) to bracket assembly (12).
2. Bolts/screws (10) attaching cruise control module assembly (11) to bracket assembly (12).

Tighten

- Bolts/screws (10) to 6 N•m (53 lb. in.).

3. Cruise control module assembly (11) with bracket assembly (12) to left engine compartment inner side rail assembly.
4. Bolts/screws (16).

Tighten

- Bolts/screws (16) to 10 N•m (89 lb. in.).

5. Cable assembly to module assembly. Refer to "Cable Assembly Replacement" in this section.
6. Electrical connector to cruise control module assembly (11).
7. Cruise control cover (13) over connectors.
8. Left-hand front bumper fascia lower deflector. Refer to SECTION 10-4.
9. Accelerator control cable splash shield to throttle body.
10. Accelerator control cable splash shield bolts/screws to throttle body.

Tighten

- Accelerator control cable splash shield bolts/screws to 1.9 N•m (17 lb. in.).

Adjust

- Cable assembly, if necessary. Refer to "Cable Assembly Adjustment" in this section.

CRUISE CONTROL CABLE ASSEMBLY

Figures 5 through 7

The cable assembly (14) is connected between the cruise control module assembly (11) and the throttle body lever, or accelerator control/cruise control servo cable adjuster, if equipped.

Cable Assembly Replacement (Standard)

Remove or Disconnect

1. Cable assembly (14) and conduit from engine bracket.
2. Cable end fitting from throttle body lever stud.

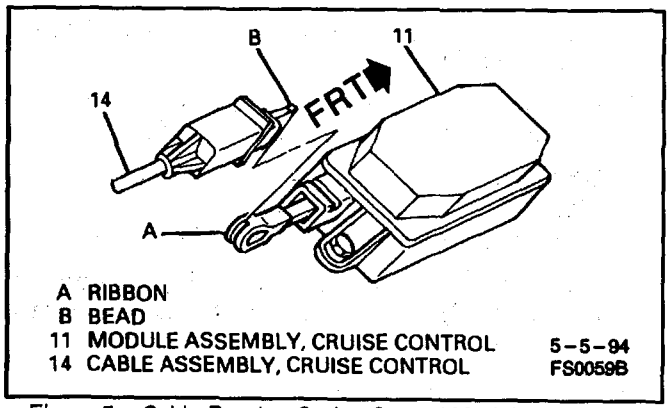


Figure 5 – Cable Bead to Cruise Control Module Assembly

3. Cruise control retainer (18) at cruise control module assembly.
4. Cable assembly (14) from cruise control module assembly (11).
   A. Compress conduit tangs and pull out of cruise control module housing. (11).
   B. Disconnect cable bead from cruise motor band end fitting on cruise control module assembly (11).
   C. Note routing and remove cable assembly (14) from vehicle.

Install or Connect

1. Cable assembly (14) to cruise control module assembly (11).
   A. Attach cable bead to cruise motor ribbon end fitting on cruise control module assembly (11).
   B. Pull engine end of cable assembly (14) until it is taut.
   C. Turn engine end of cable assembly until ribbon is flat.

Important

- Ribbon must not be twisted.
  - Slide cable conduit fitting over ribbon and snap into module housing assuring that both tangs are engaged.

2. Cruise control retainer (18) at cruise control module assembly (11).
3. Cable assembly (14) to vehicle.
   - Use routing noted during removal.
4. Cable end fitting to throttle body lever stud.
5. Cable assembly (14) and conduit to engine bracket.

Adjust

- Cable assembly. Refer to "Cable Assembly Adjustment (Standard)" in this section.

Cable Assembly Replacement (Optional)

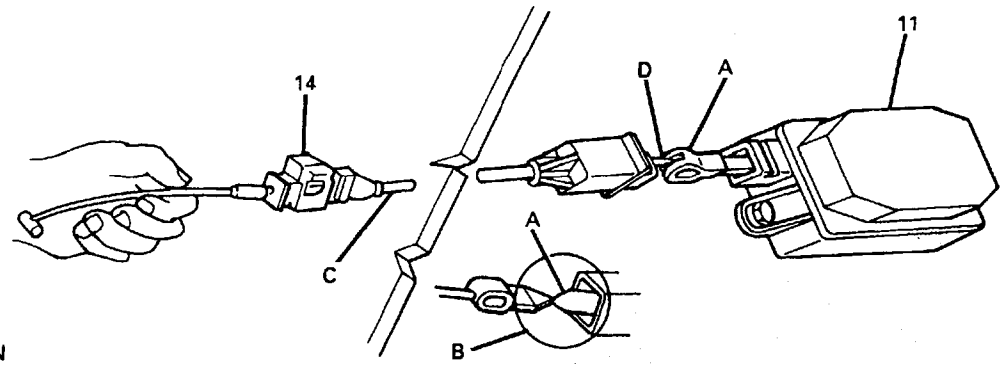
Figures 5 through 8

Important

- If vehicle is equipped with accelerator control/cruise control servo cable adjuster (throttle relaxer), follow these procedures to replace cable assembly.

Remove or Disconnect

1. Cover (19).
2. Cable assembly (14) and conduit from engine bracket.
3. Cable end fitting from accelerator control/cruise control servo cable adjuster (20).
4. Cruise control retainer (18) at cruise control module assembly.
5. Cable assembly (14) from cruise control module assembly (11).

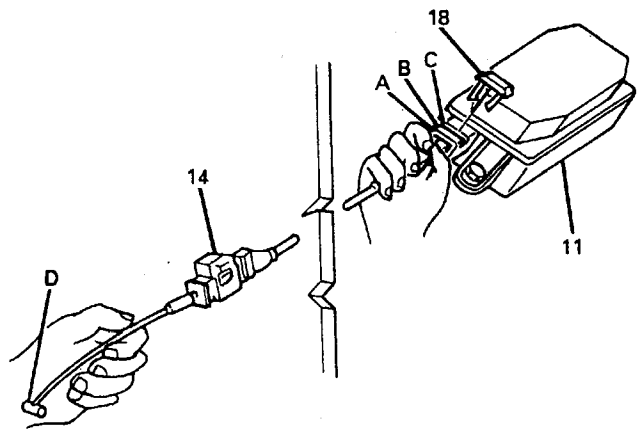


A RIBBON
B RIBBON MUST NOT BE TWISTED
C MARKINGS IN YELLOW FOR LT1 ENGINE, PINK FOR L32 ENGINE
D BEAD
11 MODULE ASSEMBLY, CRUISE CONTROL
14 CABLE ASSEMBLY, CRUISE CONTROL

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Figure 6 – Pulling Cruise Control Cable Assembly

A. Compress conduit tangs and pull out of cruise control module housing.
B. Disconnect cable bead from cruise motor band end fitting on cruise control module assembly (11).
C. Note routing and remove cable assembly (14) from vehicle.



A CONDUIT
B TANG
C HOUSING
D END FITTING
11 MODULE ASSEMBLY, CRUISE CONTROL
14 CABLE ASSEMBLY, CRUISE CONTROL
18 RETAINER, CRUISE CONTROL

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Figure 7 – Installing Cruise Control Cable Assembly to Cruise Control Module Assembly

Install or Connect

1. Cable assembly (14) to cruise control module assembly (11).
   A. Attach cable bead to cruise motor ribbon end fitting on cruise control module assembly (11).
   B. Pull engine end of cable assembly (14) until it is taught.
   C. Turn engine end of cable assembly until ribbon is flat.

Important

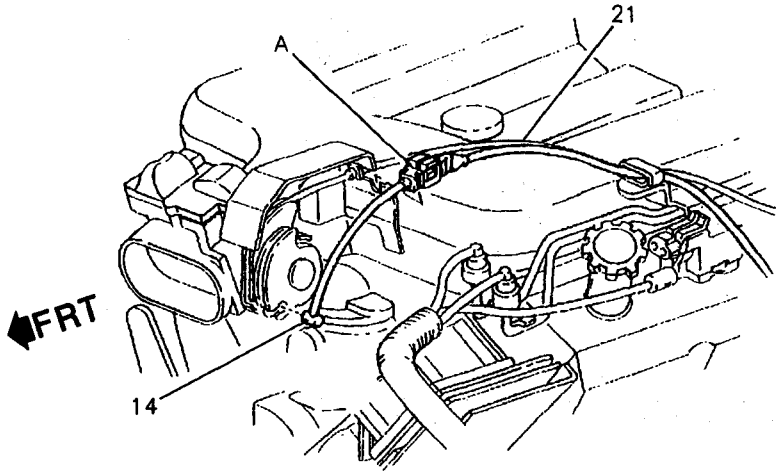
- Ribbon must not be twisted.
  - Slide cable conduit fitting over ribbon and snap into module housing assuring that both tangs are engaged.

2. Cruise control retainer (18) at cruise control module assembly (11).
3. Cable assembly (14) to vehicle.
   - Use routing noted during removal.
4. Cable end fitting to accelerator control/cruise control servo cable adjuster (20).
   - Install slug of cable into cam of throttle relaxer before installing cable end fitting to adjuster assembly.
5. Cable assembly (14) and conduit to engine bracket.
6. Cover (19).

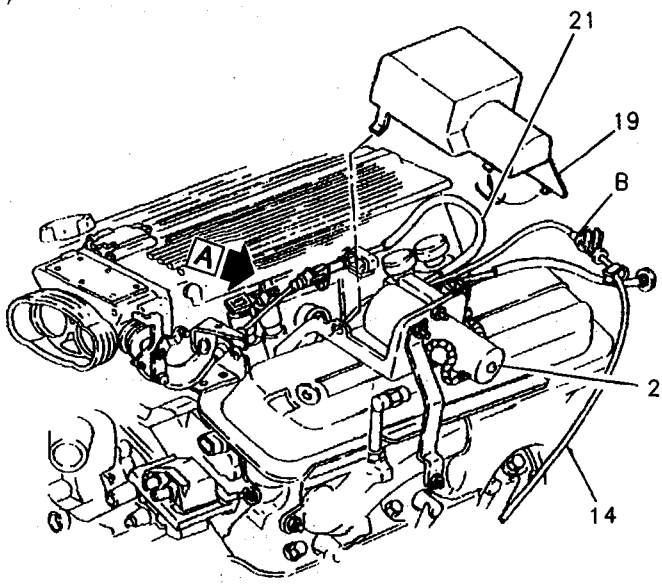
Adjust

- Cable assembly. Refer to "Cable Assembly Adjustment (Optional)" in this section.

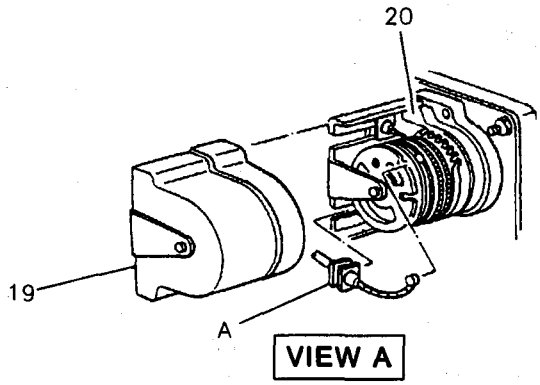
If replacing accelerator pedal/cruise control cable assembly, refer to SECTION 5E2 for replacement and adjustment procedures.



3.4L L32 ENGINE



5.7L LT1 ENGINE



A CABLE END FITTING
B CABLE LOCKING TAB
14 CABLE, ASSEMBLY, CRUISE CONTROL
19 COVER, ACCELERATOR CONTROL/CRUISE CONTROL SERVO CABLE ADJUSTER
20 ADJUSTER ASSEMLY, ACCELERATOR CONTROL/ CRUISE CONTROL SERVO CABLE
21 CABLE ASSEMBLY, ACCELERATOR PEDAL/CRUISE CONTROL

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Figure 8 – Cable Assembly Replacement (Optional)

Cable Assembly Adjustment (Standard)

- With throttle closed, lock cable conduit by pressing down on lock button.

LT1 Engine

A. Pull cruise cable adjust slider rearward out of adjuster to remove cable slack without moving throttle lever from its idle stop. Push down cruise cable adjust lock button until it snaps and locks into place.

B. A gap 0 – 2 mm (0.07 inch) between terminal end of cable to the plastic connector that snaps on to throttle body lower is allowed when checking for this condition. Pull on terminal end making sure connector to throttle body is hard against its fitting. If more than 2 mm (0.07 inch) exist, readjust cable.

L32 Engine

A. Pull cruise cable adjust slider rearward until cruise cam lever contacts throttle body lever without opening the throttle. Push down cruise cable adjust lock button until it snaps and locks into place.

B. A gap of 0 – 2 mm (0.07 inch) between cruise cam lever and throttle body lever is allowed after lock button is depressed.

Cable Assembly Adjustment (Optional)

To manually adjust the cable assembly (14):

A. Place finger on throttle making sure throttle arm is hard against stop.

B. Pull cable assembly (14) to remove slack from cable.

Important

- Do not disturb cable after removing slack.

C. Press locking tab down to retain cable.

Important

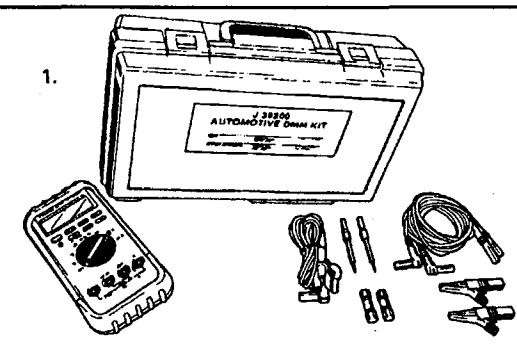
- Cable should never be adjusted so tight that tension from cable will not allow throttle to close solidly. If cable is adjusted too tight, the cable will prevent engine from returning to idle and will cause unstable idle quality.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Accelerator Control Cable Splash Shield Bolt/Screw	1.9 N•m (17 lb. in.)
Cruise Control Bolt/Screw	6 N•m (53 lb. in.)
Cruise Control Module Bracket Bolt/Screw	10 N•m (89 lb. in.)

SPECIAL TOOLS



1. J 39200

1. FLUKE 87 KIT

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BLANK

SECTION 9D

THEFT DETERRENT SYSTEMS

CAUTION: This vehicle is equipped with the Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

PASS-Key II® SYSTEM

The personal automotive security system (PASS-Key II®) is standard equipment on this vehicle. The system is designed to prevent vehicle theft by disabling the engine unless an ignition key assembly with a specific electrical resistance is used in the ignition cylinder assembly. The components of the system are the ignition key assembly, the ignition cylinder assembly, the theft deterrent module assembly, the theft deterrent relay assembly, and the powertrain control module (PCM).

SYSTEM OPERATION

The PASS-Key II® system is designed to prevent the engine from starting if the proper resistance is not sensed from the ignition key assembly. Of the 15 key codes (resistance values) available, only one will work with each theft deterrent module assembly.

The PASS-Key II® system prevents the engine from starting by controlling the theft deterrent relay assembly and the PCM fuel enable input. If the PCM does not sense the proper frequency signal on the fuel enable input, it will not provide fuel to the engine.

If the wrong resistance value is sensed when the ignition switch is in the "RUN" position, the theft deterrent module assembly will not ground the starter enable circuit and will not output the fuel enable signal for approximately three minutes. This prevents the engine from starting and discourages the thief from trying key codes (resistance values) at random.

If the correct resistance value is sensed when the ignition switch is in the "RUN" position, the theft deterrent module assembly will ground the starter enable circuit and output the fuel enable signal. This will allow the engine to start normally.

If the PASS-KEY II® system detects an open or short to ground when the ignition switch is in "RUN" position, the theft deterrent module assembly will default to fail enable. Fail enable occurs when the proper key resistance has been sensed during the open or short to ground occurring. Fail enable will illuminate the security indicator lamp and allow the operator to stop and start the vehicle until the problem is corrected.

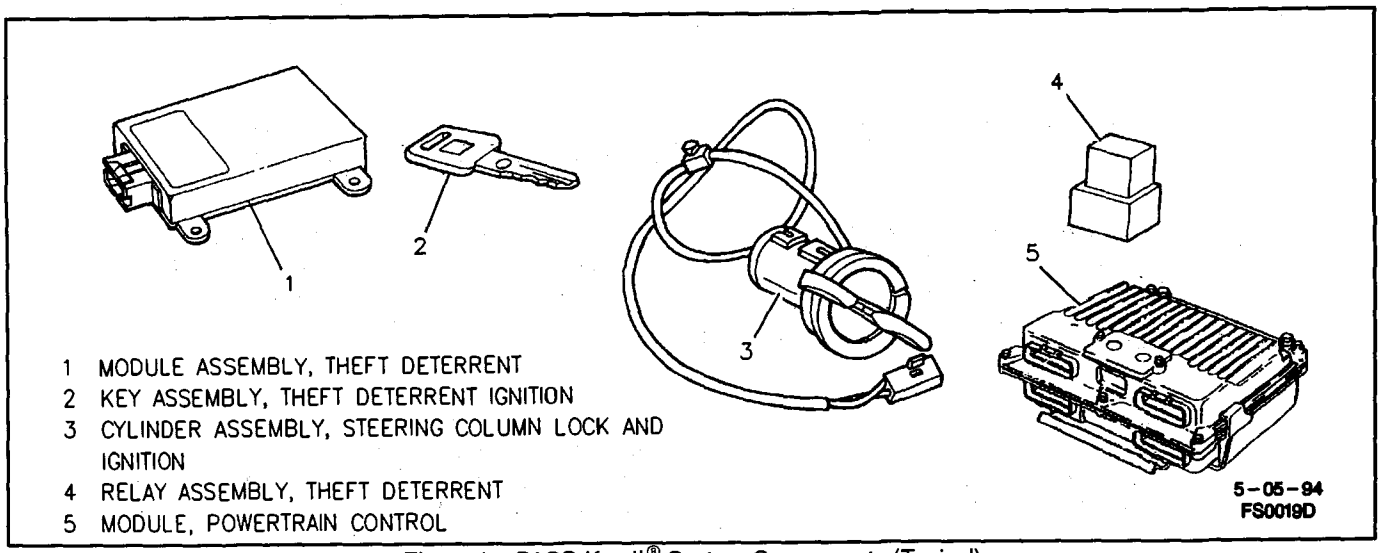


Figure 1 – PASS-Key II® System Components (Typical)

SYSTEM COMPONENTS

Figure 1

Ignition Key Assembly

The ignition key assembly for vehicles equipped with the PASS-Key II® system is an assembly of a typical square ignition key blank and resistor assembly. The ignition key blank and resistor assembly are not serviceable separately. There are 15 different ignition key assemblies, each with a different resistance value. The ignition key assembly also has mechanical cuts similar to non-PASS-Key II® ignition key assemblies.

Important

- When servicing the PASS-Key II® system, obtain all ignition key assemblies, if possible, and verify proper values with tool J 35628-A, VATS/PASS Interrogator. Refer to "Copying Ignition Key Assemblies" in this section.

Steering Column Lock and Ignition Cylinder Assembly

Figure 2

The ignition cylinder assembly in vehicles equipped with the PASS-Key II® system contains a set of electrical contacts used to measure the resistor assembly in the ignition key assembly. When servicing the ignition cylinder assembly, be certain to maintain proper wire routing. A two pin connector at the base of the steering column assembly connects the contacts to the vehicle wiring. The connector is also used for diagnostic purposes. The ignition cylinder assembly also performs all functions of ignition cylinder assemblies on non-PASS-Key II® vehicles. When replacing an ignition cylinder assembly, it will be necessary to make new ignition key assemblies which match the PASS-Key II® key code of the theft deterrent module assembly and the mechanical cut of the new ignition cylinder assembly.

Important

- The wire routing for the contacts inside the steering column assembly is critical.

Theft Deterrent Module Assembly

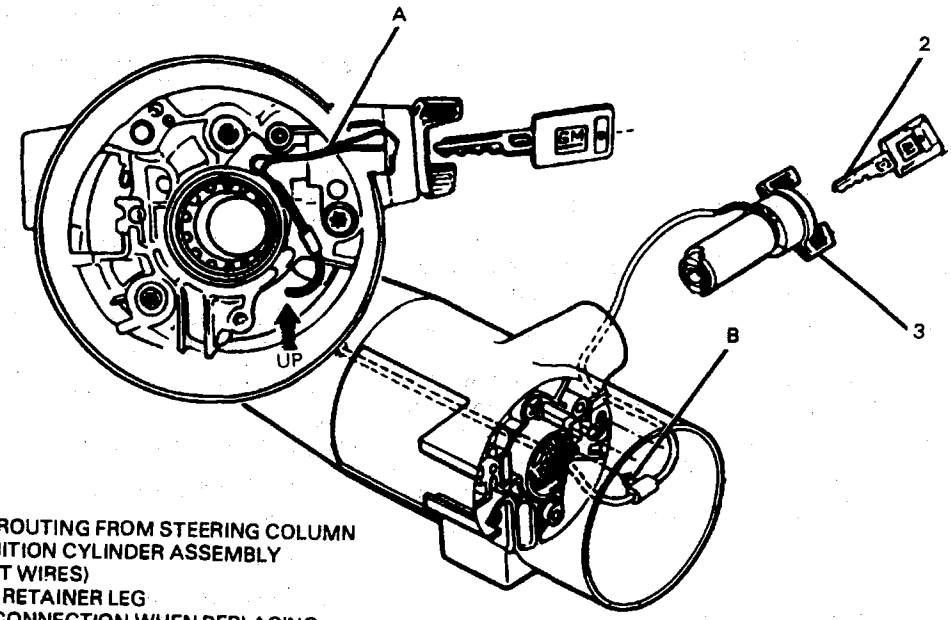
The theft deterrent module assembly contains the logic of the PASS-Key II® system. The theft deterrent module assembly has inputs from the battery, ignition circuits, and the resistor assembly. The theft deterrent module assembly has outputs to the starter enable circuit, the fuel enable circuit, and the security lamp circuit.

Ignition Input

The ignition input is used to turn the theft deterrent module assembly on. When the theft deterrent module assembly is turned on, it will read the resistor assembly and control the outputs accordingly. When the theft deterrent module assembly is turned off the resistor assembly is not read, and the theft deterrent relay assembly and fuel enable output will not allow the engine to start. When the ignition switch is in the "OFF" position, the battery input to the theft deterrent module assembly will draw about 1 milli-amp.

Key Resistor Inputs

The key resistor inputs are used to determine if the correct ignition key assembly is being used to start the vehicle. The key resistor inputs are read when the theft deterrent module assembly is turned on. If the key code (resistance value) of the ignition key assembly matches the value stored in the theft deterrent module assembly, the theft deterrent relay assembly and fuel enable output will allow the vehicle to start. If the resistance value of the ignition key assembly does not match the value stored in the theft deterrent module assembly, the relay assembly and fuel enable output will not allow the vehicle to start.



A PROPER WIRE ROUTING FROM STEERING COLUMN LOCK AND IGNITION CYLINDER ASSEMBLY (DO NOT TWIST WIRES)
B CUT OFF WIRE RETAINER LEG ON ORIGINAL CONNECTION WHEN REPLACING STEERING COLUMN LOCK AND IGNITION CYLINDER ASSEMBLY
2 KEY ASSEMBLY, THEFT DETERRENT IGNITION
3 CYLINDER ASSEMBLY, STEERING COLUMN LOCK AND IGNITION

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Figure 2 – Ignition Cylinder Assembly Wire Routing

Starter Enable Output

The starter enable circuit controls the theft deterrent relay assembly. When the theft deterrent module assembly sees the proper resistance at the ignition key assembly, it grounds the starter enable circuit which allows the engine to be cranked. If the theft deterrent module assembly does not sense the proper resistance at the ignition key assembly, it will not ground the starter enable circuit.

Fuel Enable Output

The fuel enable circuit is an output from the theft deterrent module assembly and an input to the PCM. When the theft deterrent module assembly senses the proper resistance at the ignition key assembly, it will output a signal to the PCM. If the theft deterrent module assembly does not see the proper resistance at the ignition key assembly, it will not output the signal to the PCM.

Security Indicator Lamp Output

The "SECURITY" lamp circuit is an indicator lamp output. The lamp output will be grounded during a five second "bulb test" at key on, at any time that the theft deterrent module assembly is preventing the engine from starting, during an open or short to ground, or if the theft deterrent module assembly is not properly programmed.

Theft Deterrent Relay Assembly

The relay assembly is used to stop the engine from cranking if the correct resistance is not sensed at the ignition key assembly. It prevents the engine from cranking by opening the circuit to the starter solenoid switch.

Powertrain Control Module (PCM)

The PCM reads the fuel enable circuit to determine if fuel injection should be allowed. If the fuel enable signal is not present, the PCM will not allow fuel injection. If the signal is present, the PCM will allow fuel injection and normal engine operation.

The PCM has some diagnostic features associated with the fuel enable input, including diagnostic trouble codes. For details, refer to SECTION 6E.

ON-VEHICLE SERVICE

IGNITION KEY ASSEMBLY

Copying Ignition Key Assemblies

Tool Required:

J 35628-A VATS/PASS Interrogator

To copy an ignition key assembly, it is necessary to first determine which PASS-Key II® key code (resistance value) is needed. The ignition key assembly being copied must be tested to determine the key code. The ignition key assembly may be tested using J 35628-A. To use J 35628-A, turn the tool on, make sure the tool wiring connectors are disconnected and insert the ignition key assembly into the tool lock cylinder. The "Key Code Reader" will display the key code of the ignition key assembly. Obtain an ignition key blank matching this key code and cut it to match the original ignition key assembly.

Replacing Lost Ignition Key Assemblies

Tool Required:

J 35628-A VATS/PASS Interrogator

To replace lost ignition key assemblies it is necessary to determine the mechanical cut and the electrical key code.

The mechanical and electrical key codes are recorded on the vehicle invoice. If these codes are available, use them to create a new ignition key assembly. If they are not, follow the procedure below.

The mechanical cut must be determined first. The mechanical cut can be determined from the key code on the ignition cylinder assembly or by calling Divisional Roadside Assistance. If the mechanical cut cannot be determined, the ignition cylinder assembly should be replaced. Make an ignition key blank with the correct mechanical cut to use while determining the proper electrical key code.

To determine the proper electrical key code, use J 35628-A and the following procedure:

Important

- Do not disconnect yellow two-way SIR connector.

1. Connect J 35628-A wiring to PASS-Key II® dash connector at base of steering column assembly. Do not connect to steering column wiring.
2. Turn J 35628-A on and place key code switch to "1" and attempt to start engine with proper mechanically cut key. If engine starts, key code is "1."
3. If engine does not start, turn ignition off and press 4-minute timer on J 35628-A.
4. When timer light goes out, place key code switch to "2" and attempt to start engine. If engine starts, key code is "2."
5. Continue trying different key codes until proper key code is found.
6. Make new ignition key assembly with proper key code and mechanical cut.

THEFT DETERRENT MODULE ASSEMBLY

Figure 3

Remove or Disconnect

1. Instrument panel assembly. Refer to SECTION 8C.
2. Bolts/screws (6).
3. Theft deterrent module assembly (1) from inflatable restraint bracket assembly (7).
4. Electrical connector.

Install or Connect

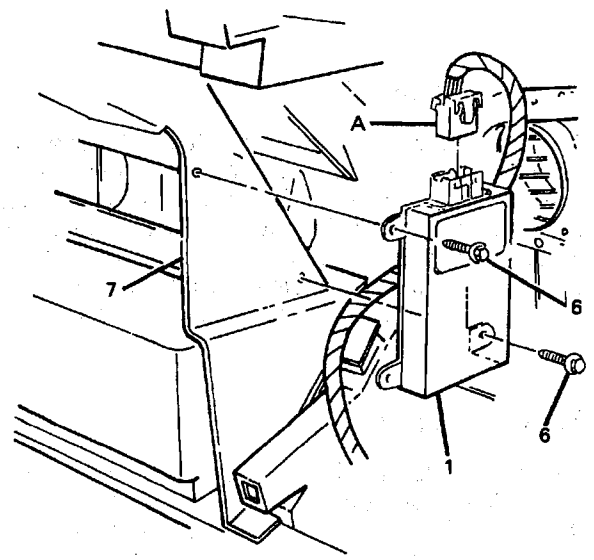
NOTICE: See "Notice" on page 9D-1 of this section.

1. Electrical connector.
2. Theft deterrent module assembly (1) to inflatable restraint bracket assembly (7).
3. Bolts/screws (6) by first securing lower right bolt/screw (6) and then securing upper left bolt/screw (6).

Tighten

- Bolts/screws (6) to 3.2 N•m (29 lb. in.).

4. Instrument panel assembly. Refer to SECTION 8C.



A CONNECTOR, ELECTRICAL
1 MODULE ASSEMBLY, THEFT DETERRENT
6 BOLT/SCREW, THEFT DETERRENT MODULE
7 BRACKET ASSEMBLY, INFLATABLE RESTRAINT INSTRUMENT PANEL MODULE

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Figure 3 - Theft Deterrent Module Assembly

THEFT DETERRENT RELAY ASSEMBLY

Figure 4

If the relay assembly is determined to be inoperative, it should be replaced.

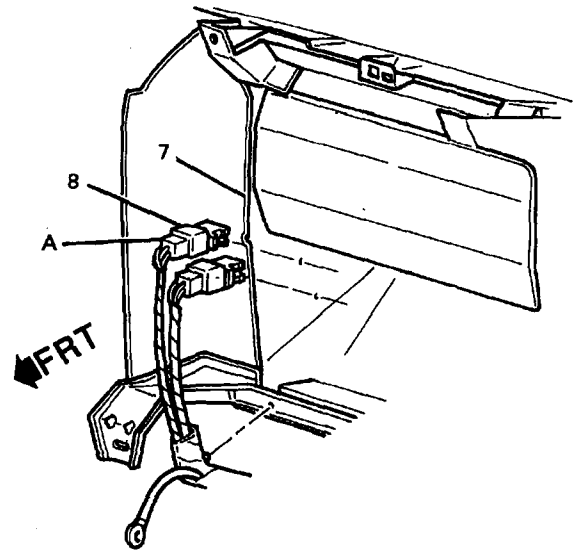
Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Instrument panel assembly. Refer to SECTION 8C.
3. Relay assembly (8) from inflatable restraint bracket assembly (7).
4. Electrical connector from relay assembly (8).

Install or Connect

1. Electrical connector to relay assembly (8).
2. Relay assembly (8) to inflatable restraint bracket assembly (7).
3. Instrument panel assembly. Refer to SECTION 8C.
4. Battery negative cable assembly.



A CONNECTOR, ELECTRICAL
7 BRACKET ASSEMBLY, INFLATABLE RESTRAINT INSTRUMENT PANEL MODULE
8 RELAY ASSEMBLY, THEFT DETERRENT

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Figure 4 - Theft Deterrent Relay Assembly

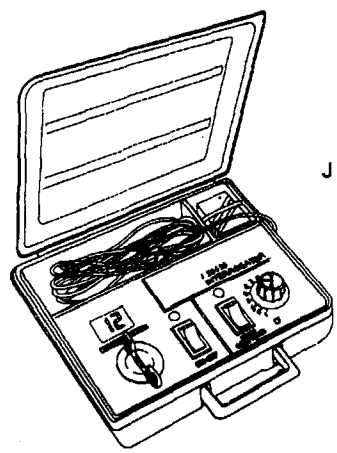
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Theft Deterrent Module Bolt/Screw	3.2 N•m (29 lb. in.)

SPECIAL TOOLS

1 J 35628-A



1. VATS/PASS INTERROGATOR

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FS0059D

BLANK

SECTION 9E

ENGINE COOLANT HEATER

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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Engine Coolant Heater Cord Assembly Replacement 9E-2
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Fastener Tightening Specifications 9E-3

GENERAL DESCRIPTION

The engine coolant heater assembly is used to heat engine coolant making it easier to start the engine in cold climates. It is installed into the engine block assembly at a water jacket plug location. An engine coolant heater cord assembly is routed inside the engine compartment. The heater assembly is rated at 600 watts and uses a 110-volt ac power supply. For electrical diagram of engine coolant heater assembly, refer to ELECTRICAL DIAGNOSIS 8A–32.

ON-VEHICLE SERVICE

ENGINE COOLANT HEATER ASSEMBLY REPLACEMENT

Figure 1 and 2

Remove or Disconnect

CAUTION: Perform this operation when the engine is cool or personal injury may result.

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Drain engine coolant from engine block assembly into an approved container. Refer to SECTION 6B.
3. Cord assembly from heater assembly (1).
4. Loosen bolt/screw (2).

   NOTICE: When removing the engine coolant heater assembly from the engine block assembly, be careful not to score the machined surface of the plug hole.
5. Heater assembly (1) carefully from plut hole.
   - If removing heater assembly (1) permanently, install water jacket plug into plug hole and replace engine coolant. For engine coolant replacement procedures, refer to SECTION 6B.

Clean

- Plug hole.
  - Remove burrs, sealer, paint and other rough spots.

Install or Connect

NOTICE: The element must not touch the engine block assembly inner wall in the installed position or damage to the engine block assembly and heater could result.

NOTICE: See "Notice" on page 9E–1 of this section.

1. Apply coat of engine coolant heater lubricant, GM P/N 9985164 or equivalent, to O-ring and walls of plug holes.
2. Engine coolant heater assembly (1) into plug hole.
   A. Insert heating element end of heater assembly (1) into plug hole.
   B. Line up heater assembly (1) with plug hole and push it straight into place.
   C. Rotate heater assembly (1) so that center electrical contact and bolt/screw (2) are in line horizontally.
   D. Turn bolt/screw (2) so that yoke presses against engine block assembly inner wall.

Tighten

- Bolt/screw (2) to 1.9 N•m (17 lb. in.).

CAUTION: Engine coolant heater cord assembly must not touch the engine, hot pipes, manifold or any moving parts or damage to the vehicle and possible personal injury may result.

3. Cord assembly to heater assembly (1).
4. Lower vehicle.
5. Replace engine coolant. Refer to SECTION 6B.

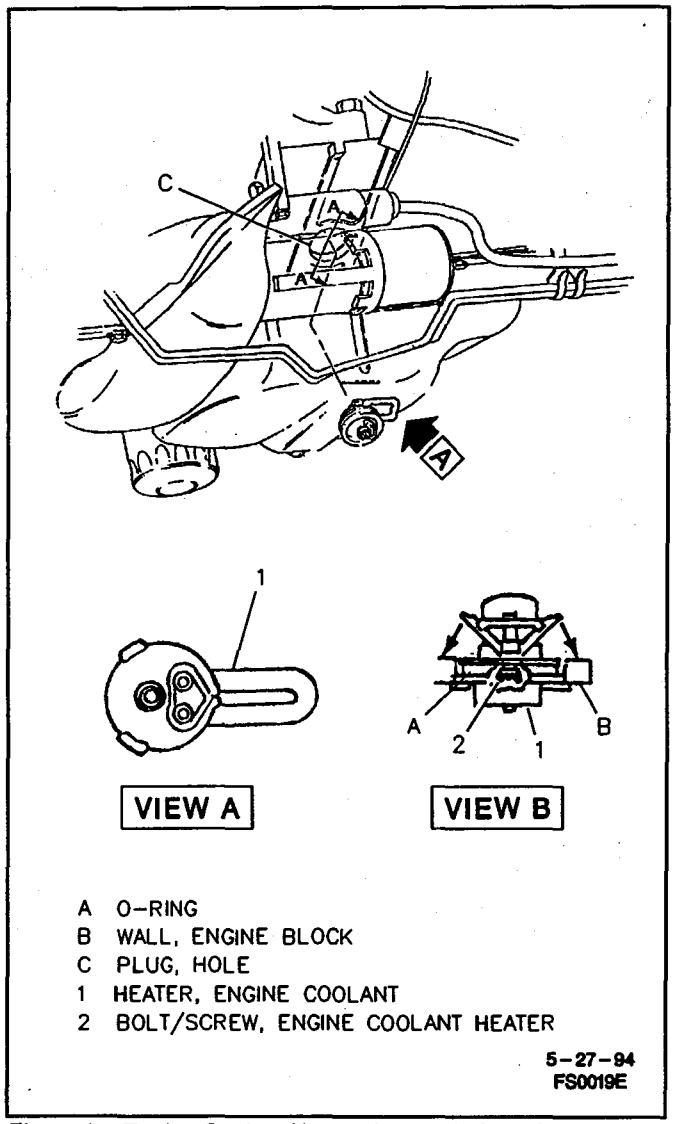


Figure 1 – Engine Coolant Heater Assembly (5.7L LT1 Engine)

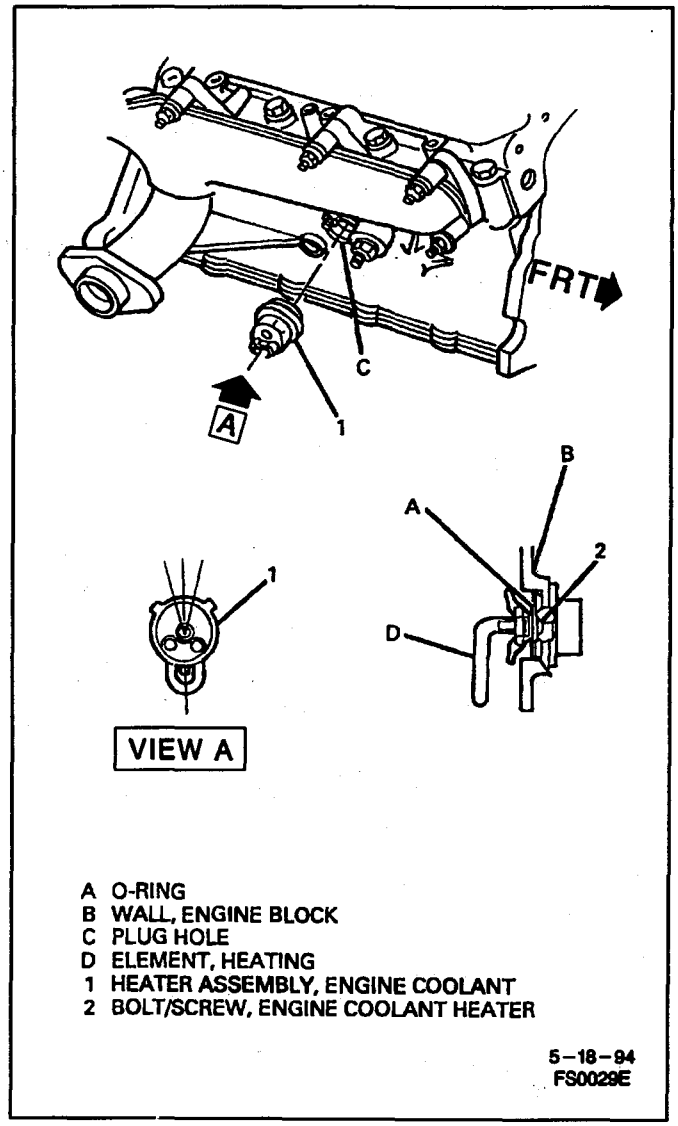


Figure 2 – Engine Coolant Heater Assembly (3.4L L32 Engine)

ENGINE COOLANT HEATER CORD REPLACEMENT

Figures 3 and 4

Remove or Disconnect

1. Note position and routing of cord assembly (3) for proper placement during installation.
2. Cord assembly (4) from heater (1).
3. Cord straps (4).
4. Cord assembly (3) from vehicle.

Install or Connect

CAUTION: Engine coolant heater cord assembly must not touch the engine, hot pipes, manifold or any moving parts, or damage to the vehicle and possible personal injury may result.

NOTICE: See "Notice" on page 9E-1 of this section.

1. Cord assembly (3) to vehicle routing as noted during removal.
2. Cord straps (4).
3. Cord assembly (3) to heater assembly (1).

Tighten

- Transmission bolt/screw (5) to 47 N•m (35 lb. ft.).

4. Cord assembly (4) to heater (1).

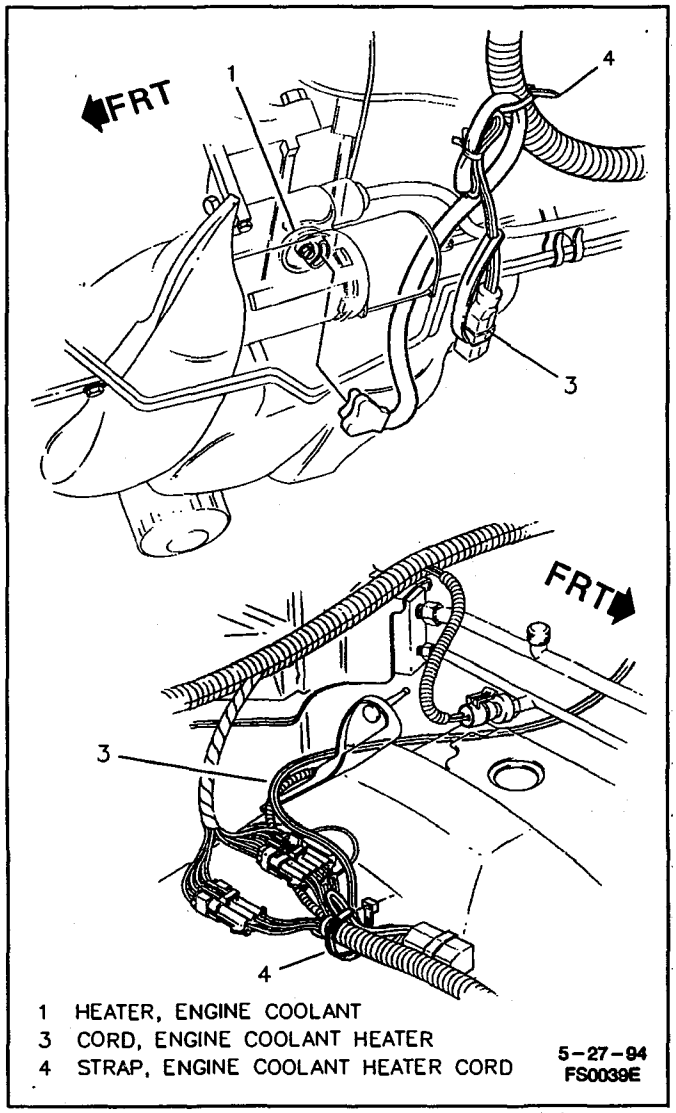


Figure 3 – Engine Coolant Heater Cord Assembly (5.7L LT1 Engine)

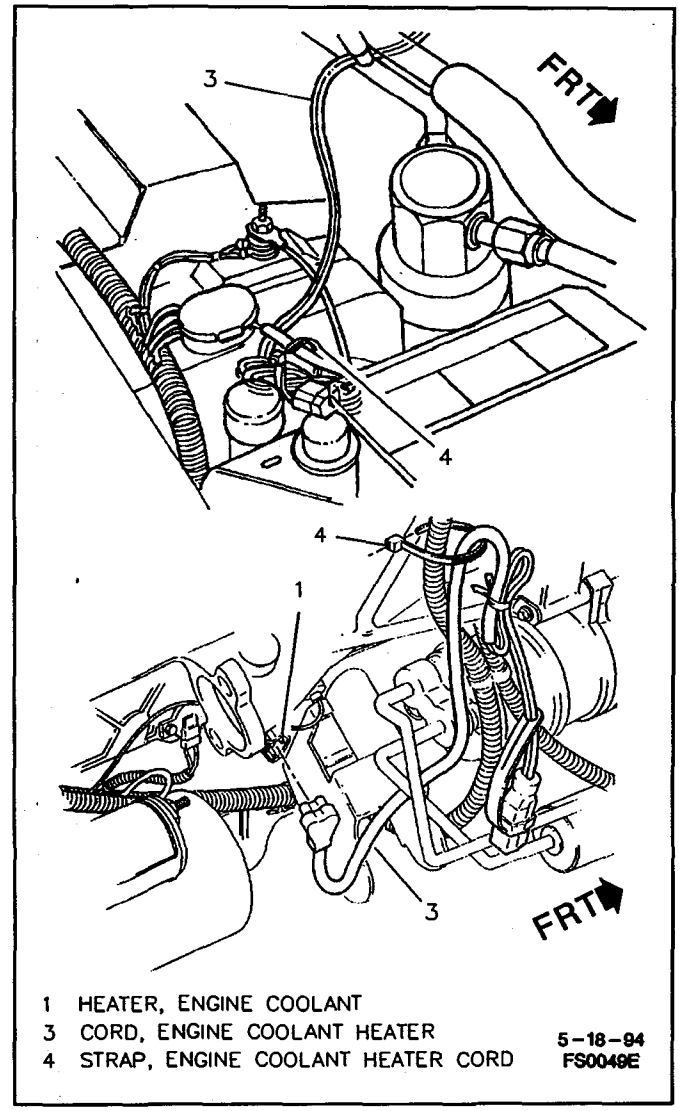


Figure 4 – Engine Coolant Heater Cord Assembly (3.4L L32 Engine)

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Engine Coolant Heater Bolt/Screw	1.9 N•m (17 lb. in.)

BLANK

SECTION 9J

SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in this section under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in this section before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread-locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

RESTRAINT DEVICES

Figures 1 and 2

The Supplemental Inflatable Restraint (SIR) system helps supplement the protection offered by the driver and front passenger seat belts by deploying an air bag from the center of the steering wheel and from the top of the right side of the instrument panel (Figure 1).

The air bag deploys when the vehicle is involved in a frontal crash of sufficient force up to 30 degrees off the centerline of the vehicle (Figure 2). To further absorb the crash energy there is a knee bolster located beneath the instrument panel for both the driver and passenger and the steering column is collapsible.

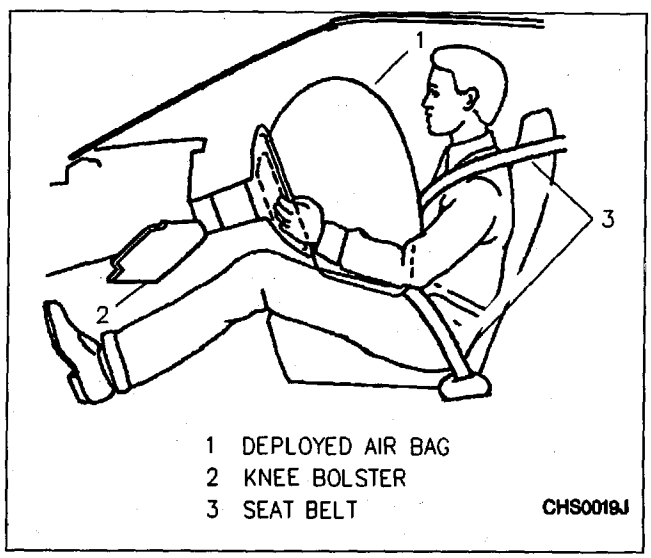


Figure 1 - Restraint Devices

SYSTEM DESCRIPTION

Figure 3

The main portions of the SIR system are the deployment loops and the Diagnostic Energy Reserve Module (DERM).

The main function of the deployment loops is to supply current through the inflator modules, which will cause deployment of the air bags in the event of a

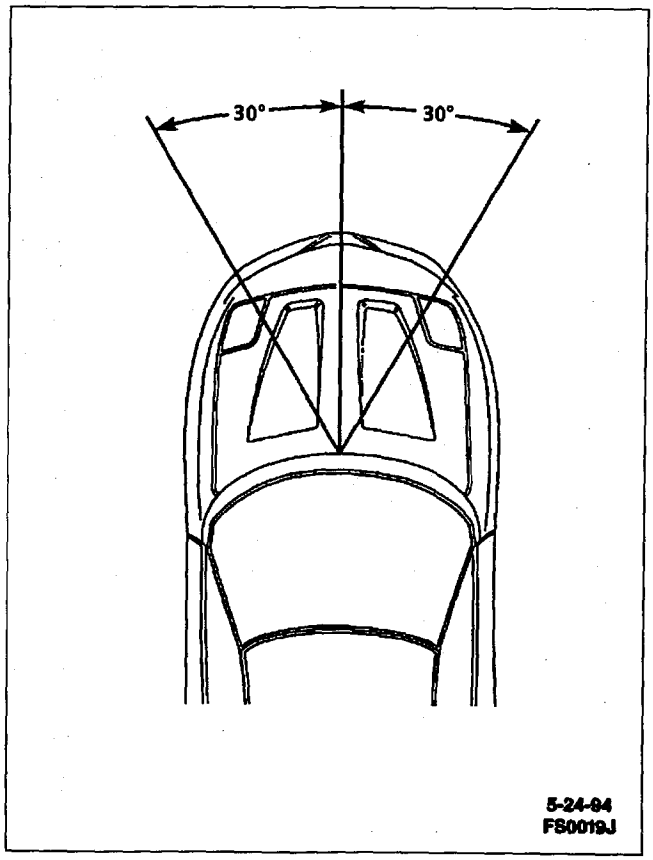


Figure 2 - SIR System "Deployment Window"

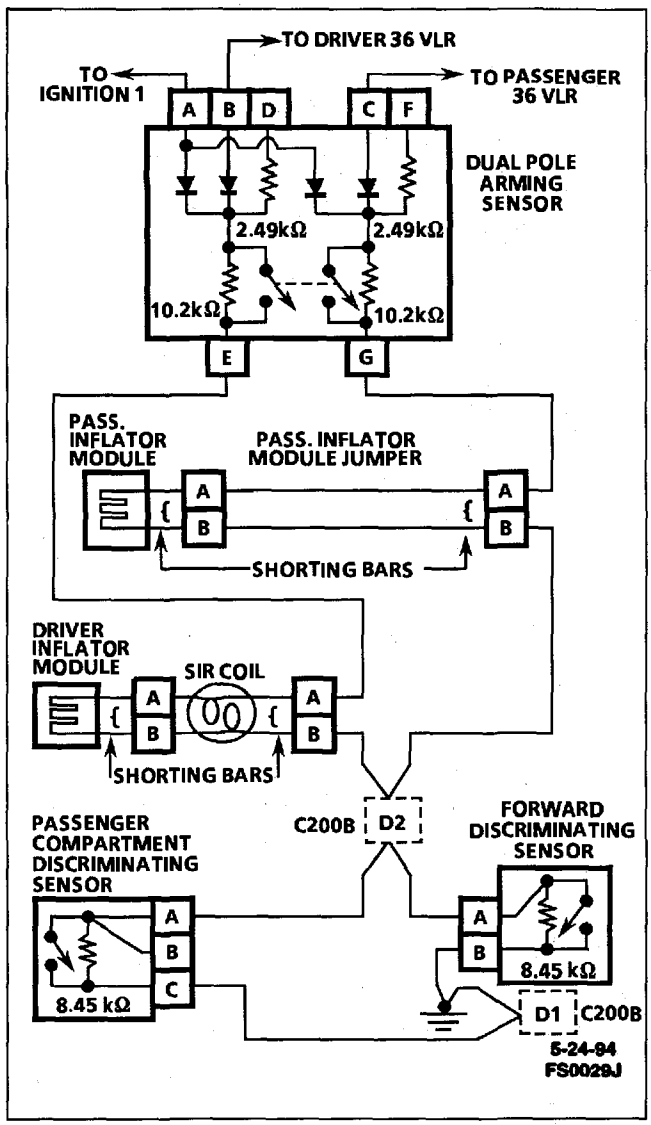


Figure 3 - Deployment Loops

frontal crash of sufficient force, up to 30 degrees off the centerline of the vehicle.

The dual pole arming sensor, SIR coil assembly (driver side only), inflator modules, passenger compartment discriminating sensor and forward discriminating sensor make up the deployment loops. The dual pole arming sensor switches power to the inflator modules on the high side (power side) of the deployment loops. Either of the discriminating sensors can supply ground to the inflator modules on the low side (ground side) of the loops. The inflator modules are only supplied sufficient current to deploy when the dual pole arming sensor and at least one of the discriminating sensors are closed simultaneously.

A function of the DERM is to supply the deployment loops with a 36 Volt Loop Reserve (36 VLR) to ensure sufficient energy to deploy the air bags if the ignition feed to the dual pole arming sensor is lost during a frontal crash.

Another function of the DERM is electrical system diagnostics. The DERM monitors the deployment loops in conjunction with the resistors in the dual pole arming sensor and forward discriminating sensors. These resistors make it possible for the DERM to detect circuit and component malfunctions within the deployment loops. The DERM monitors the voltage drop across each component within the loops during normal non-deployment operation.

If the monitored voltages fall outside of expected limits, the DERM will indicate a malfunction through the storage of a diagnostic trouble code and the illumination of the "AIR BAG" warning lamp.

COMPONENT DESCRIPTION

Figure 4

DERM

NOTICE: Do not open the DERM case for any reason. Touching the connector pins or soldered components may cause electrostatic discharge damage. Repair of a malfunctioning DERM is by replacement only.

The DERM is designed to perform the following functions in the SIR system:

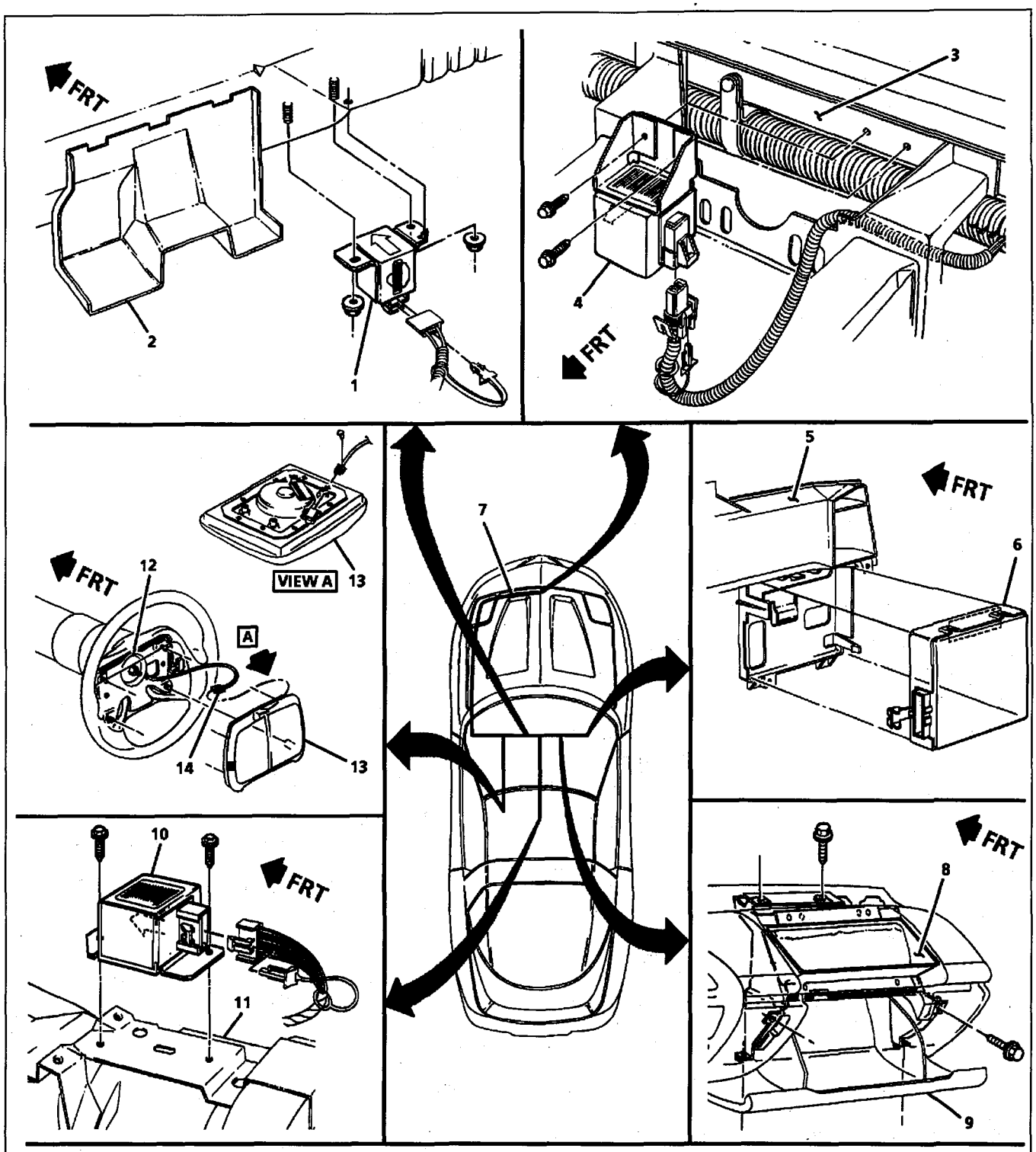
1. Energy Reserve - The DERM maintains two 36 Volt Loop Reserve (36 VLR) energy supplies to provide deployment energy when the vehicle voltage is low or lost in a frontal crash.
2. Malfunction Detection - The DERM performs diagnostic monitoring of SIR system electrical components.
3. Malfunction Recording - The DERM provides SIR system diagnostic trouble code information through a scan tool.
4. Driver Notification - The DERM warns the vehicle driver of SIR system malfunctions by controlling the "AIR BAG" warning lamp.
5. Frontal Crash Recording - The DERM records the SIR system status during a frontal crash.

The DERM is connected to the SIR wiring harness by a 24-way connector. This harness connector uses a shorting bar across certain terminals in the contact area. This shorting bar connects the "AIR BAG" warning lamp to ground when the DERM harness connector is disconnected. This will cause the "AIR BAG" warning lamp to come "ON" steady whenever the ignition switch is at the RUN, BULB TEST or START positions with the DERM disconnected.

"AIR BAG" Warning Lamp

Ignition voltage is applied to the "AIR BAG" warning lamp when the ignition switch is at the RUN, BULB TEST or START positions. The DERM controls the lamp by providing ground with a lamp driver. The "AIR BAG" warning lamp is used in the SIR system to do the following:

1. Verify lamp and DERM operation by flashing seven times when the ignition switch is first turned "ON."
2. Warn the vehicle driver of SIR electrical system malfunctions which could potentially affect the operation of the SIR system. These malfunctions could result in non-deployment in case of a



1	PASSENGER COMPARTMENT DISCRIMINATING SENSOR	8	PASSENGER INFLATOR MODULE
2	STEERING COLUMN SUPPORT BRACKET	9	I/P COMPARTMENT DOOR ASSEMBLY
3	FRONT END TIE BAR	10	DUAL POLE ARMING SENSOR
4	FORWARD DISCRIMINATING SENSOR	11	FLOOR TUNNEL
5	HVAC DUCT	12	SIR COIL ASSEMBLY
6	DERM	13	DRIVER INFLATOR MODULE
7	SIR WIRING HARNESS	14	DRIVER INFLATOR MODULE HARNESS CONNECTOR

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Figure 4 - SIR Component and Wiring Location View

frontal crash or deployment for conditions less severe than intended.

The "AIR BAG" warning lamp is the key to driver notification of SIR system malfunctions. For proper lamp operation, refer to the "SIR Diagnostic System Check" in this section.

Dual Pole Arming Sensor

The dual pole arming sensor is a protective switch located in the high side (power side) of the deployment loops. The dual pole arming sensor is calibrated to close at low level velocity changes (lower than the discriminating sensors).

This ensures that the inflator modules are connected directly to the "36 VLR" outputs of the DERM or "Ignition 1" voltage when either discriminating sensor closes.

The dual pole arming sensor consists of: a sensing element, two sets of normally open switch contacts, diagnostic resistors and diodes. The sensing element closes both sets of switch contacts when the velocity of the vehicle changes at a rate indicating a potential need for deployment.

Two of the diagnostic resistors are connected in parallel with the switch contacts. This allows a small amount of current to flow through each of the deployment loops during normal, non-deployment operation. This current flow results in voltage drops across each component in the deployment loops. The DERM monitors these voltage drops to detect circuit or component malfunctions. There are two additional diagnostic resistors within the dual pole arming sensor which allow the DERM to monitor the voltage supplied to the high side of the deployment loops. These monitored voltages are used by the diagnostic logic of the DERM to make a more precise determination of the actual deployment loop malfunction.

The diodes within the dual pole arming sensor provide isolation between the "36 VLR" outputs of the DERM and the vehicle electrical system "Ignition 1" voltage. The presence of the diodes prevents a direct continuity measurement through the dual pole arming sensor resistors to terminals "A", "B" or "C".

Discriminating Sensors

The discriminating sensors are protective switches wired in parallel on the low side (ground side) of the deployment loops. These sensors are calibrated to close with velocity changes which are severe enough to warrant deployment.

The discriminating sensors consist of a sensing element and normally open switch contacts. The sensing element closes the switch contacts when the vehicle velocity changes are severe enough to warrant deployment.

A diagnostic resistor is connected in parallel with the switch contacts within the discriminating sensors. These parallel resistors supply he ground path for the current passing through the deployment loops during normal, non-deployment operation. This current flow results in voltage drops across each component within the deployment loops. The DERM monitors these voltage drops to detect circuit or component malfunctions.

SIR Coil Assembly

Figure 5

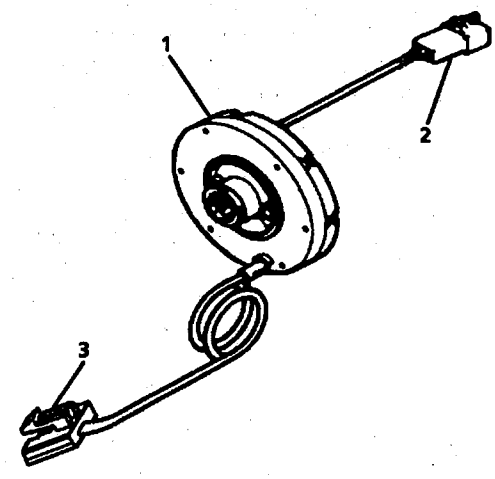
The SIR coil assembly consists of two current carrying coils. They are attached to the steering column and allow rotation of the steering wheel while maintaining continuous contact of the driver deployment loop to the driver inflator module.

There is a shorting bar on the yellow 2-way connector near the base of the steering column which connects the SIR coil to the SIR wiring harness. The shorting bar shorts the circuits to the SIR coil and driver inflator module when the yellow 2-way connector is disconnected. The circuit to the driver inflator module is shorted in this way to help prevent unwanted deployment of the air bag when servicing the steering column or other SIR system components.

Inflator Modules

Figures 6 and 7

The inflator modules consist of an inflatable bag and an inflator (a canister of gas-generating material and an initiating device). When the vehicle is in a frontal crash of sufficient force to close the dual pole arming sensor and at least one of the discriminating sensors simultaneously, current flows through the deployment loops. Current passing through the initiator

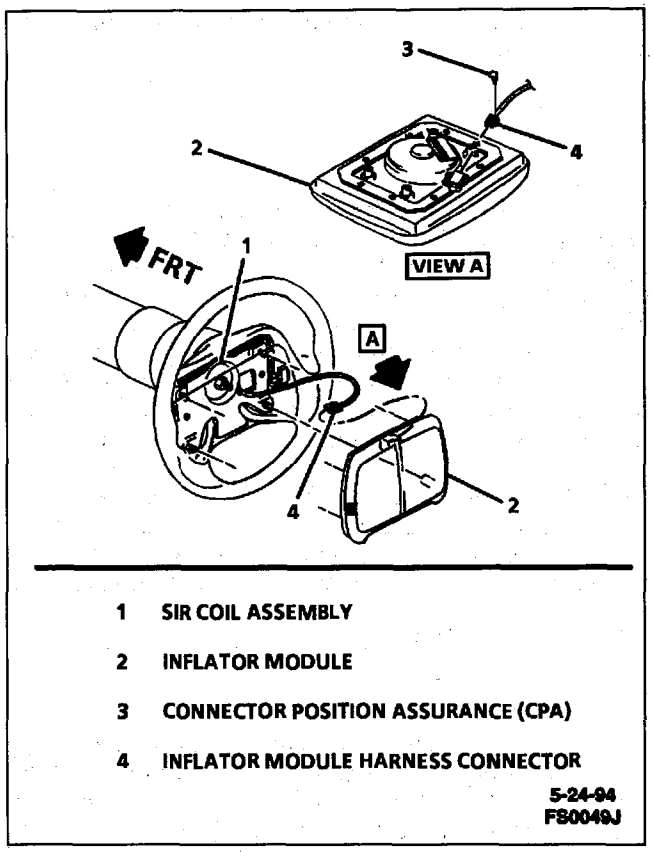


1 SIR COIL ASSEMBLY

2 INFLATOR MODULE CONNECTOR

3 STEERING COLUMN CONNECTOR

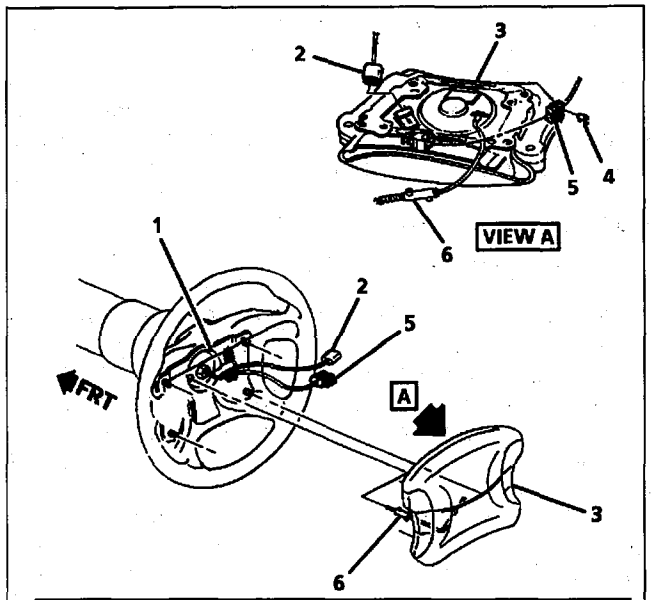
Figure 5 - SIR Coil Assembly



1 SIR COIL ASSEMBLY
2 INFLATOR MODULE
3 CONNECTOR POSITION ASSURANCE (CPA)
4 INFLATOR MODULE HARNESS CONNECTOR

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Figure 6A - Driver Inflator Module (Camaro)



1 SIR COIL ASSEMBLY
2 REDUNDANT STEERING WHEEL CONTROLS
3 DRIVER INFLATOR MODULE
4 CONNECTOR POSITION ASSURANCE (CPA)
5 INFLATOR MODULE HARNESS CONNECTOR
6 HORN LEAD

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Figure 6B - Driver Inflator Module (Firebird)

ignites the material in the inflator module. The gas produced from this reaction rapidly inflates the air bag.

There is a shorting bar on the driver inflator module side of the upper steering column connector which connects the SIR coil assembly to the driver inflator module. The shorting bar shorts across the driver inflator module circuits when the upper steering column connector is disconnected. The circuit to the driver inflator module is shorted in this way to help prevent unwanted deployment of the air bag when servicing the driver inflator module, the steering column or other SIR system components.

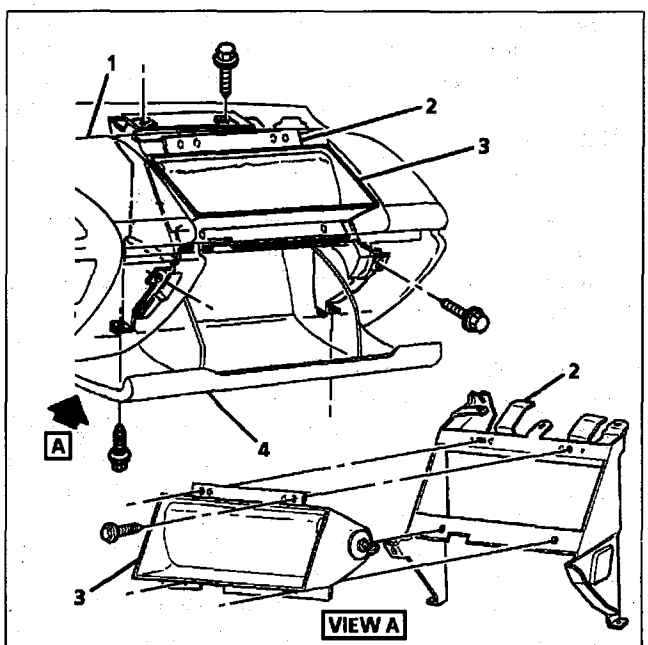
There is a shorting bar on the passenger inflator module connector which connects to the SIR wiring harness. The shorting bar shorts across the passenger inflator module circuit when the passenger inflator module connector is disconnected. The circuit to the passenger inflator module is shorted in this way to help prevent unwanted deployment of the air bag when servicing the passenger inflator module, the instrument panel or other SIR system components.

Steering Column

The steering column is energy absorbing and is designed to compress in a frontal crash to decrease the chance of injury to the driver. A steering column reinforcement is also used for additional support.

Knee Bolster

The knee bolsters are used to absorb energy and control the forward movement of the vehicle's front seat occupants during a frontal crash, by limiting leg



1 I/P TRIM PAD
2 SIR BRACKET ASSEMBLY
3 PASSENGER INFLATOR MODULE
4 I/P COMPARTMENT DOOR ASSEMBLY

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Figure 7 - Passenger Inflator Module

movement.

DEFINITIONS:

AIR BAG - An inflatable cloth cushion designed to deploy in certain frontal crashes. It supplements the protection offered by the seat belts by distributing the impact load more evenly over the vehicle occupant's head and torso.

ASYNCHRONOUS - Performed in a non-periodic fashion, i.e. no defined time or interval.

B+ - Battery voltage, the voltage available at the battery at the time of the indicated measurement. With the key "ON" and the engine not running, the system voltage will likely be between 12 and 12.5 volts. At idle the voltage may be 14 to 16 volts. The voltage could be as low as 10 volts during engine cranking.

BULB CHECK - The DERM will cause the "AIR BAG" warning lamp to flash seven times and then go "OFF" whenever the ignition switch transitions to the RUN position from any other ignition switch position and no malfunctions are detected.

"CONTINUOUS MONITORING" - Tests performed by the DERM on the SIR system every 100 milliseconds while "Ignition 1" voltage is in the normal operating voltage range at the DERM.

DATA LINK CONNECTOR (DLC) - Formerly "ALDL", a connector which is connected by wires to multiple on-board computers allowing communication with an off-board computer, such as a scan tool.

DATUM LINE - A base line parallel to the plane of the underbody or frame from which all vertical measurements originate.

DEPLOY - To inflate the air bag.

DEPLOYMENT LOOPS - The circuits which supply current to the inflator modules to deploy the air bags.

DERM - Diagnostic energy reserve module which provides reserve energy to the deployment loops and performs diagnostic monitoring of all SIR system components.

DIAGNOSTIC TROUBLE CODE (DTC) - Formerly "Code," a numerical designator used by the DERM to indicate specific SIR system malfunctions.

DRIVER CURRENT SOURCE - An output of the DERM which injects current into the driver inflator module circuit during the "Initiator Assembly Resistance Test."

DRIVER INFLATOR MODULE - An assembly located in the steering wheel hub consisting of an inflatable bag, an inflator and an initiator.

DUAL POLE ARMING SENSOR - A sensor on the high side (power side) of the deployment loops that is calibrated to supply voltage to the inflator modules when the vehicle velocity changes are severe enough to warrant arming of the air bags in preparation for deployment.

EEPROM - Electrically Erasable Programmable Read Only Memory. Memory which retains its contents when power is removed from the DERM.

FORWARD DISCRIMINATING SENSOR - A sensor on the low side (ground side) of the deployment loops that is calibrated to supply ground to the inflator modules when the vehicle velocity changes are severe enough to warrant deployment of the air bags.

HIGHER PRIORITY FAULT - Each diagnostic trouble code is assigned a priority based on the detectability with other DTCs present. The priority corresponds to the detectability of the malfunction ONLY, and does NOT relate to the criticality of the malfunction with respect to deployment or non-deployment under any given condition.

IGNITION CYCLE - The voltage at the DERM "Ignition 1" inputs, with ignition switch "ON," is within the normal operating voltage range for at least ten seconds before turning ignition switch "OFF."

IGNITION 1 - A battery voltage (B+) circuit which is only powered with the ignition switch in the RUN, BULB TEST, or START positions.

INITIATOR - The electrical component inside the inflator module which, when sufficient current flows, sets off the chemical reaction that inflates the air bag.

"INITIATOR ASSEMBLY RESISTANCE TEST" - Tests performed once each ignition cycle when no malfunctions are detected during "Turn-ON" or "Continuous Monitoring." This test verifies the integrity of the discriminating sensor interconnect circuit, checks for the correct DERM configuration for the vehicle, shorts to "Ignition 1" in the deployment loops, high resistance or opens in the "Driver Side High," "Driver Side Low," "Passenger Side High" and "Passenger Side Low" circuits and measures the resistance of the inflator assembly consisting of: 1) Initiators, 2) SIR coil assembly (driver side only), 3) Connectors and associated wiring.

NORMAL OPERATING VOLTAGE RANGE - The voltage measured between the DERM "Ignition 1" terminals and "Ground" terminals is between 7.25 and 16 volts.

PASSENGER COMPARTMENT DISCRIMINATING SENSOR - A sensor on the low side (ground side) of the deployment loops that is calibrated to supply ground to the inflator modules when the vehicle velocity changes are severe enough to warrant deployment of the air bags.

PASSENGER CURRENT SOURCE - An output of the DERM which injects current into the passenger inflator module circuit during the "Initiator Assembly Resistance Test."

PASSENGER INFLATOR MODULE - An assembly located in the right side of the I/P consisting of an inflatable bag, an inflator and an initiator.

SCAN TOOL - An off-board computer used to read diagnostic information from on-board computers via the data link connector.

SERIAL DATA - Information representing the status of the SIR system.

SIR - Supplemental inflatable restraint.

SIR COIL ASSEMBLY - An assembly of two current-carrying coils in the driver deployment loop that allows the rotation of the steering wheel while maintaining the continuous contact of the driver deployment loop to the driver inflator module.

SIR WIRING HARNESS - The wires and connectors that electrically connect the components in the SIR system.

"10 MINUTE LOOP TEST" - Portions of the "Initiator Assembly Resistance Test" are repeated every ten minutes during an ignition cycle. These are the check for shorts to "Ignition 1" in the deployment loops and the check for an open discriminating sensor interconnect circuit.

"TURN-ON" - Test which the DERM performs on the SIR system once during each ignition cycle immediately after "Ignition 1" voltage is applied to the DERM and before "Continuous Monitoring."

36 VLR - The 36 volt loop reserve energy supplies from the DERM which provide deployment power when vehicle voltage is low or lost in a frontal crash.

36 VLR DELAY - Charging of the 36 VLR power supplies is inhibited briefly during "Turn-ON." This allows detection of certain malfunctions related to "Ignition 1" voltage which cannot be tested with 36 volts present.

DIAGNOSIS

CAUTION: To avoid deployment when troubleshooting the SIR system, do not use electrical test equipment such as a battery powered or ac powered voltmeter, ohmmeter, etc., or any type of electrical equipment other than that specified in this manual. Do not use a non-powered probe type tester. Instructions in this manual must be followed carefully, otherwise personal injury may result.

DIAGNOSTIC TROUBLE CODES

The "SIR Diagnostic System Check" must always be the starting point of any SIR system diagnosis. The "SIR Diagnostic System Check" checks for proper "AIR BAG" warning lamp operation and checks for SIR diagnostic trouble codes using the scan tool.

1. Current diagnostic trouble codes - Malfunctions that are presently being detected. Current diagnostic trouble codes are stored in RAM (Random Access Memory).
2. History diagnostic trouble codes - All malfunctions detected since the last time the history memory was cleared. History diagnostic trouble codes are stored in EEPROM.

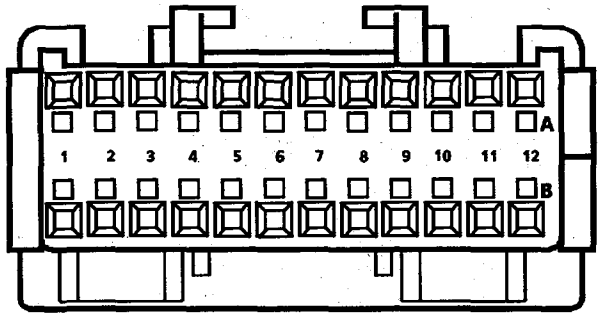
Scan Tool Diagnostics

A scan tool is used to read current and history diagnostic trouble codes and to clear all diagnostic trouble codes after a repair is completed. The scan tool must be updated to communicate with the SIR system through a replaceable cartridge before it can be used for SIR diagnostics. To use the scan tool, connect it to the data link connector and turn the ignition switch "ON." The scan tool reads serial data from the DERM "Serial Data" output terminal "B11" to the data link connector terminal "M".

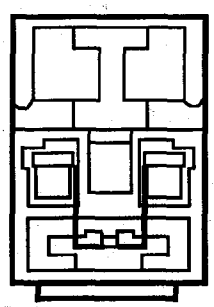
USE OF SPECIAL TOOLS

CAUTION: To avoid deployment when troubleshooting the SIR system, do not use electrical test equipment such as a battery powered or ac powered voltmeter, ohmmeter, etc., or any type of electrical equipment other than that specified in this manual. Do not use a non-powered probe type tester. Instructions in this manual must be followed carefully, otherwise personal injury may result.

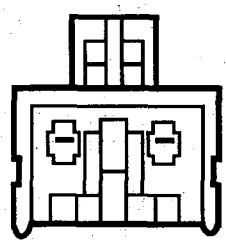
You should be familiar with the tools listed in this section under the heading "SIR SPECIAL TOOLS." You should be able to measure voltage and resistance. You should be familiar with proper use of a scan tool such as the Tech 1 Diagnostic Computer TK-0, SIR Driver/Passenger Load Tool J 38715 and appropriate adapters, Connector Test Adapter Kit J 35616-A, and the DVM (Digital Multimeter) J 39200.



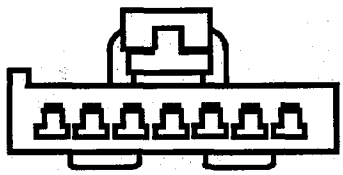
DERM



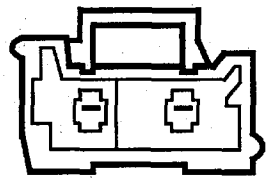
Passenger Jumper Harness and Inflator Connectors (Female)



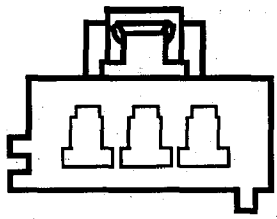
Passenger Jumper Harness and Inflator Connectors (Male)



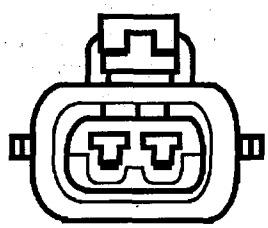
Dual Pole Arming Sensor Harness Connector



Steering Column Harness Connector



Passenger Compartment Discriminating Sensor Harness Connector



Forward Discriminating Sensor Harness Connector

ALL SIR SYSTEM CONNECTORS ARE YELLOW

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Figure 8 - SIR Connector Body Face Views

CAUTION: To avoid deployment when troubleshooting the SIR system, do not use electrical test equipment such as a battery powered or ac powered voltmeter, ohmmeter, etc., or any type of electrical equipment other than that specified in this manual. Do not use a non-powered probe type tester. Instructions in this manual must be followed carefully, otherwise personal injury may result.

SIR DIAGNOSTIC SYSTEM CHECK

The diagnostic procedures used in this section are designed to find and repair SIR system malfunctions. To get the best results, it is important to use the diagnostic charts and follow the sequence listed below.

A. PERFORM THE "SIR DIAGNOSTIC SYSTEM CHECK." The "SIR Diagnostic System Check" must be the starting point of any SIR diagnostics. The "SIR Diagnostic System Check" checks for proper "AIR BAG" warning lamp operation, the ability of the DERM to communicate through the "Serial Data" line and whether SIR diagnostic trouble codes exist.

B. REFER TO THE PROPER DIAGNOSTIC CHART AS DIRECTED BY THE "SIR DIAGNOSTIC SYSTEM CHECK." The "SIR Diagnostic System Check" will lead you to the correct chart to diagnose any SIR system malfunctions. Bypassing these procedures may result in extended diagnostic time, incorrect diagnosis and incorrect parts replacement.

C. REPEAT THE "SIR DIAGNOSTIC SYSTEM CHECK" AFTER ANY REPAIR OR DIAGNOSTIC PROCEDURES HAVE BEEN PERFORMED. Performing the "SIR Diagnostic System Check" after all repair or diagnostic procedures will ensure that the repair has been made correctly and that no other malfunctions exist.

CIRCUIT DESCRIPTION

When the ignition switch is first turned "ON," "Ignition 1" voltage is applied from the "AIR BAG" fuse to the DERM at the "Ignition 1" input terminals "A9" and "A10" and from the "GAGES" fuse to the DERM at the "Redundant Indicator Ignition 1" input terminal "B2". The DERM responds by flashing the "AIR BAG" warning lamp seven times while performing tests on the SIR system.

When the engine is being cranked, "Ignition 1" voltage is applied from the "CRANK" fuse to the DERM at the "Crank" input terminal "B10". The DERM responds by grounding the "SIR Indicator" output terminal "B1" until "Ignition 1" voltage is removed from the "Crank" input. This results in the "AIR BAG" warning lamp being "ON" steady during cranking.

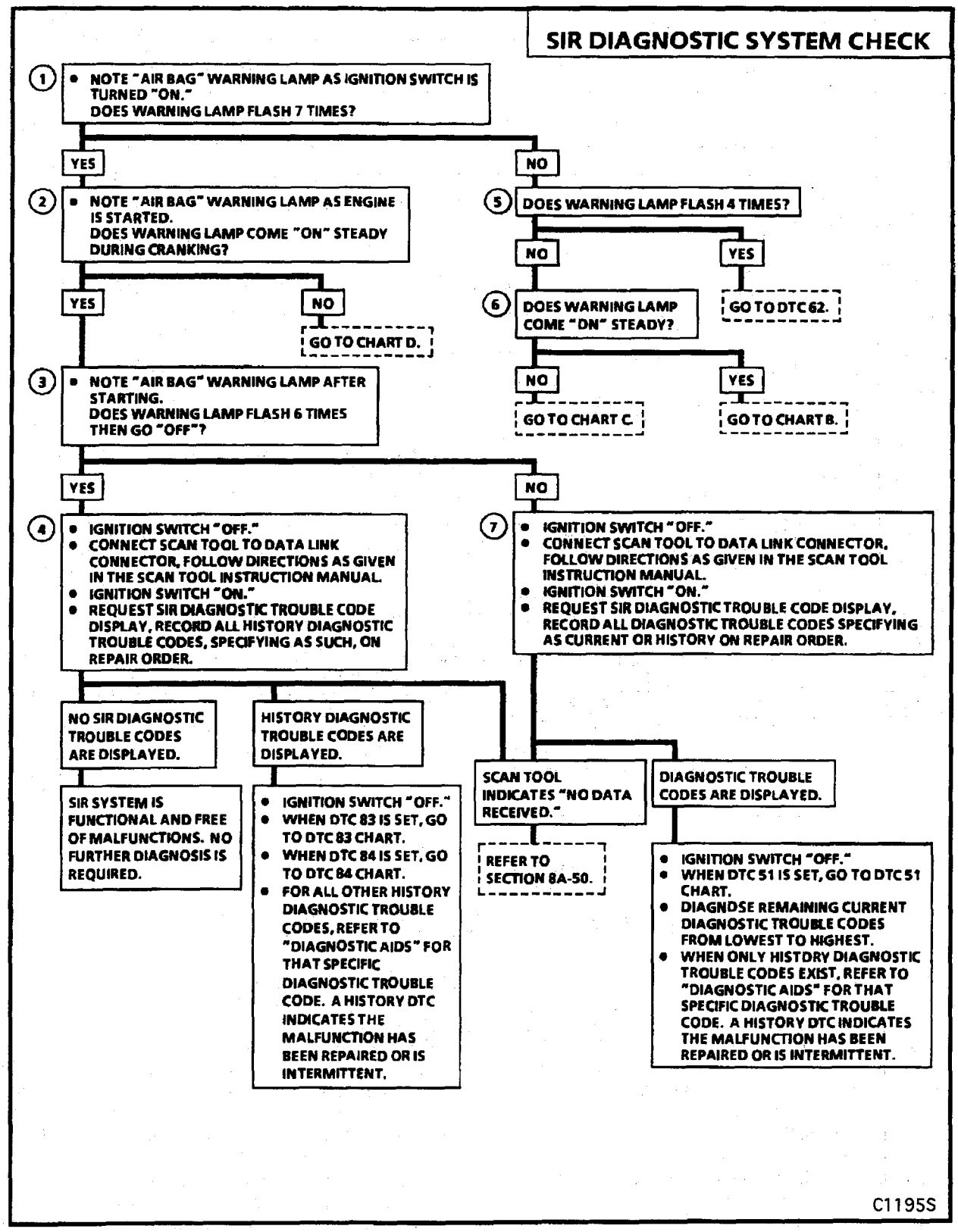
After cranking the DERM will flash the "AIR BAG" warning lamp six times and perform tests on the SIR system.

NOTES ON SYSTEM CHECK CHART:

1. The "AIR BAG" warning lamp should flash seven times after ignition is first turned "ON."
2. The "AIR BAG" warning lamp should remain "ON" steady during cranking.
3. After cranking, the "AIR BAG" warning lamp should flash six times then go "OFF."
4. This test checks for the proper operation of the "Serial Data" line. This test will also determine whether history diagnostic trouble codes are stored and, if so, identify them.
5. When the "AIR BAG" warning lamp flashes four times during "Bulb Check" this indicates a malfunction in the redundant lamp driver circuitry. These malfunctions are diagnosed by DTC 62 chart.
6. Improper operation of the "AIR BAG" warning lamp is indicated. This test differentiates a warning lamp stays "ON" condition from a warning lamp does not come "ON" condition.
7. This test checks for proper operation of the "Serial Data" line. This test will also identify the stored diagnostic trouble codes and whether they are current or history.

DIAGNOSTIC AIDS:

The order in which diagnostic trouble codes are diagnosed is very important. Failure to diagnose the diagnostic trouble codes in the order specified may result in extended diagnostic time, incorrect diagnosis and incorrect parts replacement.


SIR DIAGNOSTIC SYSTEM CHECK
1
• NOTE "AIR BAG" WARNING LAMP AS IGNITION SWITCH IS TURNED "ON."
DOES WARNING LAMP FLASH 7 TIMES?
YES
NO
2
• NOTE "AIR BAG" WARNING LAMP AS ENGINE IS STARTED.
DOES WARNING LAMP COME "ON" STEADY DURING CRANKING?
YES
NO
GO TO CHART D.
3
• NOTE "AIR BAG" WARNING LAMP AFTER STARTING.
DOES WARNING LAMP FLASH 6 TIMES THEN GO "OFF"?
YES
NO
4
• IGNITION SWITCH "OFF."
• CONNECT SCAN TOOL TO DATA LINK CONNECTOR, FOLLOW DIRECTIONS AS GIVEN IN THE SCAN TOOL INSTRUCTION MANUAL.
• IGNITION SWITCH "ON."
• REQUEST SIR DIAGNOSTIC TROUBLE CODE DISPLAY, RECORD ALL HISTORY DIAGNOSTIC TROUBLE CODES, SPECIFYING AS SUCH, ON REPAIR ORDER.
NO SIR DIAGNOSTIC TROUBLE CODES ARE DISPLAYED.
SIR SYSTEM IS FUNCTIONAL AND FREE OF MALFUNCTIONS. NO FURTHER DIAGNOSIS IS REQUIRED.
HISTORY DIAGNOSTIC TROUBLE CODES ARE DISPLAYED.
• IGNITION SWITCH "OFF."
• WHEN DTC 83 IS SET, GO TO DTC 83 CHART.
• WHEN DTC 84 IS SET, GO TO DTC 84 CHART.
• FOR ALL OTHER HISTORY DIAGNOSTIC TROUBLE CODES, REFER TO "DIAGNOSTIC AIDS" FOR THAT SPECIFIC DIAGNOSTIC TROUBLE CODE. A HISTORY DTC INDICATES THE MALFUNCTION HAS BEEN REPAIRED OR IS INTERMITTENT.
5
DOES WARNING LAMP FLASH 4 TIMES?
NO
YES
6
DOES WARNING LAMP COME "ON" STEADY?
GO TO DTC 62.
NO
YES
GO TO CHART C.
GO TO CHART B.
7
• IGNITION SWITCH "OFF."
• CONNECT SCAN TOOL TO DATA LINK CONNECTOR, FOLLOW DIRECTIONS AS GIVEN IN THE SCAN TOOL INSTRUCTION MANUAL.
• IGNITION SWITCH "ON."
• REQUEST SIR DIAGNOSTIC TROUBLE CODE DISPLAY, RECORD ALL DIAGNOSTIC TROUBLE CODES SPECIFYING AS CURRENT OR HISTORY ON REPAIR ORDER.
SCAN TOOL INDICATES "NO DATA RECEIVED."
REFER TO SECTION 8A-50.
DIAGNOSTIC TROUBLE CODES ARE DISPLAYED.
• IGNITION SWITCH "OFF."
• WHEN DTC 51 IS SET, GO TO DTC 51 CHART.
• DIAGNOSE REMAINING CURRENT DIAGNOSTIC TROUBLE CODES FROM LOWEST TO HIGHEST.
• WHEN ONLY HISTORY DIAGNOSTIC TROUBLE CODES EXIST, REFER TO "DIAGNOSTIC AIDS" FOR THAT SPECIFIC DIAGNOSTIC TROUBLE CODE. A HISTORY DTC INDICATES THE MALFUNCTION HAS BEEN REPAIRED OR IS INTERMITTENT.
C1195S

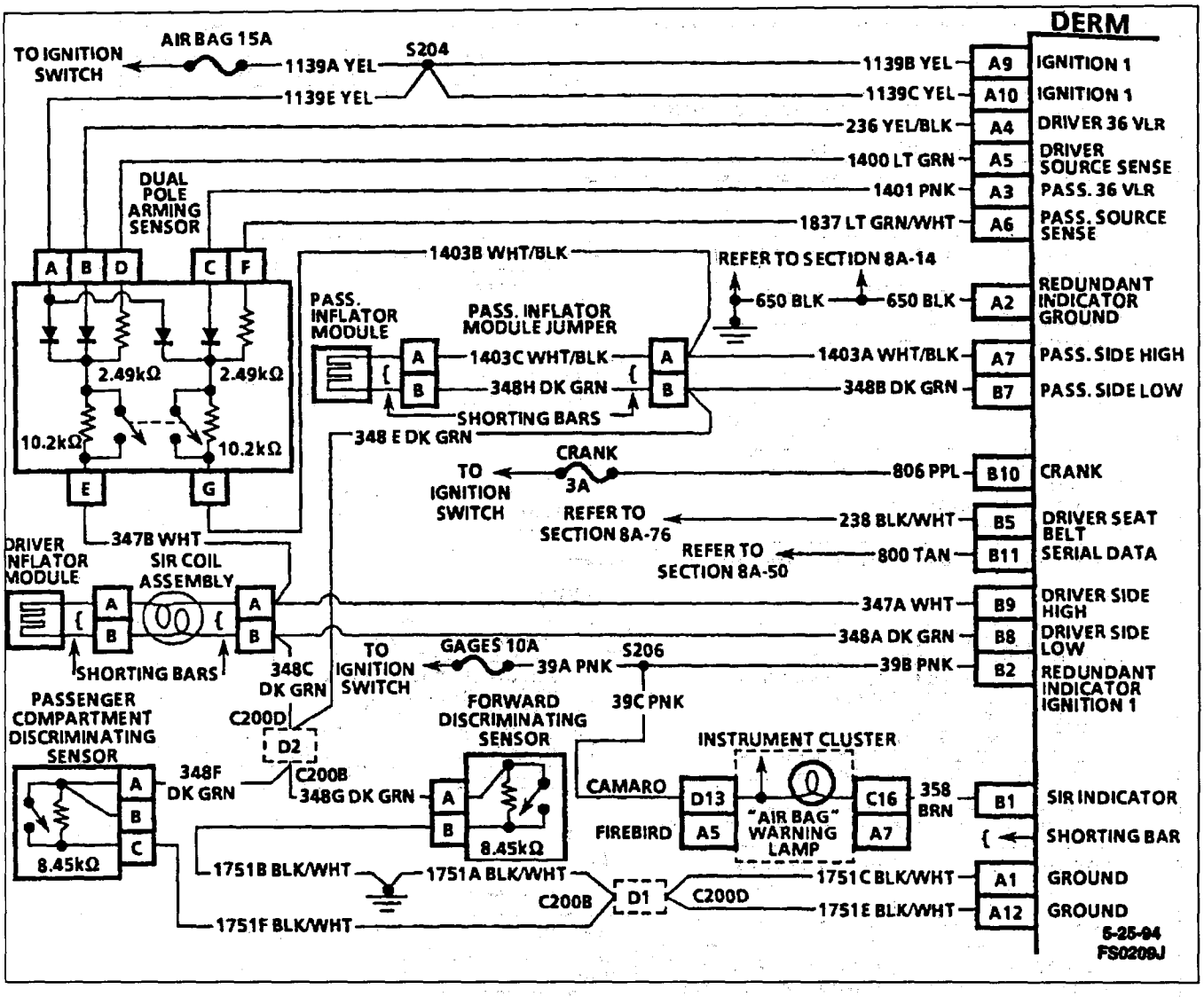


CHART A
DERM INTEGRITY CHECK

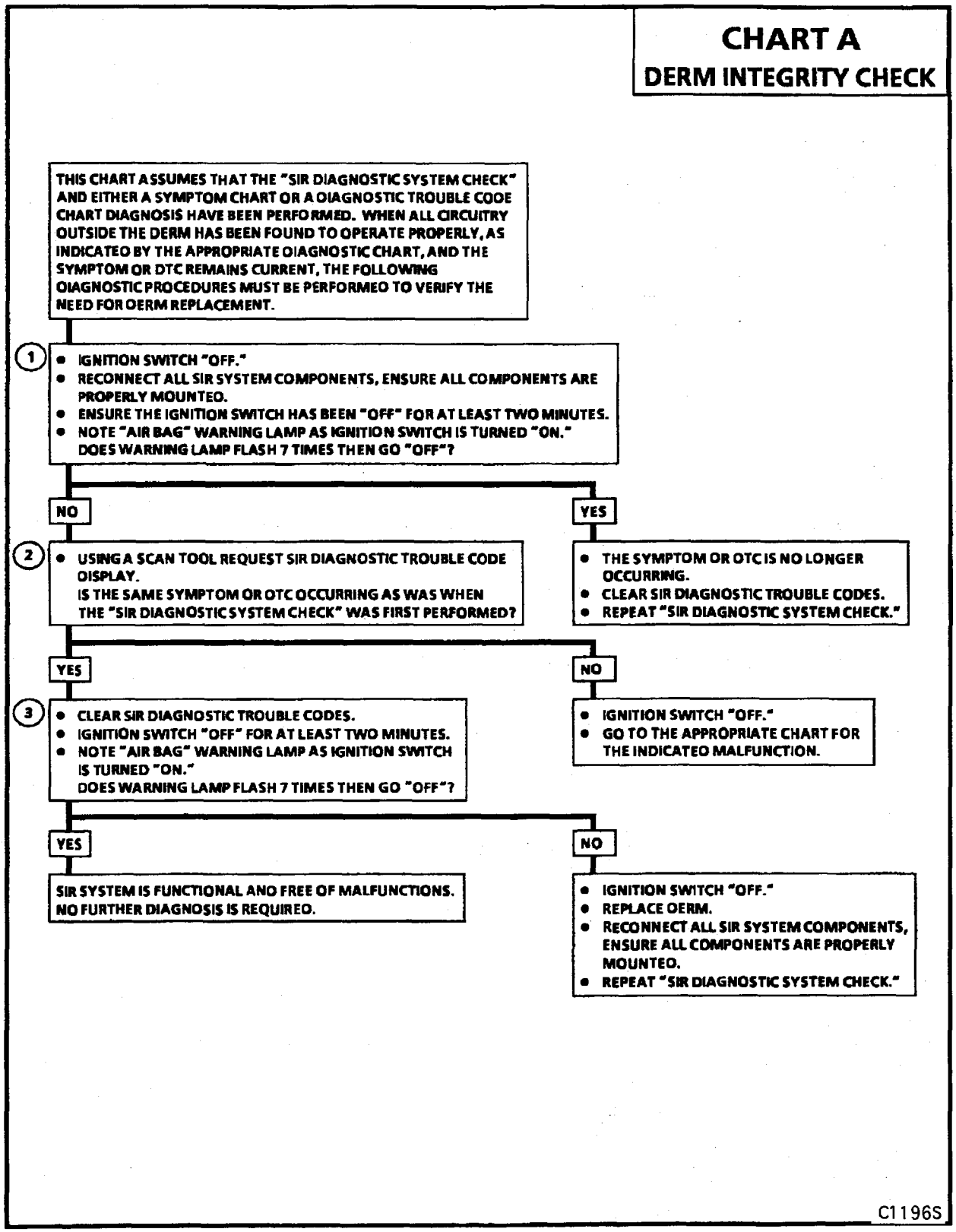
Circuit Description:

When the DERM recognizes "Ignition 1" voltage, applied to terminals "A9" and "A10", is in the normal operating voltage range, the "AIR BAG" warning lamp is flashed seven times to verify operation. At this time the DERM performs "Turn-ON" tests followed by "Continuous Monitoring" tests. When no malfunctions are detected the DERM proceeds to the "Initiator Assembly Resistance Test." When a malfunction is detected the DERM sets a current diagnostic trouble code and illuminates the "AIR BAG" warning lamp. The DERM will clear current diagnostic trouble codes and move them to a history file when the malfunction is no longer detected and/or the ignition switch is cycled, except for DTC 51. DTC 51 can only be cleared using a scan tool "Clear Codes" command.

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test confirms a current malfunction. If no current malfunction is occurring (History DTC set) the "Diagnostic Aids" for the appropriate diagnostic trouble code should be referenced. The DERM should not be replaced for a History Diagnostic Trouble Code.
2. This test checks for a malfunction introduced into the SIR system during the diagnostic process. It is extremely unlikely that a malfunctioning DERM would cause a new malfunction to occur during the diagnostic process.
3. When all circuitry outside the DERM has been found to operate properly, as indicated by the appropriate diagnostic chart, then and only then should the DERM be replaced.


CHART A
DERM INTEGRITY CHECK
THIS CHART ASSUMES THAT THE "SIR DIAGNOSTIC SYSTEM CHECK" AND EITHER A SYMPTOM CHART OR A DIAGNOSTIC TROUBLE CODE CHART DIAGNOSIS HAVE BEEN PERFORMED. WHEN ALL CIRCUITRY OUTSIDE THE DERM HAS BEEN FOUND TO OPERATE PROPERLY, AS INDICATED BY THE APPROPRIATE DIAGNOSTIC CHART, AND THE SYMPTOM OR DTC REMAINS CURRENT, THE FOLLOWING DIAGNOSTIC PROCEDURES MUST BE PERFORMED TO VERIFY THE NEED FOR DERM REPLACEMENT.
1
• IGNITION SWITCH "OFF."
• RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
• ENSURE THE IGNITION SWITCH HAS BEEN "OFF" FOR AT LEAST TWO MINUTES.
• NOTE "AIR BAG" WARNING LAMP AS IGNITION SWITCH IS TURNED "ON." DOES WARNING LAMP FLASH 7 TIMES THEN GO "OFF"?
NO
YES
2
• USING A SCAN TOOL REQUEST SIR DIAGNOSTIC TROUBLE CODE DISPLAY. IS THE SAME SYMPTOM OR DTC OCCURRING AS WAS WHEN THE "SIR DIAGNOSTIC SYSTEM CHECK" WAS FIRST PERFORMED?
• THE SYMPTOM OR DTC IS NO LONGER OCCURRING.
• CLEAR SIR DIAGNOSTIC TROUBLE CODES.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
YES
NO
3
• CLEAR SIR DIAGNOSTIC TROUBLE CODES.
• IGNITION SWITCH "OFF" FOR AT LEAST TWO MINUTES.
• NOTE "AIR BAG" WARNING LAMP AS IGNITION SWITCH IS TURNED "ON." DOES WARNING LAMP FLASH 7 TIMES THEN GO "OFF"?
• IGNITION SWITCH "OFF."
• GO TO THE APPROPRIATE CHART FOR THE INDICATED MALFUNCTION.
YES
NO
SIR SYSTEM IS FUNCTIONAL AND FREE OF MALFUNCTIONS. NO FURTHER DIAGNOSIS IS REQUIRED.
• IGNITION SWITCH "OFF."
• REPLACE DERM.
• RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
C1196S

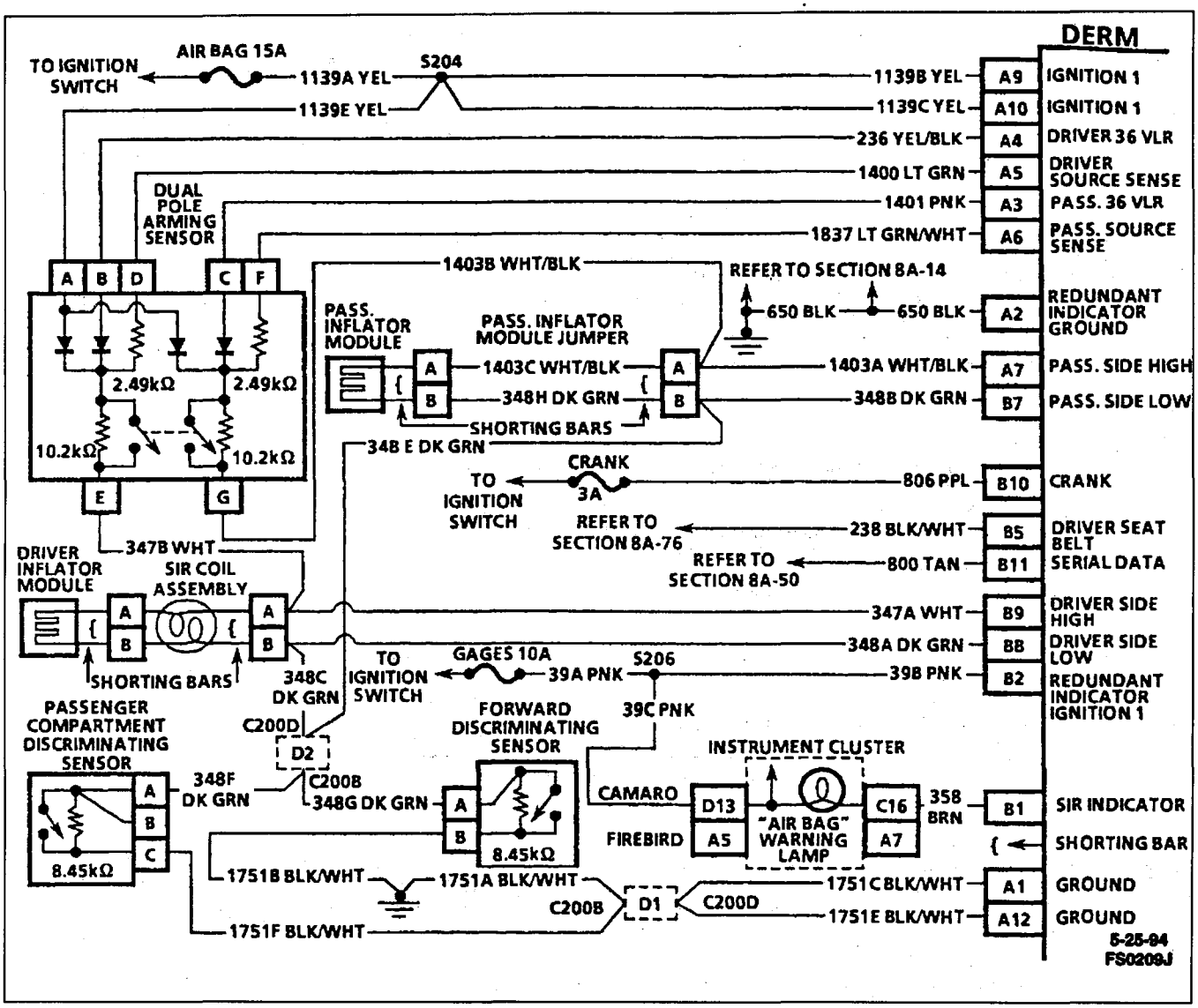


CHART B - "AIR BAG" WARNING LAMP COMES "ON" STEADY

Circuit Description:

When the ignition switch is first turned "ON," "Ignition 1" voltage is applied from the "GAGES" fuse to "Redundant Indicator Ignition 1," terminal "B2", and to the "AIR BAG" warning lamp which is connected to "SIR Indicator," terminal "B1". The "AIR BAG" fuse applies system voltage to the "Ignition 1" inputs, terminals "A9" and "A10". The DERM responds by flashing the "AIR BAG" warning lamp seven times. If "Ignition 1" is outside of the normal operating voltage range, the "AIR BAG" warning lamp will come "ON" solid with no DTCs set.

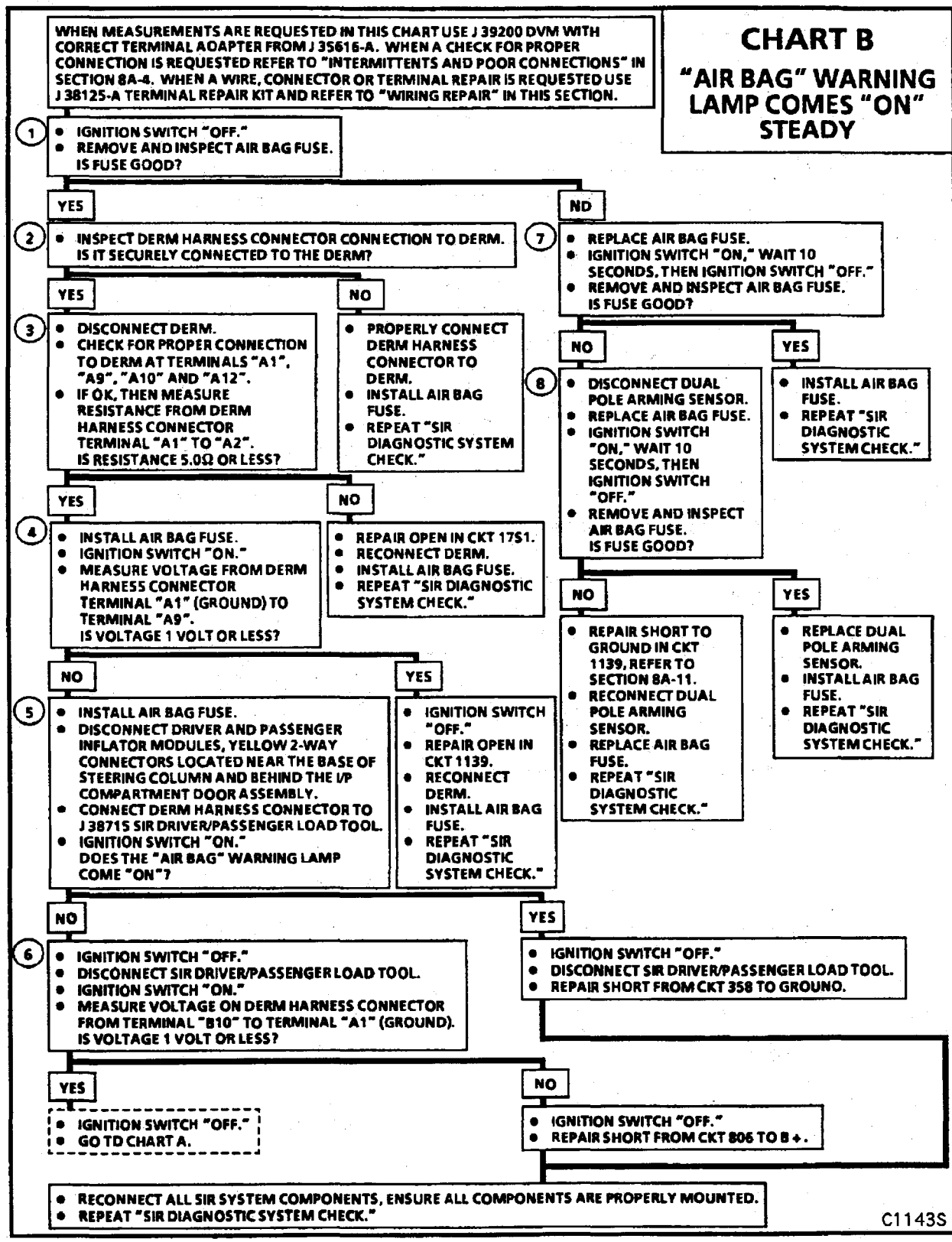
When the engine is being cranked, "Ignition 1" voltage is applied from the "CRANK" fuse to the DERM at the "Crank" input. The DERM responds by grounding the "SIR Indicator" output until "Ignition 1" voltage is removed from the "Crank" input. This results in the "AIR BAG" warning lamp being "ON" during cranking.

After cranking, the DERM will flash the "AIR BAG" warning lamp six times.

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. An open "AIR BAG" fuse would cause the "AIR BAG" warning lamp to come "ON" steady.
2. A disconnected DERM harness connector will cause the warning lamp to come "ON" steady via the shorting bar from terminal "A1" to terminal "B1".
3. This test checks for an open in the "Ground" circuitry to the DERM.
4. This test checks for an open in the "Ignition 1" circuitry to the DERM.
5. This test checks for a short from the "SIR Indicator" circuit to ground.
6. This test checks for a short from the "Crank" input circuit to B+.
7. This test checks whether a short to ground caused the "AIR BAG" fuse to open.
8. This test determines whether the short to ground is due to a malfunctioning dual pole arming sensor or a short in the wiring.


WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.
CHART B
"AIR BAG" WARNING LAMP COMES "ON" STEADY
1
• IGNITION SWITCH "OFF."
• REMOVE AND INSPECT AIR BAG FUSE.
IS FUSE GOOD?
YES
NO
2
• INSPECT DERM HARNESS CONNECTOR CONNECTION TO DERM.
IS IT SECURELY CONNECTED TO THE DERM?
YES
NO
3
• DISCONNECT DERM.
• CHECK FOR PROPER CONNECTION TO DERM AT TERMINALS "A1", "A9", "A10" AND "A12".
• IF OK, THEN MEASURE RESISTANCE FROM DERM HARNESS CONNECTOR TERMINAL "A1" TO "A2".
IS RESISTANCE 5.0Ω OR LESS?
• PROPERLY CONNECT DERM HARNESS CONNECTOR TO DERM.
• INSTALL AIR BAG FUSE.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
YES
NO
4
• INSTALL AIR BAG FUSE.
• IGNITION SWITCH "ON."
• MEASURE VOLTAGE FROM DERM HARNESS CONNECTOR TERMINAL "A1" (GROUND) TO TERMINAL "A9".
IS VOLTAGE 1 VOLT OR LESS?
• REPAIR OPEN IN CKT 1751.
• RECONNECT DERM.
• INSTALL AIR BAG FUSE.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
NO
YES
5
• INSTALL AIR BAG FUSE.
• DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
• CONNECT DERM HARNESS CONNECTOR TO J 38715 SIR DRIVER/PASSENGER LOAD TOOL.
• IGNITION SWITCH "ON."
DOES THE "AIR BAG" WARNING LAMP COME "ON"?
• IGNITION SWITCH "OFF."
• REPAIR OPEN IN CKT 1139.
• RECONNECT DERM.
• INSTALL AIR BAG FUSE.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
NO
YES
6
• IGNITION SWITCH "OFF."
• DISCONNECT SIR DRIVER/PASSENGER LOAD TOOL.
• IGNITION SWITCH "ON."
• MEASURE VOLTAGE ON DERM HARNESS CONNECTOR FROM TERMINAL "B10" TO TERMINAL "A1" (GROUND).
IS VOLTAGE 1 VOLT OR LESS?
• IGNITION SWITCH "OFF."
• DISCONNECT SIR DRIVER/PASSENGER LOAD TOOL.
• REPAIR SHORT FROM CKT 358 TO GROUND.
YES
NO
• IGNITION SWITCH "OFF."
• GO TO CHART A.
• IGNITION SWITCH "OFF."
• REPAIR SHORT FROM CKT 806 TO B+.
• RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
7
• REPLACE AIR BAG FUSE.
• IGNITION SWITCH "ON," WAIT 10 SECONDS, THEN IGNITION SWITCH "OFF."
• REMOVE AND INSPECT AIR BAG FUSE.
IS FUSE GOOD?
NO
YES
8
• DISCONNECT DUAL POLE ARMING SENSOR.
• REPLACE AIR BAG FUSE.
• IGNITION SWITCH "ON," WAIT 10 SECONDS, THEN IGNITION SWITCH "OFF."
• REMOVE AND INSPECT AIR BAG FUSE.
IS FUSE GOOD?
• INSTALL AIR BAG FUSE.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
NO
YES
• REPAIR SHORT TO GROUND IN CKT 1139, REFER TO SECTION 8A-11.
• RECONNECT DUAL POLE ARMING SENSOR.
• REPLACE AIR BAG FUSE.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
• REPLACE DUAL POLE ARMING SENSOR.
• INSTALL AIR BAG FUSE.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
C1143S

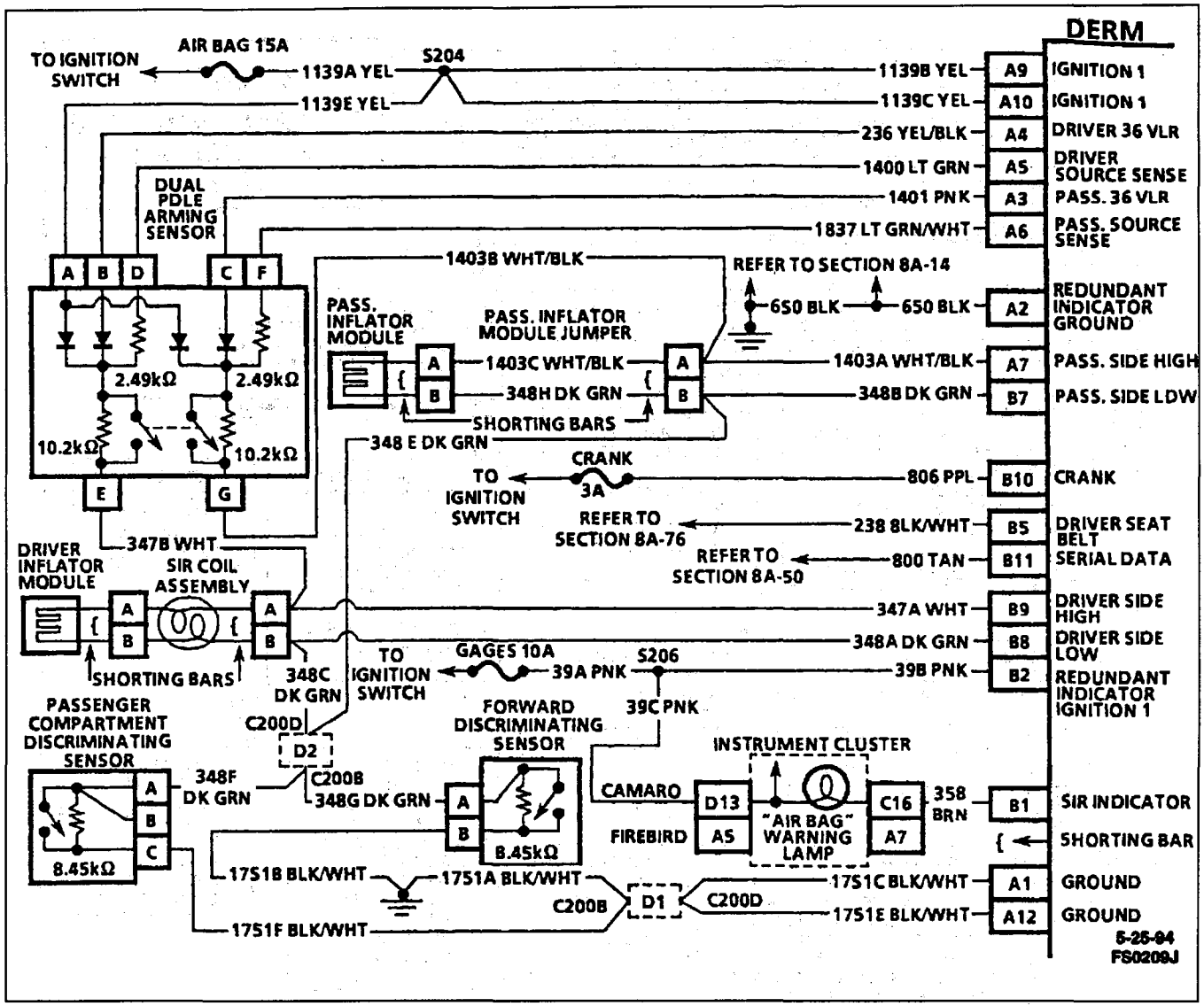


CHART C- (Page 1 of 2)
"AIR BAG" WARNING LAMP DOES NOT COME "ON"

Circuit Description:

When the ignition switch is first turned "ON," "Ignition 1" voltage is applied from the "GAGES" fuse to "Redundant Indicator Ignition 1," terminal "B2", and to the "AIR BAG" warning lamp which is connected to "SIR Indicator," terminal "B1". The "AIR BAG" fuse applies system voltage to the "Ignition 1" inputs, terminals "A9" and "A10". The DERM responds by flashing the "AIR BAG" warning lamp seven times.

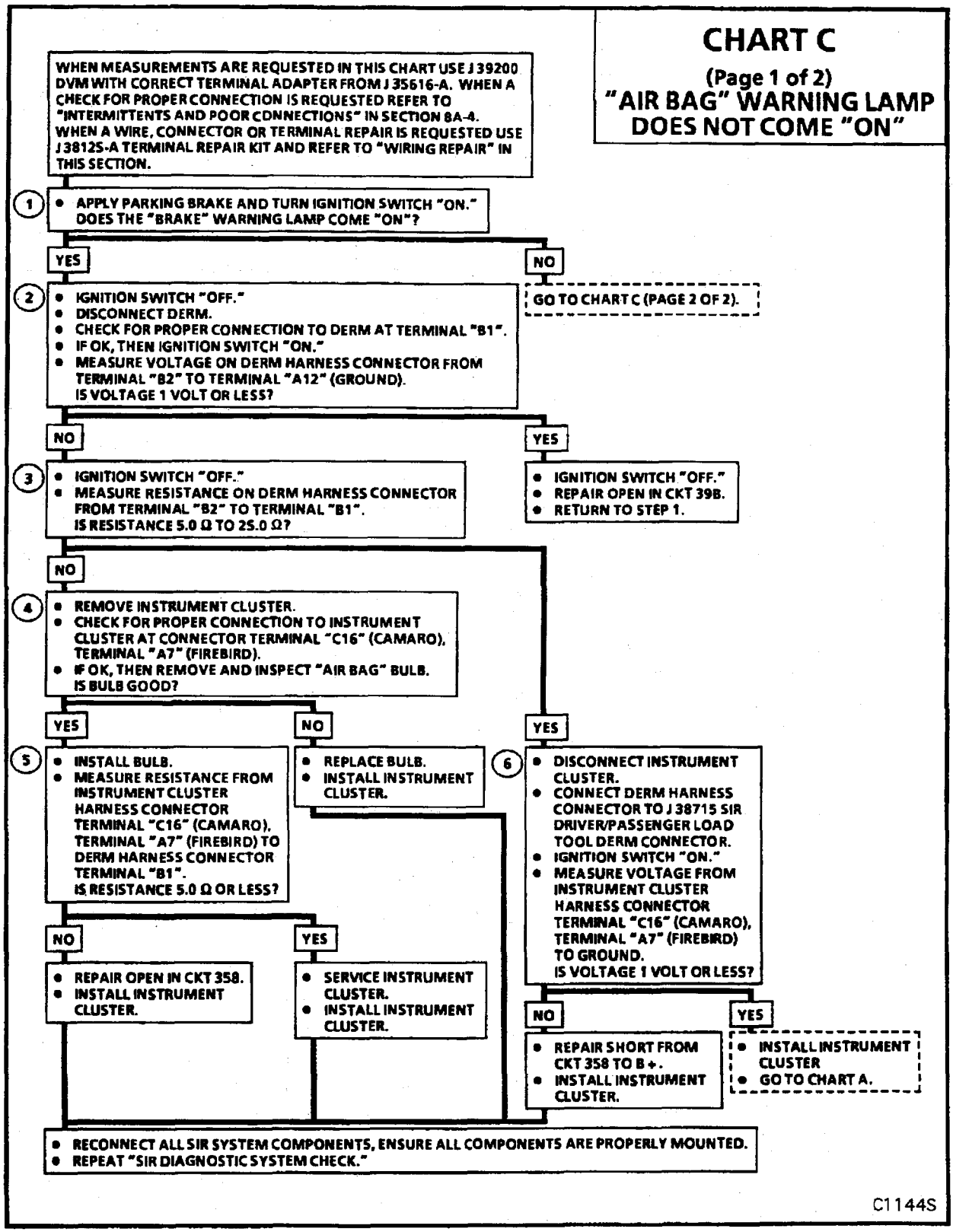
When the engine is being cranked, "Ignition 1" voltage is applied from the "CRANK" fuse to the DERM at the "Crank" input. The DERM responds by grounding the "SIR Indicator" output until "Ignition 1" voltage is removed from the "Crank" input. This results in the "AIR BAG" warning lamp being "ON" during cranking.

After cranking, the DERM will flash the "AIR BAG" warning lamp six times.

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test determines whether the malfunction is in the DERM circuitry or in the instrument panel cluster power feed circuitry.
2. This test confirms the integrity of the "Redundant Indicator Ignition 1" circuit.
3. This test checks for an open in the "SIR Indicator" circuit, instrument panel cluster circuitry, and "AIR BAG" warning lamp bulb.
4. This test checks whether the open is due to a bad bulb.
5. This test determines whether the malfunction is an open in the "SIR Indicator" circuit or an open in the instrument panel cluster.
6. This test determines whether the malfunction is due to a short from the "SIR Indicator" circuit to B+.


CHART C
(Page 1 of 2)
"AIR BAG" WARNING LAMP DOES NOT COME "ON"
WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.
1
• APPLY PARKING BRAKE AND TURN IGNITION SWITCH "ON." DOES THE "BRAKE" WARNING LAMP COME "ON"?
YES
NO
GO TO CHART C (PAGE 2 OF 2).
2
• IGNITION SWITCH "OFF."
• DISCONNECT DERM.
• CHECK FOR PROPER CONNECTION TO DERM AT TERMINAL "B1".
• IF OK, THEN IGNITION SWITCH "ON."
• MEASURE VOLTAGE ON DERM HARNESS CONNECTOR FROM TERMINAL "B2" TO TERMINAL "A12" (GROUND). IS VOLTAGE 1 VOLT OR LESS?
NO
YES
3
• IGNITION SWITCH "OFF."
• MEASURE RESISTANCE ON DERM HARNESS CONNECTOR FROM TERMINAL "B2" TO TERMINAL "B1". IS RESISTANCE 5.0 Ω TO 25.0 Ω?
• IGNITION SWITCH "OFF."
• REPAIR OPEN IN CKT 39B.
• RETURN TO STEP 1.
NO
4
• REMOVE INSTRUMENT CLUSTER.
• CHECK FOR PROPER CONNECTION TO INSTRUMENT CLUSTER AT CONNECTOR TERMINAL "C16" (CAMARO), TERMINAL "A7" (FIREBIRD).
• IF OK, THEN REMOVE AND INSPECT "AIR BAG" BULB. IS BULB GOOD?
YES
NO
YES
5
• INSTALL BULB.
• MEASURE RESISTANCE FROM INSTRUMENT CLUSTER HARNESS CONNECTOR TERMINAL "C16" (CAMARO), TERMINAL "A7" (FIREBIRD) TO DERM HARNESS CONNECTOR TERMINAL "B1". IS RESISTANCE 5.0 Ω OR LESS?
• REPLACE BULB.
• INSTALL INSTRUMENT CLUSTER.
6
• DISCONNECT INSTRUMENT CLUSTER.
• CONNECT DERM HARNESS CONNECTOR TO J 38715 SIR DRIVER/PASSENGER LOAD TOOL DERM CONNECTOR.
• IGNITION SWITCH "ON."
• MEASURE VOLTAGE FROM INSTRUMENT CLUSTER HARNESS CONNECTOR TERMINAL "C16" (CAMARO), TERMINAL "A7" (FIREBIRD) TO GROUND. IS VOLTAGE 1 VOLT OR LESS?
NO
YES
NO
YES
• REPAIR OPEN IN CKT 358.
• INSTALL INSTRUMENT CLUSTER.
• SERVICE INSTRUMENT CLUSTER.
• INSTALL INSTRUMENT CLUSTER.
• REPAIR SHORT FROM CKT 358 TO B+.
• INSTALL INSTRUMENT CLUSTER.
• INSTALL INSTRUMENT CLUSTER
• GO TO CHART A.
• RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
C1144S

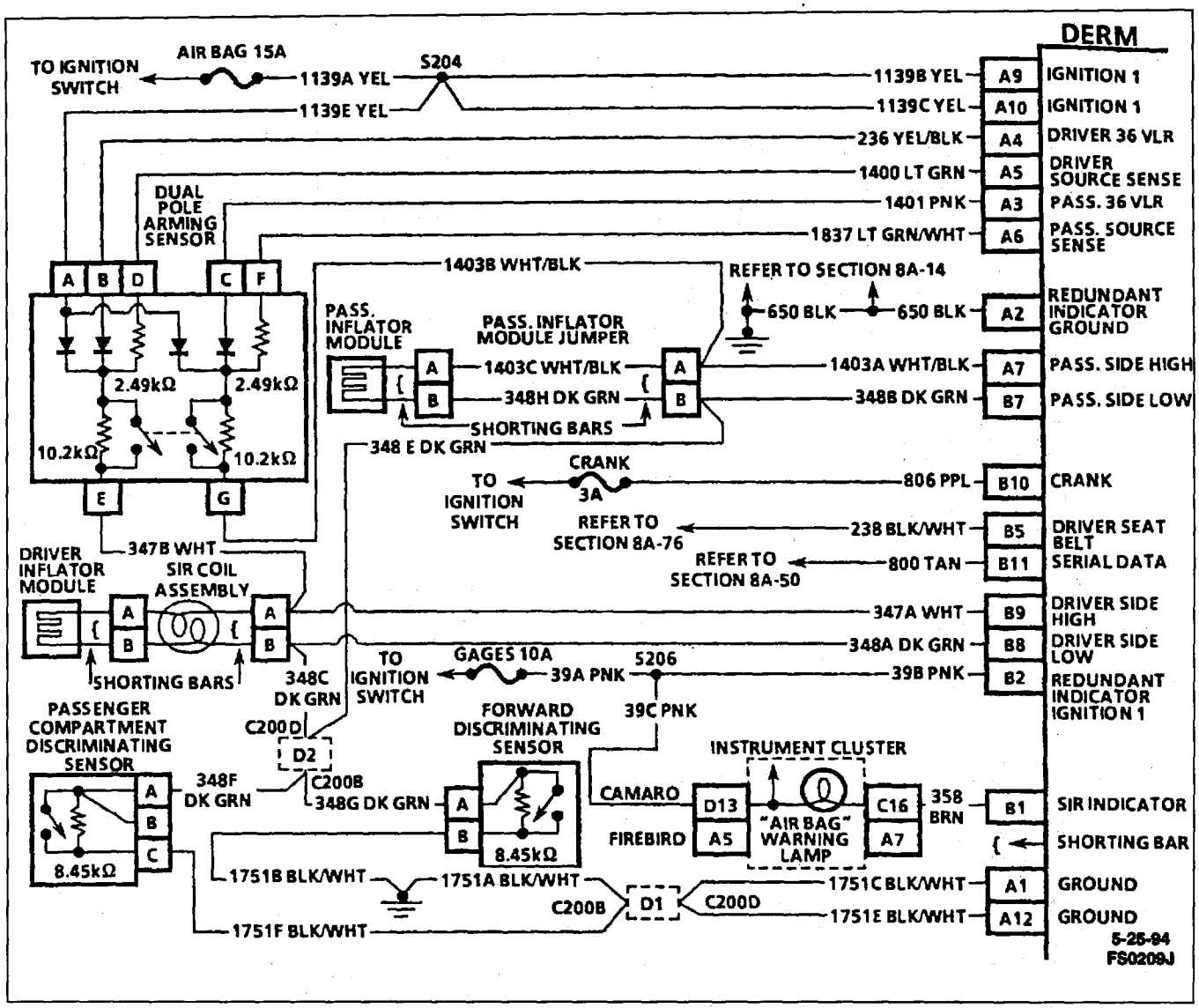


CHART C - (Page 2 of 2)
"AIR BAG" WARNING LAMP DOES NOT COME "ON"

Circuit Description:

When the ignition switch is first turned "ON," "Ignition 1" voltage is applied from the "GAGES" fuse to "Redundant Indicator Ignition 1," terminal "B2", and to the "AIR BAG" warning lamp which is connected to "SIR Indicator," terminal "B1". The "AIR BAG" fuse applies system voltage to the "Ignition 1" inputs, terminals "A9" and "A10". The DERM responds by flashing the "AIR BAG" warning lamp seven times.

When the engine is being cranked, "Ignition 1" voltage is applied from the "CRANK" fuse to the DERM at the "Crank" input. The DERM responds by grounding the "SIR Indicator" output until "Ignition 1" voltage is removed from the "Crank" input. This results in the "AIR BAG" warning lamp being "ON" during cranking.

After cranking, the DERM will flash the "AIR BAG" warning lamp six times.

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

7. This test checks whether power is available to the instrument panel cluster power feed circuit.

8. This test checks for a short from the instrument panel cluster power feed circuit to ground.

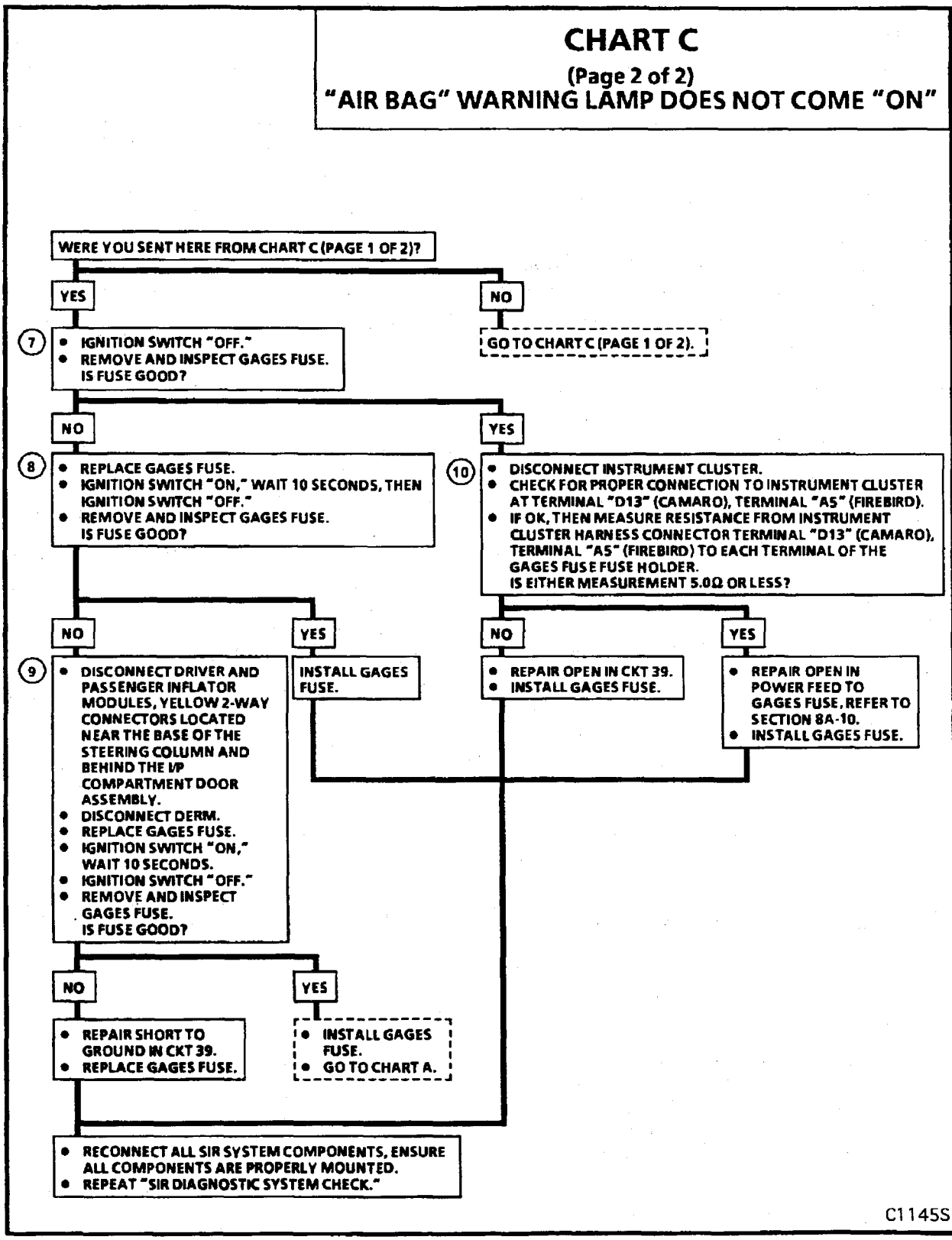
9. This test determines whether the short to ground is due to a short in the wiring.

10. This test determines whether the malfunction is due to an open power feed circuit from the "GAGES" fuse to the instrument panel cluster or an open power feed to the "GAGES" fuse.

CHART C

(Page 2 of 2)

"AIR BAG" WARNING LAMP DOES NOT COME "ON"



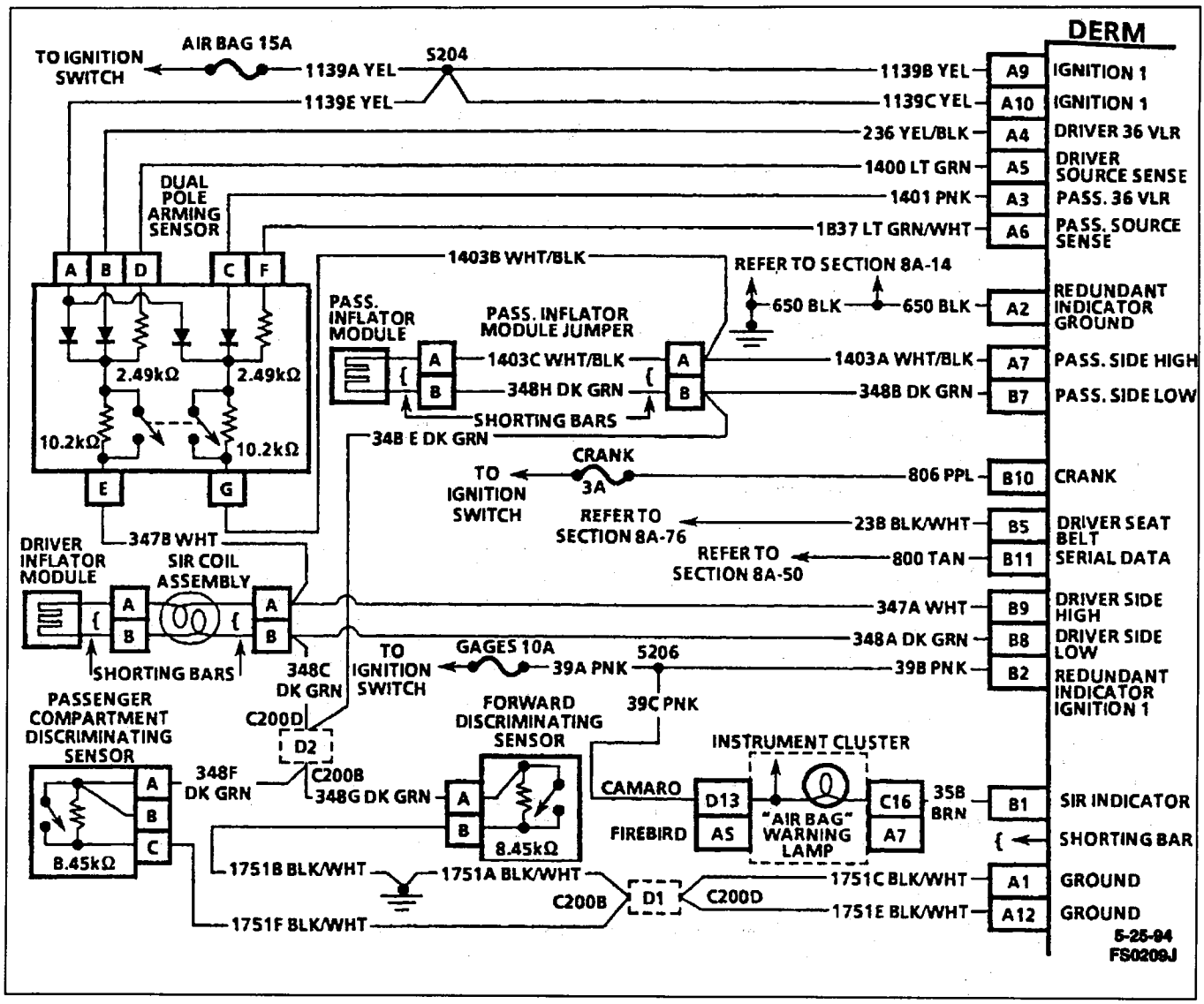


CHART D

"AIR BAG" WARNING LAMP DOES NOT COME "ON" STEADY DURING CRANK

Circuit Description:

When the ignition switch is first turned "ON," "Ignition 1" voltage is applied from the "GAGES" fuse to "Redundant Indicator Ignition 1," terminal "B2", and to the "AIR BAG" warning lamp which is connected to "SIR Indicator," terminal "B1". The "AIR BAG" fuse applies system voltage to the "Ignition 1" inputs, terminals "A9" and "A10". The DERM responds by flashing the "AIR BAG" warning lamp seven times.

When the engine is being cranked, "Ignition 1" voltage is applied from the "CRANK" fuse to the DERM at the "Crank" input. The DERM responds by grounding the "SIR Indicator" output until "Ignition 1" voltage is removed from the "Crank" input. This results in the "AIR BAG" warning lamp being "ON" during cranking.

After cranking, the DERM will flash the "AIR BAG" warning lamp six times.

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks whether the malfunction is due to an open "CRANK" fuse.
2. This test checks for a proper signal to the "Crank" input during cranking.
3. This test determines whether the lack of a proper crank signal is due to an open "Crank" input circuit or an open power feed to the "CRANK" fuse.
4. This test checks whether the "CRANK" fuse is open due to a short to ground in the "Crank" input circuit.
5. This test determines whether the short to ground is in the wiring harness.

CHART D

"AIR BAG" WARNING LAMP DOES NOT COME "ON" STEADY DURING CRANK

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

1. • IGNITION SWITCH "OFF."
   • REMOVE AND INSPECT CRANK FUSE.
   IS FUSE GOOD?

YES

2. • INSTALL CRANK FUSE.
   • DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
   • DISCONNECT DERM.
   • MEASURE VOLTAGE ON DERM HARNESS CONNECTOR FROM TERMINAL "B10" TO TERMINAL "A1" (GROUND) WHILE STARTING ENGINE.
   IS VOLTAGE GREATER THAN 7.25 VOLTS?

NO

3. • IGNITION SWITCH "OFF."
   • REMOVE CRANK FUSE.
   • MEASURE RESISTANCE FROM EACH TERMINAL OF THE CRANK FUSE FUSE HOLDER TO DERM HARNESS CONNECTOR TERMINAL "B10".
   IS EITHER MEASUREMENT 5.0Ω OR LESS?

NO

• REPAIR OPEN IN CKT 806.
• INSTALL CRANK FUSE.

YES

• REPAIR OPEN IN POWER FEED TO CRANK FUSE, REFER TO SECTION 8A-10.
• INSTALL CRANK FUSE.

YES

• IGNITION SWITCH "OFF."
• CHECK FOR PROPER CONNECTION AT DERM HARNESS CONNECTOR TERMINAL "B10".
• IF OK, THEN GO TO CHART A.

NO

4. • REPLACE CRANK FUSE.
   • START ENGINE, THEN IGNITION SWITCH "OFF."
   • REMOVE AND INSPECT CRANK FUSE.
   IS FUSE GOOD?

NO

5. • DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
   • DISCONNECT DERM.
   • REPLACE CRANK FUSE.
   • START ENGINE, THEN IGNITION SWITCH "OFF."
   • REMOVE AND INSPECT CRANK FUSE.
   IS FUSE GOOD?

NO

• REPAIR SHORT FROM CKT 806 TO GROUND.
• REPLACE CRANK FUSE.

YES

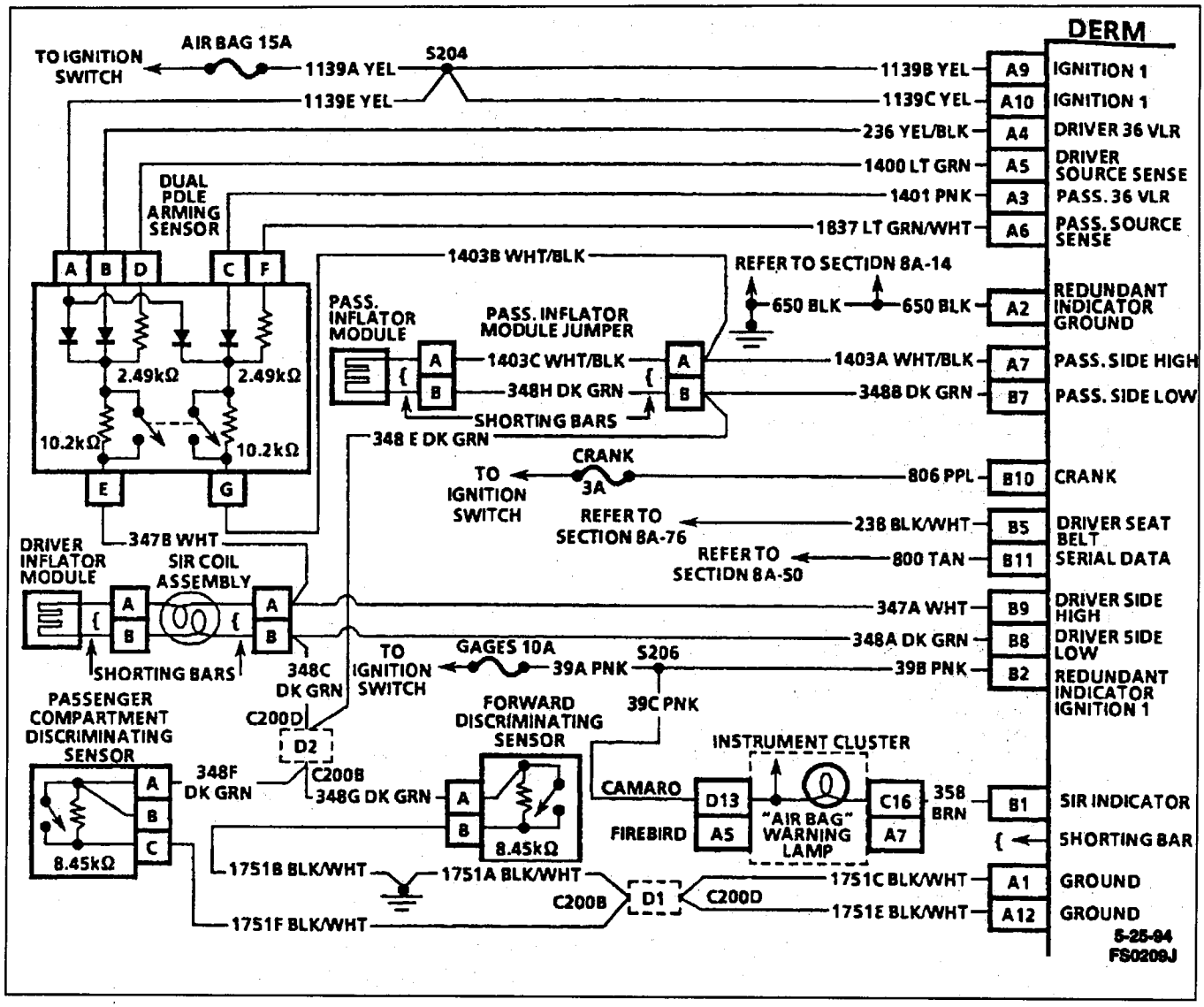
• INSTALL CRANK FUSE.
• GO TO CHART A.

YES

• INSTALL CRANK FUSE.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

• RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

C1146S



DTC 14
DUAL POLE ARMING SENSOR DISCONNECTED

Circuit Description:

The DERM monitors the voltage at the "Driver Source Sense" terminal "A5", the "Passenger Source Sense" terminal "A6", the "Driver Side High" terminal "B9", the "Passenger Side High" terminal "A7", the "Driver Side Low" terminal "B8" and the "Passenger Side Low" terminal "B7" during the "Continuous Monitoring" tests. When all voltages are simultaneously below a specified value for 500 milliseconds DTC 14 sets.

DTC Will Set When:

The voltages at terminals "A5", "A6", "B9", "A7", "B8" and "B7" of the DERM harness connector are simultaneously below a specified value for 500 milliseconds.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage at terminal "A5", "A6", "B9", "A7", "B8" or "B7" of the DERM harness connector is above specified value for 500 milliseconds.

DTC Chart Test Description:

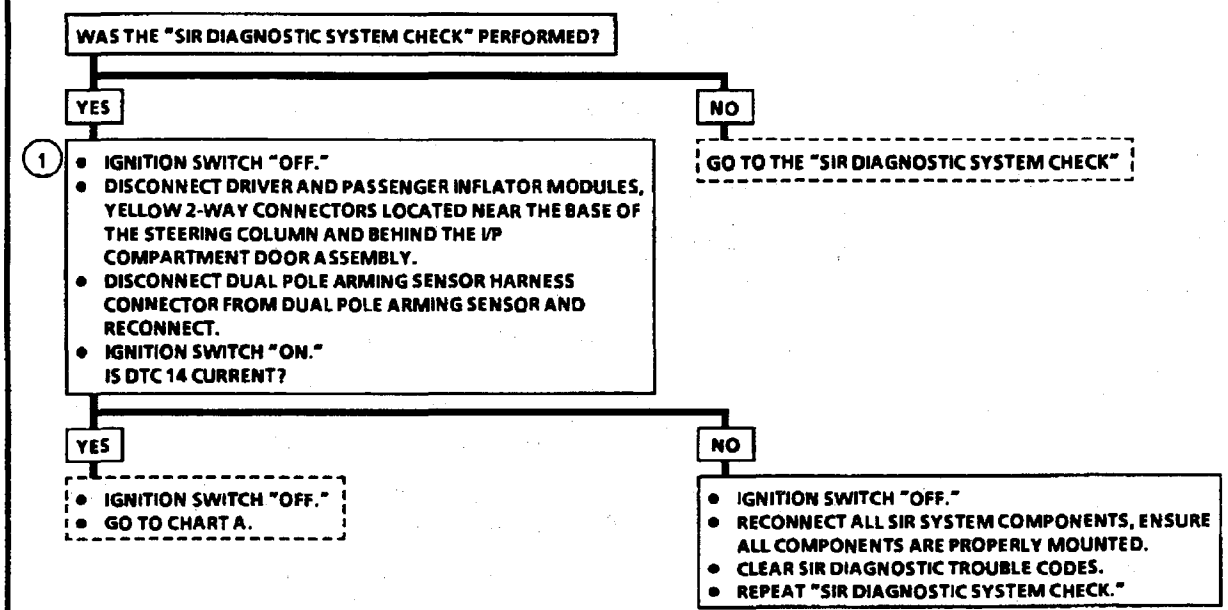
Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for a situation which prevents a proper connection of the dual pole arming sensor to the wiring harness.

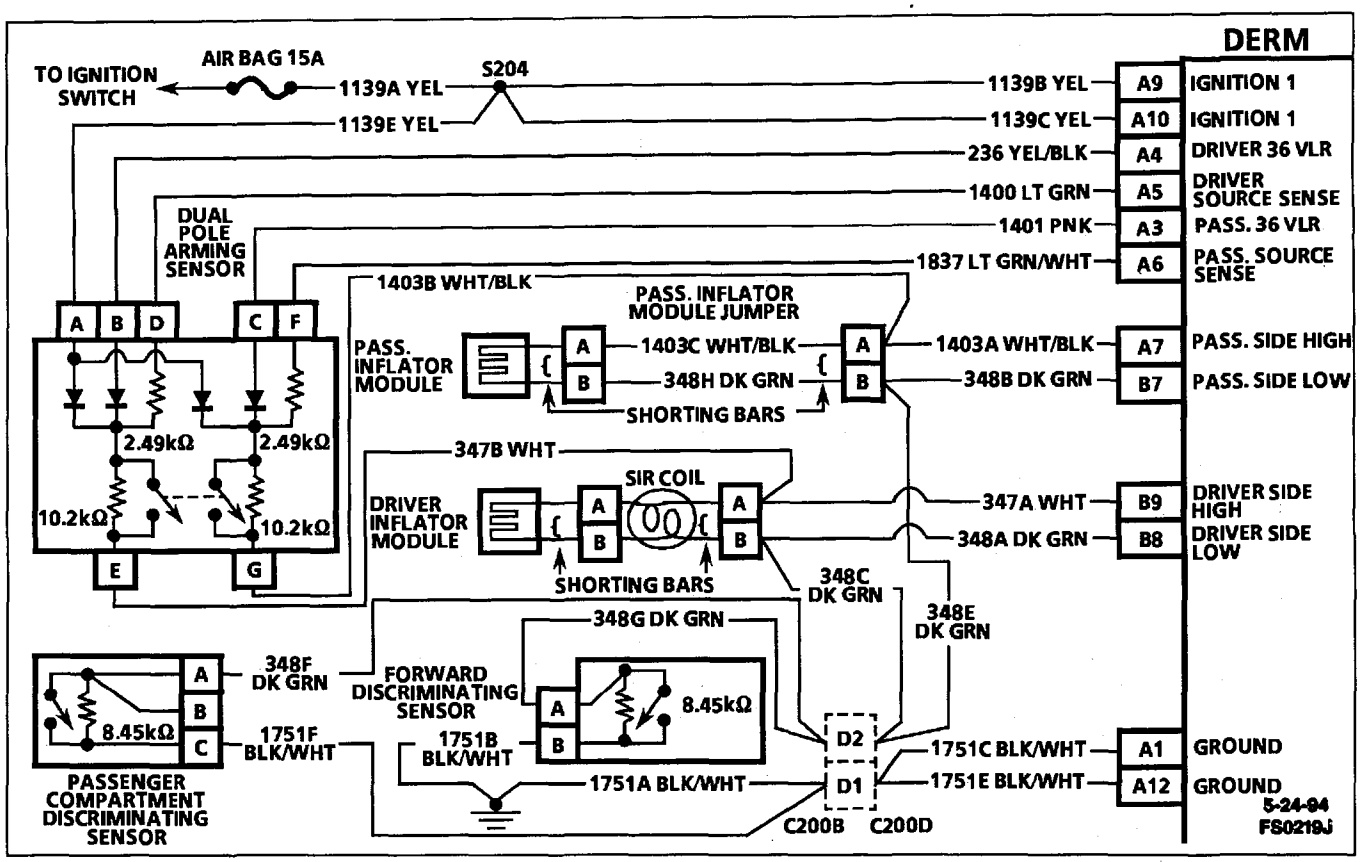
Diagnostic Aids:

It is highly unlikely that an intermittent condition has set this diagnostic trouble code as this would require a poor connection at terminals "A", "B" and "C" or at terminals "D", "E", "F" and "G".

DTC 14
DUAL POLE ARMING SENSOR DISCONNECTED



C1147S



DTC 15
PASSENGER INITIATOR CIRCUIT RESISTANCE HIGH

Circuit Description:

During the "Initiator Assembly Resistance Test" the DERM grounds the "Driver Side Low" terminal "B8" and turns "ON" the passenger current source at the "Passenger Side High" terminal "A7". This causes a known amount of current to flow through the passenger initiator circuit. By monitoring the difference between the voltage at the "Passenger Side High" terminal "A7" and the "Passenger Side Low" terminal "B7" the DERM calculates the combined resistance of the passenger inflator module, passenger inflator module jumper, harness wiring CKTs 1403A and 348B and connector terminal contact.

DTC Will Set When:

The combined resistance of the passenger inflator module, harness wiring CKT 1403A and connector terminal contact is above a specified value. This test is run once each ignition cycle during the "Initiator Assembly Resistance Test" when: 1) No "higher priority faults" are detected during "Turn-ON," 2) No "higher priority faults" are detected during "Continuous Monitoring" for one second, 3) No "Crank" signal present, 4) "Ignition 1" voltage is above a specified value.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The ignition switch is turned "OFF."

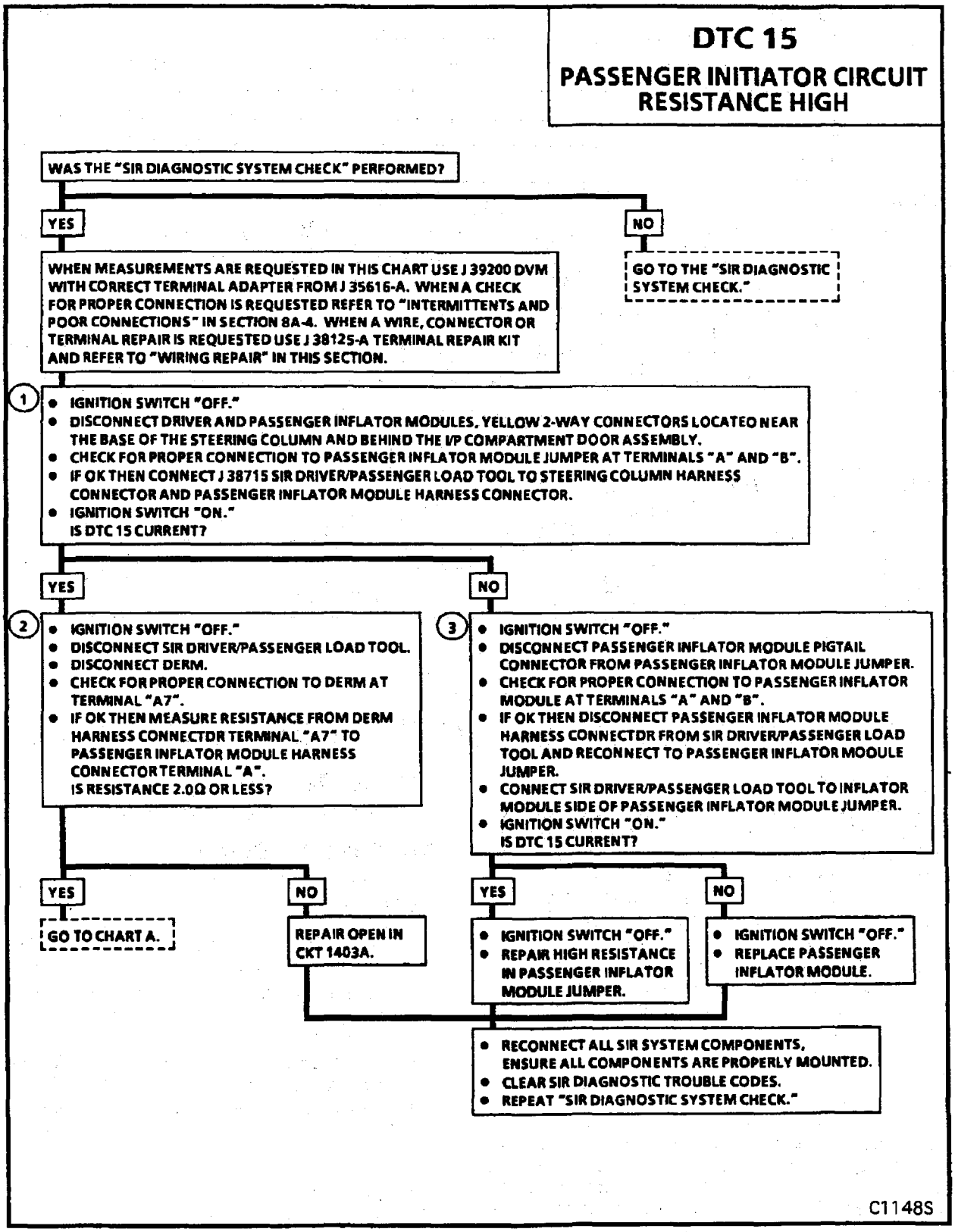
DTC Chart Test Description:

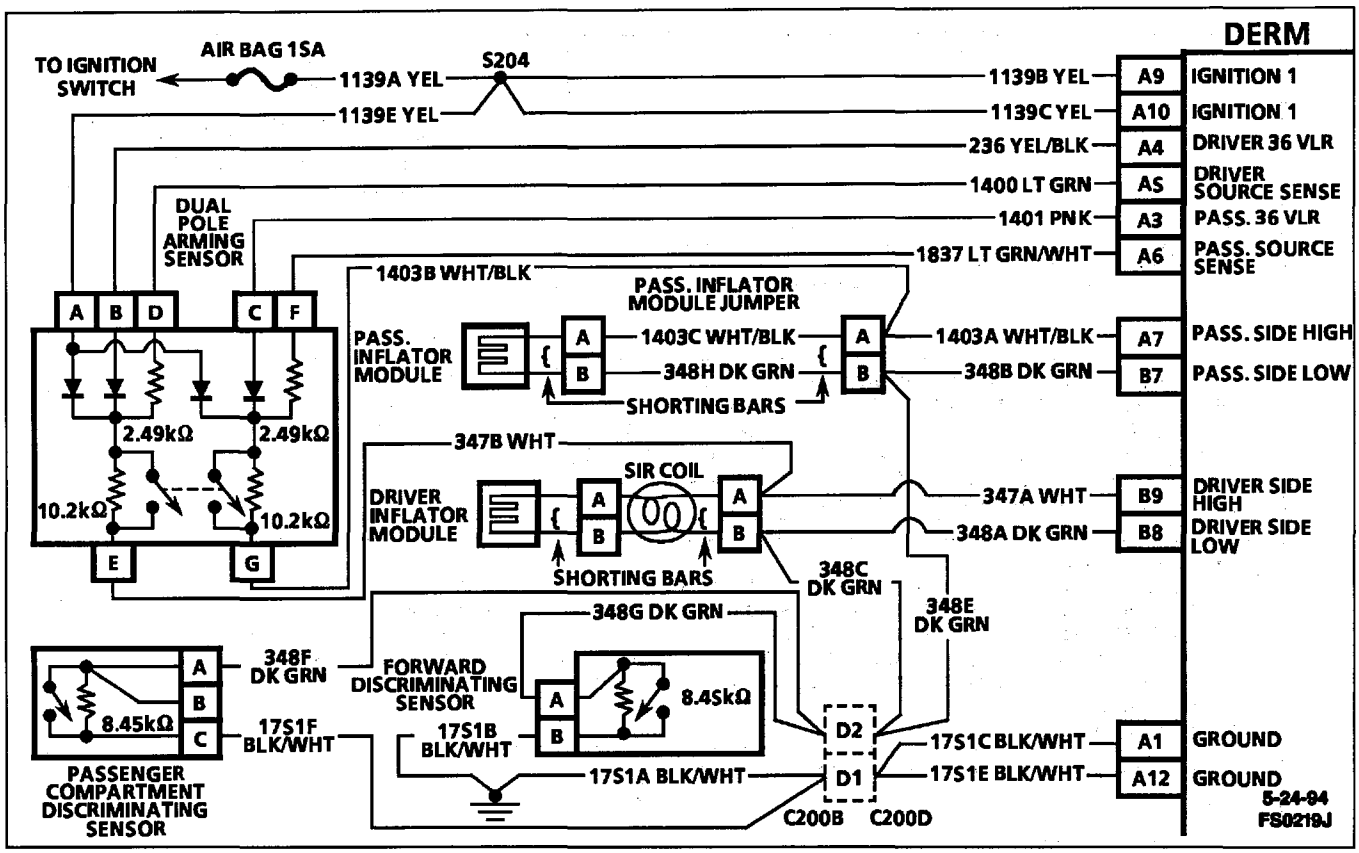
Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test determines whether the malfunction is in the passenger inflator module circuitry or in the DERM wiring harness circuitry.
2. This test determines whether the malfunction is an open in CKT 1403A.
3. This test determines whether the malfunction is in the passenger inflator module jumper or the passenger inflator module.

Diagnostic Aids:

An intermittent condition is likely to be caused by a poor connection to the passenger inflator module at terminal "A" or terminal "B", poor connection to the passenger inflator module jumper at terminal "A" or terminal "B", a poor connection to the DERM at terminal "A7", or a malfunctioning passenger inflator module. The test for this diagnostic trouble code is only run while the "AIR BAG" warning lamp is performing the bulb check. When a scan tool "Clear Codes" command is issued and the malfunction is still present, the DTC will not reappear until the next ignition cycle.


DTC 15
PASSENGER INITIATOR CIRCUIT RESISTANCE HIGH
WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?
YES
NO
WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.
GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."
1
• IGNITION SWITCH "OFF."
• DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
• CHECK FOR PROPER CONNECTION TO PASSENGER INFLATOR MODULE JUMPER AT TERMINALS "A" AND "B".
• IF OK THEN CONNECT J 38715 SIR DRIVER/PASSENGER LOAD TOOL TO STEERING COLUMN HARNESS CONNECTOR AND PASSENGER INFLATOR MODULE HARNESS CONNECTOR.
• IGNITION SWITCH "ON."
IS DTC 15 CURRENT?
YES
NO
2
• IGNITION SWITCH "OFF."
• DISCONNECT SIR DRIVER/PASSENGER LOAD TOOL.
• DISCONNECT DERM.
• CHECK FOR PROPER CONNECTION TO DERM AT TERMINAL "A7".
• IF OK THEN MEASURE RESISTANCE FROM DERM HARNESS CONNECTOR TERMINAL "A7" TO PASSENGER INFLATOR MODULE HARNESS CONNECTOR TERMINAL "A".
IS RESISTANCE 2.0Ω OR LESS?
3
• IGNITION SWITCH "OFF."
• DISCONNECT PASSENGER INFLATOR MODULE PIGTAIL CONNECTOR FROM PASSENGER INFLATOR MODULE JUMPER.
• CHECK FOR PROPER CONNECTION TO PASSENGER INFLATOR MODULE AT TERMINALS "A" AND "B".
• IF OK THEN DISCONNECT PASSENGER INFLATOR MODULE HARNESS CONNECTOR FROM SIR DRIVER/PASSENGER LOAD TOOL AND RECONNECT TO PASSENGER INFLATOR MODULE JUMPER.
• CONNECT SIR DRIVER/PASSENGER LOAD TOOL TO INFLATOR MODULE SIDE OF PASSENGER INFLATOR MODULE JUMPER.
• IGNITION SWITCH "ON."
IS DTC 15 CURRENT?
YES
NO
YES
NO
GO TO CHART A.
REPAIR OPEN IN CKT 1403A.
• IGNITION SWITCH "OFF."
• REPAIR HIGH RESISTANCE IN PASSENGER INFLATOR MODULE JUMPER.
• IGNITION SWITCH "OFF."
• REPLACE PASSENGER INFLATOR MODULE.
• RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
• CLEAR SIR DIAGNOSTIC TROUBLE CODES.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
C1148S



DTC 16
PASSENGER INITIATOR CIRCUIT RESISTANCE LOW

Circuit Description:

During the "Initiator Assembly Resistance Test" the DERM grounds the "Driver Side Low" terminal "B8" and turns "ON" the passenger current source at the "Passenger Side High" terminal "A7". This causes a known amount of current to flow through the passenger initiator circuit. By monitoring the difference between the voltage at the "Passenger Side High" terminal "A7" and the "Passenger Side Low" terminal "B7" the DERM calculates the combined resistance of the passenger inflator module, passenger inflator module jumper, harness wiring CKTs 1403A and 348B and connector terminal contact.

DTC Will Set When:

The combined resistance of the passenger inflator module, harness wiring CKTs 1403 and 348 and connector terminal contact is below a specified value. This test is run once each ignition cycle during the "Initiator Assembly Resistance Test" when: 1) No "higher priority faults" are detected during "Turn-ON," 2) No "higher priority faults" are detected during "Continuous Monitoring" for one second, 3) No "Crank" signal present, 4) "Ignition 1" voltage is above a specified value.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The ignition switch is turned "OFF."

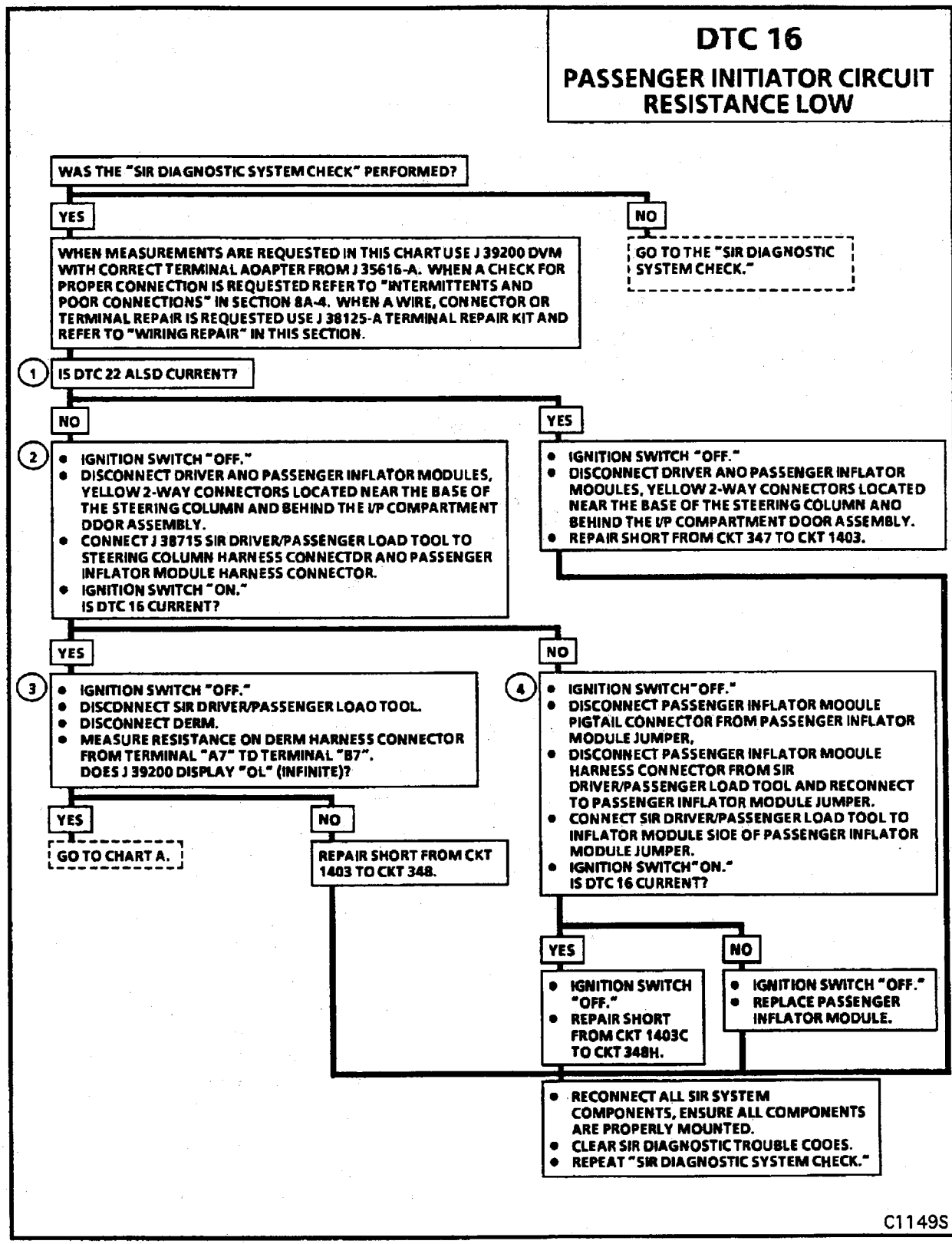
DTC Chart Test Description:

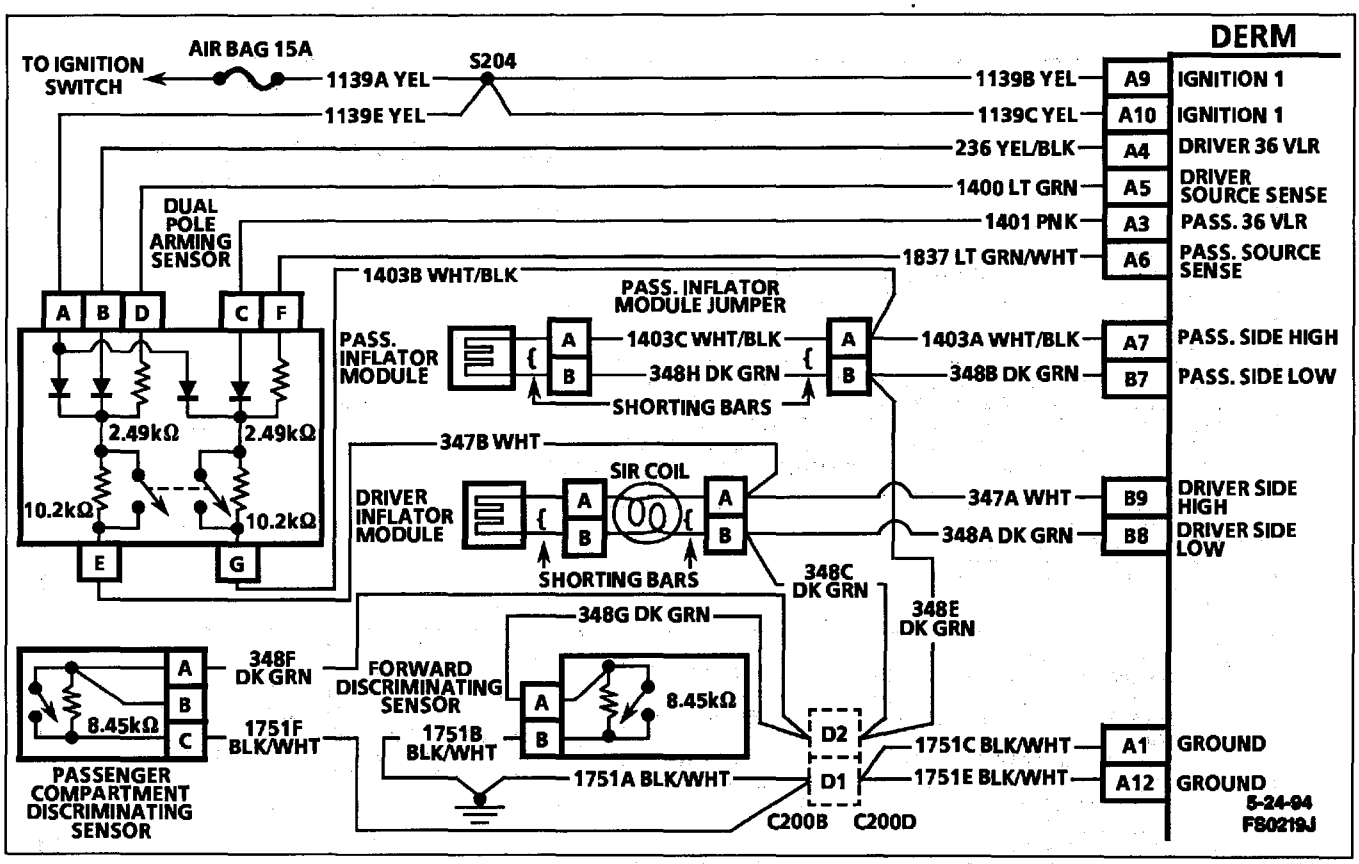
Number(s) below refer to circled number(s) on the diagnostic chart.

1. DTC 16 and 22 will set simultaneously when the "Driver Side High" circuit is shorted to the "Passenger Side High" circuit due to parallel current paths.
2. This test determines whether the malfunction is in the passenger inflator module circuitry or in the DERM wiring harness circuitry.
3. This test checks for a short from the "Passenger Side High" circuit to the "Passenger Side Low" circuit.
4. This test determines whether the malfunction is due to the passenger inflator module or the passenger inflator jumper.

Diagnostic Aids:

An intermittent condition is likely to be caused by a short between CKT 1403 and CKT 347, CKT 348 or a malfunctioning passenger inflator module. The test for this diagnostic trouble code is only run while the "AIR BAG" warning lamp is performing the bulb check. When a scan tool "Clear Codes" command is issued and the malfunction is still present, the DTC will not reappear until the next ignition cycle.


DTC 16
PASSENGER INITIATOR CIRCUIT RESISTANCE LOW
WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?
YES
NO
WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.
GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."
1
IS DTC 22 ALSD CURRENT?
NO
YES
2
• IGNITION SWITCH "OFF."
• DISCONNECT DRIVER ANO PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DDOR ASSEMBLY.
• CONNECT J 38715 SIR DRIVER/PASSENGER LOAD TOOL TO STEERING COLUMN HARNESS CONNECTDR ANO PASSENGER INFLATOR MODULE HARNESS CONNECTOR.
• IGNITION SWITCH "ON."
IS DTC 16 CURRENT?
• IGNITION SWITCH "OFF."
• DISCONNECT DRIVER ANO PASSENGER INFLATOR MOOULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN ANO BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
• REPAIR SHORT FROM CKT 347 TO CKT 1403.
YES
NO
3
• IGNITION SWITCH "OFF."
• DISCDNNECT SIR DRIVER/PASSENGER LOAO TOOL.
• DISCONNECT DERM.
• MEASURE RESISTANCE ON DERM HARNESS CONNECTOR FROM TERMINAL "A7" TD TERMINAL "B7".
DOES J 39200 DISPLAY "OL" (INFINITE)?
4
• IGNITION SWITCH "OFF."
• DISCONNECT PASSENGER INFLATOR MOOULE PIGTAIL CONNECTOR FROM PASSENGER INFLATOR MODULE JUMPER,
• DISCONNECT PASSENGER INFLATOR MOOULE HARNESS CONNECTOR FROM SIR DRIVER/PASSENGER LOAD TOOL AND RECONNECT TO PASSENGER INFLATOR MODULE JUMPER.
• CONNECT SIR DRIVER/PASSENGER LOAD TOOL TO INFLATOR MODULE SIOE OF PASSENGER INFLATOR MODULE JUMPER.
• IGNITION SWITCH "ON."
IS DTC 16 CURRENT?
YES
NO
YES
NO
GO TO CHART A.
REPAIR SHORT FROM CKT 1403 TO CKT 348.
• IGNITION SWITCH "OFF."
• REPAIR SHORT FROM CKT 1403C TO CKT 348H.
• IGNITION SWITCH "OFF."
• REPLACE PASSENGER INFLATOR MODULE.
• RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
• CLEAR SIR DIAGNOSTIC TROUBLE COOES.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
C1149S



DTC 17
PASSENGER INITIATOR CIRCUIT OPEN

Circuit Description:

When there is an open in the passenger inflator module the resistance between "Passenger Side High" terminal "A7" and "Passenger Side Low" terminal "B7" increases. This causes a larger voltage drop from the "Passenger Side High" to the "Passenger Side Low" across a resistor inside the DERM which connects these two terminals together. The increase in the voltage difference between "Passenger Side High" and "Passenger Side Low" is detected by the DERM during the "Continuous Monitoring" tests and DTC 17 is set.

DTC Will Set When:

The voltage difference between "Passenger Side High" terminal "A7" and "Passenger Side Low" terminal "B7" is above or equal to a specified value for 500 milliseconds.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage difference between "Passenger Side High" terminal "A7" and "Passenger Side Low" terminal "B7" is below a specified value for 500 milliseconds.

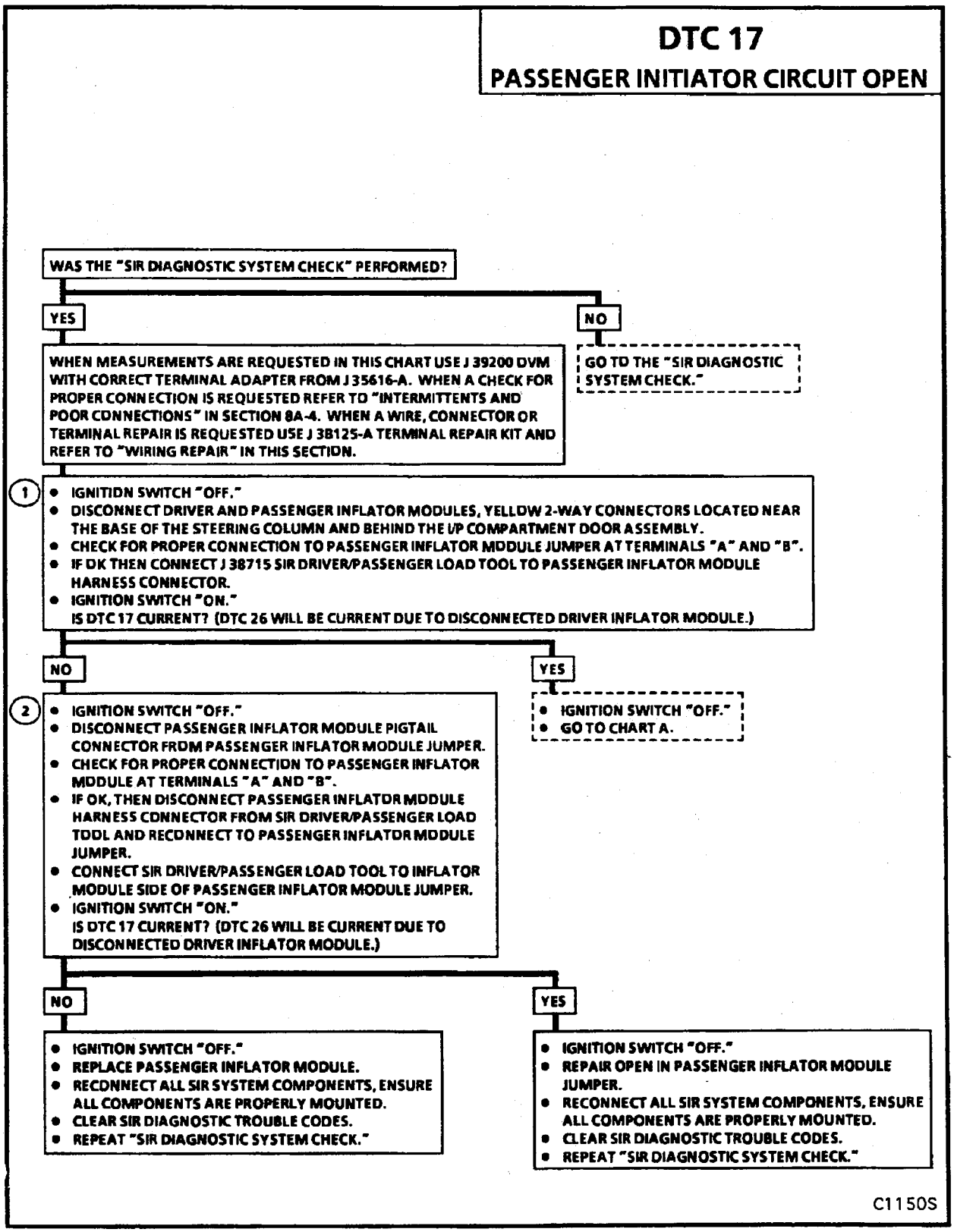
DTC Chart Test Description:

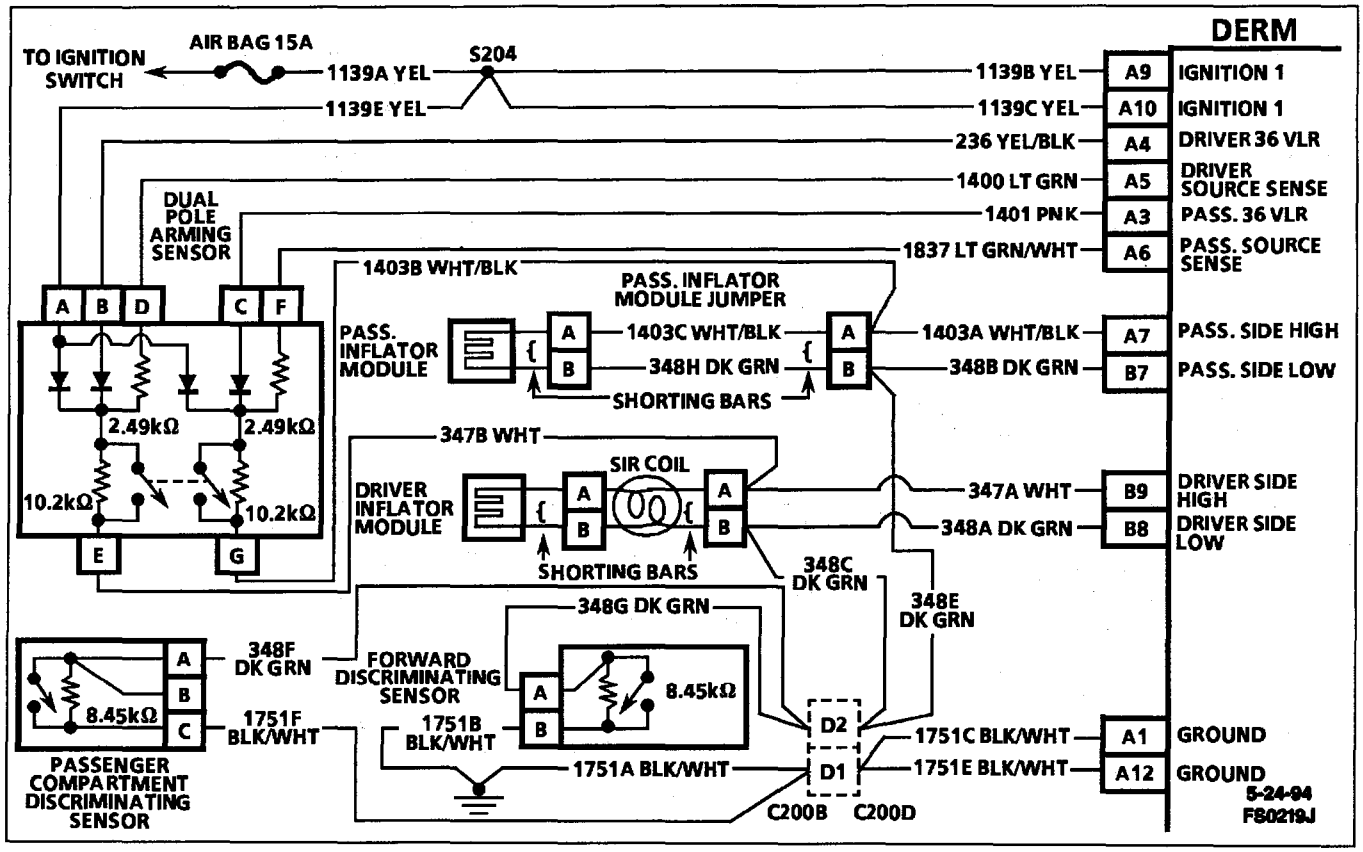
Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test determines whether the malfunction is in the passenger inflator module circuitry.
2. This test determines whether the malfunction is in the passenger inflator module or the passenger inflator module jumper.

Diagnostic Aids:

This diagnostic trouble code will only set when there is an improper connection to the passenger inflator module, an improper connection to the passenger inflator module jumper, or an open in the passenger inflator module or pigtail.


DTC 17
PASSENGER INITIATOR CIRCUIT OPEN
WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?
YES
NO
WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.
GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."
1
• IGNITION SWITCH "OFF."
• DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
• CHECK FOR PROPER CONNECTION TO PASSENGER INFLATOR MODULE JUMPER AT TERMINALS "A" AND "B".
• IF OK THEN CONNECT J 38715 SIR DRIVER/PASSENGER LOAD TOOL TO PASSENGER INFLATOR MODULE HARNESS CONNECTOR.
• IGNITION SWITCH "ON."
IS DTC 17 CURRENT? (DTC 26 WILL BE CURRENT DUE TO DISCONNECTED DRIVER INFLATOR MODULE.)
NO
YES
2
• IGNITION SWITCH "OFF."
• DISCONNECT PASSENGER INFLATOR MODULE PIGTAIL CONNECTOR FROM PASSENGER INFLATOR MODULE JUMPER.
• CHECK FOR PROPER CONNECTION TO PASSENGER INFLATOR MODULE AT TERMINALS "A" AND "B".
• IF OK, THEN DISCONNECT PASSENGER INFLATOR MODULE HARNESS CONNECTOR FROM SIR DRIVER/PASSENGER LOAD TOOL AND RECONNECT TO PASSENGER INFLATOR MODULE JUMPER.
• CONNECT SIR DRIVER/PASSENGER LOAD TOOL TO INFLATOR MODULE SIDE OF PASSENGER INFLATOR MODULE JUMPER.
• IGNITION SWITCH "ON."
IS DTC 17 CURRENT? (DTC 26 WILL BE CURRENT DUE TO DISCONNECTED DRIVER INFLATOR MODULE.)
• IGNITION SWITCH "OFF."
• GO TO CHART A.
NO
YES
• IGNITION SWITCH "OFF."
• REPLACE PASSENGER INFLATOR MODULE.
• RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
• CLEAR SIR DIAGNOSTIC TROUBLE CODES.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
• IGNITION SWITCH "OFF."
• REPAIR OPEN IN PASSENGER INFLATOR MODULE JUMPER.
• RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
• CLEAR SIR DIAGNOSTIC TROUBLE CODES.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
C1150S



DTC 18
DISCRIMINATING SENSOR INTERCONNECT OPEN

Circuit Description:

During the "Initiator Assembly Resistance Test" the DERM grounds the "Driver Side Low" terminal "B8" and measures the voltage at "Driver Side Low" and "Passenger Side Low." The DERM then grounds "Passenger Side Low" terminal "B7" and again measures the voltage at "Driver Side Low" and "Passenger Side Low." For a properly operating circuit the voltage measurements during each of these tests will be below a specified value. When the voltage measured at either "Driver Side Low" or "Passenger Side Low," but not both, is above a specified value during either test DTC 18 is set.

DTC Will Set When:

The voltage measured at either "Driver Side Low" or "Passenger Side Low," but not both, is above a specified value while the DERM attempts to ground either of these terminals. This test is run during the "Initiator Assembly Resistance Test" and the "10 Minute Loop Test" when: 1) No "higher priority faults" are detected during "Turn-ON," 2) No "higher priority faults" are detected during "Continuous Monitoring" for one second, 3) No "Crank" signal present, 4) "Ignition 1" voltage is above a specified value.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltages measured at both "Driver Side Low" and "Passenger Side Low" are below specified value while the DERM grounds each of the terminals.

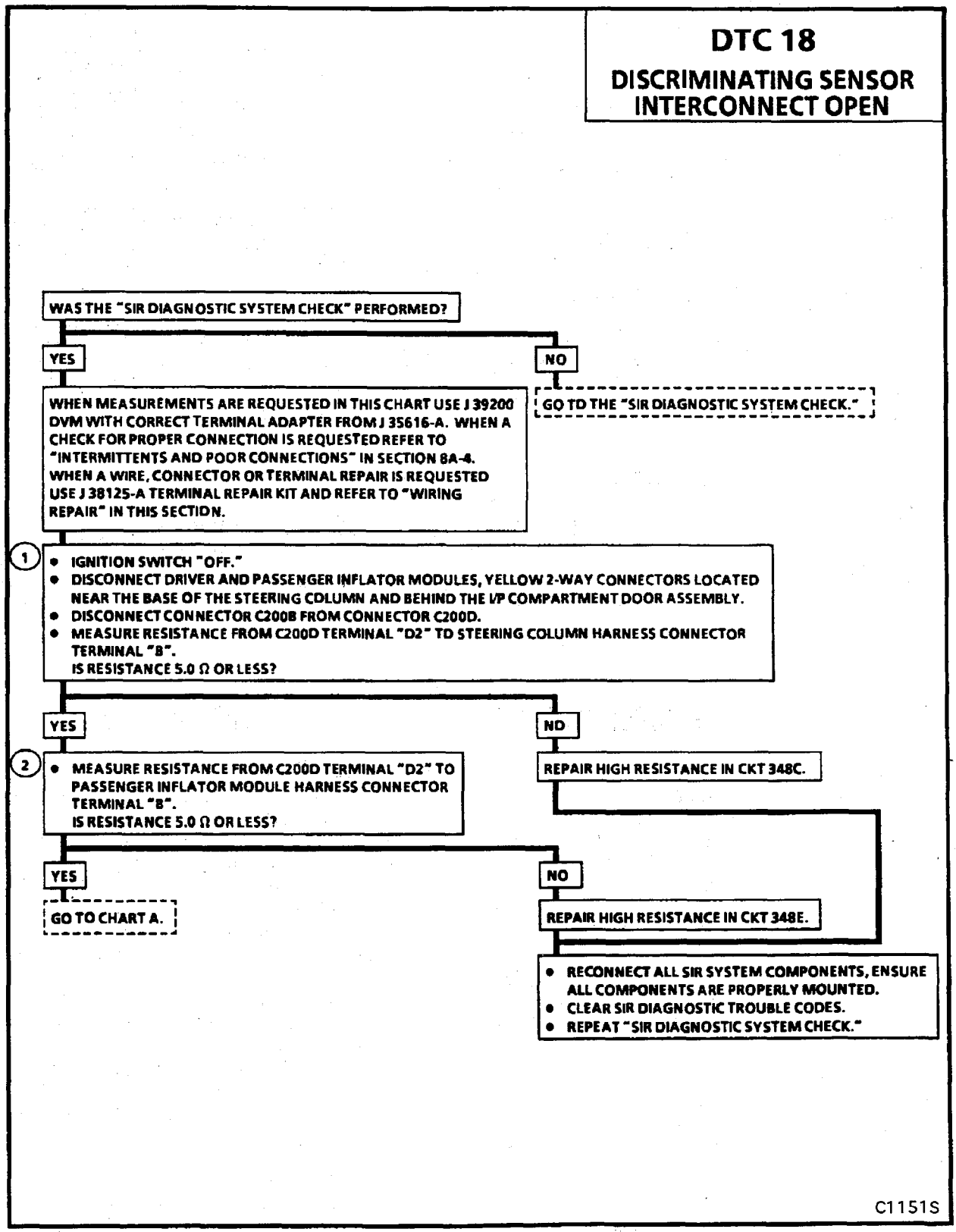
DTC Chart Test Description:

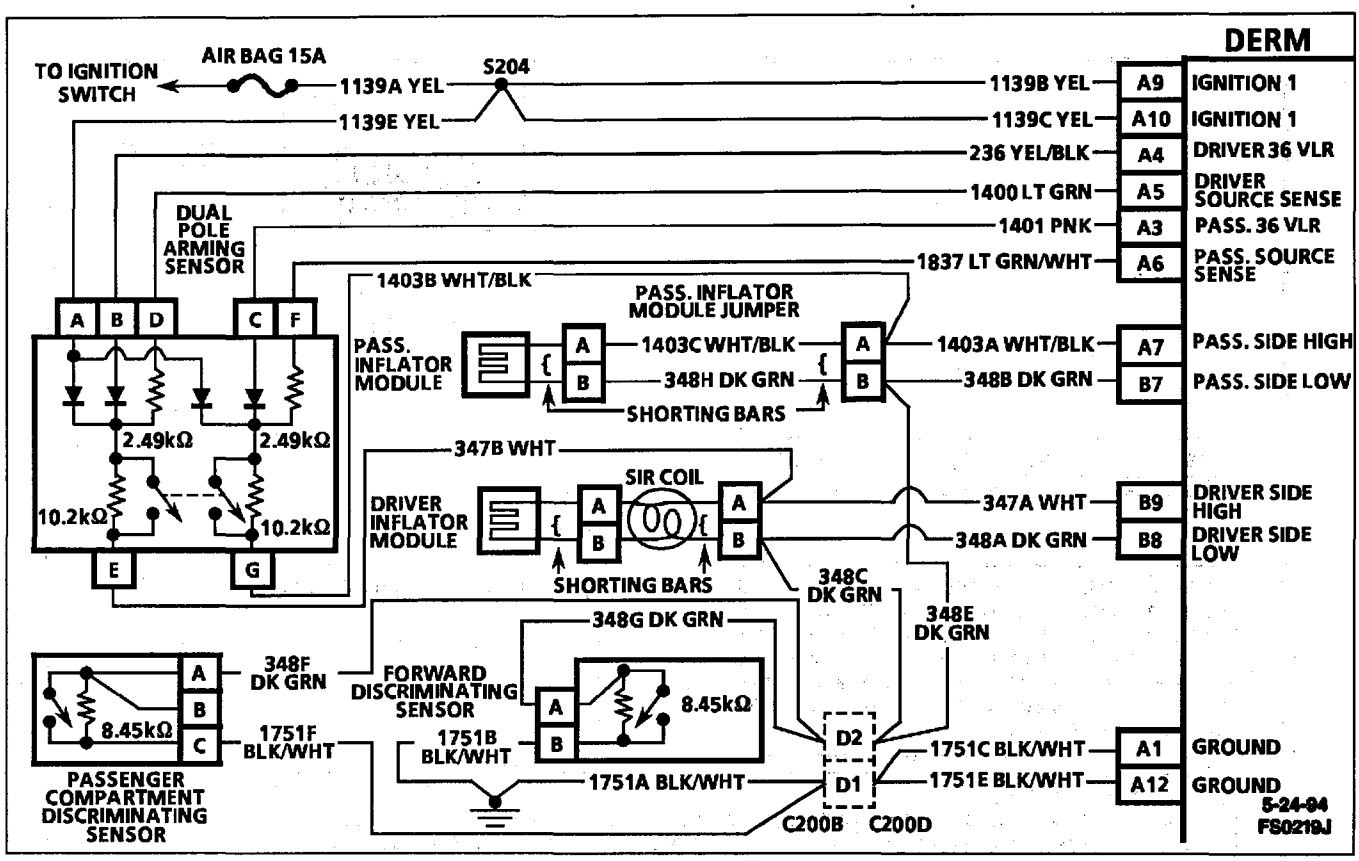
Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks whether the malfunction is in the wiring harness. The wiring harness malfunction would be a high resistance rather than an open. An open would set a different DTC.
2. This test checks whether the malfunction is in the wiring harness. The wiring harness malfunction would be a high resistance rather than an open. An open would set a different DTC.

Diagnostic Aids:

An intermittent condition is likely to be caused by a poor wire to terminal connection in CKT 348C or 348E. When a scan tool "Clear Codes" command is issued and the malfunction is still present, the DTC will not reappear for ten minutes or until the next ignition cycle.


DTC 18
DISCRIMINATING SENSOR INTERCONNECT OPEN
WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?
YES
NO
GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."
WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.
1
• IGNITION SWITCH "OFF."
• DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
• DISCONNECT CONNECTOR C200B FROM CONNECTOR C200D.
• MEASURE RESISTANCE FROM C200D TERMINAL "D2" TO STEERING COLUMN HARNESS CONNECTOR TERMINAL "B".
IS RESISTANCE 5.0 Ω OR LESS?
YES
NO
2
• MEASURE RESISTANCE FROM C200D TERMINAL "D2" TO PASSENGER INFLATOR MODULE HARNESS CONNECTOR TERMINAL "B".
IS RESISTANCE 5.0 Ω OR LESS?
REPAIR HIGH RESISTANCE IN CKT 348C.
YES
NO
GO TO CHART A.
REPAIR HIGH RESISTANCE IN CKT 348E.
• RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
• CLEAR SIR DIAGNOSTIC TROUBLE CODES.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
C1151S



DTC 19 - (Page 1 of 3)
PASSENGER INITIATOR CIRCUIT VOLTAGE HIGH

Circuit Description:

During normal, non-deployment operation of the SIR system, a small amount of current flows through both the driver and passenger deployment loops. The diagnostic resistors within the dual pole arming sensor and the discriminating sensors along with the resistance of the inflator modules cause voltage drops within the deployment loops. The DERM monitors the voltage at "Passenger Side Low" terminal "B7" to detect shorts or opens within the passenger deployment loop. When the measured voltage is above a specified percentage of "Passenger 36 VLR" for 500 milliseconds DTC 19 is set.

DTC Will Set When:

The voltage measured at "Passenger Side Low" terminal "B7" is above a specified percentage of "Passenger 36 VLR" for 500 milliseconds and DTC 35 is not set. This test is run every 100 milliseconds during the "Continuous Monitoring" tests.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage measured at "Passenger Side Low" terminal "B7" is within a specified percentage of "Passenger 36 VLR" for 500 milliseconds.

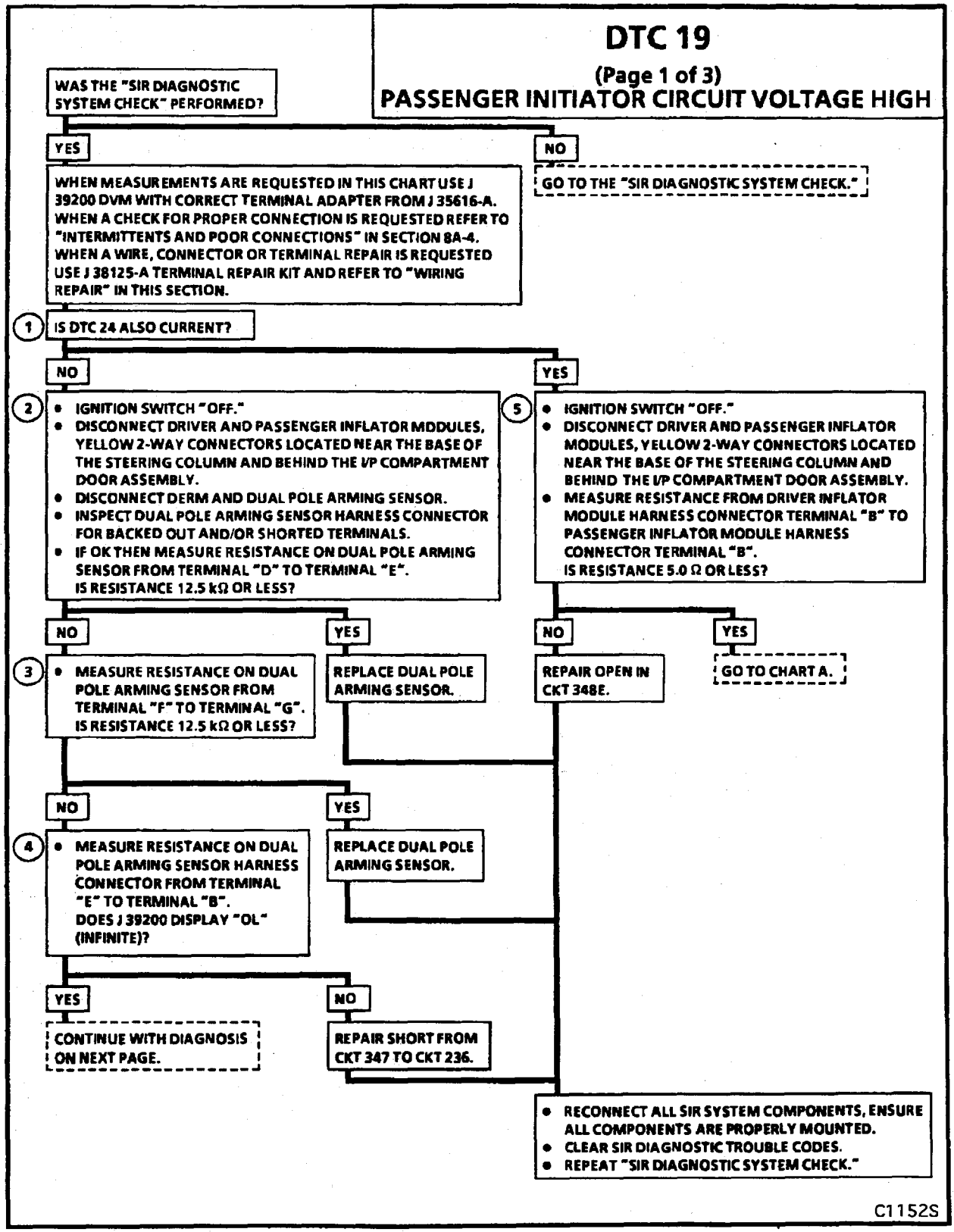
DTC Chart Test Description:

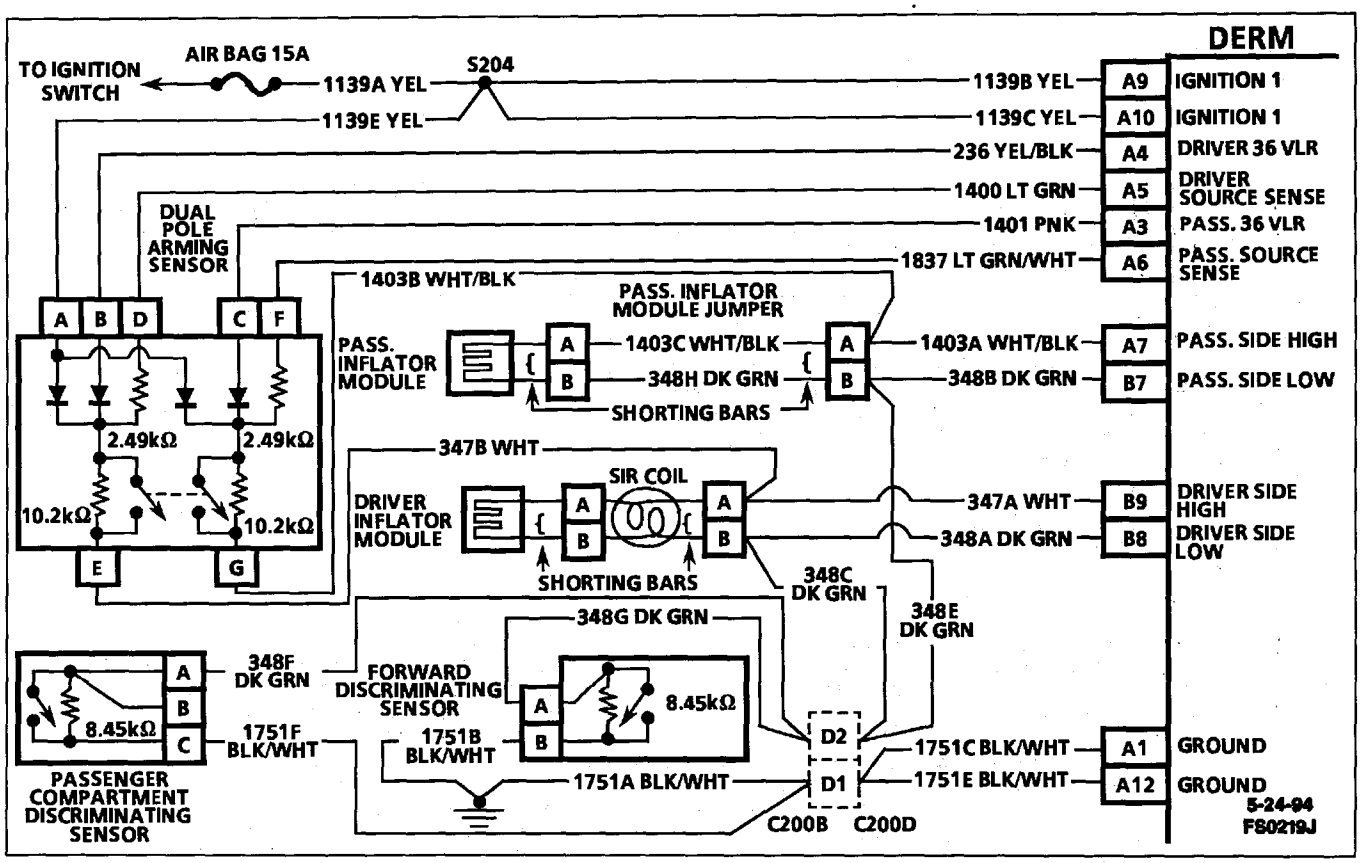
Number(s) below refer to circled number(s) on the diagnostic chart.

