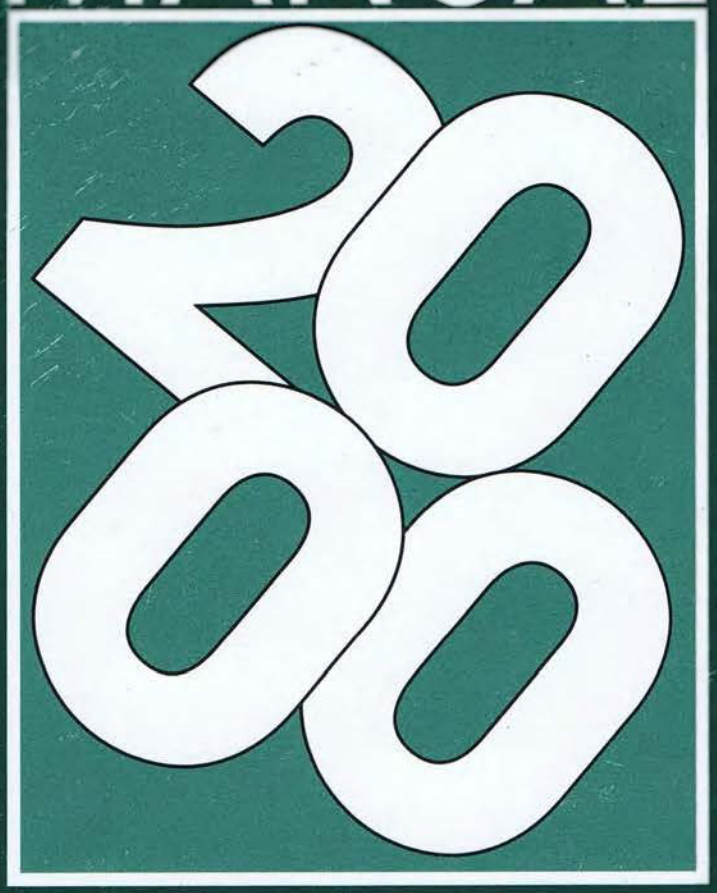
SERVICE MANUAL



CHEVROLET Camaro

PONTIAC Firebird

AUTHENTIC • TECHNICAL • SERVICE • INFORMATION

GM

F - PLATFORM

VOLUME 1 OF 3

GMP/00-F-1

2000 Chevrolet Camaro and Pontiac Firebird Service Manual

Volume 1

This manual provides information on the diagnosis, the service procedures, the adjustments, and the specifications for the 2000 Chevrolet Camaro and Pontiac Firebird.

Information on transmission unit repair (overhaul) can be found in the 2000 Transmission/ Transaxle/Transfer Case Unit Repair Manual (TURM) available separately. The TURM manual contains information on automatic and manual transmissions, including the fluid flow and circuit description information.

The technicians who understand the material in this manual and in the appropriate Dealer Service Bulletins better serve the vehicle owners.

When this manual refers to a brand name, a part number, or a specific tool, you may use an equivalent product in place of the recommended item. All information, illustrations, and specifications in this manual are based on the latest product information available at the time of publication approval. General Motors reserves the right to make changes at any time without notice.

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Cautions and Notices

Definition of Caution, Notice, and Important

The diagnosis and repair procedures in the GM Service Manual contain both general and specific Cautions, Notices, and Importants. GM is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for the proper operation of the vehicle, however, certain procedures may present a hazard to the technician if they are not followed in the recommended manner. Cautions, Notices, and Importants are elements designed to prevent these hazards, however, not all hazards can be foreseen. This information is placed at strategic locations within the service manual. This information is designed to prevent the following from occurring:

- Serious bodily injury to the technician
- Damage to the vehicle
- Unnecessary vehicle repairs
- Unnecessary component replacement
- Improper repair or replacement of vehicle components. Any caution or notice that appears in general information is referenced from the individual service categories.

CAUTION Defined

When encountering a CAUTION, you will be asked to take a necessary action or not to take a prohibited action. If a CAUTION is not heeded, the following consequences may occur:

- Serious bodily injury to the technician
- Serious bodily injury to other technicians in the workplace area
- Serious bodily injury to the driver and/or passenger(s) of the vehicle, if the vehicle has been improperly repaired

NOTICE Defined

Notices call special attention to a necessary action or to a prohibited action. If a NOTICE is not heeded, the following consequences may occur:

- Damage to the vehicle
- Unnecessary vehicle repairs
- Unnecessary component replacement
- Improper operation or performance of the system or component under repair
- Damage to any systems or components which are dependent upon the proper operation of the system or component under repair
- Improper operation or performance of any systems or components which are dependent upon the proper operation or performance of the system or component under repair
- Damage to fasteners, basic tools, or special tools
- The leakage of coolant, lubricant, or other vital fluids

IMPORTANT Defined

IMPORTANT statements emphasize a necessary characteristic of a diagnostic or repair procedure. IMPORTANT statements are designed to do the following:

- Clarify a procedure
- Present additional information for accomplishing a procedure
- Give insight into the reason or reasons for performing a procedure in the manner recommended
- Present information that will help to accomplish a procedure in a more effective manner
- Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease

ABS Handling Caution

Caution: Certain components in the Antilock Brake System (ABS) 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 should be serviced.

Batteries Produce Explosive Gases Caution

Caution: Batteries produce explosive gasses. Batteries contain corrosive acid. Batteries supply levels of electrical current high enough to cause burns. Therefore, to reduce the risk of personal injury while working near a battery:

- ***Always shield your eyes.***
- ***Avoid leaning over the battery whenever possible.***
- ***Do not expose the battery to open flames or sparks.***
- ***Do not allow battery acid to contact the eyes or the skin.***
  - ***Flush any contacted areas with water immediately and thoroughly.***
  - ***Get medical help.***

Battery Disconnect Caution

Caution: Before servicing any electrical component, the ignition key must be in the OFF or LOCK position and all electrical loads must be OFF, unless instructed otherwise in these procedures. If a tool or equipment could easily come in contact with a live exposed electrical terminal, also disconnect the negative battery cable. Failure to follow these precautions may cause personal injury and/or damage to the vehicle or its components.

Brake Dust Caution

Caution: Avoid taking the following actions when you service wheel brake parts:

- *Do not grind brake linings.*
- *Do not sand brake linings.*
- *Do not clean wheel brake parts with a dry brush or with compressed air.*

Some models or aftermarket brake parts may contain asbestos fibers which can become airborne in dust. Breathing dust with asbestos fibers may cause serious bodily harm. Use a water-dampened cloth in order to remove any dust on brake parts. Equipment is available commercially in order to perform this washing function. These wet methods prevent fibers from becoming airborne.

Brake Fluid Irritant Caution

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.*

Brake Pipe Replacement Caution

Caution: Always use double-walled steel brake pipe when replacing brake pipes. The use of any other pipe is not recommended and may cause brake system failure. Carefully route and retain replacement brake pipes. Always use the correct fasteners and in the original location for replacement brake pipes. Failure to properly route and retain brake pipes may cause damage to the brake pipes and brake system resulting in personal injury.

Breathing R-134a Caution

Caution: Avoid breathing the A/C Refrigerant 134a (R-134a) and the lubricant vapor or the mist. Exposure may irritate the eyes, nose, and throat. Work in a well ventilated area. In order to remove R-134a from the A/C system, use service equipment that is certified to meet the requirements of SAE J 2210 (R-134a recycling equipment). If an accidental system discharge occurs, ventilate the work area before continuing service. Additional health and safety information may be obtained from the refrigerant and lubricant manufacturers.

Clutch Dust Caution

Caution: When servicing clutch parts, do not create dust by grinding or sanding the clutch disc or by cleaning parts with a dry brush or with compressed air. A water-dampened cloth—NOT SOAKED—should be used. The clutch disc contains asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm.

Electric Coolant Fan Caution

Caution: An electric fan under the hood can start up even when the engine is not running and can injure you. Keep hands, clothing and tools away from any underhood electric fan.

Express Window Down Caution

Caution: Disconnect the power window switch when working inside the driver's door. When operated, the Express Down Feature allows the door window to drop very quickly, without stopping, which could cause personal injury.

Fuel and EVAP Pipe Caution

Caution: In order to reduce the risk of fire and personal injury observe the following items:

- *Replace all nylon fuel pipes that are nicked, scratched or damaged during installation, do not attempt to repair the sections of the nylon fuel pipes*
- *Do not hammer directly on the fuel harness body clips when installing new fuel pipes. Damage to the nylon pipes may result in a fuel leak.*
- *Always cover nylon vapor 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.*
- *Apply a few drops of clean engine oil to the male pipe ends before connecting fuel pipe fittings. 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.)*

Fuel Gauge Leak Caution

Caution: Wrap a shop towel around the fuel pressure connection in order to reduce the risk of fire and personal injury. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete.

Fuel Pipe Fitting Caution

Caution: Always apply a few drops of clean engine oil to the male pipe ends before connecting fuel pipe fittings in order to reduce the risk of fire and personal injury.

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.

Fuel Storage Caution

Caution: Do not drain the fuel into an open container. Never store the fuel in an open container due to the possibility of a fire or an explosion.

Gasoline/Gasoline Vapors Caution

Caution: Gasoline or gasoline vapors are highly flammable. A fire could occur if an ignition source is present. Never drain or store gasoline or diesel fuel in an open container, due to the possibility of fire or explosion. Have a dry chemical (Class B) fire extinguisher nearby.

Lower O-Ring Removal Caution

Caution: Verify that the lower (small) O-ring of each injector does not remain in the lower manifold in order to reduce the risk of fire and personal injury.

If the O-ring is not removed with the injector, the replacement injector with new O-rings will not seat properly in the injector socket. Improper seating could cause a fuel leak.

Moving Parts and Hot Surfaces Caution

Caution: While working around a running engine, avoid contact with moving parts and hot surfaces to prevent possible bodily injury.

Radiator Cap Removal Caution

Caution: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

Relieving Fuel Pressure Caution

Caution: Relieve the fuel system pressure before servicing fuel system components in order to reduce the risk of fire and personal injury.

After relieving the system pressure, a small amount of fuel may be released when servicing the fuel lines or connections. In order to reduce the chance of personal injury, cover the regulator and the fuel line fittings with a shop towel before disconnecting. This will catch any fuel that may leak out. Place the towel in an approved container when the disconnection is complete.

Road Test Caution

Caution: Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury.

Safety Glasses and Compressed Air Caution

Caution: Wear safety glasses when using compressed air in order to prevent eye injury.

Safety Goggles and Fuel Caution

Caution: Always wear safety goggles when working with fuel in order to protect the eyes from fuel splash.

Seat Belt Replacement Caution

Caution: To help avoid personal injury from unrepaired crash damage to a restraint system:

- *Replace each seat belt system worn during a crash unless the crash was minor.*
- *Perform the seat belt check for each seat belt system. Replace the seat belt system if there is any doubt about the condition of system components.*

SIR Caution

Caution: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Failure to follow the correct procedure could cause air bag deployment, personal injury, or unnecessary SIR system repairs. To help avoid that: (1) Refer to SIR Component Views to determine if you are performing service on or near the SIR components or the SIR wiring. (2) If you are [performing service on or near SIR components or the SIR wiring], you must disable the SIR system, refer to Disabling the SIR System.

SIR Handling Caution

Caution: When you are performing service on or near the SIR components or the SIR wiring, you must disable the SIR system. Refer to Disabling the SIR System. Failure to follow the correct procedure could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

SIR Inflator Module Disposal Caution

Caution: In order to prevent accidental deployment of the air bag which could cause personal injury, do not dispose of an undeployed inflator module as normal shop waste. The undeployed inflator module contains substances that could cause severe illness or personal injury if the sealed container is damaged during disposal. Use the following deployment procedures to safely dispose of an undeployed inflator module. Failure to dispose of an inflator module as instructed may be a violation of federal, state, province, or local laws.

SIR Inflator Module Handling and Storage Caution

Caution: When you are carrying an undeployed inflator module:

- *Do not carry the inflator module by the wires or connector on the inflator module*
- *Make sure the bag opening points away from you*

When you are storing an undeployed inflator module, make sure the bag opening points away from the surface on which the inflator module rests. When you are storing a steering column, do not rest the column with the bag opening facing down and the column vertical. Provide free space for the air bag to expand in case of an accidental deployment. Otherwise, personal injury may result.

SIR Special Tool Caution

Caution: In order to avoid deploying the air bag when troubleshooting the SIR system, use only the equipment specified in this manual and the instructions given in this manual. Failure to use the specified equipment as instructed could cause air bag deployment, personal injury to you or someone else, or unnecessary SIR system repairs.

Vehicle Lifting Caution

Caution: To avoid any vehicle damage, serious personal injury or death when major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed.

Window Removal Caution

Caution: When working with any type of glass, use approved safety glasses and gloves to reduce the chance of personal injury.

Window Retention Caution

Caution: When replacing stationary windows, Urethane Adhesive Kit GM P/N 12346392, or a urethane adhesive system meeting GM Specification GM3651M, must be used to maintain original installation integrity. Failure to use the urethane adhesive kit will result in poor retention of the window which may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.

Work Stall Test Caution

Caution: One or more of the following guidelines may apply when performing specific required tests in the work stall:

- *When a test requires spinning the drive wheels with the vehicle jacked up, adhere to the following precautions:*
  - *Do not exceed 56 km/h (35 mph) when spinning one drive wheel with the other drive wheel stopped. This limit is necessary because the speedometer indicates only one-half the actual vehicle speed under these conditions. Personal injury may result from excessive wheel spinning.*
  - *If all of the drive wheels are spinning at the same speed, do not exceed 112 km/h (70 mph). Personal injury may result from excessive wheel spinning.*
  - *All persons should stay clear of the rotating components and the balance weight areas in order to avoid possible personal injury.*
  - *When running an engine in the repair stall for an extended period of time, use care not to overheat the engine and the transmission.*
- *When a test requires jacking up the vehicle and running with the wheels and brake rotors removed, adhere to the following precautions:*
  - *Support the suspension of all drive wheels at normal ride height.*
  - *Do not apply the brake with the brake rotors removed.*
  - *Do not place the transmission in PARK with the drive wheels still spinning.*
  - *Turn Off the ignition in order to stop the powertrain components from spinning.*

Air in the Power Steering System Notice

Notice: If the power steering system has been serviced, an accurate fluid level reading cannot be obtained unless air is bled from the steering system. The air in the fluid may cause pump cavitation noise and may cause pump damage over a period of time.

Anti-Corrosion Materials Notice

Notice: Anti-corrosion compounds have been applied to the interior surfaces of some metal panels to provide rust resistance. When servicing these panels in areas on which this material has been disturbed, or when installing new panels, avoid corrosion damage by coating with anti-corrosion compound.

Belt Dressing Notice

Notice: Do not use belt dressing on the drive belt. Belt dressing causes the breakdown of the composition of the drive belt. Failure to follow this recommendation will damage the drive belt.

Component Fastener Tightening Notice

Notice: Replacement components must be the correct part number for the application. Components requiring the use of the thread locking compound, lubricants, corrosion inhibitors, or sealants are identified in the service procedure. Some replacement components may come with these coatings already applied. Do not use these coatings on components unless specified. These coatings can affect the final torque, which may affect the operation of the component. Use the correct torque specification when installing components in order to avoid damage.

Defective Scan Tool Notice

Notice: Do not use a scan tool that displays faulty data. Report the scan tool problem to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Engine Emission Notice

Notice: Modifications made to the engine or its individual components can effect the vehicle's emission controls and may cause the Malfunction Indicator Lamp (MIL), Check Engine, or Service Engine Soon lamp to illuminate. Modifications may also cause the vehicle to fail a required Emission Inspection/Maintenance test.

Fastener Notice

Notice: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

Fuel Pressure Notice

Notice: Do not allow the fuel pressure to exceed the specified value because damage to the fuel pressure regulator or the fuel pressure gauge may result.

Fuel Tank Strap Fastener Notice

Notice: Tighten the strap fasteners by steps, alternating between the fasteners, until the specified torque is reached. A failure to tighten the strap fasteners as specified will cause the bottom of the tank to flex upward. This will result in the fuel gauge indicating that there is fuel remaining in the tank when the tank runs dry.

Handling ESD Sensitive Parts Notice

Notice: Electrostatic discharge (ESD) can damage many solid-state electrical components. ESD susceptible components may or may not be labeled with the ESD symbol. Handle all electrical components carefully. Use the following precautions in order to avoid ESD damage:

- Touch a metal ground point in order to remove your body's static charge before servicing any electronic component; especially after sliding across the vehicle seat.
- Do not touch exposed terminals. Terminals may connect to circuits susceptible the ESD damage.
- Do not allow tools to contact exposed terminals when servicing connectors.
- Do not remove components from their protective packaging until required to do so.
- Avoid the following actions unless required by the diagnostic procedure:
  - Jumpering or grounding of the components or connectors.
  - Connecting test equipment probes to components or connectors. Connect the ground lead first when using test probes.
- Ground the protective packaging of any component before opening. Do not rest solid-state components on metal workbenches, or on top of TVs, radios, or other electrical devices.

Handling IAC Valve Notice

Notice: If the IAC valve has been in service: DO NOT push or pull on the IAC valve pintle. The force required to move the pintle may damage the threads on the worm drive. Also, DO NOT soak the IAC valve in any liquid cleaner or solvent, as damage may result.

Heated Oxygen and Oxygen Sensor Notice

Notice: Do not remove this pigtail from either the heated oxygen sensor (HO2S) or the oxygen sensor (O2S). Removing the pigtail or the connector will affect sensor operation.

Handle the oxygen sensor carefully. Do not drop the HO2S. Keep the in-line electrical connector and the louvered end free of grease, dirt, or other contaminants. Do not use cleaning solvents of any type.

Do not repair the wiring, connector or terminals. Replace the oxygen sensor if the pigtail wiring, connector, or terminal is damaged.

This external clean air reference is obtained by way of the oxygen sensor signal and heater wires. Any attempt to repair the wires, connectors, or terminals could result in the obstruction of the air reference and degraded sensor performance.

The following guidelines should be used when servicing the heated oxygen sensor:

- Do not apply contact cleaner or other materials to the sensor or vehicle harness connectors. These materials may get into the sensor causing poor performance.
- Do not damage the sensor pigtail and harness wires in such a way that the wires inside are exposed. This could provide a path for foreign materials to enter the sensor and cause performance problems.
- Ensure the sensor or vehicle lead wires should not be bent sharply or kinked. Sharp bends or kinks could block the reference air path through the lead wire.
- Do not remove or defeat the oxygen sensor ground wire (where applicable). Vehicles that utilize the ground wired sensor may rely on this ground as the only ground contact to the sensor. Removal of the ground wire will cause poor engine performance.
- Ensure that the peripheral seal remains intact on the vehicle harness connector in order to prevent damage due to water intrusion. The engine harness may be repaired using Packard's Crimp and Splice Seals Terminal Repair Kit. Under no circumstances should repairs be soldered since this could result in the air reference being obstructed.

Ignition OFF When Disconnecting Battery Notice

Notice: Always turn the ignition OFF when connecting or disconnecting battery cables, battery chargers, or jumper cables. Failing to do so may damage the Powertrain Control Module (PCM) or other electronic components.

Installing Hoses without Twists or Bends Notice

Notice: The inlet and outlet hoses must not be twisted during installation. Do not bend or distort the inlet or outlet hoses to make installation easier. Failure to follow these procedures could result in component damage.

Nylon Fuel Lines Notice

Notice: Do not attempt to straighten any kinked nylon fuel lines. Replace any kinked nylon fuel feed or return pipes in order to prevent damage to the vehicle.

OBDII System Description Notice

Notice: The OBD II symbol is used on the circuit diagrams in order to alert the technician that the circuit is essential for proper OBD II emission control circuit operation. Any circuit which, if it fails causes the Malfunction Indicator Lamp (MIL) to turn on, is identified as an OBDII circuit.

PCM and ESD Notice

Notice: Do not touch the connector pins or soldered components on the circuit board in order to prevent possible electrostatic discharge (ESD) damage to the PCM.

Servicing and Replacing Seat Belts Notice

Notice: To prevent possible seat belt damage, refer to the following items before servicing or replacing lap and shoulder belts, including single loop belt systems:

- Lap and shoulder belts will be serviced as follows:
  - Replace only the part in question.
  - All belts need to be serviced as a set to assure the belt components are from the same supplier.
  - Do not intermix standard and deluxe belts on front or rear seats.
  - All attachment hardware must be replaced, not reused.
- Keep sharp edges and damaging objects away from belts.
- Avoid bending or damaging any portion of the belt buckle or latch plate.
- Do not bleach or dye belt or strap webbing. Clean with a mild soap solution and water.
- When installing lap or shoulder belt anchor bolts, start the bolts by hand to ensure that the bolts are threaded straight.
- Do not attempt repairs on lap or shoulder belt retractor mechanisms to lap belt retractor covers. Replace defective assemblies with new service replacement parts.
- Do not attempt to remove the seat belt retractor cover. The cover and the long rivet securing the cover to the retractor are not available as service replacement parts.

Test Probe Notice

Notice: Do not insert test equipment probes into any connector or fuse block terminal. The diameter of the test probes will deform most terminals. A deformed terminal can cause a poor connection, which can result in system failures. Always use the J 35616-A Connector Test Adapter Kit or the J 42675 Flat Wire Probe Adapter Kit in order to frontprobe terminals. Do not use paper clips or other substitutes as they can damage terminals and cause incorrect measurements.

Using Proper Power Steering Fluid Notice

Notice: When adding fluid or making a complete fluid change, always use the proper power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

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General Information

Conversion - English/Metric

English	Multiply/ Divide by	Metric
Length		
in	25.4	mm
ft	0.3048	m
yd	0.9144	
mi	1.609	km
Area		
sq in	645.2	sq mm
	6.45	sq cm
sq ft	0.0929	sq m
sq yd	0.8361	
Volume		
cu in	16,387.0	cu mm
	16.397	cu cm
	0.0164	L
qt	0.9464	
gal	3.7854	
cu yd	0.746	cu m
Mass		
lb	0.4536	kg
ton	907.18	
	0.907	tonne (t)
Force		
kg	9.807	newtons (N)
oz	0.2780	
lb	4.448	
Acceleration		
ft/s^2	0.3048	m/s^2
in/s^2	0.0254	
Torque		
lb in	0.11296	N·m
lb ft	1.3558	
Power		
hp	0.745	kW
Pressure (Stress)		
inches of H2O	0.2491	kPa
lb/sq in	6.895	
Energy (Work)		
Btu	1055.0	J (J= one Ws)
lb ft	1.3558	
kW hour	3,600,000.0	
Light		
Foot Candle	10.764	lm/m^2
Velocity		
mph	1.6093	km/h

Conversion - English/Metric (cont'd)

English	Multiply/ Divide by	Metric
Temperature		
(°F-32) / 1.8	=	°C
°F	=	(°C X 1.8) + 32
Fuel Performance		
235.215/mpg	=	L/100 km

Equivalents - Decimal and Metric

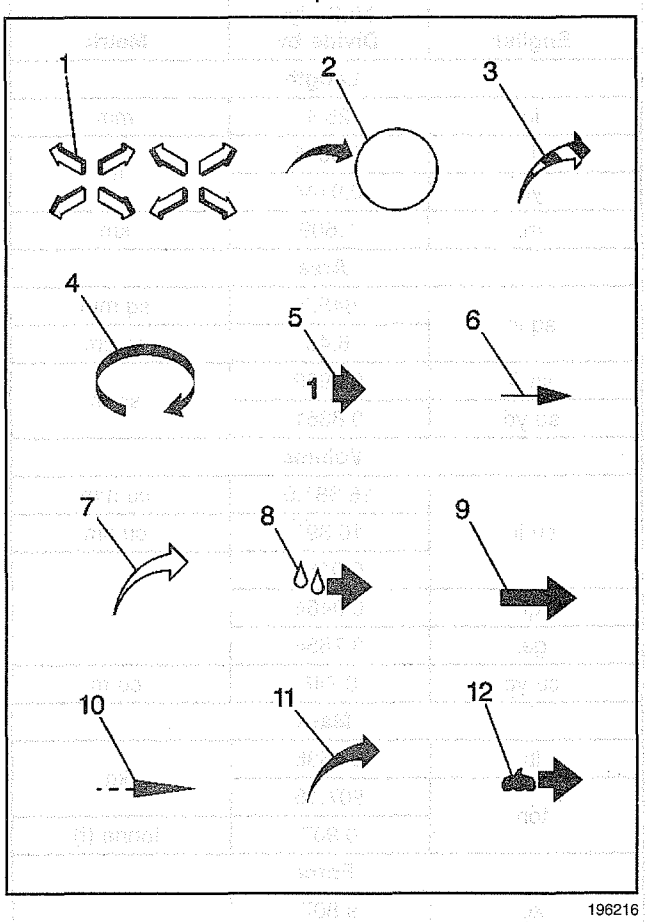
Fraction (in)	Decimal (in)	Metric (mm)
1/64	0.015625	0.39688
1/32	0.03125	0.79375
3/64	0.046875	1.19062
1/16	0.0625	1.5875
5/64	0.078125	1.98437
3/32	0.09375	2.38125
7/64	0.109375	2.77812
1/8	0.125	3.175
9/64	0.140625	3.57187
5/32	0.15625	3.96875
11/64	0.171875	4.36562
3/16	0.1875	4.7625
13/64	0.203125	5.15937
7/32	0.21875	5.55625
15/64	0.234375	5.95312
1/4	0.25	6.35
17/64	0.265625	6.74687
9/32	0.28125	7.14375
19/64	0.296875	7.54062
5/16	0.3125	7.9375
21/64	0.328125	8.33437
11/32	0.34375	8.73125
23/64	0.359375	9.12812
3/8	0.375	9.525
25/64	0.390625	9.92187
13/32	0.40625	10.31875
27/64	0.421875	10.71562
7/16	0.4375	11.1125
29/64	0.453125	11.50937
15/32	0.46875	11.90625
31/64	0.484375	12.30312
1/2	0.5	12.7
33/64	0.515625	13.09687
17/32	0.53125	13.49375
35/64	0.546875	13.89062
9/16	0.5625	14.2875
37/64	0.578125	14.68437
19/32	0.59375	15.08125

Equivalents - Decimal and Metric (cont'd)

Fraction (in)	Decimal (in)	Metric (mm)
39/64	0.609375	15.47812
5/8	0.625	15.875
41/64	0.640625	16.27187
21/32	0.65625	16.66875
43/64	0.671875	17.06562
11/16	0.6875	17.4625
45/64	0.703125	17.85937
23/32	0.71875	18.25625
47/64	0.734375	18.65312
3/4	0.75	19.05
49/64	0.765625	19.44687
25/32	0.78125	19.84375
51/64	0.796875	20.24062
13/16	0.8125	20.6375
53/64	0.828125	21.03437
27/32	0.84375	21.43125
55/64	0.859375	21.82812
7/8	0.875	22.225
57/64	0.890625	22.62187
29/32	0.90625	23.01875
59/64	0.921875	23.41562
15/16	0.9375	23.8125
61/64	0.953125	24.20937
31/32	0.96875	24.60625
63/64	0.984375	25.00312
1	1.0	25.4

Arrows and Symbols

This service manual uses various symbols in order to describe different service operations.



196216

Legend

(1) Front of Vehicle
(2) View Detail
(3) Ambient Air Mixed With Another Gas or Indicate Temperature Change
(4) Motion or Direction
(5) View Angle
(6) Dimension (1:2)
(7) Ambient/Clean Air Flow or Cool Air Flow
(8) Lubrication Point—Oil or Fluid
(9) Task Related
(10) Sectioning (1:3)
(11) Gas Other Than Ambient Air or Hot Air Flow
(12) Lubrication Point—Grease or Jelly

Special Tools Ordering Information

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

OE Tool and Equipment Group
Kent-Moore
28635 Mound Road
Warren, MI, U.S.A. 48092–3499
Phone: 1–800–345–2233 or 810–574–2332
Monday through Friday
8:00 a.m.–7:00 p.m. Eastern Standard Time
Fax: 1–800–578–7375 or 810–578–7321

The TECH 2® scan tool and accessories can be purchased through:

Dealer Equipment and Services
5775 Enterprise Dr.
Warren, MI, U.S.A. 48092–3463
Phone: 1–800–GM-TOOLS or 810–574–2332
Monday through Friday
8:00 a.m.–6:00 p.m. EST
Fax: 1–810–578–7205

Diagnostic Work Sheets

The GM Diagnostic Worksheet has been designed to improve communications between the service customer and the technician. The diagnostic worksheet can provide the technician with more information than the conventional repair order, since it is filled out by the service customer. The GM Diagnostic Worksheets are available to you at no cost. GM Service Bulletin 58-01-01 has information on how to order this diagnostic worksheet.

Training

General Motors makes available automotive classroom training through the GM Training Centers and colleges.

GMCL (General Motors of Canada Ltd)

Dealers

Course scheduling for GMCL Training Centres, remote and college locations is determined by Dealer Training Needs requested in TAMS (Technician Activity Monitoring System). Dealers register their Training Needs electronically via DCS. Training is then scheduled when sufficient Needs are received to support minimum classroom attendance. Dealers who have entered Needs will receive invitations via DCS (Dealer Communication System) to attend the requested training. Dealers having questions concerning the GMCL training process can directly contact GMCL Training Co-ordinators via toll free numbers 1-800-263-9555 (English) or 1-800-263-9770 (French).

Fleets

GMCL Fleet Training is accomplished through a separate training organization in Canada. Fleets can request training by faxing a document contained in a GMCL brochure (Fleet Training - Your Competitive Advantage) distributed to fleets (FAX # 905-831-1598). Further information concerning Fleet training can be obtained by calling toll free to 1-888-456-6660.

United States

Dealers

All US Dealers enroll through the GM Enrollment Calling Center (EEC). Each GM Dealer has an assigned consultant that calls the Service Manager each month. During this consultation call, the EEC processes enrollments requested by the Dealer Service Manager. Technicians should advise their Service Manager of the training they need, course names, and course numbers for the classes the want to attend.

Fleets

Fleets are to call their GM Training Center.

Non-GM Dealer Technician

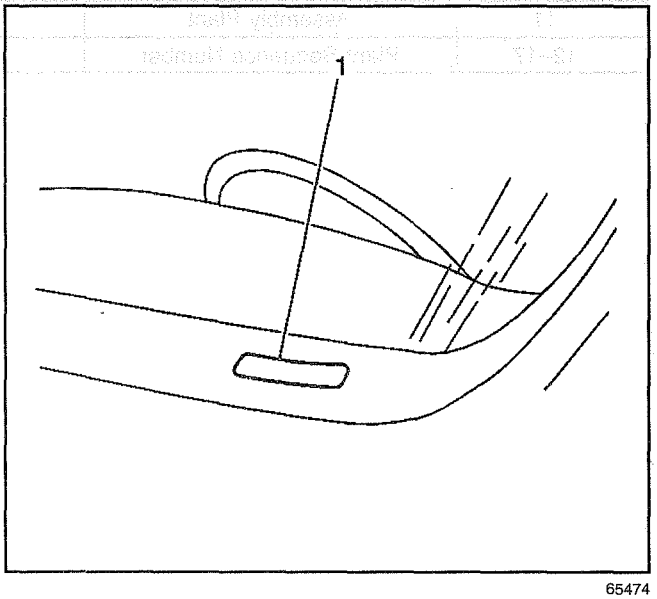
Technician training for non-GM dealers is available through ACDelco. This training is for ACDelco customers employed in the automotive or truck service industry.

GM Training Center course availability and schedules can be obtained by calling 1-800-825-5886.

Clinics are offered through ACDelco Warehouse Distributors. Contact yours directly.

Correspondence courses are available on batteries, spark plugs and filters. These courses can be obtained through any ACDelco Representative or ACDelco Warehouse Distributor.

Vehicle Identification



65474

Legend

(1) Vehicle Identification Number Plate Location

The vehicle identification number (VIN) plate is the legal identifier of the vehicle. The VIN plate is located on the upper LH corner of the instrument panel (IP) and can be seen through the windshield from the outside of the vehicle.

The last five digits of the assembly plant sequential number are stamped onto the rear side of the front sill (tie bar). This number is the same as the last five digits on the VIN plate. The VIN plate also has bar code characteristics.

Vehicle Identification Number (VIN) System

Position	Definition	Character	Description
1	Country of Origin	2	Canada
2	Manufacturer	G	General Motors
3	Division	1	Chevrolet
—	2	Pontiac	Camaro Sport Coupe
4–5	Carline/Series	FP	
—	FS	Firebird	Two Door
—	FV	Formula/ Trans Am	
6	Body Type	2	
—	3	Two Door Convertible	Active (Manual) Belts with Driver and Passenger Inflatable Restraint System
7	Restraint System	2	
8	Engine	G	RPO LS1, V8, 5.7L, SFI, United States Production, Mid/Lux Division
—	K	RPO L36, V6, 3.8L, SFI, United States Production, Mid/Lux Division	—
9	Check Digit	0	
10	Model Year	Y	2000
11	Assembly Plant	2	St Therese, Quebec
12–17	Plant Sequence Number	—	—

VIN Derivative

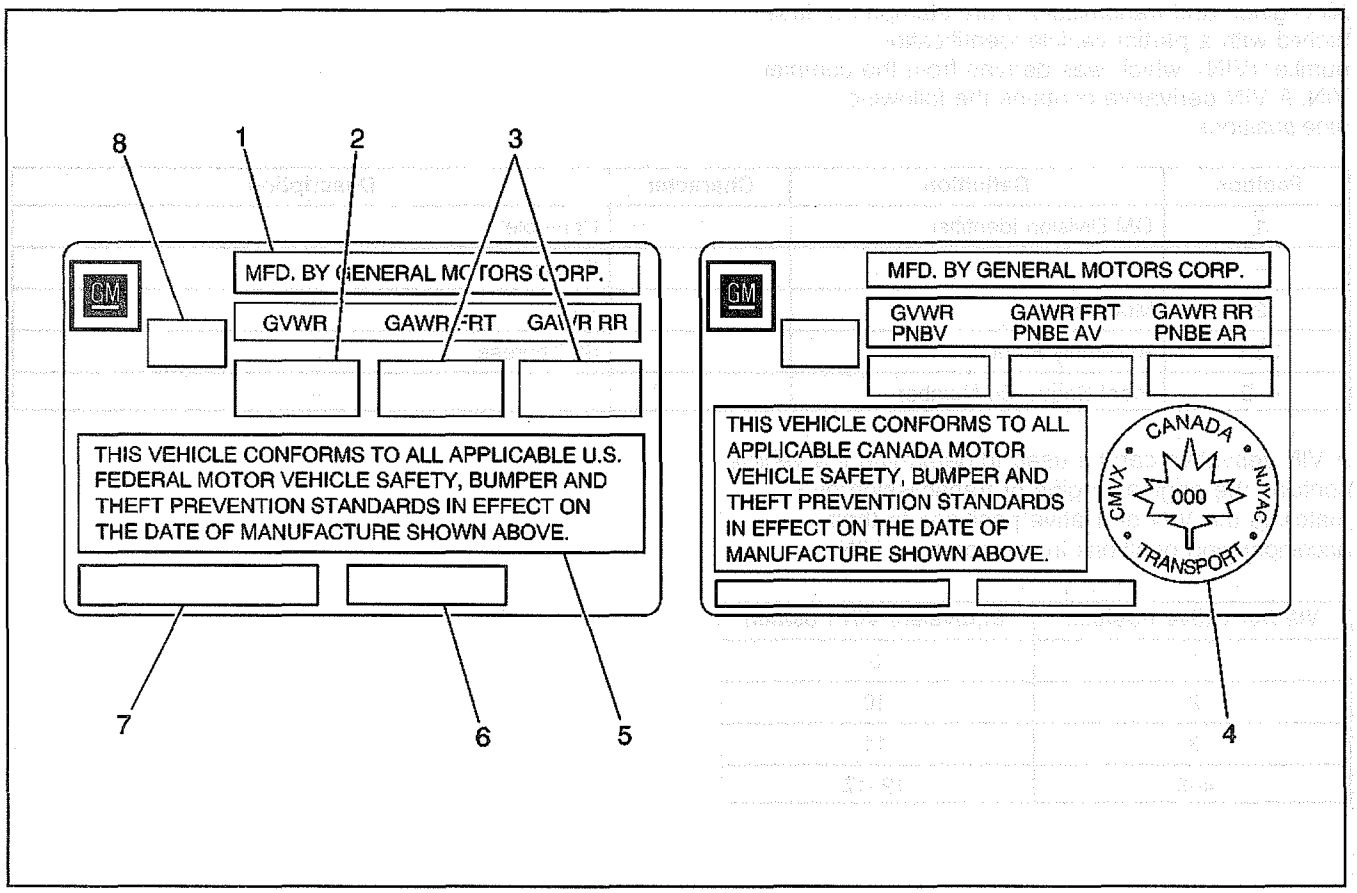
All engines and transmissions are stamped or laser etched with a partial vehicle identification number (VIN), which was derived from the complete VIN. A VIN derivative contains the following nine positions:

Position	Definition	Character	Description
1	GM Division Identifier	1	Chevrolet
—	—	2	Pontiac
2	Model Year	Y	2000
3	Assembly Plant	2	St. Therese
4–9	Plant Sequence Number	—	—

A VIN derivative can be used to determine if a vehicle contains the original engine or transmission by matching the VIN derivative positions to their accompanying positions in the complete VIN:

VIN Derivative Position	Equivalent VIN Position
1	3
2	10
3	11
4–9	12–17

Label - Vehicle Certification



65484

The vehicle certification label displays the following assessments:

- The name of the manufacturer (1)
- The Gross Vehicle Weight Rating (GVWR) (2)
- The Gross Axle Weight Rating (GAWR) (3)
- The vehicle payload rating
- The vehicle class type (Pass Car, etc) (6)
- The vehicle identification number (7)
- The date of manufacture (Mo/Yr) (8)
- The original equipment tire sizes and the recommended tire pressures

Gross vehicle weight (GVW) is the weight of the vehicle and everything it carries. Include the following items when figuring the GVW:

- The base vehicle weight (factory weight)
- The weight of the vehicle accessories
- The weight of the driver and the passengers
- The weight of the cargo

The gross vehicle weight must not exceed the Gross Vehicle Weight Rating.

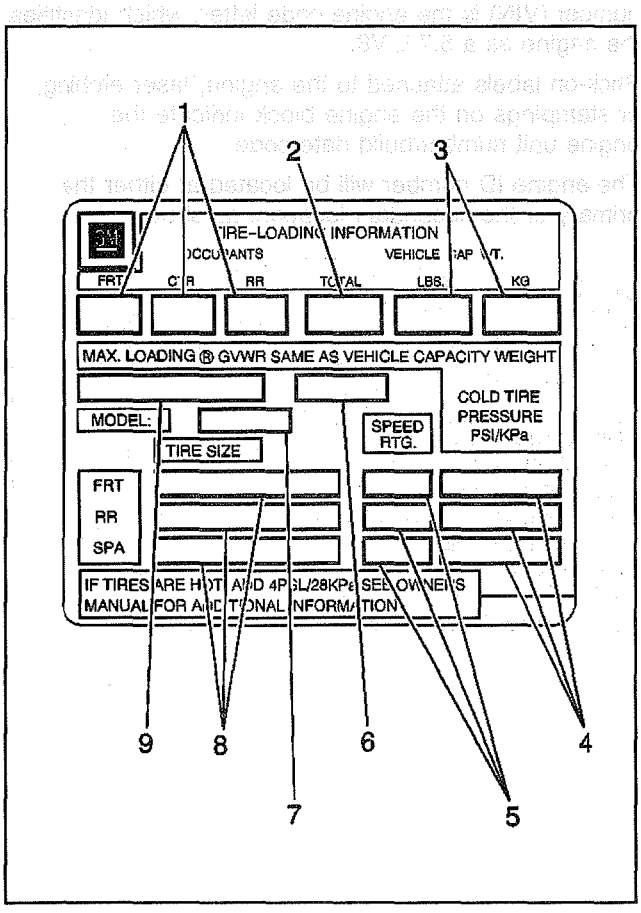
The front gross axle weight (GAW) is the weight exerted on the front axle. The rear gross axle weight (GAW) is the weight exerted on the rear axle. The front and rear gross axle weights must not exceed the front and rear gross axle weight ratings.

The payload rating defines the vehicle's maximum allowable cargo load. The cargo load includes the driver and the passengers. The payload rating is based on the vehicle's factory installed equipment. Deduct the weight of accessories added to the vehicle after the final date of manufacture from the payload rating.

The vehicle may have a Gross Combination Weight Rating (GCWR). The Gross Combination Weight Rating refers to the total maximum weight of the loaded tow vehicle (including driver and passengers) and a loaded trailer.

The vehicle's tires must be the proper size and properly inflated for the load the vehicle is carrying. For more information on tires refer to *Tire Placard*.

Tire Placard



65541

Legend

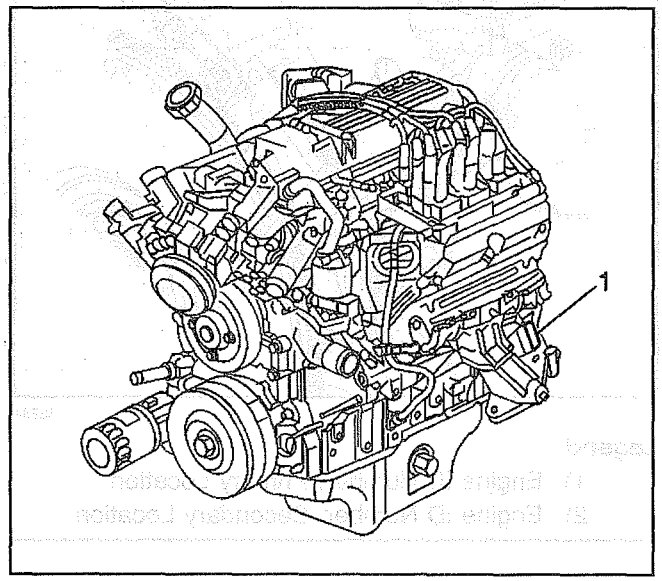
(1) Specified Occupant Seating Positions
(2) Total Occupant Seating
(3) Maximum Vehicle Capacity Weight
(4) Tire Pressures, Front, Rear, and Spare
(5) Tire Speed Rating, Front, Rear, and Spare
(6) Tire Label Code
(7) Engineering Model Minus First Character
(8) Tire Sizes, Front, Rear, and Spare
(9) Vehicle Identification Number

The Tire Placard is permanently located on the edge of the driver's door. Refer to the placard to obtain:

- The maximum vehicle capacity weight
- The cold tire inflation pressures
- The tire sizes (original equipment tires)
- The tire speed ratings (original equipment tires)

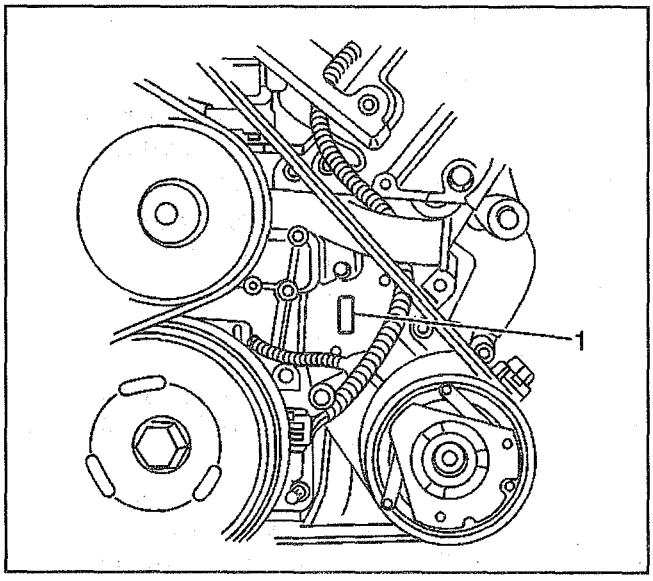
Engine ID and VIN Derivative Location (RPO L36)

The eighth character in the Vehicle Identification Number (VIN) identifies the engine. Adhesive-backed labels attached to the engine, laser etching, or stampings on the engine block indicate the engine unit number/date code. All engines are stamped with a VIN derivative. For added information on VIN derivative, refer to *VIN Derivative*.



446246

The primary location of the VIN derivative for the 3.8 L engine is above the starter motor on the engine block (1).

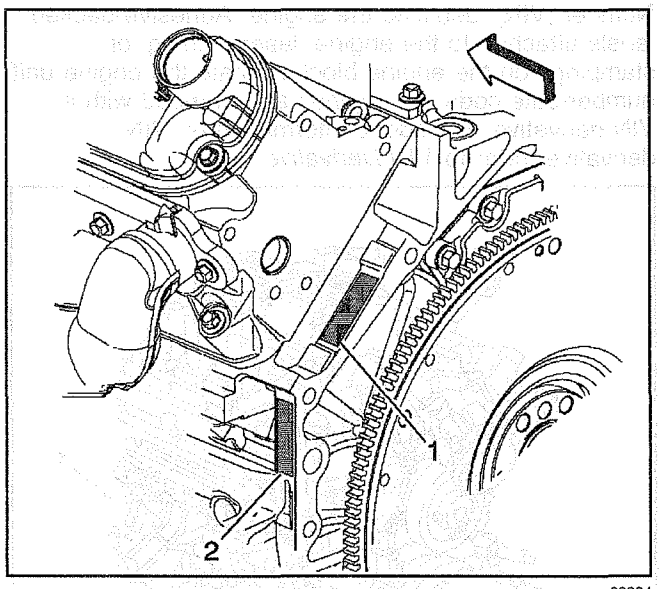


182099

The secondary location of the VIN derivative for the 3.8 L engine is below the water pump on the engine block (1).

Engine ID and VIN Derivative Location (RPO LS1)

Engine ID Number Locations



63234

Legend

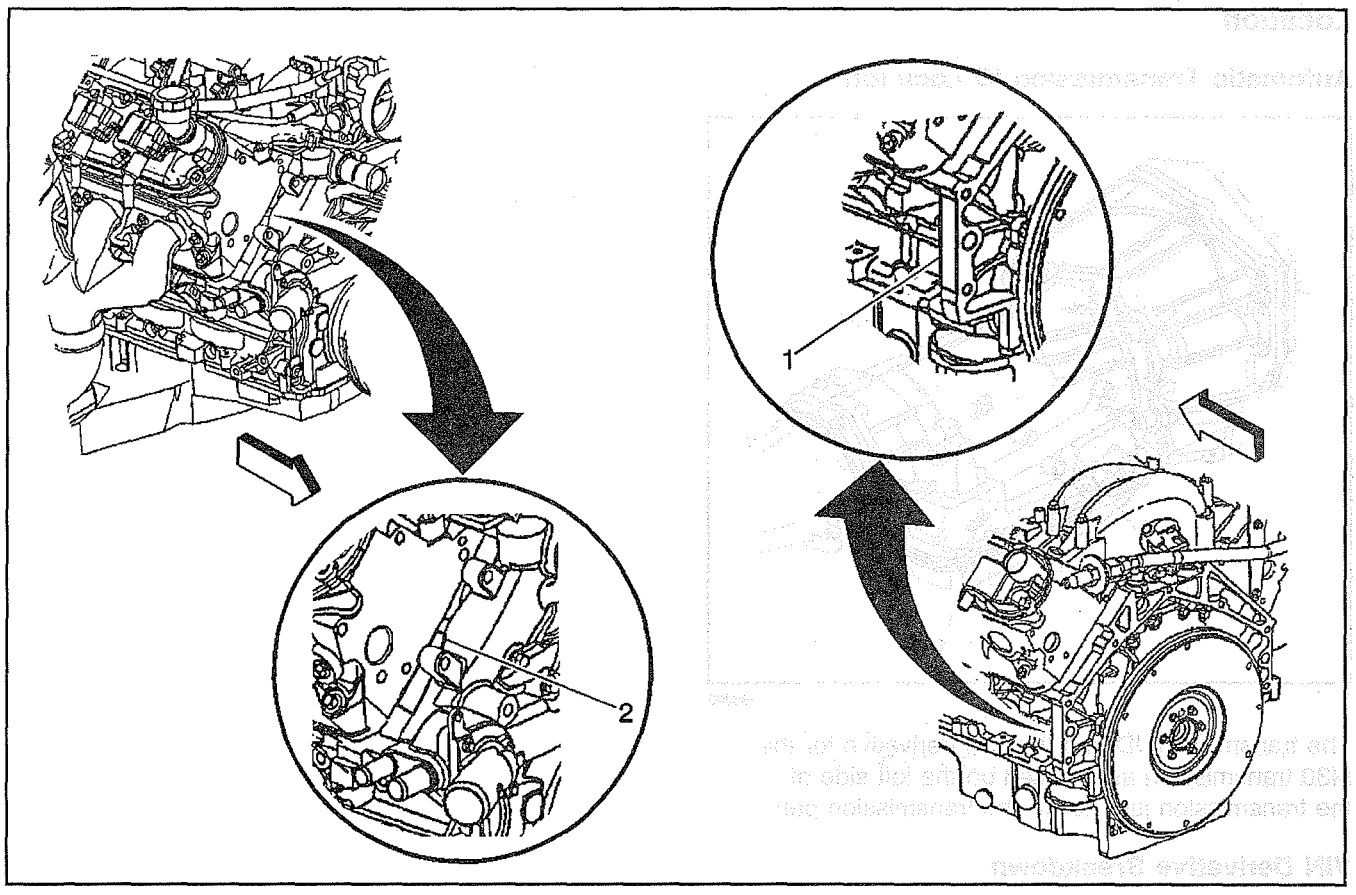
(1) Engine ID Number, Primary Location
(2) Engine ID Number, Secondary Location

The eighth digit of the vehicle identification number (VIN) is the engine code letter, which identifies the engine as a 5.7 L V8.

Stick-on labels attached to the engine, laser etching, or stampings on the engine block indicate the engine unit number/build date code.

The engine ID number will be located at either the primary or the secondary location, as shown.

Engine VIN Derivative Locations



171897

Legend

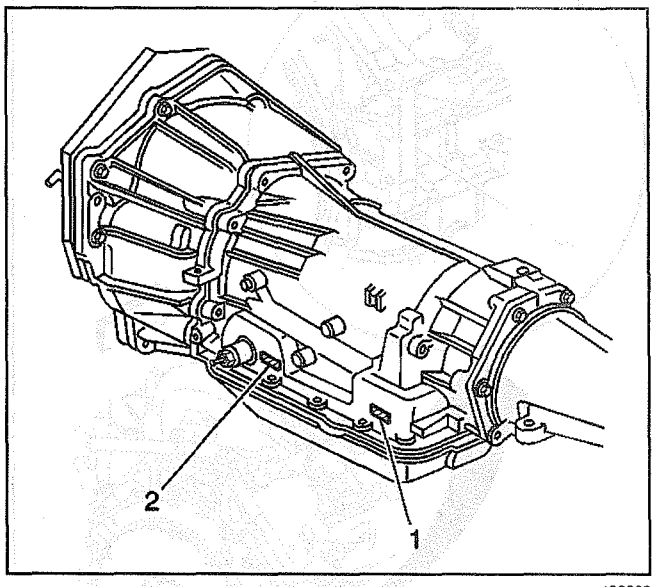
(1) VIN Derivative, Primary Location

(2) VIN Derivative, Secondary Location

The engine is also stamped with a VIN derivative which will be located at either the primary or secondary location, as shown.

Transmission ID and VIN Derivative Location

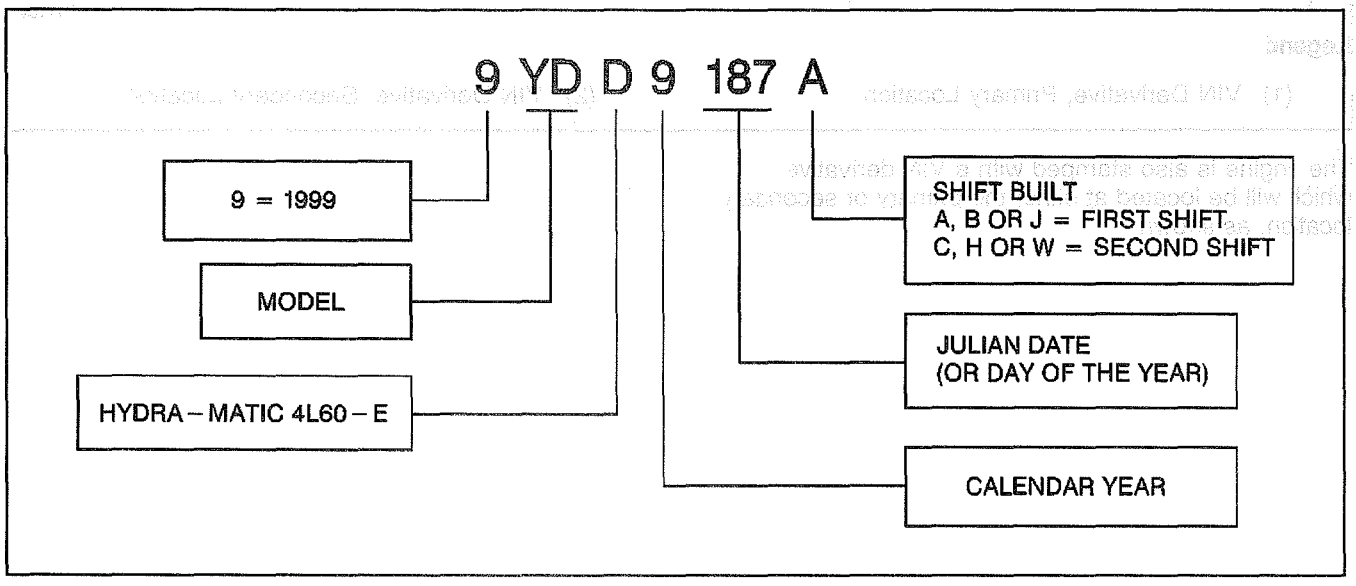
Automatic Transmission ID Location



486303

The transmission ID and the VIN derivative for the M30 transmission are located on the left side of the transmission just above the transmission pan.

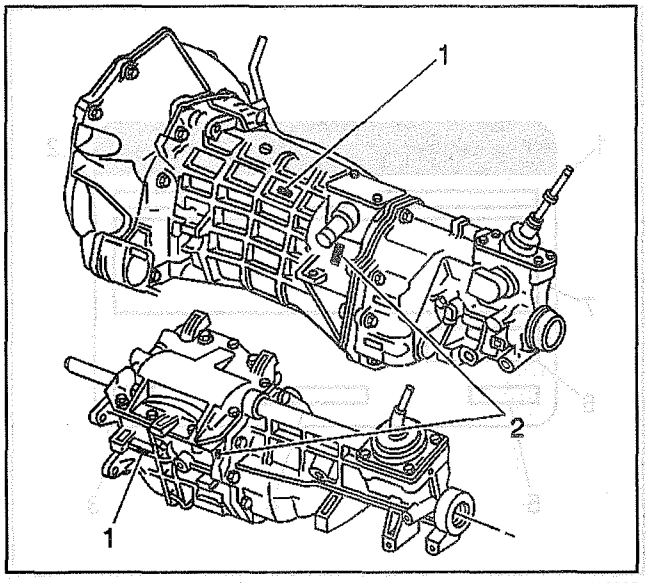
VIN Derivative Breakdown



174101

The transmission identification (ID) number indicates the transmission model year, type and when the unit was built.

Manual Transmission ID Location



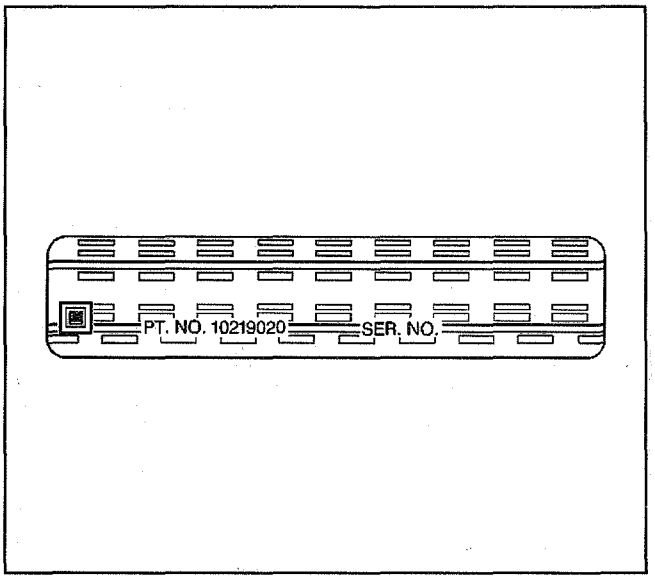
486305

The transmission model identification is located on a label or tag on the transmission case. If this label is missing or unreadable, use the service parts identification label in order to identify the vehicle's transmission.

Transmission Usage

Body Type	Car Line (Division)	Engine Size	Fuel System	Engine RPO	Automatic Transmission Used	Manual Transmission Used
F	CAMARO (CHEVROLET)	5.7L V8	SFI	LS1	4L60-E (M30)	T56 (MM6)
F	CAMARO (CHEVROLET)	3.8L V6	SFI	L36	4L60-E (M30)	T-5 (M49)
F	FIREBIRD (PONTIAC)	5.7L V8	SFI	LS1	4L60-E (M30)	T56 (MM6)
F	FIREBIRD (PONTIAC)	3.8L V6	SFI	L36	4L60-E (M30)	T-5 (M49)

Labeling - Anti-Theft

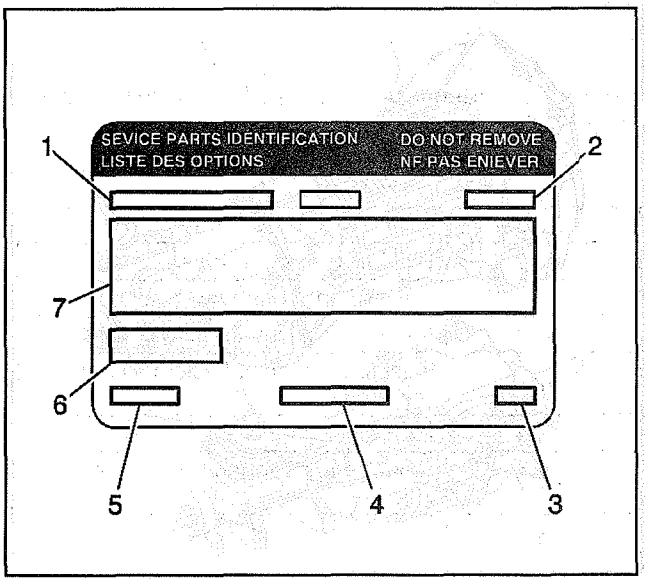


175291

Federal law requires that General Motors label certain body parts on every vehicle with the VIN. The purpose of the law is to reduce the number of motor vehicle thefts by helping in the tracing and recovery of parts from stolen vehicles.

The labels are permanently affixed to an interior surface of the part. The label on a replacement part contains the letter R, the manufacturer's logo, and the DOT symbol.

Label - Service Parts ID



65485

Legend

(1) Vehicle Identification Number
(2) Engineering Model Number (Vehicle Division, Vehicle Line and Body Style)
(3) Interior Trim and Decor Level
(4) Exterior (Paint Color) WA Number
(5) Paint Technology
(6) Special Order Paint Colors and Numbers
(7) Vehicle Option Content

The Service Parts Identification Label aids the service personnel in identifying the parts and options originally installed on the vehicle.

RPO Code List

The production/process codes provide a description of the Regular Production Options (RPOs) used on the Camaro and Firebird. The RPO list is printed on the Service Parts Identification Label. The following is a list of the RPO abbreviations and the description of each:

RPO Table

RPO	Description
A26	Window Glazing, European
AG1	Driver Front Seat, Power Adjuster
AH3	Front Seat, Manual 4-Way Adjuster
AK5	Inflatable Restraint System, Driver and Passenger
AN4	Restraint Provisions, Child
AQ9	Front Seat, Driver and Passenger Recline
AR9	Front Bucket Seat, Deluxe European Style
AU0	Remote Entry Lock Control
AU3	Side Door Elec Lock Control
AX4	Restraint Conversion Seat, Manual European
A31	Window, Power Operated Side
A90	Lock Control, Rear Compt Lid Remote Elec Release
B35	Covering Rear Floor Mats
B4C	Sales Special Service Pkg (Police)
B84	Molding, B/S Exterior
CC1	Roof Hatch Removable Panels, Glass
C49	Rear Window Defogger, Electric
C60	HVAC System AC Man Controls
DD9	Mirror, O/S LH & RH Remote Control Electric Color
DE4	Sunshade, Removable Hatch Roof
DG7	Mirror, O/S LH & RH Remote Control Electric Color
D21	Sunshade, Windshield
D35	Mirror, O/S LH Remote Control, RH Manual Color
D82	Paint Special
FE2	Suspension System, Ride and Handling
FE4	Suspension System, Special Ride and Handling
FE7	Suspension System, Front and Rear Heavy Duty
FE9	Certification Emission-Federal
F41	Suspension System, Front and Rear Firm Ride and Handling
GU2	Axle Ratio 2.73
GU4	Axle Ratio 3.08
GU5	Axle Ratio 3.23
GU6	Axle Ratio 3.42

RPO Table (cont'd)

RPO	Description
G80	Axle Positraction
IL2	Trim, Interior Leather (W/AQ9) Pontiac
IL4	Trim, Interior European Camaro
IL5	Trim, Interior (w/AQ9) Pontiac
IPB	Trim, Interior Cloth Camaro and Firebird
IPD	Trim, Interior (w/AR9) European Camaro
IP2	Trim, Interior Leather Camaro
IP3	Trim, Interior Leather Pontiac
JAF	Brake Provisions, European
J65	Brake System, PWR Front and Rear Disc
K05	Heater, Engine Block
K29	Module Powertrain Control, Export
K34	Cruise Control, Automatic
K68	Generator, 105 Amp
LS1	Engine, Gas V8 5.7L SFI Aluminum
L36	Engine, Gas V6 3.8L MFI HO
M49	Transmission, Manual 5 Speed OD
MM6	Transmission, Manual 6 Speed OD
M30	Transmission, Auto 4 Speed Electronic
NK3	Steering Wheel, Sport Soft Rim Simulated Leather
NM8	Leaded Fuel System Compatible, European
NP5	Steering Wheel, Leather Wrapped
NP7	Steering Column, EEC Approved
NW9	Traction Control, Electronic
N36	Steering Wheel, 4 Spoke Sport
N60	Wheel, Aluminum Painted
N66	Wheel, Styled Aluminum 17" 5 Spoke Polished
N73	Wheel, Custom Sport Var4 17" (Restricted to Camaro SS)
N92	Cover, Wheel Bolt-on
N96	Wheel, 16 X 8 Cast Aluminum
N98	Wheel, 16 X 8 Cast Aluminum Chrome
PA6	Wheel, Styled Painted 16"
P05	Wheel, Styled Chrome 16"
QA9	Wheel, 17 X 9 Aluminum Painted (Blue Tint)
QB3	Wheel, 16 X 7.5 Steel
QCB	Tire, All P235/55R16 BW
QEA	Tire, All P215/60R16 BW
QFK	Tire, All P275/40R17 BW
QFZ	Tire, All P245/50R16 BW
QLC	Tire, All P245/50R16 BW

RPO Table (cont'd)

RPO	Description
TR7	Headlamps, Control Leveling System Automatic
T1G	Vehicle, Military Personnel
T37	Lamp, Fog Deluxe
T39	Lamp, Turn Signal Aux
T43	Spoiler, Rear
T62	Lighting, Daytime Running Delete
T65	Lighting, Daytime Running Export
T78	Headlamp Control, Delete
T79	Lamp, Fog Rear
T82	Headlamp Control, Automatic ON-OFF
T84	Headlamps, RH Rule of Road
T85	Headlamps, LH Rule of the Road
T89	Lamp, Tail & Stop Export
T96	Lamp, Fog
UA6	Theft Deterrent System
UB3	Cluster, Inst Oil Cool Temp Volts Trip Odom Tach
UC2	Speedometer, Inst Kilo Positive Bias
UK3	Electronic System Steering Wheel Acc Controls
UL0	Radio, AM/FM Stereo Auto Rev Music Srch Cass Clock ETR
UM6	Radio, AM/FM Stereo Auto Rev Cass Clock ETR
UN0	Radio, AM/FM Stereo Compact Disc Auto Tone Clock
UQ0	Speaker Sys, 4 Dual Frt Dr Mtd Dual STD RGE Qtr/Shelf
UW3	Radio, AM/FM Stereo Auto Rev Music Search Cass Data Sys
UZ7	Speaker System, 8 Quat Frt Dr Mtd Dual RR Hatch Amplifier
U1S	Player, Multiple Compact Disc
U62	Speaker System, 4 Dual Coax Frt Dual Coax PKG Shelf
U73	Antenna, Fixed Radio
U75	Antenna, Power Radio
VK3	License Plate, Front Mounting Pkg
VL4	License Plate, Rear Mounting Pkg
V12	Cooling System, Power Steering
V76	Hook, Tow
WS6	Performance Package Special
WS9	Model Conversion, Formula
WU6	Sales Package, Firehawk Upfitter
WU8	Sales Package, Z28 SS
W52	Entertainment System Option B
W53	Entertainment System Option C
W54	Entertainment System Option D
W55	Entertainment System Option E (MONSOON)

RPO Table (cont'd)

RPO	Description
W59	Entertainment System Option I
W66	Merchandised Pkg, Formula
W68	Sales Package, Firebird Upfitter
W73	Entertainment System Option J
X10	Entertainment System, Option I
X20	Entertainment System, Option J
Y3F	Sales Package, RS Camaro
Y81	Merchandised Pkg, Firebird
Y82	Merchandised Pkg, Trans Am
Y84	Merchandised Pkg, Trans Am GTA
Y87	Merchandised Pkg, Performance Enhancement
Z5X	Mirror Provisions, Arabic Language
01U	Primary Color, Exterior Special
1LE	Performance Package, Component Special
1OI	Interior Trim, Arctic White
10Q	Molding Color, Arctic White
10T	Top Color, Arctic White
10U	Primary Color, Exterior Arctic White
11Q	Molding Color, Pewter Metallic
11U	Exterior Color, Pewter Metallic
102	Trim Combination, Leather Arctic White Camaro and Firebird
103	Trim Combination, Leather Arctic White Pontiac
105	Trim Combination, Leather Arctic White Pontiac
14B	Trim Combination, Cloth Dark Gray
14D	Trim Combination, Cloth Dark Gray
14I	Interior Trim, Very Dark Gray
142	Trim Combination, Leather Very Dark Gray Camaro and Firebird
143	Trim Combination, Leather Very Dark Gray Firebird
144	Trim Combination, Leather Very Dark Gray Camaro
20Q	Molding Color, Blue Metallic
20U	Exterior Color, Blue Metallic
28Q	Molding Color, Navy Blue Met
28U	Primary Color, Exterior Navy Blue Metallic
31Q	Molding Color, Bright Green
31U	Primary Color, Exterior Bright Green
36Q	Molding Color, Fern Green
36U	Exterior Color, Fern Green
41Q	Molding Color, Black
41T	Top Color, Black
41U	Primary Color, Exterior Black
52B	Trim Combination, Cloth Light Neutral

RPO Table (cont'd)

RPO	Description
52D	Trim Combination, Cloth Light Neutral
52I	Interior Trim, Medium Neutral
522	Trim Combination, Leather Light Neutral
523	Trim Combination, Leather Medium Neutral II
524	Trim Combination, Leather Medium Neutral
56T	Top Color, Medium Dark Neutral
63Q	Molding Color, Sport Gold
63U	Exterior Color, Sport Gold
73B	Trim Combination, Cloth Flame Red
73I	Interior Trim, Flame Red
79Q	Molding Color, Mystic Teal
79U	Primary Color, Exterior Mystic Teal
81Q	Molding Color, Bright Red
81U	Primary Color, Exterior Bright Red
88Q	Molding Color, Bright Purple
88U	Primary Color, Exterior Bright Purple
92B	Trim Combination, Cloth Medium Pewter
92I	Interior Trim, Pewter
96Q	Molding Color, Cayenne Red
96U	Primary Color, Exterior Cayenne Red Metallic
99Q	Molding Color, Hugger Orange
99U	Exterior Color, Hugger Orange

Labels - How to Obtain Replacement

Obtain replacements for the following labels through the GM Service Parts Operations:

- The vehicle emission control information (exhaust emission tune-up) label
- The spare wheel caution label
- The jacking label
- The serpentine belt routing label
- The engine fan caution label
- The spare tire storage label

The following labels are not available as service parts:

- The vehicle certification label
- The tire pressure placard
- The service parts identification label

Fasteners

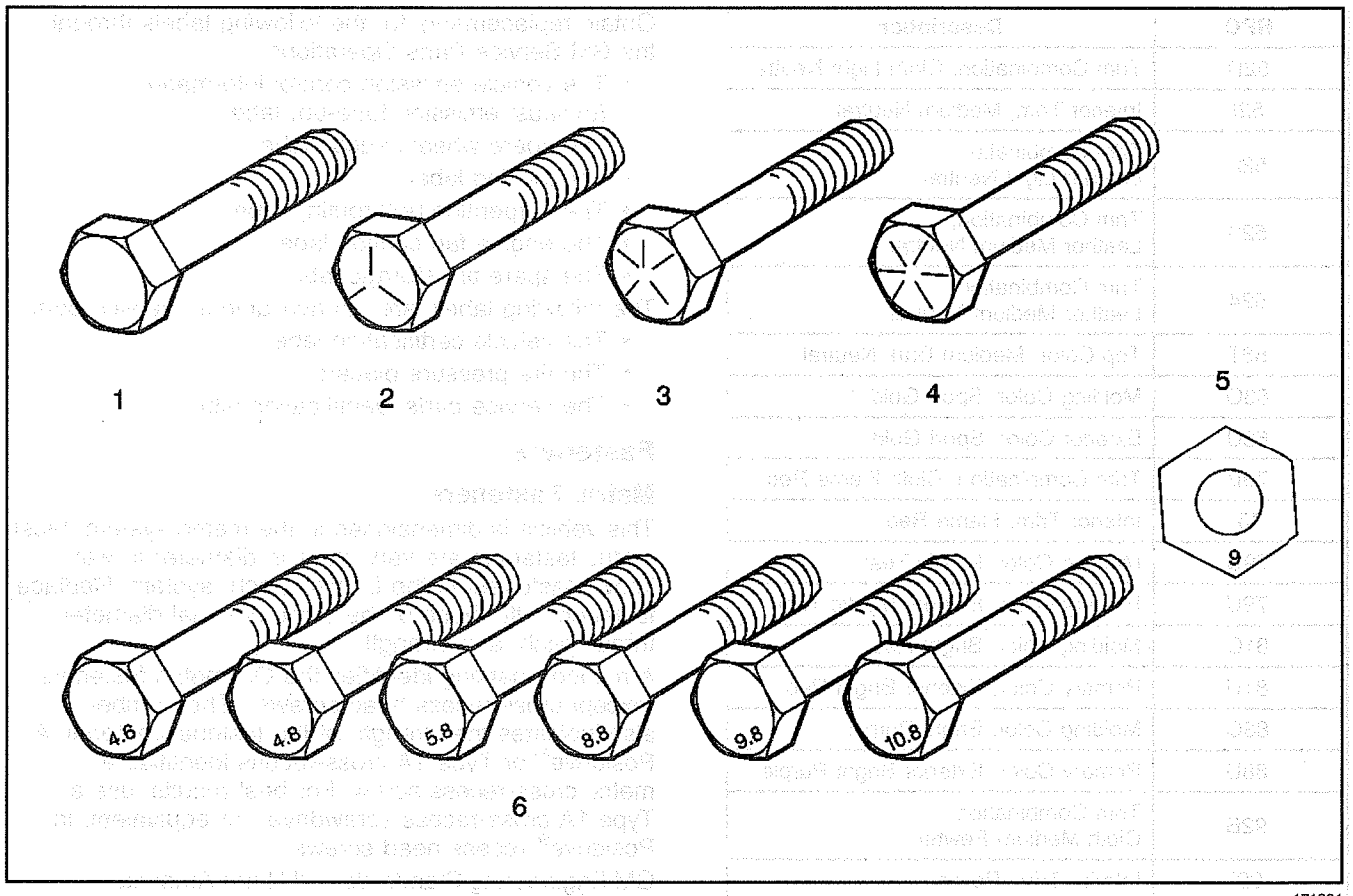
Metric Fasteners

This vehicle is dimensioned in the metric system. Most metric fasteners are very close in diameter to well known fasteners in the English (inch) system. Replace fasteners with those of the same nominal diameter, thread pitch, and strength.

A number marking identifies the OE metric fasteners (except cross-recess head screws). The number also indicates the strength of the fastener material. A Posidrive® or Type 1A cross-recess identifies a metric cross-recess screw. For best results, use a Type 1A cross-recess screwdriver, or equivalent, in Posidrive® recess head screws.

GM Engineering Standards and North American Industries have adopted a portion of the ISO-defined standard metric fastener sizes. The purpose of this was to reduce the number of fastener sizes used while retaining the best thread qualities in each thread size. For example, the metric M6.0 X 1 screw, with nearly the same diameter and 25.4 threads per inch replaced the English 1/4–20 and 1/4–28 screws. The thread pitch is midway between the English coarse and fine thread pitches.

Fastener Strength Identification



171891

Legend

(1) English Bolt, Grade 2 (Strength Class)
(2) English Bolt, Grade 5 (Strength Class)
(3) English Bolt, Grade 7 (Strength Class)
(4) English Bolt, Grade 8 (Strength Class)
(5) Metric Nut, Strength Class 9
(6) Metric Bolts, Strength Class Increases as Numbers Increase

The 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. The English (inch) strength classes range from grade 2 to grade 8. Radial lines are embossed on the head of each bolt to identify the strength class. The number of lines on the head of the bolt is two lines less than the actual grade. For example, a grade 8 bolt will have 6 radial lines on the bolt head. Some metric nuts are marked with a single-digit strength identification number on the nut face.

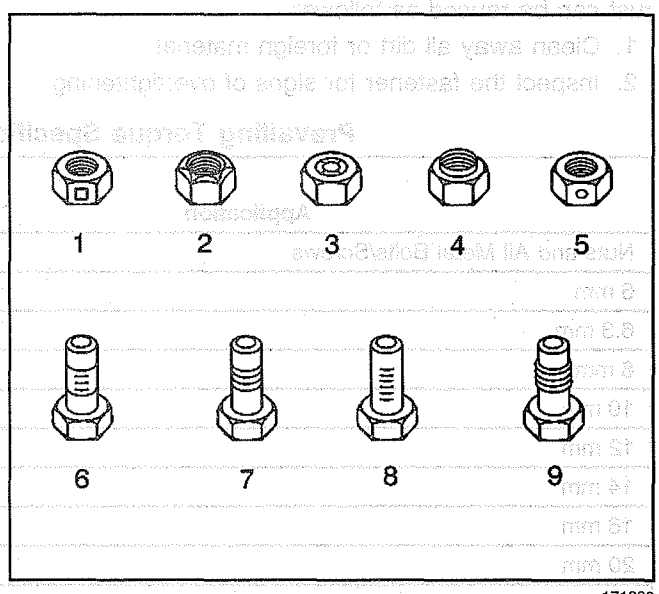
The correct fasteners are available through GM SPO. Many metric fasteners available in the aftermarket parts channels were designed to meet the metric standards of countries other than the United States, and may exhibit the following defects:

- Reduced strength
- No numbered head marking system
- Wrong thread pitch

The metric fasteners on GM products are designed to new, international standards. The following are the most common sizes and pitches, except for special applications:

- M6.0 X 1
- M8 X 1.25
- M10 X 1.5
- M12 X 1.75

Prevailing Torque Fasteners



171892

Legend

(1) Prevailing Torque Nut, Center Lock Type
(2) Prevailing Torque Nut, Top Lock Type
(3) Prevailing Torque Nut, Nylon Patch Type
(4) Prevailing Torque Nut, Nylon Washer Insert Type
(5) Prevailing Torque Nut, Nylon Insert Type
(6) Prevailing Torque Bolt, Dry Adhesive Coating Type
(7) Prevailing Torque Bolt, Thread Profile Deformed Type
(8) Prevailing Torque Bolt, Nylon Strip Type
(9) Prevailing Torque Bolt, Out-of-Round Thread Area Type

A prevailing torque nut is designed to develop an interface between the nut and bolt threads. Distortion of the top of a metal nut or the use of a nylon patch on the threads in the middle of the hex flat provides the interface.

A prevailing torque bolt/nut that is clean and free of rust can be reused as follows:

1. Clean away all dirt or foreign material.
2. Inspect the fastener for signs of overtightening.
3. Hand start the fastener at the original location.
4. Inspect the fastener for torque development, referring to the following table.
5. Tighten the fastener within specifications.

Prevailing Torque Specifications (Metric-Size Fasteners)

Application	Specification	
	Metric	English
Nuts and All Metal Bolts/Screws		
6 mm	0.4 N·m	4 lb in
6.3 mm	0.4 N·m	4 lb in
8 mm	0.6 N·m	7 lb in
10 mm	1.4 N·m	12 lb in
12 mm	2.2 N·m	18 lb in
14 mm	3.0 N·m	27 lb in
16 mm	4.2 N·m	37 lb in
20 mm	7.0 N·m	62 lb in
Adhesive or Nylon Coated Bolts/Screws		
6 mm	0.4 N·m	4 lb in
6.3 mm	0.4 N·m	4 lb in
8 mm	0.6 N·m	7 lb in
10 mm	1.2 N·m	11 lb in
12 mm	1.6 N·m	14 lb in
14 mm	2.4 N·m	21 lb in
16 mm	3.4 N·m	30 lb in
20 mm	5.6 N·m	50 lb in

Prevailing Torque Specifications (English-Size Fasteners)

Application	Specification	
	Metric	English
Nuts and All Metal Bolts/Screws		
0.250 in	0.4 N·m	4 lb in
0.312 in	0.6 N·m	5 lb in
0.375 in	1.4 N·m	12 lb in
0.437 in	1.6 N·m	16 lb in
0.500 in	2.4 N·m	21 lb in
0.562 in	3.2 N·m	28 lb in
0.625 in	4.2 N·m	37 lb in
0.750 in	7.0 N·m	62 lb in
Adhesive or Nylon Coated Bolts/Screws		
0.250 in	0.4 N·m	4 lb in
0.312 in	0.6 N·m	5 lb in
0.375 in	1.0 N·m	9 lb in
0.437 in	1.4 N·m	12 lb in
0.500 in	1.8 N·m	16 lb in
0.562 in	2.6 N·m	23 lb in
0.625 in	3.4 N·m	30 lb in
0.750 in	5.2 N·m	49 lb in

Thread Inserts

Repair Procedure

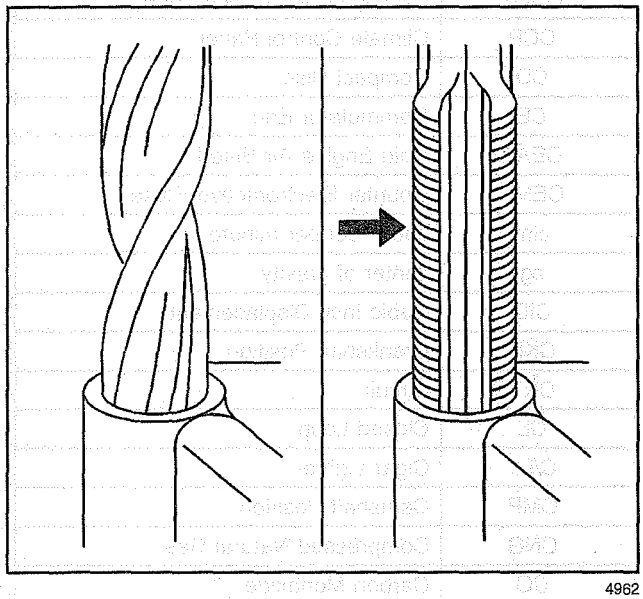
Tools Required

General purpose thread repair kits. These kits are available commercially.

Caution: Wear safety glasses in order to avoid eye damage.

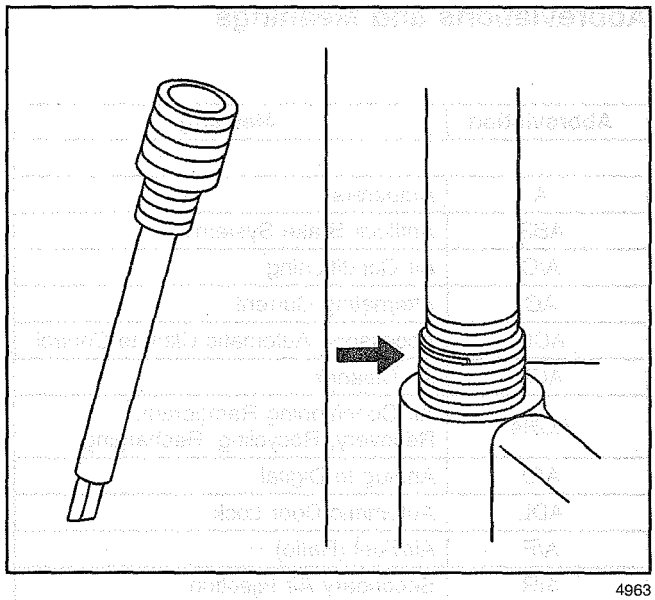
Important: Refer to the thread repair kit manufacturer's instructions regarding the size of the drill and tap to use.

Avoid any buildup of chips. Back out the tap every few turns and remove the chips.



4962

1. Determine the size, the pitch, and the depth of the damaged thread. If necessary, adjust the stop collars on the cutting tool and tap to the required depth.
2. Drill out the damaged threads. Clean out any chips.
3. Lubricate the tap with light engine oil. Tap the hole. Clean the threads.



4963

4. Thread the thread insert onto the mandrel of the installer. Engage the tang of the insert onto the end of the mandrel.

Important: The insert should be flush to one turn below the surface.

5. Lubricate the insert with light engine oil (except when installing in aluminum) and install the insert.
6. If the tang of the insert does not break off when backing out the installer, break the tang off with a drift.

Abbreviations and Meanings

Abbreviation	Meaning
A	
A	Ampere(s)
ABS	Antilock Brake System
A/C	Air Conditioning
AC	Alternating Current
ACC	Accessory, Automatic Climate Control
ACL	Air Cleaner
ACR4	Air Conditioning Refrigerant, Recovery, Recycling, Recharging
A/D	Analog to Digital
ADL	Automatic Door Lock
A/F	Air/Fuel (Ratio)
AIR	Secondary Air Injection
ALC	Automatic Level Control
AM/FM	Amplitude Modulation/Frequency Modulation
Ant	Antenna
AP	Accelerator Pedal
API	American Petroleum Institute
APP	Accelerator Pedal Position
APT	Adjustable Part Throttle
ARS	Automatic Restraint System
ASR	Acceleration Slip Regulation
A/T	Automatic Transmission/Transaxle
ATC	Automatic Temperature Control
ATDC	After Top Dead Center
Auto	Automatic
avg	average
AWD	All Wheel Drive
AWG	American Wire Gage
B	
B+	Battery Positive Voltage
B-	Battery Negative Voltage
BARO	Barometric (pressure)
batt	battery
BBV	Brake Booster Vacuum
BCM	Body Control Module
BHP	Brake Horsepower
BLK	Black
BLU	Blue
BP	Back Pressure
BPM	Brake Pressure Modulator
BPMV	Brake Pressure Modulator Valve
BPP	Brake Pedal Position
BRN	Brown
BTDC	Before Top Dead Center
BTSI	Brake Transmission Shift Interlock

Abbreviation	Meaning
Btu	British thermal units
C	
°C	Degrees Celsius
CAC	Charge Air Cooler
CAFE	Corporate Average Fuel Economy
Cal	Calibration
Cam	Camshaft
CARB	California Air Resources Board
cc	cubic centimeters
CCM	Central Control Module
CCOT	Cycling Clutch Orifice Tube
CCP	Climate Control Panel
CD	Compact Disc
CE	Commutator End
CEAB	Cold Engine Air Bleed
CEMF	Counter Electromotive Force
cfm	cubic feet per minute
cg	center of gravity
CID	Cubic Inch Displacement
CKP	Crankshaft Position
CKT	Circuit
CL	Closed Loop
C/Ltr	Cigar Lighter
CMP	Camshaft Position
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO2	Carbon Dioxide
Coax	Coaxial
COMM	Communication
Conn	Connector
CPA	Connector Position Assurance
CPP	Clutch Pedal Position
CPS	Central Power Supply
CPU	Central Processing Unit
CRT	Cathode Ray Tube
CRTC	Cathode Ray Tube Controller
CS	Charging System
CTP	Closed Throttle Position
cu ft	cubic foot/feet
cu in	cubic inch/inches
CV	Contant Velocity (joint)
CVRSS	Continuously Variable Road Sensing Suspension
Cyl	Cylinder(s)

Abbreviation	Meaning
D	
DAB	Delayed Accessory Bus
dB	decibels
dBA	decibels on A-weighted scale
DC	Direct Current
DCM	Door Control Module
DE	Drive End
DEC	Digital Electronic Controller
DERM	Diagnostic Energy Reserve Module
DI	Distributor Ignition
dia	diameter
DIC	Driver Information Center
Diff	Differential
DK	Dark
DLC	Data Link Connector
DMM	Digital Multimeter
DOHC	Dual Overhead Camshafts
DR	Driver
DRL	Daytime Running Lamps
DTC	Diagnostic Trouble Code
E	
EBCM	Electronic Brake Control Module
EBTCM	Electronic Brake and Traction Control Module
EC	Electrical Center
ECC	Electronic Climate Control
ECI	Extended Compressor at Idle
ECL	Engine Coolant Level
ECM	Engine Control Module
ECS	Emission Control System
ECT	Engine Coolant Temperature
EEPROM	Electronically Erasable Programmable Read Only Memory
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
ELAP	Elapsed
ELC	Electronic Level Control
E/M	English / Metric
EMF	Electromotive Force
Eng	Engine
EOP	Engine Oil Pressure
EOT	Engine Oil Temperature
EPA	Environmental Protection Agency
EPR	Exhaust Pressure Regulator

Abbreviation	Meaning
EPROM	Erasable Programmable Read Only Memory
ESC	Electronic Suspension Control
ESD	Electrostatic Discharge
ETC	Electronic Throttle Control, Electronic Temperature Control
ETCC	Electronic Touch Climate Control
ETR	Electronically Tuned Receiver
EVAP	Evaporative Emission
EVO	Electronic Variable Orifice
Exh	Exhaust
F	
°F	Degrees Fahrenheit
FC	Fan Control
FDC	Fuel Data Center
FED	Federal (all United States except California)
FEDS	Fuel Enable Data Stream
FF	Flexible Fuel
FI	Fuel Injection
FMVSS	Federal Motor Vehicle Safety Standards
F/P	Fuel Pump
ft	foot/feet
FT	Fuel Trim
F4WD	Full Time Four Wheel Drive
4WAL	Four Wheel Antilock
4WD	Four Wheel Drive
FW	Flat Wire
FWD	Front Wheel Drive
G	
g	grams, gravitational accelaration
GA	Gage
gal	gallon
gas	gasoline
GCW	Gross Combination Weight
Gen	Generator
GL	Gear Lubricant
GM	General Motors
GM SPO	General Motors Service Parts Operations
gnd	ground
gpm	gallons per minute
GRN	Green
GRY	Gray
GVWR	Gross Vehicle Weight Rating

Abbreviation	Meaning
H	
H	Hydrogen
H2O	Water
Harn	Harness
HC	Hydrocarbons
H/CMPR	High Compression
HD	Heavy Duty
HDC	Heavy Duty Cooling
hex	hexagon
Hg	Mercury
Hi Alt	High Altitude
HO2S	Heated Oxygen Sensor
hp	horsepower
HPL	High Pressure Liquid
HPS	High Performance System
HPV	High Pressure Vapor
Htd	Heated
HTR	Heater
HUD	Head-up Display
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
ICM	Ignition Control Module
ID	Identification, Inside Diameter
IDI	Integrated Direct Ignition
ign	ignition
ILC	Idle Load Compensator
in	inch/inches
INJ	Injection
inst	instantaneous
I/P	Instrument Panel
IPC	Instrument Panel Cluster
I/PEC	Instrument Panel Electrical Center
ISC	Idle Speed Control
ISO	International Standards Organization
ISS	Input Speed Shaft
K	
KAM	Keep Alive Memory
KDD	Keyboard Display Driver
kg	kilogram
kHz	kilohertz
km	kilometer
km/h	kilometers per hour

Abbreviation	Meaning
km/l	kilometers per liter
kPa	kilopascals
KS	Knock Sensor
kV	kilovolts
L	
L	Liter
L4	Four Cylinder Engine, In-line
L6	Six Cylinder Engine, In-Line
lb	pound
lb ft	pound feet (torque)
lb in	pound inch (torque)
LCD	Liquid Crystal Display
LDCL	Left Door Closed Locking
LDCM	Left Door Control Module
LED	Light Emitting Diode
LF	Left Front
LH	Left Hand
lm	lumens
LR	Left Rear
lt	left
LT	Light
M	
MAF	Mass Air Flow
Man	Manual
MAP	Manifold Absolute Pressure
MAT	Manifold Absolute Temperature
max	maximum
M/C	Mixture Control
MDP	Manifold Differential Pressure
MFI	Multiport Fuel Injection
mi	miles
MIL	Malfunction Indicator Lamp
min	minimum
ml	milliliter
mm	millimeter
mpg	miles per gallon
mph	miles per hour
ms	millisecond
MST	Manifold Surface Temperature
M/T	Manual Transmission/Transaxle
MV	Megavolt
mV	millivolt
N	
NAES	North American Export Sales
NC	Normally Closed
NEG	Negative
Neu	Neutral
NLGI	National Lubricating Grease Institute

Abbreviation	Meaning
N·m	Newton-meter (torque)
NO	Normally Open
NOx	Oxides of Nitrogen
NPTC	National Pipe Thread Coarse
NPTF	National Pipe Thread Fine
NVRAM	Non Volatile Random Access Memory
O	
O2	Oxygen
O2S	Oxygen Sensor
OBD II	On-Board Diagnostics II
OC	Oxidation Converter (Catalytic)
OD	Outside Diameter
ODO	Odometer
OE	Original Equipment
OEM	Original Equipment Manufacturer
OHC	Overhead Camshaft
OL	Open Loop
ORN	Orange
OSS	Output Shaft Speed
oz	ounce(s)
P	
PAG	Polyalkylene Glycol
PASS	Passenger
PASS-Key®	Personalized Automotive Security System
P/B	Power Brakes
PC	Pressure Control
PCB	Printed Circuit Board
PCM	Powertrain Control Module
PCS	Pressure Control Solenoid
PCV	Positive Crankcase Ventilation
PM	Permanent Magnet (Generator)
P/N	Part Number
PNK	Pink
PNP	Park/Neutral Position
PRNDL	Park, Reverse, Neutral, Drive, Low
POA	Pilot Operated Absolute (Valve)
POS	Positive
POT	Potentiometer (Variable Resistor)
PPL	Purple
ppm	parts per million
PROM	Programmable Read Only Memory
P/S	Power Steering
PSD	Power Sliding Door
PSP	Power Steering Pressure
psi	pounds per square inch
psia	pounds per square inch absolute
psig	pounds per square inch gage

Abbreviation	Meaning
pt	pint
PWM	Pulse Width Modulated
Q	
qt	quart(s)
R	
R-12	Refrigerant-12
R-134a	Refrigerant-134a
RAM	Random Access Memory (non permanent memory devise, memory contents are lost when power is removed)
RAP	Retained Accessory Power
RAV	Remote Activation Verification
RCDLR	Remote Control Door Lock Receiver
RDCM	Right Door Control Module
Ref	Reference
Rev	Reverse
RF	Right Front, Radio Frequency
RFA	Remote Function Actuation
RFI	Radio Frequency Interference
RH	Right Hand
RKE	Remote Keyless Entry
Rly	Relay
ROM	Read Only Memory (permanent memory devise, memory contents are retained when power is removed)
RPM	Engine Speed (Revolutions Per Minute)
RPO	Regular Production Option
RR	Right Rear
rt	right
RTD	Real Time Damping
RTV	Room Temperature Vulcanizing (sealer)
RWAL	Rear Wheel Antilock
RWD	Rear Wheel Drive
S	
s	second(s)
SAE	Society of Automotive Engineers
SC	Supercharger
SCB	Supercharger Bypass
SCM	Seat Control Module
SDM	Sensing and Diagnostic Module
SEO	Special Equipment Option
SFI	Sequential Multiport Fuel Injection
SI	System International (modern version of metric system)
SIR	Supplemental Inflatable Restraint
SLA	Short/Long Arm (suspension)
sol	solenoid

Abbreviation	Meaning
SO2	Sulfur Dioxide
SP	Splice Pack
SPO	Service Parts Operations
sq ft	square foot/feet
sq in	square inch/inches
SRC	Service Ride Control
SRI	Service Reminder Indicator
ST	Scan Tool
S4WD	Selectable Four Wheel Drive
Sw	Switch
syn	synchronizer
T	
Tach	Tachometer
TBI	Throttle Body Fuel Injection
TC	Turbocharger
TCC	Torque Converter Clutch
TCS	Traction Control System
TDC	Top Dead Center
TEMP	Temperature
Term	Terminal
TFP	Transmission Fluid Pressure
TFT	Transmission Fluid Temperature
TOC	Transmission Oil Cooler
TP	Throttle Position
TPA	Terminal Positive Assurance
TPM	Tire Pressure Monitoring
TR	Transmission Range
TRANS	Transmission/Transaxle
TV	Throttle Valve
TVRS	Television and Radio Suppression
TVV	Thermal Vacuum Valve
TWC	Three Way Converter (Catalytic)
TWC+OC	Three Way + Oxidation Converter (Catalytic)
TXV	Thermal Expansion Valve
U	
UART	Universal Asynchronous Receive and Transmit
U/H	Underhood
U/HEC	Underhood Electrical Center
U-joint	Universal Joint
UTD	Universal Theft Deterrent
UV	Ultraviolet

Abbreviation	Meaning
V	
V	Volt(s), Voltage
V6	Six Cylinder Engine, V-Type
V8	Eight Cylinder Engine, V-Type
Vac	Vacuum
VAC	Vehicle Access Code
VATS	Vehicle Anti-Theft System
VCM	Vehicle Control Module
VDOT	Variable Displacement Orifice Tube
VDV	Vacuum Delay Valve
vel	velocity
VES	Variable Effort Steering
VF	Vacuum Fluorescent
VIO	Violet
VIN	Vehicle Identification Number
VMV	Vacuum Modulator Valve
VR	Voltage Regulator
V ref	Voltage Reference
VSS	Vehicle Speed Sensor
W	
w/	with
W/B	Wheel Base
WHL	Wheel
WHT	White
w/o	without
WOT	Wide Open Throttle
W/P	Water Pump
W/S	Windshield
WSS	Wheel Speed Sensor
WU-OC	Warm Up Oxidation Converter (Catalytic)
WU-TWC	Warm Up Three Way Converter (Catalytic)
X	
X-valve	Expansion valve
Y	
yd	yard(s)
YEL	Yellow

Key and Lock Cylinder Coding

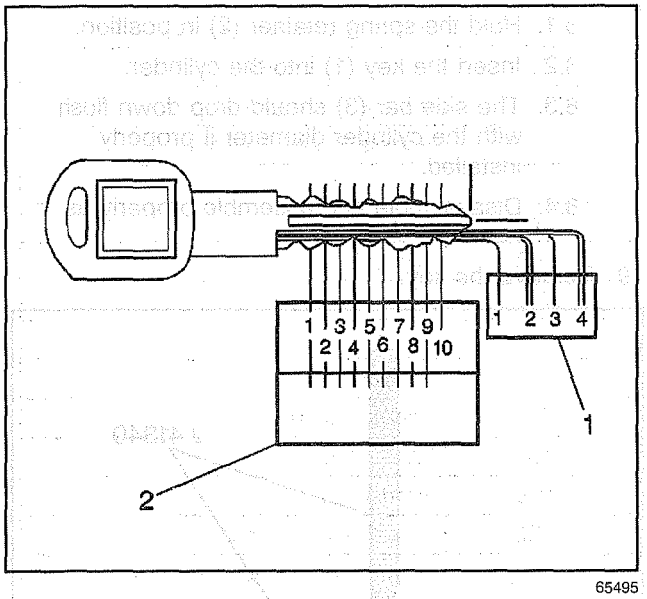
Key Identification and Usage

The lock cylinder keyway is designed so that other model keys will not enter a current model lock cylinder. A single key is used for all locks on the vehicle.

The key identification is obtained from the four-character key code stamped on the knockout portion of the key head. Knock the plugs out of the key head after the code numbers have been recorded. The code list, available to owners of key cutting equipment from equipment suppliers, determines the lock combinations from the code numbers.

If the code numbers are not available from the records or from the knockout plug, lay the key on the key code diagram in order to determine the lock combinations (the tumbler numbers and the position arrangement).

Cutting Keys



65495

After the code has been determined from the code list or the key code diagram, perform the following steps:

1. Cut a blank key to the proper level (1) of each of the tumbler positions (2).
2. Inspect the key operation in the lock cylinder.

Replacement Lock Cylinders

New lock cylinders (except ignition lock cylinders) are available from the service parts warehouse with new lock cylinder locking bars. The tumblers are also available and must be assembled into the cylinder as recommended. For additional information, refer to the following.

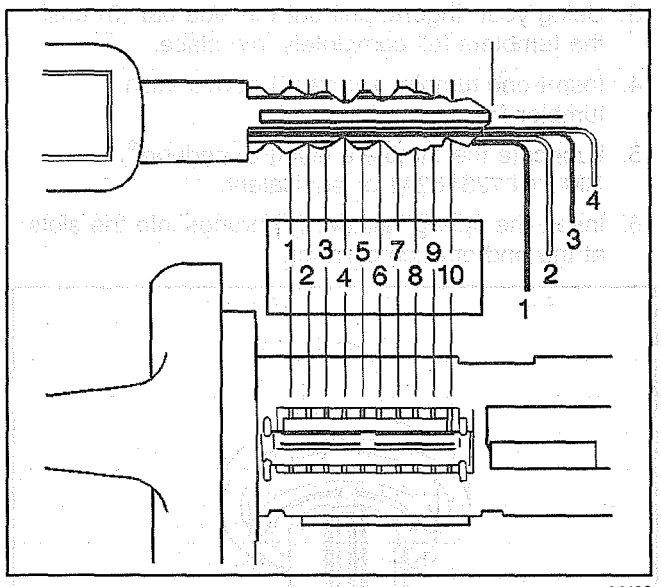
Lock Cylinder Tumbler Operation

All lock tumblers are shaped alike with the exception of the notched position on one side. As the key is inserted into the lock cylinder, the tumblers are lowered to the correct height so that the notches on each tumbler are at the same level. When the notches on all six tumblers line up, two small springs push the side bar into the notches, allowing the cylinder to turn in the cylinder bore. Five types of tumblers are used in making the lock combinations, and each tumbler is coded and stamped with a number between 1 and 5.

Assembling and Coding Ignition Lock Cylinders

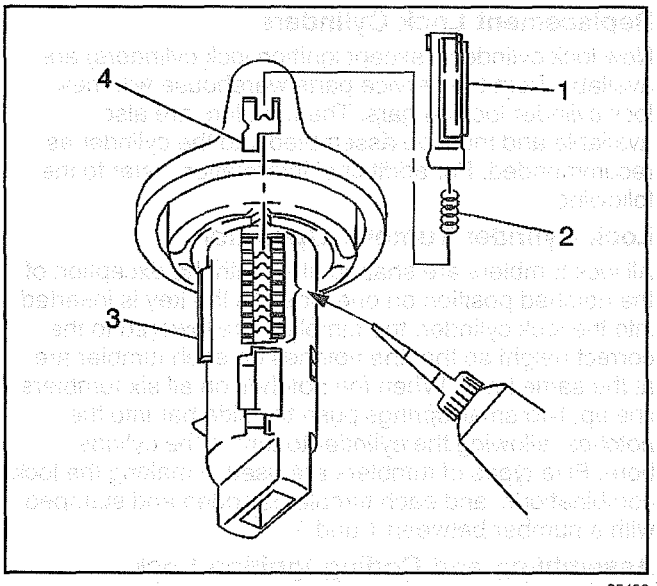
Tools Required

J 41340 Lock Cylinder Staking and Holding Fixture



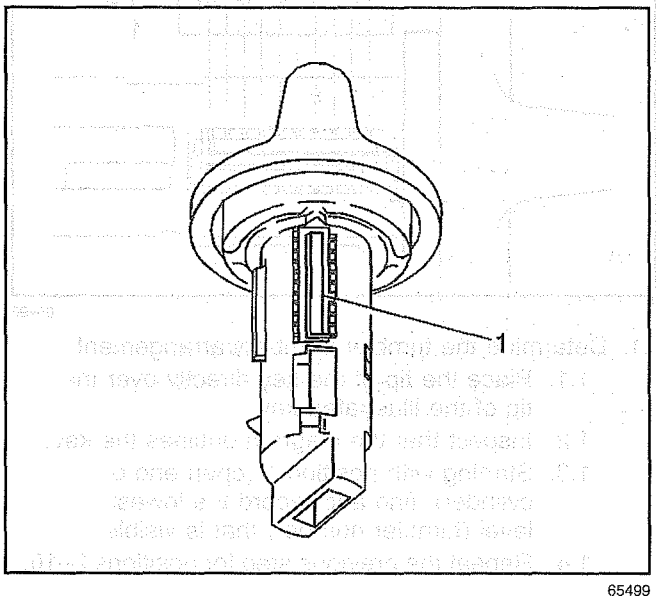
65496

1. Determine the tumbler numbers/arrangement:
   1.1. Place the tip of the key directly over the tip of the illustrated key.
   1.2. Inspect that the diagram outlines the key.
   1.3. Starting with position 1 (open end of cylinder), find and record the lowest level (tumbler number) that is visible.
   1.4. Repeat the previous step for positions 2–10.



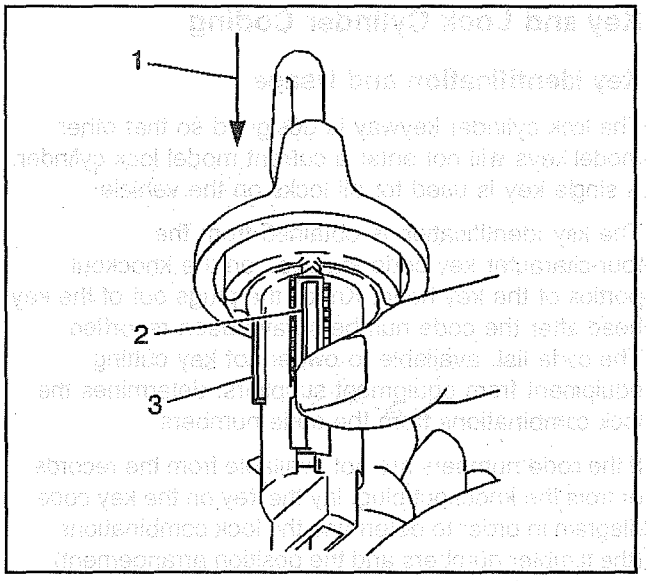
65498

2. Starting with position 1, insert the tumblers (4) into their corresponding slots in the coded order.
3. Using your fingers, pull out the side bar (3) until the tumblers fall completely into place.
4. Insert one tumbler spring (2) above each tumbler (4).
5. Lubricate the tumblers using Superlube® GM P/N 12346241 or equivalent.
6. Insert the spring retainer (1) prongs into the slots at the end of each cylinder.



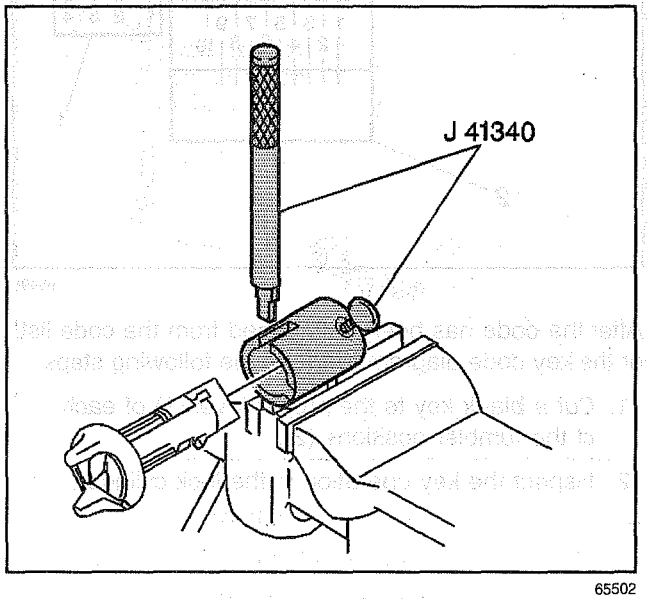
65499

7. Press down the retainer (1) until fully seated in the depression.



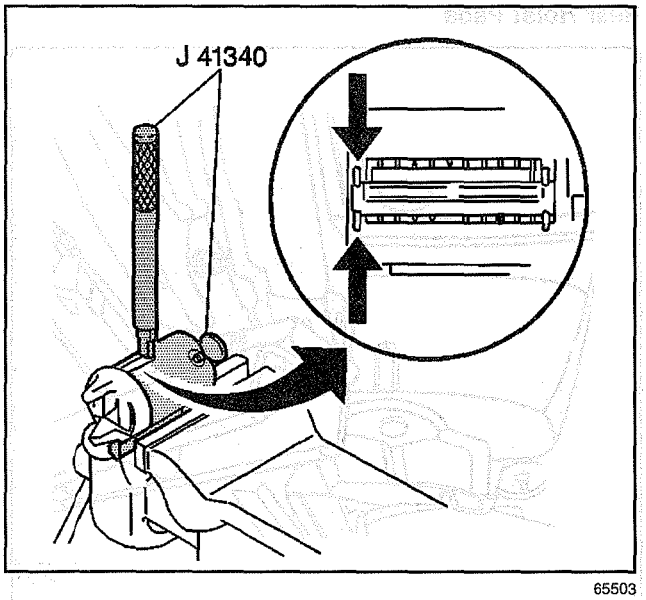
65501

8. Inspect for proper tumbler installation:
   - 8.1. Hold the spring retainer (2) in position.
   - 8.2. Insert the key (1) into the cylinder.
   - 8.3. The side bar (3) should drop down flush with the cylinder diameter if properly installed.
   - 8.4. Disassemble and assemble properly as needed.
9. Remove the key.



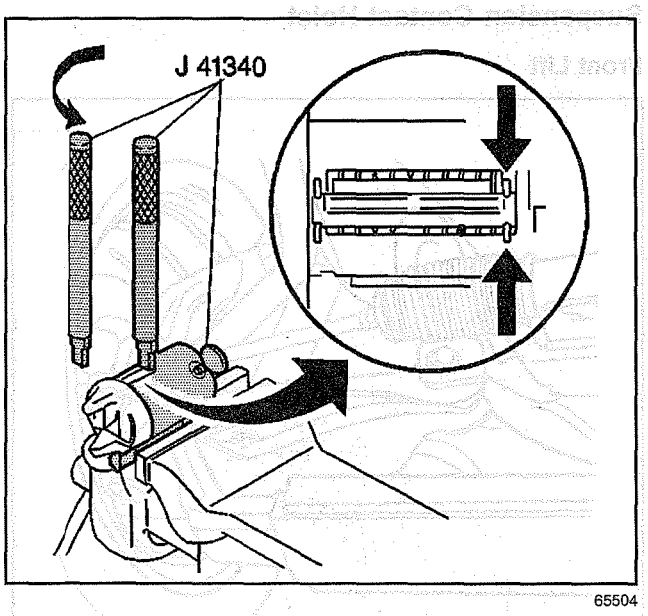
65502

10. Secure the cylinder in the *J 41340*.
    - 10.1. Inspect that the spring retainer is facing up and positioned directly under the punch slots.
    - 10.2. Push the cylinder into the *J 41340* until butted with the cylinder bezel.
    - 10.3. Tighten the holding screw.



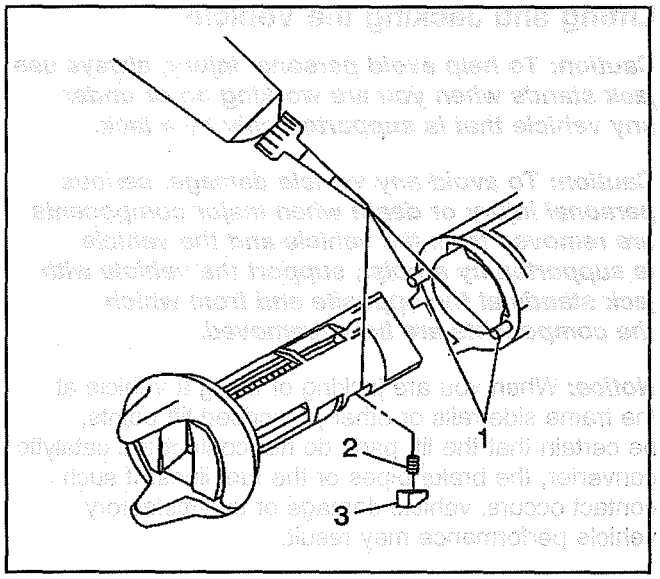
65503

11. Stake the bezel end of the retainer in place:
    11.1. Hold the flat side of the punch, part of *J 41340*, squarely against the face of the cylinder bezel.
    11.2. Stake the lock cylinder metal over the retainer corners.



65504

12. Stake the other end of the retainer:
    12.1. Remove the punch, part of *J 41340*.
    12.2. Rotate the punch, part of *J 41340*, 180 degrees.
    12.3. Hold the punch, part of *J 41340*, squarely against the end of the punch slot on *J 41340*.
    12.4. Stake the metal over the other end of the retainer.



65505

13. Loosen the holding screw.
14. Remove the cylinder from the *J 41340*.
15. Inspect that the retainer is properly staked. Restake as needed.
16. Lubricate the cylinder retainer slot.
17. Insert the following parts into the cylinder retainer slot:
    - The retainer spring (2)
    - The retainer (3)

Important: Use a paste type grease, not a spray, for the following step.

18. Lubricate the following parts with GM P/N 12345996 or equivalent as needed:
    - The detent pins (1)
    - The cylinder retainer (3)

Side Door Lock Cylinder Coding

The side door lock cylinder has five snap-in tumblers. The number 1–5 positions (beginning closest to the cylinder head) are a brass retainer tumbler. The 6–10 positions are standard tumbler positions. Therefore, only the 6–10 positions are required.

Lifting and Jacking the Vehicle

Caution: To help avoid personal injury, always use jack stands when you are working on or under any vehicle that is supported only by a jack.

Caution: To avoid any vehicle damage, serious personal injury or death when major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed.

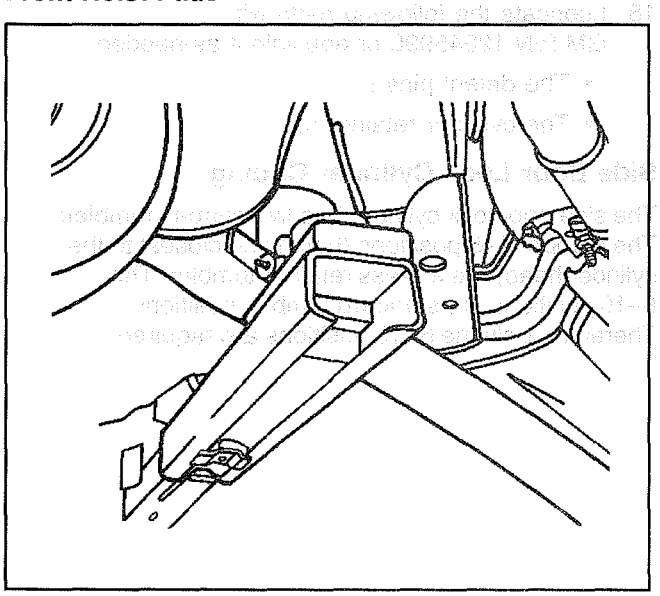
Notice: When you are jacking or lifting a vehicle at the frame side rails or other prescribed lift points, be certain that the lift pads do not contact the catalytic converter, the brake pipes or the fuel lines. If such contact occurs, vehicle damage or unsatisfactory vehicle performance may result.

For lifting the vehicle, various lift points are recommended. Before you begin any lifting procedure, be sure the vehicle is on a clean, hard, level surface. Be sure all the lifting equipment meets weight standards and is in good working order. Be sure all the vehicle loads are equally distributed and secure. If you are only supporting the vehicle at the frame side rails, make sure the lifting equipment does not put too much stress on, or weaken, the frame side rails.

If you use any other hoisting methods than those called out, take special care not to damage the fuel tanks, the exhaust system or the underbody.

Frame Contact Hoist

Front Hoist Pads

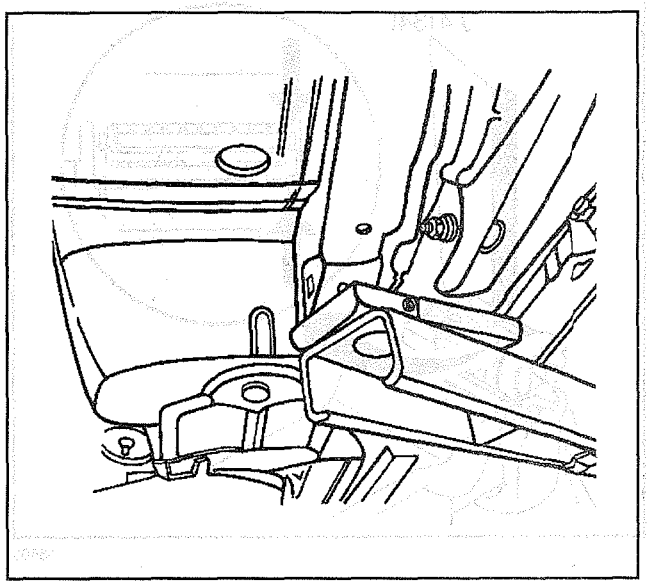


255759

Important: The front hoist pads must not contact the rocker panels, the front fenders, or the floor pan.

Position the front hoist pads (frame contact) as shown.

Rear Hoist Pads



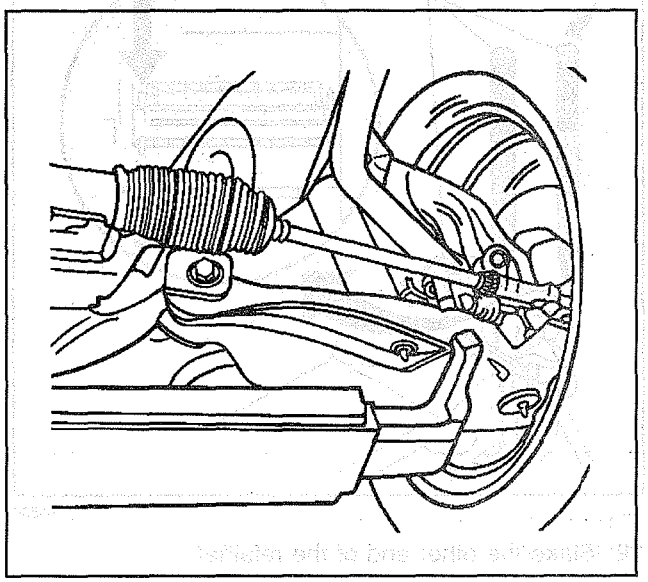
255757

Important: The rear hoist pads must not contact the body rocker panels or the floor pan.

Position the rear hoist pads (body/frame contact) as shown.

Suspension Contact Hoist

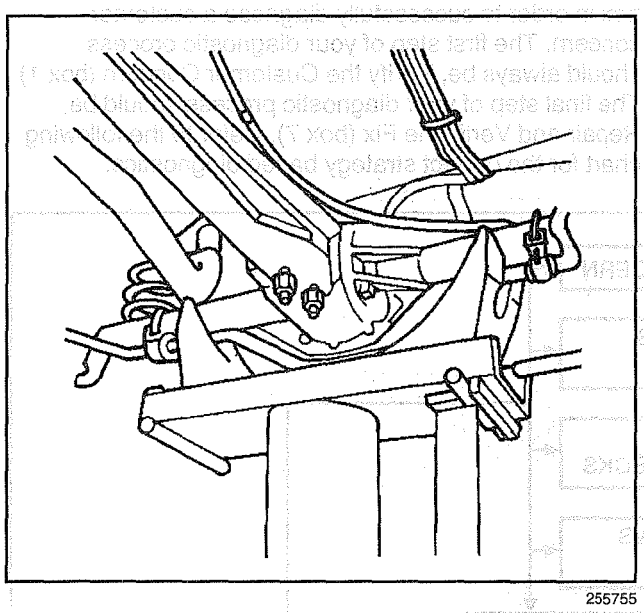
Front Lift



255761

Position the front lift (suspension contact) as follows: under the outer edge of the front suspension lower control arms.

Rear Lift

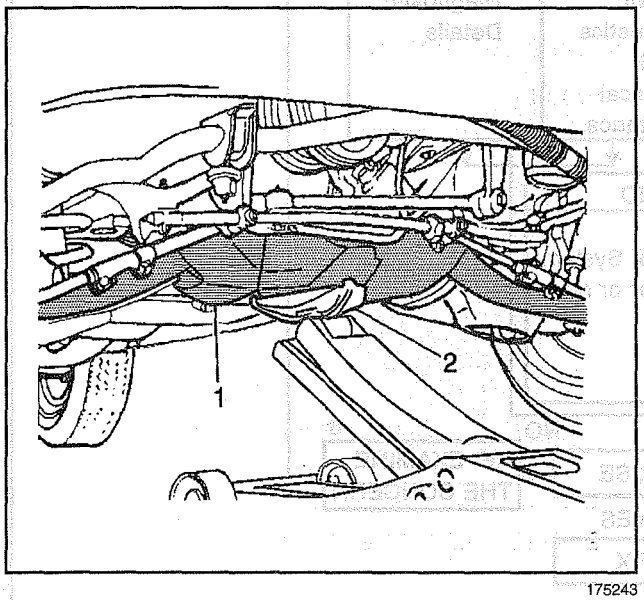


255755

Position the rear lift (suspension contact) as shown.

Vehicle Jacking

Under the Front Crossmember

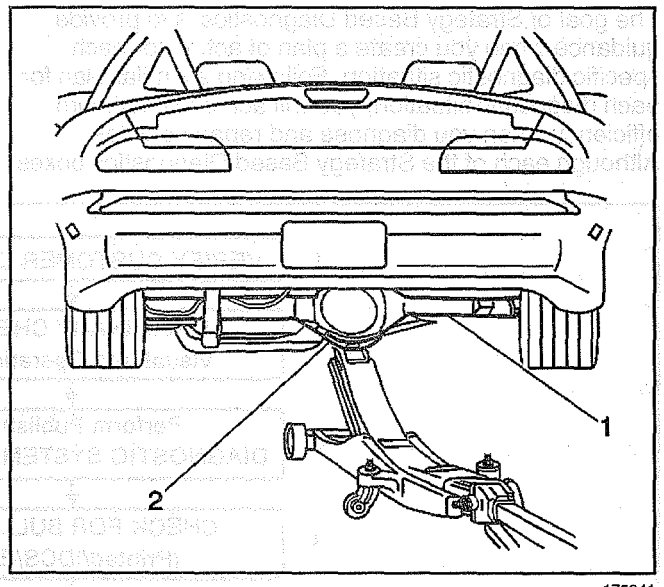


175243

Important: When lifting the vehicle with a floor jack, block the wheels at the opposite end from which you are raising.

Position the floor jack pad under the center of the front crossmember.

Under the Rear Differential



175241

Important: When lifting the vehicle with a floor jack, block the wheels at the opposite end from which you are raising.

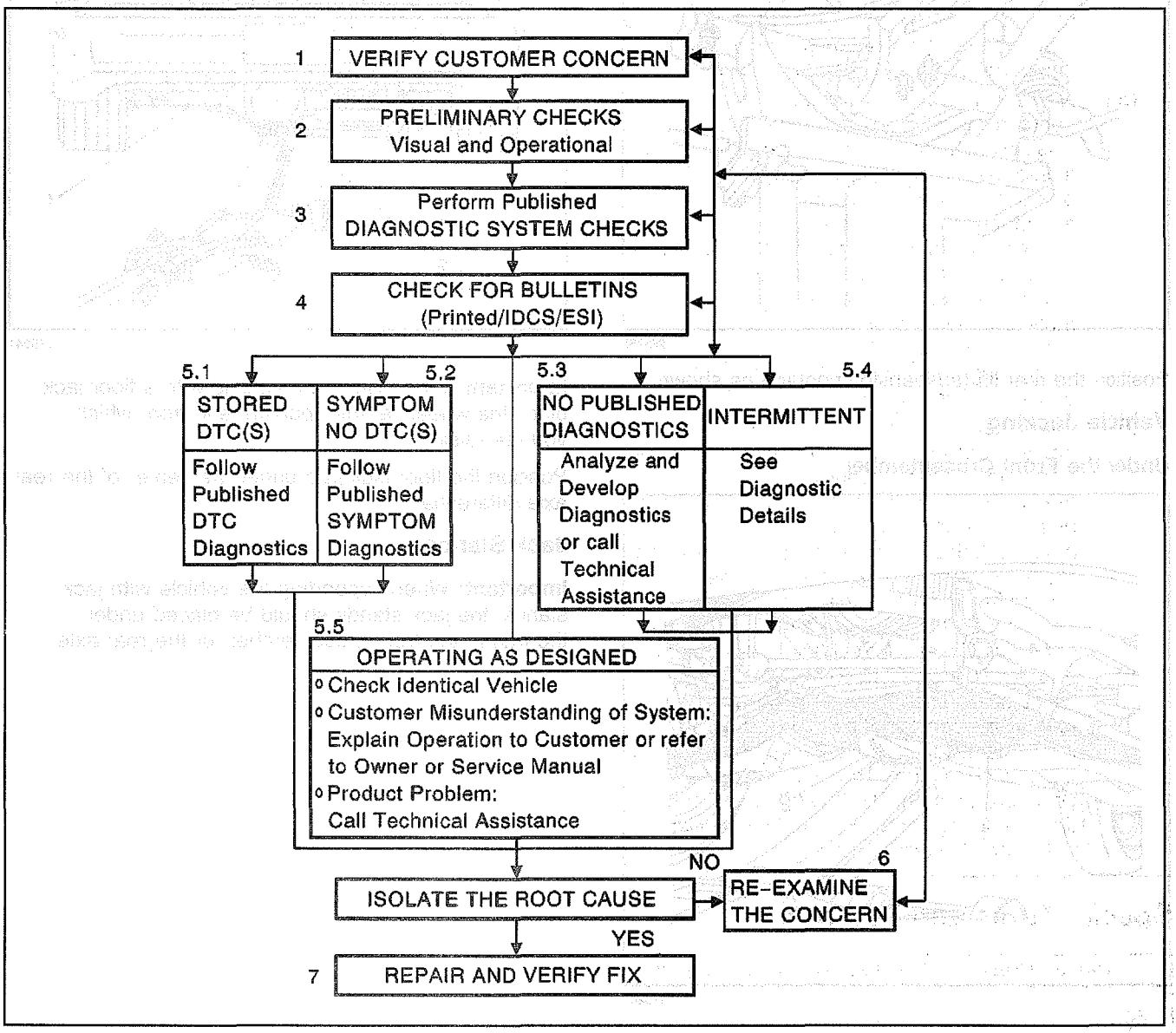
Position the floor jack pad under the center of the rear axle differential.

Jack Stands

Important: When supporting the vehicle with jack stands, the jack stands should be placed under the frame, the front crossmember, or the rear axle.

Strategy Based Diagnosis

The goal of Strategy Based Diagnostics is to provide guidance when you create a plan of action for each specific diagnostic situation. Following a similar plan for each diagnostic situation, you will achieve maximum efficiency when you diagnose and repair vehicles. Although each of the Strategy Based Diagnostics boxes is numbered, you are not required to complete every box in order to successfully diagnose a customer concern. The first step of your diagnostic process should always be, Verify the Customer Concern (box 1). The final step of your diagnostic process should be, Repair and Verify the Fix (box 7). Refer to the following chart for the correct strategy based diagnostics.



6508

Legend

(1) Verify the customer concern: The first part of this step is to obtain as much information as possible from the customer such as: Are there aftermarket accessories on the vehicle? When does the condition occur? Where does the condition occur? How long and how often does the condition occur? In order to verify the concern the technician should know the normal operation of the system and refer to the owner or service manual for any information needed.

(2) Preliminary Checks: Conduct a thorough visual inspection. Review the service history. Detect unusual sounds or odors. Gather diagnostic trouble code information in order to achieve an effective repair.

(3) Perform Published Diagnostic System Checks: One or more DTCs may not support a system. System checks verify the proper operation of the system. This will lead the technician in an organized approach to diagnostics.

(4) Check Bulletins and Other Service Information: Such as videos, newsletters, and the Pulsat programs.

(5.1) Stored DTCs: Follow the designated DTC table exactly in order to make an effective repair.

(5.2) Symptom No DTC: Select the symptom from the symptom tables. Follow the diagnostic steps or suggestions in order to complete the repair, or refer to the applicable component/system check.

(5.3) No Published Diagnostics: Analyze the concern. Develop a plan for the diagnostics. The service manual schematics will help you to see system power, ground, input and output circuits. You can also identify splices and other areas where multiple circuits are tied together. Look at component locations to see if components, connectors or harnesses may be exposed to extreme temperature, moisture, road salt or other corrosives (battery acid, oil or other fluids). Utilize the wiring diagrams, system description and operation, and system circuit description.

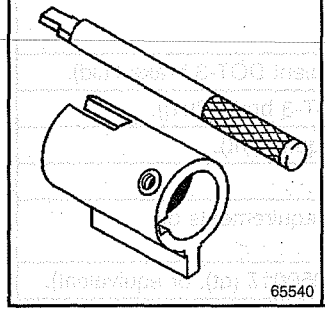
(5.4) Intermittents: An intermittent condition is one that does not occur continuously and will occur when certain conditions are met. Generally, intermittents are caused by: Faulty electrical connections and wiring, malfunctioning components, electromagnetic/ radio frequency interference, and aftermarket equipment.. Combine the technician knowledge with efficient use of the available service information. Evaluate the symptoms and conditions described by the customer. Use a check sheet or other method in order to identify the component. Follow the suggestions for intermittent diagnosis found in the service manual. The Tech 1, Tech 2 scan tools, and the J39200 (Fluke 87) have data capturing capabilities that can assist in detection of intermittents.

(5.5) Vehicle Operates as Designed: This condition exists when the vehicle is found to operate normally. The condition described by the customer may be normal. Verify against another like vehicle that is operating normally under the same conditions described by the customer. Explain your findings and the operation of that system to the customer.

(6) Re-examine the Concern: If a technician cannot successfully find or isolate the concern, a reevaluation is necessary. Re-verify the concern. The concern could be an intermittent or normal.

(7) Repair and Verify Fix: After isolating the cause, make the repairs and validate for proper operation. Verify that the symptom has been corrected which may involve road testing the vehicle.

Special Tools and Equipment

Tool Illustration	Tool Number/Description
 65540	J 41340 Lock Cylinder Staking and Holding Fixture

Maintenance and Lubrication

Specifications

Capacities - Approximate Fluid

Approximate Fluid Capacities

Description	Specification	
	Metric	English
Engine Cooling System		
3.8 L With Manual Transmission	11.0 liters	11.6 quarts
3.8 L With Automatic Transmission	10.8 liters	11.4 quarts
5.7 L With Manual Transmission	11.3 liters	11.9 quarts
5.7 L With Automatic Transmission	11.2 liters	11.8 quarts
Engine Crankcase		
3.8 L With Filter	4.2 liters	4.5 quarts
5.7 L With Filter	5.2 liters	5.5 quarts
Transmission		
4L60-E	4.7 liters	5.0 quarts
After Complete Overhaul (L36)	8.3 liters	8.8 quarts
After Complete Overhaul (LS1)	10.2 liters	10.8 quarts
M49 5-Speed Manual Transmission	3.2 liters	3.4 quarts
MM6 6-Speed Manaual Transmission	3.8 liters	4.0 quarts
Approximate Fuel Capacities (All Vehicles)	63.6 liters	16.8 quarts

Fluid and Lubricant Recommendations

Component	Fluid or Lubricant Recommended
Automatic Transmission	DEXRON®-III Automatic Transmission Fluid.
Chassis Lubrication	Chassis lubricant (GM P/N 12377985 or equivalent) or lubricant meeting requirements of NLGI Grade 2, Category GC or GC-LB.
Differential, Locking	Axle Lubricant (GM P/N 12378261) Synthetic 75W-90 GL-5 Gear Lubricant with Limited Slip Differential Additive (GM P/N 1052358)
Differential, Non-Locking	Axle Lubricant (GM P/N 12378261) Synthetic 75W-90 GL-5 Gear Lubricant.
Engine Coolant	50/50 mixture of clean water (preferably distilled) and GM Goodwrench® DEX-COOL® or Havoline® DEX-COOL® coolant (only).
Engine Oil	Engine oil with the American Petroleum Institute Certified For Gasoline Engines "Starburst" symbol of the proper viscosity. To determine the preferred viscosity for your vehicle's engine, refer to the Explanation of Scheduled Services.
Hinges, Hood and Door	Multi-Purpose lubricant, Superlube® (GM P/N 12346241 or equivalent).
Hood Latch • Pivots and Spring Anchor • Release Pawl	Lubriplate lubricant aerosol (GM P/N 12346293 or equivalent) or lubricant meeting requirements of NLGI Grade 2, Category LB or GC-LB.
Hydraulic Brake System	Delco Supreme 11® Brake Fluid (GM P/N 12377967 or equivalent DOT-3 brake fluid).
Hydraulic Clutch System	Hydraulic Clutch Fluid (GM P/N 12345347 7 or equivalent DOT-3 brake fluid).
Lock Cylinders	Multi-Purpose Lubricant, Superlube® (GM P/N 12346241 or equivalent).
Manual Transmission	DEXRON®-III Automatic Transmission Fluid.
Parking Brake Cable Guides	Chassis lubricant (GM P/N 12377985 or equivalent) meeting requirements of NLGI Grade 2, Category GC or GC-LB.
Power Steering System	GM Hydraulic Power Steering Fluid (GM P/N 1052884 (pt), 1050017 (qt), or equivalent).
Weatherstrip Conditioning	Dielectric Silicone Grease (GM P/N 12345579 or equivalent).
Windshield Washer Solvent	GM Optikleen® Washer Solvent (GM P/N 1051515) or equivalent.

Tire Inflation Pressure Specifications (Tire Inflation Specifications)

Application	Specification	
	Metric	English
Compact spare tire	420 kPa	60 psi
Tires under normal driving conditions	210 kPa	30 psi
Tires under sustained high speed driving of 160 km/h (100 mph) or higher	265 kPa	38 psi

Maintenance Items

Usage	Type
Air Cleaner/Filter	
3.8 L and 5.7 L	AC Type A917C
Engine Oil Filter	
3.8 L (L36)	AC Type PF-47
5.7 L (LS1)	AC Type PF-44
Fuel Filter	
3.8 L (L36)	AC Type G627
5.7 L (LS1)	AC Type GF-578
PCV Valve	
3.8 L (L36)	AC Type CV892C
5.7 L (LS1)	AC Type CV948C
Radiator Cap	
3.8 L (L36) and 5.7 L (LS1)	AC Type RC-24
Spark Plugs and Gaps	
3.8 L (L36)	AC Type 41-921 (GAP 1.52 mm, 0.060 in)
5.7 L (LS1)	AC Type 41-952 (GAP 1.52 mm, 0.060 in)

Maintenance

Maintenance Schedule

Normal Vehicle Use

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

- To carry passengers and cargo within the recommended limitations as indicated on the Tire Placard located on the edge of the driver's door.
- On reasonable road surfaces within legal driving limits.
- On unleaded gasoline of the recommended type. For information on the proper type of fuel to use, refer to the Owner's Manual.

Maintenance Schedule Intervals

The services shown in this schedule up to 166 000 km (100,000 miles) should be performed after 166 000 km (100,000 miles) at the same intervals. The services shown in this schedule to be performed at 240 000 km (150,000 miles) should be performed after 240 000 km (150,000 miles) at the same intervals.

For explanations of the maintenance inspections and services included in this Maintenance Schedule, refer to *Explanation of Scheduled Services*.

For additional maintenance inspections and services which are not included in this Maintenance Schedule, refer to *Periodic Maintenance Inspection*.

Maintenance Schedule Engine Oil Change Intervals

This vehicle is equipped with an engine oil life monitor. The engine oil life monitor will indicate when to change the engine oil – usually between 5 000 km (3,000 miles) and 16 000 km (10,000 miles) since the last oil change. Under severe conditions, the CHANGE OIL message may be displayed before 5 000 km (3,000 miles).

The vehicle MUST NOT be driven more than 16 000 km (10,000 miles) or 12 months without an oil change.

The engine oil life monitor will not detect dust in the oil. If the vehicle is driven in a dusty area, be sure to change the oil every 5 000 km (3,000 miles) or sooner if the CHANGE OIL message is displayed.

Footnotes

‡ The U.S. Environmental Protection Agency or the California Air Resources Board 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 the vehicle's useful life. We, however, urge that all recommended maintenance services be performed at the indicated intervals and the maintenance be recorded.

* This vehicle is equipped with an oil life monitor. For description and resetting information, refer to *Oil Life Monitor - Resetting*.

16 000 km (10,000 Miles)

- Check the engine oil life monitor. If the engine oil and filter are changed, reset the engine oil life monitor. Refer to *Oil Life Monitor - Resetting*.

  This is an emission control service. *
- Inspect the air cleaner filter if the vehicle is driven in dusty conditions. Replace the filter if necessary.

  This is an emission control service. ‡

32 000 km (20,000 Miles)

- Check the engine oil life monitor. If the engine oil and filter are changed, reset the engine oil life monitor. Refer to *Oil Life Monitor - Resetting*.

  This is an emission control service. *
- Inspect the air cleaner filter if the vehicle is driven in dusty conditions. Replace the filter if necessary.

  This is an emission control service. ‡

48 000 km (30,000 Miles)

- Check the engine oil life monitor. If the engine oil and filter are changed, reset the engine oil life monitor. Refer to *Oil Life Monitor - Resetting*.

  This is an emission control service. *
- Replace the air cleaner filter.

  This is an emission control service.
- Inspect the fuel tanks, cap and lines for damage or leaks. Inspect the fuel cap gasket for any damage. Replace parts as needed.

  This is an emission control service. ‡

64 000 km (40,000 Miles)

- Check the engine oil life monitor. If the engine oil and filter are changed, reset the engine oil life monitor. Refer to *Oil Life Monitor - Resetting*.

  This is an emission control service. *
- Inspect the air cleaner filter if the vehicle is driven in dusty conditions. Replace the filter if necessary.

  This is an emission control service. ‡

80 000 km (50,000 Miles)

- Check the engine oil life monitor. If the engine oil and filter are changed, reset the engine oil life monitor. Refer to *Oil Life Monitor - Resetting*.

  This is an emission control service. *
- Inspect the air cleaner filter if the vehicle is driven in dusty conditions. Replace the filter if necessary.

  This is an emission control service. ‡
- Change the automatic transmission fluid and filter if the vehicle is mainly driven under one or more of these conditions:
  - In heavy traffic where the outside temperature regularly reaches 32°C (90°F) or higher.
  - In hilly or mountainous terrain.
  - Uses such as high performance operation.

If the vehicle is not used under any of these conditions, change the fluid and filter at 166 000 km (100,000 miles).

96 000 km (60,000 Miles)

- Check the engine oil life monitor. If the engine oil and filter are changed, reset the engine oil life monitor. Refer to *Oil Life Monitor - Resetting*.

  This is an emission control service. *
- Replace the air cleaner filter.

  This is an emission control service.
- Inspect the fuel tanks, cap and lines for damage or leaks. Inspect the fuel cap gasket for any damage. Replace parts as needed.

  This is an emission control service. ‡
- Inspect the accessory drive belts.

  This is an emission control service.

112 000 km (70,000 Miles)

- Check the engine oil life monitor. If the engine oil and filter are changed, reset the engine oil life monitor. Refer to *Oil Life Monitor - Resetting*.

  This is an emission control service. *
- Inspect the air cleaner filter if the vehicle is driven in dusty conditions. Replace the filter if necessary.

  This is an emission control service. ‡

128 000 km (80,000 Miles)

- Check the engine oil life monitor. If the engine oil and filter are changed, reset the engine oil life monitor. Refer to *Oil Life Monitor - Resetting*.

  This is an emission control service. *
- Inspect the air cleaner filter if the vehicle is driven in dusty conditions. Replace the filter if necessary.

  This is an emission control service. ‡

144 000 km (90,000 Miles)

- Check the engine oil life monitor. If the engine oil and filter are changed, reset the engine oil life monitor. Refer to *Oil Life Monitor - Resetting*.

  This is an emission control service. *
- Replace the air cleaner filter.

  This is an emission control service.
- Inspect the fuel tanks, cap and lines for damage or leaks. Inspect the fuel cap gasket for any damage. Replace parts as needed.

  This is an emission control service. ‡

160 000 km (100,000 Miles)

- Check the engine oil life monitor. If the engine oil and filter are changed, reset the engine oil life monitor. Refer to *Oil Life Monitor - Resetting*.

  An emission control service. *
- Inspect the air cleaner filter if the vehicle is driven in dusty conditions. Replace the filter if necessary.

  This is an emission control service. ‡
- Replace the spark plugs.

  This is an emission control service.
- Inspect the spark plug wires.

  This is an emission control service.

- Change the automatic transmission fluid and filter if the vehicle is mainly driven under one or more of these conditions:
  - In heavy traffic where the outside temperature regularly reaches 32°C (90°F) or higher.
  - In hilly or mountainous terrain.
  - Uses such as high performance operation.

If the vehicle has not been used under any of the severe conditions listed previously and, therefore, has not had the automatic transmission fluid and filter changed, change both the fluid and filter.

240 000 km (150,000 Miles)

Drain, flush and refill the cooling system (or every 60 months since the last cooling system service, whichever occurs first). For information on the proper coolant to use, refer to *Fluid and Lubricant Recommendations*.

Explanation of Scheduled Services

The following text and illustrations describe the details of the scheduled required maintenance services.

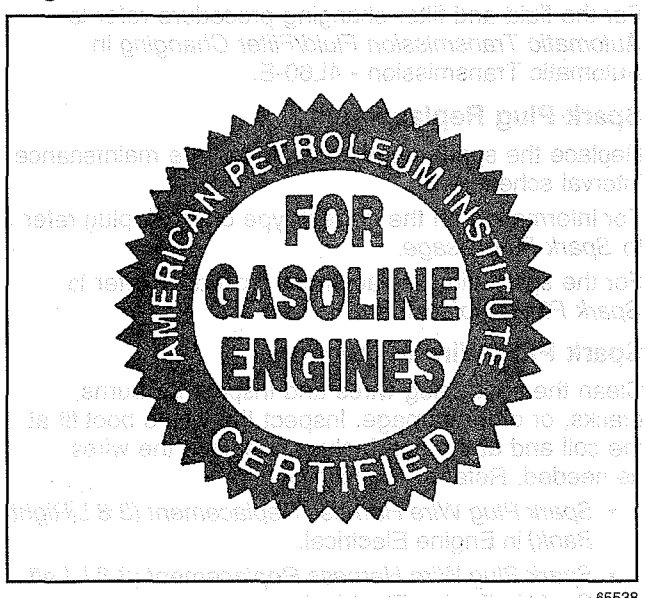
For information on the proper fluids and lubricants to use refer to *Fluid and Lubricant Recommendations*.

Engine Oil and Oil Filter Change

For the engine oil and oil filter changing procedure refer to the following:

- *Engine Oil and Oil Filter Replacement* in Engine Mechanical - 3.8 L.
- *Engine Oil and Oil Filter Change* in Engine Mechanical - 5.7 L.

Engine Oil Quality

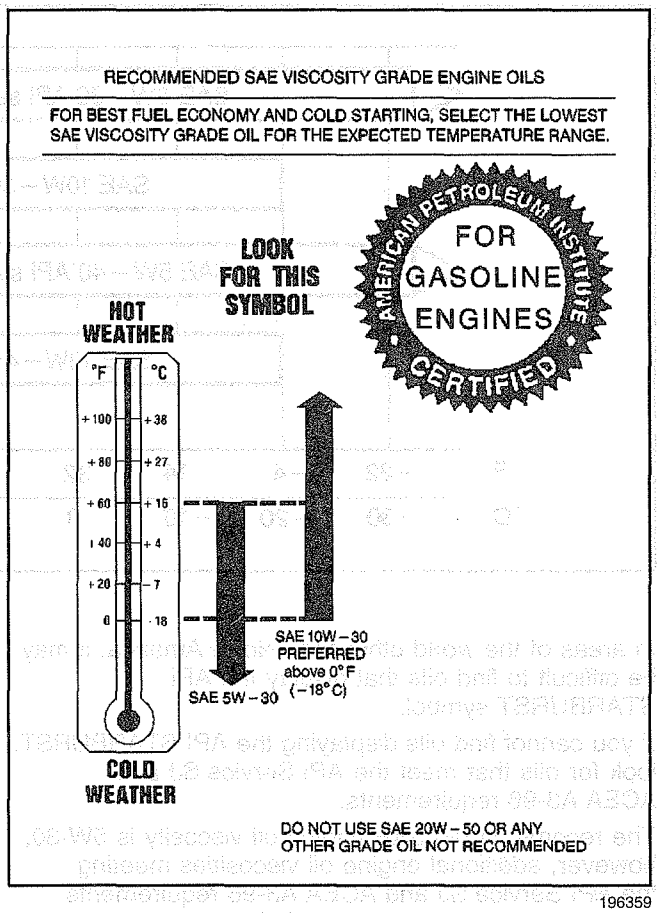


65538

Important: DO NOT use engine oil additives in Camaro and Firebird engines.

When changing or adding to the motor oil, use ONLY motor oils of the proper quality. The engines in the Camaro and Firebird require motor oils of the proper viscosity (thickness) and marked by the American Petroleum Institute (API) Certified For Gasoline Engines STARBURST symbol.

Engine Oil Viscosity



196359

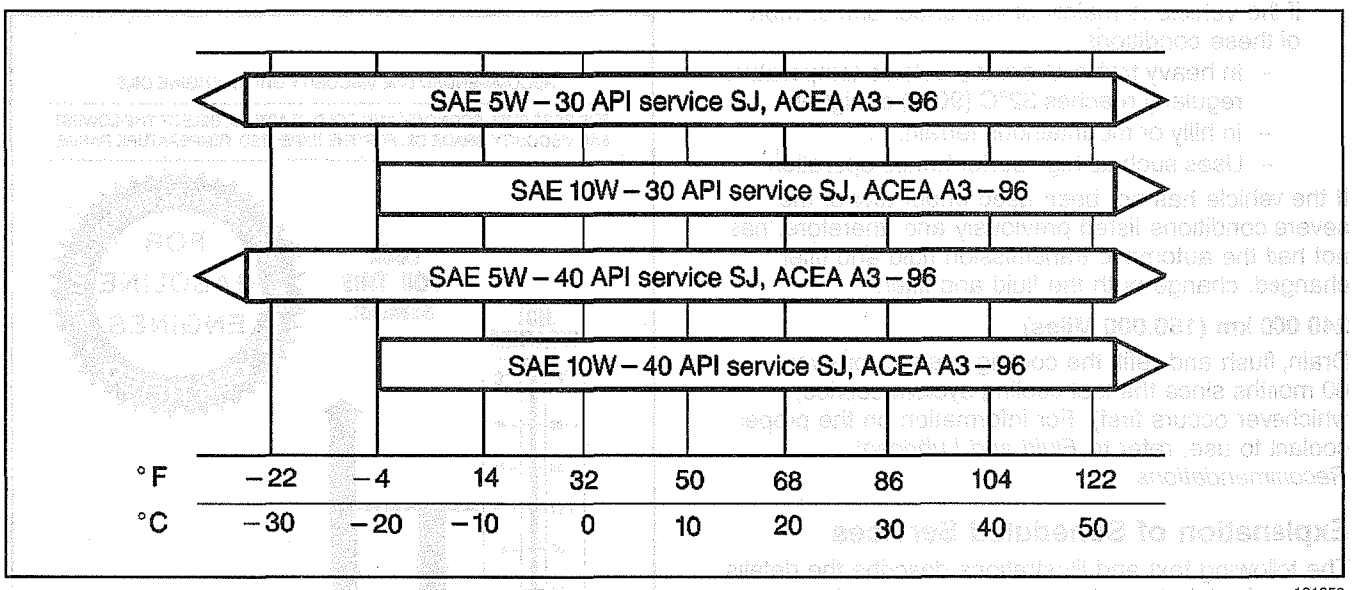
Notice: Using engine oils of any viscosity other than those viscosities recommended could result in engine damage.

Motor oil viscosity has an effect on fuel economy and cold-weather operation (starting and oil flow). Lower viscosity motor oils can provide better fuel economy and cold-weather performance.

When choosing an motor oil, consider the range of outdoor temperatures the vehicle will be operated in before the next oil change. Then select the recommended oil viscosity.

The recommended SAE motor oil viscosity is 5W-30. However, if outdoor temperatures will remain above –18°C (0°F), 10W-30 may be used.

Engine Oil Quality and Viscosity (Export)



191050

In areas of the world other than North America, it may be difficult to find oils that display the API STARBURST symbol.

If you cannot find oils displaying the API STARBURST, look for oils that meet the API Service SJ and ACEA A3-96 requirements.

The recommended SAE engine oil viscosity is 5W-30, however, additional engine oil viscosities meeting the API Service SJ and ACEA A3-96 requirements may be used in accordance with the temperature ranges shown.

Accessory Drive Belt Inspection

Inspect the accessory drive belts for the following:

- Cracks
- Fraying
- Wear
- Proper tension

Replace as needed. (A belt can develop many small cracks in individual ribs without affecting the belt's performance.) Refer to the following:

- *Drive Belt Replacement* in Engine Mechanical - 3.8 L.
- *Drive Belt Replacement - Accessory* or *Drive Belt Replacement - A/C* in Engine Mechanical - 5.7 L.

Cooling System Service

Important: If silicate coolant is added to the cooling system, premature engine, heater core, or radiator corrosion may result. In addition, the coolant will require replacement much more frequently (every 50 000 km (30,000 miles) or 24 months.)

Drain, flush, and refill the system with a 50/50 mixture of clean water (preferably distilled) and ONLY GM Goodwrench® DEX-COOL® or Havoline® DEX-COOL® (silicate-free) coolant. Refer to *Draining and Filling Cooling System (3.8 L)* or *Draining and Filling Cooling System (5.7 L)* in Engine Cooling.

Transmission Service

Manual Transmission

No fluid service is required. For fluid level inspection refer to *Manual Transmission Fluid Level Check* in Manual Transmission - M49 or *Manual Transmission Fluid Level Check* in Manual Transmission - MM6.

Automatic Transmission

Change both the fluid and the filter according to the maintenance interval schedule.

For the fluid and filter changing procedure refer to *Automatic Transmission Fluid/Filter Changing* in Automatic Transmission - 4L60-E.

Spark Plug Replacement

Replace the spark plugs according to the maintenance interval schedule.

For information on the correct type of spark plug refer to *Spark Plug Usage.*

For the spark plug replacement procedure refer to *Spark Plug Replacement.*

Spark Plug Wire Inspection

Clean the spark plug wires and inspect for burns, cracks, or other damage. Inspect the wire's boot fit at the coil and at the spark plugs. Replace the wires as needed. Refer to the following:

- *Spark Plug Wire Harness Replacement (3.8 L Right Bank)* in Engine Electrical.
- *Spark Plug Wire Harness Replacement (3.8 L Left Bank)* in Engine Electrical.
- *Spark Plug Wire Harness Replacement (5.7 L)* in Engine Electrical.

Air Cleaner Filter Replacement

Replace the air cleaner filter according to the maintenance schedule intervals with the correct type.

For information on the correct type of air cleaner filter refer to *Maintenance Items.*

Oil Life Monitor - Resetting

Description

The engine oil life monitor will indicate when to change the engine oil – usually between 5 000 km (3,000 miles) and 12 500 km (7,500 miles) since the last oil change. Under severe conditions, the CHANGE OIL message may be displayed before 5 000 km (3,000 miles). The vehicle must not be driven more than 12 500 km (7,500 miles) or 12 months without an oil change.

The engine oil life monitor will not detect dust in the oil. If the vehicle is driven in a dusty area, be sure to change the oil every 5 000 km (3,000 miles) or sooner if the CHANGE OIL message is displayed.

Reset the oil life monitor when the oil has been changed, use the following procedure.

Resetting Procedure

Follow this procedure to reset the engine oil life monitor:

1. Turn the ignition to RUN (engine off)..
2. Press the TRIP/OIL RESET button on the instrument panel for 12 seconds.
   The OIL CHANGE light will start to flash to confirm that the system is reset.
   The reset is complete when the OIL CHANGE light goes out.
3. Turn the ignition OFF.

Owner Checks and Services

The following information covers the tests, inspections, and services required to maintain the safety, dependability, and emission control performance of the vehicle.

Make certain that any necessary repairs are completed on time. Whenever any fluids and/or lubricants are added to the vehicle, be certain to use the proper fluids and/or lubricants. Refer to *Fluid and Lubricant Recommendations*.

At Each Fuel Fill

Perform the following underhood inspections at each fuel fill.

Engine Oil Level

Inspect the engine oil level and add the proper oil when necessary. Refer to *Fluid and Lubricant Recommendations*.

Engine Coolant Level

Inspect the engine coolant level and add the proper coolant mixture when necessary. Refer to *Fluid and Lubricant Recommendations*.

Windshield Washer Fluid Level

Inspect the windshield washer fluid level in the windshield washer reservoir and add the proper fluid when necessary. Refer to *Fluid and Lubricant Recommendations*.

At Least Once a Month

Inspect the tire inflation. Make certain that the tires are inflated to the pressures specified on the Certification/Tire label located on the driver's door lock pillar. Refer to *Tire Placard*.

Clean the playback heads and the capstan of the cassette deck. Cleaning should be done after every 50 hours of tape playing time. Refer to *Cleaning Tape Head and Capstan, Cassette Cleaning* in Body and Accessories.

At Least Twice A Year

Restraint System Check

Make sure the safety belt reminder light and all of your belts, buckles, latch plates, retractors, and anchorages are working properly. Look for any other loose or damaged safety belt system parts. If you see anything that might keep am safety belt system from doing its job, have it repaired. Have any torn or frayed safety belts replaced.

Also look for any opened or broken air bag coverings, and have them repaired or replaced. (The SIR system does not need regular maintenance).

Wiper Blade Check

Inspect wiper blades for wear or cracking. Replace the blade inserts that appear worn or damaged or that streak or miss areas of the windshield.

Air Cleaner Filter Restriction Indicator Check

Your vehicle has an indicator on the engine that lets you know when the air cleaner filter is dirty and needs to be changed. Inspect indicator at least twice a year or when your oil is changed, whichever occurs first. Inspect your air cleaner filter restriction indicator more often if the vehicle is used in dusty areas.

Weatherstrip Lubrication

Silicone grease on weatherstrips will make them last longer, seal better, and not stick or squeak. Apply silicone grease with a clean cloth. During very cold, damp weather more frequent application may be required.

Automatic Transmission Check

Inspect the automatic transmission fluid level; add if needed. A fluid loss may indicate a problem. Inspect the system and repair as needed.

At Least Once a Year

Key Lock Cylinders

Lubricate the lock cylinders with the recommended lubricant. Refer to *Fluid and Lubricant Recommendations*.

Important: More frequent lubrication may be required when any of the listed parts are exposed to a corrosive environment. In order to locate the proper lubricant, refer to *Fluid and Lubricant Recommendations*.

Body Lubrications

Lubricate all of the following areas:

- Body door hinges
- Body hood, safety lever, and prop rod pivot
- Fuel door
- Rear compartment hinges
- Rear compartment latches and locks
- Instrument panel compartment hinges, latch, and lock cylinder
- Console cover hinges and latch
- Seat hardware

Starter Switch

Test the starter switch:

- Before you start, make sure you have enough room around the vehicle in case the vehicle moves suddenly.
- Firmly apply both the parking brake and the regular (hydraulic) brake. DO NOT use the accelerator pedal, and be ready to turn off the engine immediately if it starts.
- For vehicles equipped with an automatic transmission try to start the engine in each gear. The starter should work ONLY in PARK (P) or NEUTRAL (N). If the starter activates in any other gear position the vehicle requires immediate service.

For vehicles equipped with the manual transmission, place the shift lever in the NEUTRAL (N) position, push the clutch pedal in halfway, and try to start the engine. The starter should work only when the clutch pedal is pushed all the way to the floor. If the starter works when the clutch pedal is not pushed all the way in, the vehicle requires immediate service.

Steering Column Lock

Test the steering column lock:

While the vehicle is parked and with the parking brake set, try to turn the key to LOCK in each of the shift lever positions.

For an automatic transmission, the key should turn to LOCK only when the shift lever is in the PARK (P) position.

For vehicles with a key release button, try to turn the key to lock without the button. The key should turn to LOCK only with the key button depressed.

Park Brake and Automatic Transmission PARK (P) Mechanism Test

Test the parking brake and automatic transmission PARK (P) mechanism:

Caution: When performing this check, the vehicle could begin to move. You or others could be injured and property could be damaged. Make sure there is room in front of the vehicle in case the vehicle begins to roll. Be ready to apply the regular brake at once, should the vehicle begin to move.

Follow this procedure to test the parking brake and automatic transmission PARK mechanism:

1. Park on a fairly steep hill, with the vehicle facing downhill.
2. Keep your foot on the brake pedal.
3. Set the parking brake.
4. In order to test the parking brake:
   - 4.1. Start the engine
   - 4.2. Place the shift lever in the NEUTRAL (N) position
   - 4.3. Slowly remove foot pressure from the brake pedal
5. In order to test the PARK (P) mechanism follow steps 1–3 above and then do the following:
   - 5.1. Place the shift lever in the PARK (P) position
   - 5.2. Release all of the brakes

Lap and Shoulder Belts Condition and Operation

Inspect all of the following seat belt system components:

- Webbing
- Buckles
- Latch plates
- Retractors
- Guide loops
- Anchors

Replace the belt if the webbing is cut or otherwise damaged.

Periodic Maintenance Inspection

Steering and Suspension Inspection

Inspect the front and the rear suspension for the following:

- Damaged parts
- Loose or missing parts
- Signs of wear or lack of lubrication

Inspect the power steering lines and the hoses for the following:

- Proper hookup
- Binding
- Leaks
- Cracks
- Chafing, etc.

Tire and Wheel Inspection

Inspect the tires for uneven wear or damage. If there is irregular or premature wear, test the wheel alignment. Inspect for damaged wheels. For tire diagnosis information, refer to *Abnormal or Excessive Tire Wear* in Suspension General Diagnosis.

For wheel alignment diagnosis information, refer to *Preliminary Alignment Inspection* in Wheel Alignment.

Exhaust System Inspection

Inspect the complete system. Inspect the body near the exhaust system. Look for broken, damaged, missing or out-of-position parts as well as open seams, holes, loose connections or other conditions which could cause a heat build-up in the floor pan or could let exhaust fumes into the vehicle. For exhaust system inspection diagnosis refer to *Exhaust System Inspection* in Engine Exhaust.

Engine Cooling System Inspection

Caution: NEVER spray water on a hot radiator. The resulting steam could cause personal injury.

Notice: Compressed air or water can be used to clean the radiator fins. Do not exceed 138 kPa (20 psi). Pressure over 138 kPa (20 psi) will damage the radiator.

Inspect and replace the radiator hoses if they are cracked, swollen, or deteriorated.

Inspect all of the pipes, the fittings, and the clamps and replace as needed.

Important: The radiator and the A/C condenser should be kept clean to ensure proper system performance. Cleaning is recommended at least once a year.

Inspect the front surface of the radiator and the A/C condenser. Insects, leaves, debris, etc. can affect the performance of the radiator and the A/C condenser.

If the front surface of either or both of these components requires cleaning, the unwanted material can be removed by performing the following:

- Ensure that the engine is off and cool.
- Blow compressed air through the radiator from the rear surface of the radiator toward the front of the vehicle.
- If compressed air is not available, use a water hose to force water through the radiator from the rear surface of the radiator toward the front of the vehicle.

To help ensure proper cooling system pressure, a pressure test of the cooling system and pressure cap is recommended at least once a year.

Throttle System Inspection

The throttle system (including the accelerator and the cruise control) should operate freely and without hesitation between full closed and wide open throttle.

Important: The accelerator and the cruise control cables should NOT be lubricated under any circumstance. Any throttle system components causing hesitation or sticking should be replaced.

Inspect for the following:

- Missing parts such as retainers or clips.
- Interference of the linkage or the cable conduit to critical components such as fuel lines, brake lines, harness leads, etc.
- Proximity of the cable to the exhaust system and other heat sources. Inspect for melting and/or discoloration.
- Cable kinking. Avoid sharp bends in cables.
- Clearance of the throttle system's moving parts throughout their travel from other stationary components.
- Damage of any components due to cable kinking, severe abrasion, misalignment, etc. If any of the above conditions exist, see your dealer for a rerouting, adjustment, or replacement recommendation.

Brake System Inspection

Inspect the entire brake system.

Notice: A low brake fluid level can indicate worn disc brake pads which may need to be serviced. Also, if the brake system warning light stays on or comes on, something may be wrong with the brake system. If the anti-lock brake system warning light stays on or comes on, something may be wrong with the anti-lock brake system.

Inspect the brake lines and the hoses for the following:

- Proper hookup
- Binding
- Leaks
- Cracks
- Chafing, etc.

Inspect the disc brake pads for wear. Inspect the surface condition of the rotors. Inspect all other brake parts including the calipers, the parking brake, etc.

The brakes may need to be inspected more often if driving habits or conditions result in frequent braking.

Vibration Diagnosis and Correction

Specifications

Tire and Wheel Runout Specifications

Application	Specification	
	Metric	English
Aluminum Wheel		
Lateral	0.762 mm	0.030 in
Radial	0.762 mm	0.030 in
Steel Wheel		
Lateral	1.143 mm	0.045 in
Radial	1.015 mm	0.040 in
Tire and Wheel (Radial and Lateral)		
Off-Vehicle	1.27 mm	0.05 in
On-Vehicle	1.52 mm	0.06 in
Wheel Stud	0.25 mm	0.01 in
Wheel Hub	0.132 mm	0.0052 in

Propeller Shaft Runout Specifications

Application	Metric	English
One-Piece Propeller Shaft Runout		
• Front	1.016 mm	0.040 in
• Center	1.27 mm	0.050 in
• Rear	1.40 mm	0.055 in
Two-Piece Propeller Shaft Runout		
• Front	0.762 mm	0.030 in
• Center	0.762 mm	0.030 in
• Rear	0.889 mm	0.035 in
Pinion Runout	0.076 mm	0.003 in

Propeller Shaft Balancing Weight Amounts

Correction, Total Weight	Clamp Spread, Degrees
0.0	180
0.1	174
0.2	169
0.3	163
0.4	157
0.5	151
0.6	145
0.7	139
0.8	133
0.9	127
1.0	120
1.1	113
1.2	106
1.3	99
1.4	91
1.5	83
1.6	74
1.7	64
1.8	52
1.9	36
2.0	0

Diagnostic Information and Procedures

Systematic Approach

During the last 10–15 years, vehicle design and engineering have dramatically changed due to the following factors:

- Increased fuel costs
- Decreased fuel supplies
- Corporate Average Fuel Economy requirements
- Clean air legislation
- Foreign competition
- Ability to withstand collision
- Rising customer expectations

Vehicle designs have evolved from full-frame construction to lighter unibody designs. These designs transfer noise and vibration much more readily.

General Motors has greatly reduced the use of heavier and smoother running V8 engines, replacing these engines with lighter, more fuel-efficient 4-cylinder and 6-cylinder engines. During this same time period, the following options have become increasingly popular:

- Air conditioning
- Power steering
- All-wheel drive

Such options increase engine load and can also generate unwanted noise and vibration.

Customer perception of quality can be directly linked to the presence or absence of unwanted noise and vibration. The technician's ability to quickly diagnose and repair a noise or vibration concern directly affects that customer's loyalty to the dealership. The technician who is capable of satisfying this need will be highly regarded and in great demand.

The intentions of this section of the service manual are to provide systematic approaches to vehicle vibration diagnosis and correction. By using the Strategy Based Diagnosis and the troubleshooting philosophies covered in this section, the technician will be able to provide effective and timely repairs.

Diagnostic Information and Procedures

This section describes the techniques and procedures for correcting the following types of vibrations:

- Tire and wheel shake
- Steering/suspension shimmy and shake
- Launch shudder
- Exhaust moan
- Engine firing frequency

Identifying the Complaint

The first step in diagnosing a vibration complaint is to identify the exact vibration that concerns the customer.

Sometimes the vibration can be duplicated at a given speed. Other vibrations may not be as evident and may require questioning the customer carefully. Perform a road test with the customer in the vehicle in order to determine the specific vibration complaint.

Ask the following questions when attempting to identify a vibration complaint:

- At what speed is the vibration the worst?
- Can the customer feel the vibration? If so, where?
- Can the customer hear the vibration?
- Does the engine or the vehicle load affect the vibration?
- Does the vibration occur in more than one gear range?
- When did the vibration first appear?

The answers to these questions will help in duplicating and diagnosing the vibration.

If you suspect that the vibration is normal, compare the vibration with a vehicle that is equipped in the same way, including the following factors:

- Body style
- Engine option
- Engine driven accessories
- Transmission type
- Tire size
- Suspension performance type
- Axle ratio

Important: Do NOT attempt to repair a normal condition, or the customer will probably be convinced that the vehicle has a problem. Customer satisfaction becomes extremely difficult after this point.

If necessary, ride with the customer. Make the comparison with the customer present and explain the situation.

Duplicate the Condition

All vehicles produce vibrations. Some vibrations are normal, while others are not. Some vibrations can be repaired, some cannot. Duplicate or experience the customer's complaint. Evaluate the vibration and the cause of the vibration under changing conditions. Otherwise, you cannot know for certain that you are fixing what the customer would like fixed.

The symptoms and characteristics of a noise or vibration are also important information. Ask yourself the following questions before you begin:

- What does the vibration feel like?
- Does the vibration make noise? If so, what does the vibration sound like?

Different types of noise and vibration have particular characteristics. These characteristics will help determine the cause of the condition, and the best way to correct the condition.

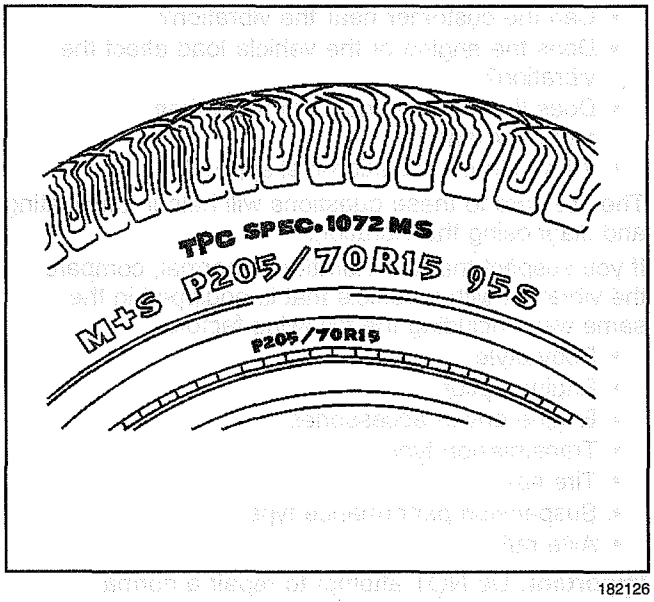
A Process of Elimination

You must understand a few basic concepts before attempting to diagnose a vibration. As in any diagnostic process, you must perform the following steps:

- Gather the information
- Decipher the information
- Make your correction based on the results

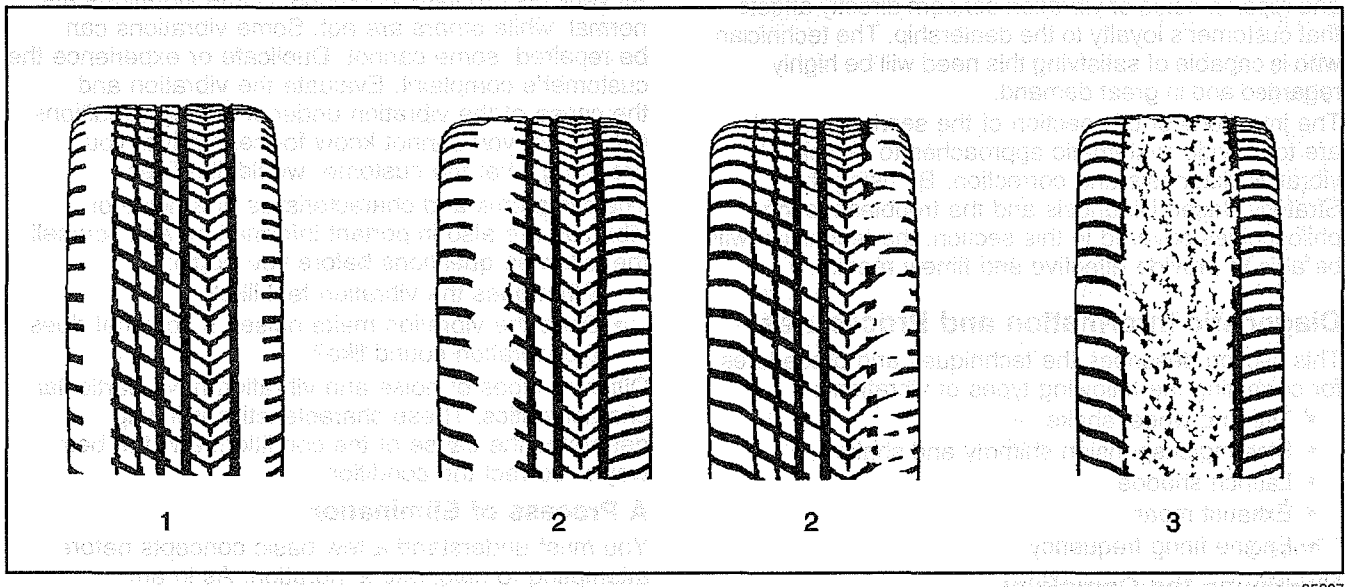
Road test the vehicle and inspect the vehicle in a manner which systematically eliminates different components. This process supplements the information which you have received from the customer concerning the complaint. Concentrating efforts on the areas that have not been eliminated will make repairs faster and more effective.

Tire and Wheel Inspection



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The tires on all new GM models have a tire performance criteria (TPC) rating number molded on the sidewall. The TPC rating will appear as a 4-digit number preceded by the letters TPC SPEC on the tire wall near the tire size. A replacement tire should have the same TPC rating.



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Legend

(1) Hard Cornering, Under Inflation
(2) Excessive Toe on Non–Drive Axle
(3) Heavy Acceleration on Drive Axle, Excessive Toe on Drive Axle, Over Inflation

Inspect the tire and wheel assemblies for the following conditions:

- Unusual wear such as cupping, flat spots, and heel-and-toe wear

  (These conditions can cause tire growl, howl, slapping noises, and vibrations throughout the vehicle.)
- Proper inflation
- Bulges in the sidewalls

  (Do not confuse bulges with normal ply splices, commonly seen as indentations in the sidewall).
- Bent rim flanges

By inspecting these characteristics of the tire and wheel assemblies, you may discover the cause of the vibration. The inspection will also provide assurance that the vehicle is safe for road testing.

Road Test

Purpose of Road Testing

The purpose of road testing is to duplicate the vibration complaint and to find any operating conditions that change or eliminate the vibration. Most importantly, road testing will determine whether the vibration is related to the engine speed or to the road speed.

In order to complete a quick and accurate road test, install an engine tachometer (such as a scan tool) and the EVA in the vehicle. Place the EVA vibration sensor in a location where the customer's concern can be felt.

Which Component Group is Causing the Vibration

After you have related a vibration to either the engine or to the vehicle-speed, break the vibration down further in order to fit into one of the following groups of rotating components:

- The engine, the clutch disc (manual transmission), the propeller shaft (within the driveline support assembly), the transmission flexplate (automatic transmission), and the transmission torque converter
- The transmission output shaft and the rear axle differential pinion (mounted in the rear of the differential)
- The tires, the wheels, the hubs, and the rotors

These 3 groups represent the major areas that can produce vibration complaints. The components in each group are related to each other because the components are either bolted or splined together. This means that each group of components rotates at the exact same speed.

These categories can be broken down further in order to identify the exact component responsible for the disturbance. The emphasis is on testing (and more testing) in order to pinpoint the source and to eliminate unnecessary parts replacement.

Perform a road test for ALL vibration complaints unless the disturbance occurs only with the vehicle at a standstill.

Types of Road Test Procedures

Caution: Refer to Road Test Caution in Cautions and Notices.

Important: Before performing any road test, inspect the tires and wheels. Refer to *Tire and Wheel Inspection*

The following road test procedures are the most informative and the most used:

- Slow acceleration test
- Neutral coast-down test
- Downshift test
- Neutral run-up test
- Brake torque test
- Steering input test
- Standing start acceleration test (launch shudder)

These tests will help to pinpoint the vibration. Perform all of the tests on a smooth and level road.

Slow Acceleration Test

This test will identify those conditions which are related to the engine-speed or to the vehicle-speed. Additional tests may be necessary in order to determine the exact cause of the vibration.

Caution: Refer to Road Test Caution in Cautions and Notices.

1. On a smooth, level road, slowly accelerate up to highway speed.
2. Look for disturbances that match the customer's description.
3. Observe the following readings where the disturbance occurs:
   - The vehicle speed, km/h (mph)
   - The engine speed (RPM)
   - The frequency (if possible)

Now perform the neutral coast-down test and the downshift test.

Neutral Coast-Down Test

Caution: Refer to Road Test Caution in Cautions and Notices.

1. On a smooth level road, accelerate to a speed slightly higher than the speed at which the vibration occurs.
2. Shift the vehicle into NEUTRAL gear and coast down through the vibration range.

   Observe whether the vibration is present in NEUTRAL gear.

If the vibration still occurs in NEUTRAL gear, then the vibration is definitely sensitive to vehicle-speed. At this point, the following components have been eliminated as a cause of the vibration:

- The engine
- The clutch disc (manual transmission)
- The transmission flywheel (automatic transmission)
- The torque converter

Depending on the symptoms or the frequency, the repair will concentrate on one of the following components:

- The tire and wheel assemblies
- The transmission output shaft
- The propeller shaft
- The rear axle differential pinion
- The rear drive axle or the rear drive axle shafts

Downshift Test

Caution: Refer to Road Test Caution in Cautions and Notices.

1. On a smooth, level road, accelerate to the speed at which the concern vibration occurs.

   Observe the engine RPM.
2. Decelerate and safely downshift to the next lower gear.
3. Operate the vehicle at the previous engine RPM.

If the vibration returns at the same engine RPM, the following conditions are the most probable causes of the vibration:

- The engine
- The clutch disc (manual transmission)
- The propeller shaft
- The transmission flywheel (automatic transmission)
- The torque converter

Repeat this test in lower gears, and in NEUTRAL, in order to confirm the results.

In some cases, a vibration may also be sensitive to torque or engine load, as well as being related to a specific engine speed or vehicle speed. These vibrations can be most difficult to diagnose, and require additional testing. A systematic approach usually leads to isolating the problem.

Neutral Run-Up Test

This test is designed to identify vibrations which are related to the speed of the engine. Use this test when the customer has a concern with vibration at idle, or as a follow-up to the downshift test. This test probably doesn't apply when the complaint is related to vehicle speed only (appearing at the same vehicle speed regardless of the engine speed).

Caution: Refer to Road Test Caution in Cautions and Notices.

1. Slowly increase the engine speed while looking for disturbances that match the customer's complaint.
2. Observe the engine speed (RPM) and the frequency (if possible) where the vibration occurs.

Brake Torque Test

This test is designed to identify engine-related vibrations that were not uncovered with the neutral run-up test. This test also works for vibrations that are sensitive to the engine load or to the torque. This test will probably not apply to vibrations which are related only to the speed of the vehicle.

Caution: Refer to Road Test Caution in Cautions and Notices.

1. Apply the park brake.
2. Block the front wheels.
3. Step firmly on the brake pedal.
4. Place the vehicle in DRIVE.
5. Slowly increase the engine speed while looking for vibrations that match the customer's description.
6. Observe the engine speed (RPM) and the frequency (if possible) at which the disturbance occurs.
7. If necessary, place the vehicle in REVERSE gear and repeat steps 5 and 6.

Steering Input Test

This test is intended to determine how much the wheel bearings and other suspension components contribute to the vibration, especially a vibration relating to noise, such as growl, grinding, and roaring.

Caution: Refer to Road Test Caution in Cautions and Notices.

1. With the vehicle at the vibration speed (mph), drive through slow sweeping turns, first in one direction and then in the other direction.
2. If the vibration gets worse or if the vibration goes away, inspect the following components as possible causes of the vibration:
   - The wheel bearings
   - The hubs
   - The tire tread
3. The CV joint angle increases when the vehicle is turning. On front wheel drive (FWD) and four wheel drive (4WD) vehicles, CV joint condition systems may appear when the angle increases. Putting a load on the CV joint may increase the vibration amplitude. The third order, tire speed related amplitude would remain the same.

Standing Start Acceleration (Launch Shudder) Test

The purpose of this test is to duplicate a vibration called launch shudder. In some cases, a powertrain mount or an exhaust ground-out may also be the cause of the vibration, depending on the symptoms.

Caution: Refer to Road Test Caution in Cautions and Notices.

1. With the vehicle at a complete stop and in gear, remove your foot from the brake pedal.
2. Accelerate to 48–64 km/h (30–40 mph) while looking for vibrations that match the customer's description.

Other possible causes of launch shudder include the following conditions:

- Incorrect trim height. Refer to *Trim Height Specifications* in Suspension General Diagnosis.
- A worn or damaged drive axle CV joint
- A ground-out through the engine or transmission mounts
- Faulty exhaust hangers and mounts

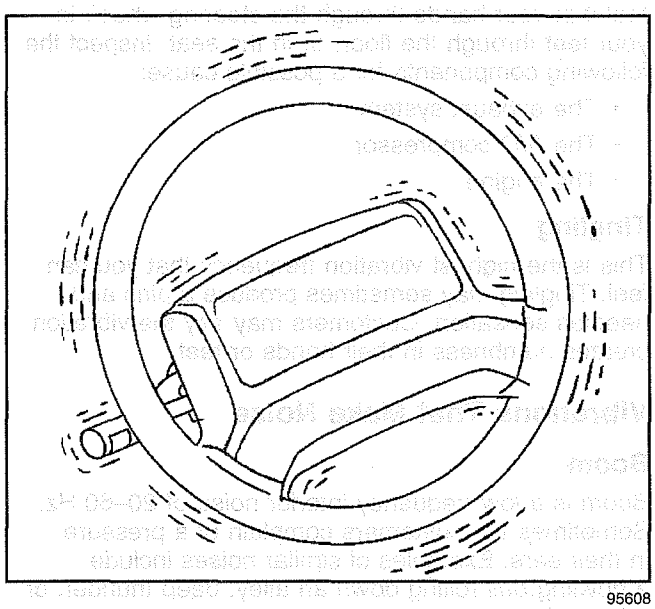
Classifying the Vibration

The next step after road testing the vehicle is to identify the frequency of the duplicated and abnormal vibration. Use the EVA in order to measure the frequency. If the EVA is not available, observe how the vibration feels or sounds. The majority of vibrations will fit into one of the following categories.

- Vibrations that can be felt:
  - Shake
  - Roughness
  - Buzz
  - Tingling
- Vibrations that make noise:
  - Boom
  - Moan and groan
  - Howl
  - Whine

Vibrations That Can Be Felt

Shake



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The shake is a low frequency vibration, typically 5–20 Hz. The shake is sometimes seen in the steering wheel, the seat, or the console. The best description is the feeling from an out-of-round or unbalanced tire. Customers may refer to a shake in one of the following terms:

- Shimmy
- Wobble
- Shudder
- Waddle
- Hop

In most cases, shake is caused by damage or wear to the following components:

- The tires
- The wheels
- The brake rotors (vehicle-speed sensitive)
- The steering tie rod ends
- The suspension ball joints
- The engine (engine-speed sensitive)

Roughness

Roughness is a vibration with a slightly higher frequency than the shake, usually 20–50 Hz. Roughness is similar to the feeling you get from holding a jigsaw.

Buzz

Buzz is slightly higher in frequency: 50–100 Hz. A buzz is similar to the feel of an electric razor. You may feel it in your hands through the steering wheel, in your feet through the floor, or in the seat. Inspect the following components for a possible cause:

- The exhaust system
- The A/C compressor
- The engine

Tingling

This is the highest vibration frequency that you can feel. Tingling may sometimes produce a pins and needles sensation. Customers may say the vibration creates numbness in their hands or feet.

Vibrations That Make Noise

Boom

Boom is a low frequency interior noise of 20–60 Hz. Sometimes the customers complain of a pressure in their ears. Examples of similar noises include a bowling ball rolling down an alley, deep thunder, or a bass drum.

A customer may use the following words to describe boom:

- Droning
- Growling
- Moaning
- Roaring
- Rumbling
- Humming

Boom may be accompanied by a perceptible vibration (roughness).

Moan or Drone

Moan or drone is a sustained tone at a low frequency of 60–120 Hz, somewhat higher than boom.

Examples of similar noises include a bumble bee or blowing air across the top of a soda bottle. A customer may use the following words to describe moan or drone:

- Humming
- Buzzing
- Resonance

Moan or drone may be accompanied by a perceptible buzzing vibration. Inspect the following systems:

- The powertrain mounts
- The exhaust system

Howl

Howl is a noise at mid-range frequency of 120–300 Hz. This sounds like the wind howling.

Whine

Whine is a prolonged, high-pitched sound in the 300–500 Hz range. Whine is usually related to the meshing gears or gear noise. Similar sounds include mosquitoes, turbine engines, and vacuum cleaners.

Matching Frequency to Component RPM

At this point in the diagnosis, the vibration has gone through the following analysis:

- The vibration has been duplicated.
- The vibration has been designated as abnormal.
- The vibration has been related either to engine speed or to vehicle speed.
- The vibration has been assigned a frequency from the EVA or identified based on its feel or its sound.

Automotive vibrations are usually related to the rotating speed of a component. Calculate the speed of these components using either an engine speed method or a vehicle speed method. Use the engine RPM readings taken during the road test in order to diagnose the vibrations that are sensitive to engine speed.

If the vibration is sensitive to vehicle speed, determine the rotational speed of the tires. As long as you operate the vehicle at a constant speed, the tires will operate at a constant speed. This speed is measured in rotations, or cycles per second. The reading is then compared to the frequency of the vibration, which is also measured in cycles per second.

Calculating Tire Rotation

TIRE/WHEEL AND PROPSHAFT ROTATION

Vehicle Information

Complaint Speed: _____ km/h (mph)
Symptom: _____
Frequency: _____
Engine Speed: _____ rpm
Gear: _____

Year: _____ Model: _____
VIN: _____
Engine: _____ Trans: _____
Tire Size: _____ Axle Ratio: _____
TPC Spec: _____

Tire/Wheel Speed

Vibration Occurs at:	[ ]	km/h ÷ 8(km/h) mph ÷ 5(mph)			=	[ ] Increments of 8 km/h (5mph)
8 km/h (5mph) increments	[ ]	x	[ ]	tire RPS* at 8 km/h (5mph) (from chart)	=	[ ] Tire/Wheel Speed, RPS (Hz) 1st order
1st order	[ ]	x 2			=	[ ] 2nd order
1st order	[ ]	x 3			=	[ ] 3rd order

Propeller Shaft Speed

1st order tire	[ ]	x	[ ] (axle ratio)		=	[ ] Propeller Shaft Speed 1st order
1st order propshaft	[ ]	x 2			=	[ ] 2nd order

*RPS = revolutions per second; equates to cycles per second (Hz).

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Determine the rotational speed of the tires in revolutions per second, or Hertz (Hz), based on the vehicle speed at which the vibration occurs. In order to determine the rotational speed, use the following procedure:

1. Determine the speed at which the vibration occurs.
2. Determine the number of 8 km/h (5 mph) increments:
   - Divide the complaint speed by eight when using kilometers.
   - Divide the complaint speed by five when using miles.
3. Determine the vehicle tire size.
4. Locate on the table below, the Hertz value at 8 km/h (5 mph) for that tire size.
5. Multiply the Hertz value by the number of 8 km/h (5 mph) increments.
6. The result is the rotational speed of the tires in Hertz at the complaint speed. If this figure matches the vibration frequency, a first-order vibration is present in the tire and wheel assembly.

For example, if the complaint speed is 60 mph, the number of increments is 12. According to the following table, a tire with size of P235/75R15 has a value of 1.00 Hz. You can calculate the rotational speed at 60 mph:

12 increments x 1 Hz = 12 Hz

Tire/Speed

Tire Size	Tread	Revs/Sec (Hz) at 5 MPH
P235/55R16	AL2	1.11
P215/60R16	AL2	1.10
P275/40ZR17	HW4	1.12
P245/50ZR16	AL3	1.13
P215/60R16	AL3	1.10
P245/50ZR16	HW4	1.13
Tread Types: AL2: Touring AL3: Export HW4: Performance Tire		

Sometimes, the tire/wheel vibration may be of a higher-order. In order to compute possible higher-order vibrations, multiply the rotational speed of the tires, in Hertz, at the complaint speed by the order number. If any of these matches the vibration frequency, a vibration of that particular order is present in one of the tire/wheel assemblies.

Steering and Suspension Assembly Vibrations

Steering and suspension assembly vibrations are the first level of testing for low-frequency vibrations that are sensitive to vehicle speed. The symptoms of a steering/suspension first-order vibration are a shimmy or a shake. This is usually felt in the steering wheel or in the seat. Inspect the following components for wear or damage:

- The steering tie rod ends
- The suspension ball joints

Calculating Propeller Shaft Rotation

The propeller shaft drives the tires through the rear axle. Knowing the rotational speed of the tires enables you to easily calculate the speed of the propeller shaft. Therefore, you can determine the rotational speed of the propeller shaft by multiplying the rotational speed of the tires by the ratio of the rear axle.

RPO	Description	Ratio
GU2	Ratio, Rear Axle	2.73
GU4	Ratio, Rear Axle	3.08
GU5	Ratio, Rear Axle	3.23
GU6	Ratio, Rear Axle	3.42

1. Obtain the tire speed by performing the tire speed calculation, described earlier in this section.
2. Determine the axle ratio using one of the following methods:
   - Cross reference the axle information from the service information part label to the parts book.
   - Cross reference the axle identification code that is stamped on the axle to the parts book.
   - Perform the following calculation:
     2.1. Make a mark on the tires and the propeller shaft.
     2.2. Rotate the tires for one complete revolution, counting the number of propeller shaft rotations.

     For example, the propeller shaft rotates approximately 3½ times for every tire revolution. The axle ratio is 3.5:1
3. In order to find the propeller shaft rotation speed, multiply the tire speed by the rear axle ratio.

In the earlier example, at a 60 mph complaint speed:

12 Hz x 3.5 = 42 Hz

Match the frequency of the vibration from the EVA with the rotational speed of a component (either a tire or a wheel). If none of the frequencies match, do one of the following actions:

- Recheck the data.
- Attempt to match the figures again, allowing for 1–5 mph of speedometer error.

When you have matched the speed of the component with the frequency of the vibration, refer to the service information that outlines the repair procedures for that particular component.

Rotor/Drum Imbalance

Rotors and drums do not have a set tolerance. However, rotors or drums with more than 21 g (0.75 ounce) imbalance have the potential to cause vibration. Inspect the rotors and the drums for imbalance using either the on-vehicle or the off-vehicle method.

Checking Rotor/Drum Imbalance (On-Vehicle)

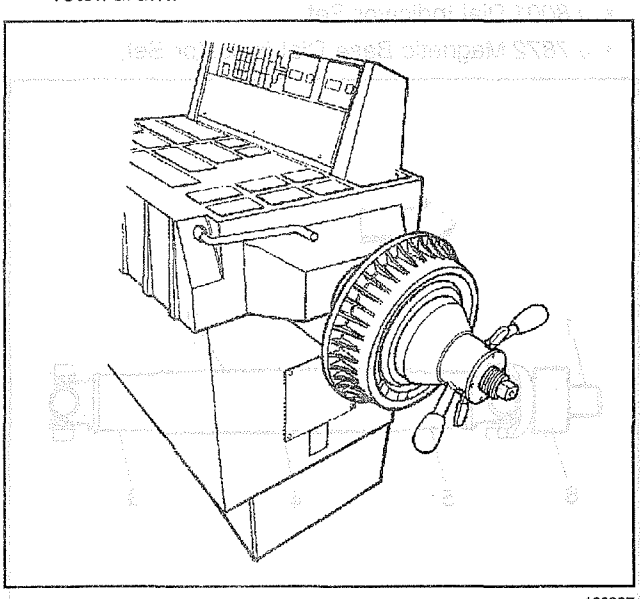
1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the rear tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.

Caution: Refer to Work Stall Test Caution in Cautions and Notices.

3. Reinstall the wheel nuts in order to retain the rotors/drums.
4. Run the vehicle at the complaint speed while inspecting for the vibration.
5. If the vibration still exists, perform the following steps:
   5.1. Remove the rotors/drums.
   5.2. Run the vehicle back to speed.
6. If the vibration is eliminated, perform the following steps:
   6.1. Remove the rotors/drums one at a time.
   6.2. Perform the vibration test for each rotor/drum.
   6.3. Replace the rotor/drum that is causing the imbalance.
   6.4. Inspect the balance of the new rotor/drum.

Checking Rotor/Drum Imbalance (Off-Vehicle)

1. Measure the diameter and the width of the rotor/drum.



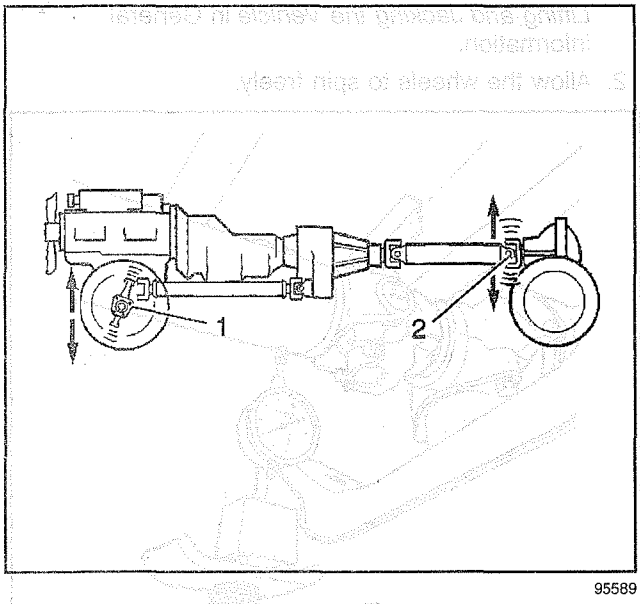
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2. Mount the rotor/drum on a balancer in the same manner as a wheel.

Important: You can only inspect the rotors/drums for static imbalance. Ignore the dynamic imbalance reading.

3. Inspect for static imbalance.
4. If the rotor/drum shows imbalance, replace the rotor/drum.
5. Inspect the balance of the new rotor/drum before you install the rotor/drum on the vehicle.

Driveline Vibration Analysis



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The following components are possible sources of driveline vibration:

- The transmission output shaft
- The propeller shaft(s)/driveshaft(s)
- The pinion yoke/flange (2)
- The pinion gear

The above components are either bolted or splined together. Therefore, all of the components rotate at the same speed, vibrate at the same frequency, and have the same symptoms.

Driveline vibrations may relate either to the first order or to the second order of driveline rotation. Driveline vibrations are always related to the speed of the vehicle. The vibration is often related to torque. If the vibration is worse or only noticeable when accelerating, decelerating, or crowding the throttle, the vibration is related to the torque. In this case, the vibration will always occur at the same speed.
If a vibration is sensitive both to torque and to speed, the driveline is the probable cause. Tire/wheel vibrations are speed-sensitive, but not torque-sensitive.

First-Order Driveline Vibration Symptoms

The following symptoms may indicate first-order driveline vibration:

- The vibration is related to vehicle speed.
- The vibration is torque sensitive.
- A boom or moan noise is present.
- The vibration occurs commonly above 72 km/h (45 mph), but possibly at speeds as low as 48 km/h (30 mph).
- The roughness or buzz vibration is felt in the seat, the floor or the steering wheel.
- The corresponding frequency on the EVA equals first-order driveline rotation (25–60 Hz), depending on the speed of the vehicle and the ratio of the axle. Refer to *Matching Frequency to Component RPM* in order to obtain the rotation speed of the propeller shaft.

Diagnosing First-Order Driveline Vibration

Diagnosis will be much easier once you have identified a vibration as first-order of driveline rotation during the road test. Next identify the exact area of the vibration and take proper action.

In most cases, vibration may be reproduced in the stall. In the stall the vibration may be better or worse than that experienced during the road test.

The objective is to reduce the vibration to the lowest point possible in the stall, then evaluate the results during a road test. Many times, a vibration you were only able to reduce drastically in the stall will be completely eliminated on the road.

The cause of first-order driveline vibration is usually excessive runout or an imbalanced component.

The following procedure offers a systematic process of elimination in order to determine which component is at fault:

1. Raise the vehicle to curb height. Support the vehicle on a hoist or heavy stands. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the rear tires/wheels. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Inspect the propeller shaft. The propeller shaft should be free of undercoating before continuing.

4. Inspect the propeller shaft and the U-joint for any obvious dents or damage. Dents or damage will contribute to first-order driveline vibrations.
5. Start the engine.
6. Place the transmission in gear.
7. Run the vehicle up to the speed at which the vibration was most severe.
8. Record whether the vibration was present, and at what speed.
9. If the vibration is not present do a complete road test.
10. If the vibration is present, determine which end of the driveshaft is vibrating the most. Hold your hand against the pinion nose and the transmission tailshaft, or hold an EVA vibration sensor up to each component.
11. If the vehicle is equipped with a two-piece propeller shaft, inspect the center support bearing for vibration.
12. If the transmission tail is vibrating, touch the transmission crossmember under the transmission mount. If there is no vibration on the crossmember, then the transmission mount is working properly.
13. Remember which end of the driveshaft is the worst, and how severe the vibration is. The inspection will be a reference by which to judge future progress.

Do not fill the propeller shaft with foam, oil, or any other substance in order to correct a vibration. Filling the propeller shaft is only effective in reducing an unrelated condition called Torsional Rattle. Filling the propeller shaft should only be done in strict adherence to the procedure outlined in corporate bulletins that address Torsional Rattle. Failure to follow the correct procedure will induce a vibration and/or affect the structural integrity of the propeller shaft. The propeller shaft will then have to be replaced.

Propeller Shaft Runout

A propeller shaft or pinion (companion) flange with excessive runout causes first-order driveline vibrations. Use the following procedure in order to measure the runout of the propeller shaft:

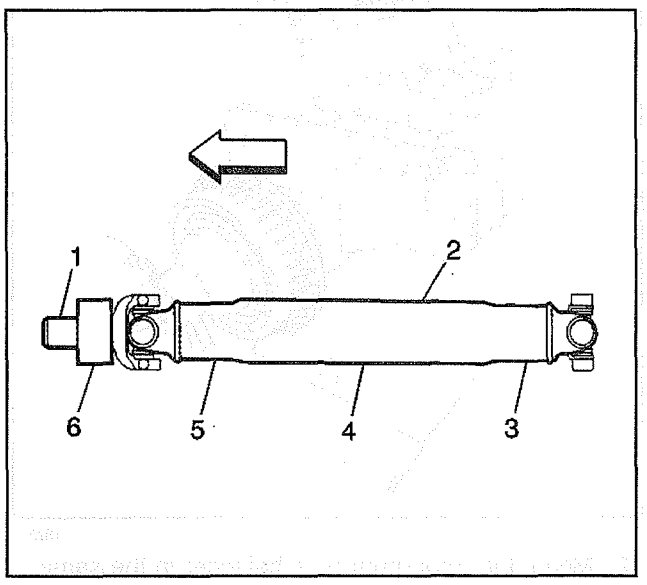
- Remove excess corrosion of the propeller shaft surface before inspecting the runout.
- Inspect for damage and dents.
- Replace dented propeller shafts.
- Remove any undercoating from the propeller shaft before proceeding.
- Refer to Measuring Propeller Shaft Runout, below, for the measurement procedure that applies to the following shaft assemblies:
  - One-piece
  - Two-piece

The splined end of a propeller shaft is critical to the smooth operation of a two-piece propeller shaft. When inspecting stub-shaft runout, ensure that the dial indicator readings are accurate.

Measuring Propeller Shaft Runout

Tools Required

- *J 8001* Dial Indicator Set
- *J 7872* Magnetic Base Dial Indicator Set

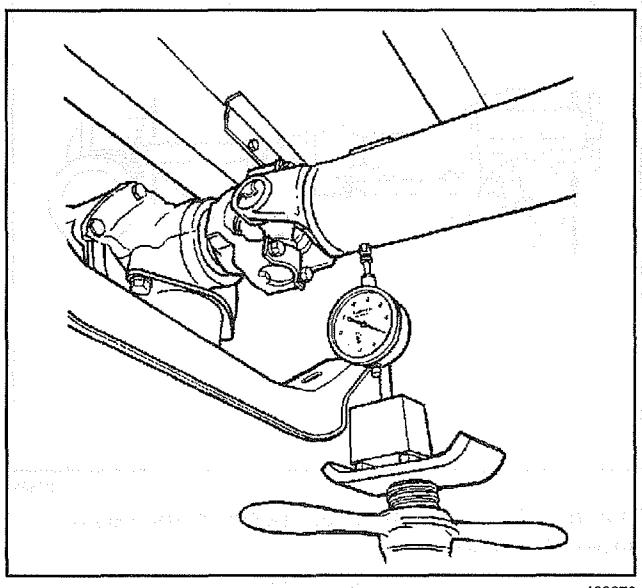


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Legend

(1) Slip Yoke
(2) Tube
(3) Rear Runout Check
(4) Center Runout Check
(5) Front Runout Check
(6) Damper

1. Raise the vehicle on a suitable hoist. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Allow the wheels to spin freely.



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3. Attach a *J 8001* and a *J 7872*.
4. Place the transmission in NEUTRAL.

5. Rotate the pinion flange or the transmission yoke by hand while taking the measurements for the runout.

Important: The propeller shaft turns easier in one direction than in the other. Removing the wheels will also help. Do not include fluctuations on the dial indicator due to welds or surface irregularities.

6. Perform the following steps for one-piece propeller shafts if the runout exceeds the tolerances at one or more points:
   6.1. Rotate the propeller shaft 180 degrees in the pinion flange.
   6.2. Reinstall the propeller shaft.
   6.3. Measure the propeller shaft runout.
   6.4. If the runout still exceeds the tolerance, inspect the pinion flange runout before replacing the propeller shaft.
7. Perform the following steps for two-piece propeller shafts if the runout exceeds the tolerances at one or more points:

Important: The runout of the rear splines on the front propeller shaft affects the runout of the front measurement on the rear propeller shaft.

   7.1. Measure the rear propeller shaft.
   7.2. Mark the position of the rear shaft in the pinion flange.
   7.3. Remove the rear shaft.
   7.4. Measure the front propeller shaft runout on the tube and the stub shaft.
   7.5. Replace the propeller shaft if either measurement is out of tolerance. Refer to *Propeller Shaft Runout Specifications*.

Important: When you replace a propeller shaft, inspect the new shaft for runout. Inspect the pinion flange runout if the replacement shaft runout is also out of tolerance.

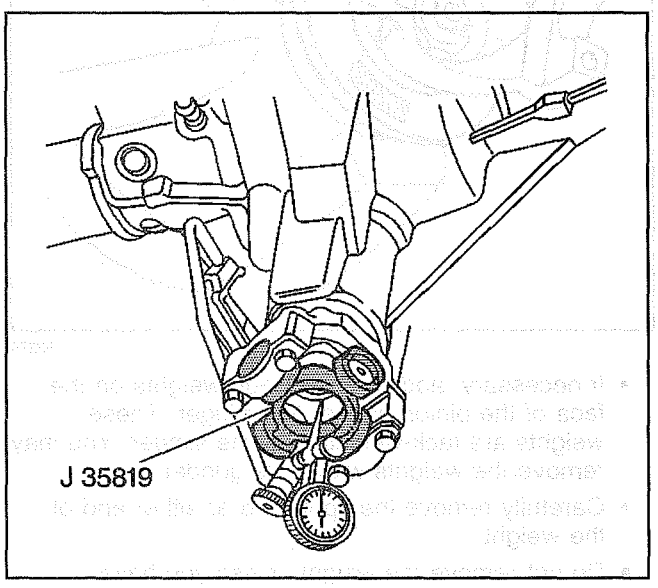
Propeller Shaft Measurement Points				
Propshaft	Front Runout	Center Runout	Rear Runout	Stub Shaft Runout
One-Piece	Measure	Measure	Measure	—
Aluminum Graphite	Measure	—	Measure	—
Two-Piece Front Slip Yoke	Measure	—	—	Measure

Measuring Pinion Flange Runout

Tools Required

- *J 8001* Dial Indicator Set
- *J 23409* Dial Indicator Extension
- *J 35819* Flange Runout Gauge

1. Place the vehicle on a suitable hoist. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Allow the wheels to rotate freely.
3. Remove the propeller shaft from the pinion flange.



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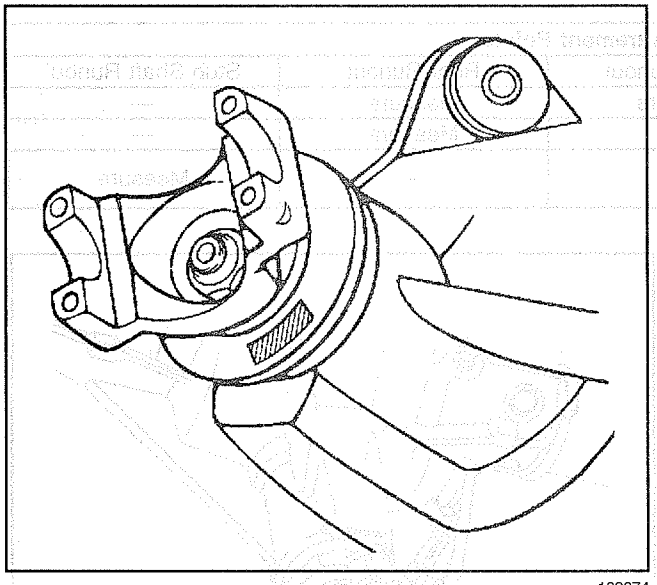
4. Install the *J 35819*.

   If a *J 35819* is not available, measure the pinion runout as close as possible to the pinion flange.

Important: The dial indicator will have inverted readings. You are measuring the inside diameter of the flange; you are not measuring the outside diameter. The highest reading on the dial indicator is the low spot. The lowest reading is the high spot.

5. Rotate the pinion shaft 360 degrees and zero the dial indicator on the low spot.

6. Rotate the pinion flange again and record the total runout.
7. If the pinion flange runout is 0.15 mm (0.006 in) or less, remove the pinion flange balance weight.
8. If the pinion flange runout is greater than 0.15 mm (0.006 in) but not less than 0.28 mm (0.011 in), and the runout compensation weight is at or near the low spot, no further action is necessary. If the runout compensation weight is not at or near the low spot, remove the weight.
9. If the pinion flange runout is greater than 0.28 mm (0.011 in) but not greater than 0.38 mm (0.015 in), and the balance weight is at or near the low point, no further action is necessary. If the runout compensation weight is not at or near the low spot, remove the weight and re-index the pinion flange until the runout is 0.25 mm (0.010 in) or less.
10. Replace the pinion flange/yolk when the runout cannot be reduced to 0.25 mm (0.010 in) or less. Then, recheck the runout. Service replacement flanges do not have balance weights.



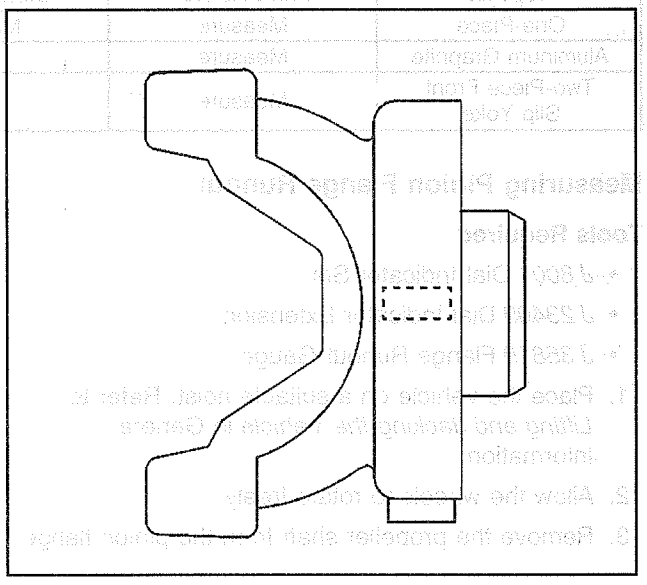
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- If necessary, add compensation weights on the face of the pinion flange dust slinger. These weights are tack-welded onto the slinger. You may remove the weights with a die-grinder.
- Carefully remove the spot weld at either end of the weight.
- Do not remove the weight unless you have inspected the pinion flange runout and the procedure requires weight removal.
- Do not remove any weights on the outboard edge of the dust slinger. These weights are present in order to balance internal axle components. The weights are not related to the pinion flange runout.
- If a *J 35819* is not available, inspect the propeller shaft runout as near as possible to the flange. Rotate the shaft 180 degrees in the pinion flange. Reinstall the shaft. Inspect the measurement at the same location.

  A large difference in the runout, greater than 0.38 mm (0.015 in), may indicate that the flange is out of tolerance. If the runout does not change at all, the flange is OK.

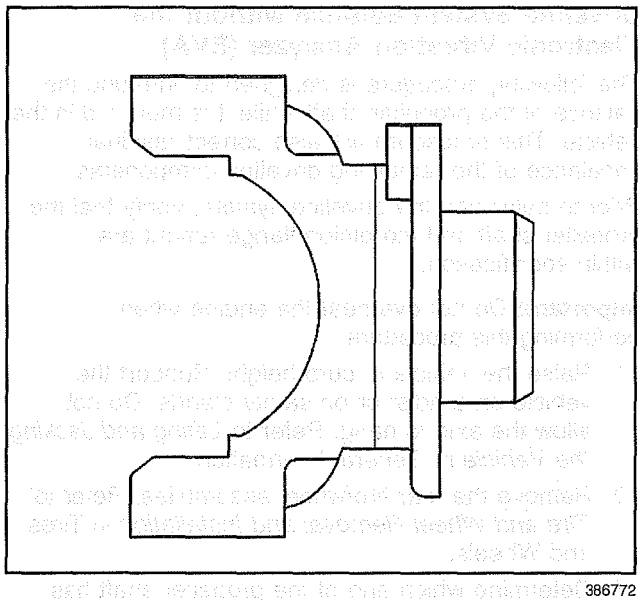
Balanced Axles

Beginning in the early 1990's, the manufacturer began system balancing rear axles. During the build process, these axle assemblies were spun with a slave fixture. A balance weight was attached to the outboard edge of the companion flange dust slinger. A system-balanced rear axle companion flange differs from a non-balanced flange. You must diagnose and service this flange in a unique way.



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Some pinion flange assemblies have a U-shaped deflector designed to hold a system balance weight on the outside diameter.



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Other pinion flange assemblies have a runout compensation weight on the face of the deflector. The pinion flange assemblies that are system balanced do not use runout compensation weights.

Measuring the runout on a system-balanced companion flange is very straight-forward. A balanced flange that is good will have a measured runout between 0.00–0.38 mm (0.00–0.015 in). If a balanced flange has more than 0.38 mm (0.015 in) runout, replace the flange or reindex the flange 180 degrees on the pinion. If you replace or reindex a balanced flange, you must system balance the rear axle again.

Correcting Vibration at the Pinion Nose

Most first-order driveline vibrations originate at the pinion nose end of the driveshaft. Ensure that the vibrations are at a minimum at this location in order to achieve acceptable results. Reduce the runout of the components to a minimum. Balance the driveline as a system when necessary.

1. Measure the runout of the propeller shaft and inspect the tolerance.
2. If the tolerance is excessive, mark the position of the shaft for future reference and rotate the shaft 180 degrees.
3. Reinstall the shaft and reinspect the runout. Inspect the level of vibration in order to determine if the vibration is lower or corrected.
4. If the runout is still excessive, or if the vibration is still present, refer to Measuring Pinion Flange Runout. Replace the pinion flange or re-index the flange 180 degrees if the pinion flange runout exceeds the tolerance.

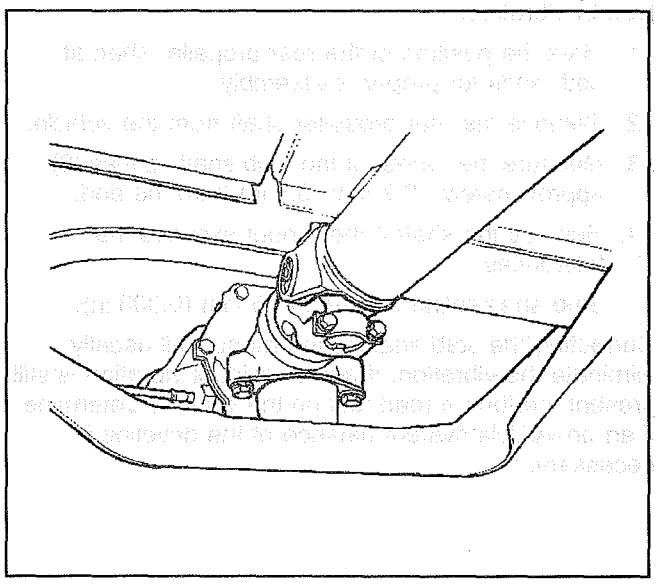
   Remove and reinstall the pinion flange only once on axles utilizing a crush type sleeve. Replace the sleeve with a new sleeve if the sleeve is crushed. Removing the sleeve requires removal of the ring and pinion set. Replace flanges with excessive runout. Regardless of the method used, measure the pinion flange runout in order to ensure that the flange is within tolerance.
5. Reinspect the propeller shaft runout if the vibration is present after the pinion flange runout is corrected. If the propeller shaft runout is still excessive, correct the runout before doing a driveline system balance. Either replace the shaft with a shaft that is within tolerance or sublet the shaft to a reputable independent for straightening and re-balance. Ensure that the new or rebuilt shaft is within runout tolerance before continuing.
6. Once the propeller shaft and pinion flange are within runout tolerances, inspect to see if the vibration is still present. If the level of the vibration is still unacceptable, perform a driveline system balance procedure.

Correcting Vibration at the Transmission Tailshaft

First-order driveline vibrations that originate at the transmission end of the propeller shaft are rare. If the tailshaft of the transmission is vibrating, inspect the tailshaft housing bushing for wear or damage. A leaky transmission tailshaft oil seal indicates bushing problems.

Feel for vibration at the crossmember underneath the transmission mount. If there is no vibration, the transmission mount is functioning properly by isolating the vibration from the structure of the vehicle. The transmission mount is therefore probably not the cause of the vibration.

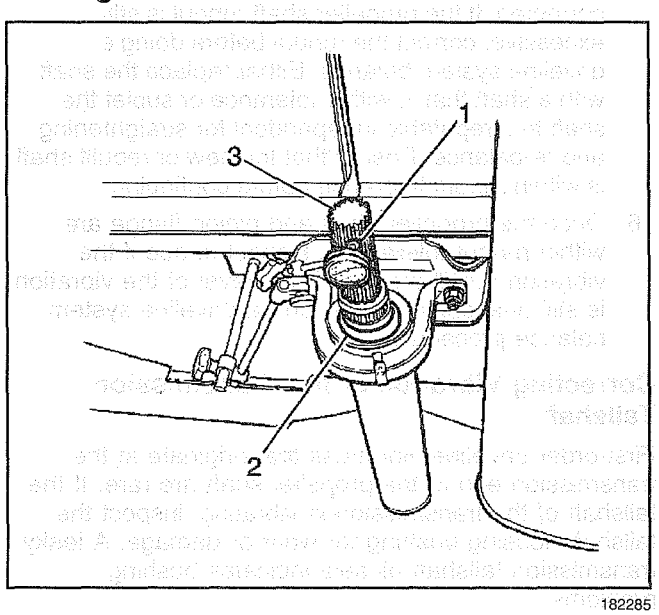
Use the following procedure if you can feel vibration on the crossmember and the tailshaft bushing, and if the transmission output is normal:



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1. Measure the propeller shaft runout. If the runout is excessive, replace the shaft with one that has acceptable runout. Alternatively, sublet the shaft to a reputable independent service shop in order to have the shaft rebalanced and the runout corrected.
2. Test drive the vehicle. If the vibration is still unacceptable, balance the shaft on the vehicle. Refer to Rear Driveline System Balance.

Correcting Vibration at the Center Support Bearing



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These guidelines apply to the two-piece propeller shaft only. First-order driveline vibrations that occur mainly at the center support bearing are usually the result of excessive runout at the stub (splined) shaft.

Unlike other first-order driveline vibrations, these vibrations can appear at unusually low speeds of 40 km/h (25 mph) and up.

Perform the following procedure in order to correct this type of vibration:

1. Mark the position of the rear propeller shaft at both ends for proper reassembly.
2. Remove the rear propeller shaft from the vehicle.
3. Measure the runout of the stub shaft splines (3) approximately 12.7 mm (0.5 in) from the end.
4. Replace the shaft if the runout exceeds the tolerances.

   Stub shaft/spline runout 0.076 mm (0.003 in).

Correcting the stub shaft/spline runout will usually eliminate the vibration. If some residual vibration is still present, perform a road test on the vehicle. Determine if an on-vehicle system balance of the driveline is necessary.

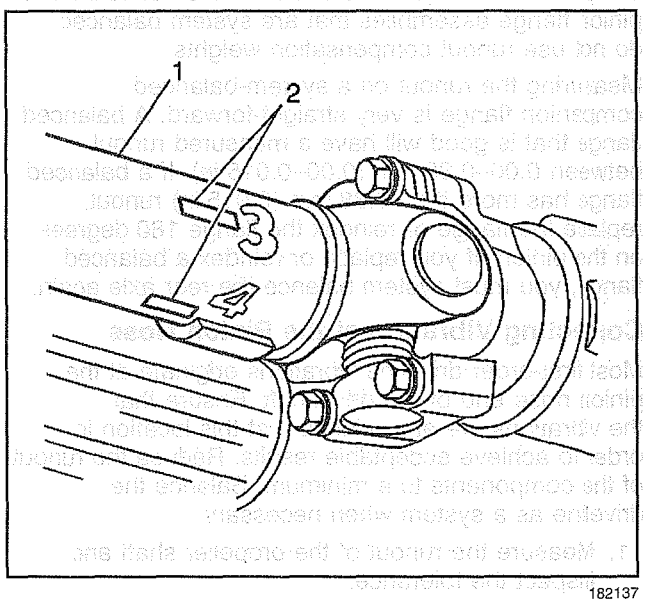
Driveline System Balance without the Electronic Vibration Analyzer (EVA)

The following procedure is designed to fine-tune the balance of the propeller shaft while it is mounted in the vehicle. This procedure will also correct residual imbalance of the remaining driveline components.

Prior to balancing the driveline system, verify that the propeller shaft and the pinion flange runout are within specification.

Important: Do not overheat the engine when performing this procedure.

1. Raise the vehicle to curb height. Support the vehicle on a hoist or on safety stands. Do not allow the axle to hang. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the rear tire/wheel assemblies. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Determine which end of the propeller shaft has the most vibration in order to identify where to begin installing the hose clamps.



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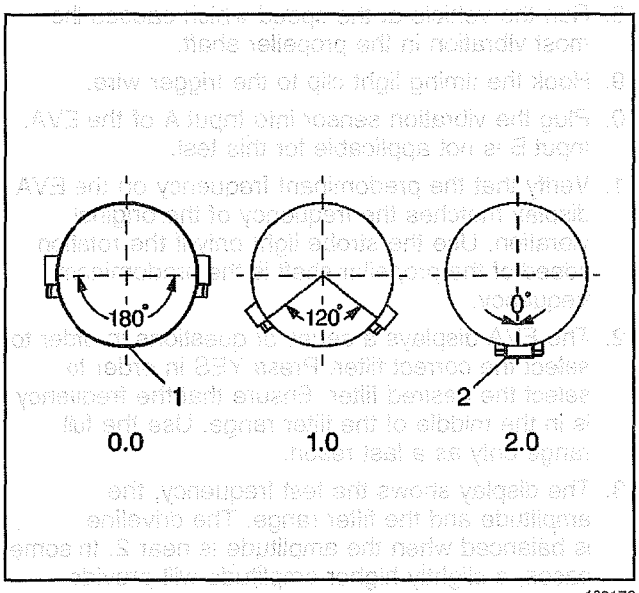
4. Mark the end of the propeller shaft (1) which has the most vibration at four points (2), 90 degrees apart. Number the marks 1 through 4.

The following procedure uses a trial and error method of determining where to place the hose clamps on the shaft. Use the following tips in order to help locate the clamps:

1. Because the imbalance may be related to propeller shaft runout, begin installing the clamps at the low point of the propeller shaft runout.
2. When the plant workers balance the propeller shaft, they use weights in graduated increments: 2 g (1/16 oz), 4 g (1/8 oz), etc. If the stock weight is too light or too heavy, place the hose clamp either directly in line with or opposite to the stock weight.

The last method involves running the vehicle at a speed which the vibration is felt.

1. Carefully hold a piece of chalk up to the very end of the propeller shaft. Barely touch the chalk to the shaft.
2. Shut the engine OFF in order to stop the propeller shaft from rotating. Do not step on the brake pedal. Do not put the transmission in PARK.
3. Inspect the chalk mark.



182176

If you performed the above procedure correctly, the chalk mark will indicate the heavy spot on the shaft. The heavy spot will deflect downward and touch the chalk. If the chalk mark circles the entire shaft, touch the chalk more gently to the shaft. Ensure that the chalk touches only the heavy spot. Once the heavy spot is located, place the hose clamp 180 degrees opposite to the chalk mark (1). Perform the following steps:

1. Place the hose clamp at the light spot, or at any of the 4 points marked previously.
2. Test drive the vehicle at the speed at which the vibration occurred. Record any changes in the vibration.
3. Move the clamp to the other positions.
4. Test drive the vehicle each time you move the clamp. Record any changes in vibration. Remember which position gives the best balance.

- If the vibration did not change at all or if the vibration becomes worse, then one clamp is either too light or too heavy. Repeat the procedure using the two clamps together (2).
- If the previous step did not correct the problem, repeat the procedure using the two clamps separated in order to reduce the spinning weight.

Continue the trial and error procedure using different weights in different locations until you achieve the best balance. If more that three clamps aligned in the same position are required, replace the propeller shaft.

If you are able to reduce the vibration in the stall, but are unable to eliminate the vibration completely, perform a road test on the vehicle. A slight vibration noticeable in the stall may not be noticeable on the road.

Driveline System Balance with Electronic Vibration Analyzer (EVA)

In order to pinpoint the source, you must reproduce the vibration in the service stall. Determine which component is vibrating the most using the EVA. Perform the following steps:

1. Support the vehicle on a suitable hoist or on safety stands. Ensure that the rear of the rear axle is at curb height. Do not allow the axle to hang. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the rear tire/wheel assemblies. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Ensure that the propeller shaft is free of undercoating. Inspect for dents or damage to the propeller shaft or the U-joint.
4. Start the engine.
5. Place the transmission in gear.
6. Run the engine at the vehicle speed at which the vibration is occurring.

Caution: Do not run the vehicle higher than 89 km/h (55 mph). Stay clear of the universal joints and the balance weight area in order to avoid personal injury. Do not run the vehicle on the hoist for extended periods of time. Running the vehicle on the hoist for extended periods of time may cause the engine or the transmission to overheat.

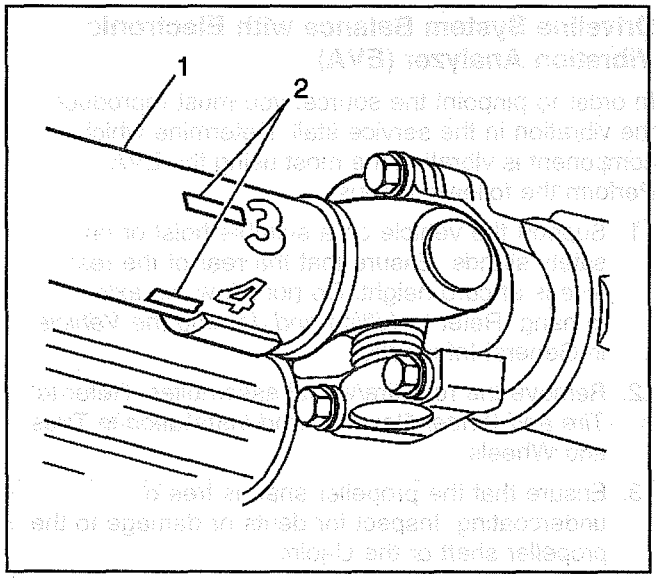
Determine which end of the propeller shaft is vibrating the most. Hold the EVA's sensor against the pinion nose and the transmission tailshaft assembly. The higher the amplitude reading, the greater the vibration.

- If the vehicle has a two-piece propeller shaft, inspect the center support bearing.
- If the transmission tailshaft vibrates, inspect the transmission crossmember under the transmission mount. The vibration should not be present if the mount is functioning correctly.

Strobe Balance Testing with the Electronic Vibration Analyzer (EVA)

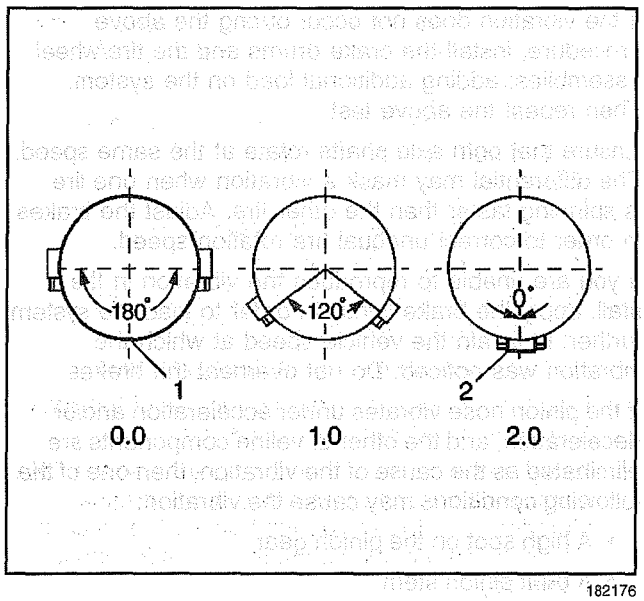
Ensure that the runout of the various driveline components are within specifications. If the runouts are within specifications, strobe balance the driveline. The EVA is able to simplify the balancing process, using the following procedure:

1. Use the EVA in order to determine which end of the propeller shaft has the most vibration.



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2. Mark the end of the propeller shaft (1) that has the most vibration at four points (2), 90 degrees apart. Number the marks 1 through 4.
3. Mount the EVA sensor onto the bottom of the following components:
   - The differential housing
   - The center bearing support (for 2-piece propeller shafts that use a center bearing support)
   - The transmission tailshaft assembly
4. Position the sensor as close to the propeller shaft as possible. Verify that the following conditions exist:
   - The UP side of the sensor faces upward.
   - The sensor is horizontal.
5. Start the engine.
6. Turn OFF all of the engine accessories.
7. Place the transmission in gear.
8. Run the vehicle at the speed which causes the most vibration in the propeller shaft.
9. Hook the timing light clip to the trigger wire.
10. Plug the vibration sensor into Input A of the EVA. Input B is not applicable for this test.
11. Verify that the predominant frequency on the EVA display matches the frequency of the original vibration. Use the strobe light only if the rotation speed of the propeller shaft is the predominant frequency.
12. The EVA displays a series of questions in order to select the correct filter. Press YES in order to select the desired filter. Ensure that the frequency is in the middle of the filter range. Use the full range only as a last resort.
13. The display shows the test frequency, the amplitude and the filter range. The driveline is balanced when the amplitude is near 2. In some cases, a slightly higher amplitude will provide adequate balance.
14. Point the timing light at the propeller shaft. The strobe effect will appear to freeze the propeller shaft. Remember which of the numbered marks is at the bottom of the propeller shaft, or the six o'clock position. This position is the light spot.
15. Turn the engine OFF.
16. Install a weight directly on the light spot.
17. Start the engine.
18. Run the vehicle at peak vibration speed.



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19. Strobe the propeller shaft again.
    - The propeller shaft is balanced if the strobe image is erratic and the amplitude is near two.
    - The propeller shaft is not balanced if one of the following conditions exist:
      - The weight and the original light spot are at the six o'clock position (1).

        The above condition means that there is not enough weight on the propeller shaft. In order to correct the balance, add a second weight next to the first weight. Inspect the balance again using the strobe light.

        If the weights are now 90–180 degrees off (between the nine o'clock and the three o'clock positions) too much weight exists. In order to correct the balance, split the two weights equally on either side of the original light spot (1) in order to produce a total weight between 1–2 weights (between 0–120 degrees apart). Inspect the balance again using the strobe light. Adjust the weights as needed.
      - The weight and original light spot are 90–180 degrees off (between the nine o'clock and the three o'clock positions).

        The above condition means that one weight is too much. In order to correct the balance, split the two weights equally on either side of the original light spot in order to produce a total weight less than one (120–180 degrees apart). Inspect the balance again using the strobe light. Adjust the weights as needed.
      - The weight and the original light spot are within 180 degrees of the six o'clock position.

        Move the weight towards the six o'clock position. Inspect the balance again using the strobe light. Adjust the weight as necessary. Refer to the previous two conditions.

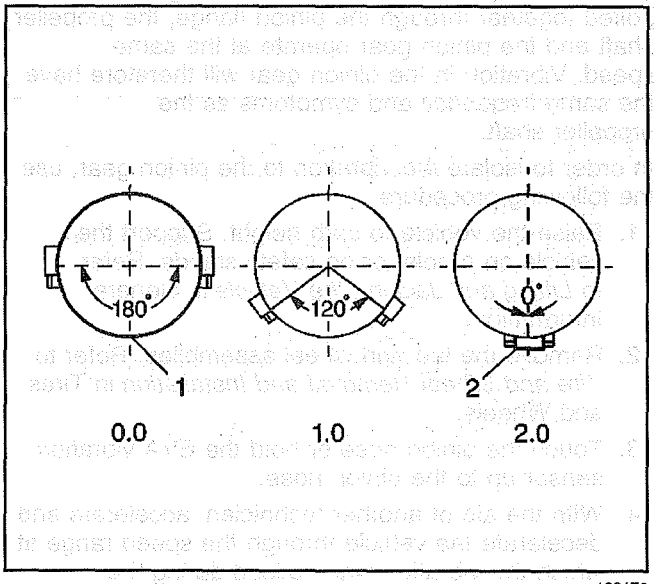
If the shaft will not balance using two weights, place a third weight on the light spot. Split the first two weights in order to produce a total weight between two and three weights.

If three weights fail to balance the driveline, replace the propeller shaft.

When the propeller shaft balances, road test the vehicle in order to verify that the vibration is eliminated.

Propeller Shaft Balance Weights

When using clamps in order to balance a propeller shaft with the total weight method, the correction weight required will often be a fraction or a multiple of one hose clamp. Use the following phasing procedure with two hose clamps in order to accurately place any required amount (0.0–2.0 total weights).



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1. Ensure that the clamps are located with even spaces on either side of the light spot, or 180 degrees opposite the heavy spot (1).

   The table containing the weight amounts in terms of the total weight and the included angle (spread) between the clamps is in specifications. Refer to *Propeller Shaft Balancing Weight Amounts*.
2. If the vibration does not change at all or gets worse, then one clamp is too light or too heavy. Repeat the procedure using the two clamps together.
3. If the previous step did not correct the problem, repeat the procedure using the two clamps separated in order to reduce the spinning weight.

4. Continue the trial and error procedure using different weights in different locations until you achieve the best balance.
5. If more than three clamps aligned in the same position are required, replace the propeller shaft.
6. If you are able to reduce the vibration in the stall, but are unable to eliminate the vibration completely, road test the vehicle. A slight vibration that is noticeable in the stall may not be noticeable on the road.

First-Order Driveline Vibration Analysis (Torque Sensitive)

If the following conditions are true, the internal rear axle components are the probable cause of the vibration:

- The vehicle has a vibration that is equal to first-order driveline rotation, and the vibration is not present you test the vehicle in the stall.
- You were able to correct the vibration in the stall, but the vibration returned during the road test.

Internal rear axle vibrations may be aggravated by the load of the vehicle working against the ring and pinion gear seat.

Since the propeller shaft and the pinion gear are bolted together through the pinion flange, the propeller shaft and the pinion gear operate at the same speed. Vibration in the pinion gear will therefore have the same frequency and symptoms as the propeller shaft.

In order to isolate the vibration to the pinion gear, use the following procedure:

1. Raise the vehicle to curb height. Support the vehicle on a hoist or on safety stands. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the tire and wheel assemblies. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Touch the pinion nose or hold the EVA vibration sensor up to the pinion nose.
4. With the aid of another technician, accelerate and decelerate the vehicle through the speed range at which the vibration was noticed during the road test.

Example

- If the vibration was originally noticed at 88 km/h (55 mph), accelerate from 72 km/h (45 mph) to 107 km/h (65 mph). Then decelerate from 107 km/h (65 mph) back to 72 km/h (45 mph).
- Repeat the above step and remember whether or not the pinion nose vibrates under load during acceleration and/or deceleration.

If the vibration does not occur during the above procedure, install the brake drums and the tire/wheel assemblies, adding additional load on the system. Then repeat the above test.

Ensure that both axle shafts rotate at the same speed. The differential may mask a vibration when one tire is spinning faster than the other tire. Adjust the brakes in order to correct unequal tire rotation speed.

If you are unable to reproduce the vibration in the stall, apply the brake lightly in order to load the system further. Maintain the vehicle speed at which the vibration was noticed. Do not overheat the brakes.

If the pinion nose vibrates under acceleration and/or deceleration, and the other driveline components are eliminated as the cause of the vibration, then one of the following conditions may cause the vibration:

- A high spot on the pinion gear
- A bent pinion stem
- A cocked pinion bearing
- An improper axle housing bore

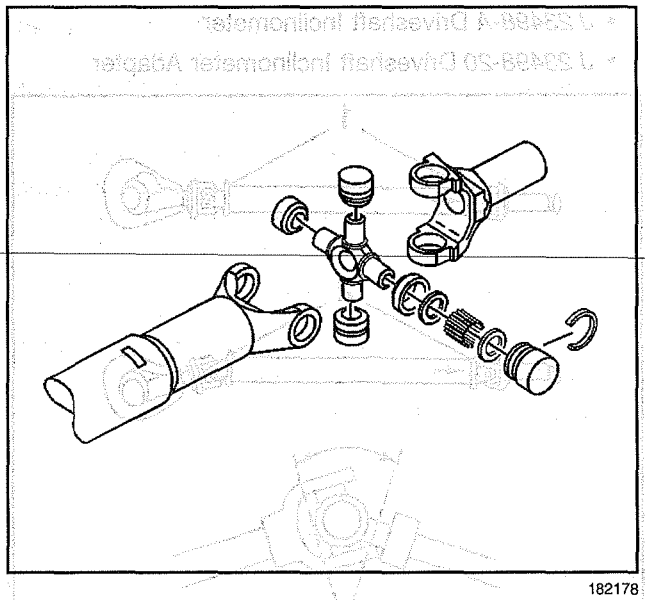
Anything that effects the pinion gear and how the pinion gear contacts the rotating ring gear may contribute to a first-order, torque-sensitive driveline vibration. The only way to correct the condition is to replace the faulty components. In most cases, you must replace the ring and pinion gear set and the related bearings. In some cases, you must replace the axle housing. Complete a close-up visual inspection for damage or unusual wear in order to measure or identify the specific faulty component.

It is possible to isolate an internal axle vibration. Install a known good axle assembly from a stock unit. Verify that the known good axle assembly does not have a vibration problem.

Once you correct the internal axle problem, road test the vehicle. Inspect the vehicle for vibration. Balance the driveline, as necessary, in order to eliminate any remaining vibration.

Diagnosing Second-Order Driveline Vibration

Second-Order Driveline Vibration Theory



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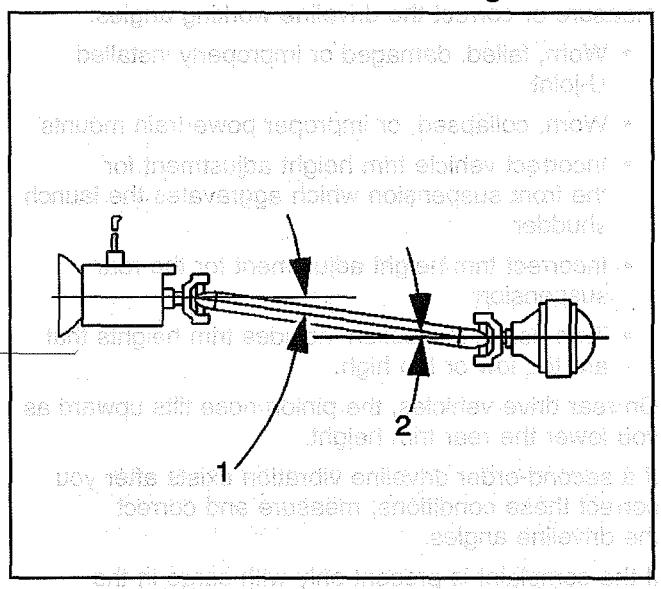
A faulty universal joint (U-joint) may cause a vibration that occurs twice for each rotation of the propeller shaft. This type of vibration is called a second-order vibration.

Second-order driveline vibrations are independent of runout or balance of a driveline component.

The following description of basic U-joint theory will help you to understand where second-order driveline vibrations originate and why they occur.

- As the propeller shaft rotates, the U-joint speeds up and slows down twice for each rotation of the propeller shaft.
- The acceleration and deceleration of the U-joint is not visible. If there is vibration in the U-joint, the acceleration and deceleration will be audible and tactile.
- Compare the U-joint in a vehicle to a universal-type socket. When a universal-type socket is used to tighten a bolt, the socket will bind and release as the socket turns toward 90 degrees. The bind and release occurs twice for each revolution of the socket.
- The U-joint in a vehicle works in the same way as the universal-type socket. The bind and release effect is directly proportional to the angle that the U-joint operates: the greater the angle, the greater the effect.
- Because the transmission output speed is constant, the binding and releasing of the U-joint is better described as an acceleration and deceleration which occurs twice for each revolution of the propeller shaft.
- If the propeller shaft is running slowly, the accelerating and decelerating effect is visible. The acceleration and deceleration may create a vibration due to the fluctuations in force that are generated at high speeds.

Canceled Out Driveline Angles



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Legend

(1) Front Working Angle
(2) Rear Working Angle

Engineers design drivelines in order to compensate for the accelerations and decelerations in order to produce a smooth, constant flow of power, as listed below:

- The transmission drives the front yoke of the propeller shaft at a smooth and constant speed.
- The first U-joint causes the power to fluctuate twice for each revolution of the propeller shaft.
- The second U-joint, oriented 90 degrees from the first U-joint, causes the power to fluctuate opposite that of the first U-joint.
- As the first U-joint slows down, the second U-joint speeds up.

This design causes one U-joint to cancel out the effect of the other U-joint. The cancelled effects result in a smooth, constant power flow from the output yoke of the propeller shaft.

Second-order driveline vibrations occur when the cancellation becomes unequal between the front U-joint and the rear U-joint.

The main objective of this section is to correct the conditions that interfere with the proper cancellation effect of the U-joint. The most common condition, especially where the launch shudder is concerned, is incorrect driveline working angles (1,2). Other factors may aggravate the condition.

Address the following factors before you attempt to measure or correct the driveline working angles:

- Worn, failed, damaged or improperly installed U-joint
- Worn, collapsed, or improper powertrain mounts
- Incorrect vehicle trim height adjustment for the front suspension which aggravates the launch shudder
- Incorrect trim height adjustment for the rear suspension
- Trim height inspection includes trim heights that are too low or too high.

On rear drive vehicles, the pinion nose tilts upward as you lower the rear trim height.

If a second-order driveline vibration exists after you correct these conditions, measure and correct the driveline angles.

If the complaint is present only with cargo in the vehicle, perform the measurements with the vehicle fully loaded. Once you correct a second-order driveline vibration with the vehicle loaded, the vibration may reappear with the vehicle unloaded. The reverse of this condition is also true. You may have to reach a compromise with the customer in this case.

Second-Order Driveline Vibration Symptoms

Second-Order driveline vibration has the following signs and symptoms:

- The vibration is always related to vehicle speed.
- The vibration is usually torque-sensitive.
- The vibration is worse under a torque load.

Launch shudder is the most common complaint of a second-order driveline vibration.

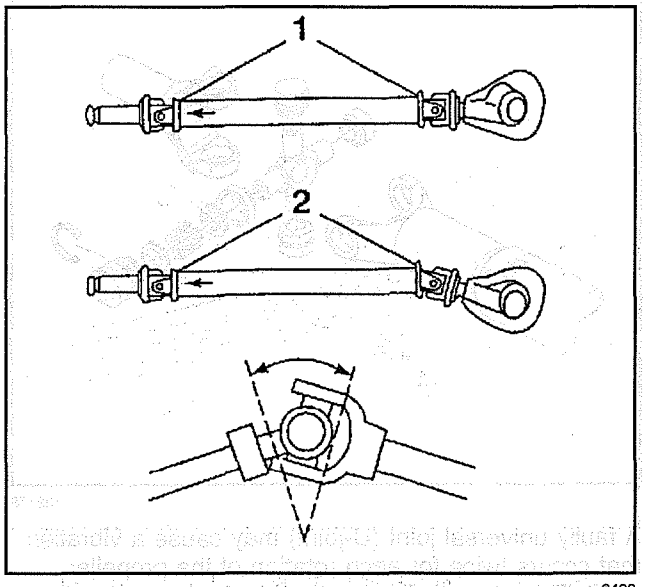
Launch shudder occurs during acceleration from 0–40 km/h (0–25 mph). Launch shudder appears as a low frequency shake, wobble, or shudder. The driver may feel the vibrations in the seat or steering wheel at low speeds of 0–24 km/h (0–15 mph). The vibrations will increase in frequency as the vehicle speed increases. Launch shudder feels more like driveline roughness at higher speeds of 24–40 km/h (15–25 mph). At speeds greater than 40 km/h (25 mph) the vibration usually disappears.

Launch shudder vibration is equal to a second-order vibration of the driveline. The EVA will not perceive frequency information due to the transitory nature of launch shudder.

Driveline Working Angles

Tools Required

- *J 38460* Digital Inclinometer
- *J 23498-A* Driveshaft Inclinometer
- *J 23498-20* Driveshaft Inclinometer Adapter



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Driveline working angle does not refer to the angle of any one shaft, but to the angle that is formed by the intersection of two shafts.

The procedure for measuring and correcting driveline working angles depends on whether the vehicle is equipped with a propeller shaft consisting of one piece, two pieces, or three pieces.

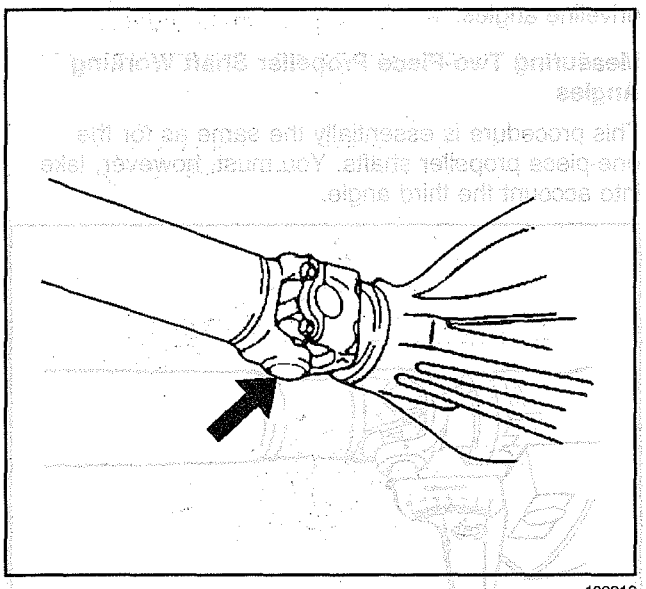
In order to verify the accuracy of the adapter, inspect the angle of an accessible joint with the inclinometer prior to assigning the adapter on an inaccessible joint.

One-Piece Propeller Shaft System

Raise the vehicle on a suitable hoist or on safety stands. Ensure that the rear axle is supported at curb height and that the wheels are free to spin. Refer to *Lifting and Jacking the Vehicle* in General Information. Place the transmission in NEUTRAL. Ensure that the vehicle has a full tank of fuel or the equivalent amount of weight in the rear to simulate a full tank. The weight of 3.8 liters of gasoline (1 gallon) is approximately 2.8 kg (6.2 lb).

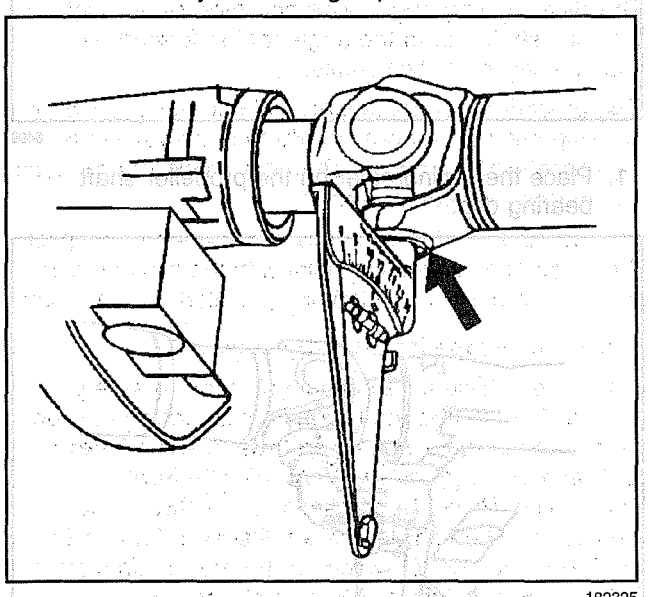
Checking Phasing of U-joint

Inspect the propeller shaft for correct phasing. Correct phasing means that the front and the rear U-joint are directly in line or parallel with each other so that proper cancellation takes place.



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1. Rotate the propeller shaft so that the propeller shaft rear U-joint bearing cap is vertical.

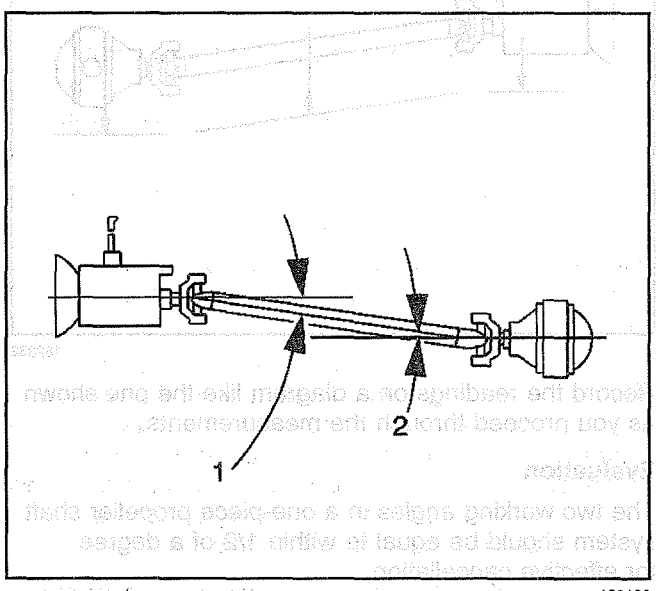


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2. Ensure that the front bearing cap is also vertical.
3. Place the inclinometer on the propeller shaft rear U-joint bearing cap in order to ensure that both U-joints are vertical.
4. Set the indicator line above the sight glass on 15 (the horizontal reference). Rotate the propeller shaft until the bubble centers in the sight glass. This action brings the rear U-joint to vertical.
5. Remove the inclinometer without disturbing the setting. Leave the setting on 15.
6. Install the inclinometer on the front U-joint. The bubble should remain centered plus or minus 3 degrees if the shaft is properly phased.

The out of phasing of the single-piece propeller shaft is very unusual. If the shaft is visibly out of place, the end yokes are welded on in the wrong position or the shaft is damaged due to twisting. In either case, replace the propeller shaft before continuing with this procedure.

Measuring the Working Angles



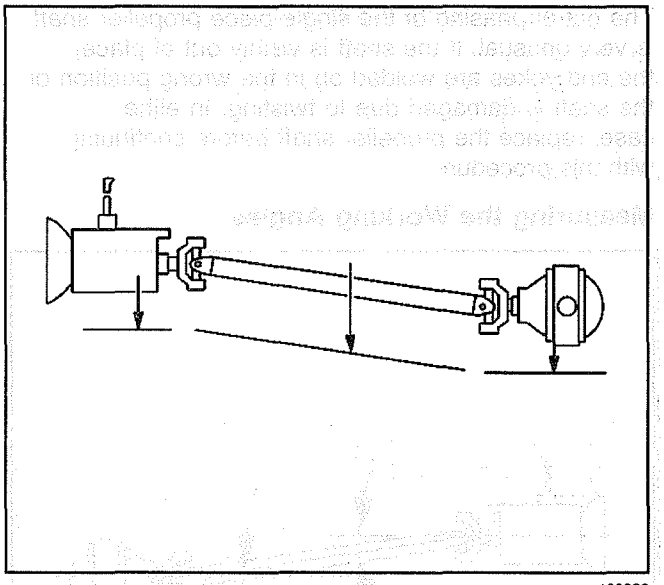
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The working angle of a U-joint is the difference between the angles formed when two shafts intersect. One piece propeller shaft systems have two working angles, the front (1) and the rear (2).

- The two working angles should be equal within ½ of a degree.
- The working angles should not exceed 4 degrees.
- The working angles should not be equal to ZERO because a ZERO working angle will cause premature U-joint wear due to lack of rotation of the U-joint.
- The angle formed by the propeller shaft and the rear axle pinion from the rear working angle (2)
- The angle formed by the propeller shaft and the transmission output shaft form the front working angle (1)

The angles of these components are most accurately measured from the U-joint bearing caps. Verify that the bearing caps are free of corrosion or foreign material in order to ensure accurate readings. Remove any snap rings that may interfere with the correct placement of the inclinometer. Reinstall the snap rings after you take the measurements.

Take the measurements from the same side of the propeller shaft in order to maintain consistent angle measurements (either on the driver side or on the passenger side).



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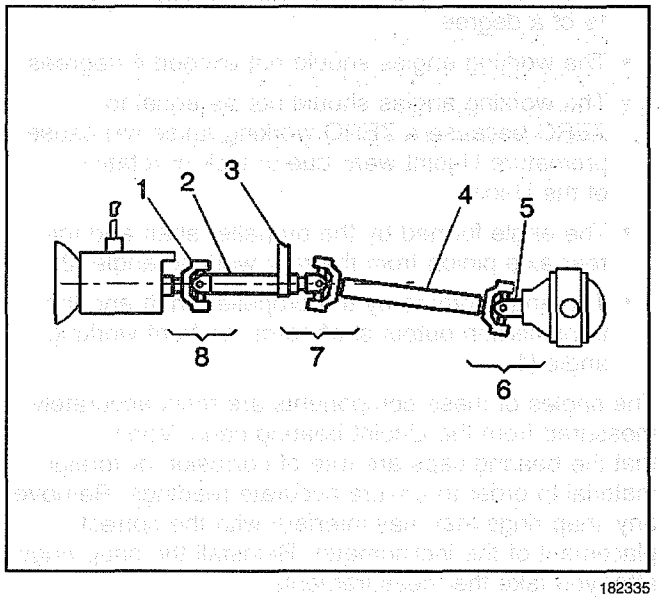
Record the readings on a diagram like the one shown as you proceed through the measurements.

Evaluation

The two working angles in a one-piece propeller shaft system should be equal to within 1/2 of a degree for effective cancellation.

Measuring Two-Piece Propeller Shaft System Working Angles

Two-piece propeller shaft systems have three working angles instead of two working angles as in the one-piece systems.



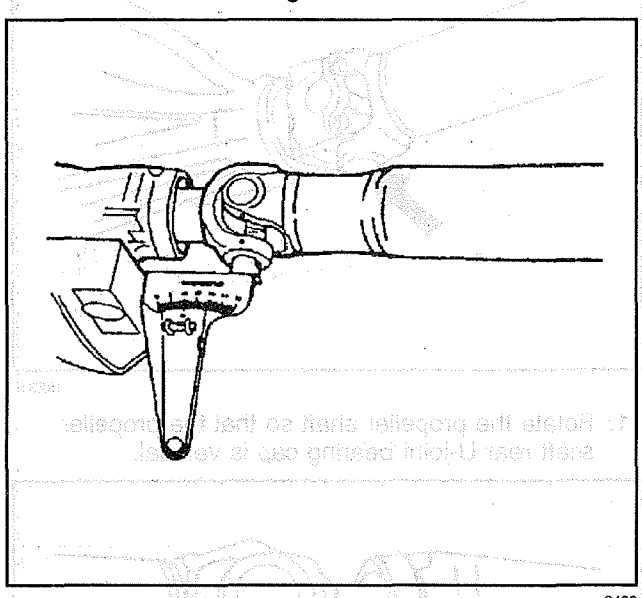
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- The first angle is the front working angle (8). It is formed by the angle of the output shaft of the transmission and the angle of the front propeller shaft.
- The second angle (7) is the middle working angle. It is formed by the angle of the front propeller shaft and the angle of the rear propeller shaft.
- The third angle (6) is the rear working angle. It is formed by the angle of the rear propeller shaft and the angle of the pinion yoke of the rear axle.

If the launch shudder or the second-order driveline vibration is still present, measure and correct the driveline angles.

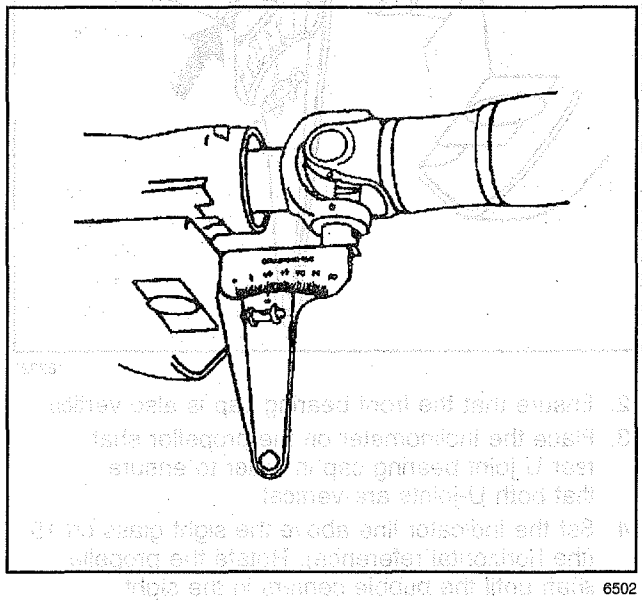
Measuring Two-Piece Propeller Shaft Working Angles

This procedure is essentially the same as for the one-piece propeller shafts. You must, however, take into account the third angle.



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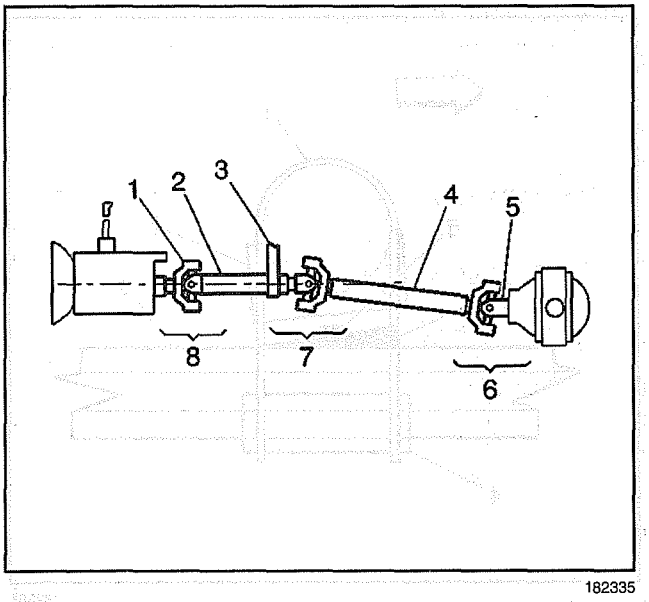
1. Place the inclinometer on the propeller shaft bearing cap.



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2. Center the bubble in the sight glass.
3. Record the measurement. The bearing cap must be straight up and down in order to obtain an accurate measurement.
4. Enter the measurements on your diagram.

5. Rotate the propeller shaft 90 degrees and place the inclinometer on the transmission output yoke bearing cap. The bearing cap must be straight up and down in order to obtain an accurate measurement.
6. Center the bubble in the sight glass.
7. Record the measurement.
8. Subtract the smaller reading from the larger reading in order to obtain the front U-joint working angle.



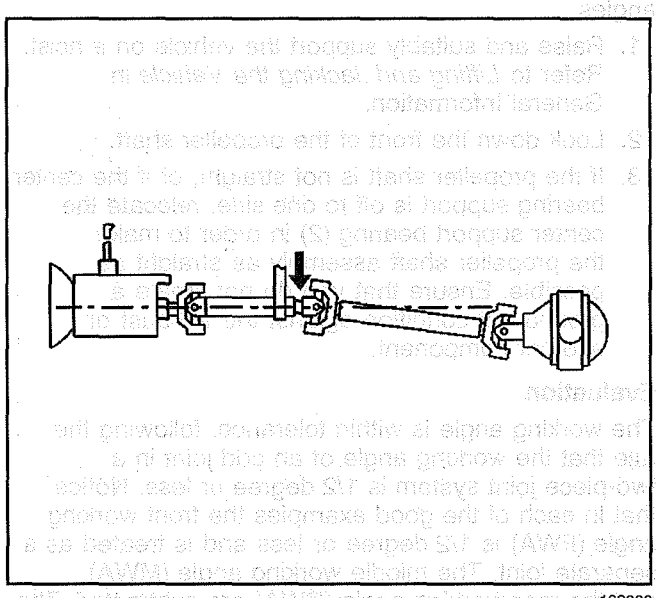
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The front angle is considered the odd U-joint because this angle does not have another joint to provide cancellation. The rear working angle (6) and the middle working angle (7) act as a pair of U-joints in order to cancel each other out, as in the one-piece propeller shaft systems. Because of this condition, keep the working angle of the odd U-joint (8) at or under 1/2 of a degree.

Keep the working angle of this odd joint to a minimum so that there are not any great fluctuations in speed that need to be canceled out. The front joint is used as the odd joint because the front joint angle does not change with suspension bounce, rebound, or axle windup. For this reason, think of the front propeller shaft of a two-piece system as an extension of the transmission output shaft.

Two-Piece Propeller Shaft Phasing

The setup and measurement techniques are identical to that of a the one-piece propeller shaft system. First, test for proper phasing, using the following procedure:


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1. Turn the rear propeller shaft so that the rear U-joint is straight up and down. Verify that the front U-joint of the rear propeller shaft is also straight up and down.
2. Rotate the shafts 90 degrees so that the front propeller shaft front U-joint is straight up and down. Ensure that the front propeller shaft is also straight up and down (actually part of the slip yoke on the rear shaft).

If the two U-joint of the front propeller shaft are not in this phase, the two halves of the propeller shaft may have been assembled incorrectly.

Two-Piece Propeller Shaft Lateral Alignment

The procedure for lateral alignment of a two-piece propeller shaft is used for launch shudder or any second-order driveline vibrations. Adjust the lateral alignment before you measure and adjust the driveline angles.

1. Raise and suitably support the vehicle on a hoist. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Look down the front of the propeller shaft.
3. If the propeller shaft is not straight, or if the center bearing support is off to one side, relocate the center support bearing (2) in order to make the propeller shaft assembly as straight as possible. Ensure that you do not create a ground-out condition against the exhaust or another component.

Evaluation

The working angle is within tolerance, following the rule that the working angle of an odd joint in a two-piece joint system is 1/2 degree or less. Notice that in each of the good examples the front working angle (FWA) is 1/2 degree or less and is treated as a separate joint. The middle working angle (MWA) and the rear working angle (RWA) are subtracted. The difference (DIFF) is 1/2 degree or less. The middle and the rear joints may cancel each other.

Correcting Working Angles

In order to change the working angles, shim the components up or down. Look closely at the existing angles. Use the existing angles and the shims in order to achieve the correct working angles.

Compared to horizontal or true level, the components located at the rear of the vehicle are usually lower than the components located at the front of the vehicle. This condition is called down in the rear. If a component with a down in the rear angle is shimmed up at the rear, the shim will bring the component closer to the horizontal (zero). Alternately, if a component with a down in the rear angle is shimmed down, the component will move farther from the horizontal (zero).

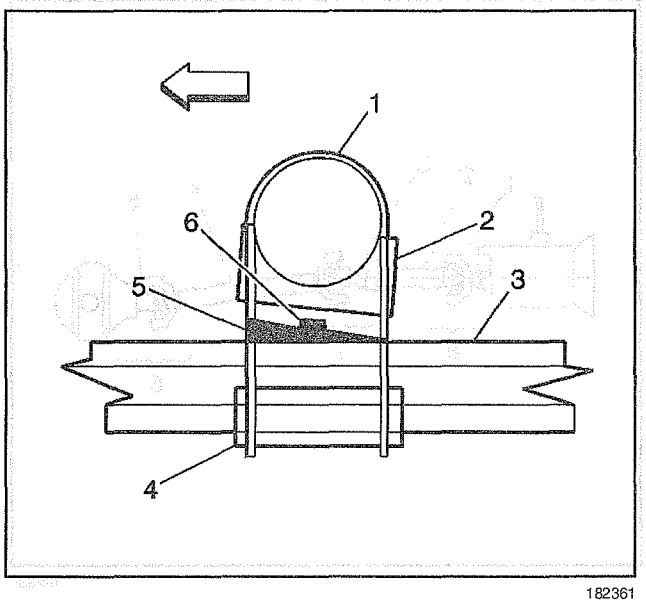
Rear Axle Wind-Up

Rear axle wind-up may cause launch shudder even when all of the working angles are within specifications. Rear axle wind-up occurs when heavy torque during acceleration causes the pinion nose to point upward. In order to compensate for axle wind-up, tip the pinion nose downward. Install the axle shims incrementally, performing a road test after each shim. Add shims until the road test indicates that the shudder is eliminated.

Rear Axle Shims

Wedge shims of different sizes are available through the parts' system and independent suppliers for the purpose of shimming the rear axle angle. Wedge shims are available in 2, 3, and 4 degrees.

Caution: Never attempt to shim a rear axle using anything except shims that are designed for this purpose. Failure to do so will result in the shims falling out and a loss of vehicle control and that could cause personal injury.

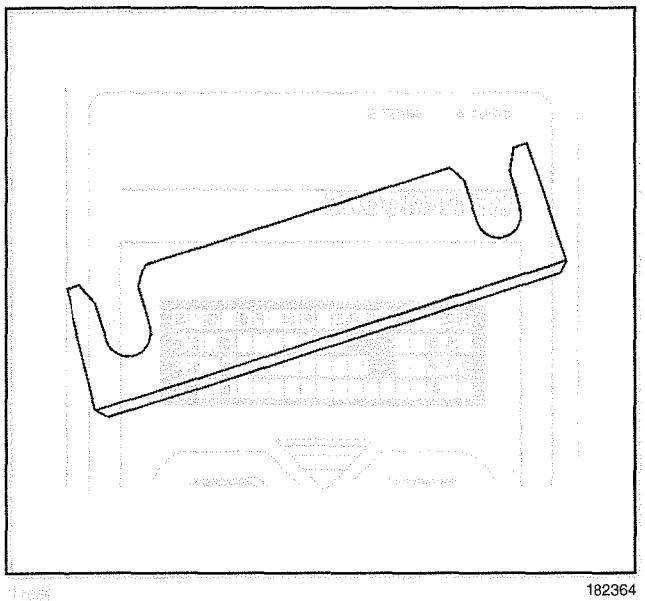


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Install the shims (5) in order to increase or decrease the angle of the rear axle pinion. Install the shims between the leaf spring (3) and the spring seat (2). Depending on the design of the suspension [leaf spring on top or underneath the axle (1)], and the direction of the desired change, install the shims with either the thick side toward the front of the vehicle or toward the rear of the vehicle.

Important: After installing the shims, ensure that the U-bolt has two or three threads above the nut. Ensure also that the center bolt, located in the spring seat, is long enough to seat in the locator hole. If these two conditions do not exist, use longer U-bolts and center bolts. Longer U-bolts and center bolts are available through local spring shops.

Transmission Shims



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If a transmission requires shims, order the shims through the parts distribution system.

Installing most shims will change the transmission angle approximately 1/2 degree.

When shimming transmissions, use a shim made from steel stock at the necessary thickness. Ensure that the shim contacts the full width of the area to be shimmed. Do not use washers.

Engine Related Vibration

Engine vibration is usually due to one or more of the following conditions:

- First-order engine imbalance
- Inherent engine firing sequence
- Inherent engine shaking forces
- Engine-driven accessories

Because these vibrations are engine-speed related, they are also usually torque sensitive. These vibrations may appear and disappear at different vehicle or road speeds, but will always appear at the same engine speed.

For example, if a customer states that a vibration is present at 40 km/h (25 mph), 64 km/h (40 mph), and again at 104 km/h (65 mph), and that the symptoms of the vibration are similar at each of these speeds, the vibration is probably engine-speed related. Any disturbance or vibration that is present during the following road tests would be considered engine-speed related:

- The neutral run-up test
- The downshift test
- The brake torque test

Any vibration that is present during the neutral coast-down test is not engine-speed related. The engine-related vibrations covered in this diagnosis are engine-speed sensitive only.

First-Order Engine Imbalance

Notice: Proper flywheel installation requires carefully WALKING the flywheel onto the crankshaft and stagger-tightening the bolts. Proper torque converter to flywheel installation then requires gradually WALKING the torque converter to be flush with the flywheel, prior to installing the bolts. Do not draw the torque converter to the flywheel with the bolts. If these precautions are not followed, warping or bending of the flywheel and/or damage to the transmission torque converter may result.

Engine imbalance is a condition that exists when a component that rotates at crankshaft speed is either unbalanced or has excessive runout. In rare cases, the crankshaft may be unbalanced. In any case, balancing the component or correcting the runout may reduce the disturbance to an acceptable level.

Symptoms

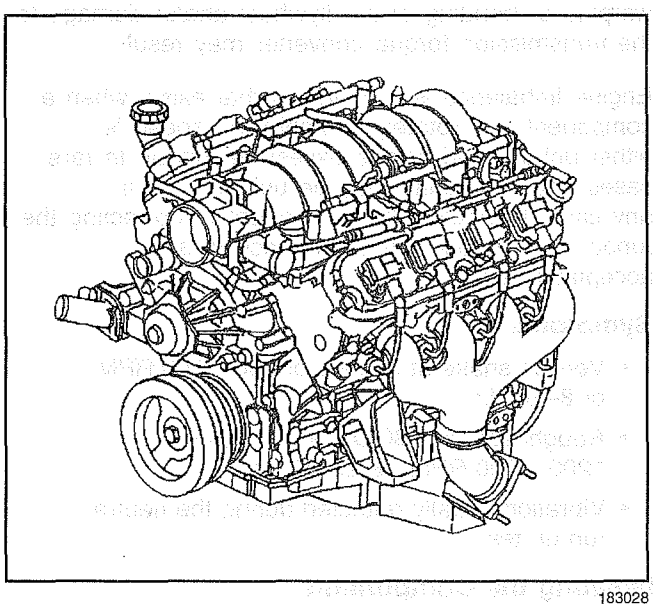
- Vehicle shake at speeds of 500–1200 RPM, or 8–20 Hz
- Roughness and BOOM at speeds of 1200–3000 RPM, or 20–50 Hz
- Vibration usually detected during the neutral run-up test

Isolating the Components

1. Perform the neutral run-up test, noting the RPM at which the vibration is the worst, and the severity. Refer to *Road Test*.
2. Inspect all powertrain mounts. Repair or replace as needed.
3. Inspect for any bindings or ground-outs in the exhaust system.
4. Matchmark the torque converter and the flywheel.
5. Disconnect the torque converter from the flywheel.
6. Tie up the converter, away from the flywheel.
7. Perform the neutral run-up test again.
   - If the flywheel shows any wobble or lateral runout, replace the flywheel. Refer to *Engine Flywheel Replacement* in Engine Mechanical-3.8 L or *Engine Flywheel Replacement* in Engine Mechanical-5.7 L.
   - Re-index the torque converter in three different positions. If the disturbance still exists, replace the torque converter.

8. If the vibration still exists, inspect the propeller shaft runout.
9. If the vibration still exists, inspect the harmonic balancer.
10. If the vibration still exists, the problem is related to residual engine imbalance. Refer to the procedure below.

Excessive Inherent Engine Firing Frequency



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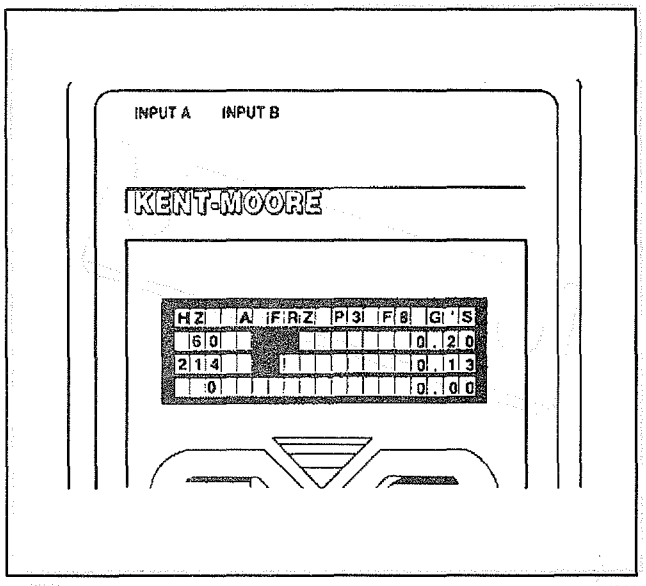
Firing frequency is a term used to describe the pulses created as the engine fires in each cylinder. All engines have a firing frequency. The intention here is to keep these disturbances from entering the passenger compartment. Initially, inspect for the following conditions:

- The engine and the exhaust system are mounted in the correct position.
- All of the mounts and hangers are in good condition and are correct for the application.
- No components, hoses, or lines are grounding to the frame or to the body.

The frequency of these disturbances will depend on the number of cylinders. The engine order will always be equal to one-half the number of cylinders. This is because a four-stroke engine requires two complete revolutions of the crankshaft in order to fire all of the cylinders.

For example, a V6 engine will fire cylinders 1, 3, and 5 on the first revolution. Cylinders 2, 4, and 6 will fire on the second revolution. This results in three firing pulses per revolution of the crankshaft.

Engine Vibration Diagnosis with the EVA



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1. Place the EVA vibration sensor on the seat track rail with the UP label facing upward.
2. Plug the EVA into a 12 volt power supply.
3. Prepare the EVA for data recording:
   3.1. Press RECORD
   3.2. Select a snapshot tag number
   3.3. Press ENTER in order to begin recording
4. Slowly accelerate until the vibration occurs.
5. Note the vehicle speed and the engine RPM where the disturbance occurs.
6. Press ENTER on the EVA in order to record the vibration data.
7. Perform the road test diagnoses in order to determine engine-speed or vehicle-speed sensitivity. Refer to *Road Test*.

Engine Firing Frequency Symptoms

- The vibration may be torque sensitive.
- The vibration is engine-speed related.
- The vibration is heard as a boom or a moan.
- The vibration is felt as a shake, roughness or buzz (depending on the number of cylinders).
- The vibration affects the resonance of a system or a component, causing the system or the component to have a narrow RPM range.

The key to correcting these types of complaints is to isolate the vibration from the passenger compartment or the body.

Diagnosis and Repair of Engine Firing Frequency-Related Vibrations

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.

Caution: Refer to Work Stall Test Caution in Cautions and Notices.

2. Attempt to duplicate the vibration.
3. While the vibration is present, find the area of the vehicle affected by the vibration.
4. Inspect for witness marks caused by rubbing components.
5. Isolate the component and re-evaluate the vibration.
6. Inspect for proper torque on the affected component. Tighten as needed.
7. If the vibration still exists, follow the procedure below.

Engine Firing-Frequency Related Vibration Causing Components

1. Inspect for collapsed engine mounts.

   Replace as needed. Refer to *Engine Mount Replacement* in Engine Mechanical - 3.8 L or, refer to *Engine Mount Replacement (Left)* or *Engine Mount Replacement (Right)* in Engine Mechanical - 5.7 L.
2. Inspect for a collapsed or broken transmission mount. Replace as needed. Refer to *Transmission Support and Mount Assembly* in Manual Transmission - M49, *Transmission Support and Mount Assembly* in Manual Transmission - MM6 or *Transmission Support Replacement* in Frame and Underbody.
3. Inspect the exhaust hangers.
   - Exhaust systems can expand one to two inches when hot.
   - Remove the hangers one at a time.
   - Adjust or replace the exhaust hangers as needed.
4. Inspect the A/C and P/S lines.
   - Isolate the hoses from the body.
   - Install the retainers.
5. Inspect the drive belt for the proper tension.
6. Inspect the accessory unit fasteners for damage or looseness.
7. Inspect the body panels for missing or loose welds.
8. Remove any aftermarket equipment that may complete a transfer path into the passenger compartment.
9. Inspect the exhaust system and powertrain mounts. Re-bed the engine and align the exhaust system as follows if needed:
   - Loosen the mounts and hangers.
   - Tighten all fasteners with the powertrain in the relaxed position.

Some residual vibrations may be normal. Compare the vibrations with a similar vehicle to get a feel for what is commercially acceptable, preferably with the customer present. Also, refer to bulletins for updates on the use of mass damper weights for specific applications.

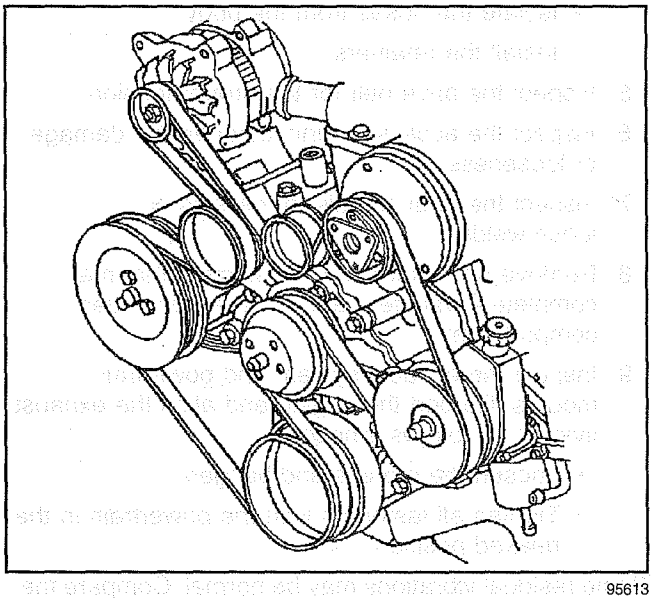
Inherent Engine Shaking Forces

Just as with firing frequency, some engine disturbances are the result of normal operation. Some engines can have additional inherent vibration due to the cylinder arrangement, the design, or the firing order.

Before attempting to repair a disturbance, compare the disturbance to another, known good, vehicle. Some vibrations could be normal though they may not be pleasing to the customer.

The key to resolving an inherent engine disturbance is to isolate the vibration from the passenger compartment. Follow the same procedures as outlined for the engine firing-frequency related vibrations.

Engine-Driven Accessories



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Engine driven accessories that exhibit vibration pose some special challenges. For example, the drive belts can no longer be removed one at a time in order to isolate the condition. If removing the belt eliminates the vibration, reinstall the belt and operate each accessory individually in order to determine which has the most effect on the vibration. However, one component may affect another because the drive belt drives all of the accessories.

Verify that the accessory load is not affecting the engine firing frequency.

Diagnosis

1. Compare the vibrations to a known good vehicle in order to ensure they are abnormal.
2. Remove the drive belt.
3. If the vibration stops, perform the following steps:
   3.1. Install the drive belt.

Important: The drive belt drives all of the engine accessories. Therefore, one component may affect another.

   3.2. Operate each accessory individually in order to determine which has the most effect on the vibration.
4. Test for the accessory load affecting the engine firing frequency.
5. Inspect the pulleys for misalignment or lateral runout. Repair or replace as needed.
6. Inspect the A/C system for overcharging. Evacuate and recharge as needed. Refer to *Refrigerant Recovery and Recharging* in Heating, Ventilation and Air Conditioning.
7. Inspect the engine oil level. Add or drain oil as needed.

Tire and Wheel Vibration

Tire and wheel assembly vibrations are the next level of testing for low-frequency vibrations that are vehicle speed sensitive. The tires, wheels, brake rotors and wheel hubs should be systematically tested, according to the symptoms.

First-Order Tire and Wheel Assembly Vibration

The following are symptoms of first-order vibrations caused by tire and wheel assemblies:

- The vibration is always vehicle-speed related.

  If the vibration is affected by the speed of the engine, or is eliminated by placing the transmission in NEUTRAL, then the vibration is not related to the tire and wheel assemblies.
- The vibration will feel like a SHAKE, usually in the steering wheel or the seat:
  - Tire and wheel vibrations that are felt in the steering wheel are most likely related to the front tire and wheel assemblies.
  - Tire and wheel vibrations that are felt in the seat or the floor are most likely related to the rear tire and wheel assemblies.

  This may not always hold true, but is a general rule that may serve to initially isolate a problem to the front or the rear of the vehicle.
- The customer may complain of a WADDLE at low speeds of 8 to 56 km/h (5 to 35 mph).
- The frequency on the EVA will correspond to the first-order of tire rotation. This frequency will usually be in the 10 to 20 Hz range, depending on the speed of the complaint and the size of the tire. The smaller the tire, the faster it will rotate at any given speed.
- The range of the human ear begins at 20 Hz. For this reason, first-order tire vibrations are rarely produce noise. The exception to this would be if the tires display an irregular tread pattern or flat spots, causing a GROWLING or SLAPPING noise.

Repair Instructions

Balancing Tires and Wheels

Tire Balancer Calibration Test

Caution: Failure to adhere to the following precautions before tire balancing can result in personal injury or damage to components:

- ***Clean away any dirt or deposits from the inside of the wheels.***
- ***Remove any stones from the tread.***
- ***Wear eye protection.***
- ***Use coated weights on aluminum wheels.***

Important: Tires may be balanced either on–vehicle or off–vehicle, but the off–vehicle balancing procedures are recommended. Off–vehicle methods are better because tire rotation will not affect the balancing. The off–vehicle balancers are also more accurate than the on–vehicle balancers. Off–vehicle balancers can perform dynamic balancing as well as static balancing.

Tire and wheel balancers can drift out of calibration without warning or become inaccurate as a result of abuse. The balancer calibration should be inspected every two weeks or whenever the readings become questionable.

1. Spin the balancer without a wheel or any of the adapters on the shaft.
2. Inspect the balancer readings.

   Specification

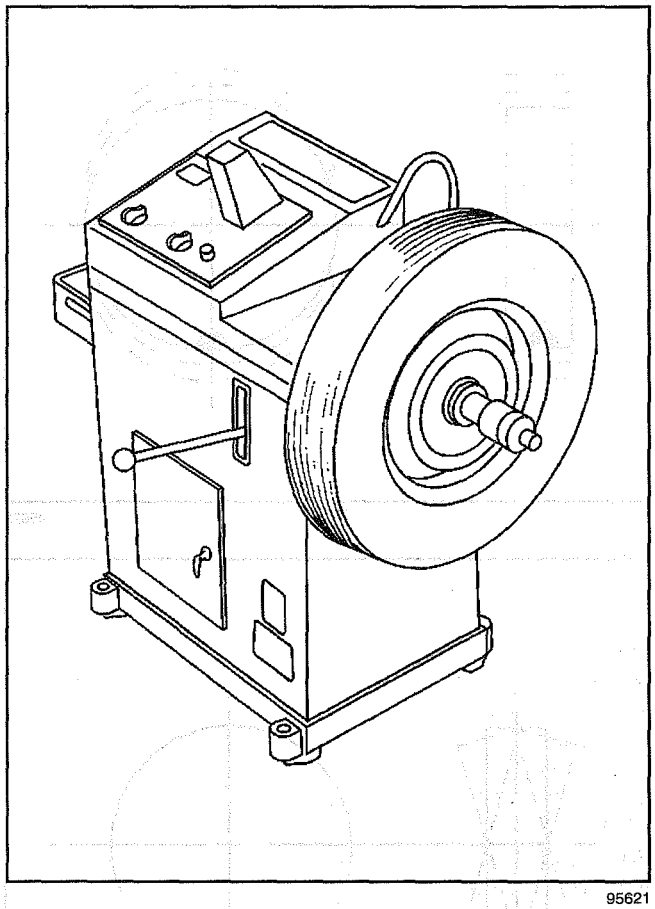
   0.00–0.25 oz.
3. Balance a tire and wheel that is within radial and lateral tolerances to ZERO.
4. Add a 3–ounce test weight to the wheel at any location.
5. Spin the tire and wheel again. Observe the readings.
   - In the static and dynamic modes, the balancer should call for 3 ounces of weight, 180 degrees opposite the test weight.
   - In the dynamic mode only, the weight should be called for on the flange of the wheel opposite the last weight.
6. With the wheel unbalanced to 3 ounces, cycle the balancer five times.
7. Take the balancer readings:

   Specification

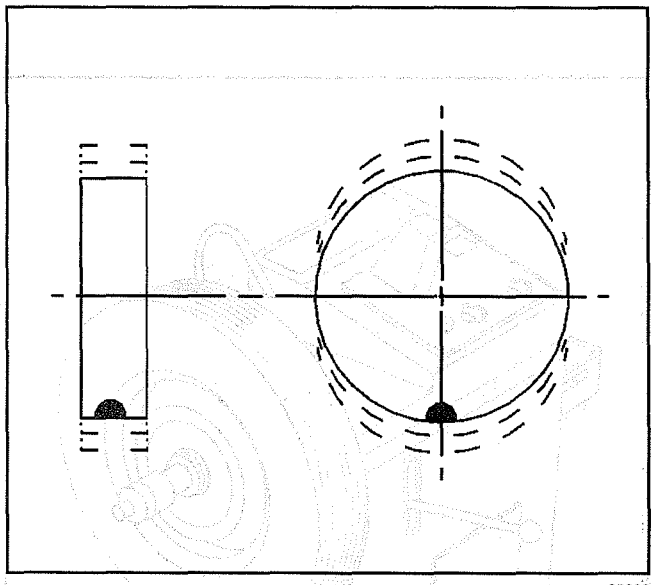
   Variation: 0.25 oz or less.
8. Index the tire and wheel at four separate locations on the balancer shaft, 90 degrees apart.
9. Cycle the balancer with the weights at each location.
10. Take the balancer readings:

    Specification

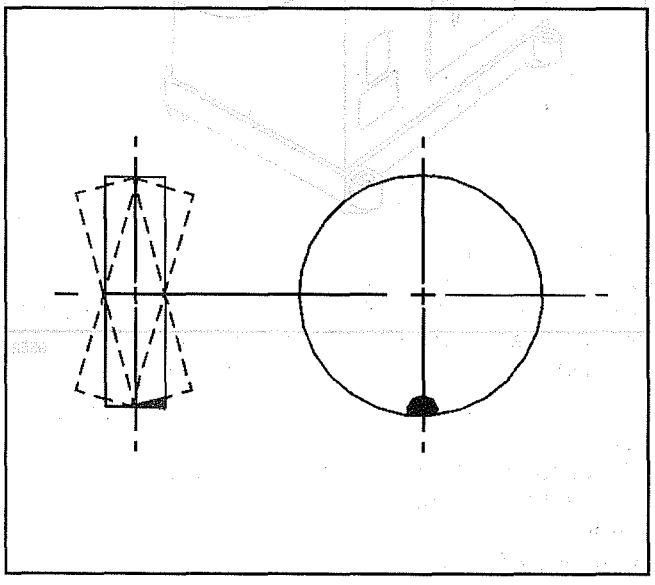
    Variation: 0.25 oz or less.



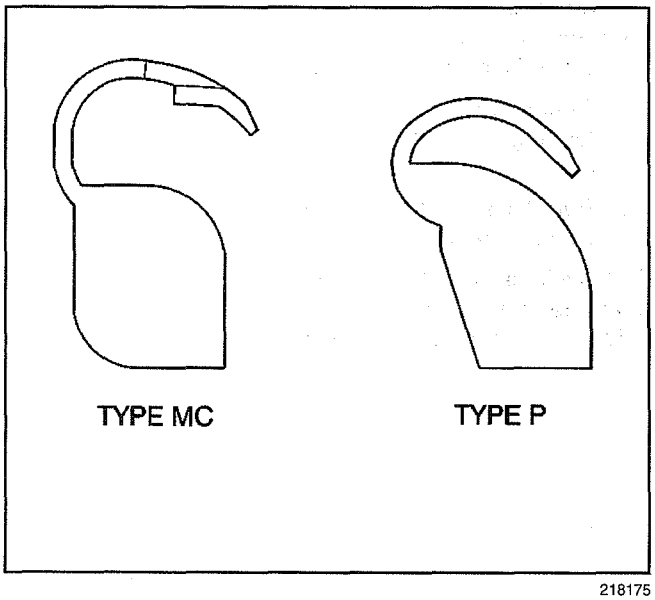
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Tire Balancing Guidelines

Static and dynamic balance are two kinds of tire/wheel balancing:

1. Static balance, also called single plane balance, affects the distribution of weights around the wheel circumference.
2. Dynamic balance, or two–place balance, affects the distribution of weight on each side of the tire/wheel centerline.
3. Most off–vehicle balancers can check both types of balance simultaneously.
4. As a general rule, most balancers are most sensitive to static imbalance that to dynamic imbalance. As little as 0.50 – 0.75 oz may induce a vibration in some vehicles. Vibration induced by static imbalance will cause a vertical, or bouncing motion of the tire. Dynamic imbalance results in a side–to–side motion of the tire, or shimmy.
5. Balance all four tires/wheels as close to ZERO as possible.
6. Carefully follow the wheel balancer manufacturers instructions for proper mounting techniques for different types of wheels.
7. Aftermarket wheels, especially those incorporating universal lug patterns, are potential sources of runout and mounting problems.
8. Use the correct coated weights on aluminum wheels.
9. Retest the tire and wheel for excessive runout after correction and installation.
10. Evaluate the vehicle at the complaint speed and note if the vibration has been corrected.
11. If the vibration is still present, or is reduced but still unacceptable, consider these possibilities:
    - On–vehicle imbalance
    - Radial or lateral force variation

Wheel Weight Usage (Aluminum Wheels)

1. Locate the wheel weights on the inboard rim flange. If during static balancing more than 28 grams (1 ounce) is needed, split the weights as equally as possible between the inboard and outboard flanges.
2. Use special polyester–coated clip–on wheel weights in order to balance factory aluminum wheels. These weights are designated MC or P, and must be used on aluminum wheels having a wide 7.6 mm (19/64 in) flange. Use a plastic tipped hammer in order to prevent damage to the weight's coating during installation.

3. Adhesive wheel weights are also available. Use the following procedure in order to install adhesive wheel weights.
   3.1. Determine where the wheel weigh is to be located on the inboard side of the wheel.
   3.2. Clean that area by sanding to bare aluminum. Do NOT sand the outboard side of the wheel as this will damage the clear coat finish.
   3.3. Wipe the sanded area with a mixture of half ispopropyl alcohol and half water. Use a clean cloth or paper towel.
   3.4. Dry the area with hot air until the wheel surface is warm to the touch.
   3.5. Warm the adhesive backing on the wheel balance weight to room temperature.
   3.6. Remove the tape from the back of the weight. Do not touch the adhesive tape.
   3.7. Apply the wheel weight and press on with hand pressure.
   3.8. Secure the wheel weight with a 70–110 N·m (16–25 lb ft) force applied with a roller.

Description and Operation

Basic Terms

The following are the two primary components of vibration diagnosis:

- The physical properties of objects
- The object's properties of conducting mechanical energy

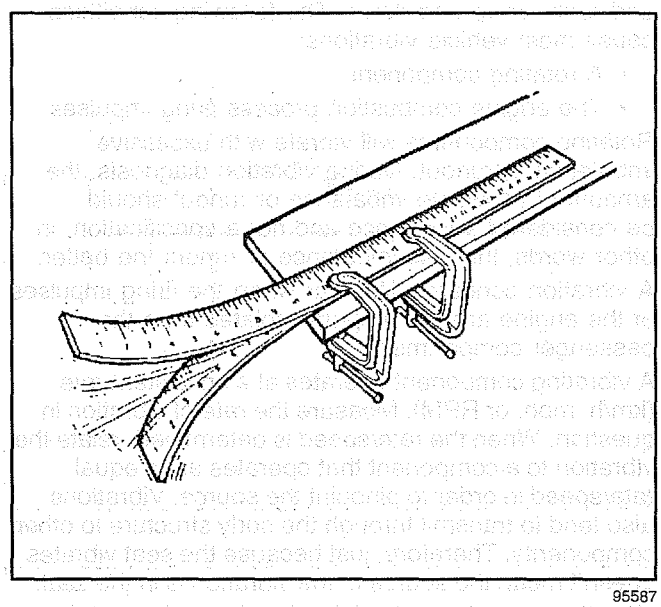
The repetitive up/down or back/forth movement of a component causes most customer vibration complaints. The following are the components that often vibrate:

- The steering wheel
- The seat cushion
- The frame
- The instrument panel

Vibration diagnosis involves the following steps:

1. Measure the repetitive motion and assign a value to the measurement in cycles per second or cycles per minute.
2. Relate the frequency to the rotational speed of a component that is operating at the same rate or speed.
3. Inspect and test the components for conditions that cause vibration.

For example, performing the following steps will help demonstrate the vibration theory:



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1. Clamp a yardstick to the edge of a table, leaving about 50 cm (20 in) hanging over the edge of the table.
2. Pull down on the edge of the stick and release while observing the movement of the stick.

The motion of the stick occurs in repetitive cycles. The cycle begins at midpoint, continues through the lowest extreme of travel, then back past the midpoint, through the upper extreme of travel, and back to the midpoint where the cycle begins again.

The cycle occurs over and over again at the same rate, or frequency. In this case, the frequency is about 10 cycles per second. If we measure the frequency to reflect the number of complete cycles that the yardstick made in one minute, the measure would be 10 cycles x 60 seconds = 600 cycles per minute (cpm).

We could have also found a specific amount of motion, or amplitude, in the total travel of the yardstick from the very top of the cycle to the very bottom of the cycle. Redo the experiment as follows:

1. Reclamp the yardstick to the edge of a table, leaving about 25 cm (10 in) hanging over the edge of the table.
2. Pull down on the edge of the stick and release while observing the movement of the stick.

The stick vibrates at a much faster frequency: 30 cycles per second (1800 cycles per minute). The total travel, or amplitude, is less.

Vibration

Vibration is the repetitive motion of an object, back and forth, or up and down. The following conditions cause most vehicle vibrations:

- A rotating component
- The engine combustion process firing impulses

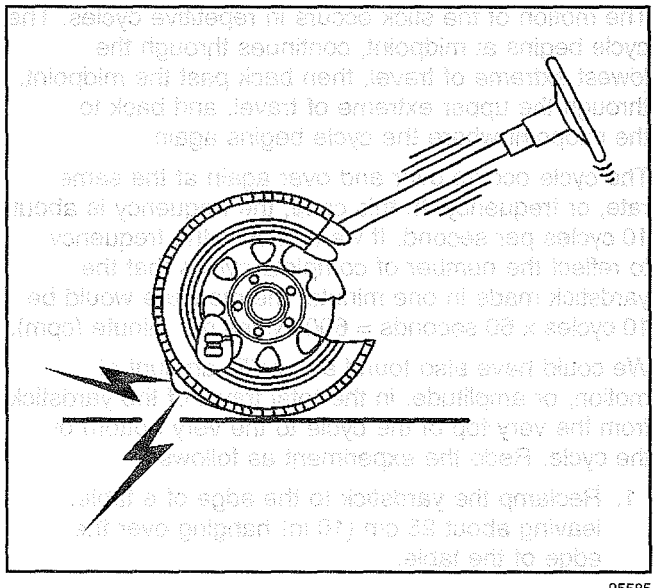
Rotating components will vibrate with excessive imbalance or runout. During vibration diagnosis, the amount of allowable imbalance or runout should be considered a tolerance and not a specification. In other words, the less imbalance or runout the better.

A vibration concern will occur when the firing impulses of the engine are not properly isolated from the passenger compartment.

A vibrating component operates at a consistent rate (km/h, mph, or RPM). Measure the rate of vibration in question. When the rate/speed is determined, relate the vibration to a component that operates at an equal rate/speed in order to pinpoint the source. Vibrations also tend to transmit through the body structure to other components. Therefore, just because the seat vibrates doesn't mean the source of the vibration is in the seat.

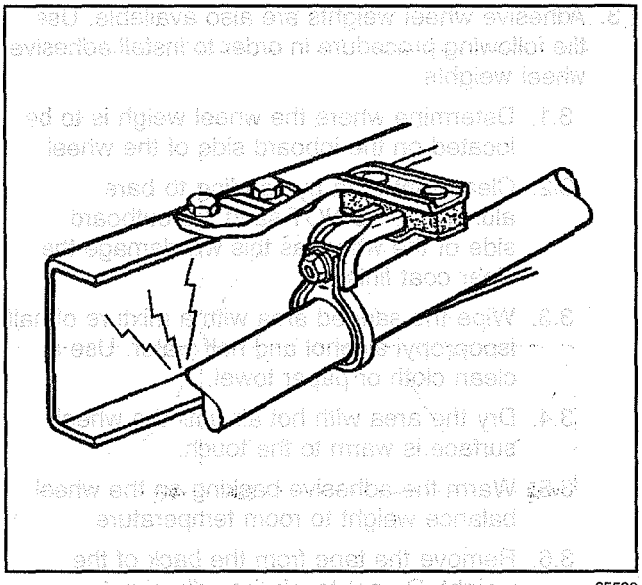
Vibrations consist of the following three elements:

- The source — the cause of the vibration
- The transfer path — the path the vibration travels through the vehicle
- The responder — the component where the vibration is felt



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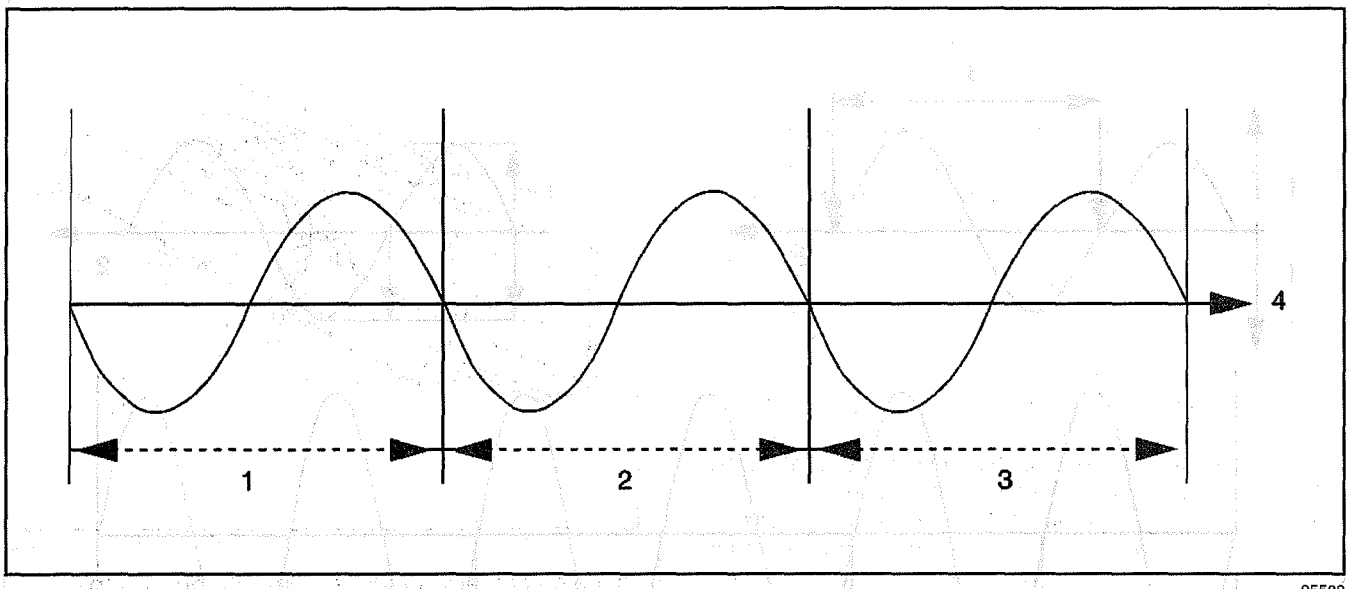
In the preceding figure, the source of the vibration is the unbalanced tire. The transfer path is the route the vibrations travels through the vehicle's suspension system into the steering column. The responder is the steering wheel, which the customer reports as vibrating. Eliminating any one of these three elements will usually correct the condition. Decide, from the gathered information, which element makes the most sense to repair. Adding a brace to the steering column may keep the steering wheel from vibrating, but adding a brace is not a practical solution. The most direct and effective repair would be to properly balance the tire.



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Vibration can also produce noise. As an example, consider a vehicle that has an exhaust pipe which is grounded to the frame. The source of the vibration is the engine firing impulses traveling through the exhaust. The transfer path is a grounded or bound-up exhaust hanger. The responder is the frame. The floor panel vibrates, acting as a large speaker, which produces noise. The best repair would be to eliminate the transfer path. Aligning the exhaust system and correcting the grounded condition at the frame would eliminate the transfer path.

Cycle

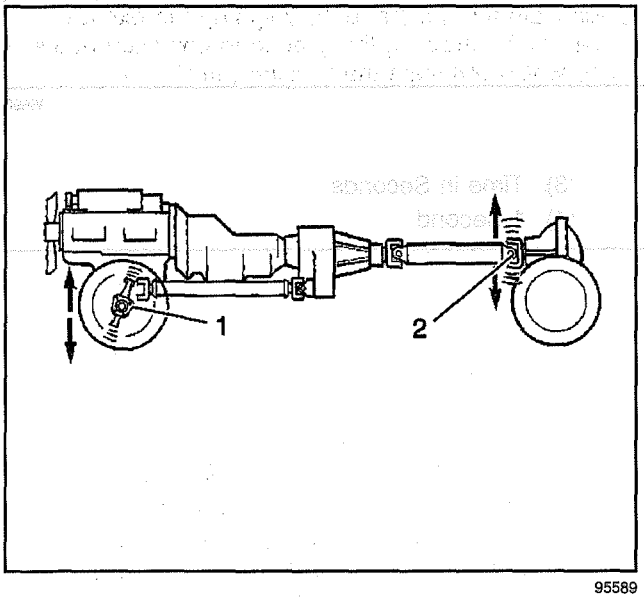


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Legend

(1) 1st Cycle
(2) 2nd Cycle
(3) 3rd Cycle
(4) Time

Vibration Cycles in Powertrain Components



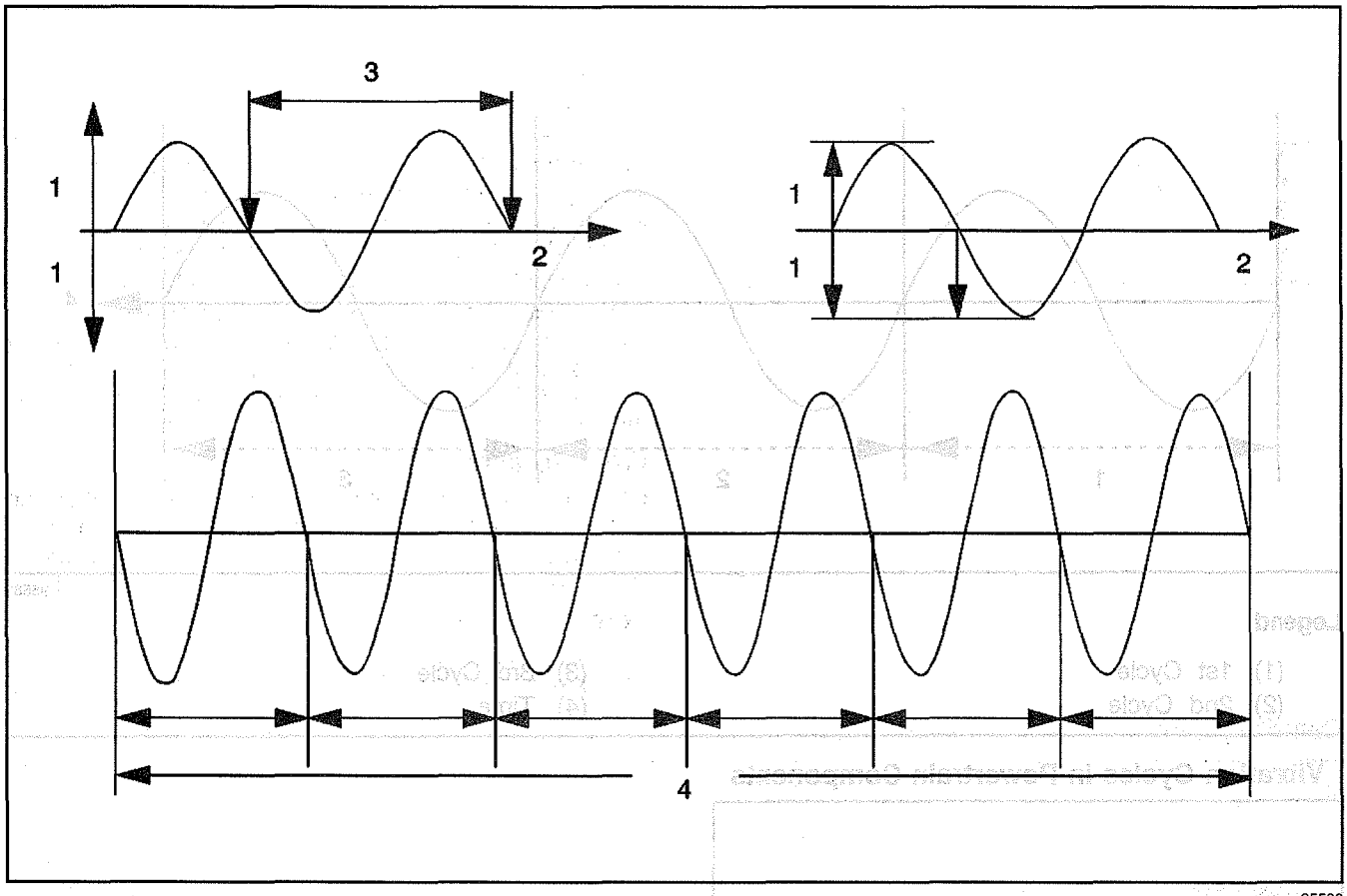
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Legend

(1) Spindle
(2) Pinion Nose

The word "cycle" comes from the same root as the word "circle." A circle begins and ends at the same point, and so does a cycle. All vibrations consist of repetitive cycles.

Frequency

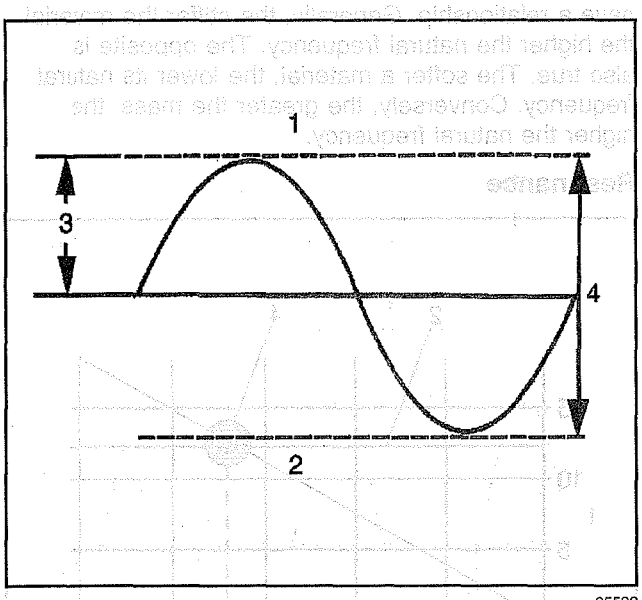


Legend

(1) Amplitude
(2) Reference
(3) Time in Seconds
(4) 1 Second

Frequency is defined as the rate at which an event occurs during a given period of time. With a vibration, the event is a cycle, and the period of time is one second. Thus, frequency is expressed in cycles per second, or Hertz (Hz). Multiply the Hertz by 60 to get the cycles, or revolutions, per minute (RPM).

Amplitude



Legend

(1) Maximum
(2) Minimum
(3) Zero-to-Peak Amplitude
(4) Peak-to-Peak Amplitude

Amplitude is the maximum value of a periodically varying quantity. Used in vibration diagnostics, amplitude is the magnitude of the disturbance. A severe disturbance would have a high amplitude; a minor disturbance would have a low amplitude.

Amplitude is measured by the amount of actual movement, or the displacement. For example, consider the vibration caused by an out-of-balance wheel at 80 km/h (50 mph) as opposed to 40 km/h (25 mph). As the speed increases, the amplitude increases.

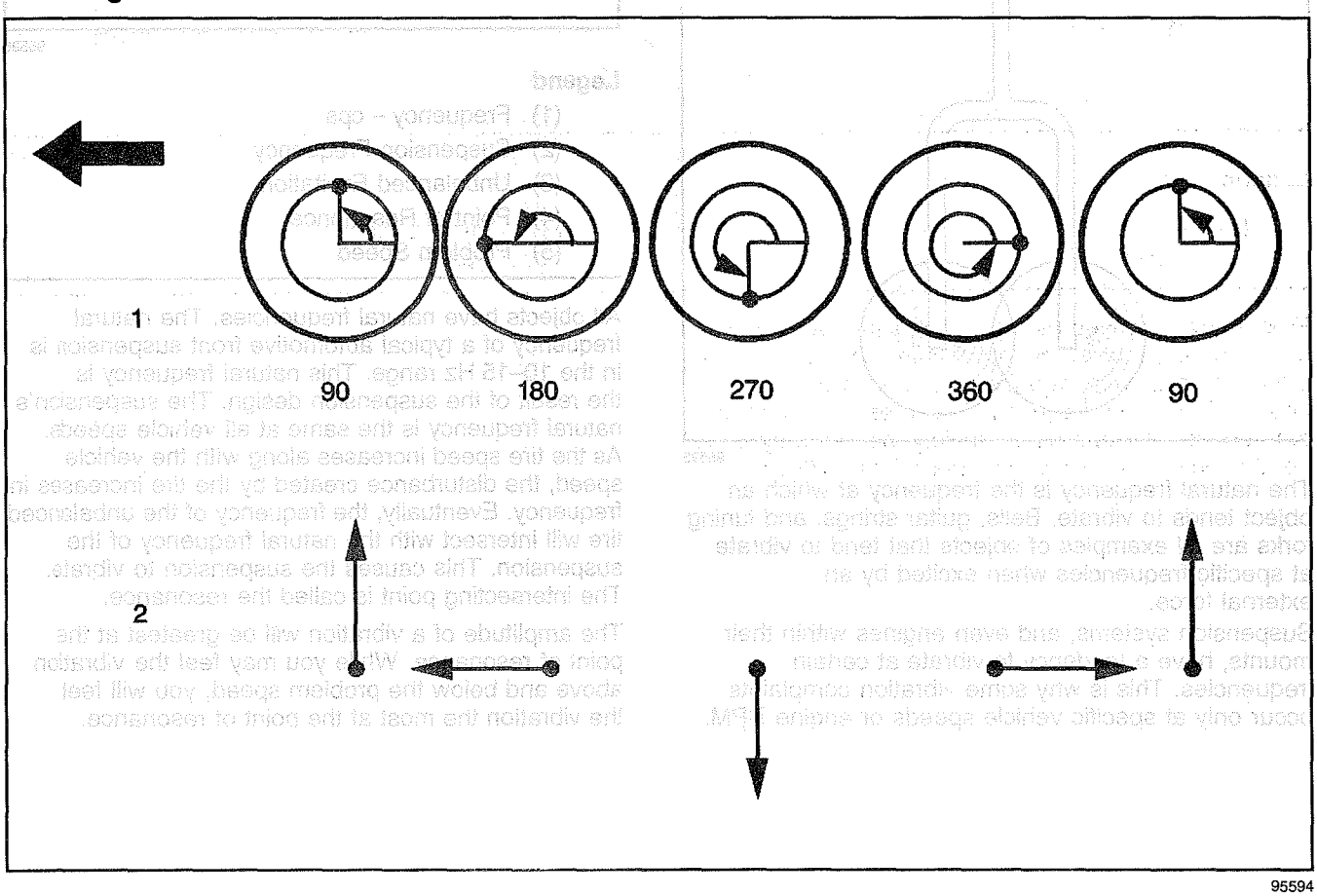
Free Vibration

Free vibration is the continued vibration in the absence of any outside force. In the yardstick example, the yardstick continued to vibrate even after the end was released.

Forced Vibration

Forced vibration is when an object is vibrating continuously as a result of an outside force.

Centrifugal Force Due to an Imbalance



Legend

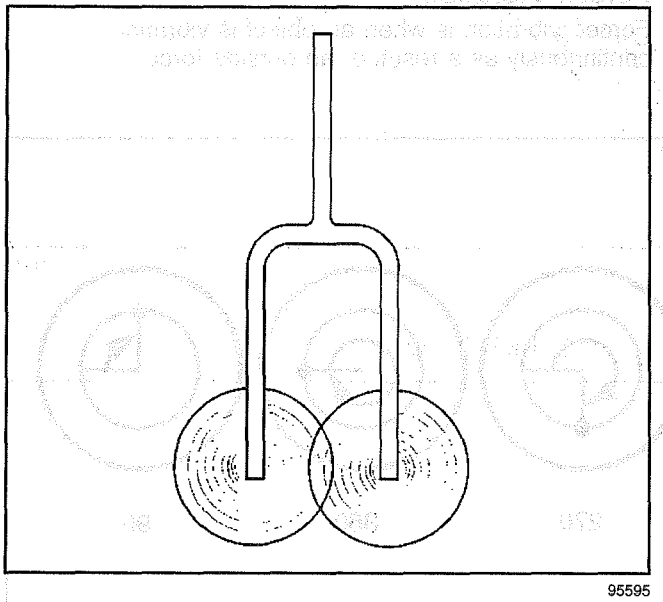
(1) Location of Imbalance (Degrees)
(2) Centrifugal Force Acting on Spindle

A spinning object with an imbalance generates a centrifugal force. Performing the following steps will help to demonstrate centrifugal force:

1. Tie a nut to a string.
2. Hold the string. The nut hangs vertically due to gravity.
3. Spin the string. The nut will spin in a circle.

Centrifugal force is trying to make the nut fly outward, causing the pull you feel on your hand. An unbalanced tire follows the same example. The nut represents the imbalance in the tire. The string represents the tire/wheel/suspension assembly. As the vehicle speed increases, you can feel the disturbing force of the unbalanced tire in the steering wheel, the seat, and the floor. This disturbance will be repetitive (Hz) and the amplitude will increase. At higher speeds, both the frequency and the amplitude will increase. As the tire revolves, the imbalance, or the centrifugal force, will alternately lift the tire up and force the tire downward, along with the spindle, once for each revolution of the tire.

Natural or Resonant Frequency



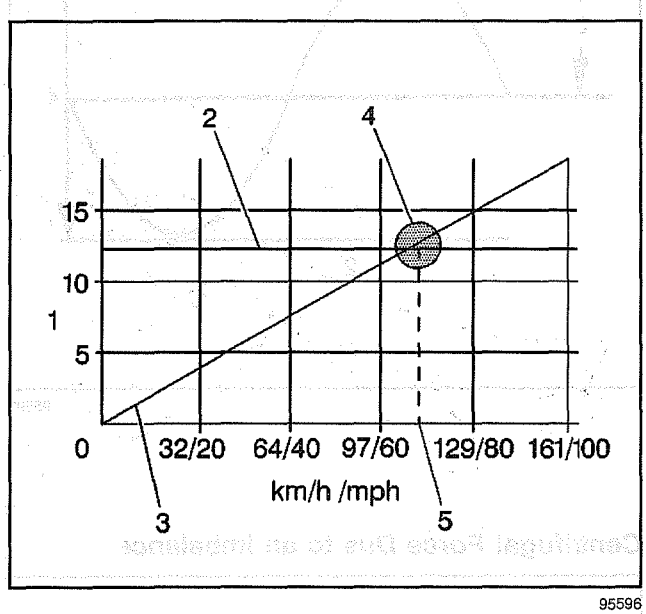
95595

The natural frequency is the frequency at which an object tends to vibrate. Bells, guitar strings, and tuning forks are all examples of objects that tend to vibrate at specific frequencies when excited by an external force.

Suspension systems, and even engines within their mounts, have a tendency to vibrate at certain frequencies. This is why some vibration complaints occur only at specific vehicle speeds or engine RPM.

The stiffness and the natural frequency of a material have a relationship. Generally, the stiffer the material, the higher the natural frequency. The opposite is also true. The softer a material, the lower its natural frequency. Conversely, the greater the mass, the higher the natural frequency.

Resonance



95596

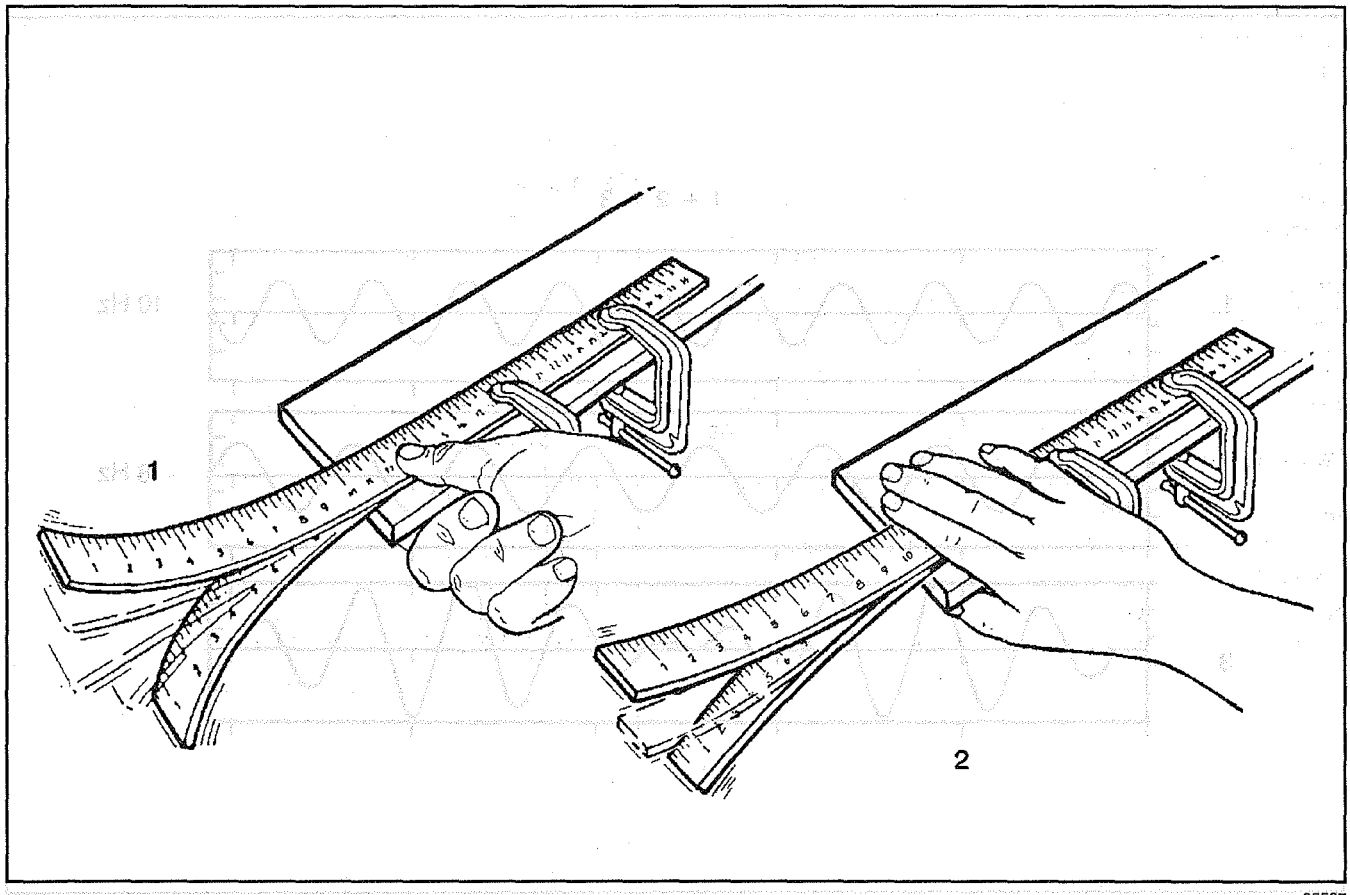
Legend

(1) Frequency – cps
(2) Suspension Frequency
(3) Unbalanced Excitation
(4) Point of Resonance
(5) Problem Speed

All objects have natural frequencies. The natural frequency of a typical automotive front suspension is in the 10–15 Hz range. This natural frequency is the result of the suspension design. The suspension's natural frequency is the same at all vehicle speeds. As the tire speed increases along with the vehicle speed, the disturbance created by the tire increases in frequency. Eventually, the frequency of the unbalanced tire will intersect with the natural frequency of the suspension. This causes the suspension to vibrate. The intersecting point is called the resonance.

The amplitude of a vibration will be greatest at the point of resonance. While you may feel the vibration above and below the problem speed, you will feel the vibration the most at the point of resonance.

Damping



95597

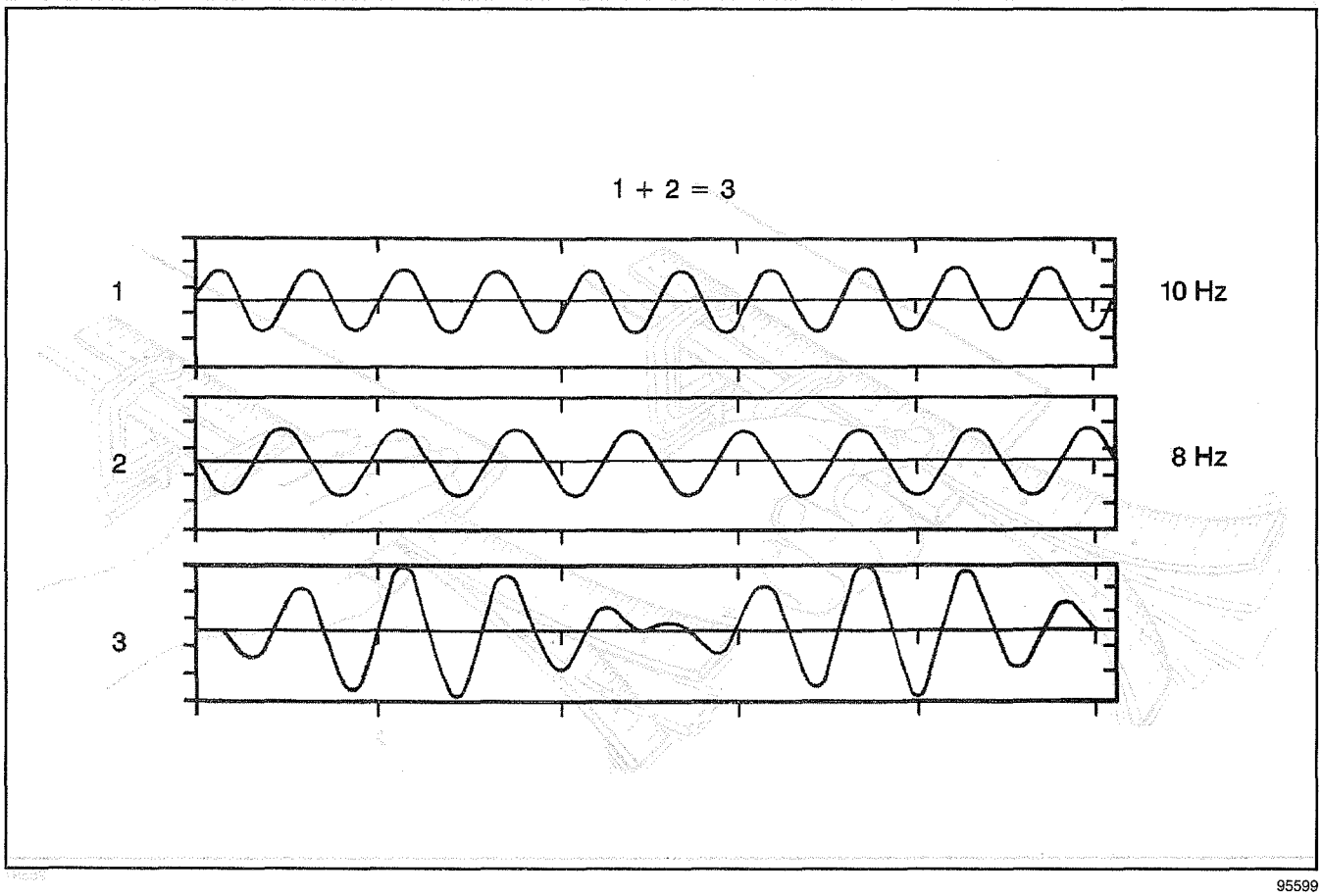
Legend

(1) Low Damping

(2) High Damping

Damping is the ability of an object or material to dissipate or absorb vibration. The automotive shock absorber is a good example. The function of the shock absorber is to absorb or dampen the oscillations of the suspension system.

Beating (Phasing)



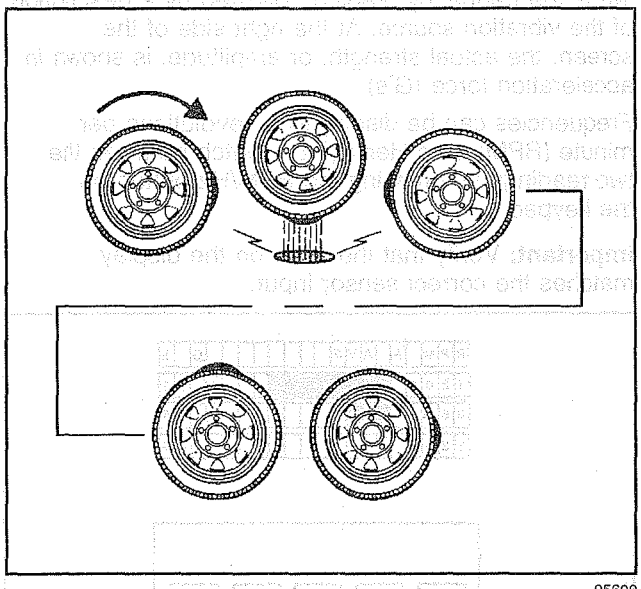
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Two separate disturbances that are relatively close together in frequency will lead to a condition called beating, or phasing. A beating vibration condition will increase in intensity or amplitude in a repetitive fashion as the vehicle travels at a steady speed. This beating vibration can produce the familiar droning noise heard in some vehicles.

Beating occurs when two vibrating forces are adding to each other's amplitude. However, two vibrating forces can also subtract from each other's amplitude. The adding and subtracting of amplitudes in similar frequencies is called beating. In many cases, eliminating either one of the disturbances can correct the condition.

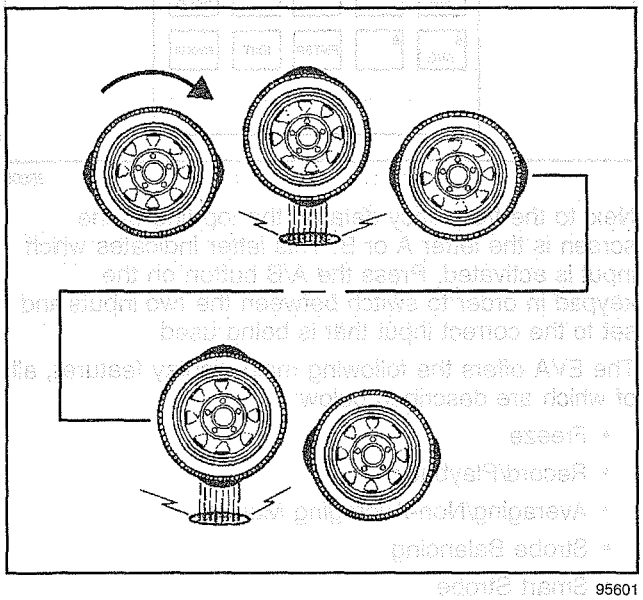
Order

Order refers to how many times an event occurs during one revolution of a rotating component.



95600

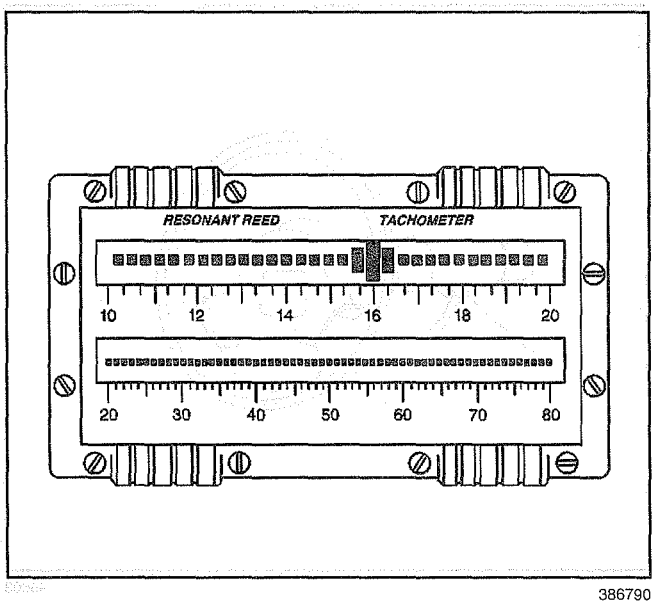
For example, a tire with one high spot would create a disturbance once for every revolution of the tire. This is called first-order vibration.



95601

An oval-shaped tire with two high spots would create a disturbance twice for every revolution. This is called second-order vibration. Three high spots would be third-order, and so forth. Two first-order vibrations may add or subtract from the overall amplitude of the disturbance, but that is all. Two first-order vibrations do not equal a second-order vibration. Due to centrifugal force, an unbalanced component will always create at least a first-order vibration.

Reed Tachometer



386790

The reed tachometer consists of two rows of reeds arranged side-by-side. Each reed vibrates when excited by a specific frequency. The reeds are tuned to vibrate at increasing frequencies from left to right. This allows for a visual display of the frequency range from 10–80 Hz.

Due to increasing costs, limited availability and limited diagnostic capability, the reed tachometer is no longer recommended as the primary tool in diagnosing vibration.

Electronic Vibration Analyzer (EVA)

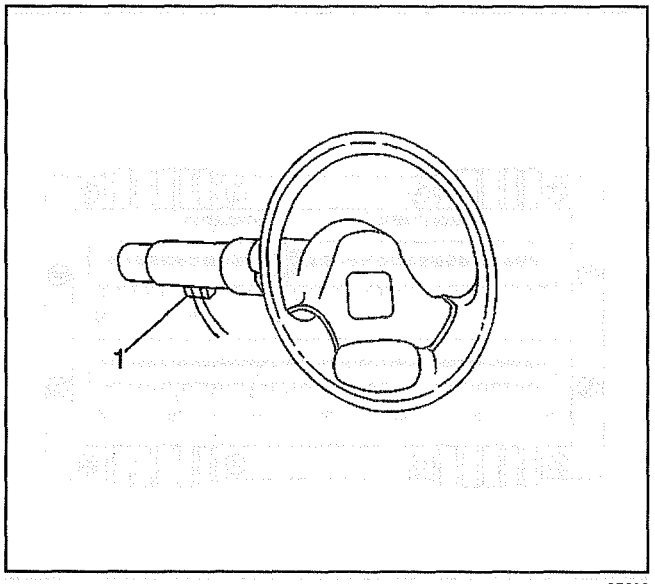
The *J 38792* Electronic Vibration Analyzer (EVA), with the *J 38792-60* Electronic Vibration Analyzer Cartridge, is specifically designed to diagnose vibrations. This hand-held device is similar to a scan tool. A standard 12-volt power feed supplies the power. The vibration sensor, or the accelerometer, is at the end of a 6 mm (20 ft) cord. The vibration sensor can be mounted virtually anywhere on the vehicle where a vibration is felt.

EVA Basic Hookup

1. Verify that the software cartridge is correctly inserted at the bottom of the unit. (The cartridge usually remains there at all times.)
2. Connect the vibration sensor cord into either Input A or B.
3. Line up the sensor connector so that the release button is at the bottom.
4. Push the sensor connector into the input until the connector clicks and locks into place.
5. Plug the power cord into a 12-volt power feed in order to turn the EVA on. (The EVA is not equipped with an ON-OFF switch.)

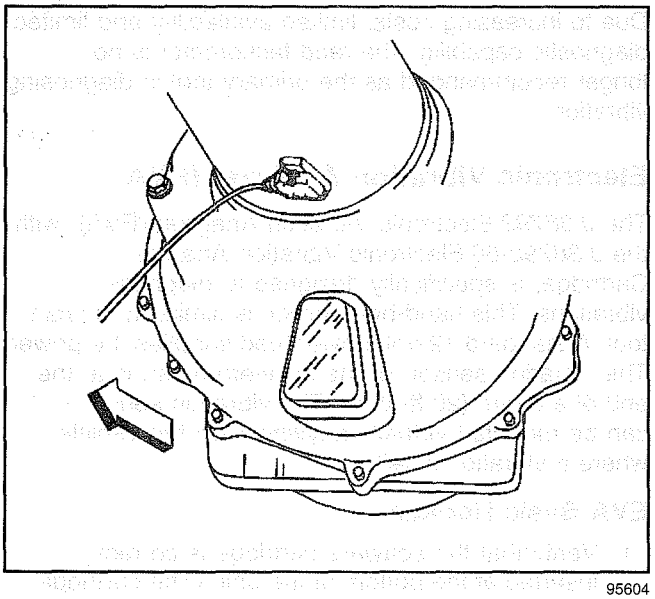
To disconnect the sensor connector, press the release button and gently pull the connector straight out.

EVA Sensor Placement



95603

Proper EVA sensor placement is critical in order to take proper vibration readings. You can place the sensor anywhere on the vehicle where vibrations are felt (1). Use putty or a hook and loop fastener in order to hold the sensor in place on non-ferrous surfaces, such as the surface of the steering column.



95604

A magnet holds the sensor to ferrous surfaces.

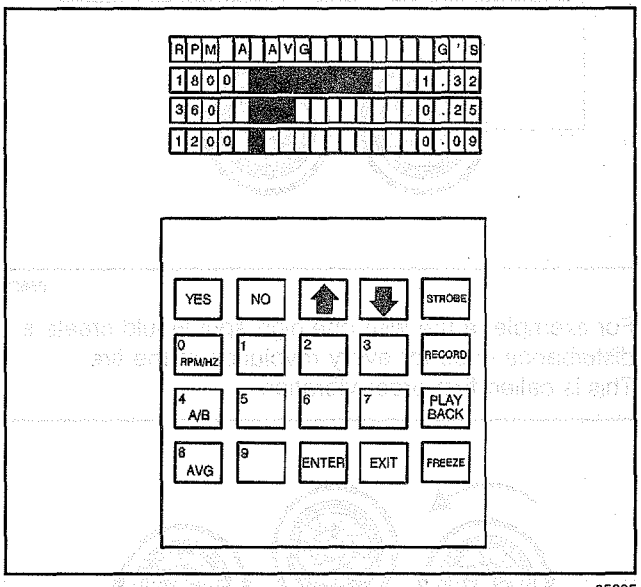
Vibrations are typically felt in an up-and-down direction. The sensor is directionally sensitive. Therefore, place the sensor as flat as possible with the side marked UP facing upward. Place the UP side of the sensor in the exact position every time for consistent results when repeating the tests or making a comparison.

EVA Display

Up to three dominant vibration frequencies are displayed on the EVA's liquid crystal screen. On the left is the frequency reading, followed by a description of the vibration source. At the right side of the screen, the actual strength, or amplitude, is shown in acceleration force (G's).

Frequencies can be displayed in revolutions per minute (RPM) or in Hertz (Hz). Switch between the two readings by pressing the RPM/Hz button on the keypad.

Important: Verify that the letter on the display matches the correct sensor input.



95605

Next to the frequency data on the top line of the screen is the letter A or B. This letter indicates which input is activated. Press the A/B button on the keypad in order to switch between the two inputs and set to the correct input that is being used.

The EVA offers the following main display features, all of which are described below:

- Freeze
- Record/Playback
- Averaging/Non-Averaging Modes
- Strobe Balancing
- Smart Strobe
- Auto Mode

Freeze

Pressing the FREEZE button on the keypad activates the freeze function, which locks the display of data. The display changes to Hz__FR_V = XX_____G and a caret symbol points to a vibration source. Additional diagnostic information or that vibration source can be viewed by pressing ENTER. The freeze function is useful when conducting an acceleration/deceleration test in which the significant amount of vibration registers only for a very short time. Pressing EXIT or the FREEZE button again deactivates the freeze function.

Record/Playback

The displayed vibration information can be recorded for later playback. The EVA retains stored data for approximately 70 hours after the unit has been unplugged from a power source. Data is recorded as snapshots of vibration information. Each snapshot consists of 10 different frames. Up to 10 snapshots can be recorded.

Press the RECORD button in order to record a snapshot. The screen will display R? in order to request a tag number between 0 and 9. These tag numbers are the individual frames of the snapshot recording. Then press ENTER to begin recording. New data will replace the existing data when a number is chosen that has already been used in order to tag a snapshot.

Pressing the PLAYBACK button plays back the recorded data. The screen shows P? in order to request the tag number for the wanted snapshot. Once the number is entered, the snapshot data displays the letter P followed by the tag number then press ENTER to play back the data. Then the screen displays the letter F followed by a number between 0 and 9 in order to indicate which frame of the snapshot is being displayed.

Use the freeze function in order to freeze the display at any point in the sequence during playback. You can view individual frames in a forward or backward sequence using the UP and DOWN arrow keys.

The display returns to the active screen when the recording or playback of a snapshot is finished, or when EXIT is pressed.

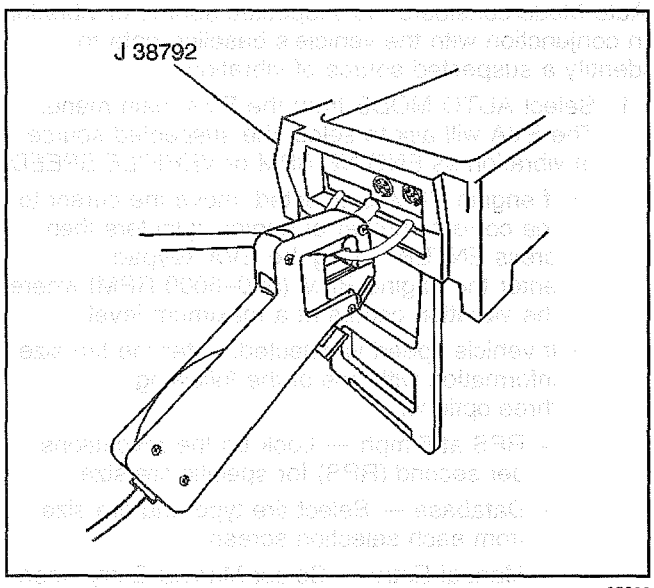
Averaging/Non-Averaging Modes

The EVA normally operates in an averaging mode that averages multiple vibration samples over a period of time. The averaging mode minimizes the effects of a sudden vibration that is not related to the problem (such as from potholes or from uneven road surfaces). Most tests use the averaging mode.

The EVA is more sensitive to vibrations in the non-averaging mode. The display is more instantaneous and not averaged over a period of time. The non-averaging mode is used when measuring a vibration that exists for only a short period of time, and during acceleration/deceleration tests.

Pressing the AVG button switches between the averaging and non-averaging modes. During the averaging mode, the screen will display AA. During the instantaneous mode the top of the screen will display IA

Strobe Balancing



95606

The *J 38792* can strobe balance a rotating component. A trigger wire is located on the top of the EVA, which is used with an inductive pick-up strobe light (timing light). The EVA triggers the strobe light at the same frequency as the most predominant vibration. The timing light clips on to the trigger wire. The vibration sensor must be attached to input A. Input B does not provide the strobe function.

Pressing the STROBE button starts the strobe balancing function. The EVA will ask a series of questions in order to determine the correct filter range: low, medium or high.

The low, medium and high ranges prevent other vibrations from interfering with the operation of the strobe light. Press YES in order to select a range. Press NO in order to go on to the next range. The vibration/strobe frequency must fall within the selected range.

The EVA will display the signal frequency, signal level (amplitude), and filter range. The EVA is now ready to begin the strobe balance procedure.

Auto Mode

Auto Mode considers the suspected source of vibration in conjunction with the vehicle's baseline data to identify a suspected source of vibration.

1. Select AUTO MODE from the EVA main menu. The EVA will ask to select the suspected source of vibration as ENGINE RPM or VEHICLE SPEED.
   - If engine RPM is selected, move the cursor to the correct number of engine cylinders then press ENTER. Using the EVA keypad, enter the engine RPM (500–6000 RPM) where the vibration occurs at a maximum level.
   - If vehicle speed is selected, enter the tire size information with one of the following three options:
     - RPS at 5 mph — Look up the revolutions per second (RPS) for specific tire size.
     - Database — Select tire type and tire size from each selection screen.
     - Manual Entry — Select Manual Entry when the vehicle is fitted with specialty tires.
2. Enter one of the following driveshaft configurations:
   - FWD (Front Wheel Drive)
   - RWD (Rear Wheel Drive)
   - AWD (All Wheel Drive)
   - 4WD (Four Wheel Drive)
3. Enter the axle ratio only if FWD is not selected.
4. Select the vehicle speed units in mph (miles-per-hour) or km/h (kilometers-per-hour).

Smart Strobe

The Smart Strobe mode enables complete control of the frequency at which the strobe light will flash. Smart Strobe is well suited for identifying the speed at which objects are rotating at. This is helpful for identifying the source of a vibration. The pulley RPM can be converted to a frequency by pressing the RPM/Hz key.

1. To use the Smart Strobe function, begin by clipping the inductive pickup of the timing light to the "wiring loop" of the EVA.
2. Connect to a 12–volt power source.
3. If a timing light with an advance feature is used, set advance to 0 degrees.
4. From the Main Menu, select Smart Strobe.
5. With the engine off, mark the object you suspect is causing vibration. A dab of white paint or correction fluid works well.
6. Enter an initial test point strobe frequency between 10–200 Hz (600–12000 RPM).
7. Run the engine at the RPM at which the vibration is the greatest and trigger the strobe.
8. As you point the strobe light at the spinning object, press the Strobe Light trigger.
9. Press the EVA up or down keys to manually adjust the RPM until only one mark is seen and the mark on the object appears stationary.
10. As the test is run, the strobe speed must be manually adjusted to match the actual object RPM.

EVA Calibration

The EVA features the following two built-in calibration procedures:

- Sensor calibration
- Phase shift calibration

Calibrate a replaced or an added sensor in order to function properly with the EVA unit. The phase shift calibration is performed at the factory. Do NOT repeat this calibration under normal use.

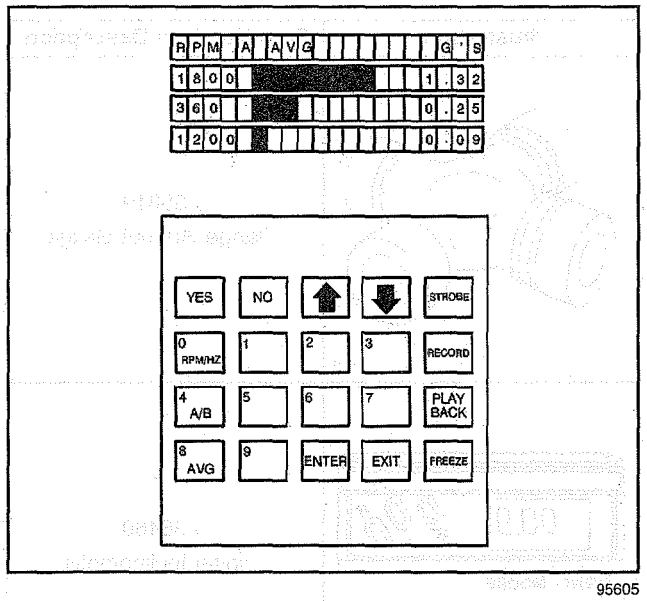
Sensor Calibration

1. Lay the sensor on a flat stationary surface with the UP side facing upward.
2. Plug the sensor into either input A or B.
3. Plug the EVA into a 12-volt power supply.
4. After the display initializes, select the proper input.
5. Press the number 1 to initiate sensor calibration.
6. Press the number 2 three times on the keypad. The message BURNING will appear, followed by a request to turn the sensor over.
7. Turn the sensor over.
8. Press any key in order to commence calibration:
   - Calibration will take approximately 20 seconds.
   - The display will return to the active mode when calibration is complete.

Phase Shift Calibration

1. Plug the EVA into a 12-volt power supply.
2. Press the number 5 to initiate phase shift calibration.
3. Press the number 2 on the keypad three times in order to begin calibration:
   - Do not press any key until the message ANY KEY TO CONTINUE appears. Pressing a key will cancel the calibration process.
   - The display will flash numbers for 5–6 minutes. (If the numbers flash for more than 10 minutes, the EVA is defective.)
   - The message BURNING PHASE SHIFT CONSTANTS will appear for one minute.
   - The BURNING CENTER FREQUENCIES LOW=40, MEDIUM=50, HIGH=60 message will appear.
   - The ANY KEY TO CONTINUE message should appear.
4. Press any key in order to return to the active mode.

Keypad Reference



95605

A/B: Switches the display between the A Input and the B Input. You must use Input A when strobe balancing.

AVG: Switches the display between the non-averaging mode and the averaging mode. The non-averaging mode is more sensitive to sudden vibration variations. When in the averaging mode, the word AVG appears at the top of the display.

RPM/HZ: Switches the frequency display between RPM and Hz.

FREEZE: Locks the display data at that moment and displays the word FRZ at the top of the screen. This key operates in the active display or during playback. Pressing the FREEZE key again or pressing the EXIT key unlocks the display.

RECORD: Places the EVA in the record mode. Pressing the EXIT key will return the screen to the active display.

PLAYBACK: Places the EVA in the playback mode in order to view vibration information that was previously recorded. Pressing the EXIT key will return the key screen to the active display.

Numeric Keys (0–9): The numbered keys are used in order to select one of ten snapshot tag numbers between 0 and 9 when recording or playing back information.

Arrow Keys: The arrow keys are used in order to move through the individual frames of a snapshot during a freeze in the playback mode. Pressing the UP arrow moves forward one frame and pressing the DOWN arrow moves backward one frame.

ENTER: Once the EVA is in the record mode and you have selected a snapshot tag number, press ENTER in order to start recording.

STROBE: Places the EVA in the strobe mode for driveshaft balancing and diagnosis. Pressing the EXIT key will return the screen to the active display.

YES and NO: Used in order to select a filter range when in the strobe balancing mode.

EXIT: Returns the screen to the active display when the EVA is in the freeze mode, the record mode, the playback mode, or the strobe mode.

Special Tools and Equipment

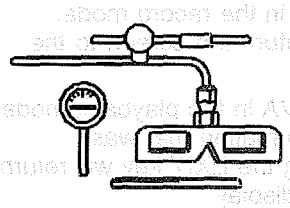
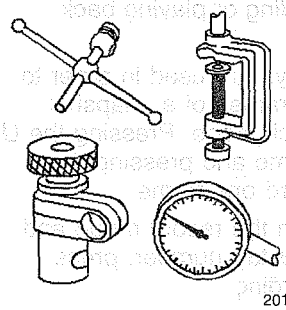
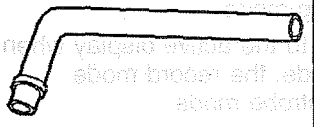
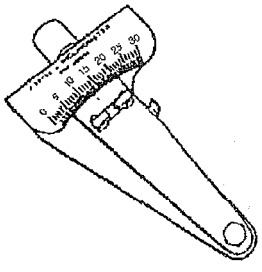
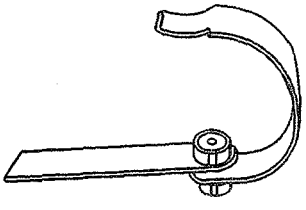
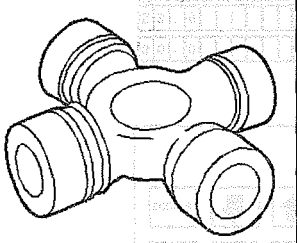
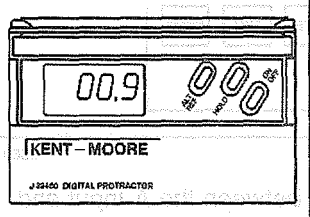
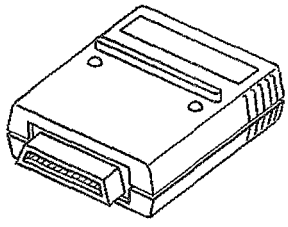
Illustration	Tool Number/ Description
 35463	J 7872 Magnetic Base Dial Indicator Set
 2014	J 8001 Dial Indicator Set
 1517	J 23409 Dial Indicator Extension
 8224	J 23498-A Driveshaft Inclinometer
 180348	J 23498-20 Driveshaft Inclinometer Adapter

Illustration	Tool Number/ Description
 1512	J 35819 Flange Runout Gauge
 198883	J 38460 Digital Inclinometer
 6826	J 38792 Electronic Vibration Analyzer (EVA)
 580649	J 38792-50 Electronic Vibration Analyzer Cartridge

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Heating, Ventilation and Air Conditioning

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Air Conditioning Accumulator Bracket Bolt	6 N·m	53 lb ft
Air Conditioning Accumulator Bolt (At Module)	16 N·m	12 lb ft
Air Conditioning Accumulator Hose Bracket Nut (At Strut Tower)	8 N·m	71 lb in
Air Conditioning Compressor and Condenser Hose Bolt (At Accumulator)	16 N·m	12 lb ft
Air Conditioning Compressor and Condenser Hose Nut (At Condenser)	16 N·m	12 lb ft
Air Conditioning Compressor and Condenser Hose Bolt (At Compressor)	33 N·m	24 lb ft
Air Conditioning Compressor Bracket Bolt (3.8 L)	50 N·m	37 lb ft
Air Conditioning Compressor Bracket Rear Bolt (3.8 L)	30 N·m	22 lb ft
Air Conditioning Compressor Bracket Bolt (5.7 L)	50 N·m	37 lb ft
Air Conditioning Compressor Bolt (5.7 L)	50 N·m	37 lb ft
Air Conditioning Compressor Bolt (3.8 L)	50 N·m	37 lb ft
Air Conditioning Crankcase Oil Drain Bolt	20 N·m	15 lb ft
Air Conditioning Compressor Rear Bolt (3.8 L)	30 N·m	22 lb ft
Air Conditioning Evaporator Bracket Bolt	2 N·m	18 lb in
Air Conditioning Evaporator Tube Bolt (At Module)	16 N·m	12 lb ft
Air Conditioning Evaporator Tube Bolt (At Condenser)	16 N·m	12 lb ft
Air Conditioning Evaporator Upper and Lower Case Bolt	2 N·m	18 lb in
Heater Core Clamp Bolt	1.8 N·m	16 lb in
Heater Core Tube Clamp Bolt	2.0 N·m	18 lb in
Heater Hose Bracket Bolt	14 N·m	10 lb ft
Heater Rear Case Bolt	2.0 N·m	18 lb in
Negative Battery Cable Nut to Engine Block Stud (3.8L)	25 N·m	18 lb ft
Temperature Control Cable Bolt	1.9 N·m	17 lb in

Fitting and Line Tightening Specifications

Application	Specification	
	Metric	English
Air Conditioning Refrigerant Pressure Sensor	6 N·m	53 lb in
Air Conditioning Refrigerant Service Valve	11 N·m	98 lb in
Compressor Pressure Relief Valve	9 N·m	80 lb in

System Capacities

Application	Specification	
	Metric	English
Air Conditioning (A/C) System R-134a Charge Capacity	0.68 kg	1.50 lb

Refrigerant Oil Distribution Specifications

Application	Specification	
	Metric	English
DEFINITION: During A/C refrigerant system component replacement and conditions stated, new refrigerant system oil quantities should be added to the system as indicated.		
A/C Compressor	60 ml	2 oz
Accumulator	Add 60 ml (2 oz) more than amount drained from old accumulator	
Condenser	30 ml	1 oz
Evaporator	90 ml	3 oz
Abrupt oil loss due to large refrigerant leak	Add 90 ml (3 oz) plus required amount for the component being replaced (cause of large leak)	

GM SPO Group Numbers

Application	GM SPO Group Number
Air Conditioning Accumulator	9.000
Air Conditioning Clutch	9.000
Air Conditioning Clutch Coil	9.000
Air Conditioning Compressor	9.000
Air Conditioning Compressor and Condenser Hose Assembly	9.000
Air Conditioning Compressor Pressure Relief Valve	9.000
Air Conditioning Compressor Pulley	9.000
Air Conditioning Compressor Pulley Bearing	9.000
Air Conditioning Compressor Relay	9.000
Air Conditioning Compressor Shaft Seal Kit	9.000
Air Conditioning Compressor Suction Screen	9.000
Air Conditioning Compressor Variable Displacement Control Valve	9.000
Air Conditioning Condenser	9.000
Air Conditioning Evaporator	9.000
Air Conditioning Evaporator Tube	9.000
Air Conditioning Evaporator Tube Orifice	9.000
Air Conditioning Refrigerant Pressure Sensor	9.000
Air Conditioning Refrigerant Service Valve	9.000
Blower Motor Relay	9.000
Temperature Control Cable	9.000

Diagnostic Information and Procedures

Leak Testing

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.

Electronic Leak Detection Method

Tools Required

J 39400-A Halogen Leak Detector

Use the electronic leak detector when inspecting for refrigeration system leaks. This unit operates on a 12 volt DC. The leak detector provides an audible signal which increases in frequency when a refrigerant leak is detected. Properly calibrate the tool. Use the tool at the proper setting for the system that you are testing. The electronic leak detector has the following three settings:

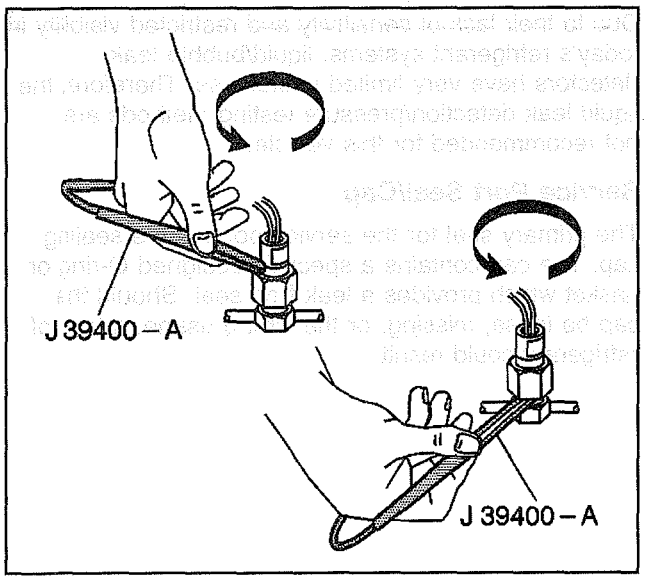
- R-12
- R-134a
- Gross leaks

  This setting isolates very large leaks that are found at one of the other settings

The halogen leak detectors are sensitive to windshield washing solution, many solvents and cleaners, and some adhesives. Work on a clean and dry surface. Complete the following actions when you test the joints:

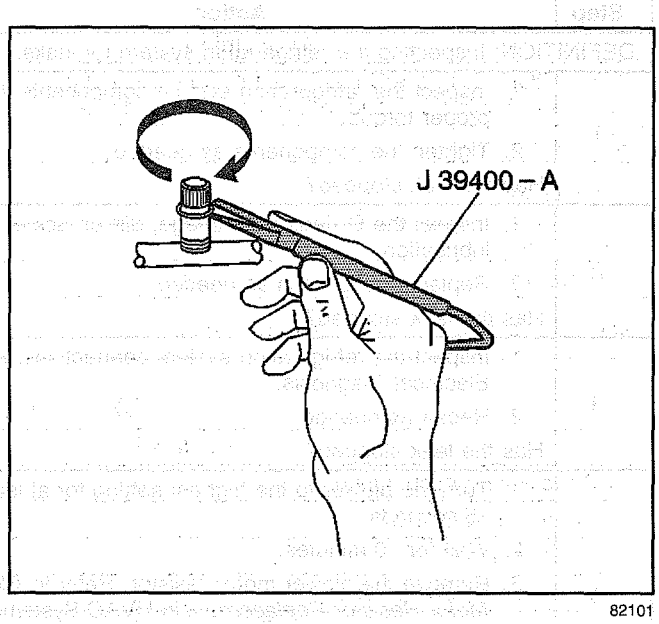
- Completely circle each joint.
- Move the tool 25-50 mm (1-2 inch) per second.
- Ensure that the tip of the probe is no more than 6 mm (0.25 inch) from the surface.

You may use this detector in order to inspect the following joints:



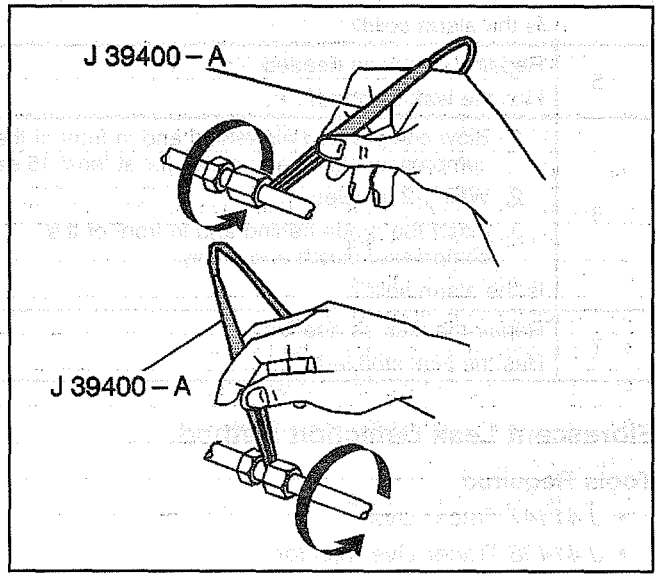
82107

1. Refrigerant pressure sensor.



82101

2. Service valves.



82106

3. Evaporator inlet/outlet.
4. Accumulator dryer inlet/outlet.
5. Compressor rear head.
6. Compressor housing joints.
7. A leak is indicated when the audible tone goes from a steady 1–2 clicks per second to a solid alarm. Adjust the balance knob frequently in order to maintain the 1–2 clicks per second.

   If a leak is not found, proceed to the Refrigerant Leak Diagnosis table.

Refrigerant Leak Diagnosis

Step	Action	Value(s)	Yes	No
DEFINITION: Inspecting the refrigeration system for leaks.				
1	1. Inspect the refrigeration system components for proper torque. 2. Tighten the components as needed. Has the leak stopped?	—	System OK	*Go to Step 2*
2	1. Inspect the O-rings for damage, dirt or lack of lubrication. 2. Replace the O-rings as needed. Has the leak stopped?	—	System OK	*Go to Step 3*
3	1. Inspect the refrigeration system connections. Refer to Electrical Diagnosis. 2. Repair as needed. Has the leak stopped?	—	System OK	*Go to Step 4*
4	1. Turn the blower to the highest setting for at least 15 seconds. 2. Wait for 10 minutes. 3. Remove the blower motor resistor. Refer to *Blower Motor Resistor Replacement* in HVAC Systems - Manual. 4. Insert the probe into the resistor opening. Is the alarm solid?	—	*Go to Step 5*	*Go to Step 6*
5	Repair the leak as needed. Has the leak stopped?	—	System OK	*Go to Step 6*
6	1. Blow compressed air behind and in front of the compressor clutch and pulley for at least 15 seconds. 2. Wait 1-2 minutes. 3. Insert the probe behind and in front of the compressor clutch and pulley. Is the alarm solid?	—	*Go to Step 7*	System OK
7	Repair the leak as needed. Has the leak stopped?	—	System OK	—

Florescent Leak Detection Method

Tools Required

- *J 41447* Tracer Dye
- *J 41436* Tracer Dye Injector
- *J 28428-E* High Intensity Black Light

The R-134a refrigerant is uniquely different from the R-12 used in the past and may require additional methods for leak detection. The R-134a molecule is smaller than the R-12 molecule and can leak through smaller openings. R-134a also does not contain chlorine, which is easily detected using the black light. The efflorescence leak detection method is meant to be used in conjunction with the electronic method, and will pinpoint smaller leaks. The R-134a takes time to work. Depending on the rate of the leak, the dye may take up to 7 days to become visible.

Liquid Leak Detection/Pressure Testing Methods

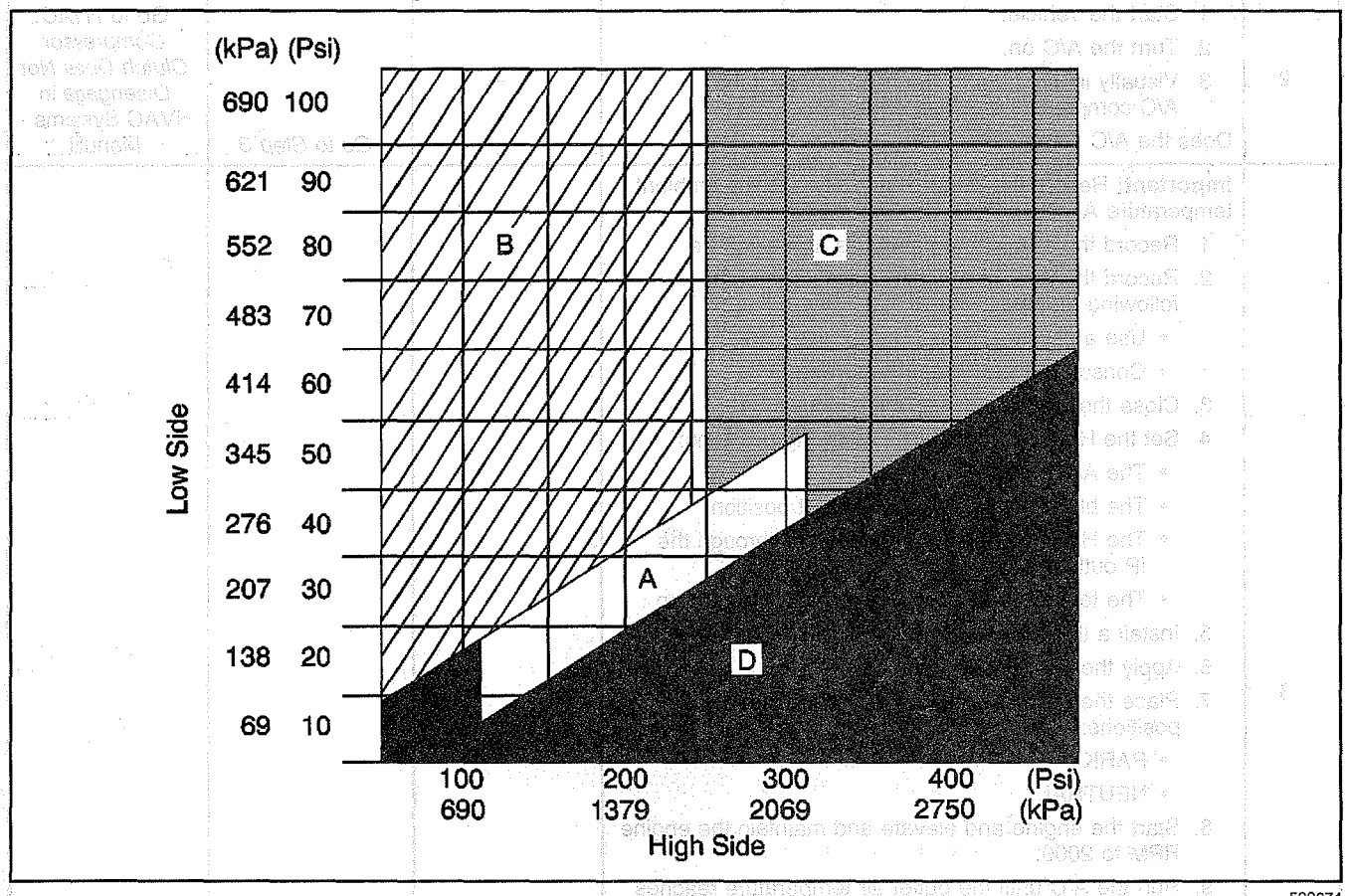
Due to their lack of sensitivity and restricted visibility in today's refrigerant systems, liquid/bubble leak detectors have very limited usefulness. Therefore, the liquid leak detection/pressure testing methods are not recommended for this vehicle.

Service Port Seal/Cap

The primary seal for the service ports is the sealing cap. The cap contains a specially designed O-ring or gasket which provides a leak free seal. Should the cap be loose, missing, or the wrong usage, a loss of refrigerant could result.

Cooling Insufficient, A/C System

A/C System Pressure - Zone Classification Graph



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Cooling Insufficient, A/C System

Step	Action	Value(s)	Yes	No
The following test measures the air conditioning (A/C) system operating efficiency by comparing the following: • The ambient air temperature • The ambient air humidity • The pressure at the high-pressure side of the refrigeration system • The pressure at the low-pressure side of the refrigeration system • The temperature of the air being discharged into the passenger compartment				
1	1. Park the vehicle inside or in the shade. 2. Open the windows in order to ventilate the interior of the vehicle. 3. If the engine is at operating temperature, allow the engine to cool. 4. Ensure that the ignition key is in the OFF position. 5. Install *J 39500-B*. 6. Record the readings of the low and high side STATIC pressures. The low and high side pressure readings should be almost equal to each other once the system has come to rest. Are both the low and high side pressures above the specified value?	345 kPa (50 psi)	*Go to Step 2*	Go to *Leak Testing.*

Cooling Insufficient, A/C System (cont'd)

Step	Action	Value(s)	Yes	No
2	1. Start the vehicle. 2. Turn the A/C on. 3. Visually inspect under the hood to see if the A/C compressor clutch is engaged. Does the A/C compressor clutch engage?	—	*Go to Step 3*	Go to *HVAC Compressor Clutch Does Not Disengage* in HVAC Systems - Manual
3	**Important:** Record the relative humidity and the ambient temperature AT THE TIME OF THE TEST. 1. Record the ambient temperature at the vehicle. 2. Record the relative humidity, using one of the following methods: • Use a psychrometer • Consult the local weather bureau 3. Close the vehicles doors and windows. 4. Set the HVAC control to the following positions: • The A/C on • The blower control to the highest position • The HVAC control to discharge air through the IP outlets • The temperature control to the coldest position 5. Install a thermometer into the IP center air outlet. 6. Apply the park brake. 7. Place the transmission in one of the following positions: • PARK • NEUTRAL 8. Start the engine and elevate and maintain the engine RPM to 2000. 9. Run the A/C until the outlet air temperature reaches the lowest temperature. This will take approximately 3 minutes. 10. Record the following information: • The outlet air temperature • The low-side pressure • The high-side pressure 11. Compare the low and high side pressures and the output temperature to the table. Does all the data recorded fall within the specified ranges of the table below?	—	*Go to Step 8*	*Go to Step 4*
4	Compare the recorded pressures to the *A/C System Pressure - Zone Classification Graph.* Do both the low and high side pressures fall within Zone A on the graph?	—	Go to *Cooling Insufficient, A/C System - Pressure Zone A*	*Go to Step 5*
5	Do the pressures fall within Zone B?	—	Go to *Cooling Insufficient, A/C System - Pressure Zone B*	*Go to Step 6*

Cooling Insufficient, A/C System (cont'd)

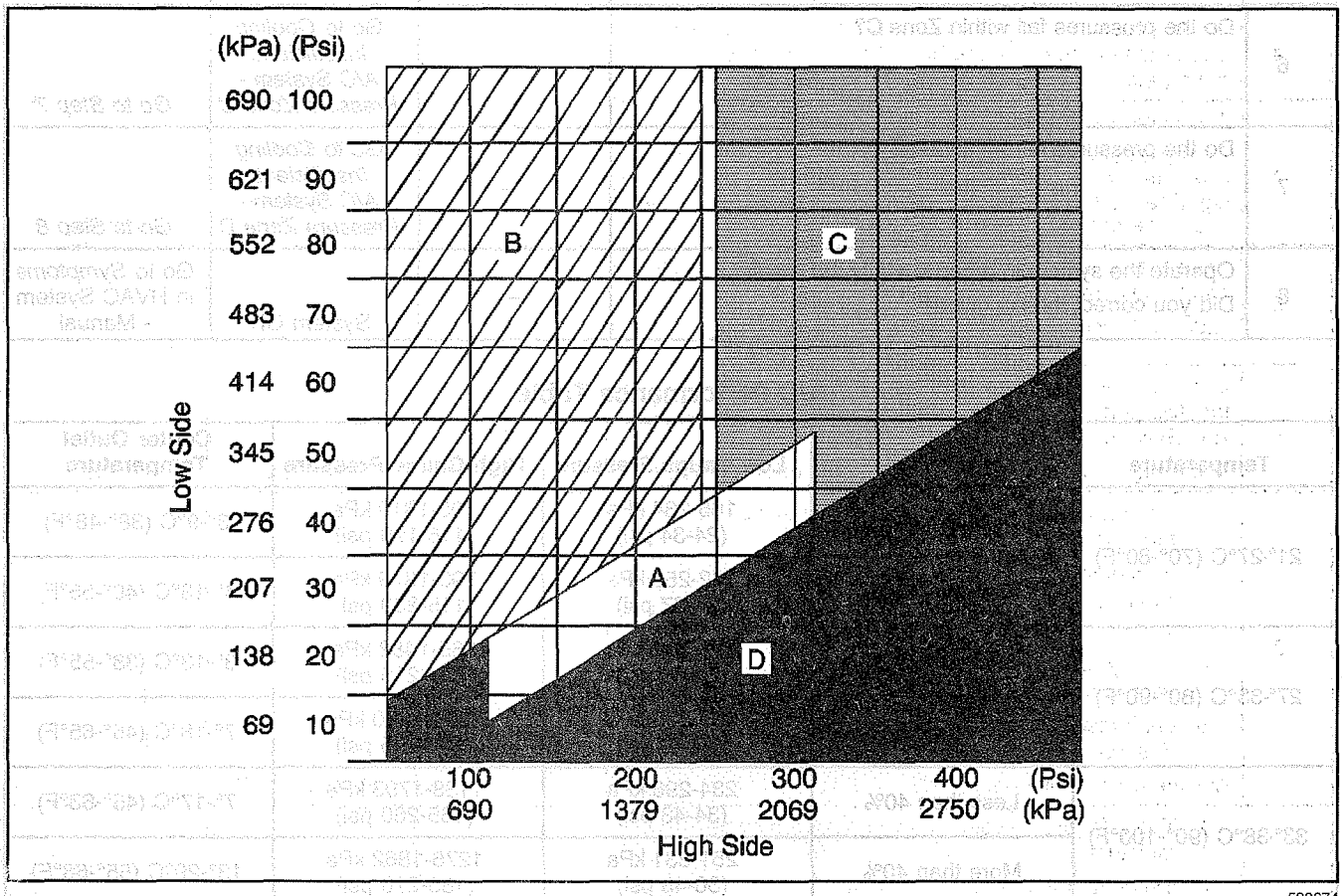
Step	Action	Value(s)	Yes	No
6	Do the pressures fall within Zone C?	—	Go to *Cooling Insufficient, A/C System - Pressure Zone C*	*Go to Step 7*
7	Do the pressures fall within Zone D?	—	Go to *Cooling Insufficient, A/C System - Pressure Zone D*	*Go to Step 8*
8	Operate the system in order to verify the repair. Did you correct the condition?	—	System OK	Go to *Symptoms* in HVAC System - Manual

A/C Performance Table

Temperature	Humidity	Low Gauge Pressure	High Gauge Pressure	Center Outlet Temperature
21°-27°C (70°-80°F)	Less than 50%	165-234 kPa (24-34 psi)	793-1310 kPa (115-190 psi)	3°-9°C (38°-48°F)
	More than 50%	172-255 kPa (25-37 psi)	793-1379 kPa (115-200 psi)	4°-13°C (40°-55°F)
27°-33°C (80°-90°F)	Less than 50%	193-262 kPa (28-38 psi)	965-1482 kPa (140-215 psi)	3°-13°C (38°-55°F)
	More than 50%	207-276 kPa (30-40 psi)	1034-1620 kPa (150-235 psi)	7°-18°C (45°-65°F)
33°-38°C (90°-100°F)	Less than 40%	234-296 kPa (34-43 psi)	1138-1793 kPa (165-260 psi)	7°-17°C (45°-63°F)
	More than 40%	251-331 kPa (36-48 psi)	1276-1862 kPa (185-270 psi)	13°-20°C (55°-68°F)
38°-44°C (100°-110°F)	Less than 20%	276-338 kPa (40-49 psi)	1448-2000 kPa (210-290 psi)	12°-18°C (53°-64°F)
	More than 20%	296-359 kPa (43-52 psi)	1517-2137 kPa (220-310 psi)	14°-21°C (58°-70°F)

Cooling Insufficient, A/C System - Pressure Zone A

A/C System Pressure - Zone Classification Graph



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Cooling Insufficient, A/C System - Pressure Zone A

Step	Action	Value(s)	Yes	No
1	Were you sent here from the Cooling Insufficient, A/C System diagnostic table?	—	*Go to Step 2*	Go to *Cooling Insufficient, A/C System*
2	During continued operation of the A/C system, does the compressor clutch disengage and re-engage with no abnormal change to the low and high side pressure readings?	—	*Go to Step 3*	*Go to Step 4*
3	1. Check for an intermittent in the clutch coil and/or the clutch coil circuit. Refer to *HVAC Compressor Clutch Does Not Engage* in HVAC Systems - Manual. 2. If replacement of the clutch coil is necessary, recover the refrigerant. 3. Replace the clutch coil and/or repair the clutch coil circuit. For clutch coil replacement, refer to *Compressor Clutch Coil Removal (V5 - Conventional Mount)* and *Compressor Clutch Coil Install (V5 - Conventional Mount)* or *Compressor Clutch Coil Removal (V7 - Direct Mount)* and *Compressor Clutch Coil Install (V7 - Direct Mount).* Is the repair complete?	—	*Go to Step 12*	—

Cooling Insufficient, A/C System - Pressure Zone A (cont'd)

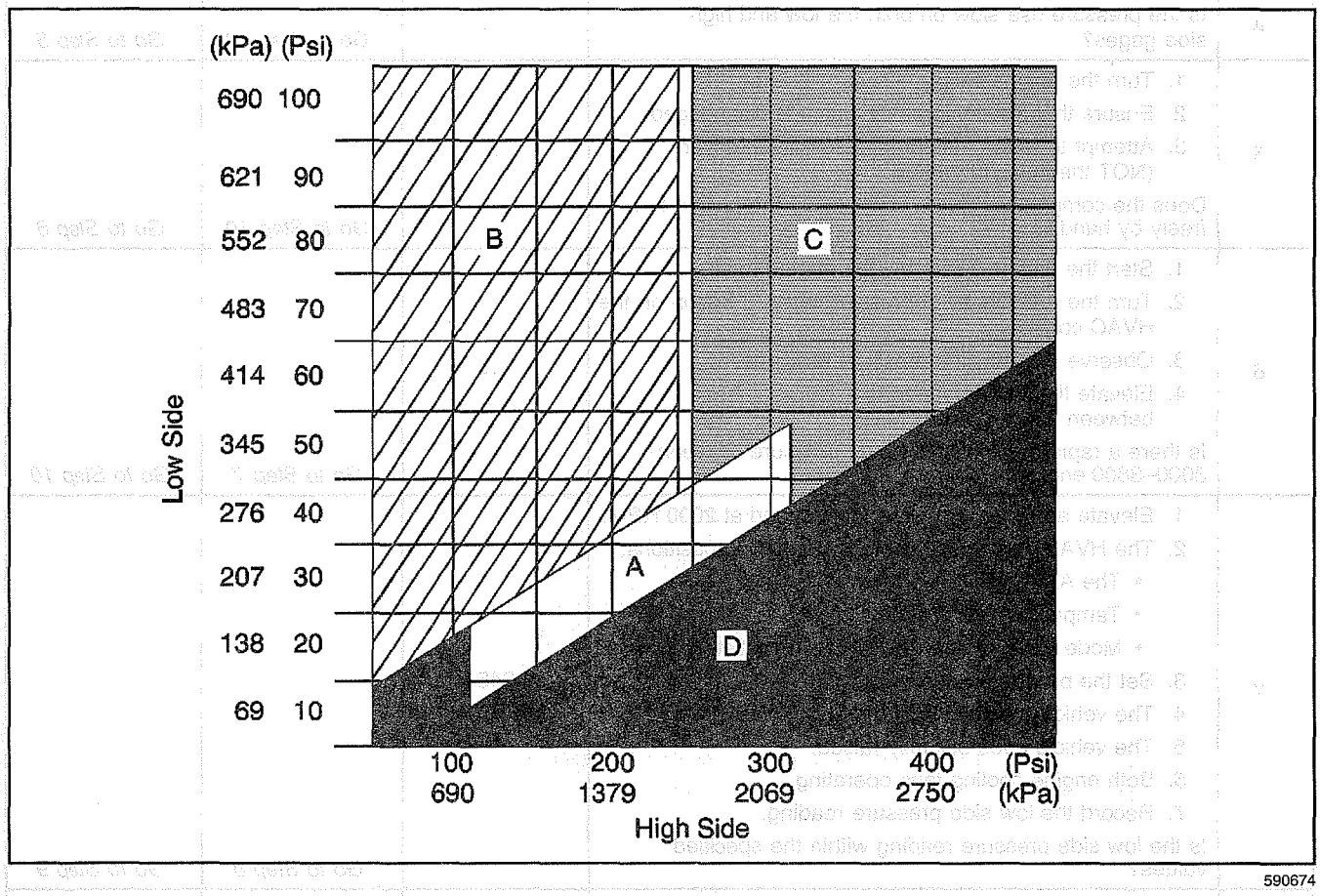
Step	Action	Value(s)	Yes	No
4	Did the customer concern mention that the A/C system output temperatures are good at first, but then turn warm during extended drives?	—	*Go to Step 5*	*Go to Step 7*
5	The engine still running with a speed of 2000 RPM. During extended operation of the A/C system, does the low side (and possibly the high side) pressure increase significantly (possibly accompanied by heavy frost on the liquid line between the orifice and the evaporator)?	—	Go to *Cooling Insufficient, A/C System - Pressure Zone B*	*Go to Step 6*
6	Take the vehicle on a test drive under the same conditions as the customer, to verify the concern. Has the concern been verified?	—	Go to *Cooling Insufficient, A/C System - Pressure Zone B*	*Go to Step 11*
7	Compare the low and high side pressures to those listed in the A/C performance table. Refer to *Cooling Insufficient, A/C System.* Is the high side pressure slightly above normal pressure?	—	*Go to Step 8*	*Go to Step 9*
8	1. The refrigerant system oil charge level may be too high. 2. Evacuate the refrigerant system. 3. Check the amount of refrigerant oil removed from the system. 4. Charge the refrigerant system to specifications, using care to maintain the proper oil level. 5. Leak test the refrigerant system. Refer to *Leak Testing.* Are the operations completed?	—	*Go to Step 10*	—
9	1. The refrigerant system may contain too much moisture. 2. Evacuate the refrigerant system. 3. Charge the refrigerant system to specifications. 4. Leak test the refrigerant system. Refer to *Leak Testing.* 5. If no leaks are found, replace the accumulator. Refer to *Accumulator Replacement.* Are the operations completed?	—	*Go to Step 10*	—
10	Compare the outlet temperature to those listed in the A/C performance table. Refer to *Cooling Insufficient, A/C System.* Is the outlet temperature within specifications?	—	Go to *A Diagnostic System Check* in HVAC Systems - Manual	—

Cooling Insufficient, A/C System - Pressure Zone A (cont'd)

Step	Action	Value(s)	Yes	No
11	1. Start the engine and allow the engine to idle. 2. With an accurate thermometer still installed to the IP center air outlet. 3. Set the HVAC control to the following positions: • The A/C on • The temperature control to coldest position • The mode control knob to UPPER (IP outlets) • The blower switch to high 4. Elevate and maintain the engine speed at 2000 RPM. 5. Allow the low and high side pressure readings to stabilize, if necessary. (Stabilization usually requires 2–3 minutes.) 6. Record the low and high pressure readings and the delivered air output temperature. 7. Compare the low and high side pressures and the output temperatures to those listed in the A/C Performance Table. Refer to *Cooling Insufficient, A/C System.* Are both the low and high side pressures as well as the output temperatures within specifications?	—	System OK	—
12	1. Evacuate and charge the refrigerant system. 2. Leak test the refrigerant system. Refer to *Leak Testing.* Are the operations completed?	—	*Go to Step 13*	—
13	1. Start the engine and allow the engine to idle. 2. With an accurate thermometer still installed to the IP center air outlet. 3. Set the HVAC control to the following positions: • A/C button to ON • Temperature control to full cold • Mode control knob to UPPER (IP outlets) • Blower switch to high 4. Elevate and maintain the engine speed at 2000 RPM. 5. Allow the low and high side pressure readings to stabilize, if necessary. (Stabilization usually requires 2–3 minutes.) 6. Record the low and high pressure readings and the delivered air output temperature. 7. Compare the low and high side pressures and the output temperatures to those listed in the A/C Performance Table. Refer to *Cooling Insufficient, A/C System.* Are both the low and high side pressures as well as the output temperatures within specifications?	—	Go to *A Diagnostic System Check* in HVAC Systems - Manual	—

Cooling Insufficient, A/C System - Pressure Zone B

A/C System Pressure - Zone Classification Graph



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Cooling Insufficient, A/C System - Pressure Zone B

Step	Action	Value(s)	Yes	No
1	Were you sent here from the Cooling Insufficient, A/C System — Pressure Zone A.	—	*Go to Step 3*	*Go to Step 2*
2	Were you sent here from the Cooling Insufficient, A/C System.	—	*Go to Step 3*	Go to *Cooling Insufficient, A/C System*
3	1. The engine still idling in PARK. 2. The HVAC control still set to the following positions: • A/C button to ON • Temperature control to full cold • Mode control knob to UPPER (IP outlets) • Blower switch to high 3. Close the vehicle windows and doors. 4. The vehicle hood fully raised. 5. Both engine cooling fans operating. 6. Elevate and maintain the engine speed to 3000 RPM. 7. Cycle the A/C from ON to OFF to ON — by depressing the A/C button on the HVAC control — every 20 seconds for 3 minutes. 8. Record the low and high side pressure readings. Are the low and high side pressure readings within 207 kPa (30 psi) of each other?	—	*Go to Step 4*	*Go to Step 11*

Cooling Insufficient, A/C System - Pressure Zone B (cont'd)

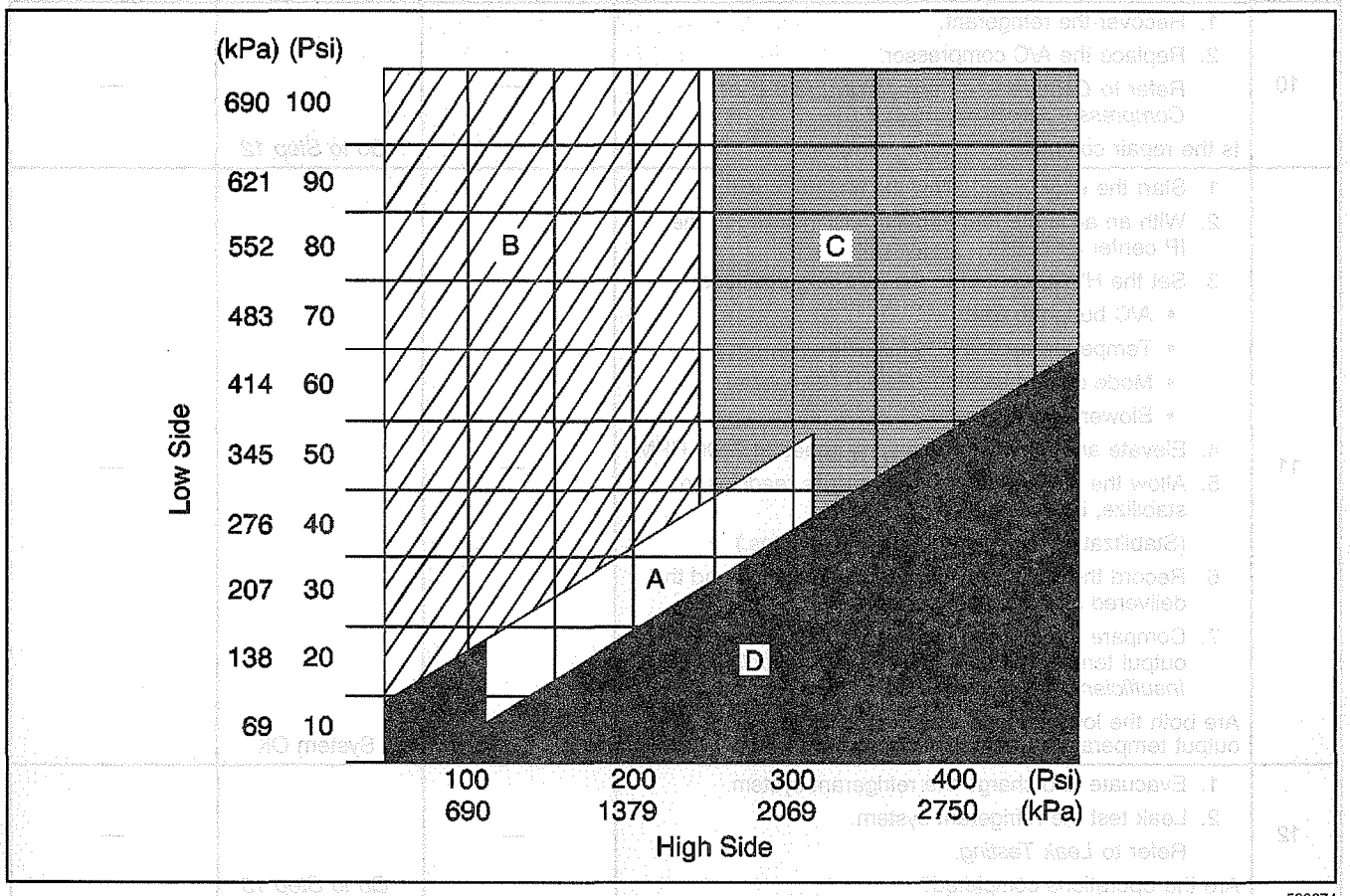
Step	Action	Value(s)	Yes	No
4	Is the pressure rise slow on both the low and high side gages?	—	*Go to Step 10*	*Go to Step 5*
5	1. Turn the engine OFF. 2. Ensure that the compressor clutch is disengaged. 3. Attempt to rotate the compressor clutch driver (NOT the pulley) by hand. Does the compressor clutch driver (NOT the pulley) turn freely by hand?	—	*Go to Step 10*	*Go to Step 6*
6	1. Start the engine and allow the engine to idle. 2. Turn the A/C ON by depressing the A/C button on the HVAC control. 3. Observe the low side pressure readings. 4. Elevate the engine speed to between 3000–3800 RPM. Is there a rapid rise in the low side pressure between 3000–3800 engine RPM?	—	*Go to Step 7*	*Go to Step 10*
7	1. Elevate and maintain the engine speed at 2000 RPM. 2. The HVAC control still set to the following positions: • The A/C on • Temperature control to full cold • Mode control knob to UPPER (IP outlets) 3. Set the blower switch to low 4. The vehicle windows and doors still closed. 5. The vehicle hood still fully raised. 6. Both engine cooling fans operating. 7. Record the low side pressure reading. Is the low side pressure reading within the specified values?	69-345 kPa (10-50 psi)	*Go to Step 8*	*Go to Step 9*
8	1. The engine still idling in PARK. 2. The HVAC control set to the following positions: • A/C button to ON • Temperature control to full cold • Mode control knob to UPPER (IP outlets) • Blower switch to high 3. Elevate and maintain the engine speed at 2000 RPM. 4. Allow the low and high side pressure readings to stabilize, if necessary. (Stabilization usually requires 2–3 minutes.) 5. Record the low and high pressure readings. 6. Compare the low and high side pressures to the A/C System Pressure - Zone Classification Graph above. Do both the low and high side pressures fall within Zone B on the chart (low side pressure still high and high side pressure still low)?	—	*Go to Step 10*	*Go to Step 11*
9	1. Recover the refrigerant. 2. Replace the control valve. Refer to *Compressor Pressure Relief Valve Removal (V5 - Conventional Mount)* and *Compressor Pressure Relief Valve Install (V5 - Conventional Mount)* or *Compressor Pressure Relief Valve Removal (V7 - Direct Mount)* and *Compressor Pressure Relief Valve Install (V7 - Direct Mount).* Is the repair complete?	—	*Go to Step 12*	—

Cooling Insufficient, A/C System - Pressure Zone B (cont'd)

Step	Action	Value(s)	Yes	No
10	1. Recover the refrigerant. 2. Replace the A/C compressor. Refer to *Compressor Replacement (3.8 L)* or *Compressor Replacement (5.7 L)*. Is the repair complete?	—	*Go to Step 12*	—
11	1. Start the engine and allow the engine to idle. 2. With an accurate thermometer still installed to the IP center air outlet. 3. Set the HVAC control to the following positions: • A/C button to ON • Temperature control to full cold • Mode control knob to UPPER (IP outlets) • Blower switch to high 4. Elevate and maintain the engine speed at 2000 RPM. 5. Allow the low and high side pressure readings to stabilize, if necessary. (Stabilization usually requires 2–3 minutes.) 6. Record the low and high pressure readings and the delivered air output temperature. 7. Compare the low and high side pressures and the output temperatures to those listed in *Cooling Insufficient, A/C System* Are both the low and high side pressures as well as the output temperatures within specifications?	—	System OK	—
12	1. Evacuate and charge the refrigerant system. 2. Leak test the refrigerant system. Refer to *Leak Testing*. Are the operations completed?	—	*Go to Step 13*	—
13	1. Start the engine and allow the engine to idle. 2. An accurate thermometer still installed to the IP center air outlet. 3. Set the HVAC control to the following positions: • A/C button to ON • Temperature control to full cold • Mode control knob to UPPER (IP outlets) • Blower switch to high 4. Elevate and maintain the engine speed at 2000 RPM. 5. Allow the low and high side pressure readings to stabilize, if necessary. (Stabilization usually requires 2–3 minutes.) 6. Record the low and high pressure readings and the delivered air output temperature. 7. Compare the low and high side pressures and the output temperatures to those listed in the A/C Performance Table. Refer to *Cooling Insufficient, A/C System*. Are both the low and high side pressures as well as the output temperatures within specifications?	—	Go to *A Diagnostic System Check* in HVAC Systems - Manual	—

Cooling Insufficient, A/C System - Pressure Zone C

A/C System Pressure - Zone Classification Graph



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Cooling Insufficient, A/C System - Pressure Zone C

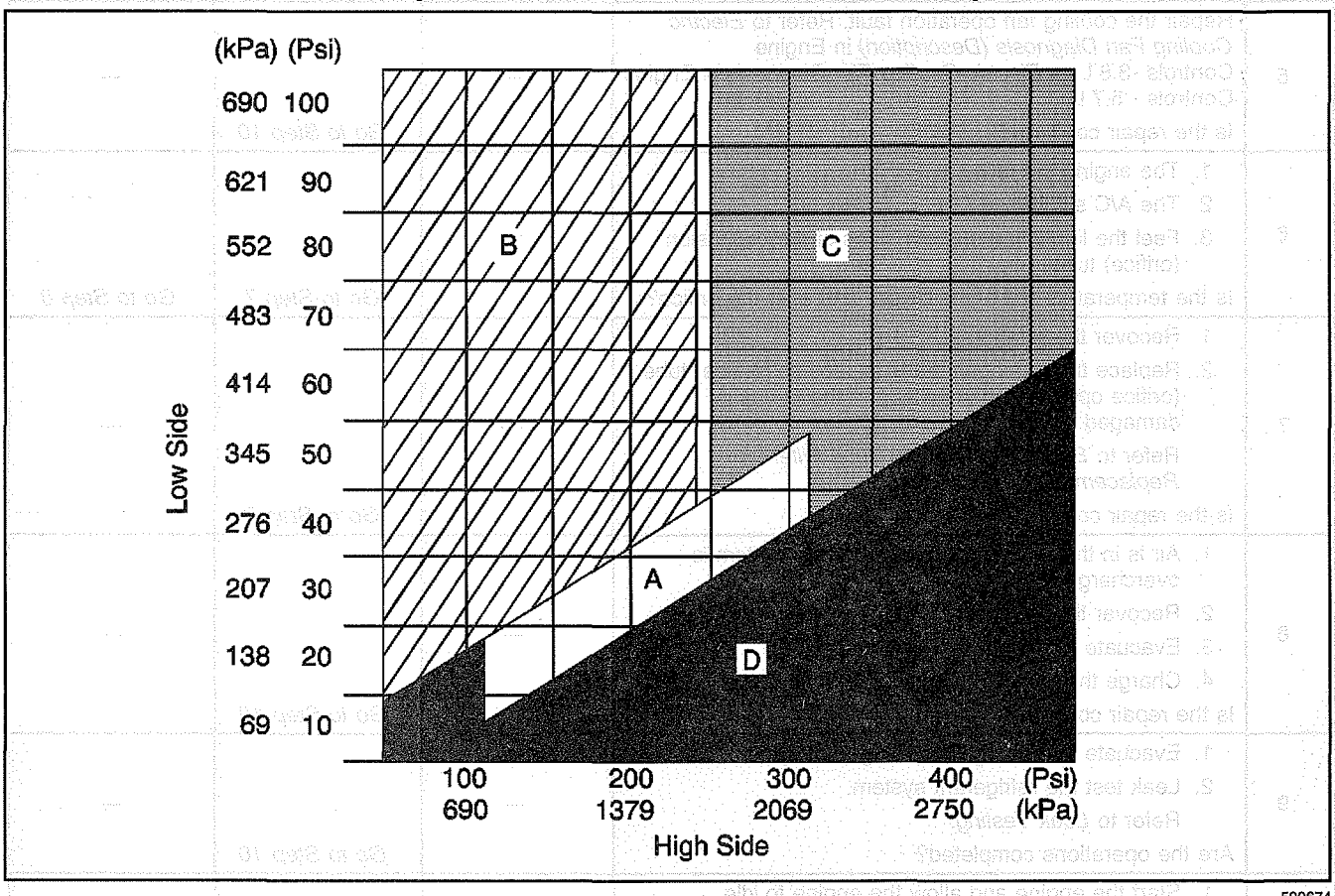
Step	Action	Value(s)	Yes	No
1	Were you sent here from the Cooling Insufficient, A/C System diagnostic table?	—	*Go to Step 2*	Go to *Cooling Insufficient, A/C Sysiem*
2	Visually inspect for restricted air flow at the condenser. Is the air flow through the condenser restricted	—	*Go to Step 3*	*Go to Step 4*
3	1. Repair the condition (air flow restriction) or replace the condenser, if damaged. 2. If replacement of the condenser is necessary, recover the refrigerant, then refer to *Condenser Replacement.* 3. Evacuate and charge the refrigerant system. 4. Leak test the refrigerant system. Refer to *Leak Testing.* Is the repair complete?	—	*Go to Step 4*	—
4	1. Start the engine and allow the engine to idle. 2. Turn ON the A/C, using the A/C button. 3. Inspect for proper cooling fan operation. Refer to *Electric Cooling Fan Diagnosis (Description)* in Engine Controls - 3.8 L or *Electric Cooling Fan Diagnosis* in Engine Controls - 5.7 L. Are the cooling fans ON and operating properly?	—	*Go to Step 6*	*Go to Step 5*

Cooling Insufficient, A/C System - Pressure Zone C (cont'd)

Step	Action	Value(s)	Yes	No
5	Repair the cooling fan operation fault. Refer to *Electric Cooling Fan Diagnosis (Description)* in Engine Controls -3.8 L or *Electric Cooling Fan Diagnosis* in Engine Controls - 5.7 L. Is the repair complete?	—	*Go to Step 10*	—
6	1. The engine still idling in PARK. 2. The A/C still turned ON. 3. Feel the liquid line on both sides of the expansion (orifice) tube. Is the temperature the same before and after the orifice?	—	*Go to Step 7*	*Go to Step 8*
7	1. Recover the refrigerant. 2. Replace the damaged/faulty expansion (orifice) tube (orifice opening too large and/or the O-ring is damaged or missing). Refer to *Expansion (Orifice) Tube Filter Replacement.* Is the repair complete?	—	*Go to Step 9*	—
8	1. Air is in the refrigerant system, or the system is overcharged. 2. Recover the refrigerant. 3. Evacuate the refrigerant system. 4. Charge the refrigerant system to specifications. Is the repair complete?	—	*Go to Step 10*	—
9	1. Evacuate and charge the refrigerant system. 2. Leak test the refrigerant system. Refer to *Leak Testing.* Are the operations completed?	—	*Go to Step 10*	—
10	1. Start the engine and allow the engine to idle. 2. With an accurate thermometer still installed to the IP center air outlet. 3. Set the HVAC control to the following positions: • A/C button to ON • Temperature control to full cold • Mode control knob to UPPER (IP outlets) • Blower switch to high 4. Elevate and maintain the engine speed at 2000 RPM. 5. Allow the low and high side pressure readings to stabilize, if necessary. (Stabilization usually requires 2–3 minutes.) 6. Record the low and high pressure readings and the delivered air output temperature. 7. Compare the low and high side pressures and the output temperatures to those listed in the A/C Performance Table. Refer to *Cooling Insufficient, A/C System.* Are both the low and high side pressures as well as the output temperatures within specifications?	—	Go to *A Diagnostic System Check* in HVAC Systems - Manual	—

Cooling Insufficient, A/C System - Pressure Zone D

A/C System Pressure - Zone Classification Graph



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Cooling Insufficient, A/C System - Pressure Zone D

Step	Action	Value(s)	Yes	No
1	Were you sent here from the Cooling Insufficient, A/C System diagnostic table?	—	*Go to Step 2*	Go to *Cooling Insufficient, A/C System*
2	1. The engine still idling in PARK. 2. The A/C still ON. 3. Feel the liquid line before the expansion (orifice) tube. Is the liquid line cold before the orifice?	—	*Go to Step 3*	*Go to Step 5*
3	1. The A/C system still operating. 2. Carefully feel along the surfaces of the following high side components for a sudden drop in temperature. (The high side components should feel warm/hot from the compressor all the way to the orifice.) • The compressor discharge hose • The condenser • The liquid line between the condenser and the orifice. Was an abrupt drop in temperature noted along the surfaces of any of the components listed?	—	*Go to Step 4*	*Go to Step 5*
4	1. Recover the refrigerant. 2. Remove the restriction from the component, or replace the component which produced an abrupt temperature drop Is the repair complete?	—	*Go to Step 17*	—

Cooling Insufficient, A/C System - Pressure Zone D (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Recover the refrigerant. 2. Evacuate the system. 3. Weigh the charge which was removed. Is the weight of the removed refrigerant charge equal to or above the specified value?	0.68 kg (1.50 lb)	*Go to Step 9*	*Go to Step 6*
6	Add 0.40 kg (14 oz) of R-134a to the refrigerant system. Does the cooling performance improve?	—	*Go to Step 7*	*Go to Step 9*
7	Leak test the system. Refer to *Leak Testing.* Was a refrigerant leak found?	—	*Go to Step 8*	*Go to Step 17*
8	Repair the refrigerant leak. Is the repair complete?	—	*Go to Step 17*	—
9	1. The A/C system still operating. 2. Feel the liquid line at the orifice location for extreme cold, possibly accompanied by heavy frost, then feel along the liquid line after the orifice location for warm temperature. Was the liquid line extremely cold at the orifice location and warm after the orifice location?	—	*Go to Step 10*	*Go to Step 11*
10	1. The orifice tube is nearly plugged or damaged/faulty (opening too small). 2. Recover the refrigerant. 3. Replace the orifice tube. Refer to *Expansion (Orifice) Tube Filter Replacement.* 4. If the orifice tube was plugged or nearly plugged, note the amount of debris present. 5. If heavy debris is present, components in-line before the orifice may need to be flushed. Is the repair complete?	—	*Go to Step 17*	—
11	1. The A/C system still operating. 2. Carefully feel along the surfaces of the following low side components for a sudden change in temperature. • The liquid line between the orifice and the evaporator core • The vapor hose between the evaporator core and the accumulator • The accumulator • The compressor suction hose Was an abrupt temperature change noted along the surfaces of any of the components listed?	—	*Go to Step 12*	*Go to Step 13*
12	1. Recover the refrigerant. 2. Remove the restriction from the component, or replace the component which produced an abrupt temperature drop Are the operations complete?	—	*Go to Step 17*	—
13	1. The A/C system still operating. Ensure that the A/C has been operating for several minutes. 2. Carefully feel along the surfaces of the following low AND high side components to compare the overall temperatures of the low and high sides. • The liquid line between the orifice and the evaporator core • The vapor hose between the evaporator core and the accumulator • The accumulator • The compressor suction hose • The compressor discharge hose • The condenser • The liquid line between the condenser and the orifice. Are the overall temperatures of the low and high side components close to the same (both only mildly warm)?	—	*Go to Step 14*	*Go to Step 18*

Cooling Insufficient, A/C System - Pressure Zone D (cont'd)

Step	Action	Value(s)	Yes	No
14	1. Recover the refrigerant. 2. Disconnect the compressor hose from the compressor. Refer to *Compressor Hose Assembly Replacement (3.8 L)* or *Compressor Hose Assembly Replacement (5.7 L)*. 3. Inspect for the presence of heavy debris on the compressor suction port screen. Is heavy debris present on the compressor suction port screen?	—	*Go to Step 15*	*Go to Step 16*
15	1. Remove the debris from the suction port screen. 2. Inspect the orifice for damage, in order to determine if the debris originated from the high side. 3. If the orifice does not show any signs of damage, inspect the accumulator for damage, in order to determine if the debris originated from the evaporator core. 4. Replace any components found damaged. Is the repair complete?	—	*Go to Step 17*	—
16	Install components or connectors which were removed or disconnected. Is the action complete?	—	*Go to Step 17*	—
17	1. Evacuate and charge the refrigerant system. 2. Leak test the refrigerant system. Refer to *Leak Testing*. Are the operations completed?	—	*Go to Step 18*	—
18	1. Start the engine and allow the engine to idle. 2. With an accurate thermometer still installed to the IP center air outlet. 3. Set the HVAC control to the following positions: • A/C button to ON • Temperature control to full cold • Mode control knob to UPPER (IP outlets) • Blower switch to high 4. Elevate and maintain the engine speed at 1000 RPM. 5. Allow the low and high side pressure readings to stabilize, if necessary. (Stabilization usually requires 2–3 minutes.) 6. Record the low and high pressure readings and the delivered air output temperature. 7. Compare the low and high side pressures and the output temperatures to those listed in the A/C Performance Table. Refer to *Cooling Insufficient, A/C System*. Are both the low and high side pressures as well as the output temperatures within specifications?	—	Go to *A Diagnostic System Check* in HVAC Systems - Manual	—

Defrosting Insufficient

1. Inspect for an obstruction in both of the defroster nozzles.
   Perform the following steps, as necessary:
   - Remove any foreign objects.
   - Repair any loose instrument panel pad that blocks an outlet.
2. Inspect for the proper operation of the defroster air valve.
3. Inspect for one of the following conditions.
   Replace the defroster vacuum actuator or hose if one of the following conditions exist:
   - A faulty defroster air valve vacuum actuator
   - A faulty defroster air valve vacuum hose
4. Inspect for insufficient heating.
   Refer to *Heating Insufficient.*

Heating Insufficient

1. Inspect the duct work for the following conditions:
   - The proper installation
   - Obstructions
2. Inspect the blower operation.
3. Inspect the following components for the proper installation and the proper operation:
   - The temperature lever
   - The temperature motor
4. Inspect for the incorrect operation of the controls.
   Advise the driver of the proper operation of the controls.
5. Inspect the engine for low engine coolant level.
   Perform the following steps, as necessary:
   - Add coolant.
   - Inspect the engine for coolant leaks.
   - Run the engine in order to clear any air locks.
6. Inspect for a faulty engine thermostat.
   Replace the thermostat, if necessary.
7. Inspect for a kinked heater hose.
   Perform the following steps, as necessary:
   - Straighten the heater hose.
   - Replace the heater hose.
8. Inspect for obstructed heater core tubes.
   An obstruction usually causes a squishing noise in the heater core.
   Perform the following steps, as necessary:
   - Remove any foreign material from the heater core.
   - Replace the heater core.
9. Inspect for one of the following conditions:
   - A faulty blower motor
     Replace a faulty blower motor.
   - A faulty blower circuit
     Repair or replace faulty wires or connections.

Noise Diagnosis - Blower Motor

Step	Action	Value(s)	Yes	No
DEFINITION: Noise originating from the blower motor and/or the air delivery system. No loss of battery or ground is occurring in the blower motor circuit. The blower motor resistor and the blower motor are not exhibiting any intermittent internal shorts. For electrical diagnosis of the blower motor circuit, refer to *Blower Motor Inoperative at Any Speed* in HVAC Systems - Manual				
1	Were you sent here from A Diagnostic System Check?	—	*Go to Step 2*	Go to *A Diagnostic System Check* in HVAC Systems - Manual
2	1. Sit inside the vehicle. 2. Close the vehicle doors and windows. 3. Turn the ignition switch to ON; engine OFF. 4. Turn the blower switch to position 5 (high). 5. Set the temperature control to full cold. 6. Set the mode control to UPPER (I/P outlets). 7. Cycle through all the blower motor speeds, modes (including outside air and recirc) and temperature control positions to determine where noise occurs and where noise does not occur. 8. Attempt to define the type of noise: • Scrape, pop • Tick/click, chirping, groaning, scraping • Air rush/whistle Is a scrape or pop noise evident when selecting modes or temperature settings (moving a mode or temperature valve)?	—	*Go to Step 12*	*Go to Step 3*

Noise Diagnosis - Blower Motor (cont'd)

Step	Action	Value(s)	Yes	No
3	Is a tick/click, chirping, groaning or scraping noise present — constantly but decreases as blower motor speed is decreased, or only at start-up/intermttent — in all modes?	—	*Go to Step 6*	*Go to Step 4*
4	Is an air rush/whistle noise evident in all modes but not all temperature settings?	—	*Go to Step 13*	*Go to Step 5*
5	Is an air rush/whistle noise evident only in defrost or lower mode?	—	*Go to Step 14*	*Go to Step 15*
6	Check for blower motor and impeller excess vibration at each blower motor speed by feeling the blower case. Is excessive vibration present?	—	*Go to Step 7*	*Go to Step 9*
7	1. Remove the blower motor (w/impeller). Refer to *Blower Motor and Fan Replacement.* 2. Examine the blower motor impeller for the following conditions: • Deposits of foreign material • Wear spots • Cracked blades • Cracked hub • Loose impeller retainer • Improper impeller alignment Does the blower motor impeller exhibit any of these abnormal conditions?	—	*Go to Step 8*	*Go to Step 9*
8	1. Repair or replace the blower motor impeller. 2. Install the blower motor and impeller. Refer to *Blower Motor and Fan Replacement.* Is the action complete?	—	*Go to Step 16*	—
9	1. Remove the blower motor (w/impeller). Refer to *Blower Motor and Fan Replacement.* 2. Check for the presence of foreign material at the opening of the blower intake. Was foreign material found?	—	*Go to Step 11*	*Go to Step 10*
10	1. Replace the blower motor. 2. Install the blower motor and impeller. Refer to *Blower Motor and Fan Replacement.* Is the repair complete?	—	*Go to Step 17*	—
11	1. Remove the foreign material from the blower case. 2. Repair as necessary. Is the action complete?	—	*Go to Step 17*	—
12	1. Remove the instrument panel (IP) upper trim pad. Refer to *Trim Pad Replacement - IP Upper* in Instrument Panel, Gauges and Console. 2. Check the defroster, mode, air inlet and temperature valve function. 3. Repair or replace as necessary. Is the action complete?	—	*Go to Step 17*	—

Noise Diagnosis - Blower Motor (cont'd)

Step	Action	Value(s)	Yes	No
13	1. Remove the IP upper trim pad. Refer to *Trim Pad Replacement - IP Upper* in Instrument Panel, Gauges and Console. 2. Check the temperature valve seals. 3. Repair or replace as necessary. Is the action complete?	—	*Go to Step 17*	—
14	1. Remove the IP upper trim pad. Refer to *Trim Pad Replacement - IP Upper* in Instrument Panel, Gauges and Console. 2. Check the ducts for obstructions or foreign materials. 3. Remove any obstructions or foreign material found. 4. Check the defroster valve function. 5. Repair or replace as necessary. Is the action complete?	—	*Go to Step 17*	—
15	1. Remove the IP upper trim pad. Refer to *Trim Pad Replacement - IP Upper* in Instrument Panel, Gauges and Console. 2. Check the ducts for obstructions or foreign materials. 3. Remove any obstructions or foreign material found. 4. Check the defroster valve seals. 5. Repair or replace as necessary. Is the action complete?	—	*Go to Step 17*	—
16	1. Turn OFF the ignition switch. 2. Reconnect or install any connectors or components which were disconnected or removed. 3. Recheck for the presence of blower motor/air delivery system noise. Is the noise still present?	—	*Go to Step 10*	Go to *A Diagnostic System Check* in HVAC Systems - Manual
17	1. Turn OFF the ignition switch. 2. Reconnect or install any connectors or components which were disconnected or removed. 3. Recheck for the presence of blower motor/air delivery system noise. Is the noise still present?	—	*Go to Step 2*	Go to *A Diagnostic System Check* in HVAC Systems - Manual

Noise Diagnosis - A/C System

Step	Action	Value(s)	Yes	No
1	Were you sent here from A Diagnostic System Check?	—	*Go to Step 2*	Go to *A Diagnostic System Check* in HVAC Systems - Manual
2	1. Sit inside the vehicle. 2. Close the vehicle doors and windows. 3. Turn the ignition switch to the ON position; engine OFF. 4. Turn the blower switch to position 5 (high). 5. Set the temperature control to the full cold position. 6. Set the mode control to the UPPER (I/P outlets). 7. Depress the air conditioning (A/C) button to the OFF position. Is an abnormal noise present?	—	Go to *Noise Diagnosis - Blower Motor*	*Go to Step 3*
3	1. Start the engine and allow the engine to idle in PARK. 2. Depress the A/C button to the ON position. Is the A/C clutch engaged and supplying cold air to the passenger compartment?	—	*Go to Step 4*	Go to *HVAC Compressor Clutch Does Not Engage* in HVAC Systems - Manual
4	A/C system noises can be generally categorized into three areas: • Screech/Squealing noises • Moaning noises • Vibration/Rattle noises Is a screech/squealing noise heard when the A/C clutch is engaged?	—	*Go to Step 5*	*Go to Step 14*
5	Inspect the A/C compressor drive belt for excessive wear or oil coverage. Is the drive belt excessively worn or covered with oil?	—	*Go to Step 6*	*Go to Step 7*
6	1. Repair the source of the oil leak, if a leak was present. Refer to *Oil Leak Diagnosis* in Engine Mechanical. 2. Replace the A/C compressor drive belt. Refer to *Drive Belt Replacement* in Engine Mechanical - 3.8 L or *Drive Belt Replacement - A/C* in Engine Mechanical - 5.7 L. Is the repair complete?	—	*Go to Step 30*	—
7	1. Start the engine and allow the engine to idle in PARK. 2. Engage the A/C compressor clutch. 3. Using a stethoscope, check the A/C compressor drive belt idler pulley for any abnormal noises. Is the idler pulley operating normally without abnormal noise?	—	*Go to Step 9*	*Go to Step 8*
8	Replace the A/C compressor drive belt idler pulley. Refer to *Drive Belt Idler Pulley Replacement* in Engine Mechanical - 3.8 L or *Drive Belt Idler Pulley Replacement - A/C* in Engine Mechanical - 5.7 L. Is the repair complete?	—	*Go to Step 30*	—

Noise Diagnosis - A/C System (cont'd)

Step	Action	Value(s)	Yes	No
9	1. A/C compressor clutch engaged and engine idling in PARK. 2. Using a stethoscope, check the A/C compressor drive belt tensioner pulley for any abnormal noises. 3. Turn the ignition switch to the OFF position. 4. Check the tensioner for proper spring load Is the tensioner pulley operating normally with proper tension and without noise?	—	*Go to Step 11*	*Go to Step 10*
10	Replace the A/C compressor drive belt tensioner/tensioner pulley as needed. Refer to *Drive Belt Tensioner Replacement* in Engine Mechanical - 3.8 L or *Drive Belt Tensioner Replacement - A/C* in Engine Mechanical - 5.7 L. Is the repair complete?	—	*Go to Step 30*	—
11	Is the A/C compressor locked up?	—	*Go to Step 12*	*Go to Step 13*
12	1. Recover the refrigerant. 2. Replace the A/C compressor. Refer to *Compressor Replacement (3.8 L)* or *Compressor Replacement (5.7 L).* Is the repair complete?	—	*Go to Step 31*	—
13	1. Recover the refrigerant. 2. Remove the A/C compressor clutch coil. Refer to *Compressor Clutch Coil Removal (V5 - Conventional Mount)* or *Compressor Clutch Coil Removal (V7 - Direct Mount).* 3. Install the compressor clutch coil. Refer to *Compressor Clutch Coil Install (V5 - Conventional Mount)* or *Compressor Clutch Coil Install (V7 - Direct Mount).* Is the repair complete?	—	*Go to Step 31*	—
14	Does a moaning noise exist when the A/C clutch is engaged?	—	*Go to Step 15*	*Go to Step 23*
15	1. Connect an R-134a manifold gage set to the low and high side service ports on the vehicle refrigerant system. 2. Increase and maintain the engine speed at 2000 RPM, in PARK. 3. Engage the A/C clutch. 4. Check the low and high side refrigerant pressures. 5. Compare the pressure readings to those listed in the Cooling Insufficient, A/C System. Refer to *Cooling Insufficient, A/C System.* Are the high and low side refrigerant pressures within the normal specified limits?	—	*Go to Step 17*	*Go to Step 16*
16	1. Recover the refrigerant, evacuate and charge the refrigerant system to specifications. 2. Start the engine and allow the engine to idle in PARK. 3. Engaged the A/C compressor clutch. Does the moaning noise exist when the A/C clutch is engaged?	—	*Go to Step 32*	*Go to Step 17*
17	Inspect the A/C compressor mounting, idler pulley, and tensioner for concerns using a stethoscope. Are any of these components loose, damaged or excessively worn?	—	*Go to Step 18*	*Go to Step 19*

Noise Diagnosis - A/C System (cont'd)

Step	Action	Value(s)	Yes	No
18	Repair or replace the A/C compressor mounting, idler pulley or tensioner/tensioner pulley as needed. • For A/C compressor drive belt idler pulley replacement, refer to *Drive Belt Idler Pulley Replacement* in Engine Mechanical - 3.8 L or *Drive Belt Idler Pulley Replacement - A/C* in Engine Mechanical - 5.7 L. • For A/C compressor drive belt tensioner/tensioner pulley replacement, refer to *Drive Belt Tensioner Replacement* in Engine Mechanical - 3.8 L or *Drive Belt Tensioner Replacement - A/C* in Engine Mechanical - 5.7 L. Is the repair or replacement complete?	—	*Go to Step 30*	—
19	1. A/C compressor clutch engaged and engine idling in PARK. 2. Using a stethoscope, move around the entire refrigerant plumbing system checking for any abnormal noises being caused by component ground-out. Are any of the A/C components grounding out and causing a noise?	—	*Go to Step 20*	*Go to Step 21*
20	1. Recover the refrigerant, if necessary. 2. Repair or replace the component which is causing the moaning concern as needed. Is the repair or replacement complete?	—	*Go to Step 31*	—
21	Does the concern go away with the A/C clutch disengaged and the engine idling in PARK?	—	*Go to Step 22*	Go to *Engine Related Vibration* in Vibration Diagnosis and Correction
22	1. Recover the refrigerant. 2. Replace the A/C compressor. Refer to *Compressor Replacement (3.8 L)* or *Compressor Replacement (5.7 L)*. Is the repair complete?	—	*Go to Step 31*	—
23	Does a vibration or rattle noise exist when the A/C clutch is engaged?	—	*Go to Step 24*	System OK
24	Inspect the A/C compressor mounting, idler pulley, and tensioner for concerns using a stethoscope. Are any of these components loose, damaged or excessively worn?	—	*Go to Step 18*	*Go to Step 25*
25	Is the A/C compressor drive belt misaligned ?	—	*Go to Step 26*	*Go to Step 27*
26	Repair any alignment concern with the A/C pulley system and replace the drive belt as needed. Refer to *Drive Belt Replacement* in Engine Mechanical - 3.8 L or *Drive Belt Replacement - A/C* in Engine Mechanical - 5.7 L. Is the repair complete?	—	*Go to Step 30*	—
27	1. A/C compressor clutch engaged and engine idling in PARK. 2. Using a stethoscope, move around the entire A/C system checking for any abnormal noises being caused by a component. Are any of the A/C components causing an abnormal noise?	—	*Go to Step 28*	*Go to Step 29*
28	1. Recover the refrigerant. 2. Repair or replace the component which is causing the vibration/rattle concern as needed. Is the repair complete?	—	*Go to Step 31*	—

Noise Diagnosis - A/C System (cont'd)

Step	Action	Value(s)	Yes	No
29	Is the vibration/rattle coming from the A/C compressor internally?	—	*Go to Step 12*	Go to *Engine Related Vibration* in Vibration Diagnosis and Correction
30	1. Turn OFF the ignition switch. 2. Reconnect or install any connectors or components which were disconnected or removed. 3. Recheck for the presence of the A/C system noise. Is the A/C system noise still present?	—	*Go to Step 2*	Go to *A Diagnostic System Check* in HVAC Systems - Manual
31	1. Evacuate and charge the refrigerant system. 2. Leak test the refrigerant system. Refer to *Leak Testing*. Are the actions completed?	—	*Go to Step 32*	—
32	Recheck for the presence of the A/C system noise. Is the A/C system noise still present?	—	*Go to Step 2*	Go to *A Diagnostic System Check* in HVAC Systems - Manual

Cold Drafts on Floor

1. Inspect for a partially open air inlet valve.
   Ensure that the air inlet valve closes properly in all modes except the MAX air conditioning mode. Perform repairs as necessary.
2. Inspect all of the side door seals for the following conditions. Repair or replace faulty seals as necessary.
   - Damaged seals
   - Missing seals

Odor Diagnosis

Problem	Possible Cause	Correction
Musty Smell	• Water leaks (body) • The evaporator drain is blocked. • There is mold or mildew on the evaporator core.	• Locate and repair any water leaks. Refer to the appropriate repair procedure in Water Leaks. • Clean the evaporator drain. • Clean the evaporator. Refer to *Odor Correction*.
Coolant Smell	• The heater core is leaking. • The heater core pipes or hoses are leaking.	• Replace the heater core. Refer to *Heater Core Replacement*. • Replace the heater core pipes or hoses. Refer to *Heater Hose Assembly Replacement (3.8 L)* or *Heater Hose Assembly Replacement (5.7 L)*.
Refrigerant Oil Smell	The evaporator core is leaking.	Replace the evaporator core. Refer to *Evaporator Core Replacement*.
Mold/mildew odor problem—Under certain climate and operating conditions a musty odor can develop. The odor is caused by a microbial growth in the evaporator core. This odor is generally temporary, and as climate conditions change, the odor will disappear. Should the odor persist it may become necessary to clean the evaporator core with an appropriate cleaner.		

Repair Instructions

Odor Correction

Eliminating Air Conditioning Odor

Odors may be emitted from the air conditioning system primarily at start up in hot, humid climates. The following conditions may cause the odor:

- Debris is present in the heating, ventilation and air conditioning (HVAC) module.
- Microbial growth on the evaporator core.

When the blower motor fan is turned on, the microbial growth may release an unpleasant musty odor into the passenger compartment.

A service kit that can correct the condition is available through General Motors Service Parts Operation (GMSPO) to address this condition.

To remove odors of this type, it is necessary to eliminate the mirocbial growth and prevent its recurrence. To accomplish this, these two procedures must be completed.

- Deodorize the evaporator core using Deodorizing Aerosol Kit P/N 12377951
- Install the new air conditioning (A/C) Delayed Blower Control Package, P/N 12370470

The blower control package will enable the blower to run at high speed for 5 minutes. It will do so approximately 50 minutes after the ignition has been turned off it the compressor had been engaged for 4 or more minutes prior to shutting off the engine. By doing so, the evaporator case and core are dried out, reducing the chances of a recurring A/C odor.

Perform the following steps in order to deodorize the A/C system:

1. Ensure that the plenum that draws outside air into the HVAC module is clear of all debris.
2. Disable the A/C compressor clutch operation by disconnecting the clutch coil electrical connector.
3. Dry the evaporator core by performing the following steps:
   - 3.1. Start the vehicle.
   - 3.2. Set the temperature control on maximum heat.
   - 3.3. Set the control to the MAX setting.
   - 3.4. Run the blower motor on high for 10 minutes.
4. Locate an area in the air conditioning duct between the blower motor and the evaporator core downstream of the blower motor.
5. Drill a 3.175 mm (0.125 in) hole where it will not interfere with, or damage the following components:
   - The blower motor
   - The evaporator core
   - Any other operating part the of system
6. Wear safety goggles and latex gloves in order to perform the following actions:
   - 6.1. Continue to operate the blower motor on high.
   - 6.2. Insert the extension tube of the deodorizer GM P/N 12377951 into the hole, past the mark on the extension tube.
   - 6.3. Use short spray bursts and vary the direction of spray for a 2-3 minute period of time, in order to dispense the contents of the can into the duct.
7. Shut the engine OFF. Allow the vehicle to sit for 3-5 minutes.
8. Seal the 3.175 mm (0.125 in) hole with body sealer or RTV gasket compound.
9. Start the engine.
10. Operate the blower motor on high for 15-20 minutes to dry.
11. Reconnect the A/C compressor clutch coil electrical connector.
12. Verify proper clutch operation.

Refrigerant Recovery and Recharging

Tools Required

- *J 39500-B* A/C Refrigerant Recovery, Recycling and Recharging (ACR4) System
- *J 41810* PureGuard 2
- *J-41810-100A* Active Flow Control Valve

Caution: Refer to Caution - Breathing R-134a in Cautions and Notices.

Caution: For personal protection, goggles and gloves should be worn and a clean cloth wrapped around fittings, valves, and connections when doing work that includes opening the refrigerant system. If R-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: R-134a is the only approved refrigerant for use in this vehicle. The use of any other refrigerant may result in poor system performance or component failure.

Notice: To avoid system damage use only R-134a dedicated tools when servicing the A/C system.

Notice: Use only Polyalkylene Glycol Synthetic Refrigerant Oil (PAG) for internal circulation through the R-134a A/C system and only 525 viscosity mineral oil on fitting threads and O-rings. If lubricants other than those specified are used, compressor failure and/or fitting seizure may result.

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. Refer to the manufacturer instructions included with the service equipment before servicing.

The *J 39500-B* removes the Refrigerant-134a from the vehicle's A/C system. The recovery procedure uses one filtering cycle. The evacuation procedure uses an automatic multiple pass filtering cycle. These filtering cycles ensure a constant supply of clean, dry refrigerant for A/C system charging.

The Initial Set-Up Instruction Manual, provided with the *J 39500-B*, contains specific procedures for proper recovery, evacuation and recharging.

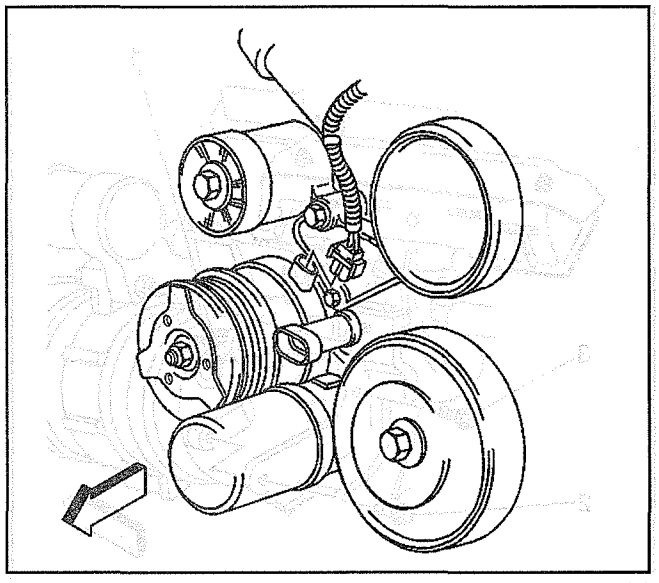
For ACR4 technical assistance in the U.S., call 1-800-345-2233.

Compressor Replacement (3.8 L)

Removal Procedure

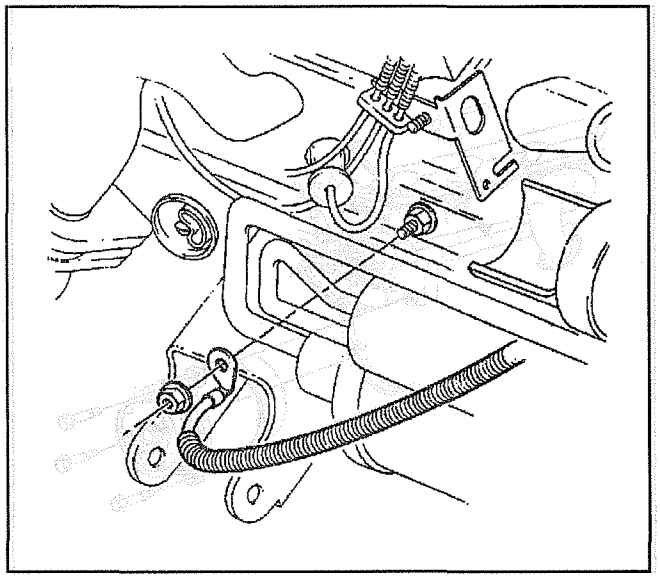
Important: Compressor related noise is generally air conditioning (A/C) system related and not always caused by the compressor itself. Prior to replacing compressor, refer to *Noise Diagnosis - A/C System*.

1. Recover the refrigerant. Refer to *Refrigerant Recovery and Recharging*.
2. Remove the serpentine drive belt. Refer to *Drive Belt Replacement* in Engine Mechanical - 3.8 L.
3. Disconnect the electrical connector at the air conditioning (A/C) compressor.



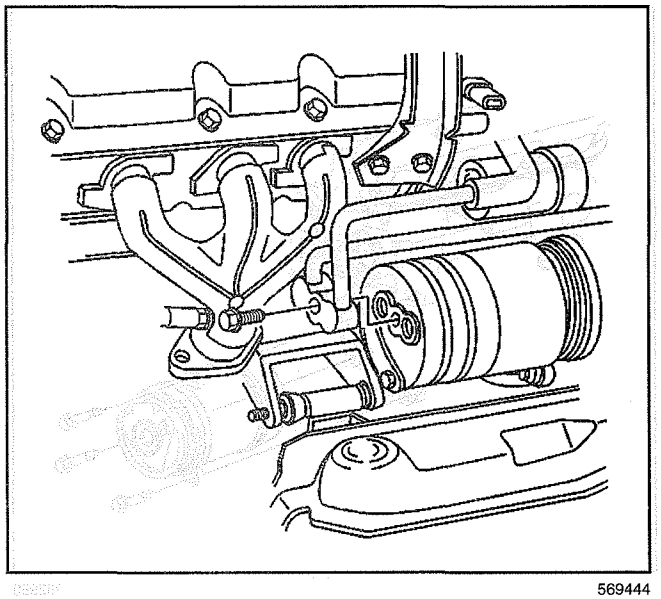
365420

4. Remove the negative battery cable nut from the engine block stud.
5. Remove the negative battery cable from the stud.
6. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.

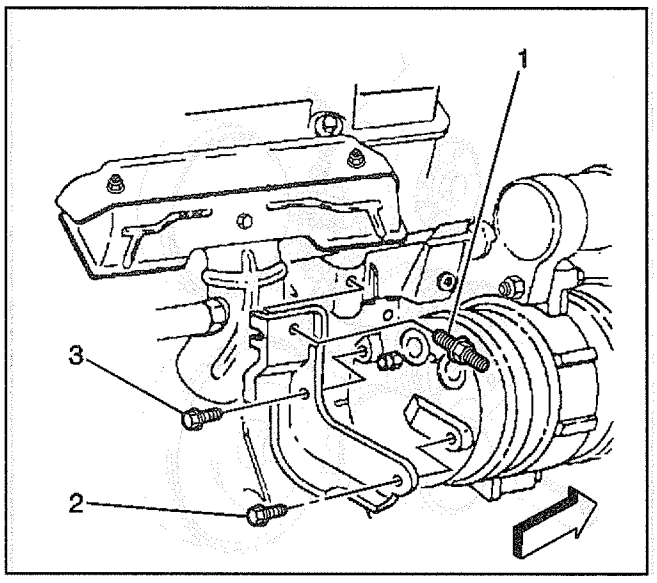


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7. Remove the A/C compressor and condenser hose bolt.
8. Discard the O-ring.

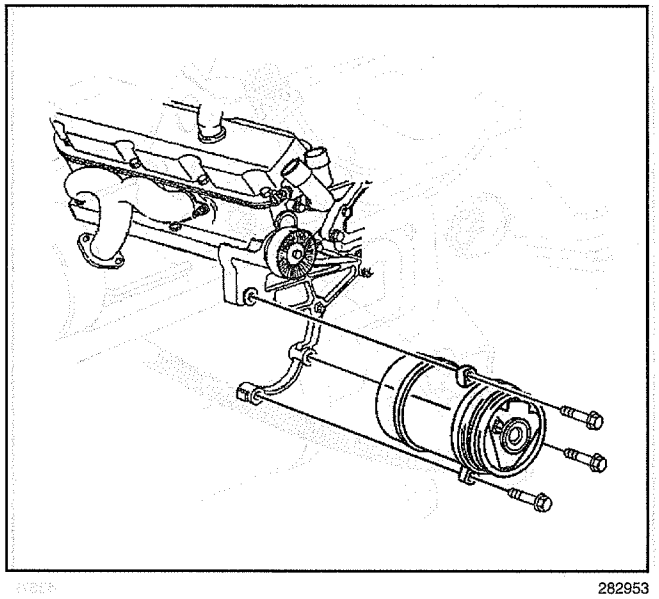


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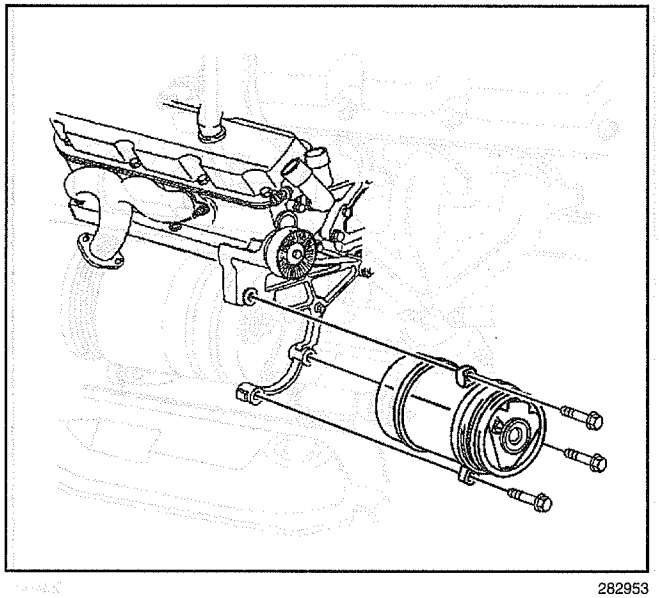


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9. Remove the A/C compressor rear bolts (2, 3).


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10. Remove the A/C compressor bolts.
11. Remove the A/C compressor.


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Installation Procedure

Important: NEW A/C compressors are shipped WITHOUT poly-alkylene glycol (PAG) oil.

1. If a NEW A/C compressor is being installed, add 60 ml (2 oz) of PAG oil to the compressor.
2. If reinstalling the old A/C compressor perform the following:
   - 2.1. Drain, measure and record the amount of PAG oil in the A/C compressor.
   - 2.2. If the measured amount of PAG oil drained is less than or equal to 60 ml (2 oz), add 60 ml (2 oz) of new, clean PAG oil to the A/C compressor.
   - 2.3. If the measured amount of PAG oil drained is greater than 60 ml (2 oz), add the same amount of new, clean PAG oil to the A/C compressor.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2.4. Install the compressor crankcase oil drain bolt to the replacement compressor.

Tighten

Tighten the compressor crankcase oil drain bolt to 20 N·m (15 lb ft).

3. Install the A/C compressor.
4. Install the A/C compressor bolts.

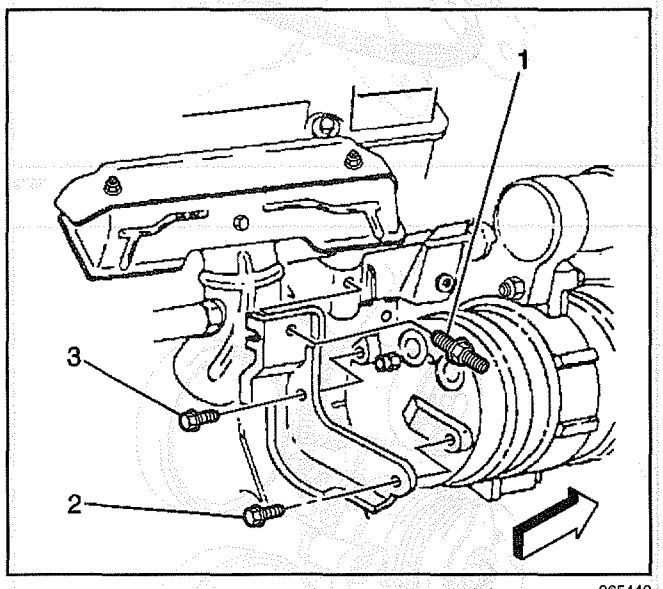
Tighten

Tighten the A/C compressor bolts to 50 N·m (37 lb ft).

5. Install the A/C compressor rear bolts (2, 3).

Tighten

Tighten the A/C compressor rear bolts (2, 3) to 30 N·m (22 lb ft).



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6. Install a new O-ring.

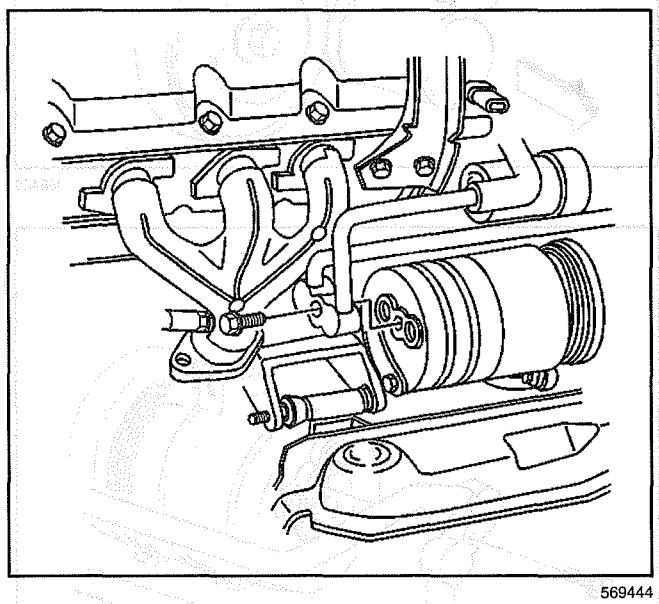
Lightly coat the O-ring with a mineral base 525 viscosity refrigerant oil.

7. Install the A/C compressor and condenser hose bolt.

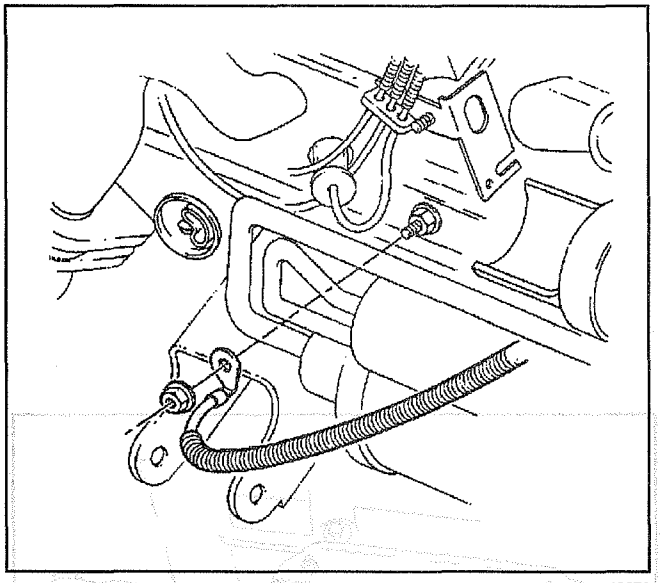
Tighten

Tighten the A/C compressor and condenser hose bolt to 33 N·m (24 lb ft).

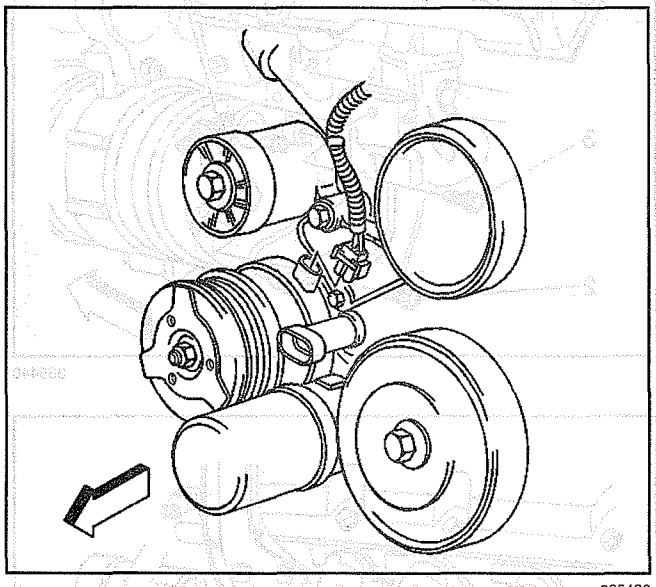
8. Lower the vehicle.



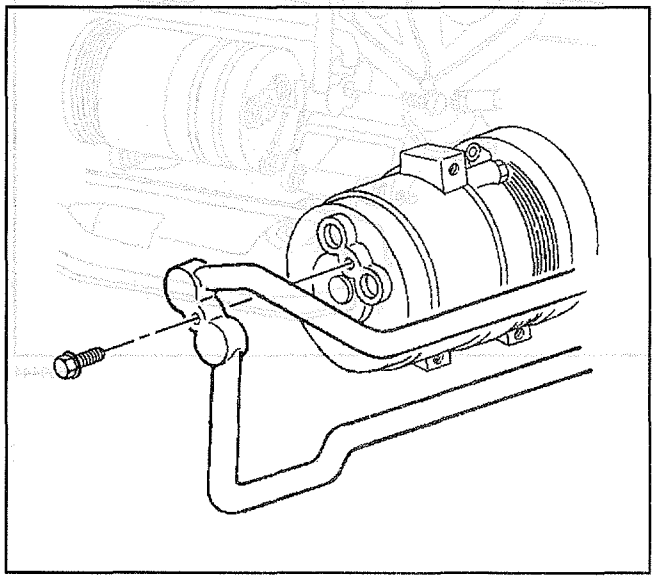
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9. Install the negative battery cable to the stud.
10. Install the negative battery cable nut to the engine block stud.

    Tighten

    Tighten the negative battery cable nut to the engine block stud to 25 N·m (18 lb ft).

11. Connect the electrical connector at the A/C compressor.
12. Install the serpentine drive belt. Refer to *Drive Belt Replacement* in Engine Mechanical - 3.8 L.
13. Charge the A/C system. Refer to *Refrigerant Recovery and Recharging.*
14. Perform a leak test on the A/C system. Refer to *Leak Testing.*

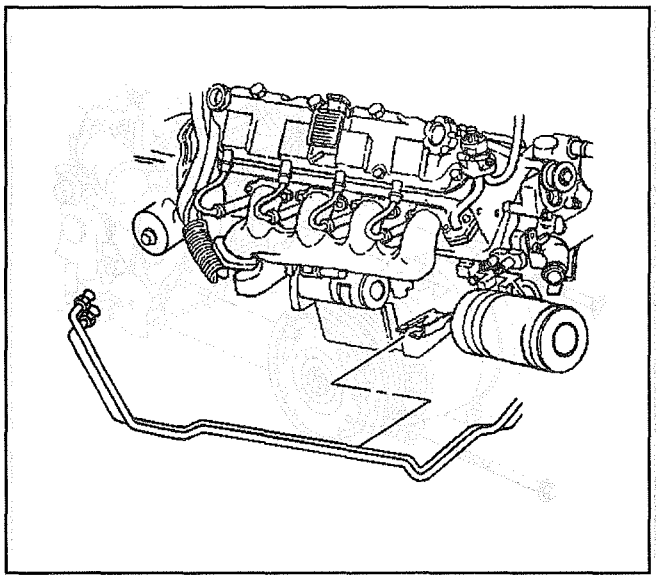
Compressor Replacement (5.7 L)

Removal Procedure

Important: Compressor related noise is generally air conditioning (A/C) system related and not always the compressor itself. Prior to replacing the compressor, refer to *Noise Diagnosis - A/C System.*

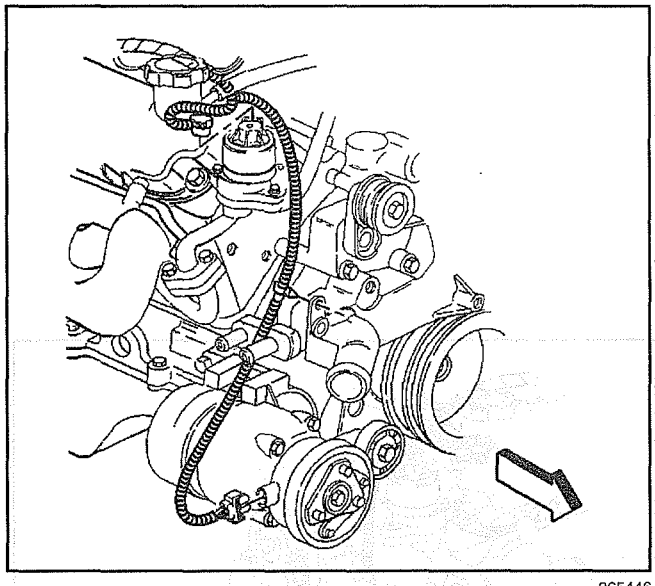
1. Recover the refrigerant. Refer to *Refrigerant Recovery and Recharging.*
2. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Remove the serpentine drive belt. Refer to *Drive Belt Replacement - A/C* in Engine Mechanical - 5.7 L.
4. Remove the air conditioning (A/C) compressor and condenser hose bolt.
5. Discard the O-ring.

6. Remove the transmission oil cooler pipes from the engine bracket, if necessary.



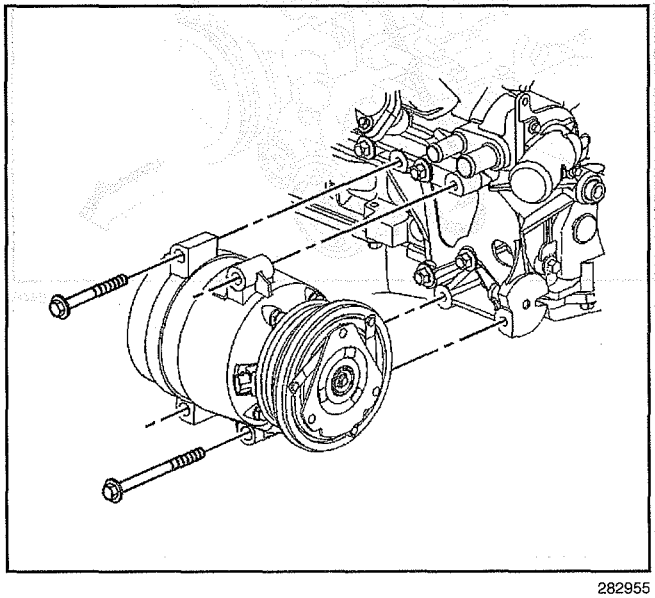
208334

7. Disconnect the electrical connector from the A/C compressor.

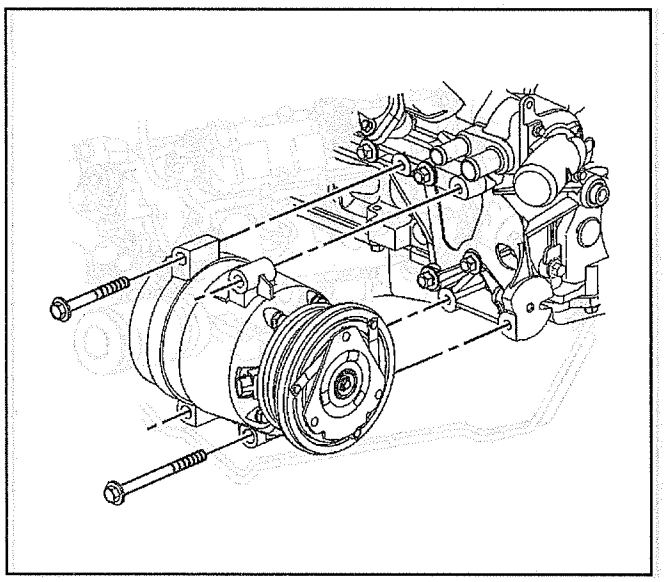


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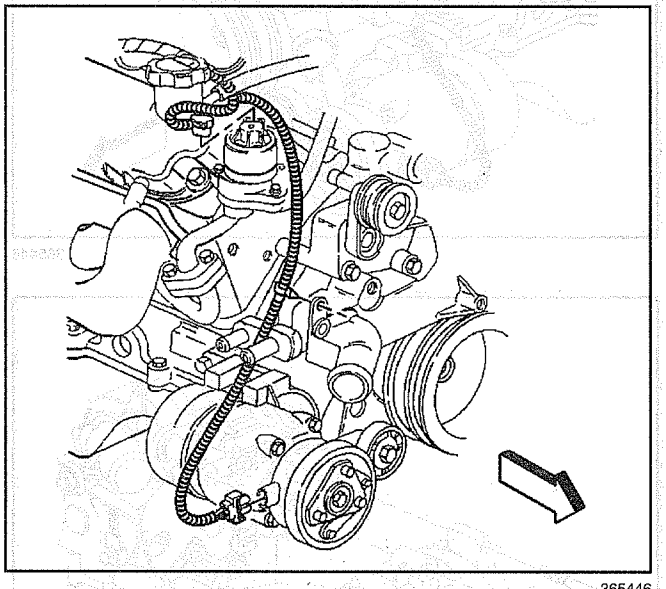
8. Remove the A/C compressor bolts.
9. Remove the A/C compressor.



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Installation Procedure

Important: NEW A/C compressors are shipped WITHOUT poly-alkylene glycol (PAG) oil.

1. If a NEW A/C compressor is being installed, add 60 ml (2 oz) of PAG oil to the compressor.
2. If reinstalling the old A/C compressor perform the following:
   2.1. Drain, measure and record the amount of PAG oil in the A/C compressor.
   2.2. If the measured amount of PAG oil drained is less than or equal to 60 ml (2 oz), add 60 ml (2 oz) of new, clean PAG oil to the A/C compressor.
   2.3. If the measured amount of PAG oil drained is greater than 60 ml (2 oz), add the same amount of new, clean PAG oil to the A/C compressor.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

   2.4. Install the compressor crankcase oil drain bolt (1) to the replacement compressor.

   Tighten

   Tighten the compressor crankcase oil drain bolt (1) to 20 N·m (15 lb ft).

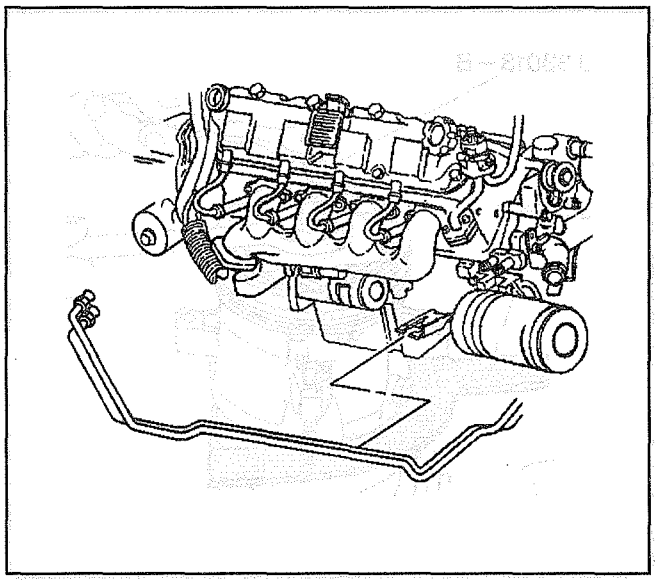
3. Install the A/C compressor.
4. Install the A/C compressor bolts.

   Tighten

   Tighten the A/C compressor bolts to 50 N·m (37 lb ft).

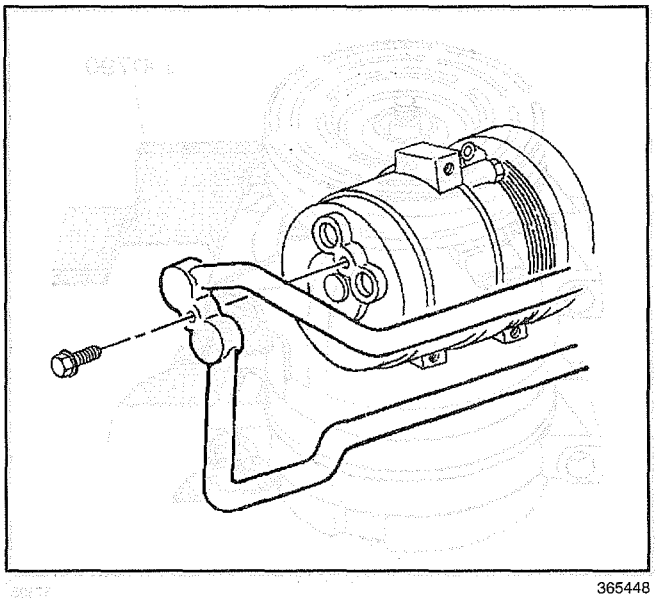
5. Connect the electrical connector to the A/C compressor.

6. Install the transmission oil cooler pipes to the engine bracket, if removed.



208334

7. Install a new O-ring.
   Lightly coat the O-ring with a mineral base 525 viscosity refrigerant oil.
8. Install the A/C compressor and condenser hose bolt.
   Tighten
   Tighten the A/C compressor and condenser hose bolt to 33 N·m (24 lb ft).
9. Install the serpentine drive belt. Refer to *Drive Belt Replacement - A/C* in Engine Mechanical 5.7 L.
10. Lower the vehicle.
11. Recharge the A/C system. Refer to *Refrigerant Recovery and Recharging.*
12. Perform a leak test on the A/C system. Refer to *Leak Testing.*



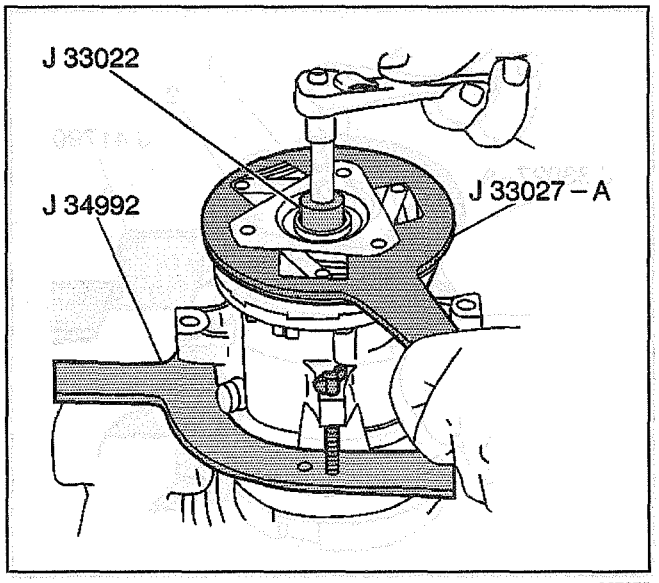
365448

Compressor Clutch Plate and Hub Assembly Removal (V5 - Conventional Mount)

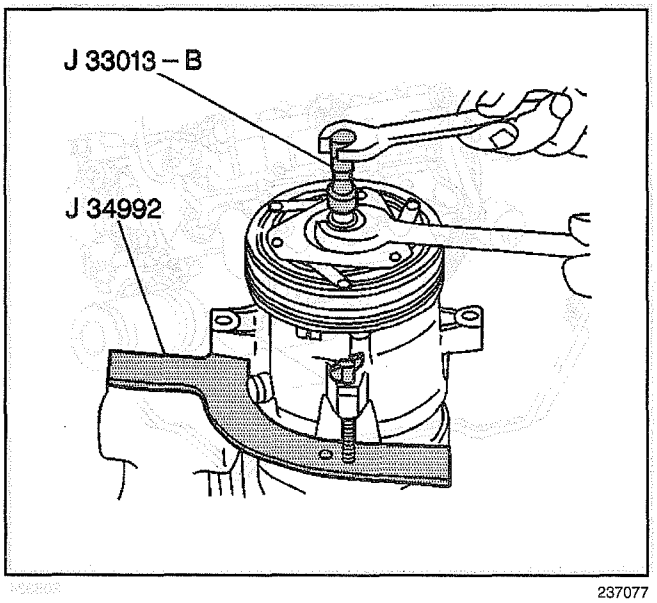
Tools Required

- *J 33022* Shaft Nut Socket
- *J 33027-A* Clutch Hub Holding Tool
- *J 33013-B* Hub And Drive Plate Remover And Installer
- *J 34992* Compressor Holding Fixture

1. Clamp the *J 34992* in a vise.
2. Attach the compressor to the holding fixture using the thumb screws.
3. Use the *J 33027-A* in order to prevent the clutch hub and drive plate assembly from turning.
4. Use the *J 33022* in order to remove the shaft nut.

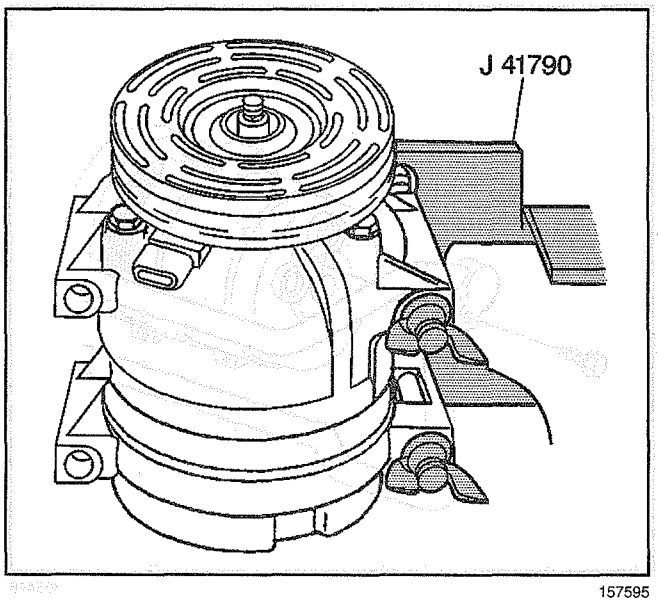


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5. Thread the *J 33013-B* into the hub.
6. Use a wrench in order to hold the body of the *J 33013-B*.
7. Turn the center screw into the body of the *J 33013-B* in order to remove the clutch plate and hub assembly.
8. Remove the shaft key. Retain the shaft key for reassembly.



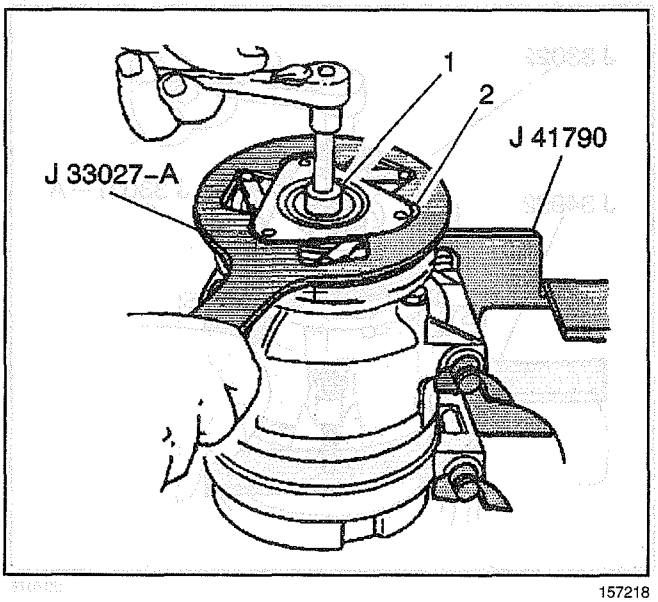
157595

Compressor Clutch Plate and Hub Assembly Removal (V7 - Direct Mount)

Tools Required

- *J 33013-B* Hub and Drive Plate Remover/Installer
- *J 33027-A* Clutch Hub Holding Tool
- *J 41790* Compressor Holding Fixture

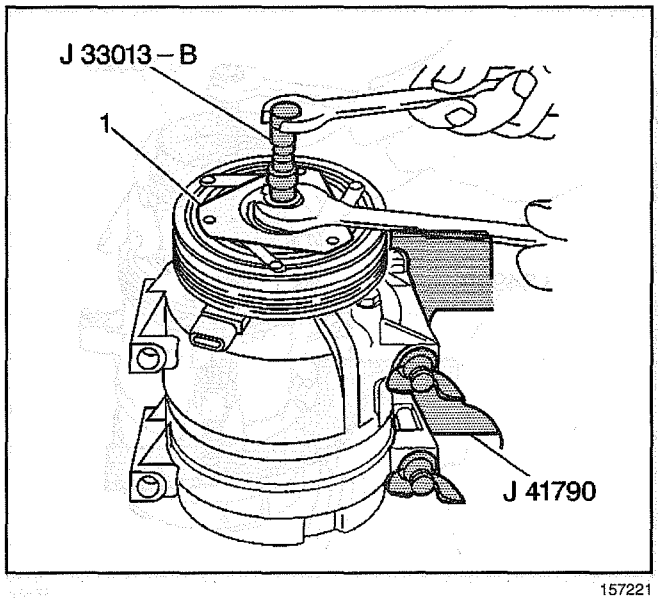
1. Remove the compressor from the vehicle.
2. Clamp the compressor holding fixture, *J 41790* in a vise and attach the compressor to the *J 41790*.



157218

3. Hold the clutch hub and drive plate assembly (2) in place using the *J 33027-A*.
4. Remove the compressor shaft nut with a 13 mm socket (1).

5. Thread the *J 33013-B* into the hub.
6. Remove the hub and drive plate assembly (1) by turning the center screw into the body of the *J 33013-B* and against the compressor shaft.
7. Remove the shaft key and retain for reassembly.



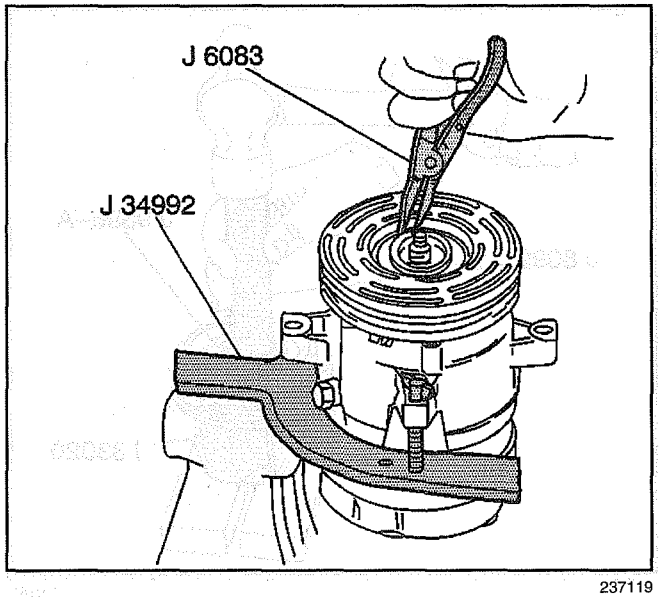
157221

Clutch Rotor and/or Bearing Removal (V5 - Conventional Mount)

Tools Required

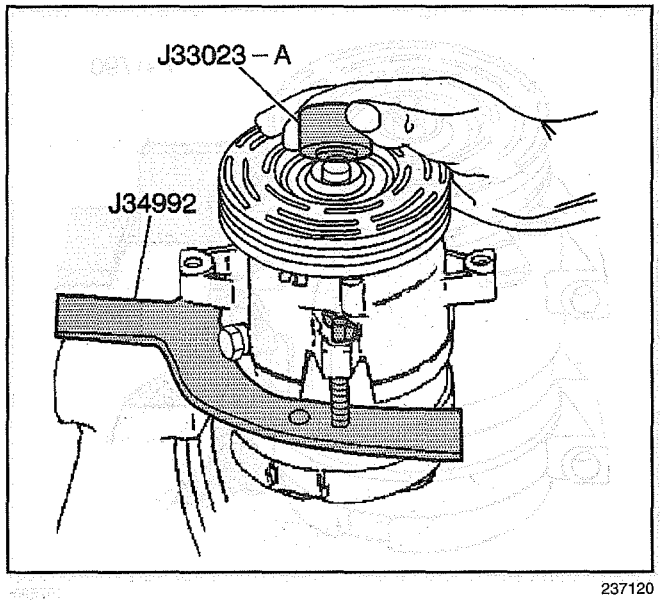
- *J 6083* Snap Ring Pliers
- *J 9398* Bearing Remover
- *J 8092* Driver Handle
- *J 33020* Pulley Puller
- *J 33023-A* Puller Pilot

1. Remove the clutch plate and hub assembly. Refer to *Compressor Clutch Plate and Hub Assembly Removal (V5 - Conventional Mount)*.
2. Use the *J 6083* in order to remove the rotor and bearing assembly retaining ring.

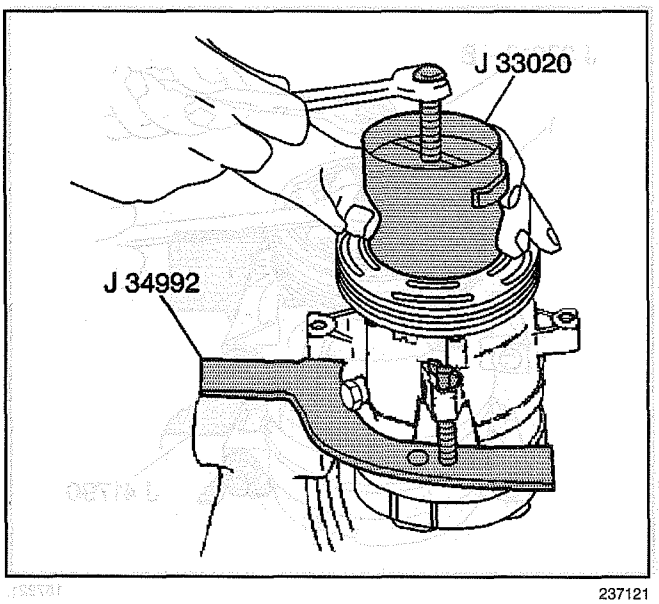


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3. Install the *J 33023-A* to the front head.

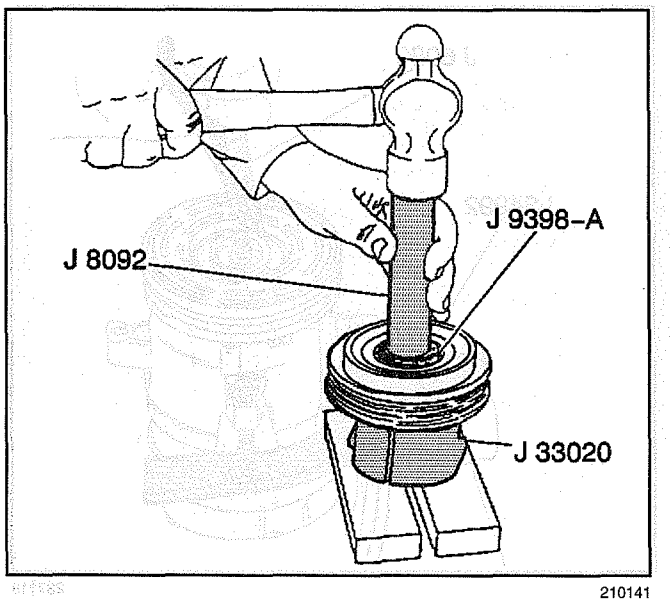


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4. Install the *J 33020* into the inner circle of slots in the rotor.
5. Turn the *J 33020* clockwise in the slots in order to engage the tangs of the puller with the segments between the slots in the rotor.
6. Hold the *J 33020* in place. Tighten the puller screw against the puller guide in order to remove the puller rotor and bearing assembly.

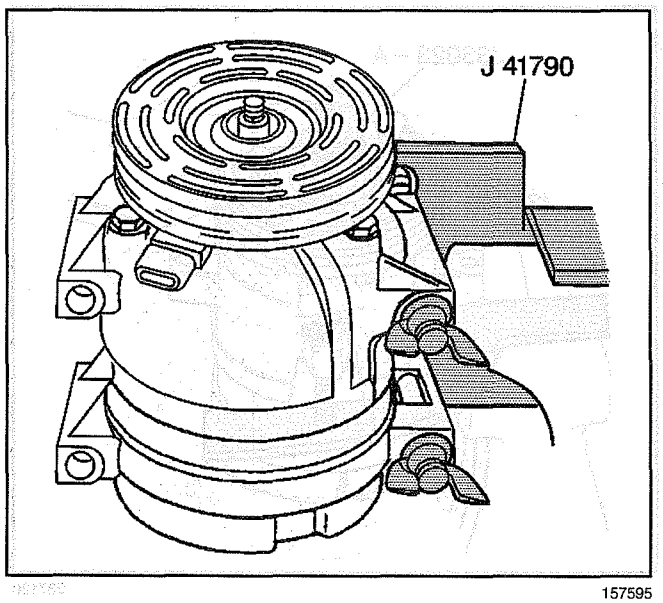


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7. Support the rotor hub in order to prevent damage to the pulley rotor during bearing removal.
   7.1. Remove the forcing screw from the *J 33020*.
   7.2. With the tangs of the *J 33020* still engaged in the rotor slots, invert the assembly onto a solid, flat surface or blocks.

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.

8. Use a *J 9398* with the *J 8092* in order to drive the bearing out of the rotor hub.



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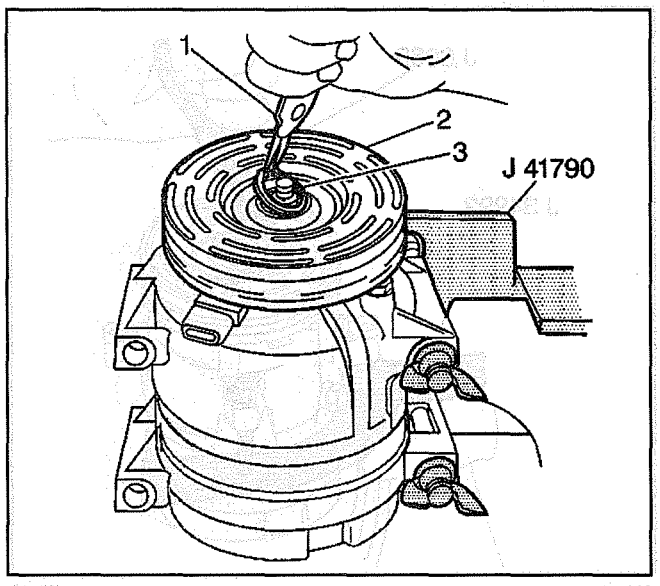
Clutch Rotor and/or Bearing Removal (V7 - Direct Mount)

Tools Required

- *J 33023-A* Puller Pilot
- *J 41552* Compressor Pulley Puller
- *J 41790* Compressor Holding Fixture

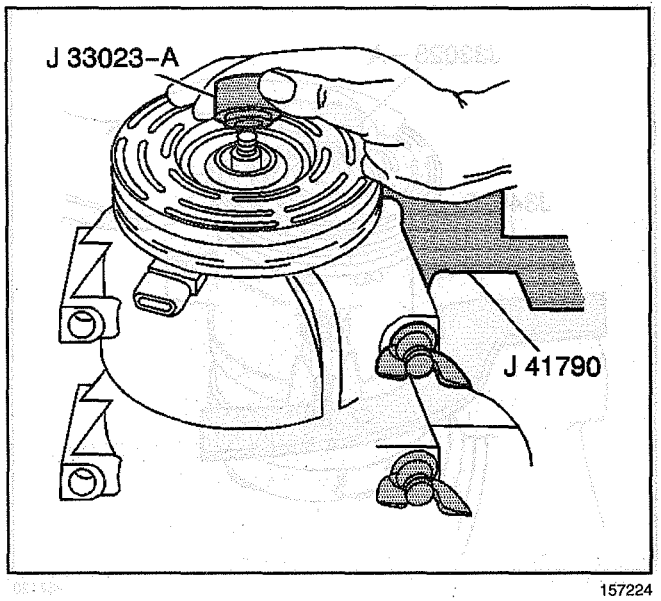
1. Remove the compressor from the vehicle.
2. Clamp the compressor holding fixture, *J 41790* in a vise and attach the compressor to the *J 41790*.

3. Remove the clutch plate and hub assembly. Refer to *Compressor Clutch Plate and Hub Assembly Removal (V7 - Direct Mount)*.
4. Using external snap ring pliers (1), remove the clutch rotor and bearing assembly retaining ring (3).



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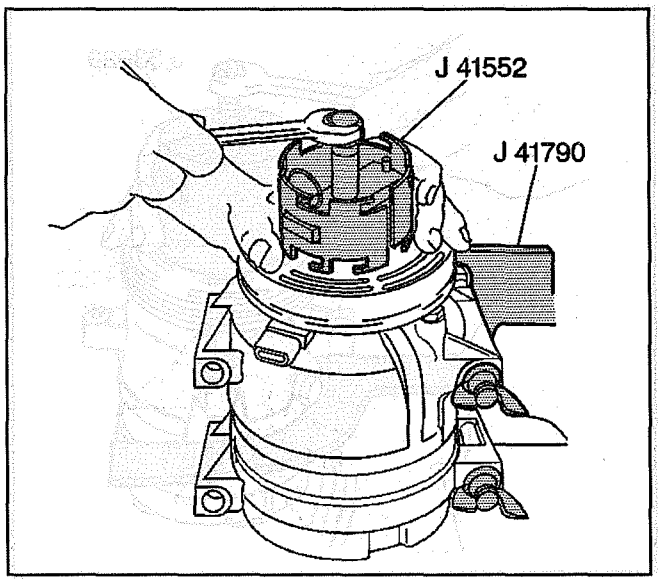
5. Place the *J 33023-A* on the clutch rotor.



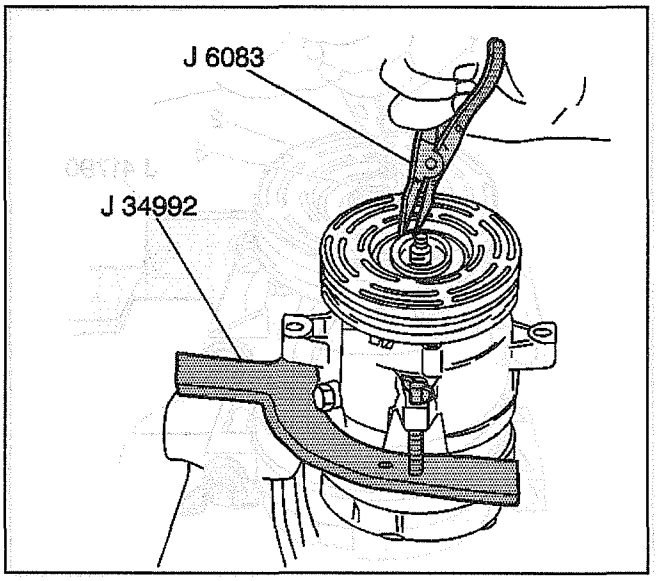
157224

6. Install the *J 41552* down into the inner circle of slots in the rotor.

   Turn the *J 41552* clockwise in the slots to engage the puller tangs with the rotor.
7. Hold the *J 41552* in place and use a wrench to turn the center forcing screw against the *J 33023-A* to remove the clutch rotor and bearing assembly.



157225



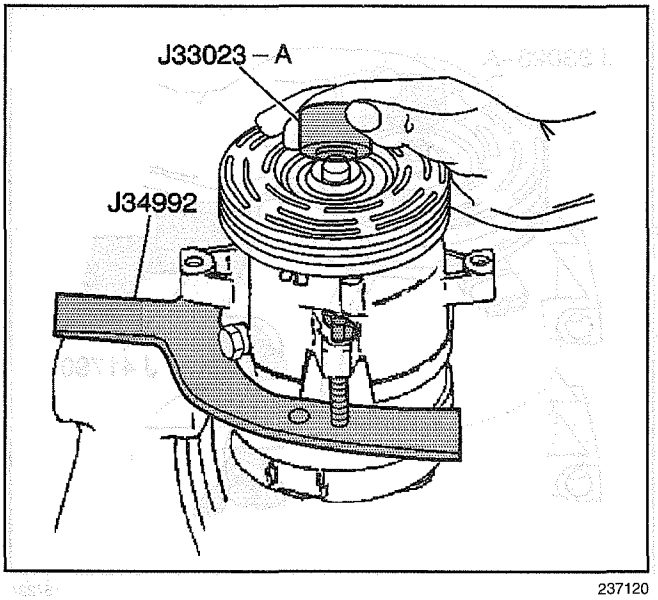
237119

Compressor Clutch Coil Removal (V5 - Conventional Mount)

Tools Required

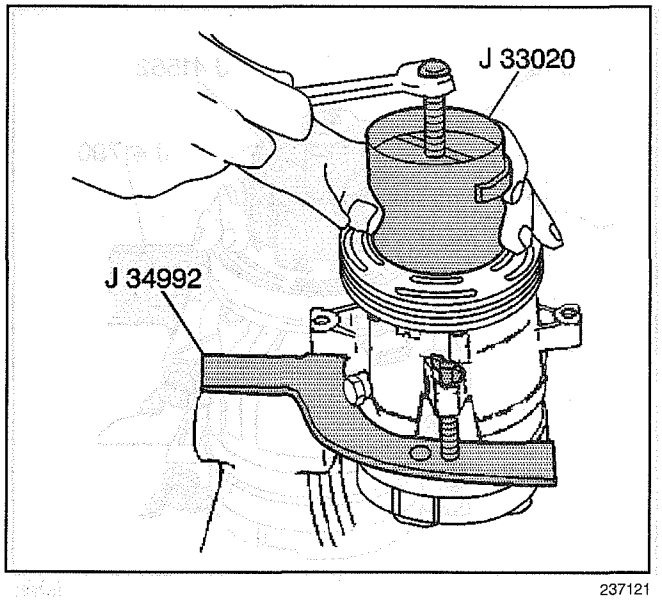
- *J 6083* Snap Ring Pliers
- *J 8433-1* Puller Bar
- *J 8433-3* Forcing Screw
- *J 33020* Pulley Puller
- *J 33023-A* Puller Pilot
- *J 33025* Clutch Coil Puller Legs

1. Remove the clutch plate and hub assembly. Refer to *Compressor Clutch Plate and Hub Assembly Removal (V5 - Conventional Mount)*.
2. Use the *J 6083* in order to remove the rotor and bearing assembly retaining ring.



237120

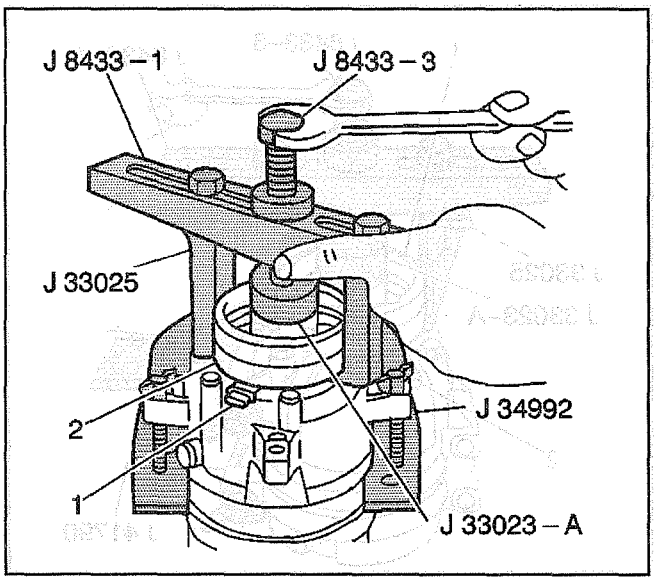
3. Install the *J 33023-A* to the front head.



237121

4. Install the *J 33020* into the inner circle of slots in the rotor.
5. Turn the *J 33020* clockwise in the slots in order to engage the tangs of the puller with the segments between the slots in the rotor.
6. Hold the *J 33020* in place. Tighten the puller screw against the puller guide in order to remove the puller rotor and bearing assembly.

7. Mark the location of the clutch coil terminal (1) on the compressor front head.
8. Install the *J 33023-A* on the front head of the compressor.
9. Install the *J 8433-1* and the *J 8433-3* with the *J 33025* on the front head of the compressor.
10. Tighten the *J 8433-3* against the *J 33023-A* in order to remove the clutch coil (2).



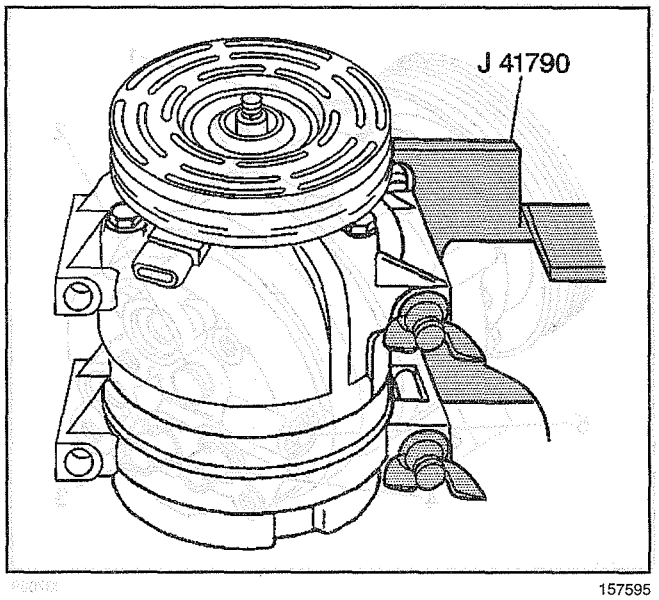
237123

Compressor Clutch Coil Removal (V7 - Direct Mount)

Tools Required

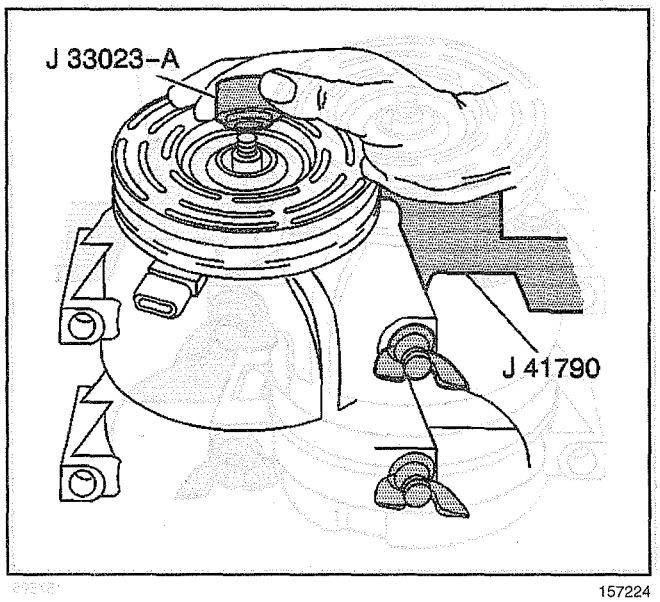
- *J 8433* Compressor Pulley Puller
- *J 8433-3* Forcing Screw
- *J 33023-A* Puller Pilot
- *J 33025* Clutch Coil Puller Legs
- *J 41790* Compressor Holding Fixture

1. Remove the compressor from the vehicle.
2. Clamp the compressor holding fixture, *J 41790* in a vise and attach the compressor to the *J 41790*.

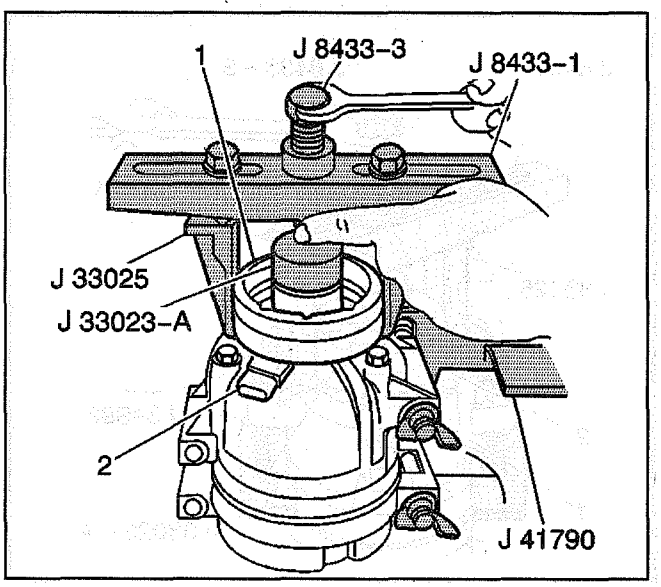


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3. Remove the compressor clutch plate and hub assembly. Refer to *Compressor Clutch Plate and Hub Assembly Removal (V7 - Direct Mount)*.
4. Install the *J 33023-A* onto the front head of the compressor.
5. Remove the compressor rotor and bearing assembly. Refer to *Clutch Rotor and/or Bearing Removal (V7 - Direct Mount)*.

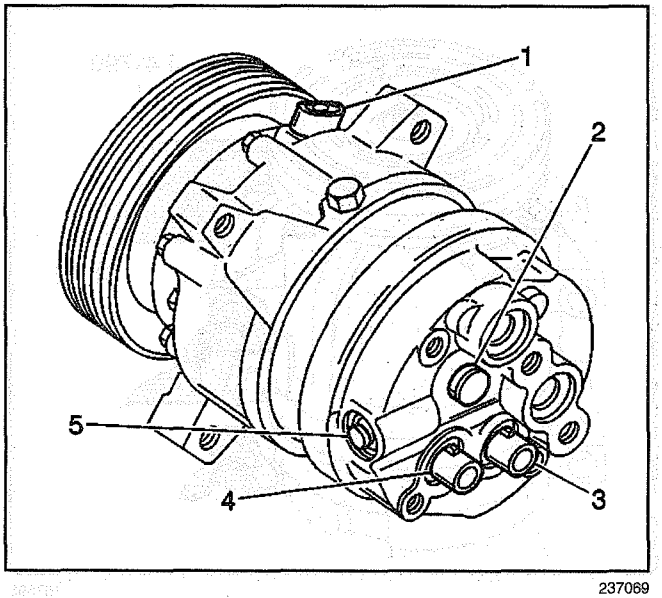


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6. Mark the clutch coil terminal location (2) on the compressor front head.
7. Install the *J 33025* onto the *J 8433*.
8. Install the *J 8433* onto the compressor clutch coil (1) and tighten the puller leg bolts.
9. Tighten the center forcing screw *J 8433-3* of the compressor pulley puller *J 8433* against the *J 33023-A* to remove the compressor clutch coil from the compressor.
10. Remove the *J 8433-3*, the *J 33023-A*, the *J 33025* and the *J 8433*.



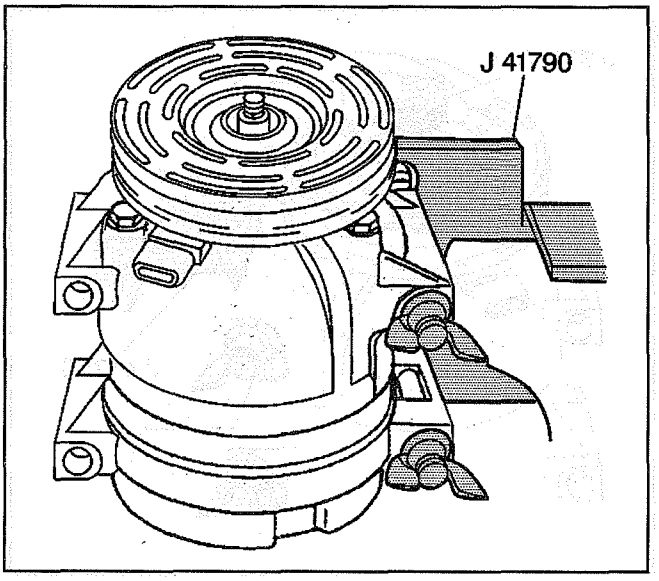
237069

Compressor Control Valve Assembly Removal (V5 - Conventional Mount)

Tools Required

- *J 5403* Snap Ring Pliers
- *J 39500-B* A/C Refrigerant Recovery, Recycling and Recharging (ACR4) System

1. Recover the refrigerant using the *J 39500-B*.
2. Remove the control valve retaining ring using the *J 5403*.
3. Remove the control valve assembly (5).



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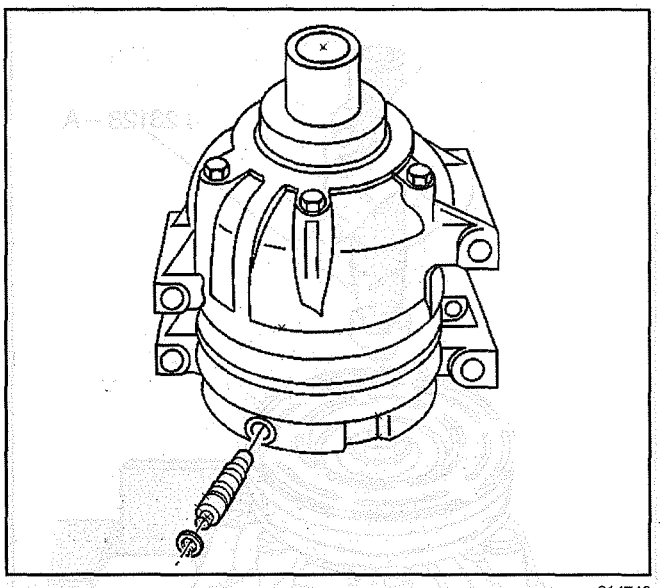
Compressor Control Valve Assembly Removal (V7 - Direct Mount)

Tools Required

J 41790 Compressor Holding Fixture

1. Remove the compressor from the vehicle.
2. Clamp the compressor holding fixture, *J 41790* in a vise and attach the compressor to the *J 41790*.

3. Using internal snap ring pliers, remove the compressor control valve retaining ring.
4. Remove the compressor control valve from the compressor.



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Compressor Shaft Seal Removal (V5 - Conventional Mount)

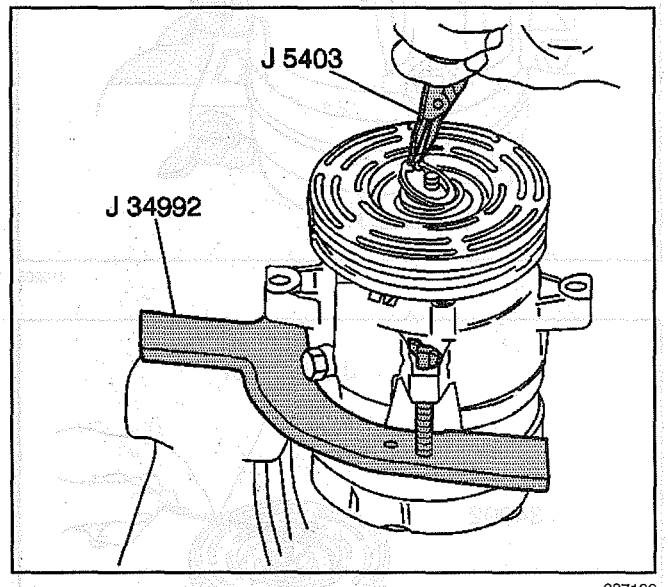
Tools Required

- *J 34992* Compressor Holding Fixture
- *J 39400-A* Electronic Halogen Leak Detector
- *J 9553-01* O-Ring Remover
- *J 5403* Snap Ring Pliers
- *J 23128-A* Seal Seat Installer and Remover

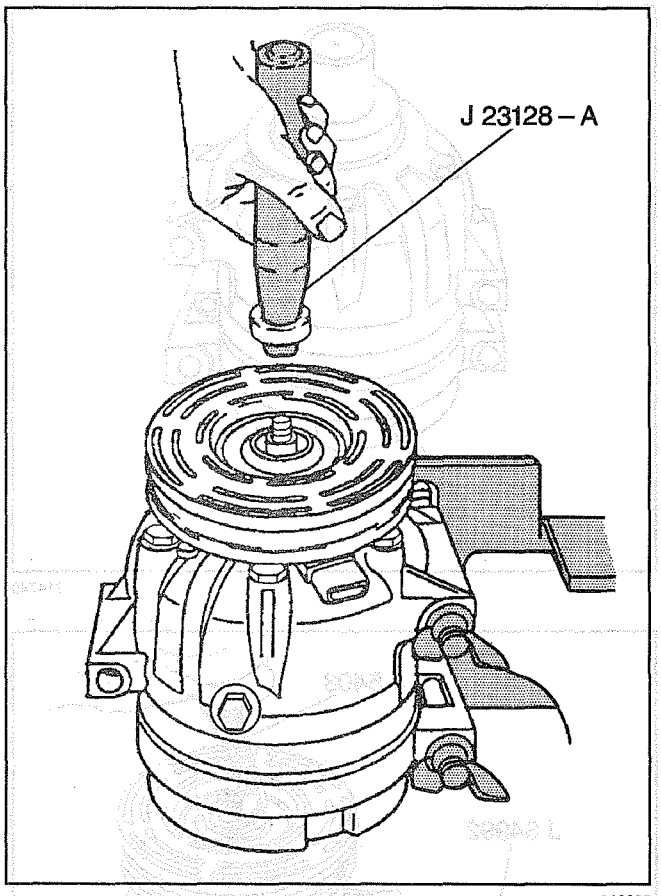
Important: Do not change a shaft seal because of small amounts of oil found on an adjacent surface. The seal allows some oil to pass for lubrication purposes. Change the shaft seal when the following conditions exist:

- A large amount of sprayed oil is found.
- Actual refrigerant leak is found, using a *J 39400-A* or equivalent.

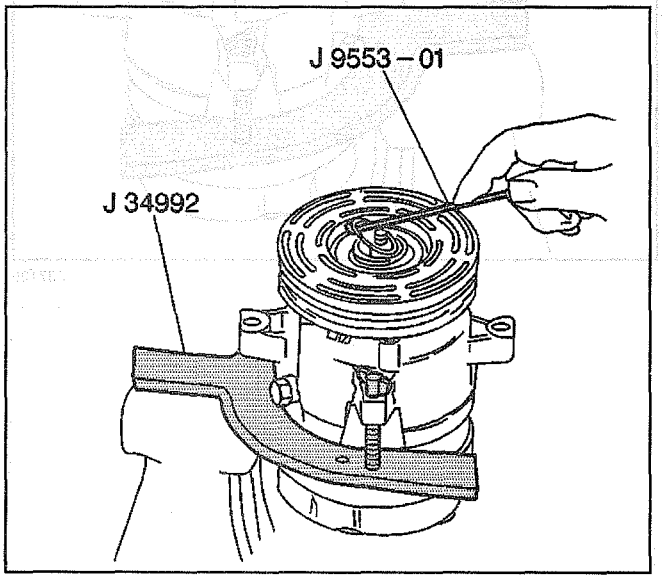
1. Install the compressor into the *J 34992*.
2. Remove the clutch plate and hub assembly. Refer to *Compressor Clutch Plate and Hub Assembly Removal (V5 - Conventional Mount)*.
3. Remove the shaft seal retaining ring using the *J 5403*.
4. In order to prevent dirt or foreign material from damaging the compressor, thoroughly clean the following parts:
   - The inside of the compressor neck area surrounding the shaft
   - The exposed portion of the seal
   - The compressor shaft
   - The O-ring groove



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Important: Securely hand-tighten the handle of the *J 23128-A*. Do not use a wrench or pliers.

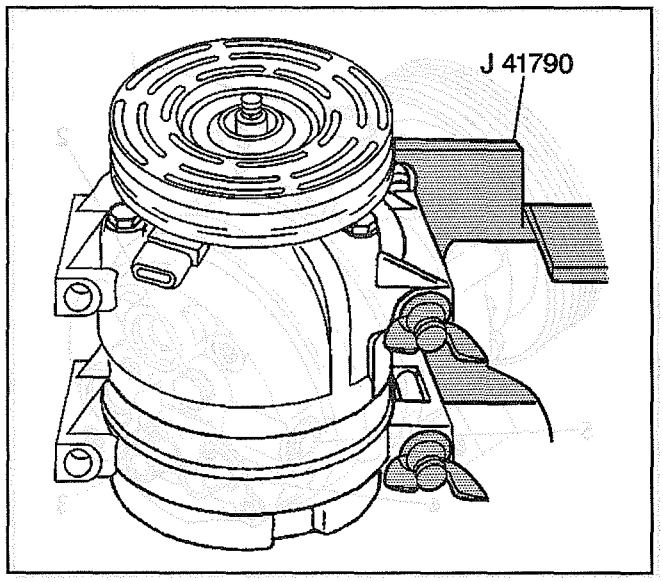
5. Fully engage the knurled tangs of the *J 23128-A* into the recessed portion of the seal by turning the handle clockwise.
6. Remove the seal from the compressor using a rotary-pulling motion. Discard the seal.
7. Remove the seal O-ring from the compressor neck using the *J 9553-01*. Discard the seal O-ring.
8. Inspect the shaft and the inside of the compressor neck again for dirt and foreign material.
9. Ensure that the shaft and the inside of the compressor neck are perfectly clean prior to installing new parts.

Compressor Shaft Seal Removal (V7 - Direct Mount)

Tools Required

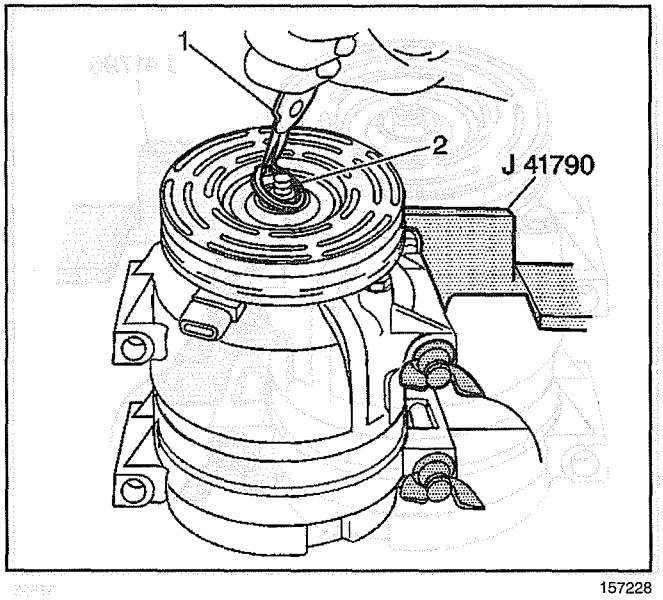
- *J 41790* Compressor Holding Tool
- *J 42136* A/C Lip Seal Remover

1. Remove the compressor from the vehicle.
2. Clamp the compressor holding fixture, *J 41790* in a vise and attach the compressor to the *J 41790*.



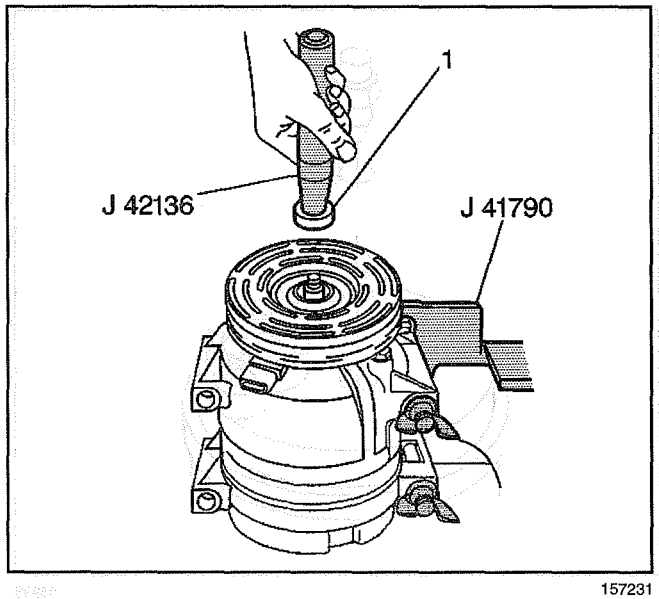
157595

3. Remove the compressor clutch plate and hub assembly. Refer to *Compressor Clutch Plate and Hub Assembly Removal (V7 - Direct Mount)*.
4. Using internal snap ring pliers (1), remove the compressor shaft seal retainer ring (2).
5. To keep any dirt or foreign material from getting into the compressor, thoroughly clean the following components:
   - The inside of the compressor neck area surrounding the shaft
   - The exposed portion of the compressor shaft seal
   - The compressor shaft
   - The O-ring groove

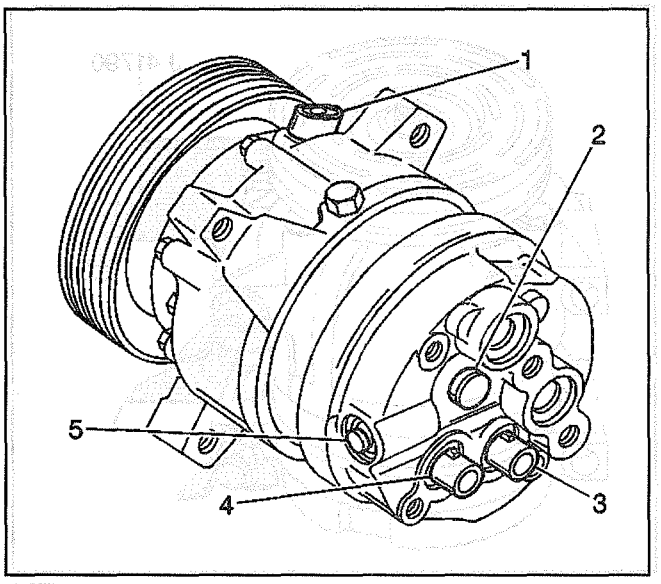


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6. Fully engage the lip of the *J 42136* into the recessed portion of the seal (1) by turning the handle clockwise.
7. Remove the compressor shaft seal from the compressor with a rotary pulling motion.
8. Recheck the shaft and inside of the compressor neck for dirt or foreign material and make sure these areas are perfectly clean before installing the new compressor shaft seal.



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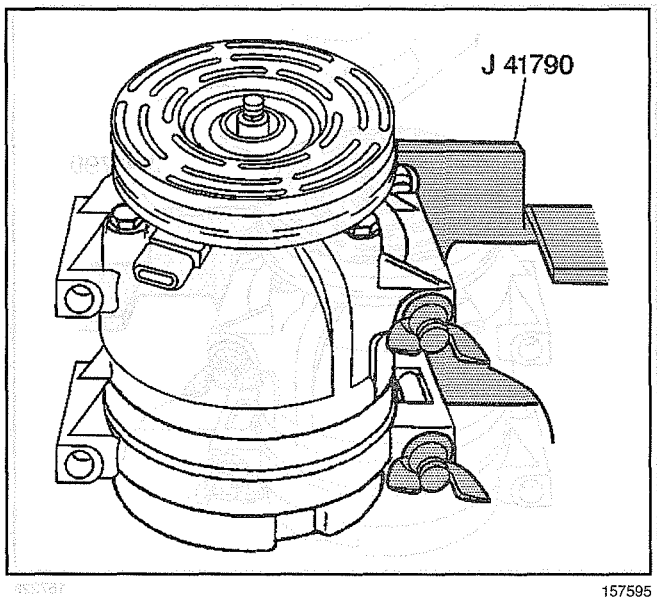
237069

Compressor Pressure Relief Valve Removal (V5 - Conventional Mount)

Tools Required

J 39500-B A/C Refrigerant Recovery, Recycling and Recharging (ACR4) System

1. Recover the refrigerant using the *J 39500-B*.
2. Remove the pressure relief valve (2).



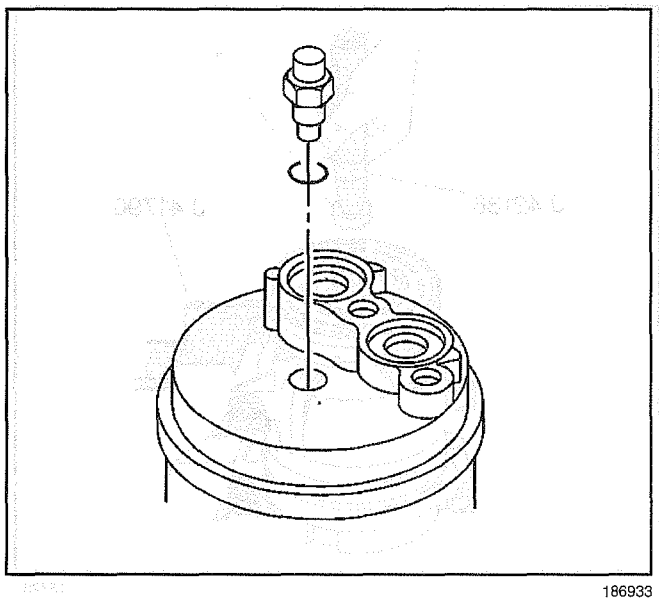
157595

Compressor Pressure Relief Valve Removal (V7 - Direct Mount)

Tools Required

J 41790 Compressor Holding Fixture

1. Remove the compressor from the vehicle.
2. Clamp the compressor holding fixture, *J 41790* in a vise and attach the compressor to the *J 41790*.



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3. Remove the pressure relief valve from the rear head of the compressor.

Compressor Control Switches Removal (V5 - Conventional Mount)

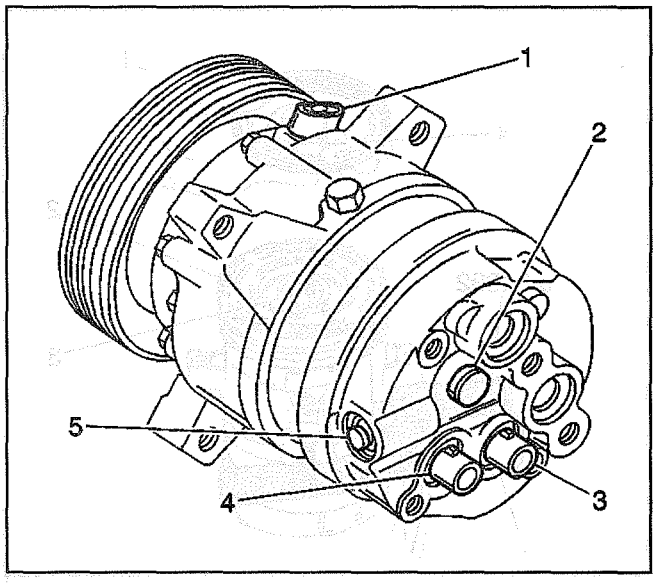
Tools Required

- *J 5403* Snap Ring Pliers
- *J 9553-01* O-Ring Remover
- *J 39500-B* R–134a Air Conditioning Refrigerant Recovery, Recycling And Recharging System

1. Recover the refrigerant using the *J 39500-B*.
2. Disconnect the electrical connector from the switch (3 or 4) in the rear head of the compressor.
3. Remove the switch retaining ring using the *J 5403*.
4. Remove the switch (3 or 4) from the compressor.

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

5. Remove the old O-ring seal from the switch cavity using the *J 9553-01*.



237069

Compressor Control Valve Assembly Install (V5 - Conventional Mount)

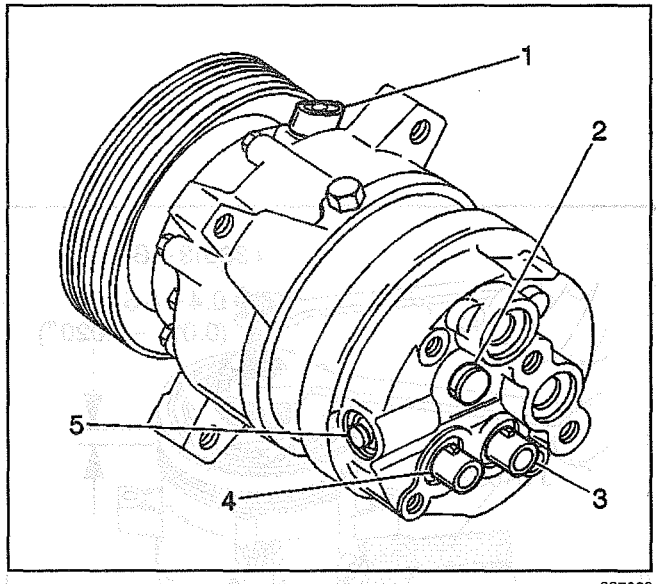
Tools Required

J 5403 Snap Ring Pliers

1. Coat the O-rings with 525 viscosity refrigeration oil.
2. Using thumb pressure, push the O-rings in place.

Important: Ensure that the retaining ring is properly seated in the ring groove.

3. Using the *J 5403*, install the valve retaining ring (5) with the high point of the curved sides against the valve housing.
4. Evacuate the system. Recharge the system.
5. Perform a leak test. Refer to *Compressor Leak Testing (V5 - Conventional Mount)*.



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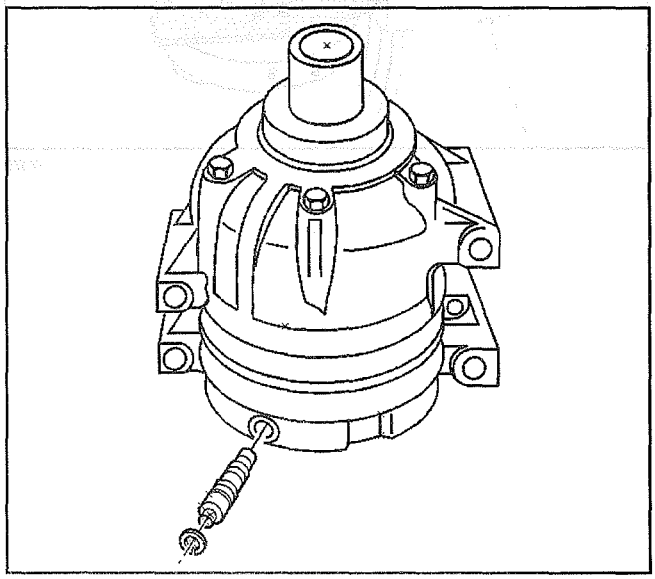
Compressor Control Valve Assembly Install (V7 - Direct Mount)

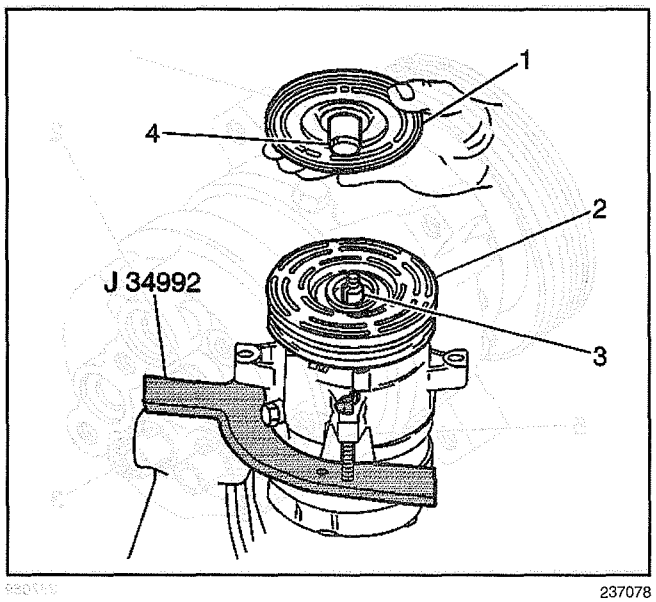
Tools Required

J 41790 Compressor Holding Fixture

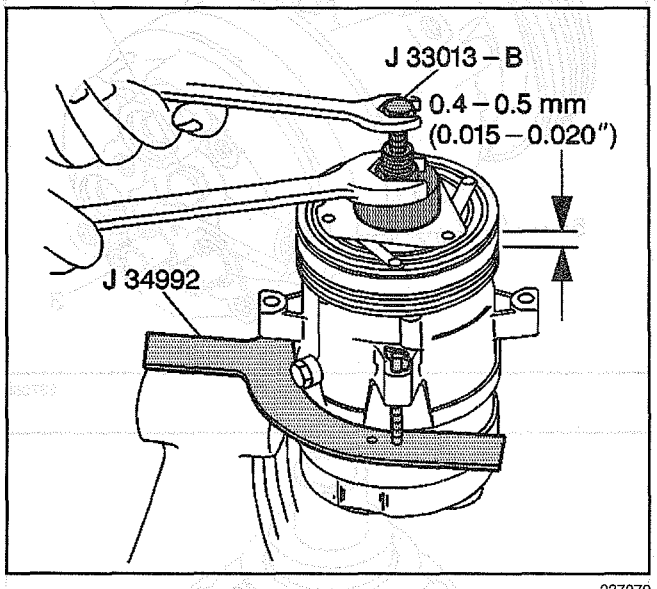
1. Coat the control valve O-rings with clean 525 viscosity refrigeration oil.
2. Push the compressor control valve into the compressor with thumb pressure.
3. Using internal snap ring pliers, install the compressor control valve retaining ring.

   Make sure the retaining ring is properly seated in the ring groove.
4. Remove the compressor from the *J 41790*.
5. Install the compressor into the vehicle.


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Compressor Clutch Plate/Hub Assembly Install (V5 - Conventional Mount)

Tools Required

- *J 33013-B* Hub And Drive Plate Remover And Installer
- *J 33022* Shaft Nut Socket
- *J 33027-A* Clutch Hub Holding Tool
- *J 34992* Compressor Holding Fixture

1. Install the compressor into the *J 34992*.
2. Install the shaft key (4) into the key groove of the clutch plate and hub (1).
   - Allow the key to project 3.2 mm (0.126 in) out of the key groove.
   - The shaft key is curved slightly in order to provide an interference fit in the key groove of the hub.
3. Clean the frictional surfaces of the clutch plate and hub and the clutch pulley rotor (2).
4. Align the shaft key with the shaft keyway (3).

Notice: Do not drive or pound on the clutch hub or the shaft. Internal damage to the compressor may result.

5. Place the clutch plate and hub assembly onto the compressor shaft.
6. Remove the center screw from the *J 33013-B*.
7. Reverse the body direction of the center screw of the *J 33013-B*.
8. Install the *J 33013-B* with the bearing.
9. Back off the body of the *J 33013-B* in order to allow the center screw to be threaded onto the end of the compressor shaft.
10. Hold the center screw of the *J 33013-B* with a wrench.

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.

11. Tighten the hex portion of the body of the *J 33013-B* in order to press the hub onto the shaft.
12. Tighten the body of the *J 33013-B* several turns.
13. Remove the *J 33013-B*.
14. Verify that the shaft key remains in the keyway before installing the clutch plate and hub assembly to the final position.
15. Ensure that the gap between the frictional surfaces of the clutch plate and the clutch rotor is within 0.40–0.50 mm (0.016–0.020 in).
16. Remove the *J 33013-B*.
17. Verify that the shaft key is even with or slightly above the clutch hub.
18. Install the shaft nut.
19. Hold the clutch plate and hub assembly with the *J 33027-A*.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

20. Tighten the shaft nut against the crankshaft shoulder, using a 17.5 N·m (12.5 lb ft) torque wrench and the *J 33022*.

    Tighten

    Tighten the nut to 16.5 N·m (12 lb ft).

21. Spin the pulley rotor by hand in order to verify that the rotor does not rub the clutch drive plate.

Compressor Clutch Plate/Hub Assembly Install (V7 - Direct Mount)

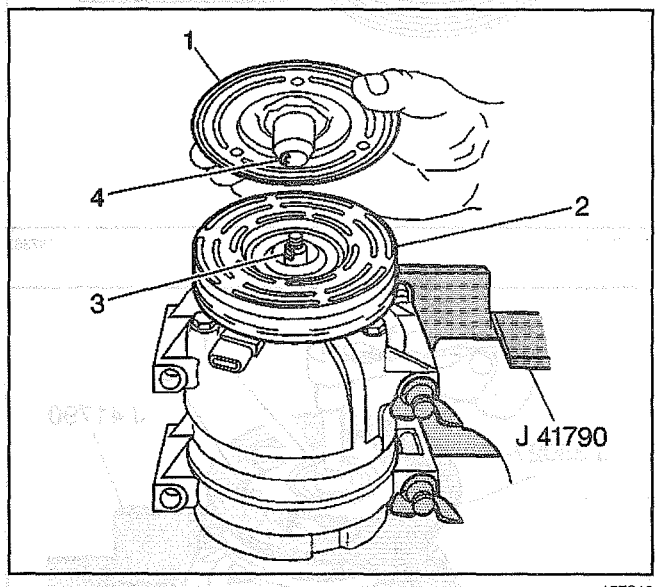
Tools Required

- *J 33013-B* Hub and Drive Plate Remover/Installer
- *J 33017* Pulley and Bearing Assembly Installer
- *J 33027-A* Clutch Hub Holding Tool

1. Install the shaft key into the hub key groove (4) approximately 3.2 mm (1/8 in) out of the keyway.

   The shaft key is curved slightly to provide an interference fit in the hub key groove.

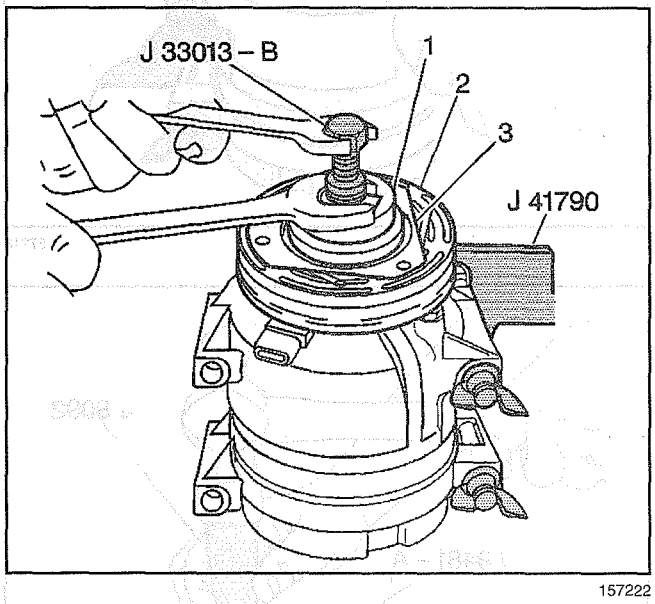
2. Clean the surfaces of the clutch plate (1) and the clutch rotor (2) before installing the clutch plate and hub assembly.
3. Align the shaft key with the shaft keyway in the clutch plate and the hub assembly and place onto the compressor shaft (3).



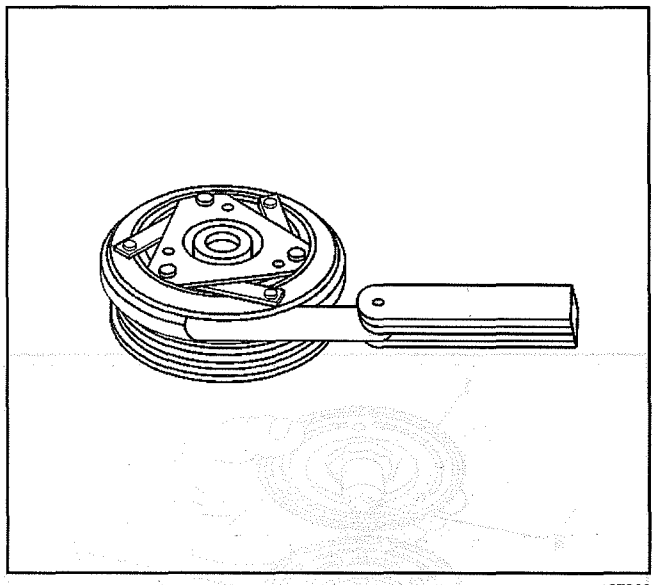
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4. Remove the *J 33013-B*.
   - 4.1. Remove the center screw from the body of the *J 33013-B*.
   - 4.2. Install the center screw into the opposite end of the *J 33013-B*.
5. Install the *J 33013-B* and bearing tools (1) onto the clutch plate (3) and the hub assembly (2).
   - 5.1. Back the body of the *J 33013-B* off enough to allow the center screw to be threaded onto the end of the compressor shaft.
   - 5.2. Thread the center screw several turns onto the end of the compressor shaft.

     Do not tighten the center screw on the compressor shaft.
6. Hold the center screw with a wrench.
   - 6.1. Tighten the hex portion of the *J 33013-B* body several turns.
   - 6.2. Remove the *J 33013-B* from the clutch plate and hub.
   - 6.3. Make sure that the shaft key is still in place in the keyway.
7. Reinstall the *J 33013-B*.



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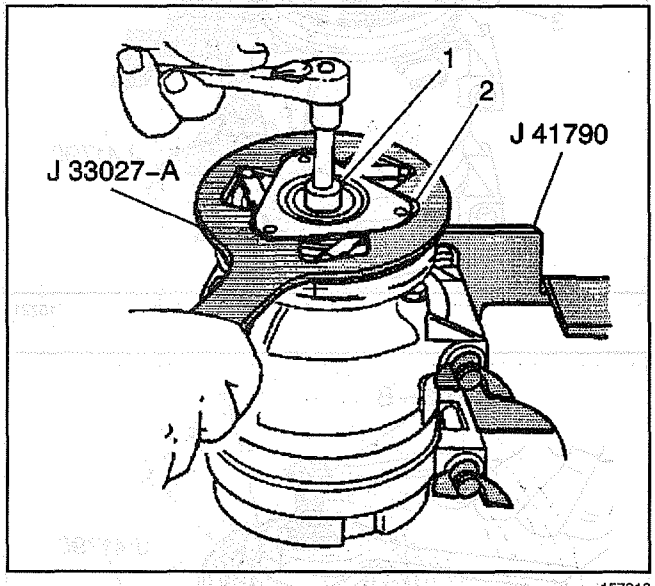


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8. Place a feeler gage between the clutch plate and the clutch rotor.

Important: Make sure that the air gap is even all around the clutch plate and hub assembly.

9. Tighten the hex portion of the *J 33013-B* until the air gap between the clutch plate and clutch rotor is 0.40 mm (0.015 in).

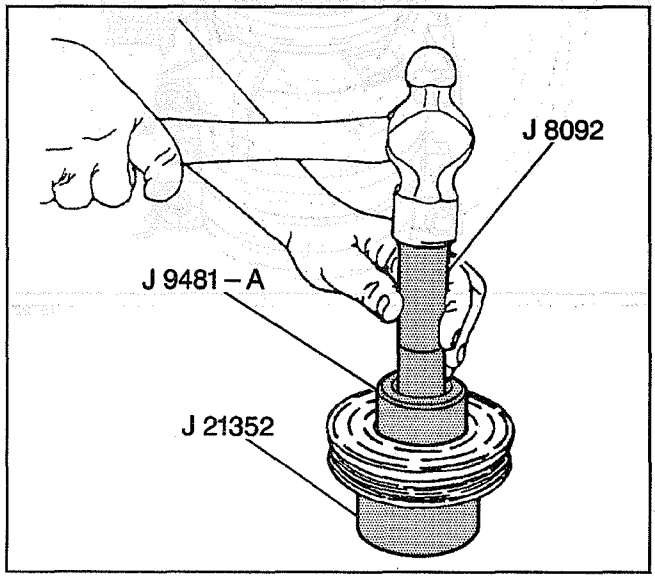


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10. Remove the *J 33013-B.*
11. Hold the clutch plate and hub assembly (2) with the *J 33027-A.*
12. Install the compressor shaft nut.

    Tighten

    Tighten the compressor shaft nut to 17.5 N·m (13 lb ft).
13. Spin the pulley rotor by hand to make sure the rotor is not rubbing against the clutch drive plate.
14. Remove the compressor from the *J 41790.*
15. Install the compressor into the vehicle.



210146

Clutch Rotor and/or Bearing Install (V5 - Conventional Mount)

Tools Required

- *J 6083* Snap Ring Pliers
- *J 8092* Driver Handle
- *J 8433-1* Puller Bar
- *J 8433-3* Forcing Screw
- *J 9481-A* Bearing Installer
- *J 21352-A* Support Block
- *J 33017* Pulley And Bearing Assembly Installer
- *J 33019* Bearing Staking Tool
- *J 33023-A* Puller Pilot
- *J 34992* Compressor Holding Fixture

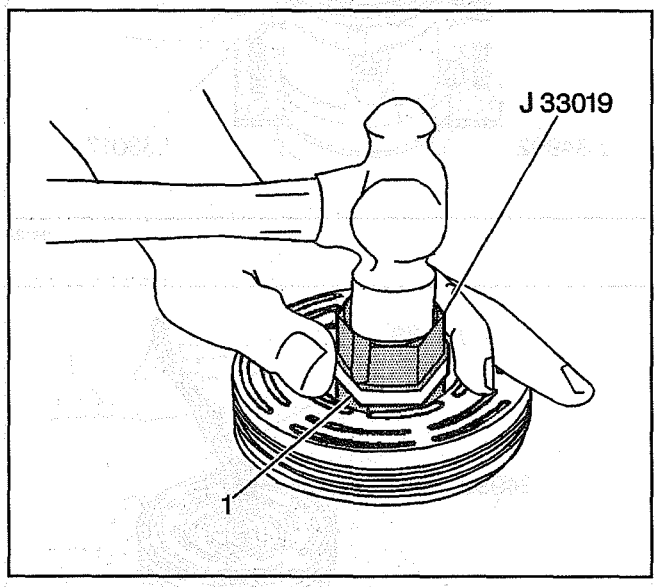
Notice: Do not support the rotor by resting the pulley rim on a flat surface during the bearing installation or the rotor face will be bent.

1. Place the pulley rotor on the *J 21352-A* in order to fully support the rotor hub during the bearing installation.
2. Align the new bearing with the hub bore.
3. Using the *J 9481-A* and the *J 8092,* drive the bearing into the hub.

   The *J 9481-A* applies force to the outer race of the bearing.
4. Place the *J 33019* and the staking pin in the hub bore.
5. Shift the rotor and bearing assembly on the *J 21352-A* in order to fully support of the hub under the location of the staking pin.
6. Use a heavy-duty rubber band (1) in order to hold the stake pin in the guide of the *J 33019.*

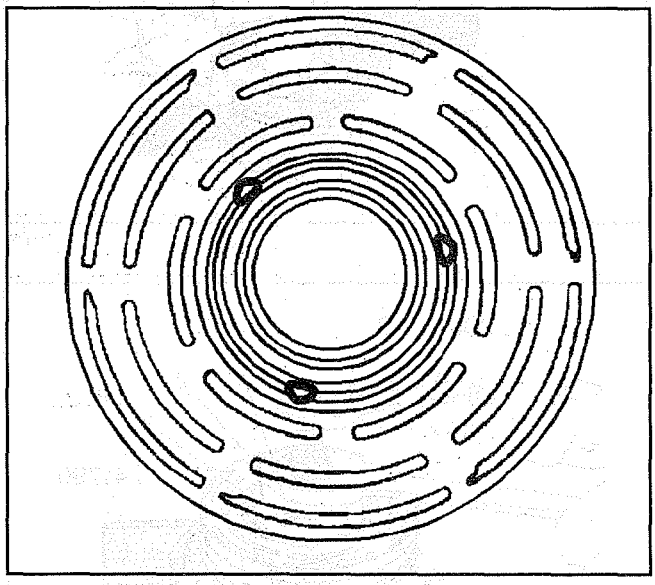
Important: Do not allow a metal stake to contact the outer face of the bearing in order to prevent distortion of the outer race.

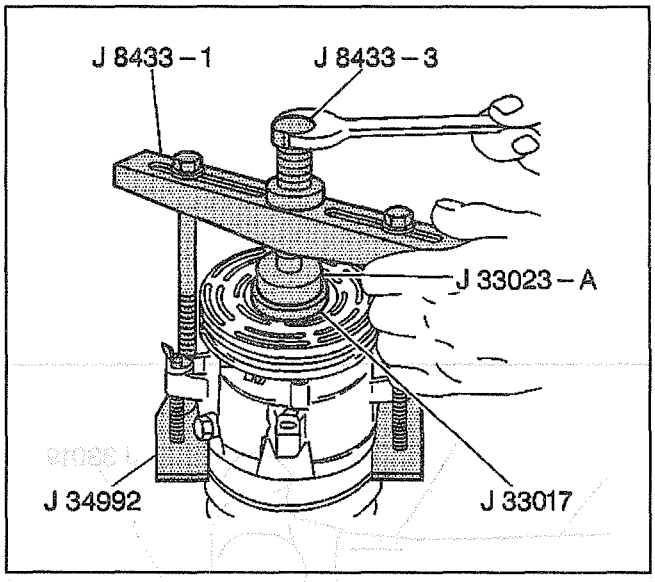
7. Using care in order to prevent injury, strike the staking pin of the *J 33019.* Properly position the stake pin in the guide after each impact on the pin.
8. Continue to strike the pin of the *J 33019* until a stake, similar to the original stake, is formed down to, but not touching, the bearing.



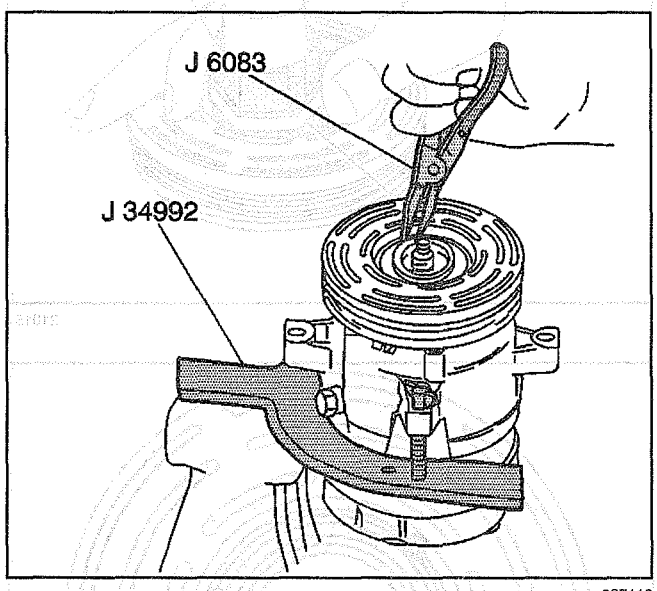
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9. Stake three places 120 degrees apart.

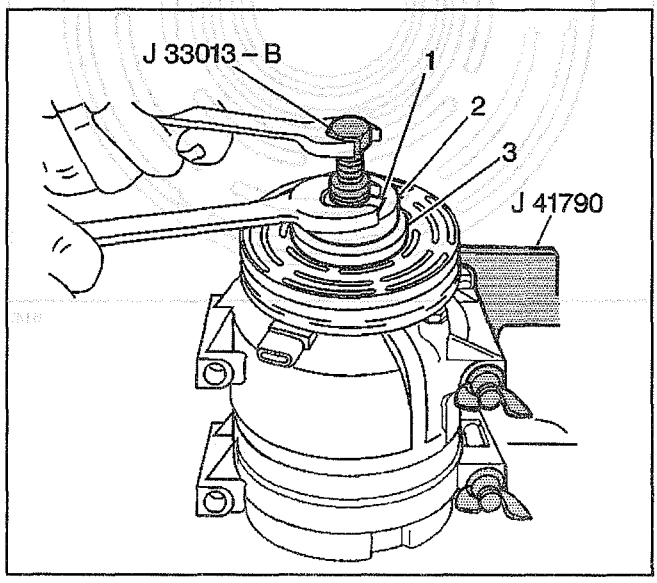

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10. With the compressor mounted to the *J 34992*, position the rotor and bearing assembly on the front head.
11. Position the *J 33017* and the *J 33023-A* directly over the inner race of the bearing.
12. Position the *J 8433-1* on the *J 33023-A*.
13. Assemble the two through bolts and the washers of the *J 34992* through the slots of the *J 8433-1*.
14. Thread the two through bolts into the *J 34992*. Ensure that the thread of the through bolts engages the full thickness of the *J 34992*.
15. Tighten the *J 8433-3* in the *J 8433-1* in order to force the pulley rotor and bearing assembly onto the front head of the compressor.
16. If the *J 33017* slips off direct, in-line contact with inner face of the bearing, use the following steps:
    16.1. Loosen the *J 8433-3*.
    16.2. Realign the *J 33017* and the *J 33023-A* in order to ensure that the installer clears the front head.
17. Install the rotor and bearing assembly retainer ring using the *J 6083*.
18. Install the clutch plate and hub assembly. Refer to *Compressor Clutch Plate/Hub Assembly Install (V5 - Conventional Mount)*.

Clutch Rotor and/or Bearing Install (V7 - Direct Mount)

Tools Required

- *J 33013-B* Hub and Drive Plate Remover/Installer
- *J 33017* Pulley and Bearing Assembly Installer

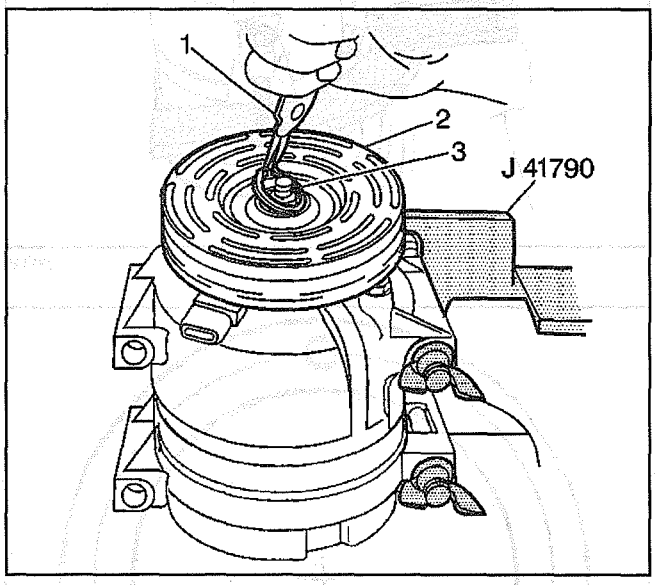
1. Position the clutch rotor and bearing assembly (2) onto the compressor.
2. Position the *J 33017* and bearing (1) from the *J 33013-B* directly over the inner race of the bearing.
3. Place the washer (3) from the J 42126 tool kit onto the body of the *J 33013-B*.
4. Remove the center screw from the body of the *J 33013-B*.
5. Install the center screw into the opposite end of the *J 33013-B*.

6. Back the body of the *J 33013-B* off enough to allow the center screw to be threaded onto the end of the compressor shaft.
7. Thread the center screw several turns onto the end of the compressor shaft.

   Do not tighten the center screw on the compressor shaft.
8. Hold the center screw with a wrench.
9. Tighten the hex portion of the *J 33013-B* body several turns.
10. Remove the *J 33013-B* from the clutch rotor and bearing assembly.
11. Make sure that the clutch rotor and bearing (2) is pressed onto the nose of the compressor far enough to clear the groove for the retaining ring.

    If the clutch rotor and bearing does not clear the groove, repeat steps 7, 8 and 9.
12. Install the clutch rotor and bearing retaining ring (3) using external snap ring pliers (1).

    Make sure that the camphor side of the retaining ring is facing up when the retaining ring is being installed.
13. Install the clutch plate and hub assembly. Refer to *Compressor Clutch Plate/Hub Assembly Install (V7 - Direct Mount)*.
14. Remove the compressor from the *J 41790*.
15. Install the compressor into the vehicle.



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Compressor Clutch Coil Install (V5 - Conventional Mount)

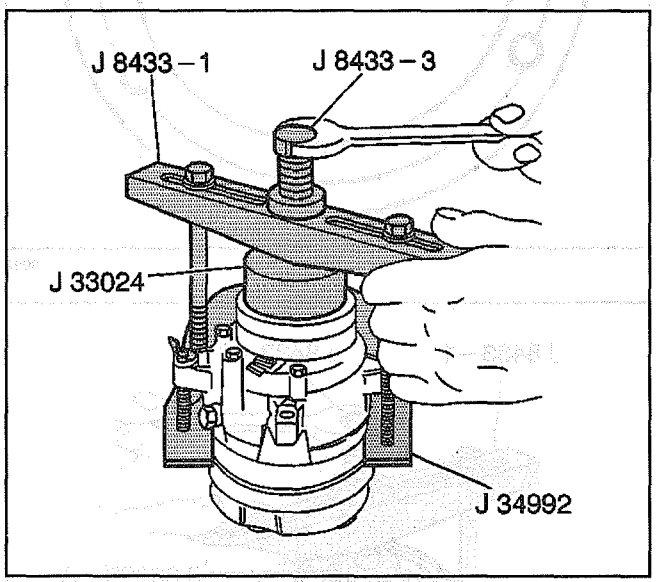
Tools Required

- *J 8433-1* Puller Bar
- *J 8433-3* Forcing Screw
- *J 33024* Clutch Coil Installer
- *J 34992* Compressor Holding Fixture
- *J 33025* Clutch Coil Puller Legs

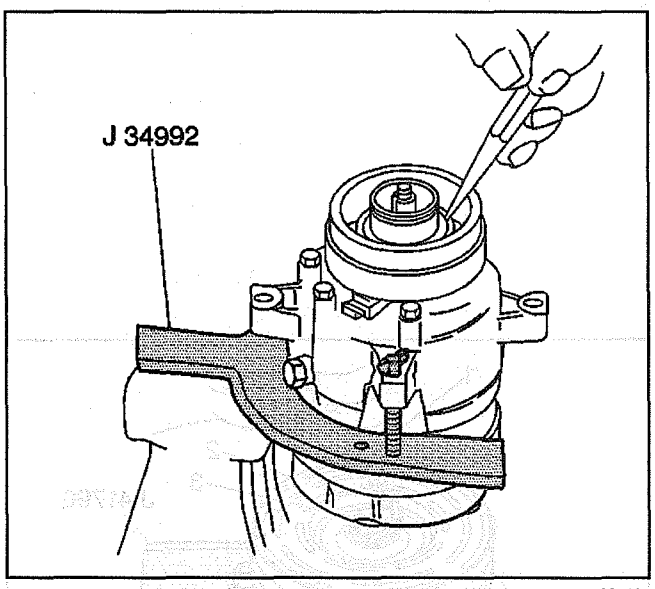
1. Place the clutch coil assembly on the front head with the terminals positioned at the marked location.
2. Place the *J 33024* over the internal opening of the clutch coil housing.
3. Align the *J 33024* with the compressor front head.
4. Center the *J 8433-1* on the countersunk center hole of the *J 33024*.
5. Install the through bolts and the washers of the *J 34992* through the slots in the *J 8433-1*.
6. Thread the through bolts into the *J 33025* in order to achieve full fixture thickness.

Important: Ensure that the clutch coil and the *J 33024* stay in-line during the installation.

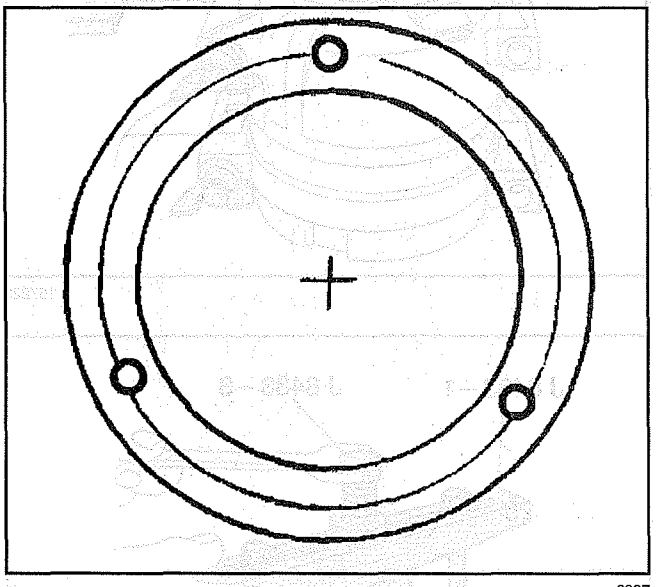
7. Turn the *J 8433-3* of the *J 8433-1* in order to force the clutch coil onto the head.



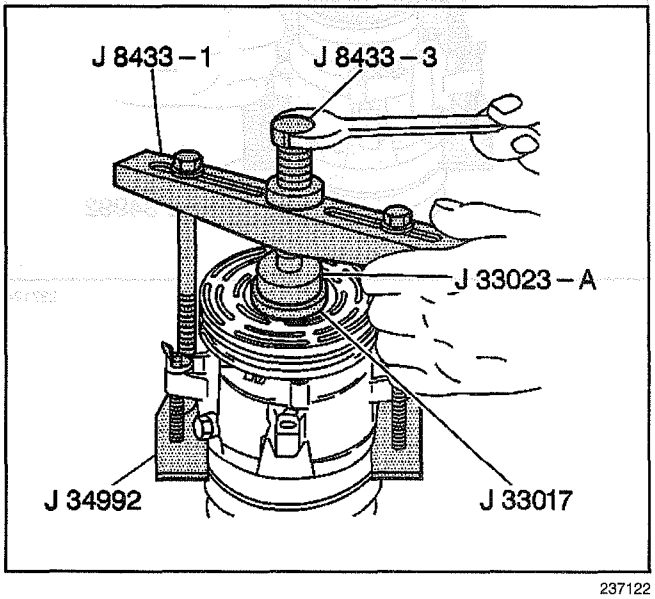
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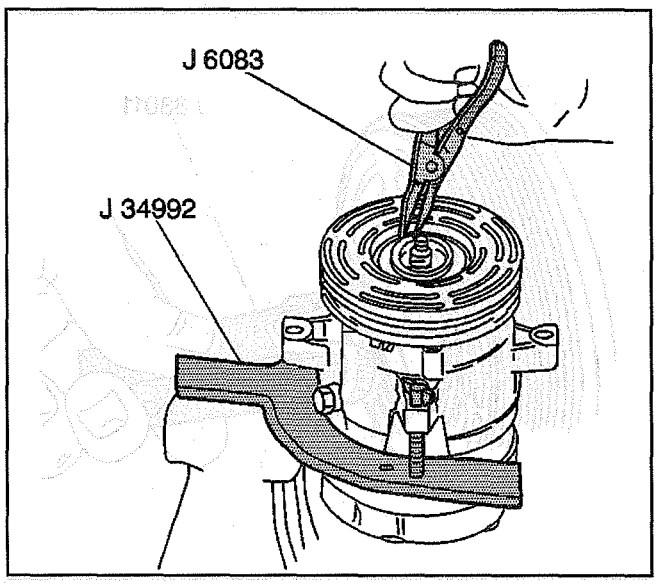
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8. With the compressor still mounted to the *J 34992* and the coil seated on the front head, stake the front head using a drift punch with a diameter of 3.175 mm (0.125 in).
9. Stake the front head at 3 places 120 degrees apart in order to ensure that the clutch coil remains in position.
10. Ensure that the stake size is only one half of the area of the punch tip and only 0.28–0.35 mm (0.010–0.015 in) in depth.
11. With the compressor mounted to the *J 34992*, position the rotor and bearing assembly on the front head.
12. Position the *J 33017* and the *J 33023-A* directly over the inner race of the bearing.
13. Position the *J 8433-1* on the *J 33023-A*.
14. Assemble the two through bolts and the washers of the *J 34992* through the slots of the *J 8433-1*.
15. Thread the two through bolts into the *J 34992*. Ensure that the thread of the through bolts engages the full thickness of the *J 34992*.
16. Tighten the *J 8433-3* in the *J 8433-1* in order to force the pulley rotor and bearing assembly onto the front head of the compressor.
17. If the *J 33017* slips off direct, in-line contact with inner face of the bearing, use the following steps:
    17.1. Loosen the *J 8433-3*.
    17.2. Realign the *J 33017* and the *J 33023-A* in order to ensure that the installer clears the front head.

18. Install the rotor and bearing assembly retainer ring using the *J 6083*.
19. Install the clutch plate and hub assembly. Refer to *Compressor Clutch Plate/Hub Assembly Install (V5 - Conventional Mount)*.
20. Install the shaft nut.



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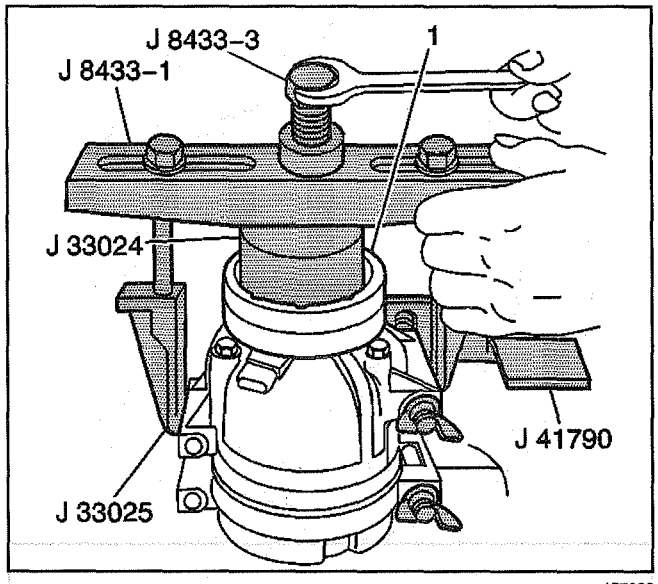
Compressor Clutch Coil Install (V7 - Direct Mount)

Tools Required

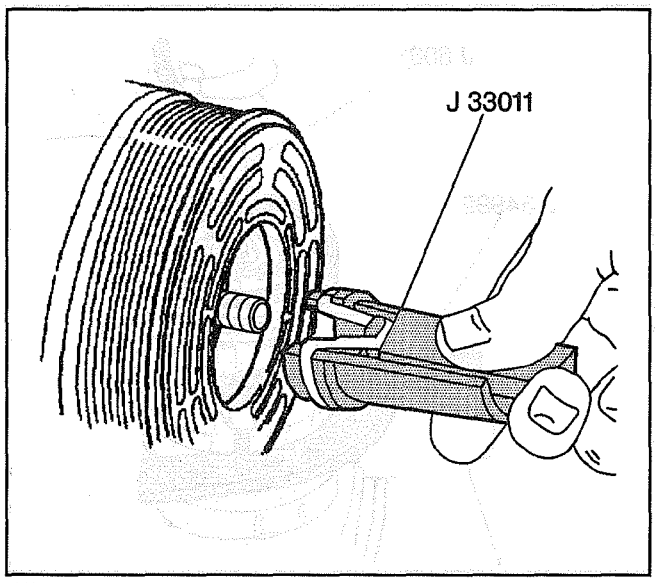
- *J 8433* Compressor Pulley Puller
- *J 8433-3* Forcing Screw
- *J 33024* Clutch Coil Installer Adaptor
- *J 33025* Clutch Coil Puller Legs
- *J 41790* Compressor Holding Fixture

1. Place the clutch coil assembly (1) on the front head with the clutch coil terminal positioned at the mark made during disassembly.
2. Place the *J 33024* over the internal opening of the clutch coil housing and align installer with the compressor front head.
3. Install the *J 8433-3* into the *J 8433* and center the screw in the countersunk center hole of the *J 33024*.
4. Install the 4 inch through bolts and washers from the J 42136 tool kit into the *J 33025* and attach them to the compressor mounting bosses.
5. Turn the center forcing screw of the *J 8433* to press the clutch coil onto the front head until the clutch coil is fully seated.

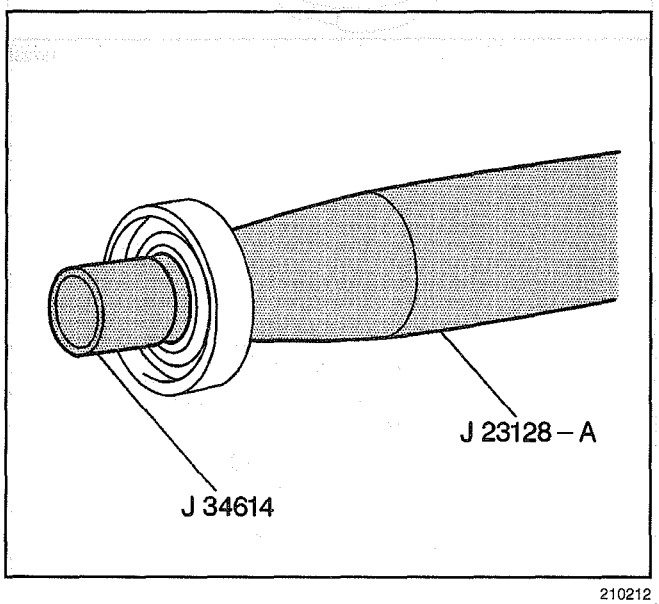
   Make sure the clutch coil and the *J 33024* stay in-line with each other while pressing the clutch coil onto the compressor.
6. Install the compressor clutch rotor and bearing assembly. Refer to *Clutch Rotor and/or Bearing Install (V7 - Direct Mount)*.
7. Install the compressor clutch plate and hub assembly. Refer to *Compressor Clutch Plate/Hub Assembly Install (V7 - Direct Mount)*.
8. Remove the compressor from the *J 41790*.
9. Install the compressor into the vehicle.



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Compressor Shaft Seal Install (V5 - Conventional Mount)

Tools Required

- *J 5403* Snap Ring Pliers
- *J 23128-A* Seal Seat Installer And Remover
- *J 33011* O-Ring Installer
- *J 34614* Shaft Seal Protector
- *J 39500-B* A/C Refrigerant Recovery, Recycling And Recharging System
- *J 39893* Pressure Testing Connector

Notice: Seals should not be re-used. Always use a new specification service seal kit. Be sure that the seal to be installed is not scratched or damaged in any way. Make sure that the seal is free of lint and dirt that could damage the seal surface or prevent sealing.

1. Thoroughly clean the seal O-ring groove in the front head.
2. Dip the new seal O-ring in clean 525 viscosity refrigerant oil.

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

3. Assemble the O-ring onto the *J 33011*.
4. Install the O-ring.
   - 4.1. Insert the *J 33011* into the compressor neck until the installer bottoms out.

Important: The top groove in the compressor neck is for the shaft seal retainer ring.

   - 4.2. Lower the moveable slide of the *J 33011* in order to release the O-ring into the seal O-ring lower grove.
   - 4.3. Rotate the *J 33011* in order to seat the O-ring.
   - 4.4. Remove the installer.
5. Dip the new shaft seal in clean 525 viscosity refrigerant oil.
6. Assemble the seal to the *J 23128-A* by turning the handle clockwise.
   - 6.1. Ensure that the stamped steel case side of the lip seal engages with the knurled tangs of the *J 23128-A*.
   - 6.2. Ensure that the flared-out side of the lip seal faces toward the compressor.

Notice: Use care when handling the seal protector. Do not nick the seal protector. This may damage the seal during installation. Ensure that the bottom of the seal protector is not flared. This may damage the seal during installation.

7. Install the *J 34614* on the lip seal.
8. Install the lip seal onto the shaft.
   - 8.1. Place the *J 34614* over the end of the compressor shaft.
   - 8.2. Slide the new seal onto the shaft using a rotary motion of the *J 23128-A*.

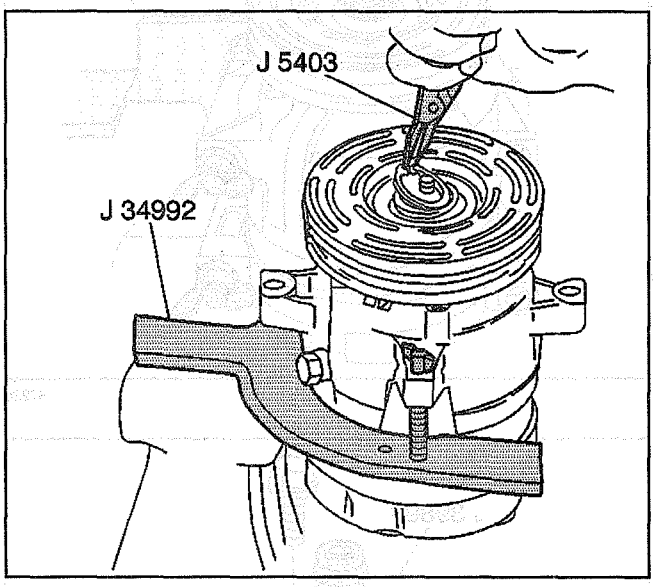
8.3. Ensure that the seal makes good contact with the O-ring.

Do not dislodge the O-ring.

8.4. Disengage the *J 23128-A* from the seal.

8.5. Remove the *J 23128-A* and the *J 34614* from the compressor.

9. Use the *J 5403* in order to install the new seal retainer ring with the flat side against the seal.
10. Use the sleeve of the *J 33011* in order to press in the seal retainer ring. Ensure that the ring snaps into the groove.
11. Leak test the compressor.
    11.1. Install the *J 39893* on the rear head of the compressor.
    11.2. Connect the gage charging lines using the *J 39500-B*.
    11.3. Pressurize the suction and the high-side of the compressor using R–134a Refrigerant.
    11.4. Temporarily install the shaft nut.
    11.5. With the compressor in a horizontal position, rotate by hand the compressor shaft several turns in the operating direction.
    11.6. Leak test the seal area. Correct any leaks found.
    11.7. Recover the refrigerant.
    11.8. Remove the shaft nut.
12. Remove any excess oil from the shaft and the inside of the compressor neck.
13. Install the clutch plate and hub assembly. Refer to *Compressor Clutch Plate/Hub Assembly Install (V5 - Conventional Mount)*.
14. Install the compressor and the compressor belt. Tighten the bracket.
15. Evacuate and charge the refrigerant system using the *J 39500-B*.



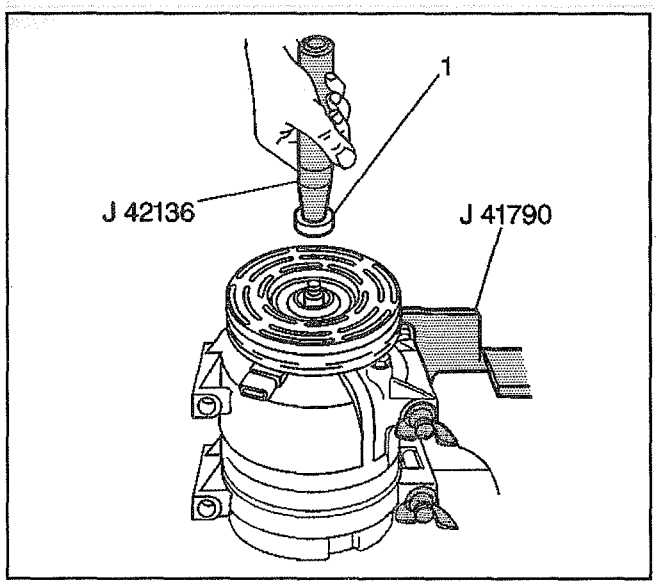
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Compressor Shaft Seal Install (V7 - Direct Mount)

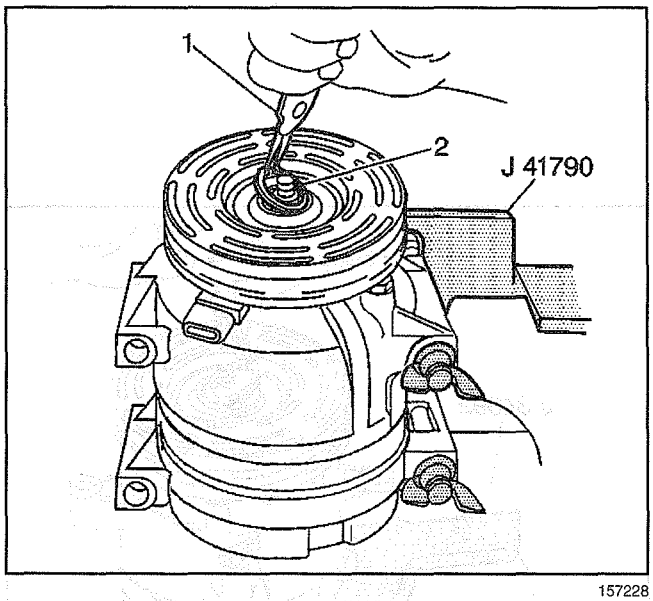
Tools Required

- *J 39893* Pressure Test Adaptor
- *J 34614* Shaft Seal Protector
- *J 42136* A/C Lip Seal Remover

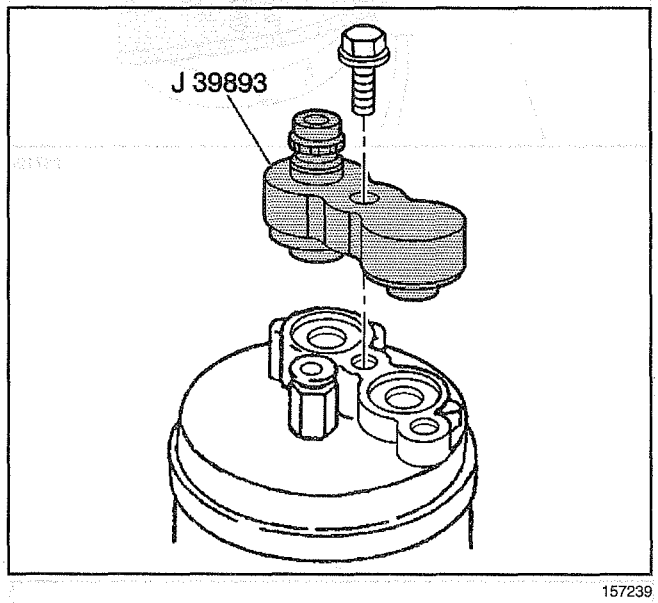
1. Dip the new compressor shaft seal (1) in clean 525 viscosity refrigerant oil and assemble the seal onto the *J 42136*, by turning the handle clockwise.
2. Install the *J 34614* onto the compressor shaft.
3. Using a rotary motion, slide the new compressor shaft seal onto the compressor shaft until the seal is fully seated.
4. Remove the *J 34614* by turning the handle counterclockwise.



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5. Install a new compressor shaft seal retaining ring (2), using internal snap ring pliers (1).
   Make sure that the chamfer side of the retaining ring is facing up and that the retaining ring snaps into the groove.
6. Leak test the compressor, using the *J 39893*.
   6.1. Install the *J 39893* onto the compressor and pressurize the suction and high-side of the compressor with R-134a.
   6.2. Temporarily install the shaft nut.
   6.3. With the compressor in a horizontal position, rotate the compressor shaft in the normal direction of rotation, several turns by hand.
   6.4. Leak test the seal area and repair if necessary.
   Remove the shaft nut.
7. Recover the refrigerant.
8. Remove the *J 39893*.
9. Remove and clean any excess oil resulting from installing the new seal parts from the shaft and inside the compressor neck.
10. Install the compressor clutch plate and hub assembly. Refer to *Compressor Clutch Plate/Hub Assembly Install (V7 - Direct Mount)*.
11. Remove the compressor from the *J 41790*.
12. Install the compressor into the vehicle.

Compressor Pressure Relief Valve Install (V5 - Conventional Mount)

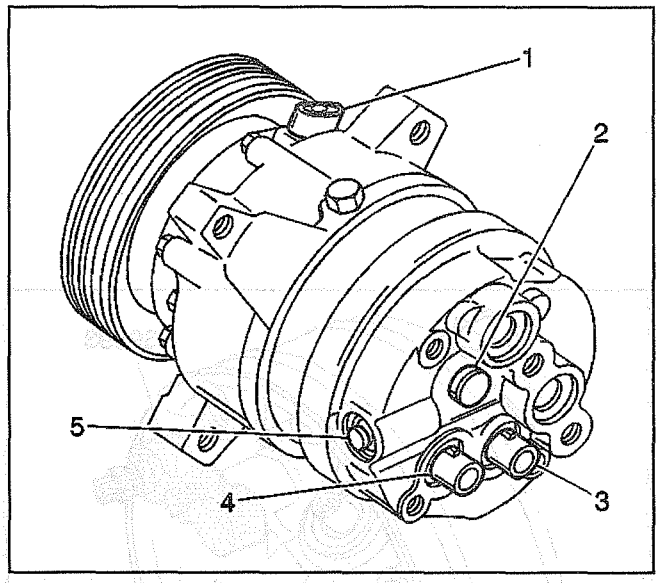
1. Clean the valve seat area on the rear head.
2. Lubricate the O-ring of the new pressure relief valve and the O-ring assembly using new 525 viscosity refrigerant oil.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the new pressure relief valve (2).

   Tighten

   Tighten the valve to 9 N·m (80 lb in).
4. Evacuate and recharge the system.
5. Perform a leak test. Refer to *Compressor Leak Testing (V5 - Conventional Mount)*.



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Compressor Pressure Relief Valve Install (V7 - Direct Mount)

Tools Required

J 41790 Compressor Holding Fixture

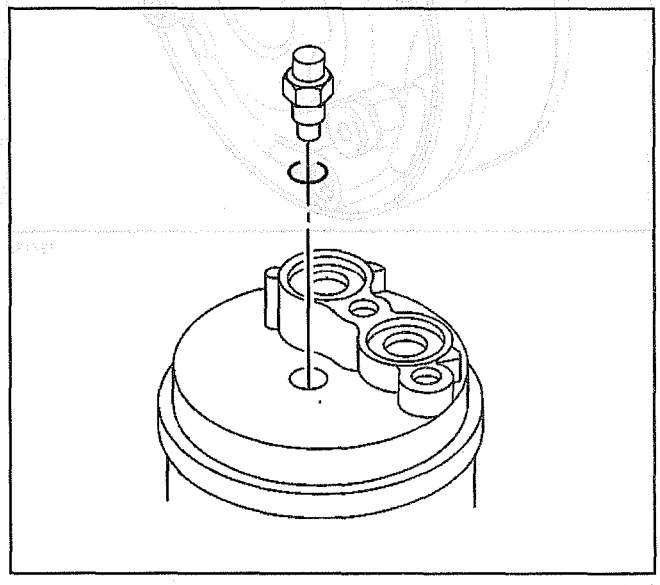
1. Clean the pressure relief valve seat area of the rear head.
2. Lubricate the O-ring of the new pressure relief valve with clean 525 viscosity refrigerant oil.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the new pressure relief valve into the compressor.

   Tighten

   Tighten the compressor pressure relief valve to 9 N·m (80 lb in).
4. Remove the compressor from the *J 41790*.
5. Install the compressor into the vehicle.


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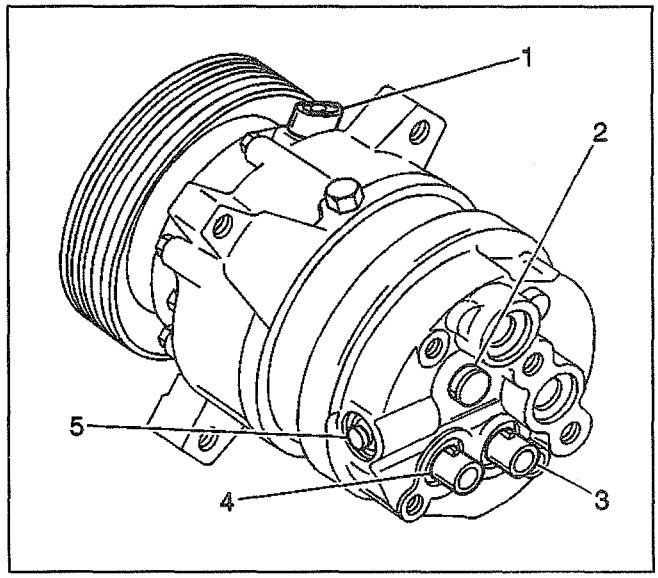
Compressor Control Switches Install (V5 - Conventional Mount)

Tools Required

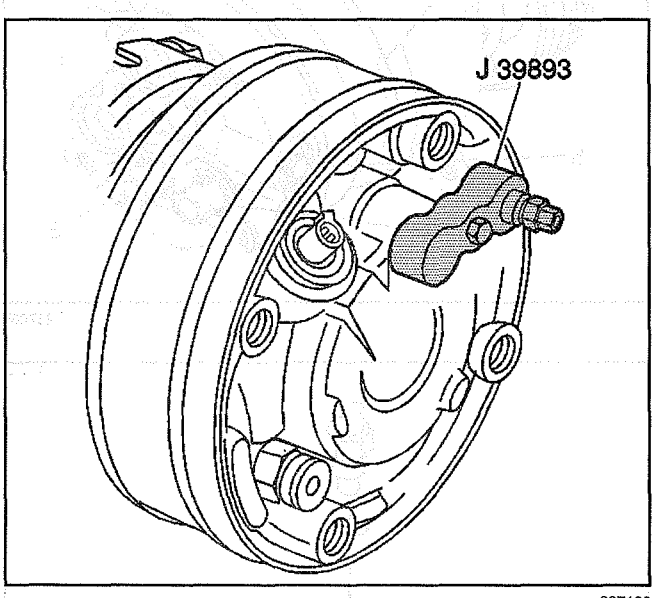
J 5403 Snap Ring Pliers

1. Inspect the switch cavity and the O-ring groove in the rear head for dirt or foreign material.

   Clean the cavity and groove as necessary.
2. Coat the new O-ring using clean 525 viscosity refrigerant oil.
3. Install the O-ring into the groove in the switch cavity.
4. Lubricate the switch housing using clean 525 viscosity refrigerant oil.
5. Carefully insert the switch (3 or 4) into the switch cavity until the switch bottoms in the cavity.



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6. Using the *J 5403*, install the switch retaining ring with the high point of the curved sides adjacent to the switch housing.
7. Ensure that the retaining ring is seated in the retaining ring groove in the switch cavity.
8. Evacuate and recharge the system.
9. Perform a leak test. Refer to *Compressor Leak Testing (V5 - Conventional Mount).*

Compressor Leak Testing (V5 - Conventional Mount)

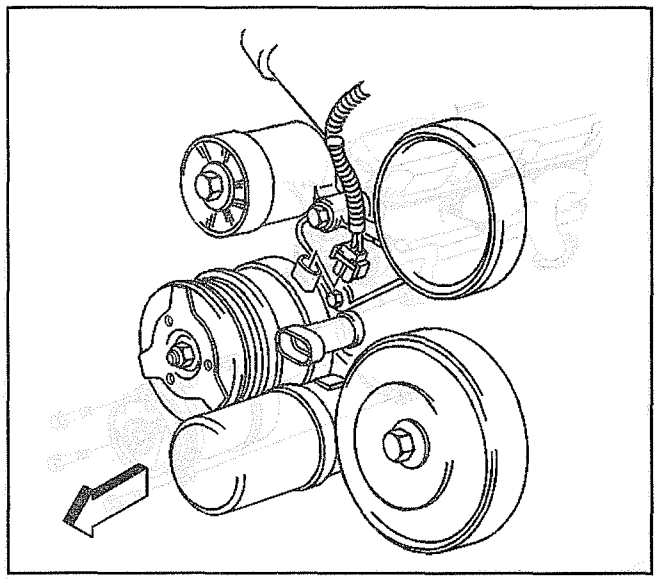
- *J 39400-A* Electronic Halogen Leak Detector
- *J 39500-B* A/C Refrigerant Recovery, Recycling and Recharging (ACR4) System
- *J 39893* Pressure Testing Connector

1. With the sealing washers in place, install the *J 39893* on the rear head of the compressor.
2. Connect the gage charging lines and the *J 39500-B*.
3. Pressurize the suction and the high-side of the compressor using R-134a refrigerant.
4. With the compressor in a horizontal position, rotate the compressor shaft several turns by hand in the operating direction.
5. Using the *J 39400-A*, inspect for leaks at the following locations:
   - The pressure relief valve
   - The rear head switch
   - The front head seal
   - The rear head seal
   - The through bolt head gaskets
   - The compressor shaft seal
6. Perform the measures necessary to correct any external leaks found.
7. Inspect for leaks again following any repair.
8. Recover the refrigerant.
9. Disconnect the hoses from the *J 39893*.
10. Remove the *J 39893*.

Compressor Mounting Bracket Replacement (3.8 L)

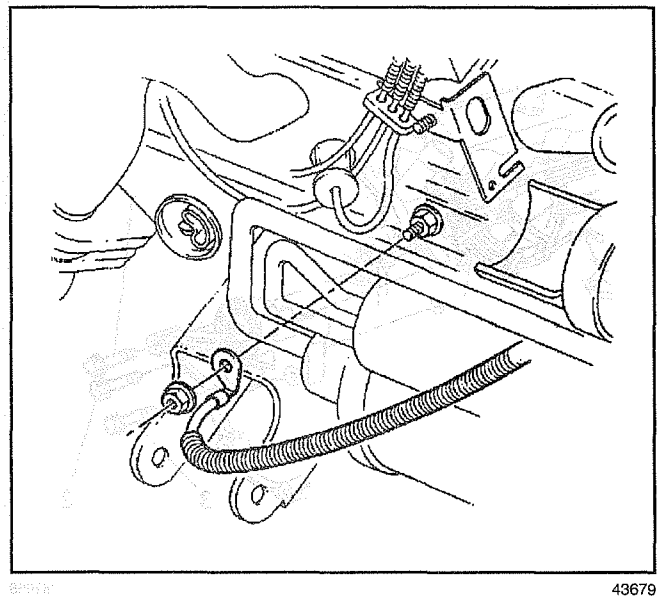
Removal Procedure

1. Remove the serpentine drive belt. Refer to *Drive Belt Replacement* in Engine Mechanical - 3.8 L.
2. Disconnect the electrical connector at the air conditioning (A/C) compressor.



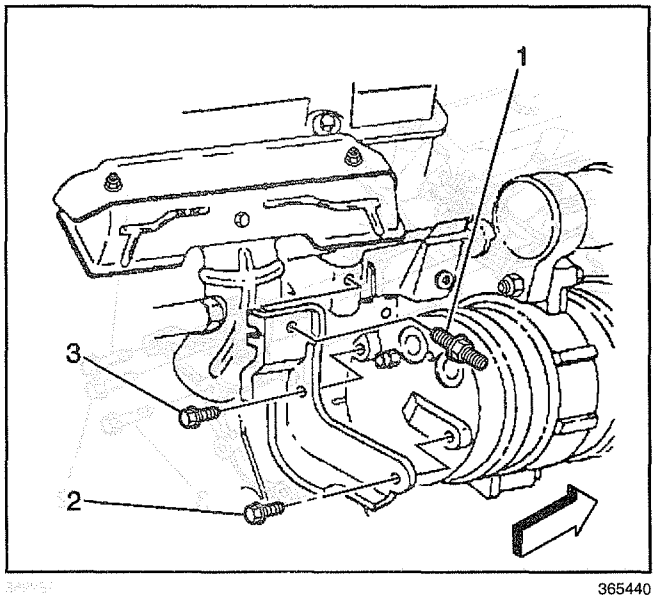
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3. Remove the negative battery cable nut from the engine block stud.
4. Remove the negative battery cable from the stud.
5. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.

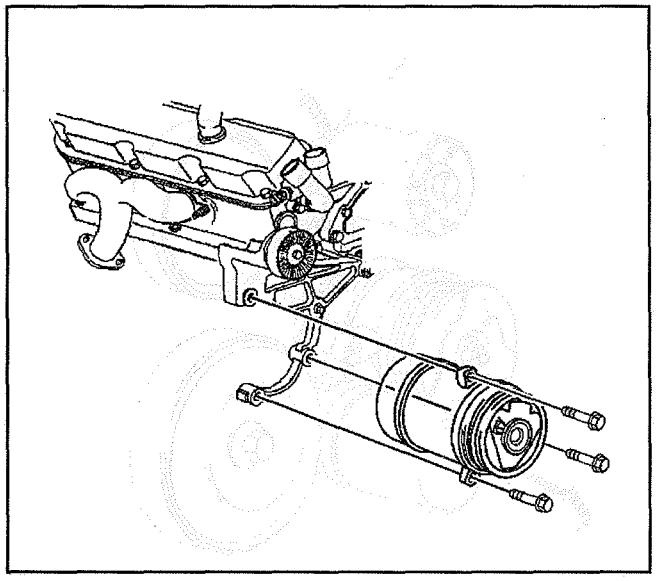


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6. Remove the A/C compressor bracket rear bolts (2, 3).

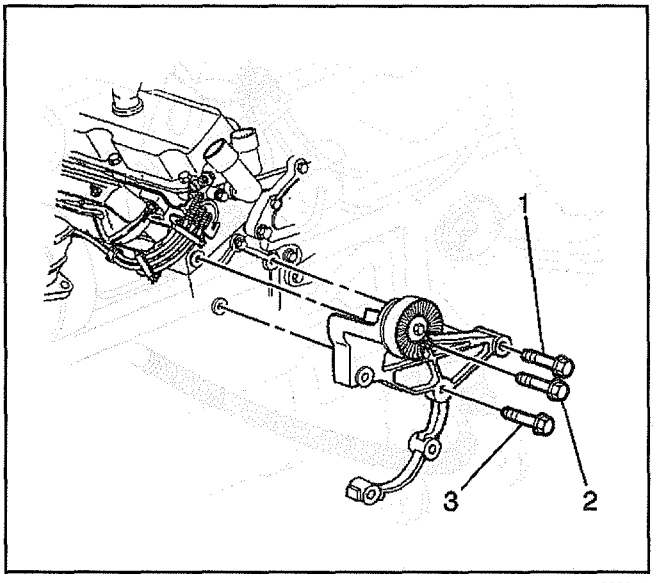


365440



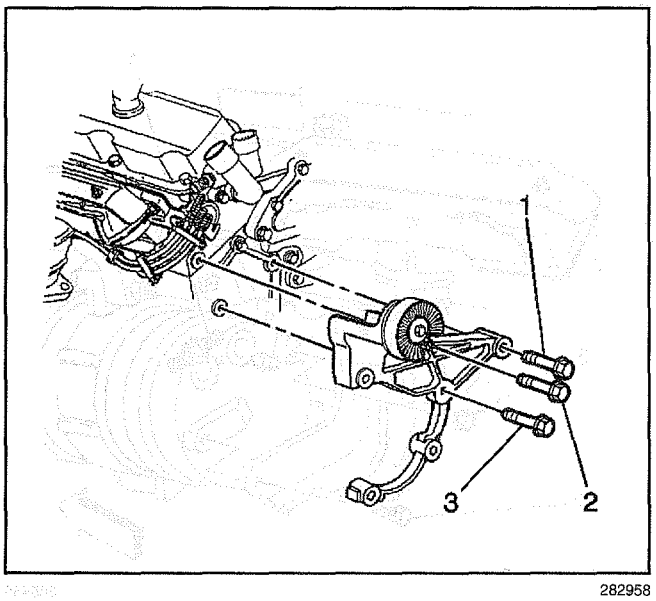
282953

7. Remove the A/C compressor bolts.
8. Move the A/C compressor forward in order to allow access to the bracket.



282958

9. Remove the A/C compressor bracket bolts (1, 2, 3).
10. Remove the A/C compressor bracket.
    Transfer the idler pulley from the old bracket to the new bracket.



282958

Installation Procedure

1. Install the A/C compressor bracket.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the A/C compressor bracket bolts (1, 2, 3).

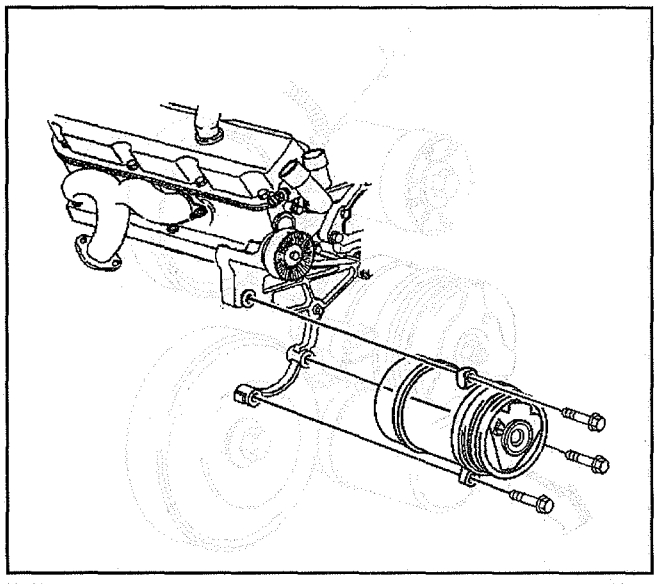
Tighten

- Tighten the A/C compressor bracket bolt (1) to 30 N·m (22 lb ft).
- Tighten the A/C compressor bracket bolts (2, 3) to 50 N·m (37 lb ft)

3. Move the A/C compressor rearward to the bracket.
4. Install the A/C compressor bolts.

   Tighten

   Tighten the A/C compressor bracket bolts to 50 N·m (37 lb ft).