1. DTC 19 and 24 together means that there is an open between the passenger inflator jumper harness connector and the discriminating sensor interconnect.
2. This test checks for decreased resistance in the driver side diagnostic resistors of the dual pole arming sensor.
3. This test checks for decreased resistance in the passenger side diagnostic resistors of the dual pole arming sensor.
4. This test checks for a short from the high side of the driver deployment loop to "Driver 36 VLR."
5. this test determines whether the malfunction is an open in CKT 348E.

Diagnostic Aids:

An open between the passenger inflator module and the forward discriminating sensor causes the voltage to increase at "Passenger Side Low" due to the loss of a ground path. This also causes the voltage to decrease at "Driver Side Low" due to decreased current flow through the discriminating sensor network. Refer to DTC 19 (Page 3 of 3).


DTC 19
(Page 1 of 3)
PASSENGER INITIATOR CIRCUIT VOLTAGE HIGH
WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?
YES
NO
GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."
WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.
1
IS DTC 24 ALSO CURRENT?
NO
YES
2
• IGNITION SWITCH "OFF."
• DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
• DISCONNECT DERM AND DUAL POLE ARMING SENSOR.
• INSPECT DUAL POLE ARMING SENSOR HARNESS CONNECTOR FOR BACKED OUT AND/OR SHORTED TERMINALS.
• IF OK THEN MEASURE RESISTANCE ON DUAL POLE ARMING SENSOR FROM TERMINAL "D" TO TERMINAL "E". IS RESISTANCE 12.5 kΩ OR LESS?
5
• IGNITION SWITCH "OFF."
• DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
• MEASURE RESISTANCE FROM DRIVER INFLATOR MODULE HARNESS CONNECTOR TERMINAL "B" TO PASSENGER INFLATOR MODULE HARNESS CONNECTOR TERMINAL "B". IS RESISTANCE 5.0 Ω OR LESS?
NO
YES
3
• MEASURE RESISTANCE ON DUAL POLE ARMING SENSOR FROM TERMINAL "F" TO TERMINAL "G". IS RESISTANCE 12.5 kΩ OR LESS?
REPLACE DUAL POLE ARMING SENSOR.
REPAIR OPEN IN CKT 348E.
GO TO CHART A.
NO
YES
4
• MEASURE RESISTANCE ON DUAL POLE ARMING SENSOR HARNESS CONNECTOR FROM TERMINAL "E" TO TERMINAL "B". DOES J 39200 DISPLAY "OL" (INFINITE)?
REPLACE DUAL POLE ARMING SENSOR.
YES
NO
CONTINUE WITH DIAGNOSIS ON NEXT PAGE.
REPAIR SHORT FROM CKT 347 TO CKT 236.
• RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
• CLEAR SIR DIAGNOSTIC TROUBLE CODES.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
C1152S



DTC 19 - (Page 2 of 3)
PASSENGER INITIATOR CIRCUIT VOLTAGE HIGH

Circuit Description:

During normal, non-deployment operation of the SIR system, a small amount of current flows through both the driver and passenger deployment loops. The diagnostic resistors within the dual pole arming sensor and the discriminating sensors along with the resistance of the inflator modules cause voltage drops within the deployment loops. The DERM monitors the voltage at "Passenger Side Low" terminal "B7" to detect shorts or opens within the passenger deployment loop. When the measured voltage is above a specified percentage of "Passenger 36 VLR" for 500 milliseconds DTC 19 is set.

DTC Will Set When:

The voltage measured at "Passenger Side Low" terminal "B7" is above a specified percentage of "Passenger 36 VLR" for 500 milliseconds and DTC 35 is not set. This test is run every 100 milliseconds during the "Continuous Monitoring" tests.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage measured at "Passenger Side Low" terminal "B7" is within a specified percentage of "Passenger 36 VLR" for 500 milliseconds.

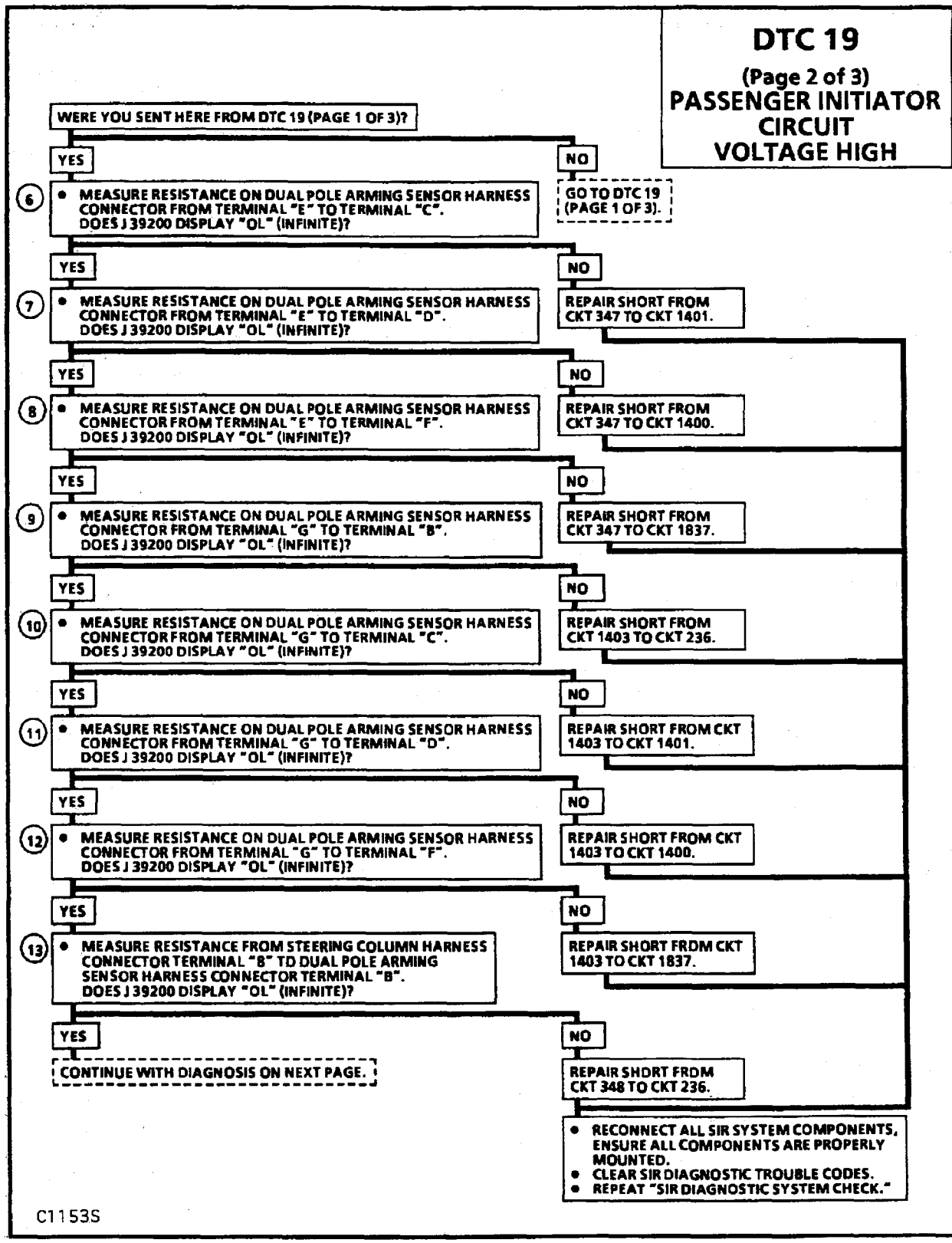
DTC Chart Test Description:

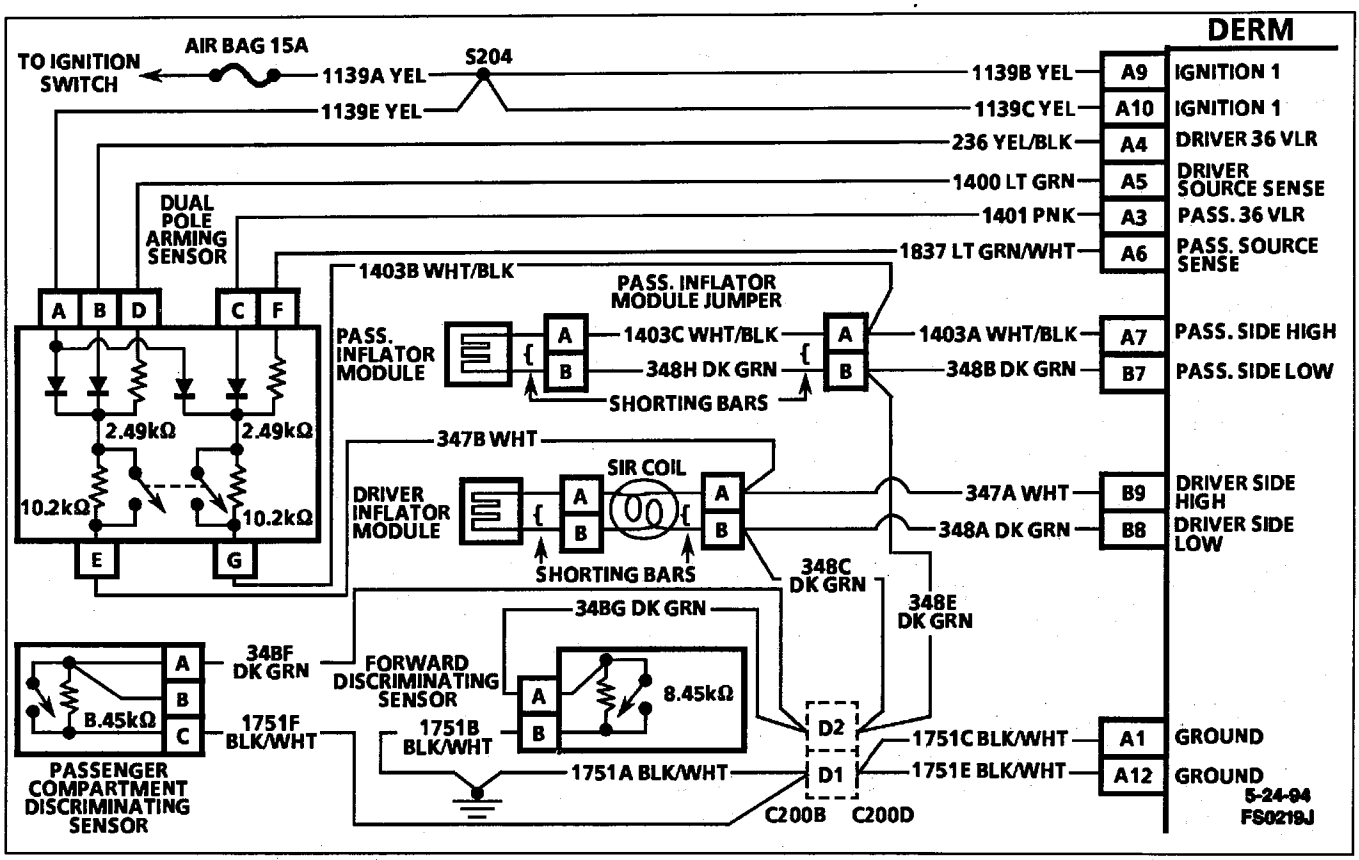
Number(s) below refer to circled number(s) on the diagnostic chart.

6. This test checks for a short from the high side of the driver deployment loop to "Passenger 36 VLR."
7. This test checks for a short from the high side of the driver deployment loop to "Driver Source Sense."
8. This test checks for a short from the high side of the driver deployment loop to "Passenger Source Sense."
9. This test checks for a short from the high side of the passenger deployment loop to "Driver 36 VLR."
10. This test checks for a short from the high side of the passenger deployment loop to "Passenger 36 VLR."
11. This test checks for a short from the high side of the passenger deployment loop to "Driver Source Sense."
12. This test checks for a short from the high side of the passenger deployment loop to "Passenger Source Sense."
13. This test checks for a short from the low side of the deployment loops to "Driver 36 VLR."

Diagnostic Aids:

Refer to DTC 19 (Page 3 of 3).


DTC 19
(Page 2 of 3)
PASSENGER INITIATOR CIRCUIT VOLTAGE HIGH
WERE YOU SENT HERE FROM DTC 19 (PAGE 1 OF 3)?
YES
NO
GO TO DTC 19 (PAGE 1 OF 3).
6
• MEASURE RESISTANCE ON DUAL POLE ARMING SENSOR HARNESS CONNECTOR FROM TERMINAL "E" TO TERMINAL "C". DOES J 39200 DISPLAY "OL" (INFINITE)?
YES
NO
7
• MEASURE RESISTANCE ON DUAL POLE ARMING SENSOR HARNESS CONNECTOR FROM TERMINAL "E" TO TERMINAL "D". DOES J 39200 DISPLAY "OL" (INFINITE)?
REPAIR SHORT FROM CKT 347 TO CKT 1401.
YES
NO
8
• MEASURE RESISTANCE ON DUAL POLE ARMING SENSOR HARNESS CONNECTOR FROM TERMINAL "E" TO TERMINAL "F". DOES J 39200 DISPLAY "OL" (INFINITE)?
REPAIR SHORT FROM CKT 347 TO CKT 1400.
YES
NO
9
• MEASURE RESISTANCE ON DUAL POLE ARMING SENSOR HARNESS CONNECTOR FROM TERMINAL "G" TO TERMINAL "B". DOES J 39200 DISPLAY "OL" (INFINITE)?
REPAIR SHORT FROM CKT 347 TO CKT 1837.
YES
NO
10
• MEASURE RESISTANCE ON DUAL POLE ARMING SENSOR HARNESS CONNECTOR FROM TERMINAL "G" TO TERMINAL "C". DOES J 39200 DISPLAY "OL" (INFINITE)?
REPAIR SHORT FROM CKT 1403 TO CKT 236.
YES
NO
11
• MEASURE RESISTANCE ON DUAL POLE ARMING SENSOR HARNESS CONNECTOR FROM TERMINAL "G" TO TERMINAL "D". DOES J 39200 DISPLAY "OL" (INFINITE)?
REPAIR SHORT FROM CKT 1403 TO CKT 1401.
YES
NO
12
• MEASURE RESISTANCE ON DUAL POLE ARMING SENSOR HARNESS CONNECTOR FROM TERMINAL "G" TO TERMINAL "F". DOES J 39200 DISPLAY "OL" (INFINITE)?
REPAIR SHORT FROM CKT 1403 TO CKT 1400.
YES
NO
13
• MEASURE RESISTANCE FROM STEERING COLUMN HARNESS CONNECTOR TERMINAL "B" TD DUAL POLE ARMING SENSOR HARNESS CONNECTOR TERMINAL "B". DOES J 39200 DISPLAY "OL" (INFINITE)?
REPAIR SHORT FRDM CKT 1403 TO CKT 1837.
YES
NO
CONTINUE WITH DIAGNOSIS ON NEXT PAGE.
REPAIR SHDRT FRDM CKT 348 TO CKT 236.
• RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
• CLEAR SIR DIAGNOSTIC TROUBLE CODES.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
C1153S



DTC 19 - (Page 3 of 3)
PASSENGER INITIATOR CIRCUIT VOLTAGE HIGH

Circuit Description:

During normal, non-deployment operation of the SIR system, a small amount of current flows through both the driver and passenger deployment loops. The diagnostic resistors within the dual pole arming sensor and the discriminating sensors along with the resistance of the inflator modules cause voltage drops within the deployment loops. The DERM monitors the voltage at "Passenger Side Low" terminal "B7" to detect shorts or opens within the passenger deployment loop. When the measured voltage is above a specified percentage of "Passenger 36 VLR" for 500 milliseconds DTC 19 is set.

DTC Will Set When:

The voltage measured at "Passenger Side Low" terminal "B7" is above a specified percentage of "Passenger 36 VLR" for 500 milliseconds and DTC 35 is not set. This test is run every 100 milliseconds during the "Continuous Monitoring" tests.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage measured at "Passenger Side Low" terminal "B7" is within a specified percentage of "Passenger 36 VLR" for 500 milliseconds.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

14. This test checks for a short from the low side of the deployment loops to "Passenger 36 VLR."
15. This test checks for a short from the low side of the driver deployment loop to "Driver Source Sense."
16. This test checks for a short from the low side of the deployment loops to "Passenger Source Sense."
17. This test checks for increased resistance of the diagnostic resistor in the forward discriminating sensor.
18. This test determines whether the malfunction is increased resistance of the diagnostic resistor in the passenger compartment discriminating sensor.

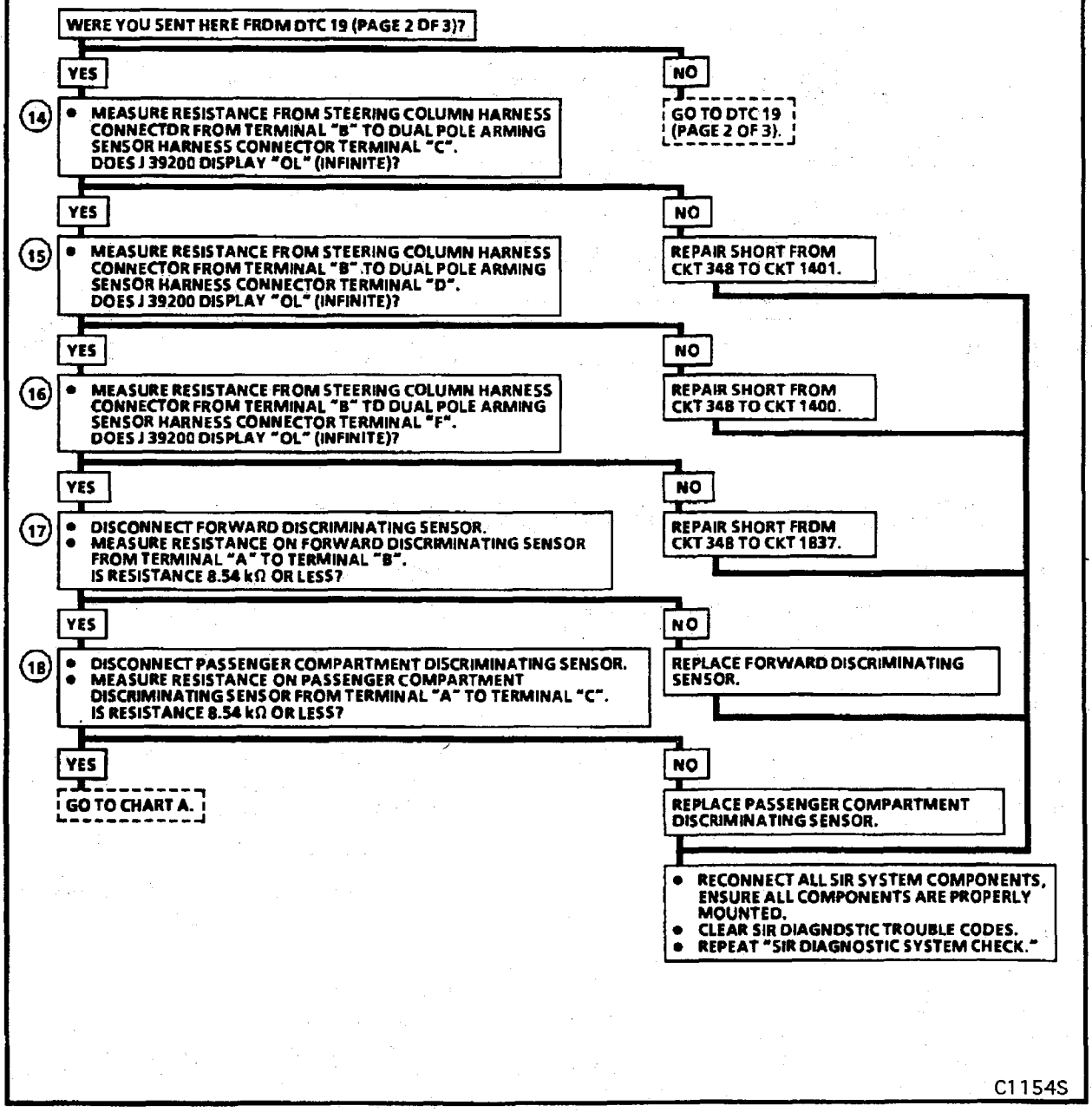
Diagnostic Aids:

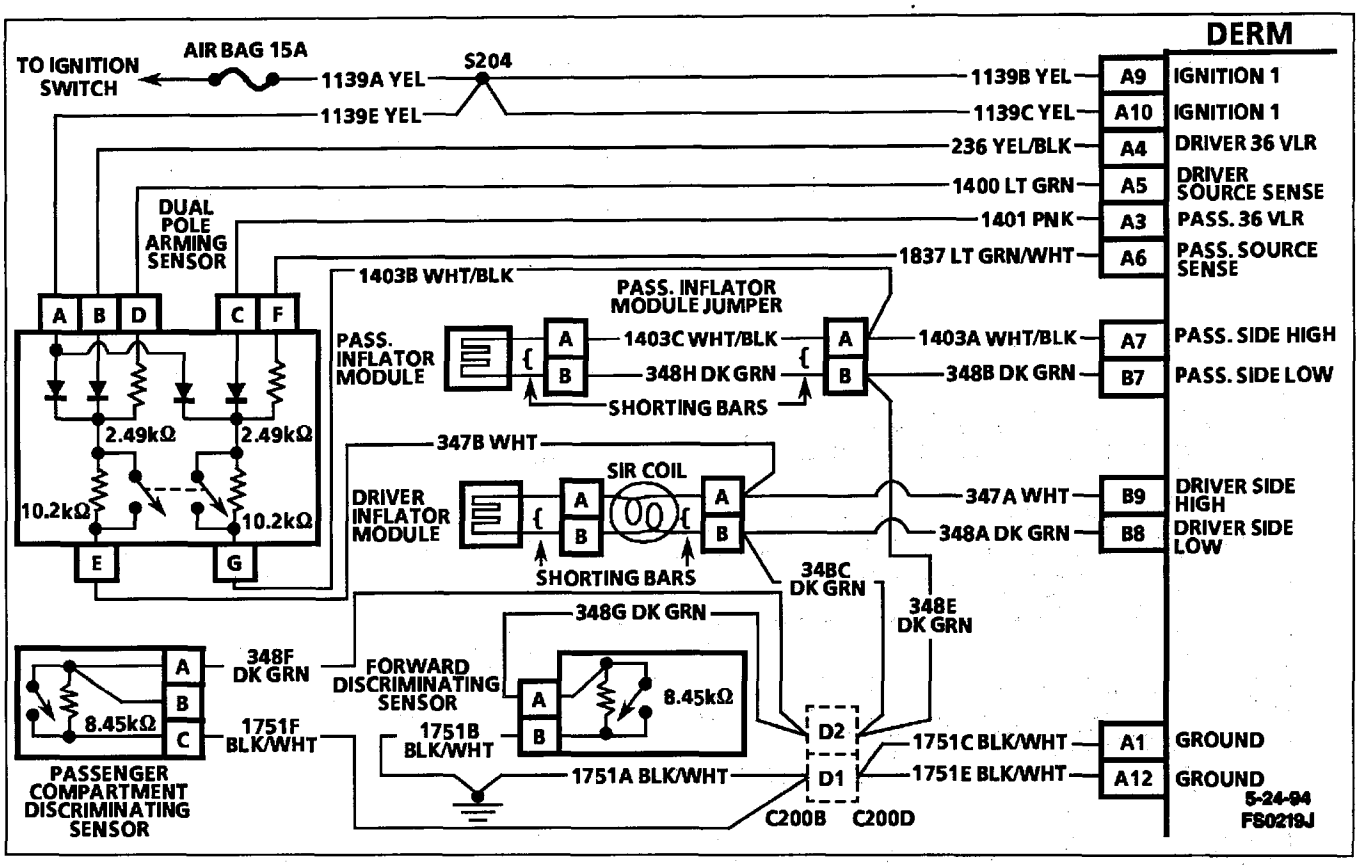
An intermittent condition is likely to be caused by backed out/shorted terminals on the dual pole arming sensor harness connector, a malfunctioning dual pole arming sensor, poor connection at any of the discriminating sensor terminals, a malfunctioning discriminating sensor, a short from CKT 236 or 1401 to CKT 347, CKT 348 or CKT 1403, a short from CKT 1400 or CKT 1837 to CKT 347, CKT 348, or CKT 1403.

DTC 19

(Page 3 of 3)

PASSENGER INITIATOR CIRCUIT VOLTAGE HIGH





DTC 21
DRIVER INITIATOR CIRCUIT RESISTANCE HIGH

Circuit Description:

During the "Initiator Assembly Resistance Test" the DERM grounds the "Passenger Side Low" terminal "B7" and turns "ON" the driver current source at the "Driver Side High" terminal "B9". This causes a known amount of current to flow through the driver initiator circuit. By monitoring the difference between the voltage at the "Driver Side High" terminal "B9" and the "Driver Side Low" terminal "B8" the DERM calculates the combined resistance of the driver inflator module, SIR coil assembly, harness wiring CKTs 347A and 348A and connector terminal contact.

DTC Will Set When:

The combined resistance of the driver inflator module, SIR coil assembly, harness wiring CKT 347A and connector terminal contact is above a specified value. This test is run during the "Initiator Assembly Resistance Test" when: 1) No "higher priority faults" are detected during "Turn-ON," 2) No "higher priority faults" are detected during "Continuous Monitoring" for one second, 3) No "Crank" signal present, 4) "Ignition 1" voltage is above a specified value.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The ignition switch is turned "OFF."

DTC Chart Test Description:

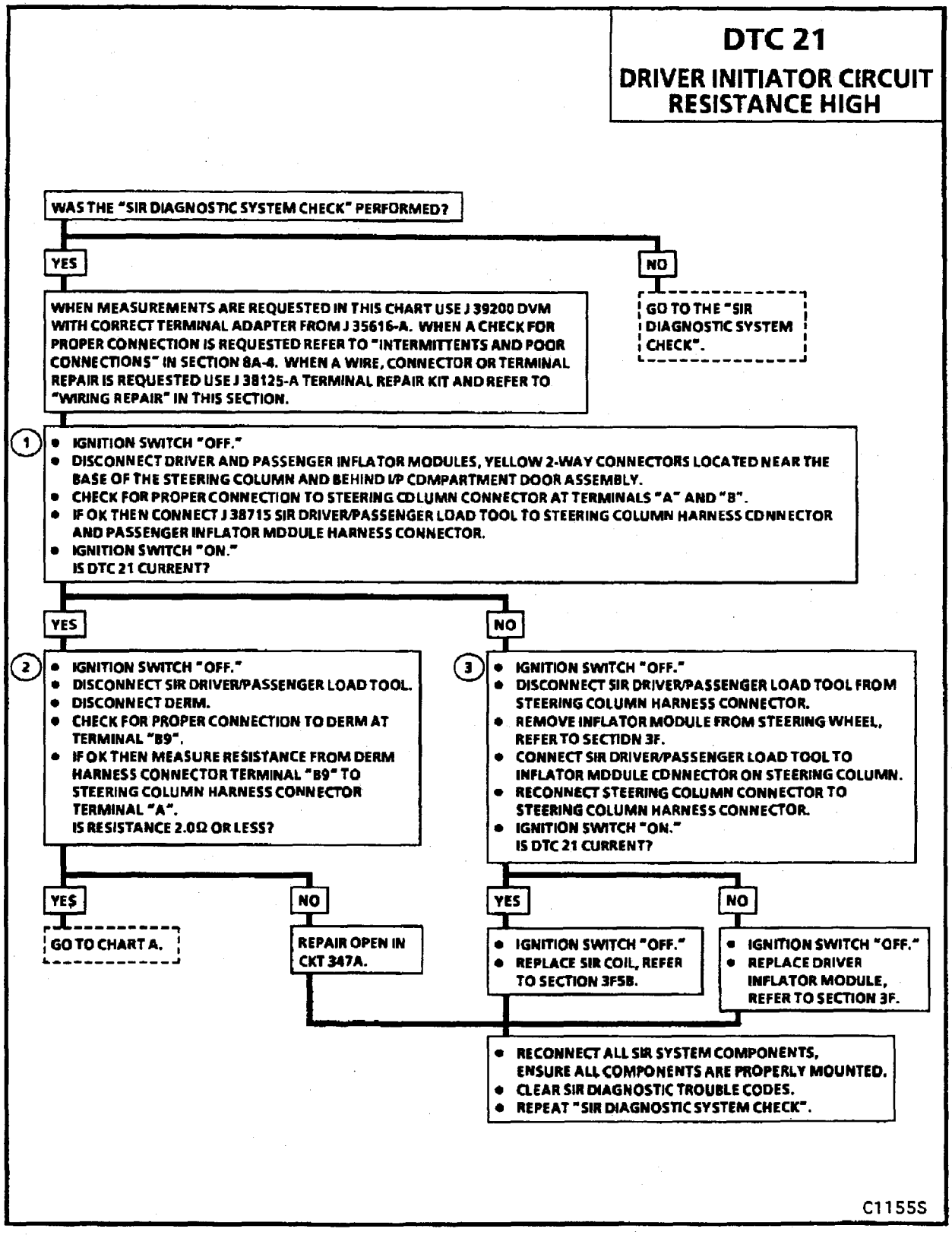
Number(s) below refer to circled number(s) on the diagnostic chart.

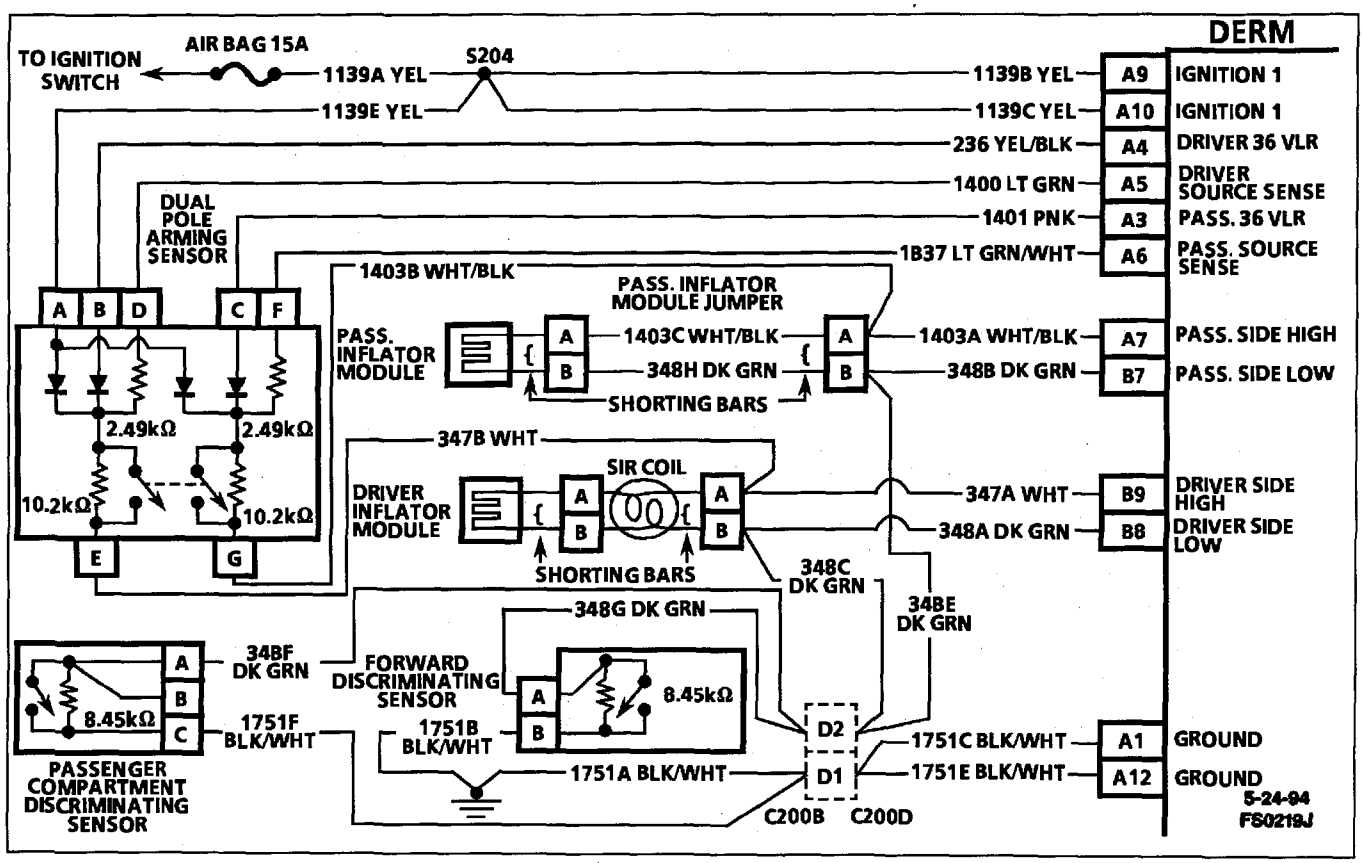
1. This test determines whether the malfunction is in the driver inflator module circuitry or in the DERM wiring harness circuitry.
2. This test determines whether the malfunction is an open in CKT 347A.
3. This test determines whether the malfunction is in the driver inflator module or the SIR coil assembly.

Diagnostic Aids:

An intermittent condition is likely to be caused by a poor connection at: the yellow 2-way connector at the base of the steering column, DERM terminal "B9", or the connection at the top of the steering column to the driver inflator module.

The test for this DTC is only run while the "AIR BAG" warning lamp is performing the bulb check. When a scan tool "Clear Codes" command is issued and the malfunction is still present, the DTC will not reappear until the next ignition cycle.


DTC 21
DRIVER INITIATOR CIRCUIT RESISTANCE HIGH
WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?
YES
NO
WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.
GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK".
1
• IGNITION SWITCH "OFF."
• DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND I/P COMPARTMENT DOOR ASSEMBLY.
• CHECK FOR PROPER CONNECTION TO STEERING COLUMN CONNECTOR AT TERMINALS "A" AND "B".
• IF OK THEN CONNECT J 38715 SIR DRIVER/PASSENGER LOAD TOOL TO STEERING COLUMN HARNESS CONNECTOR AND PASSENGER INFLATOR MODULE HARNESS CONNECTOR.
• IGNITION SWITCH "ON."
IS DTC 21 CURRENT?
YES
NO
2
• IGNITION SWITCH "OFF."
• DISCONNECT SIR DRIVER/PASSENGER LOAD TOOL.
• DISCONNECT DERM.
• CHECK FOR PROPER CONNECTION TO DERM AT TERMINAL "B9".
• IF OK THEN MEASURE RESISTANCE FROM DERM HARNESS CONNECTOR TERMINAL "B9" TO STEERING COLUMN HARNESS CONNECTOR TERMINAL "A".
IS RESISTANCE 2.0Ω OR LESS?
3
• IGNITION SWITCH "OFF."
• DISCONNECT SIR DRIVER/PASSENGER LOAD TOOL FROM STEERING COLUMN HARNESS CONNECTOR.
• REMOVE INFLATOR MODULE FROM STEERING WHEEL, REFER TO SECTION 3F.
• CONNECT SIR DRIVER/PASSENGER LOAD TOOL TO INFLATOR MODULE CONNECTOR ON STEERING COLUMN.
• RECONNECT STEERING COLUMN CONNECTOR TO STEERING COLUMN HARNESS CONNECTOR.
• IGNITION SWITCH "ON."
IS DTC 21 CURRENT?
YES
NO
GO TO CHART A.
REPAIR OPEN IN CKT 347A.
YES
NO
• IGNITION SWITCH "OFF."
• REPLACE SIR COIL, REFER TO SECTION 3F5B.
• IGNITION SWITCH "OFF."
• REPLACE DRIVER INFLATOR MODULE, REFER TO SECTION 3F.
• RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
• CLEAR SIR DIAGNOSTIC TROUBLE CODES.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK".
C1155S



DTC 22
DRIVER INITIATOR CIRCUIT RESISTANCE LOW

Circuit Description:

During the "Initiator Assembly Resistance Test" the DERM grounds the "Passenger Side Low" terminal "B7" and turns "ON" the driver current source at the "Driver Side High" terminal "B9". This causes a known amount of current to flow through the driver initiator circuit. By monitoring the difference between the voltage at the "Driver Side High" terminal "B9" and the "Driver Side Low" terminal "B8" the DERM calculates the combined resistance of the driver inflator module, SIR coil assembly, harness wiring CKTs 347A and 348A and connector terminal contact.

DTC Will Set When:

The combined resistance of the driver inflator module, SIR coil assembly, harness wiring CKTs 347 and 348 and connector terminal contact is below a specified value. This test is run during the "Initiator Assembly Resistance Test" when: 1) No "higher priority faults" are detected during "Turn-ON", 2) No "higher priority faults" are detected during "Continuous Monitoring" for one second, 3) No "Crank" signal present, 4) "Ignition 1" voltage is above a specified value.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The ignition switch is turned "OFF."

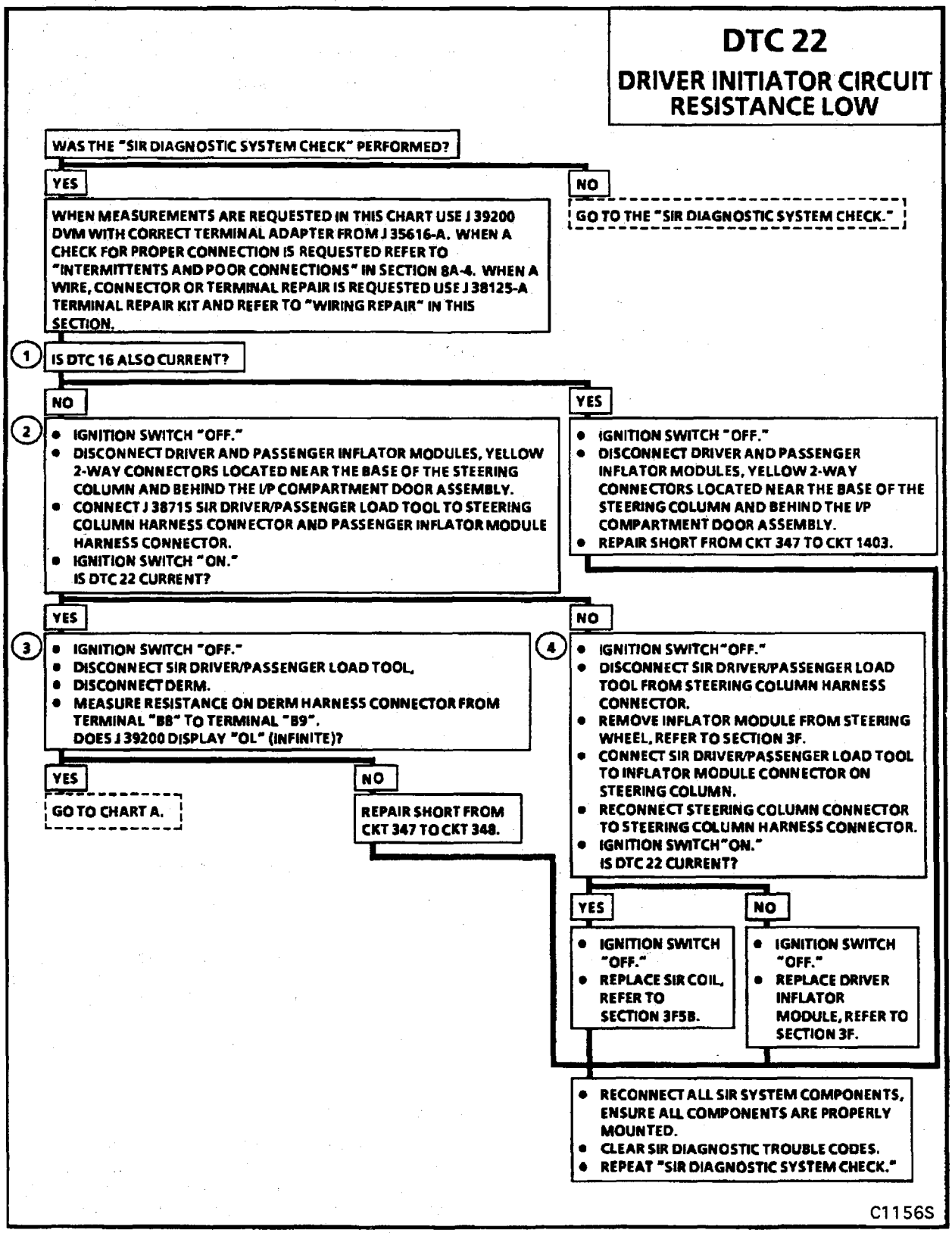
DTC Chart Test Description:

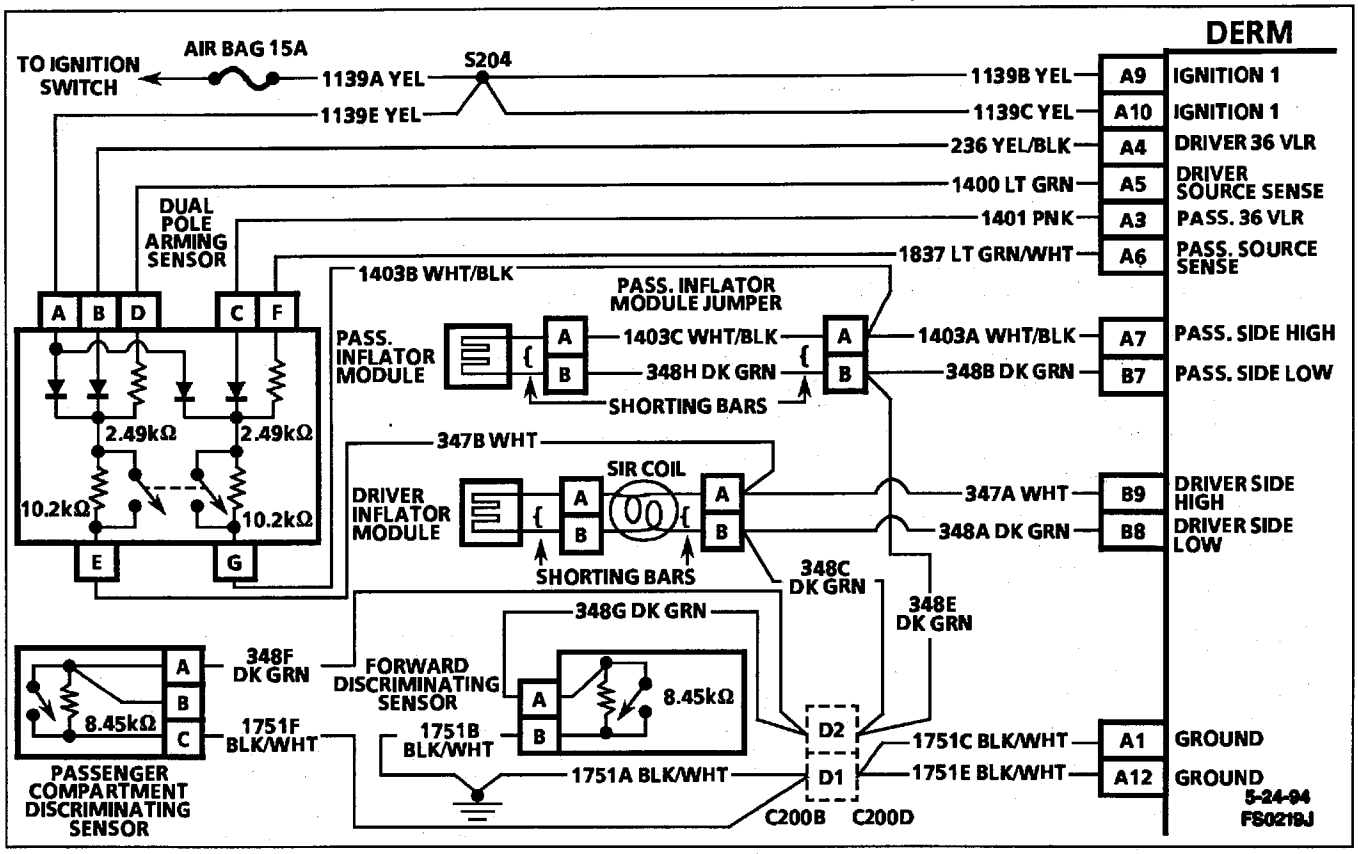
Number(s) below refer to circled number(s) on the diagnostic chart.

1. DTC 16 and 22 will set simultaneously when the "Driver Side High" circuit is shorted to the "Passenger Side High" circuit due to parallel current paths.
2. This test determines whether the malfunction is in the driver inflator module circuitry or in the DERM wiring harness circuitry.
3. This test checks for a short from the "Driver Side High" circuit to the "Driver Side Low" circuit.
4. This test determines whether the malfunction is in the driver inflator module or the SIR coil assembly.

Diagnostic Aids:

An intermittent condition is likely to be caused by a short between CKT 347 and CKT 348 or CKT 1403, or a malfunctioning shorting clip at the base of the steering column. The test for this DTC is only run while the "AIR BAG" warning lamp is performing the bulb check. When a scan tool "Clear Codes" command is issued and the malfunction is still present, the DTC will not reappear until the next ignition cycle.


DTC 22
DRIVER INITIATOR CIRCUIT RESISTANCE LOW
WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?
YES
NO
GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."
WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.
1
IS DTC 16 ALSO CURRENT?
NO
YES
2
• IGNITION SWITCH "OFF."
• DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
• CONNECT J 38715 SIR DRIVER/PASSENGER LOAD TOOL TO STEERING COLUMN HARNESS CONNECTOR AND PASSENGER INFLATOR MODULE HARNESS CONNECTOR.
• IGNITION SWITCH "ON."
IS DTC 22 CURRENT?
• IGNITION SWITCH "OFF."
• DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
• REPAIR SHORT FROM CKT 347 TO CKT 1403.
YES
NO
3
• IGNITION SWITCH "OFF."
• DISCONNECT SIR DRIVER/PASSENGER LOAD TOOL.
• DISCONNECT DERM.
• MEASURE RESISTANCE ON DERM HARNESS CONNECTOR FROM TERMINAL "B8" TO TERMINAL "B9".
DOES J 39200 DISPLAY "OL" (INFINITE)?
4
• IGNITION SWITCH "OFF."
• DISCONNECT SIR DRIVER/PASSENGER LOAD TOOL FROM STEERING COLUMN HARNESS CONNECTOR.
• REMOVE INFLATOR MODULE FROM STEERING WHEEL, REFER TO SECTION 3F.
• CONNECT SIR DRIVER/PASSENGER LOAD TOOL TO INFLATOR MODULE CONNECTOR ON STEERING COLUMN.
• RECONNECT STEERING COLUMN CONNECTOR TO STEERING COLUMN HARNESS CONNECTOR.
• IGNITION SWITCH "ON."
IS DTC 22 CURRENT?
YES
NO
GO TO CHART A.
REPAIR SHORT FROM CKT 347 TO CKT 348.
YES
NO
• IGNITION SWITCH "OFF."
• REPLACE SIR COIL, REFER TO SECTION 3F5B.
• IGNITION SWITCH "OFF."
• REPLACE DRIVER INFLATOR MODULE, REFER TO SECTION 3F.
• RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
• CLEAR SIR DIAGNOSTIC TROUBLE CODES.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
C1156S



DTC 23
DRIVER INITIATOR CIRCUIT VOLTAGE HIGH

Circuit Description:

During normal, non-deployment operation of the SIR system, a small amount of current flows through both the driver and passenger deployment loops. The diagnostic resistors within the dual pole arming sensor and the discriminating sensors along with the resistance of the inflator modules cause voltage drops within the deployment loops. The DERM monitors the voltage at "Driver Side Low" terminal "B8" to detect shorts or opens within the driver deployment loop. When the measured voltage is above a specified percentage of "Driver 36 VLR" for 500 milliseconds DTC 23 is set.

DTC Will Set When:

The voltage measured at "Driver Side Low" terminal "B8" is above a specified percentage of "Driver 36 VLR" for 500 milliseconds and DTC 35 is not set. This test is run during the "Continuous Monitoring" tests.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage measured at "Driver Side Low" terminal "B8" is within a specified percentage of "Driver 36 VLR" for 500 milliseconds.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. DTC 23 and 24 together means that there is an open between the driver inflator module harness connector and the discriminating sensor interconnect.
2. This test determines whether the malfunction is an open in CKT 348C.

Diagnostic Aids:

An open between the driver inflator module harness connector and the discriminating sensor interconnect causes the voltage to increase at "Driver Side Low" due to the loss of a ground path. This also causes the voltage to decrease at "Passenger Side Low" due to decreased current flow through the discriminating sensor network. Refer to DTC 19 (Page 3 of 3) to diagnose history DTC 23.

DTC 23
DRIVER INITIATOR CIRCUIT VOLTAGE HIGH

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

1. IS DTC 24 ALSO CURRENT?

YES

2.
- IGNITION SWITCH "OFF."
- DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY
- MEASURE RESISTANCE FROM STEERING COLUMN HARNESS CONNECTOR TERMINAL "B" TO PASSENGER INFLATOR MODULE HARNESS CONNECTOR TERMINAL "B".

IS RESISTANCE 5.0 Ω OR LESS?

YES

GO TO CHART A.

NO

- REPAIR OPEN IN CKT 348C.
- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

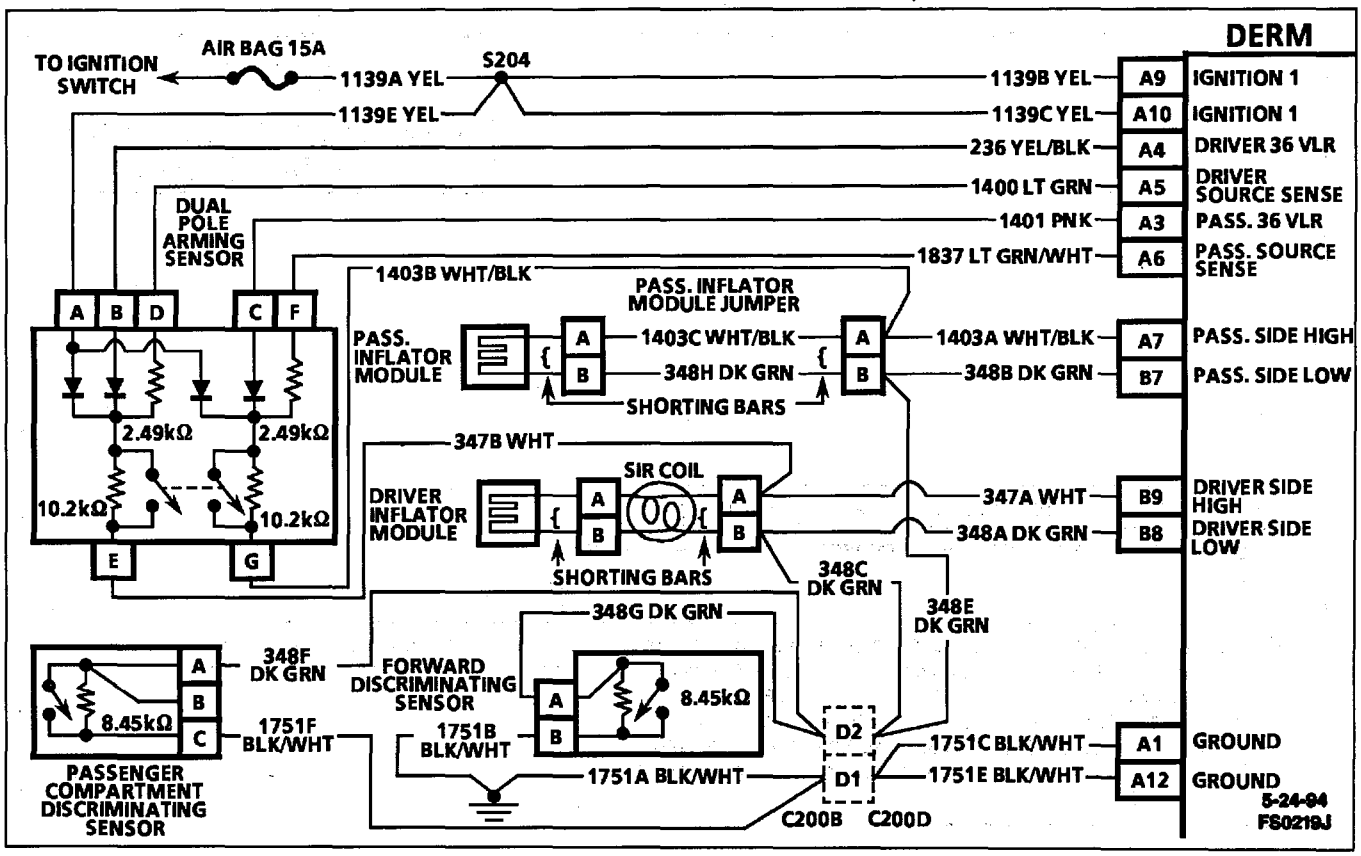
NO

GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

1. NO

GO TO AND FOLLOW DTC 19 (PAGE 1 OF 3). MALFUNCTIONS WHICH SET DTC 19 AND DTC 23 SIMULTANEOUSLY ARE DIAGNOSED IN DTC 19 CHARTS.

C3655S



DTC 24 - (Page 1 of 3)
INITIATOR CIRCUIT VOLTAGE LOW

Circuit Description:

During normal, non-deployment operation of the SIR system, a small amount of current flows through both the driver and passenger deployment loops. The diagnostic resistors within the dual pole arming sensor and the discriminating sensors along with the resistance of the inflator modules cause voltage drops within the deployment loops. The DERM monitors the voltages at "Driver Side Low" terminal "B8" and "Passenger Side Low" terminal "B7" to detect shorts or opens within the deployment loops. When the measured voltage at terminal "B8" or "B7" is below a specified percentage of its respective 36 VLR power supply voltage for 500 milliseconds DTC 24 is set.

DTC Will Set When:

The voltage measured at "Driver Side Low" terminal "B8" is below a specified percentage of "Driver 36 VLR" or when the voltage measured at "Passenger Side Low" terminal "B7" is below a specified percentage of "Passenger 36 VLR" for 500 milliseconds. This test is run during the "Continuous Monitoring" test.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage measured at "Driver Side Low" terminal "B8" is within a specified percentage of "Driver 36 VLR" and the voltage measured at "Passenger Side Low" terminal "B7" is within a specified percentage of "Passenger 36 VLR" for 500 milliseconds.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test determines whether the malfunction is occurring in the steering column circuitry.
2. This test determines whether the malfunction is occurring in the passenger inflator module circuitry.

Diagnostic Aids:

An intermittent condition is likely to be caused by a poor connection at DERM terminals "A3" and "A4", dual pole arming sensor terminals "B", "C", "E" or "G", water intrusion in any discriminating sensor, an open in CKT 1403B or CKT 347B, or a short to ground in CKT 347, CKT 348 or CKT 1403. Refer to DTC 25 to diagnose a possible short to B+. When the malfunction occurs during an ignition cycle DTC 24 will set. If the malfunction is present at the beginning of the next ignition cycle DTC 25 will set and DTC 24 will be moved to a history file.

DTC 24

(Page 1 of 3)

INITIATOR CIRCUIT VOLTAGE LOW

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

NO

GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND PODR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

1

- IGNITION SWITCH "OFF."
- DISCONNECT DRIVER INFLATOR MODULE, YELLOW 2-WAY CONNECTOR AT THE BASE OF THE STEERING COLUMN, LEAVE PASSENGER INFLATOR MODULE CONNECTED.
- CONNECT SIR DRIVER/PASSENGER LOAD TOOL J 38715 TO STEERING COLUMN HARNESS CONNECTOR.
- IGNITION SWITCH "ON."

IS DTC 24 CURRENT?

YES

NO

2

- IGNITION SWITCH "OFF."
- DISCONNECT PASSENGER INFLATOR MODULE, YELLOW 2-WAY CONNECTOR LOCATED BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
- CONNECT SIR DRIVER/PASSENGER LOAD TOOL TO PASSENGER INFLATOR MODULE HARNESS CONNECTOR, LEAVE DRIVER INFLATOR MODULE HARNESS CONNECTOR CONNECTED TO LOAD TOOL.
- IGNITION SWITCH "ON."

IS DTC 24 CURRENT?

- IGNITION SWITCH "OFF."
- REMOVE INFLATOR MODULE FROM STEERING WHEEL, REFER TO SECTION 3F.
- REMOVE AND INSPECT SIR COIL AND CONNECTING WIRES FOR DAMAGE. DETERMINE AND REPAIR THE CAUSE OF DAMAGE AND REPLACE SIR COIL, REFER TO SECTION 3F5B.

YES

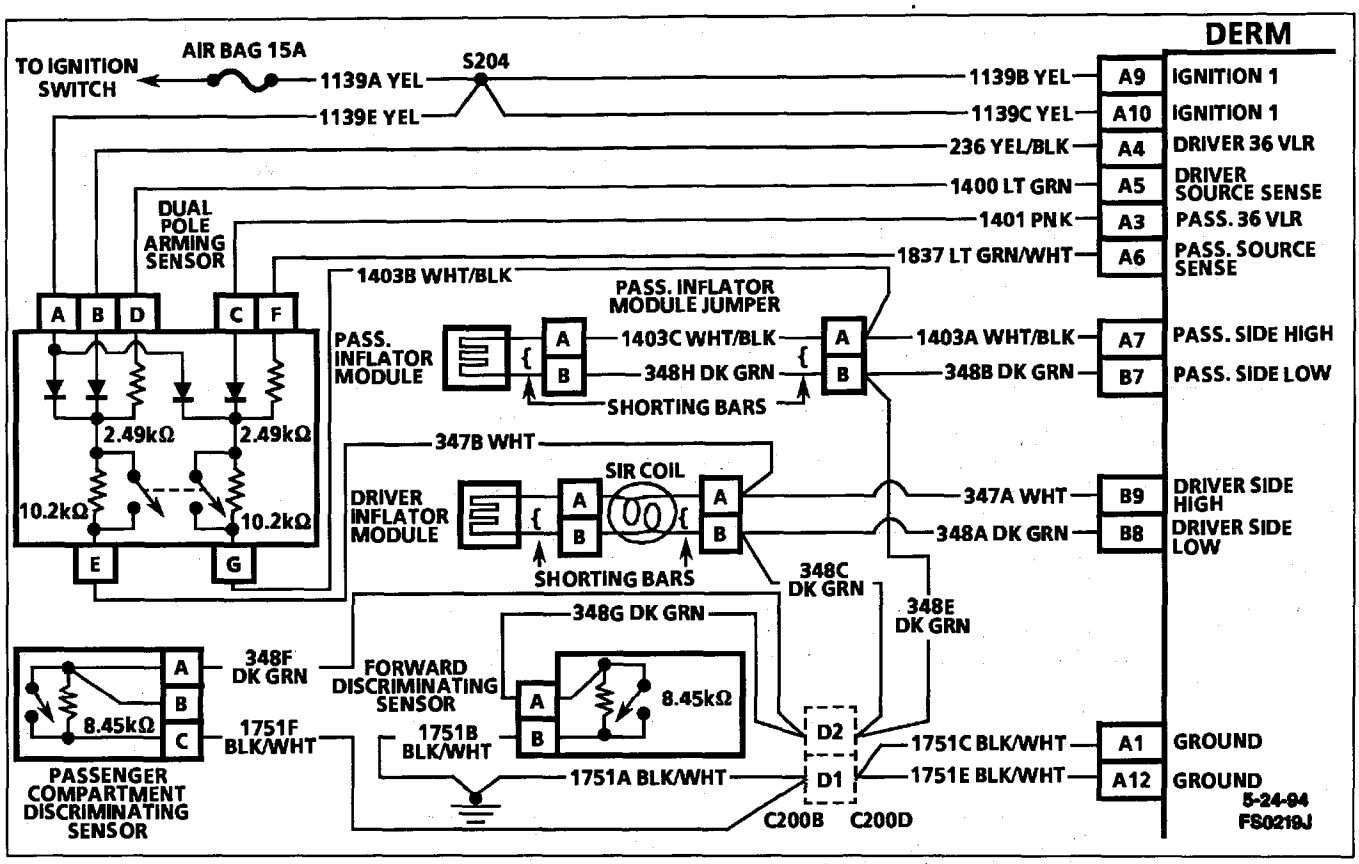
NO

CONTINUE WITH DIAGNOSIS ON NEXT PAGE.

- IGNITION SWITCH "OFF."
- REMOVE LOWER SOUND INSULATOR PANEL-RH, REFER TO SECTION 8C, TO ACCESS PASSENGER INFLATOR MODULE
- INSPECT INFLATOR MODULE WIRES AND CONNECTOR FOR CUTTING OR PINCHING WHICH COULD CAUSE A SHORT. IF ANY DAMAGE IS DETECTED REPLACE INFLATOR MODULE, DETERMINE AND REPAIR THE CAUSE OF DAMAGE.
- IF INFLATOR MODULE IS OK, INSPECT PASSENGER INFLATOR MODULE JUMPER WIRES FOR DAMAGE. DETERMINE AND REPAIR THE CAUSE OF DAMAGE AND REPAIR THE JUMPER WIRE.

- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK".

C3656S



DTC 24 - (Page 2 of 3)
INITIATOR CIRCUIT VOLTAGE LOW

Circuit Description:

During normal, non-deployment operation of the SIR system, a small amount of current flows through both the driver and passenger deployment loops. The diagnostic resistors within the dual pole arming sensor and the discriminating sensors along with the resistance of the inflator modules cause voltage drops within the deployment loops. The DERM monitors the voltages at "Driver Side Low" terminal "B8" and "Passenger Side Low" terminal "B7" to detect shorts or opens within the deployment loops. When the measured voltage at terminal "B8" or "B7" is below a specified percentage of its respective 36 VLR power supply voltage for 500 milliseconds DTC 24 is set.

DTC Will Set When:

The voltage measured at "Driver Side Low" terminal "B8" is below a specified percentage of "Driver 36 VLR" or when the voltage measured at "Passenger Side Low" terminal "B7" is below a specified percentage of "Passenger 36 VLR" for 500 milliseconds. This test is run during the "Continuous Monitoring" test.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage measured at "Driver Side Low" terminal "B8" is within a specified percentage of "Driver 36 VLR" and the voltage measured at "Passenger Side Low" terminal "B7" is within a specified percentage of "Passenger 36 VLR" for 500 milliseconds.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

3. This test checks for a partial short across the diagnostic resistor in the forward discriminating sensor.
4. This test checks for a partial short across the diagnostic resistor in the passenger compartment discriminating sensor.
5. This test checks for a short from the discriminating sensor interconnect circuit to ground.
6. This test checks for a short from the low side of the passenger deployment loop to ground.
7. This test checks for a short from the high side of the driver deployment loop to ground.

Diagnostic Aids:

Refer to DTC 24 (Page 1 of 3).

DTC 24

(Page 2 of 3)

INITIATOR CIRCUIT VOLTAGE LOW

WERE YOU SENT HERE FROM DTC 24 (PAGE 1 OF 3)?

YES

NO

GO TO DTC 24 (PAGE 1 OF 3).

3
- IGNITION SWITCH "OFF."
- DISCONNECT SIR DRIVER/PASSENGER LOAD TOOL.
- DISCONNECT FORWARD DISCRIMINATING SENSOR.
- MEASURE RESISTANCE OF FORWARD DISCRIMINATING SENSOR FROM TERMINAL "A" TO TERMINAL "B". IS RESISTANCE LESS THAN 8.36 kΩ?

NO

YES

4
- DISCONNECT PASSENGER COMPARTMENT DISCRIMINATING SENSOR.
- MEASURE RESISTANCE OF PASSENGER COMPARTMENT DISCRIMINATING SENSOR FROM TERMINAL "A" TO TERMINAL "C". IS RESISTANCE LESS THAN 8.36 kΩ?

REPLACE FORWARD DISCRIMINATING SENSOR.

NO

YES

5
- DISCONNECT CONNECTOR C200B FROM CONNECTOR C200D.
- MEASURE RESISTANCE ON PASSENGER COMPARTMENT DISCRIMINATING SENSOR HARNESS CONNECTOR FROM TERMINAL "A" TO TERMINAL "C" (GROUND). DOES J 39200 DISPLAY "OL" (INFINITE)?

REPLACE PASSENGER COMPARTMENT DISCRIMINATING SENSOR.

NO

YES

6
- RECONNECT CONNECTOR C200B TO CONNECTOR C200D.
- DISCONNECT DERM.
- CHECK FOR PROPER CONNECTION TO DERM AT TERMINALS "A3" AND "A4".
- IF OK, THEN MEASURE RESISTANCE ON DERM HARNESS CONNECTOR FROM TERMINAL "B8" TO TERMINAL "A1" (GROUND). DOES J 39200 DISPLAY "OL" (INFINITE)?

REPAIR SHORT FROM CKT 348F OR CKT 348G TO GROUND.

NO

YES

7
- MEASURE RESISTANCE ON DERM HARNESS CONNECTOR FROM TERMINAL "B9" TO TERMINAL "A1" (GROUND). DOES J 39200 DISPLAY "OL" (INFINITE)?

REPAIR SHORT FROM CKT 348A, 348B, 348C OR 348E TO GROUND.

NO

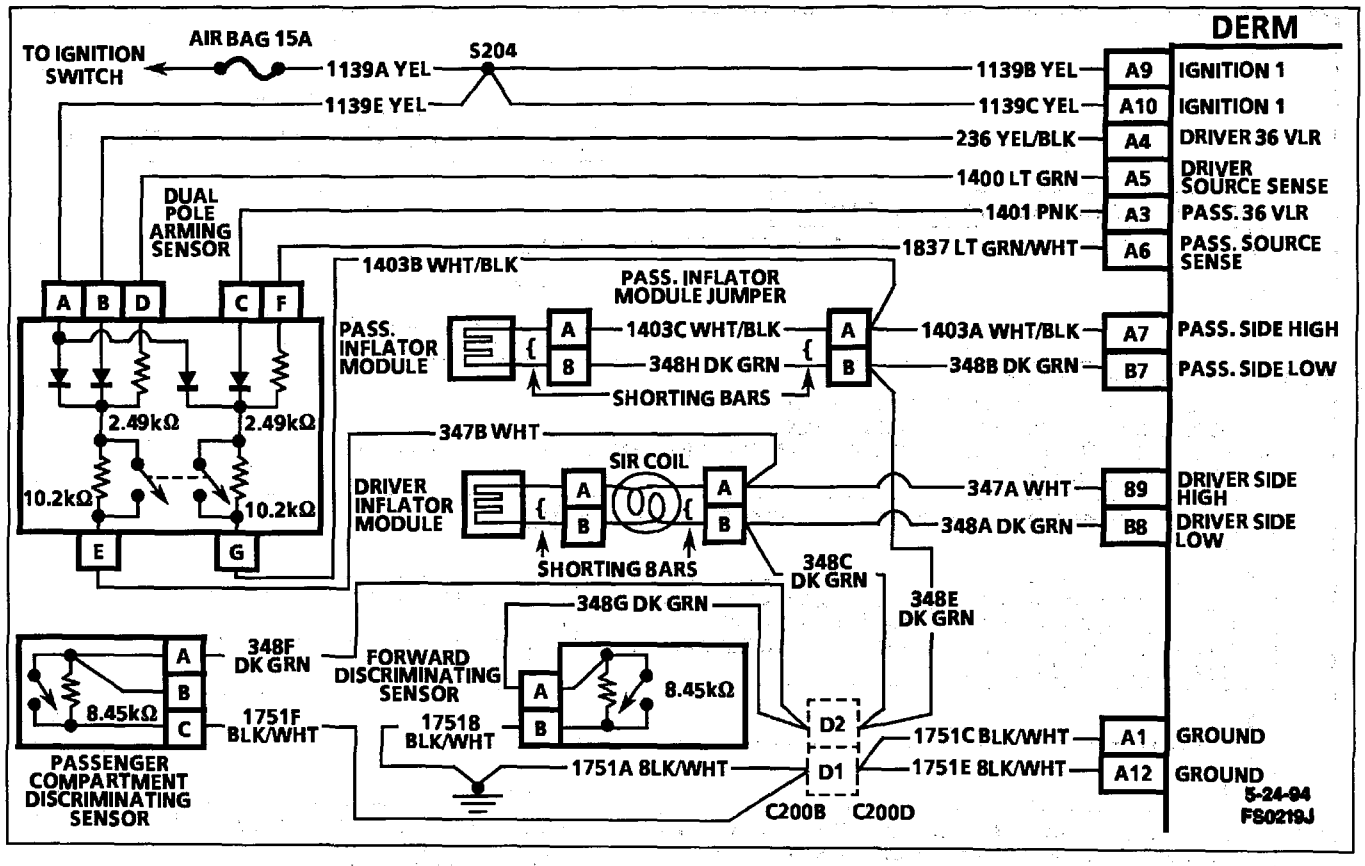
YES

CONTINUE WITH DIAGNOSIS ON NEXT PAGE.

REPAIR SHORT FROM CKT 347 TO GROUND.

- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

C3657S



DTC 24 - (Page 3 of 3)
INITIATOR CIRCUIT VOLTAGE LOW

Circuit Description:

During normal, non-deployment operation of the SIR system, a small amount of current flows through both the driver and passenger deployment loops. The diagnostic resistors within the dual pole arming sensor and the discriminating sensors along with the resistance of the inflator modules cause voltage drops within the deployment loops. The DERM monitors the voltages at "Driver Side Low" terminal "B8" and "Passenger Side Low" terminal "B7" to detect shorts or opens within the deployment loops. When the measured voltage at terminal "B8" or "B7" is below a specified percentage of its respective 36 VLR for 500 milliseconds DTC 24 is set.

DTC Will Set When:

The voltage measured at "Driver Side Low" terminal "B8" is below a specified percentage of "Driver 36 VLR" or when the voltage measured at "Passenger Side Low" terminal "B7" is below a specified percentage of "Passenger 36 VLR" for 500 milliseconds. This test is run during the "Continuous Monitoring" test.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage measured at "Driver Side Low" terminal "B8" is within a specified percentage of "Driver 36 VLR" and the voltage measured at "Passenger Side Low" terminal "B7" is within a specified percentage of "Passenger 36 VLR" for 500 milliseconds.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

8. This test determines whether the malfunction is a short from the high side of the passenger deployment loop to ground.

9. This test checks for an open in the driver deployment loop diagnostic resistor of the dual pole arming sensor.

10. This test checks for an open in the passenger deployment loop diagnostic resistor of the dual pole arming sensor.

11. This test checks for high resistance in the "Driver 36 VLR" circuit.

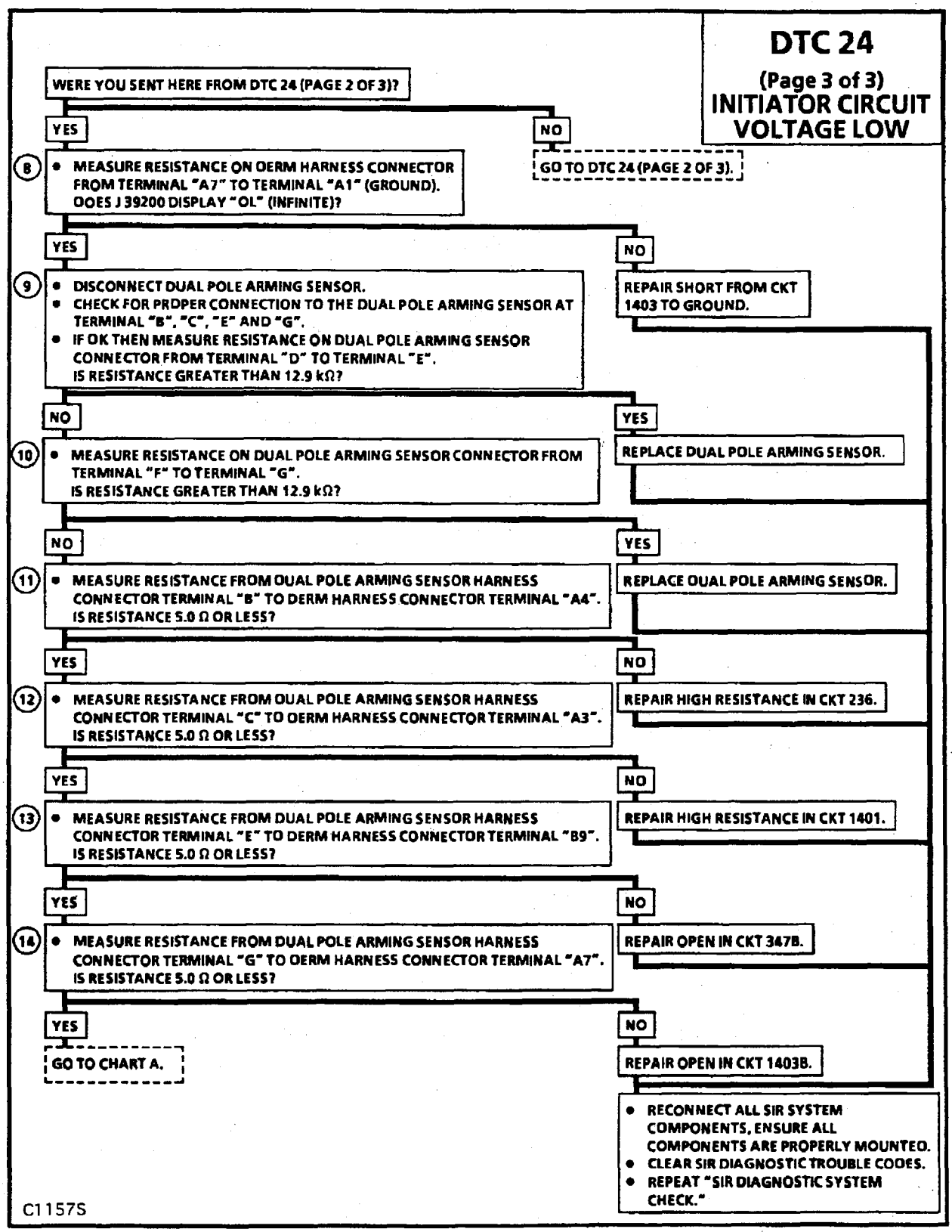
12. This test checks for high resistance in the "Passenger 36 VLR" circuit.

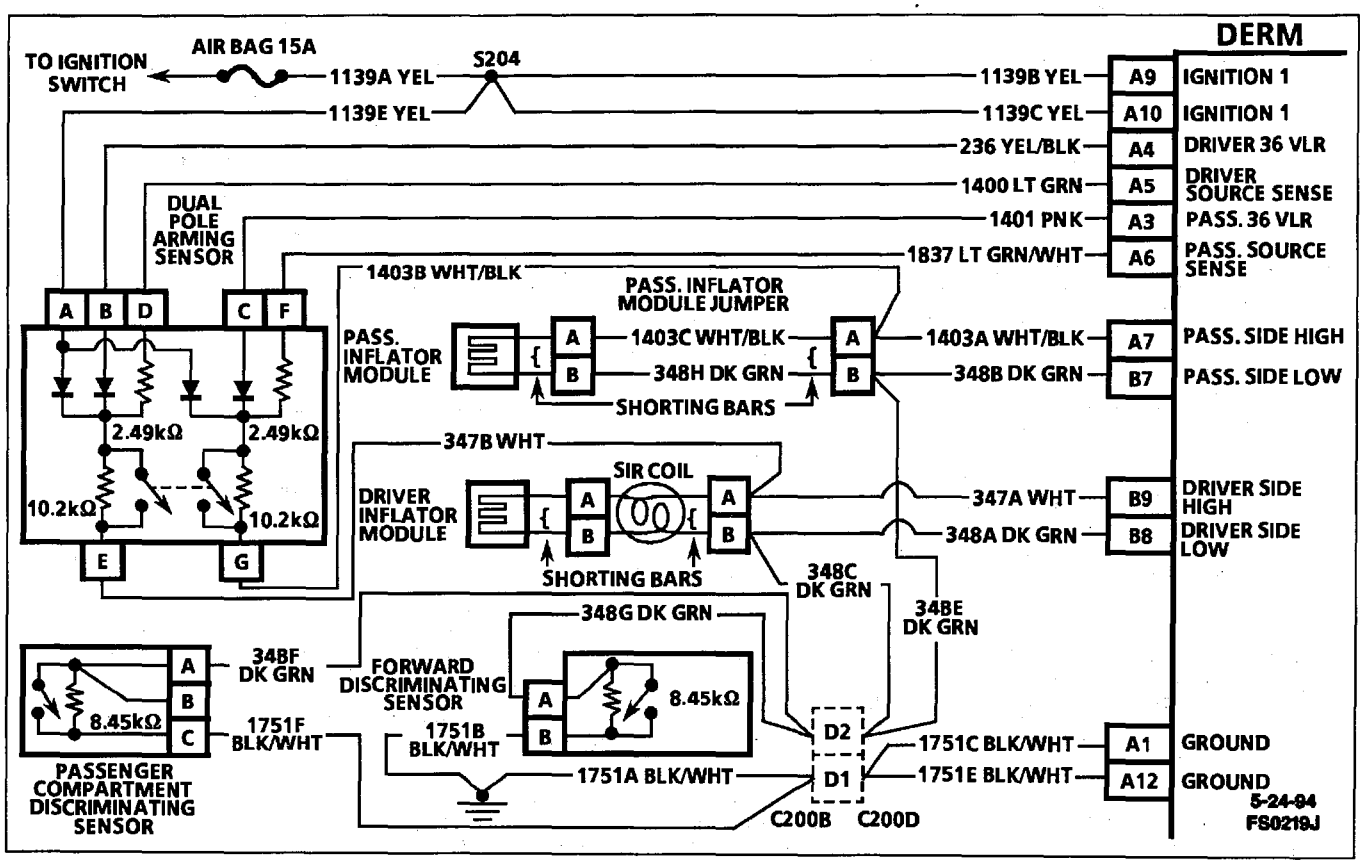
13. This test checks for an open in the high side of the driver deployment loop.

14. This test checks for an open in the high side of the passenger deployment loop.

Diagnostic Aids:

Refer to DTC 24 (Page 1 of 3).


DTC 24
(Page 3 of 3)
INITIATOR CIRCUIT VOLTAGE LOW
WERE YOU SENT HERE FROM DTC 24 (PAGE 2 OF 3)?
YES
NO
GO TO DTC 24 (PAGE 2 OF 3).
8
• MEASURE RESISTANCE ON OERM HARNESS CONNECTOR FROM TERMINAL "A7" TO TERMINAL "A1" (GROUND). DOES J 39200 DISPLAY "OL" (INFINITE)?
YES
NO
REPAIR SHORT FROM CKT 1403 TO GROUND.
9
• DISCONNECT DUAL POLE ARMING SENSOR.
• CHECK FOR PROPER CONNECTION TO THE DUAL POLE ARMING SENSOR AT TERMINAL "B", "C", "E" AND "G".
• IF OK THEN MEASURE RESISTANCE ON DUAL POLE ARMING SENSOR CONNECTOR FROM TERMINAL "D" TO TERMINAL "E". IS RESISTANCE GREATER THAN 12.9 kΩ?
NO
YES
REPLACE DUAL POLE ARMING SENSOR.
10
• MEASURE RESISTANCE ON DUAL POLE ARMING SENSOR CONNECTOR FROM TERMINAL "F" TO TERMINAL "G". IS RESISTANCE GREATER THAN 12.9 kΩ?
NO
YES
REPLACE DUAL POLE ARMING SENSOR.
11
• MEASURE RESISTANCE FROM DUAL POLE ARMING SENSOR HARNESS CONNECTOR TERMINAL "B" TO OERM HARNESS CONNECTOR TERMINAL "A4". IS RESISTANCE 5.0 Ω OR LESS?
YES
NO
REPAIR HIGH RESISTANCE IN CKT 236.
12
• MEASURE RESISTANCE FROM DUAL POLE ARMING SENSOR HARNESS CONNECTOR TERMINAL "C" TO OERM HARNESS CONNECTOR TERMINAL "A3". IS RESISTANCE 5.0 Ω OR LESS?
YES
NO
REPAIR HIGH RESISTANCE IN CKT 1401.
13
• MEASURE RESISTANCE FROM DUAL POLE ARMING SENSOR HARNESS CONNECTOR TERMINAL "E" TO OERM HARNESS CONNECTOR TERMINAL "B9". IS RESISTANCE 5.0 Ω OR LESS?
YES
NO
REPAIR OPEN IN CKT 347B.
14
• MEASURE RESISTANCE FROM DUAL POLE ARMING SENSOR HARNESS CONNECTOR TERMINAL "G" TO OERM HARNESS CONNECTOR TERMINAL "A7". IS RESISTANCE 5.0 Ω OR LESS?
YES
NO
GO TO CHART A.
REPAIR OPEN IN CKT 1403B.
• RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
• CLEAR SIR DIAGNOSTIC TROUBLE CODES.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
C1157S



DTC 25 - (Page 1 of 2)
INITIATOR CIRCUIT SHORT TO IGNITION

Circuit Description:

During the "Initiator Assembly Resistance Test" the DERM grounds the "Driver Side Low" terminal "B8" and measures the voltage at "Driver Side Low" and "Passenger Side Low." The DERM then grounds "Passenger Side Low" terminal "B7" and again measures the voltage at "Driver Side Low" and "Passenger Side Low." For a properly operating circuit the voltage measurements during each of these tests will be below a specified value. When the voltages measured at both "Driver Side Low" and "Passenger Side Low" are above a specified value during both tests DTC 25 is set.

DTC Will Set When:

The voltages measured at both "Driver Side Low" and "Passenger Side Low" are above a specified value while the DERM attempts to ground each of these terminals. This test is run during the "Initiator Assembly Resistance Test" and the "10 Minute Loop Test" when: 1) No "higher priority faults" are detected during "Turn-ON," 2) No "higher priority faults" are detected during "Continuous Monitoring" for one second, 3) No "Crank" signal present, 4) "Ignition 1" voltage is above a specified value.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage measured at either "Driver Side Low" or "Passenger Side Low" is below a specified value while the DERM grounds either of these terminals.

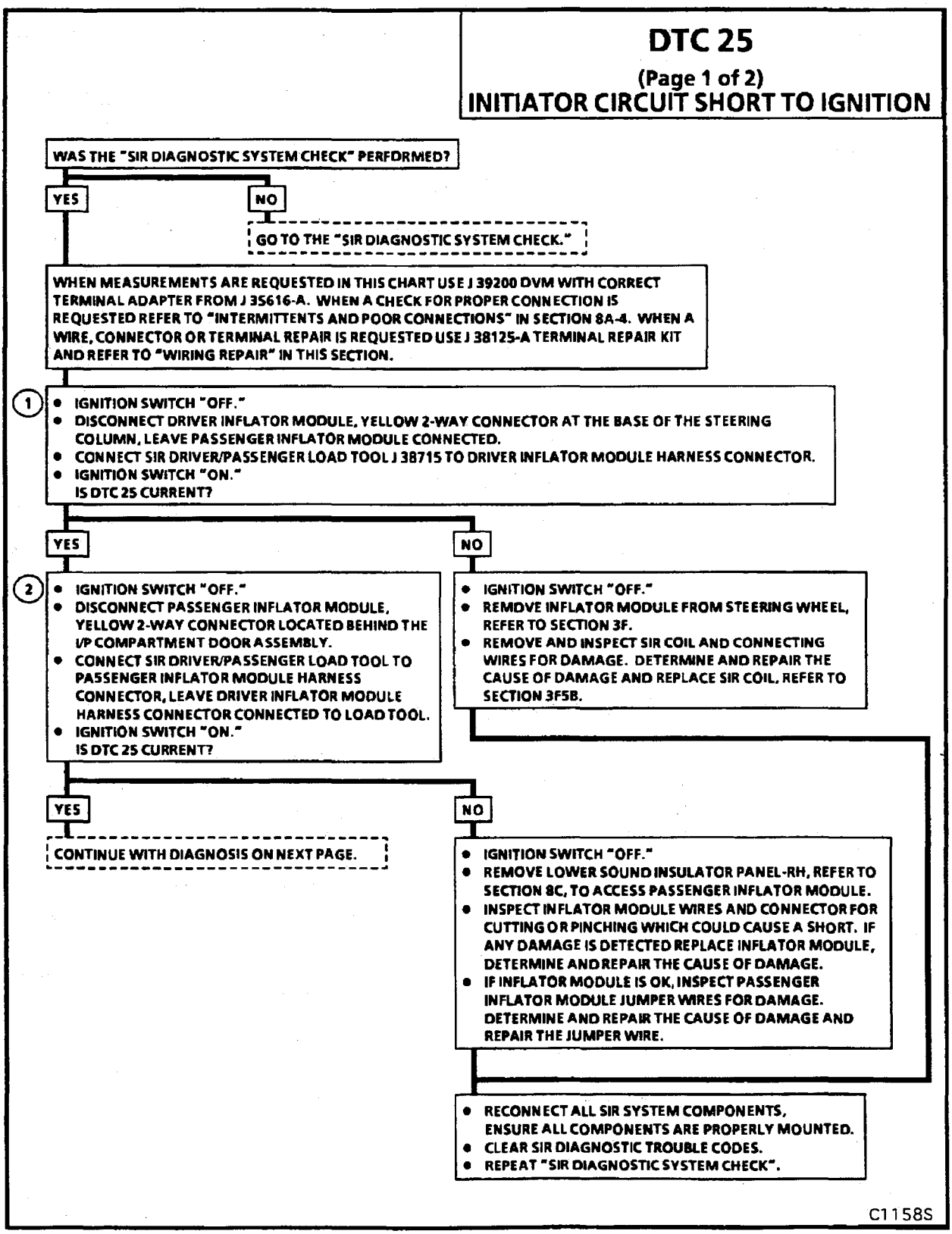
DTC Chart Test Description:

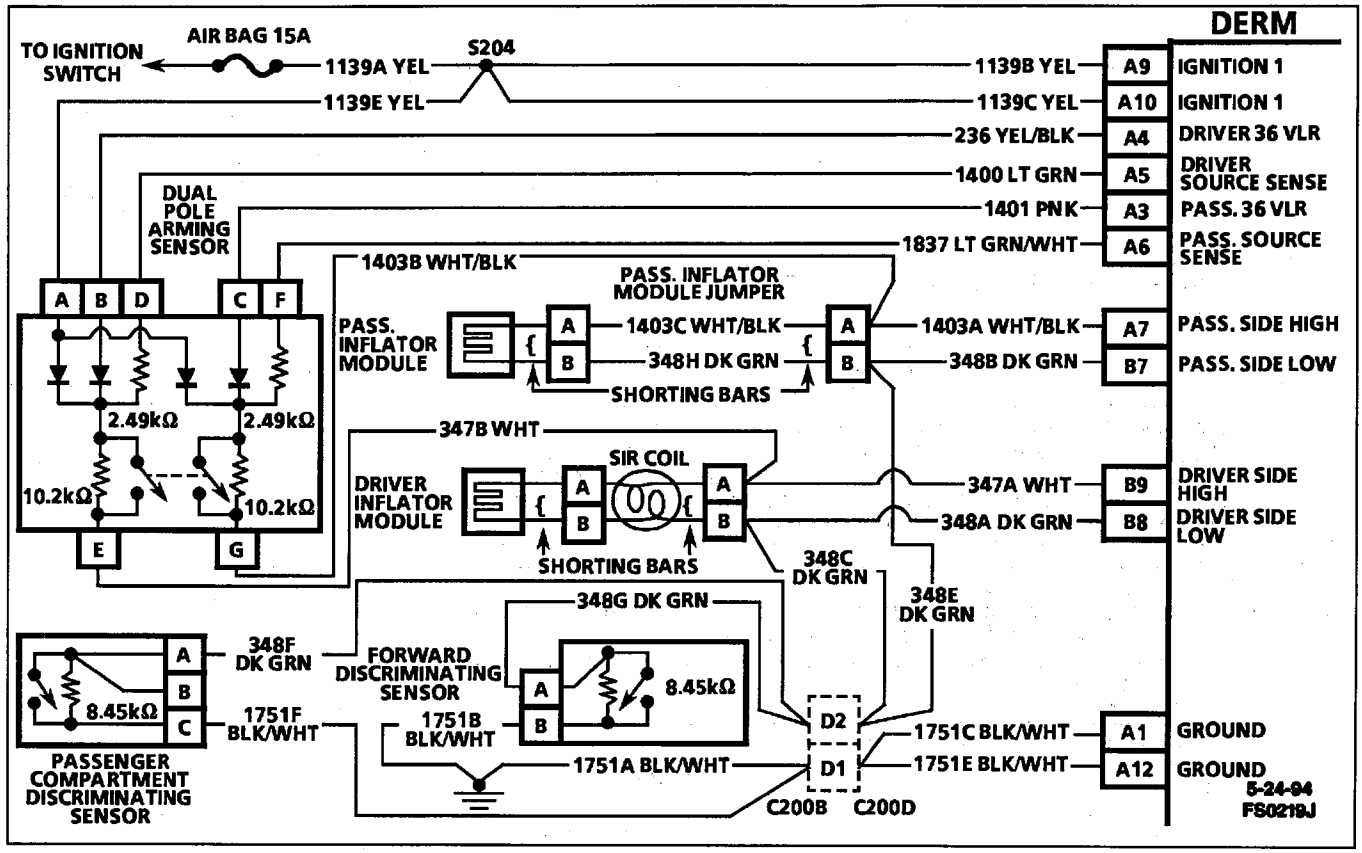
Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test determines whether the malfunction is occurring in the steering column circuitry.
2. This test determines whether the malfunction is occurring in the passenger inflator module circuitry.

Diagnostic Aids:

Refer to DTC 25 (Page 2 of 2).


DTC 25
(Page 1 of 2)
INITIATOR CIRCUIT SHORT TO IGNITION
WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?
YES
NO
GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."
WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.
1
• IGNITION SWITCH "OFF."
• DISCONNECT DRIVER INFLATOR MODULE, YELLOW 2-WAY CONNECTOR AT THE BASE OF THE STEERING COLUMN, LEAVE PASSENGER INFLATOR MODULE CONNECTED.
• CONNECT SIR DRIVER/PASSENGER LOAD TOOL J 38715 TO DRIVER INFLATOR MODULE HARNESS CONNECTOR.
• IGNITION SWITCH "ON."
IS DTC 25 CURRENT?
YES
NO
2
• IGNITION SWITCH "OFF."
• DISCONNECT PASSENGER INFLATOR MODULE, YELLOW 2-WAY CONNECTOR LOCATED BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
• CONNECT SIR DRIVER/PASSENGER LOAD TOOL TO PASSENGER INFLATOR MODULE HARNESS CONNECTOR, LEAVE DRIVER INFLATOR MODULE HARNESS CONNECTOR CONNECTED TO LOAD TOOL.
• IGNITION SWITCH "ON."
IS DTC 25 CURRENT?
• IGNITION SWITCH "OFF."
• REMOVE INFLATOR MODULE FROM STEERING WHEEL, REFER TO SECTION 3F.
• REMOVE AND INSPECT SIR COIL AND CONNECTING WIRES FOR DAMAGE. DETERMINE AND REPAIR THE CAUSE OF DAMAGE AND REPLACE SIR COIL, REFER TO SECTION 3F5B.
YES
NO
CONTINUE WITH DIAGNOSIS ON NEXT PAGE.
• IGNITION SWITCH "OFF."
• REMOVE LOWER SOUND INSULATOR PANEL-RH, REFER TO SECTION 8C, TO ACCESS PASSENGER INFLATOR MODULE.
• INSPECT INFLATOR MODULE WIRES AND CONNECTOR FOR CUTTING OR PINCHING WHICH COULD CAUSE A SHORT. IF ANY DAMAGE IS DETECTED REPLACE INFLATOR MODULE, DETERMINE AND REPAIR THE CAUSE OF DAMAGE.
• IF INFLATOR MODULE IS OK, INSPECT PASSENGER INFLATOR MODULE JUMPER WIRES FOR DAMAGE. DETERMINE AND REPAIR THE CAUSE OF DAMAGE AND REPAIR THE JUMPER WIRE.
• RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
• CLEAR SIR DIAGNOSTIC TROUBLE CODES.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK".
C1158S



DTC 25 - (Page 2 of 2)
INITIATOR CIRCUIT SHORT TO IGNITION

Circuit Description:

During the "Initiator Assembly Resistance Test" the DERM grounds the "Driver Side Low" terminal "B8" and measures the voltage at "Driver Side Low" and "Passenger Side Low." The DERM then grounds "Passenger Side Low" terminal "B7" and again measures the voltage at "Driver Side Low" and "Passenger Side Low." For a properly operating circuit the voltage measurements during each of these tests will be below a specified value. When the voltages measured at both "Driver Side Low" and "Passenger Side Low" are above a specified value during both tests DTC 25 is set.

DTC Will Set When:

The voltages measured at both "Driver Side Low" and "Passenger Side Low" are above a specified value while the DERM attempts to ground each of these terminals. This test is run during the "Initiator Assembly Resistance Test" and the "10 Minute Loop Test" when: 1) No "higher priority faults" are detected during "Turn-ON," 2) No "higher priority faults" are detected during "Continuous Monitoring" for one second, 3) No "Crank" signal present, 4) "Ignition 1" voltage is above a specified value.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage measured at either "Driver Side Low" or "Passenger Side Low" is below a specified value while the DERM grounds either of these terminals.

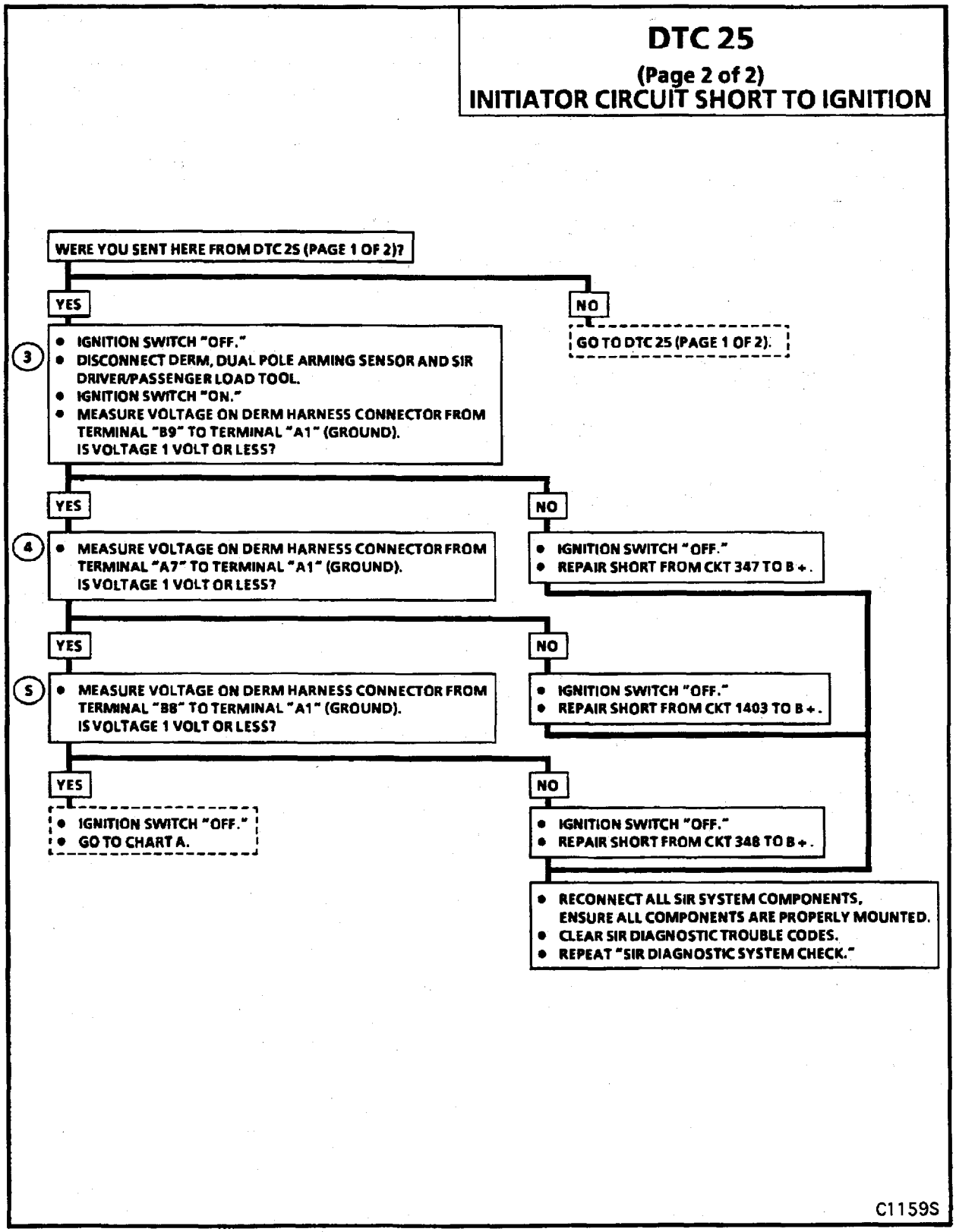
DTC Chart Test Description:

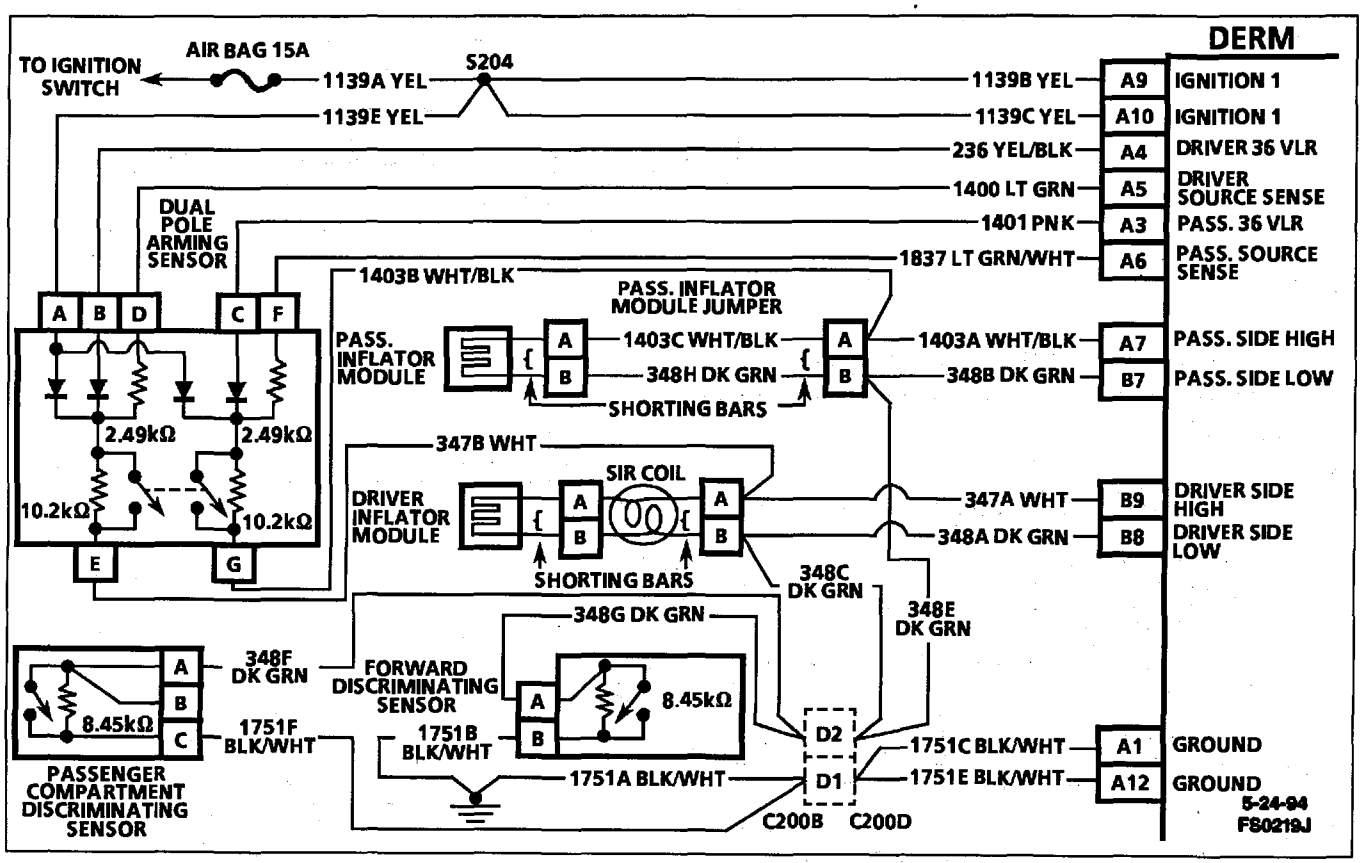
Number(s) below refer to circled number(s) on the diagnostic chart.

3. This test checks for a short from the high side of the driver deployment loop to B+.
4. This test checks for a short from the high side of the passenger deployment loop to B+.
5. This test checks for a short from the low side of the driver deployment loop or passenger deployment loop to B+.

Diagnostic Aids:

This DTC can only be set when the malfunction is present as the ignition switch is turned "ON." After the "Initiator Assembly Resistance Test" is completed a short to B+ in the steering column, CKT 347, CKT 348 or CKT 1403 will cause DTC 24 to set. When a scan tool "Clear Codes" command is issued and the malfunction is still present, the DTC will not reappear for ten minutes or until the next ignition cycle.


DTC 25
(Page 2 of 2)
INITIATOR CIRCUIT SHORT TO IGNITION
WERE YOU SENT HERE FROM DTC 25 (PAGE 1 OF 2)?
YES
NO
GO TO DTC 25 (PAGE 1 OF 2).
3
IGNITION SWITCH "OFF."
DISCONNECT DERM, DUAL POLE ARMING SENSOR AND SIR DRIVER/PASSENGER LOAD TOOL.
IGNITION SWITCH "ON."
MEASURE VOLTAGE ON DERM HARNESS CONNECTOR FROM TERMINAL "B9" TO TERMINAL "A1" (GROUND). IS VOLTAGE 1 VOLT OR LESS?
YES
NO
4
MEASURE VOLTAGE ON DERM HARNESS CONNECTOR FROM TERMINAL "A7" TO TERMINAL "A1" (GROUND). IS VOLTAGE 1 VOLT OR LESS?
IGNITION SWITCH "OFF."
REPAIR SHORT FROM CKT 347 TO B+.
YES
NO
5
MEASURE VOLTAGE ON DERM HARNESS CONNECTOR FROM TERMINAL "B8" TO TERMINAL "A1" (GROUND). IS VOLTAGE 1 VOLT OR LESS?
IGNITION SWITCH "OFF."
REPAIR SHORT FROM CKT 1403 TO B+.
YES
NO
IGNITION SWITCH "OFF."
GO TO CHART A.
IGNITION SWITCH "OFF."
REPAIR SHORT FROM CKT 348 TO B+.
RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
CLEAR SIR DIAGNOSTIC TROUBLE CODES.
REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
C1159S



DTC 26
DRIVER INITIATOR CIRCUIT OPEN

Circuit Description:

When there is an open in the driver inflator module or the SIR coil assembly the resistance between "Driver Side High" terminal "B9" and "Driver Side Low" terminal "B8" increases. This causes a larger voltage drop from the "Driver Side High" to the "Driver Side Low" across a resistor inside the DERM which connects these two terminals together. The increase in the voltage difference between "Driver Side High" and "Driver Side Low" is detected by the DERM during the "Continuous Monitoring" tests and DTC 26 is set.

DTC Will Set When:

The voltage difference between "Driver Side High" terminal "B9" and "Driver Side Low" terminal "B8" is above or equal to a specified value for 500 milliseconds.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage difference between "Driver Side High" terminal "B9" and "Driver Side Low" terminal "B8" is below a specified value for 500 milliseconds.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks whether the DERM has set the diagnostic trouble code falsely.
2. This test determines whether the malfunction is in the driver inflator module or the SIR coil assembly.

Diagnostic Aids:

This diagnostic trouble code will only set when there is an improper connection of either the yellow 2-way connector near the base of the steering column or the yellow 2-way connector at the top of the steering column, an open SIR coil assembly or an open driver inflator module.

DTC 26
DRIVER INITIATOR CIRCUIT OPEN

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

NO

GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

1

- IGNITION SWITCH "OFF."
- DISCONNECT DRIVER AND PASSENGER INFLATOR MOODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
- CHECK FOR PROPER CONNECTION TO STEERING COLUMN CONNECTOR AT TERMINALS "A" AND "B".
- IF OK THEN CONNECT J 38715 SIR DRIVER/PASSENGER LOAD TOOL TO STEERING COLUMN HARNESS CONNECTOR.
- IGNITION SWITCH "ON."

IS DTC 26 CURRENT? (DTC 17 WILL BE CURRENT DUE TO DISCONNECTED PASSENGER INFLATOR MODULE).

NO

YES

- IGNITION SWITCH "OFF."
- GO TO CHART A.

2

- IGNITION SWITCH "OFF."
- DISCONNECT SIR DRIVER/PASSENGER LOAD TOOL.
- REMOVE DRIVER INFLATOR MODULE FROM STEERING WHEEL, REFER TO SECTION 3F.
- CONNECT SIR DRIVER/PASSENGER LOAD TOOL TO INFLATOR MODULE CONNECTOR ON STEERING COLUMN.
- RECONNECT STEERING COLUMN CONNECTOR TO STEERING COLUMN HARNESS CONNECTOR.
- IGNITION SWITCH "ON."

IS DTC 26 CURRENT? (DTC 17 WILL BE CURRENT DUE TO DISCONNECTED PASSENGER INFLATOR MODULE).

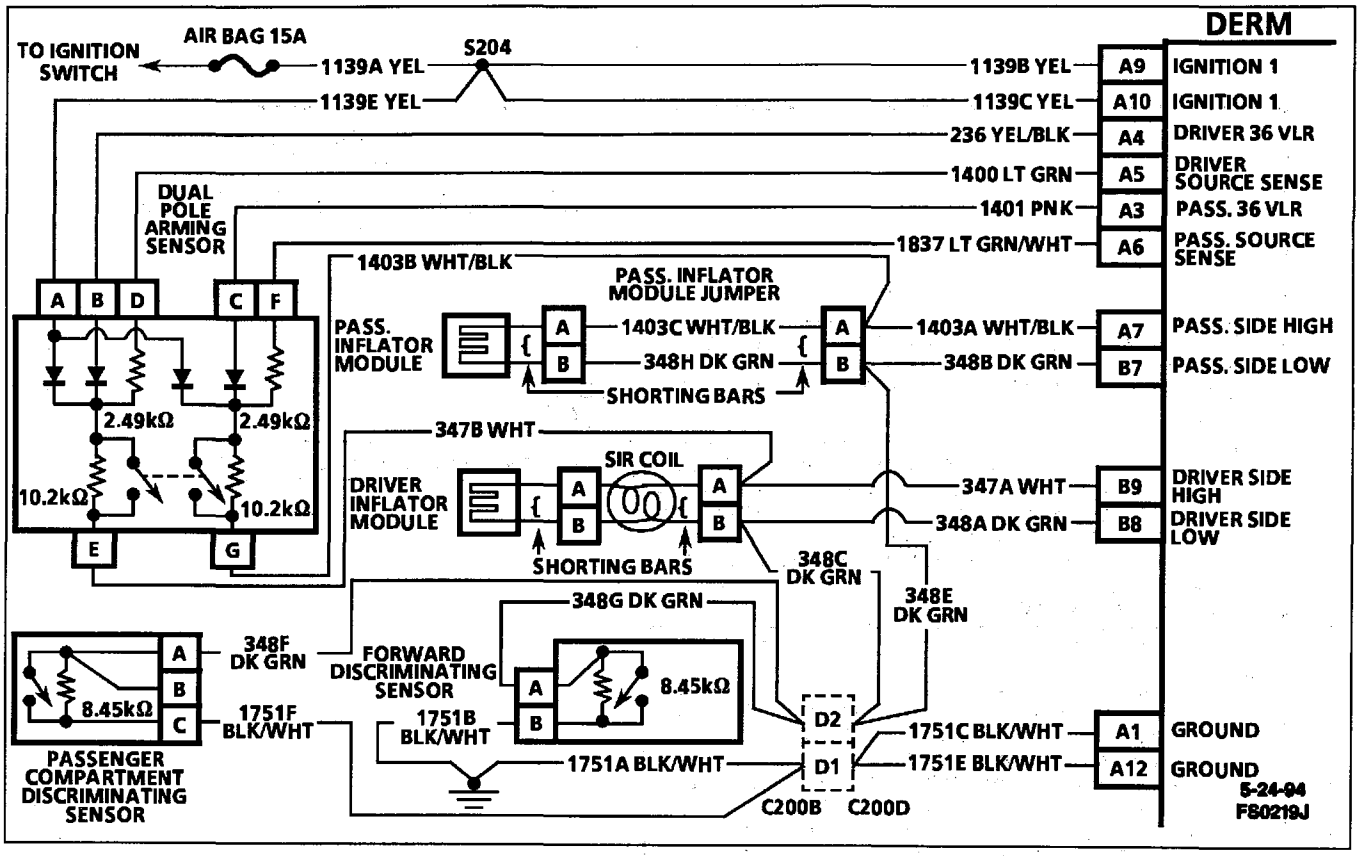
NO

- IGNITION SWITCH "OFF."
- REPLACE DRIVER INFLATOR MODULE, REFER TO SECTION 3F.
- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

YES

- IGNITION SWITCH "OFF."
- REPLACE SIR COIL ASSEMBLY, REFER TO SECTION 3F5B.
- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

C1160S



DTC 28
CURRENT SINK OR SOURCE FAILURE

Circuit Description:

During the "Initiator Assembly Resistance Test" the DERM grounds the "Passenger Side Low" terminal "B7" and turns "ON" the driver current source at the "Driver Side High" terminal "B9". The DERM then grounds the "Driver Side Low" terminal "B8" and turns "ON" the passenger current source at the "Passenger Side High" terminal "A7". During each of these tests the DERM monitors voltage at "Driver Side Low," "Passenger Side Low," the difference between "Driver Side High" and "Driver Side Low" and the difference between "Passenger Side High" and "Passenger Side Low." When the measured values are outside the expected range DTC 28 is set.

DTC Will Set When:

The voltage measured at "Driver Side Low" or "Passenger Side Low" is below a specified value while its respective initiator resistance is in range or when the voltage measured at "Driver Side Low" or "Passenger Side Low" is above a specified value. This test is run once each ignition cycle during the "Initiator Assembly Resistance Test" when: 1) No "higher priority faults" are detected during "Turn-ON," 2) No "higher priority faults" are detected during "Continuous Monitoring" for one second, 3) No "Crank" signal present, 4) "Ignition 1" voltage is above a specified value.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The ignition switch is turned "OFF."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks whether the malfunction is in the wiring harness. The wiring harness malfunction would be a high resistance rather than an open. An open would set a different DTC.
2. This test checks whether the malfunction is in the wiring harness. The wiring harness malfunction would be a high resistance rather than an open. An open would set a different DTC.

Diagnostic Aids:

An intermittent condition is likely to be caused by a poor wire to terminal connection in CKT 348C or 348E. When a scan tool "Clear Codes" command is issued and the malfunction is still present, the DTC will not reappear for ten minutes or until the next ignition cycle.

DTC 28
CURRENT SINK OR SOURCE FAILURE

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

NO

GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

1
- IGNITION SWITCH "OFF."
- DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
- DISCONNECT CONNECTOR C200B FROM CONNECTOR C200D.
- MEASURE RESISTANCE FROM C200D TERMINAL "D2" TO STEERING COLUMN HARNESS CONNECTOR TERMINAL "B".

IS RESISTANCE 5.0 Ω OR LESS?

YES

2
- MEASURE RESISTANCE FROM C200D TERMINAL "D2" TO PASSENGER INFLATOR MODULE HARNESS CONNECTOR TERMINAL "B".

IS RESISTANCE 5.0 Ω OR LESS?

YES.

GO TO CHART A.

NO

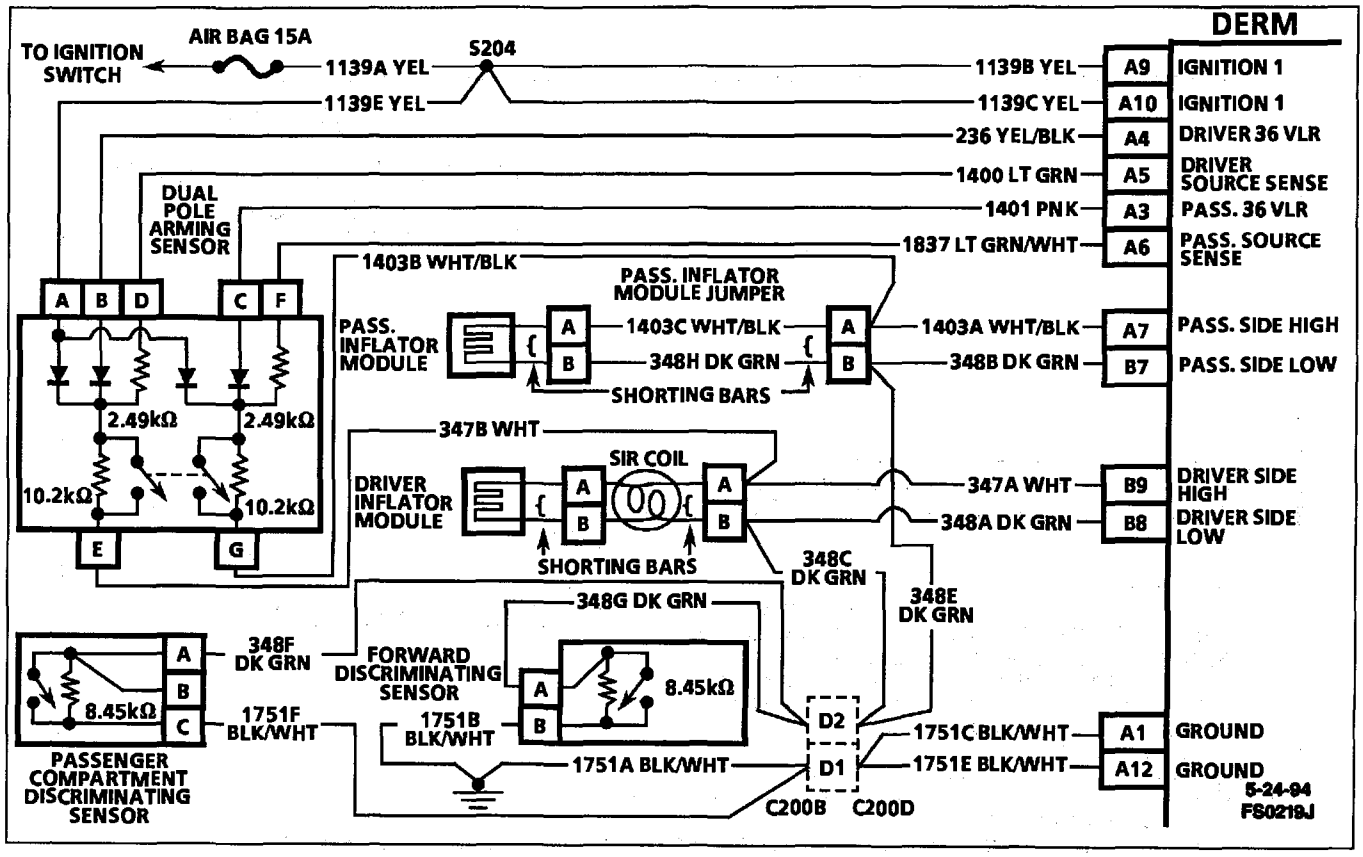
REPAIR HIGH RESISTANCE IN CKT 348C.

NO

REPAIR HIGH RESISTANCE IN CKT 348E.

- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

C1161S



DTC 31
DRIVER LOOP ENERGY RESERVE FEED OPEN

Circuit Description:

During the "Continuous Monitoring" tests the DERM monitors the voltage at "Driver Source Sense" terminal "A5." When the circuit is operating normally the measured voltage will be slightly less than "Driver 36 VLR." If the "Driver 36 VLR" circuit opens the voltage measured at "Driver Source Sense" will decrease to slightly less than "Ignition 1" voltage. When the voltage measured at "Driver Source Sense" is within a specified range of "Ignition 1" for 500 milliseconds DTC 31 is set.

DTC Will Set When:

The voltage measured at "Driver Source Sense" terminal "A5" is within a specified range of "Ignition 1" for 500 milliseconds. This test is run every 100 milliseconds during "Continuous Monitoring" tests.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage measured at "Driver Source Sense" terminal "A5" is outside the specified range of "Ignition 1" which sets the diagnostic trouble code, for 500 milliseconds.

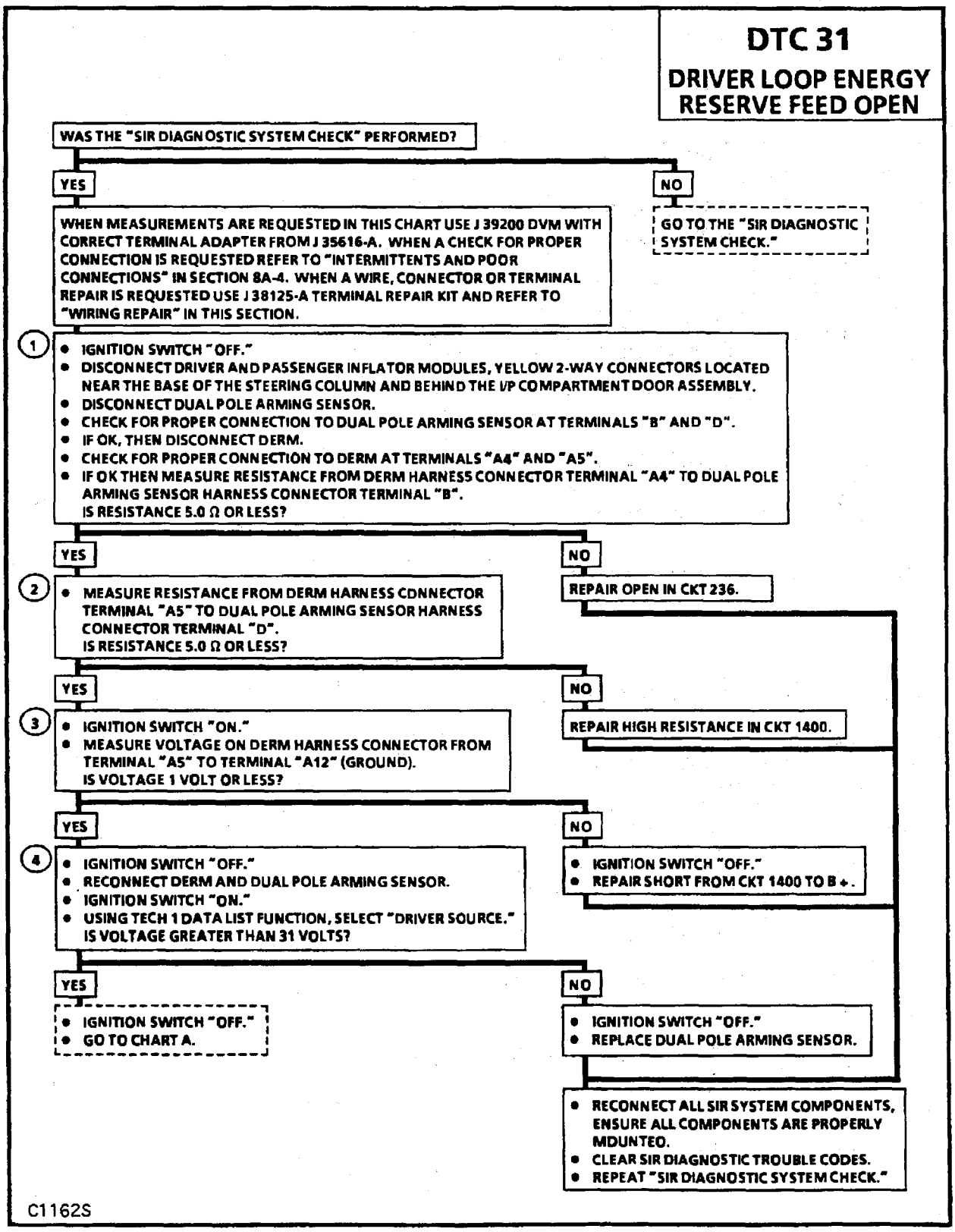
DTC Chart Test Description:

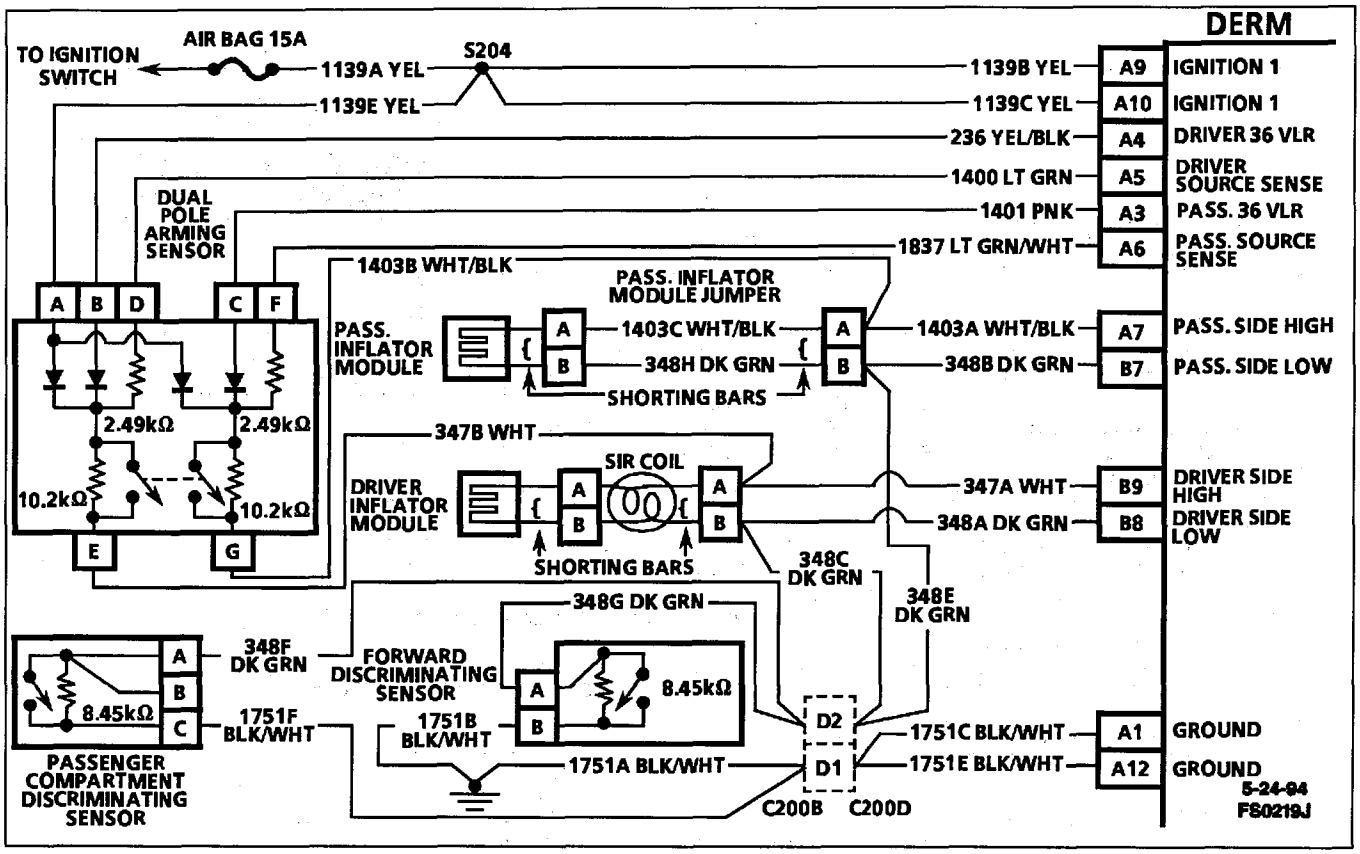
Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for an open in the "Driver 36 VLR" circuit.
2. This test checks for high resistance, but not an open, in the "Driver Source Sense" circuit.
3. This test checks for a short from the "Driver Source Sense" circuit to B+.
4. This test determines whether the malfunction is due to the dual pole arming sensor.

Diagnostic Aids:

An intermittent condition is likely to be caused by a poor connection at dual pole arming sensor terminal "B" or "D", poor connection at DERM terminal "A4" or "A5", an open in CKT 236 or CKT 1400, or a malfunctioning dual pole arming sensor.


DTC 31
DRIVER LOOP ENERGY RESERVE FEED OPEN
WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?
YES
NO
GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."
WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.
1
• IGNITION SWITCH "OFF."
• DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
• DISCONNECT DUAL POLE ARMING SENSOR.
• CHECK FOR PROPER CONNECTION TO DUAL POLE ARMING SENSOR AT TERMINALS "B" AND "D".
• IF OK, THEN DISCONNECT DERM.
• CHECK FOR PROPER CONNECTION TO DERM AT TERMINALS "A4" AND "A5".
• IF OK THEN MEASURE RESISTANCE FROM DERM HARNESS CONNECTOR TERMINAL "A4" TO DUAL POLE ARMING SENSOR HARNESS CONNECTOR TERMINAL "B".
IS RESISTANCE 5.0 Ω OR LESS?
YES
NO
REPAIR OPEN IN CKT 236.
2
• MEASURE RESISTANCE FROM DERM HARNESS CONNECTOR TERMINAL "A5" TO DUAL POLE ARMING SENSOR HARNESS CONNECTOR TERMINAL "D".
IS RESISTANCE 5.0 Ω OR LESS?
YES
NO
REPAIR HIGH RESISTANCE IN CKT 1400.
3
• IGNITION SWITCH "ON."
• MEASURE VOLTAGE ON DERM HARNESS CONNECTOR FROM TERMINAL "A5" TO TERMINAL "A12" (GROUND).
IS VOLTAGE 1 VOLT OR LESS?
YES
NO
• IGNITION SWITCH "OFF."
• REPAIR SHORT FROM CKT 1400 TO B+.
4
• IGNITION SWITCH "OFF."
• RECONNECT DERM AND DUAL POLE ARMING SENSOR.
• IGNITION SWITCH "ON."
• USING TECH 1 DATA LIST FUNCTION, SELECT "DRIVER SOURCE."
IS VOLTAGE GREATER THAN 31 VOLTS?
YES
NO
• IGNITION SWITCH "OFF."
• GO TO CHART A.
• IGNITION SWITCH "OFF."
• REPLACE DUAL POLE ARMING SENSOR.
• RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
• CLEAR SIR DIAGNOSTIC TROUBLE CODES.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
C1162S



DTC 34

DUAL POLE ARMING SENSOR IGNITION FEED OPEN

Circuit Description:

During the "Turn-ON" tests, performed at the beginning of each ignition cycle, the DERM delays the charging of the "Driver 36 VLR" and "Passenger 36 VLR" power supplies. While the delay is active the DERM measures the voltage at the "Driver 36 VLR" terminal "A4", "Passenger 36 VLR" terminal "A3", "Driver Source Sense" terminal "A5", and "Passenger Source Sense" terminal "A6". When the voltage measured at the two "36 VLR" power supplies indicates they are in a discharged state and the voltage measured at each "Source Sense" terminal is a specified amount below "Ignition 1" voltage DTC 34 is set.

DTC Will Set When:

With both "36 VLR" power supplies in a discharged state, the voltage measured at "Driver Source Sense" terminal "A5" and "Passenger Source Sense" terminal "A6" are simultaneously a specified amount below "Ignition 1" voltage and no "higher priority faults" are detected. This test is run once each ignition cycle during the "Turn-ON" tests while the "36 VLR Delay" is active.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

With both "36 VLR" power supplies in a discharged state, the voltage measured at "Driver Source Sense" terminal "A5" and "Passenger Source Sense" terminal "A6" are simultaneously within specified range of "Ignition 1" voltage. When neither the failure nor clear conditions are met, the state of the diagnostic trouble code from the previous ignition cycle is used.

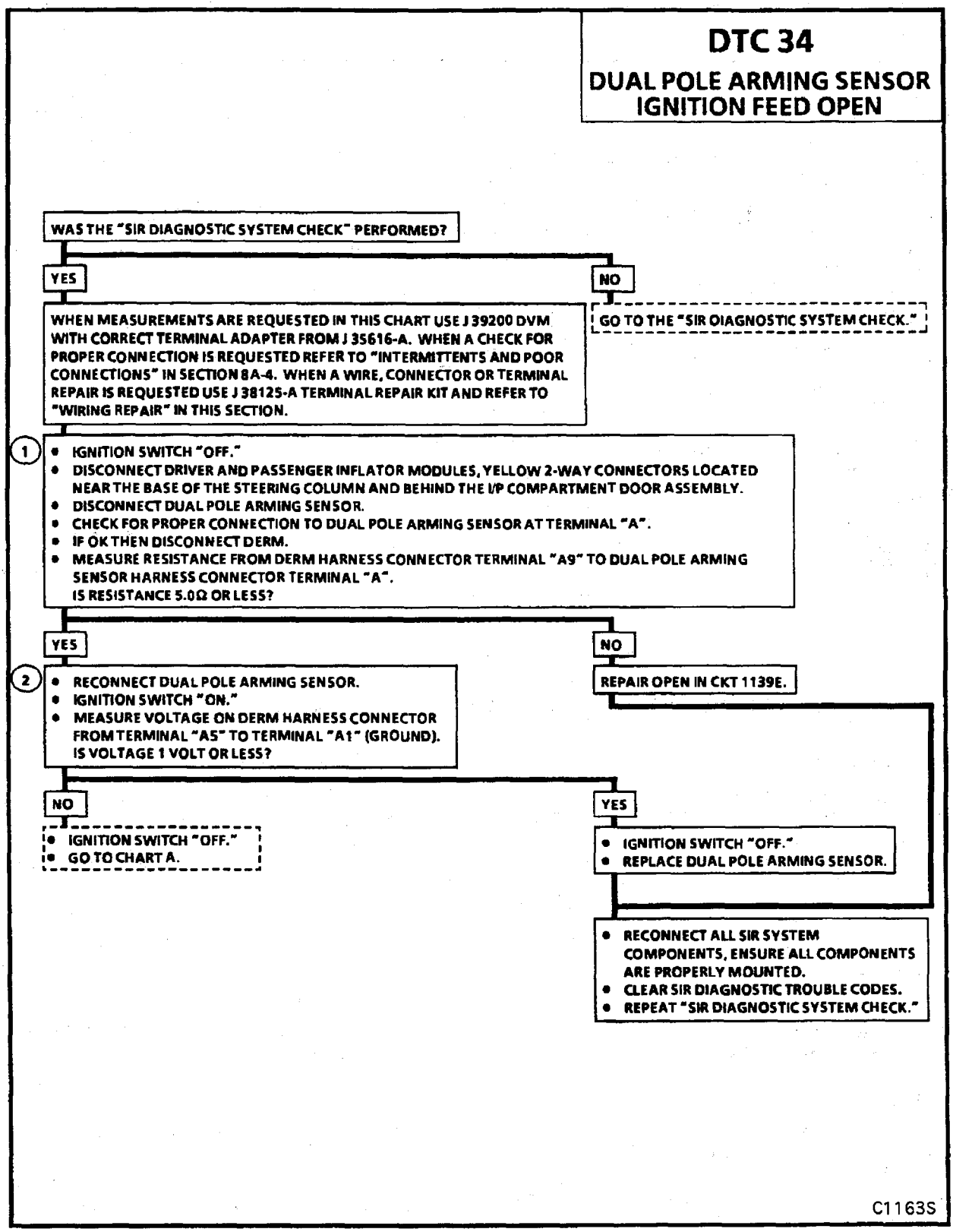
DTC Chart Test Description:

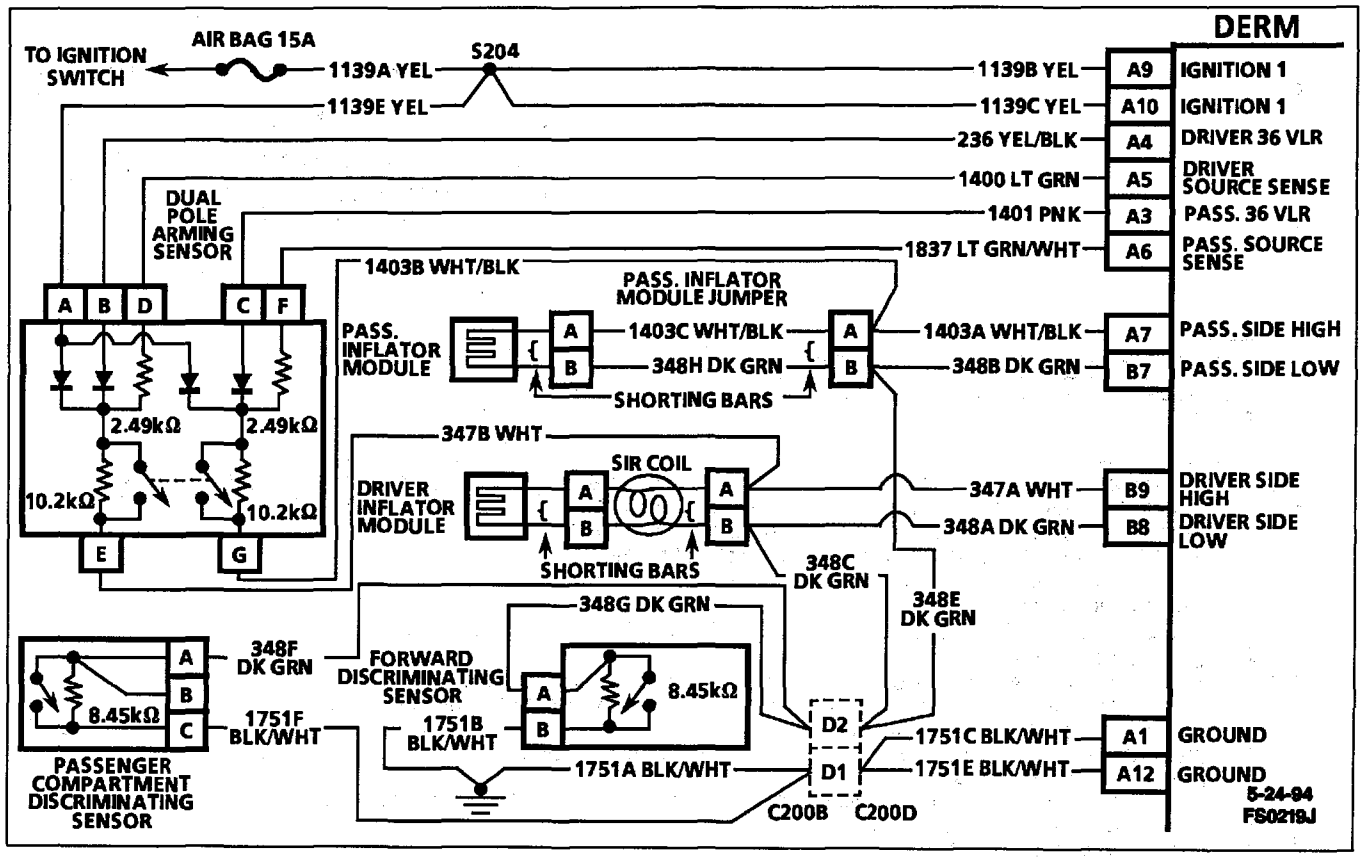
Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for an open in the "Ignition 1" circuit between the splice and the dual pole arming sensor.
2. This test determines whether the malfunction is internal to the dual pole arming sensor.

Diagnostic Aids:

An intermittent condition is likely to be caused by an improper connection at dual pole arming sensor terminal "A" or "D" and "F", improper connection at DERM terminal "A5" and "A6", open ignition feed to the dual pole arming sensor, open "Driver Source Sense" circuit and open "Passenger Source Sense" circuit, or a malfunctioning dual pole arming sensor. The test for this diagnostic trouble code is only run while the "AIR BAG" warning lamp is performing the bulb check. When a scan tool "Clear Codes" command is issued and the malfunction is still present, the DTC will not reappear until the ignition switch is turned "OFF" for at least two minutes with the entire SIR system connected and then the ignition switch is turned "ON."


DTC 34
DUAL POLE ARMING SENSOR IGNITION FEED OPEN
WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?
YES
NO
GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."
WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.
1
• IGNITION SWITCH "OFF."
• DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
• DISCONNECT DUAL POLE ARMING SENSOR.
• CHECK FOR PROPER CONNECTION TO DUAL POLE ARMING SENSOR AT TERMINAL "A".
• IF OK THEN DISCONNECT DERM.
• MEASURE RESISTANCE FROM DERM HARNESS CONNECTOR TERMINAL "A9" TO DUAL POLE ARMING SENSOR HARNESS CONNECTOR TERMINAL "A".
IS RESISTANCE 5.0Ω OR LESS?
YES
NO
REPAIR OPEN IN CKT 1139E.
2
• RECONNECT DUAL POLE ARMING SENSOR.
• IGNITION SWITCH "ON."
• MEASURE VOLTAGE ON DERM HARNESS CONNECTOR FROM TERMINAL "A5" TO TERMINAL "A1" (GROUND).
IS VOLTAGE 1 VOLT OR LESS?
NO
• IGNITION SWITCH "OFF."
• GO TO CHART A.
YES
• IGNITION SWITCH "OFF."
• REPLACE DUAL POLE ARMING SENSOR.
• RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
• CLEAR SIR DIAGNOSTIC TROUBLE CODES.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
C1163S



DTC 35 - (Page 1 of 2)
DISCRIMINATING SENSOR OPEN OR MISSING

Circuit Description:

During normal, non-deployment operation of the SIR system a small amount of current flows through both the driver and passenger deployment loops. The diagnostic resistors within the dual pole arming sensor and the discriminating sensors along with the resistance of the inflator modules cause voltage drops within the deployment loops. The DERM monitors the voltage at "Driver Side Low" terminal "B8" and "Passenger Side Low" terminal "B7" to detect shorts or opens within the deployment loops. When the measured voltage at either terminal is within a specified percentage of its respective "36 VLR" power supply voltage for 500 milliseconds DTC 35 is set.

DTC Will Set When:

The voltage measured at "Driver Side Low" terminal "B8" or at "Passenger Side Low" terminal "B7" is within a specified percentage of its respective "36 VLR" power supply voltage for 500 milliseconds. This test is run every 100 milliseconds during the "Continuous Monitoring" tests.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltages measured at "Driver Side Low" terminal "B8" and "Passenger Side Low" terminal "B7" are both above or below the percentage of their respective "36 VLR" power supply voltage which sets DTC 35.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for an open inside the forward discriminating sensor.
2. This test checks for an open ground feed to the forward discriminating sensor.
3. This test checks for an open inside the passenger compartment discriminating sensor.
4. This test checks for an open ground feed to the passenger compartment discriminating sensor.

Diagnostic Aids:

Refer to DTC 35 (Page 2 of 2).

DTC 35

(Page 1 of 2)

DISCRIMINATING SENSOR OPEN OR MISSING

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

NO — GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

1. • DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
   • DISCONNECT FORWARD DISCRIMINATING SENSOR.
   • CHECK FOR PROPER CONNECTION TO FORWARD DISCRIMINATING SENSOR AT TERMINALS "A" AND "B".
   • IF OK THEN MEASURE RESISTANCE ON FORWARD DISCRIMINATING SENSOR FROM TERMINAL "A" TO TERMINAL "B". IS RESISTANCE LESS THAN 8.54 kΩ?

YES

NO — REPLACE FORWARD DISCRIMINATING SENSOR.

2. • MEASURE RESISTANCE FROM FORWARD DISCRIMINATING SENSOR HARNESS CONNECTOR TERMINAL "B" TO GROUND. IS RESISTANCE 5.0Ω OR LESS?

YES

NO — REPAIR OPEN IN CKT 1751B.

3. • DISCONNECT PASSENGER COMPARTMENT DISCRIMINATING SENSOR.
   • CHECK FOR PROPER CONNECTION TO PASSENGER COMPARTMENT DISCRIMINATING SENSOR AT TERMINALS "A" AND "C".
   • IF OK, THEN MEASURE RESISTANCE ON PASSENGER COMPARTMENT DISCRIMINATING SENSOR FROM TERMINAL "A" TO TERMINAL "C". IS RESISTANCE LESS THAN 8.54 kΩ?

YES

NO — REPLACE PASSENGER COMPARTMENT DISCRIMINATING SENSOR.

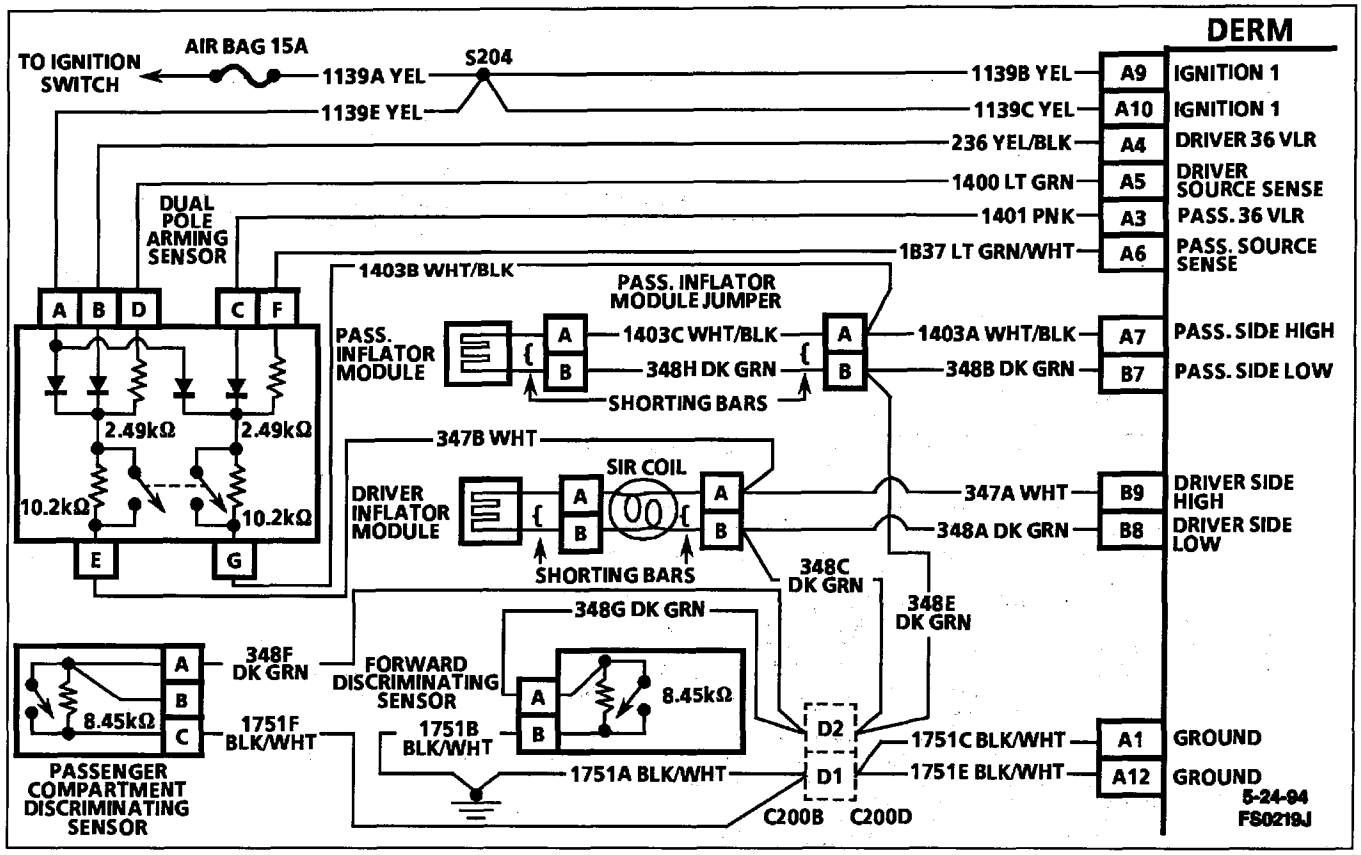
4. • MEASURE RESISTANCE FROM PASSENGER COMPARTMENT DISCRIMINATING SENSOR HARNESS CONNECTOR TERMINAL "C" TO GROUND. IS RESISTANCE 5.0Ω OR LESS?

YES — CONTINUE WITH DIAGNOSIS ON NEXT PAGE.

NO — REPAIR OPEN IN CKT 1751F.

- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

C1164S



DTC 35 - (Page 2 of 2)
DISCRIMINATING SENSOR OPEN OR MISSING

Circuit Description:

During normal, non-deployment operation of the SIR system a small amount of current flows through both the driver and passenger deployment loops. The diagnostic resistors within the dual pole arming sensor and the discriminating sensors along with the resistance of the inflator modules cause voltage drops within the deployment loops. The DERM monitors the voltage at "Driver Side Low" terminal "B8" and "Passenger Side Low" terminal "B7" to detect shorts or opens within the deployment loops. When the measured voltage at either terminal is within a specified percentage of its respective "36 VLR" power supply voltage for 500 milliseconds DTC 35 is set.

DTC Will Set When:

The voltage measured at "Driver Side Low" terminal "B8" or at "Passenger Side Low" terminal "B7" is within a specified percentage of its respective "36 VLR" power supply voltage for 500 milliseconds. This test is run every 100 milliseconds during the "Continuous Monitoring" tests.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltages measured at "Driver Side Low" terminal "B8" and "Passenger Side Low" terminal "B7" are both above or below the percentage of their respective "36 VLR" power supply voltage which sets DTC 35.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

5. This test checks for an open in the discriminating sensor interconnect circuit to the passenger compartment discriminating sensor.

6. This test checks for an open in the discriminating sensor interconnect circuit to the forward discriminating sensor.

7. This test determines whether the malfunction is due to decreased resistance of the diagnostic resistors in the dual pole arming sensor.

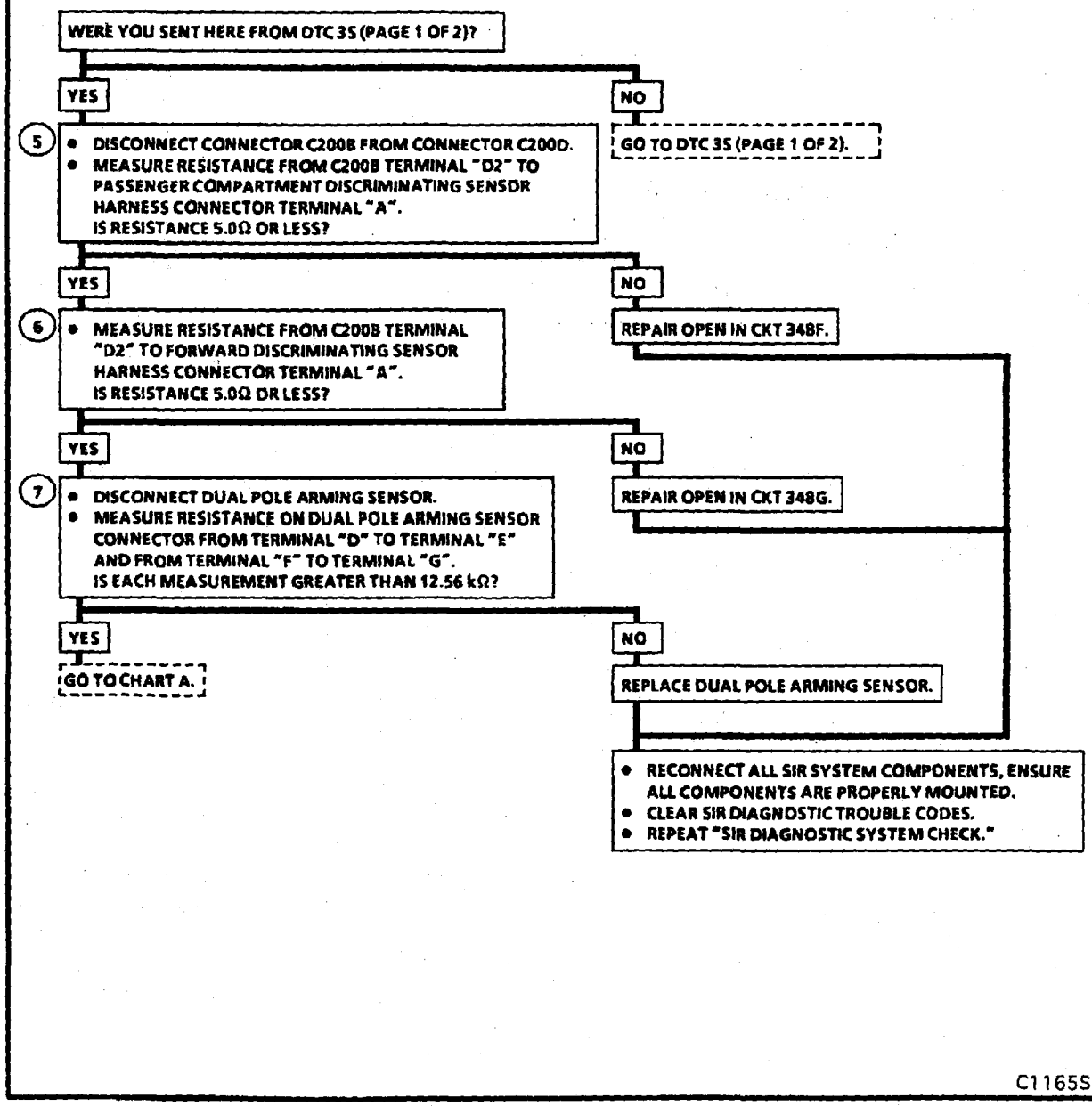
Diagnostic Aids:

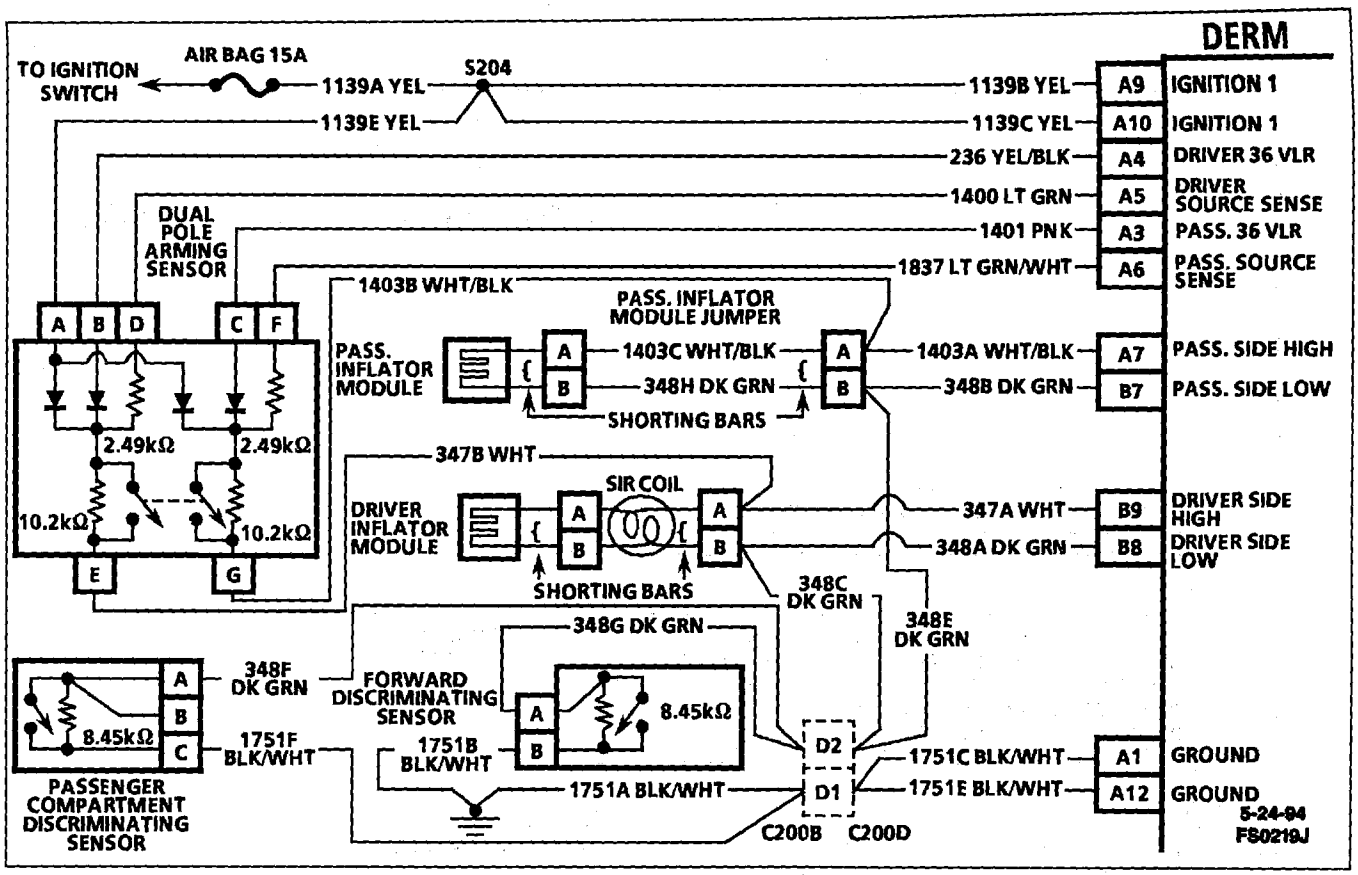
An intermittent condition is likely to be an improper connection at any of the discriminating sensor terminals, an open in either ground feed to the discriminating sensors, an open discriminating sensor interconnect circuit, increased resistance of any discriminating sensor or decreased resistance of the dual pole arming sensor.

DTC 35

(Page 2 of 2)

DISCRIMINATING SENSOR OPEN OR MISSING





DTC 36
PASSENGER LOOP ENERGY RESERVE FEED OPEN

Circuit Description:

During the "Continuous Monitoring" tests the DERM monitors the voltage at "Passenger Source Sense" terminal "A6". When the circuit is operating normally the measured voltage will be slightly less than "Passenger 36 VLR." If the "Passenger 36 VLR" circuit opens the voltage measured at "Passenger Source Sense" will decrease to slightly less than "Ignition 1" voltage. When the voltage measured at "Passenger Source Sense" is within a specified range of "Ignition 1" for 500 milliseconds DTC 36 is set.

DTC Will Set When:

The voltage measured at "Passenger Source Sense" terminal "A6" is within a specified range of "Ignition 1" for 500 milliseconds. This test is run every 100 milliseconds during "Continuous Monitoring" tests.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage measured at "Passenger Source Sense" terminal "A6" is outside the specified range of "Ignition 1" which sets the diagnostic trouble code, for 500 milliseconds.

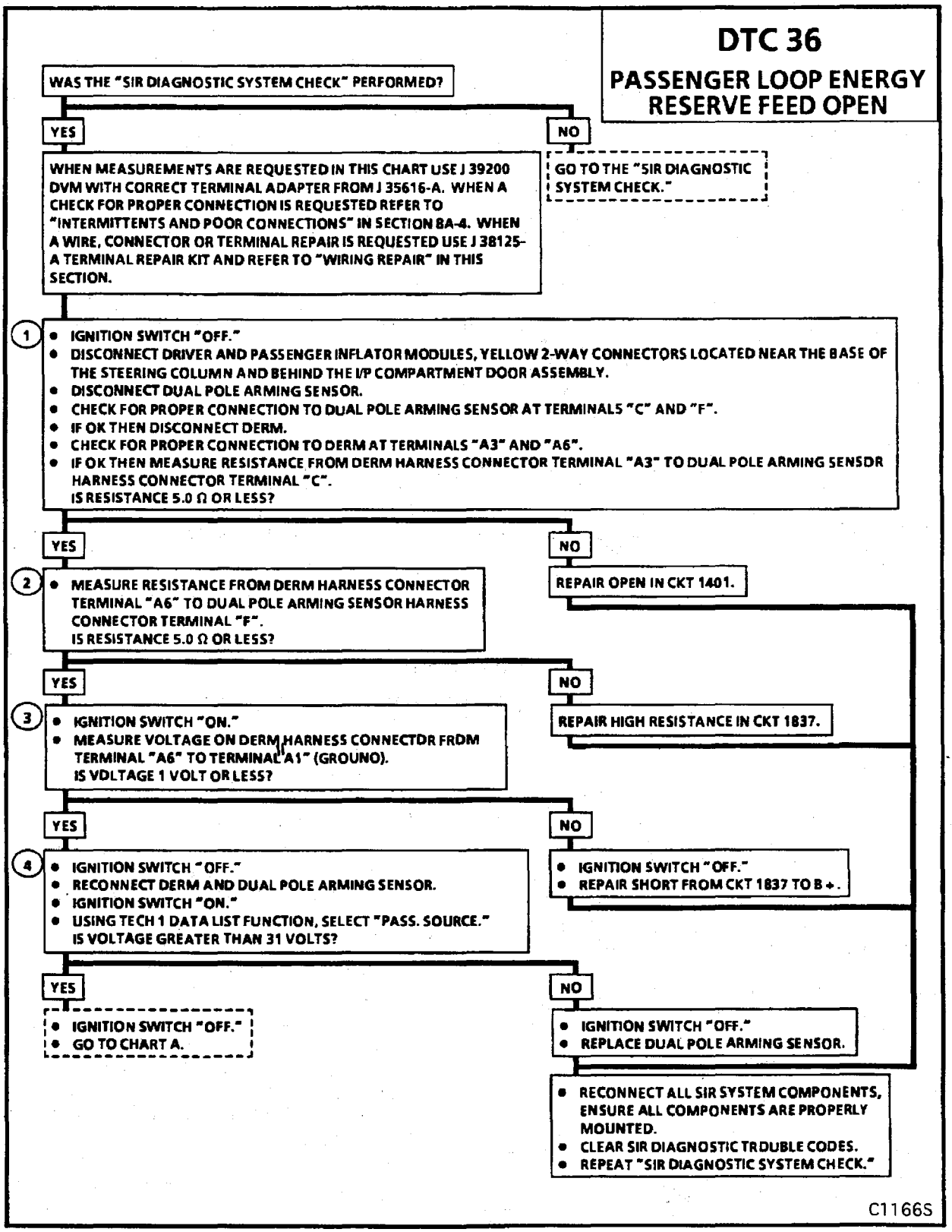
DTC Chart Test Description:

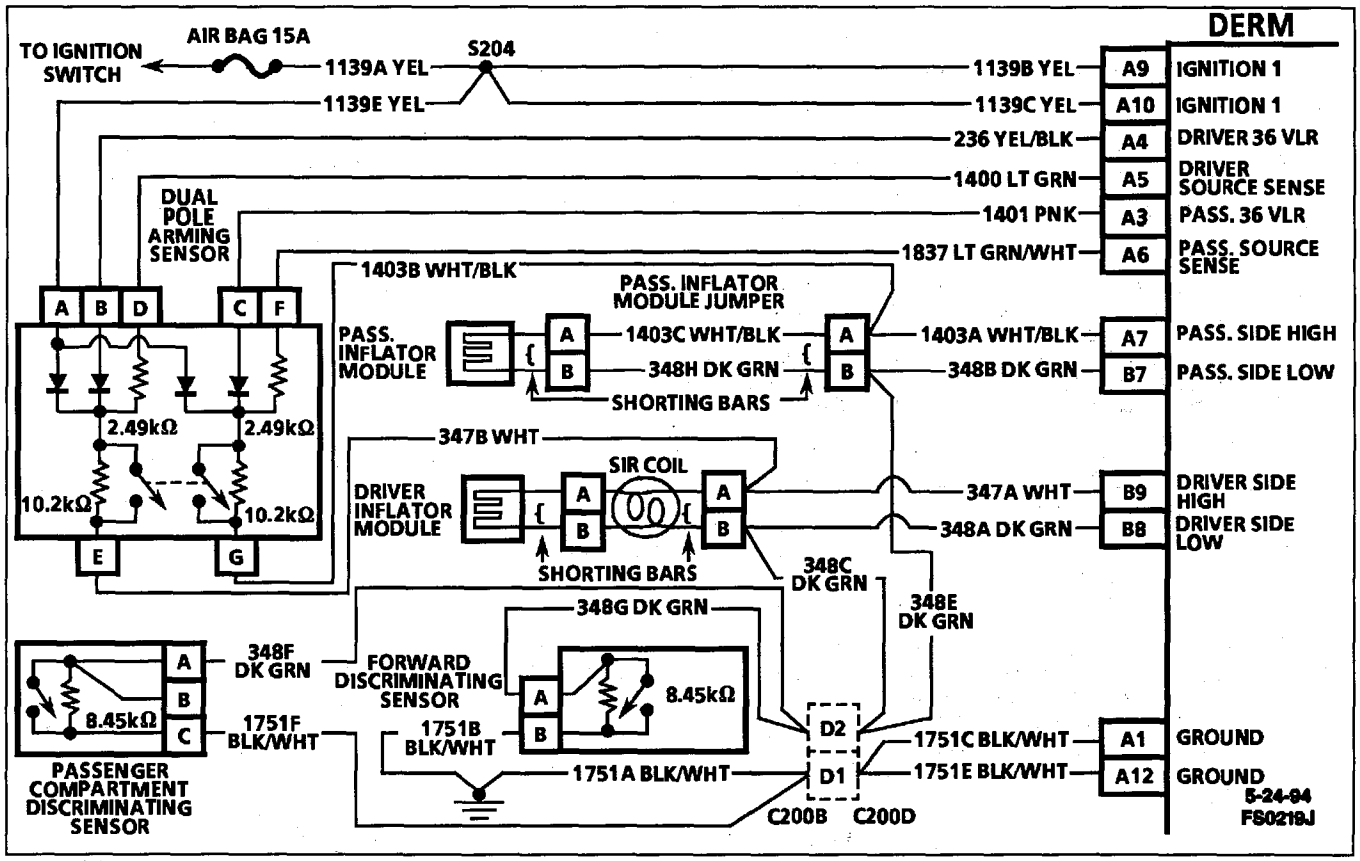
Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for an open in the "Passenger 36 VLR" circuit.
2. This test checks for high resistance, but not an open, in the "Passenger Source Sense" circuit.
3. This test checks for a short from the "Passenger Source Sense" circuit to B+.
4. This test determines whether the malfunction is due to the dual pole arming sensor.

Diagnostic Aids:

An intermittent condition is likely to be caused by a poor connection at dual pole arming sensor terminal "C" or "F", poor connection at DERM terminal "A3" or "A6", an open in CKT 1401 or CKT 1837, or an open inside the dual pole arming sensor.


DTC 36
PASSENGER LOOP ENERGY RESERVE FEED OPEN
WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?
YES
NO
GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."
WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.
1
• IGNITION SWITCH "OFF."
• DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
• DISCONNECT DUAL POLE ARMING SENSOR.
• CHECK FOR PROPER CONNECTION TO DUAL POLE ARMING SENSOR AT TERMINALS "C" AND "F".
• IF OK THEN DISCONNECT DERM.
• CHECK FOR PROPER CONNECTION TO DERM AT TERMINALS "A3" AND "A6".
• IF OK THEN MEASURE RESISTANCE FROM DERM HARNESS CONNECTOR TERMINAL "A3" TO DUAL POLE ARMING SENSDR HARNESS CONNECTOR TERMINAL "C".
IS RESISTANCE 5.0 Ω OR LESS?
YES
NO
REPAIR OPEN IN CKT 1401.
2
• MEASURE RESISTANCE FROM DERM HARNESS CONNECTOR TERMINAL "A6" TO DUAL POLE ARMING SENSOR HARNESS CONNECTOR TERMINAL "F".
IS RESISTANCE 5.0 Ω OR LESS?
YES
NO
REPAIR HIGH RESISTANCE IN CKT 1837.
3
• IGNITION SWITCH "ON."
• MEASURE VOLTAGE ON DERM HARNESS CONNECTOR FROM TERMINAL "A6" TO TERMINAL "A1" (GROUND).
IS VOLTAGE 1 VOLT OR LESS?
YES
NO
• IGNITION SWITCH "OFF."
• REPAIR SHORT FROM CKT 1837 TO B+.
4
• IGNITION SWITCH "OFF."
• RECONNECT DERM AND DUAL POLE ARMING SENSOR.
• IGNITION SWITCH "ON."
• USING TECH 1 DATA LIST FUNCTION, SELECT "PASS. SOURCE."
IS VOLTAGE GREATER THAN 31 VOLTS?
YES
NO
• IGNITION SWITCH "OFF."
• GO TO CHART A.
• IGNITION SWITCH "OFF."
• REPLACE DUAL POLE ARMING SENSOR.
• RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
• CLEAR SIR DIAGNOSTIC TROUBLE CODES.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
C1166S



DTC 42
LOOP ENERGY RESERVE VOLTAGE LOW

Circuit Description:

During the "Turn-ON" tests, performed at the beginning of each ignition cycle, the DERM delays charging of the "Driver 36 VLR" terminal "A4" and "Passenger 36 VLR" terminal "A3" power supplies. After the delay has expired both "36 VLR" power supplies are allowed to charge. The DERM monitors each "36 VLR" power supply to ensure each has charged to a voltage above a specified value within 10 seconds after "Ignition 1" voltage is first applied to the DERM. When either "36 VLR" power supply does not reach the specified voltage within the allowed time or, once reaching the specified voltage, falls below it for 500 milliseconds, DTC 42 is set.

DTC Will Set When:

The voltage at either "36 VLR" power supply does not exceed a specified value within 10 seconds after "Ignition 1" voltage is first applied to the DERM or, once having reached the specified value, either "36 VLR" power supply voltage falls below the specified value for 500 milliseconds. This test is run each ignition cycle at "Turn-ON" to detect a charge time failure and, after charging, tested every 100 milliseconds during the "Continuous Monitoring" tests.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltages measured at "Driver 36 VLR" terminal "A4" and "Passenger 36 VLR" terminal "A3" are above a specified value for 500 milliseconds.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks whether the DERM has set the diagnostic trouble code falsely.
2. This test checks whether a malfunctioning dual pole arming sensor is preventing the "Driver 36 VLR" or "Passenger 36 VLR" from charging.
3. This test checks for a short from the "Driver 36 VLR" or "Passenger 36 VLR" circuit to B+.
4. This test checks for a short from the "Driver 36 VLR" or "Passenger 36 VLR" circuit to ground.

Diagnostic Aids:

An intermittent condition is likely to be caused by a short from "Driver 36 VLR" or "Passenger 36 VLR" to B+ or ground, or a malfunctioning dual pole arming sensor.

DTC 42
LOOP ENERGY RESERVE VOLTAGE LOW

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

1
- IGNITION SWITCH "ON."
- USING TECH 1 SIR DATA LIST FUNCTION SELECT "DRIVER 36 VLR" AND "PASS. 36 VLR."
- RECORD BOTH "DRIVER 36 VLR" AND "PASS. 36 VLR" VOLTAGES ON REPAIR ORDER.

ARE BOTH RECORDED VOLTAGES 32.5 VOLTS OR MORE?

NO

2
- IGNITION SWITCH "OFF "
- DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BELOW THE I/P COMPARTMENT DOOR ASSEMBLY.
- DISCONNECT DUAL POLE ARMING SENSOR.
- IGNITION SWITCH "ON."
- USING TECH 1 SIR DATA LIST FUNCTION SELECT "DRIVER 36 VLR" AND "PASS. 36 VLR."

ARE THE DISPLAYED VOLTAGES WITHIN 2 VOLTS OF THE RECORDED VOLTAGES?

YES

3
- USING TECH 1 SIR DATA LIST FUNCTION SELECT "IGNITION."

IS THE DISPLAYED VOLTAGE WITHIN 2 VOLTS OF THE RECORDED "DRIVER 36 VLR" OR "PASS. 36 VLR" VOLTAGE?

NO

4
- IGNITION SWITCH "OFF "

ARE EITHER OF THE RECORDED VOLTAGES 1 VOLT OR LESS?

NO

GO TO CHART A.

YES

- IGNITION SWITCH "OFF."
- REPAIR SHORT FROM EITHER CKT 236 (DRIVER 36 VLR) OR CKT 1401 (PASS. 36 VLR) TO B+.

YES

REPAIR SHORT FROM EITHER CKT 236 (DRIVER 36 VLR) OR CKT 1401 (PASS. 36 VLR) TO GROUND.

NO

- IGNITION SWITCH "OFF."
- REPLACE DUAL POLE ARMING SENSOR.

YES

GO TO CHART A.

NO

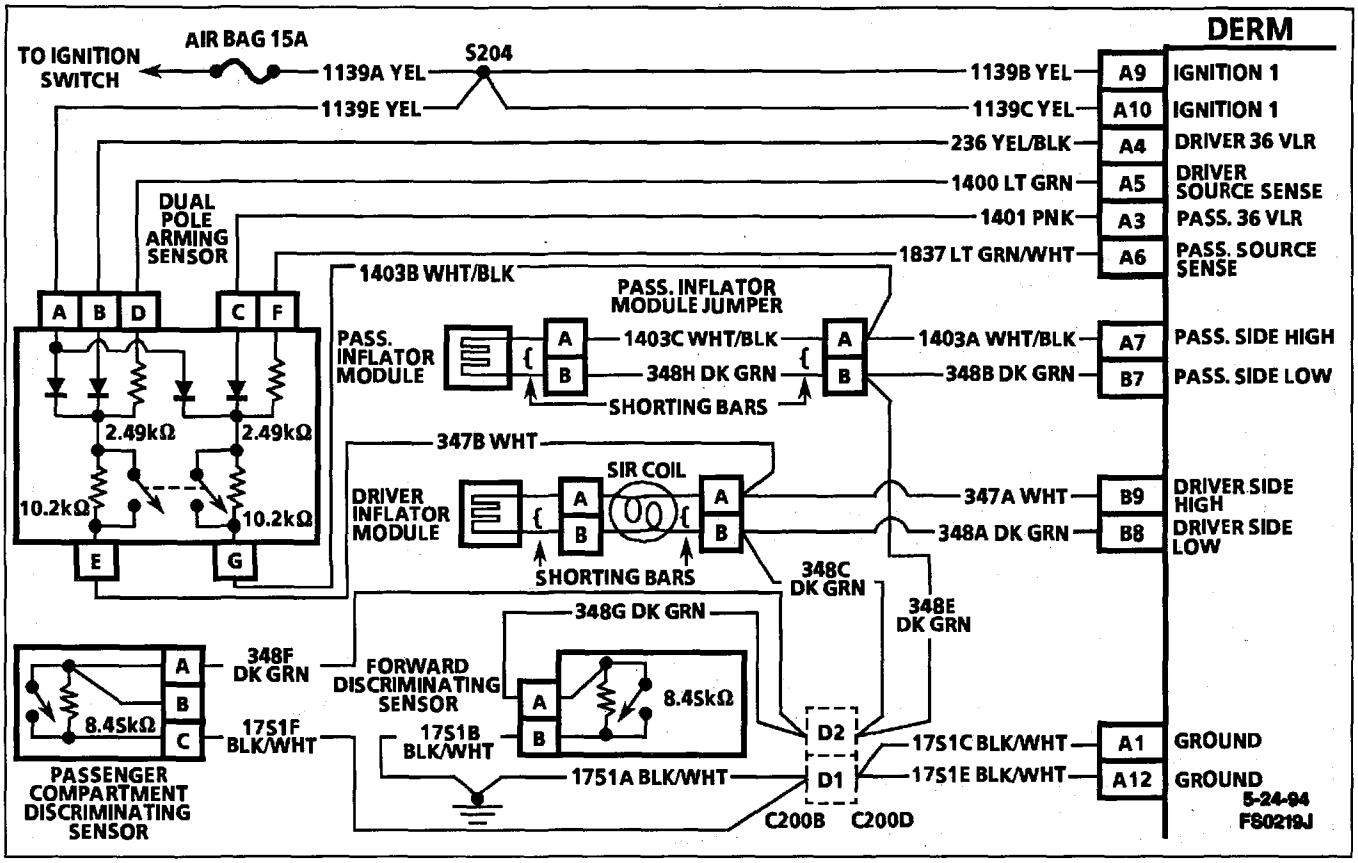
GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

YES

- IGNITION SWITCH "OFF."
- GO TO CHART A.

- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

C3658S



DTC 43
DRIVER SOURCE FEED LOW

Circuit Description:

During normal, non-deployment operation of the SIR system the DERM monitors the voltage supplied through the dual pole arming sensor to the high side of the driver deployment loop at the "Driver Source Sense" terminal "A5". This measured voltage will have a value approximately equal to "Driver 36 VLR." When the voltage measured at "Driver Side Low" terminal "B8" is in its normal operating range, indicating driver deployment loop integrity has been maintained, while simultaneously the voltage measured at "Driver Source Sense" is a specified amount below "Driver 36 VLR" for 500 milliseconds DTC 43 is set.

DTC Will Set When:

The voltage measured at "Driver Side Low" terminal "B8" is within a specified percentage of "Driver 36 VLR" while simultaneously the voltage measured at "Driver Source Sense" terminal "A5" is a specified amount below "Driver 36 VLR" for 500 milliseconds. This test is run every 100 milliseconds during the "Continuous Monitoring" tests.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage measured at "Driver Side Low" terminal "B8" is within a specified percentage of "Driver 36 VLR" while simultaneously the voltage measured at "Driver Source Sense" terminal "A5" is within a specified amount of "Driver 36 VLR" for 500 milliseconds.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for an open in "Driver Source Sense" circuit.
2. This test checks for a short from the "Driver Source Sense" circuit to ground.
3. The test determines whether the malfunction is due to increased resistance across the "Driver Source Sense" resistor in the dual pole arming sensor.

Diagnostic Aids:

An intermittent condition is likely to be caused by a poor connection to the DERM at terminal "A5", a poor connection to the dual pole arming sensor at terminal "D", an open or short to ground in CKT 1400 or a partial open inside the dual pole arming sensor.

DTC 43
DRIVER SOURCE FEED LOW

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

NO

GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

(1)
- IGNITION SWITCH "OFF."
- DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
- DISCONNECT DERM.
- CHECK FOR PROPER CONNECTION TO DERM AT TERMINAL "A5".
- IF OK THEN DISCONNECT DUAL POLE ARMING SENSOR.
- CHECK FOR PROPER CONNECTION TO DUAL POLE ARMING SENSOR AT TERMINAL "D"
- IF OK, THEN MEASURE RESISTANCE FROM DUAL POLE ARMING SENSOR HARNESS CONNECTOR TERMINAL "D" TO DERM HARNESS CONNECTOR TERMINAL "A5". IS RESISTANCE 5.0Ω OR LESS?
- CHECK FOR HIGH RESISTANCE IN CKT 236, DUAL POLE ARMING SENSOR TERMINAL "B" AND DERM TERMINAL "A4".

YES

NO

REPAIR OPEN IN CKT 1400.

(2)
- MEASURE RESISTANCE ON DERM HARNESS CONNECTOR FROM TERMINAL "A5" TO TERMINAL "A1" (GROUND). DOES J 39200 DISPLAY "OL" (INFINITE)?

YES

NO

REPAIR SHORT FROM CKT 1400 TO GROUND.

(3)
- MEASURE RESISTANCE ON DUAL POLE ARMING SENSOR CONNECTOR FROM TERMINAL "D" TO TERMINAL "E". IS RESISTANCE 12.9 kΩ OR MORE?

NO

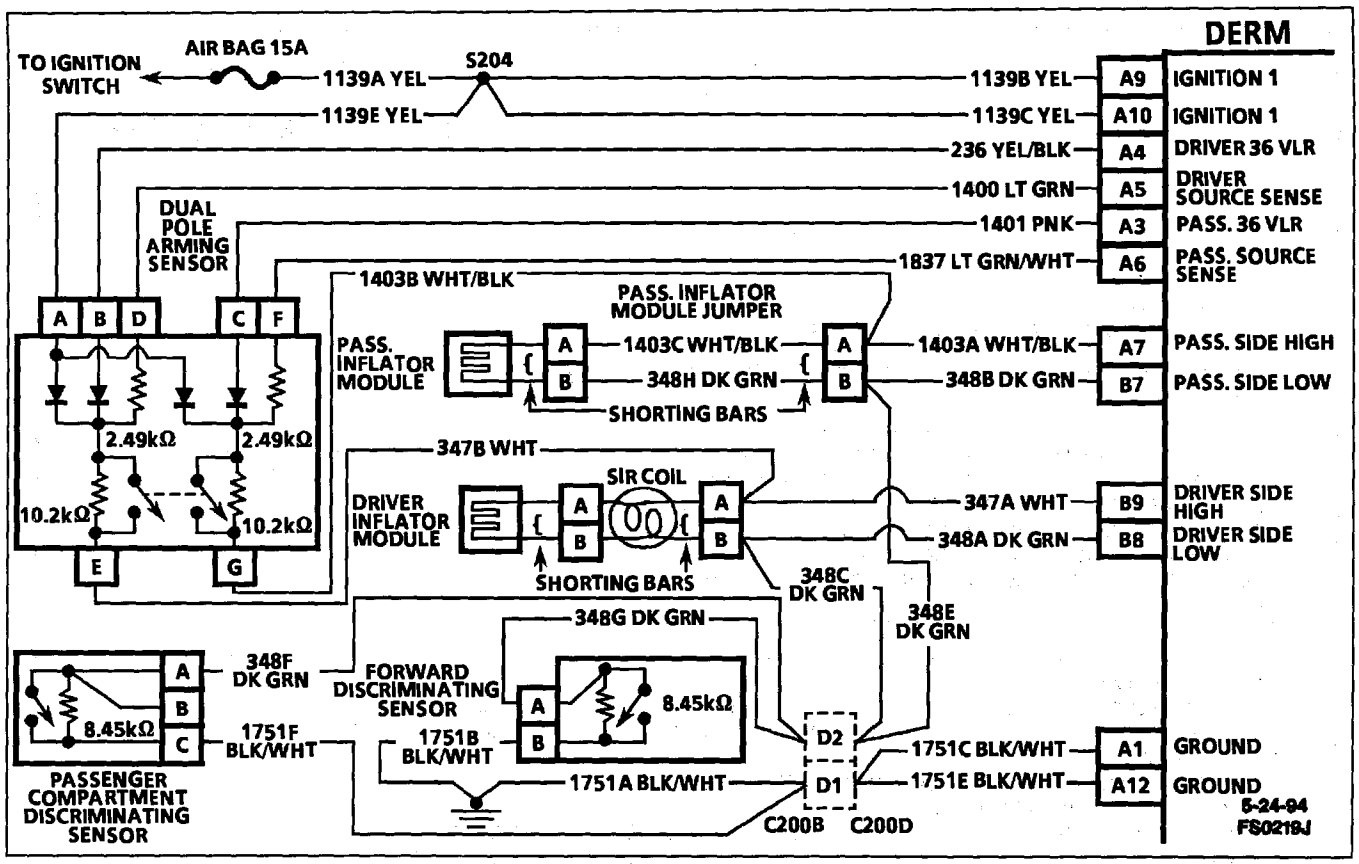
GO TO CHART A.

YES

REPLACE DUAL POLE ARMING SENSOR.

- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

C3659S



DTC 44
PASSENGER SOURCE FEED LOW

Circuit Description:

During normal, non-deployment operation of the SIR system the DERM monitors the voltage supplied through the dual pole arming sensor to the high side of the passenger deployment loop at the "Passenger Source Sense" terminal "A6". The measured voltage will have a value approximately equal to "Passenger 36 VLR." When the voltage measured at "Passenger Side Low" terminal "B7" is in its normal operating range, indicating passenger deployment loop integrity has been maintained, while simultaneously the voltage measured at "Passenger Source Sense" is a specified amount below "Passenger 36 VLR" for 500 milliseconds DTC 44 is set.

DTC Will Set When:

The voltage measured at "Passenger Side Low" terminal "B7" is within a specified percentage of "Passenger 36 VLR" while simultaneously the voltage measured at "Passenger Source Sense" terminal "A6" is a specified amount below "Passenger 36 VLR" for 500 milliseconds. This test is run every 100 milliseconds during the "Continuous Monitoring" tests.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The voltage measured at "Passenger Side Low" terminal "B7" is within a specified percentage of "Passenger 36 VLR" while simultaneously the voltage measured at "Passenger Source Sense" terminal "A6" is within a specified amount of "Passenger 36 VLR" for 500 milliseconds.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for an open in the "Passenger Source Sense" circuit.
2. This test checks for a short from the "Passenger Source Sense" circuit to ground.
3. This test determines whether the malfunction is due to increased resistance across the "Passenger Source Sense" resistor in the dual pole arming sensor.

Diagnostic Aids:

An intermittent condition is likely to be caused by a poor connection to the DERM at terminal "A6", a poor connection to the dual pole arming sensor at terminal "F", an open or short to ground in CKT 1837 or a partial open inside the dual pole arming sensor.

DTC 44
PASSENGER SOURCE FEED LOW

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

NO

GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

1
- IGNITION SWITCH "OFF."
- DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
- DISCONNECT DERM.
- CHECK FOR PROPER CONNECTION TO DERM AT TERMINAL "A6".
- IF OK, THEN DISCONNECT DUAL POLE ARMING SENSOR.
- CHECK FOR PROPER CONNECTION TO DUAL POLE ARMING SENSOR AT TERMINAL "F".
- IF OK, THEN MEASURE RESISTANCE FROM DUAL POLE ARMING SENSOR HARNESS CONNECTOR TERMINAL "F" TO DERM HARNESS CONNECTOR TERMINAL "A6". IS RESISTANCE 5.0Ω OR LESS?
- CHECK FOR HIGH RESISTANCE IN CKT 1401, DUAL POLE ARMING SENSOR TERMINAL "C" AND DERM TERMINAL "A3".

YES

NO

REPAIR OPEN IN CKT 1837.

2
- MEASURE RESISTANCE ON DERM HARNESS CONNECTOR FROM TERMINAL "A6" TO TERMINAL "A1" (GROUND). DOES J 39200 DISPLAY "OL" (INFINITE)?

YES

NO

REPAIR SHORT FROM CKT 1837 TO GROUND.

3
- MEASURE RESISTANCE ON DUAL POLE ARMING SENSOR CONNECTOR FROM TERMINAL "F" TO TERMINAL "G". IS RESISTANCE 12.9 kΩ OR MORE?

NO

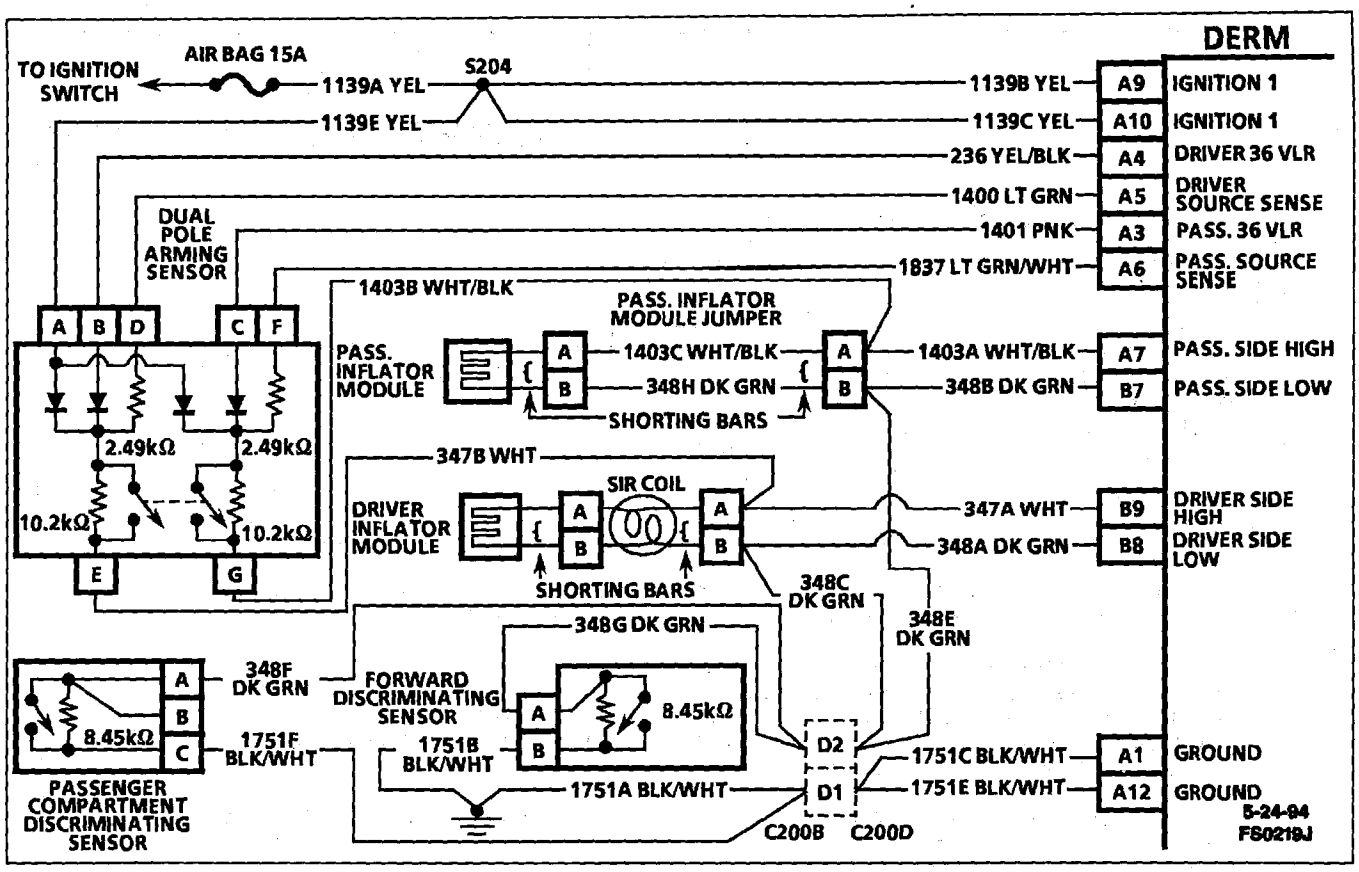
GO TO CHART A.

YES

REPLACE DUAL POLE ARMING SENSOR.

- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

C3660S



DTC 51
FRONTAL CRASH DETECTED

Circuit Description:

Closure of the dual pole arming sensor is detected when the voltage measured at "Driver Side High" terminal "B9" or at "Passenger Side High" terminal "A7" is within a specified amount of its respective deployment loop supply voltage. Closure of either discriminating sensor is detected when the voltage measured at "Driver Side Low" terminal "B8" or at "Passenger Side Low" terminal "B7" is within a specified amount of ground potential. When both conditions are met simultaneously on either the driver side or passenger side for not less than 250 microseconds "Crash Data" is recorded and DTC 51 is set.

DTC Will Set When:

Closure of the dual pole arming sensor and at least one of the discriminating sensors is detected for not less than 250 microseconds on either the driver side or passenger side. Conditions are monitored whenever the DERM is functioning normally.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp, records "Crash Data," and sets a diagnostic trouble code.

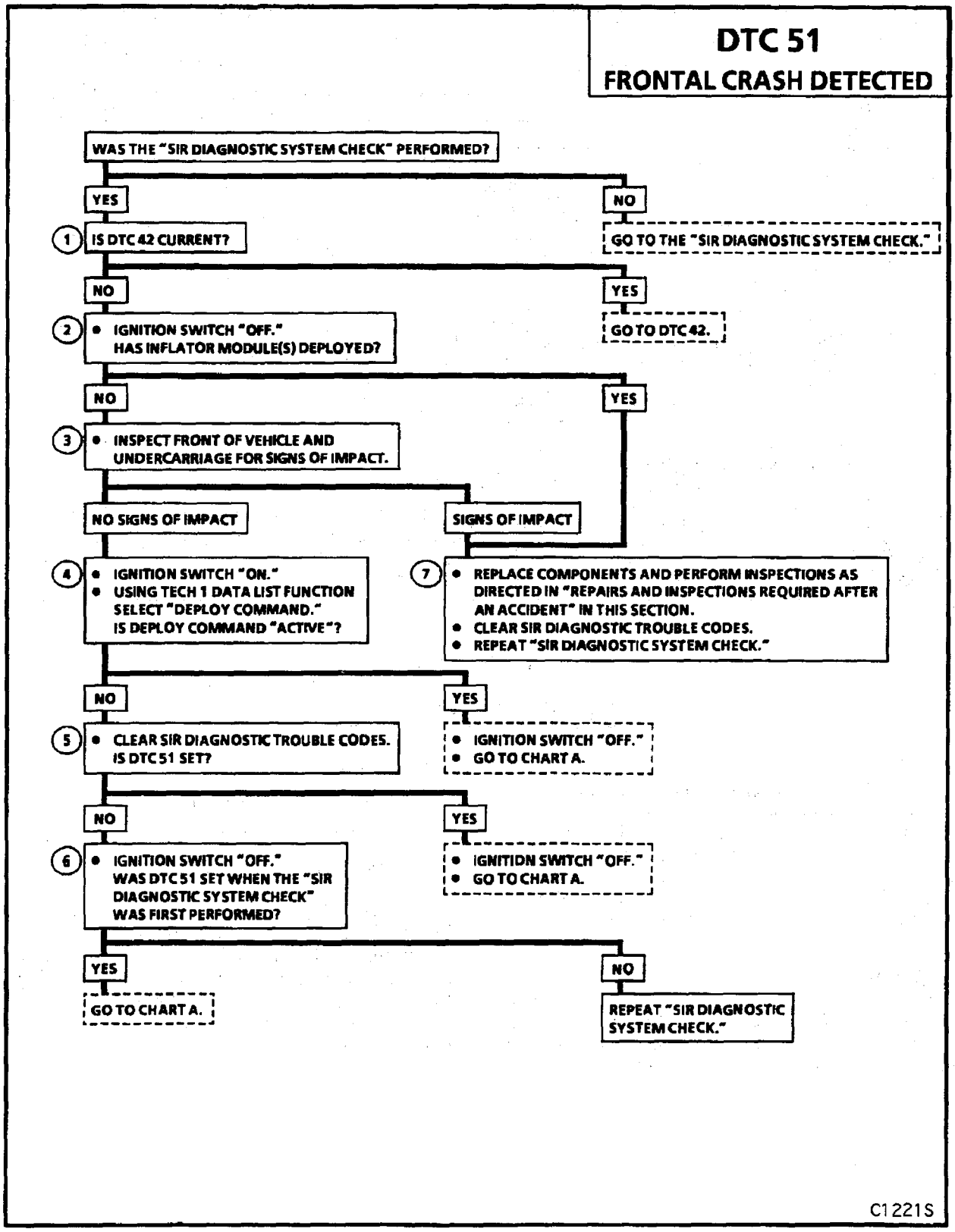
DTC Will Clear When:

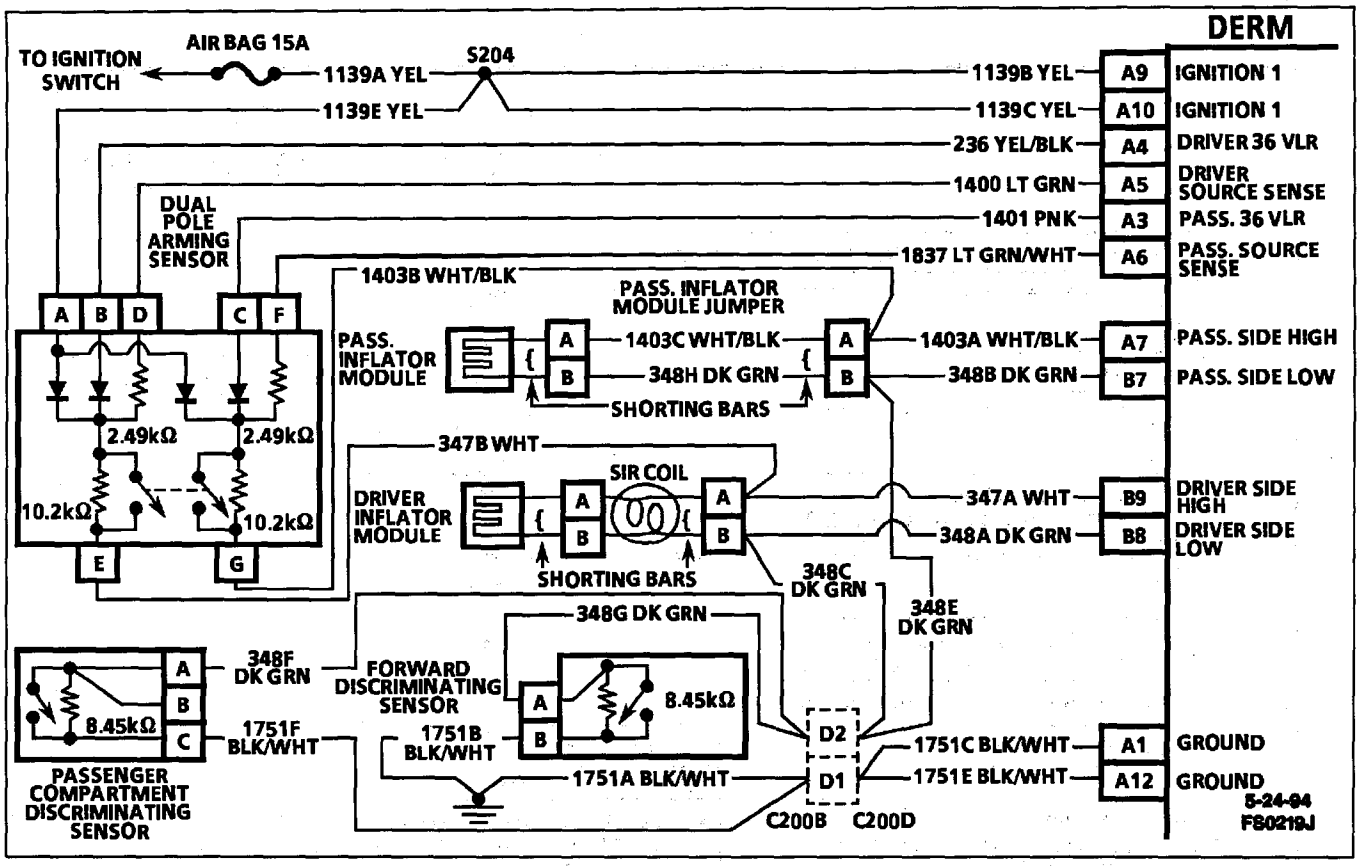
A scan tool "Clear Codes" command is received by the DERM.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. When DTC 42 and DTC 51 are set simultaneously, perform DTC 42 diagnosis first.
2. If inflator module(s) has not deployed, DTC 51 may have set falsely.
3. If DTC 51 has set with no signs of frontal impact, the diagnostic trouble code has set falsely.
4. This test checks for a DERM malfunction setting the diagnostic trouble code.
5. This test checks for a DERM malfunction setting the diagnostic trouble code.
6. This test determines whether the diagnostic trouble code was set inadvertently during diagnosis.
7. When a frontal crash has occurred, it is necessary to perform the indicated procedures to ensure the SIR system is fully functional.


DTC 51
FRONTAL CRASH DETECTED
WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?
YES
NO
GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."
1
IS DTC 42 CURRENT?
NO
YES
GO TO DTC 42.
2
• IGNITION SWITCH "OFF."
HAS INFLATOR MODULE(S) DEPLOYED?
NO
YES
3
• INSPECT FRONT OF VEHICLE AND UNDERCARRIAGE FOR SIGNS OF IMPACT.
NO SIGNS OF IMPACT
SIGNS OF IMPACT
4
• IGNITION SWITCH "ON."
• USING TECH 1 DATA LIST FUNCTION SELECT "DEPLOY COMMAND."
IS DEPLOY COMMAND "ACTIVE"?
7
• REPLACE COMPONENTS AND PERFORM INSPECTIONS AS DIRECTED IN "REPAIRS AND INSPECTIONS REQUIRED AFTER AN ACCIDENT" IN THIS SECTION.
• CLEAR SIR DIAGNOSTIC TROUBLE CODES.
• REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
NO
YES
5
• CLEAR SIR DIAGNOSTIC TROUBLE CODES.
IS DTC 51 SET?
• IGNITION SWITCH "OFF."
• GO TO CHART A.
NO
YES
6
• IGNITION SWITCH "OFF."
WAS DTC 51 SET WHEN THE "SIR DIAGNOSTIC SYSTEM CHECK" WAS FIRST PERFORMED?
• IGNITIDN SWITCH "OFF."
• GO TO CHART A.
YES
NO
GO TO CHART A.
REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
C1221S



DTC 52
DATA AREA FULL

Circuit Description:

When there is a frontal crash of sufficient force to activate the dual pole arming sensor and at least one of the two discriminating sensors simultaneously, DTC 51 is set. At this time the DERM will record information regarding SIR system status and vehicle status in EEPROM. DTC 52 will set when the DERM has stored information regarding eight frontal crash events.

DTC Will Set When:

The DERM attempts to store frontal crash information and finds the EEPROM data area full. This test is run each time the DERM stores or attempts to store information regarding a frontal crash event.

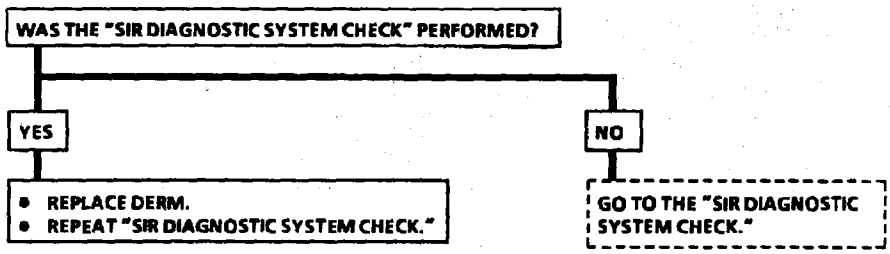
Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

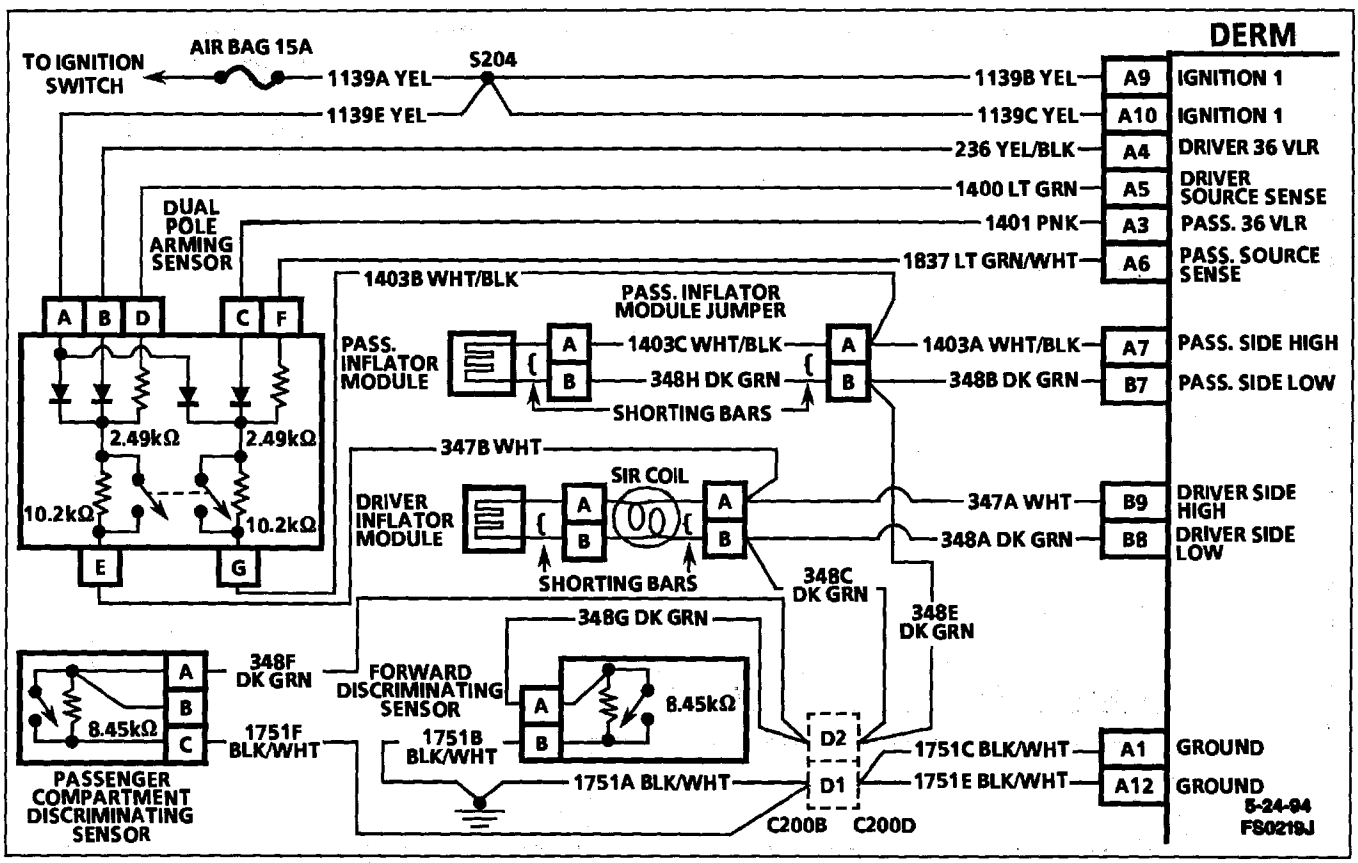
DTC Will Clear When:

A scan tool "Clear Codes" command is received by the DERM. If, at the next ignition "ON" after receiving a "Clear Codes" command, the DERM detects the data area is full, a history diagnostic trouble code is set. This allows the "AIR BAG" warning lamp to illuminate should any additional malfunctions be detected.

DTC 52
DATA AREA FULL



C1222S



DTC 53
DRIVER SIDE LOW HIGH RESISTANCE

Circuit Description:

During the "Initiator Assembly Resistance Test" the DERM grounds the "Driver Side Low" terminal "B8" and turns "ON" the passenger current source at the "Passenger Side High" terminal "A7". This causes a known amount of current to flow through the passenger initiator circuit allowing this resistance to be calculated. The normal, non-deployment current flow through the driver deployment loop is also affected since the DERM is supplying ground through a resistor bypassing the ground supplied by the resistance of the discriminating sensor network. When the voltage difference between "Driver Side High" terminal "B9" and "Driver Side Low" terminal "B8" is above a specified value DTC 53 is set.

DTC Will Set When:

The voltage difference between "Driver Side High" terminal "B9" and "Driver Side Low" terminal "B8" is above a specified value. This test is run once each ignition cycle during the "Initiator Assembly Resistance Test" when: 1) No "higher priority faults" are detected during "Turn-ON," 2)No "higher priority faults" are detected during "Continuous Monitoring" for one second, 3) No "Crank" signal present, 4) "Ignition 1" voltage is above a specified value.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The ignition switch is turned "OFF."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test determines whether the malfunction is due to a high resistance or open in the "Driver Side Low" circuit between the DERM and the steering column harness connector.

Diagnostic Aids:

An intermittent condition is likely to be caused by a poor connection at DERM terminal "B8" or an open in CKT 348A. The test for this diagnostic trouble code is run only while the "AIR BAG" warning lamp is performing the bulb check. When a scan tool "Clear Codes" command is issued and the malfunction is still present, the DTC will not reappear until the next ignition cycle.

DTC 53

DRIVER SIDE LOW HIGH RESISTANCE

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

NO

GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

(1)

- IGNITION SWITCH "OFF."
- DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY
- DISCONNECT DERM.
- CHECK FOR PROPER CONNECTION TO DERM AT TERMINAL "B8".
- IF OK THEN MEASURE RESISTANCE FROM DERM HARNESS CONNECTOR TERMINAL "B8" TO STEERING COLUMN HARNESS CONNECTOR TERMINAL "B".

IS RESISTANCE 5.0Ω OR LESS?