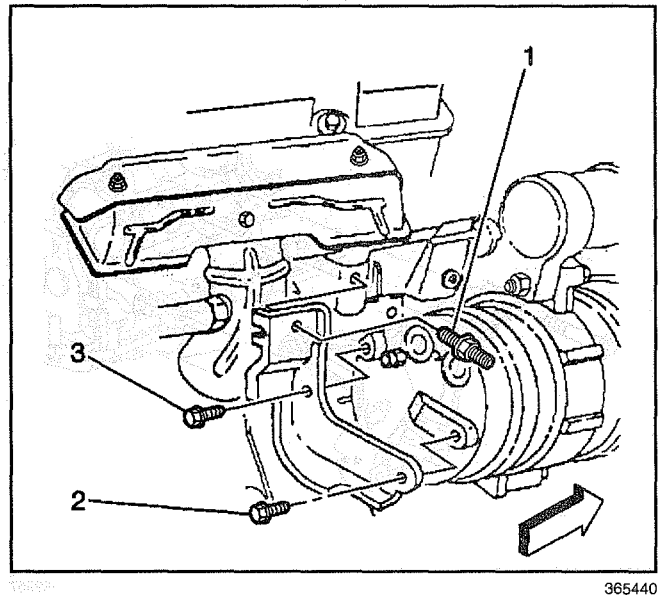


282953

5. Install the A/C compressor rear bolts (2, 3).

   Tighten

   Tighten the A/C compressor bracket rear bolts (2, 3) to 30 N·m (22 lb ft).
6. Lower the vehicle.

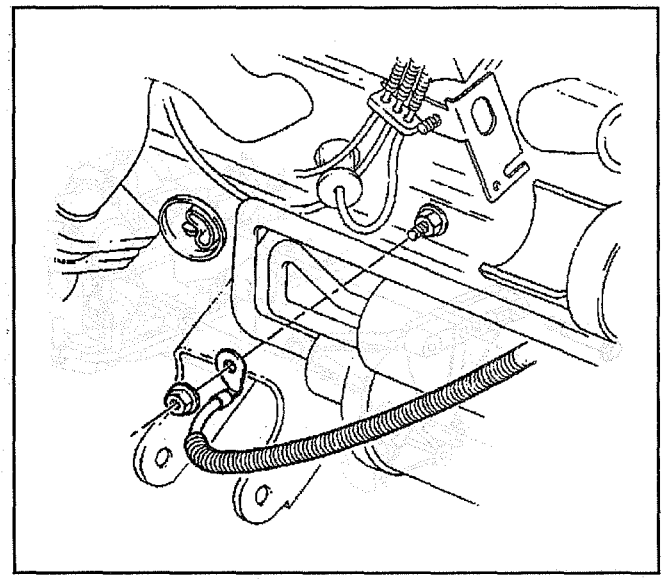


365440

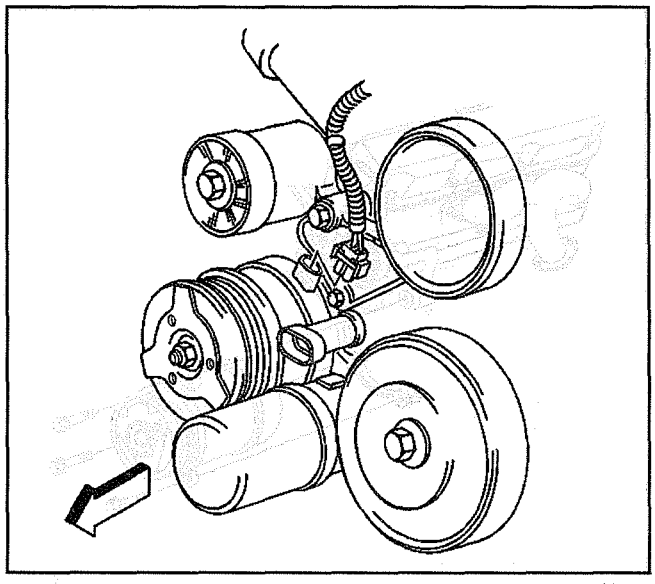
7. Install the negative battery cable to the stud.
8. Install the negative battery cable nut to the engine block stud.

   Tighten

   Tighten the negative battery cable nut to the engine block to 25 N·m (18 lb ft).

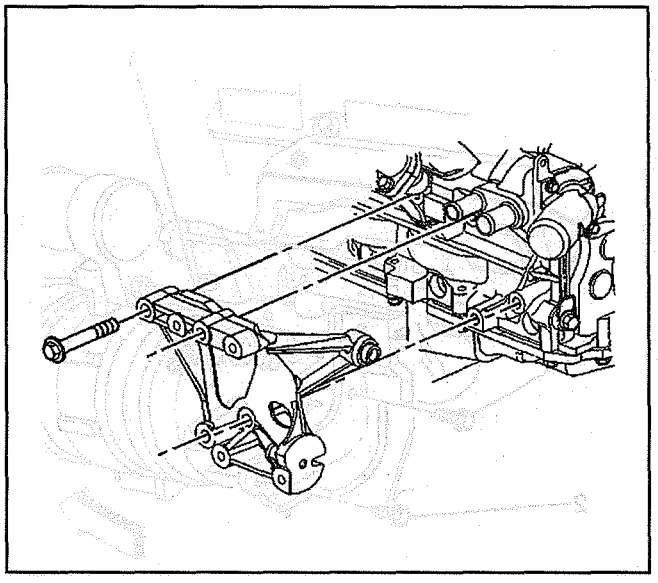


43679



365420

9. Connect the electrical connector at the A/C compressor.
10. Install the serpentine drive belt. Refer to *Drive Belt Replacement* in Engine Mechanical - 3.8 L.

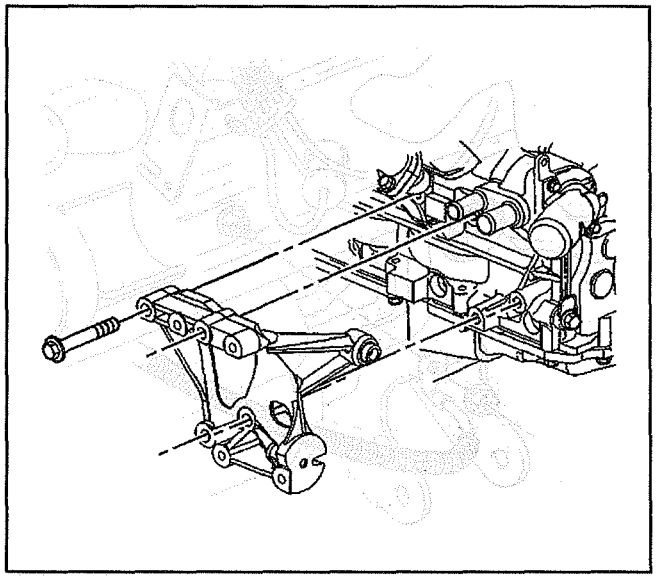


282957

Compressor Mounting Bracket Replacement (5.7 L)

Removal Procedure

1. Remove the air conditioning (A/C) compressor. Refer to *Compressor Replacement (5.7 L)*.
2. Remove the A/C compressor bracket bolts.
3. Remove the A/C compressor bracket.
4. Remove the A/C belt tensioner from the bracket. Refer to *Drive Belt Tensioner Replacement - A/C* in Engine Mechanical - 5.7 L.
5. Remove the A/C belt idler pulley from the bracket. Refer to *Drive Belt Idler Pulley Replacement - A/C* in Engine Mechanical - 5.7 L.



282957

Installation Procedure

1. Install the A/C belt idler pulley from the bracket. Refer to *Drive Belt Idler Pulley Replacement - A/C* in Engine Mechanical - 5.7 L.
2. install the A/C belt tensioner from the bracket. Refer to *Drive Belt Tensioner Replacement - A/C* in Engine Mechanical - 5.7 L.
3. Install the A/C compressor bracket.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the A/C compressor bracket bolts.

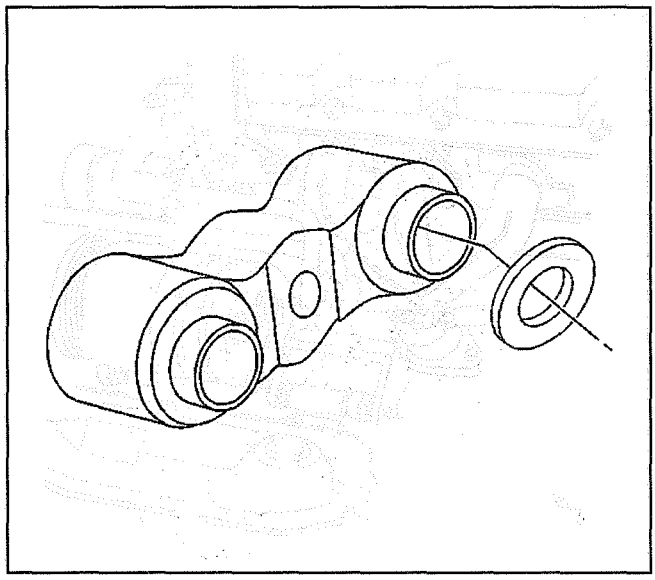
   Tighten

   Tighten the A/C compressor bracket bolts to 50 N·m (37 lb ft).
5. Install the A/C compressor. Refer to *Compressor Replacement (5.7 L)*.

Compressor Sealing Washers Replacement

1. Keep dirt and foreign material from the sealing surfaces of the washers, the hose block, and the compressor ports.

   Clean all of the sealing surfaces with a lint-free rag.
2. Do not reuse sealing washers.
3. The sealing washers do not need oiling prior to assembly.
4. Ensure that the sealing washers are seated within the compressor machined surfaces.
5. The washers must bottom against the surface of the block fitting.

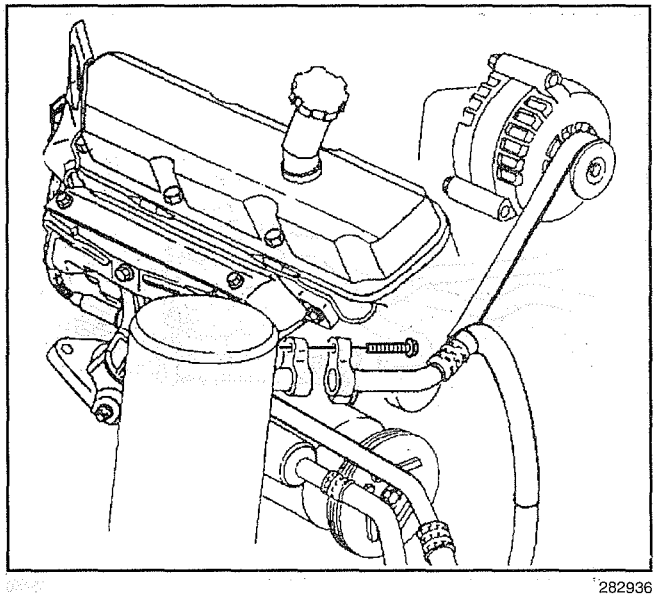


257968

Compressor Hose Assembly Replacement (3.8 L)

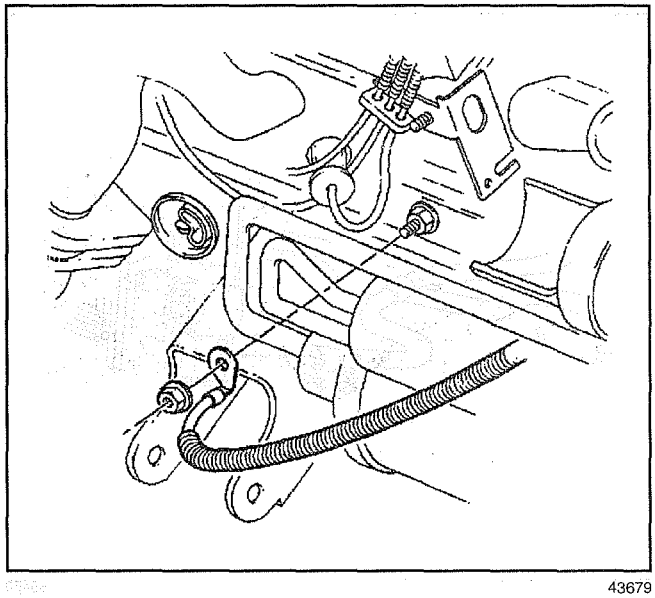
Removal Procedure

1. Recover the refrigerant. Refer to *Refrigerant Recovery and Recharging.*
2. Remove the air conditioning (A/C) compressor and condenser hose bolt at the accumulator.
3. Discard the O-ring.

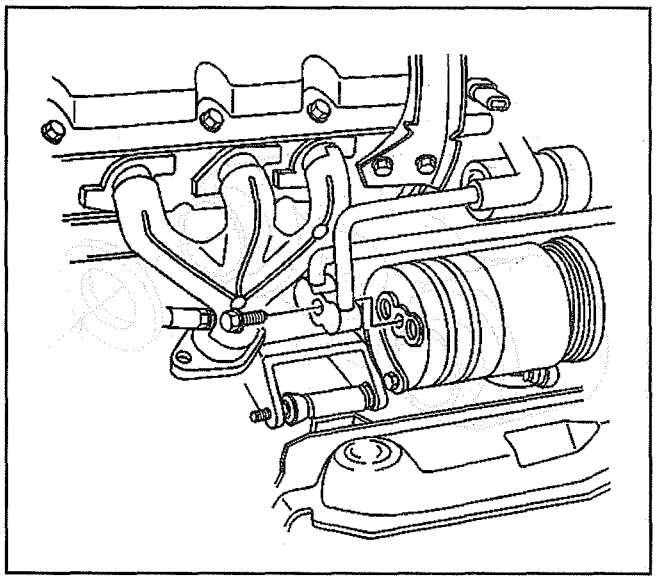


282936

4. Remove the negative battery cable nut from the engine block stud.
5. Remove the negative battery cable from the stud.
6. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.

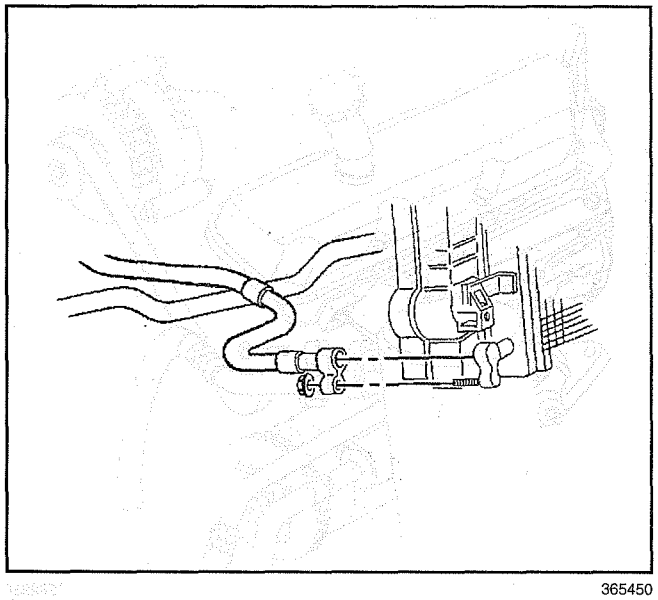


43679



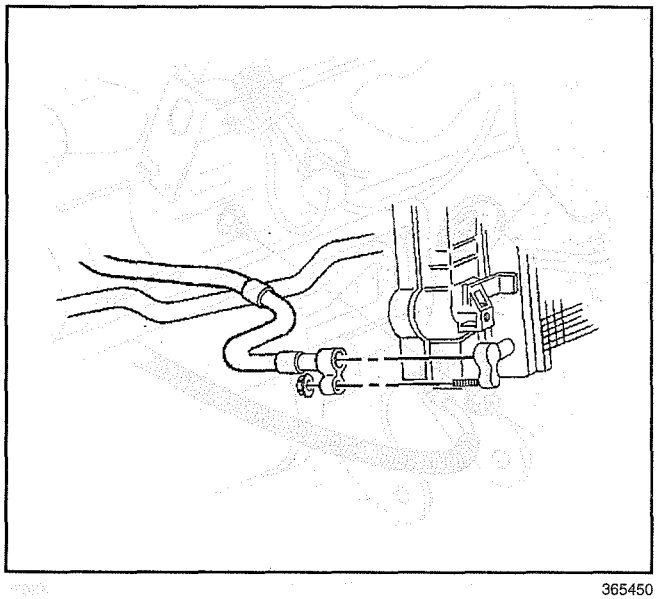
569444

7. Remove the A/C compressor and condenser hose bolt.
8. Discard the O-ring.



365450

9. Remove the A/C compressor and condenser hose nut at the condenser.
10. Discard the O-ring.
11. Lower the vehicle.
12. Remove the A/C compressor and condenser hose from the vehicle.



365450

Installation Procedure

Lightly coat the O-rings with a mineral base 525 viscosity refrigerant oil.

1. Install the A/C compressor and condenser hose to the vehicle.
2. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Install a new O-ring.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the A/C compressor and condenser hose nut at the condenser.

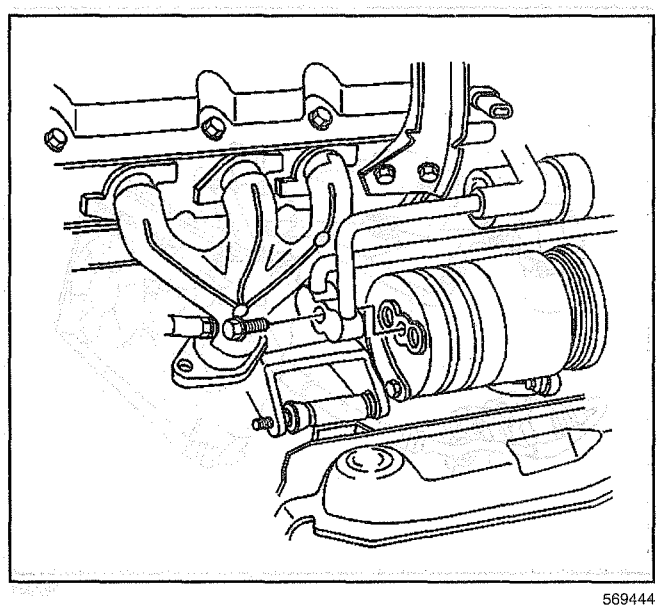
   Tighten

   Tighten the A/C compressor and condenser hose nut at the condenser to 16 N·m (12 lb ft).

5. Install a new O-ring.
6. Install the A/C compressor and condenser hose bolt.

   Tighten

   Tighten the A/C compressor and condenser hose bolt to 33 N·m (24 lb ft).
7. Lower the vehicle.

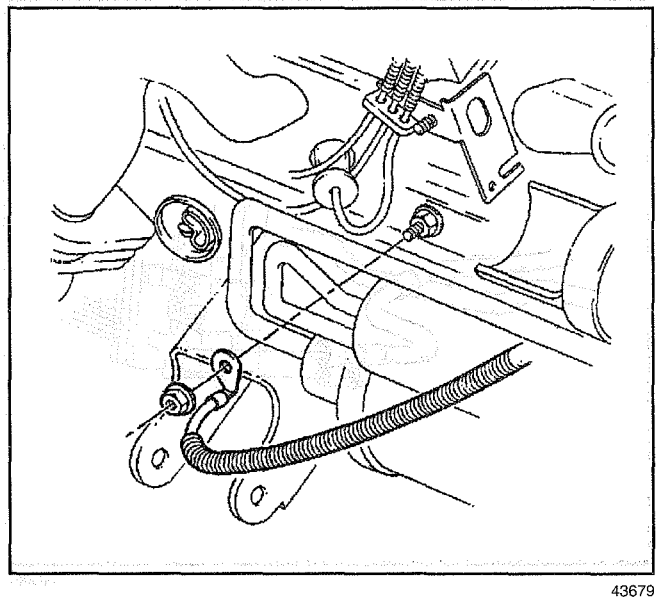


569444

8. Install the negative battery cable to the stud.
9. Install the negative battery cable nut to the engine block stud.

   Tighten

   Tighten the negative battery cable nut to the engine block stud to 25 N·m (18 lb ft).

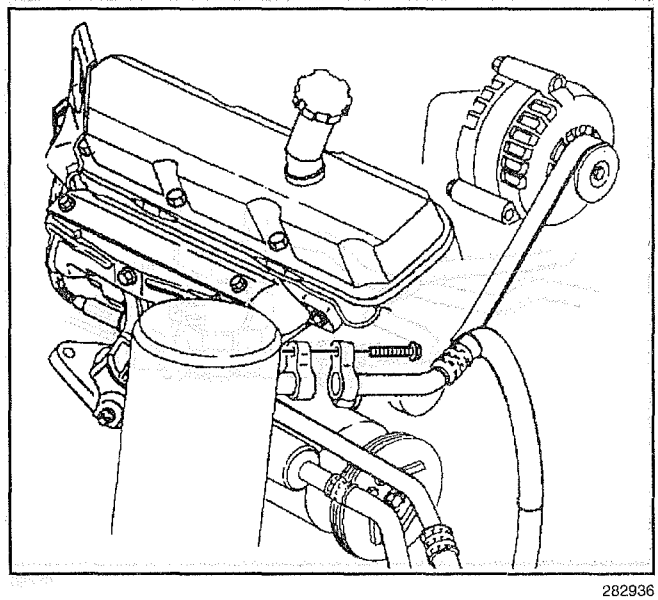


43679

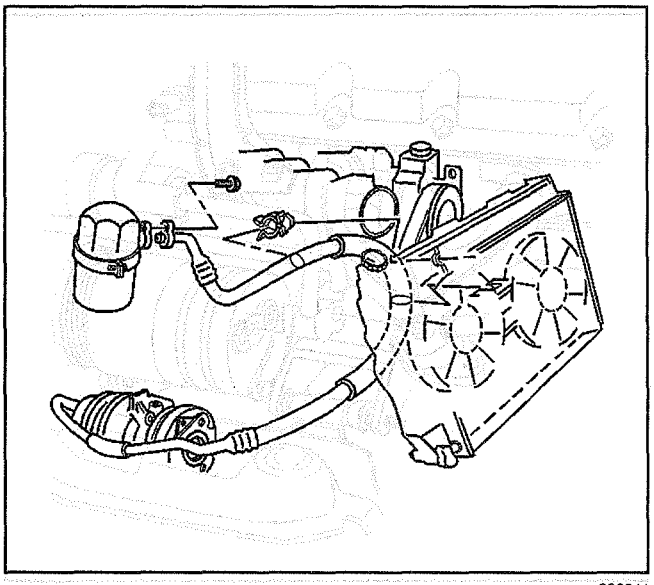
10. Install a new O-ring.
11. Install the A/C compressor and condenser hose bolt at the accumulator.

    Tighten

    Tighten the A/C compressor and condenser hose bolt at the accumulator to 16 N·m (12 lb ft).
12. Recharge the A/C system. Refer to *Refrigerant Recovery and Recharging*.
13. Perform a leak test on the A/C system. Refer to *Leak Testing*.



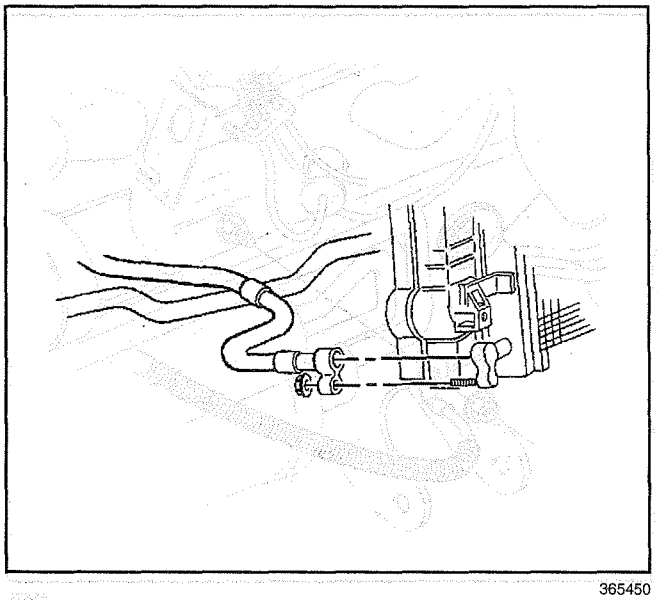
282936


282941

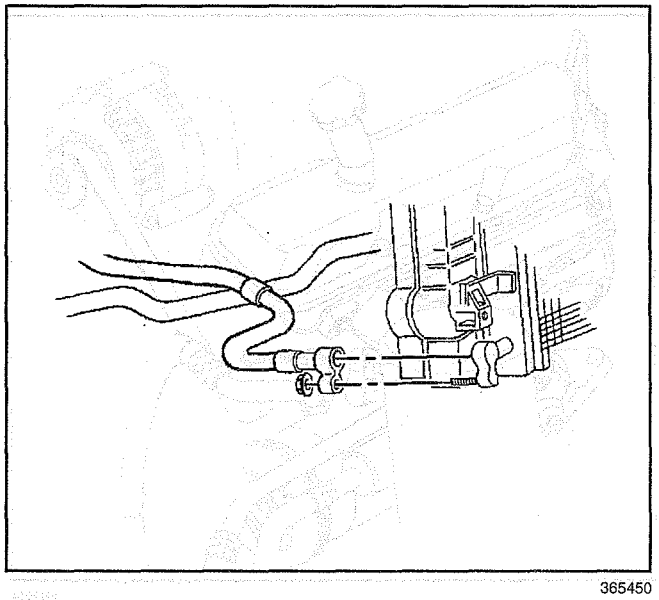
Compressor Hose Assembly Replacement (5.7 L)

Removal Procedure

1. Recover the refrigerant. Refer to *Refrigerant Recovery and Recharging*.
2. Remove the air conditioning (A/C) compressor and condenser hose from the clip on the fan shroud.
3. Remove the A/C compressor and condenser hose bolt at the accumulator.
4. Discard the O-ring.
5. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.


365450

6. Remove the A/C compressor and condenser hose nut at the condenser.
7. Discard the O-ring.
8. Remove the A/C compressor. Refer to *Compressor Replacement (5.7 L)*.
9. Remove the A/C compressor and condenser hose from the vehicle.
10. Discard the O-ring.


365450

Installation Procedure

Lightly coat the O-rings with the mineral base 525 viscosity refrigerant oil.

1. Install a new O-ring to the A/C compressor and condenser hose.
2. Install the compressor and condenser hose to the vehicle.
3. Install the A/C compressor. Refer to *Compressor Replacement (5.7 L)*.
4. Install a new O-ring.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

5. Install the A/C compressor and condenser hose nut at the condenser.

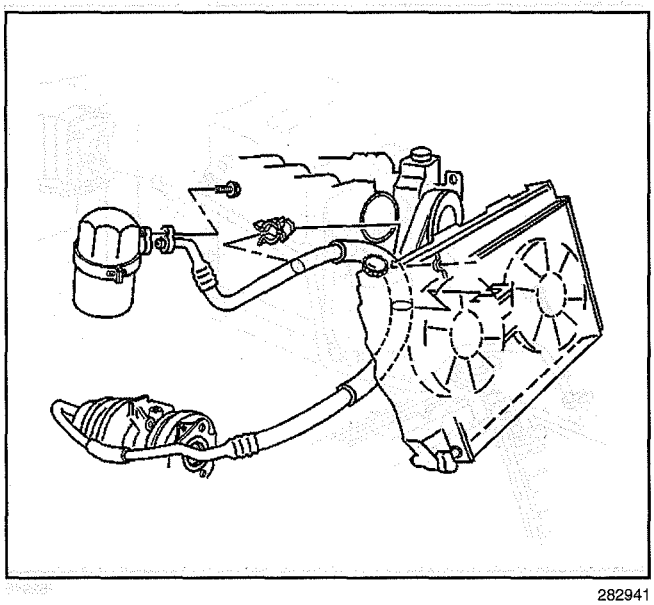
   Tighten

   Tighten the A/C compressor and condenser hose nut at the condenser to 16 N·m (12 lb ft).
6. Lower the vehicle.

7. Install a new O-ring.
8. Install the A/C compressor and condenser hose bolt at the accumulator.

   Tighten

   Tighten the A/C compressor and condenser hose bolt at the accumulator to 16 N·m (12 lb ft).
9. Install the A/C compressor and condenser hose to the clip on the fan shroud.
10. Recharge the A/C system. Refer to *Refrigerant Recovery and Recharging*.
11. Perform a leak test on the A/C system. Refer to *Leak Testing*.

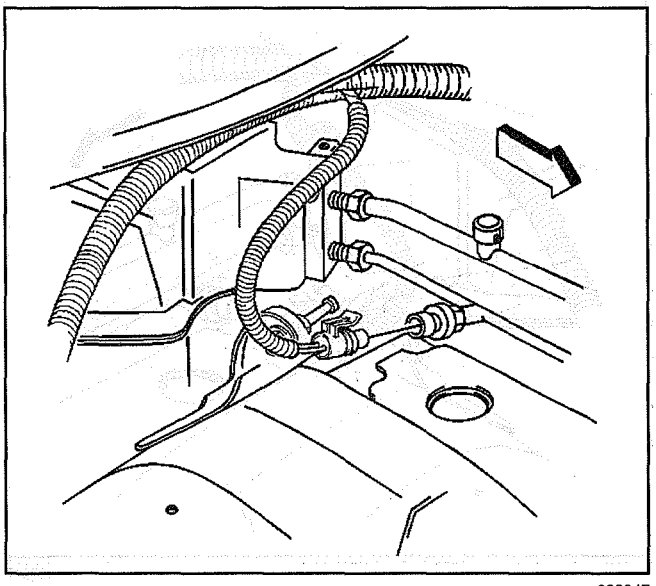


282941

Evaporator Tube Replacement

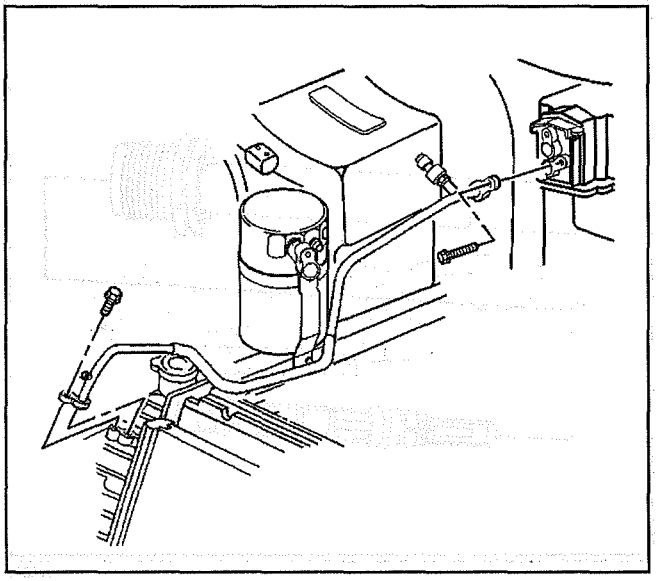
Removal Procedure

1. Recover the refrigerant. Refer to *Refrigerant Recovery and Recharging*.
2. Disconnect the electrical connector at the air conditioning (A/C) refrigerant pressure sensor.

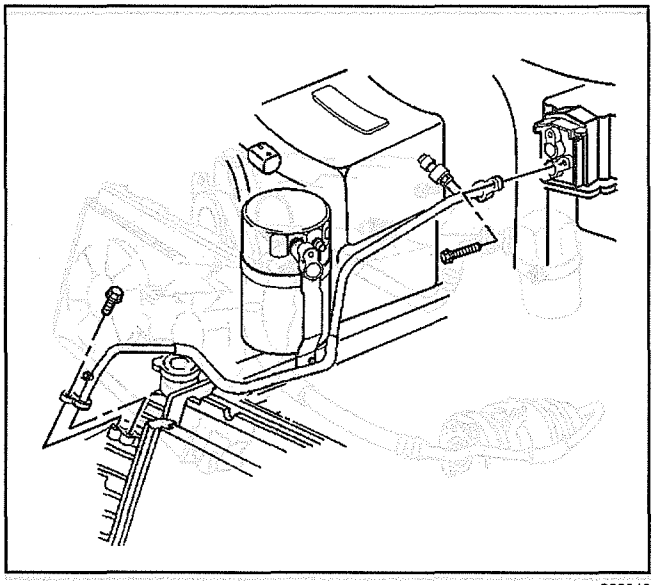


282947

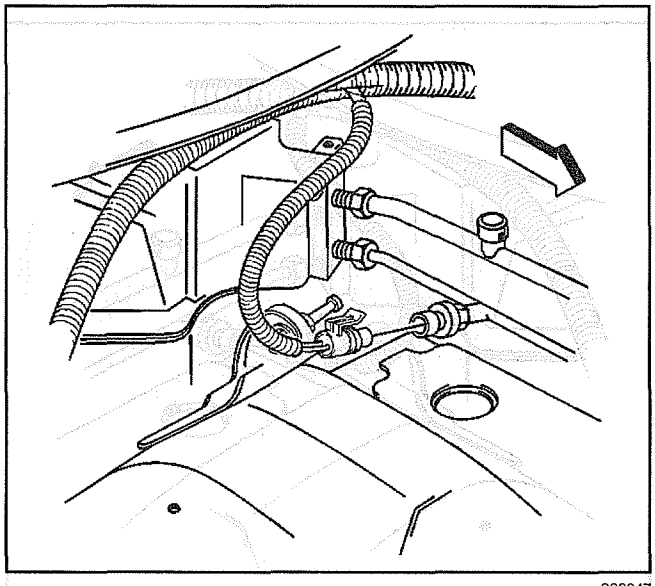
3. Remove the A/C evaporator tube bolt at the module.
4. Remove the A/C evaporator tube bolt at the condenser.
5. Remove the A/C evaporator tube from the vehicle.
6. Discard the O-rings.
7. Remove the orifice and the pressure sensor, if replacing the tube.



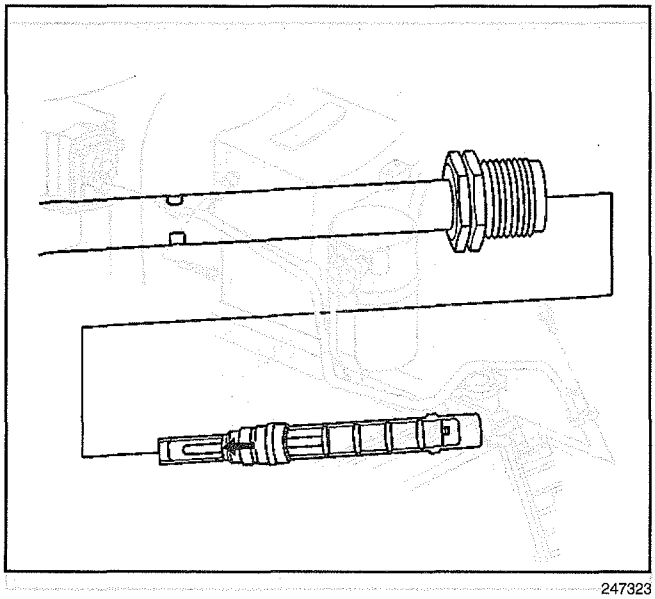
282946



282946



282947



247323

Installation Procedure

1. Lightly coat the O-rings with a mineral base 525 viscosity refrigerant oil.
2. install the orifice and the pressure sensor, if replacing the tube.
3. Install new O-rings.
4. Install the A/C evaporator tube to the vehicle.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

5. install the A/C evaporator tube bolt at the condenser.

   Tighten

   Tighten the A/C evaporator tube bolt at the condenser to 16 N·m (12 lb ft).

6. Install the A/C evaporator tube bolt at the module.

   Tighten

   Tighten the A/C evaporator tube bolt at the module to 16 N·m (12 lb ft).

7. Connect the electrical connector at the A/C refrigerant pressure sensor.
8. Recharge the A/C system. Refer to *Refrigerant Recovery and Recharging.*
9. Perform a leak test on the A/C system. Refer to *Leak Testing.*

Expansion (Orifice) Tube Filter Replacement

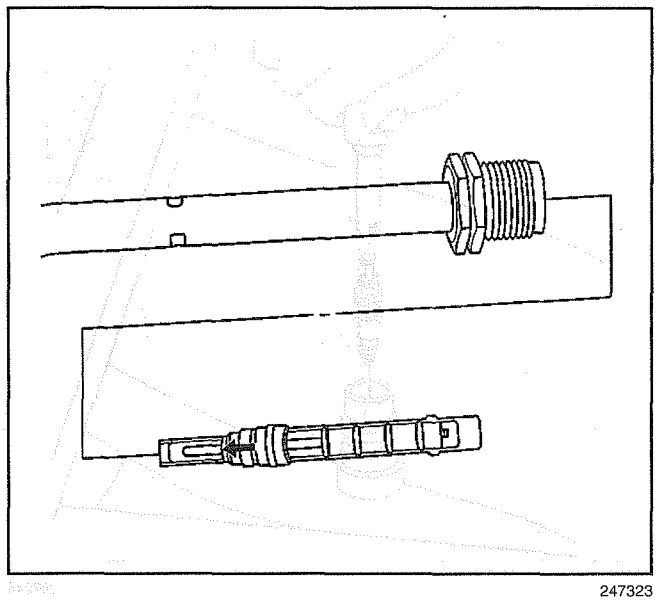
Removal Procedure

1. Recover the refrigerant. Refer to *Refrigerant Recovery and Recharging.*
2. Remove the air conditioning (A/C) evaporator. Refer to *Accumulator Replacement.*
3. Remove the orifice from the A/C evaporator tube.

Installation Procedure

Important: Install the long screen inlet end toward the condenser.

1. Install the orifice in the A/C evaporator tube.
2. Install the A/C evaporator. Refer to *Accumulator Replacement*.
3. Recharge the A/C system. Refer to *Refrigerant Recovery and Recharging*.
4. Leak test the fitting for leaks. Refer to *Leak Testing*.

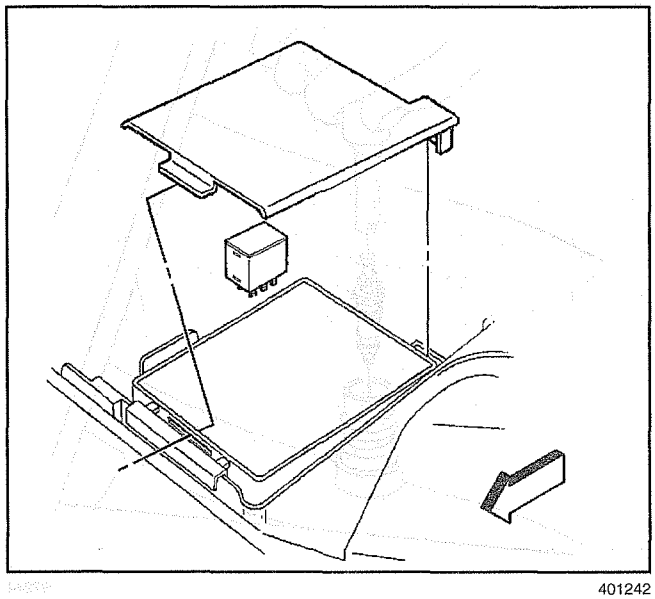


247323

Compressor Relay Replacement

Removal Procedure

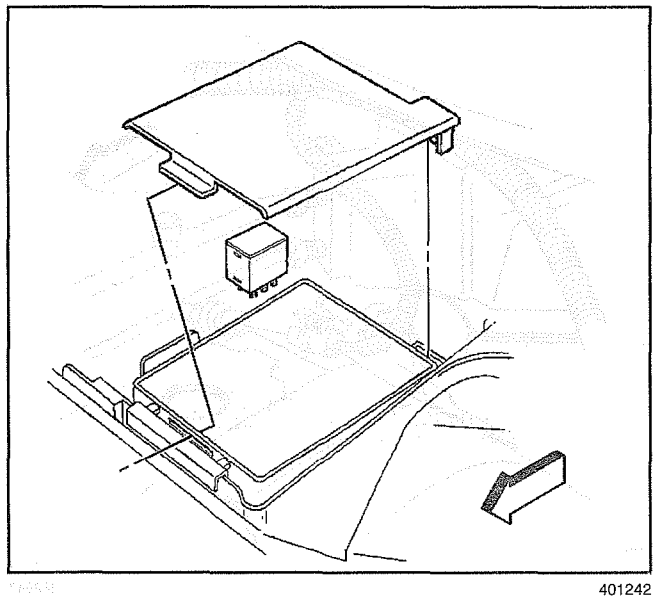
1. Remove the cover from the number 2 underhood electrical center.
2. Remove the air conditioning (A/C) compressor relay. Refer to *Electrical Center Identification Views* in Wiring Systems.



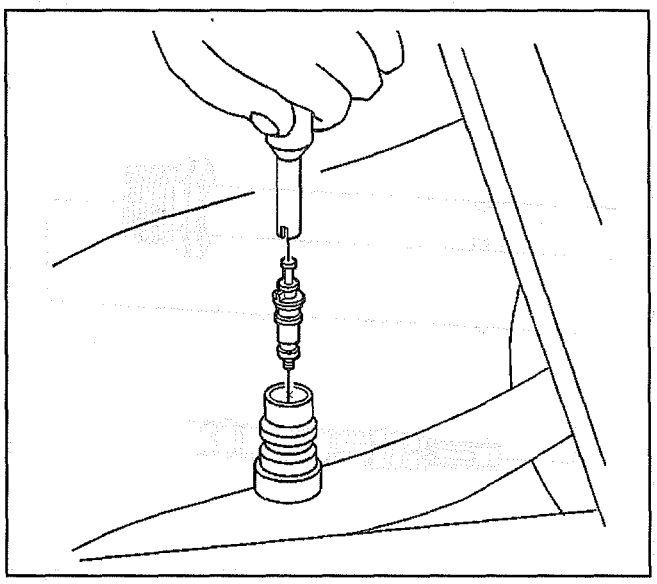
401242

Installation Procedure

1. Install the A/C compressor relay. Refer to *Electrical Center Identification Views* in Wiring Systems.
2. Install the cover on the number 2 underhood electrical center.



401242



297244

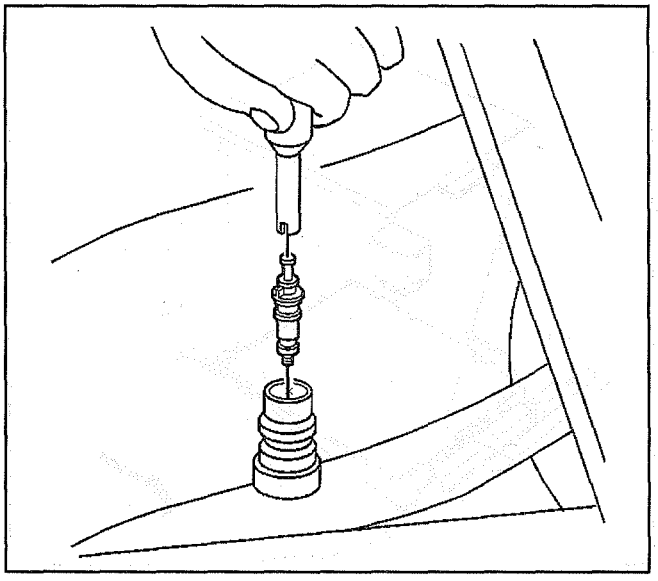
Service Port Valve Core Replacement

Removal Procedure

Tools Required

J 34611-A Valve Core Remover and Installer

1. Recover the refrigerant. Refer to *Refrigerant Recovery and Recharging*.
2. Remove the valve core using *J 34611-A*.



297244

Installation Procedure

Tools Required

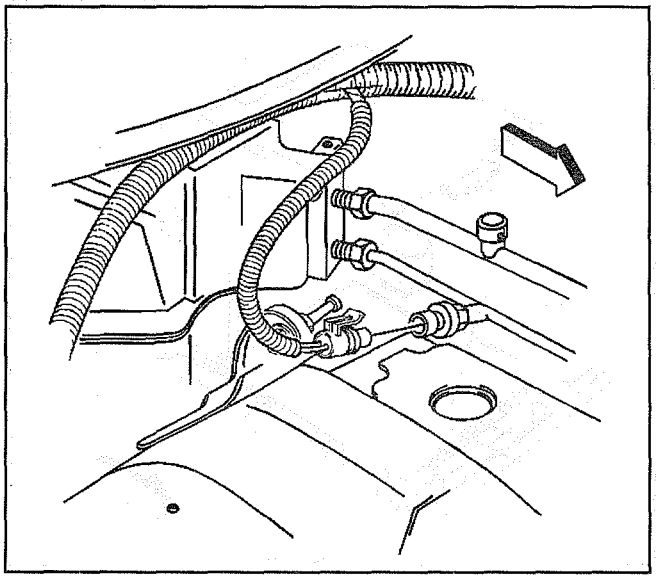
J 34611-A Valve Core Remover and Installer

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the valve core using *J 34611-A*.

   Tighten

   Tighten the service core to 11 N·m (97 lb in).
2. Recharge the air conditioning (A/C) system. Refer to *Refrigerant Recovery and Recharging*.
3. Test the fitting for leaks. Refer to *Leak Testing*.



282947

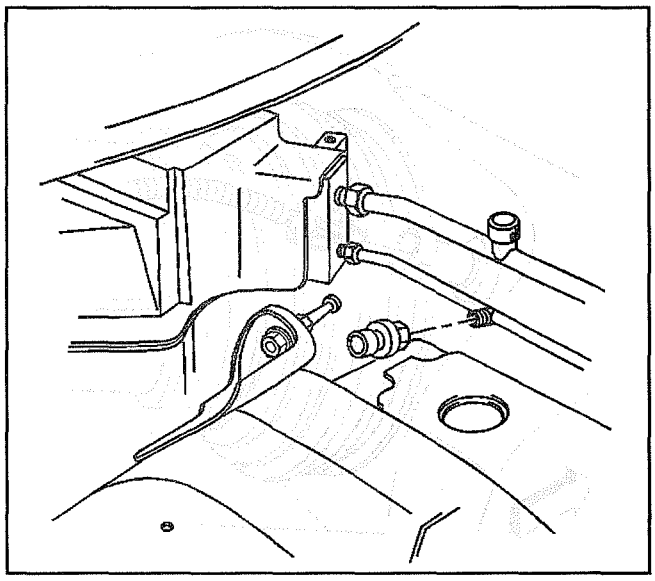
A/C Refrigerant Pressure Sensor Replacement

Removal Procedure

Important: The air conditioning (A/C) refrigerant pressure sensor is mounted on a Schrader® valve. Recovery of the air conditioning A/C system is not needed.

1. Disconnect the electrical connector at the A/C refrigerant pressure sensor.

2. Remove the A/C refrigerant pressure sensor and the seal.
3. Discard the seal.


282951

Installation Procedure

Coat the seal with a mineral base 525 viscosity refrigerant oil.

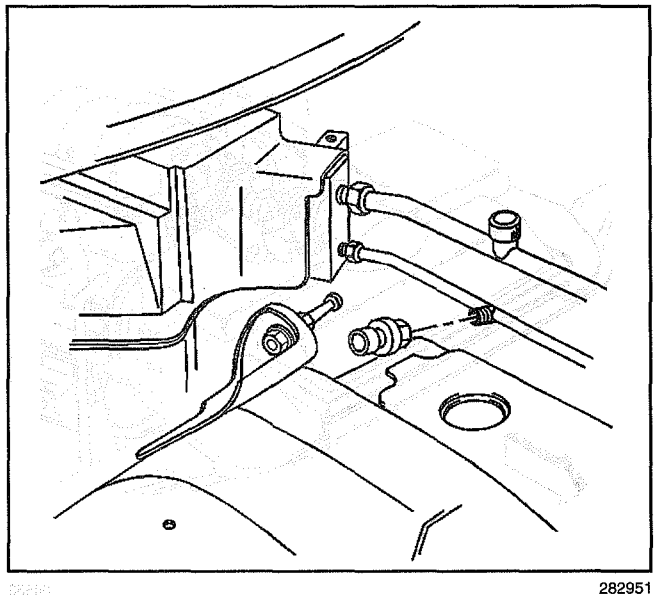
1. Install a new seal to the A/C refrigerant pressure sensor fitting.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

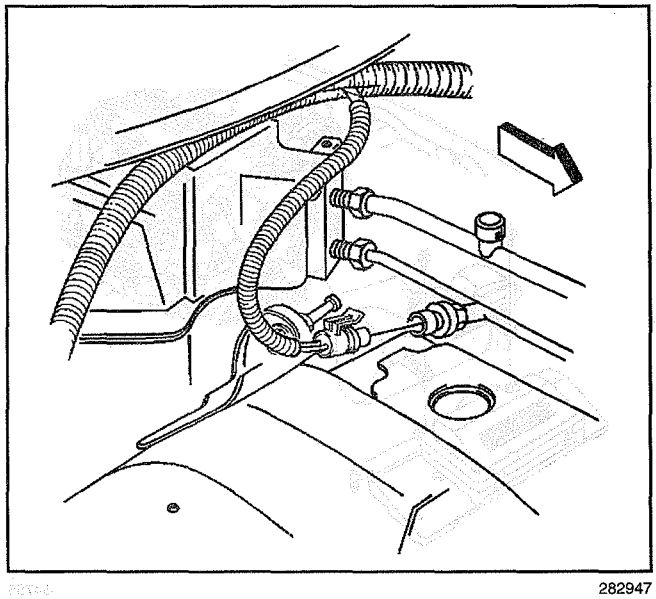
2. Install the A/C refrigerant pressure sensor.

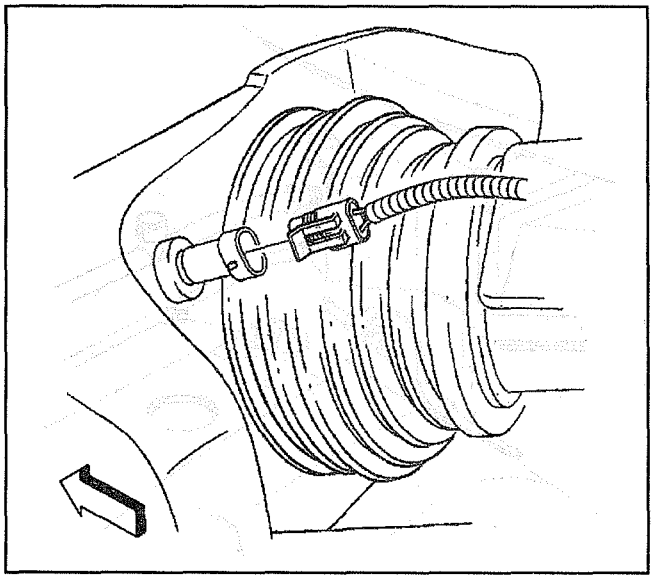
   Tighten

   Tighten the A/C refrigerant pressure sensor to 6 N·m (53 lb in).


282951

3. Connect the electrical connector to the A/C refrigerant pressure sensor.


282947

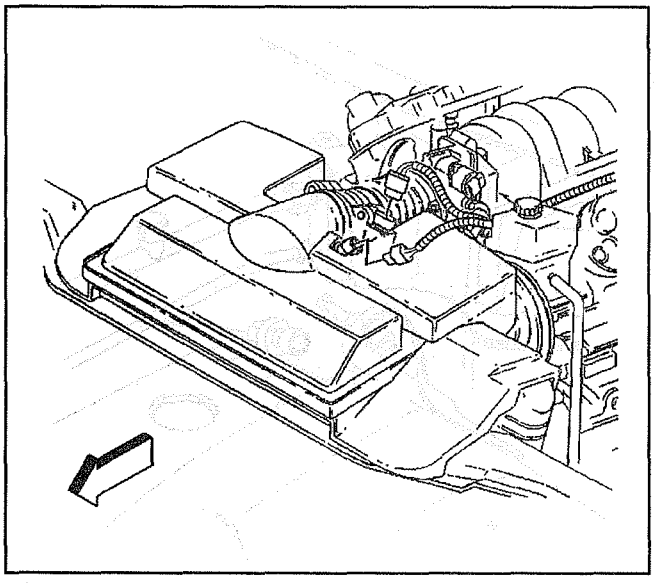


208554

Condenser Replacement

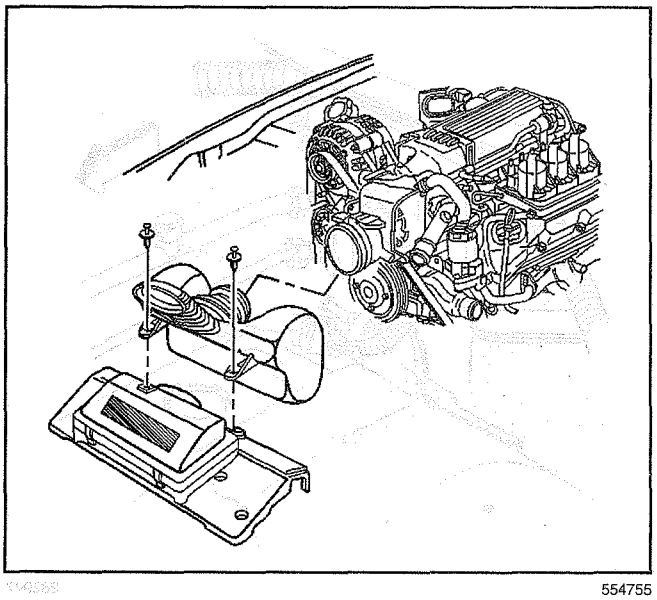
Removal Procedure

1. Recover the refrigerant. Refer to *Refrigerant Recovery and Recharging.*
2. Disconnect the intake air temperature (IAT) sensor connector at the air intake duct, if equipped with the 3.8 L engine.



208553

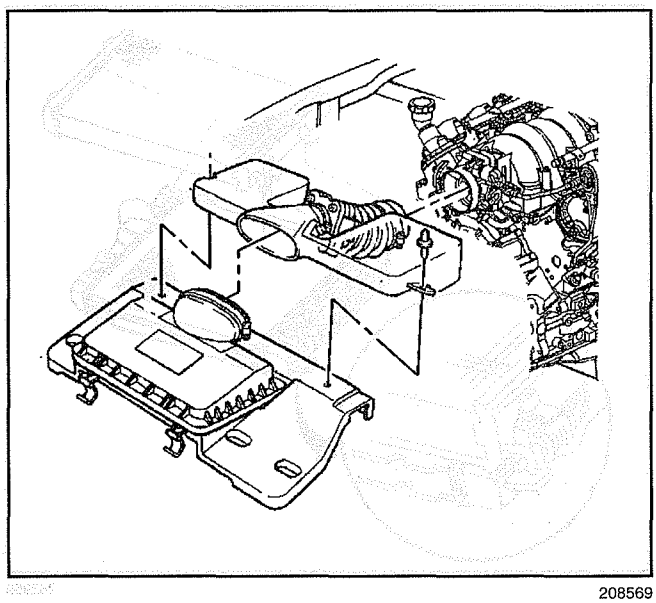
3. Disconnect the intake air temperature (IAT) sensor and mass airflow (MAF) sensor connectors at the air intake duct, if equipped with the 5.7 L engine.



554755

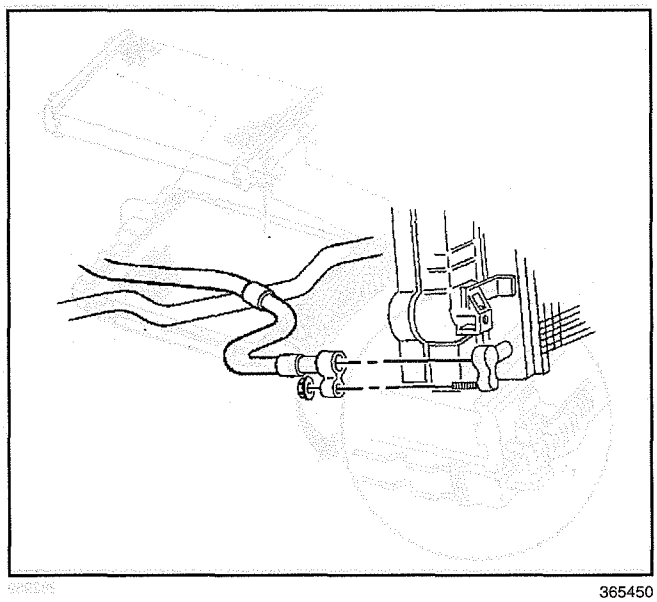
4. Remove the air intake duct, if equipped with the 3.8 L engine.

5. Remove the air intake duct, if equipped with the 5.7 L engine.
6. Remove the radiator support. Refer to *Radiator Support Replacement* in Engine Cooling.
7. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.



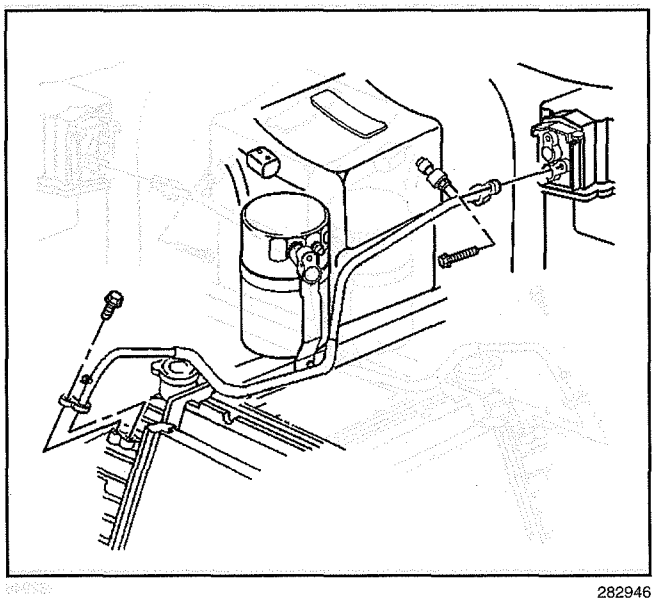
208569

8. Remove the air conditioning (A/C) compressor and condenser hose nut at the condenser.
9. Discard the O-ring.

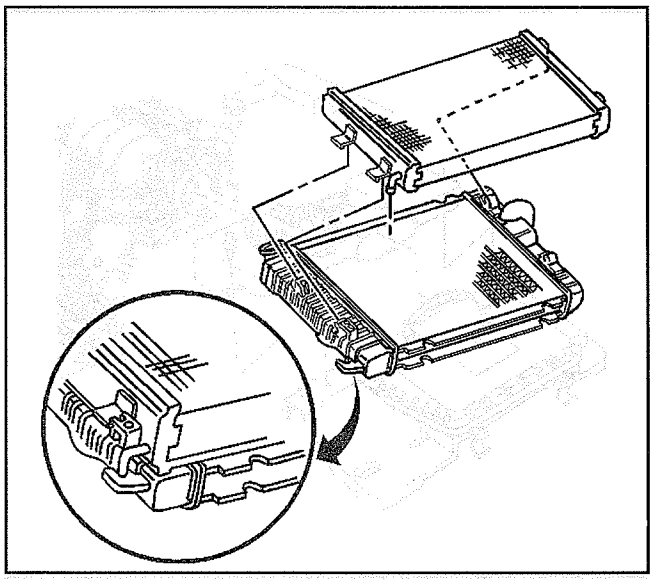


365450

10. Remove the A/C evaporator tube bolt at the condenser.
11. Discard the O-ring.
12. Remove the radiator air upper baffle from the condenser. Refer to *Radiator Air Baffle Assemblies and Deflectors (Upper)* in Engine Cooling.

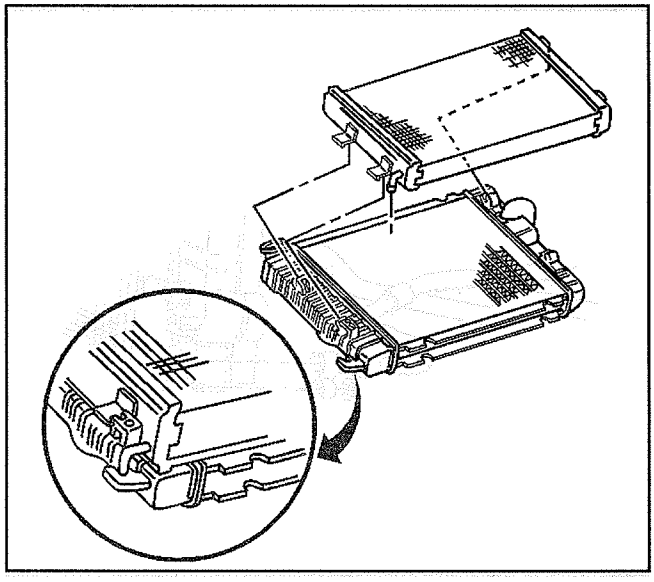


282946



282959

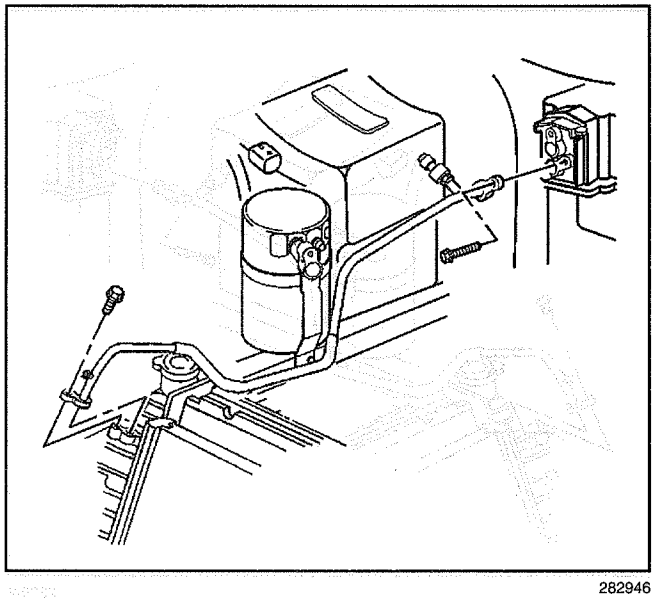
13. Remove the condenser from the radiator.



282959

Installation Procedure

1. Install the condenser to the radiator.
2. Install the radiator air upper baffle to the condenser. Refer to *Radiator Air Baffle Assemblies and Deflectors (Upper)* in Engine Cooling.



282946

3. Install a new O-ring.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the A/C evaporator tube bolt at the condenser.

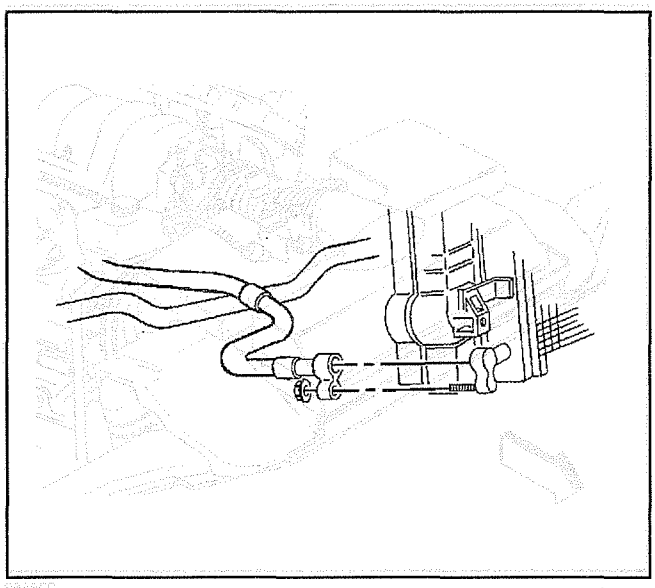
   Tighten

   Tighten the A/C evaporator tube bolt at the condenser to 16 N·m (12 lb ft).

5. Install a new O-ring.
6. Install the A/C compressor and condenser hose nut at the condenser.

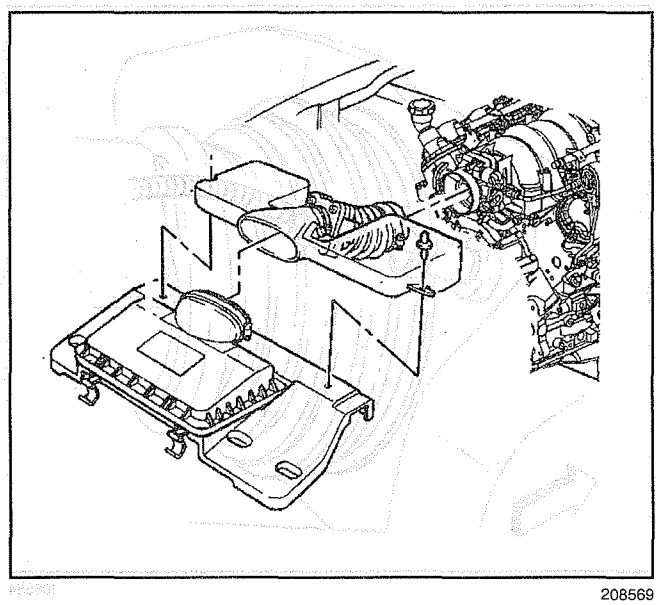
   Tighten

   Tighten the A/C compressor and condenser hose nut at the condenser to 16 N·m (12 lb ft).
7. Lower the vehicle.
8. Install the radiator support. Refer to *Radiator Support Replacement* in Engine Cooling.



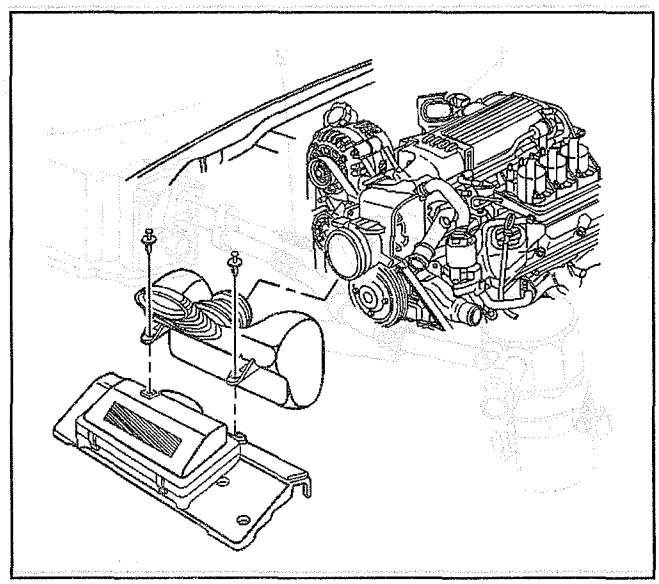
365450

9. Install the air intake duct, if equipped with the 5.7 L engine.

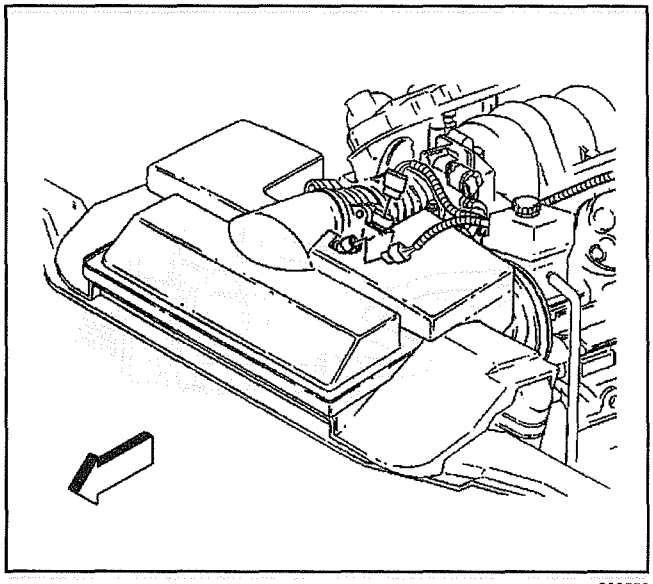


208569

10. Install the air intake duct, if equipped with the 3.8 L engine.

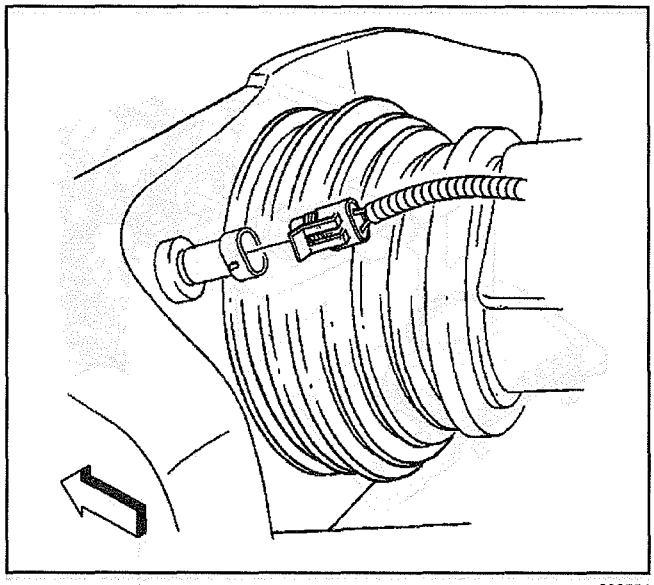


554755



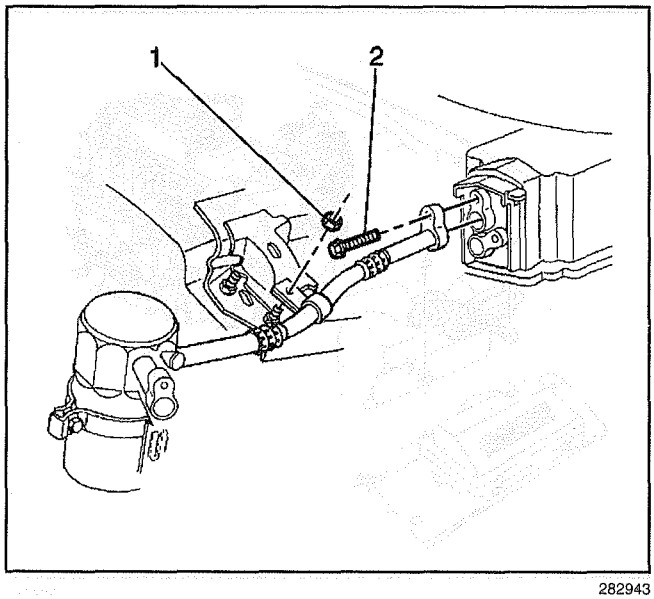
208553

11. Connect the intake air temperature (IAT) sensor and mass airflow (MAF) sensor connectors at the air intake duct, if equipped with the 5.7 L engine.



208554

12. Connect the intake air temperature (IAT) sensor connector at the air intake duct, if equipped with the 3.8 L engine.
13. Recharge the A/C system. Refer to *Refrigerant Recovery and Recharging*.
14. Perform a leak test on the A/C system. Refer to *Leak Testing*.



282943

Accumulator Replacement

Removal Procedure

1. Recover the refrigerant. Refer to *Refrigerant Recovery and Recharging*.
2. Disconnect the air conditioning (A/C) compressor and condenser hose bolt at the accumulator.
3. Remove the accumulator bolt (2) at the module.
4. Remove the accumulator hose bracket nut (1) at the strut tower.
5. Remove the accumulator bracket bolt.
6. Remove the accumulator from the bracket.
7. Discard the O-rings.

Installation Procedure

1. Before installing a new, or reinstalling the old accumulator perform the following:
   1.1. Drain, measure and record the amount of poly-alkylene glycol (PAG) oil in the accumulator that was removed.
   1.2. Add 60 ml (2 oz) of new, clean PAG oil MORE than the amount drained from the removed accumulator.
2. Install the new O-ring.
3. Install the accumulator to the bracket.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the accumulator bracket bolt.

   Tighten

   Tighten the accumulator bracket bolt to 6 N·m (53 lb in).
5. Install the accumulator hose bracket nut (1) at the strut tower.

   Tighten

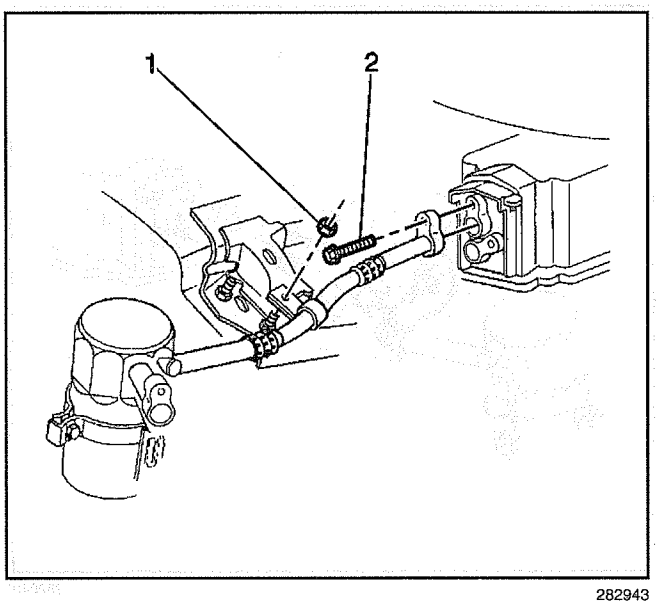
   Tighten the accumulator hose bracket nut (1) at the strut tower to 8 N·m (71 lb in).
6. Install the accumulator bolt (2) at the module.

   Tighten

   Tighten the accumulator bolt (2) at the module to 16 N·m (12 lb ft).
7. Connect the A/C compressor and condenser hose bolt at the accumulator.

   Tighten

   Tighten the A/C compressor and condenser hose bolt at the accumulator to 16 N·m (12 lb ft).
8. Recharge the A/C system. Refer to *Refrigerant Recovery and Recharging*.
9. Perform a leak test on the A/C system. Refer to *Leak Testing*.

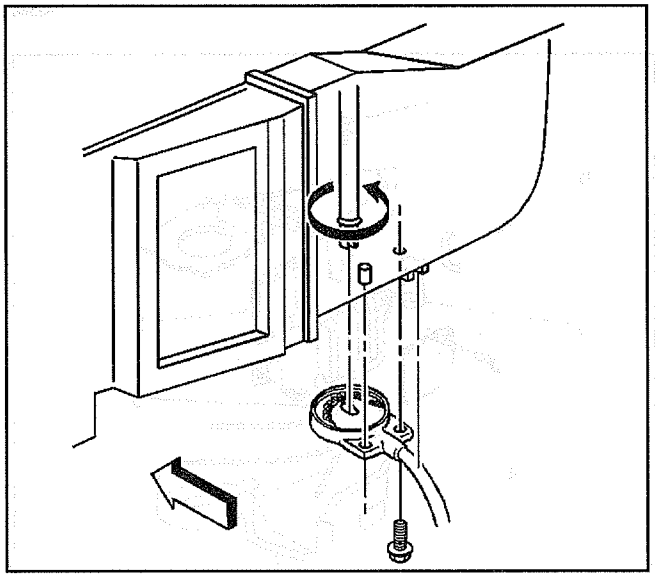


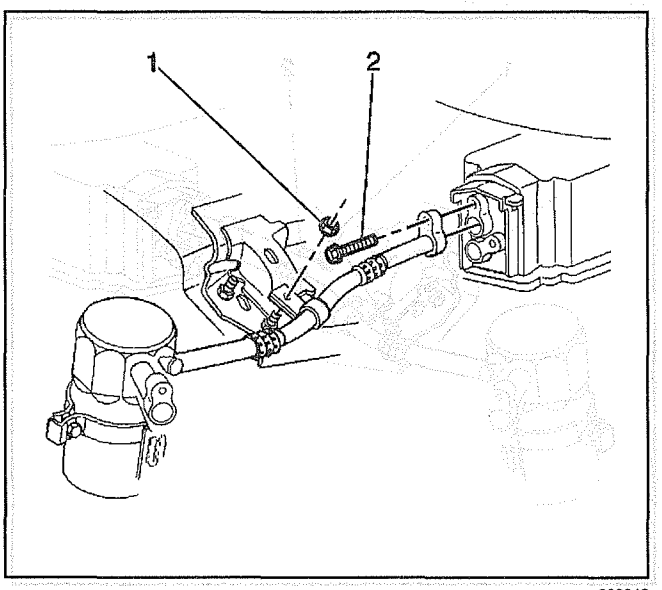
282943

Evaporator Core Replacement

Removal Procedure

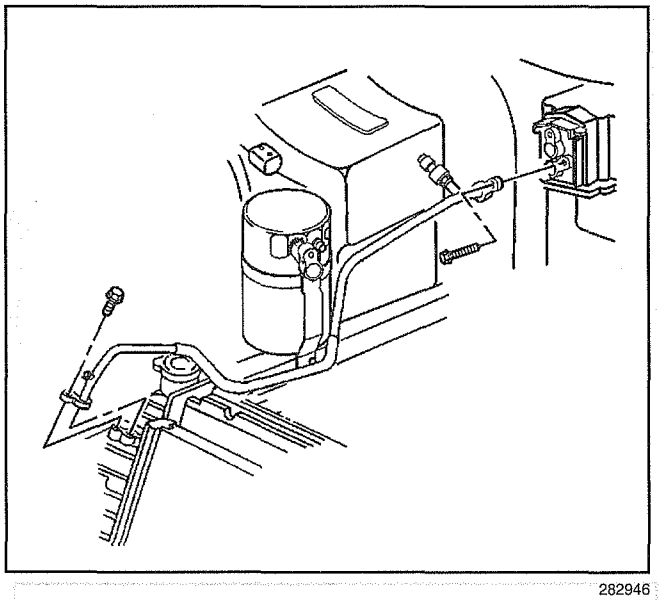
1. Drain the engine coolant. Refer to *Draining and Filling Cooling System (3.8 L)* or *Draining and Filling Cooling System (5.7 L)* in Engine Cooling.
2. Recover the refrigerant. Refer to *Refrigerant Recovery and Recharging*.
3. Remove the heater core. Refer to *Heater Core Replacement*.
4. Remove the temperature control cable bolt.
5. Remove the temperature control cable from the module.


282922

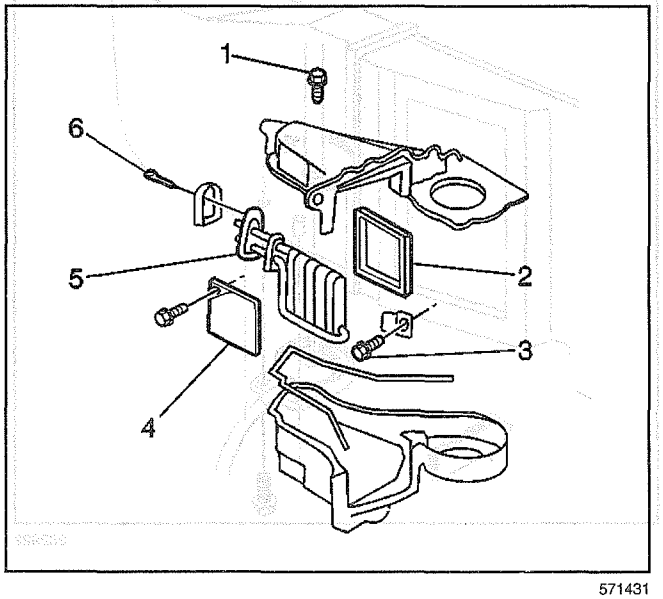


282943

6. Remove the accumulator bolt (2) at the module.
7. Discard the O-ring seal.


282946

8. Remove the air conditioning (A/C) evaporator tube bolt at the module.
9. Discard the O-ring seal.



571431

10. Remove the heater rear case bolts.
11. Remove the heater rear case (4):
    - 11.1. Slide the heater rear case (4) downward in order to disengage the upper case clip.
    - 11.2. Remove the heater rear case.
    - 11.3. Use a small hand saw to remove the perforated section of the heating, ventilation and air conditioning (HVAC) evaporator module.

      This section will be reused.
    - 11.4. Water may leak onto the carpeting when performing this procedure. Place a mat on the passenger side floor.
    - 11.5. Remove the A/C evaporator bracket nut (1).
    - 11.6. Remove the A/C evaporator bracket.

11.7. Remove the bolts from the engine compartment side of the A/C evaporator upper and lower case.

Open the case slightly.

11.8. Remove the A/C evaporator seal.

11.9. Remove the evaporator (6).

11.10. Transfer the A/C evaporator air filter (5) to the new evaporator.

Installation Procedure

1. Install the NEW A/C evaporator (6).
2. install a NEW A/C evaporator seal.
3. Apply sealer between the evaporator upper and lower case.

   Do not use epoxy glue as a sealer.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the bolts to the engine side of the A/C evaporator upper and lower case.

   Tighten

   Tighten the A/C evaporator upper and lower case bolts to 2 N·m (18 in).
5. Install the A/C evaporator bracket.
6. Install the A/C evaporator bracket bolt (1).

   Tighten

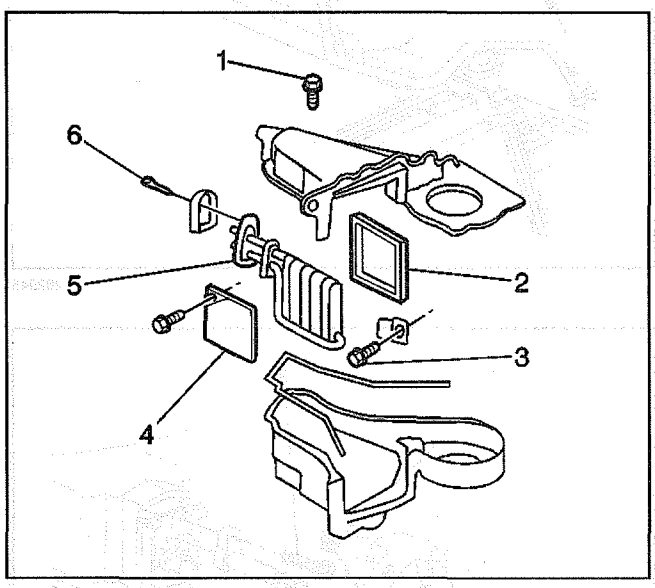
   Tighten the A/C evaporator bracket bolt (1) to 2 N·m (18 lb in).
7. Position the perforated section of the evaporator module.

   Use epoxy glue in order to adhere the perforated section to the module.

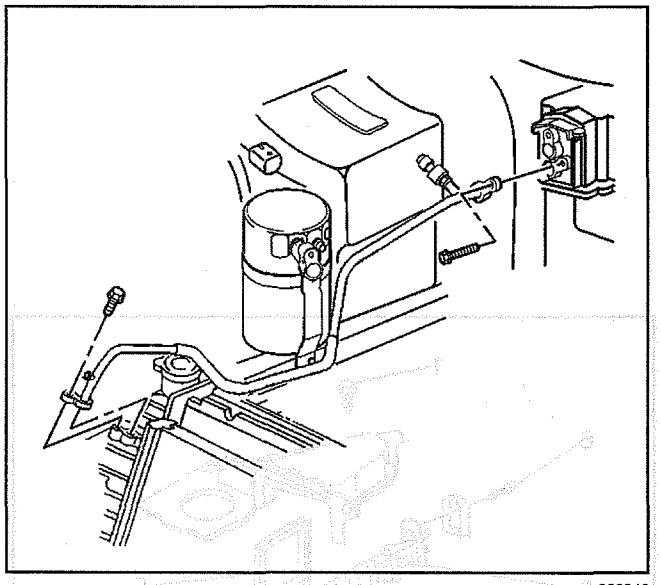
   Allow the epoxy to dry.
8. Use your thumb in order to grade the sealant on the inside and the outside in order to ensure a water-tight seal.
9. Use the following steps in order to install the heater rear case (4):
   - 9.1. Slide the heater rear case upward into position until the upper clip engages.
   - 9.2. Engage the snap on the left edge of the heater rear case to the distributor case.
   - 9.3. Install the bolts to the heater rear case.

     Tighten

     Tighten the heater rear case bolts to 2.0 N·m (18 lb in).



571431

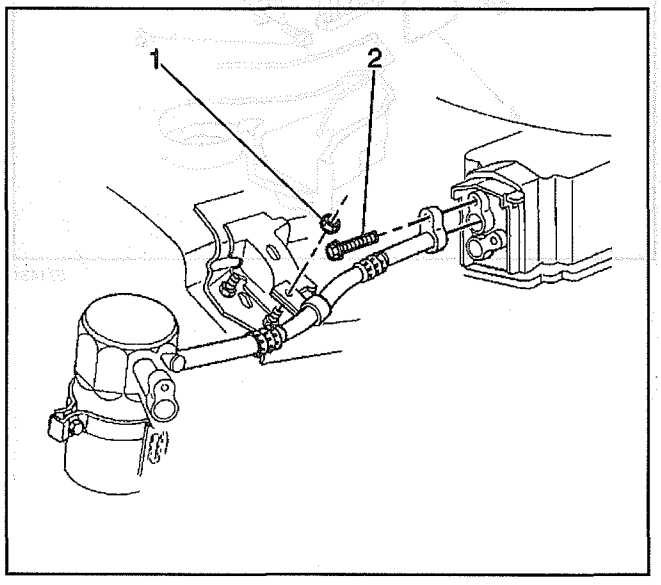


282946

10. Install a new O-ring seal.
11. Install the A/C evaporator tube bolt at the module.

Tighten

Tighten the A/C evaporator tube bolt to 16 N·m (12 lb ft).

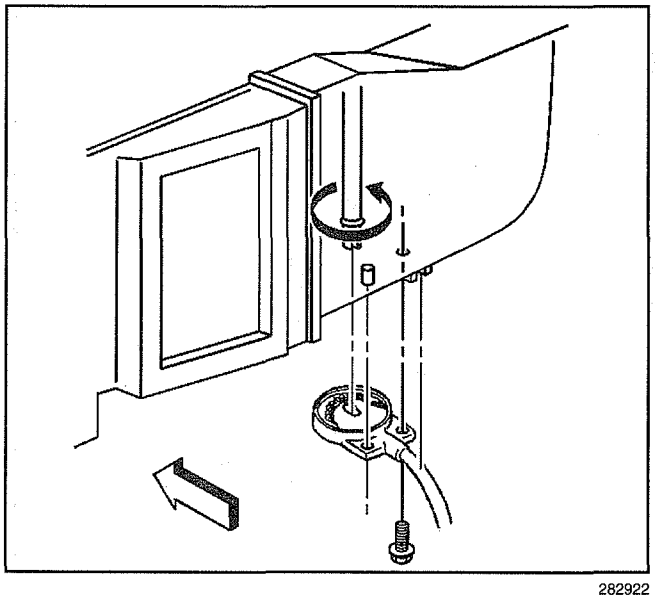


282943

12. Install a new O-ring seal.
13. Install the accumulator bolt at the module.

Tighten

Tighten the accumulator bolt (2) to 16 N·m (12 lb ft).



282922

14. Install the temperature control cable to the module.
15. install the temperature control cable bolt.

Tighten

Tighten the temperature control cable bolt to 1.9 N·m (17 lb in).

16. Install the heater core. Refer to *Heater Core Replacement*.
17. Recharge the refrigerant. Refer to *Refrigerant Recovery and Recharging*.
18. Refill the cooling system. Refer to *Draining and Filling Cooling System (3.8 L)* or *Draining and Filling Cooling System (5.7 L)* in Engine Cooling.

Heater Hose Assembly Replacement (3.8 L)

Removal Procedure

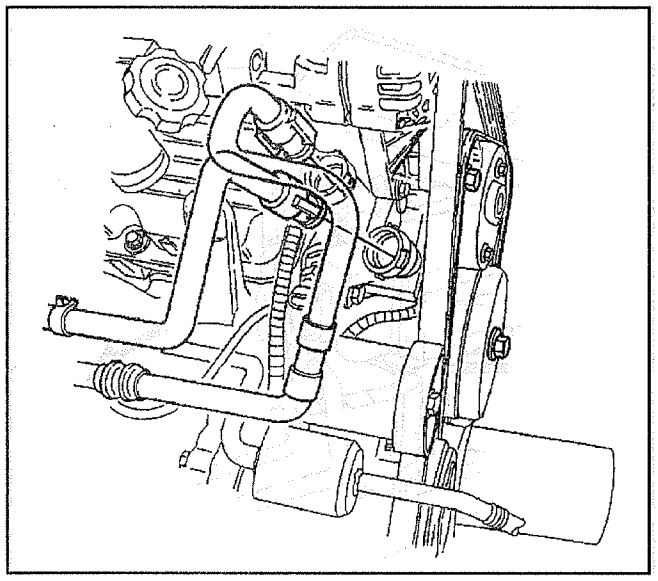
1. Partially drain the engine coolant.

Notice: Remove the heater hose quick connect fittings by hand. Do not attempt to pry the quick connect fittings from the drive belt tensioner. Prying the quick connect fittings may damage the quick connect fittings.

2. Disconnect the heater hose quick connect fittings from the drive belt tensioner.

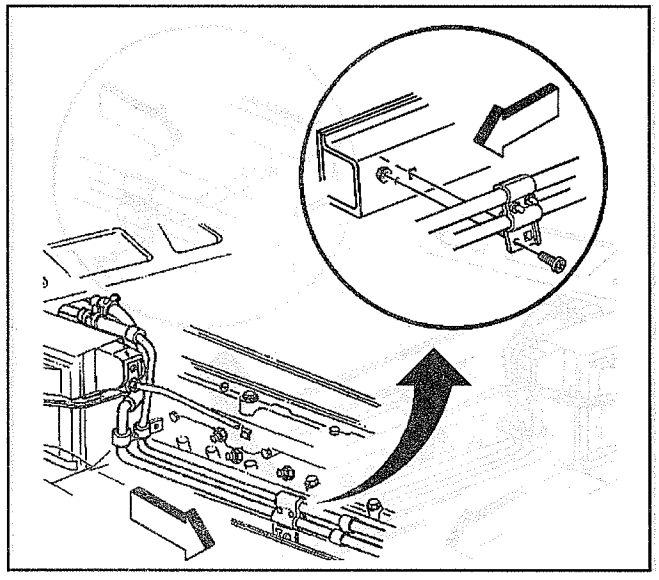
   Twist and pull the quick connect fittings from the drive belt tensioner.

3. Discard the O-rings.



282933

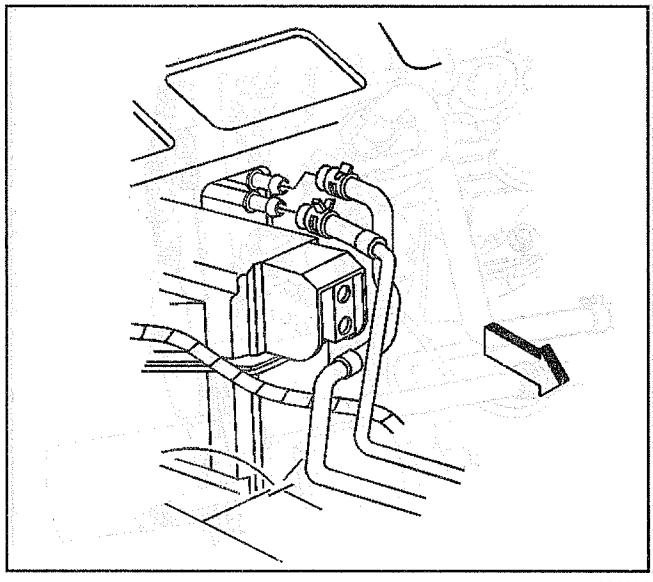
4. Remove the bolt attaching the inlet and outlet hose bracket at the mid rail.



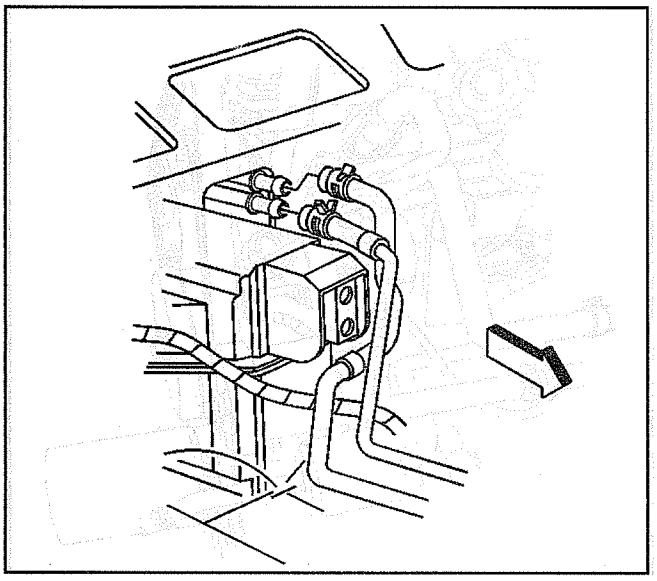
282932

Notice: Do not apply excessive force on the heater core pipes during hose removal. Applying excessive force on the heater core pipes may damage the heater core pipes.

5. Remove the inlet and outlet hoses from the heater core.
   - 5.1. Squeeze the hose clamp with the pliers.
   - 5.2. Slide the clamp away from the heater core fittings.
   - 5.3. Gently twist and pull the heater hose from the heater core fitting.
6. Remove the inlet hose from the module retainer.
7. Remove the inlet and outlet hoses (4) from the vehicle.



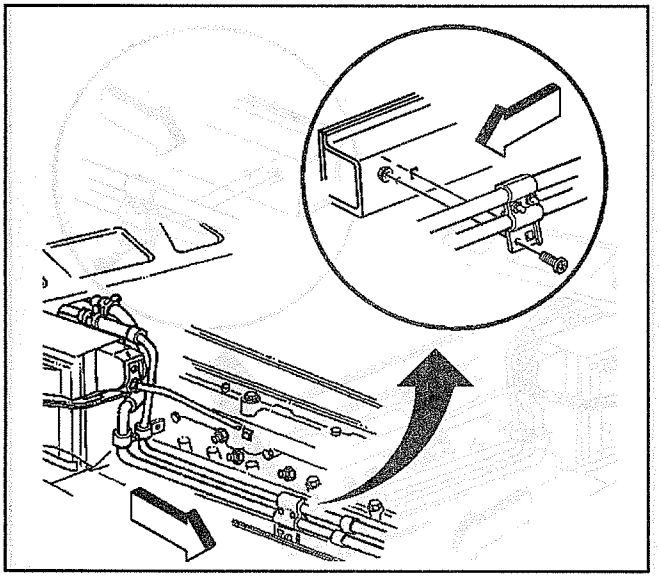
282931



282931

Installation Procedure

1. Install the inlet and outlet hoses to the vehicle.
2. Install the inlet hose to the module retainer.
3. Install the inlet and outlet hoses to the heater core.
   3.1. Apply lubricant to the inside diameter of the heater hose, if necessary.
   3.2. Push the heater hose onto the fitting with a twisting motion.
   3.3. Squeeze the hose clamp ends together and slide the clamp over the end of the heater hose.
   3.4. Install the clamp beyond the bead around the fitting.
   3.5. Install the other heater hose.



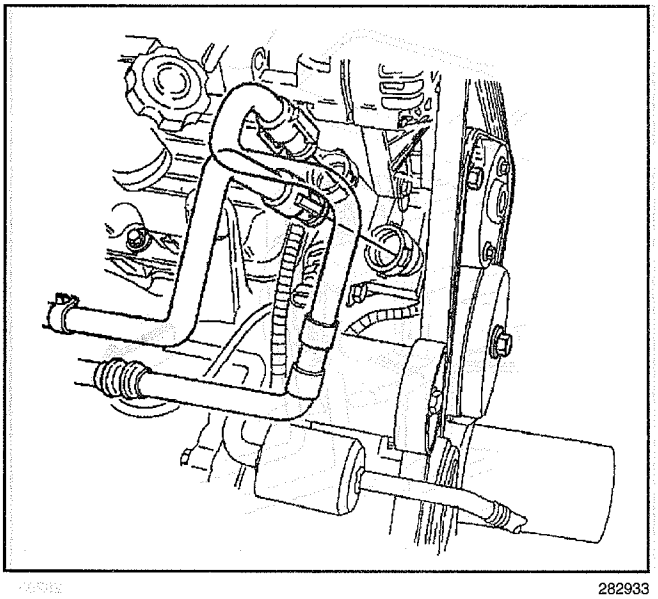
282932

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the bolt attaching the inlet and outlet hose bracket at the mid rail.

   Tighten

   Tighten the heater hose bracket bolt to 14 N·m (10 lb ft).



282933

5. Install the O-rings to the quick connect fittings.

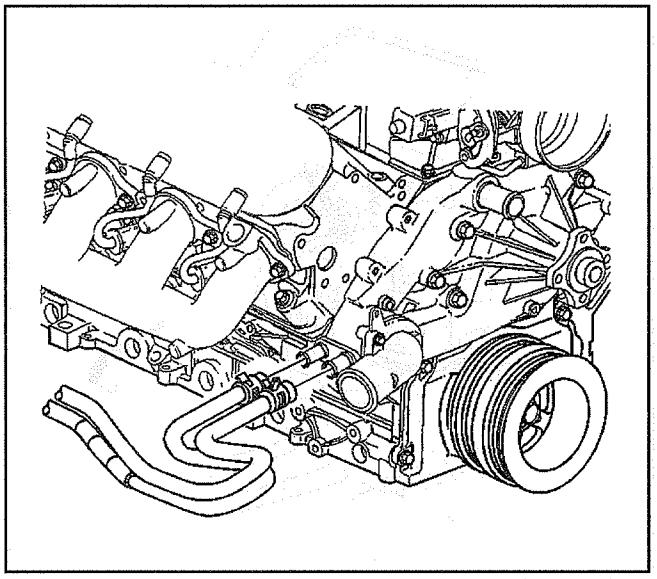
   Snap the quick connect fittings to the drive belt tensioner.
6. Pull back on the quick connect fittings in order to verify proper connector engagement.
7. Add the engine coolant.
   - If the previously drained coolant is uncontaminated, use the previously drained coolant.
   - If the previously drained coolant is contaminated, discard the contaminated coolant.

     Then, add a fresh 50/50 DEX-COOL and water mixture.

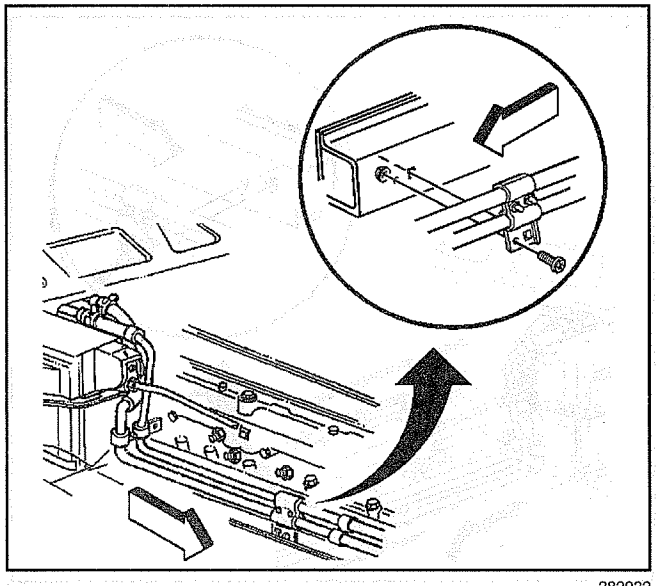
Heater Hose Assembly Replacement (5.7 L)

Removal Procedure

1. Partially drain the engine coolant.
2. Remove the inlet and outlet heater hoses from the water pump.
   2.1. Squeeze the hose clamp together with pliers.
   2.2. Slide the hose clamp away from the water pump fitting.
   2.3. Gently twist and pull the heater hose from the water pump fitting.
   2.4. Remove the heater hose.
   2.5. If the heater hoses cannot be removed easily perform the following steps:
      2.5.1. Cut the hose forward of the hose pipe.
      2.5.2. Cut the hose remaining on the water pump fitting lengthwise.
      Remove the heater hose.
3. Remove the bolt attaching the inlet and outlet hose bracket at the mid rail.



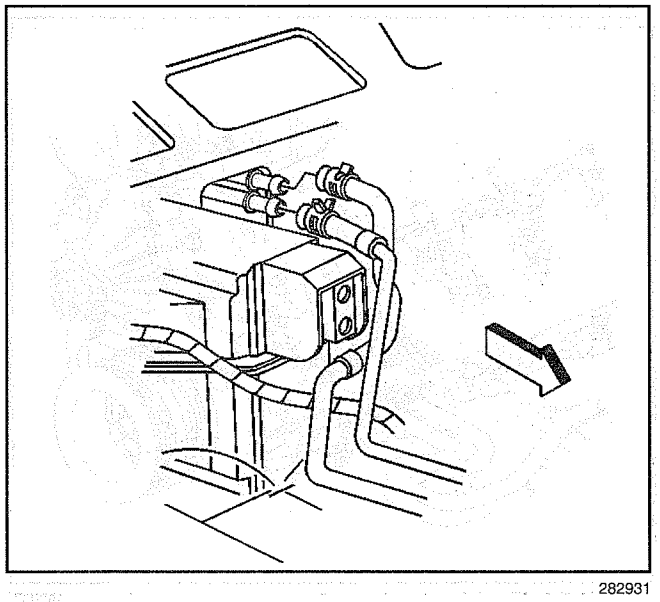
282934



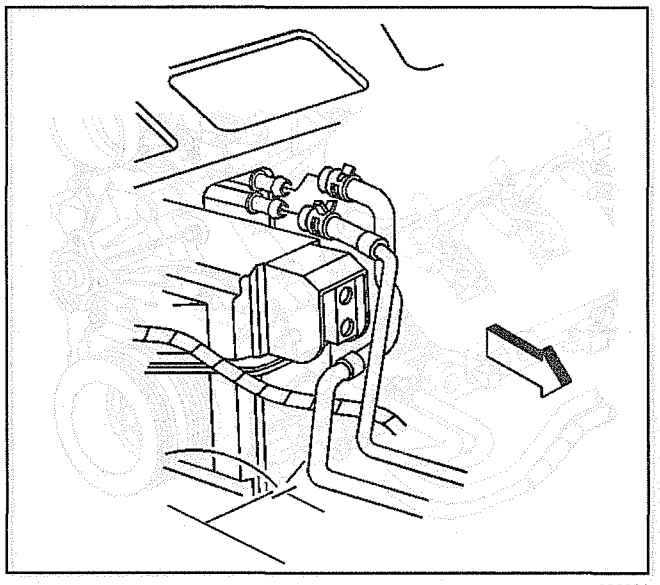
282932

Notice: Do not apply excessive force on the heater core pipes during hose removal. Applying excessive force on the heater core pipes may damage the heater core pipes.

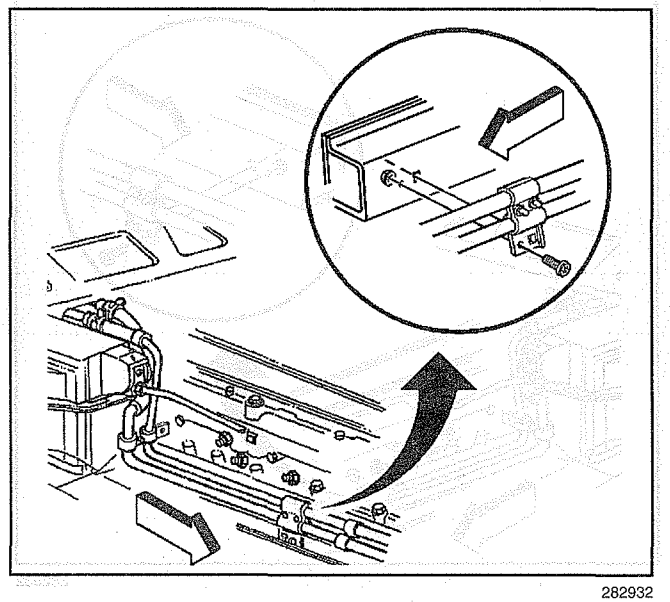
4. Remove the inlet and outlet hoses from the heater core.
   4.1. Squeeze the hose clamp with pliers.
   4.2. Slide the clamp away from the heater core fittings.
   4.3. Gently twist and pull the heater hose from the heater core fitting.
5. Remove the inlet hose from the module retainer.
6. Remove the inlet and outlet hoses from the vehicle.



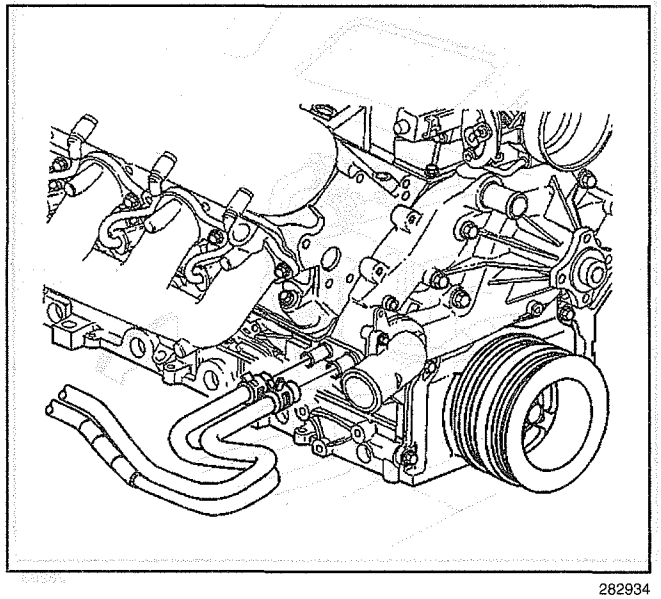
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282931



282932



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Installation Procedure

1. Install the inlet and outlet hoses to the vehicle.
2. Install the inlet hose to the module retainer.
3. Install the inlet and outlet hoses to the heater core.
   - 3.1. Apply lubricant to the inside diameter of the heater hose, if necessary.
   - 3.2. Push the heater hose onto the fitting with a twisting motion.
   - 3.3. Squeeze the hose clamp ends together and slide the clamp over the end of the heater hose.
   - 3.4. Install the clamp beyond the bead around the fitting.
   - 3.5. Install the other heater hose.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the bolt attaching the inlet and outlet hose bracket at the mid rail.

   Tighten

   Tighten the heater hose bracket bolt to 14 N·m (10 lb ft).

5. Install the inlet and outlet heater hoses to the water pump.
   - 5.1. Apply lubricant to the inside diameter of the heater hose, if necessary.
   - 5.2. Push the heater hose onto the fitting with a twisting motion.
   - 5.3. Squeeze the hose clamp ends together and slide the clamp over the end of the heater hose.
   - 5.4. Slide the hose clamp away from the water pump fitting.
   - 5.5. Install the clamp beyond the bead around the fitting.
   - 5.6. Install the other heater hose.

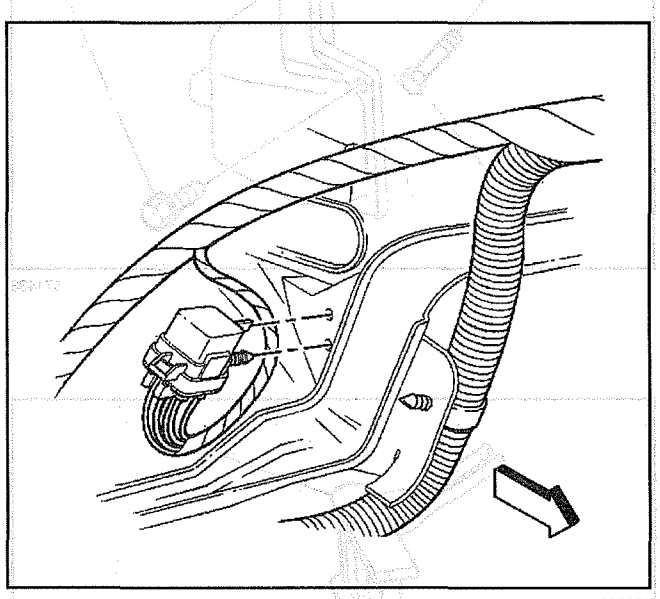
6. Add the engine coolant:
   - If the previously drained coolant is uncontaminated, use the previously drained coolant.
   - If the previously drained coolant is contaminated, discard the contaminated coolant.

   Then, add a fresh 50/50 DEX-COOL and water mixture.

Blower Motor Relay Replacement

Removal Procedure

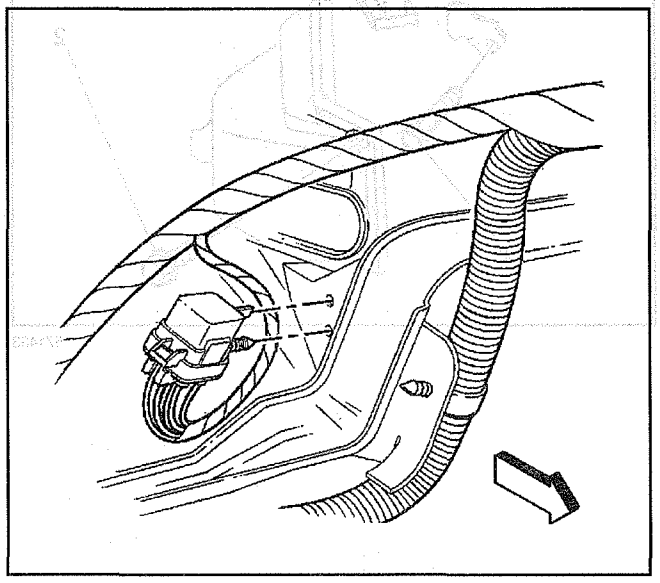
1. Remove the driver side instrument panel (IP) insulator. Refer to *Closeout/Insulator Panel Replacement - Left* in Instrument Panel, Gauges and Console.
2. Remove the knee bolster. Refer to *Knee Bolster Replacement - Left* in Instrument Panel, Gauges and Console.
3. Remove the blower motor relay from the IP tie bar.
4. Disconnect the electrical connector from the blower motor relay.



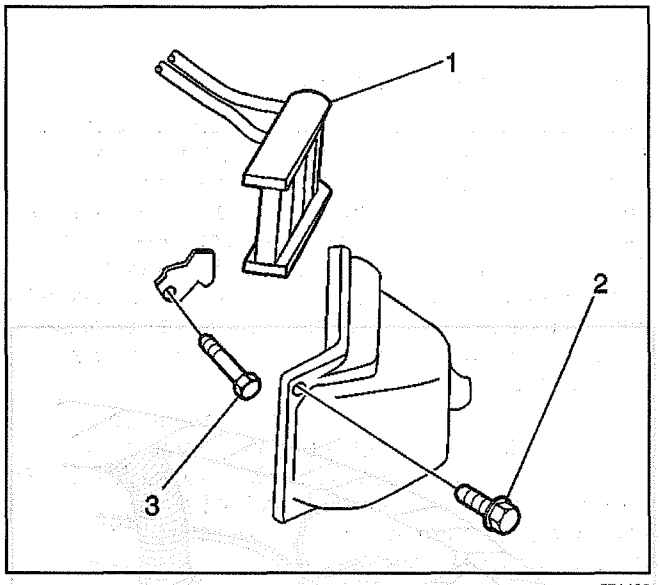
365453

Installation Procedure

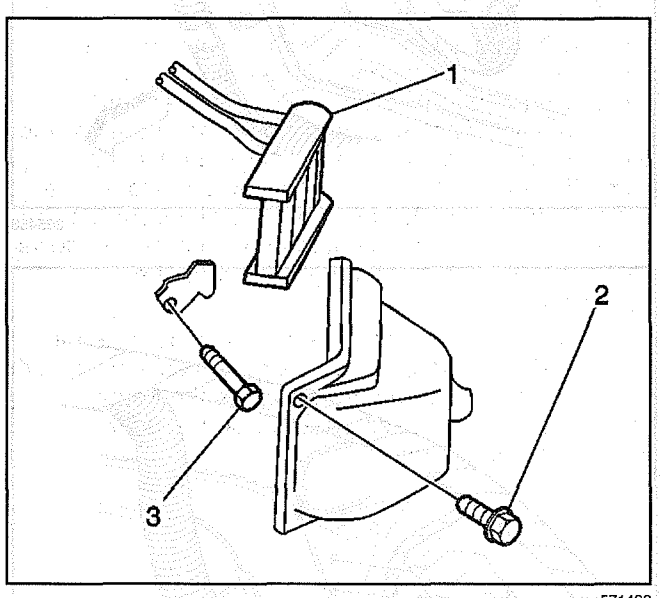
1. Connect the electrical connector to the blower motor relay.
2. Install the blower motor relay to the IP tie bar.
3. Install the knee bolster. Refer to *Knee Bolster Replacement - Left* in Instrument Panel, Gauges and Console.
4. Install the driver side IP insulator. Refer to *Closeout/Insulator Panel Replacement - Left* in Instrument Panel, Gauges and Console.



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Heater Core Replacement

Removal Procedure

1. Drain the engine coolant. Refer to *Draining and Filling Cooling System (3.8 L)* or *Draining and Filling Cooling System (5.7 L)* in Engine Cooling.
2. Remove the heater hoses/pipes. Refer to *Heater Hose Assembly Replacement (3.8 L)* or *Heater Hose Assembly Replacement (5.7 L).*
3. Remove the heater core tube clamp bolt.
4. Remove the heater core tube clamp.
5. Remove the heater core shroud seal.
6. Remove the heater rear case bolts (2).
7. Remove the heater rear case (4):
   - 7.1. Slide the heater rear case (4) downward in order to disengage the upper case clip.
   - 7.2. Remove the heater rear case.
8. Remove the instrument panel (IP) compartment door. Refer to *Door Replacement - IP Storage Compartment Door*
9. Remove the heater core clamp bolt (3).
10. Remove the heater core clamp.
11. Remove the heater core (1).

Installation Procedure

1. Install the heater core.
2. Install the heater core clamp.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the heater core clamp bolt.

   Tighten

   Tighten the heater core clamp bolt to 1.8 N·m (16 lb in).
4. Use the following steps in order to install the heater rear case (4):
   - 4.1. Slide the heater rear case upward into position until the upper clip engages.
   - 4.2. Engage the snap on the left edge of the heater rear case to the distributor case.
   - 4.3. Install the bolts to the heater rear case.

     Tighten

     Tighten the heater rear case bolts to 2.0 N·m (18 lb in).
5. Install the heater core shroud seal.
6. Install the heater core tube clamp.
7. Remove the heater core tube clamp bolt.

   Tighten

   Tighten the heater core tube clamp bolt to 2 N·m (18 lb in).
8. Remove the instrument panel (IP) compartment door. Refer to *Door Replacement - IP Storage Compartment Door*
9. Install the heater hoses/pipes. Refer to *Heater Hose Assembly Replacement (3.8 L)* or *Heater Hose Assembly Replacement (5.7 L).*
10. Drain the engine coolant. Refer to *Draining and Filling Cooling System (3.8 L)* or *Draining and Filling Cooling System (5.7 L)* in Engine Cooling.

Description and Operation

A/C System Description

The heating, ventilation and air conditioning (HVAC) system delivers air that has been heated or cooled and dehumidified for occupant comfort. The HVAC system also provides the following features:

- Ventilation
- Windshield defrosting
- Side window defogging

During most operating condition, the blower motor draws the outside air through the heater and air conditioning module. The forward movement of the vehicle forces additional air into the vehicle. The following actions occur in the evaporator core when the compressor is on:

- The air is filtered
- The air is dehumidified
- The air is cooled to about 2°C (35°F)

Some of the air then passes through the heater core where the flow of hot coolant reheats the air. Depending on the temperature door position, the heated air is mixed with cold air from the evaporator before the air enters into the passenger compartment. The air enters the passenger compartment through the upper, lower, or defroster outlets. This provides positive air flow even if the windows are closed.

When the Recirc mode is selected, most of the air entering the evaporator and heater core module is recirculated from the passenger compartment. Recirculated air is most likely cooler and dryer than outside air in very hot weather.

Heater Core Description

The heater core is the main component of the heater system. The heater core is located inside of the heater and evaporator module. Engine coolant is pumped into the heater core from the engine whenever the engine is operating. The heater core fins transfers the heat from the engine coolant to the air passing over the heater core. The heater core has specific inlet and outlet tubes. The placement of the heater hoses should be noted prior to servicing the heater core or the heater hoses.

The temperature control is linked to the temperature valve by a flexible control cable. When you rotate temperature control counterclockwise to the full COLD position, the temperature valve is held snugly against the air entrance to the heater core. The following actions occur:

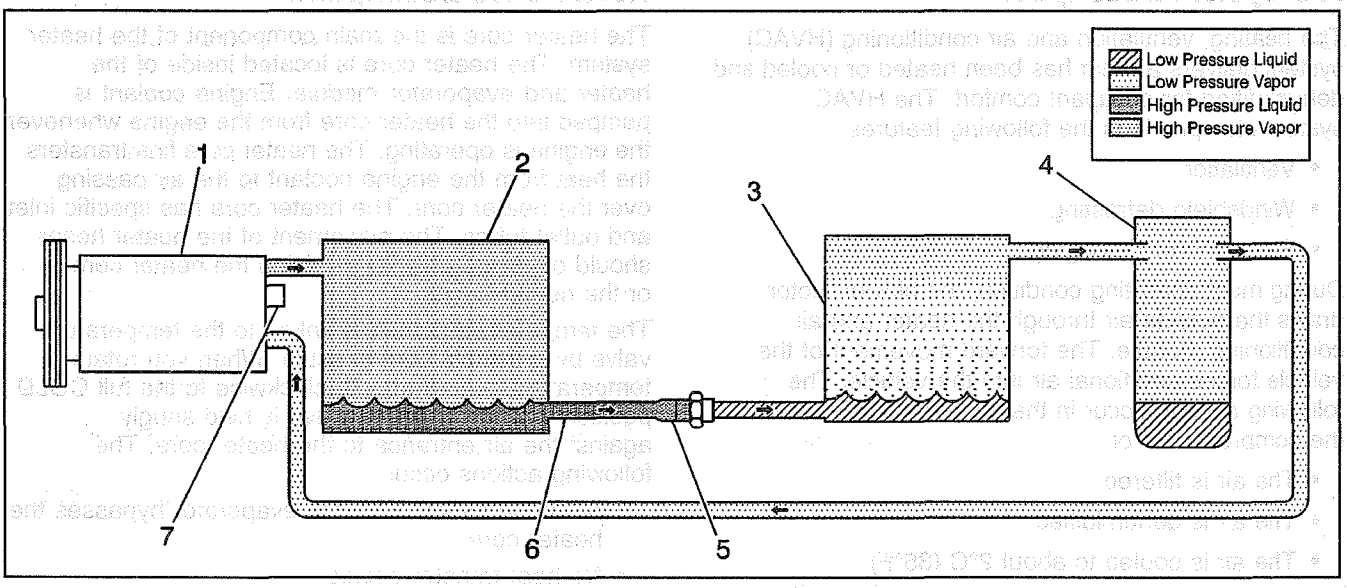
- All of the airflow from the evaporator bypasses the heater core.
- No heat transfer occurs.

When you turn the temperature control away from the full COLD position, the temperature valve begins to direct air to the heater core. This action allows air to flow through the heater core. The farther the temperature control is rotated clockwise, the more the temperature valve directs air through the heater core. The air discharge is warmer when most of the airflow is heated in this manner. The air discharge is warmer because the heated and unheated air flows join and mix together thoroughly beyond the heater core.

When you rotate the temperature lever clockwise to the full HOT position, the temperature valve blocks off the passage that allows air to bypass the heater core. This action causes passage of the airflow through the heater core.

Refrigeration System Description

VDOT Refrigeration System



194971

Legend

(1) Compressor
(2) Condenser
(3) Evaporator
(4) Accumulator
(5) Expansion (Orifice) Tube
(6) Liquid Line
(7) Pressure Relief Valve

The variable displacement orifice tube (VDOT) system is comprised of the following components:

- A variable displacement compressor (1)
- A fixed expansion tube (5)

This system matches the air conditioning demands under all modes without cycling. The basic compressor mechanism is a variable angle wobble-plate with five cylinders. The five cylinders are oriented around a common axis. The center of control of the compressor displacement is the control valve. The control valve is actuated by a bellows. The control valve is located in the rear head of the compressor (1) that senses compressor suction pressure. the crankcase-suction pressure differential controls the following conditions:

- The wobble-plate angle
- The compressor displacement

When the A/C capacity demand is high, the suction pressure will be above the control point. The valve performs the following functions:

- Maintains a bleed discharge gas into the crankcase
- Closes off a passage from the crankcase to the suction plenum

The angle of the wobble-plate is controlled by a force balance on the five pistons. A slight elevation of the crankcase suction pressure differential creates a total force on the pistons. The force on the pistons produces a movement about the wobble-plate pivot pin that reduces the plate angle.

Refrigerant R-134a

Caution: Refer to Caution - Breathing R-134a in Cautions and Notices.

Refrigerant performs the following functions in the air conditioning system:

- Absorbs heat
- Carries heat
- Releases heat

These vehicles use Refrigerant-134a (R-134a). Refrigerant-134a is a nontoxic, nonflammable, clear, colorless liquefied gas.

Handling Refrigerant R-134a

Caution: Avoid breathing the A/C Refrigerant 134a (R-134a) and the lubricant vapor or the mist. Exposure may irritate the eyes, nose, and throat. Work in a well ventilated area. In order to remove R-134a from the A/C system, use service equipment that is certified to meet the requirements of SAE J 2210 (R-134a recycling equipment). If an accidental system discharge occurs, ventilate the work area before continuing service. Additional health and safety information may be obtained from the refrigerant and lubricant manufacturers.

Important:

- Use only the approved lubricant for the R-134a system and the R-134a components. If lubricants other than those specified are used, compressor failure may occur. Coat all of the fittings and the O-ring seals with a clean approved refrigerant oil. This action will provide a leak-proof seal and to aid in assembly and disassembly.
- Do not store or heat the refrigerant containers above 125°F (52°C).
- Do not heat a refrigerant container with an open flame. If the container must be warmed, place the bottom of the container in a pail of warm water.
- Do not drop, puncture, or incinerate the refrigerant containers.
- Refrigerant will displace oxygen. Work in well-ventilated areas in order to prevent suffocation.
- Do not introduce compressed air to any refrigerant container or refrigerant component. The action may cause the contamination of the refrigerant.
- If it is necessary to carry a container of Dot CFR Refrigerant-134a in a vehicle, do not carry it in the passenger compartment.

Handling Compressor Oil

Use approved compressor oil from a closed, sealed container. When adding refrigerant oil, the transfer device and container should be clean and dry to minimize the possibility of contamination. Refrigerant oil is moisture-free and will readily absorb moisture from the air. Do not open the oil container until the service procedure requires oil. Cap the oil immediately after use. Always store compressor oil in a closed sealed container. Compressor oil left in open or improperly sealed containers will absorb moisture. Do not reuse oil that has been removed from the refrigeration system. Dispose of used oil properly, according to local regulations.

Handling of Refrigerant Lines and Fittings

- Ensure that the metal lines do not exhibit the following conditions.

  This will prevent the loss of system capacity due to line restriction:
  - Dents
  - Kinks
- Do not bend the flexible hose line to a radius of less that 4 times the diameter of the hose.
- Do not allow the flexible hose line to come within a distance of 63.5 mm (2 ½ in) of the exhaust manifold.
- Inspect the flexible hose lines regularly.

  Replace the flexible hose line with new hose if one of the following conditions exist:
  - Leaks
  - Brittleness
  - Deterioration
- Before disconnecting any fitting in the refrigeration system, discharge all of the Refrigerant-134a. Refer to *Refrigerant Recovery and Recharging*.
- Once you open a refrigerant line to the atmosphere, cap or tape the line immediately.

  This will prevent any of the following items from entering the line:
  - Moisture
  - Dirt
- Use the proper wrenches when you make connections on the O-ring fittings.

  Back-up the opposing fitting with a wrench in order to prevent distortion of the following areas:
  - The connecting lines
  - The components

- Tighten all of the tubing connections to the specified torque.

  Too much or too little torque may result in the following conditions:
  - Loose joints
  - Deformed joint parts
  - Refrigerant leakage
  - An inoperative A/C system
- Ensure that the O-rings and the seats are in perfect condition.

  A burr or a piece of dirt may cause a refrigerant leak.
- Install new O-rings that you have lubricated with the mineral base 525 viscosity refrigerant oil.

  Do not use polyalkylene glycol (PAG) synthetic oil.

  Do not wipe the threads with a cloth.
- Keep PAG synthetic refrigerant oil off fitting threads. Long term contact of PAG synthetic oil on threads may cause future disassembly difficulties. Flush threads of fitting with mineral base 525 viscosity refrigerant oil. Do not use PAG synthetic oil. Do not wipe threads with a cloth.

Handling A/C Compressor

Do not strike, drop, or turn the compressor upside down. If the compressor is knocked over or turned upside down, rotate the compressor's clutch 5–6 times by hand to circulate the oil which has settled in the cylinder. Sudden rotating with oil in the cylinder can cause valve damage and adversely affect durability.

Maintaining Chemical Stability

The chemical stability of the refrigeration system plays an important role in the efficient operation and longevity of the A/C system.

When air, moisture or particulate contamination are introduced into the refrigeration system, the following results will occur:

- The chemical stability of R-134a and polyalkylene glycol (PAG) synthetic lubricant will change.
- The pressure/temperature symmetry will change.
- The A/C system efficiency will be diminished.
- Internal A/C system parts may corrode and/or wear in an abnormal manner.

Use the following general practices to maintain chemical stability in the refrigeration system:

- Wipe away dirt and/or oil before you break a refrigerant connection. This will reduce the possibility of particulate contamination.
- Cap, plug or tape both sides of an open connection as soon as possible. This will minimize the amount of dirt and moisture entering the system.
- Ensure that the following remain clean and dry:
  - The tools being used for the repair
  - The surrounding area of the repair
  - The hoses and connectors for the ACR4 machine or manifold gage set
  - The replacement parts
- When adding polyalkylene glycol (PAG) lubricant, ensure the transfer device and the container remain clean and dry to minimize moisture intrusion.
- Do not leave the A/C system open any longer than necessary.
- Before recharging an A/C system that has been opened, properly evacuate and vacuum test the system.
- Service parts are dehydrated and sealed prior to shipping. Retain the parts in their sealed packages until you are ready to use them.
- Ensure the parts are at room temperature before opening the packages. This prevents condensation on the parts from humidity in the atmosphere.
- Attach the A/C service equipment quick-connects as soon as possible after removing the service caps.

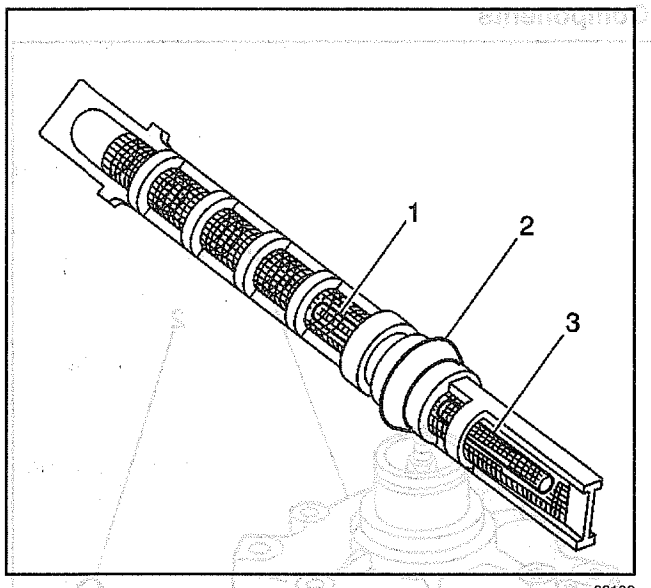
Refrigerant Oil Distribution

Notice: Use only Polyalkylene Glycol Synthetic Refrigerant Oil (PAG) for internal circulation through the R-134a A/C system and only 525 viscosity mineral oil on fitting threads and O-rings. If lubricants other than those specified are used, compressor failure and/or fitting seizure may result.

The following informations should be used to service the air conditioning (A/C) system:

- A/C system internal lubricant (including compressor) use GM P/N 12345923 or equivalent.
- A/C system O-ring and fitting lubricant use GM P/N 12301108 or equivalent.

Expansion (Orifice) Tube Description



82109

The plastic expansion (orifice) tube (2) is made of a mesh-screen (1) and orifice (3). The expansion (orifice) tube is located in the evaporator inlet pipe at the orifice connection. The tube restricts the high pressure liquid refrigerant in the liquid line. This restriction meters the refrigerant flow to the evaporator as a low pressure liquid. The expansion tube and orifice have filter screens which protect from contamination on both the inlet and outlet sides of the tube. When the engine is OFF the refrigerant in the system flows from the high pressure side of the system to the low pressure side until the pressure is equalized. This may be detected as a hissing sound for 30–60 seconds and is a normal condition.

Evaporator Description

The evaporator cools and dehumidifies air before the air enters the passenger compartment. The following events occur in the evaporator:

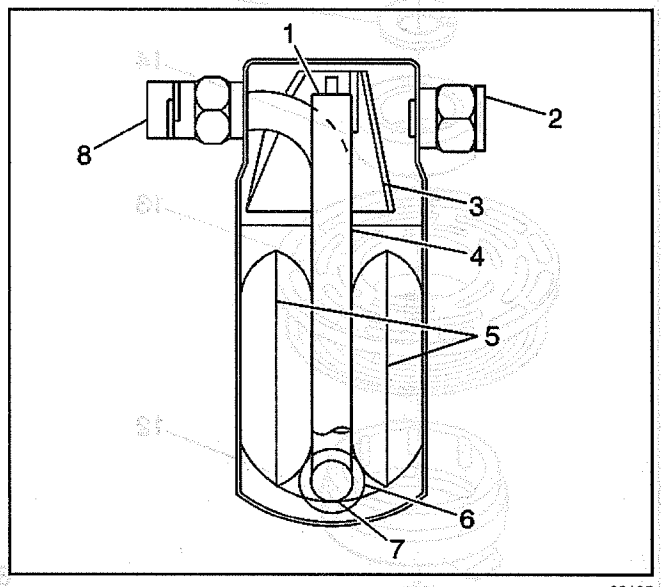
1. Low-pressure, low temperature liquid/vapor refrigerant enters the evaporator.
2. The refrigerant flows through the evaporator's tubing.
3. The refrigerant evaporates.
4. The refrigerant exits the evaporator as low-pressure, low temperature, mostly vapor refrigerant.
5. As the refrigerant evaporates, the refrigerant absorbs heat from the air flowing over the evaporator.

As the process of heat loss from the air to the evaporator core is taking place, any moisture (humidity) in the air condenses on the outside surface of the evaporator core and the moisture drains off as water.

Condenser Description

The condenser receives high pressure, high temperature refrigerant vapor from the A/C compressor. The condenser is made up of aluminum tubing and cooling fins which allow rapid heat transfer away from the high-pressure, high temperature refrigerant vapor. The cooling fins cause the high pressure, high temperature refrigerant vapor to condense into a high-pressure, medium temperature liquid.

Accumulator Description



82105

Legend

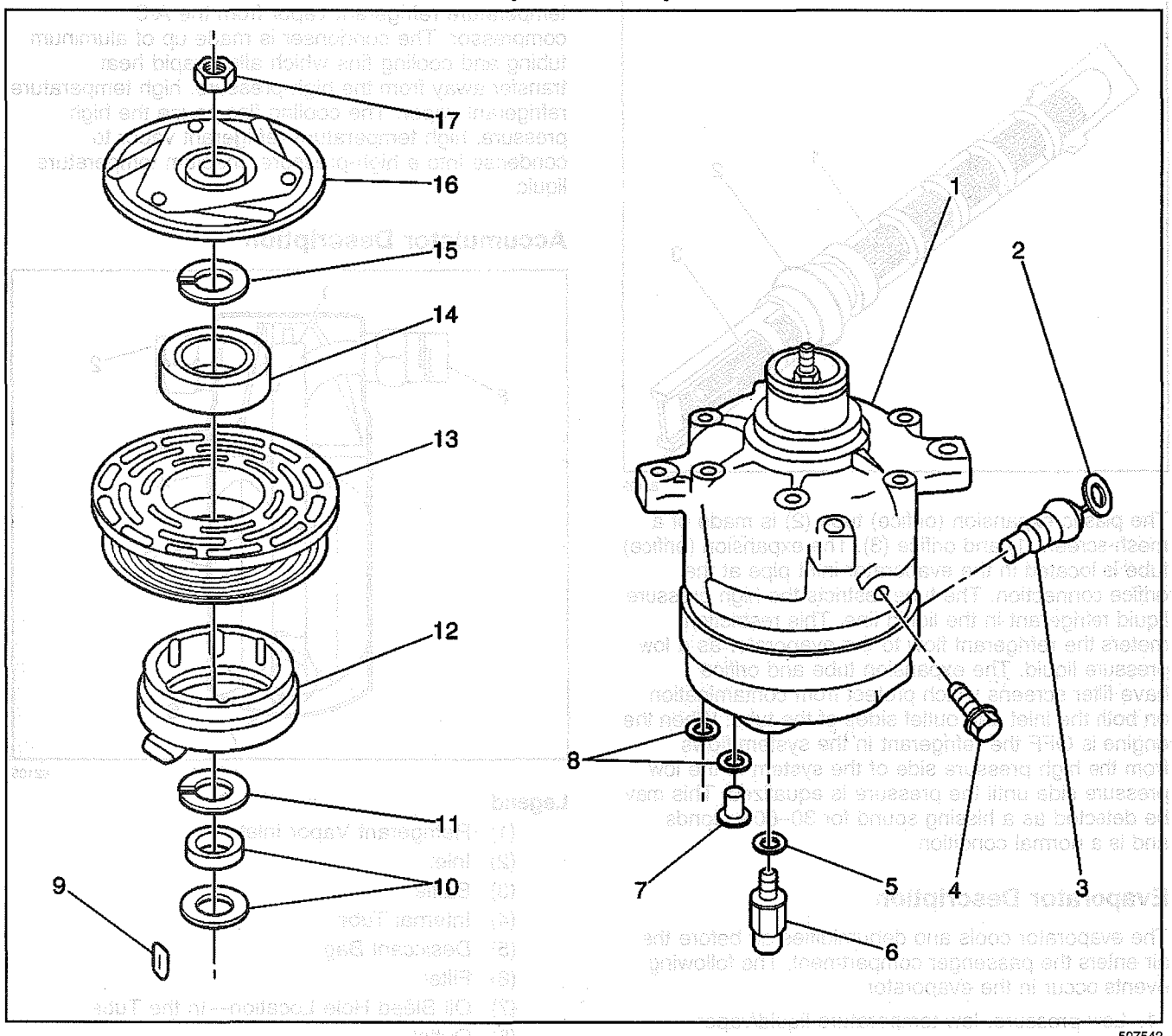
(1) Refrigerant Vapor Inlet
(2) Inlet
(3) Baffle
(4) Internal Tube
(5) Desiccant Bag
(6) Filter
(7) Oil Bleed Hole Location—In the Tube
(8) Outlet

The sealed accumulator is connected to the evaporator outlet pipe. The accumulator stores the refrigerant (vapor and liquid) and the oil from the evaporator. A desiccant at the accumulator bottom dries any moisture in the system. An oil bleed hole at the accumulator outlet pipe end provides the oil return path to the compressor. The accumulator is not serviceable and should only be replaced when leaking due to the following conditions:

- Perforation
- A damaged sealing area
- Damaged fastener threads
- Outside air has entered the system for extended periods of time

Compressor Description (3.8 L)

V5 Compressor Components



Legend

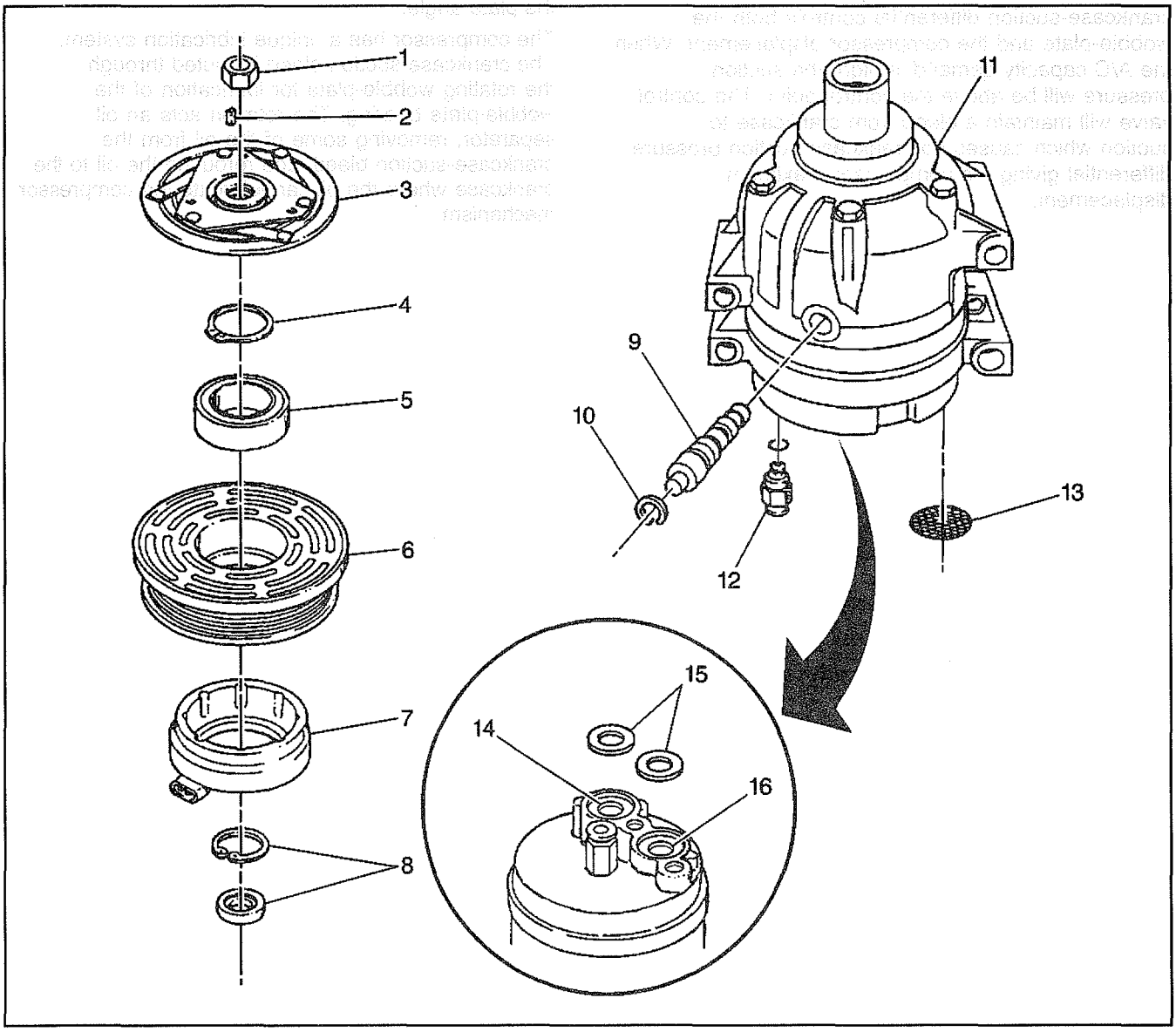
(1) Compressor
(2) Variable Displacement Control Valve Ring
(3) Variable Displacement Control Valve
(4) Oil Drain Plug
(5) Pressure Relief Valve Seal
(6) Pressure Relief Valve
(7) Suction Port Screen
(8) Seal Washers
(9) Clutch Hub Key
(10) Shaft Seals
(11) Shaft Seal Snap Ring
(12) Clutch Coil
(13) Clutch Rotor
(14) Clutch Rotor Bearing
(15) Clutch Rotor and Bearing Snap Ring
(16) Clutch Plate and Hub
(17) Shaft Nut

The V5 compressor is a variable displacement compressor that can match the automotive air conditioning demand under all conditions without cycling. The basic compressor mechanism is a variable angle wobble-plate with five axially oriented cylinders. A bellows actuated control valve located in the rear head of the compressor senses the compressor suction pressure and is the center of control for the compressor displacement. The crankshaft-suction differential controls both the wobble-plate and the control displacement. When the A/C capacity demand is high, the suction which causes no crankcase-suction pressure differential giving the compressor maximum displacement. When the A/C capacity demand is lower and the suction pressure reaches the control point, the valve will bleed discharge gas into the crankcase and close off a passage from the crankcase to the suction plenum. The wobble-plate angle is controlled by a force balance on the five pistons. A slight increase in the wobble-plate pivot pin that reduces the plate angle.

The compressor 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, removing some of the oil from the crankcase-suction bleed, and rerouting the oil to the crankcase where the oil can be lubricate the compressor mechanism.

Compressor Description (5.7 L)

V7 Compressor Components



157241

Legend

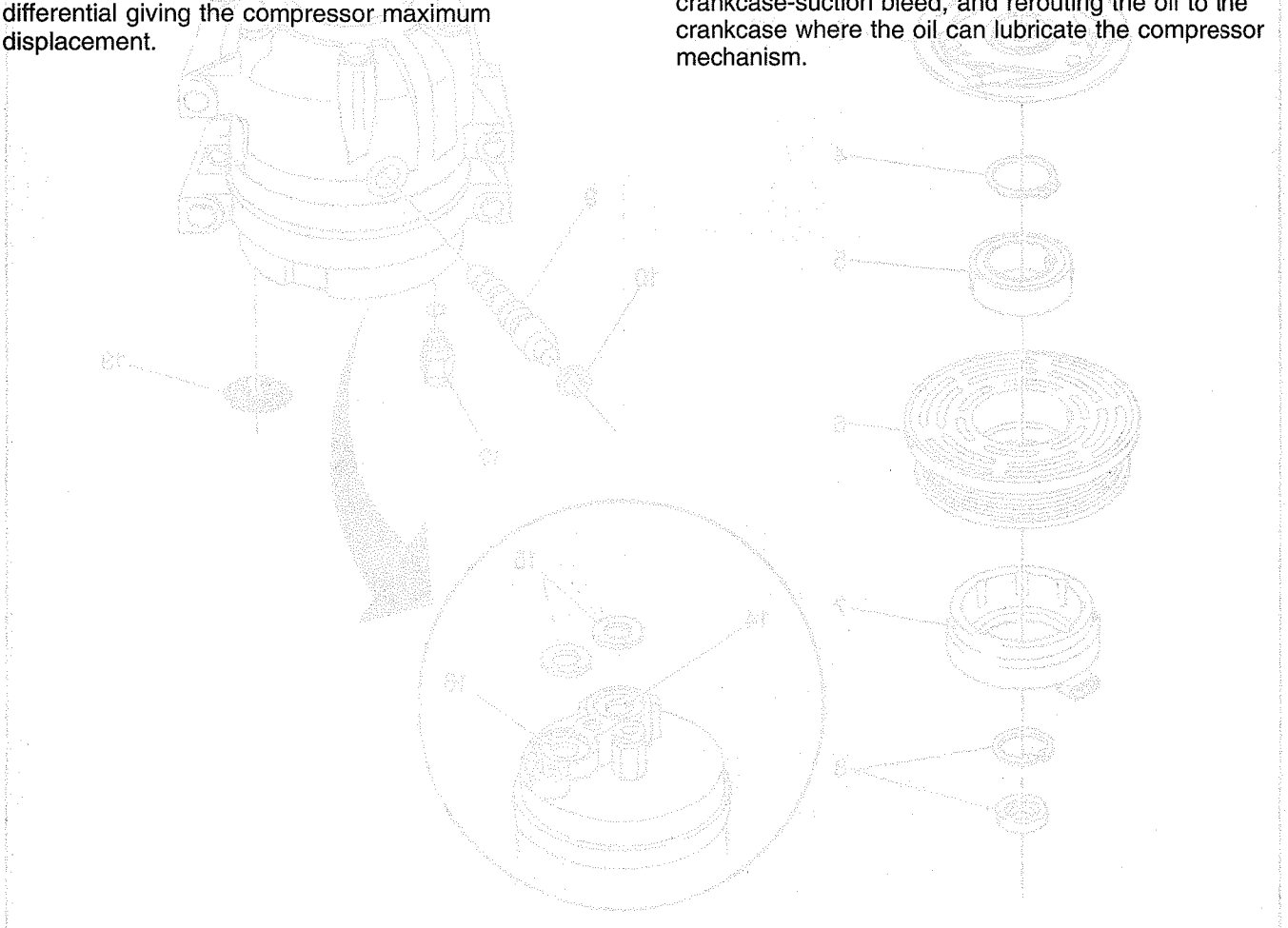
(1) Shaft Nut
(2) Clutch Hub Key
(3) Clutch Plate and Hub
(4) Clutch Rotor and Bearing Snap Ring

(5) Clutch Rotor Bearing
(6) Clutch Rotor
(7) Cluch Coil
(8) Compressor Shaft Seal and Snap Ring
(9) Compressor Control Valve
(10) Compressor Control Valve Retaing Ring
(11) Compressor
(12) Pressure Relief Valve
(13) Suction Port Screen
(14) Special R-134a Suction Port
(15) Seal Washers
(16) Special R-134a Discharge Port

The V7 compressor is a variable displacement compressor that can match the automotive air conditioning demand under all conditions without cycling. The basic compressor mechanism is a variable angle wobble-plate with seven axially oriented cylinders. A bellows actuated control valve located in the rear head of the compressor senses the compressor suction pressure and is the center of control for the compressor displacement. The crankcase-suction differential controls both the wobble-plate and the compressor displacement. When the A/C capacity demand is high, the suction pressure will be above the control point. The control valve will maintain a bleed from crankcase to suction which causes no crankcase-suction pressure differential giving the compressor maximum displacement.

When the A/C capacity demand is lower and the suction pressure reaches the control point, the valve will bleed discharge gas into the crankcase and close of a passage from the crankcase to the suction plenum. The wobble-plate angle is controlled by a force balance on the seven pistons. A slight increase in the crankcase-suction pressure differential creates a force on the pistons. This results in a movement of the wobble-plate pivot pin that reduces the plate angle.

The compressor 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 an oil separator, removing some of the oil from the crankcase-suction bleed, and rerouting the oil to the crankcase where the oil can lubricate the compressor mechanism.



High Pressure Relief Valve Description

The V7 compressor 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. The valve is designed to open automatically at approximately 3036 kPa (440 psi) in order to prevent system damage.

Correct any condition that causes the valve to open. Replace refrigerant oil as necessary. Inspect the air conditioning refrigerant pressure sensor for proper calibration. Refer to *DTC P0530 Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit* in Engine Controls–5.7 L.

Relays and Sensors Description

Blower Motor Relay

Use the blower motor relay in order to provide battery voltage to the blower motor only during high blower motor speed. Use the blower motor resistor in order to provide power to the blower motor at all other speed settings. The blower motor relay is located under the instrument panel. Refer to *Blower Motor Relay Replacement.*

Air Conditioning (A/C) Compressor Relay

Use the A/C compressor relay in order to provide battery voltage to the compressor clutch coil. The powertrain control module (PCM) controls the relay. The relay is located in the underhood electrical center. Refer to *Compressor Relay Replacement.*

O-Ring/Flat Washer Description

Install new approved service replacement air conditioning O-ring(s) and flat washers whenever a joint or fitting is disassembled.

Some vehicles use flat sealing washers and O-ring(s) to seal the refrigerant system. The flat washers are used on block fittings of refrigerant components. The O-ring(s) is used to seal the refrigerant tubes.

The O-ring fitting consists of:

- An aluminum alloy, externally threaded fitting which is welded to an aluminum tube.
- A free-spinning internally threaded nut.
- An aluminum tube end which accommodates the O-ring(s).

Verify that the flat washers or O-ring(s) have not been damaged prior to installation. Replace damaged parts.

Coat O-ring(s) and flat washers with the approved refrigerant oil.

Failure to use the proper service replacement parts and procedures may result in a leak.

Service Caps Seal

The primary seal for the service ports is the sealing cap. The cap contains a specially designed O-ring or gasket which provides a leak free seal. Should the cap be loose, missing, or the wrong usage, a loss of refrigerant could result.

Special Tools and Equipment

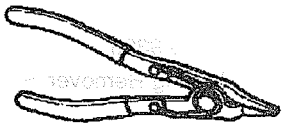
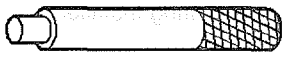
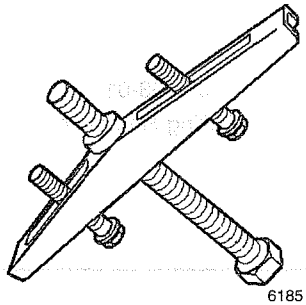
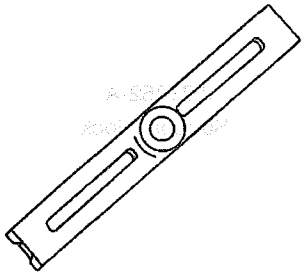
Illustration	Tool Number/ Description
 10767	J 5403 Snap Ring Pliers
 6183	J 6083 Snap Ring Pliers
 2015	J 8092 Driver Handle
 6185	J 8433 Compressor Pulley Puller
 210221	J 8433-1 Puller Bar

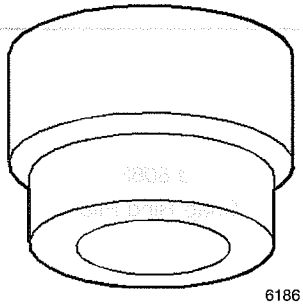
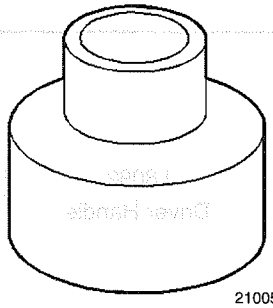
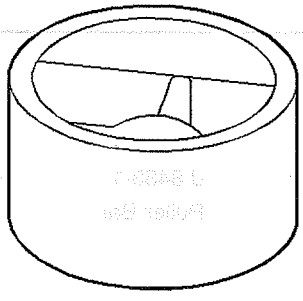
Illustration	Tool Number/ Description
 7029	J 8433-3 Forcing Screw
 6186	J 9398 Bearing Remover
 210053	J 9481-A Bearing Installer
 6190	J 9553-01 O-Ring Remover
 6192	J 21352-A Support Block

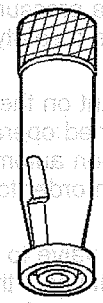
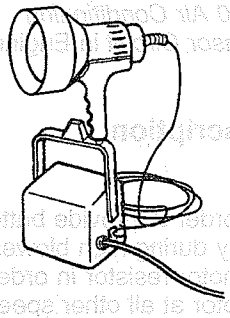
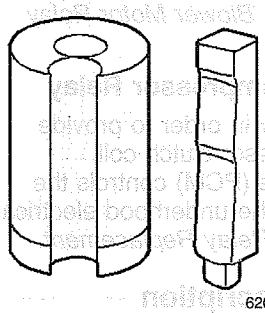
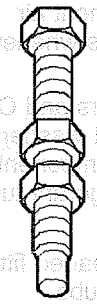
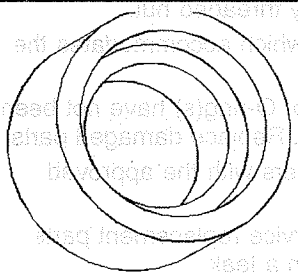
Illustration	Tool Number/ Description
 6193	J 23128-A Seal Seat Installer and Remover
 62292	J 28428-E High Intensity Black Light
 6207	J 33011 O-Ring Installer
 6187	J 33013-B Hub and Drive Plate Remover and Installer
 7032	J 33017 Pulley and Bearing Assembly Installer

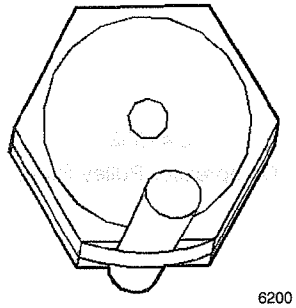
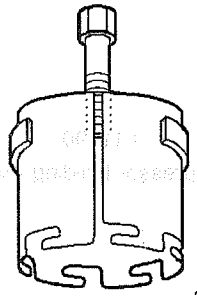
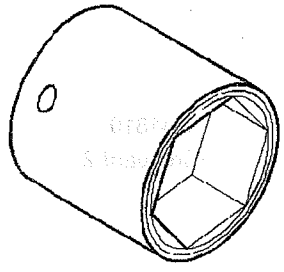
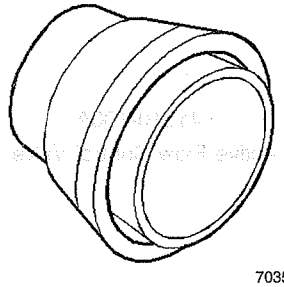
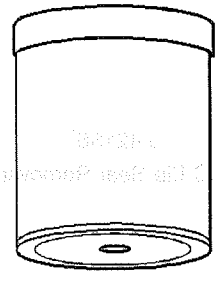
Illustration	Tool Number/ Description
 6200	J 33019 Bearing Staking Tool
 210049	J 33020 Pulley Puller
 7033	J 33022 Shaft Nut Socket
 7035	J 33023-A Puller Pilot
 7036	J 33024 Clutch Coil Installer

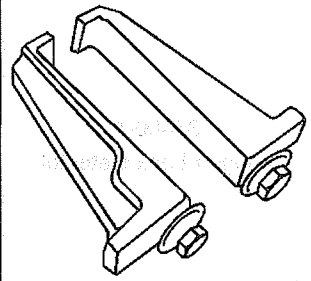
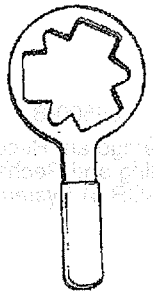
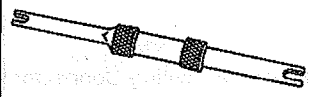
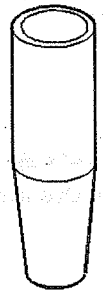
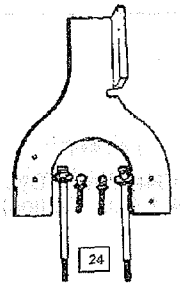
Illustration	Tool Number/ Description
 7037	J 33025 Clutch Coil Puller Legs
 7039	J 33027-A Clutch Hub Holding Tool
 283643	J 34611-A (or J 39923) Valve Core Remover and Installer
 6206	J 34614 Shaft Seal Protector
 7038	J 34992 Compressor Holding Fixture

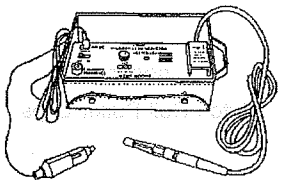
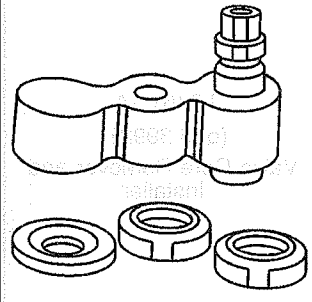
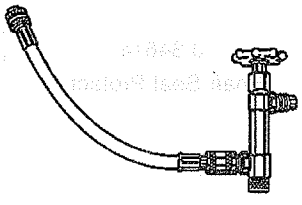
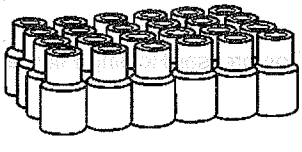
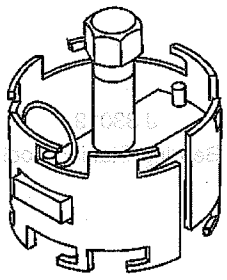
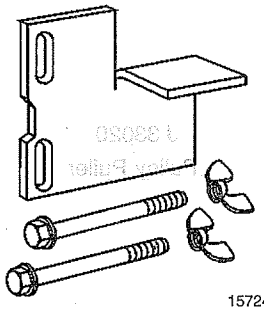
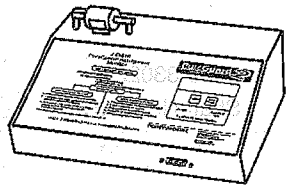
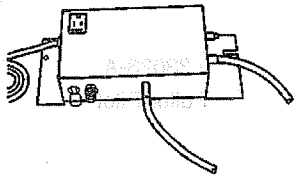
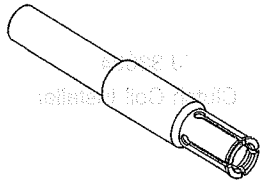
Illustration	Tool Number/ Description
 82132	J 39400-A Halogen Leak Detector
 82133	J 39500-B A/C Refrigerant Recovery, Recycling and Recharging (ACR 4) System
 210224	J 39893 Pressure Testing Connector
 283642	J 41436 Tracer Dye Injector
 258343	J 41447 R134a Tracer Dye (24 1/4 oz. Bottles)

Illustration	Tool Number/ Description
 157245	J 41552 Compressor Pulley Puller
 157244	J 41790 Compressor Holding Fixture
 353273	J 41810 Pureguard 2
 347269	J 41810-100A Active Flow Control Valve
 208026	J 42136 A/C Lip Seal Remover

HVAC Systems - Manual

Specifications

Fastener Tightening Specifications

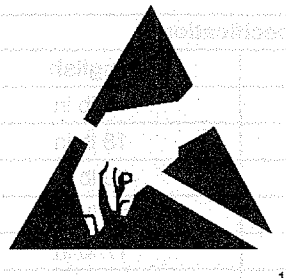
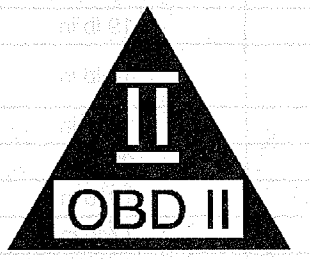
Application	Specification	
	Metric	English
Air Distributor Duct Bolt	2.2 N·m	19 lb in
Bi-Level Mode Actuator Screw	2 N·m	18 lb in
Blower Motor Bolt	2.3 N·m	20 lb in
Blower Motor Resistor Bolt	2 N·m	18 lb in
Floor Air Outlet Duct Bolt	1.9 N·m	17 lb in
Heating, Ventilation and Air Conditioning (HVAC) Control Blower Switch Screw	2 N·m	18 lb in
Heating, Ventilation and Air Conditioning (HVAC) Control Bolt	2.2 N·m	19 lb in
Heating, Ventilation and Air Conditioning (HVAC) Control Selector Switch Screw	2 N·m	18 lb in
Heater Module Screw	1.8 N·m	16 lb in
Instrument Panel (IP) Compartment Hinge Screws	2.8 N·m	25 lb in
Instrument panel (IP) Outer Air Outet Duct Bolt	2.2 N·m	19 lb in
Temperature Control Cable Bolt	1.9 N·m	17 lb in
Vacuum Tank Mounting Bolt	2.5 N·m	22 lb in
Vent Mode Valve Actuator Screw	2 N·m	18 lb in

GM SPO Group Numbers

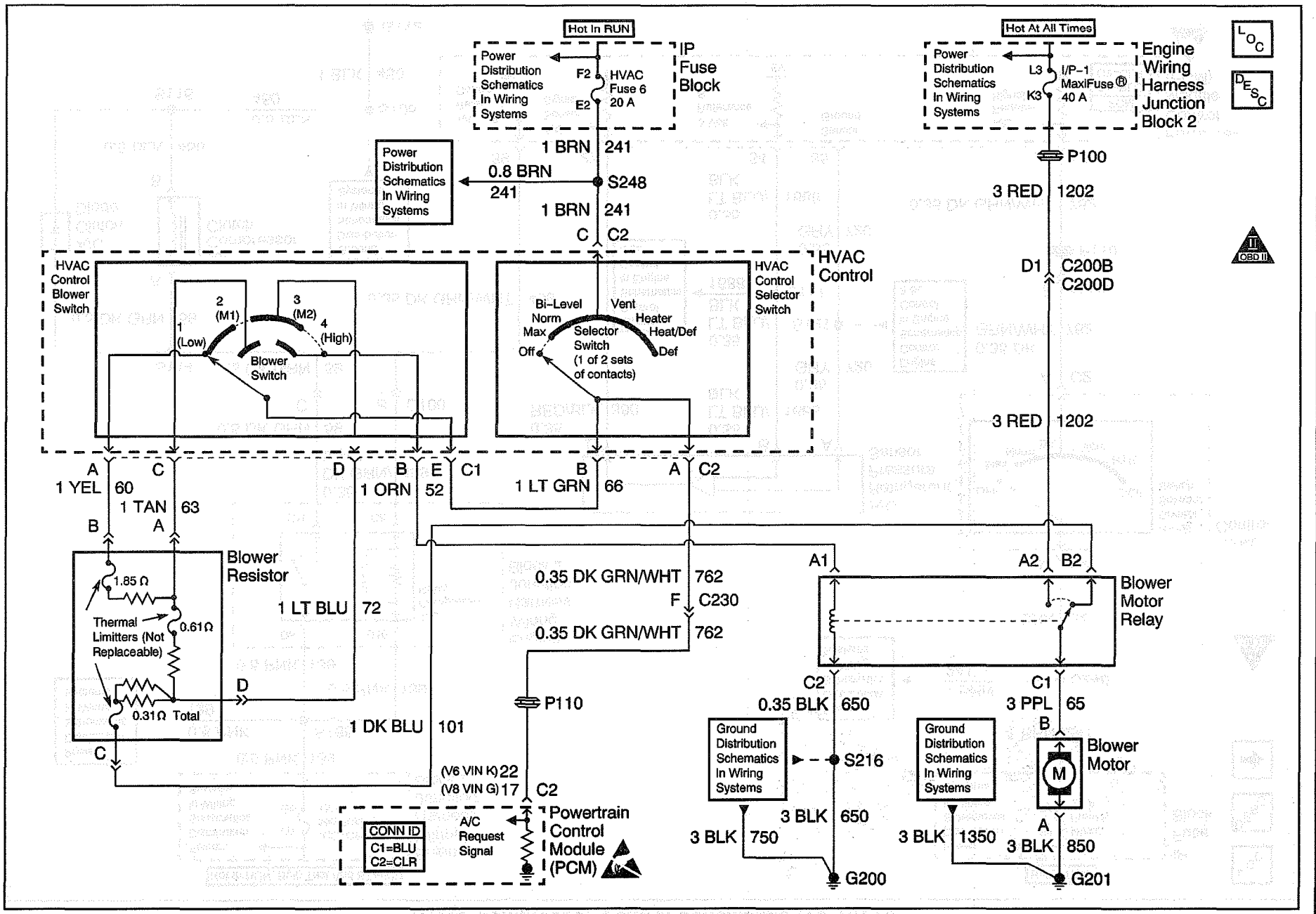
Application	GM SPO Group Number
Air Valve Actuator Vacuum Harness	9.000
Blower Impeller	8.000
Blower Motor	8.000
Blower Motor Relay	9.000
Blower Motor Resistor	9.000
Defrost Valve Actuator	9.000
Floor Air Outlet Duct	9.000
Heater and Air Conditioning Control	9.000
Heater and Air Conditioning Control Vacuum Harness	9.000
Heater and Air Conditioning Control Vacuum Tank	9.000
Inside Air Valve Actuator	9.000
Instrument Panel Outer Air Outlet Duct	9.000
Mode Valve Actuator	9.000
Side Window Defogger Outlet Duct	9.000
Vacuum Actuator	9.000
Windshield Defroster Nozzle and Air Distributor	9.000

Schematic and Routing Diagrams

HVAC Schematic Icons

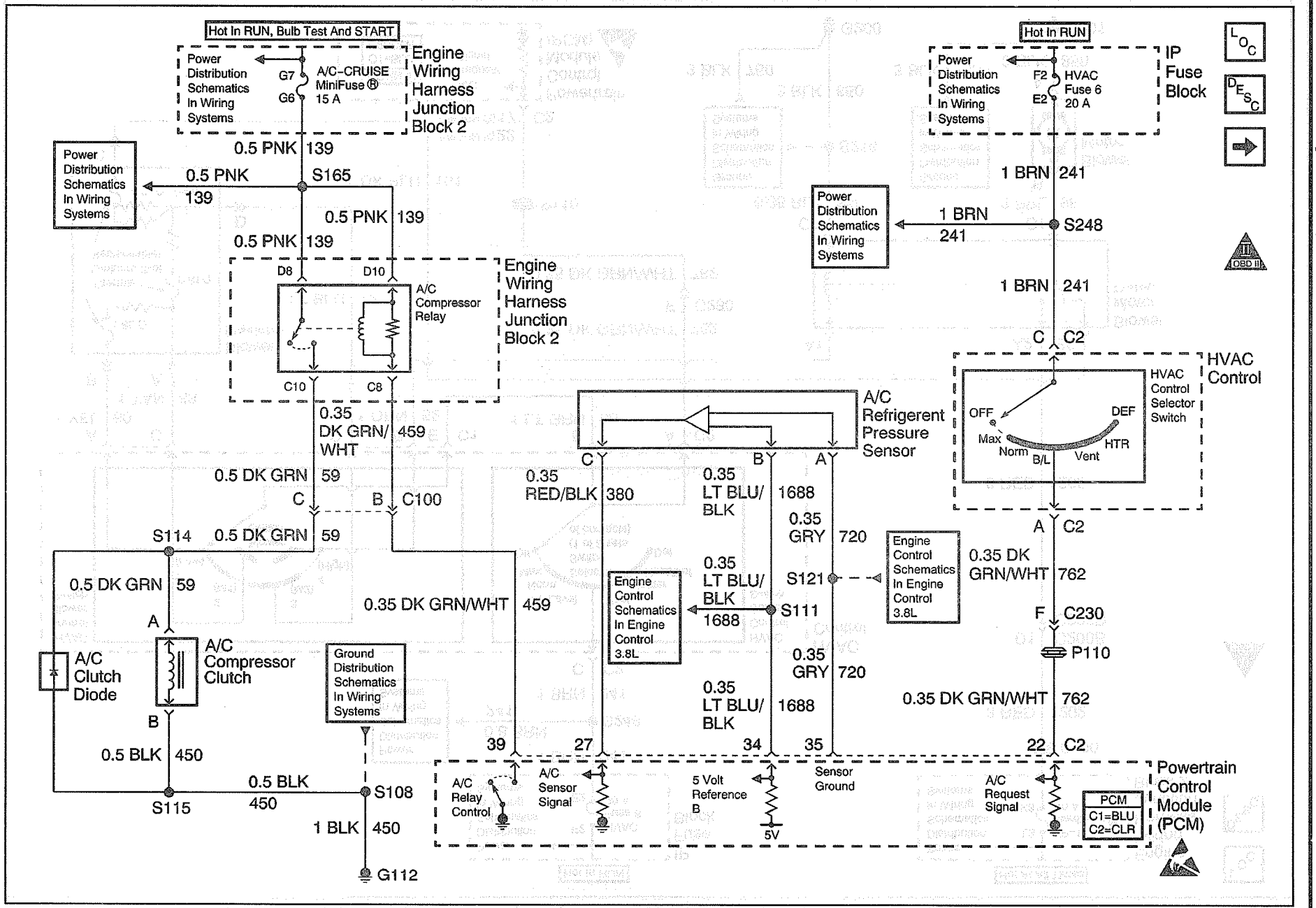
Icon	Icon Definition
 19384	Refer to *ESD Notice* in Cautions and Notices.
 19385	Refer to *OBD II Symbol Description Notice* in Cautions and Notices.

HVAC Blower Control Schematics (HVAC Control, Blower Resistor, Blower Motor Relay)

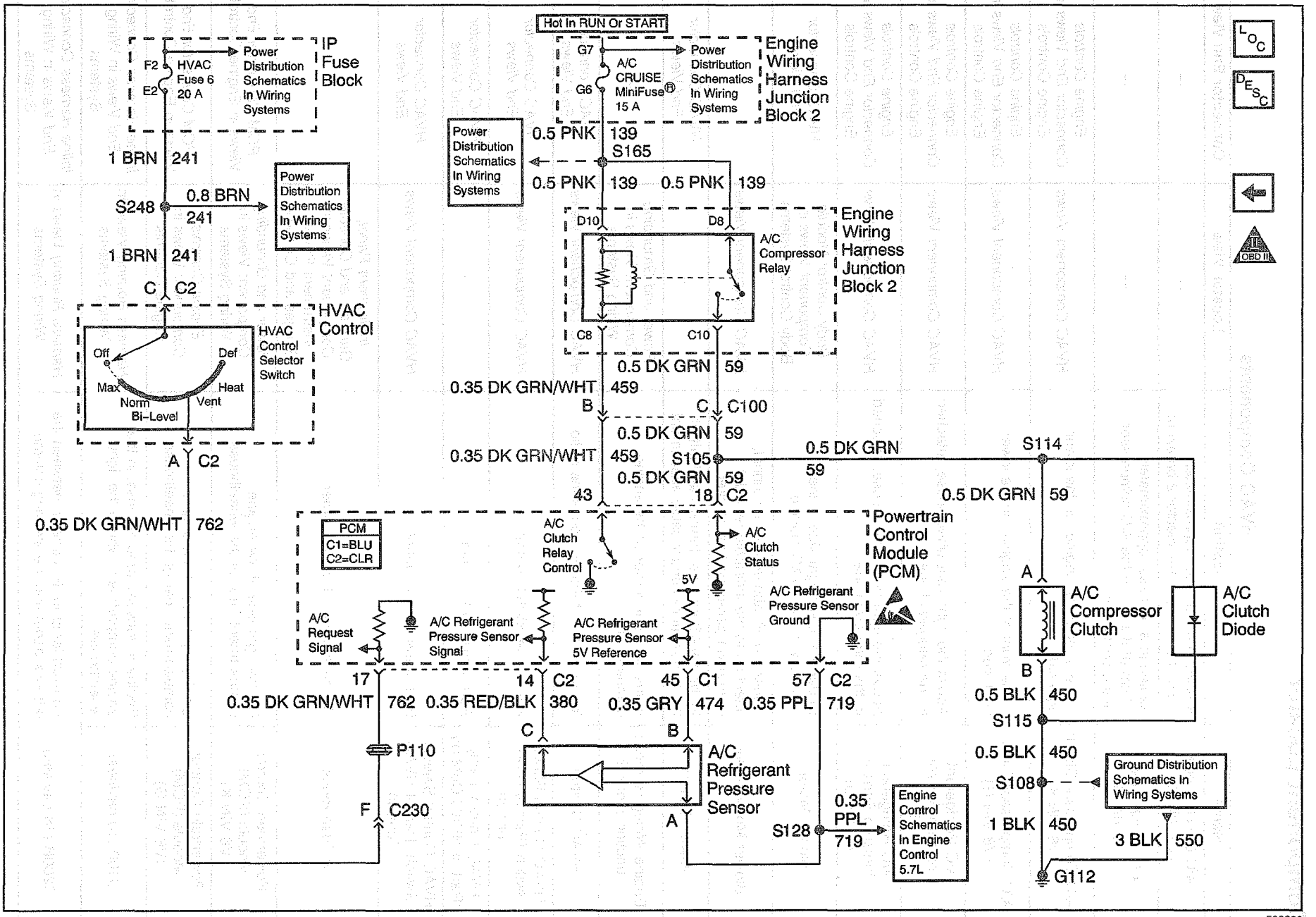


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HVAC Compressor Control Schematics (V6 VIN K)



HVAC Compressor Control Schematics (V8 VIN G)



Component Locator

HVAC Components

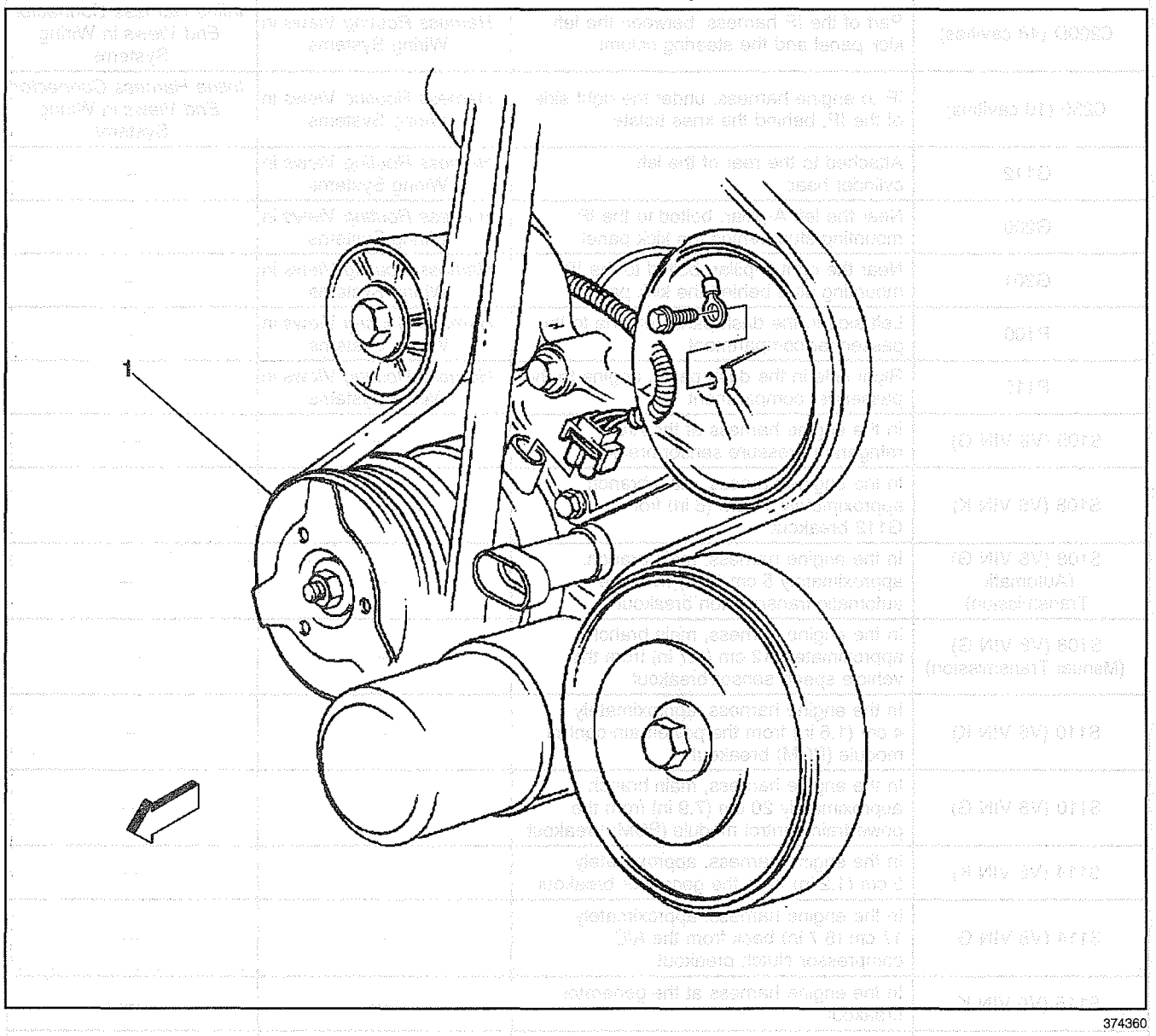
Name	Location	Locator View	Connector End View
A/C Clutch Diode (V6 VIN K)	Sealed in a harness, approximately 3 cm (1.2 in) from the injector 2 breakout	—	—
A/C Clutch Diode (V8 VIN G)	Sealed in a harness, approximately 17 cm (6.8 in) from the A/C compressor clutch connector	—	—
A/C Compressor Clutch (V6 VIN K)	In the front of the engine, on the lower right side	*HVAC Component Views*	*Engine Controls Connector End Views* in Engine Controls
A/C Compressor Clutch (V8 VIN G)	In the front of the engine, on the lower right side	*HVAC Component Views*	*Engine Controls Connector End Views* in Engine Controls
A/C Refrigerant Pressure Sensor (V6 VIN K)	Above the right front wheelhouse, attached to the refrigerant line	*HVAC Component Views*	*Engine Controls Connector End Views* in Engine Controls
A/C Refrigerant Pressure Sensor (V8 VIN G)	Above the right front wheelhouse, attached to the refrigerant line	*HVAC Component Views*	*Engine Controls Connector End Views* in Engine Controls
Blower Motor	Under the lower right side of the IP, mounted in the HVAC module	*Body Control Module Component Views* in Body Control Systems	*HVAC Connector End Views*
Blower Motor Relay	Under the IP, above the floor tunnel, attached to the inflatable restraint instrument panel module bracket	*HVAC Component Views*	—
Blower Resistor	In the HVAC module, forward and left of the temperature control cable attachment	—	*HVAC Connector End Views*
Engine Wiring Harness Junction Block 2	In the left front corner of the engine compartment	*Power and Grounding Component Views* in Wiring Systems	—
HVAC Control	In the center of the IP, above the radio	*HVAC Component Views*	*HVAC Connector End Views*
HVAC Control Blower Switch (Part of HVAC Control)	Part of the HVAC control	*HVAC Component Views*	*HVAC Connector End Views*
HVAC Control Lamp (Part of HVAC Control)	Part of the HVAC control	—	*HVAC Connector End Views*
HVAC Control Selector Switch (Part of HVAC Control)	Part of the HVAC control	*HVAC Component Views*	*HVAC Connector End Views*
IP Fuse Block	On the left end of the IP carrier	*Instrument Panel, Gauges, and Console Component Views* in Instrument Panel, Gauges and Console	—
Powertrain Control Module (PCM) (V6 VIN K)	On the right side of the engine compartment, rear of the wheelhouse	*Power and Grounding Component Views* in Wiring Systems	*PCM Connector End Views* in Engine Controls
Powertrain Control Module (PCM) (V8 VIN G)	On the right side of the engine compartment, rear of the wheelhouse	*Engine Controls Component Views* in Engine Controls	*PCM Connector End Views* in Engine Controls
C100 (10 cavities)	Engine to forward lamp harness, in the engine compartment, above the right wheelhouse	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C200B (18 cavities)	Forward lamp to IP harness, between the left kick panel and the steering column	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems

HVAC Components (cont'd)

Name	Location	Locator View	Connector End View
C200D (48 cavities)	Part of the IP harness, between the left kick panel and the steering column	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C230 (10 cavities)	IP to engine harness, under the right side of the IP, behind the knee bolster	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
G112	Attached to the rear of the left cylinder head	*Harness Routing Views* in Wiring Systems	—
G200	Near the left A-pillar, bolted to the IP mounting stud behind the kick panel	*Harness Routing Views* in Wiring Systems	—
G201	Near the right A-pillar, bolted to the IP mounting stud behind the kick panel	*Harness Routing Views* in Wiring Systems	—
P100	Left side in the dash panel, engine to the passenger compartment	*Harness Routing Views* in Wiring Systems	—
P110	Right side in the dash panel, engine to the passenger compartment	*Harness Routing Views* in Wiring Systems	—
S105 (V8 VIN G)	In the engine harness at the A/C refrigerant pressure sensor breakout	—	—
S108 (V6 VIN K)	In the engine harness, main branch, approximately 15 cm (6 in) from G112 breakout	—	—
S108 (V8 VIN G) (Automatic Transmission)	In the engine harness, main branch, approximately 5 cm (2 in) from the automatic transmission breakout	—	—
S108 (V8 VIN G) (Manual Transmission)	In the engine harness, main branch, approximately 12 cm (4.7 in) from the vehicle speed sensor breakout	—	—
S110 (V6 VIN K)	In the engine harness, approximately 4 cm (1.6 in) from the powertrain control module (PCM) breakout	—	—
S110 (V8 VIN G)	In the engine harness, main branch, approximately 20 cm (7.9 in) from the powertrain control module (PCM) breakout	—	—
S114 (V6 VIN K)	In the engine harness, approximately 3 cm (1.2 in) from the generator breakout	—	—
S114 (V8 VIN G)	In the engine harness, approximately 17 cm (6.7 in) back from the A/C compressor clutch breakout	—	—
S115 (V6 VIN K)	In the engine harness at the generator breakout	—	—
S115 (V8 VIN G)	In the engine harness, approximately 20 cm (7.9 in) back from the A/C compressor clutch breakout	—	—
S121 (V6 VIN K)	In the engine harness, main branch, approximately 8 cm (3.1 in) from the powertrain control module (PCM) breakout	—	—
S128	In the engine harness, approximately 4 cm (1.8 in) from the manifold absolute pressure (MAP) sensor breakout	—	—
S165	In the forward lamp harness, approximately 7 cm (2.8 in) from the main branch into the engine wiring harness junction block 2 breakout	—	—
S216	In the IP harness, main branch, approximately 10 cm (4 in) from the instrument cluster breakout	—	—
S248	In the IP harness, approximately 2 cm (0.8 in) from DRL module breakout	—	—

HVAC Component Views

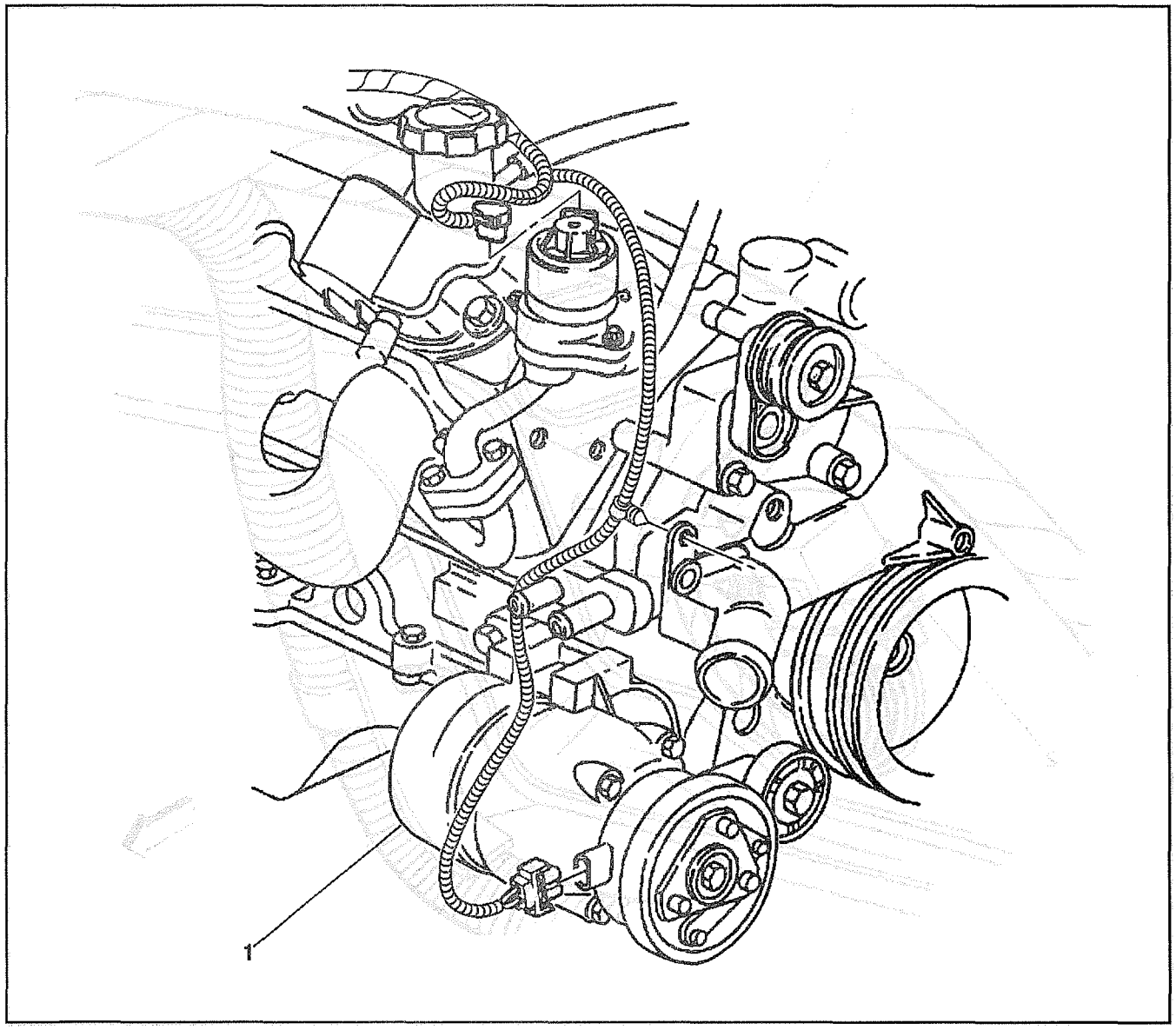
Lower Right Front Side of the Engine (V6 VIN K)



Legend

(1) A/C Compressor Clutch

Lower Right Front Side of the Engine (V8 VIN G)

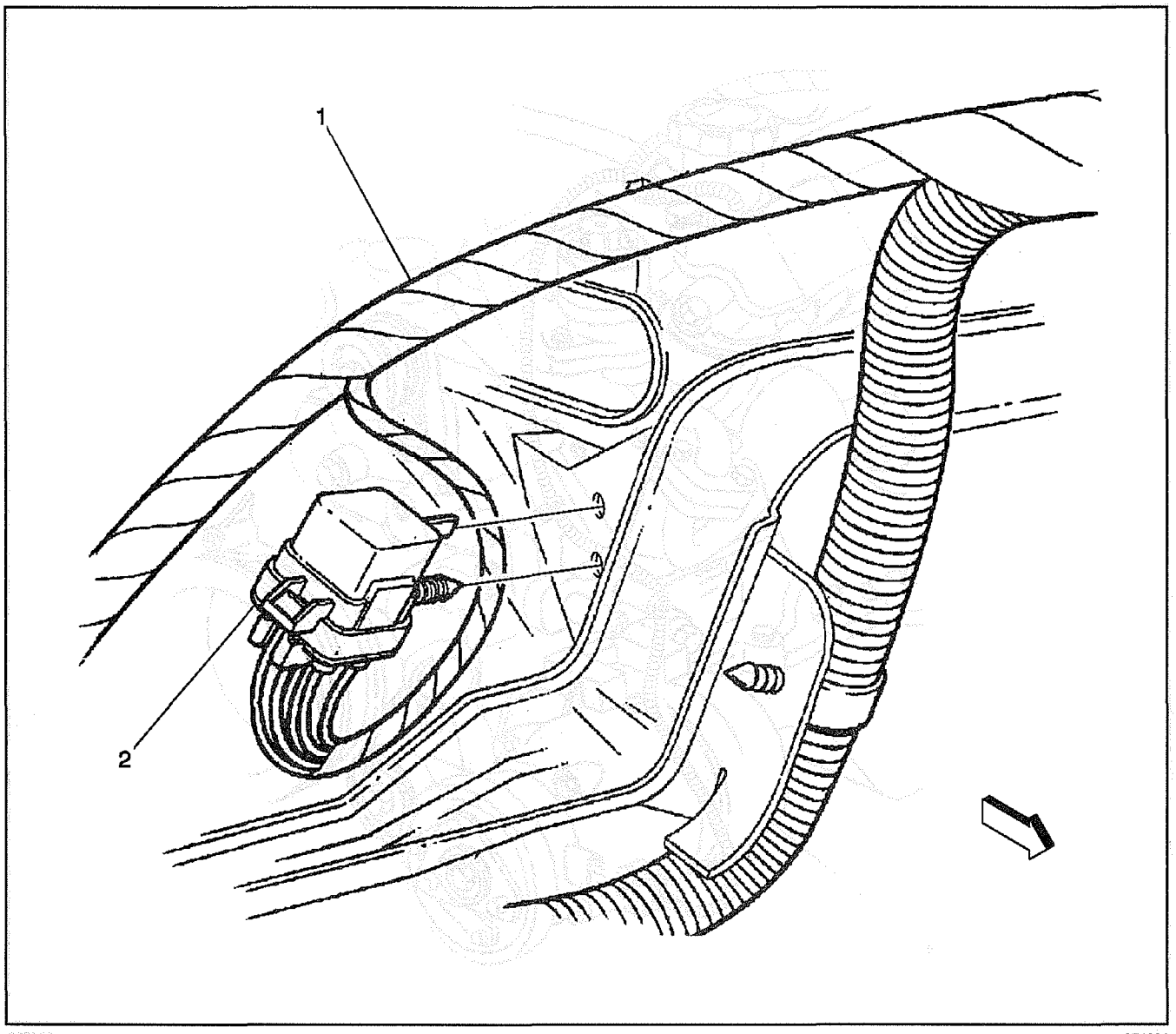


374327

Legend

(1) A/C Compressor

Under Center of the Instrument Panel



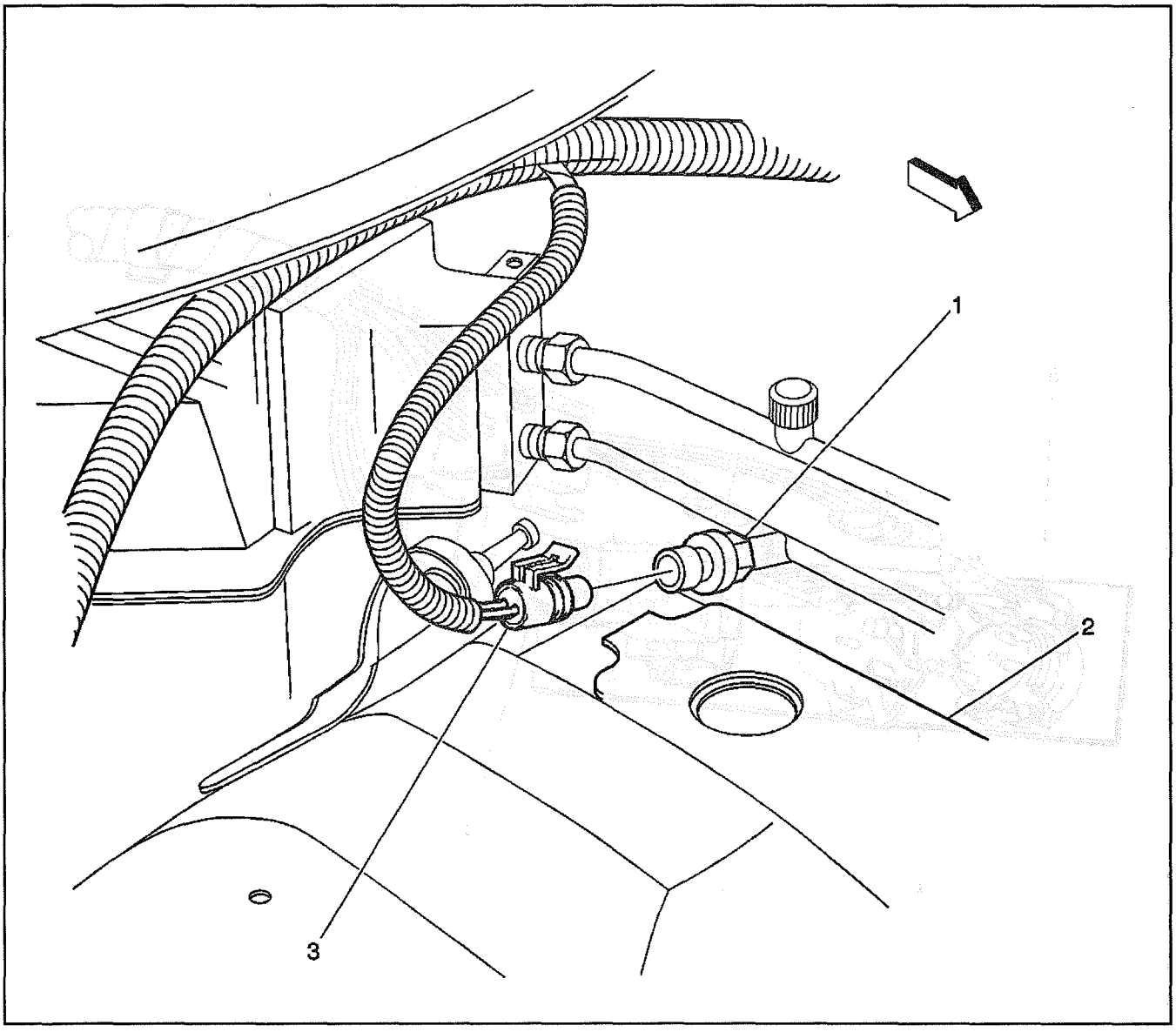
374324

Legend

(1) IP Wiring Harness

(2) Blower Motor Relay

Right Rear Side of the Engine Compartment

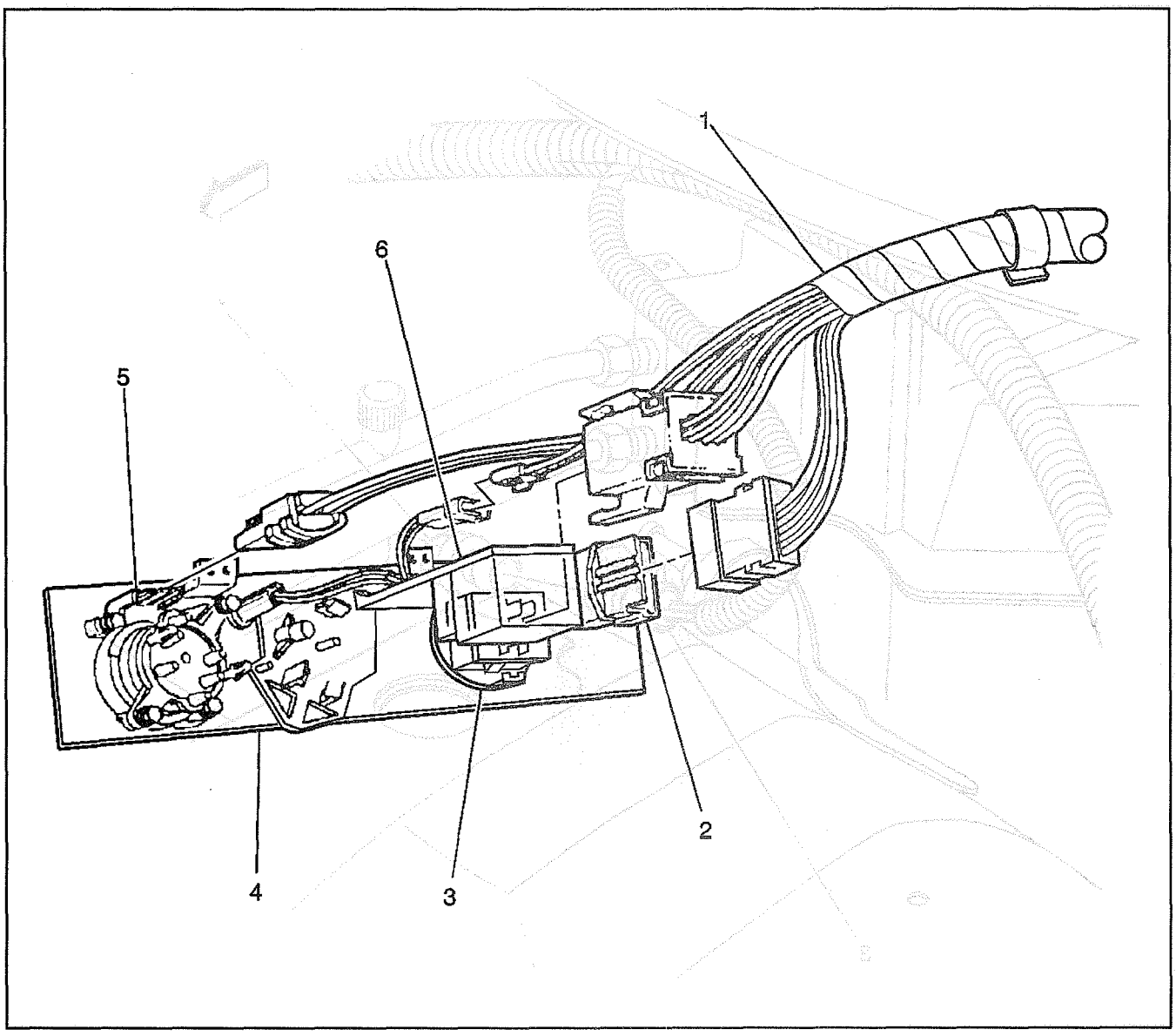


374328

Legend

(1) A/C Refrigerant Pressure Sensor
(2) Right Shock Tower
(3) Engine Wiring Harness

Center of the Instrument Panel



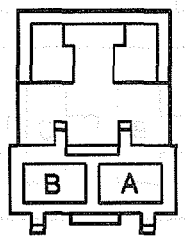
567223

Legend

(1) IP Wiring Harness
(2) Rear Defogger Switch
(3) HVAC Control Blower Switch
(4) HVAC Control
(5) HVAC Control Selector Switch
(6) Rear Defogger Timer/Relay

HVAC Connector End Views

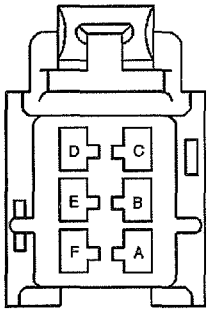
Blower Motor



287953

Connector Part Information	• 1206-4829 • 2-Way F Metri-pack 480 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	850	Ground
B	PPL	65	Blower Motor Relay Feed Input

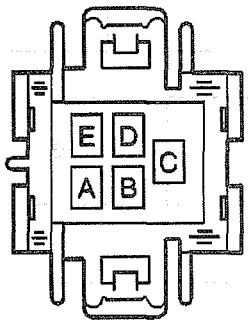
Blower Resistor



62456

Connector Part Information	• 1206-4752 • 6-Way F Metri-pack Series 280 (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	TAN	63	Blower Switch M1 Feed Input
B	YEL	60	Blower Switch LO Feed Input
C	DK BLU	101	Blow Motor Relay Feed Output
D	LT BLU	72	Blower Switch M2 Feed Input
E-F	—	—	Not Used

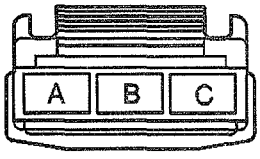
HVAC Control Connector C1 (Blower Switch)



232132

Connector Part Information	• 1202-0813 • 5-Way F Metri-pack 630 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	YEL	60	Blower Resistor LO Feed Output
B	ORN	52	Blower Motor Relay HI Feed Output
C	TAN	63	Blow Resistor MI Feed Ouput
D	LT BLU	72	Blower Resistor M2 Feed Ouput
E	LT GRN	66	Selector Switch Power Feed Input

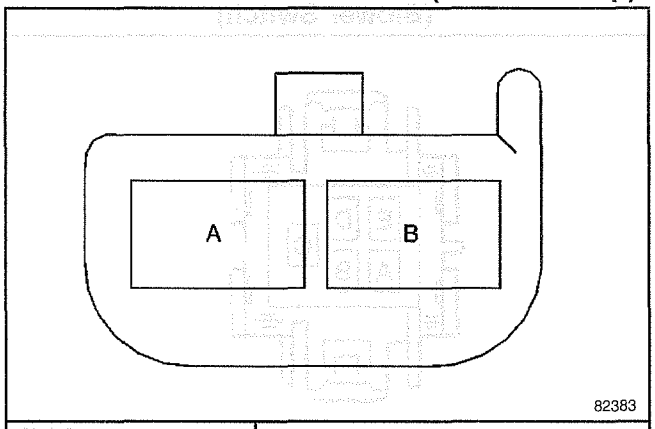
HVAC Control Connector C2 (Selector Switch)



38596

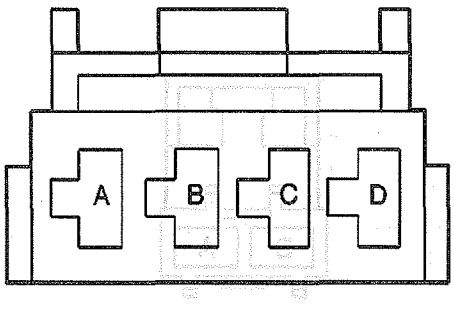
Connector Part Information	• 1202-0557 • 3-Way F Metri-pack 480 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	DK GRN/ WHT	762	PCM A/C Request Signal Feed Output
B	LT GRN	66	Blower Switch Feed Output
C	BRN	241	Fused Input Feed

HVAC Control Connector C3 (Control Lamp)



Connector Part Information		• 1204-7662 • 2-Way F Metri-pack 150 Series (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	GRY	8	Blower Switch Lamp Feed Input
B	BLK	650	Ground

HVAC Control Connector C4 (Rear Defogger Switch)



Connector Part Information		• 1201-5664 • 4-Way F Metri-pack 630 Series (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	ORN	1240	Fused Input Feed
B	PPL	293	Rear Defogger Grid Fuse Feed Output
C	BRN	241	Fused Input Feed
D	BLK	650	Ground

Diagnostic Information and Procedures

A Diagnostic Starting Point

Begin the system diagnosis by reviewing the system Description and Operation. Reviewing the Description and Operation information will help you determine the correct symptom diagnostic procedure when a malfunction exists. Reviewing the Description and Operation information will also help you determine if the condition described by the customer is normal operation. Refer to *A Diagnostic System Check* in order to identify the correct procedure for diagnosing the system and where the procedure is located.

A Diagnostic System Check

Test Description

The number(s) below refer to the step number(s) on the diagnostic table.

2. Lack of communication may be due to a partial malfunction of the class 2 serial data circuit or due to a total malfunction of the class 2 serial data circuit. The specified procedure will determine the particular condition.
4. The presence of DTCs which begin with "U" indicate some of the modules are not communicating.

A Diagnostic System Check

Step	Action	Yes	No
1	Install a scan tool. Does the scan tool power up?	Go to *Step 2*	Go to *Scan Tool Does Not Power Up* in Data Link Communications
2	1. Turn ON the ignition, with the engine OFF. 2. Attempt to establish communication with each module on the class 2 circuit serial data circuit. (If using a Tech 2, obtain this information using the Class 2 Message Monitor feature.) Does the scan tool communicate with the modules?	Go to *Step 3*	Go to *Scan Tool Does Not Communicate w/Class 2 Data Line* in Data Link Communications
3	1. Select the Display DTCs function for each module. (If using a Tech 2, use the Class 2 DTC Check feature in order to determine which modules do have DTCs set.) 2. Record all of the displayed DTCs, the DTC status, and the module which set the DTC. Does the scan tool display any DTCs?	Go to *Step 4*	Go to *Symptoms* in HVAC Systems - Manual.
4	Does the scan tool display any DTCs which begin with a "U"?	Go to *Scan Tool Does Not Communicate w/Class 2 Data Line* in Data Link Communications	Go to *Step 5*
5	Does the scan tool display any PCM DTCs?	Go to *Diagnostic Trouble Code (DTC) List/Type* in Engine Controls - 3.8 L and *Diagnostic Trouble Code (DTC) List/Type* in Engine Controls - 5.7 L.	Go to *Symptoms* in HVAC Systems - Manual.

Symptoms

Important: Review the system operation in order to familiarize yourself with the system functions. Refer to *Control Assembly Description (Pontiac)* for Pontiac or *Control Assembly Description (Chevrolet)* for Chevrolet.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the HVAC System. Refer to *Checking Aftermarket Accessories*
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to *Testing for Intermittent and Poor Connections*

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- *Blower Motor Inoperative at Any Speed*
- *Blower Motor Operates at High Speed Only*
- *Blower Motor Inoperative in One Speed Only (High Speed Operates Normally)*
- *Blower Motor High Speed Inoperative*

- *Blower Motor Always On*
- *Air Delivery Improper*
- *Defrosting Insufficient* in Heating, Ventilation and Air Conditioning.
- *Heating Insufficient* in Heating, Ventilation and Air Conditioning.
- *Noise Diagnosis - Blower Motor* in Heating, Ventilation and Air Conditioning.
- *Noise Diagnosis - A/C System* in Heating, Ventilation and Air Conditioning.
- *Odor Diagnosis* in Heating, Ventilation and Air Conditioning.

HVAC Compressor Clutch Does Not Engage

Step	Action	Value(s)	Yes	No
DEFINITION: A/C compressor clutch will not engage when an A/C request has been made and no Powertrain DTCs are set.				
1	Did you perform the Diagnostic System Check?	—	*Go to Step 2*	Go to *A Diagnostic System Check*
2	1. Turn the ignition switch to the OFF position. 2. Install both the high and low A/C freon pressure gages. 3. Read the freon pressure with the engine off. • Freon pressure in the high and low sides should equal each other after the A/C system has come to rest. • Freon pressure will fluctuate depending on ambient temperature. • Proper clutch operation depends on correct refrigerant charge. Low freon charge will shut off A/C compressor operation. Are the high and low side freon pressures below the specified value?	345 kPa (50 psi)	Go to *Leak Testing* in Heating, Ventilation, and Air Conditioning	*Go to Step 3*
3	Are the high and low side freon pressures above the specified value?	690 kPa (100 psi)	*Go to Step 4*	*Go to Step 5*
4	Evacuate and recharge the A/C system according to proper freon fill specifications. Has the A/C system been recharged properly?	—	*Go to Step 24*	—
5	Test for and repair a short to ground in the supply voltage circuit of the A/C compressor clutch. Refer to *Circuit Testing* and *Wiring Repairs* in Wiring Systems. Did you find and repair a short to ground?	—	*Go to Step 24*	*Go to Step 6*
6	1. Remove the A/C clutch relay from the engine wiring harness junction block 2. 2. Disconnect the A/C compressor clutch coil connector. 3. Connect a fused jumper between the ignition voltage terminal for the switch side of the A/C clutch relay and the engine wiring harness junction block 2 connector C1 terminal F8. 4. Connect a DMM between the A/C compressor clutch coil connector terminal B and ground. 5. Turn the ignition switch to the RUN position. 6. Measure the available voltage at the A/C compressor clutch coil connector terminal B. Is the voltage the same as the specified value?	B+	*Go to Step 8*	*Go to Step 7*
7	Repair a poor connection or an open in the supply voltage circuit of the A/C compressor clutch. Refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems. Did you complete the repair?	—	*Go to Step 24*	—
8	Using a DMM, measure for continuity between terminal B of the A/C compressor clutch coil connector and ground. Is the resistance to ground less than the specified value?	0 - 2 Ω	*Go to Step 10*	*Go to Step 9*
9	Repair a poor connection or an open in the ground circuit of the A/C compressor clutch. Refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems. Did you complete the repair?	—	*Go to Step 24*	—

HVAC Compressor Clutch Does Not Engage (cont'd)

Step	Action	Value(s)	Yes	No
10	1. Disconnect the powertrain control module (PCM) connector C2. 2. Reinstall the A/C clutch relay. 3. Connect a fused jumper between the PCM connector C2 terminal 39 and ground. 4. Turn the ignition switch to the RUN position. 5. Using a DMM, measure the voltage between the A/C compressor clutch coil connector terminal B and ground. Is the voltage the same as the specified value?	B+	*Go to Step 11*	*Go to Step 12*
11	1. Remove the fused jumper from the PCM connector C2 terminal 39 and ground. 2. Reconnect the A/C compressor clutch coil connector. 3. Reinstall the fused jumper between the PCM connector C2 terminal 39 and ground. 4. Turn the ignition switch to the ON position. Does the A/C compressor clutch engage?	—	Go to *Cooling Insufficient, A/C System* in Heating, Ventilation, and Air Conditioning	*Go to Step 23*
12	1. Turn the ignition switch to the OFF position. 2. Remove the A/C clutch relay. 3. Using a DMM, measure for continuity between the PCM connector C2 terminal 39 and the engine wiring harness junction block 2 connector C1 terminal F7. Is there continuity?	—	*Go to Step 14*	*Go to Step 13*
13	Repair a poor connection or an open in the control circuit of the A/C clutch relay. Refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems. Did you complete the repair?	—	*Go to Step 24*	—
14	Replace the A/C clutch relay and retest the A/C system. Refer to *Compressor Relay Replacement* in Heating, Ventilation, and Air Conditioning. Does replacing the A/C clutch relay correct the concern?	—	*Go to Step 24*	*Go to Step 15*
15	1. Disconnect the heater-A/C control connector C2. 2. Connect a DMM between the PCM connector C2 terminal 22 and the heater-A/C control connector C2 terminal B. 3. Measure the A/C request signal circuit for resistance between these two connectors. Is the A/C request signal circuit resistance between the specified values?	0 - 2 Ω	*Go to Step 17*	*Go to Step 16*
16	Repair a poor connection or an open in the A/C request signal circuit. Refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems. Did you complete the repair?	—	*Go to Step 24*	—
17	1. Connect a DMM between the PCM connector C2 terminal 22 and ground. 2. Measure the A/C request signal circuit for continuity to ground. Is the A/C request signal circuit continuous to ground?	—	*Go to Step 18*	*Go to Step 19*
18	Repair a short to ground in the A/C request signal circuit. Refer to *Wiring Repairs* in Wiring Systems. Did you complete the repair?	—	*Go to Step 24*	—
19	1. Disconnect the DMM. 2. Reconnect all connectors back to their respective modules. 3. Install the scan tool to the diagnostic link connector. 4. Start the engine and allow it to idle in park. 5. Select the area of the scan tool which will read HVAC button output status. 6. Depress the A/C button on/off several times. Does the scan tool read the A/C request being sent by the HVAC control head?	—	*Go to Step 20*	*Go to Step 22*

HVAC Compressor Clutch Does Not Engage (cont'd)

Step	Action	Value(s)	Yes	No
20	Test for and repair a poor connection at the PCM and at the engine wiring harness junction block 2. Refer to *Testing for Intermittent and Poor Connections* and *Connector Repairs* in Wiring Systems. Did you complete the repair?	—	*Go to Step 24*	*Go to Step 21*
21	Replace the PCM. Refer to *PCM Replacement/Programming* (V6) or *PCM Replacement/Programming* (V8) in Engine Controls. Did you complete the replacement?	—	*Go to Step 24*	—
22	Replace the heater-A/C control. Refer to *Control Assembly Replacement.* Did you complete the replacement?	—	*Go to Step 24*	—
23	Replace the A/C compressor clutch coil. Refer to *Compressor Clutch Coil Removal (V5 - Conventional Mount)* and *Compressor Clutch Coil Install (V5 - Conventional Mount)* (V6) or *Compressor Clutch Coil Removal (V7 - Direct Mount)* and *Compressor Clutch Coil Install (V7 - Direct Mount)* (V8). Did you complete the replacement?	—	*Go to Step 24*	—
24	Operate the system in order to verify the repair. Did you correct the condition?	—	System OK	*Go to Step 3*

HVAC Compressor Clutch Does Not Disengage

Step	Action	Value(s)	Yes	No
DEFINITION: A/C compressor clutch will not disengage when no A/C request has been made and no Powertrain DTCs are set.				
1	Did you perform the Diagnostic System Check?	—	*Go to Step 2*	Go to *A Diagnostic System Check*
2	1. Disconnect the Powertrain Control Module (PCM) connector C2. 2. Turn the ignition switch to the RUN position. Does the A/C compressor clutch coil disengage?	—	*Go to Step 3*	*Go to Step 4*
3	Replace the Powertrain Control Module (PCM). Refer to *PCM Replacement/Programming* (V6) or *PCM Replacement/Programming* (V8) in Engine Controls. Did you complete the replacement?	—	*Go to Step 11*	—
4	1. Disconnect the A/C CLU relay from the underhood accessory wiring junction block. 2. Turn the ignition switch to the RUN position. Does the A/C compressor clutch coil disengage?	—	*Go to Step 5*	*Go to Step 8*
5	1. Turn the ignition switch to the OFF position. 2. Powertrain Control Module (PCM) connector C2 still disconnected. 3. A/C clutch relay still removed from the engine wiring harness junction block 2. 4. Connect a DMM between the Powertrain Control Module (PCM) connector C2 terminal 39 and ground. 5. Measure for continuity in the control circuit of the A/C compressor relay to ground. Is the air conditioning compressor coil control relay output circuit continuous to ground?	—	*Go to Step 6*	*Go to Step 7*
6	Repair a short to ground in the control circuit of the A/C compressor relay between the engine wiring harness junction block 2 and the PCM connector C2. Refer to *Wiring Repairs* in Wiring Systems. Did you complete the repair?	—	*Go to Step 11*	—
7	Replace the A/C clutch relay. Refer to *Compressor Relay Replacement* in Heating, Ventilation, and Air Conditioning. Did you complete the replacement?	—	*Go to Step 11*	—

HVAC Compressor Clutch Does Not Disengage (cont'd)

Step	Action	Value(s)	Yes	No
8	1. Leave the Powertrain Control Module (PCM) connector C2 still disconnected. 2. A/C clutch relay still removed from the engine wiring harness junction block 2. 3. Disconnect the A/C compressor clutch coil connector. 4. Connect a DMM between the A/C compressor clutch coil connector terminal B and ground. 5. Turn the ignition switch to the RUN position. 6. Measure for voltage on the supply voltage circuit of the A/C compressor clutch. Is voltage present on the supply voltage circuit of the A/C compressor clutch?	—	*Go to Step 9*	*Go to Step 10*
9	Repair a short to battery voltage in the supply voltage circuit of the A/C compressor clutch between the engine wiring harness junction block 2 and the A/C compressor clutch coil. Refer to *Wiring Repairs* in Wiring Systems. Did you complete the repair?	—	*Go to Step 11*	—
10	Replace the A/C compressor clutch coil. Refer to *Compressor Clutch Coil Removal (V5 - Conventional Mount)* and *Compressor Clutch Coil Install (V5 - Conventional Mount)* (V6) or *Compressor Clutch Coil Removal (V7 - Direct Mount)* and *Compressor Clutch Coil Install (V7 - Direct Mount)* (V8). Did you complete the replacement?	—	*Go to Step 11*	—
11	Operate the system in order to verify the repair. Did you correct the condition?	—	System OK	*Go to Step 3*

Blower Motor Inoperative at Any Speed

Step	Action	Value(s)	Yes	No
1	Did you complete the Diagnostic System Check?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Place the ignition switch in the RUN position. 2. Place the selector switch in the VENT position. 3. With a test lamp, probe the HVAC control (blower switch) between connector C1 terminal E and ground. Does the test lamp illuminate?	—	Go to *Step 3*	Go to *Step 15*
3	1. Place the blower switch in position 1 (low). 2. With a test lamp, probe the HVAC control (blower switch) between connector C1 terminal A and ground. Does the test lamp illuminate?	—	Go to *Step 4*	Go to *Step 5*
4	1. Place the ignition switch in the OFF position. 2. Disconnect the blower motor relay. 3. Connect a fused jumper between the blower motor relay terminals B2 and C1. 4. Place the ignition switch in the RUN position. 5. Place the selector switch in the VENT position. 6. Place the blower switch in position 1 (low). Does the blower motor run?	—	Go to *Step 8*	Go to *Step 7*
5	Test for and repair a poor connection at the HVAC control blower switch. Refer to *Testing for Intermittent and Poor Connections* and *Connector Repairs* in Wiring Systems. Did you find and repair a poor connection?	—	Go to *Step 20*	Go to *Step 6*
6	Replace the HVAC control blower switch. Refer to *HVAC Control Blower Switch Replacement.* Did you complete the replacement?	—	Go to *Step 20*	—

Blower Motor Inoperative at Any Speed (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Leave the jumper connected from previous step. 2. Turn the ignition switch to the OFF position. 3. Disconnect the blower motor connector. 4. Turn the ignition switch to the RUN position. 5. Connect a test lamp between the blower motor connector terminals A and B. Does the test lamp illuminate?	—	Go to *Step 11*	Go to *Step 10*
8	Test for and repair a poor connection at the blower motor relay. Refer to *Testing for Intermittent and Poor Connections* and *Connector Repairs* in Wiring Systems. Did you find and repair a poor connection?	—	Go to *Step 20*	Go to *Step 9*
9	Replace the blower motor relay. Refer to *Blower Motor Relay Replacement.* Did you complete the replacement?	—	Go to *Step 20*	—
10	1. Leave the jumper connected from the previous step. 2. Connect the test lamp between the blower motor connector terminal B and ground. Does the test lamp illuminate?	—	Go to *Step 14*	Go to *Step 13*
11	Test for and repair a poor connection at the blower motor. Refer to *Testing for Intermittent and Poor Connections* and *Connector Repairs* in Wiring Systems. Did you find and repair a poor connection?	—	Go to *Step 20*	Go to *Step 12*
12	Replace the blower motor. Refer to *Blower Motor and Fan Replacement.* Did you complete the replacement?	—	Go to *Step 20*	—
13	Repair a poor connection or an open in the supply voltage circuit of the blower motor. Refer to *Connector Repairs* or *Wiring Repairs* in Wiring Systems. Did you complete the repair?	—	Go to *Step 20*	—
14	Repair a poor connection or an open in the ground circuit of the blower motor. Refer to *Connector Repairs* or *Wiring Repairs* in Wiring Systems. Did you complete the repair?	—	Go to *Step 20*	—
15	Probe the HVAC control (selector switch) between connector C2 terminal C and ground. Does the test lamp illuminate?	—	Go to *Step 16*	Go to *Step 19*
16	Test for and repair an open or a poor connection in the A/C request signal circuit at the HVAC control (selector switch) connector C2 terminals B and C. Refer to *Circuit Testing* or *Testing for Intermittent and Poor Connections* and *Wiring Repairs* or *Connector Repairs* in Wiring Systems. Did you find and repair an open or a poor connection?	—	Go to *Step 20*	Go to *Step 17*
17	Test for and repair a poor connection at the HVAC control (selector switch). Refer to *Testing for Intermittent and Poor Connections* and *Connector Repairs* in Wiring Systems. Did you complete the repair?	—	Go to *Step 20*	Go to *Step 18*
18	Replace the HVAC control (selector switch). Refer to *Control Assembly Replacement.* Did you complete the replacement?	—	Go to *Step 20*	—
19	Repair a poor connection or an open in the ignition 3 voltage circuit between the HVAC control (selector switch) connector C2 terminal C and S248. Refer to *Connector Repairs* or *Wiring Repairs* in Wiring Systems. Did you complete the repair?	—	Go to *Step 20*	—
20	Operate the system in order to verify the repair. Did you correct the condition?	—	System OK	Go to *Step 3*

Blower Motor Operates at High Speed Only

Step	Action	Value(s)	Yes	No
1	Did you complete the Diagnostic System Check?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Place the ignition switch in the RUN position. 2. Place the selector switch in the VENT position. 3. Place the blower switch in position 1 (low). 4. Probe with a test lamp between the blower resistor connector terminal C and ground. Does the test lamp illuminate?	—	Go to *Step 3*	Go to *Step 4*
3	Probe with a test lamp between the blower motor relay connector terminal B2 and ground. Does the test lamp illuminate?	—	Go to *Step 6*	Go to *Step 8*
4	Test for and repair a poor connection at the blower resistor. Refer to *Testing for Intermittent and Poor Connections* and *Connector Repairs* in Wiring Systems. Did you find and repair a poor connection?	—	Go to *Step 9*	Go to *Step 5*
5	Replace the blower resistor. Refer to *Blower Motor Resistor Replacement.* Did you complete the replacement?	—	Go to *Step 9*	—
6	Test for and repair a poor connection at the blower motor relay. Refer to *Testing for Intermittent and Poor Connections* and *Connector Repairs* in Wiring Systems. Did you find and repair a poor connection?	—	Go to *Step 9*	Go to *Step 7*
7	Replace the blower motor relay. Refer to *Blower Motor Relay Replacement.* Did you complete the replacement?	—	Go to *Step 9*	—
8	Repair a poor connection or an open in the blower resistor control circuit of the blower motor relay between the blower resistor and the blower motor relay. Refer to *Connector Repairs* or *Wiring Repairs* in Wiring Systems. Did you complete the repair?	—	Go to *Step 9*	—
9	Operate the system in order to verify the repair. Did you correct the condition?	—	System OK	Go to *Step 3*

Blower Motor Inoperative in One Speed Only (High Speed Operates Normally)

Step	Action	Value(s)	Yes	No
1	Did you complete the Diagnostic System Check?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Disconnect the blower resistor connector. 2. Place the ignition switch in the RUN position. 3. Place the blower switch in the inoperative position. 4. Connect a test lamp from the blower resistor connector inoperative terminal (position 1 (low) =B, 2 (M1) =A, 3 (M2) =D) to ground on the harness connector. Does the test lamp illuminate?	—	Go to *Step 3*	Go to *Step 5*
3	Test for and repair a poor connection at the blower resistor. Refer to *Testing for Intermittent and Poor Connections* and *Connector Repairs* in Wiring Systems. Did you find and repair a poor connection?	—	Go to *Step 9*	Go to *Step 4*
4	Replace the blower resistor. Refer to *Blower Motor Resistor Replacement.* Did you complete the replacement?	—	Go to *Step 9*	—
5	Probe with a test lamp between the HVAC control (blower switch) connector C1 of the inoperative terminal (position 1 (low) =A, 2 (M1) =C, 3 (M2) =D) and ground. Does the test lamp illuminate?	—	Go to *Step 6*	Go to *Step 7*

Blower Motor Inoperative in One Speed Only (High Speed Operates Normally) (cont'd)

Step	Action	Value(s)	Yes	No
6	Repair a poor connection or an open in the inoperative circuit (position 1 (low) =60, 2 (M1) =63, 3 (M2) =72). Refer to *Connector Repairs* or *Wiring Repairs* in Wiring Systems. Did you complete the repair?	—	Go to *Step 9*	—
7	Test for and repair a poor connection at the HVAC control (blower switch). Refer to *Testing for Intermittent and Poor Connections* and *Connector Repairs* in Wiring Systems. Did you find and repair a poor connection?	—	Go to *Step 9*	Go to *Step 8*
8	Replace the HVAC control blower switch. Refer to *HVAC Control Blower Switch Replacement.* Did you complete the replacement?	—	Go to *Step 9*	—
9	Operate the system in order to verify the repair. Did you correct the condition?	—	System OK	Go to *Step 3*

Blower Motor High Speed Inoperative

Step	Action	Value(s)	Yes	No
1	Did you complete the Diagnostic System Check?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Place the HVAC control (selector switch) in the VENT position. 2. Place the HVAC control (blower switch) in position 4 (high). 3. Connect a test lamp between the HVAC control (blower switch) connector C1 terminal B and ground. Does the test lamp illuminate?	—	Go to *Step 3*	Go to *Step 4*
3	Connect a test lamp between the blower motor relay terminal A1 and ground. Does the test lamp illuminate?	—	Go to *Step 6*	Go to *Step 7*
4	Test for and repair a poor connection at the HVAC control (blower switch). Refer to *Testing for Intermittent and Poor Connections* and *Connector Repairs* in Wiring Systems. Did you find and repair a poor connection?	—	Go to *Step 13*	Go to *Step 5*
5	Replace the HVAC control blower switch. Refer to *HVAC Control Blower Switch Replacement.* Did you complete the replacement?	—	Go to *Step 13*	—
6	Connect the test lamp between the blower motor relay terminals A1 and C2. Does the test lamp illuminate?	—	Go to *Step 8*	Go to *Step 9*
7	Repair a poor connection or an open in the control circuit of the high blower motor. Refer to *Connector Repairs* or *Wiring Repairs* in Wiring Systems. Did you complete the repair?	—	Go to *Step 13*	—
8	Connect a test lamp between the blower motor relay connector terminals A2 and C2. Does the test lamp illuminate?	—	Go to *Step 10*	Go to *Step 12*
9	Repair a poor connection or an open in the ground circuit of the blower motor relay. Refer to *Connector Repairs* or *Wiring Repairs* in Wiring Systems. Did you complete the repair?	—	Go to *Step 13*	—
10	Check for a poor connection at the blower motor relay. Refer to *Testing for Intermittent and Poor Connections* and *Connector Repairs* in Wiring Systems. Did you find and repair a poor connection?	—	Go to *Step 13*	Go to *Step 11*

Blower Motor High Speed Inoperative (cont'd)

Step	Action	Value(s)	Yes	No
11	Replace the blower motor relay. Refer to *Blower Motor Relay Replacement.* Did you complete the replacement?	—	Go to *Step 13*	—
12	Repair an open or a poor connection in the battery positive voltage circuit of the blower motor relay. Refer to *Connector Repairs* or *Wiring Repairs* in Wiring Systems. Did you complete the repair?	—	Go to *Step 13*	—
13	Operate the system in order to verify the repair. Did you correct the condition?	—	System OK	Go to *Step 3*

Blower Motor Always On

Step	Action	Value(s)	Yes	No
1	Did you complete the Diagnostic System Check?	—	Go to *Step 2*	Go to *A Diagnostic System Check*
2	1. Turn the ignition switch to the OFF position. 2. Disconnect the blower motor relay. 3. Connect a test lamp at the blower motor relay connector terminal A1 and ground. Does the test lamp illuminate?	—	Go to *Step 3*	Go to *Step 4*
3	Repair a short to battery voltage in the control circuit of the high blower motor. Refer to *Wiring Repairs* in Wiring Systems. Did you complete the repair?	—	Go to *Step 9*	—
4	Connect a test lamp at the blower motor relay connector terminal B2 and ground. Does the test lamp illuminate?	—	Go to *Step 5*	Go to *Step 6*
5	Repair a short to battery voltage in the blower resistor control circuit of the blower motor. Did you complete the repair?	—	Go to *Step 9*	—
6	Connect a test lamp at the blower motor relay connector terminal C1 and ground. Does the test lamp illuminate?	—	Go to *Step 7*	Go to *Step 8*
7	Repair a short to battery voltage in the supply voltage circuit of the blower motor. Refer to *Wiring Repairs* in Wiring Systems. Did you complete the repair?	—	Go to *Step 9*	—
8	Replace the blower motor relay. Refer to *Blower Motor Relay Replacement.* Did you complete the replacement?	—	Go to *Step 9*	—
9	Operate the system in order to verify the repair. Did you correct the condition?	—	System OK	Go to *Step 3*

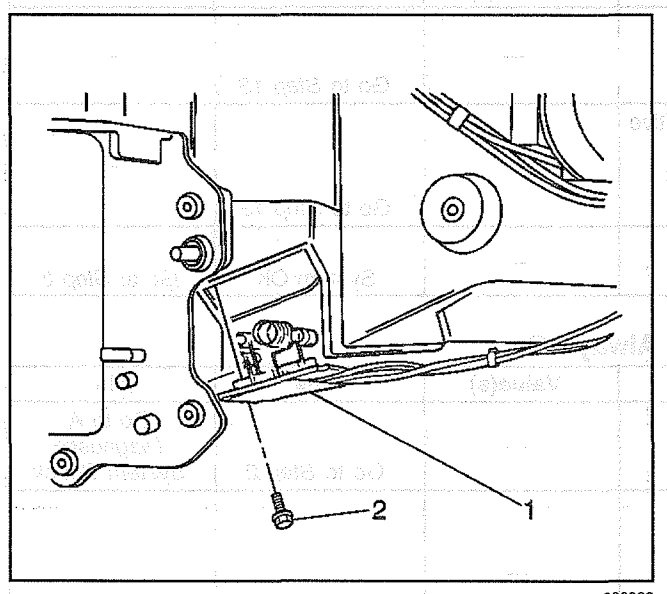
Air Delivery Improper

The air delivery system uses an engine manifold vacuum in order to position the heater A/C module valves. The positioning of the valves allows the air delivery system to achieve the desired air flow. The engine manifold vacuum is controlled by the heater A/C control.

Repair Instructions

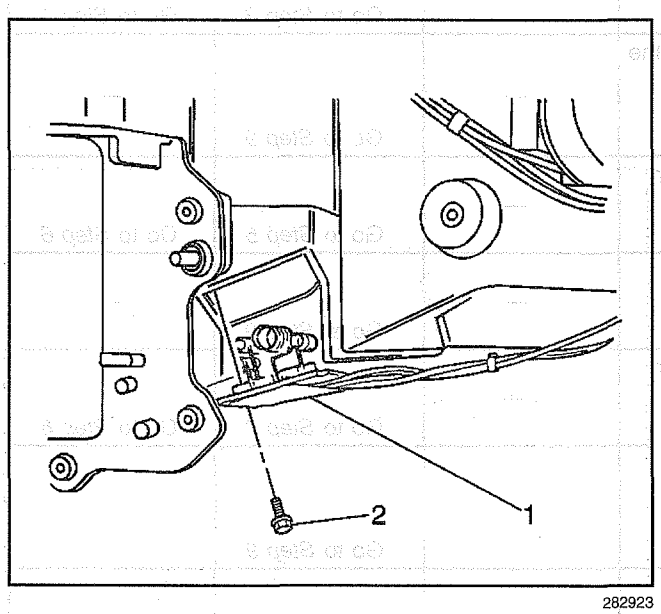
Blower Motor Resistor Replacement

Removal Procedure



282923

1. Remove the key from the ignition in order to assure that the ignition switch will remain in the OFF position.
2. Remove the right instrument panel insulator. Refer to *Closeout/Insulator Panel Replacement - Right* in Instrument Panel, Gauges and Console.
3. Pull the carpet away from the heater module.
4. Remove the blower motor resistor bolt (2).
5. Disconnect the blower motor resistor electical connector.
6. Remove the blower motor resistor (1).



282923

Installation Procedure

1. Install the blower motor resistor (1).
2. Connect the blower motor resistor electical connector.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the blower motor resistor bolt (2).

   Tighten

   Tighten the blower motor resistor bolt to 2 (18 lb in).
4. Reposition the carpet.
5. Install the right instrument panel insulator. Refer to *Closeout/Insulator Panel Replacement - Right* in Instrument Panel, Gauges and Console.
6. Test the blower motor operation at each of the four speeds.

Blower Motor and Fan Replacement

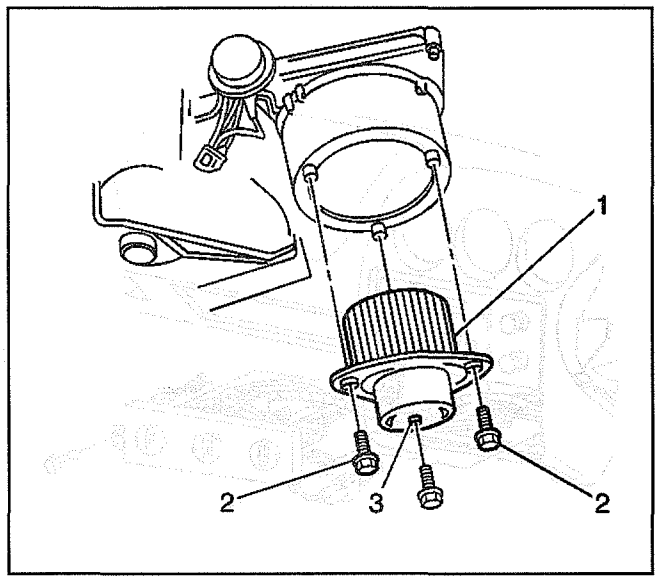
Removal Procedure

1. Remove the key from the ignition switch in order to ensure that the ignition switch will remain OFF.
2. Remove the right instrument panel insulator. Refer to *Closeout/Insulator Panel Replacement - Right* in Instrument Panel, Gauges and Console.
3. Disconnect the blower motor electrical connector.
4. Remove the blower motor bolts (2).
5. Remove the blower motor (3).
6. Inspect the blower motor terminals for corrosion.

   Perform the following tasks as necessary:
   - Clean the corrosion from the terminals.
   - Replace the blower motor.
7. Inspect the flange of the blower motor for any damage or distortion which could cause an air leak.

   Repair the flange of the blower motor as necessary.
8. Inspect the blower motor fan for damage and distortion.

   Perform the following tasks as necessary:
   - Repair the blower motor fan.
   - Replace the blower motor fan.



282924

Installation Procedure

1. Install the blower motor (3) using the following steps:
   1.1. Guide the blower motor (3) into position.

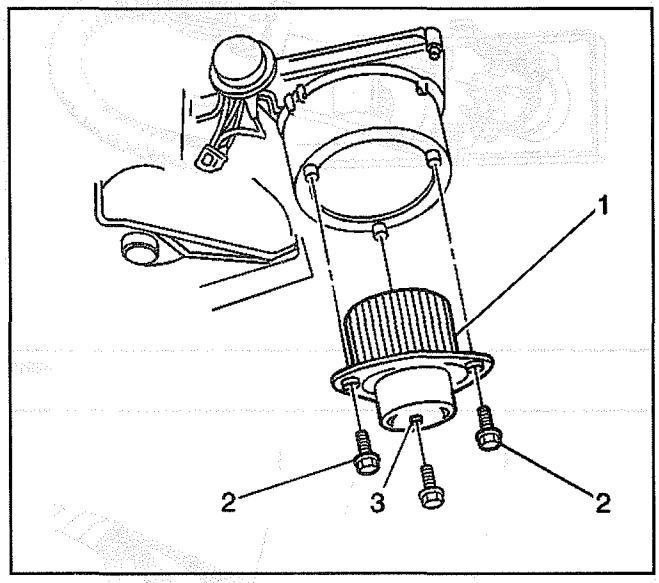
   Do not catch the blower motor fan on the protruding parts.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

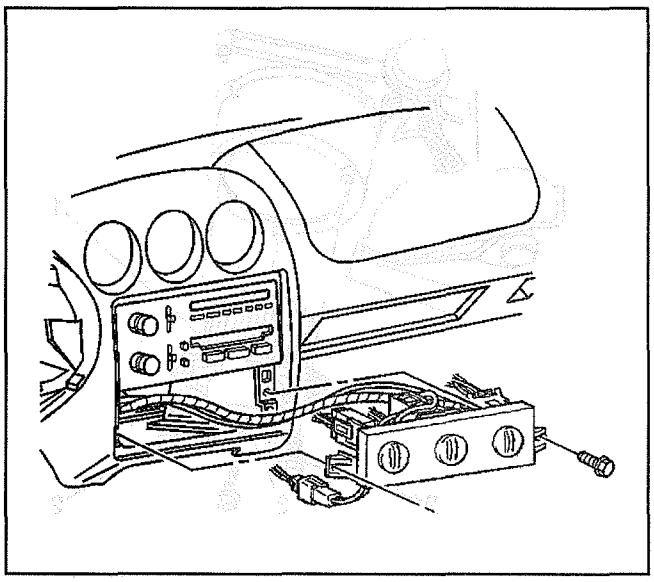
   1.2. Install the blower motor bolts (2).

   Tighten

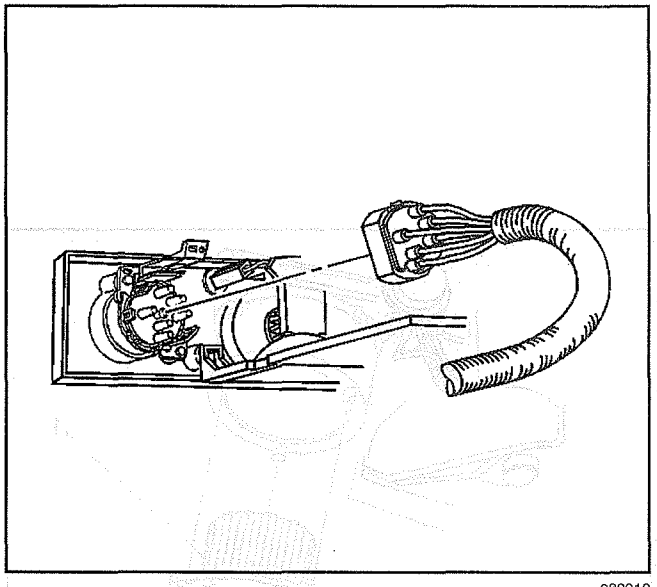
   Tighten the blower motor bolts (2) to 2.3 N·m (20 lb in).
2. Connect the blower motor electrical connector.
3. Install the right instrument panel insulator. Refer to *Closeout/Insulator Panel Replacement - Right* in Instrument Panel, Gauges and Console.
4. Check the blower for proper operation.



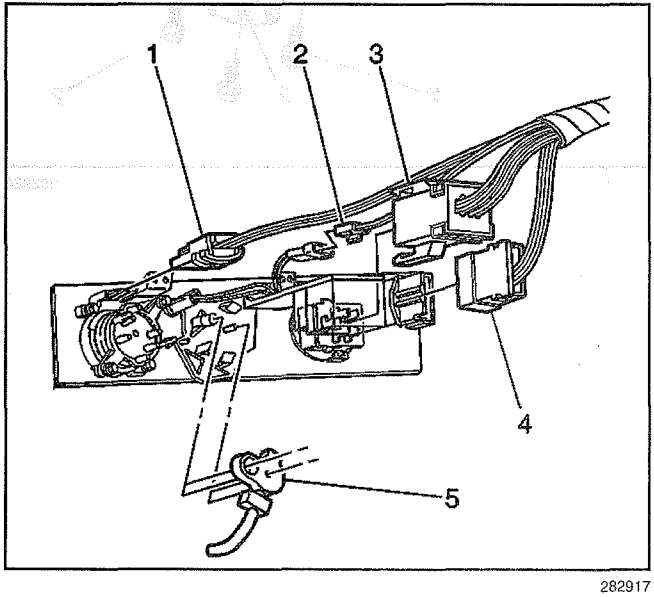
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Control Assembly Replacement

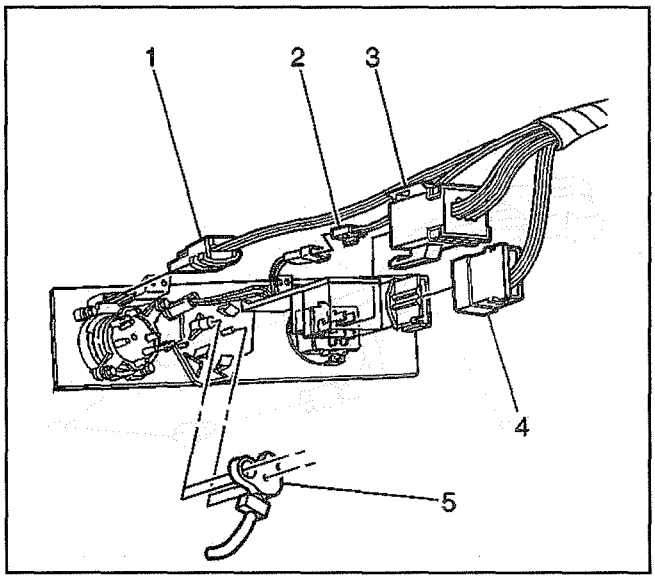
Removal Procedure

1. Remove the accessory trim plate. Refer to *Trim Plate Bezel Replacement - IP Cluster (Chevrolet)* or *Trim Plate Bezel Replacement - IP Cluster (Pontiac)* in Instrument Panel, Gauges and Console.
2. Remove the heating, ventilation and air conditioning (HVAC) control bolts.
3. Gently pull the HVAC control out from the instrument panel (IP) far enough to access the following connections:
   - Vacuum
   - Electrical
   - Temperature cable
4. Disconnect the vacuum harness connector from the vacuum selector valve.
5. Disconnect the following electrical connectors from the HVAC control:
   - HVAC mode switch (1)
   - HVAC control illumination (2)
   - HVAC blower switch (3)
   - Rear defogger (4)
6. Remove the temperature control cable (5) from the control.

   When releasing the control cable clips, use a small screwdriver to gently pry the cable from the control.

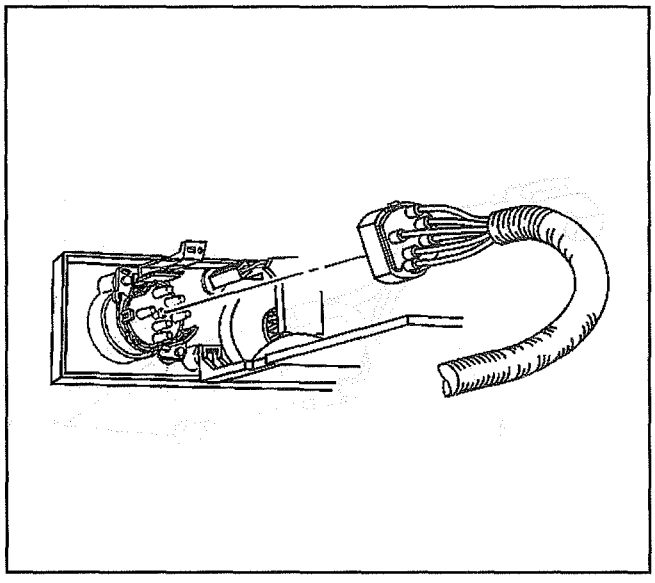
Installation Procedure

1. Install the temperature control cable connector (5) to the control.
2. Connect the following electrical connectors to the HVAC control:
   - Rear defogger (4)
   - HVAC blower switch (3)
   - HVAC control illumination (2)
   - HVAC mode switch (1)



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3. Connect the vacuum harness connector to the vacuum selector valve.


282918

4. Install the HVAC control.

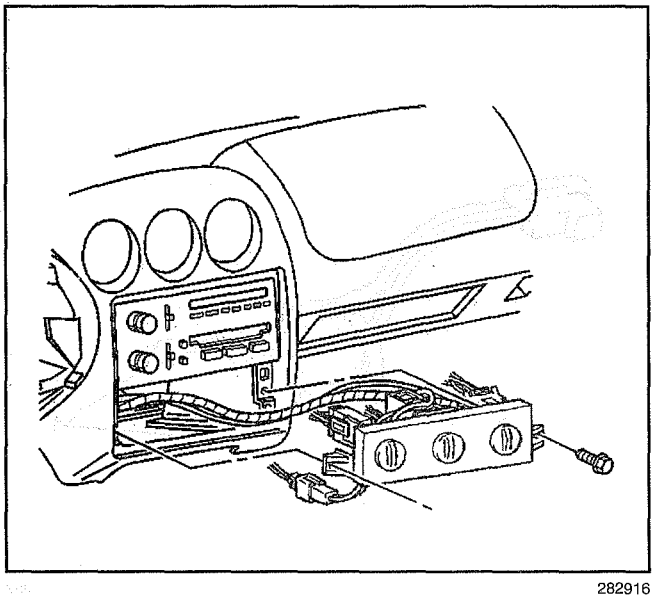
Notice: Refer to *Fastener Notice* in Cautions and Notices.

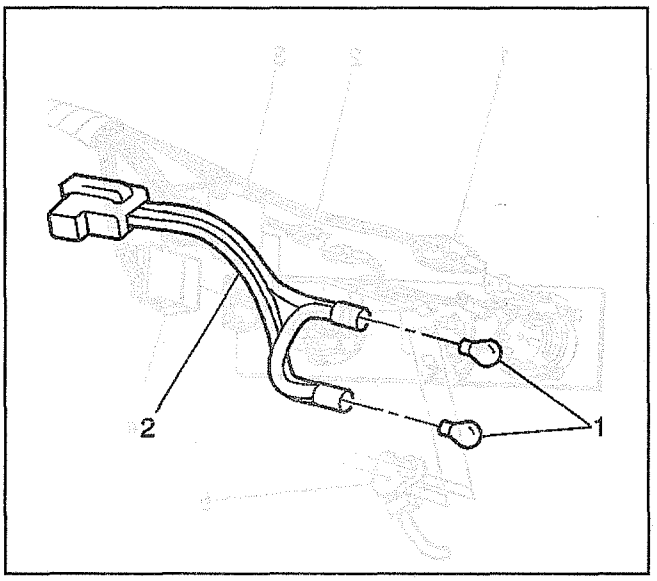
5. Install the HVAC control bolts.

   Tighten

   Tighten the HVAC control bolts to 2.2 N·m (19 lb in).

6. Install the accessory trim plate.Refer to *Trim Plate Bezel Replacement - IP Cluster (Chevrolet)* or *Trim Plate Bezel Replacement - IP Cluster (Pontiac)* in Instrument Panel, Gauges and Console.


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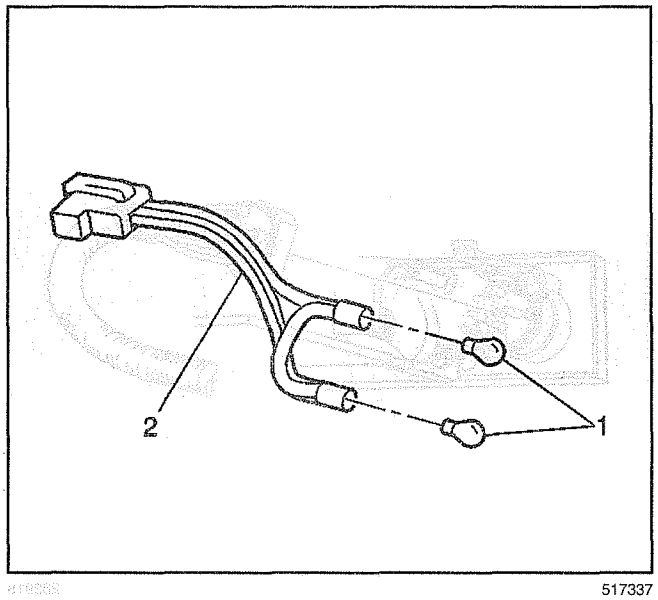


517337

HVAC Control Lamp Bulb Replacement

Removal Procedure

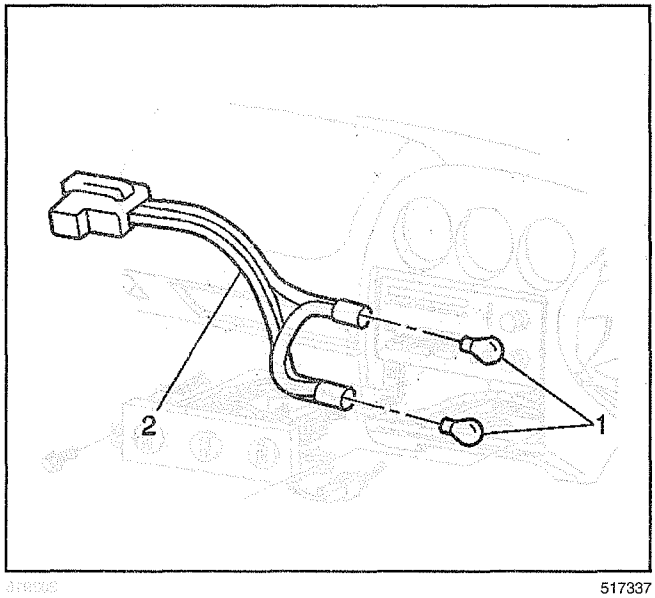
1. Remove the heating, ventilation and air conditioning (HVAC) control. Refer to *Control Assembly Replacement*.
2. Remove the HVAC control wiring harness from the control.
3. Gently, pull the burned out HVAC control lamp bulb (1) from the control lamp harness.



517337

Installation Procedure

1. Install a new HVAC control lamp bulb (1) to the control lamp harness.
2. Install the HVAC control wiring harness to the control.
3. Install the HVAC control. Refer to *Control Assembly Replacement*.



517337

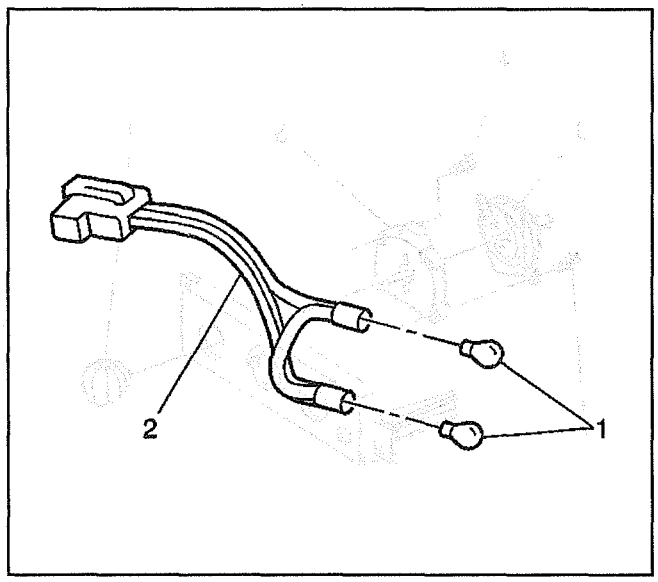
HVAC Control Lamp Bulb Wiring Harness Replacement

Removal Procedure

1. Remove the heating, ventilation and air conditioning (HVAC) control. Refer to *Control Assembly Replacement*.
2. Remove the HVAC control wiring harness (2) from the control.
3. Gently, pull the control lamp bulbs from the control lamp harness (2).

Installation Procedure

1. Install the control lamp bulbs to the control lamp harness (2).
2. Install the HVAC control wiring harness (2) to the control.
3. Install the HVAC control. Refer to *Control Assembly Replacement*.

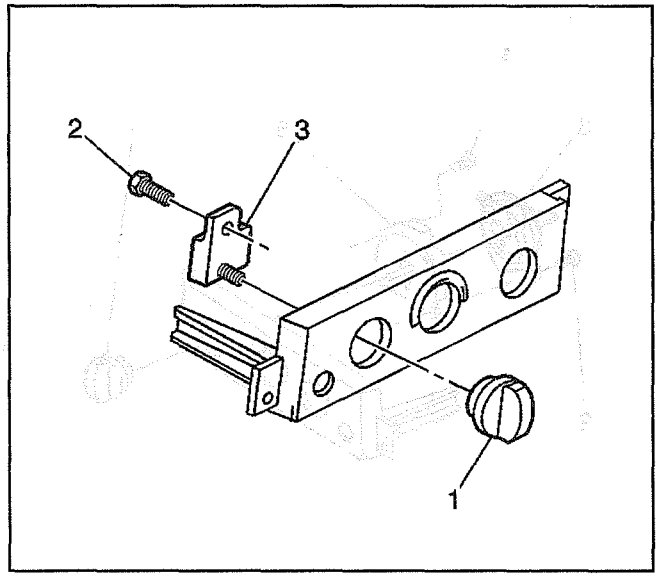


517337

HVAC Control Blower Switch Replacement

Removal Procedure

1. Remove the heating, ventilation and air conditioning (HVAC) control. Refer to *Control Assembly Replacement*.
2. Pull the HVAC control blower knob (1) off.
3. Remove the HVAC control blower switch screw (2).
4. Remove the HVAC control blower switch (3) from the control.



517336

Installation Procedure

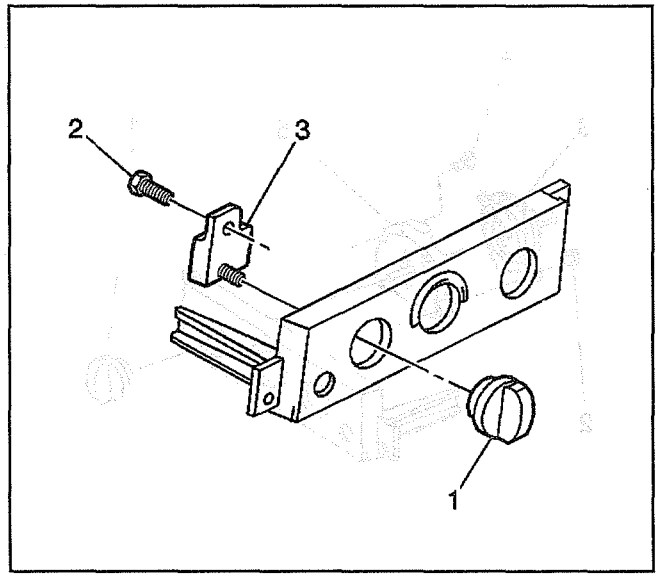
1. Install the HVAC control blower switch (3) to the control.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

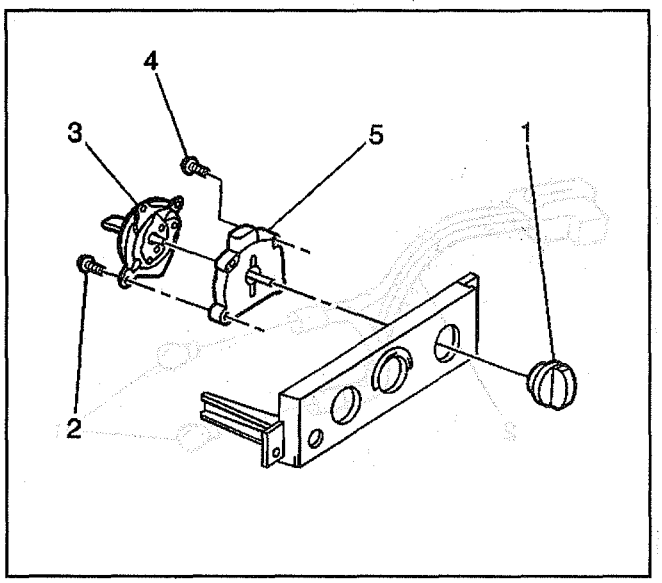
2. Install the HVAC control blower switch screw (2).

   Tighten

   Tighten the HVAC control blower switch screw (2) to 2 N·m (18 lb in).
3. Push the HVAC control blower knob (1) on.
4. Install the HVAC control. Refer to *Control Assembly Replacement*.



517336

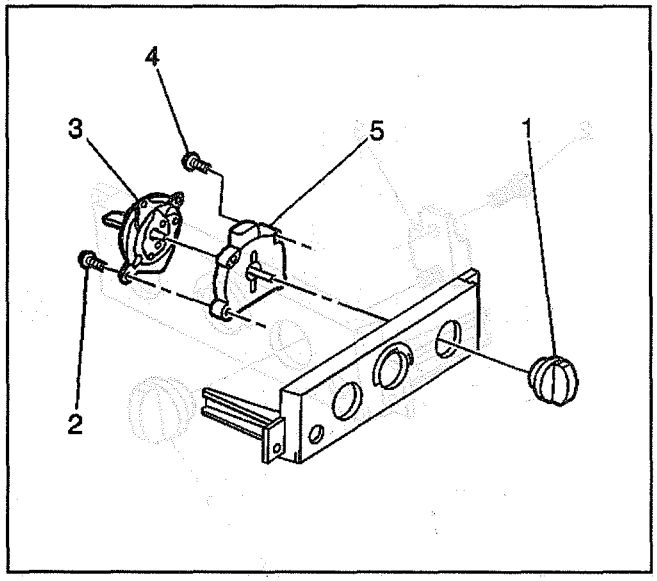


517338

HVAC Control Vacuum Valve Replacement

Removal Procedure

1. Remove the heating, ventilation and air conditioning (HVAC) control. Refer to *Control Assembly Replacement*.
2. Remove the HVAC control selector switch screws (2, 4).
3. Remove the HVAC control vacuum valve (3) from the selector switch (5).



517338

Installation Procedure

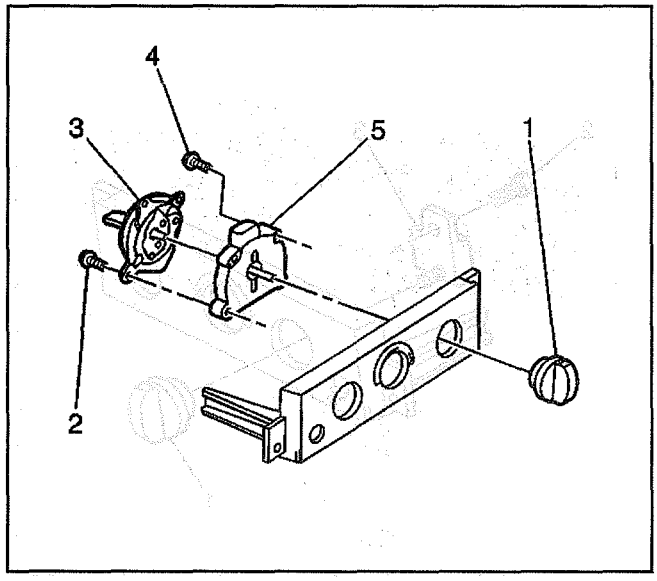
1. Install the HVAC control vacuum valve (3) to the selector switch (5).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the HVAC control selector switch screws (2, 4).

   Tighten

   Tighten the HVAC control selector switch screws to 2 N·m (18 lb in).
3. Install the HVAC control. Refer to *Control Assembly Replacement*.



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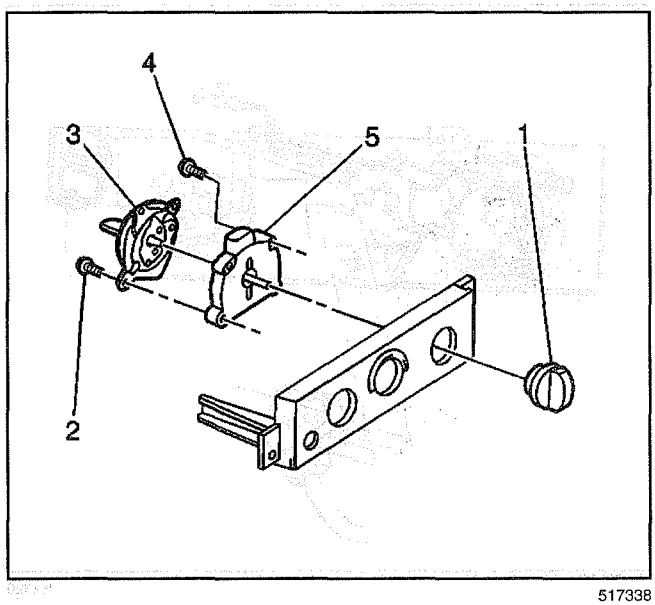
HVAC Control Selector Switch Replacement

Removal Procedure

1. Remove the heating, ventilation and air conditioning (HVAC) control vacuum valve. Refer to *HVAC Control Vacuum Valve Replacement*.
2. Pull the HVAC control selector knob (1) off.
3. Remove the HVAC control selector switch (5) from the control.

Installation Procedure

1. Install the HVAC control selector switch (5) to the control.
2. Push the HVAC control selector knob (1) on.
3. Install the HVAC control vacuum valve. Refer to *HVAC Control Vacuum Valve Replacement.*

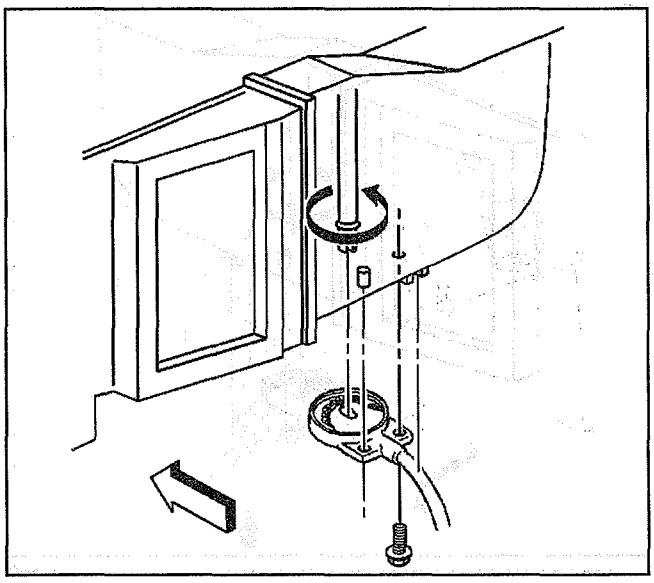


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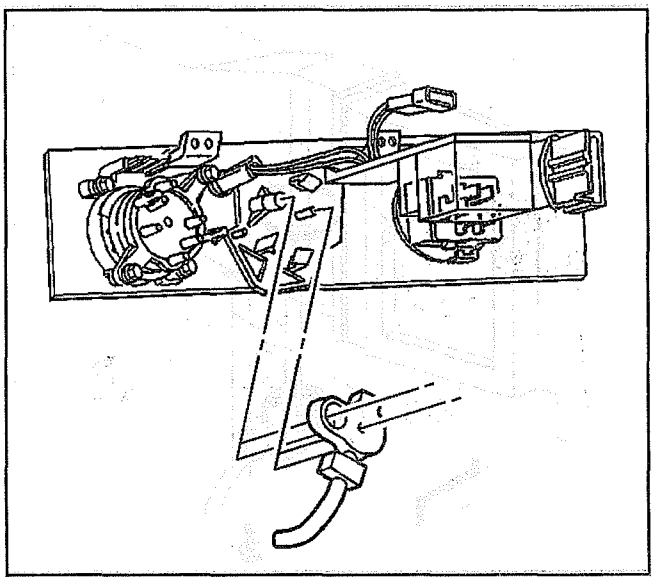
Temperature Control Cable Replacement

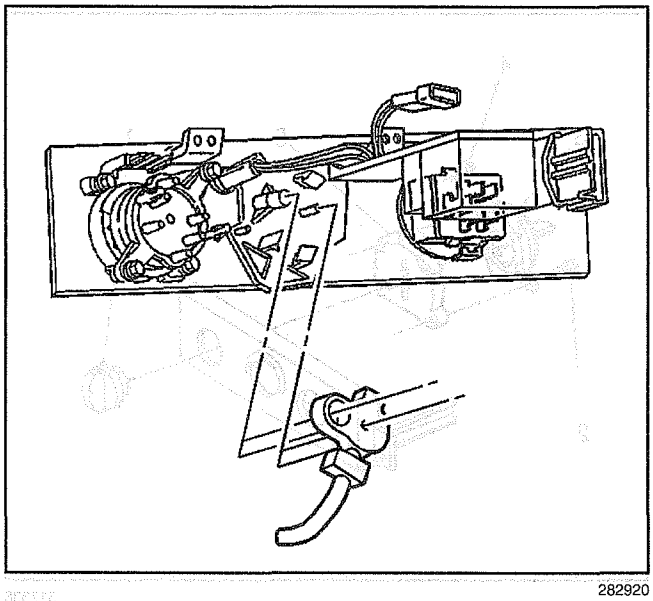
Removal Procedure

1. Remove the right instrument panel (IP) insulator. Refer to *Closeout/Insulator Panel Replacement - Right* in Instrument Panel, Gauges and Console.
2. Remove the temperature control cable bolt.
3. Disconnect the temperature control cable at the air conditioning (A/C) module.
4. Remove the accessory trim plate. Refer to *Trim Plate Bezel Replacement - IP Cluster (Chevrolet)* or *Trim Plate Bezel Replacement - IP Cluster (Pontiac)* in Instrument Panel, Gauges and Console.


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5. Remove the heating, ventilation and air conditioning (HVAC) control bolts.
6. Pull the HVAC control out of the IP far enough to access the temperature control cable connection.
7. Remove the temperature control cable from the control.
8. When releasing the control cable clips, use a small screwdriver to gently pry the cable from the control.


282920


282920

Installation Procedure

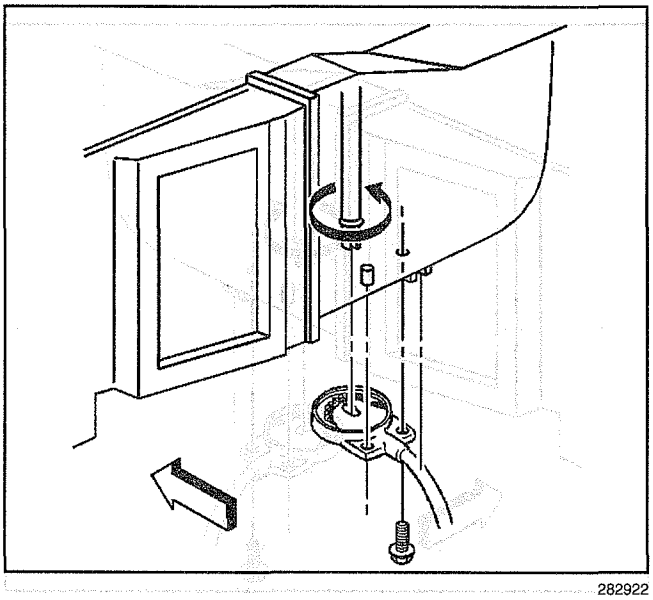
1. Install the temperature control cable to the control.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the HVAC control bolts.

   Tighten

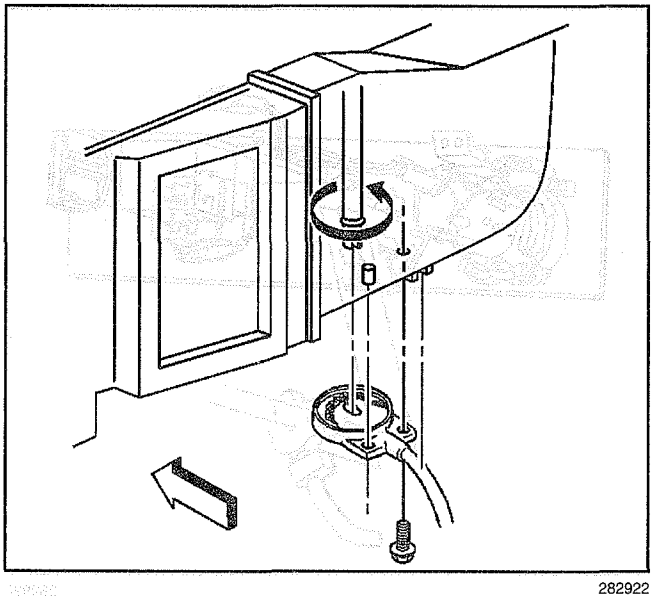
   Tighten the HVAC control bolts to 2.2 N·m (19 lb in).


282922

3. Connect the temperature control cable to the A/C module.
4. Use the following steps in order to install the temperature control cable to the control:
   4.1. Slip the temperature control cable into position over the lever arm.
   4.2. Align the shaft with the temperature control cable shaft.
   4.3. Press the temperature control cable clips into the slot in the control.
   4.4. Ensure that the temperature control cable clips are in place.
5. Install the temperature control cable bolt.

   Tighten

   Tighten the temperature control cable bolt to 1.9 N·m (17 lb in).
6. Install the accessory trim plate. Refer to *Trim Plate Bezel Replacement - IP Cluster (Chevrolet)* or *Trim Plate Bezel Replacement - IP Cluster (Pontiac)* in Instrument Panel, Gauges and Console.


282922

Temperature Control Cable Adjustment

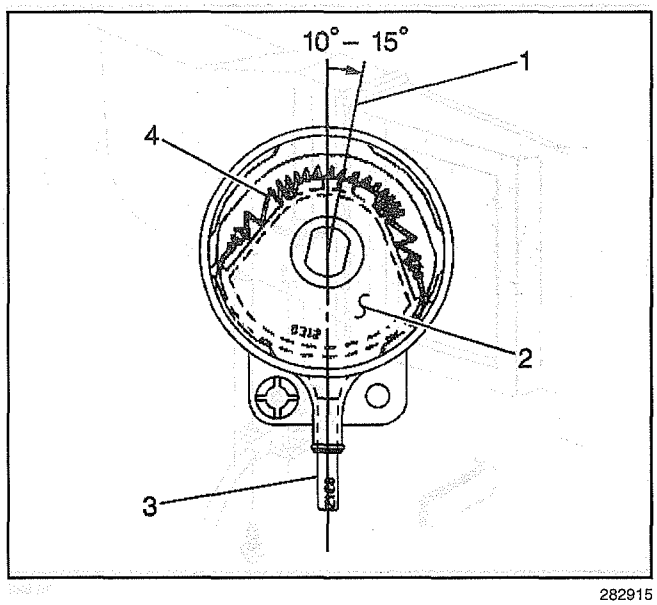
1. Remove the right instrument panel (IP) insulator. Refer to *Closeout/Insulator Panel Replacement - Right* in Instrument Panel, Gauges and Console.
2. Remove the temperature control cable bolt.
3. Disconnect the temperature control cable at the air conditioning (A/C) module.

Important: Ensure that the temperature control cable (3) is still attached to the heating, ventilation and air conditioning (HVAC) control.

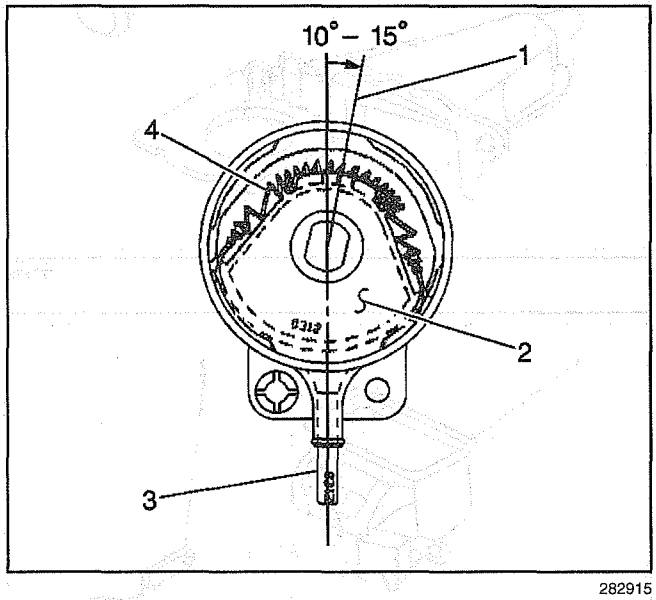
4. Cycle the temperature control knob between the following positions:
   - Full cold position
   - Full hot position
5. Replace the temperature control cable if one of the following situations occur:
   - The temperature control cable binds
   - The temperature control cable does not rotate freely

   Refer to *Temperature Control Cable Replacement*.
6. Set the temperature control knob to the detent position half way between the full cold and the full hot positions.
7. Inspect the position of the temperature control cable pulley (2).

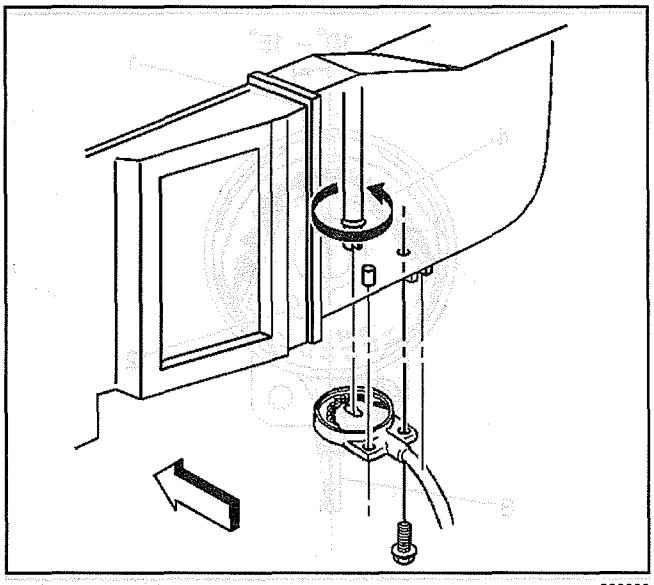
   Adjust the temperature control cable pulley (2):
   - Do not adjust the pulley if the pulley is skewed 5–10 degrees toward the full cold side.
   - Adjust the control cable if the pulley is skewed toward the full hot side.
8. Remove the spring (4) from the temperature control cable pulley.
9. Adjust the temperature control cable pulley 5–10 degrees toward the full cold position.
10. Install the temperature control cable spring (4) to the temperature control cable pulley (2).
11. Connect the temperature control cable (5) to the heater module.



282915



282915



282922

12. Connect the temperature control cable to the A/C module.

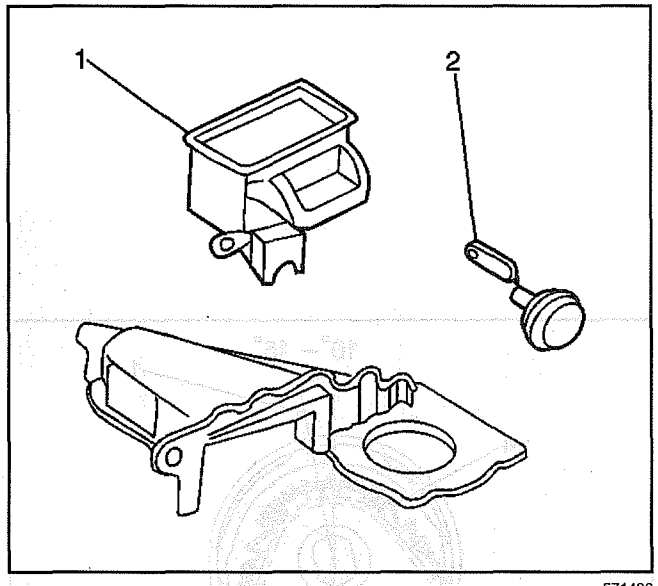
Notice: Refer to *Fastener Notice* in Cautions and Notices.

13. Install the temperature control cable bolt.

    Tighten

    Tighten the temperature control cable bolt to 1.9 N·m (17 lb in).

14. Install the right IP insulator. Refer to *Closeout/Insulator Panel Replacement - Right* in Instrument Panel, Gauges and Console.

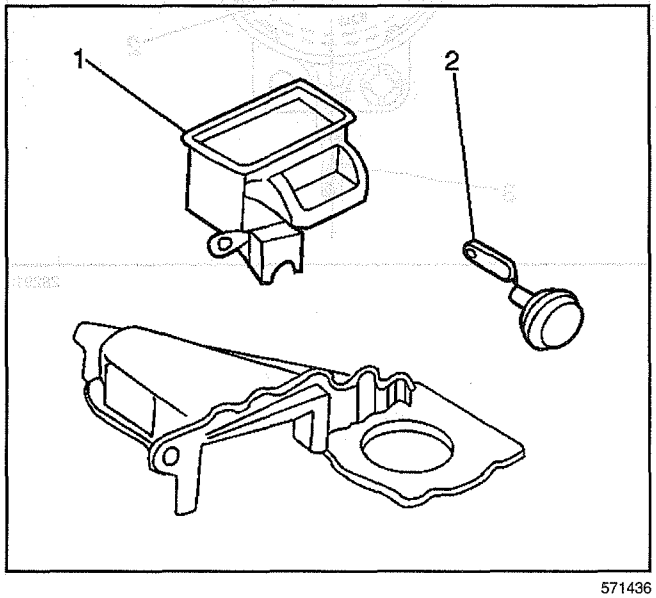


571436

Inside Air Valve Actuator Replacement

Removal Procedure

1. Remove the right side insulator. Refer to *Closeout/Insulator Panel Replacement - Right* in Instrument Panel, Gauges and Console.
2. Remove the left side insulator. Refer to *Closeout/Insulator Panel Replacement - Left* in Instrument Panel, Gauges and Console.
3. Remove the instrument panel (IP) compartment door hinge screws.
4. Remove the IP compartment door.
5. Remove the heating, ventilation and air conditioning (HVAC) module screws.
6. Remove the HVAC module cover.
7. Disconnect the air inlet valve linkage.
8. Remove the air inlet valve actuator (2) and vacuum hose.



571436

Installation Procedure

1. Install the air inlet valve actuator (2) and vacuum hose.
2. Connect the air inlet valve linkage.
3. install the HVAC module cover.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the HVAC module screws.

    Tighten

    Tighten the HVAC module screws to 1.8 N·m (16 lb in).

5. Install the IP compartment door.
6. Install the IP compartment hinge screws.

    Tighten

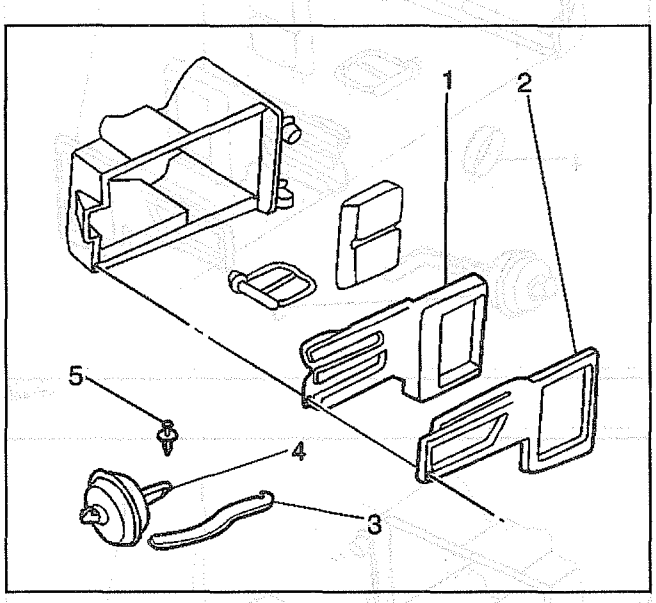
    Tighten the IP compartment hinge screws to 2.8 N·m (25 lb in).

7. Install the left side insulator. Refer to *Closeout/Insulator Panel Replacement - Left* in Instrument Panel, Gauges and Console.
8. Install the right side insulator. Refer to *Closeout/Insulator Panel Replacement - Right* in Instrument Panel, Gauges and Console.

Vacuum Actuator Replacement

Removal Procedure

1. Remove the instrument panel (IP) carrier. Refer to *IP Carrier Replacement* in Instrument Panel, Gauges and Console.
2. Remove the front floor air duct. Refer to *Air Outlet Replacement - Floor.*
3. Remove the air distributor case face (1) and seal (2).
4. Disconnect the vacuum hose from the vent mode valve actuator (4).
5. Remove the vent mode valve linkage screw (5).
6. Unsnap the vent mode valve actuator (4) from air distributor case.



571441

Installation Procedure

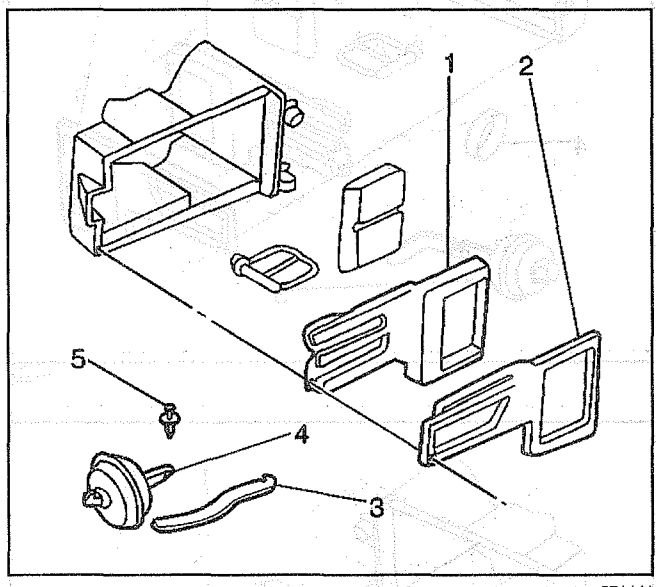
1. Snao the vent mode valve actuator (4) to the air distributor case.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

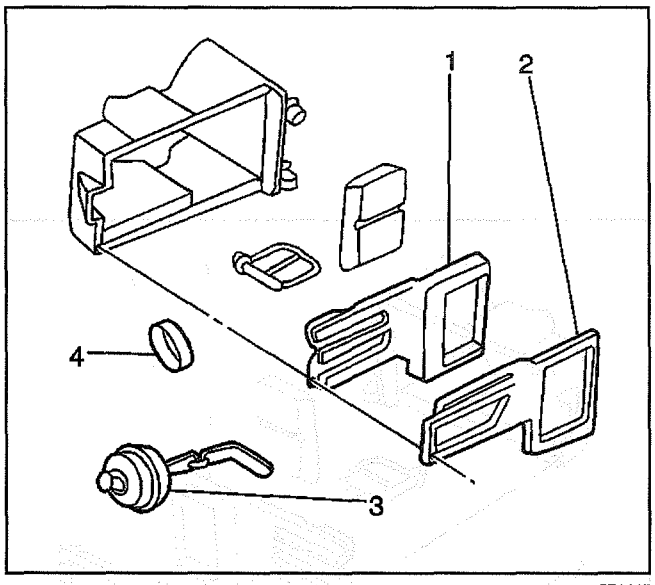
2. Install the vent mode valve linkage screw (5).

   Tighten

   Tighten the vent mode valve actuator screw to 2 N·m (18 lb in).
3. Connect the vacuum hose to the vent mode valve actuator (4).
4. Install the air distributor case face (1) and seal (2).
5. Install the front floor air duct. Refer to *Air Outlet Replacement - Floor.*
6. Install the IP carrier. Refer to *IP Carrier Replacement* in Instrument Panel, Gauges and Console.



571441

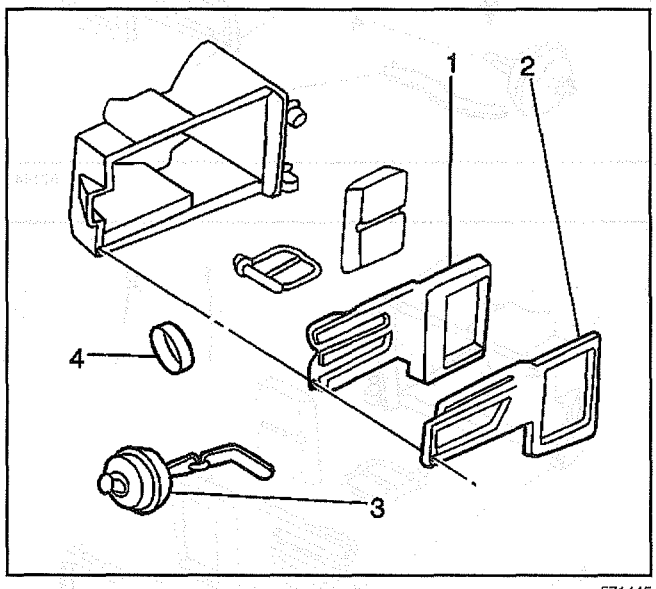


571445

Defroster Valve Actuator Replacement

Removal Procedure

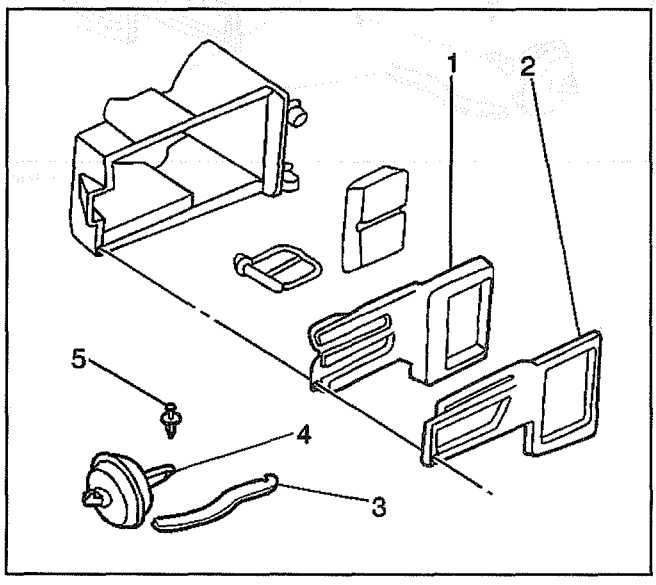
1. Remove the instrument panel (IP) carrier. Refer to *IP Carrier Replacement* in Instrument Panel, Gauges and Console.
2. Remove the front floor air duct. Refer to *Air Outlet Replacement - Floor.*
3. Remove the air distributor case face (1) and seal (2).
4. Disconnect the vacuum hose from the defroster valve actuator.
5. Disconnect the defroster valve actuator linkage from the defroster actuator.
6. Remove the defroster valve actuator (3).



571445

Installation Procedure

1. Install the defroster valve actuator (3).
2. Connect the defroster valve actuator linkage to the defroster actuator.
3. Connect the vacuum hose to the defroster valve actuator.
4. Install the air distributor case face (1) and seal (2).
5. Install the front floor air duct. Refer to *Air Outlet Replacement - Floor.*
6. Install the IP carrier. Refer to *IP Carrier Replacement* in Instrument Panel, Gauges and Console.



571448

Mode Valve Actuator Replacement

Removal Procedure

1. Remove the instrument panel (IP) carrier. Refer to *IP Carrier Replacement* in Instrument Panel, Gauges and Console.
2. Remove the front floor air duct. Refer to *Air Outlet Replacement - Floor.*
3. Remove the air distributor case face (1) and seal (2).
4. Disconnect the mode valve actuator linkage from the mode valve.
5. Remove the bi-level actuator (4) and linkage (3).
6. Remove the bi-level mode actuator screw (5).

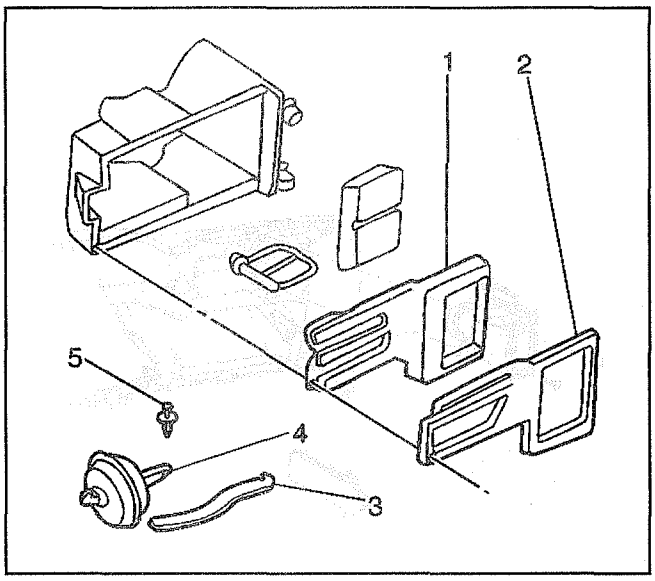
Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the bi-level mode actuator screw (5).

   Tighten

   Tighten the bi-level mode actuator screw to 2 N·m (18 lb in).
2. Install the bi-level actuator (4) and linkage (3).
3. Disconnect the mode valve actuator linkage from the mode valve.
4. Install the air distributor case face (1) and seal (2).
5. Install the front floor air duct. Refer to *Air Outlet Replacement - Floor.*
6. Install the IP carrier. Refer to *IP Carrier Replacement* in Instrument Panel, Gauges and Console.

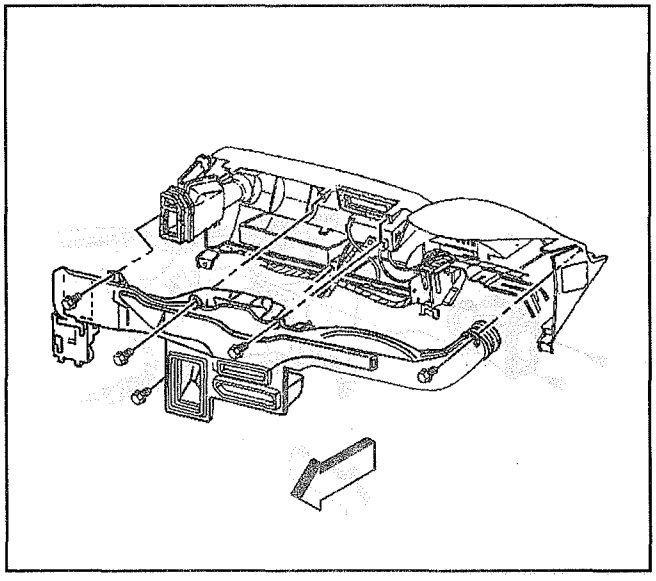


571448

Air Distributor Duct Replacement

Removal Procedure

1. Remove the instrument panel (IP) carrier. Refer to *IP Carrier Replacement* in Instrument Panel, Gauges and Console.
2. Place the IP carrier face down on a clean work surface.
3. Remove the air distributor duct bolts.
4. Remove the air distributor from the IP carrier.



365456

Installation Procedure

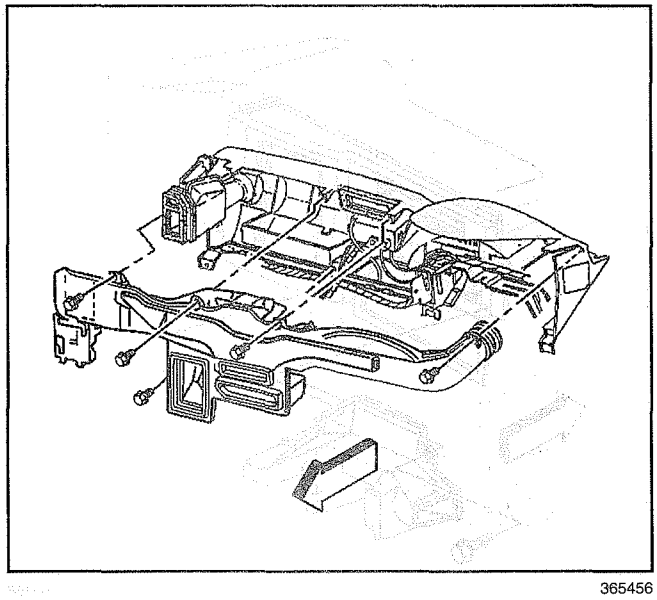
1. Install the air distributor to the IP carrier.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

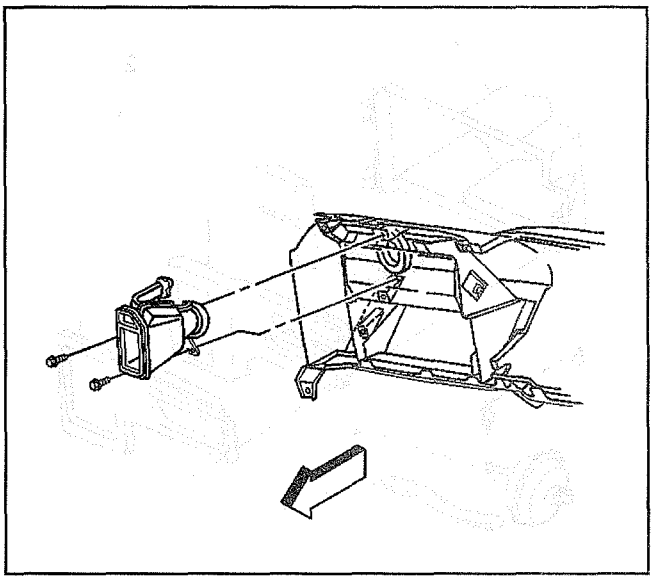
2. Install the air distributor duct bolts.

   Tighten

   Tighten the air distributor duct bolts to 2.2 N·m (19 lb in).
3. Install the IP carrier. Refer to *IP Carrier Replacement* in Instrument Panel, Gauges and Console.



365456

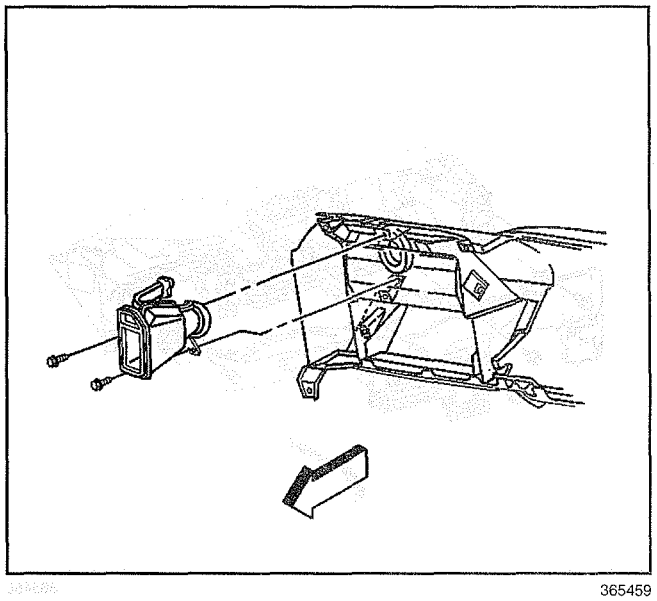


365459

Air Outlet Replacement - Right Defogger

Removal Procedure

1. Remove the instrument panel (IP) carrier. Refer to *IP Carrier Replacement* in Instrument Panel, Gauges and Console.
2. Remove the IP outer air outlet duct bolts.
3. Remove the IP outlet air outlet duct.



365459

Installation Procedure

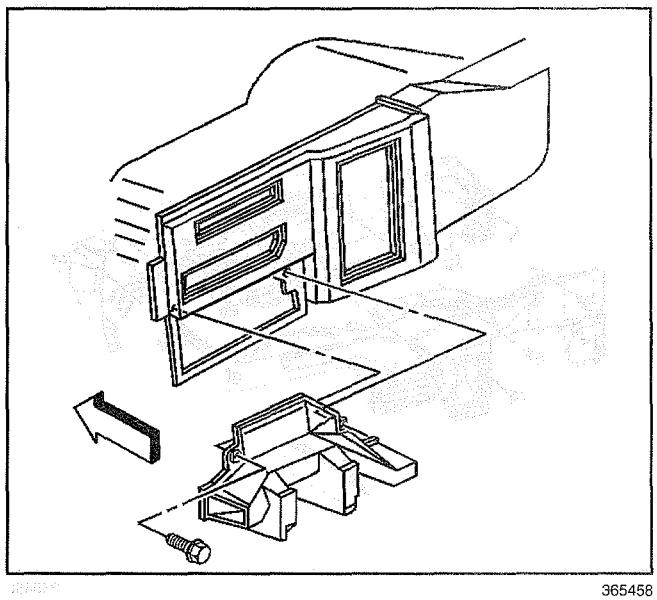
1. Install the IP outer air outlet duct.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the IP outer air outlet duct bolts.

   Tighten

   Tighten the IP outer air outlet duct bolts to 2.2 N·m (19 lb in).
3. Install the IP carrier. Refer to *IP Carrier Replacement* in Instrument Panel, Gauges and Console.



365458

Air Outlet Replacement - Floor

Removal Procedure

1. Remove the front floor console. Refer to *Console Replacement - Front Floor* in Instrument Panel, Gauges and Console.
2. Remove the front floor air outlet bolts.
3. Remove the front floor air outlet.

Installation Procedure

1. Install the front floor air outlet.

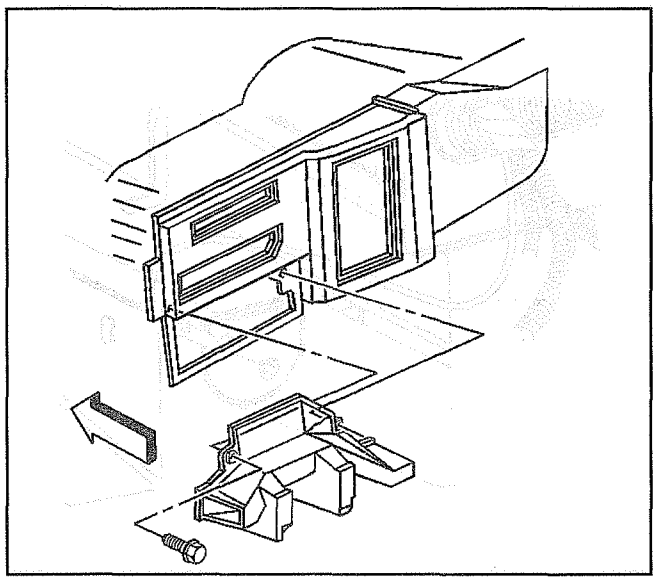
Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the front floor air outlet bolts

   Tighten

   Tighten the floor air outlet bolts to 1.9 N·m (17 lb in).

3. Install the front floor console. Refer to *Console Replacement - Front Floor* in Instrument Panel, Gauges and Console.

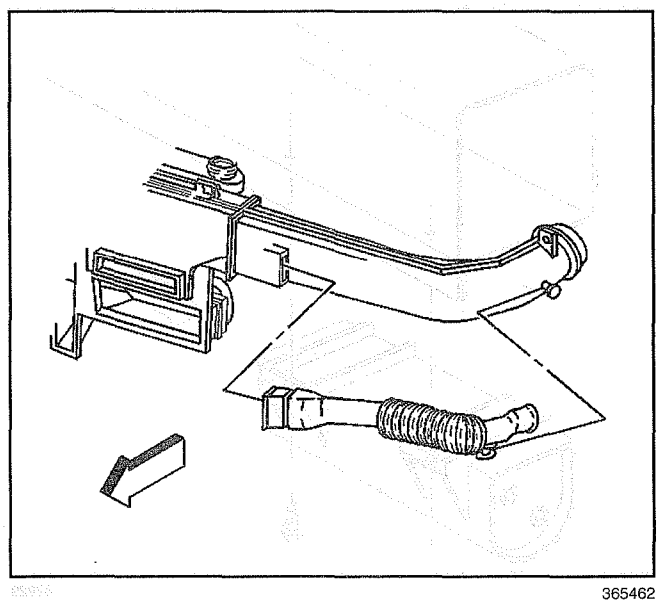


365458

Air Outlet Replacement - Side Window

Removal Procedure

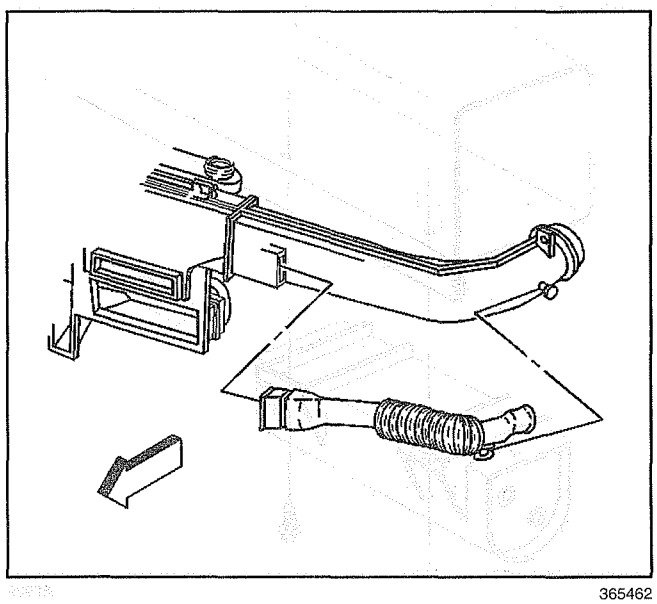
1. Remove the instrument panel (IP) carrier. Refer to *IP Carrier Replacement* in Instrument Panel, Gauges and Console.
2. Place the IP carrier face down on a clean work surface.
3. Unsnap the side window defogger outlet duct from the air distributor.



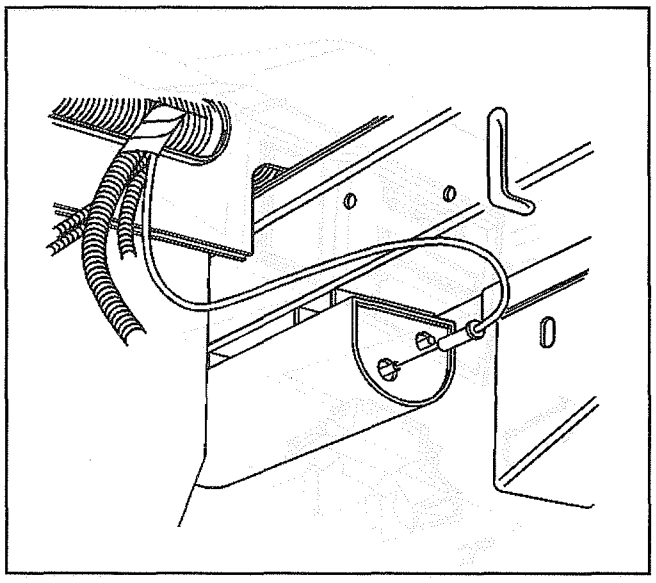
365462

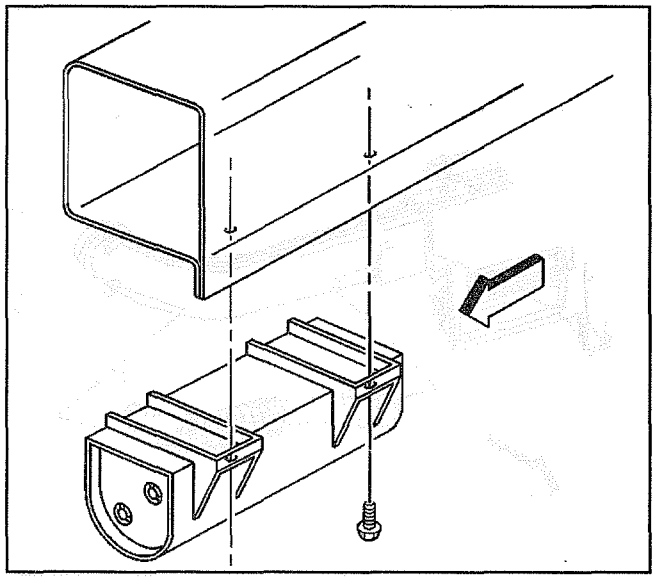
Installation Procedure

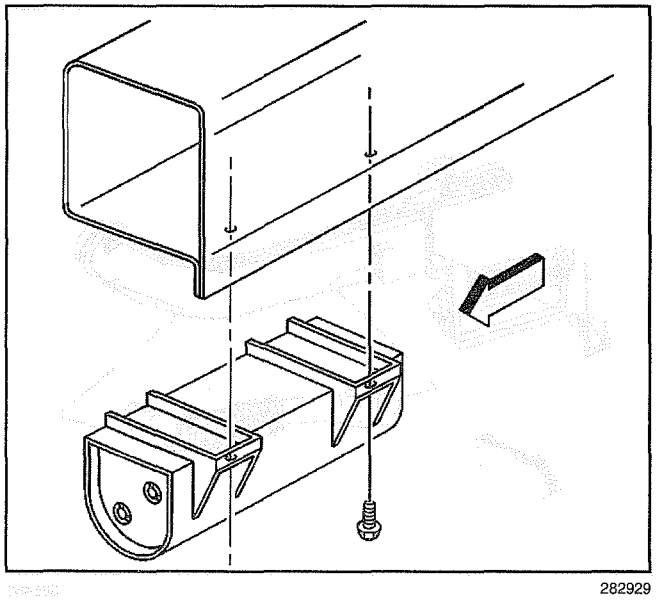
1. Snap the side window defogger outlet duct to the air distributor.
2. Install the IP carrier. Refer to *IP Carrier Replacement* in Instrument Panel, Gauges and Console.



365462


282928


282929


282929

Vacuum Tank Replacement

Removal Procedure

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the front end fascia outer deflector. Refer to *Air Deflector Replacement - Front Bumper Fascia* in Bumpers.
3. Disconnect the vacuum line from the vacuum tank.
4. Remove the vacuum tank mounting bolts
5. Remove the vacuum tank.

Installation Procedure

1. Install the vacuum tank.

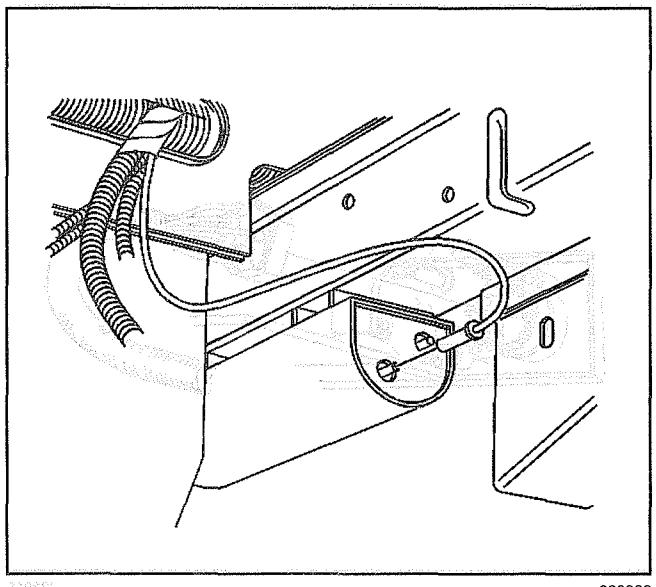
Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the vacuum tank mounting bolts.

   Tighten

   Tighten the vacuum tank mounting bolts to 1.9 N·m (17 lb in).

3. Connect the vacuum line to the vacuum tank.
4. Install the front end fascia outer deflector. Refer to *Air Deflector Replacement - Front Bumper Fascia* in Bumpers.
5. Lower the vehicle.

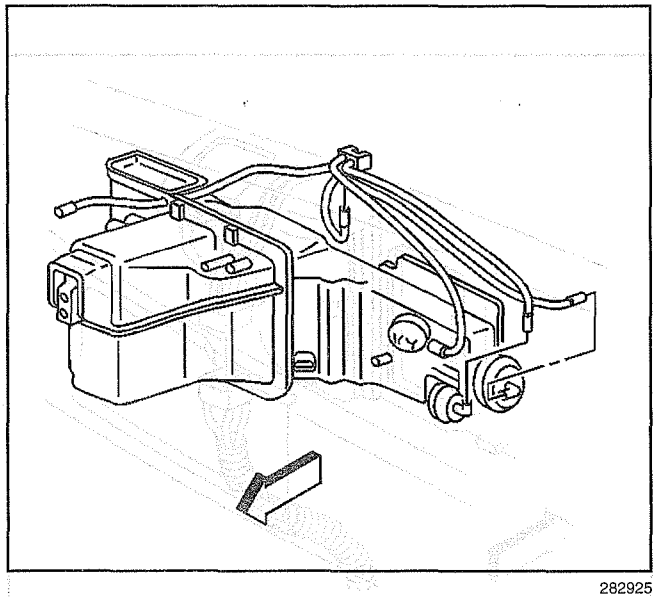


282928

Vacuum Hose Harness Replacement

Removal Procedure

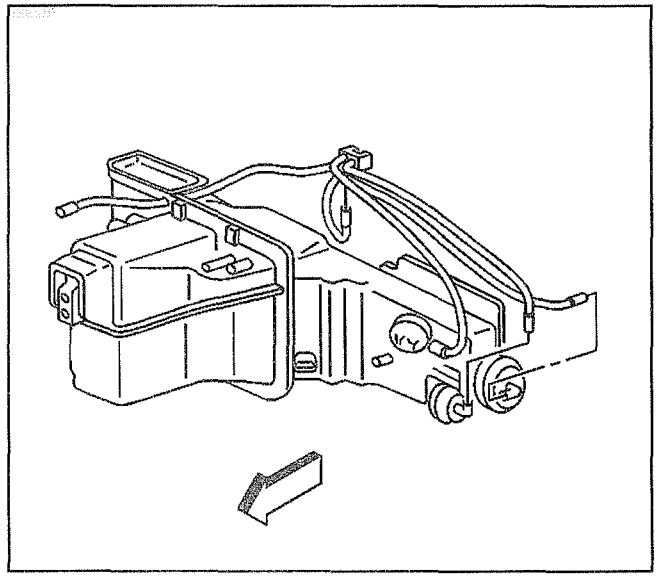
1. Remove the instrument panel (IP) carrier. Refer to *IP Carrier Replacement* in Instrument Panel, Gauge and Console.
2. Disconnect the vacuum hoses from the actuators.
3. Remove the vacuum harness.



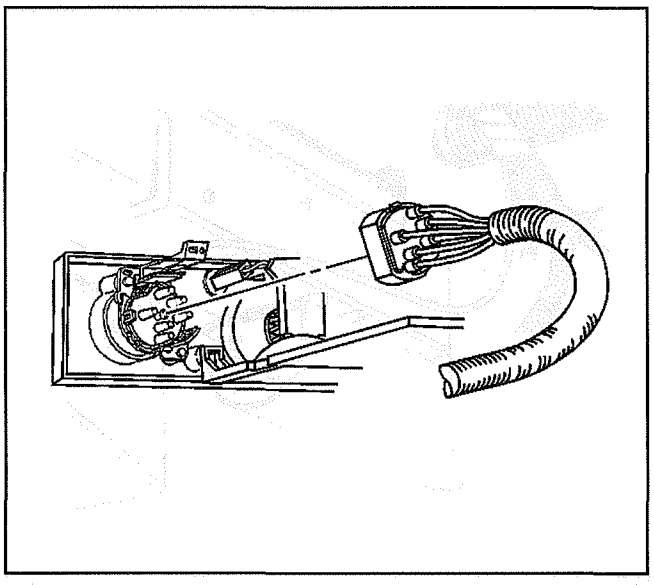
282925

Installation Procedure

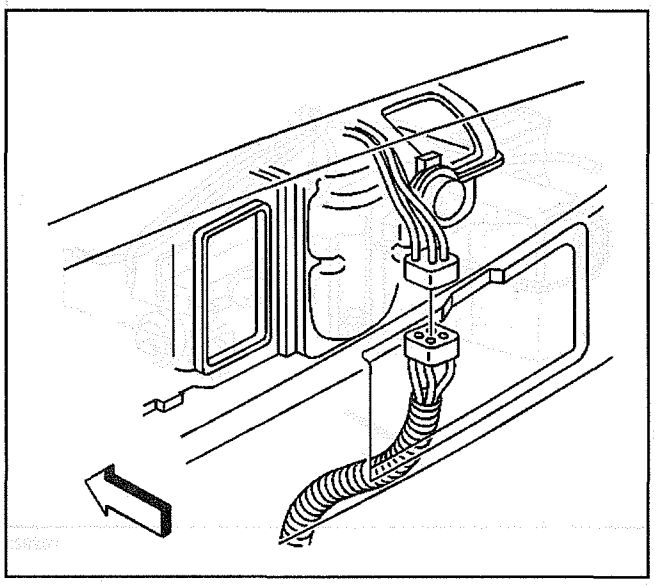
1. Install the vacuum harness.
2. Connect the vacuum hoses to the actuators.
3. Install the IP carrier. Refer to *IP Carrier Replacement* in Instrument Panel Gauges and Console.



282925



282918



282926

HVAC Control Vacuum Harness Replacement

Removal Procedure

1. It is not necessary to replace the entire vacuum harness if there is a localized leakage or collapse in the vacuum hose.

   If there is a localized leak or collapse in the vacuum hose, repair the vacuum hose:

   1.1. Cut the vacuum hose.

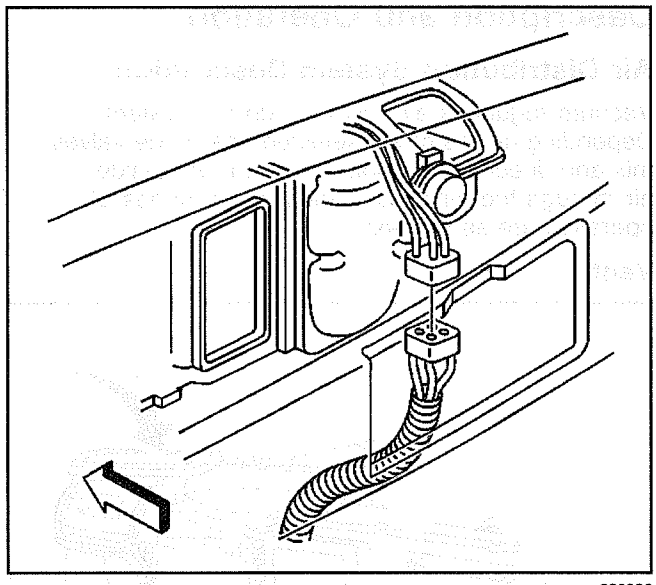
   1.2. Insert a plastic retainer into the vacuum hose.

2. Remove the heating, ventilation and air conditioning (HVAC) control. Refer to *Control Assembly Replacement*.
3. Open the instrument panel (IP) compartment.

   Push in on both sides of the IP compartment. This will cause the IP compartment to drop open completely to allow access to the vacuum harness.
4. Disconnect the vacuum harness connector from the vacuum selector valve.
5. Disconnect the vacuum harness jumper from the main harness connector.

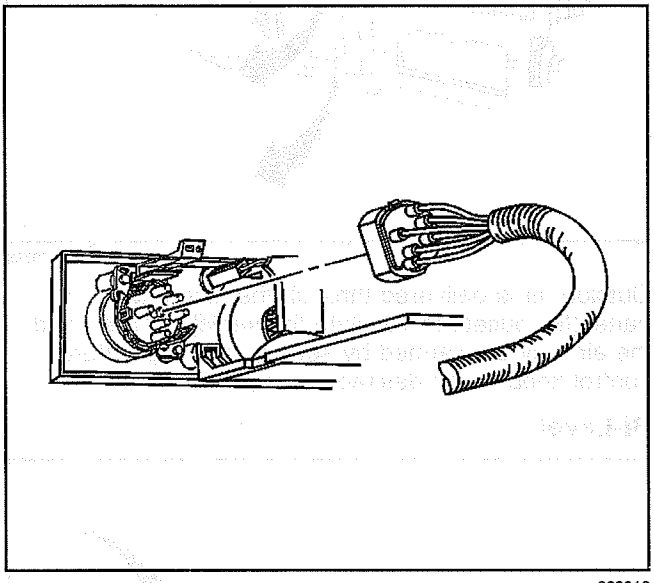
Installation Procedure

1. Connect the vacuum harness jumper to the main harness connector.



282926

2. Connect the vacuum harness connector to the vacuum selector valve.
3. Close the IP compartment.
4. Install the HVAC control. Refer to *Control Assembly Replacement*.



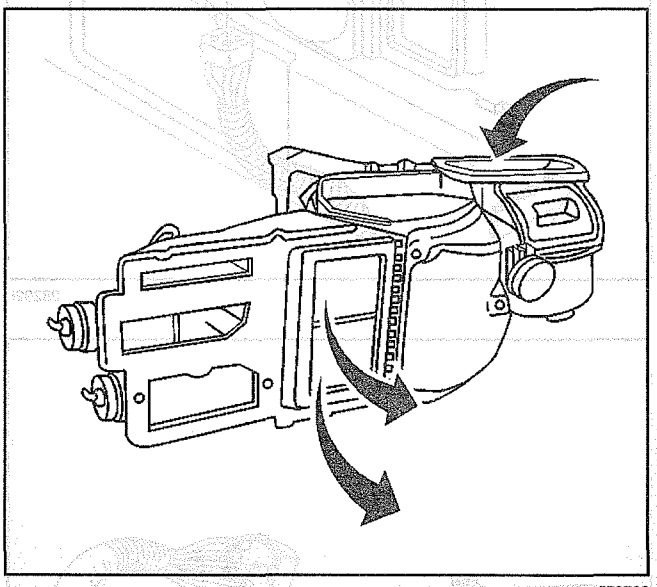
282918

Description and Operation

Air Distribution System Description

Vacuum regulates air flow through the system. Depending on the mode selected, the mode valves mix and direct either cooled, heated, or outside air through the air ducts. The various modes of operation are as follows:

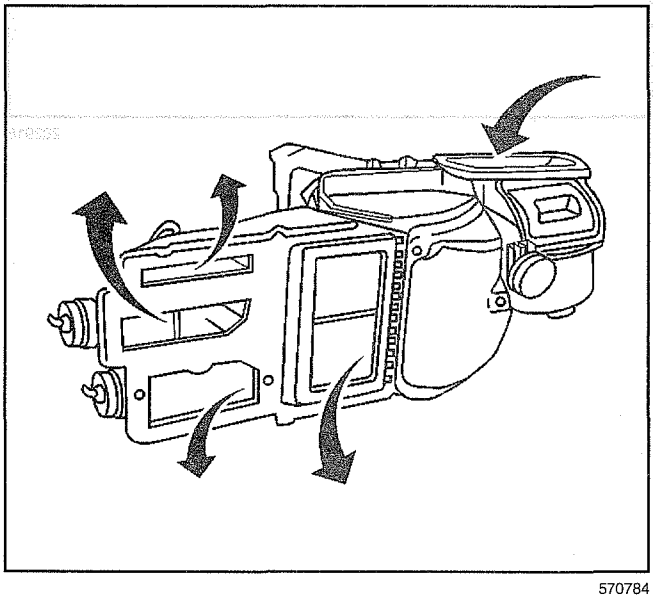
Vent



570788

Outside air is delivered through the instrument panel (IP) outlets to ventilate the vehicle. If preferred, the air may be warmed by setting the temperature control knob to the desired setting.

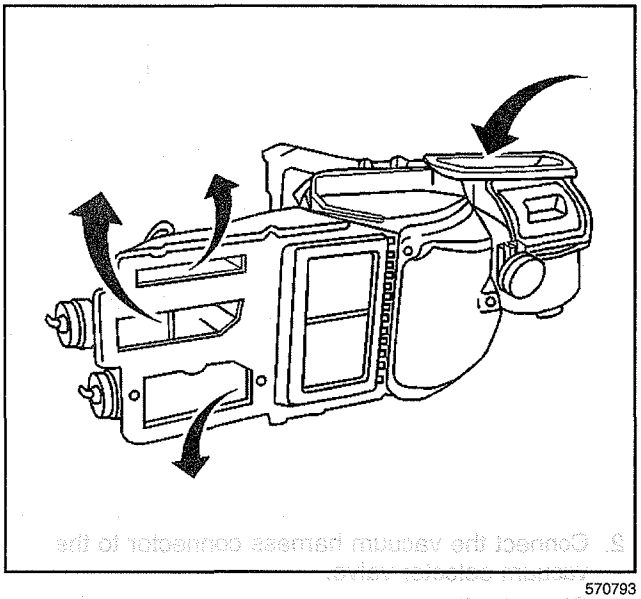
Bi-Level



570784

Electrical power is supplied to the blower motor. Outside air is drawn in and heated (depending on the position of the temperature control knob). Then the airflow is split between the IP outlets and the floor outlet.

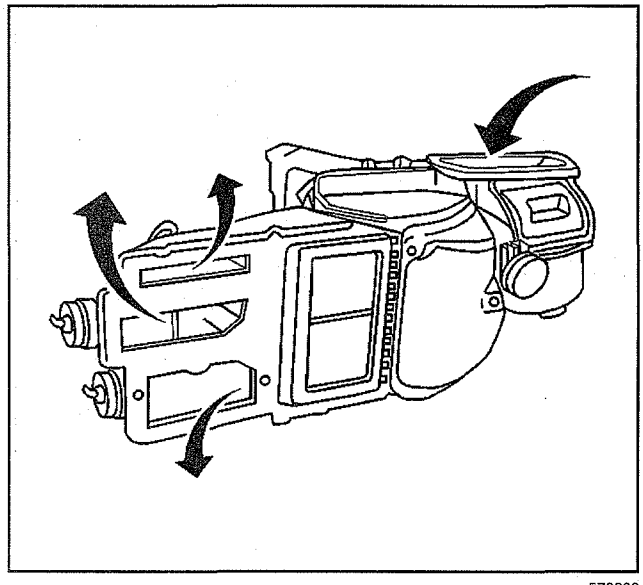
Heater



570793

Outside air is drawn into the vehicle, heated (depending on the position of the temperature control knob) and directed to the floor air outlet. A small amount of air is routed to the windshield through the defrost outlet.

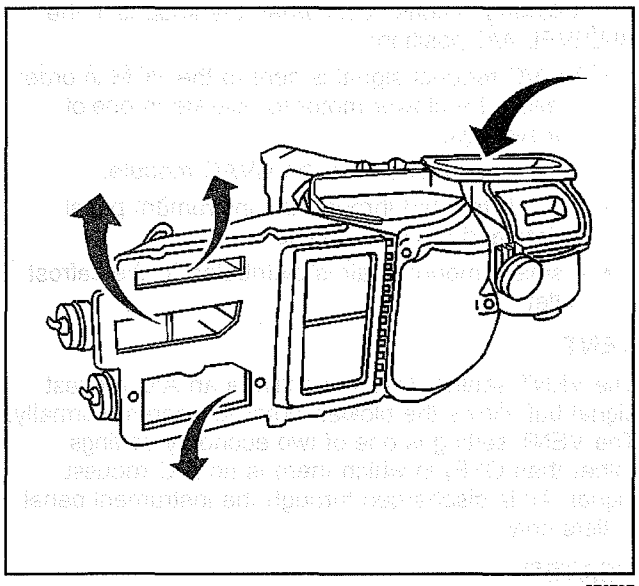
Blend



570800

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 outlet.

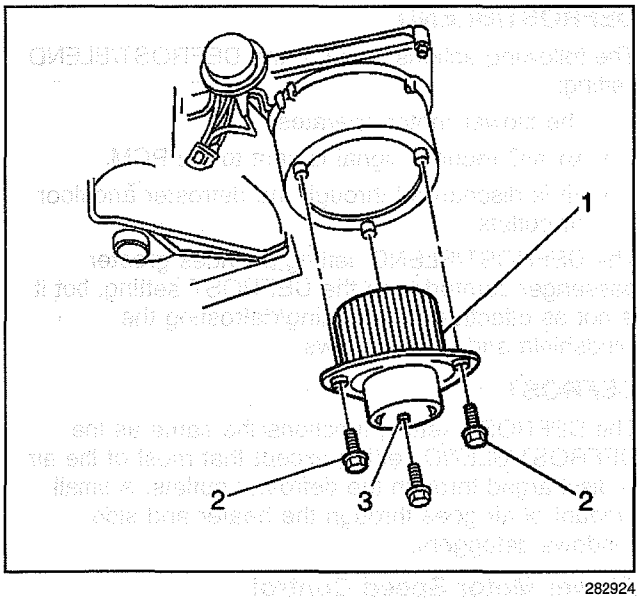
Defrost



570797

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 outlet.

Blower Motor Description



282924

The blower motor consists of the following components:

- A permanent magnet type motor (3)
- A squirrel cage type fan (1)

The blower operates at various speeds. The various speeds are determined by the resistance of the blower motor resistor which is controlled by the blower motor speed control.

Blower Motor Resistor Description

The following components, when used in combination, determine the blower speed:

- The blower resistor.
- The blower switch.

The blower resistor consists of 3 resistors located in the same housing.

With the blower switch in LO, the following actions occur:

- The blower circuit uses all 3 resistors.
- The blower motor runs at the lowest speed.

With the blower switch in M1, the following actions occur:

- Two of the resistors are in use.
- The blower motor runs faster.

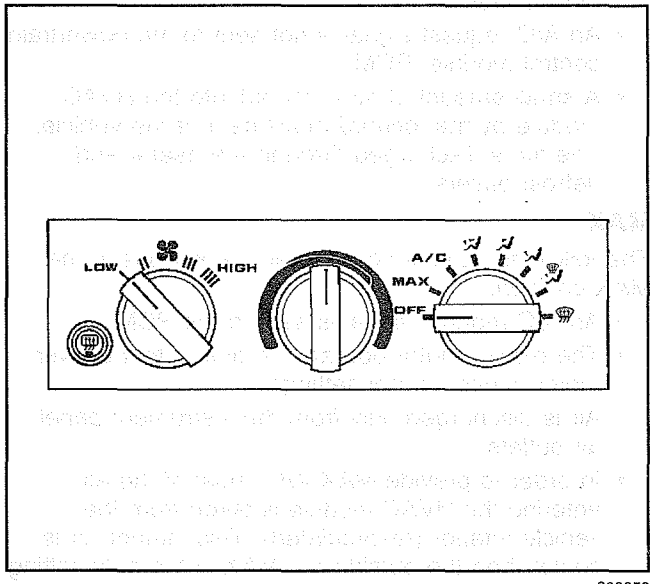
With the blower switch in M2, the following actions occur:

- Only one of the resistors is in use.
- The blower motor runs even faster.

With the blower switch in HI, the following actions occur:

- None of the resistors are in use.
- The blower motor runs at maximum speed.

Control Assembly Description (Pontiac)



283259

The heating, ventilation and air conditioning (HVAC) control head uses three knobs and one push button in order to control the following features:

- The air delivery
- The air temperature
- The blower motor speed
- The rear defroster

Temperature Control Knob

The temperature control knob regulates the HVAC system air temperature. The knob is located in the center of the HVAC control head. A temperature control cable mechanically links the knob to the temperature valve (door).

- Turn the knob toward the driver for heat.
- Turn the knob toward the passenger for air conditioning (A/C).

Mode Control Knob

The mode control knob is located on the right side of the HVAC control head. The following are the eight different modes:

- OFF
- MAX
- A/C
- BI-LEVEL A/C
- VENT
- HEATER
- DEFROST/BLEND
- DEFROST

OFF

The following actions occur when the knob is in the OFF position:

- The blower motor does not operate.
- Electrical power is not supplied to the blower motor.
- An A/C request signal is not sent to the powertrain control module (PCM).
- A small amount of air is forced into the HVAC module by the forward movement of the vehicle. The air is discharged through the heater and defrost outlets.

MAX

The following actions occur when the knob is in the MAX position:

- An A/C request signal is sent to the PCM.
- The blower motor operates in one of four blower motor speed control settings.
- Air is discharged only from the instrument panel air outlets.
- In order to provide MAX A/C, most of the air entering the HVAC module is taken from the vehicle interior (re-circulated). This interior air is cooler than the outside air. MAX is the only setting at which the air is re-circulated.

Use the MAX setting when the following conditions exist:

- High temperature
- High humidity
- The outside air has an objectionable odor

A/C

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

BI-LEVEL A/C

The following actions occur when the knob is in the BI-LEVEL A/C position:

- An A/C request signal is sent to the PCM in order to allow the blower motor to operate in one of four settings.
- Only outside air enters the HVAC module.
- Air is distributed through the instrument panel outlets and the floor outlets.
- A small amount of air is distributed to the defrost outlet.

VENT

The VENT setting does not activate an A/C request signal but allows the blower motor to operate normally. The VENT setting is one of two economy settings (other than OFF) in which there is no A/C request signal. Air is discharged through the instrument panel outlets only.

HEATER

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

DEFROST/BLEND

The following actions occur in the DEFROST/BLEND setting:

- The blower motor operates.
- An A/C request signal is sent to the PCM.
- Air is discharged through the defroster and floor air outlets.

The DEFROST/BLEND setting provides greater passenger comfort than the DEFROST setting, but it is not as effective in defogging/defrosting the windshield and side windows.

DEFROST

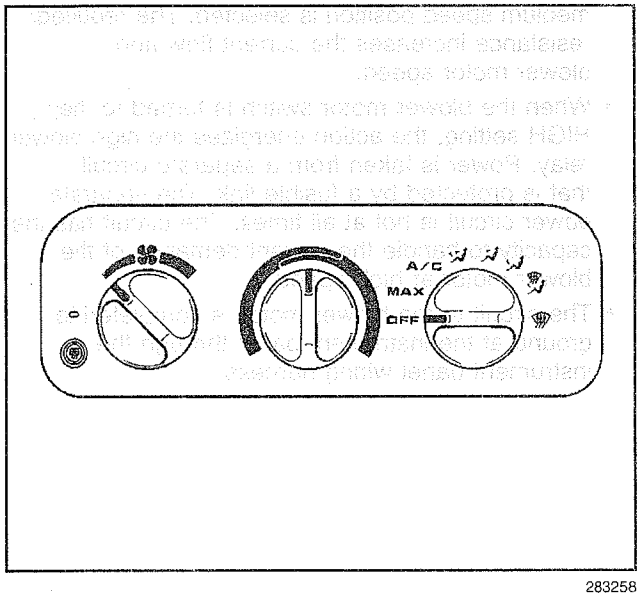
The DEFROST setting functions the same as the DEFROST/BLEND setting except that most of the air is discharged through the defroster outlets. A small amount of air goes through the heater and side windows defoggers.

Blower Motor Speed Control

- The blower motor runs in all mode positions except the OFF position when the ignition switch is in the RUN position.
- The blower motor speed is controlled by a four-position electrical blower motor speed control switch. The switch is located at the left side of the control.
- The blower motor speed control switch provides a choice of the following speeds:
  - Low
  - Medium (two settings)
  - High

- Power is routed from the HVAC fuse in the fuse block to the mode control switch.
- The mode control switch breaks the circuit when the switch is in the OFF position. The switch closes the circuit in all other positions.
- From the mode control switch the circuit goes to the blower motor speed control switch.
- When the blower motor speed control switch is turned to the LOW setting, voltage is conducted to the resistor. At the resistor, the voltage passes through all three resistors and is reduced to provide the low blower motor speed.
- When the blower switch is in either of the two medium speed positions, the switch closes. This action sends voltage through one or two of the resistors. Because the current follows the path of least resistance, the circuit branch that leads directly to all three resistors becomes ineffective. At this point the current bypasses either one or two resistors, depending upon which medium speed position is selected. The reduced resistance increases the current flow and blower motor speed.
- When the blower motor switch is turned to the HIGH setting, the action energizes the high blower relay. Power is taken from a separate circuit that is protected by a fusible link. The separate power circuit is hot at all times. The circuit has the capacity to handle the current demands of the blower motor at high speed.
- The circuit to the blower motor is completed to ground at the instrument panel through the instrument panel wiring harness.

Control Assembly Description (Chevrolet)



283258

The heating, ventilation and air conditioning (HVAC) control head uses three knobs and one push button in order to control the following features:

- The air delivery
- The air temperature
- The blower motor speed
- The rear defroster

Temperature Control Knob

The temperature control knob regulates the HVAC system air temperature. The knob is located in the center of the HVAC control head. A temperature control cable mechanically links the knob to the temperature valve (door).

- Turn the knob toward the driver for heat.
- Turn the knob toward the passenger for air conditioning (A/C).

Mode Control Knob

The mode control knob is located on the right side of the HVAC control head. The following are the eight different modes:

- OFF
- MAX
- A/C
- BI-LEVEL A/C
- VENT
- HEATER
- DEFROST/BLEND
- DEFROST

OFF

The following actions occur when the knob is in the OFF position:

- The blower motor does not operate.
- Electrical power is not supplied to the blower motor.
- An A/C request signal is not sent to the powertrain control module (PCM).
- A small amount of air is forced into the HVAC module by the forward movement of the vehicle. The air is discharged through the heater and defrost outlets.

MAX

The following actions occur when the knob is in the MAX position:

- An A/C request signal is sent to the PCM.
- The blower motor operates in one of four blower motor speed control settings.
- Air is discharged only from the instrument panel air outlets.
- In order to provide MAX A/C, most of the air entering the HVAC module is taken from the vehicle interior (re-circulated). This interior air is cooler than the outside air. MAX is the only setting at which the air is re-circulated.

Use the MAX setting when the following conditions exist:

- High temperature
- High humidity
- The outside air has an objectionable odor

A/C

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

BI-LEVEL A/C

The following actions occur when the knob is in the BI-LEVEL A/C position:

- An A/C request signal is sent to the PCM in order to allow the blower motor to operate in one of four settings.
- Only outside air enters the HVAC module.
- Air is distributed through the instrument panel outlets and the floor outlets.
- A small amount of air is distributed to the defrost outlet.

VENT

The VENT setting does not activate an A/C request signal but allows the blower motor to operate normally. The VENT setting is one of two economy settings (other than OFF) in which there is no A/C request signal. Air is discharged through the instrument panel outlets only.

HEATER

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

DEFROST/BLEND

The following actions occur in the DEFROST/BLEND setting:

- The blower motor operates.
- An A/C request signal is sent to the PCM.
- Air is discharged through the defroster and floor air outlets.

The DEFROST/BLEND setting provides greater passenger comfort than the DEFROST setting, but it is not as effective in defogging/defrosting the windshield and side windows.

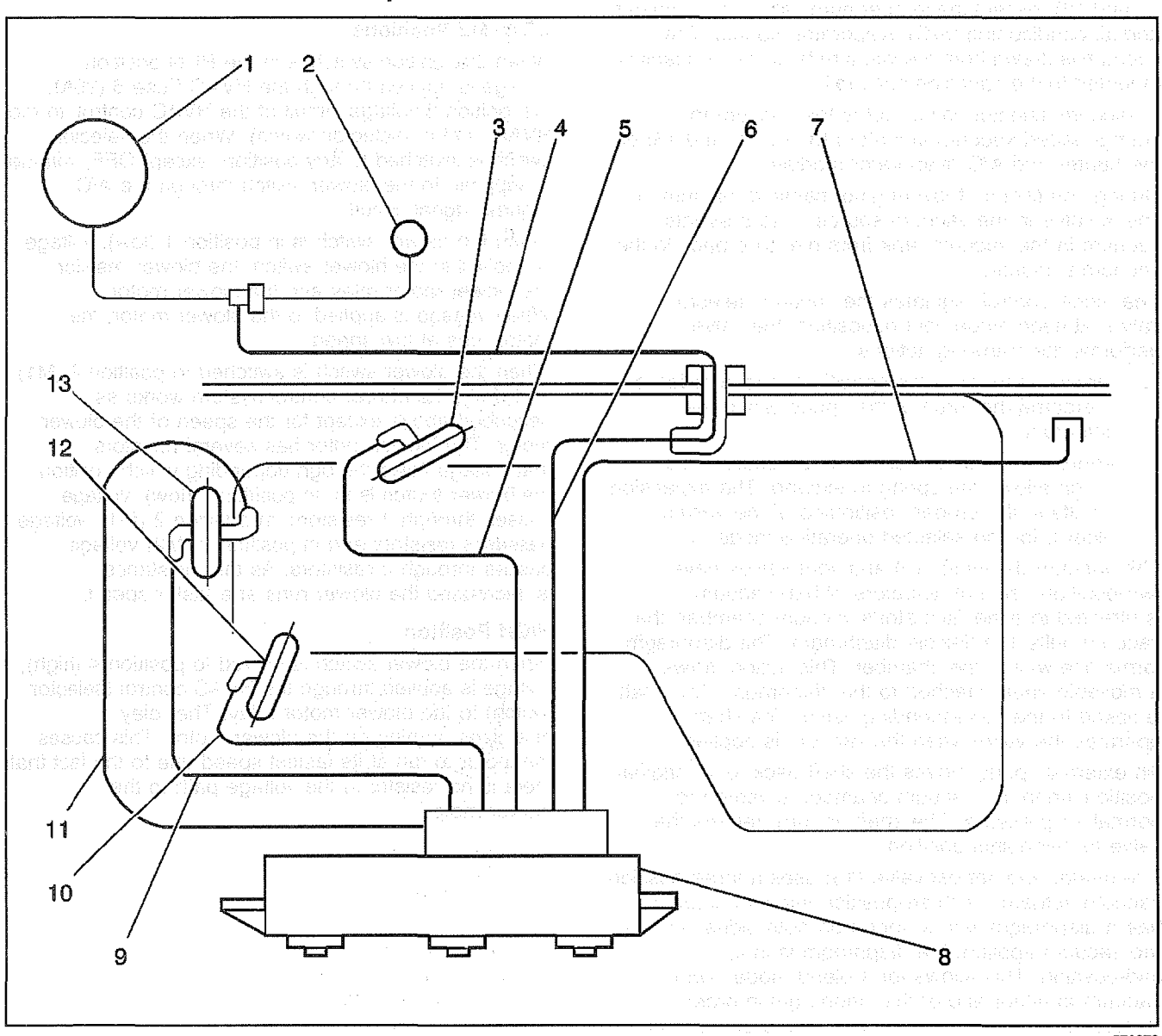
DEFROST

The DEFROST setting functions the same as the DEFROST/BLEND setting except that most of the air is discharged through the defroster outlets. A small amount of air goes through the heater and side windows defoggers.

Blower Motor Speed Control

- The blower motor runs in all mode positions except the OFF position when the ignition switch is in the RUN position.
- The blower motor speed is controlled by a four-position electrical blower motor speed control switch. The switch is located at the left side of the control.
- The blower motor speed control switch provides a choice of the following speeds:
  - Low
  - Medium (two settings)
  - High
- Power is routed from the HVAC fuse in the fuse block to the mode control switch.
- The mode control switch breaks the circuit when the switch is in the OFF position. The switch closes the circuit in all other positions.
- From the mode control switch the circuit goes to the blower motor speed control switch.
- When the blower motor speed control switch is turned to the LOW setting, voltage is conducted to the resistor. At the resistor, the voltage passes through all three resistors and is reduced to provide the low blower motor speed.
- When the blower switch is in either of the two medium speed positions, the switch closes. This action sends voltage through one or two of the resistors. Because the current follows the path of least resistance, the circuit branch that leads directly to all three resistors becomes ineffective. At this point the current bypasses either one or two resistors, depending upon which medium speed position is selected. The reduced resistance increases the current flow and blower motor speed.
- When the blower motor switch is turned to the HIGH setting, the action energizes the high blower relay. Power is taken from a separate circuit that is protected by a fusible link. The separate power circuit is hot at all times. The circuit has the capacity to handle the current demands of the blower motor at high speed.
- The circuit to the blower motor is completed to ground at the instrument panel through the instrument panel wiring harness.

Vacuum Hose Harness Description



570879

Legend

(1) Vacuum Tank
(2) To Vacuum Source
(3) Vent Mode Valve Actuator
(4) Black Hose
(5) Red Hose
(6) Black Hose
(7) Orange Hose
(8) Heating, Ventilation and Air Conditioning (HVAC) Control
(9) Yellow Hose
(10) Violet Hose
(11) Green Hose
(12) Vacuum (Bi-Level Mode) Valve Actuator
(13) Defroster Valve Actuator

The engine vacuum regulates all of the actuators (3, 10, 12 and 13) (except the temperature valve) in the heater and air conditioning (A/C) evaporator module. The vacuum is drawn from the vacuum tank (1). The tank is mounted to the right side body rail.

A vacuum selector valve routes the vacuum to spring-loaded vacuum actuators (3, 10, 12 and 13) on the heater and A/C evaporator module.

During conditions of low engine manifold vacuum, a check valve in the vacuum source hose prevents vacuum in the vacuum tank from bleeding back to the vacuum's source.

The mode control regulates the vacuum selector valve. At each mode control position, the valve performs the following actions:

- Directs vacuum to the specific hoses in order to overcome the force of the spring within the actuators.
- Vents the hoses to normal air pressure. This action allows the spring to expand. The expansion results in the proper positioning of the valves (doors) for the selected operating mode.

The vacuum (bi-level) (10) 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. The diaphragm forms one wall of the chamber. This action draws a movable shaft attached to the diaphragm. The shaft is linked to the corresponding valve. The shaft operates the valve when the vacuum is applied.

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

The heater and defrost valve (13) 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 is in a mid-position. This allows for a blend mode. Apply vacuum to either end of the diaphragm in order to move the heater and defrost valve to either stop. This action directs airflow to either the defroster outlets or the floor outlets.

When air is directed to the floor outlets, as in the HEATER setting, a small amount of air still bleeds through the defroster outlets. This action helps eliminate the refogging of the windshield.

HVAC Blower Controls Circuit Description

LOW–M2 Positions

When the ignition switch is in the RUN position, voltage is applied through the HVAC Fuse 6 (20A), the ignition 3 voltage circuit of the HVAC control, to the HVAC control (selector switch). When the selector switch is switched to any position, except OFF, voltage is supplied to the blower switch through the A/C request signal circuit.

When the blower switch is in position 1 (low), voltage is applied to the blower switch, the blower resistor, the blower motor relay and the blower motor. When voltage is applied to the blower motor, the motor runs at low speed.

When the blower switch is switched to position 2 (M1) or 3 (M2), the blower control system works as described above except for the speed of the blower motor. The blower motor has several resistors that voltage flows through depending which position the blower switch is in. In position 1 (low), voltage passes through 4 resistors. In position 2 (M1), voltage passes 3 resistors and in position 3 (M2) voltage passes through 2 resistors. As the resistance is decreased the blower runs at a faster speed.

HIGH Position

When the blower switch is moved to position 4 (high), voltage is applied through the HVAC control (selector switch) to the blower motor relay. The relay energizes, turning on the blower motor. This causes the motor to run at its fastest speed due to the fact that there is no resistor in the voltage path to the blower motor.

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Steering

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Power Steering System

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Hydraulic Pump Control Fitting-to-Power Steering Pump	75 N·m	55 lb ft
Power Steering Fluid Reservoir Bolt/Screw (5.7L VIN G)	10 N·m	89 lb in
Power Steering Fluid Reservoir Bracket Nuts (3800 VIN K)	12 N·m	107 lb in
Power Steering Gear Bolt/Screw	85 N·m	63 lb ft
Power Steering Gear Inlet Hose Fitting-to-Power Steering Gear	28 N·m	21 lb ft
Power Steering Gear Inlet Hose Fitting-to-Power Steering Pump	28 N·m	21 lb ft
Power Steering Gear Outlet Hose Fitting-to-Power Steering Gear	28 N·m	21 lb ft
Power Steering Pump Bolt/Screw (5.7L VIN G)	25 N·m	18 lb ft
Power Steering Pump Nut (3800 VIN K)	30 N·m	23 lb ft
Power Steering Pump Rear Bracket Bolt/Screw (5.7L VIN G)	50 N·m	37 lb ft

Fluid Specifications

Application	Type of Material	GM Part Number
Warm Climate	Power Steering Fluid	1050017 or 1052884 or equivalent meeting GM Specification 9985010
Cold Climate (see note)	Power Steering Fluid	12345867 or 12345866
Important: Drain and refill the system prior to using this fluid.		

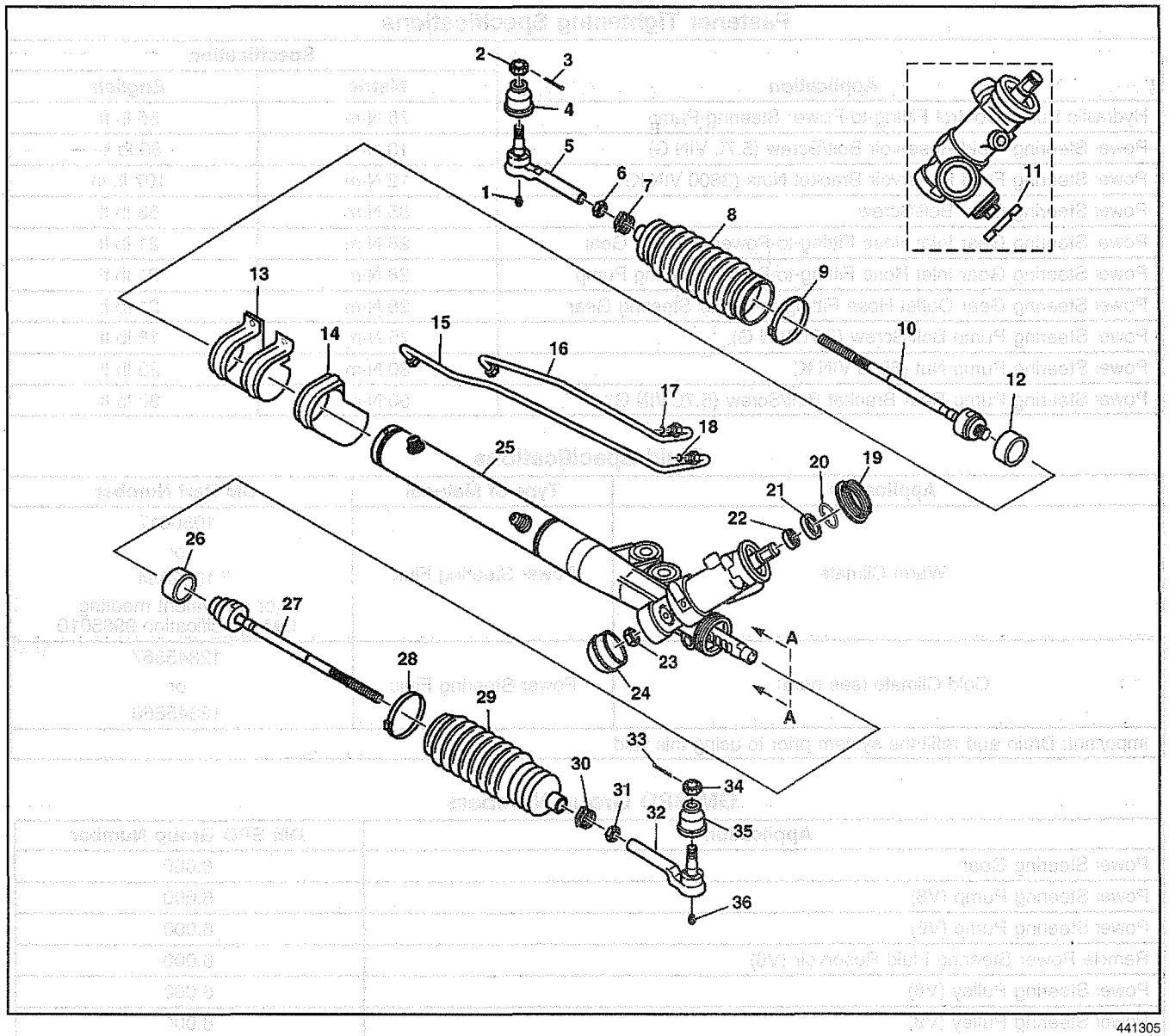
GM SPO Group Numbers

Application	GM SPO Group Number
Power Steering Gear	6.000
Power Steering Pump (V8)	6.000
Power Steering Pump (V6)	6.000
Remote Power Steering Fluid Reservoir (V6)	6.000
Power Steering Pulley (V6)	6.000
Power Steering Pulley (V8)	6.000
Power Steering Pump Front Bracket (V8)	6.000
Power Steering Pump Rear Bracket (V6)	6.000
Power Steering Hose Inlet (V6)	6.000
Power Steering Hose Inlet (V8)	6.000
Power Steering Hose Outlet (V6)	6.000
Power Steering Hose Outlet (V8)	6.000
Power Steering Cooler (V8)	6.000

Visual Identification

Power Steering Gear - Disassembled View (Quiet Valve)

Power Rack and Pinion – End Take Off



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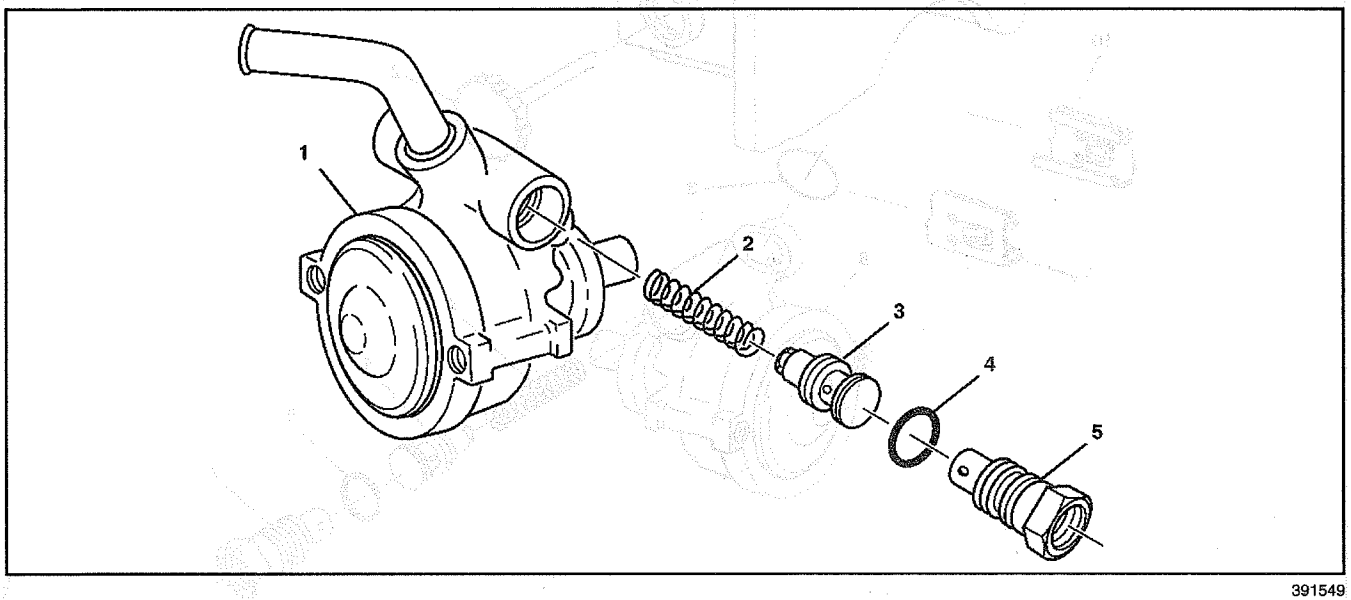
Legend

(1) Lubrication Fitting
(2) Hexagon Slotted Nut
(3) Cotter Pin
(4) Tie Rod Seal
(5) Outer Tie Rod Assembly
(6) Hexagon Jam Nut
(7) Tie Rod End Clamp
(8) Rack and Pinion Boot
(9) Boot Clamp
(10) Inner Tie Rod Assembly
(11) Adjuster Plug Lock Nut
(12) Shock Dampener Ring
(13) Mounting Bracket Assembly
(14) Mounting Grommet
(15) Cylinder Line (Left Hand) Assembly
(16) Cylinder Line (Right Hand) Assembly
(17) O-Ring Seal
(18) O-Ring Seal
(19) Seal Adapter
(20) Retaining Ring
(21) Stub Shaft Seal
(22) Annulus Bearing Assembly
(23) Hexagon Lock Nut
(24) Dust Cover

(25) Rack and Pinion (Partial) Gear Assembly
(26) Shock Dampener Ring
(27) Inner Tie Rod Assembly
(28) Boot Clamp
(29) Rack and Pinion Boot
(30) Tie Rod End Clamp
(31) Hexagon Jam Nut
(32) Outer Tie Rod Assembly
(33) Cotter Pin
(34) Hexagon Slotted Nut
(35) Tie Rod Seal
(36) Lubrication Fitting

Power Steering Pump - Disassembled View (Return Tube)

Power Steering Pump



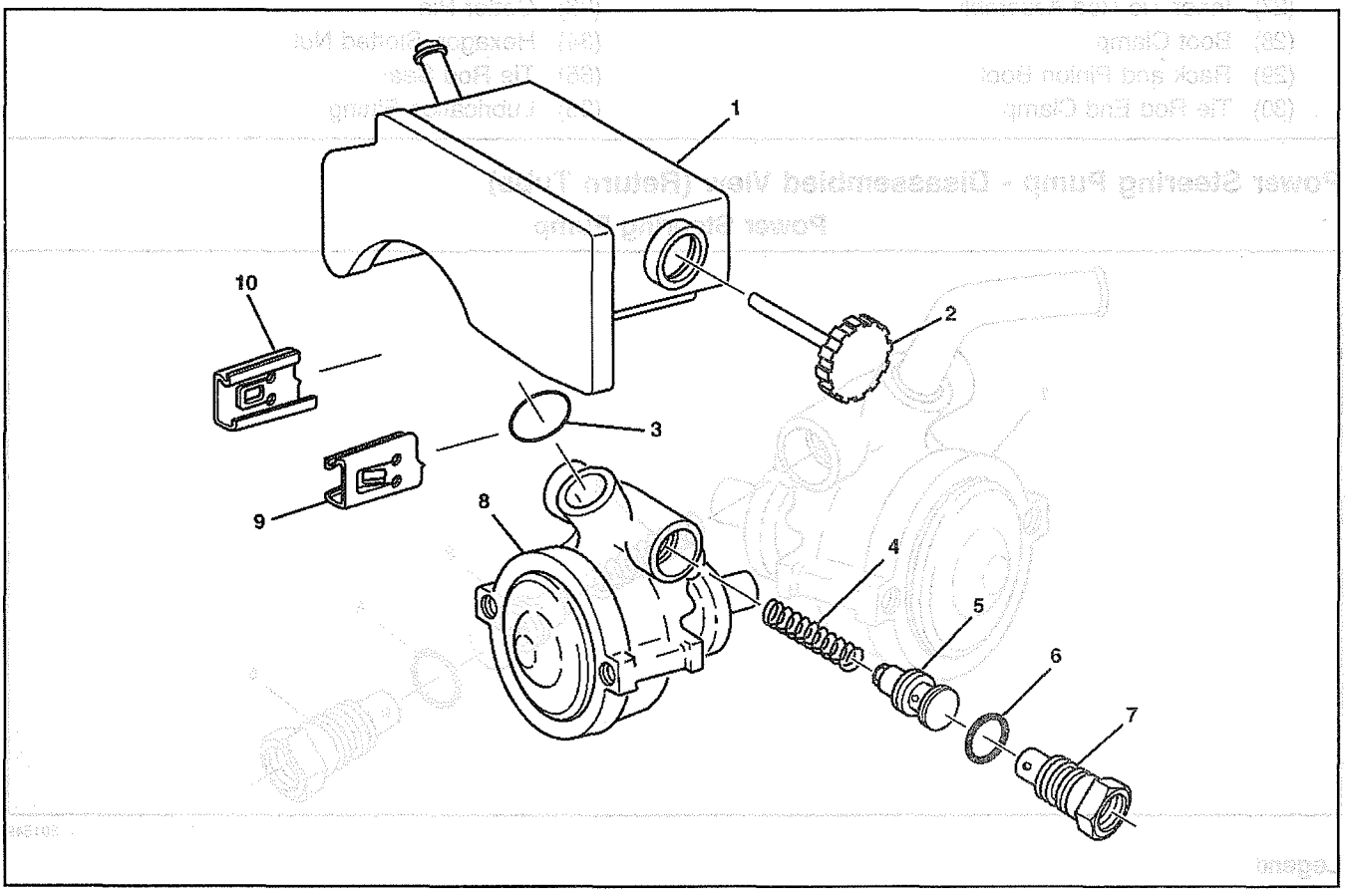
391549

Legend

(1) Hydraulic Pump Housing Assembly
(2) Flow Control Spring
(3) Control Valve Assembly
(4) O-ring Seal
(5) O-ring Union Fitting

Power Steering Pump - Disassembled View (CB Series Pump)

Power Steering Pump Assembly–CB Series



391553

Legend

(1) Hydraulic Pump Reservoir Assembly (Typical)
(2) Reservoir Capstick Assembly
(3) O-ring Seal
(4) Flow Control Spring
(5) Control Valve Assembly
(6) O-ring Seal
(7) O-ring Union Fitting
(8) Hydraulic Pump Housing Assembly
(9) Reservoir Retaining Clip (RH)
(10) Reservoir Retaining Clip (LH)

Diagnostic Information and Procedures

Hissing Noise In Steering Gear

Problem	Action
There is a hissing noise in the steering gear.	• Inspect for loose intermediate steering shaft universal joints. • If the noise is very objectionable, replace the steering gear.

Rattle in Rack and Pinion Steering Gear

Problem	Action
There is a rattling noise.	Inspect for the following conditions: • Contact between the outlet (pressure) hose and the frame • Loose tie rod ends • Loose steering gear attachment • A loose pinion shaft
A rattling noise occurs when driving over bumps.	Inspect the front brake linings for the following conditions: • A loose fit • Missing antirattle clips

Power Steering Gear and Pump Leaks

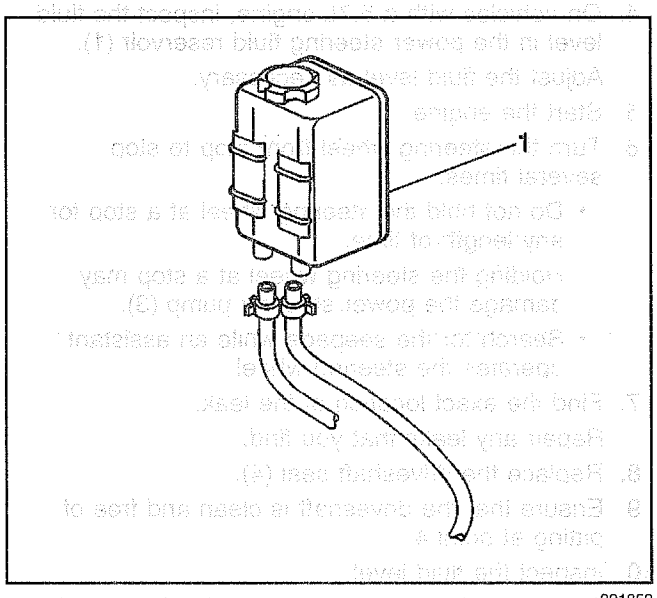
- Determine if any of the following conditions exist:
  - The vehicle leaks fluid onto the garage floor.
  - Fluid leaks are visible on the steering gear or the pump.
  - There is a growling noise when you are parking the vehicle.
  - There is a growling noise when the engine is cold.
  - The power steering does not operate when you are parking the vehicle.
  - The vehicle requires excessive steering effort.
- Inspect for an overfilled power steering fluid reservoir.
- Inspect for fluid aeration and overflow.
- Inspect the hose connections.
- Identify the exact point of system leakage. Refer to External Leakage Check.

  The point from which fluid is dripping is not necessarily the point where the system is leaking from.

External Leakage Check

Use this procedure in order to help identify the exact location of a leak. Some leaks can be easily located, but seepage type leaks may be more difficult to locate. To locate seepage leaks use the following method:

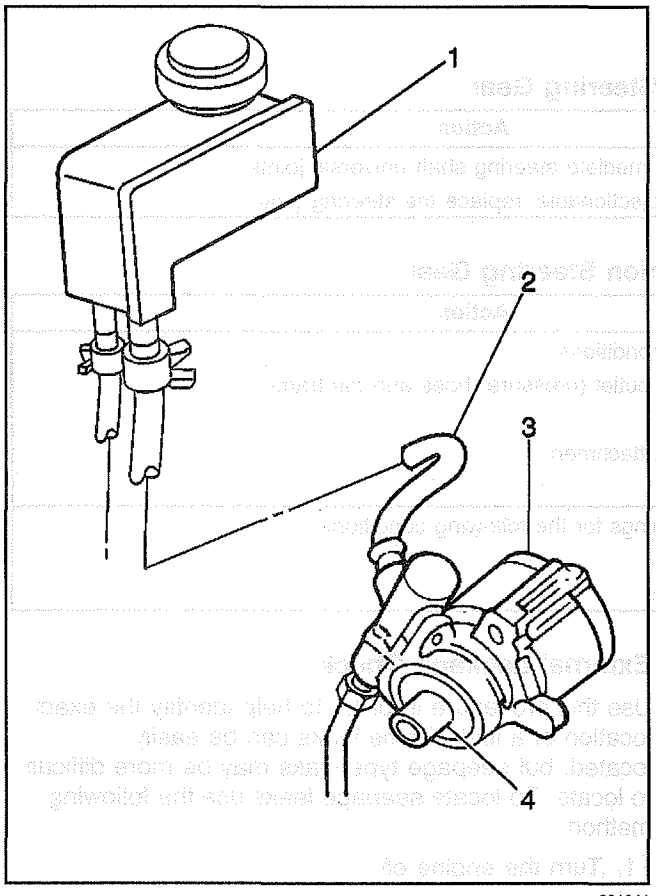
1. Turn the engine off.
2. Wipe the complete power steering system dry.



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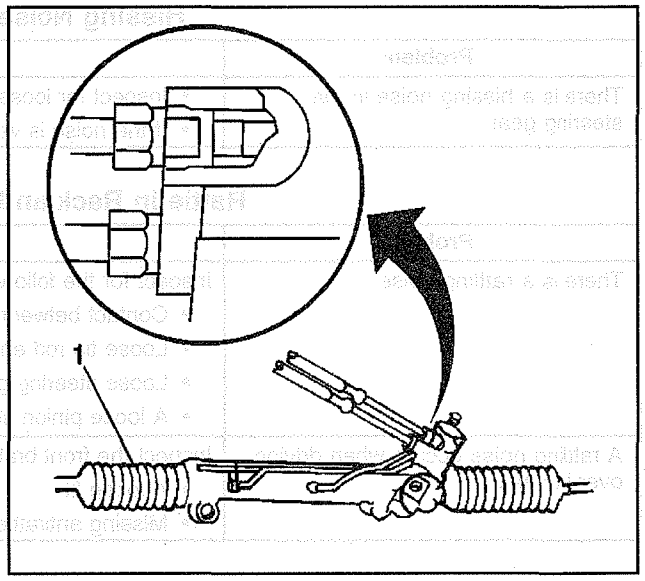
3. On vehicles with a 3800 engine, inspect the fluid level in the power steering fluid reservoir (1).

   Adjust the fluid level as necessary.



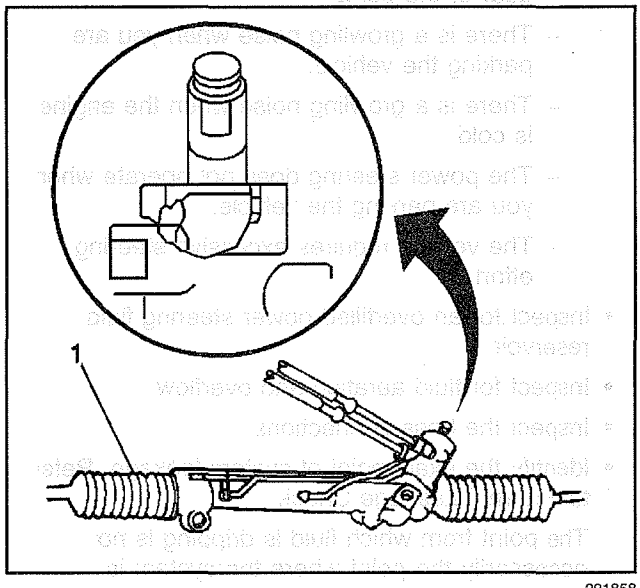
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4. On vehicles with a 5.7L engine, inspect the fluid level in the power steering fluid reservoir (1).
   Adjust the fluid level as necessary.
5. Start the engine.
6. Turn the steering wheel from stop to stop several times:
   - Do not hold the steering wheel at a stop for any length of time.
     Holding the steering wheel at a stop may damage the power steering pump (3).
   - Search for the seepage while an assistant operates the steering wheel.
7. Find the exact location of the leak.
   Repair any leaks that you find.
8. Replace the driveshaft seal (4).
9. Ensure that the driveshaft is clean and free of pitting at point 4.
10. Inspect the fluid level.
    Determine if leakage persists under the following conditions:
    - The fluid level is correct.
    - The hydraulic pump reservoir cap is tight.
11. Replace the hydraulic pump reservoir cap if leakage persists.
12. Inspect the hydraulic pump fluid reservoir for the following conditions:
    - Cracks
    - Bending
13. Replace the hydraulic pump fluid reservoir if you detect these conditions.



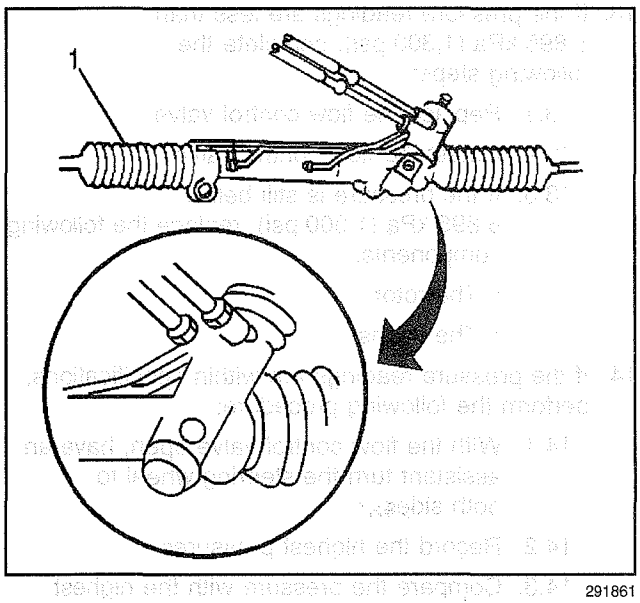
291855

14. Torque the steering gear (1) pipe fitting seat to specifications.
    If leakage persists, replace the steering gear pipe seal (O-ring).



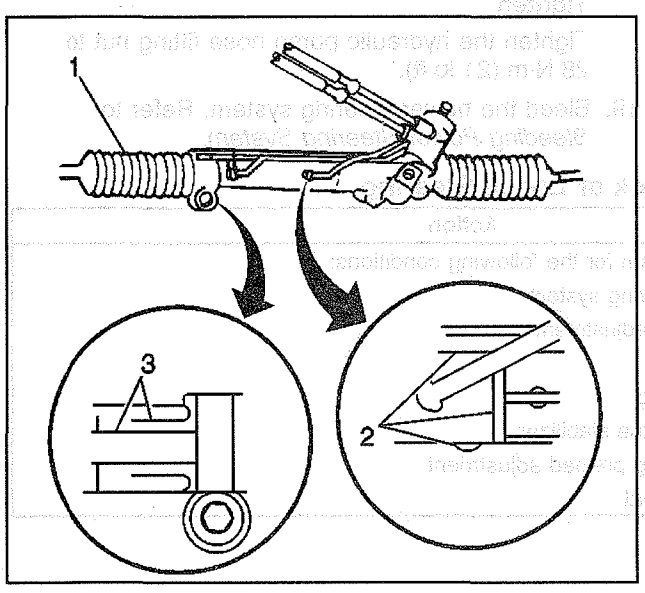
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15. Replace the steering gear (1) with a partial steering gear.
16. If you observe leakage between the torsion bar and the steering gear pinion shaft, replace the gear with a partial steering gear.



291861

17. Determine if the following conditions exist:
    - You observe a leakage at the driver side.
    - The leakage is not affected by the direction of the turn.
18. If the above conditions exist, replace the steering gear (1) with a partial steering gear.
19. Determine if the following conditions exist:
    - You observe a leakage at the steering gear housing end.
    - The fluid spurts when bottomed in a left turn.
20. If the above conditions exist, replace the steering gear with a partial steering gear.



291864

21. Determine if leakage exists (2, 3).
22. If the above conditions exist, replace the steering gear (1) with a partial steering gear.
23. Tighten the following components to specifications:
    - The hydraulic pump hose fitting.
    - The hydraulic pump hose fitting nut.
24. Replace the hydraulic pump seal (O-ring) if leakage persists.

Seal Replacement Recommendations

Lip Seals

Lip seals seal the rotating shafts. The lip seals require special treatment. Lip seals are used on the hydraulic pump shaft of the power steering pump. When the lip seals leak complete the following steps:

1. Inspect the sealing surfaces.
2. Thoroughly clean the sealing surfaces.
3. Replace the seal(s).

Replace the shaft if you find pitting. If there is slight corrosion in the lip seal contact zone, clean the surface of the shaft with crocus cloth. Replace the shaft only if you cannot stop the leakage by smoothing the shaft with crocus cloth.

O-Ring Seals

When you remove a part which forms a sealing surface for an O-ring complete the following steps:

1. Remove the original O-ring seal.
2. Replace the original O-ring seal with a new O-ring seal.

Lubricate all of the new O-ring seals with power steering fluid in order to ease the installation.

Power Steering System Test Procedure

Tools Required

- *J 5176-E* Power Steering Pressure Tester
- *J 5176-92* Pressure Tester Adapter
- *J 25323-D* Power Steering System Analyzer
- *J 29525* Steering Analyzer Adapter (18 mm)

If you suspect a hydraulic or mechanical malfunction of one of the following components, perform this procedure in order to determine the cause:

- The power steering pump
- The power steering gear

1. Place a drain pan under the reservoir.
2. Disconnect the outlet hose at the reservoir.
3. Connect a spare pressure hose to the reservoir.

Important: Test the power steering system using the *J 5176-E*. Testing the power steering system with the *J 25323-D* will also measure the flow rate as well as the pressure.

4. Connect the *J 5176-E* and the *J 5176-92* or *J 25323-D* and *J 29525* to the following hoses:
    - The outlet hose
    - The spare pressure hose
5. Open the valve on the *J 5176-E* or *J 25323-D*.
6. Start the engine and allow to reach a normal operating temperature.

7. Ensure that the engine is at idle and that the valve on the *J 5176-E* or *J 25323-D* is open.
8. Read the pressure reading.

Important: The pressure should be no more than 1 050 kPa (150 psi).

9. If the pressure is more than 1 050 kPa (150 psi), perform the following steps:
   - Inspect the hoses for restrictions.
   - Inspect the popper valve on the steering gear for the proper installation.

Notice: Do not leave the valve fully closed for more than 5 seconds, or the pump could be damaged internally.

10. Fully close the valve on the *J 5176-E* or *J 25323-D* three times.

    Record the pressure readings each time.

    The power steering pump is functioning properly when the pressure readings fall within the following range:
    - Each reading is at least 6 895 kPa (1,300 psi).
    - The 3 readings are within 345 kPa (50 psi) of each other.
11. The power steering pump control valve is sticking if the following conditions exist:
    - The pressure readings are at least 6 895 kPa (1,300 psi).
    - The pressure readings are not within 345 kPa (50 psi) of each other.
12. If the pressure readings indicate that there is a sticking flow control valve, perform the following steps:
    12.1. Remove the flow control valve.
    12.2. Clean the flow control valve.

    Remove any burrs using a crocus cloth of fine hone.

    12.3. Flush the system if the system contains any contamination.
13. If the pressure readings are less than 6 895 kPa (1,300 psi), complete the following steps:
    13.1. Replace the flow control valve.
    13.2. Retest the flow control valve.
    13.3. If the pressure is still below 6 895 kPa (1,300 psi), replace the following components:
    - The rotor
    - The vanes
14. If the pressure readings are within specifications, perform the following procedure:
    14.1. With the flow control valve open, have an assistant turn the steering wheel to both sides.
    14.2. Record the highest pressures.
    14.3. Compare the pressure with the highest pump pressures that you recorded earlier.
15. If the pressure at both stops is not the same as the maximum pressure previously recorded, then the steering gear is leaking internally.

    Repair the steering gear if the steering gear is leaking internally.
16. Turn off the engine.
17. Remove the *J 5176-E* and *J 5176-92* or *J 25323-D* and *J 29525.*

Notice: Refer to *Fastener Notice* in Cautions and Notices.

18. Connect the outlet hose to the remote reservoir.

    Tighten

    Tighten the hydraulic pump hose fitting nut to 28 N·m (21 lb ft).
19. Bleed the power steering system. Refer to *Bleeding Power Steering System.*

Excessive Wheel Kickback or Loose Steering

Problem	Action
There is excessive steering wheel kickback or loose steering.	Inspect the steering system for the following conditions: • Air in the power steering system • Loose steering gear adjustment • Loose tie rod ends • A worn wheel bearing • A loose coupling on the stabilizer • A loose thrust bearing preload adjustment • A worn pipe fitting seat

Increase in Effort While Turning Steering Wheel

Problem	Action
There is a momentary increase in effort when turning the steering wheel fast to the right or left.	Inspect the steering system for the following conditions: • High internal leakage • A sticking or damaged steering gear valve spool • Insufficient pump pressure • A low fluid level

Poor Return of Steering Wheel

Problem	Action
The steering wheel has poor returnability.	Inspect the steering system for the following conditions: • Incorrect caster setting • A bind in the following components: – The control arm ball stud – The steering column – The intermediate steering shaft joints • A misadjusted steering gear • An incorrect steering gear valve spool

Steering Wheel Surges/Jerks While Turning

Problem	Action
The steering wheel surges or jerks.	Inspect the vehicle for the following conditions: • A defective tire • A bad tire • A sluggish steering gear valve spool • A serpentine drive belt which is in one of the following conditions: – Loose – Soaked with oil • Air in the power steering system

Steering Wheel Kickback

Problem	Action
There is kickback in the steering wheel.	Inspect the steering system for the following conditions: • Air in the power steering system • A loose steering gear mounting • Loose or worn joints from the steering column to the steering gear • Loose tie rod ends • A worn or missing pipe fitting seat • A worn wheel bearing • Misadjusted steering gear

Steering Effort Hard in Both Directions

Problem	Action
The steering is hard.	• Perform the test on the hydraulic system. Refer to *Power Steering System Test Procedure.* • Inspect the steering system for the following conditions: – Misadjusted steering gear – A bind or catch in the steering gear – A loose steering gear mounting – A faulty pipe fitting seat

Too Much Play in Steering

Problem	Action
There is too much play in the steering wheel.	Inspect the steering system for the following conditions: • A loose steering gear mounting • Loose or worn joints from the steering column to the steering gear • Misadjusted steering gear

Wander or Poor Steering Stability

Problem	Action
There is a wander or poor stability in the steering.	Inspect the vehicle for the following conditions: • Mismatched tires • Uneven tires • Worn shock absorbers • A loose stabilizer shaft • A broken spring • A sagging spring • Misadjusted steering gear • A misaligned tire and wheel

Vehicle Leads to One Side or the Other

Problem	Action
The vehicle pulls or leads.	Inspect the vehicle for the following conditions: • A misaligned front tire and wheel • Mismatched tires • Uneven tires • Broken springs • Sagging springs • Radial tire lead/pull • An unbalanced steering gear valve spool • A dragging front brake

Foaming, Milky-Appearing Power Steering Fluid

Problem	Action
The following conditions exist: • The fluid is foamy or milky. • The fluid level is low. • The fluid pressure is low.	• Inspect for air in the fluid. • Inspect for an internal pump leak. • Extremely cold temperatures will cause air bubbles if the fluid level is low. • If the fluid level is correct and the pump still foams, perform the following steps: – Remove the reservoir. – Inspect the reservoir for cracks. If the reservoir is cracked, replace the reservoir.

Low Oil Pressure Due to Steering Gear

Problem	Action
There is low pressure due to the steering gear.	Inspect the steering gear for the following conditions: • A scored housing bore • Leakage at one of the following areas: – The valve rings – The seals

Low Oil Pressure Due to Steering Pump

Problem	Action
There is low pressure due to the power steering pump.	Inspect the steering system for the following conditions: • A stuck or inoperative flow control valve • A pressure plate that is not flat against the ring • An extremely worn ring • Scoring on one of the following components: – The pressure plate – The thrust plate – The rotor • Vanes sticking in the rotor slots • A break or crack on one of the following components: – The thrust plate – The pressure plate • A high internal leakage

Groan Noise in Steering Pump

Problem	Action
There is a groaning noise in the pump.	Inspect the pump for the following conditions: • Air in the fluid • A low fluid level • A loose pump mounting

Growl Noise in Steering Pump

Problem	Action
There is a growling noise in the power steering pump.	Inspect the system for the following conditions: • Excessive back pressure that is caused by one of the following conditions: – A restricted hose – A restricted steering gear • Scoring on one of the following components: – The pressure plates – The thrust plate – The rotor • A worn ring

Whine Noise in Steering Pump

Problem	Action
There is a whining noise in the power steering pump.	Inspect the system for scoring on one of the following components: • The power steering pump shaft bushing • The pressure plates • The vanes

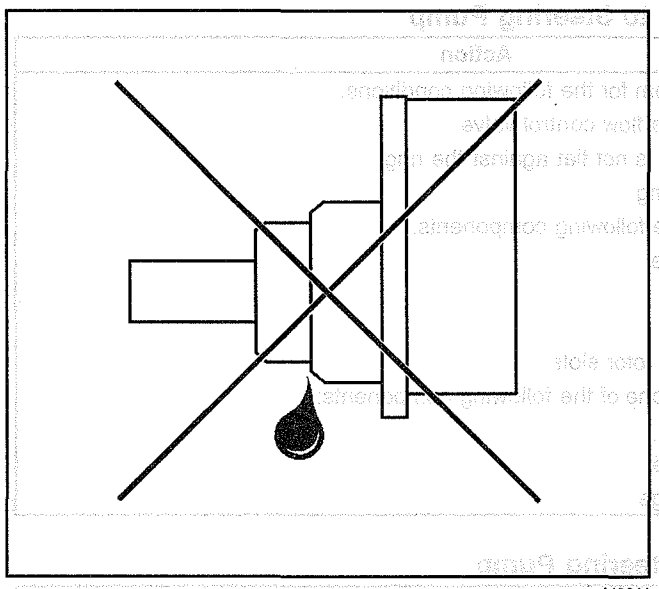
Repair Instructions

Checking and Adding Power Steering Fluid

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.

The fluid level is indicated by marks on the fluid level indicator. The fluid level indicator is located on the reservoir cap.

- 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.


443641

Bleeding Power Steering System

Tools Required

- *J 35555* Mity Vac
- *J 43485* Power Steering Bleeder Adapter

Important: Use clean, new power steering fluid type only.

- See the Maintenance and Lubrication subsection for fluid specifications.

Notice: If the power steering system has been serviced, an accurate fluid level reading cannot be obtained unless air is bled from the steering system. The air in the fluid may cause pump cavitation noise and may cause pump damage over a period of time.

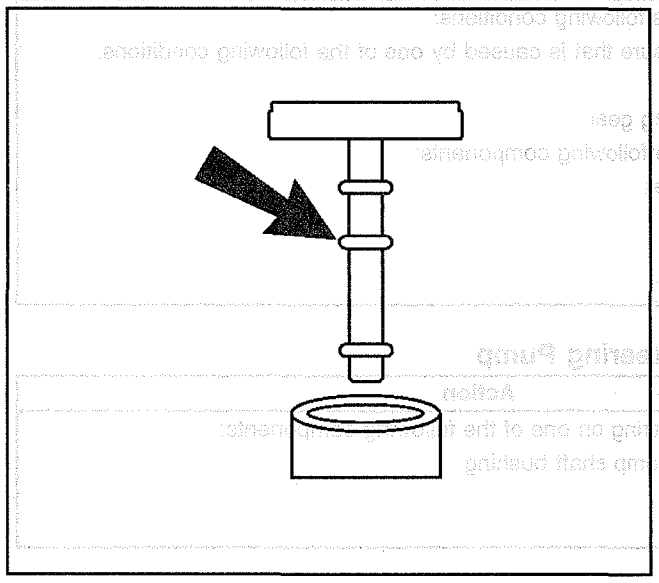
Notice: When adding fluid or making a complete fluid change, always use the proper power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

Important: Hoses touching the frame, body, or engine may cause system noise.

- Verify that the hoses do not touch any other part of the vehicle.

Important: Loose connections may not leak, but could allow air into the steering system.

- Verify that all hose connections are tight.

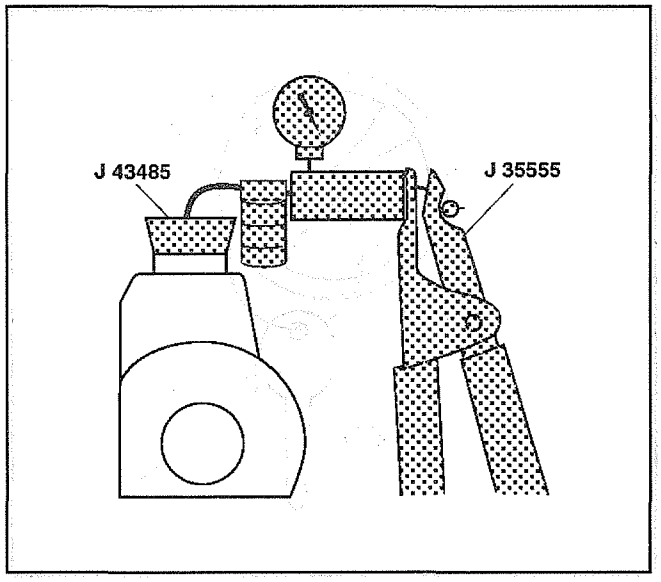

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Important: Maintain the fluid level throughout the bleed procedure.

1. Remove the pump reservoir cap.
2. Fill the pump reservoir with fluid to the "FULL COLD" level.

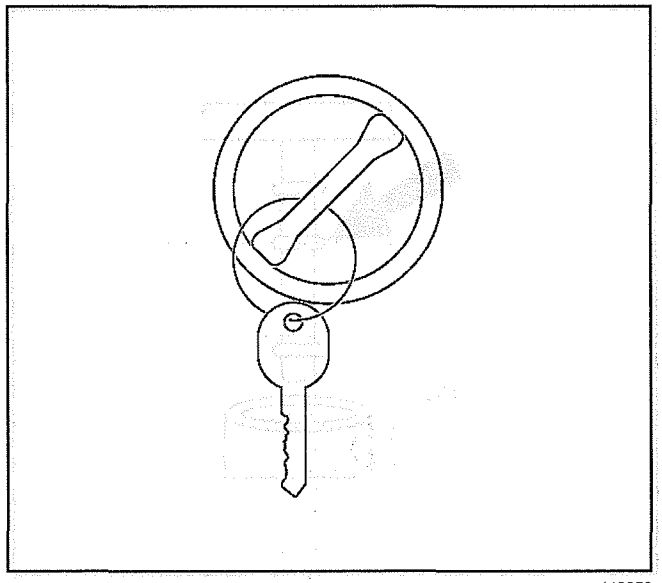
3. Attach *J 43485* to *J 35555* or equivalent.
4. Place *J 43485* on or in the pump reservoir filler neck.
5. Apply a vacuum of 68 kPa (20 in Hg) maximum.
6. Wait 5 minutes.

   Typical vacuum drop is 7–10 kPa (2–3 in Hg). If the vacuum does not remain steady, refer to Excessive Vacuum Drop Diagnosis at the end of this procedure.



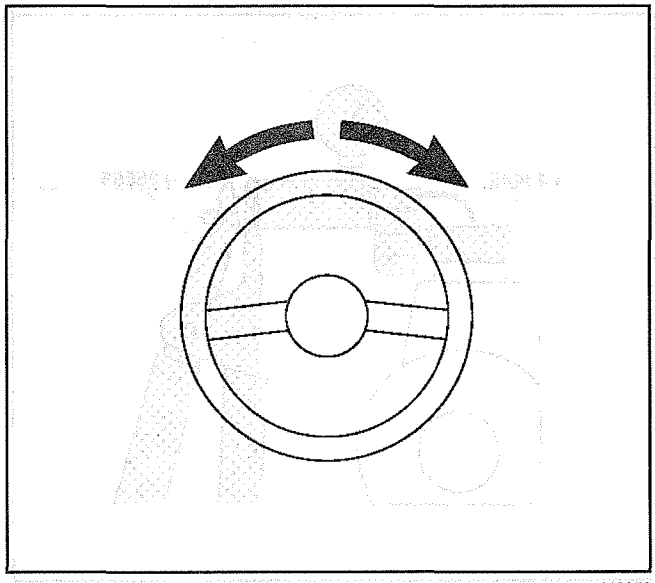
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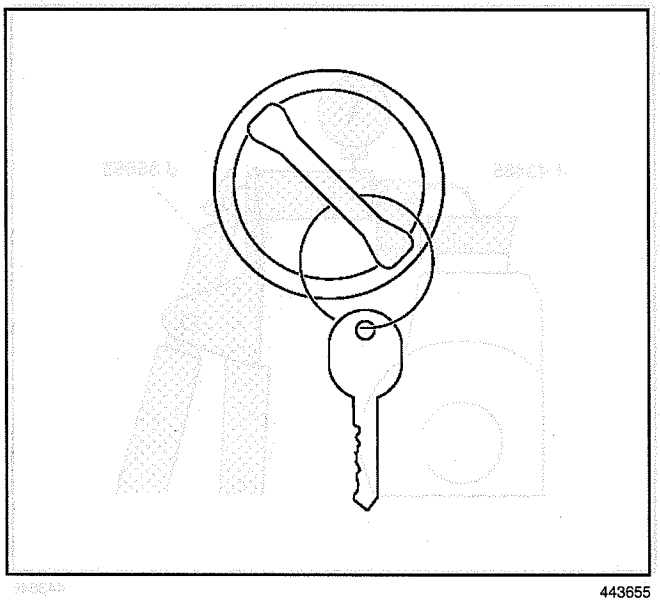
7. Remove the *J 43485* and the *J 35555*.
8. Reinstall the pump reservoir cap.
9. Start the engine. Allow the engine to idle.
10. Turn off the engine.
11. Verify the fluid level. Repeat steps 9 through 11 until fluid stabilizes.


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Important: Do not turn steering wheel to lock.

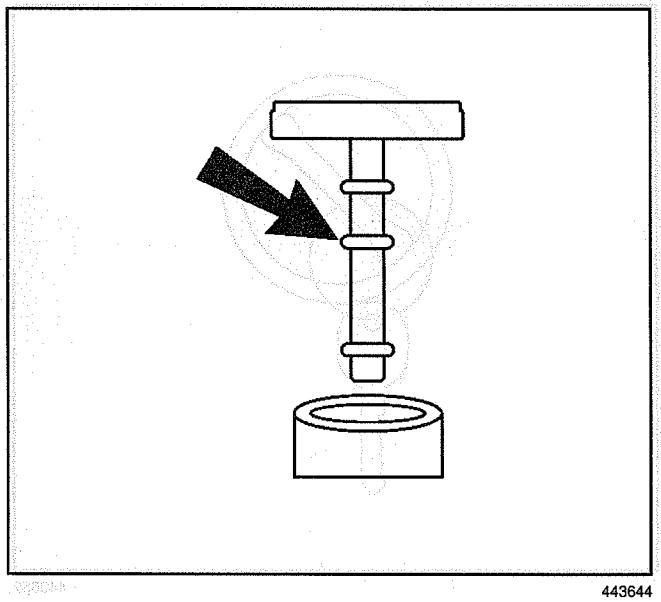
12. Start the engine. Allow the engine to idle.
13. Turn the steering wheel 180–360 degrees in both directions 5 times.


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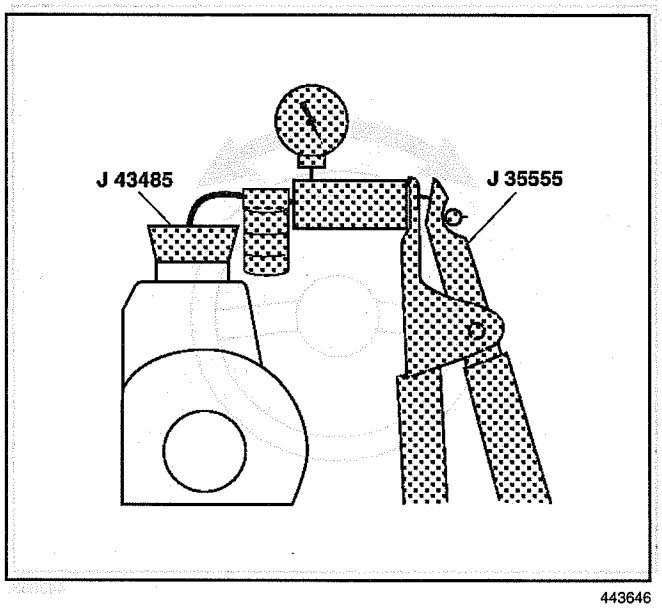
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14. Switch the ignition off.
15. Verify the fluid level.



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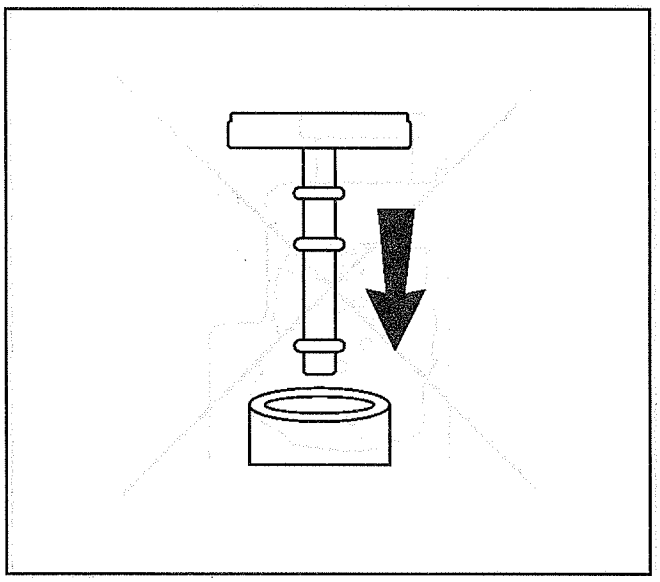
16. Remove the pump reservoir cap.



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17. Attach *J 43485* to *J 35555* or equivalent.
18. Place *J 43485* on or in the pump reservoir filler neck.
19. Apply a vacuum of 68 kPa (20 in Hg) maximum.
20. Wait 5 minutes.
21. Remove the *J 43485* and the *J 35555*.
22. Verify the fluid level.

23. Reinstall the pump reservoir cap.



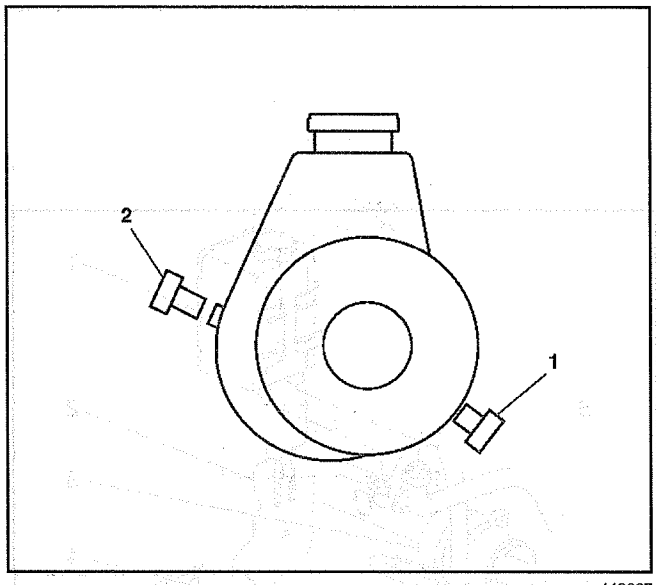
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Excessive Vacuum Drop Diagnosis

Tools Required

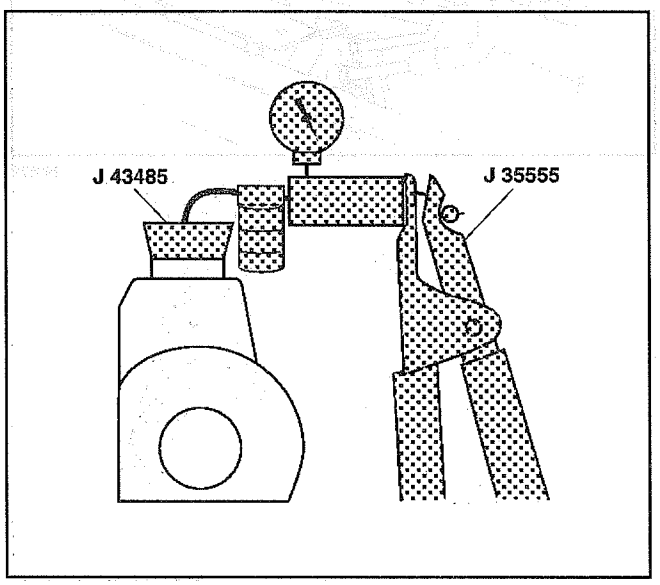
- *J 35555* Mity Vac
- *J 43485* Power Steering Bleed Adapter

1. If the vacuum continues to drop, remove the pressure and return hose from the pump.
2. Install the plugs (1) (2) supplied with *J 43485* into the pressure and return port.

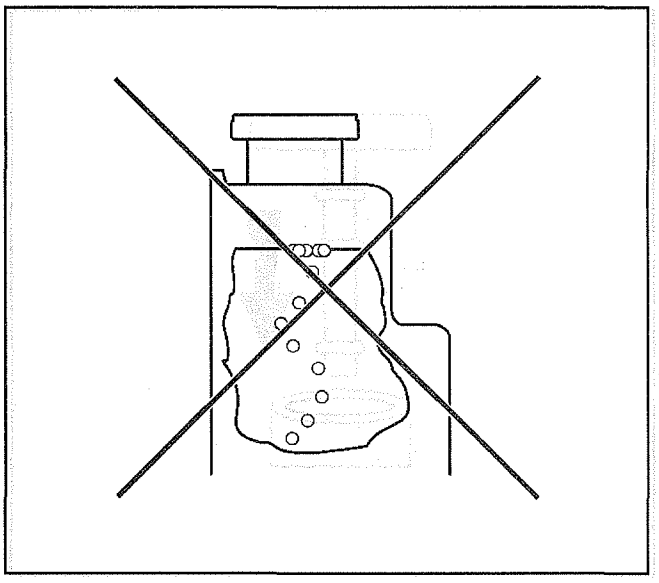


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3. Attach *J 43485* to *J 35555* or equivalent.
4. Place *J 43485* on or in the pump reservoir filler neck.
5. Apply a vacuum of 68 kPa (20 in Hg) maximum.
6. If the vacuum drops again, repair or replace the pump. If the vacuum holds steady, continue to check the other parts of the steering system.



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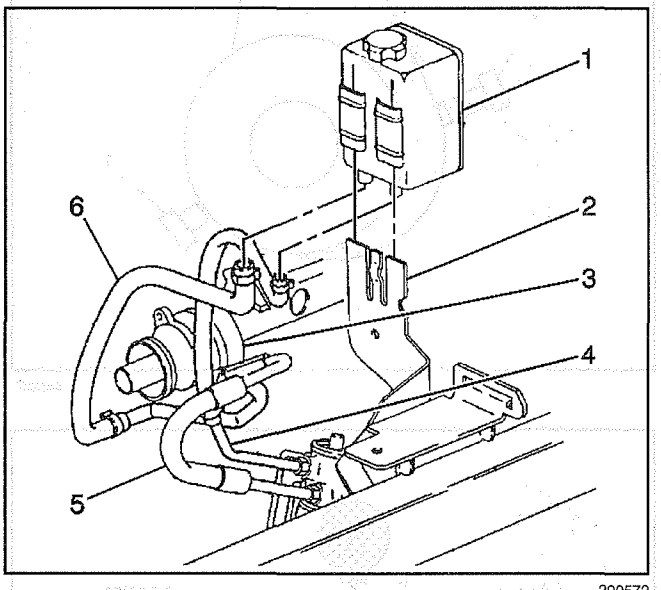


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Important: Fluid must be free from bubbles and foam. Be aware of periodic bubbles that indicate a loose connection or leaking O-ring seal in the return hose or the pressure hose.

Fluid must be free from discoloration.

7. Observe the fluid.
8. If condition persists, replace the following parts:
   - The return hose clamps
   - The return hose O-rings
   - The pressure hose O-rings
   - The gear cylinder line O-rings
   - The reservoir to pump O-ring
9. Repeat the bleed procedure from the beginning.
10. Drive the vehicle approximately 16 kilometers (10 miles) to warm the system to operating temperature. Evaluate vehicle on a smooth flat surface.
11. Verify the following conditions:
    - There is smooth power assist.
    - The vehicle operates quietly.
    - The pump maintains the proper fluid level.
    - There is no leaking in the steering system.
    - The fluid is free of foam or discoloration.



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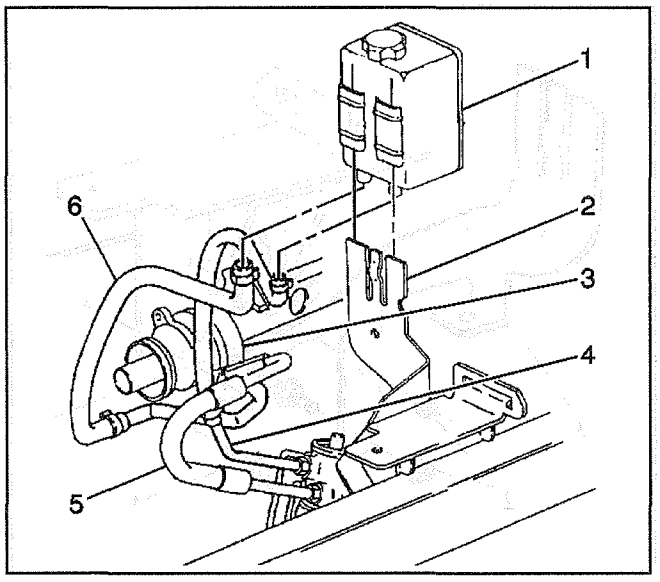
Remote Power Steering Fluid Reservoir Replacement

Removal Procedure

1. Place a drain pan under the reservoir (1).
2. Remove the cap from the reservoir (1).
3. Remove the reservoir (1) from the bracket (2).
4. Disconnect the reservoir and outlet hoses (4, 6) from the reservoir (1).

Installation Procedure

1. Connect the reservoir and outlet hoses (4, 6) to the reservoir (1).
2. Install the reservoir (1) to the bracket (2).
3. Refill the reservoir and Install the cap to the reservoir.
4. Remove drain pan.
5. Bleed the power steering system. Refer to *Bleeding Power Steering System*.

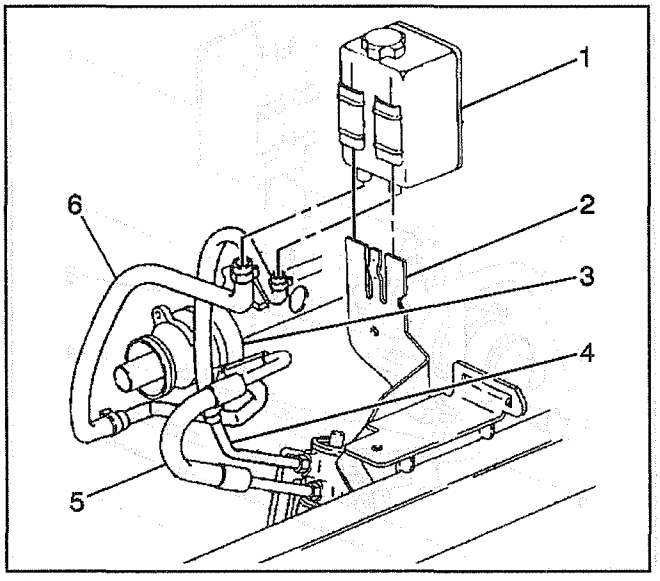


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Remote PS Fluid Reservoir Bracket Replacement

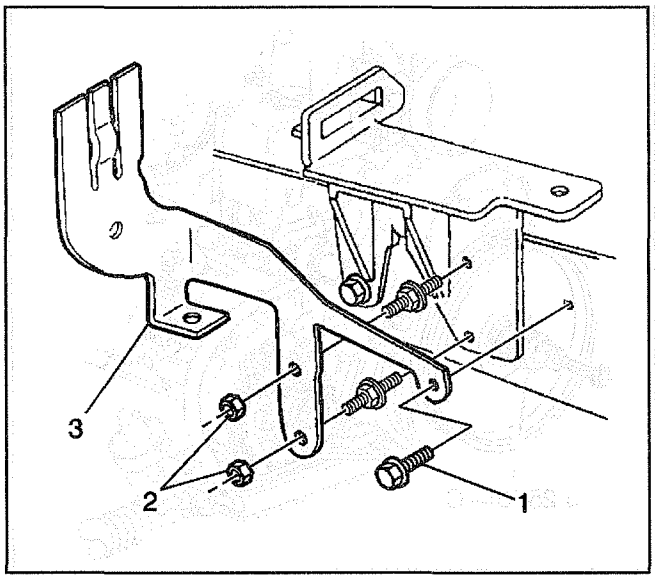
Removal Procedure

1. Remove the reservoir (1) from the bracket (2).
2. Use a wire, or an equivalent, in order to secure the reservoir (1) in an upright position.
   An upright position will prevent leakage.
3. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
4. Remove the electrical harness from the bracket (2).

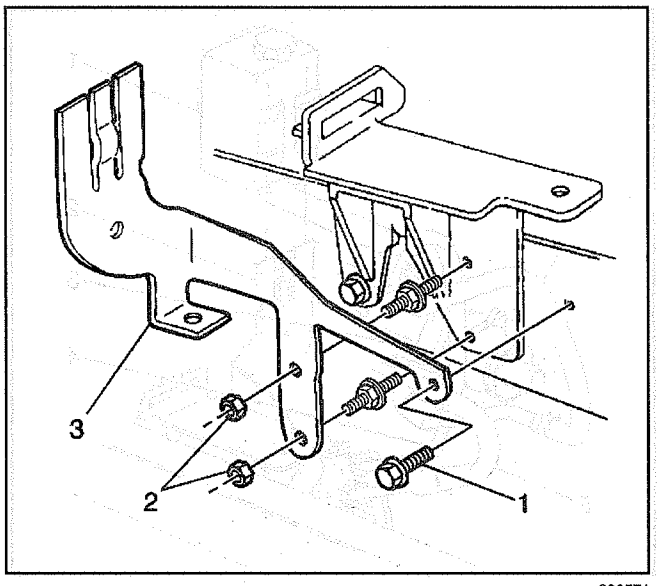


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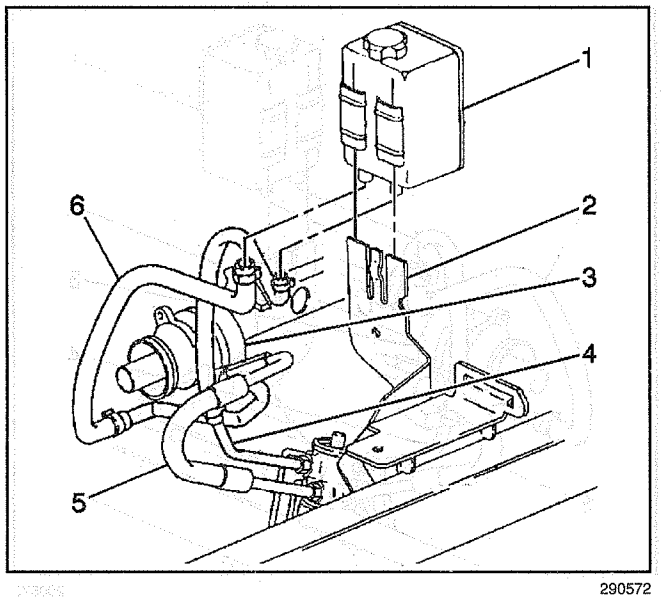
5. Remove the bolt/screw (1).
6. Remove the nuts (2).



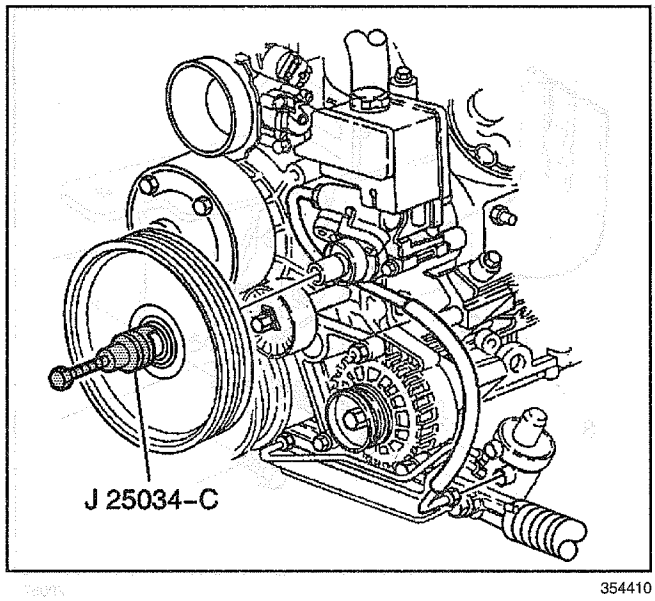
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Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the nuts (2).
   Tighten
   Tighten the nuts to 12 N·m (107 lb in).
2. Install the bolt/screw (1).
   Tighten
   Tighten the bolt/screw to 50 N·m (37 lb ft).
3. Install the electrical harness to the bracket (3).
4. Lower the vehicle.
5. Install the reservoir (1) to the bracket (2).

Power Steering Pulley Replacement

Removal Procedure

Tools Required

J 25034-C Power Steering Pump Pulley Remover

1. Remove the air intake resonator and mass airflow assembly (LS1 only).
2. Remove the serpentine belt.
3. Use the *J 25034-C* in order to remove the power steering pulley from the power steering pump.

Installation Procedure

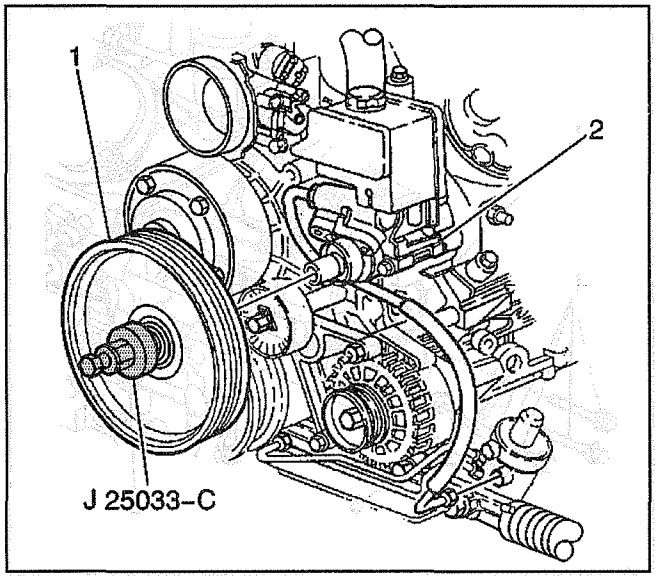
Tools Required

J 25033-C Power Steering Pump Pulley Installer

Important:

- 3.8 Liter Engine: Ensure that the face of the pulley hub is flush with the end of the pump shaft before you apply a load to the pulley hub.
- 5.7 Liter Engine: Ensure that the pulley hub shoulder bottoms out completely on the pulley shaft before you apply a load to the pulley hub.
- Ensure that the pulley goes on snug when installing the pulley with the special tool. If the pulley installs onto the pump shaft too easily, it will not relay engine power to the pump and should be replaced.

1. Use the *J 25033-C* in order to install the power steering pulley to the power steering pump.
2. Install the air intake resonator and mass airflow assembly (LS1 only)
3. Install the serpentine belt.
4. Check power steering operation and visibly check pulley for any irregular wobble when operating.

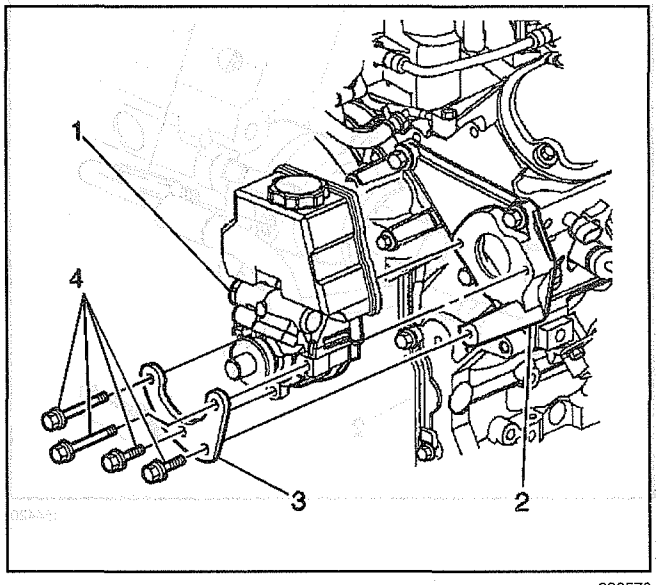


290557

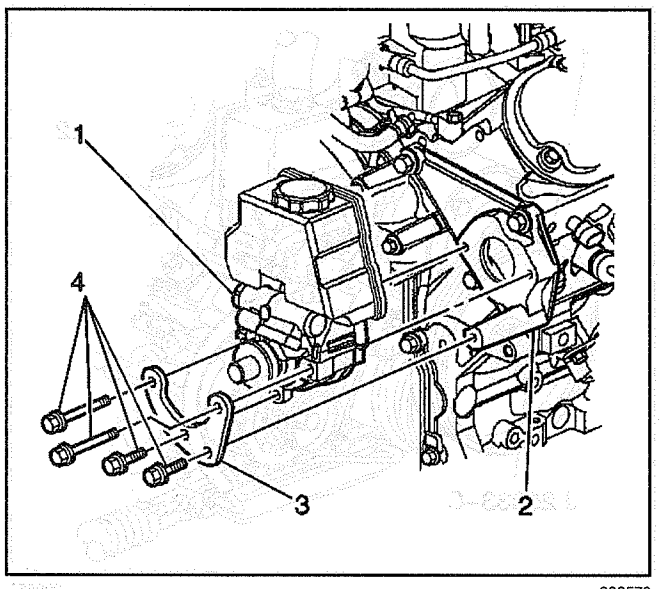
Power Steering Pump Replacement (V8)

Removal Procedure

1. Place a drain pan under the power steering pump (1).
2. Remove the air intake resonator and mass airflow assembly.
3. Remove the serpentine belt.
4. Remove the power steering pump pulley. Refer to *Power Steering Pulley Replacement.*
5. Remove the outlet hose and the clamp from the reservoir (This allows fluid to drain from reservoir).
6. Remove the inlet hose fitting from the pump.
7. Remove power steering pump attaching bolts (4) and power steering pump front brace (3) from pump (1).
8. Remove pump (1) from rear bracket (2).



290570



290570

Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

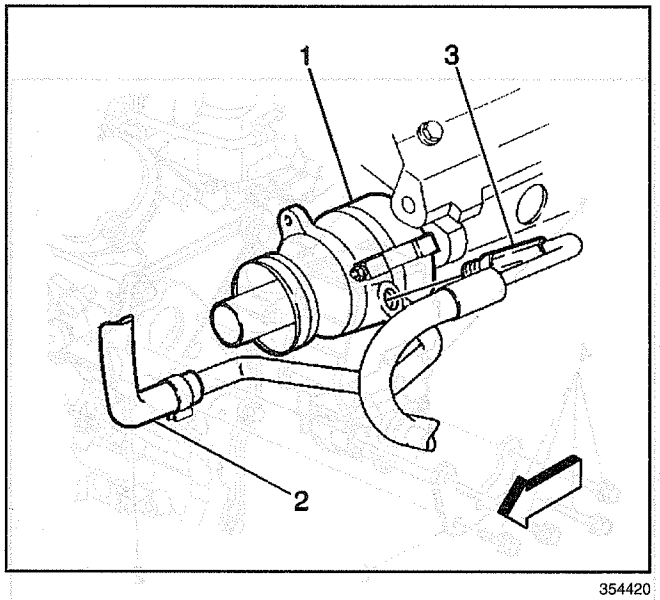
1. Install pump (1), pump front brace (3), and attaching bolts (4) to rear bracket (2).

   Tighten

   Tighten the bolts/screws to 25 N·m (18 lb ft).
2. Install the inlet hose fitting from pump.

   Tighten

   Tighten the fitting to 28 N·m (21 lb ft).
3. Install the outlet hose and clamp to reservoir.
4. Install the power steering pump pulley. Refer to *Power Steering Pulley Replacement.*
5. Install the serpentine belt.
6. Install the air intake resonator and mass airflow assembly.
7. Remove drain pan.
8. Refill and bleed the power steering system. Refer to *Bleeding Power Steering System.*



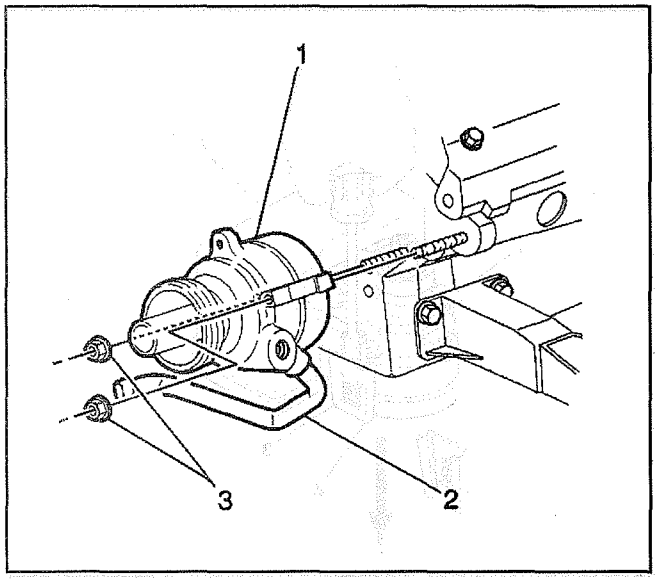
354420

Power Steering Pump Replacement (V6)

Removal Procedure

1. Place a drain pan under the power steering pump (1).
2. Remove the serpentine belt.
3. Remove the front air intake duct.
4. Remove the pulley from the power steering pump (1). Refer to *Remote Power Steering Fluid Reservoir Replacement.*
5. Disconnect the inlet hose (3) from the power steering pump (1).
6. Disconnect the reservoir hose (2) from the power steering pump (1).

7. Remove the power steering pump nuts.
8. Remove the power steering pump.



290569

Installation Procedure

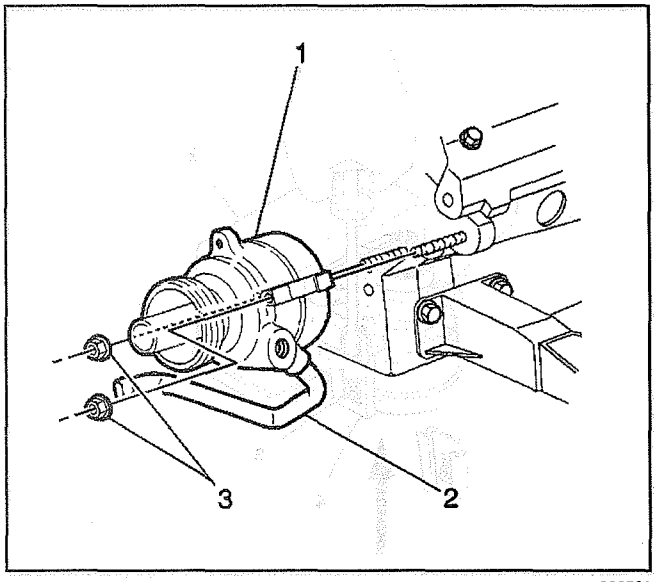
1. Position the power steering pump onto the mounting studs.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Tighten the power steering pump nuts.

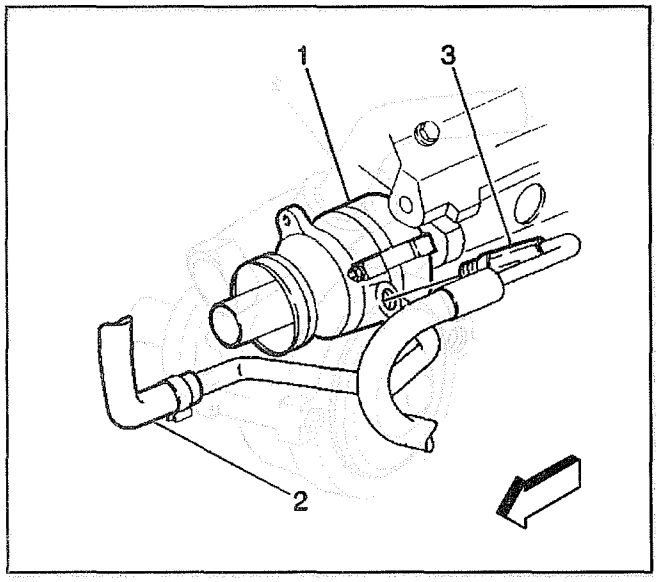
   Tighten

   Tighten the power steering pump nuts to 30 N·m (23 lb ft).

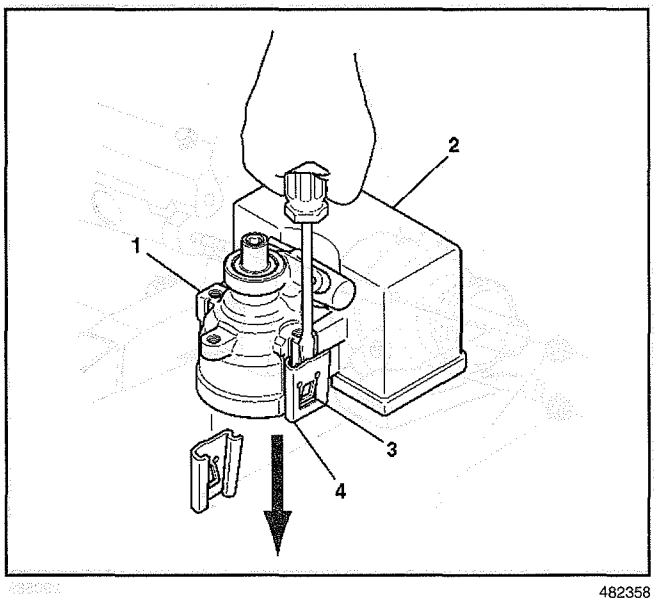


290569

3. Connect the inlet hose to the power steering pump (2).
4. Connect the reservoir hose (2) to the power steering pump (1).
5. Install the pulley to the power steering pump (1). Refer to *Remote Power Steering Fluid Reservoir Replacement*.
6. Install the front air intake duct.
7. Install the serpentine belt.
8. Refill and bleed the power steering system. Refer to *Bleeding Power Steering System*.



354420

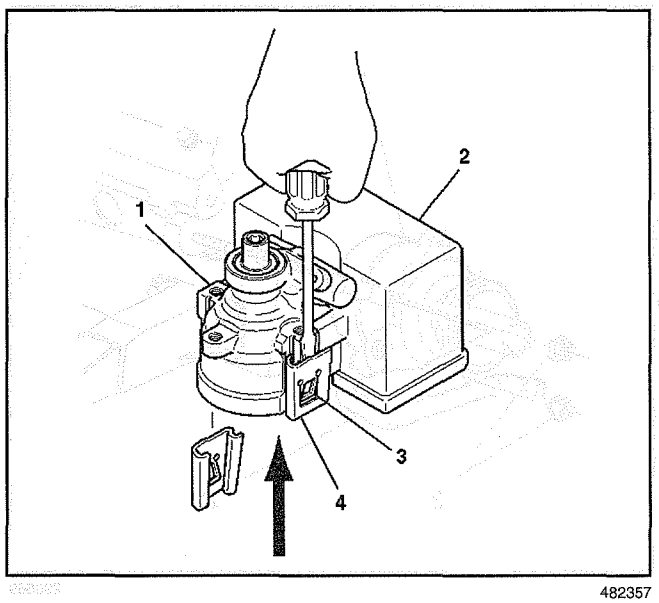


482358

Power Steering Reservoir Replacement - Off Vehicle (CB Series)

Disassembly Procedure

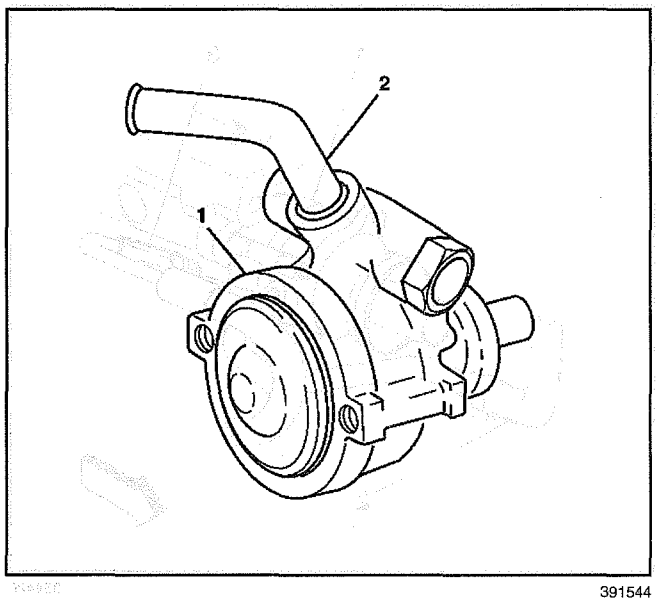
1. Place the hydraulic pump (1) on a fixed, flat surface, with the shaft facing upward.
2. Insert a screwdriver into the retaining clip tab (3).
3. Using the screwdriver, force the retaining clip tab (3) outward.
4. Slide the reservoir clip (4) away from the hydraulic pump assembly (1).
5. Remove the reservoir (2) from the hydraulic pump housing (1).
6. Remove the O-ring seal from the neck of the reservoir (2) or the hydraulic pump housing (1). Discard the O-ring seal.



482357

Assembly Procedure

1. Lubricate the new O-ring seal with power steering fluid.
2. Install the new O-ring seal onto the neck of the reservoir (2).
3. Install the reservoir (2) onto the hydraulic pump assembly (1). Ensure the reservoir neck is completely engaged onto the hydraulic pump assembly (1).
4. Align the feet of the reservoir with the sides of the hydraulic pump housing.
5. Install the new reservoir retaining clips (4) (supplied with the pump). Ensure the retaining clip tabs (3) fully engage with the hydraulic pump housing (1).



391544

Power Steering Pump Flow Control Valve Replacement - Off Vehicle (Return Tube)

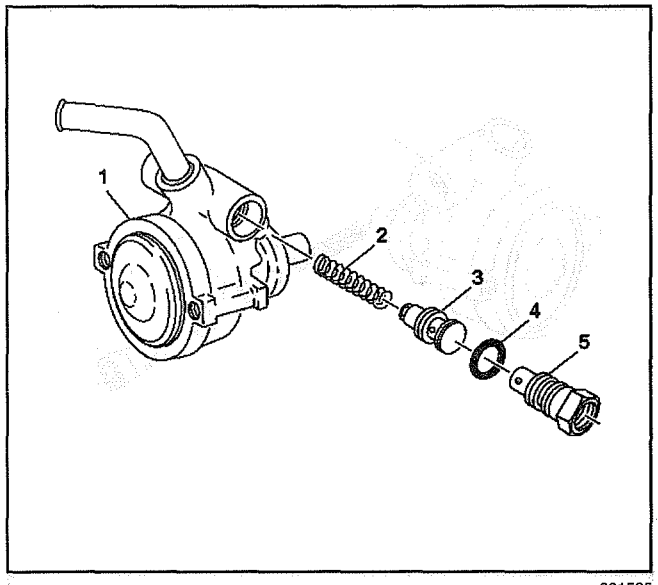
Disassembly Procedure

Important: Handle the pump with care. Do not carry the hydraulic pump housing assembly (1) by the return tube (2).

Important: Replace the hydraulic pump housing assembly (1) if the return tube (2) is cracked or loose. Do not attempt to repair the hydraulic pump housing assembly (1).

1. Inspect the return tube (2) on hydraulic pump housing assembly (1).

2. Remove the O-ring union fitting (5) from the hydraulic pump housing assembly (1).
3. Remove the O-ring seal (4) from the O-ring union fitting (5).
4. Remove the control valve assembly (3).
5. Remove the flow control spring (2).



391535

Assembly Procedure

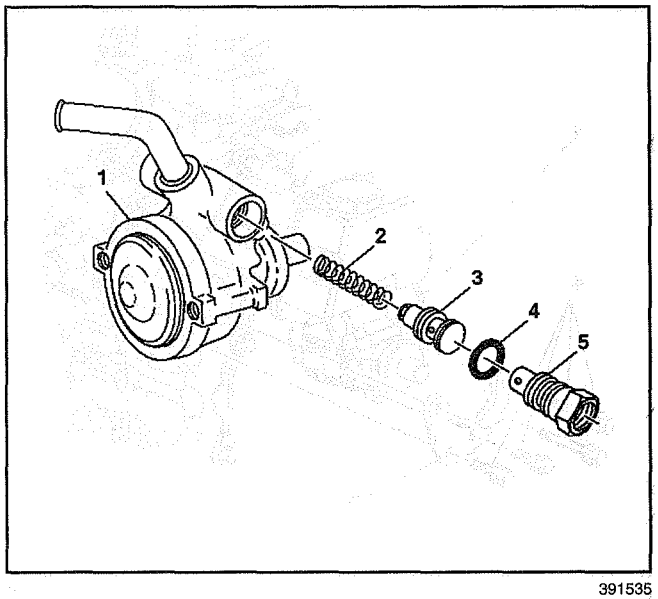
1. Install the flow control spring (2) to the hydraulic pump housing assembly (1).
2. Install the control valve assembly (3).
3. Lubricate the O-ring seal (4) with power steering fluid.
4. Install the O-ring seal (4) on to the O-ring union fitting (5).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

5. Install the O-ring union fitting (5) into the hydraulic pump housing assembly (1).

   Tighten

   Tighten the O-ring union fitting (5) to 75 N·m (55 lb ft).

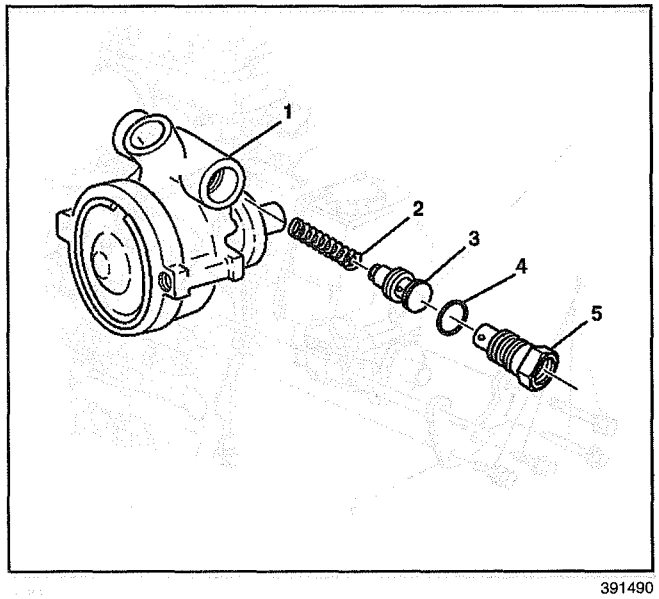


391535

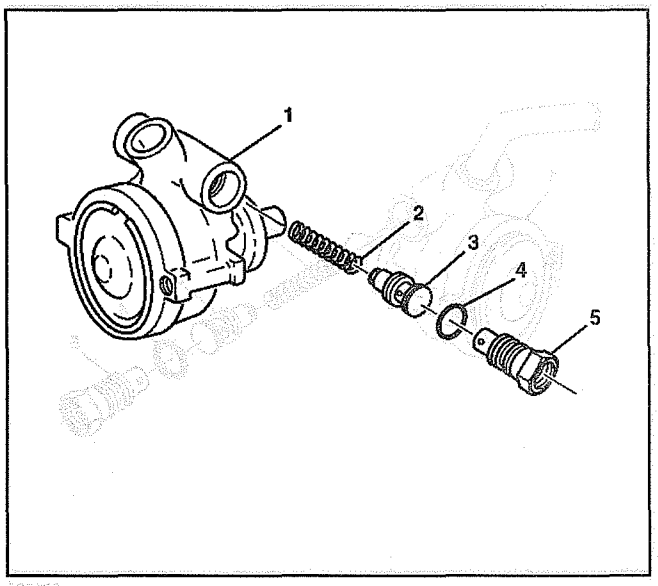
Power Steering Pump Flow Control Valve Replacement - Off Vehicle (CB Series)

Removal Procedure

1. Remove the O-ring union fitting (5) from the hydraulic pump housing assembly (1).
2. Remove the O-ring seal (4) from the O-ring union fitting (5).
3. Remove the control valve assembly (3).
4. Remove the flow control spring (2).



391490



391490

Installation Procedure

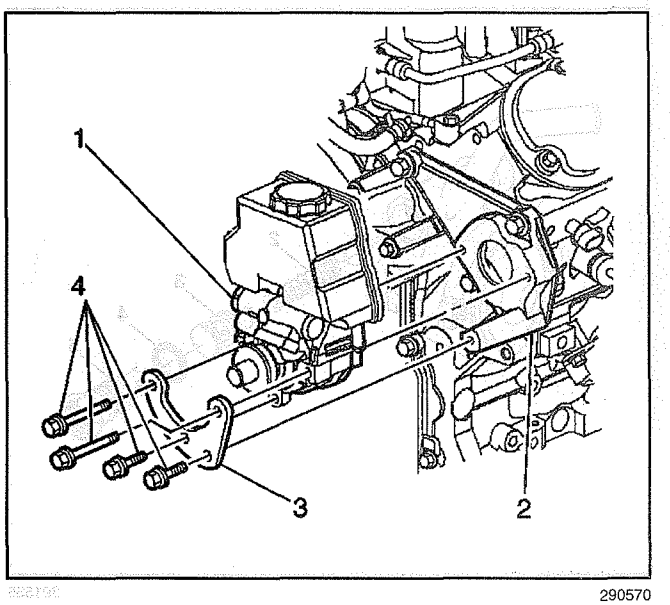
1. Install the flow control spring (2) to the hydraulic pump housing assembly (1).
2. Install the control valve assembly (3).
3. Lubricate the O-ring seal (4) with power steering fluid.
4. Install the O-ring seal (4) onto the O-ring union fitting (5).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

5. Install the O-ring union fitting (5) into the hydraulic pump housing assembly (1).

   Tighten

   Tighten the fitting (5) to 75 N·m (55 lb ft).



290570

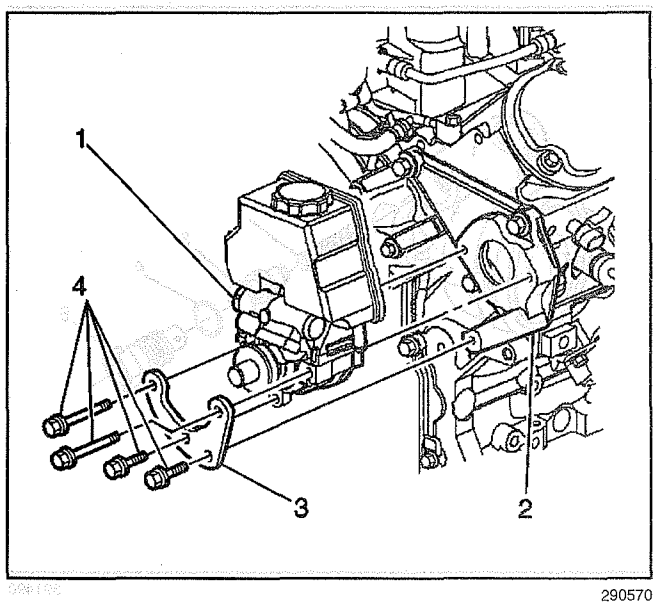
Power Steering Pump Front Bracket Replacement

Removal Procedure

1. Place drain pan under pump (1).
2. Remove air intake resonator and mass airflow sensor assembly.
3. Remove the serpentine belt.
4. Remove the power steering pump pulley from the pump. Refer to *Power Steering Pulley Replacement.*
5. Support pump assembly with twine or rope.

Important: The front power steering pump bracket can be removed without the complete disconnection of the pump. The hydraulic hoses do not need to be disconnected.

6. Remove power steering pump attaching bolts (4) and front power steering pump bracket (3).



290570

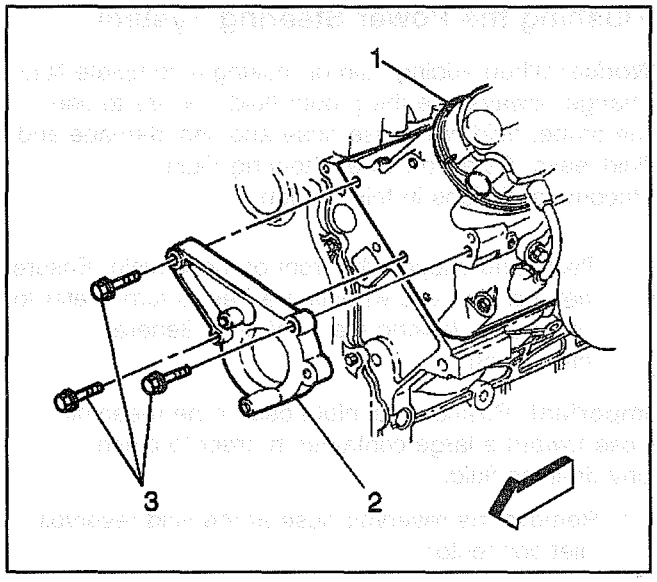
Installation Procedure

1. Install power steering pump attaching bolts (4) and front power steering pump bracket (3).
2. Remove twine or rope used for support.
3. Install the power steering pump pulley to the pump. Refer to *Power Steering Pulley Replacement.*
4. Install the serpentine belt.
5. Install the air intake resonator and mass airflow sensor assembly.
6. Remove drain pan and verify power steering operation.

Power Steering Pump Rear Bracket Replacement

Removal Procedure

1. Remove the power steering pump (V8 only). Refer to *Power Steering Pump Replacement (V8).*
2. Remove the rear power steering pump bracket bolts (3).
3. Remove the rear power steering pump bracket (2) from cylinder head (1).



354413

Installation Procedure

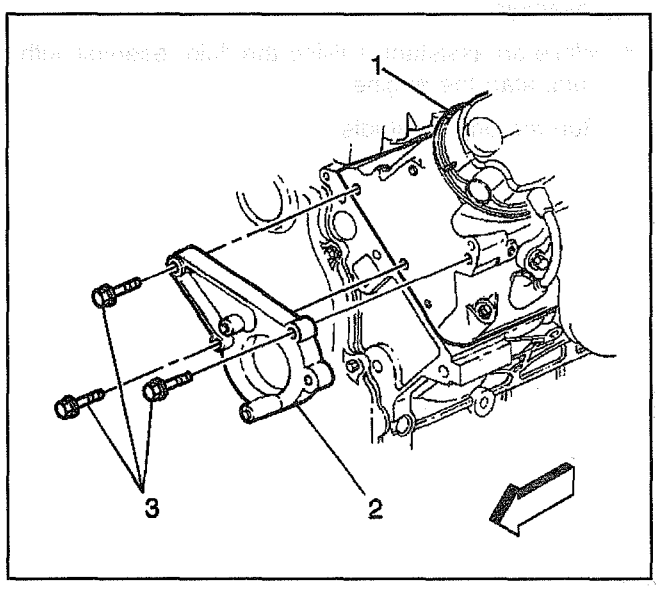
1. Install the rear power steering pump bracket (2) to cylinder head (1).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the rear power steering pump bracket bolts (3).

   Tighten

   Tighten the power steering pump bracket bolts (3) to 50 N·m (37 lb ft).
3. Install the power steering pump (V8 only). Refer to *Power Steering Pump Replacement (V8).*
4. Bleed the power steering system. Refer to *Bleeding Power Steering System.*



354413

Flushing the Power Steering System

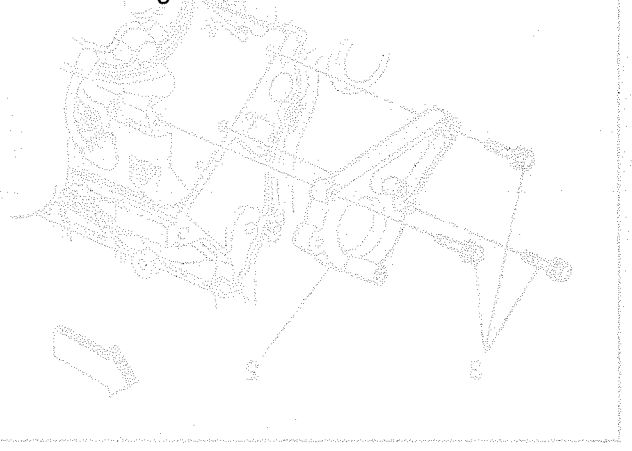
Notice: When adding fluid or making a complete fluid change, always use the proper fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks. Refer to Power Steering Fluid Recommendations in this section.

1. Raise and support the front of the vehicle. Ensure that the tires and wheels are free to turn. Refer to *Lifting and Jacking the Vehicle* in General Information.

Important: Position the inlet hose or the reservoir hose toward a large container in order to catch any draining fluid.

2. Remove the reservoir hose at the fluid reservoir inlet connector.
3. Plug the fluid inlet connector port on the fluid reservoir.
4. While an assistant is filling the fluid reservoir with fluid, start the engine.

   Run the engine at idle.



Notice: Do not hold the steering wheel against the stops while flushing the power steering system. Holding the steering wheel against the wheel stops will cause high system pressure, overheating, and damage to the power steering pump and/or gear.

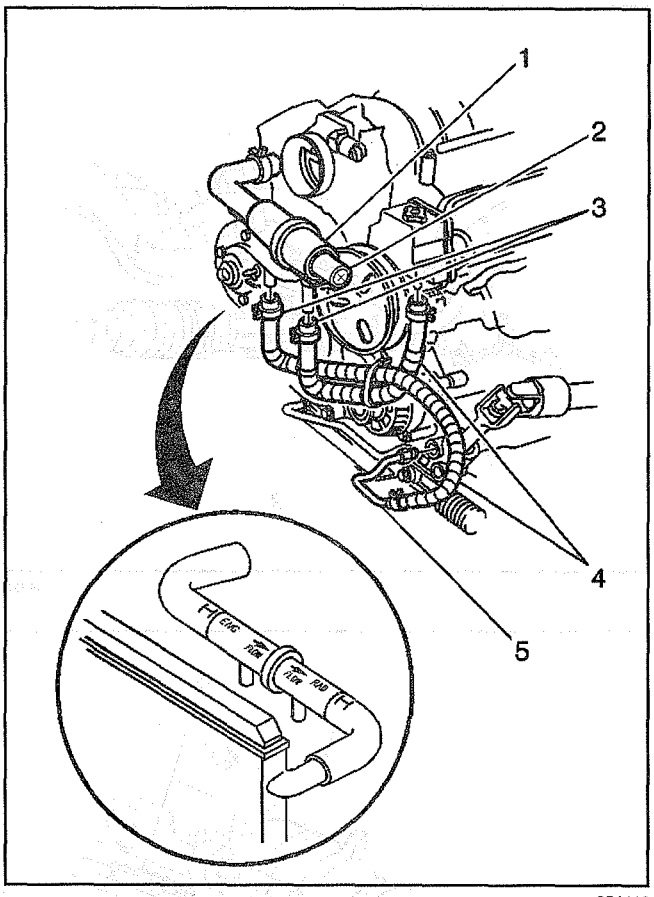
5. Turn the steering wheel from stop to stop.
6. Continue to drain the reservoir until all of the old fluid is cleared from the power steering system.
7. Add approximately 0.94 liters (1 quart) of new fluid in order to flush the system.
8. Inspect the fluid that is draining while you are refilling the fluid reservoir.

   Do not reuse any drained fluid.
9. If necessary, perform the following steps:
   - Replace all of the lines.
   - Disassemble and clean the system components.
   - Replace the system components.
10. Unplug the reservoir hose at the fluid reservoir inlet connector.
11. Turn the engine off.
12. Fill the fluid reservoir to the C mark on the fluid level indicator.
13. Bleed the power steering system. Refer to *Bleeding Power Steering System*.

Power Steering Cooler Pipe/Hose Replacement

Removal Procedure

1. Place drain pan under vehicle under cooler.
2. Drain engine coolant from engine.
3. Remove power steering gear outlet hoses (3) and clips from cooler (1).
4. Remove hose clamps from radiator hoses at cooler (1).
5. Remove radiator hoses from cooler (1).
6. Remove cooler (1) from radiator support bracket.



354416

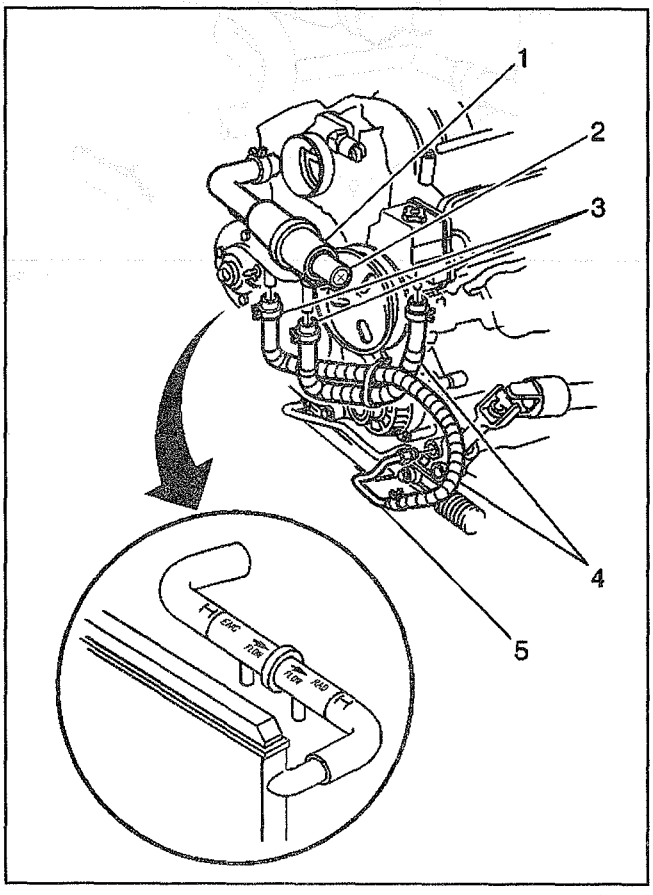
Installation Procedure

1. Install cooler (1) to radiator support bracket.

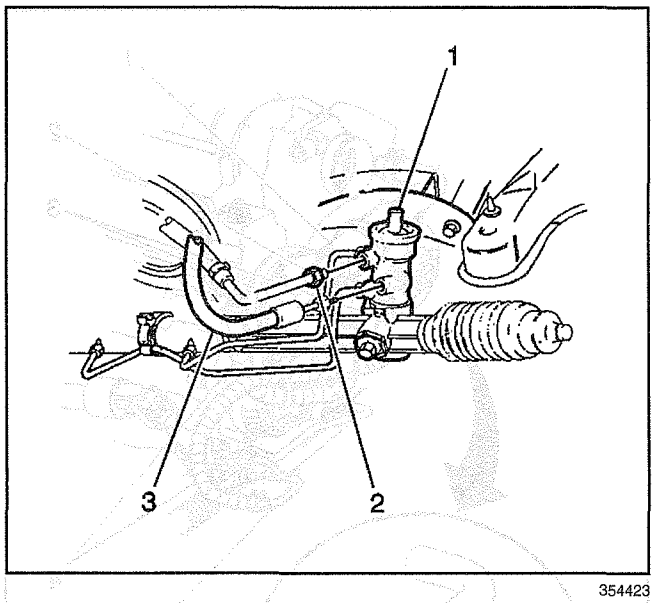
Important: Ensure that the cooler is installed with the "ENGINE" marking pointed toward the engine and the "RADIATOR" marking pointing toward the radiator (drivers side of the vehicle).

Alignment marks on cooler should align with alignment marks on radiator hoses so cooler is properly positioned (Power steering circuit outlets pointing straight down).

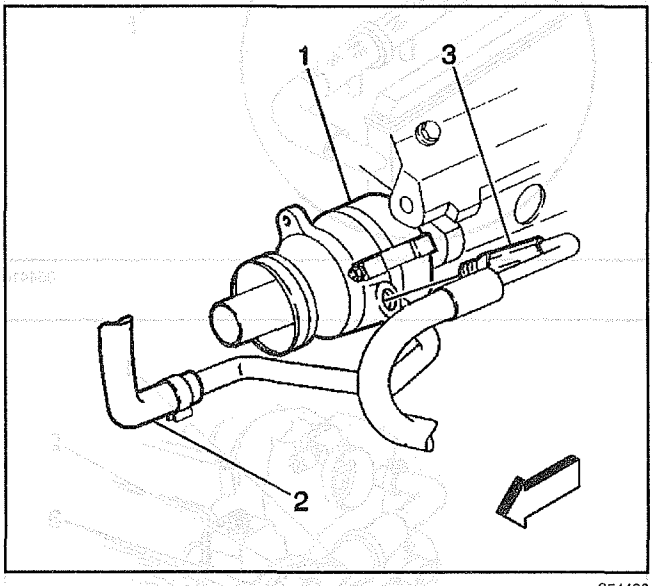
2. Install radiator hoses to cooler (1).
3. Install radiator hose clamps to radiator hoses at cooler.
4. Install the power steering gear outlet hoses (3) and clips to the cooler (1).
5. Refill engine with coolant.
6. Refill and bleed power the power steering system. Refer to *Bleeding Power Steering System*.



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354423



354420

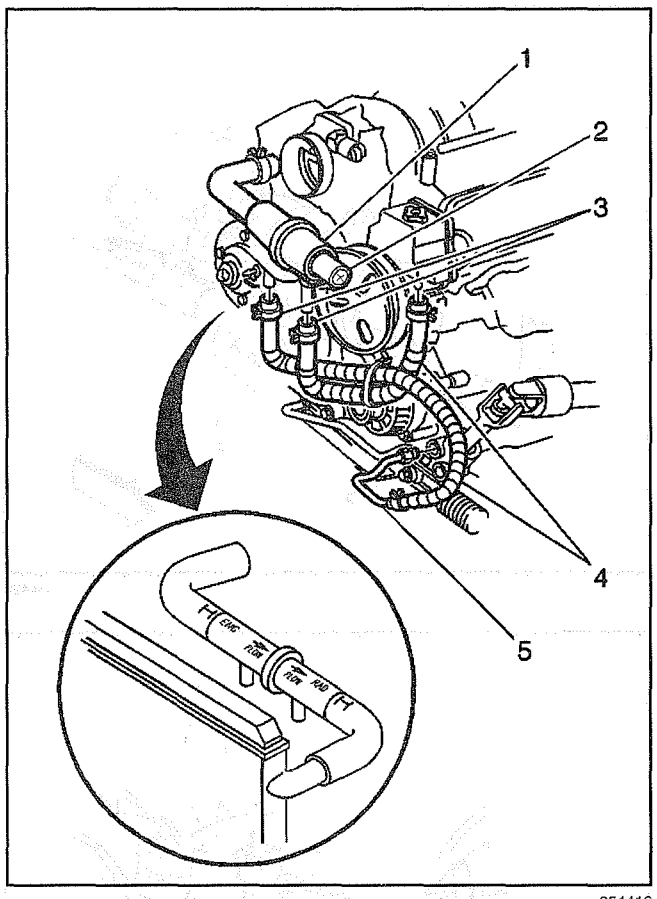
Power Steering Return Hose Replacement

Removal Procedure

1. Place drain pan(s) under vehicle under steering gear and pump.
2. Raise and suitably support vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Remove power steering gear inlet (3) and outlet (2) hoses from steering gear (1).
4. Lower vehicle.
5. Remove the serpentine belt.
6. Remove the power steering pump pulley. Refer to *Power Steering Pulley Replacement.*
7. Remove inlet hose fitting (3) from pump (1) (V6 shown, V8 similar).

Important: If vehicle is equipped with a power steering cooler (V8 only), outlet hose (3) and cooler hose (if replacing) must be removed from the power steering cooler (1) as the cooler is installed in the outlet hose (return back to reservoir).

8. Remove outlet hose from reservoir (V8 with cooler shown, remote-mount reservoir on V6).

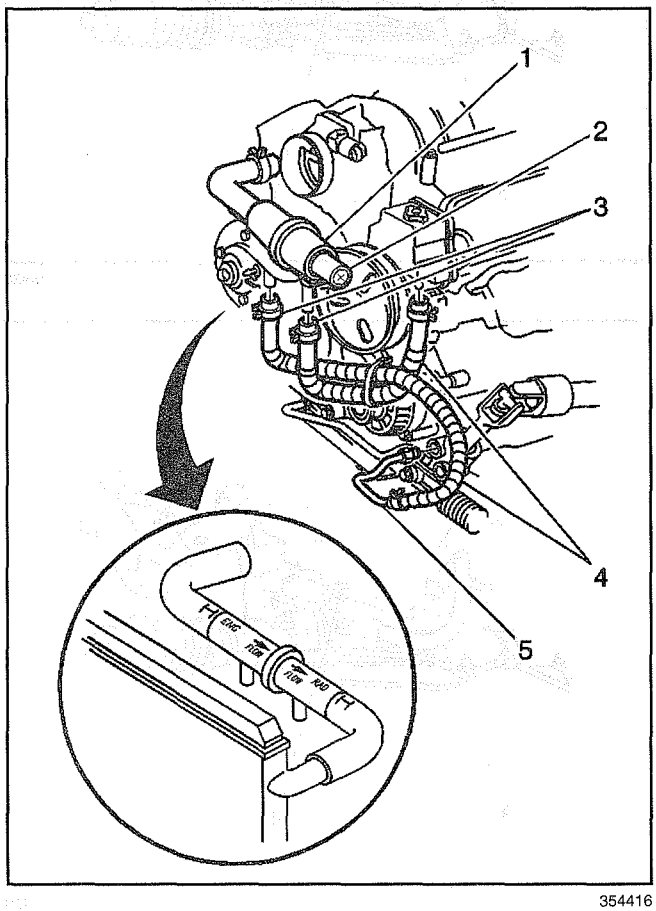


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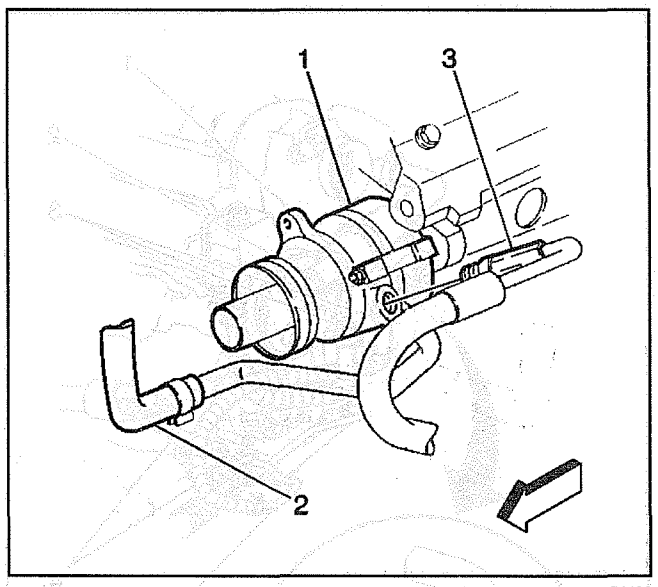
Installation Procedure

Important: Inlet and outlet hoses must be oriented so as adequate clearance is maintained between both hoses and surrounding components to prevent chafing. Use minimum clearance of 12 mm (0.47 in). The outlet hose (3) must not be twisted during installation. Do not bend or distort inlet and outlet hoses to make installation easier. Failure to follow these procedures could result in component damage.

1. Install outlet hose to reservoir (V8 with cooler shown, remote-mount reservoir on V6). (Pump mounted on V8, body mounted on V6)

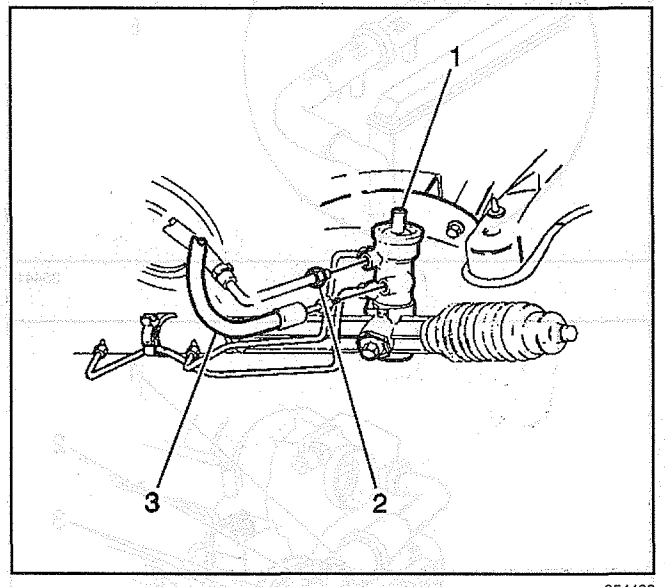


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2. Install inlet hose fitting (3) to pump (1) (V6 shown,V8 similar).



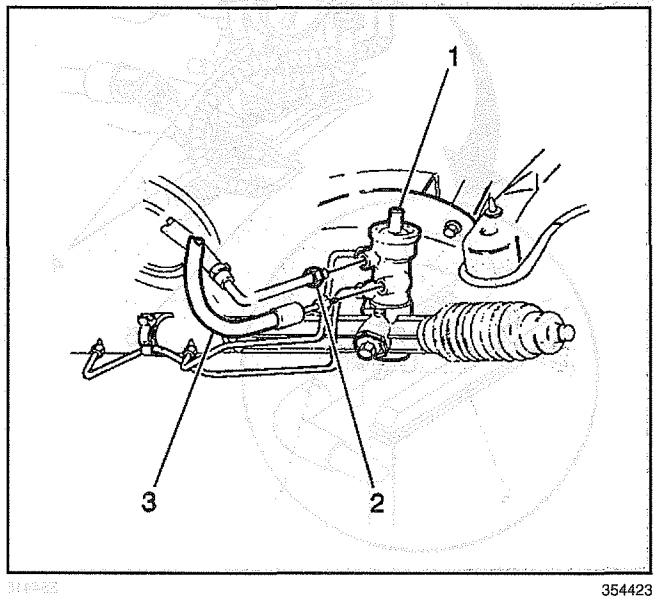
354423

3. Install the power steering pump pulley. Refer to *Power Steering Pulley Replacement.*
4. Install the serpentine belt.
5. Raise and suitably support vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
6. Install inlet and outlet hoses (2, 3) to steering gear (1).

   Tighten

   6.1. Tighten the inlet hose (3) to 28 N·m (21 lb ft).

   6.2. Tighten the outlet hose (2) to 28 N·m (21 lb ft).
7. Lower vehicle.
8. Remove drain pan.
9. Refill and bleed power steering system. Refer to *Bleeding Power Steering System.*



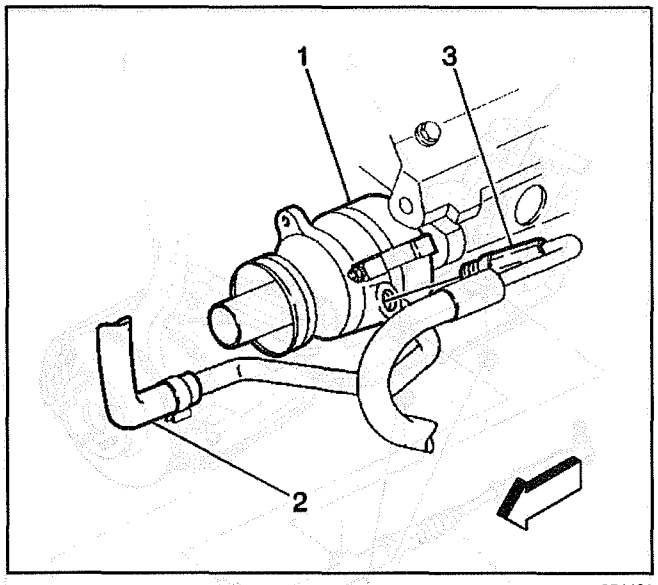
354423

Power Steering Gear Replacement (V6)

Removal Procedure

1. Place drain pan(s) under vehicle under steering gear and pump.
2. Raise and suitably support vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Remove power steering gear inlet (3) and outlet (2) hoses from steering gear (1).

4. Lower vehicle.
5. Remove the serpentine belt.
6. Remove the power steering pump pulley. Refer to *Power Steering Pulley Replacement.*
7. Remove inlet hose fitting (3) from pump (1).
8. Remove outlet hose from reservoir.

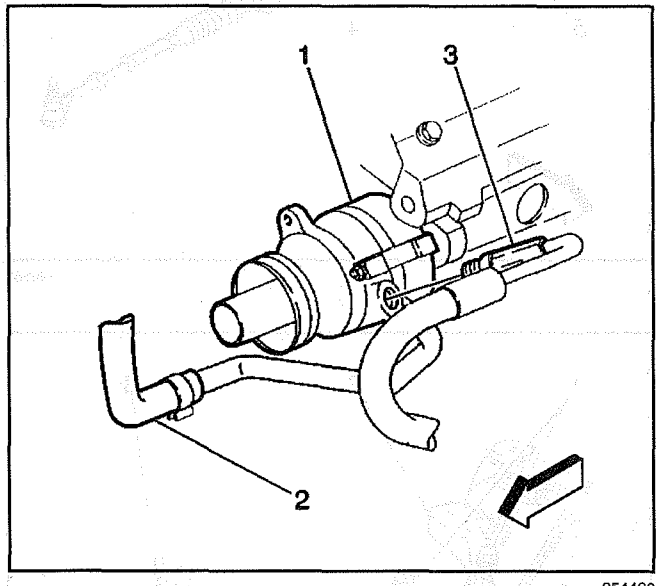


354420

Installation Procedure

Important: Inlet and outlet hoses must be oriented so as adequate clearance is maintained between both hoses and surrounding components to prevent chafing. Use minimum clearance of 12 mm (0.47 in). The outlet hose must not be twisted during installation. Do not bend or distort inlet and outlet hoses to make installation easier. Failure to follow these procedures could result in component damage.

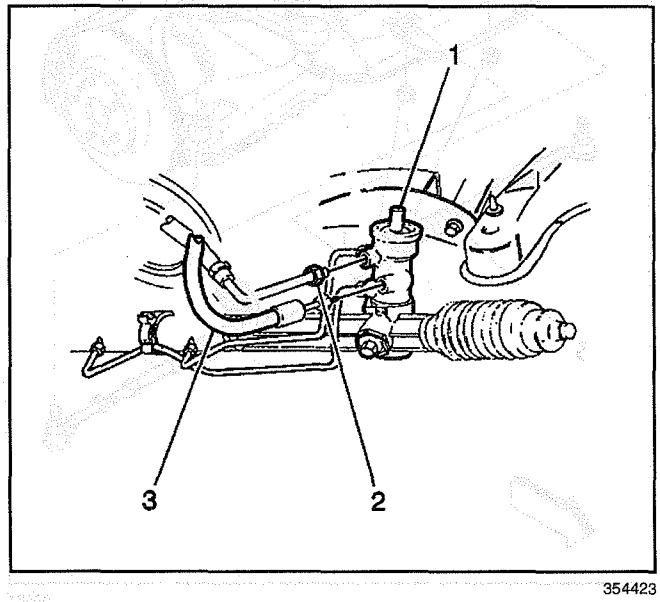
1. Install outlet hose to reservoir.
2. Install inlet hose fitting (3) to pump (1).
3. Install the power steering pump pulley. Refer to *Power Steering Pulley Replacement.*
4. Install the serpentine belt.
5. Raise and suitably support vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.



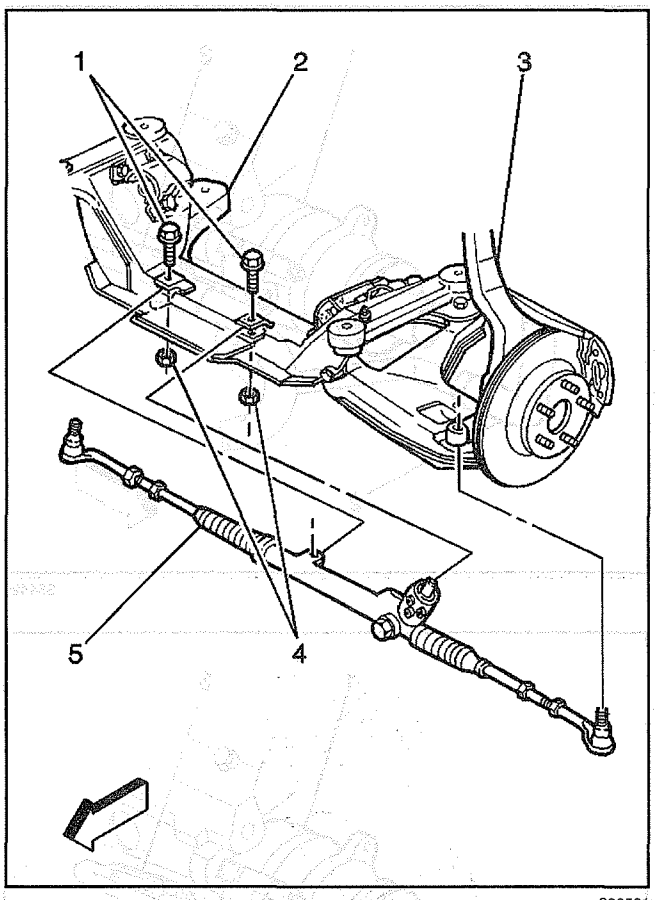
354420

Notice: Refer to *Fastener Notice* in Cautions and Notices.

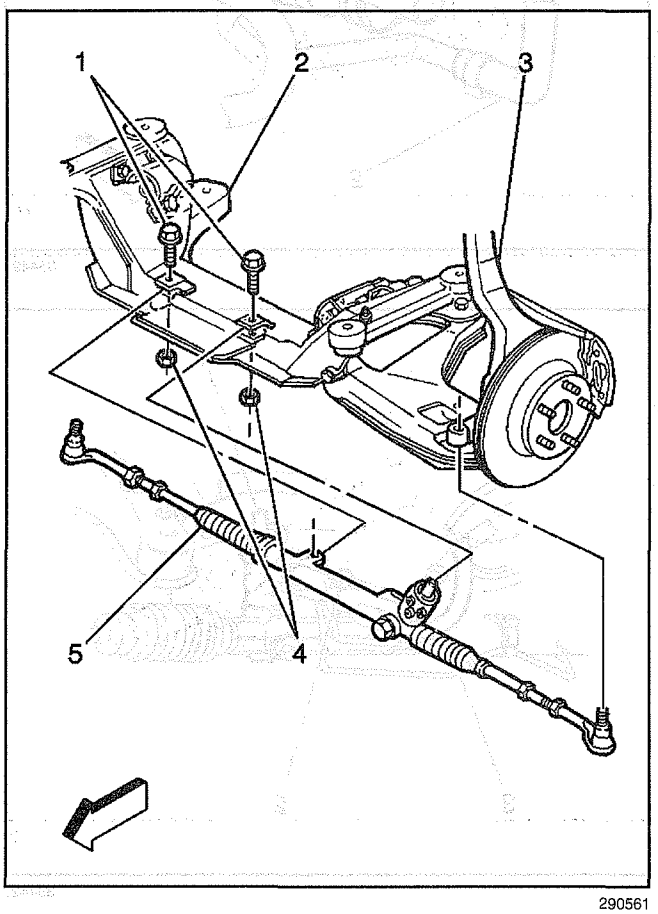
6. Install inlet and outlet hoses (2, 3) to steering gear (1).
   Tighten
   - Tighten the inlet hose (3) to 28 N·m (21 lb ft).
   - Tighten the outlet hose (2) to 28 N·m (21 lb ft).
7. Lower vehicle.
8. Remove drain pan.
9. Refill and bleed power steering system. Refer to *Bleeding Power Steering System.*



354423



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290561

Power Steering Gear Replacement (V8)

Removal Procedure

1. Remove the air intake resonator.
2. Remove the serpentine belt.
3. Support the engine with a hydraulic jack.
4. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
5. Remove the tires and wheels. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
6. Place a drain pan under the steering gear (5).
7. Disconnect the steering gear outer tie rods.
8. Remove the generator.
9. Remove the left-side engine mount through bolt.
10. Lower the vehicle.
11. Raise the engine with the hydraulic jack.
12. Disconnect the following hoses from the steering gear (5):
    - The power steering gear inlet hose
    - The power steering gear outlet hose
13. Remove the steering gear flexible coupling from the steering gear (5). Refer to *Intermediate Steering Shaft Replacement* in Steering Wheel and Column.
14. Remove the nuts (4) and bolts/screws (1).
15. Remove the steering gear (5).

Installation Procedure

1. Position the steering gear (5) to the crossmember (2).
2. Adjust the steering gear (5).
   Ensure that the steering aligns as straight as possible with the steering gear coupling shaft.
3. Hand start the bolts (1) and nut (4).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Position the back-up wrench to the nuts (4).
   Tighten
   Tighten the bolts to 85 N·m (63 lb ft).
5. Install the steering gear flexible coupling to the steering gear. Refer to *Intermediate Steering Shaft Replacement* in Steering Wheel and Column.
   Tighten
   Tighten the bolts to 47 N·m (35 lb ft).
6. Connect the following hoses to the steering gear (5).
   Tighten
   6.1. Tighten the inlet hose to 28 N·m (21 lb ft).
   6.2. Tighten the outlet hose to 28 N·m (21 lb ft).
7. Lower the vehicle. Allow the vehicle to stay slightly above the ground while the tires and wheels are not installed.

8. Lower the engine with the hydraulic jack.
9. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle*.
10. Install the left side engine mount through-bolt.
11. Install the generator.
12. Connect the steering gear outer tie rods to the steering knuckles.
13. Install the tire and wheels. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
14. Lower the vehicle.
15. Remove the hydraulic jack supporting the engine.
16. Install the serpentine belt.
17. Install the air intake resonator.
18. Refill and bleed the power steering system. Refer to *Bleeding Power Steering System*.

Rack and Pinion Gear Rack Bearing Preload Adjustment - Off Vehicle (Quiet Valve)

Adjustment Procedure

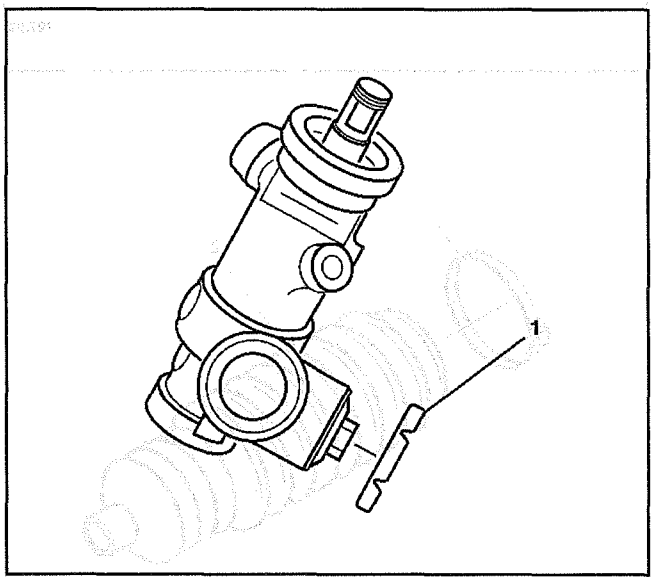
1. Loosen the adjuster plug lock nut (1).
2. Turn the adjuster plug clockwise until the adjuster plug bottoms in the gear assembly.
3. Turn the adjuster plug back 50 degrees to 70 degrees (approximately one flat).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the adjuster plug lock nut (1) to the adjuster plug. Hold the adjuster plug stationary while tightening the adjuster plug lock nut (1)

   Tighten

   Tighten the lock nut to 75 N·m (55 lb ft).



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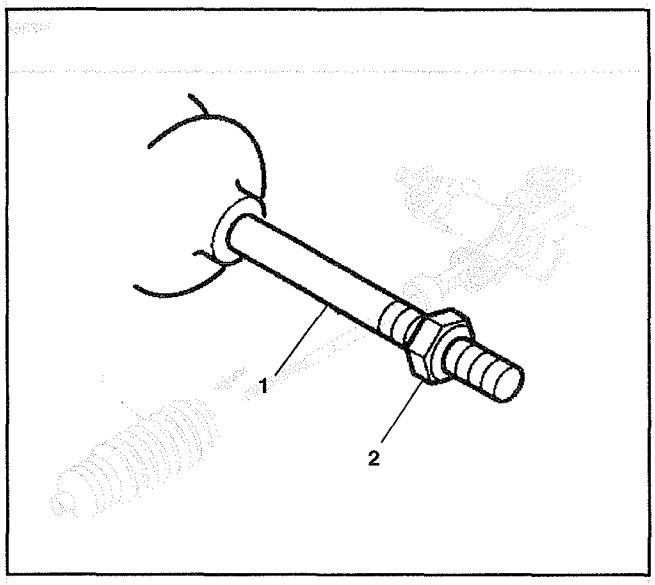
Rack and Pinion Boot Replacement - Off Vehicle (Quiet Valve)

Disassembly Procedure

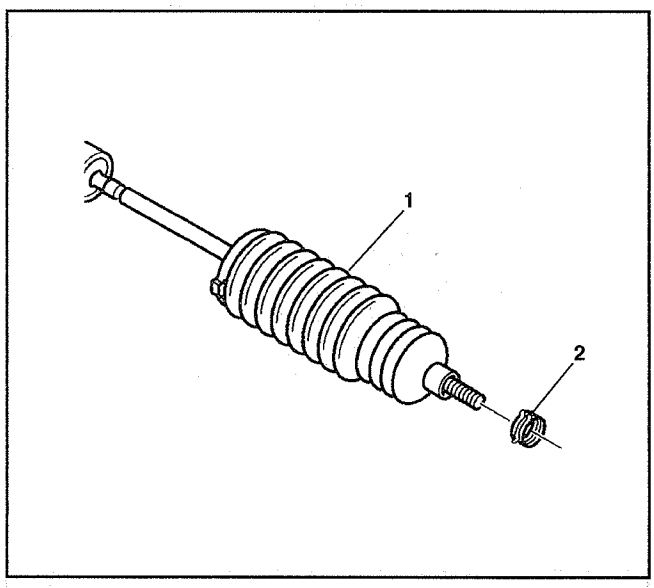
Tools Required

J 22610 Service Boot Clamp Installer

1. Remove the outer tie rod. Refer to *Tie Rod End Replacement - Outer - Off Vehicle*.
2. Remove the hex jam nut (2) from the inner tie rod assembly (1).

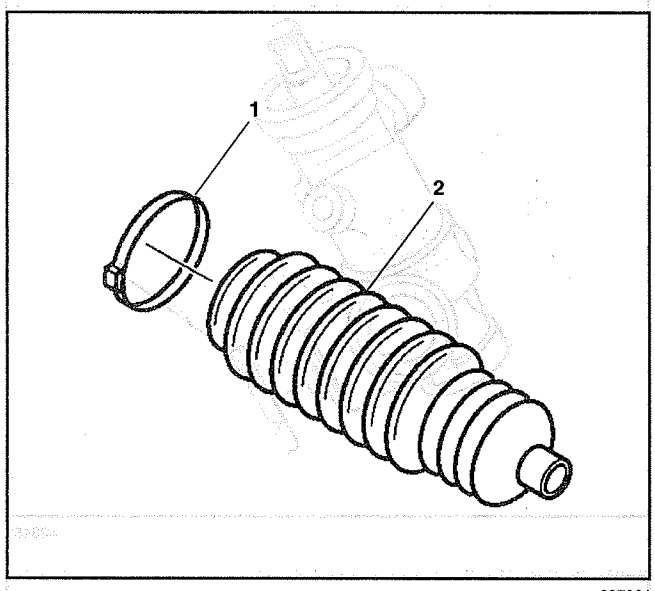


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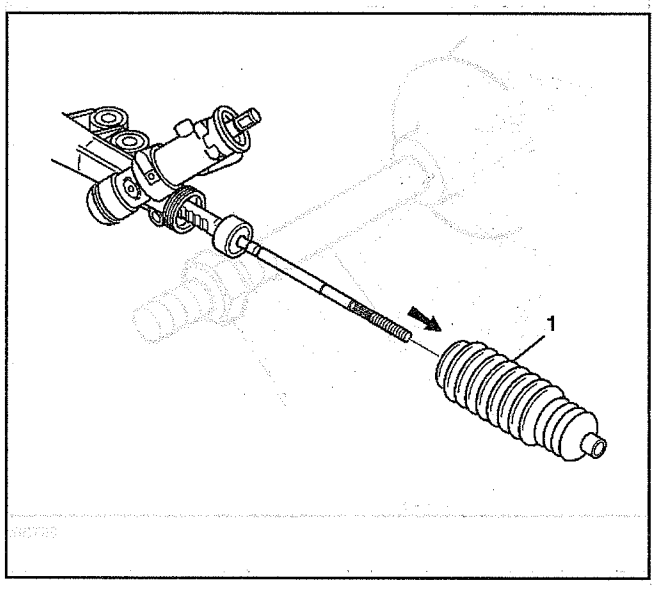
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3. Remove the tie rod end clamp (2) from the rack and pinion boot (1).



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4. Remove the boot clamp (1) from the rack and pinion boot (2) with side cutters.



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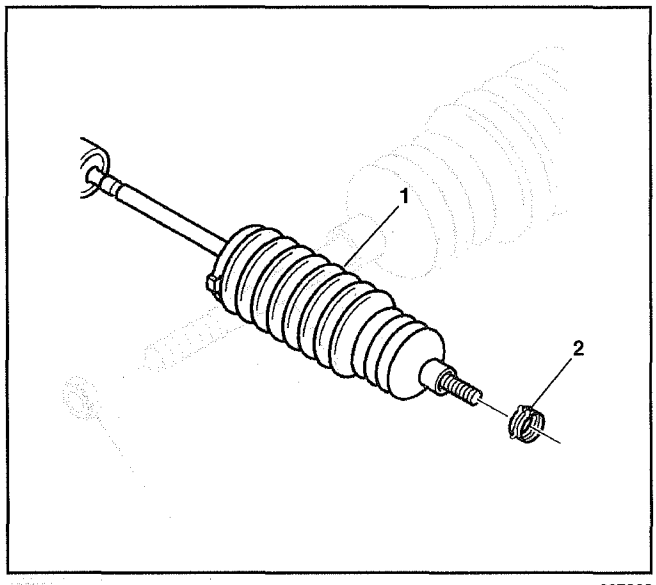
5. Remove the rack and pinion boot (1) from the rack and pinion gear assembly.
6. Discard the boot clamp.
7. Inspect the rack and pinion boot (1) for damage.
8. Look for gear oil leakage inside the rack and pinion boot (1).
9. Drain the oil.
10. Clean the rack and pinion boot (1) with solvent.

Assembly Procedure

Tools Required

J 22610 Service Boot Clamp Installer

1. Install the new boot clamp (2) onto the rack and pinion boot (1).

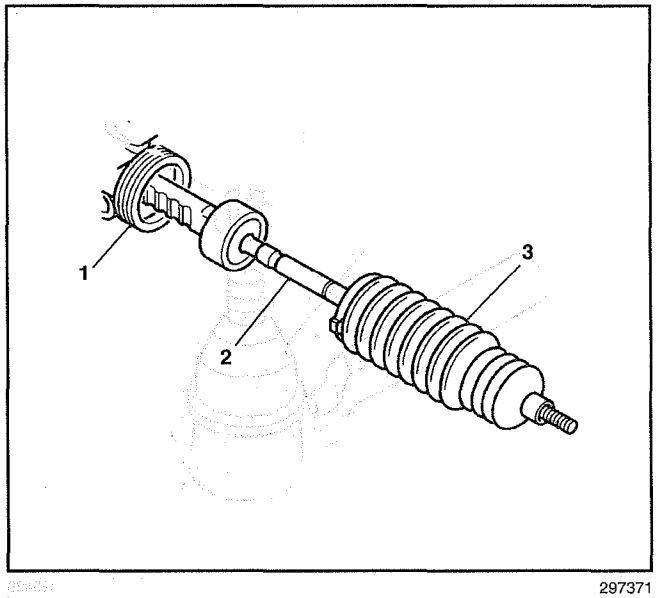


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2. Prior to rack and pinion boot installation, apply grease to the inner tie rod assembly (2) and the rack and pinion gear assembly (1).
3. Install the rack and pinion boot (3) onto the inner tie rod assembly (2).

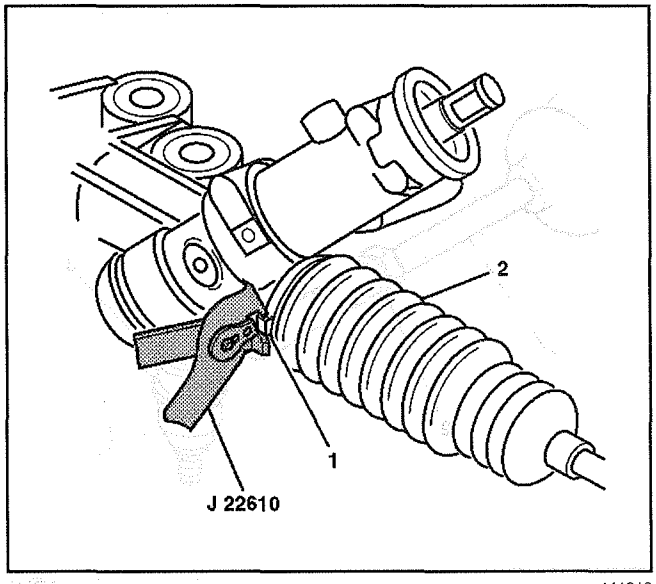
Important: The rack and pinion boot (3) must not be twisted, puckered or out of shape. If the rack and pinion boot (3) is not shaped properly, adjust the rack and pinion boot by hand before installing the boot clamp.

4. Install the rack and pinion boot onto the gear assembly (1) until the rack and pinion boot (3) is seated in the gear assembly groove.

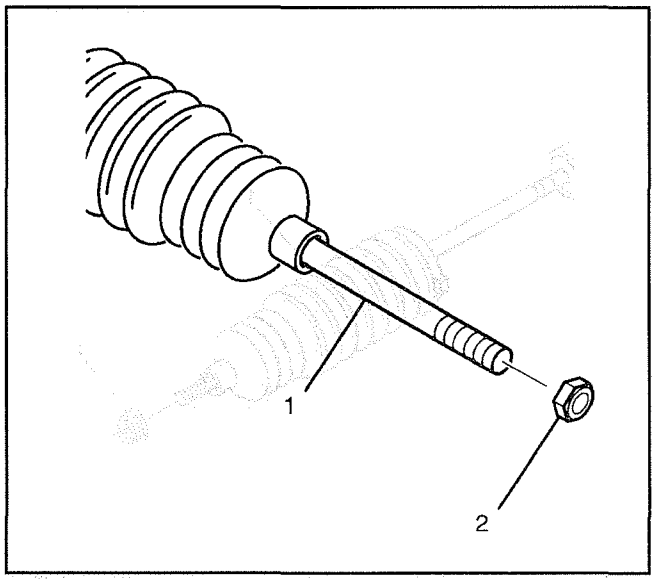


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5. Install the boot clamp (1) on the rack and pinion boot (2) with *J 22610*.
6. Crimp the boot clamp (1).
7. Pinch the pliers together on the rack and pinion boot (2) in order to install the tie rod end clamp.

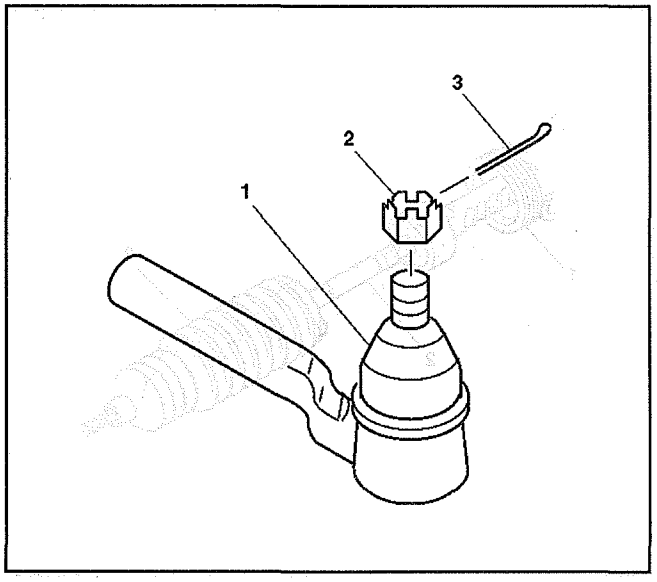


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8. Install the hex jam nut (2) to the inner tie rod assembly (1).
9. Assemble the outer tie rod assembly. Refer to *Tie Rod End Replacement - Outer - Off Vehicle*.



423439

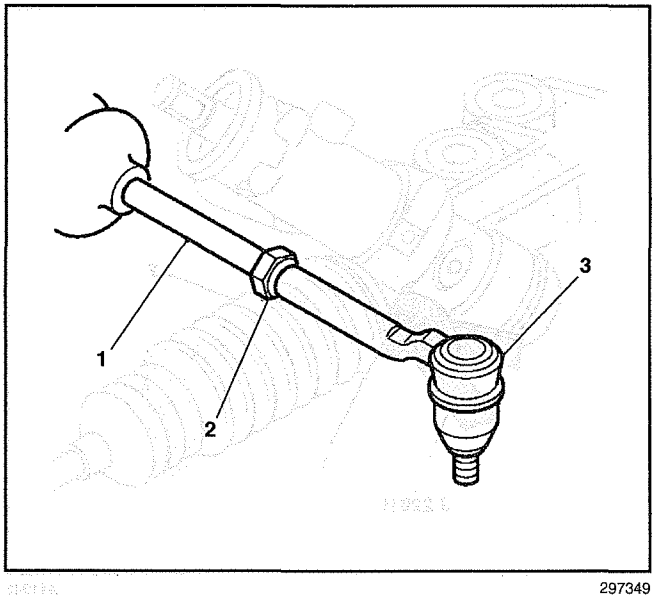
Tie Rod End Replacement - Outer - Off Vehicle

Disassembly Procedure

Tools Required

J 24319-01 Universal Steering Linkage Puller

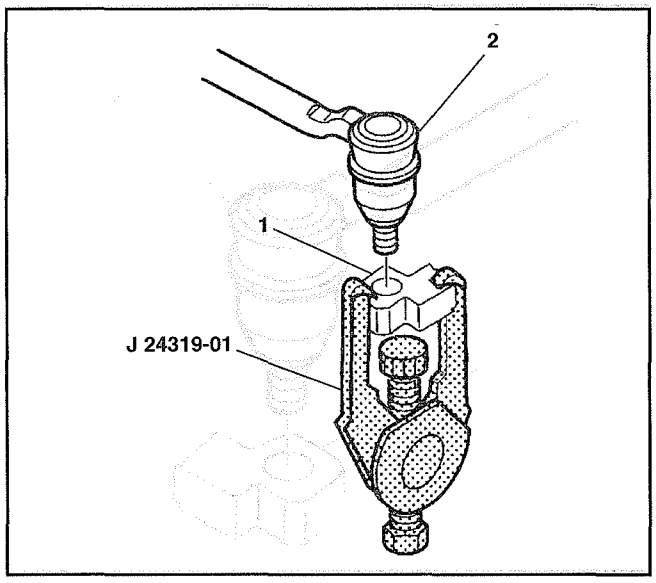
1. Pull the cotter pin (3) and the hex slotted nut (2) from outer tie rod assembly (1).



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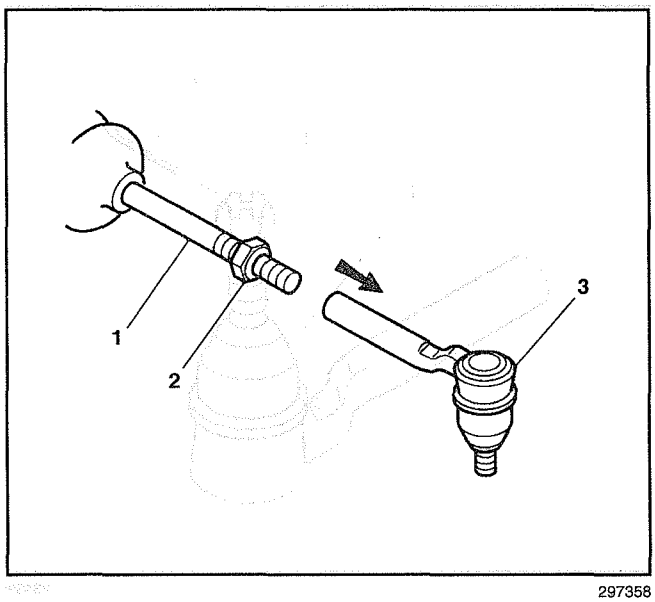
2. Loosen the jam nut (2) on the inner tie rod assembly (1).

3. Remove the outer tie rod assembly (2) from the steering knuckle (1) using *J 24319-01*.



297353

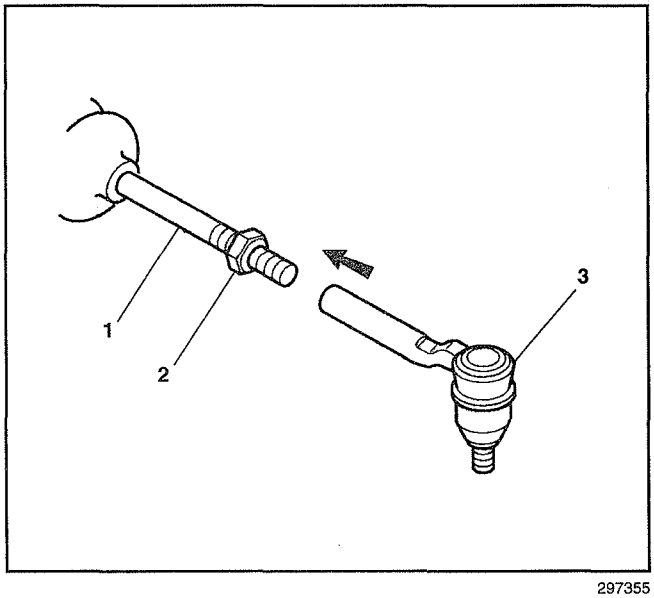
4. Remove the outer tie rod assembly (3) from the inner tie rod assembly (1).



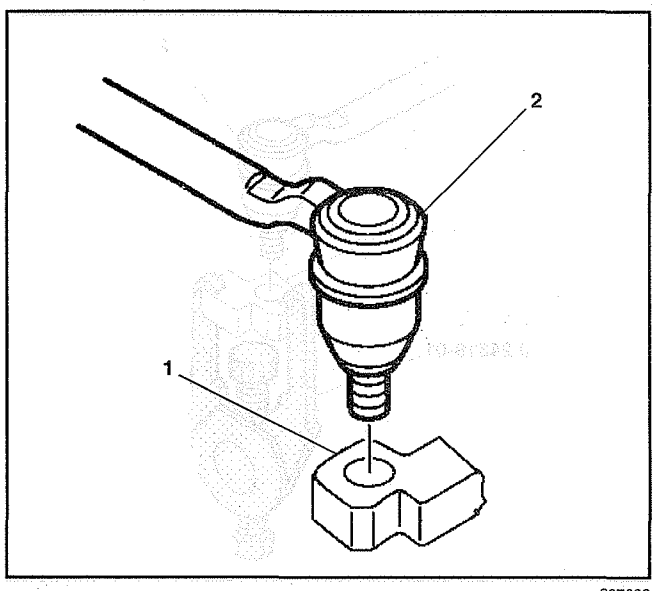
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Assembly Procedure

1. Connect the outer tie rod assembly (3) to the inner tie rod (1). Do not tighten the jam nut (2).

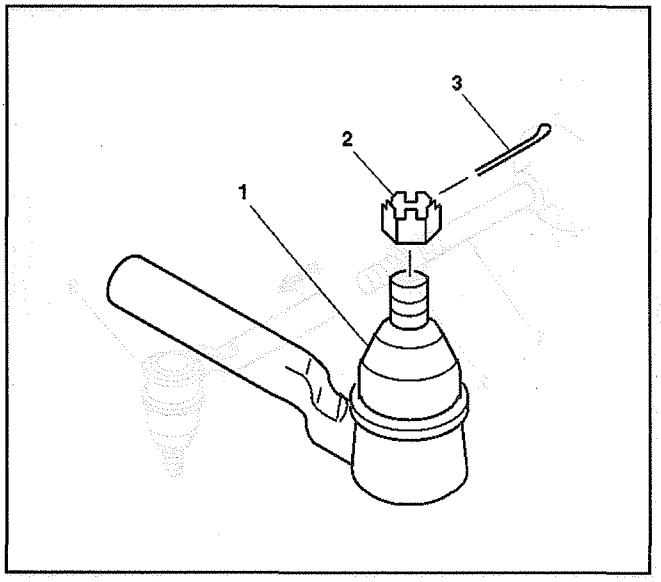


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2. Connect the outer tie rod assembly (2) to the steering knuckle (1).



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3. Connect the hex slotted nut (2) to the outer tie rod stud (1).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

Tighten

Tighten the hex slotted nut (2) to 47 N·m (35 lb ft). Align the cotter pin slot by tightening the hex slotted nut (2) up to 1/6 additional turn, or 70 N·m (52 lb ft) maximum. Do not back off the hex slotted nut (2) for the cotter pin (3) insertion.

4. Install the cotter pin (3) into the hole in the tie rod stud.

Important: Be sure the rack and pinion boot is not twisted or puckered during toe adjustment.

5. Adjust the toe by turning the inner tie rod. Follow recommended manufacturer specifications.

Tighten

Tighten the hex jam nut against the outer tie rod to 68 N·m (50 lb ft).

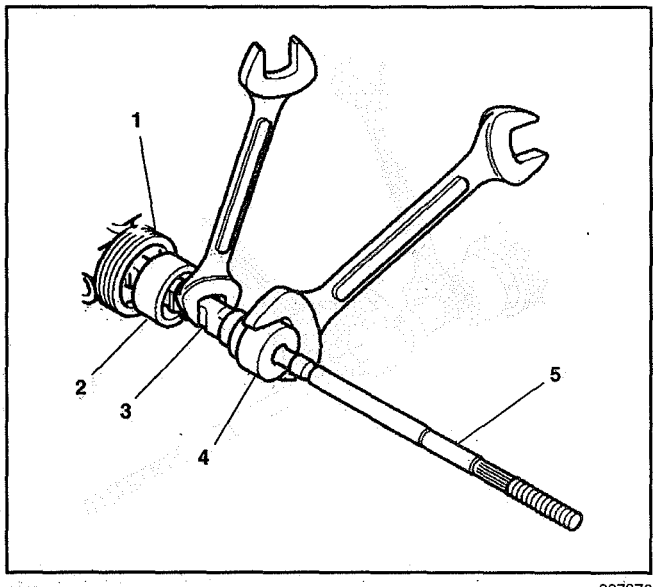
Tie Rod Replacement - Inner

Disassembly Procedure

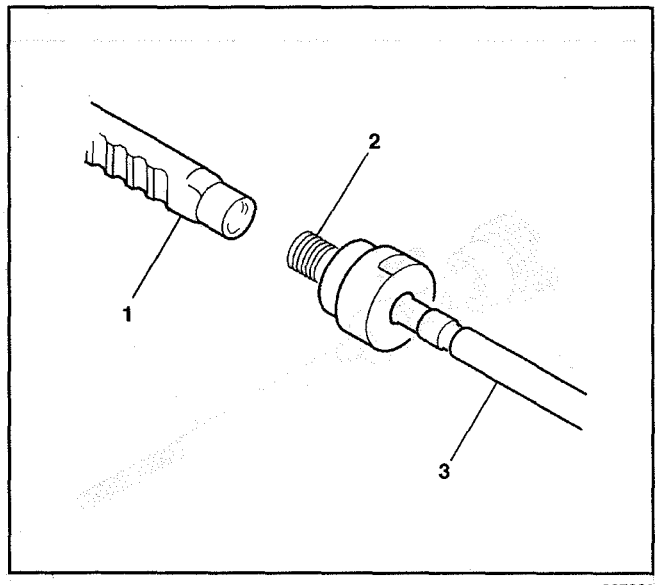
1. To remove the rack and pinion boot; refer to *Rack and Pinion Boot Replacement - Off Vehicle (Quiet Valve).*

Important: The rack must be held during removal and installation of the inner tie rod to prevent damage to the rack.

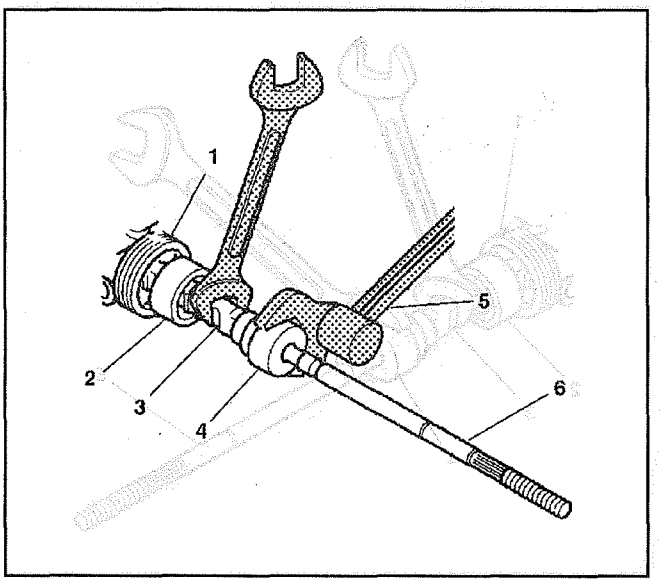
2. Remove the shock dampener (2) from the inner tie rod assembly (5).
3. Slide the shock dampener (2) back on the rack (1).
4. Remove the inner tie rod assembly (5) from the rack assembly (1) as follows:
   4.1. Place a wrench on flats of rack assembly (3).
   4.2. Place another wrench on the flats of the inner tie rod housing (4).
   4.3. Rotate the inner tie rod housing (4) counterclockwise until the inner tie rod (5) separates from the rack (1).
5. Remove the old Loctite® from the threads (2) of the rack (1) and the inner tie rod (3).



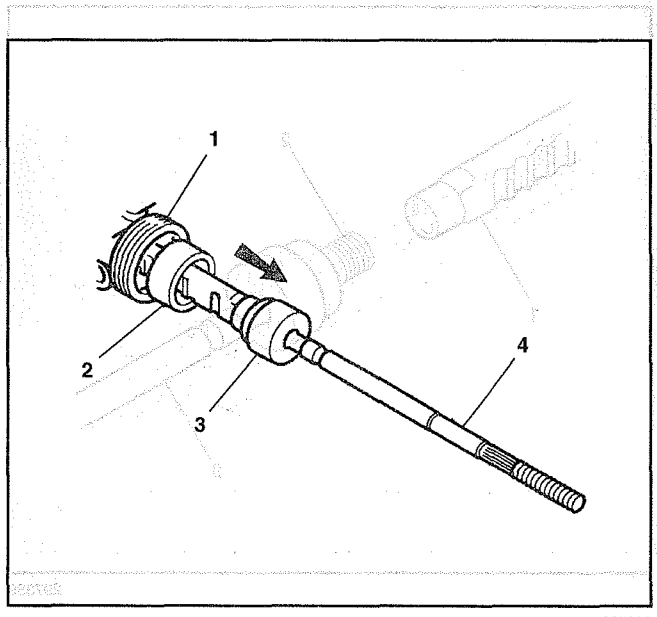
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Assembly Procedure

Important: The rack must be held during removal and installation of the inner tie rod to prevent damage to the rack.

1. Slide the shock dampener (2) forward onto the rack (1).

Important: Threads must be clean prior to Loctite® application. Check Loctite® (or equivalent) container for expiration date. Use only enough Loctite® to evenly coat threads.

2. Apply Loctite® 262 (or equivalent) to the inner tie rod threads.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Attach the inner tie rod (6) on the rack (1) as follows:
   - 3.1. Place a wrench on the flats of the rack assembly (3).
   - 3.2. Place a torque wrench (5) on the flats of the inner tie rod housing (4).

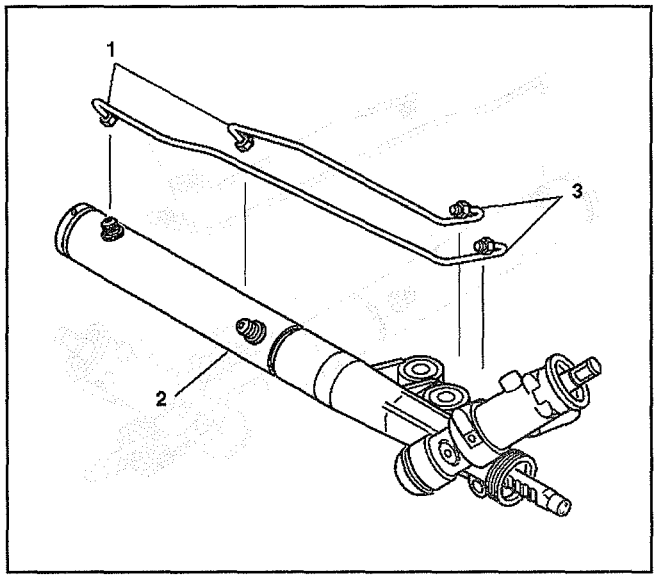
   Tighten

   Inner tie rod to 100 N·m (74 lb ft).
4. Slide the shock dampener (2) over the inner tie rod housing (3) until the front lip of the shock dampener (2) bottoms against the inner tie rod housing (3).
5. To assemble the rack and pinion boot; refer to *Rack and Pinion Boot Replacement - Off Vehicle (Quiet Valve).*

Steering Gear Cylinder Pipe Assemblies/O-Ring Seals Replacement - Off Vehicle (Quiet Valve)

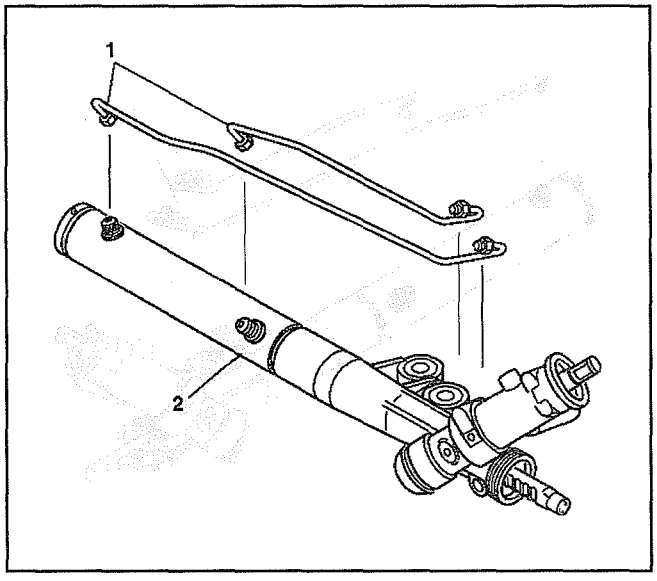
Disassembly Procedure

1. Loosen both cylinder line fittings (1) on the cylinder end of the gear assembly (2).
2. Loosen both fittings on the cylinder line assemblies (3) at the valve end of the gear assembly (2).



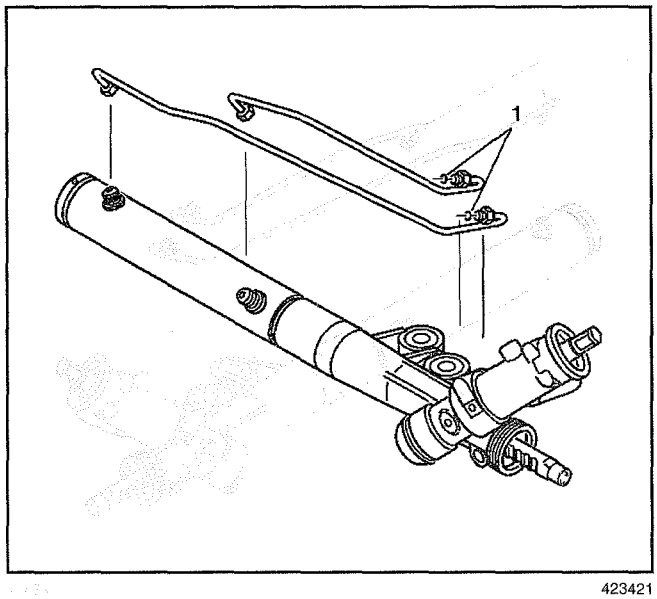
423409

3. Remove both cylinder line assemblies (1) from the rack and pinion gear assembly (2).

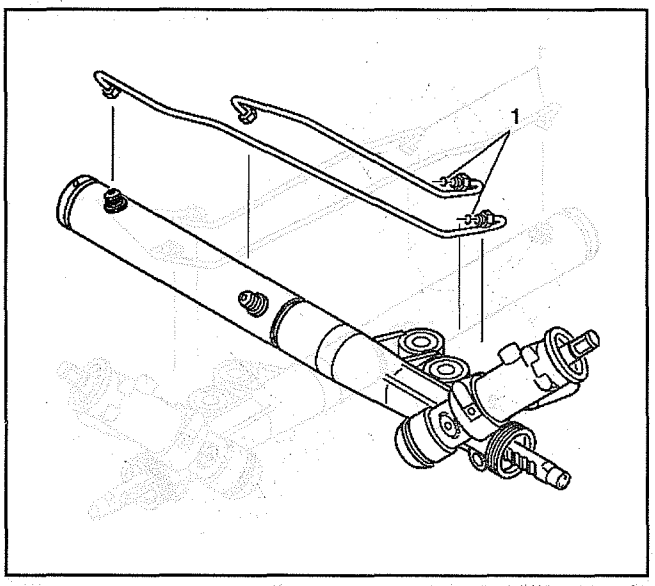


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4. Remove the O-ring seals (1) from the valve end of line.
5. Discard the O-ring seals (1).



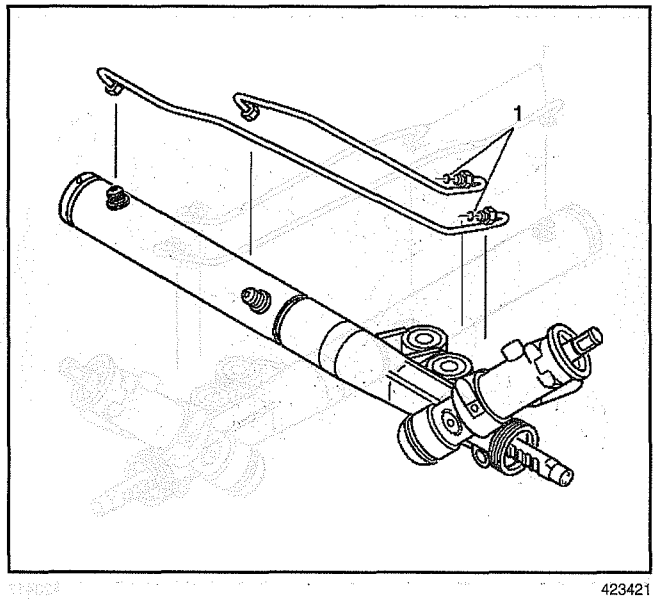
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Assembly Procedure

1. Inspect the cylinder lines (1) for the following items:
   - Cracks
   - Dents
   - Damage to the threads
2. Replace the parts as needed.

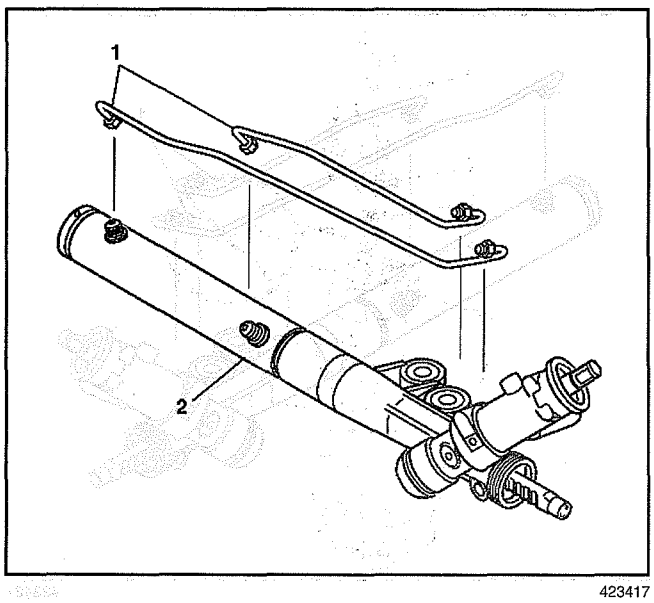


423421

3. Install the new O-ring seals (1) to the valve end of the cylinder lines.

Important: Carefully align the threads on all of the fittings.

4. Finger tighten the fittings in order to avoid stripping and cross-threading the fittings.



423417

5. Install the cylinder line assemblies (1) to the gear assembly (2).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

Tighten

Valve end fittings to 16.9 N·m (12.6 lb ft). Cylinder end fittings to 27 N·m (20 lb ft).

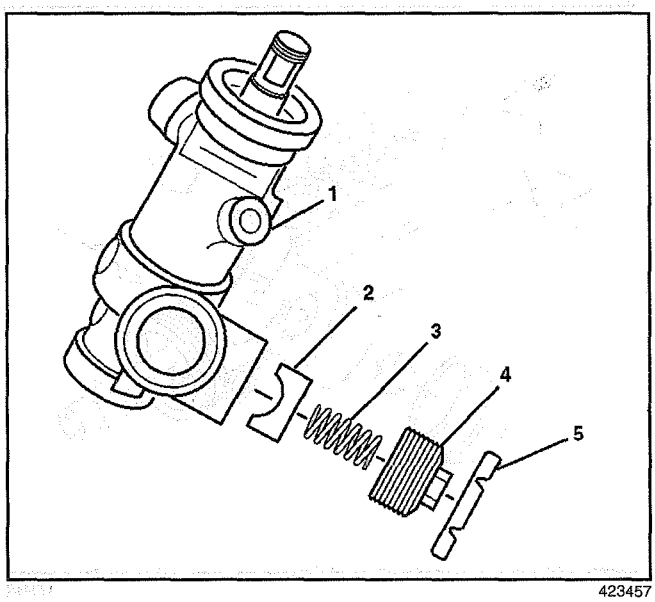
Important: Flush and bleed power steering system (hoses, reservoir and cooler lines) with power steering fluid GM Part #1050017 (or equivalent meeting GM Specification #9985010).

6. Flush and bleed power steering system. Refer to *Bleeding Power Steering System.*

Steering Gear Stub Shaft Seals and Bearing Replacement - Off Vehicle

Disassembly Procedure

1. Remove the adjuster plug lock nut (5) from the adjuster plug (4).
2. Remove the adjuster plug (4) from the gear assembly (1).
3. Remove the adjuster spring (3) and the rack bearing (2).

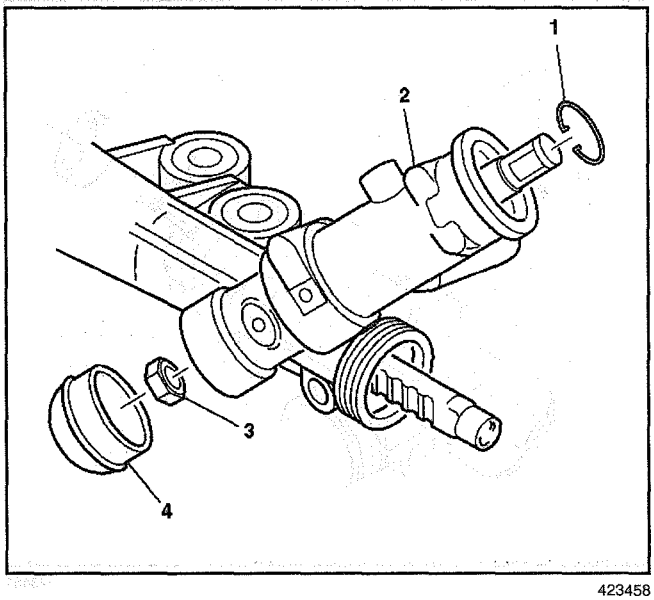


423457

4. Remove the retaining ring (1) from the valve bore of the rack and pinion gear assembly (2).
5. Remove the dust cover (4) from the bottom of the rack and pinion gear assembly (2).

Important: Hold the stub shaft in order to prevent damage to the pinion teeth.

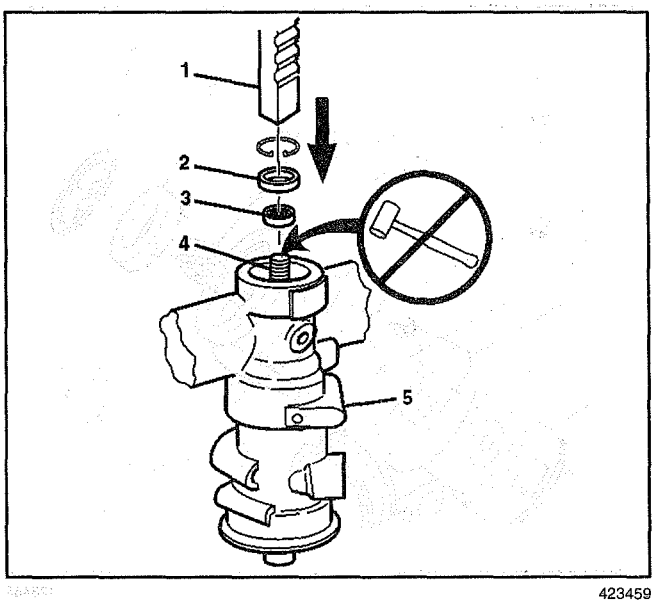
6. Remove the hex lock nut (3) from the lower end of the pinion and valve assembly while holding the stub shaft with a 14 mm crowfoot wrench.



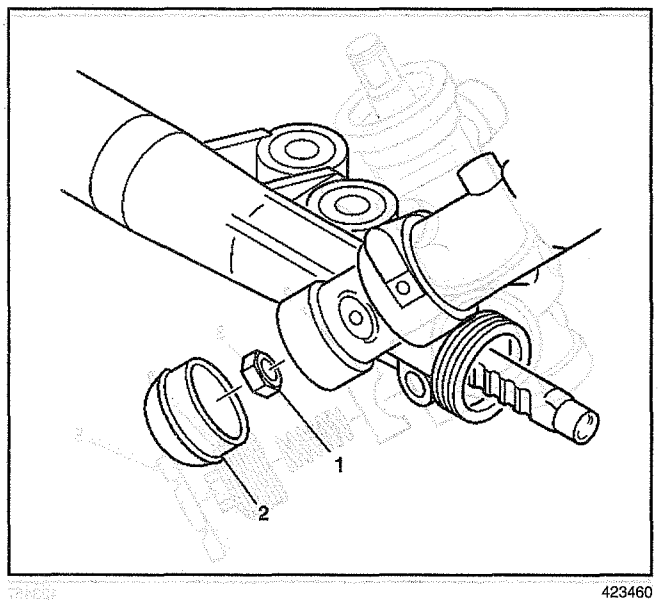
423458

Important: When performing the following procedure, do not remove pinion and valve assembly from the rack and pinion gear assembly (5). Press the pinion and valve assembly only far enough to allow removal of the stub shaft bearing annulus (2) and the stub shaft seal (2).

7. Using an arbor press (1), press on the threaded end of the pinion until removal of the following items is possible:
   - 7.1. The stub shaft (4)
   - 7.2. The stub shaft seal (3)
   - 7.3. The stub shaft bearing annulus assembly (2)



423459



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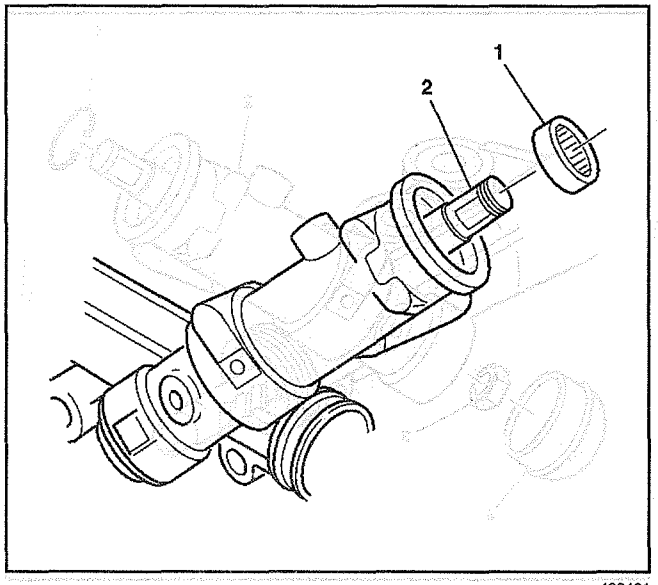
Assembly Procedure

Tools Required

J 29810 Stub Shaft Seal Protector

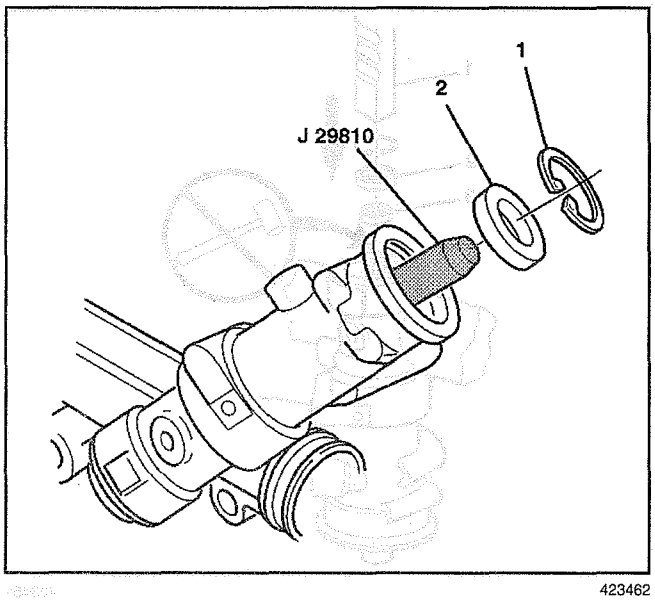
Important: Hold the stub shaft in order to prevent damage to the pinion teeth.

1. Install the hex lock nut (1) onto the pinion while holding the valve stub shaft.
2. Install the dust cover (2) to the rack and pinion gear assembly.



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3. Install the stub shaft bearing annulus assembly (1) onto the valve stub shaft (2).



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4. Install the *J 29810* onto the valve stub shaft.
5. Lubricate the stub shaft seal (2) with grease.
6. Install the stub shaft seal (2) into the rack and pinion gear assembly.
7. Install the retaining ring (1) into the groove in the rack and pinion gear assembly.

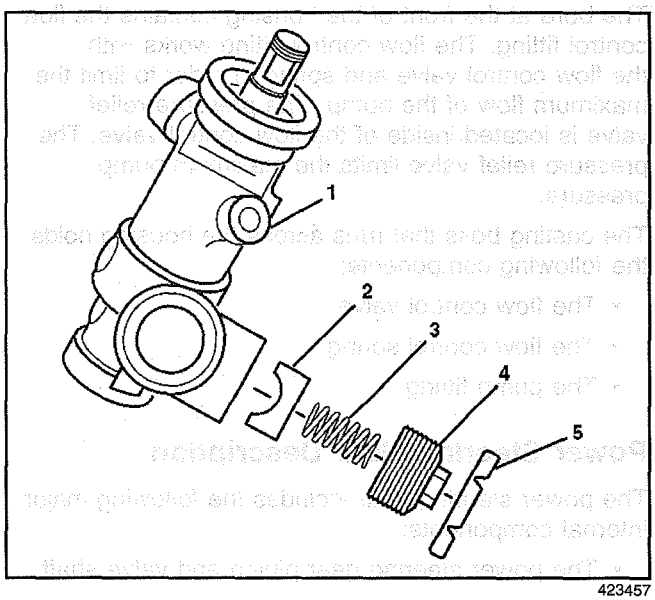
8. Lubricate the following items with lithium base grease:
   8.1. The rack bearing (2)
   8.2. The adjuster spring (3)
   8.3. The adjuster plug (4)
9. Install the following items into the gear assembly:
   9.1. The rack bearing (2)
   9.2. The adjuster spring (3)
   9.3. The adjuster plug (4)
10. Turn the adjuster plug (4) clockwise onto the rack and pinion gear assembly (1) until the adjuster plug (4) bottoms in the rack and pinion gear assembly (1), then turn the adjuster plug (4) back 50 degrees to 70 degrees.
11. Inspect the rotational torque on the pinion. The maximum pinion preload torque is 1.8 N·m (16 lb in).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

12. Install the adjuster plug lock nut (5) to the adjuster plug (4).

    Tighten

    Finger tighten the adjuster plug lock nut (5) while holding the adjuster plug (4) stationary.



423457

Description and Operation

Power Steering Pump Description

A constant displacement vane-type pump provides hydraulic pressure and flow for the power steering system. The pump is located on the engine and is belt driven by the serpentine belt through the power steering pulley. The power steering reservoir is integrally mounted on the LS1 V8 system (engine mounted) and is remote-mounted (radiator support mounted) on L36 V6 systems.

The power steering pump contains the following major components:

- The drive shaft
- The pump housing
- The pump fitting
- The flow control valve
- The flow control spring
- The thrust plates
- The pressure plates
- The pump ring
- The pump rotor
- The pump vanes

The power steering system has a remote reservoir. The reservoir cap has an attached fluid level indicator which shows the fluid level in the reservoir.

The bore at the front of the housing contains the flow control fitting. The flow control fitting works with the flow control valve and spring in order to limit the maximum flow of the pump. The pressure relief valve is located inside of the flow control valve. The pressure relief valve limits the maximum pump pressure.

The casting boss that runs across the housing holds the following components:

- The flow control valve
- The flow control spring
- The pump fitting

Power Steering Gear Description

The power steering gear includes the following major internal components:

- The power steering gear pinion and valve shaft
- The steering gear rack and piston
- The inner tie rods
- The outer tie rods

The steering gear rack and piston is supported at the ends in the steering gear housing. The steering gear rack and piston is sealed in order to prevent leakage across the piston. The pinion and valve intersects with the rack and piston and meshes directly with the teeth of the rack and piston.

Manual steering is always available during the following situations:

- When the engine is not running
- In the event of power steering pump failure
- In the event of serpentine belt failure

Steering effort is increased when the above conditions exists.

The power steering pump provides hydraulic pressure and fluid flow in order to move the gear components. This action occurs when the vehicle is parked or moving. The valve directs pressurized fluid during a steering maneuver. The fluid travels through the external steel cylinder lines in order to act on the rack and piston. When the vehicle is turned right, the steering valve opens and routes pressurized fluid to the left side of the piston. At the same time, the valve allows fluid to escape from the right side of the piston and return to the valve area. The fluid pressure is converted into a mechanical force which is applied to the piston. This difference in force across the piston causes the rack to move to the right. The opposite action occurs when the gear is turned to the left.

The effort to steer the vehicle is created by the pressure difference at the piston when the following conditions exist:

- The power steering pump (3) provides pressurized fluid to the gear.
- The valve is operating correctly.

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 of the pump. When leakage occurs in this area, always replace the seal or seals, after inspecting and thoroughly cleaning the sealing surface. 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 O-ring seal. Lubricate all new O-rings with fresh power steering fluid to ease installation.

Special Tools and Equipment

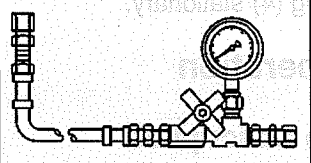
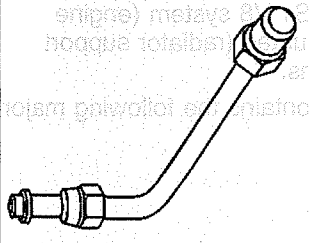
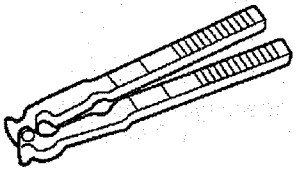
Illustration	Tool Number/ Description
 65360	J 5176-E Power Steering Pressure Tester
 293487	J 5176-92 Pressure Tester Adapter
 82243	J 22610 Keystone Clamp Plier

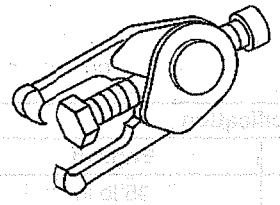
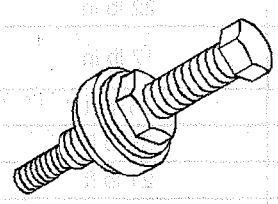
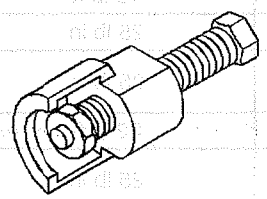
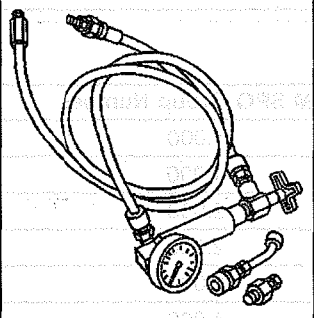
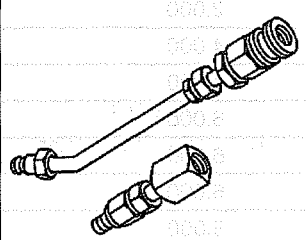
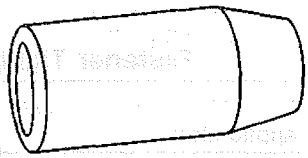
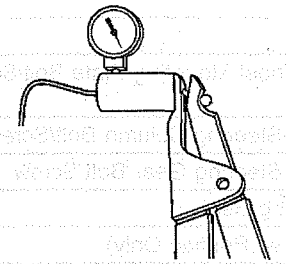
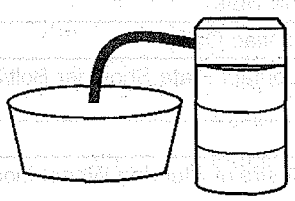
Illustration	Tool Number/ Description
 82244	J 24319-01 Universal Linkage Puller
 676	J 25033-C Power Steering Pump Pulley Installer
 675	J 25034-C Power Steering Pump Pulley Remover
 315384	J 25323-D Power Steering System Analyzer
 309644	J 29525 Steering Analyzer Adapter (18 mm)

Illustration	Tool Number/ Description
 283637	J 29810 Stub Shaft Seal Protector
 444239	J 35555 Mity Vac
 443571	J 43485 Power Steering Bleeder Adapter

Steering Wheel and Column - Tilt

Specifications

Fastener Tightening Specifications

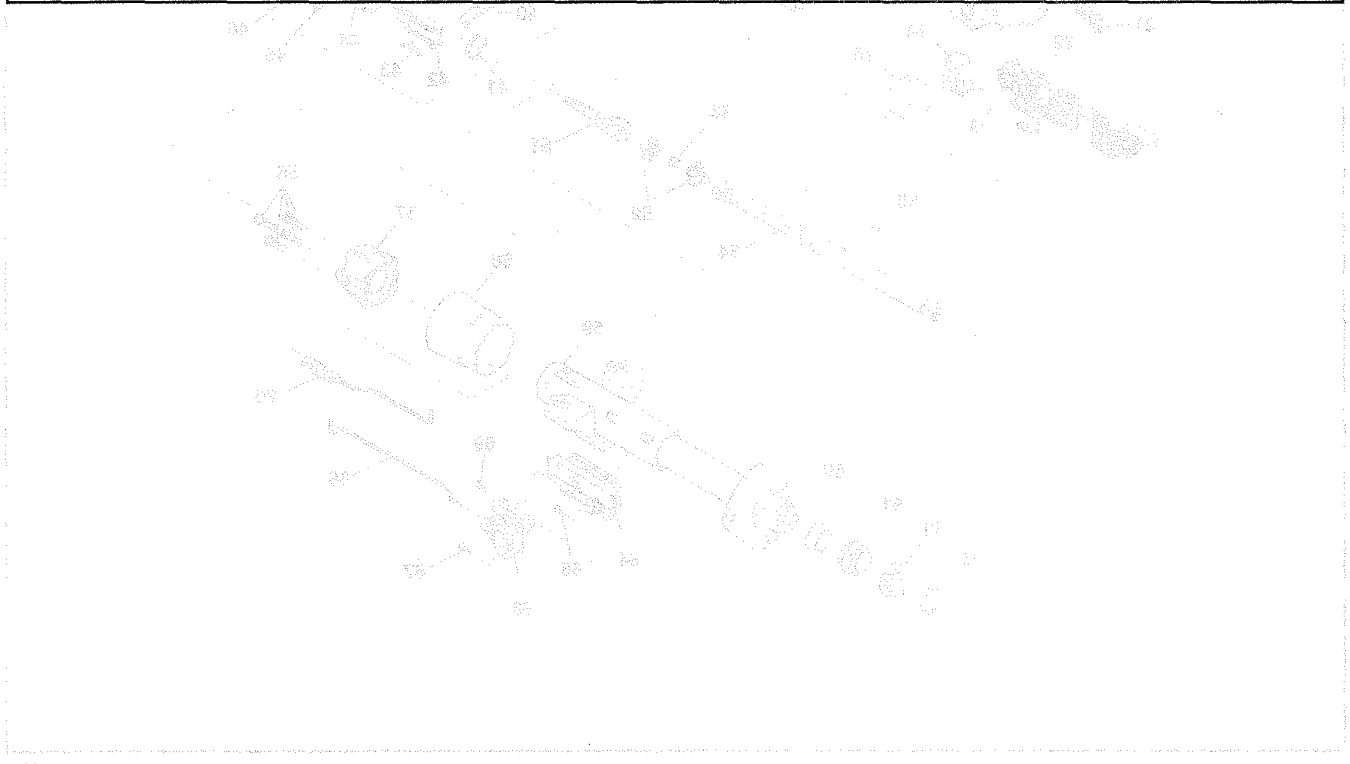
Application	Specification	
	Metric	English
Dimmer and Ignition Switch Bolts/Screws	4 N·m	35 lb in
Hazard Warning Switch Knob Bolt/Screw	0.7 N·m	6 lb in
Hydraulic Pump Fitting	75 N·m	55 lb ft
Hydraulic Pump Hose Fitting	28 N·m	21 lb ft
Ignition Switch Bolt/Screw	2.5 N·m	22 lb in
Inflatable Restraint Steering Wheel Mounting Plate Bolt/Screw (Pontiac Only)	1.9 N·m	17 lb in
Intermediate Steering Shaft-to-Steering Column Bolt/Screw	47 N·m	35 lb ft
Intermediate Steering Shaft-to-Steering Gear Bolt/Screw	47 N·m	35 lb ft
Power Steering Gear Pipe Fitting Seat	28 N·m	21 lb ft
Radio Control Switch Bolt/Screw (Pontiac Only)	1.9 N·m	17 lb in
Steering Column Bolts/Screws	18 N·m	14 lb ft
Steering Column Guide Bolt/Screw	25 N·m	18 lb ft
Steering Column Upper Support Nuts	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 Bolts/Screw (Chevrolet Only)	2.8 N·m	25 lb in
Steering Wheel-to-Steering Wheel Horn Switch Bolts/Screws (Chevrolet Only)	1.9 N·m	17 lb in

GM SPO Group Numbers

Application	GM SPO Group Number
BTSI Shift Lock Actuator	4.000
Cable Shift Cam Assembly	4.000
Dimmer Switch	2.000
Hazard Warning Switch	2.000
Ignition Switch Assembly	2.000
Linear Shift Assembly	4.000
Lock Bolt Spring	6.000
Lock Module Assembly	2.000
Shift Lever	4.000
Shift Lever Seal	4.000
Steering Column Assembly	6.000
Steering Column Boot Seal	6.000
Steering Column Housing	6.000
Steering Column Housing Support	6.000
Steering Column Jacket Assembly	6.000
Steering Column Lower Shroud	6.000
Steering Column Shift Lever Actuator	4.000
Steering Column Spring Guide	6.000
Steering Column Tilt Lever	6.000

GM SPO Group Numbers (cont'd)

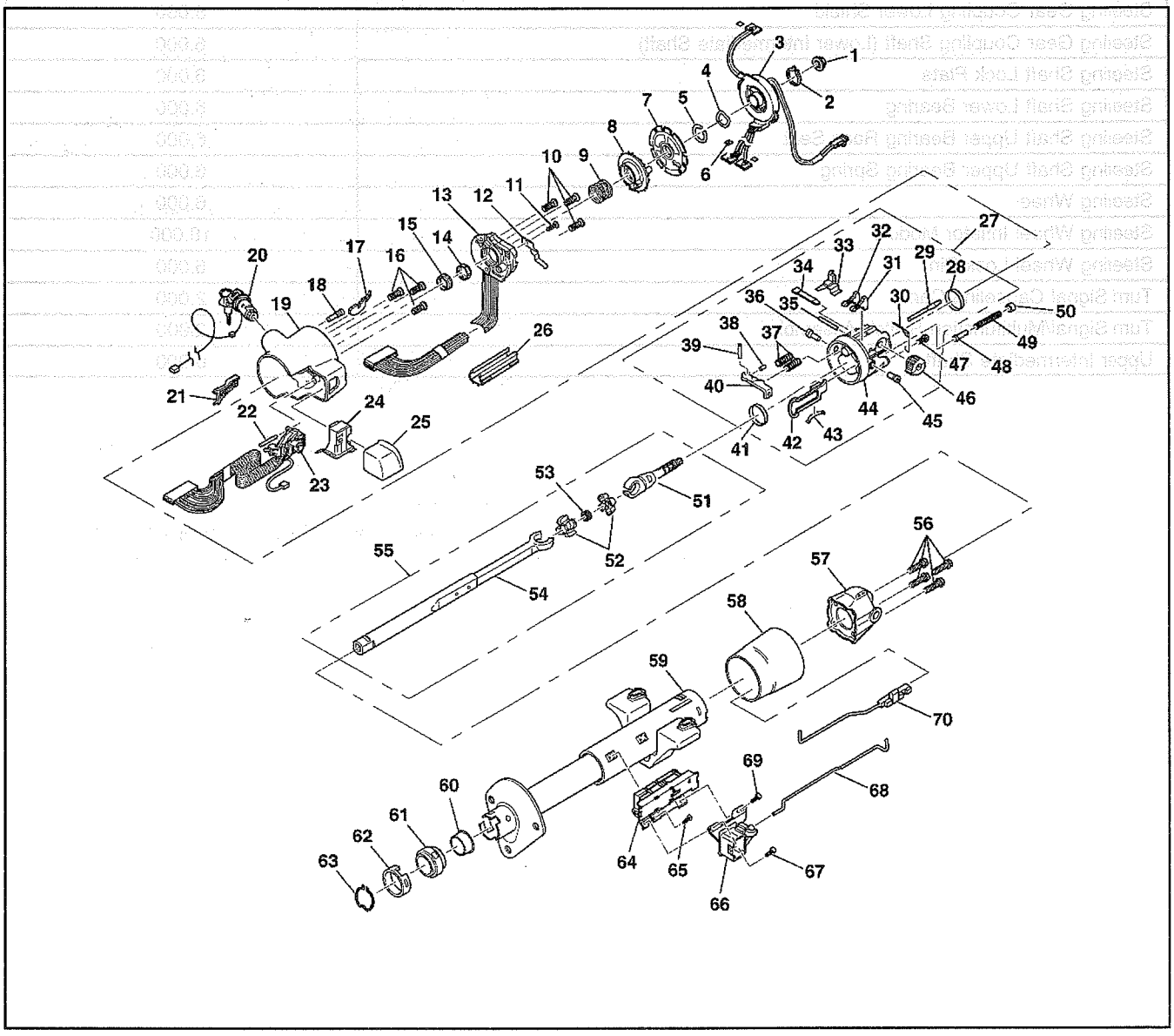
Application	GM SPO Group Number
Steering Column Tilt Spring	6.000
Steering Column Upper Shroud	6.000
Steering Gear Coupling Lower Shield	6.000
Steering Gear Coupling Shaft (Lower Intermediate Shaft)	6.000
Steering Shaft Lock Plate	6.000
Steering Shaft Lower Bearing	6.000
Steering Shaft Upper Bearing Race Seat	6.000
Steering Shaft Upper Bearing Spring	6.000
Steering Wheel	6.000
Steering Wheel Inflator Module	16.000
Steering Wheel Lock Pin	6.000
Turn Signal Canceling Cam	2.000
Turn Signal/Multifunction Switch Assembly	2.000
Upper Intermediate Shaft	6.000



Visual Identification

Steering Column - Disassembled View

Tilt Steering Column



393980

Legend

(1) Flanged Prevailing Torque Nut
(2) Retaining Ring
(3) SIR Coil Assembly
(4) Wave Washer
(5) Bearing Retainer
(6) Connector Shroud
(7) Shaft Lock Shield Assembly
(8) Turn Signal Cancel Cam Assembly
(9) Upper Bearing Spring
(10) Pan Head 6–Lobed Socket Screw
(11) Round Washer Head Screw
(12) Signal Switch Arm Assembly
(13) Turn Signal Switch Assembly
(14) Upper Bearing Inner Race Seat
(15) Inner Race
(16) Pan Head 6–Lobed Socket Screw
(17) Buzzer Switch Assembly
(18) Lock Retaining Screw
(19) Lock Housing Cover and Sleeve Assembly
(20) Steering Column Lock Cylinder Set
(21) Dimmer Switch Rod Actuator
(22) Switch Actuator Pivot Pin
(23) Pivot and Pulse Switch Assembly
(24) Column Housing Cover End Base Plate

(25) Column Housing Cover End Cap
(26) Wiring Protector
(27) Steering Column Housing Assembly
(28) Bearing Assembly
(29) Lock Bolt
(30) Lock Bolt Spring
(31) Steering Wheel Lock Shoe
(32) Steering Wheel Lock Shoe
(33) Wire Protector Shield
(34) Drive Shaft
(35) Dowel Pin
(36) Pivot Pin
(37) Shoe Spring
(38) Release Lever Spring
(39) Release Lever Pin
(40) Shoe Release Lever
(41) Bearing Assembly
(42) Switch Actuator Rack
(43) Rack Preload Spring
(44) Steering Column Housing
(45) Pivot Pin
(46) Switch Actuator Sector
(47) Hexagon Washer Head Screw
(48) Spring Guide
(49) Wheel Tilt Spring
(50) Spring Retainer
(51) Race and Upper Shaft Assembly
(52) Centering Sphere
(53) Joint Preload Spring
(54) Lower Steering Shaft Assembly
(55) Steering Shaft Assembly
(56) Hexagon Washer Head Tapping Screw
(57) Steering Column Housing Support Assembly
(58) Steering Column Housing Shroud
(59) Steering Column Jacket Assembly
(60) Lower Bearing Adapter
(61) Bearing Assembly
(62) Bearing Adapter Retainer
(63) Lower Bearing Adapter Clip
(64) Ignition Switch Assembly
(65) Flat Head Screw
(66) Dimmer Switch Assembly
(67) Hexagon Washer Head Tapping Screw
(68) Dimmer Switch Rod
(69) Washer Head Screw
(70) Ignition Switch Rod Actuator Assembly

Diagnostic Information and Procedures

Lock System Does Not Unlock

Problem	Action
The lock system will not unlock.	Inspect the lock system for the following conditions: • A collapsed shear flange on the sector shaft • A damaged lock bolt • A damaged lock cylinder • A damaged housing • A damaged sector • A damaged rack • A damaged or incorrectly cut key

Lock System Does Not Lock

Problem	Action
The lock system will not lock.	Inspect the lock system for the following conditions: • A broken or worn lock bolt spring • A damaged sector • A damaged lock cylinder • A burr on the lock bolt • A damaged housing • A damaged rack • Interference between the bowl and the rack coupling • A stuck ignition switch • A restricted actuator rod • An incorrectly installed sector

Key Cannot Be Removed in the Off Lock Position

Problem	Action
The key cannot be removed in the OFF-LOCK position.	Inspect the column for the following conditions: • An incorrectly set ignition • A damaged lock cylinder

Lock Cylinder Can Be Removed Without Depressing Retainer

Problem	Action
The lock cylinder can be removed without depressing the retainer.	Inspect the lock cylinder for a missing lock cylinder retaining screw.

High Lock Effort Between the Off Lock Positions

Problem	Action
High effort is required in the lock cylinder between the OFF and OFF-LOCK positions.	Inspect the lock cylinder for a distorted rack.

High Lock Effort

Problem	Action
High lock effort is required.	Inspect the system steering for the following conditions: • A damaged lock cylinder • A damaged ignition switch • A broken or deformed rack preload spring • Burrs on the following components: – The sector – The rack – The housing – The support – The actuator rod coupling • A bent sector shaft • A damaged rack • A damaged or misadjusted park lock cable • Misalignment of the housing to the cover • A distorted coupling slot in the rack • A bent actuator rod • A bent ignition switch mounting bracket • A restricted actuator rod • A worn or damaged key

Noise in Steering Column

Problem	Action
There is noise in the steering column.	Inspect the steering column for the following conditions: • Loose joints from the steering column to the steering gear • An incorrectly aligned steering column • An unlubricated horn contact ring • A lack of grease on the bearings • Loose sight shields • A worn or broken upper or lower steering shaft bearing • An unseated lock plate retainer ring • An unlubricated spherical joint

High Steering Shaft Effort

Problem	Action
High steering shaft effort is required.	Inspect the steering system for the following conditions: • A misaligned steering column • An improperly installed or deformed dust seal • A damaged upper or lower steering shaft bearing • A flash on the inside diameter of the shift tube • A tight universal joint

Looseness in Steering Column

Problem	Action
There is a lash in the steering column.	Inspect the steering column for the following conditions: • Loose bolts/screws on the upper and lower bracket mounting of the instrument panel (IP)-to-steering column • Broken weld nuts on the jacket • A sheared IP upper bracket capsule • Loose shoes in the housing • Loose pivot pins • A loose lock pin in the housing support • Loose housing support bolts/screws • Loose bolts/screws on the steering column upper and lower bracket-to-jacket • Loose bolts/screws on the lower bracket-to-adapter and bearing mounting

Lower Housing Scraping Upper Housing

Problem	Action
The housing scrapes the bowl.	Inspect the steering column for the following conditions: • A bent bowl • A bowl that is not concentric to the hub • An improperly installed cover and housing end cap

Loose Steering Wheel

Problem	Action
The steering wheel is loose.	Inspect the steering column for the following conditions: • Excessive clearance between the holes in the housing or housing support and the pivot pin diameters • A damaged anti-lash spring in the spheres • A missing anti-lash spring in the spheres • The steering shaft upper bearing is not seated in the housing • A missing steering shaft upper bearing inner race • Loose housing support bolts/screws • A missing bearing preload spring • A broken bearing preload spring

Loose Steering Wheel (Every Other Tilt Position)

Problem	Action
The steering wheel is loose in every other tilt position.	Inspect the steering column for the following conditions: • A loose fit between the shoe and the pivot pins • The shoe is not free in the slot.

Steering Wheel Does Not Lock in Any Tilt Position

Problem	Action
The steering column does not lock in any tilt position.	Inspect the steering column for the following conditions: • A seized shoe on the pivot pin • Burrs or dirt on the shoe grooves • A weak shoe lock spring • A broken shoe lock spring

Steering Wheel Not Returning to Top Tilt Position

Problem	Action
The steering wheel fails to return to the top tilt position.	Inspect the steering column for the following conditions: • Bound up pivot pins • A broken wheel tilt spring • A weak wheel tilt spring • Tight turn signal switch wires

Noise When Tilting Steering Column

Problem	Action
There is noise when tilting the steering column.	Inspect the steering column for the following conditions: • Worn upper tilt bumpers • Rubbing of the shoe lock spring in the housing

Turn Signal Does Not Indicate Lane Change

Problem	Action
The turn signal does not indicate a lane change.	Inspect the steering column for the following conditions: • A broken lane change pressure pad • A broken lane change spring hanger • A broken lane change spring • A missing lane change spring • A misplaced lane change spring • A jammed base • Jammed wires

Turn Signal Switch Does Not Stay in Turn Position

Problem	Action
The turn signal does not stay in the turn position.	Inspect the steering column for the following conditions: • Foreign material impeding the movement of the yoke • Loose parts impeding the movement of the yoke • A broken detent • A broken canceling spring • A missing detent • A missing canceling spring Replace the switch if none of the above conditions are found.

Turn Signal Switch Does Not Cancel

Problem	Action
The turn signal does not cancel.	Inspect the steering column for the following conditions: • Loose switch mounting screws • A broken switch • Broken anchor bosses • A broken detent • A missing detent • An out-of-position detent • A broken return • A missing return • An out-of-position return • A broken canceling spring • A missing canceling spring • An out-of-position canceling spring • A worn canceling cam

Turn Signal Switch Difficult to Operate

Problem	Action
The turn signal is difficult to operate.	1. Inspect for the following conditions: • A loose turn signal switch arm • Loose springs • Misplaced springs • Foreign parts or material • Loose turn signal switch mounting screws 2. Replace the switch if the following conditions exist: • A broken yoke • A distorted yoke

Hazard Switch Cannot Be Turned Off

Problem	Action
The hazard switch cannot be turned off.	1. Inspect for foreign material between the hazard support canceling leg and the yoke. 2. Replace the turn signal switch if no foreign material is found.

Hazard Switch Does Not Stay On

Problem	Action
The hazard switch will not stay on or is difficult to turn off.	1. Inspect the steering column for the following conditions: • A loose turn signal switch • Interference with other components • Interference from foreign material 2. Replace the turn signal switch if none of the above conditions are found.

Ignition Switch Electrical System Does Not Operate

Problem	Action
The electrical system does not function properly.	Inspect the steering column for the following conditions: • A damaged ignition switch • An improperly adjusted ignition switch • A loose connector at the ignition switch

Ignition Switch Does Not Turn

Problem	Action
The ignition switch does not turn.	Inspect the steering column for the following conditions: • A damaged ignition switch • An improperly adjusted ignition switch • A loose connector at the ignition switch

Ignition Switch Cannot Be Set Correctly

Problem	Action
The ignition switch cannot be correctly set.	Inspect the steering column for the following conditions: • A deformed switch actuator rod • A sector to rack engaged in the wrong tooth

Repair Instructions

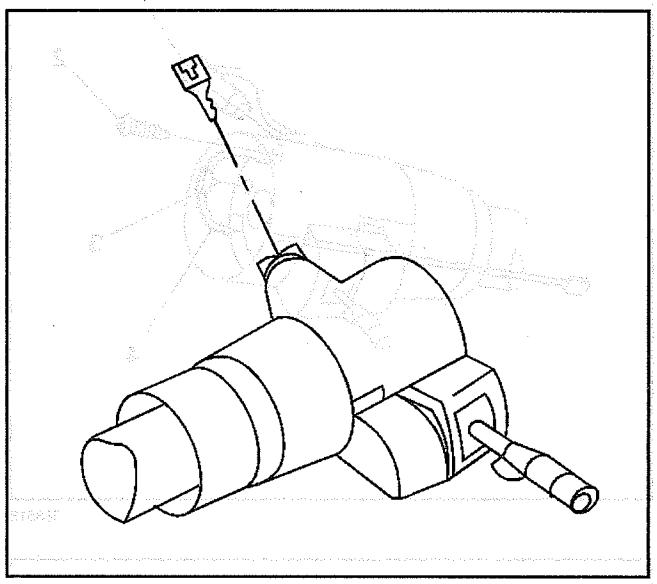
Ignition Switch Replacement - On Vehicle

Removal Procedure

Caution: Refer to SIR Handling Caution in Cautions and Notices.

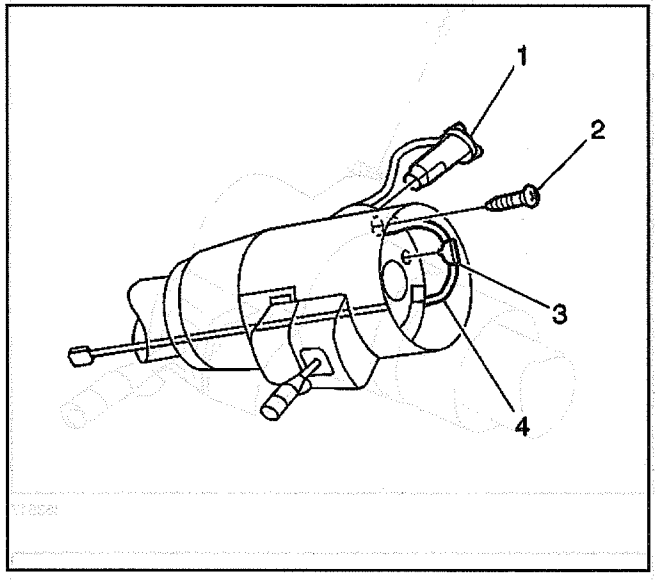
Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Remove the inflatable restraint coil.
3. Insert the ignition key into the lock cylinder. Leave the key in the LOCK position.

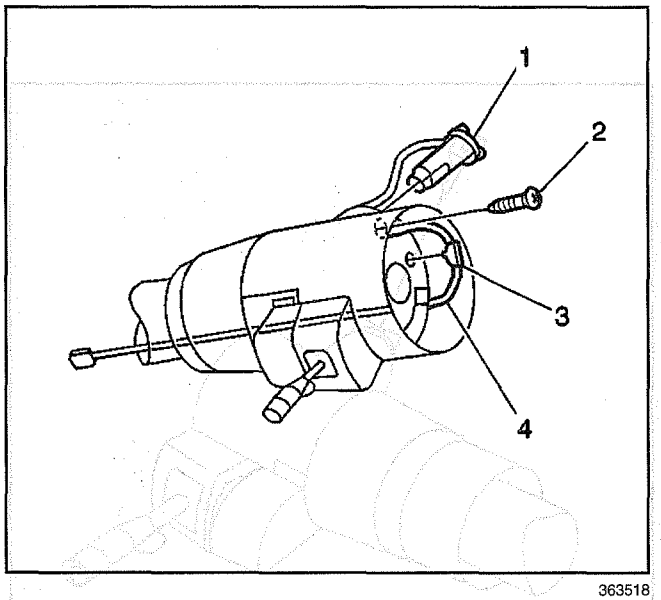


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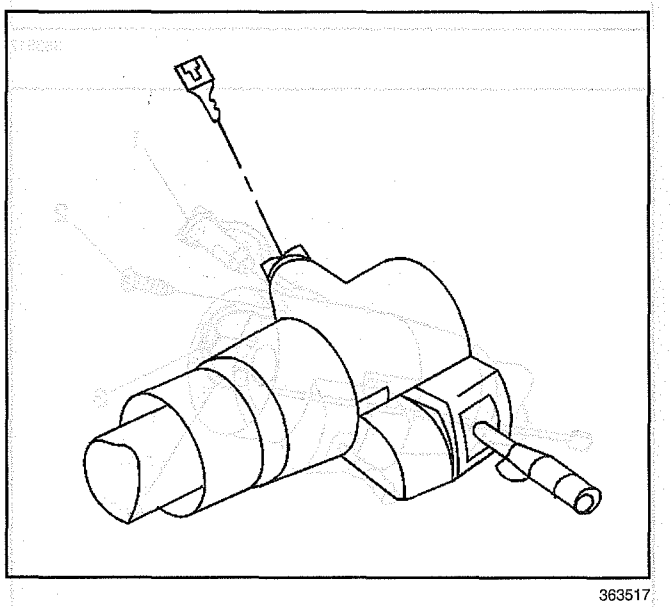
4. Remove the lock retaining screw (2).
5. Remove the lock cylinder (1) and harness (4), perform the following:
   - 5.1. Disconnect the terminal connector from the bulkhead connector.
   - 5.2. Remove the wiring protector.
   - 5.3. Disconnect the retaining clip (3) from the lock housing cover sleeve.
   - 5.4. Gently pull wire harness (4) through the column.
   - 5.5. Remove the lock cylinder (1) from the vehicle.



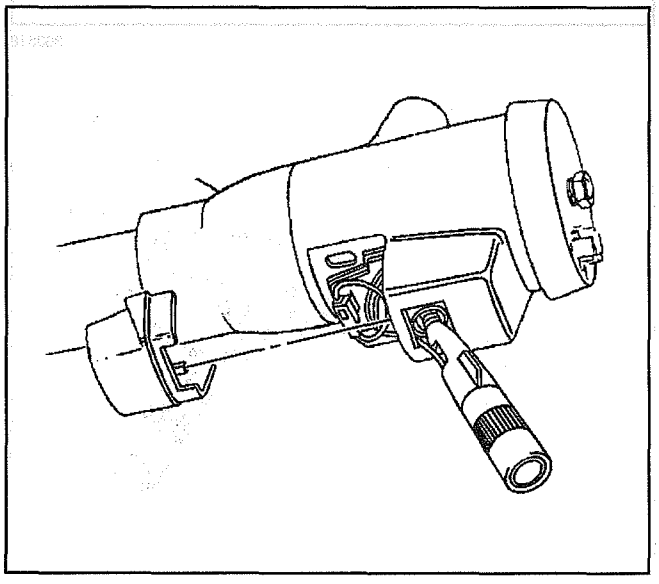
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367666

Installation Procedure

1. Install the lock cylinder (1) and harness (4), perform the following:
   1.1. Install the lock cylinder (1) to the vehicle.
   1.2. Gently pull wire harness (4) through the column.
   1.3. Connect the retaining clip (3) to the lock housing cover sleeve.
   1.4. Install the wiring protector.
   1.5. Connect the terminal connector to the bulkhead connector.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the lock retaining screw (2).

   Tighten

   Tighten the lock retaining screw to 2.5 N·m (22 lb in).

3. Remove the ignition key from the lock cylinder.
4. Install the inflatable restraint coil.
5. Connect the negative battery cable.

Multifunction Turn Signal Lever Replacement - On Vehicle

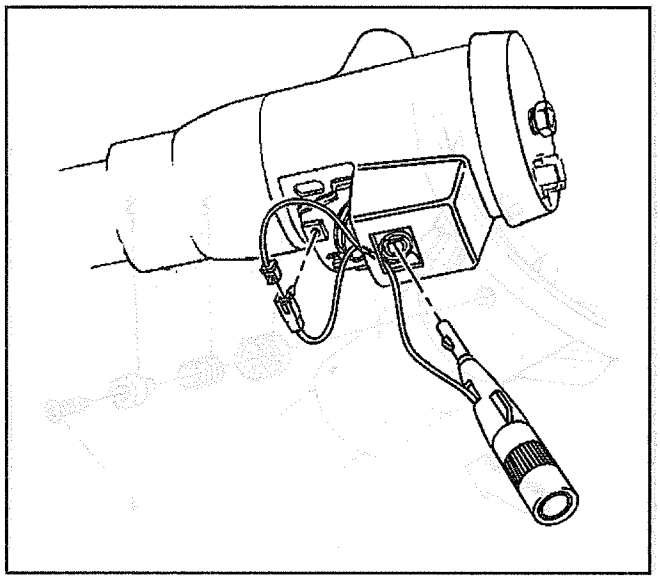
Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

Important: Position the windshield wiper switch in the OFF position.

1. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnect/Connect Procedure* in Engine Electrical.
2. Remove the steering column access cover.

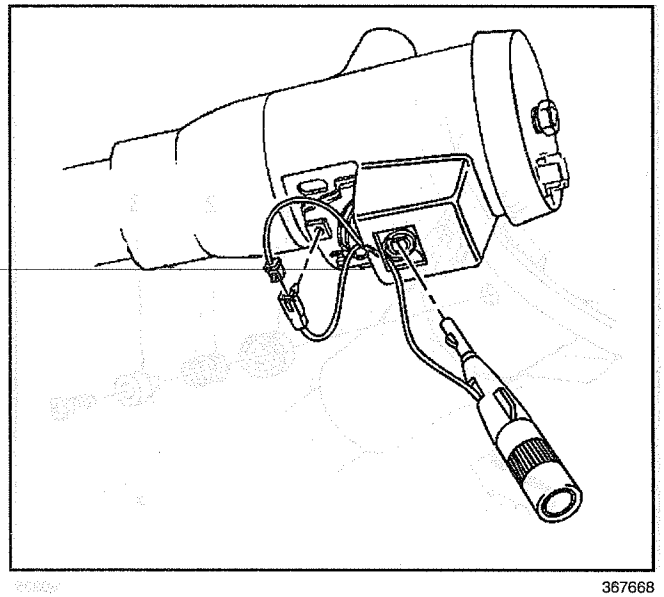
3. Disconnect the multifunction lever electrical connector.
4. Remove the multifunction lever.



367668

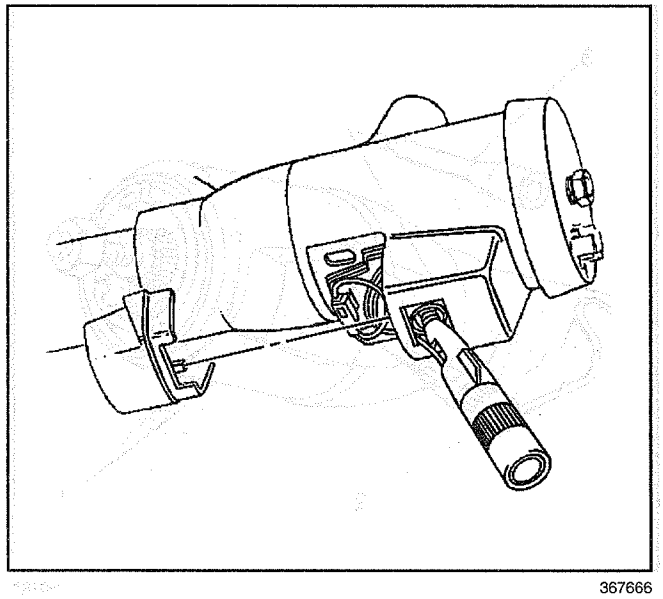
Installation Procedure

1. Install the multifunction lever.
2. Connect the multifunction lever electrical connector.

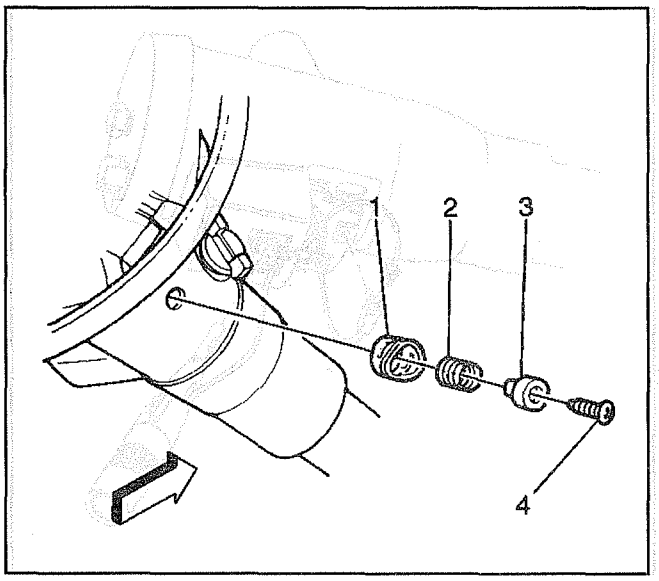


367668

3. Install the steering column access cover.
4. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnect/Connect Procedure* in Engine Electrical.



367666



290205

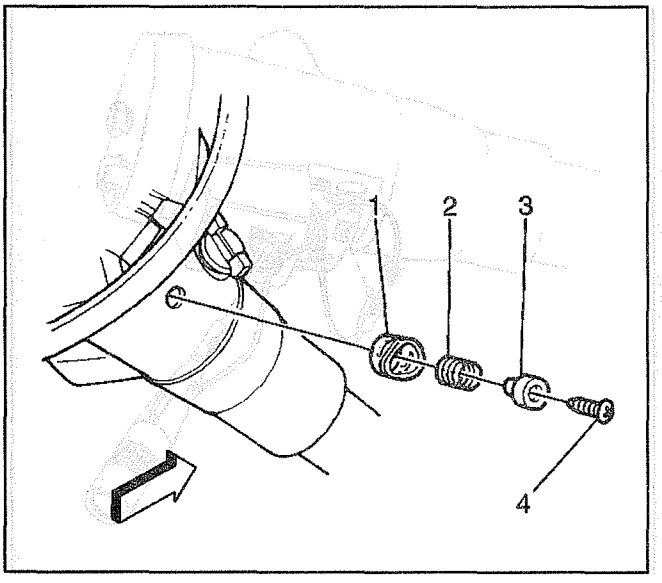
Hazard Warning Switch Replacement - On Vehicle

Removal Procedure

Caution: Refer to SIR Handling Caution in Cautions and Notices.

Important: Do not remove the steering column in order to replace the hazard warning switch. Refer to *Steering Column Replacement.*

1. Remove the bolt/screw (4).
2. Remove the button (3).
3. Remove the spring (2).
4. Remove the knob (1).



290205

Installation Procedure

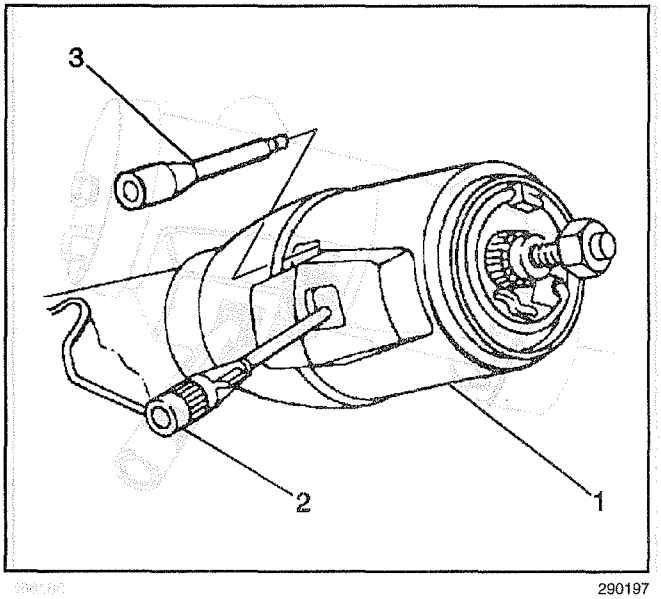
1. Install the knob (1).
2. Install the spring (2).
3. Install the button (3).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the bolt/screw (4).

   Tighten

   Tighten the bolt/screw to 0.7 N·m (6 lb in).



290197

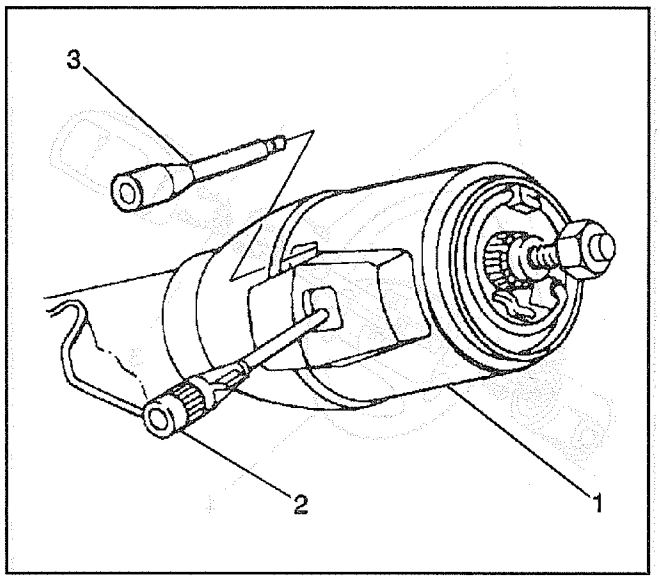
Tilt Lever Replacement - On Vehicle

Removal Procedure

1. Lower the steering wheel to access the tilt lever easier.
2. Firmly grip and twist the tilt wheel release lever (3) counterclockwise.

Installation Procedure

- Firmly grip and twist the tilt wheel release lever (3) clockwise.
- Raise the steering wheel.



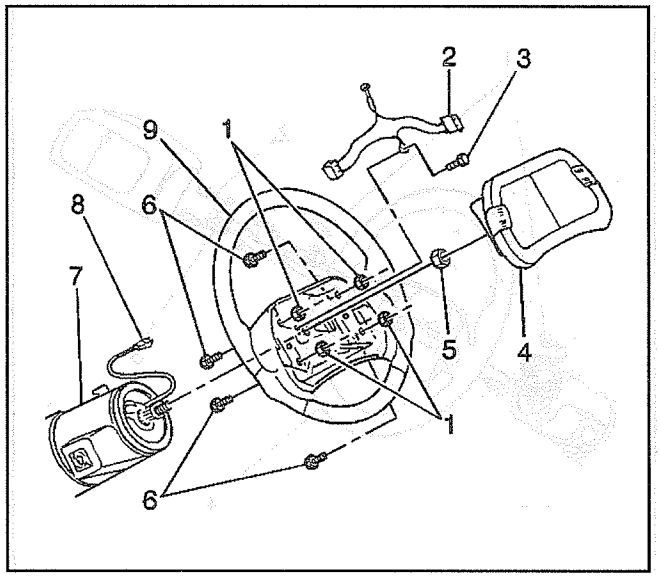
290197

Horn Switch Replacement - On Vehicle (Chevrolet)

Removal Procedure

Caution: Refer to SIR Handling Caution in Cautions and Notices.

1. Remove the inflatable restraint steering wheel module (4).
2. Remove the screw (3) from the ground lead.
3. Disconnect the power lead (8) by pulling straight out.



290190

Installation Procedure

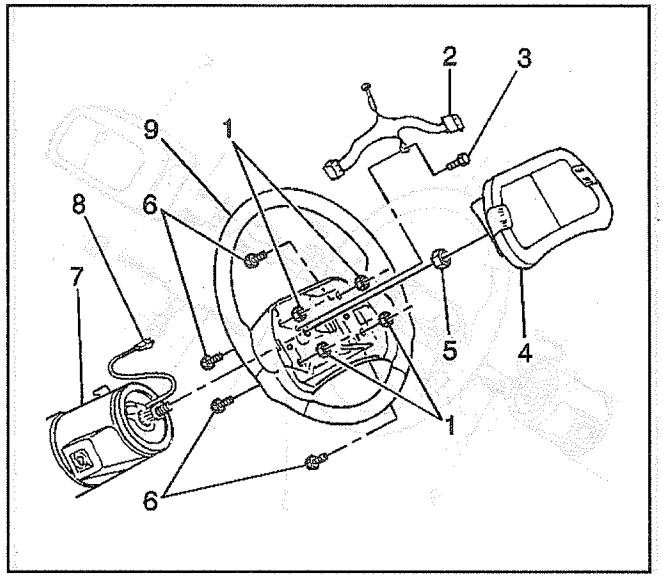
1. Install the horn switch (2) to the inflatable restraint steering wheel module (4).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

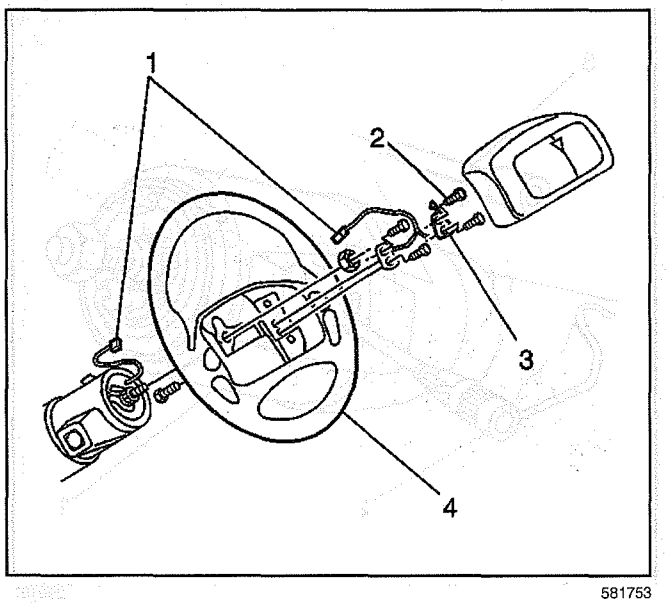
2. Install the screw (3) to the ground lead.

   Tighten

   Tighten the bolt/screw (3) to 1.9 N·m (17 lb in).
3. Connect the power lead (8) by pushing straight into the outlet.



290190



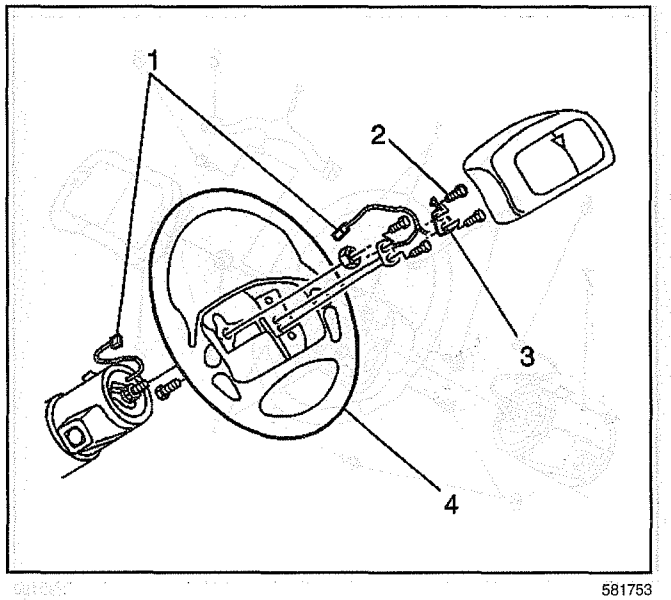
581753

Horn Switch Replacement - On Vehicle (Pontiac)

Removal Procedure

Caution: Refer to SIR Handling Caution in Cautions and Notices.

1. Disconnect the horn wiring connector (1) from the steering column.
2. Remove the horn wiring connector bolts (2).
3. Remove the horn switch (3) from the steering wheel (4).



581753

Installation Procedure

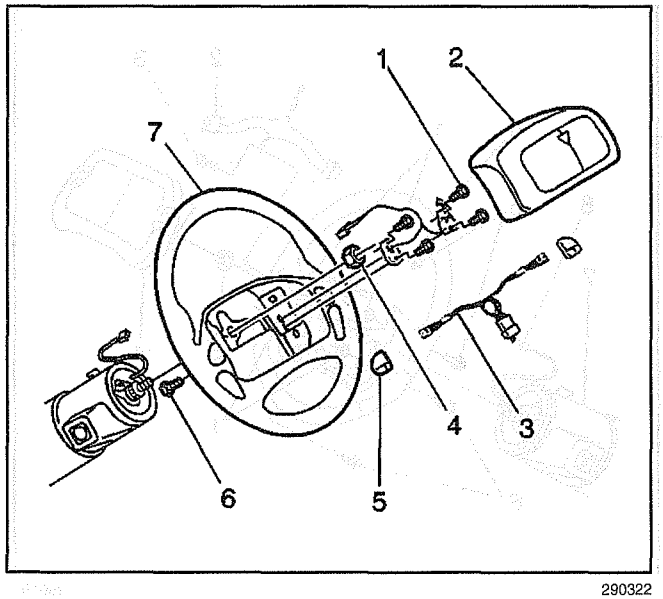
1. Position the horn switch (3) to the steering wheel (4).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the horn wiring connector bolts (2).

   Tighten

   Tighten the horn wiring connector bolts (2) to 1.9 N·m (17 lb in).
3. Connect the horn wiring connector (1) to the steering column.



290322

Steering Wheel Control Switch Assembly Replacement

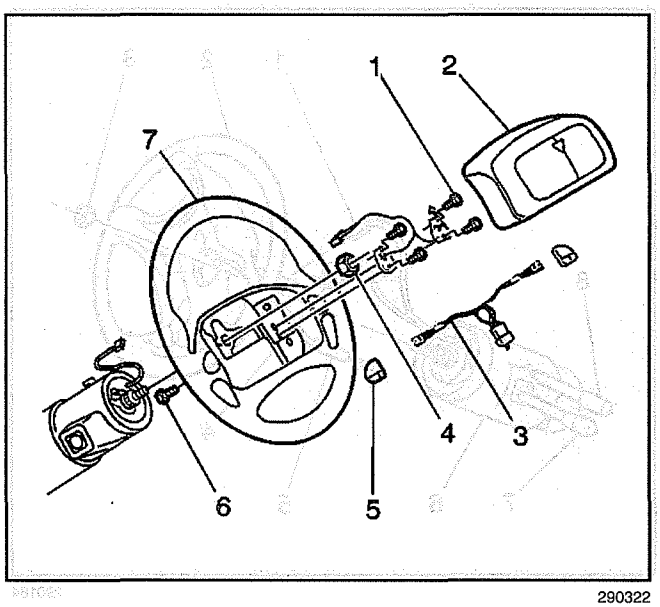
Removal Procedure

Caution: Refer to SIR Handling Caution in Cautions and Notices.