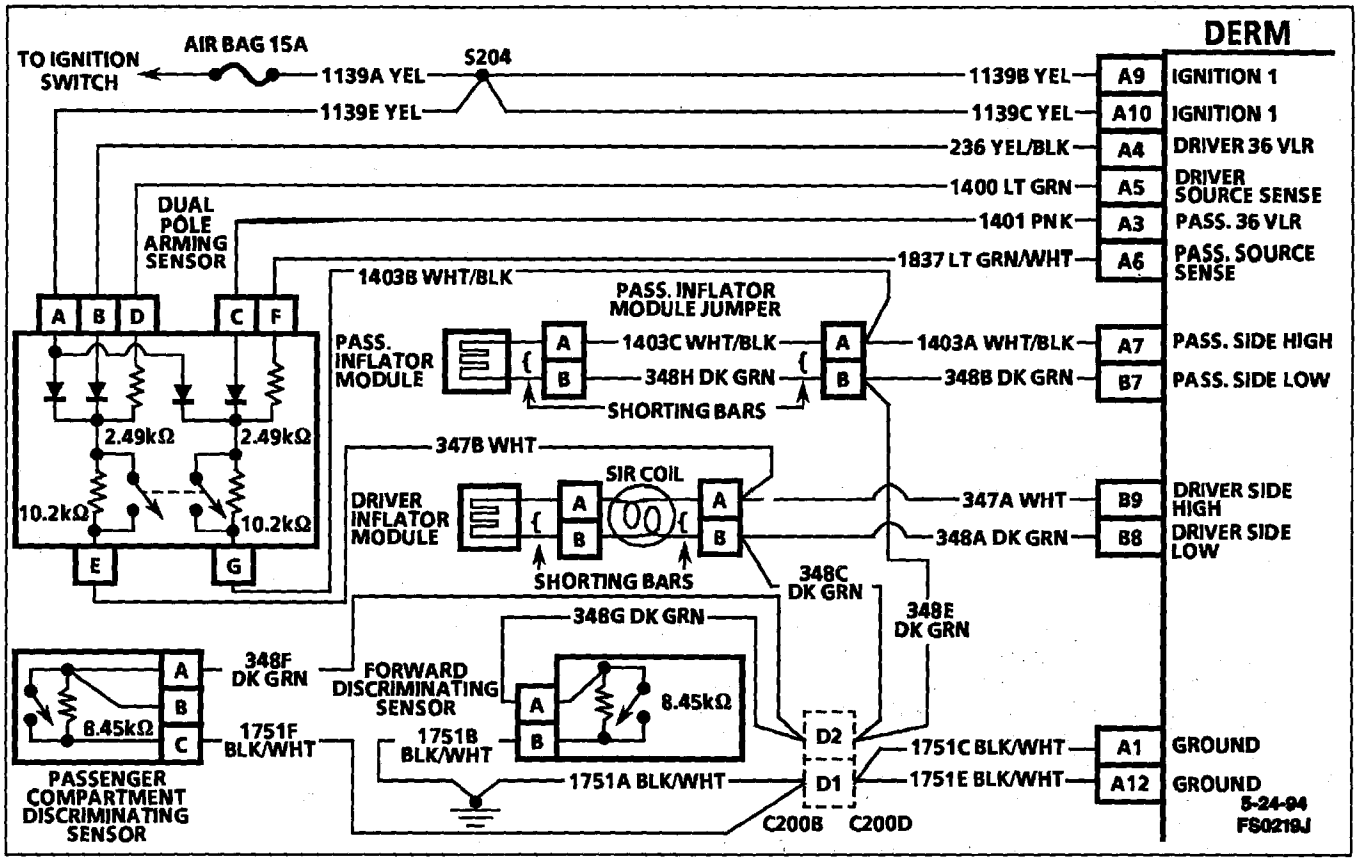
YES

GO TO CHART A.

NO

- REPAIR OPEN OR HIGH RESISTANCE IN CKT 348A.
- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

C3661S



DTC 54
PASSENGER SIDE LOW HIGH RESISTANCE

Circuit Description:

During the "Initiator Assembly Resistance Test" the DERM grounds the "Passenger Side Low" terminal "B7" and turns "ON" the driver current source at the "Driver Side High" terminal "B9". This causes a known amount of current to flow through the driver initiator circuit allowing the resistance to be calculated. The normal, non-deployment current flow through the passenger deployment loop is also affected since the DERM is supplying ground through a resistor bypassing the ground supplied by the resistance of the discriminating sensor network. When the voltage difference between "Passenger Side High" terminal "A7" and "Passenger Side Low" terminal "B7" is above a specified value DTC 54 is set.

DTC Will Set When:

The voltage difference between "Passenger Side High" terminal "A7" and "Passenger Side Low" terminal "B7" is above a specified value. This test is run once each ignition cycle during the "Initiator Assembly Resistance Test" when: 1) No "higher priority faults" are detected during "Turn-ON," 2) No "higher priority faults" are detected during "Continuous Monitoring" for one second, 3) No "Crank" signal present, 4) "Ignition 1" is above a specified value.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

The ignition switch is turned "OFF."

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test determines whether the malfunction is due to a high resistance or open in the "Passenger Side Low" circuit between the DERM and the passenger inflator jumper harness connector on SIR wiring harness.

Diagnostic Aids:

An intermittent condition is likely to be caused by a poor connection at DERM terminal "B7" or an open in CKT 348B. The test for this diagnostic trouble code is run only while the "AIR BAG" warning lamp is performing the bulb check. When a scan tool "Clear Codes" command is issued and the malfunction is still present, the DTC will not reappear until the next ignition cycle.

DTC 54
PASSENGER SIDE LOW HIGH RESISTANCE

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

(1)

- IGNITION SWITCH "OFF."
- DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
- DISCONNECT DERM.
- CHECK FOR PROPER CONNECTION TO DERM AT TERMINAL "B7".
- IF OK THEN MEASURE RESISTANCE FROM DERM HARNESS CONNECTOR TERMINAL "B7" TO PASSENGER INFLATOR MODULE JUMPER CONNECTOR TERMINAL "B".
  IS RESISTANCE 5.0Ω OR LESS?

YES

GO TO CHART A.

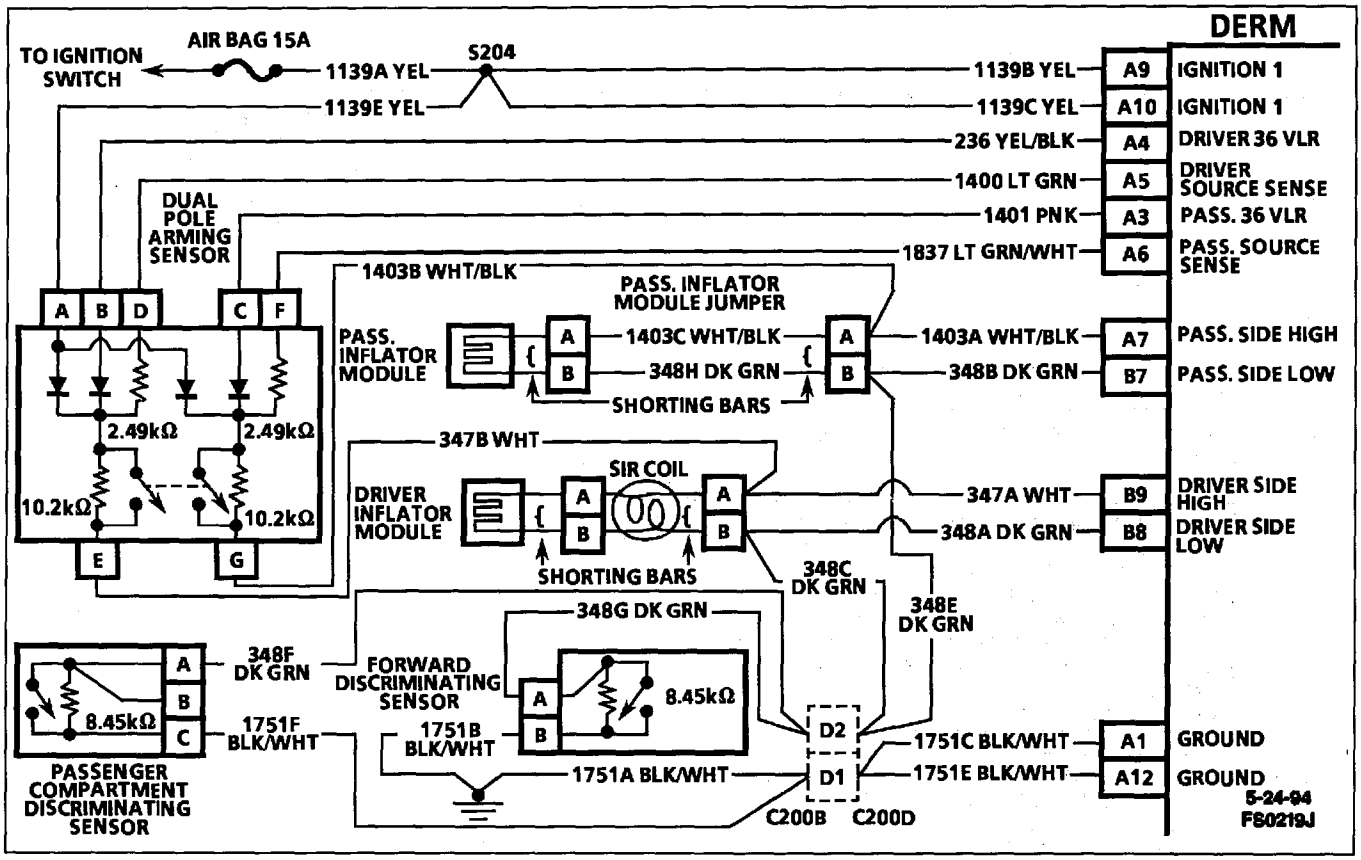
NO

- REPAIR OPEN OR HIGH RESISTANCE IN CKT 348B.
- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

NO

GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

C1167S



DTC 55
DERM INCOMPATIBILITY

Circuit Description:

During the "Initiator Assembly Resistance Test" the DERM grounds the "Passenger Side Low" terminal "B7" and measures the voltage at "Driver Source Sense" terminal "A5", "Passenger Source Sense" terminal "A6" and "Driver Side Low" terminal "B8". The DERM monitors "Driver Source Sense" to ensure that "Driver 36 VLR" is fully charged and supplying voltage to the high side of the driver deployment loop. When this condition is met, the measurement at "Passenger Source Sense" indicates no voltage is being supplied to the high side of the passenger deployment loop and grounding "Passenger Side Low" does not ground "Driver Side Low," DTC 55 is set.

DTC Will Set When:

The conditions described above indicate a driver only DERM has been installed in the vehicle. This test is run once each ignition cycle during the "Initiator Assembly Resistance Test" when: 1) No "higher priority faults" are detected during "Turn-ON," 2) No "higher priority faults" are detected during "Continuous Monitoring" for one second, 3)No "Crank" signal present, 4) "Ignition 1" voltage is above a specified value.

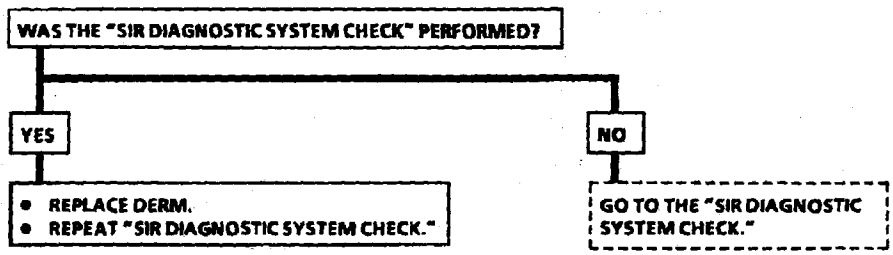
Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

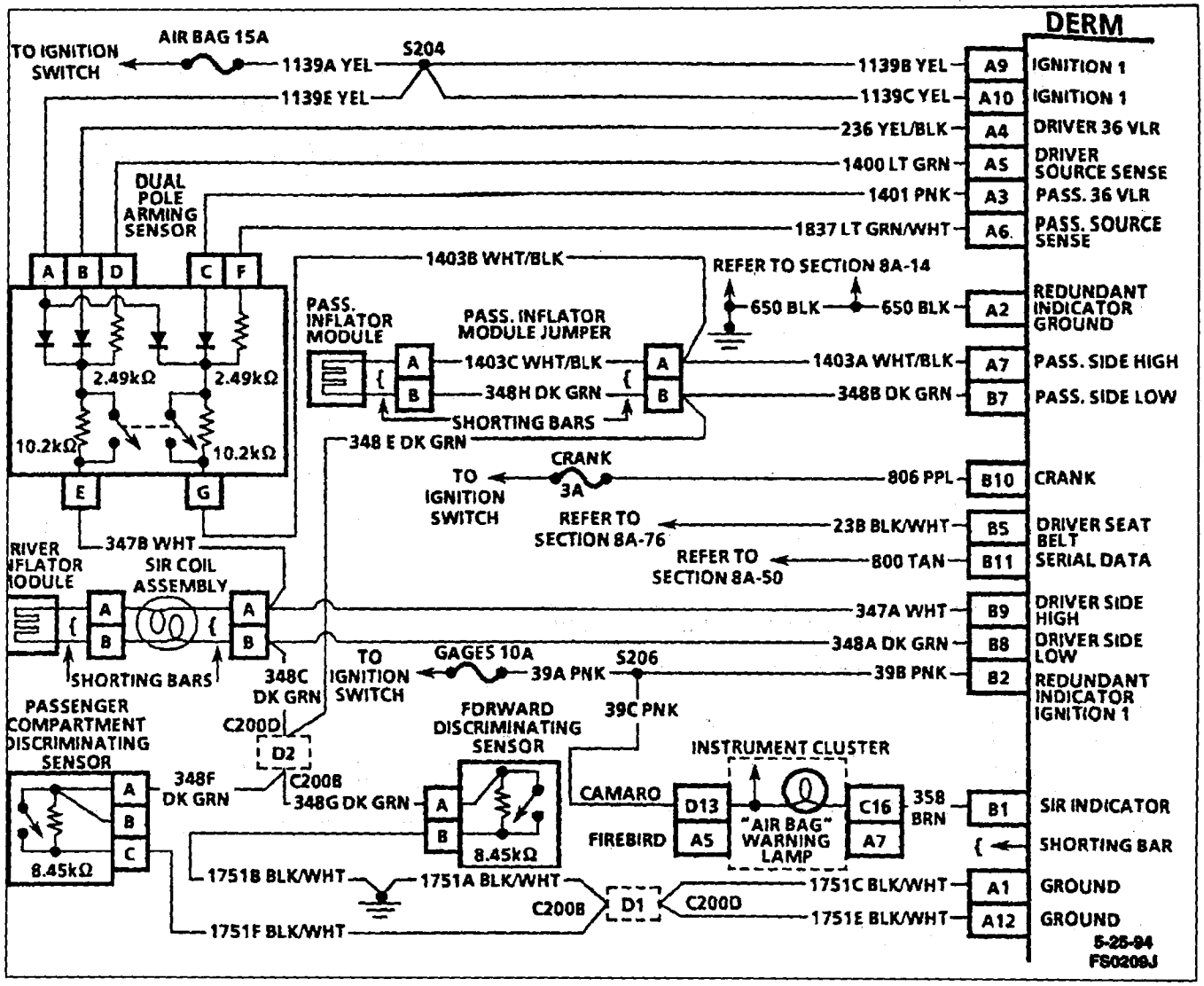
DTC Will Clear When:

The ignition switch is turned "OFF."

DTC 55
DERM INCOMPATIBILITY



C1225S



DTC 61
SIR INDICATOR CIRCUIT FAILURE

Circuit Description:

When the ignition switch is first turned "ON" battery voltage is applied to the "AIR BAG" warning lamp and to the "Ignition 1" input terminals "A9" and "A10". The DERM responds by flashing the "AIR BAG" warning lamp seven times alternating between the primary and redundant lamp drivers. The DERM monitors the primary lamp driver output by comparing the output state at "SIR Indicator" terminal "B1" to the microprocessor commanded state. When "Ignition 1" is above a specified value and the output state does not match the commanded state of the primary lamp driver for 400 milliseconds DTC 61 is set.

DTC Will Set When:

"Ignition 1" voltage is above a specified value and the output state at the "SIR Indicator" terminal "B1" does not match the commanded state of the primary lamp driver for 400 milliseconds. This test is run every 100 milliseconds during "Continuous Monitoring" tests.

Action Taken:

DERM attempts to turn "ON" the "AIR BAG" warning lamp using the redundant lamp driver and sets a diagnostic trouble code.

DTC Will Clear When:

The ignition switch is turned "OFF."

DTC Chart Test Description:

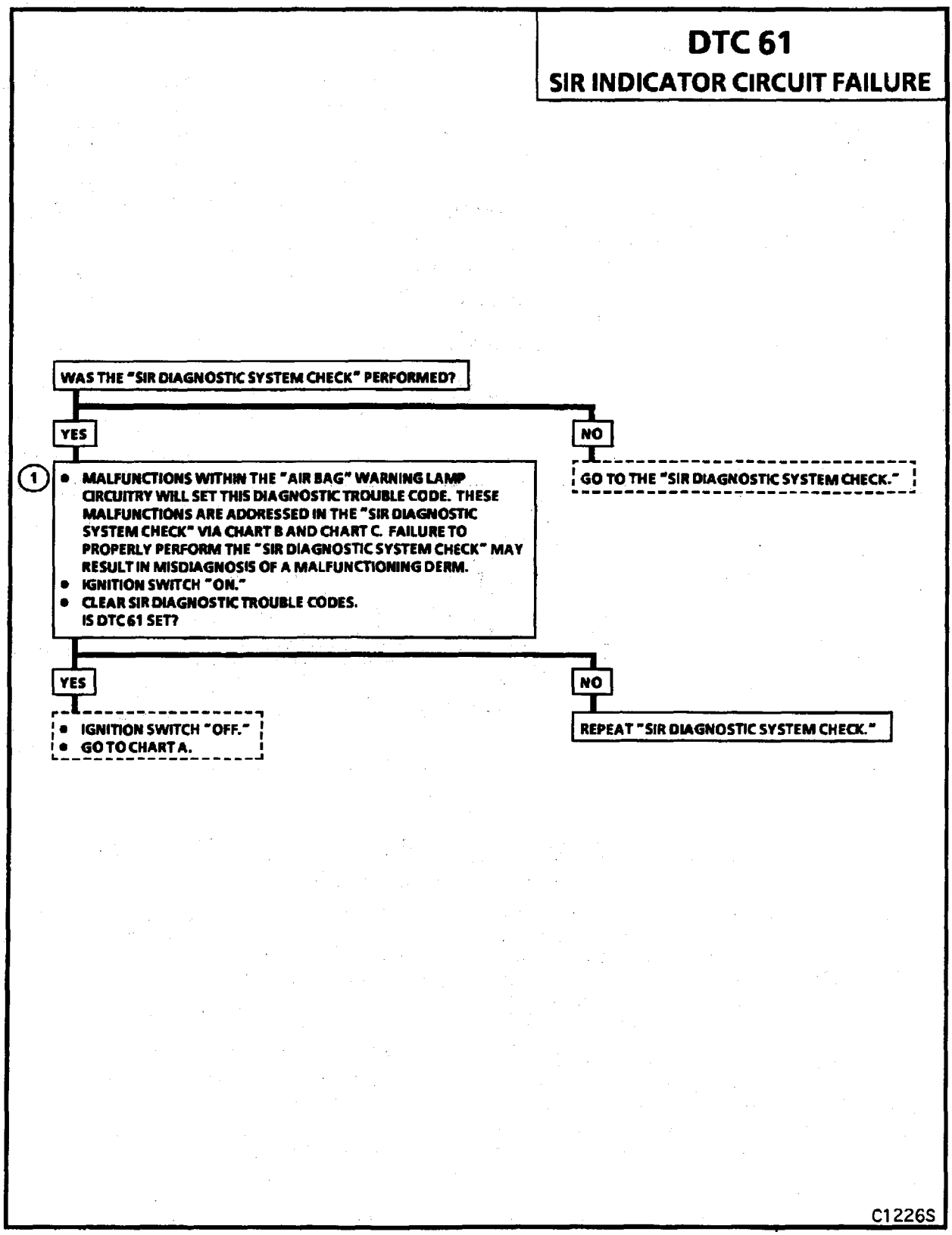
Number(s) below refer to circled number(s) on the diagnostic chart.

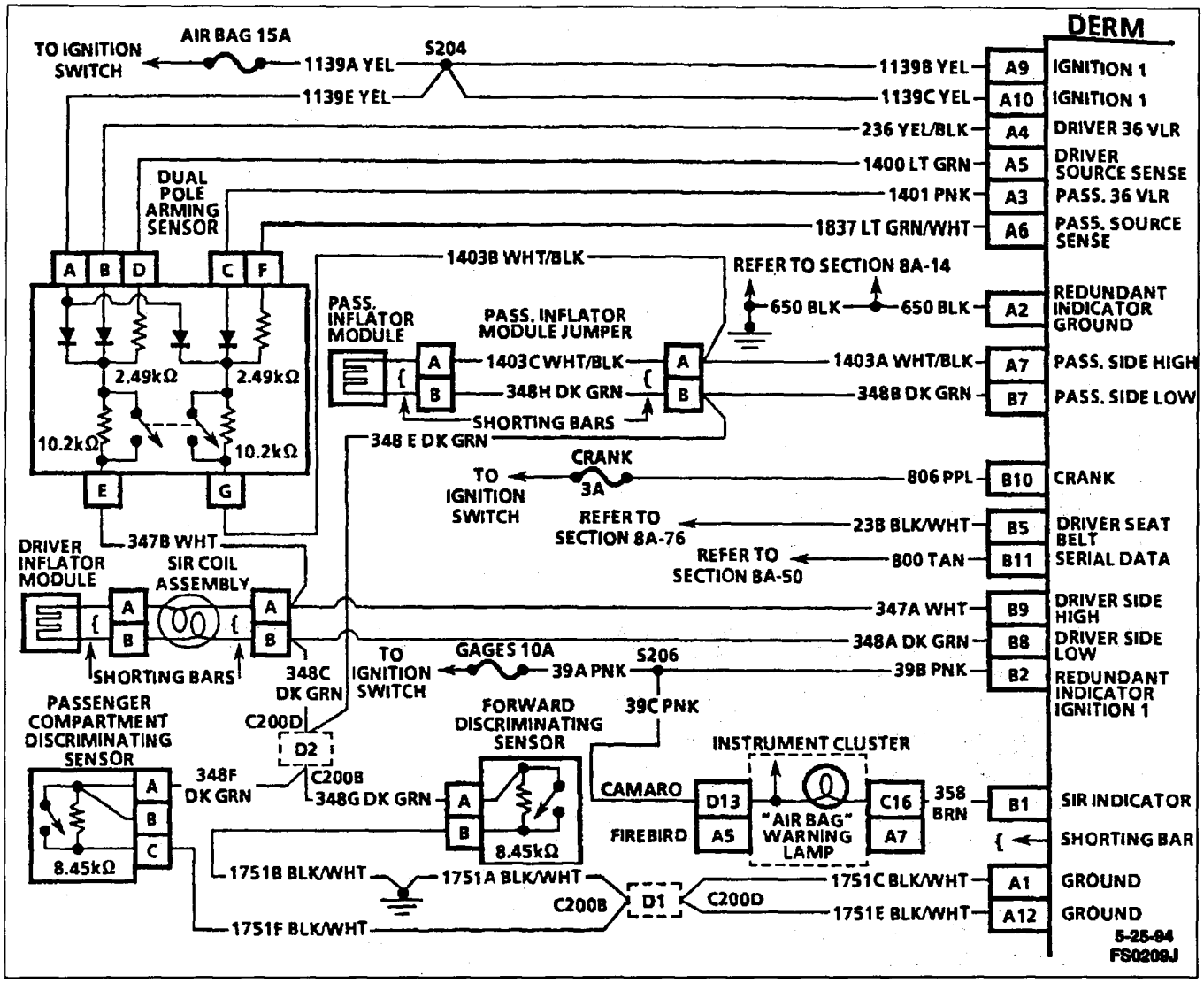
1. When the DERM is configured for a serial data controlled warning lamp (smart cluster) DTC 61 will set.

Clearing SIR diagnostic trouble codes will reset the DERM allowing the DERM to control the "AIR BAG" warning lamp.

Diagnostic Aids:

Refer to CHARTs B and C to diagnose warning lamp circuit malfunctions.


DTC 61
SIR INDICATOR CIRCUIT FAILURE
WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?
YES
NO
GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."
1
MALFUNCTIONS WITHIN THE "AIR BAG" WARNING LAMP CIRCUITRY WILL SET THIS DIAGNOSTIC TROUBLE CODE. THESE MALFUNCTIONS ARE ADDRESSED IN THE "SIR DIAGNOSTIC SYSTEM CHECK" VIA CHART B AND CHART C. FAILURE TO PROPERLY PERFORM THE "SIR DIAGNOSTIC SYSTEM CHECK" MAY RESULT IN MISDIAGNOSIS OF A MALFUNCTIONING DERM.
IGNITION SWITCH "ON."
CLEAR SIR DIAGNOSTIC TROUBLE CODES.
IS DTC 61 SET?
YES
NO
IGNITION SWITCH "OFF."
GO TO CHART A.
REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."
C1226S



DTC 62

REDUNDANT SIR INDICATOR CIRCUIT FAILURE

Circuit Description:

When the ignition switch is first turned "ON" battery voltage is applied to the "AIR BAG" warning lamp and to the "Ignition 1" input terminals "A9" and "A10". The DERM responds by flashing the "AIR BAG" warning lamp seven times alternating between the primary and redundant lamp drivers. The DERM monitors the redundant lamp driver output by comparing the output state at "SIR Indicator" terminal "B1" to the microprocessor commanded state. When "Ignition 1" is above a specified value and the output state does not match the commanded state of the redundant lamp driver for 400 milliseconds DTC 62 is set.

DTC Will Set When:

"Ignition 1" voltage is above a specified value and the output state at the "SIR Indicator" terminal "B1" does not match the commanded state of the redundant lamp driver for 400 milliseconds. This test is run every 100 milliseconds during "Continuous Monitoring" tests.

Action Taken:

DERM attempts to turn "ON" the "AIR BAG" warning lamp using the primary lamp driver and sets a diagnostic trouble code.

DTC Will Clear When:

The ignition switch is turned "OFF."

DTC Chart Test Description:

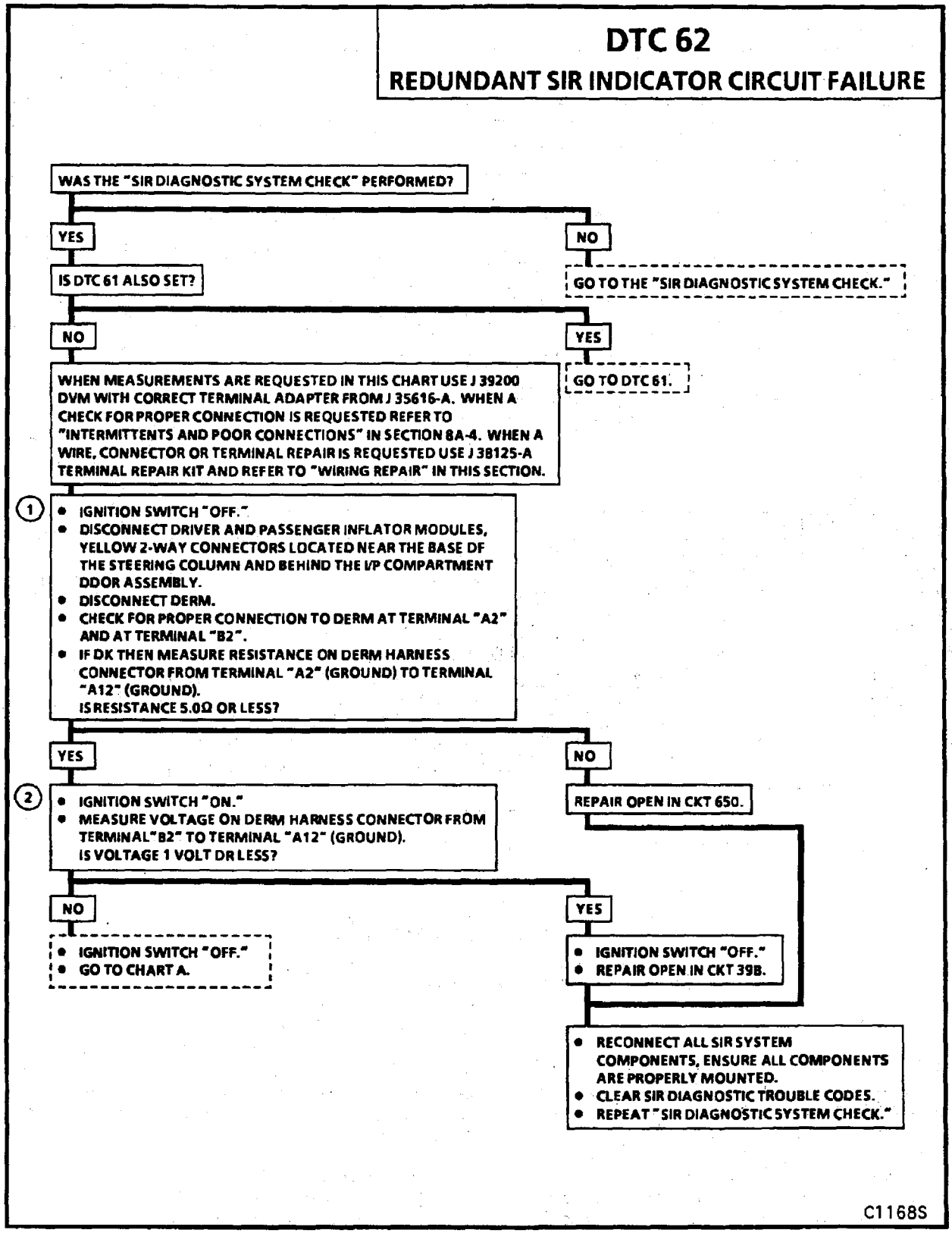
Number(s) below refer to circled number(s) on the diagnostic chart.

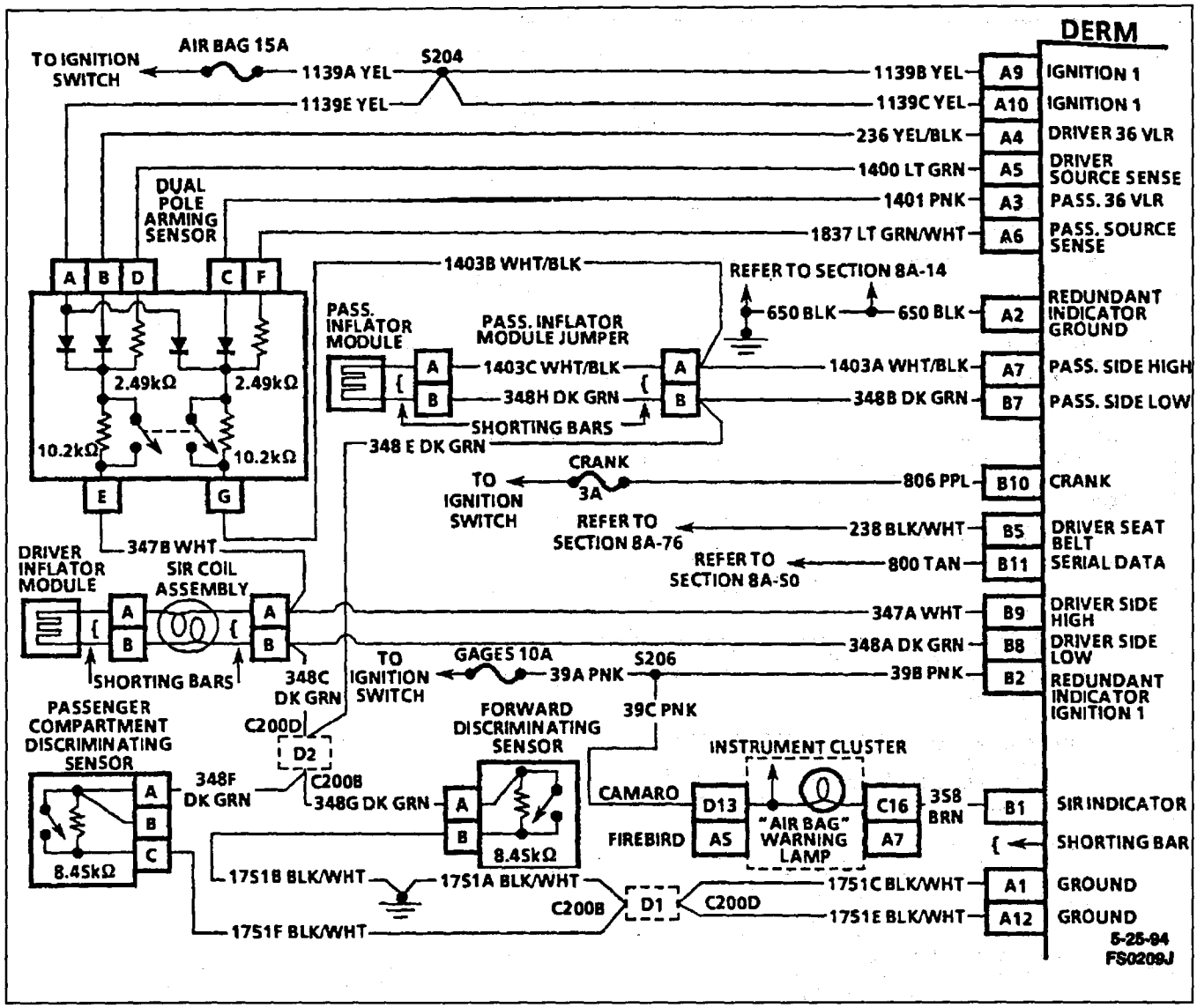
1. This test checks for an open in the "Redundant Indicator Ground" circuit.
2. This test determines whether the malfunction is due to an open in the "Redundant Indicator Ignition 1" circuit.

Diagnostic Aids:

An intermittent condition is likely to be caused by a poor connection to the DERM at terminal "A2" or "B2", an open in CKT 650 or an open in CKT 39B.

DTC 62
REDUNDANT SIR INDICATOR CIRCUIT FAILURE





DTC 71 AND/OR 75
INTERNAL DERM FAULT

Circuit Description:

DTC 71 and/or DTC 75 is an indication of an internal DERM malfunction and will set if any of the following conditions are detected: 1) DERM energy reserve voltage discharge time failure for three consecutive ignition cycles ("Turn-ON" test), 2) DERM is unable to read from or write to EEPROM (tested during "EEPROM read/write cycle"), 3) Either "36 VLR" power supply voltage is above a specified value for 500 milliseconds ("Continuous Monitoring" test), 4) The DERM calculated number for the vehicle in which it is installed does not match the value stored in EEPROM.

DTC Will Set When:

Any of the indicated malfunctions are detected by the DERM. Each of the failure conditions is tested at a different time: 1) At "Turn-ON," 2) Asynchronously, 3) During "Continuous Monitoring," 4) At "Turn-ON."

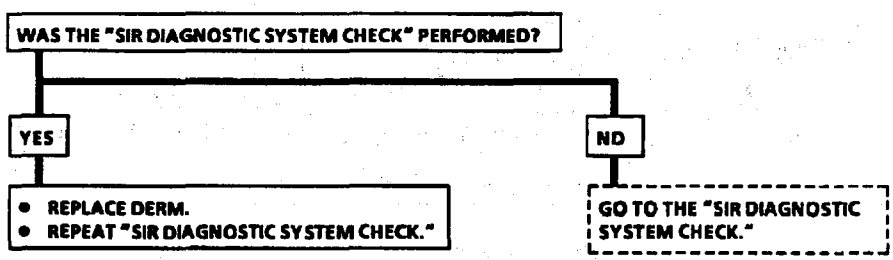
Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

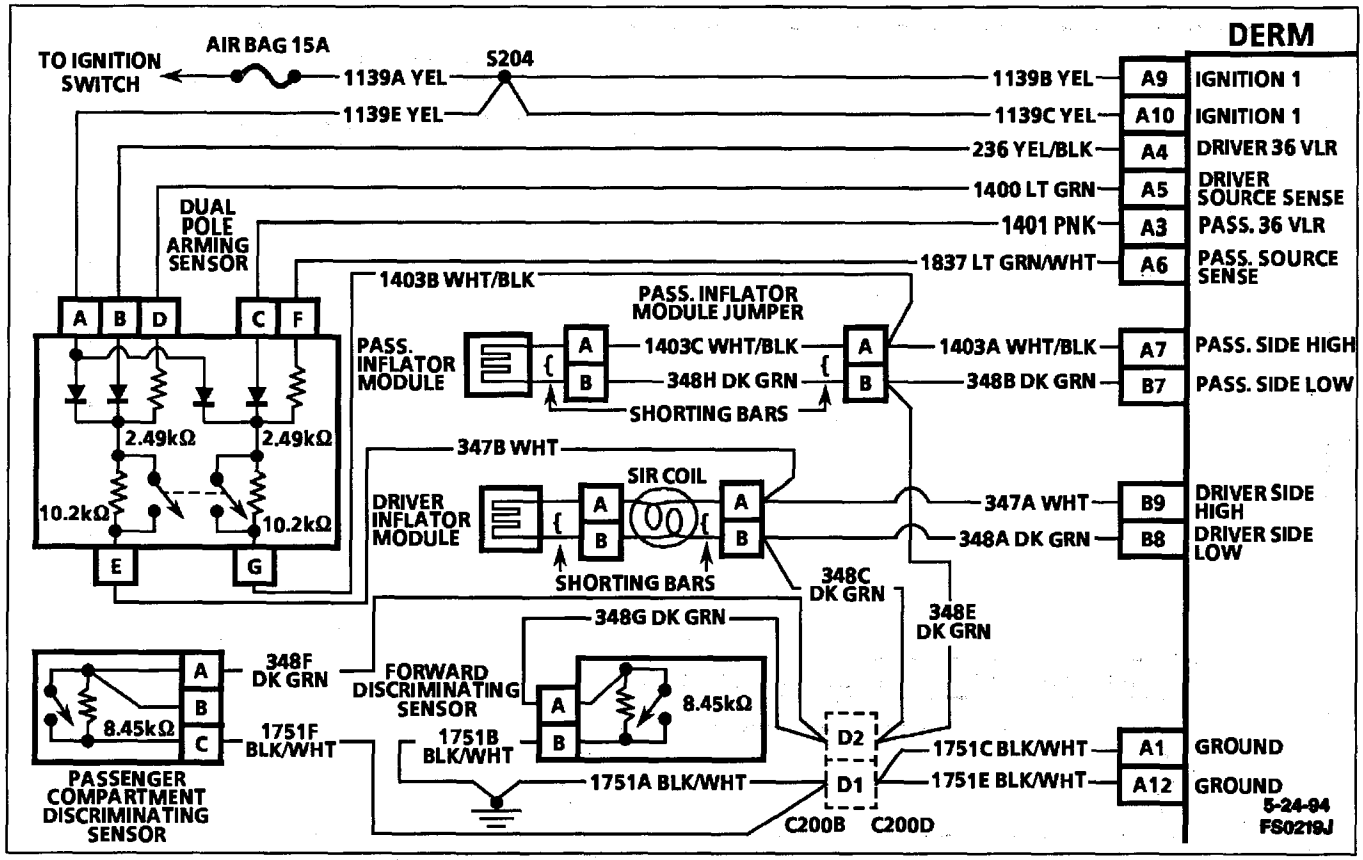
DTC Will Clear When:

The indicated malfunctions are not detected by the DERM.

DTC 71 AND/OR 75
INTERNAL DERM FAULT



C1228S



DTC 81
DRIVER IGNITION DIODE OPEN

Circuit Description:

During the "Turn-ON" tests, performed at the beginning of each ignition cycle, the DERM delays the charging of the "Driver 36 VLR" and "Passenger 36 VLR" power supplies. While the delay is active the DERM measures the voltage at the "Driver 36 VLR" terminal "A4", "Passenger 36 VLR" terminal "A3", "Driver Source Sense" terminal "A5", and "Passenger Source Sense" terminal "A6". When the voltage measured at the two "36 VLR" power supplies indicates they are in a discharged state, the voltage measured at "Passenger Source Sense" is within a specified range of "Ignition 1" voltage and the voltage measured at "Driver Source Sense" is a specified amount below "Ignition 1" voltage DTC 81 is set.

DTC Will Set When:

With both "36 VLR" power supplies in a discharged state, the DERM detects "Ignition 1" voltage at "Passenger Source Sense" terminal "A6" while simultaneously the DERM does not detect "Ignition 1" voltage at "Driver Source Sense" terminal "A5". This test is run once each ignition cycle during the "Turn-ON" tests while the "36 VLR Delay" is active.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

With both "36 VLR" power supplies in a discharged state, the voltages measured at "Driver Source Sense" terminal "A5" and "Passenger Source Sense" terminal "A6" are simultaneously within a specified range of "Ignition 1" voltage. When neither the failure nor clear conditions are met, the state of the DTC from the previous ignition cycle is used.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for a short from the "Driver Source Sense" circuit to the "Passenger 36 VLR" circuit.
2. This test checks for a short from the "Driver Source Sense" circuit to the "Driver 36 VLR" circuit.
3. This test determines whether the malfunction is due to an open within the dual pole arming sensor.

Diagnostic Aids:

An intermittent condition is likely to be caused by a short between CKT 1400 and CKT 236, a short between CKT 1400 and CKT 1401, or an open inside the dual pole arming sensor. The test for this diagnostic trouble code is only run while the "AIR BAG" warning lamp is performing the bulb check. When a scan tool "Clear Codes" command is issued and the malfunction is still present, the DTC will not reappear until the ignition switch is turned "OFF" for at least two minutes with the entire SIR system connected and then the ignition switch is turned "ON."

DTC 81
DRIVER IGNITION DIODE OPEN

WAS THE "SIR DIAGNDSTIC SYSTEM CHECK" PERFORMED?

YES

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

1
- IGNITION SWITCH "OFF."
- DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
- DISCONNECT DUAL POLE ARMING SENSOR.
- MEASURE RESISTANCE ON DUAL POLE ARMING SENSOR HARNESS CONNECTOR FROM TERMINAL "D" TO TERMINAL "C". DOES J 39200 DISPLAY "OL" (INFINITE)?

YES

2
- MEASURE RESISTANCE ON DUAL POLE ARMING SENSOR HARNESS CONNECTOR FROM TERMINAL "D" TO TERMINAL "B". DOES J 39200 DISPLAY "OL" (INFINITE)?

YES

3
- RECONNECT DUAL POLE ARMING SENSOR.
- DISCONNECT DERM.
- IGNITION SWITCH "ON."
- MEASURE VOLTAGE FROM DERM HARNESS CONNECTOR TERMINAL "A5" TO TERMINAL "A1" (GROUND). IS VOLTAGE 1 VOLT OR LESS?

NO

- IGNITION SWITCH "OFF."
- GO TO CHART A.

NO

REPAIR SHORT FROM CKT 1400 TD CKT 1401.

NO

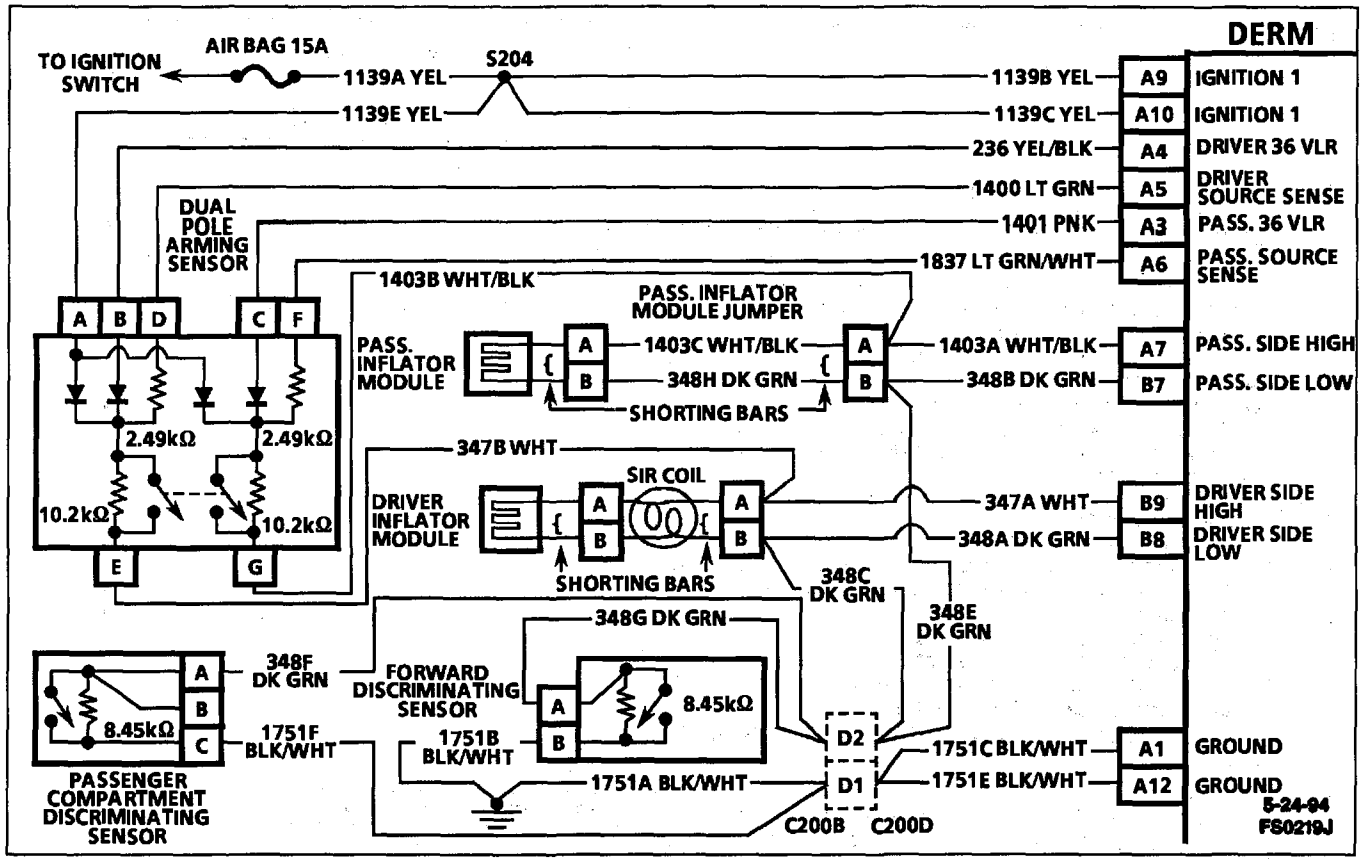
REPAIR SHORT FROM CKT 1400 TO CKT 236.

YES

- IGNITION SWITCH "OFF."
- REPLACE DUAL POLE ARMING SENSOR.

- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

C1169S



DTC 82
PASSENGER IGNITION DIODE OPEN

Circuit Description:

During the "Turn-ON" tests, performed at the beginning of each ignition cycle, the DERM delays the charging of the "Driver 36 VLR" and "Passenger 36 VLR" power supplies. While the delay is active the DERM measures the voltage at the "Driver 36 VLR" terminal "A4", "Passenger 36 VLR" terminal "A3", "Driver Source Sense" terminal "A5", and "Passenger Source Sense" terminal "A6". When the voltage measured at the two "36 VLR" power supplies indicates they are in a discharged state, the voltage measured at "Driver Source Sense" is within a specified range of "Ignition 1" voltage and the voltage measured at "Passenger Source Sense" is a specified amount below "Ignition 1"voltage DTC 82 is set.

DTC Will Set When:

With both "36 VLR" power supplies in a discharged state, the DERM detects "Ignition 1" voltage at "Driver Source Sense" terminal "A5" while simultaneously the DERM does not detect "Ignition 1" voltage at "Passenger Source Sense" terminal "A6". This test is run once each ignition cycle during the "Turn-ON" tests while the "36 VLR Delay" is active.

Action Taken:

DERM turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When:

With both "36 VLR" power supplies in a discharged state, the voltages measured at "Driver Source Sense" terminal "A5" and "Passenger Source Sense" terminal "A6" are simultaneously within a specified range of "Ignition 1" voltage. When neither the failure nor clear conditions are met, the state of the DTC from the previous ignition cycle is used.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for a short from the "Passenger Source Sense" circuit to the "Passenger 36 VLR" circuit.
2. This test check for a short from the "Passenger Source Sense" circuit to the "Driver 36 VLR" circuit.
3. This test determines whether the malfunction is due to an open within the dual pole arming sensor.

Diagnostic Aids:

An intermittent condition is likely to be caused by a short between CKT 1837 and CKT 236, a short between CKT 1837 and CKT 1401, or an open inside the dual pole arming sensor. The test for this diagnostic trouble code is only run while the "AIR BAG" warning lamp is performing the bulb check. When a scan tool "Clear Codes" command is issued and the malfunction is still present, the DTC will not reappear until the ignition switch is turned "OFF" for at least two minutes with the entire SIR system connected and then the ignition switch is turned "ON."

DTC 82
PASSENGER IGNITION DIODE OPEN

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

NO

GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

(1)
- IGNITION SWITCH "OFF."
- DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
- DISCONNECT DUAL POLE ARMING SENSOR.
- MEASURE RESISTANCE ON DUAL POLE ARMING SENSOR HARNESS CONNECTOR FROM TERMINAL "F" TO TERMINAL "C". DOES J 39200 DISPLAY "OL" (INFINITE)?

YES

NO

REPAIR SHORT FROM CKT 1837 TO CKT 1401.

(2)
- MEASURE RESISTANCE ON DUAL POLE ARMING SENSOR HARNESS CONNECTOR FROM TERMINAL "F" TO TERMINAL "B". DOES J 39200 DISPLAY "OL" (INFINITE)?

YES

NO

REPAIR SHORT FROM CKT 1837 TO CKT 236.

(3)
- RECONNECT DUAL POLE ARMING SENSOR.
- DISCONNECT DERM.
- IGNITION SWITCH "ON."
- MEASURE VOLTAGE FROM DERM HARNESS CONNECTOR TERMINAL "A6" TO TERMINAL "A1" (GROUND). IS VOLTAGE 1 VOLT OR LESS?

NO

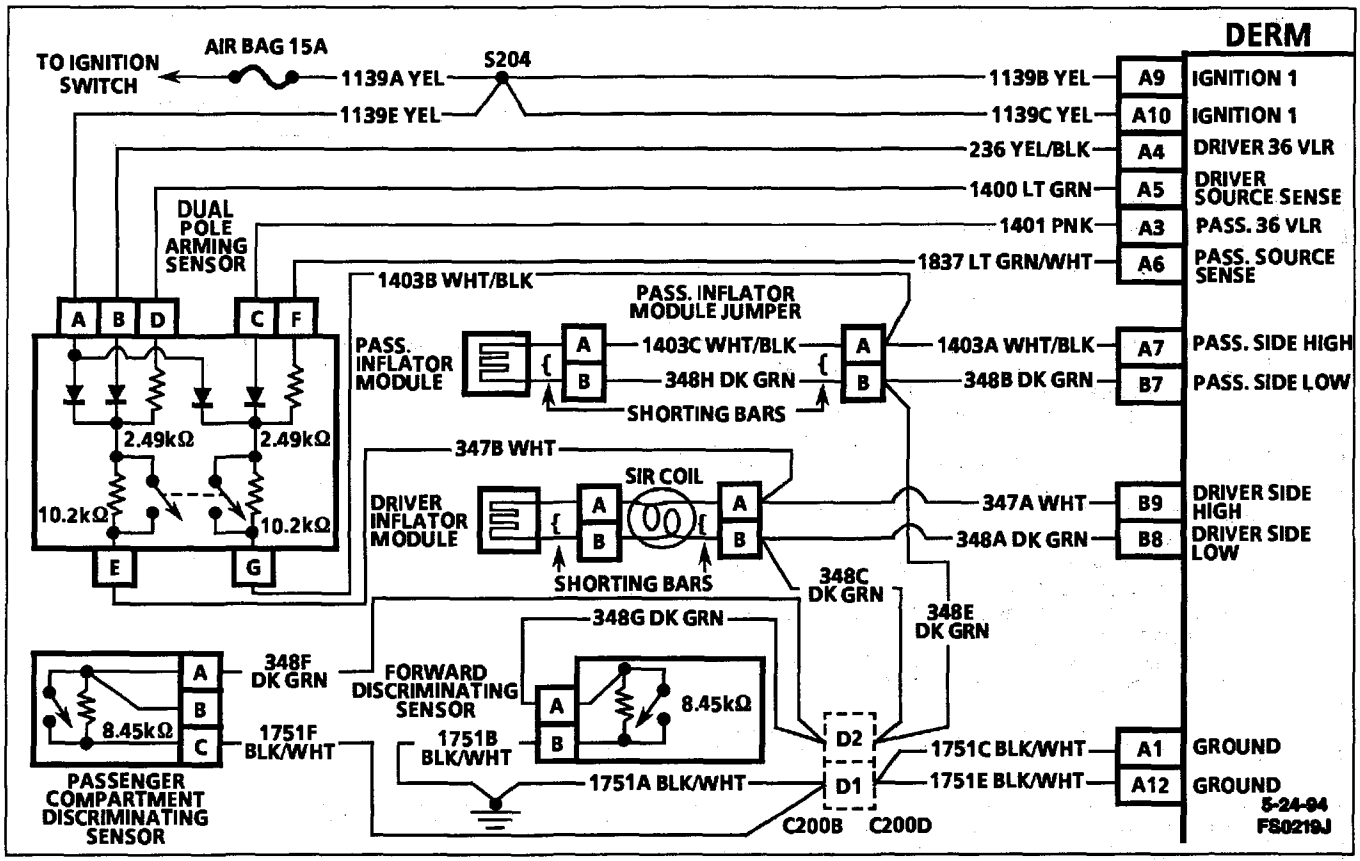
- IGNITION SWITCH "OFF."
- GO TO CHART A.

YES

- IGNITION SWITCH "OFF."
- REPLACE DUAL POLE ARMING SENSOR.

- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

C1170S



HISTORY DTC 83
DRIVER RESERVE DIODE SHORTED

Circuit Description:

During the "Turn-ON" tests, performed at the beginning of each ignition cycle, the DERM delays the charging of the "Driver 36 VLR" and "Passenger 36 VLR" power supplies. While the delay is active the DERM measures the voltage at the "Driver 36 VLR" terminal "A4", "Passenger 36 VLR" terminal "A3", "Driver Source Sense" terminal "A5", and "Passenger Source Sense" terminal "A6". When the driver reserve diode is shorted "Ignition 1" voltage is measured at "Driver 36 VLR" from the forward biased driver ignition diode. When the voltage measured at "Driver 36 VLR" is within a specified range of "Ignition 1" voltage for eight consecutive "Turn-ON" tests History DTC 83 is set.

DTC Will Set When:

The voltage measured at "Driver 36 VLR" terminal "A4" is within a specified range of "Ignition 1" voltage for eight consecutive "Turn-ON" tests and no "higher priority faults" are detected. This test is run once each ignition during the "Turn-ON" test while the "36 VLR delay" is active.

Action Taken:

DERM sets a history diagnostic trouble code.

DTC Will Clear When:

The voltage measured at "Driver 36 VLR" terminal "A4" indicated that the power supply is in a discharged state during "Turn-ON" tests.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test determines whether the malfunction is due to a shorted driver reserve diode within the dual pole arming sensor.

Diagnostic Aids:

This diagnostic trouble code will not set as a current DTC. Therefore follow the DTC chart to diagnose a history DTC 83.

HISTORY DTC 83
DRIVER RESERVE DIODE SHORTED

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

1
- IGNITION SWITCH "OFF."
- DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
- DISCONNECT DERM.
- IGNITION SWITCH "ON."
- MEASURE VOLTAGE ON DERM HARNESS CONNECTOR TERMINAL "A4" TO TERMINAL "A1" (GROUND). IS VOLTAGE 1 VOLT OR LESS?

YES

- IGNITION SWITCH "OFF."
- GO TO CHART A.

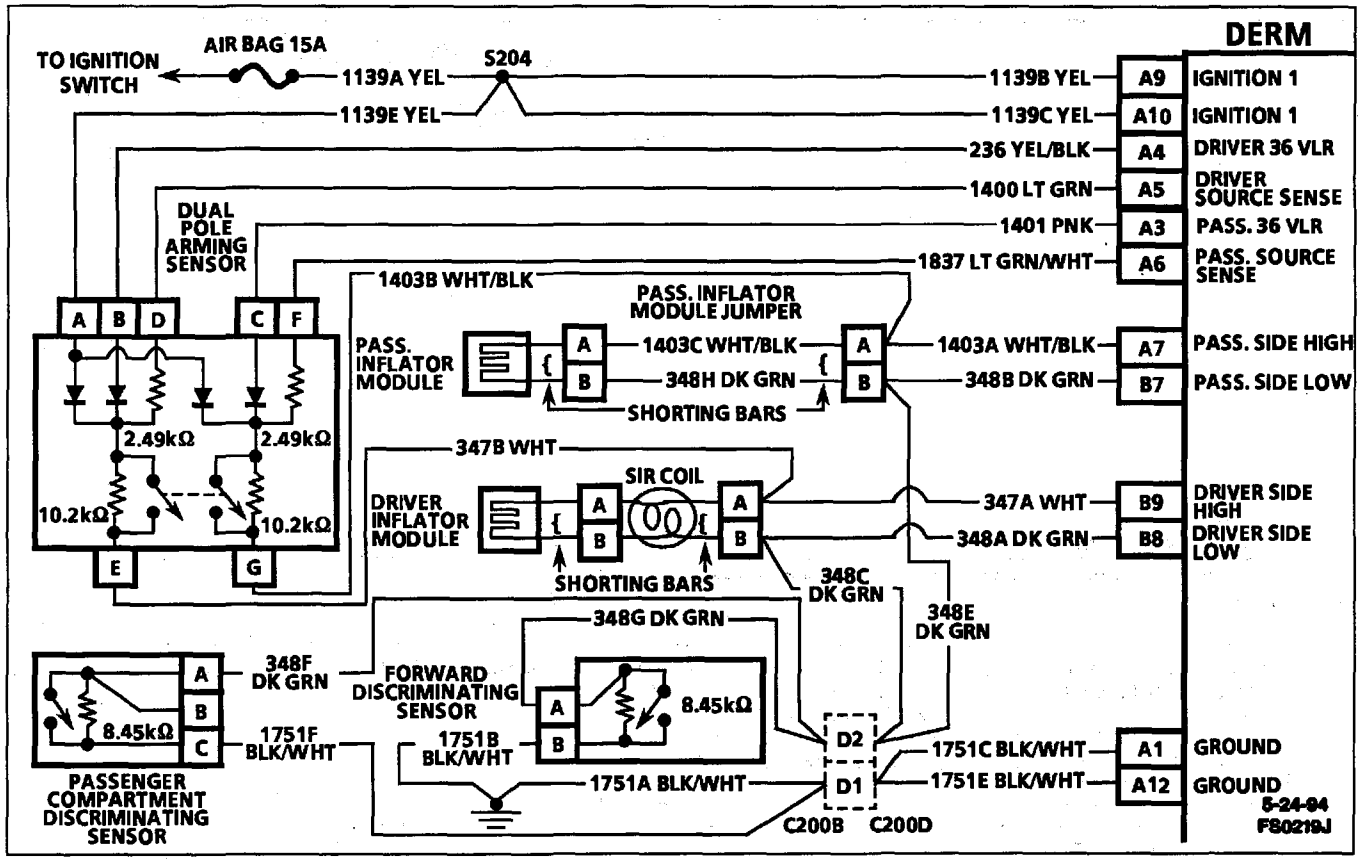
NO

- IGNITION SWITCH "OFF."
- REPLACE DUAL POLE ARMING SENSOR.
- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

NO

GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK".

C1171S



HISTORY DTC 84
PASSENGER RESERVE DIODE SHORTED

Circuit Description:

During the "Turn-ON" tests, performed at the beginning of each ignition cycle, the DERM delays charging of the "Driver 36 VLR" and "Passenger 36 VLR" power supplies. While the delay is active the DERM measures the voltage at the "Driver 36 VLR" terminal "A4", "Passenger 36 VLR" terminal "A3", "Driver Source Sense" terminal "A5" and "Passenger Source Sense" terminal "A6". When the passenger reserve diode is shorted "Ignition 1" voltage is measured at "Passenger 36 VLR" from the forward biased passenger ignition diode. When the voltage measured at "Passenger 36 VLR" is within a specified range of "Ignition 1" voltage for eight consecutive "Turn-ON" tests History DTC 84 is set.

DTC Will Set When:

The voltage measured at "Passenger 36 VLR" terminal "A3" is within a specified range of "Ignition 1" voltage for eight consecutive "Turn-ON" tests and no higher priority faults are detected. This test is run once each ignition cycle during the "Turn-ON" test while the "36 VLR Delay" is active.

Action Taken:

DERM sets a history diagnostic trouble code.

DTC Will Clear When:

The voltage measured at "Passenger 36 VLR" terminal "A3" indicates that the power supply is in a discharged state during "Turn-ON" tests.

DTC Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test determines whether the malfunction is due to a shorted passenger reserve diode within the dual pole arming sensor.

Diagnostic Aids:

This diagnostic trouble code will not set as a current DTC. Therefore follow the DTC chart to diagnose a history DTC 84.

HISTORY DTC 84
PASSENGER RESERVE DIODE SHORTED

WAS THE "SIR DIAGNOSTIC SYSTEM CHECK" PERFORMED?

YES

NO

GO TO THE "SIR DIAGNOSTIC SYSTEM CHECK."

WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART USE J 39200 DVM WITH CORRECT TERMINAL ADAPTER FROM J 35616-A. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN SECTION 8A-4. WHEN A WIRE, CONNECTOR OR TERMINAL REPAIR IS REQUESTED USE J 38125-A TERMINAL REPAIR KIT AND REFER TO "WIRING REPAIR" IN THIS SECTION.

1
- IGNITION SWITCH "OFF."
- DISCONNECT DRIVER AND PASSENGER INFLATOR MODULES, YELLOW 2-WAY CONNECTORS LOCATED NEAR THE BASE OF THE STEERING COLUMN AND BEHIND THE I/P COMPARTMENT DOOR ASSEMBLY.
- DISCONNECT DERM.
- IGNITION SWITCH "ON."
- MEASURE VOLTAGE FROM DERM HARNESS CONNECTOR TERMINAL "A3" TO TERMINAL "A1" (GROUND). IS VOLTAGE 1 VOLT OR LESS?

YES

- IGNITION SWITCH "OFF."
- GO TO CHART A.

NO

- IGNITION SWITCH "OFF."
- REPLACE DUAL POLE ARMING SENSOR.
- RECONNECT ALL SIR SYSTEM COMPONENTS, ENSURE ALL COMPONENTS ARE PROPERLY MOUNTED.
- CLEAR SIR DIAGNOSTIC TROUBLE CODES.
- REPEAT "SIR DIAGNOSTIC SYSTEM CHECK."

C1172S

ON-VEHICLE SERVICE

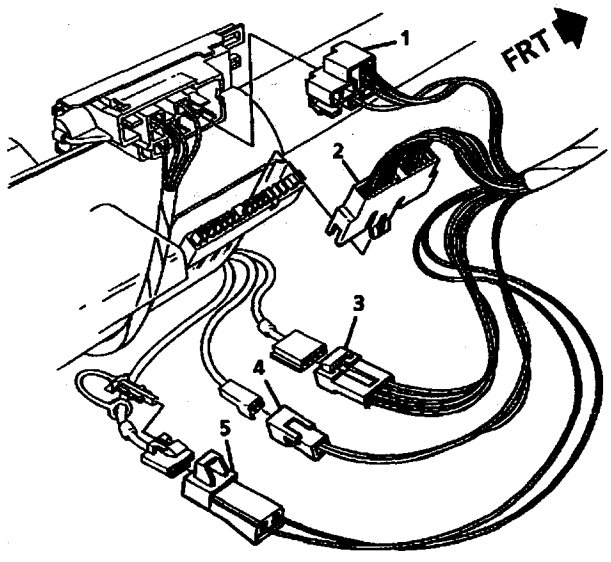
SERVICE PRECAUTIONS

CAUTION: When performing service on or around SIR components or SIR wiring, follow the procedures listed below to temporarily disable the SIR system. Failure to follow procedures could result in possible air bag deployment, personal injury or otherwise unneeded SIR system repairs.

The DERM in 1993 and previous Driver-Only SIR systems can maintain sufficient voltage to cause a deployment for up to 10 minutes after the ignition switch is turned "OFF," the battery is disconnected, or the fuse powering the DERM is removed.

The DERM in 1993 1/2 and later Driver-Only and the DERM in all Driver-Passenger SIR systems can maintain sufficient voltage to cause a deployment for up to 2 minutes after the ignition switch is turned "OFF," the battery is disconnected, or the fuse powering the DERM is removed.

Many of the service procedures require removal of the "AIR BAG" fuse, and disconnection of the inflator modules from the deployment loop to avoid an accidental deployment. If the inflator module is disconnected from the deployment loop as noted in the "Disabling the SIR System" procedure that follows, service can begin immediately without waiting for the 10 minute or 2 minute time period to expire.



1 IGNITION SWITCH HARNESS CONNECTOR
2 TURN SIGNAL, HAZARDS AND HORN HARNESS CONNECTOR
3 REDUNDANT RADIO CONTROL HARNESS CONNECTOR (FIREBIRD WITH UK3)
4 IGNITION LOCK CYLINDER (PASS-KEY®) HARNESS CONNECTOR
5 STEERING COLUMN (YELLOW 2-WAY) HARNESS CONNECTOR

5-24-94 FS0069J

Figure 9 - Yellow 2-Way SIR Connector (Driver)

Disabling the SIR System

Figure 9

Remove or Disconnect

- Turn the steering wheel so that the vehicle's wheels are pointing straight ahead.
- Turn the ignition switch to "LOCK" and remove key.

1. "AIR BAG" fuse from I/P fuse block.
2. Lower sound insulator panel - left side, refer to SECTION 8C.
3. Connector Position Assurance (CPA) and yellow 2-way connector located near the base of the steering column (Figure 9).
4. I/P compartment door assembly, refer to SECTION 8C.
5. CPA and yellow 2-way connector from passenger inflator module.

Important

- With the "AIR BAG" fuse removed and ignition switch "ON," the "AIR BAG" warning lamp will be "ON." This is normal operation and does not indicate a SIR system malfunction.

Enabling the SIR System

Figure 9

Install or Connect

- Turn ignition switch to "LOCK" and remove key.

1. Yellow 2-way connector and CPA passenger inflator module,
2. I/P compartment door assembly, refer to SECTION 8C.
3. Yellow 2-way connector and CPA near base of steering column.
4. Lower sound insulator panel - left side, refer to SECTION 8C.
5. "AIR BAG" fuse to I/P fuse block.

- Turn ignition switch to "RUN" and verify that the "AIR BAG" warning lamp flashes seven times and then turns "OFF." If it does not operate as described, perform the "SIR Diagnostic System Check" in this section.

Handling/Installation/Diagnosis

1. Inflator modules should not be subjected to temperatures above 65 degrees C (150 degrees F).
2. Discriminating sensors, inflator modules, arming sensors, or DERMs should not be used if they have been dropped from a height of 91.4 centimeters (3 feet).
3. When a discriminating sensor or arming sensor is replaced, it MUST be oriented with the arrow on the sensor pointing toward the front of the vehicle. It is very important for the discriminating sensors and arming sensor to be located flat on

the mounting surface, parallel to the vehicle datum line. It is important that the sensor mounting surface is free of any dirt or other foreign material.

4. Do not apply power to the SIR system unless all components are connected or a diagnostic chart requests it, as this will set a diagnostic trouble code.
5. The "SIR Diagnostic System Check" must be the starting point of any SIR diagnostics. The "SIR Diagnostic System Check" will verify proper "AIR BAG" warning lamp operation and will lead you to the correct chart to diagnose any SIR malfunctions. Bypassing these procedures may result in extended diagnostic time, incorrect diagnosis, and incorrect parts replacements.

REPAIRS AND INSPECTIONS REQUIRED AFTER AN ACCIDENT

Important

- If any SIR system components are damaged, they must be replaced. If SIR component mounting points are damaged, they must be repaired or replaced.
- Never use SIR parts from another vehicle. This does not include remanufactured parts purchased from an authorized GM dealer; they may be used for SIR repairs.
- Do not attempt to service discriminating sensors, the dual pole arming sensor, the DERM, the SIR coil assembly, or the inflator modules. Service of these items is by replacement only.
- Verify the part number of replacement inflator modules. Some GM inflator modules look identical but contain different internal components.

CAUTION: Proper operation of the sensors and Supplemental Inflatable Restraint (SIR) system requires that any repairs to the vehicle structure return it to the original production configuration. Deployment requires, at a minimum, replacement of the sensors, the inflator modules, and dimensional inspection of the steering column. Any visible damage to the DERM mounting bracket(s) requires replacement, sensors must be replaced, and the steering column must be dimensionally inspected, whether deployment occurred or not.

Accident With Deployment - Component Replacement and Inspections

Certain SIR components must be replaced or inspected for damage after a frontal crash involving air bag deployment. Those components are:

- Inflator modules.
- Sensors, if in the area of accident damage.

Important

- Refer to "Sensor Replacement Guidelines" below for important information on sensor replacement in both deployment and nondeployment crashes.

- SIR coil assembly - Inspect wiring and connector for any signs of scorching, melting, or damage due to excessive heat. Replace if damaged. Refer to SECTION 3F5B.

Accident With or Without Deployment - Component Inspections

Certain SIR and restraint system components must be inspected after any crash, whether the air bag deployed or not. Those components are:

- Steering column - Dimensionally inspect per "Checking Steering Column for Accident Damage" in SECTION 3F5B.
- Sensors, if in the area of accident damage.

Important

- Refer to "Sensor Replacement Guidelines" below for important information on sensor replacement in both deployment and nondeployment crashes.

- Knee bolsters and mounting points - Inspect for any distortion, bending, cracking, or other damage.
- I/P steering column reinforcement plate - Inspect for any distortion, bending, cracking, or other damage.
- I/P braces - Inspect for any distortion, bending, cracking, or other damage.
- Seat belts and mounting points - Refer to "Seat Belts" in SECTION 10-5.

Sensor Replacement Guidelines

SIR sensor replacement policy requires replacement of the sensors in the area of accident damage only.

The "area of accident damage" is defined as that area of the vehicle which is crushed, bent, or damaged in other ways. An example might be a significant front-end collision in which the forward portions of the vehicle have contacted another vehicle, tree, guardrail, etc..

In this example, a sensor on the front of the vehicle, such as the radiator tie bar, would require replacement, since that portion of the vehicle was damaged in the accident. A sensor in the passenger compartment , such as the dual pole arming sensor, would not require mandatory replacement. Of course, if the DERM sets a DTC and the diagnostic chart leads to a malfunctioning sensor that was not in the area of accident damage, that sensor should also be replaced.

Sensors in the area of accident damage should be replaced even if those sensors do not appear to be damaged. Do not attempt to determine whether a sensor is OK—ALWAYS replace it if it is in the area of accident damage.

Also, if a sensor is in the area of accident damage, but the air bag has not been deployed, replace the sensor.

DIAGNOSTIC ENERGY RESERVE MODULE

Figure 10

CAUTION: The following procedures must be followed in the order listed to temporarily disable the Supplemental Inflatable Restraint (SIR) system and prevent false diagnostic trouble codes from setting. Failure to follow procedures could result in possible air bag deployment, personal injury or otherwise unneeded SIR system repairs.

NOTICE: Do Not open the DERM case for any reason, touching the connector pins or soldered components may cause electrostatic discharge damage. Repair of a malfunctioning DERM is by replacement only.

Remove or Disconnect

- Disable the SIR system. Refer to "Disabling the SIR System" in this section.

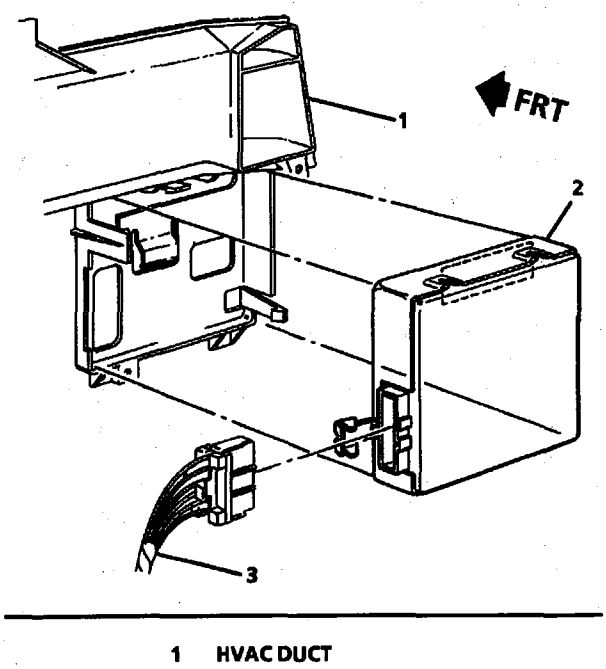


Figure 10 - Diagnostic Energy Reserve Module

1. Lower sound insulator pad - right side, refer to SECTION 8C.
2. I/P compartment door assembly.
3. Connector Position Assurance (CPA) and electrical connector.
4. DERM from vehicle.

Install or Connect

1. DERM in vehicle.
2. Electrical connector and CPA.
3. I/P compartment door assembly.
4. Lower sound insulator pad - right side, refer to SECTION 8C.

- Enable SIR system, refer to "Enabling the SIR System" in this section.

DISCRIMINATING SENSORS

Figures 11 and 12

Caution should be used to assure proper location of sensors to the mounting brackets. The keying of the sensors through the wiring harness connectors must not be modified for any reason.

Forward Discriminating Sensor

Figure 11

CAUTION: During service procedures, be very careful when handling a sensor. Never strike or jar a sensor. Under some circumstances, it could cause deployment and result in personal injury or improper operation of the Supplemental Inflatable Restraint (SIR) system. All sensors and mounting bracket bolts must be carefully torqued to assure proper operation. Never power up the SIR system when any sensor is not rigidly attached to vehicle, since the sensor could be activated when not attached and could result in deployment.

Remove or Disconnect

- Disable the SIR system. Refer to "Disabling the SIR System" in this section.

1. Sensor fasteners.
2. Sensor from vehicle.
3. Connector Position Assurance (CPA) and electrical connector.

Important

- The following procedures should be utilized in the event that the sensor mounting holes of fasteners are damaged to the extent that the sensor can no longer be properly mounted.

First Repair

1. Drill 7.4 mm (19/64 inch) hole into clinch nut.
2. Install fasteners (part # 25529109).

Tighten

- Fasteners to 15 N·m (133 lb. in.).

Second Repair

1. Drill 8.5 mm (21/64 inch) hole into clinch nut.
2. Install fasteners (part # 10082184).

Tighten

- Fasteners to 12.5 N·m (111 lb. in.).

CAUTION: Proper operation of the forward discriminating sensor requires the sensor be rigidly attached to the vehicle structure and that the arrow on the sensor be pointing toward the front of the vehicle.

Install or Connect

1. Electrical connector and CPA.
2. Sensor in vehicle.
3. Sensor fasteners.

Tighten

- Fasteners to 10 N·m (89 lb. in.).
- Enable SIR system, refer to "Enabling the SIR System" in this section.

Passenger Compartment Discriminating Sensor

Figure 12

CAUTION: During service procedures, be very careful when handling a sensor. Never strike or jar a sensor. Under some circumstances, it could cause deployment and result in personal injury or improper operation of the Supplemental Inflatable Restraint (SIR) system. All sensors and mounting bracket bolts must be carefully torqued to assure proper operation. Never power up the SIR system when any sensor is not rigidly attached to vehicle, since the sensor could be activated when not attached and could result in deployment.

Remove or Disconnect

- Disable the SIR system. Refer to "Disabling the SIR System" in this section.

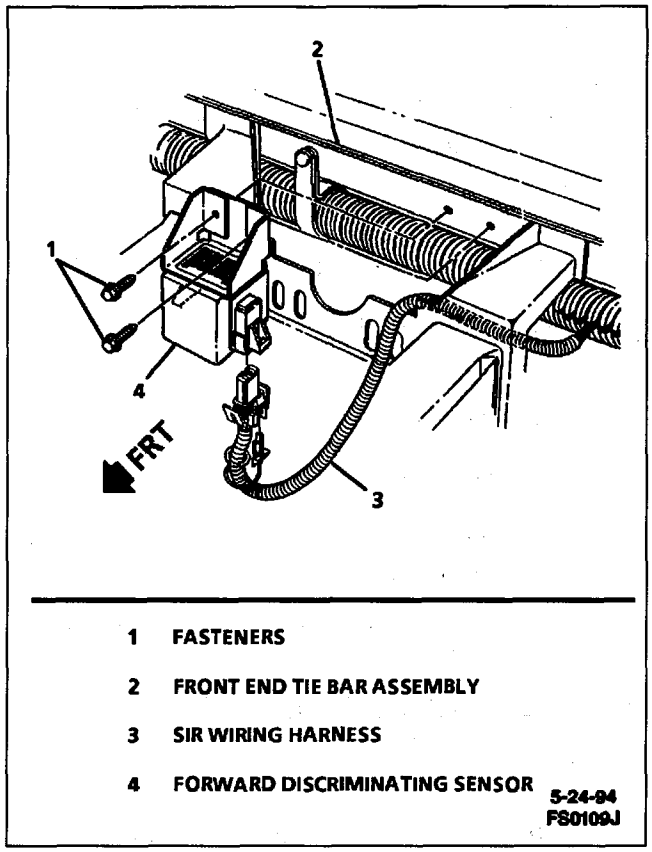


Figure 11 - Forward Discriminating Sensor

1. Connector Position Assurance (CPA) and electrical connector.
2. Sensor fasteners.
3. Sensor from vehicle.

CAUTION: Proper operation of the Passenger compartment discriminating sensor requires the sensor be rigidly attached to the vehicle structure and that the arrow on the sensor be pointing toward the front of the vehicle.

Important

- The following procedures should be utilized in the event that the sensor mounting holes of fasteners are damaged to the extent that the sensor can no longer be properly mounted.
- It is important that the fasteners do not have any oil or other foreign material on them. Oil will damage the plastic on the I/P console.

First Repair

1. Drill 3.5 mm (1/8 inch) hole through sensor and cowl.
2. Enlarge sensor hole to 5mm (3/16 inch).
3. Install fasteners (part # 11509709).

Tighten

- Fasteners to 2.6 N·m (23 lb. in.).

Second Repair

1. Grind off stud flush with panel.
2. Drill 5.6 mm (7/32 inch) hole into center of stud.
3. Install fasteners (part # 10094385).

Tighten

- Fasteners to 6 N.m (53 lb. in.).

Install or Connect

1. Sensor in vehicle.
2. Sensor fasteners.

Tighten

- Fasteners to 10 N.m (89 lb. in.).

3. Electrical connector and CPA.
   - Enable SIR system, refer to "Enabling the SIR System" in this section.

DUAL POLE ARMING SENSOR

Figure 13

CAUTION: During service procedures, be very careful when handling a sensor. Never strike or jar a sensor. Under some circumstances, it could cause deployment and result in personal injury or improper operation of the Supplemental Inflatable Restraint (SIR) system. All sensors and mounting bracket bolts must be carefully torqued to assure proper operation. Never power up the SIR system when any sensor is not rigidly attached to vehicle, since the sensor could be activated when not attached and could result in deployment.

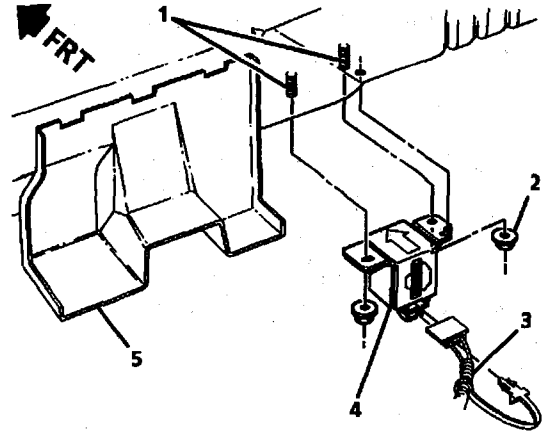
Remove or Disconnect

- Disable the SIR system. Refer to "Disabling the SIR System" in this section.

1. Center console, refer to SECTION 8C.
2. Connector Position Assurance (CPA) and electrical connector.
3. Sensor fasteners.
4. Sensor from vehicle.

Important

- The following procedures should be utilized in the event that the sensor mounting holes of fasteners are damaged to the extent that the sensor can no longer be properly mounted.
- It is important that the fasteners do not have any oil or other foreign material on them. Oil will damage the plastic on the I/P console.



1	BODY MOUNT STUDS
2	FASTENER
3	SIR WIRING HARNESS
4	PASSENGER COMPARTMENT DISCRIMINATING SENSOR
5	STEERING COLUMN SUPPORT BRACKET

5-24-94
FS0119J

Figure 12 - Passenger Compartment Discriminating Sensor

First Repair

1. Install fasteners (part # 11504352).

Tighten

- Fasteners to 6.5 N.m (58 lb. in.).

Second Repair

1. Install fasteners (part # 11504688).

Tighten

- Fasteners to 3 N.m (27 lb. in.).

CAUTION: Proper operation of the dual pole arming sensor requires the sensor be rigidly attached to the vehicle structure and that the arrow on the sensor be pointing toward the front of the vehicle.

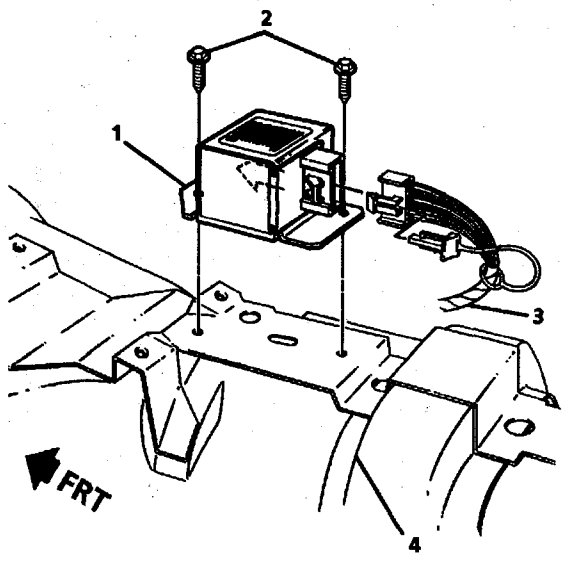
Install or Connect

1. Sensor in vehicle.
2. Sensor fasteners.

Tighten

- Fasteners to 4.5 N.m (40 lb. in.).

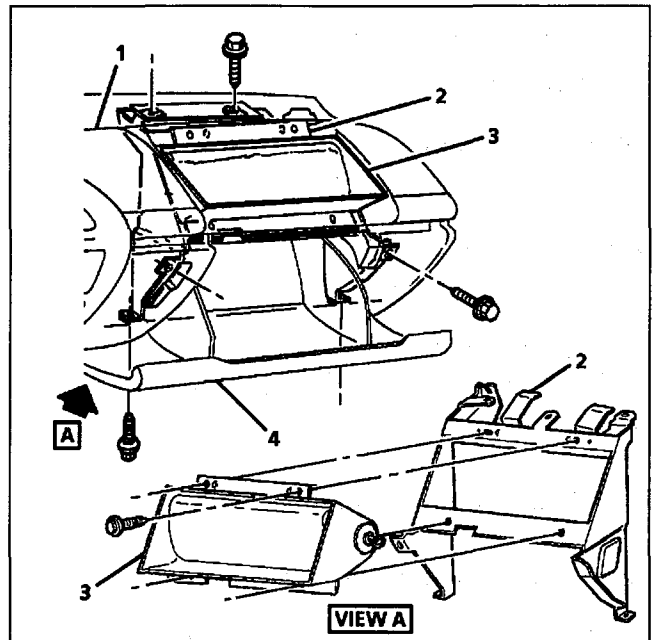
3. Electrical connector and CPA.
4. Center console, refer to SECTION 8C.
   - Enable SIR system, refer to "Enabling the SIR System" in this section.



1 DUAL POLE ARMING SENSOR
2 FASTENERS
3 SIR WIRING HARNESS
4 FLOOR TUNNEL

5-24-94
FS0129J

Figure 13 - Dual Pole Arming Sensor



1 I/P TRIM PAD
2 SIR BRACKET ASSEMBLY
3 PASSENGER INFLATOR MODULE
4 I/P COMPARTMENT DOOR ASSEMBLY

5-24-94
FS0139J

Figure 14 - Passenger Inflator Module

PASSENGER INFLATOR MODULE

Figure 14

Live (Undeployed) Inflator Module

Refer to "Inflator Module Handling/Shipping/ Scrapping" in this section.

Deployed Inflator Module

After the inflator module has been deployed, the surface of the air bag may contain a powdery residue. This powder consists primarily of cornstarch (used to lubricate the bag as it inflates) and byproducts of the chemical reaction. Sodium hydroxide dust (similar to lye soap) is produced as a byproduct of the deployment reaction. The sodium hydroxide then quickly reacts with atmospheric moisture and is converted to sodium carbonate and sodium bicarbonate (baking soda). Therefore, it is unlikely that sodium hydroxide will be present after deployment. As with any procedures, you should wear gloves and safety glasses.

Remove or Disconnect

- Disable the SIR system. Refer to "Disabling the SIR System" in this section.

1. I/P carrier assembly, refer to SECTION 8C.
2. Connector Position Assurance (CPA) and electrical connector.
3. Fasteners from inflator module.
4. Inflator module from vehicle.

CAUTION: When carrying a live inflator module, make sure the bag is pointed away from you. Never carry the inflator module by the wires or connector on the side of the module. In case of an accidental deployment, the bag will then deploy with minimal chance of injury. When placing a live inflator module on a bench or other surface, always face the bag up, away from the surface. This is necessary so that a free space is provided to allow the air bag to expand in the unlikely event of accidental deployment. Otherwise personal injury may result.

Install or Connect

NOTICE: Refer to "NOTICE" on page 9J-1.

1. Inflator module in vehicle.
2. Inflator module fasteners.

Tighten

- Fasteners to 2.8 N·m (25 lb. in.).

3. Electrical connector and CPA.
4. I/P carrier assembly, refer to SECTION 8C.
   - Enable the SIR system, refer to "Enabling the SIR System" in this section.

"AIR BAG" WARNING LAMP

Refer to SECTION 8C.

DRIVER INFLATOR MODULE

Refer to SECTION 3F.

SIR COIL ASSEMBLY

Refer to SECTION 3F5B.

INFLATOR MODULE HANDLING/SHIPPING/SCRAPPING

Figure 15

Live (Undeployed) Inflator Module

Special care is necessary when handling and storing a live (undeployed) inflator module. The rapid gas generation produced during deployment of the air bag could cause the inflator module, or an object in front of the inflator module, to be thrown through the air in the unlikely event of an accidental deployment.

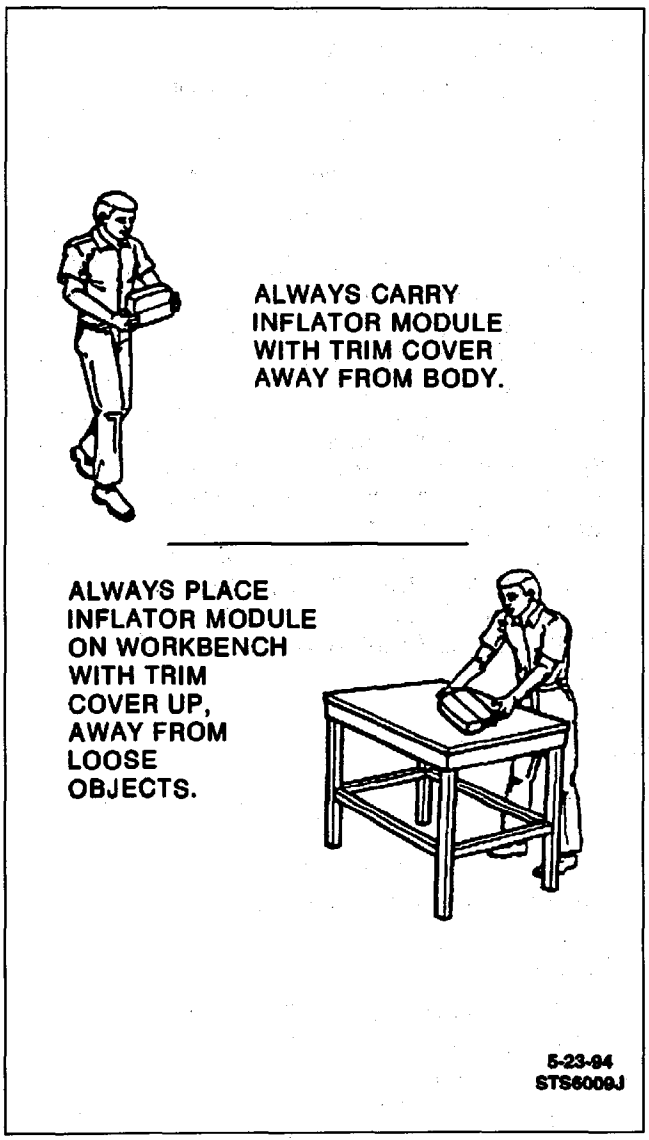


Figure 15 - Proper Live Inflator Module Handling

CAUTION: When carrying a live inflator module, make sure the bag opening is pointed away from you. In case of an accidental deployment, the bag will then deploy with minimal chance of injury. Never carry the inflator module by the wires or connector on the underside of the module. When placing a live inflator module on a bench or other surface, always face the bag and trim cover up, away from the surface. This is necessary so that a free space is provided to allow the air bag to expand in the unlikely event of accidental deployment. Never rest a steering column assembly on the steering wheel with the inflator module face down and column vertical. Otherwise, personal injury may result.

Shipping Procedures For Live (Undeployed) Inflator Modules

Service personnel should refer to the latest Service Bulletins for proper SIR inflator module shipping procedures.

Inflator Module Scrapping Procedure

During the course of a vehicle's useful life, certain situations may arise which will necessitate the disposal of a live (undeployed) inflator module. This information covers proper procedures for disposing of a live inflator module.

Before a live inflator module can be disposed of, it must be deployed. Live inflator modules must not be disposed of through normal refuse channels.

CAUTION: Failure to follow proper Supplemental Inflatable Restraint (SIR) inflator module disposal procedures can result in air bag deployment which may cause personal injury. Undeployed inflator modules must not be disposed of through normal refuse channels. The undeployed inflator module contains substances that can cause severe illness or personal injury if the sealed container is damaged during disposal. Disposal in any manner inconsistent with proper procedures may be a violation of federal, state, and/or local laws.

If a vehicle is the subject of a Product Liability Report related to the SIR system and is subject to a Preliminary Investigation (GM-1241), DO NOT DEPLOY the inflator module and DO NOT ALTER the SIR system in any manner. Refer to the applicable service bulletin on SIR shipping procedures for details on handling SIR systems involved with GM-1241. If a vehicle is the subject of a campaign affecting inflator modules, DO NOT DEPLOY the inflator module. Follow instructions in the Campaign Service Bulletin for proper disposition of the inflator module.

If an inflator module is replaced under warranty, DO NOT DEPLOY the air bag. The inflator module may need to be returned, undeployed, to Inland Fisher Guide. Refer to procedures shown in the appropriate service bulletin regarding SIR shipping procedures.

In situations which require deployment of a live inflator module, deployment may be accomplished inside or outside the vehicle. The method employed depends upon the final disposition of the particular vehicle, as noted in "Deployment Outside Vehicle" and "Deployment Inside Vehicle" in this section.

Deployment Outside Vehicle (Driver Inflator Module)

Figures 16 through 23

Deployment outside the vehicle is proper when the vehicle is to be returned to service. This includes, for example, situations in which the vehicle will be returned to useful service after a functionally or cosmetically deficient inflator module is replaced. Deployment and disposal of a malfunctioning inflator module is, of course, subject to any required retention period.

For deployment of a live (undeployed) inflator module outside the vehicle, the deployment procedure must be followed exactly. Always wear safety glasses during this deployment procedure until a deployed inflator module is scrapped or until an undeployed inflator module is shipped. Before performing the procedures you should be familiar with servicing the SIR system and with proper handling of the inflator module. Procedures should be read fully before they are performed.

The following procedure requires use of J 38826 SIR deployment harness with appropriate pigtail adapter. Do not attempt procedure without J 38826 adapter.

CAUTION: Failure to follow procedures in the order listed may result in personal injury. Never connect deployment harness to any power source before connecting deployment harness to the driver inflator module. Deployment harness shall remain shorted and not be connected to a power source until the air bag is to be deployed. The inflator module will immediately deploy the air bag when a power source is connected to it. Wear safety glasses throughout this entire deployment and disposal procedure.

Important

- This information applies only to driver inflator modules. Refer to "Deployment Outside Vehicle (Passenger Inflator Module)" in this section for information on passenger inflator module scrapping.

1. Turn ignition switch to "LOCK," remove key and put on safety glasses.
2. Inspect J 38826 SIR Deployment Harness and appropriate pigtail adapter for damage. If harness or pigtail adapter is damaged, discard and obtain a replacement.
3. Short the two SIR deployment harness leads together by fully seating one banana plug into the other. SIR deployment harness shall remain shorted and not be connected to a power source until the air bag is to be deployed (Figure 16).
4. Connect the appropriate pigtail adapter to the SIR deployment harness (Figure 16).
5. Remove driver inflator module from vehicle. Refer to SECTION 3F.
6. Remove horn lead from the back of the driver inflator module.
7. Remove all horn buttons and steering wheel control buttons from driver inflator module, if applicable.

CAUTION: When storing a live inflator module or when leaving a live inflator module unattended on a bench or other surface, always face the bag and trim cover up and away from the surface. This is necessary so that a free space is provided to allow the air bag to expand in the unlikely event of accidental deployment. Failure to follow procedures may result in personal injury.

8. Place the driver inflator module on a work bench or other surface away from all loose or flammable objects with its vinyl trim cover facing up, away from the surface (Figure 17).
9. Clear a space on the ground about 185 cm (six feet) in diameter where the driver inflator module is to be deployed. A paved, outdoor location where there is no activity is preferred. If an outdoor location is not available, a space on the shop floor where there is no activity and sufficient ventilation is recommended. Ensure no loose or flammable objects are within the deployment area (Figure 18).
10. Place the driver inflator module, with its vinyl trim cover facing up, on the ground in the space just cleared (Figure 18).
11. Stretch the SIR deployment harness and pigtail adapter from the driver inflator module to its full length (Figure 19).
12. Place a power source near the shorted end of the SIR deployment harness. Recommended application: 12 volts minimum, 2 amps minimum. A vehicle battery is suggested.
13. Connect the driver inflator module to the pigtail adapter on the SIR deployment harness. Deployment harness shall remain shorted and not be connected to a power source until the air bag is to be deployed. The driver inflator module will immediately deploy the air bag when a power source is connected to it (Figure 20).

Important

- Ensure that the pigtail adapter is firmly seated into the driver inflator module connector. Failure to fully seat the connectors may leave the shorting bar located in the driver inflator module connector functioning (shorted) and may result in non-deployment of the driver inflator module.

14. Verify that the area around the driver inflator module is clear of all people and loose or flammable objects.
15. Verify that the driver inflator module is resting with its vinyl trim cover facing up.
16. Notify all people in the immediate area that you intend to deploy the driver inflator module. The deployment will be accompanied by a substantial report which may startle the uninformed.
17. Separate the two banana plugs on the SIR deployment harness (Figure 21).

NOTICE: When the air bag deploys, the driver inflator module may jump about 30 cm (one foot) vertically. This is a normal reaction of the driver inflator module to the force of the rapid gas expansion inside the air bag.

NOTICE: When the air bag deploys, the rapid gas expansion will create a substantial report. Notify all people in the immediate area that you intend to deploy the driver inflator module.

CAUTION: Deployment harness shall remain shorted and not be connected to a power source until the air bag is to be deployed. The driver inflator module will immediately deploy the air bag when a power source is connected to it. Connecting the deployment harness to the power source should always be the last step prior to deployment in the inflator module deployment procedure. Failure to follow procedures in the order listed may result in personal injury.

18. Connect the SIR deployment harness wires to the power source to immediately deploy the driver inflator module. Recommended application: 12 volts minimum, 2 amps minimum. A vehicle battery is suggested (Figure 22).
19. Disconnect the SIR deployment harness from the power source.
20. Short the two SIR deployment harness leads together by fully seating one banana plug into the other (Figure 16).
21. In the unlikely event that the driver inflator module did not deploy after following these procedures, proceed immediately with Steps 26 through 29. If the driver inflator module did deploy, proceed with Steps 22 through 25.
22. Put on a pair of shop gloves to protect your hands from possible irritation and heat when handling the deployed driver inflator module.

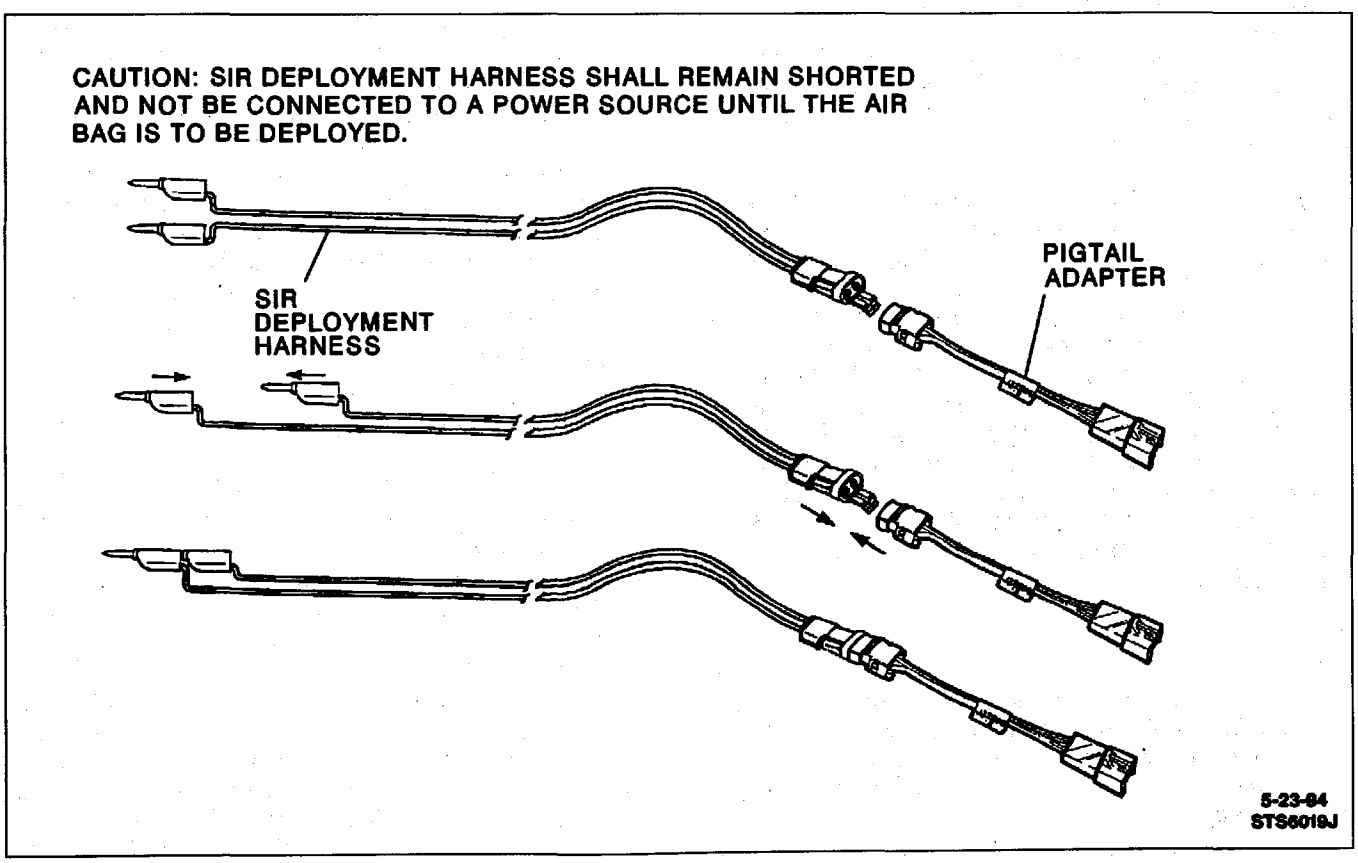


Figure 16 - Shorting the SIR Deployment Harness Wires

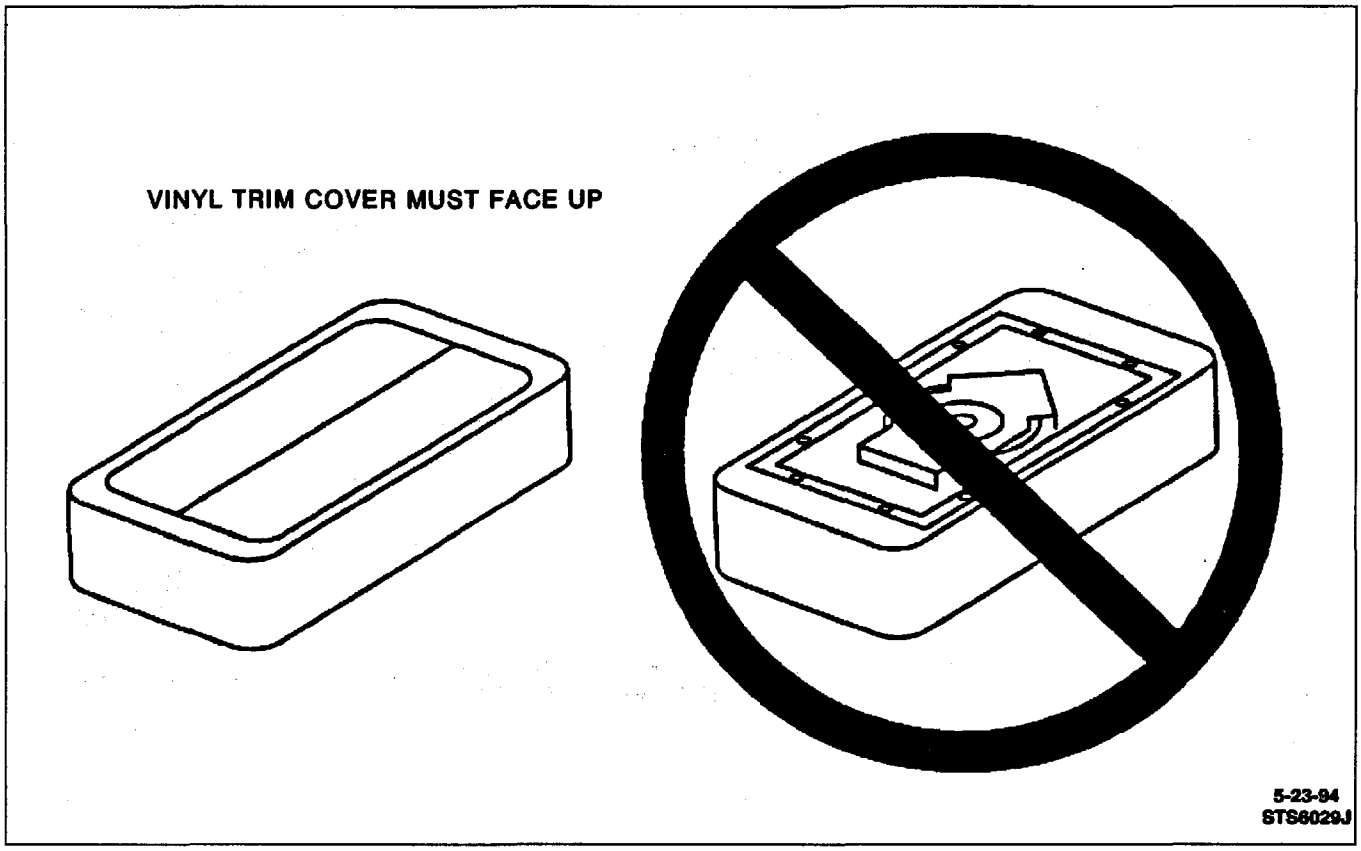


Figure 17 - Proper Storage of Inflator Module

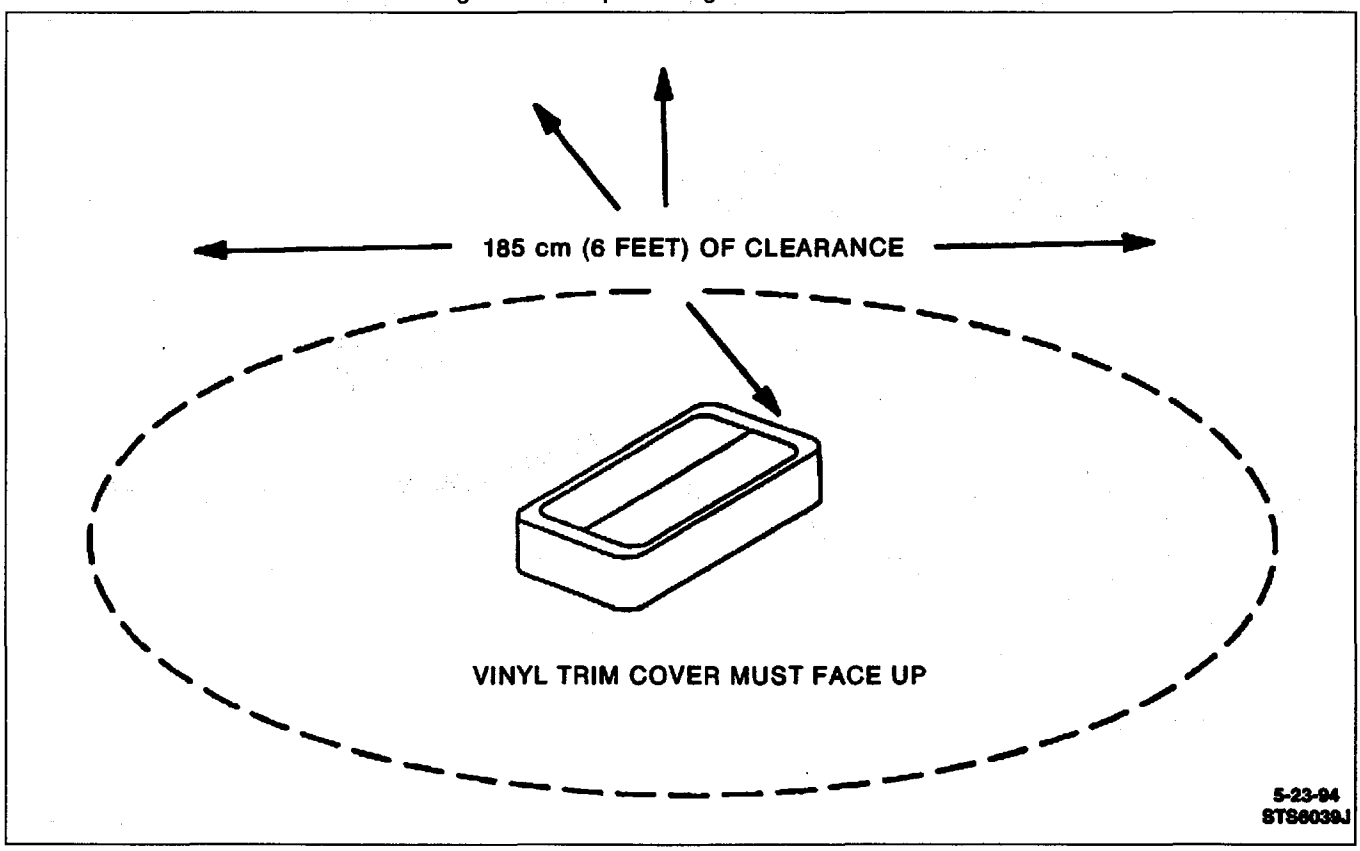


Figure 18 - Provide Adequate Clearance for the Air Bag to Deploy

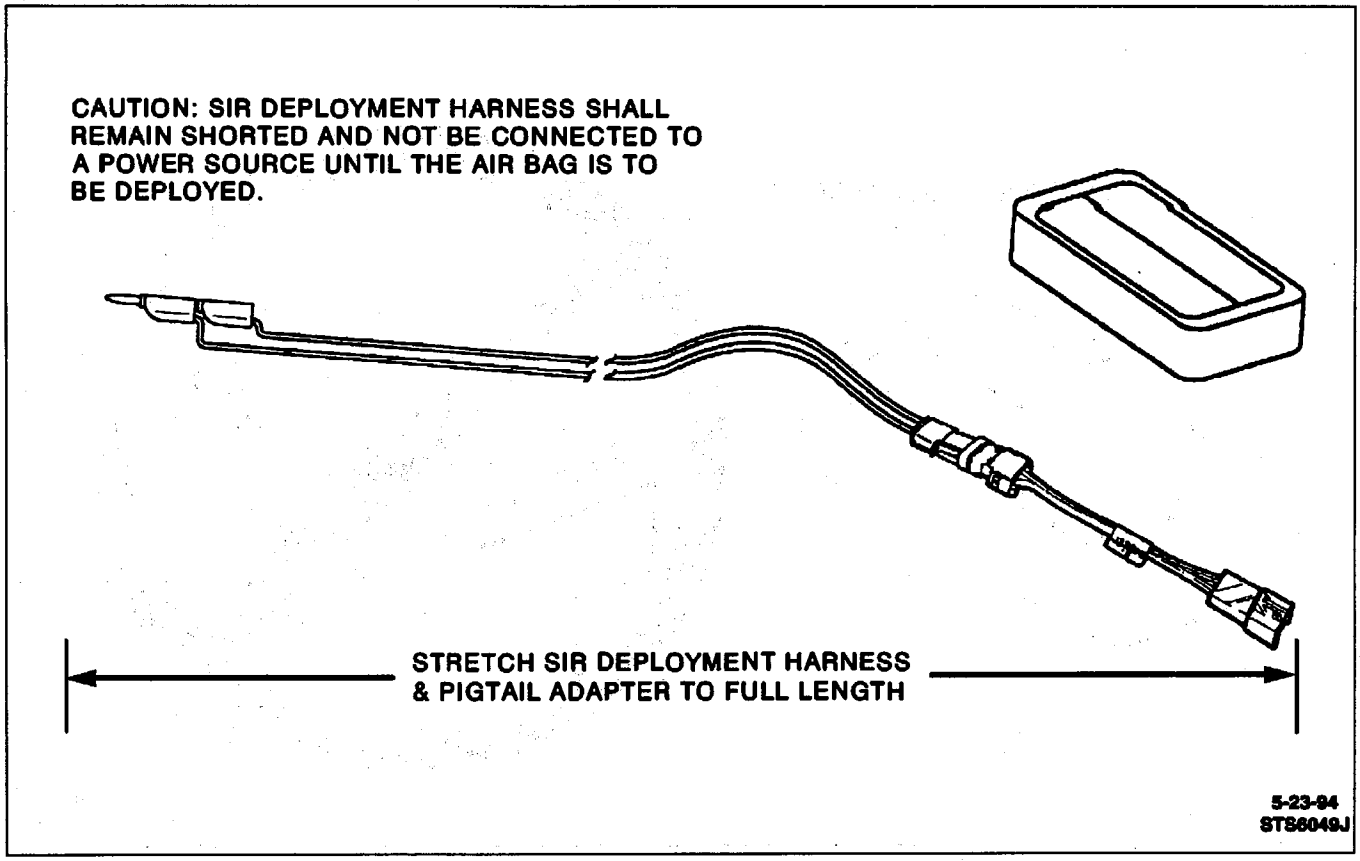


Figure 19 - Stretching the SIR Deployment Harness and Pigtail Adapter

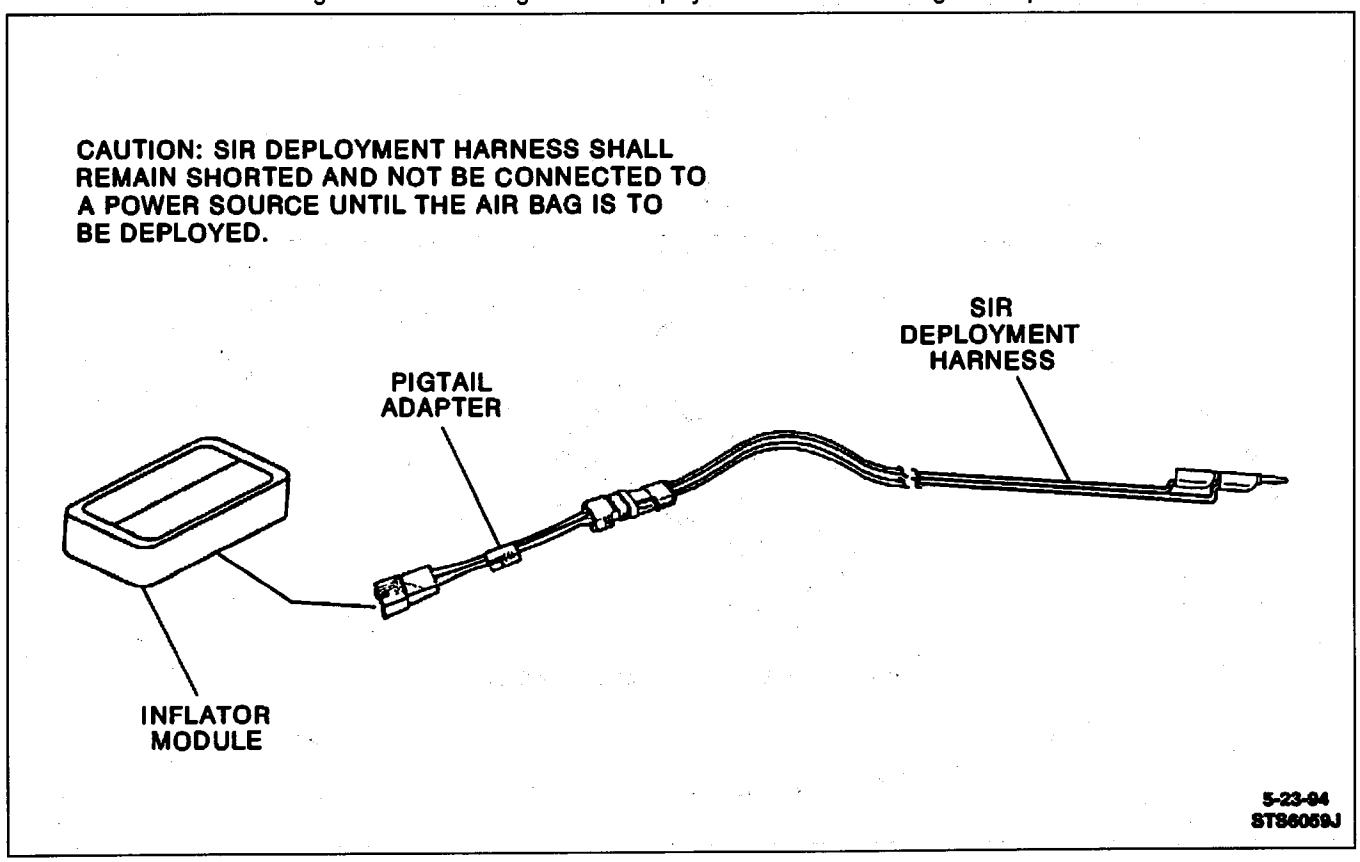


Figure 20 - Connecting the SIR Deployment Harness to the Inflator Module

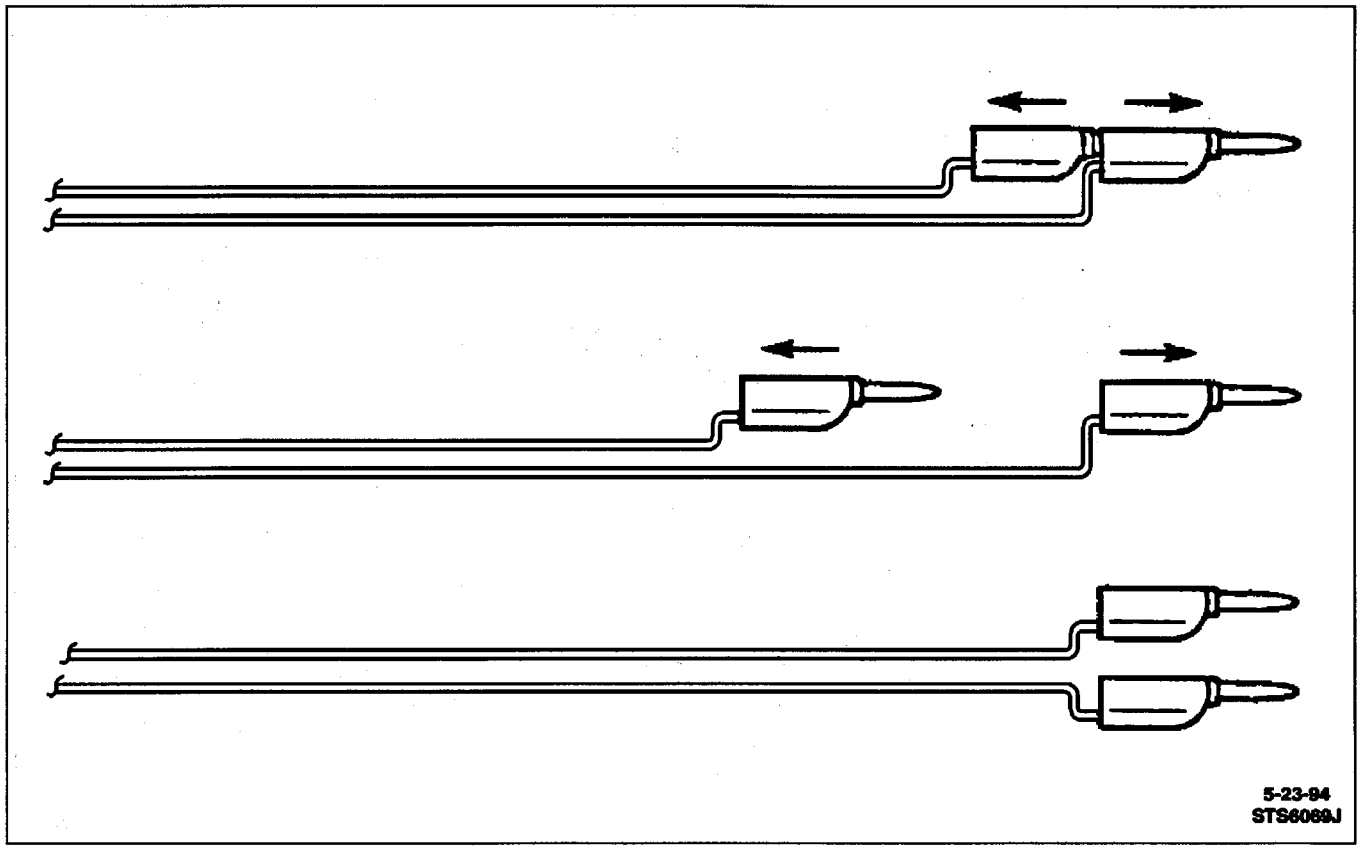


Figure 21 - Separating the Two Shorted Banana Plugs

After the driver inflator module has been deployed, the surface of the air bag may contain a powdery residue. This powder consists primarily of cornstarch (used to lubricate the bag as it inflates) and byproducts of the chemical reaction. Sodium hydroxide dust (similar to lye soap) is produced as a byproduct of the deployment reaction. The sodium hydroxide then quickly reacts with the atmospheric moisture and is converted to sodium carbonate and sodium bicarbonate (baking soda). Therefore, it is unlikely that sodium hydroxide will be present after deployment. As a precaution, however, gloves and safety glasses are recommended to prevent any possible irritation of the skin or eyes.

CAUTION: Safety precautions must be observed when handling a deployed inflator module. After deployment, the metal surfaces of the inflator module will be very hot. Allow the inflator module to cool before handling any metal portion of it. Do not place the deployed inflator module near any flammable objects. Failure to follow procedures may result in fire or personal injury.

After a driver inflator module has been deployed, the metal canister and surrounding areas of the driver inflator module will be very hot. Do not touch the metal areas of the driver inflator module for about ten minutes after deployment. If the deployed driver inflator module must be moved before it is cool, wear gloves and handle by the air bag or vinyl trim (Figure 23).

23. Disconnect the pigtail adapter from the driver inflator module as soon after deployment as possible. This will prevent damage to the pigtail adapter or SIR deployment harness due to possible contact with the hot driver inflator module canister. The pigtail adapter and SIR deployment harness are designed to be reused. They should, however, be inspected for damage after each deployment and replaced if necessary.
24. Dispose of the deployed driver inflator module through normal refuse channels after it has cooled for at least 10 minutes.
25. Wash your hands with mild soap and water afterward.

NOTICE: The remaining steps are to be followed in the unlikely event that the driver inflator module did not deploy after following these procedures.

26. Ensure that the SIR deployment harness has been disconnected from the power source and that its two banana plugs have been shorted together by fully seating one banana plug into the other (Figure 16).
27. Disconnect the pigtail adapter from the driver inflator module.

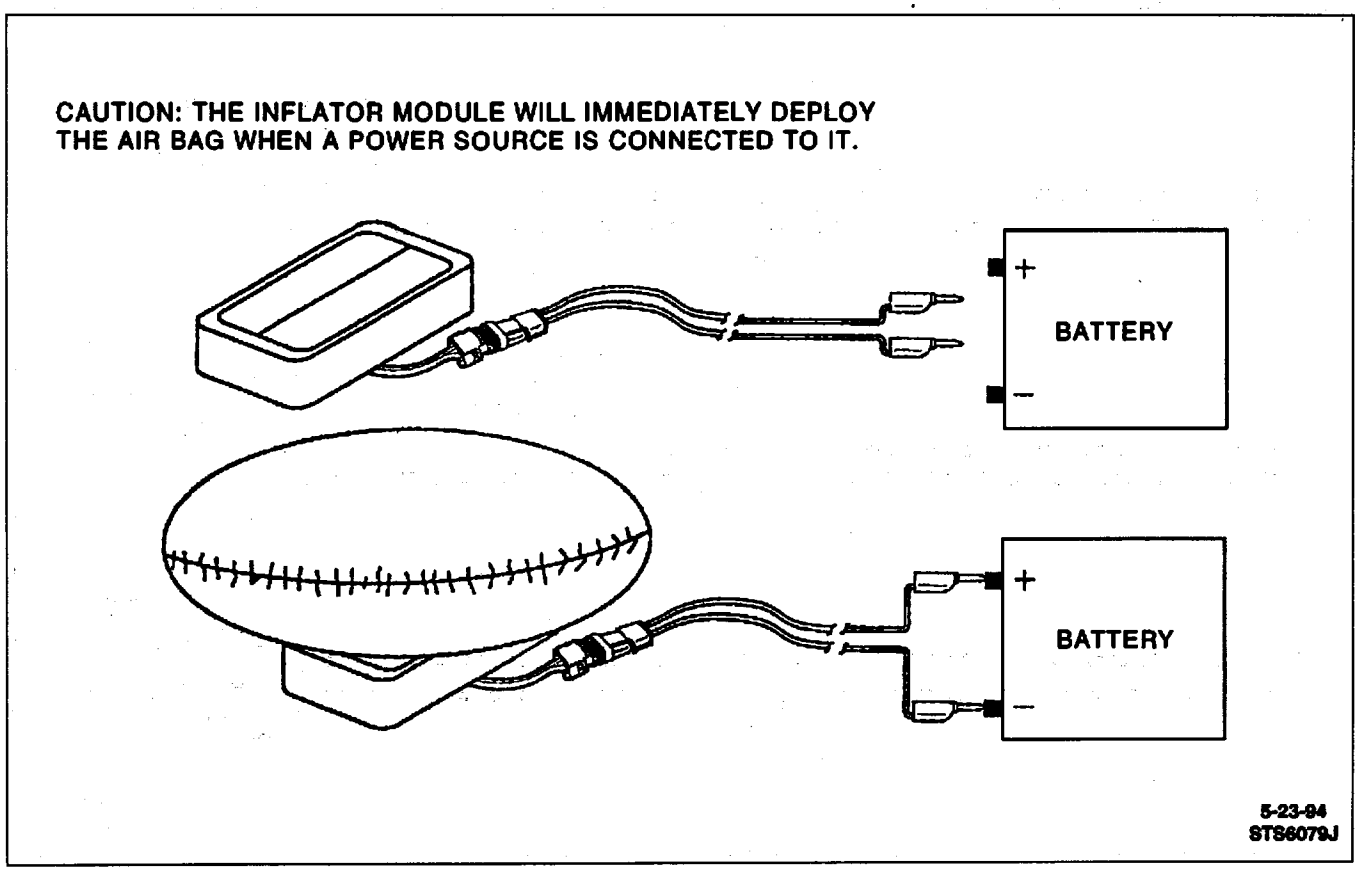


Figure 22 - Connecting to a Power Source

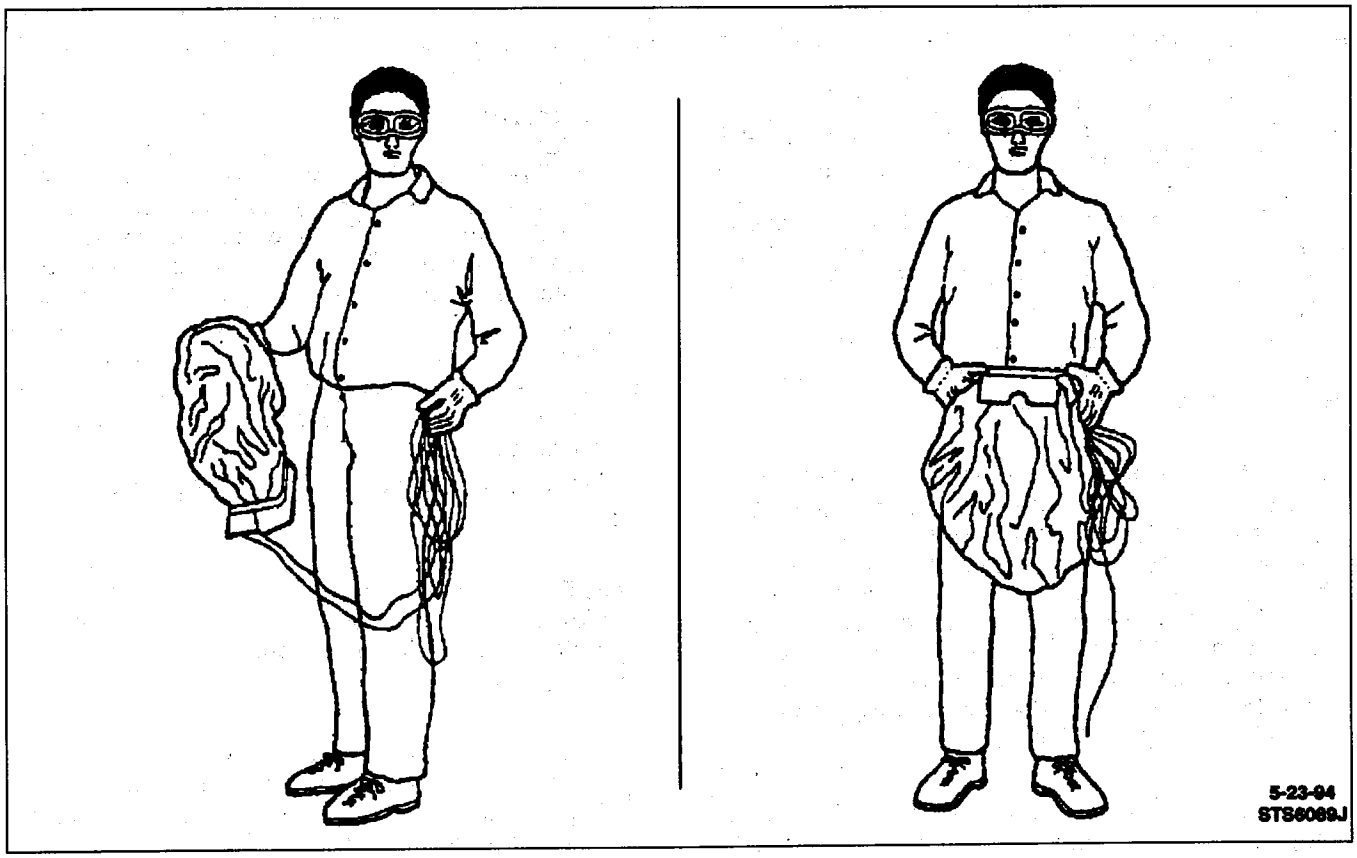


Figure 23 - Handling a Hot, Deployed Inflator Module

CAUTION: When storing a live inflator module or when leaving a live inflator module unattended on a bench or other surface, always face the bag and trim cover up and away from the surface. This is necessary so that a free space is provided to allow the air bag to expand in the unlikely event of accidental deployment. Failure to follow procedures may result in personal injury.

28. Temporarily store the driver inflator module with its vinyl trim cover facing up, away from the surface upon which it rests.
29. Call the Technical Assistance group for further assistance.

Deployment Outside Vehicle (Passenger Inflator Module)

CAUTION: Failure to follow proper SIR inflator module disposal procedures can result in air bag deployment which may cause personal injury. Undeployed inflator modules must not be disposed of through normal refuse channels. The undeployed inflator module contains substances that can cause severe illness or personal injury if the sealed container is damaged during disposal. Disposal in any manner inconsistent with proper procedures may be a violation of federal, state and/or local laws.

General Motors dealers should refer to the latest General Motors Service Bulletins for proper live (undeployed) passenger inflator module scrapping and disposal procedures. All others should contact a local General Motors dealership for proper live passenger inflator module scrapping and disposal procedures. Deployed passenger inflator modules may be disposed of through normal refuse channels.

Deployment Inside Vehicle (Vehicle Scrapping Procedure)

Deployment inside vehicle is proper when the vehicle is to be destroyed or salvaged for component parts. This includes, but is not limited to, the following situations:

1. The vehicle has completed its useful life.
2. The vehicle has been damaged beyond repair in a non-deployment type accident.
3. The vehicle has been stripped or damaged beyond repair in a theft.
4. The vehicle will be salvaged for component parts to be used on a vehicle with a different Vehicle Identification Number (VIN) as opposed to being rebuilt as the same VIN. Never use SIR components from another vehicle. This is done to ensure SIR system integrity since only new SIR system components, with the exception of remanufactured parts as noted below, may be used in servicing an SIR equipped vehicle. Remanufactured parts purchased from an authorized General Motors dealer may be used for SIR repairs.

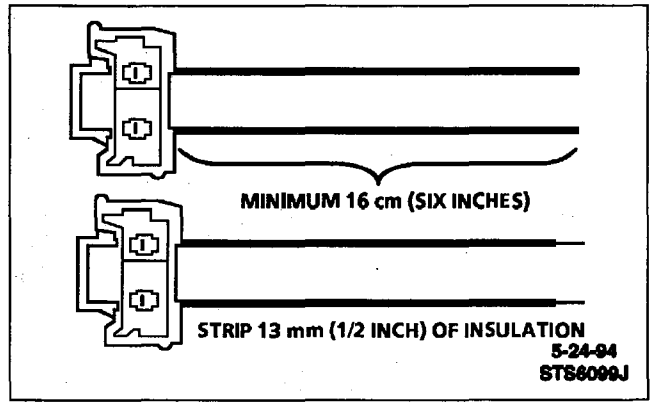


Figure 24 - Cutting the Harness Connector Wires

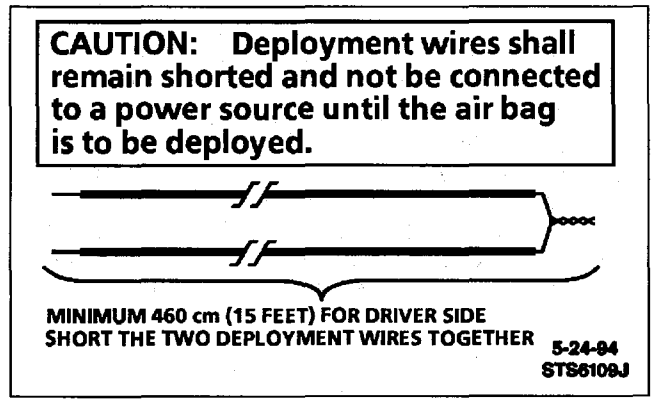


Figure 25 - Shorting the Deployment Wires

CAUTION: Failure to follow proper SIR inflator module disposal procedures can result in air bag deployment which may cause personal injury. Undeployed inflator modules must not be disposed of through normal refuse channels. The undeployed inflator module contains substances that can cause severe illness or personal injury if the sealed container is damaged during disposal. Disposal in any manner inconsistent with proper procedures may be a violation of federal, state and/or local laws.

1. Turn ignition switch to "LOCK," remove key and put on safety glasses.
2. Remove all loose objects from front seats.
3. Disconnect driver inflator module, yellow 2-way connector located at the base of the steering column.
4. Cut the driver inflator module yellow 2-way harness connector from the vehicle leaving at least 16 cm (six inches) of wire at the connector (Figure 24).
5. Strip 13 mm (1/2 inch) of insulation from each wire lead of the connector (Figure 24).

6. Cut two 460 cm (15 feet) deployment wires from 0.8 mm (18 gauge) or thicker multi-strand wire. These wires will be used to fabricate the driver deployment harness.
7. Strip 13 mm (1/2 inch) of insulation from both ends of the wires cut in the previous step.
8. Short the wires by twisting together one end from each (Figure 25). Deployment wires shall remain shorted and not be connected to a power source until the air bag is to be deployed.

CAUTION: Failure to follow procedures in the order listed could result in personal injury. Never connect deployment wires to any power source before connecting deployment wires to the inflator module leads. Deployment wires shall remain shorted and not be connected to a power source until the air bag is to be deployed. The inflator module will immediately deploy the air bag when a power source is connected to it. Wear safety glasses throughout this entire deployment and disposal procedure.

9. Twist together one connector wire lead to one deployment wire. The connection should be mechanically secure (Figure 26-A).
10. Bend twisted connection made in the previous step flat and wrap tightly with electrical tape to insulate and secure (Figure 26-B).
11. Twist together, bend and tape the remaining connector wire lead to the remaining deployment wire (Figure 26-C).
12. Connect the deployment harness to the driver inflator module, yellow 2-way connector at the base of the steering column. Route deployment harness out the driver side of the vehicle (Figure 27).

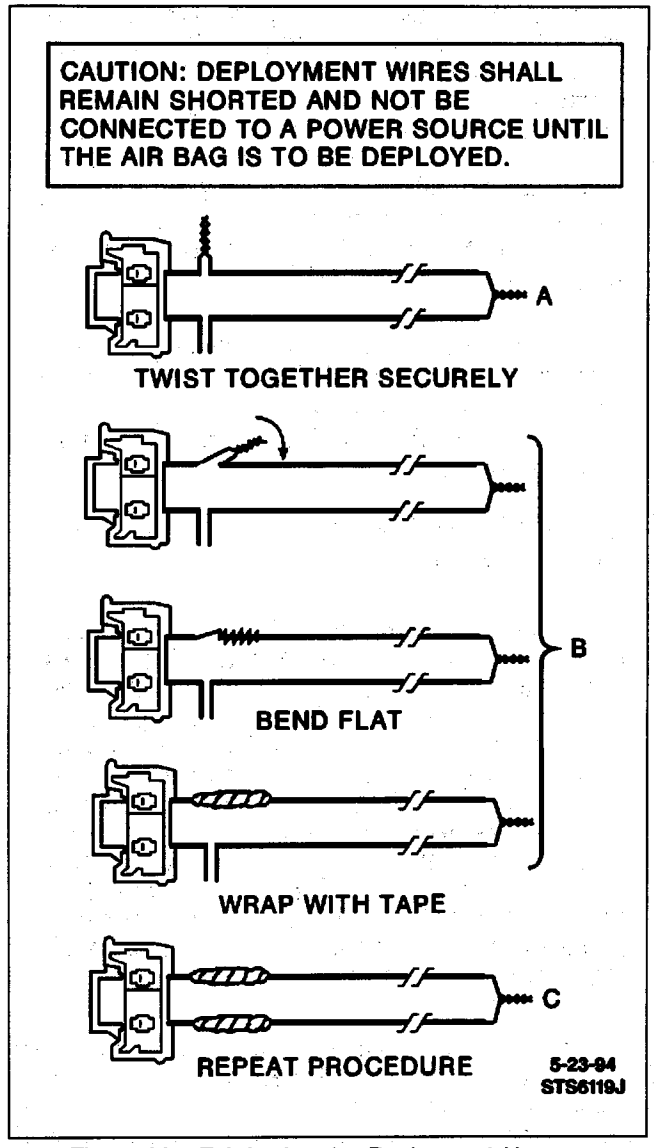


Figure 26 - Fabricating the Deployment Harness

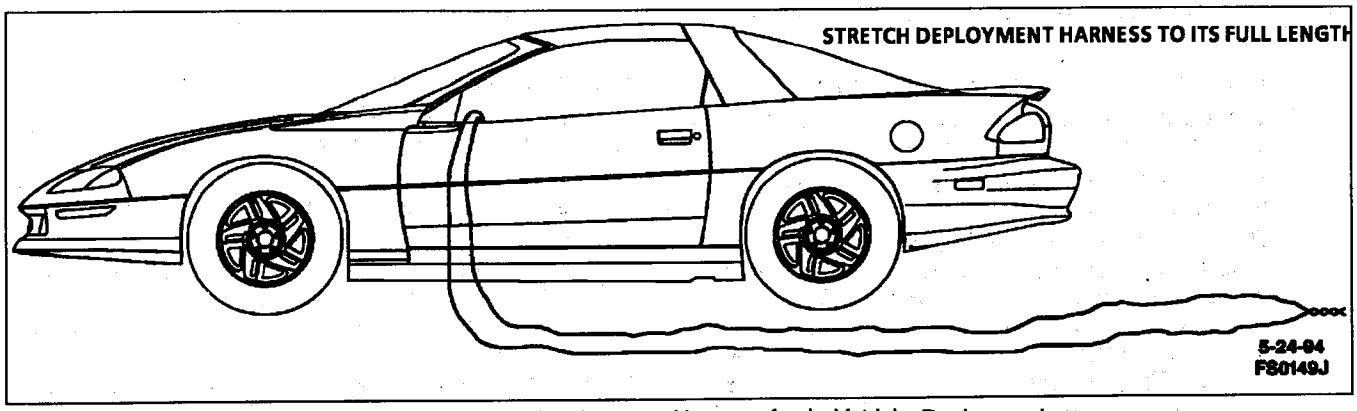


Figure 27 - Prepare Deployment Harness for In-Vehicle Deployment

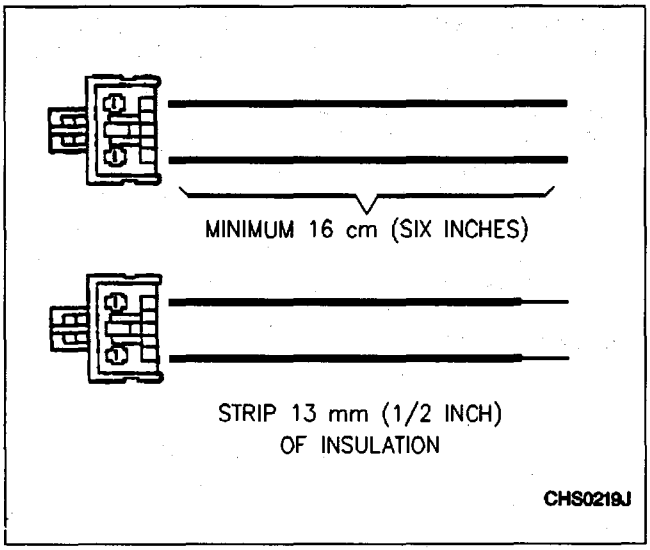


Figure 28 - Cutting the Harness Connector Wires

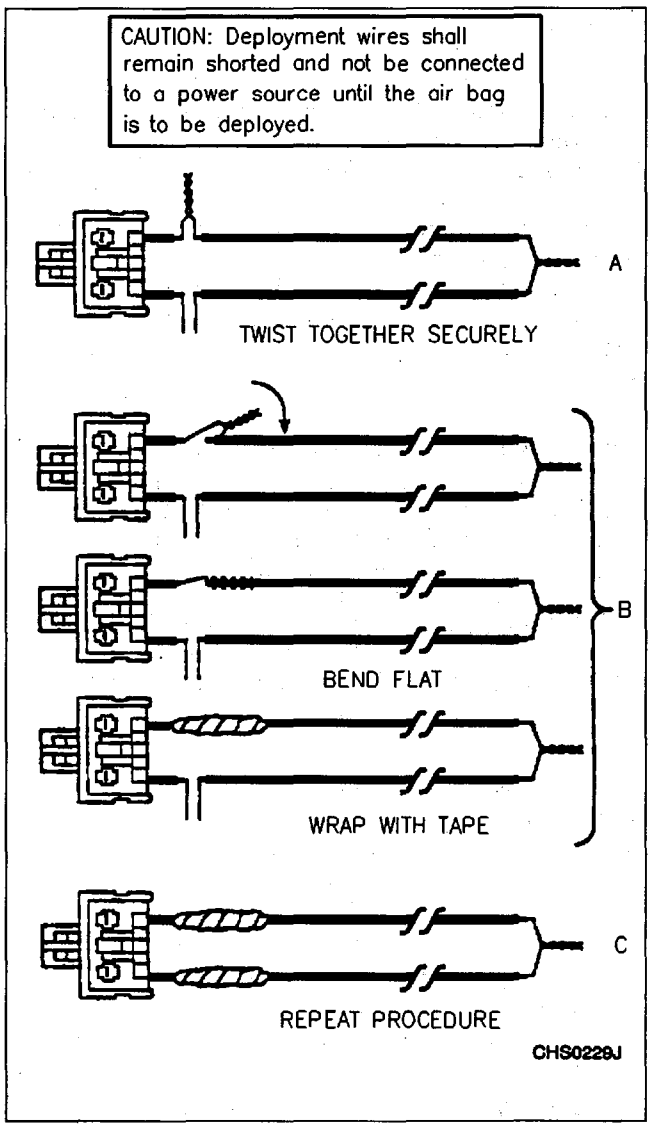


Figure 29 - Fabricating the Deployment Harness

CAUTION: Deployment wires shall remain shorted and not be connected to a power source until the air bag is to be deployed. The inflator module will immediately deploy the air bag when a power source is connected to it. Connecting the deployment wires to the power source should always be the final step in the inflator module deployment procedure. Failure to follow procedures in the order listed could result in personal injury.

13. Disconnect passenger inflator module, yellow 2-way connector located near the base of the steering column.
14. Cut the passenger inflator module harness connector from the vehicle leaving at least 16 cm (six inches) of wire at the connector (Figure 28).
15. Strip 13 mm (1/2 inch) of insulation from each wire lead of the connector (Figure 28).
16. Cut two 610 cm (20 feet) deployment wires from 0.8mm (18 gauge) or thicker multi-strand wire. These wires will be used to fabricate the passenger deployment harness.
17. Strip 13 mm (1/2 inch) of insulation from both ends of the wires cut in the previous step.
18. Short the wires by twisting together one end from each (Figure 25). Deployment wires shall remain shorted and not be connected to a power source until the air bag is to be deployed.

CAUTION: Failure to follow procedures in the order listed could result in personal injury. Never connect deployment wires to any power source before connecting deployment wires to the inflator module leads. Deployment wires shall remain shorted and not be connected to a power source until the air bag is to be deployed. The inflator module will immediately deploy the air bag when a power source is connected to it. Wear safety glasses throughout this entire deployment and disposal procedure.

19. Twist together one connector wire lead to one deployment wire. The connection should be mechanically secure (Figure 29-A).
20. Bend twisted connection made in the previous step flat and wrap tightly with electrical tape to insulate and secure (Figure 29-B).
21. Twist together, bend and tape the remaining connector wire lead to the remaining deployment wire (Figure 29-C).
22. Connect the deployment harness to the passenger inflator module, yellow 2-way connector located near the base of the steering column. Route deployment harness out the passenger side of the vehicle (Figure 30).

CAUTION: Deployment wires shall remain shorted and not be connected to a power source until the air bag is to be deployed. The inflator module will immediately deploy the air bag when a power source is connected to it. Connecting the deployment wires to the power source should always be the final step in the inflator module deployment procedure. Failure to follow procedures in the order listed could result in personal injury.

23. Verify that the inside of the vehicle and the area surrounding the vehicle are clear of all people and loose or flammable objects.
24. Stretch the driver and passenger deployment harnesses to their full length (Figures 27 and 30).
25. Completely cover windshield area and front door window openings with a drop cloth, blanket or similar item. This reduces the possibility of injury due to possible fragmentation of the vehicle's glass or interior.
26. Notify all people in the immediate area that you intend to deploy the air bags. The deployment will be accompanied by a substantial report which may startle the uninformed.
27. Separate the two ends of the driver deployment harness wires (Figure 31).

CAUTION: Deployment wires shall remain shorted and not be connected to a power source until the air bag is to be deployed. The inflator module will immediately deploy the air bag when a power source is connected to it. Connecting the deployment wires to the power source should always be the final step in the inflator module deployment procedure. Failure to follow procedures in the order listed could result in personal injury.

NOTICE: When the air bag deploys, the rapid gas expansion will create a substantial report. Notify all people in the immediate area that you intend to deploy the air bags.

28. Connect the driver deployment harness wires to a power source to immediately deploy the driver inflator module. Recommended application: 12 volts minimum, 2 amps minimum. A vehicle battery is suggested (Figure 31).
29. Separate the two ends of the passenger deployment harness wires (Figure 32).

CAUTION: Deployment wires shall remain shorted and not be connected to a power source until the air bag is to be deployed. The inflator module will immediately deploy the air bag when a power source is connected to it. Connecting the deployment wires to the power source should always be the final step in the inflator module deployment procedure. Failure to follow procedures in the order listed could result in personal injury.

30. Connect the passenger deployment harness wires to a power source to immediately deploy the passenger inflator module. Recommended application: 12 volts minimum, 2 amps minimum. A vehicle battery is suggested (Figure 32).

After an inflator module has been deployed, the surface of the air bag may contain a powdery residue. This powder consists primarily of cornstarch (used to lubricate the bag as it inflates) and byproducts of the chemical reaction. Sodium hydroxide dust (similar to lye soap) is produced as a byproduct of the deployment reaction. The sodium hydroxide then quickly reacts with atmospheric moisture and is converted to sodium carbonate and sodium bicarbonate (baking soda). Therefore, it is unlikely that sodium hydroxide will be present after deployment. As a precaution, however, gloves and safety glasses are recommended to prevent any possible irritation of the skin or eyes.

CAUTION: Safety precautions must be observed when handling a deployed inflator module. After deployment, the metal surfaces of the inflator module will be very hot. Allow the inflator module to cool before handling any metal portion of it. Do not place the hot deployed inflator module near any flammable objects. Failure to follow procedures could result in fire or personal injury.

After an inflator module has been deployed, the metal canister and surrounding areas of the inflator module will be very hot. Do not touch the metal areas of the inflator module for about 10 minutes after deployment. If the deployed inflator module must be moved before it is cool, wear gloves and handle by the air bag or vinyl trim.

31. Short the driver deployment harness wires by twisting together one end from each. Repeat this procedure for the passenger deployment harness.
32. Carefully remove drop cloth from vehicle and clean off any fragments or discard drop cloth entirely.
33. Disconnect driver deployment harness and passenger deployment harness from vehicle and discard.

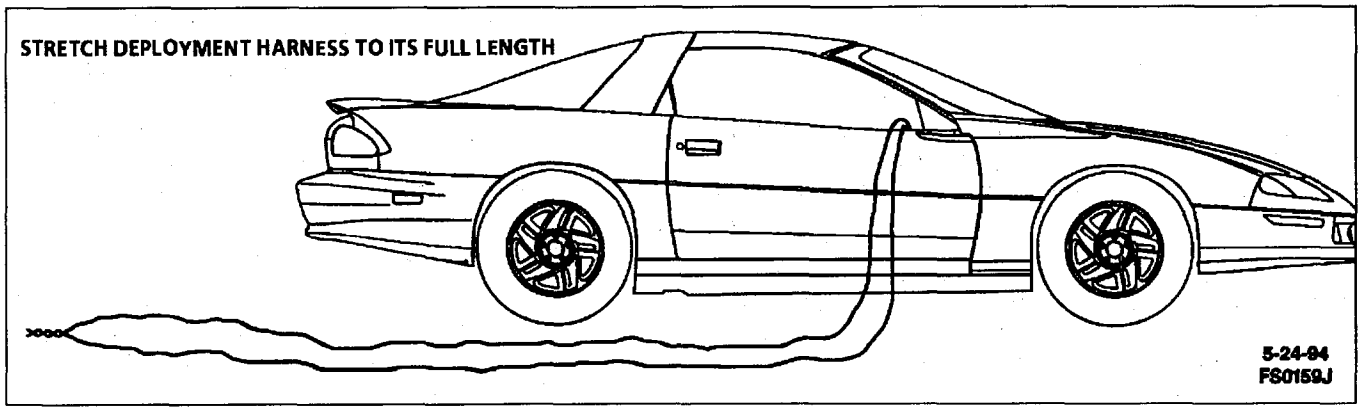


Figure 30 - Prepare Deployment Harness for In-Vehicle Deployment

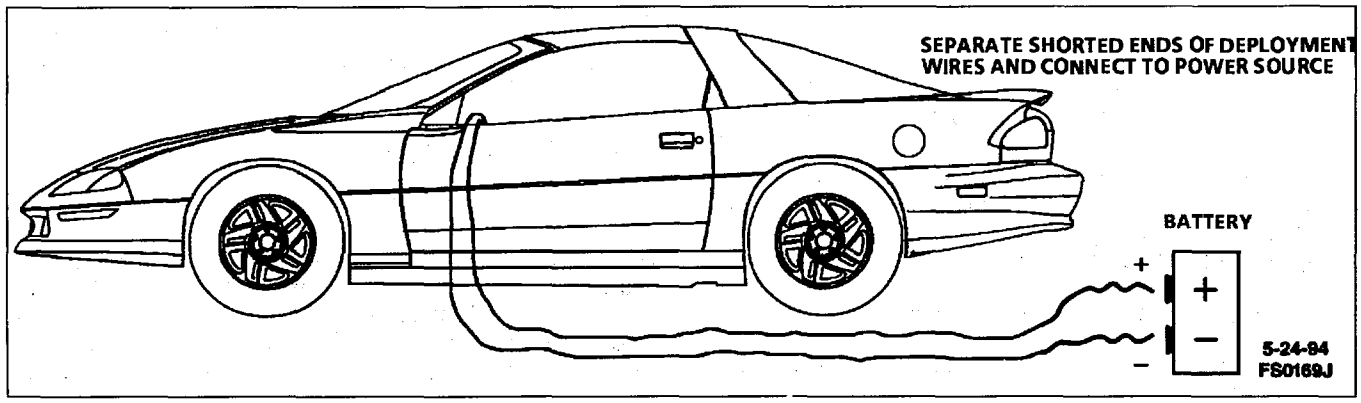


Figure 31 - Separate Shorted End of Deployment Harness and Connect to Power Source

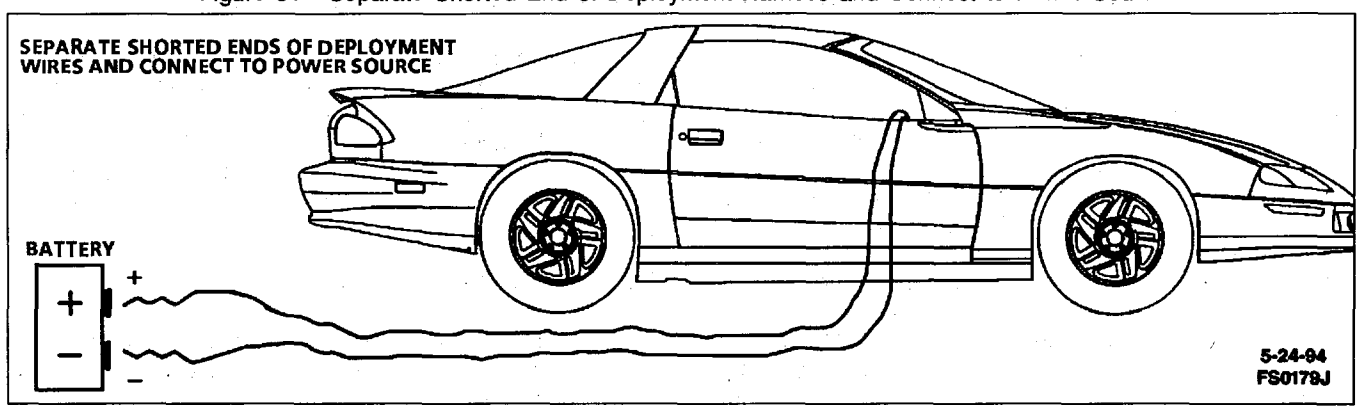


Figure 32 - Separate Shorted End of Deployment Harness and Connect to Power Source

34. In the unlikely event that either or both of the inflator modules did not deploy after following these procedures, proceed immediately with Steps 36 through 38.
35. With both air bags deployed the vehicle may be scrapped in the same manner as a non-SIR equipped vehicle.
36. Remove the undeployed inflator module(s) from the vehicle. For driver inflator module refer to SECTION 3F, for passenger inflator module refer to "On-Vehicle Service" in this section.

CAUTION: When storing a live inflator module or when leaving a live inflator module unattended on a bench or other surface, always face the bag and trim cover up, away from the surface. This is necessary so that a free space is provided to allow the air bag to expand in the unlikely event of accidental deployment. Failure to follow procedures could result in personal injury.

37. Temporarily store the inflator module with the air bag opening facing up, away from the surface upon which it rests.
38. Call the Technical Assistance group for further assistance.

Deployed Inflator Module Handling

After the inflator module has been deployed, the surface of the air bag may contain a powdery residue. This powder consists primarily of cornstarch (used to lubricate the bag as it inflates) and byproducts of the chemical reaction. Sodium hydroxide dust (similar to lye soap) is produced as a byproduct of the deployment reaction. The sodium hydroxide then quickly reacts with atmospheric moisture and is converted to sodium carbonate and sodium bicarbonate (baking soda).Therefore, it is unlikely that sodium hydroxide will be present after deployment. As with many service procedures, you should wear gloves and safety glasses.

WIRING REPAIR

Special wiring repair procedures have been developed for use on the Supplemental Inflatable Restraint (SIR) system due to the sensitive nature of the circuitry. These specific procedures and instructions must be followed when working with SIR system wiring, and wiring components (such as connectors and terminals).

TERMINAL REPAIR KIT J 38125-A

Essential tool kit J 38125-A contains special "sealed splices" for use in repairing SIR system wiring. A special crimping tool, heat torch, and instruction manual for these splices are also included.

Two critical features of the sealed splices are a special heat shrink sleeve with sealing adhesive to produce an environmentally sealed splice and a cross hatched (knurled) core crimp to provide necessary contact integrity for the sensitive, low energy circuits.

Terminal Repair Kit J 38125-A also serves as a generic terminal repair kit. The kit contains a large sampling of common GM electrical terminals and the correct tools to attach them to wires and remove them from connectors. The terminals in the kit are not to be used to replace damaged SIR system terminals unless specifically indicated by the terminal package. The DERM terminal repair assembly pack is included in J 38125-A for SIR use.

SIR CONNECTOR (PLASTIC BODY AND TERMINAL METAL PIN) REPAIR

If any connector or terminal in the SIR wire harness (except pigtails) is damaged, it should be repaired using one of the connector repair assembly packs. These kits include an instruction sheet and the sealed splices which will be used to splice the new wires, connector, and terminals to the harness. The splice crimping tool, which is color keyed to match the splices from Terminal Repair Kit J 38125-A, must be used to apply these splices.

The terminals in the SIR system are made of a special metal to provide necessary contact integrity for the sensitive, low energy circuits. These terminals are only available in the connector repair assembly packs, do not substitute any other terminals for those in the assembly packs.

If individual terminals are damaged on the DERM connector, they should be repaired using the DERM terminal repair assembly pack. If individual terminals are damaged on any other SIR connection, the entire connection should be replaced using the appropriate connector repair assembly pack. It may be necessary to replace the entire SIR wiring harness.

SIR WIRE PIGTAIL REPAIR

If the wiring pigtail (a wire or wires attached directly to the device, not by a connector) is damaged, the entire component (with pigtail) must be replaced. Examples of "pigtail" components are the passenger inflator module, the discriminating sensors and the SIR coil assembly. Absolutely no wire, connector, or terminal repairs are to be attempted on the passenger inflator module, the discriminating sensors or the SIR coil assembly.

SIR WIRE REPAIR

If any wire except the pigtail is damaged, the wire should be repaired by splicing in a new section of wire of the same gauge size (.5, .8, 1.0, etc.). The sealed splices and splice crimping tool from Terminal Repair Kit J 38125-A must be used for these repairs. The following wiring repair procedures must be used to ensure the integrity of the sealed splice application.

STEP ONE: OPEN THE HARNESS

If the harness is taped, remove the tape. To avoid wire insulation damage use a sewing "seam ripper" (available from sewing supply stores) to cut open the harness. The crimp and sealed splice sleeves may be used on all types of insulation except tefzel and coaxial and may only be used to form a one-to-one splice.

STEP TWO: CUT THE WIRE

Begin by cutting as little wire off the harness as possible. You may need the extra length of wire later if you decide to cut more wire to change the location

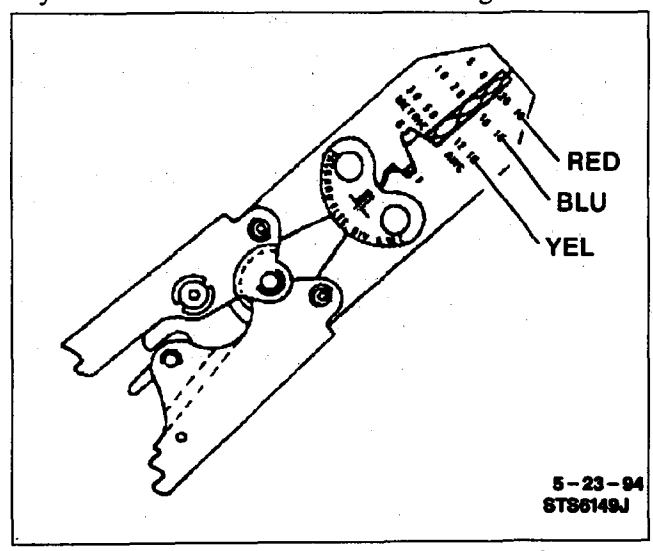


Figure 33 - Splice Crimp Tool J 38125-A

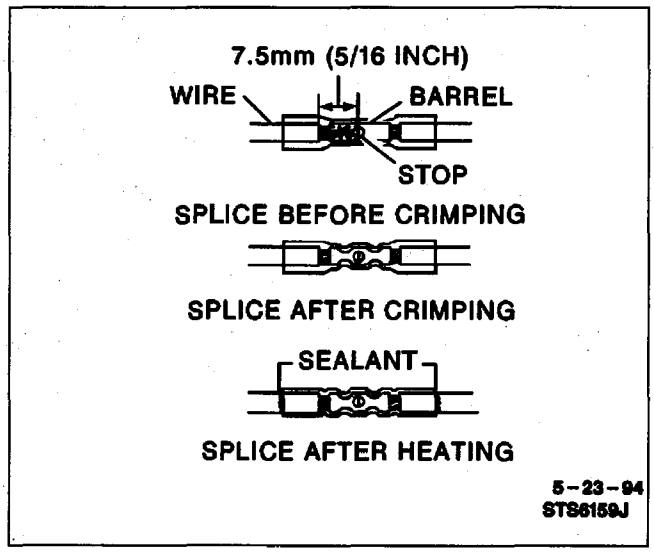


Figure 34 - Seal Splice Sequence

of a splice. You may have to adjust splice locations to make certain that each splice is at least 40 mm (1.5 in.) away from other splices, harness branches, or connectors.

STEP THREE: STRIP THE INSULATION

NOTICE: The following procedures must be followed in the order listed. If wire strands are damaged, the procedure must be repeated until a clean strip with all wire strands intact is obtained.

If it is necessary to add a length of wire to the existing harness, be certain to use the same size as the original wire.

To find the correct wire size either find the wire on the schematic and convert the metric size to the equivalent AWG size or use an AWG wire gage.

If unsure about the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation. Strip approximately 7.5 mm (5/16 in.) of insulation from each wire to be spliced. Be careful to avoid nicking or cutting any of the strands. Check the stripped wire for nicks or cut strands. If the wire is damaged, repeat this procedure after removing the damaged section.

STEP FOUR: SELECT AND POSITION THE SPLICE SLEEVE

Select the proper sealed splice sleeve according to wire size. The splice sleeves and tool nests are color coded (see following chart).

Color Splice Sleeve	Crimp Tool Nest Color	Wire Gage AWG/(Metric)
Salmon (yellow-pink)	Red	20, 18/(0.5, 0.8)
Blue	Blue	16, 14/(1.0, 2.0)
Yellow	Yellow	12, 10/(3.0, 5.0)

Crimp and Seal Splice Chart

Using the J 38125-A Splice Crimp Tool (Figure 33), position the splice sleeve in the proper color nest of the hand crimp tool. Place the splice sleeve in the nest so that the crimp falls midway between the end of the barrel and the stop.

The sleeve has a stop in the middle of the barrel to prevent the wire from going further (Figure 34). Close the hand crimper handles slightly to hold the splice sleeve firmly in the proper nest.

STEP FIVE: INSERT WIRES INTO SPLICE SLEEVE AND CRIMP

Insert the wire into the splice sleeve until it hits the barrel stop and close the handles of the crimp tool tightly until the crimper handles open when released (Figure 34). The crimper handles will not open until the proper amount of pressure is applied to the splice sleeve. Repeat Steps 4 and 5 for opposite end of the splice.

STEP SIX: SHRINK THE INSULATION AROUND THE SPLICE

Using the heat torch apply heat where the barrel is crimped. Gradually move the heat barrel to the open end of the tubing, shrinking the tubing completely as the heat is moved along the insulation. A small amount of sealant will come out of the end of the tubing when sufficient shrinking is achieved (Figure 34).

SIR SYSTEM WIRE SPLICE REPAIR

If any of the original equipment splices (three wires or more) in the SIR system wiring are damaged they should be repaired by applying a new splice (not sealed) from the Terminal Repair Kit J 38125-A. Carefully follow the instructions included in the kit for proper splice clip application. Cloth duct tape may be substituted for splice tape if necessary.

ALTERNATIVE REPAIR METHODS

No alternative repair methods are available for the SIR system wiring and components.

CONNECTOR POSITION ASSURANCE (CPA)

The Connector Position Assurance (CPA) is a small plastic insert that is inserted through the locking tabs of all of the SIR system connectors. The purpose of the CPA is to assure the connector halves are securely connected and they cannot vibrate apart. The CPA must be in place to ensure good contact between the SIR mating terminals.

TERMINAL POSITION ASSURANCE (TPA)

The Terminal Position Assurance (TPA) insert is similar to the plastic "combs" used in ECM connectors. The function of the TPA is to keep the terminal securely seated in the connector body. The TPA is not to be removed from the connector body unless a terminal must be removed for replacement.

SPECIAL TOOLS

CAUTION: To avoid deployment when troubleshooting the SIR system, do not use electrical test equipment such as a battery powered or ac powered voltmeter, ohmmeter, etc., or any type of electrical equipment other than that specified in this manual. Do not use a non-powered probe type tester. Instructions in this manual must be followed carefully, otherwise personal injury may result.

SIR DRIVER/PASSENGER LOAD TOOL

The SIR Driver/Passenger Load Tool J 38715 is used only when called for in this section. It is used as a diagnostic aid and safety device to prevent inadvertent inflator module deployment.

The load tool has four yellow connectors attached to its case. The three small connectors are electrically functional and serve as resistive load substitutions. The large dummy connector does not serve as a load substitution but merely takes the physical place of the DERM connector when needed.

No more than two connectors are used at any time. One of the small connectors with adapter J 38715-5 is used to substitute the load of the driver inflator module when it is connected at the top of the column to the SIR coil assembly. Another small connector is used to substitute the load of the driver inflator module and the SIR coil assembly when it is connected at the base of the column to the SIR wiring harness. The third small connector is used to substitute for the load of the passenger inflator module when connected to the passenger inflator jumper harness connector or when connected to the SIR wiring harness passenger inflator jumper harness connector (adapter may be needed). The large dummy connector separates the shorting bar in the DERM harness connector when it is connected to it in place of the DERM.

By substituting the resistance of the load tool when called for, a determination can be made as to whether an inflator circuit component is causing system malfunction and which component is causing the malfunction. The load tool should be used only when specifically called for in the diagnostic procedures.

J 39200 DVM

The J 39200 DVM is the preferred DVM for use in SIR diagnosis and repair. However, J 34029-A may be used if J 39200 is not available. No other DVMs are approved for SIR diagnosis and repair.

SCAN TOOL

The Tech 1 is used to read and clear SIR system Diagnostic Trouble Codes (DTCs). Refer to the Tech 1 Operator's Manual for specific information on how to use the Tech 1.

Scan tools from other manufacturers may be used. Refer to the Operator's Manual for the tool for specific instructions.

J 35616-A CONNECTOR TEST ADAPTER KIT

The J 35616-A Connector Test Adapter Kit must be used whenever a diagnostic procedure requests checking or probing a terminal. Using the appropriate adapter will ensure that no damage to the terminal will occur from the DVM probe, such as spreading or bending. The adapter will also give an idea of whether contact tension is sufficient, helping to find an open or intermittent open due to poor terminal contact.

SPECIFICATIONS

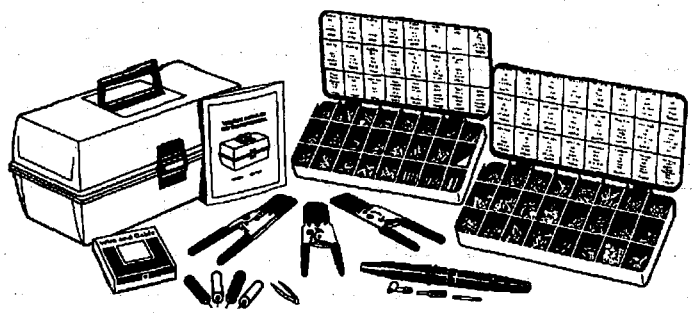
FASTENER TIGHTENING SPECIFICATIONS

Driver Inflator Module Fasteners	2.8 N.m (25 lb. in.)
Dual Pole Arming Sensor Fasteners	4.5 N.m (40 lb. in.)
Forward Discriminating Sensor Fasteners	10 N.m (89 lb. in.)
Passenger Compartment Discriminating Sensor Fasteners	10 N.m (89 lb. in.)
Passenger Inflator Module Fasteners	2.8 N.m (25 lb. in.)

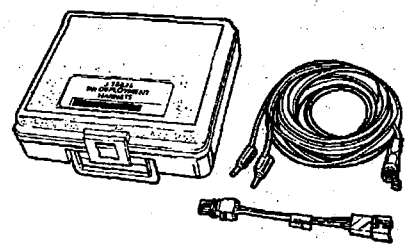
SERVICE PARTS INFORMATION

PART NAME	SERVICE PARTS CATALOG REFERENCE NAME	SERVICE PARTS CATALOG GROUP
COMPONENTS	DERM	MODULE, INFL RST RESV ENGY
Driver Inflator Module	MODULE, INFL RST STRG WHL	14.865
Dual Pole Arming Sensor	SENSOR, INFL RST ARMING	14.865
Forward Discriminating Sensor	SENSOR, INFL RST F/END SH MET	14.865
Passenger Compartment Discriminating Sensor	SENSOR, INFL RST PASS COMPT	14.865
Passenger Inflator Module	MODULE, INFL RST I/P	14.865
SIR Coil Assembly	COIL KIT, INFL RST STRG WHL MDL	14.865
Warning Lamp "AIR BAG"		9.744
		(Standard Parts Cat.)

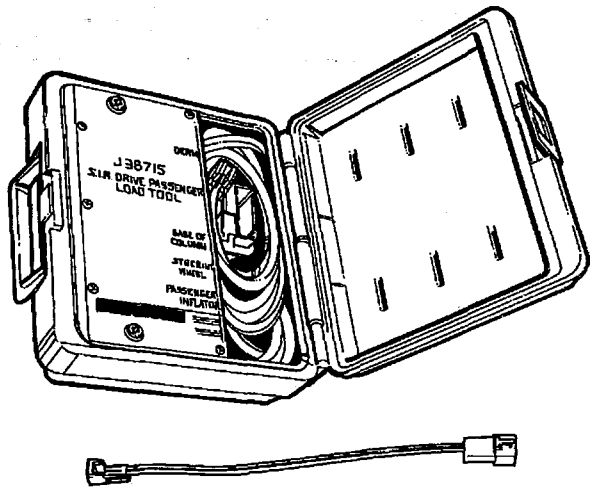
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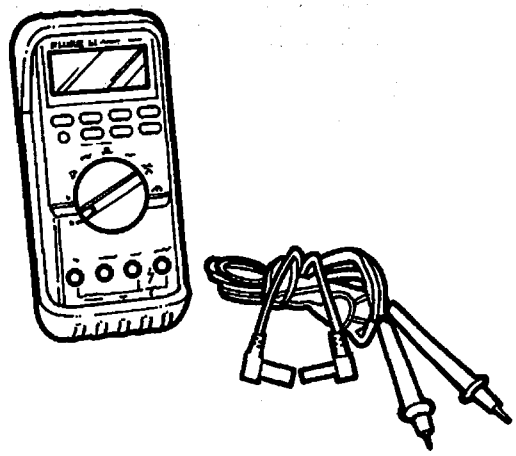
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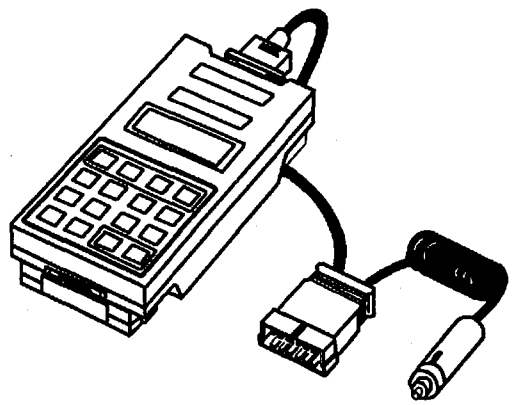
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1 J 38125-A - TERMINAL REPAIR KIT

2 J 38826 - SIR DEPLOYMENT HARNESS

3 J 38715 - SIR DRIVER/PASSENGER LOAD TOOL (J 38715-5)

4 J 39200 - DIGITAL MULTIMETER

5 J 35616-A - CONNECTOR TEST ADAPTER KIT

6 SCAN TOOL

5-24-94
FS0199J

SIR Special Tools

SECTION 9K

REMOTE KEYLESS ENTRY

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

Important

- The Remote Keyless Entry System is intended to be used as a supplementary vehicle entry device. It is not intended to replace, but rather should be used in conjunction with a door lock key. The system could be disabled due to radio frequency interference or low transmitter battery power level. It is therefore necessary to always maintain access to a door lock key.

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Receiver Assembly 9K-2
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Receiver Assembly 9K-3
Programming Receiver Assembly 9K-3
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Fastener Tightening Specifications 9K-4

GENERAL DESCRIPTION

The remote keyless entry system (remote control door lock system) is used to lock and unlock front side doors and release the rear compartment lift window panel assembly of the vehicle. The system will also turn on the interior lights for about 40 seconds, or until the ignition switch assembly is turned to "RUN," when the doors are unlocked and for about two seconds when the doors are locked. A small receiver assembly is installed in a pocket near the right-hand hinge pillar. The receiver assembly operates on a 315 MHz radio frequency at a low energy level and complies with FCC rules Part 15. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference that may be received, including interference that may cause undesired operation.

The transmitter assembly is a hand-held item that is attached to a key ring. It has three buttons that control the functions of the system. If the remote lock control feature fails to operate from a normal distance, check for two conditions: weak batteries in remote lock control transmitter assembly (expected battery life is two years); or close proximity to a radio transmitter, such as a radio station tower, airport transmitter, and some mobile or CB radios.

FUNCTIONAL OPERATION

Figure 1

To Unlock Doors

1. Press "UNLOCK" button once and release to unlock driver's front side door only.
2. Press "UNLOCK" button a second time (within 1 to 5 seconds of first depression) to unlock remaining door.

To Release Rear Compartment Lift Window Panel Assembly

- Press bottom button marked with vehicle symbol on top cover to release rear compartment lift window panel assembly.

To Lock Doors

- Press "DOOR" button marked with key symbol.

TRANSMITTER ASSEMBLY

The transmitter assembly will transmit a radio signal, which will control functions of the receiver assembly. The range is approximately 7 to 10 m (22 to 33 feet).

Battery Replacement

Figure 1

Remove or Disconnect

1. Key ring from transmitter assembly.
2. Top cover from bottom cover, using a flat-bladed tool at eyelet end to unsnap, if necessary.
3. Batteries.

Install or Connect

NOTICE: Use of wrong type of battery will cause damage to the transmitter assembly.

1. Batteries.
   - Use battery type DL2016, or equivalent.
2. Top cover by snapping into bottom cover.
3. Key ring to transmitter assembly.

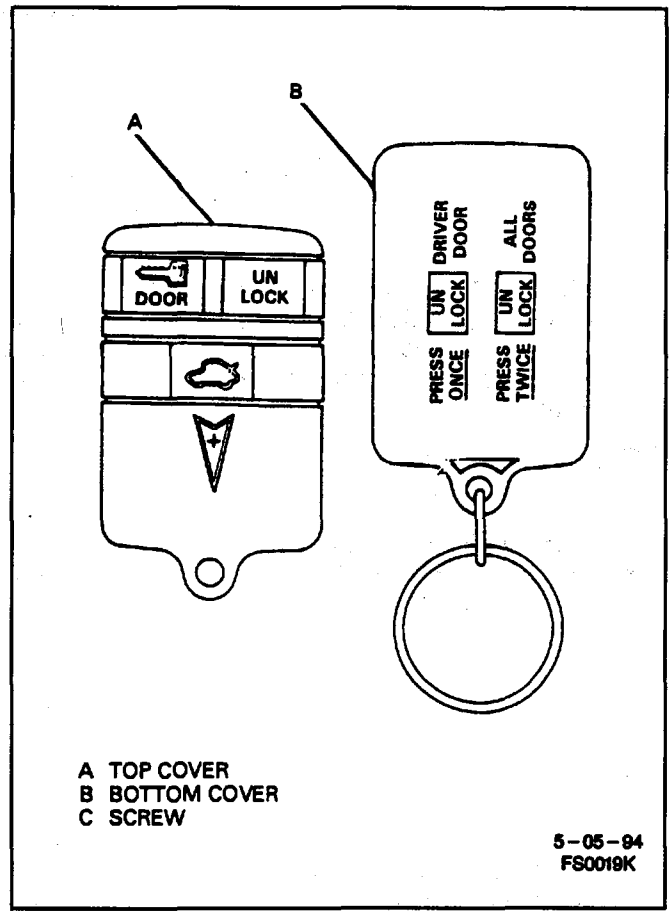


Figure 1 – Remote Control Door Lock Transmitter Assembly (Typical)

Inspect

- Transmitter assembly operation.

RECEIVER ASSEMBLY

The remote control door lock receiver assembly is battery fed and is always monitoring the transmitter signal. When the correct transmitter signal is received to lock the doors, a transistor driver will energize the correct lock control relay coil. The receiver assembly will also control which lock control relays will be energized to unlock the doors, or release the rear compartment lift window panel assembly.

ON-VEHICLE SERVICE

RECEIVER ASSEMBLY

Figure 2

Remove or Disconnect

The remote control door lock receiver assembly (4) is mounted in a pocket near the right-hand hinge pillar.

1. Body hinge pillar trim bolts/screws.
2. Right-hand body hinge pillar trim panel.
3. Receiver assembly (4) from pocket on hinge pillar.
4. Electrical connector secondary lock retainers from electrical connectors.
5. Electrical connectors from receiver assembly (4).

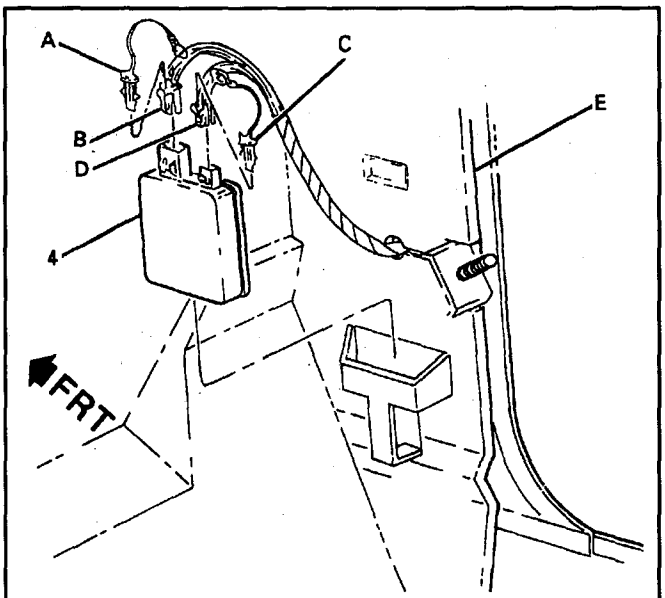
Install or Connect

NOTICE: See "Notice" on page 9K-1 of this section.

1. Electrical connectors to receiver assembly (4).
   - Connector should snap into place.
   - Check for positive connection by tugging on connector, not wire.
2. Electrical connector secondary lock retainers to electrical connectors.
3. Receiver assembly (4) to pocket on hinge pillar.
4. Right-hand body hinge pillar trim panel.
5. Body hinge pillar trim bolts/screws.

   Tighten

   - Body hinge pillar trim bolts/screws to 1.3 N•m (12 lb. in.).
6. If programming the system is necessary, refer to "Programming Receiver Assembly" in this section.



A RETAINER, ELECTRICAL CONNECTOR SECONDARY LOCK
B CONNECTOR, ELECTRICAL
C RETAINER, ELECTRICAL CONNECTOR SECONDARY LOCK
D CONNECTOR, ELECTRICAL
E PILLAR, RIGHT-HAND HINGE
4 RECEIVER ASSEMBLY, REMOTE CONTROL DOOR LOCK

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Figure 2 – Remote Control Door Lock Receiver Assembly

Programming Receiver Assembly

1. Ground receiver program input line by connecting fused jumper wire between terminal "4" and terminal "8" of DLC (data link connector).
   - Door lock assemblies will cycle indicating receiver assembly is in program mode.
2. Press any button (only once) on transmitter assembly.
   A. Door lock assemblies will cycle once confirming that transmitter code is programmed.
   B. Any transmitter code that was previously programmed has been erased.
   C. Receiver assembly is now programmed to transmitter assembly.
3. When programming receiver assembly to match transmitter assemblies, first transmitter code

matched will be stored in both receiver memories unless second transmitter assembly is matched at the same time. If programming a receiver assembly to match a second transmitter assembly, press any button (only once) on second transmitter assembly. This must be done before fused jumper wire is disconnected.

Important

- When a receiver is being programmed to a replacement transmitter, the second transmitter must be reprogrammed.
- Door lock assemblies and lift window lock system will cycle once confirming that second transmitter code is programmed.

4. Disconnect fused jumper wire from DLC.
   - System will not operate if ground connection is not removed.
5. Verify operation of each transmitter assembly.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Body Hinge Pillar Trim Bolt/Screw	1.3 N•m (12 lb. in.)

SECTION 10

BODY SERVICE

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General Body Service ..... Section 10-1
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Seats and Carpet ..... Section 10-10
Seat Belts ..... Section 10-11

BLANK

SECTION 10-1

GENERAL BODY SERVICE

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location View in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: The theft deterrent label found on some major sheet metal, engines, and transmissions must be masked prior to painting, rustproofing, undercoating, etc. The mask must be removed following the above operations. Failure to keep the label clean and readable may result in liability for violation of Federal Vehicle Theft Prevention Standard, and subject the vehicle owner to possible suspicion that the part was stolen.

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GENERAL DESCRIPTION

The information in this section provides body service procedures that apply to the entire vehicle.

ON-VEHICLE SERVICE

FASTENERS

NOTICE: When replacing fasteners avoid substituting otherwise similar fasteners in locations which require the use of special fasteners meeting GM specifications 6111M, 6047, 6174M for aluminum components. Failing to follow this precaution may result in premature corrosion of the sheet metal in the areas mentioned above.

Weld Stud Replacement

If during a repair procedure, a weld stud becomes damaged, the following procedure may be used to replace the weld stud.

1. Drill a hole into same location as damaged weld stud.
2. Drive a screw into drilled hole.

3. Use screw to retain clips, molding assemblies, etc. in same manner used with weld studs.
4. If surface becomes marred, repair and/or paint to provide a smooth surface. Refer to "Metal Part Refinishing – Basecoat/Clearcoat" in this section.

LUBRICATION

Mechanical parts having contacting surfaces in relative motion with any other body parts are lubricated during assembly. To maintain ease of operation, it is recommended that these parts be lubricated at the basic service intervals shown in SECTION 0B, using the following lubricants:

- Door hinge assemblies – oil (30 weight preferred). Apply lubricant to roller and hinge pin bushings.

Important

- Do not apply lubrication to hold-open link and roller contacting surfaces as this could cause improper roller operation.

- Compartment lid assembly hinges and torque rod-to -hinge surfaces – Lithium Lubricant (3M P/N 8915) or equivalent.
- Chrome key lock cylinder assemblies should be lubricated with Multi-Purpose Lubricant (GM P/N 12345120 or equivalent) and black key lock cylinder assemblies with Synthetic SAE 5W-30 engine oil.
- Seat assembly mechanism and door assembly hardware are covered in their specific body sections in this manual.
- All weatherstrip assemblies should be periodically lubricated with a silicone grease (GM P/N 12345579 or equivalent). A thin film of lubricant should be applied using a clean cloth.

STRIPES AND DECALS

Stripes and decals adhere to a painted surface using pressure sensitive adhesive.

The use of a wetting solution aids the technician in lifting and positioning the stripe or decal during installation. A wetting solution also ensures a better bond between stripe or decal and panel assembly.

Stripe or decal replacement involving collision damage, or damage to underlying painted surface, requires that metal repair and/or refinish operations be completed before stripe or decal is installed.

NOTICE: Freshly painted surfaces must be allowed to dry thoroughly before installing stripe or decal. Residual solvents in fresh painted surfaces can lead to subsequent blistering problems if stripe or decal is applied before complete release of solvents. The striping material highlights vehicle surface imperfection. All dings, rough metal, paint defects and uneven two-tone paint break lines must be eliminated before stripe/decal application can take place.

Body surfaces and decals must be maintained between 21° to 38°C (70° to 100°F) during installation. Auxiliary heat sources to warm the body surfaces and decals are required if the temperature is below 21°C (70°F), or the body surface must be allowed to cool if above 38°C (100°F).

Important

- Never apply decals when body surface and decal temperatures are below 21°C (70°F).

Stripes and decals may be applied "dry." If this does not result in a consistent bubble free application, the "wet" method must be used as in the case of large graphics packages.

Important

- Stripes or decals that are applied on flexible surfaces (fascias, etc.) **must be applied using the "wet" method.** This will reduce the formation of bubbles under the decal due to the outgassing potential of the flexible materials.

The following equipment and materials are necessary when making a quality stripe or decal installation. Equivalent products may be used.

- Wetting solution – a foaming type window cleaner, that does not contain ammonia.
- A silicone, wax and grease remover.
- Isopropyl alcohol.
- Squeegee – 75 to 100 mm (3 to 4 inches) wide, plastic or hard rubber. Deburr any sharp or rough edges to prevent scratching of the stripe or decal.
- Water bucket and sponge or spray bottle.
- Sandpaper – 600 grit or finer, wet-or-dry type.
- Heat gun or infrared heat lamp.
- Clean, lint-free wiping rags.
- Sharp knife or razor blade.
- Scissors.
- Fine pin or needle.
- Marking pencil.

Remove or Disconnect

1. Necessary molding assemblies or trim panel assemblies.
2. Wash and clean repair surfaces, adjacent panel assemblies and openings as required.
3. Molding assembly attaching clips, handles, side-marker reflector assemblies and/or other stripe or decal overlapping parts.

   NOTICE: To avoid damaging underlying paint finish, do not use pointed or sharp instruments for removal of stripe or decal from panel assembly.
4. Stripe or decal by starting at one edge and peeling stripe or decal from panel assembly surface.
   - Application of heat to stripe or decal at point of removal aids removal operation.
5. All traces of adhesive residue from painted surfaces with a silicone, wax and grease remover.

Install or Connect

1. Prepare surface.

   NOTICE: Always refer to manufacturer's packaged instructions to avoid damage.

   Important

   - If area where stripe or decal is to be applied has been refinished, remove any imperfections that would show through stripe or decal.

   Clean

   A. Painted surface with a silicone, wax and grease remover.

   B. Area where stripe or decal will be applied with a 50-50 mixture of isopropyl alcohol and water.

   C. Wipe panel assembly surface with a clean cloth while solvent is still wet and allow to dry.

2. Apply wetting solution to area where stripe or decal is to be installed.

3. Put wetting solution on adhesive side of stripe or decal.

   - Remove backing material of stripe or decal as necessary.

4. Stripe or decal to panel assembly. Wetting solution will allow movement of stripe or decal for proper positioning.

   A. Working from center where possible, squeegee stripe or decal into position. Application of additional wetting solution may be necessary to ease installation of stripe or decal. Application of soapy wetting solution on top side of stripe or decal will ease pull of squeegee on stripe or decal and help to eliminate damage to it.

   B. Apply heat to stripe or decal at recessed areas. Press stripe or decal into recess to obtain firm bond.

   Inspect

   - Stripe or decal from critical angle using adequate light reflection to detect any irregularities that may have developed during installation.

   C. Remove all air bubbles by piercing with a safety pin, needle or tool with same size piercing tip. **Never** use razor blade or knife edge.

   - Pierce bubble on its outer edge and force air out from opposite edge with blade of squeegee.

5. Previously removed parts and clean as required.

ADHESIVE NAMEPLATE/EMBLEM ASSEMBLIES

For information on adhesive nameplate and emblem assemblies, refer to the specific body sections in which the nameplate and emblem assemblies are located.

ADHESIVE MOLDING ASSEMBLIES

The molding assemblies are attached to the body panel assemblies with adhesive tape. To ensure a good replacement of new or old molding assemblies, the panel assembly surface should be warm, 21° to 32°C (70° to 90°F), clean and free of any wax or oily film. Methods are listed to attach loose molding assembly ends, completely removed molding assemblies, and replacement molding assemblies.

Secure Loose Molding Assemblies

1. Wash affected area with soap and water and wipe dry. Wipe panel assembly and adhesive side of molding assembly with clean rag using oil-free naphtha or alcohol.
   - If molding assembly has been pulled loose from adhesive backing (tape remains on body panel assembly), do not remove tape from body panel assembly. Clean back of molding assembly and tape on body panel assembly with oil-free naphtha or alcohol and proceed with step 3.
2. If needed, apply length of masking tape as molding guide. Straight edge may also be used.
3. Apply adhesive to back of molding assembly and press in place. If adhesive (GM P/N 1052621 or equivalent), is used, apply constant pressure to molding assembly for 30 seconds or until firm bond has been made.

Molding Assembly Completely Removed (Method 1)

Figure 1

Important

- Do not use this procedure if molding assembly is dented or was pried from body panel assembly.

1. Wash affected area with soap and water and wipe dry.
2. Remove all traces of adhesive from body panel assembly and back of molding assembly using oil-free naphtha or isopropyl alcohol.
3. Mark proper position of molding assembly with length of masking tape (Figure 1). Use adjacent molding assemblies as guide.
4. Warm body panel assembly with heat lamp or heat gun to 21°C (70°F).
5. Apply double-coated foam tape (3M P/N 06380 or equivalent) to the molding assembly.
6. Line up molding assembly to tape guideline on body panel assembly or use straight edge to align molding assembly to front or rear molding assemblies already on vehicle.

7. Peel backing from end of molding.
8. Press firmly into place while continuing to remove backing.
9. Hand roll molding assembly to body panel assembly to ensure proper adhesion.

Molding Assembly Completely Removed (Method 2)

Scotch-Brite™ Molding Adhesive and Stripe Removal Discs (3M P/Ns 07501 and 07502) and the Roloc™ + Holder (3M P/N 07500) can be used for quick removal of adhesives from molding assemblies and panel assemblies.

CAUTION: Approved safety glasses should be worn when performing this procedure to reduce the chance of personal injury.

1. Tighten holder in collet or chuck of any standard tool.
2. Twist disc assembly securely into holder.
3. With tool running, bring outer edges of disc into contact with material to be removed. Light contact is all that is needed.
4. Guide tool so it works against the rotation of the disc.

Molding Assembly Replacement

Figure 1

Remove or Disconnect

- Molding assembly.
  - A. Hold hot air gun 152 mm (6 inches) from surface of molding assembly to be removed.
  - B. Apply heat, using circular motion for about 30 seconds.
  - C. Place catgut or fishing line between molding assembly and body panel assembly. Using sawing motion, remove molding assembly from panel assembly surface.
  - D. Discard molding.

Install or Connect

- Molding assembly.
  - A. Mark proper position of molding assembly with length of masking tape or straight edge, aligning to front or rear molding assemblies already on vehicle.

    Clean

    - Area with soap and water and wipe dry.
    - Body panel assembly using oil-free naphtha or isopropyl alcohol.
  - B. If needed, warm body panel assembly with heat lamp or heat gun to 21°C (70°F).
  - C. Peel backing from front end of molding assembly.

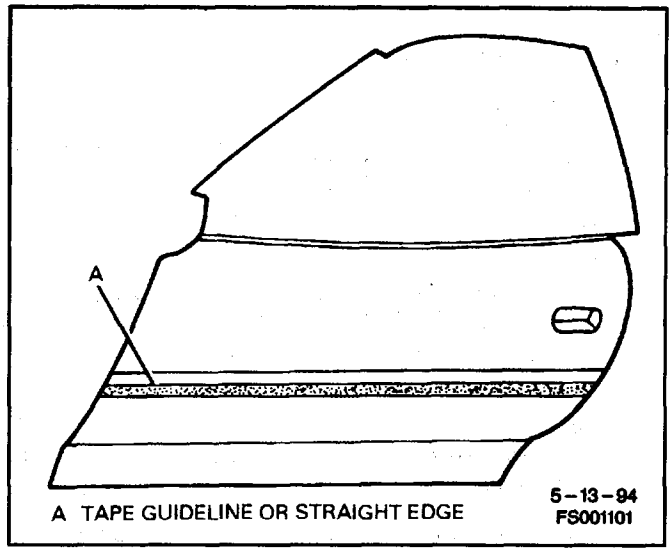


Figure 1 – Adhesive Molding Assembly Repair

    - Do not touch adhesive backing.
  - D. Press molding assembly to body panel assembly while continuing to remove backing.
  - E. Hand roll molding assembly to body panel assembly to ensure proper adhesion.
  - F. Molding assembly ends should not overlap door assembly edge, door assembly edge guard, lock cylinder assembly or body openings.

    Inspect

    - Molding assembly ends for bonding.
    - Hand roll loose ends.

WATERLEAK DIAGNOSIS AND REPAIR

GM vehicles are designed to operate under normal environmental conditions. The design criteria for sealing materials and components takes into consideration the sealing forces required to withstand the natural elements. These specifications do not, and cannot, take into consideration all artificial conditions such as may be encountered in some high-pressure car washes.

The watertest procedure has been correlated to the natural elements and will determine the ability of a vehicle to perform under normal operating conditions.

Repairing body waterleaks is a problem of proper testing, diagnosis and repair through adjustment of misaligned components and/or application of proven repair materials. The first step in waterleak diagnosis is finding the condition under which the leak occurs. For example, the leak is noticed only when parked on an inclined drive, or when water is in the jack and spare tire stowage assembly.

If the general leak area can be found, the exact entry point can be quickly isolated by use of a localized test such as a water hose or air hose. If the leak source is not obvious, a testing method using watertest equipment should be used. It may be necessary to remove some interior trim panel assemblies or components to locate areas needing repairs.

Generalized Testing

The watertest stand must be constructed.

- Watertest stand specifications:
  - Volume of flow should be 14 liters (3.7 gallons) per minute.
  - Water pressure, measured at nozzle – 155 kPa (22 psi).
  - Windshield assembly and front body pillar – approximately 30 degrees down, 45 degrees toward rear and aimed at corner of windshield assembly.
  - Doors – approximately 30 degrees down, 45 degrees toward rear and aimed at center of rear door assembly or rear quarter panel assembly.
  - Rear window assembly and rear compartment lid assembly or end gate assembly – approximately 30 degrees down, 30 degrees toward front and aimed about 600 mm (24 inches) from corner of rear window assembly.
- If specified water pressure of 155 kPa (22 psi) cannot be obtained because of local situation, both test stands may be moved toward body until water spray overlap can be obtained.

Localized Testing (Spot Test)

Localized testing may be made with either water or air. Begin the test at the base of the suspected area and continue up slowly until the leak is located.

Important

- Pinpoint the leak area before any repair is made. Random repair may only temporarily restrict water entry and make future diagnosis and repair more difficult.

Continue localized testing in the same general area to confirm that all leaks have been located.

Water Hose Test

Figures 2 and 3

1. Have helper inside vehicle to detect actual leak point.
2. Use unrestricted water flow (no nozzle).
3. Begin at base of suspected leak area and move upward slowly.

Air Hose Test

Figures 4 and 5

1. Apply bubble solution (liquid soap) to suspected leak area.
2. Apply air pressure with an air hose from inside vehicle. Do not exceed 205 kPa (30 psi).
3. Observe for bubbles on outside at suspected leak area.

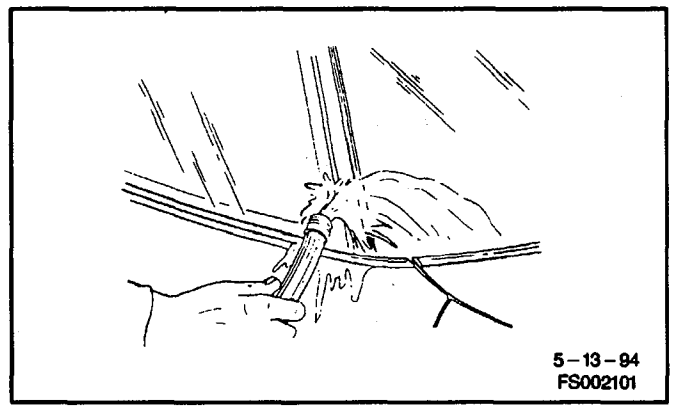


Figure 2 – Water Hose Test of Windshield Pillar

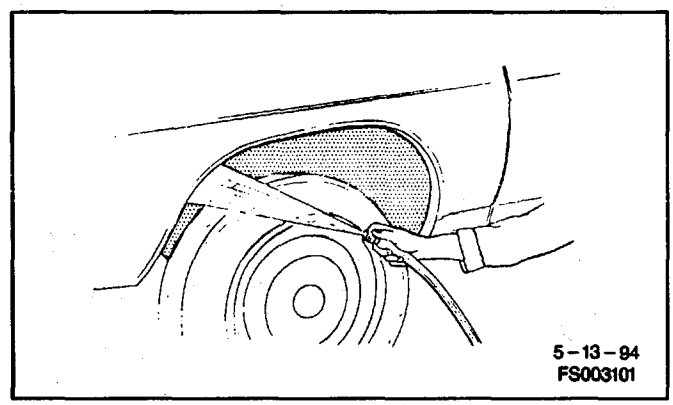


Figure 3 – Water Hose Test of Wheelhouse Assembly

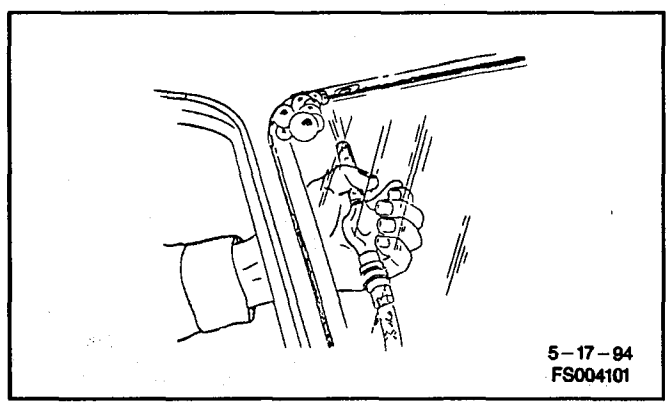


Figure 4 – Air Hose and Bubble Solution Test of Windshield Assembly Glass Sealant

Waterleak Repair

Figure 6

To locate the exact leak point or to repair the leak, it may be necessary to remove some interior trim panel assemblies or components. Waterleak repair is covered in the section covering the component. For example, for the repair procedure on stationary window assemblies, refer to SECTION 10-2.

After completion of any waterleak repair, the general area should be retested using the watertest stand. Do not use high-pressure air hose.

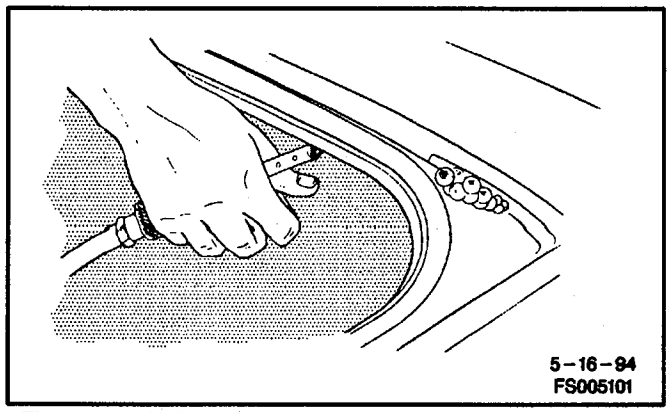


Figure 5 – Air Hose and Bubble Solution Test of Panel Joints

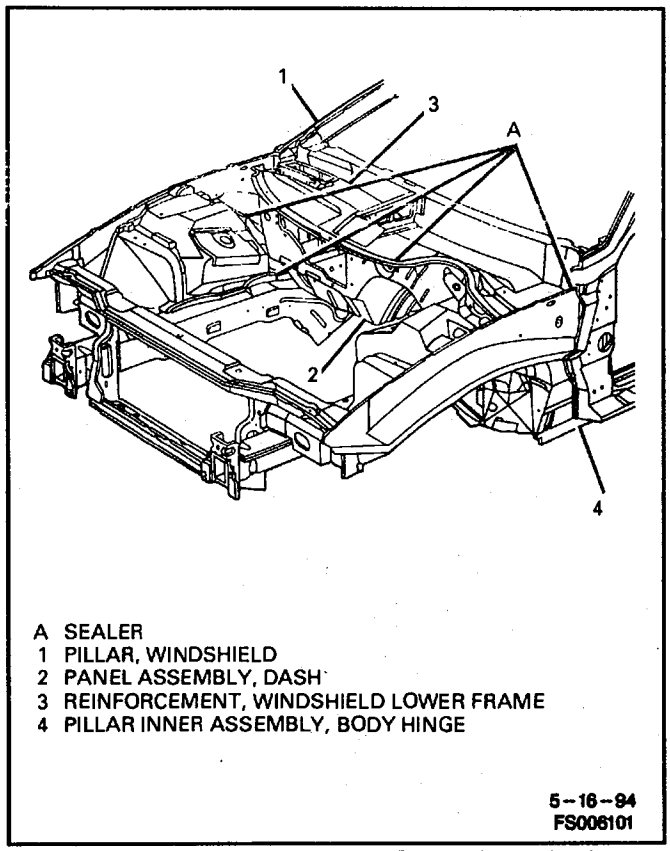


Figure 6 – Sealing Front End to Prevent Water Leaks

Materials recommended for specific leak areas include:

- Urethane adhesive caulking kit (GM P/N 12345633 or equivalent) for windshield assembly, rear window assembly, and stationary window assembly repair.
- Brushable seam sealer which can be painted on metal joints.
- Bedding and glazing compound for ventilation ducts and drip moldings.
- Drip-check sealer for small cracks and pin holes.
- All-Around Autobody Sealant (3M P/N 08500 or equivalent) for large holes.
- Weatherstrip adhesive (3M P/N 08011 or equivalent) for weatherstrip assemblies.
- Strip caulk for bolts, studs and screws.

WINDNOISE DIAGNOSIS AND REPAIR

Figures 4, 5 and 7

Many of the waterleak diagnosis tests are also used for windnoise diagnosis.

- Visual inspection.
  - Misaligned components
  - Loose fasteners
  - Torn weatherstrip assemblies
  - Broken weld joints
  - Sealer and/or adhesive skips
- Tracing powder or chalk test.
  A. Clean weatherstrip assemblies and contact surfaces with solvent.
  B. Apply powder or chalk in an unbroken line to contact surface of weatherstrip assembly around perimeter of rear compartment lid assembly, door assembly, side door window assembly or hood assembly. Surrounding areas must be free of chalk or powder.
  C. Close panel assembly completely. Do not slam. This presses weatherstrip assembly firmly against mating surfaces.

Inspect

- Applied chalk line on weatherstrip assembly will be marred where contact is good. A corresponding imprint will be on mating surfaces.
- Gaps or irregularities in powder or chalk line on mating surfaces indicate areas with poor seal.

- Air pressure test.
  A. Mask off pressure relief valves.
  B. Turn on vehicle's ventilation fan.
  C. Close all openings – windows, doors, etc. An abnormal amount of high pressure will build up in vehicle and will escape through poor seals.
  D. With stethoscope or length of heater hose, listen for escaping air along door and window seals.
     - Smoke or dusting powder test can be used in same manner. Exact leak location can be seen as smoke or powder travels through poor seal.
- Soap suds or bubble test.
  A. Pressurize interior of vehicle as outlined in air pressure test above.
  B. Apply soapy solution to potential leak areas. Escaping air pinpoints leak area. Air pressure from air hose inside vehicle can be used instead of pressurizing vehicle's interior. Do not exceed 205 kPa (30 psi) when using air hose. (Figures 4 and 5).

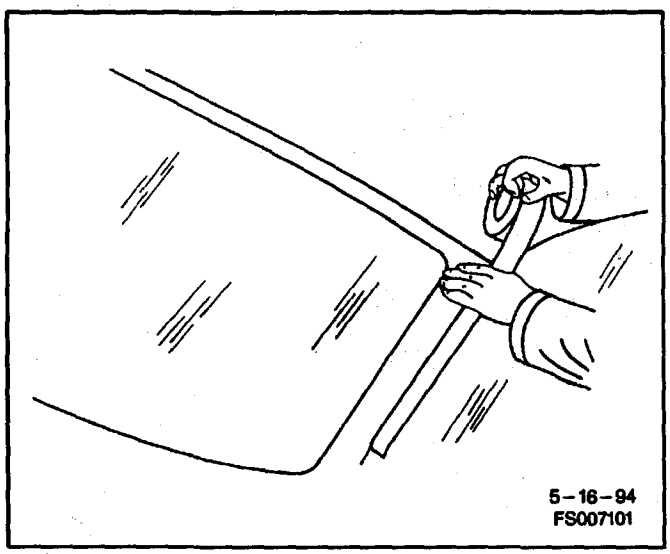


Figure 7 – Masking Tape Application to Identify Windnoise

- External windnoise.
  - A. Road-test vehicle to determine source of noise.
    - Wind roar is caused by outside air passing over an opening.
    - Wind whistle is caused by inside air seeping through a bad seal, or by outside air passage over a protruding edge.
    - Wind rush is outside air passing over the vehicle's body.
  - B. Tape various moldings and gaps until noise is eliminated (Figure 7).