1. Remove the radio control wire harness retainer.
2. Pry out the radio control switch (5) at the lower edge.
3. Remove the radio control switch (5) from the steering wheel (7).
4. Disconnect the wire harness connector (3) from the control(s).

Installation Procedure

1. Connect the wire harness connector (3) to the control(s).
2. Install the radio control switch (5) to the steering wheel (7).
3. Install the radio control wire harness retainer.



290322

Steering Wheel Replacement

Removal Procedure

Caution: Refer to SIR Handling Caution in Cautions and Notices.

Tools Required

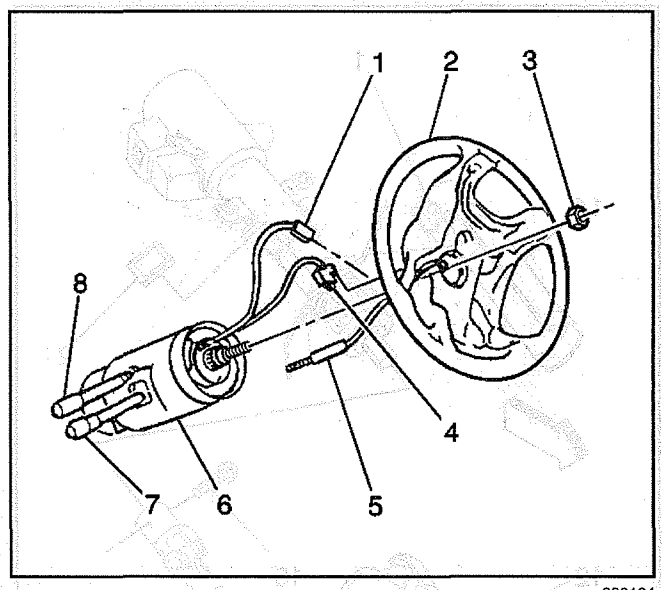
- *J 1859-A* Steering Wheel Puller
- *J 38720* Steering Wheel Puller Bolts

1. Remove the nut (3).
2. Disconnect the horn ground lead (5).

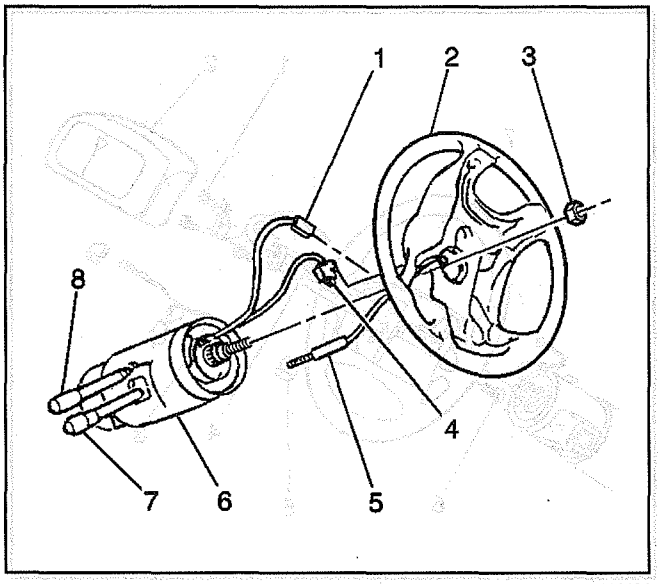
Notice: When removing the steering wheel, use only the specified steering wheel puller. Under no conditions should the end of the steering column shaft be hammered on, as hammering could loosen the plastic injections which maintain steering column rigidity.

Notice: When attaching J 1859–A and J 38720 to the steering wheel, use care to prevent threading J 39720 (bolts) all the way through the steering wheel hub into the SIR coil and damaging the SIR coil.

3. Use a *J 1859-A* and a *J 38720* in order to remove the steering wheel (2).
4. Remove the steering wheel horn switch. Refer to *Horn Switch Replacement - On Vehicle (Chevrolet)* or *Horn Switch Replacement - On Vehicle (Pontiac)*.



290184



290184

Installation Procedure

1. Route the SIR coil electrical connector to the steering wheel (2).
2. Install the steering wheel horn switch.

Important: Align the tooth on the steering wheel with the block tooth on the steering column shaft within one female serration.

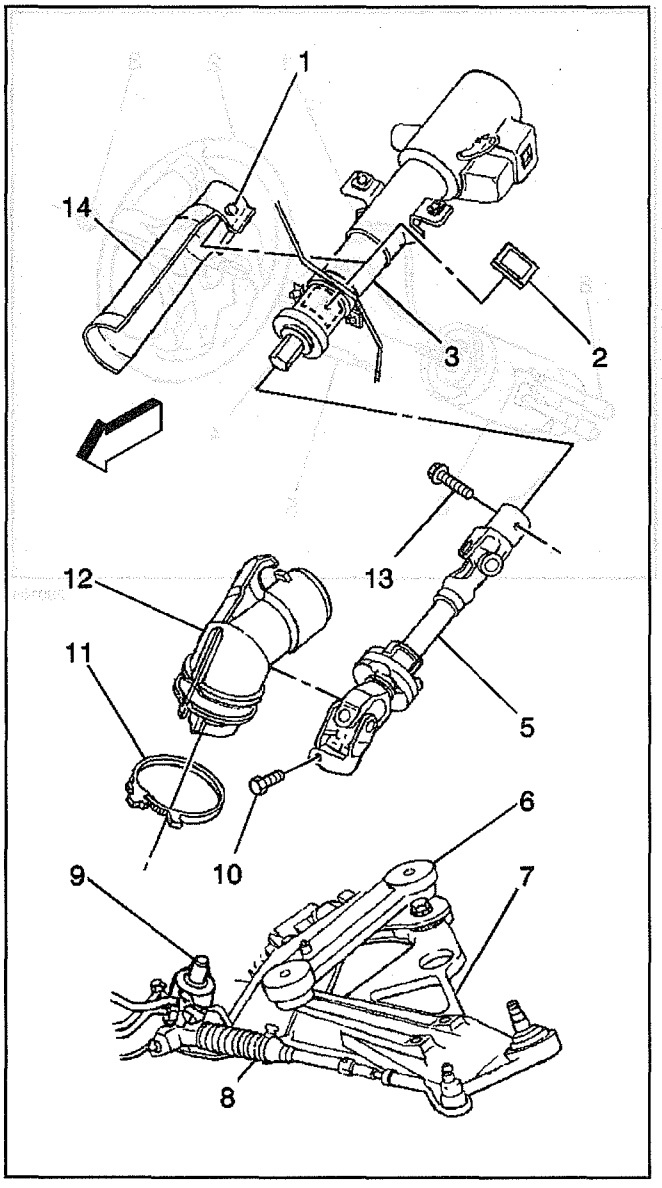
3. Install the steering wheel (2).
4. Connect the horn ground lead (5).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

5. Install the nut (3).

   Tighten

   Tighten the nut to 43 N·m (32 lb ft).



581793

Intermediate Steering Shaft Replacement

Removal Procedure

Notice: The vehicle's wheels must be in a straight-ahead position and the key must be in a LOCK position when removing or installing the steering column. Failure to do so may cause the SIR coil assembly to become uncentered and may result in unneeded SIR system repairs.

1. Remove the clamp (11) from the boot (12).
2. Remove the boot (12) from the shaft (5).
3. Remove the steering gear bolt (10) from the gear (8).
4. Remove the shaft (5) from the steering gear (8).
5. Remove the shield (14) from the shaft (5) and column (3) on 5.7L VIN G only.
6. Remove the bolt (13) from the column (3).
7. Remove the shaft (5) from the column (3).

Installation Procedure

1. Position the shaft (5) to the column (3).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the column bolt (13).

   Tighten

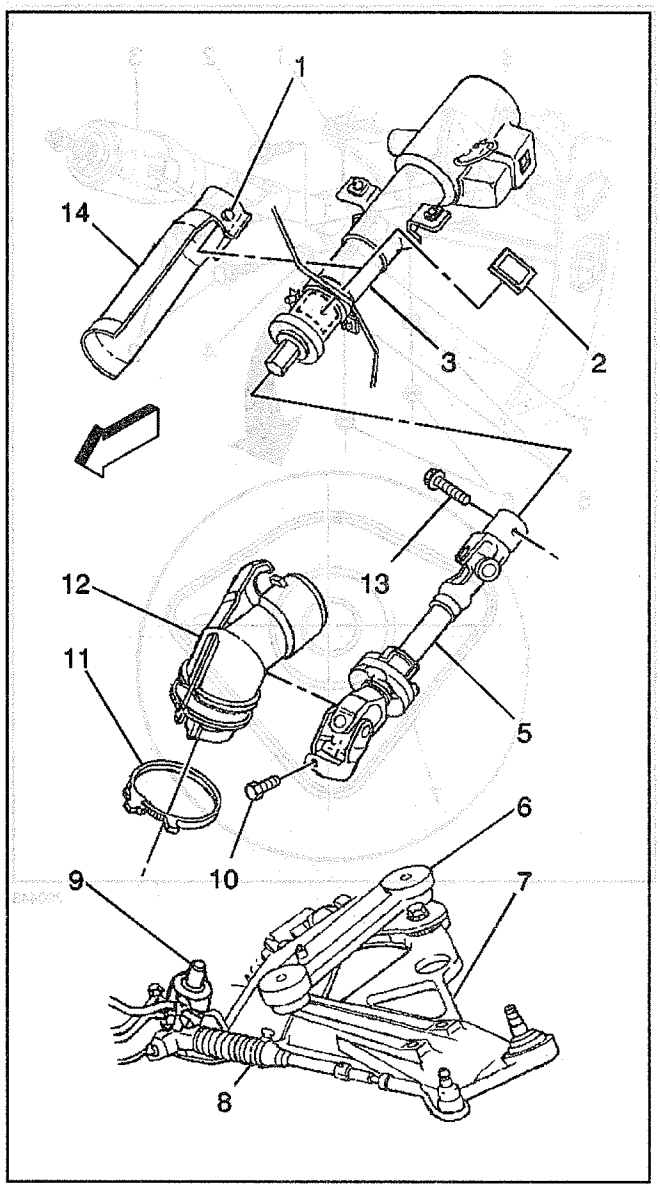
   Tighten the column bolt (13) to 47 N·m (35 lb ft).

3. Position the shaft (5) to the gear (8).
4. Install the steering gear bolt (10).

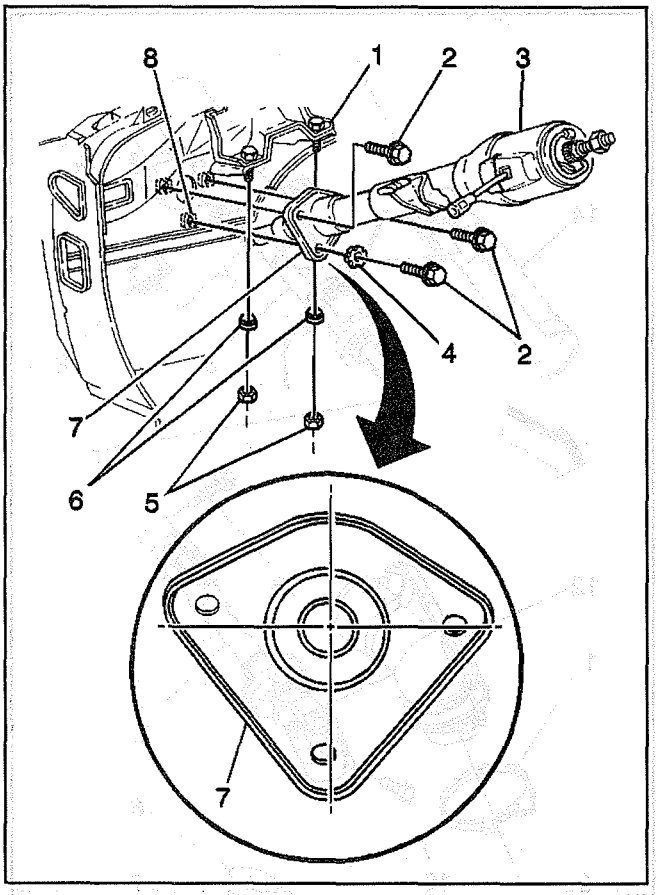
   Tighten

   Tighten the steering gear bolt (10) to 47 N·m (35 lb ft).

5. Install the boot (12) to the shaft (5).
6. Use a clamp (11) in order to secure the boot to the shaft.
7. Position the shield (14) to the shaft (5) and column (3) on 5.7L VIN G only.
8. On 5.7L VIN G only, insert the button into the hole in the column (3) in order to install the shield (14).



581793



290448

Steering Column Replacement

Removal Procedure

Notice: The vehicle's wheels must be in a straight-ahead position and the key must be in a LOCK position when removing or installing the steering column. Failure to do so may cause the SIR coil assembly to become uncentered and may result in unneeded SIR system repairs.

Notice: When the steering column is removed from the vehicle, it is extremely susceptible to damage. Dropping the column on its end could collapse the steering shaft or loosen plastic injections that keep the column rigid. Leaning on the column 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 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 right.

1. Remove the left instrument panel insulator.
2. Remove the instrument panel driver knee bolster and deflector.
3. Disable the SIR system.
4. Remove the steering wheel, if the column is to be replaced. Refer to *Steering Wheel Replacement*.
5. Remove the intermediate steering shaft bolt from the steering gear coupling shaft and column.
6. Remove the bolts (2) that attach the cover (7) to the dash panel.
7. Remove the cover (7) from the dash panel.
8. Disconnect the electrical connectors.
9. Remove the nuts (5) and shims (6) from the steering column support.
10. Remove the automatic transmission park lock cable from the ignition switch, if equipped.
11. Remove the column (3) from the vehicle.

Installation Procedure

Notice: If a service replacement steering column is being installed, do not remove the antirotation pin until after the column has been connected to the steering gear. Removing the antirotation pin before the column is connected to the steering gear may damage the SIR coil.

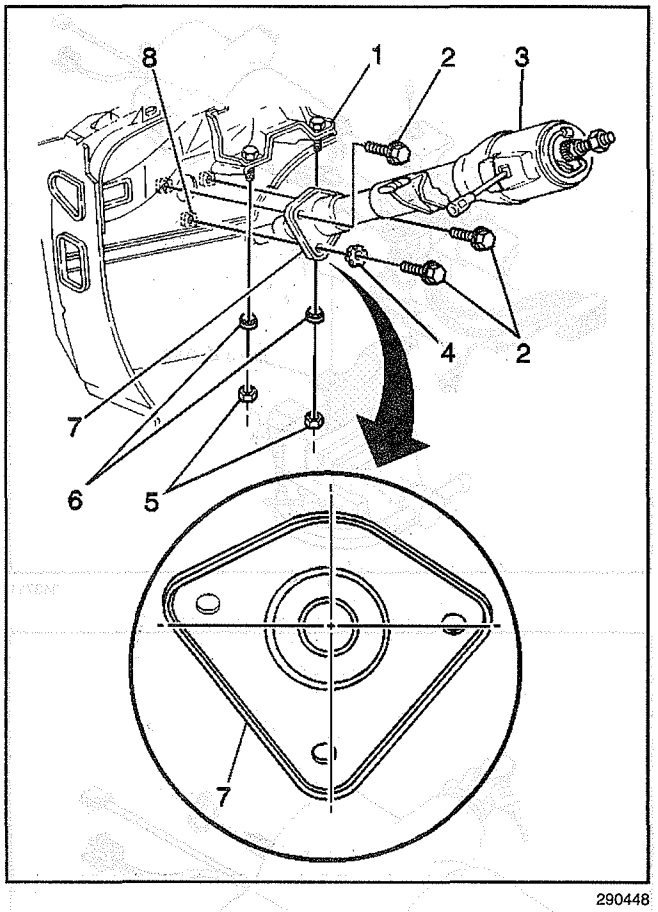
1. Position the column (3) into the vehicle.
2. Install the automatic transmission park lock cable to the ignition switch, if equipped. Refer to Automatic Transmission, On-Vehicle Service.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the shims (6) and the nuts (5) to the steering column support.

   Tighten

   Tighten the steering column support nuts to 25 N·m (18 lb ft).
4. Install the intermediate steering shaft bolt to the steering gear coupling shaft. Refer to Steering Gear Coupling Shaft.

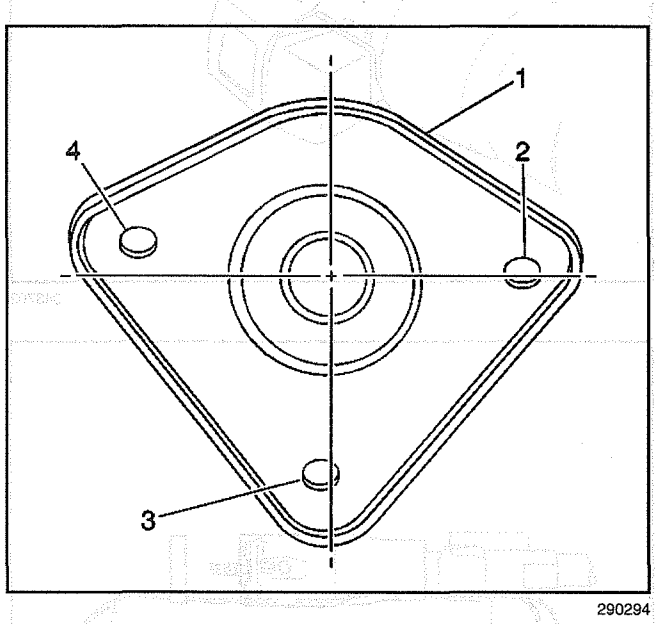


290448

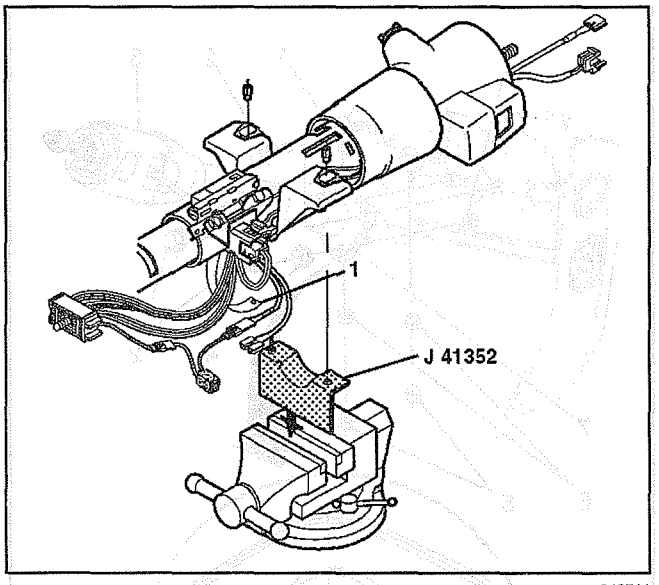
5. Install the cover to the dash. Install the bolt in the following order:
   5.1. Install the lower (3) bolt.
   5.2. Install the outboard (4) bolt.
   5.3. Install the inboard (2) bolt.
6. Position the cover to the dash panel.
7. Connect the electrical connectors.
8. Install the dash panel bolts.

   Tighten

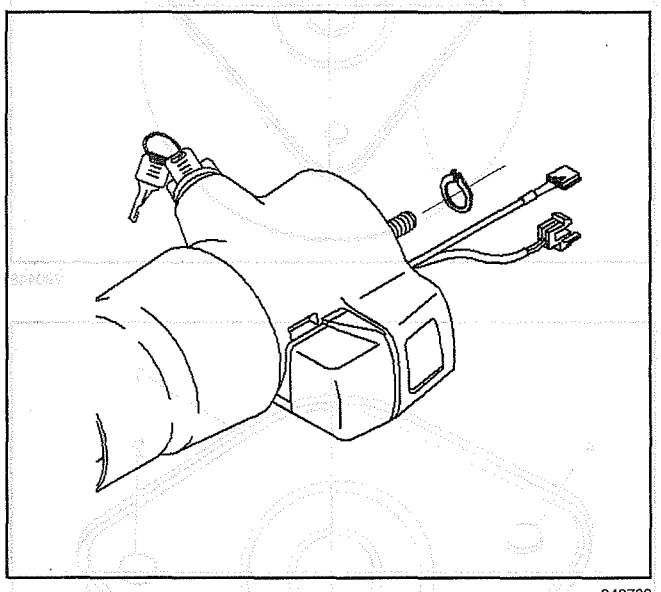
   Tighten the dash panel bolts to 18 N·m (14 lb ft).
9. Install the steering wheel, if column is replaced. Refer to *Steering Wheel Replacement*.
10. Enable the SIR system.
11. Install the instrument panel driver knee bolster and deflector.
12. Install the left instrument panel insulator.



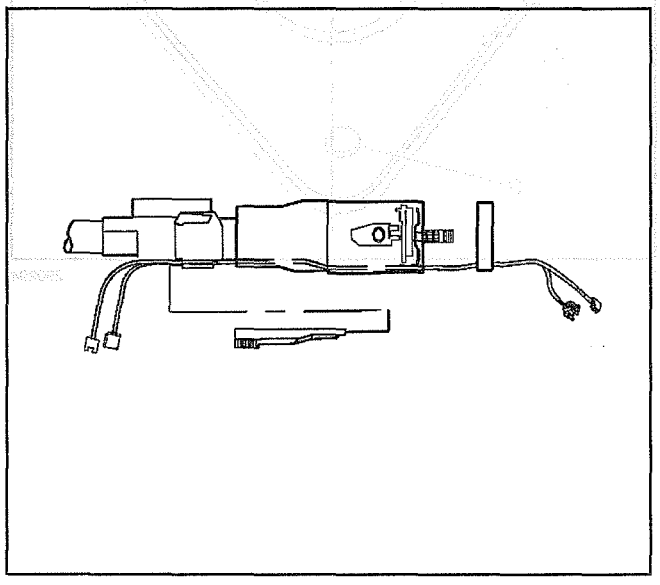
290294



343711



343702



343717

Inflatable Restraint Steering Wheel Module Coil - Disassemble - Off Vehicle

Disassembly Procedure

Tools Required

J 41352 Modular Column Holding Fixture

1. Set the steering column and *J 41352* into a vise.

Important: Align the block tooth on the race and upper shaft assembly to the 12 o'clock position.

Remove only those components necessary to do the repairs.

2. Check the steering column jacket assembly for any accident damage. Refer to *Steering Column Accident Damage Inspection - Off Vehicle.*
3. Place the ignition in the "LOCK" position to center the coil assembly.
4. Remove the wire harness assembly strap (1).
5. Remove the retaining ring from the steering shaft assembly.
6. Remove the wire harness straps and the wire protector from the steering column.
7. Disconnect the SIR coil assembly connector at the base of the steering column, if needed.
8. Remove the SIR coil assembly from the steering shaft assembly.
9. Attach mechanics wire to the SIR coil assembly connectors for reassembly.
10. Pull the SIR coil assembly connectors through the steering column, if needed.

Inflatable Restraint Steering Wheel Module Coil - Assemble - Off Vehicle

Assembly Procedure

Tools Required

J 41352 Modular Column Holding Fixture

Important: The SIR coil assembly must be centered before it is assembled on the steering shaft assembly.

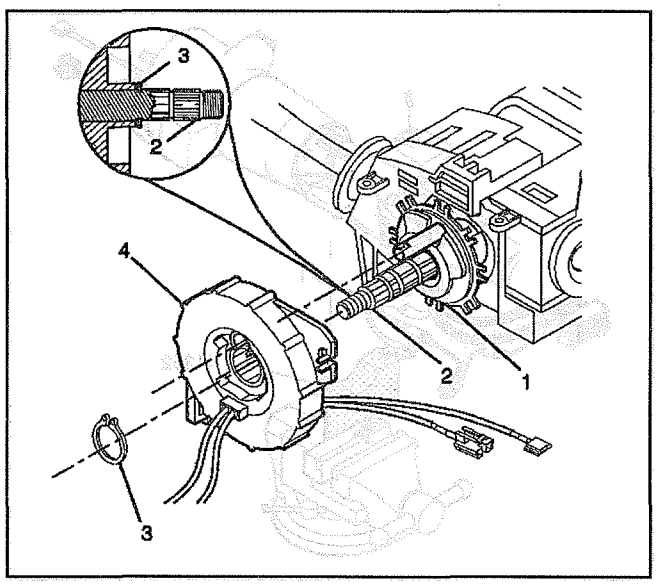
1. If reusing the original SIR coil assembly, Refer to *Inflatable Restraint Coil Centering - Off Vehicle (Column Shift And Floor Shift).*
2. Feed the SIR coil assembly connectors through the steering column.

Important: A new SIR coil assembly will come precentered. Do not remove the orange tab until the SIR coil assembly is installed.

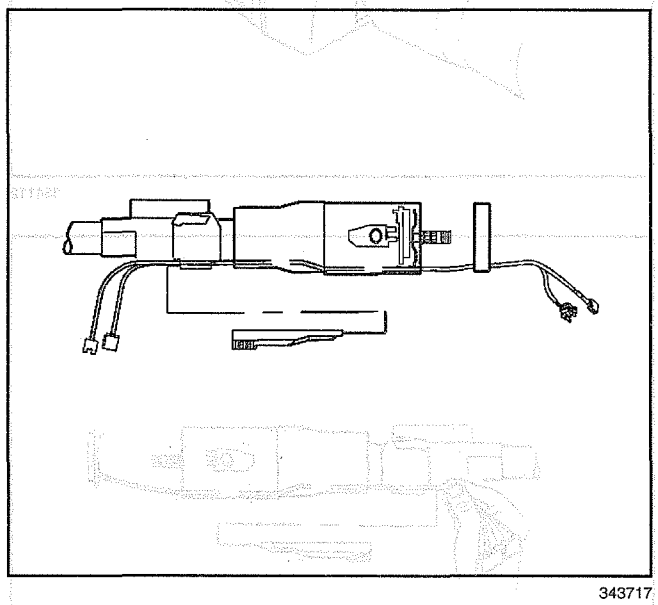
3. Install the SIR coil assembly (4) following these steps:
   - 3.1. Position the SIR coil assembly (4) to the steering shaft assembly (2).
   - 3.2. Align the opening in the SIR coil assembly (4) with the horn tower (1) and the "locating bump" between the 2 tabs on the lock housing cover and sleeve assembly.
   - 3.3. Seat the SIR coil assembly (4) onto the steering shaft assembly (2).
4. Remove and dispose of the orange tab if using a new SIR coil.
5. Install the retaining ring (3) to the steering shaft assembly (2).

Important: Pull carefully on all the wires to remove any wire kinks that may be inside the steering column assembly. If this is not done it may cause damage to the wire harness.

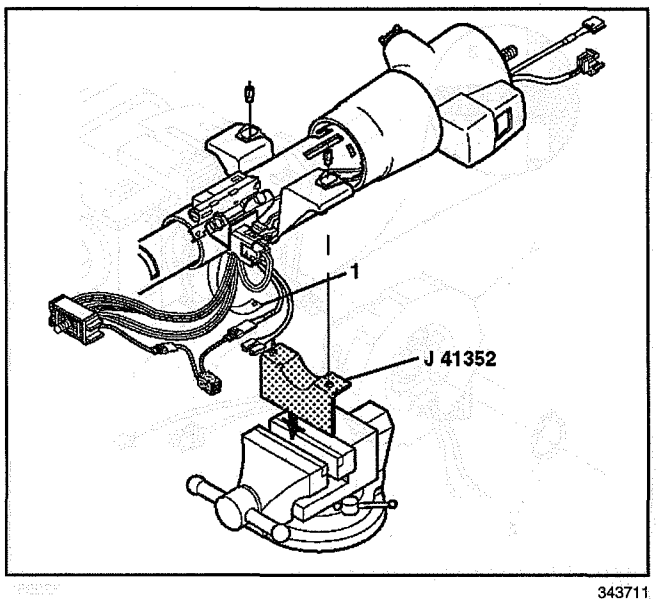
6. Install the wiring protector and the wire harness straps to the steering column.
7. Connect the SIR coil assembly connector at the base of the column.



322951

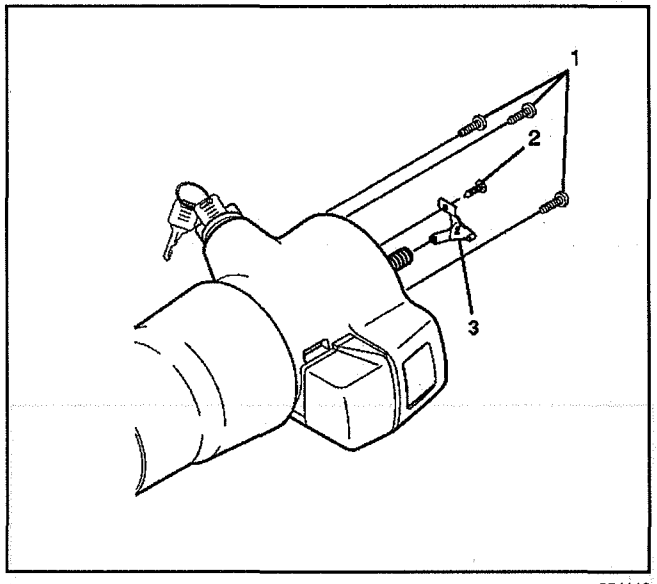


343717



343711

8. Install the small wire harness straps.
9. Install the wire harness assembly strap (1).
10. Remove the steering column and *J 41352* from the vise.

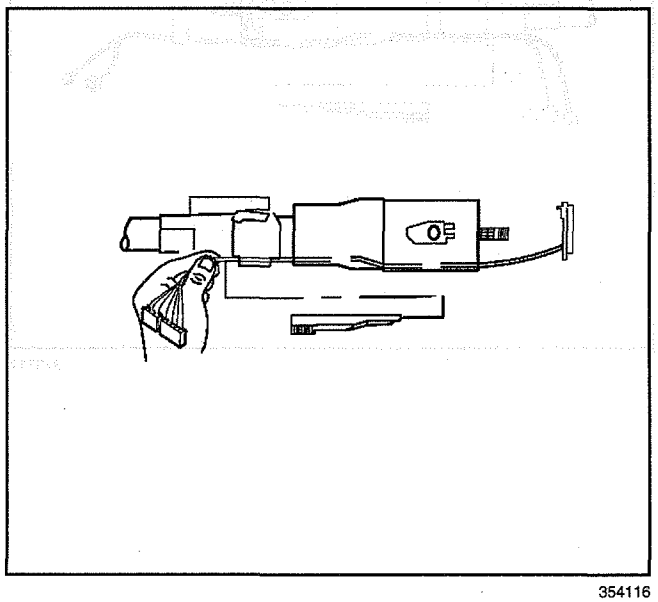


354112

Turn Signal and Multifunction Switch Assembly - Disassemble - Off Vehicle

Disassembly Procedure

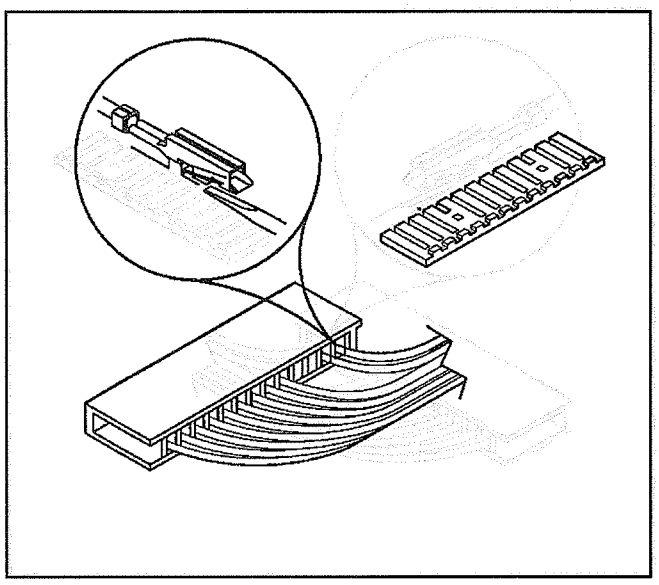
1. Remove the tilt lever.
2. Remove the multifunction lever.
3. Remove the hazard knob.
4. Remove the turn signal cancel cam assembly. Refer to *Turn Signal Cancel Cam and Upper Bearing Inner Race - Disassemble - Off Vehicle*.
5. Remove the round washer head screw (2) from the signal switch arm assembly (3).
6. Pry out the signal switch arm assembly (3) from the lock housing cover and sleeve assembly.
7. Remove the 3 pan head 6 lobed socket screws (1) from the turn signal switch assembly.



354116

8. In order to remove the turn signal switch assembly, use the following steps:
   8.1. Remove the steering column wire harness strap.
   8.2. Remove the wiring protector.

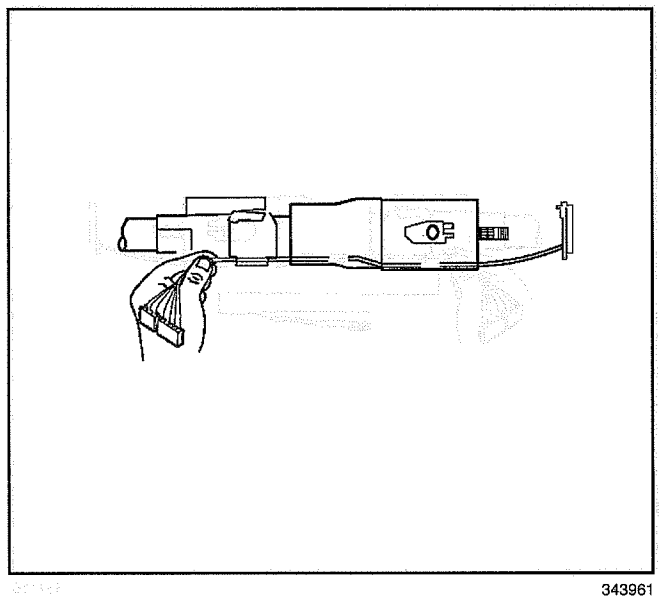
9. Disconnect the terminal connector from the turn signal switch assembly connector.
10. Pull the turn signal switch assembly connector through the steering column, if needed.


343824

Turn Signal and Multifunction Switch Assembly - Assemble - Off Vehicle

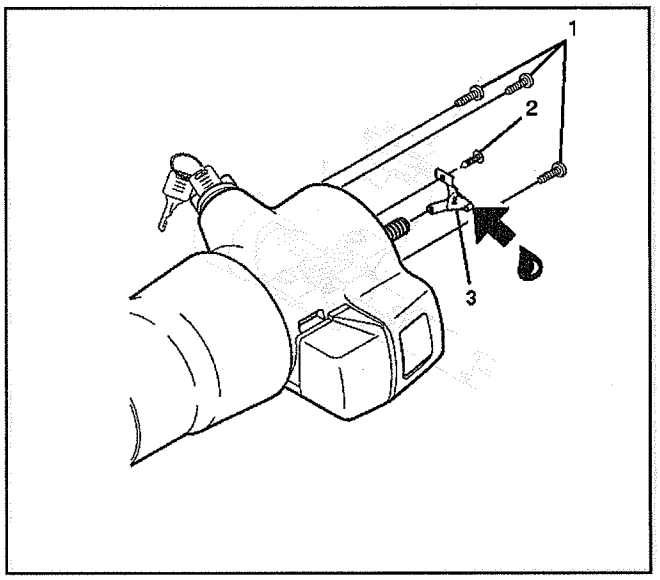
Assembly Procedure

1. Thread the turn signal switch assembly connector through the lock housing cover and sleeve assembly, if the switch is hanging.

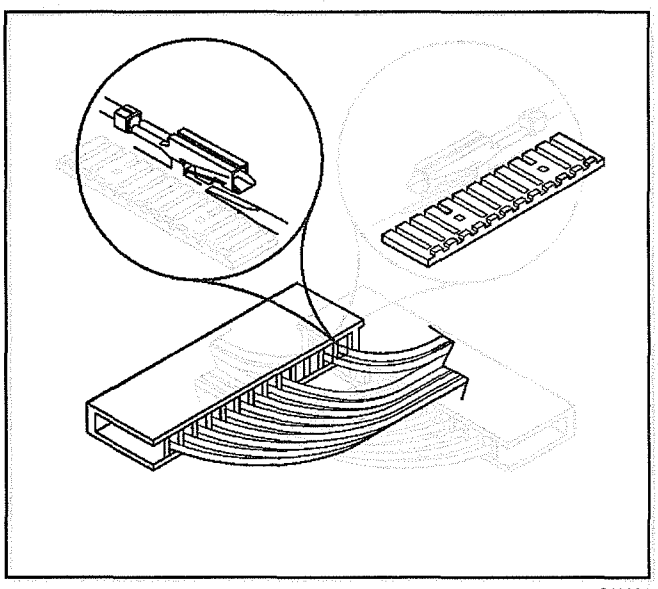

343961

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the turn signal switch assembly and secure using 3 pan head 6 lobed socket screws (1).
   Tighten
   Tighten the 3 pan head 6 lobed socket screws to 3.5 N·m (31 lb in).
3. Lubricate the signal switch arm assembly (3) with lithium grease.
4. Install the signal switch arm assembly (3) onto the turn signal switch assembly.
5. Secure the signal switch arm assembly (3) using the round washer head screw (2).
   Tighten
   Tighten the screw to 2.5 N·m (22 lb in).

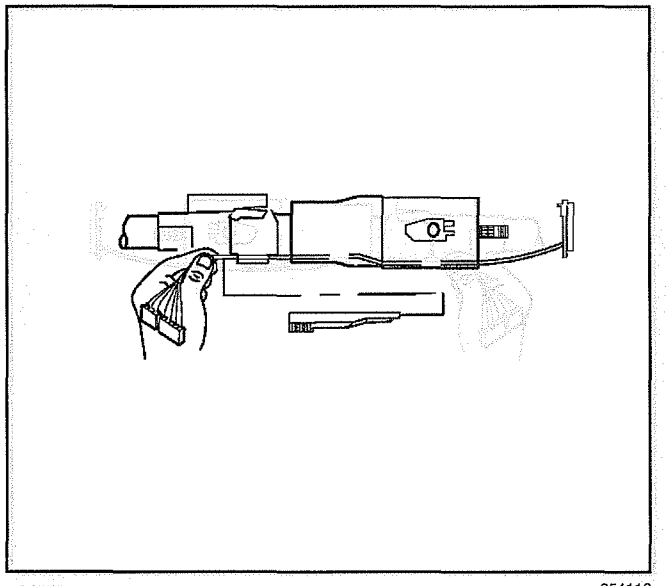


354114



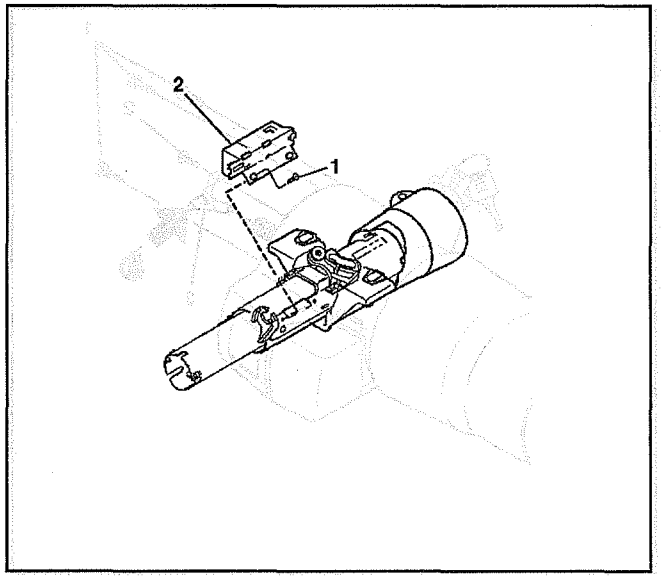
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6. Install the terminal connector to the turn signal switch assembly connector.



354116

7. Pull the turn signal switch assembly connector towards the base of the column.
8. Insert the wiring protector into the steering column bracket.
9. Insert the steering column wire harness into the steering column wire harness strap.
10. Install the turn signal cancel cam assembly. Refer to *Turn Signal Cancel Cam and Upper Bearing Inner Race - Assemble - Off Vehicle.*
11. Install the tilt lever.
12. Install the multifunction lever.
13. Install the hazard knob.



393976

Ignition Switch Assembly - Disassemble - Off Vehicle

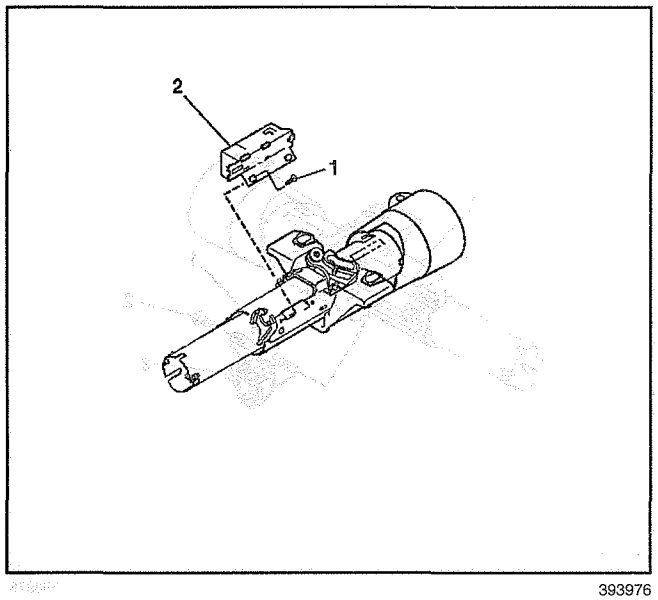
Disassembly Procedure

1. Remove the dimmer switch assembly. Refer to *Dimmer Switch Assembly - Disassemble - Off Vehicle.*
2. Slide the vehicle wire harness from the ignition switch assembly (2).
3. Remove the flat head screw (1) from the ignition switch assembly (2).
4. Remove the ignition switch assembly (2) from the ignition switch rod actuator assembly.

Ignition Switch Assembly - Assemble - Off Vehicle

Assembly Procedure

1. Install the vehicle wire harness into the ignition switch assembly (2).
2. Install the ignition switch assembly (2) to the ignition switch actuator assembly.
3. Install the flat head screw (1) to the ignition switch assembly (2).
4. Tighten the flat head screw (1) finger tight.



393976

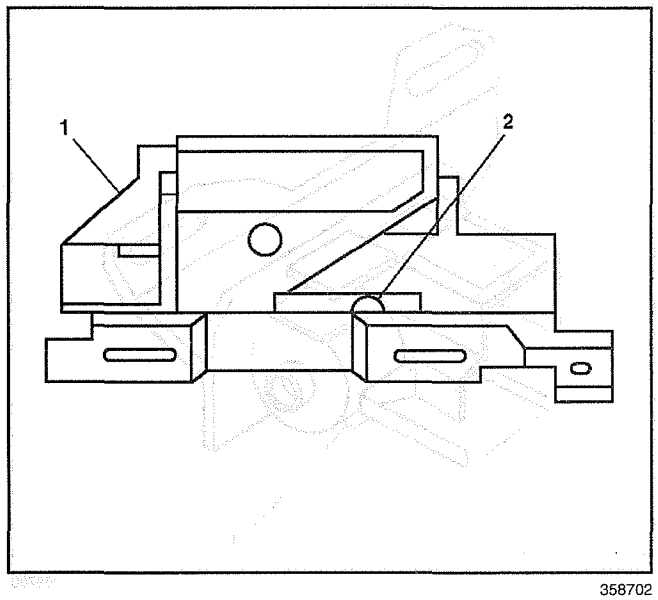
5. Move the ignition switch assembly slider (2) to the far right position.
6. Move the ignition switch assembly slider (2) detent to the left. This is the OFF LOCK position.
7. Install a 3/32 inch drill bit into the hole on the ignition switch assembly (1) to limit travel.
8. Push against the ignition switch actuator assembly to limit all the lash.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

9. Install the flat head screw.

   Tighten

   Tighten the screw to 4 N·m (35 lb in).
10. Install the dimmer switch assembly. Refer to *Dimmer Switch Assembly - Assemble - Off Vehicle*.



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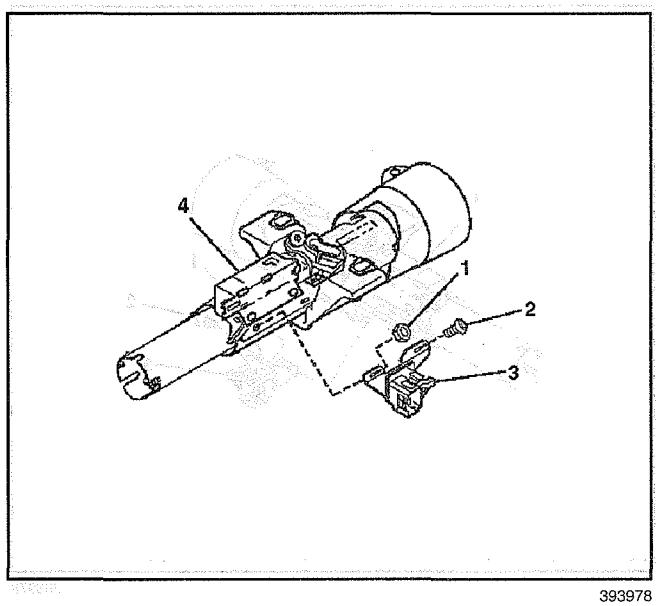
Dimmer Switch Assembly - Disassemble - Off Vehicle

Disassembl Procedure

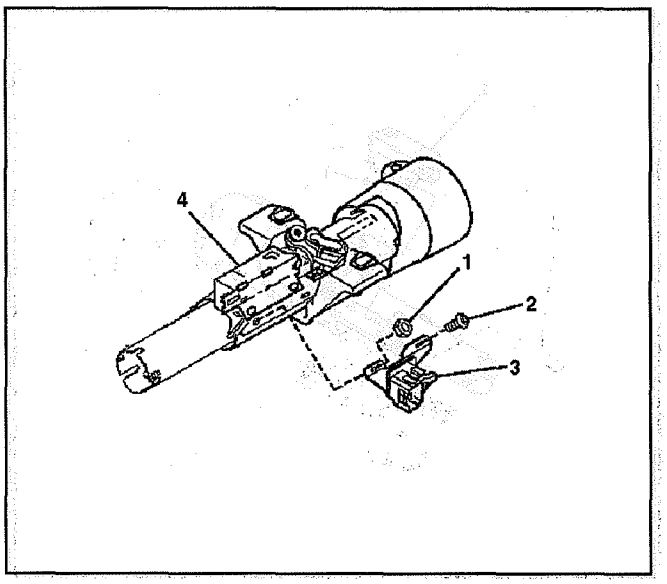
Tools Required

J 41352 Modular Column Holding Fixture

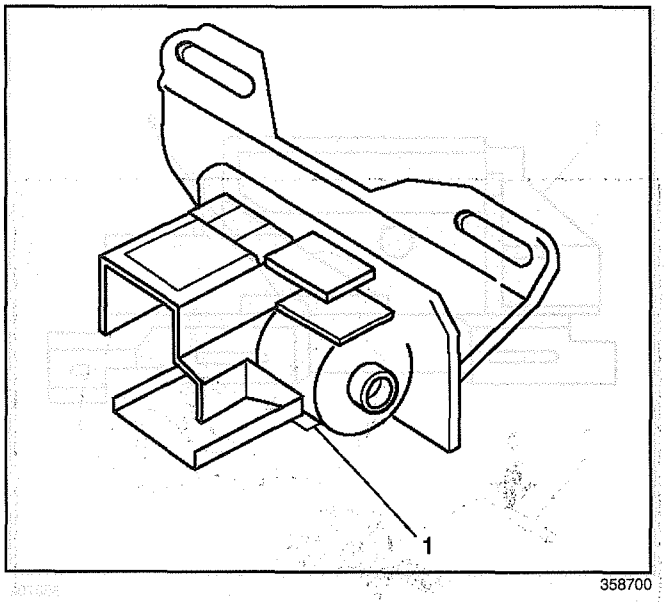
1. Insert the steering column and *J 41352* into a vise.
2. Remove the hexagon washer head tapping screw (1) from the dimmer switch assembly (3).
3. Remove the washer head screw (2) from the dimmer switch assembly (3).
4. Remove the dimmer switch rod from the dimmer switch assembly (3).
5. Remove the dimmer switch assembly (3) from the ignition switch assembly (4).
6. Remove the dimmer switch assembly (3) from the vehicle wire harness.



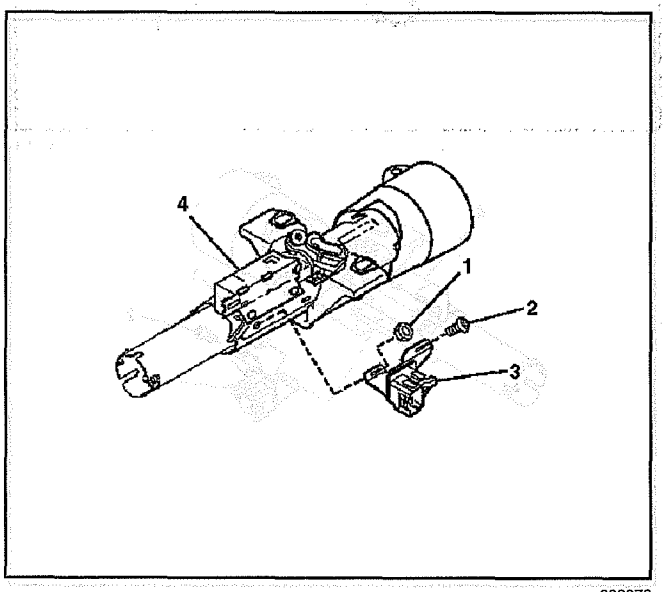
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393978

Dimmer Switch Assembly - Assemble - Off Vehicle

Assembly Procedure

Tools Required

J 41352 Modular Column Holding Fixture

1. Install the dimmer switch assembly (3) to the ignition switch assembly (4).
2. Install the hexagon washer head tapping screw (1) to the dimmer switch assembly (3).
3. Tighten the hexagon washer head tapping screw (1) finger tight.
4. Install the washer head screw (2) to the dimmer switch assembly (3).
5. Tighten the washer head screw (2) finger tight.
6. Insert the dimmer switch rod into the slot on the dimmer switch assembly (3).
7. Adjust the dimmer switch assembly following these steps:
   - 7.1. Install a 3/32 inch drill bit into the hole (1) on the dimmer switch assembly to limit travel.
   - 7.2. Position the dimmer switch assembly onto the column and push it against the dimmer switch actuator rod to remove all the lash.
   - 7.3. Remove the drill bit.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

8. Install the hexagon washer head screw (1).

   Tighten

   Tighten the hexagon washer head screw to 2.5 N·m (22 lb in).
9. Install the washer head screw (2).

   Tighten

   Tighten the washer head screw to 4 N·m (35 lb in).
10. Insert the vehicle wire harness into the dimmer switch assembly (3).
11. Remove the steering column and *J 41352* from the vise.

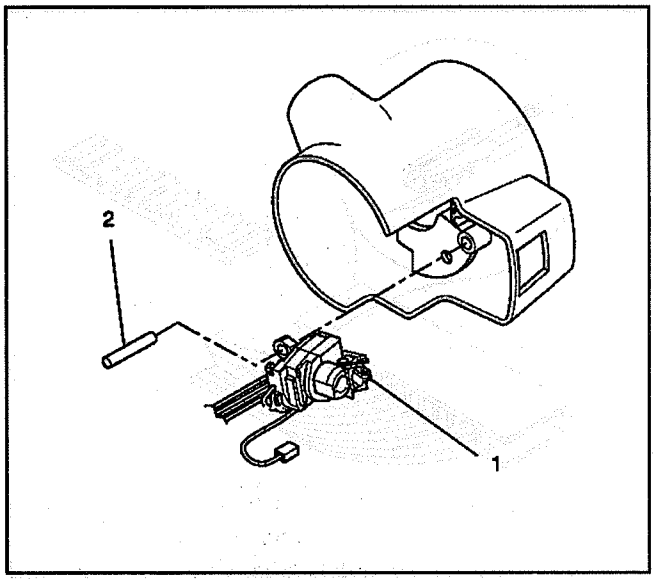
Windshield Wiper and Washer Switch Assembly - Disassemble - Off Vehicle

Disassembly Procedure

1. Remove the lock housing cover and sleeve assembly. Refer to *Lock Housing Assembly - Disassemble - Off Vehicle*.
2. Remove the switch actuator pivot pin (2) from the pivot and pulse switch assembly (1).
3. If removal of the pivot and pulse switch assembly (1) is not needed let the pivot and pulse switch assembly (1) hang freely.
4. Remove the pivot and pulse switch assembly (1) from the lock housing cover and sleeve assembly following these steps:
   - 4.1. Remove the wire protector shield.
   - 4.2. Remove the pivot and pulse switch assembly connector from the bulk head connector.

Important: Use care not to damage the wires when pulling the pivot and pulse switch assembly wire harness through the steering column.

   - 4.3. Pull the wire harness through the steering column.



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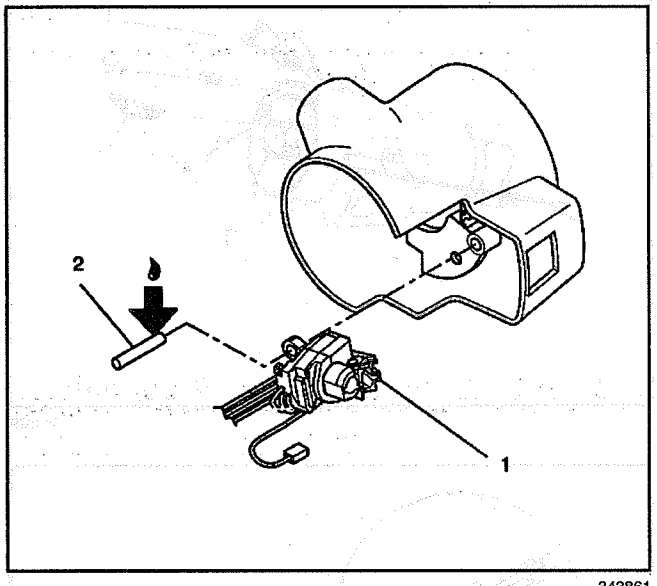
Windshield Wiper and Washer Switch Assembly - Assemble - Off Vehicle

Assembly Procedure

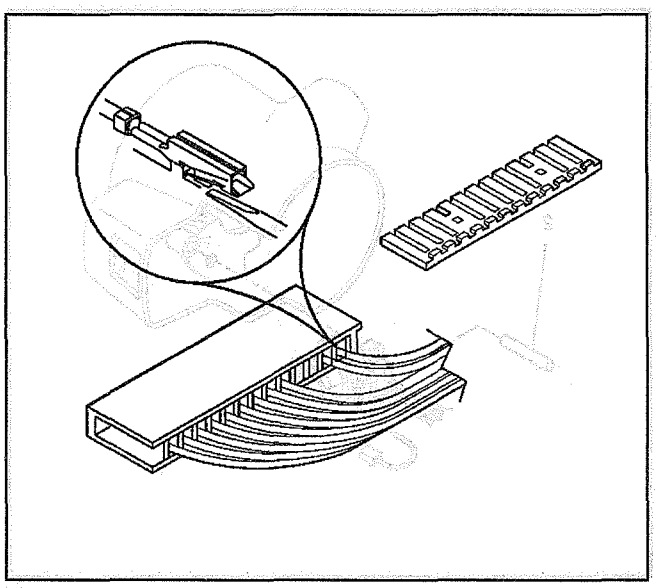
1. Install the pivot and pulse switch assembly to the lock housing cover and sleeve assembly.
2. Lubricate the switch actuator pivot pin (2) with lithium grease.
3. Install the switch actuator pivot pin (2) into the pivot and pulse switch assembly (1) and the lock housing cover and sleeve assembly.

Important: Use care not to damage the wires when pulling the pivot and pulse switch assembly wire harness through the steering column.

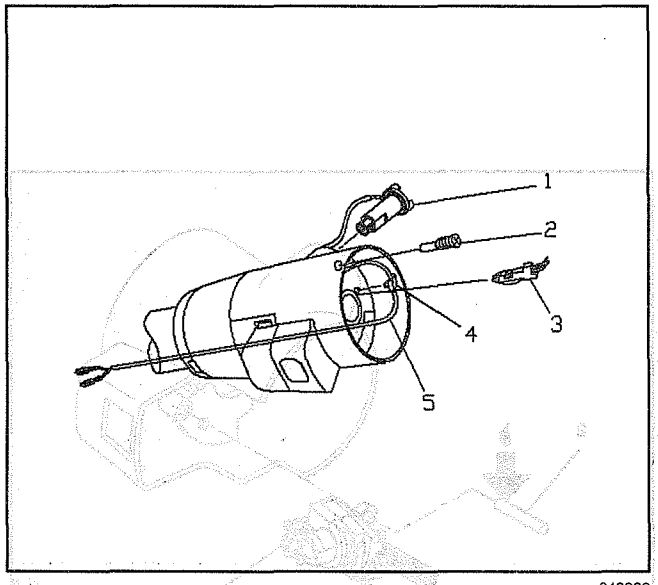
4. Pull the pivot and pulse switch assembly wire harness through the steering column.
5. Install the pivot and pulse switch assembly connector to the bulkhead connector.
6. Install the wire protector shield.
7. Install the lock housing cover and sleeve assembly. Refer to *Lock Housing Assembly - Assemble - Off Vehicle*.



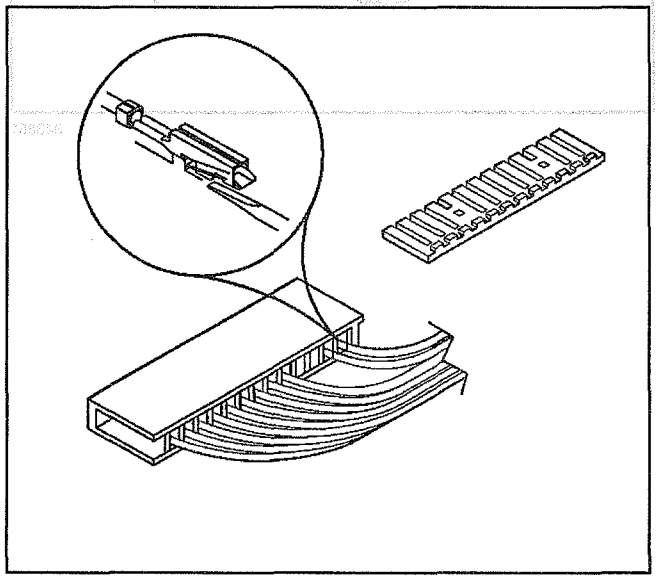
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343824

Steering Column Lock Cylinder Set - Disassemble - Off Vehicle

Disassembly Procedure

Important: The turn signal switch assembly does not have to be pulled through the column when removing unless necessary. Let the turn signal switch assembly hang freely after removal of the screws.

1. Remove the turn signal switch assembly. Refer to *Turn Signal and Multifunction Switch Assembly - Disassemble - Off Vehicle.*
2. Put the key in the LOCK position.
3. Disconnect the steering column key lock cylinder set terminal connectors.
4. Attach a wire to the terminal connectors. This will make installation easier.
5. Remove the buzzer switch assembly (3).
6. Remove the lock retaining screw (2).
7. Remove the retaining clip (4) from the steering column lock cylinder set terminal connector (5).
8. Remove the steering column lock cylinder set (1).
9. Gently pull the terminal connectors (5) through the column.

Steering Column Lock Cylinder Set - Assemble - Off Vehicle

Assembly Procedure

1. Pull the steering column lock cylinder set terminal connectors through the column and reconnect.

2. Put the steering column passkey lock cylinder set (1) into the lock housing cover assembly.

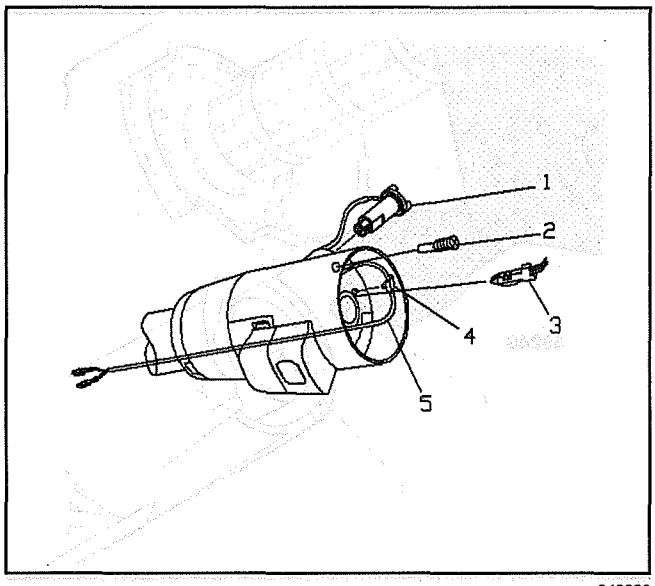
Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the lock retaining screw (2).

   Tighten

   Tighten the screw to 2.5 N·m (22 lb in).

4. Install the buzzer switch assembly (3).
5. Install the retaining clip (4) onto the steering column passkey lock cylinder set terminal lead and the lock housing cover assembly.
6. Install the turn signal switch assembly. Refer to *Turn Signal and Multifunction Switch Assembly - Assemble - Off Vehicle.*



343829

Tilt Spring - Disassemble - Off Vehicle

Disassembly Procedure

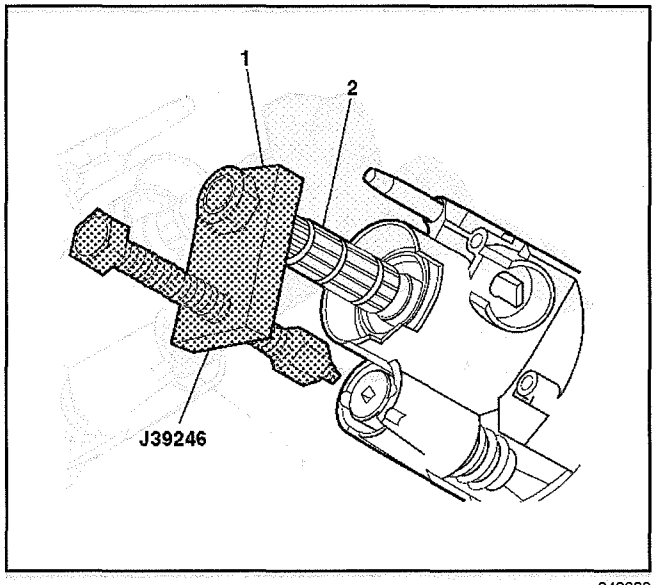
Tool Required

J 39246 Tilt Spring Compressor

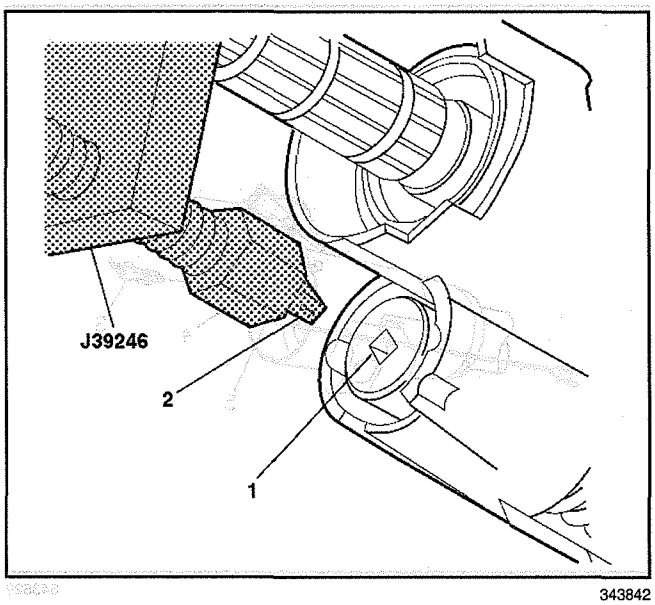
1. Remove the lock housing cover and sleeve assembly. Refer to *Lock Housing Assembly - Disassemble - Off Vehicle.*

Caution: The tilt spring and the spring guide are under pressure. The tilt spring and the spring guide may become a projectile. Secure the spring with locking pliers during removal. Secure the spring with locking pliers during installation. Bodily injury may result during removal and installation of the tilt spring and the spring guide. Always use caution during removal and installation of the tilt spring and the spring guide.

2. Seat the counterbore of *J 39246* over the steering shaft assembly (1).
3. Thread and seat the standard hexagon nut of the tool onto the steering shaft assembly (2).
4. Thread the hexagon nut of the tool until it contacts the block of *J 39246.*

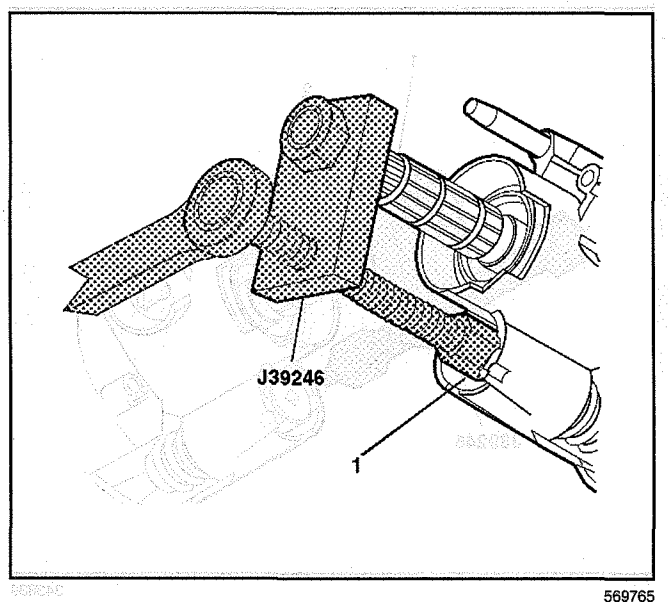


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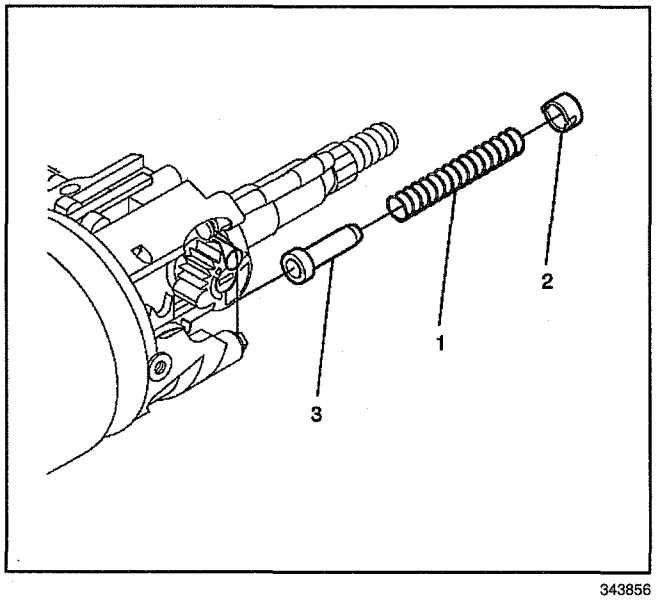
343842

5. Insert the square end (2) of *J 39246* into the spring retainer (1) and seat.



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6. Rotate the tool bolt clockwise with the wrench until it contacts the surface of the tool block.
7. Make a one fourth turn counter clockwise to the hexagon section on the end of the tool bolt.
8. Unscrew the tool bolt until the wheel tilt spring and the spring retainer (1) are free.



343856

9. Remove the spring retainer (2) from the steering column housing assembly.
10. Remove the wheel tilt spring (1) from the steering column housing assembly.
11. Remove the spring guide (3) from the steering column housing assembly.

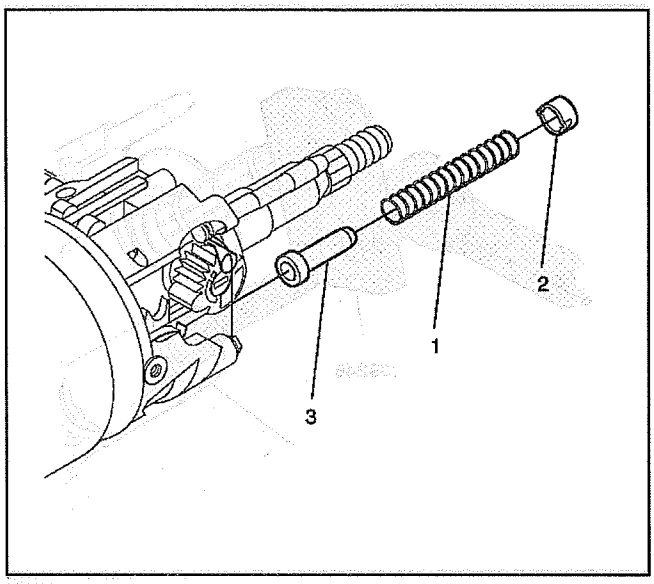
Tilt Spring - Assemble - Off Vehicle

Assembly Procedure

Tools Required

J 39246 Tilt Spring Compressor

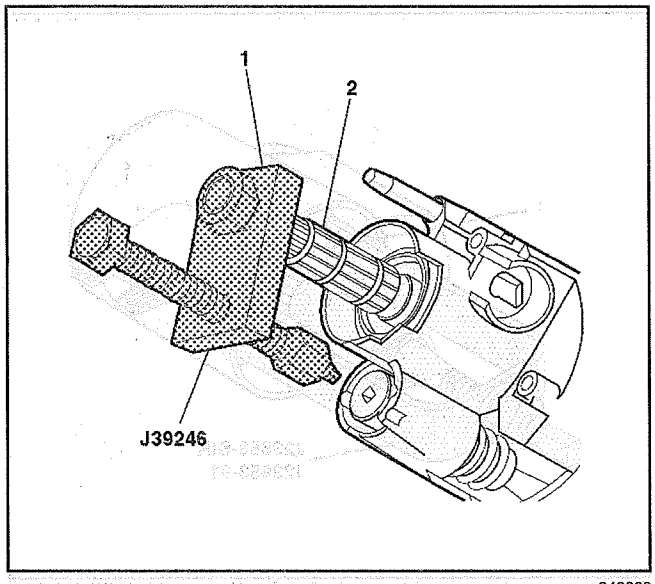
1. Install the spring guide (3) to the steering column housing assembly.
2. Lubricate the wheel tilt spring (1) with lithium grease.
3. Install the wheel tilt spring (1) to the steering column housing assembly.
4. Install the spring retainer (2) to the steering column housing assembly.



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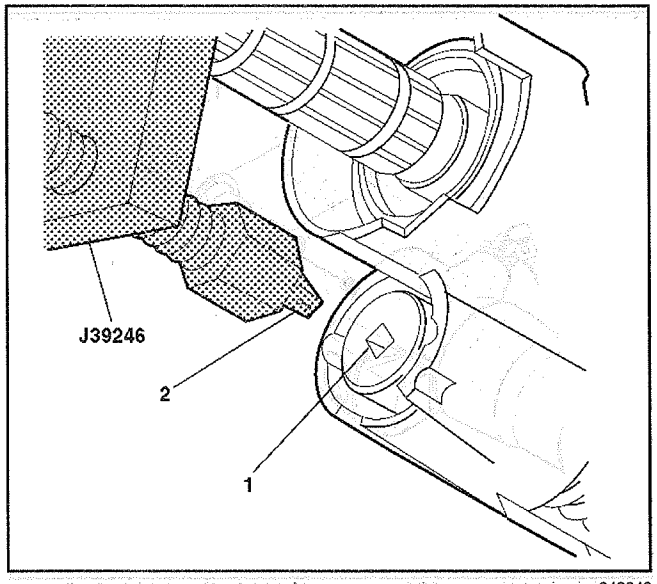
Caution: The tilt spring and the spring guide are under pressure. The tilt spring and the spring guide may become a projectile. Secure the spring with locking pliers during removal. Secure the spring with locking pliers during installation. Bodily injury may result during removal and installation of the tilt spring and the spring guide. Always use caution during removal and installation of the tilt spring and the spring guide.

5. Seat the counterbore of *J 39246* over the steering shaft assembly (2).
6. Thread and seat the standard hexagon nut onto the steering shaft assembly (2).
7. Thread the hexagon nut until it contacts the block (1) of *J 39246*.

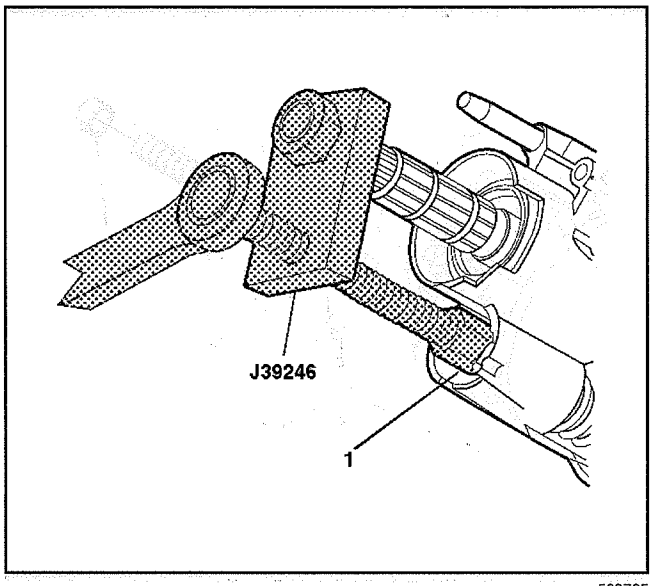


343839

8. Insert the square end (2) of *J 39246* into the spring retainer (1) and seat.

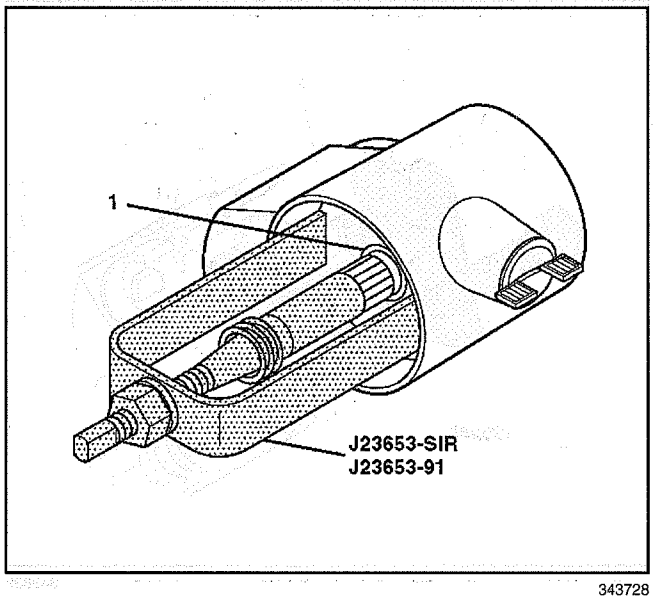


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9. Rotate the tool bolt clockwise with a wrench until it contacts the surface of the tool block.
10. Make a one fourth turn counter clockwise to the hexagon section on the end of the tool bolt.
11. Unscrew the tool bolt until the wheel tilt spring and the spring retainer (1) are free.
12. Remove *J 39246*.
13. Install the lock housing cover and sleeve assembly. Refer to *Lock Housing Assembly - Assemble - Off Vehicle*.



343728

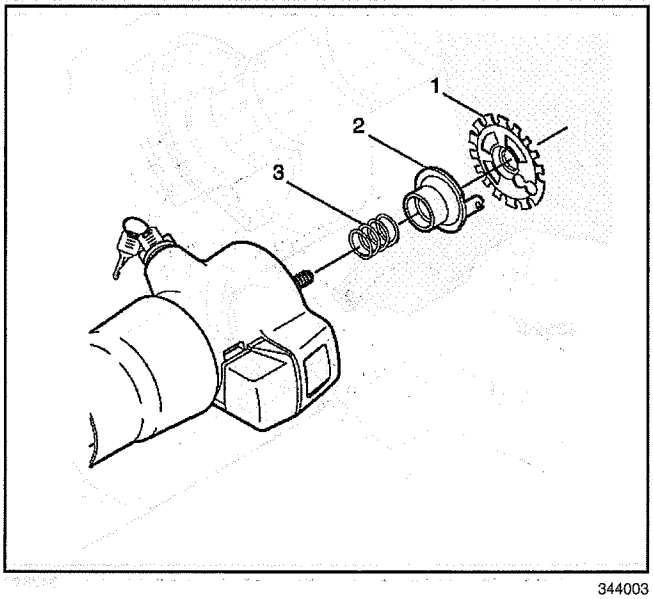
Turn Signal Cancel Cam and Upper Bearing Inner Race - Disassemble - Off Vehicle

Disassembly Procedure

Tools Required

J 23653-SIR Lock Plate Compressor

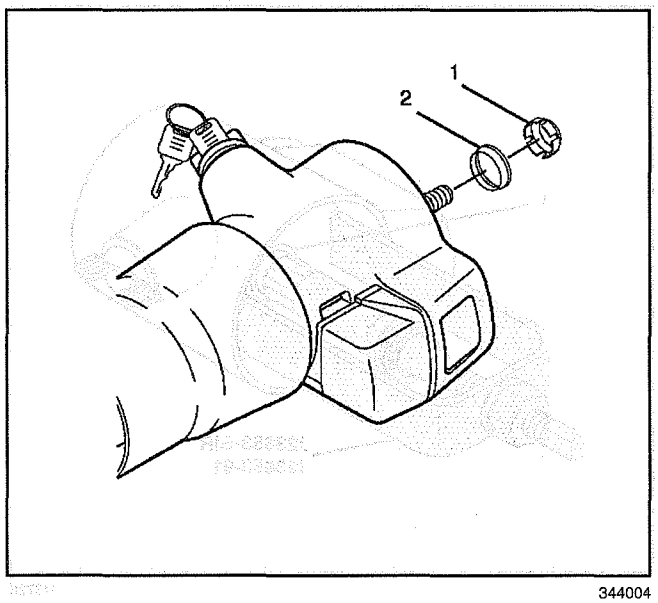
1. Remove the SIR coil assembly. Refer to *Inflatable Restraint Steering Wheel Module Coil - Disassemble - Off Vehicle*.
2. Remove the wave washer.
3. Compress the shaft lock using *J 23653-SIR*.
4. Remove the bearing retainer (1) from the steering shaft assembly and dispose of it.
5. Remove *J 23653-SIR*.



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6. Remove the following 3 parts from the steering shaft assembly:
   6.1. Remove the shaft lock shield assembly (1).
   6.2. Remove the turn signal cancel cam assembly (2).
   6.3. Remove the upper bearing spring (3).

7. Remove the following 2 parts from the steering shaft assembly:
   7.1. Remove the upper bearing inner race seat (1).
   7.2. Remove the inner race (2).



344004

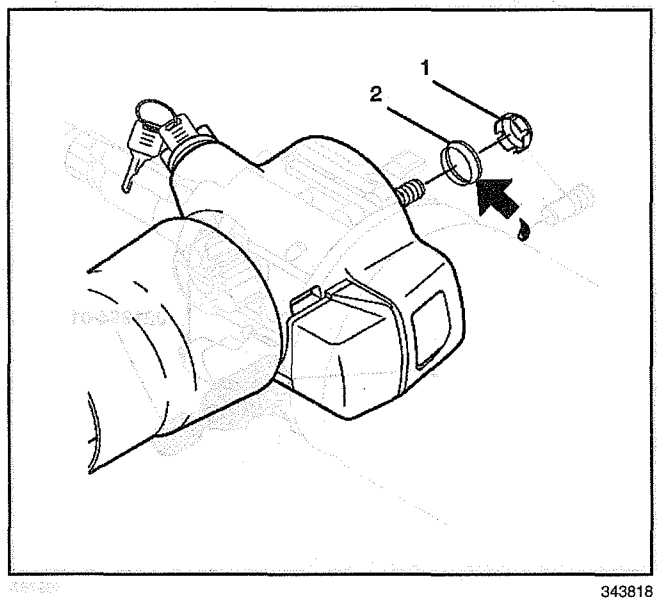
Turn Signal Cancel Cam and Upper Bearing Inner Race - Assemble - Off Vehicle

Assembly Procedure

Tools Required

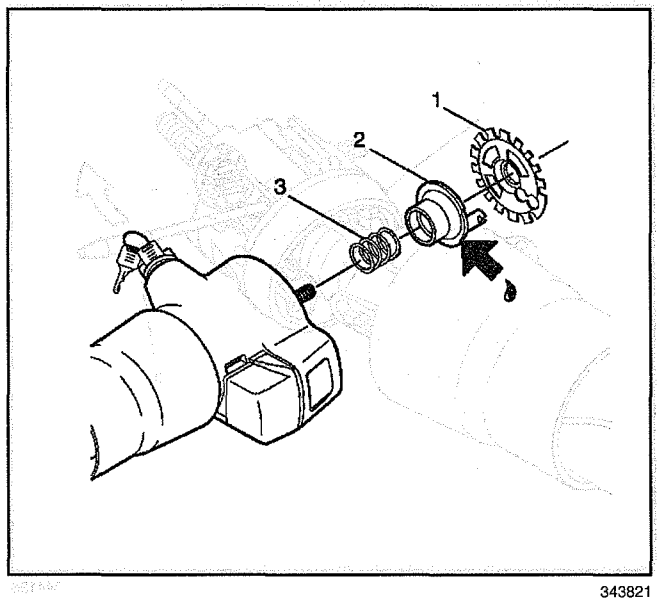
J 23653-SIR Lock Plate Compressor

1. Install the following 2 parts onto the steering shaft assembly:
   1.1. Lubricate the inner race (2) with lithium grease.
   1.2. Install the inner race (2).
   1.3. Install the upper bearing inner race seat (1).

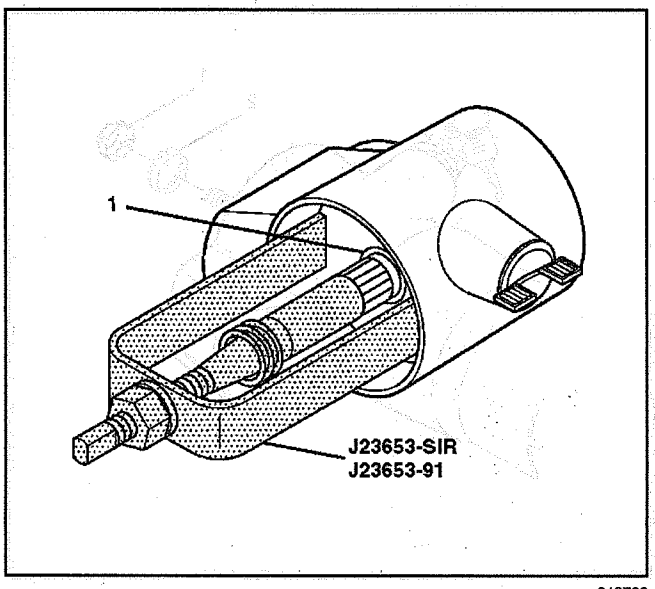


343818

2. Install the following 3 parts onto the steering shaft assembly.
   2.1. Install the upper bearing spring (3).
   2.2. Lubricate the turn signal cancel cam assembly (2) with grease kit 26001884.
   2.3. Install the turn signal cancel cam assembly (2).
   2.4. Install the shaft lock (1).

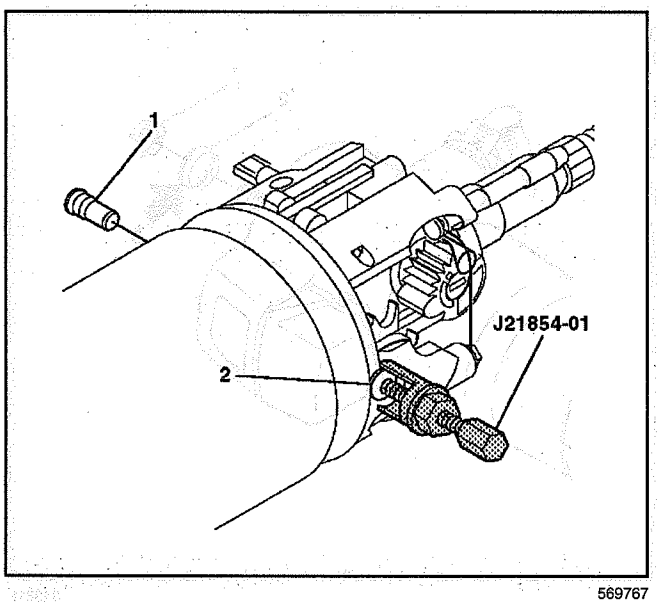


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3. Install the new bearing retainer (1) using *J 23653-SIR*.
4. Seat the bearing retainer (1) in the groove on the steering shaft assembly.
5. Remove *J 23653-SIR*.
6. Install the wave washer.
7. Install the SIR coil assembly. Refer to *Inflatable Restraint Steering Wheel Module Coil - Assemble - Off Vehicle*.



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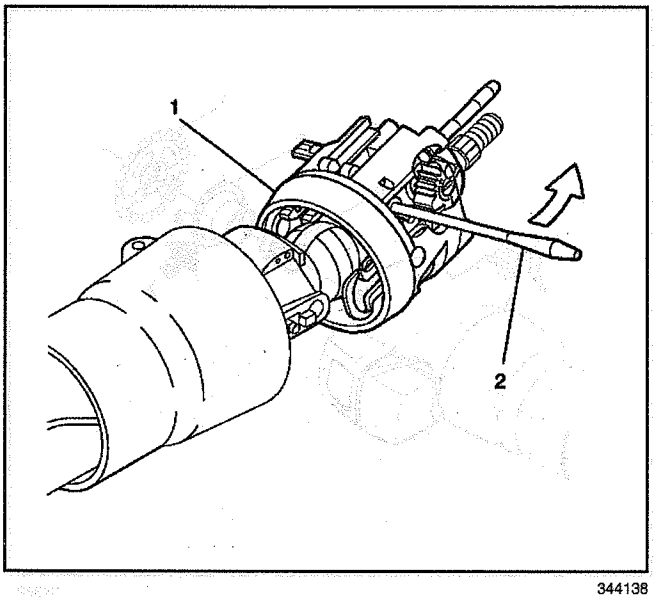
Steering Column Jacket - Disassemble - Off Vehicle

Disassembly Procedure

Tools Required

- *J 38639* Steering Column Housing Bearing Installer
- *J 8092* Driver Handle
- *J 22635* Lock Shoe and Release Lever Pin Remover and Installer
- *J 21854-01* Pivot Pin Remover

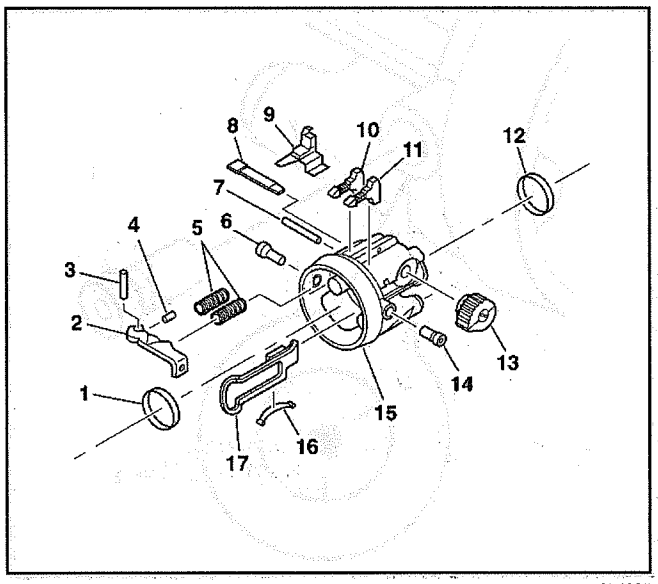
1. Remove the tilt spring assembly. Refer to *Tilt Spring - Disassemble - Off Vehicle*.
2. Remove 2 pivot pins (1) and (2) using *J 21854-01*.



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3. Use the tilt lever (2) to pull back on the steering column housing assembly (1) to release.
4. Remove the tilt lever (2).

5. Disassemble the steering column housing assembly, if needed:
   5.1. Remove the bearing assembly (12).
   5.2. Remove the wire protector shield (9).
   5.3. Remove the switch actuator rack (17) and the rack preload spring (16).
   5.4. Remove the drive shaft (8).
   5.5. Remove the switch actuator sector (13).
   5.6. Release the release lever pin (3) using *J 22635*.
   5.7. Remove the shoe release lever (2).
   5.8. Remove the release lever spring (4).
   5.9. Remove the dowel pin (7).
   5.10. Remove the steering wheel lock shoes (10) and (11) using *J 22635* and the shoe springs (5).
   5.11. Remove the bearing assembly (1).



354085

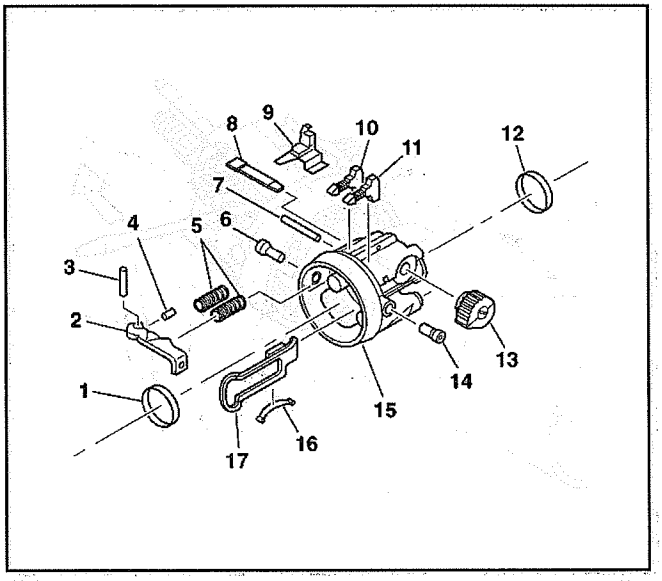
Steering Column Jacket - Assemble - Off Vehicle

Assembly Procedure

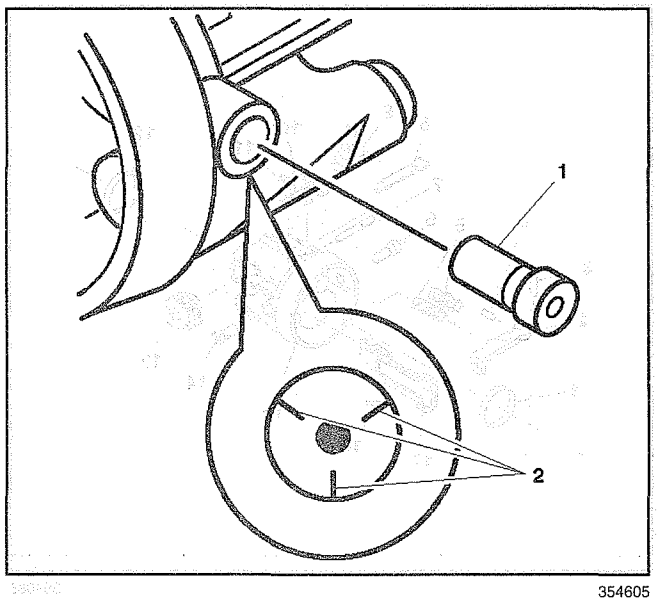
Tools Required

- *J 38639* Steering Column Housing Bearing Installer
- *J 8092* Driver Handle
- *J 22635* Lock Shoe and Release Lever Pin Remover and Installer

1. To assemble the steering column housing assembly if needed:
2. Install the bearing assembly (1)
3. Install the shoe springs (5).
4. Install the steering wheel lock shoes (10) and (11).
5. Install the dowel pin (7).
6. Install the release lever spring (4).
7. Install the shoe release lever (2).
8. Install the release lever pin (3) using *J 22635*.
9. Install the drive shaft (8).
10. Install the switch actuator sector (13).
11. Install the rack preload spring (16).
12. Install the switch actuator rack (17) to the switch actuator sector (13).
13. Install the bearing assembly (12) using *J 8092* and *J 38639*.
14. Install the wire protector shield (9).



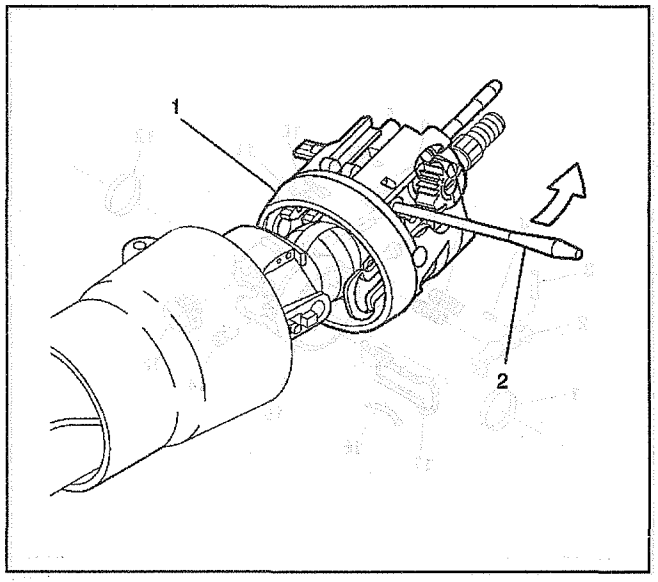
354085



354605

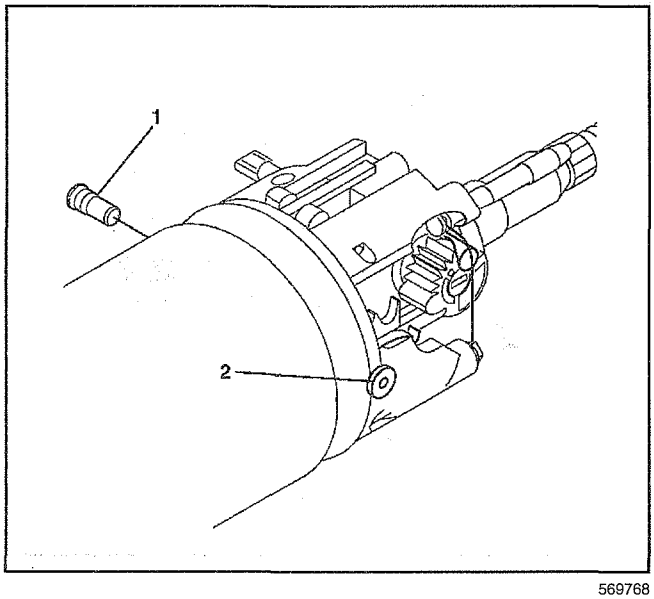
Important: If the steering column housing assembly and the pivot pins (1) have been staked (2) 3 times it must be replaced.

15. Install the steering column housing assembly.



344138

16. Install the steering column housing assembly following these steps:
    16.1. Install the tilt lever (2) and use it to pull back on the steering column housing assembly (1) to mount on the steering column housing support assembly.
    16.2. Position the steering column housing assembly (1) onto the steering column housing support assembly.
    16.3. Align the switch actuator rack with the pin on the end of the ignition switch actuator assembly.
    16.4. Pull back on the tilt lever (2) to position the steering column housing assembly (1).
    16.5. Push the steering column housing assembly (1) into the steering column housing support assembly.
    16.6. Release the tilt lever (2) to lock the steering wheel lock shoes and the dowel pin.
    16.7. Remove the tilt lever (2).



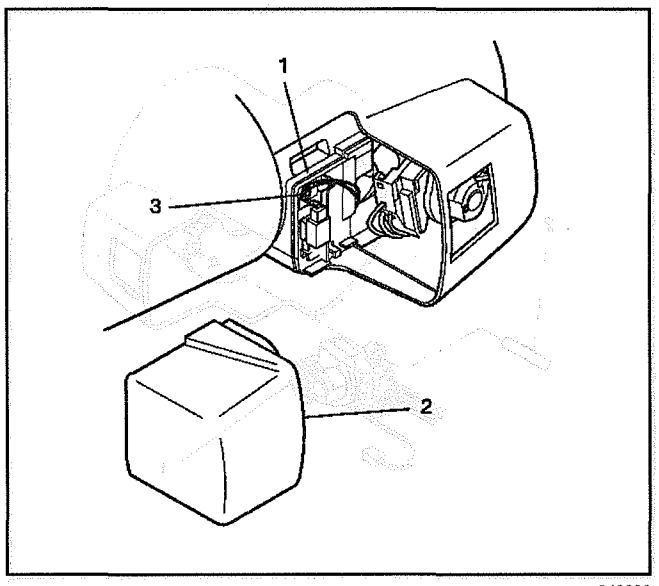
569768

17. Install 2 pivot pins (1) and (2).
18. Press the 2 pivot pins (1) and (2) until they are firmly seated.
19. Stake the pivot pins in 3 places.
20. Install the tilt spring assembly. Refer to *Tilt Spring - Assemble - Off Vehicle*.

Lock Housing Assembly - Disassemble - Off Vehicle

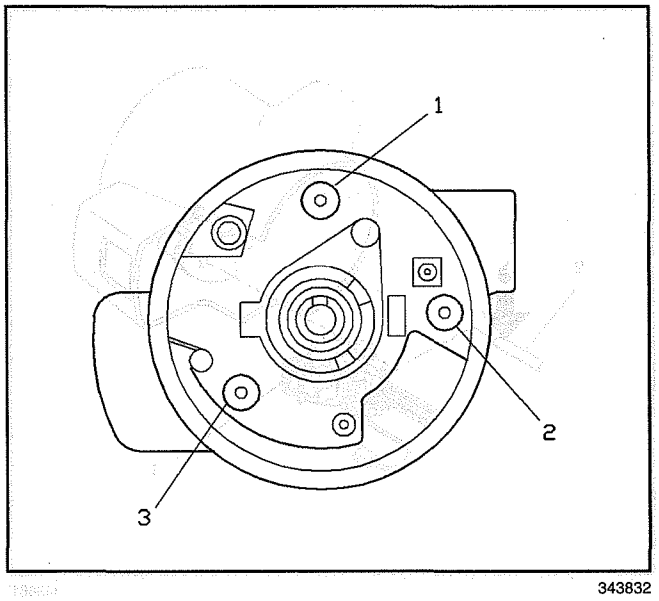
Disassembly Procedure

1. Remove the steering column lock cylinder set. Refer to *Steering Column Lock Cylinder Set - Disassemble - Off Vehicle*.
2. Remove the column housing cover end cap (2).
   Remove the cruise control connector (3) from the base plate (1) and disconnect.



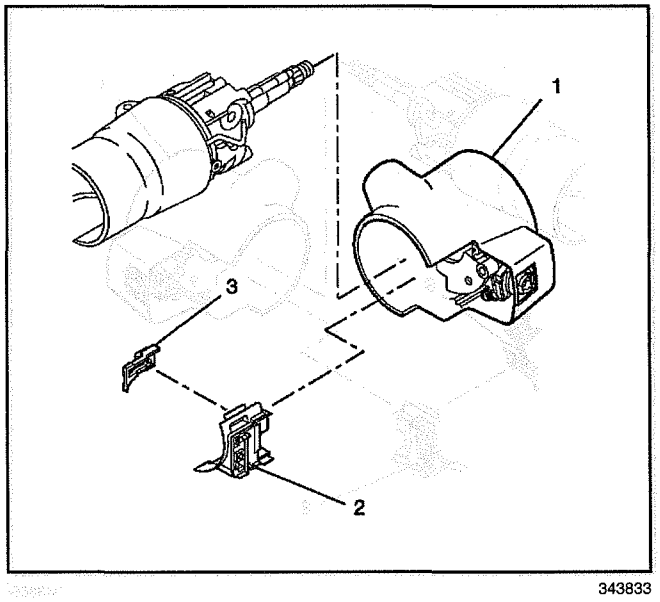
343830

3. Remove the 3 pan head 6–lobed socket tapping screws: (1) at 12 o' clock, (2) at 3 o' clock and (3) at 8 o' clock.

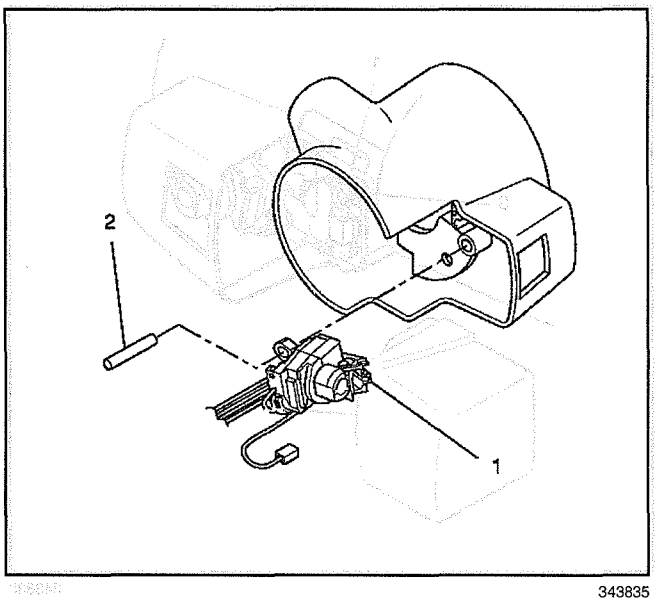


343832

4. Remove the lock housing cover and sleeve assembly (1).
   Remove the column housing cover end base plate (2) and the dimmer switch rod actuator (3).

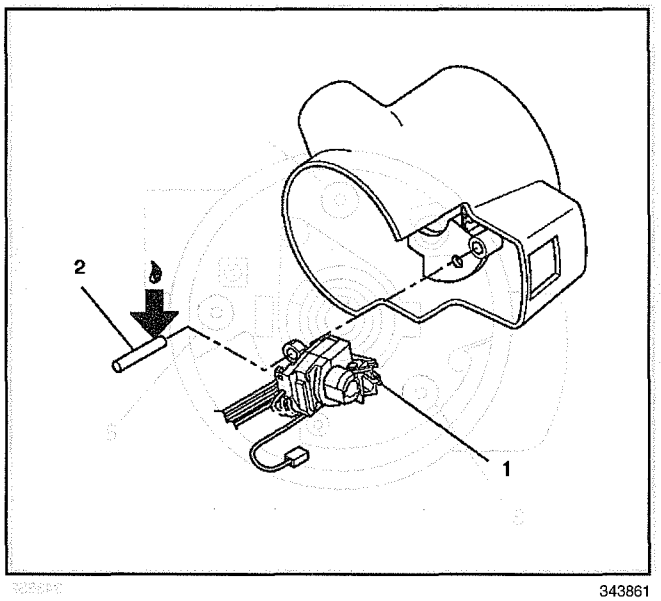


343833



343835

5. Remove the switch actuator pivot pin (2).
6. Remove the pivot and pulse switch assembly (1) from the lock housing cover assembly.

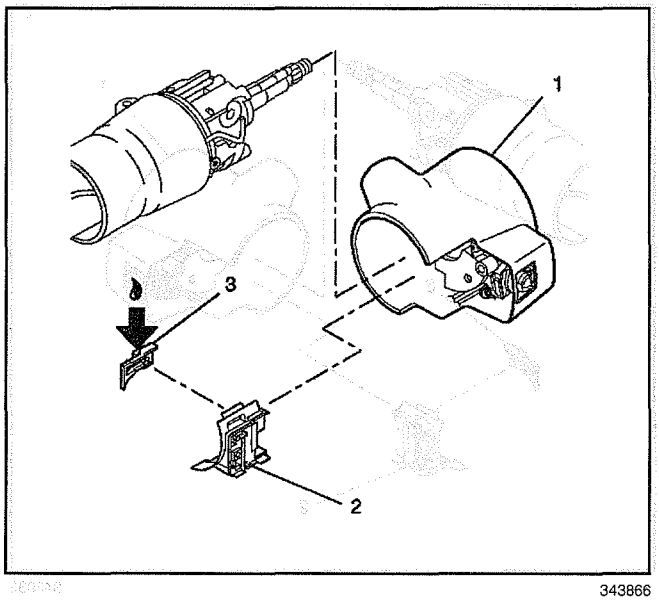


343861

Lock Housing Assembly - Assemble - Off Vehicle

Assembly Procedure

1. Lubricate the switch actuator pivot pin (2) with synthetic grease.
2. Install the switch actuator pivot pin (2) to the pivot and pulse dimmer switch assembly (1).
3. Install the pivot and pulse assembly (1) into the lock housing cover assembly.



343866

4. Lubricate the dimmer switch rod actuator (3) with lithium grease.
5. Install the dimmer switch rod actuator (3) to the column housing cover end base plate (2).
6. Install the column housing cover end base plate (2) to the lock housing cover and sleeve assembly (1).

Important: The bottom edge of the dimmer switch rod actuator must rest on the bend of the dimmer switch rod.

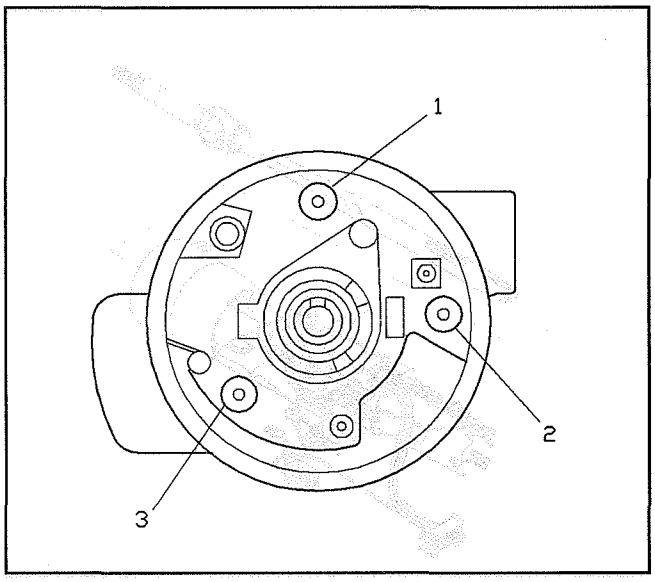
7. Align the lock housing cover and sleeve assembly (1) onto the steering column.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

8. Install 3 pan head 6–lobe socket tapping screws: (1) at 12 o' clock position first, (3) at 8 o' clock position second, and (2) at 3 o' clock position third.

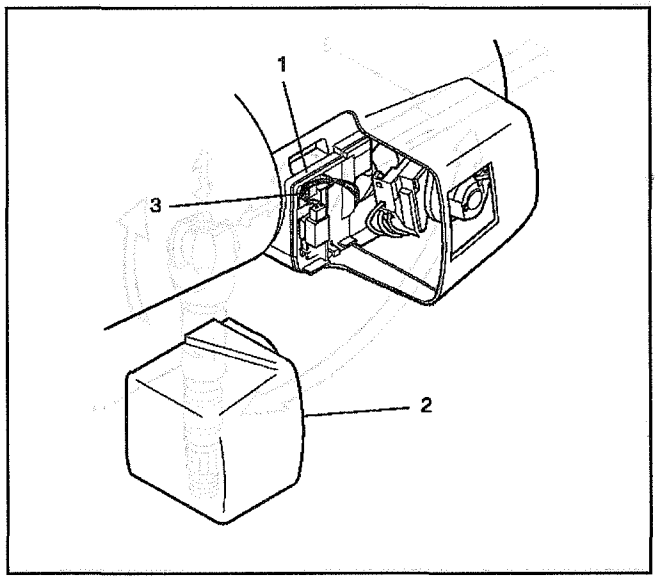
   Tighten

   Tighten the 3 pan head 6–lobed socket screws to 9 N·m (80 lb in).



343832

9. Mount the cruise control connector (3) on the base plate (1).
10. Install the column housing cover end cap (2).
11. Install the steering column lock cylinder set. Refer to *Steering Column Lock Cylinder Set - Assemble - Off Vehicle*.

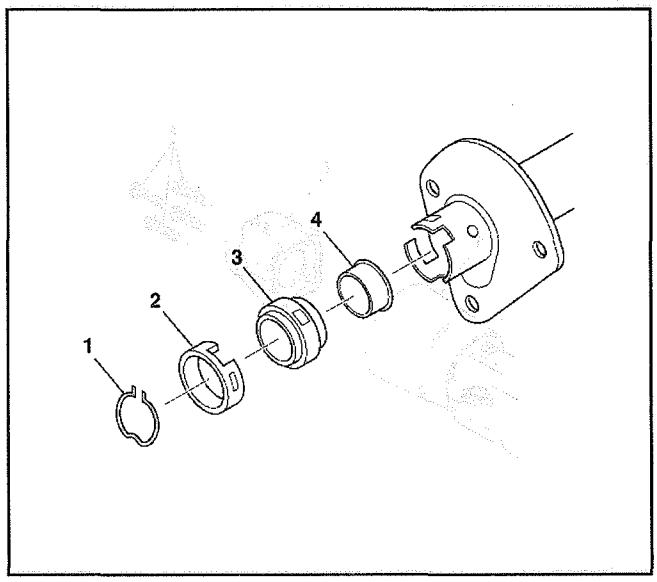


343830

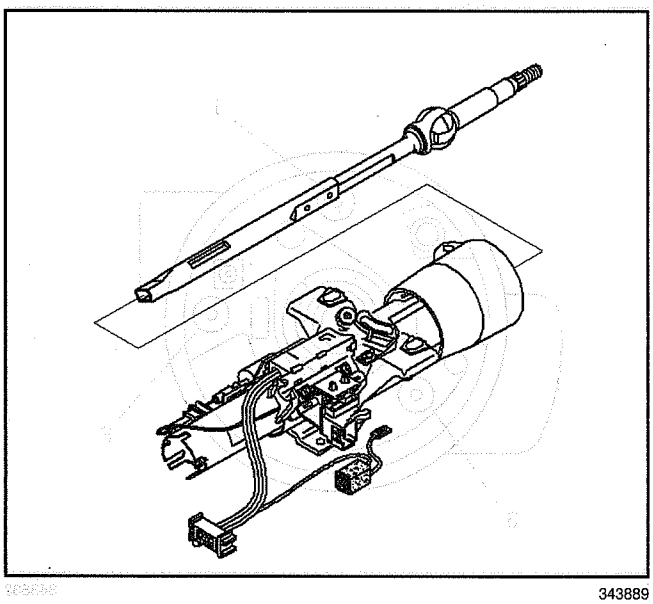
Steering Shaft, Lower Bearing, and Jacket - Disassemble - Off Vehicle

Disassembly Procedure

1. Remove the steering column housing assembly. Refer to *Steering Column Jacket - Disassemble - Off Vehicle*.
2. Remove the pivot and pulse switch assembly. Refer to *Windshield Wiper and Washer Switch Assembly - Disassemble - Off Vehicle*.
3. Remove the following 4 items from the steering column jacket assembly:
   3.1. Remove the lower bearing adapter clip (1).
   3.2. Remove the bearing adapter (2).
   3.3. Remove the bearing assembly (3).
   3.4. Remove the lower bearing adapter (4).

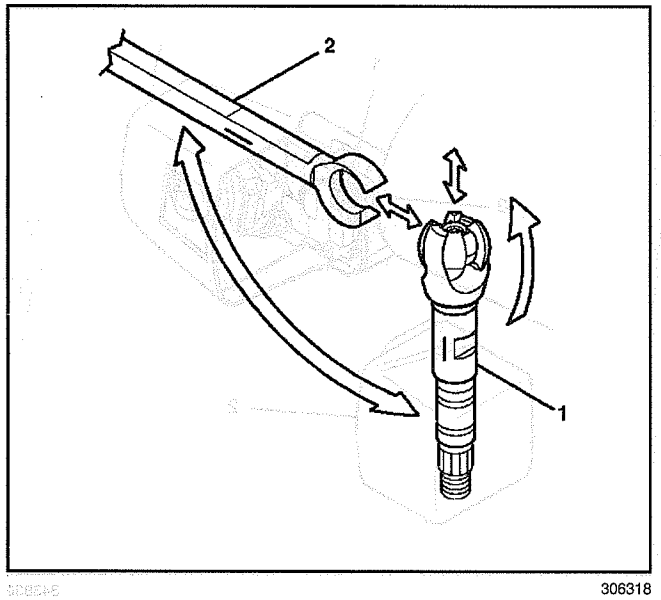


569761



343889

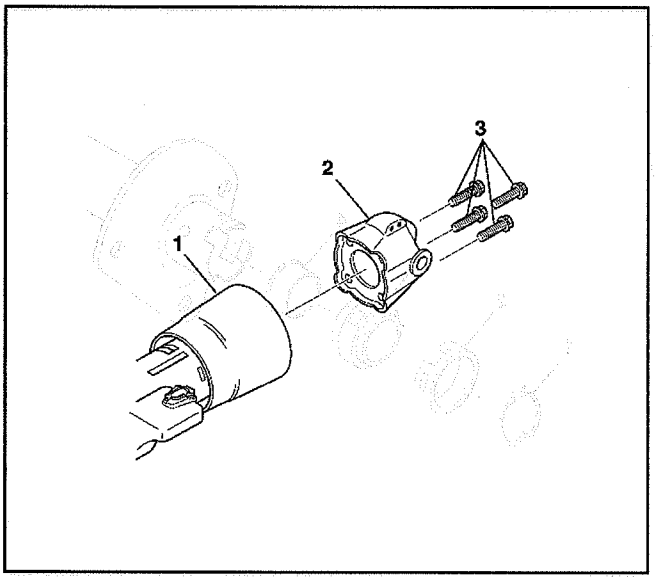
4. Remove the steering shaft assembly from the steering column.



306318

Important: Mark the race and upper shaft assembly and the lower shaft assembly before disassembly. Failure to assemble the race and upper shaft assembly and the lower shaft assembly correctly will cause the steering wheel to be turned 180 degrees.

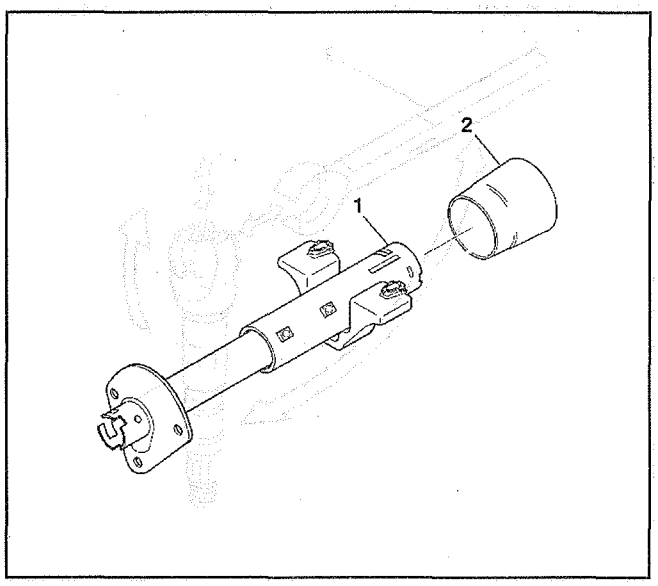
5. Tilt the race and upper shaft assembly (1) 90 degrees from the lower steering shaft assembly (2) to disengage.
6. Separate the race and upper shaft assembly (1) from the lower steering shaft assembly (2).
7. Remove the ignition switch assembly. Refer to *Ignition Switch Assembly - Disassemble - Off Vehicle*



569763

8. Remove the 4 hexagon washer head tapping screws (3).
9. Remove the steering column housing support assembly (2) from the steering column housing shroud (1).

10. Remove the steering column shroud (2) from the steering column jacket assembly (1).

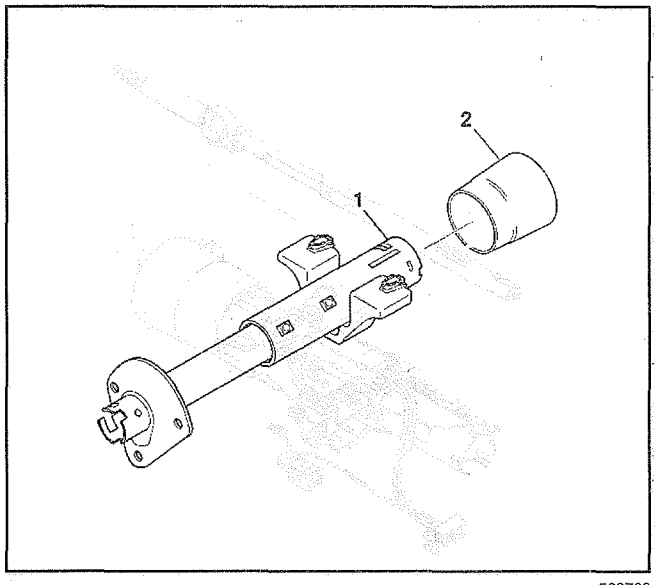


569762

Steering Shaft, Lower Bearing, and Jacket - Assemble - Off Vehicle

Assembly Procedure

1. Install the steering column shroud (2) to the steering column jacket assembly (1).



569762

2. Install the steering column housing support assembly (2).

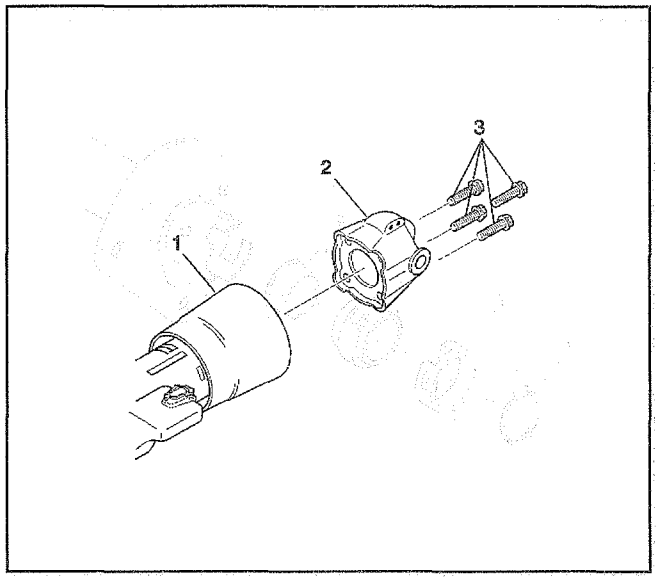
Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the 4 hexagon washer head tapping screws (3) to the steering column housing assembly (2).

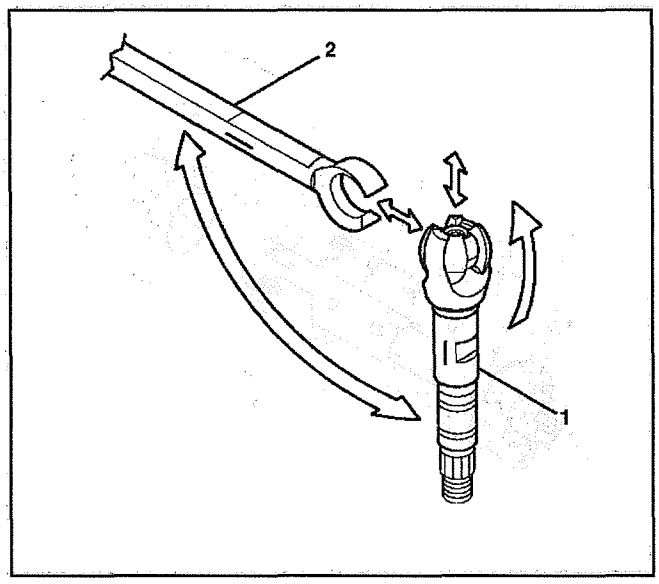
   Tighten

   Tighten the 4 hexagon washer head tapping screws to 9 N·m (80 lb in).

4. Install the ignition switch assembly. Refer to *Ignition Switch Assembly - Assemble - Off Vehicle.*



569763

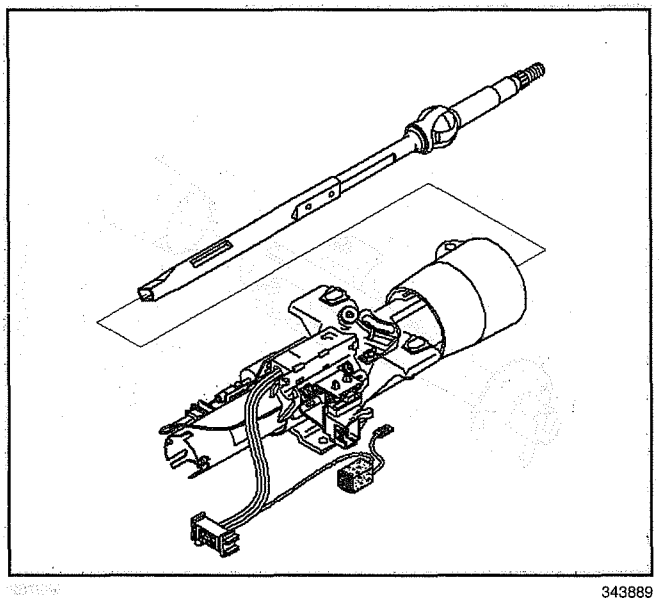


306318

5. Lubricate the exposed area of the race and upper shaft assembly (1).

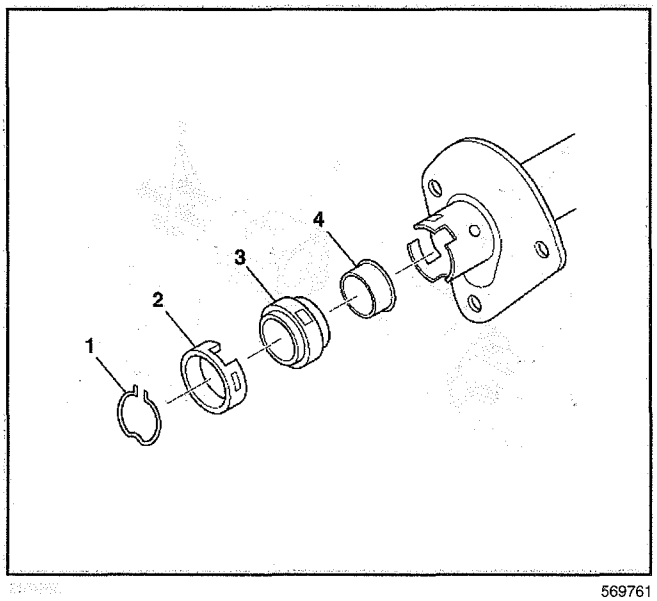
Important: Use the marks on the race and upper shaft assembly and the lower shaft assembly from the disassembly procedure. Failure to assemble the race and upper shaft assembly and the lower shaft assembly correctly will cause the steering wheel to be turned 180 degrees.

6. Align the mark on the race and upper shaft assembly (1) to the mark on the lower steering shaft assembly (2).
7. Tilt the race and upper shaft assembly (1) 90 degrees to the lower steering shaft assembly (2) to engage.



343889

8. Install the steering shaft assembly to the steering column.



569761

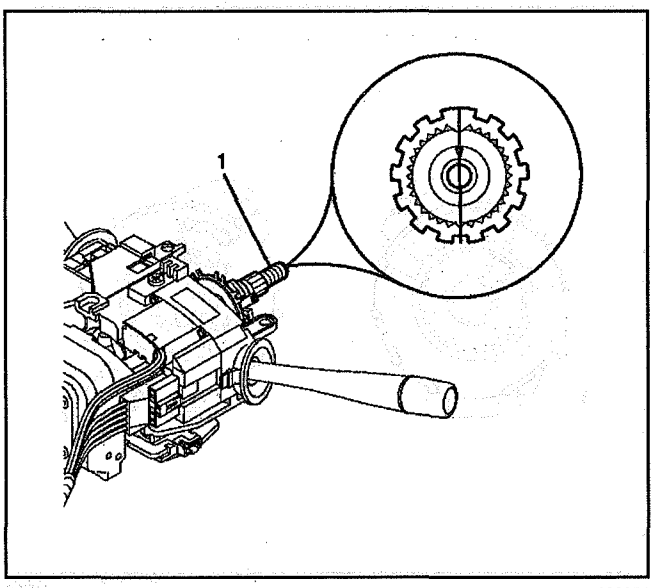
9. Install the following 4 items to the steering column jacket assembly:
   - 9.1. Install the lower bearing adapter (4).
   - 9.2. Install the bearing assembly (3).
   - 9.3. Install the bearing adapter retainer (2).
   - 9.4. Install the lower bearing adapter clip (1).
10. Install the pivot and pulse switch assembly only. Refer to *Windshield Wiper and Washer Switch Assembly - Assemble - Off Vehicle*.
11. Install the steering column housing assembly. Refer to *Steering Column Jacket - Assemble - Off Vehicle*.

Inflatable Restraint Coil Centering - Off Vehicle (Column Shift And Floor Shift)

Centering Procedure

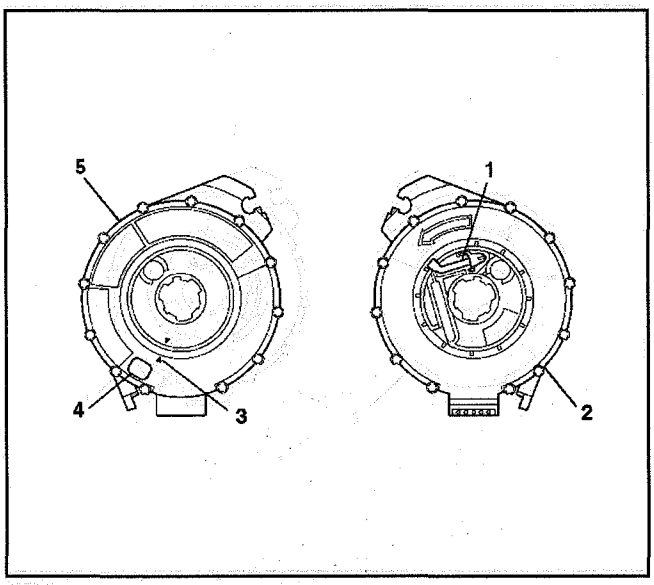
Notice: Refer to *New SIR Coil Is Centered* in Cautions and Notices.

1. Verify the following before centering the SIR coil assembly:
   - The wheels on the vehicle are straight ahead.
   - The block tooth (1) of the steering shaft assembly is in the 12 o' clock position.
   - The ignition switch is in the "LOCK" position or *J 42640* is installed in the upper tilt head assembly.



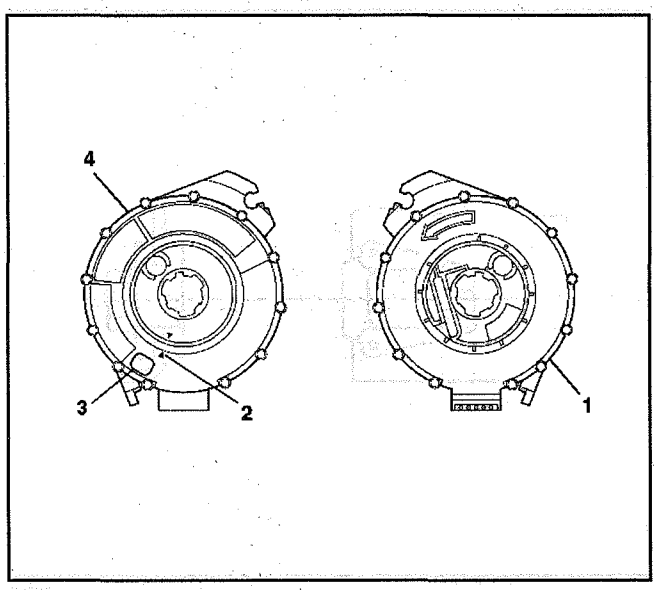
293254

2. If the front (5) of the SIR coil assembly has a centering window (4), and on the back side (2) a spring service lock (1), perform the following steps:
   2.1. Hold the coil assembly with the face up.
   2.2. While depressing the spring service lock, rotate the coil hub clockwise until the coil ribbon stops.
   2.3. Rotate the coil hub slowly, counter clockwise, until the centering window appears yellow and both arrows (3) line up.
   2.4. Release spring service lock between the locking tab. The SIR coil is now centered.
   2.5. Align the centered SIR coil assembly with the horn tower and slide onto the steering shaft assembly.

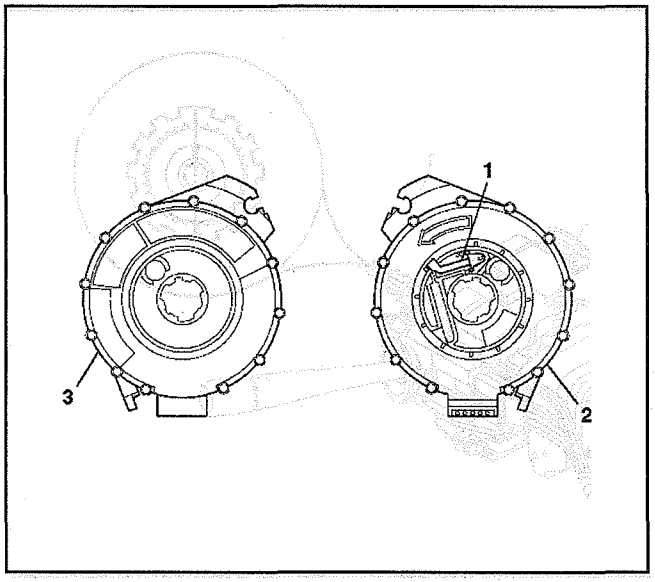


603737

3. If the front (4) of the SIR coil has a centering window (3) and no spring service lock on the back side (1), perform the following steps:
   3.1. Hold the coil assembly with the face up.
   3.2. Rotate the coil hub clockwise until the coil ribbon stops.
   3.3. Rotate the coil hub slowly, counter clockwise until the centering window appears yellow and both arrows (2) line up. This is center position.
   3.4. While holding the coil hub in center position, align the SIR coil assembly with the horn tower and slide onto the steering shaft assembly.

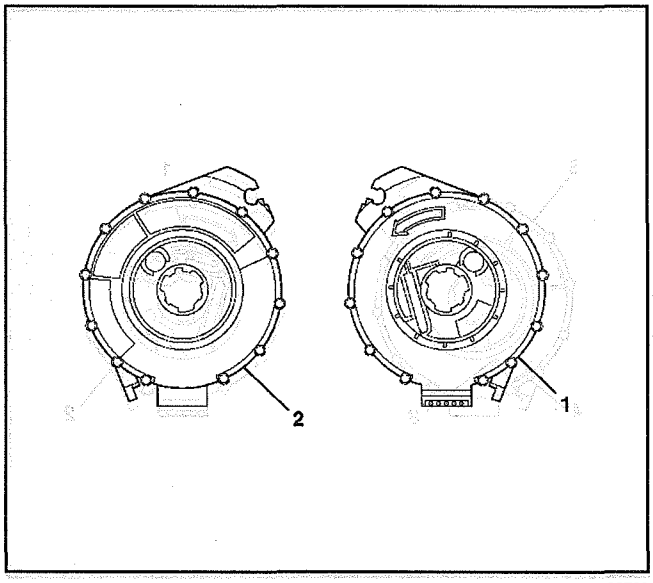


594558



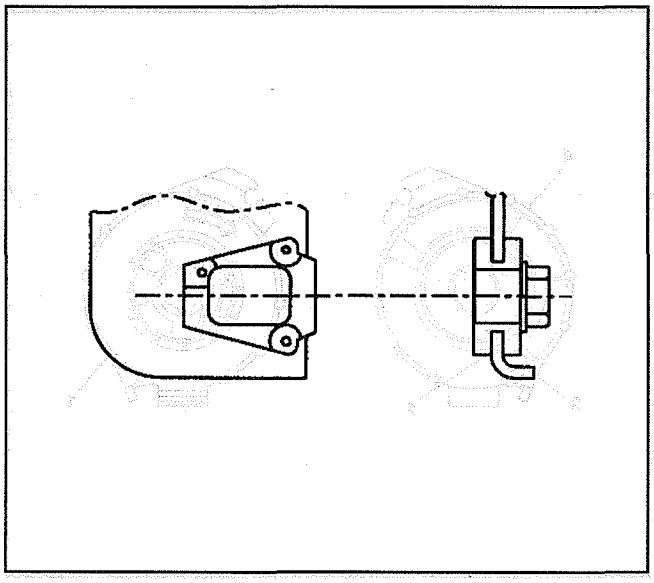
603738

4. If no centering window is present on the front side (3) of the SIR coil assembly, but a spring service lock (1) is on the back side (2), perform the following steps:
   - 4.1. Hold the SIR coil assembly with the back side up.
   - 4.2. While depressing the spring service lock, rotate the coil hub counter clockwise until the coil ribbon stops.
   - 4.3. Still pressing the spring service lock, rotate the coil hub in the opposite direction 2 ½ revolutions.
   - 4.4. Release the spring service lock between locking tabs. The SIR coil is now centered.
   - 4.5. Align the centered SIR coil assembly with the horn tower and slide onto the steering shaft assembly.



603739

5. For no centering window on the front side (2) of the SIR coil assembly and no spring service lock on the back side (1), perform the following steps:
   - 5.1. Hold the coil assembly with the face up.
   - 5.2. Rotate the coil hub clockwise until the coil ribbon stops.
   - 5.3. Rotate the coil hub, slowly, counter clockwise, for 2 ½ revolutions. This is center position.
   - 5.4. While maintaining the coil hub in center position, align the centered SIR coil assembly with the horn tower and slide onto the steering shaft assembly.



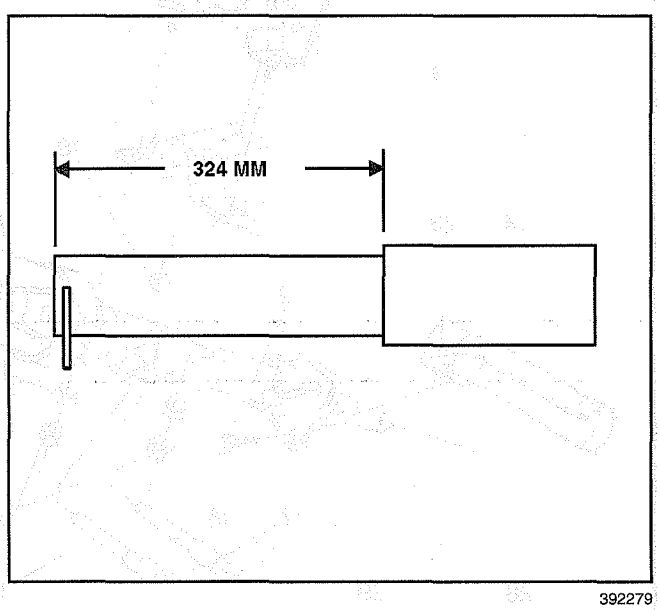
303713

Steering Column Accident Damage Inspection - Off Vehicle

Inspection Procedure

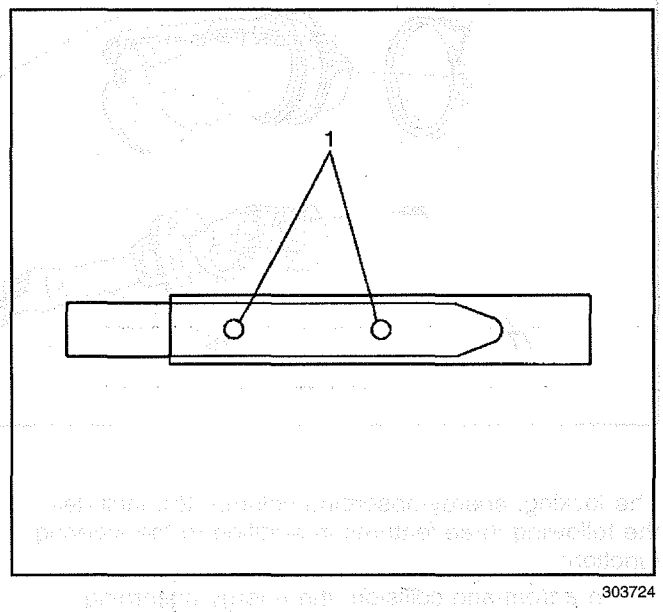
- Vehicles involved in accidents resulting in frame damage, major body or sheet metal damage, or where the steering column has been impacted, or where supplemental inflatable restraint systems deployed may also have a damaged or misaligned steering column.
- Check the capsules on the steering column bracket assembly. All capsules must be securely seated in the bracket slots and checked for any loose conditions when pushed or pulled by hand.

- Observe how the bracket is attached to the jacket assembly.
  - If the capsules are not securely seated and the bracket is bolted to the jacket assembly, replace only the bracket.
  - If the capsules are not securely seated and the bracket is welded to the jacket assembly, replace only the jacket assembly.
- Check for jacket assembly collapse by measuring the distance from the lower edge of the upper jacket to a defined point on the lower jacket. Replace the jacket assembly if the measured dimensions are not within specifications.



392279

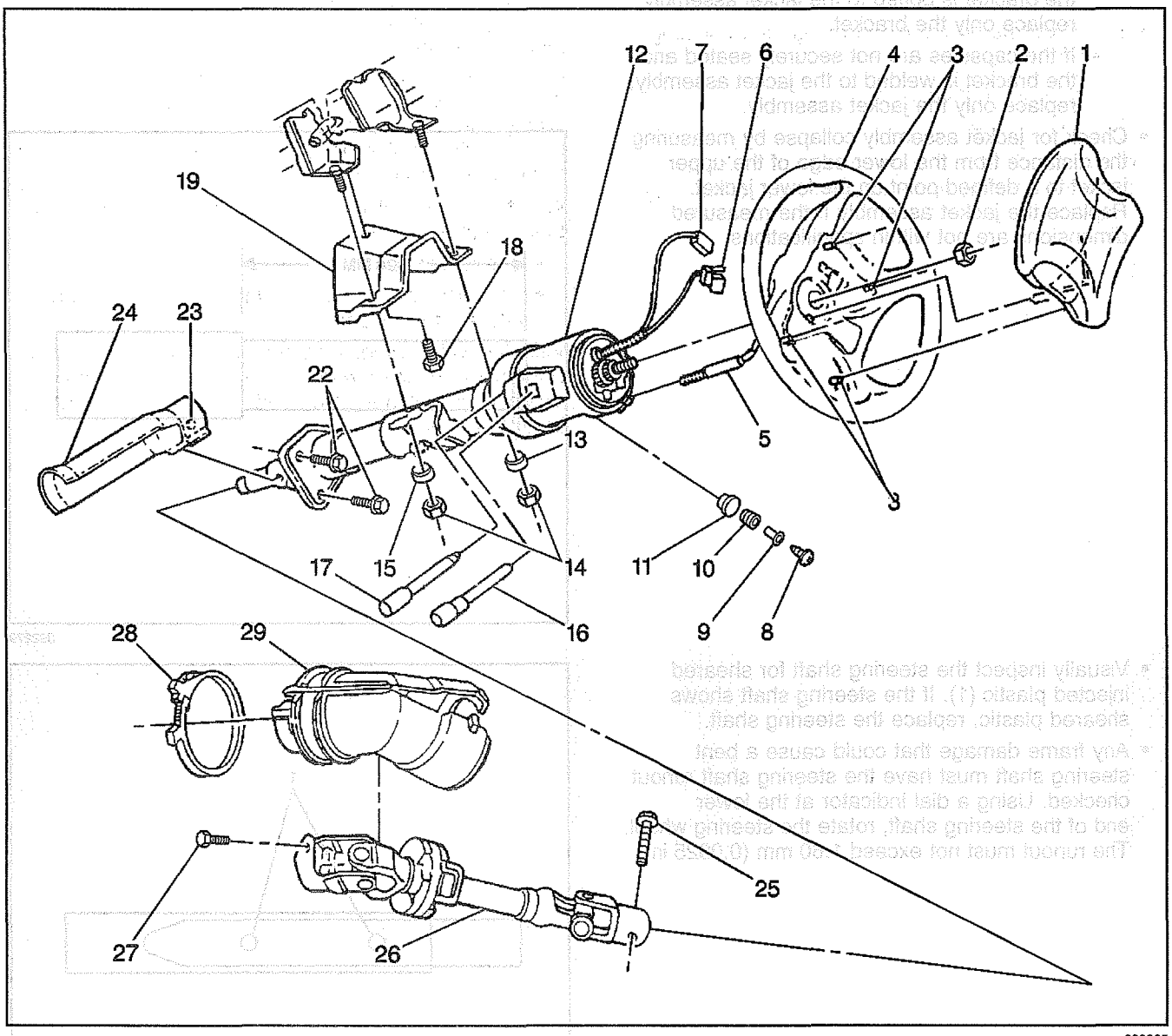
- Visually inspect the steering shaft for sheared injected plastic (1). If the steering shaft shows sheared plastic, replace the steering shaft.
- Any frame damage that could cause a bent steering shaft must have the steering shaft runout checked. Using a dial indicator at the lower end of the steering shaft, rotate the steering wheel. The runout must not exceed 1.60 mm (0.0625 in).



303724

Description and Operation

Steering Wheel and Column Description



290365

The locking, energy-absorbing column (20) includes the following three features in addition to the steering function:

- In a front-end collision, the energy-absorbing column is designed to collapse. This action minimizes the possibility of driver injury.
- The steering column lock and ignition cylinder are mounted on the column.
- When locked, the column-mounted lock prevents the operation of both the ignition and steering. This action acts as a theft deterrent.

The turn signal controls the turn signals.

The headlamp dimmer switch controls the headlamp high beam.

The windshield washer and wiper lever (16) controls the windshield washer and wipers.

The cruise control actuator controls the cruise control, if equipped.

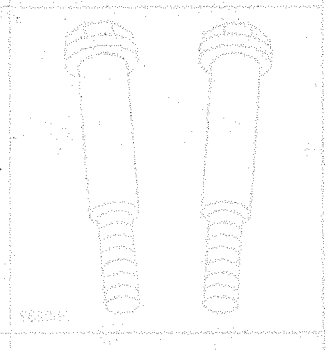
In order to ensure energy-absorbing action, complete the following steps:

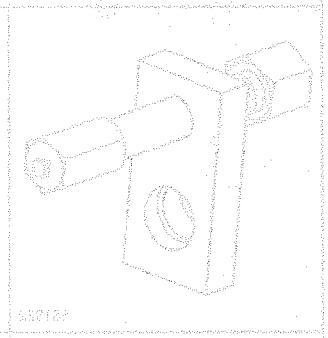
- Use only specified bolts/screws and nuts.
- Tighten the bolts/screws and nuts to the specified torque.
- Apply a thin coat of lithium grease to all friction points during reassembly.

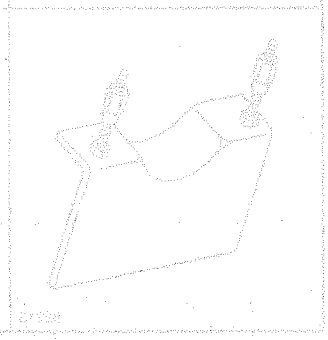
Handle the column with care when removing the column.

- Do not use a steering wheel puller other than the one recommended.
- Do not hit the end of the steering gear coupling shaft (26) sharply.
- Do not lean on the column.
- Do not drop the column.

Disregarding the above suggestions could shear or loosen the plastic fasteners that keep the column rigid.







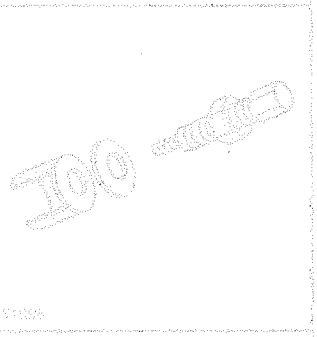
Ignition Lock System Description

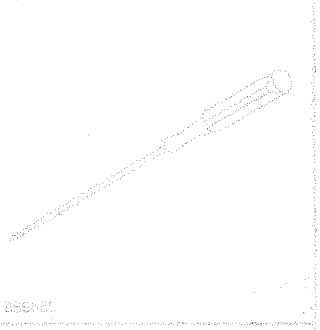
The automatic transmission uses a park lock system. This system uses a flexible automatic transmission park lock cable. The cable is attached at one end to the automatic transmission control lever and at the other end to the ignition switch. The ignition switch is mounted to the column where it actuates a locking pin. The locking pin engages an ignition switch sliding contact when the lever is in the REVERSE position. This action does not allow the ignition switch to move to the LOCK position.

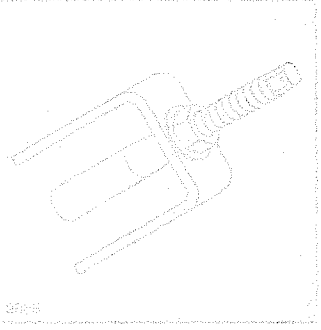
With the lever in PARK and the ignition switch slider in LOCK, the following actions occur:

- The locking pin engages a cam on the cable.
- The locking pin prevents the lever from moving into another position.

Vehicles with a manual transmission have a steering column key release lever. A manual transmission clutch start switch is also used. Depress the clutch in order to crank the engine.







Special Tools and Equipment

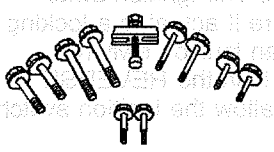
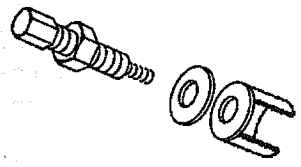
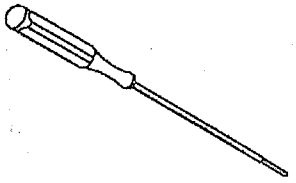
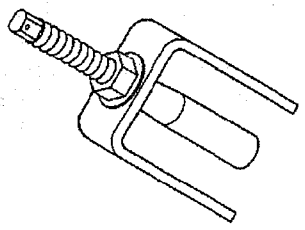
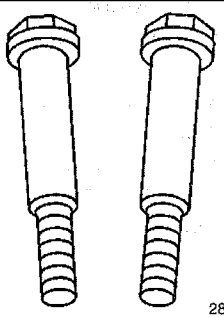
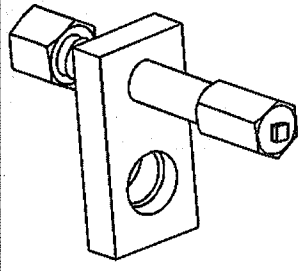
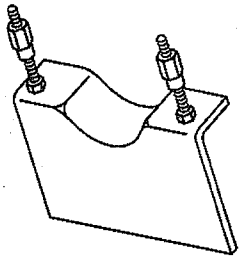
Illustration	Tool Number/ Description
 802	J 1859-A Steering Wheel Puller
 2015	J 8092 Universal Driver Handle
 82217	J 21854-01 Pivot Pin Remover
 354985	J 22635 Lock Shoe and Release Lever Pin Remover and Installer
 8669	J 23653-SIR Lock Plate Compressor

Illustration	Tool Number/ Description
 354982	J 38639 Steering Column Housing Bearing Installer
 280232	J 38720 Steering Wheel Puller Bolts
 581822	J 39246 Tilt Spring Remover and Installer
 82213	J 41352 Modular Column Holding Fixture

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Suspension

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Suspension General Diagnosis

Specifications

Trim Height Specifications

Trim Height Specifications (Front Fascia)

Suspension	Tire	Camaro Frt. Fascia		Trans Am Frt. Fascia		Firebird Frt. Fascia	
		Metric	English	Metric	English	Metric	English
F41(Base)	235/55	443 mm	17.4 in	—	—	342 mm	13.4 in
FE2(Z28, Trans Am Base)	235/55	443 mm	17.4 in	416 mm	16.3 in	—	—
	245/50	443 mm	17.4 in	416 mm	16.3 in	—	—
FE4 (Z28, Trans Am Special)	245/50	443 mm	17.4 in	342 mm	13.4 in	—	—
FE7(Z-28 SS, B4C, WS6, Firm, HD)	275/40	443 mm	17.4 in	342 mm	13.4 in	—	—

Trim Height Specifications (Rear Fascia)

Suspension	Tire	Camaro Rear Fascia		Fire/TA Rear Fascia		Side Rocker (All)	
		Metric	English	Metric	English	Metric	English
F41(Base)	235/55	367 mm	14.4 in	375 mm	14.7 in	204 mm (Front) 208 mm (Rear)	8.0 (Front) 8.2 (Rear)
FE2(Z38, Trans Am Base)	235/55	367 mm	14.4 in	375 mm	14.7 in	204 mm (Front) 208 mm (Rear)	8.0 in (Front) 8.2 in (Rear)
	245/50	367 mm	14.4 in	375 mm	14.7 in	204 mm (Front) 208 mm (Rear)	8.0 in (Front) 8.2 in (Rear)
FE4(Z28, Trans Am Special	245/50	367 mm	14.4 in	375 mm	14.7 in	204 mm (Front) 208 mm (Rear)	8.0 in (Front) 8.2 in (Rear)
FE7 (Z-28 SS, B4C, WS6, Firm, HD)	275/40	367 mm	14.4 in	375 mm	14.7 in	204 mm (Front,) 208 mm (Rear)	8.0 in (Front) 8.2 in (Rear)

Diagnostic Information and Procedures

Abnormal or Excessive Tire Wear

Many conditions, including the following list, can cause irregular or premature tire wear:

- Incorrect inflation pressure
- Lack of regular rotation
- Driving habits
- Improper tire and wheel alignment

If you reset tire and wheel alignment due to a tire wear condition, always rest the toe as close to 0 degrees as the specification allows.

Rotate the tires if you notice any of the following conditions:

- Front and rear tire wear is unequal
- The tread of any tire wear is uneven
- Left and right front tire wear is unequal

Test the tire and wheel alignment if you notice any of the following conditions:

- The left and the right front tire wear is unequal
- The tread of any front tire wear is uneven
- The front tire treads have a scuffed appearance with feather edges on one side of the tread ribs or blocks

Trim Height

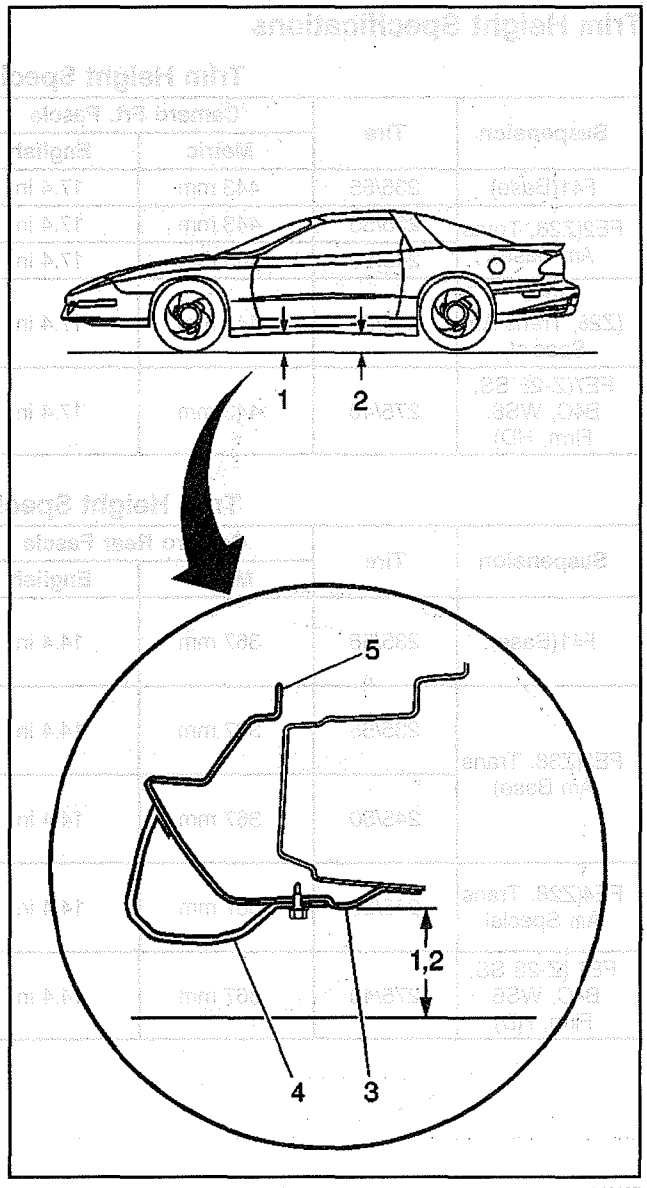
Incorrect trim heights can produce symptoms similar to those which produce tire and wheel misalignment. Inspect trim heights whenever you diagnose steering and vibration concerns.

In order to measure the trim heights accurately, use the following check list:

- Tires should be at the correct pressure as shown on the tire placard and up to vehicle capacity
- The fuel tank should be full
- The vehicle should have no additional weight or passengers
- Seats should be in the full back position
- The rear compartment should be empty, except for a spare tire and a jack, and a simulated fuel load if required
- The vehicle should be on a known level floor
- Close all doors, the hood, and the rear compartment lid
- Jounce the front and/or rear bumper of the vehicle at least 38 mm (1.5 in). After jouncing, let the vehicle settle. After recording the trim height measurements desired, repeat the jounce operation for a total of two times. Trim heights are the average of the high and the low measurements

Measure all dimensions vertical to the ground. In order to be considered correct, trim heights should be within 10 mm (0.4 in) of specification.

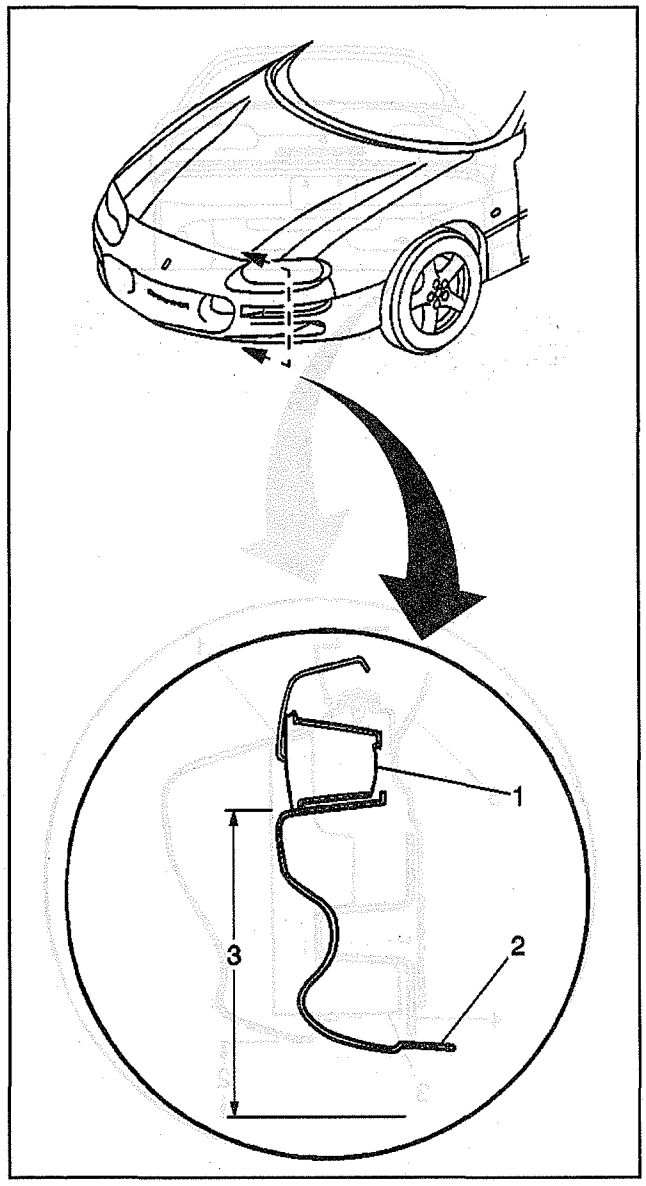
Measuring Trim Height at Vehicle Side Rocker Molding



349187

1. Calculate the trim heights (1, 2) as measured at the inner edge of the side rocker panels (3) to the ground after each jounce/rebound cycle. Record your measurement.
2. Verify the trim height measurements. Refer to *Trim Height Specifications*.
3. Continue to measure the vehicle trim heights at the front and at the rear fascia at locations shown.

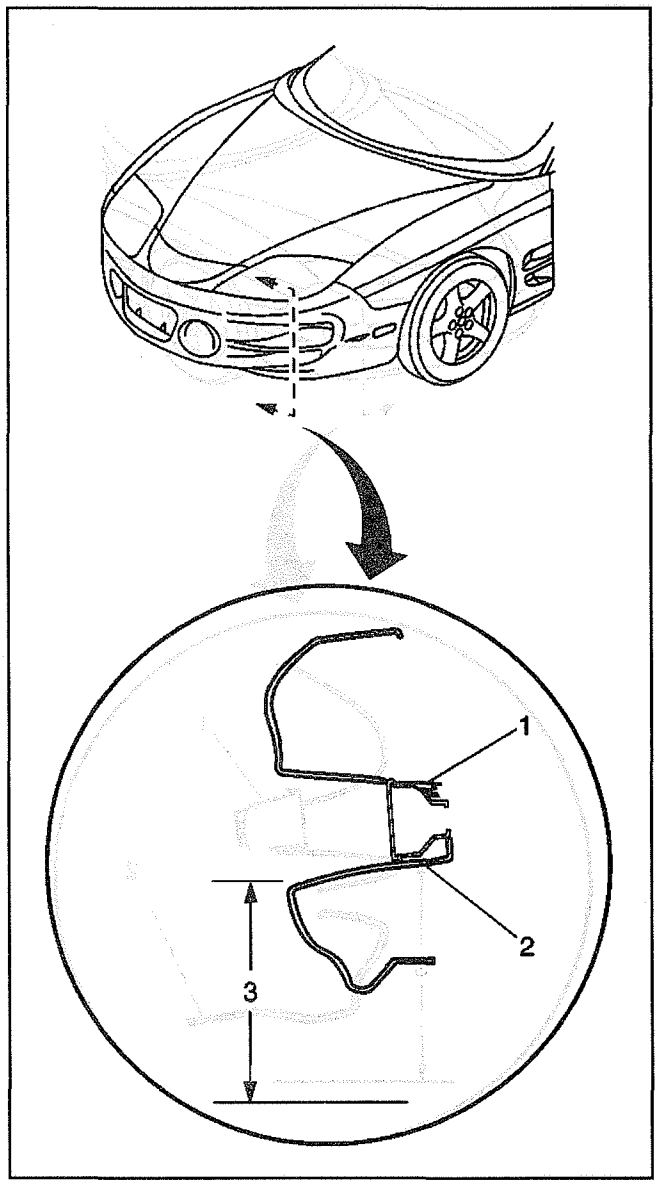
Measuring Trim Height at Front Fascia (Chevrolet)



349201

1. Calculate the trim heights (3) as measured from the ground to the bottom of the park/turn signal lamp (1) after each jounce/rebound cycle. Record your measurement.
2. Verify the trim height measurements for that particular vehicle. Refer to *Trim Height Specifications.*
3. Continue to measure the vehicle trim heights at the front and at the rear fascia at locations shown below.

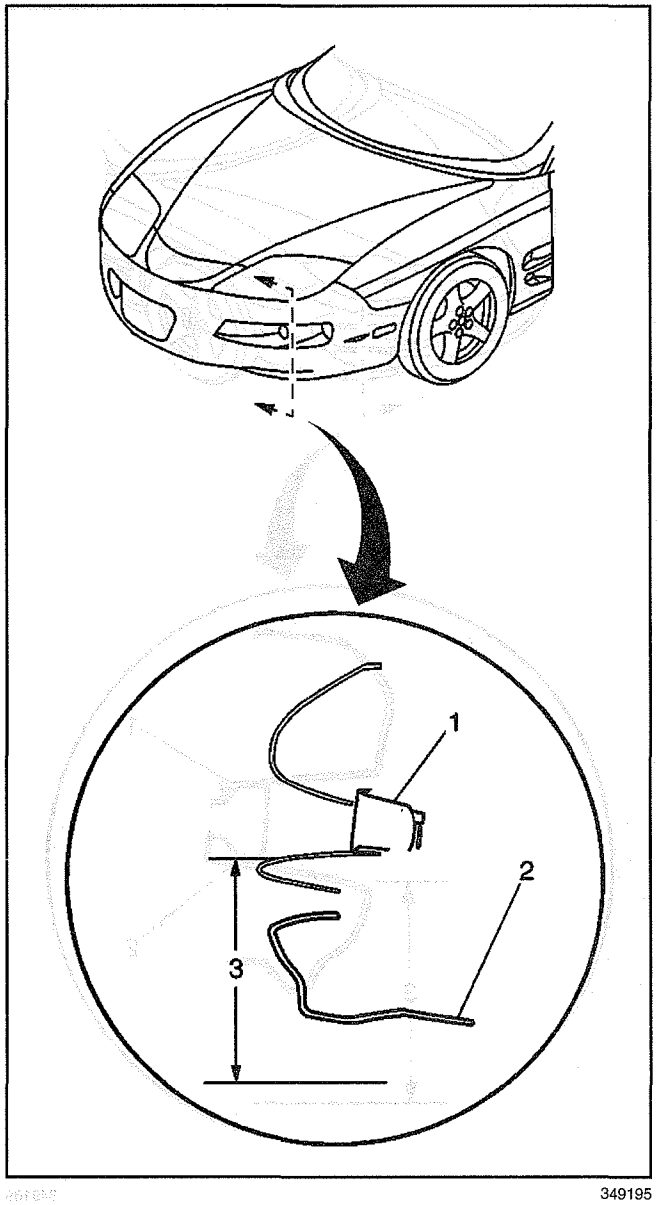
Measuring Trim Height at Front Fascia (Pontiac Trans Am)



349189

1. Calculate the trim heights (3) as measured from the ground to the bottom of the fog lamp cavity after each jounce/rebound cycle. Record your measurement.
2. Verify the trim height measurements. Refer to *Trim Height Specifications.*
3. Continue to measure the vehicle trim heights at the front and at the rear fascia at locations shown.

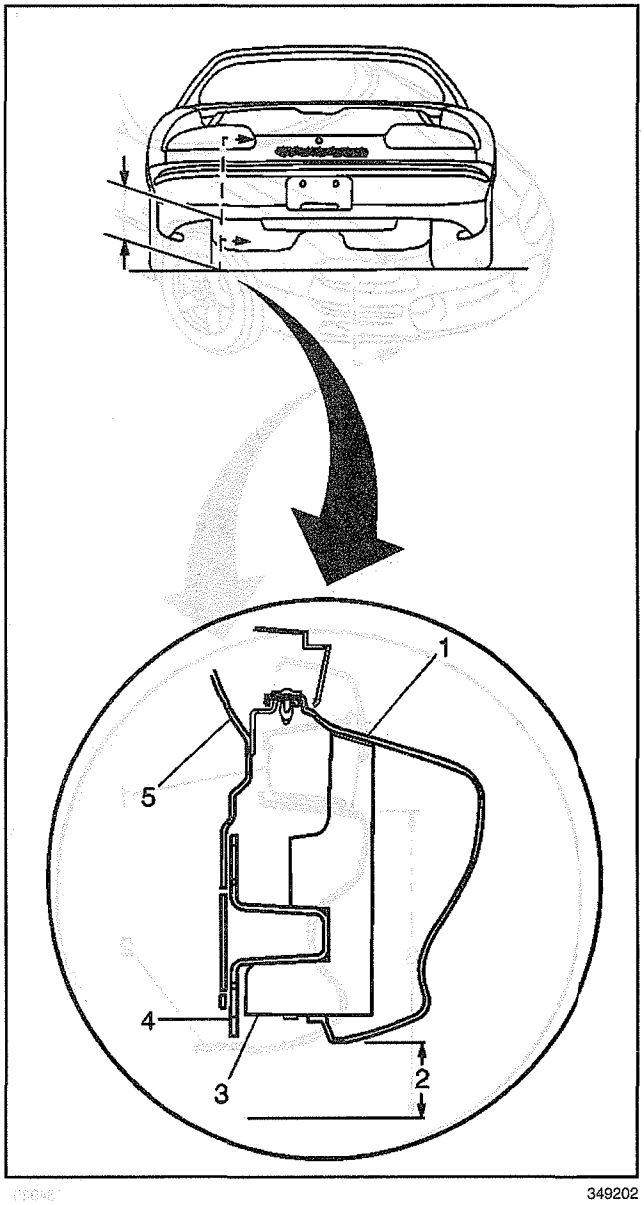
Measuring Trim Height at Front Fascia (Pontiac Non-Trans Am)



349195

1. Calculate the trim heights (3) as measured from the ground to the bottom of the park/turn signal lamp (1) after each jounce/rebound cycle. Record your measurement.
2. Verify the trim height measurements. Refer to *Trim Height Specifications*.
3. Continue to measure the vehicle trim heights at the fascia locations shown.

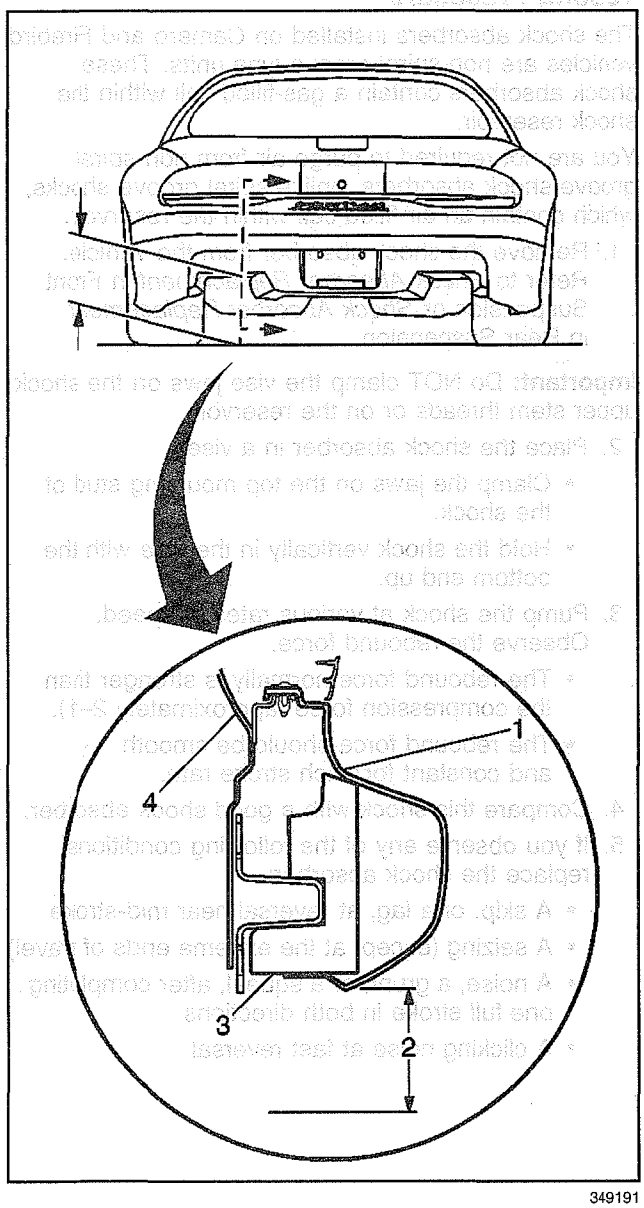
Measuring Trim Height at Rear Fascia (Chevrolet)



349202

1. Calculate the trim heights (2) as measured from the ground to the bottom of the rear fascia (1) after each jounce/rebound cycle. Record your measurement.
2. Verify the trim height measurements. Refer to *Trim Height Specifications*.
3. Continue to measure the vehicle trim heights at the fascia locations shown.

Measuring Trim Height at Rear Fascia (Pontiac)



349191

1. Calculate the trim heights (2) as measured from the ground to the bottom of the rear fascia (1) after each jounce/rebound cycle. Record your measurement.
2. Verify the trim height measurements. Refer to *Trim Height Specifications*.
3. Continue to measure the vehicle trim heights at the fascia locations shown.
4. Correct any irregular trim height dimensions as necessary.

Struts or Shock Absorbers Weak

Important: The single-tube shock absorbers are highly gas-pressurized. The shock absorbers require a force of 445 N (100 lb) in order to initiate movement of the shock absorber rod. Do NOT dent or puncture the shock absorber assemblies.

1. Test and adjust the tire pressures to those pressures shown on the tire placard.
2. Notice the load conditions in effect when the vehicle is driven under normal conditions.
3. If practical, ride with the owner in order to be sure that you understand the problem before proceeding to the next step.
4. Test each shock absorber in turn by quickly pushing down, then lifting up, on the corner of the bumper nearest to the shock absorber which you are testing.
   - 4.1. Use the same amount of effort on each test and notice the resistance on compression and rebound.
   - 4.2. Repeat this test on a similar vehicle having acceptable ride quality. The shock absorbers on both vehicles should provide the same feeling of resistance. If you notice much difference between the two vehicles, continue with the next step.
5. Support the vehicle in order to expose the shock mounts.
6. Remove the shock absorber assemblies.

Caution: The shock absorbers are highly pressurized. Be sure to properly disassemble module or personal injury could result.

7. Disassemble the plastic dust tube.
8. Remove the rod washer from the shock absorber.

Important: Do not fully compress the shock absorber. Shock absorbers are highly gas-charged and will extend when released.

9. Turn the shock absorber so that the lower mount is up and the upper mount is down. Compress the shock absorber against the ground at various rates of speed through approximately one-half of the length of the exposed chromed shock absorber rod:
   - Rear – 75 mm (3 in)
   - Front – 50 mm (2 in)
10. Compare the right and the left shock absorbers for compression resistance and rebound speed:
    - The right and the left shock absorbers should feel comparable.
    - Differences between the front and the rear shock absorbers are normal.
    - If you are doubtful about the condition of any shock absorber, compare with a shock absorber known to be good.

Struts or Shock Absorbers Noisy

Important: The single-tube shock absorbers are highly gas pressurized and require a force of 445 N (100 lb) in order to initiate movement of the shock absorber rod. Do NOT dent or puncture the shock absorber assemblies.

1. Examine all of the mountings for proper tightening. Loose mountings will cause a noise.
2. If all of the mountings are intact, test each shock absorber by quickly pushing down, then lifting up, on the corner of the bumper nearest to the shock absorber which you are testing.
   2.1. Use the same amount of effort on each test and notice the resistance on compression and rebound.
   2.2. Repeat this test on a similar vehicle having acceptable ride quality. The shock absorbers on both vehicles should provide the same feeling of resistance. If you notice much difference between the two vehicles, continue with the next step.
3. Remove the suspected shock absorber.
4. Shake the shock absorber and listen for loose metallic parts inside the shock absorber body. If you hear a suspicious noise, replace the shock absorber.
5. Turn the shock absorber so that the lower mount is up and the upper mount and rod are down. Slowly compress the shock absorber. Do not allow the chromed portion of the shock absorber rod to pass below the black seal cover.
6. Replace the shock absorber if you encounter a seize condition with more than 25 mm (1 in) of the chromed portion of the shock absorber rod exposed above the seal cover.

Struts or Shock Absorbers Leak

Important: The single-tube shock absorbers are highly gas-pressurized and require a force of 445 N (100 lb) in order to initiate movement of the shock absorber rod. Do NOT dent or puncture the shock absorber assemblies.

1. Fully extend the shock absorbers, with the tires and the wheels unsupported, in order to expose the seal cover area for inspection.
2. Look for signs of leaks at the top of the shock absorber:
   - A small amount of fluid in not cause for replacement. The seal permits some seepage in order to lubricate the shock absorber rod.
   - You can easily determine a leaking shock absorber because an excessive amount of fluid will cover the shock absorber.
3. Replace a leaking shock absorber.

Struts or Shock Absorbers Bench Test

Testing Procedure

The shock absorbers installed on Camaro and Firebird vehicles are non-spiral groove type units. These shock absorbers contain a gas-filled cell within the shock reservoir.

You are not required to purge air from non-spiral groove shock absorbers, unlike spiral groove shocks, which contain an air-filled cell within the reservoir.

1. Remove the shock absorber from the vehicle. Refer to *Shock Absorber Replacement* in Front Suspension or *Shock Absorber Replacement* in Rear Suspension.

Important: Do NOT clamp the vise jaws on the shock upper stem threads or on the reservoir.

2. Place the shock absorber in a vise.
   - Clamp the jaws on the top mounting stud of the shock.
   - Hold the shock vertically in the vise with the bottom end up.
3. Pump the shock at various rates of speed. Observe the rebound force.
   - The rebound force normally is stronger than the compression force (approximately 2–1).
   - The rebound force should be smooth and constant for each stroke rate.
4. Compare this shock with a good shock absorber.
5. If you observe any of the following conditions, replace the shock absorber:
   - A skip, or a lag, at reversal near mid-stroke
   - A seizing (except at the extreme ends of travel)
   - A noise, a grunt, or a squeal, after completing one full stroke in both directions
   - A clicking noise at fast reversal

Struts or Shock Absorbers On-Vehicle Testing

Step	Action	Yes	No
1	**Important:** A light film of oil on the top portion of the reservoir is normal. Inspect each shock absorber for external fluid leakage. Is the shock absorber leaking?	Go to *Step 5*	Go to *Step 2*
2	Inspect the vehicle trim height. Refer to *Trim Height*. Is the vehicle trim height correct?	Go to *Step 3*	Go to *Step 4*
3	1. Use your hands in order to lift up and push down each corner of the vehicle 3 times. 2. Remove your hands from the vehicle. Does the vehicle stop bouncing after 2 cycles?	System OK	Go to *Step 5*
4	Replace the springs. Refer to *Coil Spring Replacement* in Rear Suspension. Is the repair complete?	System OK	—
5	Replace the shock absorber. Refer to *Shock Absorber Replacement* in Front Suspension Is the repair complete?	System OK	—

Description and Operation

General Description

Because the problems in steering, suspension, and tires and wheels involve several systems, you must consider all of these systems whenever you diagnose a concern. In order to avoid diagnosing the wrong symptom, always road test the vehicle first. Proceed with the following preliminary tests, and correct any substandard conditions which you may find.

Inspect for the following conditions:

- Wrong pressure and uneven tire wear
- Loose connections or wear on joints, from the steering column to the steering gear
- Loose or damaged parts on the front and on the rear suspension or on the steering gear
- Out-of-round or out-of-balance tires, bent wheels, and loose or rough wheel bearings
- Leaks in the power steering system. Inspect the power steering fluid level and inspect the accessory drive belt for proper condition and tension

Wheel Alignment

Specifications

Wheel Alignment Specifications

Application	Specification	
	Set	Check
Front Caster	4.5 to 5.5 degrees	4.0 to 6.0 degrees
Cross Caster (Front)	–0.7 to 0.7 degrees	–0.7 to 0.7 degrees
Front Camber	–0.1 to 0.9 degrees	–0.6 to 1.4 degrees
Cross Camber (Front)	–0.7 to 0.7 degrees	–0.7 to 0.7 degrees
Individual Toe (Front)	–0.1 to 0.1 degrees	–0.1 to 0.1 degrees
Total Toe (Front)	–0.2 to 0.2 degrees	–0.2 to 0.2 degrees
Steering Wheel Angle (Front)	–3.5 to 3.5 degrees	–3.5 to 3.5 degrees
Rear Camber	–0.6 to 0.6 degrees	–0.6 to 0.6 degrees
Cross Camber (Rear)	–0.6 to 0.6 degrees	–0.6 to 0.6 degrees
Total Toe (Rear)	–0.3 to 0.3 degrees	–0.3 to 0.3 degrees
Rear Thrust Angle	–0.15 to 0.15 degrees	–0.15 to 0.15 degrees

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Inner Tie Rod Nut	47 N·m	35 lb ft
Lower Control Arm Nut	100 N·m	47 lb ft

Diagnostic Information and Procedures

Preliminary Alignment Inspection

Steering and vibration concerns are not always the result of improper alignment. Tire lead is a condition caused by worn or improperly-manufactured tires. Tire lead is the vehicle deviation from a straight path on a level road without pressure on the steering wheel. In order to determine if the vehicle has a tire lead problem, refer to *Radial Tire Lead/Pull Correction* in Suspension General Diagnosis.

Before making any adjustment that will affect the tire and wheel alignment, verify correct alignment readings and alignment adjustments:

- Inspect all tires for proper inflation pressures. Also verify that all the tires have nearly even tread wear.
- Inspect the control arm ball studs. If the studs are loose, correct them before adjusting the tire and wheel alignment. Refer to *Ball Stud Check* in Front Suspension.
- Inspect the tie rod ends. If the ends are loose, correct them before adjusting the tire and wheel alignment. Refer to *Power Steering Gear Replacement (V6)* or *Power Steering Gear Replacement (V8)* in Power Steering.
- Check the tires and wheels for runout.
- Inspect the vehicle trim height. If the height is out of limits and a correction is to be made, make the correction before adjusting the alignment. Refer to *Trim Height Specifications* in General Diagnosis.
- Inspect the steering gear for looseness at the frame.
- Inspect the control arms for loose bushings.
- Inspect the stabilizer shaft for loose or missing parts.
- Inspect the shock absorber and the springs for improper operation.
- Inspect the suspension and the steering components for damage. Replace the parts as necessary.
- Inspect the vehicle for stability. The fuel tank should be full, or the vehicle should have compensating ballast.
- Jounce the vehicle lightly 3 times in the rear and 3 times in the front.

Give consideration to excess loads, such as tool boxes or sample cases, which are normally carried in the vehicle. These loads should remain in the vehicle during alignment adjustments.

Give consideration also to the condition of the equipment being used in order to adjust the alignment. Follow the equipment manufacturer's instructions. Regardless of the equipment used, the vehicle must be on a level surface, both front-to-rear and side-to-side.

Repair Instructions

Measuring Wheel Alignment

Satisfactory vehicle operation may occur over a wide range of alignment settings. If settings vary beyond the specifications, correct the alignment angles.

1. Measure the front alignment angles.
2. Install the alignment equipment according to the manufacturer's instructions.
3. Jounce the front and rear bumpers lightly three times in order to normalize the suspension prior to measuring the angles.
4. Measure the alignment angles and record the readings. If adjustments are required, make the adjustments in the following order:
   4.1. The camber
   4.2. The caster
   4.3. The toe

Front Caster and Camber Adjustment

Tools Required

J 38658 Caster/Camber Adjusting Tool

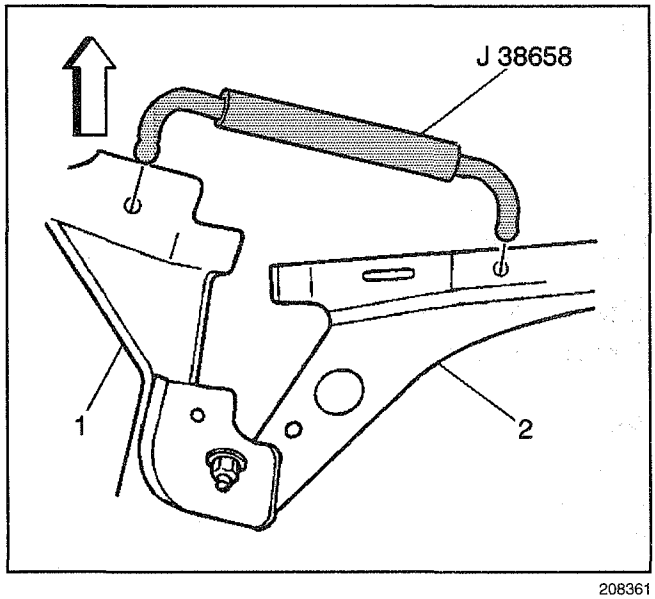
1. Before making any adjustments to the caster or camber, jounce the front bumper three times in order to allow the vehicle to return to the normal height.
2. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Loosen the lower control arm nuts.
4. Install the *J 38658* to the holes in the lower control arm (2) and front crossmember (1).
5. Adjust the camber by rotating the turnbuckle on *J 38658*.
   - Rotating the turnbuckle clockwise will increase the camber.
   - Rotating the turnbuckle counterclockwise will decrease the camber.
6. Install the *J 38658* to the holes in the lower control arm (1) and the front crossmember (2).
   - Rotating the turnbuckle clockwise will increase the caster.
   - Rotating the turnbuckle counterclockwise will decrease the caster.
7. Adjust caster by rotating the turnbuckle on the *J 38658*.
8. Remove the *J 38658* from the holes.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

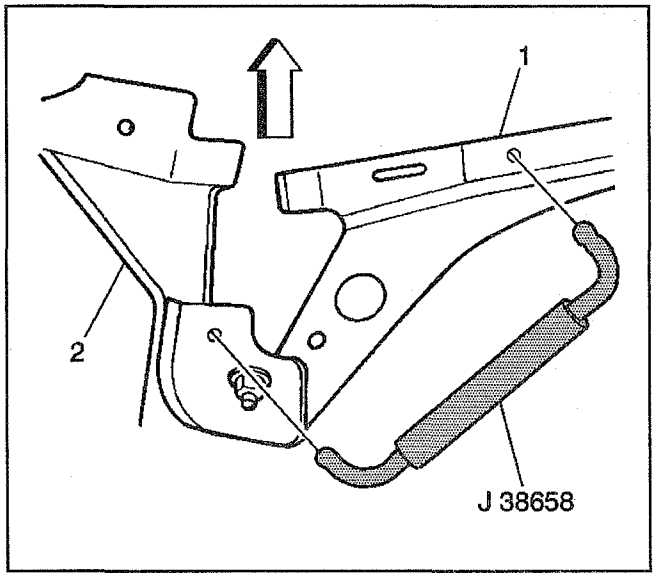
9. Tighten the lower control arm nuts.

   Tighten

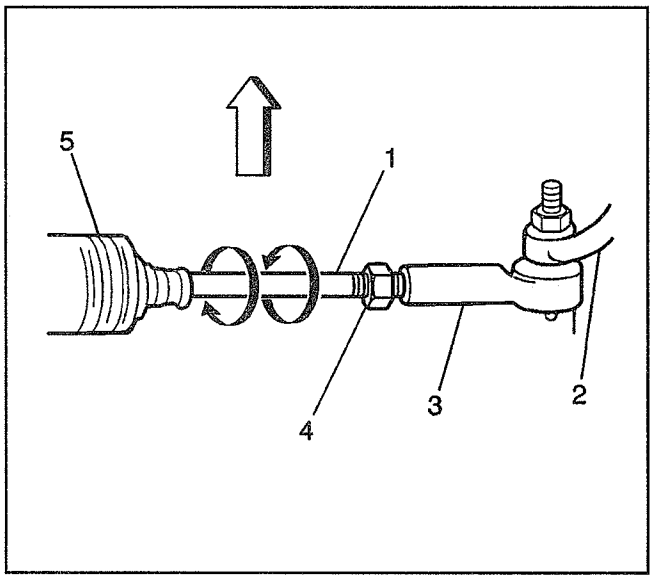
   Tighten the lower control arm nuts to 100 N·m (74 lb ft).
10. Lower the vehicle.



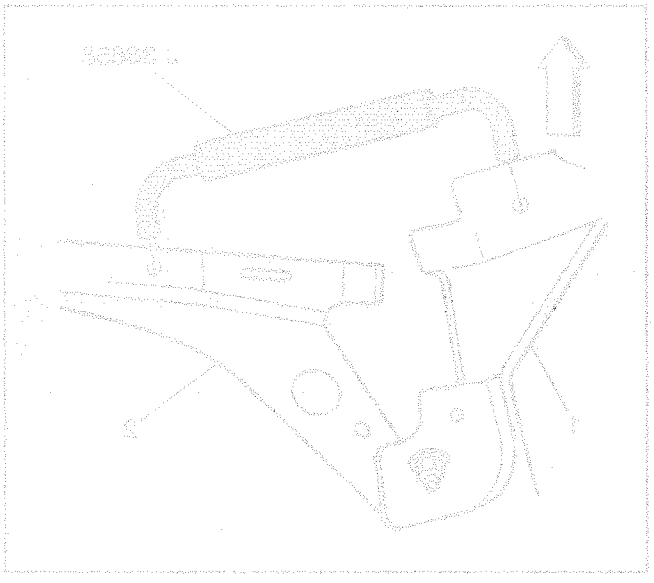
208361

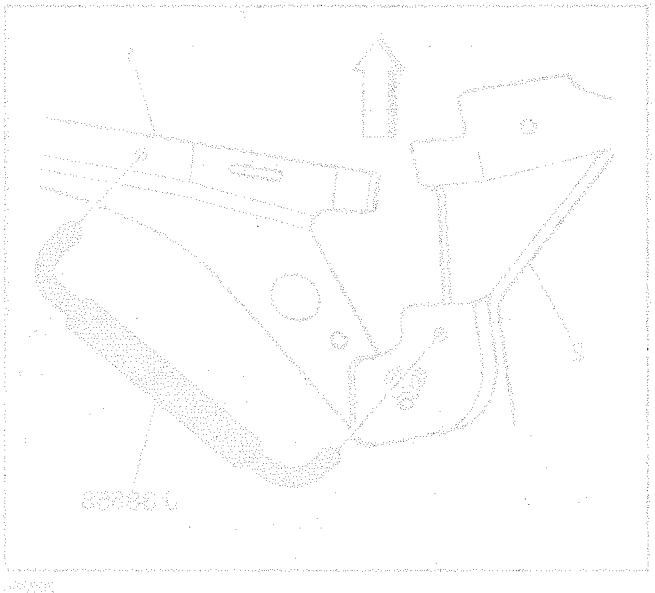


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180302





Front Toe Adjustment

1. Set the steering wheel in a straight-ahead position within –3.5 to 3.5 degrees.
2. Make toe adjustments separately at each individual tire and wheel.
3. Loosen the inner tie rod nut (4).
4. Adjust the toe to specifications by turning the inner tie rod (3). Refer to *Wheel Alignment Specifications*.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

5. Verify that the steering gear boot seal (5) is not twisted.

   Tighten

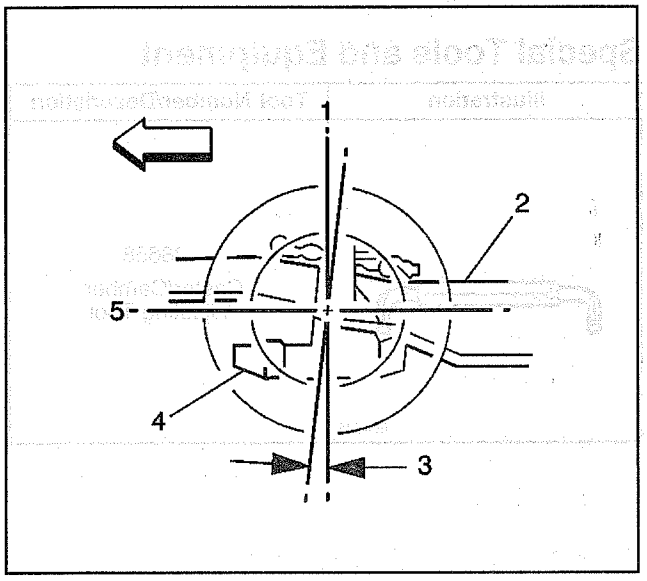
   Tighten the inner tie rod nut (4) to 47 N·m (35 lb ft).
6. Check the toe alignment. Readjust the inner tie rod (3), if necessary. Refer to *Wheel Alignment Specifications*.

Rear Thrust Angle Adjustment

If the thrust angle is not within specifications, inspect the lower control arms for damage. If the control arms are not damaged, check the frame dimensions. Refer to *Dimensions - Frame* in Frame and Underbody.

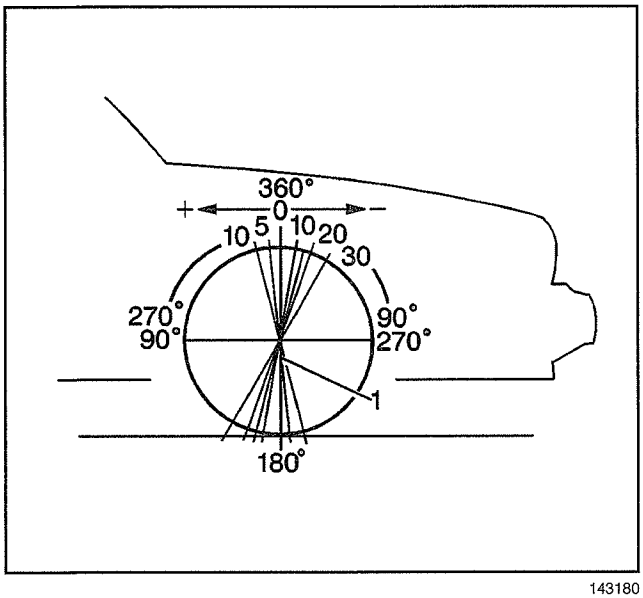
Description and Operation

Caster Description



82220

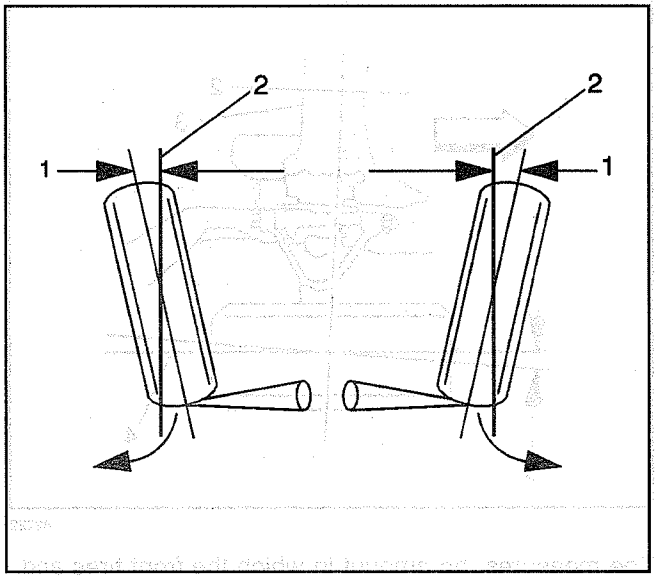
Caster is the tilting of the front steering axis (at the top) either forward or backward (3) from the vertical (1). A backward tilt is positive (+) and a forward tilt is negative (–). Caster influences the directional control of the steering but does not affect the tire wear. Caster is adjustable only at the front tires and wheels.



143180

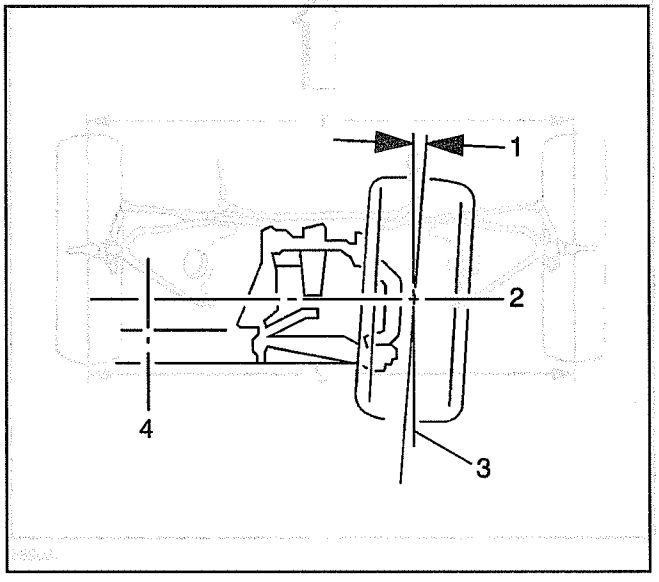
Caster is affected by the vehicle height. Therefore you must keep the body at the designated trim height. Vehicle overload or a weak sagging rear spring can affect the caster. When the rear of the vehicle is lower than the designated trim height, the front suspension moves to a more positive caster. If the rear of the vehicle is higher than the designated trim height, the front suspension moves to a less positive caster. For trim height information, refer to *Trim Height Specifications* in General Diagnosis.

Camber Description



180281

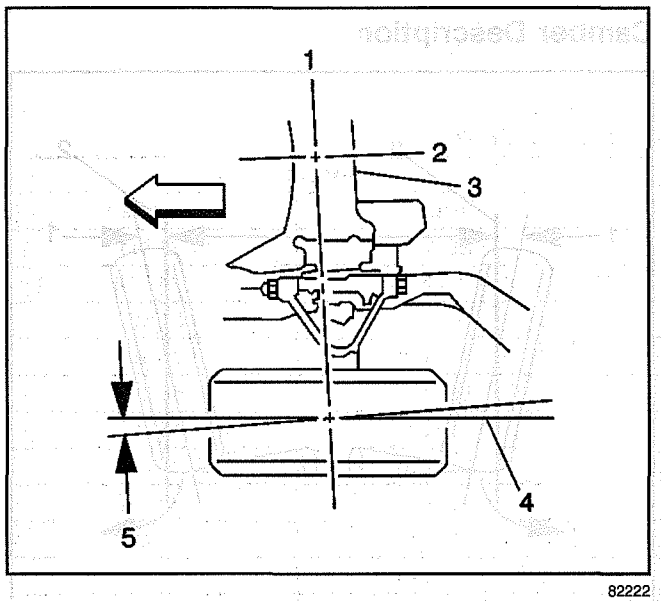
Camber is the tilting of the front tires and wheels (1) from the vertical (2) as viewed from the front of the vehicle. When the tires and wheels tilt outward (1) at the top, the camber is positive (+). When the tires and wheels tilt inward at the top, the camber is negative (–). The amount of the tilt is measured in degrees from the vertical and is called the camber angle. The camber setting influences directional control and tire wear.



82221

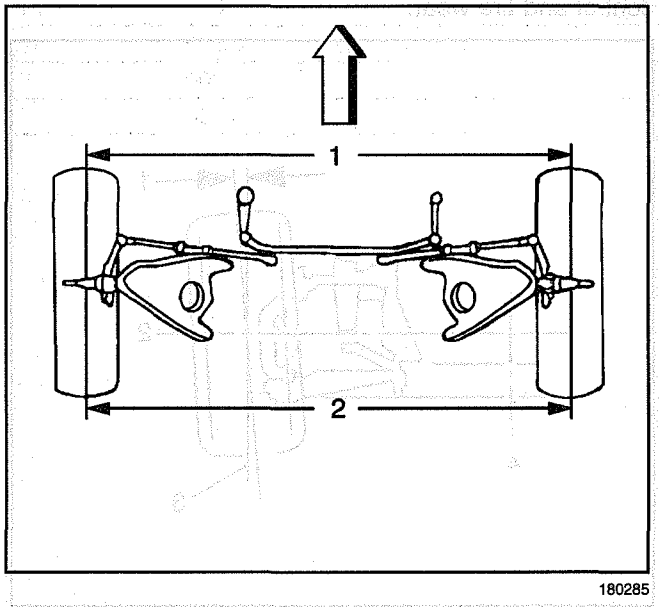
When set to a positive camber angle (1), the tires and the wheels will tend to roll in a path that is away from the true path of the vehicle. The effect of one tire and wheel tends to cancel the others. The suspension geometry and the camber setting keep the tire tread surface perpendicular (flat) on the road through the full range of suspension travel.

Toe Description



82222

Toe measures the amount in which the front tires and wheels are turned in or out (5) from a straight-ahead position (4). When the tires and the wheels are turned in, toe is positive (+). When the tires and the wheels 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 tires and the wheels roll parallel by compensating the slight tolerances that exist within the suspension components.



180285

You can also measure total toe, which is the relationship or difference between the front toe dimension (1) and the rear toe dimension (2). Total toe indicates the tire-to-tire relationship, but does not indicate the relationship of a tire to the vehicle centerline. Toe also serves to offset the small deflections of the tire and the wheel support system which occur when the vehicle is rolling forward.

In other words, even when the tires and wheels are set to toe in slightly when the vehicle is standing still, the tires tend to roll parallel on the road when the vehicle is moving. Toe affects tire wear.

Special Tools and Equipment

Illustration	Tool Number/Description
 604548	J 38658 Caster/Camber Adjusting Tool

Front Suspension

Specifications

Fastener Tightening Specifications

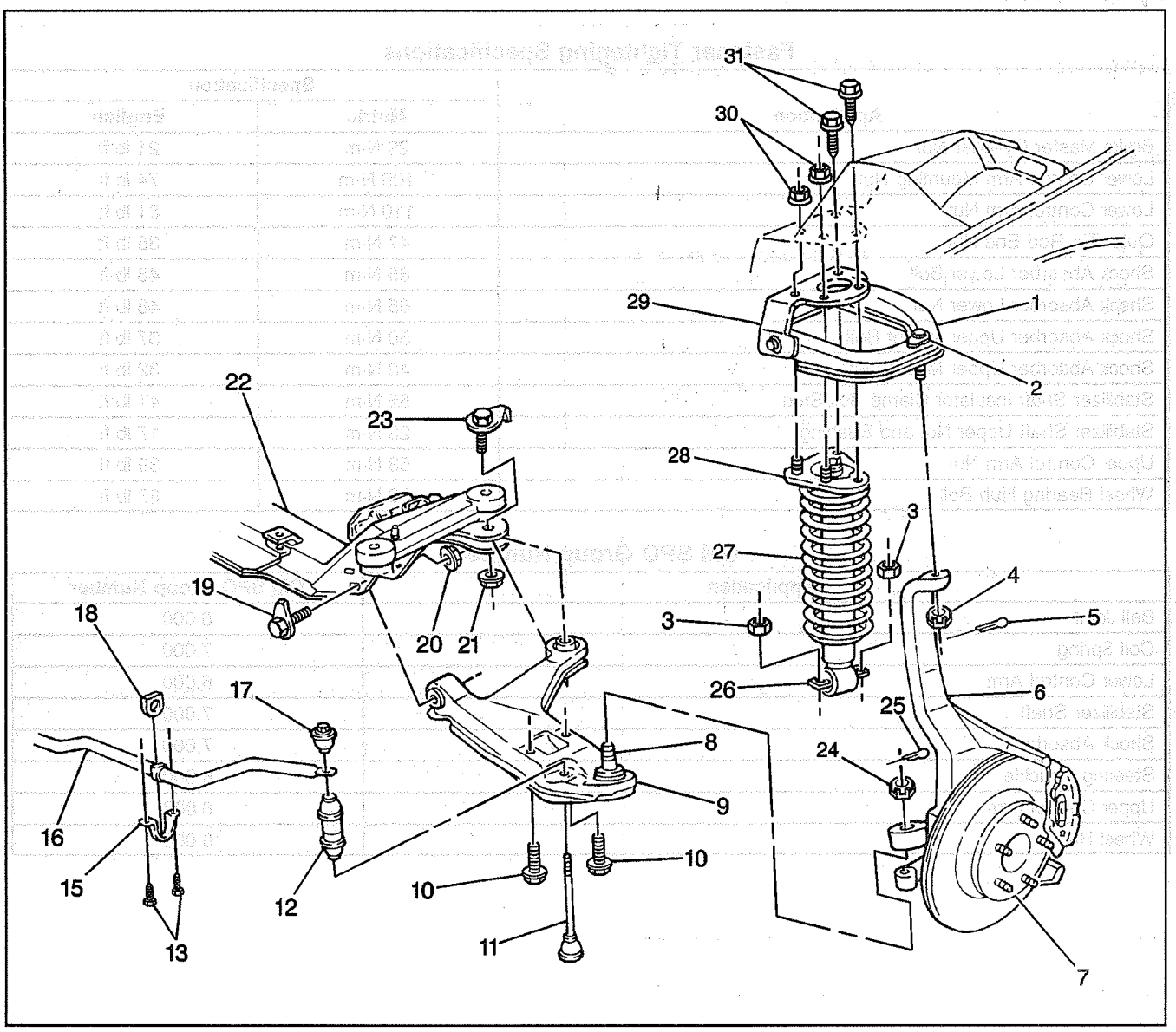
Application	Specification	
	Metric	English
Brake Master Cylinder Nut	29 N·m	21 lb ft
Lower Control Arm Mounting Nut	100 N·m	74 lb ft
Lower Control Arm Nut	110 N·m	81 lb ft
Outer Tie Rod End Nut	47 N·m	35 lb ft
Shock Absorber Lower Bolt	65 N·m	48 lb ft
Shock Absorber Lower Nut	65 N·m	48 lb ft
Shock Absorber Upper Mount Bolt	50 N·m	37 lb ft
Shock Absorber Upper Mount Nut	43 N·m	32 lb ft
Stabilizer Shaft Insulator Clamp Bolt/Stud	55 N·m	41 lb ft
Stabilizer Shaft Upper Nut and Bushing	23 N·m	17 lb ft
Upper Control Arm Nut	53 N·m	39 lb ft
Wheel Bearing Hub Bolt	86 N·m	63 lb ft

GM SPO Group Numbers

Application	GM SPO Group Number
Ball Joint	6.000
Coil Spring	7.000
Lower Control Arm	6.000
Stabilizer Shaft	7.000
Shock Absorber	7.000
Steering Knuckle	6.000
Upper Control Arm	6.000
Wheel Hub	6.000

Component Locator

Front Suspension Components



181103

Legend

(1) Arm, Front Upper Control
(2) Stud, Front Upper Control Arm Ball
(3) Nut, Front Shock Absorber Lower Bracket
(4) Nut, Front Upper Control Arm
(5) Pin, Front Upper Control Arm Cotter
(6) Knuckle and Hub, Steering
(7) Hub, Front Wheel
(8) Stud, Front Lower Control Arm Ball
(9) Arm, Front Lower Control
(10) Bolt/Screw, Front Shock Absorber
(11) Link, Front Stabilizer Shaft
(12) Sleeve, Front Stabilizer Shaft Link
(13) Bolt/Screw, Front Stabilizer Shaft Insulator Clamp
(15) Clamp, Front Stabilizer Shaft Insulator
(16) Stabilizer Shaft, Front
(17) Nut, Front Stabilizer Shaft Link
(18) Insulator, Front Stabilizer Shaft
(19) Bolt/Screw, Front Lower Control Arm
(20) Nut, Front Lower Control Arm
(21) Nut, Front Lower Control Arm
(22) Crossmember, Front
(23) Bolt/Screw, Front Lower Control Arm
(24) Nut, Front Lower Control Arm
(25) Pin, Front Lower Control Arm Cotter

(26) Absorber, Front Shock
(27) Spring, Front
(28) Mount, Front Upper Shock Absorber
(29) Support, Front Upper Control Arm
(30) Nut, Front Shock Absorber Upper
(31) Bolt/Screw, Front Shock Absorber Upper Mount

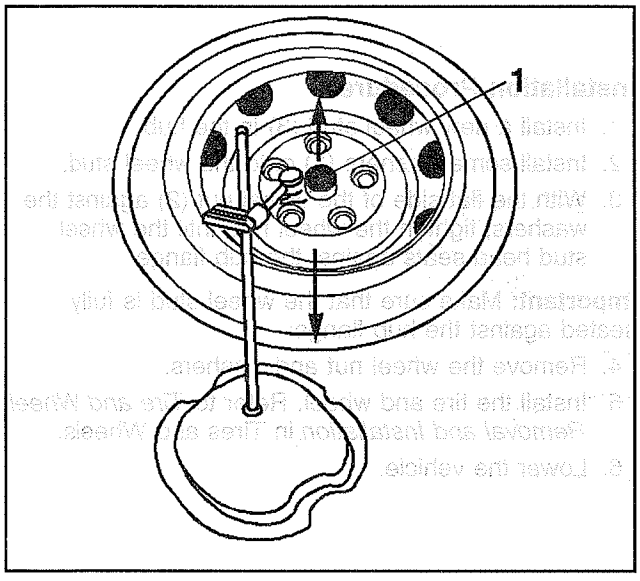
Diagnostic Information and Procedures

Ball Stud Check

Important:

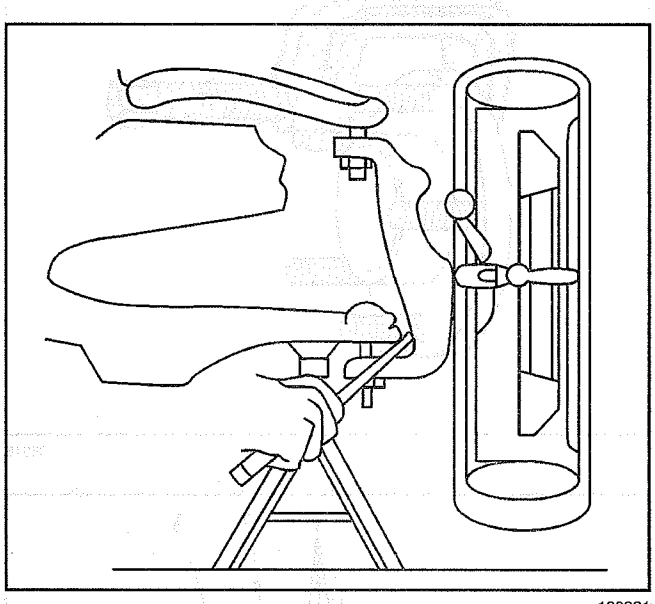
- The vehicle must be stable and should not rock on the floor stands.
- Wipe the ball joints clean and inspect the seals for cuts or for tears. If the seal is cut or torn, replace the ball joint.

1. Raise the vehicle and position the floor stands under both lower control arms as nearly as possible to each ball stud. Refer to *Lifting and Jacking the Vehicle* in General Information.



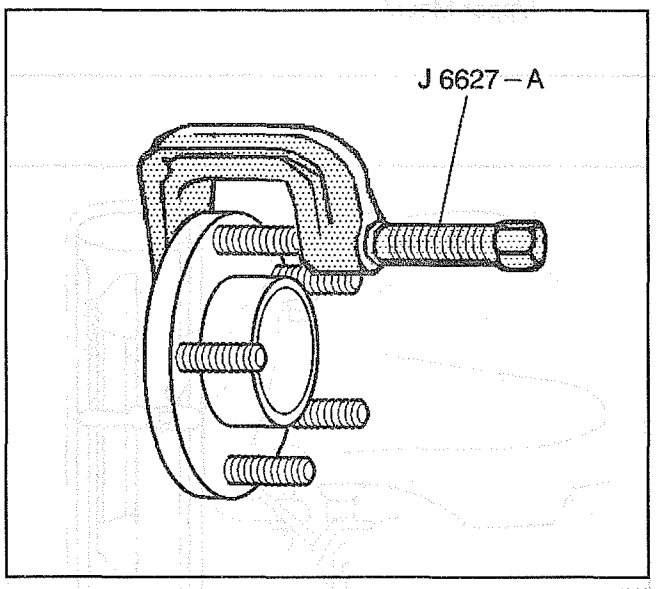
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2. Position the dial indicator against the wheel rim.

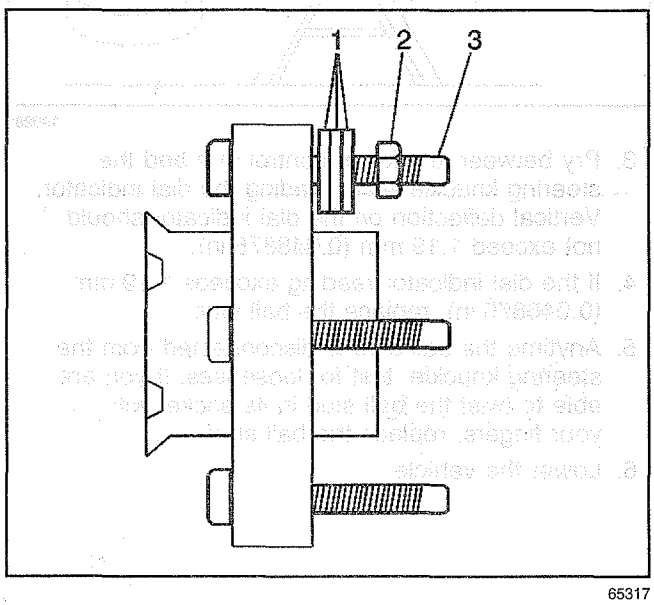


190281

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 in).
4. If the dial indicator reading exceeds 1.19 mm (0.046875 in), replace the ball stud.
5. Anytime the ball stud is disconnected from the steering knuckle, test for looseness. If you are able to twist the ball stud in its socket with your fingers, replace the ball stud.
6. Lower the vehicle.



65316



65317

Repair Instructions

Wheel Hub Bolt Replacement

Removal Procedure

Tool Required

J 6627-A Wheel Stud Remover

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Install *J 6627-A* onto the hub and over the wheel stud.
4. Turn the forcing screw in until the wheel stud is pushed out of the hub.

Installation Procedure

1. Install a new wheel stud (3) in the hub.
2. Install some washers (1) onto the wheel stud.
3. With the flat side of the wheel nut (2) against the washers, tighten the wheel nut until the wheel stud head seats against the hub flange.

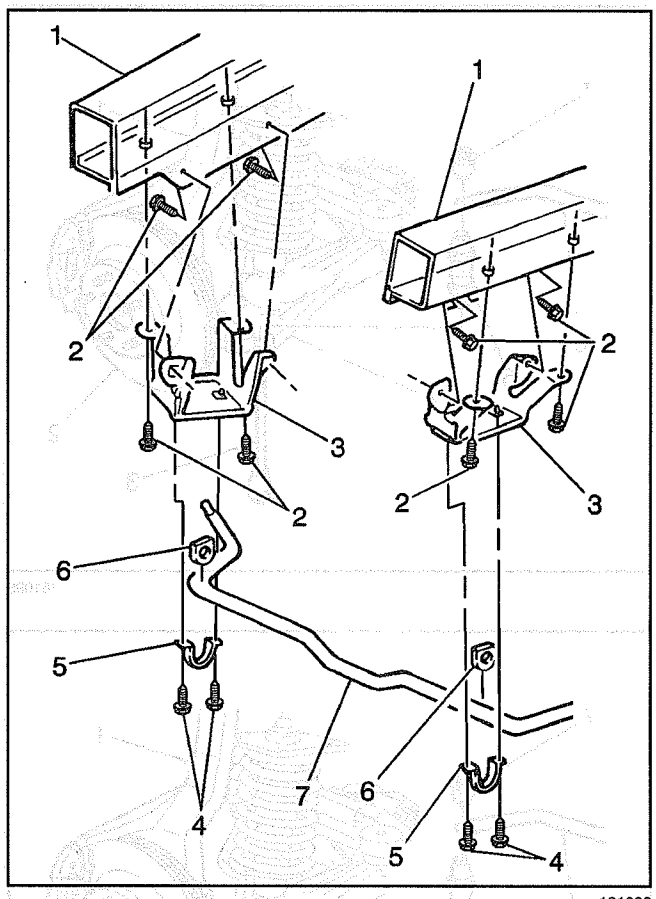
Important: Make sure that the wheel stud is fully seated against the hub flange.

4. Remove the wheel nut and washers.
5. Install the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
6. Lower the vehicle.

Stabilizer Shaft Replacement

Removal Procedure

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the stabilizer shaft link. Refer to *Stabilizer Shaft Link Replacement*.
3. Remove the stabilizer shaft insulator clamp bolts (4) and stud.
4. Remove the stabilizer shaft insulator clamps (5).
5. Remove the stabilizer shaft (7) from the vehicle.
6. Remove the insulators (6) from the stabilizer shaft (7), if necessary.



181093

Installation Procedure

Important: The slit in the insulator (6) must face toward the front of the vehicle.

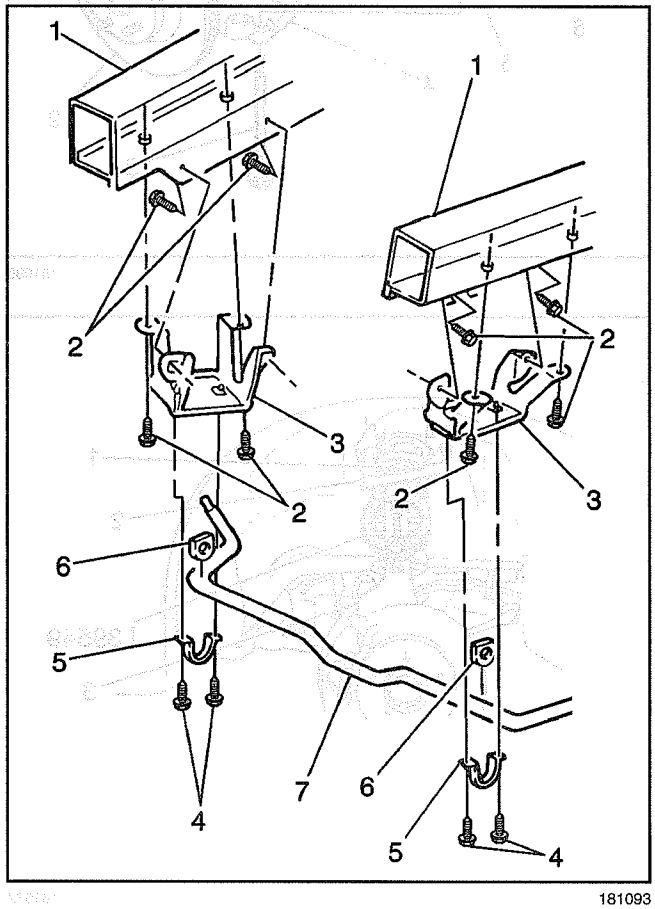
1. Install the stabilizer shaft insulators (6) over the stabilizer shaft (7), if necessary.
2. Place the stabilizer shaft (7) into position on the vehicle.
3. Install the stabilizer shaft insulator clamps (5) over the insulators.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

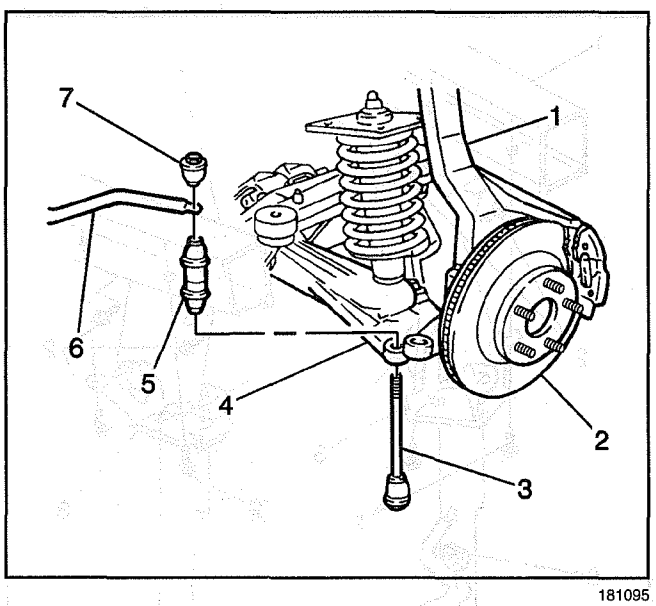
4. Install the stabilizer shaft insulator clamp bolts (4) and stud.

   Tighten

   Tighten the stabilizer shaft insulator clamp bolts (4) and stud to 55 N·m (41 lb ft).
5. Install the stabilizer shaft link. Refer to *Stabilizer Shaft Link Replacement*.
6. Lower the vehicle.



181093

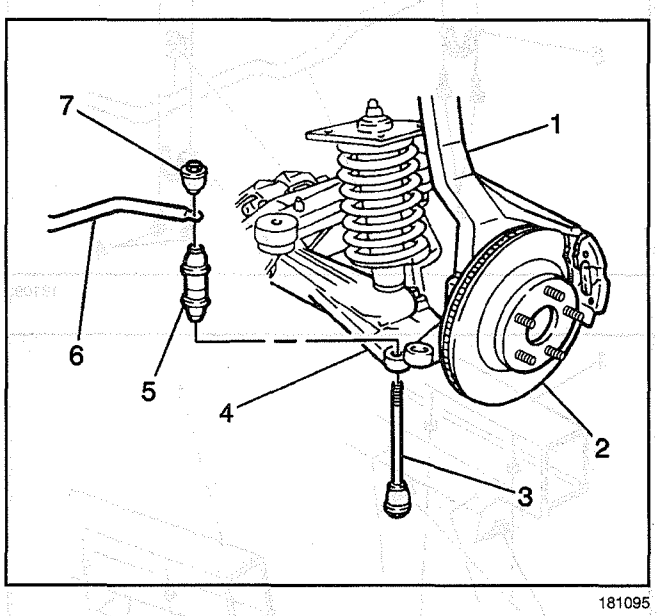


181095

Stabilizer Shaft Link Replacement

Removal Procedure

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the stabilizer shaft upper nut and bushing (7).
3. Remove the stabilizer shaft bolt (3).
4. Remove the stabilizer shaft spacer (5) between the lower control arm (4) and stabilizer shaft (6).



181095

Installation Procedure

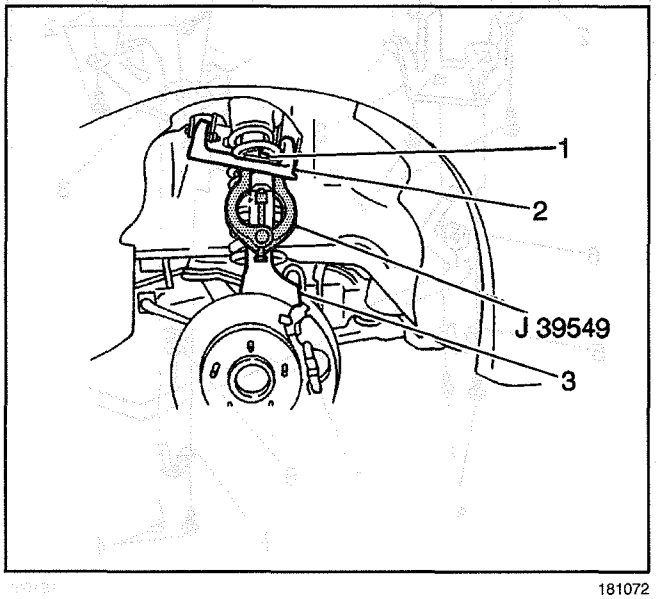
1. Install the stabilizer shaft spacer (5) between the lower control arm (4) and the stabilizer shaft (6).
2. Install the stabilizer shaft bolt (3).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the stabilizer shaft upper nut and bushing (7).

   Tighten

   Tighten the stabilizer shaft upper nut and bushing (7) to 23 N·m (17 lb ft).
4. Lower the vehicle.



181072

Upper Ball Joint Replacement

Removal Procedure

Tools Required

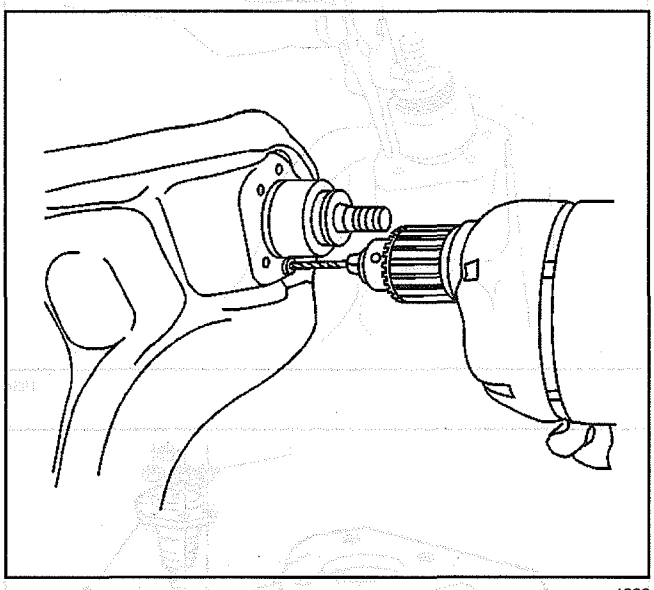
J 39549 Ball Joint/Tie Rod Separator

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.

Important: During removal and installation, the floor jack must remain under the shock absorber mounting location on the lower control arm in order to hold the spring and the lower control arm in position.

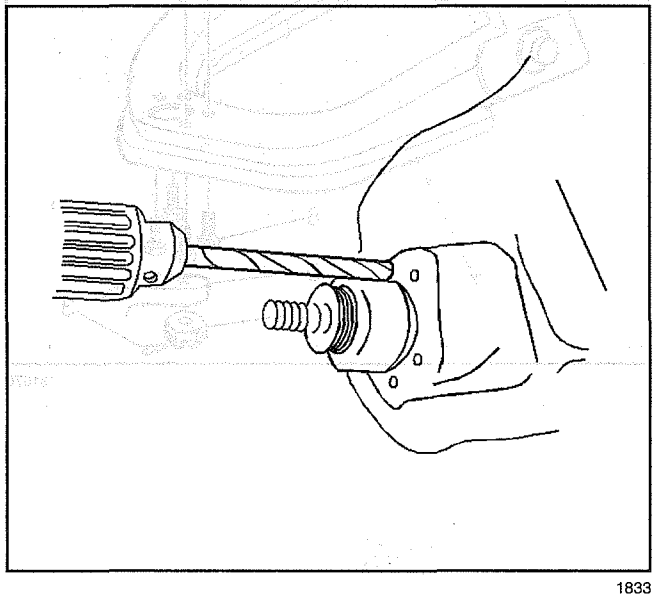
3. Place a floor jack under the shock absorber mounting location on the lower control arm.

4. Remove and discard the upper control arm cotter pin.
5. Remove the upper control arm nut.
6. Support the steering knuckle (3) with a floor jack.
7. Use *J 39549* in order to separate the upper ball joint (1) from the steering knuckle (3).
8. With the upper control arm in a raised position, drill out the four rivets approximately 6 mm (0.25 in) deep using a ⅛ inch drill bit.

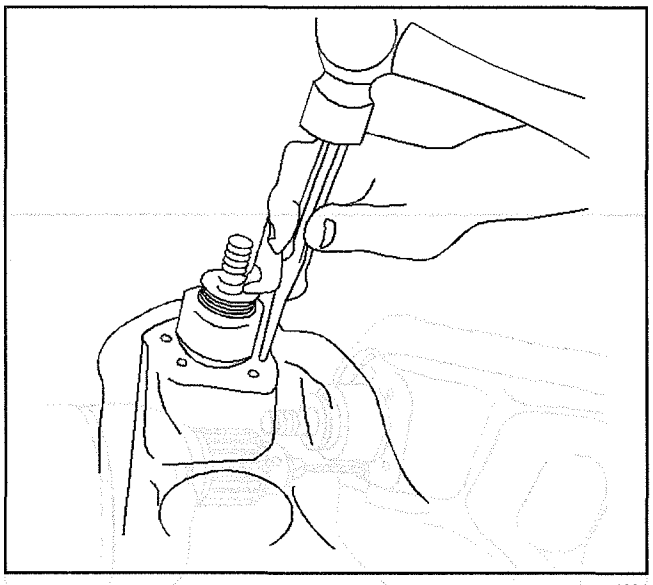


1832

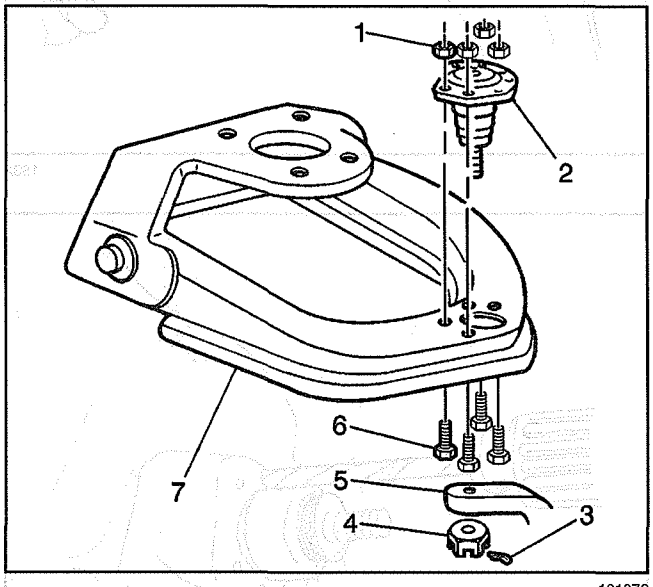
9. Drill out the rivet heads using a ½ inch drill bit.



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10. Punch out the rivets using a small punch.
11. Remove the upper ball joint.

Installation Procedure

1. Loosely install the new upper ball joint (2) into the upper control arm (7).
2. Remove the temporary support from the steering knuckle (5).
3. Align and install the upper ball joint (2) to the steering knuckle (3).
4. Install the upper control arm nut (4) finger tight.
5. Install the upper ball joint service kit bolts (6) and nuts (4). Refer to the ball joint kit for torque specifications.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

6. Torque the upper control arm nut (4) to specifications.

   Tighten

   Tighten the upper control arm nut (4) to 53 N·m (39 lb ft).

Important: Never loosen the control arm nut in order to align the cotter pin slot, it is permissible to over torque the control arm nut 1/6 of a turn MAX.

7. Install a new upper control arm cotter pin (3).
8. Remove the floor jack from under the shock absorber seat.
9. Install the tire and the wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
10. Lower the vehicle.

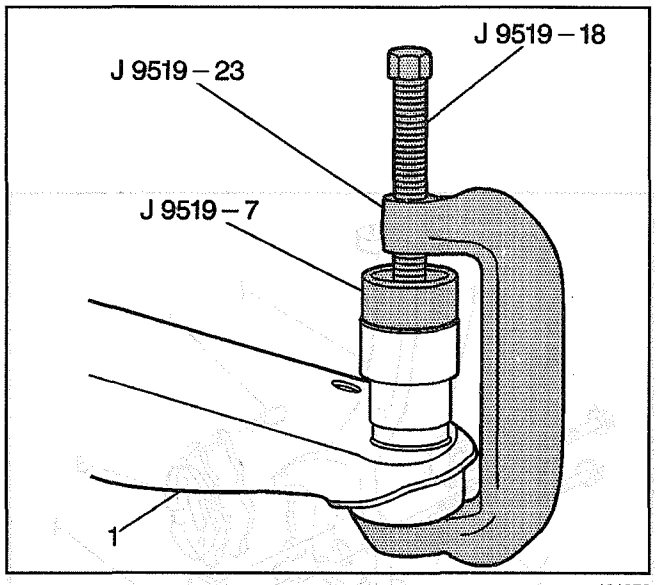
Lower Ball Joint Replacement

Removal Procedure

Tools Required

- *J 39549* Ball Joint/Tie Rod Separator
- *J 9519-7* Ball Joint Remover
- *J 9519-18* Ball Joint Pressing Screw
- *J 9519-23* Ball Joint C-Clamp

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the tire and the wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Place a floor jack under the lower control arm (1).
4. Remove and discard the lower control arm cotter pin.
5. Remove the lower control arm nut.



181070

Important: During removal and installation, the floor jack must remain under the shock absorber mounting location on the lower control arm in order to hold the spring and the lower control arm in position.

6. Use *J 39549* in order to separate the lower ball joint from the steering knuckle.
7. Use *J 9519-7*, *J 9519-18*, and *J 9519-23* in order to press the lower ball joint out of the lower control arm (1).

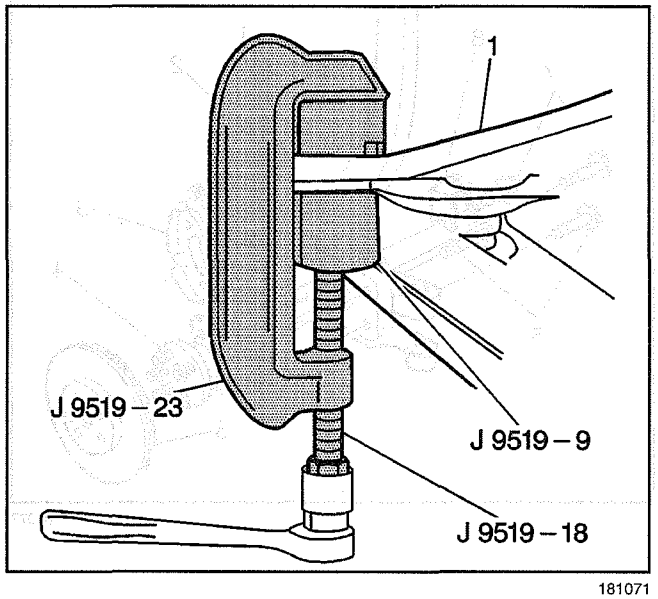
Installation Procedure

Tools Required

- *J 9519-9* Ball Joint Installer
- *J 9519-18* Ball Joint Pressing Screw
- *J 9519-23* Ball Joint C-Clamp

1. Position the lower ball joint into the opening in lower control arm (1).
2. Using *J 9519-9*, *J 9519-18*, and *J 9519-23* press in the ball joint until it extends all the way through the lower control arm (1).

   The ball joint must fit firmly into the lower control arm. If the ball joint does not fit firmly into the lower control arm, replace the lower control arm.
3. Align and Install the ball joint to the steering knuckle.



181071

Notice: Refer to *Fastener Notice* in Cautions and Notices.

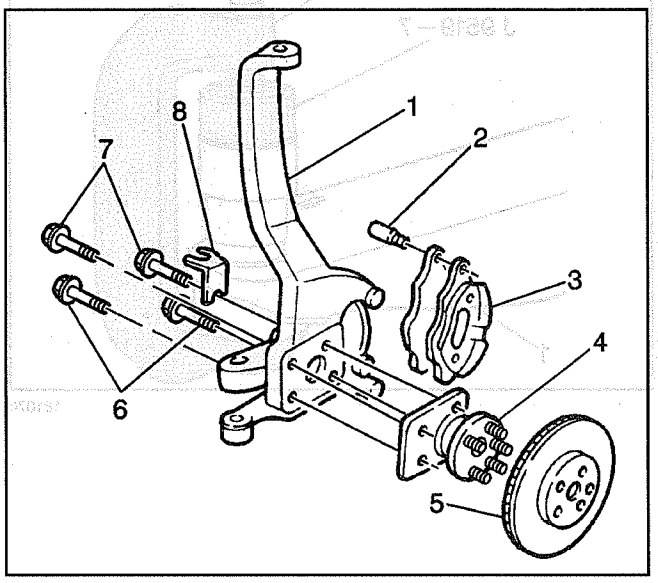
4. Install the lower control arm nut.

   Tighten

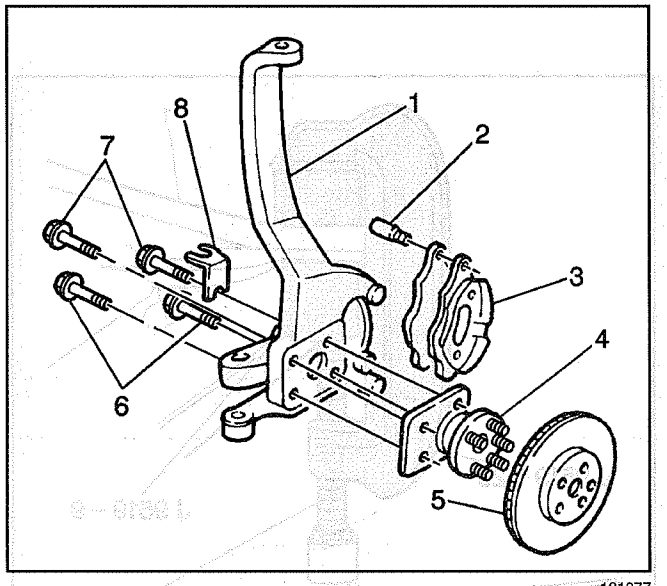
   Tighten the lower control arm nut to 110 N·m (81 lb ft).

Important: Never loosen the control arm nut in order to align the cotter pin slot, it is permissible to over torque the control arm nut 1/6 of a turn MAX.

5. Install a new lower control arm cotter pin.
6. Remove the floor jack from under the lower control arm (1).



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7. Install the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
8. Lower the vehicle.
9. Check the wheel alignment. Refer to *Measuring Wheel Alignment* in Wheel Alignment.

Wheel Bearing/Hub Replacement - Front

Removal Procedure

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Remove the brake caliper (3) from its mounting.
4. Support the brake caliper (3) on the steering knuckle using mechanics wire.
5. Remove the brake rotor (5) from the wheel bearing hub (4).
6. Disconnect the wheel speed sensor electrical connector.
7. Remove the wheel bearing hub bolts (6 and 7) and wheel speed sensor wire bracket (8).
8. Pull the wheel bearing hub (4) from the steering knuckle (1).

Installation Procedure

1. Align the wheel bearing hub (4) to the steering knuckle (1).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the wheel bearing hub bolts (6 and 7) and wheel speed sensor wire bracket (8).

   Tighten

   Tighten the wheel bearing hub bolts (6 and 7) to 86 N·m (63 lb ft).
3. Connect the wheel speed sensor electrical connector. Attach the wheel speed sensor wire to the bracket (8).
4. Install the brake rotor (5) to the wheel bearing hub (4).
5. Remove the brake caliper (3) from the mechanics wire support.
6. Install the brake caliper (3) to its mounting.
7. Install the tire and the wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
8. Lower the vehicle.

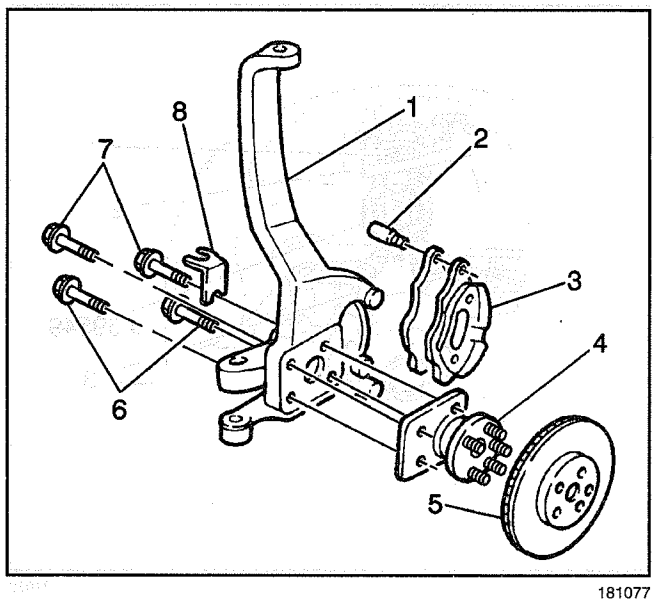
Steering Knuckle Replacement

Removal Procedure

Tools Required

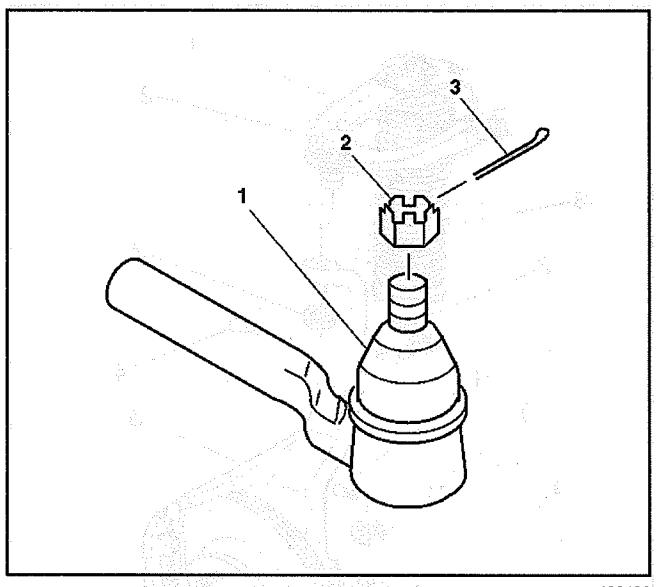
- *J 24319-01* Universal Steering Linkage Puller
- *J 39549* Ball Joint/Tie Rod Separator

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the stabilizer shaft link. Refer to *Stabilizer Shaft Link Replacement.*
3. Remove the wheel hub (4) from the steering knuckle (1). Refer to *Wheel Bearing/Hub Replacement - Front.*



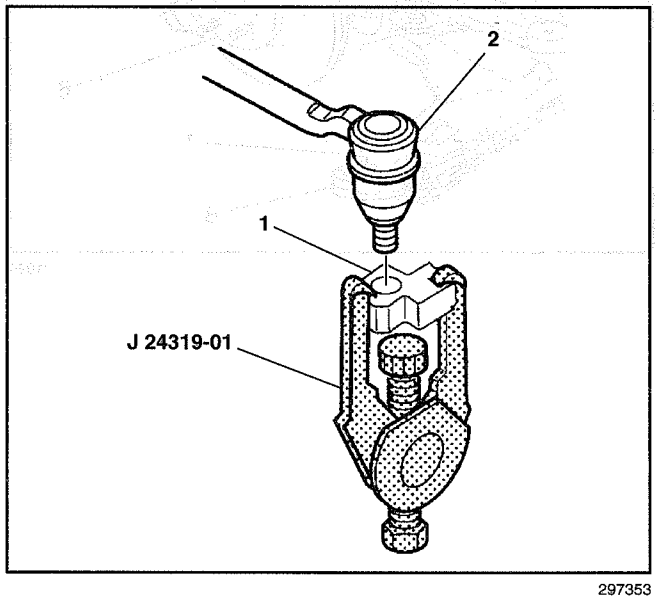
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4. Remove and discard the cotter pin (3) from the outer tie rod end (1).
5. Remove the outer tie rod end nut (2).

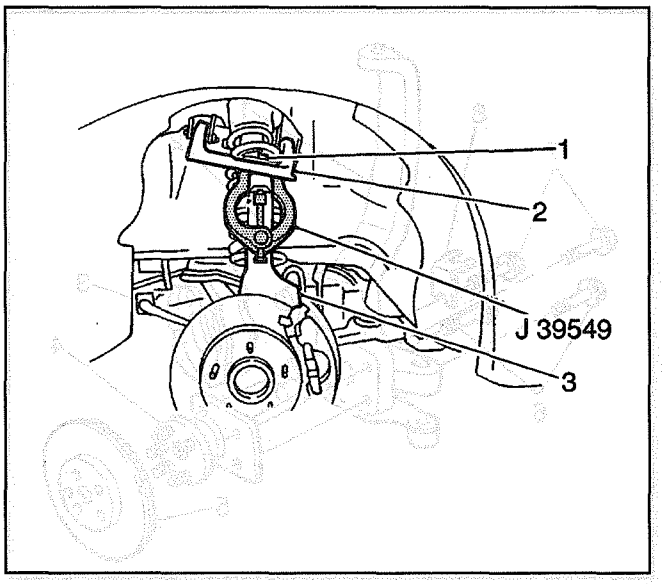


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6. Using *J 24319-01* separate the outer tie rod end (2) from the steering knuckle (1).
7. Use a jack stand to support the lower control arm.
8. Remove the shock absorber lower bolts and nuts.
9. Remove and discard the upper control arm cotter pin.
10. Remove the upper control arm nut.

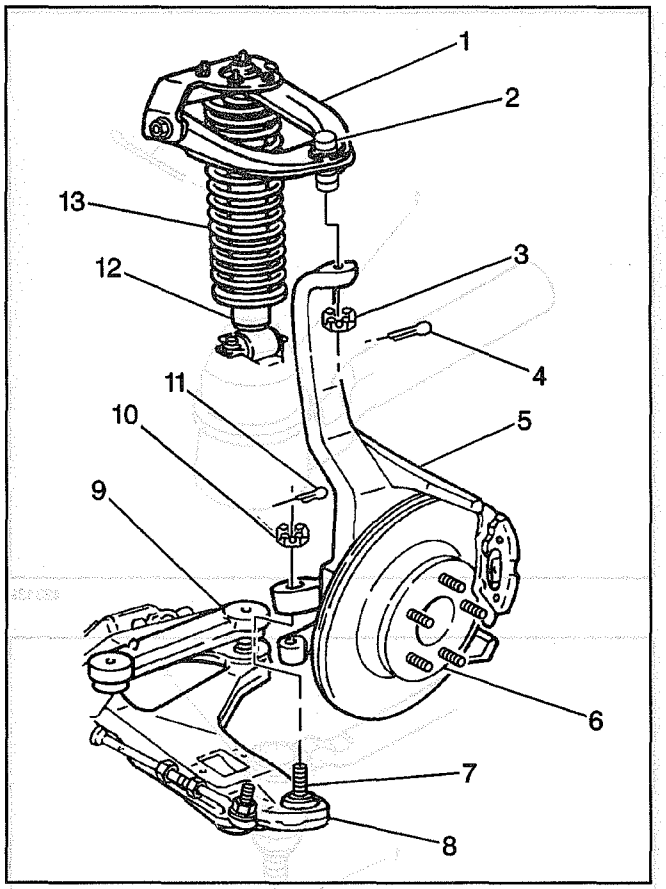


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11. Using *J 39549* separate the upper ball joint (1) from the steering knuckle (3).
12. Remove the upper control arm (2) and upper ball joint (1) from the steering knuckle (3).



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13. Remove and discard the lower control arm cotter pin.
14. Remove the lower control arm nut.
15. Using *J 39549* separate the lower ball joint (7) from the steering knuckle (5).
16. Remove the lower control arm (8) and lower ball joint (7) from the steering knuckle (5).
17. Remove the steering knuckle (5) from the vehicle.

Installation Procedure

1. Install the steering knuckle (5) to the vehicle.
2. Align and Install the lower ball joint (7) and control arm (8) to the steering knuckle (5).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the lower control arm nut.

   Tighten

   Tighten the lower control arm nut to 110 N·m (81 lb ft).

Important: Never loosen the control arm nut in order to align the cotter pin solt, it is permissible to over torque the control arm nut 1/6 of a turn MAX.

4. Install a new lower control arm cotter pin.
5. Align and install the upper control arm and upper ball joint to the steering knuckle.
6. Install the upper control arm nut.

   Tighten

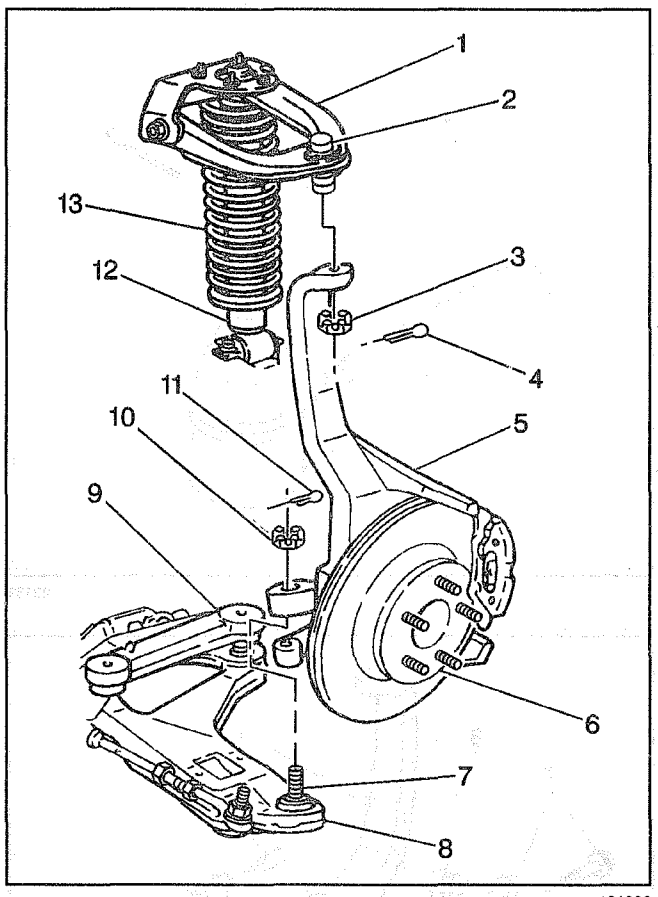
   Tighten the upper control arm nut to 53 N·m (39 lb ft).

7. Install a new upper control arm cotter pin.
8. Install the shock absorber lower bolts and nuts.

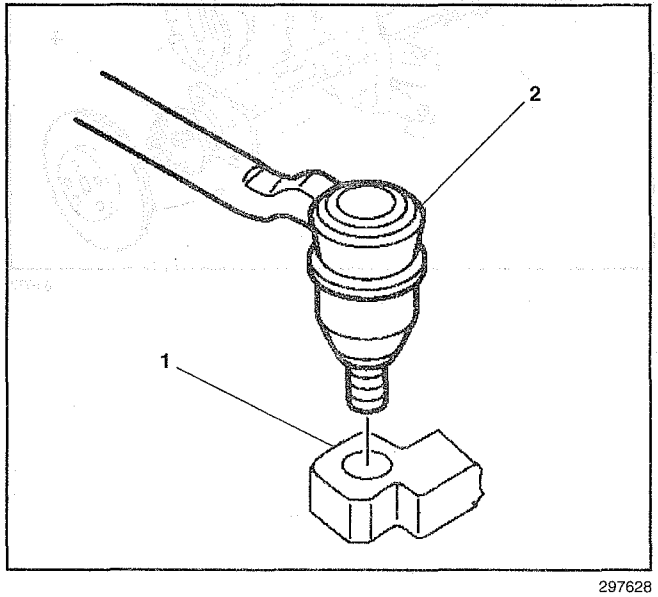
   Tighten

   Tighten the shock absorber lower bolts or nuts to 65 N·m (48 lb ft).

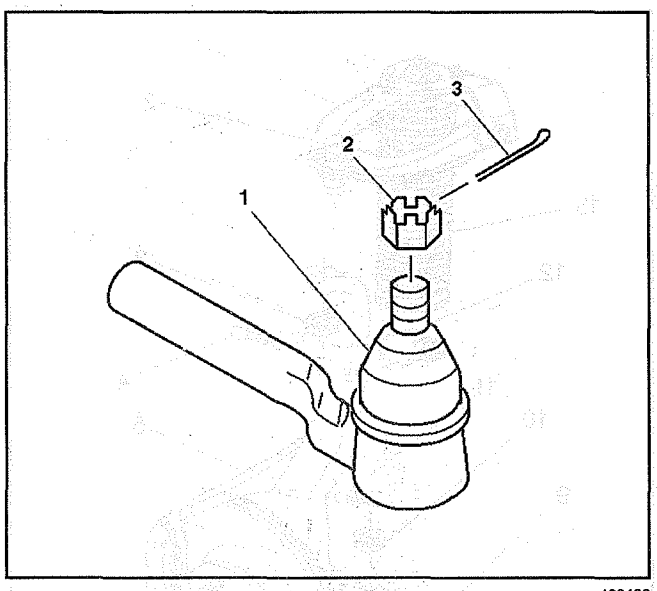
9. Remove the jack stand supporting the lower control arm.
10. Connect the outer tie rod end (2) to the steering knuckle (1).



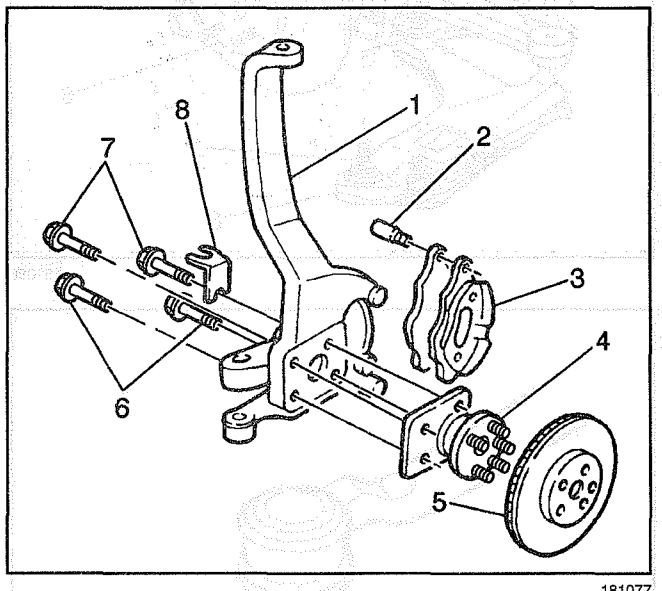
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11. Install the outer tie rod end nut (2).

    Tighten

    Tighten the outer tie rod end nut (2) to 47 N·m (35 lb ft).

12. Install a new cotter pin (3) to the outer tie rod end (1).

13. Install the wheel hub (4) from the steering knuckle (1). Refer to *Wheel Bearing/Hub Replacement - Front*.
14. Install the stabilizer shaft link. Refer to *Stabilizer Shaft Link Replacement*.
15. Lower the vehicle.
16. Check the wheel toe-in. Refer to *Front Toe Adjustment* in Wheel Alignment.

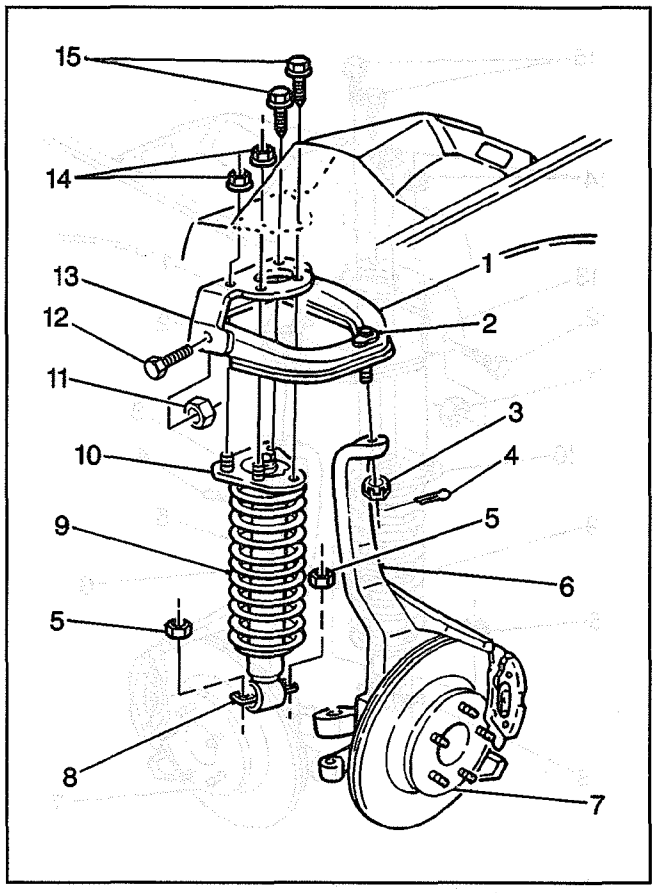
Upper Control Arm Replacement

Removal Procedure

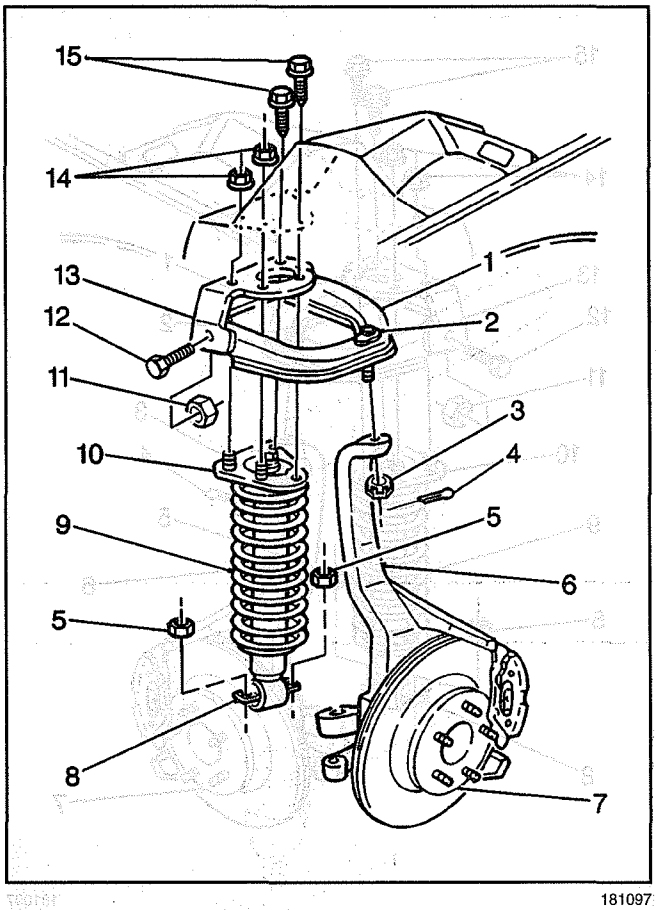
Tools Required

J 39549 Ball Joint/Tie Rod Separator

1. If servicing the driver side upper control arm, perform the following:
   1.1. Remove the brake master cylinder nuts.
   1.2. Gently, reposition the brake master cylinder to the side.
2. Remove the shock absorber upper mounting bolts (15) and nuts (14).
3. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
4. Remove the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
5. Remove the stabilizer shaft link. Refer to *Stabilizer Shaft Link Replacement.*
6. Remove the shock absorber lower bolts and nuts (5).
7. Remove and discard the upper control arm cotter pin (4).
8. Remove the upper control arm nut (3).
9. Support the steering knuckle (6) with a jack stand.
10. Use *J 39549* in order to separate the upper ball joint (2) from the steering knuckle (6).
11. Remove the steering knuckle (6) and ball joint (2) from the upper control arm (1).
12. Remove the upper control arm (1) and shock absorber (8) from the vehicle.
13. Separate the shock absorber (8) from the upper control arm (1).



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Installation Procedure

1. Place the shock absorber (8) through the upper control arm (1).
2. Install the upper control arm (1) and shock absorber (8) to the vehicle.
3. Align and install the upper control arm (1) and upper ball joint (2) to the steering knuckle (6).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the upper control arm nut (3).

   Tighten

   Tighten the upper control arm nut (3) to 53 N·m (39 lb ft).

Important: Never loosen the control arm nut in order to align the cotter pin slot, it is permissible to over torque the control arm nut 1/6 of a turn MAX.

5. Install a new upper control arm cotter pin (4).
6. Remove the jack stand supporting the lower control arm.
7. Install the shock absorber lower bolts and nuts (5).

   Tighten

   Tighten the shock absorber lower bolts or nuts (5) to 65 N·m (48 lb ft).
8. Install the stabilizer shaft link. Refer to *Stabilizer Shaft Link Replacement.*
9. Install the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
10. Lower the vehicle.
11. Install the shock absorber upper mounting bolts (15) and nuts (14).

    Tighten

    - Tighten the shock absorber upper mounting nuts (14) to 41 N·m (30 lb ft).
    - Tighten the shock absorber upper mounting bolts to 50 N·m (37 lb ft).
12. If servicing the driver side upper control arm, perform the following:
    12.1. Gently, reposition the brake master cylinder into position.
    12.2. Install the brake master cylinder nuts.

    Tighten

    Tighten the brake master cylinder nuts to 29 N·m (21 lb ft).

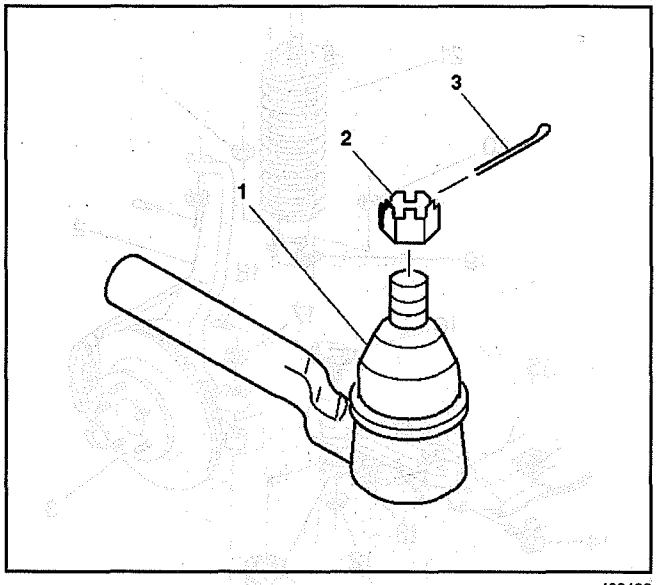
Lower Control Arm Replacement

Removal Procedure

Tools Required

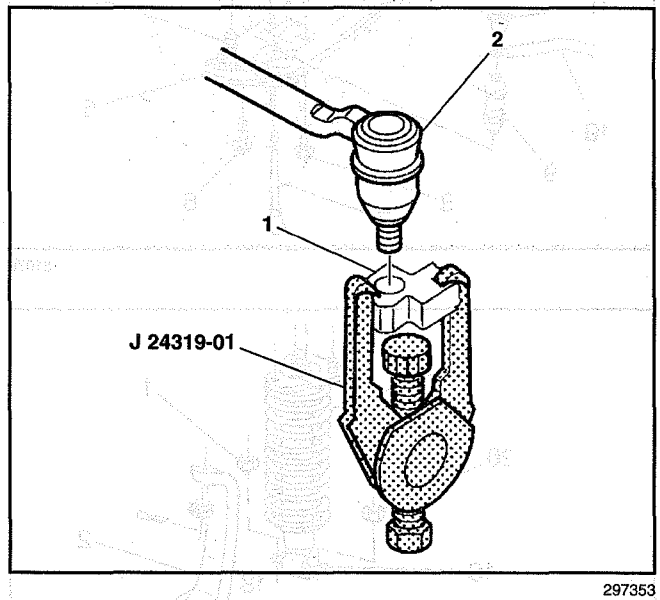
- *J 24319-01* Universal Steering Linkage Puller
- *J 39549* Ball Joint/Tie Rod Separator

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the tire and the wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Remove the stabilizer shaft link. Refer to *Stabilizer Shaft Link Replacement*.
4. Remove and discard the cotter pin (3) from the outer tie rod end (1).
5. Remove the outer tie rod end nut (2).

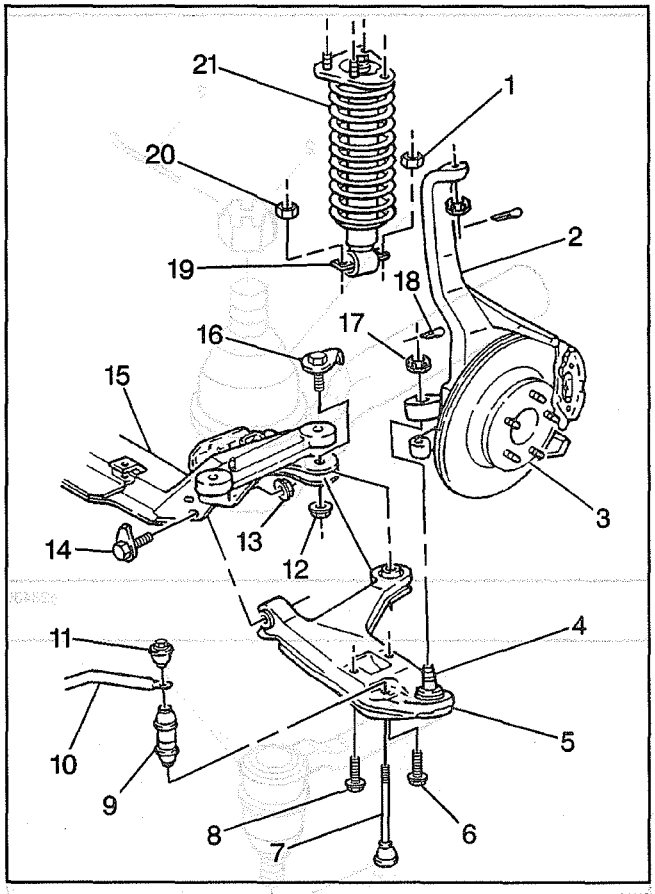


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6. Using *J 24319-01* separate the outer tie rod end (2) from the steering knuckle (1).

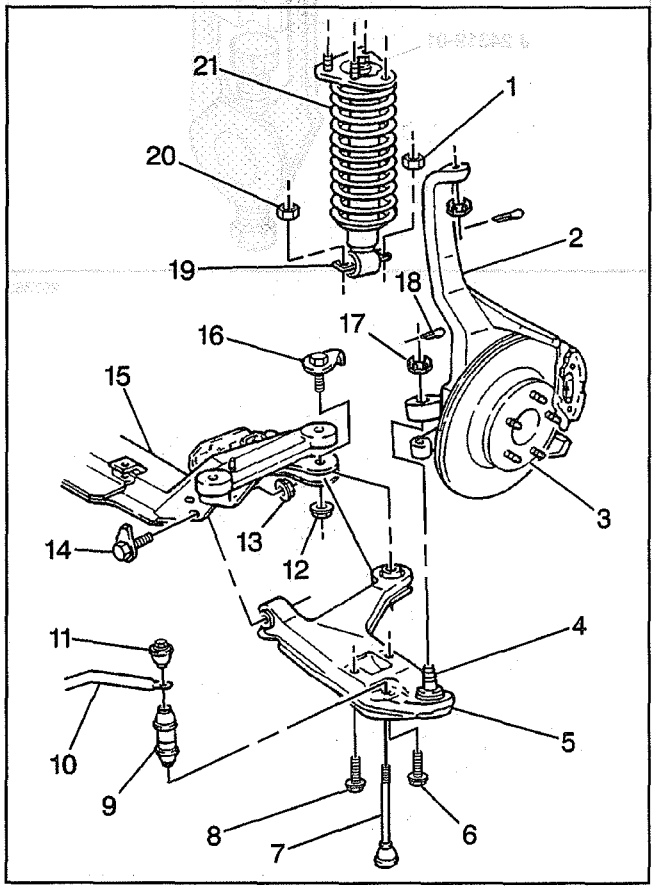


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7. Remove the shock absorber lower bolts (6 and 8) and nuts (1 and 20).
8. Remove and discard the lower control arm cotter pin (18).
9. Remove the lower control arm nut (17).
10. Using *J 39549* separate the lower ball joint (4) from the steering knuckle (2).
11. Remove the lower control arm (5) and lower ball joint (4) from the steering knuckle (2).
12. Remove the lower control arm mounting bolts (14 and 16) and nuts (12 and 13).
13. Remove the lower control arm (5).



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Installation Procedure

1. Align and install the lower control arm (5).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the lower control arm mounting bolts (14 and 16) and nuts (12 and 13).

   Tighten

   Tighten the lower control arm mounting nuts (12 and 13) to 100 N·m (74 lb ft).
3. Align and Install the lower ball joint (4) and control arm (5) to the steering knuckle (2).
4. Install the lower control arm nut (17).

   Tighten

   Tighten the lower control arm nut (17) to 110 N·m (81 lb ft).

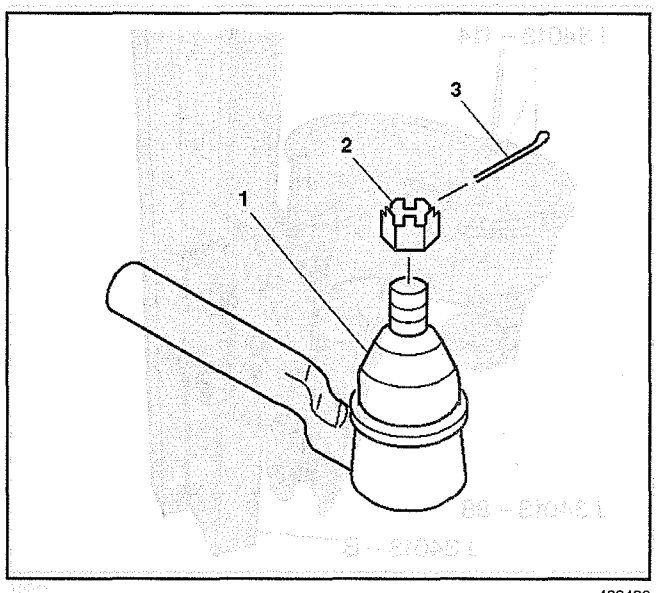
Important: Never loosen the control arm nut in order to align the cotter pin slot, it is permissible to over torque the control arm nut 1/6 of a turn MAX.

5. Install a new lower control arm cotter pin (18).
6. Install the shock absorber lower bolts (6 and 8) and nuts (1 and 20).

   Tighten

   Tighten the shock absorber lower bolts (6 and 8) or nuts (1 and 20) to 65 N·m (48 lb ft).

7. Install the outer tie rod end nut (2).
8. Install a new cotter pin (3) to the outer tie rod end (1).
9. Install the stabilizer shaft link. Refer to *Stabilizer Shaft Link Replacement*.
10. Install the tire and the wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
11. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
12. Lower the vehicle.
13. Perform a front end alignment. Refer to *Measuring Wheel Alignment* in Wheel Alignment.



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Shock Absorber Replacement

Removal Procedure

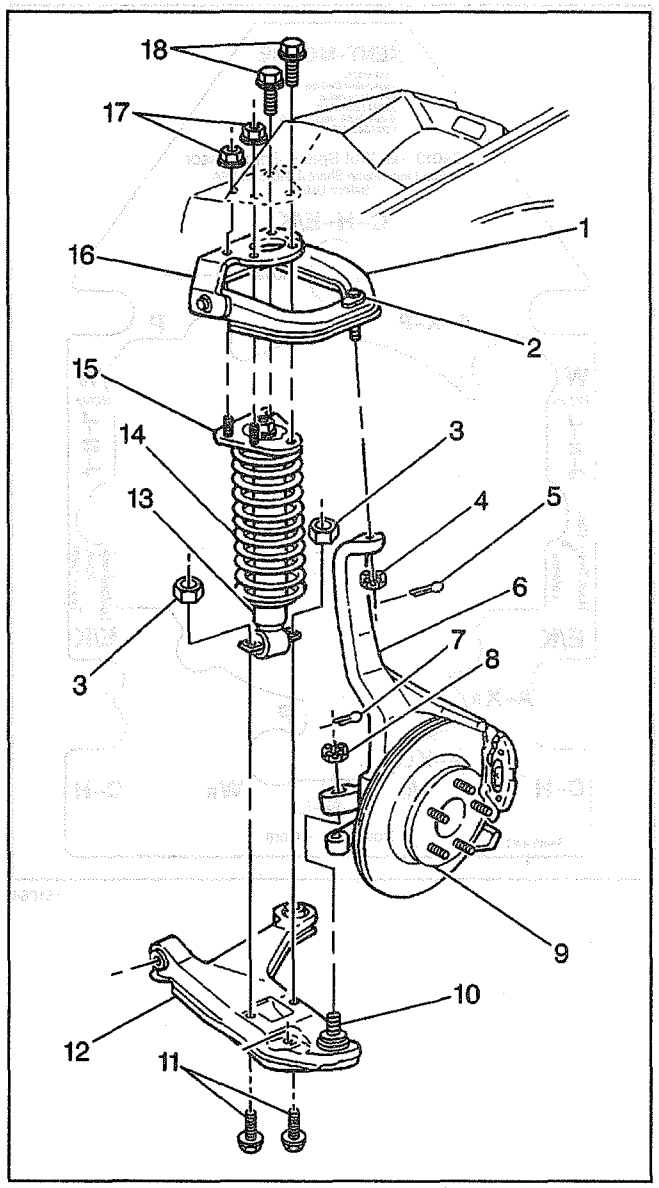
Tools Required

J 39549 Ball Joint/Tie Rod Separator

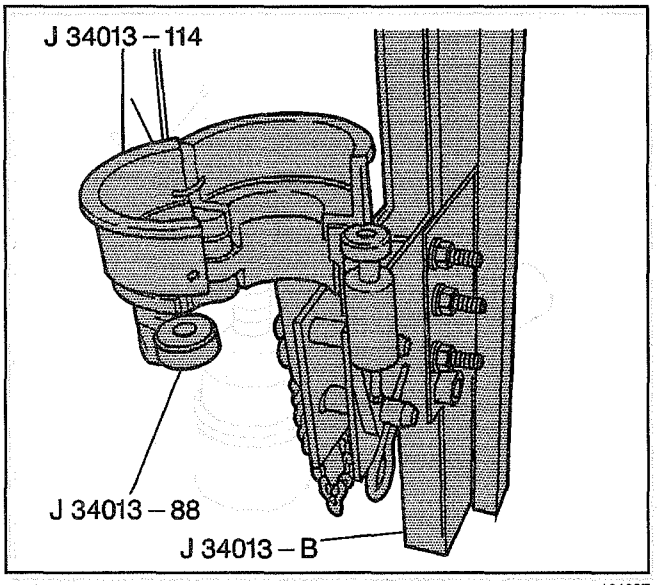
1. If servicing the driver side shock absorber, perform the following:
   1.1. Remove the brake master cylinder nuts.
   1.2. Gently move the brake master cylinder to one side.
2. Remove the shock absorber upper mounting bolts (18) and nuts (17).
3. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
4. Remove the tire and the wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
5. Remove the stabilizer shaft link. Refer to *Stabilizer Shaft Link Replacement*.
6. Remove the shock absorber lower bolts (11) and nuts (3).
7. Remove and discard the lower control arm cotter pin (7).
8. Remove the lower control arm nut (8).
9. Using *J 39549* separate the lower ball joint (10) from the steering knuckle (6).
10. Remove the lower control arm (12) and lower ball joint (10) from the steering knuckle (6).

Important: Use chalk or paint in order to mark (do not scribe) the lower mount location relative to the upper mount location before removing the shock absorber.

11. Remove the shock absorber (13) and the spring (14) from the vehicle.



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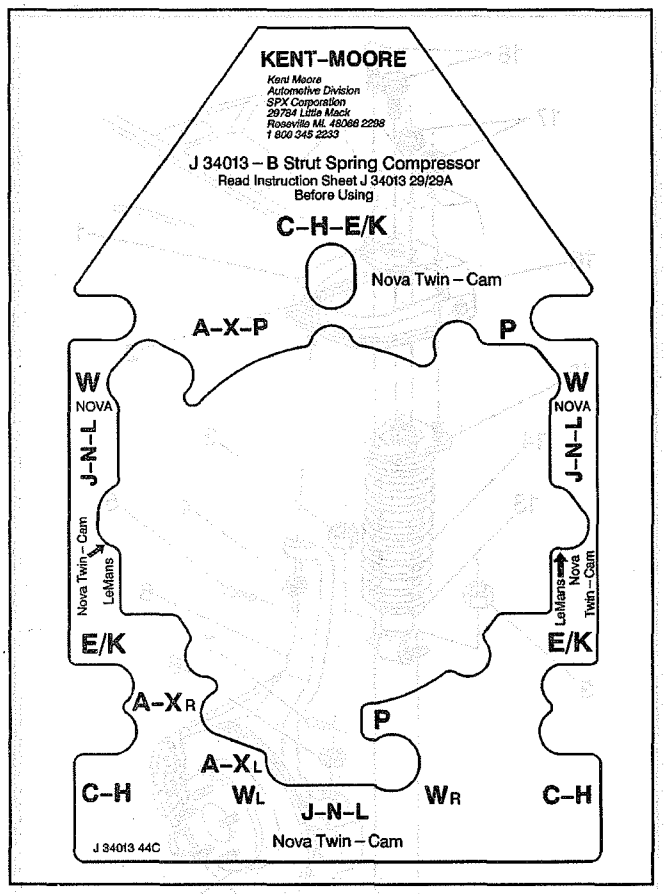
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Disassembly Procedure

Tools Required

- *J 34013-B* Strut Spring Compressor
- *J 34013-114* Modular Shock Compressor Adapter
- *J 34013-88* Strut Compressor Adapter
- *J 39642* Modular Shock Nut Removal Set, 15 mm (0.60 in)
- *J 34013-115* Modular Alignment Rod

1. Install *J 34013-114* and *J 34013-B*.

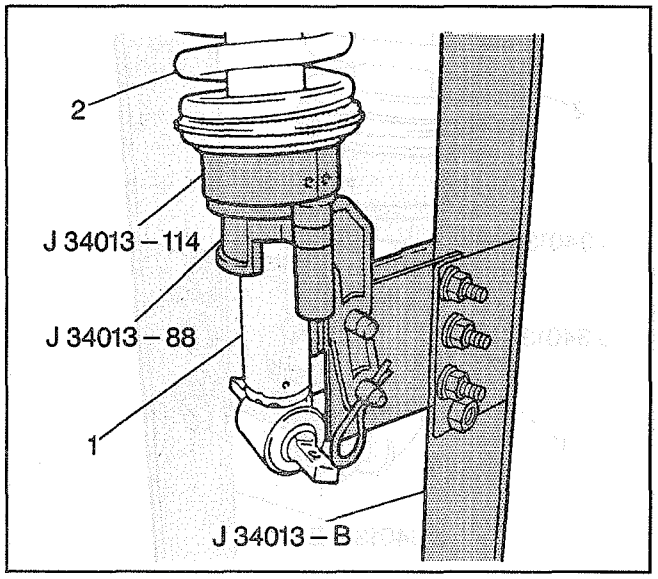


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2. Use wing nuts in order to secure the tool to the following mounting holes:
   - For the driver-side shock absorber
     - C-H (lower left corner)
     - P (upper right corner)
   - For the passenger-side shock absorber
     - A-X-P (upper left corner)
     - C-H (lower right corner)

Important: Align *J 34013-114* and *J 34013-88* so that these tools may open and close together. If *J 34013-114* and *J 34013-88* do not align properly, the tools will not open.

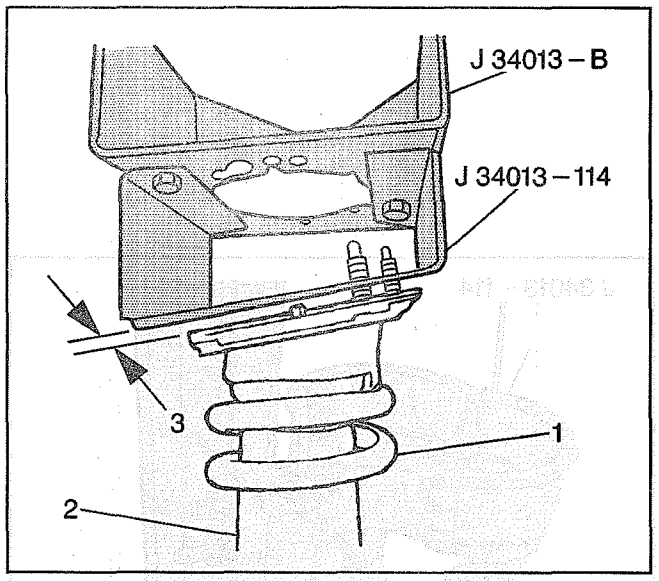
3. Install *J 34013-114* and *J 34013-88*



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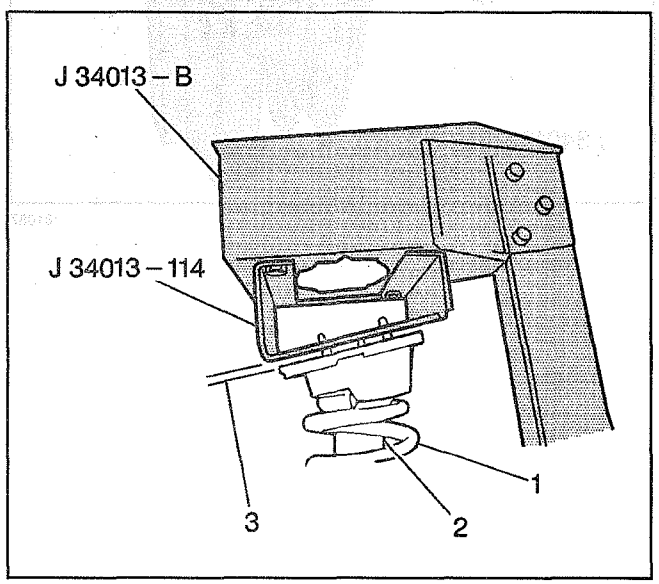
Important: Align the top of the shock absorber flat against *J 34013-114.*

4. Install the driver side shock absorber to the top of *J 34013-114.*

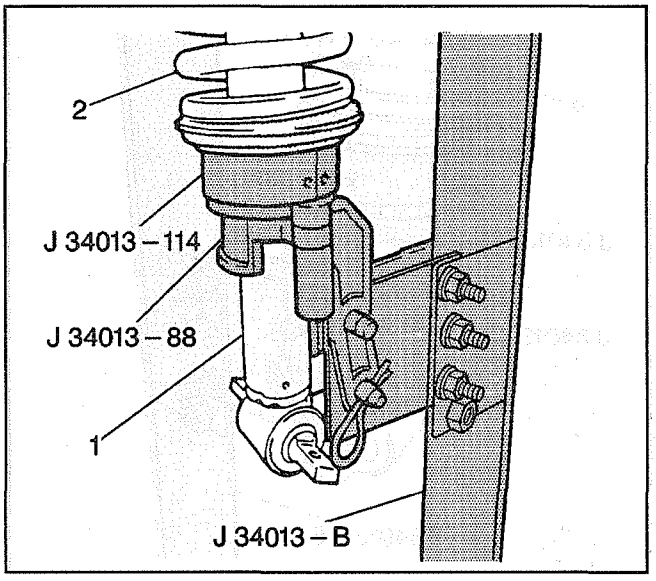


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5. Install the passenger side shock absorber to the top of *J 34013-114.*



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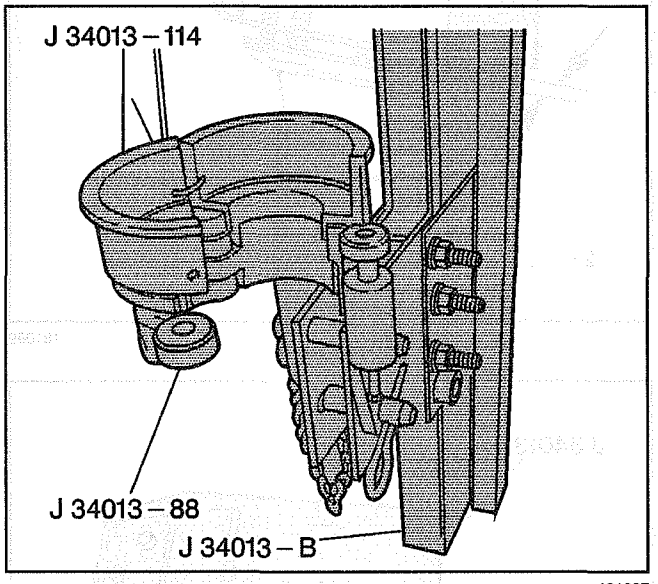
6. Install the shock absorber (1) into *J 34013-114* and *J 34013-88*.
7. Close *J 34013-114* and *J 34013-88* and install the locking pin.

Important: If the mounting ears of the shock absorber are not facing downward, toward the rear of *J 34013-B*, the shock absorber will not align properly.

8. Turn the screw on *J 34013-B* counterclockwise in order to raise the shock absorber up to *J 34013-114*. Align the top of the shock absorber flat against the tool with the studs going through the guide holes in *J 34013-114*.

Caution: Do not over compress the spring. Severe overloading may cause tool failure which could result in bodily injury.

9. Compress the front spring approximately 13 mm (0.50 in), or 3–4 complete turns of the screw on *J 34013-114*.
10. Insert *J 39642* -1 on the shock absorber nut, then insert *J 39642* -2 through *J 39642* -1 in order to hold the shock absorber rod in place.
11. Remove the shock absorber nut with *J 39642* -1 while holding the shock absorber rod from rotating with *J 39642* -2.
12. Discard the shock absorber nut.
13. Turn *J 34013-B* clockwise in order to fully relieve spring pressure.



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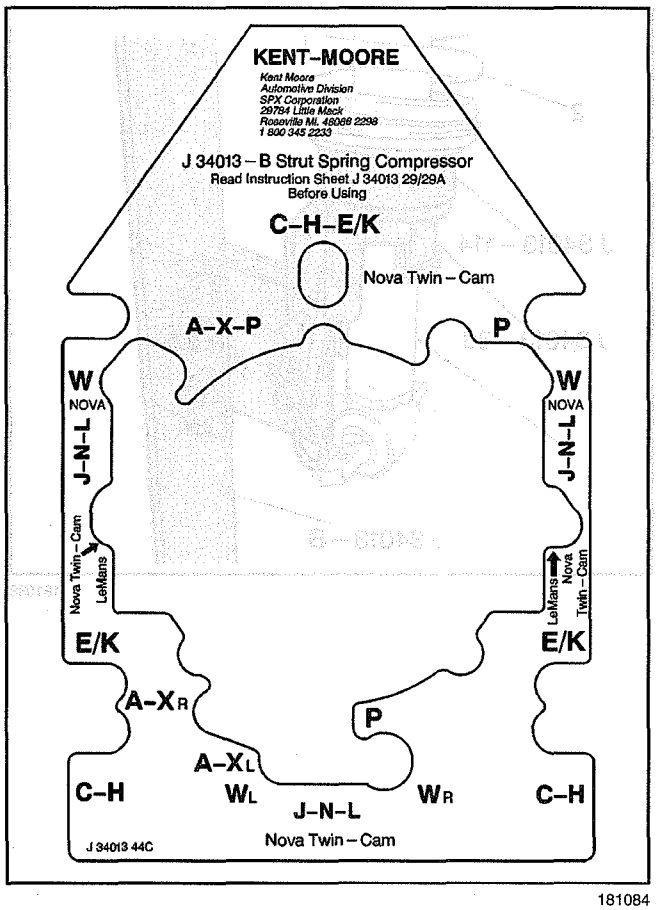
Assembly Procedure

Tools Required

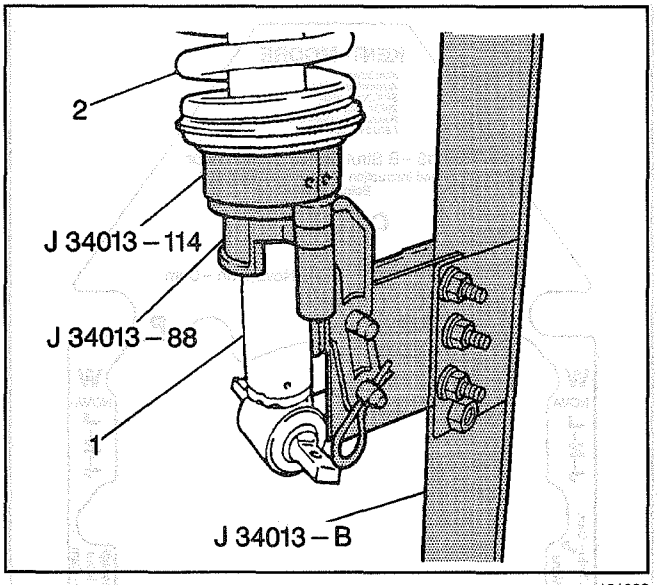
- *J 34013-B* Strut Spring Compressor
- *J 34013-114* Modular Shock Compressor Adapter
- *J 34013-88* Strut Compressor Adapter
- *J 39642* Modular Shock Nut Removal Set, 15 mm (0.60 in)
- *J 34013-115* Modular Alignment Rod

1. Install *J 34013-114* to *J 34013-B*.

2. Use wing nuts in order to secure the tool to the following mounting holes:
   - For the driver-side shock absorber
     - C-H (lower left corner)
     - P (upper right corner)
   - For the passenger-side shock absorber
     - A-X-P (upper left corner)
     - C-H (lower right corner)
3. Install *J 34013-114* and *J 34013-88*.



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4. Install the shock absorber (1) to *J 34013-114* and *J 34013-88*.

Important:

- Face the mounting ears of the shock absorber downward, toward the rear of *J 34013-B* or the shock absorber will not align properly.
- Before removing the shock absorber, use chalk or paint in order to mark the lower mount location relative to the upper mount location, or you will not be able to properly reinstall the shock absorber. Do NOT scribe.

5. Close *J 34013-114* and *J 34013-88* and engage the locking pin.
6. Position the upper and lower spring seats correctly.

Important: Align the top of the shock absorber flat against *J 34013-114*.

7. Install the shock absorber to the top of *J 34013-114*.

Important: Only turn the screw until the shock absorber secures itself in *J 34013-B*. Do not load the spring.

8. Turn the screw on *J 34013-B* counterclockwise in order to raise the shock absorber up to *J 34013-114* without compressing the spring.

Important: Ensure that *J 34013-115* is straight with the shock absorber. If *J 34013-115* is angled, repeat steps 1 through 5 until the tool is straight.

9. Place *J 34013-115* down through the top of *J 34013-B* through the top of the shock absorber and onto the top of the shock absorber rod.

Caution: Do not over compress the spring. Severe overloading may cause tool failure which could result in bodily injury.

10. Turn the operating screw clockwise in order to compress the spring until the threaded portion of the shock absorber rod is through the top of the shock absorber.
11. Remove *J 34013-115*.

Important: Always use a new shock absorber nut. Never reinstall the original nut.

12. Insert the new shock absorber nut on the shock absorber rod.
13. Place *J 39642* -1 on the shock absorber nut.

Notice: Turning the shock absorber while tightening the nut may damage the shock absorber. In order to prevent damage, keep the shock absorber in a stationary position while tightening the nut.

14. Insert *J 39642* -2 through *J 39642* -1 and tighten the shock absorber nut.
15. Tighten the shock absorber nut while holding onto *J 39642* -2.
16. Remove the shock absorber from *J 34013-B*.

Installation Procedure

1. Align and install the shock absorber (13) and spring (14) to the lower control arm (12).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the shock absorber lower bolts (11) and nuts (3).

   Tighten

   Tighten the shock absorber lower bolts (11) or nuts (3) to 65 N·m (48 lb ft).

3. Align and Install the lower ball joint (10) and control arm (12) to the steering knuckle (6).
4. Install the lower control arm nut (8).

   Tighten

   Tighten the lower control arm nut (8) to 110 N·m (81 lb ft).

Important: Never loosen the control arm nut in order to align the cotter pin slot, it is permissible to over torque the control arm nut 1/6 of a turn MAX.

5. Install a new lower control arm cotter pin (7).
6. Install the stabilizer shaft link. Refer to *Stabilizer Shaft Link Replacement.*
7. Install the tire and the wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
8. Lower the vehicle.
9. Install the shock absorber upper mounting bolts (18) and nuts (17).

   Tighten

   - Tighten the shock absorber upper mounting nuts (17) to 41 N·m (30 lb ft).
   - Tighten the shock absorber upper mounting bolts (18) to 50 N·m (37 lb ft).

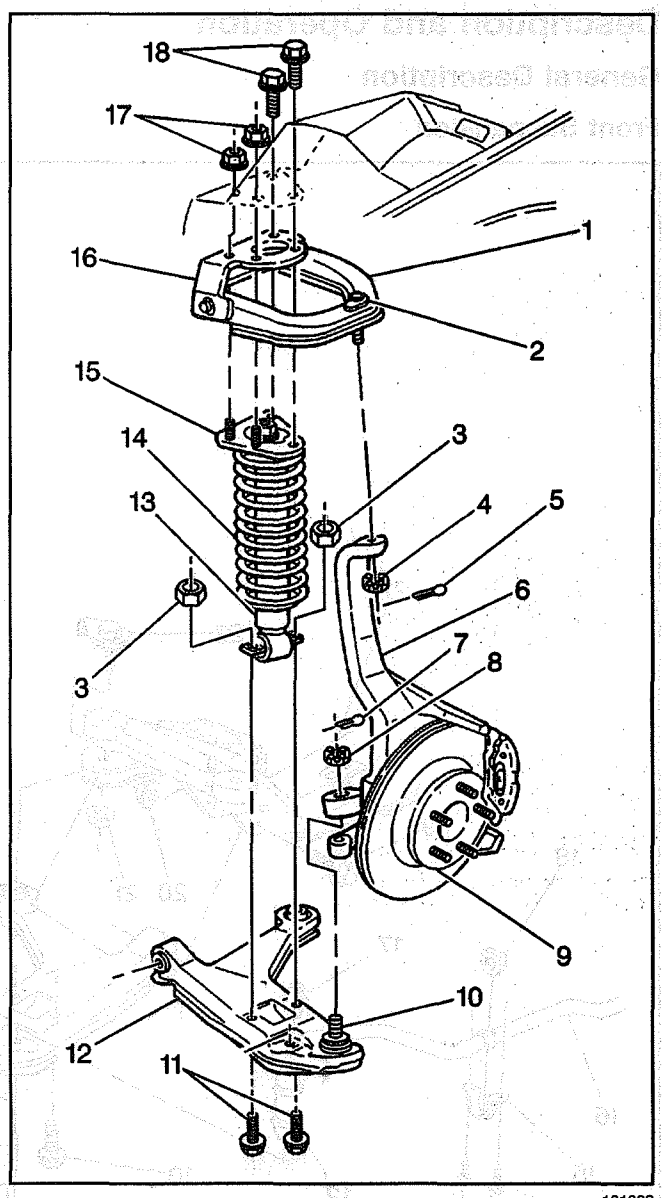
10. If servicing the driver side shock absorber, perform the following:

    10.1. Gently, reposition the brake master cylinder into position.

    10.2. Install the brake master cylinder nuts.

    Tighten

    Tighten the brake master cylinder nuts to 29 N·m (21 lb ft).

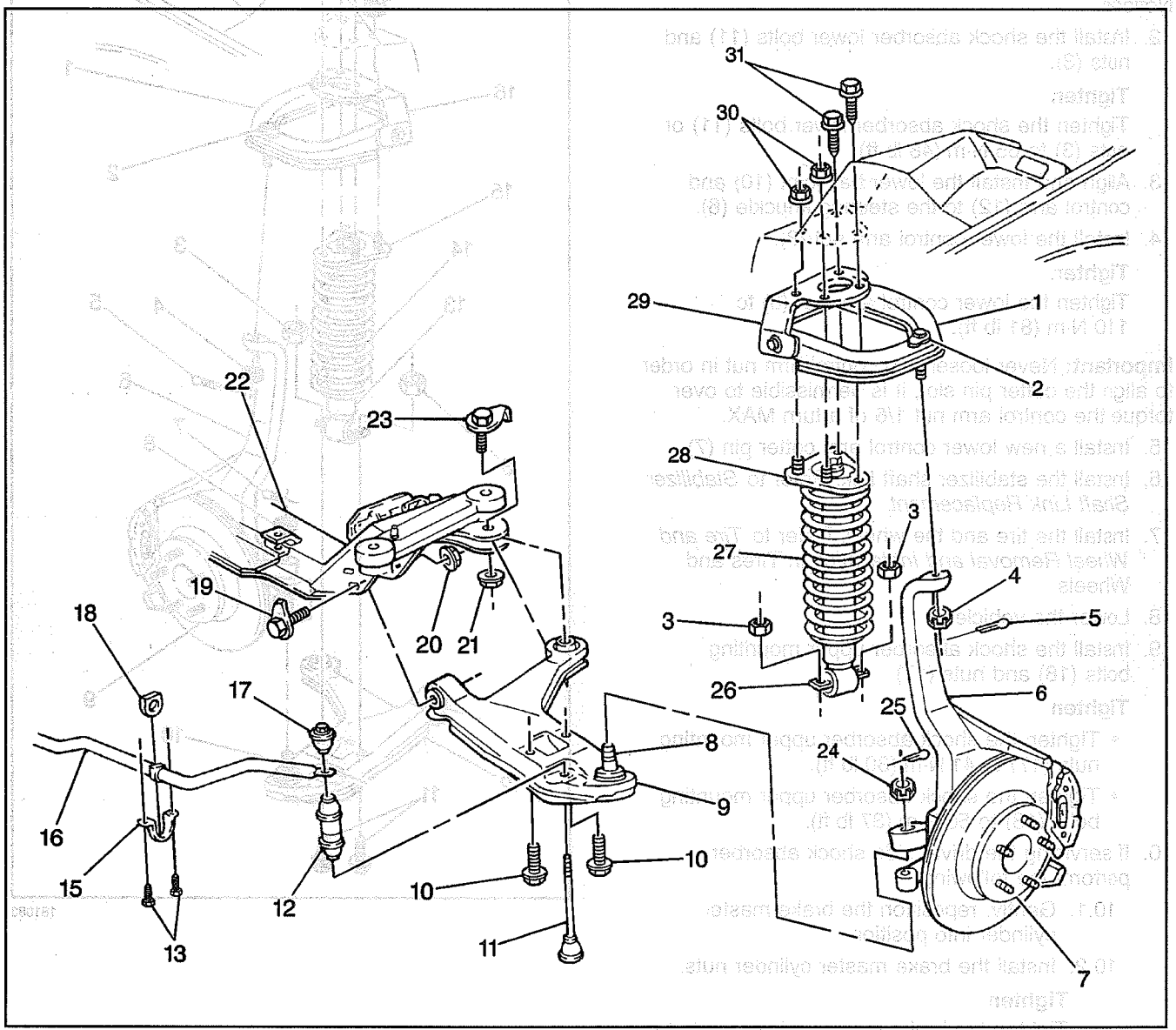


181083

Description and Operation

General Description

Front Suspension



181103

The short/long arm front suspension design allows each wheel to compensate for changes in the road surface level without appreciably affecting the opposite wheel. Each wheel independently connects to the frame by the following:

- A steering knuckle (6)
- A wheel hub (7)
- A shock absorber (26) and spring (27)
- Upper and lower ball studs (2,8)
- Upper and lower control arms (1,9)

The steering knuckle and the hubs (6,7) move in a prescribed three-dimensional arc. The front wheels are held in proper relationship to each other by the two front tie rods. The front tie rods connect to the steering arms on the knuckles and connect to the steering gear.

Springs (27) mount to the lower control arms (9). Direct-acting shock absorbers (26) provide ride control. The upper portion of the shock absorber connects to the front upper shock absorber mount (28). The upper mount (28) extends through the upper control arm support (29) and through the center wheelhouse. The upper mount attaches with two bolts/screws (31) and two nuts (30).

The stabilizer shaft (16) controls idle roll of the front suspension. The stabilizer shaft mounts to the stabilizer shaft insulators (18). These insulators attach to the frame side rails by the stabilizer shaft brackets. The ends of the stabilizer shaft (16) connect to the lower control arms (9) by the stabilizer shaft links (11). These ends are isolated by bushings.

The inner ends of the lower control arm (9) have pressed-in bushings. Bolts (19) pass through the bushings and attach the lower control arm (9) to the crossmember (22).

The upper ball stud (2) is riveted to the upper control arm (1). This stud attaches to the steering knuckle (6) with a nut (4) and a cotter pin (5). The control arm bolts to the shock absorber (26) through an upper control arm support (29) which attaches to the body.

The lower ball stud (8) is press fit into the lower control arm (9). This ball stud attaches to the steering knuckle (6) with a nut (24) and a cotter pin (25).

Rubber seals are provided at the ball sockets in order to keep dirt and moisture from entering the stud and damaging the bearing surfaces.

Special Tools and Equipment

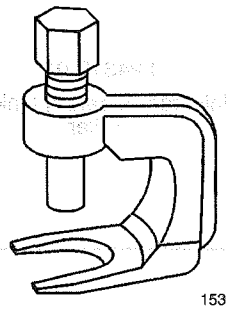
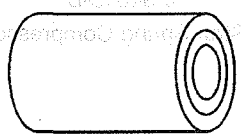
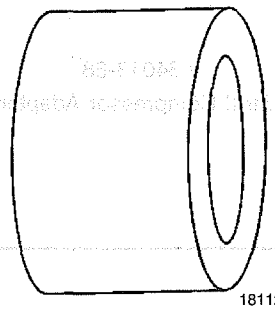
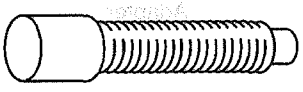
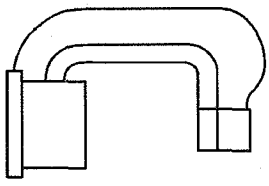
Illustration	Tool Number/ Description
 153085	J 6627-A Wheel Stud Remover
 153086	J 9519-7 Ball Joint Remover
 181128	J 9519-9 Ball Joint Installer
 153089	J 9519-18 Ball Joint Pressing Screw
 153090	J 9519-23 Ball Joint C-Clamp

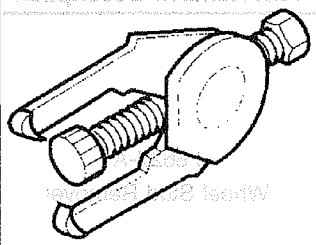
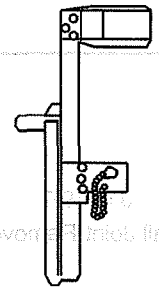
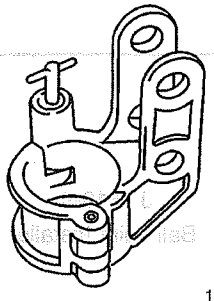
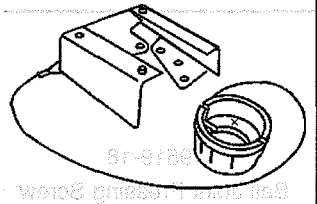
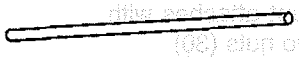
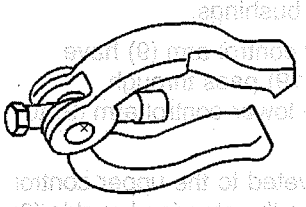
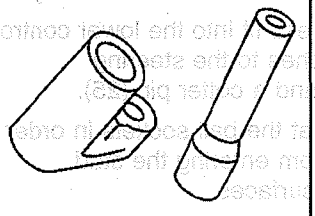
Illustration	Tool Number/ Description
 297656	J 24319-01 Universal Steering Linkage Puller
 144083	J 34013-B Strut Spring Compressor
 176280	J 34013-88 Strut Compressor Adapter
 181112	J 34013-114 Modular Shock Compressor Adapter

Illustration	Tool Number/ Description
 181114	J 34013-115 Modular Shock Alignment Rod
 181116	J 39549 Ball Joint/Tie Rod Separator
 181126	J 39642 Modular Shock Nut Removal Set, 15 mm (0.60 in)

Rear Suspension

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Center Support Bearing Bolt	50 N·m	37 lb ft
Jounce Bumper Bolt	27 N·m	20 lb ft
Lower Control Arm Bolt	118 N·m	87 lb ft
Tie Rod Bracket Brace Bolt	47 N·m	35 lb ft
Tie Rod Bolt	118 N·m	87 lb ft
Tie Rod Nut	75 N·m	55 lb ft
Torque Arm Bolt	130 N·m	96 lb ft
Torque Arm Bracket Nut	45 N·m	33 lb ft
Torque Arm Outer Bracket Bolt (Manual Transmission)	50 N·m	37 lb ft
Torque Arm Inner Bracket Bolt (AutomaticTransmission)	50 N·m	37 lb ft
Torque Arm Nut	132 N·m	97 lb ft
Torque Arm Outer Bracket Bolt (Manual Transmission)	27 N·m	20 lb ft
Shock Absorber Nut To Rear Axle	90 N·m	66 lb ft
Shock Absorber Nut	17 N·m	13 lb ft
Stabilizer Shaft Bracket Bolt	47 N·m	35 lb ft
Stabilizer Shaft Insulator Clamp Nut	24 N·m	18 lb ft
Stabilizer Shaft Bolt	23 N·m	17 lb ft

GM SPO Group Numbers

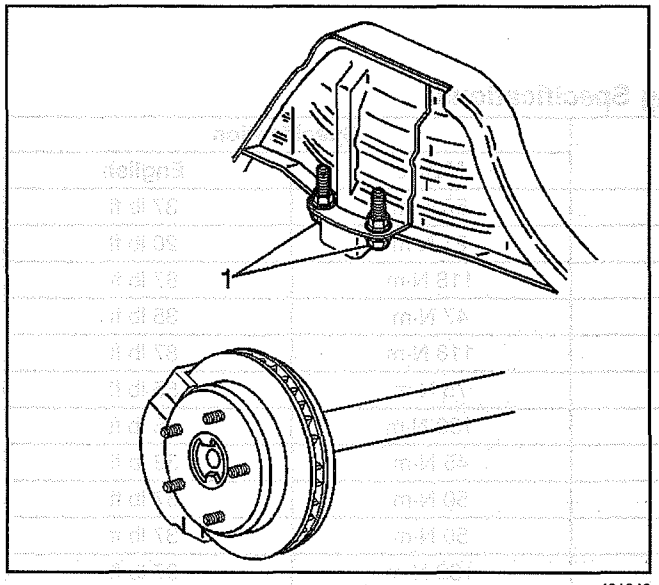
Application	GM SPO Group Number
Coil Spring	7.000
Coil Spring Insulator	7.000
Control Arm	7.000
Jounce Bumper	7.000
Propeller Shaft Center Support Bearing	5.000
Rear Axle	5.000
Shock Absorber	7.000
Stabilizer Shaft	7.000
Tie Rod	7.000
Tie Rod Bracket Brace	7.000
Torque Arm	7.000

Repair Instructions

Bumper Replacement

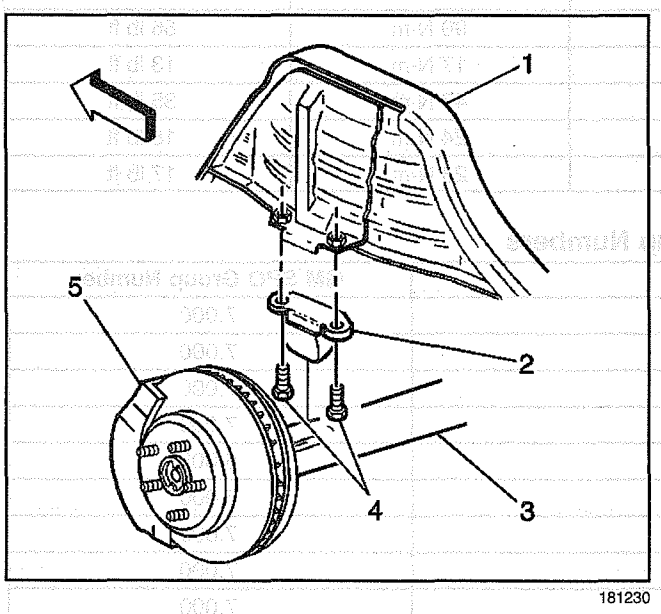
Removal Procedure

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Support the rear axle with an adjustable jack stand.
3. Remove the jounce bumper bolts (1).



481848

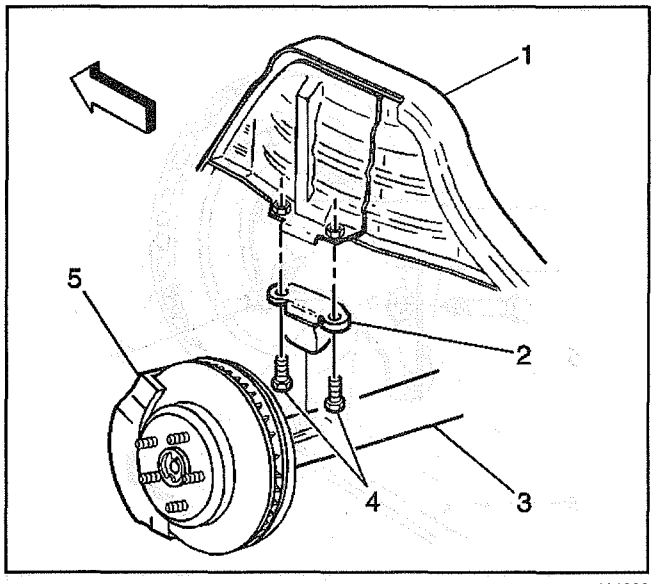
4. Remove the jounce bumper (2).
5. Remove the jounce bumper spacer, if equipped.



181230

Installation Procedure

1. Install the jounce bumper spacer, if equipped.
2. Install the jounce bumper (2).



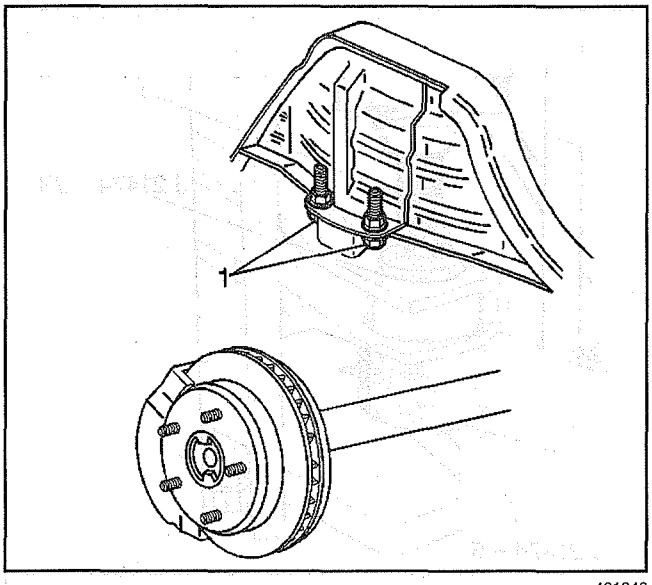
181230

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the jounce bumper bolts (1).

   Tighten

   Tighten the jounce bumper bolts (1) to 27 N·m (20 lb ft).
4. Remove the rear axle support.
5. Lower the vehicle.



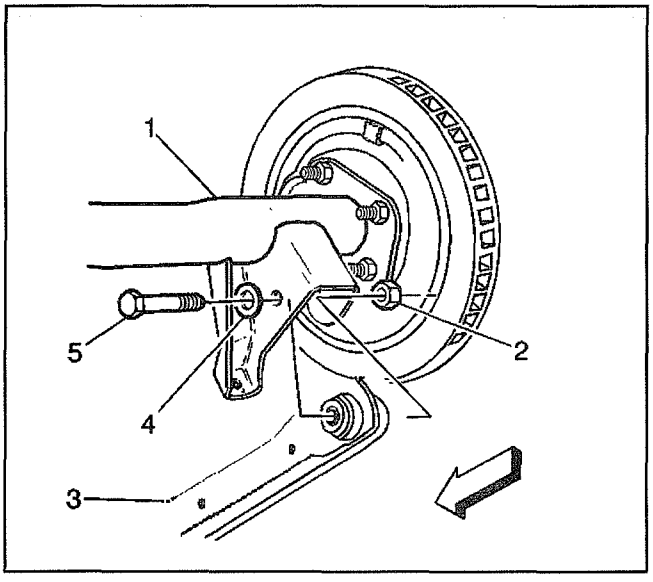
481848

Rear Axle Lower Control Arm Replacement

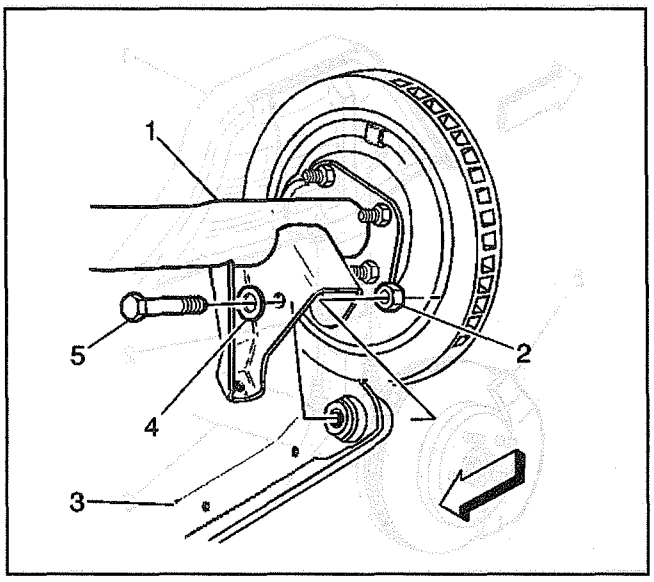
Removal Procedure

Important: If replacing both lower control arms, remove and replace only one control arm at a time in order to prevent the rear axle from rolling or slipping sideways.

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the lower control arm bolts (5), nuts (2) and washers (4) from the rear axle (1).
3. Remove the lower control arm bolts, nuts and washers from the underbody pan.
4. Remove the lower control arm (3).



181238



181238

Installation Procedure

1. Position and align the lower control arm (3) to the rear axle (1) and the underbody pan

Important: Do not tighten the bolts unless the suspension is at the curb height position.

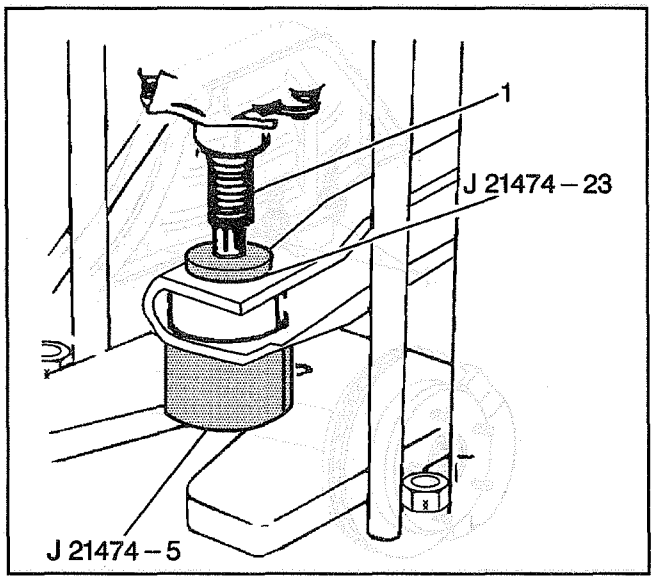
Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the lower control arm bolts (5), washers (4) and nuts (2) to the rear axle (1) from the inboard side out.

   Tighten

   Tighten the lower control arm bolts (5) to 118 N·m (87 lb ft).

3. Remove the adjustable rear axle support.
4. Lower the vehicle.



181231

Rear Axle Lower Control Arm Bushings Replace

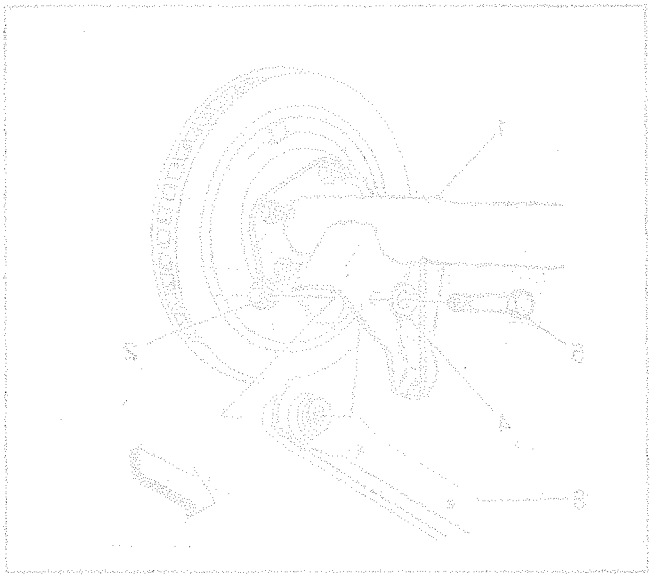
Removal Procedure

Tools Required

- *J 21474-5* Bushing Receiver
- *J 21474-23* Bushing Remover

Important: If replacing both lower control arms, remove and replace only one control arm at a time in order to prevent the rear axle from rolling or slipping sideways.

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Support the rear axle with an adjustable jack stand.
3. Remove the lower control arm. Refer to *Rear Axle Lower Control Arm Replacement.*
4. Install *J 21474-5* over the flanged side of the bushing.
5. Using a arbor press (1), place the large outside diameter of *J 21474-23* in contact with the outside diameter of the outer sleeve in order to force the bushing out of the lower control arm.

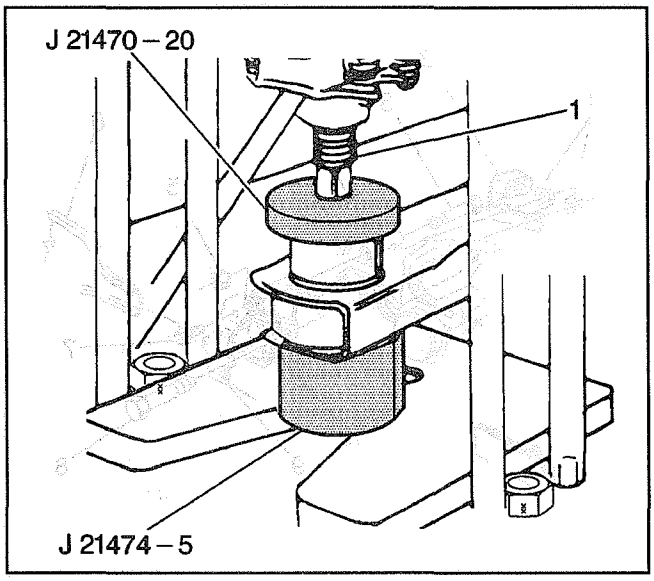


Installation Procedure

Tools Required

- *J 21474-5* Bushing Receiver
- *J 21474-20* Front and Rear Bushing Installer

1. Install *J 21474-5* over the flanged side of the bushing.
2. Install the bushing into position using *J 21474-20*.
3. Install the lower control arm. Refer to *Rear Axle Lower Control Arm Replacement*.
4. Remove the rear axle support.
5. Lower the vehicle.



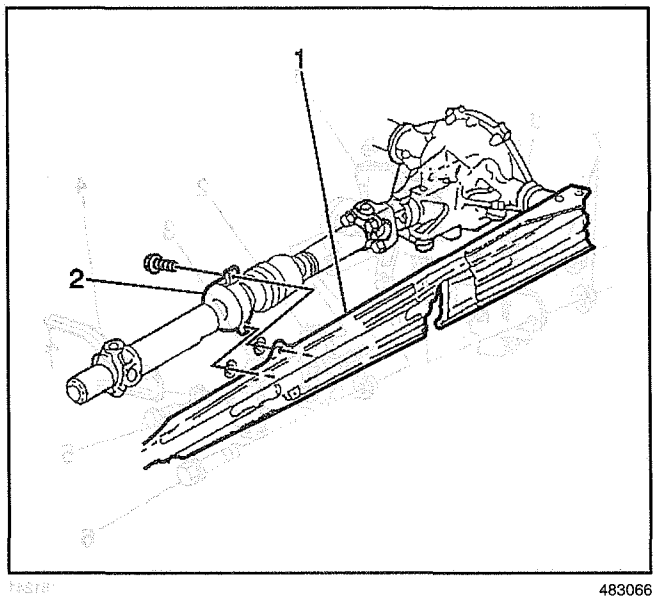
181233

Torque Arm Replacement

Removal Procedure

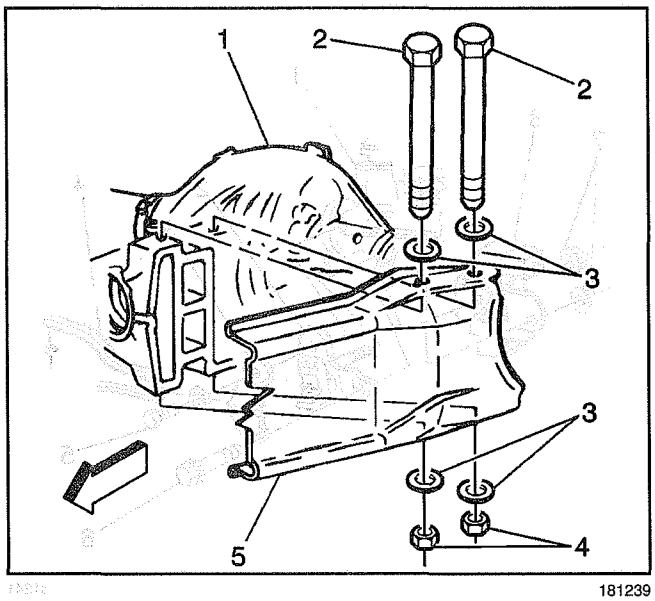
Important: When raising the vehicle, support the vehicle by the frame, allowing the suspension to fully extend (unloaded).

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Support the rear axle with an adjustable jack stand.
3. Remove the center support bearing (2) bolts from the torque arm (1), if equipped with a two-piece propeller shaft only.

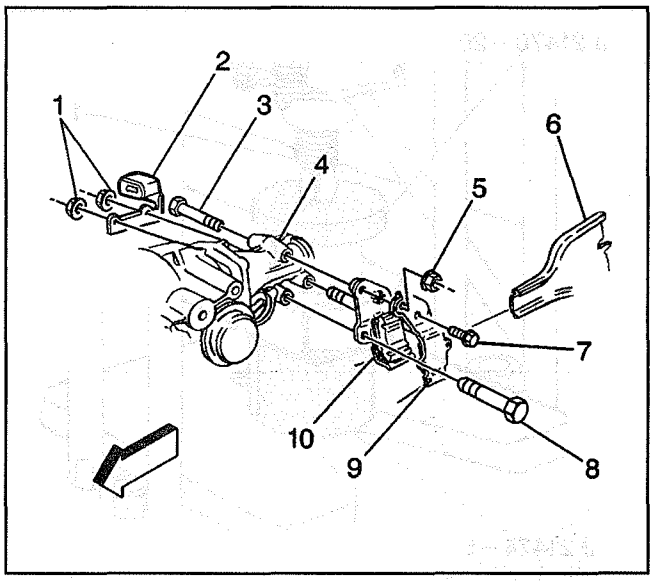


483066

4. Remove the torque arm bolts (2), washers (3) and nuts (4) from the rear axle (1).

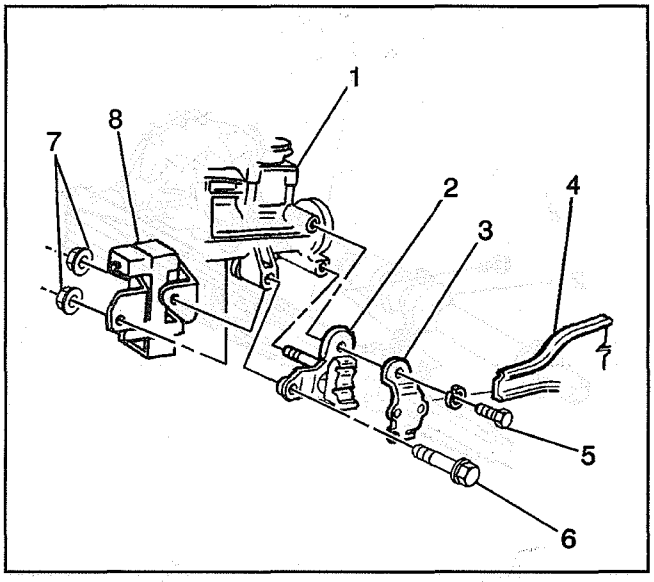


181239



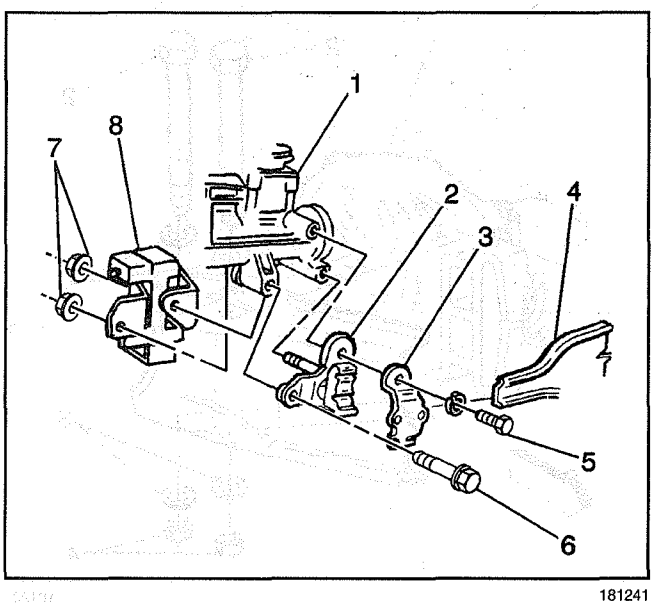
181240

5. If equipped with a automatic transmission remove the following:
   5.1. Remove the torque arm inner bracket bolts (3 and 8) and nuts (5).
   5.2. Remove the torque arm outer bracket (9).
   5.3. Remove the torque arm inner bracket (10).
   5.4. Remove the torque arm (6).



181241

6. If equipped with a manual transmission (M49 shown, MM6 similar) remove the following:
   6.1. Remove the torque arm outer bracket bolt (5), washer and nut (7).
   6.2. Remove the torque arm inner bracket bolt (6) and nut (7).
   6.3. Remove the torque arm outer bracket (3).
   6.4. Remove the torque arm inner bracket (2).
   6.5. Remove the torque arm (4).



181241

Installation Procedure

1. If equipped with a manual transmission (M49 shown, MM6 similar) install the following:
2. Install the torque arm inner bracket (2) to the transmission (1).
3. Install the torque arm outer bracket (3) to the inner bracket (2) and loosely install the torque arm outer bracket bolts (5 and 6), washer, and nuts (7).
4. Insert the torque arm (4) into the torque arm brackets (2 and 3).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

5. Tighten the torque arm outer bracket bolts (5 and 6) or nuts (7).

   Tighten

   - Tighten the torque arm outer bracket bolt (5) to 27 N·m (20 lb ft).
   - Tighten the torque arm outer bracket bolt (6) to 50 N·m (37 lb ft).
   - Tighten the torque arm bracket nuts (7) to 45 N·m (33 lb ft).

6. If equipped with a automatic transmission install the following:

   6.1. Install the torque arm inner bracket (10) to the transmission (4).

   6.2. Install the torque arm outer bracket (9) to the inner bracket (10) and loosely install the torque arm inner bracket bolts (3 and 8), washer, and nuts (1).

   6.3. Insert the torque arm (6) into the torque arm brackets (9 and 10).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

   6.4. Tighten the torque arm inner bracket bolts (3 and 8) or nuts (1).

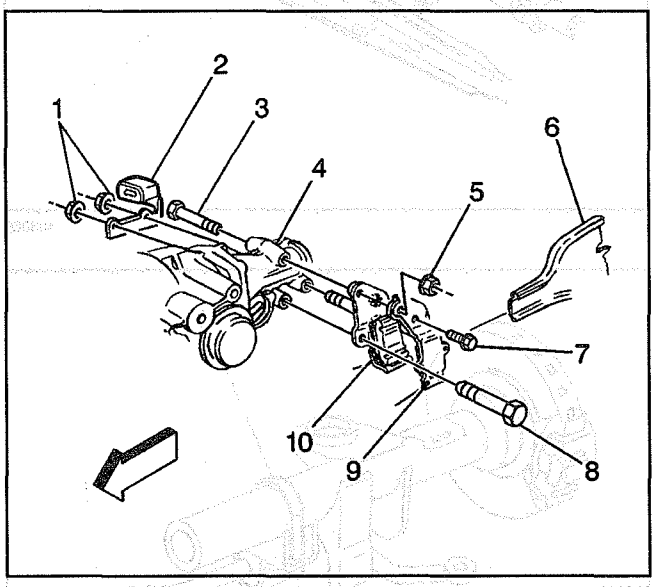
   Tighten

   - Tighten the torque arm inner bracket bolts (3 and 8) to 50 N·m (37 lb ft).
   - Tighten the torque arm bracket nuts (1) to 45 N·m (33 lb ft).

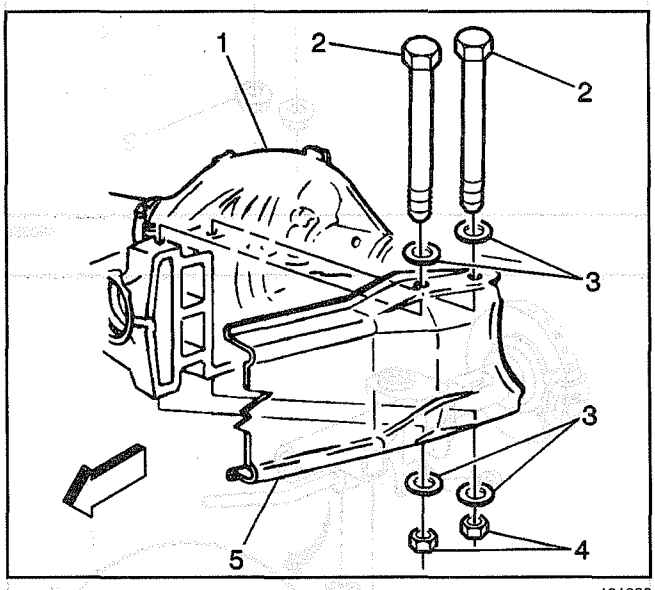
7. Position the torque arm (5) onto the rear axle (1).
8. Install the torque arm bolts (2), washers (3) and the nuts (4).
9. Tighten the torque arm bolts (2) or nuts (4).

   Tighten

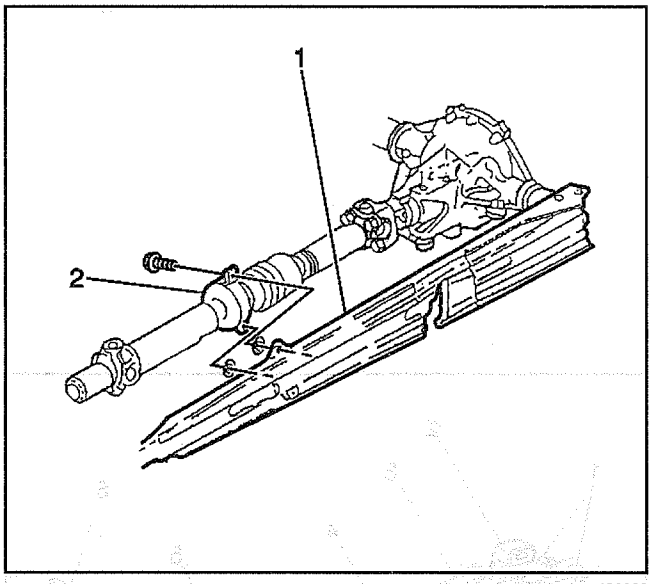
   - Tighten the torque arm bolt (2) to 130 N·m (96 lb ft).
   - Tighten the torque arm nuts (4) to 132 N·m (97 lb ft).



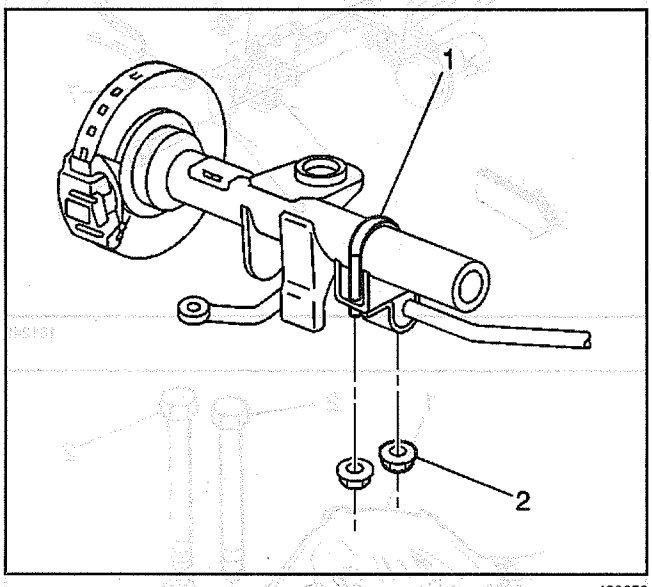
181240



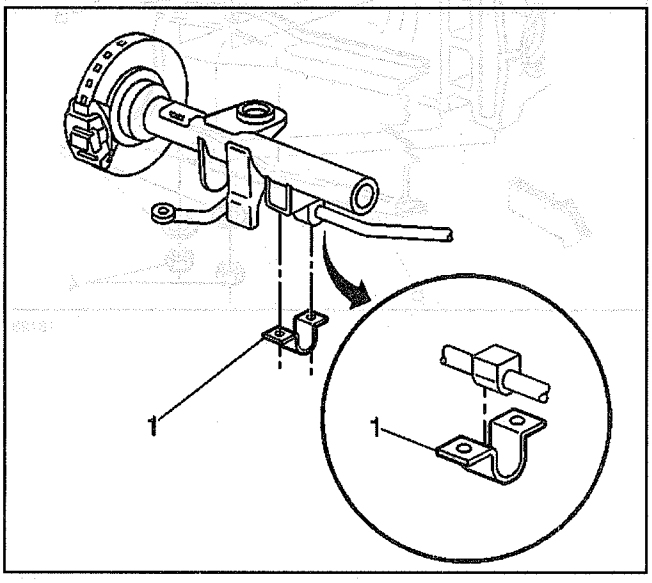
181239



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10. Install the center support bearing (2) bolts to the torque arm (1), if equipped with a two piece propeller shaft.

    Tighten

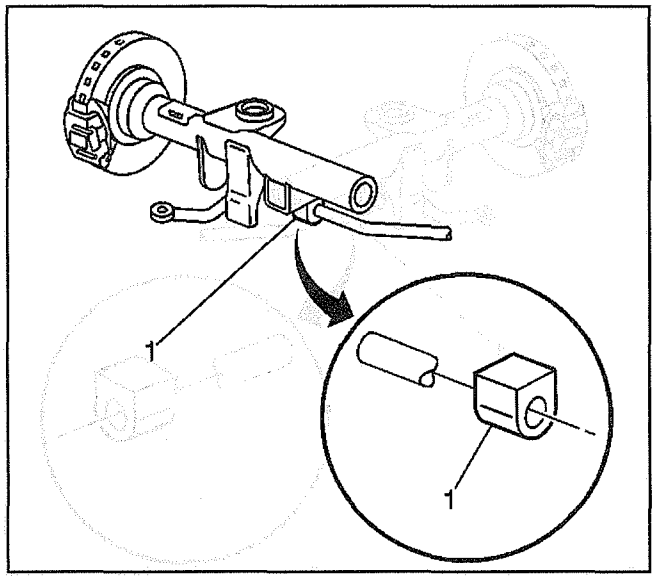
    Tighten the center support bearing (2) bolts to 50 N·m (37 lb ft).
11. Remove the adjustable jack stand.
12. Lower the vehicle.

Stabilizer Shaft Replacement

Removal Procedure

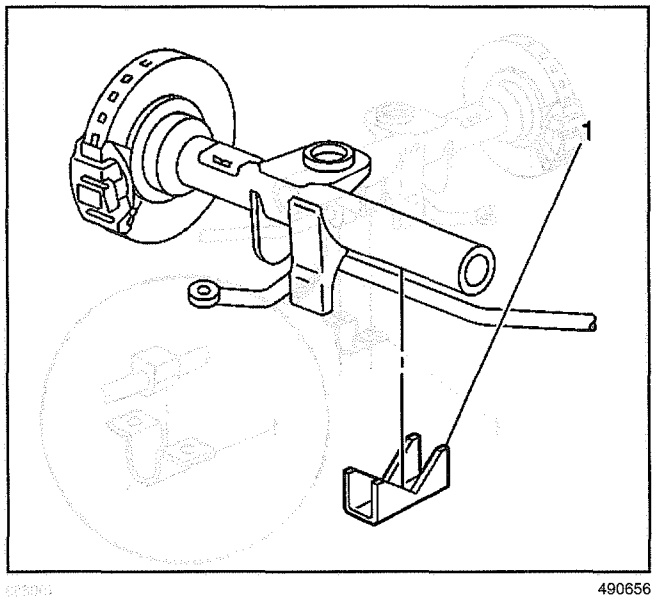
1. Remove the stabilizer shaft link. Refer to *Stabilizer Shaft Link Replacement*.
2. Remove the stabilizer shaft insulator clamp nuts (2) and bolt (1).
3. Remove the stabilizer shaft insulator clamp (1).

4. Remove the stabilizer shaft insulator (1).



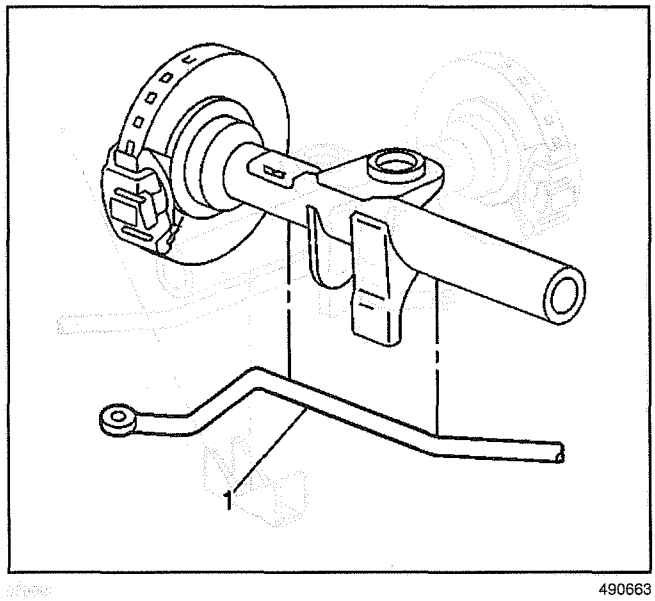
490659

5. Remove the stabilizer shaft rod bracket (1).

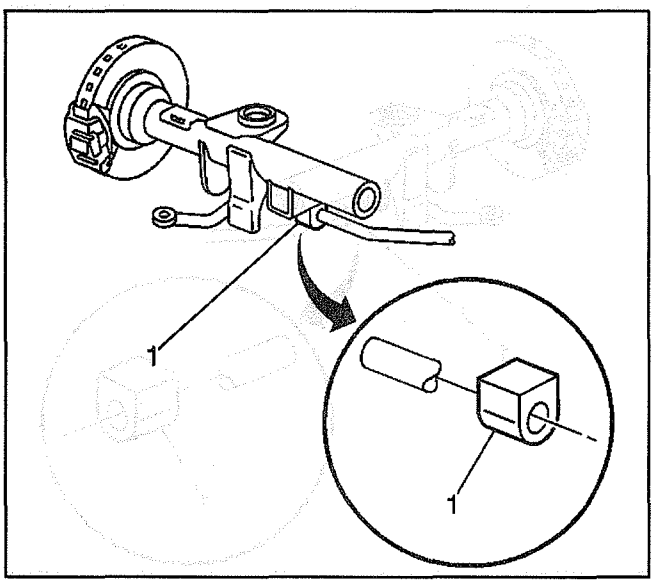


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6. Remove the stabilizer shaft (1).



490663



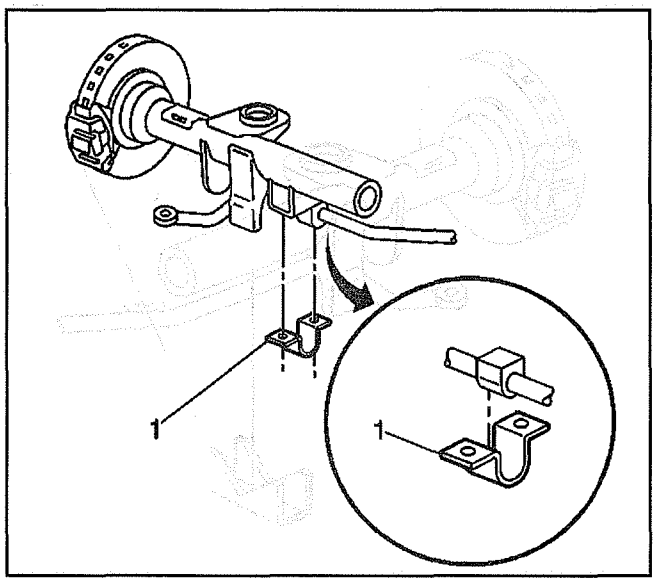
490659

Installation Procedure

Important: Install the rear stabilizer shaft with the bend of the shaft facing down.

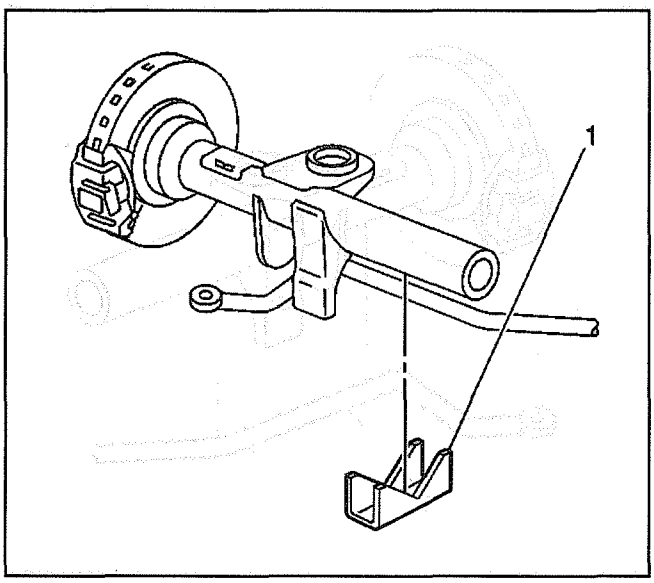
Important: The slit of the shaft insulator must face the rear of the vehicle.

1. Install the stabilizer shaft insulator (1) over the stabilizer shaft.



490653

2. Install the stabilizer shaft insulator clamp (1) over the insulator.

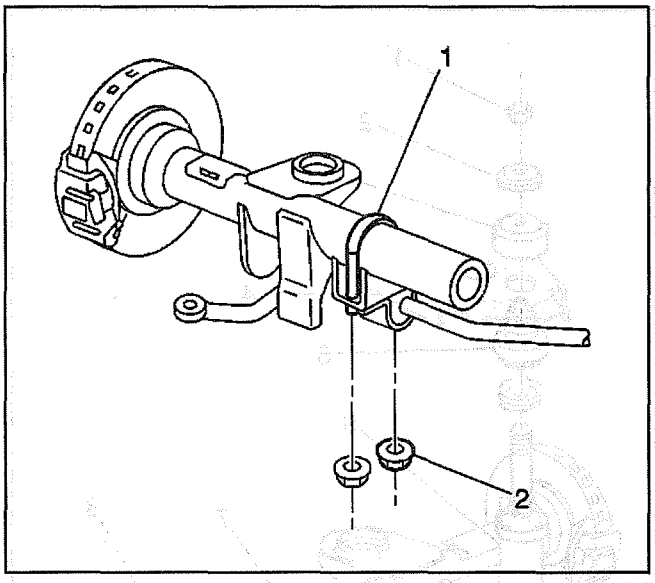


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3. Place the stabilizer shaft rod bracket (1) against rear axle.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the stabilizer shaft insulator bolt (1) and clamp nuts (2).
   Tighten
   Tighten the stabilizer shaft insulator clamp nuts (2) to 24 N·m (18 lb ft).
5. Install the stabilizer shaft link. Refer to *Stabilizer Shaft Link Replacement*.

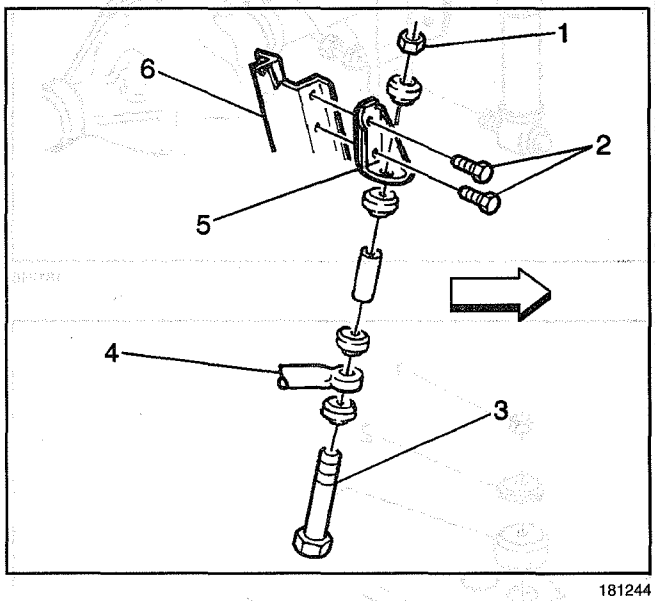


490650

Stabilizer Shaft Link Replacement

Removal Procedure

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the stabilizer shaft nut (1), bolt (3) and bushings.
3. Remove the stabilizer shaft spacer and bushings.
4. Remove the stabilizer shaft bracket bolts (2) and bracket (5), if necessary.
5. Remove the stabilizer shaft bracket (5) from the underbody pan (6), if necessary.



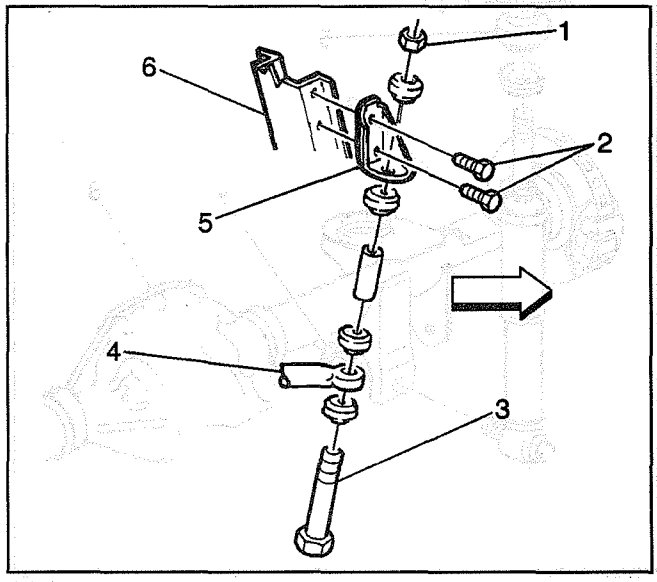
181244

Installation Procedure

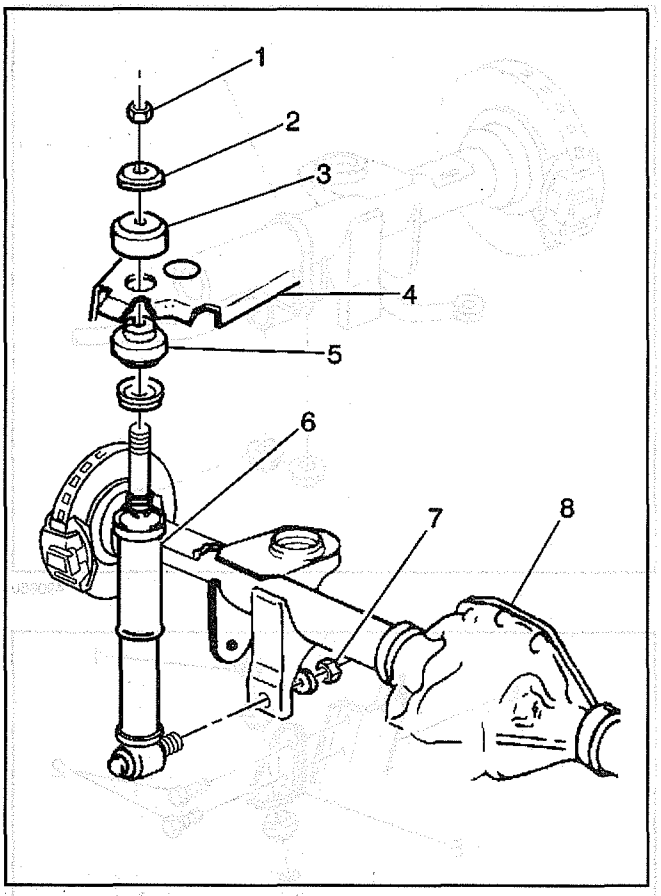
1. Align the stabilizer shaft bracket (5) to the underbody pan (6).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

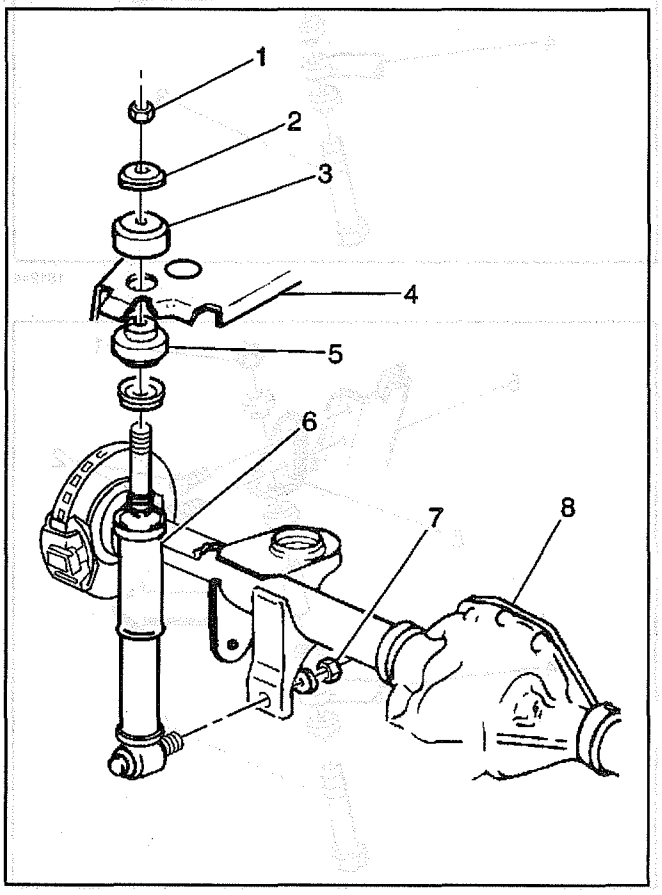
2. Install the stabilizer shaft bracket (5) and bolts (2).
   Tighten
   Tighten the stabilizer shaft bracket bolts (2) to 47 N·m (35 lb ft).
3. Install the stabilizer shaft spacer and bushings.
4. Install the stabilizer shaft bushings, bolt (3), nut (1).
   Tighten
   Tighten the stabilizer shaft bolt (3) to 23 N·m (17 lb ft).
5. Lower the vehicle.



181244



181246



181246

Shock Absorber Replacement

Removal Procedure

1. Fold down the rear seatback.
2. Remove the quarter trim panel. Refer to *Trim Panel Replacement - Cargo Area Side (Coupe)* in Interior Trim.
3. Fold the carpet back.
4. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.

Notice: The rear axle must be supported before removing the nut in order to avoid possible damage to the break hose lines, the tie rod and the propeller shaft.

5. Support the rear axle (8) with an adjustable jack stand.
6. Remove the shock absorber nut (1).
7. Remove the shock absorber insulator retainer (2) and insulator (3).
8. Remove the shock absorber lower retainer and the insulator (5).
9. Remove the shock absorber nut (7) to the rear axle (8).
10. Remove the shock absorber (6).

Installation Procedure

1. Install the shock absorber (6) stud to the rear axle (8).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the shock absorber nut (7) to rear axle.

   Tighten

   Tighten the shock absorber nut (7) to rear axle to 90 N·m (66 lb ft).
3. Install the shock absorber lower insulator (5) and retainer to the shock absorber (6).
4. Position the shock absorber (6) through the underbody pan (4) and seat the insulator.
5. Install the shock absorber insulator (3) and retainer (2) to the shock absorber (6).

Notice: Turning the shock absorber while tightening the nut could damage the shock absorber. In order to prevent damage, keep the shock absorber stationary while you tighten the nut.

6. Install the shock absorber nut (1).

   Tighten

   Tighten the shock absorber nut (1) to 17 N·m (13 lb ft).
7. Remove the rear axle support.
8. Lower the vehicle.
9. Place the folded carpet into position.

10. Install the quarter trim panel. Refer to *Trim Panel Replacement - Cargo Area Side (Coupe)* in Interior Trim.
11. Fold the rear seatback into the upright position.

Coil Spring Replacement

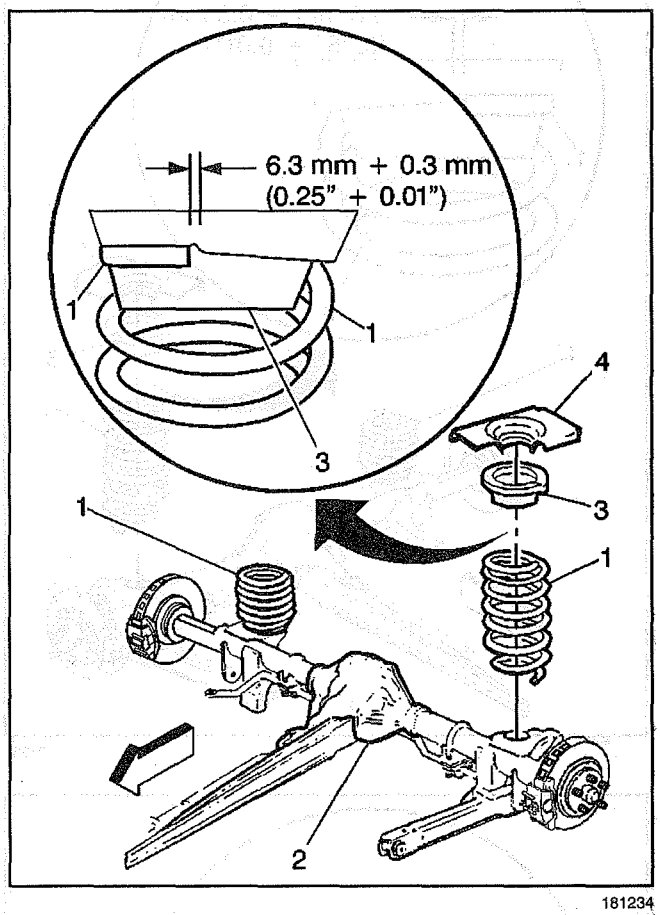
Removal Procedure

Important: When raising the vehicle, support the vehicle by the frame, allowing the suspension to fully extend (unloaded).

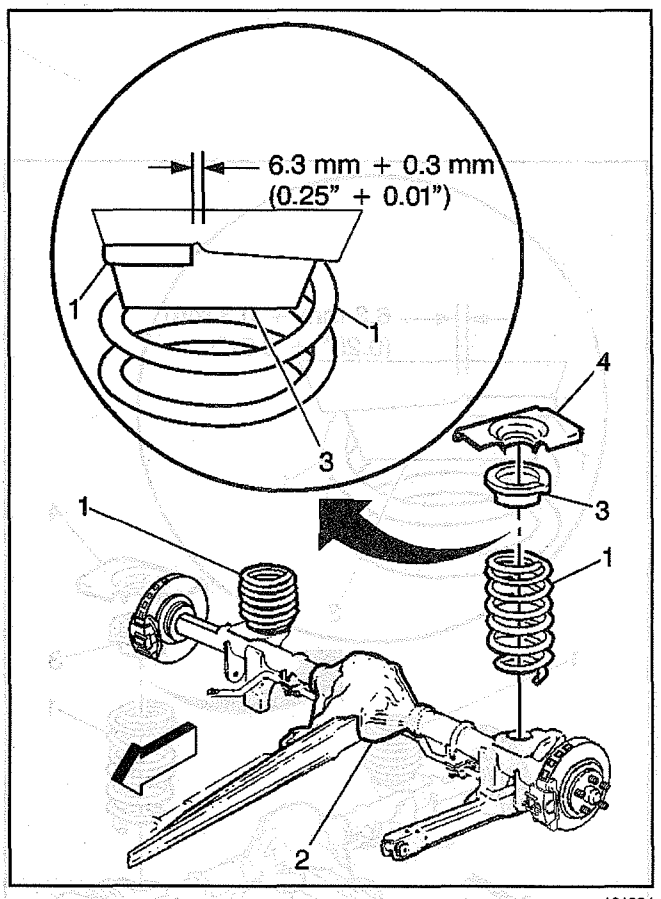
1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Support the rear axle (2) with an adjustable jack stand.
3. Remove the shock absorber to rear axle nut.

Notice: Do not suspend rear axle by brake hoses. Damage to hoses could result.

4. Slowly lower the rear axle (2).
5. Remove the rear coil spring (1).



181234



181234

Installation Procedure

Important: The lower end of the rear spring should be facing forward. Do not chip or damage the corrosion protection coating on the rear spring. Avoid contact with hard steel. If the coating is chipped or damaged, replace the rear spring.

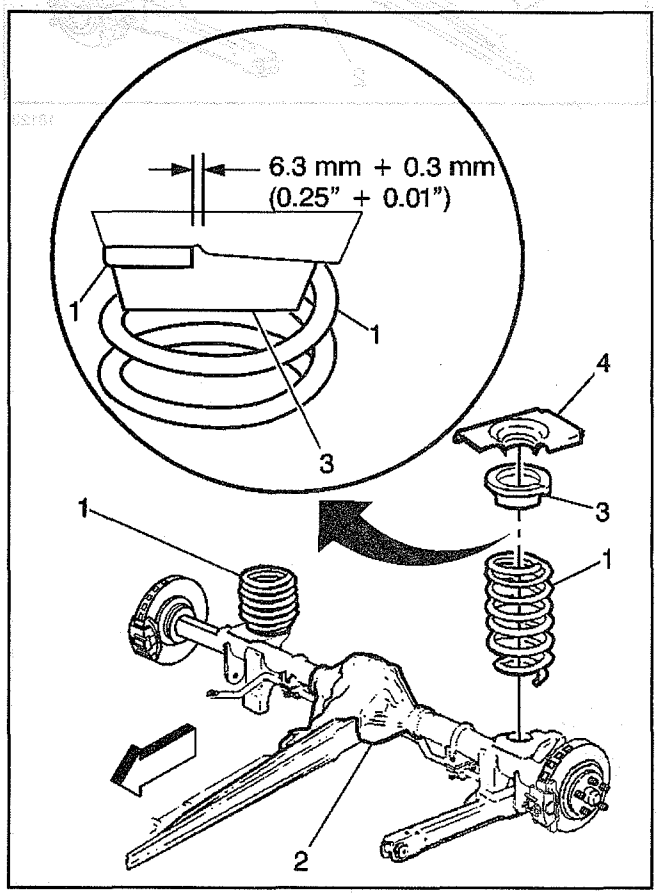
1. Install the rear spring (1) to the rear axle (2).
2. Raise the rear axle (2).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the shock absorber to rear axle nut.

   Tighten

   Tighten the shock absorber to rear axle nut to 90 N·m (66 lb ft).
4. Remove the rear axle support.
5. Lower the vehicle.



181234

Coil Spring Insulators Replacement

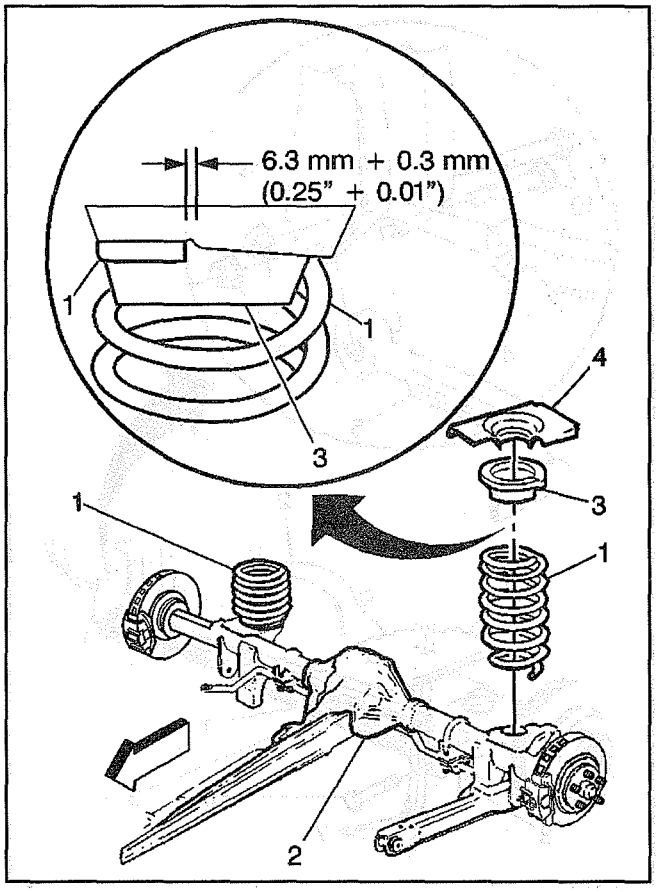
Removal Procedure

Important: When raising the vehicle, support the vehicle by the frame, allowing the suspension to fully extend (unloaded).

1. Remove the rear coil spring (1). Refer to *Coil Spring Replacement*.
2. Remove the spring upper insulator (3).

Installation Procedure

1. Position the spring upper insulator (3) to the top of the coil spring (1).
2. Install the rear coil spring (1). Refer to *Coil Spring Replacement.*

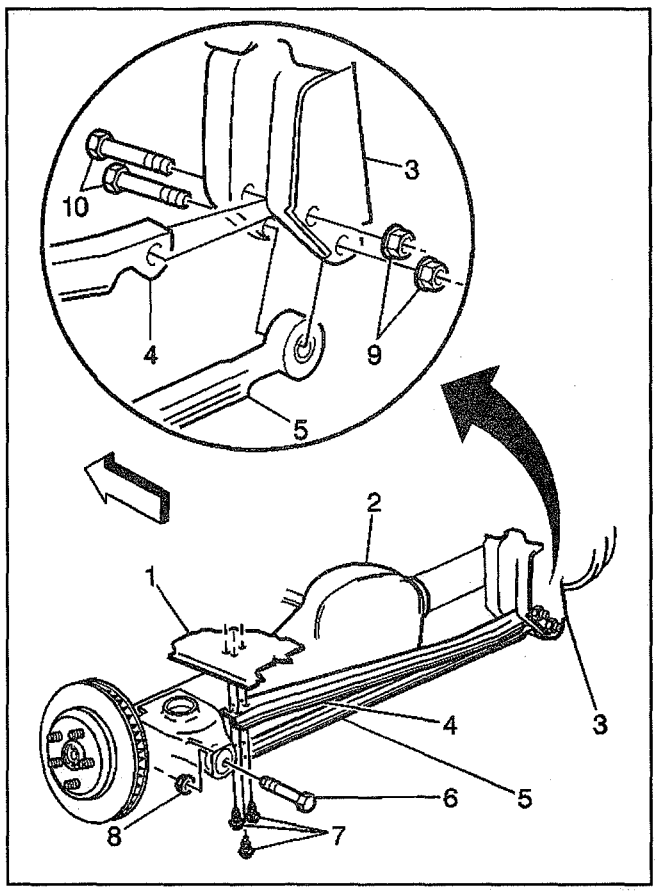


181234

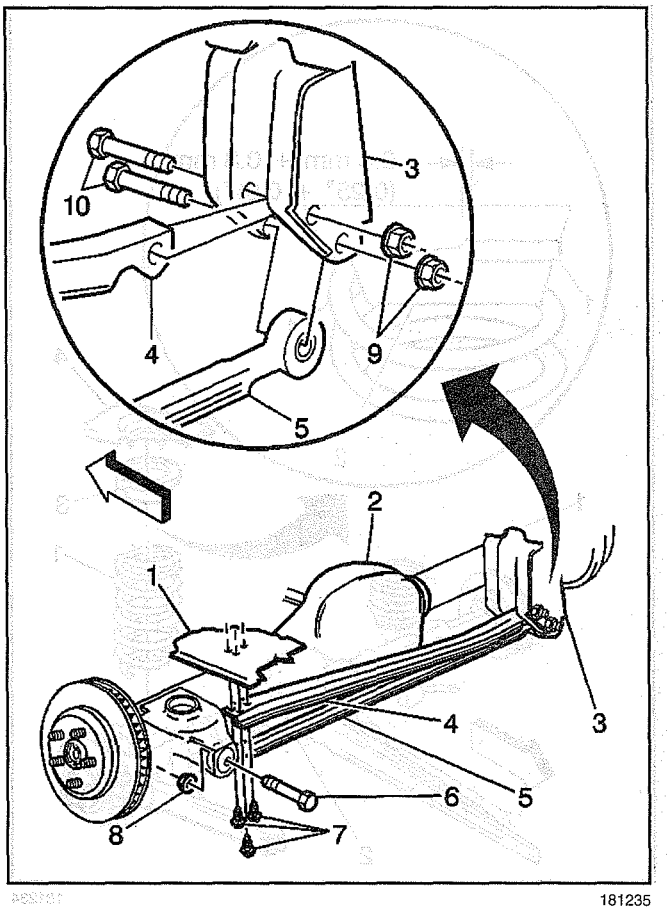
Track Bar Replacement

Removal Procedure

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Support the rear axle (2) with an adjustable jack stand.
3. Remove the tie rod bolt (6) and nut (8) from the spring seat.
4. Remove the tie rod bracket brace bolts (7) from the body brace bracket (1).
5. Remove the tie rod bolts (10) and nuts (9) from the body brace and tie rod bracket (3).
6. Remove the tie rod (5).
7. Remove the tie rod bracket brace (4).



181235



181235

Installation Procedure

1. Install the tie rod bracket brace (4) to the body brace and tie rod bracket (3).
2. Loosely install the upper tie rod bolt (10) and nut (9) to the body brace and tie rod bracket (3).
3. Install the tie rod (5) to the body brace and tie rod bracket (3).
4. Loosely install the lower tie rod bolt (10) and nut (9) to the body brace and tie rod bracket (3).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

5. Install the tie rod bracket brace bolts (7) to the body brace bracket (1).

   Tighten

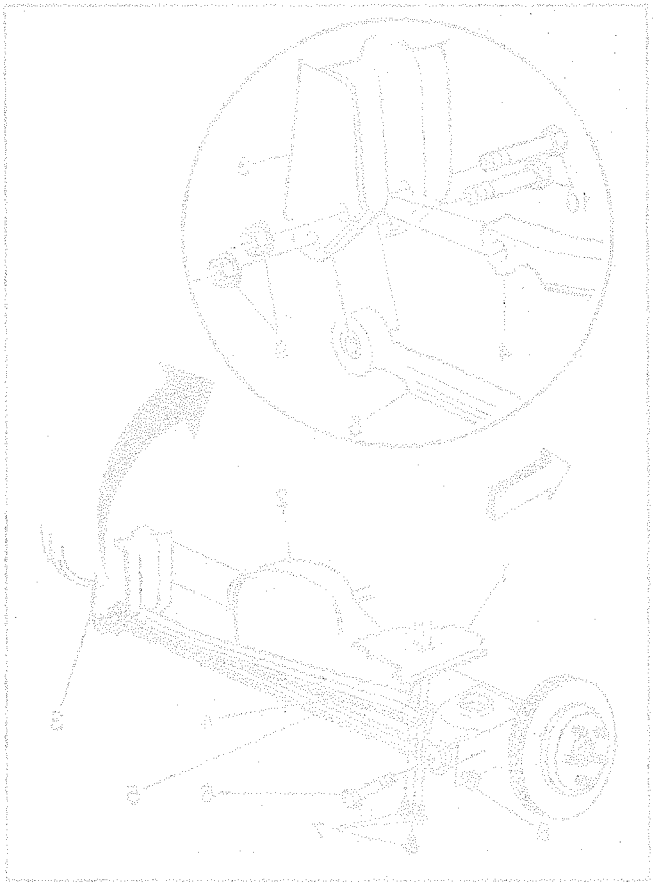
   - Tighten the tie rod bracket brace bolts (7) to 47 N·m (35 lb ft).
   - Tighten the upper tie rod bolt (10) to 118 N·m (87 lb ft) or tighten the tie rod nut (9) to 75 N·m (55 lb ft).

6. Install the tie rod bolt (6) and nut (8) to the spring seat.

   Tighten

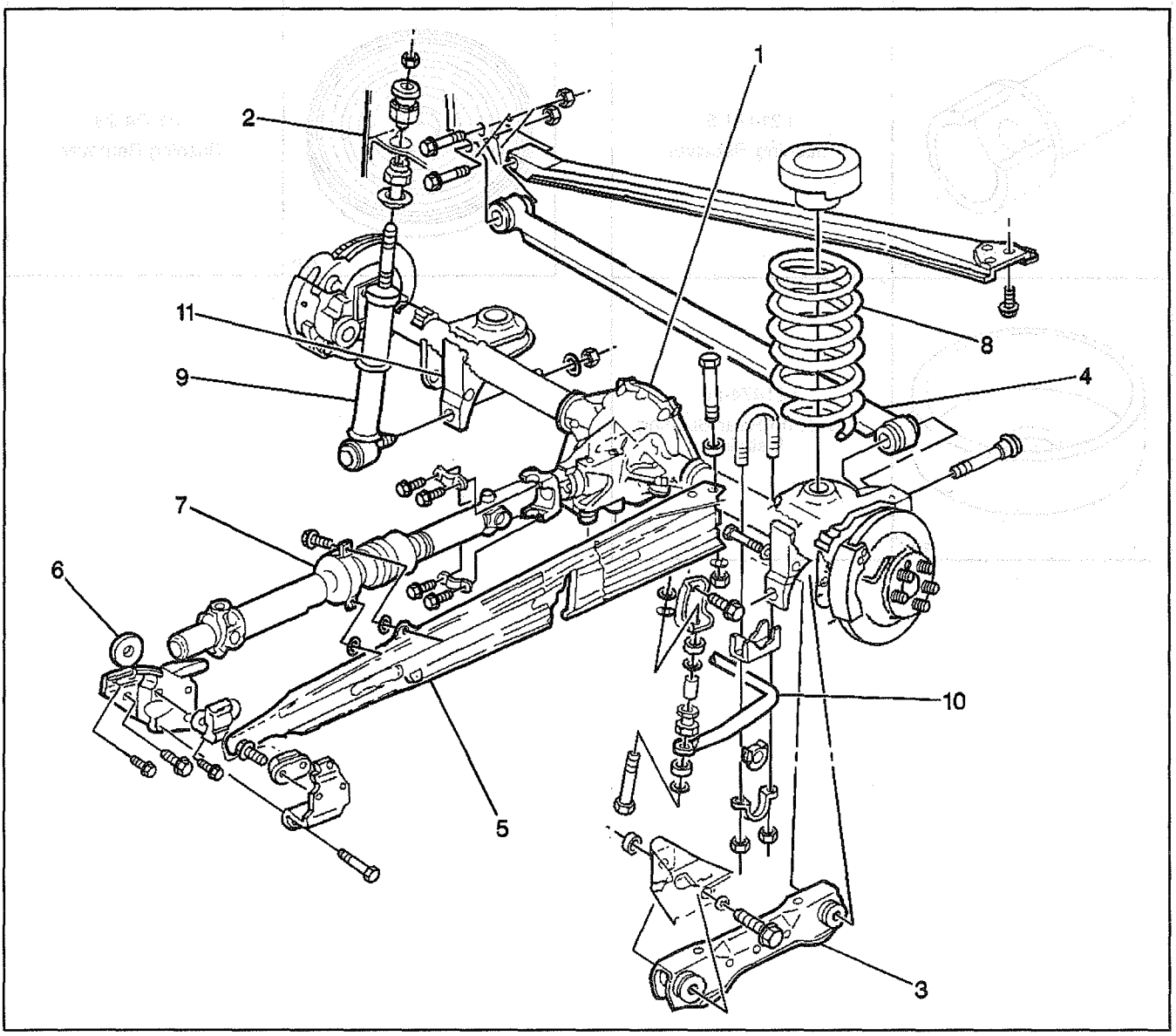
   Tighten the tie rod bolt (6) to 118 N·m (87 lb ft). Or tighten the tie rod nut (8) to 75 N·m (55 lb ft).

7. Remove the rear axle support.
8. Lower the vehicle.



Description and Operation

General Description



454513

- The rear axle (1) attaches to the vehicle with a link suspension system.
- The rear axle housing connects to the floor panel (2) by two lower control arms (3) and a track bar (4). A single torque arm (5) is used in place of an upper control arm.
- The torque arm (5) rigidly mounts to the rear axle housing at the rear.
- The torque arm (5) mounts through a torque arm bushing (6) at the front.
- On some vehicles, the torque arm (5) also mounts to the two piece propeller shaft center support bearing (7) with two bolts.
- The rear springs (8) support the weight of the vehicle.
- The rear shock absorbers (9) mount to the rear of the axle housing and provide ride control. A rear stabilizer shaft (10) is also part of the suspension system.
- The rear shock absorbers (9) mount at the bottom with a nut to brackets (11) welded to the rear of the rear axle housing and also mount at the top of the floor panel (2) with a nut.
- The only service that the rear shock absorbers require is replacement for the following conditions:
  - Loss of resistance
  - Damage or leaking fluid
- For rear shock absorber diagnosis, refer to Suspension General Diagnosis.

Special Tools and Equipment

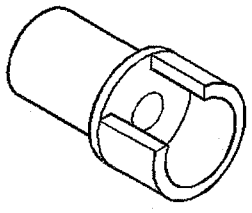
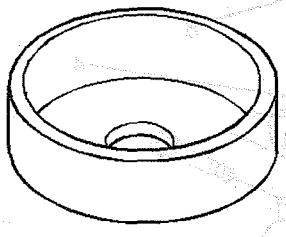
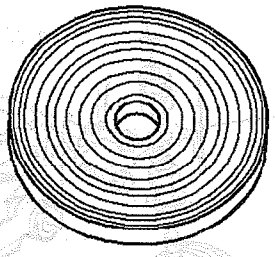
Illustration	Tool Number/Description
 3288	J 21474-5 Bushing Receiver
 2020	J 21474-20 Front and Rear Bushing Installer

Illustration	Tool Number/Description
 2021	J 21474-23 Bushing Remover

Tires and Wheels

Specifications

Tire and Wheel Specifications

Application	Specification	
	Metric	English
Maximum Radial Runout		
Aluminum Wheels	0.76	0.030
Steel Wheels	1.01	0.040
Maximum Lateral Runout		
Aluminum Wheels	0.76	0.030
Steel Wheels	1.14	0.045
Tire Pressures		
Compact Spare	420	60
Front/Rear	210	30

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Jack Stowage Bolt/Screw	6.5 N·m	58 lb in
Wheel Nut - M12 x 1.5	140 N·m	100 lb ft
Wheel Nut Cap - 16 x 8 Aluminum Wheel	6 N·m	53 lb in
Wheel Trim Cover (Chevrolet)	6 N·m	53 lb in

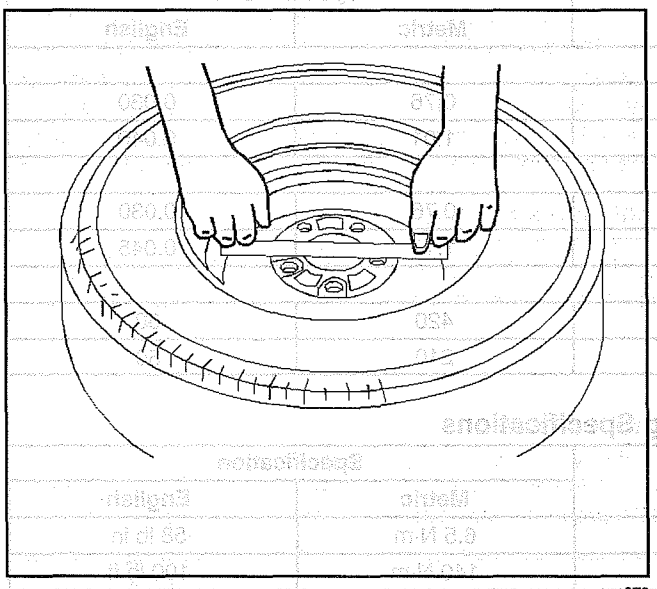
GM SPO Group Numbers

Application	GM SPO Group Number
Aluminum Wheel Hubcap	5.000
Aluminum Wheels	5.000
Conpact Spare Tire	5.000

Diagnostic Information and Procedures

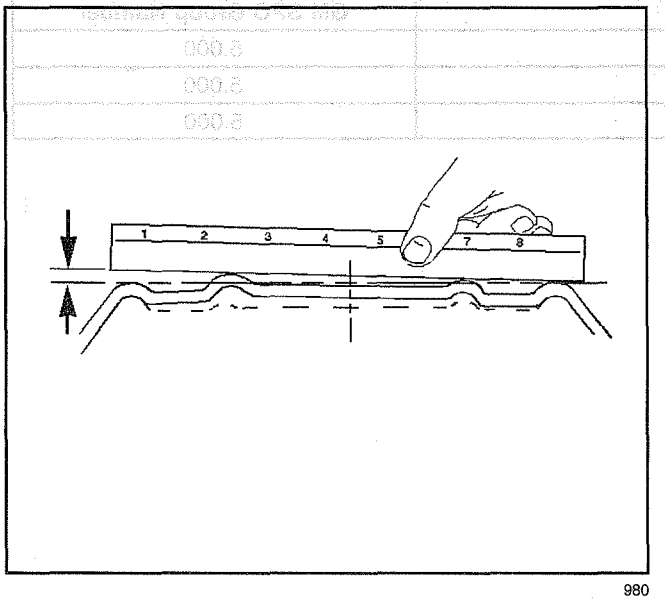
Wheel Mounting Surface Check

It is necessary to replace any wheels which are bent, dented, or which have excessive lateral or radial runout. Also, wheels with runout greater than specified may cause objectionable vibrations.



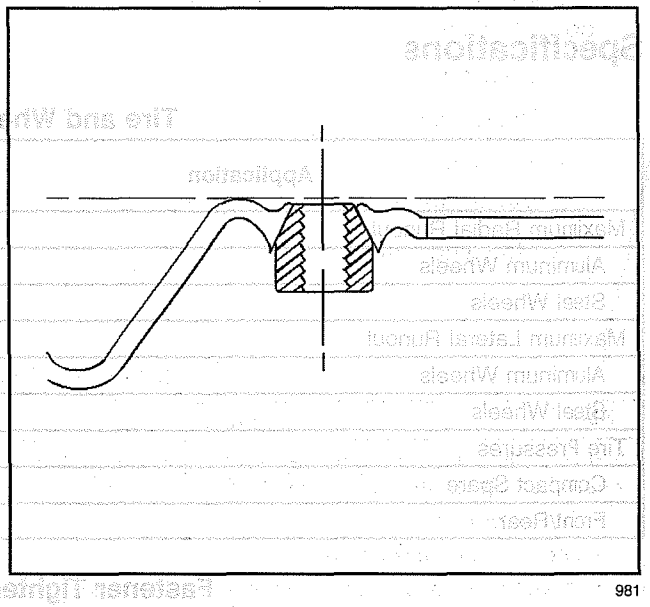
979

1. Use a straight edge 203 to 229 mm (8 to 9 in) long. Place the straight edge on the wheel inboard mounting surface. Try to rock the straight edge up and down within the mounting surface.



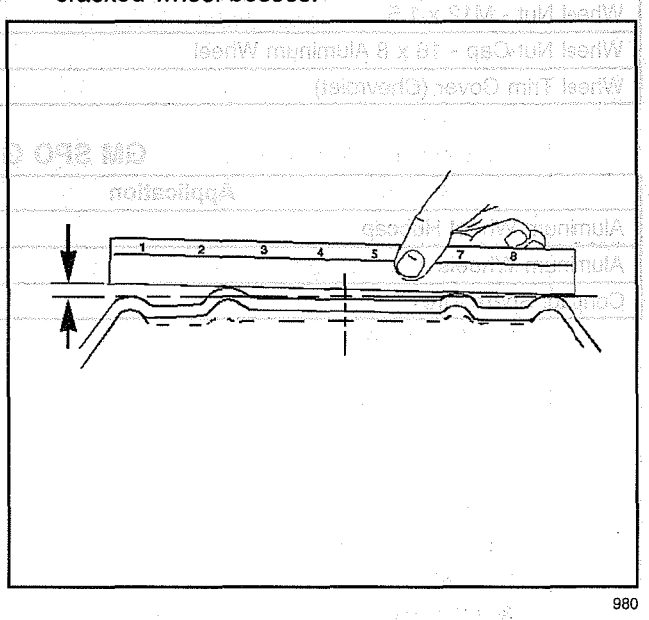
980

2. Repeat this procedure on at least three or four different positions on the inboard mounting surface.
   - The outer ring of the mounting surface normally is raised above everything inside the mounting surface.
   - The mounting surface will be raised above the outer ring if the wheel mounting surface has been bent on a tire changer.



981

3. Inspect the mounting wheel/nut holes for damage caused from over-torquing the wheel nuts. Inspect for collapsed wheel/nut bosses. Inspect for cracked wheel bosses.



980

Notice: The use of non-GM original equipment wheels may cause:

- Damage to the wheel bearing, the wheel fasteners and the wheel
- Tire damage caused by the modified clearance to the adjacent vehicle components
- Adverse vehicle steering stability caused by the modified scrub radius
- Damage to the vehicle caused by the modified ground clearance
- Speedometer and odometer inaccuracy

Important:

- Replacement wheels must be equivalent to the original equipment wheels in the following ways:
  - Load capacity
  - Wheel diameter
  - Rim width
  - Wheel offset
  - Mounting configuration
- A wheel of incorrect size or type may effect the following conditions:
  - Wheel and hub-bearing life
  - Brake cooling
  - Speedometer/odometer calibration
  - Vehicle ground clearance
  - Tire clearance to the body and the chassis

4. Replace the wheel if the wheel is bent. Replace the wheel if the wheel/nut boss area is cracked.

Identify steel wheels with a 2 or 3 letter code stamped into the rim near the valve stem. Aluminum wheels have the code, the part number, and the manufacturer identification cast into the back side of the wheel.

Radial Tire Lead/Pull Correction

Step	Action	Value(s)	Yes	No
DEFINITION: Lead/pull is the deviation of the vehicle from a straight path on a level road with no pressure on the steering wheel. Lead is usually caused by the following conditions: • Off center belt • Uneven brake assemblies • Improper tire and wheel alignment In the front tires (rear tires will not cause lead) Tire construction can be a cause of 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 a side force while rolling straight down the road, and the tire will tend to roll like a cone. **Important:** Use the lead/pull correction table in order to verify that improper tire and wheel alignment is not mistaken for tire lead.				
1	Inspect and repair/replace tire/wheel assemblies for: • Correct tire pressure. • Excessive/uneven tire wear. • Correct tire size. • Excessive radial/lateral wheel runout. • Out of balance. Is action complete?	—	*Go to Step 2*	—
2	Inspect and repair front and rear suspensions for: • Damage. • Excessive wear. • Loose Components. • Excessive wheel bearing play. Is action complete?	—	*Go to Step 3*	—
3	Inspect and repair power steering gear and pump for: • Damage. • Excessive wear. • Variable Effort steering for DTCs. Is action complete?	—	*Go to Step 4*	—
4	1. Cross-switch front tire/wheel assemblies. 2. Road test vehicle. Does vehicle still lead/pull?	—	*Go to Step 5*	System OK
5	Does the vehicle lead/pull in the opposite direction?	—	*Go to Step 6*	Go to *Measuring Wheel Alignment*
6	1. Cross-switch left front tire/wheel assembly with left rear tire/wheel assembly. 2. Road test the vehicle. Does vehicle still lead/pull?	—	*Go to Step 7*	*Go to Step 8*
7	1. Cross-switch right front tire/wheel assembly with right rear tire/wheel assembly. 2. Road test the vehicle. Does vehicle still lead/pull?	—	Go to *Measuring Wheel Alignment*	*Go to Step 9*

Radial Tire Lead/Pull Correction (cont'd)

Step	Action	Value(s)	Yes	No
8	Replace left rear tire. Is repair complete?	—	System OK	—
9	Replace right rear tire. Is repair complete?	—	System OK	—

Repair Instructions

Aluminum Wheel Hub Cap Replacement

Removal Procedure

Use the following procedure in order to remove the hub cap:

1. Insert a flat-bladed tool into the slot between the rim and the hub cap.
2. With the tool in position, pry off the hub cap.
3. Remove the hub cap.

Installation Procedure

Install the hub cap.

Use a rubber mallet in order to fully seat the hub cap into the rim.

Aluminum Wheel Porosity Repair

Removal Procedure

1. Raise and suitably support the vehicle. Refer to Vehicle Lifting and Jacking in General Information.
2. Remove the tire and the wheel. Refer to *Tire and Wheel Removal and Installation*
3. Locate the leaking areas by inflating the tire to 280 kPa (40 psi) and dipping the tire and the wheel into a water bath.
4. Mark the leak areas
5. Mark the tire at the valve stem.
6. Remove the tire from the wheel. Refer to *Tire Mounting and Dismounting.*
7. Scuff the inside rim surface at the leak area with a number 80 grit sandpaper.
8. Clean the area with a general purpose cleaner such as 3M part number 08984 or the equivalent.
9. Apply 3 mm (1/8 in) thick layer of adhesive/sealant, GM P/N 1052366 or the equivalent, to the leak test area. Allow six hours of drying time.

Installation Procedure

1. Install the tire to the wheel. Refer to *Tire Mounting and Dismounting.*
2. Align the matchmark on the tire with the valve stem.
3. Pressurize the tire to 280 kPa (40 psi) and inspect for leaks.
4. Adjust the tire pressure in order to meet the specifications on the tire placard.
5. Balance the tires and wheels. Refer to *Balancing Tires and Wheels* in Vibration Diagnosis and Correction.
6. Install the tire and the wheel. Refer to *Tire and Wheel Removal and Installation.*
7. Lower the vehicle.

Aluminum Wheel Refinishing

Wheel Refinishing

A protective clearcoat and/or base color is applied to the surface of the original equipment cast aluminum wheels. Surface degradation can begin to develop if uncoated balance weights are used, or if frequent, repeated automatic car wash cleaning wears off the factory applied protective clearcoat and/or base color. This can happen at some automatic car wash facilities that use aggressive silicone carbide tipped tire brushes to clean the whitewalls and the tires. Exposure to caustic cleaners and/or to road salt causes further surface degradation once the protective clearcoat is damaged.

The refinishing of aluminum wheels requires that the wheel surface be plastic media blasted to remove old clearcoat or paint. The remachining or the use of chemical strippers is not recommended due to the concerns for repair durability. The service procedure details how to strip, how to clean, and how to recoat the aluminum wheels that are affected by the above condition.

Wheel Refinishing Service Procedure

Caution: To avoid serious personal injury when applying any two part component paint system, follow the specific precautions provided by the paint manufacturer. Failure to follow these precautions may cause lung irritation and allergic respiratory reaction.

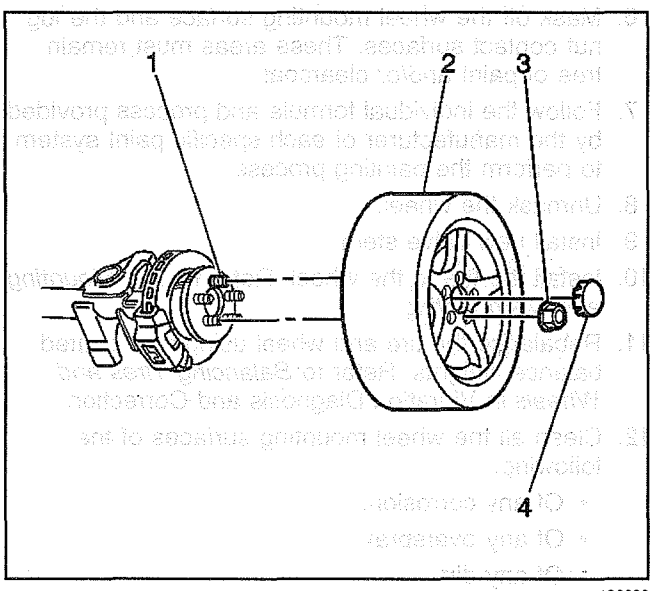
1. Remove the tire and wheel assembly from the vehicle. Refer to *Tire and Wheel Removal and Installation*
2. Remove the balance weights and valve stem from the wheel.
3. Remove the tire from the wheel. Refer to *Tire Mounting and Dismounting*
4. Use a suitable remover to wipe the following from the wheel:
   - Wipe the excess grease from the wheel.
   - Wipe the excess wax from the wheel.
   - Wipe the excess dirt from the wheel.

Important:

- Do not re-match the aluminum wheels.
- Do not use chemical strippers.

5. Remove the old clearcoat and the old paint from the wheel by plastic media blasting the wheel.

   Light sanding of the wheel, while manually spinning the wheel, may also be done to restore the circular machined appearance.
6. Mask off the wheel mounting surface and the lug nut contact surfaces. These areas must remain free of paint and/or clearcoat.
7. Follow the individual formula and process provided by the manufacturer of each specific paint system to perform the painting process.
8. Unmask the wheel.
9. Install new valve stem.
10. Install the tire to the wheel. Refer to *Tire Mounting and Dismounting*
11. Rebalance the tire and wheel using new coated balance weights. Refer to *Balancing Tires and Wheels* in Vibration Diagnosis and Correction.
12. Clean all the wheel mounting surfaces of the following:
    - Of any corrosion.
    - Of any overspray.
    - Of any dirt.
13. Install the tire and wheel assembly to the vehicle. Refer to *Tire and Wheel Removal and Installation*



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Tire and Wheel Removal and Installation

Caution: If penetrating oil gets on the vertical surfaces between the wheel and the rotor or drum, it could cause the wheel to work loose as the vehicle is driven, resulting in a loss of control and an injury accident.

Notice: Improperly tightened wheel nuts can lead to brake pulsation and rotor damage. To avoid expensive brake repairs, evenly tighten the wheel nuts in the proper torque specification.

Notice: NEVER use heat to loosen a tight wheel. It can shorten the life of the wheel, wheel nuts and wheel bearings. Excessive force, such as hammering the wheel or tire, can also cause damage and is not recommended. Slight tapping of the tire side wall, such as with one's hand or a rubber mallet, is normally acceptable.

Important: Penetrating oil has not been found to be effective in removing tight wheels. However, if used, you should apply the oil sparingly on the wheel centerhole area only.

Sometimes the wheels can be difficult to remove due to foreign material or a tight fit between the wheel centerhole and the rotor.

You can remove the wheel without damage through the following steps:

1. Retighten all the wheel nuts on the affected wheel. Then loosen each nut two turns. Rock the vehicle from side to side. If this is not effective, go to step 2.
2. Rock the vehicle from Drive and Reverse allowing the vehicle to move several feet in each direction. Apply quick, hard pressure on the brake pedal in order to loosen the wheel. If the wheel still does not loosen, then rock the vehicle again from side to side as hard as possible using one or more person's body weight. If the wheel is still tight, repeat the procedure.

Removal Procedure

1. Raise the vehicle. Support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the wheel nut cap, if equipped.
3. Remove the hub cap or the wheel trim cover (4).
4. Remove the special security lock nut, if equipped. Use a special security wheel lock key located in the front floor console.
5. Remove the wheel nuts (3).
6. Mark the location of the tires and the wheels to the hub.
7. Remove the tire and the wheel (2).

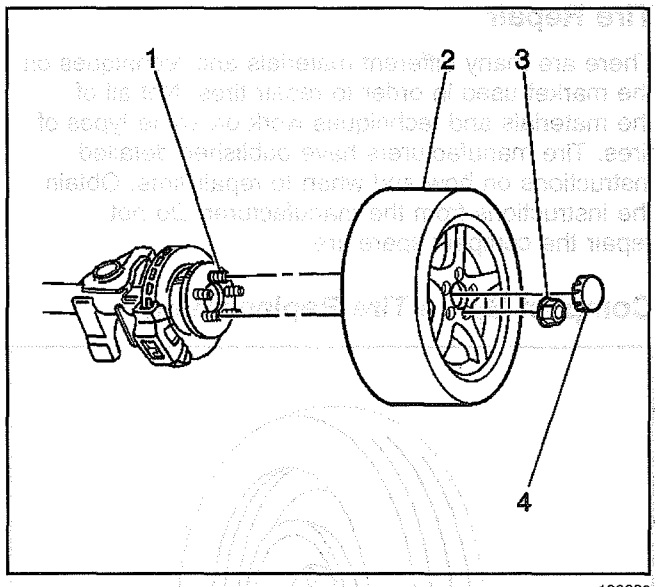
Caution: Refer to Buildup of Corrosion Removal Caution in Cautions and Notices.

8. Clean the following components:
   - The wheel nuts (3)
   - The wheel hub bolts (1)
   - The wheel (2)
   - The brake drum or rotor mounting surfaces

Installation Procedure

Caution: Never use oil or grease on studs or nuts. Tighten the wheel nuts with your fingers until they are snug. Then, tighten the nuts (in the sequence shown) to the fastener tightening specification shown in Specifications in this Section. Improperly tightened wheel nuts could eventually allow the wheel to come off while the vehicle is moving, possibly causing loss of control, personal injury, and property damage.

1. Install the tire and wheel (2).
2. Install the wheel nuts (3) and the security wheel lock nut, if equipped.



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Notice: Refer to *Fastener Notice* in Cautions and Notices.

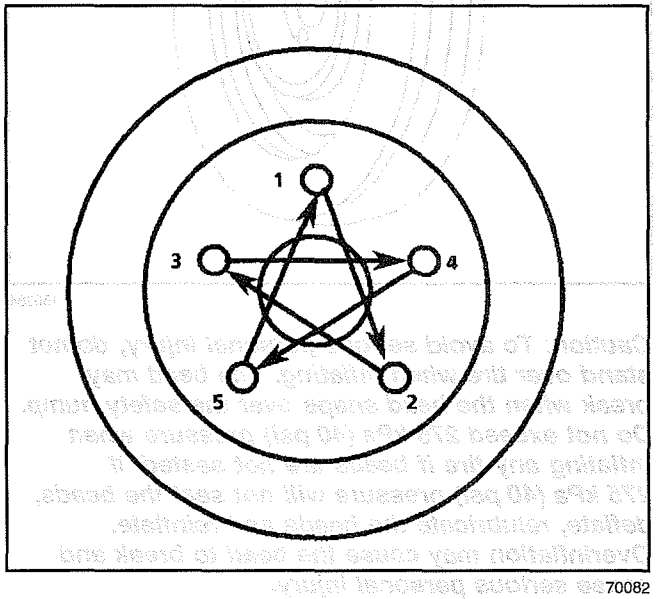
3. Tighten the wheel nuts to specifications.

   Tighten

   Tighten the wheel nuts in increments of 27 N·m (20 lb ft) in sequence up to 140 N·m (100 lb ft).
4. Tighten the special security wheel lock nut, if equipped. Use a special security wheel lock key located in the front floor console.
5. Install the hub cap or the wheel trim cover, if equipped.

   Tighten

   Tighten the wheel trim cover to 6 N·m (53 lb in).
6. Install the wheel nut cap, if equipped.
7. Lower the vehicle.

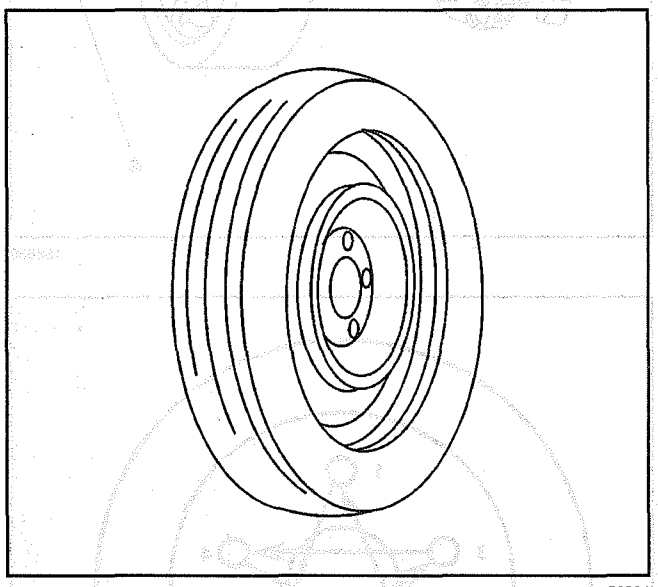


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Tire Repair

There are many different materials and techniques on the market used in order to repair tires. Not all of the materials and techniques work on some types of tires. Tire manufacturers have published detailed instructions on how and when to repair tires. Obtain the instructions from the manufacturer. Do not repair the compact spare tire.

Compact Spare Tire Replacement



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Caution: To avoid serious personal injury, do not stand over tire when inflating. The bead may break when the bead snaps over the safety hump. Do not exceed 275 kPa (40 psi) pressure when inflating any tire if beads are not seated. If 275 kPa (40 psi) pressure will not seat the beads, deflate, relubricate the beads and reinflate. Overinflation may cause the bead to break and cause serious personal injury.

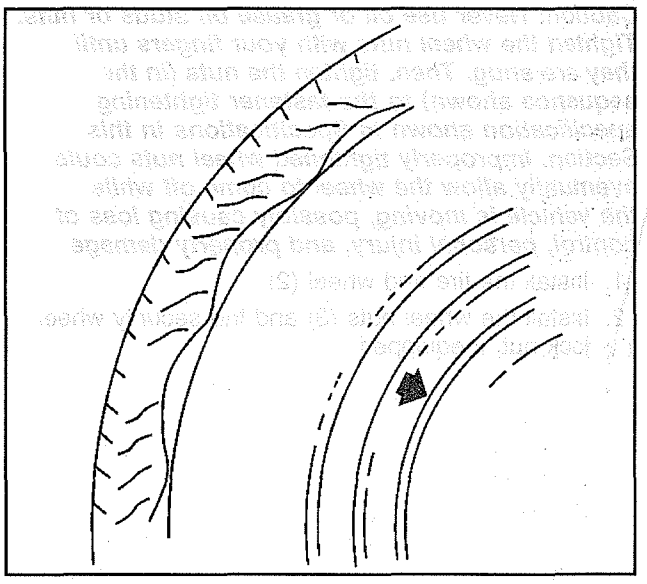
Notice: The compact spare wheel should not be used with standard tires, snow tires, wheel covers or trim rings. If such use is attempted, damage to these items or other parts of the vehicle may occur. The compact spare should be used only on vehicles that offer it as original equipment.

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.

Important: Use of the compact spare may result in activating a wheel sensor fault code.

Measure the compact spare inflation pressure periodically and maintain the inflation pressure at 420 kPa (60 psi). You can mount or dismount the tire from the wheel using present tire-changing equipment procedures.

Tire Mounting and Dismounting



70081

Use a tire changing machine in order to mount or dismount tires. Follow the equipment manufacturer's instructions. Do not use hand tools or tire irons to change the tire as they may damage the tire beads, wheel rim or flanges.

Notice: Damage to either the tire bead or the wheel mounting holes can result from the use of improper wheel attachment or tire mounting procedures. It takes up to 70 seconds for all of the air to completely exhaust from a large tire. Failure to follow the proper procedures could cause the tire changer to put enough force on the tire to bend the wheel at the mounting surface. Such damage may result in vibration and/or shimmy, and under severe usage lead to wheel cracking.

Important: Do not lubricate the tire beads or wheel rim with the lubricant containing silicone. Silicone will allow the tire to rotate on the wheel rim, throwing the tire and wheel out of balance.

Clean the rim bead seats with a wire brush or a 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% lubricant and 50% water) or equivalent.

Caution: To avoid serious personal injury, do not stand over tire when inflating. The bead may break when the bead snaps over the safety hump. Do not exceed 220 kPa (32 psi) pressure when inflating any tire if beads are not seated. If 220 kPa (32 psi) pressure will not seat the beads, deflate, relubricate the beads and reinflate. Overinflation may cause the bead to break and cause serious personal injury.

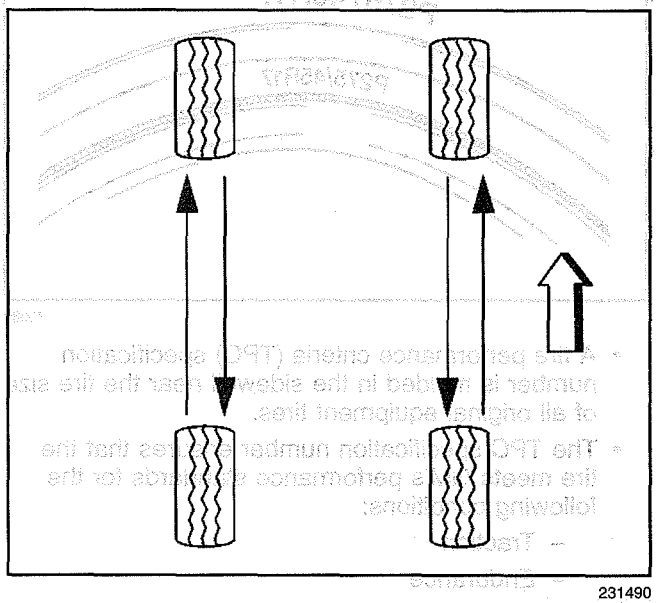
After mounting the tire, inflate the tire so that the beads are completely seated. Never exceed 280 kPa (40 psi).

Important: When mounting blackwall tires, be sure that the TPC specification number faces the outboard side of the vehicle.

Install the valve stem and inflate the tire to the pressure specified on the tire placard. Inspect the locating rings of the tire in order to determine that the rings show around the rim flanges on both sides of the wheel.

Tire Rotation

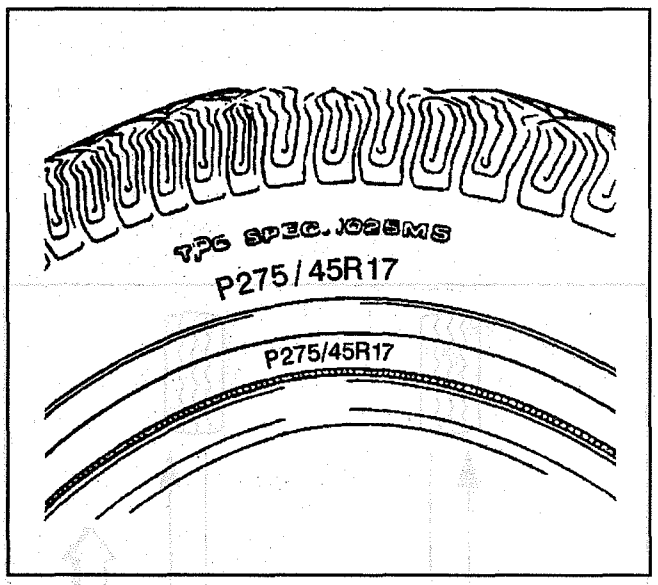
- In order to equalize tire wear, rotate the tires at intervals specified in Maintenance and Lubrication in General Information. If you notice uneven tire wear, investigate the cause.
- Due to design, radial tires tend to wear faster in the shoulder area, particularly in drive locations. Radial tires in non-drive locations may develop and 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 measure wheel nut torque and set the tire pressure. Never use oil or grease on the wheel bolts or nuts.
- On vehicles with P245/50ZR16 or P275/40ZR17 tires, follow special rotation provisions because the tires are directional.
- Rotate the tires. If you have directional tires, be sure the color-coded arrows on the tires roll forward.
- Balance the tires and wheels using a polyester-coated clip-on wheel balancing weights. Refer to *Balancing Tires and Wheels* in Vibration Diagnosis and Correction.
- Adjust the tire pressures and tighten the wheel nuts to the specified torque. Refer to *Tire and Wheel Removal and Installation*.



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Description and Operation

Tires Description



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- A tire performance criteria (TPC) specification number is molded in the sidewall near the tire size of all original equipment tires.
- The TPC specification number ensures that the tire meets GM's performance standards for the following conditions:
  - Traction
  - Endurance
  - Dimension
  - Noise
  - Handling
  - Rolling resistance
- A specific TPC number is usually assigned to each tire size.
- The following characteristics on replacement tires should be the same as on the original tires:
  - Load range
  - Speed Rating
  - Construction
- Replace the original tires with tires of the same TPC specification number.
- Use of any other tire size or type may affect the following conditions:
  - Ride
  - Handling
  - Speedometer/odometer calibration
  - Antilock brake system
  - Vehicle ground clearance
  - Tire clearance to body and chassis
- Install new tires in pairs on the same axle.
- If it is necessary to replace only one tire, the tire should be paired with the tire having the most tread in order to equalize the braking traction.

Replace the tires under the following conditions:

- Tires are worn to a point where 1.6 mm (1.16 in) or less tread remains, or the cord fabric shows.

  To help detect this condition, tires have built-in tread wear indicators that appear between the tread grooves when the tread is worn to 1.6 mm (1/16 in) or less.

  Replace the tire when the indicators appear in two or more adjacent grooves at three spots around the tire.
- The tread or sidewall is damaged in one of the following ways:

  The tread or sidewall is cracked or either cut or snagged deeply enough to expose the cord or the fabric.
  - The tread or sidewall is cracked.
  - The tread or sidewall is cut deeply enough in order to expose the cord or the fabric.
  - The tread or sidewall is snagged deeply enough in order to expose the cord or the fabric.
- One of the following conditions exists in the tire:
  - A bump
  - A bulge
  - A split

  Slight sidewall indentations are normal and should not affect the ride.
- One of the following conditions exists in the tire:
  - A puncture
  - A cut
  - Other damage that cannot be correctly repaired because of the size or location of the damage.

Tire Inflation Description

When you inflate the tires to the recommended inflation pressures, the factory-installed wheels and tires are designed to handle loads to the tire's rated load capacity. Incorrect tire pressures, or under-inflated tires, can cause the following conditions:

- Vehicle handling concerns
- Poor fuel economy
- Shortened tire life
- Tire overloading

Inspect the tire pressure when the following conditions apply:

- The vehicle has been sitting at least 3 hours.
- The vehicle has not been driven for more than 1.6 km (1 mi).
- The tires are cool.

Inspect the tires monthly or before any extended trip. Adjust the tire pressure to the specifications on the tire label. Install the valve caps or the extensions on the valves. The caps or the extensions keep out dust and water.

The kilopascal (kPa) is the metric term for pressure. The tire pressure may be printed in both kilopascal (kPa) and psi. One psi equals 6.9 kPa.

Inflation Pressure Conversion (Kilopascals to PSI)

kPa	psi	kPa	psi
140	20	215	31
145	21	220	32
155	22	230	33
160	23	235	34
165	24	240	35
170	25	250	36
180	26	275	40
185	27	310	45
190	28	345	50
200	29	380	55
205	30	415	60
Conversion: 6.9 kPa = 1 psi			

Tires with a higher than recommended pressure can cause the following conditions:

- A hard ride
- Tire bruising
- Rapid tread wear at the center of the tire

Tires with a lower than recommended pressure can cause the following conditions:

- A tire squeal on turns
- Hard steering
- Rapid wear and uneven wear on the edge of the tread
- Tire rim bruises and tire rim rupture
- Tire cord breakage
- High tire temperatures
- Reduced vehicle handling
- High fuel consumption
- Soft riding

Unequal pressure on the same axle can cause the following conditions:

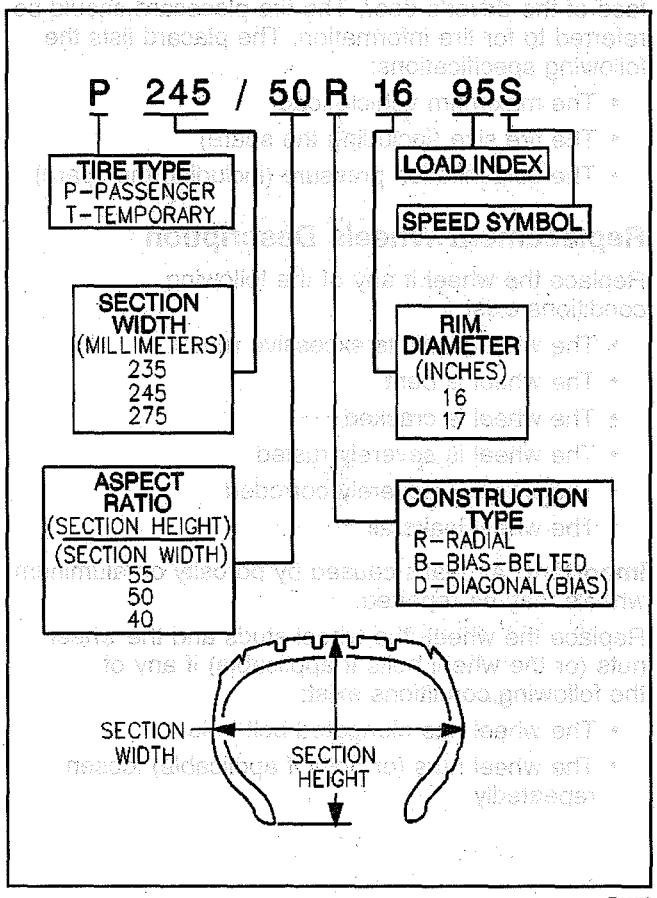
- Uneven braking
- Steering lead
- Reduced vehicle handling

See the Tire Placard for specific tire and wheel applications and tire pressures.

Tire Chain Usage Description

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.

P-Metric Sized Tires Description



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All GM vehicles now use passenger-metric (P-metric) sized tires. P-metric tires are available in the following two load ranges:

- Standard load with 210 kPa (30 psi) maximum pressure
- Extra load with 240 pKa (35 psi) maximum pressure

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. Replacement tires should be of the same TPC specification number as those originally on the vehicle. If the TPC specification number is the same then the following conditions are the same:

- The size
- The load range
- The construction

If you must replace the P-metric tires with other sizes, consult a tire dealer. A tire company can best recommend the closest match of alpha-numeric to P-metric sizes within their own tire lines.

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 for tire pressures.

Tire Placard Description

The tire placard is permanently located on the rear face of the driver's door. The tire placecard should be referred to for tire information. The placard lists the following specifications:

- The maximum vehicle load
- The tire size (including the spare)
- The cold inflation pressure (including the spare)

Replacement Wheels Description

Replace the wheel if any of the following conditions exist:

- The wheel exhibits excessive runout
- The wheel is bent
- The wheel is cracked
- The wheel is severely rusted
- The wheel is severely corroded
- The wheel leaks air

Important: Air leaks caused by porosity on aluminum wheels may be repaired.

Replace the wheel, the wheel studs and the wheel nuts (or the wheel bolts if applicable) if any of the following conditions exist:

- The wheel has elongated bolt holes
- The wheel nuts (or bolts if applicable) loosen repeatedly

Steel wheel identification is stamped into the wheel near the valve stem.

Aluminum wheel identification is cast into the inboard side of the wheel.

Caution: If you are replacing the wheel(s), the wheel stud(s), the wheel nut(s) or the wheel bolt(s), install only new GM original equipment parts. Installation of used parts or non-GM original equipment parts may cause the wheel to loosen, loss of tire air pressure, poor vehicle handling and loss of vehicle control resulting in personal injury.

Notice: The use of non-GM original equipment wheels may cause:

- Damage to the wheel bearing, the wheel fasteners and the wheel
- Tire damage caused by the modified clearance to the adjacent vehicle components
- Adverse vehicle steering stability caused by the modified scrub radius
- Damage to the vehicle caused by the modified ground clearance
- Speedometer and odometer inaccuracy

Aluminum Wheels Description

Clean aluminum wheels with mild soap and water. Wax aluminum wheels regularly. Do not use abrasive or caustic cleaners. These could damage the protective coating of the wheel.

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Driveline/Axle

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Propeller Shaft

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Propeller Shaft Bolt/Screw	22 N·m	16 lb ft
Propeller Shaft-To-Center Support Bearing Bolt/Screw	50 N·m	37 lb ft

Propeller Shaft Runout Specifications

Application	Specification	
	Metric	English
Propeller Shaft Runout	1.40 mm	0.055 in

GM SPO Group Numbers

Application	GM SPO Group Number
Center Support Bearing	5.000
One-Piece Propeller Shaft (V8)	5.000
Two-Piece Propeller Shaft (V6)	5.000
Universal Joints	5.000

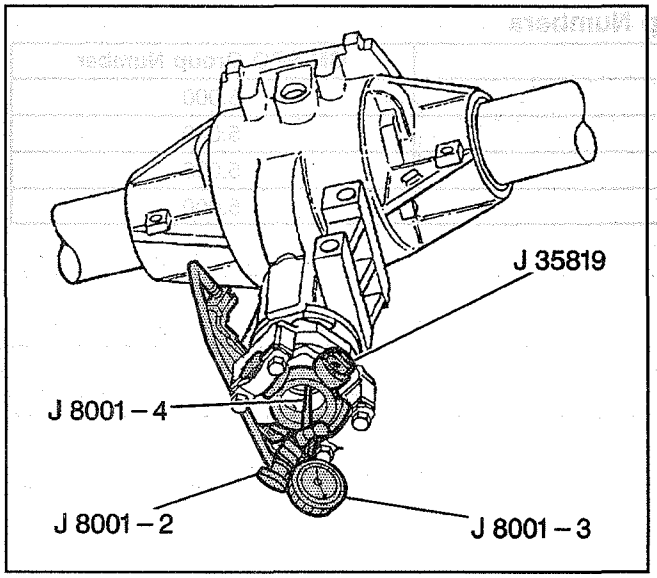
Diagnostic Information and Procedures

Propeller Shaft Diagnosis

Tools Required

- *J 8001* Dial Indicator Set
- *J 35819* Runout Gage
- *J 35819-100* Runout Gage Adapter Sleeves

1. Raise and suitable support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
   Ensure that the following conditions are met:
   - The vehicle is supported on the rear axle housing
   - The rear wheels can rotate freely
2. Remove the propeller shaft. Refer to *Propeller Shaft Replacement - One Piece* or *Propeller Shaft Replacement - Two Piece*.



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3. Use the *J 8001* the *J 35819* and the *J 35819-100* in order to measure and record the pinion gear yoke runout.
   Mark the high point and the low point of the pinion gear yoke.
4. If the pinion gear yoke runout is 0.15 mm (0.006 in) or less, remove the pinion gear yoke balance weight if the pinion gear yoke balance weight is used.
5. No further action is required if the following circumstances exist:
   - The pinion gear yoke runout is between 0.15–0.28 mm (0.006–0.011 in)
   - The balance weight is near or at the low point of pinion gear runout

   If the balance weight is not near or at the low point of pinion gear runout, remove the weight.
6. No further action is required if the following circumstances exist:
   - The pinion gear yoke runout is between 0.28–0.38 mm (0.011–0.015 in)
   - The balance weight is near or at the low point of pinion gear runout
7. If the balance weight is not at or near the low point of the pinion gear runout, complete the following steps:
   7.1. Remove the weight.
   7.2. Rotate the pinion gear yoke until the runout is 0.25 mm (0.010 in) or less.
8. If a runout of 0.25 mm (0.010 in) or less cannot be attained, complete the following steps:

Important: Service replacement differential pinion gear yokes may be equipped with balance weights. Do not remove these weights.

   8.1. Install a new differential pinion gear yoke.
   8.2. Inspect again in order to determine if the runout is 0.25 mm (0.010 in) or less.
9. Install the propeller shaft. Refer to *Propeller Shaft Replacement - One Piece* or *Propeller Shaft Replacement - Two Piece*.
10. Lower the vehicle.

Leak at Front Slip Yoke

Step	Action	Value(s)	Yes	No
Important: An occasional drop of fluid from the slip yoke is normal.				
1	Inspect the outside surface of the slip yoke for roughness. Is the outside surface of the slip yoke rough?	—	*Go to Step 2*	*Go to Step 3*
2	Replace the yoke. Is there still a leak at the front slip yoke?	—	*Go to Step 3*	System OK
3	Inspect the seal for cuts caused by burrs on the slip yoke. Are there cuts on the seal?	—	*Go to Step 4*	*Go to Step 5*
4	Replace the seal. Is there still a leak at the front slip yoke?	—	*Go to Step 5*	System OK
5	Inspect the rear transmission oil seal for damage. Is the rear transmission oil seal damaged?	—	*Go to Step 6*	—
6	Replace the rear transmission oil seal. Add fluid if fluid is needed. Is there still a leak at the front slip yoke?	—	—	System OK

Roughness or Vibration

Step	Action	Value(s)	Yes	No
1	Inspect the propeller shaft for the following conditions: • Bending • Damage Is the propeller shaft bent or damaged?	—	*Go to Step 2*	*Go to Step 3*
2	Replace the propeller shaft. Is there still roughness or vibration?	—	*Go to Step 3*	System OK
3	Inspect for undercoating on the propeller shaft. Is there undercoating on the propeller shaft?	—	*Go to Step 4*	*Go to Step 5*
4	Remove the undercoating from the propeller shaft. Is there still roughness or vibration?	—	*Go to Step 5*	System OK
5	Inspect the tires for the following conditions: • Unbalance • Vibration during vehicle operation at a speed of 48–80 km/h (30–50 mph) Do the above conditions exist?	—	*Go to Step 6*	*Go to Step 7*
6	Balance the tires. Is there still roughness or vibration?	—	*Go to Step 7*	System OK
7	Inspect the universal joints for tightness. Are the universal joints tight?	—	*Go to Step 8*	*Go to Step 9*
8	If the universal joints are equipped with snap rings, tap on the yokes with a hammer in order to free up the universal joints. If the joints cannot be freed up or if the joints feel rough, replace the joints. Is there still roughness or vibration?	—	*Go to Step 9*	System OK
9	Inspect the universal joints for wear. Are any of the universal joints worn?	—	*Go to Step 10*	*Go to Step 11*
10	Replace the worn universal joint(s). Is there still roughness or vibration?	—	*Go to Step 11*	System OK
11	Inspect the fixed yoke for bending and inspect the flange for excessive runout. Does either of the above conditions exist?	—	*Go to Step 12*	*Go to Step 13*
12	Replace the fixed yoke. Is there still roughness or vibration?	—	*Go to Step 13*	System OK

Roughness or Vibration (cont'd)

Step	Action	Value(s)	Yes	No
13	Inspect the propeller shaft for lack of balance. Is the propeller shaft unbalanced?	—	*Go to Step 14*	*Go to Step 15*
14	Inspect for the missing balance weight on the propeller shaft. Rotate the shaft 180 degrees on the fixed yoke. Is there still roughness or vibration?	—	*Go to Step 15*	System OK
15	Inspect the universal joint for incorrect angle placement. Is the universal joint at an incorrect angle?	—	*Go to Step 16*	*Go to Step 17*
16	Correct the universal joint angle. Is there still roughness or vibration?	—	*Go to Step 17*	System OK
17	Inspect the yokes and the flanges for the following conditions: • Damage • Distortion Are the yokes and/or the flanges damaged or distorted?	—	*Go to Step 18*	*Go to Step 19*
18	Replace the yokes and/or the flanges. Is there still roughness or vibration?	—	*Go to Step 19*	System OK
19	Inspect the shaft for yokes that are out of phase. Are the yokes out of phase on the shaft?	—	*Go to Step 20*	*Go to Step 21*
20	Replace the propeller shaft if the propeller shaft is a one-piece shaft. Reindex the propeller shaft if the propeller shaft is a two-piece shaft. Is there still roughness or vibration?	—	*Go to Step 21*	System OK
21	Inspect for driveline vibration during vehicle operation at a speed of 80 km/h (50 mph). Is there driveline vibration at the specified speed?	—	*Go to Step 22*	—
22	Inspect the propeller shaft runout. Inspect for missing balance weights on the propeller shaft. Is there driveline vibration at the specified speed?	—	—	System OK

Ping, Snap, or Click Noise

Step	Action	Value(s)	Yes	No
DEFINITION: A ping, a snap or a clicking noise in the driveline that is usually heard during initial load after the transmission is in gear.				
1	Inspect the rear axle lower control arm for loose bolts/screws. Are there loose bolts/screws in the lower control arm?	—	*Go to Step 2*	*Go to Step 3*
2	Tighten the bolts/screws to the specified torque. Refer to Rear Suspension in Suspension. Is there still a ping, a snap or a clicking noise?	—	*Go to Step 3*	System OK
3	Inspect the universal joints for the following conditions: • Wear • Damage Are any of the universal joints worn or damaged?	—	*Go to Step 4*	*Go to Step 5*
4	Replace the worn or damaged universal joint(s). Is there still a ping, a snap or a clicking noise?	—	*Go to Step 5*	System OK
5	Inspect the fixed yoke in order to determine if the fixed yoke is loose. Is the fixed yoke loose?	—	*Go to Step 6*	—
6	Tighten the drive pinion gear nut to the specified torque. Refer to *Fastener Tightening Specifications*. Is there still a ping, a snap or a clicking noise?	—	—	System OK

Knock or Clunk Noise

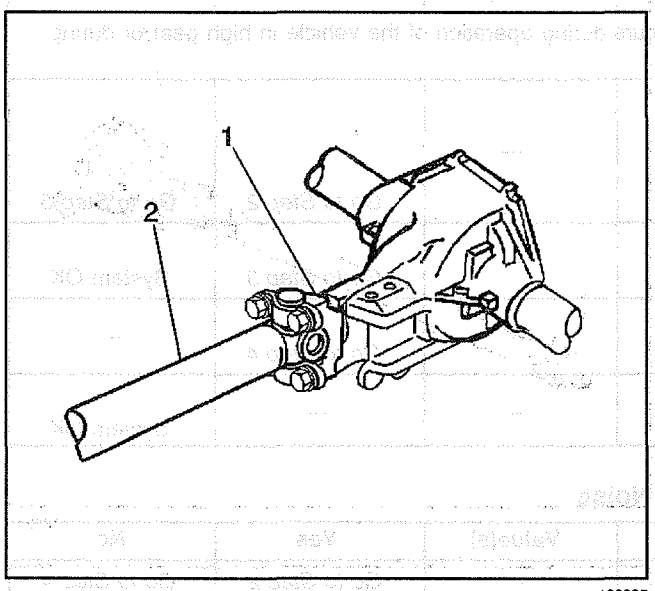
Step	Action	Value(s)	Yes	No
DEFINITION: A knock or a clunking noise in the driveline that occurs during operation of the vehicle in high gear or during coasting in neutral at a speed of 16 km/h (10 mph.)				
1	Inspect the universal joints for the following conditions: • Damage • Wear Are any of the universal joints damaged or worn?	—	*Go to Step 2*	*Go to Step 3*
2	Replace the worn or damaged universal joint(s). Is there still a knock or a clunking noise?	—	*Go to Step 3*	System OK
3	Inspect the differential side gears for wear. Are any of the differential side gears worn?	—	*Go to Step 4*	—
4	Replace the worn differential side gear(s)? Is there still a knock or a clunking noise?	—	—	System OK

Scraping Noise

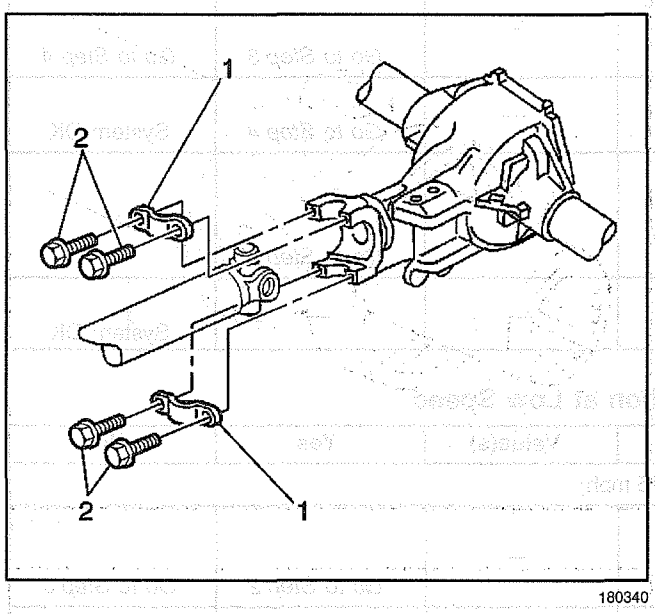
Step	Action	Value(s)	Yes	No
1	Is the vehicle equipped with drum brakes?	—	*Go to Step 2*	*Go to Step 4*
2	Inspect the backing plate for contact with the brake drum. Is there contact between the brake drum and the backing plate?	—	*Go to Step 3*	*Go to Step 4*
3	Replace the brake drum or the backing plate. Is there still a scraping noise?	—	*Go to Step 4*	System OK
4	Inspect the pinion flange and the center support bearing for rubbing. Is there rubbing between the pinion flange and the center support bearing?	—	*Go to Step 5*	—
5	Correct the interference. Is there still a scraping noise?	—	—	System OK

Shudder on Acceleration at Low Speed

Step	Action	Value(s)	Yes	No
DEFINITION: A shudder during acceleration from 0–24 km/h (0–15 mph)				
1	Inspect the universal joint angle in order to determine of the universal joint angle is incorrectly set or excessive. Is the universal joint angle incorrectly set or excessive?	—	*Go to Step 2*	*Go to Step 3*
2	Add or remove transmission mount shims as needed. Is there a shudder during acceleration?	—	*Go to Step 3*	*Go to Step 5*
3	Inspect the flanges for loose or missing bolts/screws? Are there loose or missing bolts/screws in the flanges?	—	*Go to Step 4*	*Go to Step 5*
4	Replace or tighten the bolts/screws to the specified torque. Is there a shudder during acceleration?	—	*Go to Step 5*	System OK
5	Inspect the universal joints for wear. Are the universal joints worn?	—	*Go to Step 6*	—
6	Replace the worn universal joints. Is there a shudder during acceleration?	—	—	System OK



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Repair Instructions

Propeller Shaft Replacement - One Piece

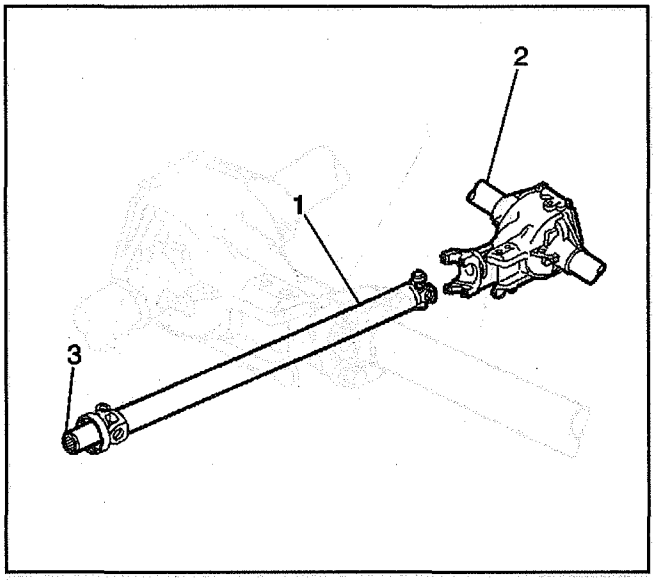
Removal Procedure

Notice: Do not strike or drop the propeller shaft, or allow the universal joints to bend to extreme angles, as internal joint damage might occur.

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Mark the relationship of the propeller shaft (2) to the pinion gear yoke (1).
3. Remove the propeller shaft bolts/screws (2).
4. Remove the propeller shaft retainers (1).

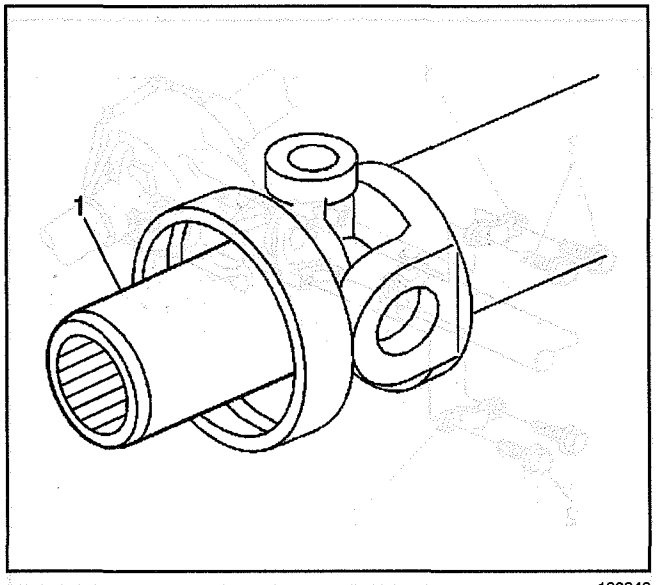
Important: Support the propeller shaft during removal.

5. Use the following steps in order to remove the propeller shaft:
   5.1. Withdraw the slip yoke (3) from the transmission.
   5.2. Move the propeller shaft (1) rearward and pass the propeller shaft under the housing (2).
   If the bearing caps are loose, tape the bearing caps together in order to prevent dropping and losing the needle roller bearings.
6. Inspect the transmission output shaft splines for burrs.



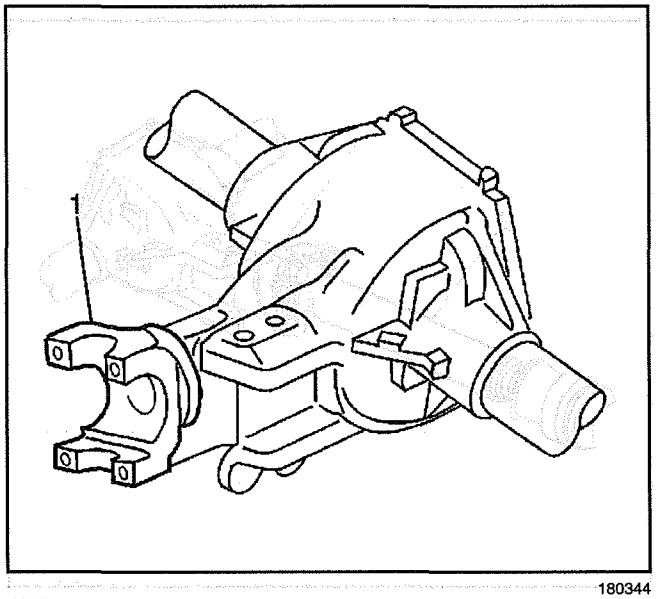
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7. Inspect the outer diameter of the slip yoke (1) for burrs.
8. Inspect the outer splines of the slip yoke (1) for the following conditions:
   - Damage
   - Twisting
   - Wear
9. Inspect the relationship of the outer splines of the slip yoke (1) to the transmission output shaft splines. The outer splines of the slip yoke should meet the following requirements:
   - The outer splines should agree in number with the transmission output shaft splines.
   - The outer splines should fit with the transmission output shaft splines.

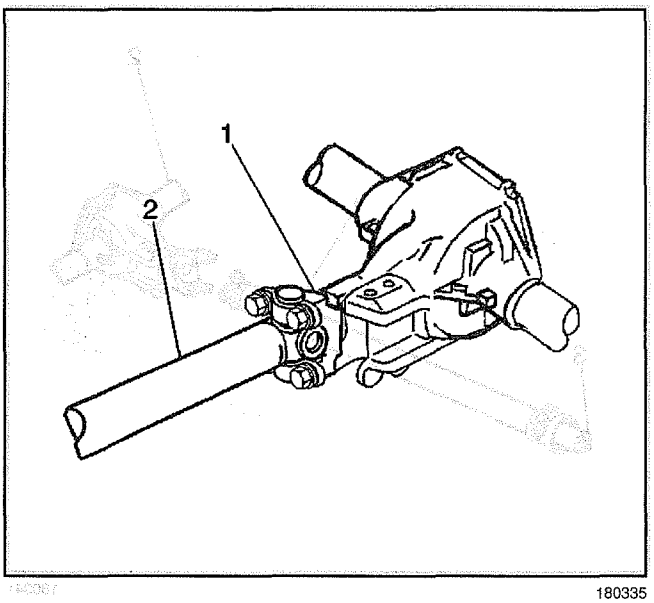


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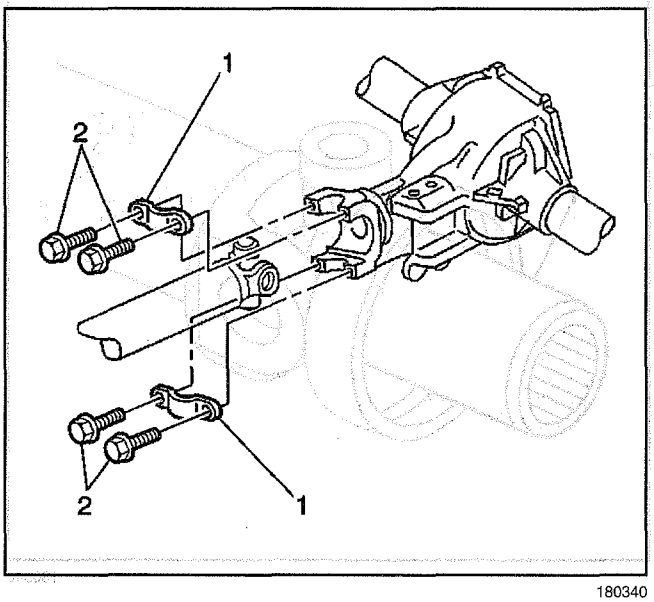
10. Inspect the pinion gear yoke (1) at the universal joint cap connecting surface for the following conditions:
    - Burrs
    - Foreign material



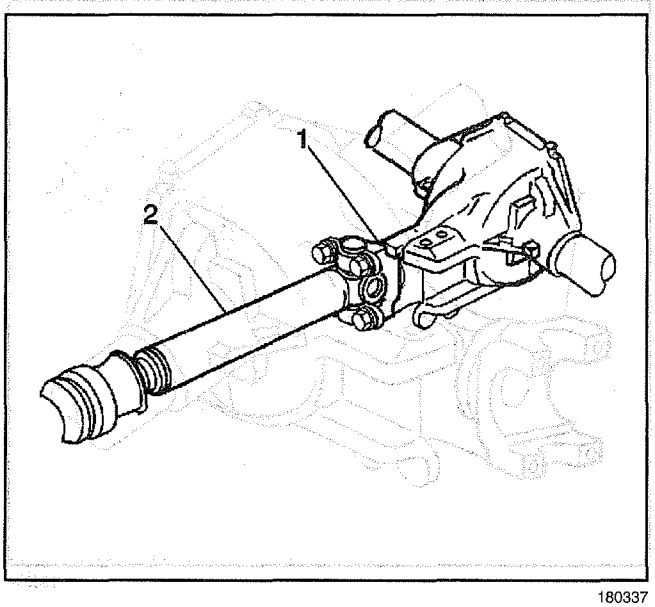
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Installation Procedure

Notice: The propeller shaft must be supported carefully during handling to avoid jamming or bending of parts.

Important: Do not place any tool between the propeller shaft slip yoke and the splines. Placing any tool between the propeller shaft slip yoke and the splines may cause damage to the transmission oil seal.

1. Lubricate the slip yoke with chassis lubricant.
2. Install the slip yoke onto the transmission output shaft.

Important: Be sure to align the mark on the pinion gear yoke with the mark on the propeller shaft.

3. Install the rear of the propeller shaft (2) to the pinion gear yoke (1).
4. Install the rear universal joint to the pinion gear yoke.

   Ensure that the bearing caps are properly seated.
5. Install the propeller shaft retainers (1).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

6. Install the propeller shaft bolts/screws (2).

   Tighten

   Tighten the propeller shaft bolts/screws evenly to 22 N·m (16 lb ft).
7. Lower the vehicle.

Propeller Shaft Replacement - Two Piece

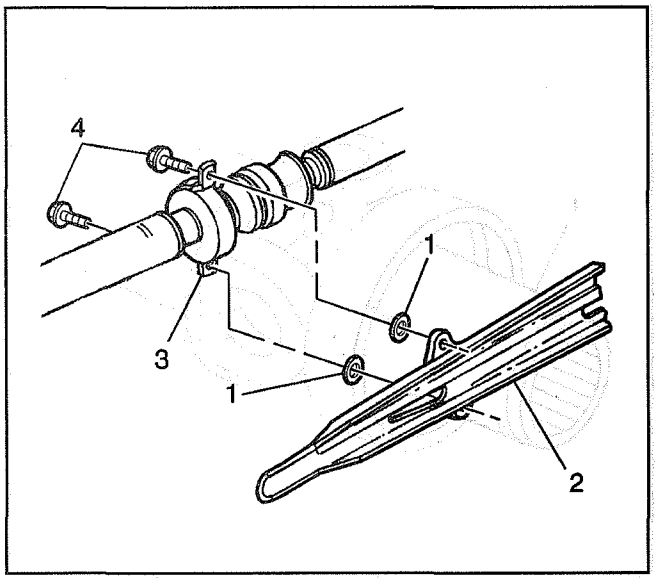
Removal Procedure

Notice: Do not strike or drop the propeller shaft, or allow the universal joints to bend to extreme angles, as internal joint damage might occur.

Important: The two-piece propeller shaft and the center support bearing used with the 3800 (VIN K) engine are not serviceable separately. The propeller shaft and the support bearing should be replaced as a complete assembly only.

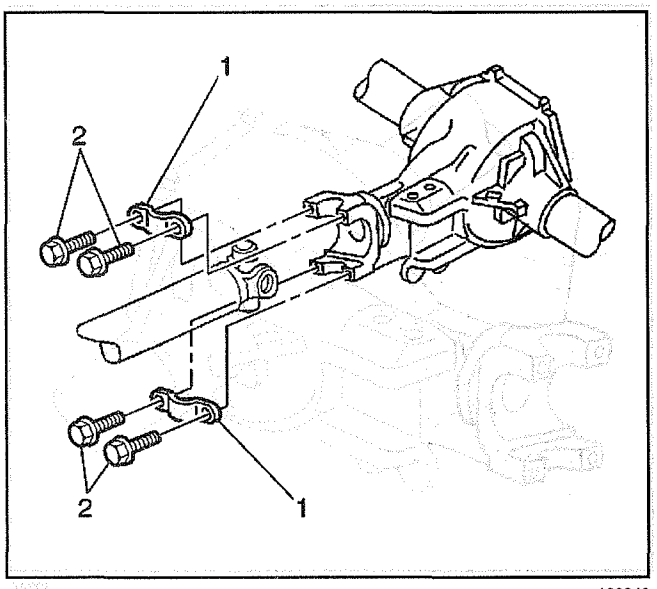
1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Mark the relationship of the propeller shaft (2) to the pinion gear yoke (1).

3. Remove the bolts/screws (4) from the center support bearing (3).
4. Remove the following components from the torque arm (2):
   - The center support bearing (3)
   - The washers (1)



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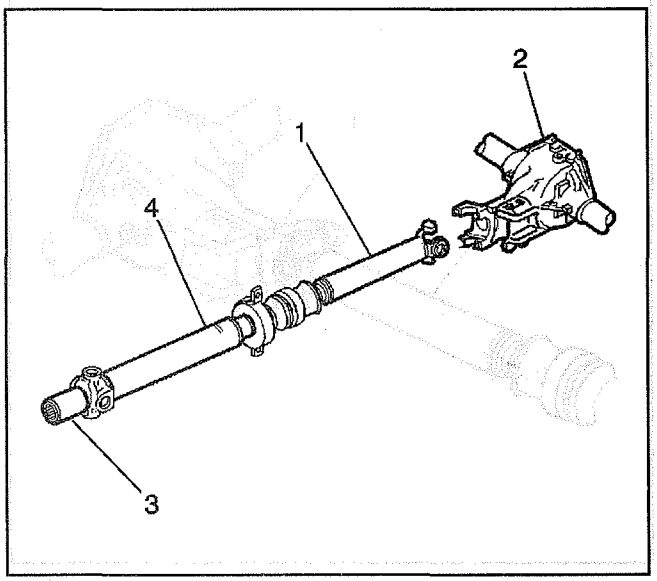
5. Remove the propeller shaft bolts/screws (2).
6. Remove the propeller shaft retainers (1).



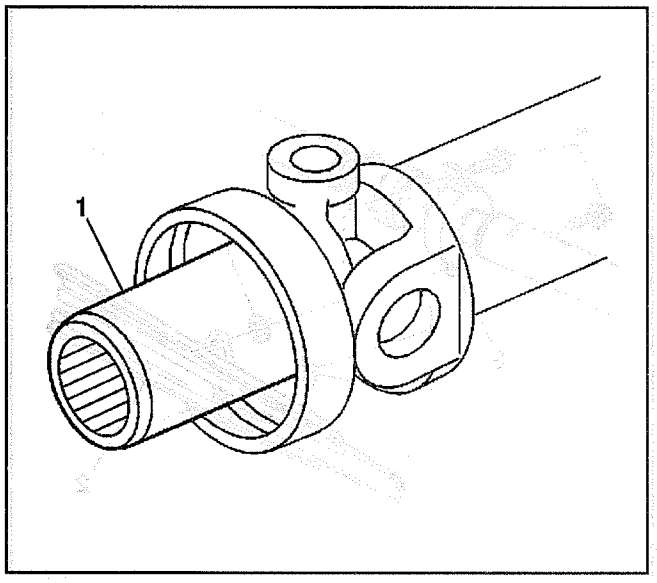
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Important: Support the propeller shaft during removal.

7. Use the following steps in order to remove the propeller shaft:
   7.1. Withdraw the slip yoke (3) from the transmission.
   7.2. Move the propeller shaft (1 and 4) rearward and pass the propeller shaft under the housing (2).
   If the bearing caps are loose, tape the bearing caps together in order to prevent dropping and losing the needle roller bearings.
8. Inspect the transmission output shaft splines for burrs.

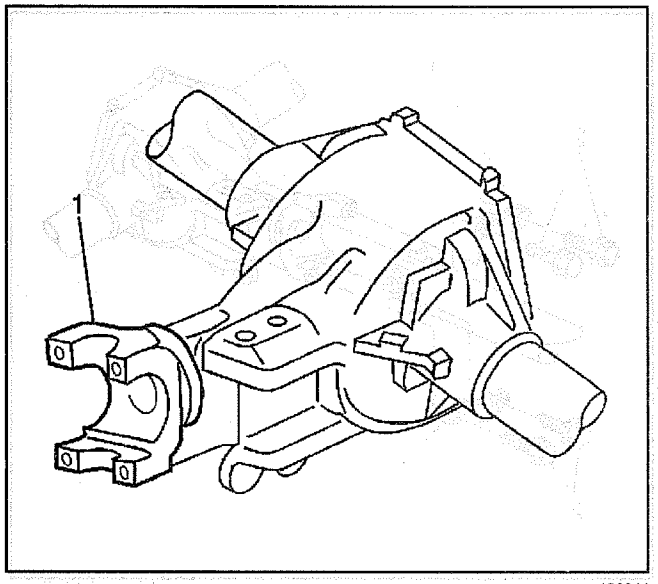


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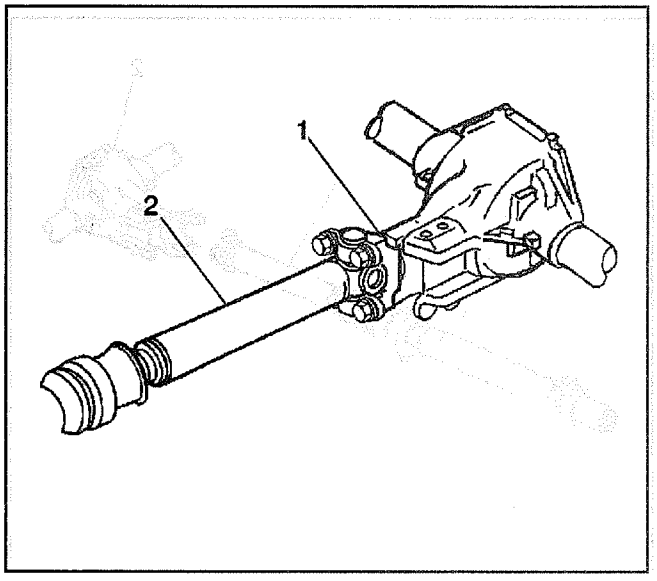
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9. Inspect the outer diameter of the slip yoke (1) for burrs.
10. Inspect the outer splines of the slip yoke (1) for the following conditions:
    - Damage
    - Twisting
    - Wear
11. Inspect the relationship of the outer splines of the slip yoke to the transmission output shaft splines. The outer splines of the slip yoke should meet the following requirements:
    - The outer splines should agree in number with the transmission output shaft splines.
    - The outer splines should fit with the transmission output shaft splines.



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12. Inspect the pinion gear yoke (1) at the universal joint cap connecting surface for the following conditions:
    - Burrs
    - Foreign material



180337

Installation Procedure

Notice: The propeller shaft must be supported carefully during handling to avoid jamming or bending of parts.

Important: Do not place any tool between the propeller shaft slip yoke and the splines. Placing any tool between the propeller shaft slip yoke and the splines may cause damage to the transmission oil seal.

1. Lubricate the slip yoke with chassis lubricant.
2. Install the slip yoke onto the transmission output shaft.

Important: Be sure to align the mark on the pinion gear yoke with the mark on the propeller shaft.

3. Install the rear of the propeller shaft (2) to the pinion gear yoke (1).
4. Install the rear universal joint to the pinion gear yoke.
   Ensure that the bearing caps are properly seated.

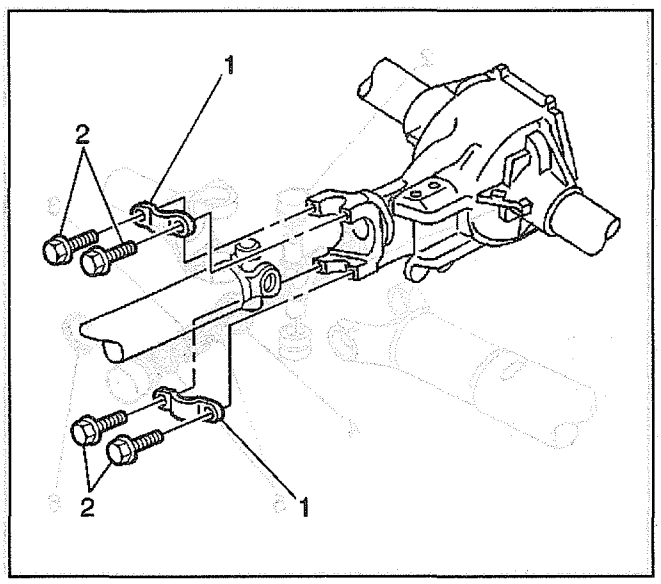
5. Install the propeller shaft retainers (1).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

6. Install the propeller shaft bolts/screws (2).

   Tighten

   Tighten the propeller shaft bolts/screws evenly to 22 N·m (16 lb ft).



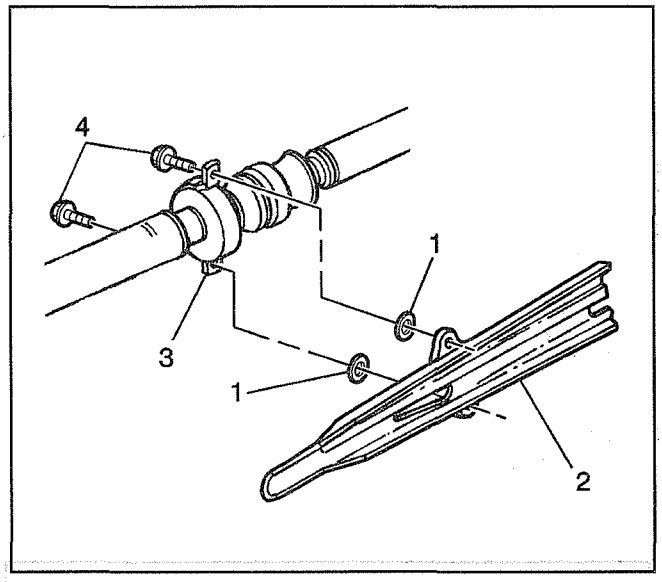
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7. Install the following components to the torque arm (2):
   - The washers (1)
   - The center support bearing (3)
   - Install the bolts/screws (4) to the center support bearing.

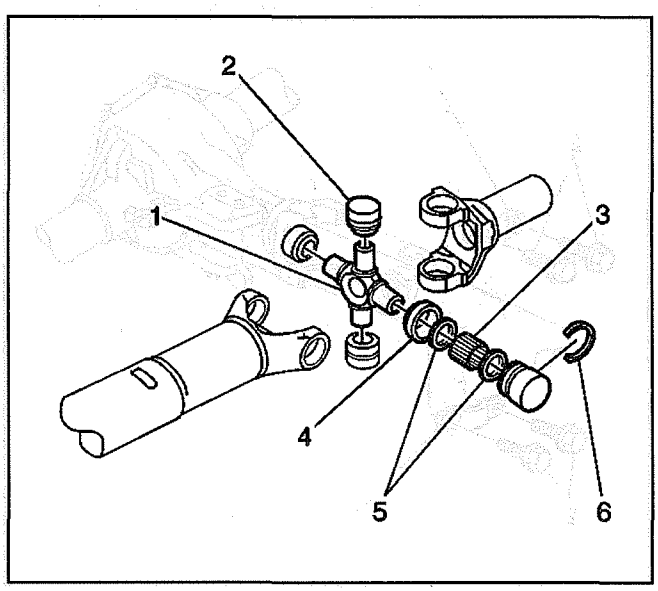
     Tighten

     Tighten the propeller shaft-to-center support bearing bolts/screws to 50 N·m (37 lb ft).

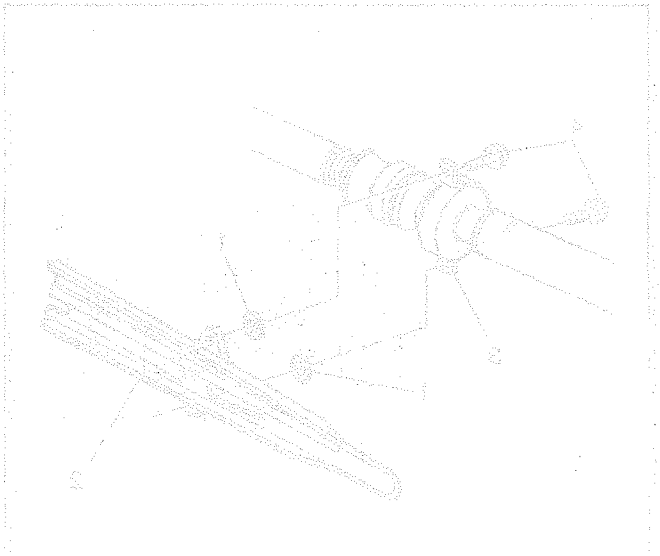
8. Lower the vehicle.

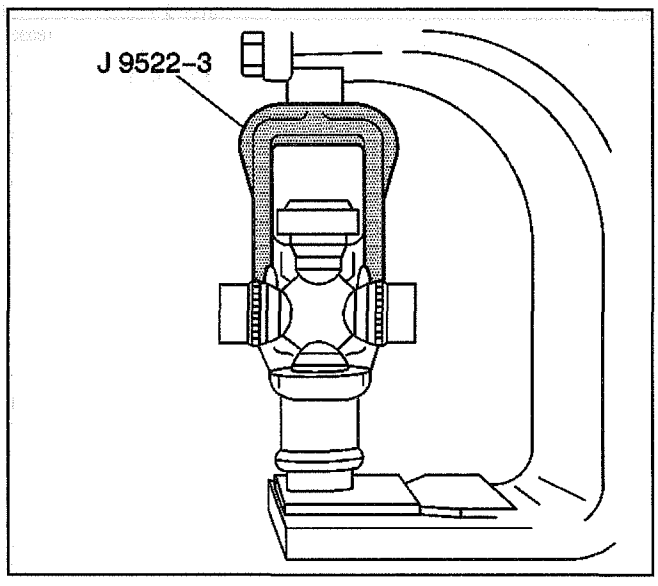


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Universal Joint and Slip Yoke Replacement

Disassembly Procedure

Tools Required

- *J 9522-3* U-Joint Bearing Separator
- *J 9522-5* U-Joint Bearing Spacer Remover

Notice: Never clamp propeller shaft tubing in a vise. Clamping propeller shaft tubing in a vise could dent or deform the tube causing an imbalance or unsafe condition. Always clamp on one of the yokes and support the shaft horizontally. Avoid damaging the slip yoke sealing surface. Nicks may damage the bushing or cut the lip seal.

Important: Nylon injected ring universal joints cannot be reassembled. Replace nylon injected ring universal joints with external snap ring universal joints.

When reassembling a propeller shaft, always install a complete propeller shaft universal joint service kit.

This kit includes the following components:

- One pregreased spider (1)
- Four service bearing caps with seals (2)
- One needle roller bearing (3)
- Delrin round washers (4)
- Delrin flat washers (5)
- Grease
- Four retainer rings (6)

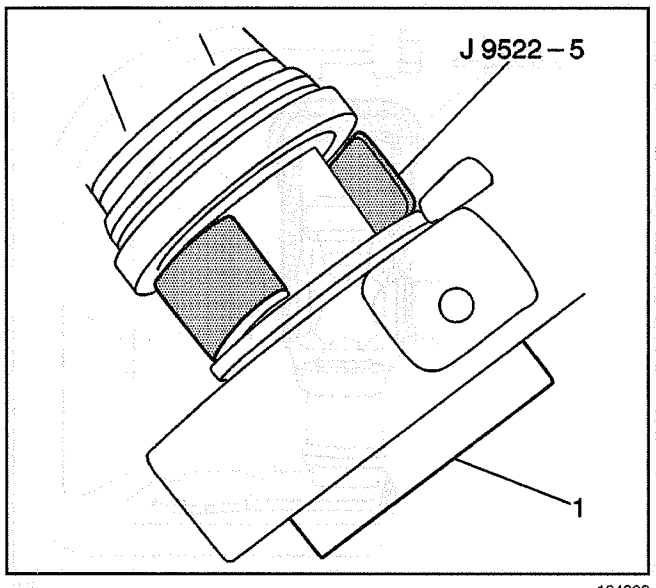
Ensure that the seals are in place on the service bearing caps (2) during handling. The seals will hold the needle roller bearings (3) in place during handling.

Important: There are no bearing retainer grooves in production bearing caps. Production bearing caps cannot be reused.

1. Support the propeller shaft in a horizontal position that is aligned with the base plate of a press.
2. Place the universal joint so that the lower ear of the shaft yoke is supported on a 28.6 mm (1.125 in) socket (2).
3. Use the following procedure in order to remove the lower bearing cap from the yoke ear:
   3.1. Place the *J 9522-3* on the open horizontal bearing cap.
   3.2. Press the lower bearing cap out of the yoke ear.

   This process shears the nylon injected ring on the lower bearing cap.

4. If the bearing cap (1) is not completely removed, use the following steps in order to completely remove the bearing cap:
   4.1. Lift the *J 9522-3*
   4.2. Insert the *J 9522-5* between the seal and the bearing cap (1).
   4.3. Press the bearing cap (1) out of the yoke.
5. Rotate the propeller shaft.
   5.1. Repeat Step 3 in order to shear the opposite nylon injected ring.
   5.2. Repeat Step 4 in order to remove the opposite bearing cap from the yoke.
6. If the front universal joint is being replaced, use the above procedure in order to remove the two bearing caps from the propeller shaft slip yoke.



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7. Remove the spider (1) from the yoke.
8. Clean the yoke in the area that will hold the retainer ring in order to ensure proper assembly.
9. Clean all of the sheared nylon from the universal joint cup bore.

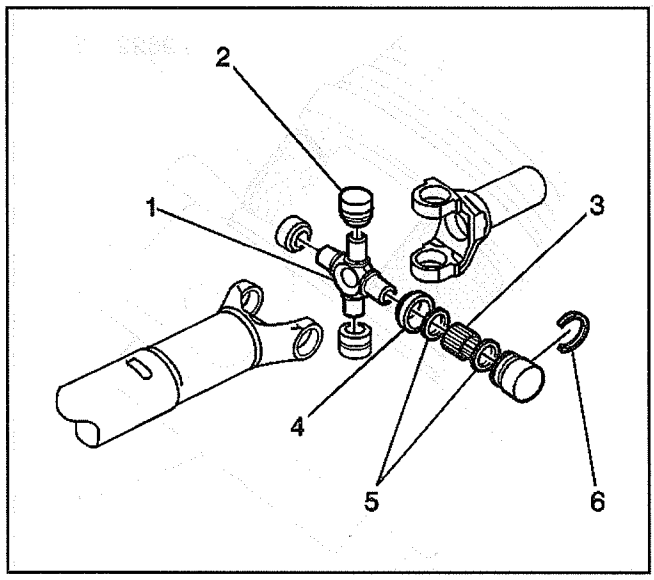
Important: Do not loosen or damage the dust seals.

If the dust seals are loose or damaged, replace the entire universal joint.

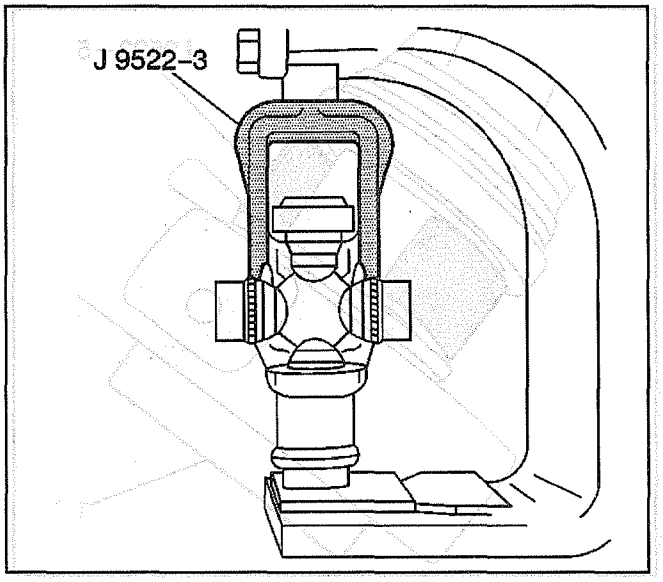
Important: These universal joints are designed for extended life and do not require periodic inspections or lubrication.

When these joints are taken apart, repack the bearing. Lubricate the reservoir at the end of the trunnions with chassis lubricant or linkage joint lubricant.

10. Remove the U-joint spider bearing retainer rings (6). If the retainer ring does not snap readily out of the grooves, lightly tap the end of the bearing cap (2) in order to relieve the pressure against the retainer ring. After relieving the pressure, remove the retainer ring.
11. Support the propeller shaft in a horizontal position that aligns with the base plate of a press.

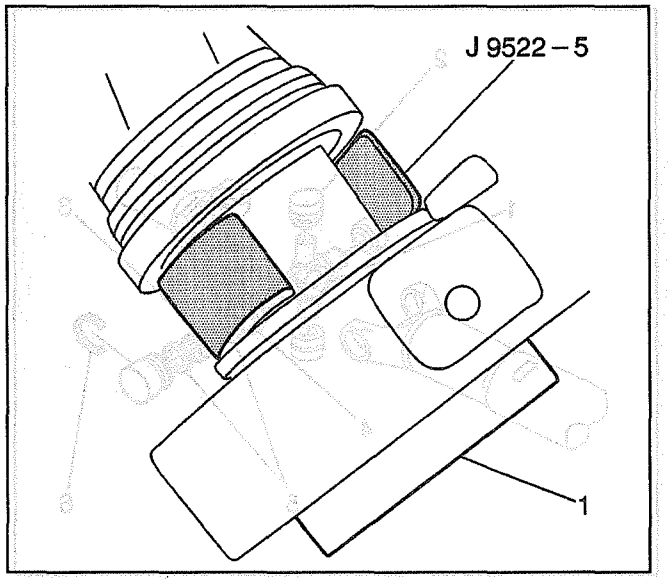


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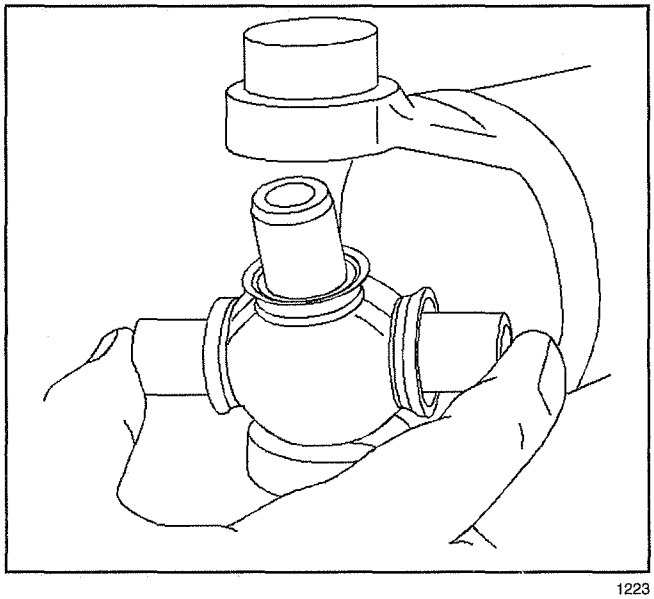
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12. Place the universal joint so the ear of the yoke is supported on a 28.6 mm (1.125 in) socket.
13. Use the following procedure in order to remove the lower bearing cap from the yoke ear:
    13.1. Place the *J 9522-3* on the open horizontal bearing cap.
    13.2. Press the lower bearing cap out of the yoke ear.



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14. If the bearing cap (1) is not completely removed, use the following steps in order to completely remove the bearing cap:
    14.1. Lift the *J 9522-3*.
    14.2. Insert the *J 9522-5* between the seal and the bearing cap (1).
    14.3. Press the bearing cap (1) out of the yoke.
15. Rotate the propeller shaft.
16. Press the opposite bearing cap out of the yoke.
17. Remove the spider from the yoke.

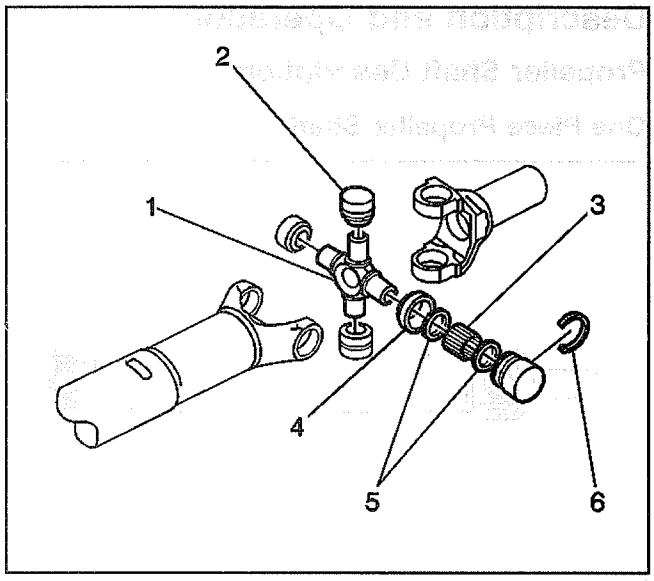


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Assembly Procedure

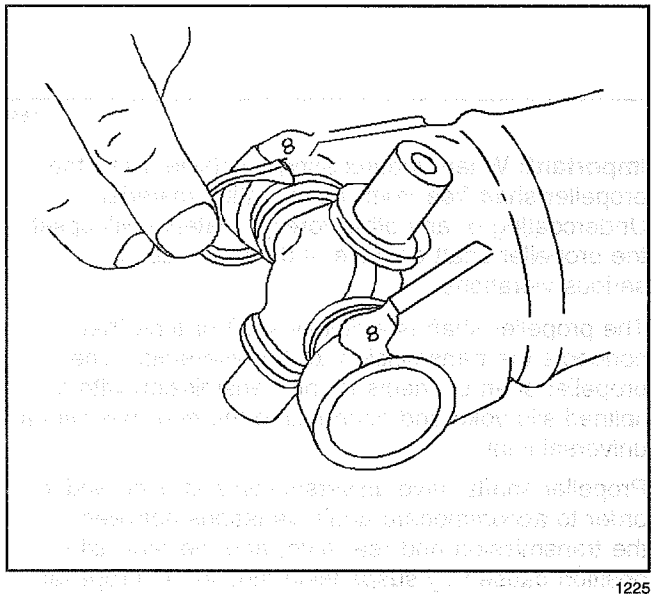
1. Install one bearing cap partially into one side of the yoke.
2. Rotate the yoke so that this yoke ear is on the bottom.
3. Insert the *J 9522-3* in order to seat the trunnion in the bearing cap.
4. Repeat Steps 1 and 2 in order to partially install the opposite bearing cap.
5. Inspect both trunnions in order to ensure their straight positioning into the bearing caps (1).
6. Press against the two opposite bearing caps while working the spider in order to ensure free movement of the trunnions in the bearings.

7. Inspect the needle roller bearing (3) for binding.
   If binding exists, one or more of the needle roller bearings may have tipped under the end of the relevant trunnion.
8. Stop pressing on the bearing caps (2) when one bearing retainer groove clears inside of the yoke.



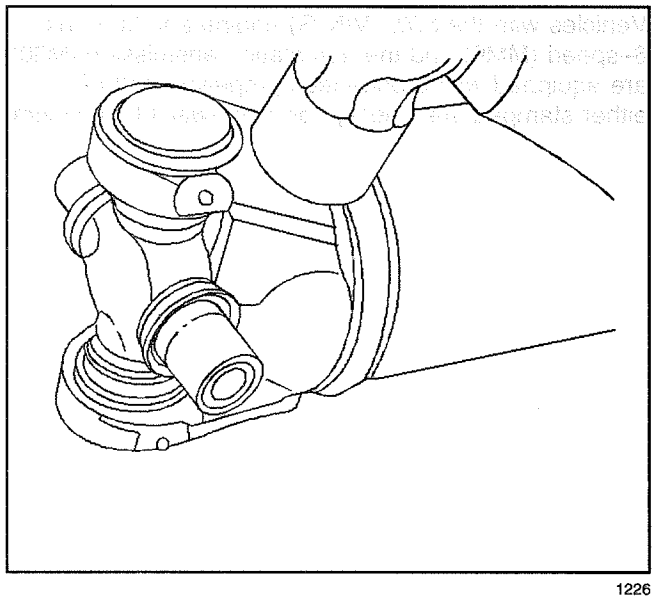
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9. Press the U-joint spider bearing retainer ring into place.



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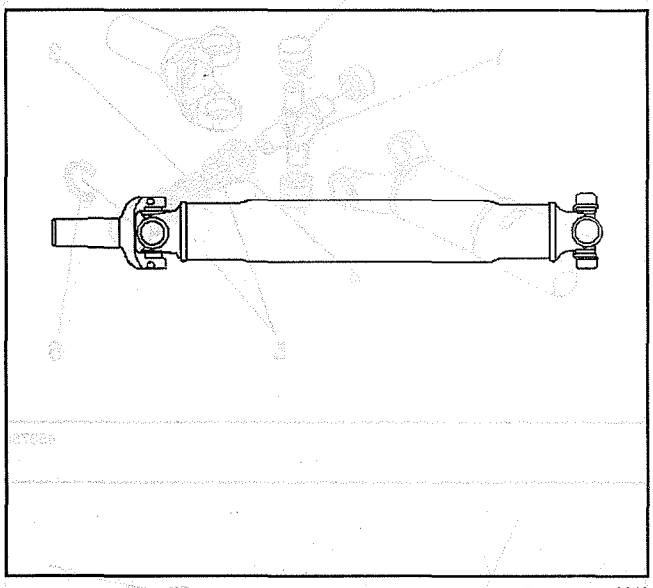
10. Continue pressing on the retainer ring until the opposite side of the ring can be snapped into place.
    If necessary, strike the yoke with a hammer in order to facilitate seating of the retainer rings. (Striking the yoke with a hammer slightly springs the yoke ears.)
11. Repeat the above procedure for the other half of the universal joint.


1226

Description and Operation

Propeller Shaft Description

One Piece Propeller Shaft



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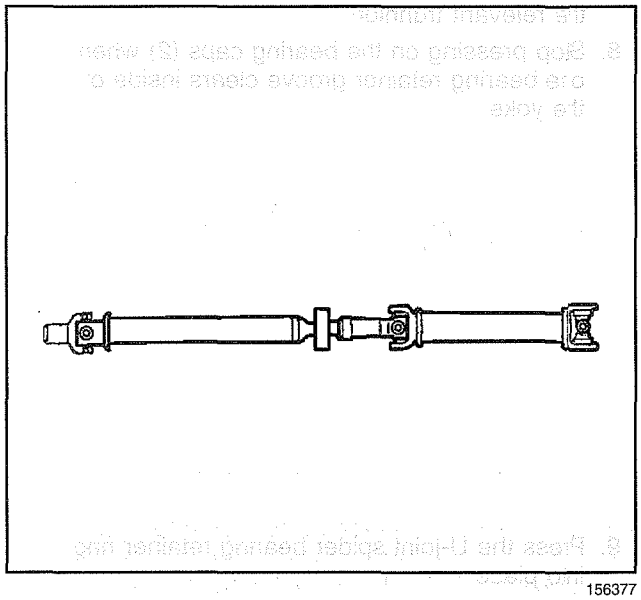
Important: When undercoating a vehicle, keep the propeller shaft free from undercoating material. Undercoating or any other foreign material will upset the propeller shaft balance and may produce serious vibrations.

The propeller shaft is a hollow shaft or tube that connects the transmission to the differential. The propeller shaft connects to the transmission with a splined slip yoke and connects to the rear axle with a universal joint.

Propeller shafts have universal joints at each end in order to accommodate angle variations between the transmission and rear axle, and the rear axle position caused by suspension motion. All propeller shafts are the balanced tubular type.

Vehicles with the 5.7L (VIN G) engine and both the 6–speed (MM6) and the automatic transmission (M30) are equipped with a one-piece propeller shaft of either stamped steel design or a lightweight aluminum.

Two Piece Propeller Shaft

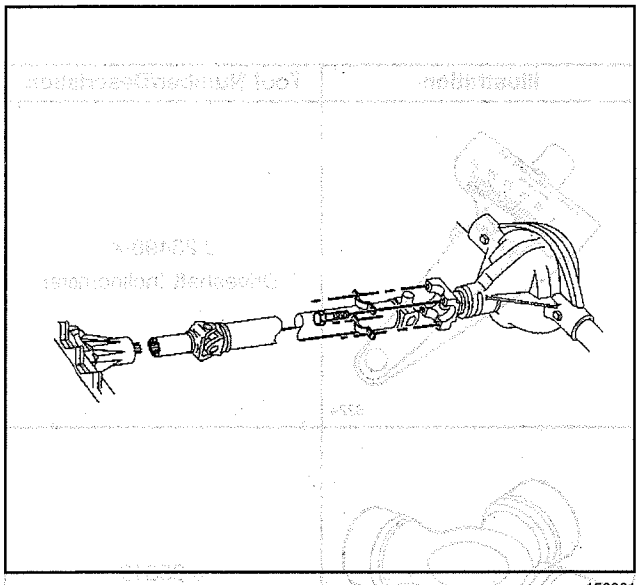


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Vehicles equipped with the 3800 (VIN K) engine and the 5–speed manual transmission (M49) are equipped with a two-piece propeller shaft assembly. The two-piece shaft assembly consists of a front propeller shaft, a rear propeller shaft, and a center support bearing. The center support bearing prevents angular movement (or "whipping") of the propeller shaft. The support bearing is a ball bearing type. The support bearing mounts in a rubber cushion. The rubber cushion mounts to the torque arm.

The bearing is prelubricated and sealed by the manufacturer.

The spline coupling has internal splines which accept the rear propeller shaft.



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A propeller shaft joint (sometimes referred to as constant velocity joint) is located on the front of the rear propeller shaft. The propeller shaft joint fits into the spline coupling of the front propeller shaft. The propeller shaft joint (or constant velocity joint) allows adjustment of the propeller shaft angle without interrupting the power flow. The up and down movement of the vehicle requires the above action.

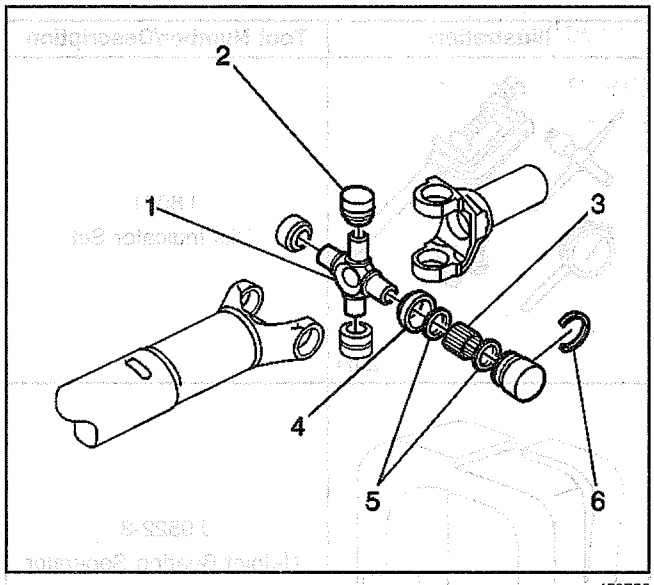
Vehicles with two or more propeller shafts use a center bearing. The center bearing is usually near the rear of the front propeller shaft. The slip joint is at the forward end of the rear propeller shaft.

Propeller Shaft Phasing Description

The propeller shaft is designed and built with the yoke lugs (ears) in line with each other which produces the smoothest running shaft possible. A propeller shaft designed with built in yoke lugs in line is known as in-phase.

An out of phase propeller shaft often causes vibration. The propeller shaft generates vibration from speeding up and slowing down each time the universal joint goes around. The vibration is the same as a person snapping a rope and watching the wave reaction flow to the end. An in phase propeller shaft is similar to two persons snapping a rope at the same time and watching the waves meet and cancel each other out. A total cancellation of vibration produces a smooth flow of power in the drive line. Since phasing of a propeller shaft is between the front and center universal joints, you must reference mark the front and rear propeller shafts before removal in order to ensure proper phasing upon reinstallation. Some splined shaft slip yokes are keyed in order to ensure proper phasing.

Universal Joint Description



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Universal joints are designed to handle the effects of various loadings and rear axle windup during acceleration and braking. Within the designed angle variations, the universal joint operates efficiently and safely. When the design angle changes or is exceeded, the operational life of the joint may decrease.

The trunnion bearings (3) used in universal joints are the needle roller type. Round bearing cups (2) hold the needle rollers in place on the trunnions. Either snap rings (6) or injected plastic hold the bearing cups in the yokes.

The Original Equipment Manufacturer (OEM) universal joints are lubricated for life and cannot be lubricated on the vehicle. A service kit which consists of a spider (1) with bearing assemblies,snap rings and derlin washers (4 and 5) may be installed if a universal joint becomes worn or noisy. If it is necessary to repair a universal joint, you must remove the propeller shaft from the vehicle. Avoid jamming, bending, or over-angulating any parts of the propeller shaft assembly. Avoid damaging the propeller weld yokes and slip yoke ears upon installation or removal of U-joints.

Center Bearing Description

Center bearings support the driveline when using two or more propeller shafts. The center bearing is a ball bearing assembly mounted in a rubber cushion that attaches to the rear axle torque arm in the Camaro and Firebird models. The manufacturer prelubricates and seals the bearing. The cushion allows vertical motion at the driveline and helps isolate the vehicle from driveline vibrations. Since the center bearing is a sealed assembly, it must be replaced as an assembly as it can not be overhauled.

Special Tools and Equipment

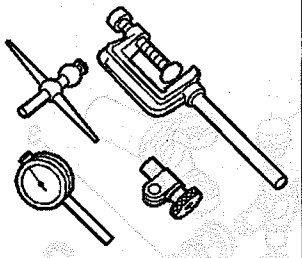
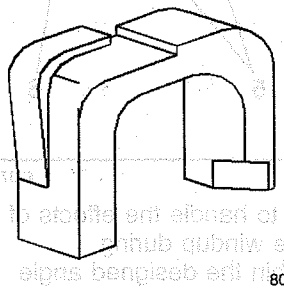
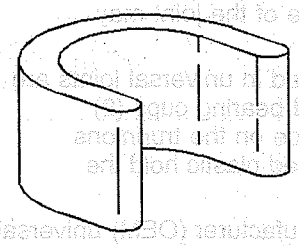
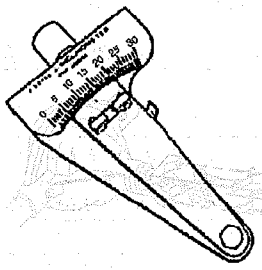
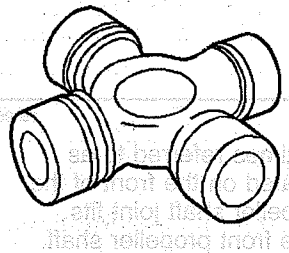
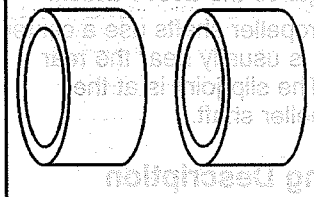
Illustration	Tool Number/Description
 25473	J 8001 Dial Indicator Set
 803	J 9522-3 U-Joint Bearing Separator
 805	J 9522-5 U-Joint Bearing Spacer Remover

Illustration	Tool Number/Description
 8224	J 23498-A Driveshaft Inclinometer
 1512	J 35819 Runout Gage
 180346	J 35819-100 Runout Gage Adapter Sleeves

Rear Drive Axle

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Important: Use a reliable torque wrench in order to tighten the parts listed. A reliable torque wrench will ensure proper tightening of the parts without straining or distorting the parts. The following specifications are for clean and lightly-lubricated threads only. Dry or dirty threads produce increased friction. Friction prevents the measurement of tightness.		
Differential Carrier Bearing Cap Bolt/Screw	75 N·m	55 lb ft
Differential Drive Pinion Gear Setting Gauge Nut	2.3 N·m	20 lb in
Differential Pinion Gear Shaft Lock Bolt/Screw	36 N·m	27 lb ft
Differential Ring Gear Bolt/Screw	120 N·m	89 lb ft
Rear Axle Housing Cover Bolt/Screw	30 N·m	22 lb ft
Rear Axle Housing Drain Plug	35 N·m	26 lb ft
Sensor Plug Mounting Bolt/Screw	10 N·m	89 lb in
Wheel Bolt	140 N·m	100 lb ft
Wheel Speed Sensor Mounting Plug	10 N·m	89 lb in

Rear Axle Specifications (General Specifications)

Application	Specification	
	Metric	English
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 and Limited Slip Differential	Synthetic 75W-90 Gear Lubricant (GM P/N 12378261) meeting GM spec. 9986115, or equivalent	
Limited Slip Differential Additive (GM P/N 1052358), or equivalent	118 ml	4 fl. oz.

Rear Axle Specifications (Bearing Shim Thickness)

Metric	English
DEFINITION: The total thickness of both the production differential bearing shims removed.	
10.57 mm	0.416 in
10.92 mm	0.430 in
11.18 mm	0.440 in
11.43 mm	0.450 in
11.68 mm	0.460 in
11.94 mm	0.470 in
12.19 mm	0.480 in
12.45 mm	0.490 in
12.70 mm	0.500 in
12.95 mm	0.510 in
13.21 mm	0.520 in
13.46 mm	0.530 in
13.97 mm	0.550 in

Service Differential Bearing Shim Thickness (Standard Spacer)

Metric	English
DEFINITION: The total thickness of the service differential bearing shims to be used as a starting point.	
1.52 mm	0.060 in
1.78 mm	0.070 in
2.03 mm	0.080 in
2.29 mm	0.090 in
2.54 mm	0.100 in
2.79 mm	0.110 in
3.05 mm	0.120 in
3.30 mm	0.130 in
3.56 mm	0.140 in
3.81 mm	0.150 in
4.06 mm	0.160 in
4.32 mm	0.170 in
4.83 mm	0.190 in

Rear Axle Usage

Engine (RPO)	Transmission	Rear Axle Ratio	Rear Axle RPO	Ring Gear Diameter	Rear Brake	Teeth Ring Gear: Pinion
3800-V6 (L36)	5-SPD Manual (M49)	3.23	GU5	194 mm (7 5/8″)	Disc	42:13
3800-V6 (L36) Y87 Package	5-SPD Manual (M49)	3.23	GU5	194 mm (7 5/8″)	Disc	42:13
3800-V6 (L36)	4-SPD Automatic (M30)	3.08	GU4	194 mm (7 5/8″)	Disc	40:13
3800-V6 (L36) Y87 Package	4-SPD Automatic (M30)	3.42	GU6	194 mm (7 5/8″)	Disc	41:12
5.7L-V8 (LS1)	6-SPD Manual (MM6)	3.42	GU6	194 mm (7 5/8″)	Disc	41:12
5.7L-V8 (LS1) WS6 Package	6-SPD Manual (MM6)	3.42	GU6	194 mm (7 5/8″)	Disc	41:12
5.7L-V8 (LS1)	4-SPD Automatic (M30)	2.73	GU2	194 mm (7 5/8″)	Disc	41:15
5.7L-V8 (LS1) WS6 Package	4-SPD Automatic (M30)	3.23	GU5	194 mm (7 5/8″)	Disc	42:13

Pinion Bearing and Differential Bearing Preload

Application	Specification	
	Metric	English
Differential Drive Pinion Gear Inner and Outer Bearing Preload (Measured at the Drive Pinion Gear Nut)		
New Bearings (Rotating Torque With a New Seal)	1.7–3.4 N·m	15–30 lb in
Used Bearings (Rotating Torque With a New Seal)	1.0–1.7 N·m	10–15 lb in
Total Preload (Measured at the Drive Pinion Gear Nut)		
New Bearings (Rotating Torque With a New Seal)	3.6–6.2 N·m	32–55 lb in
Used Bearings (Rotating Torque With a New Seal)	1.8–3.1 N·m	16–28 lb in
Differential Ring Gear-to Differential		
Drive Pinion Gear Backlash	0.13-0.23 mm	(0.005–0.009 in)

GM SPO Group Numbers

Application	GM SPO Group Number
Axle Shaft	5.000
Differential Carrier	5.000
Drive Pinion	5.000
Inner Bearing	5.000
Oil Seal and Bearing	5.000
Outer Bearing	5.000
Pinion Flange	5.000
Rear Axle	5.000
Rear Cover and Gasket	5.000

Diagnostic Information and Procedures

Noise Diagnosis

Many noises that are reported as coming from the rear axle actually originate from other components:

- The tires and wheels
- The road surfaces
- The wheel bearings
- The engine
- The transmission
- The muffler
- The body

Thoroughly inspect for the source of the noise before disassembling the rear axle. Noise that originates in other places cannot be corrected by adjustment or replacement of rear axle components. The rear axle differential gears are not absolutely quiet (like any other mechanical devices). The rear axle differential gears should be accepted as commercially quiet unless some abnormal noise exists.

Use the following procedure in order to inspect for axle noise under standard conditions:

1. Measure the rear axle lubricant in order to ensure the correct level.
2. Drive the vehicle far enough in order to thoroughly warm up the rear axle lubricant.

   Select a level asphalt road, which reduces tire noise and body drumming.
3. Note the speed at which the noise occurs.
4. Stop the vehicle.
5. Determine if the exhaust muffler roar or other engine conditions cause the noise:
   - 5.1. Place the transmission range selector lever in NEUTRAL
   - 5.2. Run the engine slowly up and down through the engine speeds that correspond to the speed at which the noise was most pronounced.
6. Determine if the tires cause the noise:
   - 6.1. Temporarily inflate all of the tires to approximately 345 kPa (50 psi).

     This will alter the noise caused by the tires, but will not affect the noise made by the rear axle.
   - 6.2. Test drive the vehicle. Coast at speeds under 48 km/h (30 mph).

     The following characteristics of tire and rear axle noise may help in determining if the tires cause the noise:
     - Rear axle noise usually stops when the vehicle is coasting at speeds under 48 km/h (30 mph).
     - Tire noise usually continues. The tone of the tire noise becomes lower as the speed of the vehicle is reduced.
     - Rear axle noise usually sounds different during driving and during coasting. Tire noise remains the same during driving and during coasting.
     - Exhaust and axle noises change during sudden acceleration and deceleration. Tire noise remains constant during sudden changes in vehicle speed.
     - Tire noise is the most noticeable at the speeds of 32–48 km/h (20–30 mph).
     - Tire noise changes on different road surfaces, but rear axle noise does not change. Drive the vehicle over smooth pavement or dirt roads (not gravel) with the tires at normal pressure. Tire noise will noticeably change, or will disappear and reappear with the road surface.
7. Determine if loose or rough front wheel inner or outer bearings cause the noise.
   - Noise in front wheel inner or outer bearings does not change between drive and coast.
   - Light application of the brake pedal while holding the vehicle speed steady takes some weight off of the bearings. This action will often cause noise in front wheel inner or outer bearings to diminish.
   - Use the following steps in order to determine if the front wheel inner and outer bearings are loose:
     - 7.1. Jack up the tires and the wheels.
     - 7.2. Spin or shake the tires and the wheels in order to determine if the bearings are loose.
8. Rear axle noise is dampened when the rear suspension rubber bushings and the spring insulators are correctly installed.

   Determine if any metallic contact exists between the following components:
   - The spring and the spring opening in the underbody
   - The lower control arm bushings and the underbody or axle housing brackets

   Metal-to-metal contact at these points may increase road noise and normal axle noise.

Rear Axle Noises

After verifying that a noise exists in the rear axle, determine the type of the noise. Determining the type of the rear axle noise will aid in repair.

Gear Noise

Gear noise (whine) is audible from 32–89 km/h (20–55 mph) under the following driving conditions:

- Drive — Acceleration or heavy pull
- Road Load — The vehicle driving load or the constant speed
- Float — Using enough throttle in order to keep the vehicle from driving the engine, the vehicle slows down gradually but the engine still pulls slightly.
- Coast — The throttle closes and the vehicle is in gear.

Gear noise is most noticeable when the vehicle is operating at the following speeds:

- 64–80 km/h (40–50 mph)
- 97–105 km/h (60–65 mph)

Bearing Noise

Poor bearings generally produce a rough growl or grating sound, rather than the whine typical of gear noise.

Bearing noise frequently "wow-wows" at constant RPMs. This noise may indicate that the following components are faulty:

- The differential drive pinion gear
- The side bearings

The "wow-wow" bearing noise may be confused with rear wheel bearing noise. Inspect and replace as necessary.

Rear Wheel Bearing Noise

The noise that is produced by a rough rear wheel bearing is evident under the following conditions:

- The vehicle is coasting at low speeds
- The transmission range selector lever is in NEUTRAL

The bearing noise may diminish with gentle braking.

Use the following steps in order to determine if a noise is caused by a rough rear wheel bearing:

1. Raise the rear tires and wheels.
2. Spin the rear tires and wheel by hand.
3. Listen at the hubs for evidence of rough (noisy) rear wheel bearings.

Knock At Low Speeds

One of the following conditions may cause a knock at low speeds:

- A worn universal joint
- A worn or oversized side gear hub counterbore in the differential case

Inspect and replace the above components as necessary.

Backlash Clunk

One of the following conditions may cause excessive backlash clunk with acceleration and deceleration:

- A worn differential drive pinion gear shaft
- A worn differential case
- Excessive clearance between the following components:
  - The rear axle shaft splines and the side gear splines
  - The side gear hub and the counterbore in the case
- A worn differential drive pinion gear and worn side gear teeth
- Worn differential pinion gear thrust washers
- Excessive differential ring gear-to-differential drive pinion gear backlash

Replace the worn components as necessary. Select close fitting replacement parts.

Adjust the differential ring gear-to-differential drive pinion gear backlash. Refer to *Backlash Adjustment*

Repair Instructions

Lubricant Level Check

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Clean any dirt or foreign material from around the rear axle housing drain plug.
3. Remove the rear axle housing drain plug.
4. Verify that the axle lubricant level is within the following range:
   - No higher than the bottom of the plug opening
   - No lower than 15 mm (9/16 in) below the plug opening
5. If necessary, add to or replace the axle lubricant. Use synthetic 75W-90 gear lubricant (GM P/N 12378261), meeting GM specification 9986115, or equivalent.
6. If the vehicle has a limited slip differential, add 118 ml (4 fl oz) of limited slip differential additive (GM P/N 1052358), or equivalent.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

7. Install the rear axle housing drain plug.

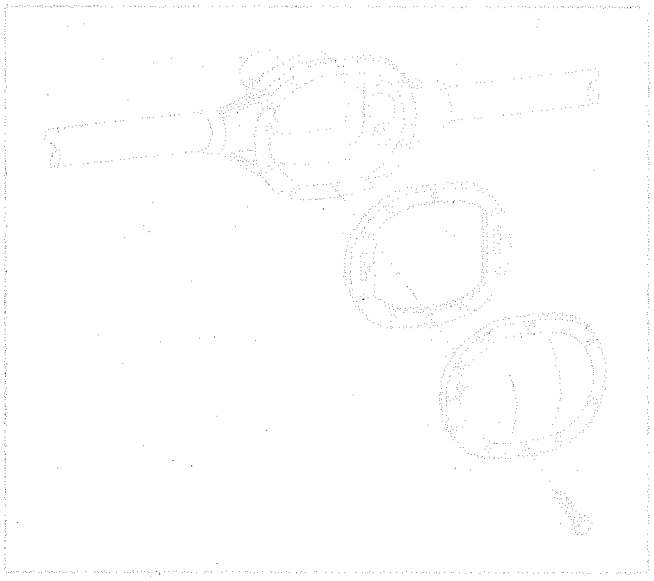
   Tighten

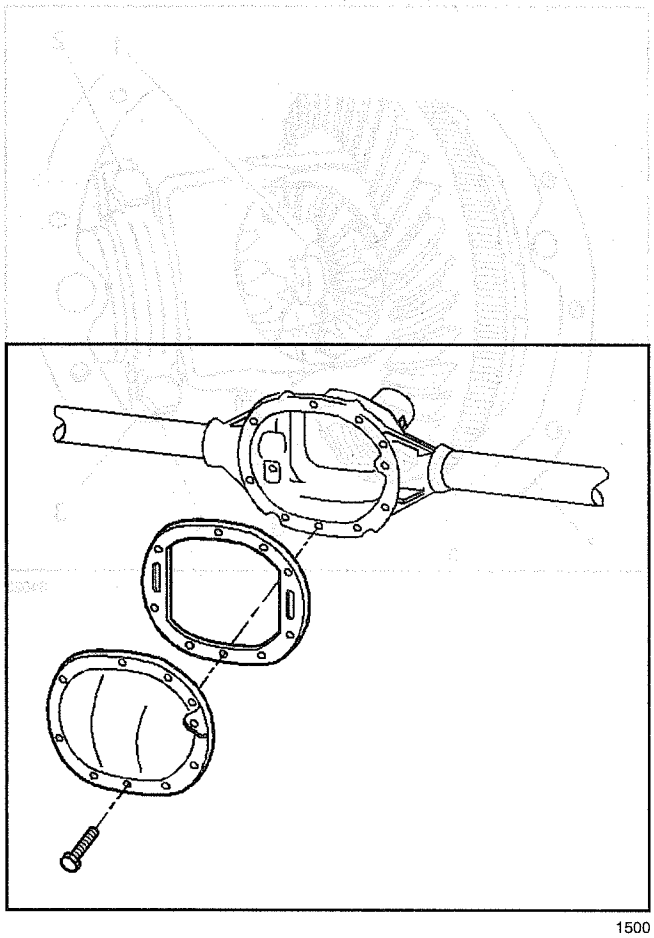
   Tighten the rear axle housing drain plug to 35 N·m (26 lb ft).
8. Lower the vehicle.

Rear Axle Housing Cover and Gasket Replacement

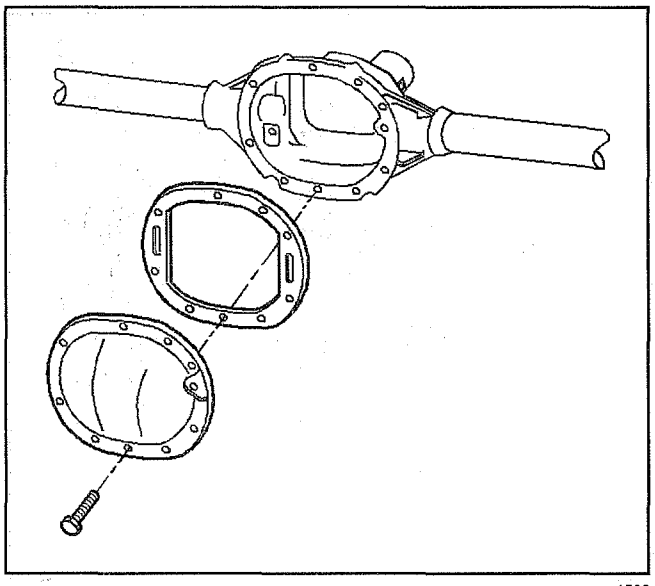
Removal Procedure

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Clean all of the dirt from the area of the rear axle housing cover before removing the cover.
3. Remove the following components:
   - The rear axle housing cover bolts/screws
   - The parking brake cable guides
4. Pry the rear axle housing cover loose. Remove the rear axle housing cover.
5. Allow lubricant to drain.
6. Remove the rear axle housing cover gasket.
7. Clean both of the gasket sealing surfaces with brake parts cleaner.

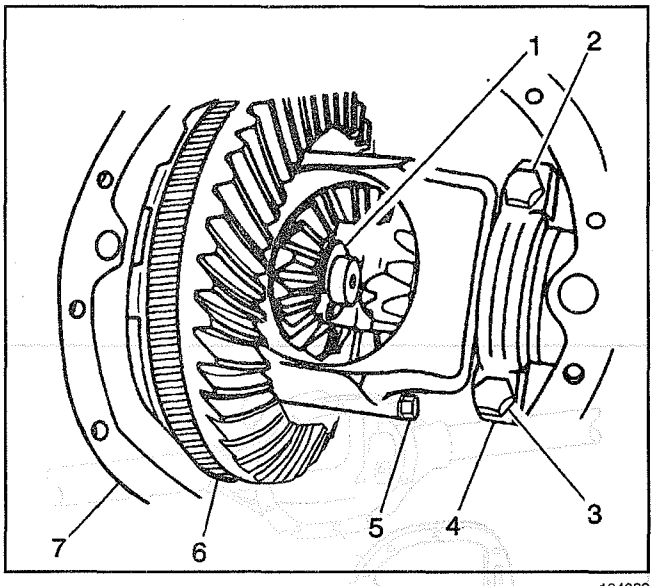




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Installation Procedure

1. Install a new rear axle housing cover gasket.
2. Install the rear axle housing cover.
3. Install the park brake cable guides.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the rear axle housing cover bolts/screws.

   Tighten

   Tighten the rear axle housing cover bolts/screws in a crosswise pattern to 30 N·m (22 lb ft).
5. Refill rear axle with lubricant. Refer to *Lubricant Level Check.*
6. Lower the vehicle.

Axle Shaft Replacement

Removal Procedure

Tools Required

J 39446 ABS Exciter Ring Protector Kit

1. Remove the rear tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
2. Remove the rear brake rotor. Refer to *Brake Rotor Replacement (Rear)* in Disc Brakes.
3. Remove the rear axle housing cover. Refer to *Rear Axle Housing Cover and Gasket Replacement.*
4. Install a *J 39446* onto the speed sensor reluctor wheel (6) on vehicles that are equipped with non-traction control axles.
5. Remove the pinion gear shaft lock bolt/screw (5) from the differential case.
6. Remove the pinion gear shaft from the differential case.
7. Push the flanged end of the axle shaft into the rear axle housing (7) in order to access the rear axle shaft lock.
8. Remove the rear axle shaft lock (1).

Important: Do not damage the rear wheel speed sensor reluctor wheel (6) during axle shaft removal on vehicles that are equipped with traction control.

The rear wheel speed sensor reluctor wheel is located on the axle shaft.

If the rear wheel speed sensor reluctor wheel is damaged, replace the rear axle shaft.

9. Remove the rear axle shaft from the rear axle housing (7).

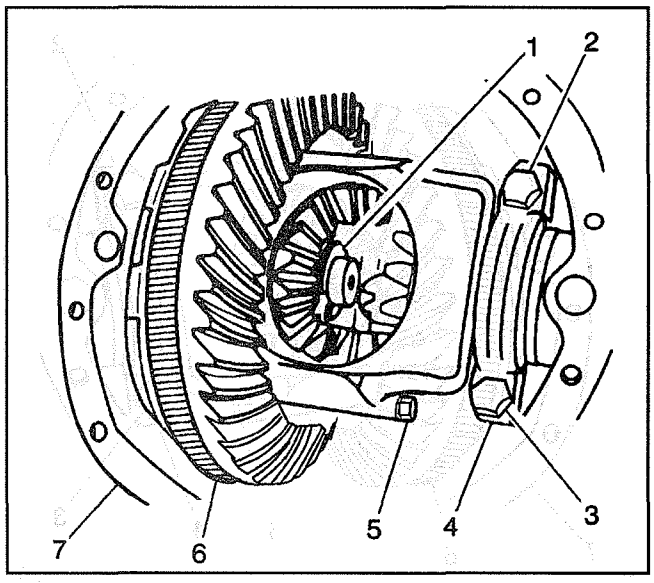
Installation Procedure

1. Install the rear axle shaft into place.
   Ensure that the following conditions are met:
   - The splines on the end of the axle shaft do not damage the rear wheel bearing seal.
   - The splines on the end of the axle shaft engage with splines of the differential side gear.
2. Install the rear axle shaft lock (1).
   Push the axle shaft outward so that the rear axle shaft lock (1) seats in the counterbore of the differential side gear.
3. Install the pinion gear shaft through the following components:
   - The differential case
   - The pinion gear thrust washers
   - The pinion gears

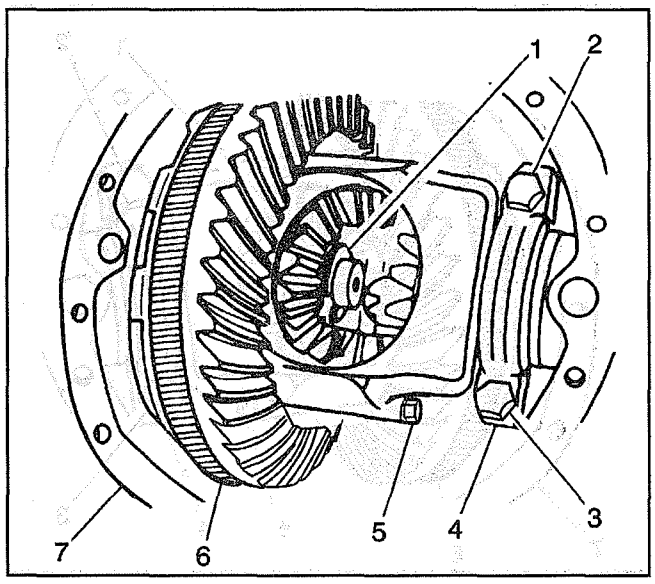
   Align the hole in the pinion gear shaft with the rear axle shaft lock bolt/screw hole in the differential case.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

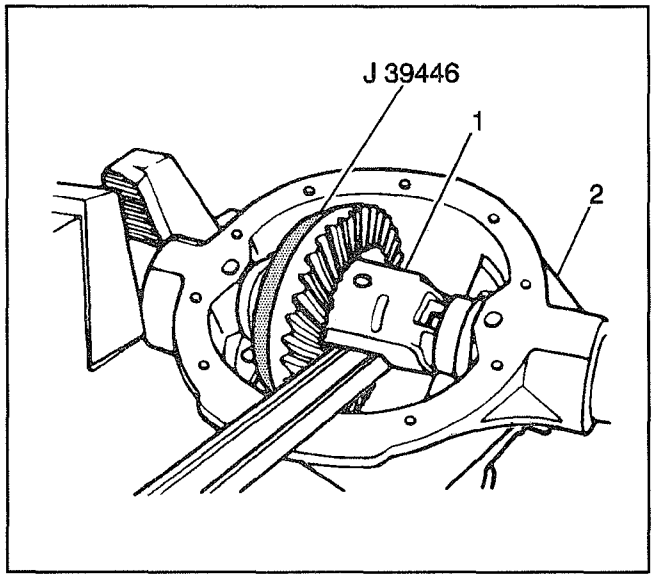
4. Coat the pinion gear shaft lock bolt/screw (5) with Loctite 242 or an equivalent.
5. Install the pinion gear shaft lock bolt/screw (5).
   Tighten
   Tighten the differential pinion gear shaft lock bolt/screw (5) to 36 N·m (27 lb ft).
6. Remove *J 39446* from the speed sensor reluctor wheel (6) if the vehicle has a standard rear axle.
   If a new speed sensor reluctor wheel (6) was installed, remove and discard the plastic covering.
7. Install the rear axle housing cover. Refer to *Rear Axle Housing Cover and Gasket Replacement.*
8. Install the rear brake rotor. Refer to *Brake Rotor Replacement (Rear)* in Disc Brakes.
9. Install the rear tire and the rear wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.



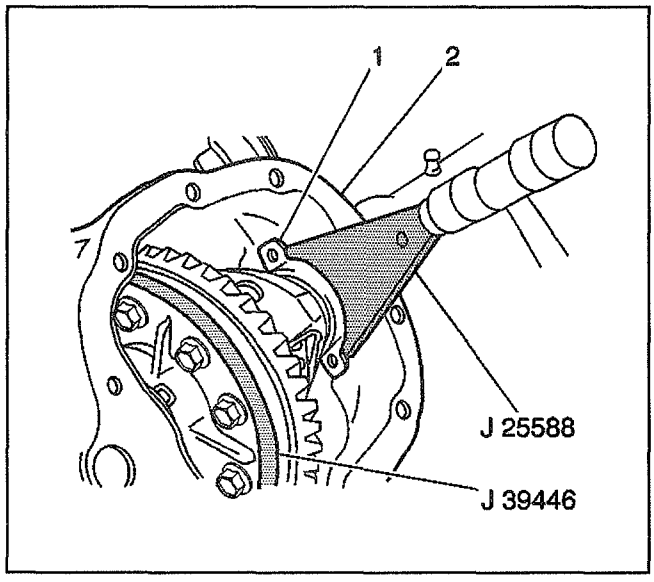
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Differential Carrier Replacement

Removal Procedure

1. Raise and suitably support vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Place drain pan under rear axle cover.
3. Remove the rear axle cover and the gasket. Drain the rear axle fluid. Refer to *Rear Axle Housing Cover and Gasket Replacement.*
4. Remove rear axle shafts. Refer to *Axle Shaft Replacement.*
5. Remove the differential carrier bearing cap bolts (2,3).

Important: Move the bearing caps (4) back and forth slightly to loosen and remove. Never use screwdrivers to pry on the parting surfaces of the cap and the housing because surface damage will occur.

6. Remove the differential carrier bearing caps (4).

Important: Group the shims together with the original installed location labeled. If you remove or replace the ring and pinion gearset, perform the bearing preload, backlash, and tooth contact pattern test in order to ensure proper contact of the gears. If you reinstall or replace the differential carrier without replacing any other component (e.g. pinion & ring gear set, bearings, etc) then you may reinstall the carrier with the original shims in the original locations. Always perform a tooth contact pattern test, even when you remove only the carrier.

7. Remove the differential carrier (1) and the shims from the rear axle housing (2).

Installation Procedure

Tools Required

J 25588 Side Bearing Shim Installer

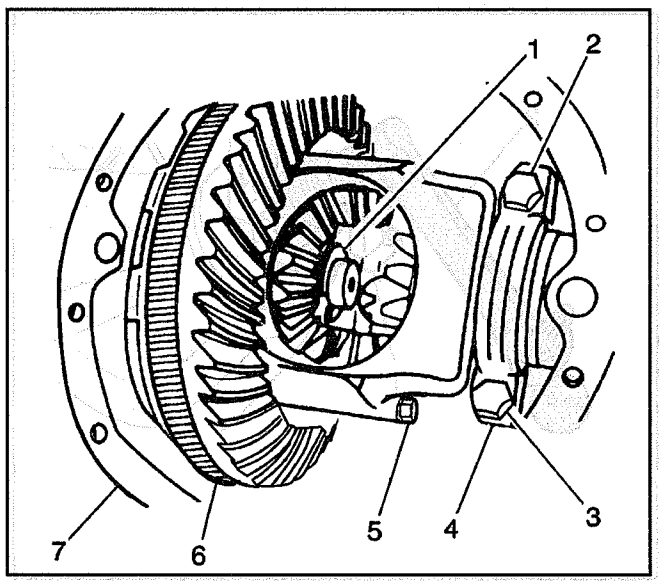
1. Install the differential carrier and the shims (1) into the housing (2) with the shims in the original location with *J 25588* and a deadblow hammer.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the differential bearing caps (4) and cap bolts (2,3).

   Tighten

   Tighten the differential bearing cap bolts to 75 N·m (55 lb ft).
3. Perform a backlash adjustment. Refer to *Backlash Adjustment.*
4. Perform a tooth contact pattern test. Refer to *Gear Tooth Contact Pattern Check.*
5. Install the rear axle shafts. Refer to *Axle Shaft Replacement.*
6. Install the rear axle cover and the gasket. Refer to *Rear Axle Housing Cover and Gasket Replacement.*
7. Lower the vehicle.
8. Road test the vehicle in order to ensure proper differential operation. If any whines or howls are now present, repeat the backlash and contact pattern test.



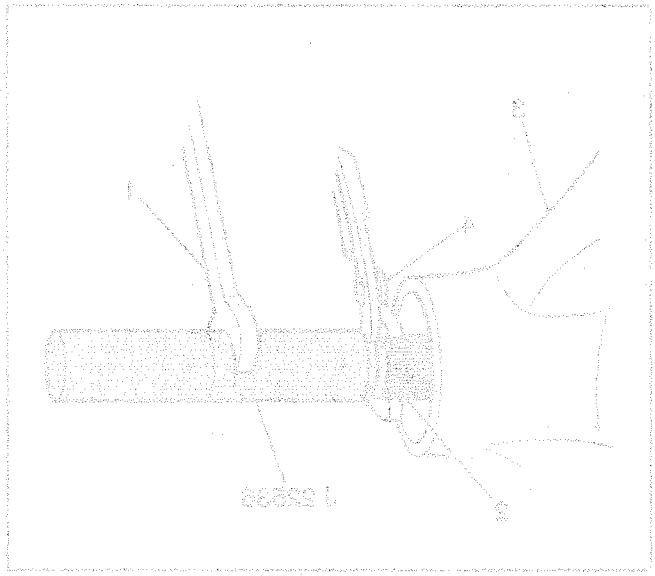
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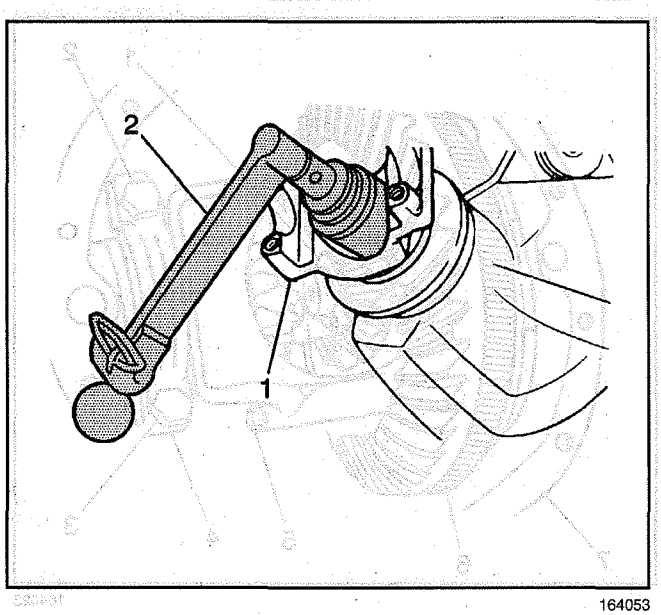
Rear Axle - Disassemble

Disassembly Procedure

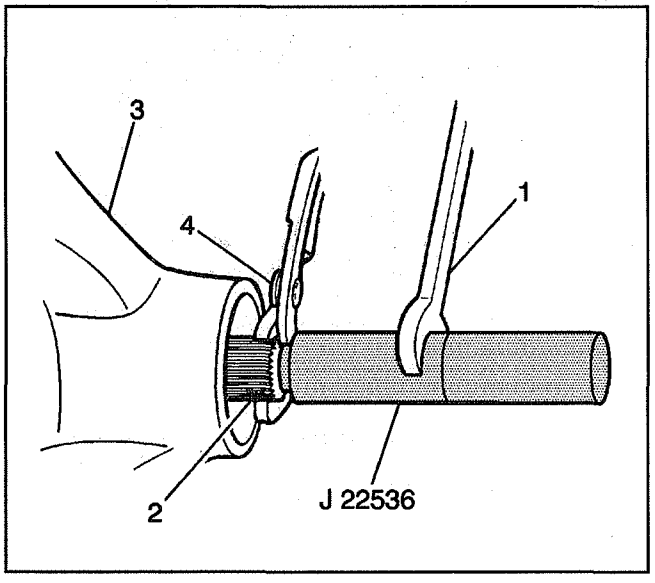
Important: It is not necessary to remove the rear axle assembly for overhaul of the rear axle components because this can be done in the vehicle. If you are replacing the rear axle housing, remove the rear axle assembly from the vehicle and overhaul the assembly on the bench. If the rear axle housing is damaged, use the following procedure in order to remove and install the rear axle housing:

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Support the rear axle with an adjustable lifting device.
3. Remove rear torque arm. Refer to *Torque Arm Replacement* in Rear Suspension.
4. Remove propeller shaft from vehicle. Refer to *Propeller Shaft Replacement - One Piece* or *Propeller Shaft Replacement - Two Piece* in Propeller Shaft.
5. If the rear axle housing is being replaced, remove the rear axle assembly from the vehicle. Refer to *Rear Axle Replacement.*
6. Remove the rear axle cover and gasket from housing. Refer to *Rear Axle Housing Cover and Gasket Replacement.*
7. Remove the axle shafts. Refer to *Axle Shaft Replacement.*
8. Remove the differential case from housing. Refer to *Differential Carrier Replacement.*
9. Remove the differential drive pinion gear and bearing races from housing. Refer to *Drive Pinion Assemble.*
10. Inspect all components for excessive wear. Replace as necessary.





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Drive Pinion Disassemble

Drive Pinion Removal Procedure

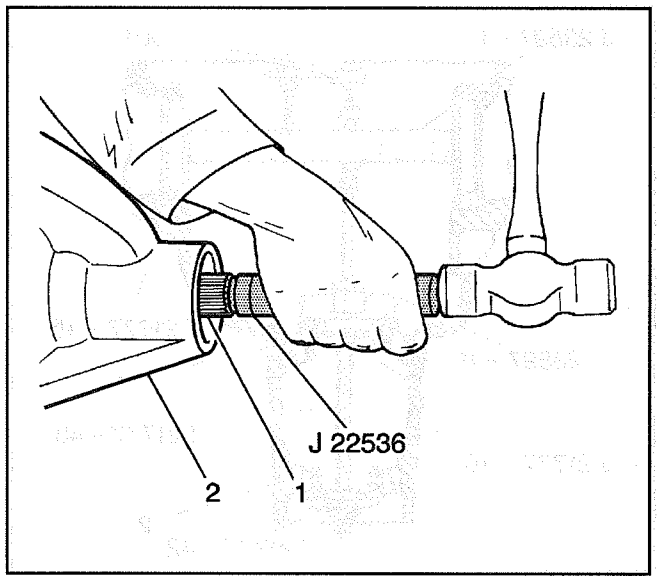
Tools Required

J 22536 Pinion Driver

1. Remove the differential case. Refer to *Rear Axle - Disassemble*.
2. Measure the differential drive pinion gear inner and outer bearing preload.
3. If no preload reading exists, then inspect for looseness of the drive pinion gear by shaking.

   The following conditions may cause looseness:
   - A worn drive pinion gear yoke
   - Defective inner or outer drive pinion gear bearings
4. If the rear axle was opened for an extended period with very loose inner and outer drive pinion gear bearings, the following components will require replacement:
   - The ring gear
   - The drive pinion gear
5. Remove the differential drive pinion gear yoke (1). Refer to *Pinion Oil Seal Replacement*.
6. With channel-locking pliers (4) and a wrench (1), Install *J 22536* to the differential drive pinion gear (2).

7. Apply heavy hand pressure on *J 22536* toward the rear axle housing (2). This pressure keeps the outer drive pinion gear (1) bearing seated in order to avoid damage to the outer race.



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Outer Bearing Removal Procedure

1. Remove the differential drive pinion gear seal from the rear axle housing.
2. Remove the drive pinion gear outer bearing from the rear axle housing.
3. Use a punch in order to remove the drive pinion gear outer bearing race from the rear axle housing, if the drive pinion gear outer bearing is being replaced.

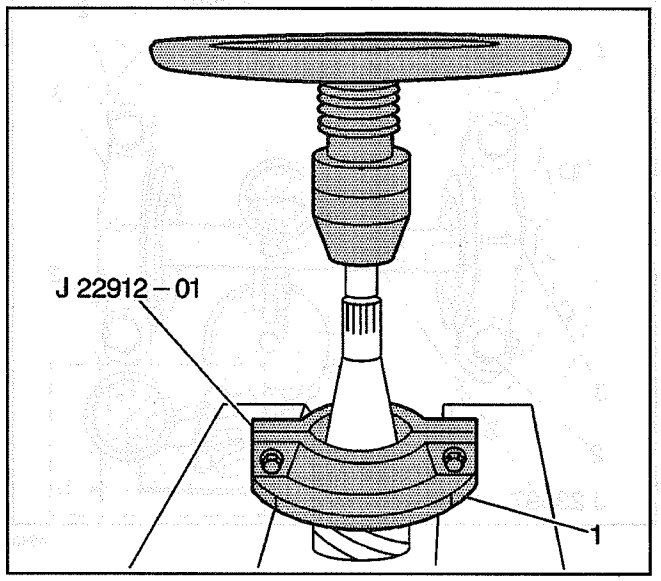
   Place the punch into the slots in the rear axle housing.

Inner Bearing Removal Procedure

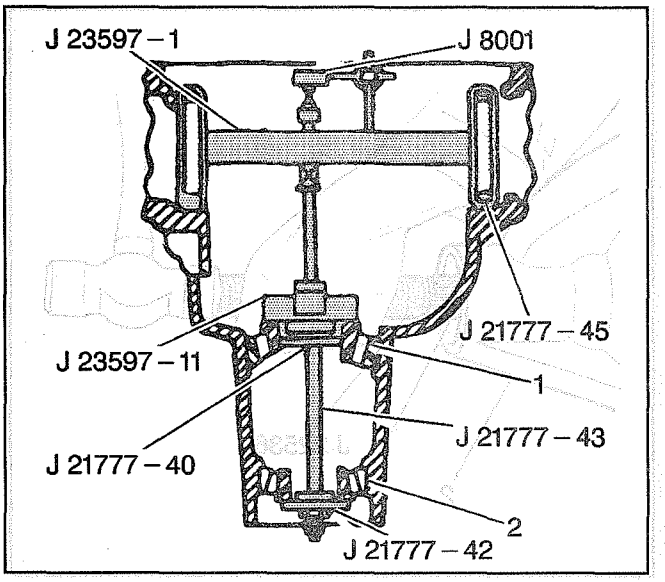
Tools Required

J 22912-01 Rear Pinion Bearing Cone Remover

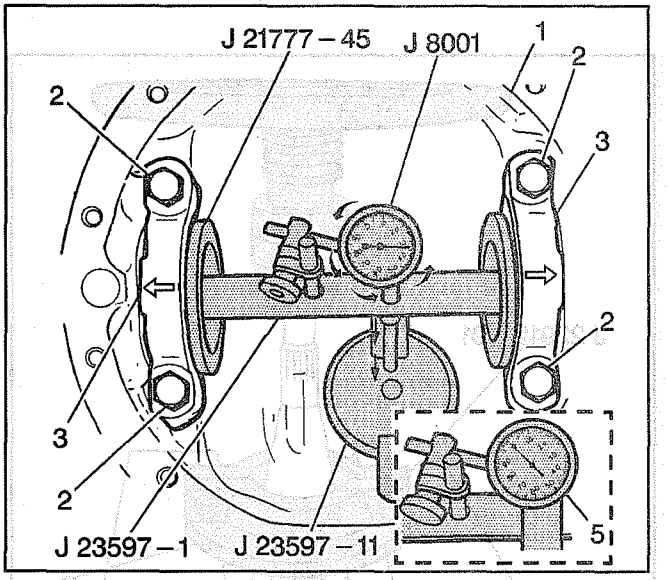
1. Remove the drive pinion gear bearing spacer from the drive pinion gear. Discard the drive pinion gear bearing spacer.
2. Use a punch in order to remove the drive pinion gear inner bearing race from the rear axle housing, if the inner drive pinion gear bearing is being replaced. Place the punch into the slots in the rear axle housing.
3. Use the *J 22912-01* in order to drive the inner drive pinion gear bearing from the drive pinion gear.



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Pinion Depth Adjustment

Tools Required

- *J 8001* Dial Indicator Set
- *J 23597-1* Pinion Setting Guage Arbor
- *J 23597-11* Pinion Setting Guage Plate
- *J 21777-40* Rear Pilot Washer
- *J 21777-42* Front Pilot Washer
- *J 21777-43* Stud Assembly-Bolt
- *J 21777-45* Side Bearing Discs

Use a pinion setting gauge in order to measure differential drive pinion gear depth. The gauge provides a normal or zero pinion as a gauging reference.

1. Install *J 21777-40*, *J 21777-42*, *J 21777-43*, and *J 21777-45*.
2. Install *J 23597-11*.
3. Install *J 21777-42* into the rear axle housing.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the drive pinion gear setting gauge nut into the rear axle housing.

   Tighten

   Tighten the differential drive pinion gear setting gauge nut to 2.3 N·m (20 lb in).
5. Rotate *J 23597-11* in order to seat the following components:
   - The differential drive pinion gear outer bearing (2)
   - The differential drive pinion gear inner bearing (1)
6. Mount *J 8001* onto *J 23597-1*.
7. Preload the dial indicator against the plunger about 1.27 mm (0.050 in).
8. Install *J 21777-45* onto *J 23597-11*.

   Position this unit into the rear axle housing.
9. Install the following components:
   - The carrier bearing caps (3)
   - The bearing cap bolts/screws (2)

   Tighten

   Tighten the differential carrier bearing cap bolt/screws (2) to 75 N·m (55 lb ft).
10. Use the following steps in order to measure the differential drive pinion gear depth:
    - 10.1. Rotate *J 23597-1* slowly back and forth until *J 8001* reads the greatest deflection. The deflection is the point where the needle changes direction.
    - 10.2. At the point of deflection, set *J 8001* to zero.
    - 10.3. Repeat the rocking action in order to verify the zero setting.
    - 10.4. After obtaining the zero setting, rotate *J 23597-1* until the plunger no longer touches *J 23597-11*.

      This action provides the gauge reference of a zero or nominal drive pinion gear.

10.5. Use the following information in order to select the correct shim:

- Record the *J 8001* reading at the pointer position.

  The required drive pinion gear shim thickness is equal to the *J 8001* reading.

  For example, if the pointer moved counterclockwise 1.70 mm (0.067 in) to a dial reading of 0.84 mm (0.033 in), a shim thickness of 0.84 mm (0.033 in) is required.

- Drive pinion gear shims are available in 0.03–0.94 mm (0.001–0.037 in).

  The thickness of each shim is etched on the flat surface of the shim.

11. Loosen the *J 21777-43*.
12. Remove all of the special tools from the rear axle housing.
13. Remove the inner (1) and the outer (2) drive pinion gear bearings from the rear axle housing.
14. Install the correct drive pinion gear shim on the drive pinion gear.
15. Use the following steps in order to set the proper drive pinion gear depth:
    15.1. Use the set-up dimension determined by *J 8001* as a starting point.
    15.2. Perform a ring gear tooth pattern test in order to fine tune the drive pinion gear depth.

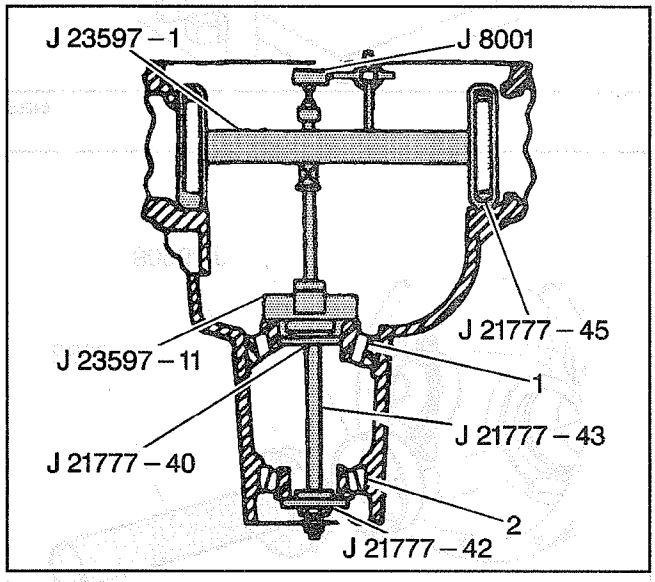
    The test may indicate additional necessary drive pinion gear shim changes.

    Refer to *Pinion and Ring Gear Inspection*.
16. Install the following components:
    - The drive pinion gear inner bearing
    - The drive pinion gear outer bearing

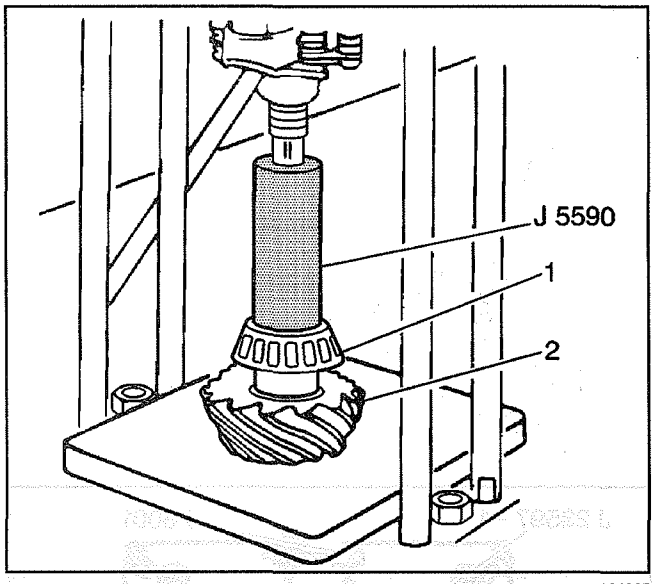
    Refer to *Drive Pinion Assemble*.
17. Assemble the differential case. Refer to *Rear Axle - Assemble*.
18. Measure the total preload at the drive pinion gear nut bearings.

    The preload should measure within the following specifications:

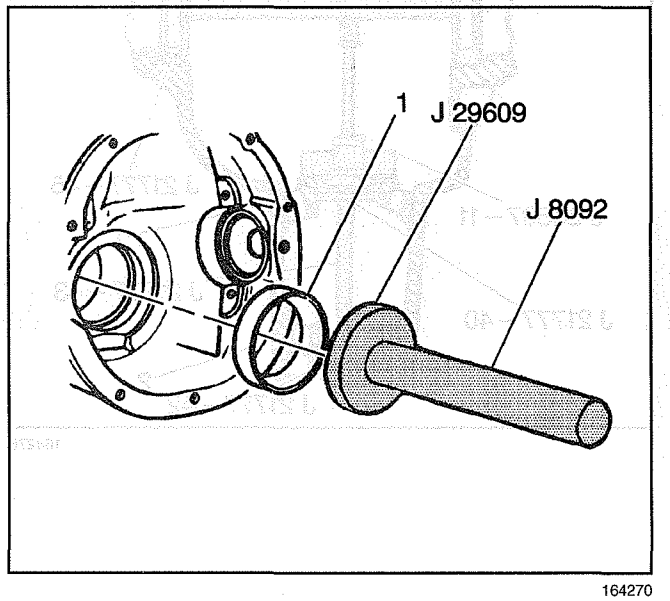
    - With new inner and outer drive pinion gear bearings and a new drive pinion gear seal, the preload should measure 3.6–6.2 N·m (32–55 lb in).
    - With used inner and outer drive pinion gear bearings and a new drive pinion gear seal, the preload should measure 1.8–3.1 N·m (16–28 lb in) when rotating with a new drive pinion gear seal.



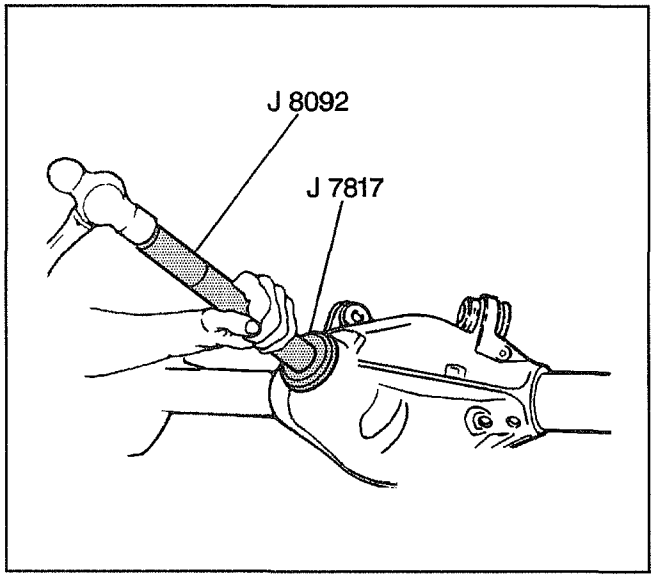
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Drive Pinion Assemble

Inner Bearing Installation Procedure

Tools Required

- *J 8092* Driver Handle
- *J 29609* Rear Pinion Bearing Cup Installer
- *J 5590* Rear Pinion Bearing Cone Installer

1. Use *J 5590* in order to install the inner drive pinion gear bearing (1) onto the drive pinion gear (2).
2. Use *J 8092* and *J 29609* in order to drive the inner bearing race (1) into the rear axle housing, if the inner drive pinion gear bearing was replaced.
3. Install the new drive pinion gear bearing spacer onto the drive pinion gear.

Outer Bearing Installation Procedure

Tools Required

- *J 8092* Driver Handle
- *J 7817* Front Pinion Bearing Cup Installer

1. Use *J 8092* and *J 7817* in order to install the drive pinion gear outer bearing race into the rear axle housing if you remove the pinion gear outer bearing race.
2. Install the drive pinion gear outer bearing into the rear axle housing.
3. Install the differential drive pinion gear seal.

Drive Pinion Installation Procedure

Tools Required

J 7817 Front Pinion Bearing Cup Installer

1. If a new ring gear and a new drive pinion gear will be installed, measure the differential drive pinion gear depth.

   (Refer to *Pinion Depth Adjustment).*
2. Install the drive pinion gear into the rear axle housing.
3. Use *J 7817* in order to install the new drive pinion gear seal (1).
4. Apply pipe sealant (GM p/n 12346004) or an equivalent onto the pinion shaft splines.
5. Install the drive pinion gear yoke.
6. Install the drive pinion gear washer and nut.

   Finger tighten the drive pinion gear washer and nut.
7. Perform the following actions in order to tighten the drive pinion gear nut.
   - Hold the drive pinion gear yoke in place.
   - Rotate the drive pinion gear in order to seat the inner and outer drive pinion gear bearings.
   - While rotating the drive pinion gear, tighten the drive pinion gear nut until the end play is taken up.

Important:

- Preload specifications are being approached when the following conditions occur:
  - The holder will no longer pivot freely as the drive pinion gear rotates.
  - No further end play exists

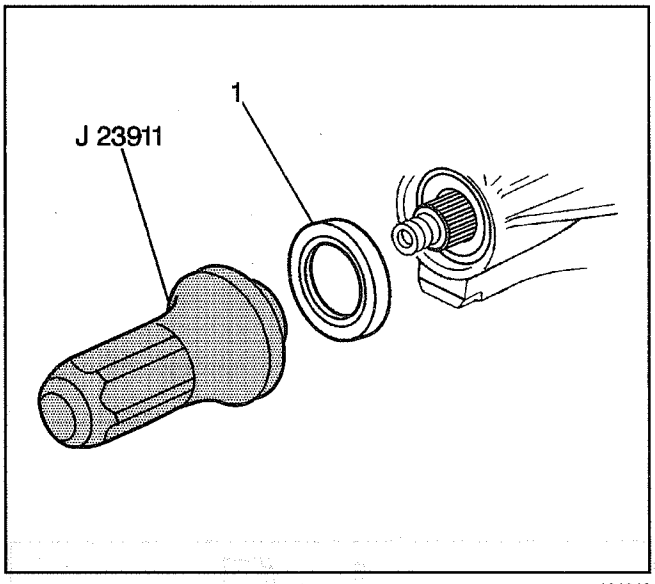
  Do not attempt further tightening until after measuring the preload if the above conditions exist.
- Exceeding the preload specifications will compress the collapsible drive pinion gear bearing spacer too far.

8. Set the preload to the following specifications on the inner and outer drive pinion gear bearings:
   - 1.7–3.4 N·m (15–30 lb in) on new inner and outer drive pinion gear bearings
   - 1.0–1.7 N·m (10–15 lb in) on used inner and outer drive pinion gear bearings
9. Rotate the drive pinion gear several times.

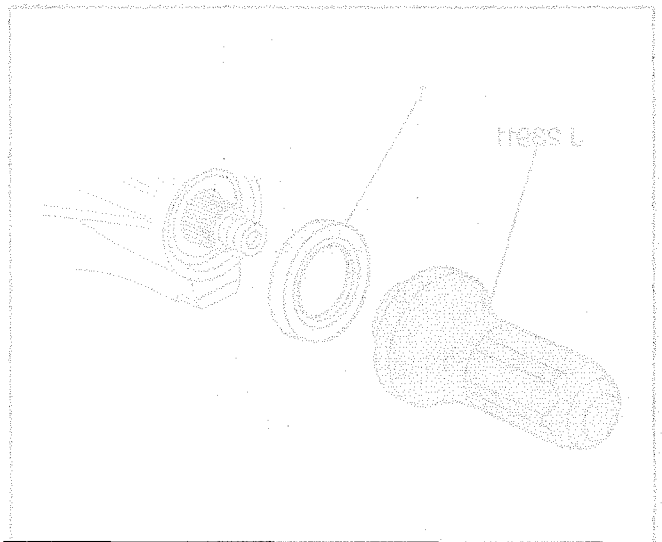
   Ensure that the inner and outer drive pinion gear bearings seat.
10. Carefully tighten the drive pinion gear nut.
11. Continue to gradually tighten the drive pinion gear nut.

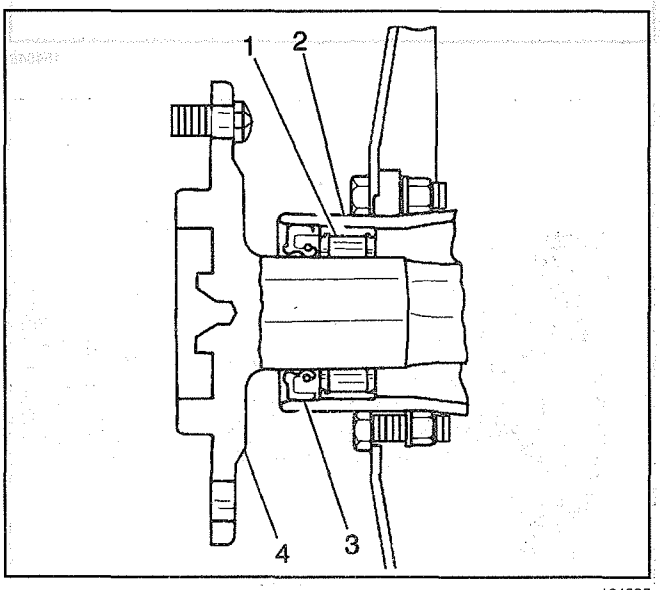
    Measure the preload after each tightening.

    (Additional tightening of the drive pinion gear nut may add additional torque).
12. Measure the preload again.
13. Reset the preload to specifications if the preload decreased by rotating the drive pinion gear.
14. Install the differential case. Refer to *Rear Axle - Assemble.*

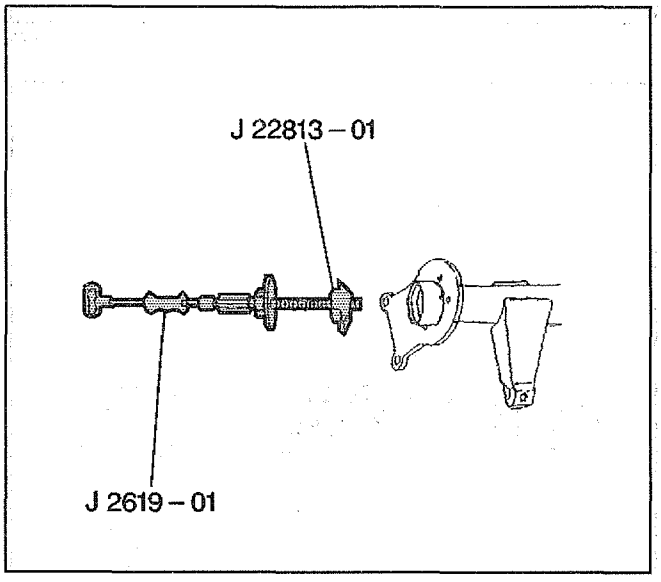


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Rear Axle - Assemble

Assembly Procedure

1. Inspect all components for excessive wear and replace as necessary.
2. Perform pinion depth measurement and adjustment. Refer to *Pinion Depth Adjustment.*
3. Install the differential drive pinion gear, bearing races, and new pinion seal from housing. Refer to *Drive Pinion Assemble.*
4. Install the differential carrier to housing. Refer to *Differential Carrier Replacement.*
5. Perform side bearing preload adjustment and measurement. Refer to *Differential Side Bearing Preload Adjustment.*
6. Perform a backlash adjustment and measurement. Refer to *Backlash Adjustment.*

Oil Seal and/or Bearing Replacement

Removal Procedure

Tools Required

- *J 2619-01* Slide Hammer
- *J 22813-01* Axle Bearing Remover

1. Remove the rear axle shaft. Refer to *Axle Shaft Replacement.*
2. Place a pry bar behind the steel case of the seal (3). Use the pry bar in order to remove the rear wheel bearing seal (3) from the rear axle housing (2).

   Do NOT damage the housing (2).

3. Insert *J 22813-01* into the bore.

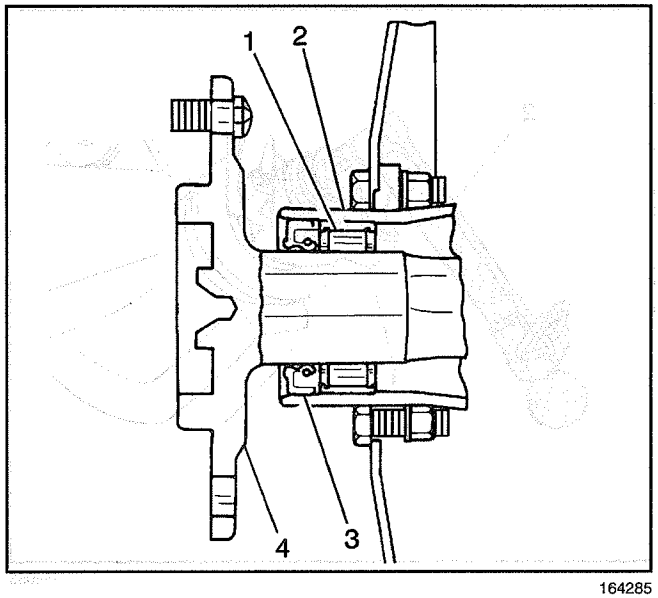
   Position *J 22813-01* behind the rear wheel bearing so that the tangs on the tool engage the bearing outer race.
4. Use *J 2619-01* in order to remove the rear wheel bearing.

Installation Procedure

Tools Required

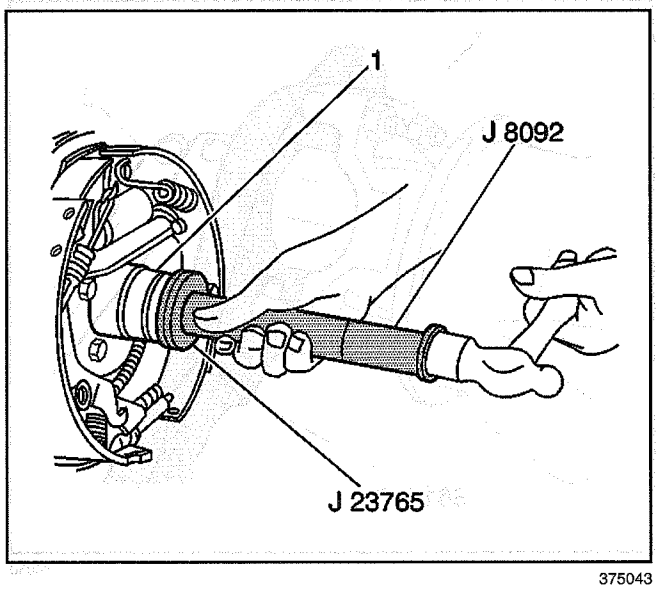
- *J 8092* Driver Handle
- *J 23765* Axle Bearing Installer
- *J 23771* Axle Oil Seal Installer

1. Lubricate the new rear wheel bearing (1).
   Use one of the following lubricants:
   - Axle lubricant
   - SAE 80W-90 GL-5 gear lubricant or an equivalent



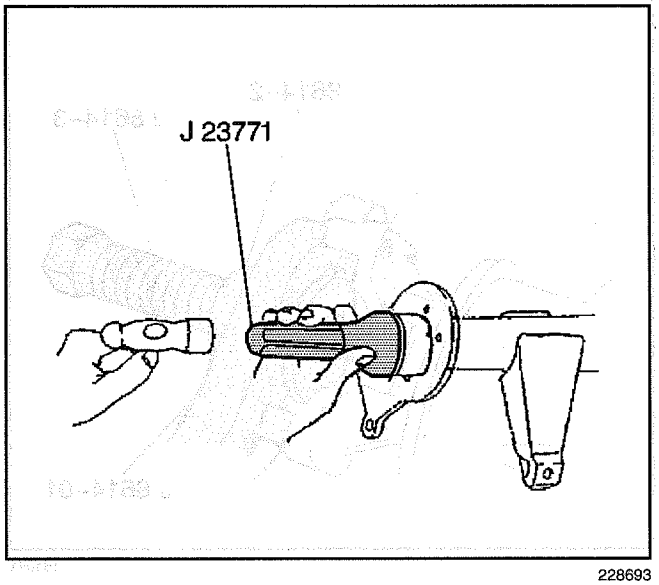
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2. Use *J 23765* and *J 8092* in order to install the rear wheel bearing.
   Ensure that the tool bottoms against the shoulder in the rear axle housing.
3. Lubricate the sealing lips. Use one of the following lubricants:
   - Axle lubricant
   - SAE 80W-90 GL-5 gear lubricant or an equivalent

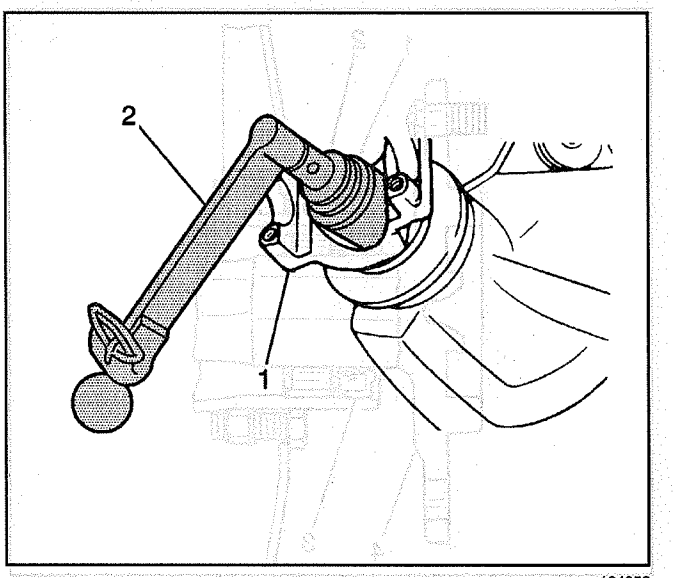


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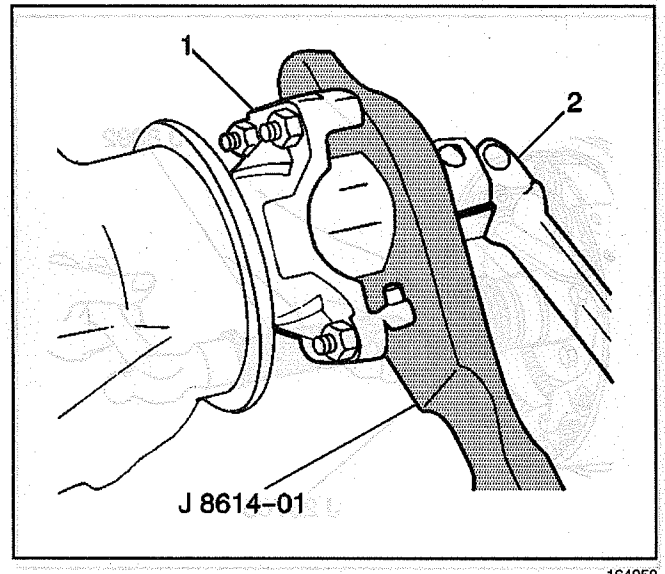
4. Position the rear wheel bearing seal onto *J 23771*.
5. Use *J 23771* in order to direct the bearing seal (3) into the housing bore.
6. Install the rear wheel bearing seal into place.
   Ensure that the rear wheel bearing seal is flush with the axle tube.
7. Install the rear axle shaft. Refer to *Axle Shaft Replacement*.
8. Road test and Inspect for correct operation of the rear axle.



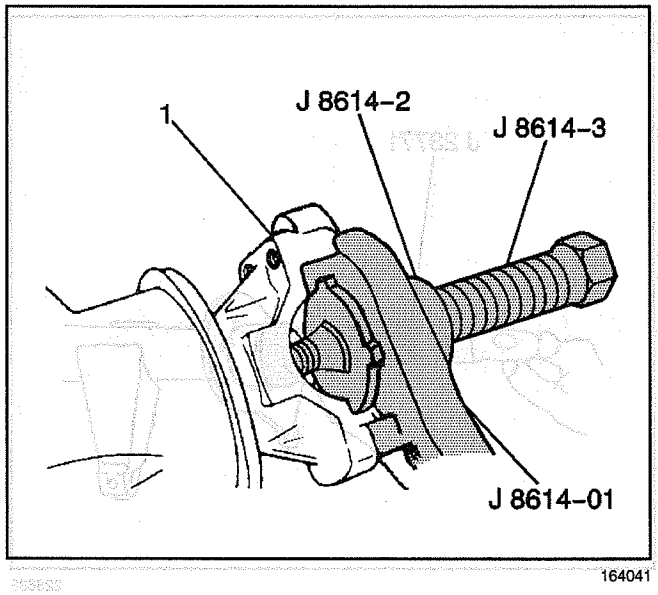
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Pinion Oil Seal Replacement

Removal Procedure

Tools Required

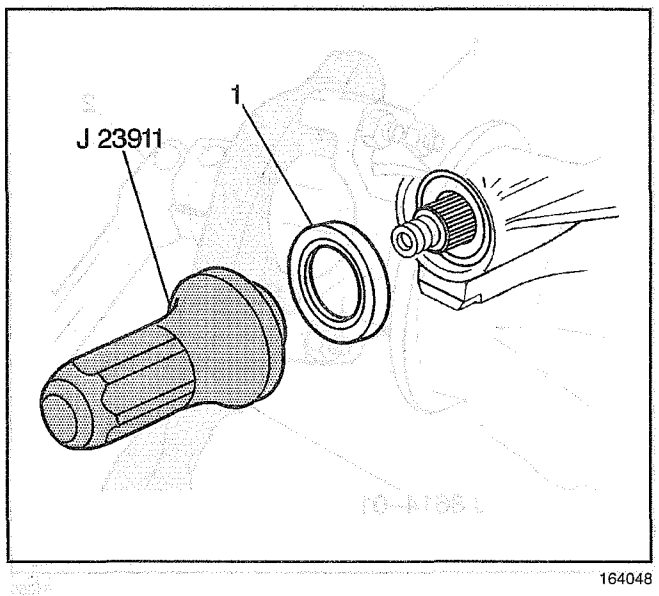
J 8614-O1 Pinion Flange Remover and Installer

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the propeller shaft. Refer to *Propeller Shaft Replacement - One Piece* or *Propeller Shaft Replacement - Two Piece* in Propeller Shaft.
3. Mark the position of the following components before disassembly:
   - The drive pinion gear yoke (1)
   - The drive pinion gear
   - The drive pinion gear nut

   This action will ensure that the correct drive pinion gear inner and outer bearing preload can be maintained.
4. Use *J 8614-O1* in order to remove the following components:
   - The drive pinion gear nut
   - The drive pinion gear washer
5. Use a suitable container in order to hold any fluid that may drain from the rear axle.
6. Use *J 8614-O1* in order to remove the drive pinion gear yoke (1).

Important: Do not damage the rear axle housing when removing the drive pinion gear seal.

7. Use a blunt chisel in order to drive the drive pinion gear seal (1) out of the rear axle housing.
8. Inspect the drive pinion gear seal (1) surface of the drive pinion gear yoke for the following conditions:
   - Tool marks
   - Nicks
   - Damage, such as a groove worn by the drive pinion gear seal.
9. If the drive pinion gear yoke is damaged, replace the drive pinion gear yoke.
10. Inspect the housing bore for burrs.
    Burrs might cause leaks around the outer diameter (OD) of the drive pinion gear seal (1).
    Remove any burrs that might cause leaks around the outer diameter (OD) of the drive pinion gear seal (1).



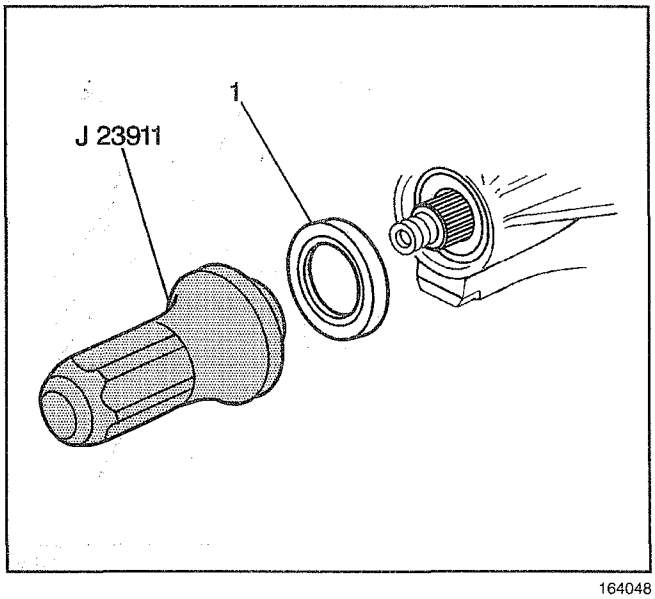
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Installation Procedure

Tools Required

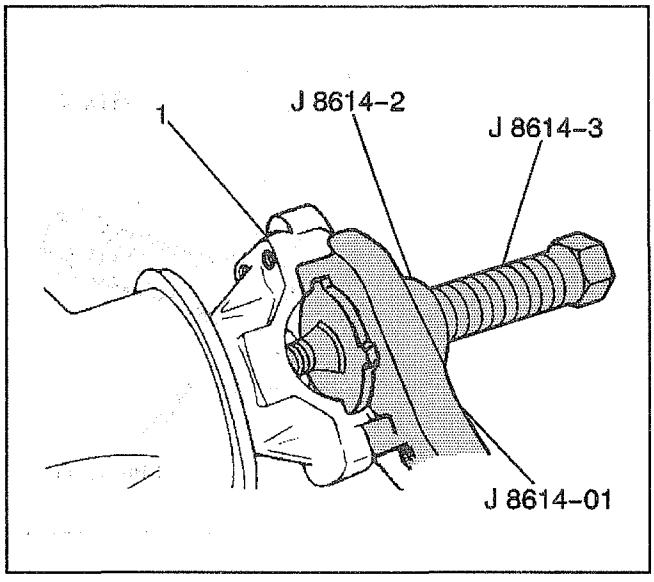
- *J 8614-01* Pinion Flange Remover and Installer
- *J 23911* Pinion Oil Seal Installer

1. Use the *J 23911* in order to install a new drive pinion gear seal (1).
2. Apply chassis lubricant or an equivalent to the following components:
   - The outside diameter of the drive pinion gear yoke
   - The sealing lip of the new drive pinion gear seal (1)

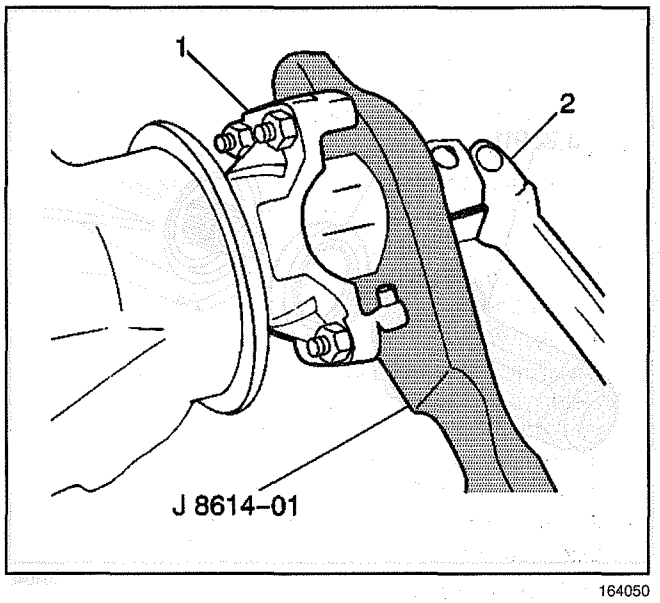


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3. Install the drive pinion gear yoke (1).
4. Install the following components:
   - The drive pinion gear washer
   - The drive pinion gear nut
   Finger tighten the drive pinion gear nut.



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Notice: Refer to *Fastener Notice* in Cautions and Notices.

5. Hold the drive pinion gear yoke. Use *J 8614-01* in order to tighten the drive pinion gear nut to the position that was marked.

   Tighten

   Tighten the drive pinion gear nut to 1.59 mm (1/16 inch) beyond the alignment mark.
6. Install the propeller shaft. Refer to *Propeller Shaft Replacement - One Piece* or *Propeller Shaft Replacement - Two Piece* in Propeller Shaft.
7. Measure the rear axle lubricant level and add lubricant, if necessary. Refer to *Lubricant Level Check*.
8. Lower the vehicle.
9. Inspect for correct operation of the rear axle.

Inspection Before Disassembly

Important: If possible, determine the cause the axle problem before you disassemble the axle.

1. Remove the cover.
2. Drain the oil.

Important: Use this information in the diagnosis of an axle problem. Information on ring gear backlash also helps in setting shim packs for locating and preloading the differential case.

3. Inspect the ring gear backlash. Refer to *Backlash Adjustment*.
4. Inspect the case for metal chips and shavings. Determine the source of the chips and shavings, such as a broken gear or a bearing cage.

Rear Axle Housing Inspection

Before assembly, carefully and thoroughly inspect all drive unit parts for wear or stress. Replacement of worn parts eliminates costly drive component repair after assembly.

- Inspect for nicks or burrs that could prevent the outer diameter of the pinion seal from sealing. Remove any burrs.
- Inspect the bearing cup bores for nicks or burrs. Remove any burrs that are found.
- Inspect the housing for cracks. Replace the housing if you find any cracks.
- Inspect the housing for foreign material such as metal chips, dirt, or rust.

Differential Inspection

Before assembly, carefully and thoroughly inspect all drive unit parts for wear or stress. Replacement of worn parts eliminates costly drive component repair after assembly.

- Inspect the pinion gear shaft for unusual wear.
- Inspect the pinion gear and the side gear teeth for wear, cracks, scoring, and spalling.
- Inspect the thrust washers for wear.
- Inspect the fit of the side gears in the differential case.
- Inspect the fit of the side gears on the axle shafts.
- Inspect the differential case for cracks and scoring.
- Inspect all parts for wear. Replace parts as necessary.

Bearings Inspection

Important: Bearings and cups are matched sets. Replace both bearing and cup when either part requires replacement.

- Before assembly, carefully and thoroughly inspect all drive unit parts for wear or stress. Replacement of worn parts eliminates costly drive component repair after assembly.
- Oil the bearings. Inspect the bearings for smooth rotation.
- Inspect the bearing rollers for wear.
- Inspect the bearing cups for wear, cracks, brinelling, and scoring.

Differential Side Bearing Preload Adjustment

Perform the differential bearing preload adjustment before installing the drive pinion gear. If the drive pinion gear is installed, remove the ring gear. Refer to *Rear Axle - Assemble*.

When adjusting the differential bearing preload, change the thickness of both the right and the left bearing shims by an equal amount. This will ensure that the original backlash remains constant.

Production bearing shims are cast iron. Production bearing shims vary in thickness from 5.33–6.91 mm (0.210–0.272 in) in increments of 0.05 mm (0.002 in).

Steel service bearing shims are available from 1.02–2.08 mm (0.040–0.082 in) in increments of 0.05 mm (0.002 in).

Standard service bearing spacers are 4.32 mm (0.170 in) thick.

Refer to Production Differential Bearing Shim Thickness (Standard Spacer) and Service Differential Bearing Shim Thickness (Standard Spacer) in *Rear Axle Specifications (General Specifications)*.

Important:

- Do not reinstall the production bearing shims. The production bearing shims may break when tapped by a hammer.
- Service bearing shims are reusable. The differential bearings must have the original outer races in place when the bearings are reused.

1. Determine the approximate required thickness of the replacement bearing shims. Measure each production bearing shim, each service bearing spacer, and each bearing shim pack.
2. Determine the necessary service bearing shims. Select a starting point in service bearing shim thickness. Refer to Service Differential Bearing Shim Thickness (Standard Spacer) in *Rear Axle Specifications (General Specifications)*.
3. Position the following components into the rear axle housing:
   - The differential case
   - The differential bearing outer races
4. Slip the correct service bearing spacer between each differential bearing race and the rear axle housing. Place the chamfered edge of the service bearing spacer against the rear axle housing.

Notice: Install the left side bearing cap loosely so the differential case may be moved while checking adjustments. Another differential bearing 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.

5. Select one or two bearing shims. Refer to Service Differential Bearing Shim Thickness in *Rear Axle Specifications (General Specifications)* for the correct total thickness.
6. Position the shims between the right side of the differential bearing race and the service bearing spacer.

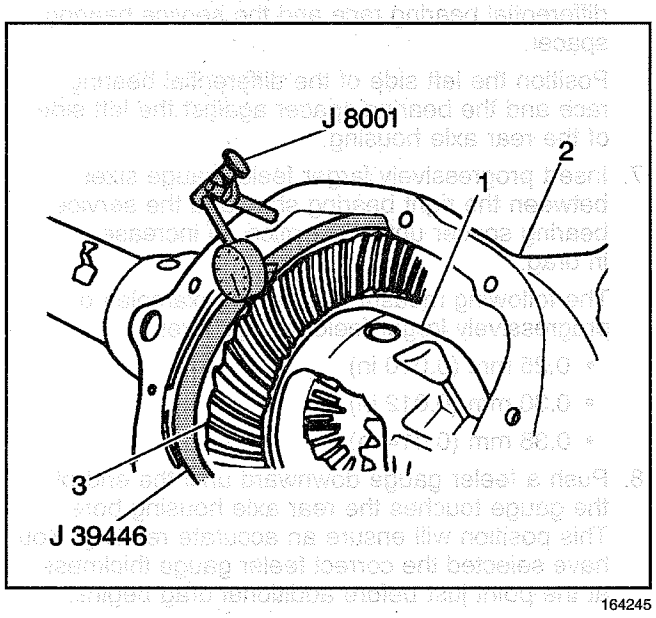
   Position the left side of the differential bearing race and the bearing spacer against the left side of the rear axle housing.
7. Insert progressively larger feeler gauge sizes between the right bearing shim and the service bearing spacer until you notice an increase in drag.

   The following measurements are examples of progressively larger feeler gauge sizes:
   - 0.25 mm (0.010 in)
   - 0.30 mm (0.012 in)
   - 0.36 mm (0.014 in)
8. Push a feeler gauge downward until the end of the gauge touches the rear axle housing bore. This position will ensure an accurate reading. You have selected the correct feeler gauge thickness at the point just before additional drag begins.

9. In order to ensure an even reading, rotate the differential case while using the feeler gauge.
   - The weight of the differential case against the rear axle housing causes the original light drag. The differential bearing preload causes the additional drag.
   - Start with a thin feeler gauge. This provides a sense of feel that is necessary in order to recognize the beginning of the preload and obtain zero clearance.
   - Work the differential case in, out, and to the left in order to insert the feeler gauge.
10. Remove the following components from the rear axle housing:
    - The left side differential bearing cap
    - The left side bearing shim
11. With no preload on the differential bearings, add the following measurements in order to obtain the size of the total shim pack:
    - The feeler gauge reading measured in Step 7.
    - The thickness of the bearing shims that were installed in Step 6.
12. Select two bearing shims of approximately equal size. The total thickness of the two shims must be equal to the value obtained in Step 9.

    When installing the differential case into the rear axle housing, install the bearing shims between the following components:
    - Each differential bearing race
    - Each service bearing spacer

    Add the additional preload after you install the differential case.
13. When the drive pinion gear is in position, install the ring gear. Refer to *Rear Axle - Assemble*.



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Backlash Adjustment

Tools Required

J 8001 Dial Indicator Set

1. Remove the rear axle housing cover. Refer to *Rear Axle Housing Cover and Gasket Replacement*.
2. Rotate the differential case (1) several times in order to seat the bearings.
3. Mount the *J 8001*.
4. Use a small button on the indicator stem in order to make contact with the near heel end of the tooth.
5. Set the *J 8001* so that the following conditions are met:
   - The stem is in line with the gear rotation
   - The stem is perpendicular to the tooth angle
6. Measure the backlash at three or four points around the ring gear (3). Hold the drive pinion gear stationary when checking backlash.

7. The lash must not vary over 0.05 mm (0.002 in) around the ring gear (3). If the variation is over 0.05 mm (0.002 in), inspect for the following conditions and correct as necessary:
   - Burrs
   - Uneven bolting conditions
   - A distorted case flange
8. The backlash at the point of minimum lash should be 0.13–0.23 mm (0.005–0.009 in) for all new gears. Adjust the backlash as necessary by increasing the thickness of one bearing shim and decreasing the thickness of the other bearing shim by the same amount.

   Transfer 0.05 mm (0.002 in) in bearing shim thickness for each 0.03-mm (0.001-in) change in backlash desired.

   For example, use the following steps in order to decrease the backlash by 0.03 mm (0.001 in):

   8.1. Decrease the thickness of the right bearing shim by 0.05 mm (0.002 in).

   8.2. Increase the thickness of the left bearing shim by 0.05 mm (0.002 in). Refer to *Differential Side Bearing Preload Adjustment* for further information.
9. Install the rear axle housing cover. Refer to *Rear Axle Housing Cover and Gasket Replacement*.

Gear Tooth Contact Pattern Check

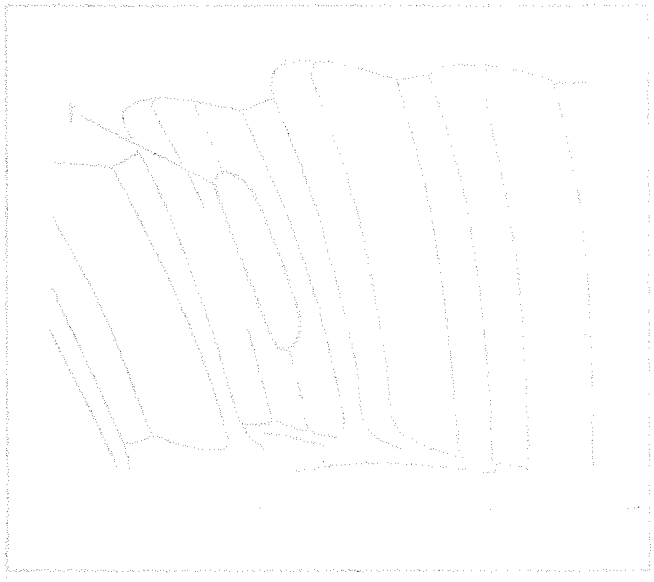
Tools Required

J 39446 ABS Exciter Ring Protector Kit

Notice: It is very important that tooth contact be tested after the differential is taken apart. Variations in the differential or differential drive pinion gear inner bearing may cause the differential drive pinion gear to be too far away from, or close to, the differential ring gear. Therefore, the tooth contact pattern must be tested and corrected, (if necessary) to prevent gear noise.

1. Clean all of the dirt from the area of the rear axle housing cover before removing the rear axle housing cover.
2. Remove the rear axle housing cover. Refer to *Rear Axle Housing Cover and Gasket Replacement*.
3. Wipe the oil out of the rear axle housing.
4. Carefully clean each tooth of the ring gear.
5. Select the correct exciter ring protector from *J 39446*.

   Attach the exciter ring protector to the speed sensor reluctor wheel on vehicles with non-traction control rear axles only.
6. Using a medium stiff brush, apply a mixture of gear marking compound sparingly to all of the ring gear teeth. The area of tooth contact of the differential drive pinion gear should remain visible





Notice: Refer to *Fastener Notice* in Cautions and Notices.

7. Tighten the differential carrier bearing cap bolts/screws.

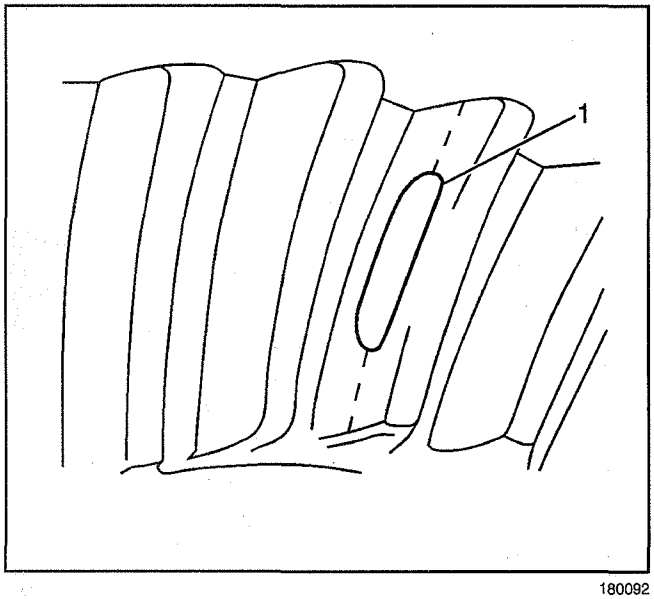
   Tighten

   Tighten the differential carrier bearing cap bolts/screw to 75 N·m (55 lb ft).

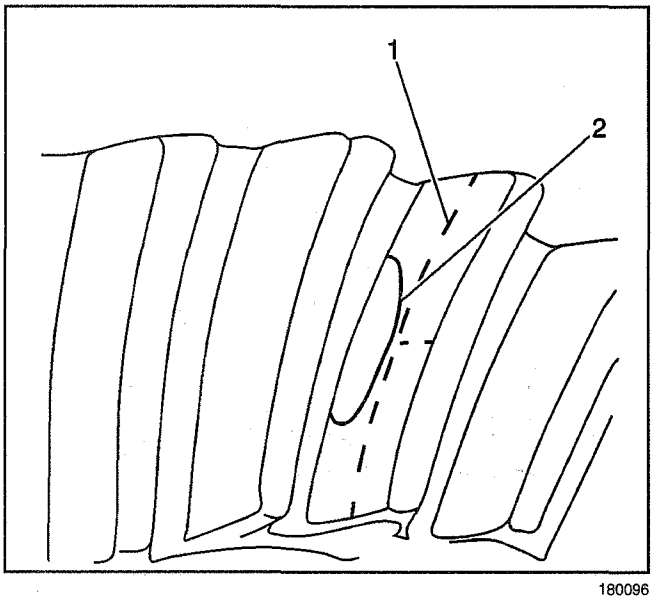
8. Apply the park brake until a torque of 54–70 N·m (40–52 lb ft) is required in order to turn the drive pinion gear.

Important: A test made without loading the gears will not give a satisfactory pattern.

9. Use the following procedure in order to obtain a ring gear tooth contact pattern:
   9.1. Turn the pinion gear yoke with a wrench so that the ring gear rotates one full revolution.
   9.2. Reverse the rotation so that the ring gear rotates one revolution in the opposite direction.
10. Inspect the differential ring gear teeth for a tooth contact pattern (1).
11. The pattern is acceptable if the area of differential drive pinion gear contact (1) remains in the center of the differential ring gear tooth. If the pattern is not acceptable, proceed to Step 14.
12. If the differential ring gear tooth pattern is acceptable, remove *J 39446*.
13. Install the rear axle housing cover. Refer to *Rear Axle Housing Cover and Gasket Replacement*.



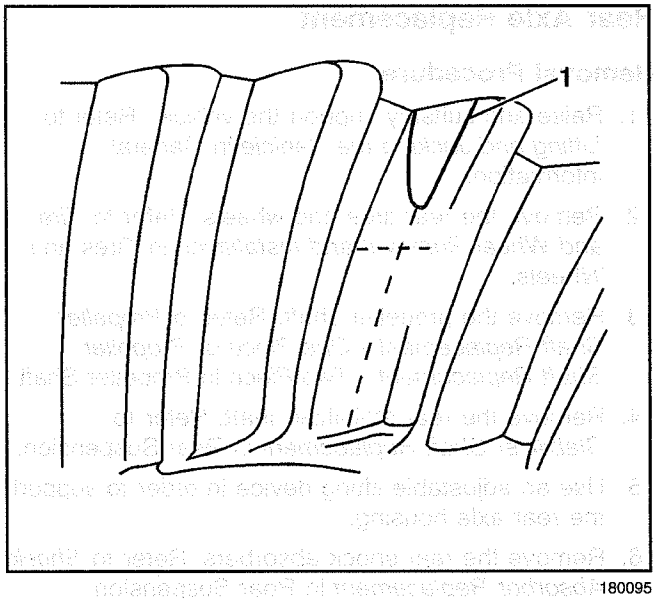
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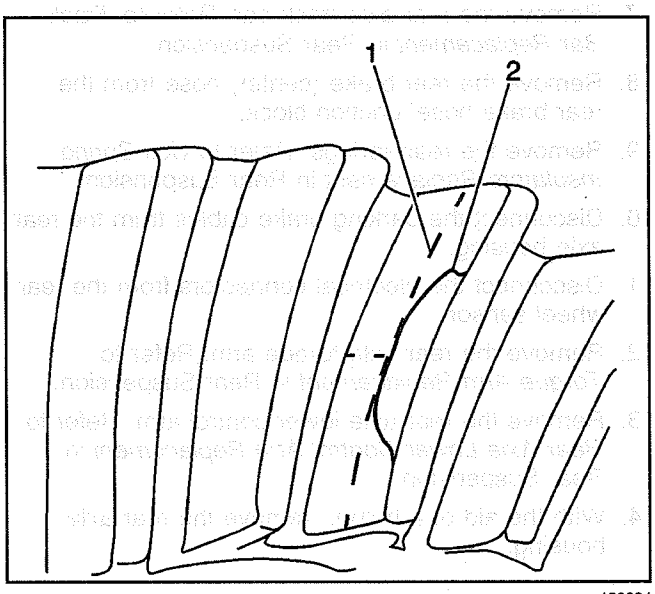
14. Inspect the differential ring gear teeth for a low flank contact pattern (2).
15. If this contact pattern (2) exists, repair the low flank contact by decreasing the shim thickness of the bearing on the differential drive pinion gear. This moves the smaller diameter of the contact (2) out toward the center line (1) of the differential ring gear.
16. Remove *J 39446*.
17. Install the rear axle housing cover. Refer to *Rear Axle Housing Cover and Gasket Replacement*.

18. Inspect the differential ring gear teeth for a heel contact pattern (1).
19. If this contact pattern (1) exists, repair the heel contact by decreasing the backlash. This moves the area of differential drive pinion gear contact (1) toward the toe.
20. Remove *J 39446*.
21. Install the rear axle housing cover. Refer to *Rear Axle Housing Cover and Gasket Replacement*.



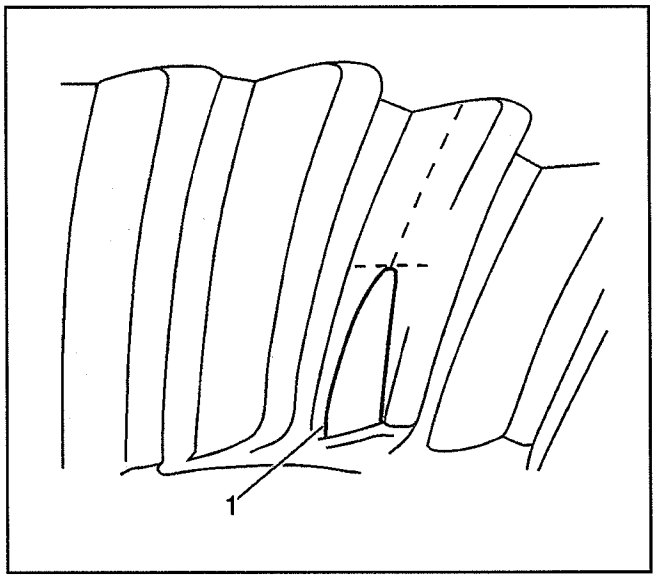
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22. Inspect the differential ring gear teeth for a high face contact pattern (2).
23. If this contact pattern (2) exists, repair the high face contact by increasing the thickness of the bearing shim of the differential drive pinion gear. This moves the area of differential drive pinion gear contact (2) out toward the differential ring gear center line (1).
24. Remove *J 39446*.
25. Install the rear axle housing cover. Refer to *Rear Axle Housing Cover and Gasket Replacement*.



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26. Inspect the differential ring gear teeth for a toe contact pattern (1).
27. If this contact pattern (1) exists repair the heel contact by Increasing the backlash. This moves the area of differential drive pinion gear contact (1) toward the heel.
28. Remove *J 39446*.
29. Install the rear axle housing cover. Refer to *Rear Axle Housing Cover and Gasket Replacement*.