NOTICE: If masking the grille assembly and headlamp capsule assembly areas, care must be taken not to restrict airflow and cause vehicle overheating.

Windnoise leak repairs are very similar to waterleak repairs. The actual procedure depends on the type of seal being repaired.

Leaks around door opening weatherstrip assemblies do not always indicate a faulty weatherstrip assembly. A door assembly or window adjustment may resolve the condition. Refer to SECTION 10-6.

SQUEAK AND RATTLE DIAGNOSIS AND REPAIR

Basically, squeaks and rattles are caused by improperly controlled relative motion between components. There are three ways to prevent the squeak or rattle.

1. Attach component securely so there is no relative motion during operation.
2. Separate components so there is no contact under operating conditions.
3. Insulate components so that no squeaks or rattles occur with relative motion between components. Low uniform friction surfaces can be provided to eliminate "stick-slip" motion.

ANTICORROSION TREATMENT

Figures 8 and 9

CAUTION: When applying sound deadeners, due care and preventive measures must be exercised to prevent any materials from being sprayed into door assembly and quarter outer panel mechanisms such as door lock cylinder assemblies, channel assemblies, window regulators and seat belt retractors, as well as any moving or rotating mechanical or suspension parts on the underbody. After material application, be sure all body drain holes are open.

Anticorrosion materials are used on interior and exterior surfaces of metal panels to provide rust resistance. These materials include metals such as one-sided and two-sided galvanized zincrometal and zinc-iron alloy steels. These treated metals are used on components such as quarter outer panels, wheelhouse assemblies and other critical parts. These materials have multiple production and field usages.

Metal conditioners and primers are used on interior and exterior surfaces along with protective waxes on interior surfaces in areas where moisture might accumulate. Sealers are applied along exposed joints and moisture-repelling asphaltic sound deadeners are applied inside the wheel wells and on some underbody components.

Any procedure that disturbs these special treatments, such as panel replacement or collision damage repair operations, may leave the metal unprotected and result in corrosion. Proper recoating of these surfaces with service-type anticorrosion material is essential.

Metal conditioners and primer coatings are applied to all metal panels at the time of vehicle manufacture. After repair and/or replacement parts are installed, all accessible bare metal surfaces must be treated with metal conditioner and reprimed using a zinc chromate primer. This operation is to be performed prior to the application of sealers, waxes, deadeners and antirust compounds.

Sealers are applied to specific joints during manufacture. These sealers are intended to prevent water and dust from entering the vehicle and also are anticorrosion barriers. Sealers are applied to such areas as lid hem flanges, wheelhouse panel assembly, quarter outer panel, floor panel assembly, cowl assembly, roof module assembly and various other panel-to-panel attaching points. The originally sealed joints are obvious and any damage to these sealed locations should be corrected by resealing. Attaching points of new replacement panels should be resealed. Replacement lid assemblies will also require sealing in the hem flange areas.

Flanged joints, overlap joints and seams should be sealed using a quality sealer of medium-bodied consistency. The sealer used must retain its flexible characteristics after curing and be paintable.

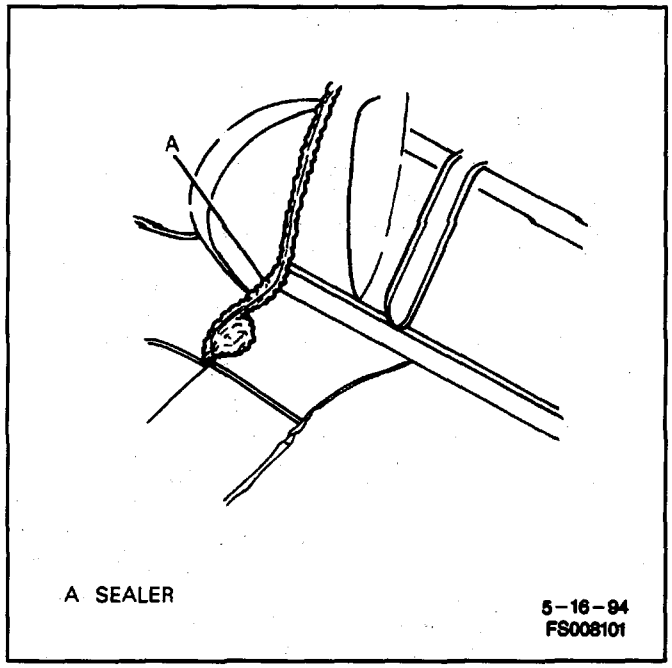


Figure 8 – Typical Joint Sealing, Rear End Area

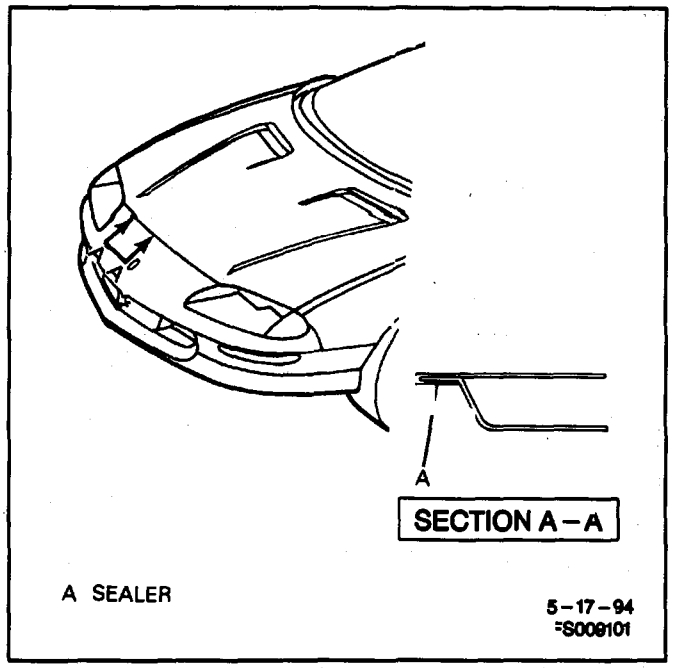


Figure 9 – Typical Anticorrosion Treatment Around Perimeter of Hood Assembly Outer-to-Inner Panel Flanges

Open joints which require bridging of the sealer to close a gap should be sealed using a heavy-bodied caulking material. Follow the label directions for the material selected.

Color application may be required to restore repaired areas such as the hood assembly, quarter outer panels, roof module assembly, engine compartment, underbody and inner panel assemblies to original appearance. When this is necessary, conventional refinishing preparation, undercoat build-up and color application techniques should be followed.

Deadener materials (spray-on type) are used on various metal panels to provide corrosion resistance and joint sealing. They control the general noise level inside the passenger area of the vehicle. When deadeners are disturbed because of damage, removed during repair operations, or a new replacement panel is installed, the deadener material must be replaced by a service equivalent material. The application pattern and location of deadener materials can be determined by observing the original production installation.

Anticorrosion compounds are light-bodied materials designed to penetrate between metal-to-metal surfaces, such as pinch-weld joints, hem flanges, and integral panel assembly attaching points where metal surfaces are difficult to coat with conventional undercoating materials, and are inaccessible for painting. Material suited for this type application is a wax-type coating (GM P/N 12345489 or equivalent).

Conventional undercoating is recommended to coat large areas such as quarter outer panels, floor panel assemblies, lid assemblies, hood assemblies, etc.

The sequence of steps for application of anticorrosion materials is as follows:

1. Clean and prepare metal.
2. Apply primer (zinc chromate).
3. Apply sealers at all previously sealed joints.
4. Apply color in areas where color is required, such as hem flanges, exposed joints and underbody components.
5. Apply deadeners as indicated by original application pattern.
6. Apply anticorrosion compounds.
7. Apply underbody rustproofing material.

Cleaning of the interior and underbody panel assembly surfaces is necessary when original galvanized or other anticorrosion materials have been burned off during welding or heating operations. Removal of the residue from burning will require additional care in such areas as interior surfaces of box-type construction and when configurations of the metal panel assemblies limit access to interior surfaces. One or more of the following methods will remove the residue.

CAUTION: Approved safety glasses should be worn when performing this procedure to reduce the chance of personal injury.

- Where access is possible, scraping can be used. If a standard putty knife or scraper will not fit into the affected area, fabricate a small, flexible scraper from a narrow piece of sheet metal.
- A jet of compressed air will remove most residue and could be effective in limited-access areas. Eye protection is absolutely necessary in an operation of this type.
- Sandblasting is most effective and should be used when the equipment is available and access to the area is good. Sandblasting is an excellent method for cleanup and preparation of open joints, underbody components and hem flange areas.
- Wire brushing (power and by hand).
- When access is good, sandpaper and steel wool can be used.

CORROSION REPAIR

Prior to replacing exterior body parts or assemblies, check condition of paint on all covered or hidden interior surfaces. If corrosion is found in these areas, proceed as follows:

1. Remove corrosion with suitable wire brush and abrasive or liquid corrosion-removing agent. Follow label directions.
2. If necessary, wash with detergent, rinse and dry.
3. Apply a heavy coating of anticorrosion compound to all cleaned hidden surfaces before installing exterior body parts. Also, apply anticorrosion compound to all inner surfaces of exterior body parts being installed.

METAL PART REFINISHING – BASECOAT/CLEARCOAT

CAUTION: Many paint repair systems require additives containing isocyanates. It is essential that all recommendations and warnings listed on the container label for materials selected be followed. It is mandatory that adequate respiratory protection such as air line respirators with a full hood be worn. Such protection should be worn during the entire painting process. Persons with respiratory problems or those allergic to isocyanates must not be exposed to isocyanate vapors or spray mist.

Basecoat/clearcoat is factory applied in four layers: a cathodic immersion primer, a primer-surfacer, base color of high-solids acrylic enamel (basecoat), and a clear acrylic top coat (clearcoat) to give the finish a high-gloss look.

Clearcoat Repair without Repainting

Figure 10

If the damage or imperfection can be sanded or polished without reaching the basecoat, you do not have to repaint.

1. Thoroughly wash repair area with mild detergent and water.
2. Apply small amount of medium to fine machine rubbing compound to repair area and smear evenly with compounding pad.
3. With polisher running at approximately 1,700 rpm, polish repair area. Keep pad flat against panel assembly while applying light pressure. Feature lines and panel assembly edges should be done with care.
4. If sanding is not required, proceed to step 9.
5. If repair is near adjacent panel assemblies, mask adjacent panel assemblies to protect against sand scratches and burn-through of panel assembly edges.
6. Saturate piece of micro-fine sandpaper of 1,500 to 2,000 grit in container of water and attach to sanding pad. Adding small amount of liquid detergent to water will improve wet-out and sanding performance.
7. Keep repair area wet while sanding. Sand lightly and evenly in one direction only, using straight strokes.

Important

- Frequently wipe or squeegee repair to determine when defect has been removed. Sand only enough clearcoat to remove defect. Sanding below clearcoat requires repainting.

8. Using clean cloth, wipe repair area clean of water and clearcoat residue.
9. Polish as necessary. Often, hand compounding and polishing of a small repair area is all that is necessary to restore appearance.
   - Keep pad flat to panel assembly and allow weight of polisher to do the work.
   - Use polish sparingly to achieve original shine.
   - Machine or hand polish repair area first, then blend in with rest of panel assembly.

Basecoat/Clearcoat Preparation

1. Wash repair area with detergent and water.
2. Clean repair area with a silicone, wax and grease remover.
3. Repair and feather-edge damaged areas.
4. Treat metal surface with metal conditioner and conversion coating. Allow to dry.
5. Apply primer-surfacer. Dry 20 to 30 minutes.
6. Sand basecoat paint area with 400 grit or finer paper. (For clearcoat only, wet sand with 600 grit or finer paper or hand compound.)
7. Clean with a silicone, wax and grease remover and tack wipe.

Important

- Do not do step 8 if the basecoat enamel used for repair does not require it. Always refer to manufacturer label directions.

8. Apply one or two coats of adhesion promoter:
   A. Within moldings or breaklines.
   B. Onto adjacent panel assembly 100 to 150 mm (4 to 6 inches) if repair is not confined and beyond area to be covered by clearcoat.
   C. Allow to flash at least 30 minutes before applying clearcoat.

Basecoat Application

CAUTION: See "Caution" under "Metal Part Refinishing – Basecoat/Clearcoat."

1. Activate enamel material per manufacturer instructions.
2. Mix thoroughly.
3. Reduce basecoat per manufacturer instructions.
4. Check viscosity with a Zahn number 2 viscosity cup or equivalent.

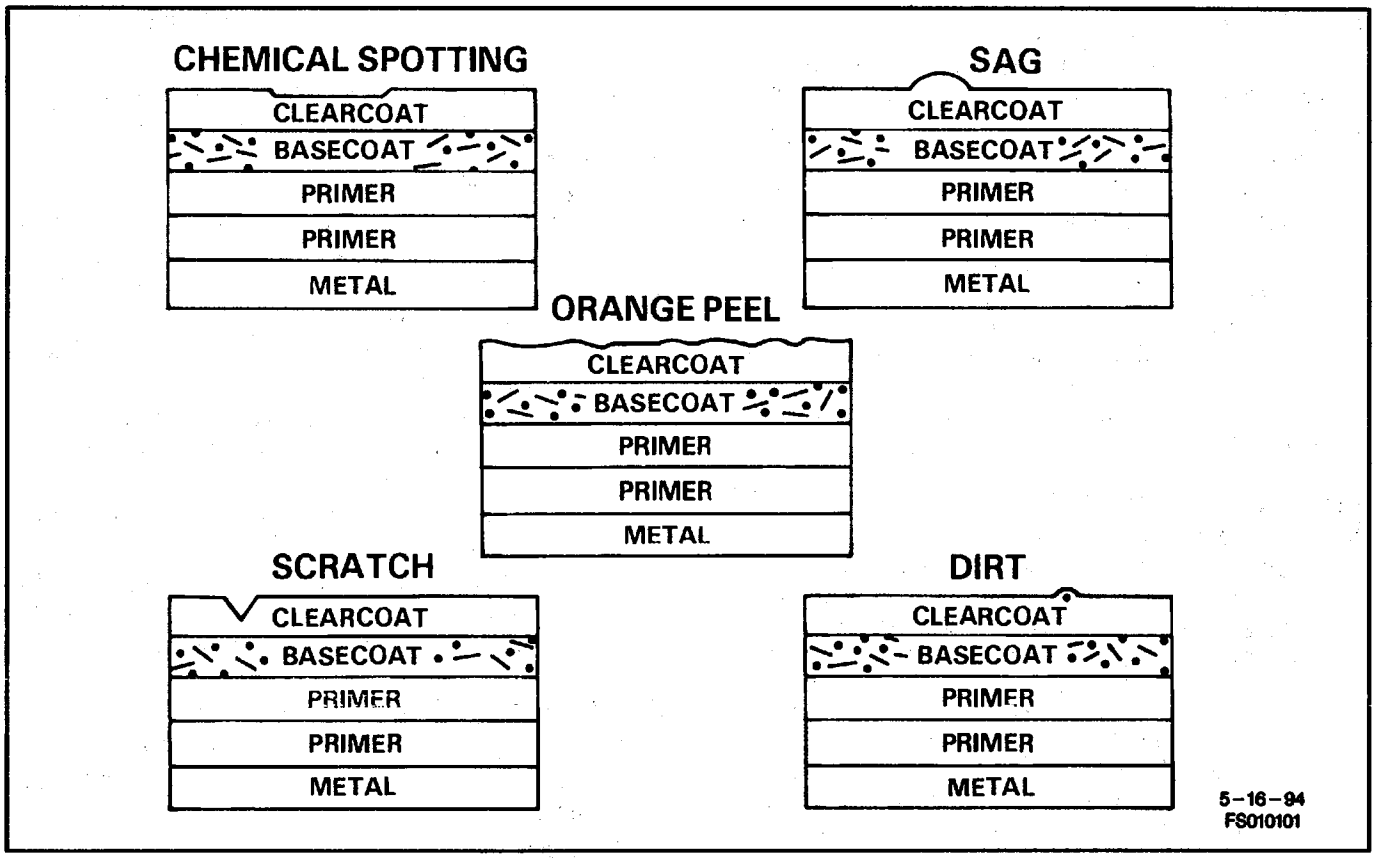


Figure 10 – Minor Paint Defects That Can Be Repaired Without Repainting

5. Spray two or more medium-wet coats, 15 to 20 minutes apart, to achieve full-hiding and color match.
6. Cure per manufacturer instructions.

Clearcoat Application

CAUTION: See "Caution" under "Metal Part Refinishing – Basecoat/Clearcoat."

1. Activate materials per manufacturer instructions.
2. Mix thoroughly.
3. Reduce clearcoat per manufacturer instructions.
4. Check viscosity with a Zahn number 2 viscosity cup or equivalent.
5. Spray at 50 psi gun pressure. Apply two medium-wet coats, 15 to 20 minutes apart.
   - Cover entire panel assembly wherever possible.
   - When there are no breaklines, blend spray within area prepared.

Important

- Clean spray equipment immediately after use with lacquer thinner.

INDUSTRIAL FALLOUT (ACID RAIN)

Important

- The following information regards the use of finesse-type repairs to industrial fallout (acid rain) and rail dust damage of basecoat/clearcoat paint finishes.

Since the severity of the condition varies from area to area, proper diagnosis of the damage extent is critical to the success of repairs. Diagnosis should be performed under high-intensity fluorescent lighting, on horizontal surfaces (hood assembly, roof panel assembly, rear compartment lid assembly) after they have been properly cleaned.

There are three basic types of acid rain damage:

- Surface level contamination – may be repaired by simply washing the vehicle, cleaning the surface with a silicone, wax and grease remover, neutralizing acidic residue and finesse polishing.
- Clearcoat etching – slight etching still noticeable after the above washing and finesse polishing procedure.
- Basecoat etching – severe etching beyond the clearcoat into the basecoat.

Surface Level Contamination Repair

1. Wash vehicle with standard car detergent and water, and dry thoroughly.
2. Clean affected area with a silicone, wax and grease remover.

3. Neutralize leftover acidic residue by cleaning damaged areas with mixture of baking soda and water (one tablespoon per one quart of water), rinse thoroughly and dry panel assemblies completely.
4. Apply finesse-type polish with foam pad.
   - If damage has been repaired, remove any swirl marks with dual-action orbital polisher and foam pad.
   - If some damage remains, proceed to "Slight Clearcoat Damage – Wet Sanding, Finesse Polishing" in following procedure.

Slight Clearcoat Damage – Wet Sanding, Finesse Polishing

1. Select small test area on damaged panel assembly.
2. Wet sand damaged area with an American grade ultra-fine sandpaper of 1,500 to 2,000 grit and rubber sponge sanding block. During wet sand process:
   A. Use ample amounts of water.
   B. Go slow to prevent removing too much clearcoat.

Important

- Be sure to use American sandpaper. European sandpaper has a P before the grit number and European grits do not align with American grits the majority of the time.

3. Remove excess water with rubber squeegee and inspect area.
   - If wet sanding has repaired the damage, continue the sanding procedure on the entire panel assembly. Apply a finesse-type polish with a foam pad and remove any swirl marks with a dual-action orbital polisher and foam pad.
   - If (during the repair) it is suspected or observed that etching has penetrated into the basecoat, too much clearcoat has been removed during sanding or base color is transferred to pad during polishing, the affected areas may require clearcoat/basecoat application or refinishing. Refer to "Metal Part Refinishing – Basecoat/Clearcoat," "Flexible Plastic Part Refinishing" and/or "Rigid Plastic Part Refinishing" in this section.
4. Polish entire vehicle after all damage has been repaired.

Clearcoat Thickness

The clearcoat on the vehicle is typically 0.059 to 0.078 mm (1.5 to 2 mils; 0.0015 to 0.0020 inch) thick.

Paint Gages

The best way to accurately measure how much clearcoat has been removed is to use a paint gage before, during and after the sanding process. Paint gages measure the total thickness of the finish and when used, can determine how much clearcoat has been removed during the repair process. Paint gages range from magnetic pull types to sophisticated electronic types and are available from a variety of sources.

The older magnetic type gages, at best have a ± 5 percent accuracy range and are not sensitive enough to detect removal of 0.020 mm (0.5 mil; 0.0005 inch) clearcoat. The newer type magnetic gages have improved accuracy ranges. Most gages are confined to checking either ferrous metal (steel) or non-ferrous metal (aluminum) panel assemblies. At this time, there are no viable gages for reading film thickness on non-metallic panel assemblies.

The more sophisticated digital type gages are able to read film thickness on both ferrous and non-ferrous metal panel assemblies. Digital gages can have an accuracy range of ± 1 percent and include thickness standards for recalibration.

Rail Dust Damage Repair

CAUTION: Rail dust remover (oxalic acid) is an acidic substance containing chemicals that will break down the iron particles embedded in the finish. When working with it, use the necessary safety equipment, including gloves and goggles. Follow the manufacturer's directions closely because it may require special handling and disposal.

Rail dust damage comes from the tiny iron particles produced from the friction between the train wheels and the track. It can also be deposited on vehicles if stored near any operation producing iron dust (i.e., steel ore yards). This dust can either lay on top of, or embed into the paint surface. It is usually diagnosed as bumps in the paint surface or rust colored spots in the paint.

1. Wash vehicle with soap and water, dry it and clean affected area with a silicone, wax and grease remover.
2. Rinse surface with cold water, keeping vehicle in cool or shaded area.
3. Soak several terry cloth towels in container of rail dust remover solution and, after damaged areas have been rinsed with cold water, lay wet towels on damaged areas.
4. Allow towels to remain in place for 20 minutes, keeping them moist by spraying with water and not allowing to dry on surface of vehicle.
5. After 20 minutes of applying towels, remove them and rinse area thoroughly with cold water. Inspect affected area to ensure dust has been removed. Use both touch (feeling for bumpy surface) and sight (magnifying glass for close inspection).
6. If, upon inspection, some particles are still present, process of applying towels can be repeated three times.
7. Select test area and hand wet sand with American ultra fine 1,500 grit to 2,000 grit sandpaper to repair damage (surface pitting from dust). Use ample amounts of water and go slow to prevent removing too much clearcoat.

   NOTICE: Use a paint gage to determine the amount of clearcoat removed. If too much has been removed, additional clearcoat will have to be applied.

Important

- If rail dust has penetrated into the basecoat, the panel assembly requires refinishing. Make sure all rail dust has been removed prior to refinishing or the rust spots will return, causing customer comebacks.

8. If damage has been repaired, complete repair to entire panel assembly.
9. Polish the entire vehicle after all damage has been repaired.

Preventing Industrial Fallout Damage

To prevent industrial fallout (acid rain) damage, customers should be urged to wash and dry their vehicles frequently and garage them, or at least cover them with a quality car cover when not in use.

Vehicles in dealer inventories should be kept clean and dry. A vehicle that sits unattended, especially after the sun has dried any water on the body surface, is a target for acid rain damage.

PLASTIC PART IDENTIFICATION

How to Identify Plastic Parts

Figures 11 through 14

CAUTION: General Motors does NOT recommend using a plastic "Burn Test" to distinguish different types of plastics. This test produces vapors that can be harmful to your health.

Specific plastics used on this vehicle are shown in Figures 12 and 13. The procedures provided in this section classify the plastics into two groups; flexible and rigid. Refer to Figures 12 and 13 to identify the parts and the repair/refinish procedure to use.

The following information can be used to specifically identify plastic parts when necessary.

1. Look on the back of the part for the International Organization for Standardization (ISO) code marking as shown in Figure 11.
2. Refer to Figures 12 and 13. Match the ISO code found on the parts with those on the charts.
3. Use the chart in Figure 14 to identify special handling procedures and the repair/refinish classification (rigid or flexible).

FLEXIBLE PLASTIC PART REPAIR AND REFINISHING

Repair Materials

Important

- Use supplies and repair materials from the same manufacturer for the best results. Do not mix systems.

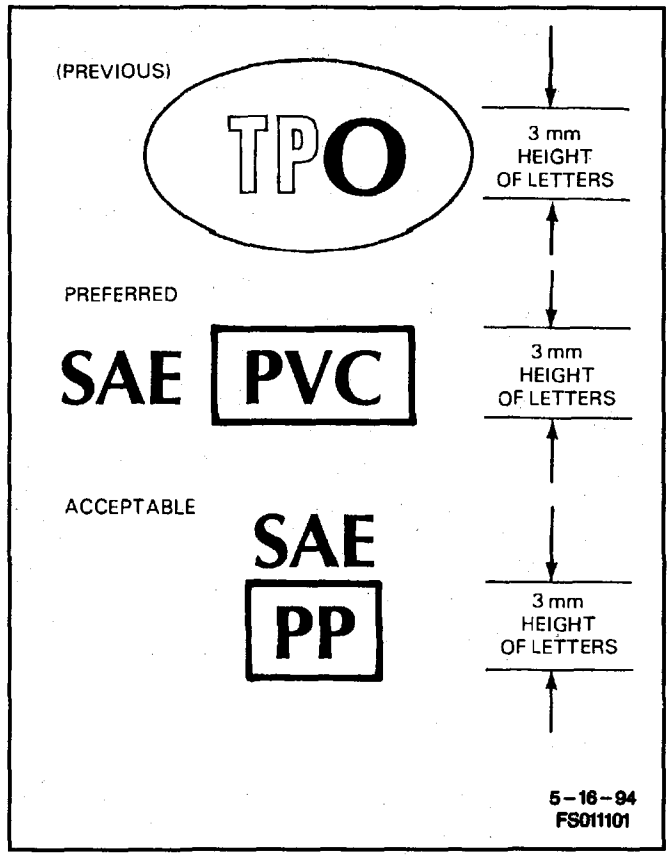


Figure 11 – Typical Plastic Parts Marking Symbol

These flexible plastic panel assembly repair procedures require the use of GM Goodwrench Compoxy Repair Material (GM P/N 12345744) or equivalent.

Fabricating a Patch Panel

Panel assemblies requiring slicing or sustaining major damage may need a reinforcement panel or patch panel. If possible, obtain this part by cutting a piece from the original damaged panel assembly. It should be 76 to 102 mm (3 to 4 inches) in width if the damage is a split or break. If a part of the damaged panel assembly is missing, the reinforcement panel or patch should extend 38 to 50 mm (1 1/2 to 2 inches) beyond the edges of the damaged area.

An adequate part may be manufactured as follows:

1. Lay out a piece of wax paper larger than the damaged area on the panel assembly.
2. Apply a layer of repair material.
3. Cut a piece of reinforcement mat material to desired size and shape and place over repair material. Extend mat 38 to 50 mm (1 1/2 to 2 inches) beyond repair area.
4. Apply a coat of repair material as necessary.
5. Place a piece of wax paper over the mat material and roll with the saturation roller to ensure saturation of mat.
6. Remove wax paper from panel assembly.
7. Apply patch to inner side of the damaged area, if accessible. Work out any air pockets.
8. Allow to cure.

CHART OF PLASTIC PARTS IDENTIFICATION AND REFINISHING SYSTEMS

Identifying Symbol Old Symbol in ( )	Chemical Composition or Plastic "Family" Name	Typical Area(s) Where Part Used	Examples of Common and/or Trade Names	Typical Paint Repair System
UP	Polyester/Thermoset	Fender Extensions, Hood, Roofs, Deck Lids, Instrument Housings, Ventilation Grids, Air Scoops, Air Spoilers	SMC, Premi-glas, Selectron, Vibrinmat, "Fiberglass"	#1 and #4
PE	Polyethylene	Inner Fender Panels, Valances, Spoilers, Interior Trim Panels, Safety Belt Covers, Gas Tank Shields	Dylan, Fortiflex, Marlex, Alathon, Hi-fax, Hosalen, Paxon	#7
PS	Polystyrene	Dash Panels, Door Panels	Lustrex, Dylan, Styron, Durathon, Polystyrol	#7
PPE (PPO)	Polyphenylene Ether	Chromed Plastic Parts; Headlamp Doors, Ornaments, Bezels	Noryl, Oreflo, Prevex	N/A
PP	Polypropoylene	Door Panels, Load Floors, Kick Panels, Deflector Panels, Cowl Panels, Wheel Covers, Interior Moldings, Radiator Shrouds, Inner Fenders, Bumper Fascia	Profax, Oleflo, Marlex, Azdel, Novolen,, Tenite, Daplen, Escorene	#2, #3, #5 and #7
TPU (TPUR)	Polyurethane, Thermoplastic	Bumper Fascia, Soft Filler Panels, Glass Moldings, Gravel Deflectors	Pellethane, Estane, Roylar, Toxin	#2, #3, #5 and #7
PUR	Polyurethane, Thermoset (Unsaturated)	Bumper Fascia, Front and Rear Body Panels, Filler Panels	Castethane, Bayflex (Commonly referred to as RIM and RRIM)	#2 and #5
ABS	Acrylonitrile, Butadiene/Styrene	Instrument Clusters, Trim Moldings, Consoles, Armrest Supports, Steering Column Brackets, Steering Column Jackets	ABS, Cycolac, Abson, Kralastic, Lustran, Absafil, Dyel	#1, #4 and #6
ABS + PC	Acrylonitrile/Butadiene Styrene + Polycarbonate	Instrument Panels, Instrument Clusters	Baybland, Proloy, Cycoloy, KHA	#1, #4 and #6
ABS/PVC	ABS/Vinyl – (Soft)	Head Restraint Covers, Instrument Panel Pads, Trim Moldings, Trim Panels	ABS Vinyl	#7 and #8
TEO (EP, EPM, TPO)	Ethylene/Propylene (Rubber)	Bumper Fascia, Valance Panels, Air Dams	TPO, TPR, (Thermoplastic Rubber) EPI, EPII	#3 and #5
EPDM	Ethylene Propylene Diene Monomer	Bumper Impact Strips, Body Panels	EPDM, Nordel	#2, #3 and #5
EVA (EVAC)	Ethylene/Vinyl Acetate	Head Restraint Cover, Miscellaneous Soft Trim Components	Elvax, Microthane	#7 and #8
PA + PPE	Polyamide + Polyphenylene Ether	Fenders, Exterior Trim	GTX	#2, #3 and #5

IMPORTANT: Follow selected paint manufacturer's product label directions. Observe all warnings on material container labels.

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Figure 12 – Plastics Identification Chart (1 of 2)

CHART OF PLASTIC PARTS IDENTIFICATION AND REFINISHING SYSTEMS

Identifying Symbol Old Symbol in ( )	Chemical Composition or Plastic "Family" Name	Typical Area(s) Where Part Used	Examples of Common and/or Trade Names	Typical Paint Repair System
PVC	Polyvinyl chloride (Vinyl)	Interior Soft Trim, Instrument Panel Skins, Roof Covers	Geon, Vinylite, Pliovic, "Vinyl", Vinoflex, Unichem	#8
SAN (SA)	Styrene-Acrylonitrite	Center Consoles, Glove Box Doors, Interior Trim Panels	Lustran, Tyril, Foracryl	#6 and #7
PC + PETP	Polycarbonate + Polybutylene Terephthalate	Bumper Covers	Xenoy, Valox, Macroblend	#1, #2, #4 and #5
PA PAG PAGG	Polyamide	Headlamp Bezels, Quarter Panel Exts, Exterior Finish, Trim Panels	Nylon, Capron, Zytel, Rilsan, Minlon, Vydyne, Wellamid	#1 and #4
PBT + TEEE (PBTP + EEBC)	Polybutylene Terephthalate + Ether Ester Block Copolymer	Rocker Cover Mldgs, Fascias	Bexloy "M"	#1 and #4
PC	Polycarbonate	Interior Hard (Rigid) Trim Panels, Valance Panels	Lexan, Merlon, Calibre	#1, #4 and #6
PF	Phenol-Formaldehyde	Ash Trays	Phenolic, Bakelite, Durez, Genal, Resinox, Ambernol, Plyophen	#6

FOR SYMBOLS NOT LISTED IN THIS CHART, CONTACT THE SOCIETY OF AUTOMOTIVE ENGINEERS, 400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096-0001 FOR A COPY OF SAR J1344.

( ) = OLD IDENTIFYING SYMBOLS IN ABOVE CHARTS.

(PVC) = TYPICAL ISO MARKING SYMBOL FOUND ON PLASTIC PARTS.

SAE [PVC] = TYPICAL NEW SAE MARKING SYMBOL FOUND ON PLASTIC PARTS.

SUGGESTED PLASTIC PARTS PAINT REPAIR SYSTEMS

SYSTEM #1 (Exterior)
Conventional Lacquer/Enamel *Acrylic Urethane

SYSTEM #2 (Exterior)
Flexible/Lacquer/Enamel/ Acrylic Urethane

SYSTEM #3 (Exterior)
Polypropylene Primer and *Special Topcoat

SYSTEM #4 (Exterior)
Base Color Coat with Acrylic Lacquer or *Acrylic Urethane Clear Coat

SYSTEM #5 (Exterior)
Base Color Coat with *Flexible Urethane Clear Coat

SYSTEM #6 (Interior)
Conventional (Standard) Interior Acrylic Lacquer

SYSTEM #7 (Interior)
Polypropylene Primer and Standard Interior Topcoat

SYSTEM #8 (Interior)
Vinyl Interior Color

FP-FS013101

Figure 13 – Plastics Identification Chart (2 of 2)

CHART OF PLASTIC PARTS IDENTIFICATION AND REFINISHING SYSTEMS

Abbreviation	Material Name	Heat Resisting Temperature C° (F°)	Resistance to Gasoline and Solvents	Other Cautions
PE	Polyethylene	80 (176)	Gasoline and most solvents are harmless.	Flammable
PVC	Polyvinyl Chloride	90 (194)	Gasoline and most solvents are harmless if applied for a very short time (wipe up quickly).	Poison gas is emitted when burned.
PP	Polypropylene	90 (194)	Gasoline and most solvents are harmless.	Flammable
ABS	Acrylonitrile Butadiene Styrene Resin	90 (194)	Avoid gasoline and solvents.	Avoid brake fluid.
AES	Acrylonitrile Ethylene Styrene	90 (194)	Avoid gasoline and solvents.	Avoid brake fluid.
PMMA	Polymethyl Methacrylate	90 (194)	Avoid gasoline and solvents.	Avoid brake fluid.
PUR	Polyurethane	90 (194)	Gasoline and most solvents are harmless.	Avoid brake fluid.
AAS	Acrylonitrile Acrylic Rubber Styrene	95 (203)	Avoid gasoline and solvents.	Avoid brake fluid.
PPE	Polyphenylene, Ether	110 (230)	Avoid gasoline and solvents.	
POM	Polyacetal	120 (248)	Gasoline and most solvents are harmless.	Avoid battery acid.
PC	Polycarbonate	120 (248)	Avoid gasoline and most solvents.	
PA, PAG, PAGG	Polyamide (Nylon)	150 (302)	Gasoline and most solvents are harmless.	Avoid immersing in water.
FRP	Fiber Reinforced Plastics	170 (338)	Gasoline and most solvents are harmless.	
PPC	Polypropylene Composite	115 (239)	Gasoline and most solvents are harmless.	Flammable
PBT	Polybutylene Terephthalate	140 (284)	Gasoline and most solvents are harmless.	
TPR	Thermoplastic Rubber	80 (176)	Avoid gasoline and most solvents.	
TPE	Thermoplastic Elastomer	80 (176)	Avoid gasoline and most solvents.	

FP–FS014101

Figure 14 – Plastics Handling Precautions

Important

- Save leftover pieces of repair material. They can be used later for reinforcing the back of small damaged areas and puncture repairs.
- When using mat reinforcement to repair inner or outer surfaces of a panel assembly, be sure there are no strands of the mat left uncovered or unsaturated by repair material. If exposed, the mat may act as a wick and draw moisture into the repaired area, affecting the integrity and finish.

Flexible Plastic Part Repair

Figures 15 through 21

1. Clean and inspect damaged area as required (Figure 15).
2. Support and line up parts as necessary using tape and a clamp for minor damage (Figure 16). Fabricate a patch panel if necessary.
3. Abrade back side of damage by scuffing the area with a 36 grit disc on a Roloc sander.

   Important

   - Use only compressed air or a clean dry cloth to remove residue.
4. If necessary, cut piece of reinforcement mat (porous or uni-directional) to desired shape. Extend mat 38 to 50 mm (1 1/2 to 2 inches) beyond repair area (Figure 17).
5. Mix and apply thin coat of GM Goodwrench Compoxy Repair Material (GM P/N 12345744) or equivalent to back side of damaged area.
6. Lay pre-cut piece of reinforcement mat into thin coat of repair material using applicator to press mat so it becomes saturated. Make sure all trapped air is forced out.
7. If mat is not screen type, use saturation roller to ensure mat is completely saturated and there are no exposed fibers or trapped air.
8. Apply second coat of flexible repair material, making sure mat is completely saturated and there are no exposed fibers or trapped air (Figure 18).
9. Allow to cure per manufacturer instructions.

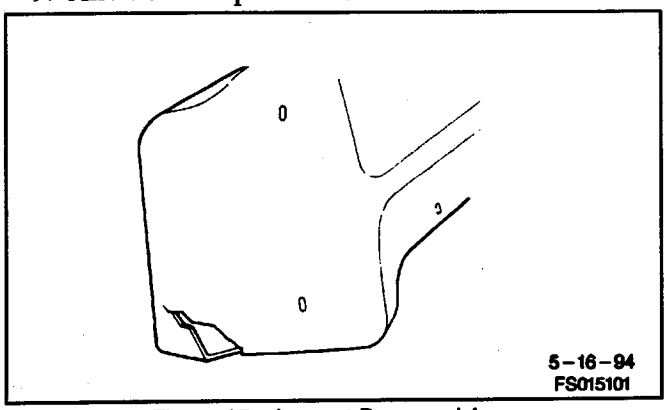


Figure 15 – Inspect Damaged Area

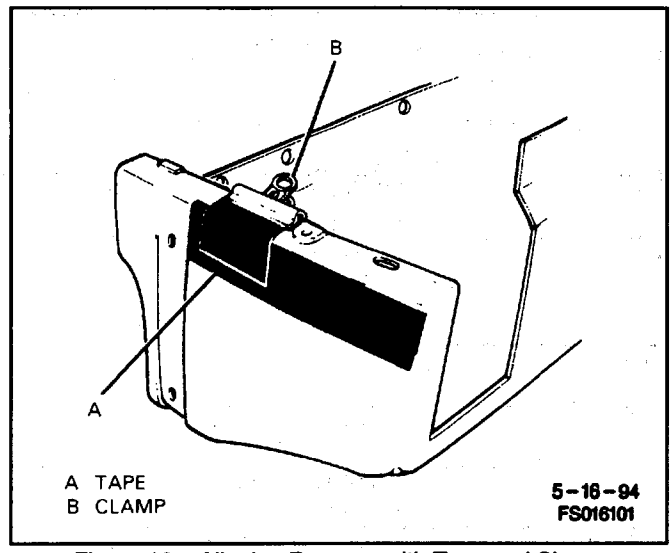


Figure 16 – Aligning Damage with Tape and Clamp

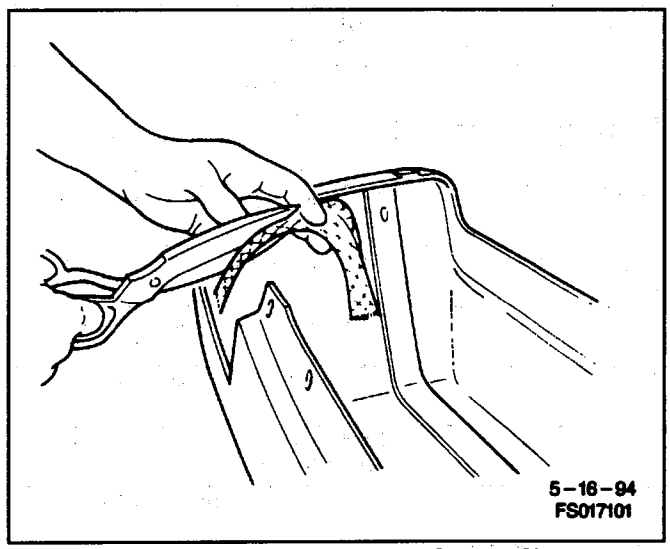


Figure 17 – Cutting Fiberglass Cloth to Size

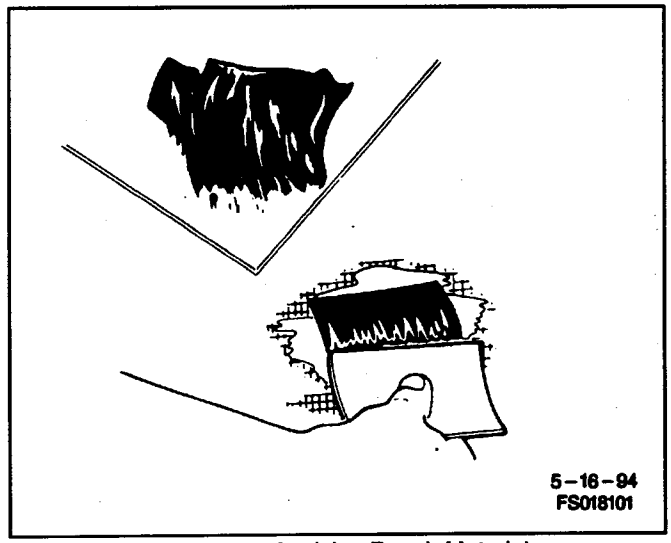


Figure 18 – Applying Repair Material

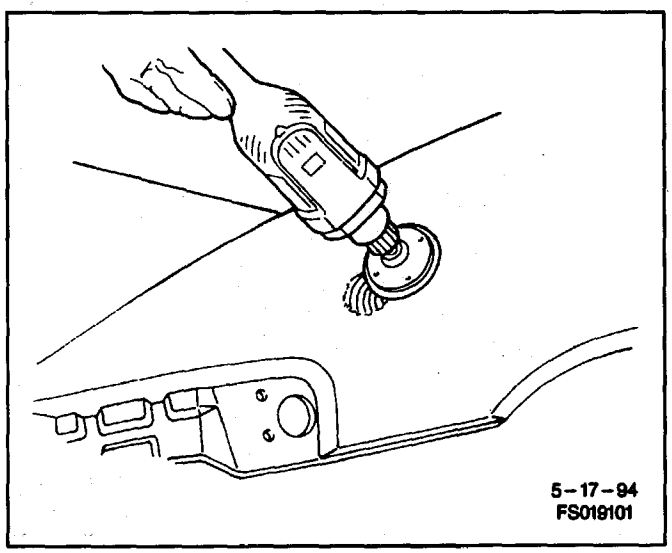


Figure 19 – Panel Beveling

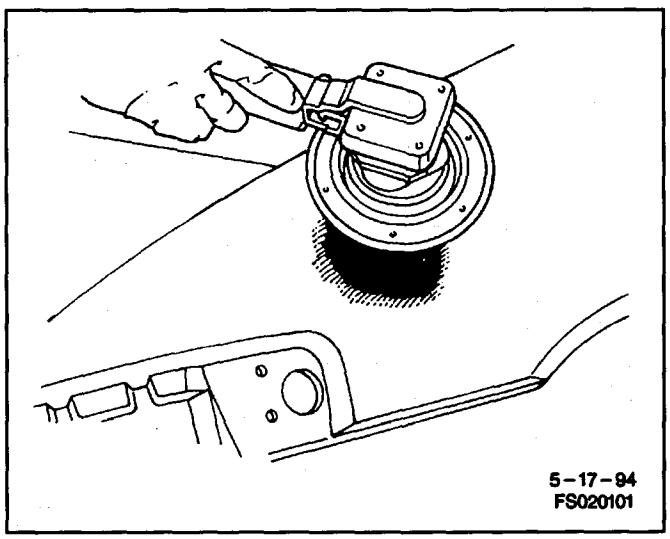


Figure 20 – Panel Feathering

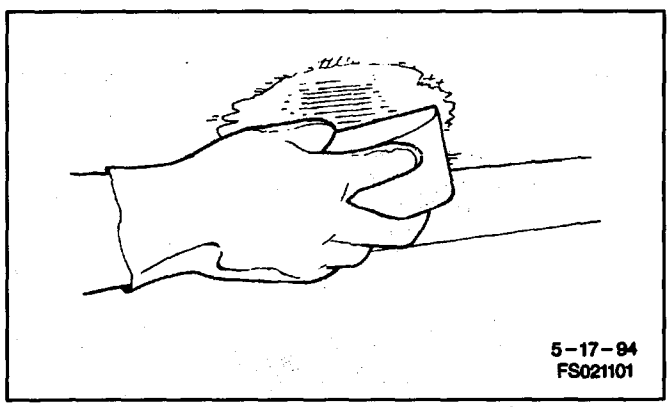


Figure 21 – Block Sanding for Accurate Contour

10. Remove tape or clamps used for maintaining alignment and contours.
11. At outer surface of panel assembly, bevel damaged area with a 50 grit Roloc disc. This step extends contact between repair material and substrate (Figure 19).
12. Using a 180 grit disc on a dual-action orbital sander, feather out several inches beyond damaged area to remove any paint or primer from substrate. This provides proper surface for adhesion (Figure 20).
13. Apply light coat of repair material to front side of damaged area, taking care to apply it smoothly. Repair material should be level and slightly above surrounding contour.
14. Allow to cure per manufacturer recommendations.
15. Rough out surface with an 80 grit disc on a dual-action orbital sander.
16. Finish contour sanding with 220 to 320 grit (wet or dry) sandpaper on a sanding block (Figure 21).

For further detailed information, refer to the STG Composite Plastic Repair Book (P/N 22005.35-10).

Flexible Plastic Part Refinishing

Figures 12 and 13

To refinish repaired flexible parts, it is very important to follow the paint manufacturer's system regarding preparation, priming, and refinishing. Because these parts are flexible, they may require special additives in the primers and topcoat to prevent cracking and poor adhesion. Always use manufacturer's recommended materials and never mix with other systems.

RIGID PLASTIC PART REPAIR AND REFINISHING

CAUTION: Many paint repair systems require additives containing isocyanates. It is essential that all recommendations and warnings listed on the container label for materials selected be followed. It is mandatory that adequate respiratory protection such as air line respirators with a full hood be worn. Such protection should be worn during the entire painting process. Persons with respiratory problems or those allergic to isocyanates must not be exposed to isocyanate vapors or spray mist.

Repair Materials

Important

- Use supplies and repair materials from the same manufacturer for the best results. Do not mix systems.

These rigid plastic panel assembly repair procedures require the use of GM Goodwrench Structural Bonding Epoxy (GM P/N 12345726) or equivalent.

Rigid Plastic Part Repair

Figures 15, 19, 20 and 22 through 25

1. Clean and inspect damaged area as required (Figure 15).
2. Begin reinforcement repair to inner surface of panel assembly by scuffing back side of area with an 80 grit disc on a dual-action orbital sander or by hand if access is limited. Do not heavily rough out surface of panel assembly.

Important

- Use only compressed air or a clean dry cloth to remove residue.

3. Apply skim coat of GM Goodwrench Structural Bonding Epoxy (GM P/N 12345726) or equivalent (Figure 23) to bonding strip.
4. Position bonding strip in place and secure with clamp (Figure 24).
5. For best results, bonding epoxy should be force dried.
   A. After applying epoxy to panel assembly, allow epoxy to air dry at room temperature for twenty minutes.
   B. Apply heat with uniform heat source to force dry at surface temperature of 70 to 82°C (160 to 180°F) for 45 minutes. Use surface temperature gage to obtain proper surface temperature.

NOTICE: Exceeding 82°C (180°F) may cause damage to interior components, weatherstrips or related trim in the heated area.

   C. Allow panel assembly to return to room temperature before sanding.
6. Remove tape or clamps used for maintaining alignment and contours.
7. At outer surface of panel assembly, bevel damaged area with 50 grit disc on a Roloc sander or equivalent. This step extends contact between bonding epoxy and substrate (Figure 19).
8. Using a 180 grit disc on a dual-action orbital sander, feather out several inches beyond damaged area to remove any paint or primer from substrate. This provides proper surface for bonding (Figure 20).
9. Apply light coat of GM Goodwrench Structural Bonding Epoxy (GM P/N 12345726) or equivalent (Figure 23).
10. Smooth out bonding epoxy. Bonding epoxy should be level and slightly above surrounding area (Figure 25).
11. Lay pre-cut piece of reinforcement cloth into bonding epoxy. Use applicator to saturate and remove all trapped air.
12. Apply second coat of bonding epoxy, making sure reinforcement mat is fully enclosed and no air is trapped. Smooth surface with applicator.

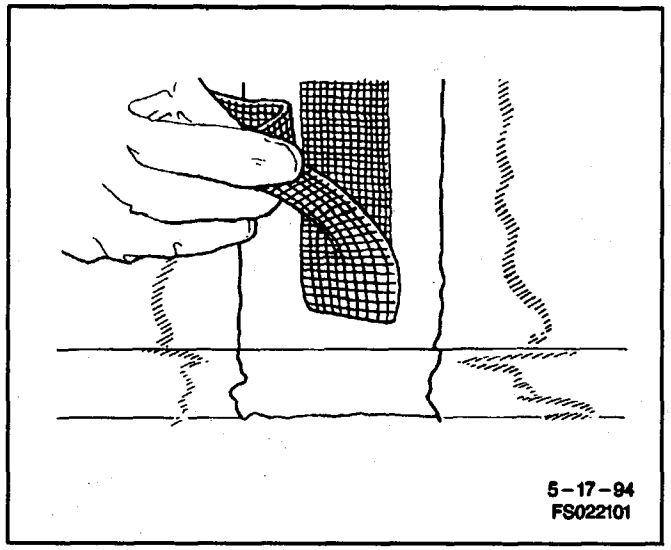


Figure 22 – Reinforcement Mat

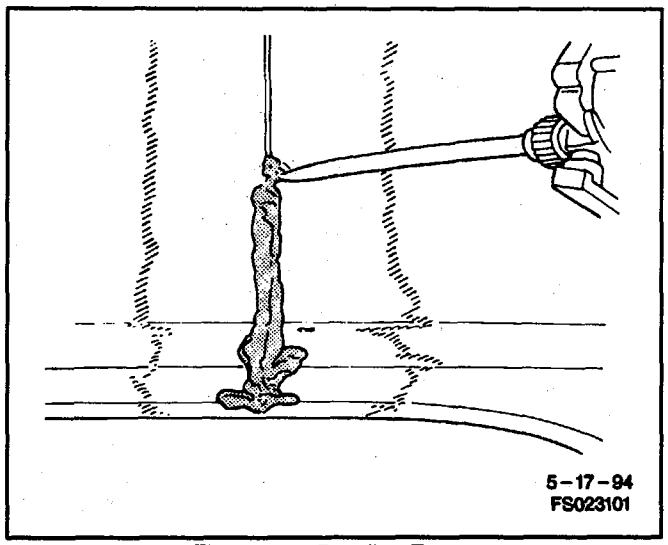


Figure 23 – Bonding Epoxy

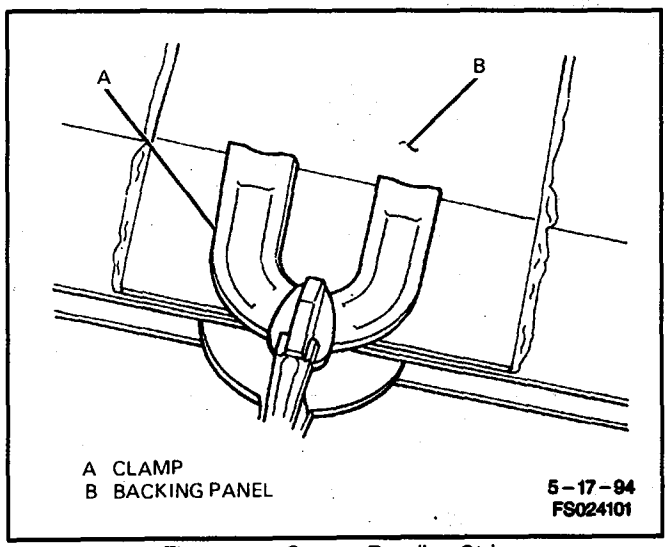


Figure 24 – Secure Bonding Strip

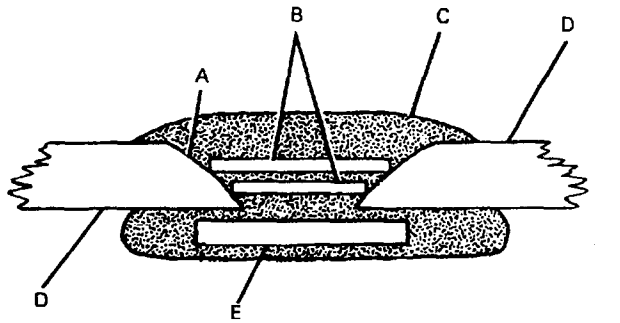


Figure 25 – Cross Section of Splice

13. Place second layer of reinforcement cloth over second coat of bonding epoxy, working it smooth and removing all trapped air.
14. Apply final coat of bonding epoxy, and place sheet of wax paper over it. Use saturation roller to ensure full penetration of bonding epoxy into mat.
15. For best results, bonding epoxy should be force dried.
    A. After applying epoxy to panel assembly, allow epoxy to air dry at room temperature for 20 minutes.
    B. Apply heat with uniform heat source to force dry at surface temperature of 70°C to 82°C (160°F to 180°F) for 45 minutes. Use surface temperature gage to obtain proper surface temperature.

    NOTICE: Exceeding 82°C (180°F) may cause damage to interior components, weatherstrips or related trim in the heated area.

    C. Allow panel assembly to return to room temperature before sanding.
16. Rough out surface with an 80 grit disc on a dual-action orbital sander.
17. Finish contour sanding with 220 to 320 grit (wet or dry) sandpaper on a sanding block.

For further detailed information, refer to the STG Composite Plastic Repair Book (P/N 22005.35-10).

Rigid Plastic Part Refinishing

Figures 12, 13 and 14

To refinish repaired rigid parts, it is very important to follow the paint manufacturer's directions regarding preparation, priming and refinishing. Some TEO (EP, EPM, TPO) rigid parts require special polypropylene primers for adhesion. Always use manufacturer's recommended materials and never mix with other systems.

CARPET INSERT REATTACHMENT

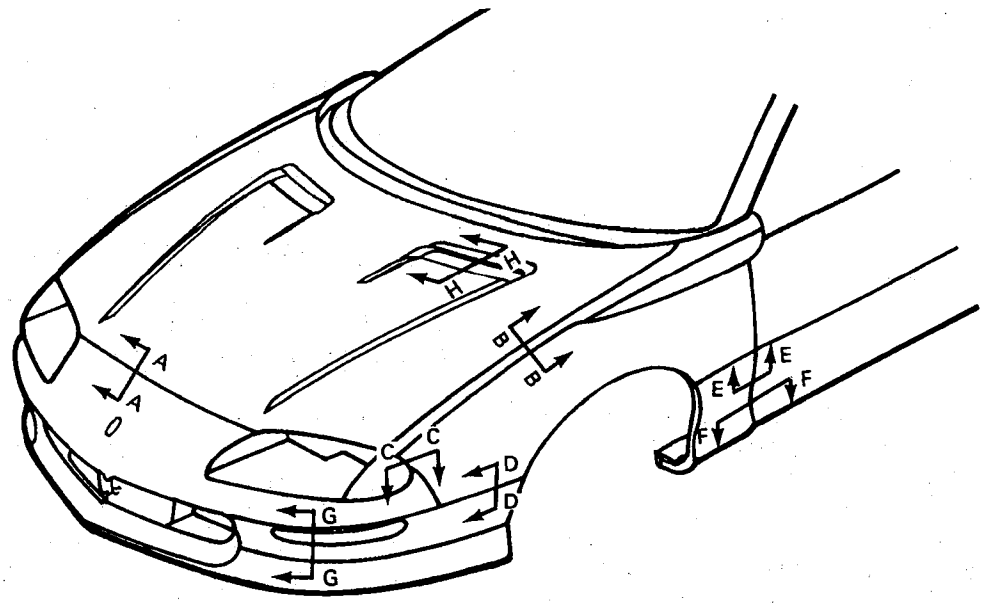
Carpet inserts attached to body side assemblies, door assemblies and quarter trim panel assemblies which have become loose may be reattached with general trim adhesive (3M P/N 08080 or equivalent).

Use the following procedure:

1. Remove trim panel assembly when necessary and place on clean work surface. Mask off trim panel assembly to prevent glue overspray.
2. Sand areas of trim panel assembly where carpet is to be reglued using a coarse grit sandpaper. Polypropylene panel assemblies should have a rough surface for best adhesion. Remove all sanding debris.
3. Spray general trim adhesive (3M P/N 08080 or equivalent) on sanded surface and back side of carpet following manufacturer instructions.
4. When both sprayed surfaces become tacky to the touch, press carpet in place and smooth out any irregularities.
5. Remove masking materials and reinstall panel assembly.

BODY PANEL ASSEMBLY ADJUSTMENT AND ALIGNMENT

Use Figures 26 through 29 as a maximum and minimum gap reference.

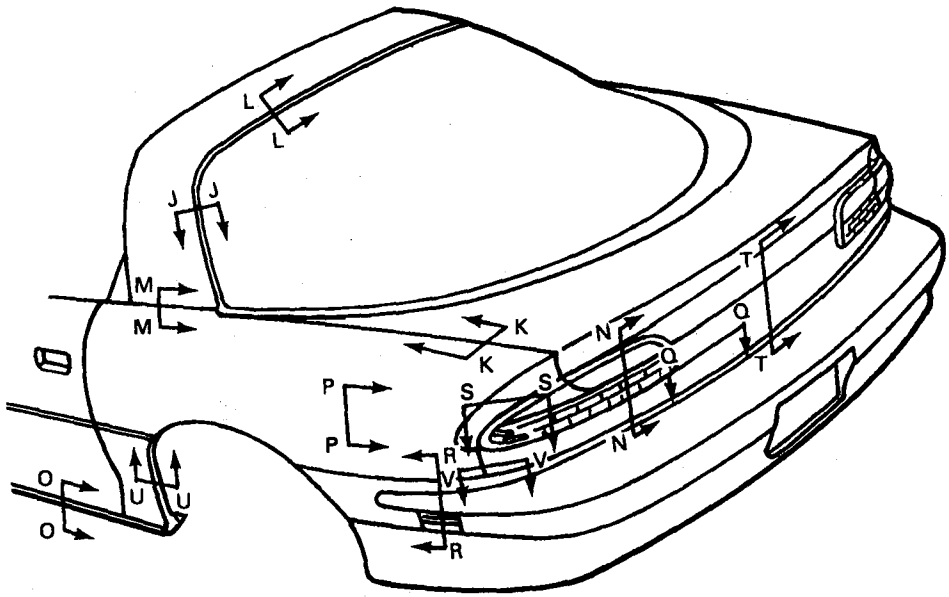


LOCATION	CLEARANCE GAP* (MILLIMETERS)	FLUSHNESS* (MILLIMETERS)
A. HOOD ASSEMBLY TO FRONT FASCIA	4.0 (± 1.5)	+ 1.0/- 0.5 (PARALLEL WITHIN 1.5)
B. HOOD ASSEMBLY TO FRONT FENDER ASSEMBLY	4.0 (± 1.5) (PARALLEL WITHIN 1.5)	± 0.5
C. FRONT FENDER ASSEMBLY TO FRONT FASCIA	0.0 (+ 0.5/- 0.0)	± 0.5
D. FRONT FENDER ASSEMBLY TO FRONT FASCIA	0.0 (+0.5/- 0.0)	± 0.5
E. FRONT SIDE DOOR ASSEMBLY TO FRONT FENDER ASSEMBLY	5.0 (± 1.5) (PARALLEL WITHIN 1.5)	2.0 (± 2.0)
F. FRONT FENDER ASSEMBLY TO OUTER ROCKER PANEL	2.0 (+ 3.0/- 2.0)	+ 1.5/- 0.0
G. FRONT TURN SIGNAL LAMP TO FRONT FASCIA	1.5 (± 0.5) (PARALLEL WITHIN 0.5)	N/A
H. HOOD ASSEMBLY AIR EXTRACTOR TO HOOD OUTER PANEL	1.0 (± 1.5)	0.5 (± 0.5)

* OPENINGS MUST BE PARALLEL WITHIN 1.0 mm UNLESS OTHERWISE NOTED.

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Figure 26 – Body Panel Assembly Fit Requirements (1 of 2) – (Chevrolet)

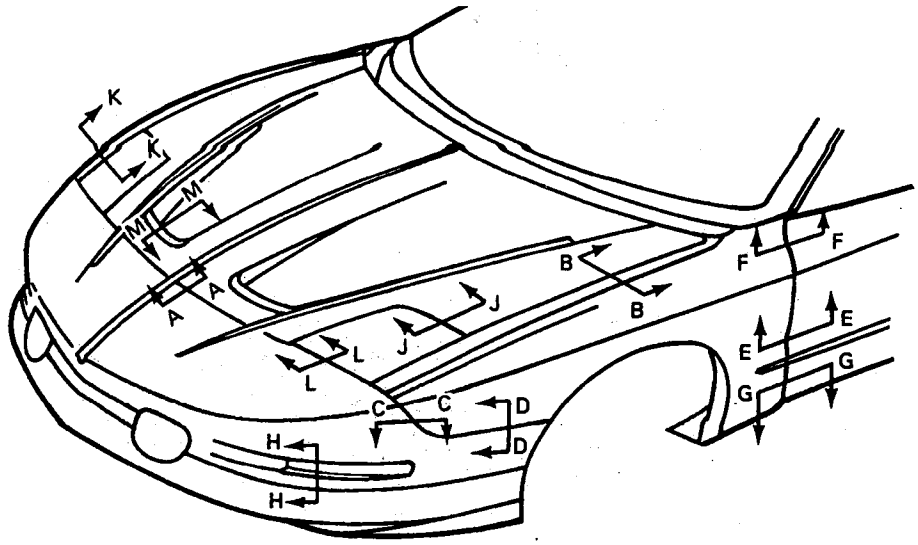


LOCATION	CLEARANCE GAP* (MILLIMETERS)	FLUSHNESS* (MILLIMETERS)
J. REAR HATCH ASSEMBLY TO ROOF OUTER SAIL	8.0 (± 1.5) (PARALLEL WITHIN 2.0)	+ 3.0 (OUTBOARD) - 1.0 (INBOARD)
K. REAR HATCH ASSEMBLY TO QUARTER PANEL	5.0 (± 1.5) (PARALLEL WITHIN 1.5)	± 1.5
L. REAR HATCH ASSEMBLY TO ROOF	8.0 (± 1.5) (PARALLEL WITHIN 1.5)	+ 3.0 (OUTBOARD) - 1.0 (INBOARD)
M. ROOF OUTER PANEL TO QUARTER OUTER PANEL	4.0 (± 1.5) (PARALLEL WITHIN ± 1.5)	N/A
N. REAR COMPARTMENT LIFT WINDOW OUTER PANEL TO OUTER LENS	10.5 (± 2.0) (PARALLEL WITHIN 3.0)	N/A
N. OUTER LENS TO REAR FASCIA	2.0 (± 2.0) (PARALLEL WITHIN 3.0)	± 1.0
O. ROCKER QUARTER OUTER PANEL TO ROCKER OUTER PANEL	N/A	+ 0.0/- 1.0
P. ROCKER QUARTER OUTER PANEL TO FUEL FILLER DOOR	3.0 (± 1.0)	± 1.5/- 0.0
Q. REAR END FINISHING PANEL TO OUTER LENS	2.0 (± 2.0) (PARALLEL WITHIN 3.0)	± 1.0
R. QUARTER OUTER PANEL TO REAR FASCIA	2.0 (± 1.5) (PARALLEL WITHIN 1.5)	± 2.0
S. QUARTER OUTER PANEL TO OUTER LENS	2.0 (± 1.5) (PARALLEL WITHIN 1.5)	± 2.0
T. REAR COMPARTMENT LID OUTER PANEL TO REAR END FINISHING PANEL	9.1 (± 2.0) (PARALLEL WITHIN 3.0)	± 2.0
T. REAR END FINISHING PANEL TO REAR BUMPER FASCIA	7.0 (± 2.0) (PARALLEL WITHIN 3.0)	N/A
U. FRONT DOOR OUTER PANEL TO QUARTER OUTER PANEL	5.0 (± 1.5) (PARALLEL WITHIN 1.5)	2.0 (± 2.0)
V. REAR FINISHING PANEL TO REAR QUARTER PANEL	2.0 (± 1.0)	+ 1.0/- 3.0

* OPENINGS MUST BE PARALLEL WITHIN 1.0 mm UNLESS OTHERWISE NOTED.

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Figure 27 – Body Panel Assembly Fit Requirements (2 of 2) – (Chevrolet)

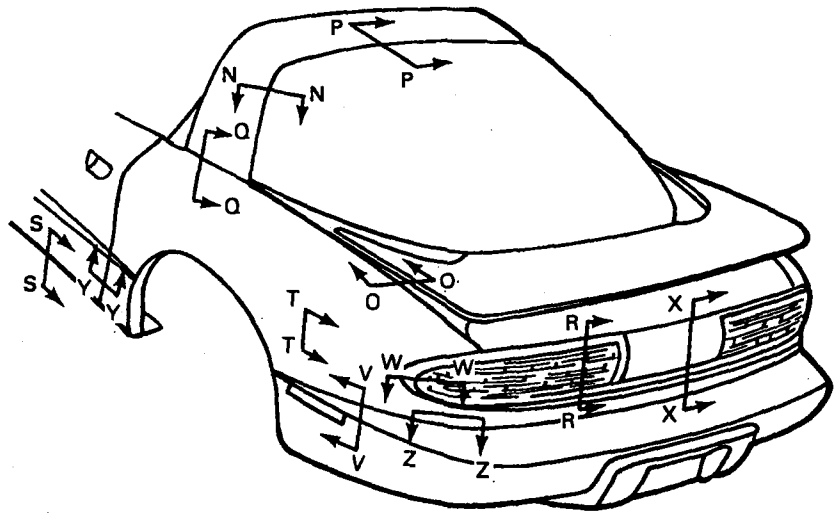


LOCATION	CLEARANCE GAP* (MILLIMETERS)	FLUSHNESS* (MILLIMETERS)
A. HOOD ASSEMBLY TO FRONT FASCIA	4.0 (± 1.5)	+ 1.0/-0.5 (PARALLEL WITHIN 1.5)
B. HOOD ASSEMBLY TO FRONT FENDER ASSEMBLY	4.0 (± 1.5) (PARALLEL WITHIN 1.5)	± 0.5
C. FRONT FENDER ASSEMBLY TO FRONT FASCIA	2.0 (± 0.5) (PARALLEL WITHIN 0.5)	± 0.5
D. FRONT FENDER ASSEMBLY TO FRONT FASCIA	2.0 (±0.5) (PARALLEL WITHIN 0.5)	± 0.5
E. FRONT SIDE DOOR ASSEMBLY TO FRONT FENDER ASSEMBLY	5.0 (± 1.5) (PARALLEL WITHIN 1.5)	2.0 (± 2.0)
F. FRONT SIDE DOOR ASSEMBLY TO FRONT FENDER ASSEMBLY	7.5 to 4.0	+ 0.0 (OUTBOARD) - 1.5 (INBOARD)
G. FRONT FENDER ASSEMBLY TO OUTER ROCKER PANEL	2.0 (+ 3.0/-2.0)	+ 1.5/- 0.0
H. FRONT TURN SIGNAL LAMP TO FRONT FASCIA	1.5 (±0.5) (PARALLEL WITHIN 0.5)	N/A
J. HOOD ASSEMBLY TO HEADLAMP DOOR	4.0 (± 1.5)	+ 0.5/- 1.0
K. FRONT FENDER ASSEMBLY TO HEADLAMP DOOR	4.0 (± 1.5)	± 0.5
L. FRONT FASCIA TO HEADLAMP DOOR	4.0 (± 1.5)	+ 0.5/- 1.0
M. HOOD ASSEMBLY AIR EXTRACTOR TO HOOD OUTER PANEL	1.0 (± 0.5)	0.5 (± 0.5)

* OPENINGS MUST BE PARALLEL WITHIN 1.0 mm UNLESS OTHERWISE NOTED.

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Figure 28 – Body Panel Assembly Fit Requirements (1 of 2) – (Pontiac)



LOCATION	CLEARANCE GAP* (MILLIMETERS)	FLUSHNESS* (MILLIMETERS)
N. REAR HATCH ASSEMBLY TO ROOF OUTER SAIL	8.0 (± 1.5) (PARALLEL WITHIN 2.0)	+ 3.0 (OUTBOARD) - 1.0 (INBOARD)
O. REAR HATCH ASSEMBLY TO QUARTER PANEL	5.0 (± 1.5) (PARALLEL WITHIN 1.5)	± 1.5
P. REAR HATCH ASSEMBLY TO ROOF	8.0 (± 1.5) (PARALLEL WITHIN 1.5)	+ 3.0 (OUTBOARD) - 1.0 (INBOARD)
Q. ROOF OUTER PANEL TO QUARTER OUTER PANEL	4.0 (± 1.5) (PARALLEL WITHIN ± 1.5)	N/A
R. REAR COMPARTMENT LIFT WINDOW OUTER PANEL TO OUTER LENS	6.0 (± 2.0) (PARALLEL WITHIN 3.0)	N/A
R. OUTER LENS TO REAR FASCIA	4.0 (± 2.0) (PARALLEL WITHIN 1.5)	± 1.0
S. ROCKER QUARTER OUTER PANEL TO ROCKER OUTER PANEL	N/A	+ 0.0/- 1.0
T. ROCKER QUARTER OUTER PANEL TO FUEL FILLER DOOR	3.0 (± 1.0)	+ 1.5/- 0.0
V. QUARTER OUTER PANEL TO REAR FASCIA	2.0 (± 1.5) (PARALLEL WITHIN 1.5)	± 2.0
W. QUARTER OUTER PANEL TO OUTER LENS	2.0 (± 1.5) (PARALLEL WITHIN 1.5)	± 2.0
X. SPOILER TO TAIL LAMP	5.0 (± 2.0) (PARALLEL WITHIN 3.0)	N/A
X. CENTER FILLER PANEL TO REAR BUMPER FASCIA	4.0 (± 2.0) (PARALLEL WITHIN 3.0)	± 1.0
Y. FRONT DOOR OUTER PANEL TO QUARTER OUTER PANEL	5.0 (± 1.5) (PARALLEL WITHIN 1.5)	2.0 (± 2.0)
Z. REAR FASCIA TO REAR QUARTER PANEL	N/A	N/A

* OPENINGS MUST BE PARALLEL WITHIN 1.0 mm UNLESS OTHERWISE NOTED.

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Figure 29 – Body Panel Assembly Fit Requirements (2 of 2) – (Pontiac)

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SECTION 10-2

STATIONARY WINDOWS

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: When replacing a windshield, back window, or hatch roof window, urethane adhesive (GM P/N 12345633 or equivalent) must be used to maintain original installation integrity. Failure to use urethane adhesive GM P/N 12345633 or equivalent will result in poor retention of the windshield which may allow unrestrained occupants to be ejected from the vehicle with resulting personal injury. For vehicles with air bag systems, windshields must be replaced properly so that occupant protection provided by the air bag system is maintained.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

STATIONARY WINDOWS

Figure 1

The windshield assembly (1) is installed from outside the body, using self-curing urethane. Replacement of the windshield assembly (1) requires removal of components and cutting it away from the adhesive.

ADHESIVE CAULKING KIT

The urethane adhesive kit (GM P/N 12345633) is used for windshield adhesive service operations and leak repair. This kit includes urethane adhesive and primers. Failure to use this kit, or an equivalent, when indicated, will result in poor retention of the windshield assembly.

WINDSHIELD REVEAL MOLDING ASSEMBLY

Figure 1

The one-piece windshield reveal molding assembly (2) is vinyl and is hand-pressed into place. The reveal molding assembly (2) is retained in place by a urethane adhesive.

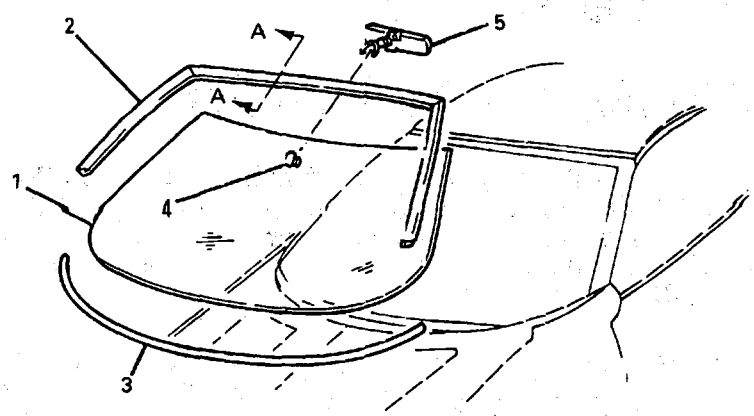
ON-VEHICLE SERVICE

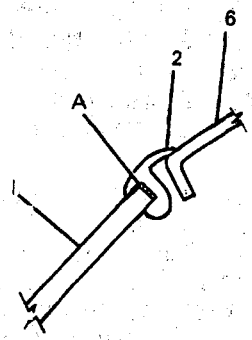
WINDSHIELD REVEAL MOLDING ASSEMBLY

Figure 1

Remove or Disconnect

1. Roof drip scalp molding assemblies, if equipped. Refer to SECTION 10-9.
2. Carefully pry end of reveal molding assembly (2) out about 76 mm (3 inches), using screwdriver.





SECTION A–A

A APPLY CLEAR AND BLACK PRIMER, THEN URETHANE ADHESIVE TO REVEAL MOLDING GLASS EDGE CHANNEL BEFORE ASSEMBLY
1 WINDSHIELD ASSEMBLY
2 MOLDING ASSEMBLY, WINDSHIELD REVEAL
3 STRIP, WINDSHIELD SEALING
4 SUPPORT, INSIDE REARVIEW MIRROR
5 MIRROR ASSEMBLY, INSIDE REARVIEW
6 ROOF

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Figure 1 – Windshield and Reveal Molding Assemblies

3. Grasp with pliers and slowly pull reveal molding assembly (2) away from body.

Inspect

- Reveal molding assembly (2).
  - If original reveal molding assembly (2) cannot be reused (due to damage, cut short, etc.), discard it and replace it with a new service reveal molding assembly (2). Be sure to prefit the service reveal molding assembly (2) by locating it on the body prior to installation.

Clean

- Windshield assembly (1) of all traces of urethane, using alcohol-dampened cloth.

Install or Connect

1. Clear primer from urethane adhesive kit (GM P/N 12345633 or equivalent) in glass edge channel of reveal molding assembly (2).
2. Black primer from urethane adhesive kit (GM P/N 12345633 or equivalent) over clear primer.
3. Urethane adhesive from kit (GM P/N 12345633 or equivalent) evenly in glass edge channel of reveal molding assembly (2) over black primer.
4. Reveal molding assembly (2).
   A. Start from center and hand press reveal molding assembly (2) in place over edge of windshield assembly (1).
   B. Tape can be applied to keep reveal molding assembly (2) flush with body.
   C. Flood reveal molding assembly (2) with warm water to speed setup of adhesive.
5. Roof drip scalp molding assemblies, if equipped. Refer to SECTION 10-9.

WINDSHIELD ASSEMBLY

All windshield assemblies are installed from outside the body using self-curing urethane adhesive. Replacing a windshield assembly installed with urethane adhesive requires either partial or complete replacement of the adhesive. Partial replacement of the adhesive is known as the short method. Complete replacement of the adhesive is known as the extended method.

Windshield assembly removal is the same for both the short and extended installation methods with one exception. Use more care with the short method during cutout to make certain that an even bead of adhesive remains on the windshield opening to serve as a base for the new windshield assembly.

Short Method

Figures 1 and 2

Tool Required:

J 24402-A Window Sealant Remover (Cold Knife) or

J 24709-01 or J 24899-01 Urethane Window Sealant Remover (Hot Knife) or

J 39032 Stationary Glass Removal Tool

CAUTION: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.

Remove or Disconnect

1. Place protective coverings around area where windshield assembly (1) is being removed.

2. Inside rearview mirror assembly. Refer to "Inside Rearview Mirror Assembly" in this section.
3. Windshield side garnish molding assemblies. Refer to SECTION 10-9.
4. Wiper arm and wiper blade assemblies. Refer to SECTION 8E.
5. Top rear front fender bolts/screws to provide clearance for tools (Chevrolet only). Refer to SECTION 10-5.
6. Air inlet screen assemblies. Refer to SECTION 10-5.
7. Roof drip scalp molding assemblies, if equipped. Refer to SECTION 10-9.
8. Windshield reveal molding assembly. Refer to "Windshield Reveal Molding Assembly" in this section.
9. Mask area around windshield opening to protect painted surfaces and to aid in cleanup after installation.
   - Tape must not touch windshield sealant surface.
10. Using J 39032, make preliminary cut into urethane adhesive around entire perimeter of windshield assembly (1), staying as close to edge of windshield assembly (1) as possible.
11. Pull away portion of reveal molding assembly (2) between windshield assembly (1) and body.
12. Cut out windshield assembly (1), using J 24402-A, J 24709-01 or J 24899-01, or J 39032.
    - Keep blade as close to edge of windshield assembly (1) as possible.
    - Use care during cutout to make certain that even bead of adhesive remains on windshield opening to serve as base for new windshield assembly (1).
13. Windshield assembly (1).
14. Windshield sealing strip (3) from windshield assembly (1).

Clean

- Windshield opening of any loose material. If old windshield assembly (1) is to be reinstalled, all old urethane adhesive must be removed from it, using alcohol-dampened cloth.

Install or Connect

1. Windshield reveal molding assembly. Refer to "Windshield Reveal Molding Assembly" in this section.
2. Windshield assembly (1) in opening for fit.
   A. With aid of helper, properly position windshield assembly (1) in opening and apply piece of masking tape over each edge of windshield assembly (1) and adjacent body pillars.
   B. Slit tape vertically at edge of windshield assembly (1).

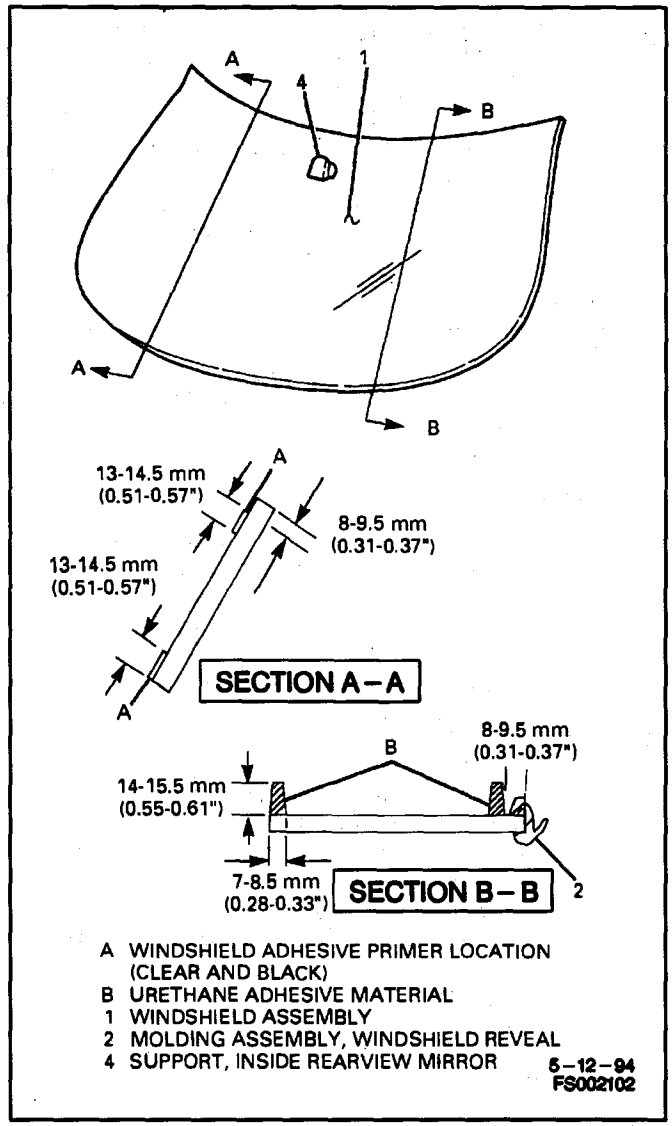


Figure 2 – Windshield Assembly Primer and Adhesive Locations

   C. During installation, tape on windshield assembly (1) can be aligned with tape on body to guide windshield assembly (1) into desired position.
3. Remove windshield assembly (1).

Clean

   A. Surface of windshield assembly (1) to which adhesive will be applied (around edge of inside surface) by wiping with clean, alcohol-dampened cloth.
   B. Allow to air dry.
4. Windshield sealing strip (3).
   - Remove paper backing from new windshield sealing strip (3) and position adjacent to lower blackout line.
5. Clear and black primers from urethane adhesive kit (GM P/N 12345633 or equivalent) around entire perimeter of windshield inner surface as shown in Figure 2.

- Two primers are provided in urethane adhesive kit (GM P/N 12345633 or equivalent). Clear primer must be applied first, immediately followed by black primer. Allow black primer to dry five minutes prior to application of urethane adhesive. Primer application is most important because it acts as bonding agent for urethane adhesive and windshield assembly (1).

Important

- Maximum surface temperature must not exceed 49°C (120°F) at time of primer application.

6. Urethane adhesive from kit (GM P/N 12345633 or equivalent).
   - With household cartridge-type caulking gun and nozzle, apply smooth continuous bead of urethane adhesive, 7.0 to 8.5 mm (0.28 to 0.33 inch) wide and 14.0 to 15.5 mm (0.55 to 0.61 inch) high, around edge of windshield assembly where primed in previous step.
7. Windshield assembly (1) into windshield opening with aid of helper.
   - Carry windshield assembly (1) with one hand on inside and one hand on outside. Guide windshield assembly (1) along rear edge of front fender assembly to avoid smearing fresh adhesive on instrument panel. At windshield opening, put windshield assembly (1) in horizontal position. While one person holds windshield assembly (1) in this position, second person can reach one arm around body pillar and support it while first person assumes same position.
8. Windshield assembly (1).
   - Center in opening.
   - Use tape guides previously applied to place windshield assembly (1) in proper position.
9. Press windshield assembly (1) firmly to wet-out and set adhesive.
   - Use care to avoid squeezing out excessive amounts of adhesive that would cause appearance problem.
10. Using small disposable brush or flat, soft fiberglass tool, paddle material around edge of windshield assembly (1) to ensure watertight seal.
    - If necessary, paddle additional material to fill voids in seal.
11. Water test vehicle at once, using soft spray.
    - Use warm water.
    - Do not direct hard stream of water at fresh adhesive material.
    - Water applied on top of urethane adhesive, either during water test or as separate operation, will speed up cure of urethane adhesive.

Inspect

- For leaks. Paddle in extra adhesive at leak point, using small disposable brush or flat, soft fiberglass tool.

12. Roof drip scalp molding assemblies, if equipped. Refer to SECTION 10-9.
13. Air inlet screen assemblies. Refer to SECTION 10-5.
14. Top rear front fender bolts/screws (Chevrolet only). Refer to SECTION 10-5.
15. Wiper arm and wiper blade assemblies. Refer to SECTION 8E.
16. Windshield side garnish molding assemblies. Refer to SECTION 10-9.
17. Inside rearview mirror assembly. Refer to "Inside Rearview Mirror Assembly" in this section.

NOTICE: On windshield assembly installations, the vehicle must remain at normal room temperature for six hours or the adhesive will not cure properly.

Extended Method

Figures 1 and 2

The extended method requires that all old urethane adhesive be completely removed from windshield opening. This method is used only for extreme cases such as:

- When the old urethane adhesive can no longer serve as a good base.
- When there is damage to the windshield opening.
- When there is a need for the windshield opening to be repainted in a body shop.

Clean

- Windshield opening.
  - Using sharp scraper or chisel, remove old adhesive material from windshield opening mounting surfaces.
  - All traces of material need not be removed, but there should not be any mounds or loose pieces left.

Install or Connect

CAUTION: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.

1. Windshield reveal molding assembly. Refer to "Windshield Reveal Molding Assembly" in this section.
2. Windshield assembly (1) in opening for fit.
   A. With aid of helper, properly position windshield assembly (1) in opening.
   B. Check relationship of new windshield assembly (1) to urethane adhesive of windshield opening mounting surfaces. Excessive gaps must be corrected by locating spacers or by applying more adhesive than specified.

C. Apply piece of masking tape over each edge of windshield assembly (1) and adjacent body pillars.

D. Slit tape vertically at edge of windshield assembly (1).

E. During installation, tape on windshield assembly (1) can be aligned with tape on body to guide windshield assembly (1) into desired position.

3. Remove windshield assembly (1).

Clean

A. Surface of windshield assembly (1) to which adhesive will be applied (around edge of inside surface) by wiping with clean, alcohol-dampened cloth.

B. Allow to air dry.

4. Windshield sealing strip (3).
   - Remove paper backing from new windshield sealing strip (3) and position adjacent to lower blackout line.
5. Black primer from urethane adhesive kit (GM P/N 12345633 or equivalent) to windshield opening mounting surfaces.
   - In certain cases when it is necessary to prepare the windshield flange for bonding, the use of a Pinchweld Primer (u413) or equivalent is recommended.

Important

- Maximum surface temperature must not exceed 49°C (120°F) at time of primer application.

6. Clear and black primers from urethane adhesive kit (GM P/N 12345633 or equivalent) around entire perimeter of windshield inner surface as shown in Figure 2.
   - Two primers are provided in urethane adhesive kit (GM P/N 12345633 or equivalent). Clear primer must be applied first, immediately followed by black primer. Allow black primer to dry five minutes prior to application of urethane adhesive. Primer application is most important because it acts as bonding agent for urethane adhesive and windshield assembly (1).
7. Urethane adhesive from adhesive kit (GM P/N 12345633 or equivalent).
   - With household cartridge-type caulking gun and nozzle, apply smooth continuous bead of urethane adhesive, 7.0 to 8.5 mm (0.28 to 0.33 inch) wide and 14.0 to 15.5 mm (0.55 to 0.61 inch) high, around edge of windshield assembly (1) where primed in previous step.
8. Windshield assembly (1) into windshield opening with aid of helper.
   - Carry windshield assembly (1) with one hand on inside and one hand on outside. Guide windshield assembly (1) along rear edge of front fender assembly to avoid smearing fresh adhesive on instrument panel. At windshield opening, put windshield assembly (1) in horizontal position. While one person holds windshield assembly (1) in this position, second person can reach one arm around body pillar and support it while first person assumes same position.
9. Windshield assembly (1) on supports.
   - Center in opening.
   - Use tape guides previously applied to place windshield assembly (1) in proper position.
10. Press windshield assembly (1) firmly to wet-out and set adhesive.
    - Use care to avoid squeezing out excessive amounts of urethane adhesive that would cause appearance problem.
11. Using small disposable brush or flat, soft fiberglass tool, paddle material around edge of windshield assembly (1) to ensure watertight seal.
    - If necessary, paddle additional material to fill voids in seal.
12. Water test vehicle at once, using soft spray.
    - Use warm water.
    - Do not direct hard stream of water at fresh adhesive material.
    - Water applied on top of urethane adhesive, either during water test or as separate operation, will speed up cure of urethane adhesive.

Inspect

- For leaks. Paddle in extra adhesive at leak point, using small disposable brush or flat, soft fiberglass tool.

13. Roof drip scalp molding assemblies, if equipped. Refer to SECTION 10-9.
14. Air inlet screen assemblies. Refer to SECTION 10-5.
15. Top rear front fender bolts/screws (Chevrolet only). Refer to SECTION 10-5.
16. Wiper arm and wiper blade assemblies. Refer to SECTION 8E.
17. Windshield side garnish molding assemblies. Refer to SECTION 10-9.
18. Inside rearview mirror assembly. Refer to "Inside Rearview Mirror Assembly" in this section.

NOTICE: On windshield assembly installations, the vehicle must remain at normal room temperature for six hours or the adhesive will not cure properly.

WATERLEAK CORRECTION

Where accessible, waterleaks can be corrected without removing and reinstalling the windshield assembly. This method applies only to urethane-installed windshield assemblies and use of windshield urethane adhesive furnished in urethane adhesive kit (GM P/N 12345633 or equivalent).

1. Remove reveal molding assembly in area of leak.

- In some cases, it may become necessary to remove interior moldings to locate source of leak.

2. Mark location of leak.
   A. Carefully push outward on windshield assembly in area of leak to determine extent of leak.
      - Operation should be performed while water is being applied to leak area.
   B. Mark extent of leak area.
3. Using sharp knife, trim off uneven edge of adhesive at leak point and 76 mm to 102 mm (3 inches to 4 inches) on both sides of leak point or beyond limits of leak area.
4. Clean dirt or foreign material from leak area with water (outside body). Dry area with air hose.
5. Prime affected area with black primer supplied in adhesive kit GM P/N 12345633 or equivalent.
   - Allow primer to dry five minutes.
6. Apply urethane adhesive from urethane adhesive kit (GM P/N 12345633 or equivalent) at leak point and 76 mm to 102 mm (3 inches to 4 inches) on both sides of leak point or beyond limits of leak area.
7. Right after performing previous step, use flat stick or other suitable flat, soft fiberglass tool to work adhesive material well into leak point and into joint of original material and body. This will ensure watertight seal along entire length of material application.
8. Using warm water, spray test to ensure leak has been corrected.
   - Do not run heavy stream of water directly on freshly applied urethane adhesive.
9. If leak still exists, use flat, soft fiberglass tool and paddle additional adhesive material into leak point.
10. Replace all previously removed parts.

INSIDE REARVIEW MIRROR ASSEMBLY

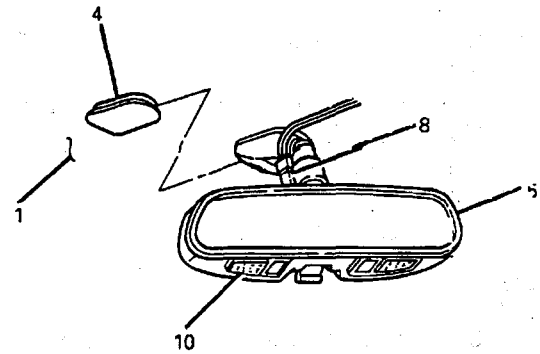
Figure 3

The inside rearview mirror assembly is fastened to an inside rearview mirror support that is secured to the windshield assembly.

The conventional mirrors offered on these vehicles are "breakaway" type. Breakaway rearview mirrors are designed to detach from the windshield in the event of an inflatable restraint deployment. The mirrors attach to the support on the windshield, but break away in different manners. Be sure to follow the appropriate procedure when servicing the rearview mirror.

Remove or Disconnect

1. Electrical connector (8).
2. Rearview mirror assembly (5) from rearview mirror support (4).
   A. Use one hand to support one end of rearview mirror assembly (5) against windshield assembly (1).



1 WINDSHIELD ASSEMBLY
4 SUPPORT, INSIDE REARVIEW MIRROR
5 MIRROR ASSEMBLY, INSIDE REARVIEW
8 CONNECTOR, INSIDE REARVIEW MIRROR COURTESY LAMP ELECTRICAL
10 LENS ASSEMBLY, COURTESY LAMP

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Figure 3 – Inside Rearview Mirror Assembly

   B. Use other hand to pull rearview mirror assembly (5) away from mirror support (4).

Install or Connect

NOTICE: See "Notice" on page 10-2-1 of this section.

1. Rearview mirror assembly (5) to rearview mirror support (4).
   A. Center bottom of rearview mirror assembly (5) to top of mirror support (4).
   B. Slide rearview mirror assembly (5) onto mirror support (4), keeping rearview mirror assembly (5) parallel to windshield assembly (1).
   C. Apply at least 90 N (20 pounds) of force to fully seat rearview mirror assembly (5) onto mirror support (4). Audible click will be heard when rearview mirror assembly (5) is fully seated.
2. Electrical connector (8).

Courtesy Lamp Bulb Replacement

There are two inside rearview mirror lamps (left and right) on the inside rearview mirror assembly. These lamps have replaceable bulbs.

Remove or Disconnect

1. Pry off courtesy lamp lens assembly.
2. Courtesy lamp bulb.

Install or Connect

1. Courtesy lamp bulb.
2. Courtesy lamp lens assembly.

Inside Rearview Mirror Support

Figure 4

The inside rearview mirror assembly is attached to an inside rearview mirror support (4) that is secured to the windshield assembly (1). The rearview mirror support (4) is installed by the window supplier, using a plastic-polyvinyl butyral adhesive.

Service replacement windshield assemblies have the rearview mirror support (4) bonded to the windshield assembly (1). To install a detached rearview mirror support (4) or install a new part, the following items are needed:

- GM P/N 1052369, Loctite 312 Adhesive kit, two-component pack or equivalent.
- Mirror support (4).
- Wax marking pencil or crayon.
- Window cleaning solution or window polishing compound.
- Rubbing alcohol.
- Clean paper towels.
- Fine grit emery cloth or sandpaper, number 320 or number 360.
- Clean toothpick.

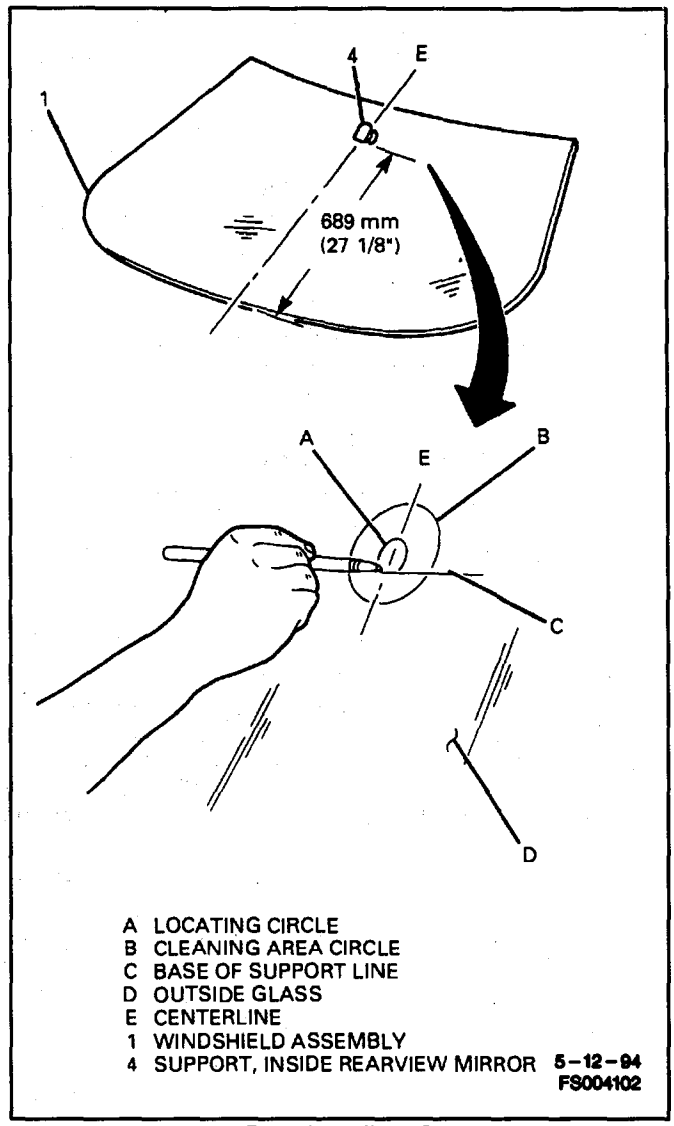


Figure 4 – Inside Rearview Mirror Support Placement

Measure

- Distance from bottom of windshield assembly (1) to determine location of rearview mirror support (4).
  - A. Rearview mirror support (4) should be located at center of windshield assembly (1), 689 mm (27 1/8 inches) from base of windshield assembly (1) to base of rearview mirror support (4).
  - B. Mark location on outside of windshield assembly (1) with wax pencil or crayon.
  - C. Make larger diameter circle around marked location on outside windshield surface.

Clean

1. Area of large circle on inside windshield surface with paper towel and window cleaning solution or window polishing compound.
   - A. Rub area until completely clean and dry.
   - B. When dry, clean area with alcohol-saturated paper towel to remove any traces of cleaning solution or polishing compound.
2. Sand bonding surface of new or detached original rearview mirror support (4) with piece of fine grit emery cloth or sandpaper, number 320 or number 360.
   - If original rearview mirror support (4) is to be reused, all traces of old adhesive must be removed prior to installation.
3. Wipe sanded rearview mirror support (4) with clean paper towel saturated with alcohol and allow to dry.

Install or Connect

- Rearview mirror support (4) to windshield assembly (1).
  - A. Follow directions on adhesive kit (GM P/N 1052369 or equivalent) to prepare rearview mirror support (4) prior to installation on windshield assembly (1).
  - B. Lightly apply adhesive accelerator to bonding surfaces of rearview mirror support (4) and windshield assembly (1) and allow to dry completely.

Important

- Due to rapid bonding of adhesive, the following steps must be performed without hesitation.

  - C. Apply two drops of adhesive to rearview mirror support (4).

D. Use toothpick to evenly distribute adhesive over entire bonding surface of rearview mirror support (4).

E. Properly position rearview mirror support (4) to pre-marked location with rounded end pointed upward.

F. Press rearview mirror support (4) against windshield assembly (1) for 30 to 60 seconds, exerting steady pressure against windshield assembly (1).

G. After five minutes, remove excess adhesive with alcohol-moistened paper towel or window cleaning solution.

REAR WINDOW DEFOGGER

The optional rear window defogger system consists of tinted windows with a number of horizontal ceramic silver compound element lines and two vertical bus bars baked into the inside surface during the glass forming operation. The feed wire or terminal is soldered to the feed bus bar on the left side. The ground wire or terminal is soldered to the ground bus bar on the right side.

The system operates on 12 volts. Under some conditions, heat from the window may not be detected by finger touch. The length of time required to remove interior fog from the rear window will vary with such conditions as vehicle speed, outside window temperature, atmospheric pressure and number of passengers.

The system uses an instrument panel mounted switch with an integral indicator lamp and will operate for five or ten minutes, automatically turning off through the use of a timer. The system can be turned off during this operation period by turning either the instrument panel mounted switch or ignition switch to "OFF."

Testing Grid Lines

Figures 5 and 6

To locate inoperative grid lines, start the engine and turn on the rear window defogger system. Ground one test lamp lead and lightly touch other probe to each grid line. Figure 5 illustrates pattern of test lamp brilliance to be expected with a properly functioning grid.

If test lamp bulb shows full brilliance at both ends of grid lines, check for loose ground wire contact to body metal.

Range of zones of bulb brilliance may vary slightly from one window to another. Bulb brilliance will decrease proportionately to increased resistance in grid line as probe is moved from feed bus bar to ground bus bar.

All grid lines must be tested in at least two places to eliminate the possibility of bridging a break. For best results, contact each grid line a few centimeters (inches) either side of window centerline. If an abnormal lamp reading is apparent on a specific grid line, place test lamp probe on that grid at the feed bus bar and move probe toward ground bus bar until lamp goes out. This will indicate a break in continuity of grid line (Figure 6).

If no break in continuity is found and braided lead wire repairs are not needed but system is still inoperative, refer to SECTION 8A for electrical diagnosis.

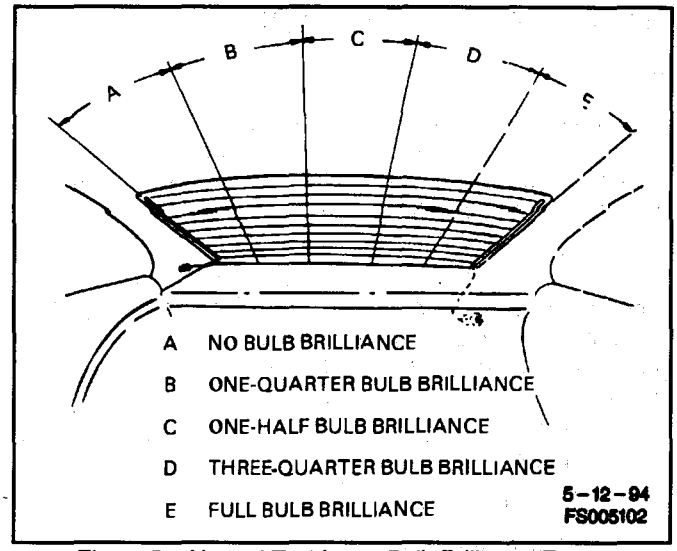


Figure 5 – Normal Test Lamp Bulb Brilliance Zones

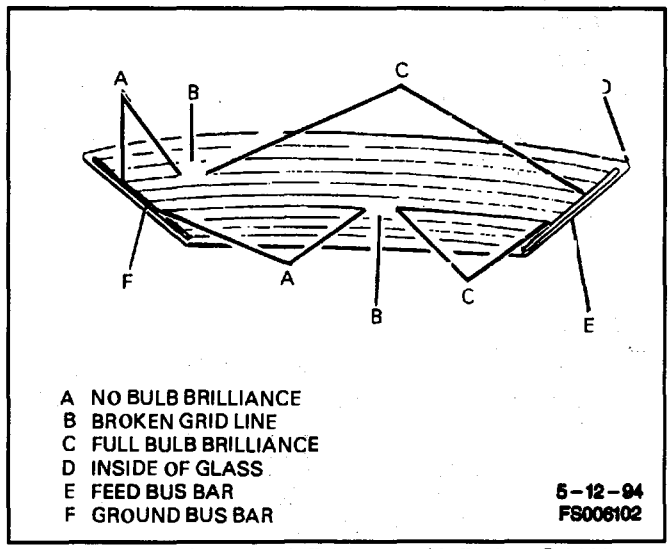


Figure 6 – Test Lamp Bulb Brilliance with Broken Grid Lines

Grid Line Repair

Figures 7 and 8

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

CAUTION: To Avoid Personal Injury

- Do not allow the repair material to come in contact with skin or eyes and avoid breathing vapor.
- Do not use near heat, sparks or open flame.

1. Battery negative cable assembly. Refer to SECTION 6D1.

Inspect

- Rear window defogger grid lines.

2. Mark grid line breaks on outside of window with grease pencil.

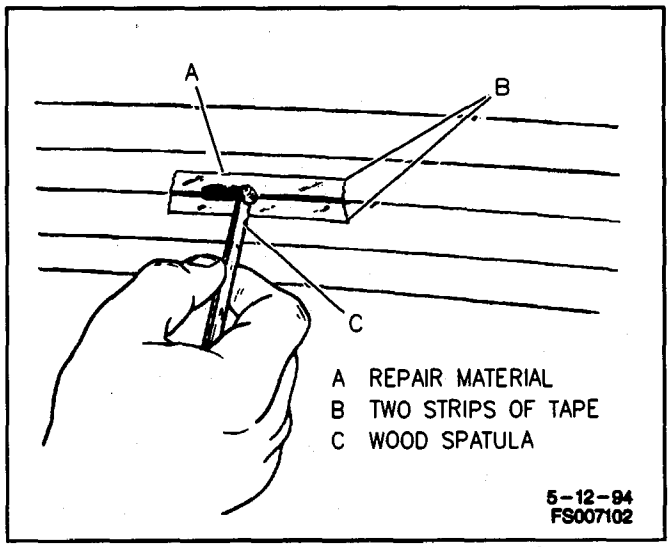


Figure 7 – Applying Repair Material to Broken Grid Line

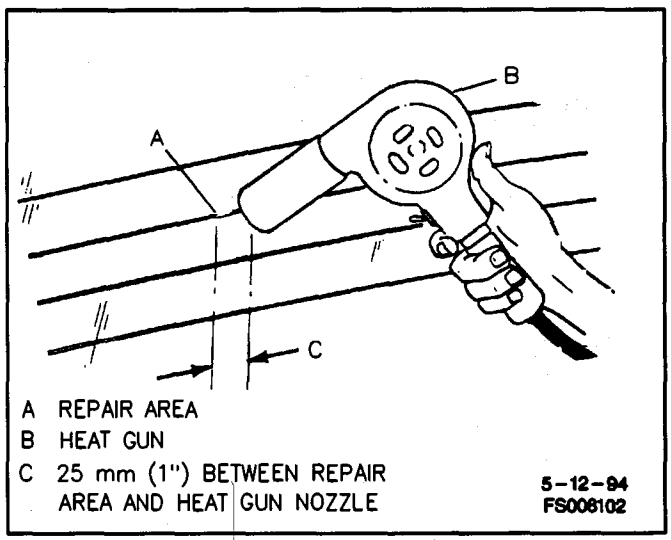


Figure 8 – Applying Heat to Grid Line Repair

Clean

- Grid line area to be repaired.

3. Buff with fine steel wool and wipe clean, using alcohol-dampened cloth.
4. Buff and clean about 6 mm (1/4 inch) beyond each side of break in grid line.

Install or Connect

CAUTION: Approved safety glasses should be worn when performing this procedure to reduce the chance of personal injury.

1. Grid line repair decal or two strips of tape positioned above and below repair area.
   - Repair decal or tape must be used to control width of repair area.
   - If decal is used, be sure die-cut metering slot is same width as grid line.
2. Mix grid repair material according to manufacturer instructions.
3. Grid repair material, at room temperature, to repair area, using small wood stick or spatula.
4. Carefully remove decal or tape.

   NOTICE: Grid line repair material must be cured with heat. To avoid heat damage to interior trim, protect trim near repair area where heat is to be applied.
5. Apply heat to repair area for one to two minutes with heat gun capable of reaching 260°C (500°F).
   - Hold heat gun nozzle 25 mm (1 inch) from surface.
   - Minimum temperature of 149°C (300°F) is required.
6. Battery negative cable assembly. Refer to SECTION 6D1.

Inspect

- Grid line repair area.
  A. If repair appears discolored, apply coating of tincture of iodine to repair area, using pipe cleaner or fine brush.
  B. Allow iodine to dry for about 30 seconds and carefully wipe off excess with lint-free cloth.

7. Test rear window defogger operation to verify grid line repair. Refer to "Testing Grid Lines" in this section.

   NOTICE: At least 24 hours are required for complete curing of repair materials. Unit should not be physically disturbed until after that time, or repair may not hold.

Braided Lead Wire Repair

Figures 8 and 9

CAUTION: Approved safety glasses should be worn when performing this procedure to reduce the chance of personal injury.

The rear defogger bus bar lead wire or terminal can be reattached by resoldering, using a solder containing 3 percent silver and a rosin flux paste.

Remove or Disconnect

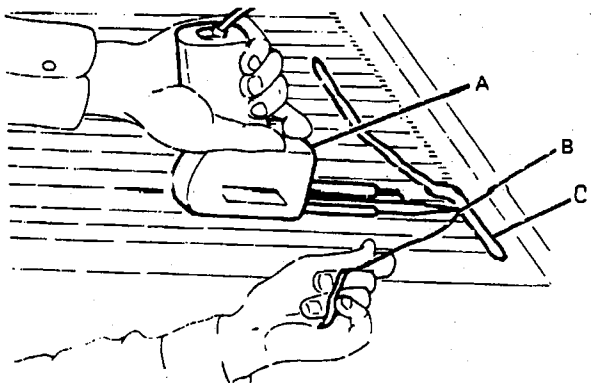
CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

- Battery negative cable assembly. Refer to SECTION 6D1.

Clean

- Buff repair area with fine steel wool to remove oxide coating formed during window manufacturing.

NOTICE: To prevent burning bus bar, soldering iron tip temperature should be just enough to melt solder and allow it to run freely. Iron should be in contact with bus bar as short a time as possible.



A SOLDERING IRON
B FLUX
C FEED BUS BAR

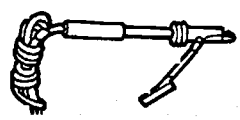
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Figure 9 – Bus Bar Repair

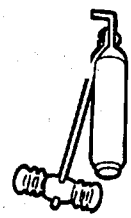
Install or Connect

1. Paste-type rosin flux in small quantities to wire lead and bus bar repair, using brush.
   - Soldering iron tip should be coated with solder beforehand.
2. Solder to feed bus bar or ground bus bar.
   - Draw soldering iron tip across fluxed area, thinly coating bus bar with solder.
3. Small amount of flux to underside of lead wire braid.
   - Align spots with fluxed and tinned spots on feed bus bar or ground bus bar.
4. Coat tip of soldering iron with solder.
5. Solder to underside of lead wire braid.
   - Draw iron across fluxed spot, thinly coating spot with solder.
6. Solder spot on braid against spot on feed bus bar or ground bus bar.
   A. Apply heat to top of lead wire braid, causing solder spots to melt and fuse together.
   B. Holding force should not be removed until solder has solidified.
7. Wipe off excess flux with solvent.
8. Battery negative cable assembly. Refer to SECTION 6D1.

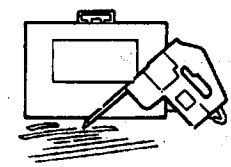
SPECIAL TOOLS

1. 

J 24709-01
OR
J 24899-01

2. 

J24402-A

3. 

J 39032

1. URETHANE GLASS SEALANT REMOVER (HOT KNIFE)
2. GLASS SEALANT REMOVER (COLD KNIFE)
3. STATIONARY GLASS REMOVAL TOOL

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SECTION 10-3

BODY DIMENSIONS AND UNDERBODY

NOTICE: The theft deterrent label found on some major sheet metal, engines, and transmissions must be masked prior to painting, rustproofing, undercoating, etc. The mask must be removed following the above operations. Failure to keep the label clean and readable may result in liability for violation of Federal Vehicle Theft Prevention Standard and subject the vehicle owner to possible suspicion that the part was stolen.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

GENERAL BODY CONSTRUCTION

Information in this section pertains to unitized body construction which incorporates integral front and rear frame side rails.

The front suspension lower control arms are supported by a crossmember. The crossmember is bolted to the body at six locations-three on each side of the engine front compartment lower rails. Mounting provisions for the front suspension system are shared by chassis components (suspension lower control arms and crossmember) and body components (engine compartment side panels). The suspension strut towers must be dimensionally correct in relation to the remainder of the underbody in order to maintain specified suspension strut and caster/camber angles.

Since the individual underbody components contribute directly to the overall strength of the body, proper welding techniques must be observed during service repair operations. The underbody components should be properly sealed and rustproofed whenever body repair operations destroy or damage the original sealing and rustproofing. When rustproofing critical underbody components, use a good quality air dry primer such as corrosion-resistant chromate or equivalent material. Combination type primer-surfaces are not recommended.

ON-VEHICLE SERVICE

ALIGNMENT CHECKING

Frame and Underbody

Use a tram gage to accurately measure underbody alignment. Make sure the tram gage set has a vertical pointer that can reach 914 mm (36 inches).

Two types of measurements can be made with a tram gage: direct point-to-point measurements and measurements calculated on a horizontal plane, or datum line, parallel to the underbody. To calculate measurements on a horizontal plane, the vertical pointers must be set as specified for each point to be measured.

Point-to-point measurements are generally taken only on engine compartment components and simply require the vertical pointers to be equally set. Dimensions-to-gage holes are measured to dead center of the holes and flush to the adjacent surface metal unless otherwise specified.

CRADLE-TO-BODY FASTENER REPAIR

1. Drill out center of drive train and front suspension nut in rear mount.
2. Insert drive train and front suspension nut.
3. Insert front crossmember bolt/screw through drive train and front suspension nut.

Tighten

- Front crossmember bolt/screw to 125 N.m (92 lb. ft.).

FRAME

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Front tire and wheel assemblies. Refer to SECTION 3E.
3. Front upper control arm pivot shaft. Refer to SECTION 3C.
4. Front shock absorber bolt/screw. Refer to SECTION 3C.
5. Lower control arm assembly from steering knuckle assembly (including cotter pin). Refer to SECTION3C
6. Front lower control arm bolts/screws from frame assembly. Refer to SECTION 3C.
7. Lower control arm assemblies. Refer to SECTION 3C.
8. Steering gear bolts/screws. Refer to SECTION 3B
9. Engine mount.Refer to SECTION 6A2A or SECTION 6A3A.
   - Support engine assembly with jacking fixtures in front and rear .
10. Brake hose brackets from engine cradle assembly. Refer to SECTION 5.
11. Brake pipe assemblies from engine cradle assembly. Refer to SECTION 5.
12. Wheel speed sensor assembly from engine cradle assembly. Refer to SECTION 5E1.
13. Engine cradle mount bolt/screw. Refer to SECTION 6A2A or SECTION 6A3A.
14. Engine cradle assembly.

Install or Connect

1. Engine cradle assembly.
2. Engine cradle mount bolt/screw. Refer to SECTION 6A2A or SECTION 6A3A.
3. Wheel speed sensor assembly to engine cradle assembly. Refer to SECTION 5E1.
4. Brake pipe assemblies to engine cradle assembly. Refer to SECTION 5.
5. Brake hose brackets to engine cradle assembly. Refer to SECTION 5.
6. Engine mount. Refer to SECTION 6A2A or SECTION 6A3A.
7. Steering gear bolts/screws. Refer to SECTION 3B.
8. Lower control arm assemblies. Refer to SECTION 3C.
9. Front lower control arm bolts/screws to frame assembly. Refer to SECTION 3C.
10. Lower control arm assembly to steering knuckle assembly. Refer to SECTION 3C.
11. Front shock absorber bolt/screw. Refer to SECTION 3C.
12. Front upper control arm pivot shaft. Refer to SECTION 3C.
13. Front tire and wheel assemblies. Refer to SECTION 3E.
14. Lower vehicle.

UNDERBODY FLUSH

Due to buildup of road salts and corrosives on the vehicle underbody, the underbody, (including suspension, exhaust and fuel line areas) should be flushed with clean water annually, preferably each spring. This will increase the life and strength of the underbody components.

STEERING UNIT RACK AND PINION SUPPORT MOUNT PLATES

The fore and aft and side-to-side dimension reference points for the rack and pinion steering mount plates are measured point to point. The vertical dimensions for the reference points are measured on a vertical plane from the datum line to the center of the steering unit attaching holes.

STEERING UNIT MOUNTING

Vehicles involved in accidents resulting in frame damage, major body or sheet metal damage, or where the steering column has been impacted, may also have a misaligned steering column.

For the procedure to check capsules on the steering column bracket assembly, refer to SECTION 3F.

FRONT SIDE DOOR SILL TRIM PLATE

To remove, pull up on front side door sill trim plate. Snap into place to install.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Front Crossmember Bolt/Screw	125 N.m (92 lb. ft.).

SECTION 10-4

BUMPERS

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

BUMPER ASSEMBLIES

Chevrolet

The front and rear bumper design is a full-width honeycomb energy absorber of guide flex (or equivalent) material backed up by rigidly mounted impact bars. The front bumper fascia is polyurea painted body color. The rear bumper fascia is polyurethane painted body color.

For repair of the front and rear bumper fascias, refer to SECTION 10-1.

Pontiac

The front bumper design includes a full-width energy absorber of a styrofoam material. The rear bumper design is a full-width honeycomb energy absorber of guide flex (or equivalent) material. Both bumpers are backed up by rigidly mounted impact bars. The front bumper fascia is polyurea painted body color. The rear bumper fascia is polyurethane painted body color.

For repair of the front and rear bumper fascias, refer to SECTION 10-1.

ENERGY ABSORBING UNITS

General Motors passenger car bumper systems are designed to take a collision into a fixed barrier at 8 km/h (5 mph) without damage. After absorbing the energy of a collision, these bumper systems restore themselves to their original position.

ON-VEHICLE SERVICE

FRONT BUMPER ASSEMBLY

Front Bumper Fascia

Chevrolet

Figure 1

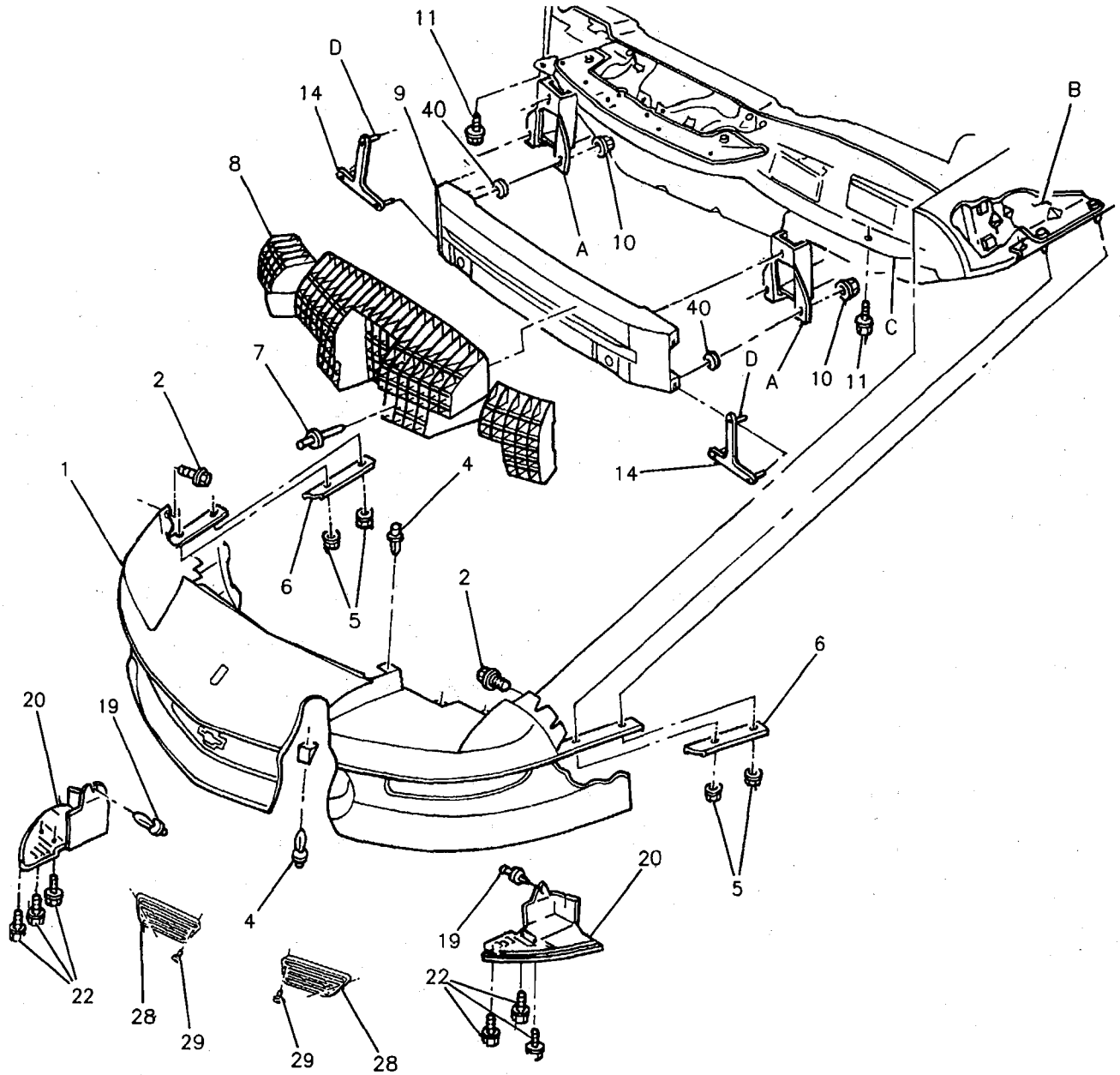
Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Front bumper fascia lower deflectors. Refer to "Front Bumper Fascia Lower Deflectors" in this section.
3. Retainers (4).
4. Nuts (5) and lower supports (6).
5. Bolts/screws (11) attaching front bumper fascia (1) to headlamp mounting panel.
6. Lower vehicle.
7. Retainers under fascia (4).
8. Bolts/screws (2).
9. Front bumper fascia (1).
10. Electrical connectors from front bumper fascia (1).

Install or Connect

NOTICE: See "Notice" on page 10-4-1 of this section.

1. Electrical connectors to front bumper fascia (1).
2. Front bumper fascia (1).
3. Bolts/screws (2).



A COLLAR, RAIL
B BRACKET, OUTER SUPPORT
C PANEL, HEADLAMP SUPPORT
D STUD, FRONT BUMPER PLATE ASSEMBLY
1 FASCIA, FRONT BUMPER
2 BOLT/SCREW, FRONT FENDER
4 RETAINER, FRONT BUMPER FASCIA (PUSH-IN)
5 NUT, FRONT BUMPER FASCIA LOWER SUPPORT
6 SUPPORT, FRONT BUMPER FASCIA LOWER
7 RIVET, FRONT BUMPER FASCIA ENERGY ABSORBER
8 ABSORBER, FRONT BUMPER FASCIA ENERGY
9 BAR ASSEMBLY, FRONT BUMPER IMPACT
10 NUT, FRONT BUMPER IMPACT BAR
11 BOLT/SCREW, HEADLAMP HOUSING PANEL
14 PLATE ASSEMBLY, FRONT BUMPER IMPACT
19 RETAINER, FRONT BUMPER FASCIA LOWER DEFLECTOR
20 DEFLECTOR, FRONT BUMPER FASCIA LOWER
22 BOLT/SCREW, FRONT BUMPER FASCIA LOWER DEFLECTOR
28 COVER FRONT FOG LAMP OPENING
29 BOLT/SCREW, FRONT FOG LAMP OPENING COVER
40 RETAINER, FRONT BUMPER IMPACT BAR STUD

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Figure 1 – Front Bumper Assembly – (Chevrolet)

Tighten

- Bolts/screws (2) to 1.7 N•m (15 lb. in.).

4. Retainers (4).
5. Raise and suitably support vehicle. Refer to SECTION 0A.
6. Bolts/screws (11) attaching front bumper fascia (1) to headlamp mounting panel.

Tighten

- Bolts/screws (11) to 1.7 N•m (15 lb. in.).

7. Lower supports (6) and nuts (5).

Tighten

- Nuts (5) to 10 N•m (89 lb. in.).

8. Retainers under fascia (4).
9. Front bumper fascia lower deflectors. Refer to "Front Bumper Fascia Lower Deflectors" in this section.
10. Lower vehicle.

Pontiac

Figures 2 and 3

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Front bumper fascia lower deflectors. Refer to "Front Bumper Fascia Lower Deflectors" in this section.
3. Retainers (4).
4. Nuts (5), bolts/screws (75) and lower supports (6).
5. Lower vehicle.
6. Battery negative cable assembly.
7. Manually raise headlamp assemblies.
8. Retainers (4).
9. Bolts/screws (2).
10. Front bumper fascia (1).
11. Electrical connectors from front bumper fascia (1).

Install or Connect

NOTICE: See "Notice" on page 10-4-1 of this section.

1. Electrical connectors to front bumper fascia (1).
2. Front bumper fascia (1).
3. Bolts/screws (2).

Tighten

- Bolts/screws (2) to 1.7 N•m (15 lb. in.).

4. Retainers (4).
5. Manually retract headlamp assemblies.
6. Battery negative cable assembly.
7. Raise and suitably support vehicle. Refer to SECTION 0A.
8. Lower supports (6), nuts (5) and bolts/screws (75).

Tighten

- Nuts (5) to 10 N•m (89 lb. in.).
- Bolts/screws (75) to 10 N•m (89 lb. in.).

9. Retainers (4).
10. Front bumper fascia lower deflectors. Refer to "Front Bumper Fascia Lower Deflectors" in this section.
11. Lower vehicle.

Front License Plate Bracket

Remove or Disconnect

1. Bolts/screws attaching front license plate bracket to front bumper fascia.
2. License plate bracket from front bumper fascia.

Install or Connect

- License plate bracket to front bumper fascia.
  - A. Align holes in license plate bracket with holes in front bumper fascia.
  - B. Install bolts/screws attaching license plate bracket to front bumper fascia.

Front Bumper Energy Absorber

Chevrolet

Figure 1

Remove or Disconnect

1. Front bumper fascia. Refer to "Front Bumper Fascia" in this section.
2. Rivets (7) using 1/4-inch drill bit.
3. Front bumper energy absorber (8).

Install or Connect

1. Front bumper energy absorber (8).
2. Rivets (7).
   - Install rivets (7) starting at center of front bumper energy absorber (8) and working outboard.
3. Front bumper fascia. Refer to "Front Bumper Fascia" in this section.

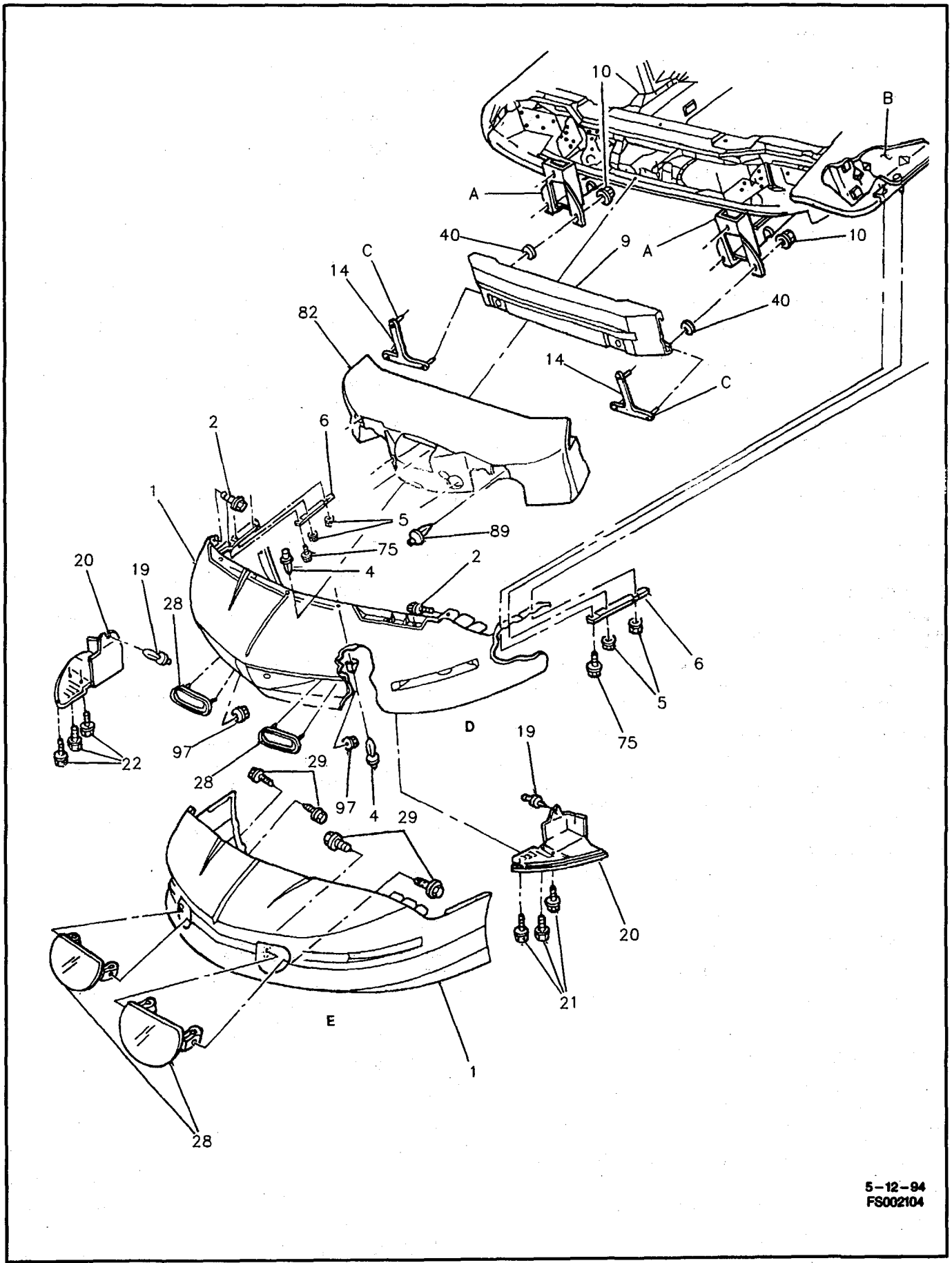


Figure 2 – Front Bumper Assembly – (Pontiac)

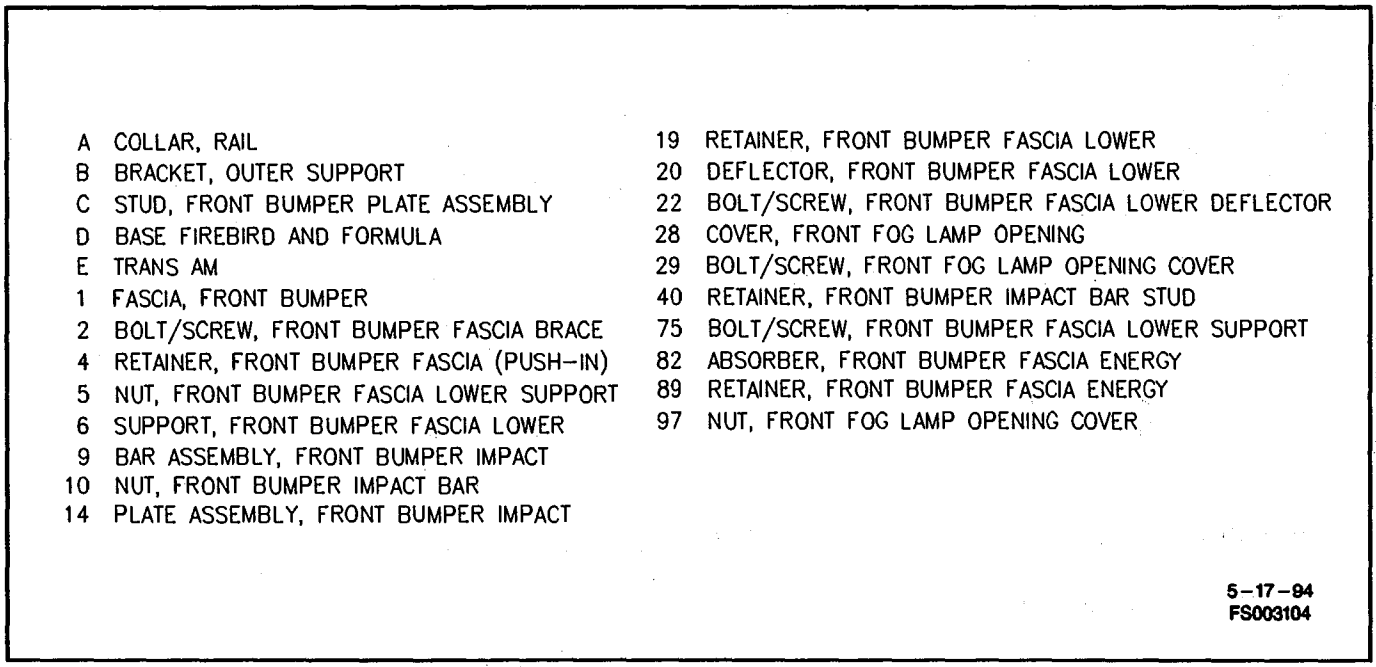


Figure 3 – Front Bumper Assembly – Legend – (Pontiac)

Pontiac

Figures 2 and 3

Remove or Disconnect

1. Front bumper fascia. Refer to "Front Bumper Fascia" in this section.
2. Retainers (89).
3. Front bumper energy absorber (82).

Install or Connect

1. Front bumper energy absorber (82).
2. Retainers (89).
   - Install retainers (89) starting at center of front bumper energy absorber (82) and working outboard.
3. Front bumper fascia. Refer to "Front Bumper Fascia" in this section.

Front Bumper Impact Bar Assembly

Figure 1, 2 and 3

Remove or Disconnect

1. Front bumper energy absorber. Refer to "Front Bumper Energy Absorber" in this section.
2. Nuts (10) from plate assembly studs.
3. Front bumper impact bar assembly (9).

Install or Connect

NOTICE: See "Notice" on page 10-4-1 of this section.

1. Front bumper impact bar assembly (9).
2. Nuts (10) to plate assembly studs.

Tighten

- Nuts (10) to 25 N•m (18 lb. ft.).

3. Front bumper energy absorber. Refer to "Front Bumper Energy Absorber" in this section.

Front Bumper Fascia Emblem Assemblies

Figures 4 and 5

Remove or Disconnect

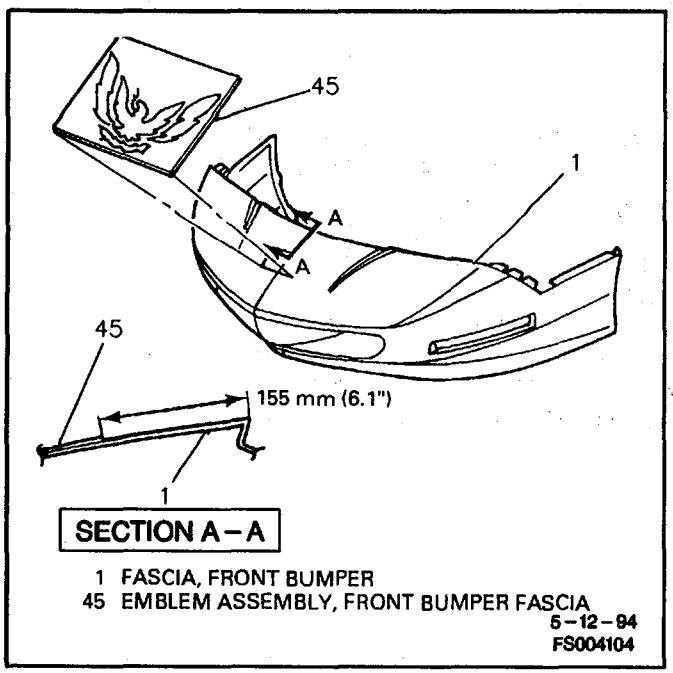
- Emblem assembly (45, or 104).
  - A. Apply heat using heat gun, making sure heat gun is moved in circular motion and is held at least 152 mm (6 inches) from emblem assembly (45, or 104) for about 30 seconds.
  - B. Peel emblem assembly (45, or 104) from front bumper fascia (1) with flat-bladed tool, making sure not to damage paint.

Clean

- Area with suitable solvent of isopropyl alcohol 50-50 mixture by volume with water or high-flash naphtha.

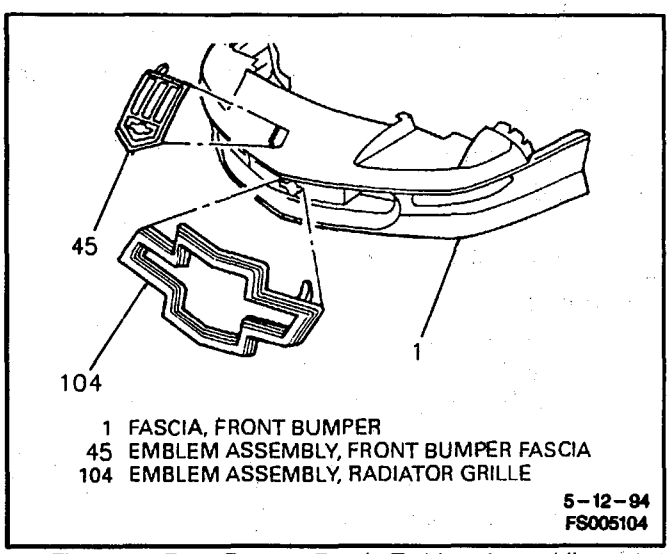
Install or Connect

- Emblem assembly (45, or 104).
  - A. Body and part temperature must be 26°C (80°F) minimum or 6°C (10°F) above ambient air temperature, whichever is higher, but not to exceed 40°C (105°F) during installation.
  - B. Peel protective paper from emblem assembly adhesive.



1 FASCIA, FRONT BUMPER
45 EMBLEM ASSEMBLY, FRONT BUMPER FASCIA
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Figure 4 – Front Bumper Fascia Emblem Assembly (Pontiac)



1 FASCIA, FRONT BUMPER
45 EMBLEM ASSEMBLY, FRONT BUMPER FASCIA
104 EMBLEM ASSEMBLY, RADIATOR GRILLE
5-12-94
FS005104

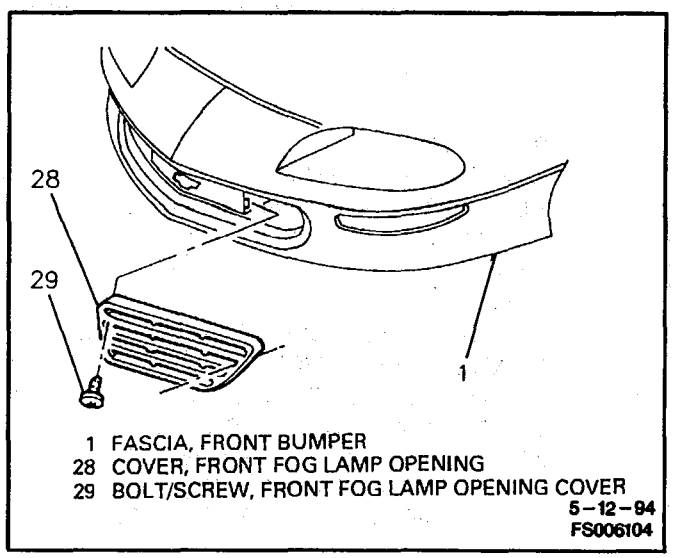
Figure 5 – Front Bumper Fascia Emblem Assemblies – (Chevrolet)

Important

- Position emblem assembly (45, or 104) carefully on front bumper fascia (1). Emblem assembly (45, or 104) cannot be easily removed after contact with vehicle.

C. Press emblem assembly (45, or 104) into place and apply constant pressure for 30 seconds.

D. Remove pre-mask from emblem assembly (45, Pontiac only).



1 FASCIA, FRONT BUMPER
28 COVER, FRONT FOG LAMP OPENING
29 BOLT/SCREW, FRONT FOG LAMP OPENING COVER
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Figure 6 – Front Fog Lamp Opening Cover (Left Side Shown, Right Side Similar) – (Chevrolet)

Front Fog Lamp Opening Cover

Chevrolet

Figure 6

Remove or Disconnect

1. Bolts/screws (29) from front bumper fascia (1).
2. Front fog lamp opening cover (28).

Install or Connect

NOTICE: See "Notice" on page 10-4-1 of this section.

1. Front fog lamp opening cover (28).
2. Bolts/screws (29) to front bumper fascia (1).

Tighten

- Bolts/screws (29) to 1.7 N•m (15 lb. in.).

Pontiac

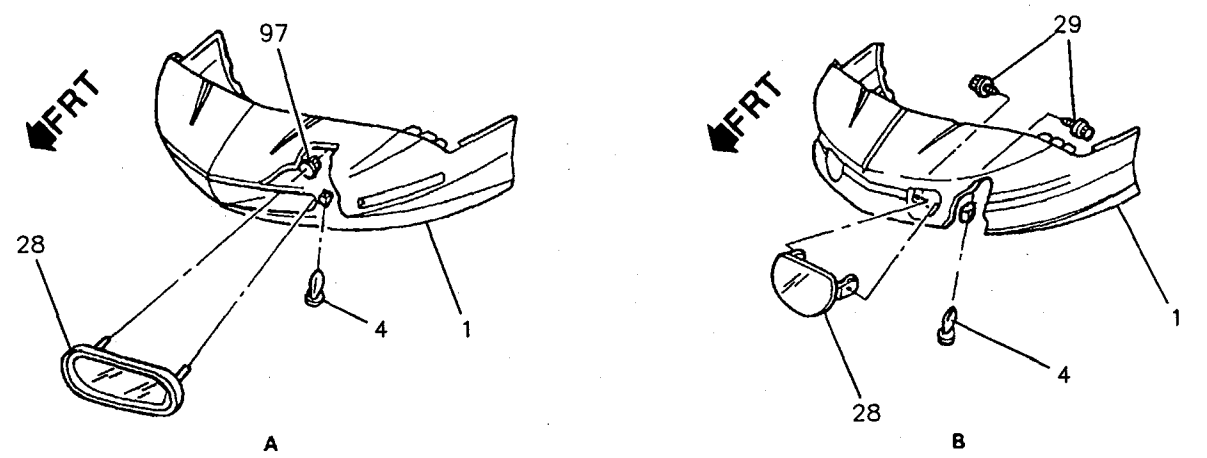
Figure 7

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Retainers (4).
   - Remove enough retainers (4) so that lower portion of front bumper fascia (1) can be pulled down to gain access to nuts (97) or bolts/screws (29).
3. Nuts (97) from front fog lamp opening cover (28) or bolts/screws (29) from front fog lamp opening cover (28).
4. Front fog lamp opening cover (28).

Install or Connect

NOTICE: See "Notice" on page 10-4-1 of this section.



A BASE FIREBIRD AND FORMULA
B TRANS AM
1 FASCIA, FRONT BUMPER
4 RETAINER, FRONT BUMPER FASCIA (PUSH-IN)
28 COVER, FRONT FOG LAMP OPENING
97 NUT, FRONT FOG LAMP OPENING COVER
29 BOLT/SCREW, FRONT FOG LAMP OPENING COVER

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Figure 7 – Front Fog Lamp Opening Covers (Left Side Shown, Right Side Similar) – (Pontiac)

1. Front fog lamp opening cover (28).
2. Nuts (97) to front fog lamp opening cover (28) or bolts/screws (29) to front fog lamp opening cover (28).

Tighten

- Nuts (97) to 2.3 N•m (20 lb. in.).
- Bolts/screws (29) to 1.7 N•m (15 lb. in.).

3. Retainers (4).
4. Lower vehicle.

Front Bumper Fascia Lower Deflectors

Figure 8

Remove or Disconnect

1. Retainers (19).
2. Bolts/screws (22) from front lower deflector (20) and wheelhouse panel liner (51).
3. Bolts/screws (22) from front lower deflector (20) and radiator air lower deflector (49).
4. Retainers (4) from front lower deflector (20) and radiator air lower baffle (48).
5. Front lower deflector (20).
   - Slide front lower deflector (20) outward from radiator air lower deflector (49) and wheelhouse panel liner (51).

Install or Connect

NOTICE: See "Notice" on page 10-4-1 of this section.

1. Front lower deflector (20).
   - Slide front lower deflector (20) inward and over radiator air lower deflector (49) and wheelhouse panel liner (51).
2. Retainer (4) to radiator air lower baffle (48) and front lower deflector (20).
3. Bolts/screws (22) to radiator air lower deflector (49) and front lower deflector (20).

Tighten

- Bolts/screws (22) to 10 N•m (89 lb. in.).

4. Bolts/screws (20) to wheelhouse panel liner (51) and front lower deflector (20).
5. Retainers (19).

REAR BUMPER ASSEMBLY

Rear Bumper Fascia

Figure 9

Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Retainers (67).
3. Bolts/screws (71).
4. Nuts (53).
5. Lower vehicle.
6. Rear end finish panel assembly. Refer to SECTION 10-8.
7. Compact spare tire and jack assembly.
8. Retainers (67).
9. Nuts (54).
10. Rear bumper fascia (68).

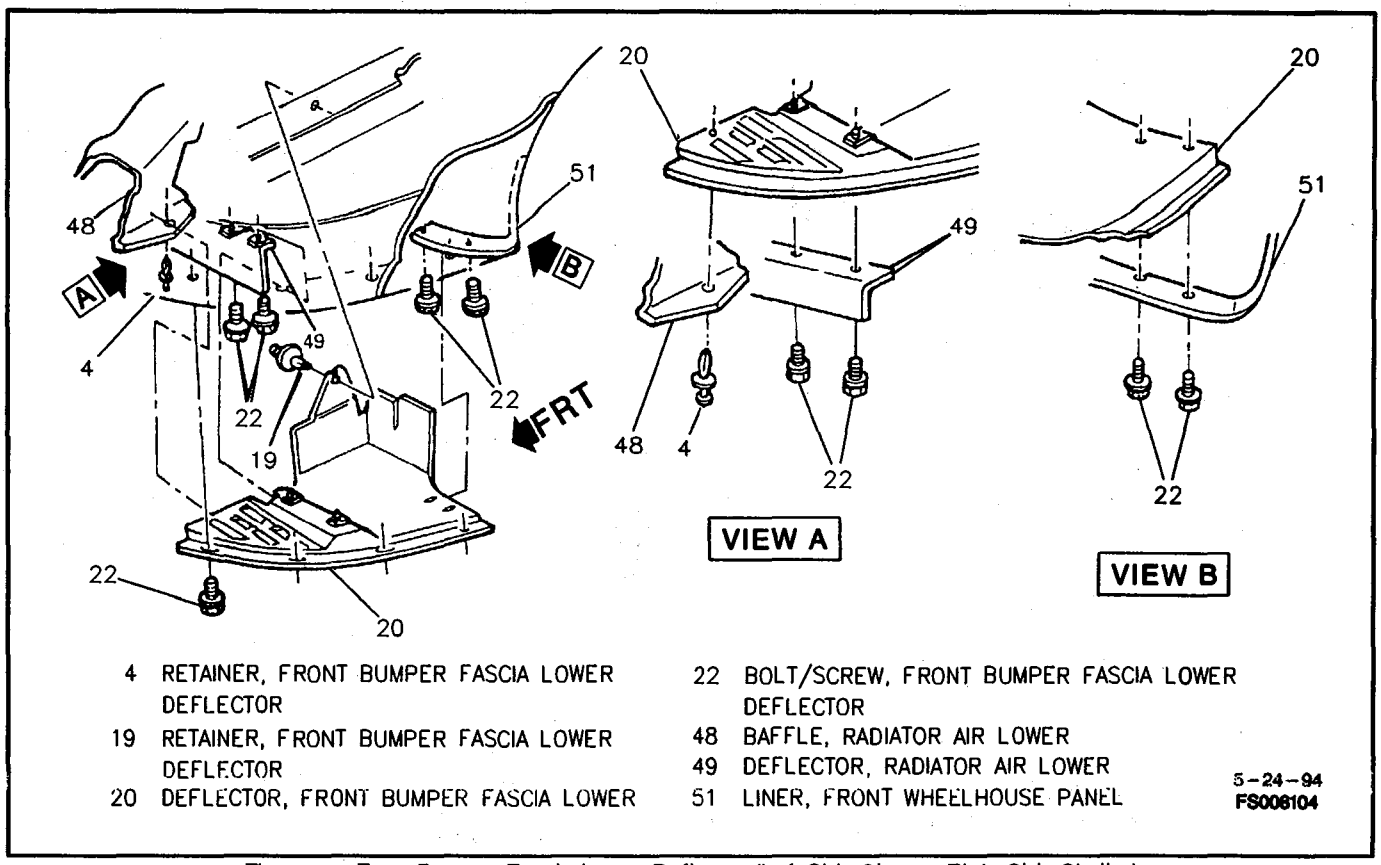


Figure 8 – Front Bumper Fascia Lower Deflector (Left Side Shown, Right Side Similar)

11. Rear body wiring harness connector from rear fascia wiring harness connector.

Install or Connect

NOTICE: See "Notice" on page 10-4-1 of this section.

1. Rear body wiring harness connector to rear fascia wiring harness connector.
2. Rear bumper fascia (68).
3. Nuts (54).

Tighten

- Nuts (54) to 10 N•m (89 lb. in.).

4. Retainers (67).
5. Compact spare tire and jack assembly.
6. Rear end finish panel assembly. Refer to SECTION 10-8.
7. Raise and suitably support vehicle. Refer to SECTION 0A.
8. Nuts (53).

Tighten

- Nuts (53) to 10 N•m (89 lb. in.).

9. Bolts/screws (71).

Tighten

- Bolts/screws (71) to 2 N•m (18 lb. in.).

10. Retainers (67).
11. Lower vehicle.

Rear Bumper Energy Absorber

Figure 9

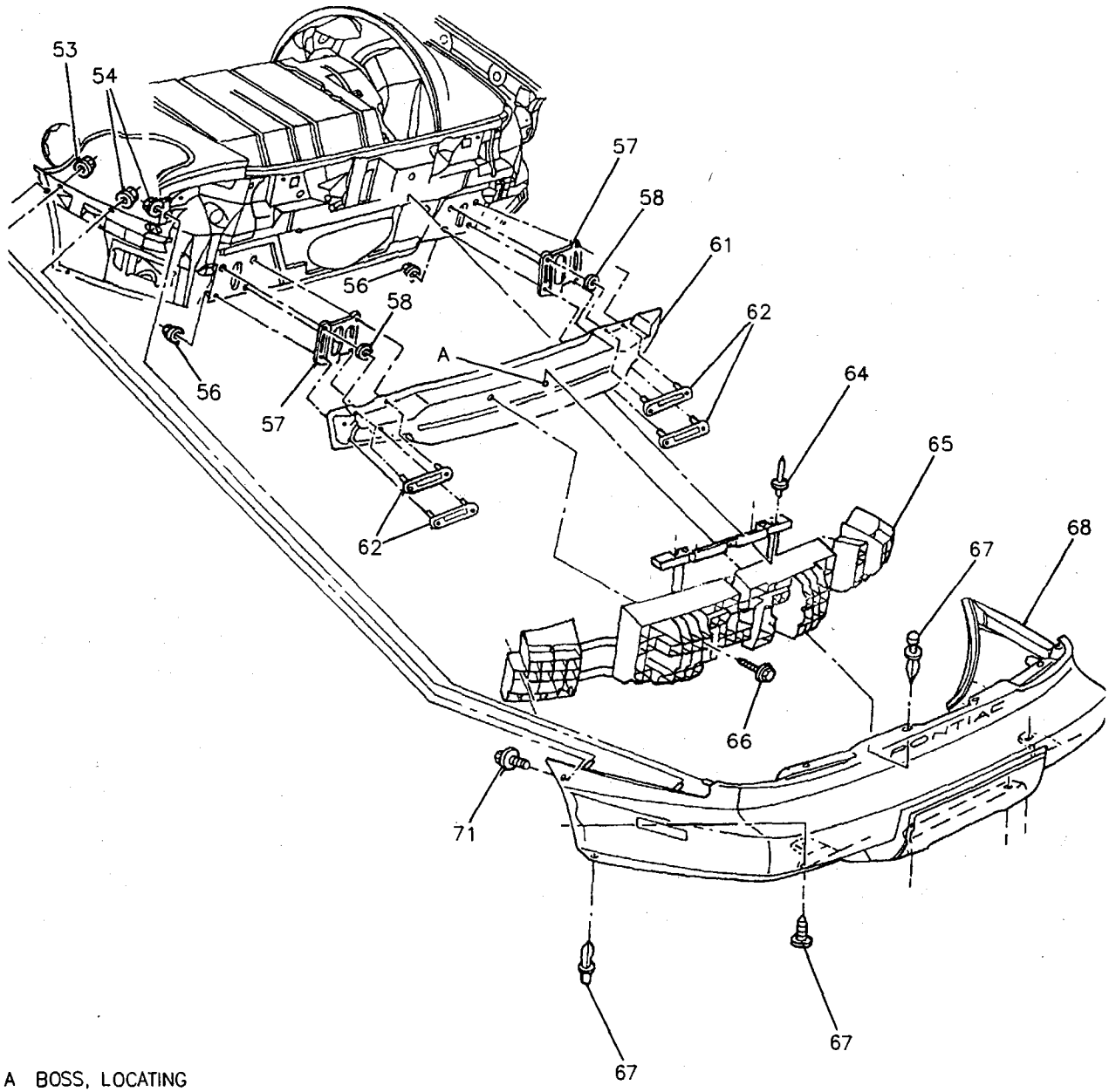
Remove or Disconnect

1. Rear bumper fascia. Refer to "Rear Bumper Fascia" in this section.
2. Rivets (64) using 1/4-inch drill bit (Pontiac only).
3. Bolts/screws (66).
4. Rear bumper energy absorber (65).

Install or Connect

NOTICE: See "Notice" on page 10-4-1 of this section.

1. Rear bumper energy absorber (65).
   - Position hole at center of rear bumper energy absorber (65) over locating boss at center of rear bumper impact bar (61).
2. Bolts/screws (66).



A BOSS, LOCATING
53 NUT, REAR BUMPER FASCIA
54 NUT, REAR BUMPER FASCIA
56 NUT, REAR BUMPER IMPACT BAR
57 SHIM, REAR BUMPER IMPACT BAR
58 RETAINER, REAR BUMPER IMPACT BAR BOLT (PUSH-ON)
61 BAR, REAR BUMPER IMPACT
62 PLATE, ASSEMBLY, REAR BUMPER IMPACT BAR STUD
64 RIVET, REAR-END FASCIA ENERGY ABSORBER (PONTIAC ONLY)
65 ABSORBER, REAR BUMPER FASCIA ENERGY
66 BOLT/SCREW, REAR END FASCIA ENERGY ABSORBER
67 RETAINER, REAR BUMPER FASCIA (PUSH-IN)
68 FASCIA, REAR BUMPER
71 BOLT/SCREW, REAR BUMPER FASCIA

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Figure 9 – Rear Bumper Assembly

- Install bolts/screws (66) starting at center of rear bumper energy absorber (65) and working outboard.

Tighten

- Bolts/screws (66) to 5.5 N•m (49 lb. in.).

3. Rivets (64) (Pontiac only).
4. Rear bumper fascia. Refer to "Rear Bumper Fascia" in this section.

Rear Bumper Impact Bar

Figure 9

Remove or Disconnect

1. Rear bumper energy absorber. Refer to "Rear Bumper Energy Absorber" in this section.
2. Nuts (56 and 72) from plate assembly studs.
3. Rear bumper impact bar (61).
   - Note number and placement of shims (57).

Install or Connect

NOTICE: See "Notice" on page 10-4-1 of this section.

1. Rear bumper impact bar (61) and shims (57).
   - Place shims (57) in location from which they were removed.
2. Nuts (56) to plate assembly studs.

Tighten

- Nuts (56) to 15 N•m (11 lb. ft.).

3. Rear bumper energy absorber. Refer to "Rear Bumper Energy Absorber" in this section.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Front Bumper Fascia Brace Bolt/Screw (Pontiac Only)	10 N•m (89 lb. in.)
Front Bumper Fascia Lower Support Bolt/Screw	10 N•m (89 lb. in.)
Front Bumper Fascia Lower Support Nut	10 N•m (89 lb. in.)
Front Bumper Impact Bar Nut	25 N•m (18 lb. ft.)
Front Fender Bolt/Screw	1.7 N•m (15 lb. in.)
Front Fog Lamp Opening Cover Bolt/Screw	1.7 N•m (15 lb. in.)
Front Fog Lamp Opening Cover Nut (Pontiac Only)	2.3 N•m (20 lb. in.)
Headlamp Housing Panel Bolt/Screw	1.7 N•m (15 lb. in.)
Radiator Air Lower Deflector Bolt/Screw	10 N•m (89 lb. in.)
Rear Bumper Fascia Bolt/Screw	2 N•m (18 lb. in.)
Rear Bumper Fascia Nut	6 N•m (53 lb. in.)
Rear Bumper Impact Bar Nut	15 N•m (11 lb. ft.)
Rear End Fascia Energy Absorber Bolt/Screw	5.5 N•m (49 lb. in.)

SECTION 10-5

BODY FRONT END

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

NOTICE: The theft deterrent label found on some major sheet metal, engines, and transmissions must be masked prior to painting, rustproofing, undercoating, etc. The mask must be removed following the above operations. Failure to keep the label clean and readable may result in liability for violation of Federal Vehicle Theft Prevention Standard and subject the vehicle owner to possible suspicion that the part was stolen.

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GENERAL DESCRIPTION

BODY FRONT END

Figures 1 through 4

The hood panel assembly (1 or 201) is composed of galvanized metal. Further rigidity is obtained by the use of reinforcement braces and brackets located so as not to interfere with adjustments or service repair. The hood primary latch assembly (27) is attached to the hood primary latch support assembly (26).

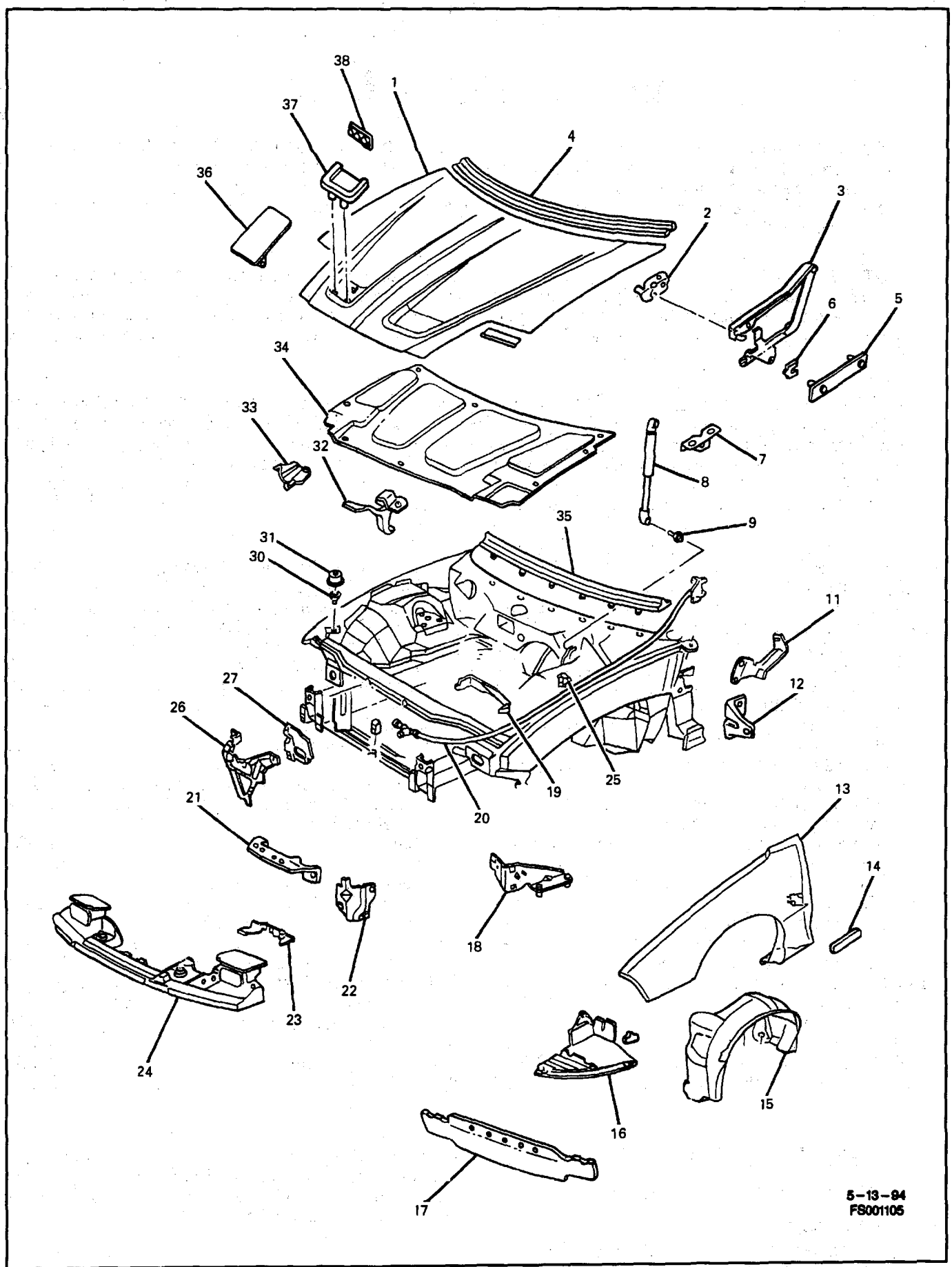


Figure 1 – Body Front End Components – (Pontiac)

1 PANEL ASSEMBLY, HOOD
2 BRACKET, HOOD HINGE
3 HINGE ASSEMBLY, HOOD
4 MOLDING ASSEMBLY, HOOD REAR
5 PLATE ASSEMBLY, HOOD HINGE MOUNT
6 SHIM, HOOD
7 BRACKET, HOOD OPEN ASSIST ROD
8 ROD ASSEMBLY, HOOD OPEN ASSIST
9 STUD, HOOD STRUT BALL
11 BRACKET, FRONT FENDER REAR UPPER
12 BRACKET, FRONT FENDER REAR CENTER
13 FENDER ASSEMBLY, FRONT
14 MOLDING, FRONT FENDER CENTER REAR
15 LINER, FRONT WHEELHOUSE PANEL
16 DEFLECTOR, FRONT BUMPER FASCIA LOWER
17 DEFLECTOR, RADIATOR AIR LOWER
18 BRACKET ASSEMBLY, FRONT BUMPER FASCIA OUTER
19 FILLER, HOOD CLOSEOUT
20 CABLE ASSEMBLY, HOOD PRIMARY LATCH RELEASE
21 BRACKET ASSEMBLY, HEADLAMP HOUSING PANEL UPPER
22 SUPPORT ASSEMBLY, HEADLAMP HOUSING PANEL
23 BRACKET, HEADLAMP HOUSING PANEL
24 PANEL ASSEMBLY, HEADLAMP HOUSING
25 CLIP, HOOD PRIMARY LATCH RELEASE CABLE
26 SUPPORT ASSEMBLY, HOOD PRIMARY LATCH
27 LATCH ASSEMBLY, HOOD PRIMARY
30 BUMPER ASSEMBLY, HOOD ADJUST FRONT
31 CAP, HOOD ADJUST FRONT BUMPER
32 LATCH ASSEMBLY, HOOD SECONDARY
33 STRIKER, HOOD PRIMARY LATCH
34 INSULATOR, HOOD
35 SEAL, HOOD REAR
36 DOOR, HEADLAMP OPENING
37 EXTRACTOR, HOOD AIR
38 SCREEN, HOOD AIR EXTRACTOR

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Figure 2 – Body Front End Components – Legend

Front fender assemblies (13 or 213) are composed of reinforced reaction injection molded (RRIM) urethane. The front fender assemblies (13 or 213) attach to the front wheelhouse panel liner (15 or 215).

LUBRICATION

For lubrication of hood hinges, hood latch assembly release pawl, hood latch assembly and pivots, headlamp door assembly, etc., refer to SECTION 0B.

FASTENERS

NOTICE: When replacing fasteners avoid substituting otherwise similar fasteners in locations which require the use of GM6174 or GM6047 type special fasteners for aluminum components, if used. Failing to follow this precaution may result in premature corrosion of the sheet metal in the areas mentioned above.

ANTICORROSION PROTECTION

Anticorrosion materials are part of the coating on most metal panels to provide rust resistance. When servicing these panels, use only GM replacement parts and recoat with specified service primers and paints.

ON-VEHICLE SERVICE

FRONT END PANELS

Radiator Air Lower Deflector

Figure 4

Remove or Disconnect

1. Bolts/screws (40) attaching radiator air lower deflector (17) to front bumper fascia lower deflectors (16).
2. Radiator air lower deflector (17).

Install or Connect

NOTICE: See "Notice" on page 10-5-1 of this section.

1. Radiator air lower deflector (17).
2. Bolts/screws (40).

Tighten

- Bolts/screws (40) to 10 N•m (89 lb. in.).

Headlamp Housing Panel Assembly and Brackets

Figures 5 and 6

Remove or Disconnect

1. Front bumper fascia. Refer to SECTION 10-4.
2. Bolts/screws (48) from pivot support brackets and panel brackets (23) (Pontiac only).
3. Bolts/screws (44) from headlamp housing panel assembly (24).
4. Electrical connectors.
   - Slide headlamp housing panel assembly (24) slightly out to gain access to headlamp assembly electrical connectors.
5. Headlamp housing panel assembly (24).
6. Panel support bolts/screws (49) and panel support assemblies (22), if necessary.

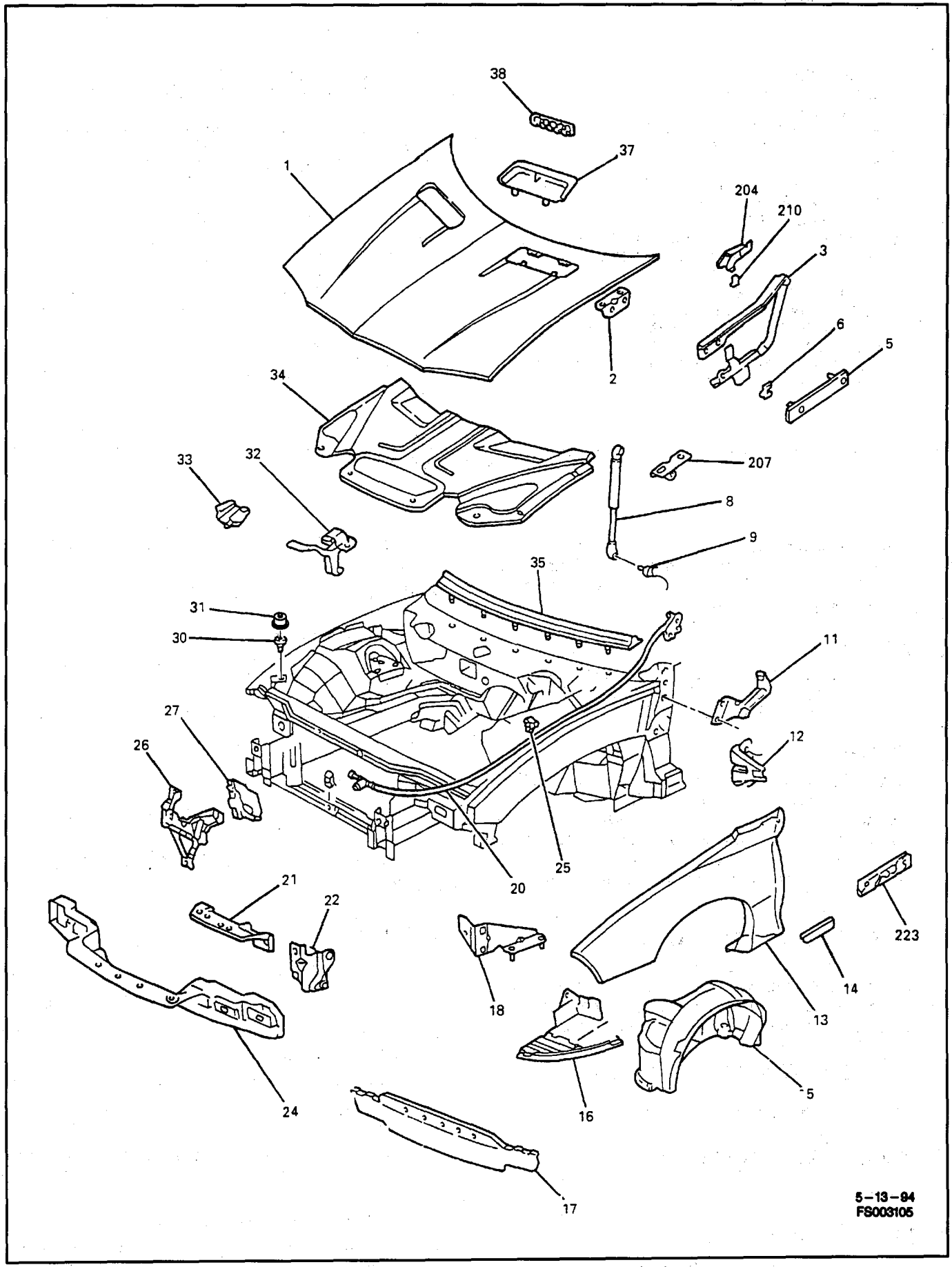
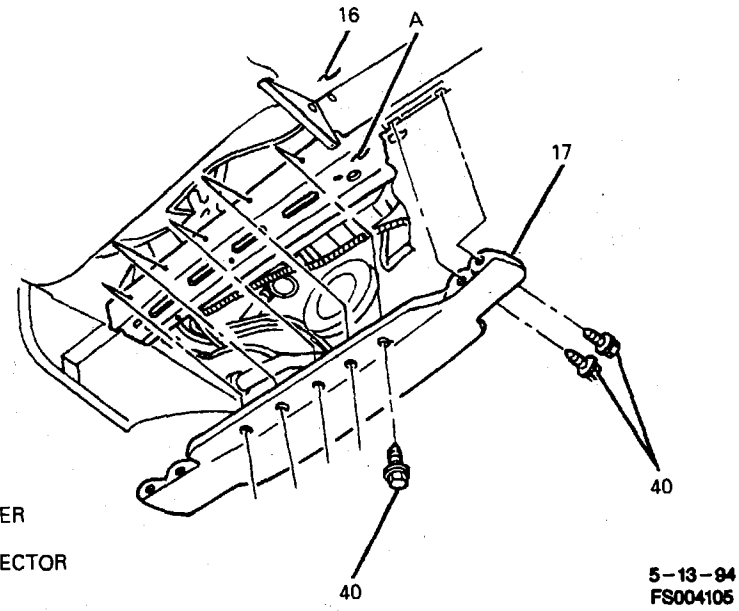


Figure 3 – Body Front End Components – (Chevrolet)



A SUPPORT, RADIATOR
16 DEFLECTOR. FRONT BUMPER FASCIA LOWER
17 DEFLECTOR. RADIATOR AIR LOWER
40 BOLT/SCREW, RADIATOR AIR LOWER DEFLECTOR

Figure 4 – Radiator Air Lower Deflector

7. Panel bracket bolts/screws (47) and panel brackets (23), if necessary (Pontiac only).
8. Upper bracket bolts/screws (50) and upper bracket assembly (21), if necessary.

Install or Connect

NOTICE: See "Notice" on page 10-5-1 of this section.

1. Panel support assemblies (22) and panel support bolts/screws (49), if removed.

Tighten

- Panel support bolts/screws (49) to 10 N•m (89 lb. in.).

2. Panel bracket (23) and panel bracket bolts/screws (47), if removed (Pontiac only).

Tighten

- Panel bracket bolts/screws (47) to 5.5 N•m (49 lb. in.).

3. Upper bracket assemblies (21) and upper bracket bolts/screws (50), if removed.

Tighten

- Upper bracket bolts/screws (50) to 10 N•m (89 lb. in.).

4. Headlamp housing panel assembly (24).
5. Electrical connectors.
6. Bolts/screws (44) to headlamp housing panel assembly (24).

Tighten

- Bolts/screws (44) to 8 N•m (71 lb. in.).

7. Panel bracket bolts/screws (48) to panel brackets (23) and pivot support brackets (Pontiac only).

Tighten

- Panel bracket bolts/screws (48) to 1.7 N•m (15 lb. in.).

8. Front bumper fascia. Refer to SECTION 10-4.

FRONT FENDER ASSEMBLY

Front Wheelhouse Panel Liner

Figure 7

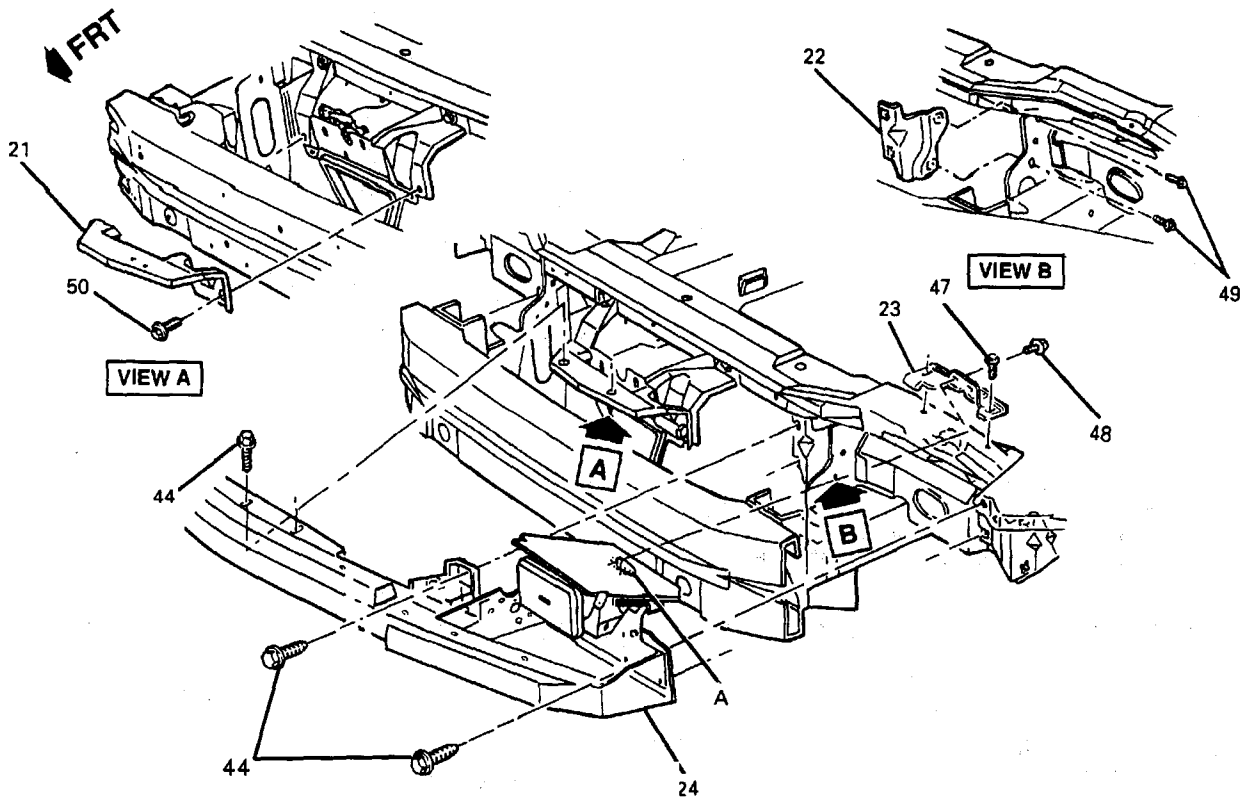
Remove or Disconnect

1. Front wheelhouse bolt/screw caps (53).
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Front tire and wheel assembly. Refer to SECTION 3E.
4. Bolts/screws (54) from wheelhouse panel liner (15) and lower deflector (16).
5. Bolts/screws (55) from wheelhouse panel liner (15).
6. Retainers (56).
7. Wheelhouse panel liner (15).

Install or Connect

NOTICE: See "Notice" on page 10-5-1 of this section.

1. Wheelhouse panel liner (15).



A BRACKET, PIVOT SUPPORT
21 BRACKET, HEADLAMP HOUSING PANEL UPPER
22 SUPPORT, HEADLAMP HOUSING PANEL
23 BRACKET, HEADLAMP HOUSING PANEL
24 PANEL, HEADLAMP HOUSING
44 BOLT/SCREW, HEADLAMP HOUSING PANEL
47 BOLT/SCREW, HEADLAMP HOUSING PANEL BRACKET
48 BOLT/SCREW, HEADLAMP HOUSING PANEL BRACKET
49 BOLT/SCREW, HEADLAMP HOUSING PANEL SUPPORT
50 BOLT/SCREW, HEADLAMP HOUSING PANEL UPPER BRACKET

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Figure 5 – Headlamp Housing Panel Assembly and Brackets – (Pontiac)

2. Retainers (56).
3. Bolts/screws (55) to wheelhouse panel liner (15).

Tighten

- Bolts/screws (55) to 1.3 N•m (12 lb. in.).

4. Bolts/screws (54) to wheelhouse panel liner (15) and lower deflector (16).

Tighten

- Bolts/screws (54) to 10 N•m (89 lb. in.).

5. Front tire and wheel assembly. Refer to SECTION 3E.
6. Lower vehicle.

Front Fender Assembly and Brackets

Figures 8 and 9

NOTICE: Tape front fender assembly and door edges to prevent vehicle damage during front fender assembly removal and installation.

Remove or Disconnect

1. Front fender bolts/screws (60).
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Front wheelhouse panel liner enough to gain access to front fender bolt/screw (63). Refer to "Front Wheelhouse Panel Liner" in this section.
4. Front fender bolts/screws (62 and 63).

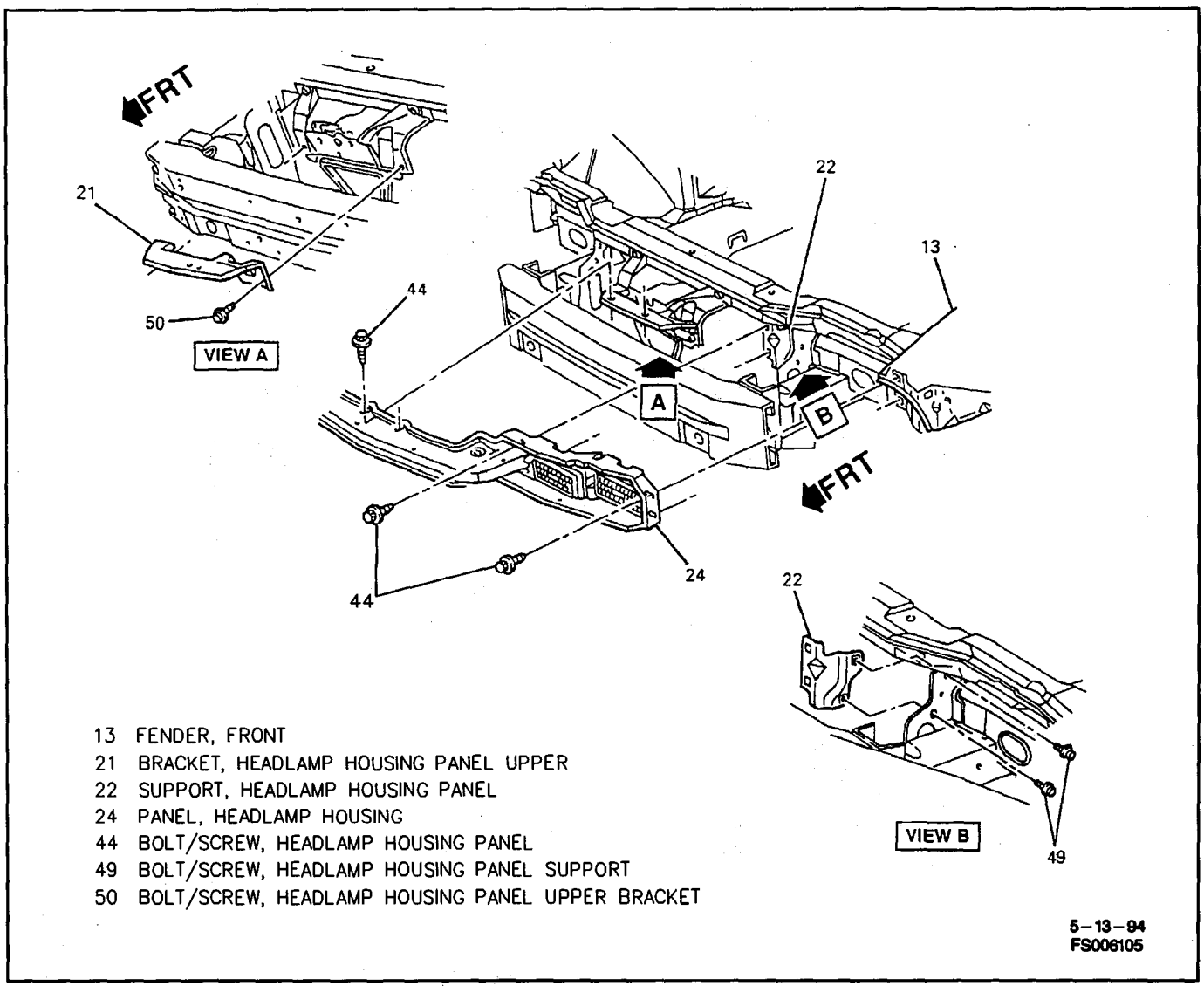


Figure 6 – Headlamp Housing Panel Assembly and Brackets – (Chevrolet)

5. Front fender assembly (13).
6. Outer bracket bolts/screws (64) and fascia outer bracket assembly (18), if necessary.
7. Rear upper bracket bolts/screws (65) and rear upper bracket (11), if necessary.
8. Rear center bracket bolts/screws (66) and rear center bracket (12), if necessary.

Install or Connect

NOTICE: See "Notice" on page 10-5-1 of this section.

1. Rear center bracket (12) and rear center bracket bolts/screws (66), if removed.

Tighten

- Rear center bracket bolts/screws (66) to 5.5 N•m (49 lb. in.).

2. Rear upper bracket (11) and rear upper bracket bolts/screws (65).

Tighten

- Rear upper bracket bolts/screws (65) to 5.5 N•m (49 lb. in.).

3. Outer bracket assembly (18) and outer bracket bolts/screws (64), if removed.

Tighten

- Outer bracket bolts/screws (64) to 5.5 N•m (49 lb. in.).

4. Front fender assembly (13).
5. Front fender bolts/screws (62 and 63).

Tighten

- Front fender bolts/screws (62 and 63) to 5.5 N•m (49 lb. in.).

6. Front wheelhouse panel liner. Refer to "Front Wheelhouse Panel Liner" in this section.

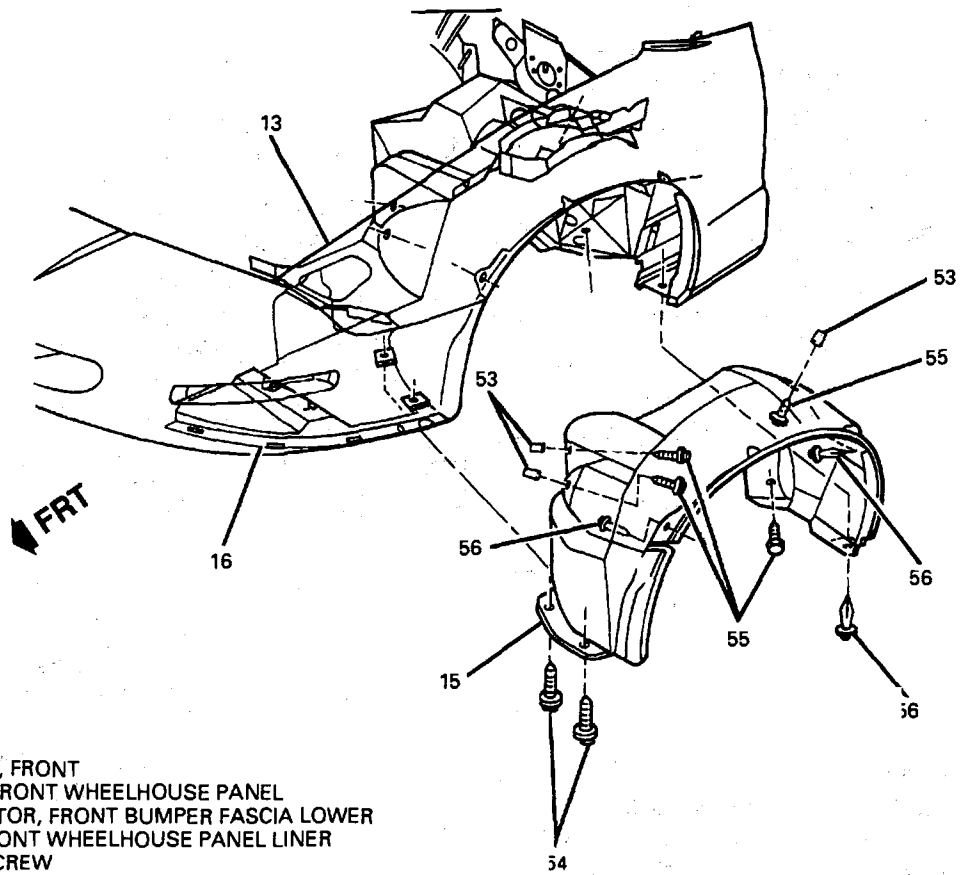


Figure 7 – Front Wheelhouse Panel Liner (Typical)

7. Lower vehicle.
8. Front fender bolts/screws (60).

Tighten

- Front fender bolts/screws (60) to 5.5 N•m (49 lb. in.).

Front Fender Emblem Assembly

Chevrolet

Figure 10

Tool Required:

J 25070 Heat Gun

Remove or Disconnect

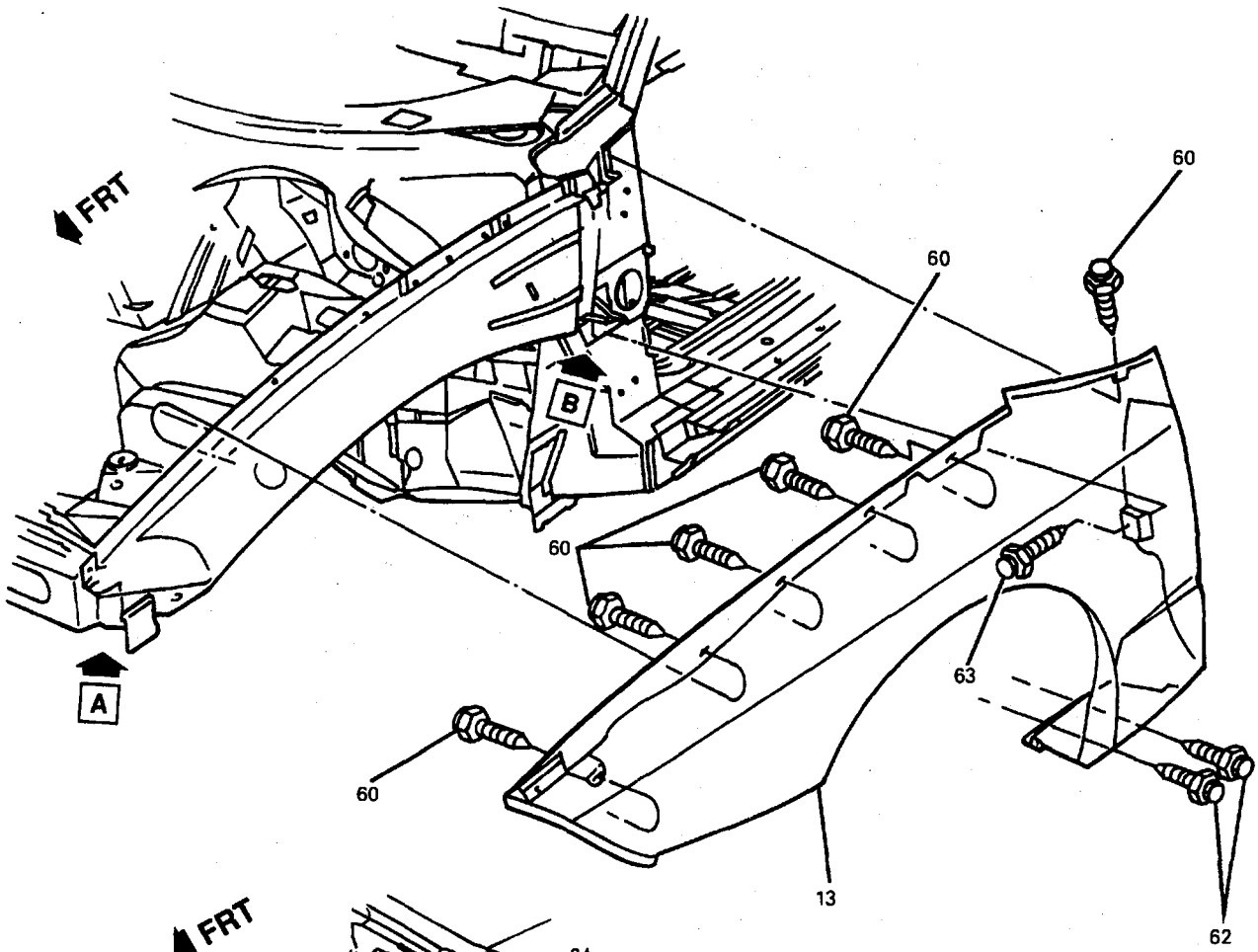
- Emblem assembly (223)
  - A. Hold J 25070 at least 152 mm (6 inches) from emblem assembly (223).
  - B. Pull emblem assembly (223) from front fender assembly (13) with flat-bladed tool, making sure not to damage paint.

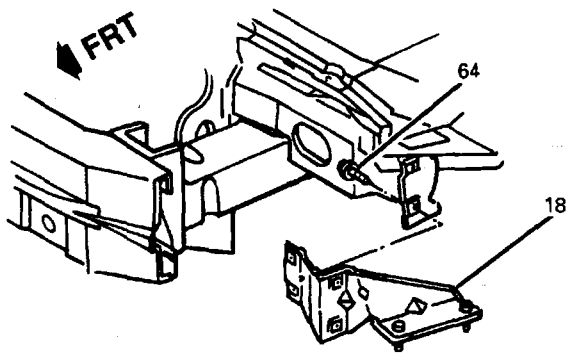
Clean

1. Area with suitable solution of isopropyl alcohol 50/50 mixture by volume with water or high-flash naphtha.
2. Area with clean dry cloth.

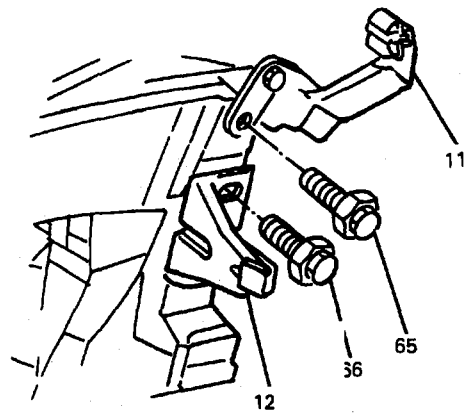
Install or Connect

- New emblem assembly (223).
  - A. Heat fender assembly surface and adhesive side of new emblem assembly (223). Temperature must be 26°C (80°F) or 6°C (10°F) above air temperature in area, whichever is higher, but not exceeding 40°C (105°F).
  - B. Remove liner from adhesive strip.





VIEW A

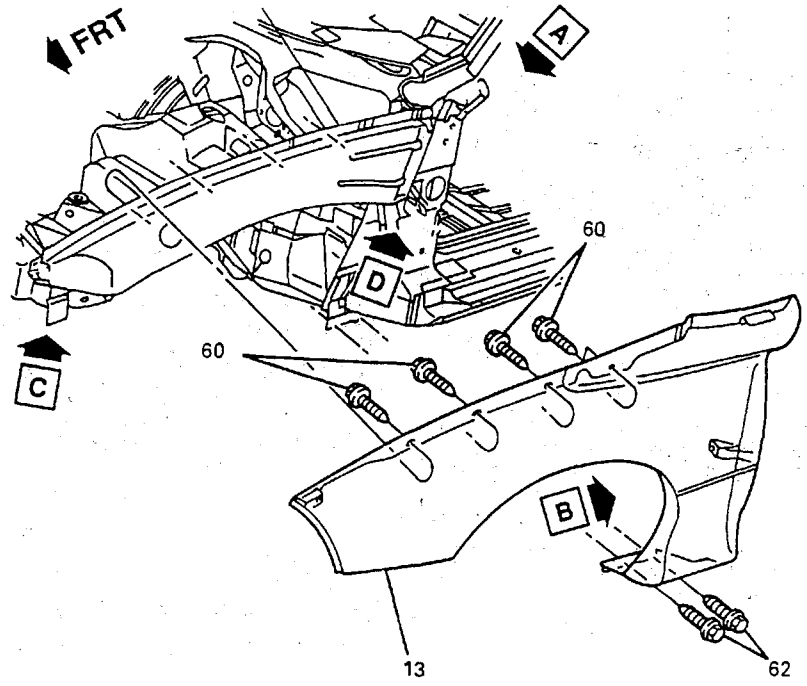


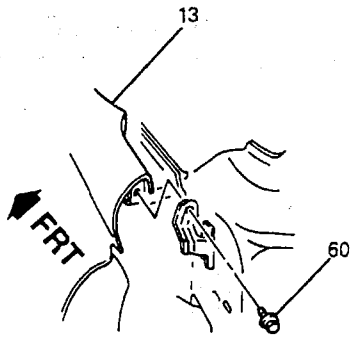
VIEW B

11 BRACKET, FRONT FENDER REAR UPPER
12 BRACKET, FRONT FENDER REAR CENTER
13 FENDER, FRONT
18 BRACKET, FRONT BUMPER FASCIA OUTER
60 BOLT/SCREW, FRONT FENDER
62 BOLT/SCREW, FRONT FENDER
63 BOLT/SCREW, FRONT FENDER
64 BOLT/SCREW, FRONT BUMPER FASCIA OUTER BRACKET
65 BOLT/SCREW, FRONT FENDER REAR UPPER BRACKET
66 BOLT/SCREW, FRONT FENDER REAR CENTER BRACKET

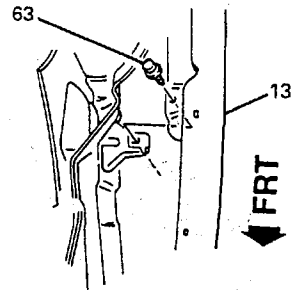
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Figure 8 – Front Fender Assembly and Brackets – (Pontiac)

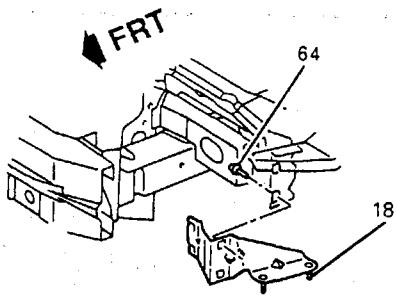




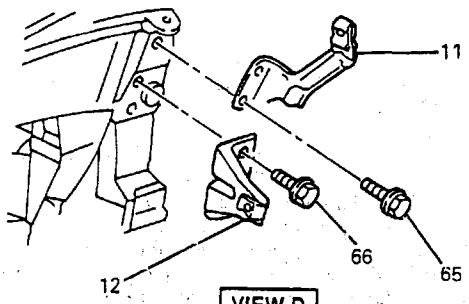
VIEW A



VIEW B



VIEW C

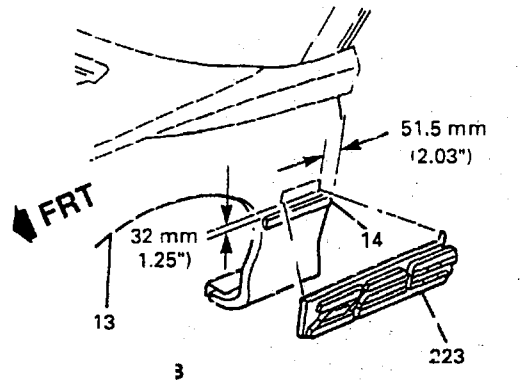


VIEW D

11 BRACKET, FRONT FENDER REAR UPPER
12 BRACKET, FRONT FENDER REAR CENTER
13 FENDER, FRONT
18 BRACKET, FRONT BUMPER FASCIA OUTER
60 BOLT/SCREW, FRONT FENDER
62 BOLT/SCREW, FRONT FENDER
63 BOLT/SCREW, FRONT FENDER
64 BOLT/SCREW, FRONT BUMPER FASCIA OUTER BRACKET
65 BOLT/SCREW, FRONT FENDER REAR UPPER BRACKET
66 BOLT/SCREW, FRONT FENDER REAR CENTER BRACKET

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Figure 9 – Front Fender Assembly and Brackets – (Chevrolet)



13 FENDER, FRONT
14 MOLDING, FRONT FENDER CENTER REAR
223 EMBLEM, FRONT FENDER

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Figure 10 – Front Fender Emblem Assemblies – (Chevrolet)

Important

- Position emblem assembly (223) carefully. Emblem assembly (223) cannot be removed without reapplying adhesive after contact with vehicle.

C. Press emblem assembly (223) into place and apply pressure.

HOOD PANEL ASSEMBLY

Figures 11 and 12

NOTICE: Raise hood panel assembly and install protective coverings over fender assembly areas to prevent damage to paint and moldings when removing or installing the hood panel assembly.

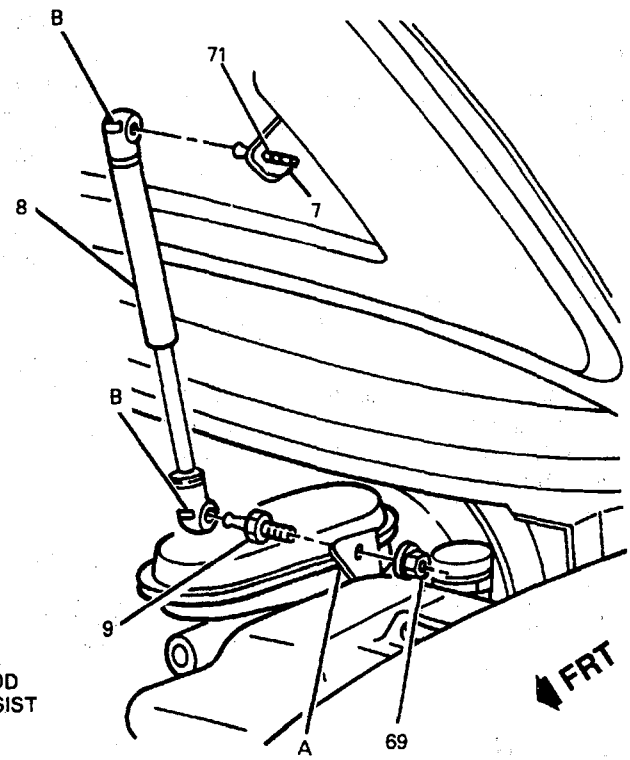
Remove or Disconnect

1. With aid of a helper, support hood panel assembly (1).
2. Rod assembly (8) from strut stud (71).
3. Hood hinge bolts/screws (72) and nuts (73), from hood hinges (3).
4. Hood panel assembly (1).

Install or Connect

NOTICE: See "Notice" on page 10-5-1 of this section.

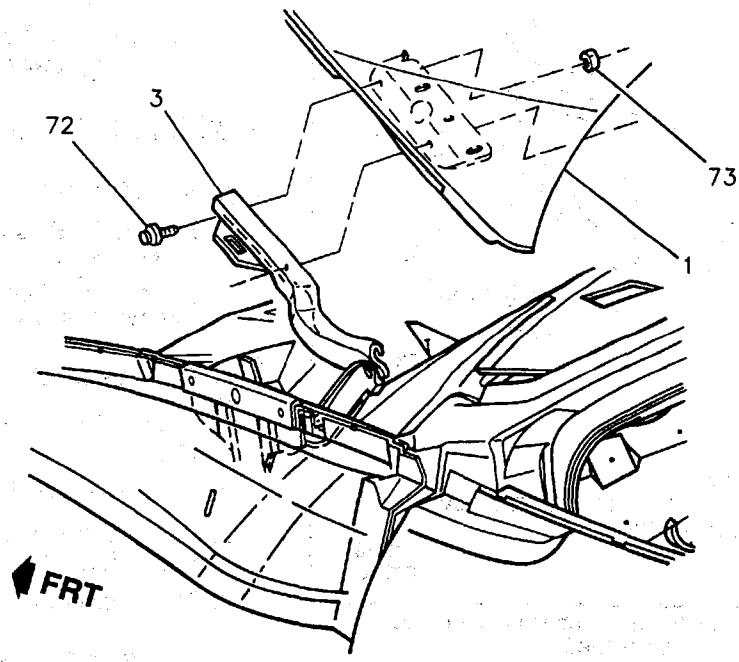
1. Hood panel assembly (1), with aid of a helper.
2. Hood hinge bolts/screws (72) and nuts (73).



A BRACKET, WHEELHOUSE
B CLIP
7 BRACKET, HOOD OPEN ASSIST ROD
8 ROD ASSEMBLY, HOOD OPEN ASSIST
9 STUD, HOOD STRUT BALL
69 NUT, HOOD STRUT
71 STUD, HOOD STRUT

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Figure 11 – Hood Open Assist Rod Assembly (Typical)



1 PANEL, HOOD
3 HINGE, HOOD
72 BOLT/SCREW, HOOD BODY SIDE HINGE
73 NUT, HOOD HINGE BRACKET

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Figure 12 – Hood Panel Assembly (Typical)

Tighten

- Hood hinge bolts/screws (72) or nuts (73) to 27 N•m (20 lb. ft.).

3. Rod assembly (8) to strut stud (71).

Inspect

1. Close hood panel assembly (1) slowly, checking clearance between hood panel assembly (1) and front fender assemblies (13) and headlamp opening doors.
2. With hood panel assembly (1) closed, check alignment of hood panel assembly (1). For hood assembly alignment specifications, refer to "Body Panel Adjustment and Alignment" in this section.

Adjust

- Hood panel assembly, if necessary. Refer to "Hood Panel Assembly Adjustment" in this section.

Hood Insulator

Figures 1 through 3 and 13

Remove or Disconnect

1. Raise hood panel assembly (1) to full-open position.
2. Retainers (74) from hood panel assembly (1) and hood insulator (34).
3. Hood insulator (34).

Install or Connect

NOTICE: See "Notice" on page 10-5-1 of this section.

1. Hood insulator (34).
2. Retainers (74) to hood panel assembly (1 or 201) and hood insulator (34).
   - Start installing retainers (74) at front of hood insulator (34) and work rearward.
3. Close hood panel assembly (1).

Hood Closeout Filler

Pontiac

Figure 14

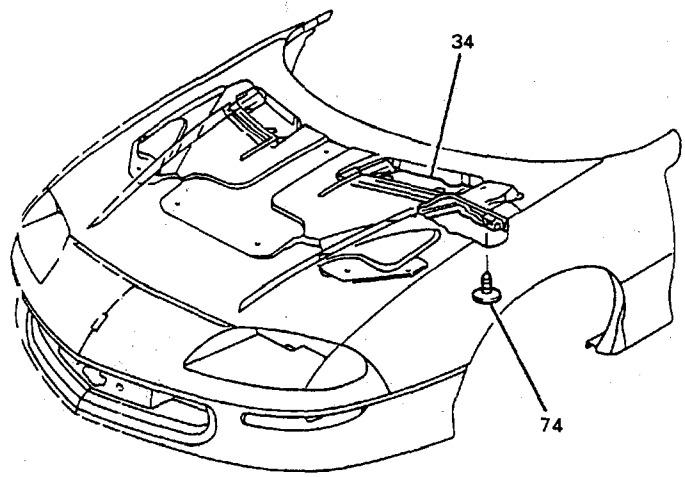
Remove or Disconnect

1. Retainers (79).
2. Hood closeout filler (19).

Install or Connect

NOTICE: See "Notice" on page 10-5-1 of this section.

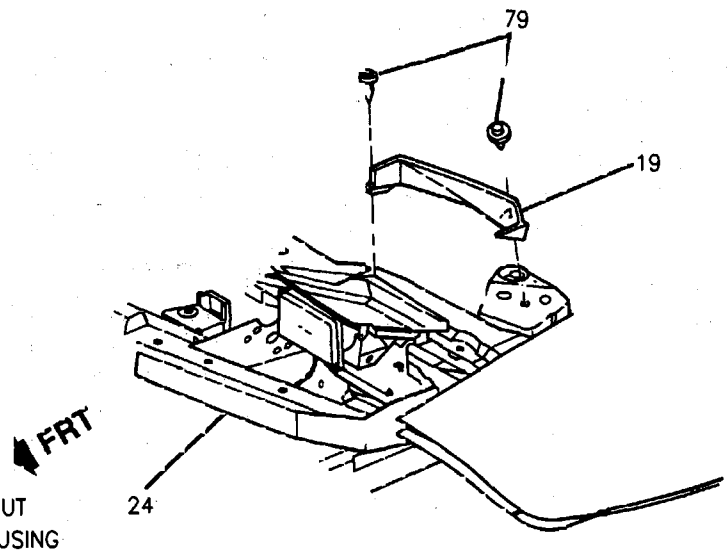
1. Hood closeout filler (19).
2. Retainers (79).



34 INSULATOR, HOOD
74 RETAINER, HOOD INSULATOR

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Figure 13 – Hood Insulator – (Typical)



19 FILLER, HOOD CLOSEOUT
24 PANEL, HEADLAMP HOUSING
79 RETAINER, HOOD CLOSEOUT FILLER

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Figure 14 – Hood Closeout Filler – (Pontiac)

Hood Hinge Cover

Chevrolet

Figure 15

Remove or Disconnect

1. Hood hinge cover retainer (210).
2. Hood hinge cover (204).

Install or Connect

1. Hood hinge cover (204).
2. Hood hinge cover retainer (210).

Hood Hinge Assembly

Figures 12 and 16

NOTICE: Raise hood panel assembly and install protective coverings over the fender assembly areas

to prevent damage to paint when removing or installing hood hinge assemblies.