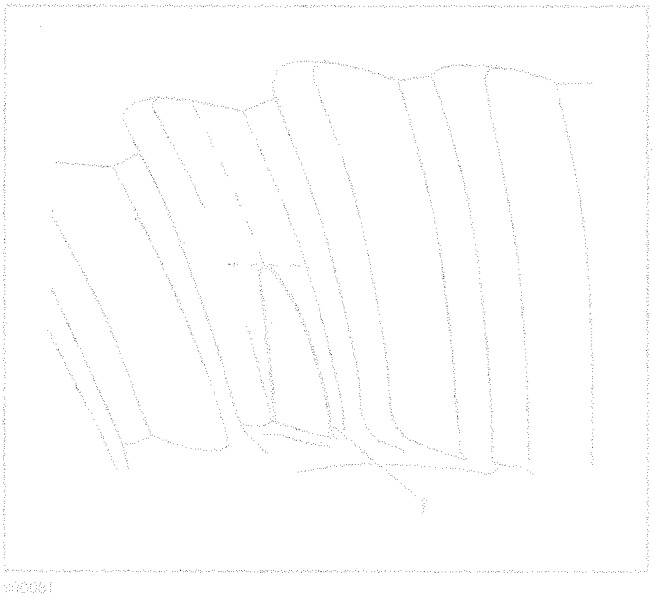


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Rear Axle Replacement

Removal Procedure

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the rear tires and wheels. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Remove the propeller shaft. Refer to *Propeller Shaft Replacement - One Piece* or *Propeller Shaft Replacement - Two Piece* in Propeller Shaft.
4. Remove the rear stabilizer shaft. Refer to *Stabilizer Shaft Replacement* in Rear Suspension.
5. Use an adjustable lifting device in order to support the rear axle housing.
6. Remove the rear shock absorbers. Refer to *Shock Absorber Replacement* in Rear Suspension.
7. Remove the rear axle track bar. Refer to *Track Bar Replacement* in Rear Suspension.
8. Remove the rear brake (center) hose from the rear brake hose junction block.
9. Remove the rear springs. Refer to *Coil Spring Insulators Replacement* in Rear Suspension.
10. Disconnect the parking brake cables from the rear axle housing.
11. Disconnect the electrical connectors from the rear wheel sensor.
12. Remove the rear axle torque arm. Refer to *Torque Arm Replacement* in Rear Suspension.
13. Remove the rear axle lower control arm. Refer to *Rear Axle Lower Control Arm Replacement* in Rear Suspension.
14. With the aid of a helper, remove the rear axle housing.



Installation Procedure

1. With the aid of a helper, install the rear axle housing.
2. Install the rear axle lower control arms. Refer to *Rear Axle Lower Control Arm Replacement* in Rear Suspension.
3. Install the rear axle torque arm. Refer to *Torque Arm Replacement* in Rear Suspension.
4. Connect the electrical connectors to the rear wheel sensor.
5. Connect the parking brake cables to the rear axle housing.
6. Install the rear springs. Refer to *Coil Spring Replacement* in Rear Suspension.
7. Install the rear brake (center) hose to the rear brake hose junction block.
8. Install the rear axle track bar. Refer to *Track Bar Replacement* in Rear Suspension.
9. Install the rear shock absorbers. Refer to *Shock Absorber Replacement* in Rear Suspension.
10. Remove the adjustable lifting device from the rear axle housing.
11. Install the rear stabilizer shaft. Refer to *Stabilizer Shaft Replacement* in Rear Suspension.
12. Install the propeller shaft. Refer to *Propeller Shaft Replacement - One Piece* or *Propeller Shaft Replacement - Two Piece* in Propeller Shaft.
13. Bleed the brake system. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* in Hydraulic Brakes.
14. Install the rear tires and wheels. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
15. Refill the rear axle with lubricant. Refer to *Lubricant Level Check*.
16. Lower the vehicle.
17. Road test the vehicle in order to ensure proper rear axle operation.

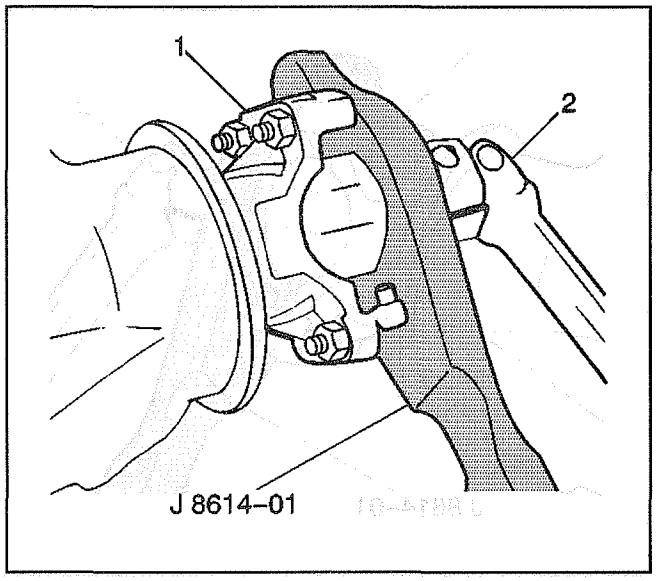
Pinion Flange Replacement

Removal Procedure

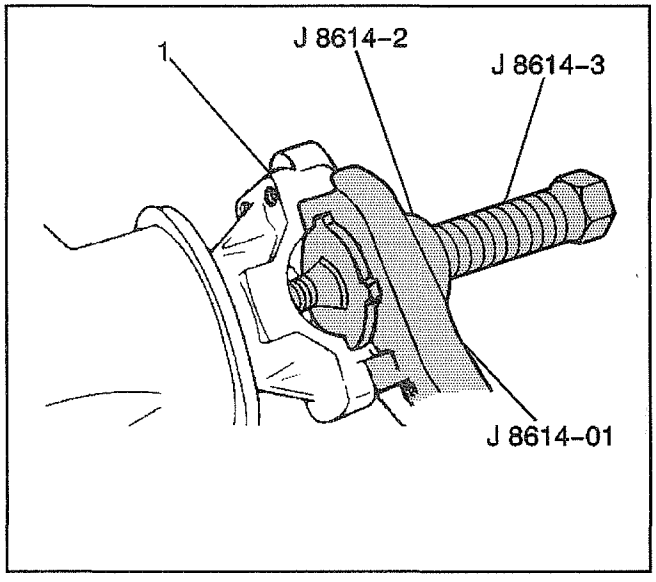
Tools Required

J 8614-O1 Pinion Flange Holder

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the propeller shaft. Refer to *Propeller Shaft Replacement - One Piece* or *Propeller Shaft Replacement - Two Piece*.
3. Mark the following components with a punch in a straight line before disassembly:
   - The drive pinion gear flange
   - The drive pinion gear
   - The drive pinion gear nut
4. Use *J 8614-O1* in order to remove the following components:
   - The drive pinion gear nut
   - The drive pinion gear washer
5. Remove the drive pinion gear flange (1).
6. If the drive pinion gear flange or flange seal is damaged, replace the component.



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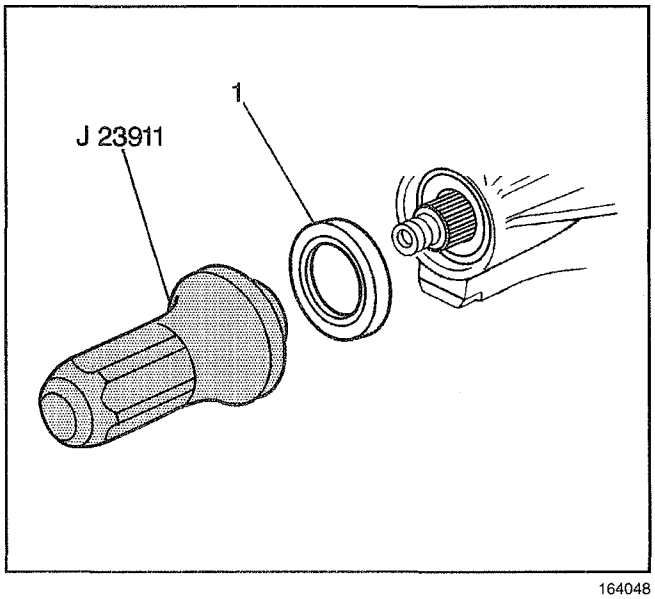
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Installation Procedure

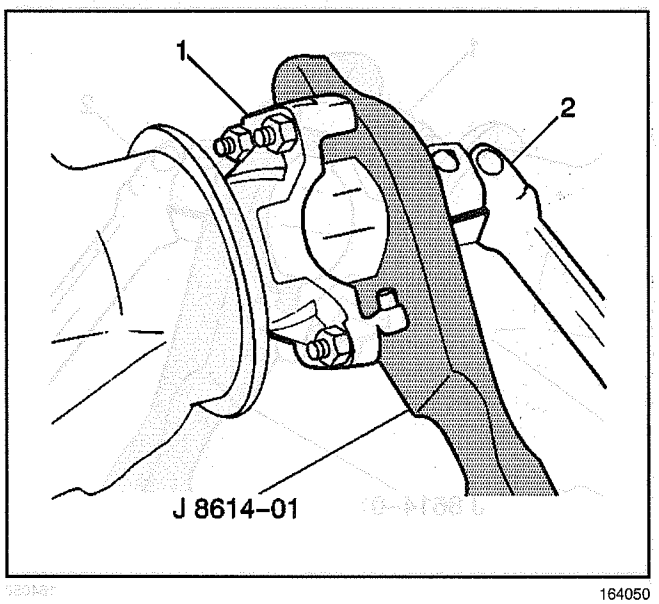
Tools Required

- *J 8614-O1* Pinion Flange Holder
- *J 23911* Pinion Oil Seal Installer

1. Install new flange seal (1) with *J 23911* into housing, if removed.
2. Apply chassis lubricant or an equivalent to the following components:
   - The outside diameter of the drive pinion gear flange
   - The sealing lip of the new drive pinion gear seal.
3. Install the drive pinion gear flange (1).
4. Install the following components:
   - The drive pinion gear washer
   - The drive pinion gear nut (finger tight)



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5. Hold the drive pinion gear flange.
6. Use *J 8614-01* in order to tighten the drive pinion gear nut to the position previously marked.

   Tighten

   Tighten the nut to 1.59 mm (1/6 inch) beyond the alignment mark.
7. Install the propeller shaft. Refer to *Propeller Shaft Replacement - One Piece* or *Propeller Shaft Replacement - Two Piece.*
8. Lower the vehicle.
9. Road test for any abnormal rear axle operation, such as whines or howls.

Pinion and Ring Gear Inspection

Inspect the rear axle before disassembly. This will aid in determining the type of repairs or adjustments that are necessary.

The following conditions may cause rear axle noise:

- Improper backlash
- The inner bearing preload of the differential drive pinion gear
- The outer bearing preload of the differential drive pinion gear
- The differential side bearing preload
- Any combination of the above items

Measure the following items before removing the differential case from the housing:

- The backlash
- The total differential preload
- The tooth contact pattern

Record and analyze these measurements before you remove the differential case from the housing.

Do not allow foreign matter (such as dirt or sand) near the rear axle. The presence of foreign matter in the rear axle may cause rear axle failure.

Differential Ring Gear Tooth Nomenclature

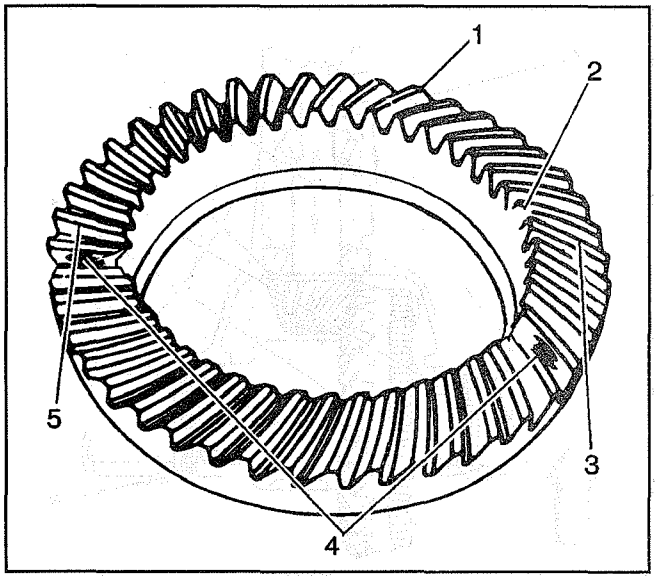
The drive side (5) of the differential ring gear tooth curves outward (convex).

The tooth contact (4) of the differential ring gear is the center area of the drive side (5) that makes the most physical contact with the pinion gear. Refer to Effects Of Increasing Load On Tooth Contact Pattern.

The coast side (3) of the differential ring gear tooth curves inward (concave).

The toe end (2) of the differential ring gear tooth is the end that is nearest to the center of the differential ring gear.

The heel end (1) of the differential ring gear tooth is the end that is farthest away from the center of the differential ring gear. The toe end of the tooth is smaller than the heel end.



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Effects Of Increasing Load On Tooth Contact Pattern

The load on the differential ring and on the drive pinion gear is increased during vehicle acceleration.

An increased load on the differential ring and on the drive pinion gear may cause the tooth contact (4) to spread out. Under a very heavy load, the tooth contact may extend from the near toe to the near heel on the drive side.

Increasingly heavier loads cause the following changes in tooth contact:

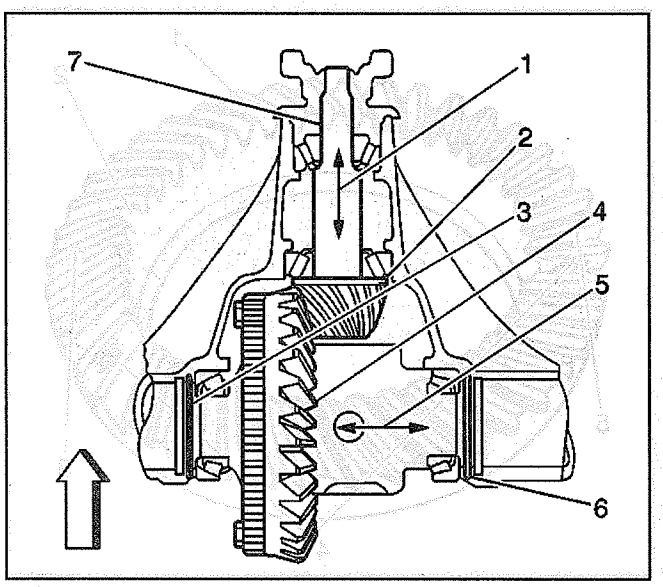
- The entire contact tends to shift toward the heel
- The entire contact becomes broader with respect to the tops and the bottoms of the teeth

The following tooth contact pattern test recreates the effects of a light load. For this reason, the patterns that will be obtained by the following test will only extend to about half of their potential expansion.

Important: The contact pattern is centrally located up and down on the face of the differential ring gear teeth.

The following conditions may cause a change in the tooth contact pattern under a load:

- A drive pinon gear is insufficiently preloaded
- The differential bearings are insufficiently preloaded



375039

Adjustments Affecting Tooth Contact

The following two adjustments will affect the tooth contact pattern:

- An adjustment to the backlash
- An adjustment to the position of the drive pinion gear (7) in the rear axle housing

The effects of bearing preloads are not readily apparent on hand-loaded tooth contact pattern tests. Use differential bearing shims (6) in order to adjust the backlash. The shims (6) move the entire differential (5) closer to or farther from the drive pinion gear (7). You can also use bearing shims (2) can in order to set both the differential bearing preload and the pinion depth (1).

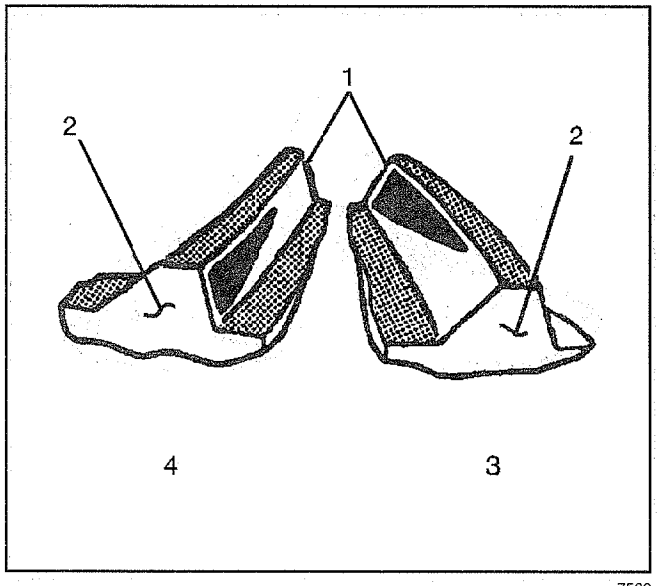
- Make the following changes in order to increase the backlash:
  - Increase the thickness of the right bearings shim (6)
  - Decrease the thickness of the left bearing shim (3)
- Make the following changes in order to decrease the backlash:
  - Decrease the thickness of the right bearings shim (6)
  - Increase the thickness of the left bearing shim (3)

You can adjust the position of the drive pinion gear (1) by changing the thickness of the shims (2) between the following components:

- The drive pinion gear head (7)
- The race of the differential drive pinion gear inner bearing

The drive pinion gear shim (2) is used in the rear axle in order to compensate for manufacturing tolerances.

- Increasing the shim thickness moves the drive pinion gear (7) closer to the centerline of the differential ring gear (4).
- Decreasing shim thickness moves the drive pinion gear (7) farther away from the centerline of the differential ring gear (4).



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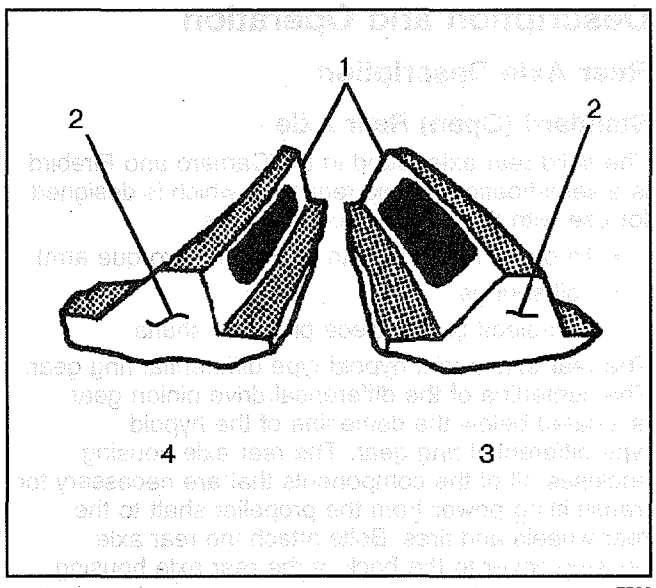
Effects Of Differential Drive Pinion Gear Position On Tooth Pattern

The following tooth contact pattern exists when the differential drive pinion gear is too far away from the centerline of the differential ring gear:

- High heel (2) contact on the drive side (4)
- High toe (1) contact on the coast side (3)

Decrease the backlash in order to move the differential drive pinion gear closer to the centerline of the differential ring gear. This will cause the following tooth contact pattern:

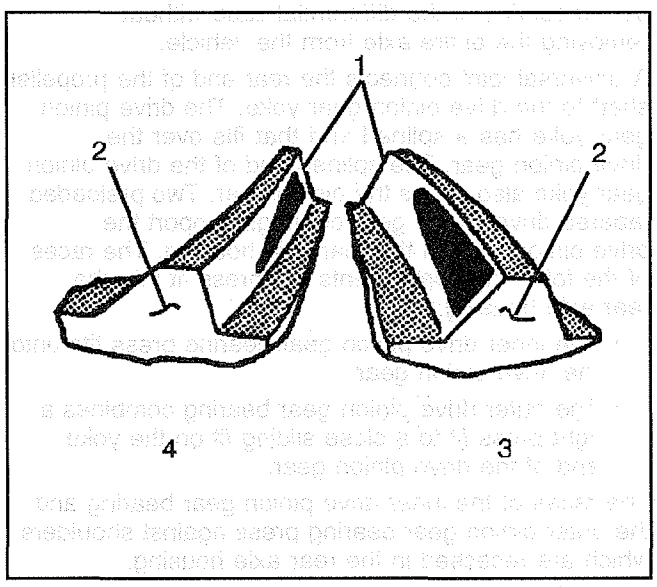
- High heel (2) contact on the drive side (4) moves down and toward the toe (1).
- High toe (1) contact on the coast side (3) moves down and toward the heel (2).



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The following tooth contact pattern exists when the differential drive pinion gear is too close to the centerline of the differential ring gear:

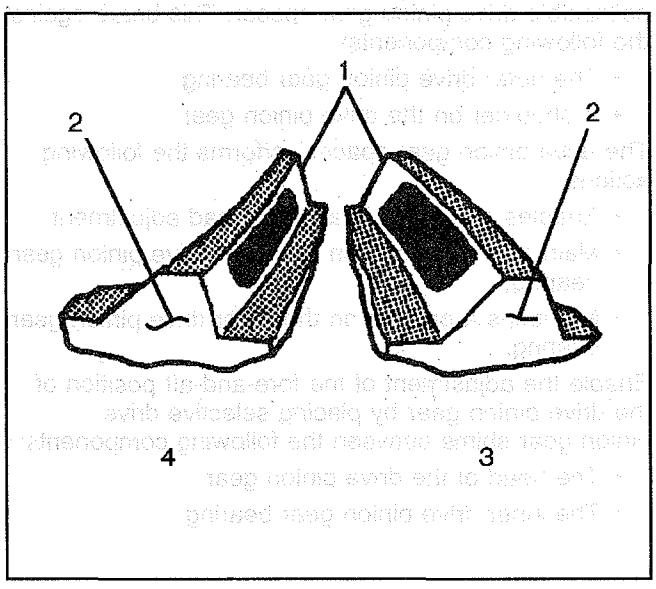
- Low toe (1) contact on the drive side (4)
- Low heel (2) contact on the coast side (3)



7579

Increase the backlash in order to move the differential drive pinion gear further away from the centerline of the differential ring gear. This will cause the following tooth contact pattern to exist:

- Low toe contact on the drive side (4) moves up and toward the heel (2).
- Low heel contact on the coast side (3) moves up and toward the toe (1).



7566

Description and Operation

Rear Axle Description

Standard (Open) Rear Axle

The solid rear axle found in the Camaro and Firebird is a semi-floating hypoid rear axle, which is designed for use with the following components:

- An open driveline (with or without a torque arm)
- Coil springs
- One-piece or two-piece propeller shafts

The rear axle has a hypoid type differential ring gear. The centerline of the differential drive pinion gear is located below the centerline of the hypoid type differential ring gear. The rear axle housing encloses all of the components that are necessary for transmitting power from the propeller shaft to the rear wheels and tires. Bolts attach the rear axle housing cover to the back of the rear axle housing. The rear axle housing cover is removable in order to permit service of the differential case without removing the entire axle from the vehicle.

A universal joint connects the rear end of the propeller shaft to the drive pinion gear yoke. The drive pinion gear yoke has a splined end that fits over the drive pinion gear. The splined end of the drive pinion gear yoke also drives the pinion gear. Two preloaded tapered drive pinion gear bearings support the drive pinion gear in the rear axle housing. The races of the following components are press fit into the rear axle housing:

- The inner drive pinion gear bearing press fits onto the drive pinion gear.
- The outer drive pinion gear bearing combines a light press fit to a close sliding fit on the yoke end of the drive pinion gear.

The races of the inner drive pinion gear bearing and the outer pinion gear bearing press against shoulders which are recessed in the rear axle housing.

Tightening the drive pinion gear nut compresses a collapsible drive pinion gear spacer. This bears against the following components:

- The outer drive pinion gear bearing
- A shoulder on the drive pinion gear

The drive pinion gear spacer performs the following actions:

- Enables automatic bearing preload adjustment.
- Maintains a preload on the inner drive pinion gear bearing.
- Maintains a preload on the outer drive pinion gear bearing.

Enable the adjustment of the fore-and-aft position of the drive pinion gear by placing selective drive pinion gear shims between the following components:

- The head of the drive pinion gear
- The inner drive pinion gear bearing

The differential case is one piece. Two differential side bearings support the differential case in the rear axle housing. The differential side bearings are preloaded by the insertion of differential bearing shims between the following components:

- The differential side bearings
- The rear axle housing

Vary the shim thickness from side to side. This positions the differential case for proper backlash between the differential ring gear and the differential drive pinion gear.

Bolts attach the differential ring gear to the differential case. The following components have splined bores used for driving the axle shaft:

- The left differential pinion gear
- The right differential pinion gear

The position of these pinion gears permits the gears to turn in counterbored cavities of the differential case. The following components have smooth bores:

- The upper differential pinion gear
- The lower differential pinion gear

The differential pinion gear shaft holds these pinion gears in position. The differential pinion gear shaft mounts and locks in the differential case. All four of the gears mesh with each other.

The following components turn freely on the pinion gear shaft:

- The upper differential pinion gear
- The lower differential pinion gear

These pinion gears act as idler gears when the rear wheels turn at different speeds.

The following components back the differential pinion gears:

- Differential pinion thrust washers
- Differential side gear thrust washers

Vehicles that are equipped with the standard rear axle and the Antilock Brake System (ABS) only, have a single rear wheel speed sensor mounted on the differential carrier behind the ring gear. A wheel speed sensor is bolted to the top of the rear axle housing opposite the reluctor wheel. This sensor provides wheel speed information to the electronic brake control module (EBCM)

Vehicles that are equipped with the limited slip rear axle, ABS, and a Traction Control System (TCS) have rear wheel speed sensors mounted on the axle shafts just behind the axle flange. The axle mounted reluctor wheels are an integral part of the rear axle shaft and cannot be replaced separately. If the wheel needs to be replaced, you must replace the entire axle.

Operation

When the vehicle turns a corner, the differential allows the outer rear tire and wheel assembly to turn faster than the inner tire and wheel assembly.

The inner tire and wheel assembly moves more slowly than the outer tire and wheel assembly. The inner tire and wheel assembly slows its (side) differential pinion gear. The side differential pinion gear is slowed because the axle shaft is splined to the side gear.

The differential pinion gears roll around the slowed (side) differential pinion gear. This action causes the other differential pinion gear and the tire and wheel assembly to move faster.

Limited Slip Rear Axle

Limited slip rear axles have several definite operating characteristics. An understanding of these characteristics is necessary in order to aid diagnostics. The rear axle limited slip differential found in Camaro and Firebird vehicles is the Zexel Torsen® rear axle. This axle differs from the previous Auburn® limited slip units. The Torsen® axle does not utilize clutches or cone clutches as in other limited slip units. The Zexel Torsen® axle is a unique design which utilizes parallel axis helical gearing to develop side gear separating force in an axial direction and planetary gear separating force in a radial direction.

There are not any major servicing differences between the Torsen® and Auburn® differentials except for a thrust block is used in the Torsen® differential for retention of the C-clip as compared to a pin used in the Auburn® differential.

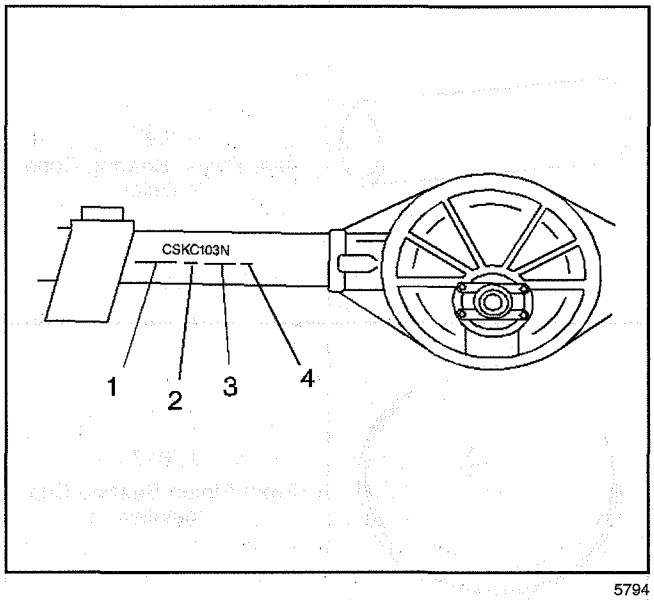
All the following rear axle components are interchangeable (except for the differentials):

- Vehicles with the limited slip rear axle
- Vehicles with the standard rear axle

The Zexel Torsen® limited slip differential is non-serviceable. The differential cases of the 2 vehicles are not interchangeable. The following procedures are the same for both the Torsen® limited slip differential case and the standard rear axle differential case:

- Removal of the differential
- Replacement of the differential
- Service of the side bearings
- Service of the ring and pinion gear set
- All backlash and tooth contact pattern procedures

Rear Axle Identification



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You must know the rear axle identification code (1) and the manufacturer's code (2) before adjusting or repairing the repair axle shafts or the differential.

The following information is stamped onto the forward side of the right axle tube or on a metal tag on the housing cover:

- The rear axle ratio
- The differential type
- The manufacturer's code (2)
- The build date (3)

RPO codes for the rear axle are also printed on the service parts identification label:

Maintenance and Lubrication

Refer to *Lubricant Level Check* for information on measuring or adding lubricant.

Special Tools and Equipment

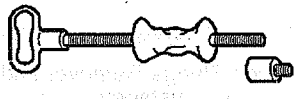
Illustration	Tool Number/ Description
 982	J 2619-01 Slide Hammer With ½ X 13 Adapter

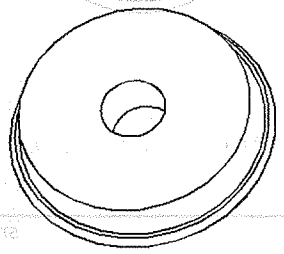
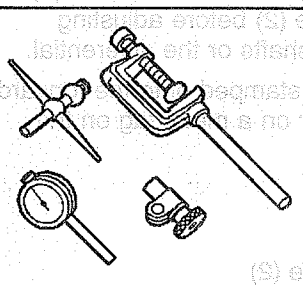
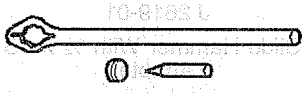
Illustration	Tool Number/ Description
 5335	J 5590 Rear Pinion Bearing Cone Installer
 12439	J 7817 Front Pinion Bearing Cup Installer
 25473	J 8001 Dial Indicator Set
 7016	J 8092 Driver Handle
 1507	J 8614-01 Pinion Flange Remover and Installer

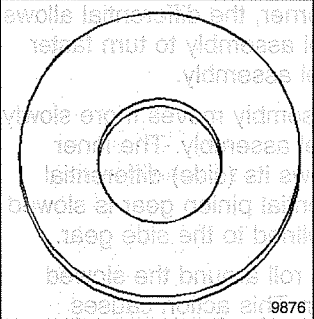
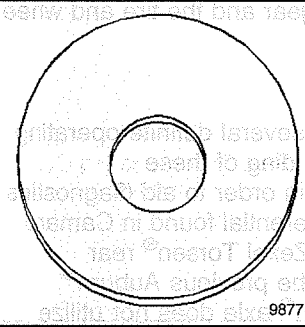
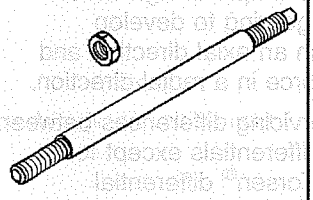
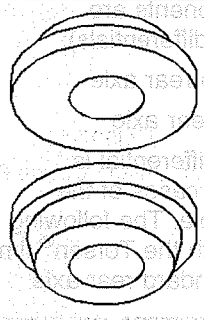
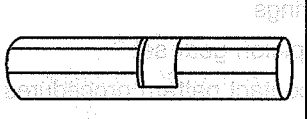
Illustration	Tool Number/ Description
 9876	J 21777-40 Pinion Setting Gauge-Rear Pilot Washer
 9877	J 21777-42 Pinion Setting Gauge-Front Pilot Washer
 9878	J 21777-43 Pinion Setting Gauge-Stud Assembly Bolt
 9879	J 21777-45 Pinion Setting Gauge-Side Bearing Discs
 180153	J 22536 Pinion Driver

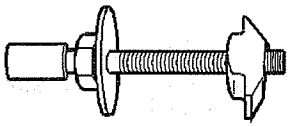
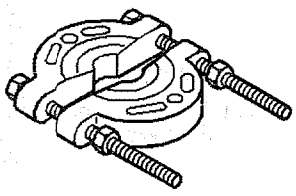
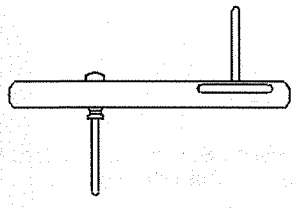
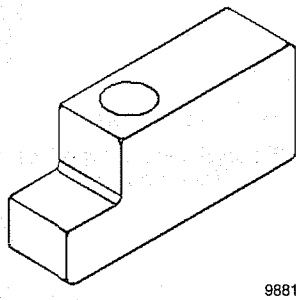
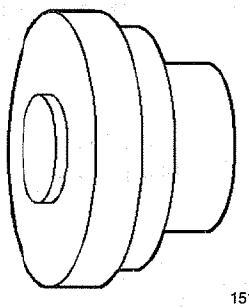
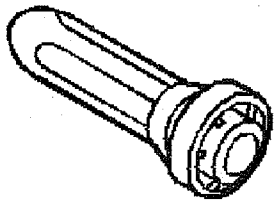
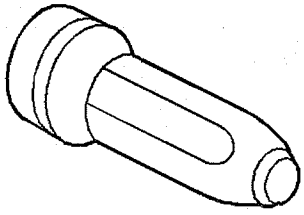
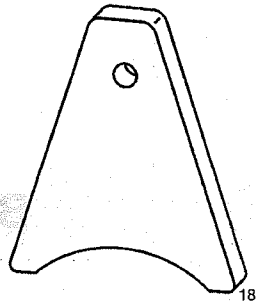
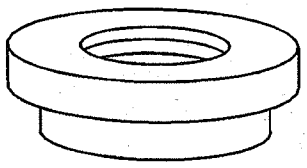
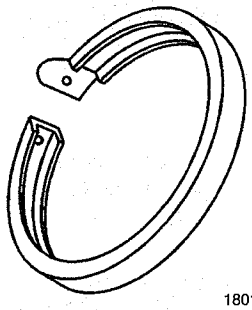
Illustration	Tool Number/ Description
 1508	J 22813-01 Axle Bearing Remover
 994	J 22912-01 Rear Pinion Bearing Cone Remover
 9880	J 23597-1 Pinion Setting Gauge Arbor
 9881	J 23597-11 Pinion Setting Gauge Plate
 1511	J 23765 Axle Bearing Installer

Illustration	Tool Number/ Description
 1510	J 23771 Axle Oil Seal Installer
 1509	J 23911 Pinion Oil Seal Installer
 180155	J 25588 Side Bearing Shim Installer
 180157	J 29609 Rear Pinion Bearing Cup Installer
 180158	J 39446 ABS Exciter Ring Protector Kit

BLANK

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BLANK

Hydraulic Brakes

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Caliper Bleed Screw	12 N·m	106 lb in
Brake Pedal Bracket Bolt	25 N·m	18 lb ft
Brake Pedal Nuts	20 N·m	15 lb ft
Brake Pedal Pivot Nut	54 N·m	40 lb ft
Brake Pipe Tube Nut	16 N·m	12 lb ft
Clutch Master Cylinder Nut	27 N·m	20 lb ft
Combination Valve Pipe Fitting	32 N·m	24 lb ft
Front Brake Hose Clip Bolt	13 N·m	115 lb in
Front Brake Hose Fitting	40 N·m	30 lb ft
Brake Master Cylinder Nut	29 N·m	21 lb ft
Master Cylinder Tube Nut	32 N·m	24 lb ft
Negative Battery Cable	15 N·m	11 lb ft
Rear Brake (Center) Hose Fitting Bolt	21 N·m	15 lb ft
Rear Brake Front Pipe to Rear Brake (Center) Hose	15 N·m	11 lb ft
Rear Brake Hose Fitting	45 N·m	33 lb ft
Rear Brake Pipe to Rear Brake (Center) Hose	24 N·m	18 lb ft
Rear Brake Pipe to Rear Brake Hose	15 N·m	11 lb ft

Brake System Specifications

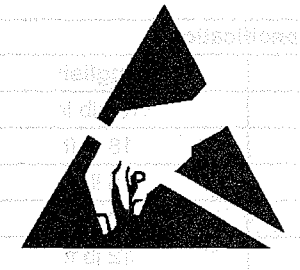
Application	Specification	
	Metric	English
Brake Pedal Travel (see note)	51–89 mm	2.0–3.5 in
Brake Pipe Clearance (Minimum)		
Moving Components	19 mm	0.75 in
Vibrating Components	13 mm	0.50 in
Hydraulic Brake (Glycol) Fluid	GM P/N 1052535 or equivalent DOT-3 fluid	
Important: Brake pedal travel maximum with 445 N (100 lb) of force applied to the pedal with the engine running at idle.		

GM SPO Group Numbers

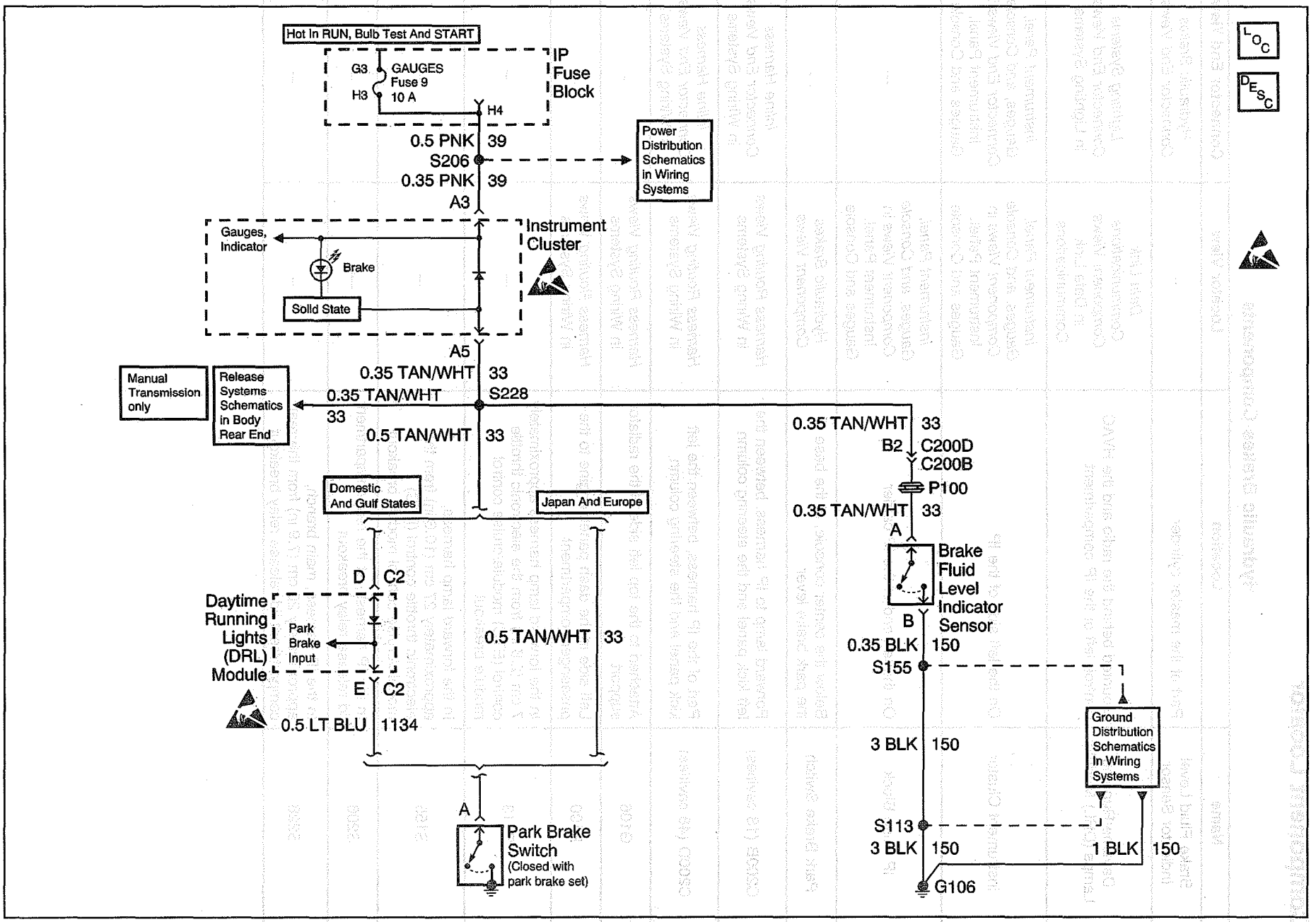
Application	GM SPO Group Number
Brake Hose	4.000
Brake Pedal	4.000
Brake Pedal Bracket	4.000
Brake Pipe	4.000
Master Cylinder	4.000
Master Cylinder Fluid Level Sensor	4.000
Master Cylinder Reservoir	4.000
Stoplamp Switch	4.000
Vacuum Brake Booster	4.000
Vacuum Brake Booster Check Valve	4.000
Vacuum Brake Booster Hose	4.000

Schematic and Routing Diagrams

Hydraulic Brakes Schematic Icons

Icon	Icon Definition
 19384	Refer to *ESD Notice* in Caution and Notices.

Brake Warning System Schematics (Brake Fluid Level Sensor, Instrument Cluster and Park Brake Switch)



502368

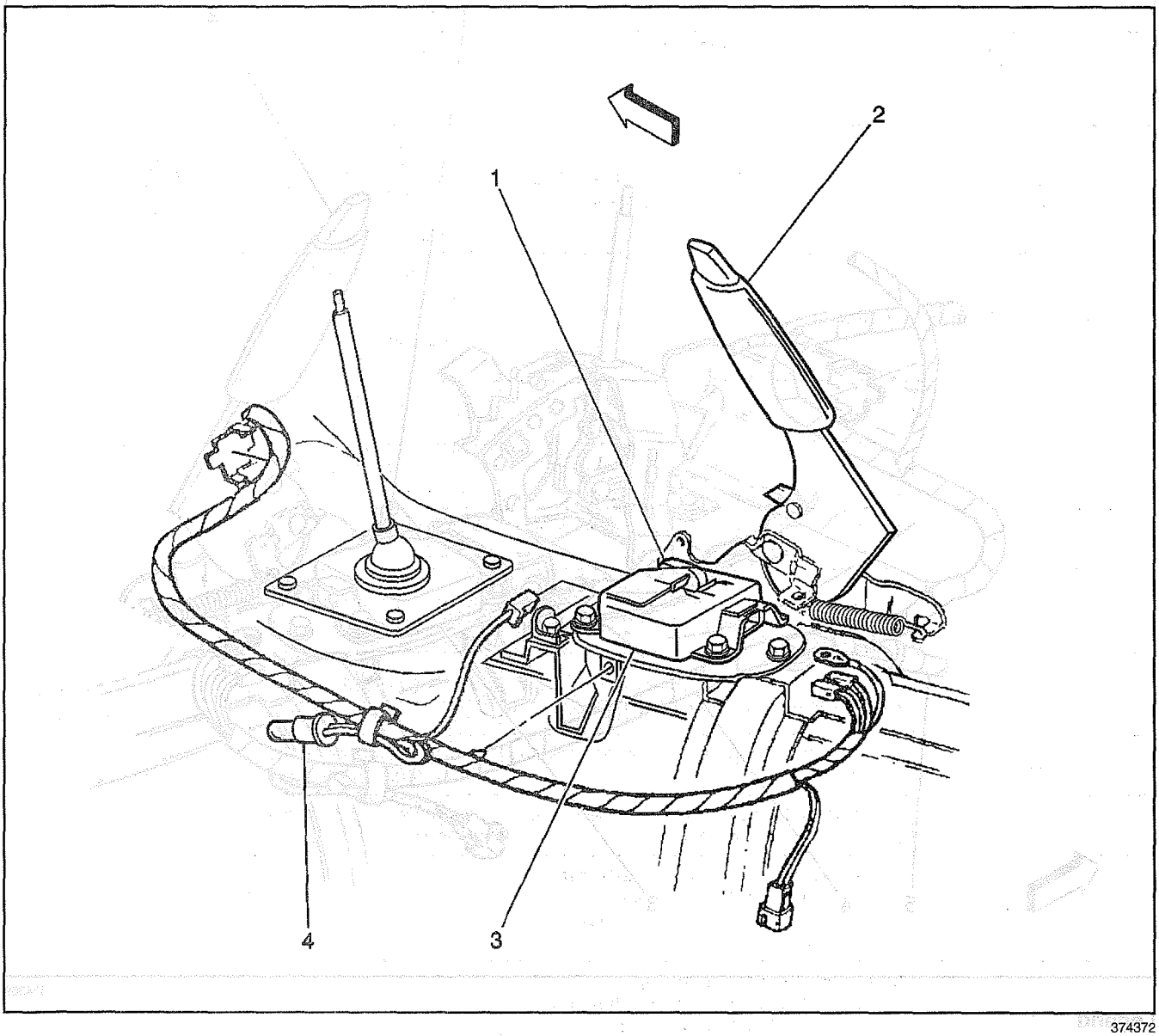
Component Locator

Hydraulic Brakes Components

Name	Location	Locator View	Connector End View
Brake Fluid Level Indicator Sensor	Part of the master cylinder	—	*Hydraulic Brakes Connector End Views*
Daytime Running Lamps (DRL) Module	Mounted behind the radio and the HVAC control, left of the IP compartment	*Data Link Communications Component Views* in Data Link Communications	*Lighting Systems Connector End Views* in Lighting Systems
Instrument Cluster	On the left side of the IP	*Instrument Panel, Gauges, and Console Component Views* in Instrument Panel, Gauges and Console	*Instrument Panel, Gauges, and Console Connector End Views* in Instrument Panel, Gauges and Console
IP Fuse Block	On the left end of the IP carrier	*Instrument Panel, Gauges, and Console Component Views* in Instrument Panel, Gauges and Console	—
Park Brake Switch	Below the center console, at the base of the park brake lever	*Hydraulic Brakes Component Views*	—
C200B (18 cavities)	Forward lamp to IP harness, between the left kick panel and the steering column	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C200D (48 cavities)	Part of the IP harness, between the left kick panel and the steering column	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
G106	Attached to the top left side of the radiator support	*Harness Routing Views* in Wiring Systems	—
P100	Left side in the dash panel, engine to the passenger compartment	*Harness Routing Views* in Wiring Systems	—
S113	In the forward lamp harness approximately 7 cm (2.8 in) from the electronic throttle control (ETC) module/cruise control module breakout	—	—
S155	In the forward lamp harness, approximately 27 cm (10.6 in) from the electronic throttle control (ETC) module/cruise control module breakout	—	—
S206	In the IP harness, at the rear compartment lid release relay breakout	—	—
S228	In the IP harness, main branch, approximately 20 cm (7.9 in) from the rear compartment lid release relay breakout	—	—

Hydraulic Brakes Component Views

Under Center Console (Manual Transmission)

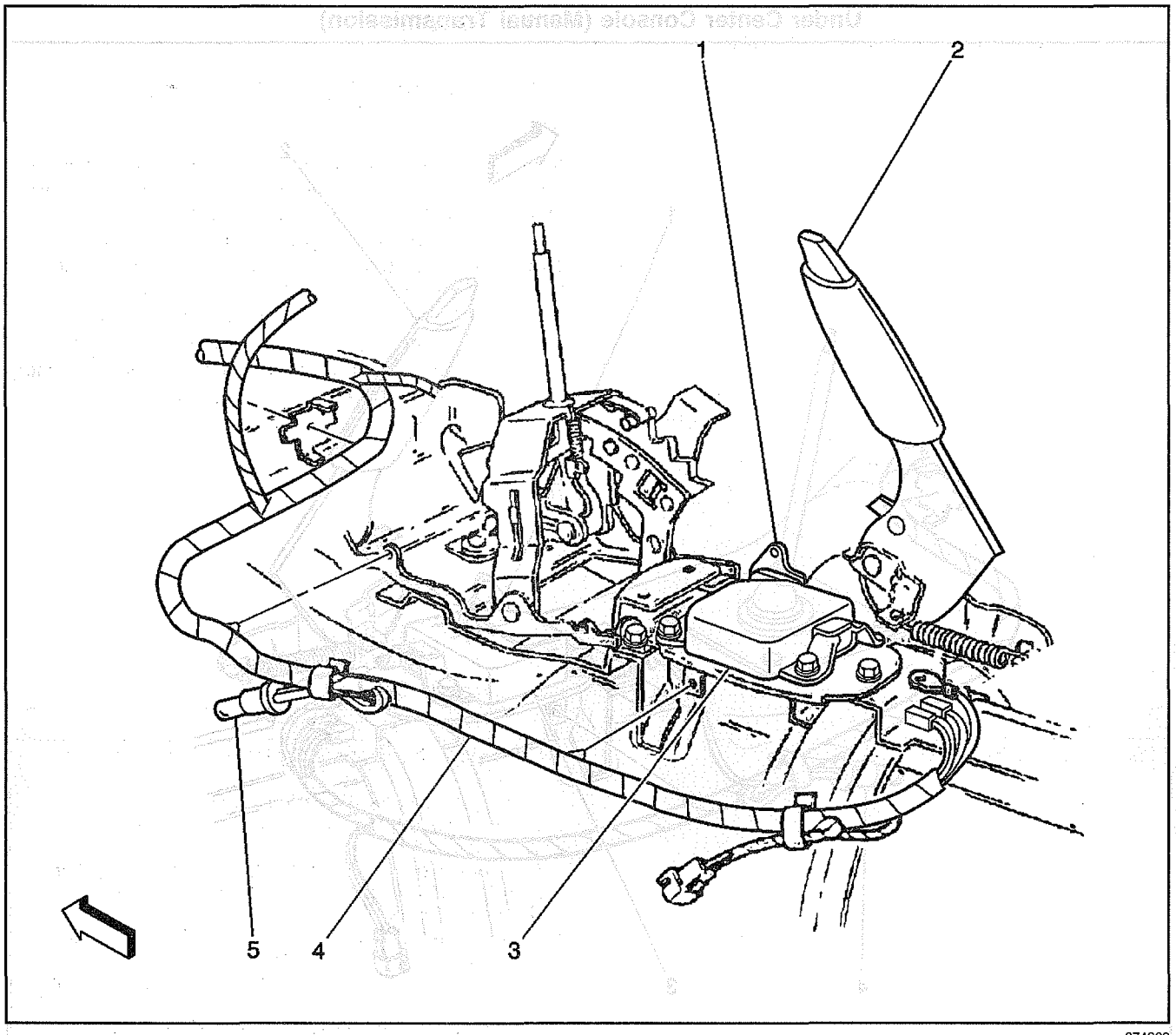


374372

Legend

(1) Park Brake Switch
(2) Park Brake Lever
(3) Inflatable Restraint Sensing and Diagnostic Module (SDM)
(4) Ash Tray Lamp

Under Center Console (Automatic Transmission)



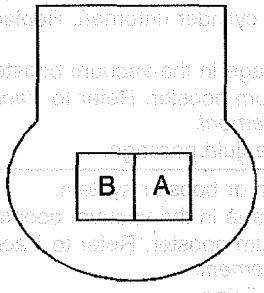
374369

Legend

(1) Park Brake Switch
(2) Park Brake Lever
(3) Inflatable Restraint Sensing and Diagnostic Module (SDM)
(4) IP Wiring Harness
(5) PRNDL Lamp

Hydraulic Brakes Connector End Views

Brake Fluid Level Indicator Sensor



62471

Connector Part Information		• 1216-2195 • 2 Way F Metri-Pack 150 Series Pull to Seat (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	TAN/WHT	33	Brake Warning Indicator Sensor Output
B	BLK	150	Ground

Diagnostic Information and Procedures

A Diagnostic Starting Point - Hydraulic Brakes

Begin the system diagnosis by reviewing the system Description and Operation. Reviewing the Description and Operation information will help you determine the correct symptom diagnostic procedure when a malfunction exists. Reviewing the Description and Operation information will also help you determine if the condition described by the customer is normal operation. Refer to *Symptoms - Hydraulic Brakes* in order to identify the correct procedure for diagnosing the system and where the procedure is located.

Hydraulic Brake Diagnostic System Check

Symptom	Causes
Improper Brake Pedal Travel	• Leaking brake line or connection. Refer to Hydraulic Brakes. • Leaking piston seal. Refer to Disc Brakes. • Leaking master cylinder (internal). Replace master cylinder. • Air in brake system. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* or *Hydraulic Brake System Bleeding (Pressure Bleeding).* • Contaminated or improper brake fluid. Refer to *Brake Fluid and Brake Fluid Handling.* • Leaking vacuum or booster system. Refer to Hydraulic Brakes. • Damaged vacuum booster. Refer to *Vacuum Brake Booster Replacement.* • Uneven brake lining wear. Refer to Disc Brakes. • Brake lining damage by abuse. Refer to Disc Brakes. • Improper thickness variation in rotor. Refer to *Brake Rotor Thickness Variation Check.* • Excessive lateral runout in rotor. Refer to *Brake Rotor Lateral Runout Check.* • Brake assembly attachments loose (including splash shield). • Improperly adjusted stoplamp switch or cruise control vacuum dump. Refer to *Stoplamp Switch Adjustment.* • Incorrect vacuum booster pushrod length. • Low brake fluid. Refer to *Master Cylinder Reservoir Filling.* • Improper rear brake adjustment. • Low engine vacuum.

Hydraulic Brake Diagnostic System Check (cont'd)

Symptom	Causes
Brake Pedal Travel Gradually Increases	• Leaking brake line or connection. Refer to *Brake Fluid Leak.* • Leaking piston seal. Refer to *Brake Caliper Overhaul (Front)* or *Brake Caliper Overhaul (Rear).* • Leaking master cylinder (internal). Replace master cylinder. • Restricted passage in the vacuum booster. • Damaged vacuum booster. Refer to *Vacuum Brake Booster Replacement.* • Restricted brake fluid passage.
Excessive Brake Pedal Effort	• Leaking vacuum or booster system. • Restricted passage in the vacuum booster. • Damaged vacuum booster. Refer to *Vacuum Brake Booster Replacement.* • Worn out brake lining. • Glazed brake lining. • Incorrect brake lining material. • Contaminated brake lining. • Brake lining damage by abuse. • Improper rotor surface finish. • Restricted brake fluid passage. • Brake pedal linkage interference or binding. • Operator riding the brake pedal. • Low engine vacuum. • Excessive vehicle loading. • Rotor corroded.
Excessive Braking Action	• Damaged vacuum booster. Refer to *Vacuum Brake Booster Replacement.* • Worn out brake lining. • Uneven brake lining wear. • Incorrect brake lining material. • Brake lining damage by abuse. • Improper rotor surface finish. • Scored rotor. Refer to *Refinishing Brake Rotors (Front).* • Brake assembly attachments loose (including splash shield).
Brakes Slow To Respond	• Air in the brake system. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* or *Hydraulic Brake System Bleeding (Pressure Bleeding).* • Contaminated or improper brake fluid. Refer to *Brake Fluid and Brake Fluid Handling.* • Leaking vacuum or booster system. • Restricted passage in the vacuum booster. • Damaged vacuum booster. Refer to *Vacuum Brake Booster Replacement.* • Glazed brake lining. • Restricted brake fluid passage. • Brake pedal linkage interference or binding. • Sticking caliper or caliper pistons. Refer to *Brake Caliper Overhaul (Front)* or *Brake Caliper Overhaul (Rear).* • Low engine vacuum.
Brakes Slow To Release	• Contaminated or improper brake fluid. Refer to *Brake Fluid and Brake Fluid Handling.* • Restricted passage in the vacuum booster. • Damaged vacuum booster. Refer to *Vacuum Brake Booster Replacement.* • Restricted brake fluid passage. • Brake pedal linkage interference or binding. • Sticking caliper or caliper pistons. Refer to *Brake Caliper Overhaul (Front)* or *Brake Caliper Overhaul (Rear).* • Parking brake not releasing. • Caliper to knuckle clearance.

Hydraulic Brake Diagnostic System Check (cont'd)

Symptom	Causes
Brakes Drag	• Contaminated or improper brake fluid. Refer to *Brake Fluid and Brake Fluid Handling.* • Brake lining damage by abuse. • Excessive lateral runout in rotor. Refer to *Brake Rotor Lateral Runout Check.* • Brake assembly attachments loose (including splash shield). • Restricted brake fluid passage. • Improperly adjusted stoplamp switch or cruise control vacuum dump. Refer to *Stoplamp Switch Adjustment.* • Brake pedal linkage interference or binding. • Incorrect vacuum booster pushrod length. • Loose front suspension parts. • Operator riding the brake pedal. • Sticking caliper or caliper pistons. Refer to *Brake Caliper Overhaul (Front)* or *Brake Caliper Overhaul (Rear).* • Parking brake not releasing. • Caliper to knuckle clearance. • Improper rear brake adjustment. • Parking brake cables seized.
Uneven Braking Action (Side to Side)	• Contaminated or improper brake fluid. Refer to *Brake Fluid and Brake Fluid Handling.* • Worn out brake lining. • Uneven brake lining wear. • Glazed brake lining. • Incorrect brake lining material. • Contaminated brake lining. • Brake lining damage by abuse. • Improper rotor surface finish. • Scored rotor. Refer to *Refinishing Brake Rotors (Front)* or *Refinishing Brake Rotors (Rear).* • Brake assembly attachments loose (including splash shield). • Restricted brake fluid passage. • Incorrect front wheel alignment. • Incorrect tire pressure. • Loose front suspension parts. • Sticking caliper or caliper pistons. Refer to *Brake Caliper Overhaul (Front)* or *Brake Caliper Overhaul (Rear).* • Parking brake not releasing. • Caliper to knuckle clearance. • Rotor corroded.

Hydraulic Brake Diagnostic System Check (cont'd)

Symptom	Causes
Uneven Braking Action (Front to Rear)	• Leaking brake line or connection. Refer to *Brake Fluid Leak.* • Leaking piston seal. Refer to *Brake Caliper Overhaul (Front)* or *Brake Caliper Overhaul (Rear).* • Leaking master cylinder (internal). Replace master cylinder. • Air in brake system. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* or *Hydraulic Brake System Bleeding (Pressure Bleeding).* • Contaminated or improper brake fluid. Refer to *Brake Fluid and Brake Fluid Handling.* • Worn out brake lining. • Uneven brake lining wear. • Glazed brake lining. • Incorrect brake lining material. • Contaminated brake lining. • Brake lining damage by abuse. • Improper rotor surface finish. • Scored rotor. Refer to *Refinishing Brake Rotors (Front)* or *Refinishing Brake Rotors (Rear).* • Brake assembly attachments loose (including splash shield). • Restricted brake fluid passage. • Sticking caliper or caliper pistons. Refer to *Brake Caliper Overhaul (Front)* or *Brake Caliper Overhaul (Rear).* • Low brake fluid. Refer to *Master Cylinder Reservoir Filling.* • Improper rear brake adjustment. • Excessive Vehicle Loading.
Scraping Noise from Brakes	• Worn out brake lining. • Uneven brake lining wear. • Contaminated brake lining. • Brake lining damage by abuse. • Brake assembly attachments loose (including splash shield). • Loose front suspension parts. • Rotor corroded.
Brakes Squeak without Application	• Worn out brake lining. • Uneven brake lining wear. • Glazed brake lining. • Incorrect brake lining material. • Contaminated brake lining. • Brake lining damage by abuse. • Scored Rotor. Refer to *Refinishing Brake Rotors (Front)* or *Refinishing Brake Rotors (Rear).* • Improperly adjusted stoplamp switch or cruise control vacuum dump. Refer to *Stoplamp Switch Adjustment.* • Incorrect vacuum booster pushrod length. • Sticking caliper or caliper pistons. Refer to *Brake Caliper Overhaul (Front)* or *Brake Caliper Overhaul (Rear).* • Caliper to knuckle clearance.
Brakes Squeak During Application	• Worn out brake lining. • Uneven brake lining wear. • Glazed brake lining. • Incorrect brake lining material. • Contaminated brake lining. • Brake lining damage by abuse. • Scored rotor. Refer to *Refinishing Brake Rotors (Front)* or *Refinishing Brake Rotors (Rear).* • Brake assembly attachments loose (including splash shield). • Excessive vehicle loading.

Hydraulic Brake Diagnostic System Check (cont'd)

Symptom	Causes
Brakes Chatter (Roughness)	• Scored rotor. Refer to *Refinishing Brake Rotors (Front)* or *Refinishing Brake Rotors (Rear).* • Improper thickness variation in rotor. Refer to *Brake Rotor Thickness Variation Check.* • Excessive lateral runout in rotor. Refer to *Brake Rotor Lateral Runout Check.* • Brake assembly attachments loose (including splash shield). • Loose front suspension parts. • Out-of-balance wheel assembly. • Improperly torqued wheel nuts. • Rotor corroded. • Grease or dirt on the rotor.
Brakes Groan at the End of Stop	• Incorrect lining material. • Contaminated brake lining. • Brake lining damage by abuse. • Grease or dirt on the rotor.
Brake Warning Lamp ON	• Leaking brake line or connection. Refer to *Brake Fluid Leak.* • Leaking piston seal. Refer to *Brake Caliper Overhaul (Front)* or *Brake Caliper Overhaul (Rear).* • Leaking master cylinder (internal). Replace master cylinder. Refer to *Master Cylinder Replacement.* • Air in brake system. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* or *Hydraulic Brake System Bleeding (Pressure Bleeding).* • Contaminated or improper brake fluid. Refer to *Brake Fluid and Brake Fluid Handling.* • Parking brake switch circuit grounded. • Parking brake not releasing. • Low brake fluid. Refer to *Master Cylinder Reservoir Filling.*
Premature Lining Wear	• Leaking brake line or connection. Refer to *Brake Fluid Leak.* • Incorrect lining material. • Brake lining damaged by abuse. • Improperly adjusted stoplamp switch or cruise control vacuum dump. Refer to *Stoplamp Switch Adjustment.* • Brake pedal linkage interference or binding. • Incorrect vacuum booster pushrod length. • Operator riding brake pedal. • Sticking caliper or caliper pistons. Refer to *Brake Caliper Overhaul (Front)* or *Brake Caliper Overhaul (Rear).* • Parking brake not releasing. • Caliper to knuckle clearance. • Improper rear brake adjustment. • Excessive vehicle loading. • Parking brake cable seized.
Parking Brake Won't Hold	• Worn out brake lining. • Uneven brake lining wear. • Incorrect lining material. • Contaminated brake lining. • Brake lining damaged by abuse. • Improper rotor surface finish. • Sticking caliper or caliper pistons. Refer to *Brake Caliper Overhaul (Front)* or *Brake Caliper Overhaul (Rear).* • Parking brake cables seized.
Parking Brake Won't Release	• Sticking caliper or caliper pistons. Refer to *Brake Caliper Overhaul (Front)* or *Brake Caliper Overhaul (Rear).* • Parking brake cables seized.

Hydraulic Brake Diagnostic System Check (cont'd)

Symptom	Causes
Brake Pulsation	• Incorrect lining material. • Contaminated brake lining. • Brake linings damaged by abuse. • Scored rotor. Refer to *Refinishing Brake Rotors (Front)* or *Refinishing Brake Rotors (Rear).* • Improper thickness variation in rotor. Refer to *Brake Rotor Thickness Variation Check.* • Excessive lateral runout in rotor. Refer to *Brake Rotor Lateral Runout Check.* • Loose front suspension parts. • Out-of-balance wheel assembly. • Improperly torqued wheel nuts. • Rotor corroded.
Brake Pulls	• Worn out brake lining. • Uneven brake lining wear. • Incorrect lining material. • Contaminated brake lining. • Brake linings damaged by abuse. • Improper rotor surface finish. • Scored rotor. Refer to *Refinishing Brake Rotors (Front)* or *Refinishing Brake Rotors (Rear).* • Restricted brake fluid passage. • Incorrect front wheel alignment. • Incorrect tire pressure. • Loose front suspension parts. • Sticking caliper or caliper pistons. Refer to *Brake Caliper Overhaul (Front)* or *Brake Caliper Overhaul (Rear).* • Caliper to knuckle clearance. • Rotor corroded.

Symptoms - Hydraulic Brakes

Important: Review the system description in order to familiarize yourself with the system functions. Refer to one of the following descriptions:

- *Master Cylinder Description*
- *Vacuum Brake Booster Description*
- *Brake Warning System Description*

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Brake Warning System. Refer to one of the following descriptions: *Checking Aftermarket Accessories* in Wiring Systems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to *Testing for Intermittent and Poor Connections* in Wiring Systems.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- *Brake Warning Indicator Always On*
- *Brake Warning Indicator Inoperative*
- *Brake System Testing*
- *Brake Pedal Travel*
- *Brake Fluid Leak*

Brake Warning Indicator Always On

Step	Action	Value(s)	Yes	No
Important: • Check for ABS diagnostic trouble codes prior to performing this diagnosis. Refer to *A Diagnostic System Check - ABS.* • Check the brake fluid level prior to performing this diagnosis. Refer to *Master Cylinder Reservoir Filling.*				
1	Did you review the system operation and perform the necessary inspections?	—	*Go to Step 2*	Go to *Symptoms - Hydraulic Brakes*
2	Turn the ignition to the RUN position. Does the brake warning indicator illuminate during the bulb test and then turn off?	—	Go to *Testing for Intermittent and Poor Connections* in Wiring Systems	*Go to Step 3*
3	1. Disconnect the brake fluid level indicator sensor. 2. Turn the ignition switch to the RUN position. Is the brake warning indicator still on?	—	*Go to Step 4*	*Go to Step 9*
4	1. Disconnect the park brake switch. 2. Turn the ignition switch to the RUN position. Is the brake warning indicator still on?	—	*Go to Step 5*	*Go to Step 10*
5	Determine if this vehicle is either of the following types: • Domestic • Gulf States Is the vehicle one of the above types?	—	*Go to Step 6*	*Go to Step 7*
6	1. Disconnect the daytime running lights (DRL) module. 2. Turn the ignition switch to the RUN position. Is the brake warning indicator on?	—	*Go to Step 7*	*Go to Step 11*
7	Test for and repair a short to ground in circuit 33. Refer to *Circuit Testing* and *Wiring Repairs* in Wiring Systems. Did you find and repair a short?	—	*Go to Step 13*	*Go to Step 8*
8	Replace the instrument cluster. Refer to *IP Cluster Replacement* in Instrument Panel, Gauges, and Console. Did you complete the replacement?	—	*Go to Step 13*	—
9	Replace the brake fluid level indicator sensor. Did you complete the replacement?	—	*Go to Step 13*	—
10	Replace the park brake switch. Did you complete the replacement?	—	*Go to Step 13*	—
11	Test for and repair a short to ground in circuit 1134. Refer to *Circuit Testing* and *Wiring Repairs* in Wiring Systems. Did you find and repair a short?	—	*Go to Step 13*	*Go to Step 12*
12	Replace the DRL module. Refer to *Daytime Running Lights (DRL) Control Module Replacement* in Lighting. Did you complete the replacement?	—	*Go to Step 13*	—
13	Operate the system in order to verify the repair. Did you correct the condition?	—	System OK	*Go to Step 3*

Brake Warning Indicator Inoperative

Step	Action	Value(s)	Yes	No
1	Did you review the system operation and perform the necessary inspections?	—	*Go to Step 2*	Go to *Symptoms - Hydraulic Brakes*
2	1. Turn the ignition to the RUN position. 2. Set the park brake. Does the brake warning indicator illuminate?	—	Go to *Testing for Intermittent and Poor Connections* in Wiring Systems	*Go to Step 3*
3	Did the brake warning indicator illuminate for the bulb test and then turn off?	—	*Go to Step 4*	*Go to Step 10*
4	1. Disconnect the brake fluid level indicator sensor. 2. Connect a 10A fused jumper from the brake fluid level indicator sensor connector terminal A to terminal B. Refer to *Circuit Testing* in Wiring Systems. 3. Turn the ignition switch to the RUN position. Is the brake warning indicator on?	—	*Go to Step 5*	*Go to Step 7*
5	Test for and repair a poor connection at the brake fluid level indicator sensor. Refer to *Testing for Intermittent and Poor Connections* and *Connector Repairs* in Wiring Systems. Did you find and repair a poor connection?	—	*Go to Step 23*	*Go to Step 6*
6	Replace the brake fluid level indicator sensor. Refer to *Master Cylinder Fluid Level Sensor Replacement.* Did you complete the replacement?	—	*Go to Step 23*	—
7	1. Connect a 10A fused jumper from the brake fluid level indicator sensor terminal A to ground. Refer to *Circuit Testing* in Wiring Systems. 2. Turn the ignition switch to the RUN position. Is the brake warning indicator on?	—	*Go to Step 8*	*Go to Step 9*
8	Repair the open in circuit 150 between the brake fluid level indicator sensor terminal B and S155. Refer to *Wiring Repairs* in Wiring Systems. Did you complete the repair?	—	*Go to Step 23*	—
9	Repair the open or poor connection in circuit 33 between the brake fluid level indicator sensor terminal A and S228. Refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems. Did you complete the repair?	—	*Go to Step 23*	—
10	Replace the instrument cluster. Refer to *IP Cluster Replacement* in Instrument Panel, Gauges, and Console. Did you complete the replacement?	—	*Go to Step 23*	—
11	1. Disconnect the park brake switch connector. 2. Connect a 10A fused jumper from the park brake switch connector to ground. Refer to *Circuit Testing* in Wiring Systems. 3. Turn the ignition switch to the RUN position. Is the brake warning indicator on?	—	*Go to Step 12*	*Go to Step 15*
12	Test for and repair a poor connection at the park brake switch. Refer to *Testing for Intermittent and Poor Connections* and *Connector Repairs* in Wiring Systems. Did you find and repair a poor connection?	—	*Go to Step 23*	*Go to Step 13*

Brake Warning Indicator Inoperative (cont'd)

Step	Action	Value(s)	Yes	No
13	Test and repair a poor connection at the park brake switch ground. Refer to *Testing for Intermittent and Poor Connections* and *Connector Repairs* in Wiring Systems. Did you find and repair a poor connection?	—	*Go to Step 23*	*Go to Step 14*
14	Replace the park brake switch. Did you complete the replacement?	—	*Go to Step 23*	—
15	Determine if this vehicle is either of the following types: • Domestic • Gulf States Is the vehicle one of the above types?	—	*Go to Step 16*	*Go to Step 19*
16	1. Leave the 10A fused jumper connected between the park brake switch connector and ground. 2. Disconnect the daytime running lights (DRL) module connector C2. 3. Connect a fused jumper between the DRL module connector C2 terminal D and terminal E. Refer to *Circuit Testing* in Wiring Systems. 4. Turn the ignition switch to the RUN position. Is the brake warning indicator on?	—	*Go to Step 21*	*Go to Step 17*
17	1. Connect a 10A fused jumper from the DRL module connector C2 terminal D to the ground. Refer to *Circuit Testing* in Wiring Systems. 2. Turn the ignition switch to the RUN position. 3. Is the brake warning indicator on?	—	*Go to Step 18*	*Go to Step 19*
18	Repair the open in circuit 1134 between the DRL module connector C2 terminal E and the park brake switch. Refer to *Wiring Repairs* in Wiring Systems. Did you complete the repair?	—	*Go to Step 23*	—
19	Test for and repair a poor connection at the instrument cluster connector terminal A5. Refer to *Testing for Intermittent and Poor Connections* and *Connector Repairs* in Wiring Systems. Did you find and repair a poor connection?	—	*Go to Step 23*	*Go to Step 20*
20	Repair the open in circuit 33 between the instrument cluster connector terminal A5 and the DRL module connector C2 terminal D (Domestic or Gulf States) or the park brake switch (Europe or Japan). Refer to *Wiring Repairs* in Wiring Systems. Did you complete the repair?	—	*Go to Step 23*	—
21	Test for and repair a poor connection at the DRL module connector C2 terminal D and terminal E. Refer to *Testing for Intermittent and Poor Connections* and *Connector Repairs* in Wiring Systems. Did you find and repair a poor connection?	—	*Go to Step 23*	*Go to Step 22*
22	Replace the DRL module. Refer to *Daytime Running Lights (DRL) Control Module Replacement* in Lighting. Did you complete the replacement?	—	*Go to Step 23*	—
23	Operate the system in order to verify the repair. Did you correct the condition?	—	System OK	*Go to Step 3*

Brake System Testing

Test the brakes on a roadway that meets all of the following conditions:

- Dry
- Clean
- Reasonably smooth
- Level

Test the brakes at different vehicle speeds with both light and heavy brake pedal force.

Do not test the brakes on a roadway with the following conditions because the tires will not grip the road equally:

- Wet
- Greasy
- Covered with loose dirt

Do not test the brakes on a crowned roadway because the weight of the vehicle will be thrown toward the wheels on one side.

Do not test the brakes on a rough roadway because the wheels will tend to bounce.

Brake Pedal Travel

Tools Required

J 28662 Brake Pedal Effort Gauge

One of the following conditions may be the cause of most low brake pedal problems:

- Air in the brake system. Bleed the system until the air is purged. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* or *Hydraulic Brake System Bleeding (Pressure Bleeding)*.
- Misadjusted rear drum brakes. Inspect the rear brake adjustment.

The following conditions may be other less frequent causes of excessive brake pedal travel:

- Incorrect pushrod length
- Malfunctioning rear brake shoe adjusters
- Excessively worn pads
- Brake hydraulic system leakage

One of the following conditions is usually the cause of high brake pedal effort problems:

- Low engine vacuum
- Vacuum leak
- Improperly functioning vacuum booster

1. Install the *J 28662* onto the brake pedal.
2. Hook the end of the tape measure over the top edge of the pedal.
3. Measure the distance from the top edge of the pedal to the rim of the steering wheel.
4. Block the tires and the wheels.
5. Run the engine at idle.
6. Put the range selector lever in NEUTRAL.
7. Apply 445 N (100 lb) of force to the brake pedal.
8. Remeasure the distance from the top edge of the pedal to the rim of the steering wheel. The difference between both of the readings is the actual brake pedal travel. The brake pedal travel should be between 51–89 mm (2.0–3.5 in).

Brake Fluid Leak

1. Run the engine at idle.
2. Put the range selector lever in NEUTRAL.
3. Depress the brake pedal. Hold the brake pedal with constant foot pressure.
4. If the pedal gradually falls away with constant pressure, the brake hydraulic system may be leaking. Inspect the hydraulic system for any suspected leaks.
5. Inspect the master cylinder fluid level.
   - A slight drop in the master cylinder reservoir level results from normal pad wear. The reservoir may be as low as 25.4 mm (1.0 in) from the top if the pads are worn. This condition is not abnormal.
   - An abnormally low level in the reservoir indicates a leak in the system. The brake hydraulic system may be leaking either internally or externally. Refer to *Hydraulic Brake Diagnostic System Check*. The system may appear to pass this test but still have a slight leakage.
6. Inspect the brake pipe and the brake hose connections for brake fluid leaks.
7. If any leaks are found, replace the hose or the pipe.
8. If any hoses or pipes are replaced, inspect the connecting brake component for damage. If damage is found, rebuild or replace the component.
9. Inspect the brake caliper boots and rear wheel cylinder boots for leaks.
10. If any leaks are found, rebuild or replace the part in question. Refer to Disc Brakes.

Brake Hose and Pipe Inspection

Notice: Do not allow components to hang from the flexible brake hoses as damage to the hoses may occur. Some brake hoses 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 the brake hoses at least twice a year for the following conditions:

- Road hazard damage
- Cracks
- Chafing of the outer cover
- Leaks
- Blisters

Use a light and a mirror for an adequate inspection. Replace any hoses with any of the above conditions.

Master Cylinder Diagnosis

Notice: Avoid spilling brake fluid on any of the painted vehicle's surfaces, wiring, cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, immediately flush the area with water to minimize potential for damage.

Visual Inspection

- Check for a cracked casting or brake fluid leaks around the master cylinder. A leak will have at least one drop of fluid. A damp condition is normal.
- Check the pedal linkage for binding and for incorrect pushrod length. Disassemble the master cylinder if you do not find improper brake pedal travel or brake pedal binding.
- Check the master cylinder for swollen or elongated primary piston seals. If you find swollen seals, refer to *Brake Fluid and Brake Fluid Handling.*

Low Pressure Check

This procedure inspects the following conditions:

- Internal seal damage
- Porosity
- Component bore integrity

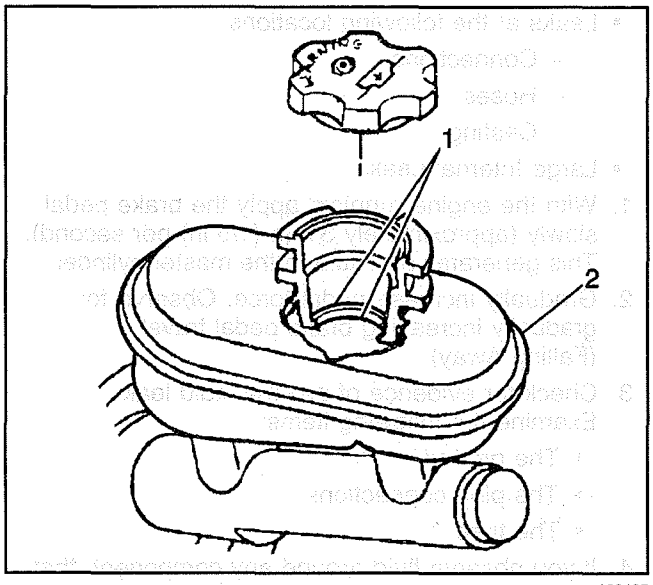
1. With the ignition switch in the OFF position, pump the brake pedal in order to relieve the vacuum.
   - Pump the brake pedal five times for vacuum-assisted brakes.
   - Pump the brake pedal twenty-five times for hydraulic-assisted brakes.
2. Apply the brake pedal slowly (approximately 3 mm {1/8 in} per second). This generates pressure in the master cylinder.
3. Gradually increase pedal force. Observe for gradually increasing brake pedal travel (Falling Away).
4. If the brake pedal travel tends to gradually increase, preform the High Pressure Check.
5. If the High Pressure Check does not locate a leak, then the master cylinder has an internal leak.

High Pressure Check

This procedure tests for the following conditions:

- Leaks at the following locations:
  - Connections
  - Hoses
  - Casting
- Large Internal Leaks

1. With the engine running, apply the brake pedal slowly (approximately 3 mm {1/8 in} per second). This generates pressure in the master cylinder.
2. Gradually increase pedal force. Observe for gradually increasing brake pedal travel (Falling Away).
3. Check for evidence of external fluid leaks. Examine the following items:
   - The ground
   - The pipe connections
   - The tires
4. If you observe fluid around any component, that component has failed and needs to be replaced.
5. If you find a leak at a connection, tighten the connection to specification, Refer to *Fastener Tightening Specifications.*
6. Perform the High Presssure Check again.



182425

Repair Instructions

Master Cylinder Reservoir Filling

Filling The Master Cylinder Reservoir

Caution: Use only SUPREME 11 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. Improper or contaminated fluid will result in damage to components or loss of braking, with possible personal injury.

Ensure that the master cylinder reservoir (2) is kept properly filled. An adequate reserve of brake fluid will prevent air from entering the brake hydraulic system. However, because heat absorbed from the brakes and the engine expands the brake fluid, do not overfill the reservoir.

A drop in the brake fluid level is normal as the pads wear. If the master cylinder reservoir is filled before new pads are installed, brake fluid may spill over once the new pads are in place. Unless there is a leak in the brake hydraulic system, or the brake hydraulic system has been serviced, do not top off the master cylinder reservoir.

Clean the master cylinder reservoir cap thoroughly before removal in order to avoid contaminating the reservoir. Remove the reservoir cap and the reservoir diaphragm.

Add brake fluid to the reservoir in order to bring the fluid level to the fill line. The fill line is located on the side of the reservoir.

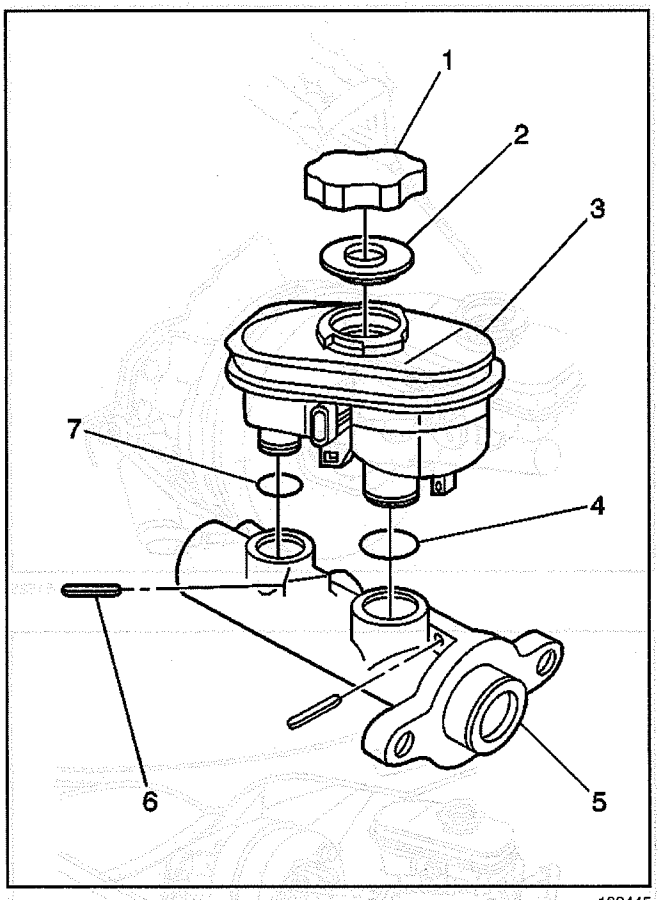
Master Cylinder Reservoir Replacement

Removal Procedure

1. Remove the master cylinder (5). Refer to *Master Cylinder Replacement*.

Notice: Do not overtighten vise, or damage to the master cylinder will result.

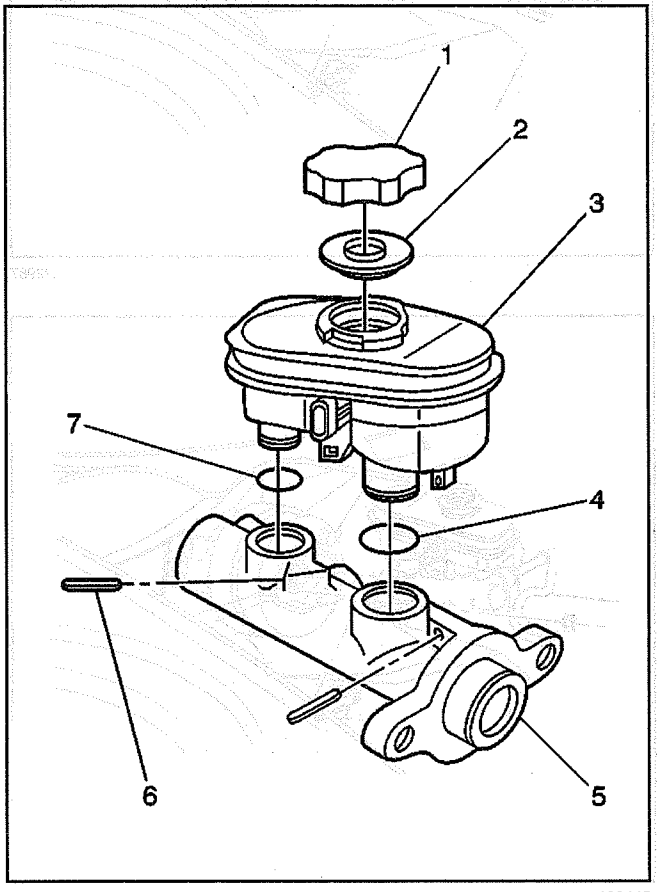
2. Clamp the flange on the master cylinder body in a vise.
3. Drive out the master cylinder reservoir pins (6). Use a 1/8-inch punch.
4. Remove the master cylinder reservoir (3) by pulling the reservoir straight up and away from the cylinder body.
5. Remove the master cylinder reservoir grommets (4 and 7) from the grooves in the reservoir. Discard the grommets.
6. Inspect the reservoir for cracks or deformation. Replace the reservoir if necessary.
7. Use clean denatured alcohol to clean the reservoir.
8. Use non-lubricated compressed air to dry the reservoir.



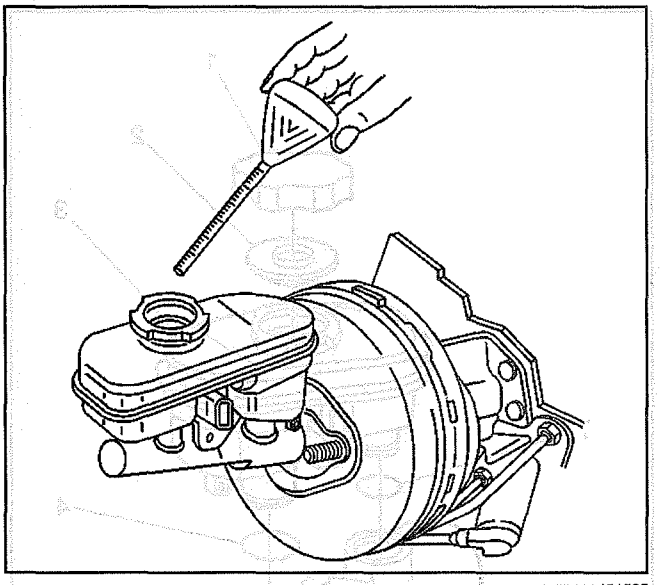
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Installation Procedure

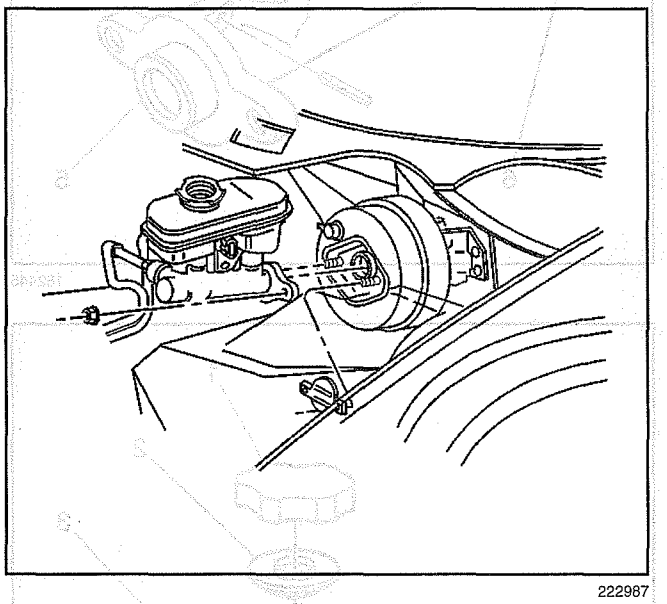
1. Use clean brake fluid to lubricate the new grommets (4 and 7) and the grooves in the reservoir.
2. Insert the grommets into the grooves in the reservoir. Verify that the grommets are properly seated.
3. Connect the reservoir (3) to the master cylinder body (5). Use your hand in order to press the reservoir straight down into the cylinder body.
4. Drive in the master cylinder reservoir pins (6) in order to retain the reservoir.
5. Install the master cylinder. Refer to *Master Cylinder Replacement*.



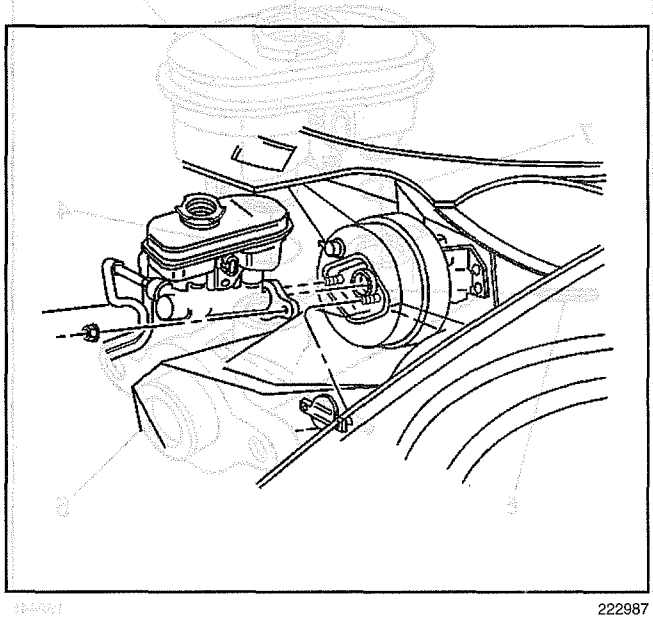
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Master Cylinder Replacement

Removal Procedure

1. Remove and discard the brake fluid from the reservoir.
2. Remove the combination valve pipes in order to prevent fluid loss and contamination.
3. Disconnect the brake fluid level sensor connector.
4. Remove the master cylinder nuts.
5. Remove the master cylinder.

Installation Procedure

1. Bench bleed the master cylinder. Refer to *Master Cylinder Bench Bleeding*.
2. Install the master cylinder.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the master cylinder nuts.

   Tighten

   Tighten the master cylinder nuts to 29 N·m (21 lb ft).
4. Fill the master cylinder reservoir. Refer to *Master Cylinder Reservoir Filling*.
5. Install the brake combination valve pipes onto the master cylinder one at a time. Complete the following steps:
   5.1. Remove the locally fabricated plugs.
   5.2. Install the brake pipe fitting finger tight.

5.3. Have an assistant depress the brake pedal in order to remove air at the loose brake pipe fittings.

Tighten

Tighten the combination valve pipe fittings to 32 N·m (24 lb ft).

5.4. Have an assistant quickly release and pump the brake pedal several times.

5.5. If the brake pedal remains high and firm, start the vehicle. If the brake pedal still feels firm, test drive the vehicle.

If the brake pedal feels soft or spongy, bleed the entire brake hydraulic system. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* or *Hydraulic Brake System Bleeding (Pressure Bleeding)*.

6. Connect the brake fluid level sensor connector.

Master Cylinder Bench Bleeding

Tools Required

- One 11 x 1.5 mm tube fitting nut
- One 12 x 1.0 mm tube fitting nut
- Two pieces of 4.75 mm (0.187 in) brake pipe, approximately 50 mm (1.969 in) long

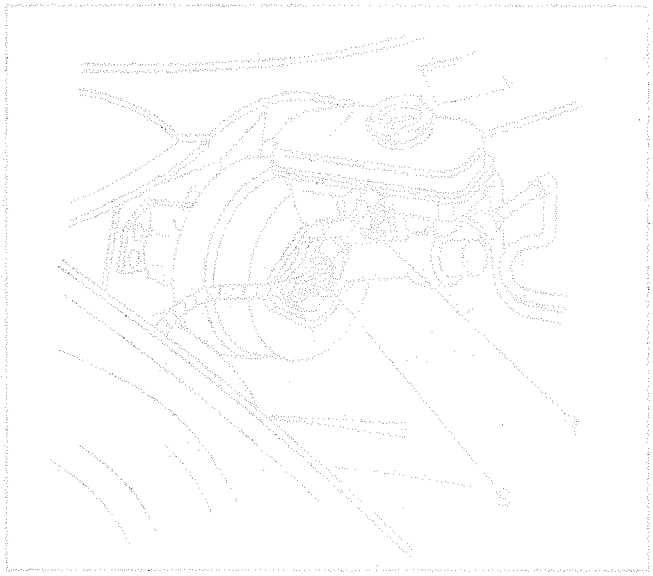
1. Fabricate two plugs in order to plug the master cylinder outlet ports. Use the following procedure:
   1.1. Fashion two ISO flares on one end of each tube.
   1.2. Install the nuts onto the flared tubes.
   1.3. One at a time, place approximately 13 mm (0.51 in) of the unflared tube end in a vise.
   1.4. Compress the end of the tube with the vise in order to collapse the tube.
   1.5. Bend the tube to a 90 degree angle.
   1.6. Remove the tube from the vise.
   1.7. Put the tube back in the vise. Fold the tube end against itself in order to form an air-tight seal.
2. Plug the master cylinder outlet ports with the fabricated plugs.

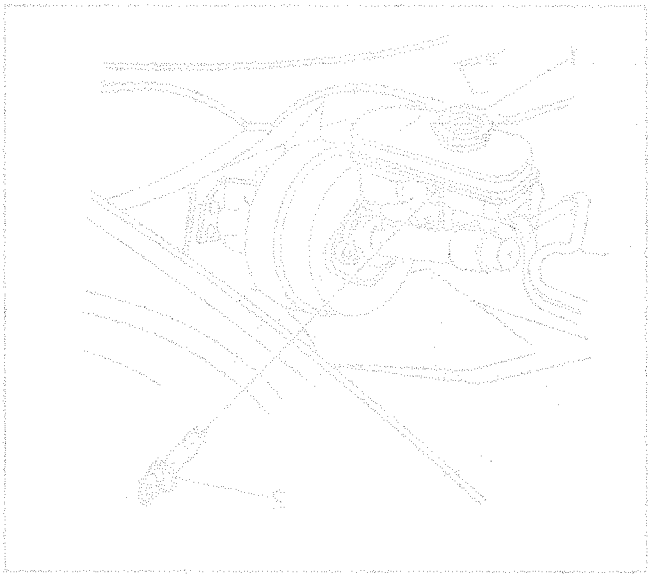
Notice: Do not overtighten vise, or damage to the master cylinder will result.

3. Place shop towels around the master cylinder in order to absorb the bled fluid.
4. Mount the master cylinder in a vise. Tilt the front end of the master cylinder down slightly.
5. Fill the master cylinder with clean brake fluid.

Important: As air bleeds from the brake master cylinder, resistance to primary piston strokes will increase, not allowing a full stroke.

6. Using a tool with a smooth, rounded end, stroke the primary piston about 25 mm (0.948 in) several times.
7. Reposition the master cylinder in the vise. Tilt the master cylinder slightly up.

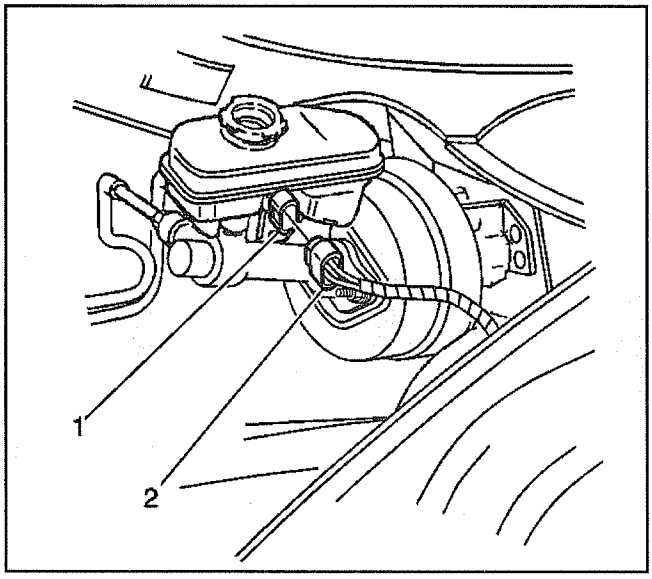




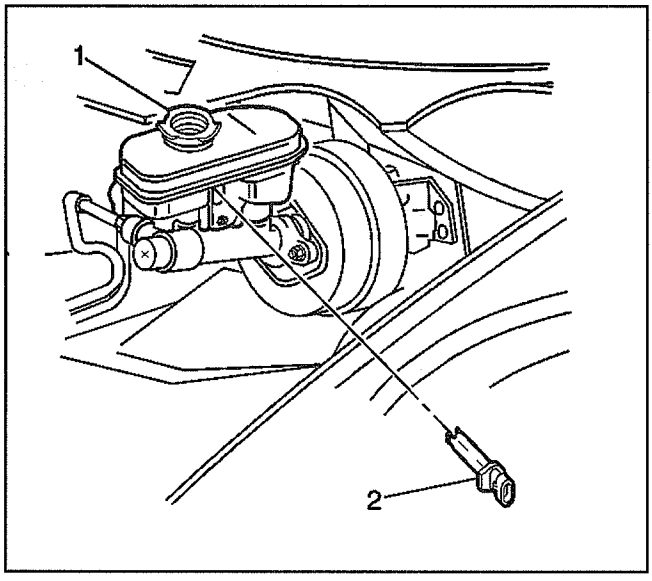
8. Stroke the primary piston several times.
9. Reposition the brake master cylinder in the vise. Level the master cylinder.
10. Loosen the fabricated plugs one at a time.
11. Push the primary piston into the master cylinder bore in order to force the air out of the master cylinder.

Important: In order to prevent air from sucking back into the master cylinder, tighten the fabricated plugs before allowing the primary piston to return to its original position.

12. Repeat the previous 6 steps until no air escapes past the plugs.
13. Install the master cylinder into the vehicle. Refer to *Master Cylinder Replacement*.



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Master Cylinder Fluid Level Sensor Replacement

Removal Procedure

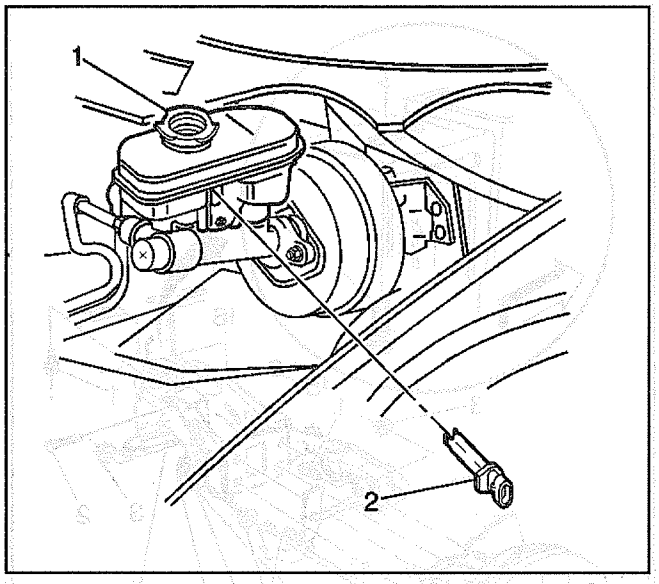
1. Disconnect low brake fluid sensor electrical connector (2) from the sensor (1).

Important: If the sensor is being replaced, remove and replace the sensor float that resides within the master cylinder reservoir.

2. Using needlenose pliers, remove the sensor (2) from the reservoir (1) by squeezing the outer tangs together and removing the sensor by hand.

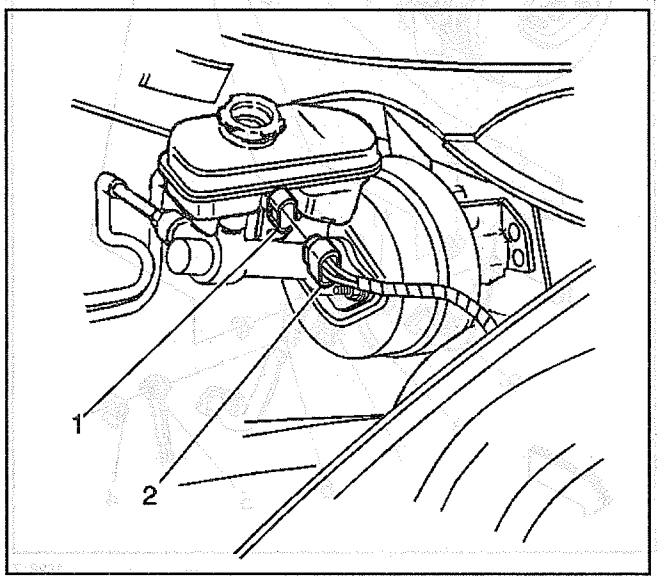
Installation Procedure

1. Insert the low brake fluid sensor (2) and float sensor if removed, into reservoir (1) cavity ensuring it is fully seated. Sensor should "snap" into position as the tangs engage.

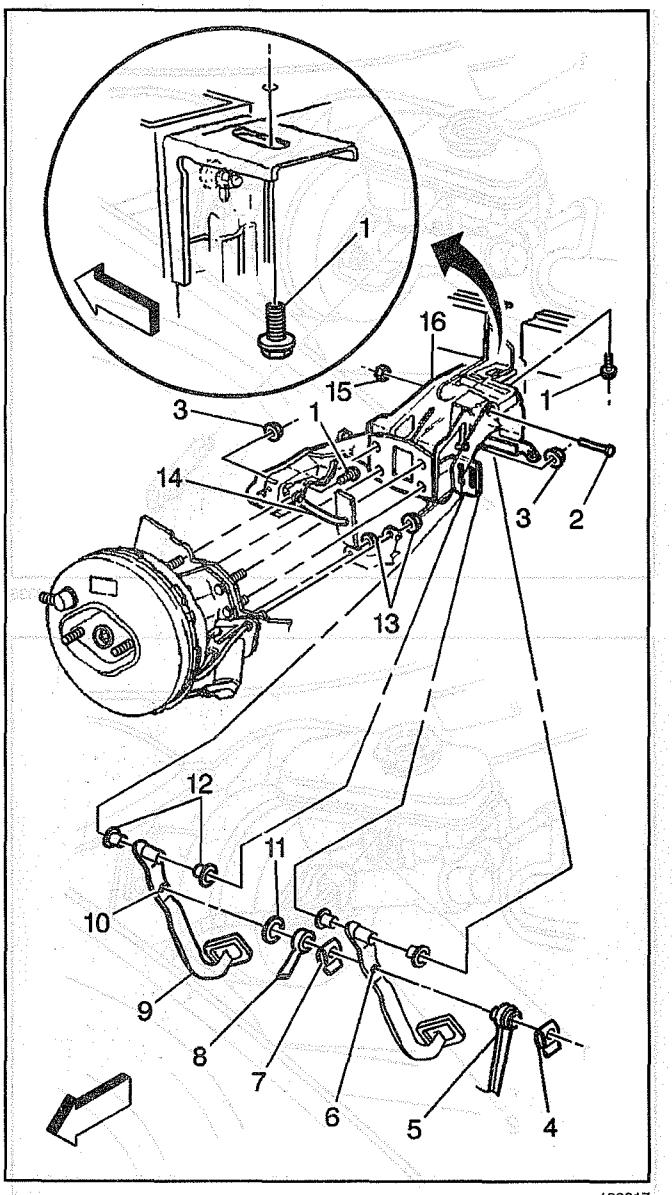


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2. Connect the low brake fluid sensor electrical connector (2) to the sensor (1).



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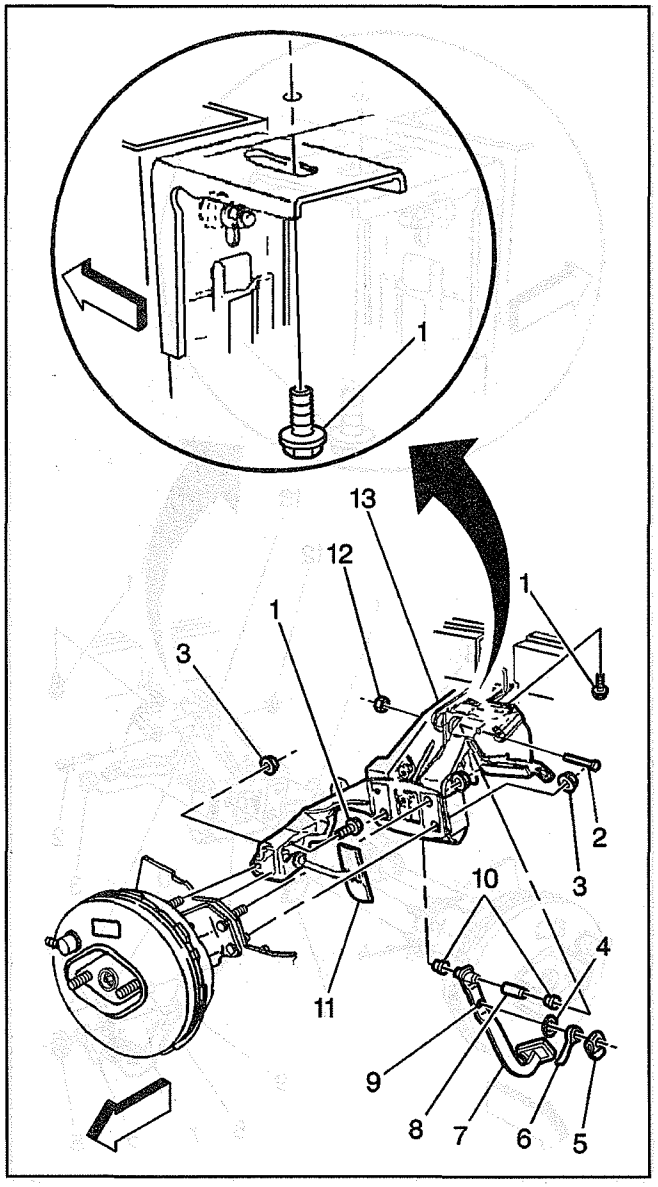
Brake Pedal Replacement

Removal Procedure

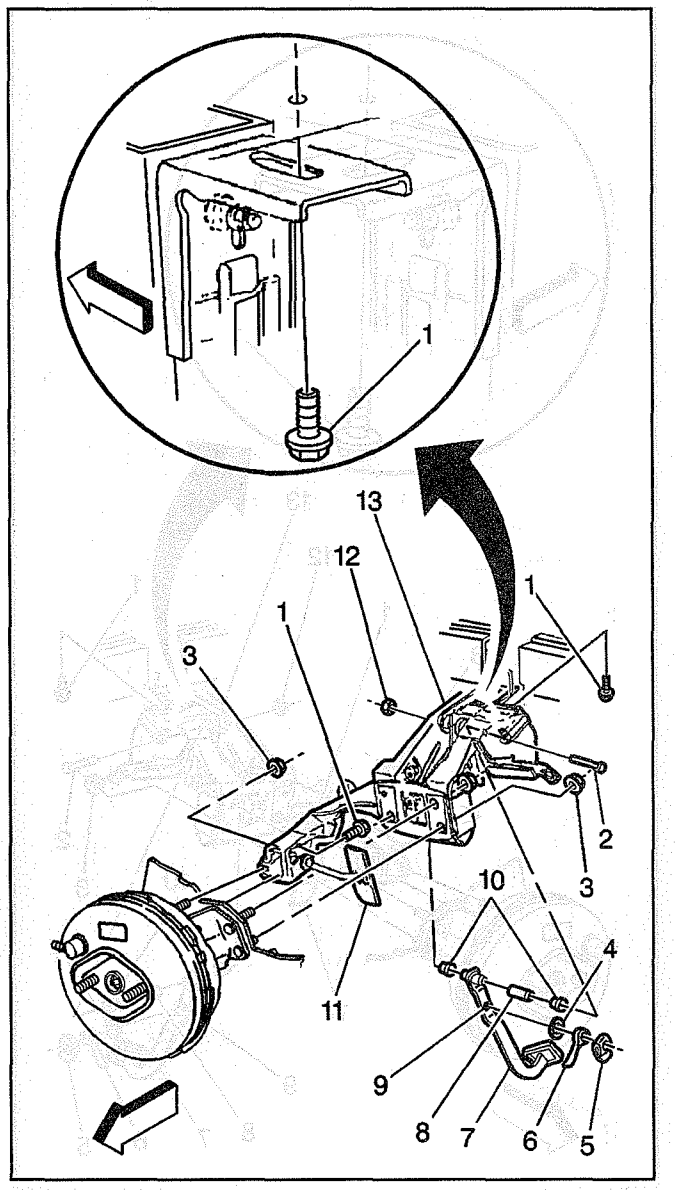
Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Remove the left side instrument panel insulator. Refer to *Closeout/Insulator Panel Replacement - Left* in Instrument Panel, Gauges and Console.
3. Remove the following components from the brake pedal pin (10):
   - The brake pedal pushrod pin retainer (7)
   - The brake pedal pushrod (8)
   - The brake pedal pushrod washer (11)

4. Remove the brake pedal pivot nut (12).
5. Slide out the brake pedal pivot bolt/screw (2) partway in order to give enough clearance in order to remove the brake pedal (7).
6. Remove the brake pedal (7).
7. Remove the brake pedal pivot bushings (10) from the brake pedal (7), if necessary.
8. Remove the brake pedal pivot spacer (8) from the brake pedal (7), if necessary.
9. Clean all the components with a suitable solvent.
10. Inspect all the components for wear. Repair or replace the components as needed.



182814



182814

Installation Procedure

1. Install the brake pedal pivot spacer (8) to the brake pedal (7), if removed.
2. Install the brake pedal pivot bushings (10) to the brake pedal (7), if removed.
3. Install the brake pedal (7).
4. Lubricate the brake pedal pivot bolt/screw (2) with chassis lubricant.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

5. Install the brake pedal pivot bolt/screw (2) and the brake pedal pivot nut (12).

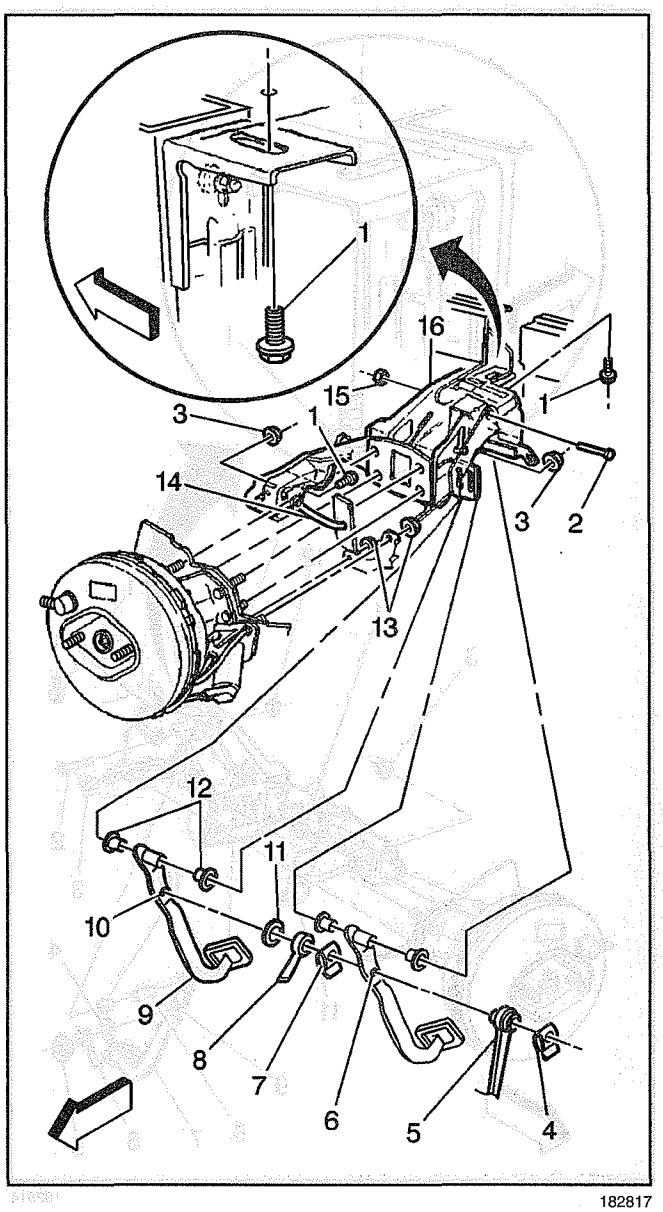
   Tighten

   Tighten the brake pedal pivot nut (12) to 54 N·m (40 lb ft).

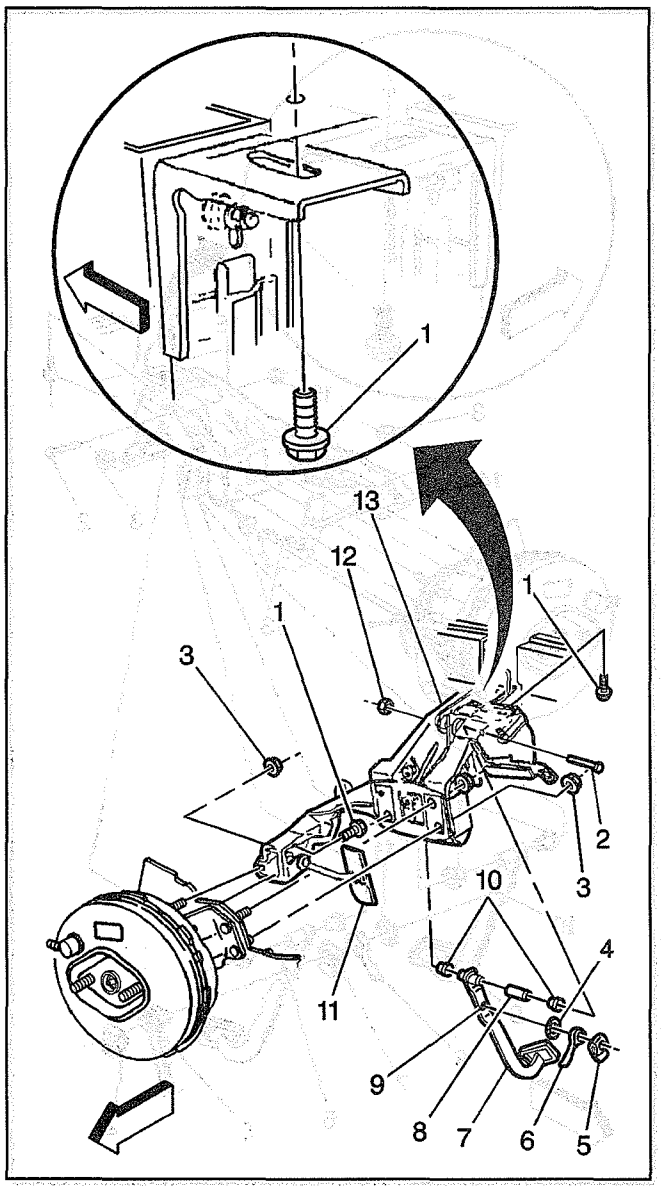
6. Lubricate the brake pedal pin (10) with chassis lubricant.
7. Install the following components to the brake pedal pin (10):
   - The brake pedal pushrod pin retainer (7)
   - The brake pedal pushrod (8)
   - The brake pedal pushrod washer (11)
8. Install the left side instrument panel insulator. Refer to *Closeout/Insulator Panel Replacement - Left* in Instrument Panel, Gauges and Console.
9. Connect the negative battery cable.

   Tighten

   Tighten the negative battery cable to 15 N·m (11 lb ft).
10. Adjust the following components. Refer to *Stoplamp Switch Adjustment*.
    - Cruise control release switch
    - Stoplamp and TCC switch
    - Cruise control clutch switch or cruise control clutch anticipate switch



182817



182814

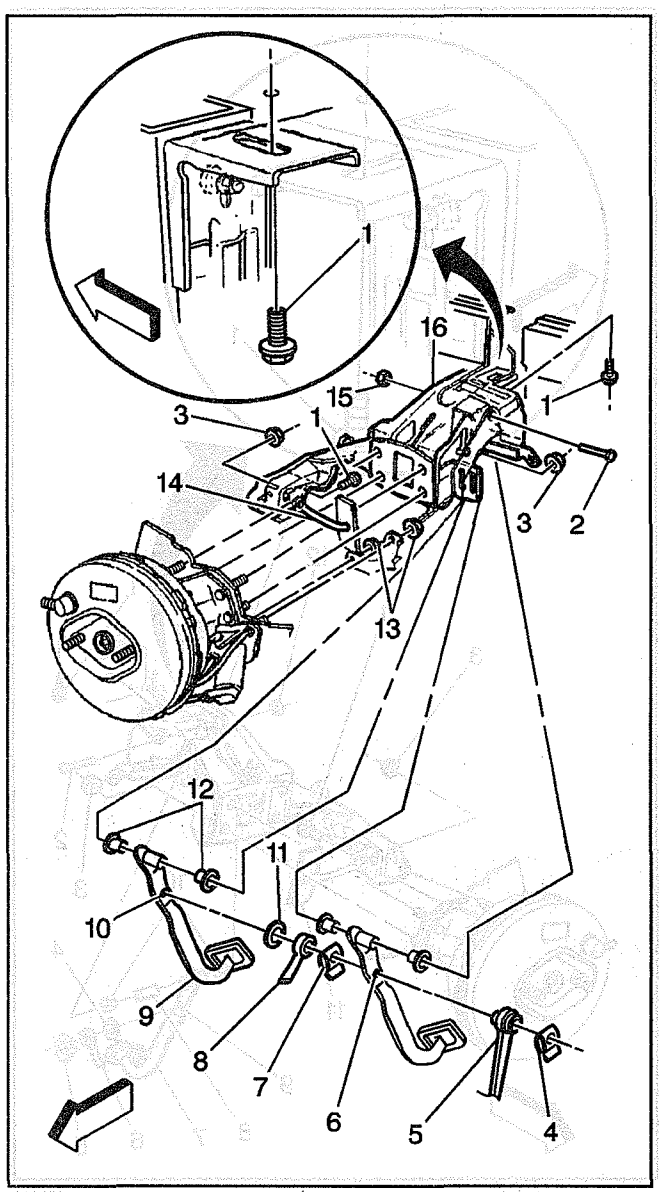
Brake Pedal Bracket Replacement

Removal Procedure

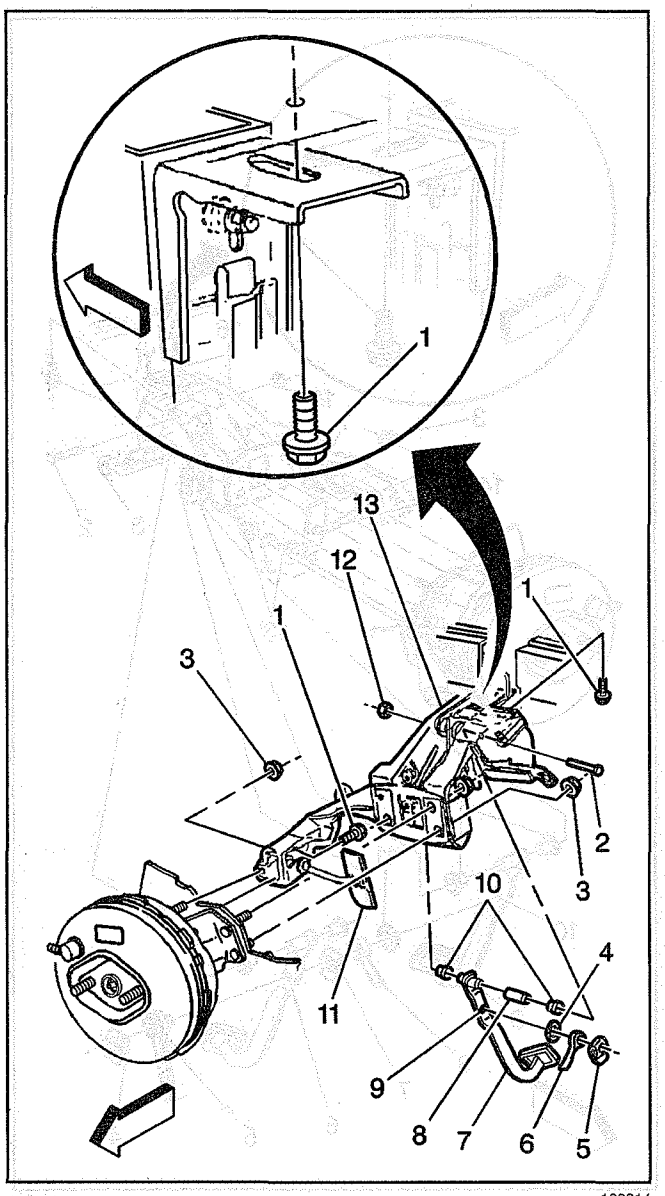
Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Remove the left side instrument panel insulator. Refer to *Closeout/Insulator Panel Replacement - Left* in Instrument Panel, Gauges and Console.
3. Remove the following components from the pedal with the bracket. Refer to *Stoplamp Switch Replacement*.
   - Cruise control release switch
   - Stoplamp and Torque Converter Clutch (TCC) switch
   - Cruise control clutch switch or cruise control clutch anticipate switch
4. Remove the clutch start switch from the brake pedal with the bracket, if equipped with a manual transmission.
5. Remove the accelerator pedal (11).
6. Remove the following components from the brake pedal pin (9):
   - The brake pedal pushrod pin retainer (5)
   - The brake pedal pushrod (6)
   - The brake pedal pushrod washer (4)

7. Remove the clutch pedal lever pin retainer (4) and the clutch pushrod (5) from the clutch pedal pin (6), if equipped with a manual transmission.
8. Remove the brake pedal nuts (3) and the brake pedal bracket bolts/screws (1).
9. Remove the clutch master cylinder nuts (13), if equipped with a manual transmission.
10. Remove the brake pedal with the bracket (16).



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182814

Installation Procedure

Important: When installing the brake pedal with the bracket, ensure that the dash panel insulator material does not get pinched between the brake pedal and the dash panel.

1. Install the brake pedal with the bracket (13).

2. Install the clutch master cylinder nuts (13), if equipped with a manual transmission.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the brake pedal nuts (3) and brake pedal bracket bolts/screws (1).

   Tighten

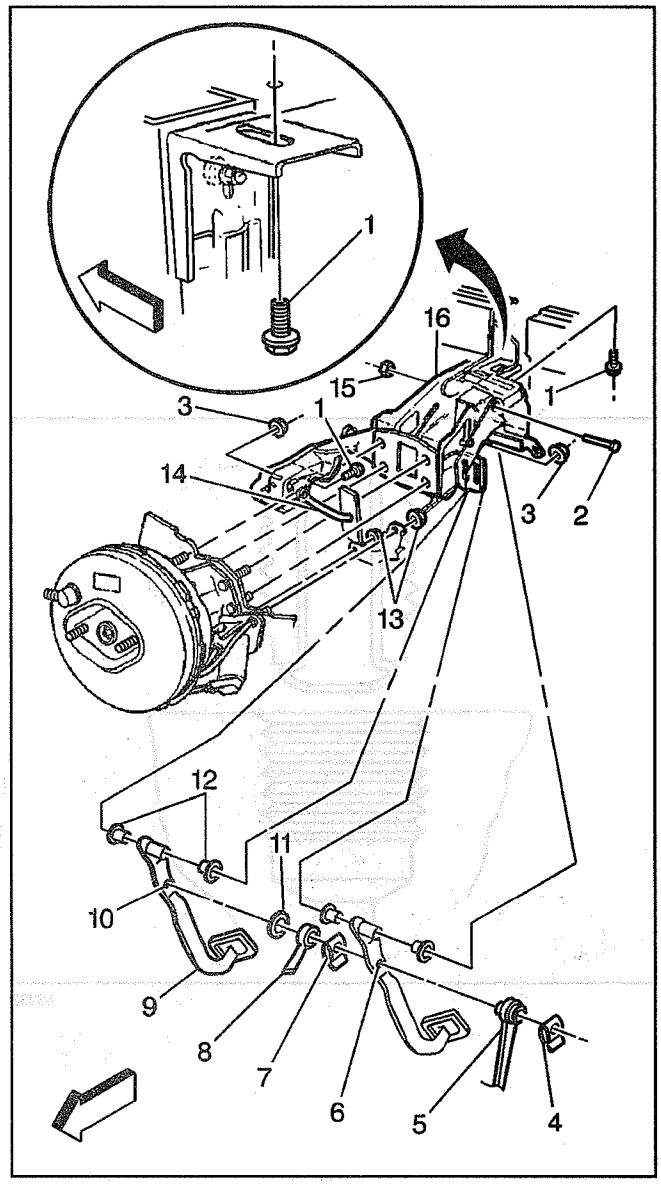
   - Tighten the clutch master cylinder nuts (13) to 27 N·m (20 lb ft), if equipped with a manual transmission.
   - Tighten the brake pedal bracket bolts (1) to 25 N·m (18 lb ft).
   - Tighten the brake pedal nuts (3) to 20 N·m (15 lb ft) in the following sequence:

   3.1. Inboard upper
   3.2. Outboard lower
   3.3. Outboard upper
   3.4. Inboard lower

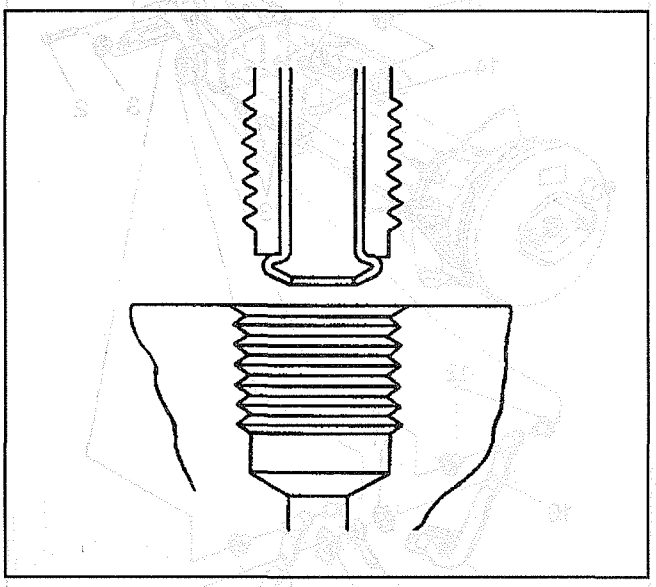
4. Install the accelerator pedal (14).
5. Lubricate the clutch pedal pin (6) with chassis lubricant.
6. Install the clutch pedal lever pin retainer (4) and the clutch master cylinder pushrod (5) to the clutch pedal pin (6), if equipped with a manual transmission.
7. Lubricate the brake pedal pin (10) with chassis lubricant.
8. Install the following components to the brake pedal pin:
   - The brake pedal pushrod pin retainer
   - The brake pedal pushrod
   - The brake pedal pushrod washer
9. Install the following components to the pedal with the bracket (16). Refer to *Stoplamp Switch Replacement*.
   - Cruise control release switch
   - Stoplamp and TCC switch
   - Cruise control clutch switch or cruise control clutch anticipate switch
10. Install the clutch start switch to the brake pedal with the bracket, if equipped with a manual transmission.
11. Adjust the following components. Refer to *Stoplamp Switch Adjustment*.
    - Cruise control release switch
    - Stoplamp and TCC switch
    - Cruise control clutch switch or cruise control clutch anticipate switch
12. Install the left side instrument panel insulator. Refer to *Closeout/Insulator Panel Replacement - Left* in Instrument Panel, Gauges and Console.
13. Connect the negative battery cable.

    Tighten

    Tighten the negative battery cable to 15 N·m (11 lb ft).



182817



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Brake Pipe Replacement

Important: Do not use ISO flares for the rear brake pipe connections to the rear wheel cylinders.

- Refer to *Master Cylinder Description* for an illustration depicting the brake pipe layout and locations. Brake pipes that are to be locally fabricated, should only be ISO flared, and not double lap flared.
- Rear brake front pipes (mid) should not be locally fabricated. These pipes should be ordered through your GM parts dealer.

ISO Flares Replacement

Tools Required

J 29803-A ISO Flaring Kit

Caution: Always use double walled steel brake pipe when replacing brake pipes. The use of any other pipe is not recommended and may cause brake system failure. Carefully route and retain replacement brake pipes. Always use the correct fasteners and the original location for replacement brake pipes. Failure to properly route and retain brake pipes may cause damage to the brake pipes and cause brake system failure.

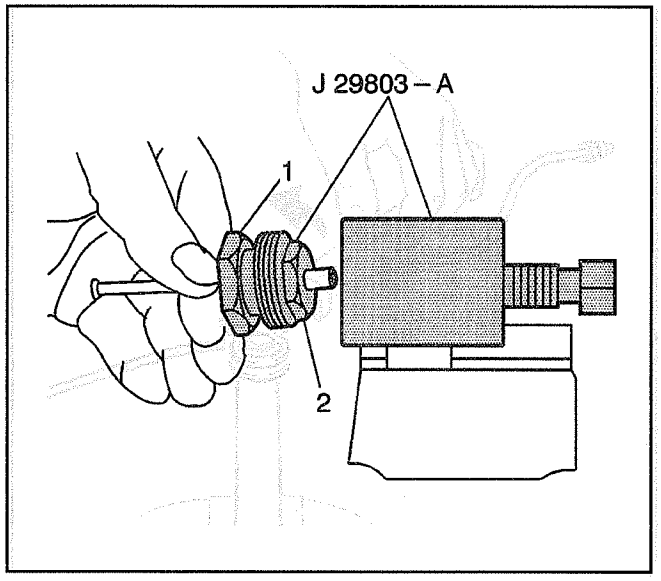
Notice: Do not use single lap flaring tools. Double lap flaring tools must be used to produce a flare strong enough to hold the system pressure. Using single lap flaring tools could cause system damage.

1. Obtain the correct size pipe and the correct size steel fitting nuts.

   Use the outside diameter of the pipe in order to specify the size.
2. Cut the pipe to the correct length using a pipe cutter.

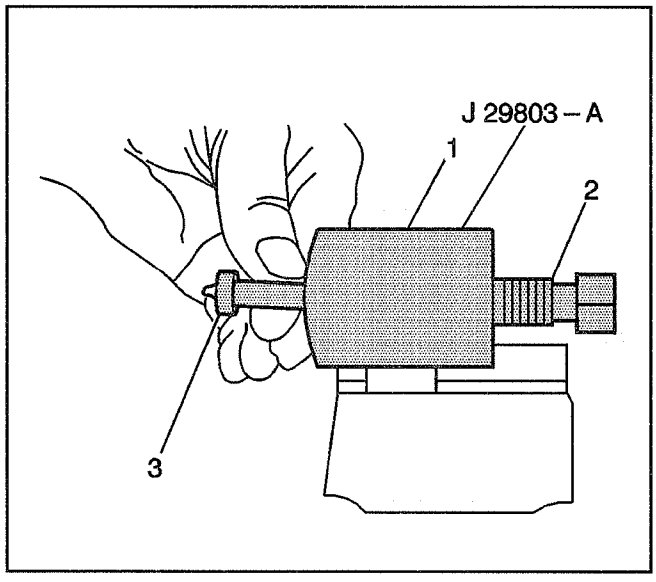
   Advance the tool only a small amount per turn of the tool. Do not force the cutter.
3. Measure the old pipe in order to determine the correct length of the pipe. Use a string in order to measure, and add 3.2 mm (0.125 in) for each ISO flare.
4. Install the fittings before starting the flare.
5. Chamfer the inside and the outside diameter of the pipe using a de-burring tool.
6. Remove all traces of lubricant from the brake pipe and the *J 29803-A*.

7. Clamp the *J 29803-A* in a vise.
8. Select the correct size collet (2) and forming mandrel for the pipe size used.



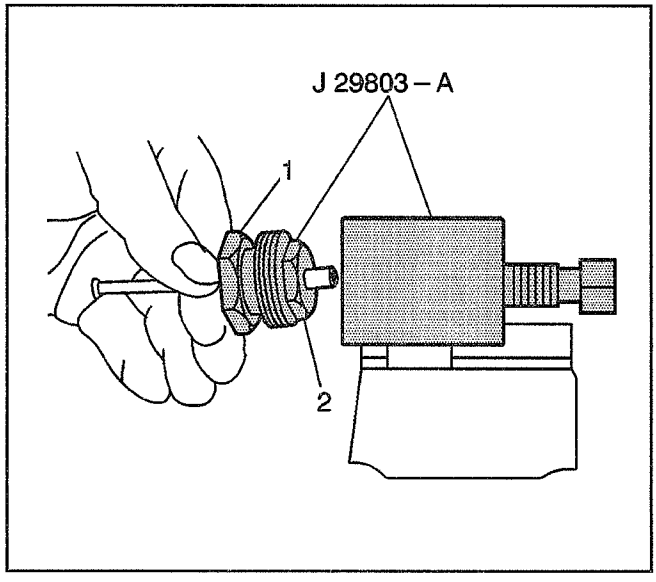
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9. Insert the properly formed mandrel (3) into the *J 29803-A*.
10. Hold the forming mandrel (3) in place using your finger.
11. Thread in the forcing screw (2) until contact is made and the screw begins to move the forming mandrel (3).

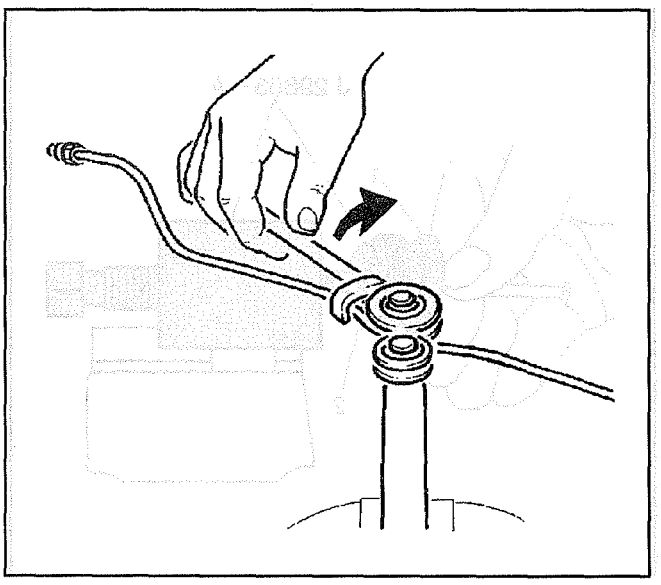


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12. Turn the forcing screw back one complete turn.
13. Slide the clamping nut over the brake pipe.
14. Insert the prepared brake pipe into the correct collet (2).
    Leave approximately 19 mm (0.750 in) of tubing extending out of the collet.
    Insert the assembly into the *J 29803-A*.
    Ensure that the brake pipe end contacts the face of the forming mandrel.
15. Tighten the clamping nut (1) into the *J 29803-A* body tightly in order to ensure that the pipe will not push out.
16. Wrench tighten the forcing screw until the screw bottoms. Do not over tighten the forcing screw or the flare may become oversized.
17. Back the clamping nut (1) out of the *J 29803-A*.
18. Disassemble the clamping nut (1) and the collet assembly.
19. The flare is now ready for use.

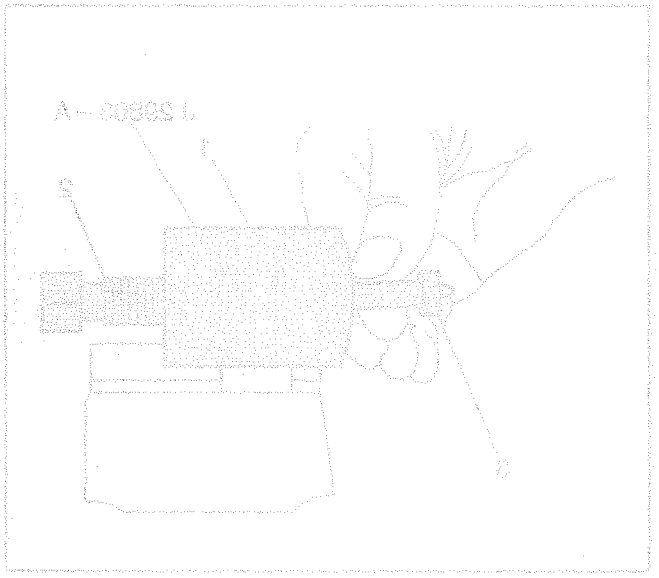


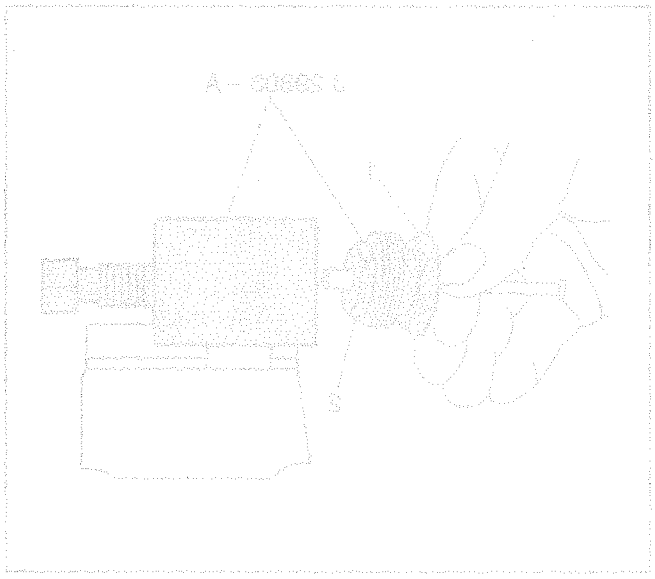
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20. Use a tube bender in order to bend the new pipe to match the old pipe.
21. Maintain the following clearances:
    - Maintain the minimum clearance of 19 mm (0.75 in) to all moving components.
    - Maintain the minimum clearance of 13 mm (0.50 in) to all vibrating components.
    - Maintain the minimum clearance of 7 mm (0.25 in) to any shielded lines, unless clipped to a component.





Brake Hose Inspection

Inspect the brake hoses and the brake pipes at least two times a year for the following problems:

- Check the outer cover for road damage.
- Check for fluid leaks.
- Check for damage at the brake hose and pipe connections.
- Check that all hose and pipe mounting hardware is securely in place. Repair the mounting hardware as needed.
- Make sure all mounting hardware is in place and secure.
- Replace or repair any parts as necessary.

Power Brake Booster Hoses, Pipes And Fittings

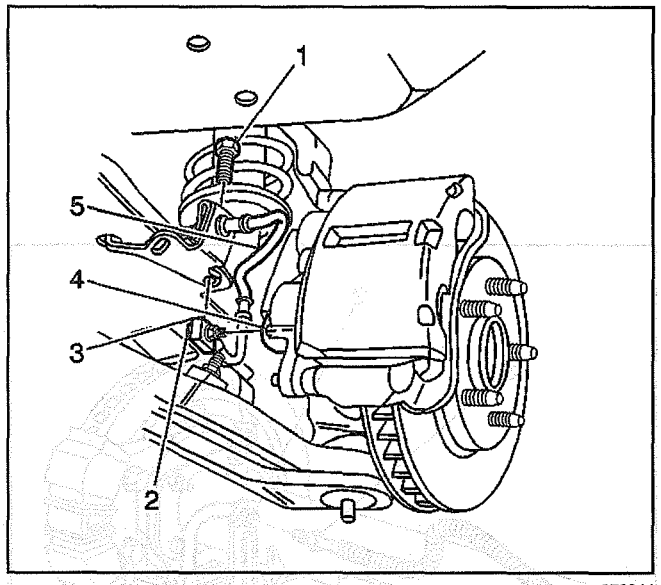
Check all pipes, hoses and fittings for leaks at regular intervals. Make sure the fittings are tight. Make sure all clamps, clips and unions supporting the pipes and hoses are in place and properly secured. Make sure all hoses are installed in a matter that does not cause chafing or wear on the hoses. Check for leaks by wiping the suspected area clean. Spotting leaking fluid is easier when the suspected area in clean. When fluid leaks appear, tighten, repair or replace nearby fittings and bolts.

Brake Hose Replacement - Front

Removal Procedure

1. Remove the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
2. Clean all dirt and foreign material from the front brake hose and the front brake hose fitting (4).
3. Remove the front brake pipe from the front brake hose.
   - Use a backup wrench on the hose fitting.
   - Do not bend the front brake hose bracket (2) or front brake pipe.
4. Remove the brake hose retainer from the hose fitting at the brake hose bracket.
5. Remove the brake hose (5) from the brake hose bracket (3).
6. Remove the following components from the front brake caliper (4):
   - The brake hose fitting (2)
   - The brake hose clip bolt (1)
   - Two brake hose fitting gaskets

   Discard the two old brake hose fitting gaskets.



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Installation Procedure

1. Lubricate the brake hose bolt (1) threads with clean brake fluid.
2. Install the following components to the front caliper (4):
   - The brake hose fitting (2)
   - The brake hose clip bolt (1)
   - Two new brake hose fitting gaskets

Notice: Refer to *Fastener Notice* in Cautions and Notices.

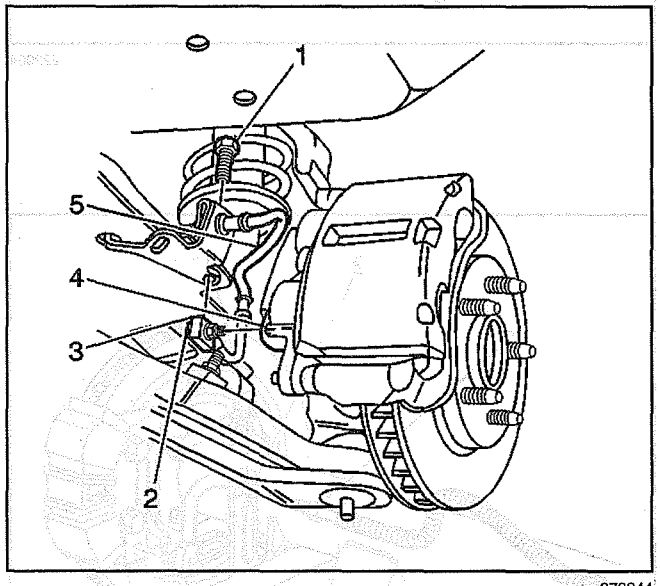
3. Ensure that the hose fitting flange engages the front caliper orientation ledge.

   Tighten

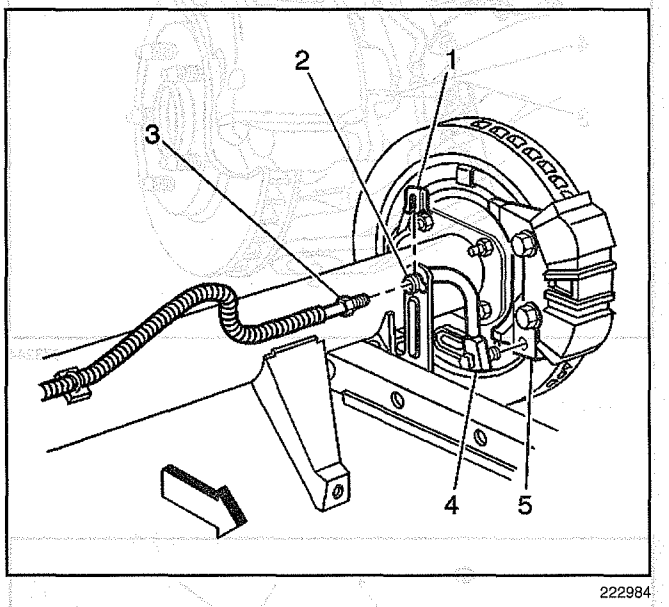
   Tighten the front brake hose fitting to 40 N·m (30 lb ft).
4. Install the brake hose (5) into the brake hose bracket (3). Ensure that there are no kinks in the brake hose.
5. Install the brake hose retainer at the brake hose bracket.
6. Install the front brake pipe to the brake hose.
7. Install the brake hose retainer.
8. Secure the retainer to the brake hose bracket using the screw.
   - Use a backup wrench on the hose fitting. Ensure that the brake hose does not contact any part of the suspension.
   - Inspect the hose in the extreme right and extreme left turn conditions.

   Tighten

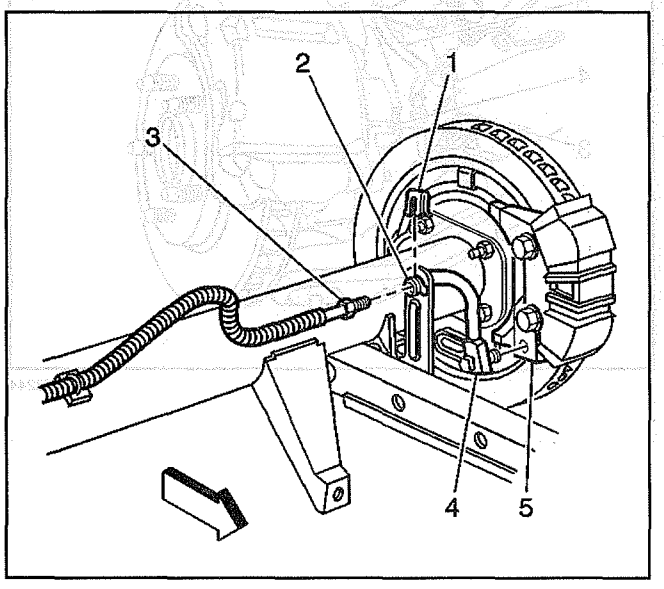
   Tighten the front brake hose clip bolt (1) to 13 N·m (115 lb in).



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9. Bleed the brake hydraulic system. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* or *Hydraulic Brake System Bleeding (Pressure Bleeding)*.
10. Install the tire and the wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.

Brake Hose Replacement - Rear (To Brake Caliper)

Removal Procedure

1. Remove the wheel and the tire. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
2. Clean all dirt and foreign material from the hose and fitting (4).
3. Remove the rear brake hose (2) from the rear brake pipe (3).
   - Use a backup wrench on the hose fitting (2).
   - Do not bend the rear brake hose bracket or the rear brake pipe (3).
4. Remove the rear brake hose retainer (1) from the brake hose bracket and the rear brake hose (2).
5. Remove the following components from the rear brake caliper (5):
   - The brake hose fitting bolt (4)
   - Two brake hose fitting gaskets. Discard the brake hose fitting gaskets.
   - The rear brake hose (2)

Installation Procedure

1. Lubricate the bolt fitting threads. Use clean brake fluid.
2. Install the following components to the rear brake caliper (5):
   - The brake hose fitting (4)
   - Two new brake hose fitting gaskets
   - The rear brake hose (2)

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Ensure that the hose fitting flange engages the caliper orientation ledge.

   Tighten

   Tighten the rear brake hose fitting (4) to 45 N·m (33 lb ft).
4. Install the rear brake hose retainer (1) to the brake hose bracket and the brake hose (2).
5. Install the rear brake hose (2) to the rear brake pipe (3).
   - Use a backup wrench on the hose fitting (2).
   - Do not bend the brake hose bracket or the brake pipe (3).

   Tighten

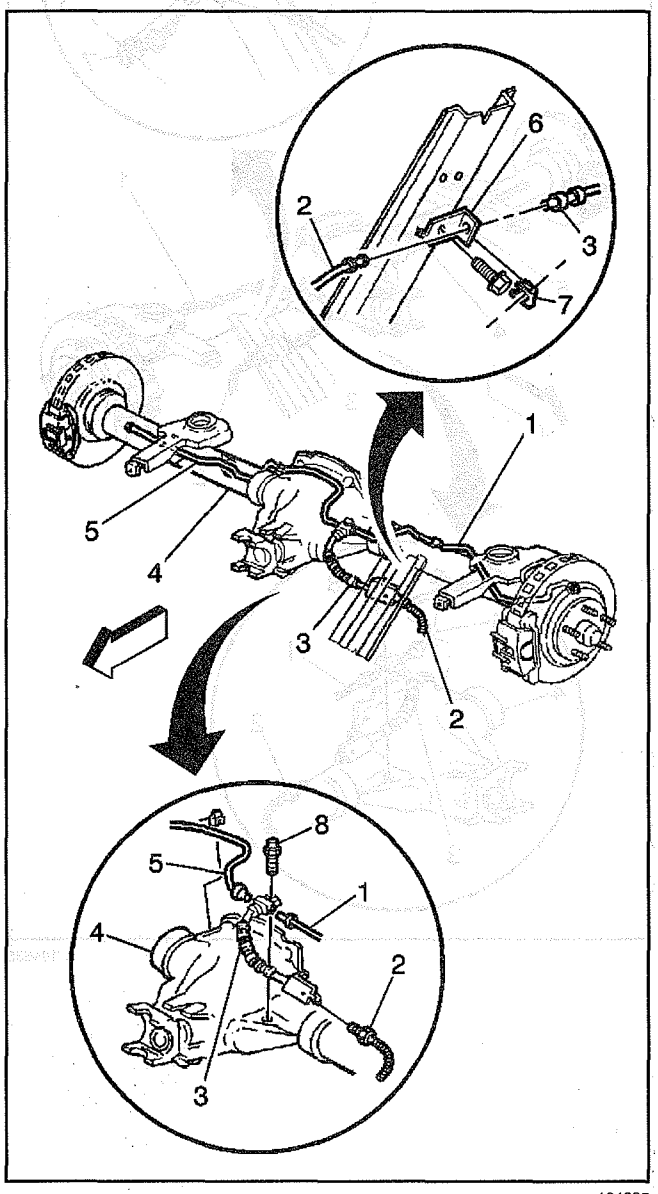
   Tighten the rear brake pipe (3) to the brake hose (2) to 15 N·m (11 lb ft).

6. Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* or *Hydraulic Brake System Bleeding (Pressure Bleeding)*.
7. Install the wheel and the tire. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.

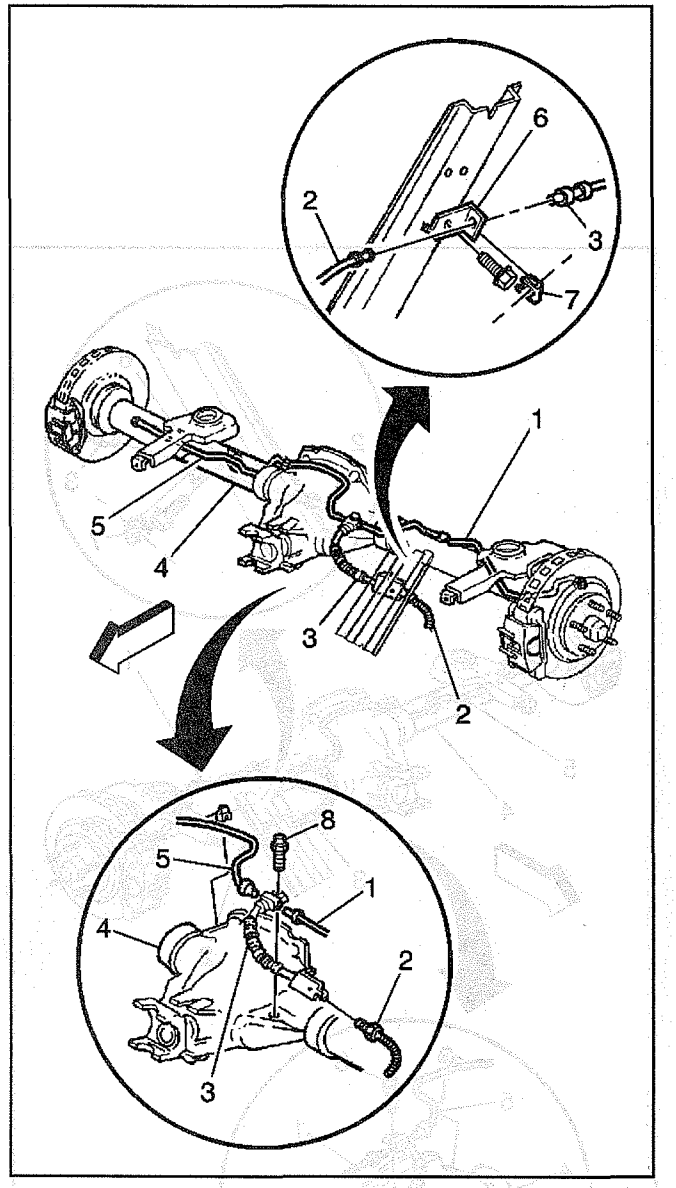
Brake Hose Replacement - Rear (Without Traction Control)

Removal Procedure

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Clean all dirt and foreign material from the brake hose (3) and the brake pipe fittings.
3. Remove the rear brake front pipe (2) from the brake hose (3).
   - Use a backup wrench on the brake hose fitting.
   - Do not bend the brake hose bracket (6) or the brake front pipe (2).
4. Remove the brake hose retainer (7) from the brake hose bracket (6) and the brake hose (3).
5. Remove the rear brake hose (3).
6. Remove the left rear pipe (1) and the right rear pipe (5) from the hose (3). Do not bend the left rear pipe (1) or the right rear pipe (5).
7. Note the position of the brake hose (3) for proper location during installation.
8. Remove the rear brake hose fitting bolt (8) and the brake hose (3) from the rear axle (4).



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Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

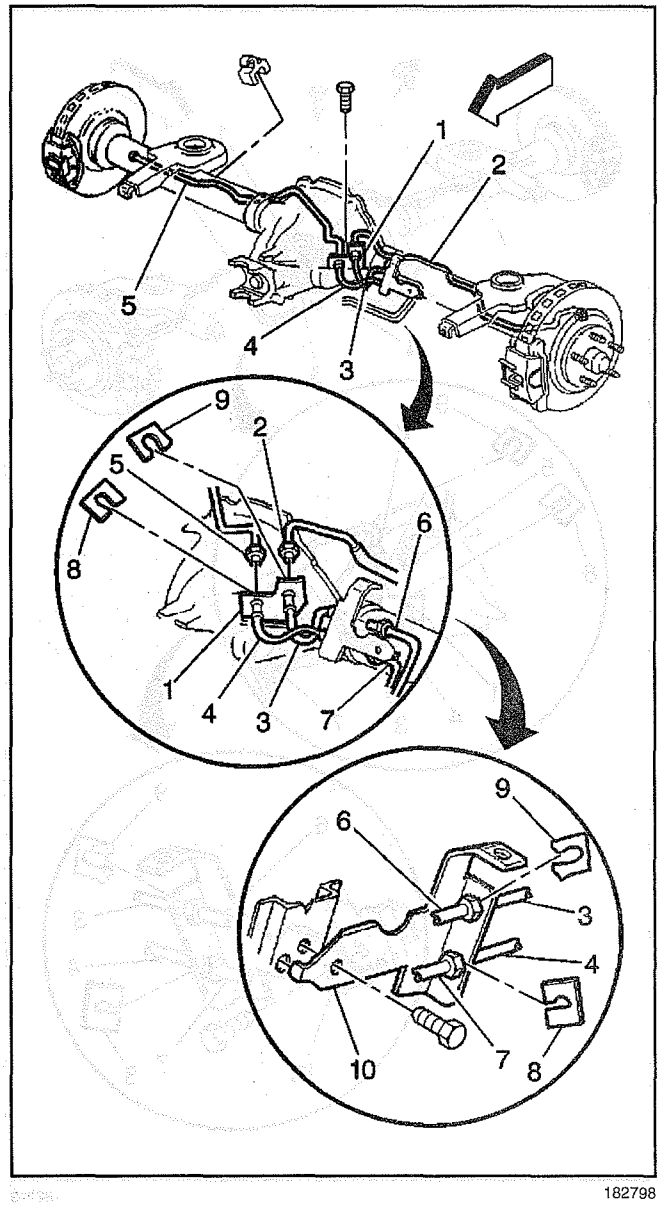
1. Install the brake hose (3) and the brake hose fitting bolt (8) to the rear axle (4).
   Tighten
   Tighten the rear brake (center) hose fitting bolt (8) to 21 N·m (15 lb ft).
2. Install the left rear pipe (1) and the right rear pipe (5) to the brake hose (3).
   Tighten
   - Tighten the left rear pipe (1) and the right rear pipe (5) at the rear brake (center) hose (3) to 24 N·m (18 lb ft).
   - Tighten the left rear pipe (1) and the right rear pipe (5) at the left hand brake hose to 15 N·m (11 lb ft).
3. Install the brake hose (3) into the brake hose bracket (6). Ensure that the brake hose (3) is properly seated and not twisted.
4. Install the rear brake hose retainer (7) to the rear brake hose bracket (6) and the brake hose (3).
5. Install the rear brake front pipe (2) to the brake hose (3).
   - Use a backup wrench on the brake hose (3).
   - Do not bend the brake hose bracket (6) or the rear brake front pipe (2).

   Tighten
   Tighten the rear brake front pipe (2) to the rear brake (center) hose (3) to 15 N·m (11 lb ft).
6. Bleed the brake hydraulic system. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* or *Hydraulic Brake System Bleeding (Pressure Bleeding)*.
7. Lower the vehicle.

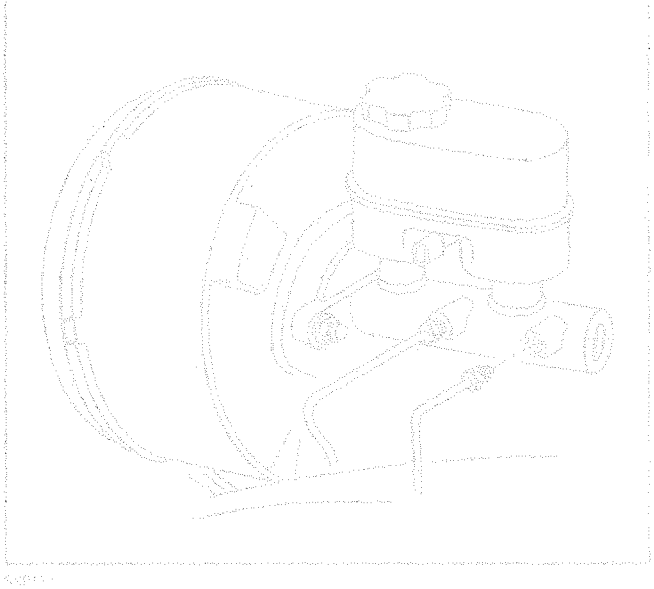
Brake Hose Replacement - Rear (With Traction Control)

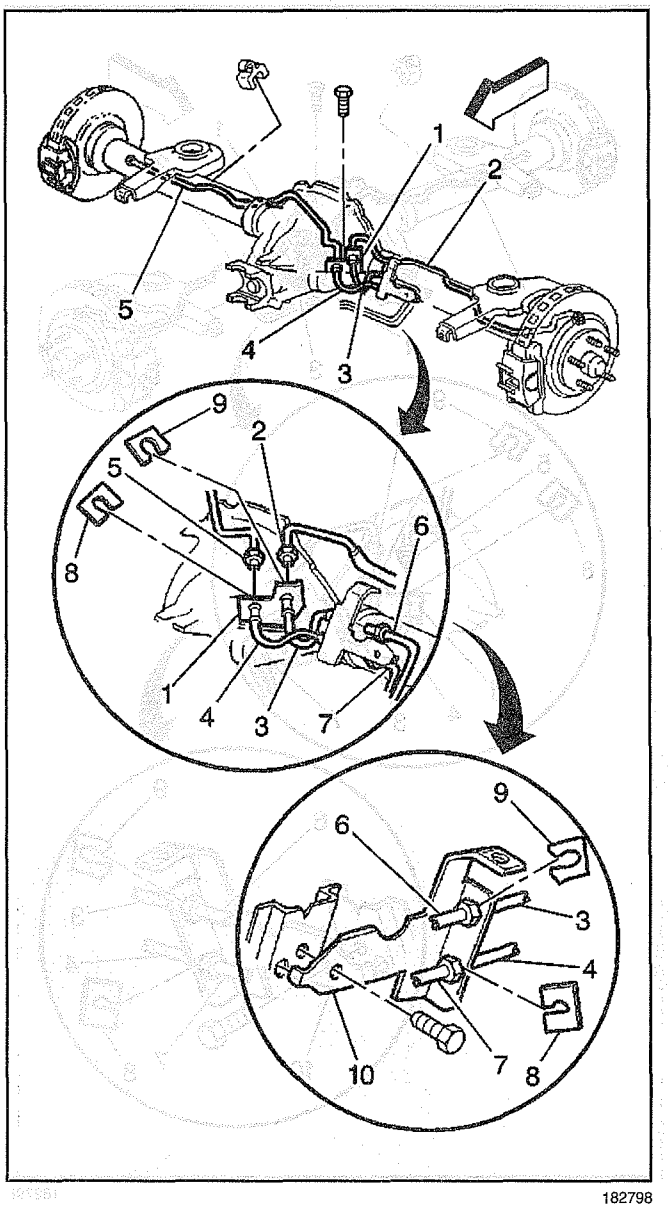
Removal Procedure

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Clean all dirt and foreign material from the brake hose and the brake pipe fittings.
3. Remove the right rear brake pipe (6) or the left rear brake pipe (7) from the rear brake hoses (3 or 4).
   - Use a backup wrench on the brake hose fittings.
   - Do not bend the rear brake hose bracket (10) or the brake pipes (6 or 7).
4. Remove the rear brake pipe clips (8 or 9) from the brake hose bracket (10) and the rear brake hoses (3 or 4).
5. Remove the left rear brake pipe (2) or the right rear brake pipe (5) from the rear brake hoses (3 or 4).
   - Use a backup wrench on the brake hose fittings.
   - Do not bend the rear brake hose bracket (1) or the rear brake pipes (2 or 5).
6. Remove the rear brake pipe clips (8 or 9) from the brake hose bracket (1) and the rear brake hoses (3 or 4).
7. Remove the rear brake hoses (3 or 4).

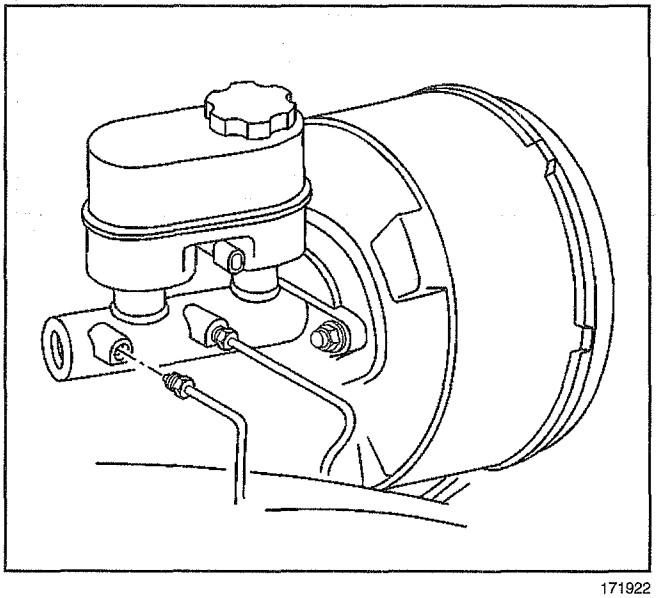


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Installation Procedure

1. Install the rear brake hose (3 or 4).
2. Install the rear brake pipe clips (8 or 9) to the brake hose bracket (1) and the rear brake hoses (3 or 4). Ensure that the rear brake hoses (3 or 4) are properly seated and not twisted.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the rear brake pipes (2 or 5) to the rear brake hoses (3 or 4).
   - Use a backup wrench on the brake hose fittings.
   - Do not bend the bracket (1) or the rear brake pipes (2 or 5).

   Tighten

   Tighten the rear brake pipes (2 or 5) to the rear brake hoses (3 or 4) to 15 N·m (11 lb ft).
4. Install the rear brake pipe clips (8 or 9) to the rear brake hose bracket (10) and the rear brake hoses (3 or 4). Ensure that the rear brake hoses (3 or 4) are properly seated and not twisted.
5. Install the right rear brake pipe (6) or the left rear brake pipe (7) to the rear brake hose (3 or 4).
   - Use a backup wrench on the brake hose fittings.
   - Do not bend the rear brake hose bracket (10) or the brake pipes (6 or 7).

   Tighten

   Tighten the right rear brake pipe (6) or the left rear brake pipe (7) to the rear brake hoses (3 or 4) to 15 N·m (11 lb ft).
6. Bleed the brake hydraulic system. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* or *Hydraulic Brake System Bleeding (Pressure Bleeding)*.
7. Lower the vehicle.

Hydraulic Brake System Bleeding (Manual Bleeding)

The time required to bleed the hydraulic system can be reduced if the master cylinder reservoir is filled with brake fluid and as much air as possible is expelled before the master cylinder is installed on the vehicle. Pumping the piston can evacuate the air from the piston cavities.

Power brakes require the vacuum reserve be depleted by applying the brakes several times with the engine off. Care must be taken to prevent brake fluid from contacting any painted surface.

1. Fill the master cylinder reservoir with brake fluid and keep the reservoir at least half full of fluid during the bleeding operation.

2. If the master cylinder is known or suspected to have air in the bore, then it must be bled in the following manner, before bleeding any caliper:
   2.1. Disconnect the forward (blind end) brake pipe connection at the master cylinder.
   2.2. Allow the brake fluid to fill the master cylinder piston bore until it begins to flow from the forward pipe connector port.
   2.3. Connect the forward brake pipe to the master cylinder and tighten.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

   2.4. Depress the brake pedal slowly one time and hold. Loosen the forward brake pipe connection at the master cylinder to purge air from the bore. Tighten the connection and then release the brake pedal slowly. Wait 15 seconds. Repeat the sequence, including the 15 second wait, until all air is removed from the bore.

   Tighten

   Tighten the brake pipe tube nut to 16 N·m (12 lb ft).

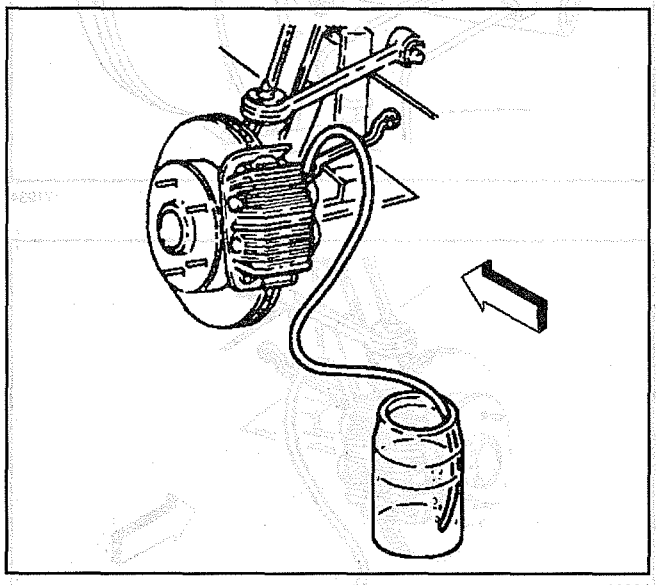
   2.5. When clear fluid flows from the forward connection, repeat steps 1 and 2 to bleed the master cylinder at the rear (cowl) connection.

3. Individual brake calipers are bled only after all air is removed from the master cylinder. If it is known that the brake calipers do not contain any air, then it will not be necessary to bleed them.
   3.1. Place a proper size box end wrench, or equivalent, over the brake caliper bleed screw.
   3.2. Attach a clear tube over the screw.
   3.3. Submerge the other end of the tube in a clear container partially filled with brake fluid.
   3.4. Depress the brake pedal slowly one time and hold.
   3.5. Loosen the brake caliper bleed screw to purge the air from the cylinder.
   3.6. Tighten the brake caliper bleed screw and slowly release the pedal. Wait 15 seconds.

   Tighten

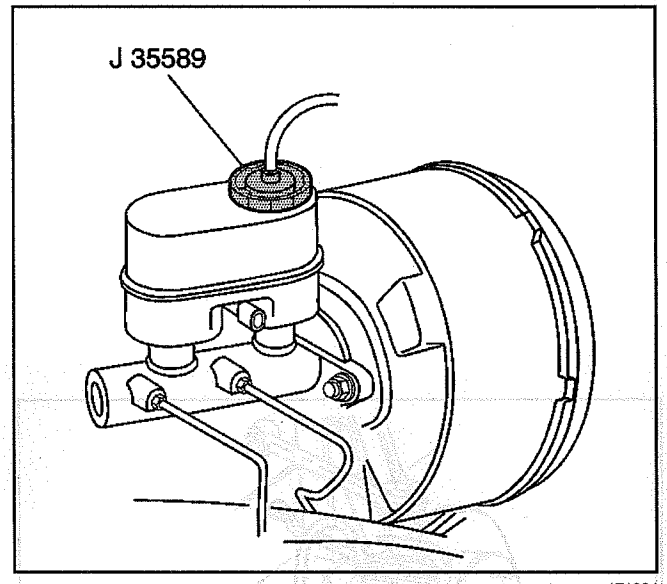
   Tighten the brake caliper bleed screw to 12 N·m (106 lb in).

   3.7. Repeat the sequence (including the 15 second wait), until all of the air is removed. It may be necessary to repeat the sequence ten or more times to remove all of the air.

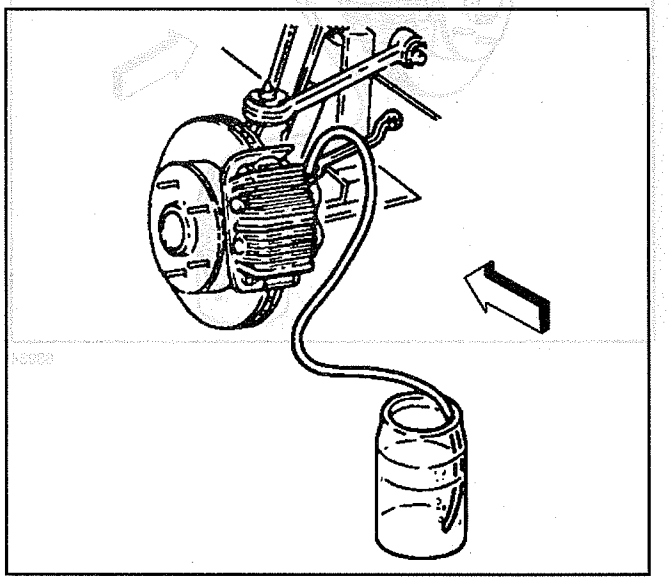


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3.8. If it is necessary to bleed all of the brake calipers, the following sequence should be used:
  3.8.1. Right rear
  3.8.2. Left rear
  3.8.3. Right front
  3.8.4. Left front
3.9. Test drive the vehicle. Check the brake pedal for sponginess.
3.10. Ensure that vehicle exceeds 5 km/h (3 mph) for ABS modulator actuation (self-test). If after ABS modulation the brake pedal is spongy or soft, then re-bleed system until pedal is firm.



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Hydraulic Brake System Bleeding (Pressure Bleeding)

Tools Required

J 35589 Pressure Bleeding Adapter

1. Remove the master cylinder reservoir cap. Replace it with *J 35589*.
2. Charge the bleeder to 140–172 kPa (20–25 psi).
3. Connect the hose to *J 35589*.
4. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
5. If it is necessary to bleed all of the brake calipers, the following sequence should be used:
   5.1. Right rear
   5.2. Left rear
   5.3. Right front
   5.4. Left front
6. Place the proper size box end wrench, or equivalent, over the brake caliper bleed screw. Attach a clear tube over the screw and allow the tube to hang submerged in a clear container partially filled with brake fluid.
7. Open the brake caliper bleed screw at least three quarters of a turn and allow the brake fluid flow to continue until no air is seen in the brake fluid. Apply intermittent pressure to the brake pedal while pressure bleeding.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

8. Close the brake caliper bleed screw.
   Tighten
   Tighten the brake caliper bleed screw to 12 N·m (106 lb in).
9. Repeat steps 6 through 8 until all of the calipers have been bled.

10. Lower the vehicle.
11. Test drive the vehicle, checking for brake pedal for sponginess or softness. Ensure that vehicle exceeds 5 km/h (3 mph) for ABS modulator actuation (self-test) which will purge any air from the secondary circuit of the modulator. If after ABS modulator actuation the pedal is still soft or spongy, then re-bleed entire system.
12. Remove the brake bleeding equipment from the master cylinder.

Hydraulic Brake System Bleeding (When To Bleed)

A bleeding operation is necessary to remove air when it is introduced into the hydraulic brake system.

It may be necessary to bleed the hydraulic system at all four corners if air has been introduced through low fluid level or by disconnecting brake pipes at the master cylinder. If a brake hose is disconnected at one wheel, only that wheel caliper needs to be bled. If brake pipes or hoses are disconnected at any fitting located between master cylinder and brakes, then the brake system served by the disconnected pipe or hose must be bled.

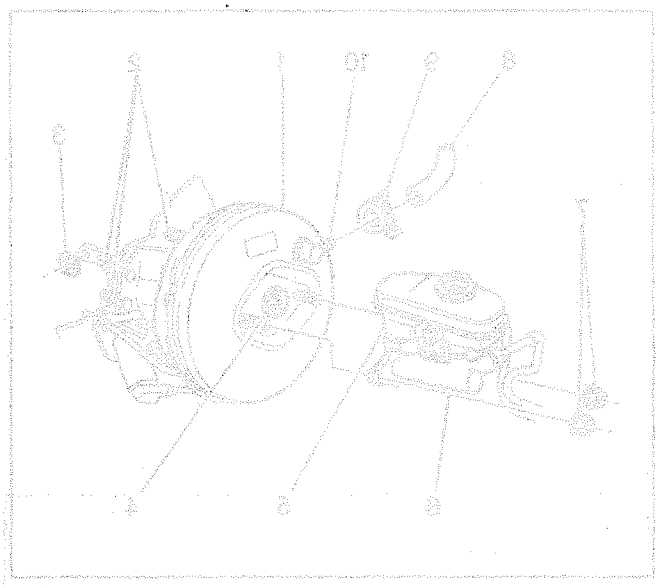
Hydraulic Brake System Flushing

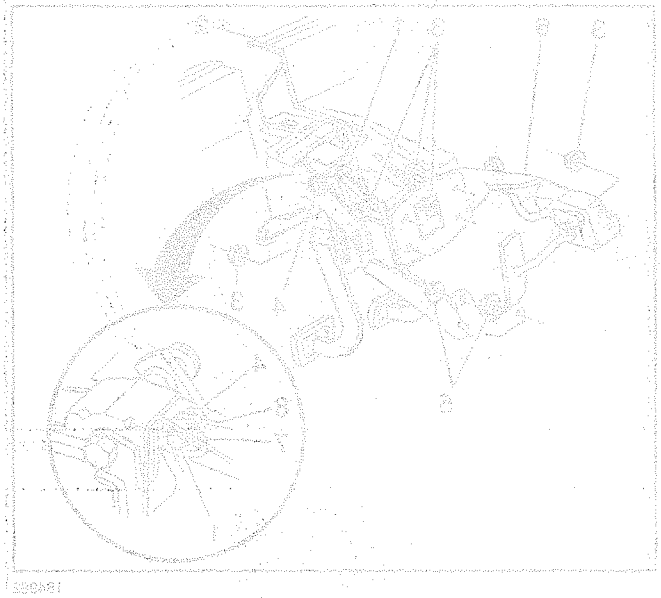
The entire hydraulic brake system should be thoroughly flushed with clean brake fluid if there is any doubt as to the grade of the fluid in the system or if the fluid used contains the slightest trace of mineral oil.

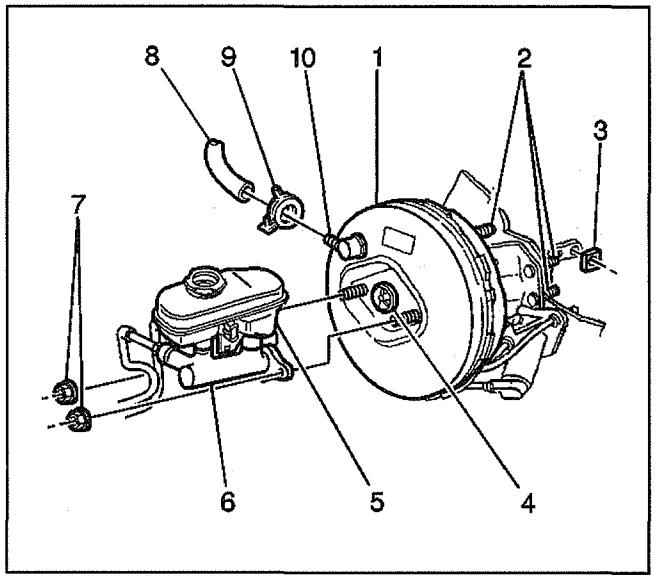
All rubber parts which have been subjected to contaminated fluid must be replaced before flushing the system.

Flushing is performed at each wheel similarly to bleeding. The new fluid must be forced through the system until it emerges clear in color. Approximately one quart of new fluid is needed to flush the system.

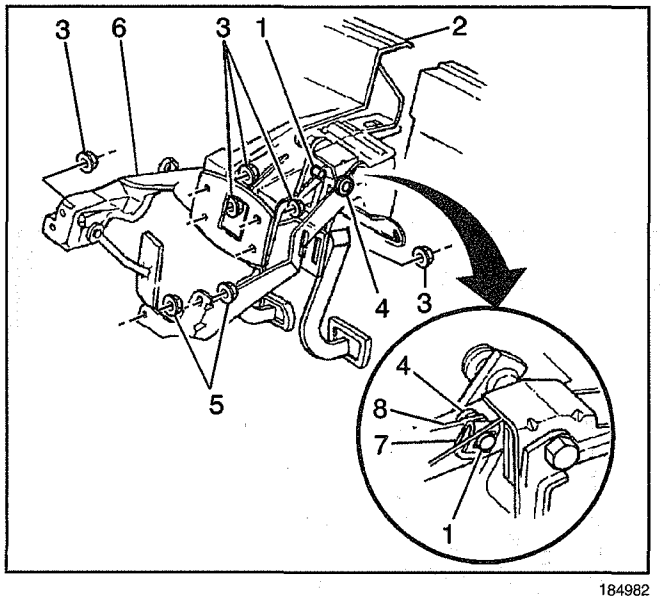
After completing the flushing operation at all of the bleeder valves check that the master cylinder is filled to the correct level.







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Vacuum Brake Booster Replacement

Removal Procedure

1. Remove the hood rear seal. Refer to *Seal Replacement - Hood Rear* in Body Front End.
2. Remove the left side air inlet screen. Refer to *Air Inlet Grille Panel Replacement* in Body Front End.
3. Remove the brake booster vacuum hose (8) and clamp (9) from the check valve (10).
4. Remove the master cylinder form the brake booster. Refer to *Master Cylinder Replacement.*
5. Remove the left side I/P insulator. Refer to *Closeout/Insulator Panel Replacement - Left* in Instrument Panel, Gauges and Console.
6. Remove the brake pedal nuts (3) attaching the brake booster to the brake pedal with bracket (6).
7. On manual transmission equipped vehicles only, loosen the clutch master cylinder nuts (5).
8. Disconnect the brake booster pushrod (8) from the brake pedal lever pin.
   - 8.1. From inside the vehicle, remove the brake pedal pushrod retainer (7) and pushrod washer (4).
   - 8.2. Tilt the entire brake booster slightly in order to work the brake booster pushrod (8) off the brake pedal pin. Do not put undue side pressure on the pushrod.
9. Remove the power brake booster from the vehicle.

Installation Procedure

1. Install the power brake booster onto the vehicle.
2. Install the brake booster pushrod (8) to the brake pedal lever pin (1).
   2.1. Tilt the entire brake booster slightly in order to work the brake booster pushrod onto the brake pedal pin.
   2.2. From inside the vehicle, install the brake pedal pushrod washer (4) and retainer (7).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the brake pedal nuts (3) attaching the brake booster to the brake pedal with bracket (6).

   Tighten

   Tighten the brake pedal nuts to 20 N·m (15 lb ft) in the following sequence:

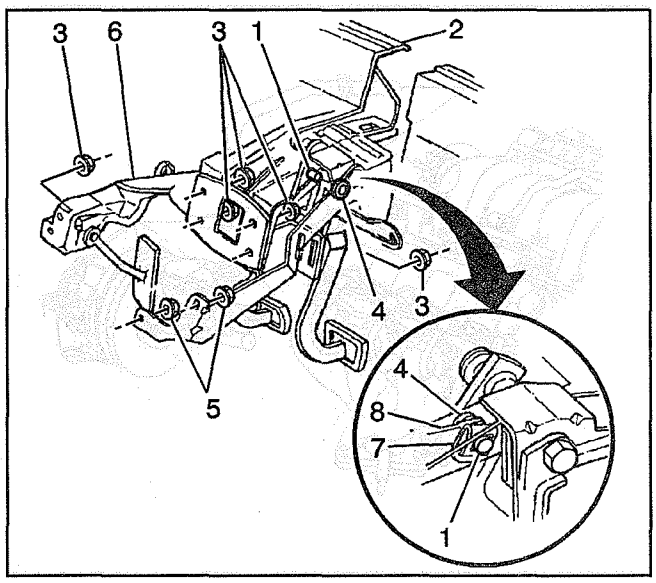
   3.1. Inboard upper
   3.2. Outboard lower
   3.3. Outboard upper
   3.4. Inboard lower
4. On manual transmission equipped vehicles only, install the clutch master cylinder nuts (7).

   Tighten

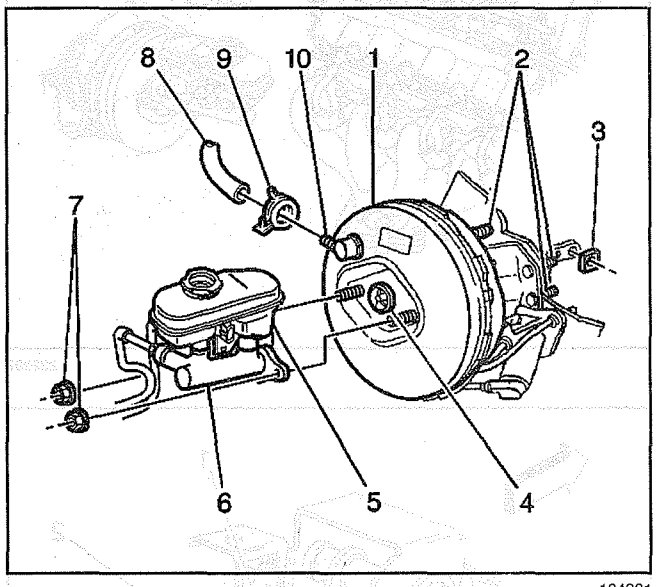
   Tighten the clutch master cylinder nuts to 27 N·m (20 lb ft).
5. Install the master cylinder (6) onto the brake booster (1).
6. Install the master cylinder nuts (7) attaching the master cylinder to the brake booster.

   Tighten

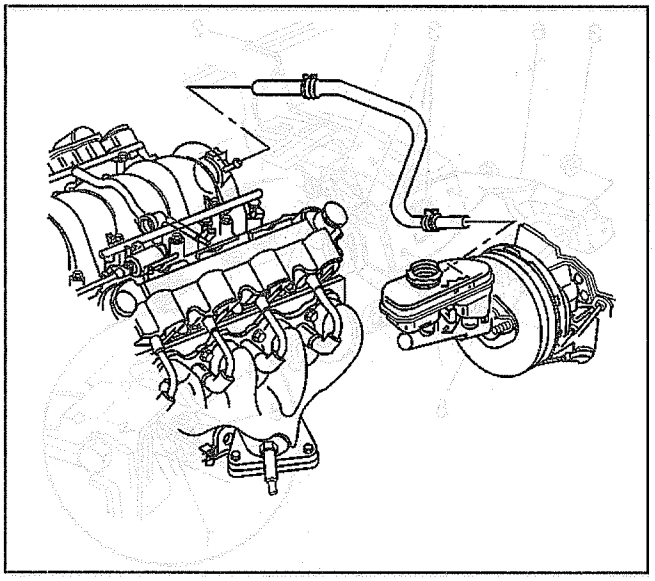
   Tighten the brake master cylinder nuts to 29 N·m (21 lb ft)
7. Connect the vacuum hose (8) and the clamp (9) to the check valve (10).
8. Install the left side instrument insulator. Refer to *Closeout/Insulator Panel Replacement - Left* in Instrument Panel, Gauges and Console.
9. Install the left side air inlet screen. Refer to *Air Inlet Grille Panel Replacement* in Body Front End.
10. Install the hood rear seal. Refer to *Seal Replacement - Hood Rear* in Body Front End.
11. Bleed the brakes. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* or *Hydraulic Brake System Bleeding (Pressure Bleeding).*



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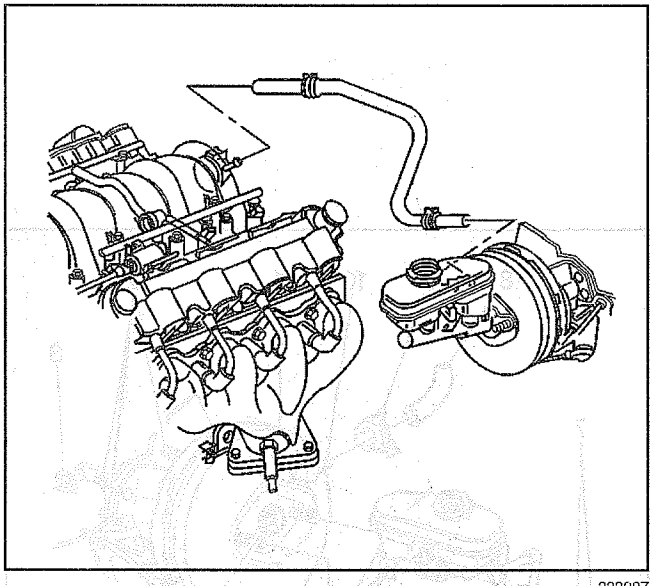


222997

Vacuum Brake Booster Hose Replacement

Removal Procedure

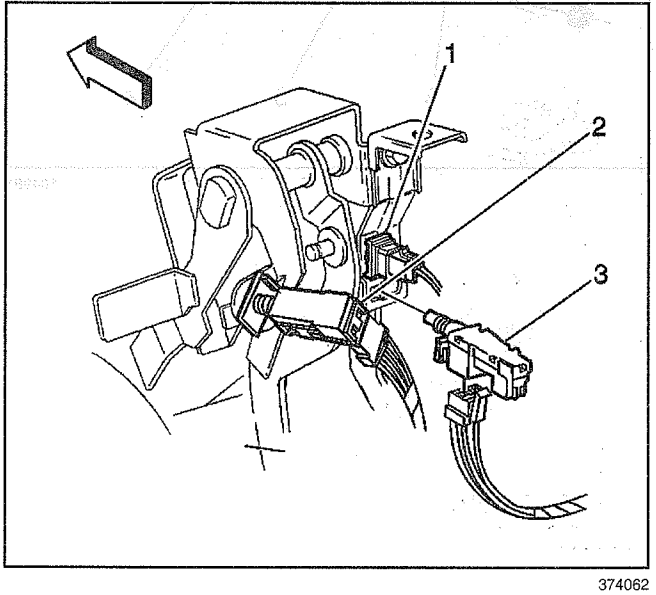
1. Reposition the vacuum brake booster hose clamps (V8 shown, V6 similar).
2. Reposition the hose clamp from the engine side of the vacuum hose.
3. Remove the vacuum brake booster hose from the engine fitting and the vacuum check valve.



222997

Installation Procedure

1. Connect the vacuum brake booster hose to the engine fitting and the vacuum check valve.
2. Reposition the hose clamp to the engine side of the vacuum hose.
3. Reposition the vacuum brake booster hose clamp.



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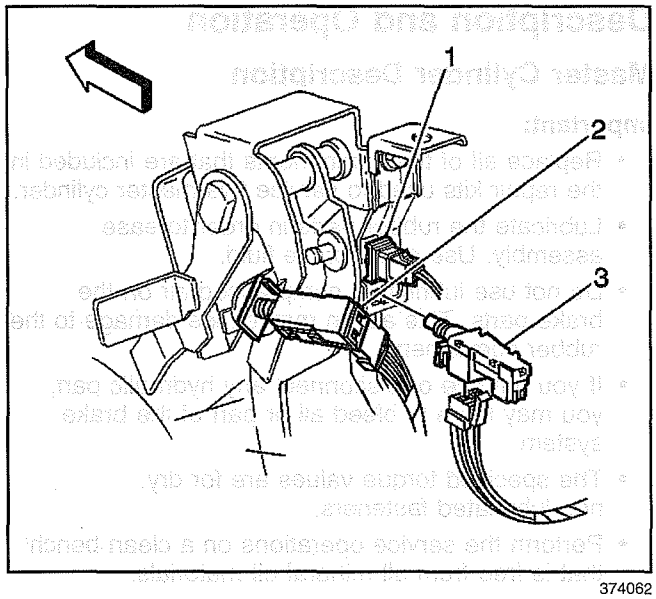
Stoplamp Switch Replacement

Removal Procedure

1. Remove the left side instrument panel insulator. Refer to *Closeout/Insulator Panel Replacement - Left* in Instrument Panel, Gauges and Console.
2. Disconnect the electrical connector from the switch.
3. Remove the Stoplamp and TCC switch (3) from the bracket (1).

Installation Procedure

1. Install the Stoplamp and TCC switch (3) to the bracket (1).
2. Connect the electrical connector to the switch.
3. Adjust the Stoplamp and TCC switch. Refer to *Stoplamp Switch Adjustment*.
4. Install the left side instrument panel insulator. Refer to *Closeout/Insulator Panel Replacement - Left* in Instrument Panel, Gauges and Console.



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Stoplamp Switch Adjustment

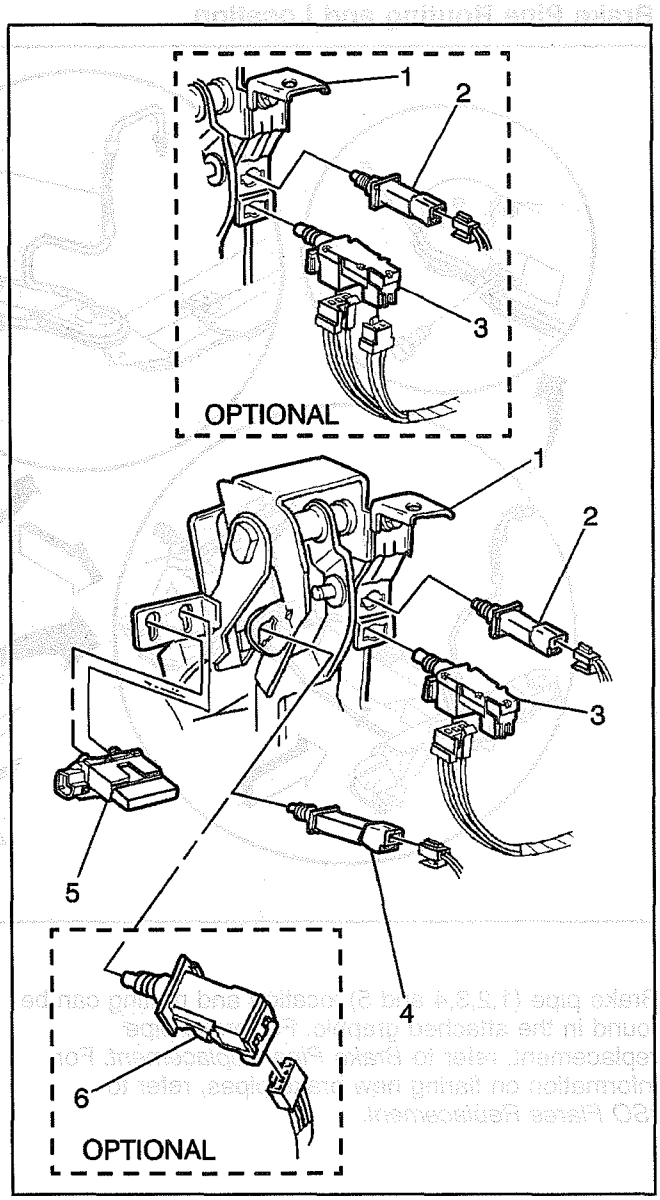
Notice: Proper stoplamp switch adjustment is essential. Improper stoplamp switch adjustment may cause brake drag, heat buildup and excessive brake lining wear.

1. Adjust the cruise control release switch (2) and the stoplamp and Torque Converter Clutch (TCC) switch (3) at the same time.
2. Adjust the cruise control clutch switch (4) or the cruise control clutch anticipate switch (6) if equipped after the clutch pedal is installed.
3. Depress the brake or the clutch pedal.
4. Insert the following switches into the pedal with the bracket until the retainers on the switches are fully seated:
   - Cruise control release switch (2)
   - Stoplamp and TCC switch (3)
   - Cruise control clutch switch (4) or cruise control clutch anticipate switch (6) if equipped.

Important: Apply the proper amount of force to the brake pedal during adjustment.

- Too much force may damage the vacuum booster.
- Too little force may cause the brakes to drag.

5. Slowly pull the brake or clutch pedal rearward with a force of 222 N (50 lbs) until clicking sounds are no longer heard. At this point, the retainers on the switches will be adjusted.
6. Measure the cruise control release switch (2).
7. Measure the stoplamp and TCC switch (3).
8. The switch contacts should be open at 25.4 mm (1.0 in) or less of pedal travel. The switch contacts should occur at the same time or before the onset of braking. The brake pedal travel can be up to 25.4 mm (1.0 in) before the cruise control system disengages.



182813

Description and Operation

Master Cylinder Description

Important:

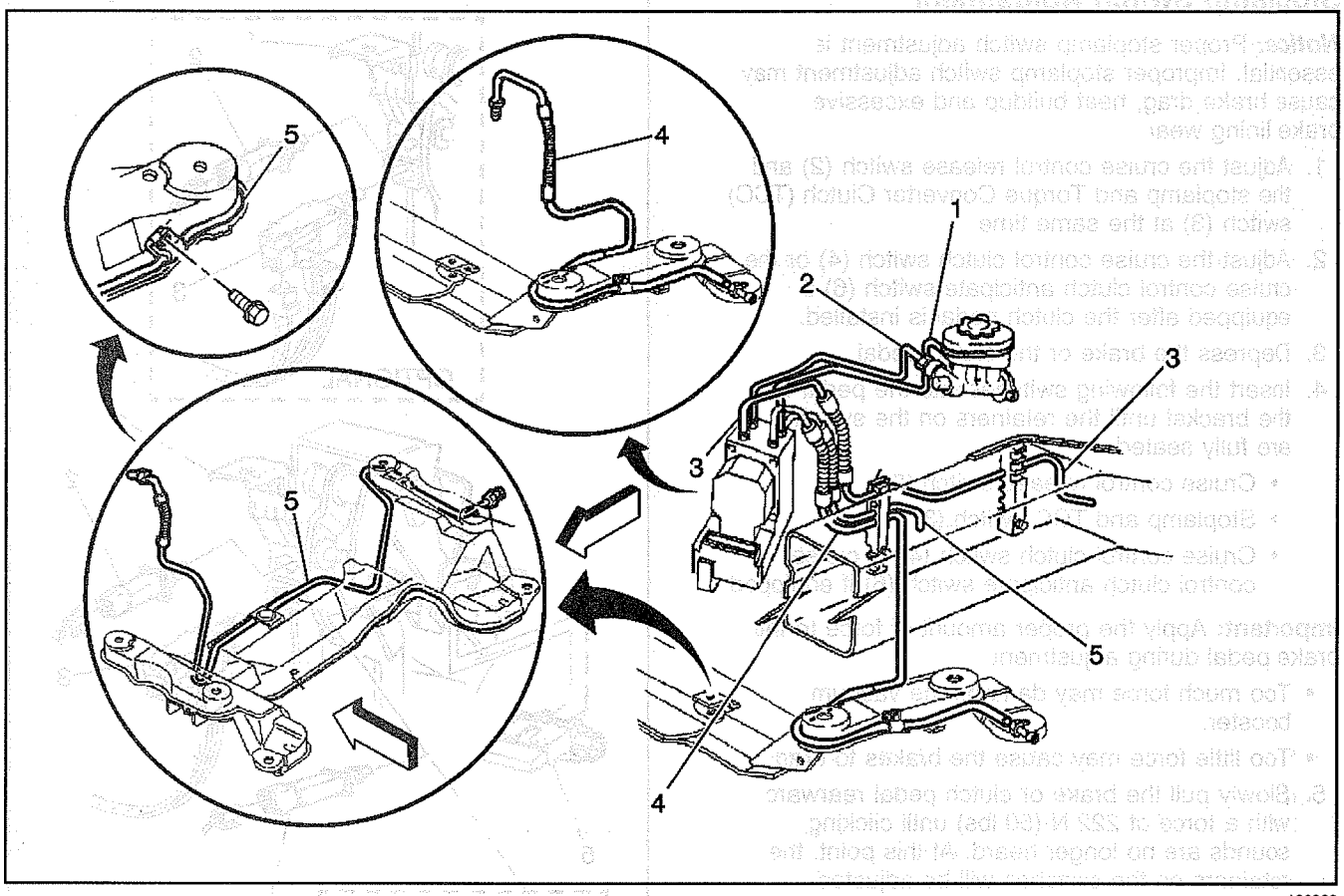
- Replace all of the components that are included in the repair kits used to service this master cylinder.
- Lubricate the rubber parts in order to ease assembly. Use clean brake fluid.
- Do not use lubricated compressed air on the brake parts. This action may cause damage to the rubber components.
- If you remove or disconnect any hydraulic part, you may have to bleed all or part of the brake system.
- The specified torque values are for dry, non-lubricated fasteners.
- Perform the service operations on a clean bench that is free from all mineral oil materials.

The master cylinder has an aluminum body and a plastic reservoir. The brake system is a conventional front-to-rear split system. The master cylinder primary piston provides the fluid pressure to the front disc brakes. The secondary piston provides the fluid pressure to the rear disc brakes. If pressure is lost from either system, the remaining system will function in order to stop the vehicle.

Brake Master Cylinder Reservoir

The reservoir has a maximum fluid level indicator mark. The fluid level indicator mark is located on the side of the reservoir.

Brake Pipe Routing and Location



186982

Brake pipe (1,2,3,4 and 5) location and routing can be found in the attached graphic. For brake pipe replacement, refer to *Brake Pipe Replacement*. For information on flaring new brake pipes, refer to *ISO Flares Replacement*.

Brake Fluid and Brake Fluid Handling

Caution: Use only SUPREME 11 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. Improper or contaminated fluid will result in damage to components or loss of braking, with possible personal injury.

Notice: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring, cables, or electric connectors. Brake fluid will damage the paint and the electrical connections. If any fluid is spilled on the vehicle, flush the area to lessen the damage.

Important:

- Do not re-use fluid accumulated during brake hydraulic system bleeding.
- 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. Fluid left in an open or improperly sealed container absorbs moisture and may become contaminated.

If rubber deterioration is evident, complete the following procedure:

1. Disassemble all hydraulic parts.
2. Wash all the hydraulic parts with alcohol.
3. Dry the parts with non-lubricated compressed air before reassembly in order to keep alcohol out of the system.
4. Replace all the rubber parts in the system, including the following components:
   - Brake hoses
   - Master cylinder rubber parts
   - Brake caliper boots and seals
   - Wheel cylinder boots and seals
5. Replace the combination valve and the brake pressure modulator valve. Both valves have rubber components inside which are not serviceable.
6. Inspect the pads for brake fluid. If excessive brake fluid is present, replace the pads.

Substandard or Contaminated Brake Fluid

Caution: Use only SUPREME 11 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. Improper or contaminated fluid will result in damage to components or loss of braking, with possible personal injury.

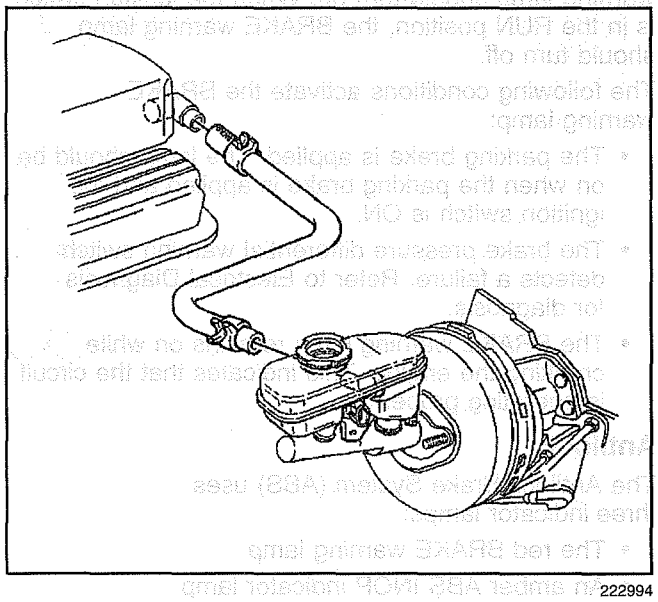
Vacuum Brake Booster Description

Important:

- Do not use lubricated compressed air on the brake parts. This action may result in damage to the rubber parts.
- Replace all of the components that are included in the repair kits used to service this booster.
- Lubricate the rubber parts in order to ease assembly. Use fresh brake fluid.
- If you remove or disconnect any hydraulic component, bleed all or part of the brake system.
- The specified torque values are for dry, non-lubricated fasteners.

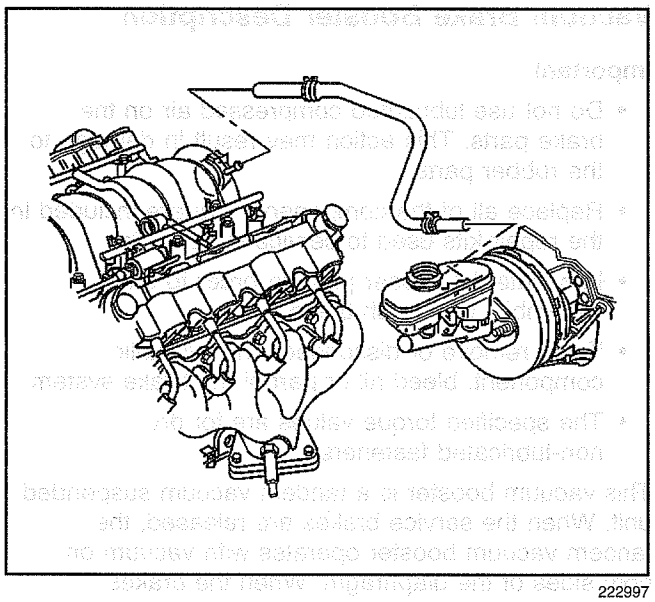
This vacuum booster is a tandem vacuum suspended unit. When the service brakes are released, the tandem vacuum booster operates with vacuum on both sides of the diaphragm. When the brakes are applied, air at atmospheric pressure is admitted to one side of the diaphragm. This draws air from the booster through the vacuum check valve to the vacuum source. The internal components of this booster cannot be serviced. Do not unstake and separate the housing. Separating the housing will cause permanent deformation of the booster and prevent the booster from holding the proper volume.

Routing



222994

Power brake booster vacuum hose routing on the 3800 V6 series engine.



222997

Power brake booster vacuum hose routing on the 5.7L V8 series engine.

Brake Warning System Description

Brake

The brake system uses a single red BRAKE warning lamp located in the instrument cluster. When the ignition switch is in the START position, the BRAKE warning lamp should turn on. When the ignition switch is in the RUN position, the BRAKE warning lamp should turn off.

The following conditions activate the BRAKE warning lamp:

- The parking brake is applied. The lamp should be on when the parking brake is applied and the ignition switch is ON.
- The brake pressure differential warning switch detects a failure. Refer to Electrical Diagnosis for diagnosis.
- The BRAKE warning lamp remains on while cranking the engine. This indicates that the 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
- An amber LOW TRAC indicator lamp

The lamps operate normally under the following conditions:

- When the ignition is turned to the RUN position, prior to starting the engine, the amber ABS INOP indicator lamp should turn on and the red BRAKE warning lamp should flash.
- While the engine is cranked, the red BRAKE warning lamp and the amber ABS INOP indicator lamp should turn on. The amber LOW TRAC indicator lamp may turn on and off.
- When the engine is started, the amber ABS INOP lamp and the red BRAKE lamp should turn off. The amber LOW TRAC indicator lamp may turn on and off.

The operation of the three lamps is an important part of the Antilock Brake System (ABS) diagnosis. A malfunction is present if the warning/indicator lamps turn on while driving the vehicle. If the warning lamps do not turn on under normal conditions as described above, service the lamps as soon as possible. For further information regarding the operation of the warning/indicator lamps for the Antilock Brake System (ABS), refer to Antilock Brakes.

Brake Warning System Circuit Description

Circuit Operation

The brake warning indicator on the instrument cluster illuminates under the following conditions:

- The instrument cluster bulb test is occurring.
- The park brake is set.
- The master cylinder brake fluid level is low.
- The electronic brake control module sends a Class 2 message to the instrument cluster.

These conditions are explained in detail below. In all cases positive voltage is applied to the brake warning indicator through circuit 39.

Instrument Cluster Bulb Test

When the ignition switch is turned to the RUN position, the instrument cluster performs an internal bulb test on the brake warning indicator. The indicator illuminates for approximately 3 seconds and then turns off.

Park Brake

The park brake switch closes when the park brake is set. On Domestic and Gulf States vehicles, ground is applied through circuit 1134, the DRL module and circuit 33 to the instrument cluster. The brake indicator illuminates. On Europe and Japan vehicles, ground is applied through circuit 33 to the cluster.

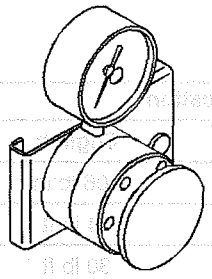
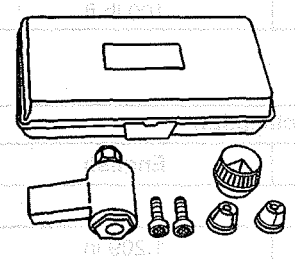
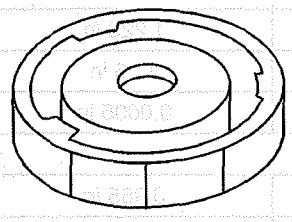
Brake Fluid Level

When the brake fluid level in the master cylinder is low, the brake fluid level indicator sensor closes. Ground is applied through the sensor and circuit 33 to the instrument cluster. The brake indicator illuminates.

EBCM Class 2

The brake indicator is also controlled by the ABS system through the class 2 serial data line. The electronic brake control module (EBCM) sends a class 2 message to illuminate the brake indicator. The indicator warns the customer that a problem exists in the ABS system. Refer to ABS brakes for further information.

Special Tools and Equipment

Illustration	Tool Number/Description
 1006	J 28662 Brake Pedal Effort Gauge
 1089	J 29803-A ISO Flaring Kit
 153149	J 35589 Bleeding Adapter

Disc Brakes

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Bleeder Valve	12 N·m	106 lb in
Brake Caliper Mounting Bracket Bolt	100 N·m	74 lb ft
Brake Hose Bolt	40 N·m	30 lb ft
Caliper Guide Pin Bolt	31 N·m	23 lb ft
Wheel Nut	140 N·m	100 lb ft

Component Specifications

Application	Specification	
	Metric	English
Front Brakes		
Discard Thickness (See Important)	30.7 mm	1.209 in
Maximum Lateral Runout	0.13 mm	0.005 in
Minimum Thickness After Refinish	31.08 mm	1.223 in
Minimum Wear Thickness	31.08 mm	1.223 in
Rotor Thickness (New)	32 mm	1.26 in
Thickness Variation	0.013 mm	0.0005 in
Rear Brakes		
Discard Thickness	24.51 mm	0.965 in
Maximum Lateral Runout	0.15 mm	0.006 in
Minimum Wear Thickness	24.89 mm	0.980 in
Rotor Thickness (New)	25.90 mm	1.020 in
Minimum Thickness After Refinish	24.89 mm	0.980 in
Rear Axle Shaft Flange	0.05 mm	0.002 in
Thickness Variation	0.013 mm	0.0005 in
Important: All brake rotors have a discard dimension cast into the rotor. Replace any rotor that does not meet this specification. After refinishing the rotor, replace any rotor that does not meet the maximum or minimum thickness after refinish specifications.		

GM SPO Group Numbers

Application	GM SPO Group Number
Brake Caliper (Front)	4.000
Brake Caliper (Rear)	4.000
Brake Caliper Bracket (Front)	4.000
Brake Caliper Bracket (Rear)	4.000
Brake Pads (Front)	5.000
Brake Pads (Rear)	5.000
Brake Rotor Front	5.000
Brake Rotor (Rear)	5.000

Diagnostic Information and Procedures

Brake Rotor Thickness Variation Check

Measure the rotor thickness at four or more points around the circumference of the rotor in order to inspect the thickness variation. Use a micrometer calibrated in ten-thousandths of an inch. Inspect each measurement at the same distance from the edge of the rotor.

A rotor that varies in thickness by more than 0.013 mm (0.0005 in) may cause pedal pulsation or front end vibration during brake applications. Refinish or replace a rotor that does not meet the above specifications.

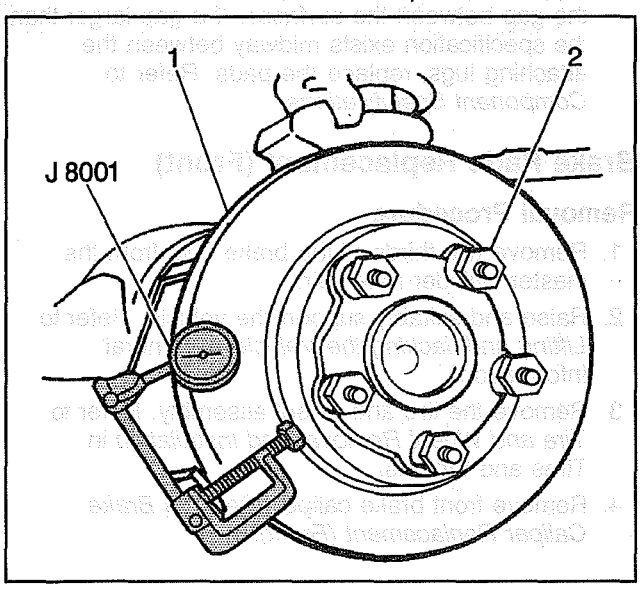
Brake Rotor Lateral Runout Check

Removal Procedure

Tools Required

J 8001 Dial Indicator Set

Notice: Any time the brake rotor is separated from the wheel bearing flange, clean any rust or foreign material from the mating surfaces of the wheel bearing flange and the rotor. Failure to do so can result in increased lateral runout of the rotor and brake pulsation.



181819

1. Clean the rotor surface (1).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Reinstall the wheel nuts (2) in order to retain the rotor.

   Tighten

   Tighten the wheel nuts in a star pattern to 140 N·m (100 lb ft).

3. Fasten the *J 8001* to the steering knuckle for front or to the brake mounting flange on the rear axle for rear so that the indicator button contacts the rotor surface about 13 mm (0.5 in) from the rotor edge.
4. Set the *J 8001* to zero.
5. Turn the rotor one complete revolution. Inspect the runout indicated on the dial. If the TIR exceeds 0.15 mm (0.006 in), refinish or replace the rotor.

   In some cases, excessive lateral runout of the rotor may be improved by indexing the rotor on the hub, one or two bolt positions from the original position. Indexing the rotor requires removal and installation of the front brake caliper. For removal of the front brake rotor, refer to *Brake Rotor Replacement (Front)*. For rear brake rotor replacement, refer to *Brake Rotor Replacement (Rear)*.

   If the lateral runout cannot be corrected by indexing the front rotor, inspect the hub and the front wheel bearing for excessive lateral runout or looseness. If the hub lateral runout exceeds 0.040 mm (0.015 in), replace the hub and bearing. If lateral runout of the hub and bearing is within specifications, refinish or replace the rotor as necessary.

   If the lateral runout cannot be corrected by indexing the rear rotor, inspect the rear axle shaft flange for excessive lateral runout. If the axle flange lateral runout exceeds 0.040 mm (0.015 in), replace the axle shaft. If lateral runout of the axle flange hub is within specifications, refinish or replace the rotor as necessary.

Brake Rotor Tolerance

Tolerances of the braking surfaces for the following conditions are held closely during the manufacture of the brake rotor:

- Flatness
- Parallelism
- Lateral runout

The maintenance of close tolerances on the shape of the braking surfaces is necessary in order to prevent brake roughness or pulsation. The surface finish must be held to a specified range of a 60 degree radius of roughness or less. A new rotor conforms to the above specifications, as will a correctly refinished rotor. For front brake rotors, refer to *Refinishing Brake Rotors (Front)*. For rear brake rotors, refer to *Refinishing Brake Rotors (Rear)*. Control of the braking surface finish will eliminate the following problems:

- Hard pedal application
- Excessive brake fade
- Pulls
- Erratic performance.

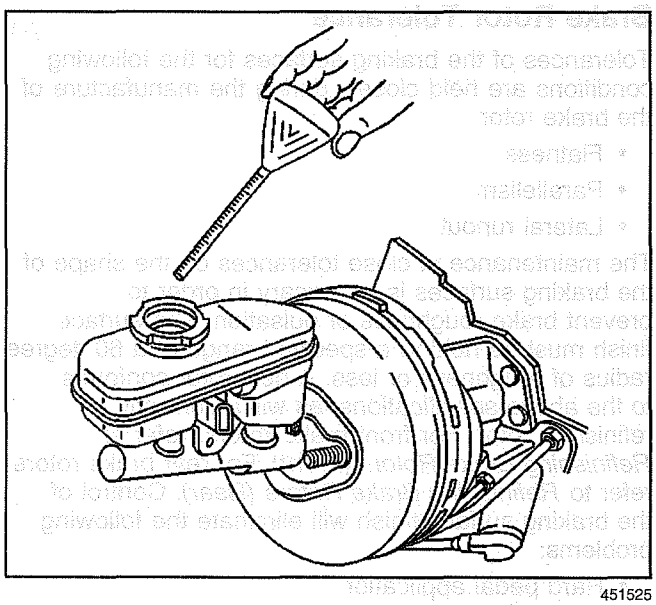
  Control of the braking surface finish will improve lining life.

Light scoring of the rotor surfaces not exceeding 1.5 mm (0.060 in) in depth is not detrimental to brake operation. Normal use may cause light scoring.

Repair Instructions

Brake Pad Inspection

- Inspect the disc brake pads every 10,000 km (6,000 miles) and anytime the wheels are removed.
- Inspect both ends of the outer pad by looking in at each end of the caliper. The highest rate of wear normally occurs at the ends.
- Inspect the thickness of the inner pad in order to ensure that it has not worn prematurely. Look through the window in the top of the caliper in order to view the inner pad.
- Both front and rear disc brakes have wear indicators that make a noise when the pads wear below specifications. The wear indicator is an integral part of the outer pad. When the pad is worn the wear indicator contacts the rotor and produces a warning noise as indicated in the illustration above.
- Replace the pads when the thickness is worn below specification. Replace all pads in axle sets. Refer to *Component Specifications*.
- Measure the flatness of the inner and outer pads. Place the pad surfaces together and measure the gap between the surfaces. If a gap larger than the specification exists midway between the attaching lugs, replace the pads. Refer to *Component Specifications*.



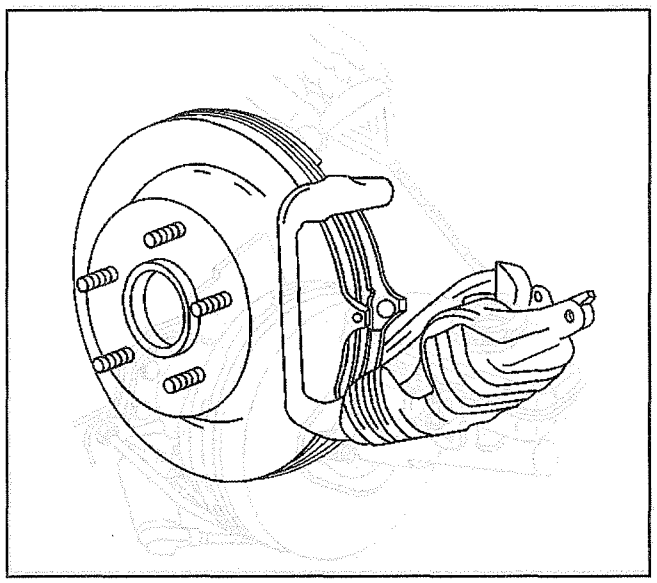
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Brake Pads Replacement (Front)

Removal Procedure

1. Remove two-thirds of the brake fluid from the master cylinder reservoir.
2. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
4. Remove front brake caliper. Refer to *Brake Caliper Replacement (Front)*.

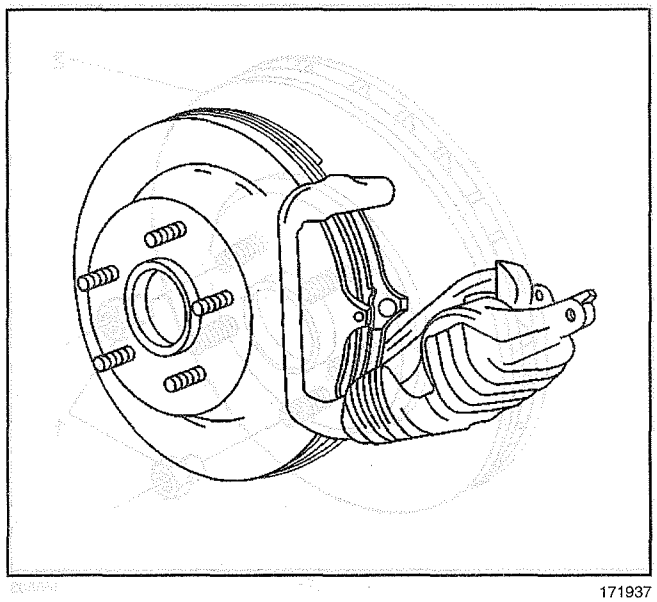
5. Remove the inner and outer brake pads from the caliper mounting plate.
   Use a screwdriver if necessary to remove the pads from their installed position.
6. Inspect the caliper guide pins for free movement in the caliper mounting plate.
7. Inspect the caliper guide pin boots for proper seating in the retaining groove of the caliper guide pin and the rear caliper mounting plate.
8. Replace the caliper guide pins and/or guide pin boots if any of the following conditions exist:
   - Excessive Corrosion
   - Excessive Wear
   - Visible Damage



171937

Installation Procedure

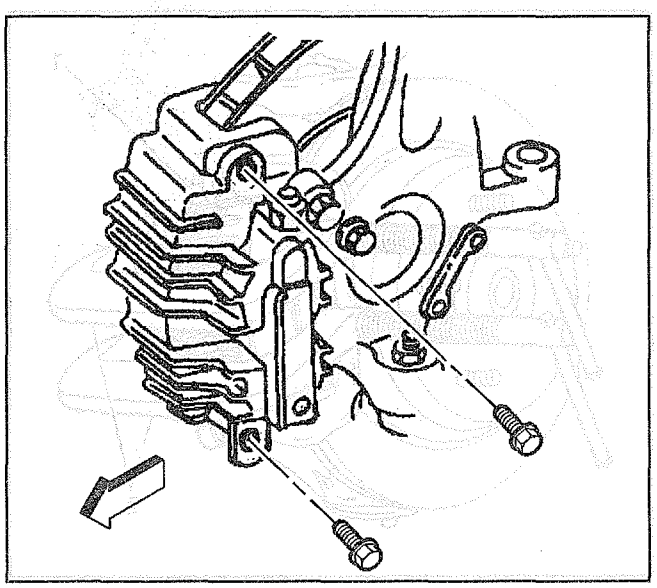
1. Install the inner and outer pads into the caliper mounting plate. Ensure that the wear sensor is at the trailing edge of the outer brake pad when the wheel is rotating forward. If the wear sensor is not at the trailing edge, the outer brake pad is on the wrong side.
2. Install the front brake caliper. Refer to *Brake Caliper Replacement (Front)*.



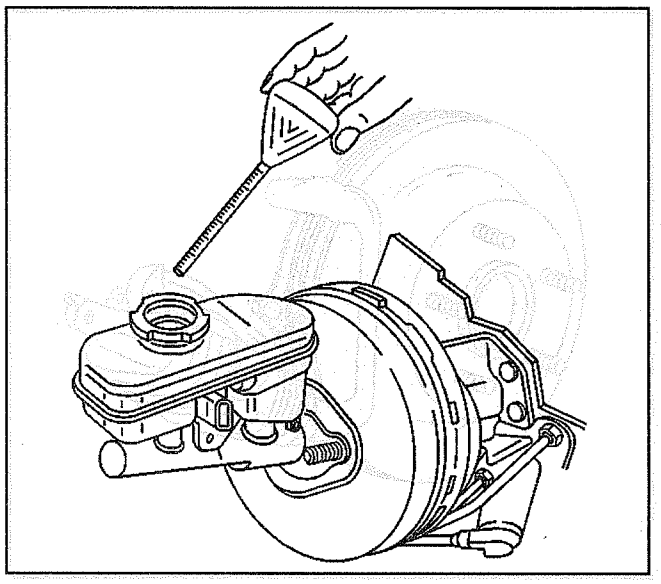
171937

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the caliper mounting pin bolts.
   Tighten
   Tighten the mounting pin bolts to 31 N·m (23 lb ft).
4. With the engine running, pump the brake pedal slowly and firmly until the inner and outer brake pads are positioned against rotor (firm pedal).
5. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
6. Lower the vehicle.
7. Refill the master cylinder to the proper level with clean, fresh brake fluid.
8. Inspect the hydraulic brake system for brake fluid leaks.
9. Burnish the new pads. Refer to *Burnishing Pads and Rotors*.



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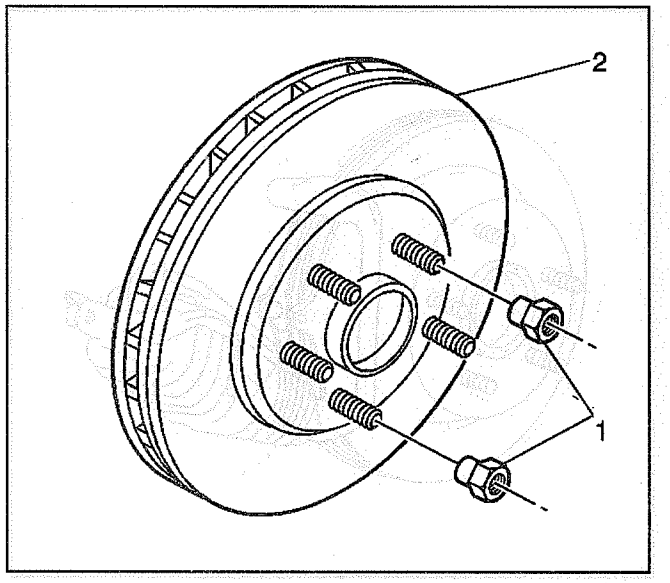


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Brake Pads Replacement (Rear)

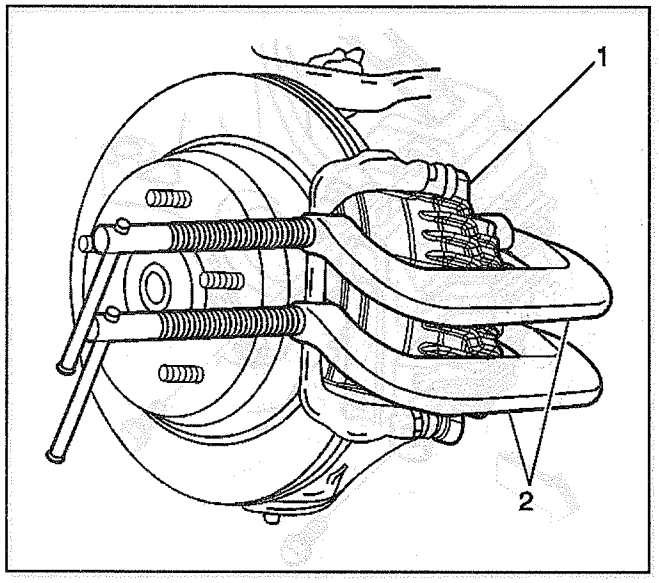
Removal Procedure

1. Remove two-thirds of the brake fluid from the master cylinder.
2. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Remove the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.



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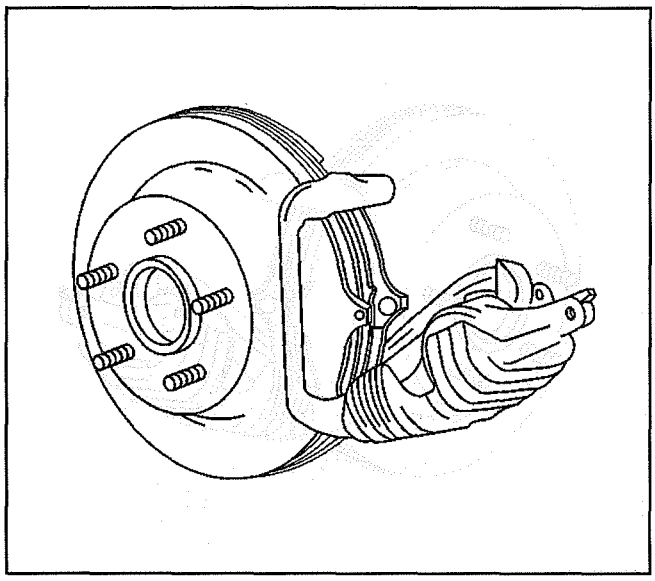
4. Install two wheel nuts (1) in order to retain the rotor (2).



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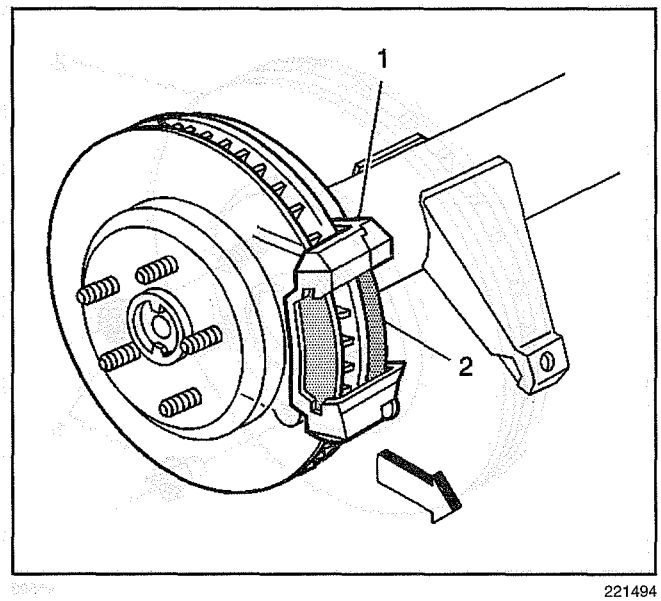
5. Position a C-clamp (2) over the caliper housing (1).
6. Tighten the C-clamp until the caliper piston bottoms in the base of the brake caliper. Verify that one end of the C-clamp rests on the brake hose fitting bolt/screw and the other end rests against the outer pad.

7. Remove the rear brake caliper from the mounting plate. Refer to *Brake Caliper Replacement (Rear)*. Ensure that weight of caliper is adequately supported.



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8. Remove the inner and outer brake pads (2) from the mounting plate (1).
9. Clean all the residue from the shoe guide surfaces on the caliper mounting plate and the rear brake caliper.
10. Inspect the caliper guide pins for free movement in the caliper mounting plate.
11. Inspect the caliper guide pin boot for proper seating in the retaining groove of the guide pin and the caliper mounting plate. Replace the caliper guide pins or the guide pin boots, if corrosion or damage exists. Refer to *Brake Caliper Overhaul (Rear)*.



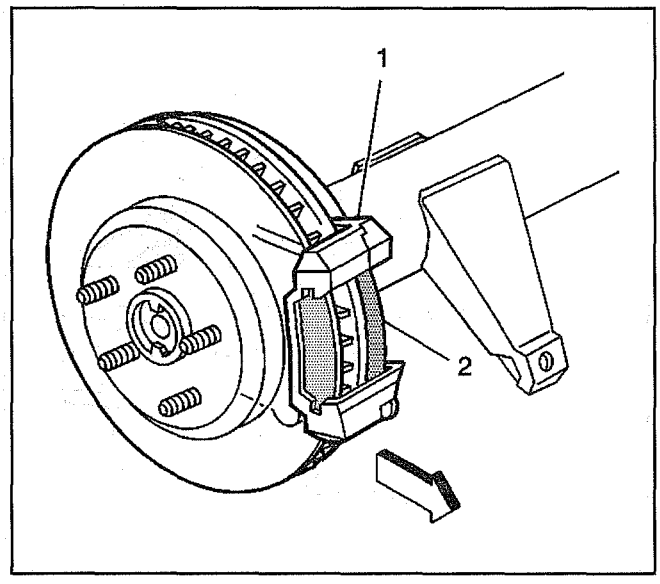
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Installation Procedure

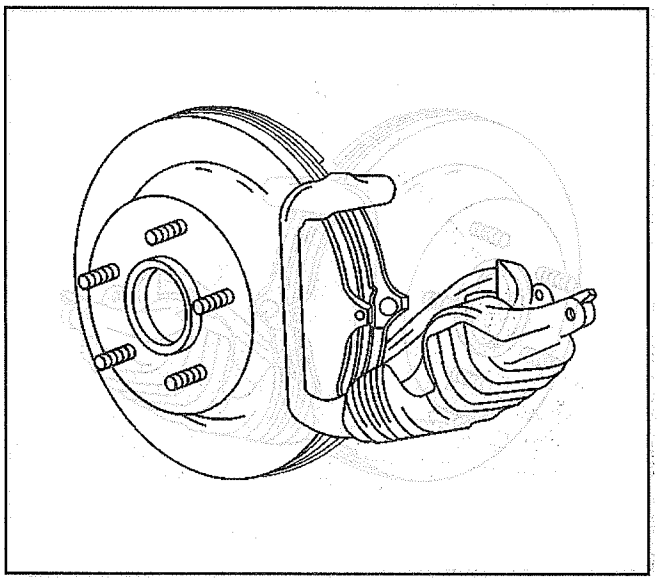
Important:

- Install the inner pad with wear sensor near the piston.
- Ensure that the wear sensor is on the leading edge of the inner pad during forward wheel rotation. If the wear sensor is not on the leading edge, use the other inner pad in the replacement kit.
- Replace the inner and outer pads in axle sets only.

1. Install new inner and outer pads (2) into mounting plate (1).

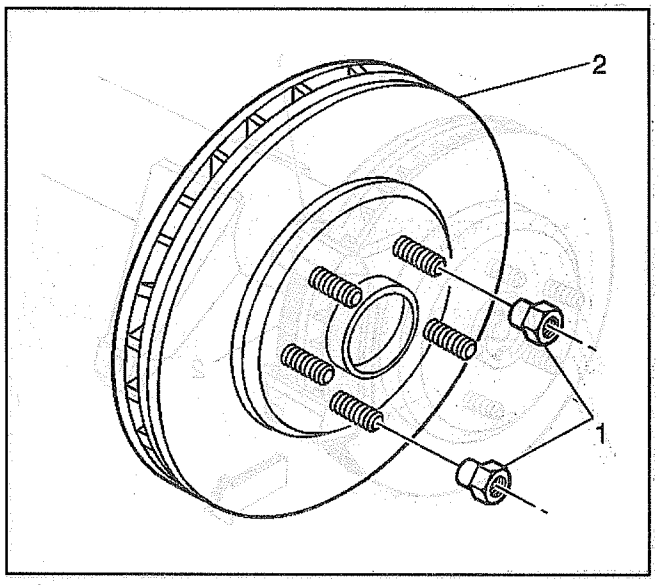


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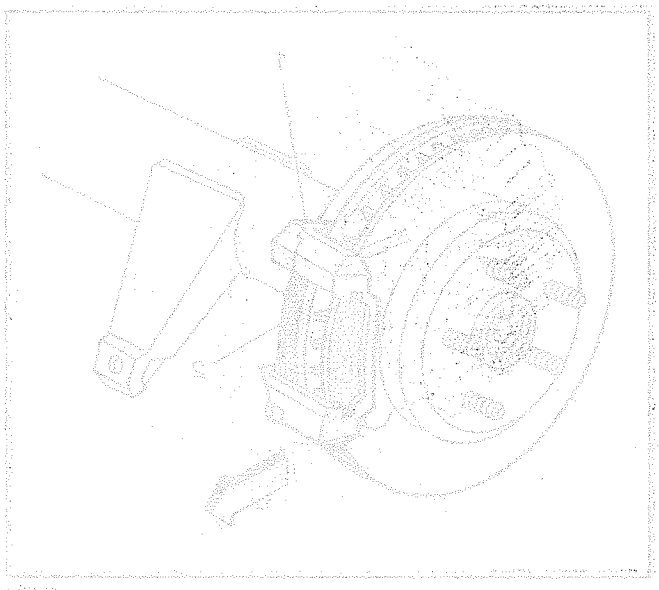
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2. Install the rear brake caliper to the mounting plate. Refer to *Brake Caliper Replacement (Rear)*.



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3. Remove the wheel nuts (1) securing the rotor (2).
4. Install the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
5. Lower the vehicle.
6. With engine running, pump brake pedal until brake pads are positioned against rotor (firm brake pedal).
7. Verify that there are no leaks in the brake hydraulic system.
8. Burnish the new pads. Refer to *Burnishing Pads and Rotors*.



Burnishing Pads and Rotors

Burnish the new braking surface after the brake pads have been replaced and the rotors have been refinished or replaced.

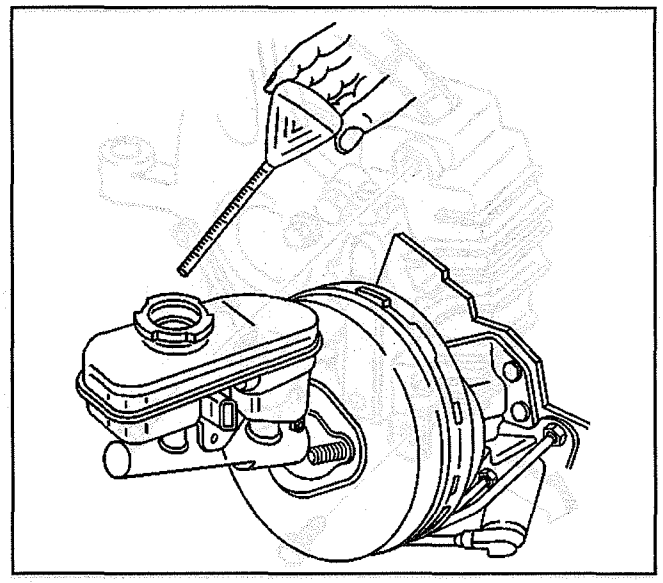
Burnishing "breaks in" the new pads or rotors. Burnishing also removes light corrosion on the rotors.

Burnish the brakes by making 20 stops from 48 km/h (30 mph) using medium to firm pressure on the brake pedal. Allow 0.8 km (0.5 miles) between stops in order to avoid overheating the brakes.

Brake Caliper Replacement (Front)

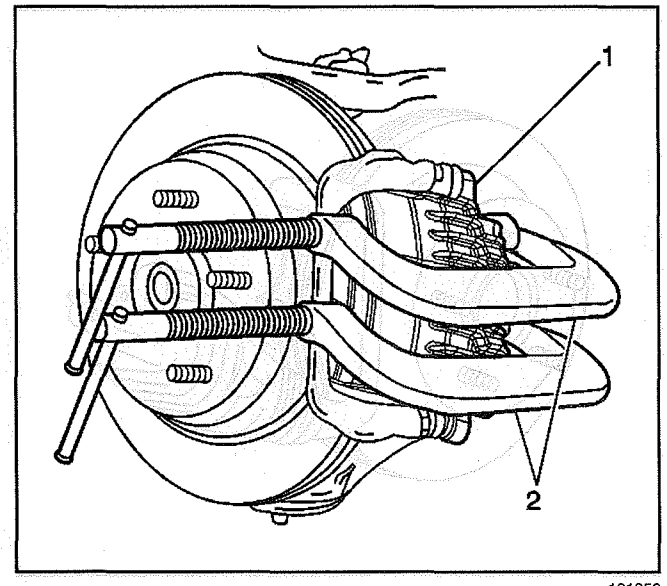
Removal Procedure

1. Remove two-thirds of the brake fluid from the master cylinder.
2. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Remove the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.



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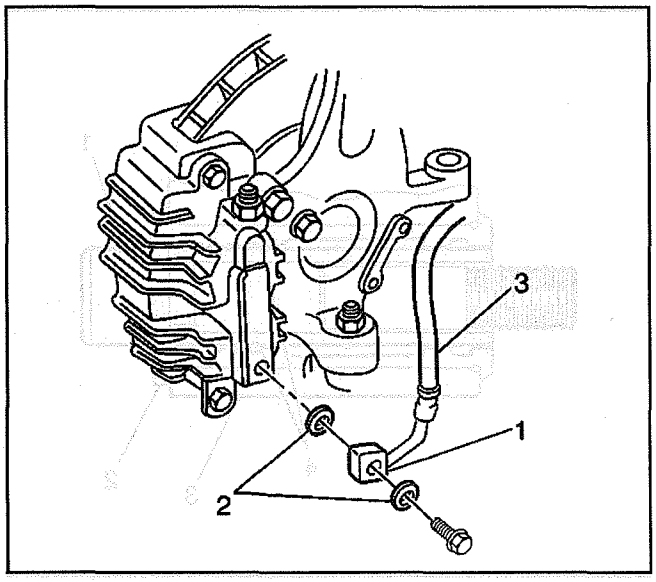
4. Push the piston into the housing bore in order to provide clearance between the pads and the rotor.
   - 4.1. Install a large C-clamp (2) over the top of the caliper housing (1) and against the back of the outboard pad.
   - 4.2. Slowly tighten the C-clamp until the piston is pushed into the caliper bore enough to slide the caliper off the rotor. Do not overtighten the C-clamp. Overtightening the C-clamp will deform the outboard shoe.



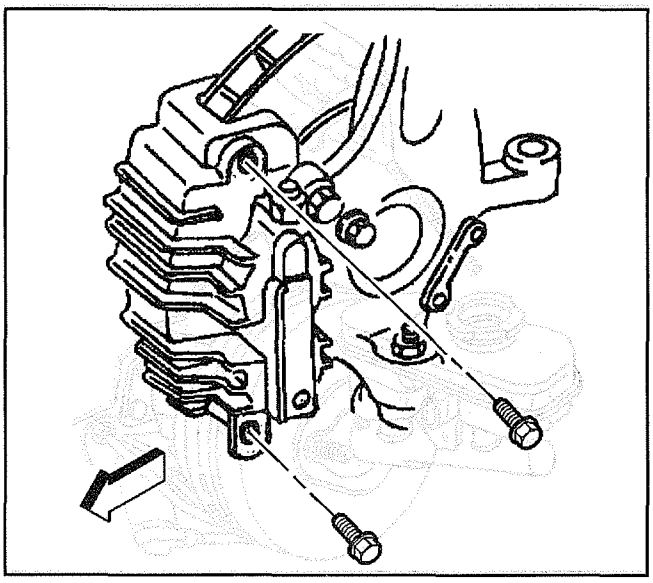
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5. Complete the following steps if the caliper is being removed from the vehicle for overhaul or replacement:
   - 5.1. Remove the brake hose bolt attaching the brake hose fitting to the caliper.
   - 5.2. Remove the following components:
     - The brake hose fitting (1)
     - The copper gaskets (2)

       Discard the copper gaskets.
     - The brake hose from the caliper (3)
   - 5.3. Plug the openings in the caliper housing and the hose in order to prevent loss or contamination of the brake fluid.
6. If the caliper is being removed for service of the mounting plate or the brake pads, do not disconnect the inlet fitting.

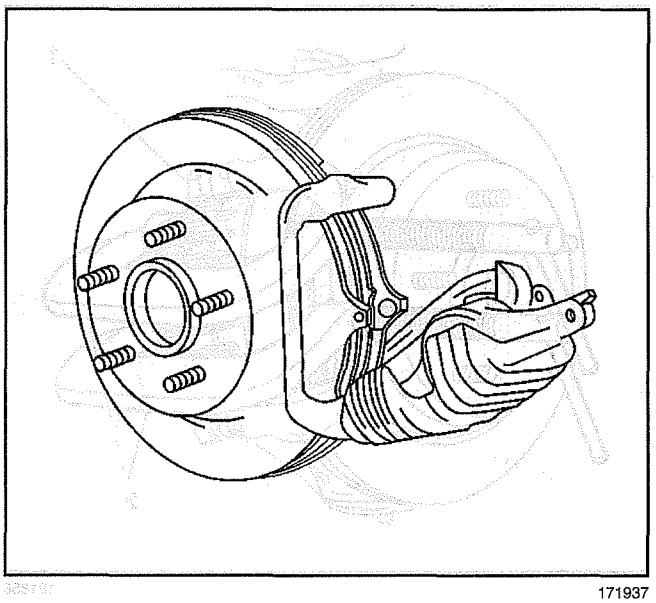


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7. Remove the brake caliper guide pin bolts.

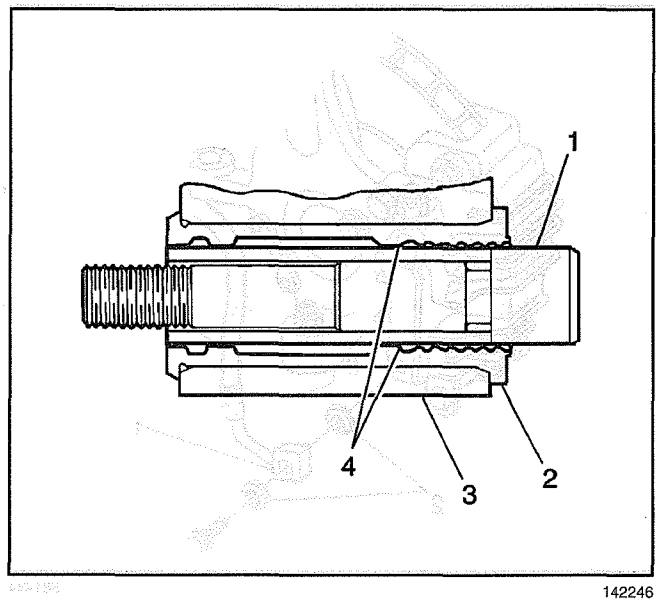


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8. Remove the caliper housing from the rotor and the brake caliper mounting bracket.

   If the caliper is not being removed from the vehicle, suspend the caliper from the front suspension using a fabricated wire hook.
9. Remove the caliper guide pin bolts and discard.
10. Inspect the following parts for corrosion, cuts, nicks or blockage. Replace any damaged parts.
    - The caliper guide pin bushings
    - The brake hose fitting

      If corrosion and/or excessive wear is found, use new parts, including bushings, when installing the caliper. Do not attempt to polish away corrosion.

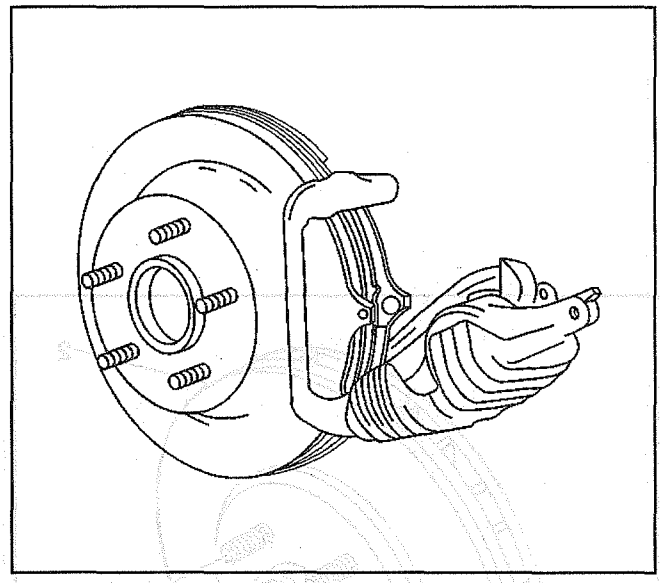


142246

Installation Procedure

1. Lubricate the inner diameters of the caliper bolt bushings (2) with silicone grease.
2. Lubricate the caliper bolts (1). Use silicone grease. Do not lubricate the threads.
3. Inspect the caliper guide pins.
   - The caliper pin should slide through the pin bushings and caliper pin bores using only hand pressure.
   - If greater force is required, remove the caliper pin and the bushings.
4. Inspect the mounting bores for corrosion.
   - If corrosion exists, remove the corrosion using a 1-inch wheel cylinder brush.
   - Clean the mounting bores using clean denatured alcohol.
5. Replace the caliper pin and bushings. Refer to *Brake Caliper Overhaul (Front).*

6. Install the caliper and pads onto the mounting bracket.

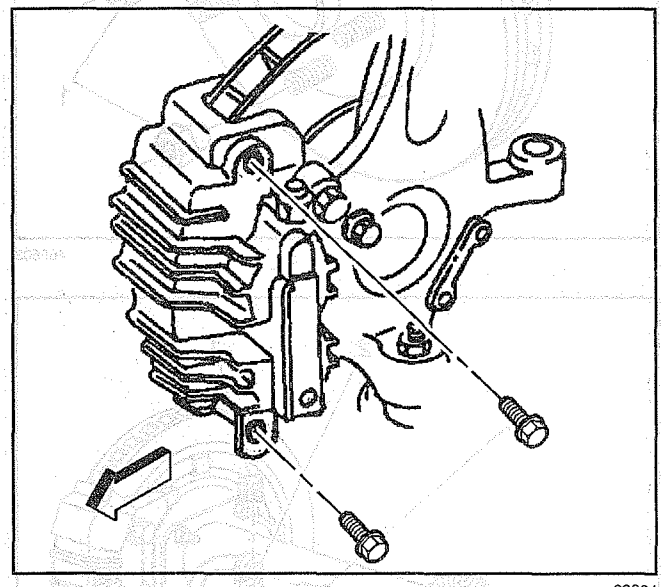

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Notice: Refer to *Fastener Notice* in Cautions and Notices.

7. Install the front brake caliper guide pin bolts.

   Tighten

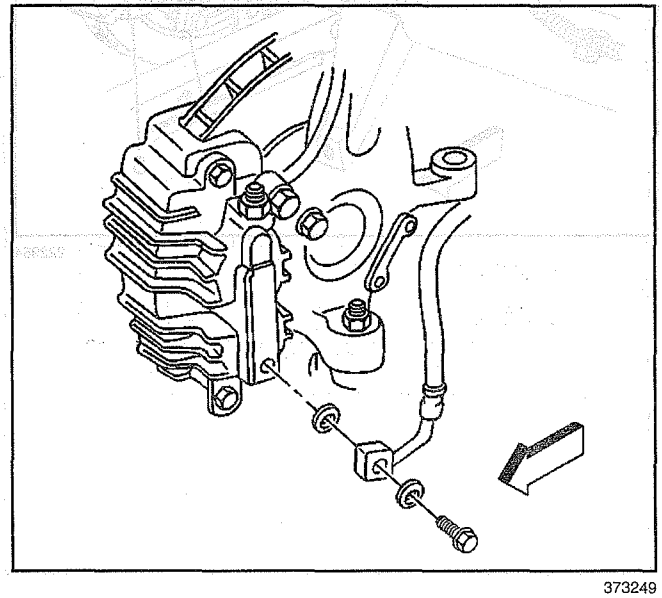
   Tighten the front brake caliper guide pin bolts to 31 N·m (23 lb ft).

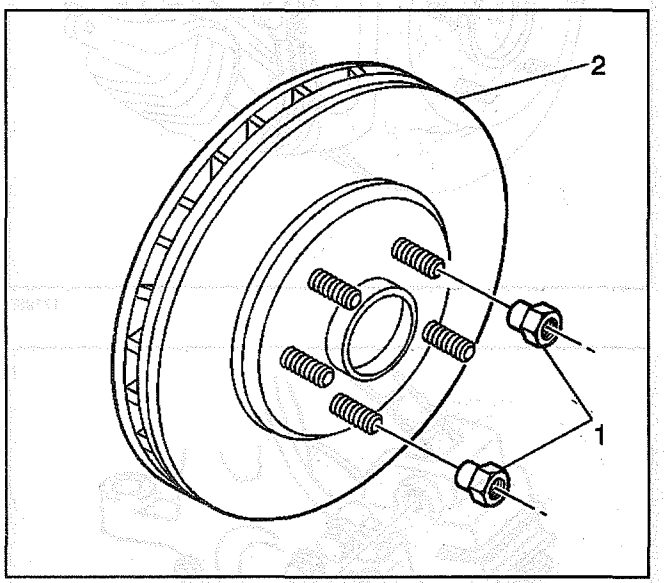

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8. If the following components were removed, install them onto the caliper housing using new copper gaskets:
   - The brake hose fitting
   - The brake hose

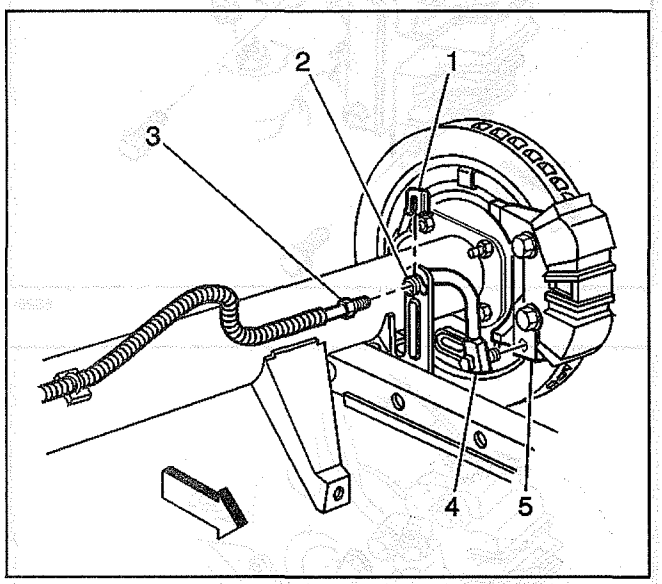
   Tighten

   Tighten the front brake hose fitting to 40 N·m (30 lb ft).
9. Install the tire and the wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
10. Lower the vehicle.


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Important: If the brake hose was removed, bleed the caliper. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* in Hydraulic Brakes.

11. Fill the master cylinder reservoir to the proper level with clean brake fluid.
12. With engine running, pump brake pedal until firm brake pedal is attained.
13. Check for leaks.

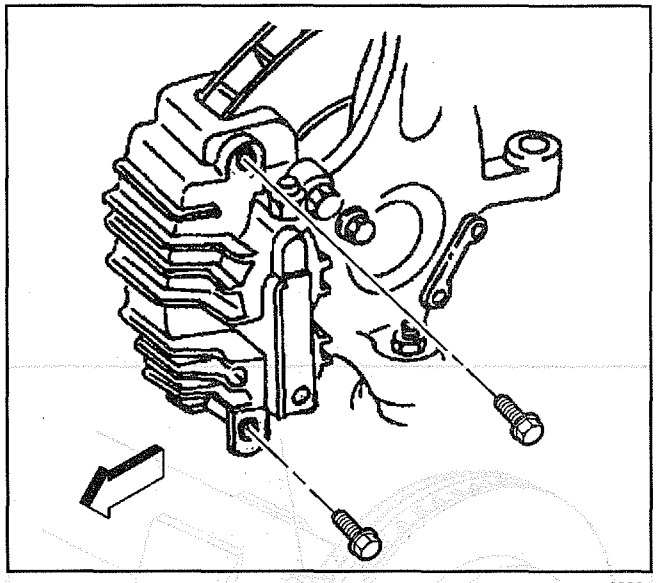
Brake Caliper Replacement (Rear)

Removal Procedure

1. Raise and suitably the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Reinstall two wheel nuts (1) in order to secure the rotor (2).
4. Complete the following steps if you are removing the caliper (5) from the vehicle:
   - 4.1. Remove the brake hose bolt attaching the brake hose fitting (4).
   - 4.2. Remove the following items:
     - The brake hose fitting (4)
     - The copper gaskets

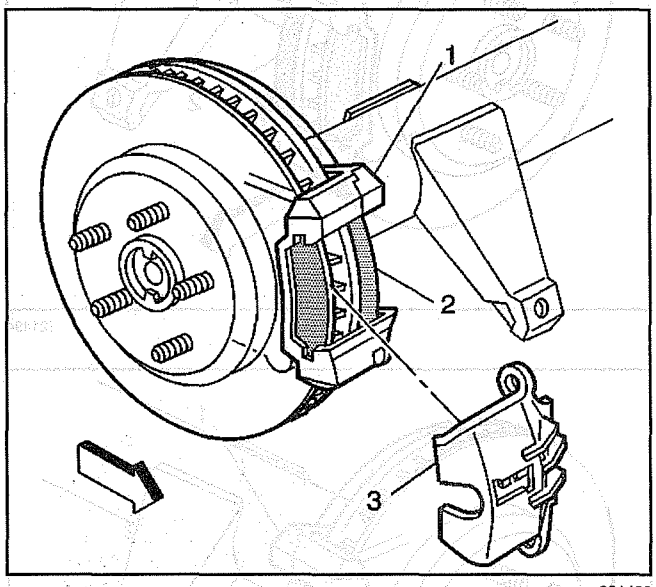
       Discard the copper gaskets.
     - The brake hose from the caliper
   - 4.3. Plug the openings in the caliper housing and the hose in order to prevent loss or contamination of the brake fluid.

5. Remove the brake caliper guide pin bolts and discard.



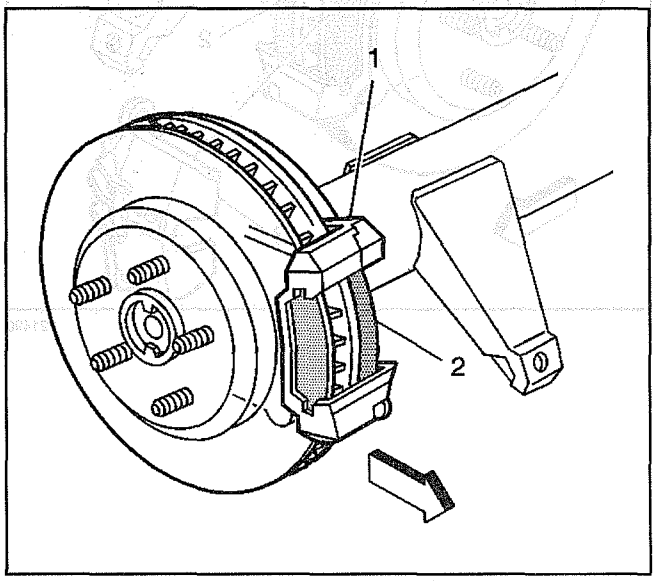
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6. Remove the rear brake caliper (3) from the inner and outer pads (2) and mounting plate (1).
   If the caliper is not being removed from the vehicle for unit repair, suspend the caliper from the rear suspension using a fabricated wire hook.

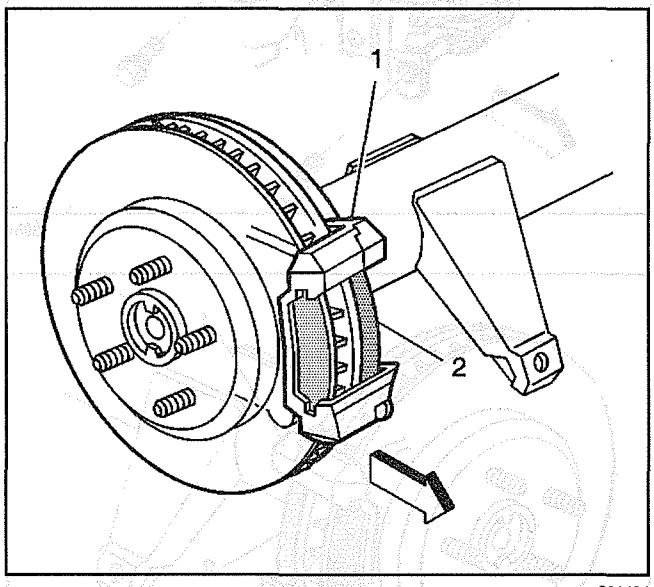


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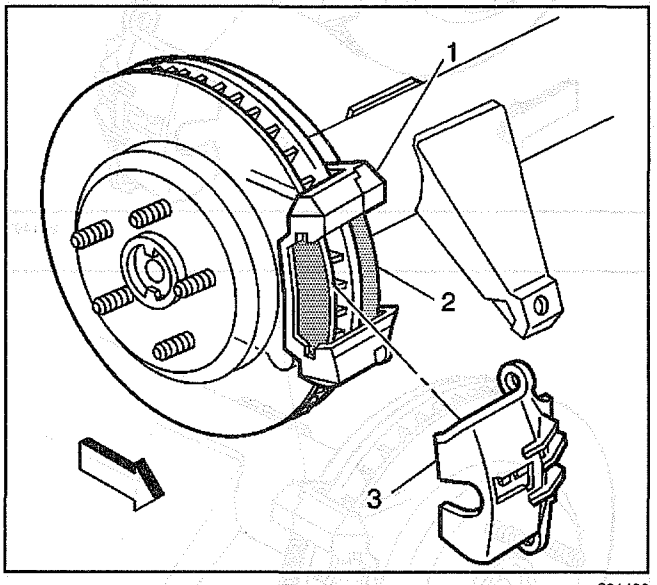
7. Remove the inner and outer brake pads (2) from the mounting plate (1) if the following conditions exist:
   - The brake pads are also being replaced.
   - The brake caliper mounting plate is also being removed.
8. Inspect the caliper guide pins for free movement in the caliper mounting plate.
9. Inspect the caliper guide pin boot for proper seating in the retaining groove of the caliper guide pin and the rear caliper mounting plate.
10. Replace the guide pins or guide pin boots if the following conditions exist:
    - Excessive Corrosion
    - Significant Wear
    - Visible Damage



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11. Lubricate the inner diameters of the caliper bolt bushings with silicone grease. Also lubricate the caliper bolts with silicone grease.
12. Inspect the inner and outer pads for wear.
13. Inspect the inner and outer pads for maximum taper.
    - Maximum taper of the rear brake pads is 0.15 mm (0.006 in).
    - If the pads are tapered beyond the maximum specification, replace the inner and outer pads as a complete set only.

Installation Procedure

1. Install the inner and outer pads (2) into the mounting plate (1).
2. Install the rear brake caliper (3) over the brake pads (2) and into the caliper mounting plate (1).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install new brake caliper guide pin bolts.

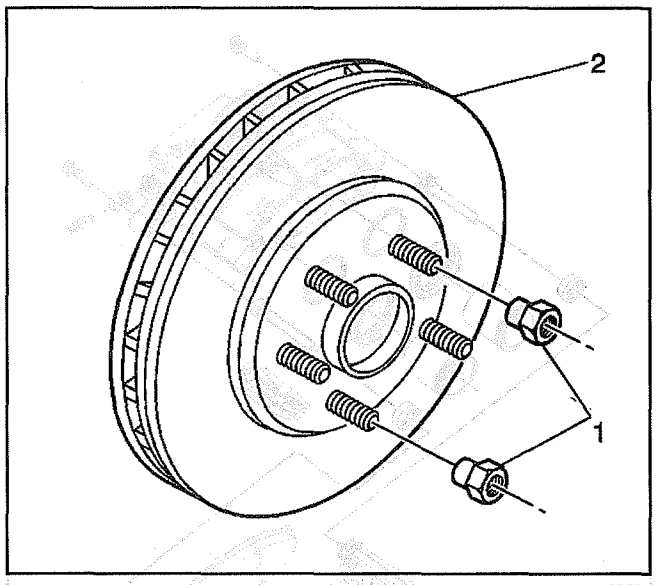
   Tighten

   Tighten the brake caliper guide pin bolts to 37 N·m (72 lb ft).

4. Install the following components, if removed:
   - The brake hose
   - The new brake hose fitting gaskets
5. Install the brake hose fitting bolt.

   Tighten

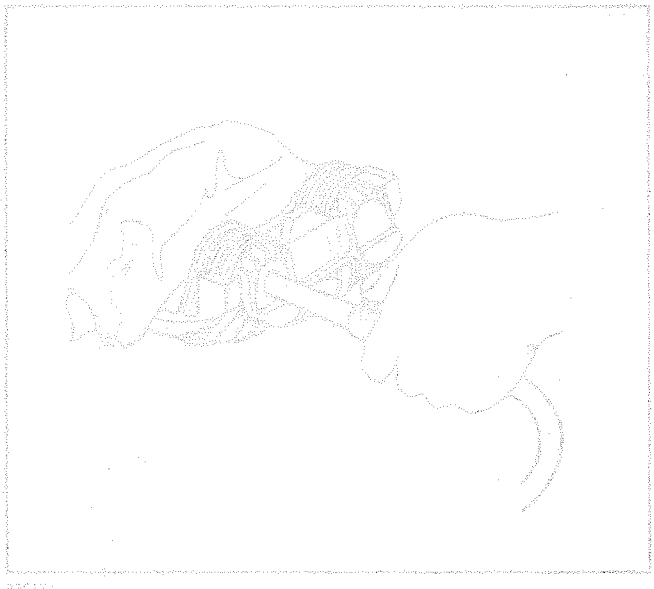
   Tighten the brake hose fitting bolt to 30 N·m (22 lb ft).
6. Bleed the brake hydraulic system, if the brake hose fitting was removed. Refer to the following procedures:
   - *Hydraulic Brake System Bleeding (Manual Bleeding)*
   - *Hydraulic Brake System Bleeding (Pressure Bleeding)*
   - *Hydraulic Brake System Bleeding (When To Bleed)*
7. Remove the wheel nuts securing the rotor.
8. Install the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
9. Lower the vehicle.
10. While the engine is running, pump the brake pedal slowly and firmly three times in order to seat the inner and outer pads.
11. Check the brake hydraulic system for leaks.

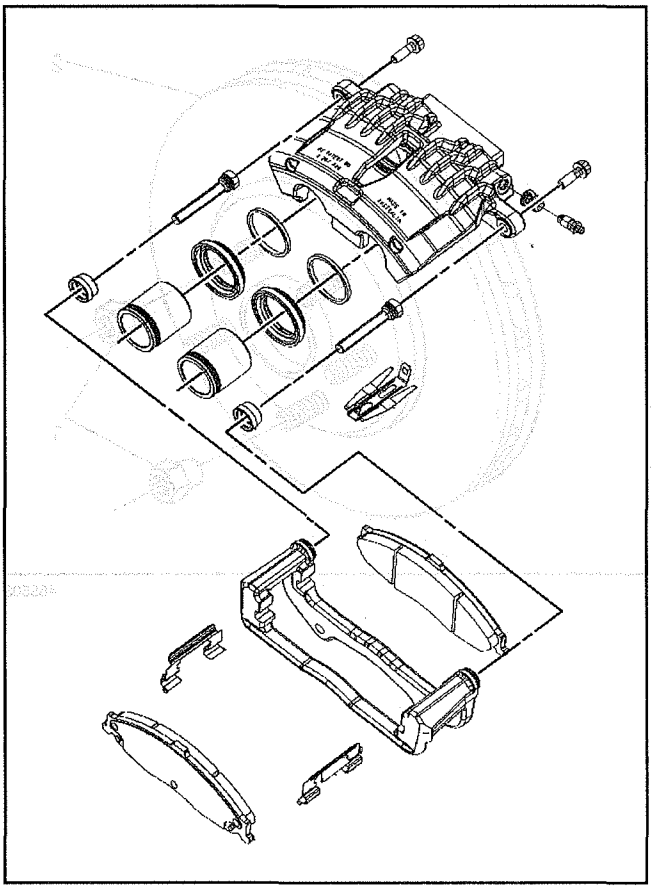


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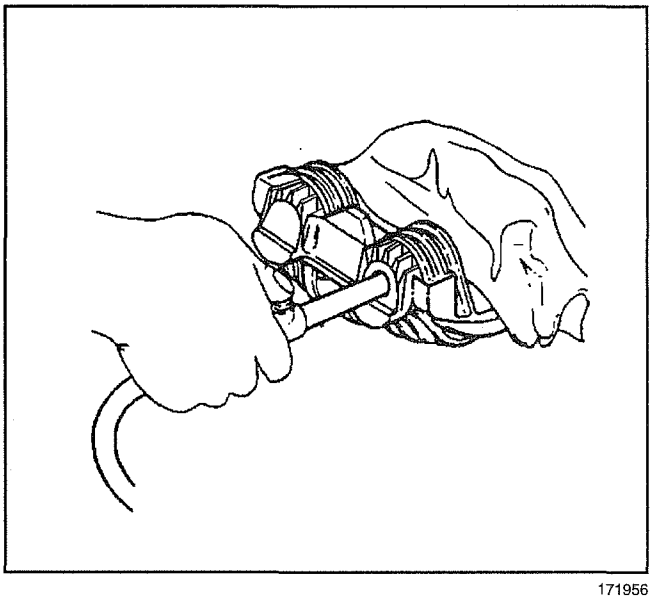
Brake Caliper Inspection

- Check the calipers for outward signs of leaking fluid and cracked or damaged piston boots.
- Check the calipers for excessive corrosion on the brake pad guiding surface.
- Perform all other types of caliper inspections during unit repair.





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Brake Caliper Overhaul (Front)

Disassembly Procedure

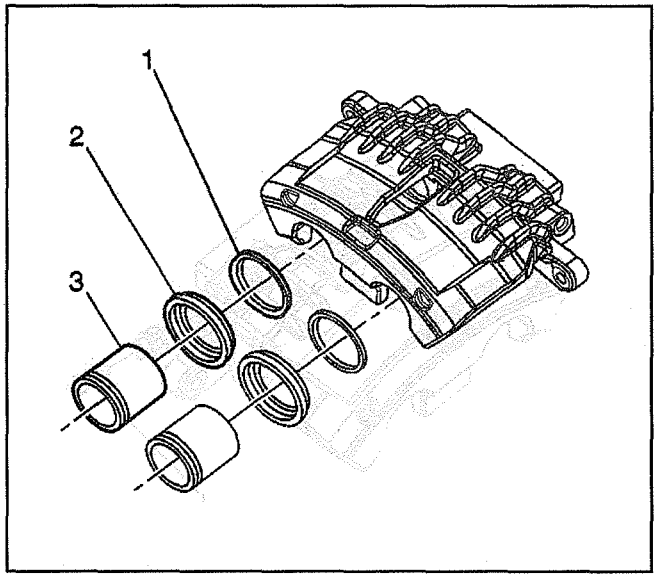
Important:

- Replace all the components included in the repair kits used to service this brake caliper.
- Lubricate the rubber parts with clean brake fluid to make assembly easier.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- Replace the brake pads in axle sets only.
- The torque values specified are for dry, unlubricated fasteners.
- Perform the service operations on a clean bench, free from all mineral oil materials.

Caution: Do not place your fingers in front of the piston in order to catch or protect the piston while applying compressed air. This could result in serious injury.

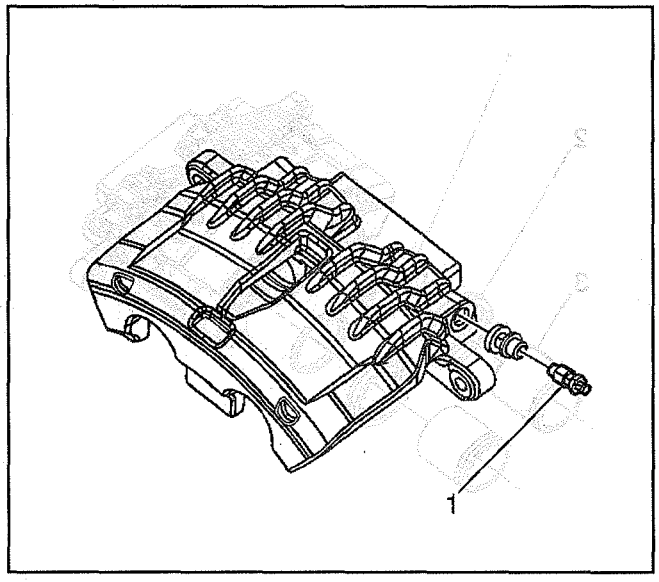
1. Remove the brake caliper from the vehicle. Refer to *Brake Caliper Replacement (Front).*
2. Remove the pistons by directing compressed air into the brake hose inlet fitting port of the brake caliper housing.

3. Remove the piston boots (2).
4. Remove the piston seals (1).



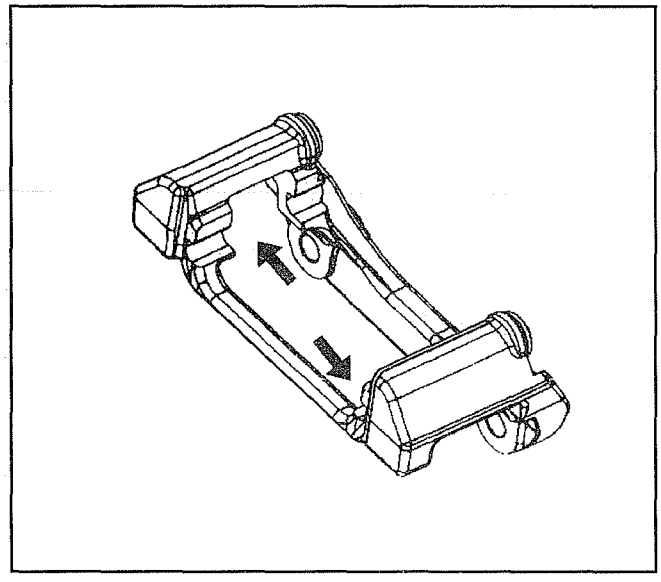
581456

5. Remove the brake caliper bleed screw cap.
6. Remove the brake caliper bleed screw (1).
7. Inspect the brake caliper bores and piston seal grooves for scoring and corrosion. If badly scored or corroded around the piston seal area, replace the brake caliper housing.

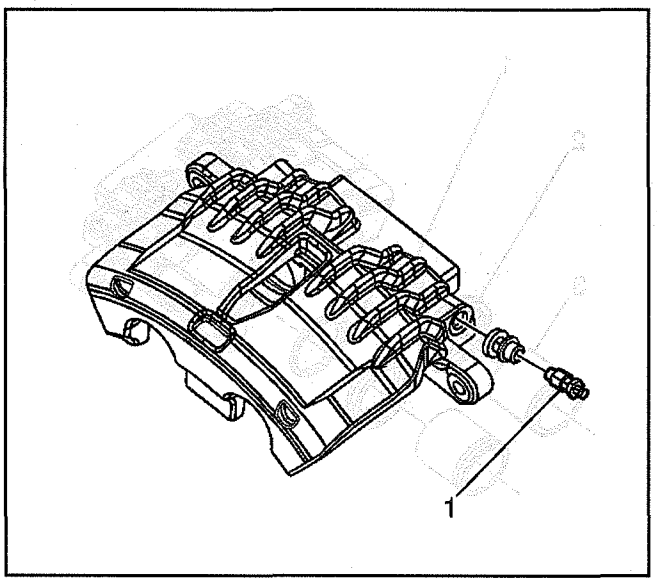


581457

8. Inspect the brake caliper mounting bracket guide surfaces for corrosion and wear. Remove and replace the brake caliper mounting bracket if necessary.
9. Clean all the residue from the brake pad guiding surfaces on the brake caliper housing and the brake caliper mounting bracket.
10. Clean all the parts not included in the repair kit with denatured alcohol.
11. Dry all the parts with filtered unlubricated compressed air.
12. Blow out all passages in the brake caliper housing and the brake caliper bleeder valve.



171985



581457

Assembly Procedure

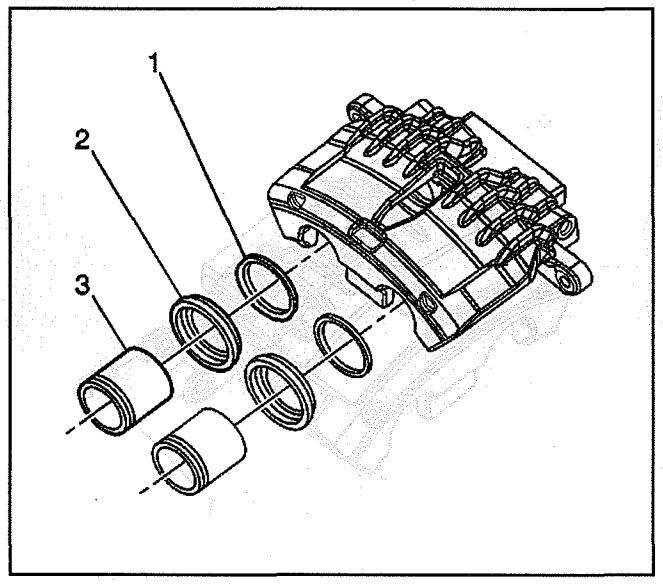
Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the brake caliper bleed screw (1).

   Tighten

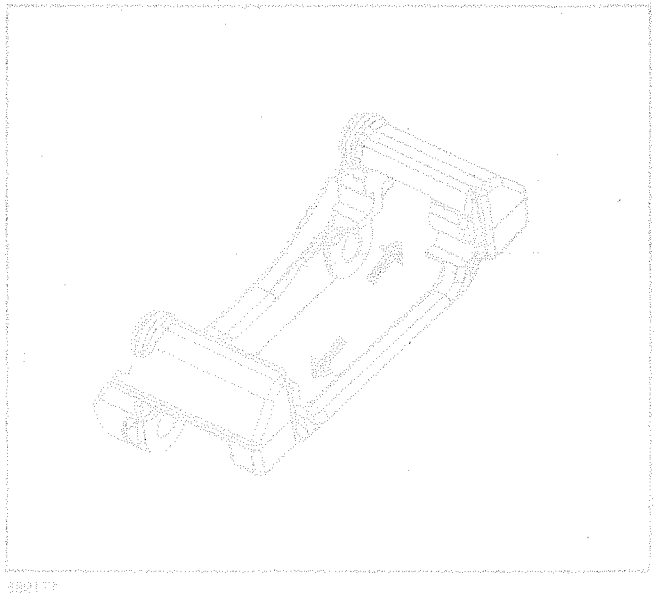
   Tighten the brake caliper bleed screw to 12 N·m (106 lb in).

2. Install the brake caliper bleed screw cap.



581456

3. Lubricate the new piston seals and the brake caliper bore seal grooves with brake fluid.
4. Install new seals (1) into the brake caliper bore seal grooves.
5. Make sure the seals are not twisted.
6. Lubricate the brake caliper bores and the pistons with brake fluid.
7. Install the boot (2) and piston (3).
   7.1. Install the boot over the end of the piston so that the fold will face toward the brake caliper housing piston bore opening.
   7.2. Seat the boot into the brake caliper bore groove and slide the piston into the brake caliper bore.
   7.3. Push down the piston to the bottom of the brake caliper bore.
   7.4. Make sure the boot is properly seated into the piston groove and into the groove in the brake caliper bore.
   7.5. Repeat Steps 5 and 6 for the remaining piston.
8. Install the brake caliper to the vehicle. Refer to *Brake Caliper Replacement (Front).*

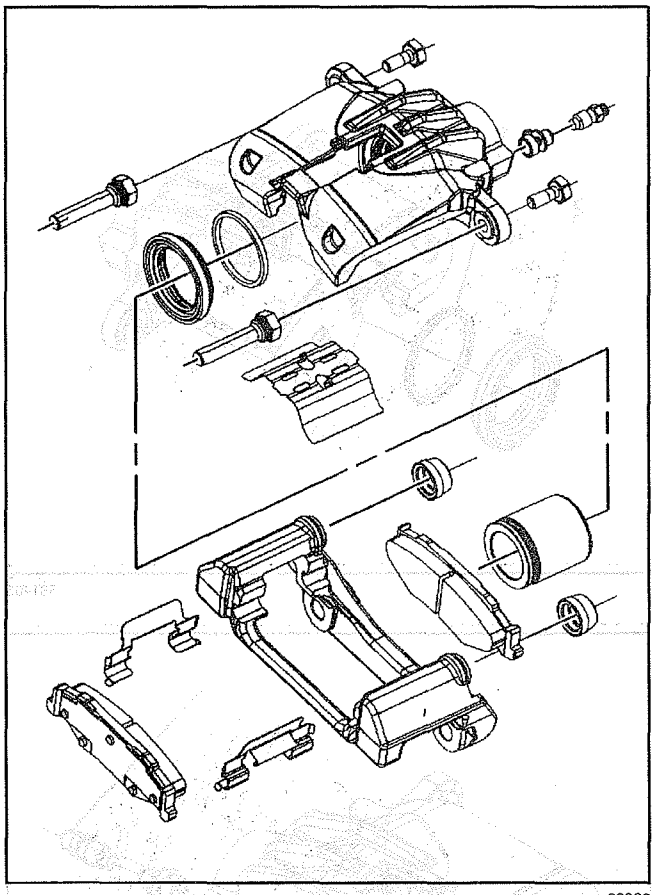


Brake Caliper Overhaul (Rear)

Disassembly Procedure

Important:

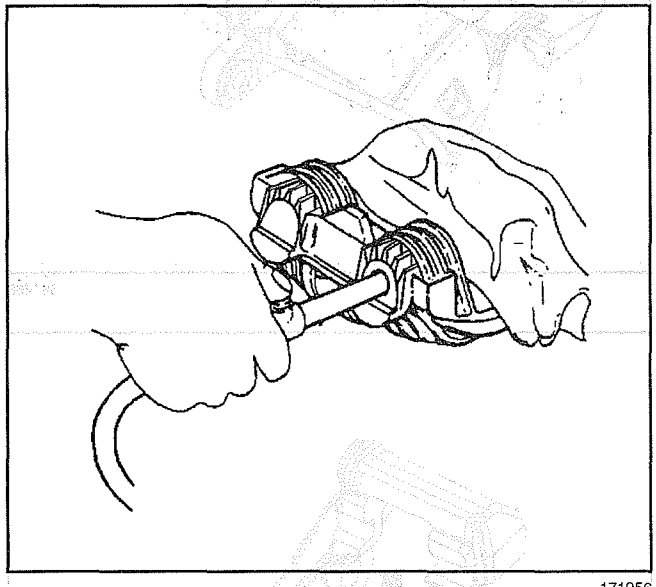
- Replace all the components included in the repair kits used to service this brake caliper.
- Lubricate the rubber parts with clean brake fluid to make assembly easier.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- Replace the brake pads in axle sets only.
- The torque values specified are for dry, unlubricated fasteners.
- Perform the service operations on a clean bench, free from all mineral oil materials.



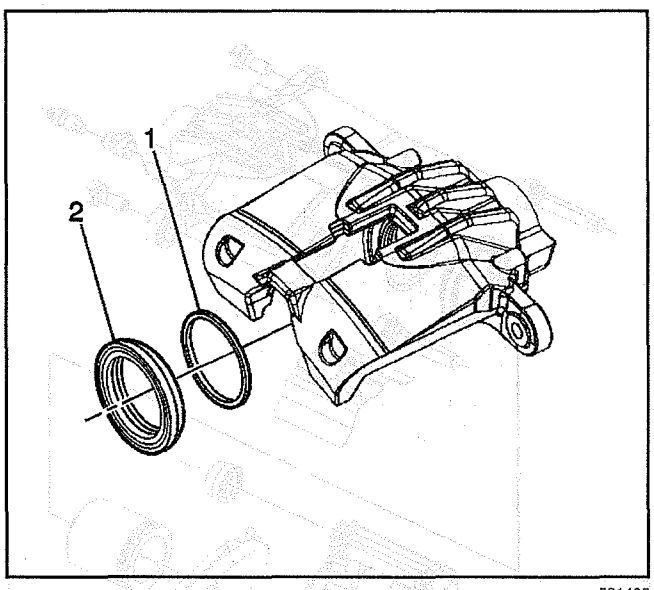
63982

Caution: Do not place your fingers in front of the piston in order to catch or protect the piston while applying compressed air. This could result in serious injury.

1. Remove the brake caliper from the vehicle. Refer to *Brake Caliper Replacement (Rear).*
2. Remove the piston by directing compressed air into the brake hose inlet fitting port of the brake caliper housing.

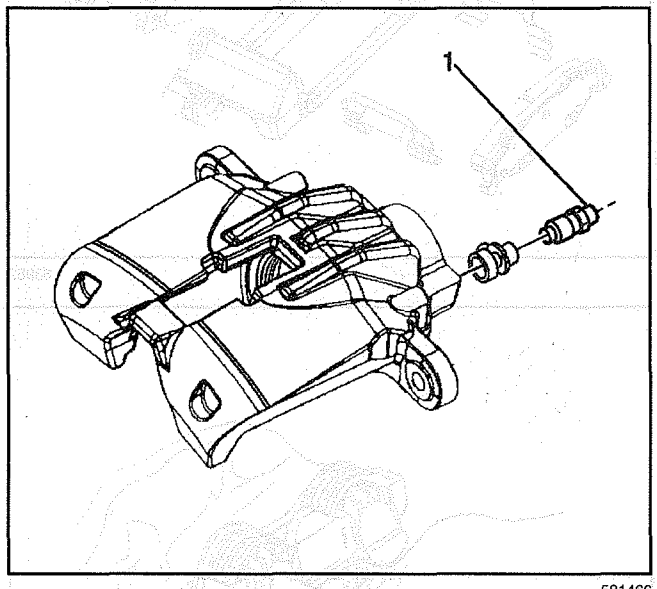


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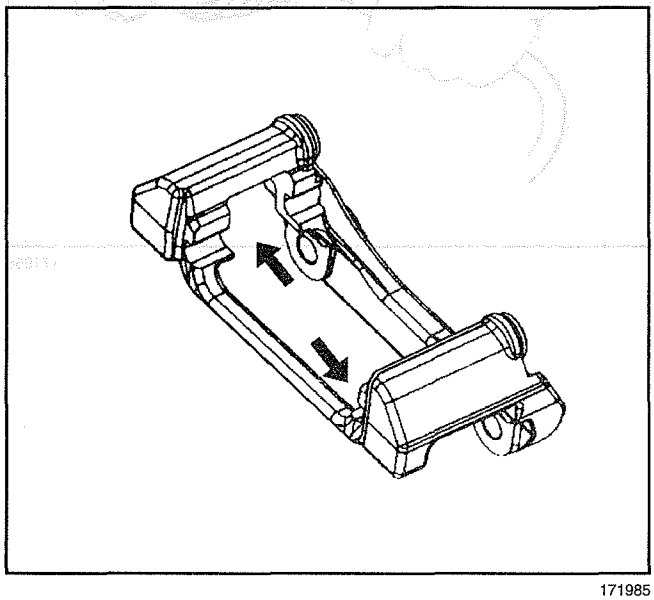
581465

3. Remove the piston boot (2).
4. Remove the piston seal (1).



581466

5. Remove the brake caliper bleed screw cap.
6. Remove the brake caliper bleed screw (1).
7. Inspect the brake caliper bore and piston seal groove for scoring and corrosion. If badly scored or corroded around the piston seal area, replace the brake caliper housing.



171985

8. Inspect the brake caliper mounting bracket guide surfaces for corrosion and wear. Remove and replace the brake caliper mounting bracket if necessary.
9. Clean all the residue from the brake pad guiding surfaces on the brake caliper housing and the brake caliper mounting bracket.
10. Clean all the parts not included in the repair kit with denatured alcohol.
11. Dry all the parts with filtered unlubricated compressed air.
12. Blow out all passages in the brake caliper housing and the brake caliper bleeder valve.