Remove or Disconnect

1. Safely support hood panel assembly (1) in full open position.
2. Hood hinge bolt/screw (76) and shim (6).
3. Hood hinge bolts/screws (72) and nuts (73).
4. Hood hinge nuts (77) from lower attachment of hood hinge assembly (3).
5. Hood hinge assembly (3).
6. Hood hinge mount plate assembly (5), if necessary.
   A. Remove front wheelhouse panel liner. Refer to "Front Wheelhouse Panel Liner" in this section.
   B. Remove retainers (78).
      - Use a flat-bladed tool to pry off retainers (78) from plate assembly studs.
   C. Remove hood hinge mount plate assembly (5).

Install or Connect

NOTICE: See "Notice" on page 10-5-1 of this section.

1. Hood hinge mount plate assembly (5), if removed.
   A. Install retainers (78).
      - Hold hood hinge plate assembly (5) in position and press retainers (78) over plate assembly studs.
   B. Install front wheelhouse panel liner. Refer to "Front Wheelhouse Panel Liner" in this section.
2. Hood hinge assembly (3).
3. Hood hinge nuts (77) to lower attachment of hood hinge assembly (3).

Tighten

- Nuts (77) to 25 N•m (18 lb. ft.).

4. Hood body side hinge bolts/screws (72) and nuts (73).

Tighten

- Bolts/screws (72) to 27 N•m (20 lb. ft.).
- Nuts (73) to 25 N•m (18 lb. ft.).

5. Shim (6) and bolt/screw (76) to lower attachment of hood hinge assembly (3).

Tighten

- Bolt/screw (76) to 10 N•m (89 lb. in.).

6. Hood support from hood panel assembly (1).

Inspect

- Hood panel assembly (1) for alignment. Refer to "Hood Panel Assembly Adjustment" in this section.

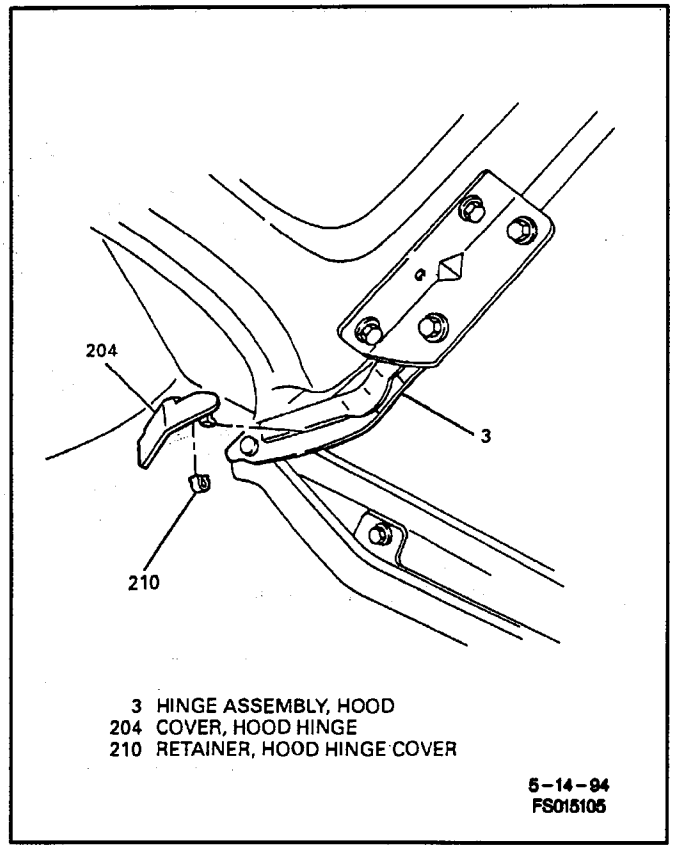


Figure 15 – Hood Hinge Cover – (Chevrolet)

Hood Primary Latch Assembly

Figures 17 and 18

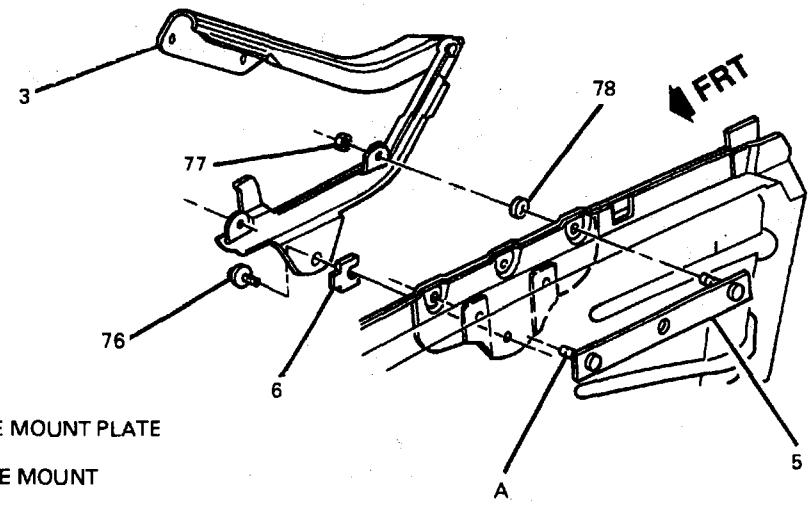
Remove or Disconnect

1. Mark position of hood primary latch bolts/screws (82) on latch support assembly (26).
2. Hood primary latch bolts/screws (82).
3. Hood latch release cable assembly (20) from hood primary latch assembly (27).
   - Insert screwdriver into latch clip and lift hood latch release cable assembly (20) from hood primary latch assembly (27).
4. Latch support assembly (26), if necessary.
   A. Mark location of hood primary latch assembly (27) on upper radiator support.
   B. Remove headlamp housing panel assembly and headlamp housing panel upper bracket assembly. Refer to "Headlamp Housing Panel Assembly and Brackets" in this section.
   C. Remove windshield washer solvent container assembly. Refer to SECTION 8E.
   D. Latch support bolts/screws (83) and latch support assembly (26).

Install or Connect

NOTICE: See "Notice" on page 10-5-1 of this section.

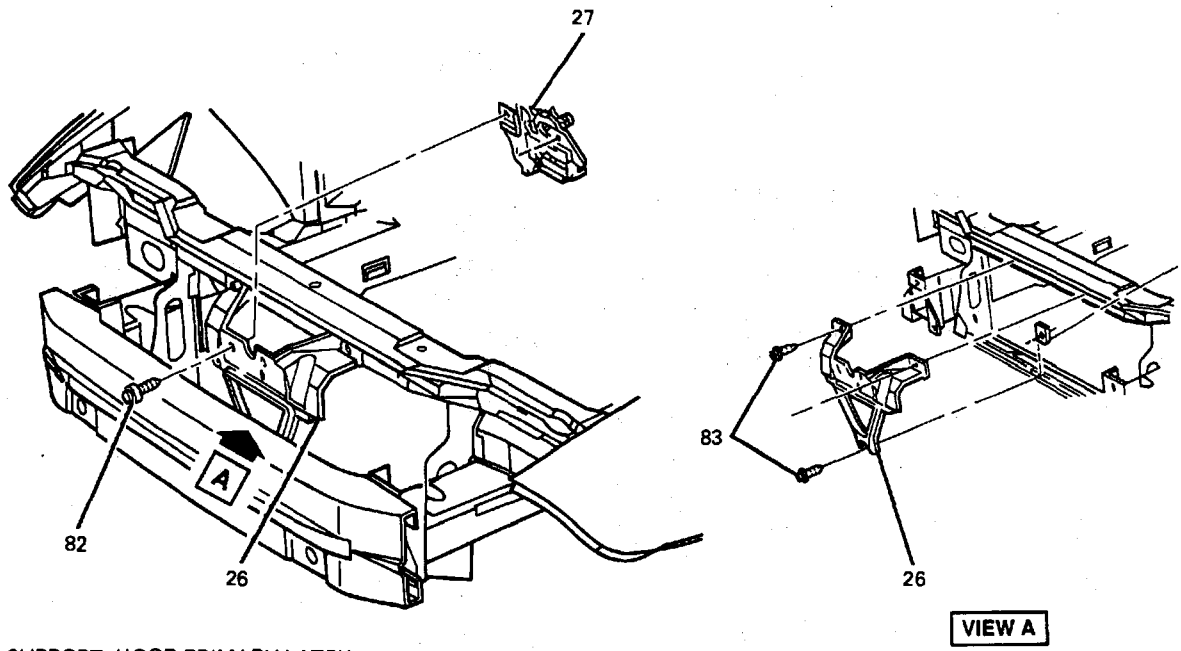
1. Latch support assembly (26), if removed.



4 STUD, HOOD HINGE MOUNT PLATE
3 HINGE, HOOD
5 PLATE, HOOD HINGE MOUNT
6 SHIM, HOOD HINGE
76 BOLT/SCREW, HOOD HINGE
77 NUT, HOOD HINGE
78 RETAINER, HOOD HINGE MOUNT PLATE

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Figure 16 – Hood Hinge Assembly



26 SUPPORT, HOOD PRIMARY LATCH
27 LATCH, HOOD PRIMARY
82 BOLT/SCREW, HOOD PRIMARY LATCH
83 BOLT/SCREW, HOOD PRIMARY LATCH SUPPORT

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Figure 17 – Hood Primary Latch Assembly

A. Position latch support assembly (26) with marks made during removal.

B. Install latch support assembly (26) and latch support bolts/screws (83), if removed.

Tighten

- Latch support bolts/screws (83) to 18 N•m (13 lb. ft.).

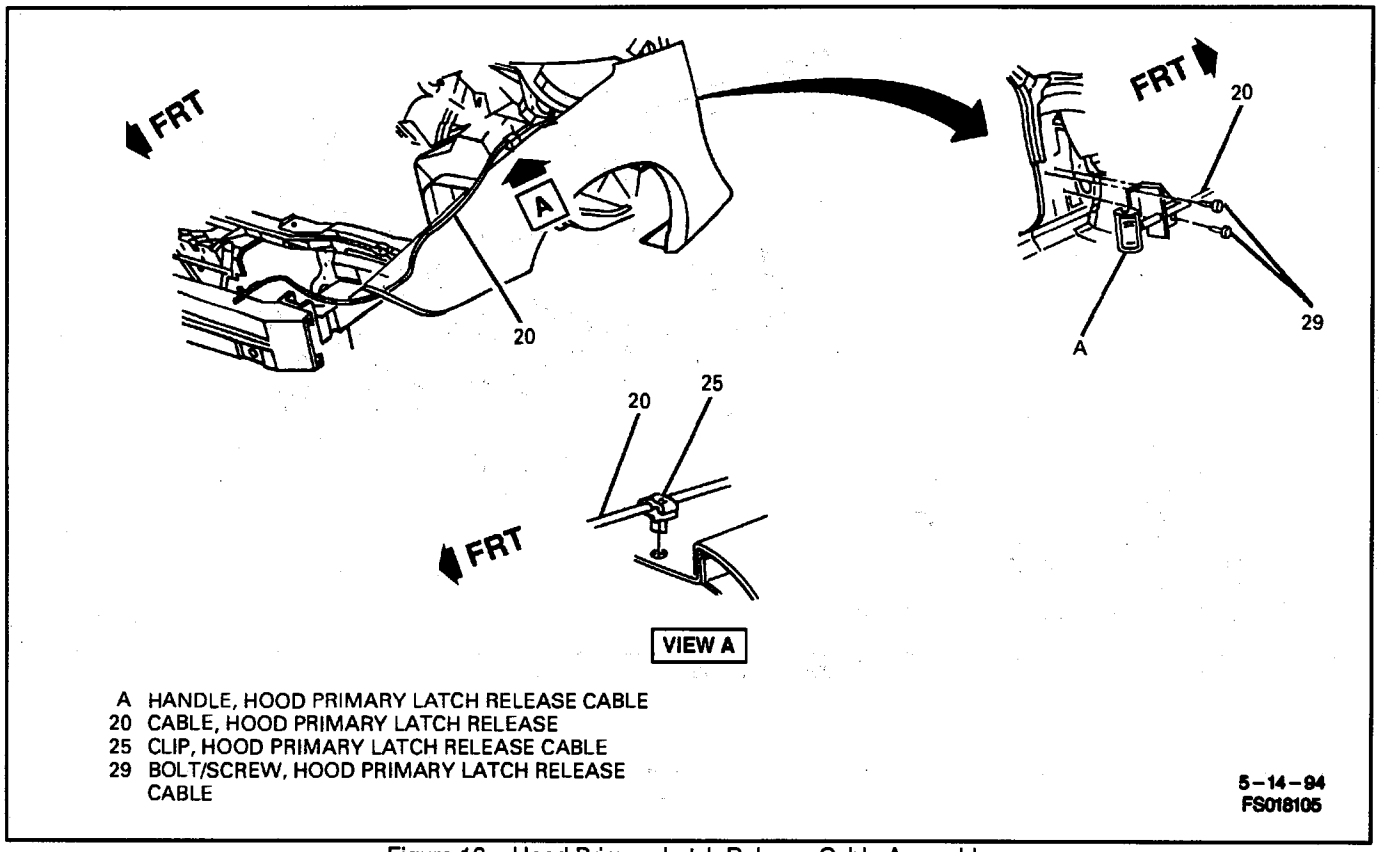


Figure 18 – Hood Primary Latch Release Cable Assembly

C. Install windshield washer solvent container assembly. Refer to SECTION 8E.

D. Install headlamp housing panel assembly and headlamp housing panel upper bracket assembly. Refer to "Headlamp Housing Panel Assembly and Brackets" in this section.

2. Hood latch release cable assembly (20) to hood primary latch assembly (27).

   A. Connect hood latch release cable assembly (20) by inserting end of hood latch release cable assembly (20) to hood primary latch assembly (27).

   B. Connect latch clip to hood primary latch assembly (27).

3. Hood primary latch assembly (27) to latch support assembly (26).

4. Hood primary latch bolts/screws (82).

   - Position hood primary latch assembly (27) so that hood primary latch bolts/screws (82) line up with marks on latch support assembly (26).

Tighten

- Hood primary latch bolts/screws (82) to 18 N•m (13 lb. ft.).

Inspect

- Hood panel assembly alignment. Refer to "Hood Panel Assembly Adjustment" in this section.

Adjust

- Hood primary latch assembly (27), if necessary.
  A. Loosen hood primary latch bolts/screws (82).
  B. Adjust hood primary latch assembly (27) up or down to specifications noted during inspection.

Hood Secondary Latch Assembly

Figure 19

Remove or Disconnect

1. Hood secondary latch bolts/screws (81).
2. Hood secondary latch assembly (32) from hood panel assembly (1).

Install or Connect

NOTICE: See "Notice" on page 10-5-1 of this section.

1. Hood secondary latch assembly (32) to hood panel assembly (1).
2. Hood secondary latch bolts/screws (81).

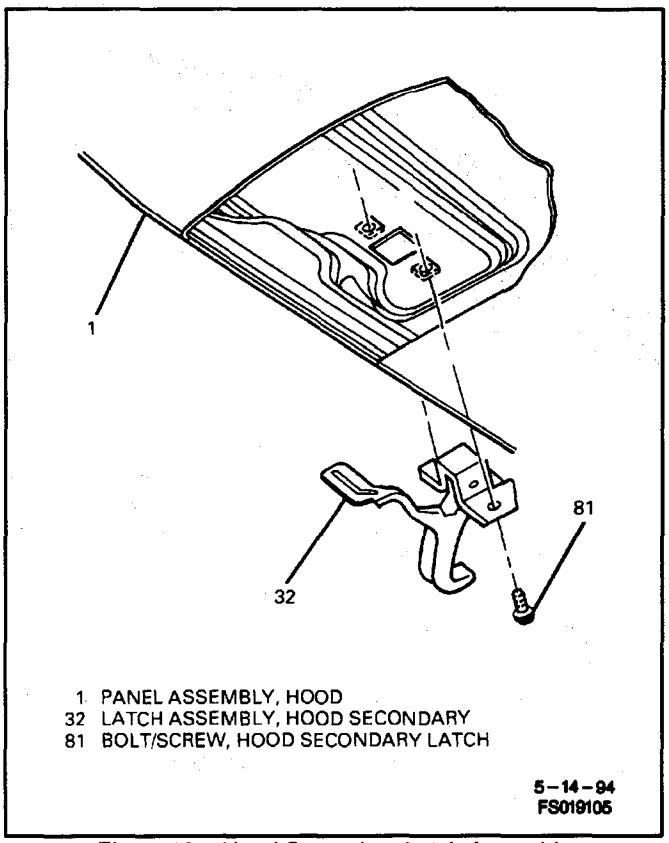


Figure 19 – Hood Secondary Latch Assembly

Tighten

- Hood secondary latch bolts/screws (81) to 12 N•m (106 lb. in.).

Hood Primary Latch Release Cable Assembly

Figures 17 and 18

Remove or Disconnect

1. Hood primary latch release cable assembly (20) from primary latch assembly (27) and radiator support.
   A. Disconnect cable assembly (20) by inserting a screwdriver into latch clip and lifting cable assembly (20) from primary latch assembly (27).
   B. Pry cable grommet from primary latch assembly (27).
   C. Pull primary latch release cable assembly (20) out through hole in radiator support.
2. Driver side body hinge pillar trim panel. Refer to "Body Hinge Pillar Trim Panel" in this section.
3. Hood primary latch release cable bolts/screws (29) and hood primary latch release cable handle.
4. Cowl grommet by prying with a screwdriver.
5. Hood primary latch release cable assembly (20).

- Note where hood primary latch release cable assembly (20) is routed before removing so it can be installed correctly.

Install or Connect

NOTICE: See "Notice" on page 10-5-1 of this section.

1. Hood primary latch release cable assembly (20) through cowl.
   - Route hood primary latch release cable assembly (20) where previously noted.
2. Cowl grommet.
3. Hood primary latch release cable handle and hood primary latch release cable bolts/screws (29).

Tighten

- Hood primary latch release cable bolts/screws (29) to 7 N•m (62 lb. in.).

4. Driver side body hinge pillar trim panel. Refer to "Body Hinge Pillar Trim Panel" in this section.
5. Hood primary latch release cable assembly (20) to primary latch assembly (27).
   A. Connect hood primary latch release cable assembly (20) to cable clip.
   B. Route hood primary latch release cable assembly (20) through hole in radiator support.
   C. Insert end of hood primary latch release cable assembly (20) into latch clip and attach cable grommet.

Hood Open Assist Rod Assembly

Figure 11

If both rod assemblies are being replaced, replace only one at a time.

CAUTION: Hood open assist rod assemblies hold the hood assembly in the up position. Insure the hood assembly is safely supported when hood open assist rod assemblies are removed or installed to avoid the possibility of damage to the vehicle or personal injury.

Remove or Disconnect

1. Safely support hood panel assembly (1) in the full open position.
2. Hood open assist rod assembly (8) from hood strut stud (71).
   - Use a small flat-bladed tool to pry clip out while pulling assist rod assembly (8) from hood strut stud (71).
3. Hood open assist rod assembly (8) from hood strut ball stud (9).
   - Use a small flat-bladed tool to pry clip out while pulling assist rod assembly (8) away from hood strut ball stud (9).

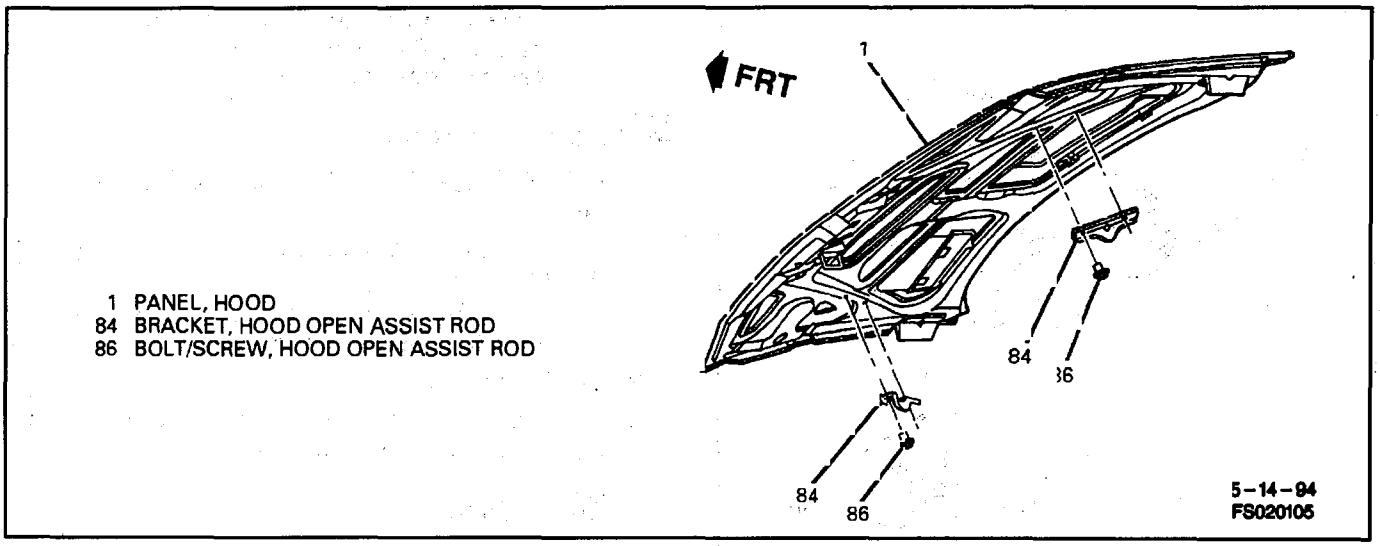


Figure 20 – Hood Open Assist Rod Bracket Assembly (Typical)

Install or Connect

NOTICE: See "Notice" on page 10-5-1 of this section.

1. Hood open assist rod assembly (8) to hood strut ball stud (9).
   - Snap rod assembly (8) to ball stud (9).
2. Hood open assist rod assembly (8) to hood strut stud (71).
   - Snap rod assembly (8) onto strut stud (71).
3. Remove hood support.

Hood Open Assist Rod Bracket Assembly

Figure 20

Remove or Disconnect

CAUTION: Hood open assist rod assemblies hold the hood assembly in the up position. Insure the hood assembly is safely supported when hood open assist rod assemblies are removed or installed to avoid the possibility of damage to the vehicle or personal injury.

1. Safely support hood panel assembly (1) in full open position.
2. Upper hood open assist rod attachment.
3. Hood open assist rod bracket bolts/screws (86).
4. Hood open assist rod bracket assembly (84).

Install or Connect

NOTICE: See "Notice" on page 10-5-1 of this section.

1. Hood open assist rod bracket assembly (84).
2. Hood open assist rod bracket bolts/screws (86).

Tighten

- Hood open assist rod bracket bolts/screws (86) to 23 N•m (17 lb. ft.).

3. Upper hood open assist rod attachment.
4. Remove hood support.

Hood Rear Seal Assembly

Figure 21

Remove or Disconnect

1. Hood rear seal assembly fasteners.
2. Hood rear seal assembly (35).

Install or Connect

1. Hood rear seal assembly (35).
2. Hood rear seal assembly fasteners.

Hood Adjust Front Bumper

Figure 22

To aid in adjustment, measure hood adjust front bumper height and record before removing.

Remove or Disconnect

- Hood adjust front bumper (30).
  - Rotate counterclockwise.

Install or Connect

1. Hood adjust front bumper (30).
   - Rotate clockwise until hood adjust front bumper (30) is at the same height as measured before removal.
2. Check hood panel assembly alignment. Refer to "Hood Panel Assembly Adjustment" in this section.

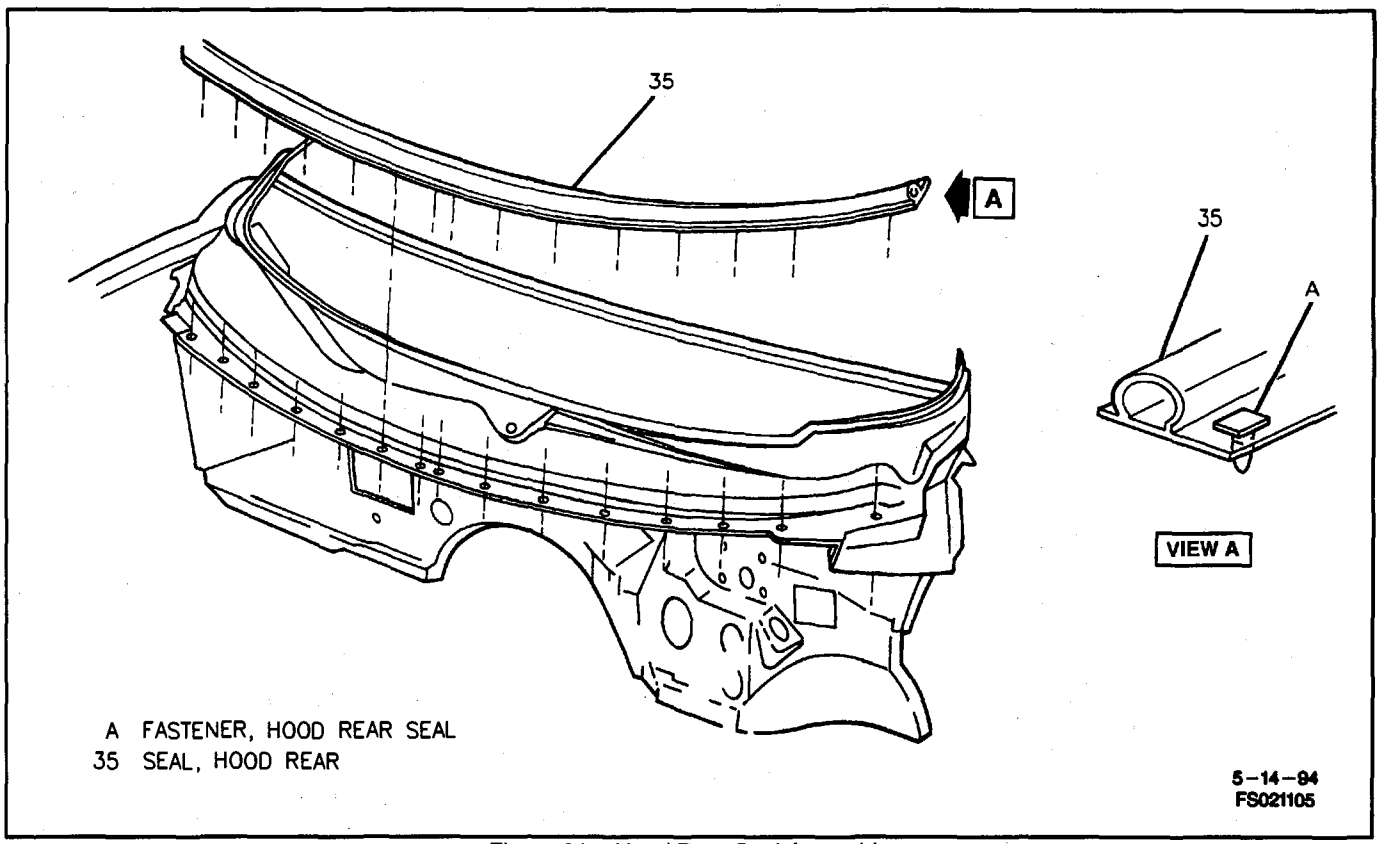


Figure 21 – Hood Rear Seal Assembly

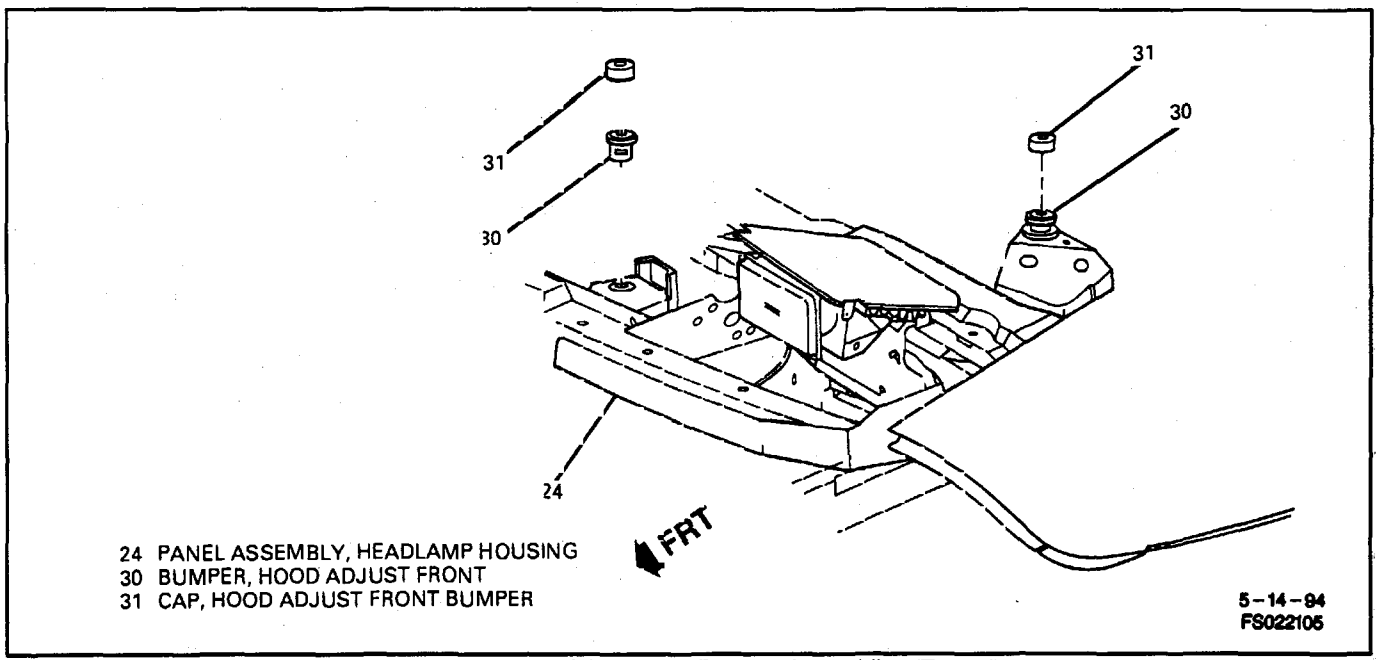


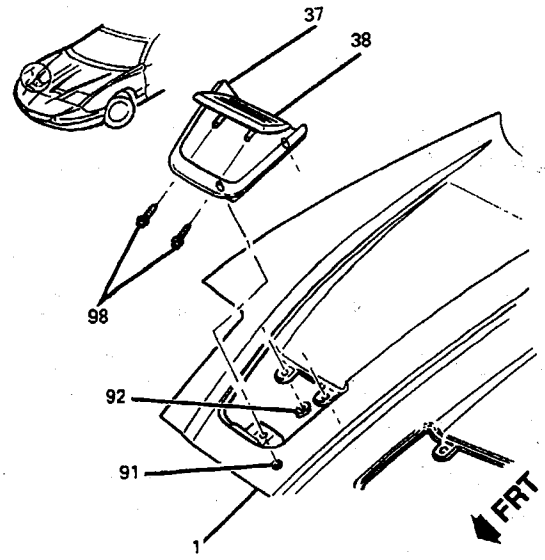
Figure 22 – Hood Adjust Front Bumper Assemblies (Typical)

Hood Air Extractors

Figures 23 and 24

Remove or Disconnect

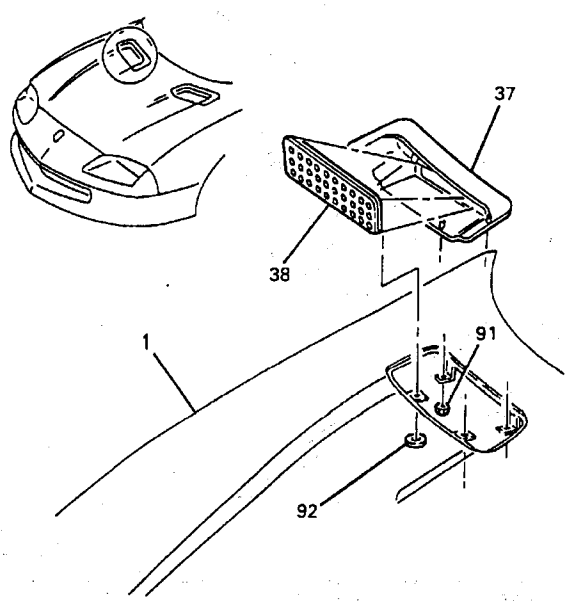
1. Hood insulator front attachments.
2. Hood air extractor push-on nut (92).
3. Hood air extractor nuts (91).
4. Hood air extractor (37).
5. Hood air extractor screen bolts/screws (98) (Pontiac only).



1 PANEL, HOOD
37 EXTRACTOR, HOOD AIR
38 SCREEN, HOOD AIR EXTRACTOR
91 NUT, HOOD AIR EXTRACTOR
92 NUT, HOOD AIR EXTRACTOR (PUSH-ON)
98 BOLT/SCREW, HOOD AIR EXTRACTOR SCREEN

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Figure 23 – Hood Air Extractor – (Pontiac)



1 PANEL, HOOD
37 EXTRACTOR, HOOD AIR
38 SCREEN, HOOD AIR EXTRACTOR
91 NUT, HOOD AIR EXTRACTOR
92 NUT, HOOD AIR EXTRACTOR (PUSH-ON)

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Figure 24 – Hood Air Extractor – (Chevrolet)

6. Hood air extractor screen (38).

Install or Connect

NOTICE: See "Notice" on page 10-5-1 of this section.

1. Hood air extractor screen (38) to hood air extractor (37).
2. Hood air extractor screen bolts/screws (98) (Pontiac only).

Tighten

- Hood air extractor screen bolts/screws (98) to 1.7 N•m (15 lb. in.)

3. Hood air extractor (37) to hood panel assembly.
4. Hood air extractor nuts (91).

Tighten

- Hood air extractor nuts (91) to 3 N•m (27 lb. in.).

5. Hood air extractor push-on nut (92).
6. Hood insulator front attachments.

PLENUM CHAMBER

Air enters the front plenum chamber through air inlet screen assemblies. The air is drawn through the plenum chamber to the heater and air conditioning evaporator module assembly by the blower motor assembly. Air is distributed in the vehicle through the air distribution system. For air distribution information, refer to SECTION 1A or 1B1. Water entering the plenum chamber is drained through openings provided for that purpose.

FRONT END SEALING

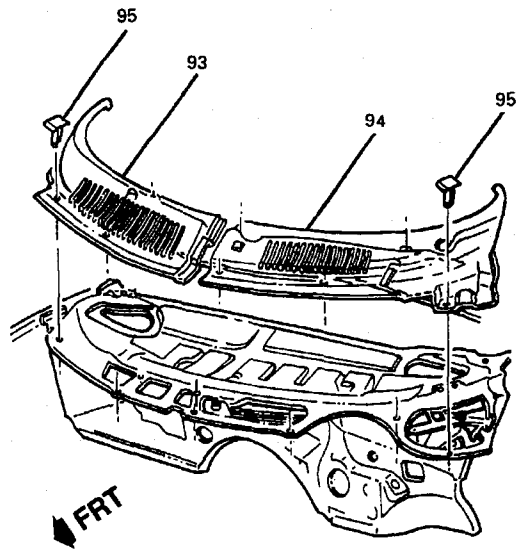
All potential waterleak locations are sealed in production with high quality durable sealers. To reseal specific areas, a high quality medium-bodied sealer that will remain flexible after curing and can be painted should be used. Refer to SECTION 10-1.

AIR INLET SCREEN ASSEMBLIES

Figure 25

Remove or Disconnect

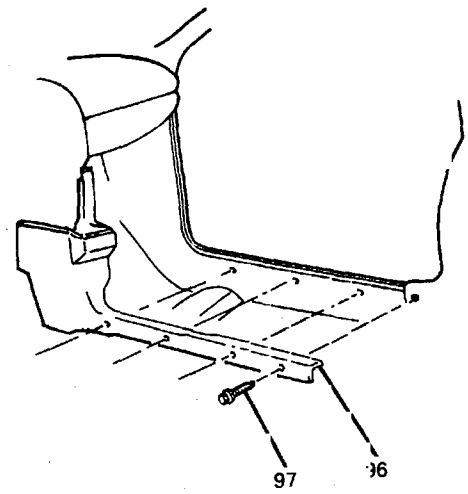
1. Hood rear seal assembly. Refer to "Hood Rear Seal Assembly" in this section.
2. Retainers (95) from driver side screen assembly.
3. Windshield wiper arm assemblies. Refer to SECTION 8E.
4. Driver side screen assembly (94).
5. Windshield washer nozzle hose clips to driver side screen assembly (94).
6. Retainers (95) from passenger side screen assemblies (93).
7. Passenger side screen assemblies (93).
8. Windshield washer nozzle hose clips from passenger side screen assembly (93).



93 SCREEN ASSEMBLY, AIR INLET (PASSENGER SIDE)
94 SCREEN ASSEMBLY, AIR INLET (DRIVER SIDE)
95 RETAINER, AIR INLET SCREEN

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Figure 25 – Air Inlet Screen Assemblies



96 PANEL ASSEMBLY, BODY HINGE PILLAR TRIM
97 BOLT/SCREW, BODY HINGE PILLAR TRIM PANEL

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Figure 26 – Body Hinge Pillar Trim Panel Assembly (Right Side Shown, Left Side Similar) (Typical)

Install or Connect

NOTICE: See "Notice" on page 10-5-1 of this section.

NOTICE: Install air inlet screen assemblies prior to water testing or the windshield wiper motor could be damaged.

1. Route windshield washer nozzle hose clips to passenger side screen assembly (93).
2. Passenger side screen assembly (93).
3. Retainers (95) to passenger side screen assembly (93).
4. Windshield washer nozzle hose clips to driver side screen assembly (94).
5. Driver side screen assembly (94).
6. Retainers (95) to driver side screen assembly (94).
7. Windshield wiper arm assemblies. Refer to SECTION 8E.
8. Check for proper operation of windshield wiper and washer system.
9. Hood rear seal assembly. Refer to "Hood Rear Seal Assembly" in this section.

BODY HINGE PILLAR TRIM PANEL ASSEMBLY

Figure 26

Remove or Disconnect

1. Bolts/screws (97).
2. Body hinge pillar trim panel assembly (96).
   - Slide upward and rearward.

Install or Connect

1. Body hinge pillar trim panel assembly (96).
   - Slide forward and downward into position.
2. Bolts/screws (97).

Tighten

- Bolts/screws (97) to 1.3 N•m (12 lb. in.).

DASH SOUND BARRIER ASSEMBLY

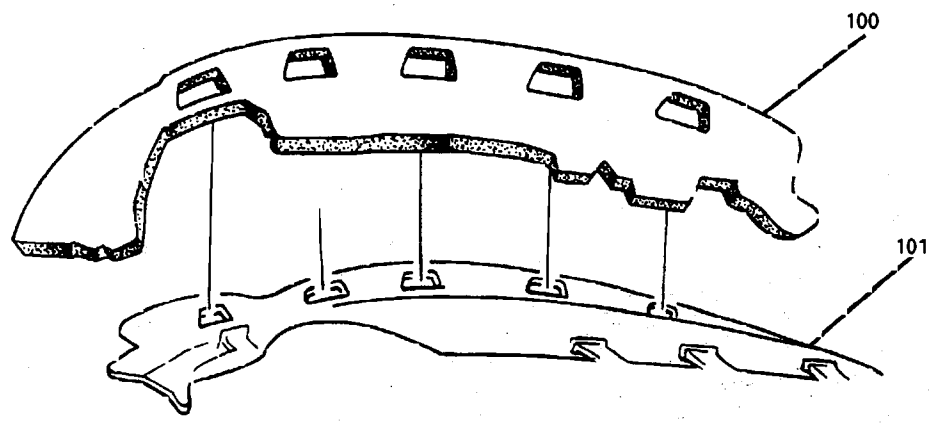
Figure 27

Remove or Disconnect

1. Instrument panel upper trim panel assembly. Refer to SECTION 8C.
2. Dash sound barrier assembly (100).

Install or Connect

1. Dash sound barrier assembly (100).



100 BARRIER ASSEMBLY, DASH SOUND
101 PANEL ASSEMBLY, INSTRUMENT

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Figure 27 – Dash Sound Barrier Assembly (Typical)

2. Instrument panel upper trim panel assembly. Refer to SECTION 8C.

BODY HINGE PILLAR INNER PANEL SOUND BARRIERS

Figure 28

Remove or Disconnect

1. Body hinge pillar trim panel assembly. Refer to "Body Hinge Pillar Trim Panel Assembly" in this section.
2. Body hinge pillar inner panel sound barriers (102, 103 and 104 or 105, 106 and 107).

Install or Connect

1. Paper backing from body hinge pillar inner panel sound barrier (102, 103 and 104 or 105, 106 and 107).
2. Body hinge pillar inner panel sound barriers (102, 103 and 104 or 105, 106 and 107).
3. Body hinge pillar trim panel assembly. Refer to "Body Hinge Pillar Trim Panel Assembly" in this section.

FRONT DOOR JAMB SWITCH ASSEMBLIES

Figure 29

Door jamb switch assemblies (108) consist of a plunger, plunger collar, threaded retainer and terminals. They are installed in the door hinge pillars. When the door of the vehicle is closed, the plunger is depressed, which creates an open in the ground circuit. When the door is opened, the plunger is released and completes the circuit to ground.

When a new door jamb switch assembly (108) is installed and the door is closed the first time, the plunger is forced into the sleeve and automatically adjusts the door jamb switch assembly (108) for that particular door. If a door jamb switch assembly (108) fails, it should not be readjusted by hand. A new door jamb switch assembly (108) should be installed.

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Double or single terminal door jamb switch assembly (108).
3. Electrical connector.
4. Seal (109).

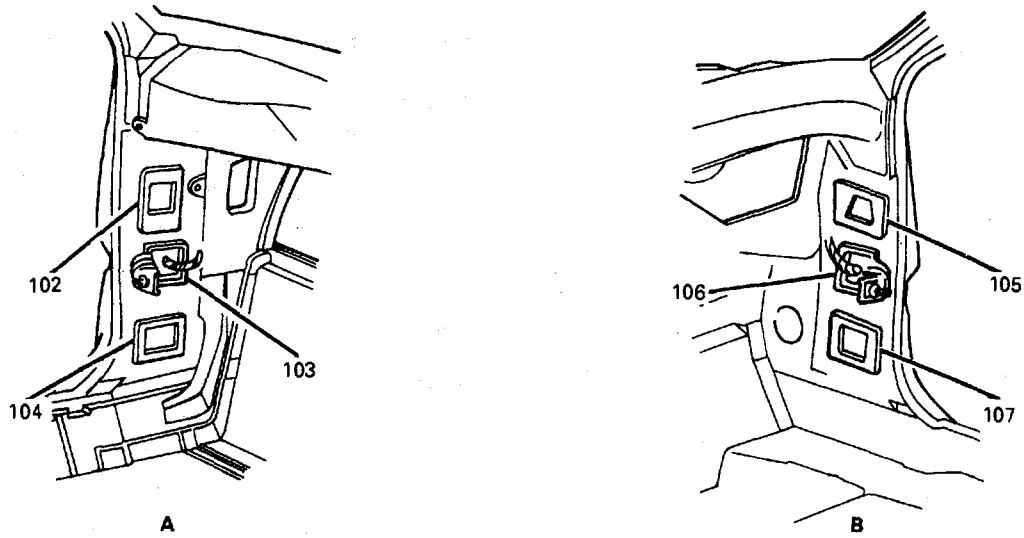
Install or Connect

NOTICE: See "Notice" on page 10-5-1 of this section.

1. Seal (109) to door jamb switch assembly (108) until fully seated.
2. Electrical connector.
3. Double or single terminal door jamb switch assembly (108).

   Tighten

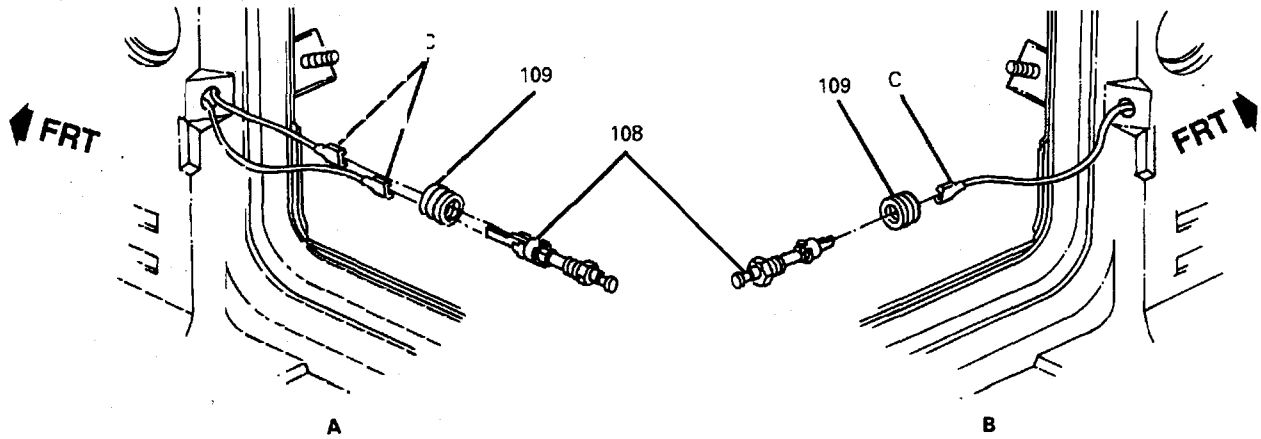
   - Door jamb switch assembly (108) to 6 N•m (53 lb. in.).
4. Battery negative cable assembly.



A DRIVER SIDE
B PASSENGER SIDE
102 BARRIER, BODY HINGE PILLAR INNER PANEL SOUND (LEFT)
103 BARRIER, BODY HINGE PILLAR INNER PANEL SOUND (LEFT)
104 BARRIER, BODY HINGE PILLAR INNER PANEL SOUND (LEFT)
105 BARRIER, BODY HINGE PILLAR INNER PANEL SOUND (RIGHT)
106 BARRIER, BODY HINGE PILLAR INNER PANEL SOUND (RIGHT)
107 BARRIER, BODY HINGE PILLAR INNER PANEL SOUND (RIGHT)

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Figure 28 – Body Hinge Pillar Inner Panel Sound Barriers



A DRIVER SIDE
B PASSENGER SIDE
C CONNECTOR, ELECTRICAL
108 SWITCH, DRIVER SIDE DOOR JAMB
109 SEAL, DOOR JAMB SWITCH

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Figure 29 – Door Jamb Switch Assemblies

EXTERIOR MOLDINGS AND DECAL

Rocker Panel Molding Assembly

Pontiac

Figure 30

Remove or Disconnect

1. Rear wheelhouse panel liner attachments. Pull rear portion of liner away from fender assembly.
2. Rocker panel molding retainer nuts (116).
3. Rocker panel molding retainers (115 and 119).
4. Rocker panel molding bolts/screws (117).
5. Rocker panel molding assembly (118).

Install or Connect

NOTICE: See "Notice" on page 10-5-1 of this section.

1. Rocker panel molding assembly (118).
2. Rocker panel molding bolts/screws (117).

Tighten

- Rocker panel molding bolts/screws (117) to 1.5 N•m (13 lb. in.).

3. Rocker panel molding retainers (115 and 119).
4. Rocker panel molding retainer nuts (116).
5. Rear wheelhouse panel liner attachments.

Front Fender Center Rear Molding Assembly

Figures 31 and 32

For information and procedures on replacing adhesive molding assemblies, refer to SECTION 10-1. Refer to Figures 31 and 32 for correct placement of the molding assembly (14 or 214).

Headlamp Opening Door Decal

Pontiac

Figure 33

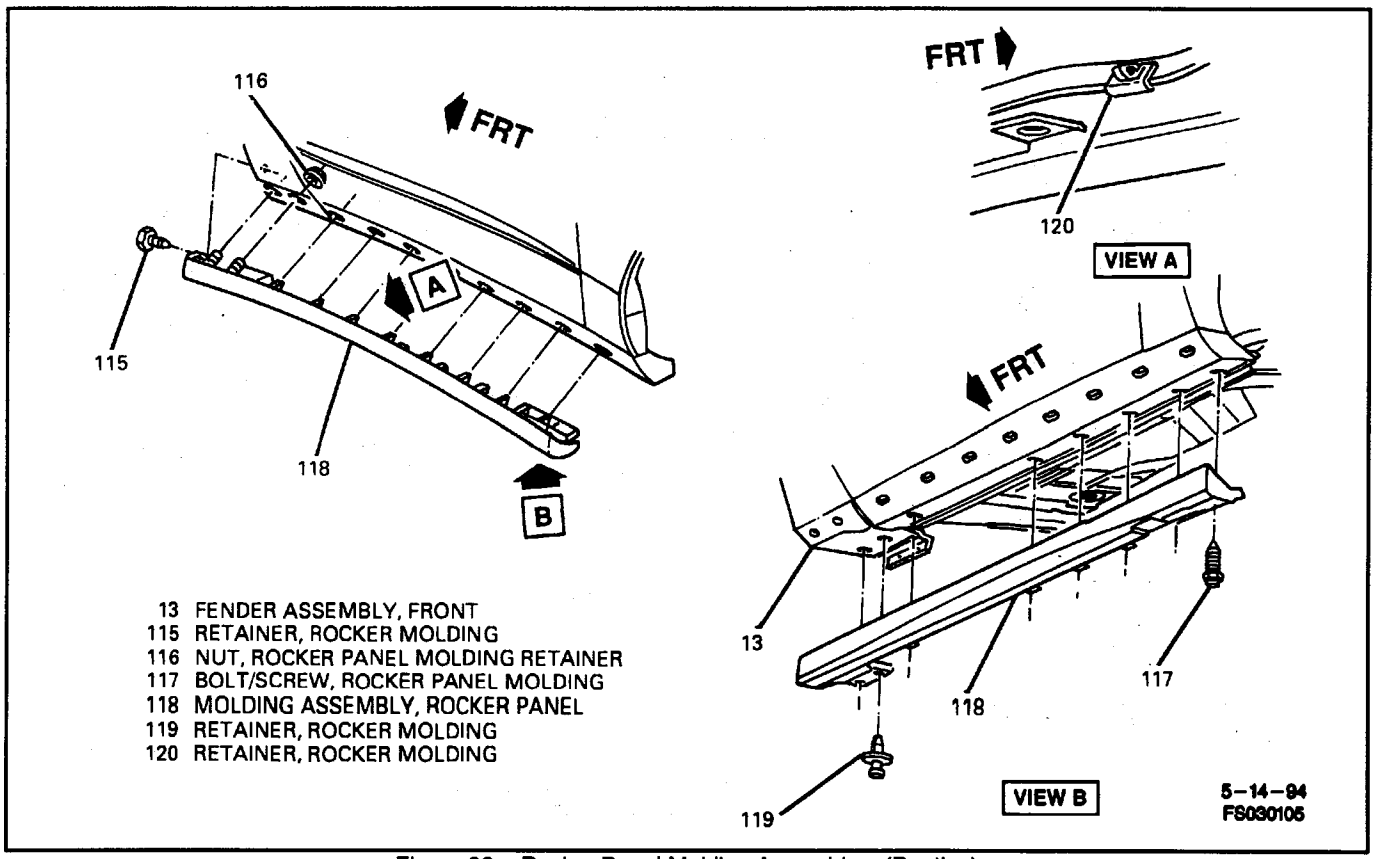
For information and procedures on replacing decals, refer to SECTION 10-1. Refer to Figure 35 for correct placement of the decal (68).

ROOF SIDE RAIL WEATHERSTRIP RETAINER

Figure 34

Remove or Disconnect

1. Lower the upper front portion of front side door weatherstrip assembly. Refer to SECTION 10-6.
2. Roof side rail weatherstrip retainer bolts/screws (121).
3. Roof side rail weatherstrip retainer (122).



13 FENDER ASSEMBLY, FRONT
115 RETAINER, ROCKER MOLDING
116 NUT, ROCKER PANEL MOLDING RETAINER
117 BOLT/SCREW, ROCKER PANEL MOLDING
118 MOLDING ASSEMBLY, ROCKER PANEL
119 RETAINER, ROCKER MOLDING
120 RETAINER, ROCKER MOLDING

Figure 30 – Rocker Panel Molding Assembly – (Pontiac)

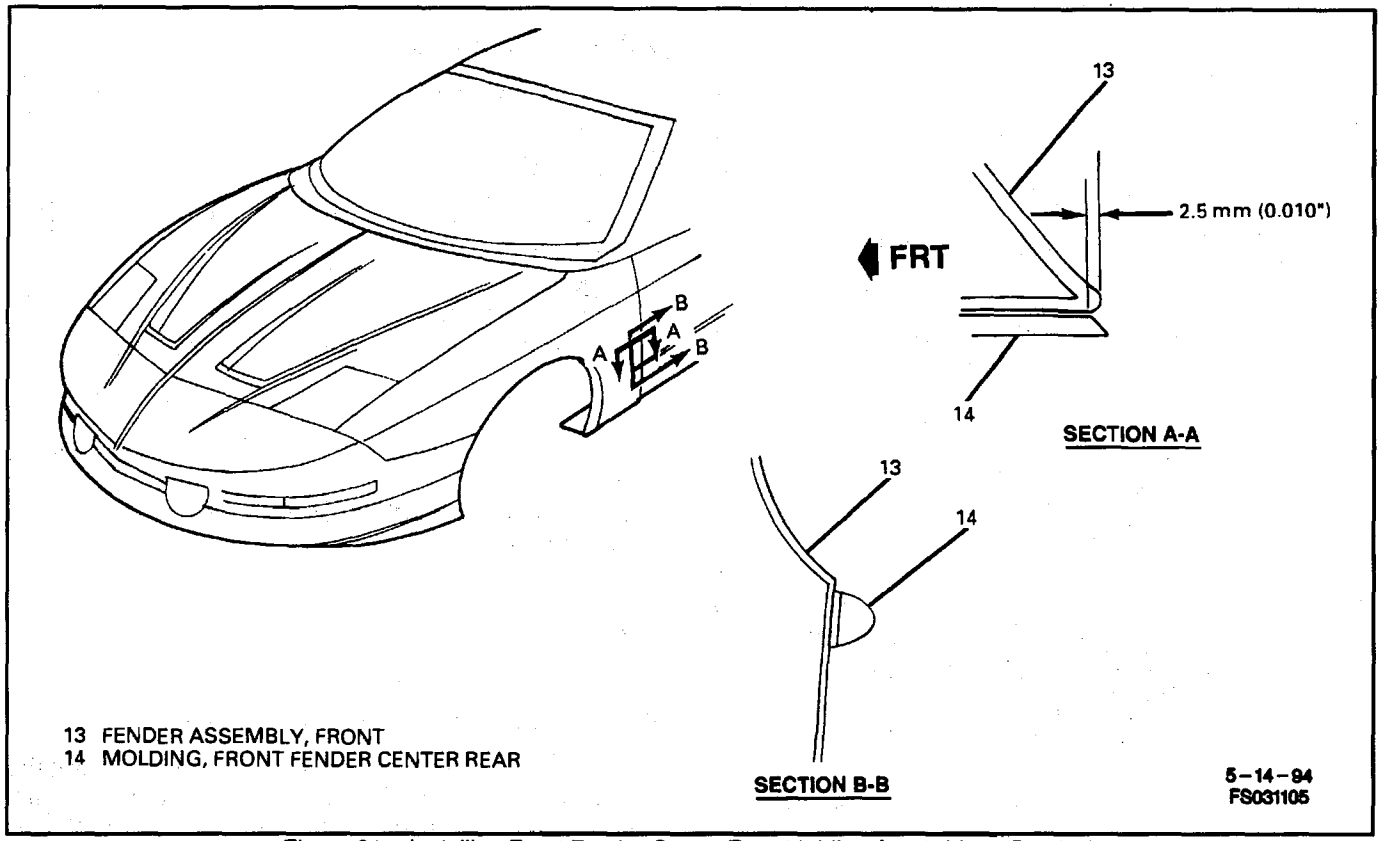


Figure 31 – Installing Front Fender Center Rear Molding Assembly – (Pontiac)

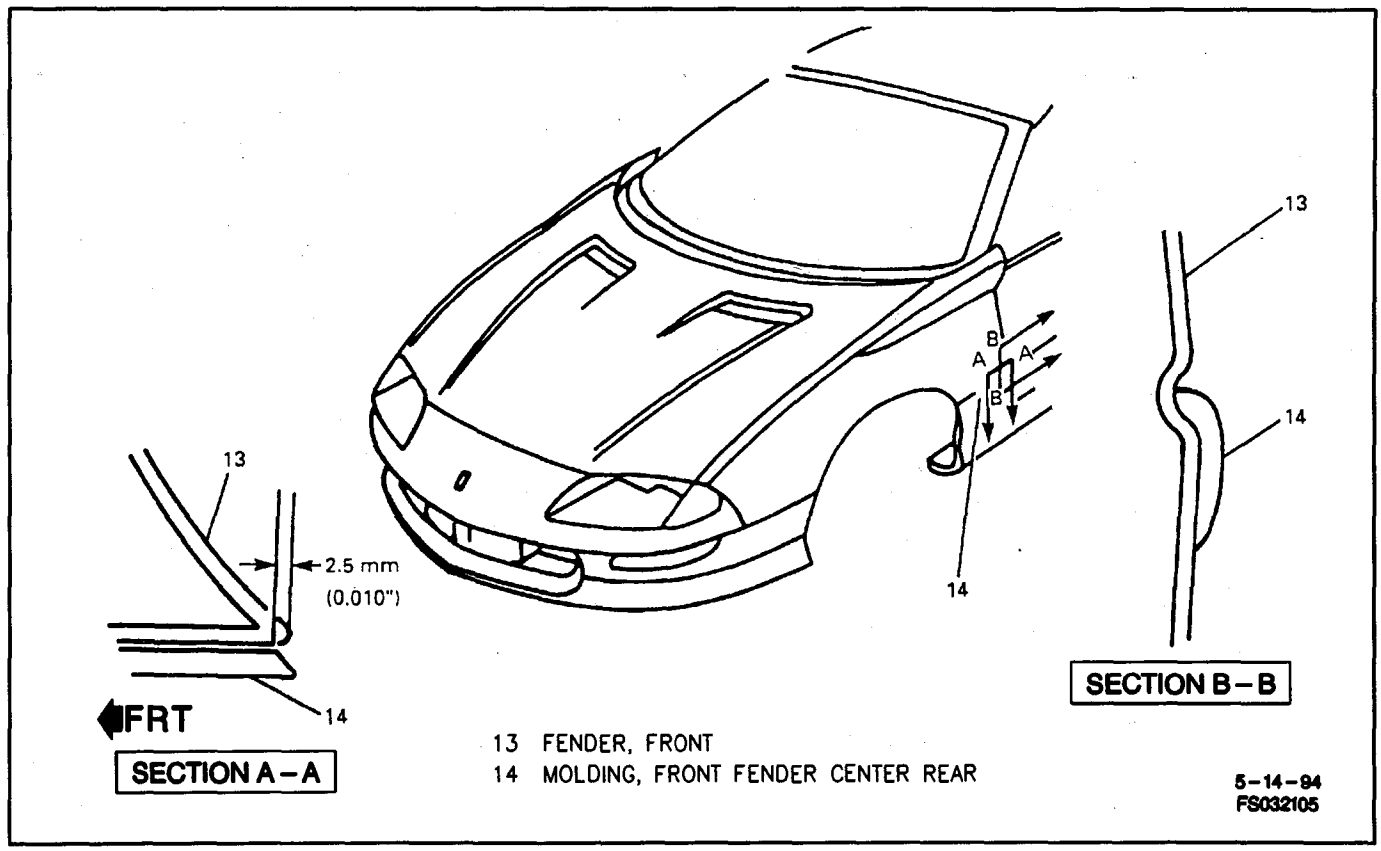
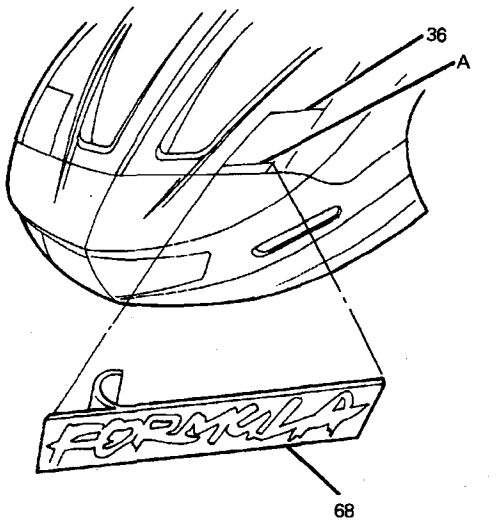


Figure 32 – Installing Front Fender Center Rear Molding Assembly – (Chevrolet)



A ALIGN INBOARD EDGE OF DECAL WITH INBOARD EDGE OF HEADLAMP OPENING DOOR AND ALIGN LOWER EDGE OF DECAL WITH FORWARD EDGE OF HEADLAMP OPENING DOOR
36 DOOR, HEADLAMP OPENING
68 DECAL, HEADLAMP OPENING DOOR (FORMULA)

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Figure 33– Headlamp Opening Door Decal – (Pontiac)

Install or Connect

NOTICE: See "Notice" on page 10-5-1 of this section.

1. Roof side rail weatherstrip retainer (122).
2. Roof side rail weatherstrip retainer bolts/screws (121).

Tighten

- Bolts/screws (121) to 1.3 N•m (12 lb. in.).

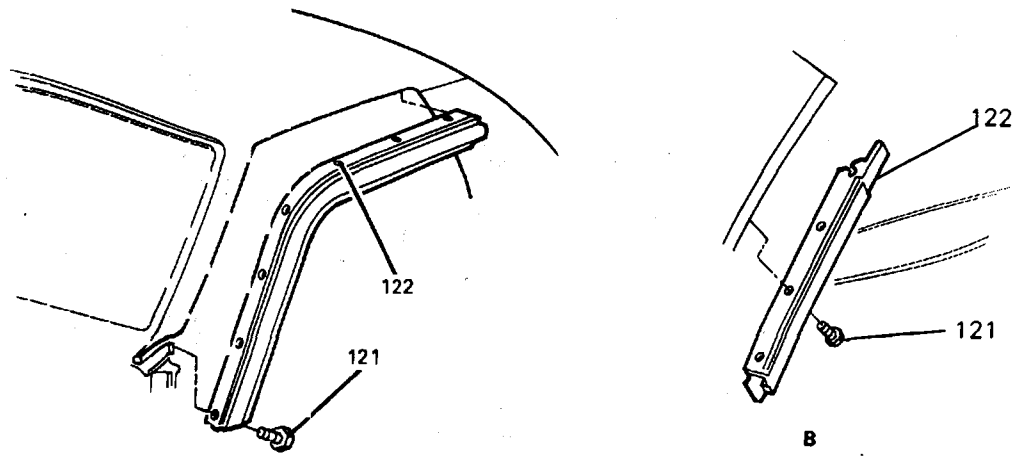
3. Front side door weatherstrip assembly. Refer to SECTION 10-6.

BODY PANEL ADJUSTMENT AND ALIGNMENT

Figures 16, 35 and 36

Hood Panel Assembly Adjustment

The hood panel assembly, front fender assemblies and hood hinges are "net build," therefore minimum adjustment can be made. If the door panel assembly can not be brought into specifications shown in Figures 37 or 38 by loosening hood hinge bolts/screws and/or adjusting the hood adjust front bumper assemblies, the structural body should be checked for damage or misalignment.



A STANDARD ROOF
B T-TOP ROOF
121 BOLT/SCREW, ROOF SIDE RAIL WEATHERSTRIP RETAINER
122 RETAINER, ROOF SIDE RAIL WEATHERSTRIP

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Figure 34 – Roof Side Rail Weatherstrip Retainer

Raising or Lowering Rear Corners of Hood Panel Assembly

Adjust

- Hood adjust front bumper assembly.
  - A. Close hood panel assembly firmly.
  - B. Determine amount of adjustment needed. Refer to Figures 37 or 38 for hood panel assembly alignment specifications.
  - C. Open hood panel assembly.
  - D. Change height by turning the hood bumper assemblies up or down.
  - E. Repeat above steps until hood panel assembly is properly aligned.

Fore and Aft Adjustment

A minimum adjustment can be obtained by loosening the hood hinge bolts/screws (76) and nuts (77), then sliding forward or rearward. For best appearance, adjust one side at a time.

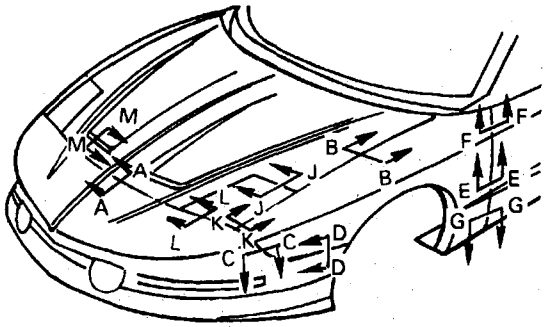
Adjust

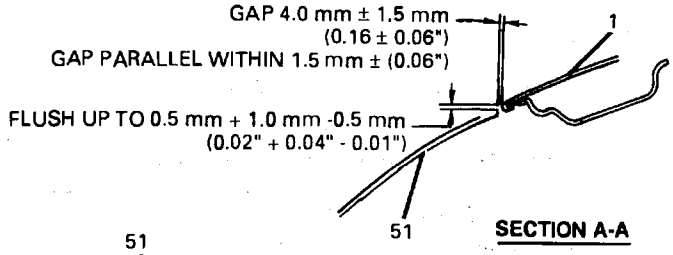
NOTICE: See "Notice" on page 10-5-1 of this section.

- Hood panel assembly.
  - A. Loosen hood hinge to body bolts/screws (76) and nuts (77).
  - B. Move hood panel assembly forward or rearward. Refer to Figures 37 and 38 for hood panel assembly alignment specifications.

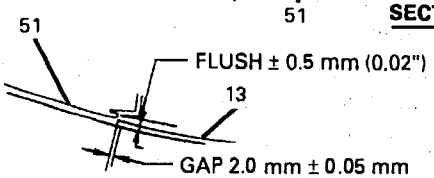
Tighten

- Hood hinge nuts (77) to 25 N•m (18 lb. ft.).
- Hood hinge bolts/screws (76) to 10 N•m (89 lb. in.).

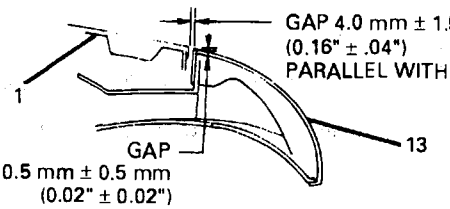




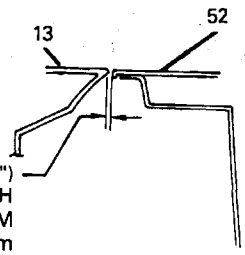
SECTION A-A



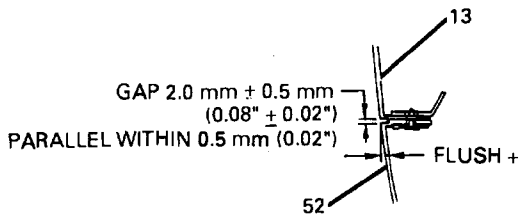
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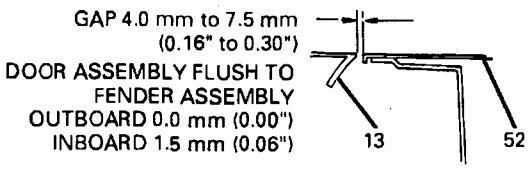
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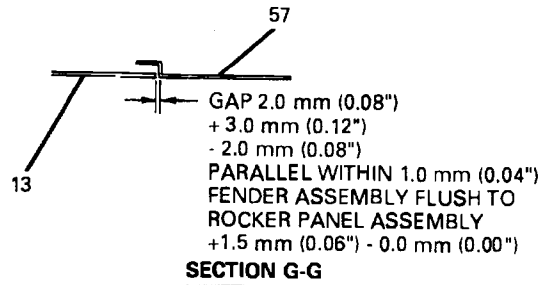
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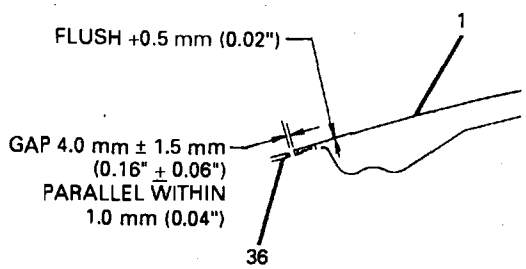
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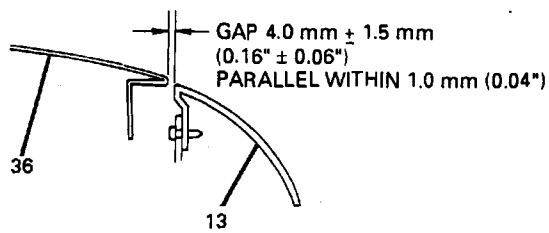
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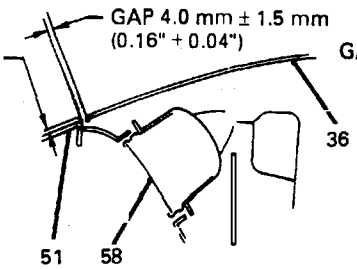
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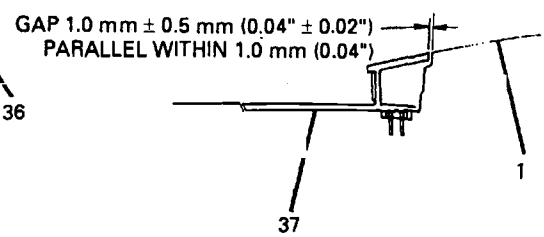
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SECTION K-K



SECTION L-L

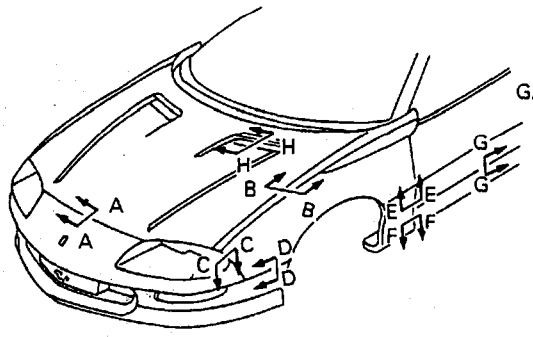


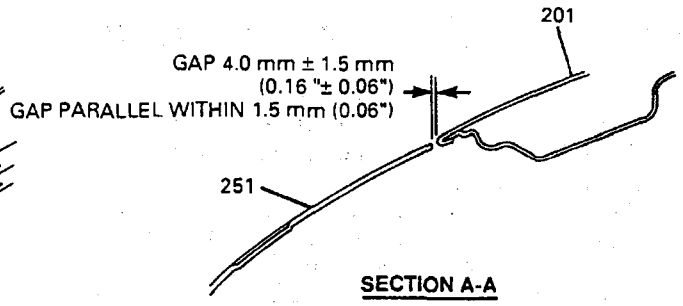
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1 PANEL ASSEMBLY, HOOD
13 FENDER ASSEMBLY, FRONT
36 DOOR, HEADLAMP OPENING
37 EXTRACTOR, HOOD AIR
51 FASCIA, FRONT BUMPER
52 DOOR ASSEMBLY, FRONT SIDE
57 PANEL ASSEMBLY, ROCKER
58 HEADLAMP ASSEMBLY

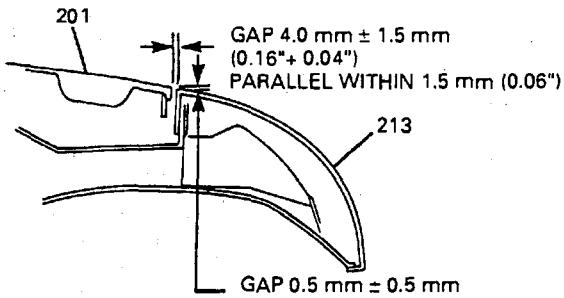
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Figure 35 – Front End Body Panel Alignment Specifications – (Pontiac)

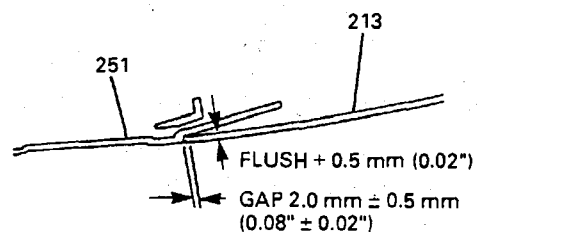




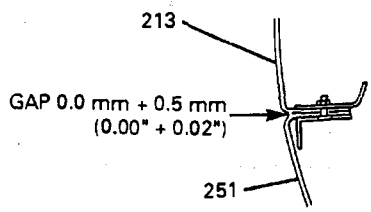
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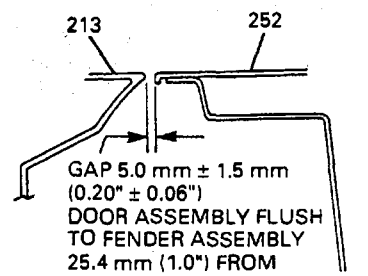
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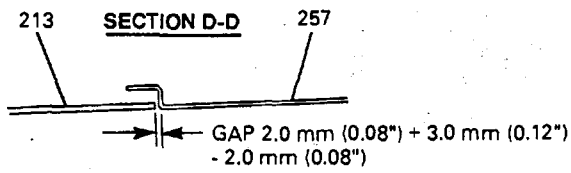
SECTION C-C



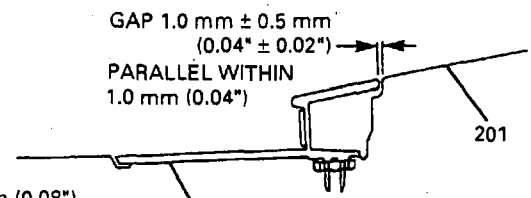
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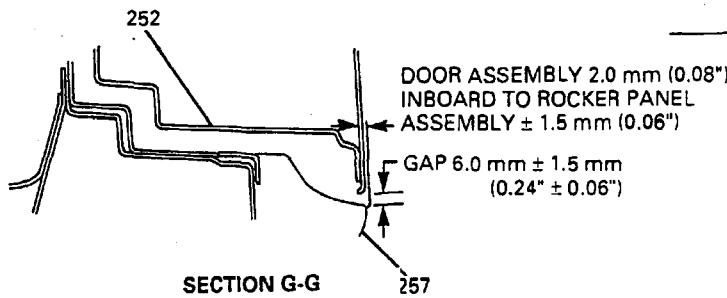
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SECTION F-F



SECTION H-H



SECTION G-G

201 PANEL ASSEMBLY, HOOD
213 FENDER ASSEMBLY, FRONT
237 EXTRACTOR, HOOD AIR
251 FASCIA, FRONT BUMPER
252 DOOR ASSEMBLY, FRONT SIDE
257 PANEL, ROCKER OUTER

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Figure 36 – Front End Body Panel Alignment Specifications – (Chevrolet)

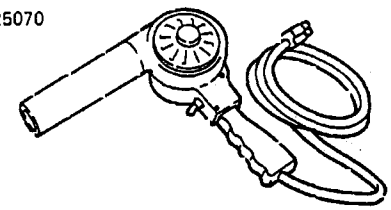
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Body Hinge Pillar Trim Panel Bolt/Screw	1.3 N•m (12 lb. in.)
Driver Side Door Jamb Switch Assembly	6 N•m (53 lb. in.)
Front Bumper Fascia Outer Bracket Bolt/Screw	10 N•m (89 lb. in.)
Front Fender Bolt/Screw	5.5 N•m (49 lb. in.)
Front Fender Rear Center Bracket Bolt/Screw	5.5 N•m (49 lb. in.)
Front Fender Rear Upper Bracket Bolt/Screw	5.5 N•m (49 lb. in.)
Front Wheelhouse Panel Liner Bolt/Screw	1.3 N•m (12 lb. in.)
Front Wheelhouse Panel Liner Bolt/Screw (Lower)	10 N•m (89 lb. in.)
Headlamp Housing Panel Bracket and Pivot Support Bracket Bolt/Screw	1.7 N•m (15 lb. in.)
Headlamp Housing Panel Bolt/Screw	8 N•m (71 lb. in.)
Headlamp Housing Panel Bracket Bolt/Screw	5.5 N•m (49 lb. in.)
Headlamp Housing Panel Support Bolt/Screw	10 N•m (89 lb. in.)
Headlamp Housing Panel Upper Bracket Bolt/Screw	10 N•m (89 lb. in.)
Hood Air Extractor Nut	3 N•m (27 lb. in.)
Hood Air Extractor Screen Bolt/Screw	1.7 N•m (15 lb. in.)
Hood Body Side Hinge Bolt/Screw	27 N•m (20 lb. ft.)
Hood Hinge Bolt/Screw	10 N•m (89 lb. in.)
Hood Hinge Nut	25 N•m (18 lb. ft.)
Hood Open Assist Rod Bolt/Screw	23 N•m (17 lb. ft.)
Hood Primary Latch Bolt/Screw	18 N•m (13 lb. ft.)
Hood Primary Latch Release Cable Bolt/Screw	7 N•m (62 lb. in.)
Hood Primary Latch Support Bolt/Screw	18 N•m (13 lb. ft.)
Hood Secondary Latch Bolt/Screw	12 N•m (106 lb. in.)
Passenger Side Door Jamb Switch Assembly	6 N•m (53 lb. in.)
Radiator Air Lower Deflector Bolt/Screw	10 N•m (89 lb. in.)
Rocker Panel Molding Bolt/Screw	1.5 N•m (13 lb. in.)
Roof Side Rail Weatherstrip Retainer Bolt/Screw	1.3 N•m (12 lb. in.)

SPECIAL TOOLS

1. J 25070



1. HEAT GUN

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SECTION 10-6

DOORS

CAUTION: Make sure to disconnect the front side door window switch when working inside the driver's door. When operated, the Express Down feature allows the front side door window to drop very quickly which could cause personal injury.

NOTICE: The theft deterrent label found on some major sheet metal, engines, and transmissions must be masked prior to painting, rustproofing, undercoating, etc. The mask must be removed following the above operations. Failure to keep the label clean and readable may result in liability for violation of Federal Vehicle Theft Prevention Standard and subject the vehicle owner to possible suspicion that the part was stolen.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

This section contains the service operations necessary for the removal, installation, adjustment and sealing of door assemblies, hardware and trim (Figures 1 through 6).

THREAD LOCKING FASTENERS

All factory installed door hardware attaching bolts/screws contain an epoxy thread-locking compound to ensure the torque will be maintained.

Service replacement bolts/screws may not contain a thread-locking compound. Such bolts/screws may be treated with GM P/N 1052279, Loctite® 75, or equivalent. The adhesive is placed on the fastener prior to installation. After the fastener is installed and tightened, the adhesive will cure, preventing the fastener from becoming loose.

FRONT SIDE DOOR WATER DEFLECTORS

Water deflectors are used to seal the door inner panels, preventing water entry.

FRONT SIDE DOOR LOCK STRIKER ASSEMBLIES

Each lock striker assembly is a dual-pin type that attaches to an anchor plate in the body lock pillar. The door assembly is held in the closed position when the lock assembly snaps over and engages the striker assembly.

An interlock striker assembly is also installed to the body lock pillar. It engages into a slot in the door assembly.

FRONT SIDE DOOR LOCK ASSEMBLIES

The lock assemblies use the fork bolt lock design which includes a safety interlock feature. The door assembly is secured in the closed position when the fork bolt engages the striker assembly. Door assemblies can be locked from the inside by moving the knob rearward and from the outside using the oval-headed key.

FRONT SIDE DOOR OUTSIDE HANDLE ASSEMBLIES

The outside handle assemblies actuate the lock assemblies through rods.

EXPRESS DOWN

Express Down fully lowers the driver's front side door window when the side window switch is pressed quickly and released.

FRONT SIDE DOOR UPPER AND LOWER HINGE ASSEMBLIES

The hinge assemblies are steel and are fastened with bolts/screws and nuts. The hinge assemblies are directly accessible.

OUTSIDE REARVIEW MIRROR ASSEMBLIES

The left-hand mirror assembly is remote control and the right-hand mirror assembly is direct control. Electric control is optional.

ON-VEHICLE SERVICE

FRONT SIDE DOOR INTERIOR TRIM

Front Side Door Right and Left Trim Assemblies

Figures 6 and 7

Remove or Disconnect

1. Accessory switch panel assembly or accessory switch opening cover assembly, as equipped. Refer to "Accessory Switch Panel Assembly and Accessory Switch Opening Cover Assembly" in this section (Pontiac only).
2. Front side door inside handle bezel. Refer to "Front Side Door Inside Handle Bezel" in this section.
3. Front side door window regulator handle assembly and front side door window regulator handle spacer. Refer to "Front Side Door Window Regulator Handle Assembly" in this section.
4. Outside rearview mirror bezel assembly. Refer to "Outside Rearview Mirror Assembly" in this section.
5. Bolts/screws (90).

   NOTICE: Do not try to pull trim assembly straight off door assembly, or hooks in trim assembly will break. To disengage hooks, trim assembly must be lifted up and then pulled away from door assembly.

6. Trim assembly (89).
   A. Pull slightly on rear of trim assembly (89) to release tab.
   B. Lift up on trim assembly (89).
   C. Pull trim assembly (89) away from door assembly (152), making sure that hooks release from holes in door inner panel.
   D. Disconnect radio front side door (tweeter) speaker electrical connector, if equipped (Pontiac only).
   E. Remove courtesy lamp socket assembly from trim assembly (89).

Important

- If trim assembly is being replaced, radio front side door (tweeter) speaker, if equipped, must be removed from trim assembly and transferred to new trim assembly. Refer to "Radio Front Side Door (Tweeter) Speaker Assembly" in this section (Pontiac only).

Install or Connect

NOTICE: See "Notice" on page 10-6-1 of this section.

1. Trim assembly (89) to door inner panel.
   A. Insert hooks along bottom of trim assembly (89) part way into holes in door inner panel.
   B. Route electrical connectors through opening in trim assembly (89), if equipped.
   C. Install courtesy lamp socket assembly to trim assembly (89).
   D. Connect radio front side door (tweeter) speaker electrical connector (Pontiac only).
   E. Align upper edge of trim assembly (89) over door inner panel flange and insert remaining hooks into holes.
   F. Push downward to engage hooks.
   G. Push rear of trim assembly (89) into door assembly (152) to engage tab.
2. Bolts/screws (90).

   Tighten

   - Bolts/screws (90) to 4.5 N•m (40 lb. in.).
3. Outside rearview mirror bezel assembly. Refer to "Outside Rearview Mirror Assembly" in this section.
4. Front side door window regulator handle assembly and front side door window regulator handle spacer. Refer to "Front Side Door Window Regulator Handle Assembly" in this section.
5. Front side door inside handle bezel. Refer to "Front Side Door Inside Handle Bezel" in this section.
6. Accessory switch panel assembly or accessory switch opening cover assembly, as equipped. Refer to "Accessory Switch Panel Assembly and Accessory Switch Opening Cover Assembly" in this section (Pontiac only).

Front Side Door Armrest and Map Pocket and Radio Front Side Door Speaker Grilles

Pontiac

Figures 3 and 4

These components of the trim assembly (89 or 100) are held in position with heat stakes. These components are included with the replacement part trim assembly, but they can also be serviced separately.

Remove or Disconnect

1. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
2. Armrest (95), pocket (110) or grille (98 or 99).
   A. Peel back the sound deadener.
   B. Using a soldering iron, melt heat stakes retaining armrest (95), pocket (110) or grille (98 or 99).
   C. Pull armrest (95), pocket (110) or grille (98 or 99) from trim assembly (89).

Install or Connect

1. Armrest (95), pocket (110) or grille (98 or 99).
   A. Insert heat stakes through holes in trim assembly (89).
   B. Melt heat stakes using a soldering iron.
   C. Press melted heat stakes flat using suitable surface.
   D. Apply adhesive to sound deadener.
   E. Reposition sound deadener.
2. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

Front Side Door Armrest and Radio Front Side Door Speaker Grille

Chevrolet

Figures 4 and 5

These components of the trim assembly (89) are held in position with heat stakes. These components are included with the replacement part trim assembly, but they can also be serviced separately.

Remove or Disconnect

1. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
2. Armrest (89) or grille (98).
   A. Peel back sound deadener.
   B. Using soldering iron, melt heat stakes retaining armrest (95) or grille (98).

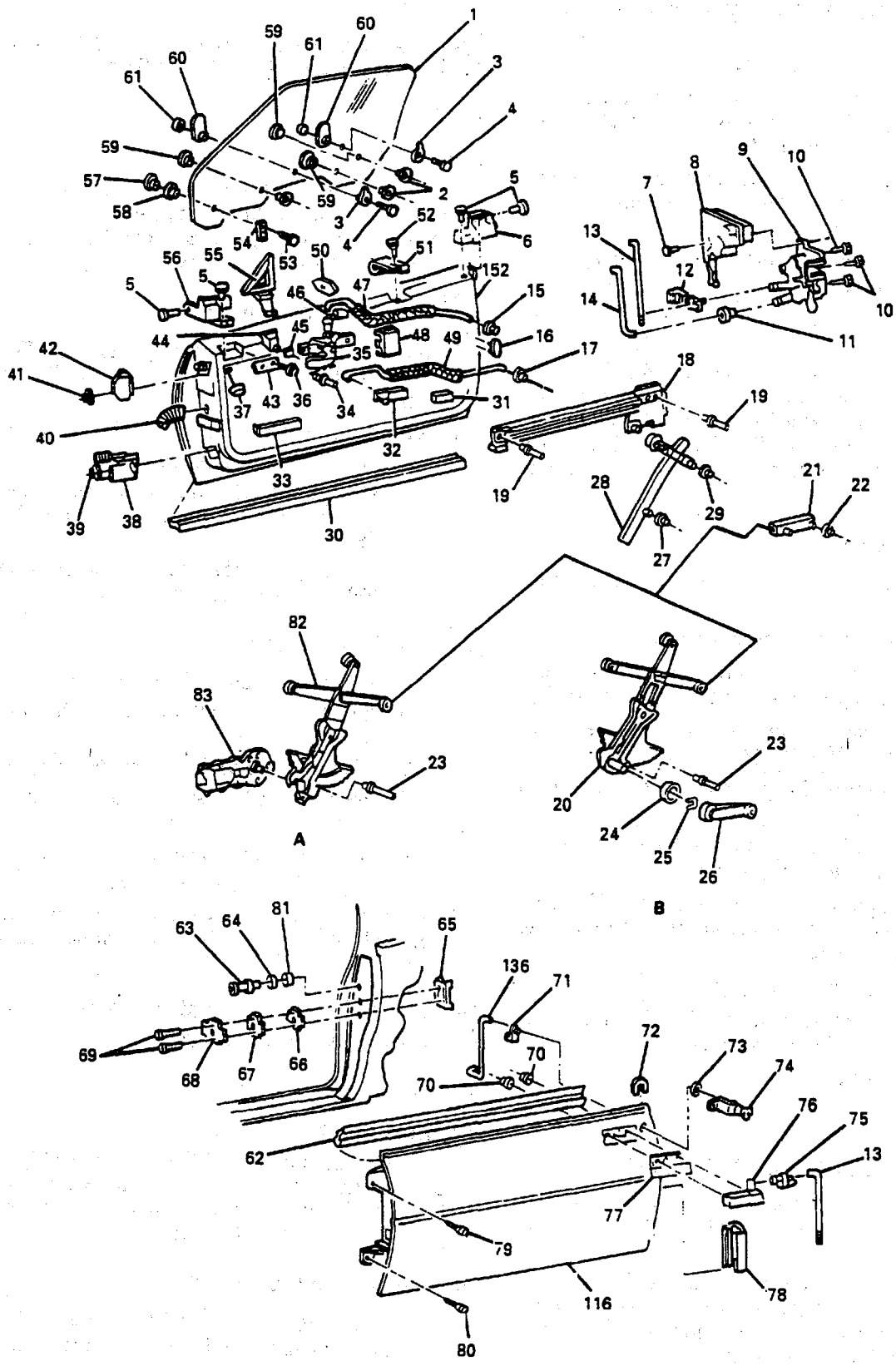


Figure 1 – Front Side Door Assembly (Typical)

A WITH ELECTRIC-OPERATED SIDE WINDOW
B WITHOUT ELECTRIC-OPERATED SIDE WINDOW
1 WINDOW, FRONT SIDE DOOR
2 RETAINER, FRONT SIDE DOOR WINDOW BUSHING
3 PIN, FRONT SIDE DOOR WINDOW STABILIZER
4 BOLT/SCREW, FRONT SIDE DOOR WINDOW STABILIZER PIN
5 RETAINER, FRONT SIDE DOOR FRONT BELT SEAL
6 SEAL, FRONT SIDE DOOR REAR BELT
7 BOLT/SCREW, FRONT SIDE DOOR LOCK ACTUATOR
8 ACTUATOR, FRONT SIDE DOOR LOCK
9 LOCK ASSEMBLY, FRONT SIDE DOOR
10 BOLT/SCREW, FRONT SIDE DOOR LOCK
11 CLIP, FRONT SIDE DOOR LOCKING ROD
12 RETAINER, FRONT SIDE DOOR OUTSIDE HANDLE ROD
13 ROD, FRONT SIDE DOOR OUTSIDE HANDLE
14 ROD, FRONT SIDE DOOR LOCK CYLINDER
15 CLIP, FRONT SIDE DOOR LOCKING ROD
16 BUMPER, FRONT SIDE DOOR
17 CLIP, FRONT SIDE DOOR LOCKING ROD
18 CHANNEL ASSEMBLY, FRONT SIDE DOOR WINDOW
19 RIVET, FRONT SIDE DOOR WINDOW
20 REGULATOR ASSEMBLY, FRONT SIDE DOOR WINDOW
21 CHANNEL ASSEMBLY, FRONT SIDE DOOR WINDOW REGULATOR COUNTERBALANCE ARM
22 NUT, FRONT SIDE DOOR WINDOW REGULATOR COUNTERBALANCE ARM CHANNEL
23 RIVET, FRONT SIDE DOOR WINDOW REGULATOR
24 SPACER, FRONT SIDE DOOR WINDOW REGULATOR HANDLE
25 SPRING, DOOR WINDOW REGULATOR HANDLE
26 HANDLE ASSEMBLY, FRONT SIDE DOOR WINDOW REGULATOR
27 NUT, FRONT SIDE DOOR WINDOW REAR GUIDE CHANNEL
28 CHANNEL ASSEMBLY, FRONT SIDE DOOR WINDOW REAR GUIDE
29 NUT, FRONT SIDE DOOR WINDOW REAR GUIDE CHANNEL
30 SEALING STRIP, FRONT SIDE DOOR BOTTOM AUXILIARY
31 BUMPER, FRONT SIDE DOOR WINDOW REAR
32 KNOB, FRONT SIDE DOOR LOCKING ROD
33 BUMPER, FRONT SIDE DOOR WINDOW FRONT
34 RIVET, FRONT SIDE DOOR INSIDE HANDLE
35 HANDLE ASSEMBLY, FRONT SIDE DOOR INSIDE
36 BOLT/SCREW, OUTSIDE REARVIEW MIRROR APPLIQUE
37 NUT, OUTSIDE REARVIEW MIRROR OPENING APPLIQUE
38 HINGE ASSEMBLY, FRONT SIDE DOOR LOWER
39 NUT, FRONT SIDE DOOR LOWER HINGE
40 GROMMET, DOOR WIRING HARNESS
41 NUT, FRONT SIDE DOOR UPPER HINGE
42 HINGE ASSEMBLY, FRONT SIDE DOOR UPPER
43 WASHER, OUTSIDE REARVIEW MIRROR APPLIQUE
44 SUPPORT ASSEMBLY, FRONT SIDE DOOR WINDOW FRONT UP STOP
45 NUT, FRONT SIDE DOOR WINDOW FRONT UP STOP SUPPORT
46 CLIP, FRONT SIDE DOOR INSIDE HANDLE ROD
47 ROD ASSEMBLY, FRONT SIDE DOOR INSIDE HANDLE
48 CLIP, FRONT SIDE DOOR LOCKING ROD
49 ROD, FRONT SIDE DOOR LOCKING
50 SEAL, FRONT SIDE DOOR INSDE HANDLE
51 STABILIZER ASSEMBLY, FRONT SIDE DOOR WINDOW
52 BOLT/SCREW, FRONT SIDE DOOR WINDOW STABILIZER
53 BOLT/SCREW, FRONT SIDE DOOR WINDOW FRONT UP STOP
54 STOP, FRONT SIDE DOOR WINDOW FRONT UP
55 APPLIQUE ASSEMBLY, OUTSIDE REARVIEW MIRROR
56 SEAL, FRONT SIDE DOOR FRONT BELT
57 NUT, FRONT SIDE DOOR WINDOW FRONT UP STOP
58 WASHER, FRONT SIDE DOOR WINDOW FRONT UP STOP
59 BUSHING ASSEMBLY, FRONT SIDE DOOR WINDOW
60 WEDGE, FRONT SIDE DOOR WINDOW
61 NUT, FRONT SIDE DOOR WINDOW STABILIZER PIN
62 SEALING STRIP ASSEMBLY, FRONT SIDE DOOR WINDOW OUTER
63 STRIKER ASSEMBLY, FRONT SIDE DOOR INTERLOCK
64 SPACER, FRONT SIDE DOOR INTERLOCK STRIKER
65 PLATE, FRONT SIDE DOOR LOCK STRIKER ANCHOR
66 WASHER, FRONT SIDE DOOR LOCK STRIKER
67 SPACER, FRONT SIDE DOOR LOCK STRIKER
68 STRIKER ASSEMBLY, FRONT SIDE DOOR LOCK
69 BOLT/SCREW, FRONT SIDE DOOR LOCK STRIKER
70 NUT, FRONT SIDE DOOR OUTSIDE HANDLE
71 CLIP, FRONT SIDE DOOR LOCK CYLINDER PAWL
72 RETAINER, FRONT SIDE DOOR LOCK CYLINDER
73 GASKET, FRONT SIDE DOOR LOCK CYLINDER
74 CYLINDER UNIT, LOCK
75 CLIP, FRONT SIDE DOOR OUTSIDE HANDLE
76 HANDLE ASSEMBLY, FRONT SIDE DOOR OUTSIDE
77 FILLER, FRONT SIDE DOOR OUTSIDE HANDLE
78 PROTECTOR, DOOR EDGE
79 BOLT/SCREW, FRONT SIDE DOOR UPPER HINGE
80 BOLT/SCREW, FRONT SIDE DOOR LOWER HINGE
81 WASHER, FRONT SIDE DOOR INTERLOCK STRIKER
82 REGULATOR ASSEMBLY, FRONT SIDE DOOR WINDOW
83 MOTOR ASSEMBLY, FRONT SIDE DOOR WINDOW REGULATOR
116 DOOR ASSEMBLY, FRONT SIDE
136 ROD, FRONT SIDE DOOR LOCK CYLINDER
152 DOOR ASSEMBLY, FRONT SIDE

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Figure 2 – Front Side Door Assembly – Legend (Typical)

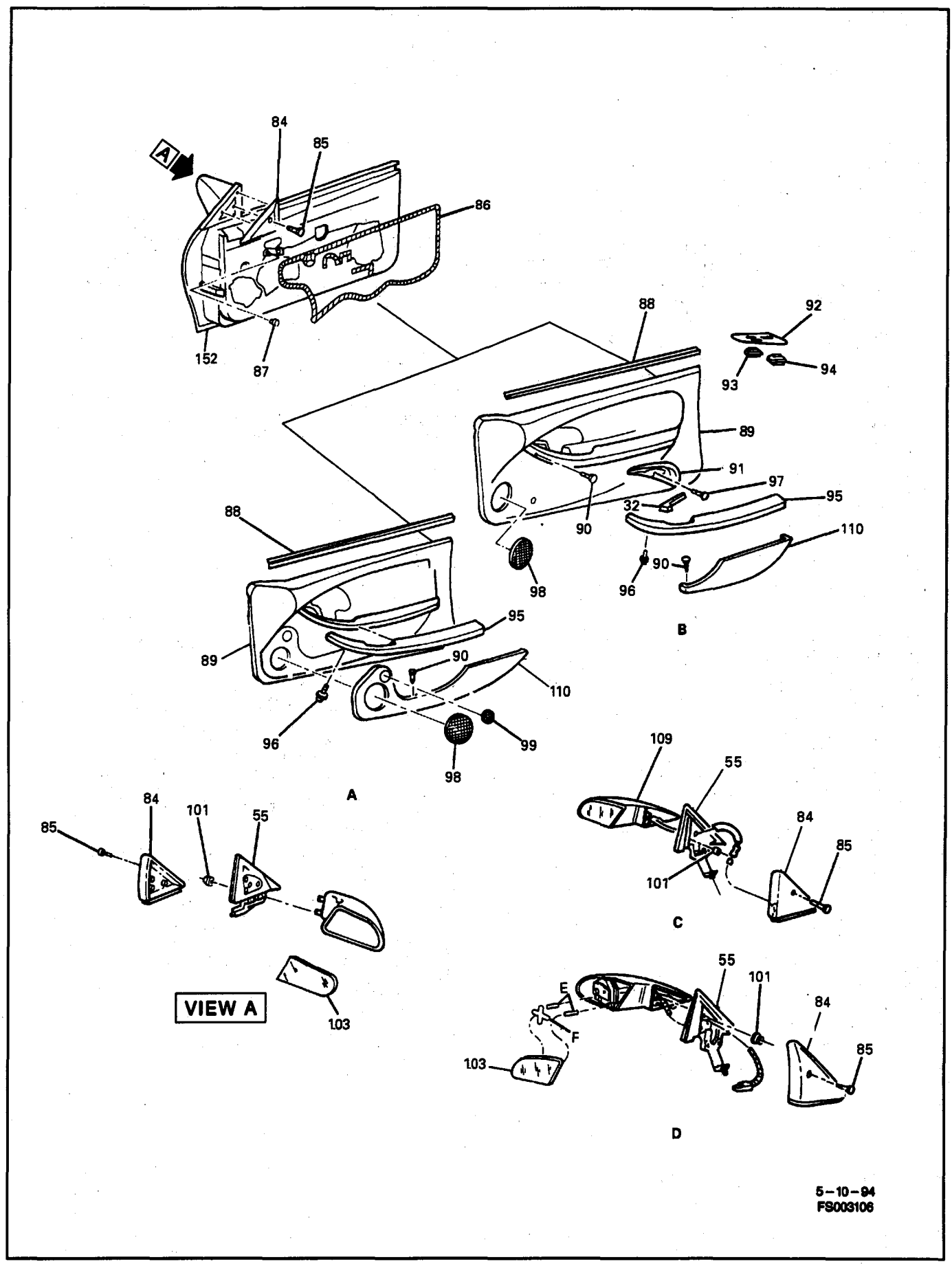


Figure 3 – Front Side Door Assembly – (Pontiac)

A	WITH QUAD FRONT DOOR–MOUNTED SPEAKERS
B	WITH DUAL FRONT DOOR–MOUNTED SPEAKERS
C	DRIVER'S SIDE MANUAL REMOTE CONTROL
D	DRIVER'S SIDE ELECTRIC CONTROL
E	JACKSCREW
F	TRUNNION, OUTSIDE REARVIEW MIRROR
32	KNOB, FRONT SIDE DOOR LOCKING ROD
55	APPLIQUE, OUTSIDE REARVIEW MIRROR
84	BEZEL, OUTSIDE REARVIEW MIRROR
85	BOLT/SCREW, OUTSIDE REARVIEW MIRROR BEZEL
86	DEFLECTOR, FRONT SIDE DOOR WATER
87	NUT, FRONT SIDE DOOR ARMREST
88	SEALING STRIP, FRONT SIDE DOOR WINDOW INNER
89	TRIM, FRONT SIDE DOOR
90	BOLT/SCREW, FRONT SIDE DOOR ARMREST
91	BEZEL, FRONT SIDE DOOR INSIDE HANDLE
92	PANEL, ACCESSORY SWITCH
93	SWITCH, DOOR LOCK
94	SWITCH, SIDE WINDOW
95	ARMREST, FRONT SIDE DOOR
96	BOLT/SCREW, FRONT SIDE DOOR ARMREST
97	BOLT/SCREW, FRONT SIDE DOOR INSIDE HANDLE BEZEL
98	GRILLE, RADIO FRONT SIDE DOOR SPEAKER
99	GRILLE, RADIO FRONT SIDE DOOR TWEETER
101	NUT, OUTSIDE REARVIEW MIRROR
103	GLASS, OUTSIDE REARVIEW MIRROR REFLECTIVE
104	MIRROR, OUTSIDE REARVIEW
109	MIRROR, OUTSIDE REARVIEW
110	POCKET, FRONT SIDE DOOR MAP
152	DOOR, FRONT SIDE
203	BEZEL, FRONT SIDE DOOR INSIDE HANDLE (CHEVROLET)

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Figure 4 – Front Side Door Assembly – Legend

C. Pull armrest (95) or grille (98) from trim assembly (89).

Install or Connect

1. Armrest (95) or grille (98).
   A. Insert heat stakes through holes in trim assembly (89).
   B. Melt heat stakes using soldering iron.
   C. Press melted heat stakes flat using suitable surface.
   D. Apply adhesive to sound deadener.
   E. Reposition sound deadener.
2. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

Accessory Switch Panel Assembly and Accessory Switch Opening Cover Assembly

Figures 8 and 9

If the vehicle is equipped with side window, mirror selector or door lock switches (92, 93 and 114 or 94, 218), it will have a panel assembly (92). If the vehicle is not equipped with any of these switches, then it will have a cover assembly. Both parts are removed in the same way.

NOTICE: When removing the panel assembly, the ignition switch must be in the "OFF" position and retained accessory power (RAP) must not be present. This will eliminate the possibility of shorting out the switch if a screwdriver, awl or metal object is used.

Pontiac

Remove or Disconnect

- Panel assembly (92) or cover assembly.
  A. Pry at front and rear of panel assembly (92) or cover assembly with a flat-bladed tool to release metal clips.
  B. Disconnect electrical connectors, if equipped.
  C. Remove switches, if equipped and panel assembly is being replaced. Refer to "Side Window, Outside Remote Control Rearview Mirror Selector and Door Lock Switches" in this section.

Install or Connect

- Panel assembly (92) or cover assembly.
  A. Install switches if removed. Refer to "Side Window, Outside Remote Control Rearview Mirror Selector and Door Lock Switches" in this section.
  B. Connect electrical connectors, if equipped.
  C. Position panel assembly (92) or cover assembly and press to secure clips.

Chevrolet

Remove or Disconnect

1. Front side door inside handle bezel. Refer to "Front Side Door Inside Handle Bezel" in this section.
2. Panel assembly (92) or cover assembly.
   A. Squeeze metal clips to release from handle bezel.

   Inspect
   - Clips for proper position.

   B. Remove switches, if equipped and panel assembly is being replaced. Refer to "Side Window, Outside Remote Control Rearview Mirror Selector and Door Lock Switches" in this section.

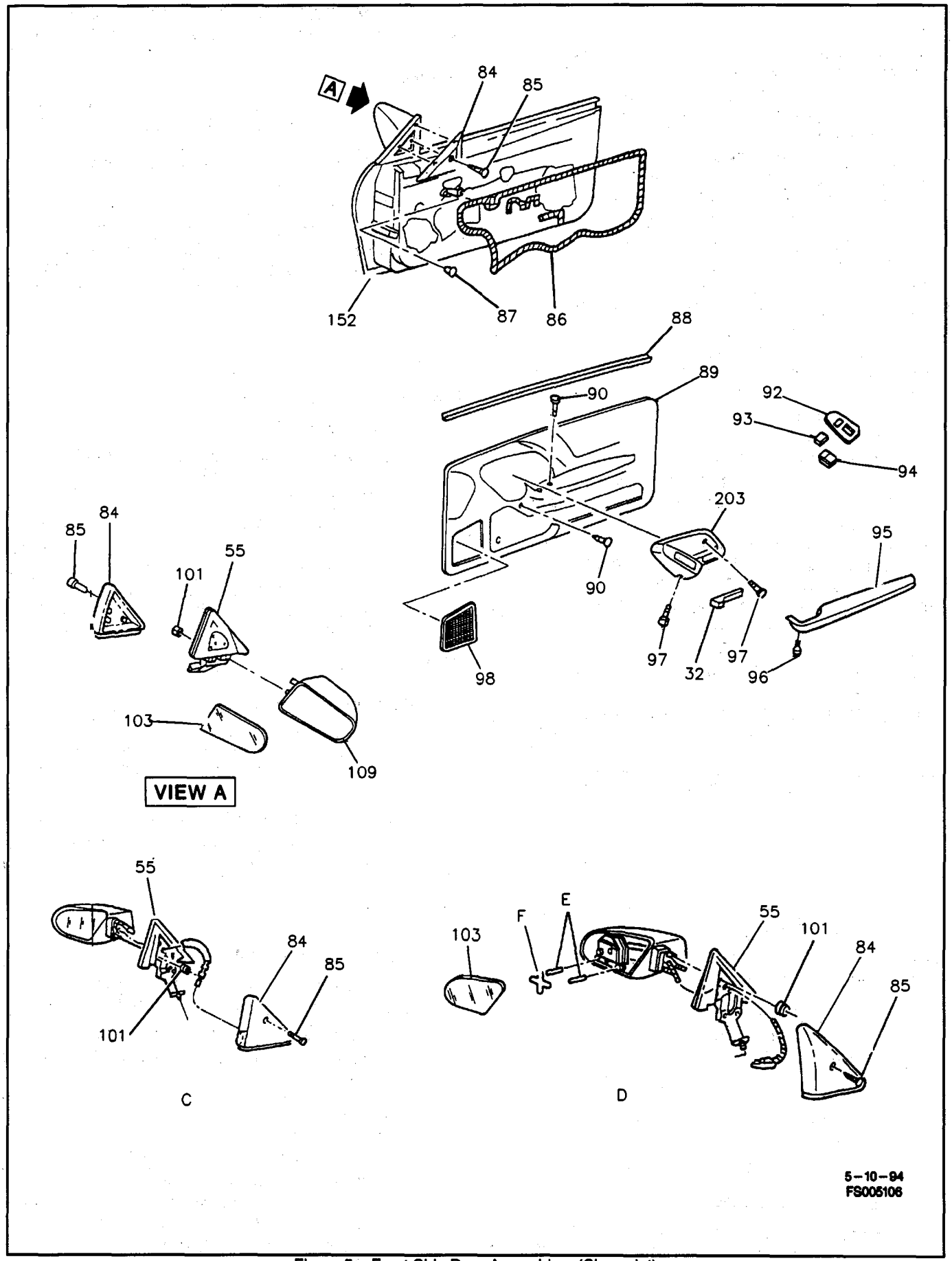
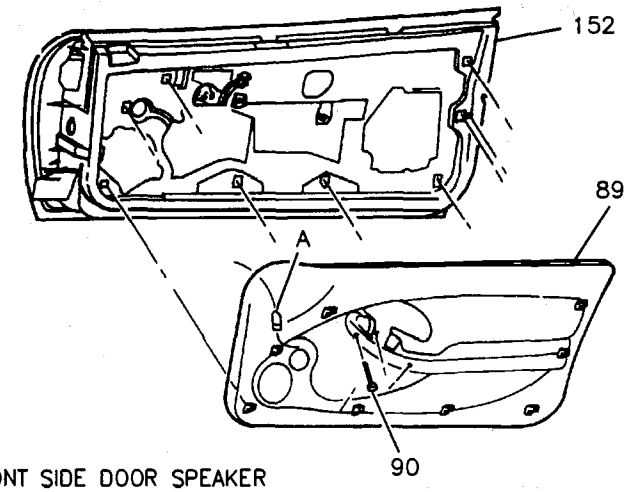


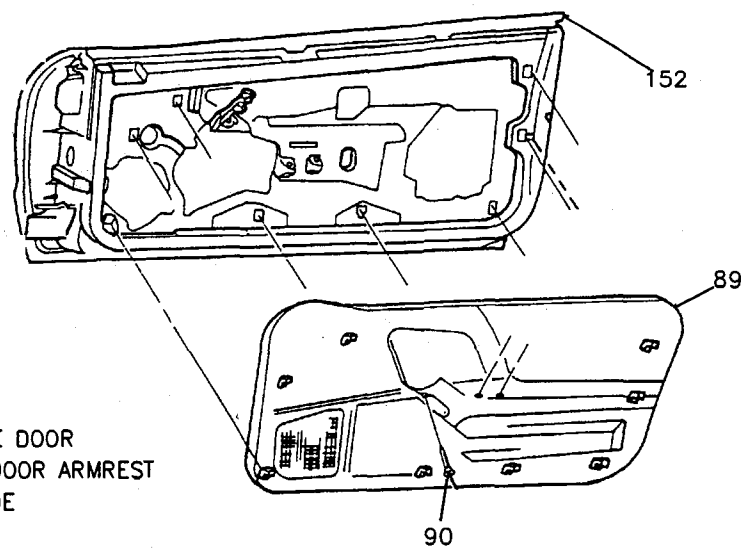
Figure 5 – Front Side Door Assembly – (Chevrolet)



A CONNECTOR, RADIO FRONT SIDE DOOR SPEAKER (TWEETER) ELECTRICAL
89 TRIM ASSEMBLY, FRONT SIDE DOOR
90 BOLT/SCREW, FRONT SIDE DOOR ARMREST
152 DOOR ASSEMBLY, FRONT SIDE

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Figure 6 – Front Side Door Trim Assembly (Typical Right Shown, Left Similar) – (Pontiac)



89 TRIM ASSEMBLY, FRONT SIDE DOOR
90 BOLT/SCREW, FRONT SIDE DOOR ARMREST
152 DOOR ASSEMBLY, FRONT SIDE

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Figure 7 – Front Side Door Trim Assembly (Right Shown, Left Similar) – (Chevrolet)

Install or Connect

1. Panel assembly (92) or cover assembly.
   A. Install switches if removed. Refer to "Side Window, Outside Remote Control Rearview Mirror Selector and Door Lock Switches" in this section.
   B. Position panel assembly (92) or cover assembly and press to secure clips.
2. Front side door inside handle bezel. Refer to "Front Side Door Inside Handle Bezel" in this section.

Front Side Door Inside Handle Bezel

Figures 10 and 11

Remove or Disconnect

1. Accessory switch panel assembly or accessory switch opening cover assembly. Refer to "Acces-

sory Switch Panel Assembly and Accessory Switch Opening Cover Assembly" in this section (Pontiac only).

2. Front side door locking rod knob. Refer to "Front Side Door Locking Rod Knob" in the following procedure.
3. Bolt/screw (97).
4. Bezel (91 or 203).
   A. Slide bezel (91) forward to release from trim assembly (Pontiac only).
   B. Unsnap bezel (203) from trim assembly (Chevrolet only).
   C. Disconnect electrical connectors, if equipped (Chevrolet only).
   D. Squeeze metal clips on panel assembly or cover assembly to release from bezel (203), if replacing bezel (203) (Chevrolet only).

Inspect

- Clips for proper position (Chevrolet only).

5. Switch illumination lamp socket by turning socket and removing from bezel (91 or 203).

Install or Connect

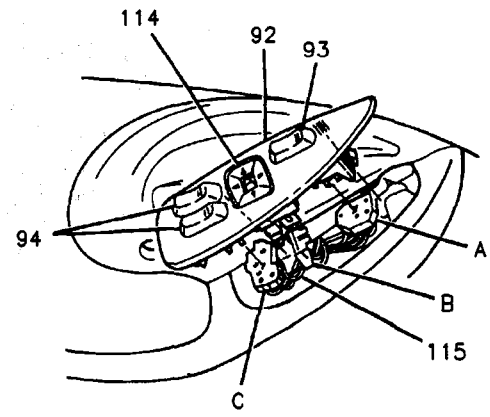
NOTICE: See "Notice" on page 10-6-1 of this section.

1. Switch illumination lamp socket.
2. Bezel (91 or 203).
   A. Route inside handle assembly (35) and locking rod through appropriate openings in bezel (91 or 203).
   B. Position bezel (91) and slide rearward (Pontiac only).
   C. Connect electrical connectors, if equipped (Chevrolet only).
   D. Position panel assembly or cover assembly to bezel (203) and press to secure clips, if removed (Chevrolet only).
   E. Snap bezel (203) into trim assembly (Chevrolet only).
3. Bolt/screw (97).

Tighten

- Bolt/screw (97) to 1.4 N•m (12 lb. in.).

4. Front side door locking rod knob. Refer to "Front Side Door Locking Rod Knob" in the following procedure.



A CONNECTOR, DOOR LOCK SWITCH ELECTRICAL
B CONNECTOR, OUTSIDE REMOTE CONTROL REARVIEW MIRROR SELECTOR SWITCH ELECTRICAL
C CONNECTOR, SIDE WINDOW SWITCH ELECTRICAL
92 PANEL ACCESSORY SWITCH
93 SWITCH, DOOR LOCK
94 SWITCH, SIDE WINDOW
114 SWITCH, OUTSIDE REMOTE CONTROL REARVIEW MIRROR SELECTOR
115 HARNESS, CROSSBODY AND FRONT SIDE DOOR WIRING

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Figure 8 – Accessory Switch Panel Assembly (Typical) – (Pontiac)

5. Accessory switch panel assembly or accessory switch opening cover assembly. Refer to "Accessory Switch Panel Assembly and Accessory Switch Opening Cover Assembly" in this section (Pontiac only).

Front Side Door Locking Rod Knob

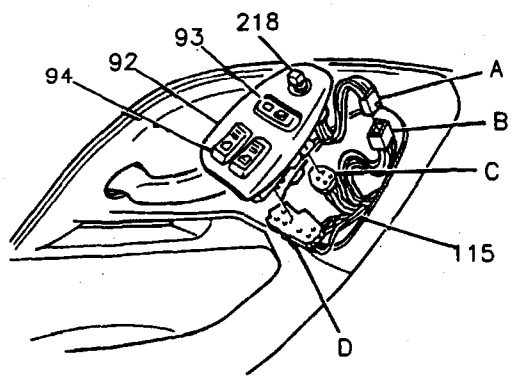
Figure 12

Remove or Disconnect

- Knob (32).
  A. Slide knob (32) forward.
  B. Insert a small flat-bladed tool behind end of knob (32) and pry it away from locking rod (49).

Install or Connect

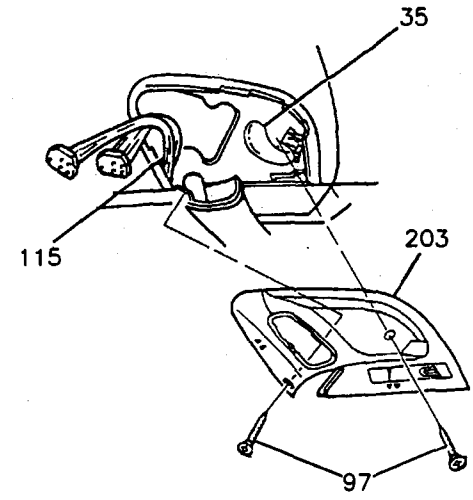
- Knob (32).
  A. Position knob (32) over locking rod (49) and insert end of knob (32) through hole in handle bezel.
  B. Slide knob (32) rearward over locking rod (49) until end of locking rod (49) fits into depression in knob (32).
  C. Snap knob (32) over locking rod (49).



A PIGTAIL, OUTSIDE REMOTE CONTROL REARVIEW MIRROR SELECTOR SWITCH
B CONNECTOR, OUTSIDE REMOTE CONTROL REARVIEW MIRROR SELECTOR SWITCH ELECTRICAL
C CONNECTOR, DOOR LOCK SWITCH ELECTRICAL
D CONNECTOR, SIDE WINDOW SWITCH ELECTRICAL
92 PANEL, ACCESSORY SWITCH
93 SWITCH, DOOR LOCK
94 SWITCH, SIDE WINDOW
115 HARNESS, CROSSBODY AND FRONT SIDE DOOR WIRING
218 SWITCH, OUTSIDE REMOTE CONTROL REARVIEW MIRROR SELECTOR

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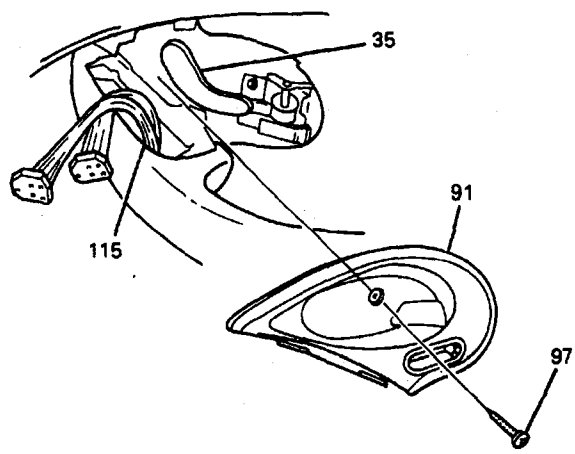
Figure 9 – Accessory Switch Panel Assembly (Typical) – (Chevrolet)



35 HANDLE, FRONT SIDE DOOR INSIDE
97 BOLT/SCREW, FRONT SIDE DOOR INSIDE HANDLE BEZEL
115 HARNESS, CROSSBODY AND FRONT SIDE DOOR WIRING
203 BEZEL, FRONT SIDE DOOR INSIDE HANDLE

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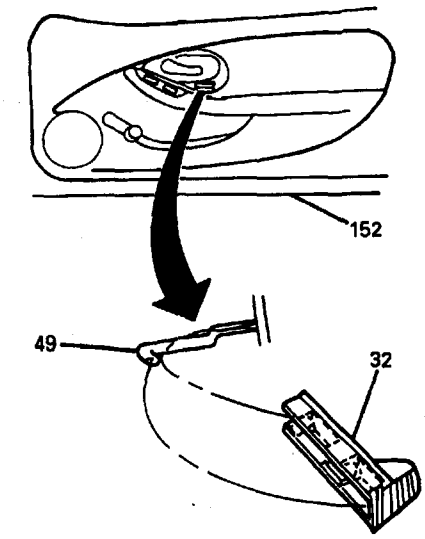
Figure 11 – Front Side Door Inside Handle Bezel (Right Shown, Left Similar) – (Chevrolet)



35 HANDLE ASSEMBLY, FRONT SIDE DOOR INSIDE
91 BEZEL, FRONT SIDE DOOR INSIDE HANDLE
97 BOLT/SCREW, FRONT SIDE DOOR INSIDE HANDLE BEZEL
115 HARNESS ASSEMBLY, CROSSBODY AND FRONT SIDE DOOR WIRING

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Figure 10 – Front Side Door Inside Handle Bezel (Right Shown, Left Similar) – (Pontiac)



32 KNOB, FRONT SIDE DOOR LOCKING ROD
49 ROD, FRONT SIDE DOOR LOCKING
152 DOOR ASSEMBLY, FRONT SIDE

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Figure 12 – Installing Front Side Door Locking Rod Knob (Typical)

FRONT SIDE DOOR EXTERIOR TRIM

Front Side Door Center Molding Assembly

Figures 13 and 14

For information and procedures on replacing adhesive molding assemblies, refer to SECTION 10-1. Refer to Figures 14 and 15 for correct placement of the molding assembly (117).

Front Side Door Emblem Assembly

Pontiac

Figure 15

Remove or Disconnect

Tool Required:
J 25070 Heat Gun

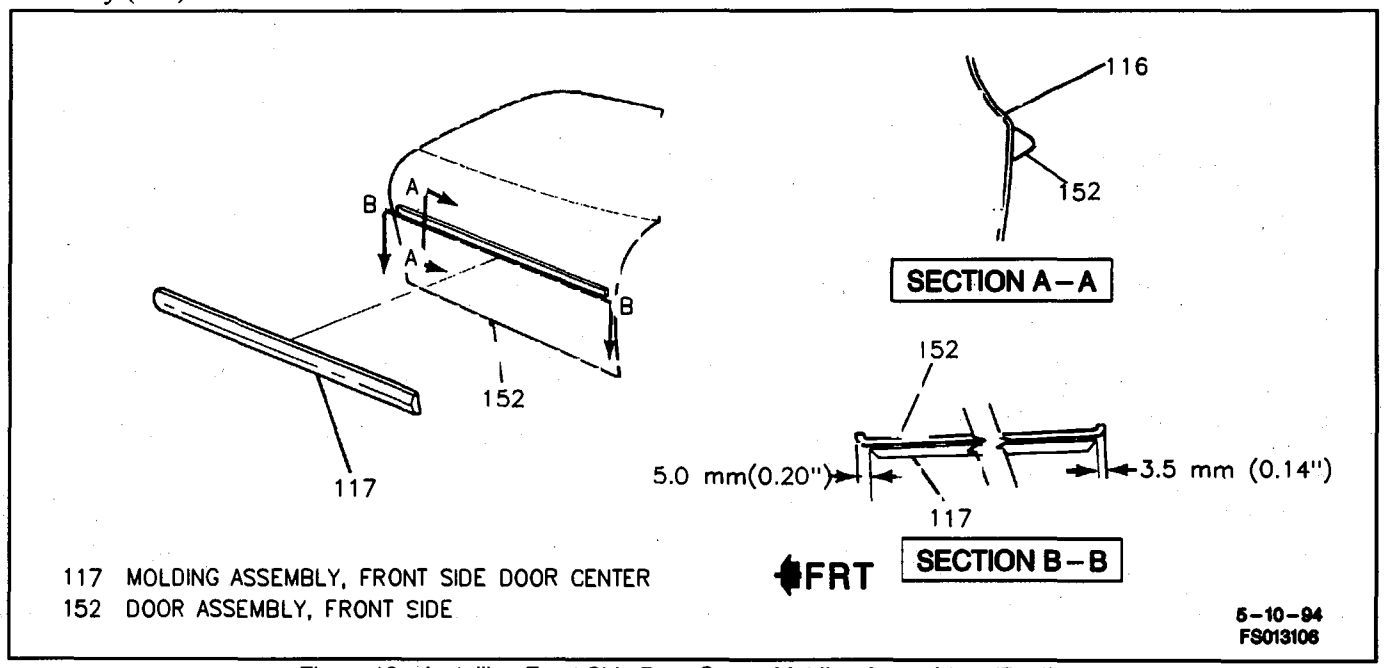


Figure 13 – Installing Front Side Door Center Molding Assembly – (Pontiac)

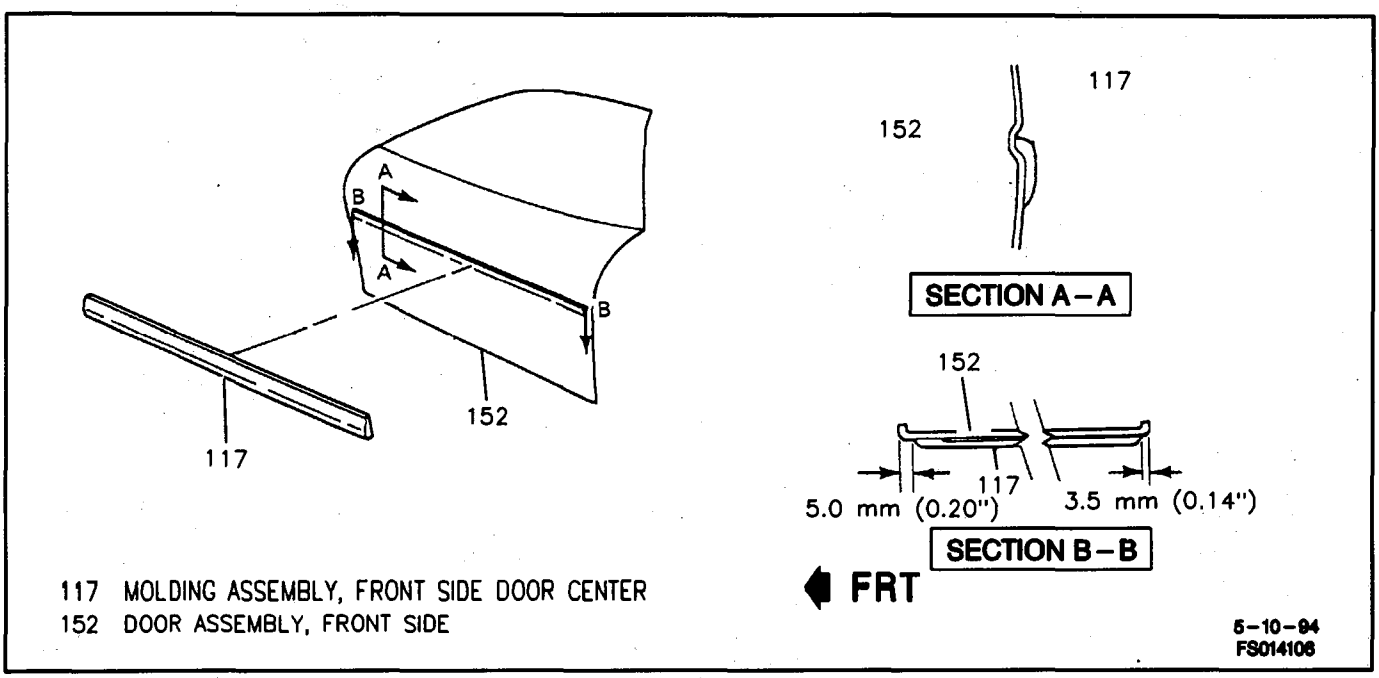
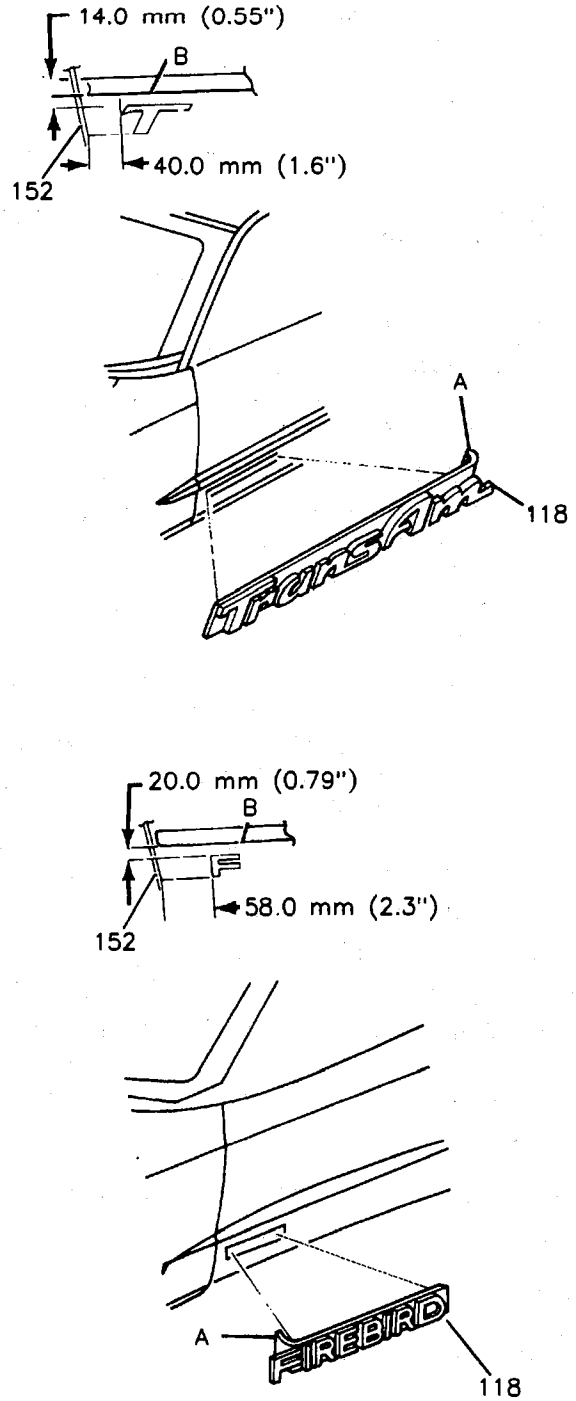


Figure 14 – Installing Front Side Door Center Molding Assembly – (Chevrolet)



A LINER, PROTECTIVE
B LOWER EDGE OF FRONT SIDE DOOR CENTER MOLDING
118 EMBLEM, FRONT SIDE DOOR
152 DOOR, FRONT SIDE

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Figure 15 – Installing Front Side Door Emblem Assembly – (Pontiac)

- Emblem assembly (118).
  - A. Hold J 25070 at least 152 mm (6 inches) from emblem assembly (118). Apply heat in an even and circular motion.
  - B. Pull emblem assembly (118) from door assembly (152) with flat-bladed tool, making sure not to damage paint.

Clean

1. Area with suitable solution of isopropyl alcohol 50/50 mixture by volume with water or high-flash naphtha.
2. Area with clean, dry cloth.

Install or Connect

- New emblem assembly (118).
  - A. Heat door assembly surface and adhesive side of new emblem assembly (118). Temperature must be 26°C (80°F) or 6°C (10°F) above air temperature in area, whichever is higher, but not exceeding 40°C (105°F).
  - B. Remove liner from adhesive strip.

Important

- Position emblem assembly (118) carefully. Emblem assembly (118) cannot be removed without reapplying adhesive after contact with vehicle.

  - C. Press emblem assembly (118) into place and apply pressure.

Door Edge Protector

Figure 16

Remove or Disconnect

Tool Required:

J 25070 Heat Gun

- Protector (78).
  - A. Hold J 25070 at least 152 mm (6 inches) from protector (78). Apply heat in an even and circular motion.
  - B. Peel protector (78) from door assembly (116) with flat-bladed tool, making sure not to damage paint.

Clean

1. Area with suitable solution of isopropyl alcohol 50/50 mixture by volume with water or high-flash naphtha.
2. Area with clean, dry cloth.

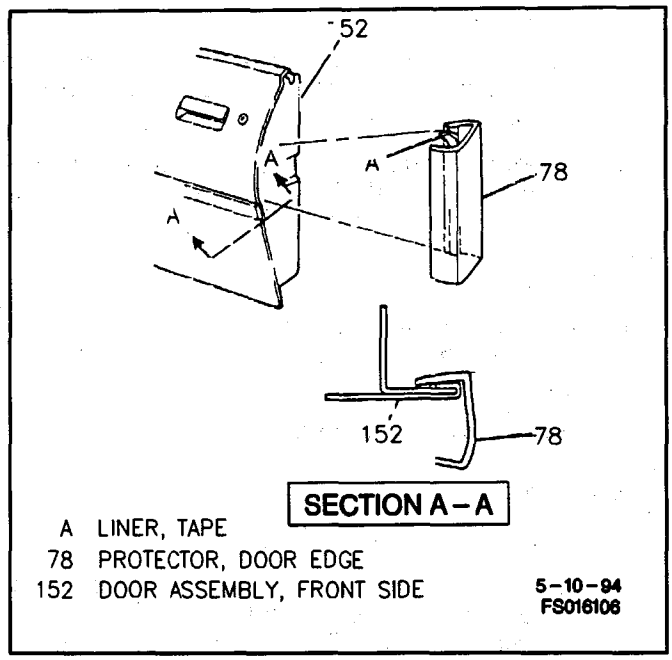


Figure 16 – Installing Door Edge Protector

Install or Connect

- Protector (78).
  A. Remove liner from protector (78).
  B. Line up top of protector (78) to bottom of handle assembly at outer edge of door assembly (116).

Important

- Be sure that inside corner of protector is against edge of door assembly.

  C. Press entire length of tape area to secure.

FRONT SIDE DOOR HARDWARE AND FRONT SIDE DOOR WINDOW

Front Side Door Weatherstrip Assembly

Figures 17 and 18

Remove or Disconnect

Tool Required:

J 21104-B Universal Weatherstrip Remover

1. Body hinge pillar trim panel. Refer to SECTION 10-5.
2. Windshield pillar trim panel. Refer to SECTION 10-5.
3. Rear quarter trim panel. Refer to SECTION 10-7.
4. Bolts/screws (124), if equipped.
5. Retainers (121) using J 21104-B.
6. Weatherstrip assembly (122).
   A. Pull weatherstrip assembly (122) from flange and weatherstrip retainer assemblies.
   B. Break adhesive bond at front belt with a flat-bladed tool.

Install or Connect

NOTICE: See "Notice" on page 10-6-1 of this section.

1. Remove protective liner from adhesive strip on weatherstip assembly (122).
2. Position weatherstrip assembly (122) at front belt.
3. Retainer (121) at front belt.
4. Weatherstrip assembly (122).
   A. Insert weatherstrip assembly (122) into retainer assembly up hinge pillar.
   B. Install retainer (121) at lock pillar belt.
   C. Insert weatherstrip assembly (122) into retainer assemblies up lock pillar and across roof assembly.
   D. Roll weatherstrip assembly (122) into retainer assembly.
      a. Starting at lock pillar belt, roll up to corner and back down to belt.
      b. Starting at lock pillar top corner, roll forward to front belt and back to lock pillar top corner.
   E. Insert weatherstrip assembly (122) into flange below belt at front, bottom and back.
   F. Roll entire length to seat.
5. Bolts/screws (124), if equipped.
6. Rear quarter trim panel. Refer to SECTION 10-7.
7. Windshield pillar trim panel. Refer to SECTION 10-5.
8. Body hinge pillar trim panel. Refer to SECTION 10-5.

Front Side Door Window Outer Sealing Strip Assembly

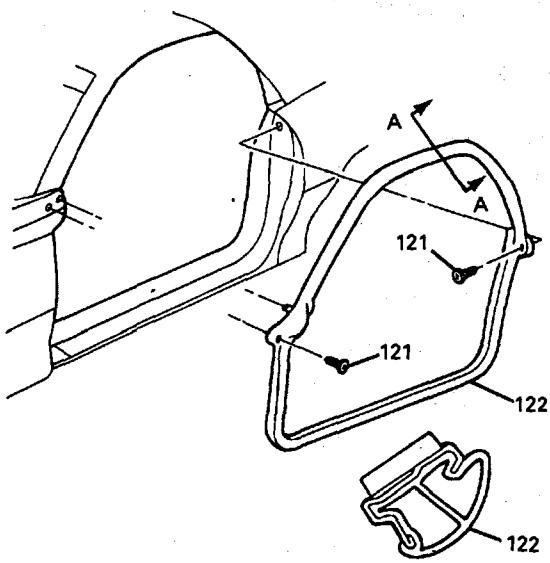
Figure 19

Remove or Disconnect

1. Lower window.
2. Sealing strip assembly (62) by pulling to release the spring clips.

Install or Connect

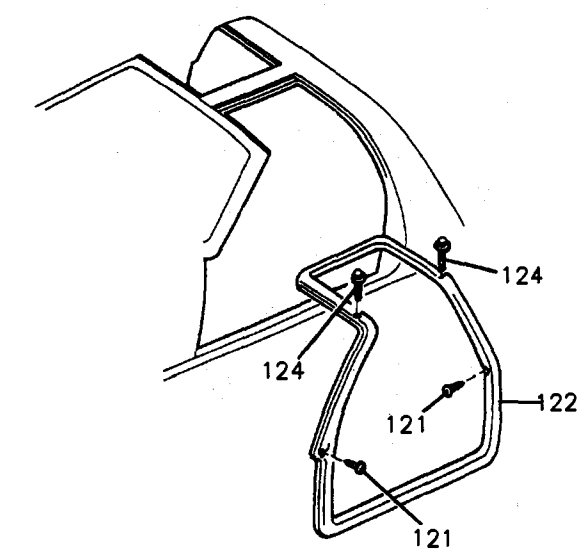
- Sealing strip assembly (62).
  A. Align spring clips to slots in door outer panel reinforcement and insert clips.
  B. Tap to secure clips.
  C. Ensure that sealing strip assembly (62) is seated flush to the door outer panel.



121 RETAINER, FRONT SIDE DOOR WEATHERSTRIP
122 WEATHERSTRIP ASSEMBLY, FRONT SIDE DOOR

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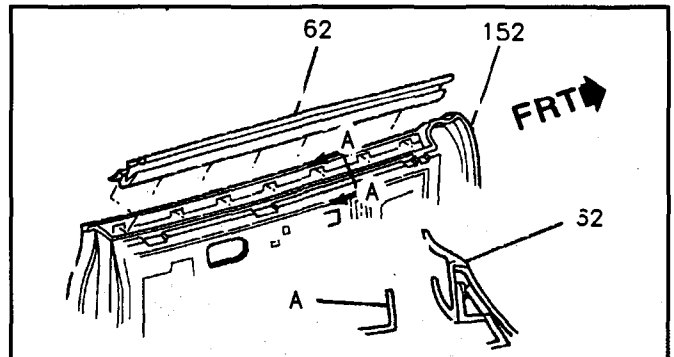
Figure 17 – Front Side Door Weatherstrip Assembly



121 RETAINER, FRONT SIDE DOOR WEATHERSTRIP
122 WEATHERSTRIP ASSEMBLY, FRONT SIDE DOOR
124 BOLT/SCREW, ROOF LIFT-OFF WINDOW BODY SIDE WEATHERSTRIP

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Figure 18 – Front Side Door Weatherstrip Assembly (With Roof Lift-Off Window Assemblies) (Typical)



A DOOR INNER PANEL
62 SEALING STRIP ASSEMBLY, FRONT SIDE DOOR WINDOW OUTER
152 DOOR ASSEMBLY, FRONT SIDE

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Figure 19 – Front Side Door Window Outer Sealing Strip Assembly

Front Side Door Window Inner Sealing Strip

Figures 3 through 5

Remove or Disconnect

1. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
2. Inner sealing strip (88) by removing staples.

Install or Connect

1. Inner sealing strip (88) to trim assembly (89).
2. Staples to secure inner sealing strip (88) to trim assembly (89).
3. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

Front Side Door Front and Rear Belt Seals

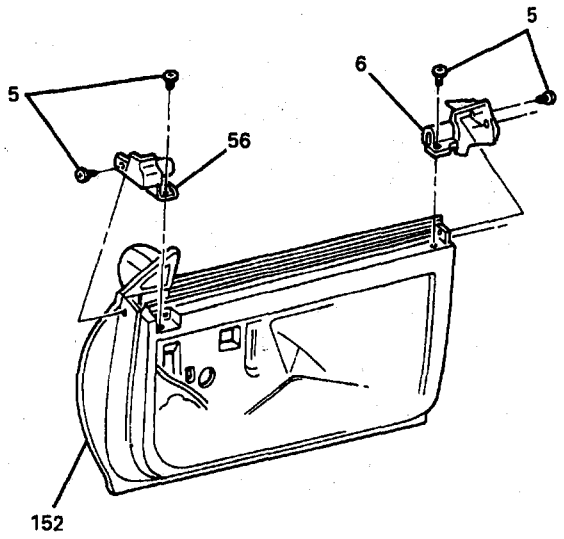
Figure 20

Remove or Disconnect

1. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
2. Retainers (5) by prying out with a flat-bladed tool.
   - Discard retainers (5).
3. Seal (6 or 56).

Install or Connect

1. Seal (6 or 56).
2. New retainers (5).
3. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.



5 RETAINER, FRONT SIDE DOOR FRONT BELT SEAL
6 SEAL, FRONT SIDE DOOR REAR BELT
56 SEAL, FRONT SIDE DOOR FRONT BELT
152 DOOR ASSEMBLY, FRONT SIDE

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Figure 20 – Front Side Door Front and Rear Belt Seals (Typical)

Front Side Door Bottom Auxiliary Sealing Strip

Figure 21

Remove or Disconnect

Tool Required:
J 25070 Heat Gun

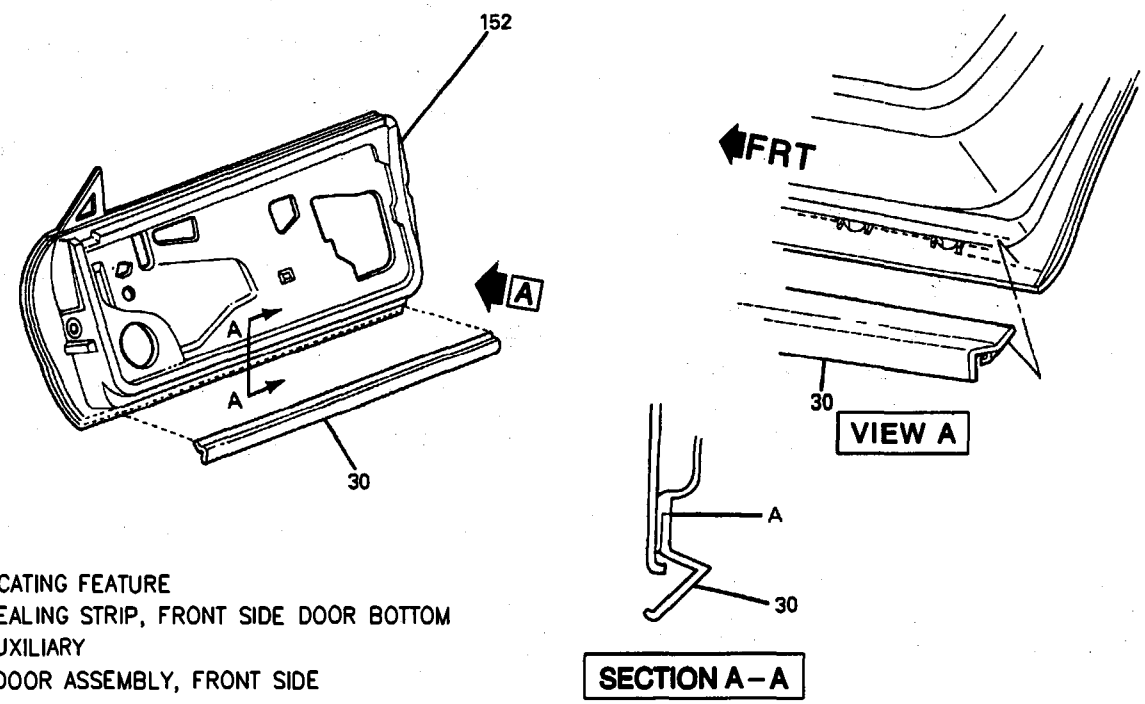
- Sealing strip (30).
  - A. Hold J 25070 at least 152 mm (6 inches) from sealing strip (30). Apply heat in an even and circular motion.
  - B. Pull sealing strip (30) from door assembly (152) with flat-bladed tool, making sure not to damage paint.

Clean

1. Area with suitable solution of isopropyl alcohol 50/50 mixture by volume with water or high-flash naphtha.
2. Area with clean, dry cloth.

Install or Connect

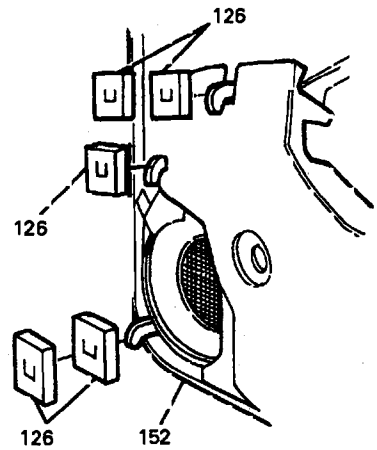
- New sealing strip (30).
  - A. Heat door surface and adhesive side of new sealing strip (30). Temperature must be 35°C ± 3°C (95°F ± 5°F).
  - B. Remove protective liner from adhesive strip.



A LOCATING FEATURE
30 SEALING STRIP, FRONT SIDE DOOR BOTTOM AUXILIARY
152 DOOR ASSEMBLY, FRONT SIDE

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Figure 21 – Installing Front Side Door Bottom Auxiliary Sealing Strip (Typical)



126 SEAL, FRONT SIDE DOOR TRIM PANEL RETAINER
152 DOOR ASSEMBLY, FRONT SIDE

5-10-94
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Figure 22 – Front Side Door Trim Panel Retainer Seals (Typical)

Important

- Position sealing strip carefully. Sealing strip cannot be removed without reapplying adhesive after contact with vehicle.

C. Align sealing strip (30) to locating feature starting at rear edge of door inner panel.

D. Press sealing strip (30) into place and apply pressure along entire surface.

Front Side Door Trim Panel Retainer Seals

Figure 22

Remove or Disconnect

1. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
2. Seals (126).

Install or Connect

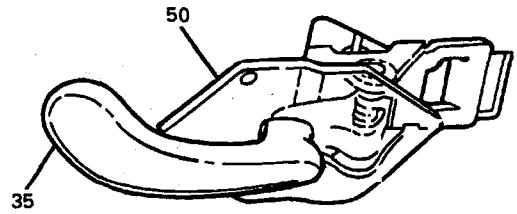
1. Seals (126).
2. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

Front Side Door Inside Handle Seal

Figure 23

Remove or Disconnect

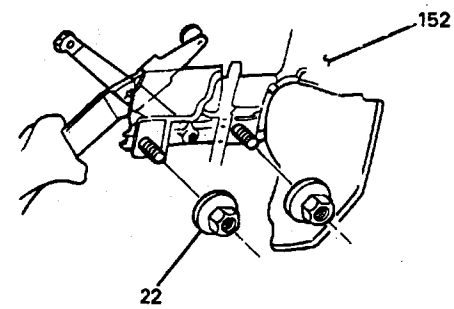
1. Front side door inside handle bezel. Refer to "Front Side Door Inside Handle Bezel" in this section.



35 HANDLE ASSEMBLY, FRONT SIDE DOOR INSIDE
50 SEAL, FRONT SIDE DOOR INSIDE HANDLE

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Figure 23 – Front Side Door Inside Handle Seal



22 NUT, FRONT SIDE DOOR WINDOW REGULATOR COUNTERBALANCE ARM CHANNEL
152 DOOR ASSEMBLY, FRONT SIDE

5-10-94
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Figure 24 – Removing Front Side Door Window Regulator Counterbalance Arm Channel Nuts (Typical)

2. Seal (50).

Install or Connect

1. Seal (50) and press down to base of handle assembly (35).
   - Install seal (50) with smooth side toward door inner panel.
2. Front side door inside handle bezel. Refer to "Front Side Door Inside Handle Bezel" in this section.

Front Side Door Window Regulator Counterbalance Arm Channel Assembly

Figures 24 and 25

Remove or Disconnect

1. Raise window.
2. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
3. Front side door water deflector as needed. Refer to "Front Side Door Water Deflector" in this section.

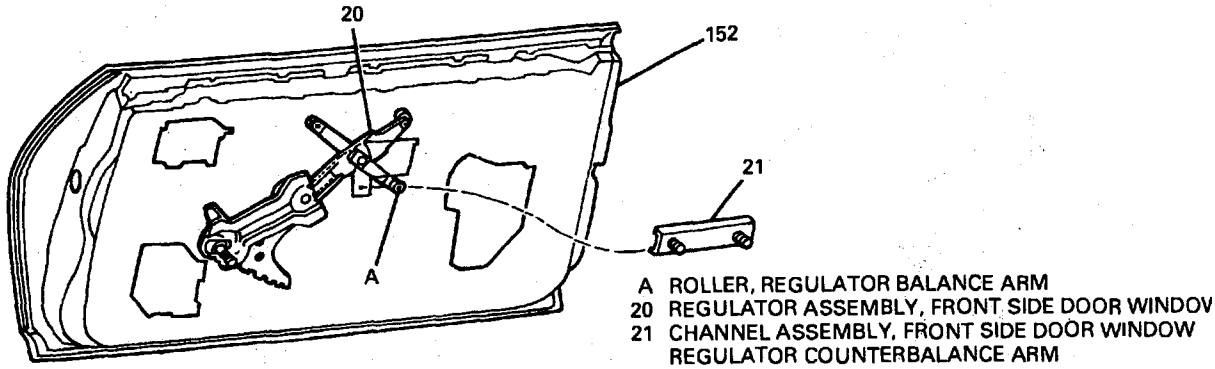


Figure 25 – Removing Front Side Door Window Regulator Counterbalance Arm Channel Assembly (Typical)

4. Nuts (22) attaching channel assembly (21) to door inner panel.
5. Channel assembly (21) from window regulator balance arm roller.
6. Channel assembly (21) through access hole.

Install or Connect

NOTICE: See "Notice" on page 10-6-1 of this section.

1. Channel assembly (21) through access hole to window regulator balance arm roller.
2. Channel assembly (21) to door inner panel.
3. Nuts (22).

Tighten

- Nuts (22) to 10 N•m (89 lb. in.).

4. Front side door water deflector. Refer to "Front Side Door Water Deflector" in this section.
5. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

Front Side Door Window Channel Assembly and Front Side Door Window Rear Guide Channel Assembly

Figures 26 and 27

Remove or Disconnect

1. Front side door window. Refer to "Front Side Door Window" in this section.
2. Nuts (27 and 29).
3. Channel assembly (18) with rear guide channel assembly (28) attached from regulator rollers.
4. Channel assembly (18) through access hole.
5. Rear guide channel assembly (28) from channel roller.

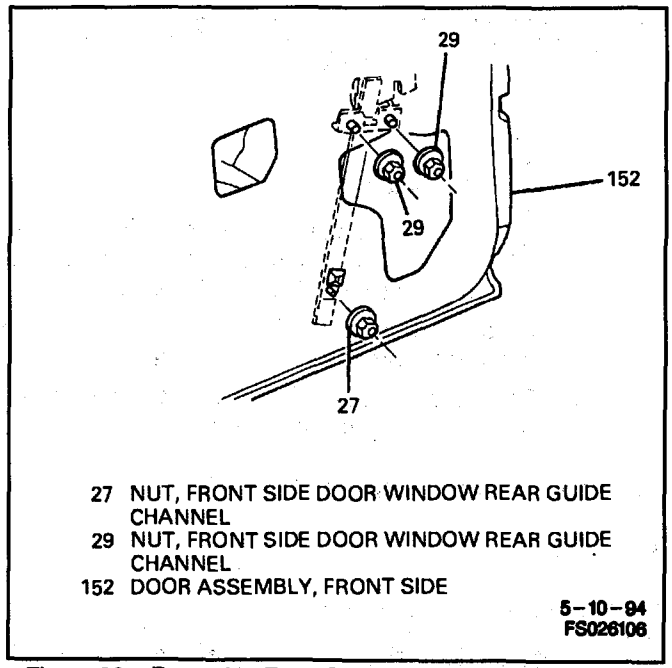


Figure 26 – Removing Front Side Door Window Rear Guide Channel Nuts (Typical)

Install or Connect

NOTICE: See "Notice" on page 10-6-1 of this section.

1. Rear guide channel assembly (28) to channel roller.
2. Channel assembly (18) with rear guide channel assembly (28) through access hole, allowing rear guide channel assembly (28) to drop.
3. Channel assembly (18) to regulator rollers.
   A. Insert front of channel assembly (18) onto front regulator roller.
   B. Push forward until rear edge of channel assembly (18) lines up with rear roller.

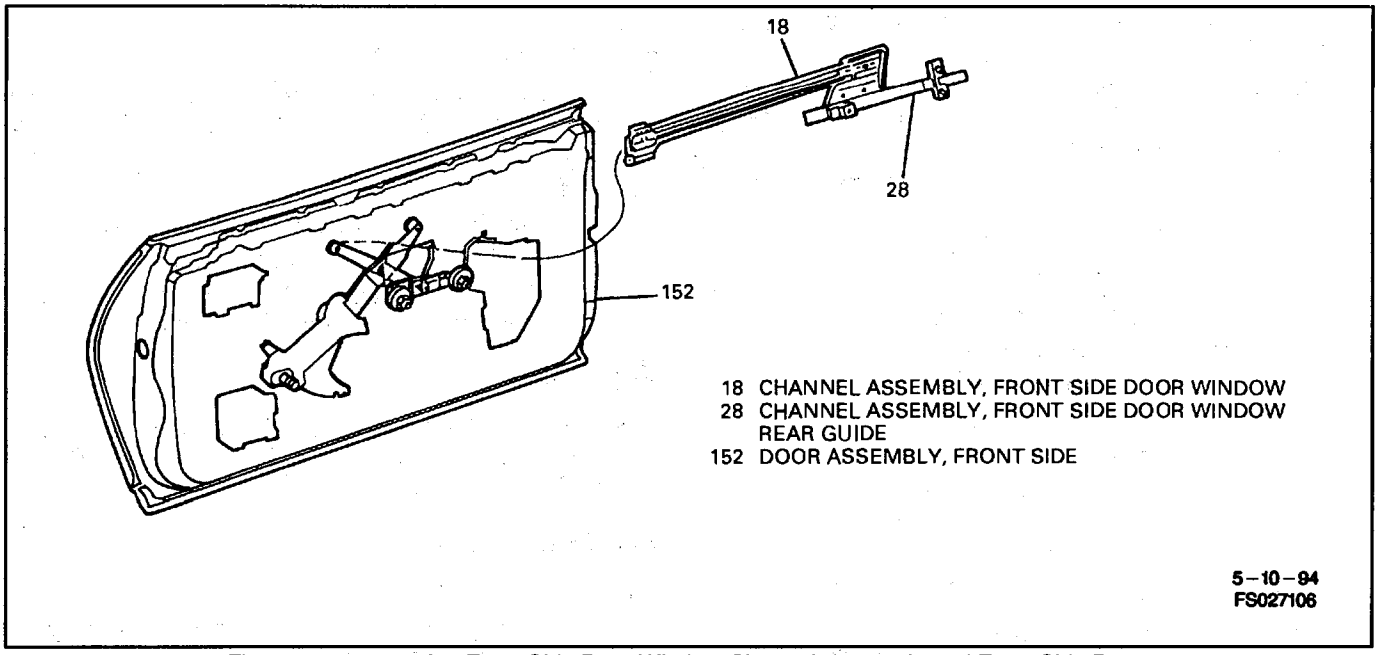


Figure 27 – Removing Front Side Door Window Channel Assembly and Front Side Door Window Rear Guide Channel Assembly (Typical)

C. Insert rear roller onto channel assembly (18) by pushing rearward.

4. Align studs on rear guide channel assembly (28) to slots in door inner panel.
5. Nuts (27 and 29).

Tighten

- Nut (27) to 10 N•m (89 lb. in.).
- Nuts (29) to 27 N•m (20 lb. ft.).

6. Front side door window. Refer to "Front Side Door Window" in this section.

Side Window, Outside Remote Control Rearview Mirror Selector and Door Lock Switches

Figures 28 and 29

Remove or Disconnect

1. Accessory switch panel assembly. Refer to "Accessory Switch Panel Assembly" in this section.
2. Switch (93, 94 or 114) on Pontiac or switch (93, 94 or 218) on Chevrolet by prying with a flat-bladed tool to release switch (93, 94, 114, or 218) from panel assembly (92).

Install or Connect

1. Switch (93, 111, 114, or 218) into panel assembly (92).
2. Accessory switch panel assembly. Refer to "Accessory Switch Panel Assembly" in this section.

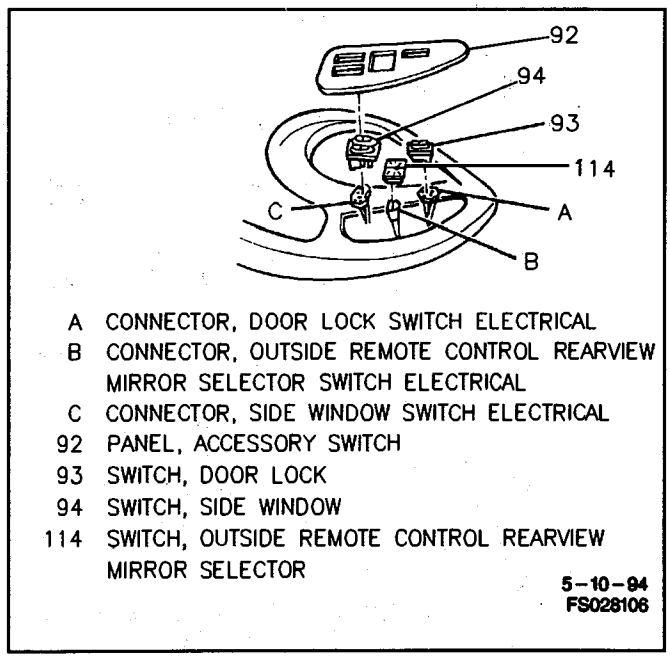


Figure 28 – Removing Switches (Typical) – (Pontiac)

Front Side Door Water Deflector

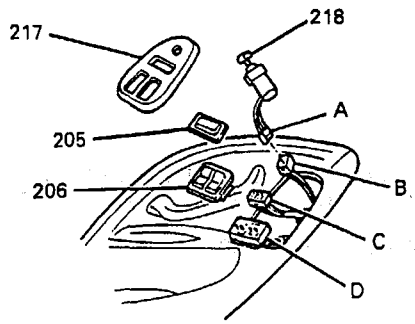
Figure 30

Whenever work is performed where the deflector (86) is disturbed, the deflector (86) must be properly sealed and taped to the door inner panel to prevent waterleaks. For service sealing, strip caulking is recommended if additional sealing material is required.

When access to the door inner panel is required to perform service operations, the deflector (86) may be completely or partially detached from the door inner panel. If the existing deflector (86) is damaged so that it

will not properly seal the door assembly, replace the deflector (86).

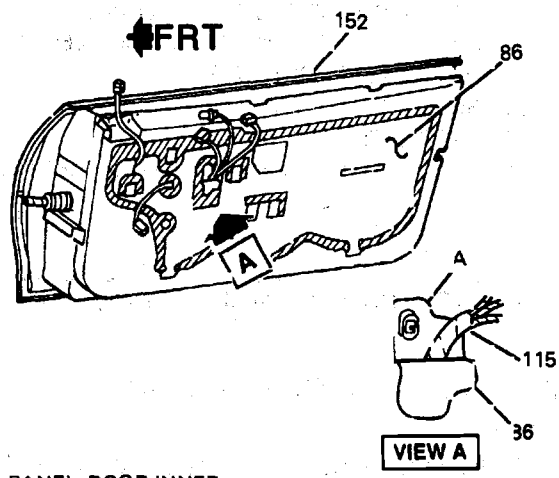
If only partial removal of the deflector (86) is required, perform only the steps that are necessary to expose the required area of the door inner panel.



A PIGTAIL, OUTSIDE REMOTE CONTROL REARVIEW MIRROR SELECTOR SWITCH
B CONNECTOR, OUTSIDE REMOTE CONTROL REARVIEW MIRROR SELECTOR SWITCH ELECTRICAL
C CONNECTOR, DOOR LOCK SWITCH ELECTRICAL
D CONNECTOR, SIDE WINDOW SWITCH ELECTRICAL
92 PANEL, ACCESSORY SWITCH
93 SWITCH, DOOR LOCK
94 SWITCH, SIDE WINDOW
218 SWITCH, OUTSIDE REMOTE CONTROL REARVIEW MIRROR SELECTOR

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Figure 29 – Removing Switches (Typical) – (Chevrolet)



A PANEL, DOOR INNER
86 DEFLECTOR, FRONT SIDE DOOR WATER
115 HARNESS ASSEMBLY, CROSSBODY AND FRONT SIDE DOOR WIRING
152 DOOR ASSEMBLY, FRONT SIDE

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Figure 30 – Front Side Door Water Deflector (Typical)

Remove or Disconnect

1. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
2. Deflector (86).
   A. Break the sealer bond with a flat-bladed tool.
   B. Peel tape from door inner panel.
   C. Disconnect tabs on lower edge of deflector (86) from slots in door inner panel.

Inspect

- Deflector (86) for tears or holes. Repair using waterproof body tape on both sides of deflector (86) or replace deflector (86).

Install or Connect

1. Deflector (86).
   A. Apply continuous bead of string sealer to guide water to drain slots.
   B. Align arrows on deflector (86) at upper outer comers to front and rear of door inner panel.
   C. Slick down top of deflector (86).
   D. Pull electrical connectors through appropriate holes or slots in deflector (86).
   E. Slick outer edge of deflector (86) to door inner panel working downward to bottom edge.
   F. Insert tabs into retaining slots and slick.
2. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

Outside Rearview Mirror Assembly

Figures 31 and 32

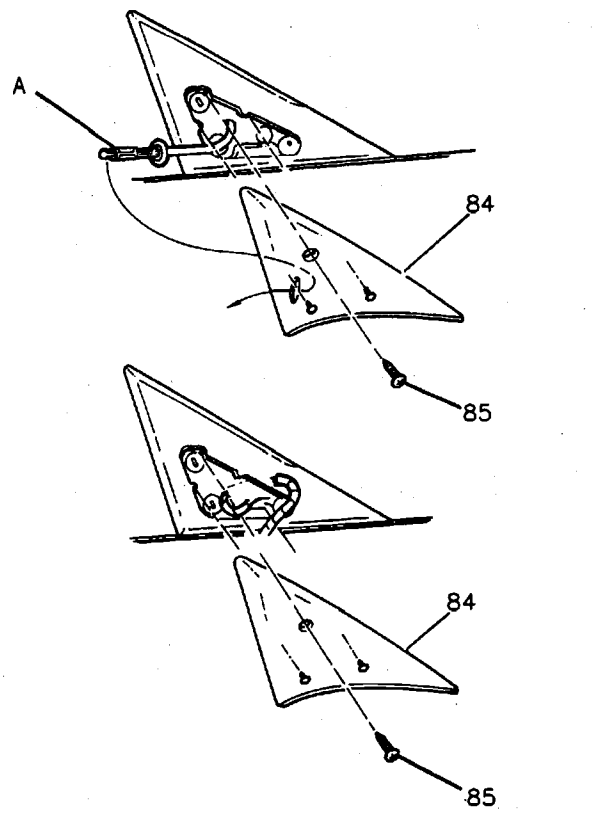
Remove or Disconnect

1. Bolt/screw (85).
2. Bezel assembly (84).
3. Remote handle from bezel assembly (84), if equipped.
4. Front side door trim assembly, if equipped with electric control mirror assemblies. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
5. Electrical connector, if equipped.
   A. Pull rosebud clip on electrical connector from mirror assembly (109).
   B. Pull apart connection.
6. Nuts (101).
7. Mirror assembly (109).

Install or Connect

NOTICE: See "Notice" on page 10-6-1 of this section.

1. Mirror assembly (109).



A HANDLE, OUTSIDE REARVIEW MIRROR REMOTE
84 BEZEL ASSEMBLY, OUTSIDE REARVIEW MIRROR
85 BOLT/SCREW, OUTSIDE REARVIEW MIROR BEZEL

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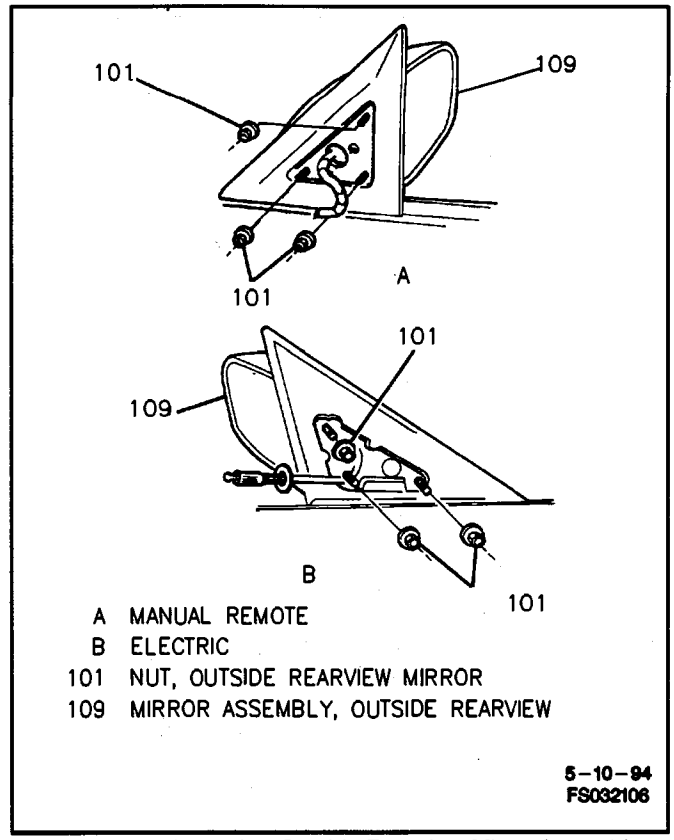
Figure 31 – Removing Outside Rearview Mirror Bezel Assembly (Typical)

2. Nuts (101).

Tighten

- Nuts (101) to 6 N•m (53 lb. in.).

3. Electrical connector, if equipped.
   A. Connect electrical connector.
   B. Push rosebud clip on electrical connector into hole in mirror assembly (109).
4. Front side door trim assembly, if removed. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
5. Remote handle to bezel assembly (84), if equipped.
   A. Align slot in remote handle to tab on bezel assembly (84).
   B. Push remote handle into bezel assembly (84) to engage threads on remote handle onto metal clip in bezel assembly (84).
6. Bezel assembly (84).



A MANUAL REMOTE
B ELECTRIC
101 NUT, OUTSIDE REARVIEW MIRROR
109 MIRROR ASSEMBLY, OUTSIDE REARVIEW

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Figure 32 – Removing Outside Rearview Mirror Assembly (Typical)

- Align retainers in bezel assembly (84) to holes in applique assembly.

7. Bolt/screw (85).

Tighten

- Bolt/screw (85) to 4 N•m (35 lb. in.).

Outside Rearview Mirror Reflective Glass

Electric

Figure 33

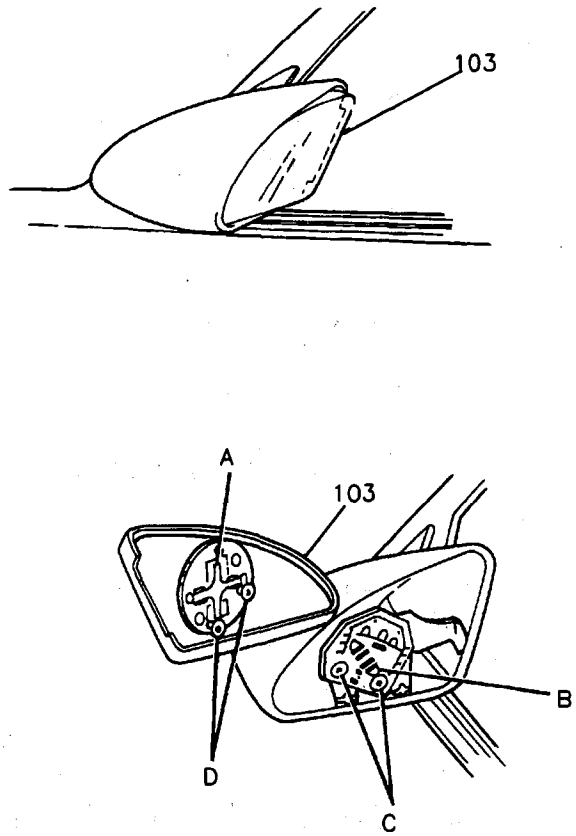
Remove or Disconnect

CAUTION: To minimize the chance of personal injury, gloves and safety glasses should be worn when removing broken glass.

1. Move mirror assembly to extreme outboard travel position.
2. Glass (108) by inserting finger at slot on inboard side of mirror assembly and pulling out.
3. Jackscrews and trunnion bar from motor pack unit.

Inspect

- Motor pack unit. If damaged, replace mirror assembly. Refer to "Outside Rearview Mirror Assembly" in this section.



A TRUNNION, OUTSIDE REARVIEW MIRROR
B RECEPTOR, OUTSIDE REARVIEW MIRROR
C RECEPTOR, JACKSCREW
D JACKSCREW
103 GLASS, OUTSIDE REARVIEW MIRROR REFLECTIVE TRUNNION

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Figure 33 – Outside Rearview Mirror Reflective Glass (Electric) (Typical)

Install or Connect

1. Jackscrews and trunnion bar to new glass (103).
2. New glass (103).
   A. Align jackscrews perpendicular to glass (103).
   B. Align trunnion bar parallel to glass (103).
   C. Position end of jackscrews at opening approximately 13 mm (1/2 inch) into motor pack unit.
   D. Visually align trunnion bar with receptor by lifting inboard corner of glass (103).
   E. Apply pressure with palm of hand until glass (103) is seated firmly to receptor.
   F. Manually rotate glass (103) to check for proper installation.

Manual

Remove or Disconnect

CAUTION: To minimize the chance of personal injury, gloves and safety glasses should be worn when removing broken glass.

NOTICE: When breaking glass, cover door area surrounding glass to avoid damage to paint.

- Glass.
  A. Place tape over glass.
  B. Break glass.
  C. Remove broken pieces from mirror assembly.

Clean

- Inside of mirror assembly with clean cloth.

Install or Connect

- Glass.
  A. Remove protective liner to expose adhesive.
  B. Press glass firmly onto center of mirror assembly.

Manual Remote Control

The reflective glass on the outside rearview mirror assembly with manual remote control is not serviceable. If the glass is broken, replace the mirror assembly. Refer to "Outside Rearview Mirror Assembly" in this section.

Outside Rearview Mirror Applique Assembly

Figure 34

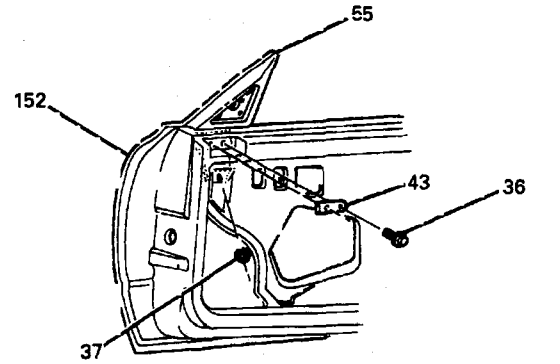
Remove or Disconnect

1. Lower window.
2. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
3. Front side door water deflector as needed. Refer to "Right Front Side Door Water Deflector" in this section.
4. Outside rearview mirror assembly. Refer to "Outside Rearview Mirror Assembly" in this section.
5. Nut (37).
6. Bolts/screws (36).
7. Washer (43).
8. Applique assembly (55).

Install or Connect

NOTICE: See "Notice" on page 10-6-1 of this section.

1. Applique assembly (55) through opening between door inner panel and door outer panel.
2. Washer (43) and bolts/screws (36).



36 BOLT/SCREW, OUTSIDE REARVIEW MIRROR APPLIQUE
37 NUT, OUTSIDE REARVIEW MIRROR OPENING APPLIQUE
43 WASHER, OUTSIDE REARVIEW MIRROR APPLIQUE
55 APPLIQUE ASSEMBLY, OUTSIDE REARVIEW MIRROR
152 DOOR ASSEMBLY, FRONT SIDE

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Figure 34 – Removing Outside Rearview Mirror Applique Assembly (Typical)

Tighten

- Bolts/screws (36) to 6 N•m (53 lb. in.).

3. Nut (37).

Tighten

- Nut (37) to 6 N•m (53 lb. in.).

4. Outside rearview mirror assembly. Refer to "Outside Rearview Mirror Assembly" in this section.
5. Front side door water deflector. Refer to "Front Side Door Water Deflector" in this section.
6. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

Inspect

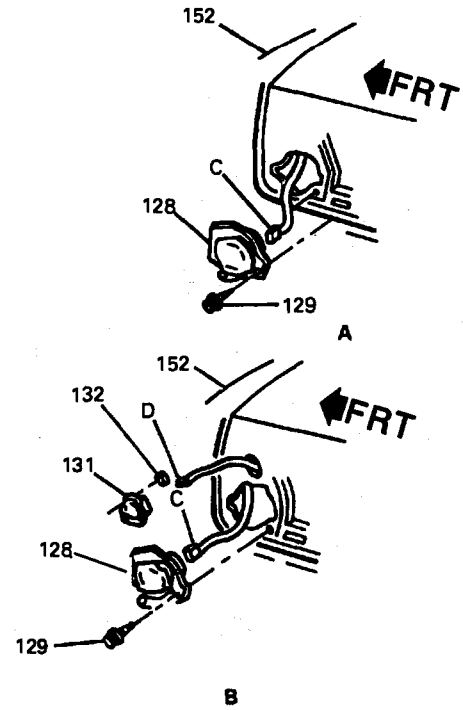
- If front side door window squeaks in outside rearview mirror applique window channel while returning to up position, lubricate channel using GM P/N 9981599 (Sol Anti-Squeak Compound) or equivalent.

Radio Front Side Door Speaker Assembly

Figures 35 and 36

Remove or Disconnect

1. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
2. Front side door water deflector as needed. Refer to "Front Side Door Water Deflector" in this section.



A WITH DUAL FRONT DOOR-MOUNTED SPEAKERS
B WITH QUAD FRONT DOOR-MOUNTED SPEAKERS
C CONNECTOR, RADIO FRONT SIDE DOOR SPEAKER ELECTRICAL
D CONNECTOR, RADIO FRONT SIDE DOOR (TWEETER) SPEAKER ELECTRICAL
128 SPEAKER ASSEMBLY, RADIO FRONT SIDE DOOI
129 BOLT/SCREW, RADIO FRONT SIDE DOOR SPEAKER
131 SPEAKER ASSEBMLY, RADIO FRONT SIDE DOOR (TWEETER)
132 NUT, RADIO FRONT SIDE DOOR (TWEETER) SPEAKER
152 DOOR ASSEMBLY, FRONT SIDE

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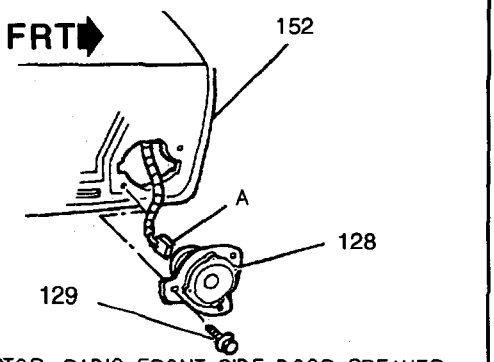
Figure 35 – Removing Radio Front Side Door Speaker Assemblies – (Pontiac)

3. Bolts/screws (129).
4. Speaker assembly (128).
5. Electrical connector.

Install or Connect

NOTICE: See "Notice" on page 10-6-1 of this section.

1. Electrical connector.
2. Speaker assembly (128).
3. Bolts/screws (129).
4. Front side door water deflector. Refer to "Front Side Door Water Deflector" in this section.
5. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.



A CONNECTOR, RADIO FRONT SIDE DOOR SPEAKER ELECTRICAL
128 SPEAKER, RADIO FRONT SIDE DOOR
129 BOLT/SCREW, RADIO FRONT SIDE DOOR SPEAKER
152 DOOR, FRONT SIDE

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Figure 36 – Removing Radio Front Side Door Speaker Assembly – (Chevrolet)

Radio Front Side Door (Tweeter) Speaker Assembly

Pontiac

Figure 35

Remove or Disconnect

1. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
2. Nuts (132).
3. Speaker assembly (131).

Install or Connect

NOTICE: See "Notice" on page 10-6-1 of this section.

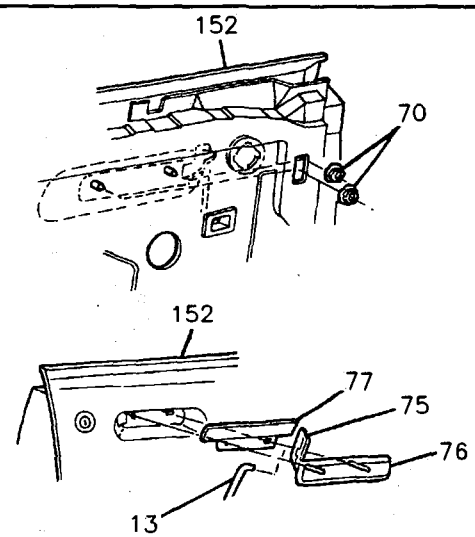
1. Speaker assembly (131).
2. Nuts (132).
3. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

Front Side Door Outside Handle Assembly

Figure 37

Remove or Disconnect

1. Raise window.
2. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
3. Front side door water deflector as needed. Refer to "Front Side Door Water Deflector" in this section.
4. Handle rod (13) from fastener on clip (75).
5. Handle rod (13) from clip (75).



13 ROD, FRONT SIDE DOOR OUTSIDE HANDLE
70 NUT, FRONT SIDE DOOR OUTSIDE HANDLE
75 CLIP, FRONT SIDE DOOR OUTSIDE HANDLE
76 HANDLE, FRONT SIDE DOOR OUTSIDE
77 FILLER, FRONT SIDE DOOR OUTSIDE HANDLE
152 DOOR, FRONT SIDE

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Figure 37 – Front Side Door Outside Handle Assembly (Typical)

6. Nuts (70).
7. Handle assembly (76) from door outer panel.
8. Filler (77) from handle assembly (76).

Install or Connect

NOTICE: See "Notice" on page 10-6-1 of this section.

1. Filler (77) to handle assembly (76).
2. Handle assembly (76) to door outer panel.
   A. Hold handle assembly (76) in open position and insert studs through holes in door outer panel.
   B. Move handle assembly (76) rearward into slots and press.
3. Nuts (70).

Tighten

- Nuts (70) to 7 N•m (62 lb. in.).

4. Handle rod (13) into clip (75) on handle assembly (76).
5. Handle rod (13) onto fastener on clip (75).
6. Front side door water deflector. Refer to "Front Side Door Water Deflector" in this section.
7. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

Front Side Door Inside Handle Assembly

Figure 38

Remove or Disconnect

1. Raise window.
2. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
3. Front side door inside handle seal. Refer to "Front Side Door Inside Handle Seal" in this section.
4. Front side door water deflector as needed. Refer to "Front Side Door Water Deflector" in this section.
5. Rivet (34).
   A. Tap rivet mandrel until it falls out of rivet (34).
   B. Drill out rivet (34) with 3/16-inch drill bit.
   C. Remove rivet fragments from hole.
6. Handle assembly tab from door inner panel slot by sliding handle assembly (35) rearward.
7. Rod assembly (47) from fastener on clip (46).
8. Rod assembly (47) from clip (46).
9. Handle assembly (35) from door inner panel.
10. Clip (46) from handle assembly (35).
    - Use needlenose pliers to squeeze clip (46) and push from handle assembly (35).

Inspect

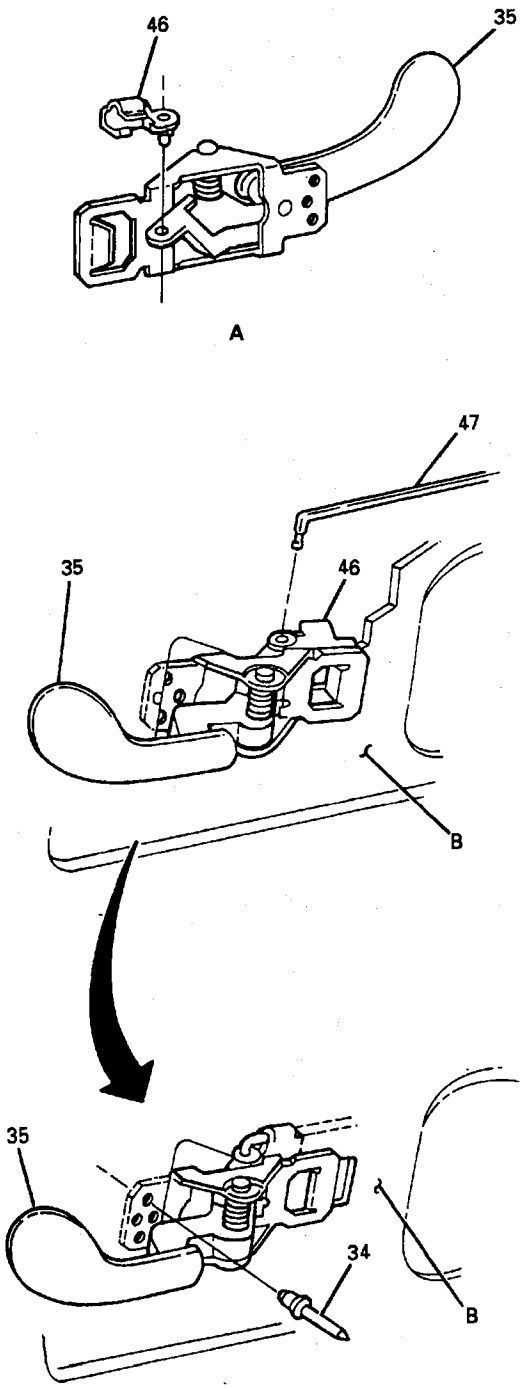
- Clip (46).

Important

- If clip (46) is damaged, it must be replaced. Use GM P/N 16627328 (left-hand) or GM P/N 9835133 (right-hand).

Install or Connect

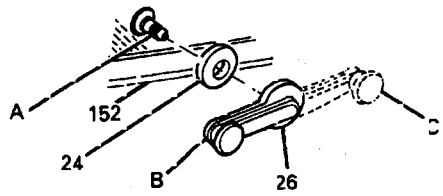
1. Clip (46) into handle assembly (35).
2. Handle assembly (35) to door inner panel.
   - Rotate front of handle assembly (35) into slot.
3. Rod assembly (47) into clip (46) on handle assembly (35).
4. Rod assembly (47) onto fastener on clip (46).
5. Tab on handle assembly (35) into slot on door inner panel by rotating and sliding forward.
6. Align hole in handle assembly (35) with hole in door inner panel.
7. Rivet (34).
8. Front side door water deflector. Refer to "Front Side Door Water Deflector" in this section.
9. Front side door inside handle seal. Refer to "Front Side Door Handle Inside Handle Seal" in this section.
10. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.



A OUTSIDE VEHICLE
B DOOR INNER PANEL
34 RIVET, FRONT SIDE DOOR INSIDE HANDLE
35 HANDLE ASSEMBLY, FRONT SIDE DOOR INSIDE
46 CLIP, FRONT SIDE DOOR INSIDE HANDLE ROD
47 ROD ASSEMBLY, FRONT SIDE DOOR INSIDE HANDLE

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Figure 38 – Installing Front Side Door Inside Handle Assembly



A SPINDLE, REGULATOR
B FRONT SIDE DOOR WINDOW UP
C FRONT SIDE DOOR WINDOW DOWN
24 SPACER, FRONT SIDE DOOR WINDOW REGULATOR HANDLE
26 HANDLE ASSEMBLY, FRONT SIDE DOOR WINDOW REGULATOR
152 DOOR ASSEMBLY, FRONT SIDE

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Figure 39 – Front Side Door Window Regulator Handle Assembly (Typical)

Front Side Door Window Regulator Handle Assembly

Figure 39

Remove or Disconnect

Tool Required:

J 9886-01 Door Handle Clip Remover

1. Handle assembly (26) by pushing J 9886-01 between handle assembly (26) and spacer (24) to release clip.
2. Spacer (24) from spindle.

Install or Connect

1. Spacer (24) to spindle.

   NOTICE: Strike handle assembly with mallet at hub when installing to avoid damage.
2. Handle assembly (26).
   A. Position handle assembly (26) to spindle pointing forward if window assembly is up, or rearward if window assembly is down.
   B. Tap handle assembly (26) with mallet until snap ring in handle assembly (26) engages groove in spindle.

Front Side Door Lock Assembly

Figure 40

CAUTION: Do not attempt to repair a broken lock assembly. A lock malfunction may result in serious bodily injury. A broken lock assembly must be replaced.

Remove or Disconnect

1. Raise window.
2. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
3. Front side door water deflector as needed. Refer to "Front Side Door Water Deflector" in this section.
4. Electrical connector from lock assembly (9), if equipped.
5. Inside handle rod assembly (47) from clip (15).
6. Clip (15) using needlenose pliers.
   - Discard clip (15).
7. Locking rod (49) from clip (17).
8. Clip (17) using needlenose pliers.
   - Discard clip (17).
9. Outside handle rod (13) from retainer (12).
   A. Use right-angle needlenose pliers to squeeze retainer tabs and pull retainer (12) through hole.
   B. Unscrew retainer (12) from outside handle rod (13).
      - Discard retainer (12).
10. Lock cylinder rod (14) from clip (11).
11. Clip (11) from lock assembly (9) using needlenose pliers.
    - Discard clip (11).
12. Bolts/screws (10).
13. Lock assembly (9) through access hole.

Install or Connect

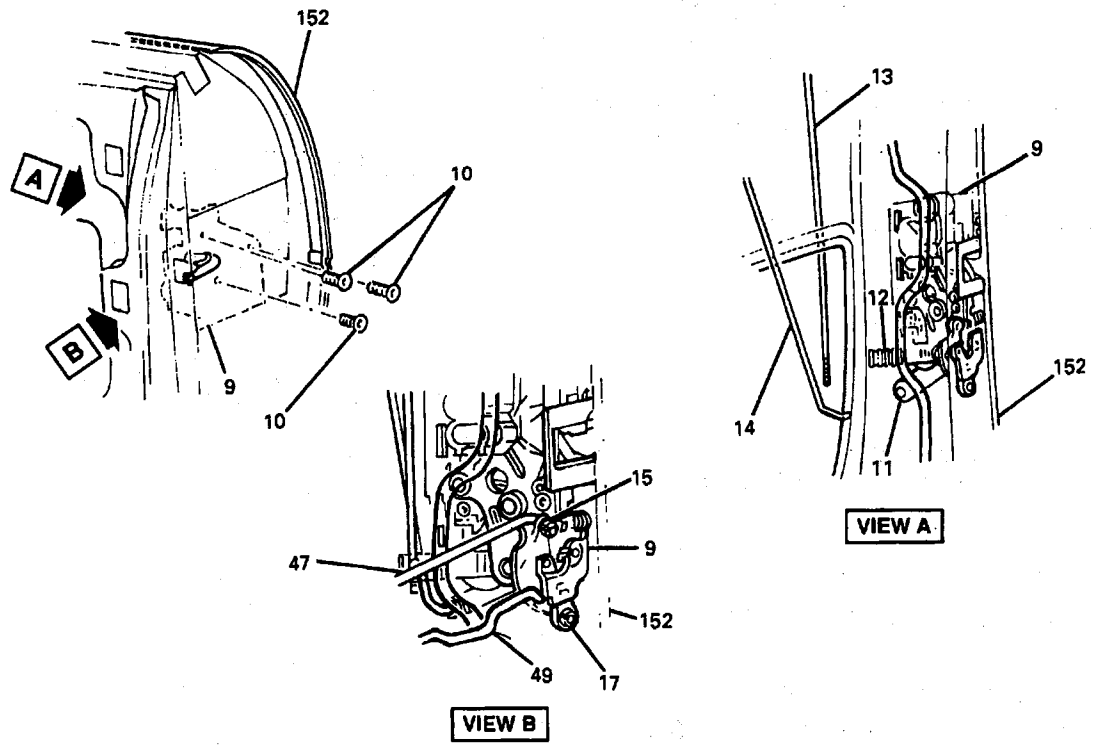
NOTICE: See "Notice" on page 10-6-1 of this section.

1. Lock assembly (9) through access hole.
2. Bolts/screws (10).

Tighten

- Bolts/screws (10) to 10 N•m (89 lb. in.).

3. New clip (11) into lock assembly.
   - Use GM P/N 16606936.
4. Lock cylinder rod (14) into clip (11).
5. New retainer (12) to lock assembly (9).
   - Use GM P/N 16623993.
6. Outside handle rod (13) to retainer (12).
   A. Line up lower end of outside handle rod (13) to retainer (12).
   B. Snap outside handle rod (13) into back half of retainer (12).
   C. Snap retainer cover closed over threaded part of outside handle rod (13).
7. New clip (17) to lock assembly (9).
   - Use GM P/N 16606936.
8. Locking rod (49) to clip (17).
9. New clip (15) to lock assembly (9).
   - Use GM P/N 16606936.
10. Inside handle rod assembly (47) to clip (15).
11. Electrical connector to lock assembly (9), if equipped.



9 LOCK ASSEMBLY, FRONT SIDE DOOR
10 BOLT/SCREW, FRONT SIDE DOOR LOCK
11 CLIP, FRONT SIDE DOOR LOCKING ROD
12 RETAINER, FRONT SIDE DOOR OUTSIDE HANDLE ROD
13 ROD, FRONT SIDE DOOR OUTSIDE HANDLE
14 ROD, FRONT SIDE DOOR LOCK CYLINDER
15 CLIP, FRONT SIDE DOOR LOCKING ROD
17 CLIP, FRONT SIDE DOOR LOCKING ROD
47 ROD ASSEMBLY, FRONT SIDE DOOR INSIDE HANDLE
49 ROD, FRONT SIDE DOOR LOCKING
152 DOOR ASSEMBLY, FRONT SIDE

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Figure 40 – Front Side Door Lock Assembly (Typical)

12. Front side door water deflector. Refer to "Front Side Door Water Deflector" in this section.
13. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

Front Side Door Outside Handle Rod

Figures 37 and 40

Remove or Disconnect

1. Raise window.
2. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
3. Front side door water deflector as needed. Refer to "Front Side Door Water Deflector" in this section.
4. Outside handle rod (13) from fastener on clip (75).
5. Outside handle rod (13) from clip (75).
6. Outside handle rod (13) from retainer (12).
   A. Use right-angle needlenose pliers to squeeze retainer tabs and pull retainer (12) through hole.
   B. Unscrew retainer (12) from outside handle rod (13).
      - Discard retainer (12).
7. Outside handle rod (13) from door assembly.

Install or Connect

1. New retainer (12) to lock assembly (9).
   - Use GM P/N 16623993.
2. Outside handle rod (13) to retainer (12).
   A. Line up lower end of outside handle rod (13) to retainer (12).
   B. Snap outside handle rod (13) into back half of retainer (12).
   C. Snap retainer cover closed over threaded part of outside handle rod (13).
3. Outside handle rod (13) into clip (75).

4. Outside handle rod (13) onto fastener on clip (75).
5. Front side door water deflector. Refer to "Front Side Door Water Deflector" in this section.
6. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

Front Side Door Inside Handle Rod Assembly

Figures 38, 40 and 41

Remove or Disconnect

1. Raise window.
2. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
3. Front side door water deflector as needed. Refer to "Front Side Door Water Deflector" in this section.
4. Rod assembly (47) from fastener on clip (46).
5. Rod assembly (47) from clip (46).
6. Clip (46) from handle assembly (35).
   - Use needlenose pliers to squeeze clip (46) and push from handle assembly (35).
7. Inside handle rod assembly (47) from clip (15).
8. Clip (15) using needlenose pliers.
   - Discard clip (15).
9. Inside handle rod assembly (47) from clip (48).

Inspect

- Clip (46).

Important

- If clip (46) is damaged, it must be replaced. Use GM P/N 16627328 (left-hand) or GM P/N 9835133 (right-hand).

Install or Connect

1. Inside handle rod assembly (47) to clip (48).
   - Line up black band on inside handle rod assembly (47) with slot in clip (48) and snap inside handle rod assembly (47) into clip (48).
2. New clip (15) to lock assembly (9).
   - Use GM P/N 16606936.
3. Inside handle rod assembly (47) to clip (15).
4. Clip (46) to handle assembly (35).
5. Inside handle rod assembly (47) to clip (46).
6. Inside handle rod assembly (47) to fastener on clip (46).
7. Front side door water deflector. Refer to "Front Side Door Water Deflector" in this section.
8. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

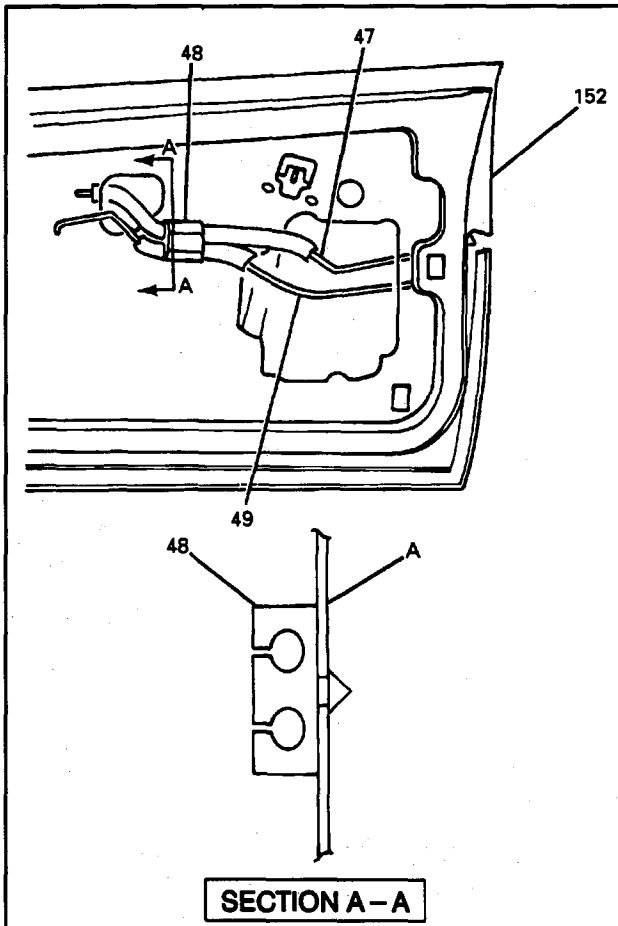


Figure 41 – Front Side Door Inside Handle Rod Assembly and Front Side Door Locking Rod (Typical)

Front Side Door Locking Rod

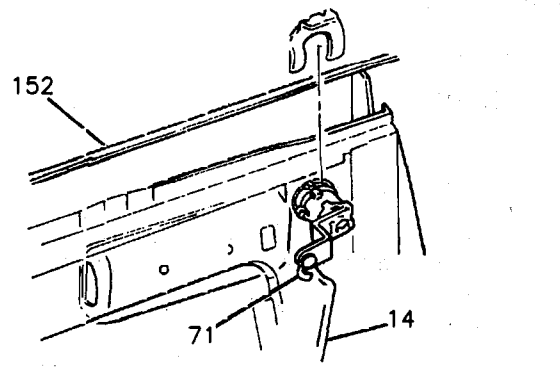
Figures 40 and 41

Remove or Disconnect

1. Raise window.
2. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
3. Front side door water deflector as needed. Refer to "Front Side Door Water Deflector" in this section.
4. Locking rod (49) from clip (17).
5. Clip (17) using needlenose pliers.
   - Discard clip (17).
6. Locking rod (49) from clip (48).

Install or Connect

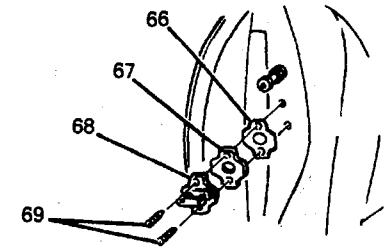
1. Locking rod (49) to clip (48).



14 ROD, FRONT SIDE DOOR LOCK CYLINDER
71 CLIP, FRONT SIDE DOOR LICK CYLINDER PAWL
152 DOOR ASSEMBLY, FRONT SIDE

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Figure 42 – Front Side Door Lock Cylinder Rod (Typical)



66 WASHER, FRONT SIDE DOOR LOCK STRIKER
67 SPACER, FRONT SIDE DOOR LOCK STRIKER
68 STRIKER ASSEMBLY, FRONT SIDE DOOR LOCK
69 BOLT/SCREW, FRONT SIDE DOOR LOCK STRIKER

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Figure 43 – Front Side Door Lock Striker Assembly

- Line up black band on locking rod (49) with slot in clip (48) and snap locking rod (49) into clip (48).

2. New clip (17) to lock assembly (9).
   - Use GM P/N 16606936.
3. Locking rod (49) to clip (17).
4. Front side door water deflector. Refer to "Front Side Door Water Deflector" in this section.
5. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

Front Side Door Lock Cylinder Rod

Figures 40 and 42

Remove or Disconnect

1. Raise window.
2. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
3. Front side door water deflector as needed. Refer to "Front Side Door Water Deflector" in this section.
4. Lock cylinder rod (14) from clip (11).
5. Clip (11) using needlenose pliers.
   - Discard clip (11).
6. Lock cylinder rod (14) from fastener on clip (71).
7. Lock cylinder rod (14) from clip (71).

Install or Connect

1. Lock cylinder rod (14) into clip (71).
2. Lock cylinder rod (14) onto fastener on clip (71).
3. New clip (11) into lock assembly (9).
   - Use GM P/N 16606936.
4. Lock cylinder rod (14) into clip (11).
5. Front side door water deflector. Refer to "Front Side Door Water Deflector" in this section.
6. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

Front Side Door Lock Striker Assembly

Figure 43

Remove or Disconnect

1. Mark position of striker assembly (68).
2. Bolts/screws (69).
3. Striker assembly (68).
4. Spacers (67), as equipped.
5. Washer (66).

Install or Connect

NOTICE: See "Notice" on page 10-6-1 of this section.

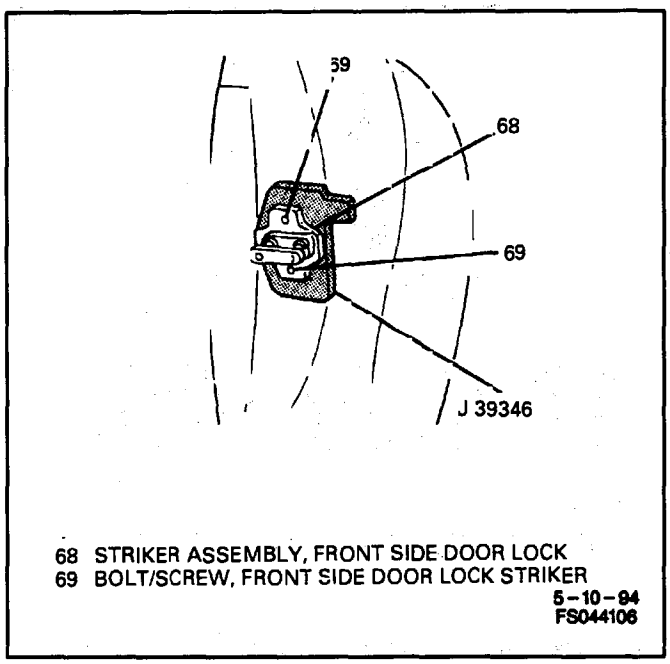
1. Washer (66).
2. Any spacers (67) that were removed.
3. Striker assembly (68) to location marked.
4. Bolts/screws (69)

Tighten

- Bolts/screws (69) to 34 N•m (25 lb. ft.).

Inspect

- Striker assembly-to-lock assembly engagement. If adjustment is needed, refer to "Front Side Door Lock Striker Adjustment" in the following procedure.



68 STRIKER ASSEMBLY, FRONT SIDE DOOR LOCK
69 BOLT/SCREW, FRONT SIDE DOOR LOCK STRIKER
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Figure 44 – Adjusting Front Side Door Lock Striker Assembly with J 39346

Front Side Door Lock Striker Adjustment

With J 39346

Figure 44

Tool Required:

J 39346 "Mini-Wedge" Door Striker Aligner

Adjust

NOTICE: See "Notice" on page 10-6-1 of this section.

Important

- Door assembly must be properly aligned before adjusting the striker assembly.

- Striker assembly (68).

A. Loosen bolts/screws (69) just enough to allow movement of the striker assembly (68).

B. Install J 39346 to striker assembly (68).

C. Close door assembly while holding outside handle assembly in open position.

- Do not slam door assembly.

D. Open door assembly.

Tighten

- Bolts/screws (69) to 34 N•m (25 lb. ft.).

E. Remove J 39346.

Without J 39346

Adjust

NOTICE: See "Notice" on page 10-6-1 of this section.

Important

- Door assembly must be properly aligned before adjusting the striker assembly.

1. Striker assembly up or down and inboard or outboard.

A. Loosen striker assembly bolts/screws.

B. Move striker assembly up or down and inboard or outboard, as required.

Tighten

- Striker assembly bolts/screws to 34 N•m (25 lb. ft.).

2. Striker assembly forward or rearward.

A. Apply modeling clay or body caulking compound to door lock assembly opening.

B. Close door assembly far enough for striker assembly to make impression in clay or caulking compound.

- Closing the door assembly all the way will make removing the clay or caulking compound difficult.

C. Open door assembly and check that striker assembly impression is centered forward and rearward in the lock assembly opening.

D. If adjustment is needed:

a. Remove striker assembly. Refer to "Front Side Door Lock Striker Assembly" in this section.

b. Add or remove spacers as needed.

c. Install striker assembly. Refer to "Front Side Door Lock Striker Assembly" in this section.

3. After adjusting striker assembly, touch up any exposed, unpainted areas.

Front Side Door Lock Striker Anchor Plate

Figure 45

Remove or Disconnect

1. Radio rear quarter trim panel speaker assembly. Refer to SECTION 10-7.
2. Front side door lock striker assembly. Refer to "Front Side Door Lock Striker Assembly" in this section.
3. Anchor plate (65) through speaker access hole.

Install or Connect

1. Anchor plate (65).

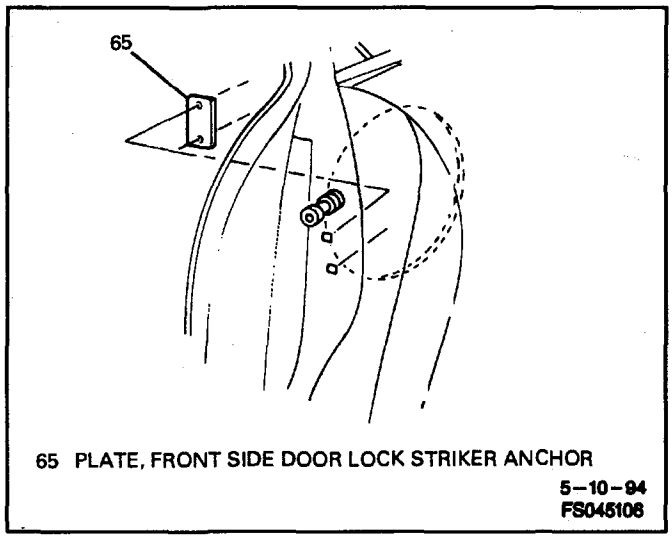


Figure 45 – Front Side Door Lock Striker Anchor Plate

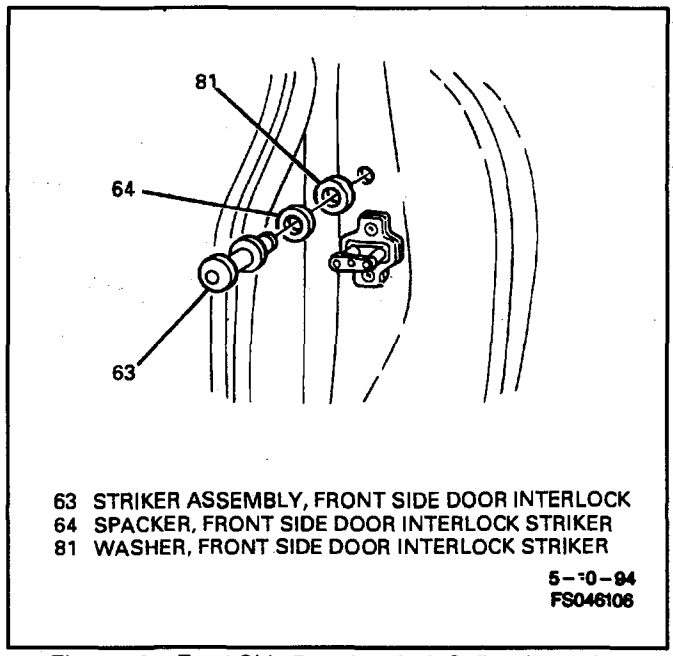


Figure 46 – Front Side Door Interlock Striker Assembly

2. Front side door lock striker assembly. Refer to "Front Side Door Lock Striker Assembly" in this section.
3. Radio rear quarter trim panel speaker assembly. Refer to SECTION 10-7.

Front Side Door Interlock Striker Assembly

Figure 46

Tool Required:

J 29843-9 Door Lock Striker and Seat Belt TORX® Wrench

Remove or Disconnect

1. Striker assembly (63) using J 29843-9.
2. Spacers (64), as equipped.
3. Washer (81).

Install or Connect

NOTICE: See "Notice" on page 10-6-1 of this section.

1. Spacers (64) to stud end of striker assembly (63).
   - Install the same number of spacers (64) as are installed with the front side door lock striker assembly.
2. Washer (81).
3. Striker assembly (63).

Tighten

- Striker assembly (63) to 45 N•m (33 lb. ft.).

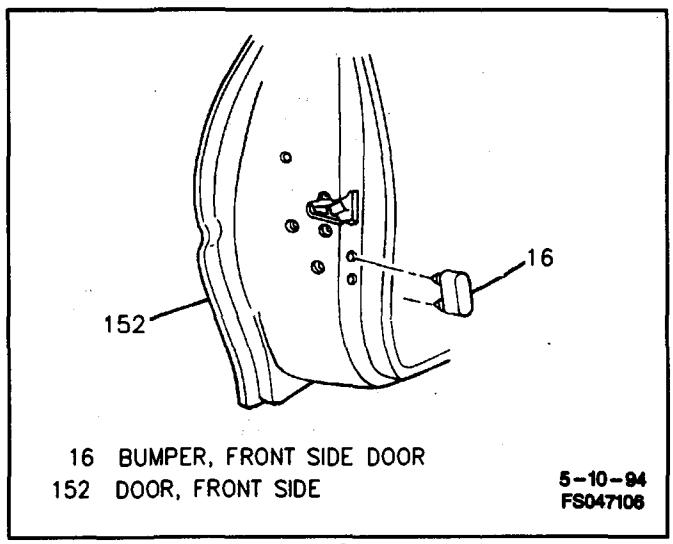


Figure 47 – Front Side Door Bumper

Front Side Door Bumper

Figure 47

Remove or Disconnect

- Bumper (16) by prying with a flat-bladed tool.

Install or Connect

- Bumper (16) by pressing into holes.

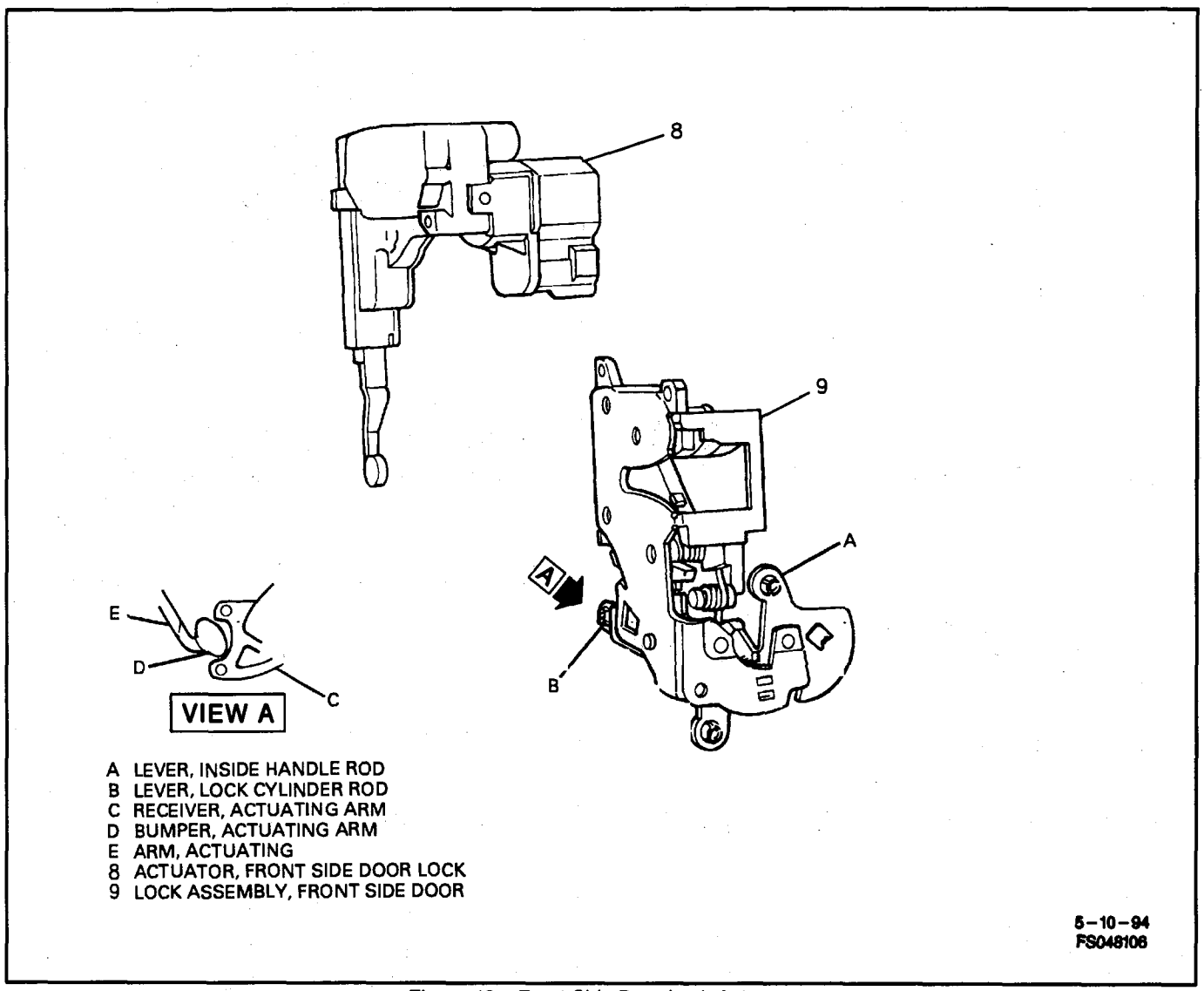


Figure 48 – Front Side Door Lock Actuator

Front Side Door Lock Actuator

Figures 48 and 49

Remove or Disconnect

1. Front side door lock assembly. Refer to "Front Side Door Lock Assembly" in this section.
2. Bolts/screws.
3. Actuator (8).

Install or Connect

NOTICE: See "Notice" on page 10-6-1 of this section.

Important

- Before installing new actuator (8), make sure the lock assembly (9) is in full open position.

1. Release lock assembly (9) to be sure it is in full open position.
   A. Push up on lock cylinder rod lever.
   B. Pull on inside handle rod lever.
2. Make sure actuating arm bumper is on actuating arm.
3. Actuating arm with bumper into actuating arm receiver.
4. Align bolt/screw holes.
5. Bolts/screws.

Inspect

- Lock assembly operation by pushing inward on fork bolt until it clicks into full closed position.
  - Lock assembly (9) must operate to full closed position without interference.

6. Electrical connector to lock assembly.

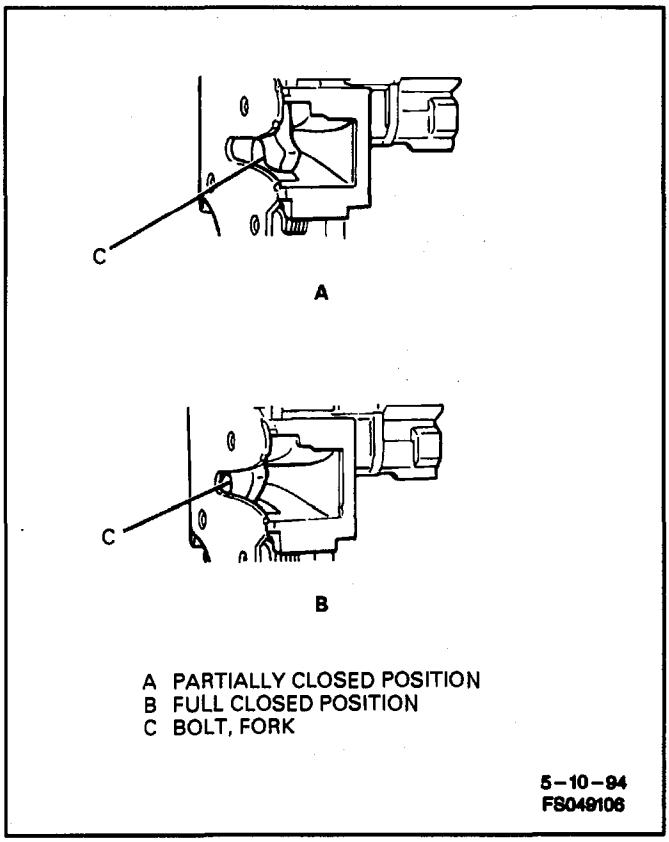


Figure 49 – Front Side Door Lock Positions

7. Electrical connector to door lock switch.

Inspect

- Actuator operation by pressing door lock switch to ensure that actuator locks and unlocks lock assembly (9).

8. Front side door lock assembly. Refer to "Front Side Door Lock Assembly" in this section.

Lock Cylinder Unit

Figure 50

Remove or Disconnect

1. Raise window.
2. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
3. Front side door water deflector as needed. Refer to "Front Side Door Water Deflector" in this section.
4. Lock cylinder rod (14) from fastener on clip (71).
5. Lock cylinder rod (14) from clip (71).
6. Retainer (72) using a screwdriver to slide upward.
7. Cylinder unit (74).
8. Gasket (73).

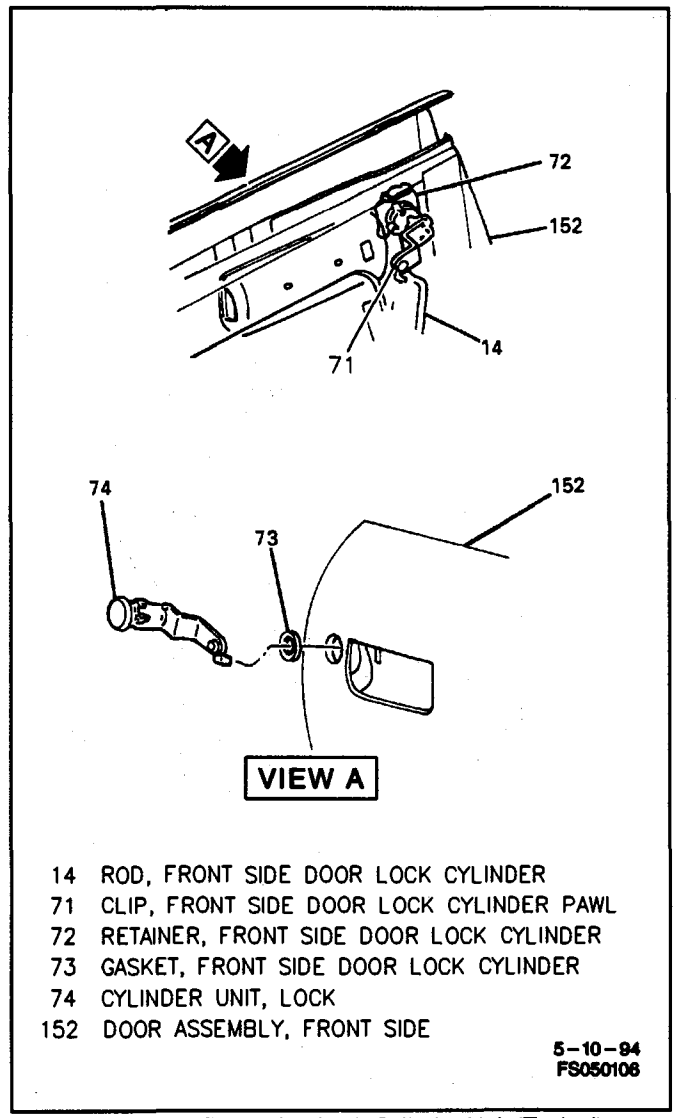


Figure 50 – Removing Lock Cylinder Unit (Typical)

Install or Connect

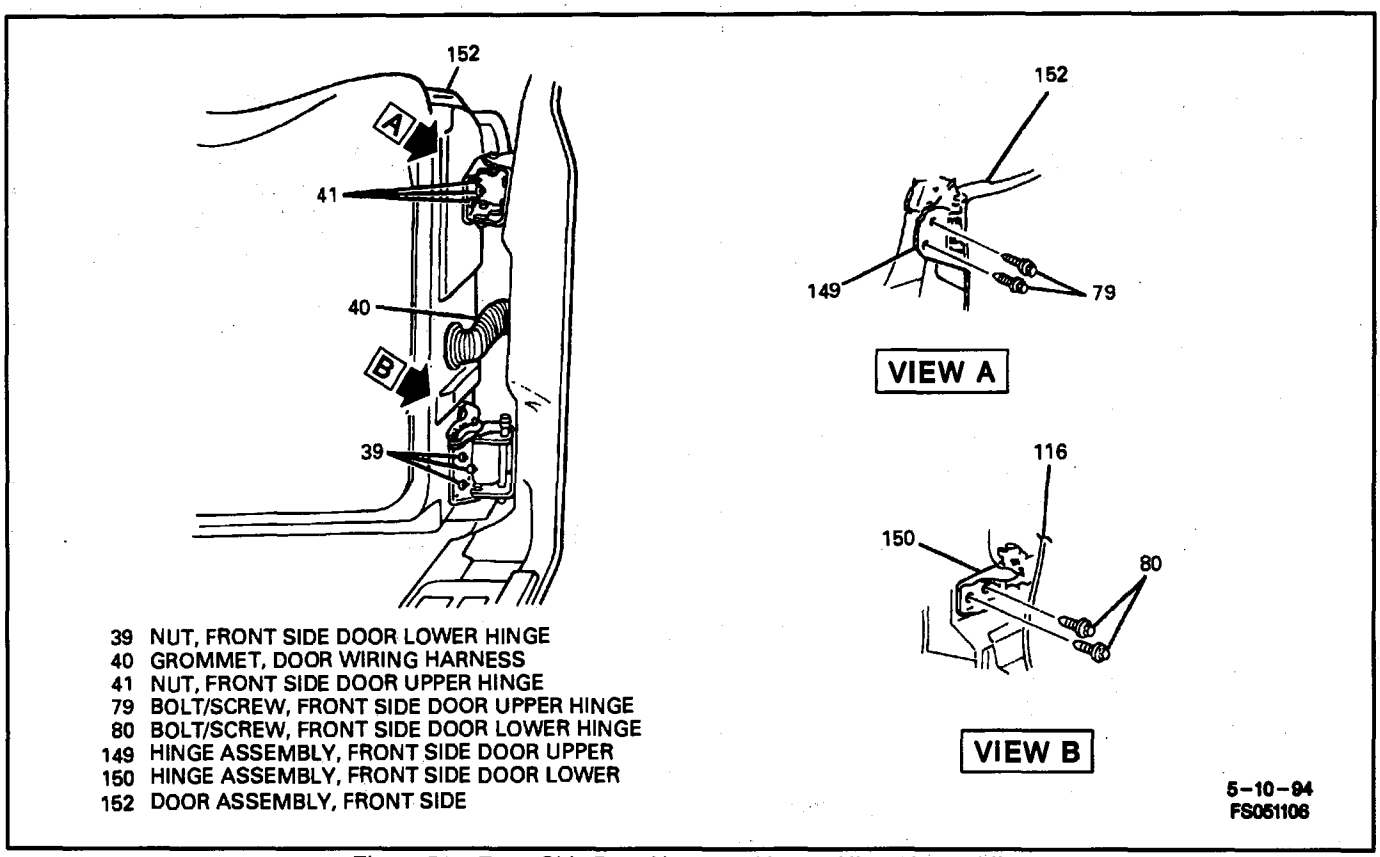
1. Gasket (73) to cylinder unit (74).
2. Cylinder unit (74).
3. Retainer (72) to shoulder of cylinder unit (74).
4. Lock cylinder rod (14) into clip (71).
5. Lock cylinder rod (14) onto fastener on clip (71).
6. Front side door water deflector. Refer to "Front Side Door Water Deflector" in this section.
7. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

Front Side Door Upper Hinge Assembly

Figures 51 and 52

Remove or Disconnect

1. Support door assembly (152) in full open position.
2. Mark position of upper hinge assembly (149) on door assembly (152) and hinge pillar.



39 NUT, FRONT SIDE DOOR LOWER HINGE
40 GROMMET, DOOR WIRING HARNESS
41 NUT, FRONT SIDE DOOR UPPER HINGE
79 BOLT/SCREW, FRONT SIDE DOOR UPPER HINGE
80 BOLT/SCREW, FRONT SIDE DOOR LOWER HINGE
149 HINGE ASSEMBLY, FRONT SIDE DOOR UPPER
150 HINGE ASSEMBLY, FRONT SIDE DOOR LOWER
152 DOOR ASSEMBLY, FRONT SIDE

Figure 51 – Front Side Door Upper and Lower Hinge Assemblies

3. Bolts/screws (79).
4. Nuts (41).
5. Upper hinge assembly (149).

Install or Connect

NOTICE: See "Notice" on page 10-6-1 of this section.

1. Upper hinge assembly (149) to position marked.
2. Nuts (41).
   A. Install nuts (41), but do not tighten.
   B. Loosen nuts (39).

Tighten

- Nuts (41 and 39) to 50 N•m (37 lb. ft.) in sequence.

3. Bolts/screws (79).
   A. Install bolts/screws (79), but do not tighten.
   B. Loosen bolts/screws (80).

Tighten

- Bolts/screws (79 and 80) to 50 N•m (37 lb. ft.) in sequence.

Front Side Door Lower Hinge Assembly

Figures 51 and 52

Tool Required:

J 36604 Door Hinge Spring Compressor

Remove or Disconnect

1. Support door assembly (152) in full open position.
2. Mark position of lower hinge assembly (150) on door assembly (152) and hinge pillar.

   CAUTION: Before removing spring, cover with shop cloth to prevent spring from flying off and causing personal injury or damage.
3. Spring using J 36604.
4. Bolts/screws (80).
5. Nuts (39).
6. Lower hinge assembly (150).

Install or Connect

NOTICE: See "Notice" on page 10-6-1 of this section.

1. Lower hinge assembly (150) to position marked.
2. Nuts (39).
   A. Install nuts (39), but do not tighten.
   B. Loosen nuts (41).

Tighten

- Nuts (39 and 41) to 50 N•m (37 lb. ft.) in sequence.

3. Bolts/screws (80).
   A. Install bolts/screws (80), but do not tighten.
   B. Loosen bolts/screws (79).

Tighten

- Bolts/screws (80 and 79) to 50 N•m (37 lb. ft.) in sequence.

4. Spring from J 36604.

Front Side Door Assembly

Figures 51 and 52

Tool Required:

J 36604 Door Hinge Spring Compressor

Remove or Disconnect

Important

- Steps 1 through 5 apply only to door assemblies equipped with power accessories.

1. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
2. Front side door water deflector as needed. Refer to "Front Side Door Water Deflector" in this section.
3. Electrical connectors from all components in door assembly.
4. Grommet (40) from door assembly.
5. Crossbody and front side door wiring harness assembly from door assembly.

CAUTION: Before removing spring, cover with shop cloth to prevent spring from flying off and causing personal injury or damage.

6. Spring using J 36604.
7. Support door assembly.
8. Nuts (39 and 41).
9. Door assembly.

Install or Connect

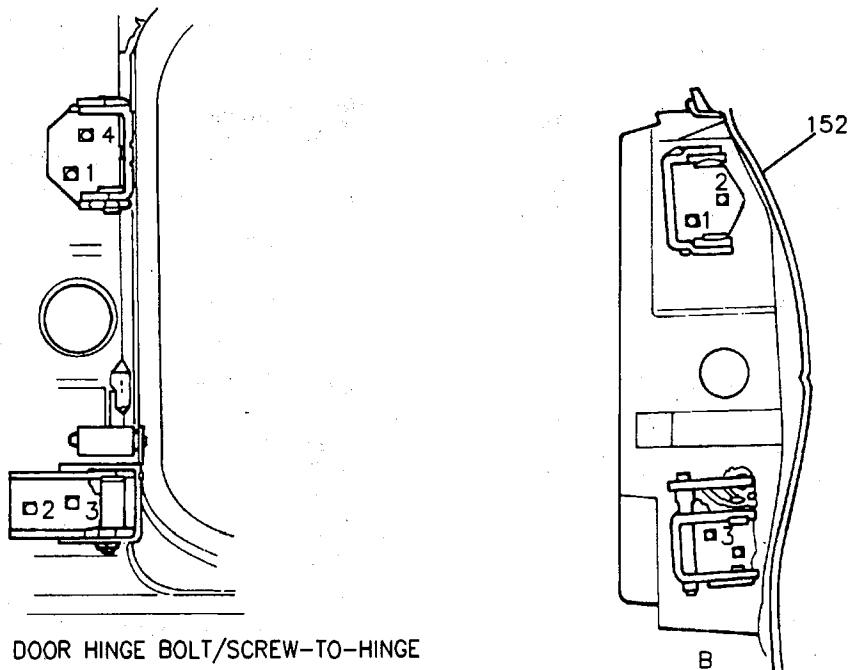
NOTICE: See "Notice" on page 10-6-1 of this section.

1. Door assembly to upper and lower hinge assemblies (149 and 150).
2. Nuts (39 and 41).

Tighten

- Nuts (39 and 41) to 50 N•m (37 lb. ft.) in sequence.

3. Spring from J 36604.



A FRONT SIDE DOOR HINGE BOLT/SCREW-TO-HINGE PILLAR TIGHTENING SEQUENCE
B FRONT SIDE DOOR HINGE NUT-TO-FRONT SIDE DOOR ASSEMBLY TIGHTENING SEQUENCE
152 DOOR ASSEMBLY, FRONT SIDE

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Figure 52 – Front Side Door Hinge Fastener Tightening Sequences

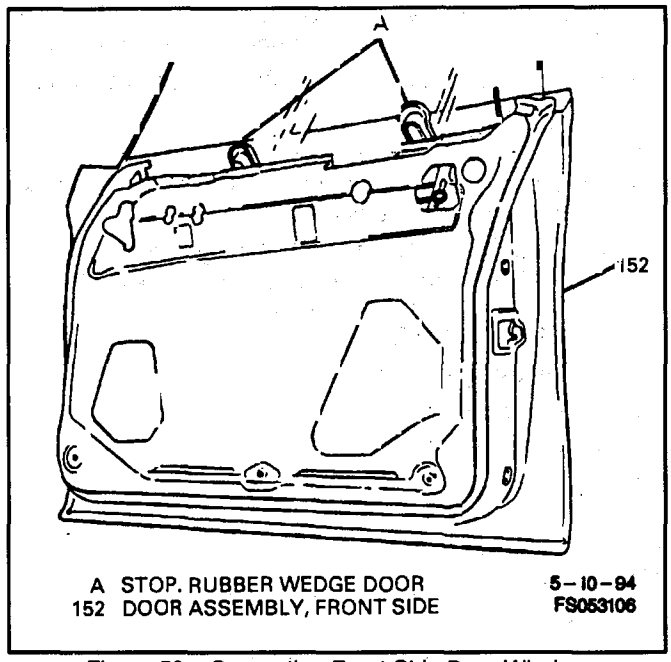


Figure 53 – Supporting Front Side Door Window

Important

- Steps 4 through 8 apply only to door assemblies equipped with power accessories.

4. Crossbody and front side door wiring harness assembly to door assembly.
5. Grommet (40) to door assembly.
6. Electrical connectors to components in door assembly.
7. Front side door water deflector. Refer to "Front Side Door Water Deflector" in this section.
8. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

Front Side Door Window

Figures 53 through 55

CAUTION: Approved safety glasses and gloves should be worn when performing these procedures to reduce the chance of personal injury should window breakage occur.

Remove or Disconnect

1. Lower window about halfway.
2. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
3. Front side door water deflector as needed. Refer to "Front Side Door Water Deflector" in this section.

CAUTION: Support front side door window. If window drops into door, personal injury or window damage may result.

4. Support window (1) in position needed to access rivets (19) by inserting rubber wedge door stops at front and rear of window (1) between window (1) and door inner panel.
5. Rivets (19).
   - Drill out rivets (19) with 1/4-inch drill bit.
6. Window (1) by raising out of door assembly (152).

Inspect

- Bushing assemblies (59), retainers (2), up stop (54), pins (3) and wedges (60) on the window (1) for damage.

7. Bushing assemblies (59) and retainers (2), if necessary, using a flat-bladed tool covered with cloth body tape.
8. Bolt/screw (53), if necessary.
9. Up stop (54), nut (57) and washer (58), if necessary.
10. Bolts/screws (4), if necessary.
11. Pins (3), nuts (61) and wedges (60), if necessary.

Install or Connect

NOTICE: See "Notice" on page 10-6-1 of this section.

1. Wedges (60) and pins (3), if removed.
2. Bolts/screws (4), if removed.

Tighten

- Bolts/screws (4) to 7 N•m (62 lb. in.).

3. Nuts (61), if removed.

Tighten

- Nuts (61) to 8 N•m (71 lb. in.).

4. Up stop (54) and washer (58), if removed.
5. Bolt/screw (53), if removed.

Tighten

- Bolt/screw (53) to 7 N•m (62 lb. in.).

6. Nut (57), if removed.

Tighten

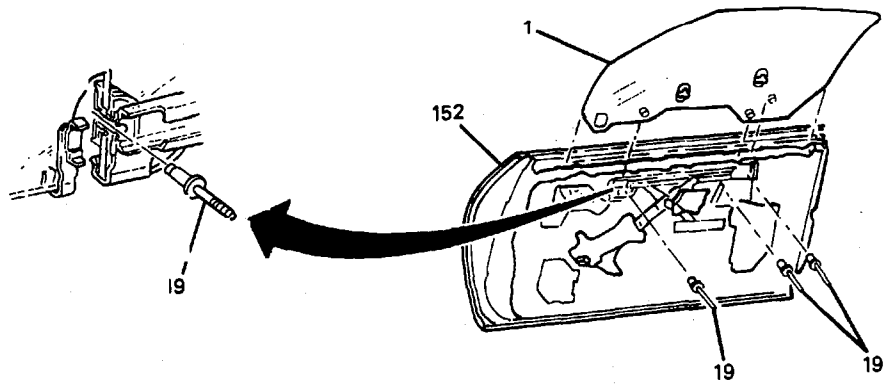
- Nuts (57) to 8 N•m (71 lb. in.).

7. Bushing assemblies (59) and retainers (2), if removed.
8. Window (1) into door assembly (152) so that holes in bushing assemblies (59) line up with holes in channel assembly.
9. Rivets (19) in sequence.

Adjust

- Window (1), if necessary. Refer to "Front Side Door Window Adjustment" in this section.

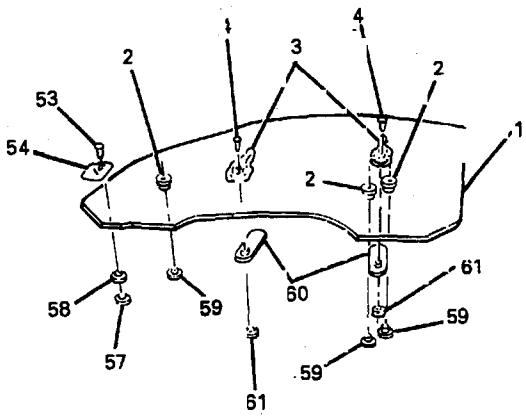
10. Front side door water deflector. Refer to "Front Side Door Water Deflector" in this section.



1 WINDOW, FRONT SIDE DOOR
19 RIVET, FRONT SIDE DOOR WINDOW
152 DOOR ASSEMBLY, FRONT SIDE

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Figure 54 – Front Side Door Window Rivets (Typical)



1 WINDOW, FRONT SIDE DOOR
2 RETAINER, FRONT SIDE DOOR WINDOW BUSHING
3 PIN, FRONT SIDE DOOR WINDOW STABILIZER
4 BOLT/SCREW, FRONT SIDE DOOR WINDOW STABILIZER PIN
53 BOLT/SCREW, FRONT SIDE DOOR WINDOW FRONT UP STOP
54 STOP, FRONT SIDE DOOR WINDOW FRONT UP
57 NUT, FRONT SIDE DOOR WINDOW FRONT UP STOP
58 WASHER, FRONT SIDE DOOR WINDOW FRONT UP STOP
59 BUSHING ASSEMBLY, FRONT SIDE DOOR WINDOW
60 WEDGE, FRONT SIDE DOOR WINDOW
61 NUT, FRONT SIDE DOOR WINDOW STABILIZER PIN

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Figure 55 – Front Side Door Window

11. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

Front Side Door Window Adjustment

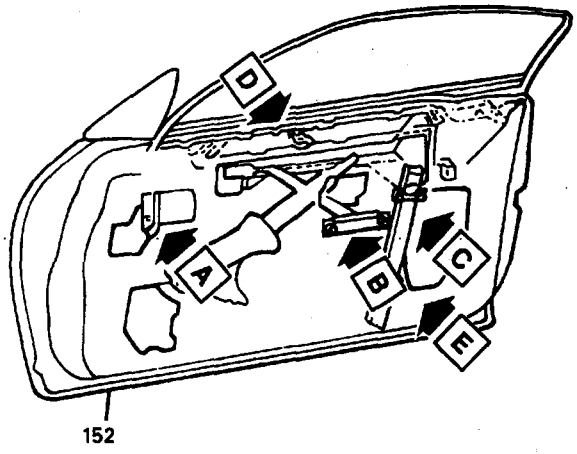
Figure 56

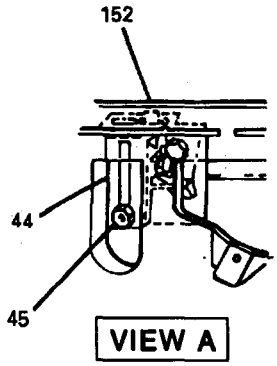
Adjust

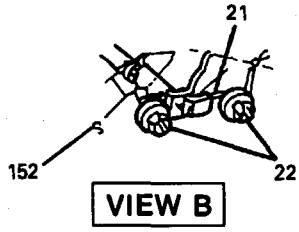
NOTICE: See "Notice" on page 10-6-1 of this section.

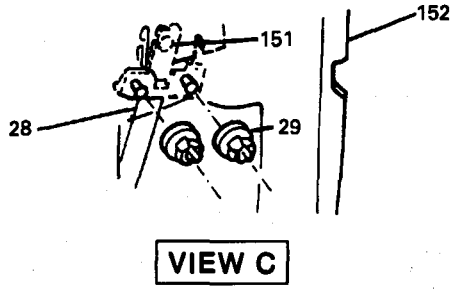
1. Window up or down at front.
   A. Loosen nut (45).
   B. Adjust up stop support (44).

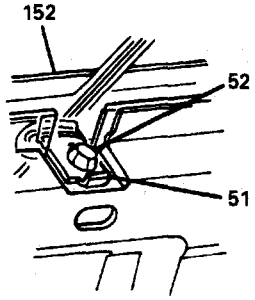
   Tighten
   - Nut (45) to 10 N•m (89 lb. in.).
2. Window up or down at rear.
   A. Loosen bolt/screw (151).
   B. Adjust rear up stop and tighten bolt/screw (151).
3. Window parallel to weatherstrip assembly.

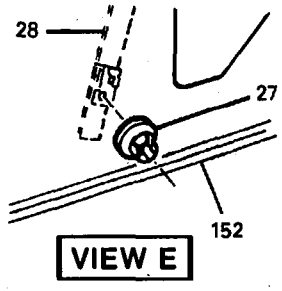












21 CHANNEL ASSEMBLY, FRONT SIDE DOOR WINDOW REGULATOR COUNTERBALANCE ARM
22 NUT, FRONT SIDE DOOR WINDOW REGULATOR COUNTERBALANCE ARM CHANNEL
27 NUT, FRONT SIDE DOOR WINDOW REAR GUIDE CHANNEL
28 CHANNEL ASSEMBLY, FRONT SIDE DOOR WINDOW REAR GUIDE
29 NUT, FRONT SIDE DOOR WINDOW REAR GUIDE CHANNEL
44 SUPPORT ASSEMBLY, FRONT SIDE DOOR WINDOW FRONT UP STOP
45 NUT, FRONT SIDE DOOR WINDOW FRONT UP STOP SUPPORT
51 STABILIZER ASSEMBLY, FRONT SIDE DOOR WINDOW
52 BOLT/SCREW, FRONT SIDE DOOR WINDOW STABILIZER
151 BOLT/SCREW, FRONT SIDE DOOR WINDOW REAR CHANNEL EXTENSION
152 DOOR ASSEMBLY, FRONT SIDE

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Figure 56 – Adjusting Front Side Door Window (Typical)

A. Lower window part way and raise back to within 25 mm (1 inch) of weatherstrip assembly.
B. Loosen nuts (22).
C. Adjust channel assembly (21).

Tighten

- Nuts (22) to 10 N•m (89 lb. in.).

4. Window forward or rearward.
   A. Loosen nuts (27 and 29).
   B. Move window forward or rearward.

Tighten

- Nut (27) to 10 N•m (89 lb. in.).
- Nuts (29) to 27 N•m (20 lb. ft.).

5. Upper edge of window inboard or outboard.
   A. Loosen nuts (29).
   B. Move jackstuds in or out using an allen wrench.

Tighten

- Nuts (29) to 27 N•m (20 lb. ft.).

6. Stabilizer assemblies (51).
   A. Raise window to full closed position.
   B. Loosen bolts/screws (52).
   C. Apply slight pressure outboard on window at belt.
   D. Move stabilizer assemblies (51).

Tighten

- Bolts/screws (52) to 10 N•m (89 lb. in.).

Inspect

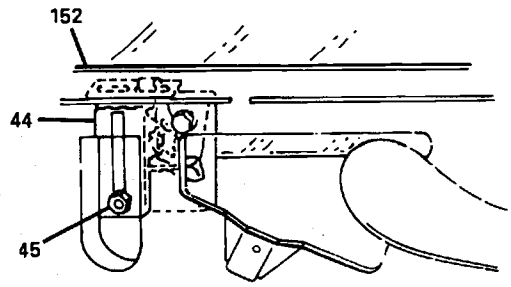
- Window operation and stability.
  - If window binds, move stabilizer assemblies (51) inboard slightly.
  - If window is unstable, move stabilizer assemblies (51) outboard.
  - If stabilizer assemblies (51) have been adjusted and window squeaks while returning to up position, lubricate outside rearview mirror applique window channel.

Front Side Door Window Front Up Stop Support Assembly

Figure 57

Remove or Disconnect

1. Lower window.
2. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.



44 SUPPORT ASSEMBLY, FRONT SIDE DOOR WINDOW FRONT UP STOP
45 NUT, FRONT SIDE DOOR WINDOW FRONT UP STOP SUPPORT
52 DOOR ASSEMBLY, FRONT SIDE

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Figure 57 – Front Side Door Window Front Up Stop Support Assembly (Typical)

3. Nut (45).
4. Support assembly (44).

Install or Connect

NOTICE: See "Notice" on page 10-6-1 of this section.

1. Support assembly (44).
2. Nut (45).

Inspect

- Window alignment. Adjust if necessary. Refer to "Front Side Door Window Adjustment" in this section.

Tighten

- Nut (45) to 10 N•m (89 lb. in.).

3. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

Front Side Door Window Stabilizer Assembly

Figure 58

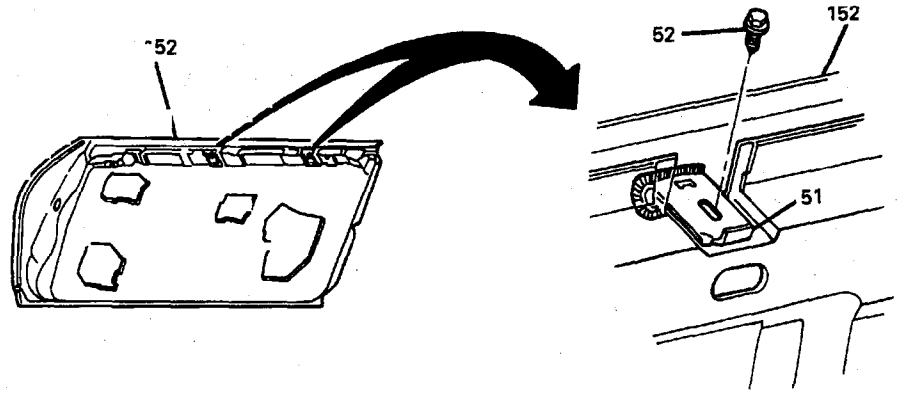
Remove or Disconnect

1. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
2. Bolt/screw (52).
3. Stabilizer assembly (51).

Install or Connect

NOTICE: See "Notice" on page 10-6-1 of this section.

1. Stabilizer assembly (51).
2. Bolt/screw (52).



51 STABILIZER ASSEMBLY, FRONT SIDE DOOR WINDOW
52 BOLT/SCREW. FRONT SIDE DOOR WINDOW STABILIZER
-52 DOOR ASSEMBLY, FRONT SIDE

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Figure 58 – Front Side Door Window Stabilizer Assembly (Typical)

Inspect

- Window stability. Adjust if necessary. Refer to "Front Side Door Window Adjustment" in this section.

Tighten

- Bolt/screw (52) to 10 N•m (89 lb. in.).

3. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

Front Side Door Window Front and Rear Bumpers

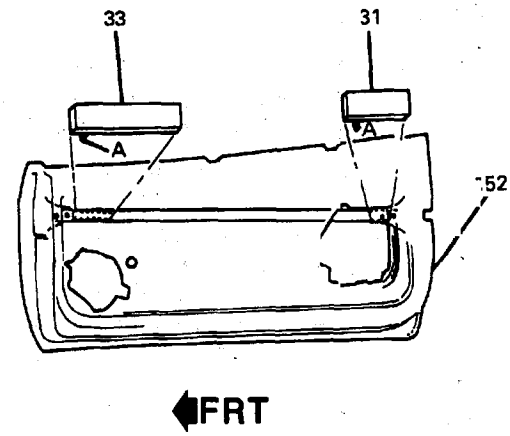
Figure 59

Remove or Disconnect

1. Raise window.
2. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
3. Radio front side door speaker assembly, if removing front bumper (33). Refer to "Radio Front Side Door Speaker Assembly" in this section.
4. Front or rear bumper (33 or 31) using a flat-bladed tool to release adhesive strip from door outer panel.

Install or Connect

1. Front or rear bumper (33 or 31).
   A. Remove protective liner from adhesive strip.
   B. Insert front or rear bumper (33 or 31) through access hole.
   C. Press front or rear bumper (33 or 31) into position on door outer panel.
2. Radio front side door speaker assembly, if removed. Refer to "Radio Front Side Door Speaker Assembly" in this section.
3. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.



A LINER, PROTECTIVE
31 BUMPER, FRONT SIDE DOOR WINDOW REAR
33 BUMPER, FRONT SIDE DOOR WINDOW FRONT
152 DOOR ASSEMBLY, FRONT SIDE

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Figure 59 – Front Side Door Window Front and Rear Bumpers (Typical)

Front Side Door Window Regulator Assembly

Figures 60 and 61

CAUTION: Approved safety glasses and gloves should be worn when performing these procedures to reduce the chance of personal injury should window breakage occur.

Remove or Disconnect

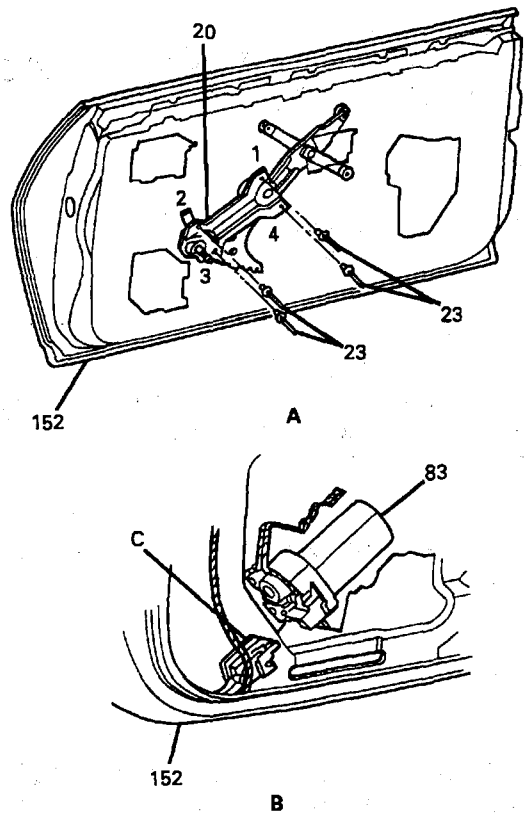
1. Raise window about halfway.
2. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.
3. Front side door water deflector as needed. Refer to "Front Side Door Water Deflector" in this section.

CAUTION: Support front side door window. If window drops into door, personal injury or window damage may result.

4. Support window in position by inserting rubber wedge door stops at front and rear of window between window and door inner panel.
5. Front side door window rear guide channel nuts so rear guide channel assembly can be moved. Refer to "Front Side Door Window Channel Assembly and Front Side Door Window Rear Guide Channel Assembly" in this section.
6. Rivets (23).
   A. Push rivet mandrel out of rivet (23) with a punch.
   B. Drill out rivet (23).
   C. Remove rivet fragments from hole.
7. Electrical connector from motor assembly (83) by sliding motor assembly (83) and regulator assembly (82) rearward, if equipped.
8. Regulator assembly (20 or 82) from channel assemblies.
9. Regulator assembly (20 or 82), with motor assembly (83) attached if equipped, through rear access hole.

Install or Connect

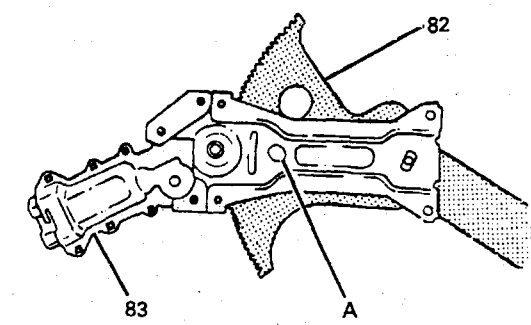
1. Regulator assembly (20 or 82), with motor assembly (83) attached if equipped, through rear access hole.
2. Regulator assembly (20 or 82) to channel assemblies.
3. Electrical connector to motor assembly (83), if equipped.



A MANUAL SHOWN, POWER SIMILAR
B POWER
C CONNECTOR, FRONT SIDE DOOR WINDOW REGULATOR MOTOR ELECTRICAL
20 REGULATOR ASSEMBLY, FRONT SIDE DOOR WINDOW
23 RIVET, FRONT SIDE DOOR WINDOW REGULATOR
83 MOTOR ASSEMBLY, FRONT SIDE DOOR WINDOW REGULATOR
52 DOOR ASSEMBLY, FRONT SIDE

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Figure 60 – Front Side Door Window Regulator Assembly (Typical)



A DRILLED HOLE
82 REGULATOR ASSEMBLY, FRONT SIDE DOOR WINDOW
83 MOTOR ASSEMBLY, FRONT SIDE DOOR WINDOW REGULATOR

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Figure 61 – Locking Sector Gear

4. Rivets (23) in sequence shown in Figure 53.
5. Front side door window rear guide channel nuts. Refer to "Front Side Door Window Channel Assembly and Front Side Door Window Rear Guide Channel Assembly" in this section.

Inspect

- Window alignment. Adjust if necessary. Refer to "Front Side Door Window Adjustment" in this section.

6. Front side door water deflector. Refer to "Front Side Door Water Deflector" in this section.
7. Front side door trim assembly. Refer to "Front Side Door Right and Left Trim Assemblies" in this section.

Front Side Door Window Regulator Motor Assembly

Figure 61

Remove or Disconnect

CAUTION: If electric motor removal from the regulator assembly is required, the sector gear must be locked in position. The regulator lift arm is under tension from the counterbalance spring and could cause personal injury if the sector gear is not locked in position.

1. Front side door window regulator assembly with motor assembly. Refer to "Front Side Door Window Regulator Assembly" in this section.
2. Drill hole through window regulator sector gear and backplate.
3. Install bolt and nut to lock sector gear into position.
4. Rivets.
   A. Push rivet mandrel out of rivet with a punch.
   B. Drill out rivet.
   C. Remove rivet fragments from hole.
5. Motor assembly (83).

Install or Connect

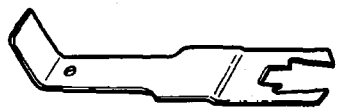
1. Motor assembly (83).
2. Rivets.
3. Remove bolt and nut used to secure sector gear.
4. Front side door window regulator assembly and motor. Refer to "Front Side Door Window Regulator Assembly" in this section.

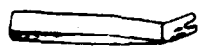
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Front Side Door Armrest Bolt/Screw	4.5 N•m (40 lb. in.)
Front Side Door Inside Handle Bezel Bolt/Screw	1.4 N•m (12 lb. in.)
Front Side Door Interlock Striker Assembly	45 N•m (33 lb. ft.)
Front Side Door Lock Bolt/Screw	10 N•m (89 lb. in.)
Front Side Door Lock Striker Bolt/Screw	29 N•m (21 lb. ft.)
Front Side Door Lower Hinge Bolt/Screw	50 N•m (37 lb. ft.)
Front Side Door Lower Hinge Nut	45 N•m (33 lb. ft.)
Front Side Door Outside Handle Nut	7 N•m (62 lb. in.)
Front Side Door Upper Hinge Bolt/Screw	50 N•m (37 lb. ft.)
Front Side Door Upper Hinge Nut	45 N•m (33 lb. ft.)
Front Side Door Window Front Up Stop Bolt/Screw	7 N•m (62 lb. in.)
Front Side Door Window Front Up Stop Nut	8 N•m (71 lb. in.)
Front Side Door Window Front Up Stop Support Nut	10 N•m (89 lb. in.)
Front Side Door Window Rear Guide Channel Nut (Lower)	10 N•m (89 lb. in.)
Front Side Door Window Rear Guide Channel Nut (Upper)	27 N•m (20 lb. ft.)
Front Side Door Window Regulator Counterbalance Arm Channel Nut	10 N•m (89 lb. in.)
Front Side Door Window Stabilizer Bolt/Screw	10 N•m (89 lb. in.)
Front Side Door Window Stabilizer Pin Bolt/Screw	7 N•m (62 lb. in.)
Front Side Door Window Stabilizer Pin Nut	8 N•m (71 lb. in.)
Lift Off Window Body Side Weatherstrip Bolt/Screw	1.3 N•m (12 lb. in.)
Outside Rearview Mirror Applique Bolt/Screw	6 N•m (53 lb. in.)
Outside Rearview Mirror Bezel Bolt/Screw	2 N•m (18 lb. in.)
Outside Rearview Mirror Nut	12 N•m (106 lb. in.)
Outside Rearview Mirror Opening Applique Nut	6 N•m (53 lb. in.)

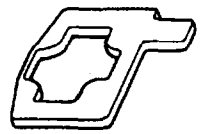
SPECIAL TOOLS

1.  J 9886-01

2.  J 21104-B

3.  J 29843-9

4.  J 25070

5.  J 39346

6.  J 36604

1. DOOR HANDLE CLIP REMOVER
2. UNIVERSAL WEATHERSTRIP REMOVER
3. DOOR LOCK STRIKER AND SEAT BELT TORX WRENCH
4. HEAT GUN
5. "MINI-WEDGE" DOOR STRIKER ALIGNER
6. DOOR HINGE SPRING COMPRESSOR

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BLANK

SECTION 10-7

REAR QUARTERS

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

REAR QUARTERS

Figure 1

The information in this section provides service procedures that apply to all rear quarter components, as shown in Figure 1.

ON-VEHICLE SERVICE

INTERIOR TRIM

Front Quarter Trim Finishing Panel Assembly

Figures 2 and 3

Remove or Disconnect

1. Lower the folding seatback.
2. Left or right shroud side trim finishing panel. Refer to SECTION 10-5.
3. Coat hook assembly (1) (Coupe only).
   - Release retainer with a screwdriver and pull out.
4. Striker bolt/screw (2), and washer (3).
5. Quarter inner trim finish panel extension bolt/screw (33) (Convertible only).
6. Quarter inner trim finish panel extension (34) (Convertible only).
7. Front quarter trim finishing panel assembly (4 or 35).
   - Push lap belt through slot in front quarter trim finishing panel assembly (4 or 35).
8. Speaker grille assembly (5 or 37), if necessary.
9. Quarter courtesy lamp (36) (Convertible only), if necessary.

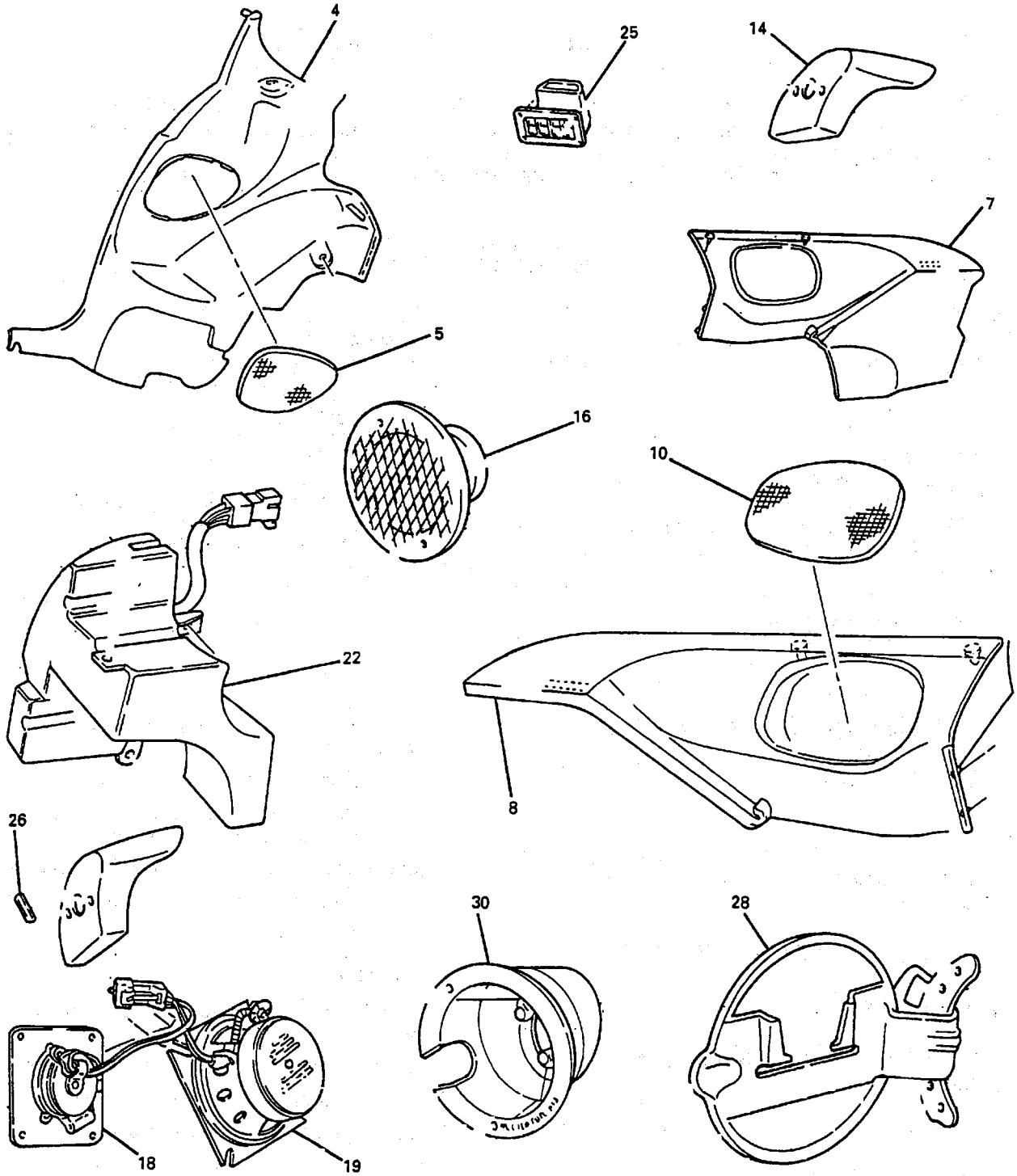
Install or Connect

NOTICE: See "Notice" on page 10-7-1 of this section.

1. Speaker grille assembly (5 or 37), if removed.
2. Quarter courtesy lamp (36), if removed.
3. Front quarter trim finishing panel assembly (4 or 35).
   - Thread lap belt through front quarter trim finishing panel (4 or 35).
4. Quarter inner trim finish panel extension (34) (Convertible only).
5. Quarter inner trim finish panel extension bolt/screw (33) (Convertible only).

Tighten

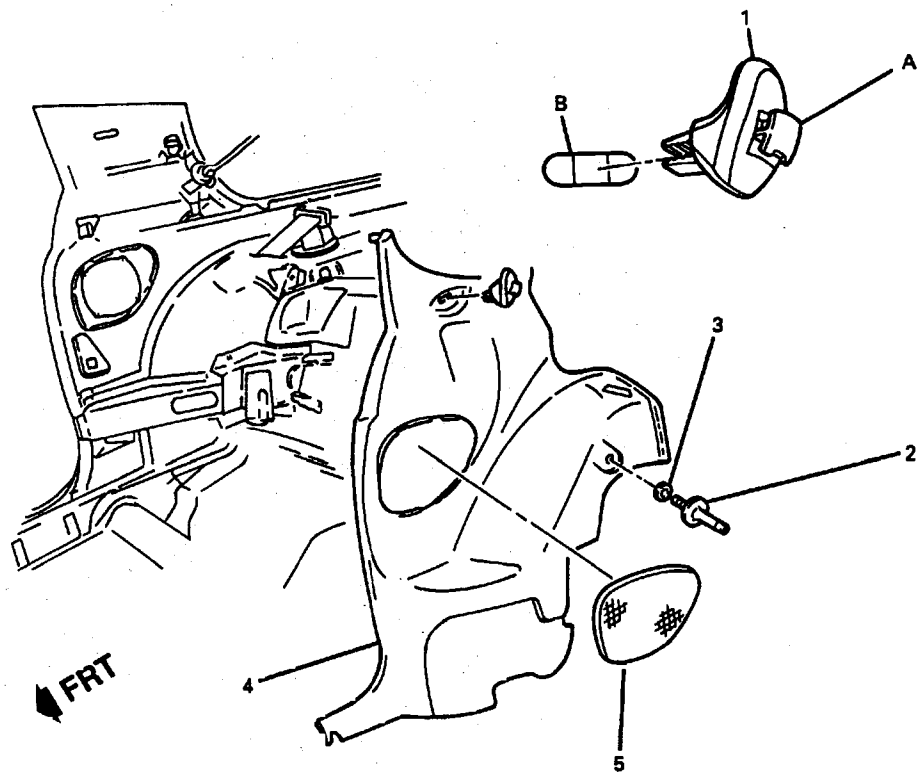
- Finish panel bolt/screw (33) to 1.9 N•m (17 lb. in.).



4 PANEL ASSEMBLY, FRONT QUARTER TRIM FINISHING
5 GRILLE ASSEMBLY, RADIO SPEAKER
7 PANEL ASSEMBLY, RIGHT QUARTER INNER REAR TRIM FINISHING
8 PANEL ASSEMBLY, LEFT QUARTER INNER REAR TRIM FINISHING
10 GRILLE ASSEMBLY, RADIO SPEAKER
14 EXTENSION, QUARTER TRIM FINISHING PANEL
16 SPEAKER ASSEMBLY, RADIO REAR SAIL PANEL
18 SPEAKER ASSEMBLY, RADIO REAR
19 SPEAKER ASSEMBLY, RADIO REAR
22 SPEAKER ASSEMBLY, REAR (CHEVROLET ONLY)
25 VALVE ASSEMBLY, QUARTER OUTER PANEL PRESSURE RELIEF
26 MOLDING ASSEMBLY, REAR QUARTER CENTER
28 DOOR ASSEMBLY, FUEL TANK FILLER
30 POCKET ASSEMBLY, FUEL TANK FILLER

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Figure 1 – Rear Quarter Components



A RETAINER
B HOLE IN FRONT QUARTER TRIM FINISHING PANEL
1 HOOK ASSEMBLY, COAT
2 BOLT/SCREW, SECOND SEATBACK CUSHION LOCK STRIKER
3 WASHER, SECOND SEATBACK CUSHION LOCK STRIKER
4 PANEL ASSEMBLY, FRONT QUARTER TRIM FINISHING
5 GRILLE ASSEMBLY, RADIO SPEAKER

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Figure 2 – Front Quarter Trim Finishing Panel Assembly (Coupe)

6. Striker bolt/screw (2) and washer (3).

Tighten

- Striker bolt/screw (2) to 48 N•m (35 lb. ft.).

7. Coat hook assembly (1) (Coupe only).
   - Slide into position and press retainer to lock.
8. Left or right shroud side trim finishing panel. Refer to SECTION 10-5.
9. Raise the folding seatback.

Quarter Inner Rear Trim Finishing Panel Assembly

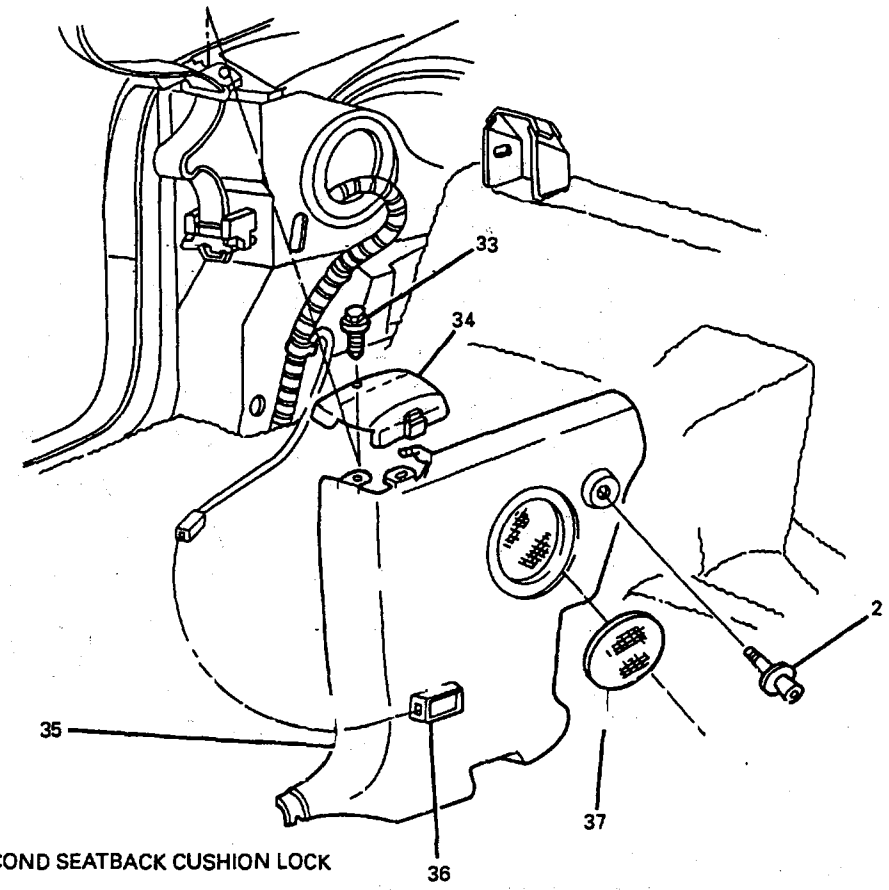
Figures 4 and 5

Tool Required:

J 38778 Trim Pad Remover

Remove or Disconnect

1. Raise rear compartment lift window.
2. Sunshade.
   - Snap out.
3. Three retainers (6), by rotating retainers a quarter turn using a key or coin if removing right side.
4. Quarter inner rear trim finishing panel assembly (7 or 8) by first lifting from front corner.
5. Three retainers (11), using J 38778 to unsnap if removing left side.
6. Radio speaker electrical connector.
7. Radio speaker grille assembly (10), if necessary.
   - Squeeze outer edges with fingertips and pull out.
8. Radio rear speaker assemblies. Refer to " Radio Rear Speaker Assembly" in this section.



2 BOLT/SCREW, SECOND SEATBACK CUSHION LOCK STRIKER
33 BOLT/SCREW, QUARTER INNER TRIM FINISH PANEL EXTENSION
34 EXTENSION, QUARTER INNER TRIM FINISH PANEL
35 PANEL ASSEMBLY, FRONT QUARTER TRIM FINISHING
36 LAMP ASSEMBLY, QUARTER COURTESY
37 GRILLE ASSEMBLY, RADIO SPEAKER

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Figure 3 – Front Quarter Trim Finishing Panel Assembly (Convertible)

9. Three retainers (11) on left side, if necessary.

Install or Connect

1. Three retainers (11), if removed from left side.
2. Radio rear speaker assemblies. Refer to "Radio Rear Speaker Assembly" in this section.
3. Radio speaker grille assembly (10), if removed.
   - Squeeze outer edges with fingertips, place in position and release pressure.
4. Radio speaker electrical connector.
5. Quarter inner rear trim finishing panel assembly (7 or 8).
   - On left quarter inner rear trim finishing panel assembly (8), align three retainers (11) with holes in quarter panel assembly (12) and press down to lock in position.
6. Three retainers (6), by rotating retainers a quarter turn using a key or coin if installing right quarter inner rear trim finishing panel assembly (7).
7. Sunshade.
   - Snap into position.
8. Lower rear compartment lift window.

Quarter Trim Finishing Panel Extension (With Lift-Off Roof Assemblies)

Figure 6

Remove or Disconnect

1. Two bolts/screws (13).
2. Quarter trim finishing panel extension (14).

Install or Connect

NOTICE: See "Notice" on page 10-7-1 of this section.

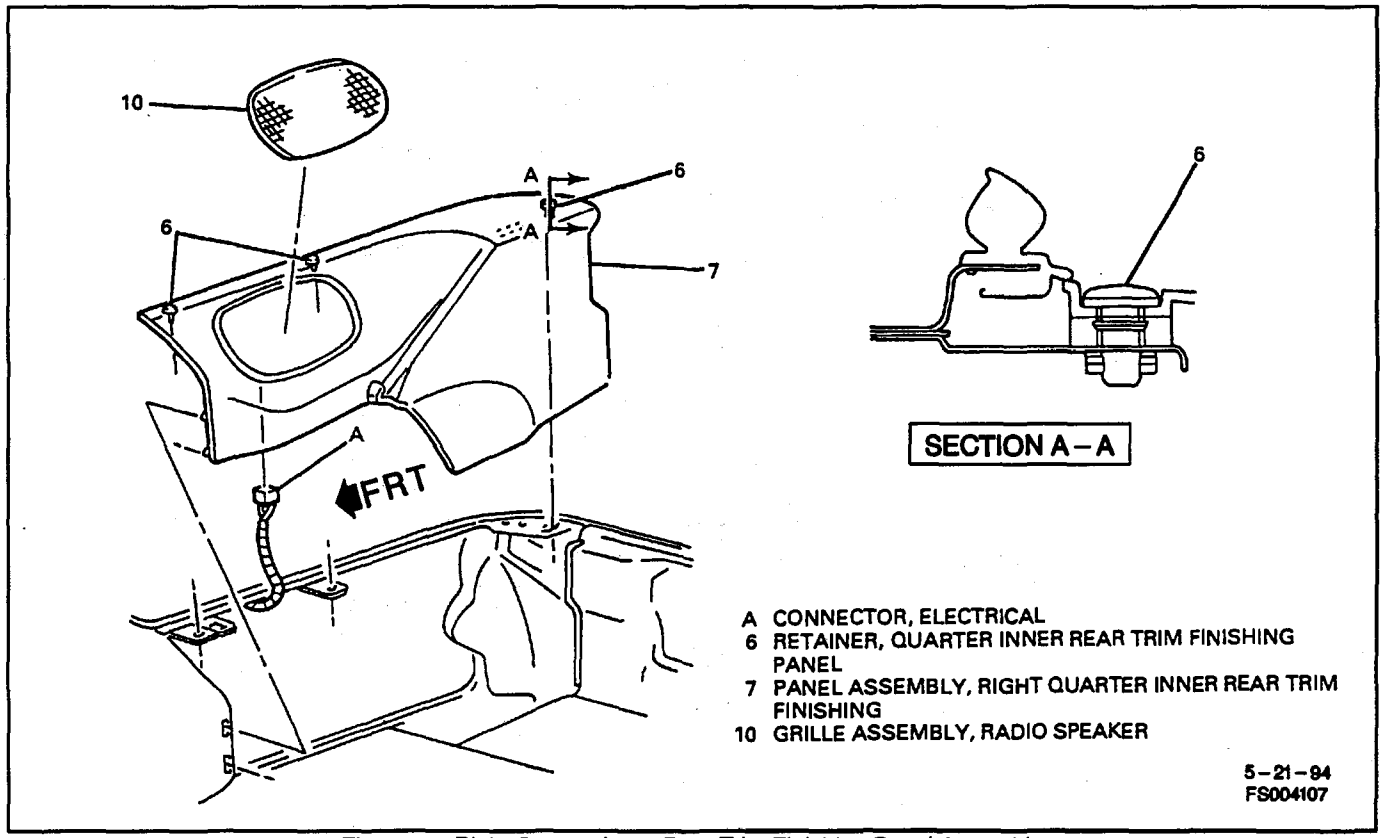


Figure 4 – Right Quarter Inner Rear Trim Finishing Panel Assembly

1. Quarter trim finishing panel extension (14).
2. Two bolts/screws (13).

Tighten

- Bolts/screws (13) to 2.5 N•m (22 lb. in.).

Quarter Courtesy Lamp Assembly

Convertible

Figure 3

Remove or Disconnect

1. Quarter courtesy lamp assembly (36) by unsnapping from front quarter trim finishing panel assembly (35).
2. Electrical connector.
3. Bulb.

Install or Connect

1. Bulb.
2. Electrical connector.
3. Quarter courtesy lamp assembly (36) to front quarter trim finishing panel assembly (35).

Radio Rear Sail Panel Speaker Grille Assembly

Coupe

Figure 2

Remove or Disconnect

- Speaker grille assembly (5).
  - Squeeze outer edges with fingertips and pull out.

Install or Connect

- Speaker grille assembly (5).
  - Squeeze outer edges, place in position and release pressure.

Front Quarter Trim Finishing Panel Speaker Grille Assembly

Convertible

Figure 3

Remove or Disconnect

1. Trim finishing panel assembly. Refer to "Front Quarter Trim Finishing Panel Assembly" in this section.
2. Speaker grille assembly (37).

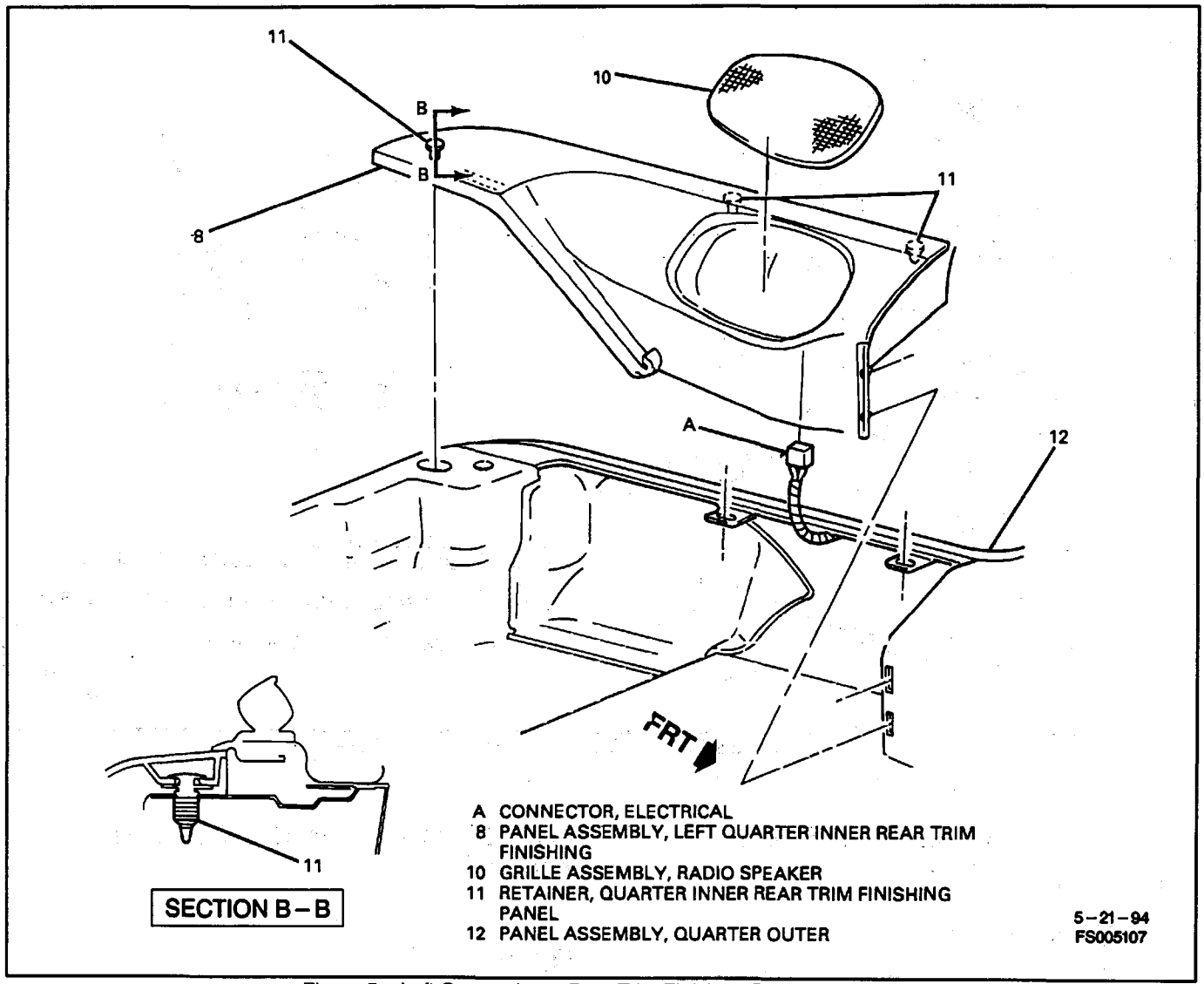


Figure 5 – Left Quarter Inner Rear Trim Finishing Panel Assembly

A. Using a soldering iron, melt heat stakes retaining speaker grille (37).

B. Pull grille from trim finishing panel assembly.

Install or Connect

1. Speaker grille assembly (37).
   A. Insert heat stakes through holes in trim finishing panel assembly.
   B. Melt heat stakes using a soldering iron.
   C. Press melted heat stakes flat using suitable surface.
2. Trim finishing panel assembly. Refer to "Front Quarter Trim Finishing Panel Assembly" in this section.

Rear Quarter Rear Radio Speaker Grille Assembly

Figures 4 and 5

Remove or Disconnect

- Speaker grille assembly (10).
  - Squeeze outer edges with fingertips and pull out.

Install or Connect

- Speaker grille assembly (10).
  - Squeeze outer edge with fingertips, place in position and release pressure.

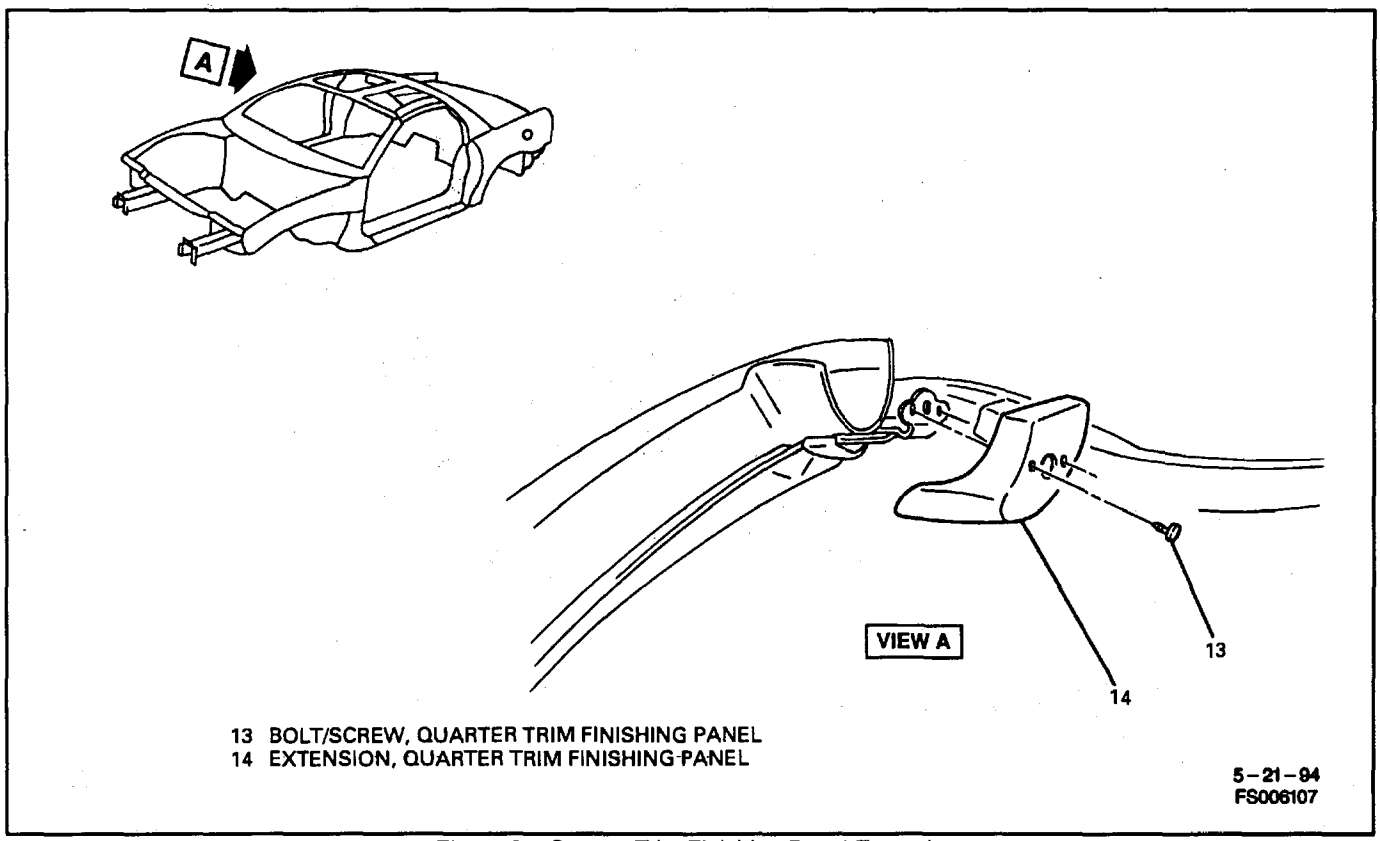


Figure 6 – Quarter Trim Finishing Panel Extension

Radio Rear Sail Panel Speaker Assembly

Figure 7

Remove or Disconnect

1. Front quarter trim finishing panel assembly. Refer to "Front Quarter Trim Finishing Panel Assembly" in this section.
2. Four bolts/screws (15).
3. Radio speaker assembly (16).
4. Electrical connector.

Install or Connect

NOTICE: See "Notice" on page 10-7-1 of this section.

1. Electrical connector.
2. Radio speaker assembly (16).
3. Bolts/screws (15).

Tighten

- Four bolts/screws (15) to 1.9 N•m (17 lb. in.).

4. Front quarter trim finishing panel assembly. Refer to "Front Quarter Trim Finishing Panel Assembly" in this section.

Radio Rear Sail Panel Speaker Opening Cover Assembly

Convertible

Figure 8

Remove or Disconnect

1. Speaker assembly. Refer to "Radio Rear Sail Panel Speaker Assembly" in this section.
2. Speaker opening cover assembly (38).

Install or Connect

1. Speaker opening cover assembly (38).
2. Speaker assembly. Refer to "Radio Rear Sail Panel Speaker Assembly" in this section.

Radio Rear Speaker Assembly

Figure 9

Remove or Disconnect

1. Quarter inner rear trim finishing panel assembly. Refer to "Quarter Inner Rear Trim Finishing Panel Assembly" in this section.
2. Radio speaker assembly (18 or 19).
   A. Drill out rivets or bolts/screws, if equipped.
   B. Rotate counterclockwise and pull out.

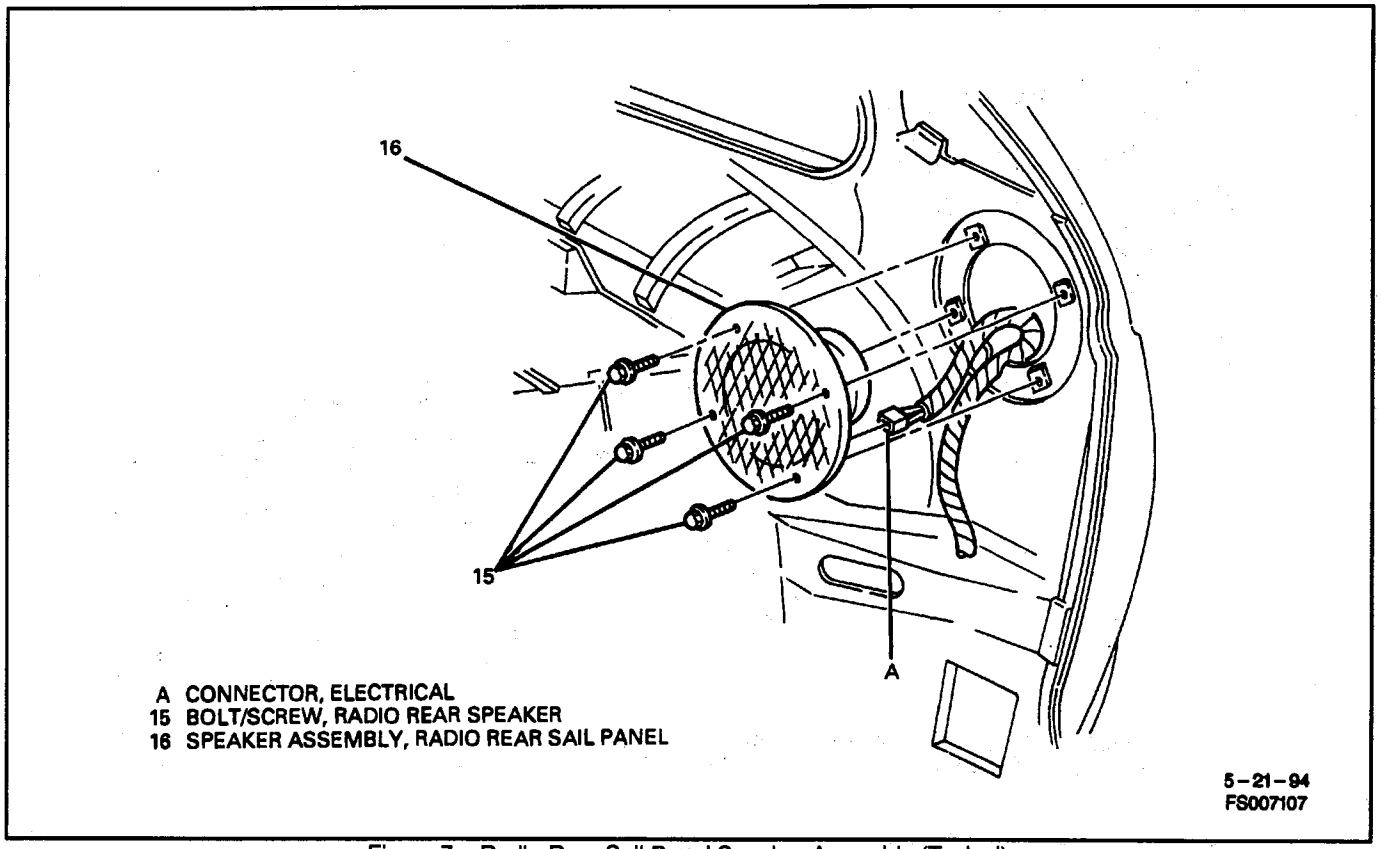


Figure 7 – Radio Rear Sail Panel Speaker Assembly (Typical)

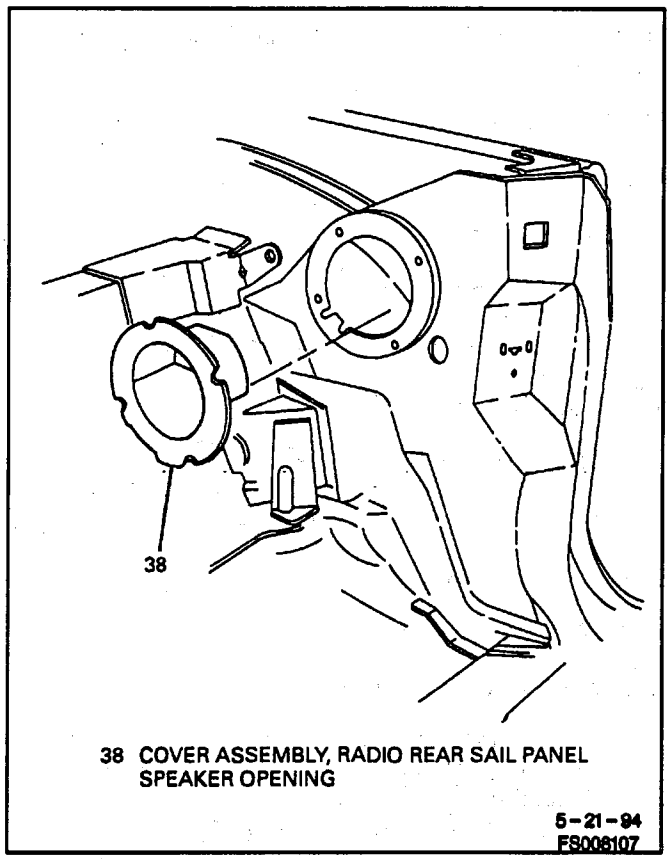


Figure 8 – Radio Rear Sail Panel Speaker Opening Cover Assembly (Convertible)

C. If replacing only one speaker assembly (18 or 19), pull wire out of electrical connector.

Install or Connect

NOTICE: See "Notice" on page 10-7-1 of this section.

1. Plug speaker wire into electrical connector, if removed.
2. Radio speaker assembly (18 or 19).
   A. Drill two 1/16-inch holes in rear quarter trim finishing panel speaker mounting bosses as shown in Figure 9, if necessary.
   B. Place radio speaker assembly (18 or 19) in position and rotate clockwise until holes in radio speaker assembly (18 or 19) align with drilled holes.
   C. Install two self-tapping bolts/screws (20), GM P/N 11505169, into drilled holes.

Tighten

- Two bolts/screws (20) to 1.9 N•m (17 lb. in.).

3. Quarter inner rear trim finishing panel assembly. Refer to "Quarter Inner Rear Trim Finishing Panel Assembly" in this section.

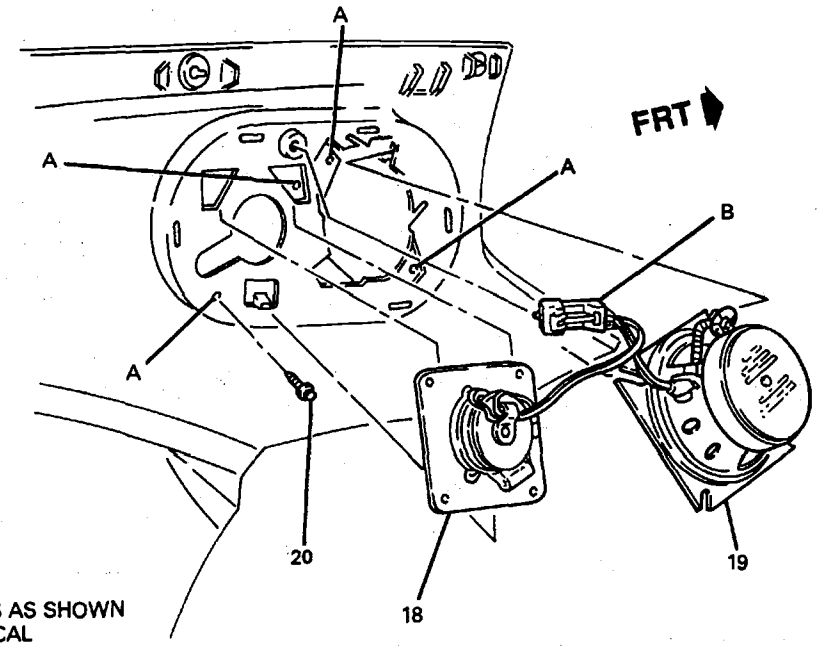


Figure 9 – Radio Rear Speaker Assembly (Typical)

Chevrolet

Figure 10

Remove or Disconnect

1. Left quarter inner rear trim finishing panel assembly. Refer to "Quarter Inner Rear Trim Finishing Panel Assembly" in this section.
2. Two bolts/screws (39).
3. Speaker assembly (40).
4. Electrical connector.

Install or Connect

NOTICE: See "Notice" on page 10-7-1 of this section.

1. Electrical connector.
2. Speaker assembly (40).
3. Two bolts/screws (39).

Tighten

- Two bolts/screws (39) to 1.9 N•m (17 lb. in.).

4. Left quarter inner rear trim finishing panel assembly. Refer to "Quarter Inner Rear Trim Finishing Panel Assembly" in this section.

Low Frequency Audio Amplifier Assembly

Pontiac

Figure 11

Tool Required:

J 38778 Trim Pad Remover

Remove or Disconnect

1. Right front quarter trim finishing panel assembly. Refer to "Front Quarter Trim Finishing Panel Assembly" in this section.
2. Two retainers (31) using J 38778 trim pad remover.
3. Amplifier assembly (32).
4. Electrical connector.

Install or Connect

1. Electrical connector.
2. Amplifier assembly (32).
3. Two retainers (31).

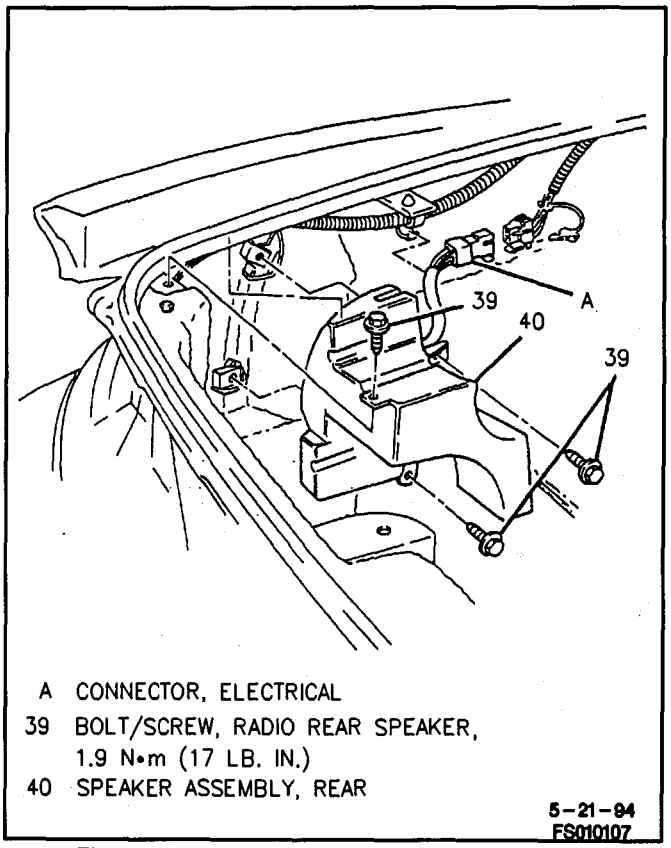


Figure 10 – Rear Speaker Assembly – (Chevrolet)

4. Right front quarter trim finishing panel assembly. Refer to "Front Quarter Trim Finishing Panel Assembly" in this section.

Quarter Outer Panel Pressure Relief Valve Assembly

Figure 12

Remove or Disconnect

1. Rear bumper fascia. Refer to SECTION 10-4.
2. Four bolts/screws (24).
3. Quarter outer panel pressure relief valve assembly (25).

Install or Connect

NOTICE: See "Notice" on page 10-7-1 of this section.

1. Quarter outer panel pressure relief valve assembly (25).
2. Four bolts/screws (24).

Tighten

- Four bolts/screws (24) to 1.4 N•m (13 lb. in.).

3. Rear bumper fascia. Refer to SECTION 10-4.

EXTERIOR TRIM

NOTICE: When removing or installing any outside molding, cover adjacent finishes with masking tape to prevent damage to the finish. Use proper tools and take care to prevent damage to the molding.

Rear Quarter Center Molding Assembly

Figure 13

Remove or Disconnect

- Molding assembly (26) from body surface.
  - A. Hold hot air gun 304 mm (12 inches) from surface of molding assembly (26).
  - B. Apply heat, using circular motion for about 30 seconds.
  - C. Using care, peel molding assembly (26) from body surface.

Install or Connect

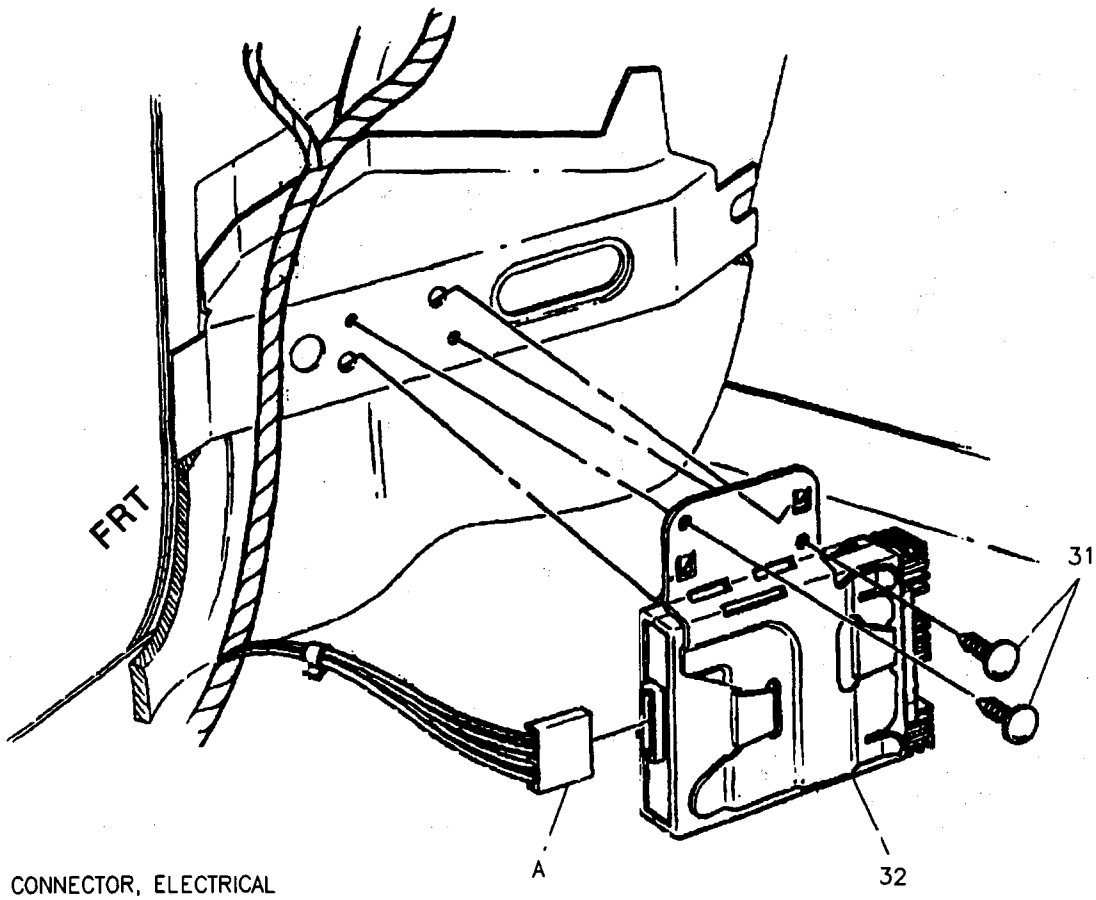
- Molding assembly (26) to body surface.
  - A. Body surface must be warm, 21°C (70°F), clean and wax free.
  - B. If installing a new part, remove adhesive backing.
  - C. When installing a previously removed part, or a partially loosened part, apply a thin, even film of GM P/N 1052621 adhesive to adhesive portion of molding assembly (26).
  - D. Align and press molding assembly (26) into position.

FUEL TANK FILLER DOOR

Figure 14

Remove or Disconnect

1. Fuel tank filler pocket assembly. Refer to "Fuel Tank Filler Pocket Assembly" in the following procedure.
2. Install fuel tank filler cap.
3. Drill out four rivets (27).
4. Fuel tank filler door assembly (28).
   - It may be necessary to gently pry back sound insulating material around filler door hinge.



A CONNECTOR, ELECTRICAL
31 RETAINER, LOW FREQUENCY AUDIO AMPLIFIER BRACKET
32 AMPLIFIER ASSEMBLY. LOW FREQUENCY AUDIO

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Figure 11 – Low Frequency Audio Amplifier Assembly – (Pontiac)

Remove or Disconnect

1. Fuel tank filler door assembly (28).
2. Four rivets (27).
   - Install rivets alternately top to bottom.
3. Remove fuel tank filler cap.
4. Fuel tank filler pocket assembly. Refer to "Fuel Tank Filler Pocket Assembly" in the following procedure.

FUEL TANK FILLER POCKET ASSEMBLY

Figure 15

Remove or Disconnect

1. Open fuel tank filler door assembly (28) and remove cap.
2. Two bolts/screws (29).
3. Fuel tank filler pocket assembly (30).

Install or Connect

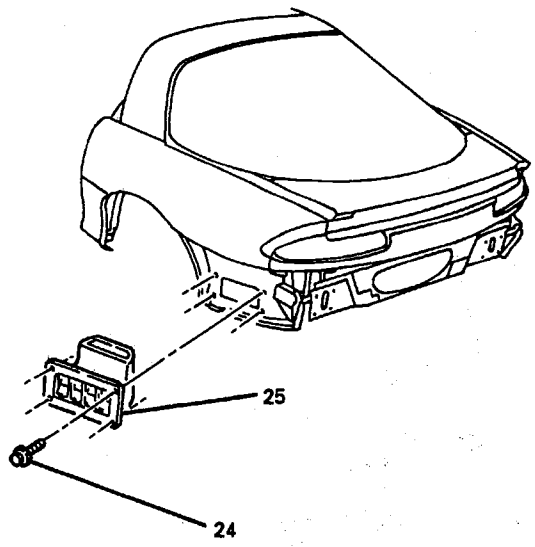
NOTICE: See "Notice" on page 10-7-1 of this section.

1. Fuel tank filler pocket assembly (30).
2. Two bolts/screws (29).

Tighten

- Two bolts/screws (29) to 1.9 N•m (17 lb. in.).

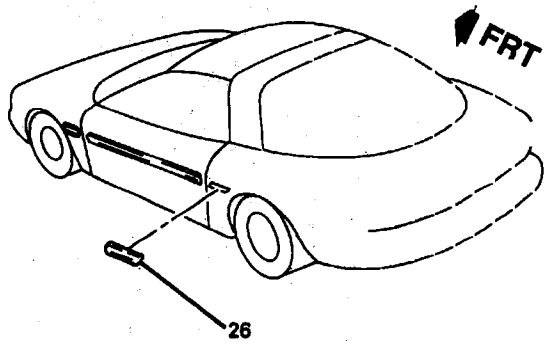
3. Install cap and close fuel tank filler door assembly (28).



24 BOLT/SCREW, QUARTER OUTER PANEL PRESSURE RELIEF VALVE
25 VALVE ASSEMBLY, QUARTER OUTER PANEL PRESSURE RELIEF

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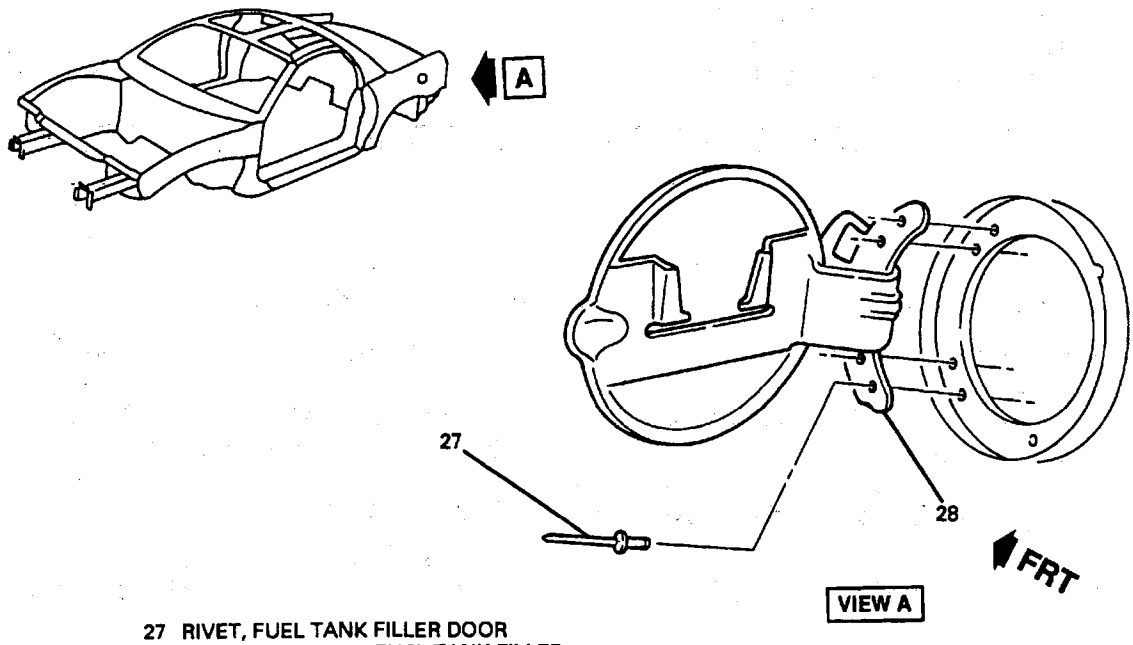
Figure 12 – Quarter Outer Panel Pressure Relief Valve Assembly



26 MOLDING ASSEMBLY, REAR QUARTER CENTER

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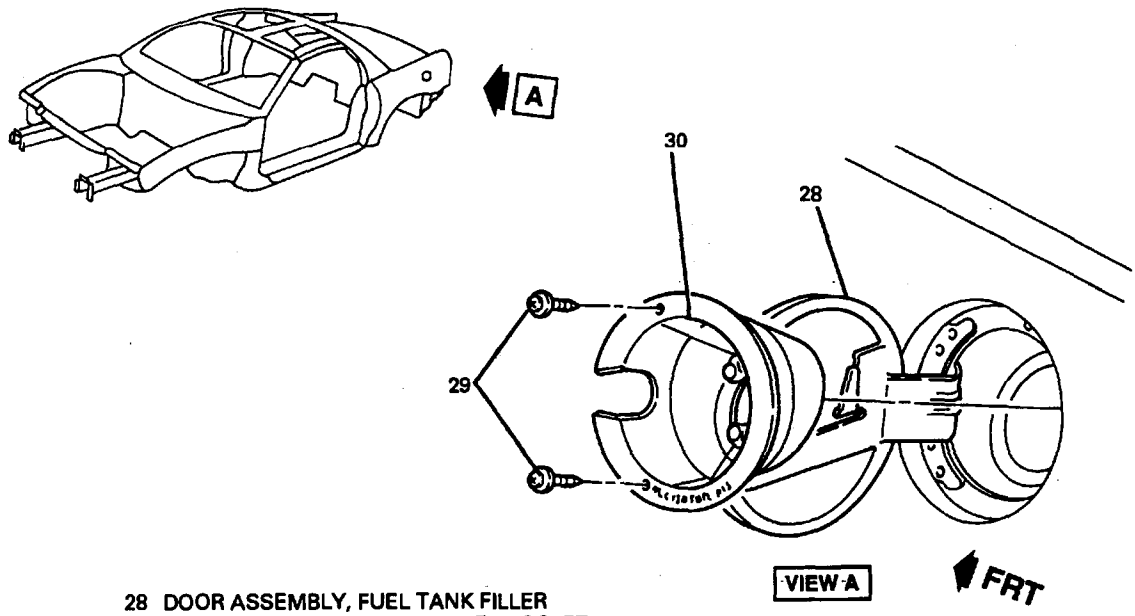
Figure 13 – Rear Quarter Center Molding Assembly (Typical)



27 RIVET, FUEL TANK FILLER DOOR
28 DOOR ASSEMBLY, FUEL TANK FILLER

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Figure 14 – Fuel Tank Filler Door Assembly



28 DOOR ASSEMBLY, FUEL TANK FILLER
29 BOLT/SCREW, FUEL TANK FILLER POCKET,
30 POCKET ASSEMBLY, FUEL TANK FILLER

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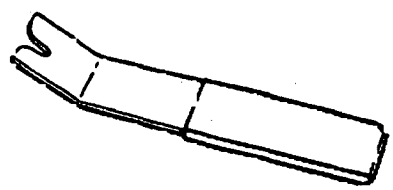
Figure 15 – Fuel Tank Filler Pocket Assembly

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fuel Tank Filler Pocket Bolt/Screw	1.9 N•m (17 lb. in.)
Quarter Inner Trim Finish Panel Extension Bolt/Screw (Convertible Only)	1.9 N•m (17 lb. in.)
Quarter Outer Panel Pressure Relief Valve Bolt/Screw	1.4 N•m (13 lb. in.)
Quarter Trim Finishing Panel Bolt/Screw	2.5 N•m (22 lb. in.)
Radio Rear Speaker Mounting Bolt/Screw	1.9 N•m (17 lb. in.)
Second Seatback Striker Bolt/Screw	48 N•m (35 lb. ft.)

SPECIAL TOOLS



1 J 38778

1 TRIM PAD REMOVER

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BLANK

SECTION 10-8
BODY REAR END

CAUTION: When replacing a lift window, urethane adhesive GM P/N 12345633 must be used to maintain original installation integrity. Failure to use urethane adhesive GM P/N 12345633 will result in poor retention of the lift window which may allow unrestrained occupants to be ejected from the vehicle with resulting personal injury.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

BODY REAR END

Figures 1, 2, 3 and 4

This section contains the service operations necessary for the removal, installation, adjustment and sealing of body rear end hardware and trim components.

ON-VEHICLE SERVICE

REAR COMPARTMENT LOCK SYSTEM

Rear Compartment Lid Lock Cylinder Assembly

Figure 5

Remove or Disconnect

1. Open window panel assembly.

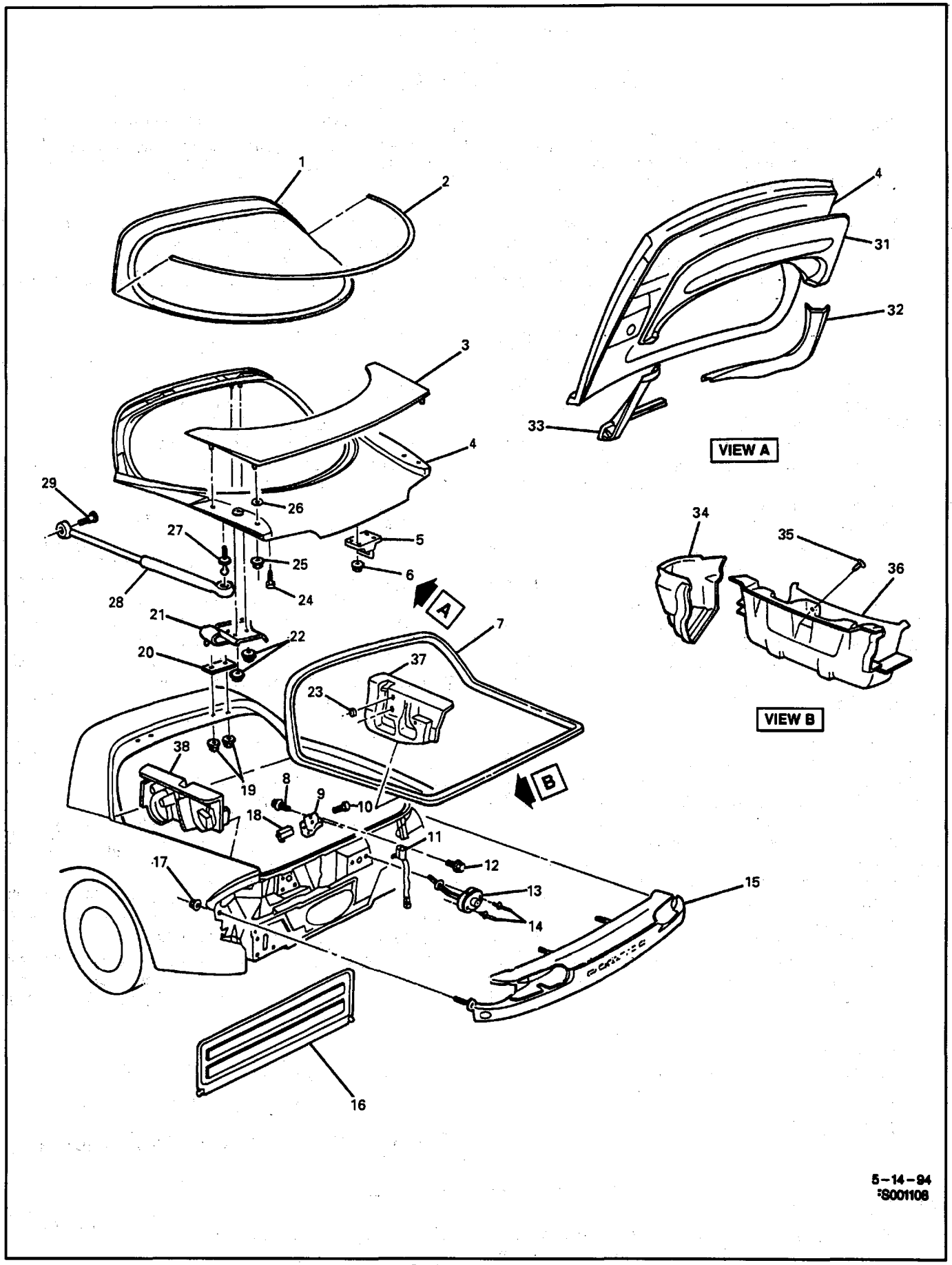


Figure 1 – Body Rear End – (Chevrolet)

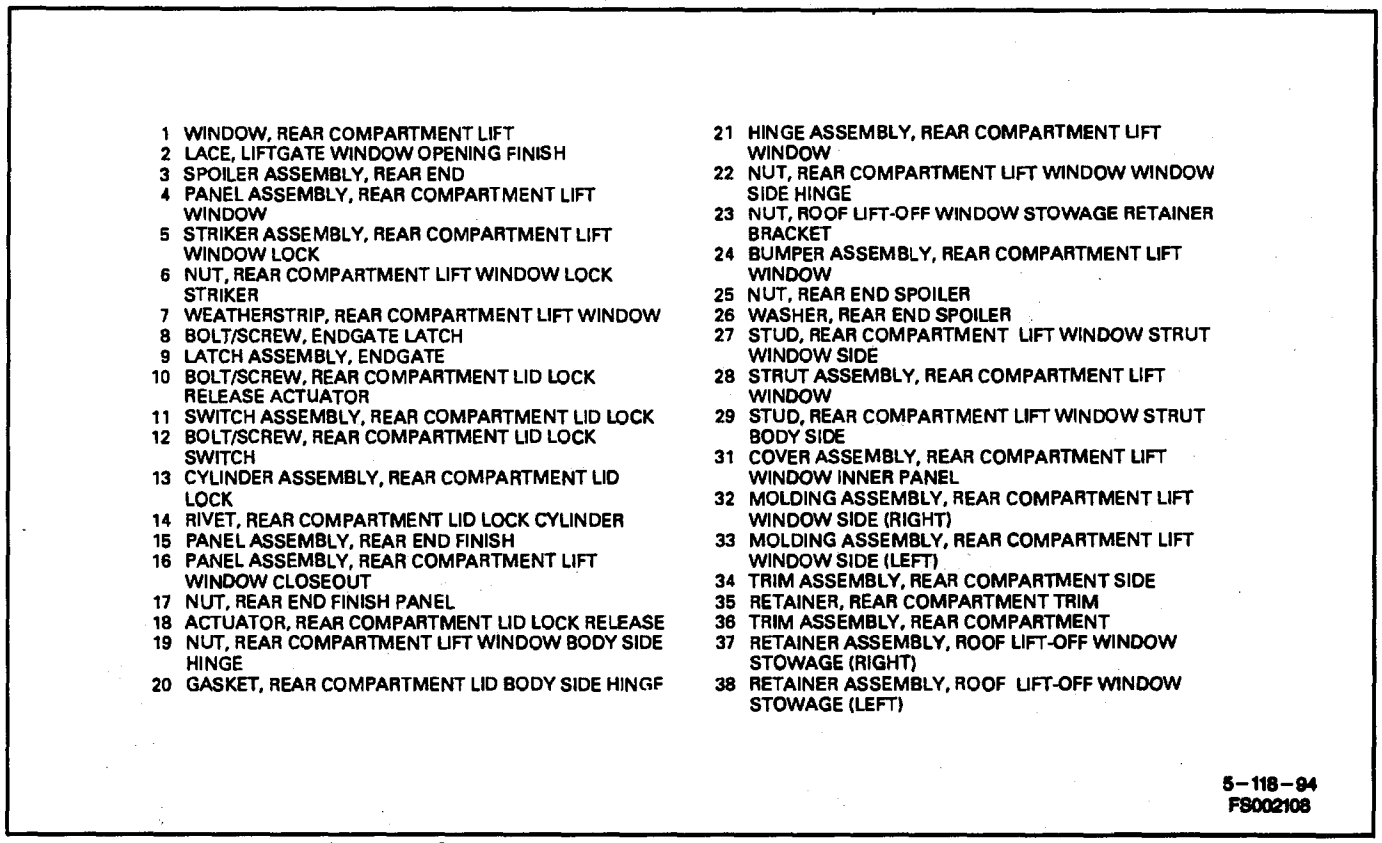


Figure 2 – Body Rear End – Legend – (Chevrolet)

2. Rear end finish panel assembly. Refer to "Rear End Finish Panel Assembly" in this section (Chevrolet only).
3. Taillamp filler. Refer to "Taillamp Filler" in this section (Pontiac only).
4. Rivets (14).
5. Lock cylinder assembly (13).

Install or Connect

Important

- Tan dot on lock cylinder assembly (13) must face upward when installing lock cylinder assembly (13).

1. Lock cylinder assembly (13), guiding lock cylinder shaft through hole in rear end panel into hole in lock support.
2. Align lock cylinder assembly (13).
3. Right rivet (14).
4. Left rivet (14).
5. Taillamp filler. Refer to "Taillamp Filler" in this section (Pontiac only).
6. Rear end finish panel assembly. Refer to "Rear End Finish Panel Assembly" in this section (Chevrolet only).

Endgate Latch Assembly

Figure 6

Remove or Disconnect

1. Open window panel assembly.
2. Rear compartment trim assembly as needed. Refer to "Rear Compartment Trim Assembly" in this section.
3. Rear compartment lid lock switch electrical connector. Refer to "Rear Compartment Lid Lock Switch Assembly" in this section.
4. Rear compartment lid lock release actuator secondary lock retainer and electrical connector. Refer to "Rear Compartment Lid Lock Release Actuator" in this section.
5. Bolts/screws (8).
6. Latch assembly (9).

Install or Connect

NOTICE: See "Notice" on page 10-8-1 of this section.

1. Latch assembly (9).
   - Align holes in latch assembly (9) with holes in support.
2. Bolts/screws (8).

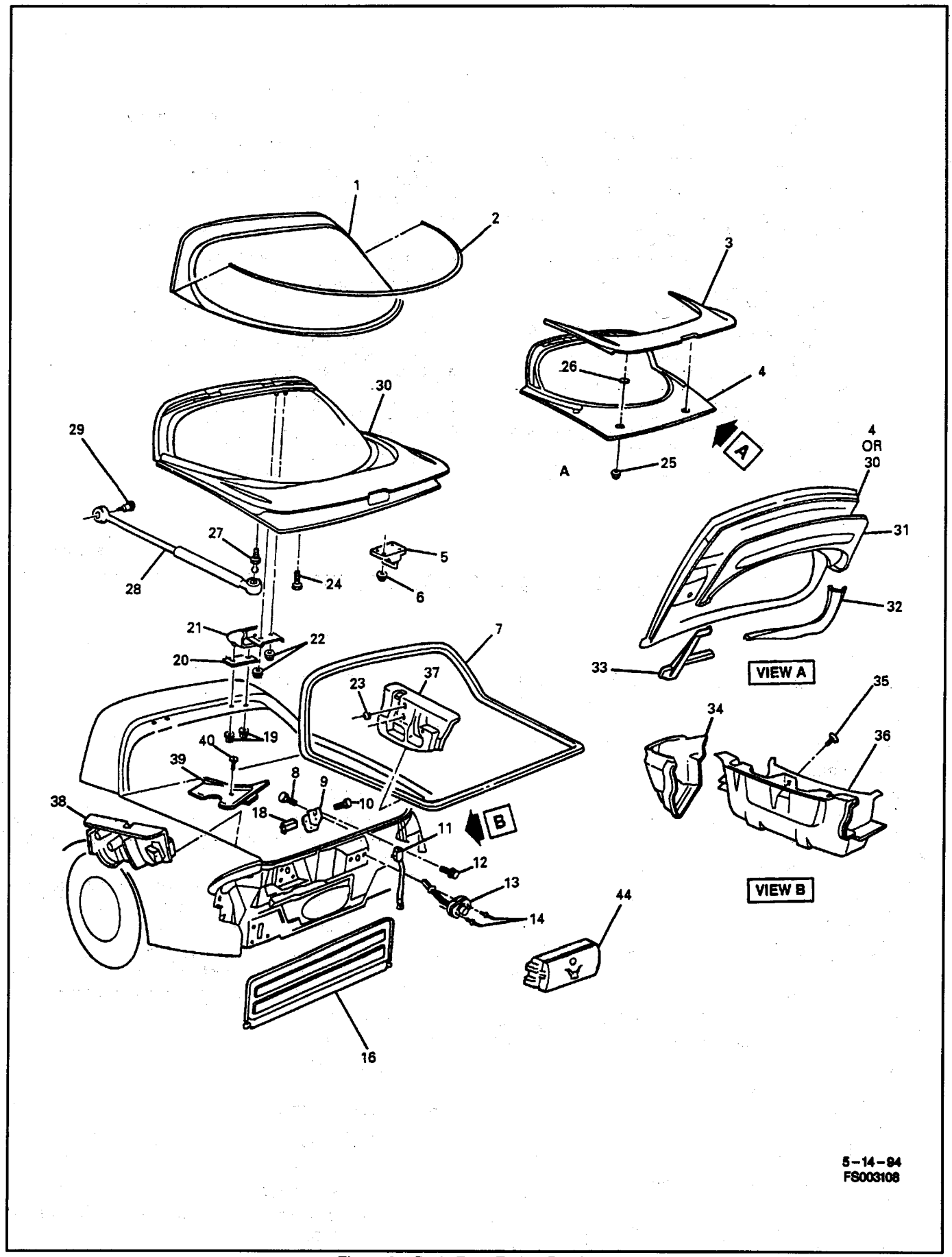


Figure 3 – Body Rear End – (Pontiac)

A TRANS AM
1 WINDOW, REAR COMPARTMENT LIFT
2 LACE, LIFTGATE WINDOW OPENING FINISH
3 SPOILER ASSEMBLY, REAR END
4 PANEL ASSEMBLY, REAR COMPARTMENT LIFT WINDOW (TRANS AM)
5 STRIKER ASSEMBLY, REAR COMPARTMENT LIFT WINDOW LOCK
6 NUT, REAR COMPARTMENT LIFT WINDOW LOCK STRIKER
7 WEATHERSTRIP, REAR COMPARTMENT LIFT WINDOW
8 BOLT/SCREW, ENDGATE LATCH
9 LATCH ASSEMBLY, ENDGATE
10 BOLT/SCREW, REAR COMPARTMENT LID LOCK RELEASE ACTUATOR
11 SWITCH ASSEMBLY, REAR COMPARTMENT LID LOCK
12 BOLT/SCREW, REAR COMPARTMENT LID LOCK SWITCH
13 CYLINDER ASSEMBLY, REAR COMPARTMENT LID LOCK
14 RIVET, REAR COMPARTMENT LID LOCK CYLINDER
16 PANEL ASSEMBLY, REAR COMPARTMENT LIFT WINDOW CLOSEOUT
18 ACTUATOR, REAR COMPARTMENT LID RELEASE
19 NUT, REAR COMPARTMENT LIFT WINDOW BODY SIDE HINGE
20 GASKET, REAR COMPARTMENT LID BODY SIDE HINGE
21 HINGE ASSEMBLY, REAR COMPARTMENT LIFT WINDOW
22 NUT, REAR COMPARTMENT LIFT WINDOW SIDE HINGE
23 NUT, ROOF LIFT-OFF WINDOW STOWAGE RETAINER BRACKET
24 BUMPER ASSEMBLY, REAR COMPARTMENT LIFT WINDOW
25 NUT, REAR END SPOILER
26 WASHER, REAR END SPOILER
27 STUD, REAR COMPARTMENT LIFT WINDOW
28 STRUT ASSEMBLY, REAR COMPARTMENT LIFT WINDOW
29 STUD, LIFTGATE STRUT BODY SIDE
30 PANEL ASSEMBLY, REAR COMPARTMENT LIFT WINDOW (EXCEPT TRANS AM)
31 COVER ASSEMBLY, REAR COMPARTMENT LIFT WINDOW INNER PANEL
32 MOLDING ASSEMBLY, REAR COMPARTMENT LIFT WINDOW SIDE (RIGHT)
33 MOLDING ASSEMBLY, REAR COMPARTMENT LIFT WINDOW SIDE (LEFT)
34 TRIM ASSEMBLY, REAR COMPARTMENT SIDE
35 RETAINER, REAR COMPARTMENT TRIM
36 TRIM ASSEMBLY, REAR COMPARTMENT
37 RETAINER ASSEMBLY, ROOF LIFT-OFF WINDOW STOWAGE (RIGHT)
38 RETAINER ASSEMBLY, ROOF LIFT-OFF WINDOW STOWAGE (LEFT)
39 FILLER, TAILLAMP CLOSEOUT
40 RETAINER, TAILLAMP CLOSEOUT FILLER
44 FILLER, TAILLAMP

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Figure 4 – Body Rear End – Legend – (Pontiac)

Tighten

- Bolts/screws (8) to 10 N•m (89 lb. in.).

3. Rear compartment lid lock release actuator electrical connector and secondary lock retainer. Refer to "Rear Compartment Lid Lock Release Actuator" in this section.
4. Rear compartment lid lock switch electrical connector. Refer to "Rear Compartment Lid Lock Switch Assembly" in this section.
5. Rear compartment trim assembly. Refer to "Rear Compartment Trim Assembly" in this section.

Rear Compartment Lift Window Lock Striker Assembly

Figure 7

Remove or Disconnect

1. Open window panel assembly.
2. Rear compartment lift window inner panel cover assembly. Refer to "Rear Compartment Lift Window Inner Panel Cover Assembly" in this section.
3. Nuts (6).
4. Striker assembly (5).

Install or Connect

NOTICE: See "Notice" on page 10-8-1 of this section.

1. Striker assembly (5).
2. Nuts (6).

Tighten

- Nuts (6) to 10 N•m (89 lb. in.).

3. Rear compartment lift window inner panel cover assembly. Refer to "Rear Compartment Lift Window Inner Panel Cover Assembly" in this section.

Inspect

- Window panel operation. Adjust if necessary. Refer to "Rear Compartment Lift Window Panel Adjustment" in this section.

Rear Compartment Lid Lock Release Actuator

Figure 8

Remove or Disconnect

1. Open window panel assembly.
2. Rear compartment trim assembly as needed. Refer to "Rear Compartment Trim Assembly" in this section.

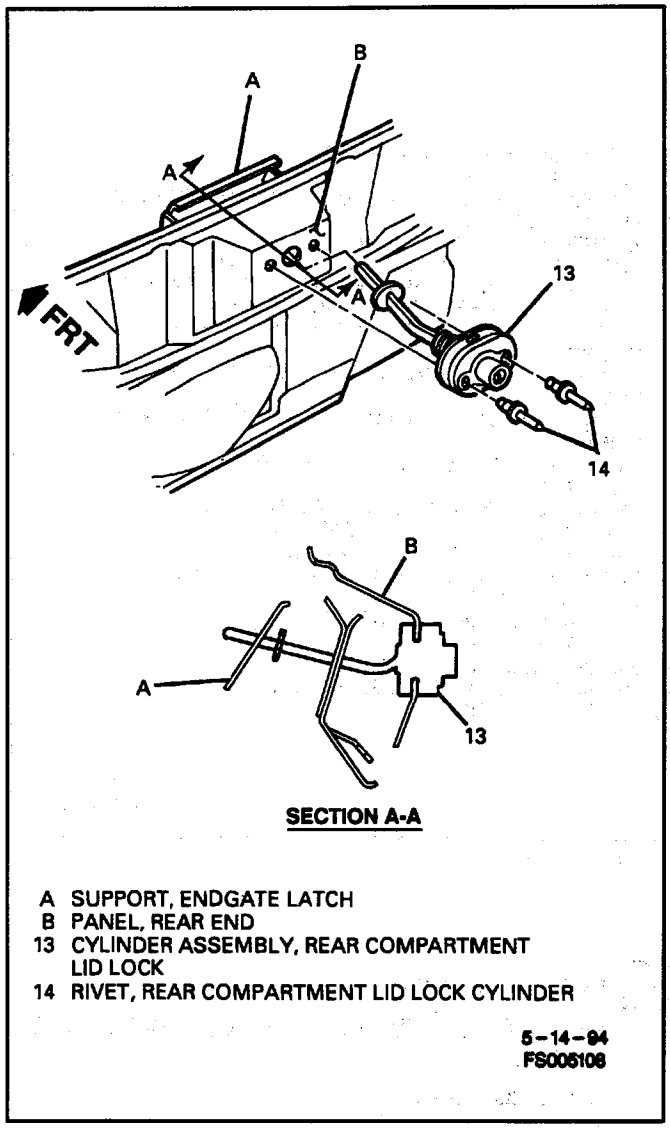


Figure 5 – Rear Compartment Lid Lock Cylinder Assembly

3. Secondary lock retainer from actuator (18).
4. Electrical connector from actuator (18).
5. Bolts/screws (10).
6. Actuator (18) from latch assembly (9).

Install or Connect

NOTICE: See "Notice" on page 10-8-1 of this section.

1. Actuator (18) to latch assembly (9).
2. Bolts/screws (10).
3. Electrical connector to actuator (18).
4. Secondary lock retainer.
5. Rear compartment trim assembly. Refer to "Rear Compartment Trim Assembly" in this section.

Rear Compartment Lid Lock Switch Assembly

Figure 8

Remove or Disconnect

1. Open window panel assembly.
2. Rear compartment trim assembly as needed. Refer to "Rear Compartment Trim Assembly" in this section.
3. Electrical connector from switch assembly (11).
4. Secondary lock retainer and electrical connector from actuator (18).
5. Endgate latch assembly. Refer to "Endgate Latch Assembly" in this section.
6. Bolt/screw (12).
7. Switch assembly (11) from latch assembly (9).

Install or Connect

NOTICE: See "Notice" on page 10-8-1 of this section.

1. Switch assembly (11) to latch assembly (9).
2. Bolt/screw (12).
3. Endgate latch assembly. Refer to "Endgate Latch Assembly" in this section.
4. Electrical connector and secondary lock retainer to actuator (18).
5. Electrical connector to switch assembly (11).
6. Rear compartment trim assembly. Refer to "Rear Compartment Trim Assembly" in this section.

REAR COMPARTMENT LIFT WINDOW WEATHERSTRIP

Figure 9

Remove or Disconnect

1. Weatherstrip (7) by peeling from flange.

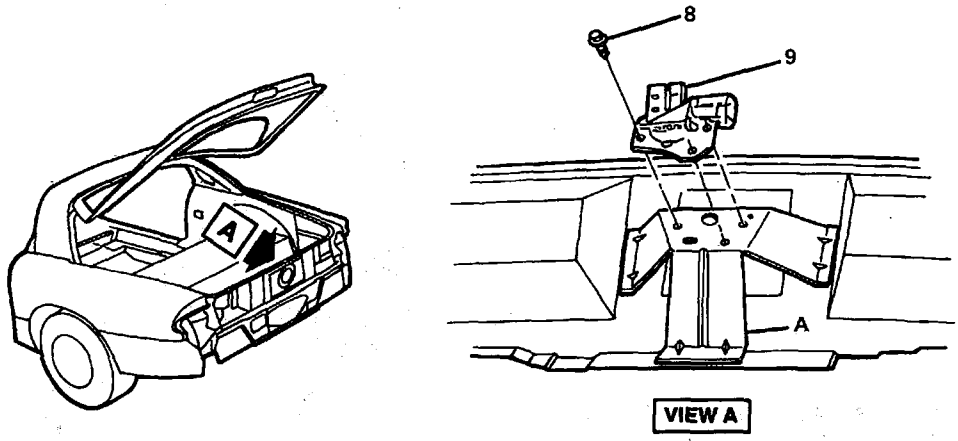
Clean

- Weatherstrip sealer from flange.

2. Support window panel assembly.
3. Strut assemblies at quarter inner roof panel. Refer to "Rear Compartment Lift Window Strut Assembly" in this section.
4. Weatherstrip (7) from opening.

Install or Connect

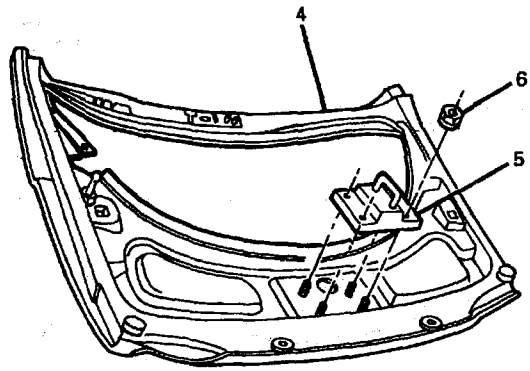
1. Weatherstrip (7) into opening.



A SUPPORT, ENDGATE LATCH
8 BOLT/SCREW, ENDGATE LATCH
9 LATCH ASSEMBLY, ENDGATE

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Figure 6 – Endgate Latch Assembly



4 PANEL ASSEMBLY, REAR COMPARTMENT LIFT WINDOW
5 STRIKER ASSEMBLY, REAR COMPARTMENT LIFT WINDOW LOCK
6 NUT, REAR COMPARTMENT LIFT WINDOW LOCK STRIKER

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Figure 7 – Rear Compartment Lift Window Lock Striker Assembly (Convertible Similar)

2. Strut assemblies at quarter inner roof panel. Refer to "Rear Compartment Lift Window Strut Assembly" in this section.
3. Weatherstrip (7).
   A. Position weatherstrip (7) to top center of flange.
   B. Attach upper corners, then work from corners to center across top.
   C. Attach elbow areas, then work from elbows to upper corners.
   D. Attach rear corners, then work from rear corners to elbows.
   E. Work from rear corners to center across rear.
   F. Roll entire weatherstrip (7) to seat.

REAR COMPARTMENT EXTERIOR TRIM

Rear End Finish Panel Emblem Assembly

Chevrolet

Figure 10

Tool Required:
J 25070 Heat Gun

Remove or Disconnect

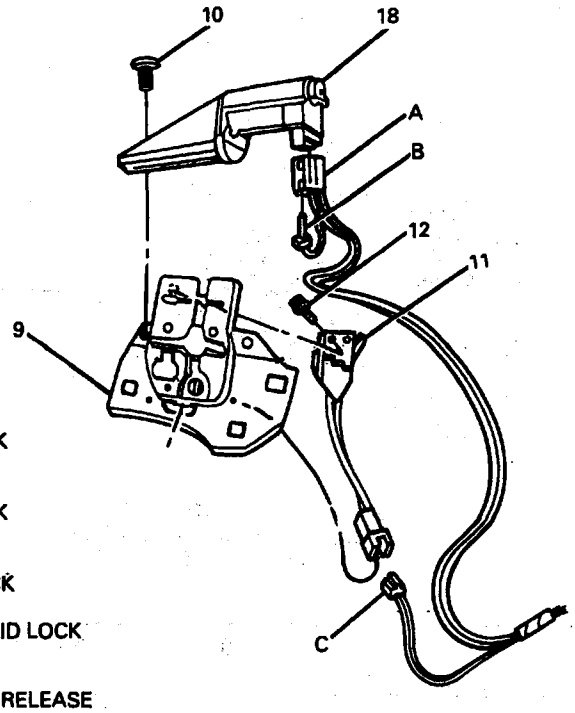
- Emblem assembly (41).
  A. Hold J 25070 at least 152 mm (6 inches) from emblem assembly (41). Apply heat in an even and circular motion.
  B. Pull emblem assembly (41) from panel assembly with flat-bladed tool, making sure not to damage paint.

Clean

1. Area with suitable solution of isopropyl alcohol 50/50 mixture by volume with water or high-flash naphtha.
2. Area with clean, dry cloth.

Install or Connect

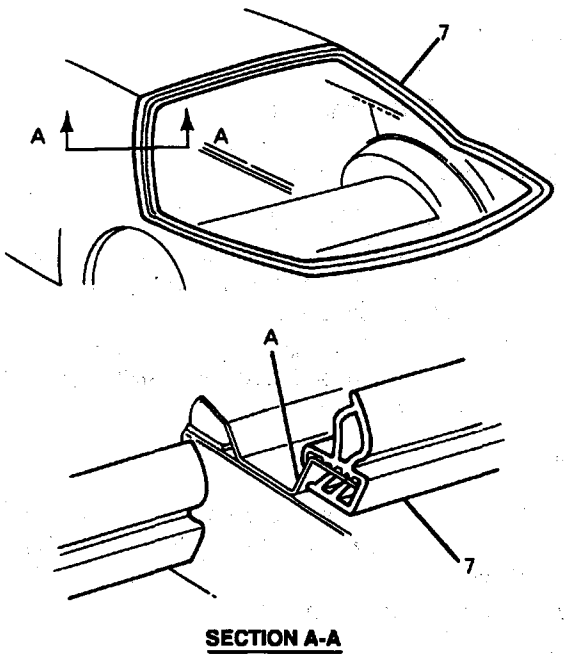
- New emblem assembly (41).
  A. Heat panel surface and adhesive side of new emblem assembly (41). Temperature must be 26°C (80°F) or 6°C (10°F) above air temperature in area, whichever is higher, but not exceeding 40°C (105°F).



A CONNECTOR, REAR COMPARTMENT LID LOCK RELEASE ACTUATOR ELECTRICAL
B RETAINER, SECONDARY LOCK.
C CONNECTOR, REAR COMPARTMENT LID LOCK SWITCH ELECTRICAL
9 LATCH ASSEMBLY, ENDGATE
10 BOLT/SCREW, REAR COMPARTMENT LID LOCK RELEASE ACTUATOR
11 SWITCH ASSEMBLY, REAR COMPARTMENT LID LOCK
12 BOLT/SCREW, REAR COMPARTMENT LID LOCK SWITCH
18 ACTUATOR, REAR COMPARTMENT LID LOCK RELEASE

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Figure 8 – Rear Compartment Lid Lock Release Actuator and Switch Assembly

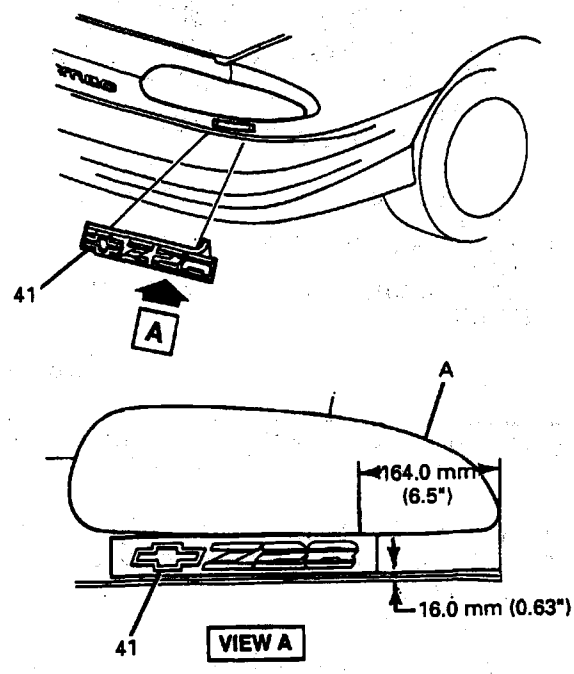


SECTION A-A

A FLANGE
7 WEATHERSTRIP, REAR COMPARTMENT LIFT WINDOW

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Figure 9 – Rear Compartment Lift Window Weatherstrip



A TAILLAMP OPENING
41 EMBLEM ASSEMBLY, REAR END FINISH PANEL

5-14-94
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Figure 10 – Installing Rear End Finish Panel Emblem Assembly – (Chevrolet)

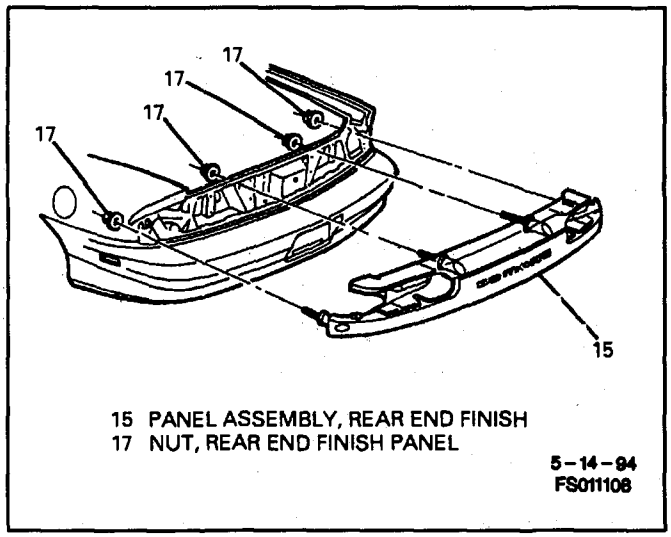


Figure 11 – Removing Rear End Finish Panel Assembly – (Chevrolet)

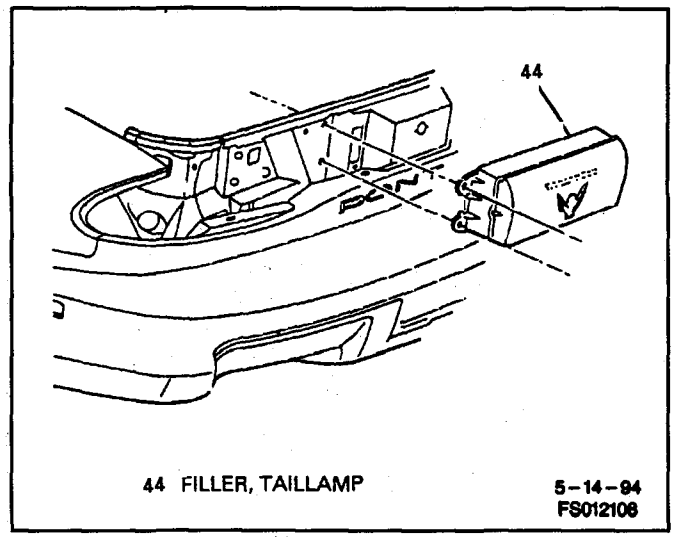


Figure 12 – Removing Taillamp Filler – (Pontiac)

B. Remove liner from adhesive strip.

Important

- Position emblem assembly (41) carefully. Emblem assembly (41) cannot be removed without reapplying adhesive after contact with vehicle.

C. Press emblem assembly (41) into place and apply pressure.

Rear End Finish Panel Assembly

Chevrolet

Figure 11

Remove or Disconnect

1. Taillamp assemblies. Refer to SECTION 8B.
2. Nuts (17).
3. Panel assembly (15).

Install or Connect

NOTICE: See "Notice" on page 10-8-1 of this section.

1. Panel assembly (15).
2. Nuts (17), starting with outboard locations.

Tighten

- Nuts (17) to 8 N•m (71 lb. in.).

3. Taillamp assemblies. Refer to SECTION 8B.

Taillamp Filler

Pontiac

Figure 12

Remove or Disconnect

1. Taillamp assemblies. Refer to SECTION 8B.
2. Filler (44).

Install or Connect

1. Filler (44).
2. Taillamp assemblies. Refer to SECTION 8B.

REAR COMPARTMENT INTERIOR TRIM

Taillamp Closeout Filler

Pontiac

Figure 13

Remove or Disconnect

1. Retainer (40).
2. Filler (39).

Install or Connect

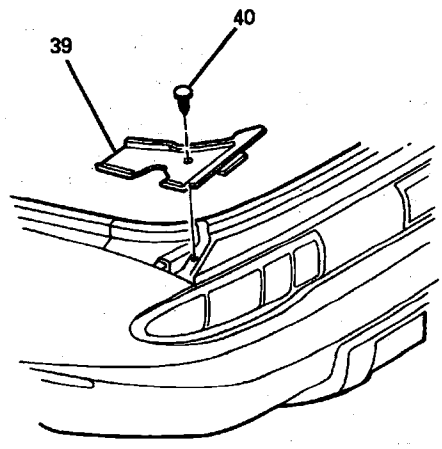
1. Filler (39).
   - Tab on filler (39) is fitted under flange on taillamp housing.
2. Retainer (40).

Rear Compartment Lift Window Closeout Panel Assembly

Figure 14

Remove or Disconnect

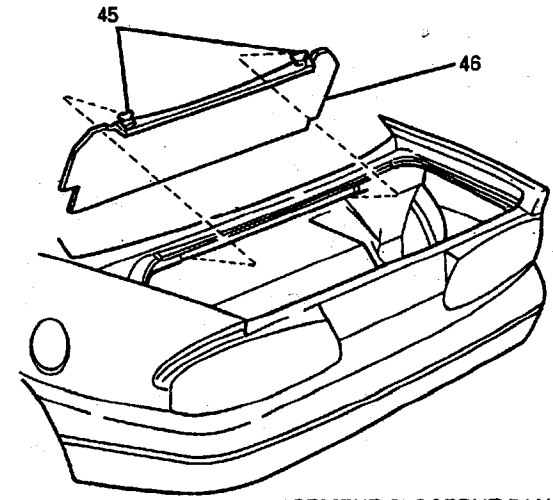
1. Close panel assembly (16).



39 FILLER, TAILLAMP CLOSEOUT
40 RETAINER, TAILLAMP CLOSEOUT FILLER

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Figure 13 – Taillamp Closeout Filler – (Pontiac)



45 FASTENER, REAR COMPARTMENT CLOSEOUT PANEL ASSEMBLY
46 PANEL ASSEMBLY, REAR COMPARTMENT CLOSEOUT

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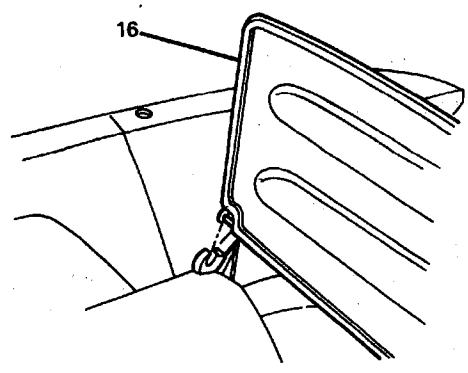
Figure 15 – Rear Compartment Closeout Panel Assembly (Convertible)

- Panel assembly (16) must be resting on rear quarter trim panel assembly to be removed.

2. Panel assembly (16).
   - Slide panel assembly (16) rearward to unsnap it from retainers on rear quarter trim panel assembly.

Install or Connect

- Panel assembly (16).
  - Slide panel assembly (16) along groove of rear quarter trim panel assembly and snap into retainers.



16 PANEL ASSEMBLY, REAR COMPARTMENT LIFT WINDOW CLOSEOUT

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Figure 14 – Rear Compartment Lift Window Closeout Panel Assembly

Rear Compartment Closeout Panel Assembly

Convertible

Figure 15

Remove or Disconnect

- Closeout panel assembly (46) by rotating fasteners (45) a one-quarter turn.

Install or Connect

- Closeout panel assembly (46) by rotating fasteners (45) a one-quarter turn.

Rear Window Drain Panel Garnish Molding

Convertible

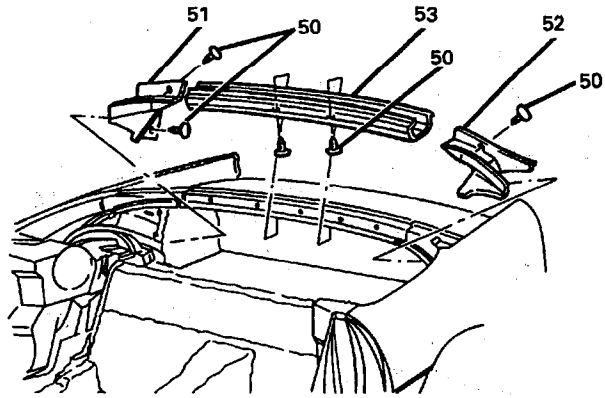
Figure 16

Remove or Disconnect

1. Retainers (50).
2. Rear window drain panel garnish right-hand molding (51).
3. Rear window drain panel garnish left-hand molding (52).
4. Rear window drain panel garnish molding (53).

Install or Connect

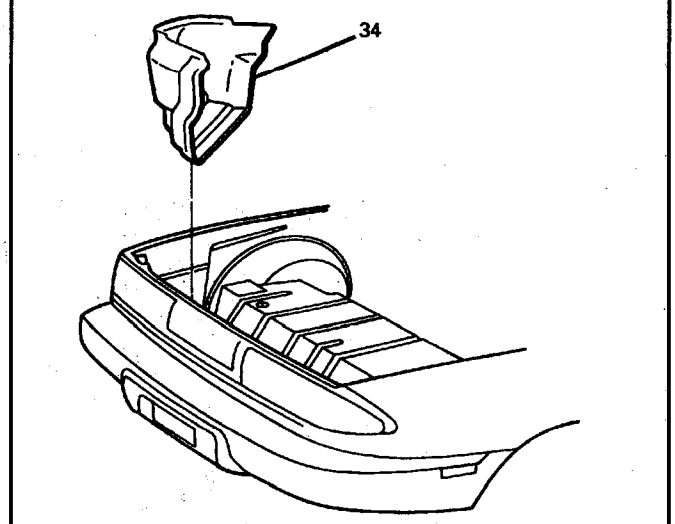
1. Rear window drain panel garnish molding (53).



50 RETAINER, REAR WINDOW DRAIN PANEL GARNISH
51 MOLDING, REAR WINDOW DRAIN PANEL GARNISH RIGHT-HAND
52 MOLDING, REAR WINDOW DRAIN PANEL GARNISH LEFT-HAND
53 MOLDING, REAR WINDOW DRAIN PANEL GARNISH

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FS016108

Figure 16 – Rear Window Drain Panel Garnish Molding



34 TRIM ASSEMBLY, REAR COMPARTMENT SIDE

5-14-94
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Figure 17 – Rear Compartment Side Trim Assembly (Coupe)

2. Rear window drain panel garnish left-hand molding (52).
3. Rear window drain panel garnish right-hand molding (51).
4. Retainers (50).

Rear Compartment Side Trim Assembly

Coupe

Figure 17

Remove or Disconnect

1. Left quarter inner rear trim finish panel assembly. Refer to SECTION 10-7.
2. Rear speaker assembly. Refer to SECTION 10-7.
3. Side trim assembly (34).
   - Reposition left side of rear compartment trim assembly and lift out side trim assembly (34).

Install or Connect

1. Side trim assembly (34).
   - Position side trim assembly (34) in rear compartment with inboard edge under rear compartment trim assembly.
2. Rear speaker assembly. Refer to SECTION 10-7.
3. Left quarter inner rear trim finish panel assembly. Refer to SECTION 10-7.

Convertible

Figure 18

Remove or Disconnect

1. Trim assembly. Refer to "Rear Compartment Trim Assembly" in this section.
2. Side trim assembly (48 or 49).

Install or Connect

1. Side trim assembly (48 or 49).
2. Trim assembly. Refer to "Rear Compartment Trim Assembly" in this section.

Roof Lift-Off Window Stowage Retainer Assemblies

Figure 19

Retainer assemblies (37 and 38) are provided in the rear compartment for vehicles equipped with roof lift-off window assemblies.

Remove or Disconnect

1. Nuts (23).
2. Retainer assembly (37 or 38).

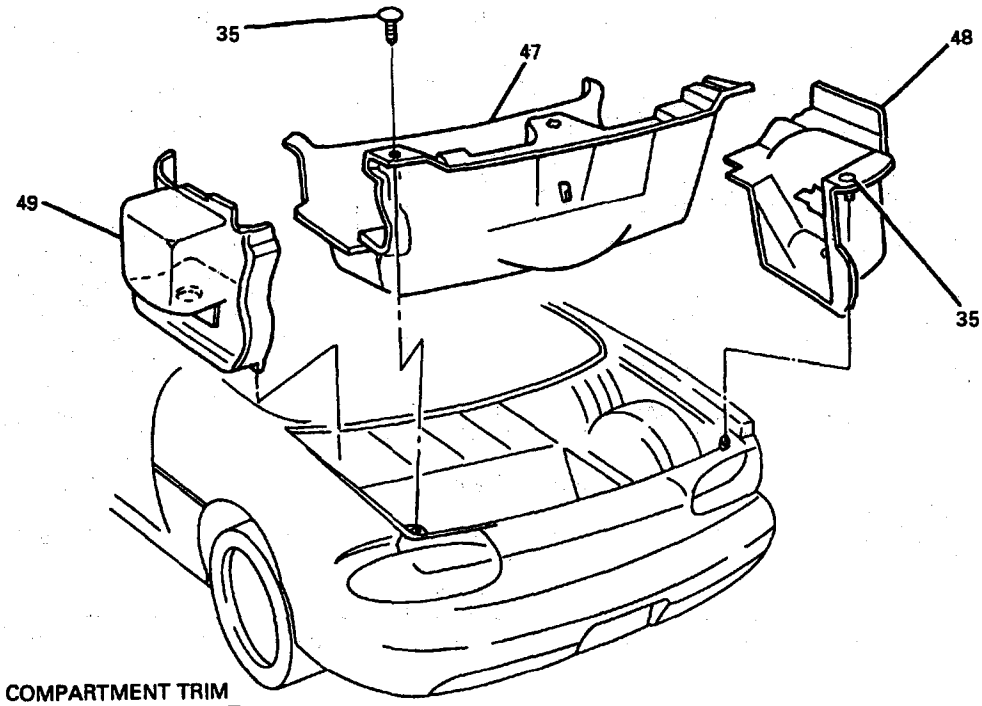
Install or Connect

NOTICE: See "Notice" on page 10-8-1 of this section.

1. Retainer assembly (37 or 38).
2. Nuts (23).
   - Hold retainer assembly (37 or 38) outboard, down and forward when installing nuts (23).

Tighten

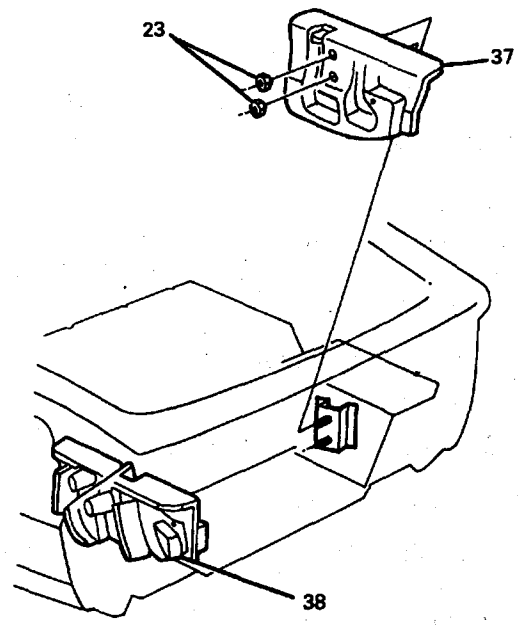
- Nuts (23) to 6 N•m (53 lb. in.).



35 RETAINER, REAR COMPARTMENT TRIM
47 TRIM ASSEMBLY, REAR COMPARTMENT
48 PANEL ASSEMBLY, REAR COMPARTMENT SIDE TRIM FINISH
49 PANEL ASSEMBLY, REAR COMPARTMENT SIDE TRIM FINISH

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FS016106

Figure 18 – Rear Compartment Trim Assembly (Convertible)



23 NUT, ROOF LIFT-OFF WINDOW STOWAGE RETAINER BRACKET
37 RETAINER ASSEMBLY, ROOF LIFT-OFF WINDOW STOWAGE (RIGHT)
38 RETAINER ASSEMBLY, ROOF LIFT-OFF WINDOW STOWAGE (LEFT)

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Figure 19 – Roof Lift-Off Window Stowage Retainer Assemblies

Rear Compartment Trim Assembly

Coupe

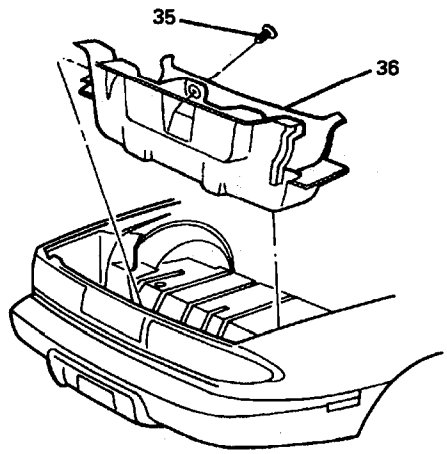
Figure 20

Remove or Disconnect

1. Roof lift-off window stowage retainer assemblies, if equipped. Refer to "Roof Lift-Off Window Stowage Retainer Assemblies" in this section.
2. Quarter inner rear trim finish panel assemblies. Refer to SECTION 10-7.
3. Retainer (35) from rear compartment latch support.
4. Trim assembly (36).
   - Separate hook-and-loop retainers on trim assembly (36) from floor carpet assembly.

Install or Connect

1. Trim assembly (36).
   - Position in rear compartment and under trim line of floor carpet assembly. Connect hook-and-loop retainers.
2. Retainer (35) by pushing into rear compartment latch support.
3. Quarter inner rear trim finish panel assemblies. Refer to SECTION 10-7.



35 RETAINER, REAR COMPARTMENT TRIM ASSEMBLY
36 TRIM ASSEMBLY, REAR COMPARTMENT

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Figure 20 – Rear Compartment Trim Assembly (Coupe)

4. Roof lift-off window stowage retainer assemblies, if equipped. Refer to "Roof Lift-Off Window Stowage Retainer Assemblies" in this section.

Convertible

Figure 18

Remove or Disconnect

1. Closeout panel. Refer to "Rear Compartment Closeout Panel Assembly" in this section.
2. Retainers (35) from rear compartment.
3. Rear compartment trim assembly (47).

Install or Connect

1. Rear compartment trim assembly (47).
2. Retainers (35) to rear compartment.
3. Closeout panel. Refer to "Rear Compartment Closeout Panel Assembly" in this section.

REAR COMPARTMENT LIFT WINDOW PANEL ASSEMBLY AND COMPONENTS

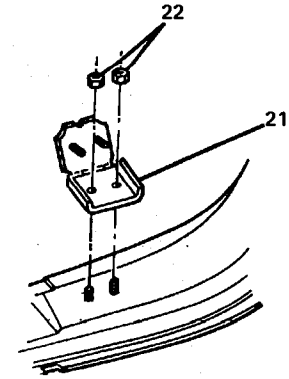
Coupe

Rear Compartment Lift Window Hinge Assemblies

Figure 21

Remove or Disconnect

1. Rear compartment lift window panel assembly. Refer to "Rear Compartment Lift Window Panel Assembly" in this section.
2. Nuts (22).



21 HINGE ASSSEMBLY, REAR COMPARTMENT LIFT WINDOW
22 NUT, REAR COMPARTMENT LIFT WINDOW WINDOW SIDE HINGE

5-14-94
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Figure 21 – Removing Rear Compartment Lift Window Hinge Assembly (Coupe)

3. Hinge assemblies (21).

Install or Connect

NOTICE: See "Notice" on page 10-8-1 of this section.

1. Hinge assemblies (21).
2. Nuts (22).

Tighten

- Nuts (22) to 42 N•m (31 lb. ft.).

3. Rear compartment lift window panel assembly. Refer to "Rear Compartment Lift Window Panel Assembly" in this section.

Rear Compartment Lift Window Strut Assembly

Figure 22

Remove or Disconnect

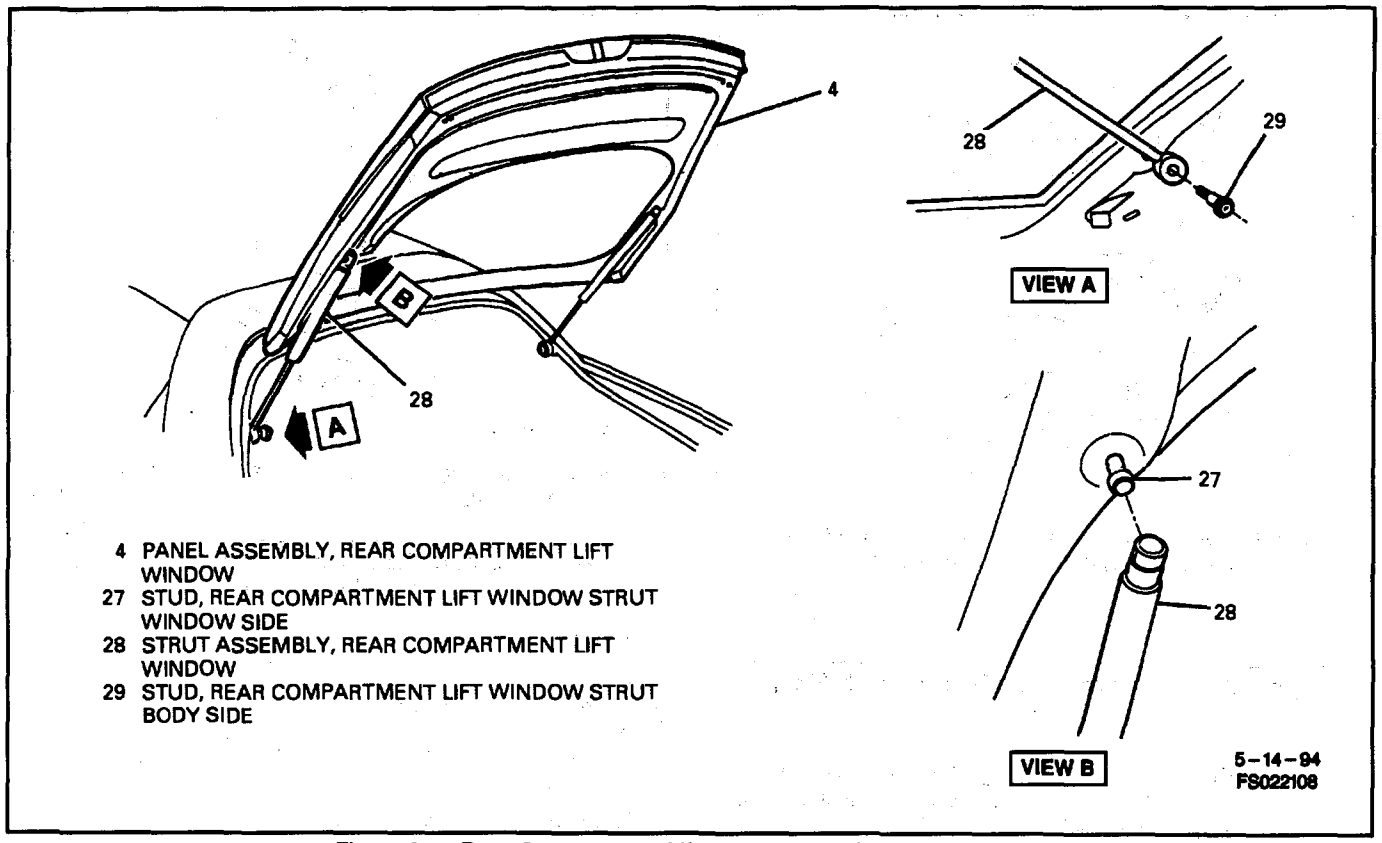
CAUTION: Do not attempt to remove or loosen the strut assemblies without the window panel assembly fully open. A strut assembly removed under pressure may result in personal injury.

1. Raise and support window panel assembly.
2. Quarter trim finish panel assembly. Refer to SECTION 10-7.
3. Strut assembly (28) from stud (27) on window panel assembly (4) by unsnapping.
4. Stud (29) from strut assembly (28).
5. Strut assembly (28).

Install or Connect

NOTICE: See "Notice" on page 10-8-1 of this section.

1. Strut assembly (28) to quarter inner roof panel.



4 PANEL ASSEMBLY, REAR COMPARTMENT LIFT WINDOW
27 STUD, REAR COMPARTMENT LIFT WINDOW STRUT WINDOW SIDE
28 STRUT ASSEMBLY, REAR COMPARTMENT LIFT WINDOW
29 STUD, REAR COMPARTMENT LIFT WINDOW STRUT BODY SIDE

Figure 22 – Rear Compartment Lift Window Strut Assembly (Coupe)

2. Stud (29) through strut assembly (28) to quarter inner roof panel.

Tighten

- Stud (29) to 27 N•m (20 lb. ft.).

3. Strut assembly (28) to stud (27).
4. Quarter trim finish panel assembly. Refer to SECTION 10-7.

Rear Compartment Lift Window Panel Assembly

Figures 23 and 24

CAUTION: The steps must be performed with the assistance of a helper to reduce the possibility of glass breakage or personal injury. Approved safety glasses and gloves should be worn to reduce the chance of personal injury should glass breakage occur.

Remove or Disconnect

1. Raise and support window panel assembly.
2. Headlining trim finishing panel. Refer to SECTION 10-9.
3. Grommet.
4. Electrical connectors.
5. Strut assemblies at window panel assembly. Refer to "Rear Compartment Lift Window Strut Assembly" in this section.
6. Nuts (19).
7. Window panel assembly (4).
8. Gaskets (20) from hinge assemblies (21).

Important

- If window panel assembly is being replaced, remove the hinge assemblies, spoiler assembly if equipped, window and harness assemblies. Refer to "Rear Compartment Lift Window Hinge Assemblies," "Rear End Spoiler Assembly" and "Rear Compartment Lift Window" in this section.

Install or Connect

NOTICE: See "Notice" on page 10-8-1 of this section.

1. Gaskets (20) to hinge assemblies (21).
2. Window panel assembly (4) aligning studs on hinge assemblies (21) to holes.
3. Nuts (19).

Tighten

- Nuts (19) to 25 N•m (18 lb. ft.).

4. Strut assemblies at window panel assembly. Refer to "Rear Compartment Lift Window Strut Assemblies" in this section.

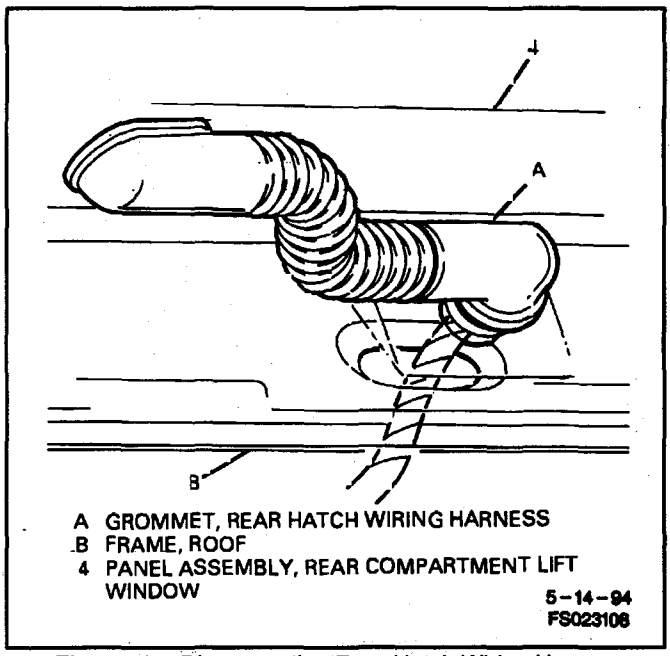


Figure 23 – Disconnecting Rear Hatch Wiring Harness Grommet (Coupe)

5. Electrical connectors.
6. Grommet.
   A. Route harness assembly.
   B. Apply soap solution to grommet.
   C. Seat grommet at window panel assembly and roof frame.

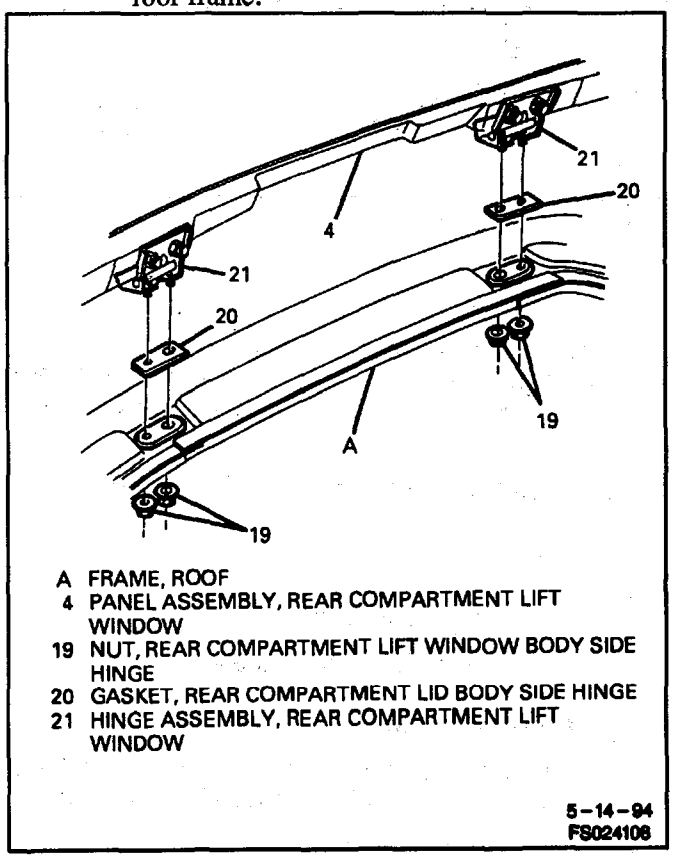


Figure 24 – Removing Rear Compartment Lift Window Panel Assembly (Coupe)

7. Headlining trim finishing panel. Refer to SECTION 10-9.

Rear Compartment Lift Window Panel Adjustment

Figure 25

Adjust

1. Window panel assembly (4) so it is flush to quarter outer panel and centered in opening.
   A. Open window panel assembly (4).
   B. Move rear compartment trim assembly as needed. Refer to "Rear Compartment Trim Assembly" in this section.
   C. Loosen bolts/screws (8).
   D. Close window panel assembly (4).
   E. Move window panel assembly (4) as required.

   Tighten

   - Bolts/screws (8) to 10 N•m (89 lb. in.).
2. Window panel assembly (4) so it is flush to quarter trim finish panel assembly.
   - Loosen or tighten bumper assemblies (24) as needed.

Rear End Spoiler Assembly (Coupe)

Figure 26

Remove or Disconnect

1. Rear compartment lift window inner panel cover assembly. Refer to "Rear Compartment Lift Window Inner Panel Cover Assembly" in this section.
2. Rear compartment lift window side molding assemblies. Refer to "Rear Compartment Lift Window Side Molding Assemblies" in this section.
3. High-mounted stoplamp. Refer to SECTION 8B.
4. Wiring extension from spoiler assembly (3).
   A. Disconnect electrical connector.
   B. Remove tape.
   C. From outside vehicle, pull wiring extension from spoiler assembly (3).
5. Nuts (25).
6. Spoiler assembly (3).
7. Washers (26).

Install or Connect

NOTICE: See "Notice" on page 10-8-1 in this section.

1. Washers (26) to studs on spoiler assembly (3).

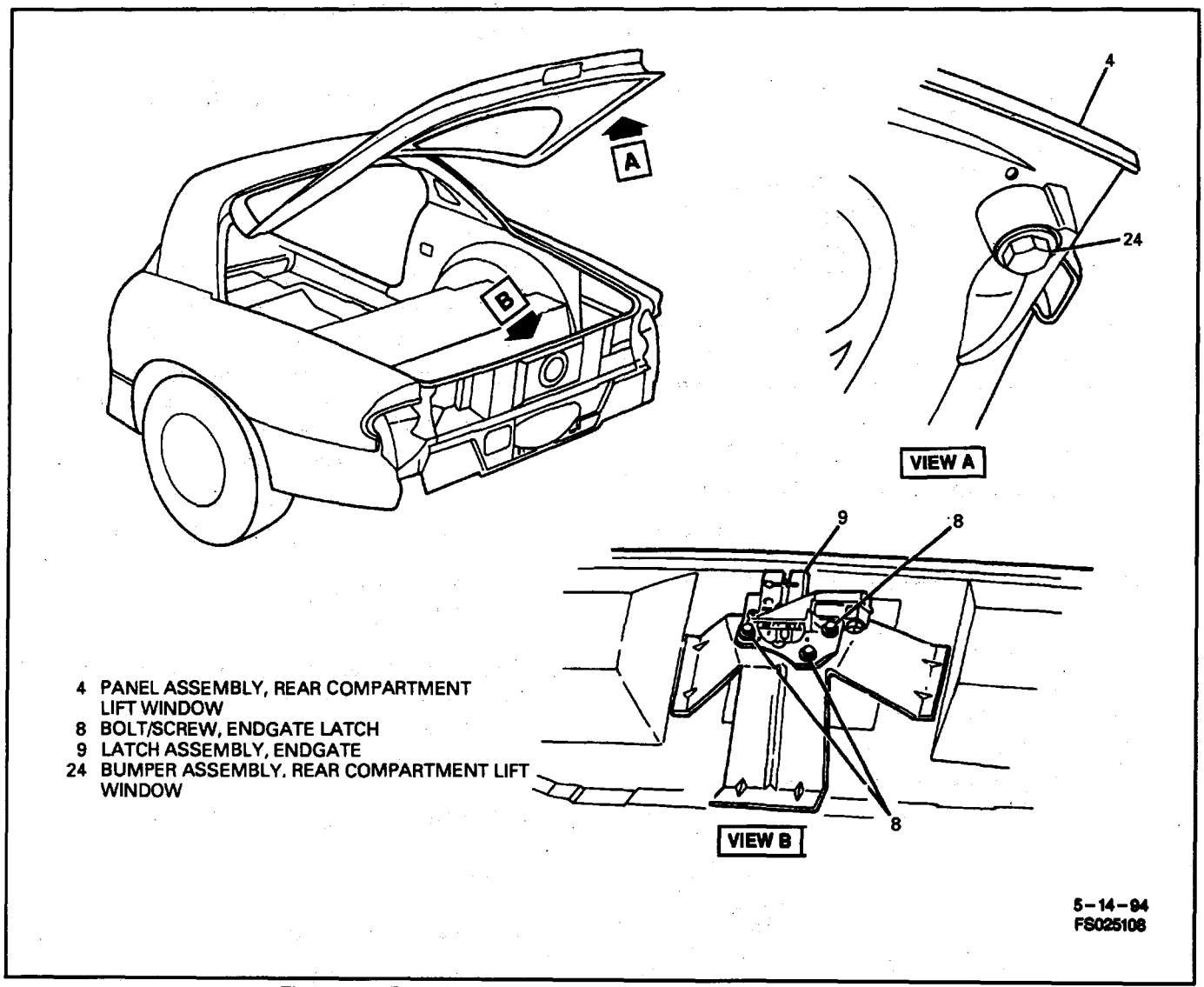


Figure 25 – Rear Compartment Lift Window Panel Adjustment (Coupe)

2. Spoiler assembly (3).
3. Push spoiler assembly (3) forward.
4. Nuts (25).

Tighten

- Nuts (25) in sequence to 6 N•m (53 lb. in.).

5. Harness assembly into spoiler assembly (3).
   A. Route wiring extension through spoiler assembly (3).
   B. Pull on wiring extension to seat grommet.
   C. Connect electrical connector.
   D. Tape wiring extension to window panel assembly.
6. High-mounted stoplamp. Refer to SECTION 8B.
7. Rear compartment lift window side molding assemblies. Refer to "Rear Compartment Lift Window Side Molding Assemblies" in this section.
8. Rear compartment lift window inner panel cover assembly. Refer to "Rear Compartment Lift Window Inner Panel Cover Assembly" in this section.

Liftgate Window Opening Finish Lace

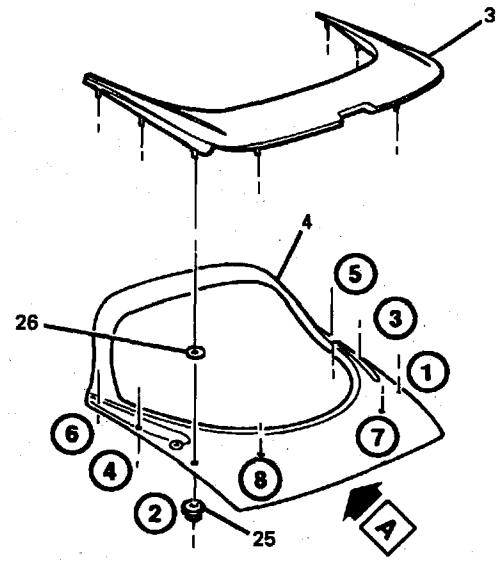
Figure 27

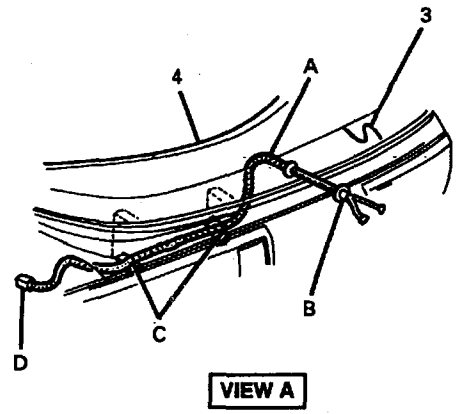
Remove or Disconnect

- Lace (2) by pulling from window (1).

Install or Connect

1. Remove rear compartment lift window. Refer to "Rear Compartment Lift Window" in this section.
2. Lace (2) to window (1).
3. Rear compartment lift window. Refer to "Rear Compartment Lift Window" in this section.





A EXTENSION, CENTER HIGH-MOUNTED STOPLAMP WIRING
B GROMMET, CENTER HIGH-MOUNTED STOPLAMP WIRING EXTENSION
C TAPE
D CONNECTOR, CENTER HIGH-MOUNTED STOPLAMP WIRING EXTENSION ELECTRICAL
3 SPOILER ASSEMBLY, REAR END
4 PANEL ASSEMBLY, REAR COMPARTMENT LIFT WINDOW
25 NUT, REAR END SPOILER
26 WASHER, REAR END SPOILER

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Figure 26 – Rear End Spoiler Assembly (Coupe)

Rear Compartment Lift Window Inner Panel Cover Assembly

Figure 28

Remove or Disconnect

- Cover assembly (31) by pulling to release retainers (42) from window panel assembly.

Install or Connect

- Cover assembly (31) by aligning retainers (42) to window panel assembly and pushing to secure.

Rear Compartment Lift Window Side Molding Assemblies

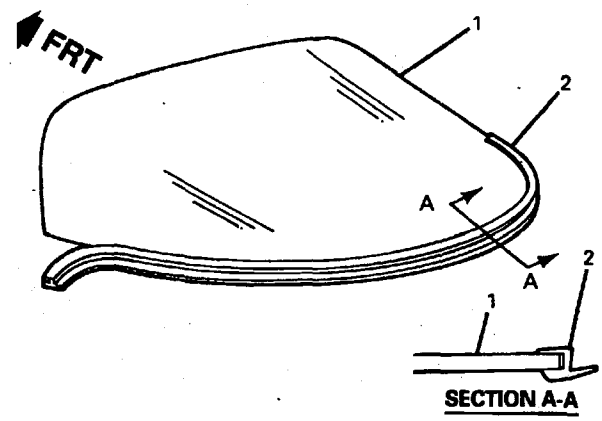
Figure 28

Remove or Disconnect

1. Cover assembly (31) by pulling to release retainers (42) from window panel assembly.
2. Molding assembly (32 or 33) by pulling to release retainers (42) and clips (43) from window panel assembly.

Install or Connect

1. Molding assembly (32 or 33) by aligning retainers (42) and clips (43) to window panel assembly and pushing to secure.
2. Cover assembly (31) by aligning retainers (42) to window panel assembly and pushing to secure.



1 WINDOW, REAR COMPARTMENT LIFT
2 LACE, LIFTGATE WINDOW OPENING FINISH

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Figure 27 – Installing Liftgate Window Opening Finish Lace (Coupe)

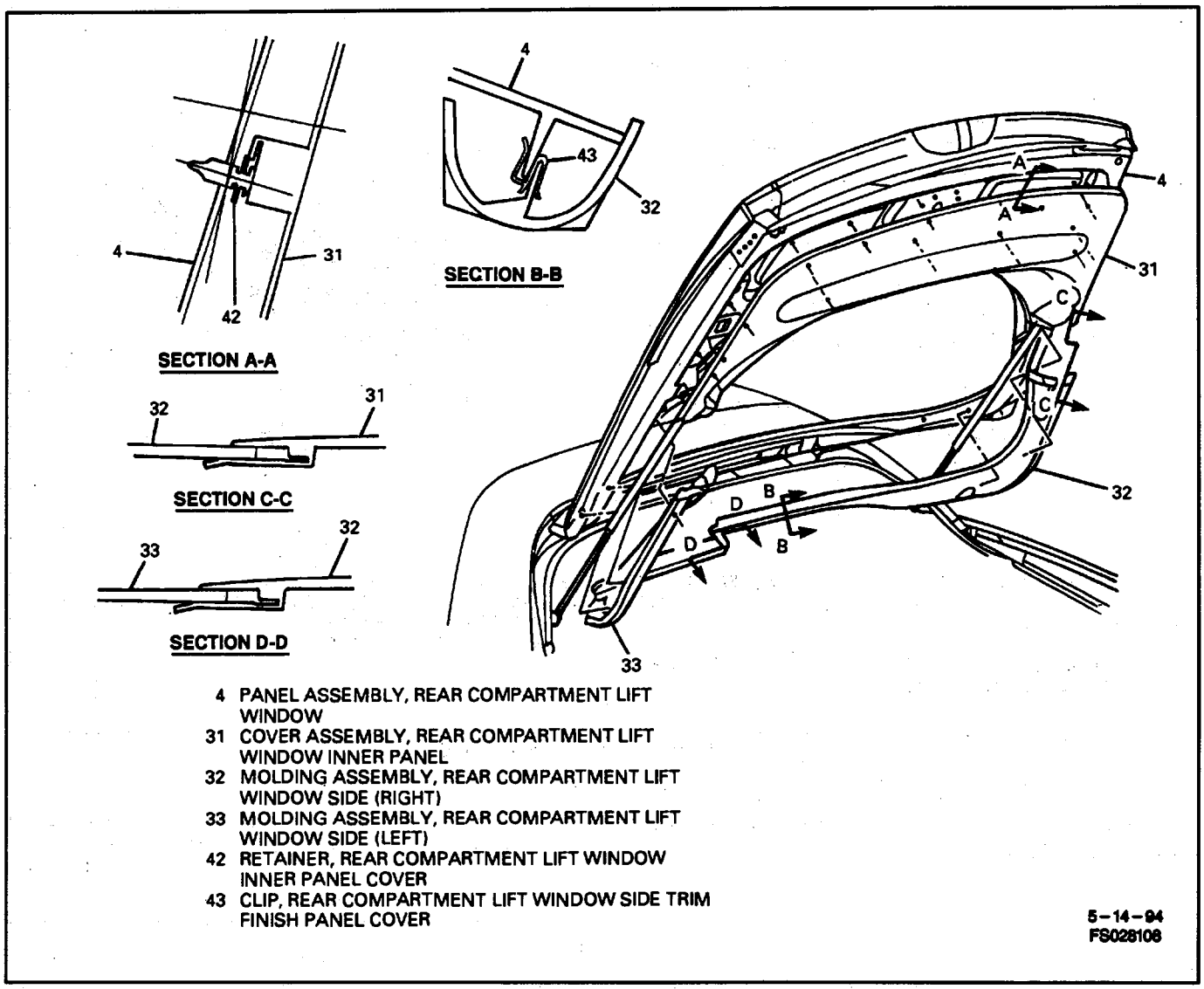


Figure 28 – Rear Compartment Lift Window Inner Panel Cover Assembly and Rear Compartment Lift Window Side Molding Assembly (Coupe)

Rear Compartment Lift Window

Figures 27 and 29

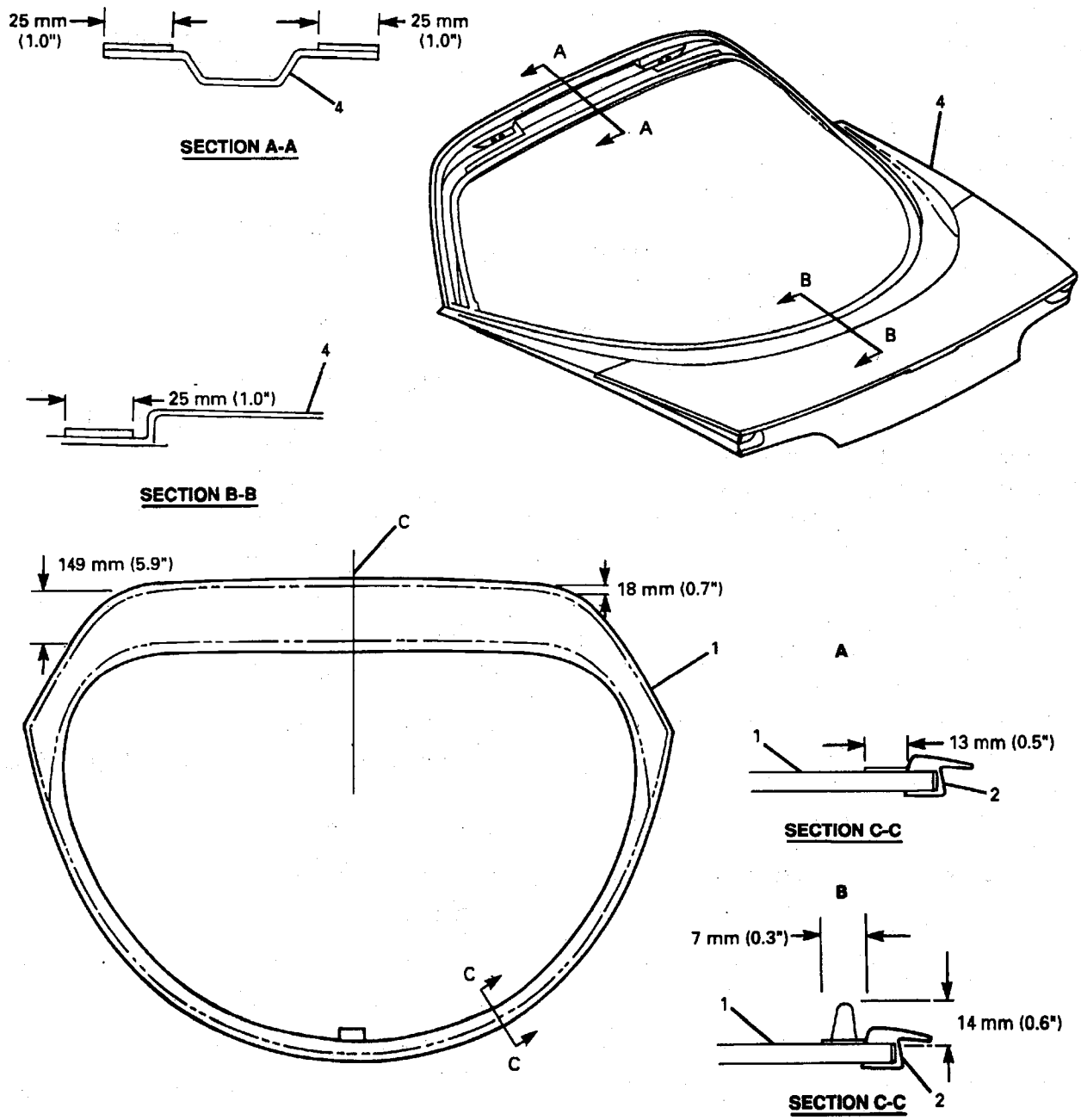
Tool Required:

J 24402-A Glass Sealant Remover (Cold Knife) or J 24709-01 or J 24899-01 Urethane Glass Sealant Remover (Hot Knife)

CAUTION: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.

Remove or Disconnect

1. Lace (2) by pulling off of window (1).
2. Rear compartment lift window inner panel cover assembly. Refer to "Rear Compartment Lift Window Inner Panel Cover Assembly" in this section.
3. Rear compartment lift window side molding assemblies. Refer to "Rear Compartment Lift Window Side Molding Assemblies" in this section.
4. Rear compartment lift window panel assembly. Refer to "Rear Compartment Lift Window Panel Assembly" in this section.
5. Place window panel assembly (4) on a protected work surface.
6. Rear window defogger electrical connector, if equipped.
7. Mask area around window (1) to protect painted surfaces and to aid in cleanup after installation.
   - Tape must not touch window sealant surface.
8. Window (1) using J 24402-A, J 24709-01 or J 24899-01 to cut through adhesive.
   - Keep blade as close to edge of window (1) as possible.
   - Make sure that an even bead of adhesive remains on window panel assembly (4) to serve as base for new window (1).



A PRIMER PATH
B PRIME AND BEAD PATH
C CENTERLINE
1 WINDOW, REAR COMPARTMENT LIFT
2 LACE, LIFTGATE WINDOW OPENING FINISH
4 PANEL ASEMBLY, REAR COMPARTMENT LIFT WINDOW

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Figure 29 – Installing Rear Compartment Lift Window Adhesive Primers and Adhesive (Coupe)

Clean

- Window panel assembly (4) of any loose material.
- Adhesive from window (1), if window (1) is not being replaced.
  - Use an alcohol-dampened cloth.

Install or Connect

1. Primers from urethane adhesive kit, GM P/N 12345633, to window (1) and window panel assembly (4).
   - Two primers are provided in urethane adhesive kit. Clear primer must be applied first, immediately followed by black primer. Allow black primer to dry five minutes prior to application of urethane adhesive. Application of primers is important because primers cause urethane adhesive to bond to window (1) and window panel assembly (4).
2. Urethane adhesive from kit to window (1).
   - With household cartridge-type caulking gun and nozzle, apply smooth continuous bead of urethane adhesive around window (1) where primed.
3. Lace (2) to window (1).
   A. Starting at one side, press lace (2) onto window (1) for about 400 mm (16 inches), being careful not to stretch lace (2).
   B. Roll lace (2) from inboard to outboard.
   C. Repeat for other side of lace (2).
   D. Press on remaining lace (2) and roll.
4. Window (1) to window panel assembly (4) with aid of helper.
   - Use vacuum cups to position window (1).
   - Position upper corners of window (1) to upper corners of window panel assembly (4), then lay window (1) onto window panel assembly (4) and press firmly on rear of window (1) to ensure proper lace fit.
5. Press window (1) firmly to wet-out and set adhesive.
   - Avoid squeezing out excess adhesive that would cause appearance problem.
6. Using small disposable brush or flat, soft fiberglass tool, paddle adhesive around edge of window (1) to ensure a watertight seal.
   - Paddle additional adhesive to fill voids in seal, if necessary.
7. Rear window defogger electrical connector, if equipped.
8. Rear compartment lift window panel assembly. Refer to "Rear Compartment Lift Window Panel Assembly" in this section.
9. Rear compartment lift window side molding assemblies. Refer to "Rear Compartment Lift Window Side Molding Assemblies" in this section.
10. Rear compartment lift window inner panel cover assembly. Refer to "Rear Compartment Lift Window Inner Panel Cover Assembly" in this section.

REAR COMPARTMENT LID PANEL ASSEMBLY AND COMPONENTS

Convertible

Rear Compartment Lid Panel Hinge Assembly

Figures 30 and 31

Remove or Disconnect

1. Rear compartment lid panel assembly. Refer to "Rear Compartment Lid Panel Assembly" in this section.
2. Bolts/screws (53) (Chevrolet only).
3. Nuts (55) (Pontiac only).
4. Adjustment bumper bolt (52).
5. Bolts/screws (51).
6. Hinge assemblies (54).

Install or Connect

NOTICE: See "Notice" on page 10-8-1 of this section.

1. Hinge assemblies (54).
2. Bolts/screws (51).

   Tighten
   - Bolts/screws (51) to 25 N•m (18 lb. ft.).
3. Adjustment bumper bolt (52).

   Tighten
   - Adjustment bumper bolt (52) to 25 N•m (18 lb. ft.).
4. Nuts (55) (Pontiac only).

   Tighten
   - Nuts (55) to 25 N•m (18 lb. ft.).
5. Bolts/screws (53) (Chevrolet only).

   Tighten
   - Bolts/screws (53) to 25 N•m (18 lb. ft.).
6. Rear compartment lid panel assembly. Refer to "Rear Compartment Lid Panel Assembly" in this section.

50 PANEL ASSEMBLY, REAR COMPARTMENT LID
51 BOLT/SCREW, REAR COMPARTMENT LID PANEL HINGE
52 BOLT, REAR COMPARTMENT LID PANEL HINGE ADJUSTMENT BUMPER
53 BOLT/SCREW, REAR COMPARTMENT LID PANEL HINGE
54 HINGE ASSEMBLY, REAR COMPARTMENT LID PANEL

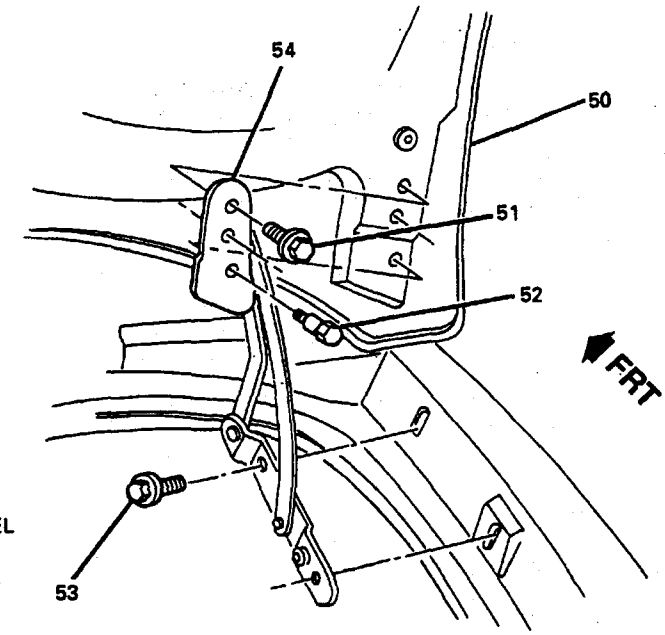


Figure 30 – Rear Compartment Lid Panel Hinge Assembly – (Chevrolet Convertible)

51 BOLT/SCREW, REAR COMPARTMENT LID PANEL HINGE
52 BOLT, REAR COMPARTMENT LID PANEL HINGE ADJUSTMENT BUMPER
54 HINGE ASSEMBLY, REAR COMPARTMENT LID PANEL
55 NUT, REAR COMPARTMENT LID PANEL ASSEMBLY
56 PANEL ASSEMBLY, REAR COMPARTMENT LID

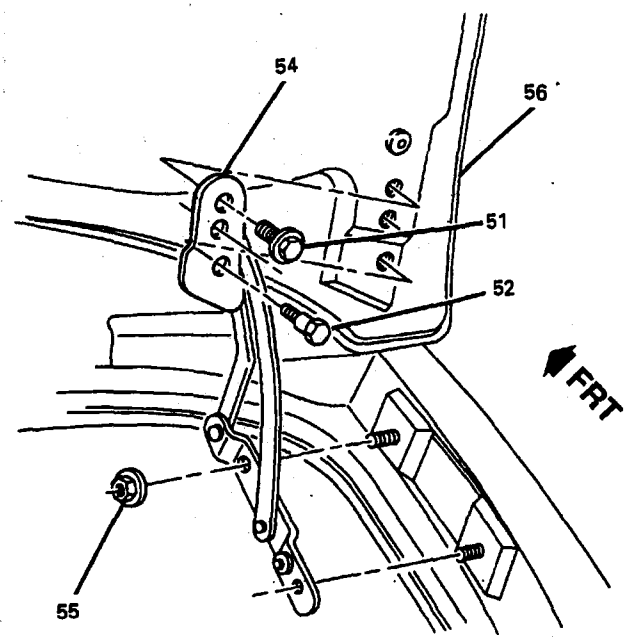


Figure 31 – Rear Compartment Lid Panel Hinge Assembly – (Pontiac Convertible)

Rear Compartment Lid Panel Strut Assembly

Figure 32

Remove or Disconnect

CAUTION: Do not attempt to remove or loosen the strut assemblies without the rear compartment lid panel assembly fully open. A strut assembly removed under pressure may result in personal injury.

1. Raise and support rear compartment lid panel assembly.
2. Strut assembly (57) from strut ball stud (58) on rear compartment lid panel assembly by unsnapping.
3. Strut assembly (57) from hinge ball stud (59) by unsnapping.
4. Strut assembly (57).
5. Strut ball stud (58).

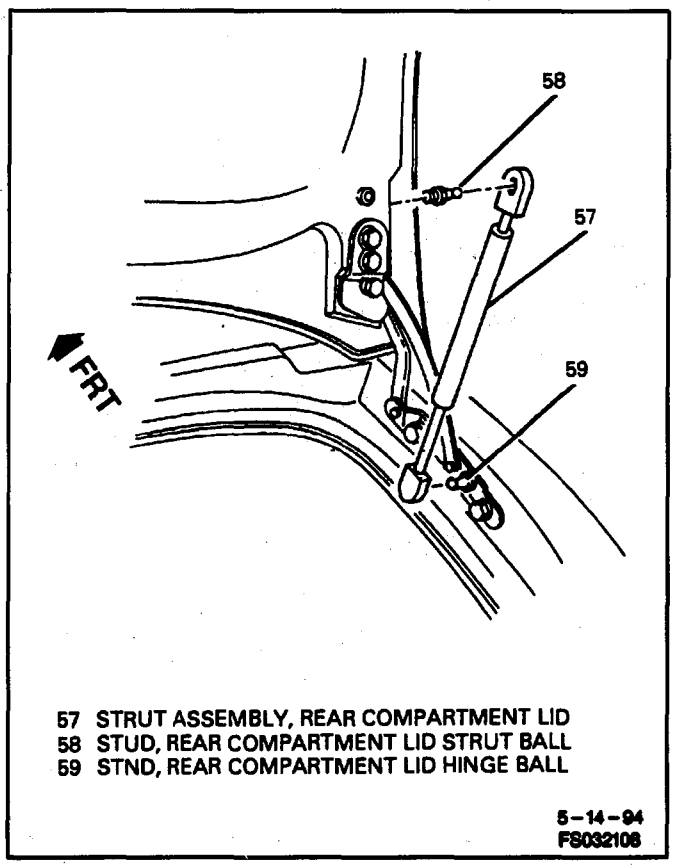
Install or Connect

NOTICE: See "Notice" on page 10-8-1 of this section.

1. Strut ball stud (58) to rear compartment lid panel assembly.

Tighten

- Strut ball stud (58) to 25 N•m (18 lb. ft.).



57 STRUT ASSEMBLY, REAR COMPARTMENT LID
58 STUD, REAR COMPARTMENT LID STRUT BALL
59 STND, REAR COMPARTMENT LID HINGE BALL

Figure 32 – Rear Compartment Lid Panel Strut Assemblies

2. Strut assembly (57) to ball studs (58 and 59).

Rear Compartment Lid Panel Assembly

Figures 30 through 32

Remove or Disconnect

1. Raise and support lid panel assembly.
2. Plastic cap.
3. Electrical connectors.
4. Strut assemblies at rear compartment lid panel assembly. Refer to "Rear Compartment Lid Panel Strut Assembly" in the previous procedure.
5. Adjustment bumper bolt (52).
6. Bolts/screws (51).
7. Lid panel assembly.

Important

- If the rear compartment lid panel assembly is being replaced, remove the spoiler assembly and harness assemblies. Refer to "Rear End Spoiler Assembly" (Convertible) in this section.

Install or Connect

NOTICE: See "Notice" on page 10-8-1 of this section.

1. Lid panel assembly.
2. Bolts/screws (51).

Tighten

- Bolts/screws (51) to 25 N•m (18 lb. ft.).

3. Adjustment bumper bolt (52).

Tighten

- Adjustment bumper bolt (52) to 25 N•m (18 lb. ft.).

4. Strut assemblies at rear compartment lid panel assembly. Refer to "Rear Compartment Lid Panel Strut Assembly" in the previous procedure.
5. Electrical connector.
6. Plastic cap.

Adjust

- Rear compartment lid fore or aft, side to side, and front height as necessary.
- Loosen or tighten bumper assemblies as needed.

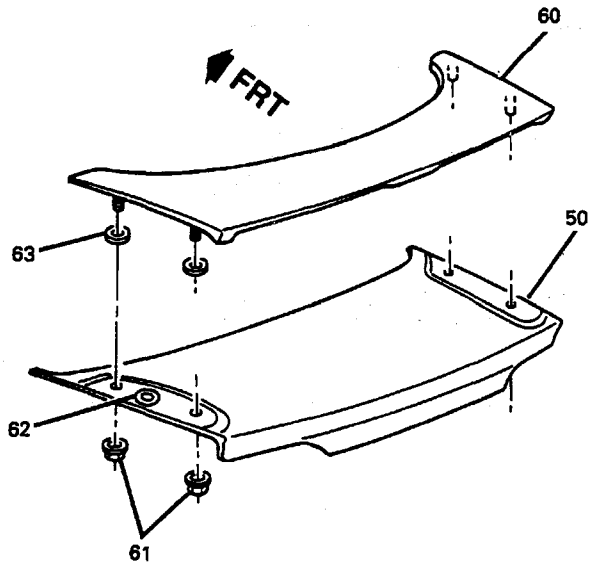
Rear End Spoiler Assembly

Chevrolet Convertible

Figure 33

Remove or Disconnect

1. High-mounted stoplamp. Refer to SECTION 8B.
2. Wiring extension from spoiler assembly (60).
   A. Disconnect electrical connector.



50 PANEL ASSEMBLY, REAR COMPARTMENT LID
60 SPOILER ASSEMBLY, REAR END
61 NUT, REAR END SPOILER
62 SEAL, REAR END SPOILER
63 WASHER, REAR END SPOILER

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Figure 33 – Rear End Spoiler Assembly – (Chevrolet Convertible)

B. Remove tape.

C. From outside vehicle, pull wiring extension from spoiler assembly (60).

3. Nuts (61).
4. Spoiler assembly (60).
5. Washers (63).
6. Seal (62).

Install or Connect

NOTICE: See "Notice" on page 10-8-1 in this section.

1. Seal (62).
2. Washers (63).
3. Spoiler assembly (60).
4. Nuts (61).

Tighten

- Nuts (61) to 6 N•m (53 lb. in.).

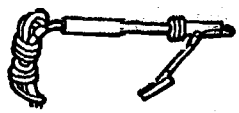
5. Harness assembly into spoiler assembly (60).
   A. Route wiring extension through spoiler assembly (60).
   B. Connect electrical connector.
   C. Tape wiring extension to lid panel assembly.
6. High-mounted stoplamp. Refer to SECTION 8B.

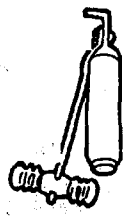
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Endgate Latch Bolt/Screw	10 N•m (89 lb. in.)
Rear Compartment Lift Window Body Side Hinge Nut	25 N•m (18 lb. ft.)
Rear Compartment Lift Window Lock Striker Nut	10 N•m (89 lb. in.)
Rear Compartment Lift Window Strut Body Side Stud	27 N•m (20 lb. ft.)
Rear Compartment Lift Window Window Side Hinge Nut	25 N•m (18 lb. ft.)
Rear End Finish Panel Nut (Chevrolet Only)	8 N•m (71 lb. in.)
Rear End Spoiler Nut (Coupe)	6 N•m (53 lb. in.)
Roof Lift-Off Window Stowage Retainer Bracket Nut	6 N•m (53 lb. in.)
Rear Compartment Lid Panel Hinge Assembly Bumper Bolt (Convertible)	25 N•m (18 lb. ft.)
Rear Compartment Lid Panel Hinge Assembly Bolt/Screw (Convertible)	25 N•m (18 lb. ft.)
Rear Compartment Lid Panel Hinge Assembly Nut (Convertible)	25 N•m (18 lb. ft.)
Rear Compartment Lid Panel Strut Assembly Ball Stud (Convertible)	25 N•m (18 lb. ft.)
Rear End Spoiler Assembly Nut (Chevrolet Convertible Only)	6 N•m (53 lb. in.)

SPECIAL TOOLS

1. 
J 24709-01
OR
J 24899-01

2. 
J 24402-A

3. 
J 25070

1. URETHANE GLASS SEALANT REMOVER (HOT KNIFE)
2. GLASS SEALANT REMOVER (COLD KNIFE)
3. HEAT GUN

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SECTION 10-9

ROOF AND FOLDING TOP

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

ROOF

Figure 1

The information in this section provides service procedures that apply to all roof components.

ON-VEHICLE SERVICE

HEADLINING PANEL ASSEMBLY

Figure 2

The headlining panel assembly (2) is partially held in place with headlining panel tape or two color matched retainers (1) with lift-off window assemblies. When the interior moldings, sunshade assemblies and dome lamp housing assembly are installed, the headlining panel assembly (2) is completely held in place.

Remove or Disconnect

1. Open rear compartment lift window.
2. Sunshade assemblies. Refer to "Sunshade Assembly" in this section.
3. Dome lamp housing assembly. Refer to "Dome Lamp" in this section.
4. Windshield side upper garnish molding assemblies. Refer to "Windshield Side Upper Garnish Molding Assembly (Without Lift-Off Window Assemblies)" or "Windshield Side Upper Garnish Molding Assembly (With Lift-Off Window Assemblies)" in this section.
5. Quarter trim finish panel assemblies. Refer to SECTION 10-7.
6. Loosen seat belt escutcheons and slide down seat belt assemblies.
7. Retainers (1) from headlining panel assembly (2).
8. Headlining panel assembly (2).
   A. Pull carefully on headlining panel assembly (2) to remove from roof panel assembly.
   B. Slide seat belt assemblies through seat belt slots.
   C. Remove headlining panel assembly (2) from vehicle through rear compartment lift window opening.

Install or Connect

1. Peel backing from new headlining panel tape and apply to depressions in roof panel assembly (without lift-off window assemblies).
2. Headlining panel assembly (2).
   A. Place headlining panel assembly (2) in vehicle through rear compartment lift window opening.
   B. Insert seat belt assemblies into seat belt slots.
   C. Pull dome lamp electrical connector through opening.
   D. Apply pressure at centerline of headlining panel assembly (2) to engage headlining panel tape (without lift-off window assemblies).
3. Retainer (1) to headlining panel assembly (2).
4. Slide seat belt escutcheons up seat belt assemblies and snap into retractor.
5. Quarter trim finish panel assemblies. Refer to SECTION 10-7.
6. Windshield side upper garnish molding assemblies. Refer to "Windshield Side Upper Garnish Molding Assembly (Without Roof Lift-Off Window Assemblies)" or "Windshield Side Upper Garnish Molding Assembly (With Roof Lift-Off Window Assemblies)" in this section.
7. Dome lamp housing assembly. Refer to "Dome Lamp" in this section.
8. Sunshade assemblies. Refer to "Sunshade Assembly" in this section.
9. Close rear compartment lift window.

SUNSHADE ASSEMBLY

Figure 3

Remove or Disconnect

1. Bolts/screws (4).
2. Sunshade assembly (5).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Sunshade assembly (5).
   - Position sunshade support to headlining panel assembly.
2. Bolts/screws (4).

Tighten

- Bolts/screws (4) to 1.7 N•m (15 lb. in.).

INTERIOR LIGHTING

Dome Lamp

Figure 4

Remove or Disconnect

1. Bolts/screws (7).
   - Loosen enough to pull dome lamp housing assembly (6) from headlining panel assembly.
2. Dome lamp housing assembly (6) by pulling from headlining panel assembly.
3. Electrical connector.

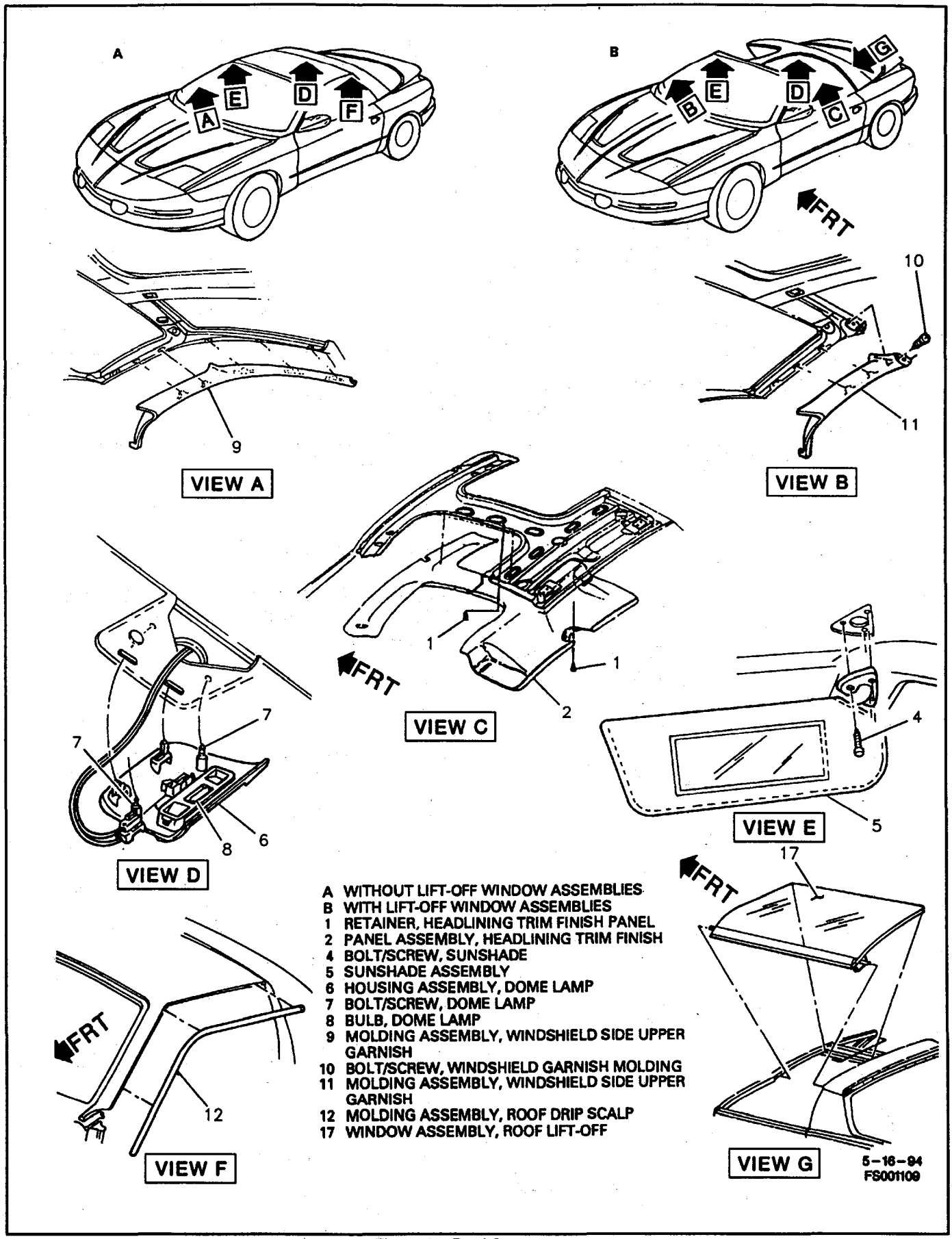


Figure 1 – Roof Components

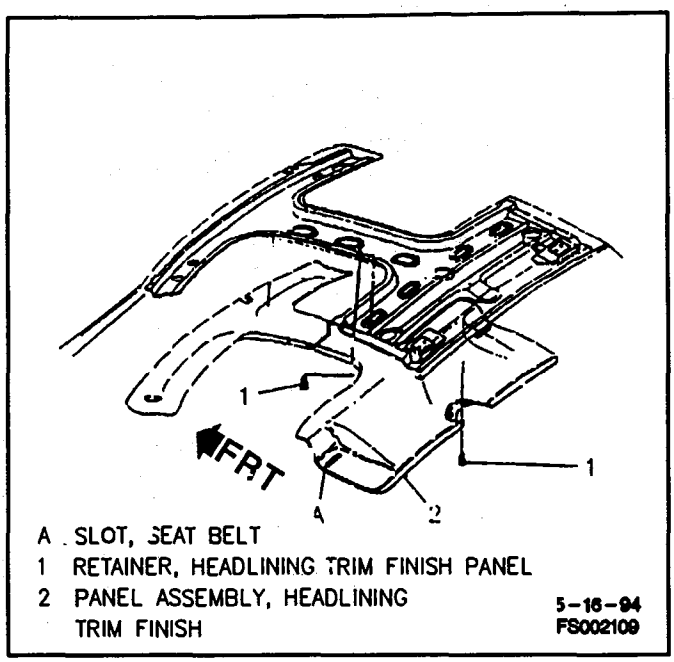


Figure 2 – Headlining Panel Assembly (Typical)

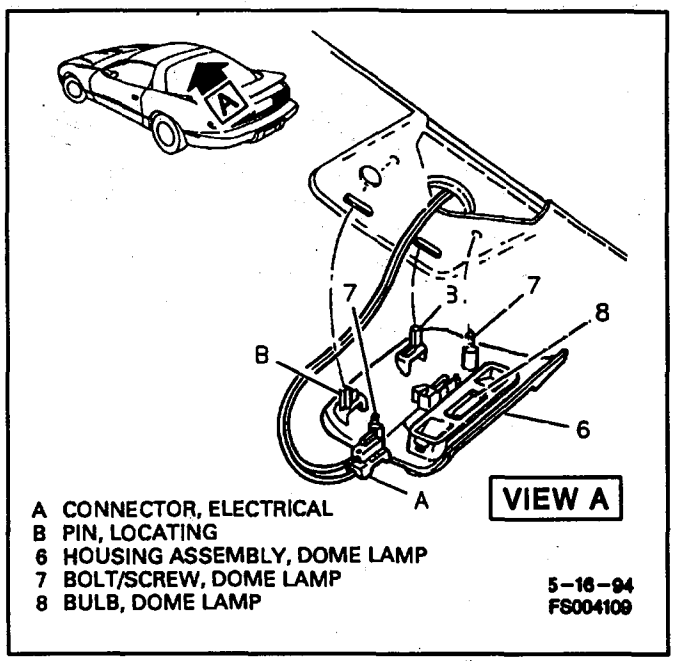


Figure 4 – Dome Lamp Housing Assembly

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Electrical connector.
2. Dome lamp housing assembly (6).
   - Use locating pins to position dome lamp housing assembly (6) to headlining panel assembly.
3. Bolts/screws (7).

Tighten

- Bolts/screws (7) to 1.7 N•m (15 lb. in.).

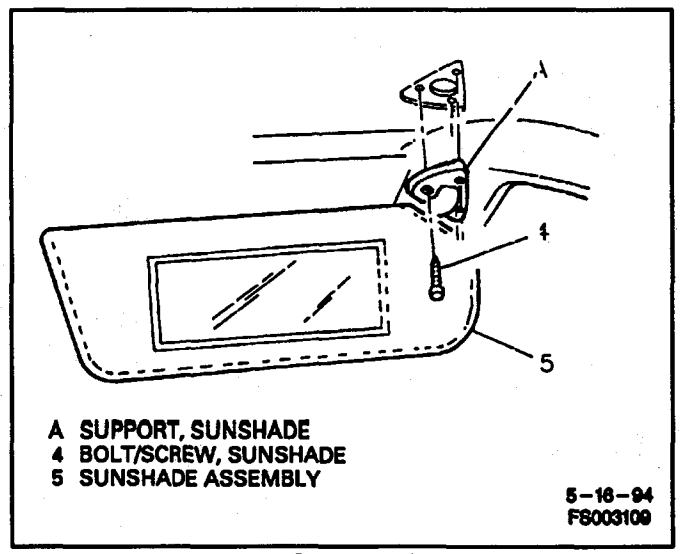


Figure 3 – Sunshade Assembly

INTERIOR MOLDINGS

Windshield Side Upper Garnish Molding Assembly (Without Lift-Off Window Assemblies)

Figure 5

Remove or Disconnect

- Windshield side upper garnish molding assembly (9) by pulling away from windshield inner side frame.

Install or Connect

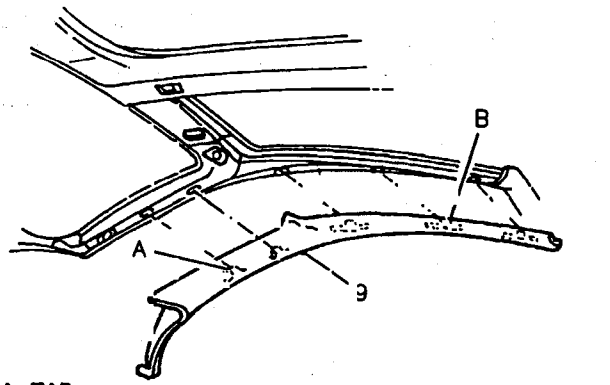
- Windshield side upper garnish molding assembly (9).
  - A. Align tabs on windshield side upper garnish molding assembly (9) to holes in windshield inner side frame and apply pressure to secure.
  - B. Align S-clips on windshield side upper garnish molding assembly (9) to door opening flange and apply pressure to secure.

Windshield Side Upper Garnish Molding Assembly (With Lift-Off Window Assemblies)

Figure 6

Remove or Disconnect

1. Bolts/screws (10).
2. Windshield side upper garnish molding assembly (11) by pulling away from windshield inner side frame.



A TAB
B S-CLIP
9 MOLDING ASSEMBLY, WINDSHIELD SIDE UPPER GARNISH

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FS005109

Figure 5 – Windshield Side Upper Garnish Molding Assembly (Without Lift-Off Window Assemblies)

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Windshield side upper garnish molding assembly (11).
   - Align clips to holes on windshield inner side frame.
2. Bolts/screws (10).

Tighten

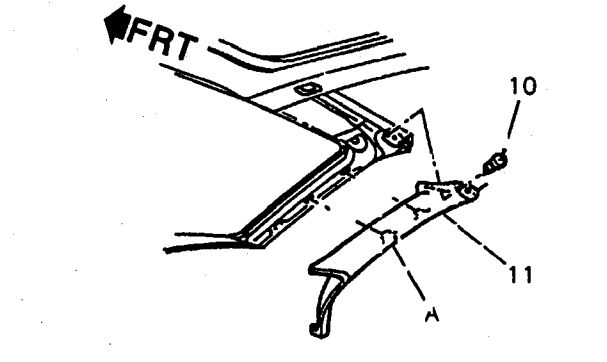
- Bolts/screws (10) to 1.7 N•m (15 lb. in.).

ROOF DRIP SCALP MOLDING ASSEMBLY

Figure 7

Remove or Disconnect

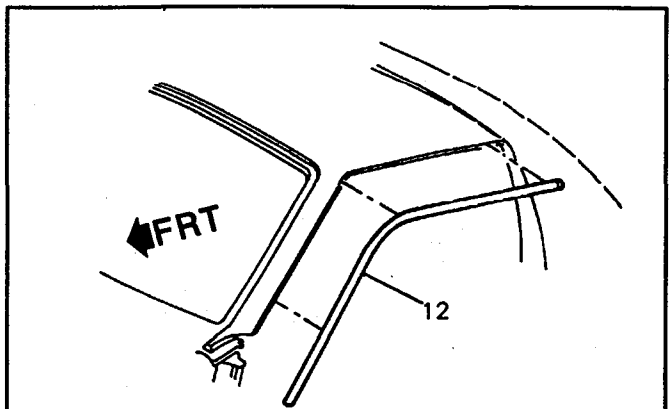
- Roof drip scalp molding assembly (12) by pulling away from door opening.



A CLIP
10 BOLT/SCREW, WINDSHIELD GARNISH MOLDING
11 MOLDING ASSEMBLY, WINDSHIELD SIDE UPPER GARNISH

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Figure 6 – Windshield Side Upper Garnish Molding Assembly (With Lift-Off Window Assemblies)



12 MOLDING ASSEMBLY, ROOF DRIP SCALP

5-16-94
FS007109

Figure 7 – Roof Drip Scalp Molding Assembly

Install or Connect

- Roof drip scalp molding assembly (12) beginning at rear of door opening and pressing entire length to secure.

FOLDING TOP (CONVERTIBLE)

Folding Top Operation

Figures 8 and 9

Lowering Top

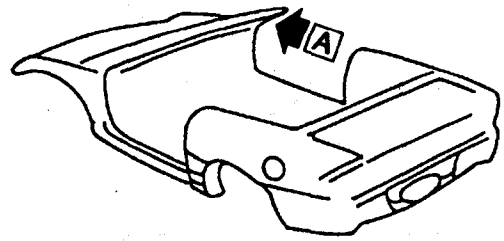
NOTICE: Do not lower folding top while vehicle is moving or it may be damaged. Before lowering the folding top into the storage area, be sure there are no objects in the way of the folded, stored top. The weight of a stored top on items in the storage area could cause the folding top rear window glass to break.

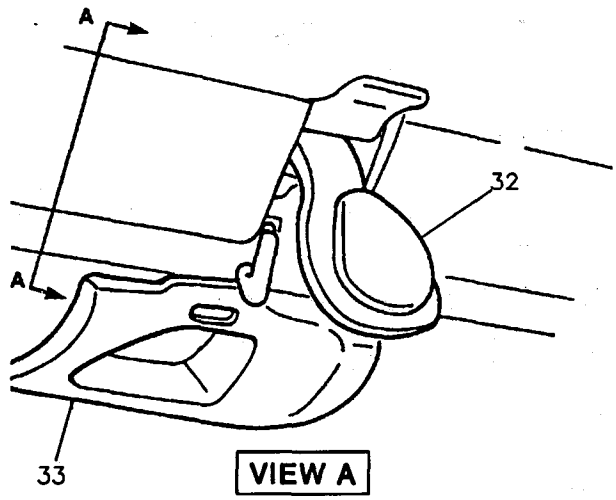
1. Ignition key must be in "ACC" or "RUN" position.
2. Lower both sun visors.
3. Unlock front of folding top assembly by pushing up on the smaller part, then pulling down on larger part, of each front latch assembly (32). Make sure hook on each front latch assembly (32) is released from front latch striker assembly (33).
4. Be sure nothing is in or around folding top assembly. Push and hold "DOWN" on convertible top switch. Top will automatically lower into storage area.

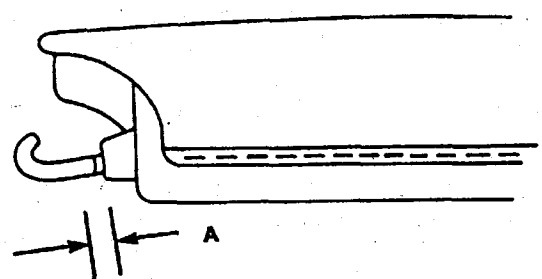
Raising Top

NOTICE: Do not raise the folding top while vehicle is moving or it may be damaged.

1. Ignition key must be in "ACC" or "RUN" position.
2. Lower both sun visors.
3. Lower both windows at least 76 mm (3 inches).
4. Push and hold "UP" on convertible top switch. Top will automatically raise to closed position.







A ADJUST FOLDING TOP FRONT LATCH HOOK
32 LATCH ASSEMBLY, FOLDING TOP FRONT
33 STRIKER ASSEMBLY, FOLDING TOP FRONT LATCH

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Figure 8 – Folding Top Latch and Striker Assembly (Right Side Shown, Left Side Similar)

5. Pull down on front latch assemblies (32) and align hooks with holes in front latch striker assemblies (33). Push forward on larger part of each front latch assembly (32) until it clicks. Do not force front latch assembly. If it is hard to lock, top is not properly aligned.

Manual Operation

Figures 9 and 10

If the vehicle battery is dead or disconnected, the folding top assembly can be manually raised or lowered by bypassing the hydraulic pump.

1. Open rear compartment lid.
2. Locate access hole for pump valve assembly in rear compartment side trim assembly. Refer to SECTION 10-8.
3. Rotate pump bypass valve (38) clockwise until it comes to a stop (1/4 turn).
4. Manually lower folding top assembly by lifting number one bow assembly (39) near the "A" pillar and lowering top as required. Operate front latch assembly (32) as described in "Lowering Top" under "Folding Top Operation" in this section.
5. Manually raise folding top assembly by grasping number one bow assembly (39) near its center and raising as required. Operate front latch assembly (32) as described in "Raising Top" in the preceding procedure.

Important

- Before operating folding top assembly electrically, return pump bypass valve (38) to its original position by rotating it counterclockwise until it comes to a stop (1/4 turn).

Electrohydraulic Diagnosis

If the folding top assembly fails to operate, or operates only partially, then mechanical causes such as misalignment of linkage, damaged links, or damaged hardware at pivot points should be checked before looking into a possible electrohydraulic problem. If the folding top mechanism is suspect, disconnect both cylinder assemblies from outer arm assemblies and operate the top by hand to diagnose mechanical problems. Refer to "Cylinder Assembly" in this section.

If top does not operate properly after complete check for mechanical problems, then check for electrical or hydraulic malfunctions. Refer to SECTION 8A-121 for diagnosis and service of electrical components. Malfunctions in the hydraulic system can be caused by lack of hydraulic fluid, leaks in hydraulic system, obstructions or kinks in hydraulic hose, or faulty operation of a cylinder pump.

If any part of the pump/motor assembly is not working properly, it is recommended that the entire unit be replaced with a new one. Refer to "Folding Top Pump Assembly with Motor" in this section.

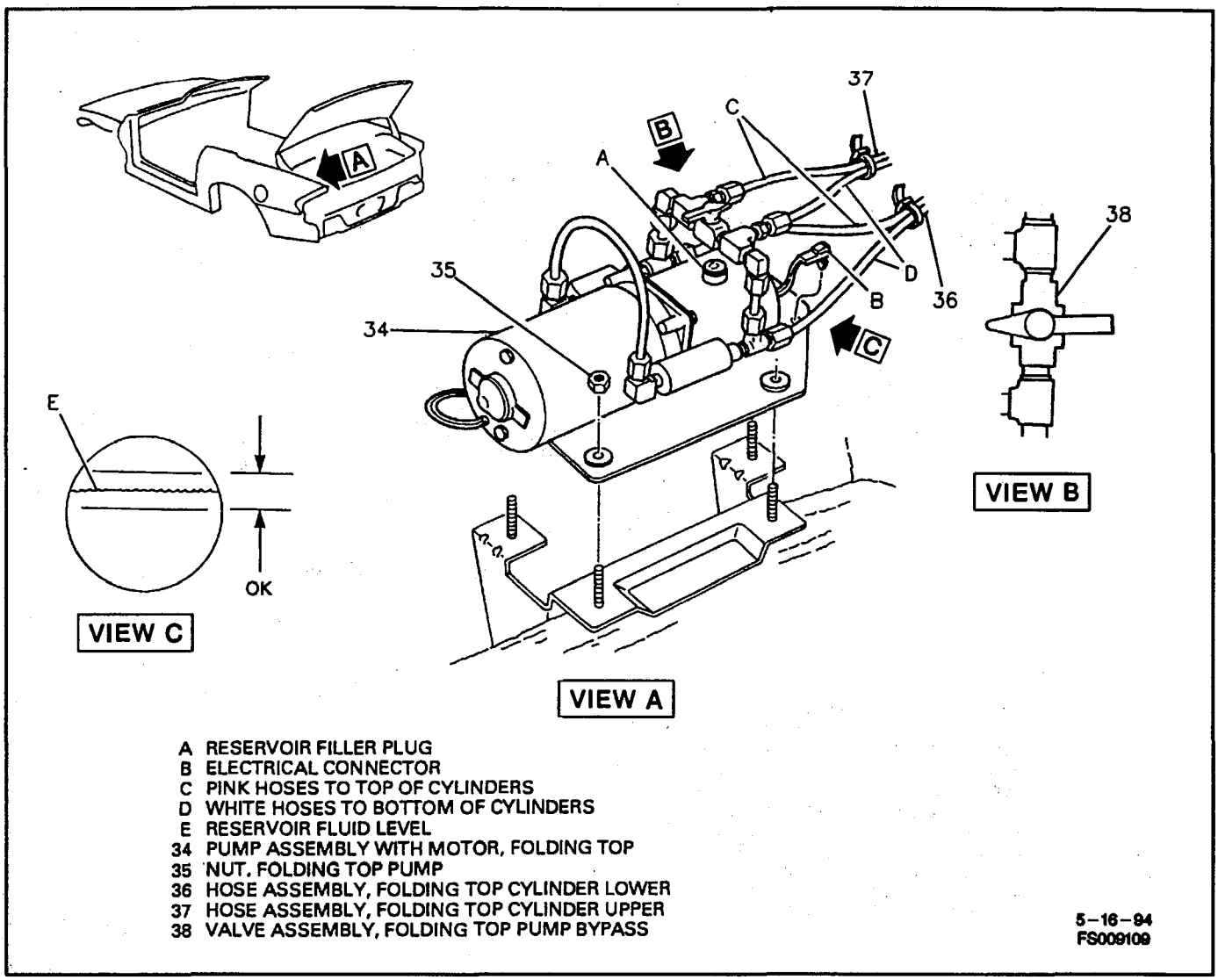


Figure 9 – Pump Assembly with Motor

Operation of Cylinder Assemblies

Disconnect both cylinder assemblies from outer arm assemblies. Refer to "Cylinder Assembly" in this section.

NOTICE: To avoid part damage during this procedure, make sure cylinder rods do not touch body components or folding top assembly when extending.

Operate the convertible top switch and observe cylinder assemblies during up and down cycles for these conditions:

Inspect

- If movement of cylinder is uncoordinated or sluggish when the motor is actuated, check hydraulic hoses from pump/motor assembly to cylinder for kinks.
- If one cylinder rod moves significantly slower than the other and hydraulic hoses are free of kinks, then the one having the slower-moving rod is defective and should be replaced. Refer to "Cylinder Assembly" in this section.
- If both cylinder rods move slowly or not at all, check pressure at pump.

FOLDING TOP BOW ASSEMBLIES

Figure 10

The five bow assemblies run from one outboard side of the vehicle to the other. They support the folding top assembly and keep its shape. The bow assemblies are numbered from front to rear, with the number one bow assembly being attached to the windshield header and the fixed-position number five bow serving as the rear tackstrip assembly.

Folding Top Number One Bow Assembly

Figures 11, 12, 13, 14 and 15

Remove or Disconnect

1. Lower folding top assembly to suitable working position.

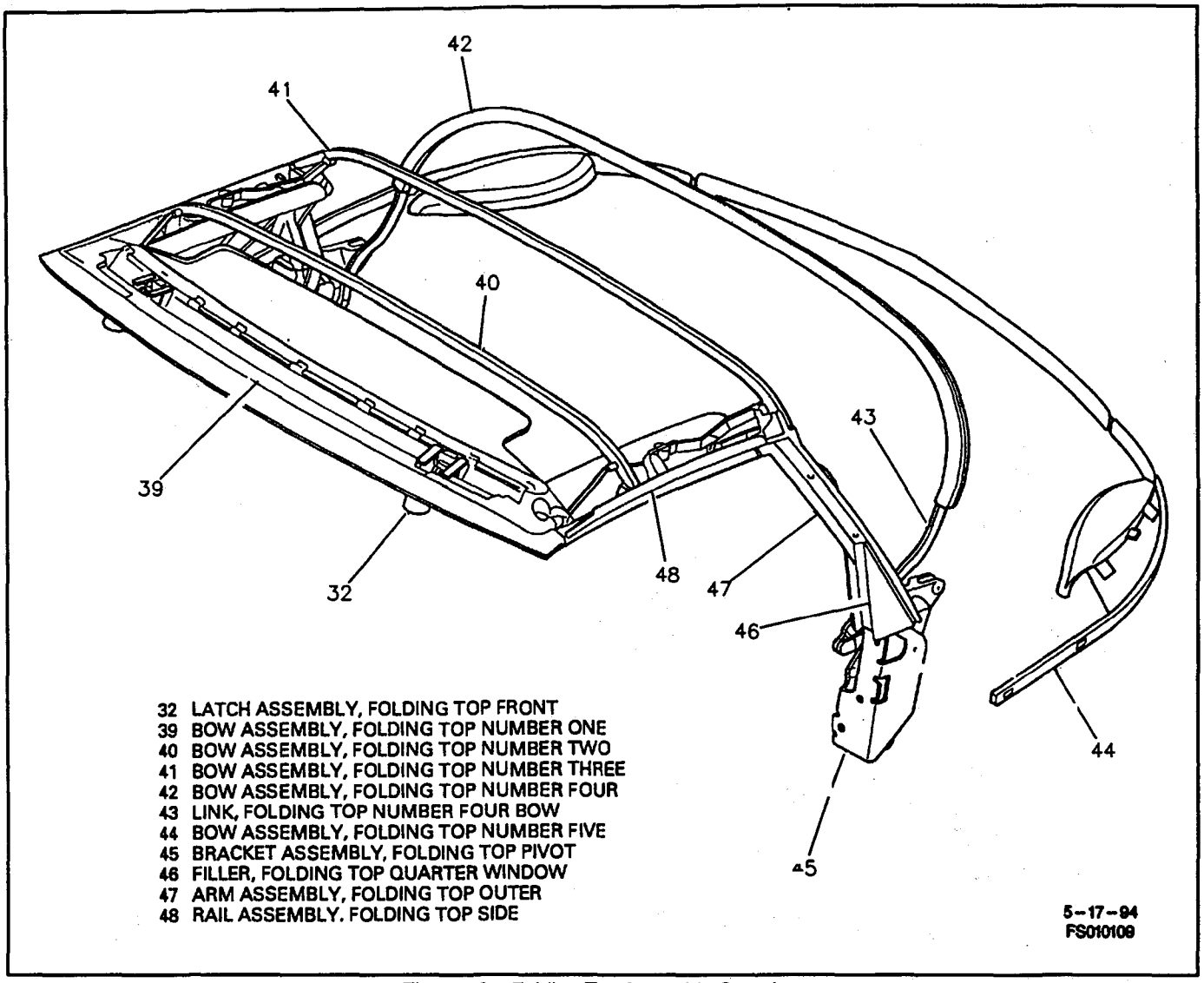


Figure 10 – Folding Top Assembly Overview

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

2. Battery negative cable assembly.
3. Turn pump bypass valve assembly to "open" position (fully clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
4. Side rail garnish molding. Refer to "Folding Top Side Rail Garnish Molding" in this section.
5. Number one bow garnish molding bolts/screws (50).
6. Number one bow garnish molding (49).
7. Rivets at each corner of headlining trim finish panel (55) by drilling out with 5/32-inch drill bit.
8. Headlining trim finish panel (55) from number one bow assembly (39) by peeling away from adhesive.
9. Mark top cover to show leading edge of number one bow assembly (39).
10. Front cover number one bow retainer bolts/screws (52).
11. Front cover number one bow retainer (51).
12. Cover assembly from number one bow assembly (39) by peeling away from adhesive.
13. Black tape covering side front stay rivets (65).
14. Side front stay rivets (65) by drilling out with 5/32-inch drill bit.
15. Number one, two, three and four bow position pad assembly (64).
16. Number one bow links (58) from number one bow (39) by punching out pins.
17. Number one bow bolts/screws (63) and bushings (53).
18. Number one bow assembly (39).
19. Old adhesive from side rail weatherstrip assemblies and number one bow assembly (39).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

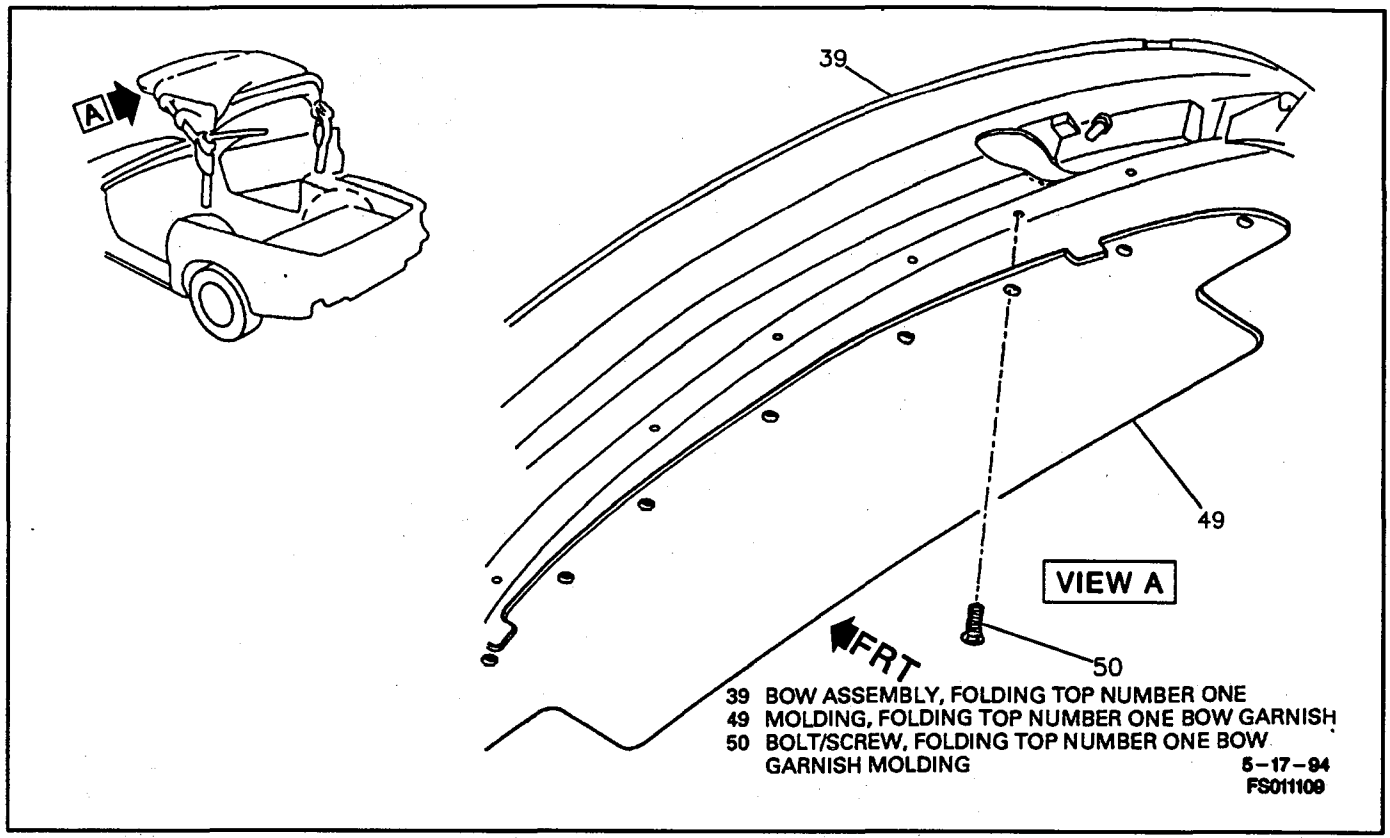


Figure 11 – Number One Bow Garnish Molding

1. Number one bow assembly (39).
2. Lubricant (CluberLube "Microlube" GL–261 or equivalent) to number one bow assembly bushings (53) and bolts/screws (63).
3. Number one bow assembly bushings (53) and bolts/screws (63).

Tighten

- Bolts/screws (63) to 17 N•m (13 lb. ft.).

4. Number one bow links (58) to number one bow assembly (39) and install pins.
5. Number one, two, three and four bow position pad assembly (64) to number one bow assembly (39).
6. Side front stay rivets (65).
7. Black tape to cover side front stay rivets (65).
8. Cover assembly to number one bow assembly. Refer to "Folding Top Cover Assembly" in this section.
9. Front cover number one bow retainer (51).
10. Front cover number one bow retainer bolts/screws (52).
11. Headlining trim finish panel (55) to number one bow assembly (39). Refer to "Headlining Trim Finish Panel Assembly" in this section.
12. Headlining trim finish panel rivets.
13. Number one bow garnish molding (49).
14. Number one bow garnish molding bolts/screws (50).
15. Side rail garnish moldings. Refer to "Folding Top Side Rail Garnish Molding" in this section.
16. Battery negative cable assembly.
17. Turn pump bypass valve assembly to "closed" position (fully counter-clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.

Folding Top Number Two Bow Assembly

Figures 11, 12, 13, 14 and 15

Remove or Disconnect

1. Lower folding top assembly to suitable working position.

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

2. Battery negative cable assembly.
3. Turn pump bypass valve assembly to "open" position (fully clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
4. Number one bow garnish molding bolts/screws (50).
5. Number one bow garnish molding (49).
6. Bolts/screws at each corner of headlining trim finish panel (55).
7. Headlining trim finish panel (55) from number one bow assembly (39) by peeling away from adhesive.

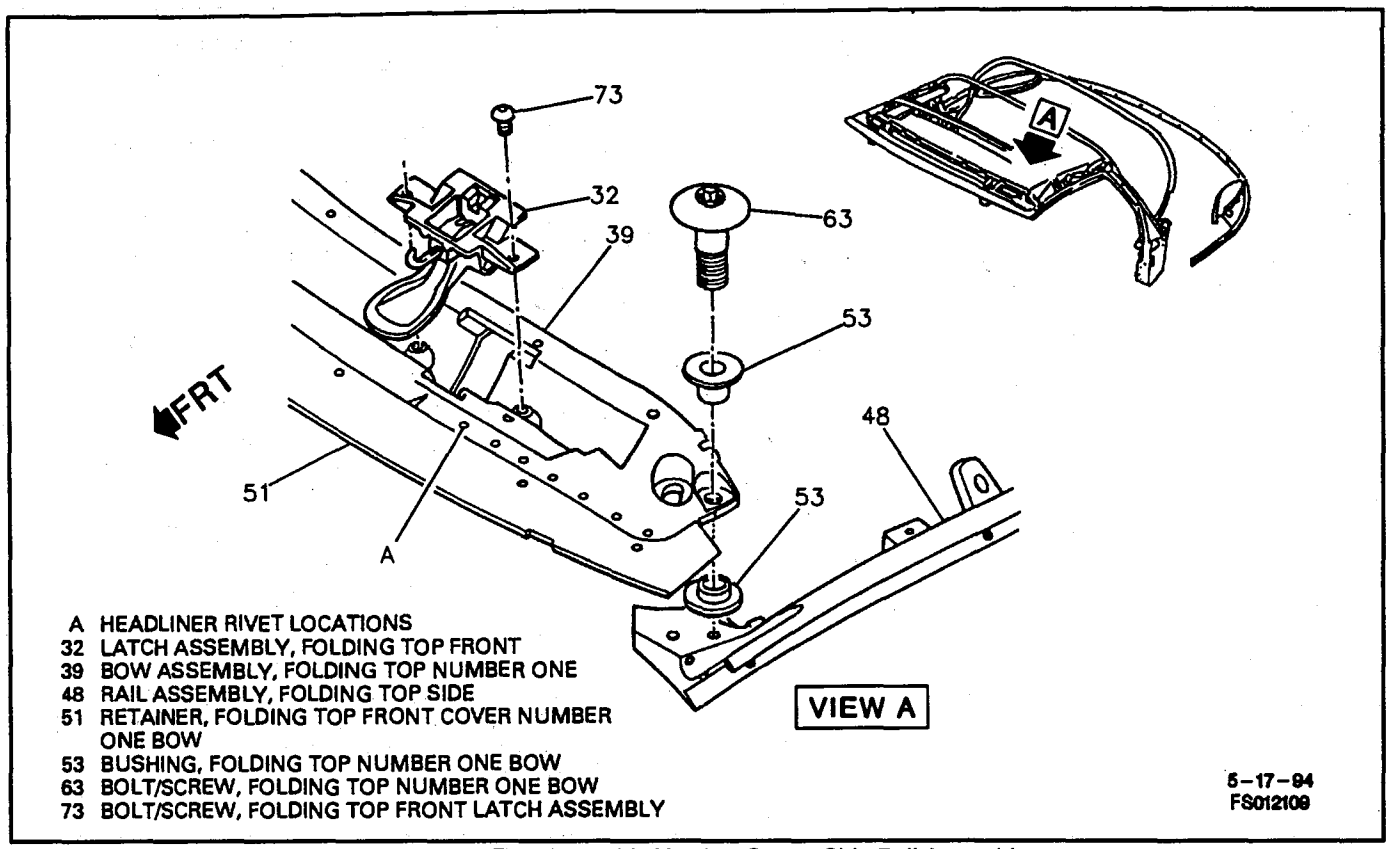


Figure 12 – Bow Assembly Number One to Side Rail Assembly

8. Side rail garnish molding. Refer to "Folding Top Side Rail Garnish Molding" in this section.
9. Top cover assembly from number one bow assembly and pull back along cover retainer cable assembly to reveal number two bow assembly. Refer to "Folding Top Cover Assembly" in this section.
10. Headlining trim finish panel (55) from number two bow assembly (40).
11. Cover assembly (54) from number two bow assembly (40) by peeling away from adhesive.
12. Staples holding number one, two, three and four bow position pad assemblies (64) to number two bow assembly (40).
    - Mark location of pad assemblies and staples.
13. Number one bow links (58) from number one bow assembly (39) by punching out pins.
14. Outside nut from number two bow links (59).
15. Number two bow links (59) from number one bow links (58).
16. Number two bow assembly (40).
17. Old adhesive from number two bow assembly (40).

Install or Connect

Use Hughes P/N HC-4183, 3M P/N 8046, or equivalent adhesive on headliner or top cover attaching surfaces.

1. Tape to number two bow assembly (40).
2. Number two bow assembly (40).
3. Number two bow links (59) to number one bow links (58).
4. Outside nut to number two bow links (59).
5. Number one bow links (58) to number one bow assembly (39) and install pins.
6. Number one, two, three and four bow position pad assemblies (64) to their original positions on number two bow assembly (40) and install staples at their original locations.
7. Cover assembly (54) to number two bow assembly (40).
    - Wrap anti-ballooning strip around bow and press into place.
8. Headlining trim finish panel to number two bow assembly. Refer to "Headlining Trim Finish Panel Assembly" in this section.
9. Top cover assembly to number one bow assembly. Refer to "Folding Top Cover Assembly" in this section.
10. Side rail garnish molding. Refer to "Folding Top Side Rail Garnish Molding" in this section.
11. Headlining trim finish panel to number one bow assembly. Refer to "Headlining Trim Finish Panel Assembly" in this section.
12. Bolts/screws at each corner of headlining trim finish panel (55).
13. Number one bow garnish molding (49).
14. Number one bow garnish molding bolts/screws (50).

15. Turn pump bypass valve assembly to "closed" position (fully counter-clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
16. Battery negative cable assembly.

Folding Top Number Three Bow Assembly

Figures 10, 11, 13, 15, 16 and 17

Remove or Disconnect

1. Lower folding top assembly to suitable working position.

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" In SECTION 0A.

2. Battery negative cable assembly.
3. Turn pump bypass valve assembly to "open" position (fully clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
4. Top cover and headliner from number one, two, and three bow assemblies. Refer to "Folding Top Cover Assembly" in this section.
5. Cover retainer cable assembly (70) from outer arm assembly (47).
6. Staples holding number one, two, three and four pad assemblies (64) to number three bow assembly (41).
   - Mark location of pad assemblies and staples.
7. Bolts/screws (68) from number three bow assembly (41).
   - Reposition plastic tackstrip along channel in number three bow to reveal bolts/screws.
8. Number three bow assembly (41).
9. Old tape from number three bow assembly (41) and adhesive from outer arm assemblies (47).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

Use Hughes P/N HC-4183, 3M P/N 8046, or equivalent adhesive on headliner or top cover attaching surfaces.

1. Tape to number three bow assembly (41).
2. Number three bow assembly (41).
3. Bolts/screws (68) to number three bow assembly (41).

Tighten

   - Bolts/screws (68) to 10 N•m (89 lb. in.).
   - Return plastic tackstrip to its original position.

4. Number one, two, three and four bow position pad assemblies (64) to their original positions on number three bow assembly (41) and install staples.
5. Cover retainer cable assembly (70) to outer arm assembly (47).
6. Top cover and headliner to number one, two and three bow assemblies and outer arm assemblies. Refer to "Folding Top Cover Assembly" in this section.
7. Turn pump bypass valve assembly to "closed" position (fully counter-clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
8. Battery negative cable assembly.

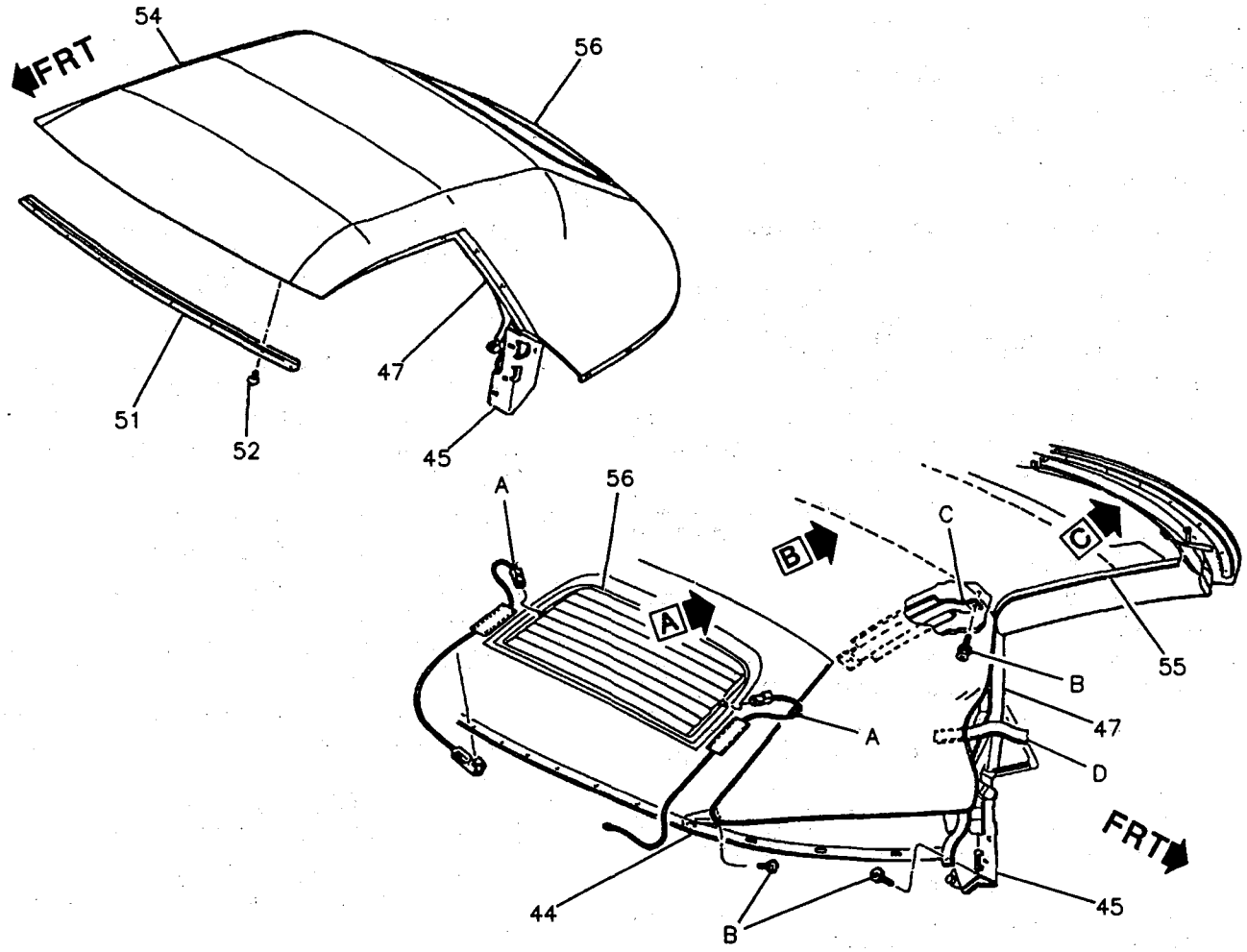
Folding Top Number Four Bow Assembly

Figures 13, 15, 16 and 17

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Bolts/screws connecting headlining trim finish panel elastic tension straps to number five bow assembly (44) and number four bow assembly (42).
3. Rear retaining nuts from number five bow assembly (44).
4. Number five bow assembly (44).
5. Electrical connectors from rear window defogger.
6. Top cover to reveal top of number four bow assembly (42) on both sides of vehicle.
7. Hook-and-loop fastener pads on number four bow assembly (42).
8. Mark position of number four and five bow position pad assemblies (66) on number four bow assembly (42).
9. Number four and five bow position pad assemblies (66) from number four bow assembly (42).
10. Lower end (inboard corner) of number four and five bow position pad assemblies (66) to reveal rear window.
11. Mark position of number one, two, three and four bow position pad assemblies (64) at number four bow assembly (42).
12. Number one, two, three and four bow position pad assemblies (64) from number four bow assembly (42).
13. Mark top edge of number five bow assembly (44) on rear window fabric.
14. Center bolt/screw for rear window (56) to number four bow assembly (42).
15. Slide out rear window (56).
16. Slide down tackstrips on number four bow assembly (42) to reveal top cover number four bow retainer (72).
17. Top cover number four bow retainer (72), using appropriate tool.
18. Top cover assembly (54) from number four bow assembly (42).
19. Mark ends of number four bow assembly (42) on number four bow links (43).
20. Number four bow link bolts/screws (69).
21. Number four bow assembly (42) from number four bow links (43).



A ELECTRICAL CONNECTOR
B BOLT/SCREW, ELASTIC TENSION STRAPS
C ELASTIC TENSION STRAP
D HOOK-AND-LOOP FASTENER STRAP
39 BOW ASSEMBLY, FOLDING TOP NUMBER ONE
41 BOW ASSEMBLY, FOLDING TOP NUMBER THREE
42 BOW ASSEMBLY, FOLDING TOP NUMBER FOUR
44 BOW ASSEMBLY, FOLDING TOP NUMBER FIVE
45 BRACKET ASSEMBLY, FOLDING TOP PIVOT
47 ARM ASSEMBLY, FOLDING TOP OUTER
49 MOLDING, FOLDING TOP NUMBER ONE BOW GARNISH
50 BOLT/SCREW, FOLDING TOP NUMBER ONE BOW GARNISH MOLDING
51 RETAINER, FOLDING TOP FRONT COVER NUMBER ONE BOW
52 BOLT/SCREW, FOLDING TOP COVER RETAINER NUMBER ONE BOW
54 COVER ASSEMBLY, FOLDING TOP
55 PANEL ASSEMBLY, FOLDING TOP HEADLINING TRIM FINISH
56 WINDOW, REAR (HEATED)

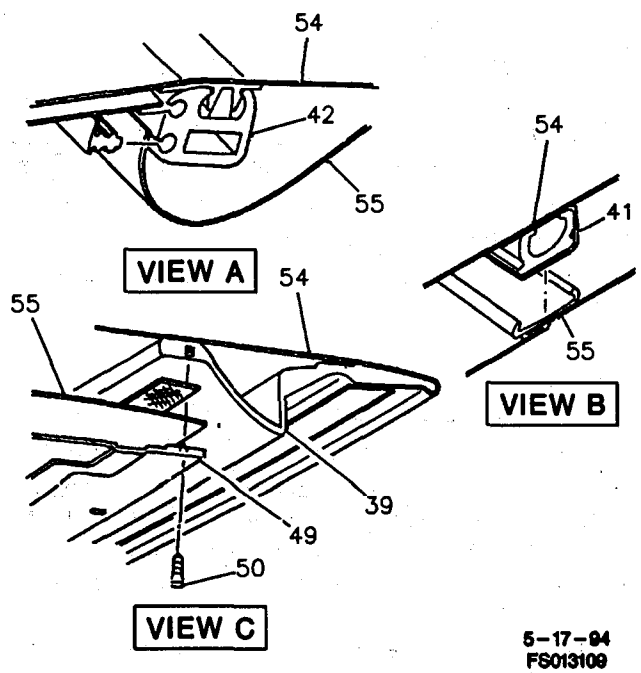


Figure 13 – Folding Top Cover and Headliner Assemblies

22. Slide number four bow assembly (42) off headlining trim finish panel assembly (55).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Slide number four bow assembly (42) over headlining trim finish panel assembly (55).
2. Number four bow assembly (42) to its original depth on number four bow links.
3. Bolts/screws (69).

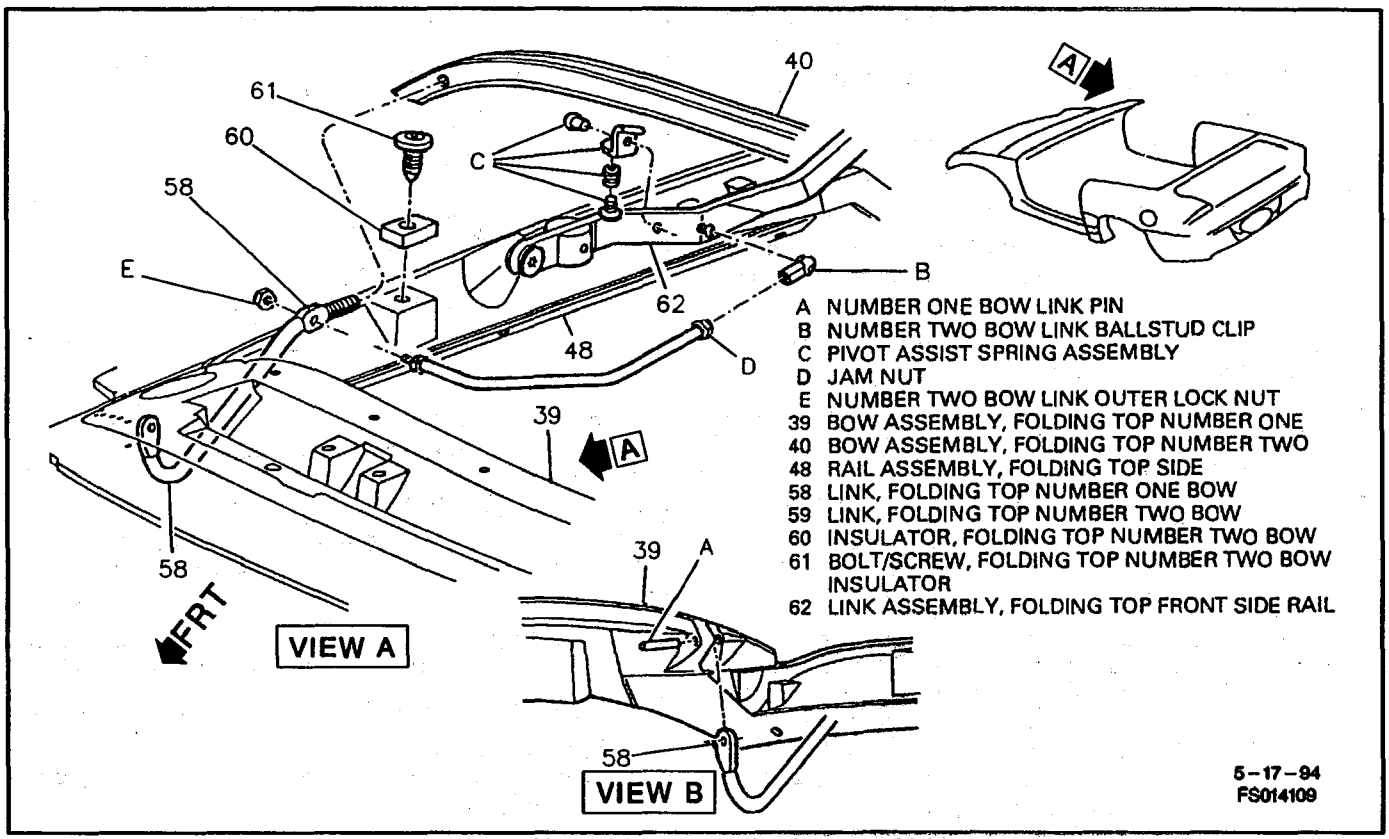


Figure 14 – Number One to Number Two Bow Linkage

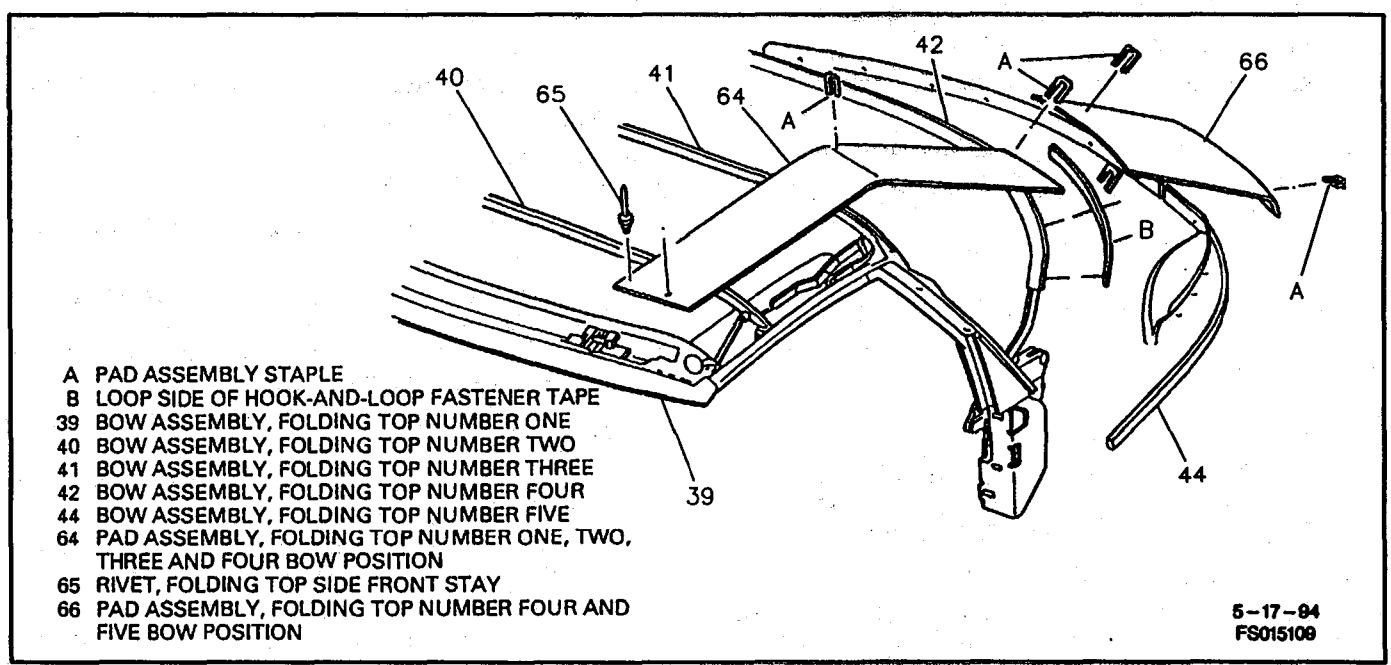


Figure 15 – Stay Pad Assemblies

Tighten

- Bolts/screws (69) to 10 N•m (89 lb. in.).

4. Top cover assembly (54) to number four bow assembly (42).
5. Top cover number four bow retainer, using appropriate tool.
6. Return tackstrips on number four bow assembly (42) to their original positions.
7. Slide rear window (56) into position.
8. Center bolt/screw for rear window (56) to number four bow assembly (42).
9. Number one, two, three and four bow position pad assemblies (64) and staples to their original positions on number four bow assembly (42).
10. Lower end of number four and five bow position pad assemblies (66) and staples.
11. Number four and five bow position pad assemblies (66) and staples to their original positions on number four bow assembly (42).
12. Hook-and-loop fastener pads on number four bow assembly (42).

Important

- The number four bow uses the "loop" (soft) portion of a hook-and-loop fastener tape to prevent the bow from showing through top cover. "Hook" portion is not used. Loop tape is self-adhesive but must also be stapled to the bow. Failure to staple the tape into place could cause the tape to bunch up under top cover.

13. Top cover assembly (54) to its original position.
14. Electrical connectors to rear window defogger.
15. Number five bow assembly (44).
16. Rear retaining nuts to number five bow assembly (44).
17. Bolts/screws connecting headlining trim finish panel elastic tension straps to number four bow assembly (42) and number five bow assembly (44).
18. Battery negative cable assembly.

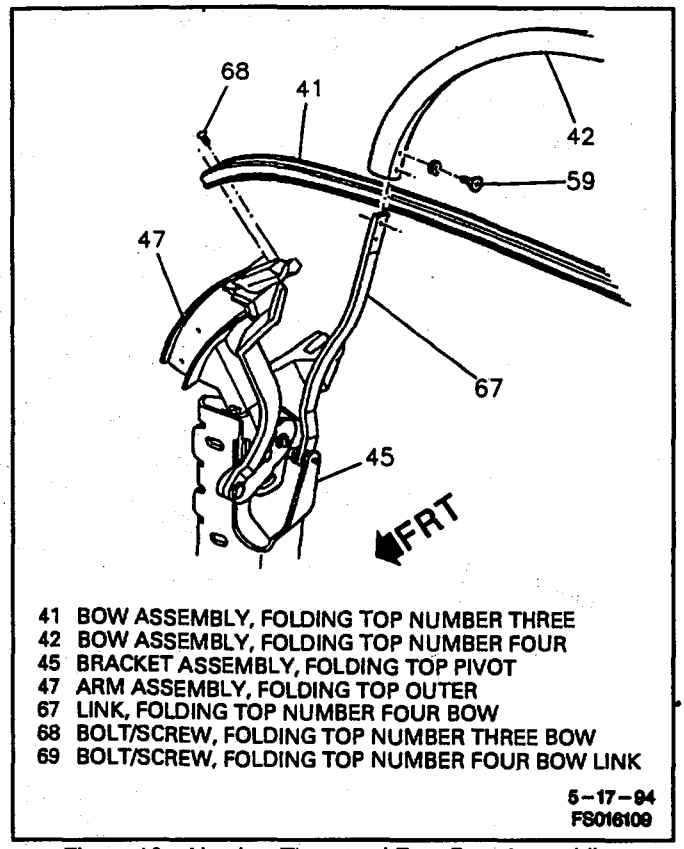
Folding Top Number Five Bow Assembly

Figures 13 and 15

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Turn pump bypass valve assembly to "open" position (fully clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
3. Bolts/screws connecting headlining trim finish panel elastic tension straps to number five bow assembly (44).



41 BOW ASSEMBLY, FOLDING TOP NUMBER THREE
42 BOW ASSEMBLY, FOLDING TOP NUMBER FOUR
45 BRACKET ASSEMBLY, FOLDING TOP PIVOT
47 ARM ASSEMBLY, FOLDING TOP OUTER
67 LINK, FOLDING TOP NUMBER FOUR BOW
68 BOLT/SCREW, FOLDING TOP NUMBER THREE BOW
69 BOLT/SCREW, FOLDING TOP NUMBER FOUR BOW LINK

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Figure 16 – Number Three and Four Bow Assemblies

4. Rear retaining nuts from number five bow assembly (44).
5. Raise number five bow assembly (44) over top cover assembly (54).
6. Staples attaching cover assembly (54), rear window assembly (56), and number four and five bow position pad assemblies (66) to number five bow assembly (44).
   - Mark positions of all staples and assemblies.
7. Number five bow assembly (44).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Number four and five bow position pad assemblies (66), rear window assembly (56) and cover assembly (54) to number five bow assembly (44) by stapling into their original positions.
2. Number five bow assembly (44) to rear mounting studs.
3. Rear retainer nuts to number five bow mounting studs.
4. Bolts/screws connecting headlining trim finish panel elastic tension strap to number five bow assembly (44).
5. Turn pump bypass valve assembly to "closed" position (fully counter-clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
6. Battery negative cable assembly.

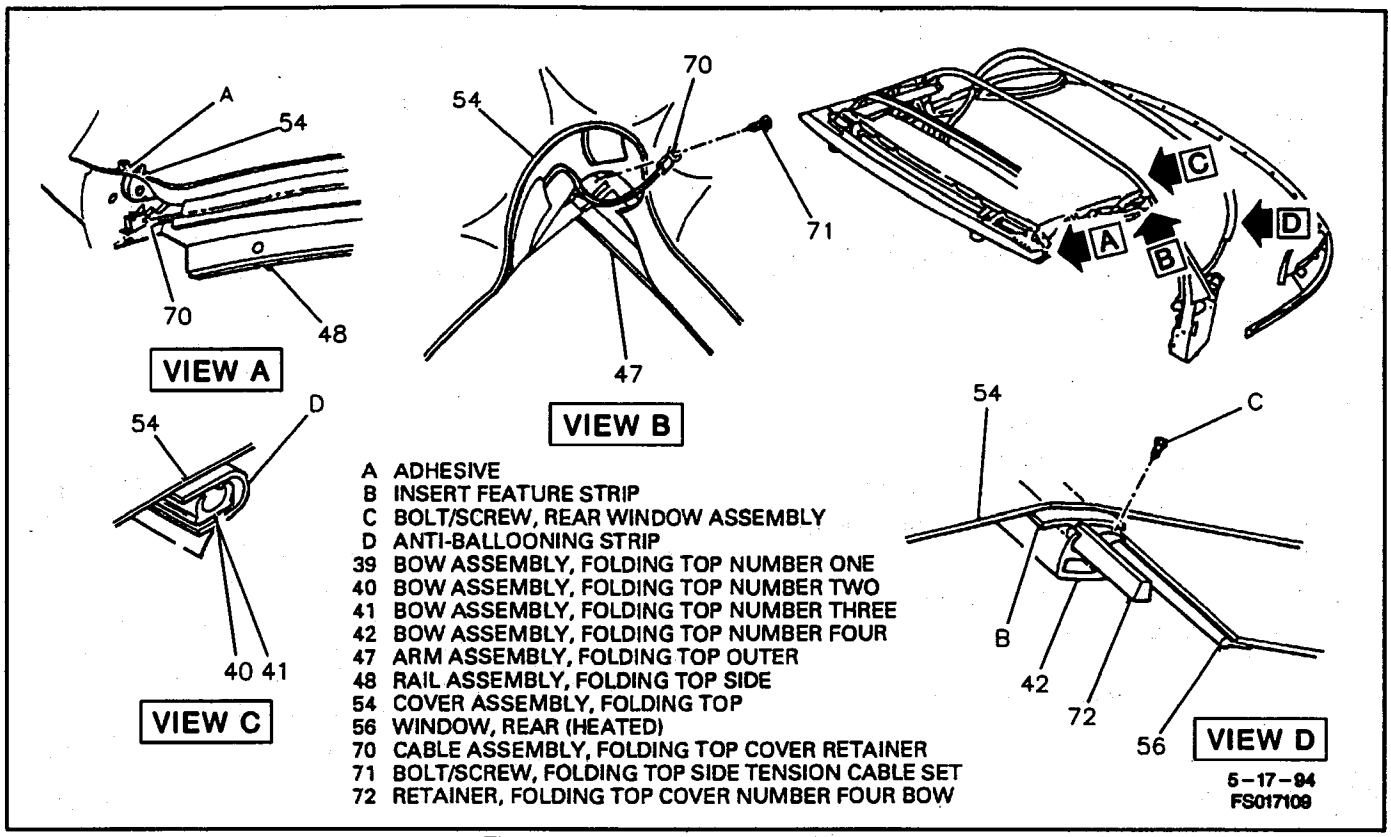


Figure 17 – Top Cover Fastening Details

FOLDING TOP FRONT LATCH ASSEMBLY

Front Latch Assembly Adjustment

Figures 8 and 18

Adjustment of the front latch assembly determines the sealing quality of the number one bow assembly to the windshield header and the latching or releasing effort of the latch mechanism.

A "long" latch hook adjustment can be identified by low latching effort or the number one bow assembly setting too high off the windshield header. This condition can cause wind noise and water leaks.

A "short" latch hook adjustment will cause excessively high latching effort and the number one bow assembly to "sink" below the windshield header when latched. This condition may cause weatherstrip damage or latch assembly failure.

Important

- A proper front latch hook adjustment should reveal three to four threads outside of the clamp body. If fewer than three or more than four threads are visible, the folding top assembly should be checked for other mechanical problems.

Use the following procedure to adjust the latch assembly:

Important

- If for any reason a latch assembly needs adjustment, both sides of the vehicle should be checked and, if necessary, adjusted.

1. Raise folding top assembly and latch to windshield header.
   A. Note operation of latch assemblies and latching effort.
   B. Latching effort should be equal on both sides.
2. Check fit between number one bow assembly and windshield header.
   A. Number one bow assembly should be flush to 2 mm (1/16 inch) below windshield header trim.
   B. Check other side of vehicle.
3. Adjust latch assembly.
   A. Raise folding top assembly off windshield header.
   B. Loosen clamp body setscrew.
   C. Turn front latch hook in desired direction.

Important

- Front latch hook must be face forward.

   D. Raise and latch folding top assembly and check latch adjustment. If further adjustment is necessary, return to step C. Otherwise, continue with step E.

E. Lower folding top assembly and tighten clamp body setscrew.

Tighten

- Clamp body setscrew to 10 N•m (89 lb. in.).

F. Repeat other side of vehicle.

Front Latch Assembly Replacement

Figures 12, 13 and 18

Remove or Disconnect

1. Lower folding top assembly.
2. Mark folding top to fabric along front edge of number one bow assembly (39) for reference.
3. Front cover number one bow retainer bolts/screws (52).
4. Front cover number one bow retainer (51).
   - Peel back top cover to reveal latch assembly bolts/screws.
5. Latch assembly bolts/screws (73).
6. Latch assembly (32).

Disassemble

1. Note position of front latch spring (74) and remove from latch handle pin.
2. Note position of front latch hook spring (75) and drive out pin (76) to remove clamp body.
3. Note position of front latch release button spring (77) and drive out pin to remove latch release button.

Assemble

1. Latch release button to latch mounting bracket and front latch release button spring (77).
2. Drive in release button pin.

   CAUTION: Failure to trim the ends of the front latch release button spring could result in personal injury when operating the front latch assembly.
3. Trim ends of front latch release button spring (77).
4. Clamp body and front latch hook spring (75).
5. Drive in pin (76).
6. Front latch spring (74) to latch handle pin.

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Latch assembly (32).
2. Latch assembly bolts/screws (73).

Tighten

- Bolts/screws (73) to 10 N•m (89 lb. in.).

3. Cover assembly. Refer to "Folding Top Cover Assembly" in this section.

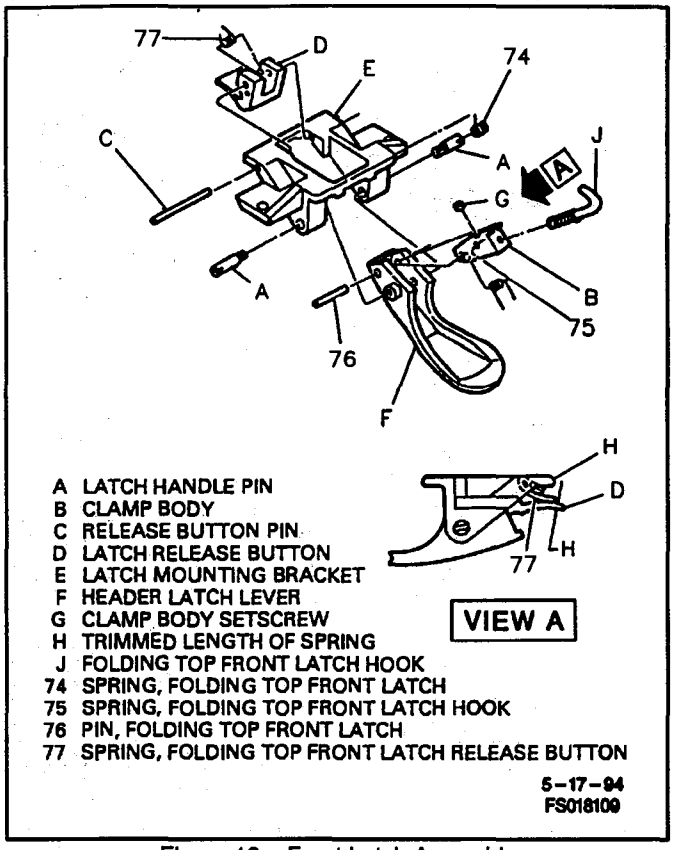


Figure 18 – Front Latch Assembly

4. Front cover number one bow retainer (51).
5. Front cover number one bow retainer bolts/screws (52).
6. Raise folding top assembly.

FOLDING TOP RAIL ASSEMBLIES

Folding Top Number One and Number Two Bow Links

Figure 14

Remove or Disconnect

1. Lower folding top assembly to suitable working position.

   CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.
2. Battery negative cable assembly.
3. Turn pump bypass valve assembly to "open" position (fully clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
4. Side rail garnish molding. Refer to "Folding Top Side Rail Garnish Molding" in this section.

   NOTICE: Do not disturb the inside nut on the forward end of number two bow links. This nut is used as a "stopper" and is not to be adjusted. Changing the position of the inside nut could cause adjustment problems and part failure.
5. Outer locknuts from number two bow links (59).

6. Number two bow links (59) from number one bow links (58).
7. Number one bow links (58) from number one bow assembly (39) by punching out pins.
8. Ball stud clip from front side rail link assembly (62).
9. Number two bow links (59).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Number two bow links (59).
2. Ball stud clip to front side rail link assembly (62).
3. Number one bow links (58) to number one bow assembly (39) and install pins.
4. Number two bow links (59) to number one bow links (58).
5. Outer locknuts to number two bow links (59). Refer to "Notice" in this procedure.

Tighten

- Locknut to 5 N•m (44 lb. in.).

6. Side rail garnish molding. Refer to "Folding Top Side Rail Garnish Molding" in this section.
7. Turn pump bypass valve assembly to "closed" position (fully counter-clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
8. Battery negative cable assembly.

Folding Top Number One and Number Two Bow Link Adjustments

Figure 14

After installing a number one bow link (58) to the number two bow assembly (40), the number one bow link must be adjusted for proper length using the following procedure:

1. Adjust number one bow link (58) so that forward hole in link is 149 mm ± 1 mm (5.9 inches ±0.04 inches) from forward most edge of number two bow assembly (40).
2. Attach front end of number two bow link (59) to number one bow link (58).

   NOTICE: Refer to "Notice" in preceding procedure.

   NOTICE: If adjustments are performed with the folding top assembly in any position other than closed and latched, the side rail link assembly ball stud will be sheared off.
3. Close and latch folding top assembly.
4. Adjust (rotate) ball stud clip until it aligns well with ball stud.
5. Cycle folding top assembly manually and observe operation. If inconsistent action or binding occur, readjust as necessary.
6. Back locknut away from ball stud clip, apply Loctite® #242 (blue) and reposition locknut.

Front Side Rail Link Assemblies

Figures 14 and 19

Remove or Disconnect

1. Lower folding top assembly to suitable working position.

   CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.
2. Battery negative cable assembly.
3. Turn pump bypass valve assembly to "open" position (fully clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
4. Number two bow link (59) from front side rail link assembly (62). Refer to "Folding Top Number One and Number Two Bow Links" in the preceding procedure.
5. Bolts/screws (82 and 83), washers (81), front side rail link assembly (62) and bushings (78 and 79).
6. Downstop from front side rail link assembly (62).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Downstop to front side rail link assembly (62).
2. Bushings (78 and 79), front side rail link assembly (62), washers (81) and bolts/screws (82 and 83).

Tighten

- Bolts/screws (82 and 83) to 17 N•m (13 lb. ft.).

3. Number two bow link (59) to front side rail link assembly (62). Refer to "Folding Top Number One and Number Two Bow Links" in the preceding procedure.
4. Turn pump bypass valve assembly to "closed" position (fully counter-clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
5. Battery negative cable assembly.

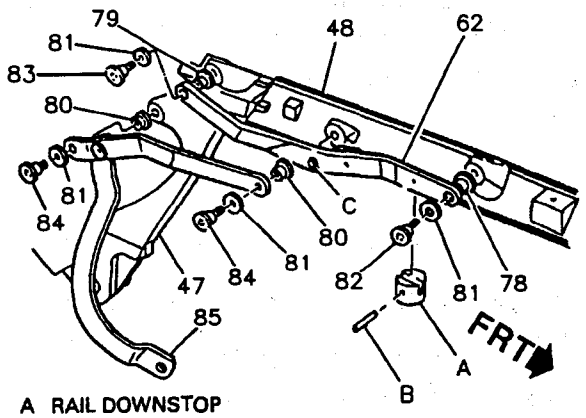
Folding Top Side Rail Assemblies

Figures 13, 14, 17 and 19

Remove or Disconnect

1. Lower folding top assembly to suitable working position.

   CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.
2. Battery negative cable assembly.
3. Turn pump bypass valve assembly to "open" position (fully clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.



A RAIL DOWNSTOP
B RAIL DOWNSTOP PIN
C FRONT SIDE RAIL LINK BALLSTUD
47 ARM ASSEMBLY, FOLDING TOP OUTER
48 RAIL ASSEMBLY, FOLDING TOP SIDE
62 LINK ASSEMBLY, FOLDING TOP FRONT SIDE RAIL
78 BUSHING, FOLDING TOP FRONT SIDE RAIL LINK FRONT
79 BUSHING, FOLDING TOP FRONT SIDE RAIL LINK REAR
80 BUSHING, FOLDING TOP SIDE RAIL LINK PIVOT
81 WASHER, FOLDING TOP SIDE RAIL LINK PIVOT
82 BOLT/SCREW, FOLDING TOP FRONT SIDE RAIL LINK FRONT
83 BOLT/SCREW, FOLDING TOP FRONT SIDE RAIL LINK REAR
84 BOLT/SCREW, FOLDING TOP SIDE RAIL LINK PIVOT
85 LINK ASSEMBLY, FOLDING TOP SIDE RAIL

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Figure 19 – Side Rail Link Assemblies

4. Side rail assembly weatherstrip. Refer to "Folding Top Side Rail Weatherstrip Assemblies" in this section.
5. Side rail assembly weatherstrip retainer. Refer to "Folding Top Side Rail Weatherstrip Retainers" in this section.
6. Side rail garnish molding. Refer to "Folding Top Side Rail Garnish Molding" in this section.
7. Bolt/screw (71) attaching cover retainer cable assembly (70) to outer arm assembly (47).
8. Folding top cover retainer number one bolts/screws (52).
9. Front cover number one bow retainer (51).
10. Mark top cover fabric along front edge of number one bow assembly (39) for reference.
    - Peel back top cover from number one bow to reveal number one bow bolts/screws. Refer to "Folding Top Number One Bow Assembly" in this section.
11. Number one bow assembly bolts/screws. Refer to "Folding Top Number One Bow Assembly" in this section.
12. Bolts/screws (82), washer (81), and bushing (78) attaching front side rail link assembly (62) to side rail assembly (48).
13. Bolt/screw (84), washer (81) and bushing (80) attaching side rail link assembly (85) to side rail assembly (48).
14. Cover retainer cable assembly (70).
15. Side rail assembly (48).

Disassemble

1. Number two bow insulator bolt/screw (61).
2. Number two bow insulator (60) from side rail assembly (48).

Assemble

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Number two bow insulator (60) to side rail assembly (48).
2. Number two bow insulator bolt/screw (61).

Tighten

- Bolt/screw (61) to 5 N•m (44 lb. in.).

Install or Connect

1. Side rail assembly (48).
2. Cover retainer cable assembly (70) at front end of side rail assembly (48).
3. Bolt/screw (84), bushing (80) and washer (81) attaching side rail link assembly (85) to side rail assembly (48).

Tighten

- Bolt/screw (84) to 17 N•m (13 lb. ft.).

4. Bolts/screws (82), washer (81), and bushing (78) attaching front side rail link assembly (62) to side rail assembly (48).

Tighten

- Bolt/screw (82) to 17 N•m (13 lb. ft.).

5. Number one bow bolts/screws. Refer to "Folding Top Number One Bow Assembly" in this section.
6. Top cover assembly. Refer to "Folding Top Number One Bow Assembly" in this section for proper cover assembly installation.
7. Front cover number one bow retainer (51).
8. Bolts/screws (52).
9. Cover retainer cable assembly (70) at front of side rail assembly (48).
10. Bolt/screw (71).
11. Side rail garnish molding. Refer to "Folding Top Side Rail Garnish Molding" in this section.
12. Side rail weatherstrip retainer. Refer to "Folding Top Side Rail Weatherstrip Retainers" in this section.
13. Side rail weatherstrip. Refer to "Folding Top Side Rail Weatherstrip Assemblies" in this section.
14. Turn pump bypass valve assembly to "closed" position. Refer to "Manual Operation" under "Folding Top Operation" in this section.
15. Battery negative cable assembly.
16. Raise folding top assembly.

Folding Top Outer Arm Assemblies

Figures 15, 16, 17, 19, 20, 21 and 22

Important

- If an outer arm assembly is being serviced on only one side of the vehicle, follow the procedure described in "On-Vehicle Service." If the outer arm assemblies are being serviced on both sides of the vehicle, follow the procedure described in "Off-Vehicle Service."

On-Vehicle Service

Remove or Disconnect

1. Lower folding top assembly about halfway down and prop up with a suitable support.

   CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

2. Battery negative cable assembly.
3. Outer arm assembly weatherstrip. Refer to "Folding Top Outer Arm Weatherstrip Assemblies" in this section.
4. Outer arm assembly weatherstrip retainer. Refer to "Folding Top Outer Arm Weatherstrip Retainers" in this section.
5. Quarter window filler bolts/screws (95).
6. Quarter window fillers (46).
7. Cover assembly (54) from outer arm assembly (47) by removing bolts/screws.
8. Cover assembly (54) from outer arm assembly (47) by peeling away from adhesive.
9. Cover retainer cable assembly (70).
10. Staples connecting number one, two, three and four bow position pad assemblies (64) to number three bow assembly (41).
    - Mark location of pad assemblies and staples.
11. Bolts/screws (68) from number three bow assembly (41).
    - Slide plastic tackstrip along channel in number three bow to reveal bolts/screws.
12. Front side rail link rear bolt/screw (83) and washer (81).
13. Front side rail link assembly (62) and bushing (79) from outer arm assembly (47).
14. Side rail link pivot bolt/screw (84) and washer (81).
15. Side rail link assembly (85) from outer arm assembly (47).
16. Pivot bracket locking pin (88) and cylinder pivot pin (87).
17. Cylinder assembly (86) from outer arm assembly (47).
18. Bolt/screw (89).
19. Outer arm pivot pin retainer (92).
20. Outer arm assembly (47) (with inner arm link cam (91) attached).

Clean

- Adhesive from outer arm assembly (47).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

Use Hughes P/N HC-4183, 3M P/N 8046, or equivalent adhesive on headliner or top cover attaching surfaces.

1. Outer arm assembly (47) (with inner arm link cam (91) attached).
2. Outer arm pivot pin retainer (92).
3. Bolt/screw (89).

   Tighten

   - Bolt/screw (89) to 5 N•m (44 lb. in.).
4. Cylinder assembly (86) to outer arm assembly (47).
5. Cylinder pivot pin (87) and pivot bracket locking pin (88).
6. Side rail link assembly (85) to outer arm assembly (47).
7. Front side rail link assembly (62) and bushing (79) to outer arm assembly (47).
8. Side rail link pivot bolt/screw (84) and washer (81).

   Tighten

   - Bolt/screw (84) to 17 N•m (13 lb. ft.).
9. Bolt/screw (83).

   Tighten

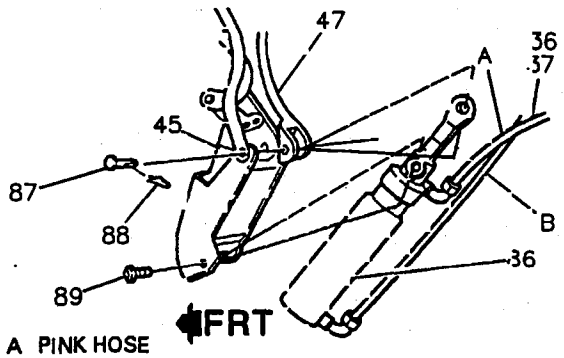
   - Bolt/screw (83) to 17 N•m (13 lb. ft.).
10. Bolts/screws (68) attaching number three bow assembly (41) to outer arm assembly (47).

    Tighten

    - Bolts/screws (68) to 10 N•m (89 lb. in.).
    - Return plastic tackstrip to its original position.
11. Number one, two, three and four bow position pad assembly (64) to its original position on number three bow assembly (41) and install staples at their original locations.
12. Cover retainer cable assembly (70).
13. Cover assembly (54) to outer arm assembly (47).
    A. Apply adhesive to outer arm assembly and to portion of cover assembly being attached.
    B. Press cover assembly into place.
    C. Install bolts/screws.
14. Quarter window filler (46).
15. Quarter window filler bolts/screws (95).

    Tighten

    - Bolts/screws (95) to 10 N•m (89 lb. in.).



A PINK HOSE
B WHITE HOSE
36 HOSE ASSEMBLY, FOLDING TOP CYLINDER LOWER (RIGHT SIDE)
37 HOSE ASSEMBLY, FOLDING TOP CYLINDER UPPER (LEFT SIDE)
45 BRACKET ASSEMBLY, FOLDING TOP PIVOT
47 ARM ASSEMBLY, FOLDING TOP OUTER
86 CYLINDER ASSEMBLY, FOLDING TOP
87 PIN, FOLDING TOP CYLINDER PIVOT
88 PIN, FOLDING TOP PIVOT BRACKET LOCKING
89 BOLT/SCREW, FOLDING TOP CYLINDER

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Figure 20 – Cylinder Assembly to Main Pivot Bracket

16. Outer arm assembly weatherstrip retainer. Refer to "Folding Top Outer Arm Weatherstrip Retainers" in this section.

Important

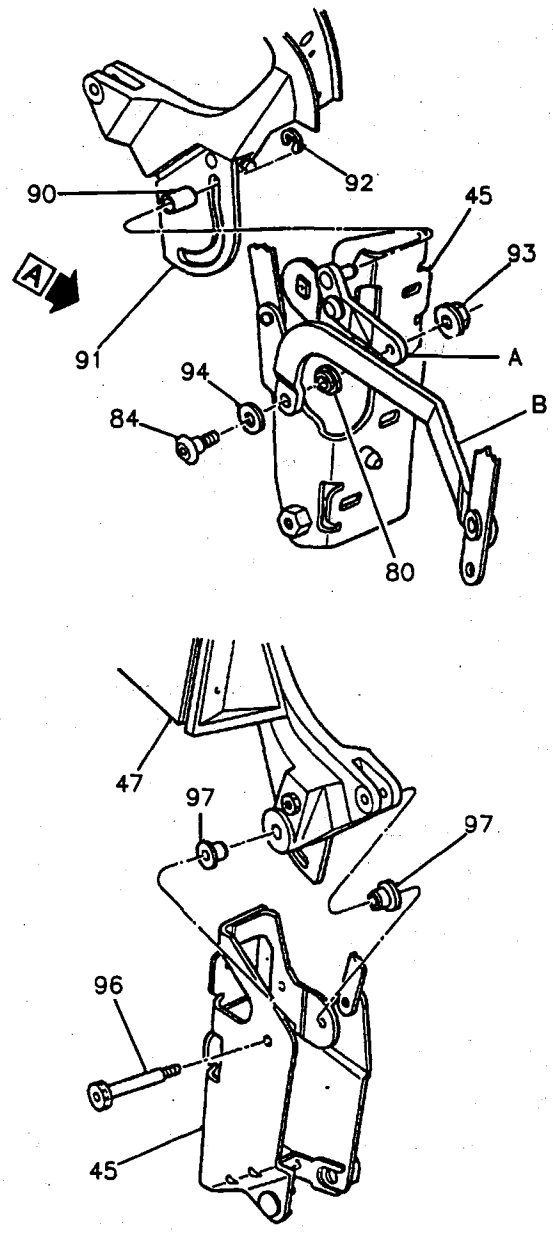
- The outer arm assembly service part is not pre-drilled for weatherstrip retainer screws. Use the weatherstrip retainer as a template to drill holes at the appropriate locations on the new outer arm assembly.

17. Outer arm assembly weatherstrip. Refer to "Folding Top Outer Arm Weatherstrip Assemblies" in this section.
18. Battery negative cable assembly.
19. Remove support and raise folding top assembly.

Off-Vehicle Service

Remove or Disconnect

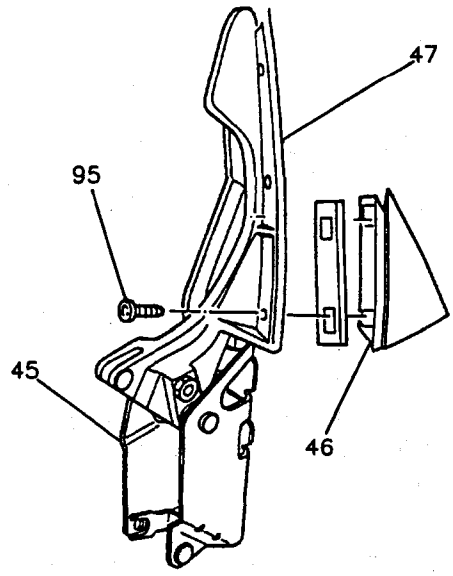
1. Folding top assembly from vehicle. Refer to "Folding Top Assembly Complete Replacement" in this section.
2. Pivot bracket assembly from outer arm assembly. Refer to "Folding Top Pivot Bracket Assembly" in this section.
3. Outer arm weatherstrip assemblies. Refer to "Folding Top Outer Arm Weatherstrip Assemblies" in this section.
4. Quarter window filler bolts/screws (95).
5. Quarter window filler (46).
6. Peel top cover back from outer arm assembly (47).
7. Side rail link pivot bolts/screws (84), washers (81) and bushings (80).
8. Side rail link assemblies (85).



A IDLER LINK ASSEMBLY
B BALANCE LINK
45 BRACKET ASSEMBLY, FOLDING TOP PIVOT
47 ARM ASSEMBLY, FOLDING TOP OUTER
80 BUSHING, FOLDING TOP SIDE RAIL LINK PIVOT
84 BOLT/SCREW, FOLDING TOP SIDE RAIL LINK PIVOT
90 BUSHING, FOLDING TOP LINK CAM PIVOT
91 CAM, FOLDING TOP INNER ARM LINK
92 RETAINER, FOLDING TOP OUTER ARM PIVOT PIN
93 NUT, FOLDING TOP REAR SIDE RAIL LINK
94 WASHER, FOLDING TOP SIDE RAIL LINK PIVOT
96 BOLT/SCREW, FOLDING TOP OUTER ARM PIVOT
97 BUSHING, FOLDING TOP OUTER ARM PIVOT

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Figure 21 – Outer Arm Assembly to Main Pivot Bracket



45 BRACKET ASSEMBLY, FOLDING TOP PIVOT
46 FILLER, FOLDING TOP QUARTER WINDOW
47 ARM ASSEMBLY, FOLDING TOP OUTER
95 BOLT/SCREW, FOLDING TOP QUARTER WINDOW FILLER

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Figure 22 – Quarter Window Filler

9. Front side rail link rear bolts/screws (83), washers (81) and bushings (79).
10. Front side rail link assemblies (62).
11. Side tension cable set bolt/screw (71) from outer arm assembly (47).
12. Cover retainer cable assembly (70) from outer arm assembly (47).
13. Mark position of number one, two, three and four bow position pad assemblies (64) along number three bow assembly (41).
14. Number one, two, three and four bow position pad assemblies (64) from number three bow assembly (41).
15. Reposition number three bow tackstrips to reveal number three bow bolts/screws (68).
16. Number three bow bolts/screws (68).
17. Number three bow assembly (41).

Clean

- Adhesive from outer arm assembly (47).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

Use Hughes P/N HC-4183, 3M P/N 8046, or equivalent adhesive on headliner or top cover attaching surfaces.

1. Number three bow assembly (41).
2. Bolts/screws (68).

Tighten

- Bolts/screws (68) to 10 N•m (89 lb. in.).

3. Return number three bow tackstrips to their original positions.
4. Number one, two, three and four bow position pad assemblies (64) to their original positions on number three bow assembly (41) and install staples.
5. Cover retainer cable assembly (70) and bolts/screws (71) to outer arm assembly (47).
6. Front side rail link assemblies (62).
7. Front side rail link rear bolts/screws (83), washers (81) and bushings (79).

Tighten

- Bolts/screws (83) to 17 N•m (13 lb. ft.).

8. Side rail link assemblies (85).
9. Side rail link pivot bolts/screws (84), washers (81) and bushings (80).

Tighten

- Bolts/screws (84) to 17 N•m (13 lb. ft.).

10. Apply adhesive and press top cover flap into outer arm assembly (47).
11. Quarter window filler (46).
12. Bolts/screws (95).

Tighten

- Bolts/screws (95) to 10 N•m (89 lb. in.).

13. Outer arm weatherstrip assemblies. Refer to "Folding Top Outer Arm Weatherstrip Assemblies" in this section.
14. Pivot bracket assembly to outer arm assembly. Refer to "Folding Top Pivot Bracket Assembly" in this section.
15. Folding top assembly onto vehicle. Refer to "Folding Top Assembly Complete Replacement" in this section.

Folding Top Side Rail Link Assembly

Figures 15, 16, 17, 19, 20, 21 and 22

Remove or Disconnect

1. Lower folding top assembly about halfway down and prop up with a suitable support.

   CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

2. Battery negative cable assembly.
3. Outer arm assembly weatherstrip. Refer to "Folding Top Outer Arm Weatherstrip Assemblies" in this section.
4. Outer arm assembly weatherstrip retainer. Refer to "Folding Top Outer Arm Weatherstrip Retainers" in this section.

5. Quarter window filler bolts/screws (95).
6. Quarter window filler (46).
7. Cover assembly from outer arm assembly (47) by removing bolts/screws and peeling cover away from adhesive.
8. Cover retainer cable assembly (70).
9. Staples connecting number one, two, three and four bow position pad assembly (64) to number three bow assembly (41).
   - Mark location of pad assembly.
10. Bolts/screws (68) from number three bow assembly (41).
    - Slide plastic tackstrip along channel in number three bow to reveal bolts/screws.
11. Bolt/screw (83) and washer (81).
12. Front side rail link assembly (62) and bushing (79) from outer arm assembly (47).
13. Side rail link assembly (85) and bushing (80) from outer arm assembly (47).
14. Pivot bracket locking pin (88) and cylinder pivot pin (87).
15. Cylinder assembly (86) from outer arm assembly (47).
16. Bolt/screw (96) attaching outer arm assembly (47) to pivot bracket assembly (45).
17. Outer arm pivot pin retainer (92).
18. Outer arm assembly (47) with inner arm link cam (91) attached.
19. Quarter inner rear trim finish panel assembly. Refer to SECTION 10-7.
20. Speaker assembly. Refer to SECTION 10-7.
21. Cylinder bolt/screw (89).
22. Number four bow links. Refer to "Folding Top Number Four Bow Assembly" in this section.
23. Side rail assembly weatherstrip. Refer to "Folding Top Side Rail Weatherstrip Assemblies" in this section.
24. Side rail assembly weatherstrip retainer. Refer to "Folding Top Side Rail Weatherstrip Retainers" in this section.
25. Side rail garnish molding. Refer to "Folding Top Side Rail Garnish Molding" in this section.
26. Bolt/screw (84) and washer (81).
27. Side rail link assembly (62) and bushing (80) from side rail assembly (48).
28. Pivot bracket nuts.
29. Pivot bracket assembly (45).
30. Old adhesive from outer arm assembly (47).

Disassemble

1. Side rail link pivot bolt/screw (84), washer (94) and rear side rail link nut (93).
2. Balance link (part of side rail link assembly) and bushing (80) from idler link assembly (part of pivot bracket assembly).

Assemble

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Balance link and bushing (80) to idler link assembly.
2. Side rail link pivot bolt/screw (84), washer (94) and rear side rail link nut (93).

Tighten

- Bolt/screw (84) to 17 N•m (13 lb. ft.).

Install or Connect

Use Hughes P/N HC-4183, 3M P/N 8046, or equivalent adhesive on headliner or top cover attaching surfaces.

1. Pivot bracket assembly (45).
2. Pivot bracket nuts.
3. Side rail link assembly (62) and bushing (80) to side rail assembly (48).
4. Bolt/screw (84) and washer (81).

Tighten

- Bolt/screw (84) to 17 N•m (13 lb. ft.).

5. Side rail garnish molding. Refer to "Folding Top Side Rail Garnish Molding" in this section.
6. Side rail assembly weatherstrip retainer. Refer to "Folding Top Side Rail Weatherstrip Retainers" in this section.
7. Side rail assembly weatherstrip. Refer to "Folding Top Side Rail Weatherstrip Assemblies" in this section.
8. Number four bow links. Refer to "Folding Top Number Four Bow Assembly" in this section.
9. Cylinder bolt/screw (89).

Tighten

- Bolt/screw (89) to 5 N•m (44 lb. in.).

10. Speaker assembly. Refer to SECTION 10-7.
11. Quarter inner rear trim finish panel assembly. Refer to SECTION 10-7.
12. Outer arm assembly (47) with inner arm cam link (91) attached.
13. Outer arm pivot pin retainer (92).
14. Bolt/screw (96) attaching outer arm assembly (47) to pivot bracket assembly (45).

Tighten

- Bolt/screw (96) to 17 N•m (13 lb. in.).

15. Cylinder assembly (86) to outer arm assembly (47).
16. Cylinder pivot pin (87) and pivot bracket locking pin (88).
17. Side rail link assembly (85) and bushing (80) to outer arm assembly (47).
18. Bolt/screw (83) and washer (81) attaching front side rail link assembly (62) and bushing (79) to outer arm assembly (47).

Tighten

- Bolt/screw (83) to 17 N•m (13 lb. ft.).

19. Number three bow bolts/screws (68).

Tighten

- Bolts/screws (68) to 10 N•m (89 lb. in.).
- Return plastic tackstrip to its original position.

20. Number one, two, three and four bow position pad assembly (64) to its original position on number three bow assembly (41) and install staples at their original locations.
21. Cover retainer cable assembly (70).
22. Cover assembly to outer arm assembly (47).
    A. Apply adhesive to outer arm assembly and to portion of cover assembly being attached.
    B. Press cover assembly into place.
    C. Install bolts/screws.
23. Quarter window filler (46).
24. Quarter window filler bolts/screws (95).

Tighten

- Bolts/screws (95) to 10 N•m (89 lb. in.).

25. Outer arm assembly weatherstrip retainer. Refer to "Folding Top Outer Arm Weatherstrip Retainers" in this section.
26. Outer arm assembly weatherstrip. Refer to "Folding Top Outer Arm Weatherstrip Assemblies" in this section.
27. Battery negative cable assembly.
28. Remove support and raise folding top assembly.

Folding Top Pivot Bracket Assembly

Figures 16 and 21

Remove or Disconnect

1. Folding top assembly from vehicle. Refer to "Folding Top Assembly Complete Replacement" in this section.
2. Mark end of number four bow assembly (42) on number four bow links (67).
3. Number four bow link bolts/screws (69).
4. Number four bow assembly (42) from number four bow links (67).
5. Side rail link pivot bolts/screws (84), washers (94), bushings (80) and nuts (93).
6. Balance link from idler link.
7. "E" clip and roller from idler link.
8. Outer arm pivot bolt/screw (96).
9. Pivot bracket assembly (45) from outer arm assembly (47).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Pivot bracket assembly (45) to outer arm assembly (47).
2. Outer arm pivot bolt/screw (96).

Tighten

- Bolt/screw (96) to 17 N•m (13 lb. ft.).

3. Roller and "E" clip to idler link.
4. Balance link to idler link.
5. Side rail link pivot bolts/screws (84), washers (94), bushings (80), and nuts (93).

Tighten

- Bolts/screws (84) to 17 N•m (13 lb. ft.).

6. Number four bow assembly (42) to number four bow links (67).
7. Number four bow link bolts/screws (69).

Tighten

- Bolts/screws (69) to 10 N•m (89 lb. in.).

8. Folding top assembly onto vehicle. Refer to "Folding Top Assembly Complete Replacement" in this section.

FOLDING TOP ASSEMBLY HYDRAULIC SYSTEM

Folding Top Cylinder Upper Hose Assembly (Left-Hand Cylinder)

Figures 9 and 20

Remove or Disconnect

NOTICE: The terms "upper hose assembly" and "lower hose assembly" refer to their respective connecting points on the upper and lower sections of the PUMP, not the cylinders.

Each hose assembly consists of one pink and one white hose bundled together. The upper hose assembly controls the left-hand cylinder and the lower hose assembly controls the right-hand cylinder. Pink hoses go to the top of each cylinder and white hoses go to the bottom of each cylinder.

Make sure hoses are always connected as indicated. If hoses are switched, one cylinder could extend while the other cylinder retracts, damaging the folding top assembly.

Important

- When servicing the hydraulic system, leave the folding top assembly raised but unlatched from the windshield header. This will keep the cylinder rods extended and minimize fluid leakage.

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Turn pump bypass valve assembly to "open" position (fully clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
3. Left rear compartment side trim assembly. Refer to SECTION 10-8.
4. Quarter inner rear trim finish panel assembly. Refer to SECTION 10-7.
5. Speaker assembly. Refer to SECTION 10-7.
6. Pivot bracket locking pin (88) and cylinder pivot pin (87) from left-hand cylinder.
7. Cylinder assembly (86) from outer arm assembly (47).
8. Cylinder bolt/screw (89).
9. Cylinder upper hose assembly (37) at pump (34).
   - Use a shop towel to control hydraulic oil leakage.
10. Cylinder upper hose assembly (37) at left-hand cylinder (86).
    - Detach hoses from metal clips and plastic clips as required.
    - Use a shop towel to control hydraulic oil leakage.
11. Cylinder upper hose assembly (37) from vehicle.

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Route cylinder upper hose assembly (37) from left-hand cylinder (86) to pump (34) along original path.
2. Secure hose to clips.
3. Cylinder upper hose assembly (37) to pump (34). Install PINK hose to LEFT side of pump. Install WHITE hose to RIGHT side of pump.
4. Cylinder upper hose assembly (37) to cylinder (86) (finger tight). Install PINK hose to TOP of cylinder. Install WHITE hose to BOTTOM of cylinder.
5. Cylinder (86).
6. Cylinder bolt/screw (89).

Tighten

- Bolt/screw (89) to 5 N•m (44 lb. in.).

7. Cylinder assembly (86) to outer arm assembly (47).
8. Cylinder pivot pin (87) and pivot bracket locking pin (88).
9. Turn pump bypass valve to "closed" position (fully counter-clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.

Tighten

- Cylinder upper hose assembly fittings to 7 N•m (62 lb. in.).

10. Speaker assembly. Refer to SECTION 10-7.
11. Quarter inner rear trim finish panel assembly. Refer to SECTION 10-7.
12. Left rear compartment side trim assembly. Refer to SECTION 10-8.
13. Battery negative cable assembly.
14. Bleed hydraulic system. Refer to "Hydraulic System Bleeding Procedure" in this section.

Folding Top Cylinder Lower Hose Assembly (Right-Hand Cylinder)

Figures 9 and 20

Remove or Disconnect

NOTICE: The terms "upper hose assembly" and "lower hose assembly" refer to their respective connecting points on the upper and lower sections of the PUMP, not the cylinders.

Each hose assembly consists of one pink and one white hose bundled together. The upper hose assembly controls the left-hand cylinder and the lower hose assembly controls the right-hand cylinder. Pink hoses go to the top of each cylinder and white hoses go to the bottom of each cylinder.

Make sure hoses are always connected as indicated. If hoses are switched, one cylinder could extend while the other cylinder retracts, damaging the folding top assembly.

Important

- When servicing the hydraulic system, leave the folding top assembly raised but unlatched from the windshield header. This will keep the cylinder rods extended and minimize fluid leakage.

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Left rear compartment side trim assembly. Refer to SECTION 10-8.
3. Turn pump bypass valve assembly to "open" position (fully clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
4. Quarter inner rear trim finish panel assembly. Refer to SECTION 10-7.
5. Speaker assembly. Refer to SECTION 10-7.
6. Pivot bracket locking pin (88) and cylinder pivot pin (87) from right-hand cylinder.
7. Cylinder assembly (86) from outer arm assembly (47).
8. Cylinder bolt/screw (89).
9. Cylinder lower hose assembly (36) at right-hand cylinder.
   - Detach hoses from metal clips and plastic clips as required.
   - Use a shop towel to control hydraulic oil leakage.
10. Cylinder lower hose assembly (36) at pump (34).

- Use a shop towel to control hydraulic oil leakage.

11. Cylinder lower hose assembly (36) from vehicle.

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Cylinder lower hose assembly (36). Route cylinder lower hose assembly (36) from right-hand cylinder (86) to pump (34) along original path.
2. Secure hose to clips.
3. Cylinder lower hose assembly (36) to pump (34). Install PINK hose to LEFT side of pump. Install WHITE hose to RIGHT side of pump.
4. Cylinder lower hose assembly (36) to right-hand cylinder. Install PINK hose to TOP of cylinder. Install WHITE hose to BOTTOM of cylinder.
5. Cylinder (86).
6. Cylinder bolt/screw (89).

Tighten

- Bolt/screw (89) to 5 N•m (44 lb. in.).

7. Cylinder assembly (86) to outer arm assembly (47).
8. Cylinder pivot pin (87) and pivot bracket locking pin (88).

Tighten

- Cylinder lower hose assembly fittings to 7 N•m (62 lb. in.).

9. Speaker assembly. Refer to SECTION 10-7.
10. Quarter inner rear trim finish panel assembly. Refer to SECTION 10-7.
11. Left rear compartment side trim assembly. Refer to SECTION 10-8.
12. Battery negative cable assembly.
13. Turn pump bypass valve to "closed" position (fully counter-clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
14. Bleed hydraulic system. Refer to "Hydraulic System Bleeding Procedure" in this section.

Cylinder Assembly

Figure 20

NOTICE: The terms "upper hose assembly" and "lower hose assembly" refer to their respective connecting points on the upper and lower sections of the PUMP, not the cylinders.

Each hose assembly consists of one white and one pink hose bundled together. The upper hose assembly controls the left-hand cylinder and the lower hose assembly controls the right-hand cylinder. Pink hoses go to the top of each cylinder and white hoses go to the bottom of each cylinder.

Make sure hoses are always connected as indicated. If hoses are switched, one cylinder could extend while the other cylinder retracts, damaging the folding top assembly.

Important

- When servicing the hydraulic system, leave the folding assembly raised but unlatched from the windshield header. This will keep the cylinder rods extended and minimize fluid leakage.

Remove or Disconnect

1. Turn pump bypass valve assembly to "open" position (fully clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

2. Battery negative cable assembly.
3. Quarter inner rear trim finish panel assembly. Refer to SECTION 10-7.
4. Speaker assembly. Refer to SECTION 10-7.
5. Pivot bracket locking pin (88) and cylinder pivot pin (87).
6. Cylinder assembly (86) from outer arm assembly (47).
7. Cylinder bolt/screw (89).
8. Cylinder upper hose assembly (37) (left-hand side) or lower hose assembly (36) (right-hand side) from cylinder (86).
   - Use a shop towel to control hydraulic oil leakage.

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

Important

- Replacement cylinder assemblies are supplied filled with oil. Do not remove sealing caps from cylinder until you are ready to connect cylinder hose assemblies.

1. Cylinder upper hose assembly (37) (left-hand side) or lower hose assembly (36) (right-hand side).
2. Cylinder (86) and cylinder bolt/screw (89).

Tighten

- Bolt/screw (89) to 5 N•m (44 lb. in.).

3. Cylinder assembly (86) to outer arm assembly (47).
4. Cylinder pivot pin (87) and pivot bracket locking pin (88).

Tighten

- Cylinder hose assembly fittings to 7 N•m (62 lb. in.).

5. Speaker assembly. Refer to SECTION 10-7.
6. Quarter inner rear trim finish panel assembly. Refer to SECTION 10-7.

7. Battery negative cable assembly.
8. Raise folding top assembly.
9. Turn pump bypass valve assembly to "closed" position (fully counter-clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
10. Bleed hydraulic system. Refer to "Hydraulic System Bleeding Procedure" in this section.

Folding Top Pump Assembly with Motor

Figure 9

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Pump assembly electrical connector.
3. Cylinder hose assemblies (36 and 37) from pump (34).
   - Use a shop towel to control hydraulic oil leakage.
4. Pump nuts (35).
5. Pump assembly with motor (34).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

NOTICE: See "Notice" under preceding procedure.

1. Pump assembly with motor (34).
2. Pump nuts (35).

Tighten

- Nuts (35) to 6 N•m (53 lb. in.).

3. Cylinder hose assemblies (36 and 37) to pump (34).

Tighten

- Cylinder hose assembly fittings to 7 N•m (62 lb. in.).

4. Pump assembly electrical connector.
5. Battery negative cable assembly.

Hydraulic System Bleeding Procedure

Figure 9

NOTICE: When performing this procedure, do not allow the hydraulic oil level to drop below the lower indicator line on the reservoir or pump damage may occur.

NOTICE: To avoid part damage during bleeding procedure, make sure cylinder rod does not touch body components or folding top assembly when extending.

Remove or Disconnect

1. Cylinder assemblies from outer arm assemblies. Refer to "Cylinder Assembly" in this section.
2. Cylinder assemblies from main pivot bracket assemblies. Refer to "Cylinder Assembly" in this section.
3. Position cylinder assemblies so cylinder rods will not touch body components or folding top assembly when fully extended.
4. Left rear compartment side trim assembly. Refer to SECTION 10-8.
5. Reservoir filler plug.
6. One pink hose from pump/motor assembly (34) and place at reservoir opening.
7. Using a rubber plug, such as a snug-fitting vacuum fitting cap, seal the open pump fitting.

Important

- Fitting must be sealed to prevent air from entering system.

8. Push and hold "UP" on convertible top switch. After cylinders are fully extended, continue to depress switch until hose being bled is free of air bubbles.

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Pink hose to pump/motor assembly (34).

Tighten

- Hose fitting to 7 N•m (62 lb. in.).

2. If fluid level is low, add fluid to reservoir. Refer to "Adding Fluid" in the following procedure.
3. Repeat bleed procedure for other cylinder.
4. Reservoir filler plug.
5. Left rear compartment side trim assembly. Refer to SECTION 10-8.
6. Rotate pump bypass valve (38) fully clockwise to "Open" position (1/4 turn).
7. Cylinder assemblies to outer arm assemblies. Refer to "Cylinder Assembly" in this section.
8. Cylinder assemblies to main pivot bracket assemblies. Refer to "Cylinder Assembly" in this section.
9. Rotate pump bypass valve (38) fully counter-clockwise to "Closed" position (1/4 turn).
10. Cycle folding top assembly up and down several times to check hydraulic system operation.

Adding Fluid

Figure 9

Important

- Vehicle must be on a level surface with top in lowered position.

1. Lower folding top assembly.

2. Remove left rear compartment side trim assembly. Refer to SECTION 10-8.
3. Place shop towel around pump/motor assembly (34) to control hydraulic oil spillage.
4. Add fluid using 10W mineral oil.
   A. Remove reservoir filler plug.
   B. Add 10W mineral oil until level is between upper and lower reservoir indicator lines.
   C. Install reservoir filler plug.
5. Cycle folding top assembly up and down several times.
   - Check fluid level with folding top assembly in the "DOWN" position and add fluid if necessary.
6. Install left rear compartment side trim assembly. Refer to SECTION 10-8.

FOLDING TOP ASSEMBLY, WEATHERSTRIPS AND GARNISHES

Folding Top Side Rail Weatherstrip Assemblies

Figure 23

Remove or Disconnect

1. Lower folding top assembly to suitable working position.

   CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.
2. Battery negative cable assembly.
3. Roof side rail weatherstrip assembly (98).

Install or Connect

1. Roof side rail weatherstrip assembly (98).
   A. Line up bottom tab of weatherstrip assembly (98) to notch in weatherstrip retainer (99).
   B. Insert weatherstrip assembly (98) into retainer (99) and roll into place.
2. Battery negative cable assembly.
3. Raise folding top assembly.

Folding Top Side Rail Weatherstrip Retainers

Figures 23 and 24

Remove or Disconnect

1. Lower folding top assembly to suitable working position.

   CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.
2. Battery negative cable assembly.
3. Roof side rail weatherstrip assembly (98).
4. Roof side rail weatherstrip retainer bolts/screws (100).
5. Roof side rail weatherstrip retainer (99).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Roof side rail weatherstrip retainer (99).
2. Roof side rail weatherstrip retainer bolts/screws (100).

Tighten

- Bolt/screw (100) to 1.3 N•m (12 lb. in.).

3. Roof side rail weatherstrip assembly. Refer to "Folding Top Side Rail Weatherstrip Assemblies" in this section.
4. Battery negative cable assembly.
5. Raise folding top assembly.

Folding Top Outer Arm Weatherstrip Assemblies

Figure 23

Remove or Disconnect

1. Lower folding top assembly to suitable working position.

   CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.
2. Battery negative cable assembly.
3. Front side door window upper rear weatherstrip assembly bolts/screws (102).
4. Front side door window upper rear weatherstrip assembly (101).

Install or Connect

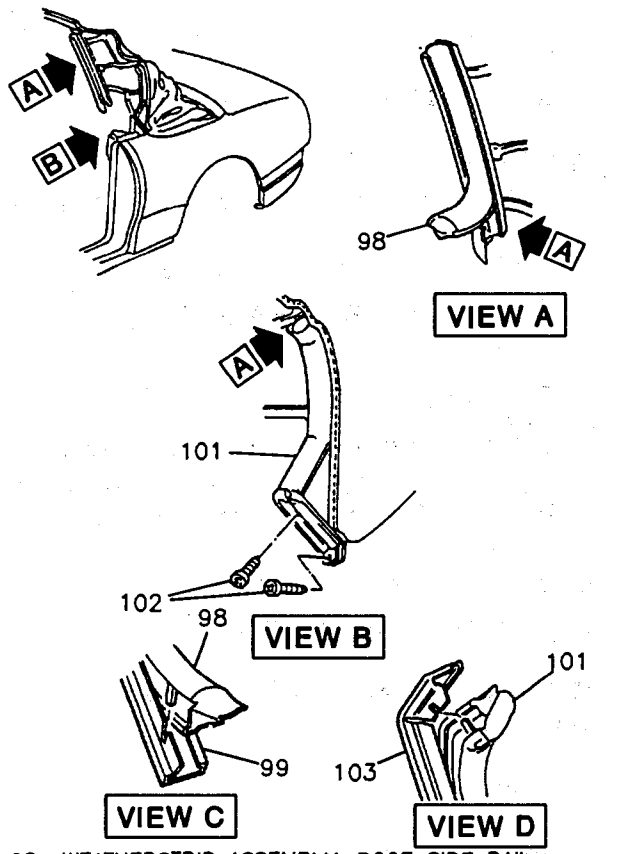
NOTICE: See "Notice" on page 10-9-1 of this section.

1. Front side door window upper rear weatherstrip assembly (101).
   A. Line up top tab of weatherstrip assembly (101) to notch in weatherstrip retainer (103).
   B. Insert weatherstrip assembly (101) into retainer (103) and roll into place.
2. Front side door window upper rear weatherstrip assembly bolts/screws (102).

Tighten

- Bolts/screws (102) to 1.3 N•m (12 lb. in.).

3. Battery negative cable assembly.
4. Raise folding top assembly.



98 WEATHERSTRIP ASSEMBLY, ROOF SIDE RAIL
99 RETAINER, ROOF SIDE RAIL WEATHERSTRIP
101 WEATHERSTRIP ASSEMBLY, FRONT SIDE DOOR WINDOW UPPER BAR
102 BOLT/SCREW, FRONT SIDE DOOR WINDOW UPPER REAR WEATHERSTRIP
103 RETAINER, FRONT SIDE DOOR WINDOW UPPER REAR WEATHERSTRIP

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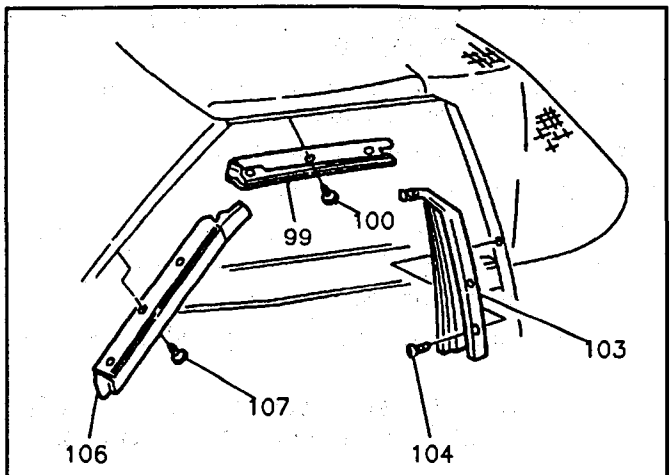
Figure 23 – Side Rail and Outer Arm Weatherstrips

Folding Top Outer Arm Weatherstrip Retainers

Figure 24

Remove or Disconnect

1. Lower folding top assembly to suitable working position.
   CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.
2. Battery negative cable assembly.
3. Front side door window upper rear weatherstrip assembly. Refer to "Folding Top Outer Arm Weatherstrip Assemblies" in the preceding procedure.
4. Front side door window upper rear weatherstrip retainer bolts/screws (104).
5. Front side door window upper rear weatherstrip retainer (103).



99 RETAINER, ROOF SIDE RAIL WEATHERSTRIP
100 BOLT/SCREW, ROOF SIDE RAIL WEATHERSTRIP RETAINER
103 RETAINER, FRONT SIDE DOOR WINDOW UPPER REAR WEATHERSTRIP
104 BOLT/SCREW, FRONT SIDE DOOR WINDOW UPPER REAR WEATHERSTRIP RETAINER
106 RETAINER, FOLDING TOP FRONT WEATHERSTRIP
107 BOLT/SCREW, FOLDING TOP FRONT WEATHERSTRIP RETAINER

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Figure 24 – Weatherstrip Retainers

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Front side door window upper rear weatherstrip retainer (103).
2. Front side door window upper rear weatherstrip retainer bolts/screws (104).

Tighten

- Bolts/screws (104) to 1.3 N•m (12 lb. in.).

3. Front side door window upper rear weatherstrip. Refer to "Folding Top Outer Arm Weatherstrip Assemblies" in the preceding procedure.
4. Battery negative cable assembly.
5. Raise folding top assembly.

Folding Top Front Weatherstrip Assembly

Figures 8 and 25

Remove or Disconnect

1. Lower folding top assembly.
2. Right and left windshield side upper garnish moldings. Refer to "Windshield Side Upper Garnish Molding (With Lift-Off Window Assemblies)" in this section.
3. Right and left body hinge pillar trim panels. Refer to SECTION 10-5.

4. Right and left front latch striker assembly bolts/screws.
5. Right and left front latch striker assemblies (33).
6. Front weatherstrip assembly (108).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Front weatherstrip assembly (108).
   A. Remove paper backing from adhesive on molded details of weatherstrip assembly at top of A-pillar.
   B. Position molded details of weatherstrip assembly to top of A-pillar.
      - Align hole in weatherstrip to previously drilled hole in body.
   C. Drive front weatherstrip bolt/screw (109) through hole in weatherstrip into previously drilled hole in body.

Tighten

- Bolt/screw (109) to 1.3 N•m (12 lb. in.).

   D. Insert front top section of weatherstrip into retainer on windshield header and roll entire length of channel.
   E. Insert rear top section of weatherstrip onto vertical flange and roll entire length onto flange.
   F. Remove paper backing from adhesive on molded details of weatherstrip at top of hinge pillar.
   G. Position weatherstrip to hinge pillar and insert plastic nail through hole in weatherstrip into hole in body at top of hinge pillar.
   H. Insert weatherstrip into A-pillar retainer and roll entire length into channel.
   I. Insert tapered end of weatherstrip into hole in front side door lower weatherstrip assembly.
   J. Insert remaining length of weatherstrip onto flange and roll into place.
2. Right and left front latch striker assemblies (33).
3. Right and left front latch striker assembly bolts/screws.
4. Right and left body hinge pillar trim panels. Refer to SECTION 10-5.
5. Right and left windshield side upper garnish moldings. Refer to "Windshield Side Upper Garnish Molding (With Lift-Off Window Assemblies)" in this section.
6. Raise folding top assembly.

Folding Top Front Weatherstrip Retainers

Figures 24 and 25

Remove or Disconnect

1. Lower folding top assembly to suitable working position.

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

2. Battery negative cable assembly.
3. Folding top front weatherstrip assembly. Refer to "Folding Top Front Weatherstrip Assembly" in the preceding procedure.
4. Folding top front weatherstrip retainer bolts/screws (107).
5. Folding top front weatherstrip retainer (106).

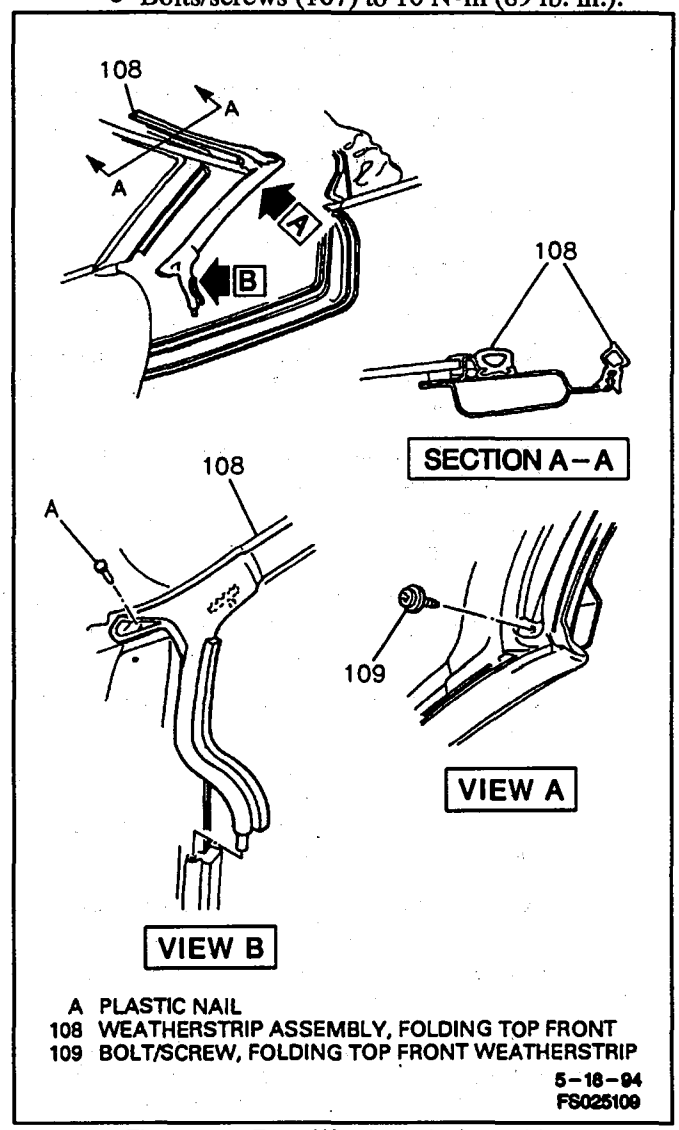
Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Folding top front weatherstrip retainer (106).
2. Folding top front weatherstrip retainer bolts/screws (107).

Tighten

- Bolts/screws (107) to 10 N•m (89 lb. in.).



A PLASTIC NAIL
108 WEATHERSTRIP ASSEMBLY, FOLDING TOP FRONT
109 BOLT/SCREW, FOLDING TOP FRONT WEATHERSTRIP

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Figure 25 – Front Weatherstrip Assembly

3. Folding top front weatherstrip assembly. Refer to "Folding Top Front Weatherstrip Assembly" in the preceding procedure.
4. Battery negative cable assembly.
5. Raise folding top assembly.

Folding Top Side Door Lower Weatherstrip Assembly

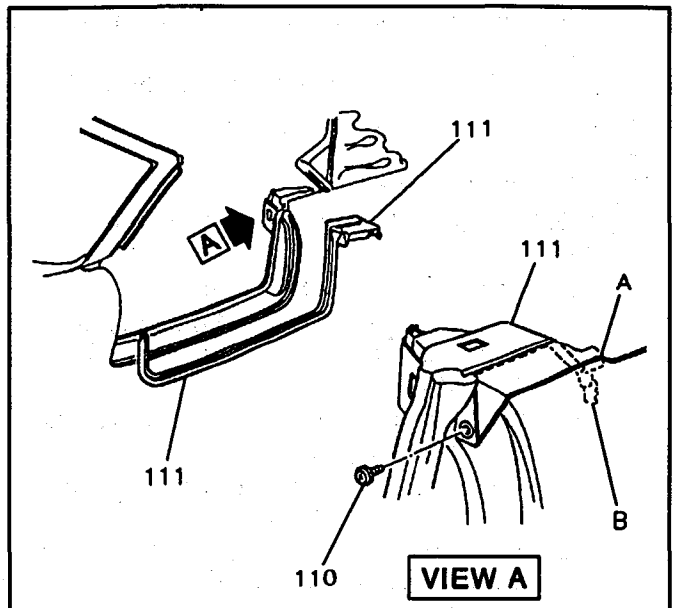
Figure 26

Remove or Disconnect

1. Lower folding top assembly.
2. Windshield side upper garnish moldings. Refer to "Windshield Side Upper Garnish Molding (With Lift-Off Window Assemblies)" in this section.
3. Body hinge pillar trim panel. Refer to SECTION 10-5.
4. Quarter inner rear trim finish panel assembly bolt/screw. Refer to SECTION 10-7.
   - Reposition quarter inner rear trim finish panel to allow access to weatherstrip area.
5. Front side door weatherstrip bolt/screw (110).
6. Front side door weatherstrip assembly (111).

Install or Connect

1. Front side door weatherstrip assembly (111).
   A. Remove paper backing from adhesive on molded detail of weatherstrip assembly at top of B-pillar.
   B. Position molded detail of weatherstrip assembly to top of B-pillar.
      a. Compress foam portion and insert into cavity.
      b. Hook vertical tab over flange on quarter panel. Make sure rearmost horizontal tab is overlapping splash shield.
   C. Drive bolt/screw (110) through hole in weatherstrip to body.
   D. Insert weatherstrip section onto door ring flange, down B-pillar area, forward along rocker and up A-pillar. Roll entire length into place.
2. Quarter inner rear trim finish panel assembly bolt/screw. Refer to SECTION 10-7.
3. Body hinge pillar trim panel. Refer to SECTION 10-5.
4. Windshield side upper garnish molding. Refer to "Windshield Side Upper Garnish Molding Assembly (With Lift-Off Window Assemblies)" in this section.
5. Raise folding top assembly.



A VERTICAL TAB
B HORIZONTAL TAB
110 BOLT/SCREW, FRONT SIDE DOOR WEATHERSTRIP
111 WEATHERSTRIP ASSEMBLY, FRONT SIDE DOOR LOWER

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Figure 26 – Side Door Lower Weatherstrip

Quarter Belt Reveal Moldings and Seals

Figures 27 and 28

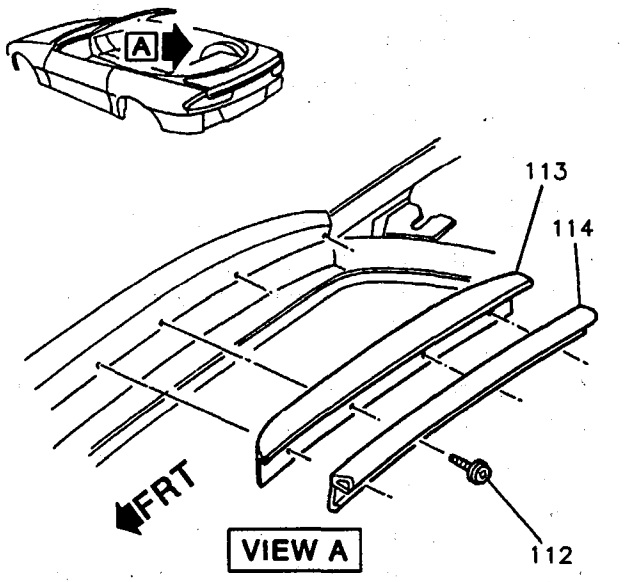
Remove or Disconnect

1. Lower folding top assembly.
2. Quarter belt reveal molding bolts/screws (112).
3. Quarter belt reveal molding (113) with seal (114).
4. Quarter belt reveal molding seal (114) from quarter belt reveal molding (113).
5. Old adhesive from quarter belt reveal molding (113).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Remove paper backing from adhesive on quarter belt reveal molding seal (114).
2. Quarter belt reveal molding seal (114) to quarter belt reveal molding (113).
3. Quarter belt reveal molding (113) with seal (114) to rear quarter.
4. Quarter belt reveal molding bolts/screws (112).



112 BOLT/SCREW, QUARTER BELT REVEAL MOLDING
113 MOLDING, QUARTER BELT REVEAL
114 SEAL, QUARTER BELT REVEAL MOLDING

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Figure 27 – Quarter Belt Reveal Molding – (Chevrolet)

Tighten

- Bolts/screws (112) to 5 N•m (44 lb. in.) (Chevrolet) or 1.7 N•m (15 lb. in.) (Pontiac).

5. Raise folding top assembly.

Folding Top Side Rail Garnish Molding

Figure 29

Remove or Disconnect

1. Lower folding top assembly to suitable working position.

   CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

2. Battery negative cable assembly.
3. Side rail weatherstrip assembly. Refer to "Folding Top Side Rail Weatherstrip Assemblies" in this section.
4. Side rail weatherstrip retainer. Refer to "Folding Top Side Rail Weatherstrip Retainers" in this section.
5. Side rail garnish molding bolts/screws (115).
6. Side rail garnish molding (116).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Side rail garnish molding (116).
2. Side rail garnish molding bolts/screws (115).

Tighten

- Bolts/screws (115) to 5 N•m (44 lb. in.).

3. Side rail weatherstrip retainer. Refer to "Folding Top Side Rail Weatherstrip Retainers" in this section.
4. Side rail weatherstrip assembly. Refer to "Folding Top Side Rail Weatherstrip Assemblies" in this section.
5. Battery negative cable assembly.
6. Raise folding top assembly.

Folding Top Cover Retention Cable Assembly

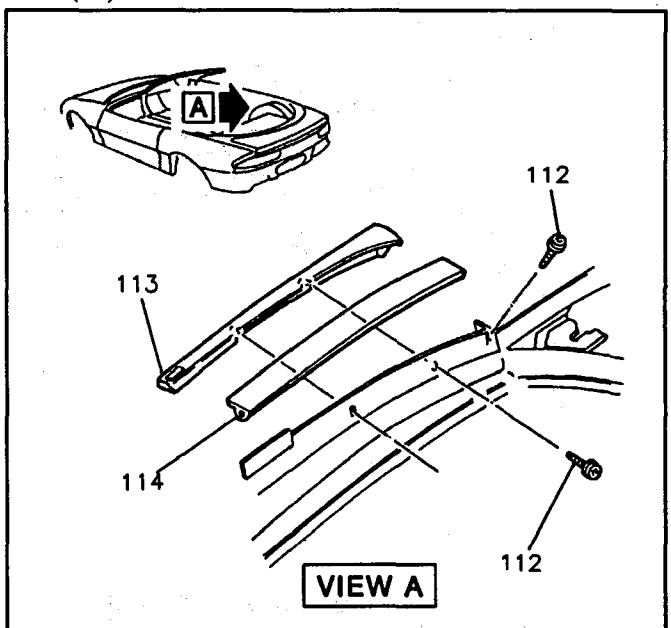
Figures 12, 13, 17 and 22

Remove or Disconnect

1. Lower folding top assembly to suitable working position.

   CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

2. Battery negative cable assembly.
3. Mark folding top cover fabric along front edge of number one bow assembly (39).
4. Front cover number one bow retainer bolts/screws (52).



112 BOLT/SCREW, QUARTER BELT REVEAL MOLDING
113 MOLDING, QUARTER BELT REVEAL
114 SEAL, QUARTER BELT REVEAL MOLDING

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Figure 28 – Quarter Belt Reveal Molding – (Pontiac)

5. Front cover number one bow retainer (51).
6. Peel back top cover assembly to reveal number one bow bolts/screws (63).
7. Number one bow bolts/screws (63).
8. Cover retention cable (70) from side rail assembly (48).
9. Front side door window upper rear weatherstrip assembly and retainer. Refer to "Folding Top Outer Arm Weatherstrip Assemblies" in this section.
10. Quarter window filler bolts/screws (95).
11. Quarter window filler (46).
12. Peel top cover upper flap at outer arm assembly (47) to reveal side tension cable set bolt/screw (71).
13. Adhesive from outer arm assembly (47).
14. Cover retention cable (70) from outer arm assembly (47).
15. Cover retention cable assembly (70).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

Use Hughes P/N HC-4183, 3M P/B 8046, or equivalent adhesive on top cover attaching surfaces.

1. Cover retention cable assembly (70).
2. Cover retention cable (70) to outer arm assembly (47).
3. Apply adhesive to outer arm assembly (47), and press top cover upper flap into place.
4. Quarter window filler (46).
5. Bolts/screws (95).

Tighten

- Bolts/screws (95) to 10 N•m (89 lb. in.).

6. Front side door window upper rear weatherstrip retainer and weatherstrip assembly. Refer to "Folding Top Outer Arm Weatherstrip Assemblies" in this section.
7. Cover retention cable (70) to side rail assembly (48).
8. Number one bow bolts/screws (63).

Tighten

- Bolts/screws (63) to 17 N•m (13 lb. ft.).

9. Top cover assembly. Refer to "Folding Top Number One Bow Assembly" in this section.
10. Front cover number one bow retainer (51).
11. Front cover number one bow retainer bolts/screws (52).
12. Battery negative cable assembly.
13. Raise folding top assembly.

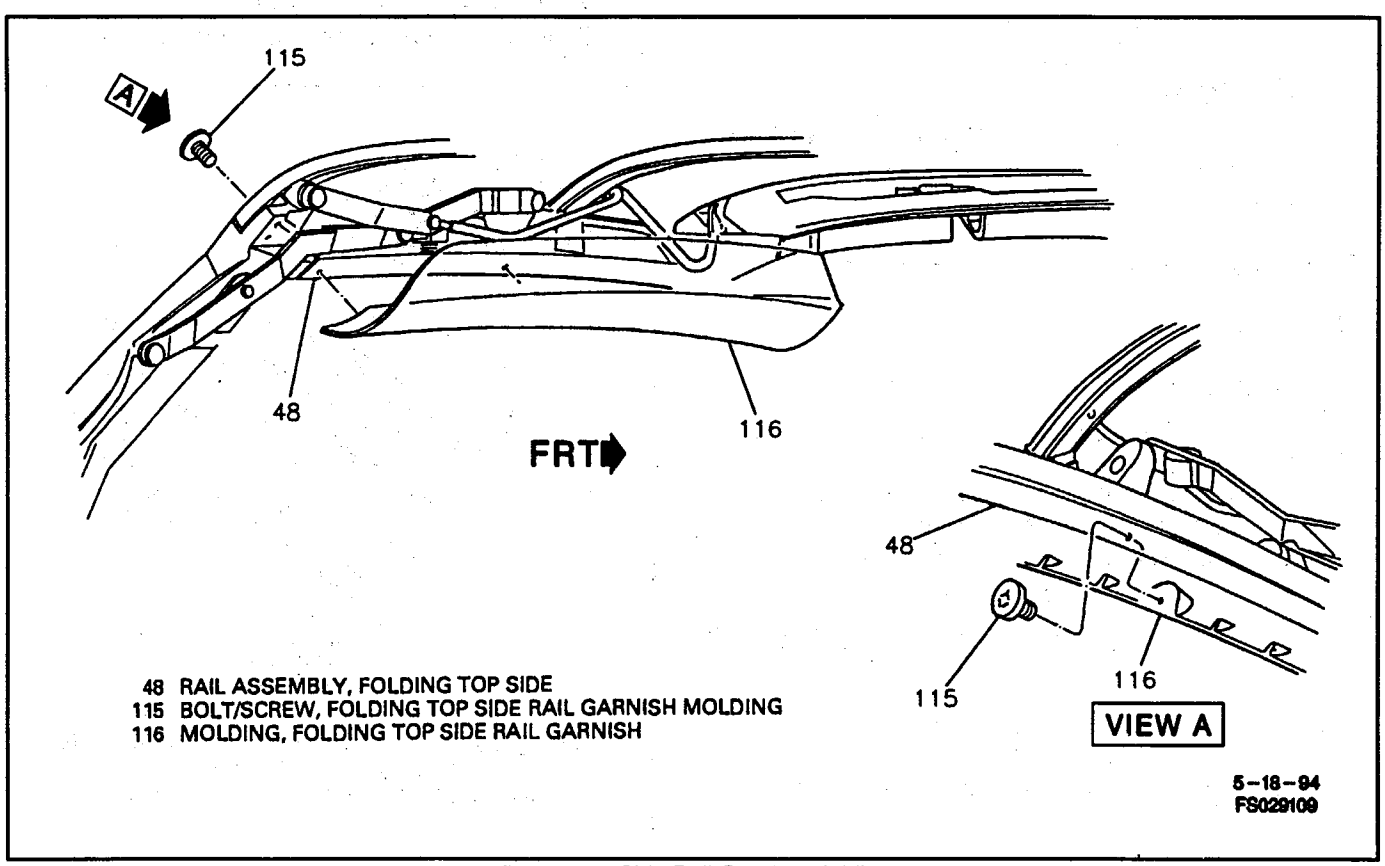


Figure 29 – Side Rail Garnish Molding

Rear Window Assembly

Figures 13 and 15

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Turn pump bypass valve assembly to "open" position (fully clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
3. Right and left quarter inner rear trim finish panel assemblies. Refer to SECTION 10-7.
4. Bolts/screws connecting headlining trim finish panel elastic tension straps to number five bow assembly (44).
5. Electrical connectors from rear window defogger.
6. Nuts from number five bow assembly retainer weld studs.
7. Reposition number five bow assembly (44) to allow easier access to rear window and number four bow assembly (42).
8. Bolt/screw attaching rear window assembly (56) to number four bow assembly (42).
9. Staples attaching cover assembly (54), rear window assembly (56) and number four and five bow position pad assemblies (66) to number five bow assembly (44).
   - Mark positions of all assemblies and staples.
10. Rear window assembly (56) from channel in number four bow assembly (42).

Install or Connect

1. Rear window assembly (56) into channel in number four bow assembly (42).
2. Staples attaching cover assembly (54), rear window assembly (56) and number four and five bow position pad assemblies (66) to their original positions on the number five bow assembly (44).
3. Bolt/screw attaching rear window assembly (56) to number four bow assembly (42).
4. Number five bow assembly (44) onto retainer weld studs.
5. Retainer nuts onto number five bow mounting studs.
6. Electrical connectors to rear window defogger.
7. Bolts/screws attaching headlining trim finish panel elastic tension straps to number five bow assembly (44).
8. Right and left quarter inner rear trim finish panel assemblies. Refer to SECTION 10-7.
9. Turn pump bypass valve assembly to "closed" position (fully counter-clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
10. Battery negative cable assembly.

Folding Top Cover Assembly

Figures 11, 12, 13, 15, 17, 22 and 29

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Turn pump bypass valve assembly to "open" position (fully clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
3.. Side rail weatherstrip assemblies. Refer to "Folding Top Side Rail Weatherstrip Assemblies" in this section.
4. Side rail weatherstrip retainers. Refer to "Folding Top Side Rail Weatherstrip Retainers" in this section.
5. Side rail garnish molding bolts/screws (115).
6. Side rail garnish moldings (116).
7. Outer arm weatherstrip assemblies. Refer to "Folding Top Outer Arm Weatherstrip Assemblies" in this section.
8. Outer arm weatherstrip retainers. Refer to "Folding Top Outer Arm Weatherstrip Retainers" in this section.
9. Quarter window filler bolts/screws (95).
10. Quarter window fillers (46).
11. Bolts/screws attaching cover assembly (54) to outer arm assemblies (47).
12. Cover assembly (54) from outer arm assemblies (47) by peeling away from adhesive.
13. Number one bow garnish molding bolts/screws (50).
14. Number one bow garnish molding (49).
15. Bolts/screws from each front corner of headlining trim finish panel (55).
16. Headlining trim finish panel (55) from number one bow assembly (39) by peeling away from adhesive.
17. Headlining trim finish panel (55) from number two bow assembly (40).
18. Headlining trim finish panel (55) from number three bow assembly (41), including bolts/screws for elastic tension straps.
19. Mark top cover fabric along front edge of number one bow assembly (39).
20. Cover assembly (54) from number one bow assembly (39) by peeling away from adhesive.
21. Cover assembly (54) from number two bow assembly (40) by peeling away from adhesive.
22. Cover assembly (54) from number three bow assembly (41) by peeling away from adhesive.
23. Cover retainer cable assembly (70) from outer arm assembly (47) only.
24. Right and left quarter inner rear trim finish panel assemblies. Refer to SECTION 10-7.

25. Bolts/screws attaching headlining trim finish panel elastic tension straps to number five bow assembly (44).
26. Nuts from number five bow assembly retainer weld studs.
27. Reposition number five bow assembly (44) to allow easier access to rear window and number four bow assembly (42).
28. Staples attaching cover assembly (54), to number five bow assembly (44).
    - Mark positions of all staples and assemblies.
29. Mark positions of number one, two, three and four bow position pad assemblies (64) and number four and five bow position pad assemblies (66) on number four bow assembly (42).
30. Number one, two, three and four bow position pad assemblies (64) and number four and five bow position pad assemblies (66) from number four bow assembly (42).
31. Move tackstrips down to access cover number four bow retainer (72).
32. Cover number four bow retainer (72) using appropriate tool.
33. Cover assembly (54) from number four bow assembly (42).
34. Adhesive from number one bow assembly (39).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

Use Hughes P/N HC-4183, 3M P/N 8046, or equivalent adhesive on headliner or top cover attaching surfaces.

1. Cover assembly (54).
2. Cover assembly to number four bow assembly (42).
3. Cover number four bow retainer (72).
4. Staples attaching cover assembly (54), to its original position on the number five bow assembly (44).
5. Cover assembly (54) to number one bow (39).
   A. Close and latch folding top assembly and pull cover assembly straight forward over number one bow to desired tension.
   B. While maintaining tension on the cover assembly over number one bow, make pencil mark on outer surface of cover assembly along forward edge of number one bow.
   C. Unlatch folding top assembly and lower the top assembly halfway.
   D. Apply adhesive to number one bow and to the portion of cover assembly being attached.
   E. Pull cover assembly over number one bow about 6 mm (1/4-inch) past reference mark. Fold cover assembly over number one bow.
   F. Attach cover assembly to number one bow starting at center, working toward each end to pull out wrinkles.
   G. Lower and latch folding top assembly to check for proper tension.
      - If additional tension is needed, repeat steps 5A through G and pull cover farther forward.
6. Number five bow assembly (44) onto retainer weld studs.
7. Retainer nuts onto number five bow mounting studs.
8. Bolts/screws attaching headlining trim finish panel elastic tension straps to number five bow assembly (44).
9. Right and left quarter inner rear trim finish panel assemblies. Refer to SECTION 10-7.
10. Retention cable assemblies. Refer to "Folding Top Cover Retention Cable Assembly" in this section.
11. Cover assembly (54) to number two bow assembly (40).
    A. Apply adhesive to number two bow and to the portion of cover assembly being attached.
    B. Press cover evenly into place.
12. Cover assembly (54) to number three bow assembly (41).
    A. Apply adhesive to number three bow and to the portion of cover assembly being attached.
    B. Press cover evenly into place.
13. Headlining trim finish panel (55) to number three bow assembly (41), including bolts/screws for elastic tension straps.
14. Headlining trim finish panel (55) to number two bow assembly (40).
15. Headlining trim finish panel (55) to number one bow assembly (39). Refer to "Headlining Trim Finish Panel Assembly" in this section.
16. Bolts/screws attaching headlining trim finish panel (55) to number one bow assembly (39).
17. Number one bow garnish molding (49).
18. Number one bow garnish molding bolts/screws (50).
19. Cover assembly (54) to outer arm assemblies (47).
    A. Clean old adhesive from outer arm assemblies (47).
    B. Apply adhesive to outer arm assembly and to the portion of cover assembly being attached.
    C. Press cover evenly into place.
20. Bolts/screws attaching cover assembly (54) to outer arm assemblies (47).
21. Quarter window fillers (46).
22. Quarter window filler bolts/screws (95).

Tighten

- Bolts/screws (95) to 10 N•m (89 lb. in.).

23. Outer arm weatherstrip retainers. Refer to "Folding Top Outer Arm Weatherstrip Retainers" in this section.
24. Outer arm weatherstrip assemblies. Refer to "Folding Top Outer Arm Weatherstrip Assemblies" in this section.
25. Side rail garnish moldings (116).
26. Side rail garnish molding bolts/screws (115).

Tighten

- Bolts/screws (115) to 5 N•m (44 lb. in.).

27. Side rail weatherstrip retainers. Refer to "Folding Top Side Rail Weatherstrip Retainers" in this section.
28. Side rail weatherstrip assemblies. Refer to "Folding Top Side Rail Weatherstrip Assemblies" in this section.
29. Battery negative cable assembly.
30. Turn pump bypass valve assembly to "closed" position (fully counter-clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.

Folding Top Assembly Complete Replacement

Figures 13 and 20

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Turn pump bypass valve assembly to "open" position (fully clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
3. Right and left quarter inner rear trim finish panel assemblies. Refer to SECTION 10-7.
4. Speaker assemblies. Refer to SECTION 10-7.
5. Right and left pivot bracket locking pins (88) and cylinder pivot pins (87).
6. Cylinder assemblies (86) from outer arm assemblies (47).
7. Right and left cylinder bolts/screws (89).
8. Nuts from number five bow retaining weld studs.
9. Mounting nuts from right and left pivot bracket assemblies (45).
10. Electrical connectors from rear window defogger.
11. Folding top assembly (54).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Folding top assembly (54).
2. Electrical connectors to rear window defogger.
3. Mounting nuts to right and left pivot bracket assemblies (45).
4. Number five bow assembly (44) and retaining nuts onto mounting studs.
5. Right and left cylinder assemblies (86) and bolts/screws (89).

Tighten

- Bolts/screws (89) to 5 N•m (44 lb. in.).

6. Cylinder assemblies (86) to outer arm assemblies (47).
7. Right and left cylinder pivot pins (87) and pivot bracket locking pins (88).
8. Speaker assemblies. Refer to SECTION 10-7.
9. Right and left quarter inner rear trim finish panel assemblies. Refer to SECTION 10-7.
10. Battery negative cable assembly.
11. Turn pump bypass valve assembly to "closed" position (fully counter-clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.

Headlining Trim Finish Panel Assembly

Figures 11 and 13

Remove or Disconnect

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

1. Battery negative cable assembly.
2. Turn pump bypass valve assembly to "open" position (fully clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
3. Folding top assembly from vehicle. Refer to "Folding Top Assembly Complete Replacement" in preceding procedure.
4. Hook-and-loop fasteners from side rail link assembly.
5. Side rail garnish moldings. Refer to "Folding Top Side Rail Garnish Molding" in this section.
6. Number one bow garnish molding bolts/screws (50).
7. Number one bow garnish molding (49).
8. Bolts/screws attaching lower end of side elastic tension straps to pivot bracket assemblies (45).
9. Left and right elastic tension straps between number three bow assembly (41) and number four bow assembly (42).
10. Front and rear hook-and-loop fasteners.
11. Headlining trim finish panel assembly (55) from number one bow assembly (39).
12. Headlining trim finish panel assembly (55) from number two bow assembly.
13. Headlining trim finish panel assembly (55) from number three bow assembly (41).

Inspect

- Top cover flaps at number two and number three bow assemblies and re-attach if necessary.

14. Slide out headlining trim finish panel assembly (55) from number four bow assembly (42).

15. Old adhesive from number one bow assembly (39).

Install or Connect

Use Hughes P/N HC-4183, 3M P/N 8046, or equivalent adhesive on headliner or top cover attaching surfaces.

1. Apply masking tape to number one bow assembly (39) as necessary to keep adhesive from unwanted areas.
2. Slide headlining trim finish panel assembly (55) into number four bow assembly (42) and align center notch of headlining trim finish panel assembly (55) with center hole in number four bow assembly.
3. Headlining trim finish panel assembly (55) to number three bow assembly (41) and align center notch with center hole.
4. Headlining trim finish panel assembly (55) to number two bow assembly and align center notch with center hole.
5. Apply adhesive to number one bow assembly (39) and to corresponding area of headlining trim finish panel (55).
6. Pull left and right side seams taut and install bolts/screws at ends of number one bow assembly (39).
7. Attach headlining trim finish panel assembly (55) along number one bow assembly (39) and press into place.
8. Trim excess material with razor.
9. Pierce holes in headlining trim finish panel assembly (55) at locations of number one bow garnish molding bolts/screws (50).
10. Number one bow garnish molding (49).
11. Bolts/screws (50).
12. Left and right elastic tension straps through pockets between number three bow assembly (41) and number four bow assembly (42).
13. Left and right elastic tension strap bolts/screws.
14. Hook-and-loop fasteners around side rail link assembly.
15. Side rail garnish moldings. Refer to "Folding Top Side Rail Garnish Molding" in this section.
16. Folding top assembly. Refer to "Folding Top Assembly Complete Replacement" in previous procedure.
17. Rear elastic tension straps to number five bow assembly (44).
18. Turn pump bypass valve assembly to "closed" position (fully counter-clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
19. Battery negative cable assembly.

FOLDING TOP ADJUSTMENTS

Downstop Adjustment

Figure 30

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Remove battery negative cable assembly.
2. Turn pump bypass valve assembly to "open" position (fully clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
3. Lower folding top assembly.
4. Lay straightedge across rearmost edge of side rail garnish moldings with straightedge extending to left and right edges of vehicle.
5. Reposition plastic splash shield to allow access to downstop bolts/screws.
6. Loosen downstop bolts/screws.
7. Adjust octagonal downstop cams so that folding top assembly is level from left to right along straightedge and allows sufficient clearance for boot cover to be installed.

Tighten

- Downstop bolts/screws to 17 N•m (13 lb. ft.).

8. Remove straightedge.
9. Raise folding top assembly.
10. Turn pump bypass valve assembly to "closed" position (fully counter-clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
11. Connect battery negative cable assembly.

Upstop Adjustments

Figures 21 and 30

CAUTION: Refer to "Caution" under "Disconnecting the Battery Negative Cable Assembly" in SECTION 0A.

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Remove battery negative cable assembly.
2. Turn pump bypass valve assembly to "open" position (fully clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
3. Lower folding top assembly.
4. Turn upstops (119) all the way in to outer arm assemblies (47).
5. Raise and latch folding top assembly.
6. With top assembly latched, turn each upstop (119) out of outer arm assembly (47) until it touches pivot bracket assembly (45).
7. Lower folding top assembly.
8. Turn upstops (119) out of outer arm assemblies (47) an additional 1/4 turn.

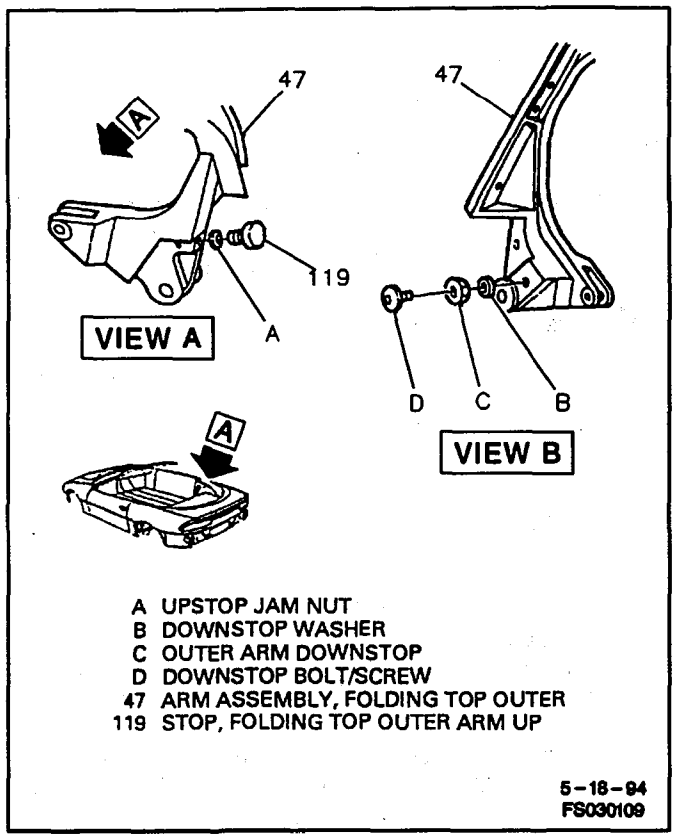


Figure 30 – Upstop and Downstop Adjustments

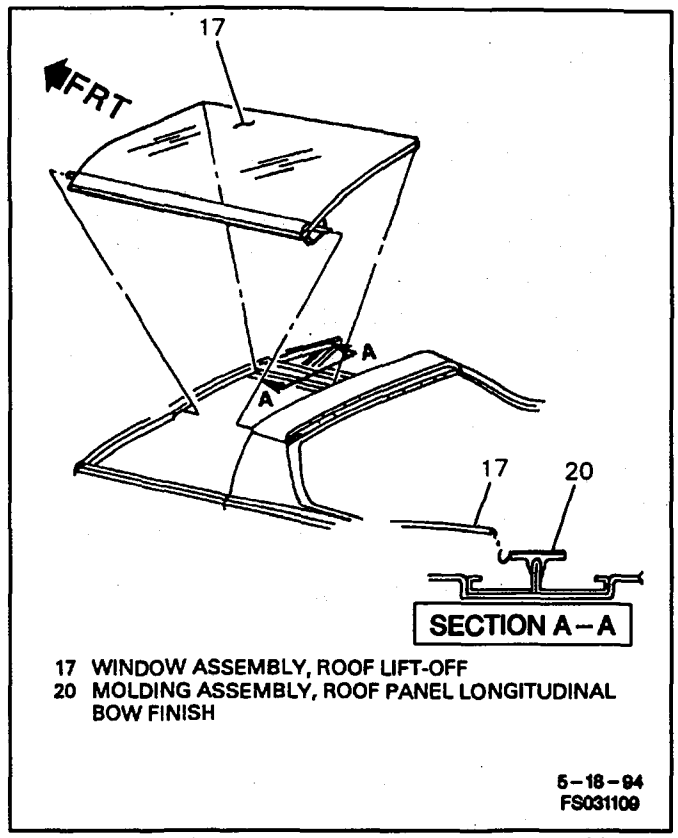


Figure 31 – Installing Roof Lift-Off Window Assembly

Tighten

- Jam nut to 17 N•m (13 lb. ft.)

9. Check operation of folding top assembly and re-adjust as necessary.
10. Turn pump bypass valve assembly to "closed" position (fully counter-clockwise). Refer to "Manual Operation" under "Folding Top Operation" in this section.
11. Connect battery negative cable assembly.

ROOF LIFT-OFF WINDOW ASSEMBLY

The roof lift-off window assemblies are manually operated. The window assemblies are curved to match the contour of the roof and are made of tinted, tempered glass. The front side door weatherstrip assemblies are one piece and molded to the shape of the roof opening. The weatherstrip assemblies are held on by retainer assemblies. For information on service of weatherstrip and retainer assemblies, refer to SECTION 10-6.

Roof Lift-Off Window Assembly Removal and Installation

Figure 31

The roof lift-off window assemblies (17) can be removed and stored in the roof lift-off window stowage retainer assembly.

Remove or Disconnect

- Roof lift-off window assemblies (17).
  - A. Turn window latch handle assembly.
  - B. Pivot roof lift-off window assembly (17) upward slightly and pull outward to release from under longitudinal bow finish molding assembly (20).
  - C. Repeat for other roof lift-off window assembly (17).

Install or Connect

- Roof lift-off window assemblies (17).
  - A. Carefully insert inside edge of roof lift-off window assembly (17) under longitudinal bow finish molding assembly (20).
  - B. Lower roof lift-off window assembly (17) and latch into place.
  - C. Repeat for other roof lift-off window assembly (17).
  - D. Check for proper fit and adjust if necessary. Refer to "Roof Lift-Off Window Assembly Adjustment" in the following procedure.

Roof Lift-Off Window Assembly Adjustment

Figure 32

The roof lift-off window assembly is adjustable within the lift-off window opening. The roof lift-off window assemblies are adjusted up and down by adding or removing backing plates (26). In-and-out and fore-and-aft travel is adjusted by loosening bolts/screws (23) and repositioning front and rear striker assemblies (25 and 24) as necessary. Adjustments should be made to get a flush fit of the roof lift-off window assemblies to the roof.

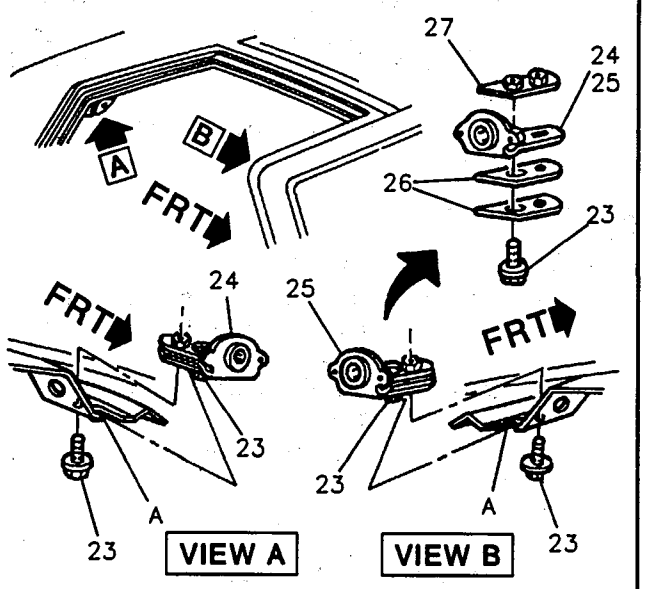
Remove or Disconnect

1. Roof lift-off window assemblies. Refer to "Roof Lift-Off Window Assembly Removal and Installation" in the preceding procedure.
2. Windshield side upper garnish molding assembly. Refer to "Windshield Side Upper Garnish Molding Assembly (With Lift-Off Window Assemblies)" in this section.
3. Quarter trim finish panel bolts/screws.
4. Quarter inner trim finish panel extension to access rear striker assemblies (24).
5. Loosen bolts/screws (23).

Adjust

NOTICE: See "Notice" on page 10-9-1 of this section.

- Front and rear striker assemblies (25 and 24).
  - A. Up and down.
    - Add or remove backing plates (26).
  - B. In and out.
    - Move front or rear striker assembly (25 or 24) in or out as required.
  - C. Fore and aft.
    - Move front or rear striker assembly (25 or 24) fore or aft as required.



A SLOT CUT-OUT
23 BOLT/SCREW, ROOF REAR PANEL LATCH STRIKER
24 STRIKER ASSEMBLY, ROOF LIFT-OFF WINDOW REAR
25 STRIKER ASSEMBLY, ROOF LIFT-OFF WINDOW FRONT
26 PLATE, ROOF LIFT-OFF WINDOW FRONT STRIKER BRACKET BACKING
27 RETAINER ASSEMBLY, ROOF LIFT-OFF PANEL/WINDOW FRONT NUT PLATE

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Figure 32 – Roof Lift-Off Window Striker Assemblies

Tighten

- Bolts/screws (23) to 10 N•m (89 lb. in.).

Inspect

1. Install roof lift-off window assemblies and inspect for proper fit.
2. Remove roof lift-off window assemblies.

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Quarter inner trim finish panel extension.
2. Quarter trim finish panel bolts/screws.

Tighten

- Quarter trim finish panel bolts/screws to 1.7 N•m (15 lb. in.).

3. Windshield side upper garnish molding assembly. Refer to "Windshield Side Upper Garnish Molding Assembly (With Lift-Off Window Assemblies)" in this section.
4. Roof lift-off window assemblies. Refer to "Roof Lift-Off Window Assembly Removal and Installation" in the preceding procedure.

Roof Lift-Off Window Assembly Repair

Figure 33

If a new roof lift-off window assembly (17) is being installed, transfer the hardware from the original roof lift-off window assembly (17) to the new one as a bench procedure.

Remove or Disconnect

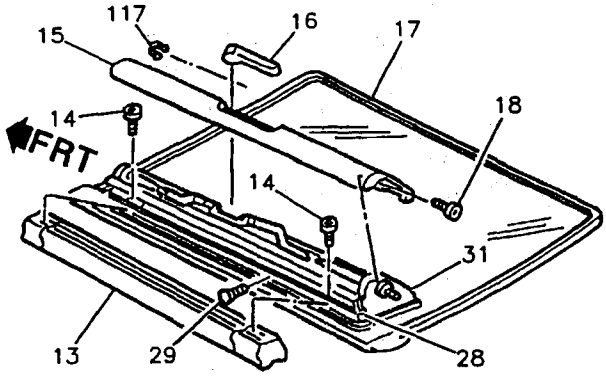
1. Roof lift-off window assemblies. Refer to "Roof Lift-Off Window Assembly Removal and Installation" in this section.
2. Place on a clean, protected surface.

Disassemble

1. Handle assembly (16), by removing handle spring (117) with small flat-blade screwdriver.
2. Trim cover bolts/screws (18).
3. Trim cover assembly (15).
4. Weatherstrip bolts/screws (14).
5. Weatherstrip assembly (13) by pulling from weatherstrip retainer assembly (28).
6. Weatherstrip retainer bolts/screws (29).
7. Weatherstrip retainer assembly (28).
8. Roof lift-off window latch bolts/screws.
9. Latch (31).

Assemble

NOTICE: See "Notice" on page 10-9-1 of this section.



13 WEATHERSTRIP ASSEMBLY, ROOF SIDE RAIL
14 BOLT/SCREW, ROOF LIFT-OFF WINDOW BODY SIDE WEATHERSTRIP
15 COVER ASSEMBLY, ROOF LIFT-OFF WINDOW LATCH TRIM
16 HANDLE ASSEMBLY, ROOF LIFT-OFF WINDOW LATCH
17 WINDOW ASSEMBLY, ROOF LIFT-OFF
18 BOLT/SCREW, ROOF LIFT-OFF WINDOW LATCH TRIM COVER
28 RETAINER ASSEMBLY, ROOF LIFT-OFF WINDOW BODY SIDE WEATHERSTRIP WINDSHIELD FRAME
29 BOLT/SCREW, ROOF LIFT-OFF WINDOW BODY SIDE WEATHERSTRIP WINDSHIELD FRAME RETAINER
31 LATCH, ROOF LIFT-OFF WINDOW
117 SPRING, ROOF LIFT-OFF PANEL HANDLE

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Figure 33 – Roof Lift-Off Window Assembly

1. Latch (31).
2. Roof lift-off window latch bolts/screws.

Tighten

- Bolt/screw (18) to 1.7 N•m (15 lb. in.).

3. Weatherstrip retainer assembly (28).
4. Weatherstrip retainer bolts/screws (29).

Tighten

- Weatherstrip retainer bolts/screws (29) to 1.3 N•m (12 lb. in.).

5. Weatherstrip assembly (13) to weatherstrip retainer assembly (28).
   - Insert outboard lip of weatherstrip assembly (13) into weatherstrip retainer assembly (28) and roll inboard lip into weatherstrip retainer assembly (28).
6. Weatherstrip bolts/screws (14).

Tighten

- Weatherstrip bolts/screws (14) to 1.3 N•m (12 lb. in.).

7. Trim cover assembly (15).
8. Trim cover bolts/screws (18).

Tighten

- Trim cover bolts/screws (18) to 1.7 N•m (15 lb. in.).

9. Handle assembly (16).
   - Place handle assembly (16) on spindle and secure with handle spring (117).
   - Install handle in open position.

Install or Connect

- Roof lift-off window assemblies. Refer to "Roof Lift-Off Window Assembly Removal and Installation" in this section.

Roof Panel Longitudinal Bow Finish Molding Assembly

Figure 34

Remove or Disconnect

1. Roof lift-off window assemblies. Refer to "Roof Lift-Off Window Assembly Removal and Installation" in this section.
2. Bolts/screws (19).
3. Longitudinal bow finish molding assembly (20).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Longitudinal bow finish molding assembly (20).
   A. Position molding so "FRT" marked on protective paper is forward.
   B. Remove protective paper.
2. Bolts/screws (19), in order, to positions 1, 2 and 3.

Tighten

- Bolts/screws (19) as they are installed in positions 1, 2 and 3 to 1.7 N•m (15 lb. in.).

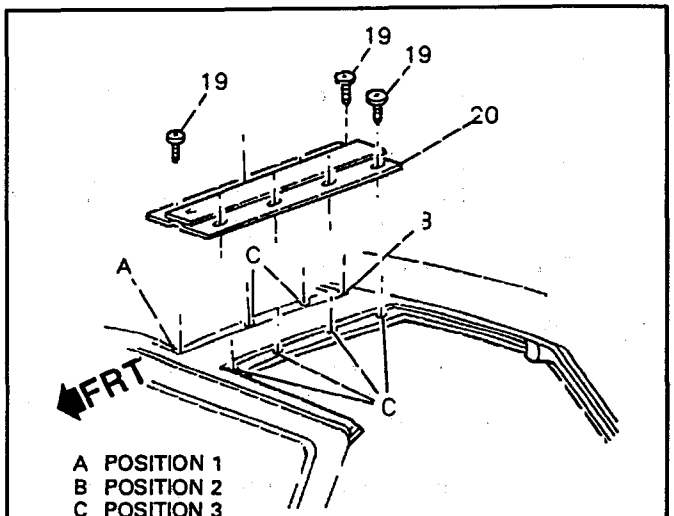
3. Roof lift-off window assemblies. Refer to "Roof Lift-Off Window Assembly Removal and Installation" in this section.

Roof Lift-Off Window Lock Cylinder Assembly

Figures 33 and 35

Remove or Disconnect

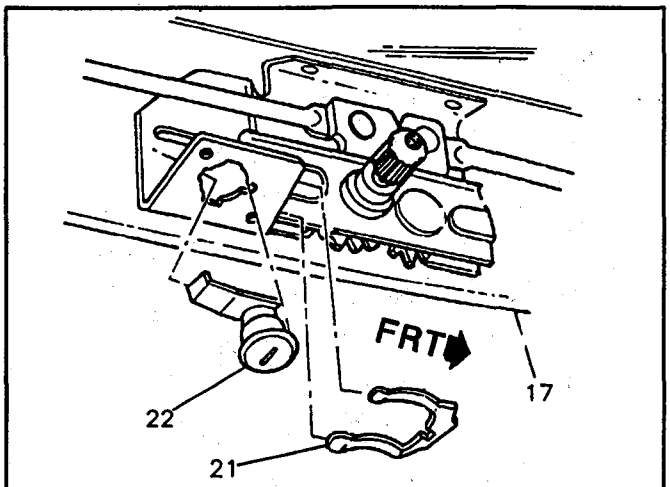
1. Roof lift-off window assembly. Refer to "Roof Lift-Off Window Assembly Removal and Installation" in this section.
2. Roof lift-off handle spring (117).
3. Handle assembly (16).
4. Trim cover bolts/screws (18).
5. Trim cover assembly (15).



A POSITION 1
B POSITION 2
C POSITION 3
19 BOLT/SCREW, ROOF PANEL LONGITUDINAL BOW FINISH MOLDING
20 MOLDING ASSEMBLY, ROOF PANEL LONGITUDINAL BOW FINISH

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Figure 34 – Roof Panel Longitudinal Bow Finish Molding Assembly



17 WINDOW ASSEMBLY, ROOF LIFT-OFF
21 RETAINER, ROOF LIFT-OFF WINDOW LOCK CYLINDER
22 CYLINDER ASSEMBLY, ROOF LIFT-OFF WINDOW LOCK

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Figure 35 – Roof Lift-Off Window Lock Cylinder Assembly (Left Side Shown)

6. Lock cylinder retainer (21).
7. Lock cylinder assembly (22).

Install or Connect

NOTICE: See "Notice" on page 10-9-1 of this section.

1. Lock cylinder assembly (22).
   - Align tabs of lock cylinder assembly (22) with notches in latch support.
2. Lock cylinder retainer (21).
3. Trim cover assembly (15).
4. Trim cover bolts/screws (18).

Tighten

- Trim cover bolts/screws (18) to 1.7 N•m (15 lb. in.).

5. Handle assembly (16).
6. Roof lift-off handle spring (117).
7. Roof lift-off window assembly. Refer to "Roof Lift- Off Window Assembly Removal and Installation" in this section.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Dome Lamp Bolt/Screw	1.7 N•m (15 lb. in.)
Downstop Bolt/Screw	17 N•m (13 lb. ft.)
Folding Top Cylinder Bolt/Screw	5 N•m (44 lb. in.)
Folding Top Cylinder Upper Hose Assembly Fitting	7 N•m (62 lb. in.)
Folding Top Front Latch Assembly Bolt/Screw	10 N•m (89 lb. in.)
Folding Top Front Side Rail Link Front Bolt/Screw	17 N•m (13 lb. ft.)
Folding Top Front Side Rail Link Rear Bolt/Screw	17 N•m (13 lb. ft.)
Folding Top Front Weatherstrip Bolt/Screw	1.3 N•m (12 lb. in.)
Folding Top Front Weatherstrip Retainer Bolt/Screw	10 N•m (89 lb. in.)
Folding Top Number One Bow Bolt/Screw	17 N•m (13 lb. ft.)
Folding Top Number Two Bow Insulator Bolt/Screw	5 N•m (44 lb. in.)
Folding Top Number Two Bow Link Nut	5 N•m (44 lb. in.)
Folding Top Number Three Bow Bolt/Screw	10 N•m (89 lb. in.)
Folding Top Number Four Bow Link Bolt/Screw	10 N•m (89 lb. in.)
Folding Top Outer Arm Pivot Bolt/Screw	17 N•m (13 lb. ft.)
Folding Top Pump Nut	6 N•m (53 lb. in.)
Folding Top Quarter Window Filler Bolt/Screw	10 N•m (89 lb. in.)
Folding Top Side Rail Garnish Molding Bolt/Screw	5 N•m (44 lb. in.)
Folding Top Side Rail Link Pivot Bolt/Screw	17 N•m (13 lb. ft.)
Front Latch Clamp Body Setscrew	10 N•m (89 lb. ft.)
Front Side Door Window Upper Rear Weatherstrip Bolt/Screw	1.3 N•m (12 lb. in.)
Front Side Door Window Upper Rear Weatherstrip Retainer Bolt/Screw	1.3 N•m (12 lb. in.)
Quarter Belt Reveal Molding Bolt/Screw (Chevrolet)	5 N•m (44 lb. in.)
Quarter Belt Reveal Molding Bolt/Screw (Pontiac)	1.7 N•m (15 lb. in.)
Quarter Trim Finish Panel Bolt/Screw	1.7 N•m (15 lb. in.)
Roof Lift-Off Window Body Side Weatherstrip Bolt/Screw	1.3 N•m (12 lb. in.)
Roof Lift-Off Window Body Side Weatherstrip Windshield Frame Retainer Bolt/Screw	1.3 N•m (12 lb. in.)
Roof Lift-Off Window Latch Trim Cover Bolt/Screw	1.7 N•m (15 lb. in.)
Roof Panel Longitudinal Bow Finish Molding Bolt/Screw	1.7 N•m (15 lb. in.)
Roof Rear Panel Latch Striker Bolt/Screw	10 N•m (89 lb. in.)
Roof Side Rail Weatherstrip Retainer Bolt/Screw	1.3 N•m (12 lb. in.)
Sunshade Bolt/Screw	1.7 N•m (15 lb. in.)
Upstop Jam Nut	17 N•m (13 lb. ft.)
Windshield Garnish Molding Bolt/Screw	1.7 N•m (15 lb. in.)

BLANK

SECTION 10-10

SEATS AND CARPET

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread-locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

FRONT SEAT ASSEMBLY

The front seat assemblies are bucket seats. Both seat assemblies have inertia seatback locks, manual seatback recliners and manual seatback adjuster assemblies. A 4-way manual or a power 6-way seat adjuster assembly is available on the driver's seat as an option.

Also, both front seats can be ordered with pneumatic seats that have an adjustable thigh support, and inflatable lumbar and lateral support bladders (Pontiac only).

The seatback and cushion assemblies have formed foam pads that fit the contours of the seatback and seat cushion frames.

CAUTION: Do not try to change the designed seat position by changing the seat adjust-to-floor pan anchor placement or the seat adjust-to-seat frame anchor placement. Changing the designed seat position could affect the safe performance of the seat and cause personal injury.

Front Seatback

Bucket seat assemblies have a tubular frame seatback and a standard manual seatback recliner assembly. The recliner control is mounted on the outboard side of the seat assembly and controls the seatback angle. The inner hinge arm bolt/screw acts as a pivot point for the seatback. The recliner control has an inertia seatback lock that lets the occupant move the seatback without the lever. If the vehicle stops or slows suddenly, or is declined 20 degrees or more, the inertia seatback lock locks the seatback and the emergency release lever must be used to move the seatback.

The seatback angle can be changed by lifting the reclining control handle. Lifting the recliner control handle releases the lock bars and lets the seatback pivot forward and rearward. Releasing the recliner control handle lets the cam plate move counterclockwise, causing the lock bar teeth to lock the seatback in a new position. The recliner control handle should return automatically to its original position.

REAR SEAT ASSEMBLY

The rear seat assembly is of the solid, folding bench type. It is fastened onto the vehicle with studs and nuts and bolts/screws.

FLOOR CARPET ASSEMBLY

All floor carpet assemblies consist of a molded one-piece carpet over both front and rear floor pan assemblies.

DIAGNOSIS

FRONT SEAT ASSEMBLY

Manual Front Seat Adjuster Assembly

All passenger seats and some driver seats have manual seat adjuster assemblies attached to the seat cushion frame. An adjuster actuator lever is located at the lower front edge of the seat cushion. When the lever is moved to the left, the seat adjuster assemblies unlock. The set can then be moved forward and rearward. The seat locks in place when the lever is released.

The seat adjuster assemblies are held onto the seat cushion frame with bolts/screws and to the floor pan with nuts installed over studs. Adjuster channel covers are installed between the seat cushion frame and the seat adjuster assemblies.

1. Adjuster assemblies will not lock or will not unlock.
   - Linking wire may be too loose, too tight or disconnected.
   - Return spring may be disconnected or damaged.
   - Lock bar may be stuck or damaged.
2. One adjuster assembly locks and other adjuster assembly does not lock.
   - One adjuster assembly may be forward or rearward of another adjuster assembly. Make adjustments at floor pan attachments.
3. Seat is hard to move forward or rearward.
   - Adjuster assemblies may be new. Move seat forward and rearward several times to work tightness out of channels.
   - Adjuster assemblies may not be lubricated properly.
   - Adjuster channels may be damaged.
   - Adjuster assemblies may not be parallel. Make adjustments at floor pan attachments.

Power Front Seat Adjuster Assembly

Six-way power seat adjuster assemblies are available on the driver's seat. The adjuster assemblies are three 12 volt reversible, permanent-magnet motors controlled by a switch on the forward outboard side of the seat.

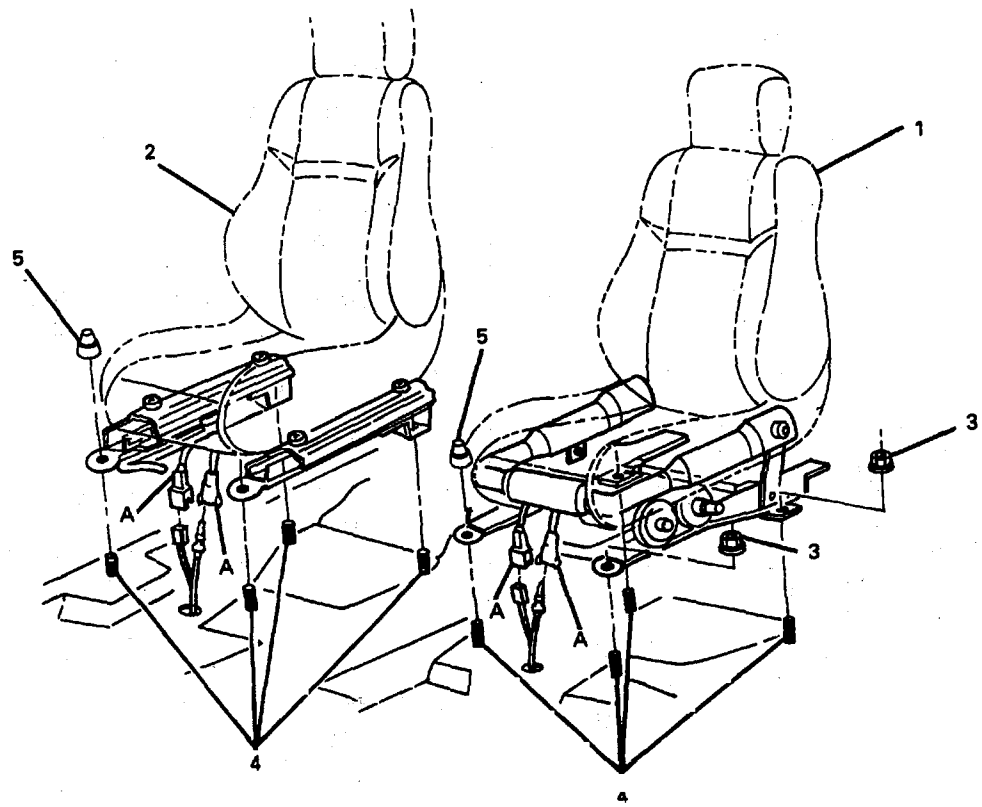
1. One adjuster assembly reaches maximum horizontal or vertical position before other adjuster assembly.
   - Adjuster assemblies may be out of phase.
2. Seat assembly does not move smoothly.
   - Adjuster shoes and channels may not be properly lubricated.
   - Horizontal actuator gear may be too tight.
3. One adjuster assembly will not move forward and backward.
   - Horizontal drive cable assembly may be damaged.
   - Horizontal actuator may be damaged.
4. One adjuster assembly will not move up or down.
   - Vertical drive cable assembly may be disconnected or damaged.
   - Vertical actuator may be damaged.

Pneumatic Comfort Controls

Pontiac

These seats have inflatable lumbar and lateral support bladders in the seatback. The lumbar support bladder is located in the lower middle section of the seatback, and the lateral support bladders are located in the sides of the seatback. The control switch to inflate or deflate the support bladders is located on the lower outboard side of the seat cushion. A pump, valve and relay are attached to the bottom of the driver's seat cushion. The pump operates both front seats.

1. Driver and passenger seats will not function at the same time.
   - Operate one seat at a time. Although each seat has a switch, one pump runs both seats; so the two seats cannot be run at the same time.
2. Switch button is pushed, but no electrical "click" is heard.
   - Seat may not be plugged into vehicle electrical system.
   - Wiring harness fuse may be blown.
3. Wiring harness fuse blows often.
   - Grommet that prevents the switch from contacting the trim support panel may be damaged or missing. Repair kits are available to correct this condition.
4. Pump runs and does not shut off.
   - Hose may be disconnected or damaged.
   - Hose may be pinched.
5. Driver seat operates, but passenger seat does not.
   - Hose crossover may be pinched.



A CONNECTOR, BODY WIRING HARNESS ELECTRICAL
1 SEAT, DRIVER
2 SEAT, PASSENGER
3 NUT, DRIVER/PASSENGER SEAT ADJUSTER
4 STUD, DRIVER/PASSENGER SEAT ADJUSTER
5 CAP, DRIVER/PASSENGER SEAT ADJUSTER STUD

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Figure 1 – Removing Seat Assemblies from Floor Pan Assembly – (Pontiac)

ON-VEHICLE SERVICE

FRONT SEAT ASSEMBLY

Figures 1 and 2

Remove or Disconnect

1. Caps (5) covering nuts (3) and studs (4).
2. Nuts (3) from studs (4).
3. Body wiring harness electrical connector, if necessary.
4. Seat air supply hose, if necessary (Pontiac only).

   NOTICE: Failure to place a protective shield over nearby trim and paint may cause damage to the vehicle.
5. Place protective shield over nearby trim and paint.
6. Seat assembly (1 or 2) from floor pan assembly.
7. Seat assembly (1 or 2) from vehicle.

Install or Connect

CAUTION: Replace belts, retractors, and hardware in use during all but a minor collision. Also, restraint systems should be replaced and anchorages properly repaired if they were in areas damaged by a collision, whether the belt was in use or not. If there is any question, replace the belt system. Damage, whether visible or not, could result in serious personal injury in the event of an accident.

NOTICE: See "Notice" on page 10-10-1 of this section.

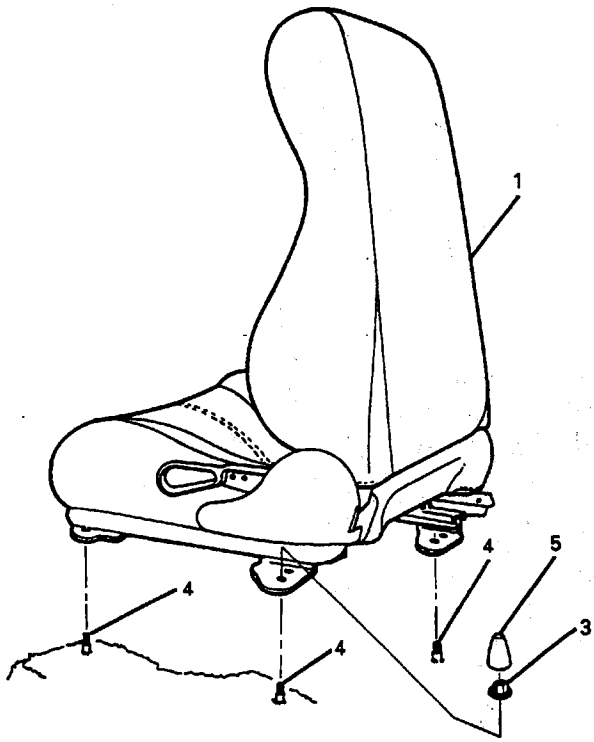


Figure 2 – Removing Seat Assembly from Floor Pan Assembly (Driver Seat Shown, Passenger Seat Similar)– (Chevrolet)

1. Seat assembly (1 or 2) to vehicle.
2. Seat assembly (1 or 2) over studs (4) to floor pan assembly.
3. Remove protective shield.
4. Nuts (3) to studs (4).

Tighten

- Nuts (3) to 24 N•m (18 lb. ft.).

5. Body wiring harness electrical connector, if disconnected.
6. Seat air supply hose, if removed (Pontiac only).
7. Caps (5) covering nuts (3) and studs (4).

Front Seatback

Figure 3

Remove or Disconnect

1. Front seat assembly. Refer to "Front Seat Assembly" in this section.
2. Hinge arm trim covers. Refer to "Trim Covers" in this section.
3. Bolts/screws (6 and 7) attaching hinge arm assembly (8) to cushion assembly (9).
4. Seatback (10) from cushion assembly (9) by unsnapping from front seatback pivot bushing (11).

Install or Connect

NOTICE: See "Notice" on page 10-10-1 of this section.

NOTICE: Anytime the front seatback is removed, a new seatback pivot bushing must be installed.

1. Front seatback pivot busing (11).
2. Seatback (10) to cushion assembly (9).
   - Align pivot shaft on seatback with hole in cushion assembly (9).
3. Bolts/screws (6 and 7).

Tighten

- Bolts/screws (6 and 7) to 24 N•m (18 lb. ft.).

4. Hinge arm trim covers. Refer to "Trim Covers" in this section.
5. Front seat assembly. Refer to "Front Seat Assembly" in this section.

Inertia Seatback Lock Check

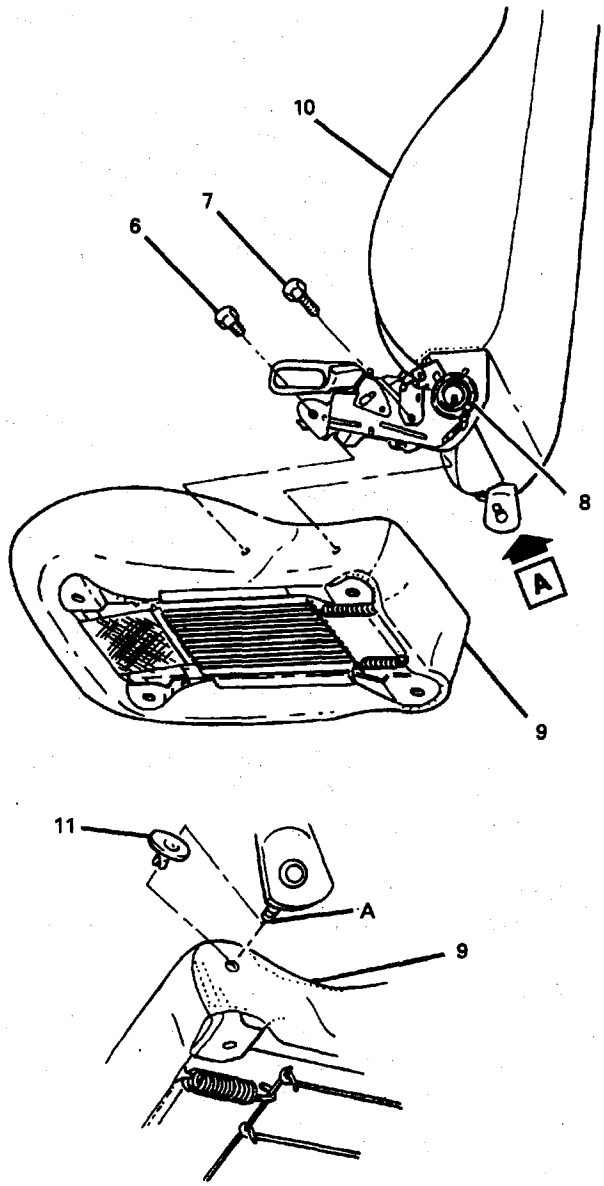
In-Vehicle

Inspect

1. Inertia seatback lock.

   CAUTION: Perform the check in an area clear of other vehicles or obstructions. The driver must be buckled into the restraint system, and a helper must be buckled into the rear seat restraint system. The helper should hold the sides of the passenger seatback near the top with arms still and body relaxed. Failure to perform these precautions may cause damage to the vehicle and possible personal injury.

   A. Drive vehicle forward between 16 and 24 km/h (10 and 15 mph).
      - When performing check on driver's seatback, driver should lean forward slightly.
      - Helper must not push forward on seatback before drive applies brakes.



A SHAFT, PIVOT
6 BOLT/SCREW, FRONT SEATBACK HINGE ARM
7 BOLT/SCREW, FRONT SEATBACK HINGE ARM
8 ARM, FRONT SEATBACK HINGE
9 CUSHION, FRONT SEAT
10 SEATBACK, FRONT
11 BUSHING, FRONT SEATBACK PIVOT

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Figure 3 – Removing Front Seatback (Typical)

B. Quickly apply brakes to stop vehicle as fast as possible without skidding tires.

C. Inertia seatback lock should lock and top of seatback should only move forward about 100 mm (4 inches).

2. If either inertia seatback lock does not lock, perform out-of-vehicle check.

Out-of-Vehicle

Figure 4

Inspect

1. Inerta seatback lock.
   A. Remove seat assembly from vehicle. Refer to "Front Seat Assembly" in this section.
   B. Place seat assembly right side up on clean surface.
   C. Raise rear of seat assembly until seatback is 6 degrees forward of vertical.
   D. Place blocks under rear of seat assembly to hold seat assembly in position.
   E. Check that seatback is located in position.
   F. Install seat assembly into vehicle if inertia seatback lock works properly. Refer to "Front Seat Assembly" in this section.
2. If inertia seatback lock does not work properly, entire recliner control must be replaced. Refer to "Front Seat Recliner Assembly" in this section

Trim Covers

Front Trim Covers

Figure 5

Remove or Disconnect

1. Bolts/screws (13 and 16) attaching covers (15 and 17) to driver seat adjuster track assemblies.
2. Covers (15 and 17) from driver seat adjuster track assemblies.

Install or Connect

NOTICE: See "Notice" on page 10-10-1 of this section.

1. Covers (15 and 17) to driver seat adjuster track assemblies.
2. Bolts/screws (13 and 16) to covers (15 and 17).

Tighten

- Bolts/screws (13 and 16) to 1.7 N•m (15 lb. in.).

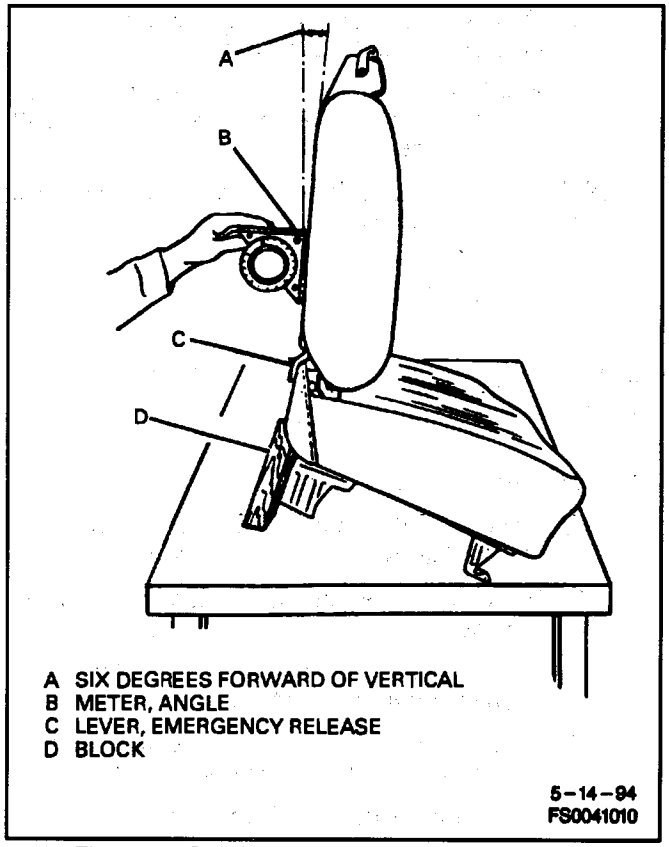


Figure 4 – Checking Inertia Seatback Lock (Typical)

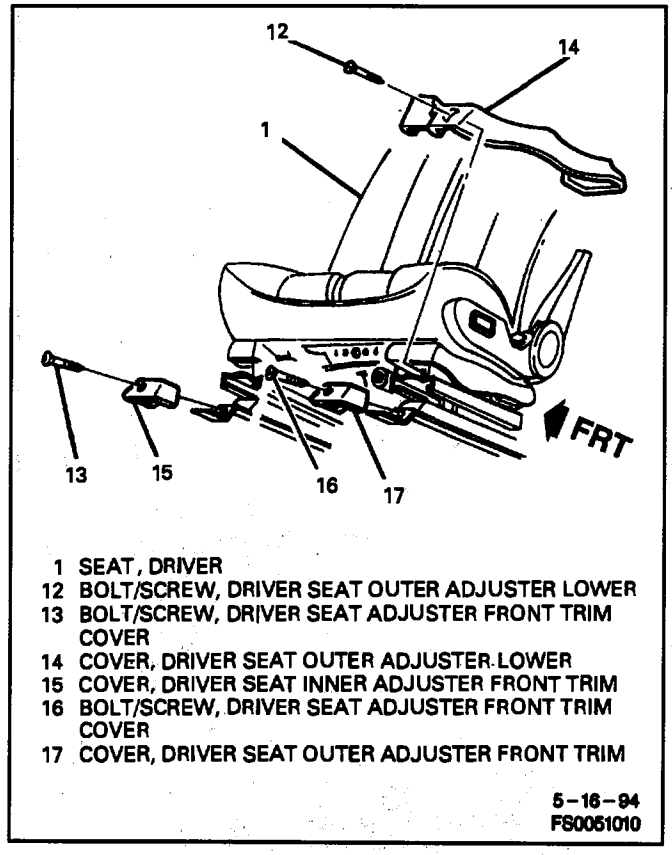


Figure 5 – Driver Seat Adjuster and Trim Covers

Outer Adjuster Lower Cover

Figure 5

Remove or Disconnect

1. Bolt/screw (12) attaching cover (14) to driver seat adjuster track assembly.
2. Cover (14) from driver seat adjuster track assembly.

Install or Connect

NOTICE: See "Notice" on page 10-10-1 of this section.

1. Cover (14) to driver seat adjuster track assembly.
2. Bolt/screw (12) to cover (14).

Tighten

- Bolts/screws (12) to 1.7 N•m (15 lb. in.).

Hinge Arm Trim Covers

Figure 6

Remove or Disconnect

1. Bolts/screws (21 and 22) attaching cover (18 or 19) to seat assembly (1 or 2).
2. Cover (18 or 19).
3. Bolts/screws (23 or 27) attaching panel (20 or 26) to seat assembly (1 or 2) (Pontiac only).
4. Panel (20 or 26) (Pontiac only).

Install or Connect

NOTICE: See "Notice" on page 10-10-1 of this section.

1. Panel (20 or 26) (Pontiac only).
2. Bolts/screws (23 or 27) attaching panel (20 or 26) to seat assembly (1 or 2) (Pontiac only).
3. Cover (18 or 19) to seat assembly (1 or 2).
4. Bolts/screws (21 and 22).

Tighten

- Bolts/screws (21) to 24 N•m (18 lb. ft.).

5. Secure bolts/screws (22, 23 and 27).

Uplevel Seat Trim

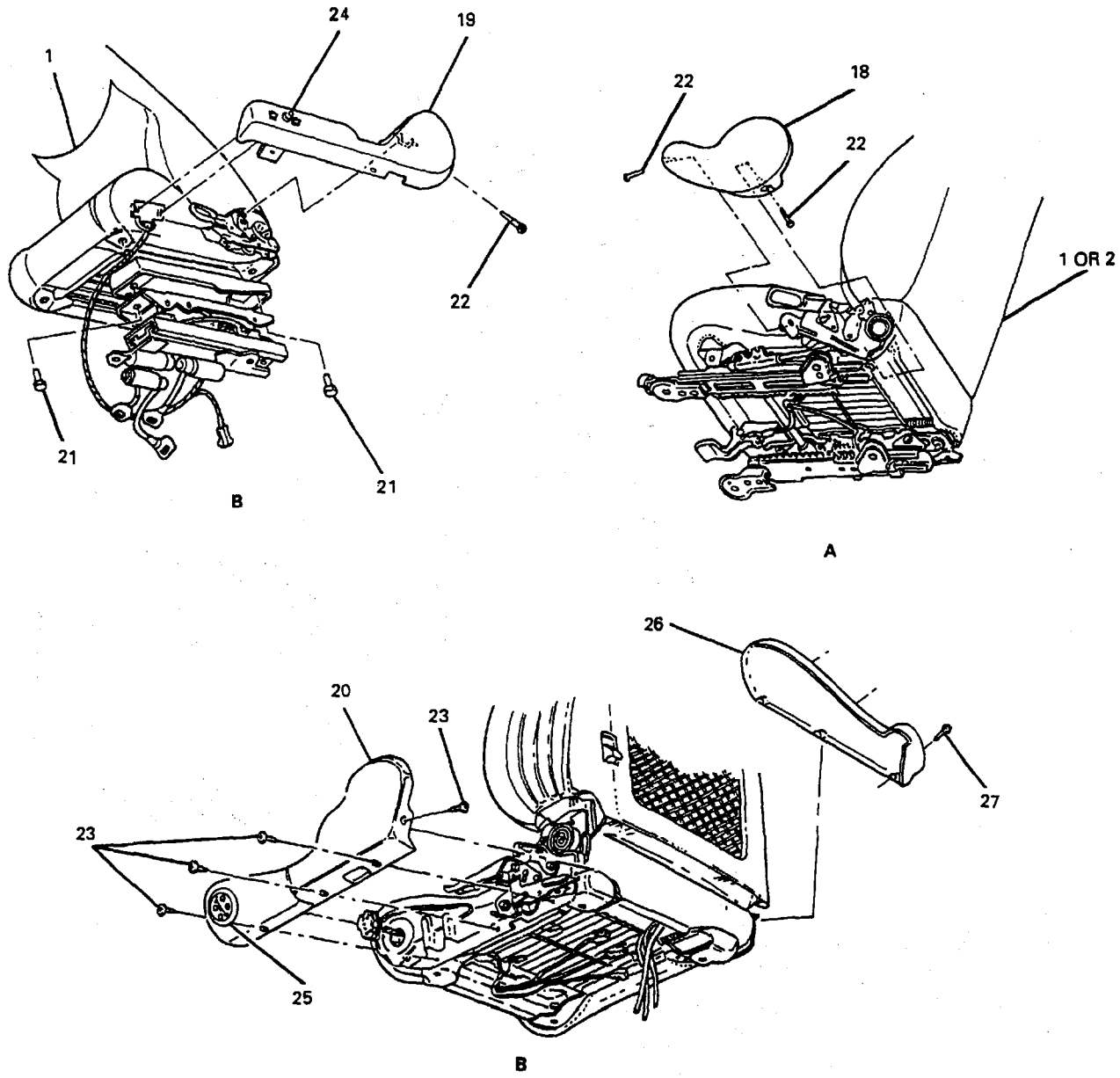
Pontiac

Figure 7

Seat Cushion Trim

Remove or Disconnect

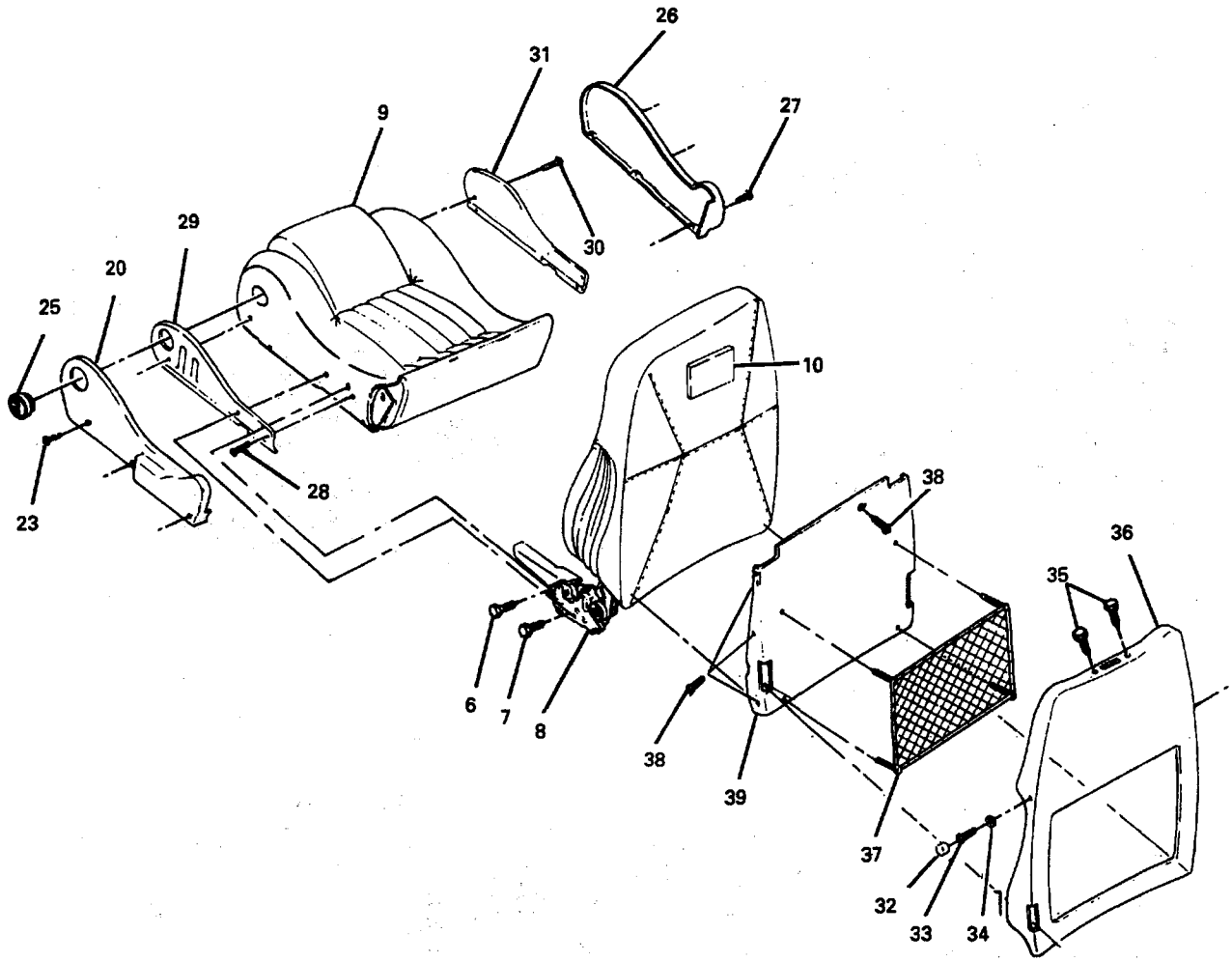
1. Cushion outer finish panel bolts/screws (23).
2. Cushion outer finish panel (20).



A DRIVER AND PASSENGER SEAT
B DRIVER SEAT ONLY (PONTIAC ONLY)
1 SEAT ASSEMBLY, DRIVER
2 SEAT ASSEMBLY, PASSENGER
18 COVER, FRONT SEATBACK FRAME HINGE ARM TRIM
19 COVER, FRONT SEATBACK FRAME HINGE ARM TRIM
20 PANEL, DRIVER SEAT CUSHION OUTER FINISH (PONTIAC ONLY)
21 BOLT/SCREW, DRIVER SEAT ADJUSTER
22 BOLT/SCREW, FRONT SEATBACK FRAME HINGE
23 BOLT/SCREW, DRIVER SEAT CUSHION OUTER FINISH PANEL (PONTIAC ONLY)
24 ADJUSTER ASSEMBLY, FRONT SEAT
25 SWITCH, DRIVER SEAT PNEUMATIC PUMP AND VALVE (PONTIAC ONLY)
26 PANEL, DRIVER SEAT CUSHION INNER FINISH (PONTIAC ONLY)
27 BOLT/SCREW, DRIVER SEAT CUSHION INNER FINISH PANEL (PONTIAC ONLY)

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Figure 6 – Hinge Arm Trim Covers (Typical)



6 BOLT/SCREW, FRONT SEATBACK HINGE ARM
7 BOLT/SCREW, FRONT SEATBACK HINGE ARM
8 ARM ASSEMBLY, FRONT SEATBACK HINGE
9 CUSHION ASSEMBLY, FRONT SEAT
10 SEATBACK, FRONT
20 PANEL, DRIVER SEAT CUSHION OUTER FINISH
23 BOLT/SCREW, DRIVER SEAT CUSHION OUTER FINISH PANEL
25 SWITCH, DRIVER SEAT PNEUMATIC PUMP AND VALVE
26 PANEL, DRIVER SEAT CUSHION INNER FINISH
27 BOLT/SCREW, DRIVER SEAT CUSHION INNER FINISH PANEL
28 BOLT/SCREW, DRIVER SEAT CUSHION FINISH PANEL OUTER SUPPORT
29 SUPPORT, DRIVER SEAT CUSHION FINISH PANEL OUTER
30 BOLT/SCREW, DRIVER SEAT CUSHION FINISH PANEL INNER SUPPORT
31 SUPPORT, DRIVER SEAT CUSHION FINISH PANEL INNER
32 CAP, DRIVER SEATBACK FINISH PANEL BOLT/SCREW
33 BOLT/SCREW, DRIVER SEATBACK FINISH PANEL
34 RETAINER, DRIVER SEAT TRIM FINISH PANEL
35 BOLT/SCREW, DRIVER SEATBACK FINISH PANEL
36 PANEL, DRIVER SEATBACK FINISH
37 NET, DRIVER SEATBACK MAP POCKET
38 BOLT/SCREW, DRIVER SEATBACK INNER TRIM PANEL
39 PANEL, DRIVER SEATBACK INNER TRIM

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Figure 7 – Uplevel Seat Trim – (Pontiac)

3. Pneumatic pump and valve switch. Refer to "Seat Pneumatic Pump and Valve Switch" under "Lumbar and Lateral Support Bladders" in this section.
4. Cushion inner finish panel bolts/screws (27).
5. Cushion inner finish panel (26).
6. Front seatback hinge arm bolts/screws (6 and 7).
7. Cushion finish panel outer support bolts/screws (28).
8. Cushion finish panel outer support (29).
9. Cushion finish panel inner support bolts/screws (30).
10. Cushion finish panel inner support (31).

Install or Connect

NOTICE: See "Notice" on page 10-10-1 of this section.

1. Cushion finish panel inner support (31).
2. Cushion finish panel inner support bolts/screws (30).
3. Secure bolts/screws (30).
4. Cushion finish panel outer support (29).
5. Cushion finish panel outer support bolts/screws (28).
   - Secure bolts/screws (28).
6. Front seatback hinge arm bolts/screws (6 and 7).

Tighten

- Bolts/screws (6 and 7) to 24 N•m (18 lb. ft.).

7. Cushion inner finish panel (26).
8. Cushion inner finish panel bolts/screws (27).
   - Secure bolts/screws (27).
9. Cushion outer finish panel (20).
10. Pneumatic pump and valve switch (25). Refer to "Seat Pneumatic Pump and Valve Switch" under "Lumbar and Lateral Support Bladders" in this section.
11. Cushion outer finish panel bolts/screws (23).
    - Secure bolts/screws (23).

Seatback Trim

Remove or Disconnect

1. Seatback finish panel bolt/screw caps (32).
2. Bolts/screws (33) and retainer (34).
3. Seatback finish panel bolts/screws (35).
4. Seatback finish panel (36).
5. Seatback map pocket net (37).
6. Seatback inner trim panel bolts/screws (38).
7. Seatback inner trim panel (39).

Install or Connect

NOTICE: See "Notice" on page 10-10-1 of this section.

1. Seatback inner trim panel (39).
2. Seatback inner trim panel bolts/screws (38).
   - Secure bolts/screws (38).
3. Seatback map pocket net (37).
4. Seatback finish panel (36).
5. Seatback finish panel bolts/screws (35).
   - Secure bolts/screws (35).
6. Bolts/screws (33) with retainers (34).
   - Secure bolts/screws (33).
7. Seatback finish panel bolt/screw caps (32).

Front Seat Cushion Assemblies

Seat Cushion Cover Assembly

Figure 8

Remove or Disconnect

1. Front seat assembly. Refer to "Front Seat Assembly" in this section.
2. J–retainers from seat cushion frame assembly.
3. Cover assembly (40).

Install or Connect

1. Cover assembly (40) over seat cushion frame assembly.
   - Cap front and rear corners of cover assembly (40) over cushion assembly (9) and regulate to desired appearance.
2. J–retainers to seat cushion frame assembly.
3. Front seat assembly. Refer to "Front Seat Assembly" in this section.

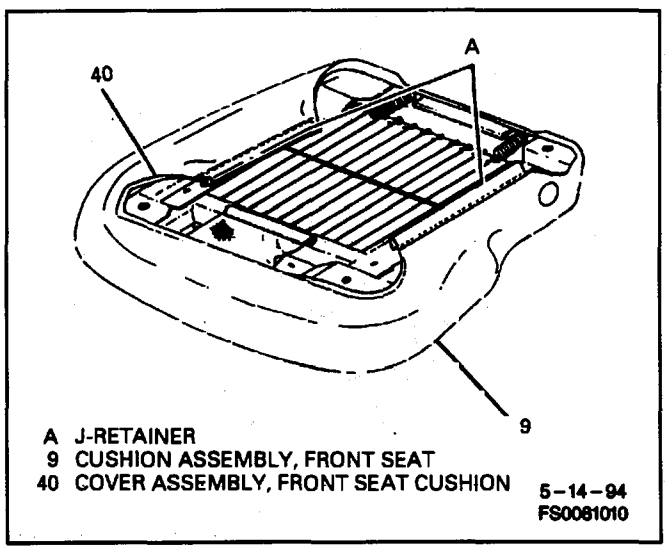


Figure 8 – Front Seat Cushion Cover Assembly

Seatback Cover Assemblies (Base Level)

Figure 9

Remove or Disconnect

1. Seatback. Refer to "Front Seatback" in this section.
2. Head restraint. Refer to "Base Level" under "Head Restraint Assembly" in this section.
3. Seatback lock release knob (42).
4. Seat shoulder belt guide and bolts/screws (Chevrolet only).
5. Cover assembly (41).

Install or Connect

1. Cover assembly (41) to seat cushion pad assembly.
2. Seat shoulder belt guide and bolts/screws (Chevrolet only).
3. Head restraint. Refer to "Base Level" under "Head Restraint Assembly" in this section.
4. Seatback lock release knob (42).
5. Seatback. Refer to "Front Seatback" in this section.

Seatback Cover Assemblies (Uplevel)

Pontiac

Figure 10

Remove or Disconnect

1. Seat trim. Refer to "Uplevel Seat Trim" under "Trim Covers" in this section.
2. Head restraint. Refer to "Uplevel" under "Head Restraint Assembly" in this section.
3. Seatback. Refer to "Front Seatback" in this section.
4. Rings (43) attaching cover assembly (41) to seat cushion pad assembly and wire assembly (44).
5. Wire assembly (44).
6. Cover assembly (41).

Install or Connect

1. Cover assembly (41) to seat cushion pad assembly.
2. Wire assembly (44) attaching cover assembly (41) to seat cushion pad assembly.
3. Rings (43).
4. Seatback. Refer to "Front Seatback" in this section.
5. Head Restraint. Refer to "Uplevel" under "Head Restraint Assembly" in this section.
6. Seat trim. Refer to "Uplevel Seat Trim" under "Trim Covers" in this section.

Lumbar and Lateral Support Bladders

Bladder Replacement

Pontiac

Figure 11

Remove or Disconnect

1. Seatback cover. Refer to "Seatback Cover Assemblies (Uplevel)" under "Front Seat Cushion Assemblies" in this section.
2. Seatback pad (45) from frame (46).
3. Seatback lumbar bladder (47) and hose.
4. Seat lateral support bladder retainer (48).

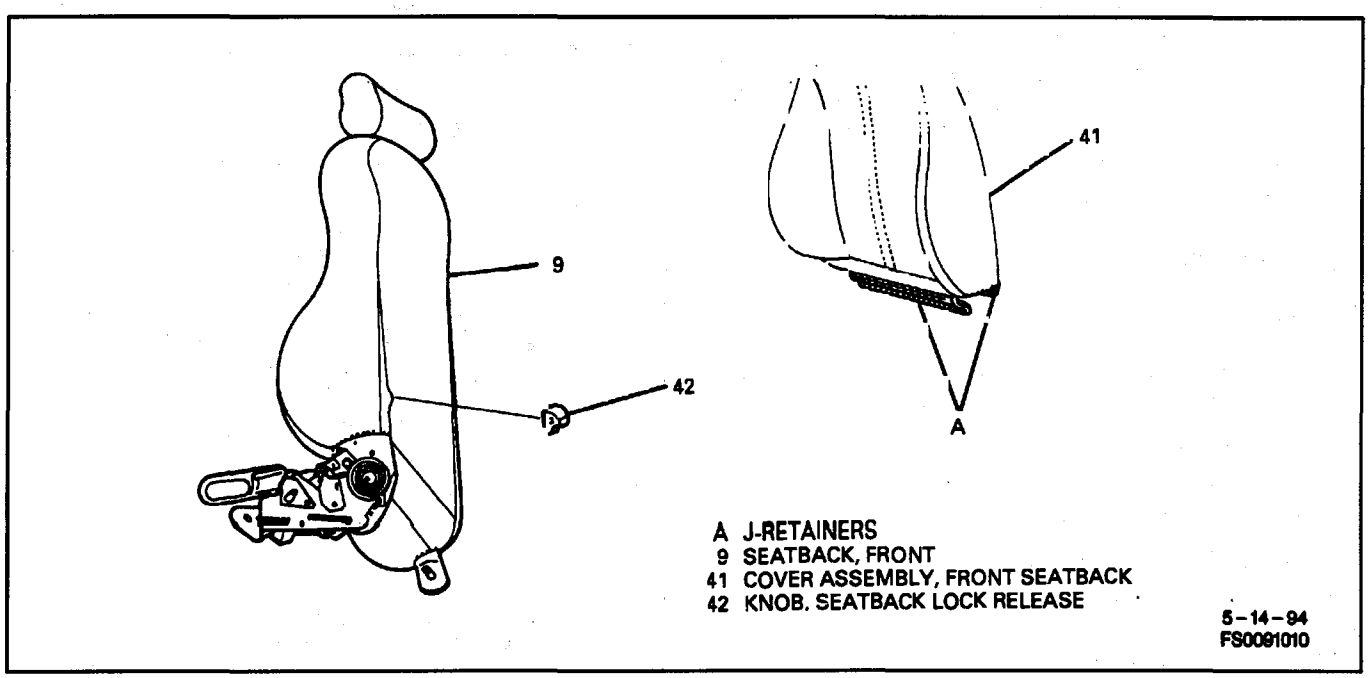


Figure 9 – Front Seatback Cover Assemblies (Base Level (Typical)

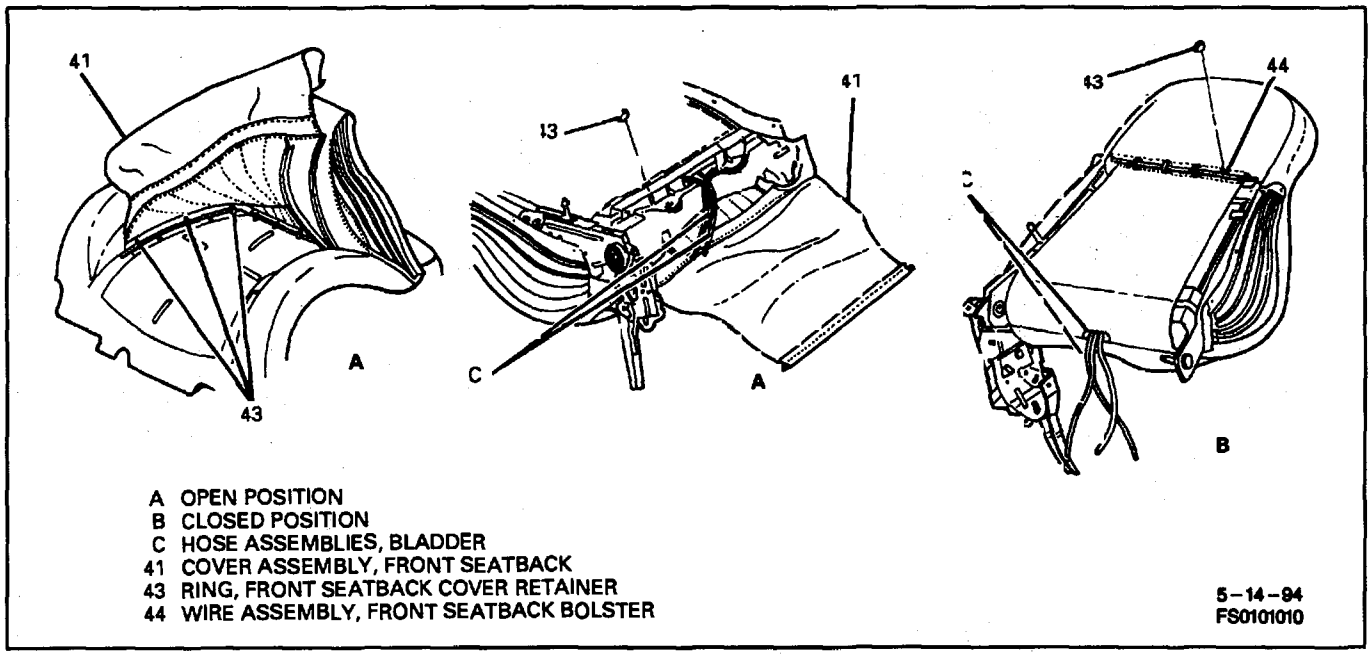


Figure 10 – Front Seatback Cover Assemblies (uplevel) – (Pontiac)

5. Seat lateral support bladders (49) and hose.

Install or Connect

1. Seat lateral support bladders (49) and hose.
2. Seat lateral support bladder retainer (48).
3. Seatback lumbar bladder (47) and hose.
4. Seatback pad (45) to frame (46).
5. Seatback cover. Refer to "Seatback Cover Assemblies (Uplevel)" under "Front Seat Cushion Assemblies" in this section.

Pump, Valve and Module

Pontiac

Figure 12

Remove or Disconnect

1. Front seat assembly. Refer to "Front Seat Assembly" in this section.
2. Adjuster. Refer to "Manual Front Seat Adjuster Assembly" in this section.
3. Air supply hoses.
4. Electrical connectors.
5. Seat pneumatic control module bolts/screws (50). Driver side only.

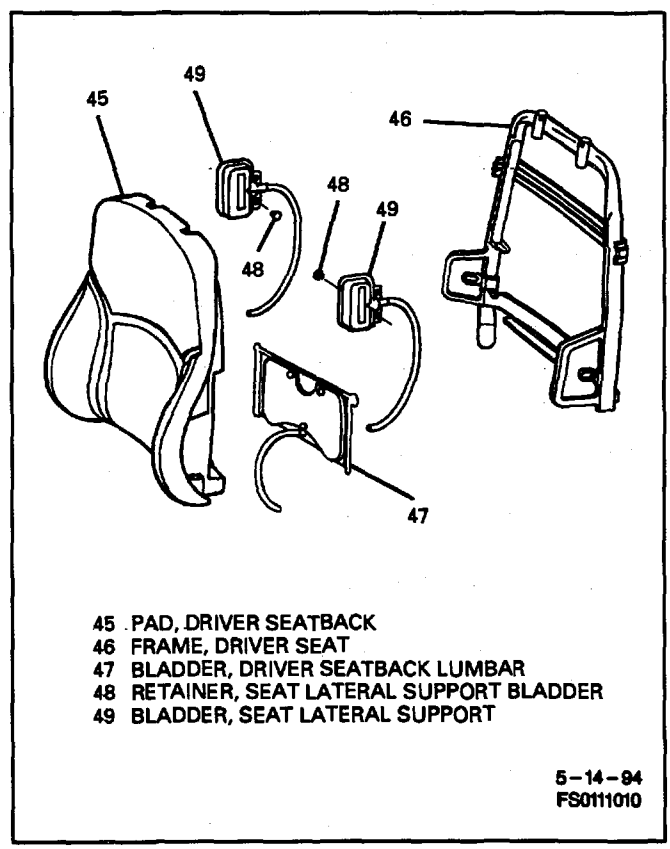


Figure 11 – Bladder Replacement - (Pontiac)

6. Seat pneumatic control module (51). Driver side only.
7. Seat inflator pump bolts/screws (52).
8. Seat inflator pump (53).

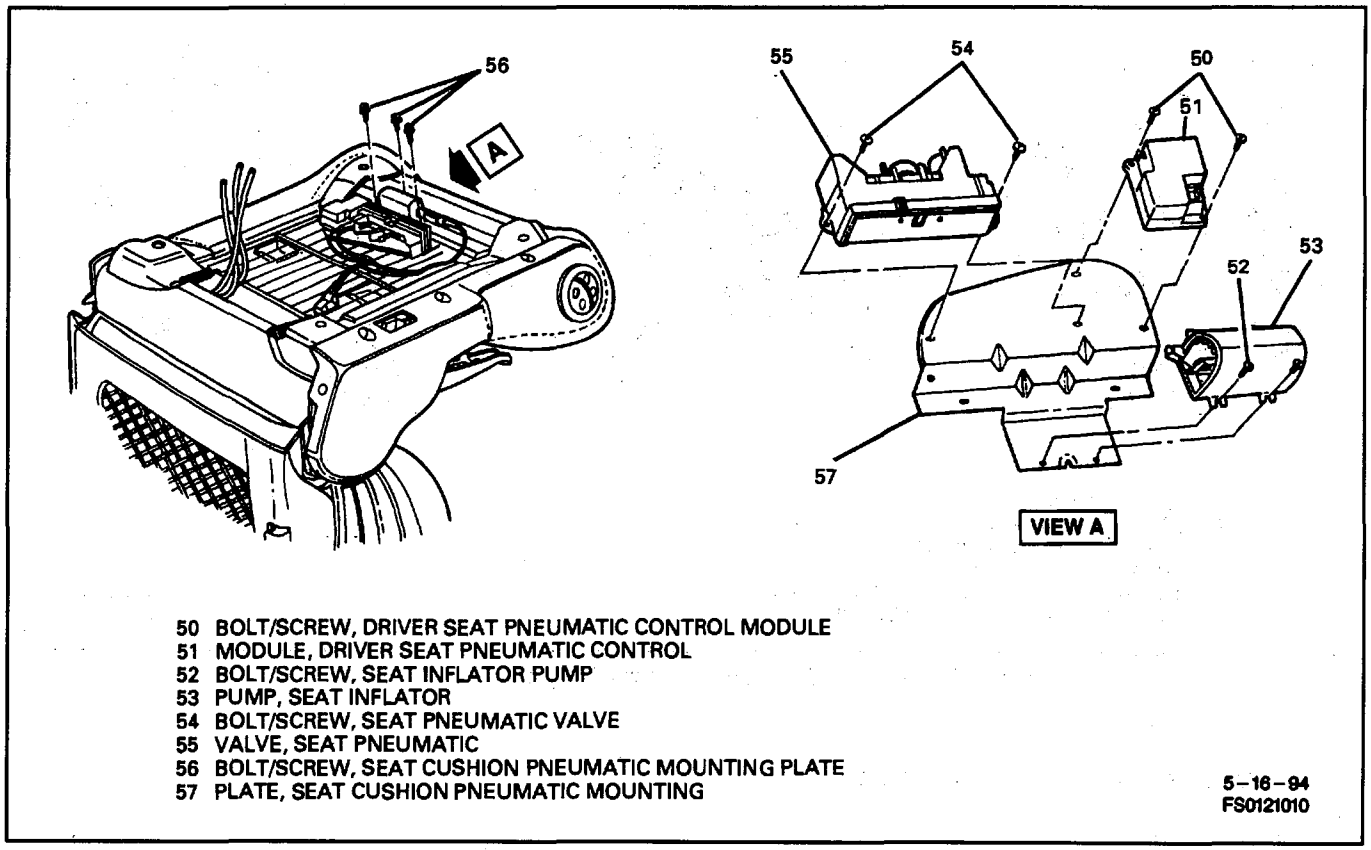


Figure 12 – Pump, Valve and Module – (Pontiac)

9. Seat pneumatic valve bolts/screws (54).
10. Seat pneumatic valve (55).
11. Seat cushion pneumatic mounting plate bolts/screws (56), if necessary.
12. Seat cushion pneumatic mounting plate (57), if necessary.

Install or Connect

NOTICE: See "Notice" on page 10-10-1 of this section.

1. Seat cushion pneumatic mounting plate (57), if necessary.
2. Seat cushion pneumatic mounting plate bolts/screws (56), if necessary.
   - Secure bolts/screws (56).
3. Seat pneumatic valve (55).
4. Seat pneumatic valve bolts/screws (54).
   - Secure bolts/screws (54).
5. Seat inflator pump (53).
6. Seat inflator pump bolts/screws (52).
   - Secure bolts/screws (52).
7. Seat pneumatic control module (51). Driver side only.
8. Seat pneumatic control module bolts/screws (50). Driver side only.
9. Electrical connectors.
10. Air supply hoses.
11. Adjuster. Refer to "Manual Front Seat Adjuster Assembly" in this section.
12. Front seat assembly. Refer to "Front Seat Assembly" in this section.

Seat Pneumatic Pump and Valve Switch

Pontiac

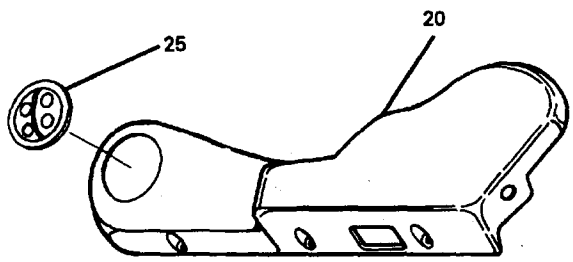
Figure 13

Remove or Disconnect

1. Cushion outer finish panel. Refer to "Hinge Arm Trim Covers" under "Trim Covers" in this section.
2. Electrical connector from switch (25).
3. Switch (25) by unsnapping from outer finish panel (20).

Install or Connect

1. Switch (25).
2. Electrical connector to switch (25).
3. Cushion outer finish panel. Refer to "Hinge Arm Trim Covers" under "Trim Covers" in this section.



20 PANEL, DRIVER SEAT CUSHION OUTER FINISH
25 SWITCH, DRIVER SEAT PNEUMATIC PUMP AND VALVE

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Figure 13 – Seat Pneumatic Pump and Valve Switch – (Pontiac)

Head Restraint Assembly

Pontiac

Base Level

Figure 14

Tool Required:

J 39641 Removal Tool

Remove or Disconnect

1. Seatback release knob.
2. Separate J–retainers at bottom of seat and pull seat cover past head restraint posts.
3. Slide J 39641 up head restraint posts with tool tabs fitting into open slots between head restraint guide tabs.
4. With headrest removal tools in place, rotate each tool so head restraint guide tabs expand outward.
5. Head restraint (58).

Install or Connect

1. Head restraint (58).
2. Pull down on seat cover firmly to enable J–retainers at the bottom of seat to lock together.
3. Seatback release knob.

Uplevel

Pontiac

Figure 14

Tool Required:

J 39641 Headrest Removal Tool

Remove or Disconnect

1. Seatback trim. Refer to "Uplevel Seat Trim" under "Trim Covers" in this section.
2. Cover retainer rings (43) and raise cover to access guides (62).
3. Head restraint post retaining rings (64) from bottom of posts.
4. Slide J 39641 up head restraint posts with tool tabs fitting into open slots between head restraint guide tabs.
5. With headrest removal tools in place, rotate each tool so head restraint guide tabs expand outward.
6. Head restraint (61).
7. Bolts/screws (60 and 63) and seat shoulder belt guide (65 and 66), if necessary.

Install or Connect

NOTICE: See "Notice" on page 10-10-1 of this section.

1. Head restrainer post retaining rings (64) to bottom of posts.
2. Head restraint (61).
3. Cover retainer rings (43).
4. Seatback trim. Refer to "Uplevel Seat Trim" under "Trim Covers in this section.
5. Seat shoulder belt guide (65 and 66) and bolts/screws (60 and 63), if necessary.
   - Secure bolts/screws (60 and 63).

Front Seat Recliner Assembly

Figures 15 and 16

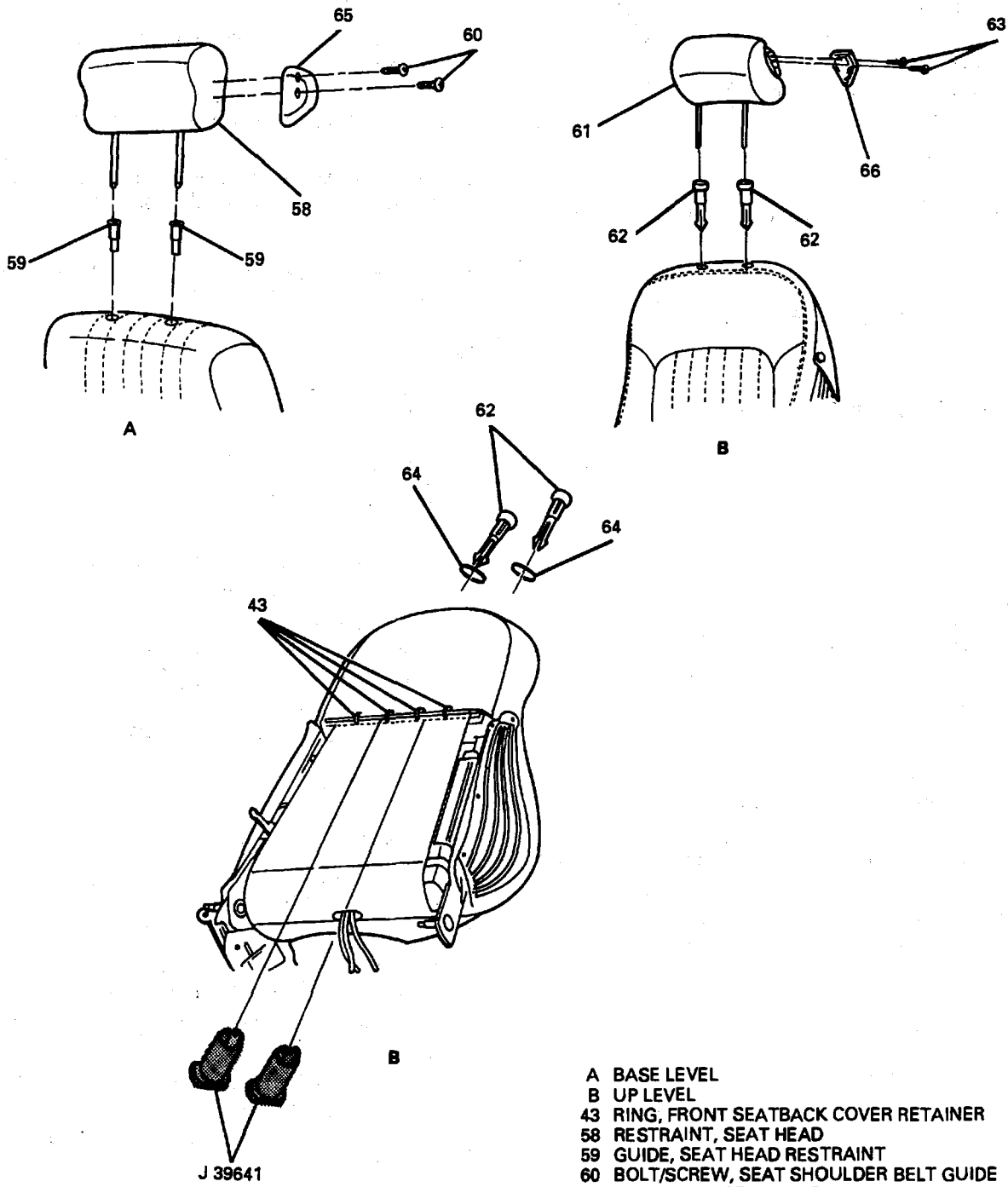
Remove or Disconnect

1. Bolts/screws (23) attaching panel (20) to front seat assembly (Pontiac only).
2. Panel (20) (Pontiac only).
3. Seat cushion trim. Refer to "Seat Cushion Trim" under "Trim Covers" in this section.
4. Pull seatback cover far enough forward to access bolts/screws (68).
5. Bolts/screws (68) attaching recliner assembly (67) to front seat assembly.
6. Front seatback. Refer to "Front Seatback: in this section.
7. Recliner assembly (67).

Install or Connect

NOTICE: See "Notice" on page 10-10-1 of this section.

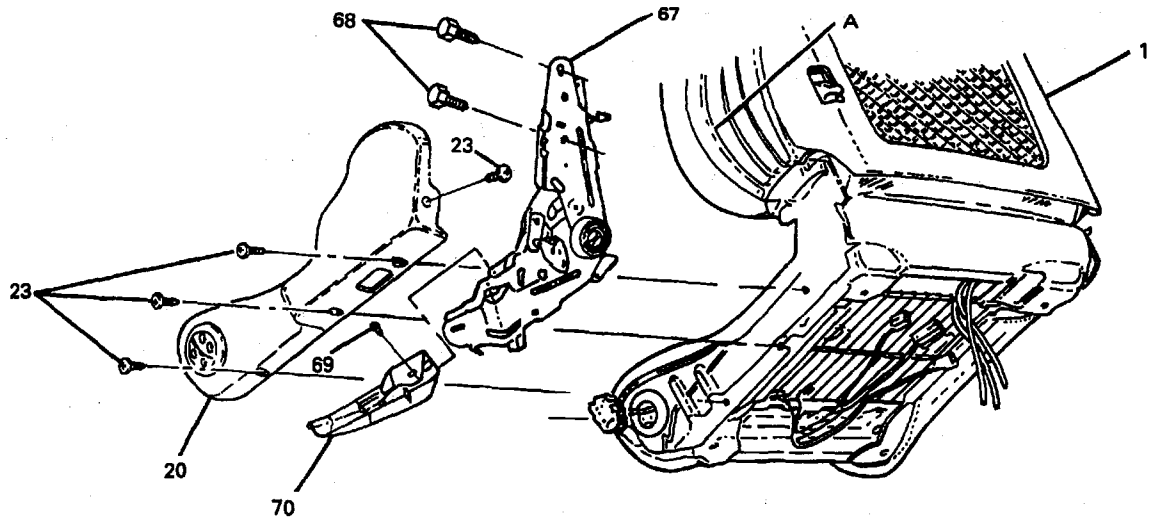
1. Recliner assembly (67) to front seat assembly.
2. Bolts/screws (68) attaching recliner assembly (67) to front seat assembly.



A BASE LEVEL
B UP LEVEL
43 RING, FRONT SEATBACK COVER RETAINER
58 RESTRAINT, SEAT HEAD
59 GUIDE, SEAT HEAD RESTRAINT
60 BOLT/SCREW, SEAT SHOULDER BELT GUIDE
61 RESTRAINT, SEAT HEAD
62 GUIDE, SEAT HEAD RESTRAINT
63 BOLT/SCREW, SEAT SHOULDER BELT GUIDE
64 RETAINING RINGS, HEAD RESTRAINT POST
65 GUIDE, SEAT SHOULDER BELT
66 GUIDE, SEAT SHOULDER BELT

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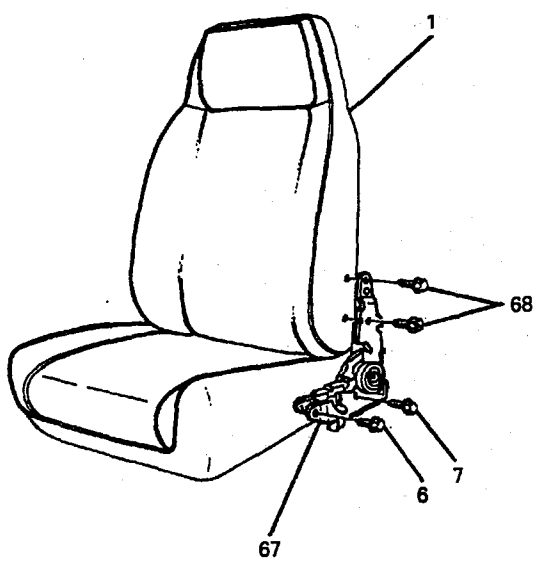
Figure 14 – Head Restraint Assemblies – (Pontiac)



A COVER ASSEMBLY, FRONT SEATBACK
1 SEAT ASSEMBLY, DRIVER
20 PANEL, DRIVER SEAT CUSHION OUTER FINISH
23 BOLT/SCREW, DRIVER SEAT CUSHION OUTER FINISH PANEL
67 RECLINER ASSEMBLY, DRIVER/PASSENGER SEAT
68 BOLT/SCREW, DRIVER/PASSENGER SEAT RECLINER,
69 FASTENER, DRIVER SEAT RECLINER HANDLE
70 HANDLE, DRIVER SEAT RECLINER

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Figure 15 – Removing Recliner Assembly (Typical) – (Pontiac)



1 SEAT ASSEMBLY, DRIVER
6 BOLT/SCREW, FRONT SEATBACK HINGE ARM
7 BOLT/SCREW, FRONT SEATBACK HINGE ARM
67 RECLINER ASSEMBLY, DRIVER SEAT
68 BOLT/SCREW, DRIVER SEAT RECLINER

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Figure 16 – Removing Recliner Assembly (Driver Seat Shown, Passenger Seat Similar) (Typical)

Tighten

- Bolts/screws (68) to 24 N•m (18 lb. ft.).

3. Front seatback. Refer to "Front Seatback" in this section.
4. Seatback cover to original position.
5. Seat cushion trim. Refer to "Seat Cushion Trim" under "Trim Covers" in this section.
6. Panel (20) over recliner assembly (67) (Pontiac only).
7. Secure bolts/screws (23) through panel (20) to front seat assembly (Pontiac only).

Recliner Assembly Control Check

Inspect

1. Recliner control
   A. Lift recliner control handle and press seatback rearward into fully-reclined position, checking ease of recliner control handle operation and seatback movement.
   B. Release recliner control handle, checking that it returns to its original position and that seatback remains fully reclined.
   C. Lift recliner control handle and pull seatback forward to an intermediate reclined position.
   D. Release recliner control handle.
   E. Press seatback rearward to check that seatback is locked and stays in position.

F. Lift recliner control handle and move seatback to normal position, checking ease of recliner control handle operation and seatback return.
G. Release recliner control handle.
H. Press seatback rearward to check that seatback is locked and stays in position.

2. If recliner control does not operate correctly, remove or replace. Refer to "Front Seat Recliner Assembly" in this section.

Manual Front Seat Adjuster Assembly

Figure 17

Remove or Disconnect

1. Front seat assembly. Refer to "Front Seat Assembly" in this section.
2. Bolts/screws (71 and 78) attaching adjuster assembly (75) to front seat assembly.
3. Adjuster assembly (75).
4. Bolts/screws (72 and 79) attaching adjuster assembly (76) to front seat assembly.
5. Adjuster assembly (76).

Install or Connect

NOTICE: See "Notice" on 10-10-1 of this section.

1. Adjuster assembly (76) to front seat assembly.
2. Bolts/screws (72 and 79).

Tighten

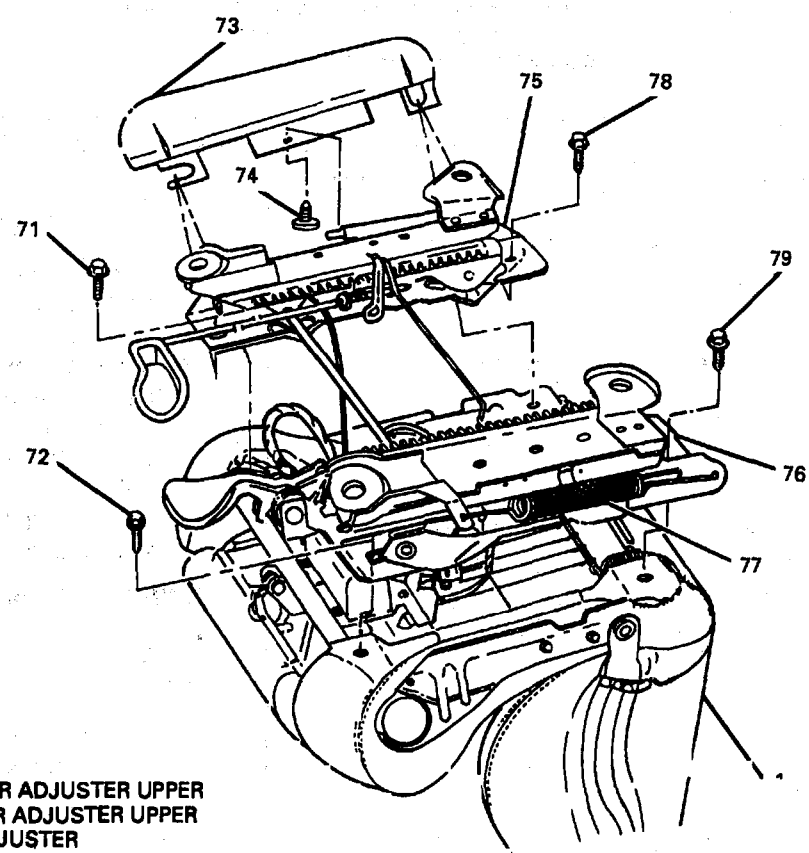
- Bolts/screws (72 and 79) to 24 N•m (18 lb. ft.).

3. Adjuster assembly (75) to front seat assembly.
4. Bolts/screws (71 and 78).

Tighten

- Bolts/screws (71 and 78) to 24 N•m (18 lb. ft.).

5. Front seat assembly. Refer to "Front Seat Assembly" in this section.



1 SEAT ASSEMBLY, DRIVER
71 BOLT/SCREW, DRIVER SEAT OUTER ADJUSTER UPPER
72 BOLT/SCREW, DRIVER SEAT INNER ADJUSTER UPPER
73 SPACER, DRIVER SEAT OUTER ADJUSTER
74 FASTENER, DRIVER SEAT OUTER ADJUSTER SPACER
75 ADJUSTER ASSEMBLY, DRIVER SEAT OUTER
76 ADJUSTER ASSEMBLY, DRIVER SEAT INNER
77 SILENCER, DRIVER SEAT ADJUSTER RETURN SPRING
78 BOLT/SCREW, DRIVER SEAT OUTER ADJUSTER LOWER
79 BOLT/SCREW, DRIVER SEAT INNER ADJUSTER LOWER

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Figure 17 – Driver Seat Adjuster Assemblies (Manual) (Typical)

Driver Seat Adjuster and Drive Motor Assemblies

Figures 18 and 19

Remove or Disconnect

1. Front seat assembly. Refer to "Front Seat Assembly" in this section.
2. Drive cables (86).
3. Nut (83) securing motor support (84) with motor assemblies (85) attached.
4. Motor support (84) with motor assemblies (85) attached.
5. Bolts/screws (80).
6. Adjuster assembly (82).
7. Adjuster cover bolts/screws, if necessary.
8. Adjuster covers, if necessary.

Disassemble

CAUTION; Failure to place the power adjuster assembly in a bench vise before removing the rear vertical actuator will cause ejection of the compressed assist spring and possible personal injury.

1. Rear adjuster nut (92).
   A. Place adjuster assembly (82) in a bench vise and remove rear adjuster assembly (82) from vise.
   B. Open vise slowly to relieve assist spring compression and remove adjuster assembly (82) from vise.
2. Vertical assist spring (88).
3. Front adjuster nut (91).
4. Bolts/screws (90) from adjuster horizontal actuator (81).
5. Adjuster horizontal actuator (81).
6. Adjuster bolts/screws (93).
7. Rear vertical actuator (89).
8. Front vertical actuator (87).

Assemble

1. Front vertical actuator (87).
2. Rear vertical actuator (89).
3. Adjuster bolts/screws (93).
4. Adjuster horizontal actuator (81).
5. Bolts/screws (90) to adjuster horizontal actuator (81).
6. Front adjuster nut (91).
7. Vertical assist spring (88).
8. Rear adjuster nut (92).
   A. Place adjuster assembly (82) into a bench vise.
   B. Carefully compress vertical assist spring (88) and install rear adjuster nut (92).
   C. Remove power adjuster assembly (45) from bench vise.

Install or Connect

NOTICE: See "Notice" on page 10-10-1 of this section.

1. Adjuster covers, if removed.
2. Adjuster cover bolts/screws, if removed.

Tighten

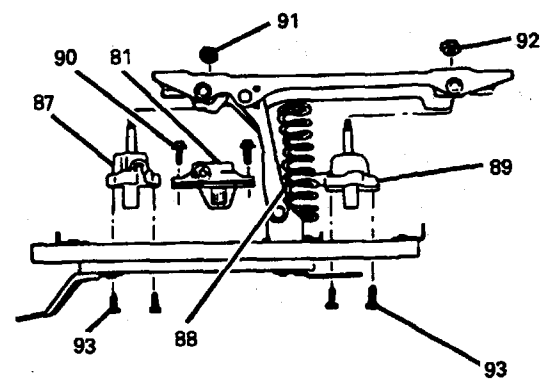
- Adjuster cover bolts/screws to 1.7 N•m (15 lb. ft.).

3. Adjuster assembly (82).
4. Bolts/screws (80).

Tighten

- Bolts/screws (80) to 24 N•m (18 lb. ft.).

5. Motor support (84) with motor assemblies (85) attached.
6. Nut (83) securing motor support (84).
7. Drive cables (86).
8. Front seat assembly. Refer to "Front Seat Assembly" in this section.



81 ACTUATOR, DRIVER SEAT ADJUSTER HORIZONTAL
87 ACTUATOR, DRIVER SEAT ADJUSTER FRONT VERTICAL
88 SPRING, DRIVER SEAT VERTICAL ASSIST
89 ACTUATOR, DRIVER SEAT ADJUSTER REAR VERTICAL
90 BOLT/SCREW, DRIVER SEAT ADJUSTER
91 NUT, DRIVER SEAT FRONT ADJUSTER
92 NUT, DRIVER SEAT REAR ADJUSTER
93 BOLT/SCREW, DRIVER SEAT ADJUSTER

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Figure 19 – Adjuster Horizontal and Vertical Actuator

Motor Assemblies Replacement

Remove or Disconnect

1. Front seat assembly. Refer to "Front Seat Assembly" in this section.
2. Drive cables (86).
3. Nuts (83).
4. Motor support (84) with motor assemblies (85) attached.
5. Electrical connectors from motor assemblies (85).
6. Motor assemblies (85) from motor support (84).
   - Grind off ends of grommet to separate motor assemblies (85) from motor support (84).

Install or Connect

NOTICE: See "Notice" on page 10-10-1 of this section.

1. Motor assemblies (85) to motor support (84).
   A. Drill out top end of grommet, using a 3/16-inch drill bit.
   B. Secure motor assemblies (85) to motor support (84) with 3/16-inch rivets.
2. Electrical connectors to motor assemblies (85).
3. Motor support (84) with motor assemblies (85) attached.
4. Nut (83).
5. Drive cables (86).
6. Front seat assembly. Refer to "Front Seat Assembly" in this section.

Passenger Seat Adjuster Assemblies

Figure 20

Remove or Disconnect

1. Seat assembly. Refer to "Front Seat Assembly" in this section.
2. Bolts/screws (96 and 98) attaching adjuster assemblies (97 and 99) and covers (94 and 95) to seat assembly (2).
3. Adjuster assemblies (97 and 99).
4. Covers (94 and 95).

Install or Connect

NOTICE: See "Notice" on page 10-10-1 of this section.

1. Covers (94 and 95).
2. Adjuster assemblies (97 and 99).
3. Bolts/screws (96 and 98).

Tighten

- Bolts/screws (96 and 98) to 24 N•m (18 lb. ft.).

4. Seat assembly. Refer to "Front Seat Assembly" in this section.

Power Front Seat Adjuster Assembly

Figure 21

Remove or Disconnect

1. Driver seat assembly. Refer to "Front Seat Assembly' in this section.
2. Hinge arm trim cover. Refer to "Hinge Arm Trim Cover" under "Trim Covers" in this section.
3. Connector (101) from adjuster assembly (24) by releasing retainers (102).

Install or Connect

1. Connector (101) to adjuster assembly (24) by reengaging retainers (102).
2. Hinge arm trim cover. Refer to "Hinge Arm Trim Cover" under "Trim Covers" in this section.
3. Driver seat assembly. Refer to "Front Seat Assembly" in this section.

Power Front Seat Adjuster Assembly Adjustments

Figure 22

With the seat adjuster assembly installed, chucking or jerking can be corrected by tightening or loosening the horizontal actuator and pinion gear to the adjuster lower track rack gear.

Adjust

NOTICE: See "Notice" on page 10-10-1 of this section.

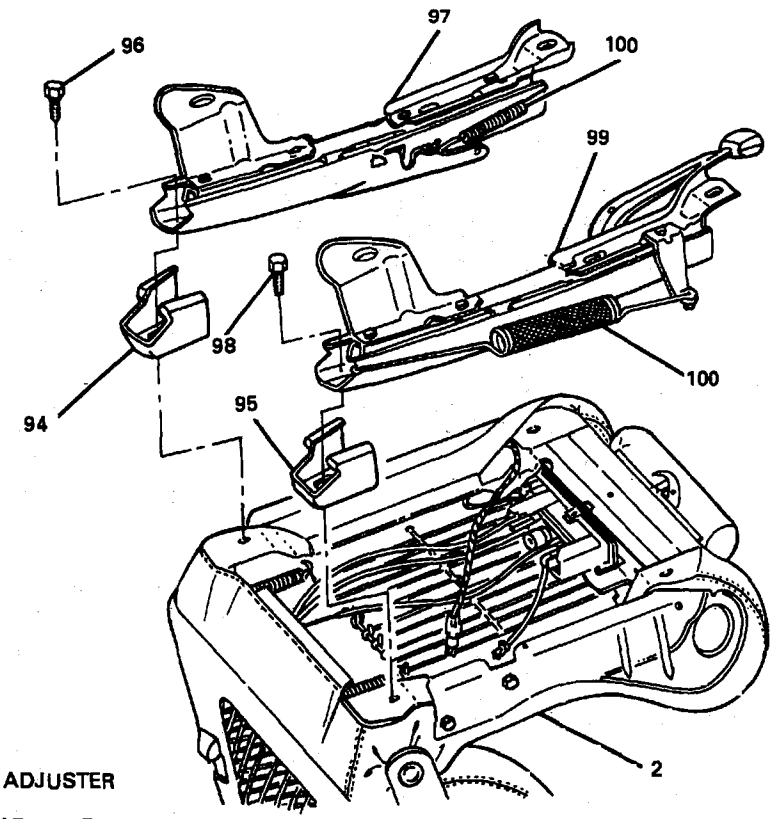
- Actuator (104).
  A. Operate seat assembly to full–up position and about 3/4-forward position.
  B. Loosen bolt/screw (103).
  C. Using large screwdriver, apply 67 to 111 N (15 to 25 pounds) of outward pressure on actuator (104). At same time, use horizontal adjuster switch to move seat forward and backward to help seat horizontal actuator pinion gear teeth tight to lower track rack gear teeth and eliminate any free play.
  D. While keeping pressure on actuator (104), tighten bolt/screw (103) to 28 N•m (20 lb. ft.).

Power Front Seat Adjuster Assembly Phase

When one adjuster assembly reaches either maximum horizontal or maximum vertical travel before the other, the adjuster assemblies are out of phase. Out-of-phase adjuster assemblies can occur over time or when the seat assemblies are serviced.

Adjust

1. Horizontal phase.
   A. Operate horizontal adjuster switch until one adjuster reaches full-forward position.



2 SEAT, PASSENGER
94 COVER, PASSENGER SEAT OUTER ADJUSTER REAR TRIM
95 COVER, PASSENGER SEAT INNER ADJUSTER REAR TRIM
96 BOLT/SCREW, PASSENGER SEAT OUTER ADJUSTER
97 ADJUSTER, PASSENGER SEAT OUTER
98 BOLT/SCREW, PASSENGER SEAT INNER ADJUSTER
99 ADJUSTER, PASSENGER SEAT INNER
100 SPRING, PASSENGER SEAT ADJUSTER RETURN

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Figure 20 – Passenger Seat Adjuster Assemblies (Typical)

B. Detach horizontal drive cable assembly from full-forward adjuster assembly.

C. Operate horizontal adjuster switch until other adjuster assembly reaches full-forward position.

D. Connect horizontal drive cable assembly.

Inspect

- Horizontal travel.

2. Vertical phase.

A. Operate vertical adjuster switch until one adjuster assembly reaches full-up position at both front and rear.

B. Disconnect both front and rear vertical drive cable assemblies from full-up adjuster assemblies.

C. Operate vertical adjuster switch until other adjuster assembly reaches full-up position at both front and rear.

D. Connect vertical drive cable assemblies.

Inspect

- Vertical travel.

Front Seat Adjuster Actuator Lever Knob

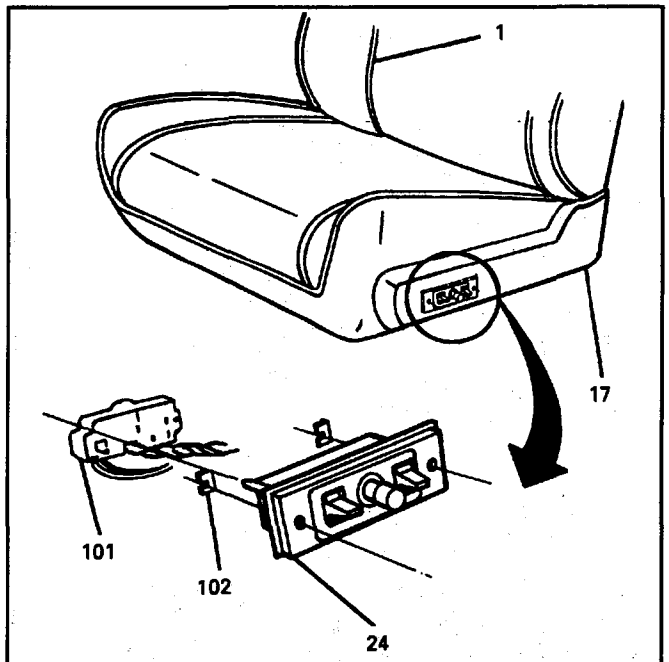
Figure 23

The adjuster actuator lever knob fits over the end of the adjuster actuator lever assembly that comes out from the lower seat cushion assembly. The knob can generally be removed and installed several times without becoming too loose.

Remove or Disconnect

- Knob (105) from adjuster actuator lever assembly.

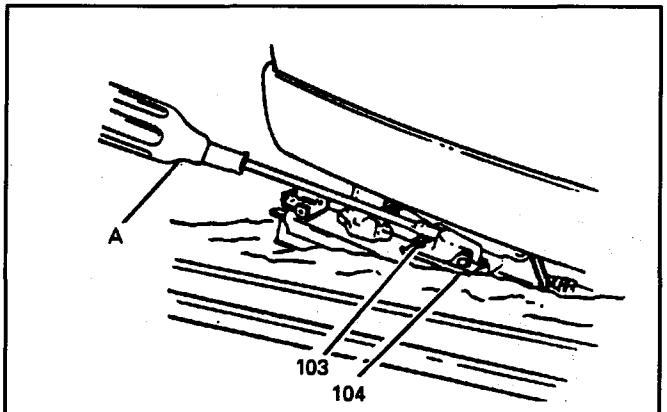
A. Place protective covering over nearby trim.



1 SEAT ASSEMBLY, DRIVER
17 COVER, FRONT SEATBACK FRAME HINGE ARM TRIM
24 ADJUSTER ASSEMBLY, FRONT SEAT
101 CONNECTOR, FRONT SEAT ADJUSTER ELECTRICAL
102 RETAINER, FRONT SEAT ADJUSTER

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Figure 21 – Front Seat Adjuster Assembly (Power)



A SCREWDRIVER
103 BOLT/SCREW, DRIVER SEAT ADJUSTER ACTUATOR
104 ACTUATOR, DRIVER SEAT ADJUSTER

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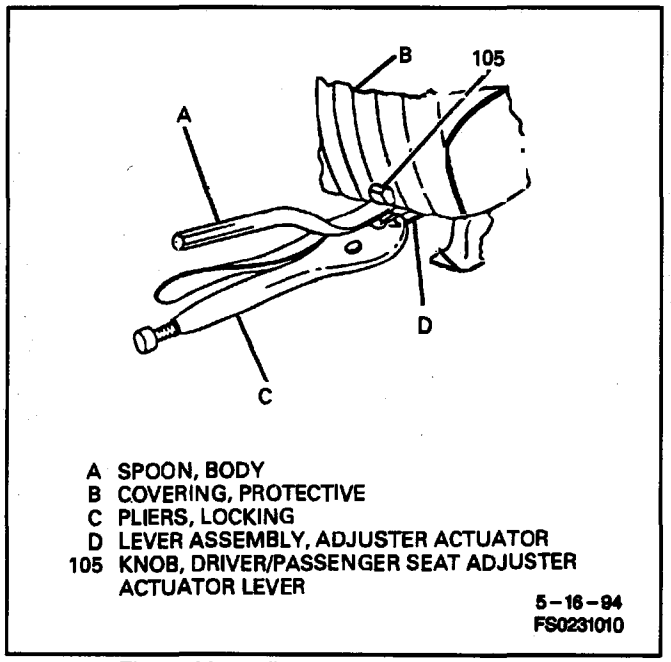
Figure 22 – Adjusting Seat Adjuster Actuator

B. Clamp locking pliers onto adjuster actuator lever assembly.

C. Using body spoon, pry downward to remove knob (105).

Install or Connect

- Knob (105) to adjuster actuator lever assembly.



A SPOON, BODY
B COVERING, PROTECTIVE
C PLIERS, LOCKING
D LEVER ASSEMBLY, ADJUSTER ACTUATOR
105 KNOB, DRIVER/PASSENGER SEAT ADJUSTER ACTUATOR LEVER

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Figure 23 – Adjuster Actuator Lever Knob

A. Place protective covering over nearby trim.

B. Draw pencil line on adjuster actuator lever assembly 25 mm (1 inch) from end as guide for full-depth fit of knob (105).

C. Secure locking pliers to adjuster actuator lever assembly and seat.

NOTICE: While installing the adjuster actuator lever knob, take care not to bend the adjuster actuator lever assembly.

D. Insert knob (105) onto adjuster actuator lever assembly.

- Gate marks on knob (105) must face to rear.

E. Press knob (105) firmly onto adjuster actuator lever assembly.

REAR SEAT ASSEMBLY

Rear Seat Cushion Assembly

Figure 24

Remove or Disconnect

1. Bolt/screw (107).
2. Seat Cushion assembly (106) by pulling upward and forward.

   NOTICE: Failure to place a protective shield over nearby trim and paint may cause damage to the vehicle.
3. Place protective shield over nearby trim and paint.
4. Seat cushion assembly (106) from vehicle.

   A. Remove seat cushion assembly (106) through rear compartment lift window, being careful not to damage rear seatback.

B. Remove protective shield.

Install or Connect

1. Place protective shield over nearby trim and paint.
2. Seat cushion assembly (106) into vehicle.

   NOTICE: See "Notice" on page 10-10-1 of this section.

   NOTICE: Failure to place a protective shield over nearby trim and paint may cause damage to the vehicle.

   A. Load seat cushion assembly (106) through rear compartment lift window, being careful not to dent rear seatback.

   B. Remove protective shield.
3. Seat cushion assembly (106) by pushing rearward.
4. Bolt/screw (107) through anchor wire loop in hole in floor pan assembly.

Tighten

- Bolt/screw (107) to 24 N•m (18 lb. ft.).

Rear Seatback Cushion Assembly

Figure 25

Remove or Disconnect

1. Rear seat cushion assembly. Refer to "Rear Seat Cushion Assembly" in this section.
2. Shoulder restraint guide. Refer to "Shoulder Restraint Guide" in this section.
3. Lock assembly (109) from striker (108).
4. Nuts (111) from rear seatback cushion studs.
5. Seat studs from outer pivot supports by lifting upward on outboard side of cushion assembly (110).

   NOTICE: Failure to place protective shield over nearby trim and paint may cause damage to vehicle.
6. Place protective shield over nearby trim and paint.
7. Cushion assembly (110) from vehicle.

   A. Remove cushion assembly (110) through rear compartment lift window, being careful not to damage front seat assemblies.

   B. Remove protective shield.

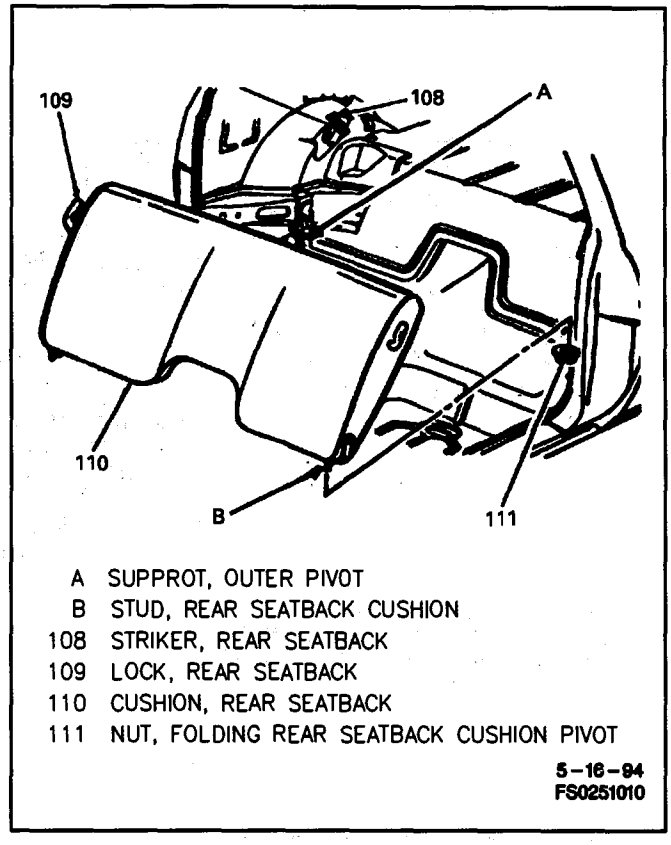
Install or Connect

NOTICE: See "Notice" on page 10-10-1 of this section.

NOTICE: Failure to place protective shield over nearby trim and paint may cause damage to vehicle.

1. Protective shield over nearby trim and paint.
2. Cushion assembly (110) into vehicle.

   - Load cushion assembly (110) through rear compartment window.



A SUPPROT, OUTER PIVOT
B STUD, REAR SEATBACK CUSHION
108 STRIKER, REAR SEATBACK
109 LOCK, REAR SEATBACK
110 CUSHION, REAR SEATBACK
111 NUT, FOLDING REAR SEATBACK CUSHION PIVOT

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Figure 25 – Rear Seatback Cushion Assembly

3. Remove protective shield.
4. Seat studs into outer pivot supports.
5. Nuts (111) to seat studs loosely.
6. Lock assembly (109) to striker (108).

Tighten

- Nuts (111) to 24 N•m (18 lb. ft.).

7. Rear seat cushion assembly. Refer to "Rear Seat Cushion Assembly" in this section.
8. Shoulder restraint guide. Refer to "Shoulder Restraint Guide" in the following procedure.

Shoulder Restraint Guide

Figures 26 and 27

Remove or Disconnect

1. Bolts/screws (113 or 128) attaching guide (112 or 127) to rear seatback cushion assembly.
2. Guide (112 or 127).

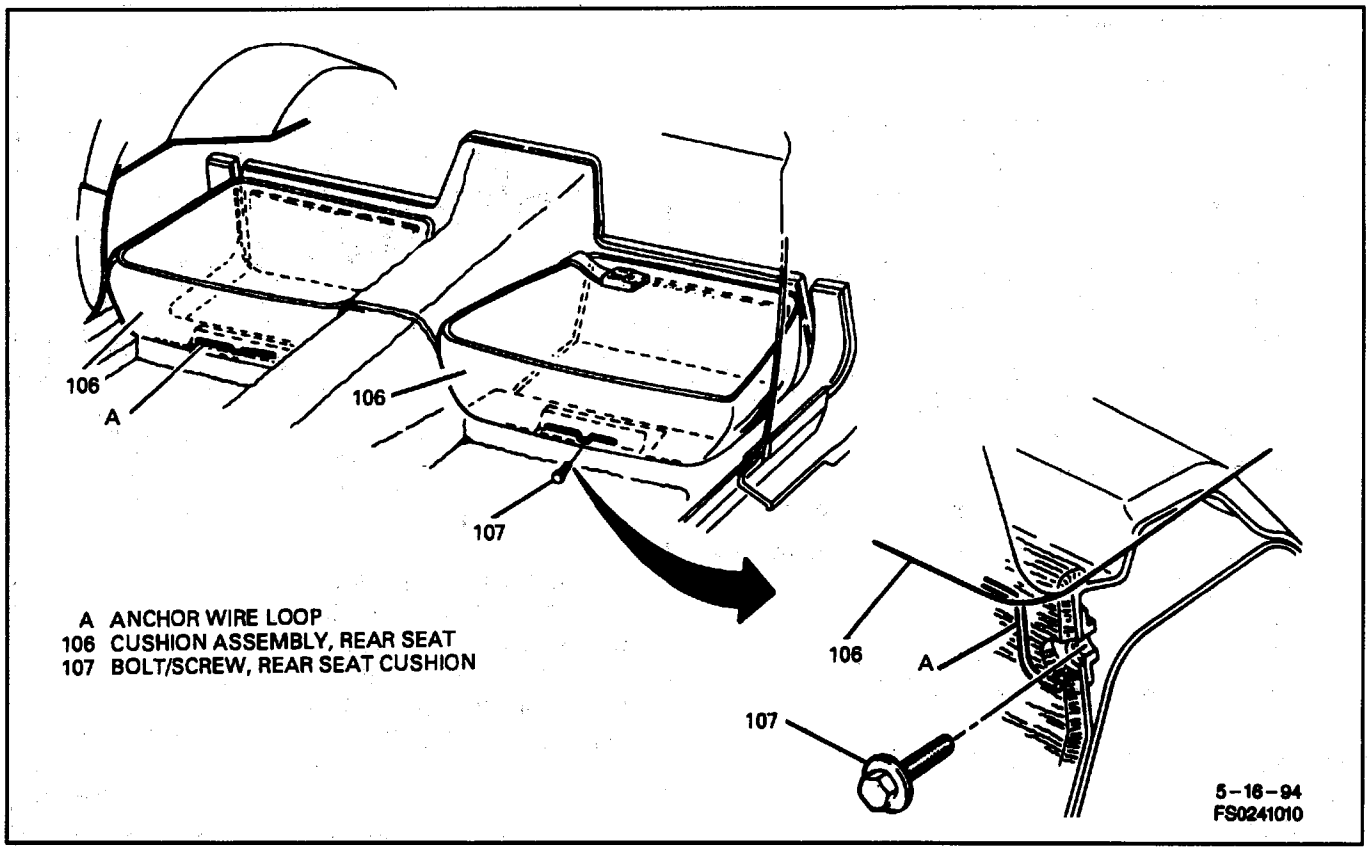
Install or Connect

NOTICE: See "Notice" on page 10-10-1 of this section.

1. Guide (112 or 127) to rear seatback cushion assembly.
2. Bolts/screws (113) or (128).

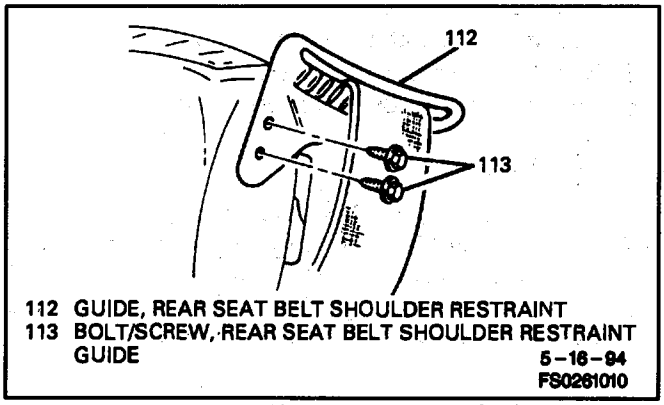
Tighten

- Bolts/screws (113 or 128) to 10 N•m (89 lb. in.).



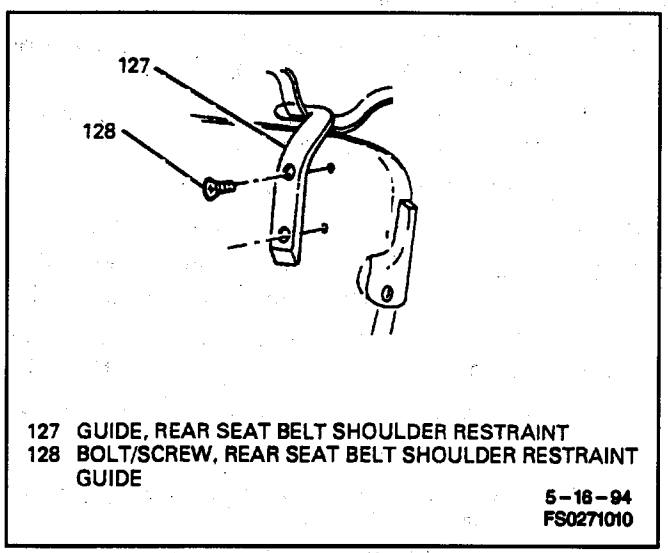
A ANCHOR WIRE LOOP
106 CUSHION ASSEMBLY, REAR SEAT
107 BOLT/SCREW, REAR SEAT CUSHION

Figure 24 – Rear Seat Cushion Assembly



112 GUIDE, REAR SEAT BELT SHOULDER RESTRAINT
113 BOLT/SCREW, REAR SEAT BELT SHOULDER RESTRAINT GUIDE

Figure 26 – Shoulder Restraing Guide



127 GUIDE, REAR SEAT BELT SHOULDER RESTRAINT
128 BOLT/SCREW, REAR SEAT BELT SHOULDER RESTRAINT GUIDE

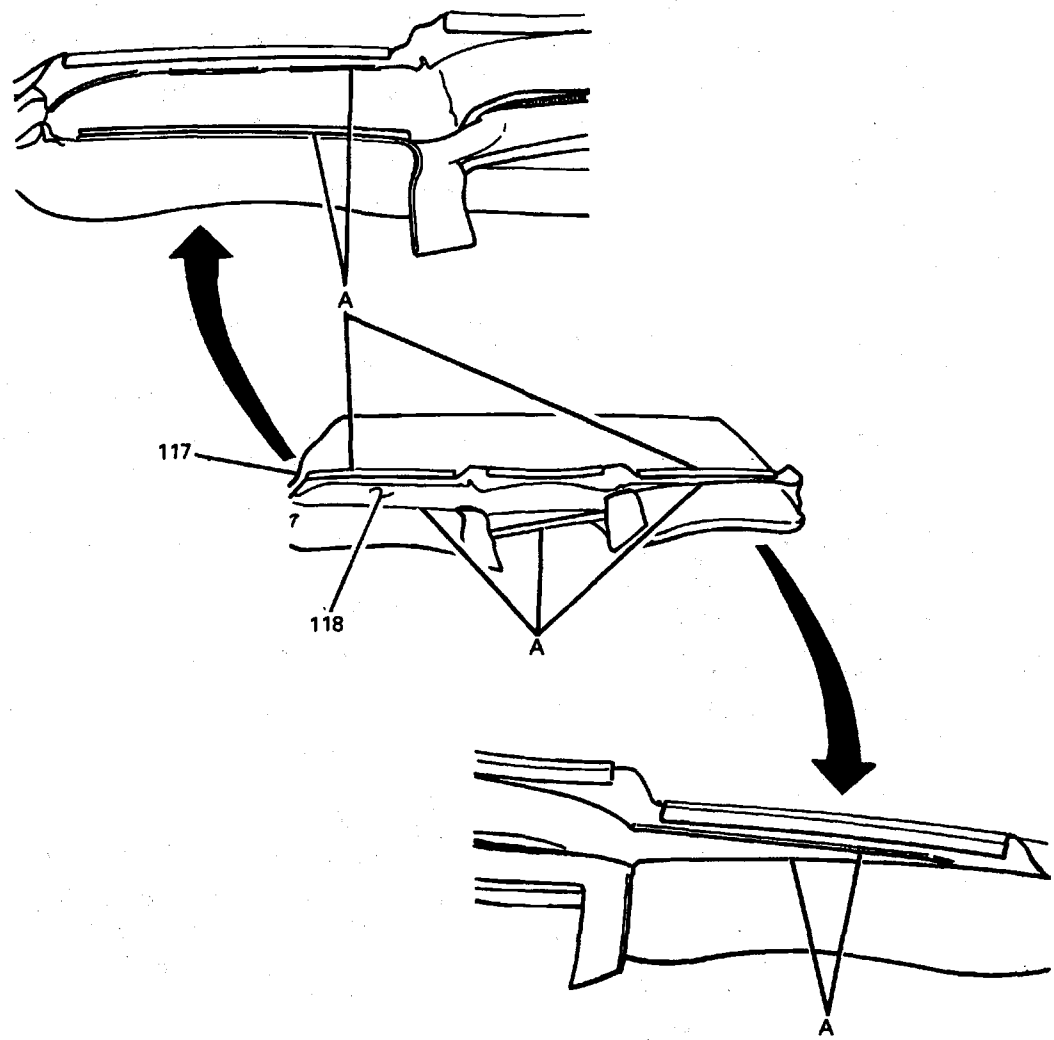
Figure 27 – Shoulder Restraint Guide (Convertible Only)

Rear Trim and Covers

The rear seat cushion and seatback cushion assemblies have formed foam pads that fit the contour of the seat frames. The seat covers are either cloth or leather. They are held on to the seat assembly with trim retainer rings, bolster wires and zippers. A shoulder restraint guide is attached to the outboard sides of the seat assemblies with with bolts and screws.

Rear Seat Cushion Cover

The rear seat cushion cover and foam pad are bonded together with an adhesive glue. If the seat cushion cover needs to be replaced, the entire rear seat cushion assembly must be replaced.



A J-RETAINERS
117 COVER, REAR SEATBACK
118 PAD, REAR SEATBACK

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Figure 28 – Rear Seatback Cover Bottom Attachment

Rear Seatback Cover

Figures 28 and 29

Remove or Disconnect

1. Rear seatback from vehicle. Refer to "Rear Seatback Cushion Assembly" in this section.
2. Seatback lock assemblies. Refer to "Seatback Lock Assembly and Striker" in this section.
3. Shoulder Restraint guide. Refer to "Shoulder Restraint Guide" in this section.
4. Rear seatback cover (117).

Install or Connect

1. Rear seatback cover (117).
2. Shoulder restraint guide. Refer to "Shoulder Restraint Guide" in this section.
3. Seatback lock assemblies. Refer to "Seatback Lock Assembly and Striker" in this section.
4. Rear seatback to the vehicle. Refer to "Rear Seatback Cushion Assembly" in this section.

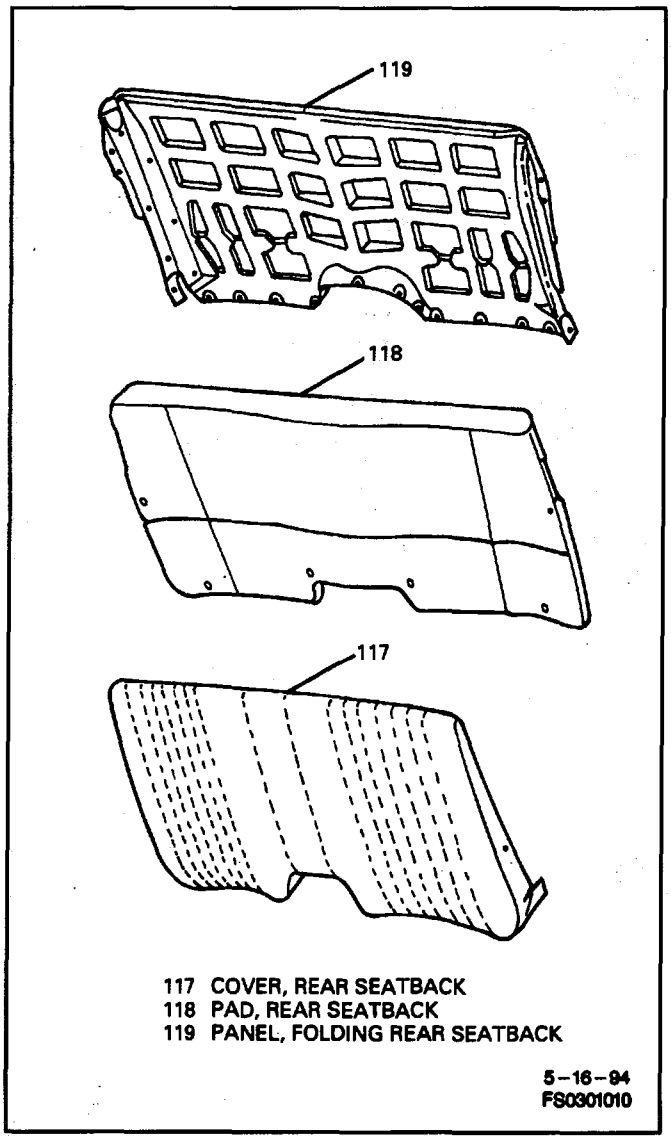


Figure 29 – Rear Seatback Cover

Seatback Lock Assembly and Striker

The rear seat assembly folds down to provide additional storage space in the rear of the vehicle. The seatback lock assemblies are located on the outboard sides of the seat assembly. The strikers are located on the wheelhouse panel assemblies.

Seatback Lock Assembly

Figure 30

Remove or Disconnect

1. Rear seat cushion assembly. Refer to "Rear Seat Cushion Assembly" in this section.
2. Rear seatback cushion assembly. Refer to "Rear Seatback Cushion Assembly" in this section.
3. Bolt/screw (121).
4. Lock assembly (120) and washer (122).

Install or Connect

NOTICE: See "Notice" on page 10-10-1 of this section.

1. Washer (122) and lock assembly (120).
2. Bolt/screw (121).

Tighten

- Bolt/screw (121) to 27 N•m (20 lb. ft.).

3. Rear seatback cushion assembly. Refer to "Rear Seatback Cushion Assembly" in this section.
4. Rear seat cushion assembly. Refer to "Rear Seat Cushion Assembly" in this section.

Rear Seatback Lock Striker

Figure 31

Remove or Disconnect

- Bolt/screw (125), sleeve (124) and washer (123).

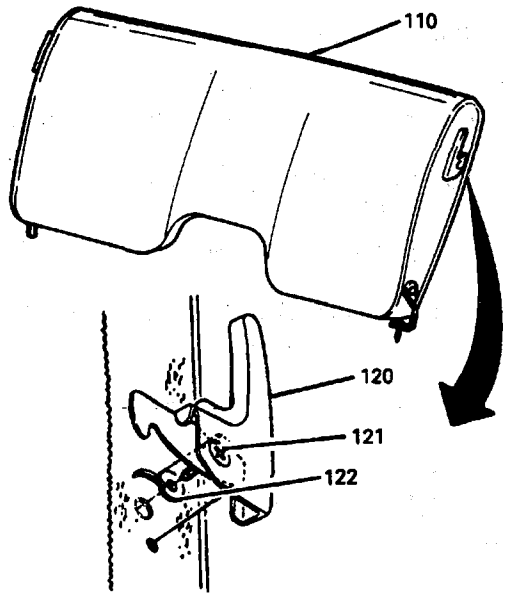
Install or Connect

NOTICE: See "Notice" on page 10-10-1 of this section.

1. Washer (123) and sleeve (124) over bolt/screw (125).
2. Bolt/screw (125).

Tighten

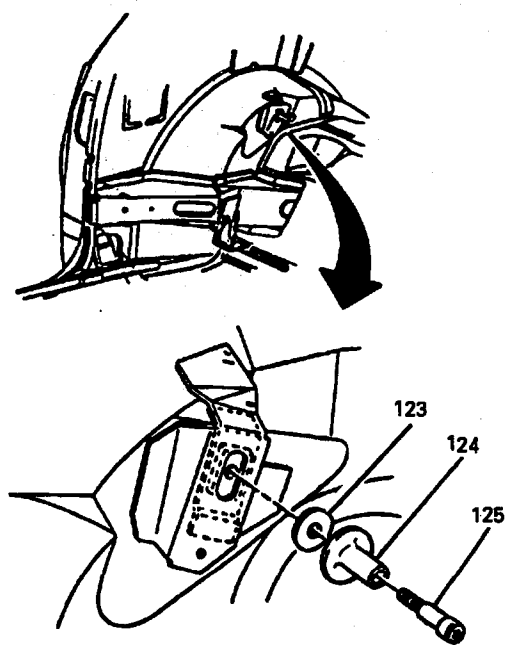
- Bolt/screw (125) to 35 N•m (26 lb. ft.).



110 CUSHION ASSEMBLY, REAR SEATBACK
120 LOCK ASSEMBLY, REAR SEATBACK
121 BOLT/SCREW, REAR SEATBACK LOCK
122 WASHER, REAR SEATBACK LOCK

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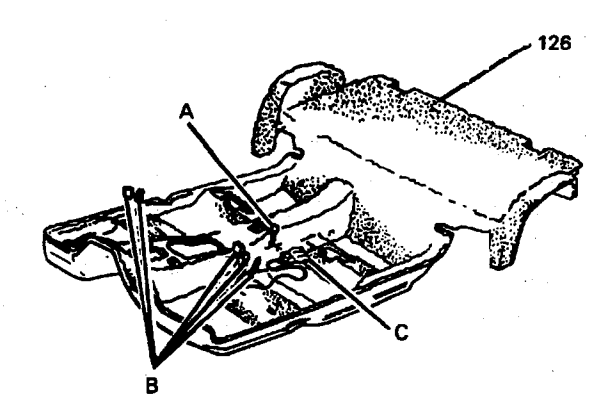
Figure 30 – Rear Seatback Lock Assembly



123 WASHER, FOLDING SEATBACK LOCK STRIKER
124 SLEEVE, FOLDING REAR SEATBACK CUSHION LOCK STRIKER
125 BOLT/SCREW, FOLDING REAR SEATBACK CUSHION LOCK STRIKER

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Figure 31 – Folding Rear Seatback Lock Assembly



A CONNECTOR, SEAT BELT ALARM ELECTRICAL
B CONNECTOR, DRIVER/PASSENGER SEAT WIRING ELECTRICAL
C CONNECTOR, POWER SEAT ADJUSTER ELECTRICAL
126 CARPET ASSEMBLY, FLOOR

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Figure 32 – Floor Carpet Assembly (Typical)

FLOOR CARPET ASSEMBLY

Figure 32

Floor carpet assemblies have been designed for the high floor pan temperatures caused by the catalytic converter in the exhaust system. When servicing a vehicle in the field, it is essential that any floor pan carpet assemblies that have been disturbed or removed be reinstalled in the original sequence and location.

CAUTION: Any carpet service repair or replacement should be the same thickness, size and location as the original installation in the vehicle or vehicle damage and personal injury could result.

When servicing or replacing interior carpets, the following instructions must be observed.

- Carpets must be installed in the original position and sequence. Pieces should be butted together to avoid gapping or overlapping.
- If it is necessary to replace a carpet, specified material must be used.
- Use original part to determine the amount of replacement material and as a template for cutting and fitting new piece to floor pan assembly.
- When installing a carpet, do not enlarge cutouts or holes used for attachment of interior components such as seat assemblies or seat belt assemblies.
- Spray-on deadeners and trim adhesives should not be applied to the top of the floor pan assembly at the area directly over the Three Way + Oxidation catalytic converter or muffler assembly.

Remove or Disconnect

1. Front seat assembly. Refer to "Front Seat Assembly" in this section.
2. Rear seat assembly. Refer to "Rear Seat Assembly" in this section.
3. Front seat belt assemblies. Refer to SECTION 10-11.
4. Rear seatbelt assemblies. Refer to SECTION 10-11.
5. Body hinge pillar trim panels. Refer to SECTION 10-5.
6. Quarter trim finish panel assembly. Refer to SECTION 10-7.
7. Front floor console assembly. Refer to SECTION 8C.
8. Floor carpet assembly (126).

Install or Connect

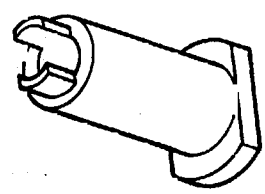
1. Floor carpet assembly (126).
2. Front floor console assembly. Refer to SECTION 8C.
3. Quarter trim finish panel assembly. Refer to SECTION 10-7.
4. Body hinge pillar trim panels. Refer to SECTION 10-5.
5. Rear seat belt assemblies. Refer to SECTION 10-11.
6. Front seat belt assemblies. Refer to SECTION 10-11.
7. Rear seat assembly. Refer to "Rear Seat Assembly" in this section.
8. Front seat assembly. Refer to "Front Seat Assembly" in this section.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Driver Seat Adjuster Bolt/Screw	24 N•m (18 lb. ft.)
Driver Seat Adjuster Front Trim Cover Bolt/Screw (Left)	1.7 N•m (15 lb. in.)
Driver Seat Adjuster Front Trim Cover Bolt/Screw (Right)	1.7 N•m (15 lb. in.)
Driver Seat Inner Adjuster Lower Bolt/Screw	24 N•m (18 lb. in.)
Driver Seat Inner Adjuster Upper Bolt/Screw	24 N•m (18 lb. ft.)
Driver Seat Outer Adjuster Lower Bolt/Screw	24 N•m (18 lb. ft.)
Driver Seat Outer Adjuster Lower Bolt/Screw (Trim Cover)	1.7 N•m (15 lb. in.)
Driver Seat Outer Adjuster Upper Bolt/Screw	24 N•m (18 lb. ft.)
Driver/Passenger Seat Adjuster Actuator Bolt/Screw	28 N•m (20 lb. ft.)
Driver/Passenger Seat Adjuster Nut	24 N•m (18 lb. ft.)
Driver/Passenger Seat Recliner Bolt/Screw	24 N•m (18 lb. ft.)
Folding Rear Seatback Cushion Lock Striker Bolt/Screw	35 N•m (26 lb. ft.)
Folding Rear Seatback Cushion Pivot Nut	24 N•m (18 lb. ft.)
Front Seatback Hinge Arm Bolt/Screw (Front)	24 N•m (18 lb. ft.)
Front Seatback Hinge Arm Bolt/Screw (Rear)	24 N•m (18 lb. ft.)
Passenger Seat Inner Adjuster Bolt/Screw	24 N•m (18 lb. ft.)
Passenger Seat Outer Adjuster Bolt/Screw	24 N•m (18 lb. ft.)
Rear Seatback Lock Bolt/Screw	27 N•m (20 lb. ft.)
Rear Seat Belt Shoulder Restraint Guide Bolt/Screw	10 N•m (89 lb. in.)
Rear Seat Cushion Bolt/Screw	24 N•m (18 lb. ft.)

SPECIAL TOOLS



1. HEADREST REMOVAL TOOL

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SECTION 10-11

SEAT BELTS

CAUTION: Replace belts, retractors, and hardware in use during all but a minor collision. Also, restraint systems should be replaced and anchorages properly repaired if they were in areas damaged by a collision, whether the belt was in use or not. If there is any question, replace the belt system. Damage, whether visible or not, could result in serious personal injury in the event of an accident.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

FRONT SEAT BELT ASSEMBLIES

The front seat belt system includes front seat retractor-side belt assemblies. The front seat belt assemblies are attached to the floor. The shoulder retractors are attached near the rear window panel assembly.

Special care must be taken when servicing the front seat belt assemblies. Front seat belt assemblies must be serviced as complete sets. The driver and passenger retractor-side belt assemblies may be serviced individually. Do not attempt to make repairs to these units. The entire seat belt assembly must be replaced with a new service replacement part.

The driver's seat belt assembly includes a reminder lamp and tone alarm to warn the driver that the driver seat belt assembly is not buckled when the ignition switch is turned "ON." If the driver's seat belt assembly is buckled, the tone alarm and the reminder lamp will not operate.

If the driver's seat belt assembly is not buckled, the tone alarm will operate for 4 to 8 seconds; the reminder lamp will remain on until the driver's seat belt assembly is buckled. To diagnose a system failure for the seat belt and ignition key and lamps and turn signal alarm assembly (tone alarm) or the seat belt indicator assembly (reminder lamp) refer to SECTION 8A.

REAR SEAT BELT ASSEMBLIES

The rear seat belt system includes rear seat retractor-side belt assemblies. Special care must be taken when servicing the rear seat belt assemblies. Rear seat belt assemblies must be serviced as complete sets. The rear seat retractor-side belt assemblies may be serviced individually. Do not attempt to make repairs to these units. The entire seat belt assembly must be replaced with a new service replacement part.

ON-VEHICLE SERVICE

OPERATIONAL AND FUNCTIONAL CHECKS

1. Grasp seat belt floor attachments and manually check that attachments are secure.
2. Visually check that shoulder belt buckles face inboard and are accessible.
3. Grasp retractor units and manually check that attachments are secure.
4. Fully extend shoulder belt and visually check that no twists are in it.
5. Allow shoulder belt to retract.
6. Grasp shoulder belt latch and extend completely, checking that it extends easily.
7. Snap shoulder belt latch into buckle.

8. Tug sharply on buckle, checking that it remains locked.
9. Push button on buckle. Latch must release from buckle easily and button return to its original position.

Service Precautions

NOTICE: See "Notice" on page 10-11-1 of this section.

- Keep sharp edges and damaging objects away from seat belt assemblies.
- Avoid bending or damaging any part of the belt buckle or latch plate.
- Do not bleach or dye seat belt webbing. Clean only with a mild soap solution and water.
- Use correct seat belt anchor bolts/screws and tighten to the correct torque value.

FRONT SEAT BELT ASSEMBLIES

Front Driver and Passenger Seat Buckle-Side Belt Assemblies

Figure 1

Driver seat buckle-side belt assembly is shown, passenger seat buckle-side belt assembly is similar.

Remove or Disconnect

1. Front seat cushion assembly, if necessary. Refer to SECTION 10-10.
2. Driver side seat belt warning electrical connector.
3. Plug (2) from bolt/screw (3).
4. Bolt/screw (3) attaching belt assembly (1) to floor pan assembly.
5. Belt assembly (1).

Install or Connect

NOTICE: See "Notice" on page 10-11-1 of this section.

1. Belt assembly (1).
2. Bolt/screw (3) attaching belt assembly (1) to floor pan assembly.

Tighten

- Bolt/screw (3) to 42 N•m (31 lb. ft.).

3. Plug (2) to bolt/screw (3).
4. Driver side seat belt warning electrical connector.
5. Front seat cushion assembly. Refer to SECTION 10-10.

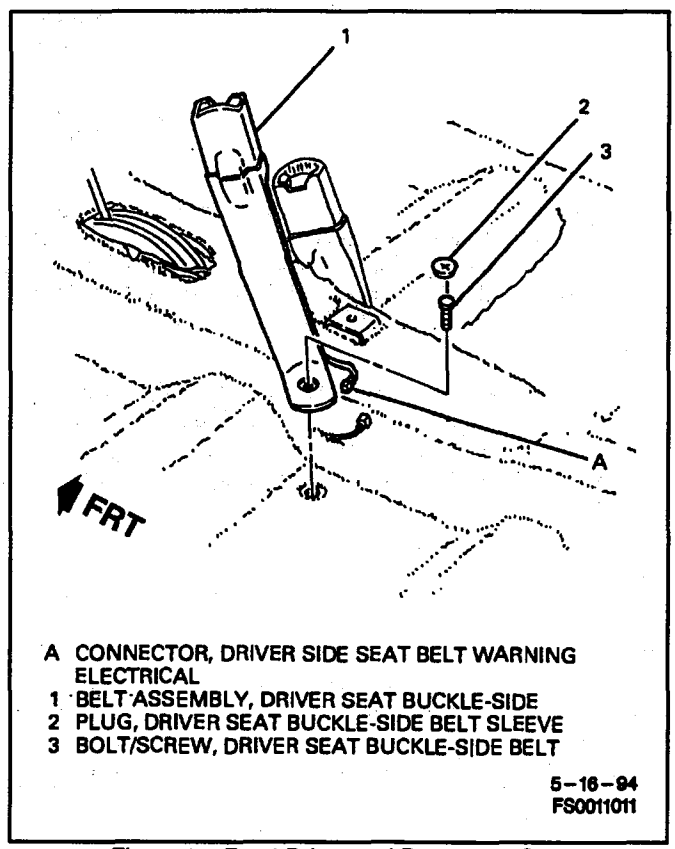


Figure 1 – Front Driver and Passenger Seat Buckle-Side Belt Assemblies (Typical)

Front Driver and Passenger Seat Retractor-Side Belt Assemblies

Coupe

Figures 2 and 3

Remove or Disconnect

1. Plug (4) from bolt/screw (5)
2. Bolt/screw (5) attaching plate to rocker panel assembly.
3. Plate.
4. Pull webbing and plate out of shoulder belt guide.
5. Lower rear portion of headliner finishing trim panel. Refer to SECTION 10-9.
6. Bolts/screws (8) attaching belt assembly (7) to rear roof panel assembly.
7. Belt assembly (7) from rear roof panel assembly.

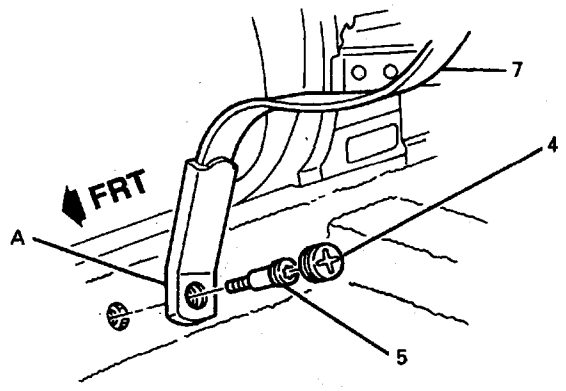
Install or Connect

NOTICE: See "Notice" on page 10-11-1 of this section.

1. Belt assembly (7) to rear roof panel assembly.
2. Bolts/screws (8).

Tighten

- Bolts/screws (8) to 28 N•m (20 lb. ft.).



A PLATE, FRONT SEAT BELT ANCHOR
4 PLUG, PASSENGER SEAT RETRACTOR-SIDE BELT SLEEVE
5 BOLT/SCREW, FRONT SEAT BELT ANCHOR PLATE
7 BELT ASSEMBLY, FRONT SEAT RETRACTOR-SIDE

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Figure 2 – Front Seat Belt Anchor Plate (Typical)
(Passenger Side Shown – Driver Side Similar)

3. Raise rear portion of headliner finishing trim panel back into position. Refer to SECTION 10-9.
4. Route webbing and plate through shoulder belt guide.
5. Plate to rocker panel assembly.
6. Bolt/screw (5).

Tighten

- Bolt/screw (5) to 42 N•m (31 lb. ft.).

7. Plug (4) to bolt/screw (5).

Convertible

Figures 2 and 4

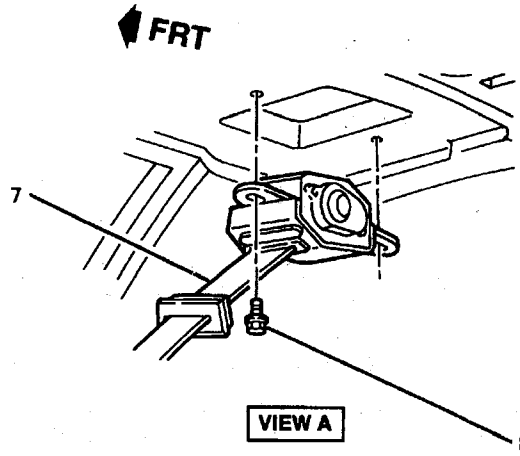
Remove or Disconnect

1. Front quarter trim finishing panel assembly. Refer to SECTION 10-7.
2. Plug (4) from bolt/screw (5).
3. Bolt/screw (5) attaching plate to rocker panel assembly.
4. Shoulder belt guide bolt/screw (40).
5. Shoulder belt retractor-side bolt/screw (41).
6. Retractor-side belt assembly (42).

Install or Connect

NOTICE: See "Notice" on page 10-11-1 of this section.

1. Retractor-side belt assembly (42).
2. Shoulder belt guide bolt/screw (40).



7 BELT ASSEMBLY, PASSENGER SEAT RETRACTOR-SIDE
8 BOLT/SCREW, PASSENGER SEAT SHOULDER BELT

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Figure 3 – Front Seat Retractor-Side Belt Assembly
(Passenger Side Shown – Driver Side Similar) (Coupe)

Tighten

- Bolt/screw (40) to 42 N•m (31 lb. ft.).

3. Shoulder belt retractor-side bolt/screw (41).

Tighten

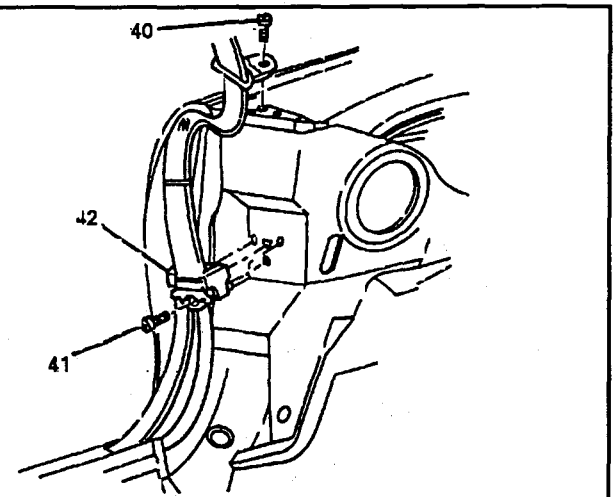
- Bolt/screw (41) to 42 N•m (31 lb. ft.).

4. Bolt/screw (5) attaching plate to rocker panel assembly.

Tighten

- Bolt/screw (5) to 42 N•m (31 lb. ft.).

5. Front quarter trim finishing panel assembly. Refer to SECTION 10-7.



40 BOLT/SCREW, FRONT SEAT SHOULDER BELT GUIDE
41 BOLT/SCREW, FRONT SEAT SHOULDER BELT RETRACTOR-SIDE
42 BELT ASSEMBLY, FRONT SEAT RETRACTOR-SIDE SHOULDER
5-16-94 FS0041011

Figure 4 – Front Seat Retractor-Side Belt Assembly (Convertible)

REAR SEAT BELT ASSEMBLIES

Rear Seat Outer-Side Belt Assemblies

Coupe

Figure 5

Remove or Disconnect

1. Quarter inner rear trim finish panel assembly. Refer to SECTION 10-7.
2. Rear seat cushion assembly. Refer to SECTION 10-10.
3. Nut (16) attaching rear seat shoulder belt retractor to inner wheelhouse panel assembly (28).
4. Bolts/screws (14) attaching rear seat shoulder belt guide (13) to rear seatback cushion assembly (17).
5. Bolt/screw (9) and spacer (11) attaching belt assembly (10) to floor panel assembly (19).
6. Belt assembly (10) from vehicle.

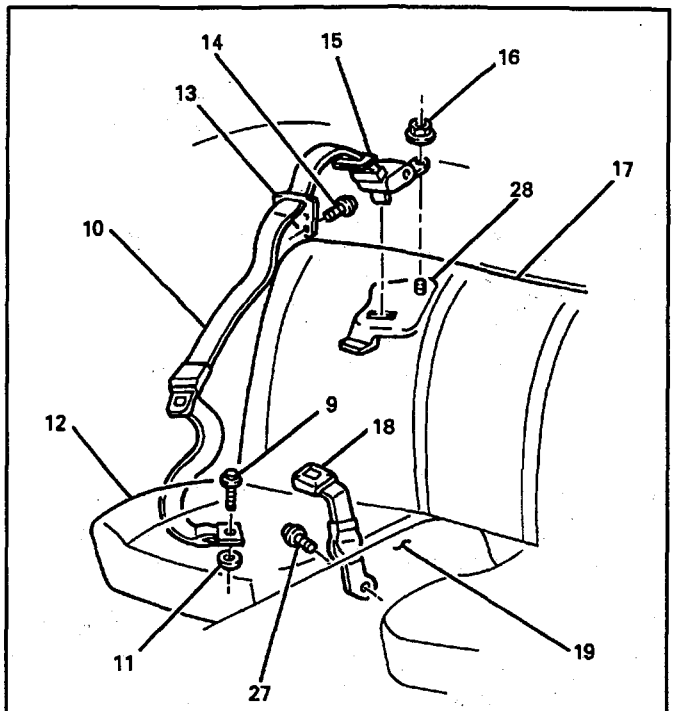
Install or Connect

NOTICE: See "Notice" on page 10-11-1 of this section.

1. Belt assembly anchor plate to floor panel assembly (19).
2. Bolt/screw (9) through belt assembly anchor plate and spacer (11) to floor panel assembly (19).

Tighten

- Bolt/screw (9) to 42 N•m (31 lb. ft.).



9 BOLT/SCREW, REAR SEAT SHOULDER BELT
10 BELT ASSEMBLY, REAR SEAT OUTER SIDE
11 SPACER, REAR SEAT BELT ANCHOR PLATE
12 CUSHION ASSEMBLY, REAR SEAT
13 GUIDE, REAR SEAT SHOULDER BELT
14 BOLT/SCREW, REAR SEAT SHOULDER BELT GUIDE
15 ESCUTCHEON, QUARTER LOWER TRIM FINISH PANEL REAR SEAT BELT
16 NUT, REAR SEAT SHOULDER BELT RETRACTOR
17 CUSHION ASSEMBLY, REAR SEATBACK
18 BELT ASSEMBLY, CENTER
19 PANEL ASSEMBLY, FLOOR
27 BOLT/SCREW, CENTER BELT
28 PANEL ASSEMBLY, INNER WHEELHOUSE
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Figure 5 – Rear Seat Outer-Side and Center Belt Assemblies (Coupe)

3. Shoulder belt guide (13) to rear seatback cushion assembly (17).
4. Bolts/screws (14).

Tighten

- Bolts/screws (14) to 10 N•m (89 lb. in.).

5. Belt retractor assembly to inner wheelhouse panel assembly (28).
6. Nut (16).

Tighten

- Nut (16) to 55 N•m (41 lb. ft.).

7. Rear seat cushion assembly. Refer to SECTION 10-10.
8. Quarter inner rear trim finishing panel assembly. Refer to SECTION 10-7.

Convertible

Figures 6 and 7

Remove or Disconnect

1. Retractor trim cover. Refer to "Rear Seat Shoulder Belt Retractor Trim Cover Assembly" in this section.
2. Rear seat cushion assembly. Refer to SECTION 10-10.
3. Rear seat shoulder belt guide bolt/screw (33).
4. Rear seat retractor-side shoulder belt bolt/screw (34).
5. Bolt/screw (36) and spacer (37) attaching belt assembly (35) to floor panel assembly.
6. Rear seat belt assembly (35).

Install or Connect

NOTICE: See "Notice" on page 10-11-1 of this section.

1. Rear seat belt assembly anchor plate to floor panel assembly.
2. Bolt/screw (36) through belt assembly anchor plate and spacer (37) to floor panel assembly.

Tighten

- Bolt/screw (36) to 42 N•m (31 lb. ft.).

3. Rear seat shoulder belt retractor-side bolt/screw (34).

Tighten

- Bolt/screw (34) to 42 N•m (31 lb. ft.).

4. Rear seat shoulder belt guide bolt/screw (33).

Tighten

- Bolt/screw (33) to 42 N•m (31 lb. ft.).

5. Rear seat cushion assembly. Refer to SECTION 10-10.
6. Retractor trim cover. Refer to "Rear Seat Shoulder Belt Retractor Trim Cover Assembly" in this section.

Center Belt Assemblies

Coupe

Figure 5

Remove or Disconnect

1. Rear seat cushion assembly. Refer to SECTION 10-10.
2. Bolt/screw (27) attaching belt assembly (18) to floor panel assembly (19).
3. Belt assembly (18).

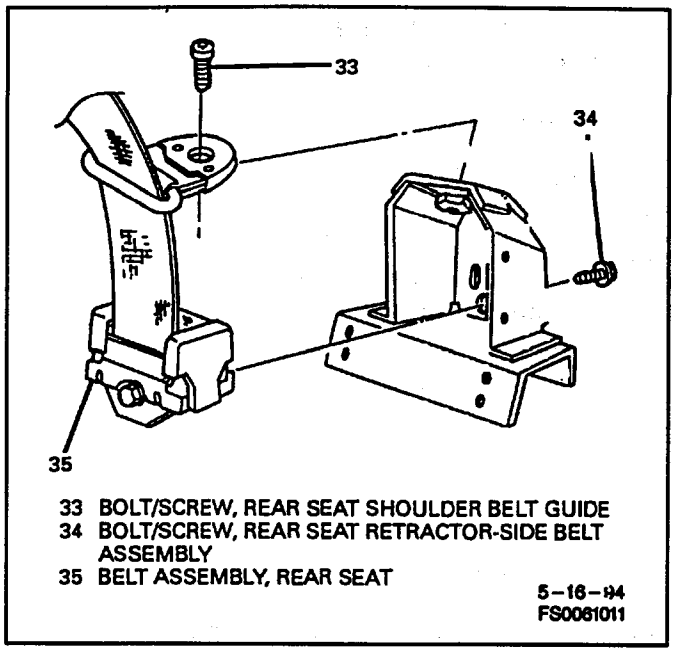


Figure 6 – Rear Seat Belt Assembly (Convertible)

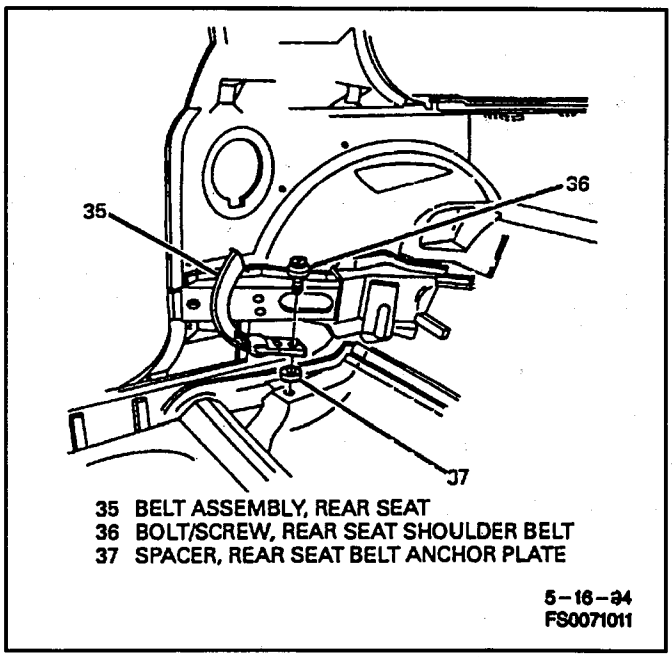


Figure 7 – Rear Seat Belt Assembly, Forward Attachment (Convertible)

Install or Connect

NOTICE: See "Notice" on page 10-11-1 of this section.

1. Belt assembly (18).
2. Bolt/screw (27).

Tighten

- Bolt/screw (27) to 42 N•m (31 lb. ft.).

3. Rear seat cushion assembly. Refer to SECTION 10-10.

Rear Seat Shoulder Belt Retractor Trim Cover Assembly

Convertible

Figure 8

Remove or Disconnect

1. Trim cover (30) by unsnapping from cover (32) to retractor trim cover.
2. Trim cover retainer (31).
3. Cover (32) to retractor trim cover.

Install or Connect

1. Cover (32) to retractor trim cover.
2. Trim cover retainer (31).
3. Trim cover (30).

Rear Seat Shoulder Belt Retractor Bracket Assembly

Convertible

Figures 6 and 9

Remove or Disconnect

1. Retractor trim cover. Refer to "Rear Seat Shoulder Belt Retractor Trim Cover Assembly" in this section.
2. Rear seat shoulder belt guide bolt/screw (33).
3. Rear seat shoulder belt retractor-side bolt/screw (34).
4. Retractor from bracket assembly (39).
5. Bracket bolts/screws (38).
6. Bracket assembly (39).

Install or Connect

NOTICE: See "Notice" on page 10-11-1 of this section.

1. Bracket assembly (39).
2. Bracket bolts/screws (38).

Tighten

- Bolts/screws (38) to 30 N•m (22 lb. ft.).

3. Retractor to bracket assembly (39).
4. Rear seat shoulder belt retractor bolt/screw (34).

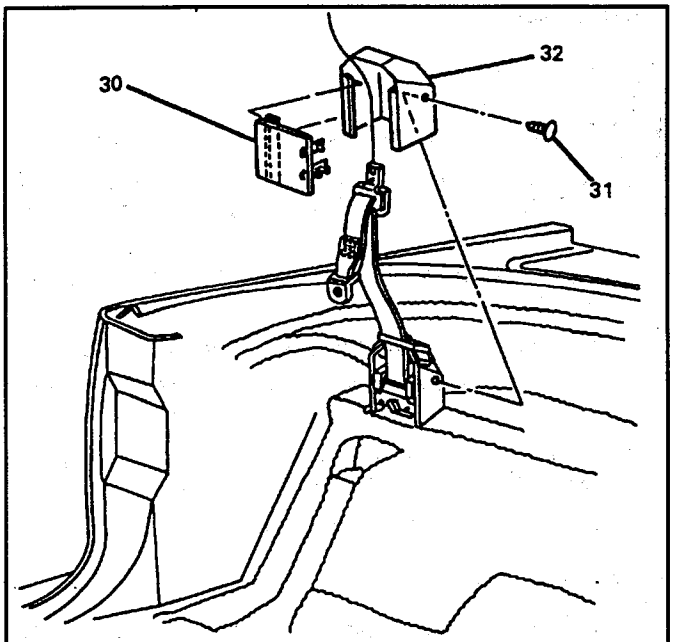
Tighten

- Bolt/screw (34) to 42 N•m (31 lb. ft.).

5. Rear seat shoulder belt guide bolt/screw (33).

Tighten

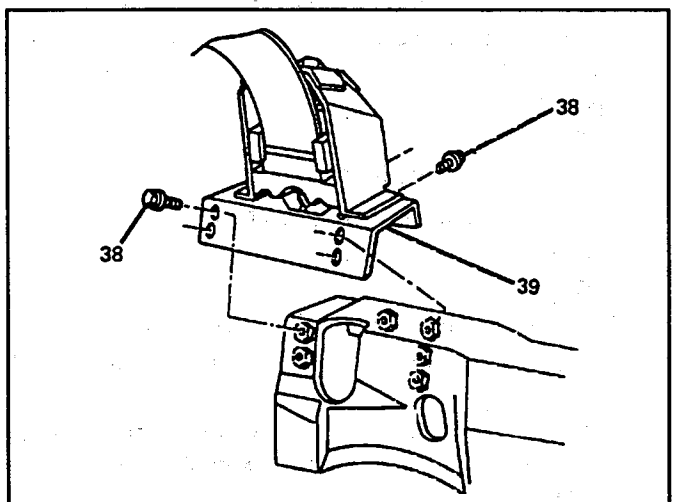
- Bolt/screw (33) to 42 N•m (31 lb. ft.).



30 COVER, REAR SEAT SHOULDER BELT RETRACTOR TRIM
31 RETAINER, REAR SEAT SHOULDER BELT RETRACTOR TRIM COVER
32 COVER, REAR SEAT SHOULDER BELT RETRACTOR TRIM COVER

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Figure 8 – Rear Seat Shoulder Belt Retractor Trim Cover Assembly (Convertible)



38 BOLT/SCREW, REAR SEAT SHOULDER BELT RETRACTOR BRACKET
39 BRACKET ASSEMBLY, REAR SEAT SHOULDER BELT RETRACTOR

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Figure 9 – Rear Seat Shoulder Belt Retractor Bracket Assembly (Convertible)

6. Retractor trim cover. Refer to "Rear Seat Shoulder Belt Retractor Trim Cover Assembly" in this section.

CHILD SEAT

If a child seat that requires a top strap is to be used in a rear seat position, a special dealer-installed anchor

bracket must be used to anchor the child seat top-tether to the rear compartment front panel on Canadian vehicles, or the rear compartment rear panel on U.S. vehicles. To ensure the correct child seat top-tether angle, the child seat must only be used in the seating position for which the anchor bracket is installed.

Child Seat Top-Tether Anchor Bracket

U.S. Vehicles

Figure 10

If an anchor bracket (21) is being installed for the first time, use the following procedure.

Top-Tether Anchor Bracket Initial Installation

Install or Connect

NOTICE: See "Notice" on page 10-11-1 of this section.

Important

- This procedure is not to be used for Canadian vehicles.

1. Depending on whether or not vehicle has roof lift-off window assemblies, make proper paper or cardboard template as shown in Figure 10.
2. Center template on rear compartment rear panel. If it does not fit exactly, make certain that proper end is facing front of vehicle.
3. Using one of two hole-position marks on template, depending on which side of vehicle child restraint is to be installed, make a dimple in rear compartment rear panel sheet metal using a center punch.
4. From underneath vehicle, make sure there is clearance for washer (23) to be installed at this location.
5. From inside vehicle, make sure there is clearance to install anchor bracket (21).

Adjust

- Location as needed to provide clearance for parts and mark new location using center punch.

6. Using 9 mm (3/8-inch) drill bit, drill hole at center-punched location through floor carpet assembly and rear compartment rear panel.

CAUTION: All bolt/screw holes to the exterior of the vehicle must be sealed completely to prevent carbon monoxide from entering the vehicle. Breathing carbon monoxide can cause carbon monoxide poisoning and may be fatal.

7. Install anchor bracket (21), bolt/screw (20), gasket sealer (22), washer (23), and nut (24).

Important

- Do not use a nut driver to tighten this hardware, or fasteners will not be properly seated.

Tighten

- Bolt/screw (20) and nut (24) until fully seated, but not stripped.

Top-Tether Anchor Bracket Replacement

If the anchor bracket (21) becomes damaged, it must be replaced.

CAUTION: All bolt/screw holes to the exterior of the vehicle must be sealed completely to prevent carbon monoxide from entering the vehicle. Breathing carbon monoxide can cause carbon monoxide poisoning and may be fatal.

Remove or Disconnect

1. Nut (24), washer (23), gasket sealer (22), bolt/screw (20), and anchor bracket (21).
2. Seal hole in rear compartment rear panel if permanently removing anchor bracket (21).

Install or Connect

NOTICE: See "Notice" on page 10-11-1 of this section.

- Anchor bracket (21), bolt/screw (20), gasket sealer (22), washer (23), and nut (24).

Important

- Do not use a nut driver to tighten this hardware, or fasteners will not be properly seated.

Tighten

- Bolt/screw (20) and nut (24) until fully seated, but not stripped.

Canadian Vehicles

Figure 11

All Canadian vehicles are equipped with drilled and tapped plates welded to the rear compartment front panel. These plates serve as mounting points for child seat top-tether anchor brackets (25).

If an anchor bracket (25) is being installed for the first time, use the following procedure.

Top-Tether Anchor Bracket Initial Installation

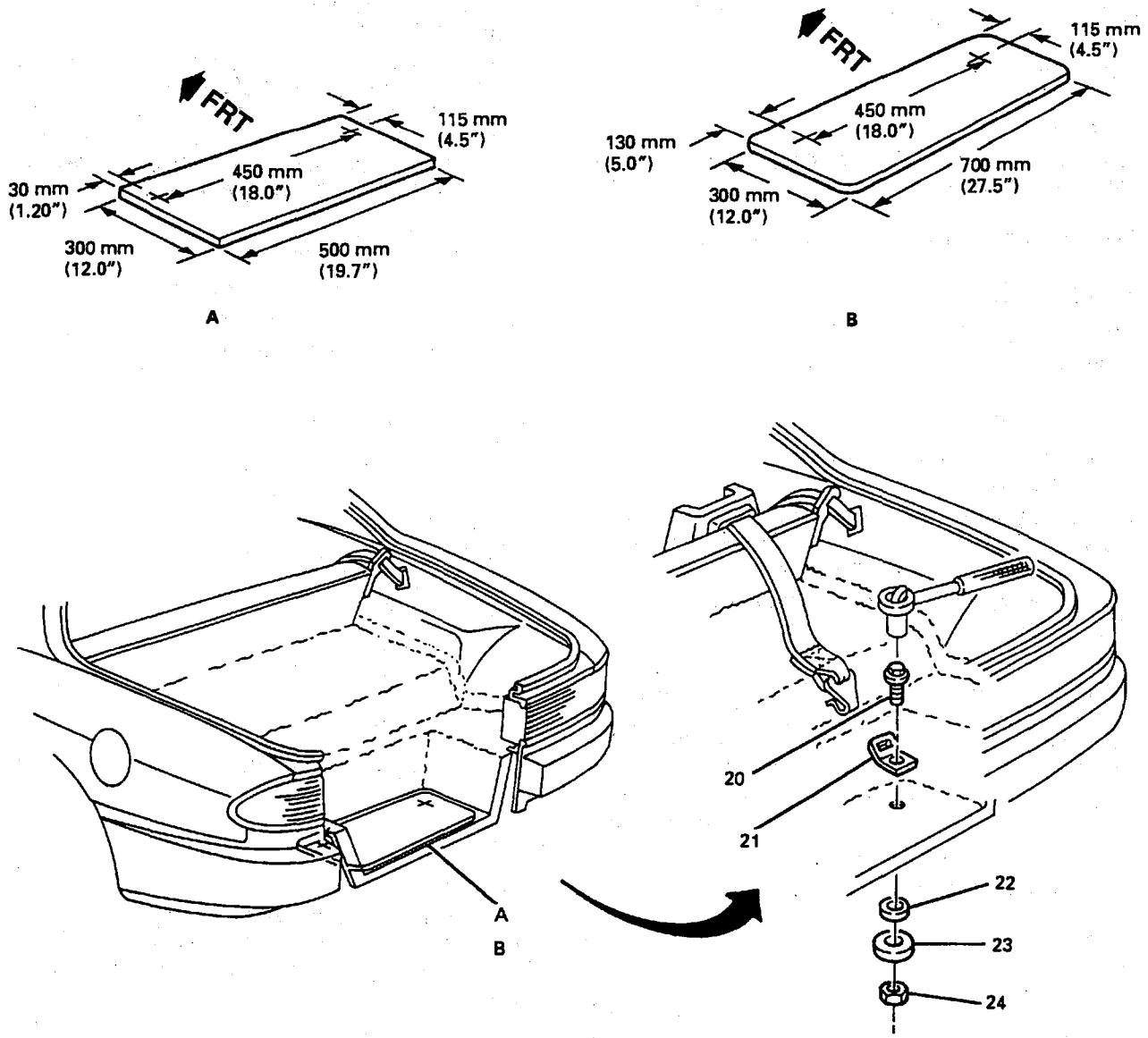
Install or Connect

NOTICE: See "Notice" on page 10-11-1 of this section.

Important

- This procedure is not to be used for U.S. vehicles.

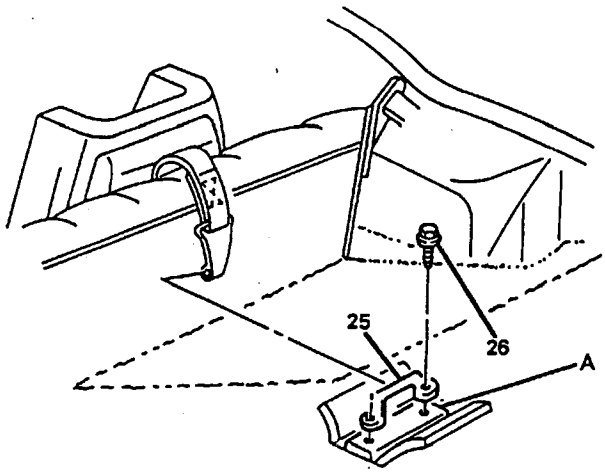
1. Remove quarter inner trim finishing panel assembly. Refer to SECTION 10-7.
2. Carefully lift up on rear edge of carpeting to reveal anchor bracket mounting plate locations.



A LOCALLY FABRICATED TEMPLATE, WITH ROOF LIFT-OFF PANEL ASSEMBLIES
B LOCALLY FABRICATED TEMPLATE, HARDTOP
20 BOLT/SCREW, TOP-TETHER ANCHOR BRACKET
21 ANCHOR BRACKET, TOP-TETHER
22 GASKET SEALER, TOP-TETHER ANCHOR BRACKET
23 WASHER, TOP-TETHER ANCHOR BRACKET
24 NUT, TOP-TETHER ANCHOR BRACKET

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Figure 10 – Child Seat Top-Tether Anchor Bracket (U.S. Vehicles)



A MOUNTING PLATE, ANCHOR BRACKET
25 BRACKET, TOP-TETHER ANCHOR
26 BOLT/SCREW, TOP-TETHER ANCHOR BRACKET

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Figure 11 – Child Seat Top-Tether Anchor Bracket (Canadian Vehicles)

3. Choose either driver or passenger side mounting locations depending on which seating position child restraint is to be installed.
4. Position anchor bracket (25) to anchor bracket mounting plate.
5. Bolts/screws (26).

Important

- Do not use a nut driver to tighten this hardware, or fasteners will not be properly seated.

Tighten

- Bolts/screws (26) until fully seated, but not stripped.

6. Replace carpeting, noting bump created by anchor bracket (25).
7. Carefully slit carpeting to allow anchor bracket to protrude through.

Important

- Make sure carpet is pulled taut before making cut in carpet.

8. Follow instructions in owner's manual and in product information accompanying child seat regarding positioning and installation using rear safety belts.

Top-Tether Anchor Bracket Replacement

If the anchor bracket (25) becomes damaged, it must be replaced.

Remove or Disconnect

1. Bolts/screws (26).
2. Anchor bracket (25).

Install or Connect

NOTICE: See "Notice" on page 10-11-1 of this section.

1. Anchor bracket (25) to anchor bracket mounting plate.
2. Bolts/screws (26).

Important

- Do not use a nut driver to tighten this hardware, or fasteners will not be properly seated.

Tighten

- Bolts/screws (26) until fully seated, but not stripped.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Front Driver/Passenger Seat Buckle-Side Belt Bolt/Screw	42 N•m (31 lb. ft.)
Front Driver/Passenger Seat Shoulder Belt Bolt/Screw	28 N•m (20 lb. ft.)
Front Seat Belt Anchor Plate Bolt/Screw	42 N•m (31 lb. ft.)
Front Seat Retractor-Side Belt Assembly Bolt/Screw (Convertible)	42 N•m (31 lb. ft.)
Front Seat Shoulder Belt Guide Bolt/Screw (Convertible)	42 N•m (31 lb. ft.)
Rear Seat Center Belt Bolt/Screw	42 N•m (31 lb. ft.)
Rear Seat Retractor-Side Belt Assembly Bolt/Screw (Convertible)	42 N•m (31 lb. ft.)
Rear Seat Shoulder Belt Bolt/Screw (Convertible)	42 N•m (31 lb. ft.)
Rear Seat Shoulder Belt Bolt/Screw (Coupe)	42 N•m (31 lb. ft.)
Rear Seat Shoulder Belt Guide Bolt/Screw (Convertible)	42 N•m (31 lb. ft.)
Rear Seat Shoulder Belt Guide Bolt/Screw (Coupe)	10 N•m (89 lb. in.)
Rear Seat Shoulder Belt Retractor Bracket Bolt/Screw (Convertible)	30 N•m (22 lb. ft.)
Rear Seat Shoulder Belt Retractor Nut (Coupe)	55 N•m (41 lb. ft.)

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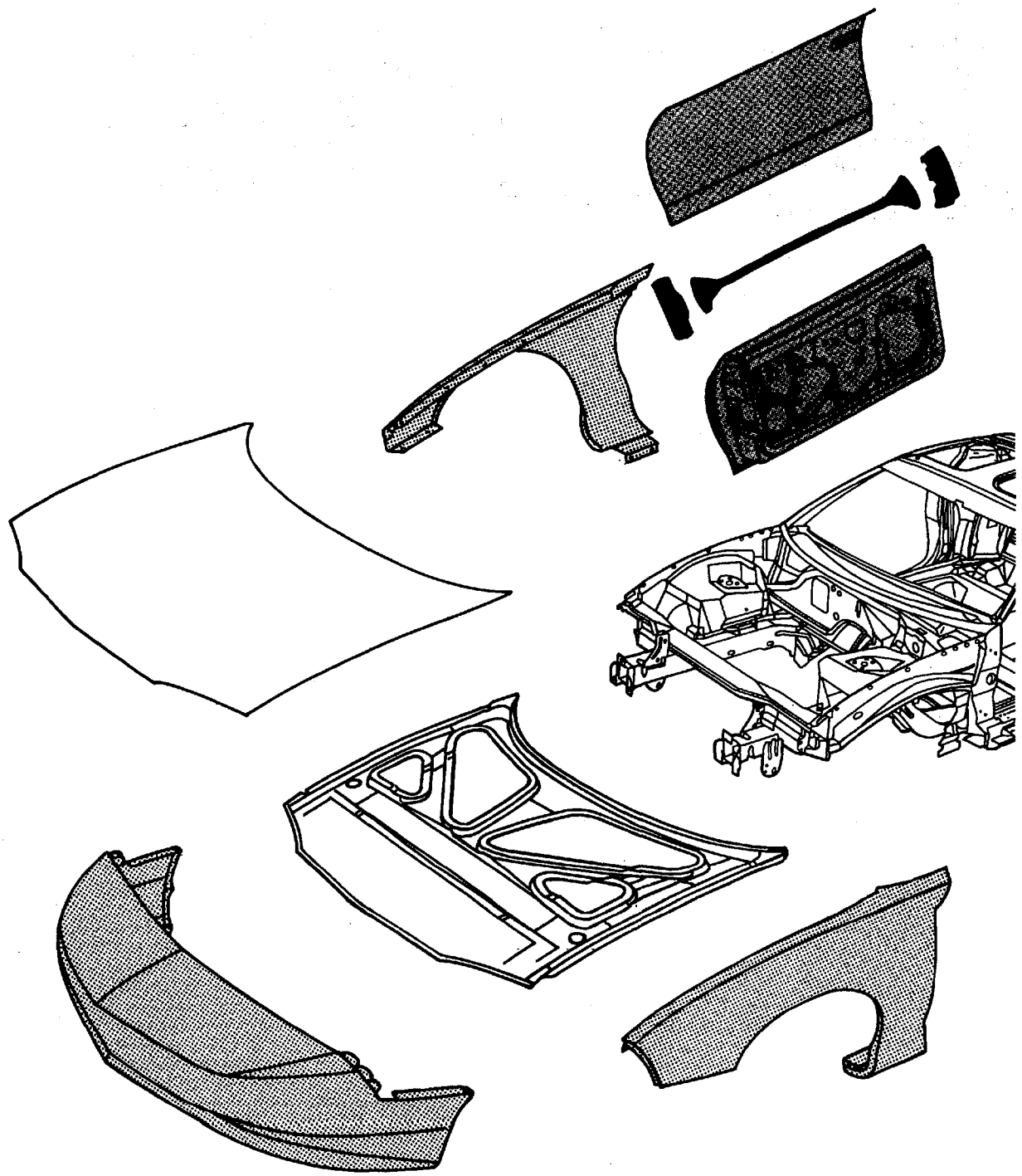
SECTION 11

STRUCTURAL BODY REPAIR AND DIMENSIONS

CONTENTS

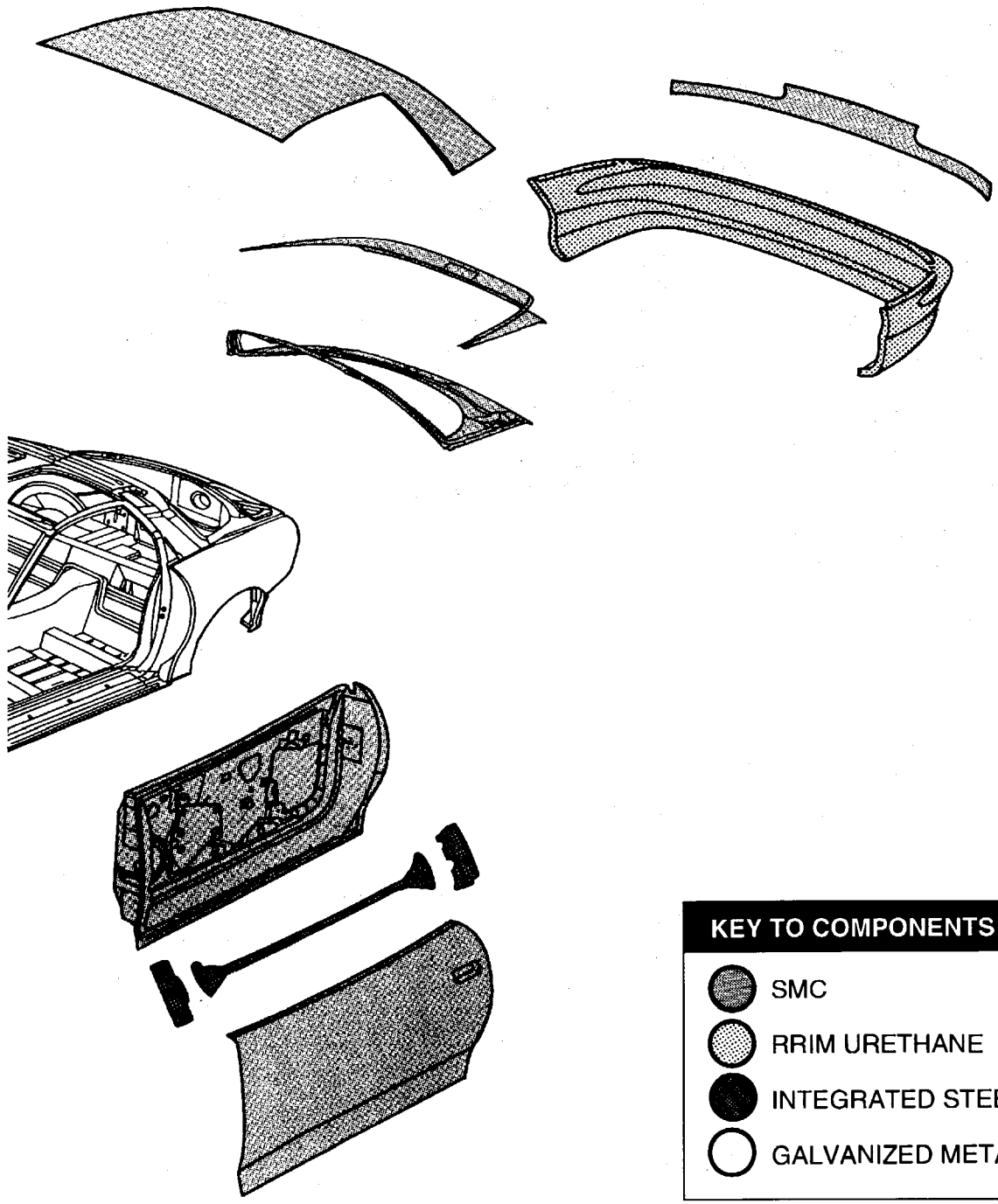
Panel Identification (1) 11-2
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PANEL IDENTIFICATION 1



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PANEL IDENTIFICATION 1



KEY TO COMPONENTS

- SMC
- RRIM URETHANE
- INTEGRATED STEEL PARTS
- GALVANIZED METAL

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RADIATOR SUPPORT ASSEMBLY

The radiator support assembly consists of eight pieces: four upper, two sides (left and right) and two lower (Figure 2-1).

Replacement of the radiator support assembly has been noticeably improved over past vehicle models. Virtually all attaching surfaces are easily accessible for service, which makes replacement much less complicated, as well as economical.

The radiator support is available as an entire unit including all brackets and reinforcements. Note: the lower outer support is serviced separately (Figure 2-2). In addition, the lower left, right, and inner support are also available separately (Figure 2-1).

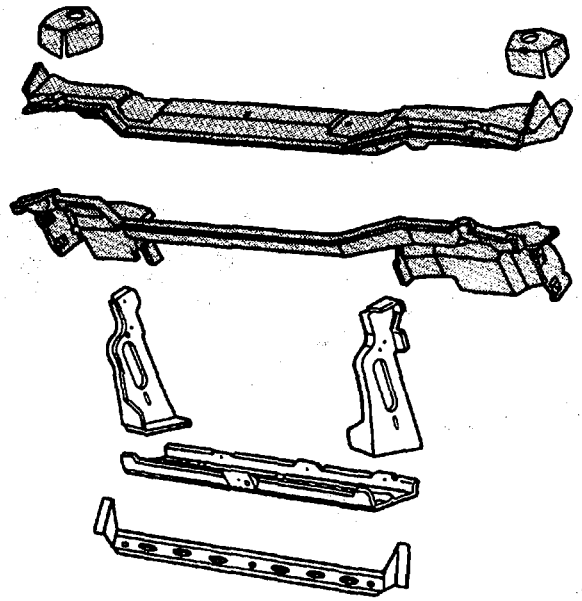


Figure 2-1. Radiator Support Assembly (Exploded View)

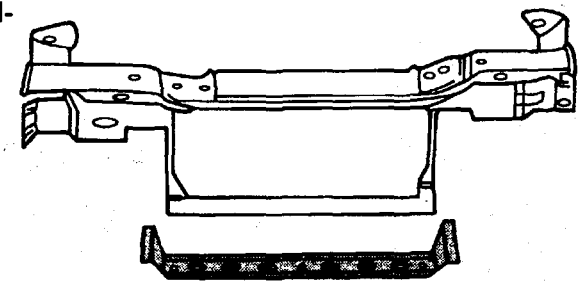


Figure 2-2. Radiator Support Assembly and Lower Outer Support

UPPER RAIL 3

ENGINE COMPARTMENT FRONT OUTER SIDE RAIL

Before attempting to remove the engine compartment front outer side rail, visually inspect the damage and restore as much of the damage as possible to factory specifications. The engine compartment front outer side rail is attached to the front wheelhouse panel upper side rail assembly with spot welds. To remove the outer side rail, the spot welds must be drilled out. On the service part outer side rail, plug weld holes are not included. They must be drilled in the same location as the original spot welds.

Remove or Disconnect

1. Remove front fender assembly, hood assembly and hood hinge assembly.
2. Note number and location of welds for installation of new outer side rail.
3. Drill out all related factory welds (Figure 3-1).
4. Remove outer side rail.
5. Remove air baffle material from side rail assembly (Figure 3-2).
6. Remove sealant from side rail assembly, as necessary.

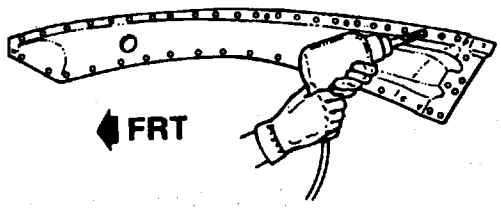
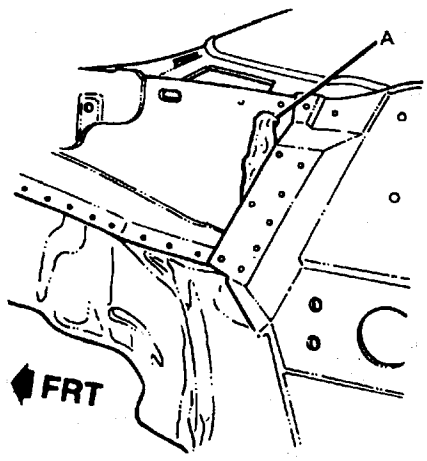


Figure 3-1. Drilling Plug Welds



A AIR BAFFLE

Figure 3-2. Removing Air Baffle Material

Install or Connect

1. Position the new outer side rail to side rail assembly and clamp in place.

Install or Connect (Continued)

2 Mark seven formed and pierced locations from the side rail assembly to the new outer side rail.

3 Mark the hood hinge hole locations (Figure 3-3).

4 Remove clamps and outer side rail.

5 Drill 1/8-inch holes in marked locations on the new outer side rail at formed and pierced locations (Figure 3-4).

6 Drill two 3/8-inch holes at hood hinge hole locations (Figure 3-4).

7 Drill 5/16-inch holes 3/4-inch fore and aft of seven formed and pierced locations (Figure 3-4).

8 Drill 5/16-inch holes on remaining locations as noted from old outer side rail (Figure 3-4).

- *If the original outer side rail is damaged beyond recognition, place holes for welding 1-1/2 inches apart.*

9 Install J-clips included with rail, GM P/N 10079170, at five formed and pierced locations (Figure 3-5).

- *Two formed and pierced locations at hood hinge mounting panel do not require J-Clips.*

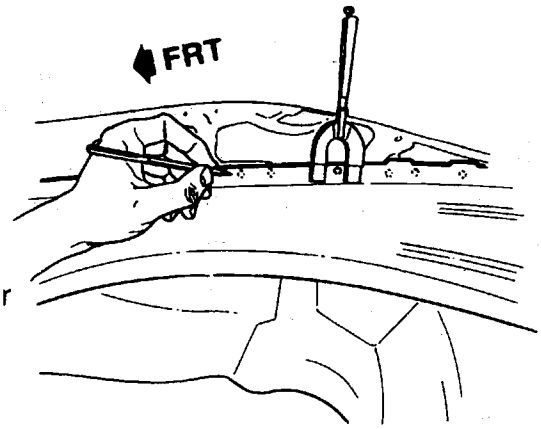


Figure 3-3. Marking Hole Locations

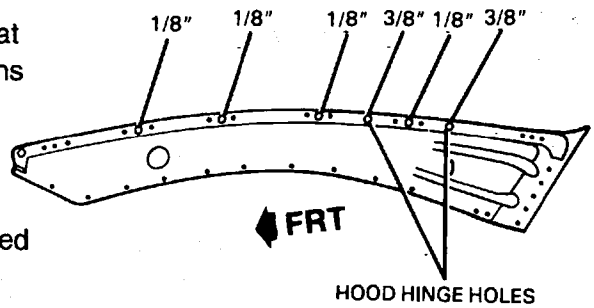


Figure 3-4. Hole Size and Locations

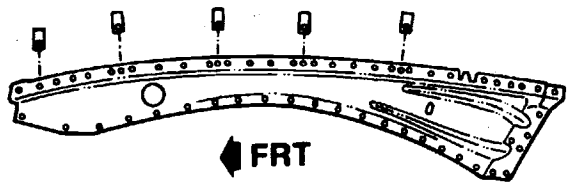


Figure 3-5. Installing J-Clips

UPPER RAIL 3

ENGINE COMPARTMENT FRONT OUTER SIDE RAIL

Install or Connect (Continued)

10 Position the new outer side rail in place, insert locating tab through slot (Figure 3-6).

11 Install fender mounting bolts/screws included with rail, GM P/N 11505023, at five J-clips to secure outer side rail in place. Note: The new outer rail may be manually positioned to accommodate the J-Clips at the five formed locations.

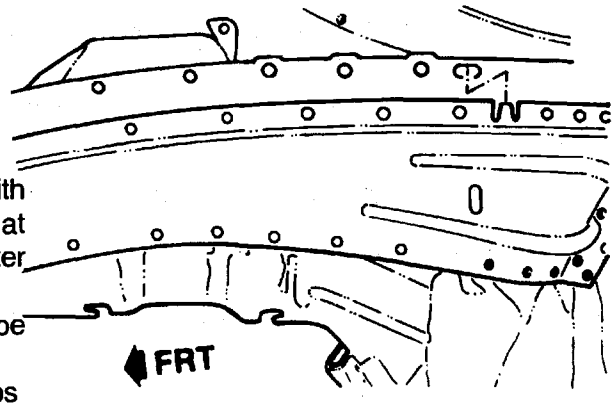


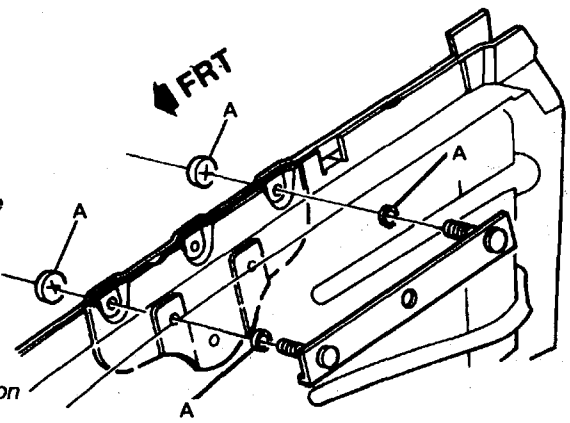
Figure 3-6. Installing Outer Side Rail

MEASURE

- *Refer to service manual for proper dimensions.*

12 Follow the next steps accordingly:

- *Outer Rail Replacement Only. Match the new outer rail to the contour of the two formed locations at the hood hinge. (Use hood hinge bracket with original spacers intact.)*
- *Inner and Outer Rail Replacement. Replace original two spacers on hood hinge bracket bolt/screw with two washers provided. Install hood hinge bracket upside down, washers and bolts/screws to outer side rail assembly at hood hinge mounting panel (Figure 3-7).*



A SERVICE KIT WASHERS

Figure 3-7. Installing Hood Hinge Bracket

13 Using MIG welder, randomly plug weld new outer side rail in place (Figure 3-8).

IMPORTANT

- *Be sure to measure continually throughout welding process to maintain correct dimensions.*

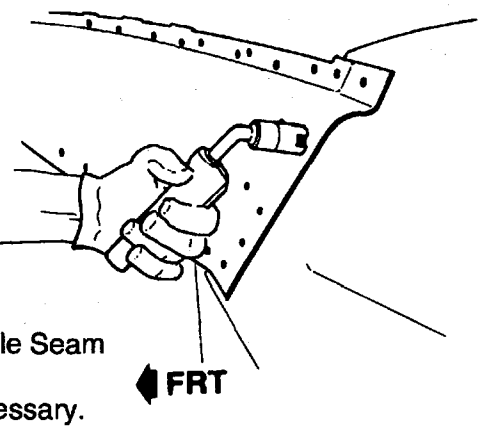


Figure 3-8. Welding Outer Side Rail

14 Clean and prepare welded surfaces. Apply 3M Brushable Seam Sealer, part number 08361 or equivalent, as necessary.

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Install or Connect (Continued)

15 Apply "Handi Foam " to replace air baffle material. "Handi Foam" kit is available from FoMo Products Inc., 2775 Barber Rd., P.O. Box 1078, Norton, Ohio 44203, or call 1-800-321-5585 or 216-753-4585. Note: It is recommended that a small amount be applied into a disposable container to become familiar with the rate of discharge.

16 Refinish according to paint manufacturer's recommendations.

17 Apply anticorrosion material, as necessary.

18 Install hood hinge assembly, hood assembly and front fender assembly.

FRONT WHEELHOUSE PANEL UPPER SIDE RAIL ASSEMBLY

When replacing the upper side rail assembly, it will be necessary to cut a section of the damaged side rail assembly away and section a new side rail assembly in its place. Removal of the side rail assembly requires the use of a template to help in determining the location of the cut to be made.

Remove or Disconnect

1 Outer side rail. Refer to "Engine Compartment Front Outer Side Rail".

2 Position template included with rail to side rail assembly at forward edge where indicated by arrows and scribe line onto side rail assembly where shown (Figure 3-9).

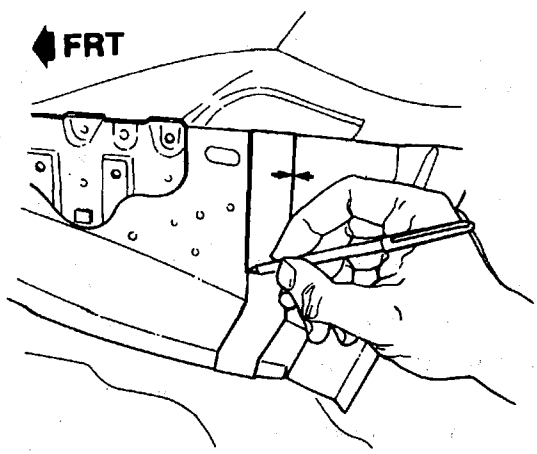


Figure 3-9. Scribing Line on Inner Side Rail

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UPPER RAIL 3

FRONT WHEELHOUSE PANEL UPPER SIDE RAIL ASSEMBLY

Remove or Disconnect (Continued)

3 Drill out welds at cowl panel.

- *Drill out welds at cowl panel only. Remaining welds will hold side rail assembly in place while cutting.*

4 Separate side rail assembly away from cowl panel (Figure 3-10).

5 Cut side rail assembly at scribed lines, being careful not to cut adjacent panels (Figure 3-11).

6 Note number and location of remaining welds for installation of new side rail assembly.

7 Drill out remaining welds.

8 Remove side rail assembly (Figure 3-12).

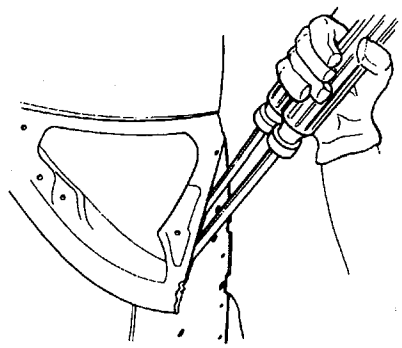


Figure 3-10. Separating Inner Side Rail Assembly from Cowl

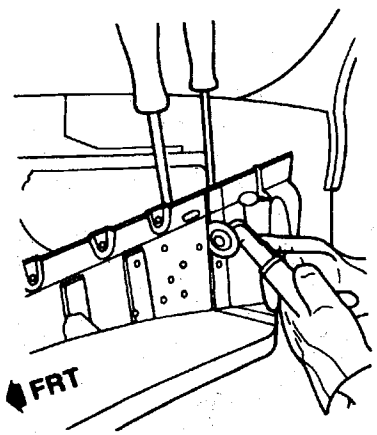


Figure 3-11. Cutting Inner Side Rail Assembly

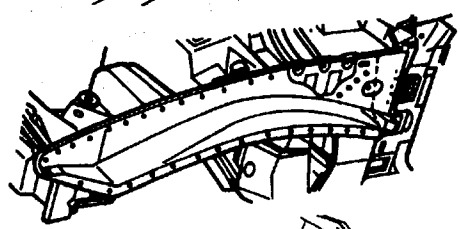


Figure 3-12. Removing Inner Side Rail Assembly

Install or Connect

1 Prepare mating surfaces for proper fit of new side rail assembly.

2 Clean sealer away from mating surfaces, as necessary (Figure 3-13).

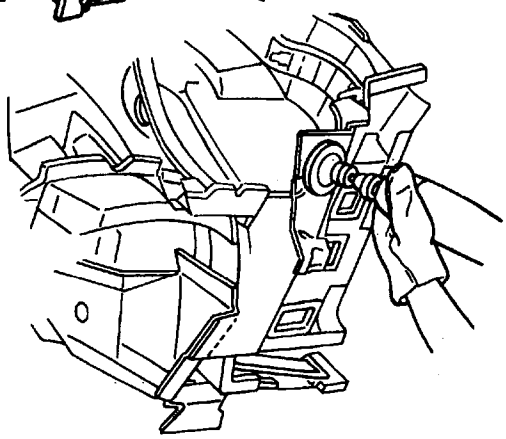


Figure 3-13. Preparing Mating Surface

UPPER RAIL 3

Install or Connect (Continued)

3 On new side rail assembly, drill 5/16-inch holes in remaining locations as noted from original side rail assembly.

- *If original side rail assembly is damaged beyond recognition, place holes for welding 1 1/2 inches apart.*

4 Clean the surface of seven pierced locations on side rail assembly with mild soap and water and wipe dry. Clean with wax and grease remover.

5 Remove backing from washers included with rail and carefully apply to motor compartment side of new side rail assembly at pierced locations shown (Figure 3-14).

NOTICE:

- *Use only service kit washers provided with rail, GM P/N 12520407. Use of any other washer could cause improper positioning of side rail assembly.*

6 Position new side rail assembly to overlap remainder of original side rail assembly by 35 mm. Align to arrows on remainder of original side rail assembly and clamp.

MEASURE

- *Refer to service manual for proper dimensions.*

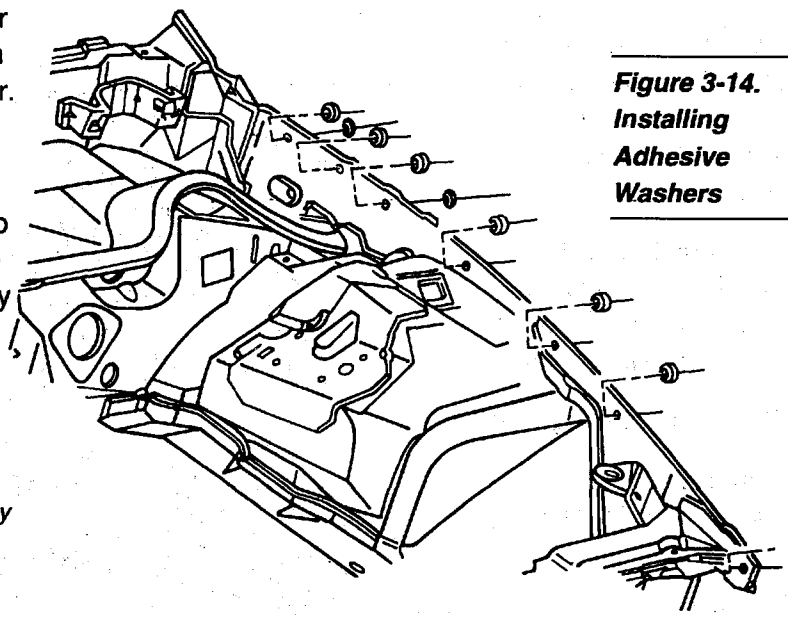


Figure 3-14. Installing Adhesive Washers

NOTE:

- *The forward pierced location may need to be manually positioned according to upper body dimensions, utilizing common tools and techniques.*

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FRONT WHEELHOUSE PANEL UPPER SIDE RAIL ASSEMBLY

Install or Connect (Continued)

7 Using MIG welder at overlap, plug weld all 8 mm pre-drilled holes in new side rail assembly in sequence shown.

8 Using MIG welder, make 1-inch stitch welds along seam leaving 1-inch gaps.

9 Using MIG welder, randomly plug weld all remaining holes in new side rail assembly.

IMPORTANT

- *Be sure to measure continually throughout welding process to maintain correct dimensions.*

10 Complete stitch welding along seam (Figure 3-15).

11 Remove clamps.

12 Clean and prepare welded surfaces. Prime with two-part catalyzed primer. Do not combine paint systems. Refer to paint manufacturer's recommendations.

13 Install outer side rail. Refer to "Engine Compartment Front Outer Side Rail".

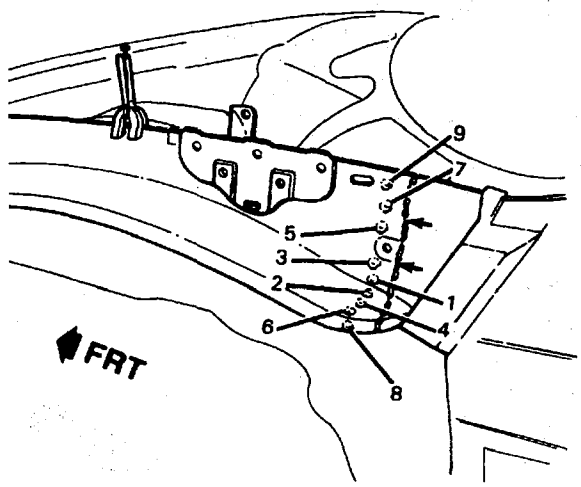


Figure 3-15. Welding Inner Side Rail Assembly

LOWER RAIL

Replacement of the engine compartment inner and outer side rail assemblies has been noticeably improved over past vehicle models. Virtually all attaching surfaces are easily accessible from underneath for service, which makes replacement much less complicated.

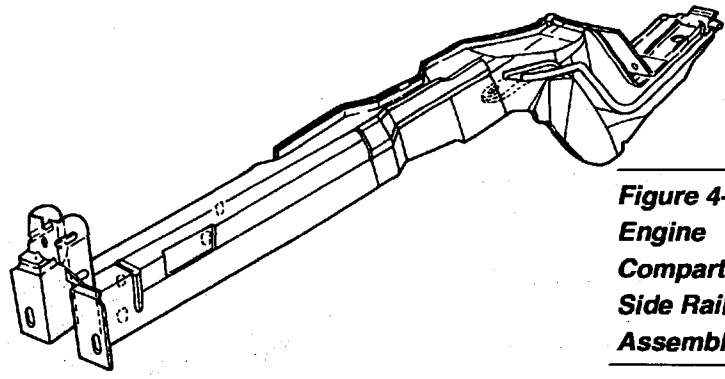


Figure 4-1. Engine Compartment Side Rail Assemblies

The service part comes as an entire unit, including all brackets and reinforcements as shown in Figure 4-1. The outer side rail extension is also available as shown in Figure 4-2.

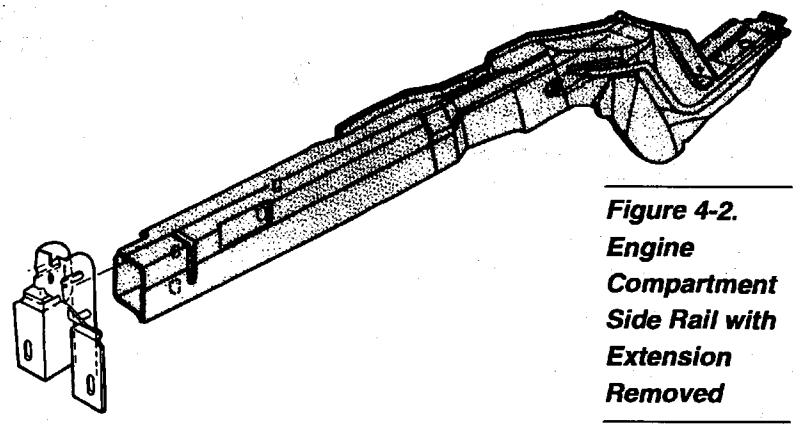


Figure 4-2. Engine Compartment Side Rail with Extension Removed

NOTICE:

At this time, sectioning of the engine compartment inner and outer side rail assemblies is not recommended, as doing so could compromise the structural integrity of the vehicle.

FRONT WHEELHOUSE ASSEMBLY 5

FRONT WHEELHOUSE ASSEMBLY

This service part is available as an entire part including all brackets and reinforcements, as shown in Figure 5-1. The Front Wheelhouse Apron is also available separately as shown in Figure 5-2.

Remove or Disconnect

1. Remove outer body panels and related components.
2. Visually inspect the damage.
3. Restore as much of the damage as possible to factory specifications.
4. Remove sealants and corrosion materials as necessary.
5. Note number and location of welds for installation of the new front wheelhouse assembly.
6. Drill out all related factory welds.
7. Remove front wheelhouse assembly.
8. Prepare mating surfaces for proper fit of new front wheelhouse assembly.

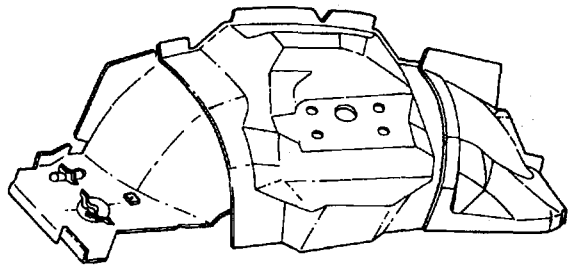


Figure 5-1. Front Wheelhouse Available as Complete Assembly

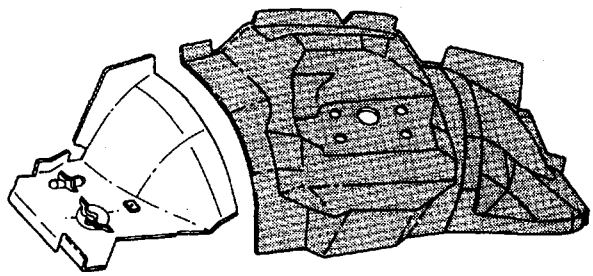


Figure 5-2. Front Wheelhouse Apron Available Separately

FRONT WHEELHOUSE ASSEMBLY 5

Install or Connect

1. Set the new front wheelhouse assembly on a work surface with underside up.
2. Position template (included in service kit) in the front wheelhouse assembly as shown (Figure 5-3).
3. With a center punch, locate four strut attaching holes (Figure 5-4).
4. Remove template. Drill 12-mm (15/32-inch) holes in marked locations on new front wheelhouse assembly (Figure 5-5).
5. Drill 8-mm (5/16-inch) holes in remaining locations 1 1/2 inches apart.
6. Position new front wheelhouse assembly in place, align and clamp.

MEASURE

- *Refer to the appropriate service manual for proper dimensions or see Body Dimensions Section in this publication.*

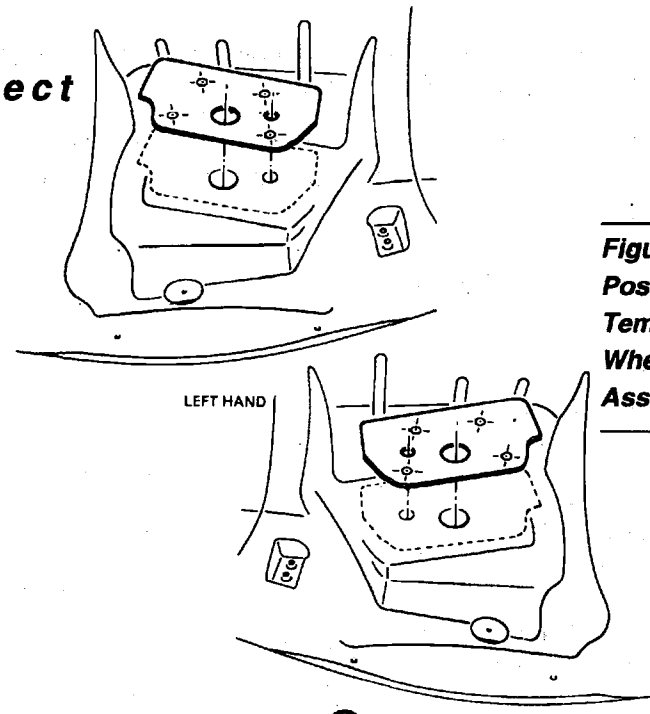


Figure 5-3. Positioning Template to Wheelhouse Assembly

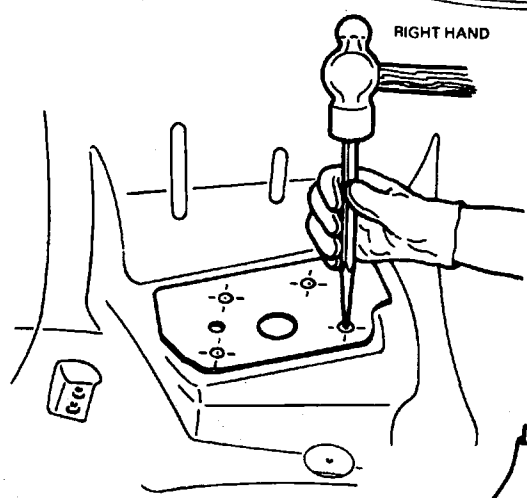


Figure 5-4. Punching Strut Attaching Holes

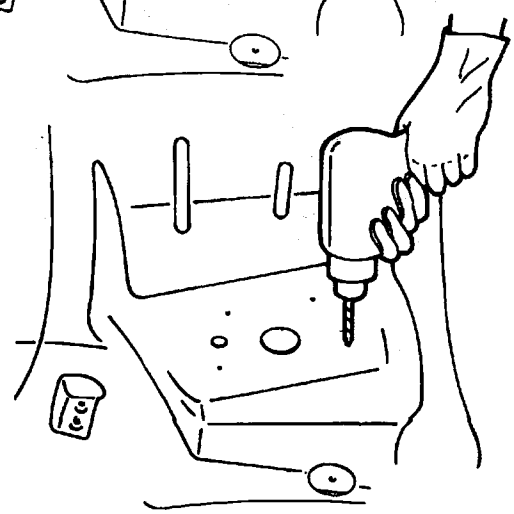


Figure 5-5. Drilling Strut Attaching Holes

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FRONT WHEELHOUSE ASSEMBLY
Install or Connect (Continued)

7 Using a MIG welder, randomly plug weld the new front wheelhouse assembly in place (Figure 5-6).

IMPORTANT
- *Be sure to measure continually throughout welding process to maintain correct dimensions.*

8 Remove clamps. Clean and prepare welded surfaces. Apply 3M Brushable Seam Sealer, part number 08361 or equivalent, as necessary.

9 Refinish according to paint manufacturer's recommendations.

10 Apply anticorrosion material, as necessary.

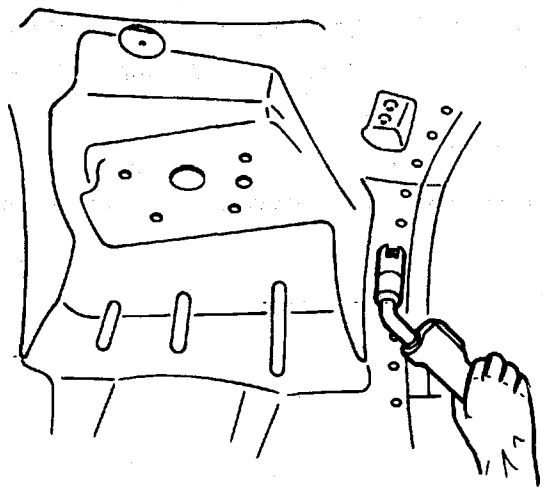


Figure 5-6. Welding Wheelhouse Assembly

SIDE DOOR OPENING FRAME 6

The side door opening frame on the Camaro/Firebird can be either replaced as a unit or sectioned, following the proper techniques. The service part frame will come as a complete unit and will need to be trimmed to fit each application such as coupe, T-Tops, etc. Templates are provided with the service part as a guide for trimming.

The following items may need to be removed or protected before replacing or sectioning the frame, the Door hinges, outer rocker panel, upper outer side rail, windshield, weatherstripping, roof outer panel and T-Tops (if applicable), quarter panel assembly and rear end deck lid assembly.

REPLACEMENT

Remove or Disconnect

1. Remove all applicable panels and components.
2. Remove appropriate sealer.
3. Drill out factory welds around the frame perimeter with a 5/16-inch drill bit.

NOTICE:

- *When drilling out welds, use caution so that inner panels are not damaged.*

4. Note number and location of welds for installation of new door frame.
5. Remove frame.
6. Prepare mating surfaces for installation of new frame.

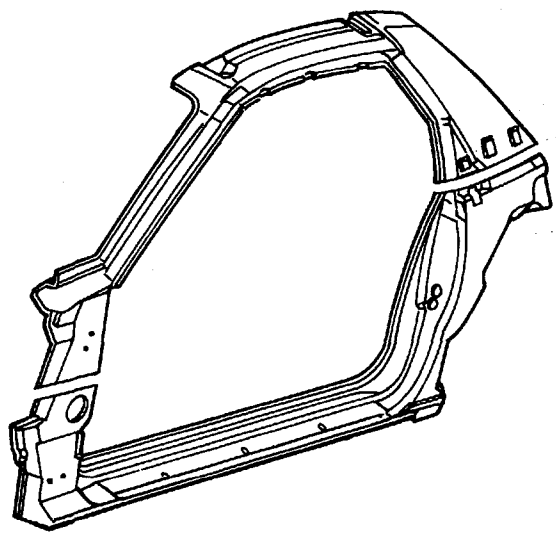


Figure 6-1. Recommended Locations for Sectioning

The recommended locations for sectioning are shown in Figure 6-1. A sectioning procedure may be performed at these locations by overlapping the original panel by 20mm. Use the MIG welding procedures previously discussed.

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SIDE DOOR OPENING FRAME 6

REPLACEMENT

Install or Connect

1 On the new frame, drill 5/16-inch holes in locations as noted from the original frame.

NOTICE:

- *If the original frame is damaged beyond recognition, place holes for welding 1 1/2 inches apart.*

2 Align frame and clamp to hold in place.

3 Using a MIG welder, plug weld at same locations as original.

4 Clean and prepare welded surfaces. Apply Brushable Seam Sealer 3M P/N 08361 or equivalent, as necessary.

5 Refinish according to paint manufacturer's recommendations.

6 Apply anticorrosion material, as necessary.

7 Install all panels and components that were removed.

SIDE DOOR OPENING FRAME 6

SECTIONING

When sectioning the door opening frame, note that there are five locations where sectioning should not take place (Figure 6-2). Sectioning in these areas would jeopardize the structural integrity of the vehicle. When sectioning in an area with no reinforcement, a backing plate or sleeve must be used.

1. Remove all applicable panels and components.
2. Measure, mark, cut and remove the damaged panel, being careful in areas where there are multiple layers of steel.
3. Measure, mark, cut and install the new panel to check for a proper fit (Figure 6-3).
   - *A gap of 1 1/2 times the thickness of the metal must be maintained at the joint between the old panel and the replacement panel. Trim as required.*
4. When the replacement panel fits properly, remove it from the vehicle and set aside.

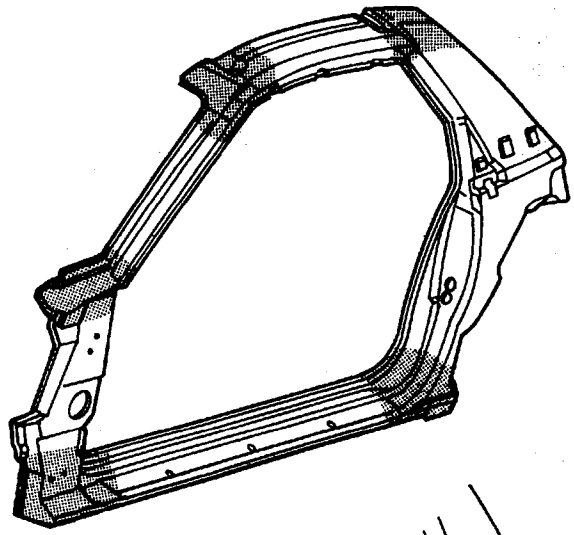


Figure 6-2. Areas Where Sectioning Should Not Take Place

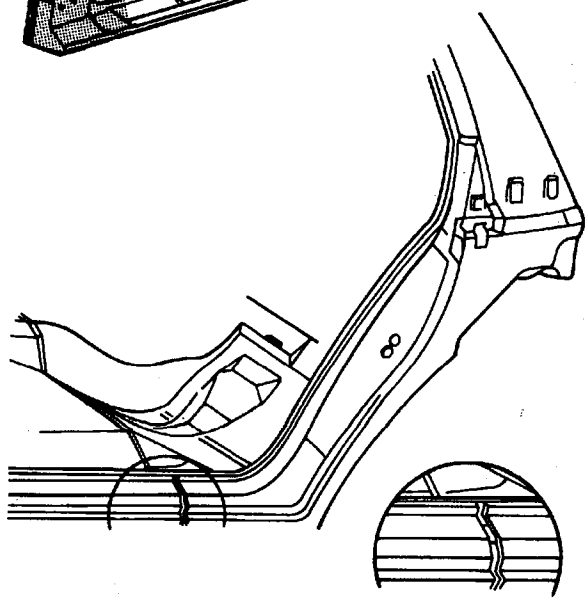


Figure 6-3. Fitting the New Panel

SIDE DOOR OPENING FRAME 6

5 In areas having no inner reinforcements, cut pieces to serve as backing plates of the same configuration (approximately 3 inches long) from the areas where the splices are to be made. Use the damaged panel or the excess portions of the replacement panel (Figure 6-4).

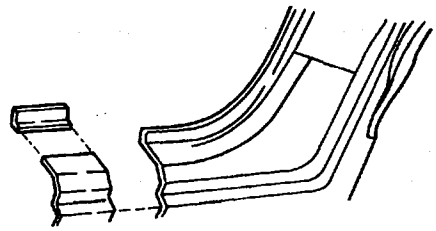


Figure 6-4. Fitting the Backing Plate

6 Modify the pieces so they fit snugly to the backside of the splice joints.

7 Pre-drill 5/16-inch plug weld holes indicated on the following illustrations for installation of new panel (Figure 6-5).

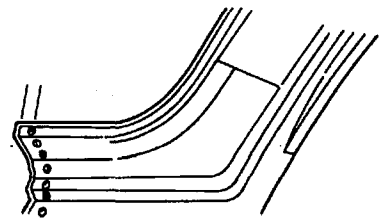


Figure 6-5. Pre-drilling Plug Weld Holes

8 Fit the backing plate halfway into the splice joint on the vehicle. Clamp and MIG weld the backing plate to the vehicle (Figure 6-6).

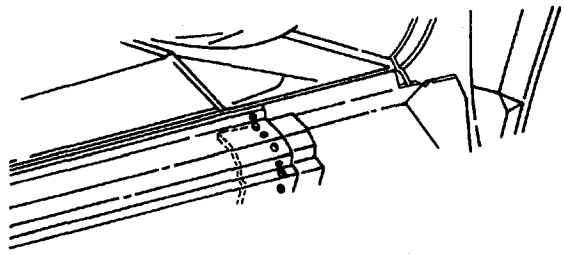


Figure 6-6. Fitting the Backing Plate for Welding

9 When all the backing plates are welded in place, reinstall the new part and check the fit.

10 When the replacement panel is properly fit and aligned, clamp and MIG weld it to the backing plates (Figure 6-7). An alternating weld sequence is recommended to reduce heat and metal distortion.

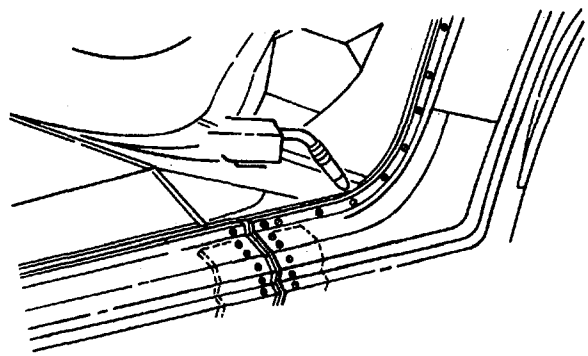


Figure 6-7. Welding the Joint Gap

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SIDE DOOR OPENING FRAME 6

SECTIONING (CONTINUED)

11 Complete the splice joint (Figure 6-7) by welding the joint gap closed using an alternating stitch MIG weld. This will minimize heat build up and distortion. MIG weld the remaining weld holes to attach the panel permanently (Figure 6-8).

12 Grind excess weld off joints and inspect.

13 When satisfied that the weld and splice joints are structurally sound, proceed with the recommended finishing procedures.

14 Clean and prepare welded surfaces. Apply Brushable Seam Sealer 3M P/N 08361, as necessary.

15 Paint and refinish according to paint manufacturer's recommendations.

16 Apply anticorrosion material, as necessary.

17 Install all panels and components that were removed.

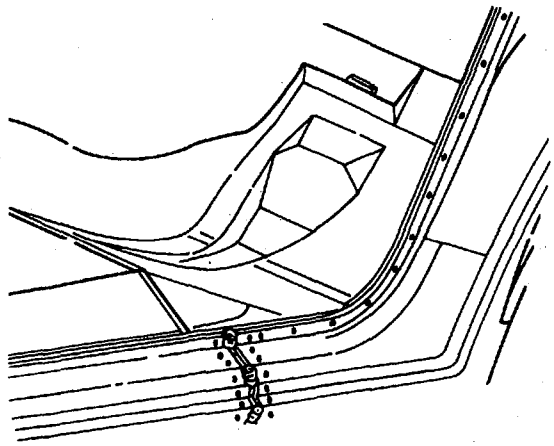


Figure 6-8. Welding the Remaining Holes

DOOR SERVICE

The inner and outer door panels on the new Camaro/Firebird are composed of sheet molded compound (SMC). (Figure 7-1) Repair of the door assembly can be performed using conventional procedures. Detailed information and instructions are available by obtaining General Motors Corporation STG Composite (plastic) Panel Repair publication No. 22005.35-1.

The steps listed below are provided as a reference for removal and replacement of the door outer panel.

Door Outer Panel Replacement

Door outer panels are available through General Motors Service Parts Operations (GMSPO). When a door outer panel requires replacement, remove it from the vehicle and place it on a suitable surface, door outer panel facing up, being careful not to damage the door assembly.

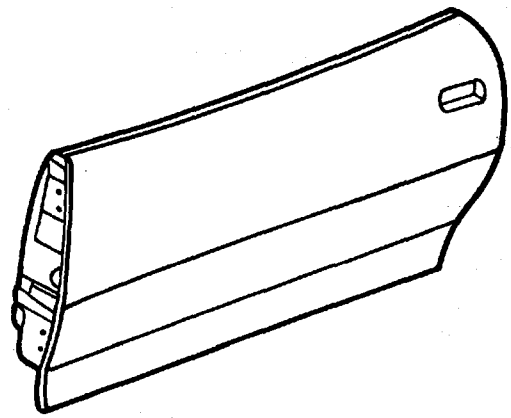


Figure 7-1. Complete Door Assembly

Remove or Disconnect

1. Using the Chicago Pneumatic Pneu-nife CP 838, cut an access hole into the bottom of the door panel. Cut through the outer panel, being careful not to cut into the inner panel, as shown in Figure 7-2.

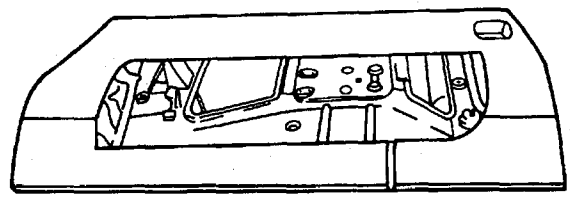


Figure 7-2. Door Outer Panel Replacement

DOOR SERVICE 7

Remove or Disconnect (Continued)

2 Using a heat gun, apply heat to the door outer panel while prying with a putty knife. When the adhesive reaches approximately 400°F, the bond will begin to break. (Figure 7-3)

NOTICE:

- *Do not heat the door inner panel more than necessary as this will soften the panel and cause damage.*

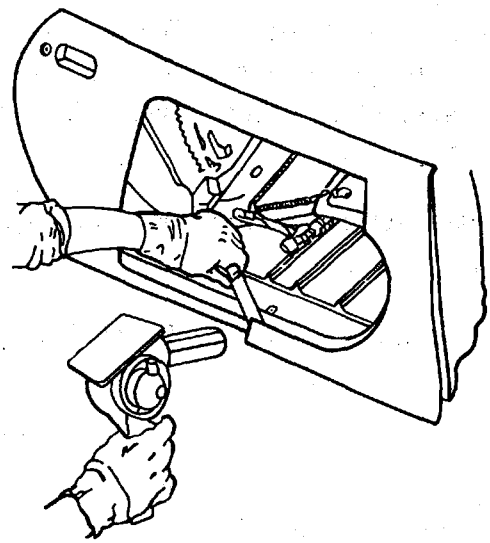


Figure 7-3. Door Outer Panel Removal

3 Continue applying heat and prying with the putty knife until the entire panel is removed. (Figure 7-4)

4 After the door panel has been removed, clean off any excess adhesive left on the inner panel.

Install or Connect

1 Check the fit of the new outer panel. Apply adhesive to the door inner panel.

NOTE:

- *GM Goodwrench Strucural Bonding Epoxy Part No. 12345726 material is recommended.*

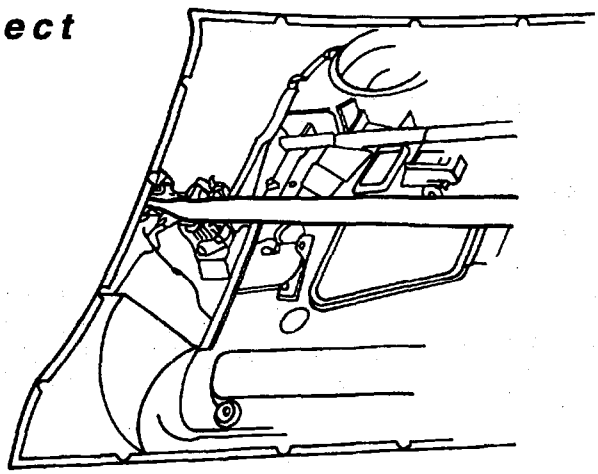


Figure 7-4. Entire Door Outer Panel Removed

2 Set the outer panel in place and clamp until the adhesive is cured.

NOTICE:

- *To avoid unnecessary work, be sure the clamps do not distort the outer door panel.*

3 Clean up excess adhesive.

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ROOF OUTER PANEL

The roof outer panel assembly is composed of sheet molded compound (SMC). It attaches to the steel roof structure with urethane adhesive. Repair of the roof outer panel assembly can be performed using conventional procedures. Detailed information and instructions are available by obtaining General Motors Corporation STG Composite (plastic) Panel Repair publication No. 22005.35-1.

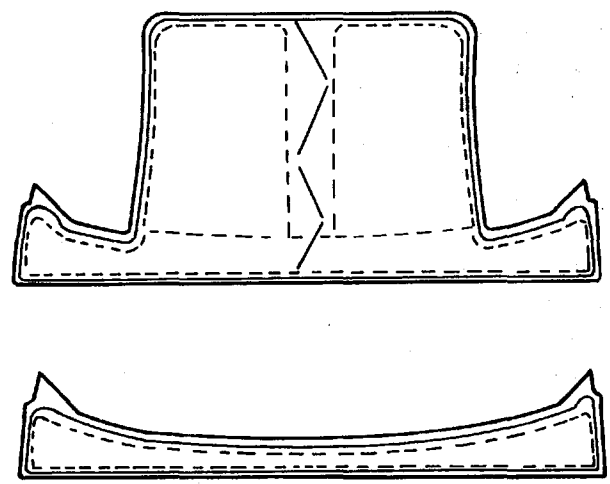
The steps listed below are provided as a reference for removal and replacement of the roof outer panel assembly. Refer to Figure 8-1 for illustrations of the T-top and coupe outer roof panels.

Remove or Disconnect

NOTICE:

- *When cutting, use care to protect adjacent panels, glass, weatherstrips and moldings.*

1. Using a Chicago pneumatic knife with a panel blade, cut roof outer panel 3 inches from all edges and lift off.
2. With a Chicago pneumatic knife with a urethane blade or service wire or Equalizer Magnum, cut urethane adhesive and remove remaining roof outer panel.
3. Remove all loose or damaged urethane as necessary.



- - - CUT LINES
— URETHANE

Figure 8-1. Replacing the Roof Outer Panel

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ROOF OUTER PANEL (CONTINUED)

Install or Connect

1. Temporarily set new roof outer panel into place and check alignment.
2. Remove roof outer panel and set aside.
3. Use appropriate body primer supplied in Adhesive Caulking Kit GM P/N 12345633, on both inner structure and new roof outer panel as required.

NOTICE:

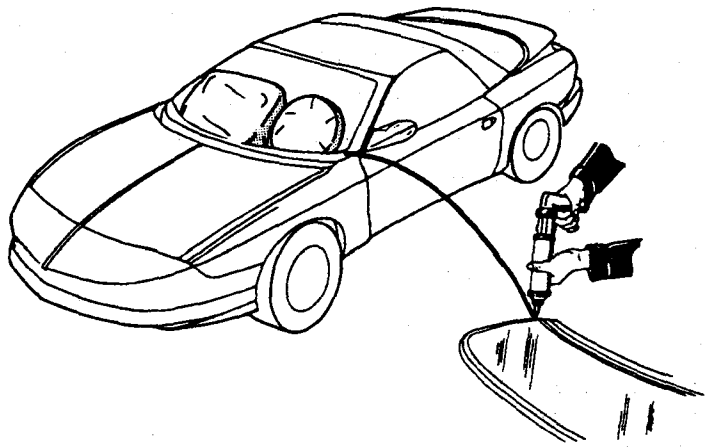
- *Do not prime over remaining urethane adhesive.*

4. Apply urethane adhesive, GM P/N 12345633, approximately 10 mm in diameter, around the perimeter of the roof outer panel.
5. With the aid of a helper, install new roof outer panel and press firmly to set adhesive.
6. Install surrounding weatherstrips and moldings while the roof outer panel cures.

WINDSHIELD REPLACEMENT

CAUTION:

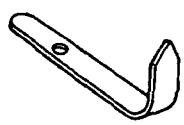
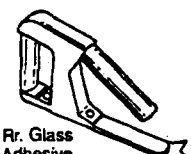
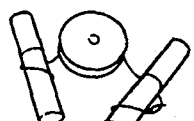
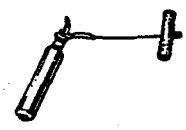
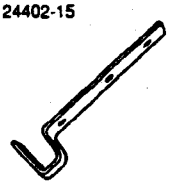
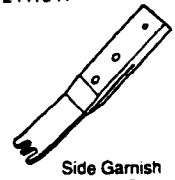
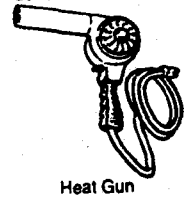
- *When replacing a windshield or hatch roof glass, urethane adhesive GM P/N 12345633, or equivalent must be used to maintain original installation integrity. Failure to use the urethane adhesive GM P/N 12345633, or equivalent will result in poor retention of the windshield which may allow unrestrained occupants to be ejected from the vehicle with resulting personal injury.*



Proper installation of the windshield is extremely important so that occupant protection provided by the supplemental inflatable restraint (SIR) system is maintained.

GM material is available in kit form, GM P/N 12345633, through your local GM Dealer. Essex materials may be ordered through your local PTI jobber or call: 1-800-453-3779 for additional information.

The tools listed below are approved and recommended for GM automotive glass replacement. Tools may be ordered through Kent-Moore. Specify part number when ordering glass.

J 24852  Hot Knife Blade	J 28628  Rr. Glass Adhesive Push-Pull Knife	J 3602D  Windshield Remover	J 39032  Stationary Glass Removal Tool	J 24402-A  Glass Sealant Remover
J 24709-01  Urethane Glass Sealant Remover	J 21549-1  Handle	J 24402-15  Windshield Remover Blade	J 24416-A  Side Garnish Molding Remover	J 25070  Heat Gun

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QUARTER PANEL ASSEMBLY

The quarter panel assembly has been specially designed for improved serviceability. Additional panels have been added allowing for easier and faster service. The quarter panel assembly is attached to the structure with plug welds. To remove the quarter panel assembly, the welds must be drilled out using a 5/16-inch drill bit. The roof outer panel covers a section of the quarter panel assembly at the top and must be positioned out of the way to provide access to the welds. At the bottom of the quarter panel assembly at the rocker panel, there are four hidden welds. They can only be accessed after all the other welds have been drilled out. The quarter panel assembly can be pulled forward and the welds drilled from inside.

NOTICE:

- *Care must be taken when working around the roof outer panel. Failure to use care may result in damage to the roof outer panel. In this case, additional time will be needed in repairing it. Refer to "Rigid Plastic Repair" procedures.*

NOTICE:

- *Service of the quarter panel assembly by splicing a joint just below the roof panel is not recommended. The panel is structural in this area, and splicing will reduce the integrity of the vehicle.*

Remove or Disconnect

1. Make a cut at the top of the quarter panel assembly, as close to the roof panel overlap as possible without damaging it (Figure 10-1).
2. Drill out visible plug welds around the quarter panel assembly. Be sure to note the number and location of welds for the new quarter panel assembly.

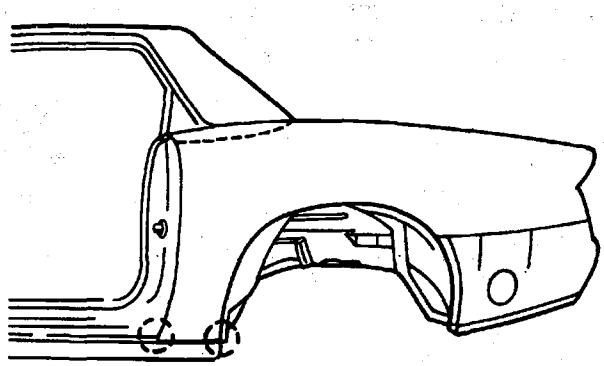


Figure 10-1. Cutting the Top and Bottom of the Quarter Panel

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QUARTER PANEL ASSEMBLY 10

Remove or Disconnect (Continued)

3 Cut inboard flanges fore and aft of the lower quarter panel assembly at the rocker panel assembly (Figure 10-1).

4 Pull upper portion of the quarter panel assembly away from the vehicle and drill out the four inner plug welds at the rocker panel assembly (Figure 10-2). Remove the quarter panel assembly.

5 With a hammer and flat punch, flatten the quarter panel flange remaining at the roof line (Figure 10-3).

6 With a Chicago pneumatic knife using the 3 1/2-inch offset blade, part number KF-140665 or the Equalizer Magnum, cut the urethane adhesive at the bottom edge of the roof outer panel (Figure 10-3).

7 With a service wire, using upward movements, saw urethane from the roof panel away from the "B" pillar area. Cut to the top of the roof outer panel, using caution to avoid damage (Figure 10-4).

NOTICE:

- *When working around the roof outer panel, care must be taken to avoid causing damage.*

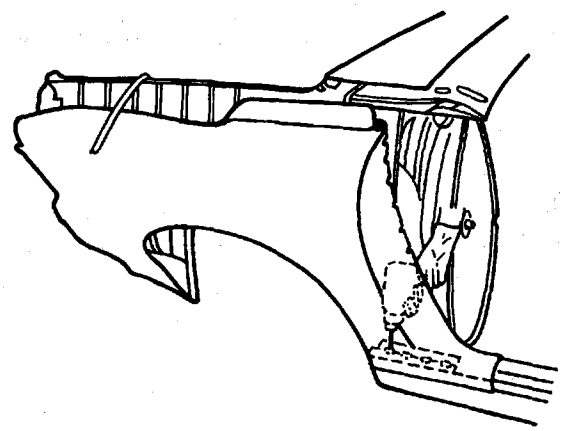


Figure 10-2. Separating the Quarter Panel from the Vehicle

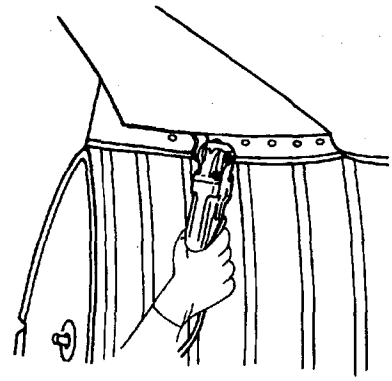


Figure 10-3. Cutting the Roof Outer Panel

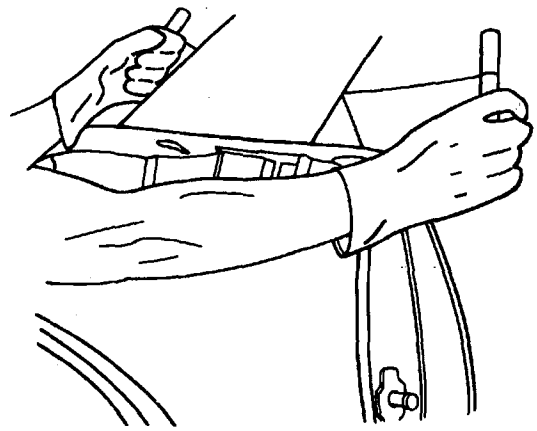


Figure 10-4. Cutting the Urethane from the Roof Panel

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QUARTER PANEL ASSEMBLY

Remove or Disconnect (Continued)

8 To reveal welds, pull the roof outer panel outward and support it out of the way, being careful not to lift too far as damage to the roof outer panel may occur.

9 Drill out exposed welds to remove flange (Figure 10-5).

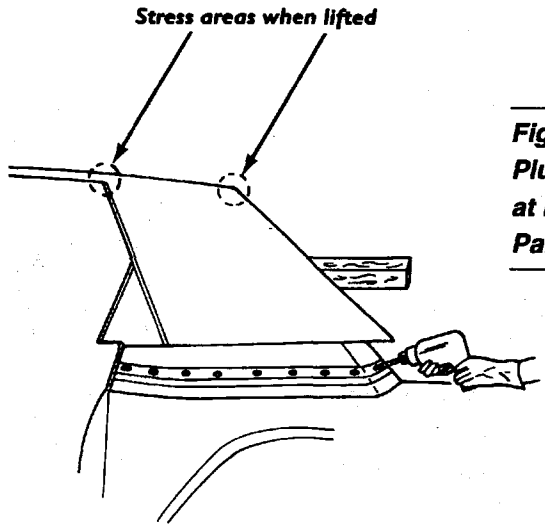


Figure 10-5. Plug Welds at Roof Outer Panel

Install or Connect

1 Prepare mating surfaces for installation of the new quarter panel assembly.

2 Drill holes in locations as noted from the original quarter panel assembly.

IMPORTANT

- *If original is beyond recognition, place holes for welding 1 1/2 inches apart.*

3 Align the new quarter panel assembly and measure.

QUARTER PANEL ASSEMBLY 10

Install or Connect (Continued)

4 With the upper quarter panel assembly pulled away from the vehicle, use a MIG welder to replace the welds in the bottom at the rocker panel (Figure 10-6).

5 Align the remainder of the quarter panel assembly and clamp in place.

6 Plug weld remaining locations (Figure 10-5).

7 At the roof outer panel, remove loose adhesive and clean all surfaces for refinishing, as necessary.

8 Prime with an anticorrosion-type primer to restore damaged ELPO surface. If additional primer for adhesive area is required, see package for appropriate primer.

NOTICE:

- *Be careful not to prime over existing or remaining urethane.*

9 Rebond roof outer panel using GM Urethane P/N 12345633, or equivalent.

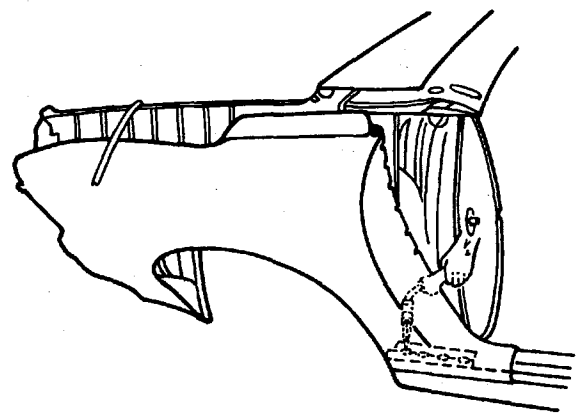
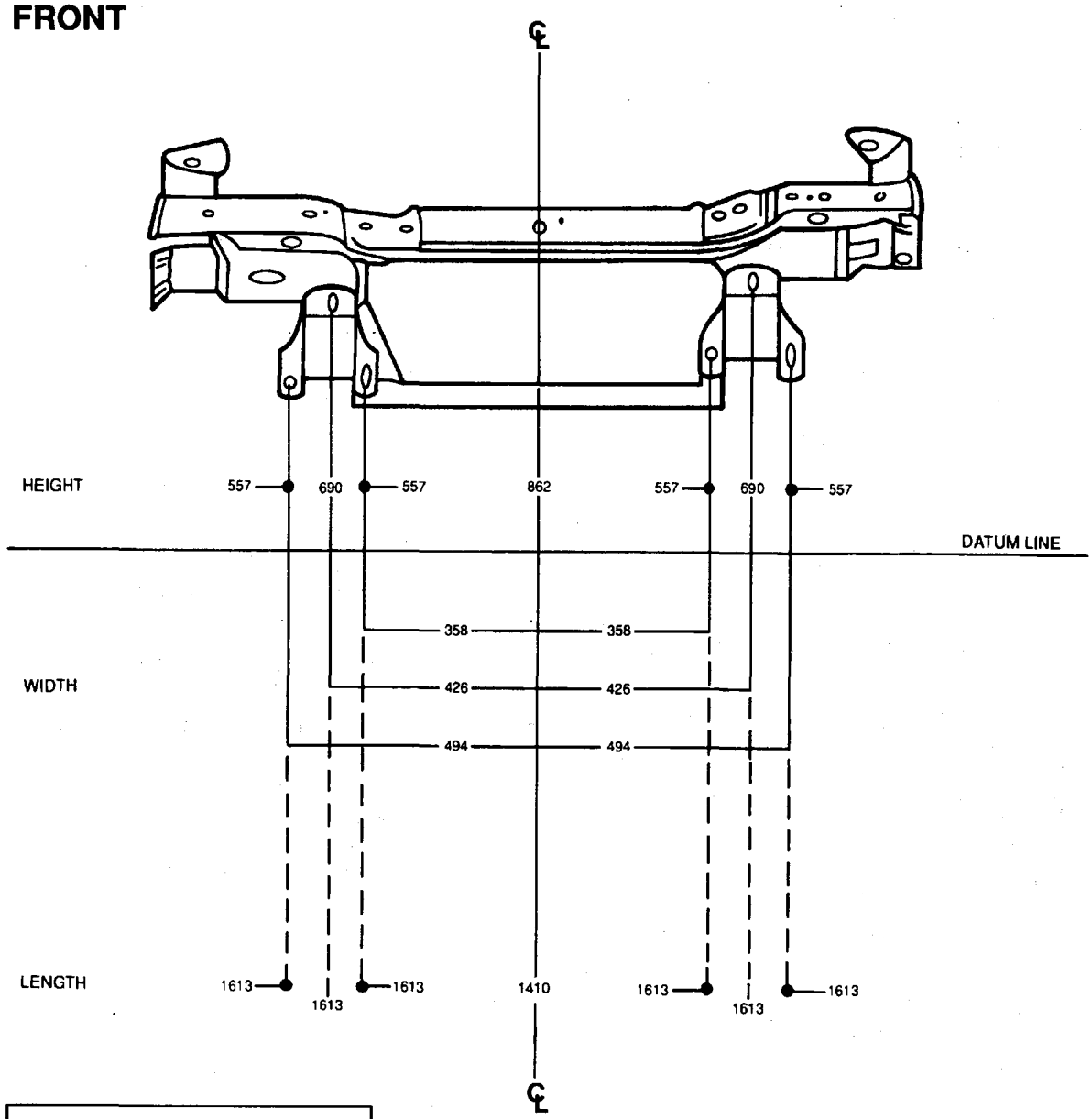


Figure 10-6. Welding the Quarter Panel at the Bottom of the Rocker Panel

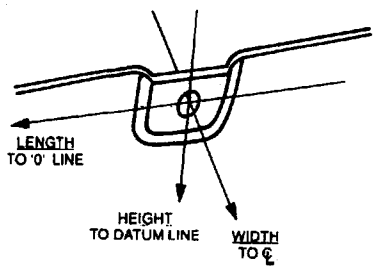
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BODY DIMENSIONS 11

FRONT



FORM AND PIERCE

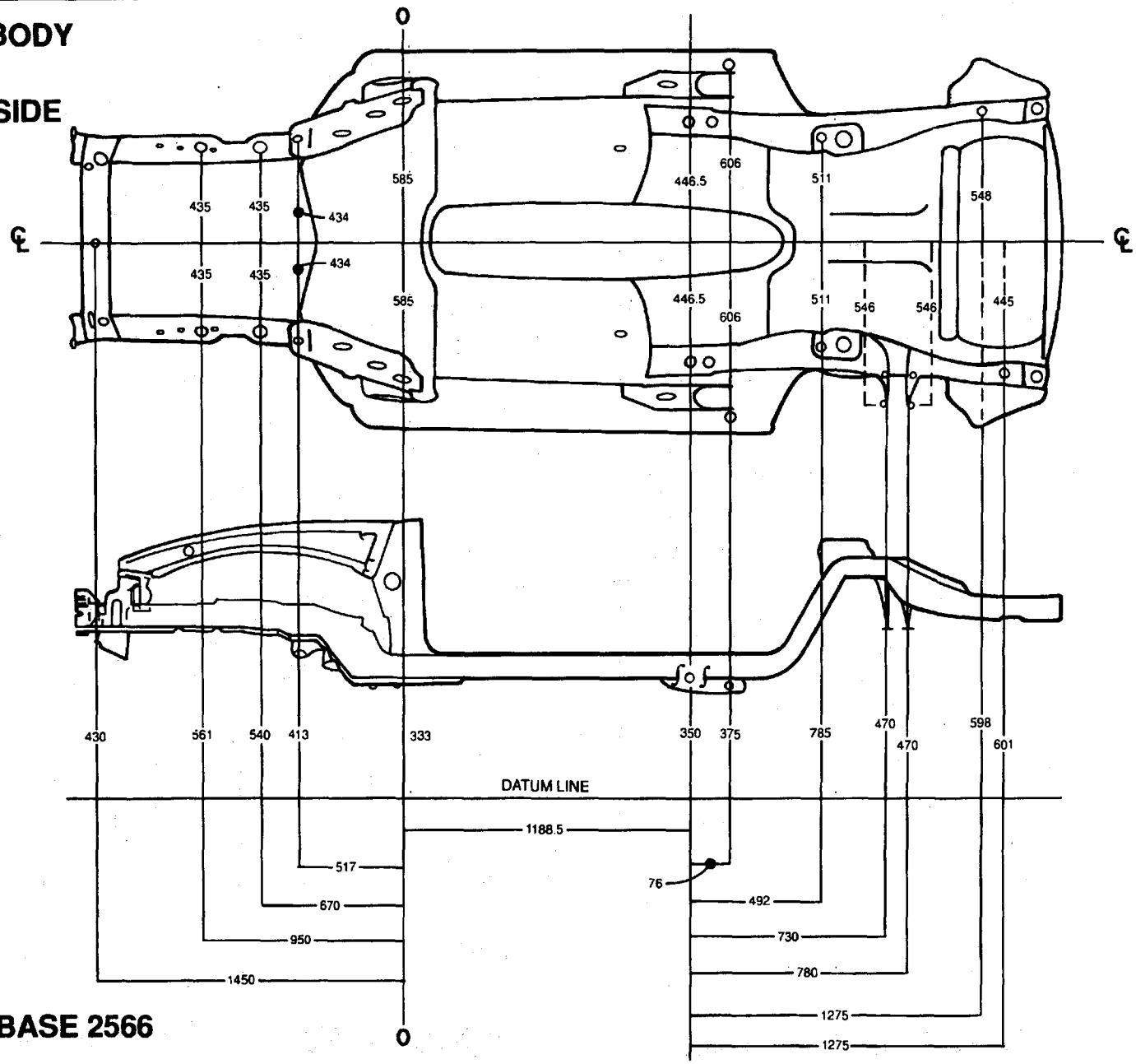


ALL MEASUREMENTS ARE READ FROM (FORMED SURFACES) AND CENTER OF HOLE

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UNDER BODY

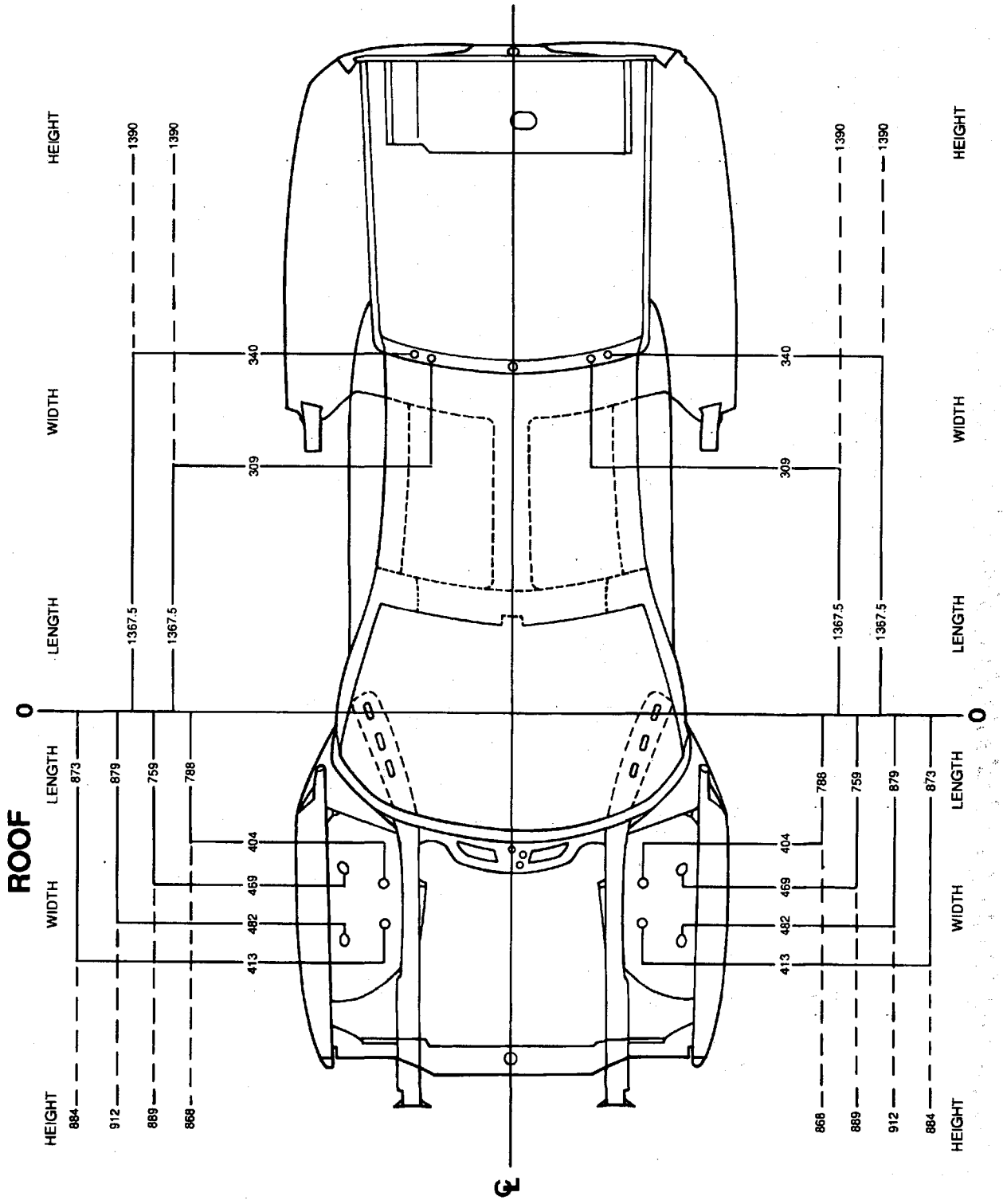
DRIVER SIDE



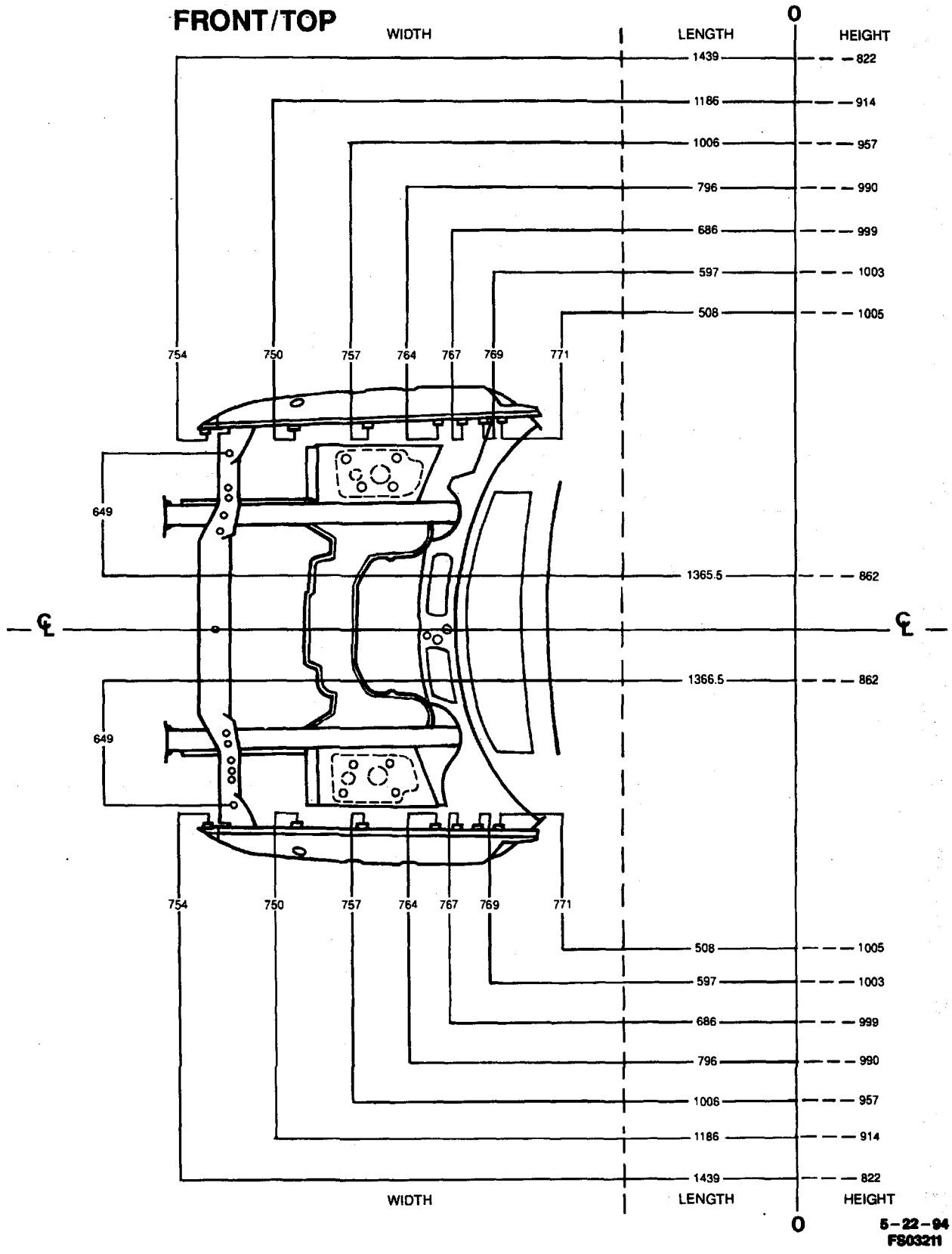
WHEELBASE 2566

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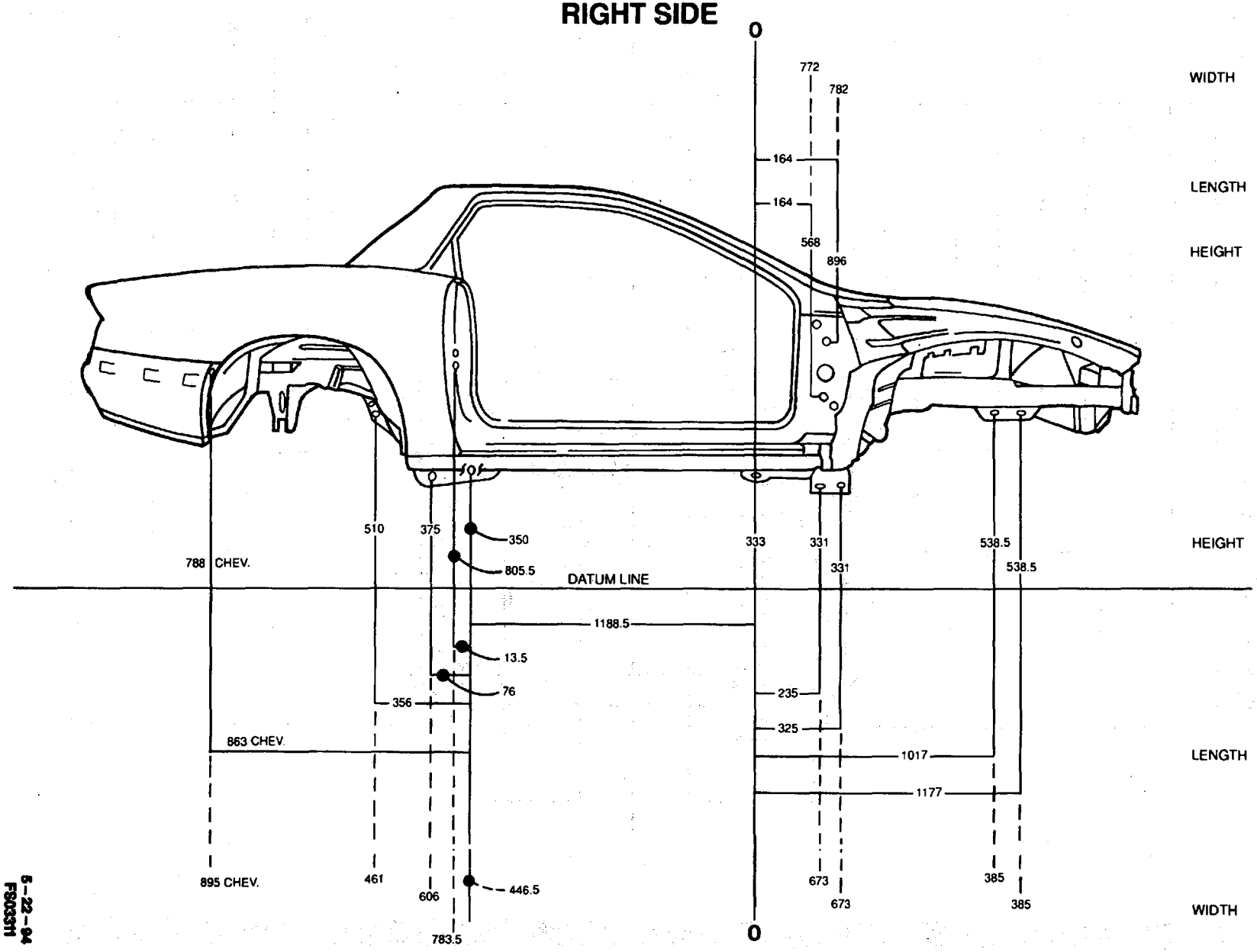
BODY DIMENSIONS 11



BODY DIMENSIONS 11

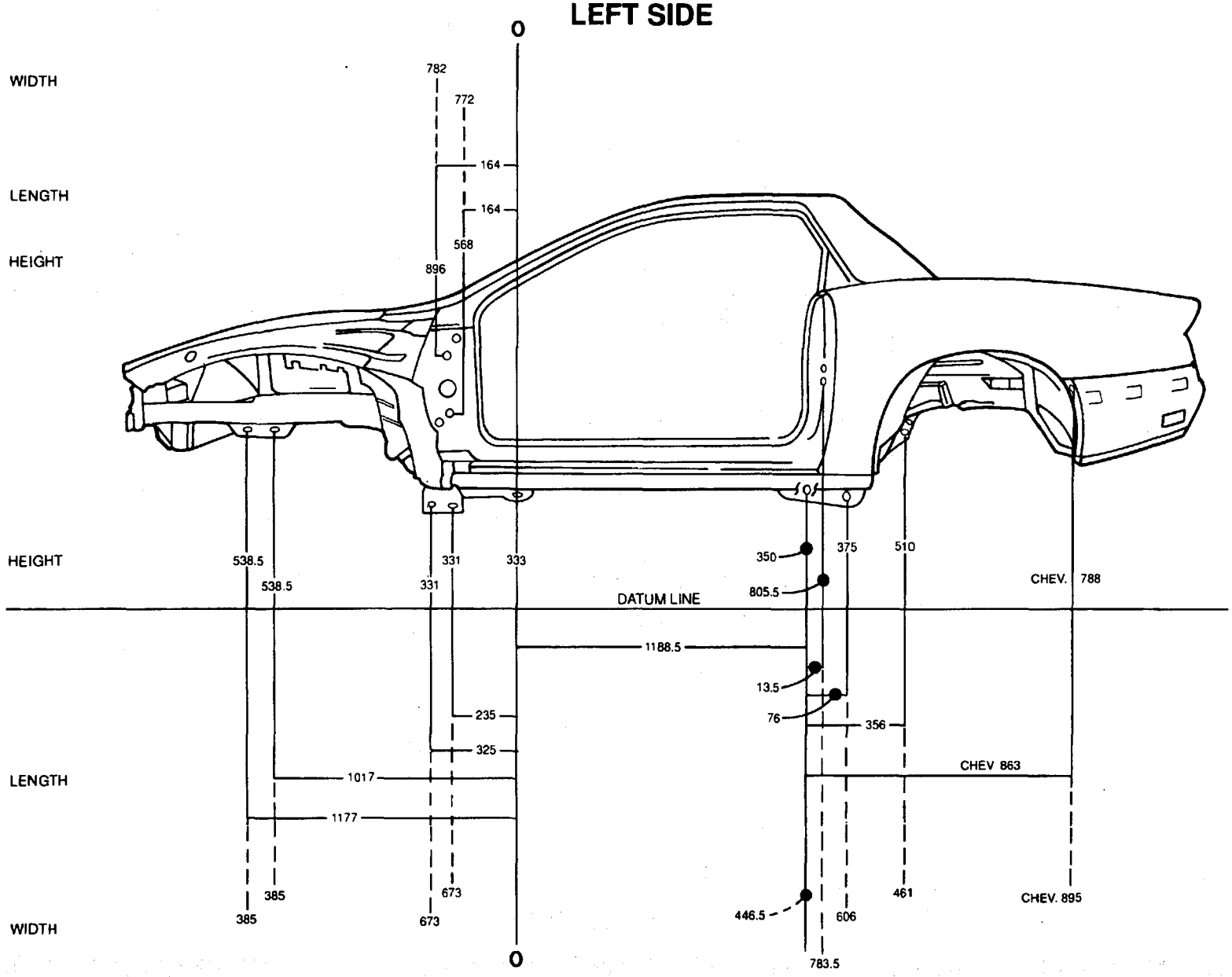


RIGHT SIDE



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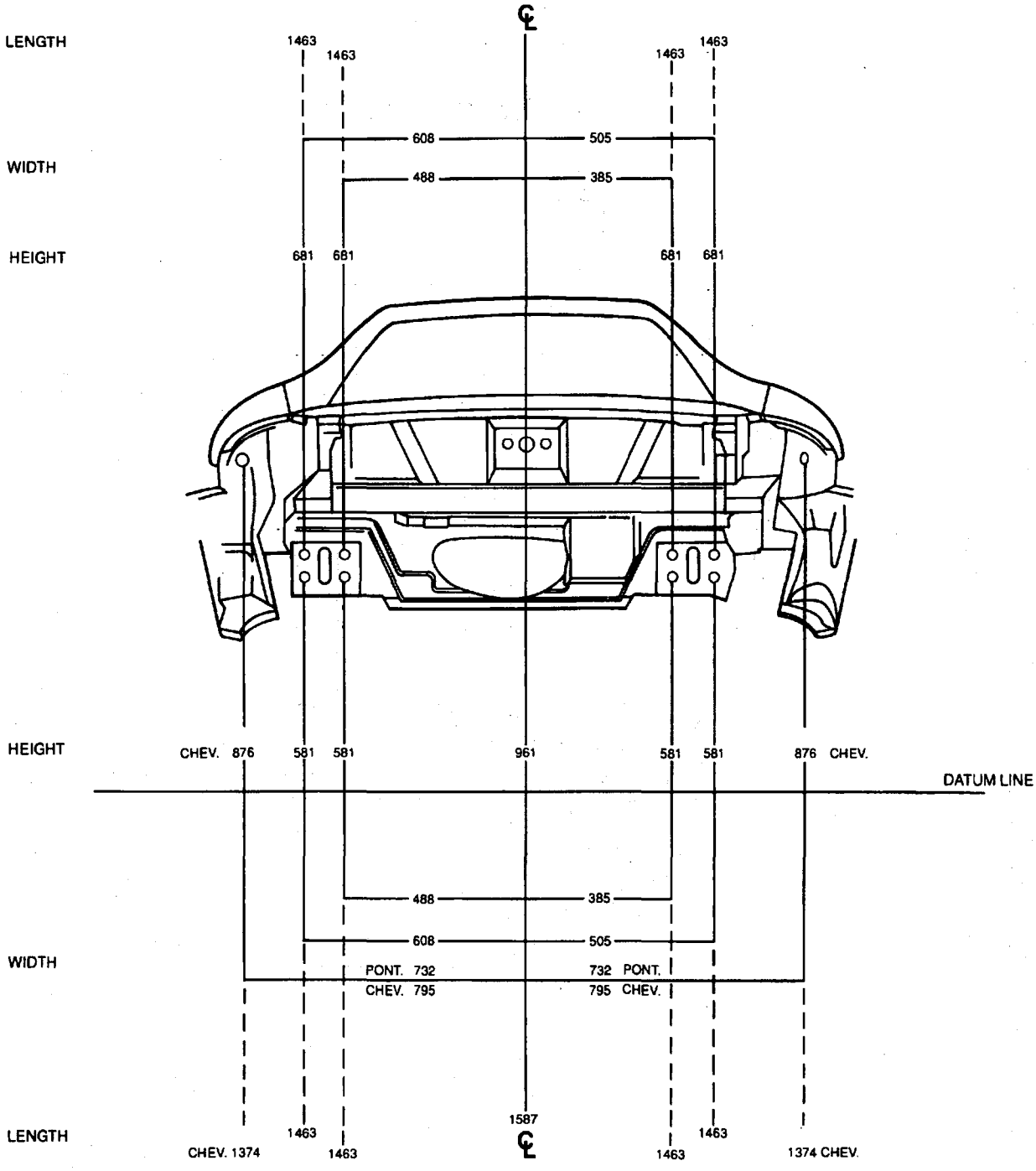
LEFT SIDE



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BODY DIMENSIONS 11

REAR



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A

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