Assembly Procedure

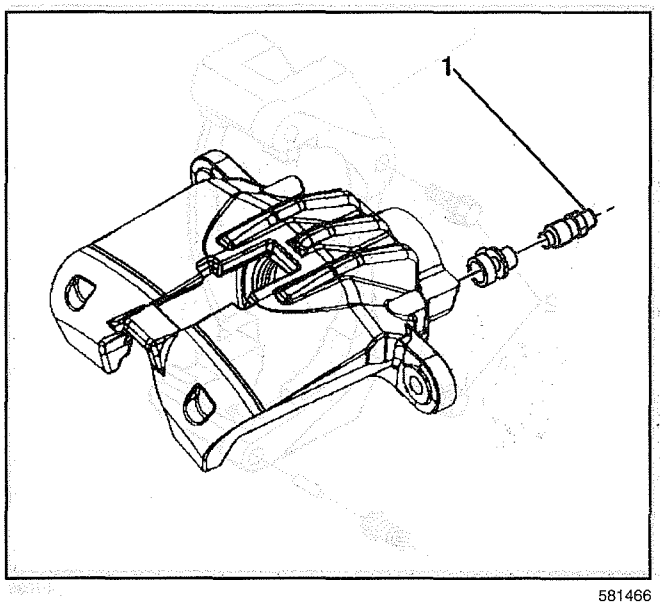
Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the brake caliper bleed screw (1).

   Tighten

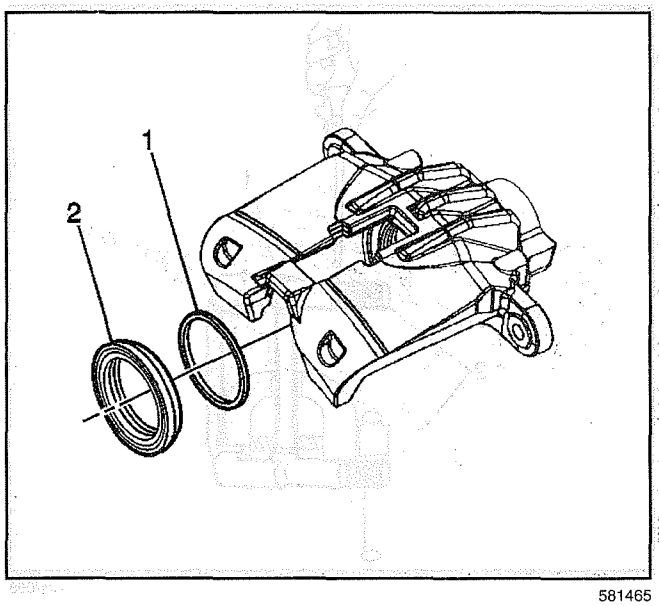
   Tighten the brake caliper bleed screw to 12 N·m (106 lb in).

2. Install the brake caliper bleed screw cap.

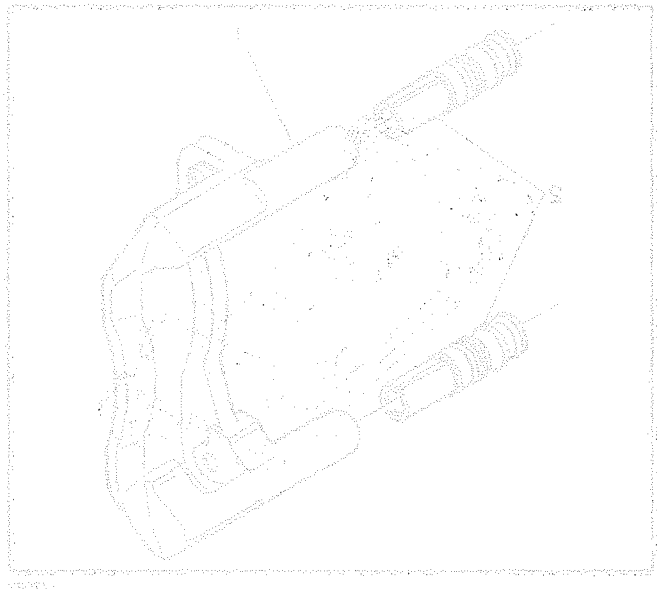


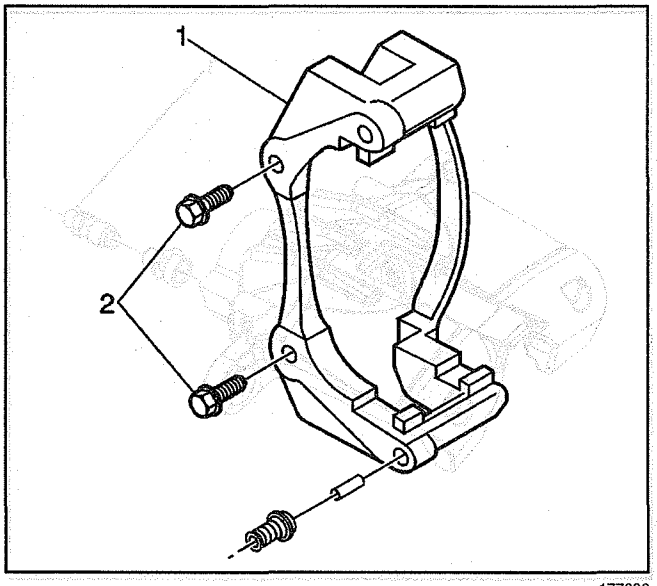
581466

3. Lubricate the new piston seal and the brake caliper bore seal groove with brake fluid.
4. Install the new seal (1) into the brake caliper bore seal groove.
5. Make sure the seal is not twisted.
6. Lubricate the brake caliper bore and the piston with brake fluid.
7. Install the boot (2) and piston.
   - 7.1. Install the boot over the end of the piston so that the fold will face toward the brake caliper housing piston bore opening.
   - 7.2. Seat the boot into the brake caliper bore groove and slide the piston into the brake caliper bore.
   - 7.3. Push down the piston to the bottom of the brake caliper bore.
   - 7.4. Make sure the boot is properly seated into the piston groove and into the groove in the brake caliper bore.
   - 7.5. Repeat Steps 5 and 6 for the remaining piston.
8. Install the brake caliper to the vehicle. Refer to *Brake Caliper Replacement (Rear)*.

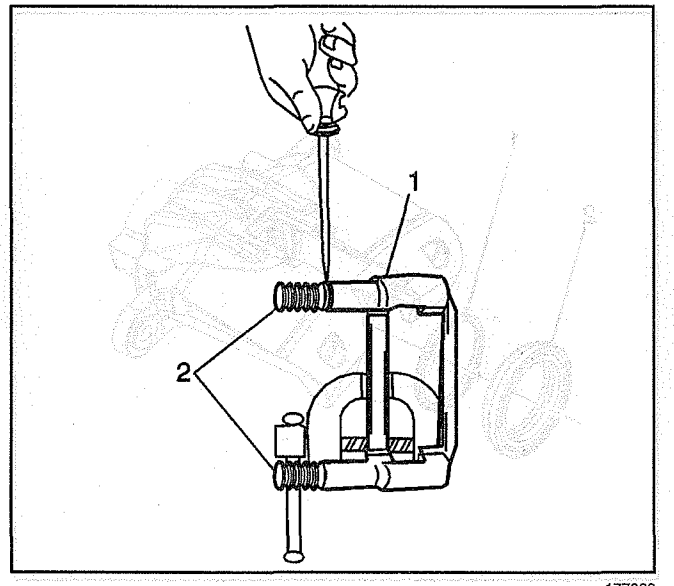


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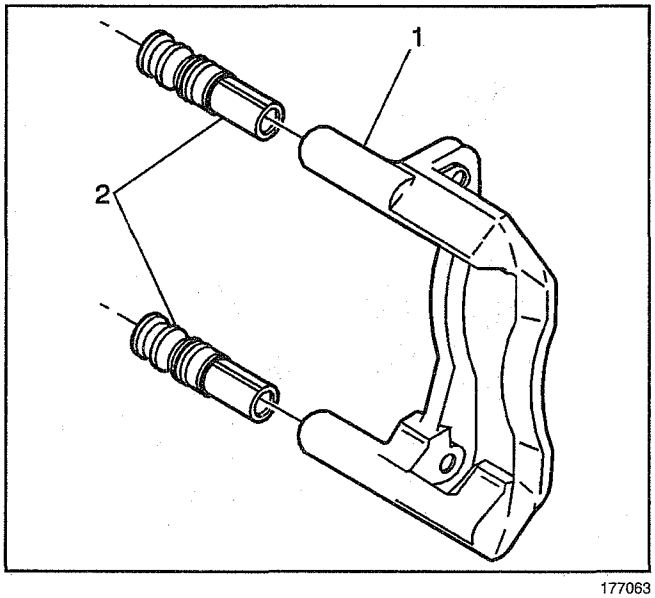




177036



177068



177063

Brake Caliper Bracket Replacement (Front)

Removal Procedure

1. Remove the inner and outer pads. Refer to *Brake Pads Replacement (Front)*.

Caution: These fasteners MUST be replaced with new fasteners anytime they become loose or are removed. Failure to replace these fasteners after they become loose or are removed may cause loss of vehicle control and personal injury.

2. Remove the caliper bracket bolts (2).
3. Remove the caliper bracket (1).
4. Remove the following components from the bracket (1):
   - The boot bolts (2)
   - The bushings
5. Inspect the bracket for cracks.
6. Replace the bracket if necessary.

Installation Procedure

1. Lubricate the following components with silicone grease:
   - New bolt boots
   - New bushings
2. Install the following components into the caliper bracket (1):
   - The bolt boots (2)
   - The bushings

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the caliper bracket with the bracket bolts.

   Tighten

   Tighten the caliper bolts to 100 N·m (74 lb ft).
4. Install the inner and outer brake pads. Refer to *Brake Pads Replacement (Front)*.

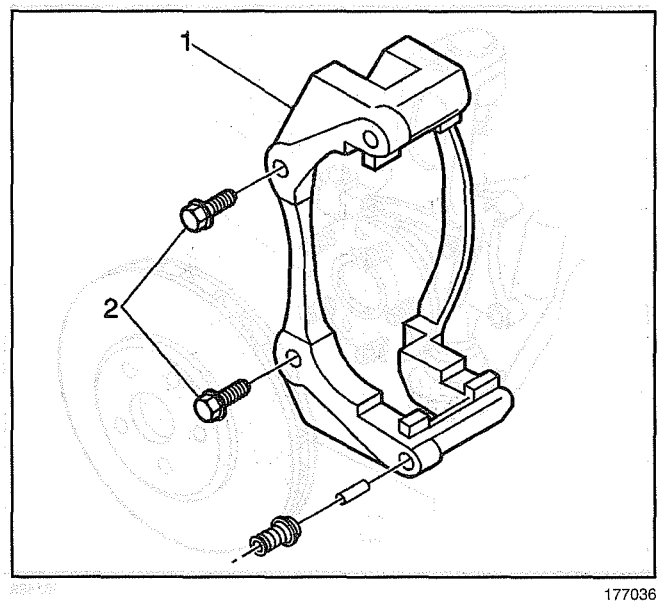
Brake Caliper Bracket Replacement (Rear)

Removal Procedure

1. Remove the inner and outer brake pads. Refer to *Brake Pads Replacement (Rear)*.

Caution: These fasteners MUST be replaced with new fasteners anytime they become loose or are removed. Failure to replace these fasteners after they become loose or are removed may cause loss of vehicle control and personal injury.

2. Remove the caliper bracket bolts (2).
3. Remove the caliper bracket (1).



177036

Installation Procedure

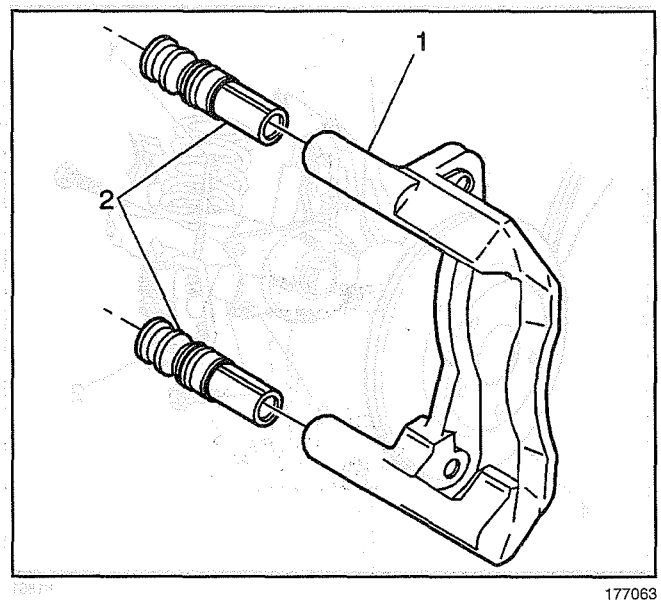
1. Lubricate the following components with silicone grease:
   - New bolt boots
   - New bushings
2. Install the following components into the caliper bracket (1):
   - The bolt boots (2)
   - The bushings

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the caliper bracket with the bracket bolts.

   Tighten

   Tighten the caliper bolts to 100 N·m (74 lb ft).
4. Install the inner and outer brake pads. Refer to *Brake Pads Replacement (Rear)*.

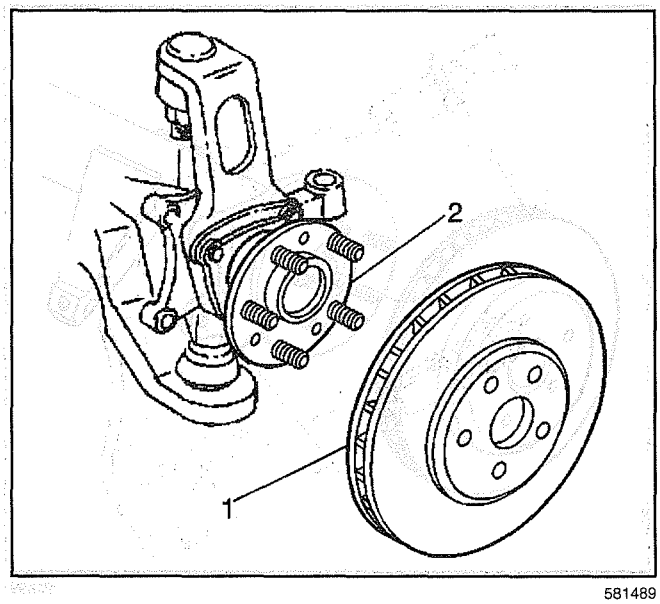


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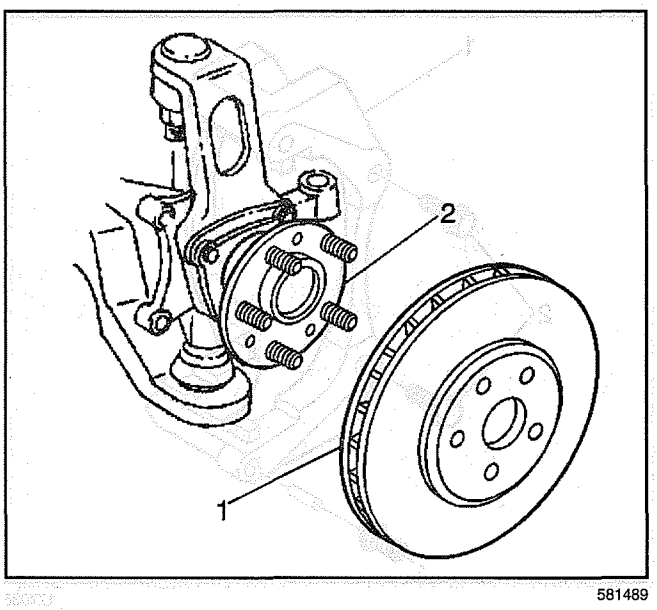
Brake Rotor Replacement (Front)

Removal Procedure

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the tire and the wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Remove the front brake caliper. Refer to *Brake Caliper Replacement (Front)*.
4. Remove the caliper mounting bracket bolts and the caliper mounting bracket.
5. Remove the brake rotor (1) from the wheel hub (2).
6. Clean the metal contact surfaces between the brake rotor and the hub bearing flange.



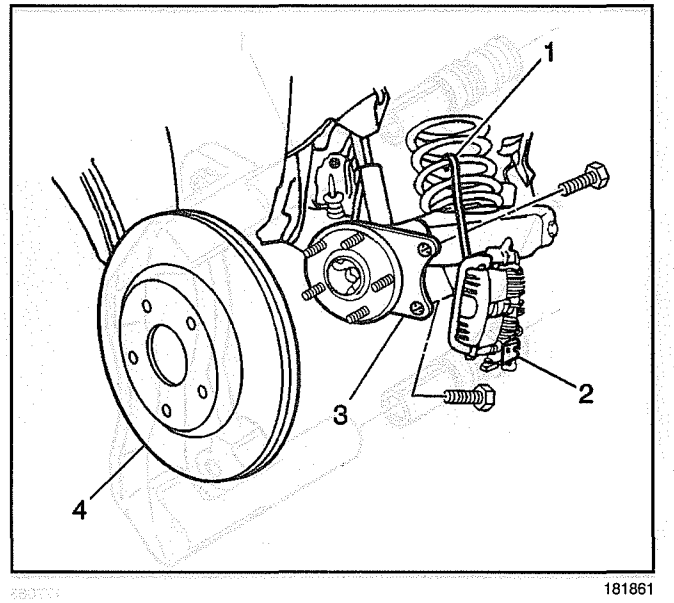
581489



581489

Installation Procedure

1. Install the brake rotor (1) onto the wheel hub (2).
2. Install the caliper mounting bracket and caliper mounting bracket bolts.
3. Install the front brake caliper. Refer to *Brake Caliper Replacement (Front)*.
4. Install the tire and the wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
5. Lower the vehicle.
6. Pump the brake pedal several times until firm.



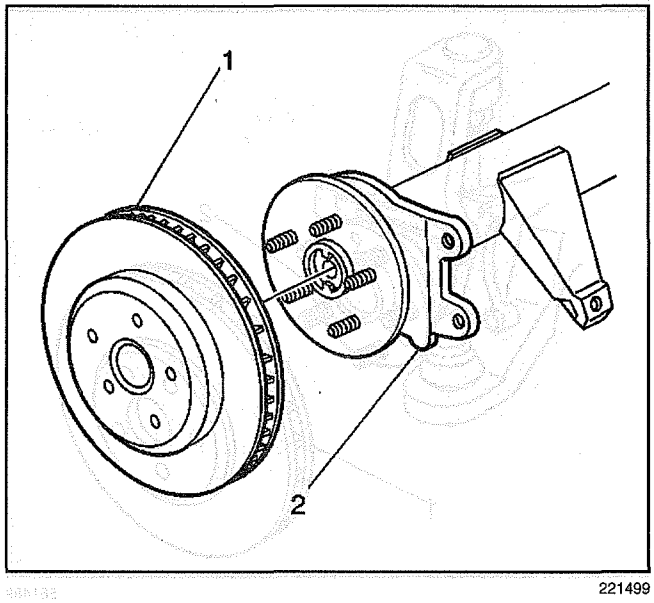
181861

Brake Rotor Replacement (Rear)

Removal Procedure

The rear brake rotor can be removed without separating the caliper from the mounting plate (remove as an assembly).

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the tire and the wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Remove the rear brake caliper (2) and mounting bracket. Support with a locally fabricated hook (1). Refer to *Brake Caliper Replacement (Rear)*.



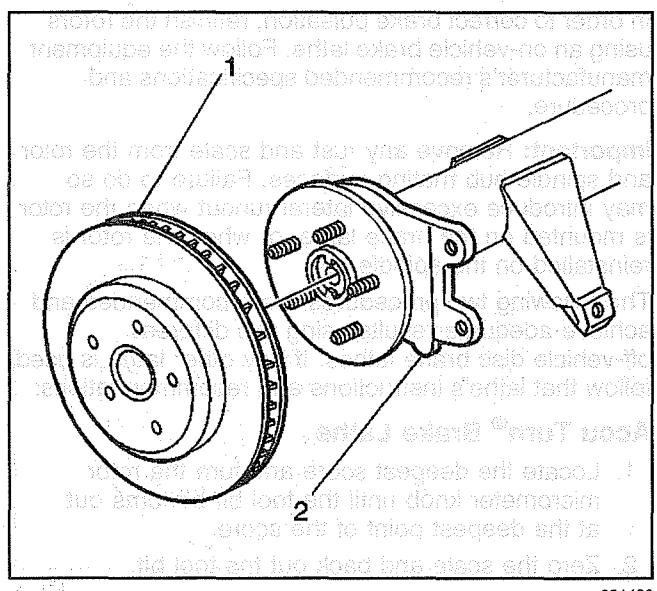
221499

4. Remove the brake rotor (1) from the wheel hub (2).

Installation Procedure

Notice: Any new rotor must have the protective coating removed from the friction surfaces before being placed in service. Use Goodwrench Brake Parts Cleaner P/N 123777981 or the equivalent, and wipe the surface clean with clean cloths. Do not use gasoline, kerosene, or other oil base solvents which may leave an oily residue. This residue is damaging to the brake lining and is flammable.

1. Install the brake rotor (1) onto the wheel hub (2).
2. Install the rear brake caliper and mounting plate assembly. Refer to *Brake Caliper Replacement (Rear).*
3. Install the tire and the wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
4. Lower the vehicle.
5. Pump the brake pedal several times until the pedal is firm.



221499

Refinishing Brake Rotors (Front)

Important: DO NOT refinish brake rotors when performing routine brake maintenance, such as replacing worn disc brake pads. Refinish a rotor ONLY under the following circumstances:

- There is a complaint of brake pulsation.
- There is scoring greater than 1.5 mm (0.060 in).

All brake rotors have a minimum thickness dimension cast into the rotor. This dimension is not a minimum refinishing dimension. The minimum refinishing dimension is larger than the discard dimension. Do not use a brake rotor that, after refinishing, will not meet the minimum thickness shown on the rotor. Replace it with a new rotor. Refer to *Component Specifications.*

Accurate control of the rotor tolerance is necessary for proper performance of the disc brakes. Machine the rotor using precise equipment. Service machining equipment on a regular basis. Follow the manufacturer's recommended maintenance procedure.

Ensure that the following tool accessories are in good condition when refinishing the rotors:

- The attaching adapters
- The tool holders
- The vibration dampeners
- The tool bits

Always use sharp cutting tools and bits. Replace cutting bits using equipment recommended by the manufacturer. Dull or worn tools leave a poor surface finish which will affect braking performance. Always use anti-chatter silencer attachments when refinishing braking surfaces. The attachments eliminate tool chatter and will result in a better surface finish. Ensure that the adapters are clean and free of nicks.

In order to correct brake pulsation, refinish the rotors using an on-vehicle brake lathe. Follow the equipment manufacturer's recommended specifications and procedure.

Important: Remove any rust and scale from the rotor and spindle hub mating surfaces. Failure to do so may introduce excessive lateral runout when the rotor is mounted on the brake lathe, or when the rotor is reinstalled on the spindle hub.

The following two procedures are recommended and achieve adequate results using two different off-vehicle disc brake lathes. If any other lathe is used, follow that lathe's instructions and recommendations:

Accu Turn® Brake Lathe

1. Locate the deepest score and turn the rotor micrometer knob until the tool bit bottoms out at the deepest point of the score.
2. Zero the scale and back out the tool bit.
3. Advance the cutter handwheel until the bits have cleared the inner edges of the rotor face.
4. Adjust the micrometer knobs for approximately 0.127 mm (0.005 in) more than the first reading. Use this method in order to resurface the rotor in one cut.

Front Rotor Finish Cut

Spindle Speed	105 rpm
Depth of Cut	As necessary
Cross Feed (per rev.)	0.08 mm (0.003 in)
Vibration Dampener	Yes

Nondirectional Finishing

Ensure that the rotor surface is nondirectional by dressing the rotor surfaces. Use a non-directional rotor finisher such as the 54–433179 Non-Directional Rotor Refinisher listed in the GM Dealer Equipment Catalog, or a suitable equivalent.

If the brake lathe is not equipped with an adequate nondirectional finishing tool, 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.

Important: Replace any rotor that does not meet the minimum thickness specification recommended by the manufacturer. Do not resurface new brake rotors. New brake rotors are manufactured with the proper surface finish.

The finished rotor surface should be as close as possible to that of a new rotor. Failure to obtain the best possible rotor finish may affect braking performance.

Refinishing Brake Rotors (Rear)

Important: DO NOT refinish brake rotors when performing routine brake maintenance, such as replacing worn disc brake pads. Refinish a rotor ONLY under the following circumstances:

- There is a complaint of brake pulsation.
- There is scoring greater than 1.5 mm (0.060 in).

All brake rotors have a minimum thickness dimension cast into the rotor. This dimension is not a minimum refinishing dimension. The minimum refinishing dimension is larger than the discard dimension. Do not use a brake rotor that, after refinishing, will not meet the minimum thickness shown on the rotor. Always use a new rotor. Refer to *Component Specifications*.

Accurate control of the rotor tolerance is necessary for proper performance of the disc brakes. Machine the rotor using precise equipment. Service the machining equipment on a regular basis. Follow the manufacturer's recommended maintenance procedure.

Ensure that the following tool accessories are in good condition when refinishing the rotors:

- The attaching adapters
- The tool holders
- The vibration dampeners
- The tool bits

Always use sharp cutting tools and bits. Replace cutting bits using equipment that is recommended by the manufacturer. Dull or worn tools leave a poor surface finish which will affect braking performance. Always use anti-chatter silencer attachments when refinishing braking surfaces. The attachments eliminate tool chatter and will result in a better surface finish. Ensure that the adapters are clean and free of nicks.

In order to correct brake pulsation, refinish rotors using an on-vehicle brake lathe. Follow the equipment manufacturer's recommended specifications and procedure.

Important: Remove any rust and scale from the rotor and spindle hub mating surfaces. Failure to do so may introduce excessive lateral runout when the rotor is mounted on the brake lathe, or when the rotor is reinstalled on the spindle hub.

The following two procedures are recommended and achieve adequate results using two different off-vehicle disc brake lathes. If any other lathe is used, follow that lathe's instructions and recommendations:

Accu Turn® Brake Lathe

1. Locate the deepest score. Turn the rotor micrometer knob until the tool bit bottoms out at the deepest point of the score.
2. Zero the scale and back out the tool bit.
3. Advance the cutter handwheel until the bits have cleared the inner edges of the rotor face.
4. Adjust the micrometer knobs for approximately 0.127 mm (0.005 in) more than the first reading. Use this method in order to resurface the rotor in one cut.

Rear Rotor Finish Cut

Spindle Speed	105 rpm
Depth of Cut	As necessary
Cross Feed (per rev.)	0.08 mm (0.003 in)
Vibration Dampener	Yes

Rotor Mounting Adapter

Tools Required

- *J 37160-A* Rotor Mounting Adapter
- *J 37160-50* Rotor Mounting Adapter Sleeve

Important: Verify that the mounting surfaces of these components are clean and free from nicks, burrs or rust.

1. Inspect all of the mounting hardware for the following conditions:
   - Rust
   - Nicks
   - Dirt
   - Abnormal wear

   For proper results, ensure that all components are in good condition and clean.
2. Inspect the rotor:
   - Measure the lateral runout. Refer to *Brake Rotor Lateral Runout Check.*
   - Measure the thickness variation. Refer to *Brake Rotor Thickness Variation Check.*

   Ensure that the mounting surface of the rotor is clean and free from rust and nicks.
3. Mount the *J 37160-A* on a spindle arbor.
   - Use a suitable combination of spacers or collets in order to tighten the *J 37160-A* to the arbor.
   - When using lathes with a 7/8-inch spindle arbor, use the *J 37160-50* with the *J 37160-A.*
   - The *J 37160-50* is not required with lathes using a 1–inch spindle arbor.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Mount the rotor onto the *J 37160-A*
   - Mount the clamp plate to the rotor using the enclosed bolts/screws.
   - The rotor may be installed and removed while the *J 37160-A* is mounted on the machine spindle.

   Tighten

   Tighten the rotor mounting adapter nuts in a cross pattern to 34 N·m (23 lb ft).
5. Install the anti-chatter silencer onto the rotor.
6. Set the spindle speed to approximately 150 RPM (or mid-range).
7. While the machine is running, bring the tool bit up and touch off.
   - Stop the machine.
   - Inspect the witness mark. If the witness mark goes ¾ of the way around, the rotor is mounted properly.
   - Continue turning the rotor using normal methods in order to resurface the rotor.
8. If the witness mark does not go ¾ of the way around, repeat the above steps.

Nondirectional Finishing

Ensure that the rotor surface is nondirectional by dressing the rotor surfaces. Use a non-directional rotor finisher such as the 54–433179 Non-Directional Rotor Refinisher listed in the GM Dealer Equipment Catalog, or a suitable equivalent.

If the brake lathe is not equipped with an adequate nondirectional finishing tool, use a sanding block with 150 grit aluminum oxide sandpaper.

After the rotor has been sanded, clean each surface with denatured alcohol or a suitable brake cleaner.

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.

Important: Replace any rotor that does not meet the minimum thickness specification recommended by the manufacturer. Do not resurface new brake rotors. New brake rotors are manufactured with the proper surface finish.

The finished rotor surface should be as close as possible to that of a new rotor. Failure to obtain the best possible rotor finish may affect braking performance.

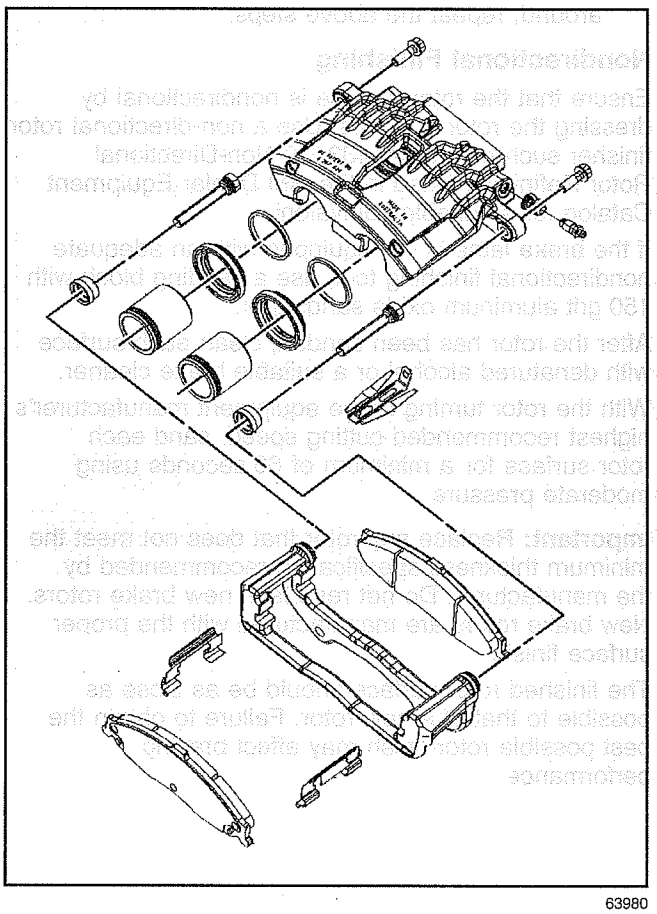
Description and Operation

Disc Brakes System Description (Front)

Front Brake Rotor

The front brake rotor is a machined, cast iron ventilated rotor. The rotor is cast with cooling fins between the friction surfaces. The internal fins or vanes radiate from the center of the rotor to the outer edge of the rotor. This design enables the rotor to act as its own cooling fan.

Front Brake Caliper



63980

The aluminum dual piston front caliper used on this vehicle is mounted onto the front brake caliper mounting plate, and ultimately to the steering knuckle. Applying the brake pedal creates hydraulic pressure. This pressure exerts equally against the bottom of the pistons and against the bottom of the cylinder bores. The pressure applied to the pistons transmits to the inner pad and forces the pad against the inner rotor surface. The pressure applied to the bottom of the cylinders forces the caliper to slide in the caliper bolt bushings toward the center of the vehicle. This movement forces the outer section of the caliper against the back of the outer pad and presses the pad against the outer rotor surface. As hydraulic pressure builds, the pads press against the rotor surface with increasing force. The increasing force causes the vehicle to stop. In addition, it is this sliding action that allows a disc brake caliper to compensate for wear of the inner and outer pads. If upon inspection, it is found that one pad is significantly thicker or thinner than its counterpart, it would be an indication that the caliper is not sliding freely, and therefore not self-adjusting as it is should.

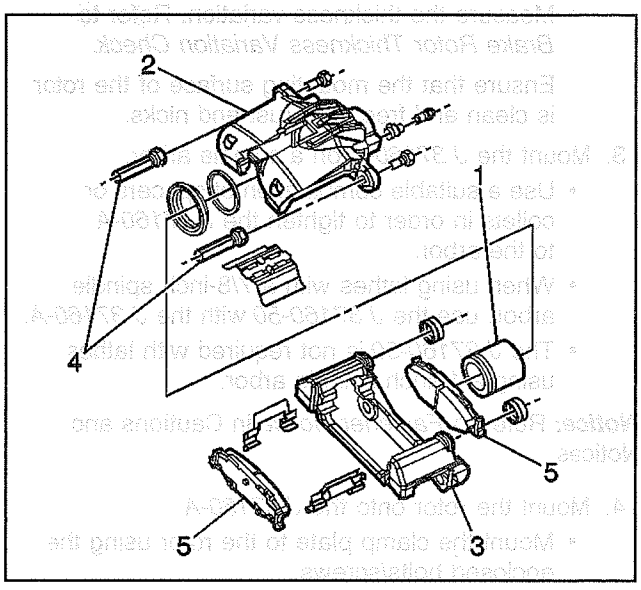
The brake caliper piston seals, while sealing the hydraulic circuit at the wheels, have a second function. These seals while firmly mounted in their channels, do distort very slightly under brake actuation. When the brakes are applied, the movement of the pistons out of the caliper bores distort the piston seals. When the brake pedal is released, the piston returns only as far as the seal was distorted. While this distortion of the seal shape is very minimal, it is enough to allow the brake pads to retract very slightly so as to eliminate any significant drag of the brakes.

Disc Brakes System Description (Rear)

Rear Brake Rotor

The rear brake rotor is a composite cast iron ventilated rotor. The rear brake rotor has a stamped sheet metal flange which is insert cast. The internal fins or vanes between the friction surfaces radiate from the center of the rotor to the outer edge of the rotor. This design enables the rotor to act as its own cooling fan.

Rear Brake Caliper



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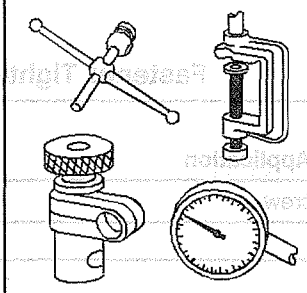
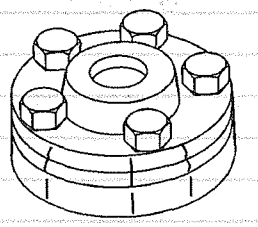
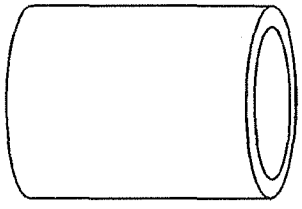
The rear brake caliper has a single piston (1) in an aluminum housing (2). The housing is suspended in an anchor bracket (3) on two guide pins (4). The caliper mounts to the steering knuckle with two mounting bolts. Applying the brake pedal creates hydraulic pressure. This pressure exerts equally against the bottom of the piston and against the bottom of the cylinder bore. The pressure applied to the piston transmits to the brake pads (5). The brake pads clamp down on the rotor, creating friction in order to stop the car.

Application of the parking brake causes the following components to move outward:

- The pushrod (23)
- The actuating collar (10)
- The clamp rod (19)

The outward motion of the above components causes the caliper to move inward. Inward motion of the caliper forces the brake pads against the rotor in order to hold the vehicle in place. The parking brake mechanism is completely independent of the hydraulic braking system.

Special Tools and Equipment

Illustration	Tool Number/ Description
 2014	J 8001 Dial Indicator Set
 155093	J 37160-A Brake Rotor Mounting Adapter
 180911	J 37160-50 Brake Rotor Mounting Adapter Arbor

Park Brake

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Park Brake Indicator Switch Screw	2.8 N·m	25 lb in
Park Brake Lever Bolt	12 N·m	106 lb in

GM SPO Group Numbers

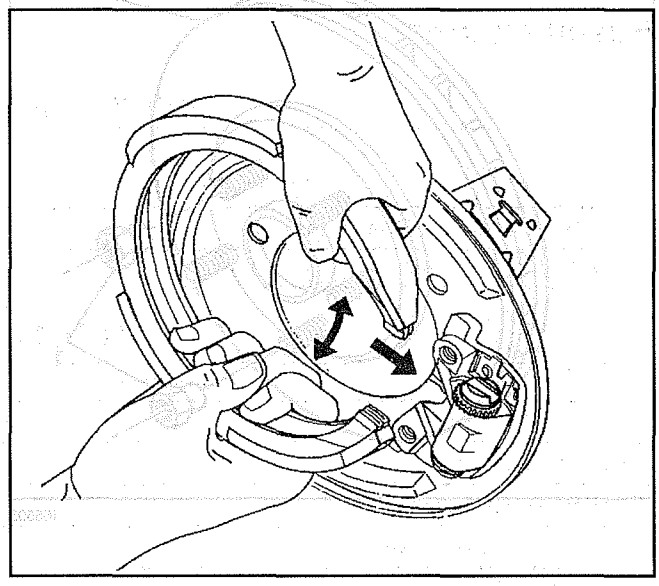
Application	GM SPO Group Number
Backing Plate	5.000
Park Brake Actuator	4.000
Park Brake Cable (Front)	4.000
Park Brake Cable (Rear)	4.000
Park Brake Drum	5.000
Park Brake Lever	4.000
Park Brake Shoe	5.000

Repair Instructions

Park Brake Shoe Replacement

Removal Procedure

1. Remove the brake rotor. Refer to *Brake Rotor Replacement (Rear)* in Disc Brakes.
2. Remove the parking brake shoe retaining clip and attaching screw.
3. Remove the parking brake shoe by sliding the brake shoe downward off tappet slot.



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Installation Procedure

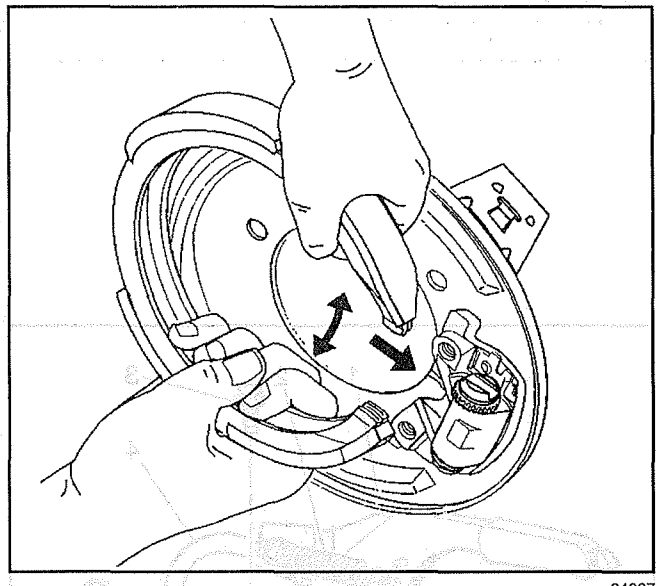
1. Turn the adjustable tappet until the tappet is seated against adjuster nut. Orient the slot radially (parallel with mounting flange).
2. Install the parking brake shoe by sliding the shoe upwards into the tappet slots.

Notice: Refer to *Fastener Notice* in a Cautions and Notices.

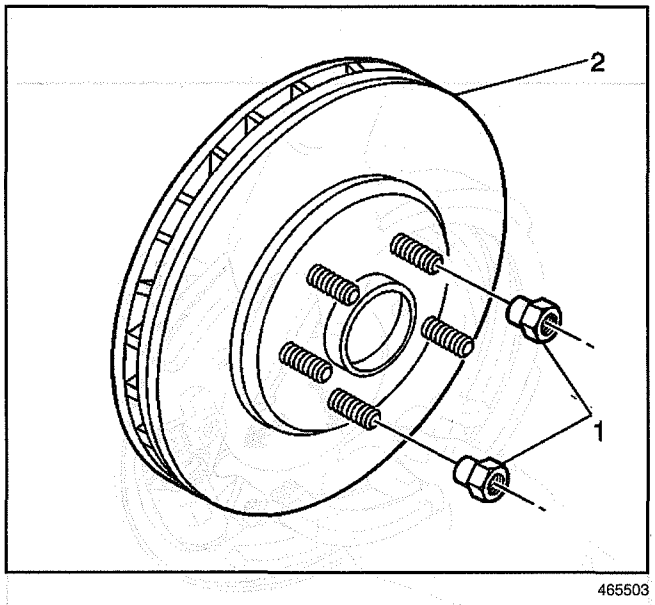
3. Install the parking brake shoe retaining clip and the attaching screw.

   Tighten

   Clip screw to 5 N·m (44 lb in).
4. Adjust the parking brake shoe to drum clearance. Refer to *Park Brake Shoe Adjustment.*
5. Install the brake rotor. Refer to *Brake Rotor Replacement (Rear)* in Disc Brakes.



64007



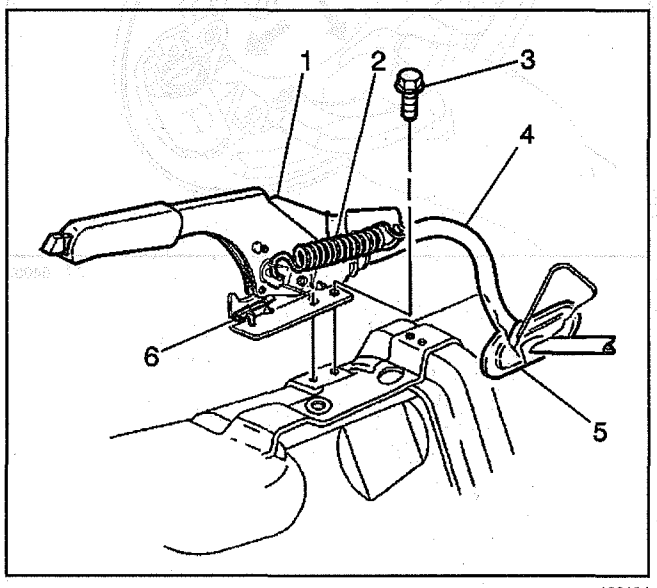
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Park Brake Shoe Adjustment

Important: Do not operate the park brake lever while the rotor is removed.

1. Remove the rear tires and wheels. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
2. Disconnect the rear cable from the brake shoe lever.
3. Pull on the lever until there is a firm stop. Release the lever and measure free lever travel at the cable interface. If the travel is less than 10 mm, adjustment is complete. If the travel is more than 10 mm, further adjust brake shoe.
4. Remove the brake rotor. Refer to *Brake Rotor Replacement (Rear)* in Disc Brakes.
5. Rotate the adjustment nut with a screwdriver in order to extend the slotted tappet in order to increase the gap between the adjuster nut and the screw by .38 mm.
6. Install the rotor onto the axle mounting flange.

   Ensure that the rotor is flush against the flange. Use two hand-tightened lugnuts (1) in order to keep the rotor (2) in position.
7. Measure the lever (free) travel per step 2. Repeat the adjuster in order to obtain the ideal 3–8 mm free travel of the brake shoe lever.
8. Check the rotor for drag. The rotor must rotate freely within the stud hole clearance.
9. Install rear tires and wheels. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.



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Park Brake Lever Replacement

Removal Procedure

Notice: Do not lubricate the parking brake cables. Lubrication may damage the plastic coating on the parking brake cables.

If the park brake lever does not adjust the cable, lubricate the following components using chassis lubricant or the equivalent:

- The adjust pawl pin
- The handle ratchet
- The adjusting ratchet

Tools Required

J 37043 Parking Brake Cable Release Tool

1. Remove the front floor console.

Important: If the park brake handle cannot be pulled up far enough in order to lift out console, then release handle and hold the adjuster pawl disengaged. The lever handle can then be pulled up further.

2. Disconnect the electrical connector from the park brake indicator switch (6).
3. With the park brake lever (1) in the up position, remove the park brake lever spring (2).

4. With the park brake lever (1) in the down position, rotate the adjuster arm toward the front of the vehicle until the adjuster arm stops.
5. On the adjuster ratchet, bend the tab at the barrel-shaped front cable end back in order to allow the cable strand to pass by.
6. Unhook cable front end button from adjuster ratchet.
7. Remove the barrel-shaped front cable end fitting from the adjuster track on the pulley.
8. Remove the park brake lever bolts (3) and the park brake lever (1) from the floor pan.
9. Use the *J 37043* in order to remove the park brake front cable (4) from the park brake lever (1) and remove the lever from vehicle.

Installation Procedure

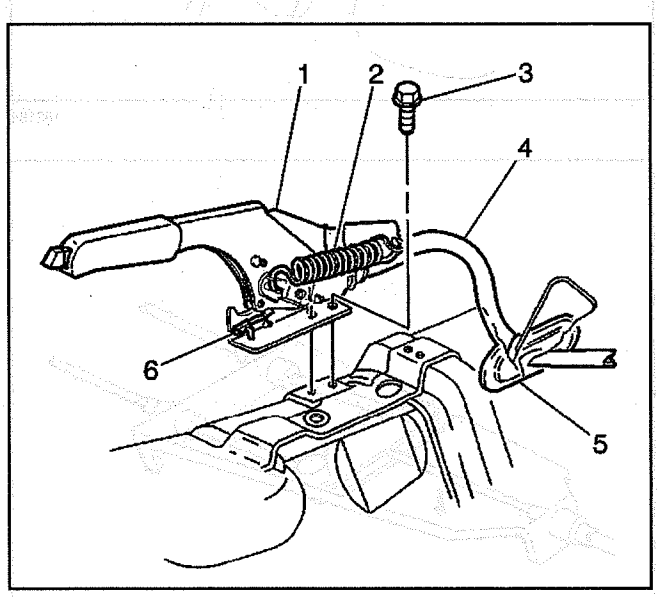
1. On the new park brake lever assemblies, pull the lever up to full travel. Remove the adjuster spring (2).
2. Push out the plastic shear pin.
3. Install the park brake front cable (4) to the park brake lever (1).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

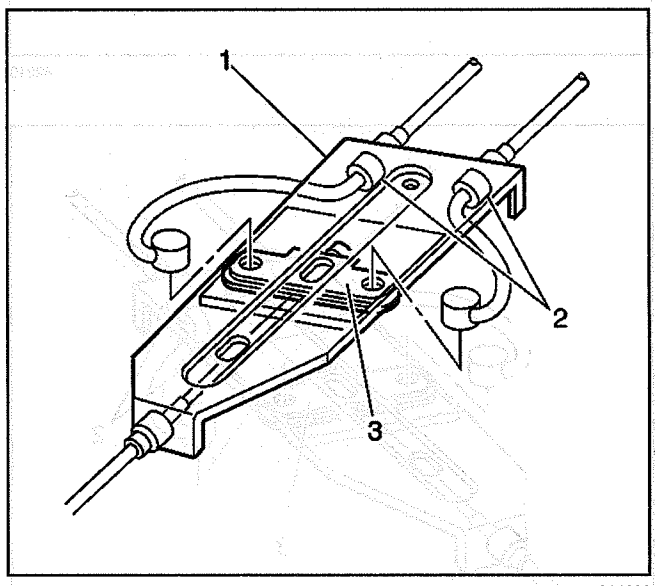
4. Install the park brake lever (1) and the park brake lever bolts (3) to the floor pan.

   Tighten

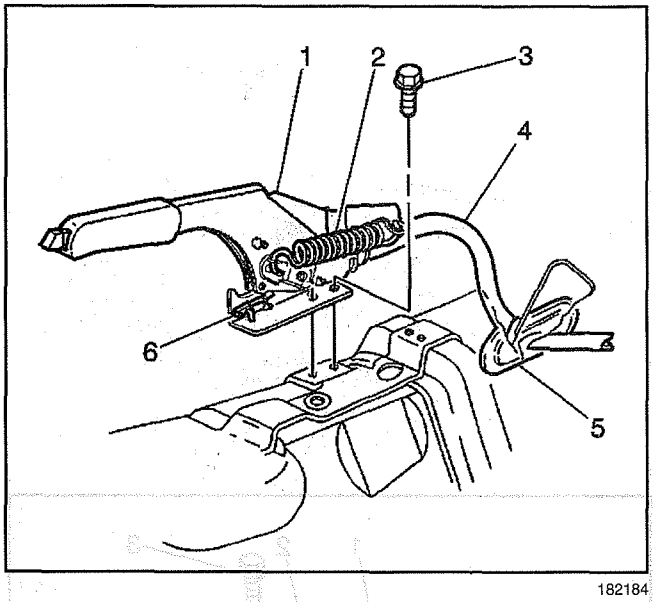
   Tighten the park brake lever bolts (3) to 12 N·m (106 lb in).
5. Connect the electrical connector to the park brake indicator switch (6).
6. With the park brake lever in the down position and adjuster pawl released, rotate the adjuster arm toward the front of the vehicle until the adjuster arm stops.
7. Connect the barrel-shaped front cable end fitting to the adjuster track on the pulley.
8. If the rear cables were not disconnected from the equalizer, skip to step 12.
9. Raise the vehicle. Suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
10. Connect the rear cables (2) to the equalizer (1).
11. Lower the vehicle.



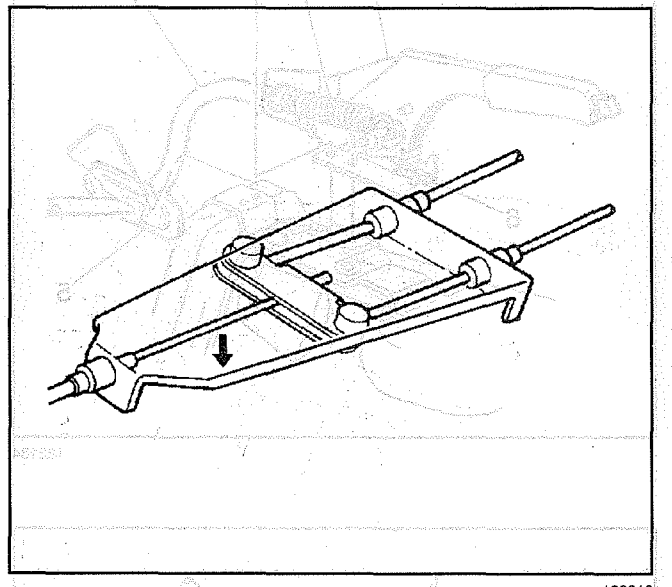
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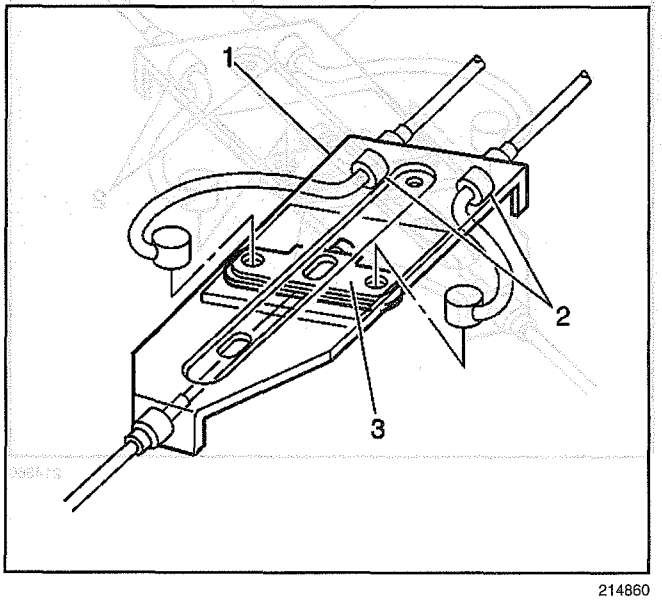
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12. Rotate the adjuster arm toward the rear of the vehicle and completely raise the park brake lever (1).
13. Install the park brake adjuster spring (2).
14. Cycle the park brake lever 3 times.
15. Install the front floor console.

Park Brake Cable Replacement (Front)

Removal Procedure

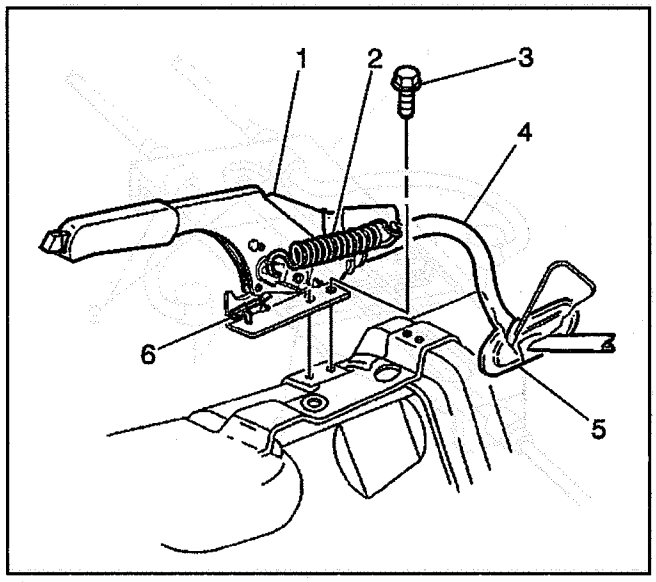
Tool Required

J 37043 Parking Brake Cable Release Tool

Notice: Use care when performing service operations on or around parking brake cables. 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.

1. Ensure that the park brake hand lever is in the down position in order to disengage the adjuster pawl.
2. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Pull down on the front cable strand until the strand stops and stays extended.
4. Remove the rear cables (2) from the equalizer (3).
5. Use the *J 37043* in order to remove the fitting of the park brake front cable from the bracket.

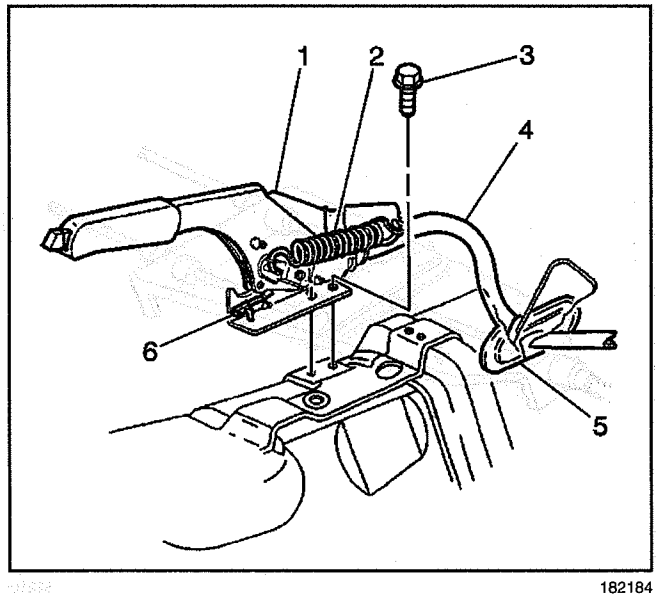
6. Remove the cable grommet from the underbody cavity.
7. Lower the vehicle.
8. Remove the front floor console.
9. Remove the park brake spring (2) while the park brake lever is in the up position.
10. With the park brake lever (1) in the down position, rotate the adjuster arm toward the front of the vehicle until the adjuster arm stops.
11. On adjuster ratchet, bend tab at barrel-shaped front cable end back in order to allow the cable strand to pass by.
12. Remove the barrel-shaped front cable end fitting from the adjuster track on the pulley.
13. Use the *J 37043* in order to remove the park brake front cable (4) from the park brake lever (1).
14. Remove the park brake front cable (4) from the floor plan.



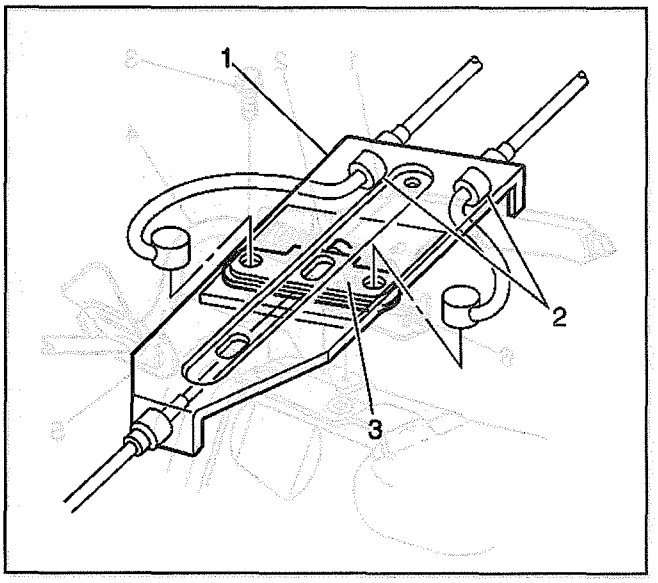
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Installation Procedure

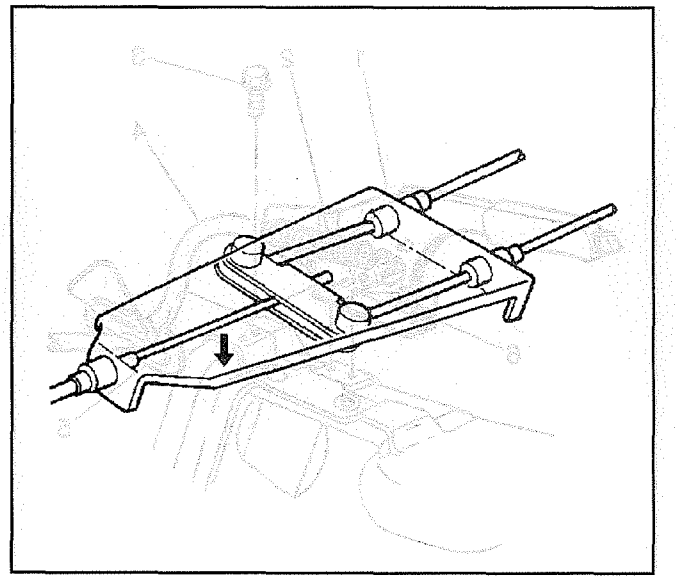
1. Install the park brake front cable (4) and the grommet (5) into the slot in the floor pan. Use the following procedure in order to install the grommet into the floor pan:
   1.1. Use soapy water as a lubricant.
   1.2. Feed the forward end of the grommet (5) into the slot.
   1.3. Use a small, curved, flat-ended pry bar in order to gently press the rearward end of the grommet (5) into the slot.
   1.4. Ensure that the grommet (5) is properly seated in the slot in the floor pan.
2. Connect the front park brake cable (4) to the park brake lever (1).
3. Install the barrel-shaped front cable end fitting into the adjuster track on the pulley.
4. Rotate the adjuster arm toward the rear of the vehicle and install the adjuster spring.
5. Ensure that the park brake lever (1) is in the down position.
6. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.



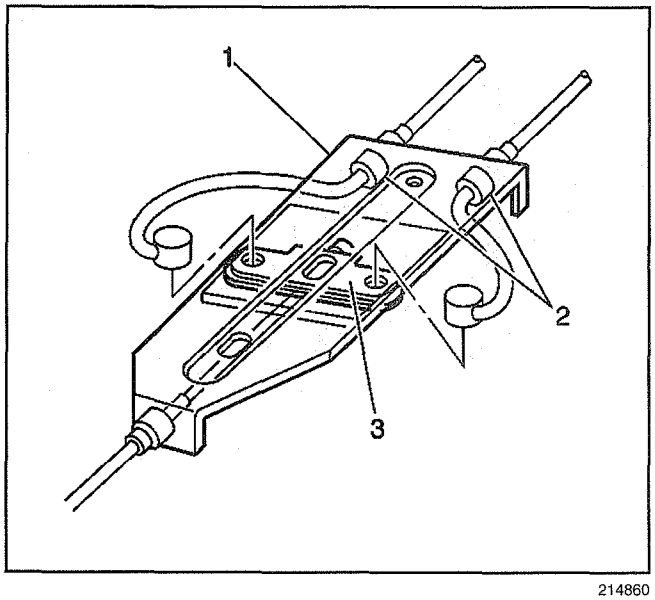
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7. Connect the rear fitting of the front cable conduit to the floor panbracket (1).
   - Pull the equalizer (3) back until the equalizer stops.
   - Connect the rear cables (2) to the equalizer (3).
8. Lower the vehicle.
9. Cycle the park brake lever (1) three times.
10. Install the front floor console.

Park Brake Cable Replacement (Rear)

Removal Procedure

Tools Required

J 37043 Parking Brake Cable Release Tool

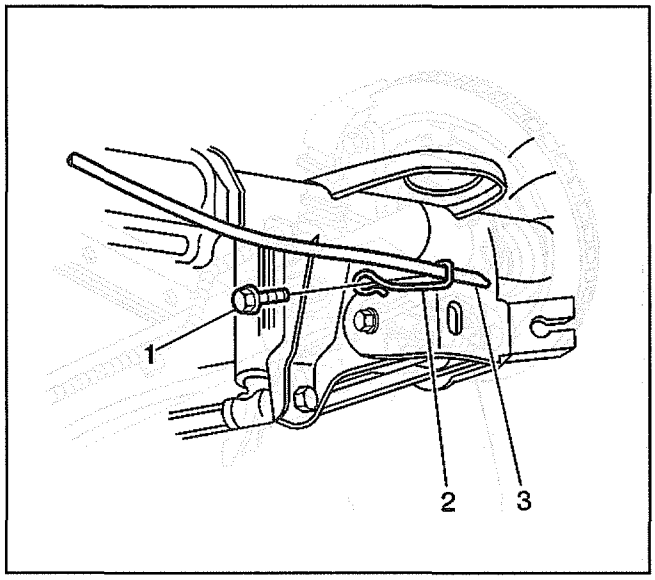
1. Fully disengage the park brake lever. Ensure that the handle is down and that the brake indicator lamp is not lit.

Important: If the park brake lever is partially engaged, you will not be able to pull the equalizer rearward later in this procedure.

2. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Pull down on the front cable strand until the strand stops and stays extended.
4. Cut off the tie strap.
5. Remove the rear cable from the underbody bracket.

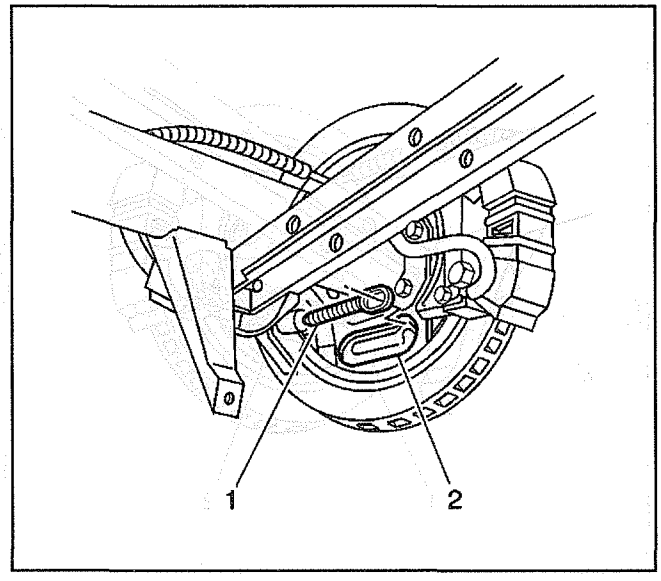
   Use the *J 37043* in order to compress the retainer fingers on the casing and pull the rear cable from the underbody bracket.
6. Remove the rear park brake cables (2) from the park brake cable equalizer (3).

7. Pull the park brake rear cable (3) through the guides (2) that are installed on the rear axle housing.



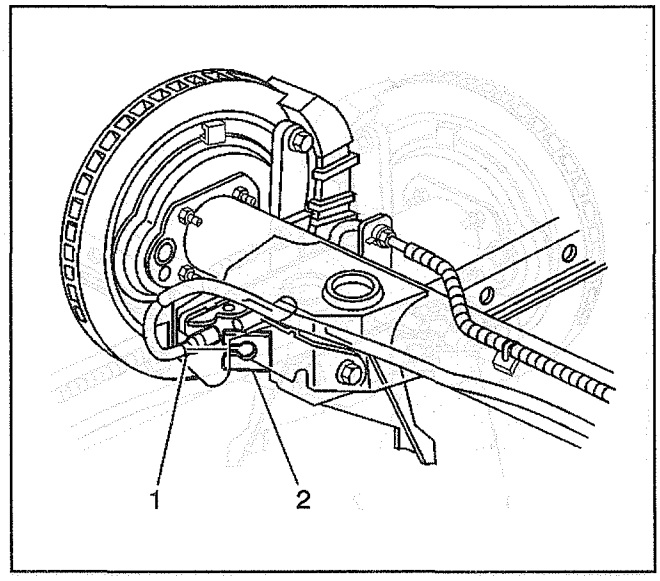
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8. Unhook the rear cable eyelet (1) from the park brake actuator lever (2).

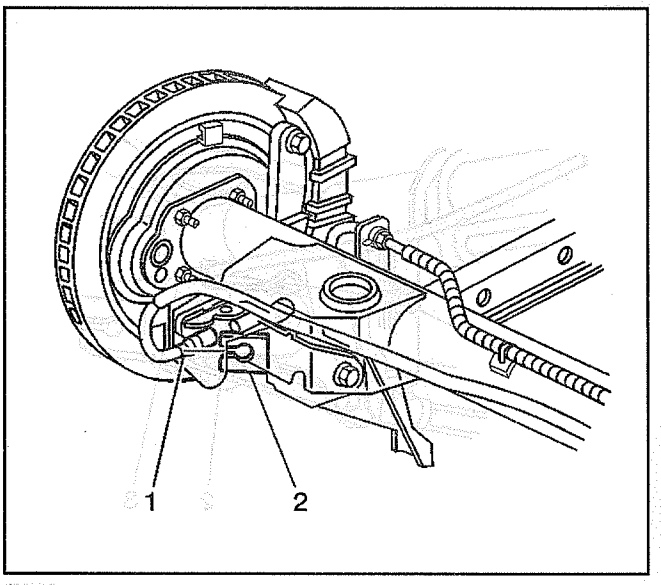


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9. Use the *J 37043* in order to compress the retainer fingers on the conduit fitting (1) and pull the rear cable from the cable bracket (2).



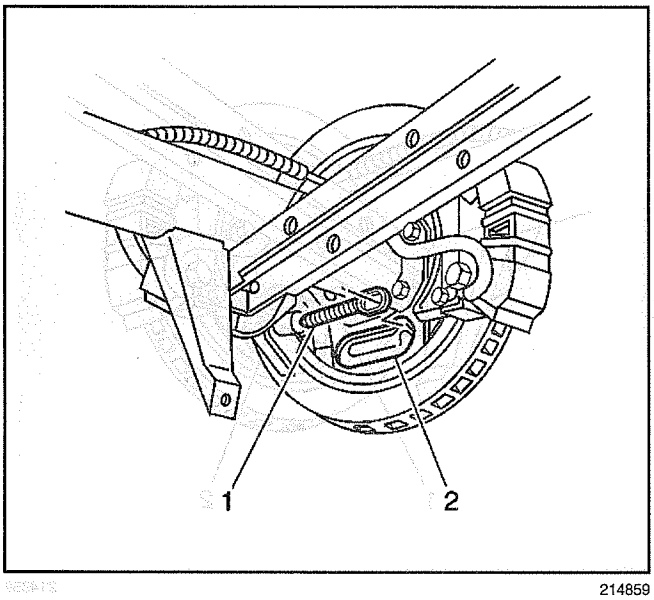
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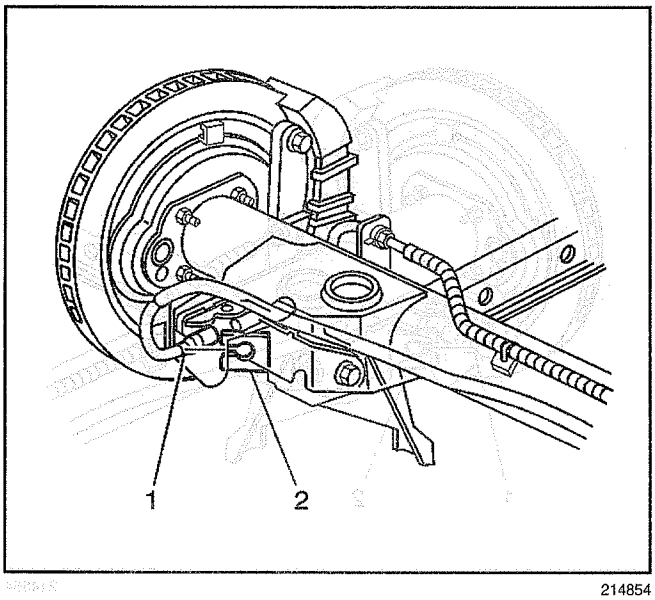
Installation Procedure

1. Install the rear (1) conduit fitting to the park brake cable bracket (2).



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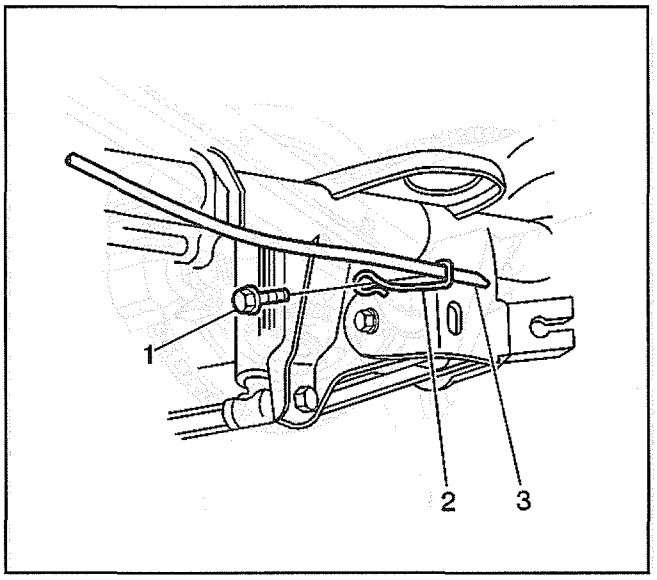
2. Install the rear cable eyelet (1) to the park brake actuator lever (2).



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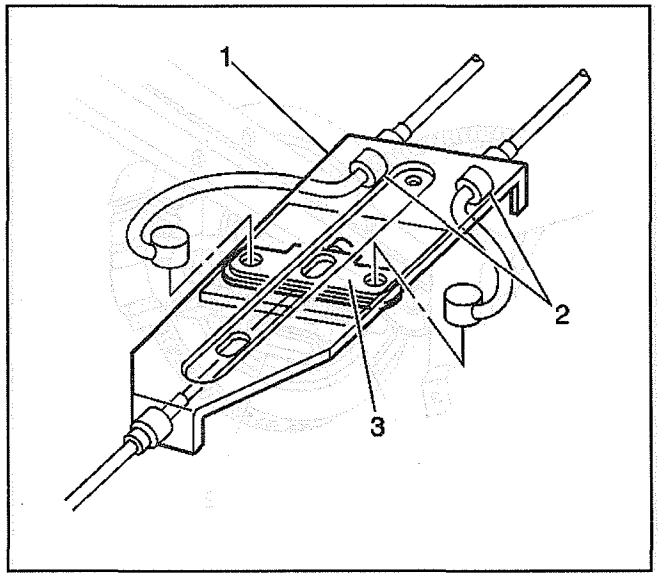
3. Seat the retainer fingers into the park brake cable bracket (2).

4. Pull the rear cable (3) through the park brake cable guides (2) on the rear axle housing. Ensure that the LH cable is routed over the tie rod bracket.



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5. Connect the rear park brake cable to the park brake cable equalizer (3).
6. Install the rear cable (2) into the underbody bracket (1).
   If the tie strap was removed, install a new tie strap.
7. Lower the vehicle.
8. Cycle the park brake lever 3 times.

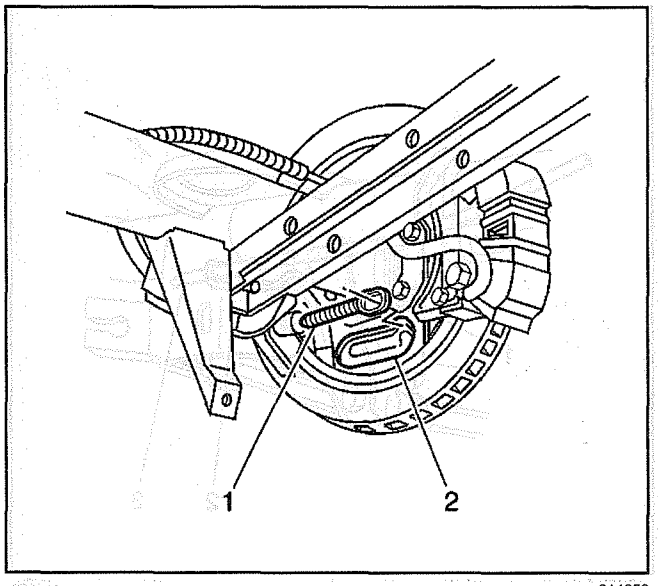


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Brake Drum Inspection

Refinishing Rear Brake Rotor Parking Brake Surface

The rear brake rotor parking brake contact surface should not be refinished. If the parking brake system can't effectively hold the vehicle, and all other parking brake components are functioning properly, replace the rotor. In addition, If the parking brake surface is excessively scored (vehicle driven with parking brake on), replace the rotor.

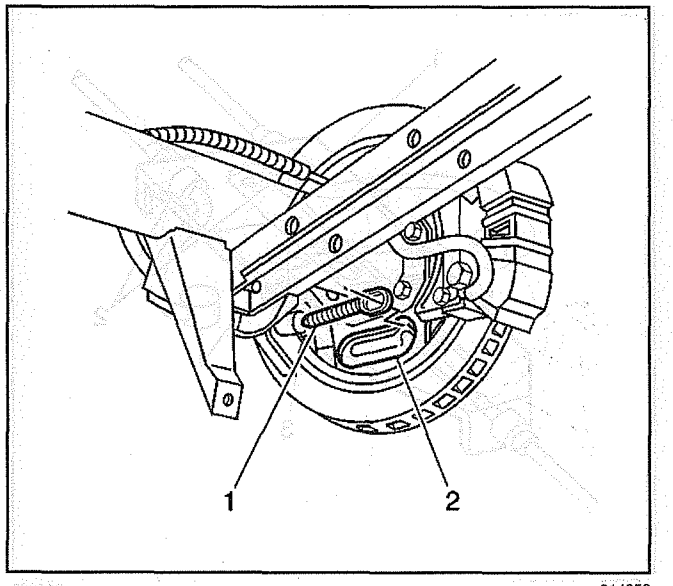


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Backing Plate Replacement

Removal Procedure

1. Unhook the rear cable eyelet (1) from the park brake actuator lever (2).
2. Remove the parking brake shoe. Refer to *Park Brake Shoe Replacement*.
3. Remove the parking brake actuator. Refer to *Park Brake Actuator Replacement*.
4. Remove the brake backing plate bolts.
5. Remove the brake backing plate from the axle.



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Installation Procedure

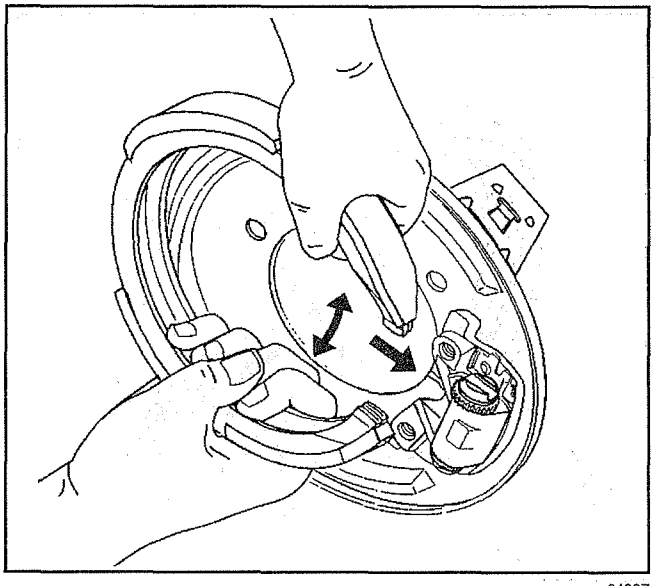
1. Install the brake backing plate to axle.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the brake backing plate bolts.

   Tighten

   Tighten the brake backing plate bolts to 58 N·m (43 lb ft).
3. Install the parking brake actuator. Refer to *Park Brake Actuator Replacement*.
4. Install the parking brake shoe. Refer to *Park Brake Shoe Replacement*.
5. Hook the rear cable eyelet (1) onto the park brake actuator lever (2).



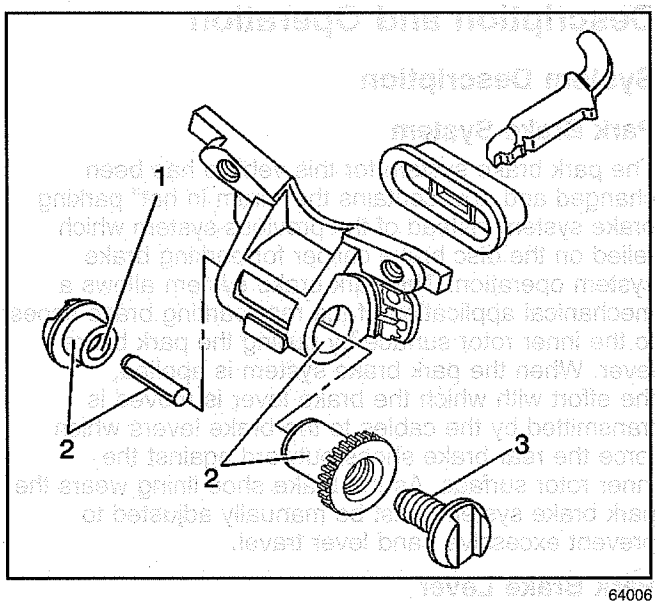
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Park Brake Actuator Replacement

Removal Procedure

1. Remove the parking brake shoe. Refer to *Park Brake Shoe Replacement*.

2. Move the brake lever back and forth in order to push out the tappets (2).
3. Pull out the following components:
   - The tappets (2)
   - The pin (3)
   - The lever (4)



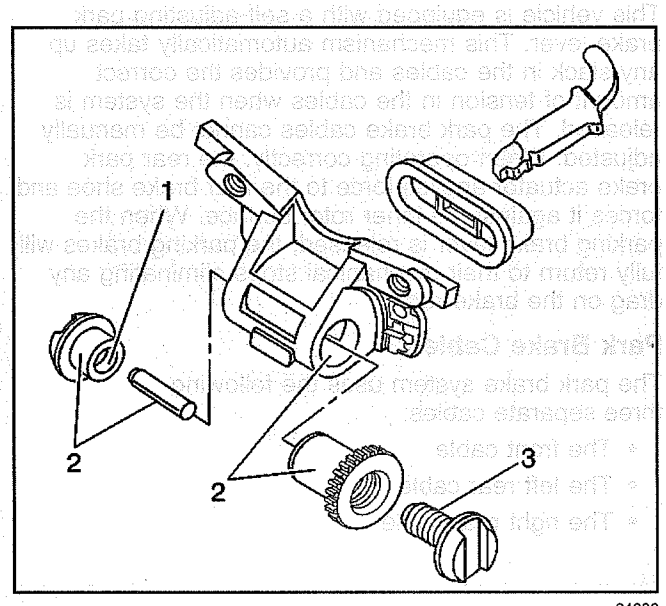
64006

Installation Procedure

1. Push the brake lever into the housing.
2. Apply grease to positions 1, 2, and 3.

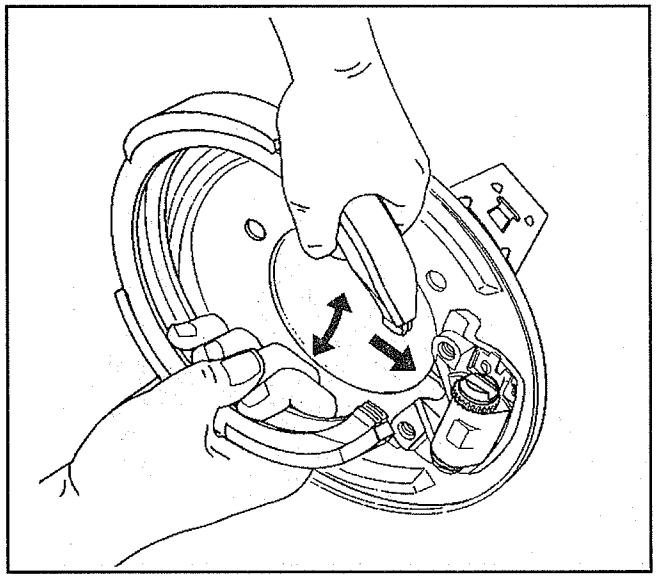
Important: Check operation by pinching the tappets together and moving the brake lever. One or both tappets must extend. With the tappets pinched together, the brake lever must feel firmly seated. You must not be able to pull out the lever.

3. Install the pin and the tappets (2 and 3).



64006

4. Install the parking brake shoe. Refer to *Park Brake Shoe Replacement.*


64007

Description and Operation

System Description

Park Brake System

The park brake system for this vehicle has been changed and now contains the "drum in hat" parking brake system instead of the previous system which relied on the disc brake caliper for parking brake system operation. The park brake system allows a mechanical application of the rear parking brake shoes to the inner rotor surface by pulling the park brake lever. When the park brake system is applied, the effort with which the brake lever is moved is transmitted by the cables to the brake levers which force the rear brake shoes outward against the inner rotor surface. As the brake shoe lining wears the park brake system must be manually adjusted to prevent excessive hand lever travel.

Park Brake Lever

This vehicle is equipped with a self-adjusting park brake lever. This mechanism automatically takes up any slack in the cables and provides the correct amount of tension in the cables when the system is released. The park brake cables cannot be manually adjusted. When operating correctly, the rear park brake actuator applies force to the rear brake shoe and forces it against the inner rotor surface. When the parking brake lever is released, the parking brakes will fully return to their mechanical stops eliminating any drag on the brake rotor.

Park Brake Cables

The park brake system uses the following three separate cables:

- The front cable
- The left rear cable
- The right rear cable

The left and right rear cables are joined to the front cable at the park brake cable equalizer. This vehicle is equipped with coated park brake cables. The cable is coated with a plastic material which slides over the plastic seals inside the conduit end fittings. The plastic material coating is for corrosion protection, and reduced park brake effort.

BRAKE Warning Lamp

- The red BRAKE warning lamp illuminates when the ignition switch is in the START position and the park brake lever is applied or is not fully released.
- The park brake warning switch is located on the park brake lever.
- The park brake lever will ground the BRAKE warning lamp circuit and cause the BRAKE warning lamp to illuminate.

Special Tools and Equipment

Illustration	Tool Number/Description
 157368	J 37043 Parking Brake Cable Release Tool

Antilock Brake System

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Pipe Fittings At Brake Pressure Modulator Valve (BPMV)	15 N·m	11 lb ft
Brake Pressure Modulator Valve Bracket Bolt/Nut	10 N·m	7 lb ft
Brake Pressure Modulator Valve Bracket Nut to Brake Pressure Modulator Valve	12 N·m	8 lb ft
Electronic Brake and Traction Control Module (EBCM/EBTCM) to Brake Pressure Modulator Valve Bolt/Screw	2.9 N·m	26 lb in
Wheel Speed Sensor Mounting Bolt	10 N·m	89 lb in
Adjuster Assembly Attaching Nuts	25 N·m	19 lb ft

ABS Diagnostic Specifications

WSS Temperature vs. Sensor Resistance

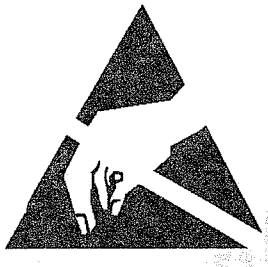
Sensor	°C	°F	Ohms
Front Wheel Speed Sensor	-34 to 4	-30 to 40	800 to 1100
Front Wheel Speed Sensor	5 to 43	41 to 110	950 to 1300
Front Wheel Speed Sensor	44 to 93	111 to 200	2250 to 3280
Rear Wheel Speed Sensor	-34 to 4	-30 to 40	2032 to 3107
Rear Wheel Speed Sensor	5 to 43	41 to 110	2417 to 3615
Rear Wheel Speed Sensor	44 to 93	111 to 200	2812 to 4266

GM SPO Group Numbers

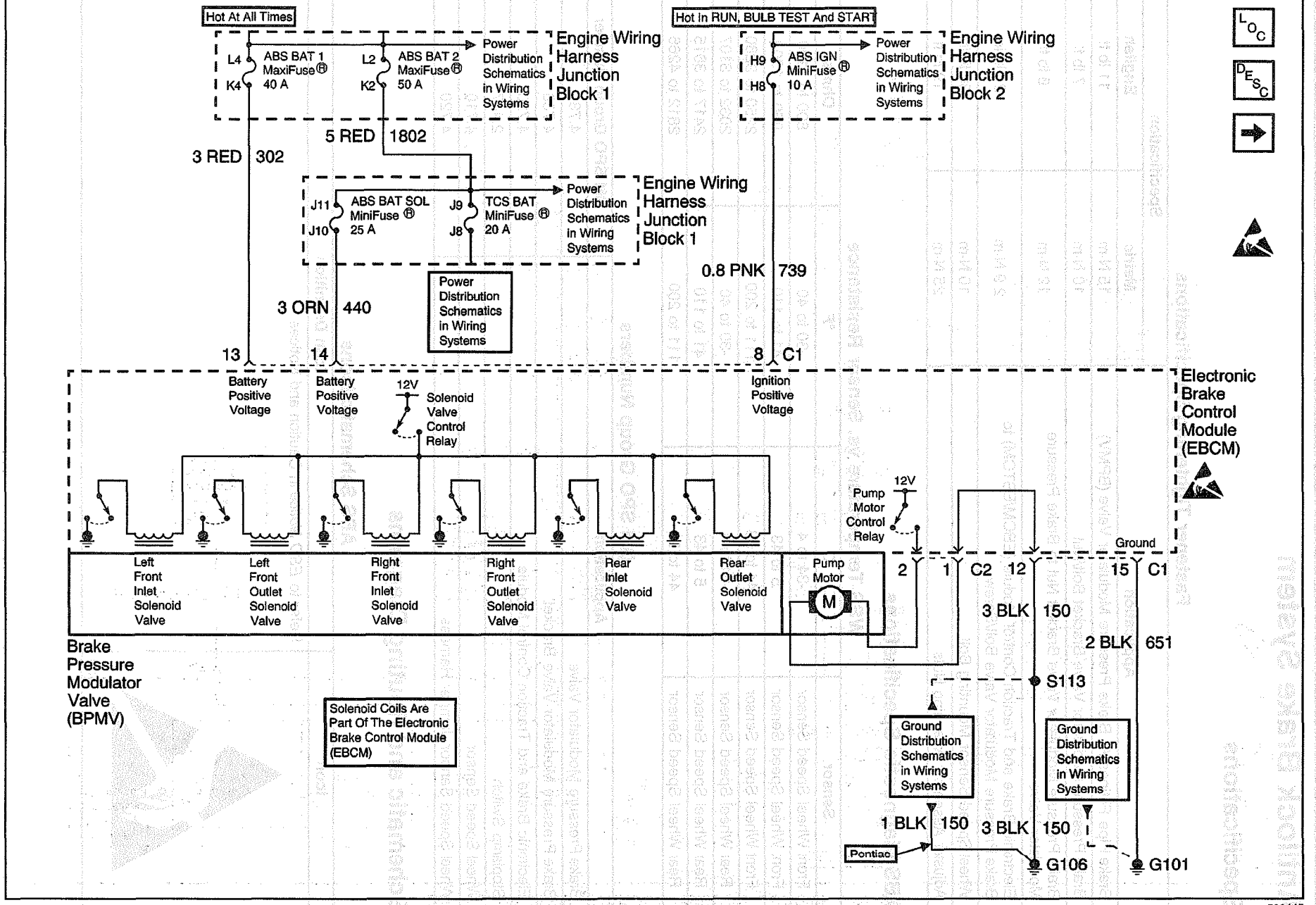
Application	GM SPO Group Number
Brake Pressure Modulator Valve	4.730
Brake Pressure Modulator Valve Bracket	4.730
Electronic Brake and Traction Control Module	4.720
Stoplamp Switch	2.447
Wheel Speed Sensor	4.710
Wheel Speed Sensor Jumper Harness	4.720

Schematic and Routing Diagrams

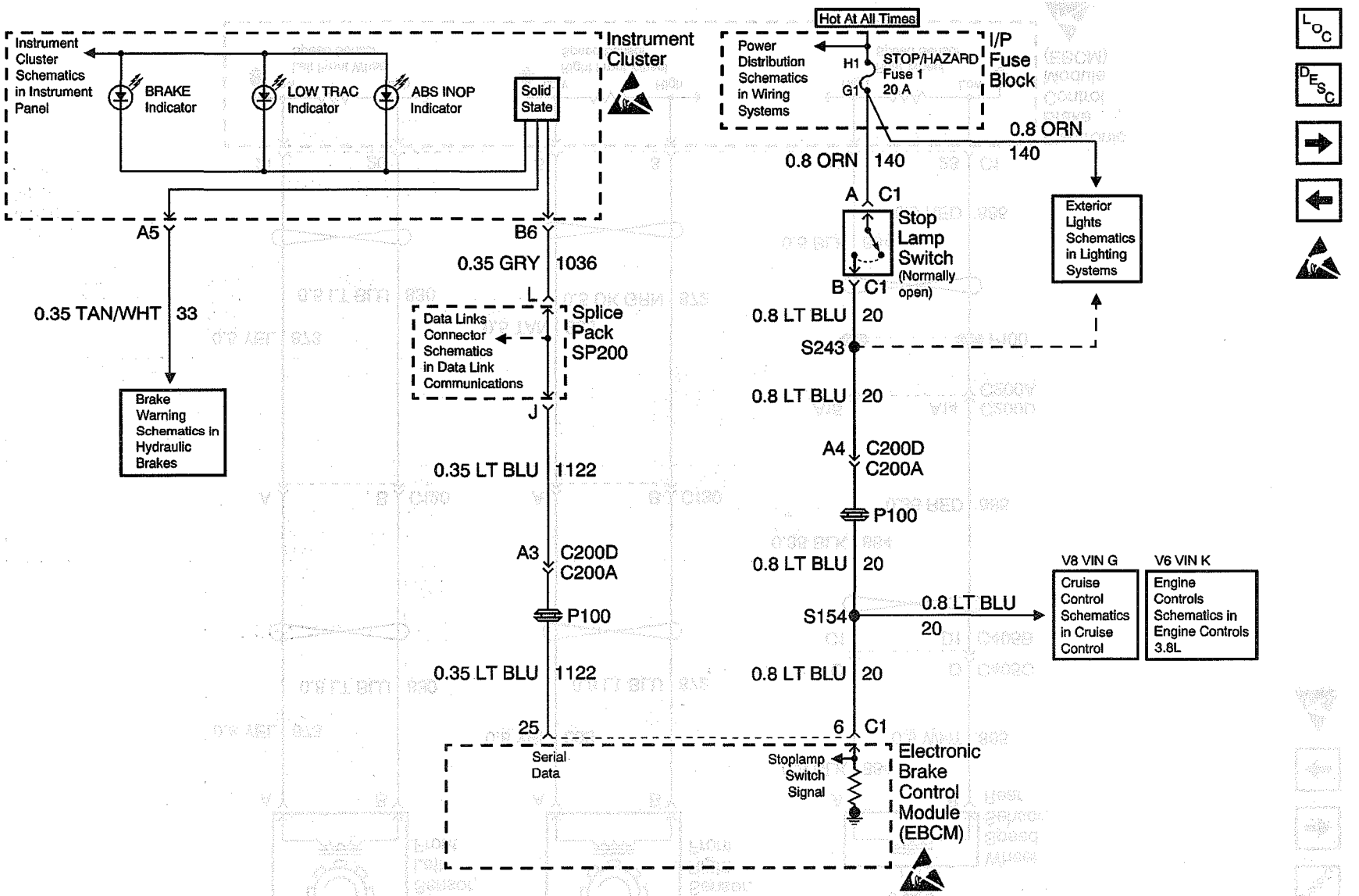
ABS Schematic Icons

Icon	Icon Definition
 19384	Refer to *ESD Notice* in Caution and Notices.

ABS Schematics (Without Traction Control 1 of 3)

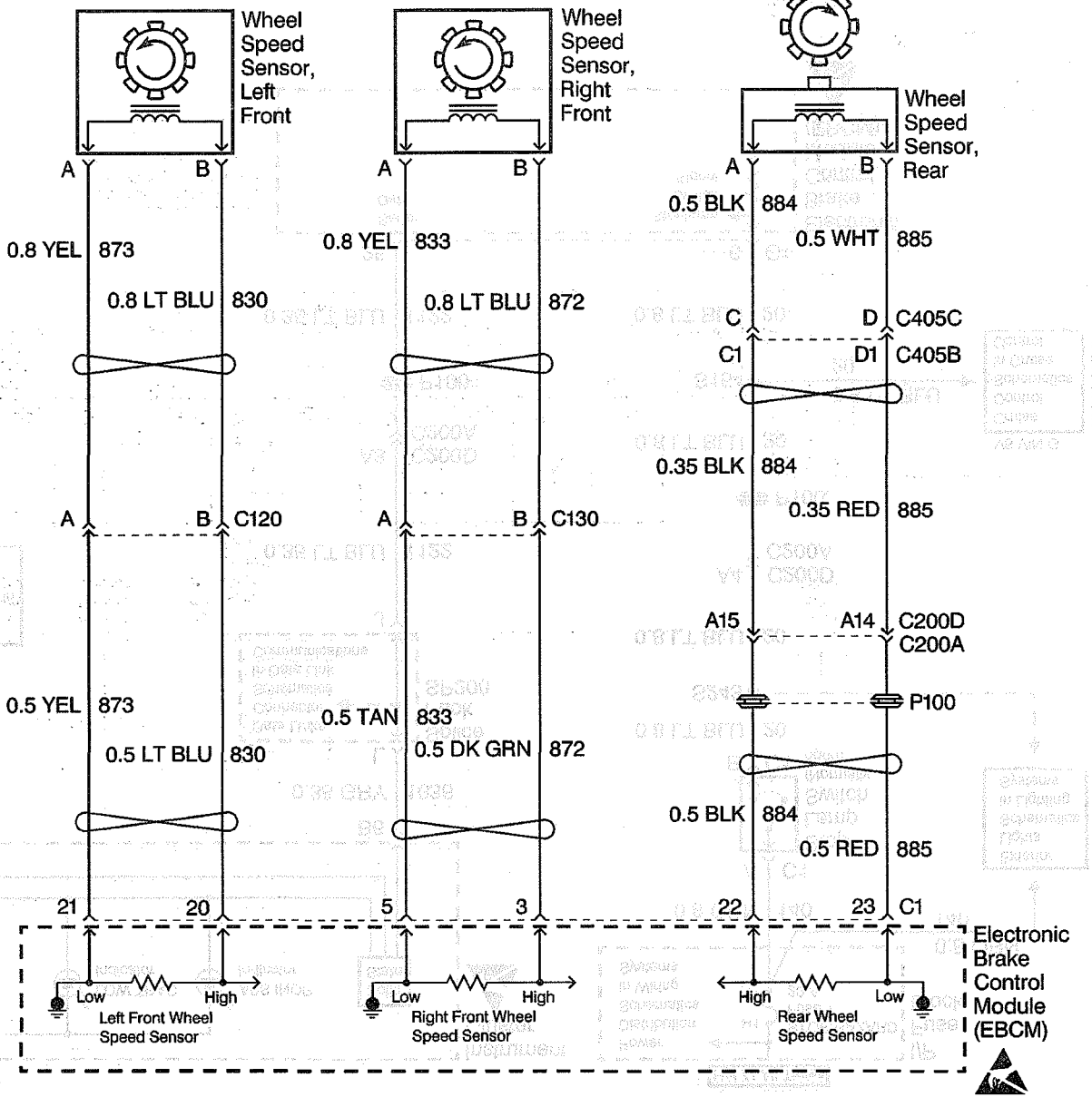


ABS Schematics (Without Traction Control 2 of 3)



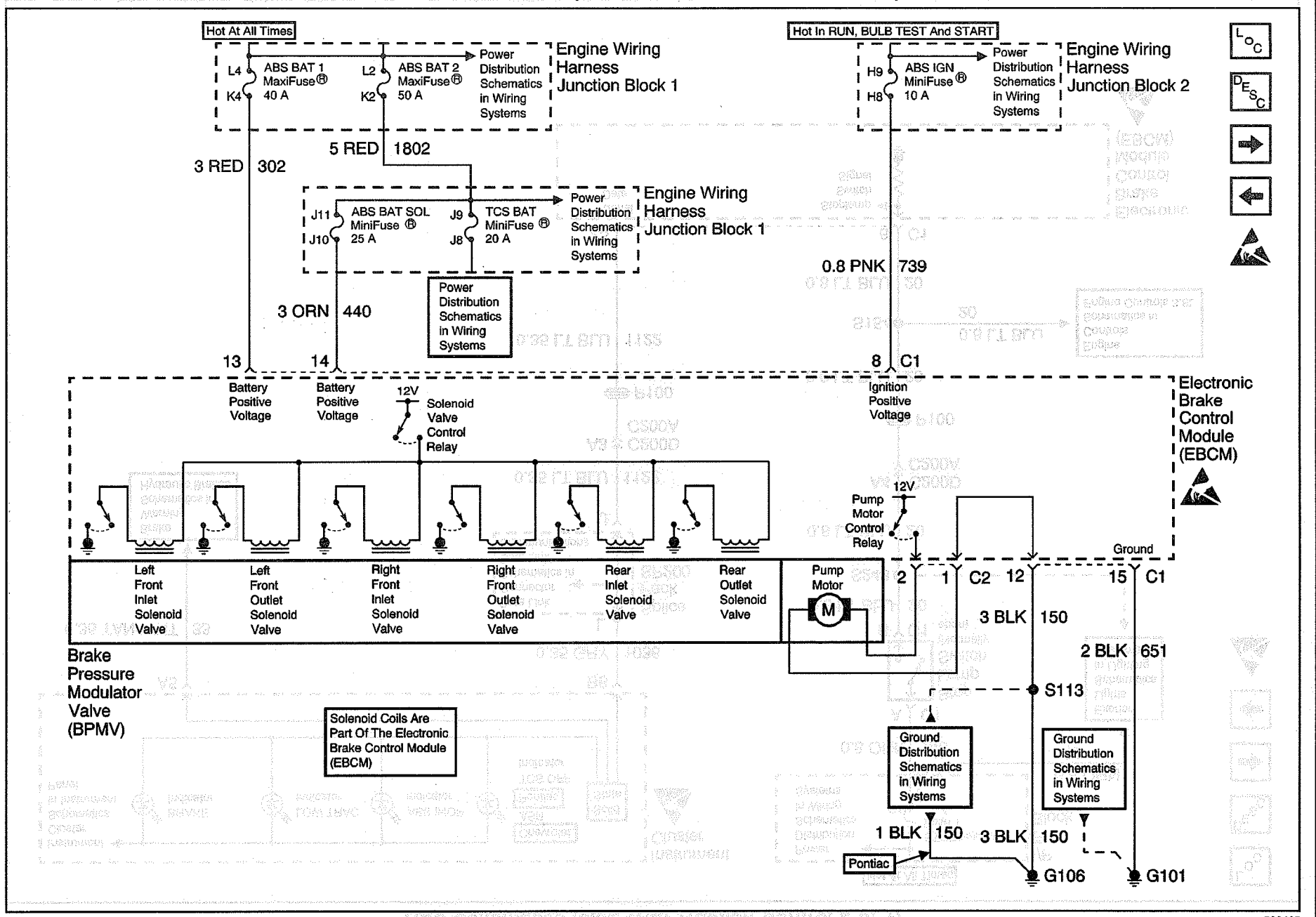
500456

ABS Schematics (Without Traction Control 3 of 3)



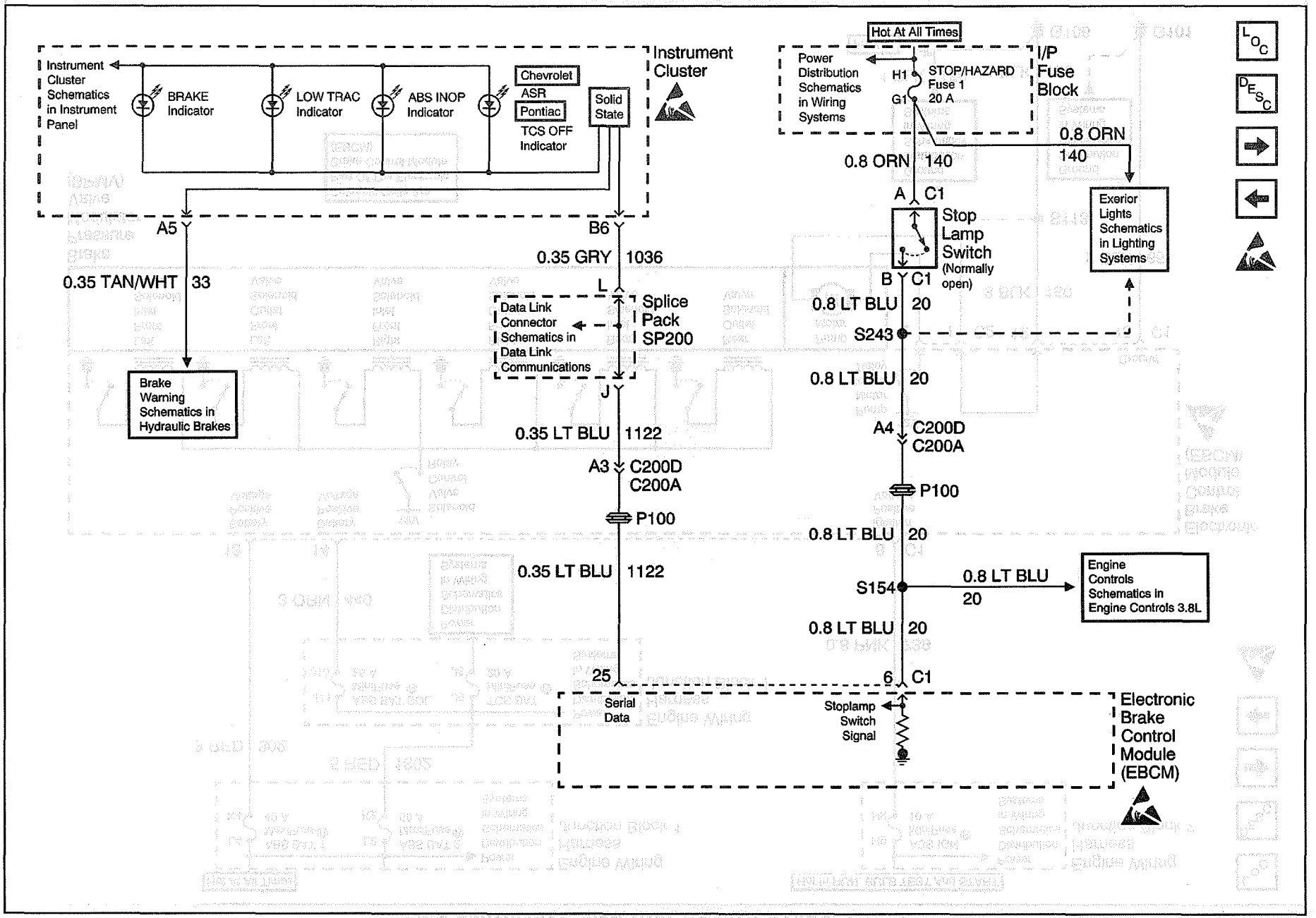
500462

ABS Schematics (3.8L With Traction Control 1 of 4)

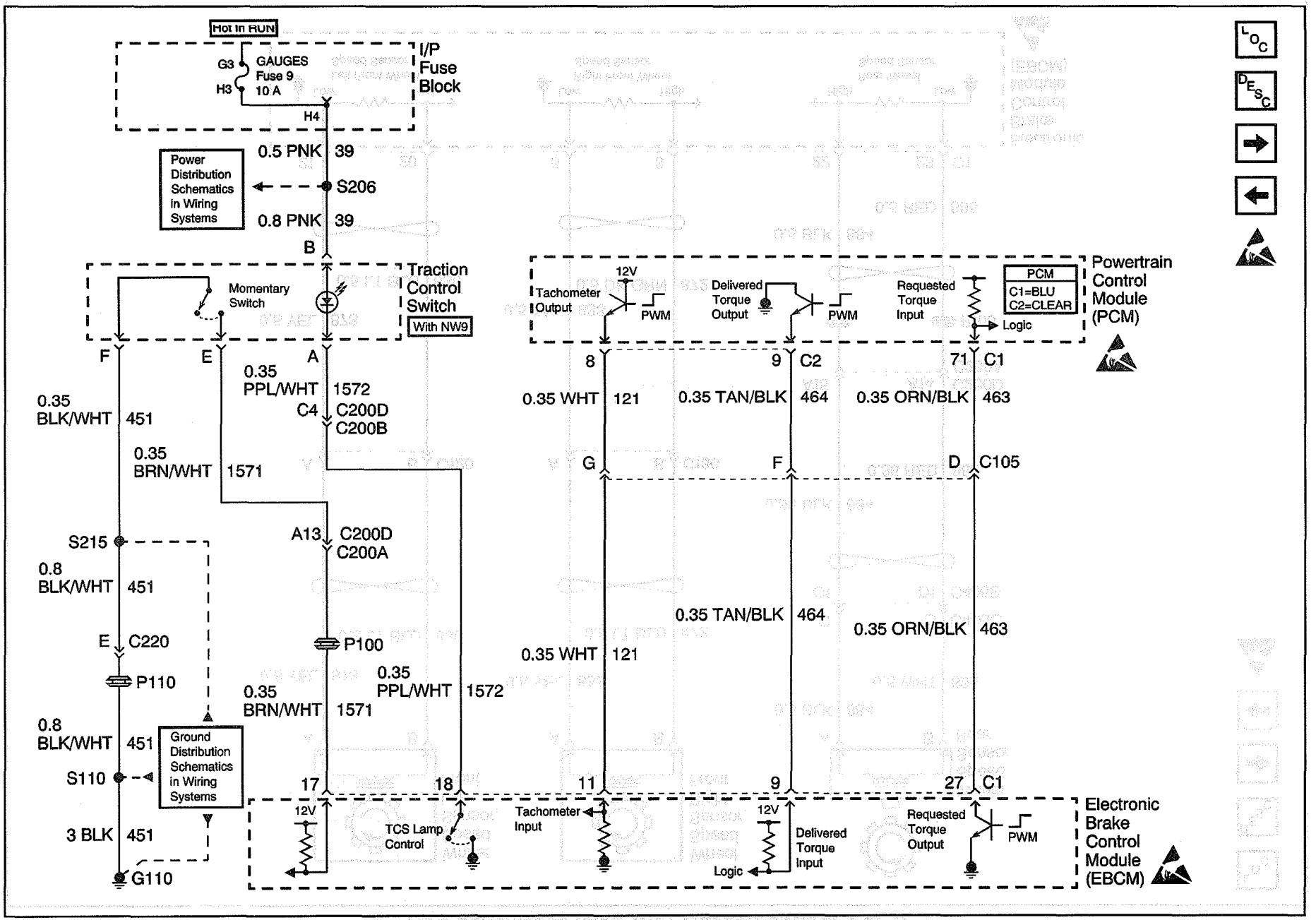


500465

ABS Schematics (3.8L With Traction Control 2 of 4)

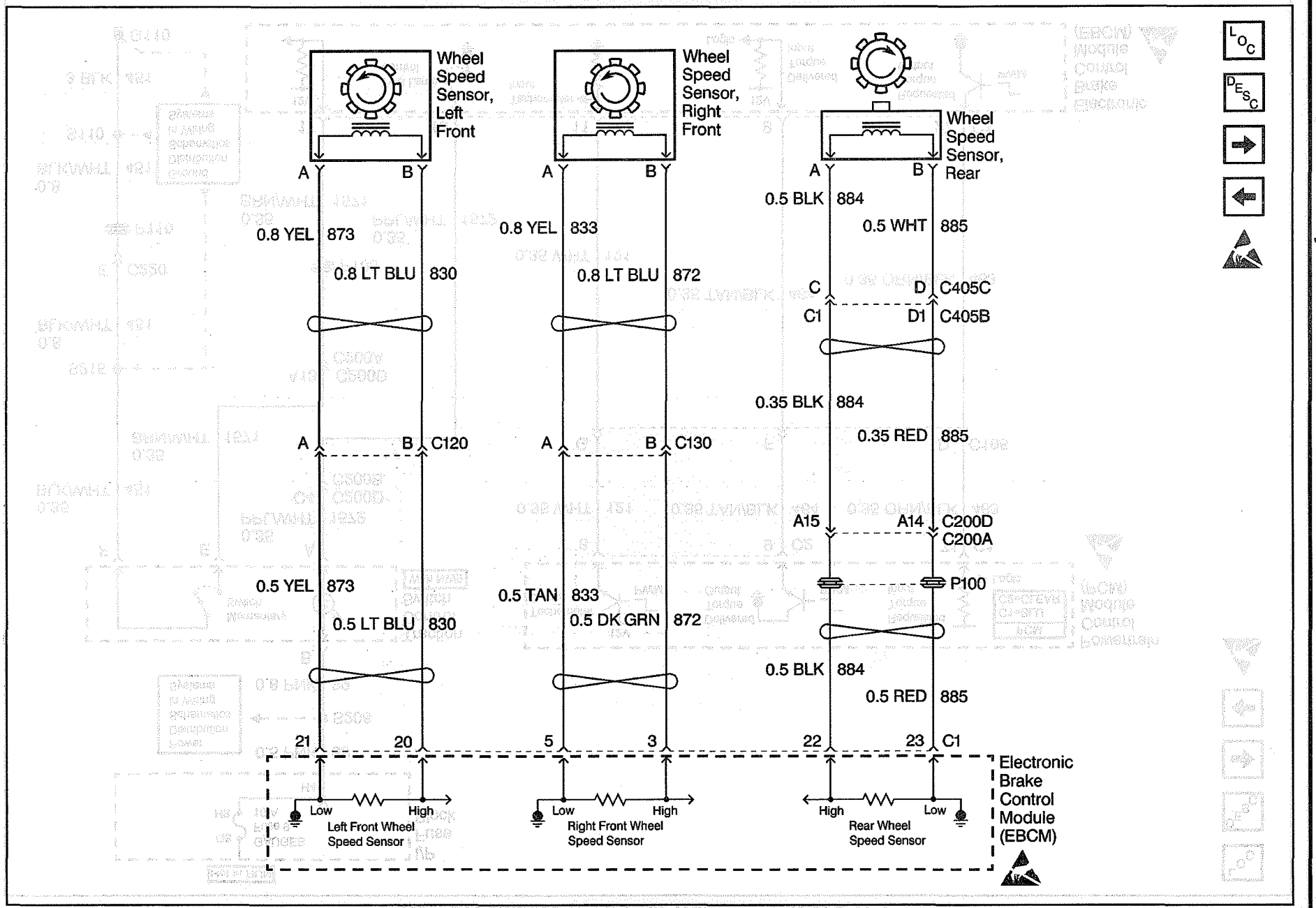


ABS Schematics (3.8L With Traction Control 3 of 4)



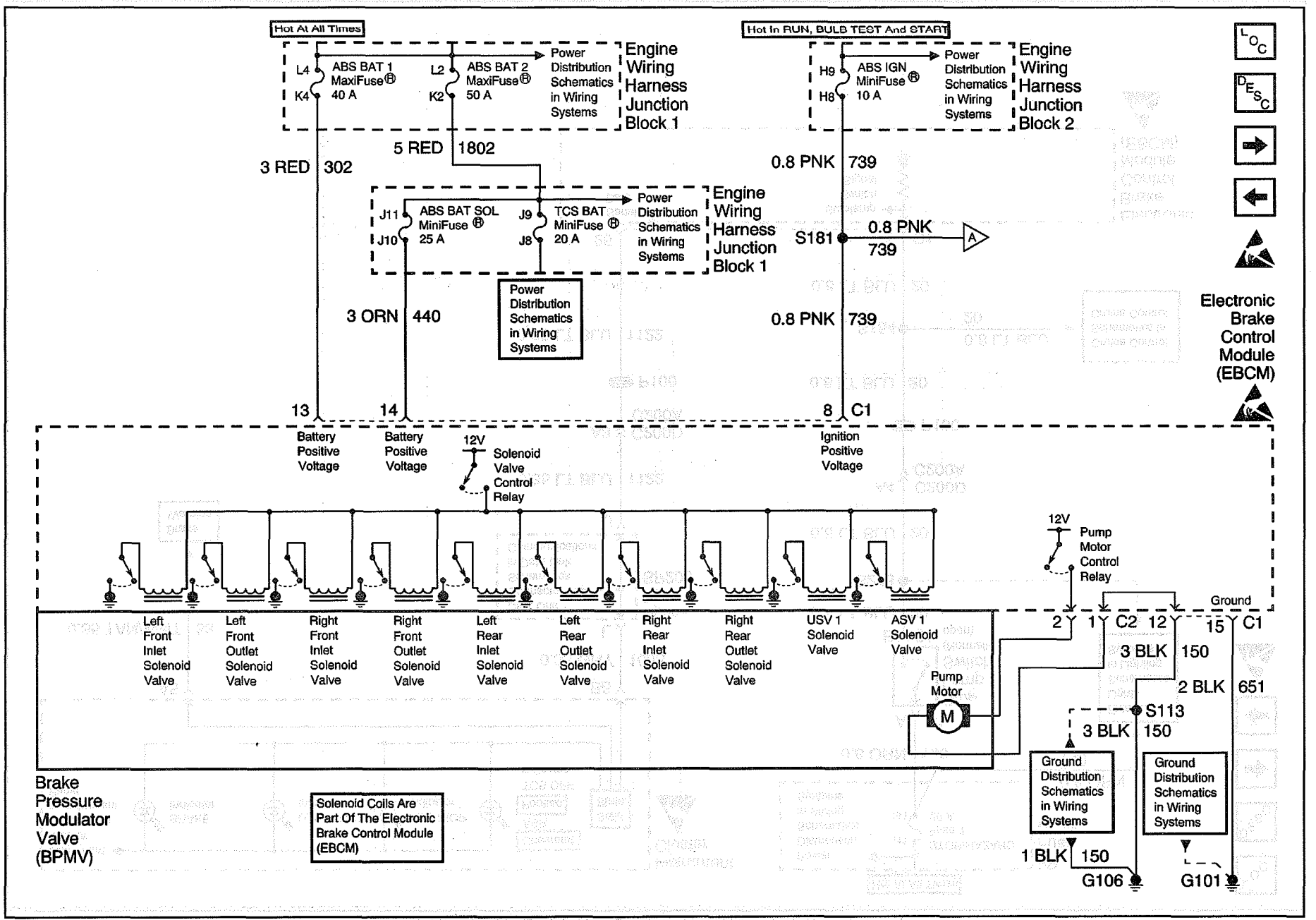
500483

ABS Schematics (3.8L With Traction Control 4 of 4)



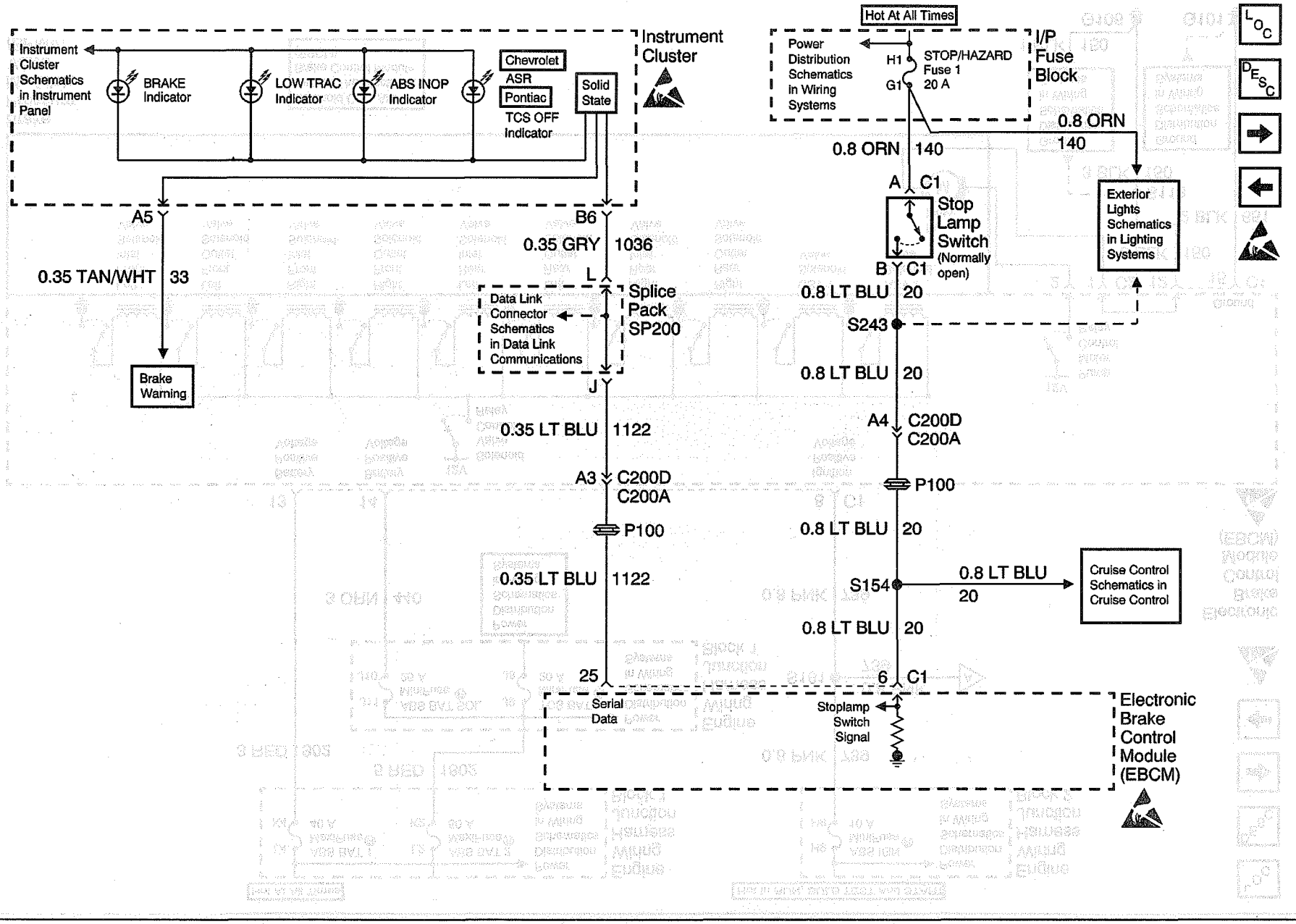
500489

ABS Schematics (5.7L With Traction Control 1 of 5)

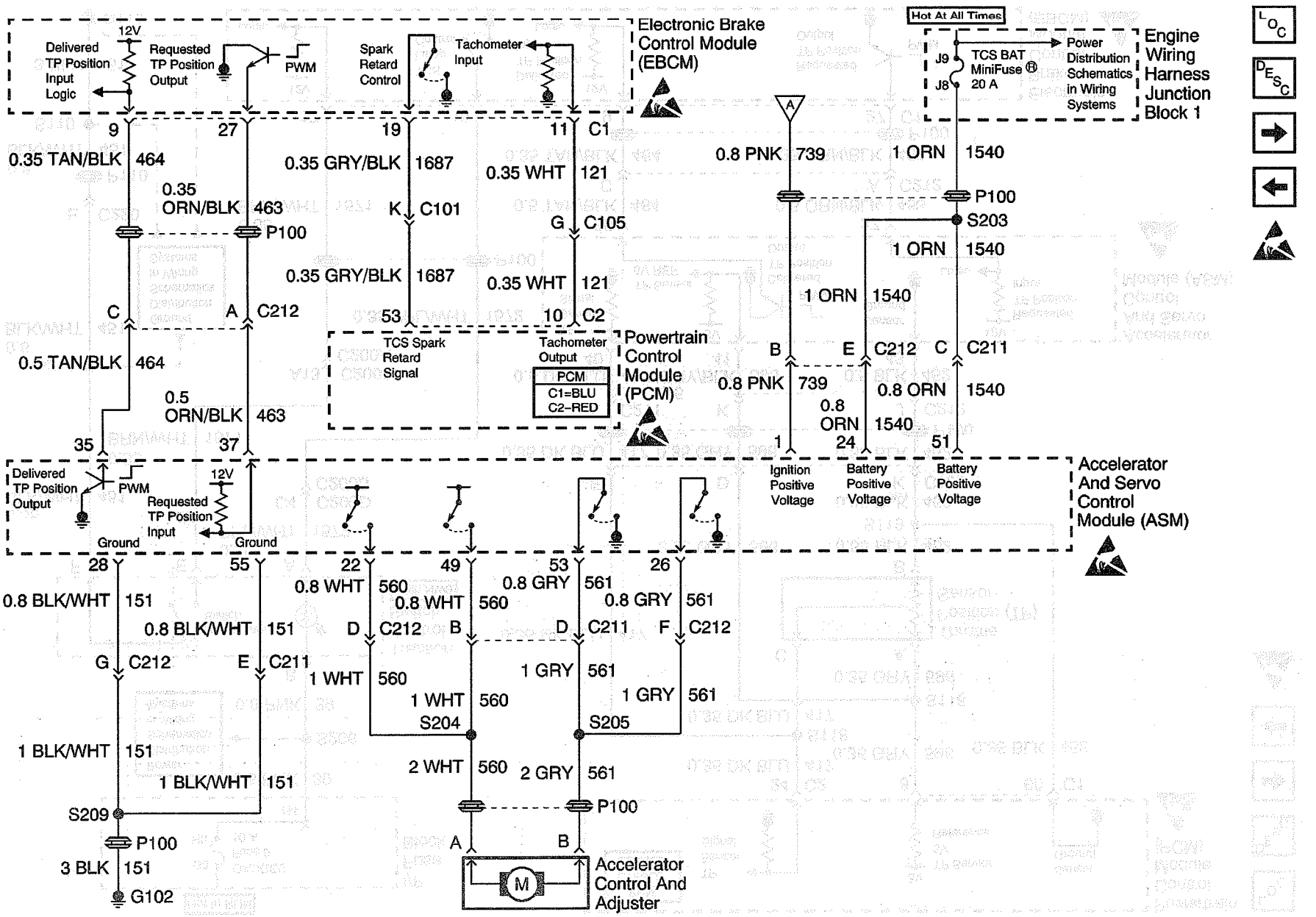


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ABS Schematics (5.7L With Traction Control 2 of 5)

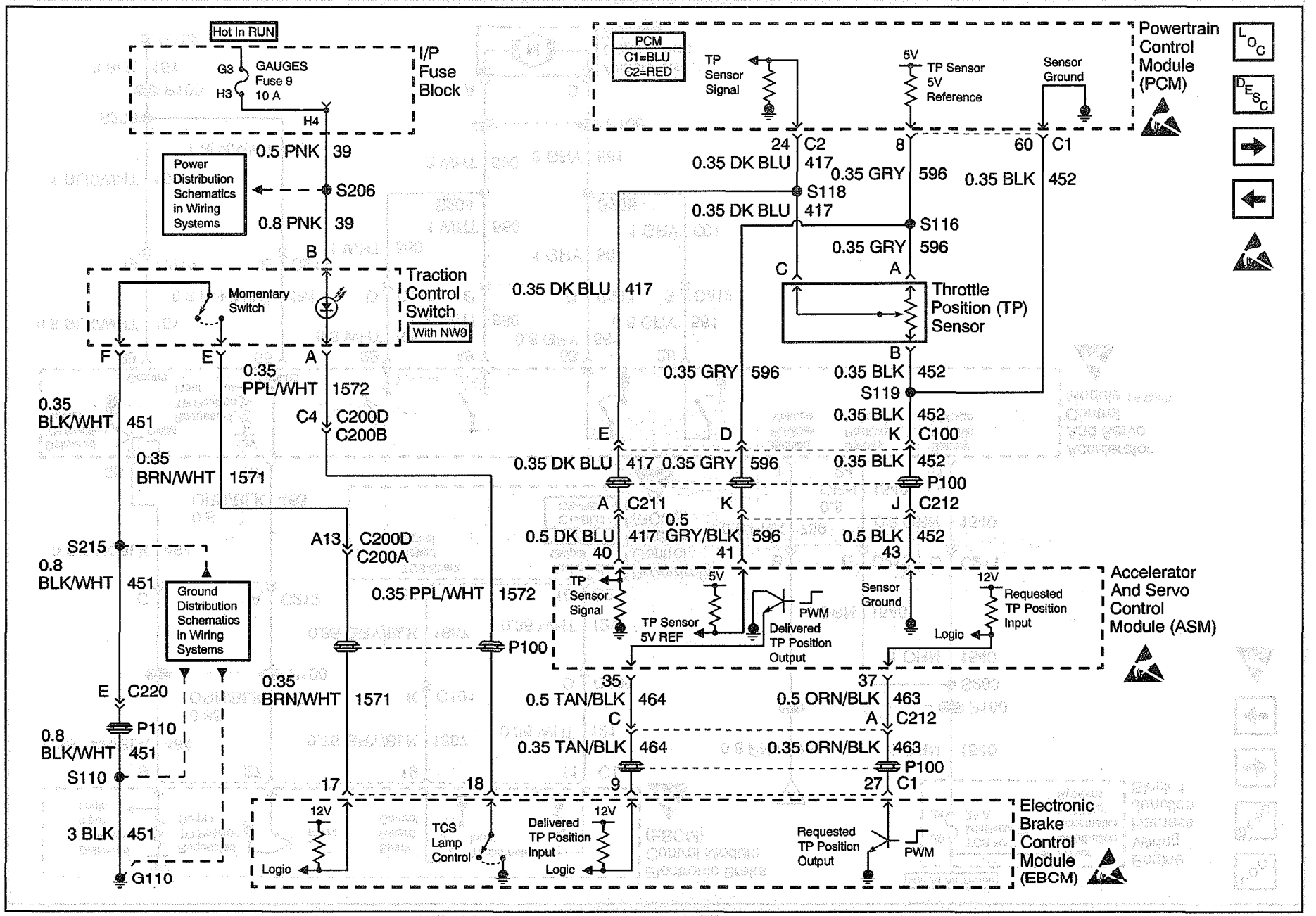


ABS Schematics (5.7L With Traction Control 3 of 5)



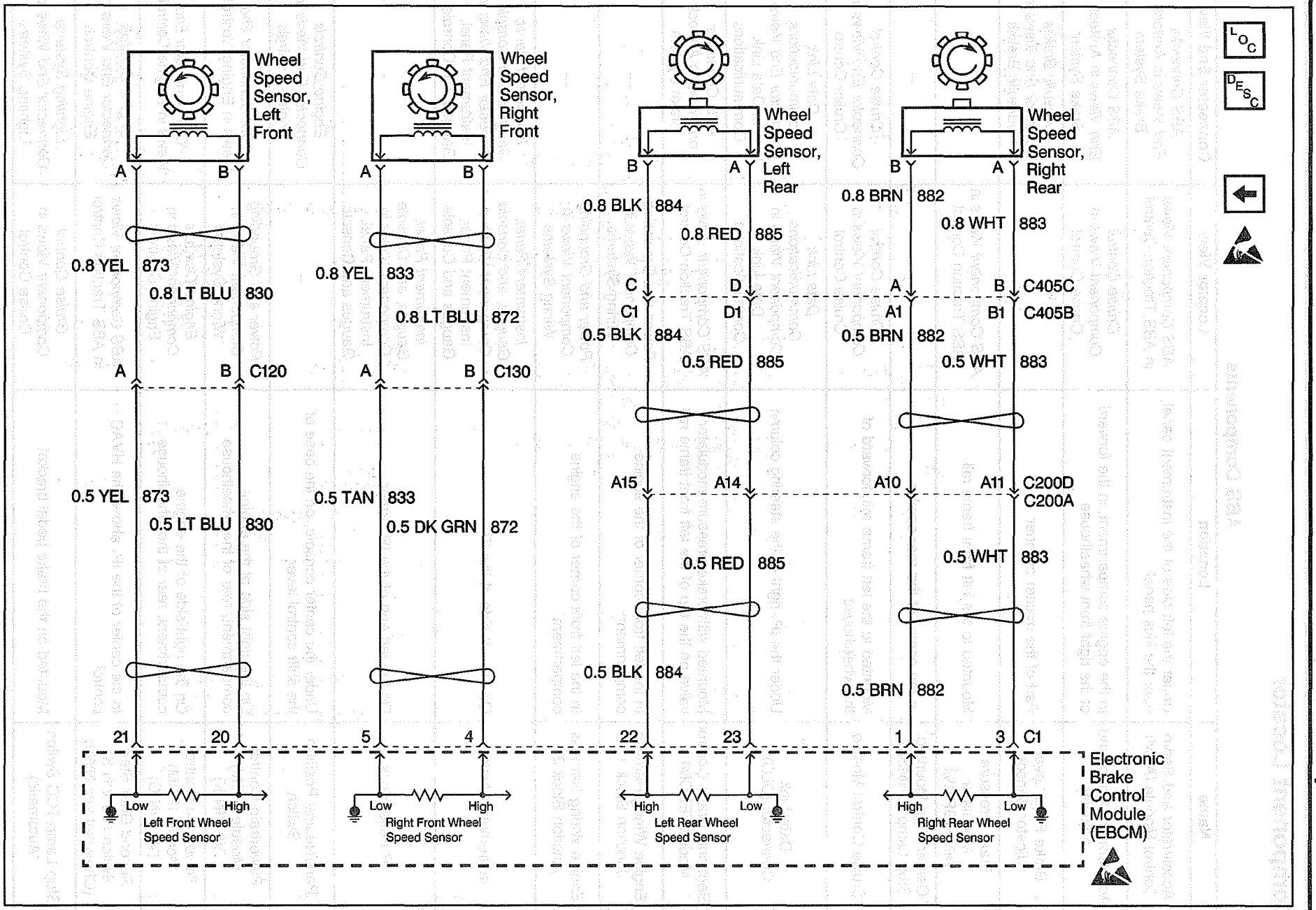
500500

ABS Schematics (5.7L With Traction Control 4 of 5)



500503

ABS Schematics (5.7L With Traction Control 5 of 5)



500508

Component Locator

ABS Components

Name	Location	Locator View	Connector End View
Accelerator and Servo Control Module (ASM)	Under the left side of the instrument panel, near the kick panel	*ABS Component Views* in ABS Traction Control	*ABS Connector End Views* in Antilock Brake System
Accelerator Control and Adjuster	In the engine compartment, in the forward of the right front wheelhouse	*Cruise Control Component Views* in Cruise Control	*ABS Connector End Views* in Antilock Brake System
Brake Fluid Level Indicator Sensor	Part of the master cylinder	—	*Hydraulic Brakes Connector End Views* in Hydraulic Brakes
Brake Pressure Modulator Valve (BPMV)	Mounted to the left front frame rail	*ABS Component Views* in ABS Traction Control	—
Center High Mounted Stop Lamp (CHMSL)	In the center of the rear spoiler	—	—
Cruise Control Module	Mounted to the left frame rail, forward of the wheelhouse	*Cruise Control Component Views* in Cruise Control	*Cruise Control Connector End Views* in Cruise Control
Data Link Connector (DLC)	Under the IP, right of the steering column	*Data Link Communications Component Views* in Data Link Communications	*Data Link Communications Connector End Views* in Data Link Communications
Electronic Brake Control Module (EBCM)	Mounted with brake pressure modulator valve on the top of the left front frame rail	*ABS Component Views* in ABS Traction Control	*ABS Connector End Views* in Antilock Brake System
Engine Wiring Harness Junction Block 1	In the left front corner of the engine compartment	*Power and Grounding Component Views* in Wiring Systems	—
Engine Wiring Harness Junction Block 2	In the left front corner of the engine compartment	*Power and Grounding Component Views* in Wiring Systems	—
Instrument Cluster	On the left side of the IP	*Instrument Panel, Gauges, and Console Component Views* in Instrument Panel, Gauges and Console	*Instrument Panel, Gauges, and Console Connector End Views* in Instrument Panel, Gauges and Console
IP Fuse Block	On the left end of the IP carrier	*Instrument Panel, Gauges, and Console Component Views* in Instrument Panel, Gauges and Console	—
Park/Neutral Position Switch	Under the center console, on the base of the shift control lever	—	*Engine Controls Connector End Views* in Engine Controls
Powertrain Control Module (PCM) (V6 VIN K)	On the right side of the engine compartment, rear of the wheelhouse	*Power and Grounding Component Views* in Wiring Systems	*PCM Connector End Views* in Engine Controls
Powertrain Control Module (PCM) (V8 VIN G)	On the right side of the engine compartment, rear of the wheelhouse	*Engine Controls Component Views* in Engine Controls	*PCM Connector End Views* in Engine Controls
Second Gear Start Switch (V6 VIN K) (Chevrolet w/o NW9)	In the center of the IP, above the HVAC control	*ABS Component Views* in ABS Traction Control	*Engine Controls Connector End Views* in Engine Controls
Stop Lamp/TCC Switch (Automatic)	Mounted on the brake pedal bracket	*Cruise Control Component Views* in Cruise Control	*Lighting Systems Connector End Views* in Lighting Systems

ABS Components (cont'd)

Name	Location	Locator View	Connector End View
Throttle Actuator Control (V6 VIN K)	On the plenum, with throttle body	—	*Engine Controls Connector End Views* in Engine Controls
Throttle Actuator Control (TAC) Module (V6 VIN K)	Mounted on the accelerator pedal bracket	—	*Engine Controls Connector End Views* in Engine Controls
Throttle Position (TP) Sensor (V8 VIN G)	Mounted to the front of the throttle body	*Engine Controls Component Views* in Engine Controls	*Engine Controls Connector End Views* in Engine Controls
Traction Control Switch (Chevrolet with NW9)	In the center of the IP, above the HVAC control	*ABS Component Views* in ABS Traction Control	*ABS Connector End Views* in Antilock Brake System
Traction Control Switch (Pontiac)	On the left side of the upper console	*Power Roof Systems Component Views* in Roof	*ABS Connector End Views* in Antilock Brake System
Vehicle Speed Sensor (Automatic) (V6 VIN K)	On the rear right side of the transmission	*Instrument Panel, Gauges, and Console Component Views* in Instrument Panel, Gauges and Console	*Engine Controls Connector End Views* in Engine Controls
Vehicle Speed Sensor (Automatic) (V8 VIN G)	On the rear right side of the transmission	*Instrument Panel, Gauges, and Console Component Views* in Instrument Panel, Gauges and Console	*Engine Controls Connector End Views* in Engine Controls
Vehicle Speed Sensor (Manual) (V6 VIN K)	On the rear left side of the transmission	*Instrument Panel, Gauges, and Console Component Views* in Instrument Panel, Gauges and Console	*Engine Controls Connector End Views* in Engine Controls
Vehicle Speed Sensor (Manual) (V8 VIN G)	On the rear left side of the transmission	*Instrument Panel, Gauges, and Console Component Views* in Instrument Panel, Gauges and Console	*Engine Controls Connector End Views* in Engine Controls
Wheel Speed Sensor, Front	On the middle of the left and right front steering knuckle	*ABS Component Views* in ABS Traction Control	*ABS Connector End Views* in Antilock Brake System
Wheel Speed Sensor, Rear (V8 VIN G with NW9)	Mounted to the left and right rear backing plate of the wheel disc	*ABS Component Views* in ABS Traction Control	*ABS Connector End Views* in Antilock Brake System
Wheel Speed Sensor, Rear (w/o NW9)	On the top of the rear differential	*ABS Component Views* in ABS Traction Control	*ABS Connector End Views* in Antilock Brake System
Splice Pack SP200	Under the left side of the IP, near the DLC	*Lighting Systems Component Views* in Lighting Systems	*Data Link Communications Connector End Views* in Data Link Communications
C100 (10 cavities)	Engine to forward lamp harness, in the engine compartment, above the right wheelhouse	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C120 (2 cavities)	Forward lamp to wheel speed sensor jumper harness, mounted to the left frame rail	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C200A (17 cavities)	Forward lamp to IP harness, between the left kick panel and the steering column	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems

ABS Components (cont'd)

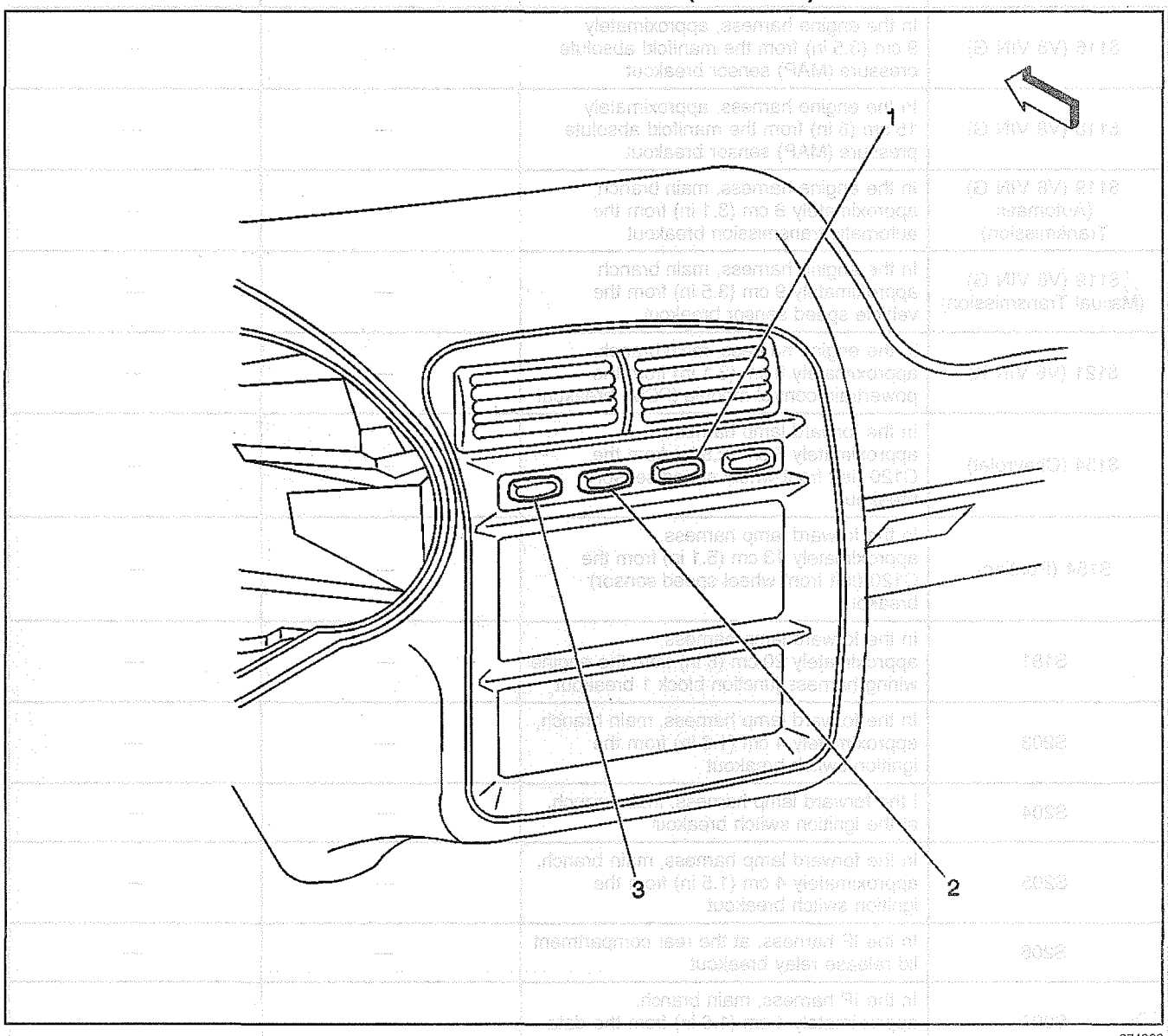
Name	Location	Locator View	Connector End View
C200B (18 cavities)	Forward lamp to IP harness, between the left kick panel and the steering column	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C200C (13 cavities)	Cross car to IP harness, between the left kick panel and the steering column	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C200D (48 cavities)	Part of the IP harness, between the left kick panel and the steering column	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C211 (8 cavities)	Forward lamp to traction control module jumper harness, under the left side of the IP, near the kick panel	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C212 (10 cavities)	Forward lamp to traction control module jumper harness, under the left side of the IP, near the kick panel	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C220 (10 cavities)	IP to engine harness, under the right side of the IP, behind the knee bolster	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C405B (16 cavities)	IP harness pass through connector, forward of the rear axle	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C405C (4 cavities)	Rear wheel speed sensor jumper to the IP harness pass through connector, forward of the rear axle to the speed sensor	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
G100 (V6 VIN K)	On the lower right side of the engine, above the A/C compressor	*Harness Routing Views* in Wiring Systems	—
G100 (V8 VIN G)	On the lower right side of the engine, above the starter solenoid	*Harness Routing Views* in Wiring Systems	—
G101	In the engine compartment, attached to the front of the left wheelhouse	*Harness Routing Views* in Wiring Systems	—
G106	Attached to the top left side of the radiator support	*Harness Routing Views* in Wiring Systems	—
G110 (V6 VIN K)	In the front of the engine, bolted to the pulley above the A/C clutch connector	*Harness Routing Views* in Wiring Systems	—
G110 (V8 VIN G)	Attached to the rear of the left cylinder head	*Harness Routing Views* in Wiring Systems	—
P100	Left side in the dash panel, engine to the passenger compartment	*Harness Routing Views* in Wiring Systems	—
P110	Right side in the dash panel, engine to the passenger compartment	*Harness Routing Views* in Wiring Systems	—
S110 (V6 VIN K)	In the engine harness, approximately 4 cm (1.6 in) from the powertrain control module (PCM) breakout	—	—
S110 (V8 VIN G)	In the engine harness, main branch, approximately 20 cm (7.9 in) from the powertrain control module (PCM) breakout	—	—
S113	In the forward lamp harness approximately 7 cm (2.8 in) from the electronic throttle control (ETC) module/cruise control module breakout	—	—
S114 (V8 VIN G)	In the engine harness, approximately 17 cm (6.7 in) back from the A/C compressor clutch breakout	—	—
S115 (V6 VIN K)	In the engine harness at the generator breakout	—	—

ABS Components (cont'd)

Name	Location	Locator View	Connector End View
S116 (V8 VIN G)	In the engine harness, approximately 9 cm (3.5 in) from the manifold absolute pressure (MAP) sensor breakout	—	—
S118 (V8 VIN G)	In the engine harness, approximately 15 cm (6 in) from the manifold absolute pressure (MAP) sensor breakout	—	—
S119 (V8 VIN G) (Automatic Transmission)	In the engine harness, main branch, approximately 8 cm (3.1 in) from the automatic transmission breakout	—	—
S119 (V8 VIN G) (Manual Transmission)	In the engine harness, main branch, approximately 9 cm (3.5 in) from the vehicle speed sensor breakout	—	—
S121 (V6 VIN K)	In the engine harness, main branch, approximately 8 cm (3.1 in) from the powertrain control module (PCM) breakout	—	—
S154 (Chevrolet)	In the forward lamp harness, approximately 7 cm (2.8 in) from the C120 (left front wheel speed sensor) breakout	—	—
S154 (Pontiac)	In the forward lamp harness, approximately 13 cm (5.1 in) from the C120 (left front wheel speed sensor) breakout	—	—
S181	In the forward lamp harness, approximately 20 cm (8 in) from the engine wiring harness junction block 1 breakout	—	—
S203	In the forward lamp harness, main branch, approximately 4 cm (1.6 in) from the ignition switch breakout	—	—
S204	I the forward lamp harness, main branch, at the ignition switch breakout	—	—
S205	In the forward lamp harness, main branch, approximately 4 cm (1.5 in) from the ignition switch breakout	—	—
S206	In the IP harness, at the rear compartment lid release relay breakout	—	—
S207	In the IP harness, main branch, approximately 4 cm (1.6 in) from the data link connector (DLC) breakout	—	—
S209	In the forward lamp harness, main branch, approximately 11 cm (4.3 in) from the ignition switch breakout	—	—
S215	In the IP harness, main branch, approximately 11 cm (4 in) from the antenna cable breakout	—	—
S216	In the IP harness, main branch, approximately 10 cm (4 in) from the instrument cluster breakout	—	—

ABS Component Views

Center of Instrument Panel (Chevrolet)

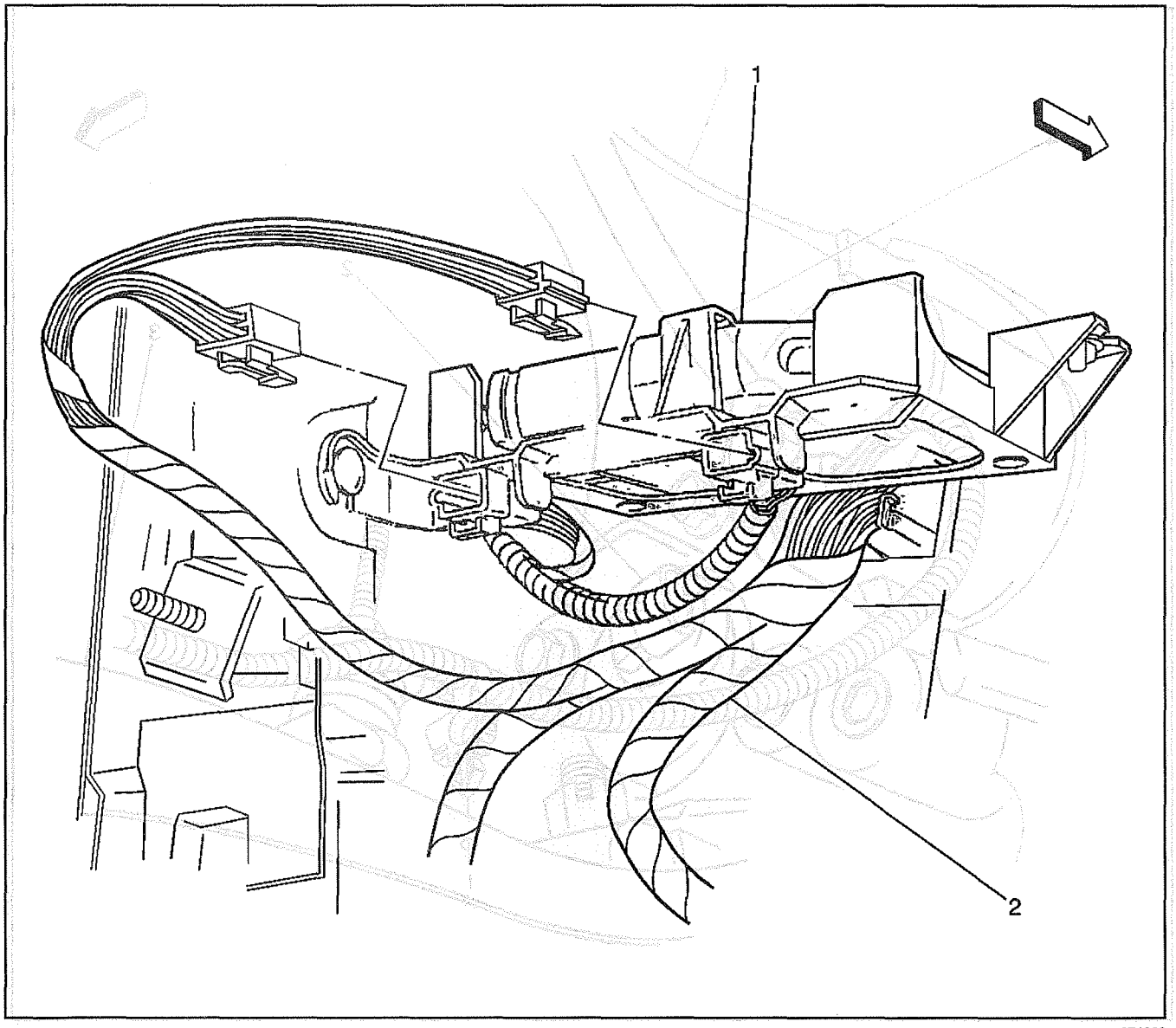


374362

Legend

(1) Rear Fog Lamp Switch (Export)
(2) Second Gear Start Switch or Traction Control Switch or Rear Fog Lamp Switch (Export)
(3) Second Gear Start Switch or Fog Lamp Switch

Behind the Lower Left Side of the Instrument Panel



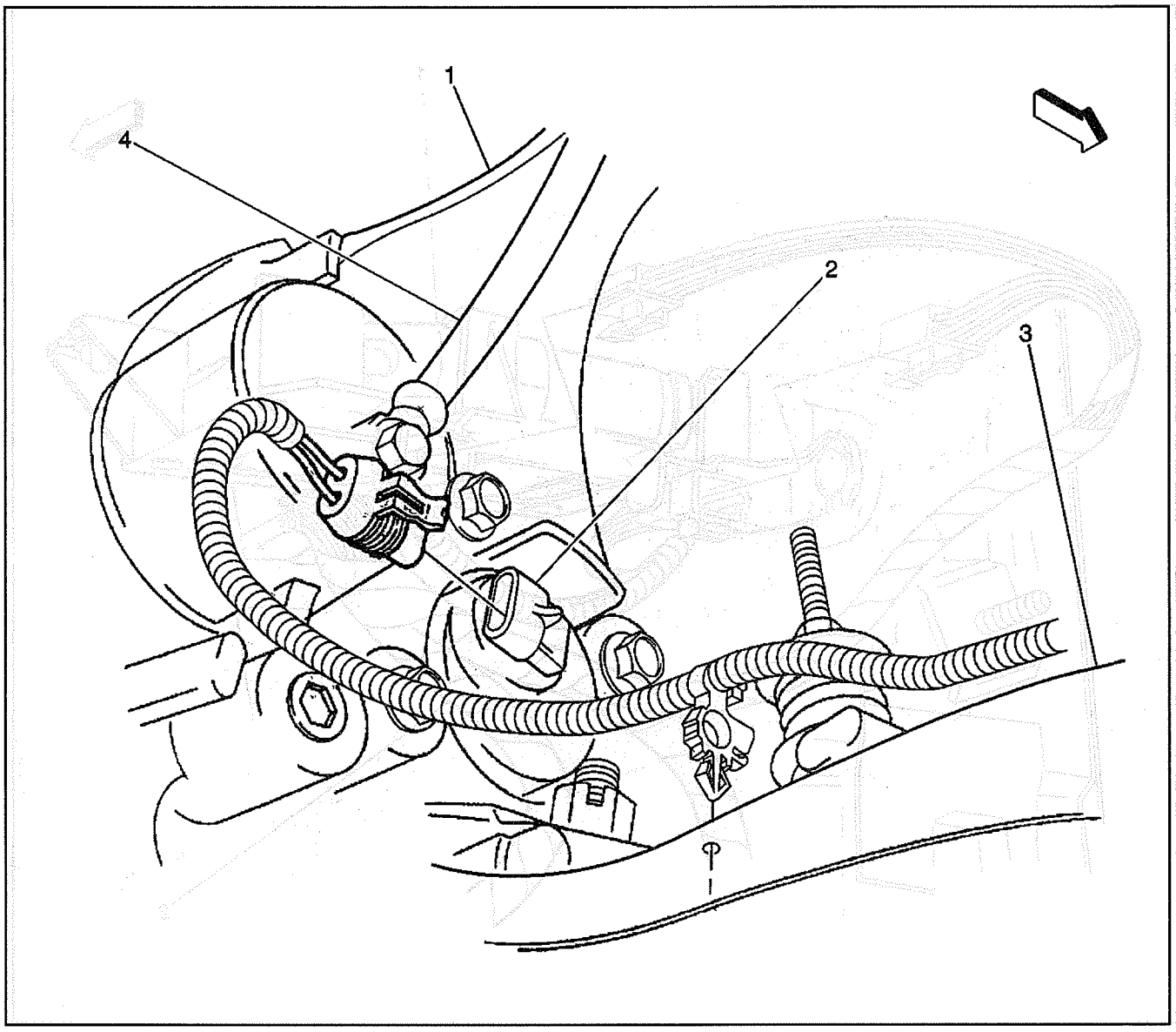
374363

Legend

(1) Accelerator and Servo Control Module

(2) Forward Lamp Wiring Harness

Inside of Left Steering Knuckle

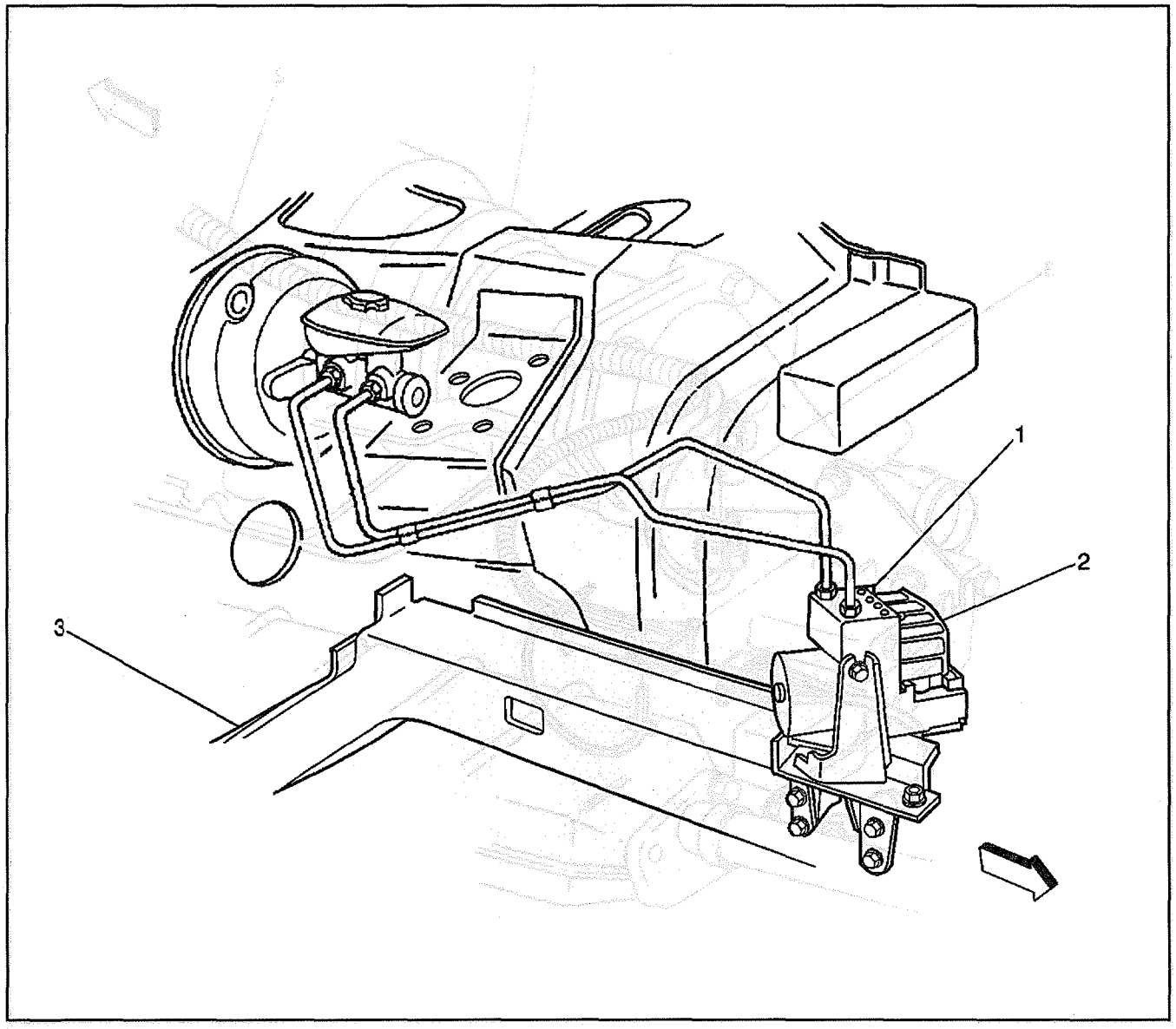


374393

Legend

(1) Front Wheel
(2) Left Front Wheel Speed Sensor (Right side similar)
(3) Lower Control Arm
(4) Brake Line

Lower Left Front of the Engine Compartment

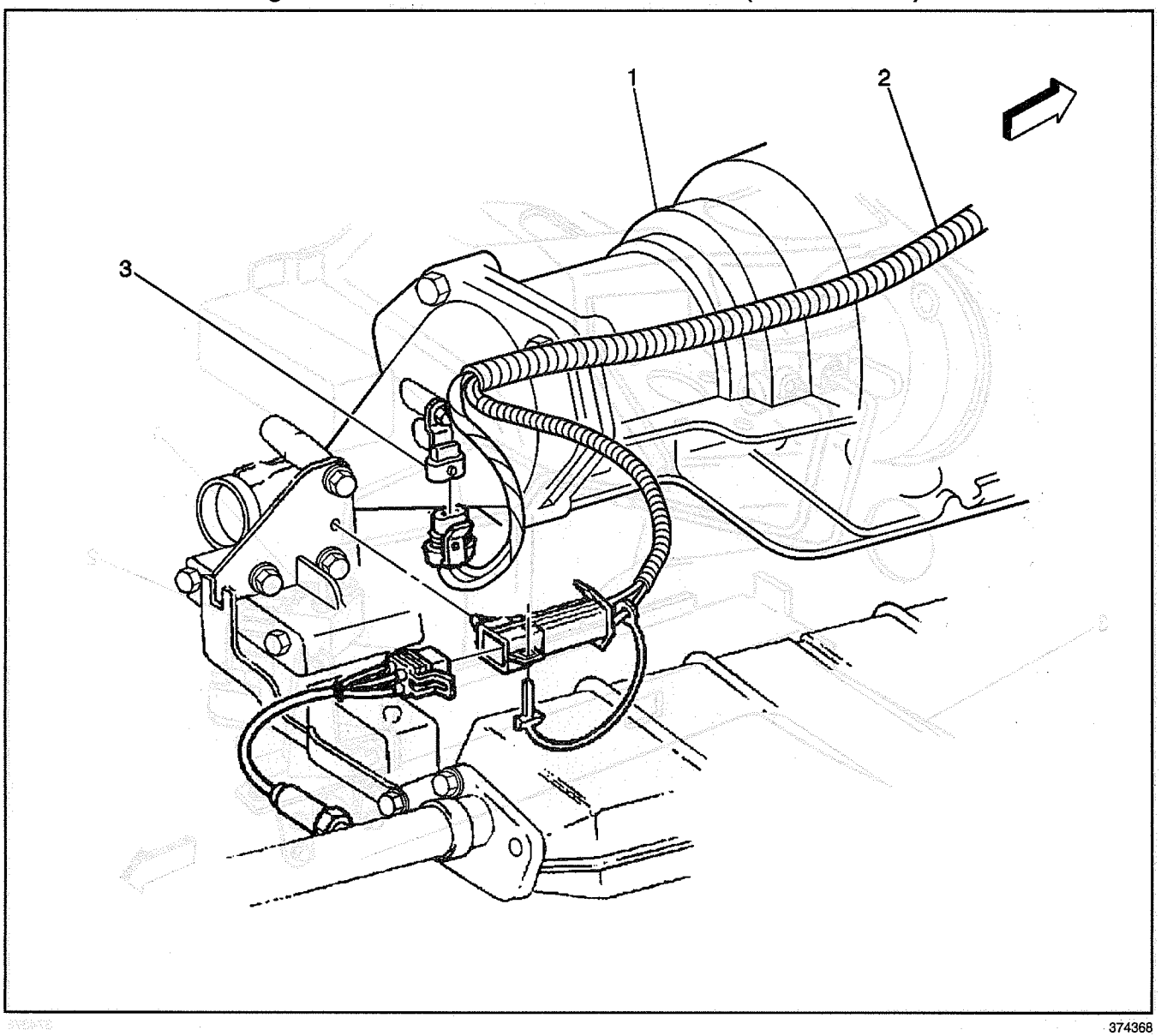


374373

Legend

(1) Brake Pressure Modulator Valve (BPMV)
(2) Electronic Brake Control Module (EBCM)
(3) Left Front Frame Rail

Right Side of the Automatic Transmission (V6 VIN K M30)

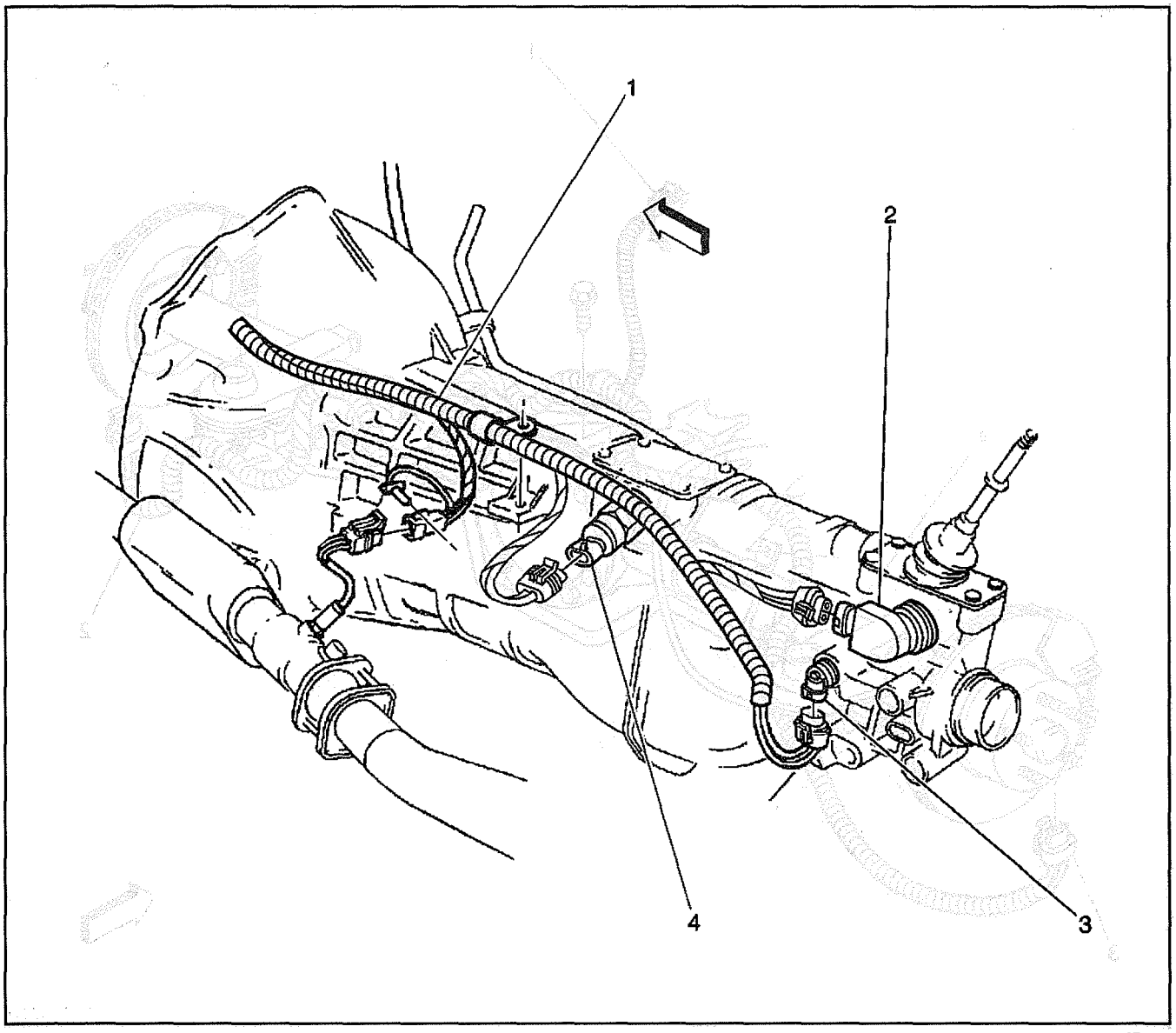


374368

Legend

(1) Automatic Transmission
(2) Engine Wiring Harness
(3) Vehicle Speed Sensor

Left Side of the Manual Transmission

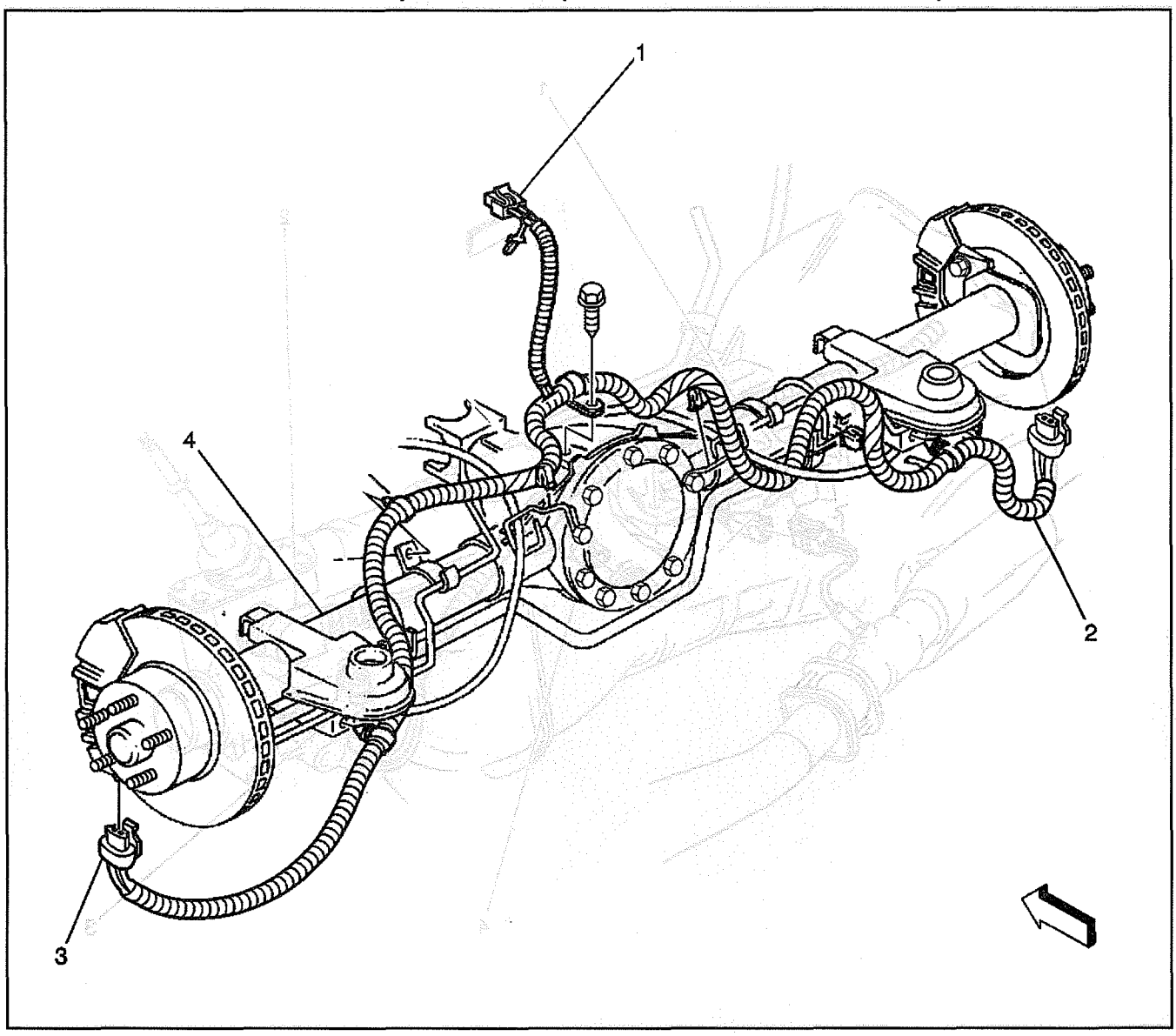


374377

Legend

(1) Engine Wiring Harness
(2) Reverse Lockout Solenoid
(3) Vehicle Speed Sensor
(4) Skip Shift Solenoid

Rear Wheel Speed Sensor (V8 VIN G With Traction Control)

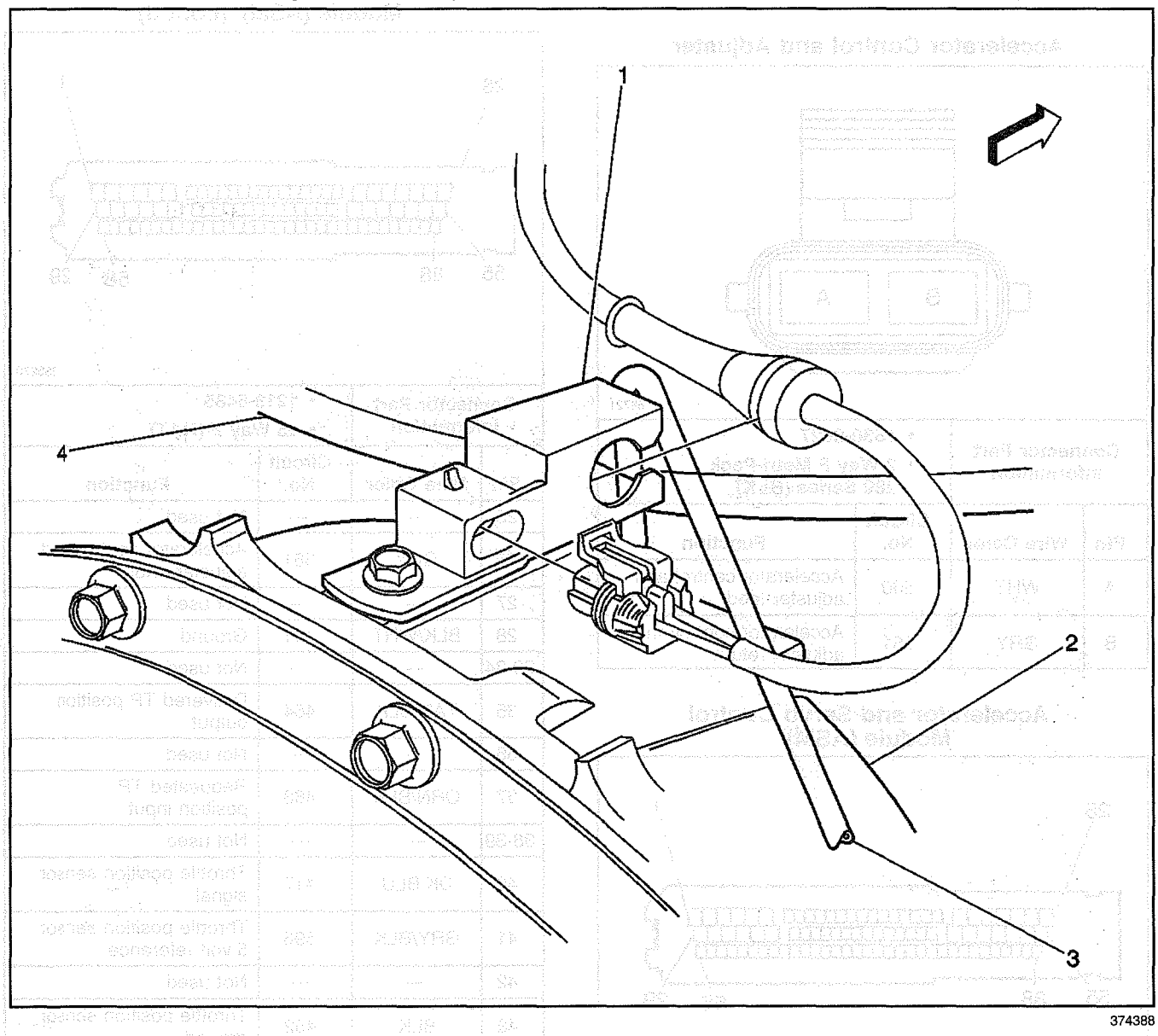


374381

Legend

(1) Rear Wheel Speed Sensor Jumper Wiring Harness
(2) Right Rear Wheel Speed Sensor
(3) Left Rear Wheel Speed Sensor
(4) Rear Axle

Rear Wheel Speed Sensor (V8 VIN G Without Traction Control and V6 VINK)



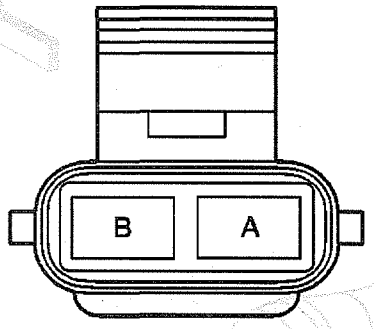
374388

Legend

(1) Rear Wheel Speed Sensor
(2) Rear Axle
(3) Brake Line
(4) Park Brake Cable

ABS Connector End Views

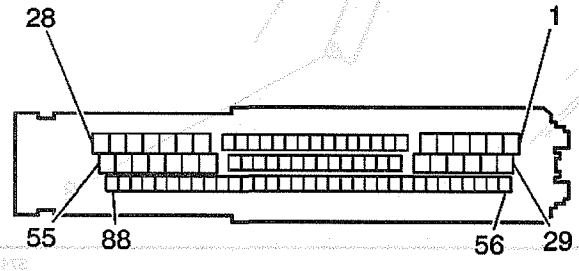
Accelerator Control and Adjuster



68721

Connector Part Information	• 1530-0027 • 2 Way F Metri-Pack 280 Series (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	WHT	560	Accelerator control and adjuster feed
B	GRY	561	Accelerator control and adjuster return

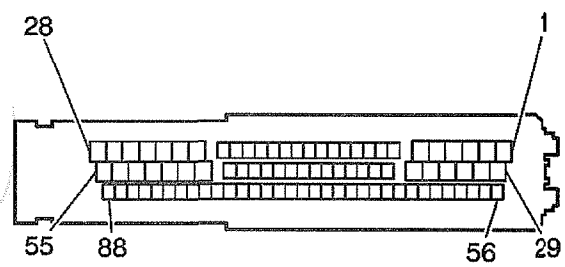
Accelerator and Servo Control Module (ASM)



235270

Connector Part Information	• 1218-6485 • 55 Way F (NAT)		
Pin	**Wire Color**	**Circuit No.**	**Function**
1	PNK	739	Fused ignition feed
2-21	—	—	Not used
22	WHT	560	Accelerator control and adjuster feed
23	—	—	Not used
24	ORN	1540	Fused battery feed

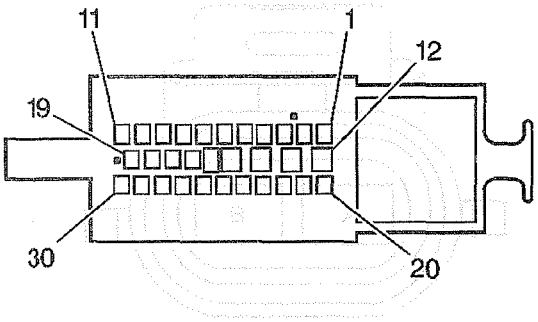
Accelerator and Servo Control Module (ASM) (cont'd)



235270

Connector Part Information	• 1218-6485 • 55 Way F (NAT)		
Pin	**Wire Color**	**Circuit No.**	**Function**
25	—	—	Not used
26	GRY	561	Accelerator control and adjuster return
27	—	—	Not used
28	BLK/WHT	151	Ground
29-34	—	—	Not used
35	TAN/BLK	464	Delivered TP position output
36	—	—	Not used
37	ORN/BLK	463	Requested TP position input
38-39	—	—	Not used
40	DK BLU	417	Throttle position sensor signal
41	GRY/BLK	596	Throttle position sensor 5 volt reference
42	—	—	Not used
43	BLK	452	Throttle position sensor ground
44-48	—	—	Not used
49	WHT	560	Accelerator control and adjuster feed
50	—	—	Not used
51	ORN	1540	Fused battery feed
52	—	—	Not used
53	GRY	561	Accelerator control and adjuster return
54	—	—	Not used
55	BLK/WHT	151	Ground
56-88	—	—	Not used

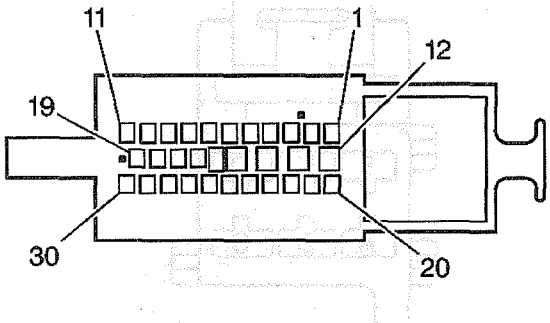
Electronic Brake Control Module



231364

Connector Part Information		• 1532-6390 • 30 Way F GT 150 Series Sealed (BLK)	
Pin	Wire Color	Circuit No.	Function
1	BRN	882	Right rear wheel speed sensor signal (LS1 with NW9)
2	—	—	Not used
3	DK GRN	872	Right front wheel speed sensor signal (LS1 without NW9 and L36)
3	WHT	883	Right rear wheel speed sensor return
4	DK GRN	872	Right front wheel speed sensor signal (LSI with NW9)
5	TAN	833	Right front wheel speed sensor return
6	LT BLU	20	Stop lamp feed
7	—	—	Not used
8	PNK	739	Fused ignition feed
9	TAN/BLK	464	Delivered torque input (with NW9)
10	—	—	Not used
11	WHT	121	Tachometer input (with NW9)
12	BLK	150	Ground
13	RED	302	Fused battery feed
14	ORN	440	Fused battery feed
15	BLK	651	Ground
16	—	—	Not used

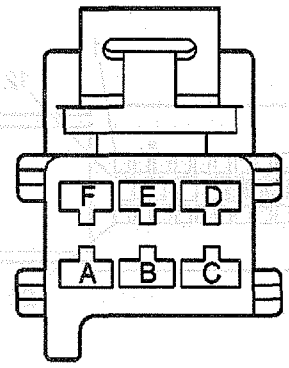
Electronic Brake Control Module (cont'd)



231364

Connector Part Information		• 1532-6390 • 30 Way F GT 150 Series Sealed (BLK)	
Pin	Wire Color	Circuit No.	Function
17	BRN/WHT	1571	Traction control switch signal (with NW9)
18	PPL/WHT	1572	Traction control lamp control
19	GRY/BLK	1687	TCS spark retard signal (LS1 with NW9)
20	LT BLU	830	Left front wheel speed sensor signal
21	YEL	873	Left front wheel speed sensor return
22	BLK	884	Rear wheel speed sensor signal (LS1 without NW9 and L36)
22	BLK	884	Left rear wheel speed sensor signal (LS1 with NW9)
23	RED	885	Rear wheel speed sensor return (LS1 without NW9 and L36)
23	RED	885	Left rear wheel speed sensor signal (LS1 with NW9)
24	—	—	Not used
25	LT BLU	1122	Class 2 serial data
26	—	—	Not used
27	ORN/BLK	463	Requested torque input (with NW9)
28-30	—	—	Not used

Traction Control Switch

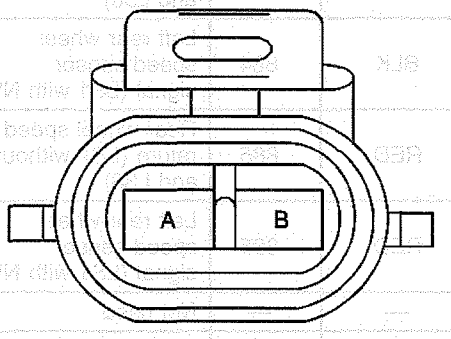


304345

Connector Part Information	• 1217-7195 • 6 Way F Metri-Pack 150 Series (BLK)

Pin	Wire Color	Circuit No.	Function
A	PPL/WHT	1572	Traction control lamp control
B	BRN	141	Fused ignition feed
C	GRY	8	Switch illumination lamp feed
D	—	—	Not used
E	BRN/WHT	1571	Traction control switch signal
F	BLK/WHT	451	Ground

Wheel Speed Sensor, Left Front

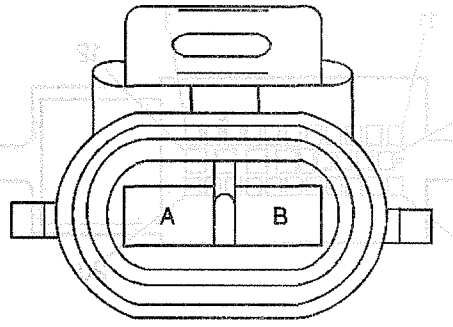


35437

Connector Part Information	• 1205-2644 • 2 Way F Metri-Pack 150 Sealed (GRY)

Pin	Wire Color	Circuit No.	Function
A	YEL	873	Left Front Wheel Speed Sensor Signal - Low
B	LT BLU	830	Left Front Wheel Speed Sensor Signal - High

Wheel Speed Sensor, Left Rear (With NW9)

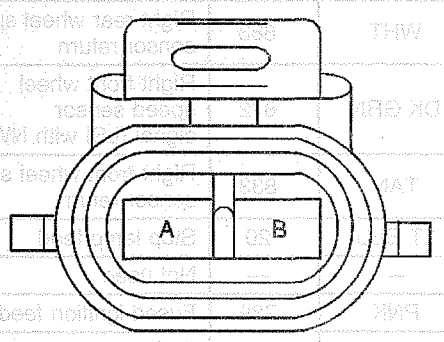


35437

Connector Part Information	• 1205-2644 • 2 Way F Metri-Pack 150 Sealed (GRY)

Pin	Wire Color	Circuit No.	Function
A	RED	885	Left Rear Wheel Speed Sensor Signal - Low
B	BLK	884	Left Rear Wheel Speed Sensor Signal - High

Wheel Speed Sensor, Right Front

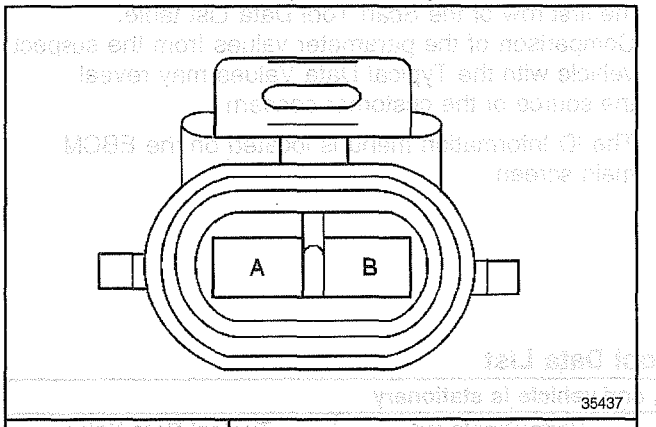


35437

Connector Part Information	• 1205-2644 • 2 Way F Metri-Pack 150 Sealed (GRY)

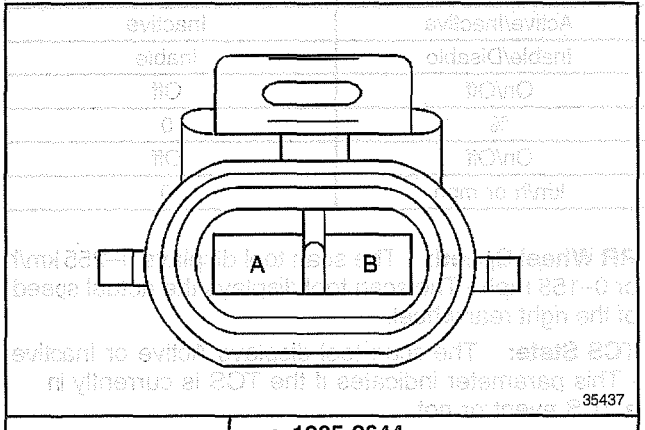
Pin	Wire Color	Circuit No.	Function
A	YEL	833	Right Front Wheel Speed Sensor Signal - Low
B	LT BLU	872	Right Front Wheel Speed Sensor Signal - High

Wheel Speed Sensor, Right Rear (With NW9)



Connector Part Information	• 1205-2644 • 2 Way F Metri-Pack 150 Sealed (GRY)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	WHT	883	Right Rear Wheel Speed Sensor Signal - Low
B	BRN	882	Right Rear Wheel Speed Sensor Signal - High

Wheel Speed Sensor, Rear (Without NW9)



Connector Part Information	• 1205-2644 • 2 Way F Metri-Pack 150 Sealed (LT GRY)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	884	Rear Wheel Speed Sensor Signal - High
B	WHT	885	Rear Wheel Speed Sensor Signal - Low

Diagnostic Information and Procedures

A Diagnostic Starting Point

Begin the system diagnosis with the *A Diagnostic System Check - ABS*. The Diagnostic System Check will provide the following information:

- The identification of the control module(s) which command the system.
- The ability of the control module(s) to communicate through the serial data circuit.
- The identification of any stored diagnostic trouble codes (DTCs) and their status.

The use of the Diagnostic System Check will identify the correct procedure for diagnosing the system and where the procedure is located.

Scan Tool Diagnostics

Plug the scan tool into the Data Link Connector (DLC). The scan tool becomes part of the vehicle's electronic system. The scan tool performs the following functions:

- Display ABS/TCS data
- Display diagnostic trouble codes
- Clear ABS/TCS diagnostic trouble codes
- Control ABS/TCS components
- Perform extensiveABS/TCS diagnosis
- Provide diagnostic testing for intermittent ABS/TCS conditions

  Each test mode has specific diagnostic capabilities which depend upon various keystrokes.

  The keys on the scan tool perform the following functions:

  - Select operating modes
  - Perform functions within an operating mode
  - Enter DTC designations
  - Enter model year designations

Refer to *Enhanced Diagnostics* for more scan tool diagnostic information.

Scan Tool Data List

The EBCM Scan Tool Data Lists contain all the antilock brake system related parameters that are available on the scan tool. The parameters in the list are arranged in alphabetical order. The column, 'Data List,' indicates the location of the parameter within the scan tool menu selections.

Use the EBCM Scan Tool Data Lists as directed by a diagnostic table or in order to supplement the diagnostic procedures. Begin all the diagnostic procedures with the ABS Diagnostic Starting Point. Use the EBCM Scan Tool Data Lists only after the following is determined:

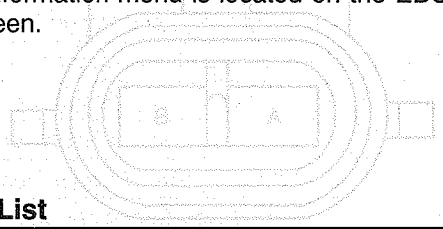
- There is no published DTC procedure nor published symptom procedure for the customer concern.

  OR

- The DTC or symptom diagnostic procedure indicated by the diagnostic system check does not resolve the customer concern.

The Typical Data Values are obtained from a properly operating vehicle under the conditions specified in the first row of the Scan Tool Data List table. Comparison of the parameter values from the suspect vehicle with the Typical Data Values may reveal the source of the customer concern.

The ID Information menu is located on the EBCM main screen.



EBCM Scan Tool Data List

Ignition is ON, engine OFF, and vehicle is stationary			
Scan Tool Parameter	**Data List**	**Units Displayed**	**Typical Data Value**
Brake Switch Status	ABS	Applied/Released	Released
EBCM to PCM Requested Torque	TCS	%	90
Engine Speed	ABS/TCS	RPM	0
Left Front Wheel Speed	ABS/TCS	km/h or mph	0
Left Rear Wheel Speed	ABS/TCS	km/h or mph	0
Pump Monitor State	ABS	On/Off	Off
Right Front Wheel Speed	ABS/TCS	km/h or mph	0
Right Rear Wheel Speed	ABS/TCS	km/h or mph	0
Rear Wheel Speed	ABS/TCS	Km/h or mph	0
TCS State	ABS/TCS	Active/Inactive	Inactive
TCS Status	ABS/TCS	Inable/Disable	Inable
TCS Switch State	TCS	On/Off	Off
Throttle Angle	ABS/TCS	%	0
Valve Relay State	ABS/TCS	On/Off	Off
Vehicle Speed	ABS/TCS	km/h or mph	0

Scan Tool Data Definitions

The ABS Scan Tool Data Definitions contain a brief description of all the ABS/traction scan tool parameters. This list is in alphanumeric order.

Brake Switch Status: The scan tool displays Applied or Released - The scan tool displays the state of the brake switch.

Engine Speed: The scan tool displays 0–10200 RPM - This is essentially a digital tachometer display.

LF Wheel Speed: The scan tool displays 0–255 km/h or 0–158 mph - The scan tool displays the actual speed of the left front wheel.

LR Wheel Speed: The scan tool displays 0–255 km/h or 0–158 mph - The scan tool displays the actual speed of the left rear wheel.

Pump Monitor State: The scan tool displays On or Off - This parameter indicates the state of the return pump relay.

Rear Wheel Speed: The scan tool displays 0–255 km/h or 0–158 mph - The scan tool displays the actual speed of the rear wheels.

RF Wheel Speed: The scan tool displays 0–255 km/h or 0–158 mph - The scan tool displays the actual speed of the right front wheel.

RR Wheel Speed: The scan tool displays 0–255 km/h or 0–158 mph - The scan tool displays the actual speed of the right rear wheel.

TCS State: The scan tool displays Active or Inactive - This parameter indicates if the TCS is currently in a TCS event or not.

TCS Status: The scan tool displays Inable or Disable - The parameter indicates the state of the TCS based on if the operator has disabled TCS by pressing the TCS On/Off switch, or if the TCS is disabled because of a malfunction.

TCS Switch State: The scan tool displays On or Off - This parameter indicates the state of the traction control switch.

Throttle Angle: The scan tool displays % - The scan tool displays in percent of throttle open.

Valve Relay State: The scan tool displays On or Off - This parameter indicates the state of the valve relay.

Vehicle Speed: The scan tool displays 0–255 km/h or 0–158 mph - The scan tool displays the vehicle speed.

Diagnostic Trouble Code (DTC) List/Type

DTC/Description	Type	Illuminate Indicator or Turn ON DIC Message
DTC C0035 LF Wheel Speed Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0036 LF Wheel Speed Circuit Range/Performance	ABS	ABS/TCS/BRAKE
DTC C0040 RF Wheel Speed Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0041 RF Wheel Speed Circuit Range/Performance	ABS	ABS/TCS/BRAKE
DTC C0045 LR Wheel Speed Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0046 LR Wheel Speed Circuit Range/Performance	ABS	ABS/TCS/BRAKE
DTC C0050 RR Wheel Speed Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0051 RR Wheel Speed Circuit Range/Performance	ABS	ABS/TCS/BRAKE
DTC C0055 Rear Wheel Speed Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0056 Rear Wheel Speed CKT Range/Performance	ABS	ABS/TCS/BRAKE
DTC C0060 LF ABS Solenoid #1 Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0065 LF ABS Solenoid #2 Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0070 RF ABS Solenoid #1 Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0075 RF ABS Solenoid #2 Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0080 LR ABS Solenoid #1 Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0085 LR ABS Solenoid #2 Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0090 RR ABS Solenoid #1 Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0095 RR ABS Solenoid #2 Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0100 Rear ABS Solenoid #1 Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0105 Rear ABS Solenoid #2 Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0110 Pump Motor Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0121 Valve Relay Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0161 ABS/TCS Brake Switch Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0166 TCS Priming Line Valve CKT Malfunction	ABS	ABS/TCS/BRAKE
DTC C0171 TCS Pilot Valve Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0181 Throttle Reduction Motor CKT Malfunction	ABS	ABS/TCS/BRAKE
DTC C0182 Throttle Reduction Motor CKT Range Perf	ABS	ABS/TCS/BRAKE
DTC C0236 TCS RPM Signal Circuit Malfunction	ABS	ABS/TCS/BRAKE
DTC C0237 TCS Throttle Position Signal Malfunction	ABS	ABS/TCS/BRAKE
DTC C0238 TCS TP Sensor Comparison Malfunction	ABS	ABS/TCS/BRAKE
DTC C0239 TCS Spark Retard Monitoring Malfunction	ABS	ABS/TCS/BRAKE
DTC C0240 PCM Traction Control Not Allowed	ABS	ABS/TCS/BRAKE
DTC C0241 PCM Indicated Requested Torque Malf	ABS	ABS/TCS/BRAKE
DTC C0244 PWM Delivered Torque Malfunction	ABS	ABS/TCS/BRAKE
DTC C0245 Wheel Speed Sensor Frequency Error	ABS	ABS/TCS/BRAKE
DTC C0266 ADS Controller Malfunction	ABS	ABS/TCS/BRAKE
DTC C0550 ECU Malfunction	ABS	ABS/TCS/BRAKE
DTC C0896 Device Voltage Range/Performance	ABS	ABS/TCS/BRAKE
DTC C0901 Device #2 Voltage Low	ABS	ABS/TCS/BRAKE
DTC U1000 and DTC U1255 Class 2 Communication Malfunction	ABS	ABS/TC/BRAKE
DTC U1300 Class 2 Data Link Low	ABS	ABS/TC
DTC U1301 Class 2 Data Link High	ABS	ABS/TC

Self-Diagnostics

The EBCM/EBTCM performs system self-diagnostics, and can detect and often isolate system malfunctions. When a malfunction is detected the EBCM/EBTCM sets a Diagnostic Trouble Code (DTC). The DTC represents the malfunction, and may turn on the Antilock Indicator, Red BRAKE Warning Indicator, and Traction Control indicators (if equipped), and may disable the ABS/TCS functions as necessary for the duration of the ignition cycle.

Initialization Sequence

The EBCM/EBTCM performs the Initialization test once each ignition cycle, when the vehicle speed reaches 6 Km/h (4 mph) and the EBCM/EBTCM does not see a brake switch input, if the EBCM/EBTCM sees a brake switch input the initialization test runs when the vehicle speed reaches 15 Km/h (9 mph). The Initialization sequence cycles each valve solenoid and the pump motor (as well as the necessary relays) to check component operation. If any error is detected, the EBCM/EBTCM will set a DTC. The Initialization sequence may be heard and felt while it is taking place, and is considered part of normal operation.

Enhanced Diagnostics

Enhanced diagnostic information is found in the DTC HISTORY function of the scan tool. Enhanced diagnostic information provides the service technician with specific malfunction occurrence information. The following occurs for each of the first five diagnostic trouble codes stored and the very last diagnostic trouble code stored:

- Data is stored to identify the specific DTC
- The number of diagnostic trouble code occurrences are stored
- The number of drive cycles since the malfunction first and last occurred are stored. A drive cycle occurs when the ignition is turned to ON.
- The drive cycle counter will increment by turning the ignition to ON and OFF if a malfunction is present.
- The first five diagnostic trouble codes are stored in the order of occurrence. The order of the first five diagnostic trouble codes are used to determine if a previous malfunction is linked to the most recent malfunction, such as an intermittent wheel speed sensor which later becomes completely open.

In difficult diagnostic situations use the above information to identify malfunction occurrence trends.

- Did the malfunction only occur once 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 diagnostic techniques may be required to identify the source of the malfunction?

Review the following malfunction example:

- A malfunction occurred 1 out of 50 drive cycles
- This malfunction is intermittent and has not recurred for 49 drive cycles
- A malfunction of this type is difficult or impossible to duplicate
- The malfunction may have been caused by a severe vehicle impact such as a large pot hole or speed bump at high speed, etc.
- A severe vehicle impact can momentarily open an electrical connector
- A severe vehicle impact can cause unusual vehicle suspension movement
- A malfunction resolution is unlikely
- The malfunction may never recur
- Check the diagnostic aids provided for that DTC

Review the following examples:

- A malfunction occurred 3 out of 15 drive cycles
- The odds of finding the cause are not good
- However, the occurrence rate is known
- A malfunction occurred 10 out of 20 drive cycles
- The odds of finding the cause of the malfunction are good
- The malfunction may be easily reproduced

A malfunction that occurs more frequently increases the odds of finding the cause of the malfunction.

Use the additional malfunction data to determine if a malfunction is randomly intermittent. Use the additional malfunction data to determine if it has not recurred for long periods of time due to whether changes or a repair prior to this visit.

Review the following example:

- A DTC occurred 10 of 20 drive cycles, but has not recurred for 10 drive cycles
- This means a malfunction occurred 10 of 10 driver cycles, but has not reoccurred since.
- A significant environment change or a repair may have occurred 10 drive cycles ago
- If customer information confirms a recent repair, repair may not be necessary.
- If no repair was made, focus on diagnosis techniques used to locate difficult-to-recreate problems.

Electromagnetic Interference

Due to the sensitivity of electronics to Electromagnetic Interference (EMI), the following checks should be performed if an intermittent malfunction is suspected.

1. Check for proper installation of wiring harnesses resulting from add-on options.
2. Check for proper routing of front wheel speed sensor wiring near spark plug wires.

A Diagnostic System Check - ABS

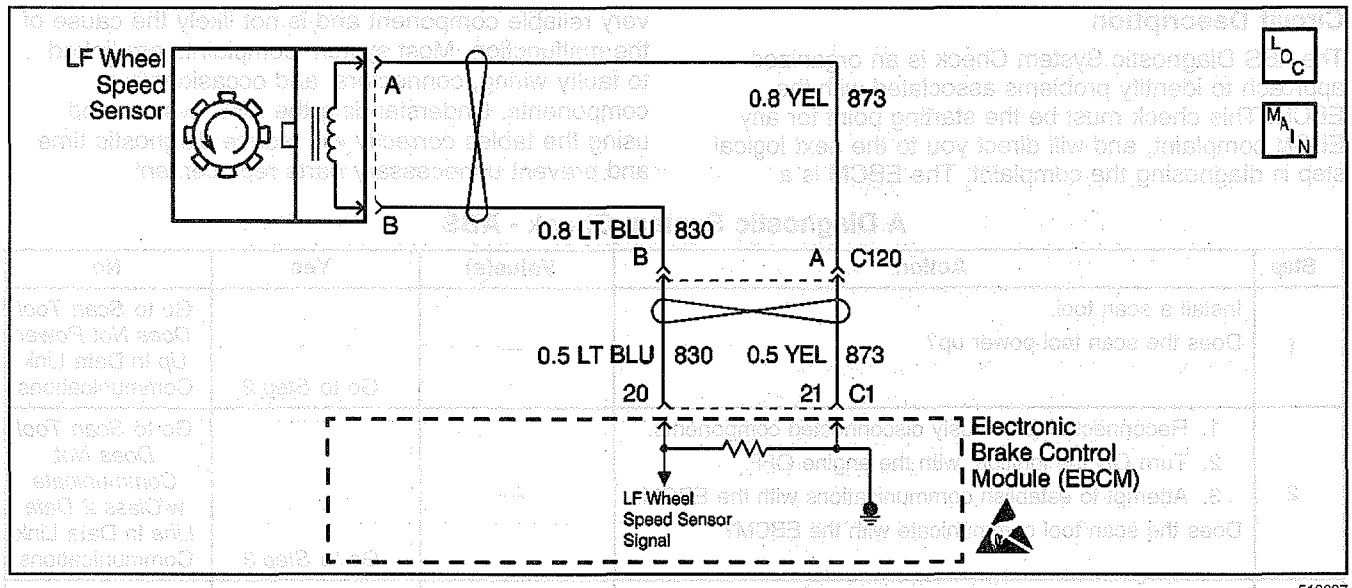
Circuit Description

The ABS Diagnostic System Check is an organized approach to identify problems associated with the EBCM. This check must be the starting point for any EBCM complaint, and will direct you to the next logical step in diagnosing the complaint. The EBCM is a very reliable component and is not likely the cause of the malfunction. Most system complaints are linked to faulty wiring, connectors, and occasionally to components. Understanding the ABS system and using the tables correctly will reduce diagnostic time and prevent unnecessary parts replacement.

A Diagnostic System Check - ABS

Step	Action	Value(s)	Yes	No
1	Install a scan tool. Does the scan tool power up?	—	Go to *Step 2*	Go to *Scan Tool Does Not Power Up* In Data Link Communications
2	1. Reconnect all previously disconnected components. 2. Turn ON the ignition, with the engine OFF. 3. Attempt to establish communications with the EBCM. Does the scan tool communicate with the EBCM?	—	Go to *Step 3*	Go to *Scan Tool Does Not Communicate w/Class 2 Data Line* In Data Link Communications
3	1. With the scan tool, in ABS/TCS Special Functions in order to run the Automated Test. 2. Select the ABS/TCS display DTC function on the scan tool. Does the scan tool display any DTCs?	—	Go to *Step 4*	Go to *Symptoms*
4	Does the scan tool display any DTCs which begin with a U (i.e. DTC U1016, U1000 or U1300, U1301)?	—	Go to *Scan Tool Does Not Communicate w/Class 2 Data Line*	Go to *Diagnostic Trouble Code (DTC) List/Type* For The Applicable DTC

DTC C0035 LF Wheel Speed Circuit Malfunction



Circuit Description

The speed sensor used on this vehicle is a multiple pole magnetic pickup. This sensor produces an AC signal that the EBCM uses the frequency from to calculate the wheel speed.

Conditions for Setting the DTC

The DTC can be set any time the ignition is in the RUN position and the EBCM detects an open or a short to voltage.

Action Taken When the DTC Sets

- A malfunction DTC stores.
- The ABS/TCS disables.
- The amber ABS/TCS indicator(s) turn on.
- The Red BRAKE Warning indicator could turn on.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- 100 ignition cycles pass with no DTC(s) detected.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness
- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If the customer's comments reflect that the amber ABS/TCS indicator is on only during moist environmental conditions (rain, snow, vehicle wash), inspect all the wheel speed sensor circuitry for signs of water intrusion. If the DTC is not current, clear all DTCs and simulate the effects of water intrusion by using the following procedure:
  1. Spray the suspected area with a five percent saltwater solution.
     Add two teaspoons of salt to twelve ounces of water to make a five percent saltwater solution.
  2. Test drive the vehicle over various road surfaces (bumps, turns, etc.) above 40 km/h (25 mph) for at least 30 seconds.
  3. If the DTC returns, replace the suspected harness.
- If an intermittent malfunction exists refer to *Testing for Intermittent and Poor Connections* in Wiring Systems.

Front Wheel Speed Sensor Resistance

Use the following table that contains resistance values for the front wheel speed sensors at varying sensor temperatures for use in diagnosis. The values are approximate and should be used as a guideline for diagnosis. Refer to *ABS Diagnostic Specifications*.

Test Description

The numbers below refer to step numbers on the diagnostic table.

6. This step checks for an open in the WSS or WSS CKT.
13. Checks for a short to voltage in the WSS CKT.
15. Checks for a short to voltage in the WSS CKT.

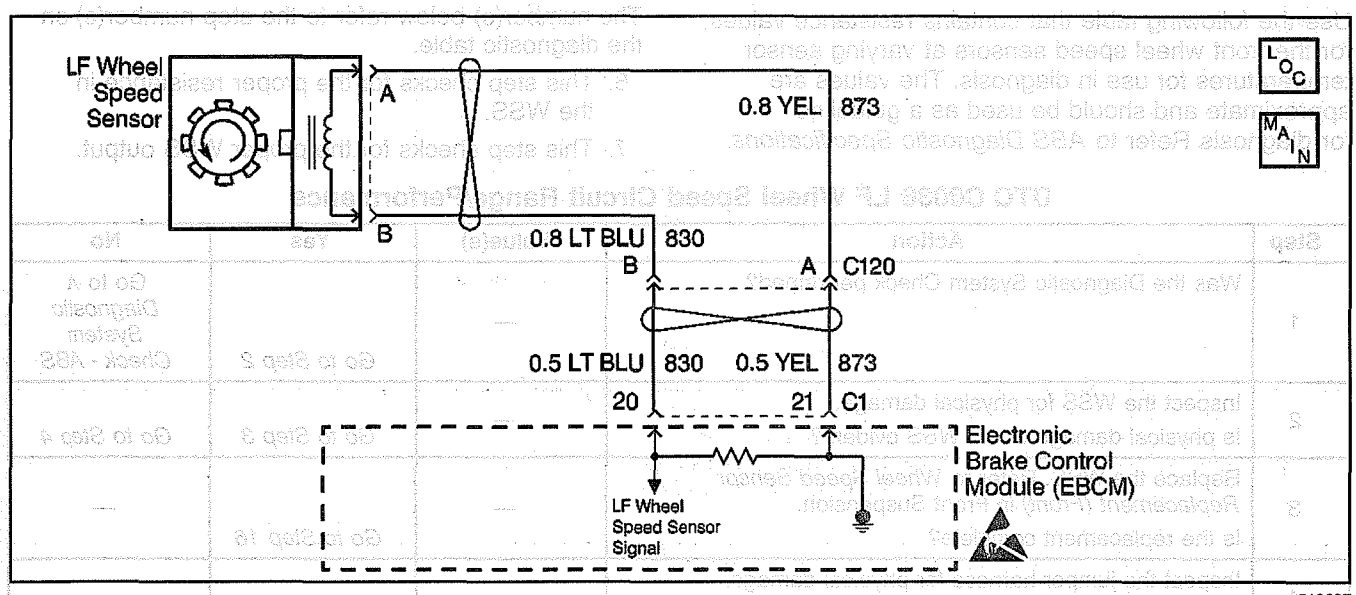
DTC C0035 LF Wheel Speed Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Inspect the WSS for physical damage. Is physical damage of the WSS evident?	—	*Go to Step 3*	*Go to Step 4*
3	Replace the WSS. Refer to *Wheel Speed Sensor Replacement (Front)* in Front Suspension. Is the replacement complete?	—	*Go to Step 18*	—
4	Inspect the jumper harness for physical damage. Is physical damage of the jumper harness evident?	—	*Go to Step 5*	*Go to Step 6*
5	Replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Front Left).* Is the replacement complete?	—	*Go to Step 18*	—
6	1. Turn the ignition switch to the OFF position. 2. Disconnect the EBCM connector C1. 3. Install the *J 39700* Universal Pinout Box using the J 39700-530 cable adapter to the EBCM harness connector C1 only. 4. Using *J 39200* DMM, measure the resistance between terminals 20 and 21 of *J 39700.* Is the resistance within the range specified in the value(s) column?	800–1600 Ω	*Go to Step 13*	*Go to Step 7*
7	1. Disconnect the Wheel Speed Sensor. 2. Using *J 39200* DMM, measure the resistance between terminals A and B of the Wheel Speed Sensor Connector. Is the resistance within the range specified in the value(s) column?	800–1600 Ω	*Go to Step 8*	*Go to Step 3*
8	Using *J 39200* DMM, measure the resistance between terminal 20 of *J 39700* and terminal B of the WSS harness connector. Is the resistance within the range specified in the value(s) column?	0-5Ω	*Go to Step 10*	*Go to Step 9*
9	Repair CKT 830 for an open or high resistance. Refer to *Wiring Repairs.* If an open or high resistance is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Front Left).* Is the repair complete?	—	*Go to Step 18*	—
10	Using *J 39200* DMM, measure the resistance between terminal 21 of *J 39700* and terminal A of the WSS harness connector. Is the resistance within the range specified in the value(s) column?	0-5Ω	*Go to Step 12*	*Go to Step 11*
11	Repair CKT 873 for an open or high resistance. Refer to *Wiring Repairs.* If an open or high resistance is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Front Left).* Is the repair complete?	—	*Go to Step 18*	—

DTC C0035 LF Wheel Speed Circuit Malfunction (cont'd)

Step	Action	Value(s)	Yes	No
12	Malfunction is intermittent. Inspect all connectors and harnesses for damage that may result in an open or high resistance when connected. Refer to *Wiring Repairs*. Is the repair complete?	—	*Go to Step 18*	—
13	1. Disconnect the Wheel Speed Sensor. 2. Turn the ignition switch to the RUN position, engine off. 3. Using *J 39200* DMM, measure the voltage at terminal 20 of *J 39700*. Is the voltage within the range specified in the value(s) column?	Above 1V	*Go to Step 14*	*Go to Step 15*
14	Repair CKT 830 for a short to voltage. Refer to *Wiring Repairs*. If a short to voltage is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Front Left)*. Is the repair complete?	—	*Go to Step 18*	—
15	Using *J 39200* DMM, measure the voltage at terminal 21 of *J 39700*. Is the voltage within the range specified in the value(s) column?	Above 1V	*Go to Step 16*	*Go to Step 17*
16	Repair CKT 873 for a short to voltage. Refer to *Wiring Repairs*. If a short to voltage is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Front Left)*. Is the repair complete?	—	*Go to Step 18*	—
17	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement*. Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
18	1. Reconnect all previously disconnected components. 2. Using a scan tool clear the DTC. 3. Remove the scan tool from the DLC. 4. Carefully drive the vehicle above 12 Km/h (8 mph) for several minutes. Does the DTC reset as a current DTC?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*

DTC C0036 LF Wheel Speed Circuit Range/Performance



519697

Circuit Description

The speed sensor used on this vehicle is a multiple pole magnetic pickup. This sensor produces an AC signal that the EBCM uses the frequency from to calculate the wheel speed.

Conditions for Setting the DTC

- The DTC will set if one wheel speed = 0 and the other WSS are greater than 40 km/h (25 mph) for 10 ms, or if the EBCM detects a short to ground.
- The DTC will set if during drive off, one wheel speed = 0, and the other WSS are greater than 12 km/h (7.5 mph).

Action Taken When the DTC Sets

- A malfunction DTC stores.
- The ABS/TCS disables.
- The amber ABS/TCS indicator(s) turn on.
- The Red BRAKE Warning indicator could turn on.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- 100 ignition cycles pass with no DTC(s) detected.

Important: After the DTC is cleared by ignition cycle default, the vehicle must be driven above 12 km/h (8 mph) for the ABS/TCS indicator(s) to turn off.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness
- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If the customer's comments reflect that the amber ABS/TCS indicator is on only during moist environmental conditions (rain, snow, vehicle wash), inspect all the wheel speed sensor circuitry for signs of water intrusion. If the DTC is not current, clear all DTCs and simulate the effects of water intrusion by using the following procedure:
  1. Spray the suspected area with a five percent saltwater solution.
     Add two teaspoons of salt to twelve ounces of water to make a five percent saltwater solution.
  2. Test drive the vehicle over various road surfaces (bumps, turns, etc.) above 40 km/h (25 mph) for at least 30 seconds.
  3. If the DTC returns, replace the suspected harness.
- If an intermittent malfunction exists refer to *Testing for Intermittent and Poor Connections* in Wiring Systems.

Front Wheel Speed Sensor Resistance

Use the following table that contains resistance values for the front wheel speed sensors at varying sensor temperatures for use in diagnosis. The values are approximate and should be used as a guideline for diagnosis Refer to *ABS Diagnostic Specifications*.

Test Description

The number(s) below refer to the step number(s) on the diagnostic table.

6. This step checks for the proper resistance in the WSS.
7. This step checks for the proper WSS output.

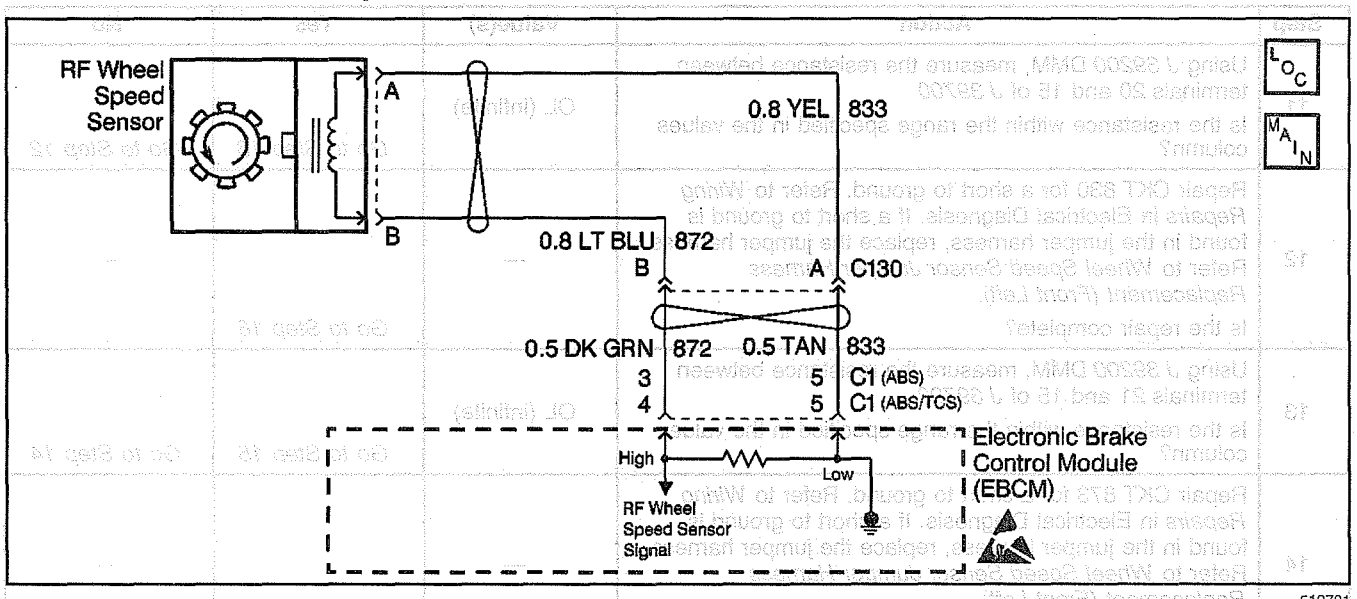
DTC C0036 LF Wheel Speed Circuit Range/Performance

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Inspect the WSS for physical damage. Is physical damage of the WSS evident?	—	*Go to Step 3*	*Go to Step 4*
3	Replace the WSS. Refer to *Wheel Speed Sensor Replacement (Front)* in Front Suspension. Is the replacement complete?	—	*Go to Step 16*	—
4	Inspect the jumper harness for physical damage. Is physical damage of the jumper harness evident?	—	*Go to Step 5*	*Go to Step 6*
5	Replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Front Left)*. Is the replacement complete?	—	*Go to Step 16*	—
6	1. Disconnect the WSS connector directly at the WSS. 2. Using *J 39200* DMM, measure the resistance between terminals A and B of the WSS. Is the resistance within the range specified in the value(s) column?	800–1600 Ω	*Go to Step 7*	*Go to Step 3*
7	1. With the *J 39200* DMM still connected to the WSS select the mV AC scale. 2. Spin the wheel as fast as you can by hand while monitoring the AC output. Is the AC voltage within the range specified in the value(s) column?	Above 100 mV	*Go to Step 8*	*Go to Step 3*
8	Using *J 39200* DMM, measure the resistance between the WSS terminal A and ground. Is the resistance within the range specified in the value(s) column?	OL (infinite)	*Go to Step 9*	*Go to Step 3*
9	1. Disconnect the EBCM harness connector C1. 2. Install the *J 39700* Universal Pinout Box using the J 39700-530 cable adapter to the EBCM harness connector C1 only. 3. Using *J 39200* DMM, measure the resistance between terminals 20 and 21 of *J 39700*. Is the resistance within the range specified in the values column?	OL (infinite)	*Go to Step 11*	*Go to Step 10*
10	Repair short between CKT(s) 830 and 873. Refer to *Wiring Repairs*. If a short between wheel speed sensor circuits is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Front Left)*. Is the repair complete?	—	*Go to Step 16*	—

DTC C0036 LF Wheel Speed Circuit Range/Performance (cont'd)

Step	Action	Value(s)	Yes	No
11	Using *J 39200* DMM, measure the resistance between terminals 20 and 15 of *J 39700*. Is the resistance within the range specified in the values column?	OL (infinite)	*Go to Step 13*	*Go to Step 12*
12	Repair CKT 830 for a short to ground. Refer to *Wiring Repairs* in Electrical Diagnosis. If a short to ground is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Front Left)*. Is the repair complete?	—	*Go to Step 16*	—
13	Using *J 39200* DMM, measure the resistance between terminals 21 and 15 of *J 39700*. Is the resistance within the range specified in the values column?	OL (infinite)	*Go to Step 15*	*Go to Step 14*
14	Repair CKT 873 for a short to ground. Refer to *Wiring Repairs* in Electrical Diagnosis. If a short to ground is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Front Left)*. Is the repair complete?	—	*Go to Step 16*	—
15	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement*. Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
16	1. Reconnect all previously disconnected components. 2. Using a scan tool clear the DTC. 3. Remove the scan tool from the DLC. 4. Carefully drive vehicle above 12 Km/h (8 mph) for several minutes. Does the DTC reset as a current DTC?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*

DTC C0040 RF Wheel Speed Circuit Malfunction



Circuit Description

The speed sensor used on this vehicle is a multiple pole magnetic pickup. This sensor produces an AC signal that the EBCM uses the frequency from to calculate the wheel speed.

Conditions for Setting the DTC

The DTC can be set any time the ignition is in the RUN position and the EBCM detects an open or a short to voltage.

Action Taken When the DTC Sets

- A malfunction DTC stores.
- The ABS/TCS disables.
- The amber ABS/TCS indicator(s) turn on.
- The Red BRAKE Warning indicator could turn on.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- 100 ignition cycles pass with no DTC(s) detected.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness
- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If the customer's comments reflect that the amber ABS/TCS indicator is on only during moist environmental conditions (rain, snow, vehicle wash), inspect all the wheel speed sensor circuitry for signs of water intrusion. If the DTC is not current, clear all DTCs and simulate the effects of water intrusion by using the following procedure:
  1. Spray the suspected area with a five percent saltwater solution.
     Add two teaspoons of salt to twelve ounces of water to make a five percent saltwater solution.
  2. Test drive the vehicle over various road surfaces (bumps, turns, etc.) above 40 km/h (25 mph) for at least 30 seconds.
  3. If the DTC returns, replace the suspected harness.
- If an intermittent malfunction exists refer to *Testing for Intermittent and Poor Connections* in Wiring Systems.

Front Wheel Speed Sensor Resistance

Use the following table that contains resistance values for the front wheel speed sensors at varying sensor temperatures for use in diagnosis. The values are approximate and should be used as a guideline for diagnosis Refer to *ABS Diagnostic Specifications*.

Test Description

The numbers below refer to step numbers on the diagnostic table.

6. This step checks for an open in the WSS or WSS CKT.
13. Checks for a short to voltage in the WSS CKT.
15. Checks for a short to voltage in the WSS CKT.

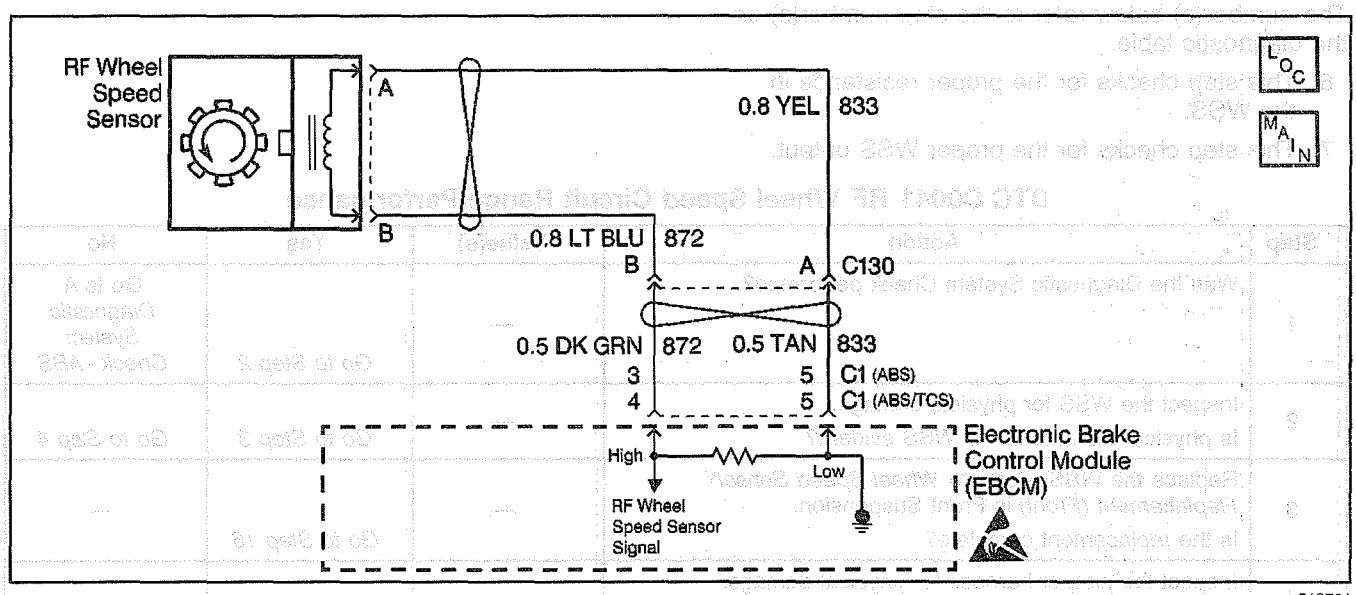
DTC C0040 RF Wheel Speed Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Inspect the WSS for physical damage. Is physical damage of the WSS evident?	—	*Go to Step 3*	*Go to Step 4*
3	Replace the WSS. Refer to *Wheel Speed Sensor Replacement (Front)* in Front Suspension. Is the replacement complete?	—	*Go to Step 18*	—
4	Inspect the jumper harness for physical damage. Is physical damage of the jumper harness evident?	—	*Go to Step 5*	*Go to Step 6*
5	Replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Front Right).* Is the replacement complete?	—	*Go to Step 18*	—
6	1. Turn the ignition switch to the OFF position. 2. Disconnect the EBCM connector C1. 3. Install the *J 39700* Universal Pinout Box using the J 39700-530 cable adapter to the EBCM harness connector C1 only. 4. Using *J 39200* DMM, measure the resistance between terminals 4 and 5 of *J 39700* if the vehicle is equipped with Traction Control. If the vehicle is not equipped with Traction Control then measure the resistance between terminals 3 and 5 of *J 39700.* Is the resistance within the range specified in the value(s) column?	800–1600 Ω	*Go to Step 13*	*Go to Step 7*
7	1. Disconnect the Wheel Speed Sensor. 2. Using *J 39200* DMM, measure the resistance between terminals A and B of the Wheel Speed Sensor Connector. Is the resistance within the range specified in the value(s) column?	800–1600 Ω	*Go to Step 8*	*Go to Step 3*
8	Using *J 39200* DMM, measure the resistance between terminal 4 of *J 39700* and terminal B of the WSS harness connector if the vehicle is equipped with Traction Control. If the vehicle is not equipped with Traction Control measure the resistance between terminal 3 of *J 39700* and terminal B of the WSS harness connector. Is the resistance within the range specified in the value(s) column?	0–5Ω	*Go to Step 10*	*Go to Step 9*
9	Repair CKT 872 for an open or high resistance. Refer to *Wiring Repairs.* If an open or high resistance is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Front Right).* Is the repair complete?	—	*Go to Step 18*	—
10	Using *J 39200* DMM, measure the resistance between terminal 5 of *J 39700* and terminal A of the WSS harness connector. Is the resistance within the range specified in the value(s) column?	0–5Ω	*Go to Step 12*	*Go to Step 11*

DTC C0040 RF Wheel Speed Circuit Malfunction (cont'd)

Step	Action	Value(s)	Yes	No
11	Repair CKT 833 for an open or high resistance. Refer to *Wiring Repairs*. If an open or high resistance is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Front Right)*. Is the repair complete?	—	*Go to Step 18*	—
12	Malfunction is intermittent. Inspect all connectors and harnesses for damage that may result in an open or high resistance when connected. Refer to *Wiring Repairs*. Is the repair complete?	—	*Go to Step 18*	—
13	1. Disconnect the Wheel Speed Sensor. 2. Turn the ignition switch to the RUN position, engine off. 3. Using *J 39200* DMM, measure the voltage at terminal 4 of *J 39700* if the vehicle is equipped with Traction Control. If the vehicle is not equipped with Traction Control measure the voltage at terminal 3 of *J 39700*. Is the voltage within the range specified in the value(s) column?	Above 1V	*Go to Step 14*	*Go to Step 15*
14	Repair CKT 872 for a short to voltage. Refer to *Wiring Repairs*. If a short to voltage is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Front Right)*. Is the repair complete?	—	*Go to Step 18*	—
15	Using *J 39200* DMM, measure the voltage at terminal 5 of *J 39700*. Is the voltage within the range specified in the value(s) column?	Above 1V	*Go to Step 16*	*Go to Step 17*
16	Repair CKT 833 for a short to voltage. Refer to *Wiring Repairs*. If a short to voltage is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Front Right)*. Is the repair complete?	—	*Go to Step 18*	—
17	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement*. Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
18	1. Reconnect all previously disconnected components. 2. Using a scan tool clear the DTC. 3. Remove the scan tool from the DLC. 4. Carefully drive the vehicle above 12 Km/h (8 mph) for several minutes. Does the DTC reset as a current DTC?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*

DTC C0041 RF Wheel Speed Circuit Range/Performance



519701

Circuit Description

The speed sensor used on this vehicle is a multiple pole magnetic pickup. This sensor produces an AC signal that the EBCM uses the frequency from to calculate the wheel speed.

Conditions for Setting the DTC

- The DTC will set if one wheel speed = 0 and the other WSS are greater than 40 km/h (25 mph) for 10 ms, or if the EBCM detects a short to ground.
- The DTC will set if during drive off, one wheel speed = 0, and the other WSS are greater than 12 km/h (7.5 mph).

Action Taken When the DTC Sets

- A malfunction DTC stores.
- The ABS/TCS disables.
- The amber ABS/TCS indicator(s) turn on.
- The Red BRAKE Warning indicator could turn on.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- 100 ignition cycles pass with no DTC(s) detected.

Important: After the DTC is cleared by ignition cycle default, the vehicle must be driven above 12 km/h (8 mph) for the ABS/TCS indicator(s) to turn off.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness
- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If the customer's comments reflect that the amber ABS/TCS indicator is on only during moist environmental conditions (rain, snow, vehicle wash), inspect all the wheel speed sensor circuitry for signs of water intrusion. If the DTC is not current, clear all DTCs and simulate the effects of water intrusion by using the following procedure:
  1. Spray the suspected area with a five percent saltwater solution.

     Add two teaspoons of salt to twelve ounces of water to make a five percent saltwater solution.
  2. Test drive the vehicle over various road surfaces (bumps, turns, etc.) above 40 km/h (25 mph) for at least 30 seconds.
  3. If the DTC returns, replace the suspected harness.
- If an intermittent malfunction exists refer to *Testing for Intermittent and Poor Connections* in Wiring Systems.

Front Wheel Speed Sensor Resistance

Use the following table that contains resistance values for the front wheel speed sensors at varying sensor temperatures for use in diagnosis. The values are approximate and should be used as a guideline for diagnosis. Refer to *ABS Diagnostic Specifications.*

Test Description

The number(s) below refer to the step number(s) on the diagnostic table.

6. This step checks for the proper resistance in the WSS.
7. This step checks for the proper WSS output.

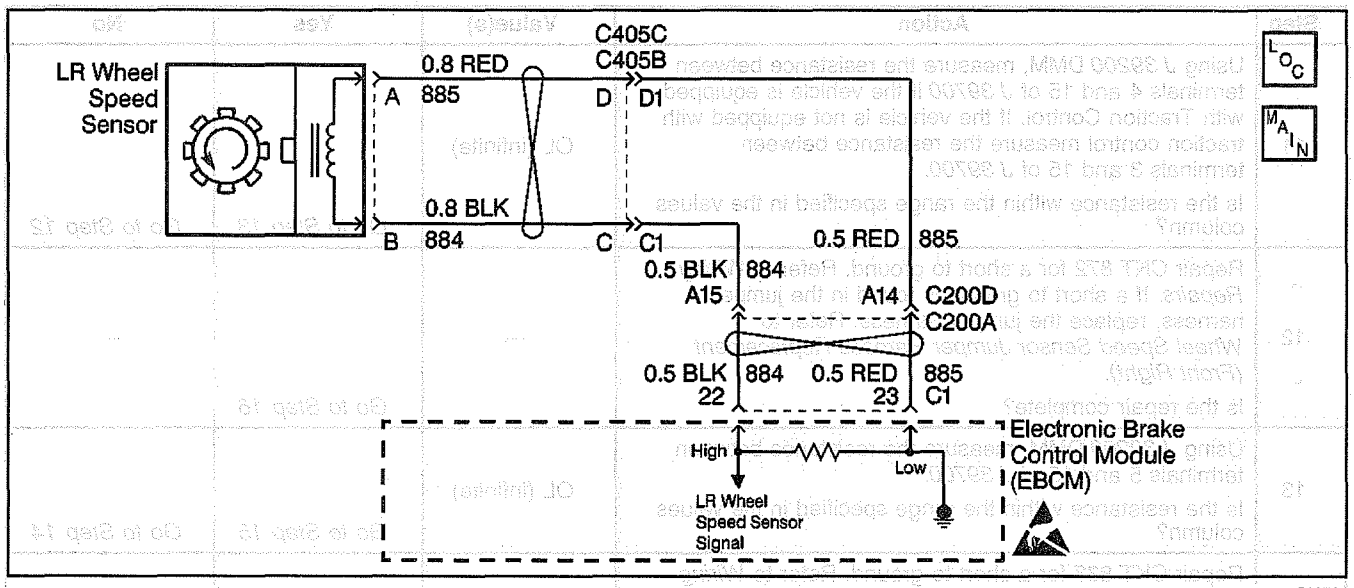
DTC C0041 RF Wheel Speed Circuit Range/Performance

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Inspect the WSS for physical damage. Is physical damage of the WSS evident?	—	*Go to Step 3*	*Go to Step 4*
3	Replace the WSS. Refer to *Wheel Speed Sensor Replacement (Front)* in Front Suspension. Is the replacement complete?	—	*Go to Step 16*	—
4	Inspect the jumper harness for physical damage. Is physical damage of the jumper harness evident?	—	*Go to Step 5*	*Go to Step 6*
5	Replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Front Right).* Is the replacement complete?	—	*Go to Step 16*	—
6	1. Disconnect the WSS connector directly at the WSS. 2. Using *J 39200* DMM, measure the resistance between terminals A and B of the WSS. Is the resistance within the range specified in the value(s) column?	800–1600 Ω	*Go to Step 7*	*Go to Step 3*
7	1. With the *J 39200* DMM still connected to the WSS select the mV AC scale. 2. Spin the wheel as fast as you can by hand while monitoring the AC output. Is the AC voltage within the range specified in the value(s) column?	Above 100 mV	*Go to Step 8*	*Go to Step 3*
8	Using *J 39200* DMM, measure the resistance between the WSS terminal A and ground. Is the resistance within the range specified in the value(s) column?	OL (infinite)	*Go to Step 9*	*Go to Step 3*
9	1. Disconnect the EBCM harness connector C1. 2. Install the *J 39700* Universal Pinout Box using the J 39700-530 cable adapter to the EBCM harness connector C1 only. 3. Using *J 39200* DMM, measure the resistance between terminals 4 and 5 of *J 39700* if the vehicle is equipped with Traction Control. If the vehicle is not equipped with traction control measure the resistance between terminals 3 and 5 of *J 39700.* Is the resistance within the range specified in the values column?	OL (infinite)	*Go to Step 11*	*Go to Step 10*
10	Repair short between CKT(s) 833 and 872. Refer to *Wiring Repairs.* If a short between wheel speed sensor circuits is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Front Right).* Is the repair complete?	—	*Go to Step 16*	—

DTC C0041 RF Wheel Speed Circuit Range/Performance (cont'd)

Step	Action	Value(s)	Yes	No
11	Using *J 39200* DMM, measure the resistance between terminals 4 and 15 of *J 39700* if the vehicle is equipped with Traction Control. If the vehicle is not equipped with traction control measure the resistance between terminals 3 and 15 of *J 39700*. Is the resistance within the range specified in the values column?	OL (infinite)	*Go to Step 13*	*Go to Step 12*
12	Repair CKT 872 for a short to ground. Refer to *Wiring Repairs*. If a short to ground is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Front Right)*. Is the repair complete?	—	*Go to Step 16*	—
13	Using *J 39200* DMM, measure the resistance between terminals 5 and 15 of *J 39700*. Is the resistance within the range specified in the values column?	OL (infinite)	*Go to Step 15*	*Go to Step 14*
14	Repair CKT 833 for a short to ground. Refer to *Wiring Repairs*. If a short to ground is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Front Right)*. Is the repair complete?	—	*Go to Step 16*	—
15	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement*. Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
16	1. Reconnect all previously disconnected components. 2. Using a scan tool clear the DTC. 3. Remove the scan tool from the DLC. 4. Carefully drive vehicle above 12 Km/h (8 mph) for several minutes. Does the DTC reset as a current DTC?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*

DTC C0045 LR Wheel Speed Circuit Malfunction



Circuit Description

The speed sensor used on this vehicle is a single point magnetic pickup. This sensor produces an AC signal that the EBCM uses the frequency from to calculate the wheel speed.

Conditions for Setting the DTC

The DTC can be set any time the ignition is in the RUN position and the EBCM detects an open or a short to voltage.

Action Taken When the DTC Sets

- A malfunction DTC stores.
- The ABS/TCS disables.
- The amber ABS/TCS indicator(s) turn on.
- The Red BRAKE Warning indicator turns on.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- 100 ignition cycles pass with no DTC(s) detected.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness
- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If the customer's comments reflect that the amber ABS/TCS indicator is on only during moist environmental conditions (rain, snow, vehicle wash), inspect all the wheel speed sensor circuitry for signs of water intrusion. If the DTC is not current, clear all DTCs and simulate the effects of water intrusion by using the following procedure:
  1. Spray the suspected area with a five percent saltwater solution.
     Add two teaspoons of salt to twelve ounces of water to make a five percent saltwater solution.
  2. Test drive the vehicle over various road surfaces (bumps, turns, etc.) above 40 km/h (25 mph) for at least 30 seconds.
  3. If the DTC returns, replace the suspected harness.
- If an intermittent malfunction exists refer to *Testing for Intermittent and Poor Connections* in Wiring Systems.

Rear Wheel Speed Sensor Resistance

Use the following table that contains resistance values for the rear wheel speed sensors at varying sensor temperatures for use in diagnosis. The values are approximate and should be used as a guideline for diagnosis. Refer to *ABS Diagnostic Specifications*.

Test Description

The numbers below refer to step numbers on the diagnostic table.

6. This step checks for an open in the WSS or WSS CKT.
13. Checks for a short to voltage in the WSS CKT.
15. Checks for a short to voltage in the WSS CKT.

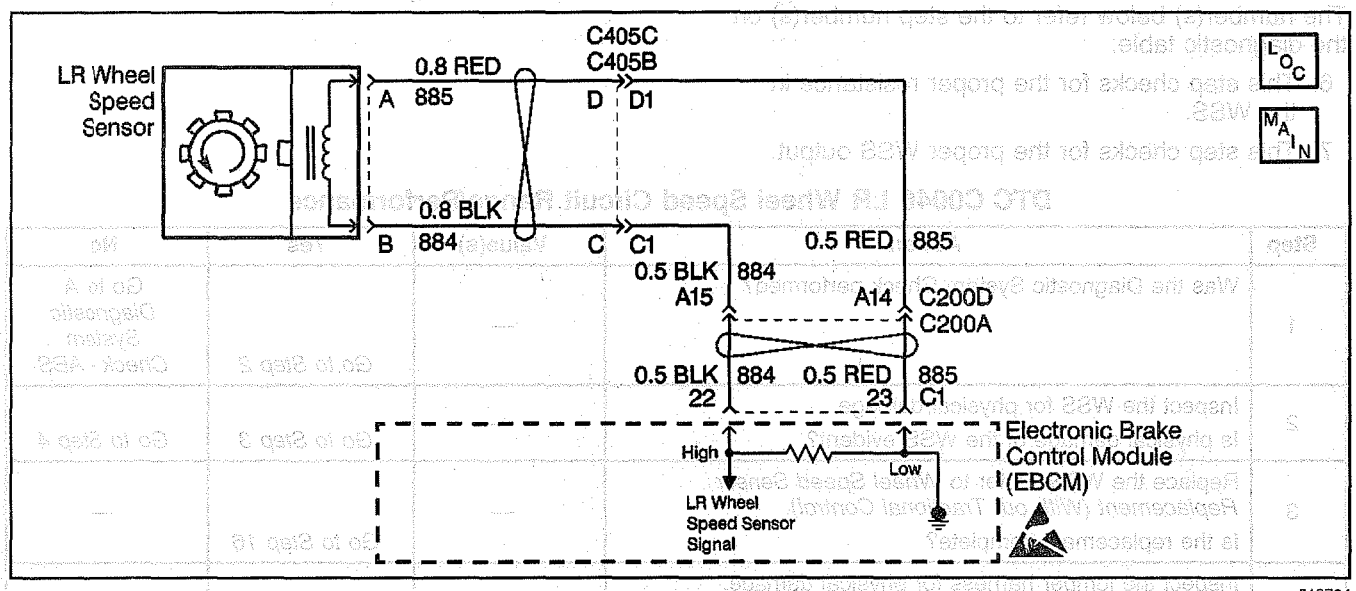
DTC C0045 LR Wheel Speed Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Inspect the WSS for physical damage. Is physical damage of the WSS evident?	—	*Go to Step 3*	*Go to Step 4*
3	Replace the WSS. Refer to *Wheel Speed Sensor Replacement (With out Tractional Control).* Is the replacement complete?	—	*Go to Step 18*	—
4	Inspect the jumper harness for physical damage. Is physical damage of the jumper harness evident?	—	*Go to Step 5*	*Go to Step 6*
5	Replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with Traction Control).* Is the replacement complete?	—	*Go to Step 18*	—
6	1. Turn the ignition switch to the OFF position. 2. Disconnect the EBCM connector C1. 3. Install the *J 39700* Universal Pinout Box using the J 39700-530 cable adapter to the EBCM harness connector C1 only. 4. Using *J 39200* DMM, measure the resistance between terminals 22 and 23 of *J 39700.* Is the resistance within the range specified in the value(s) column?	2032–4266Ω	*Go to Step 13*	*Go to Step 7*
7	1. Disconnect the Wheel Speed Sensor. 2. Using *J 39200* DMM, measure the resistance between terminals A and B of the Wheel Speed Sensor Connector. Is the resistance within the range specified in the value(s) column?	2032–4266Ω	*Go to Step 8*	*Go to Step 3*
8	Using *J 39200* DMM, measure the resistance between terminal 22 of *J 39700* and terminal B of the WSS harness connector. Is the resistance within the range specified in the value(s) column?	0-5Ω	*Go to Step 10*	*Go to Step 9*
9	Repair CKT 884 for an open or high resistance. Refer to *Wiring Repairs.* If an open or high resistance is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with Traction Control).* Is the repair complete?	—	*Go to Step 18*	—
10	Using *J 39200* DMM, measure the resistance between terminal 23 of *J 39700* and terminal A of the WSS harness connector. Is the resistance within the range specified in the value(s) column?	0-5Ω	*Go to Step 12*	*Go to Step 11*
11	Repair CKT 885 for an open or high resistance. Refer to *Wiring Repairs.* If an open or high resistance is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with Traction Control).* Is the repair complete?	—	*Go to Step 18*	—

DTC C0045 LR Wheel Speed Circuit Malfunction (cont'd)

Step	Action	Value(s)	Yes	No
12	Malfunction is intermittent. Inspect all connectors and harnesses for damage that may result in an open or high resistance when connected. Refer to *Wiring Repairs*. Is the repair complete?	—	*Go to Step 18*	—
13	1. Disconnect the Wheel Speed Sensor. 2. Turn the ignition switch to the RUN position, engine off. 3. Using *J 39200* DMM, measure the voltage at terminal 22 of *J 39700*. Is the voltage within the range specified in the value(s) column?	Above 1V	*Go to Step 14*	*Go to Step 15*
14	Repair CKT 884 for a short to voltage. Refer to *Wiring Repairs*. If a short to voltage is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with Traction Control)*. Is the repair complete?	—	*Go to Step 18*	—
15	Using *J 39200* DMM, measure the voltage at terminal 23 of *J 39700*. Is the voltage within the range specified in the value(s) column?	Above 1V	*Go to Step 16*	*Go to Step 17*
16	Repair CKT 885 for a short to voltage. Refer to *Wiring Repairs*. If a short to voltage is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with Traction Control)*. Is the repair complete?	—	*Go to Step 18*	—
17	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement*. Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
18	1. Reconnect all previously disconnected components. 2. Using a scan tool clear the DTC. 3. Remove the scan tool from the DLC. 4. Carefully drive the vehicle above 12 Km/h (8 mph) for several minutes. Does the DTC reset as a current DTC?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*

DTC C0046 LR Wheel Speed Circuit Range/Performance



Circuit Description

The speed sensor used on this vehicle is a single point magnetic pickup. This sensor produces an AC signal that the EBCM uses the frequency from to calculate the wheel speed.

Conditions for Setting the DTC

- The DTC will set if one wheel speed = 0 and the other WSS are greater than 40 Km/h (25 mph) for 10 ms, or if the EBCM detects a short to ground.
- The DTC will set if during drive off, one wheel speed = 0, and the other WSS are greater than 12 Km/h (7.5 mph).

Action Taken When the DTC Sets

- A malfunction DTC stores.
- The ABS/TCS disables.
- The amber ABS/TCS indicator(s) turn on.
- The Red BRAKE Warning indicator turns on.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- 100 ignition cycles pass with no DTC(s) detected.

Important: After the DTC is cleared by ignition cycle default, the vehicle must be driven above 12 Km/h (8 mph) for the ABS/TCS indicator(s) to turn off.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness
- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If the customer's comments reflect that the amber ABS/TCS indicator is on only during moist environmental conditions (rain, snow, vehicle wash), inspect all the wheel speed sensor circuitry for signs of water intrusion. If the DTC is not current, clear all DTCs and simulate the effects of water intrusion by using the following procedure:
  1. Spray the suspected area with a five percent saltwater solution.

     Add two teaspoons of salt to twelve ounces of water to make a five percent saltwater solution.
  2. Test drive the vehicle over various road surfaces (bumps, turns, etc.) above 40 km/h (25 mph) for at least 30 seconds.
  3. If the DTC returns, replace the suspected harness.
- If an intermittent malfunction exists refer to *Testing for Intermittent and Poor Connections* in Wiring Systems.

Rear Wheel Speed Sensor Resistance

Use the following table that contains resistance values for the rear wheel speed sensors at varying sensor temperatures for use in diagnosis. The values are approximate and should be used as a guideline for diagnosis. Refer to *ABS Diagnostic Specifications*.

Test Description

The number(s) below refer to the step number(s) on the diagnostic table.

6. This step checks for the proper resistance in the WSS.
7. This step checks for the proper WSS output.

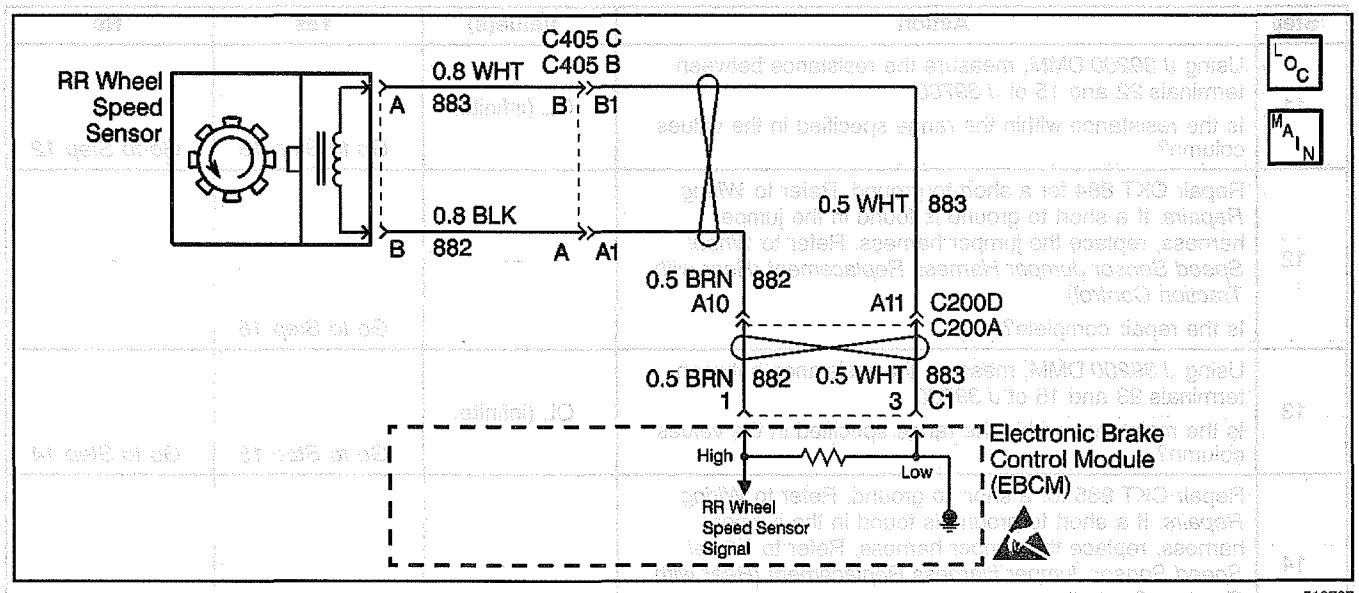
DTC C0046 LR Wheel Speed Circuit Range/Performance

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Inspect the WSS for physical damage. Is physical damage of the WSS evident?	—	*Go to Step 3*	*Go to Step 4*
3	Replace the WSS. Refer to *Wheel Speed Sensor Replacement (With out Tractional Control).* Is the replacement complete?	—	*Go to Step 16*	—
4	Inspect the jumper harness for physical damage. Is physical damage of the jumper harness evident?	—	*Go to Step 5*	*Go to Step 6*
5	Replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with Traction Control).* Is the replacement complete?	—	*Go to Step 16*	—
6	1. Disconnect the WSS connector directly at the WSS. 2. Using *J 39200* DMM, measure the resistance between terminals A and B of the WSS. Is the resistance within the range specified in the value(s) column?	2032–4266 Ω	*Go to Step 7*	*Go to Step 3*
7	1. With the *J 39200* DMM still connected to the WSS select the mV AC scale. 2. Spin the wheel as fast as you can by hand while monitoring the AC output. Is the AC voltage within the range specified in the value(s) column?	Above 100 mV	*Go to Step 8*	*Go to Step 3*
8	Using *J 39200* DMM, measure the resistance between the WSS terminal A and ground. Is the resistance within the range specified in the value(s) column?	OL (infinite)	*Go to Step 9*	*Go to Step 3*
9	1. Disconnect the EBCM harness connector C1. 2. Install the *J 39700* Universal Pinout Box using the J 39700-530 cable adapter to the EBCM harness connector C1 only. 3. Using *J 39200* DMM, measure the resistance between terminals 22 and 23 of *J 39700.* Is the resistance within the range specified in the values column?	OL (infinite)	*Go to Step 11*	*Go to Step 10*
10	Repair short between CKT(s) 884 and 885. Refer to *Wiring Repairs.* If a between wheel speed sensor circuits is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with Traction Control).* Is the repair complete?	—	*Go to Step 16*	—

DTC C0046 LR Wheel Speed Circuit Range/Performance (cont'd)

Step	Action	Value(s)	Yes	No
11	Using *J 39200* DMM, measure the resistance between terminals 22 and 15 of *J 39700*. Is the resistance within the range specified in the values column?	OL (infinite)	*Go to Step 13*	*Go to Step 12*
12	Repair CKT 884 for a short to ground. Refer to *Wiring Repairs*. If a short to ground is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with Traction Control)*. Is the repair complete?	—	*Go to Step 16*	—
13	Using *J 39200* DMM, measure the resistance between terminals 23 and 15 of *J 39700*. Is the resistance within the range specified in the values column?	OL (infinite)	*Go to Step 15*	*Go to Step 14*
14	Repair CKT 885 for a short to ground. Refer to *Wiring Repairs*. If a short to ground is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with Traction Control)*. Is the repair complete?	—	*Go to Step 16*	—
15	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement*. Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
16	1. Reconnect all previously disconnected components. 2. Using a scan tool clear the DTC. 3. Remove the scan tool from the DLC. 4. Carefully drive vehicle above 12 Km/h (8 mph) for several minutes. Does the DTC reset as a current DTC?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*

DTC C0050 RR Wheel Speed Circuit Malfunction



Circuit Description

The speed sensor used on this vehicle is a single point magnetic pickup. This sensor produces an AC signal that the EBCM uses the frequency from to calculate the wheel speed.

Conditions for Setting the DTC

The DTC can be set any time the ignition is in the RUN position and the EBCM detects an open or a short to voltage.

Action Taken When the DTC Sets

- A malfunction DTC stores.
- The ABS/TCS disables.
- The amber ABS/TCS indicator(s) turn on.
- The Red BRAKE Warning indicator turns on.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- 100 ignition cycles pass with no DTC(s) detected.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness
- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If the customer's comments reflect that the amber ABS/TCS indicator is on only during moist environmental conditions (rain, snow, vehicle wash), inspect all the wheel speed sensor circuitry for signs of water intrusion. If the DTC is not current, clear all DTCs and simulate the effects of water intrusion by using the following procedure:
  1. Spray the suspected area with a five percent saltwater solution.
     Add two teaspoons of salt to twelve ounces of water to make a five percent saltwater solution.
  2. Test drive the vehicle over various road surfaces (bumps, turns, etc.) above 40 km/h (25 mph) for at least 30 seconds.
  3. If the DTC returns, replace the suspected harness.
- If an intermittent malfunction exists refer to *Testing for Intermittent and Poor Connections* in Wiring Systems.

Rear Wheel Speed Sensor Resistance

Use the following table that contains resistance values for the rear wheel speed sensors at varying sensor temperatures for use in diagnosis. The values are approximate and should be used as a guideline for diagnosis. Refer to *ABS Diagnostic Specifications.*

Test Description

The numbers below refer to step numbers on the diagnostic table.

6. This step checks for an open in the WSS or WSS CKT.
13. Checks for a short to voltage in the WSS CKT.
15. Checks for a short to voltage in the WSS CKT.

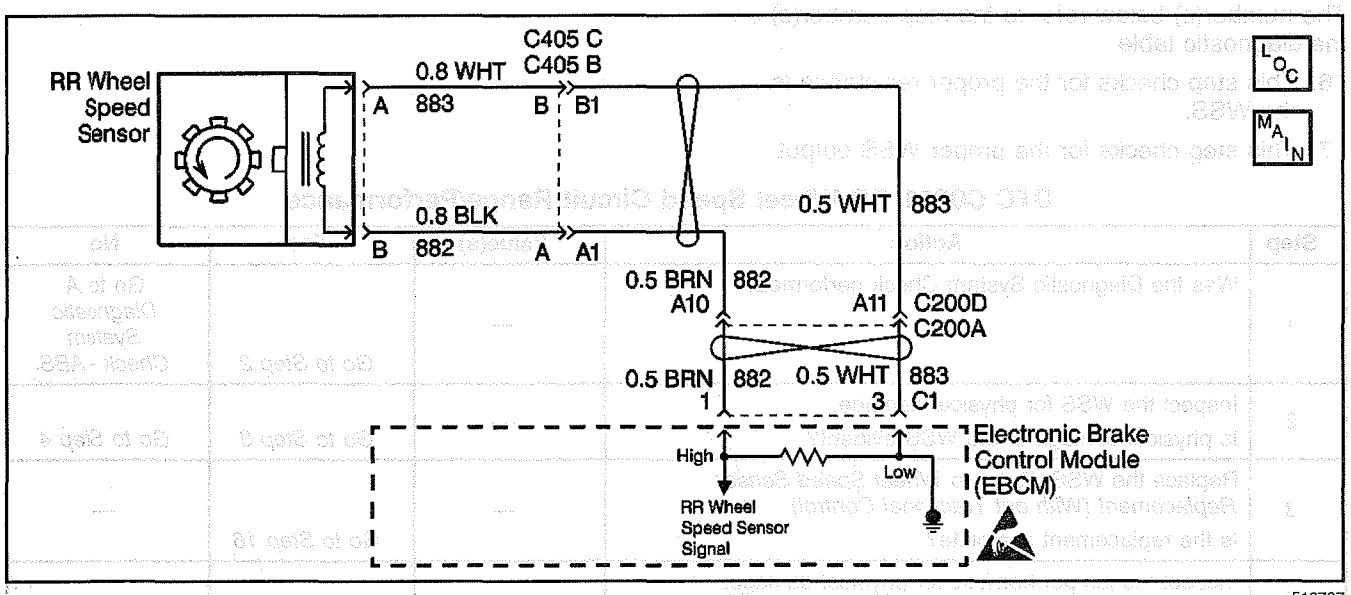
DTC C0050 RR Wheel Speed Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Inspect the WSS for physical damage. Is physical damage of the WSS evident?	—	*Go to Step 3*	*Go to Step 4*
3	Replace the WSS. Refer to *Wheel Speed Sensor Replacement (With out Tractional Control).* Is the replacement complete?	—	*Go to Step 18*	—
4	Inspect the jumper harness for physical damage. Is physical damage of the jumper harness evident?	—	*Go to Step 5*	*Go to Step 6*
5	Replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with Traction Control).* Is the replacement complete?	—	*Go to Step 18*	—
6	1. Turn the ignition switch to the OFF position. 2. Disconnect the EBCM connector C1. 3. Install the *J 39700* Universal Pinout Box using the J 39700-530 cable adapter to the EBCM harness connector C1 only. 4. Using *J 39200* DMM, measure the resistance between terminals 1 and 3 of *J 39700.* Is the resistance within the range specified in the value(s) column?	2032–4266Ω	*Go to Step 13*	*Go to Step 7*
7	1. Disconnect the Wheel Speed Sensor. 2. Using *J 39200* DMM, measure the resistance between terminals A and B of the Wheel Speed Sensor Connector. Is the resistance within the range specified in the value(s) column?	2032–4266Ω	*Go to Step 8*	*Go to Step 3*
8	Using *J 39200* DMM, measure the resistance between terminal 1 of *J 39700* and terminal B of the WSS harness connector. Is the resistance within the range specified in the value(s) column?	0-5Ω	*Go to Step 10*	*Go to Step 9*
9	Repair CKT 882 for an open or high resistance. Refer to *Wiring Repairs.* If an open or high resistance is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with Traction Control).* Is the repair complete?	—	*Go to Step 18*	—
10	Using *J 39200* DMM, measure the resistance between terminal 3 of *J 39700* and terminal A of the WSS harness connector. Is the resistance within the range specified in the value(s) column?	0-5Ω	*Go to Step 12*	*Go to Step 11*
11	Repair CKT 883 for an open or high resistance. Refer to *Wiring Repairs.* If an open or high resistance is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with Traction Control).* Is the repair complete?	—	*Go to Step 18*	—

DTC C0050 RR Wheel Speed Circuit Malfunction (cont'd)

Step	Action	Value(s)	Yes	No
12	Malfunction is intermittent. Inspect all connectors and harnesses for damage that may result in an open or high resistance when connected. Refer to *Wiring Repairs.* Is the repair complete?	—	*Go to Step 18*	—
13	1. Disconnect the Wheel Speed Sensor. 2. Turn the ignition switch to the RUN position, engine off. 3. Using *J 39200* DMM, measure the voltage at terminal 1 of *J 39700.* Is the voltage within the range specified in the value(s) column?	Above 1V	*Go to Step 14*	*Go to Step 15*
14	Repair CKT 882 for a short to voltage. Refer to *Wiring Repairs.* If a short to voltage is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with Traction Control).* Is the repair complete?	—	*Go to Step 18*	—
15	Using *J 39200* DMM, measure the voltage at terminal 3 of *J 39700.* Is the voltage within the range specified in the value(s) column?	Above 1V	*Go to Step 16*	*Go to Step 17*
16	Repair CKT 883 for a short to voltage. Refer to *Wiring Repairs.* If a short to voltage is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with Traction Control).* Is the repair complete?	—	*Go to Step 18*	—
17	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
18	1. Reconnect all previously disconnected components. 2. Using a scan tool clear the DTC. 3. Remove the scan tool from the DLC. 4. Carefully drive the vehicle above 12 Km/h (8 mph) for several minutes. Does the DTC reset as a current DTC?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*

DTC C0051 RR Wheel Speed Circuit Range/Performance



Circuit Description

The speed sensor used on this vehicle is a single point magnetic pickup. This sensor produces an AC signal that the EBCM uses the frequency from to calculate the wheel speed.

Conditions for Setting the DTC

- The DTC will set if one wheel speed = 0 and the other WSS are greater than 40 km/h (25 mph) for 10 ms, or if the EBCM detects a short to ground.
- The DTC will set if during drive off, one wheel speed = 0, and the other WSS are greater than 12 km/h (7.5 mph).

Action Taken When the DTC Sets

- A malfunction DTC stores.
- The ABS/TCS disables.
- The amber ABS/TCS indicator(s) turn on.
- The Red BRAKE Warning indicator turns on.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- 100 ignition cycles pass with no DTC(s) detected.

Important: After the DTC is cleared by ignition cycle default, the vehicle must be driven above 12 km/h (8 mph) for the ABS/TCS indicator(s) to turn off.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness
- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If the customer's comments reflect that the amber ABS/TCS indicator is on only during moist environmental conditions (rain, snow, vehicle wash), inspect all the wheel speed sensor circuitry for signs of water intrusion. If the DTC is not current, clear all DTCs and simulate the effects of water intrusion by using the following procedure:
  1. Spray the suspected area with a five percent saltwater solution.

     Add two teaspoons of salt to twelve ounces of water to make a five percent saltwater solution.
  2. Test drive the vehicle over various road surfaces (bumps, turns, etc.) above 40 km/h (25 mph) for at least 30 seconds.
  3. If the DTC returns, replace the suspected harness.
- If an intermittent malfunction exists refer to *Testing for Intermittent and Poor Connections* in Wiring Systems.

Rear Wheel Speed Sensor Resistance

Use the following table that contains resistance values for the rear wheel speed sensors at varying sensor temperatures for use in diagnosis. The values are approximate and should be used as a guideline for diagnosis. Refer to *ABS Diagnostic Specifications.*

Test Description

The number(s) below refer to the step number(s) on the diagnostic table.

6. This step checks for the proper resistance in the WSS.
7. This step checks for the proper WSS output.

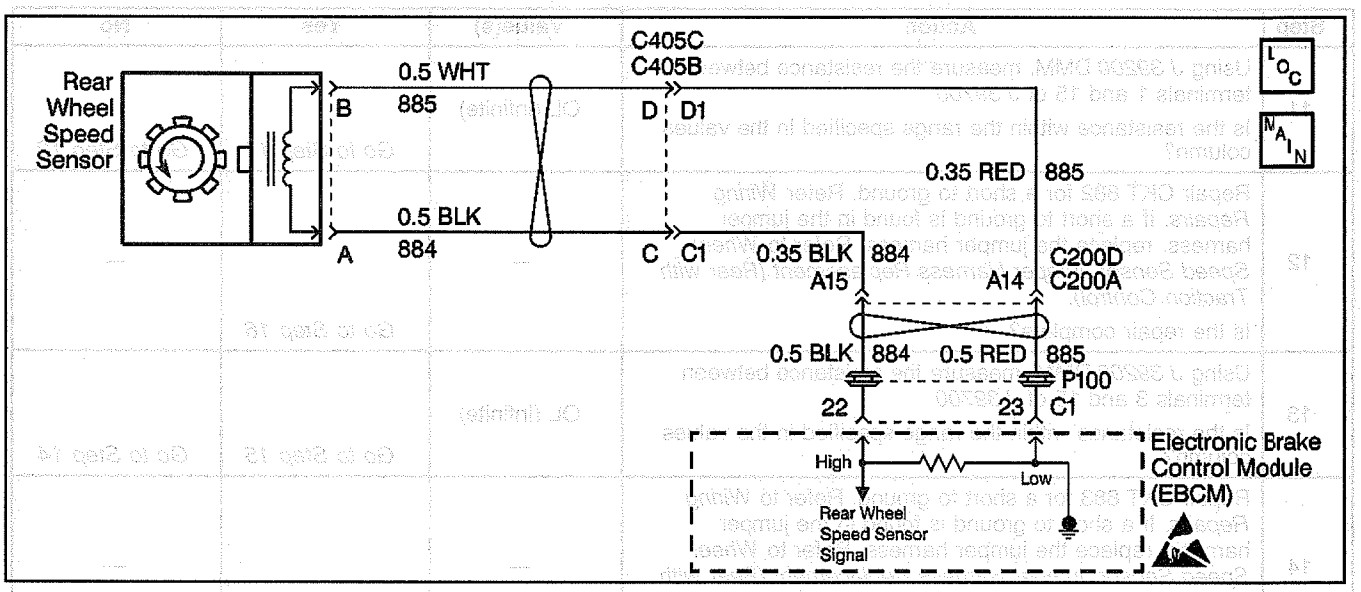
DTC C0051 RR Wheel Speed Circuit Range/Performance

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Inspect the WSS for physical damage. Is physical damage of the WSS evident?	—	*Go to Step 3*	*Go to Step 4*
3	Replace the WSS. Refer to *Wheel Speed Sensor Replacement (With out Tractional Control).* Is the replacement complete?	—	*Go to Step 16*	—
4	Inspect the jumper harness for physical damage. Is physical damage of the jumper harness evident?	—	*Go to Step 5*	*Go to Step 6*
5	Replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with Traction Control).* Is the replacement complete?	—	*Go to Step 16*	—
6	1. Disconnect the WSS connector directly at the WSS. 2. Using *J 39200* DMM, measure the resistance between terminals A and B of the WSS. Is the resistance within the range specified in the value(s) column?	2032–4266 Ω	*Go to Step 7*	*Go to Step 3*
7	1. With the *J 39200* DMM still connected to the WSS select the mV AC scale. 2. Spin the wheel as fast as you can by hand while monitoring the AC output. Is the AC voltage within the range specified in the value(s) column?	Above 100 mV	*Go to Step 8*	*Go to Step 3*
8	Using *J 39200* DMM, measure the resistance between the WSS terminal A and ground. Is the resistance within the range specified in the value(s) column?	OL (infinite)	*Go to Step 9*	*Go to Step 3*
9	1. Disconnect the EBCM harness connector C1. 2. Install the *J 39700* Universal Pinout Box using the J 39700-530 cable adapter to the EBCM harness connector C1 only. 3. Using *J 39200* DMM, measure the resistance between terminals 1 and 3 of *J 39700.* Is the resistance within the range specified in the values column?	OL (infinite)	*Go to Step 11*	*Go to Step 10*
10	Repair short between CKT(s) 882 and 883. Refer to *Wiring Repairs.* If a short between wheel speed sensor circuits is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with Traction Control).* Is the repair complete?	—	*Go to Step 16*	—

DTC C0051 RR Wheel Speed Circuit Range/Performance (cont'd)

Step	Action	Value(s)	Yes	No
11	Using *J 39200* DMM, measure the resistance between terminals 1 and 15 of *J 39700*. Is the resistance within the range specified in the values column?	OL (infinite)	*Go to Step 13*	*Go to Step 12*
12	Repair CKT 882 for a short to ground. Refer *Wiring Repairs*. If a short to ground is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with Traction Control)*. Is the repair complete?	—	*Go to Step 16*	—
13	Using *J 39200* DMM, measure the resistance between terminals 3 and 15 of *J 39700*. Is the resistance within the range specified in the values column?	OL (infinite)	*Go to Step 15*	*Go to Step 14*
14	Repair CKT 883 for a short to ground. Refer to *Wiring Repairs*. If a short to ground is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with Traction Control)*. Is the repair complete?	—	*Go to Step 16*	—
15	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement*. Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
16	1. Reconnect all previously disconnected components. 2. Using a scan tool clear the DTC. 3. Remove the scan tool from the DLC. 4. Carefully drive vehicle above 12 Km/h (8 mph) for several minutes. Does the DTC reset as a current DTC?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*

DTC C0055 Rear Wheel Speed Circuit Malfunction



Circuit Description

The speed sensor used on this vehicle is a single point magnetic pickup. This sensor produces an AC signal that the EBCM uses the frequency from to calculate the wheel speed.

Conditions for Setting the DTC

The DTC can be set any time the ignition is in the RUN position and the EBCM detects an open or a short to voltage.

Action Taken When the DTC Sets

- A malfunction DTC stores.
- The ABS disables.
- The amber ABS indicator turns on.
- The Red BRAKE Warning indicator turns on.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- 100 ignition cycles pass with no DTC(s) detected.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness
- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If the customer's comments reflect that the amber ABS indicator is on only during moist environmental conditions (rain, snow, vehicle wash), inspect all the wheel speed sensor circuitry for signs of water intrusion. If the DTC is not current, clear all DTCs and simulate the effects of water intrusion by using the following procedure:
  1. Spray the suspected area with a five percent saltwater solution.
     Add two teaspoons of salt to twelve ounces of water to make a five percent saltwater solution.
  2. Test drive the vehicle over various road surfaces (bumps, turns, etc.) above 40 km/h (25 mph) for at least 30 seconds.
  3. If the DTC returns, replace the suspected harness.
- If an intermittent malfunction exists refer to *Testing for Intermittent and Poor Connections* in Wiring Systems.

Rear Wheel Speed Sensor Resistance

Use the following table that contains resistance values for the rear wheel speed sensors at varying sensor temperatures for use in diagnosis. The values are approximate and should be used as a guideline for diagnosis. Refer to *ABS Diagnostic Specifications.*

Test Description

The numbers below refer to step numbers on the diagnostic table.

6. This step checks for an open in the WSS or WSS CKT.
13. Checks for a short to voltage in the WSS CKT.
15. Checks for a short to voltage in the WSS CKT.

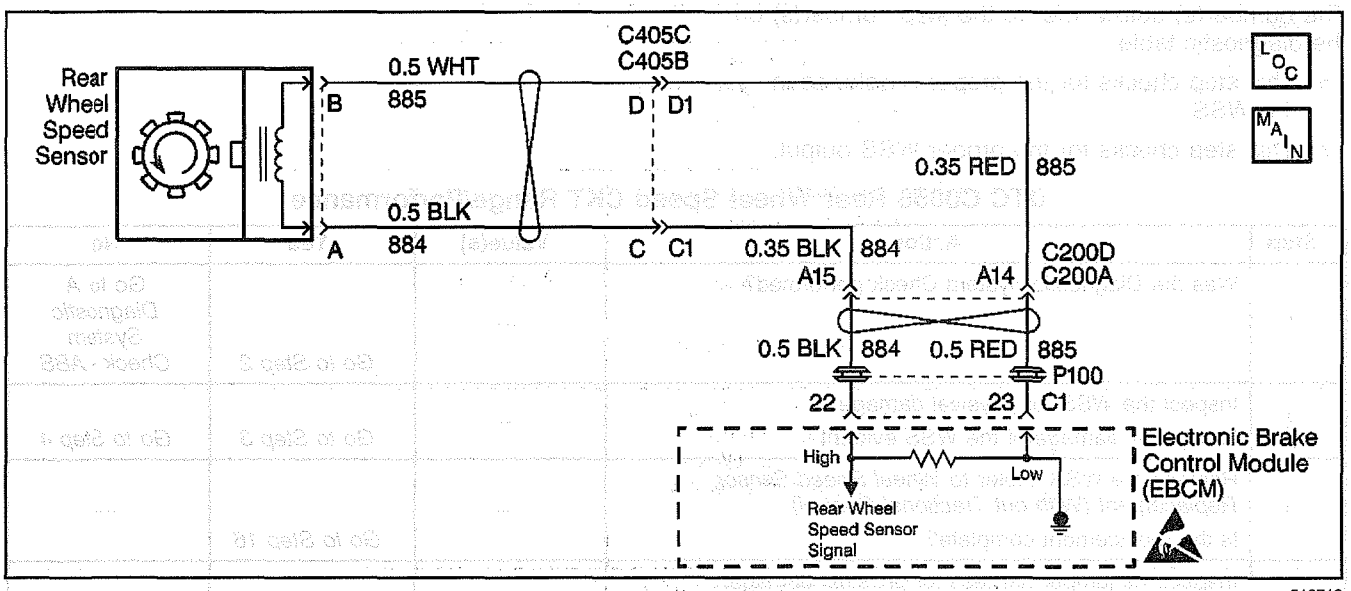
DTC C0055 Rear Wheel Speed Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Inspect the WSS for physical damage. Is physical damage of the WSS evident?	—	*Go to Step 3*	*Go to Step 4*
3	Replace the WSS. Refer to *Wheel Speed Sensor Replacement (With out Tractional Control).* Is the replacement complete?	—	*Go to Step 18*	—
4	Inspect the jumper harness for physical damage. Is physical damage of the jumper harness evident?	—	*Go to Step 5*	*Go to Step 6*
5	Replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with out Traction Control).* Is the replacement complete?	—	*Go to Step 18*	—
6	1. Turn the ignition switch to the OFF position. 2. Disconnect the EBCM connector C1. 3. Install the *J 39700* Universal Pinout Box using the J 39700-530 cable adapter to the EBCM harness connector C1 only. 4. Using *J 39200* DMM, measure the resistance between terminals 22 and 23 of *J 39700.* Is the resistance within the range specified in the value(s) column?	763–1525Ω	*Go to Step 13*	*Go to Step 7*
7	1. Disconnect the Wheel Speed Sensor. 2. Using *J 39200* DMM, measure the resistance between terminals A and B of the Wheel Speed Sensor Connector. Is the resistance within the range specified in the value(s) column?	763–1525Ω	*Go to Step 8*	*Go to Step 3*
8	Using *J 39200* DMM, measure the resistance between terminal 22 of *J 39700* and terminal A of the WSS harness connector. Is the resistance within the range specified in the value(s) column?	0-5Ω	*Go to Step 10*	*Go to Step 9*
9	Repair CKT 884 for an open or high resistance. Refer to *Wiring Repairs.* If an open or high resistance is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with out Traction Control).* Is the repair complete?	—	*Go to Step 18*	—
10	Using *J 39200* DMM, measure the resistance between terminal 23 of *J 39700* and terminal B of the WSS harness connector. Is the resistance within the range specified in the value(s) column?	0-5Ω	*Go to Step 12*	*Go to Step 11*
11	Repair CKT 885 for an open or high resistance. Refer to *Wiring Repairs.* If an open or high resistance is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with out Traction Control).* Is the repair complete?	—	*Go to Step 18*	—

DTC C0055 Rear Wheel Speed Circuit Malfunction (cont'd)

Step	Action	Value(s)	Yes	No
12	Malfunction is intermittent. Inspect all connectors and harnesses for damage that may result in an open or high resistance when connected. Refer to *Wiring Repairs*. Is the repair complete?	—	*Go to Step 18*	—
13	1. Disconnect the Wheel Speed Sensor. 2. Turn the ignition switch to the RUN position, engine off. 3. Using *J 39200* DMM, measure the voltage at terminal 22 of *J 39700*. Is the voltage within the range specified in the value(s) column?	Above 1V	*Go to Step 14*	*Go to Step 15*
14	Repair CKT 884 for a short to voltage. Refer to *Wiring Repairs*. If a short to voltage is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with out Traction Control)*. Is the repair complete?	—	*Go to Step 18*	—
15	Using *J 39200* DMM, measure the voltage at terminal 23 of *J 39700*. Is the voltage within the range specified in the value(s) column?	Above 1V	*Go to Step 16*	*Go to Step 17*
16	Repair CKT 885 for a short to voltage. Refer to *Wiring Repairs*. If a short to voltage is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with out Traction Control)*. Is the repair complete?	—	*Go to Step 18*	—
17	Replace the EBCM. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with out Traction Control)*. Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
18	1. Reconnect all previously disconnected components. 2. Using a scan tool clear the DTC. 3. Remove the scan tool from the DLC. 4. Carefully drive the vehicle above 12 Km/h (8 mph) for several minutes. Does the DTC reset as a current DTC?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*

DTC C0056 Rear Wheel Speed CKT Range/Performance



Circuit Description

The speed sensor used on this vehicle is a single point magnetic pickup. This sensor produces an AC signal that the EBCM uses the frequency from to calculate the wheel speed.

Conditions for Setting the DTC

- The DTC will set if one wheel speed = 0 and the other WSS are greater than 40 km/h (25 mph) for 10 ms, or if the EBCM detects a short to ground.
- The DTC will set if during drive off, one wheel speed = 0, and the other WSS are greater than 12 km/h (7.5 mph).

Action Taken When the DTC Sets

- A malfunction DTC stores.
- The ABS disables.
- The amber ABS indicator turns on.
- The Red BRAKE Warning indicator turns on.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- 100 ignition cycles pass with no DTC(s) detected.

Important: After the DTC is cleared by ignition cycle default, the vehicle must be driven above 12 km/h (8 mph) for the ABS/TCS indicator(s) to turn off.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness
- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If the customer's comments reflect that the amber ABS indicator is on only during moist environmental conditions (rain, snow, vehicle wash), inspect all the wheel speed sensor circuitry for signs of water intrusion. If the DTC is not current, clear all DTCs and simulate the effects of water intrusion by using the following procedure:
  1. Spray the suspected area with a five percent saltwater solution.

     Add two teaspoons of salt to twelve ounces of water to make a five percent saltwater solution.
  2. Test drive the vehicle over various road surfaces (bumps, turns, etc.) above 40 km/h (25 mph) for at least 30 seconds.
  3. If the DTC returns, replace the suspected harness.
- If an intermittent malfunction exists refer to *Testing for Intermittent and Poor Connections* in Wiring Systems.

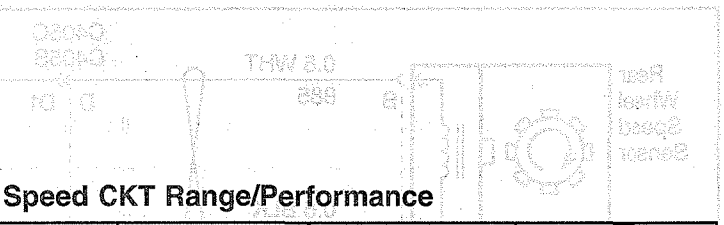
Rear Wheel Speed Sensor Resistance

Use the following table that contains resistance values for the rear wheel speed sensors at varying sensor temperatures for use in diagnosis. The values are approximate and should be used as a guideline for diagnosis. Refer to *ABS Diagnostic Specifications*.

Test Description

The number(s) below refer to the step number(s) on the diagnostic table.

6. This step checks for the proper resistance in the WSS.
7. This step checks for the proper WSS output.



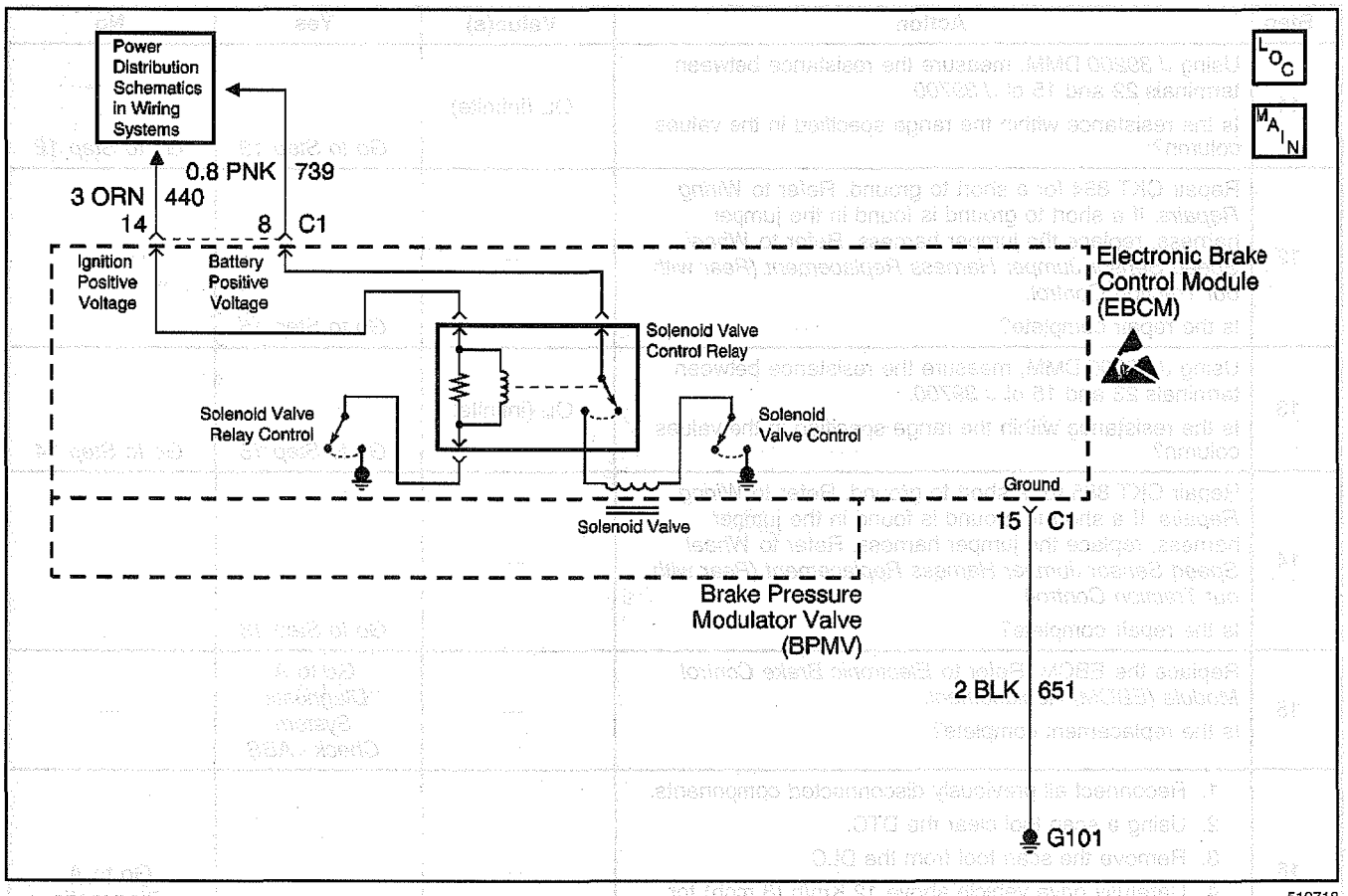
DTC C0056 Rear Wheel Speed CKT Range/Performance

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Inspect the WSS for physical damage. Is physical damage of the WSS evident?	—	*Go to Step 3*	*Go to Step 4*
3	Replace the WSS. Refer to *Wheel Speed Sensor Replacement (With out Tractional Control).* Is the replacement complete?	—	*Go to Step 16*	—
4	Inspect the jumper harness for physical damage. Is physical damage of the jumper harness evident?	—	*Go to Step 5*	*Go to Step 6*
5	Replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with out Traction Control).* Is the replacement complete?	—	*Go to Step 16*	—
6	1. Disconnect the WSS connector directly at the WSS. 2. Using *J 39200* DMM, measure the resistance between terminals A and B of the WSS. Is the resistance within the range specified in the value(s) column?	763–1525 Ω	*Go to Step 7*	*Go to Step 3*
7	1. With the *J 39200* DMM still connected to the WSS select the mV AC scale. 2. Spin the rear wheel as fast as you can by hand while monitoring the AC output. Is the AC voltage within the range specified in the value(s) column?	Above 100 mV	*Go to Step 8*	*Go to Step 3*
8	Using *J 39200* DMM, measure the resistance between the WSS terminal A and ground. Is the resistance within the range specified in the value(s) column?	OL (infinite)	*Go to Step 9*	*Go to Step 3*
9	1. Disconnect the EBCM harness connector C1. 2. Install the *J 39700* Universal Pinout Box using the J 39700-530 cable adapter to the EBCM harness connector C1 only. 3. Using *J 39200* DMM, measure the resistance between terminals 22 and 23 of *J 39700.* Is the resistance within the range specified in the values column?	OL (infinite)	*Go to Step 11*	*Go to Sep 10*
10	Repair short between CKT(s) 884 and 885. Refer to *Wiring Repairs.* If a short between wheel speed circuits is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with out Traction Control).* Is the repair complete?	—	*Go to Step 16*	—

DTC C0056 Rear Wheel Speed CKT Range/Performance (cont'd)

Step	Action	Value(s)	Yes	No
11	Using *J 39200* DMM, measure the resistance between terminals 22 and 15 of *J 39700*. Is the resistance within the range specified in the values column?	OL (infinite)	*Go to Step 13*	*Go to Step 12*
12	Repair CKT 884 for a short to ground. Refer to *Wiring Repairs*. If a short to ground is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with out Traction Control)*. Is the repair complete?	—	*Go to Step 16*	—
13	Using *J 39200* DMM, measure the resistance between terminals 23 and 15 of *J 39700*. Is the resistance within the range specified in the values column?	OL (infinite)	*Go to Step 15*	*Go to Step 14*
14	Repair CKT 885 for a short to ground. Refer to *Wiring Repairs*. If a short to ground is found in the jumper harness, replace the jumper harness. Refer to *Wheel Speed Sensor Jumper Harness Replacement (Rear with out Traction Control)*. Is the repair complete?	—	*Go to Step 16*	—
15	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement*. Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
16	1. Reconnect all previously disconnected components. 2. Using a scan tool clear the DTC. 3. Remove the scan tool from the DLC. 4. Carefully drive vehicle above 12 Km/h (8 mph) for several minutes. Does the DTC reset as a current DTC?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*

DTC C0060 LF ABS Solenoid #1 Circuit Malfunction



Circuit Description

The Inlet valve solenoid circuits are supplied with battery power when the ignition is in the run position. The EBCM controls the valve functions by grounding the circuit when necessary.

Conditions for Setting the DTC

The EBCM senses a discrepancy such as an open, short to ground, or short to voltage in the circuit.

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- ABS/TCS disabled
- ABS/TCS Indicators are turned on.
- The Red BRAKE Warning Indicator turns on.

Conditions for Clearing the DTC

- Condition for DTC is no longer present and scan tool clear DTC function is used.
- 100 ignition cycles pass with no DTC detected.

Test Description

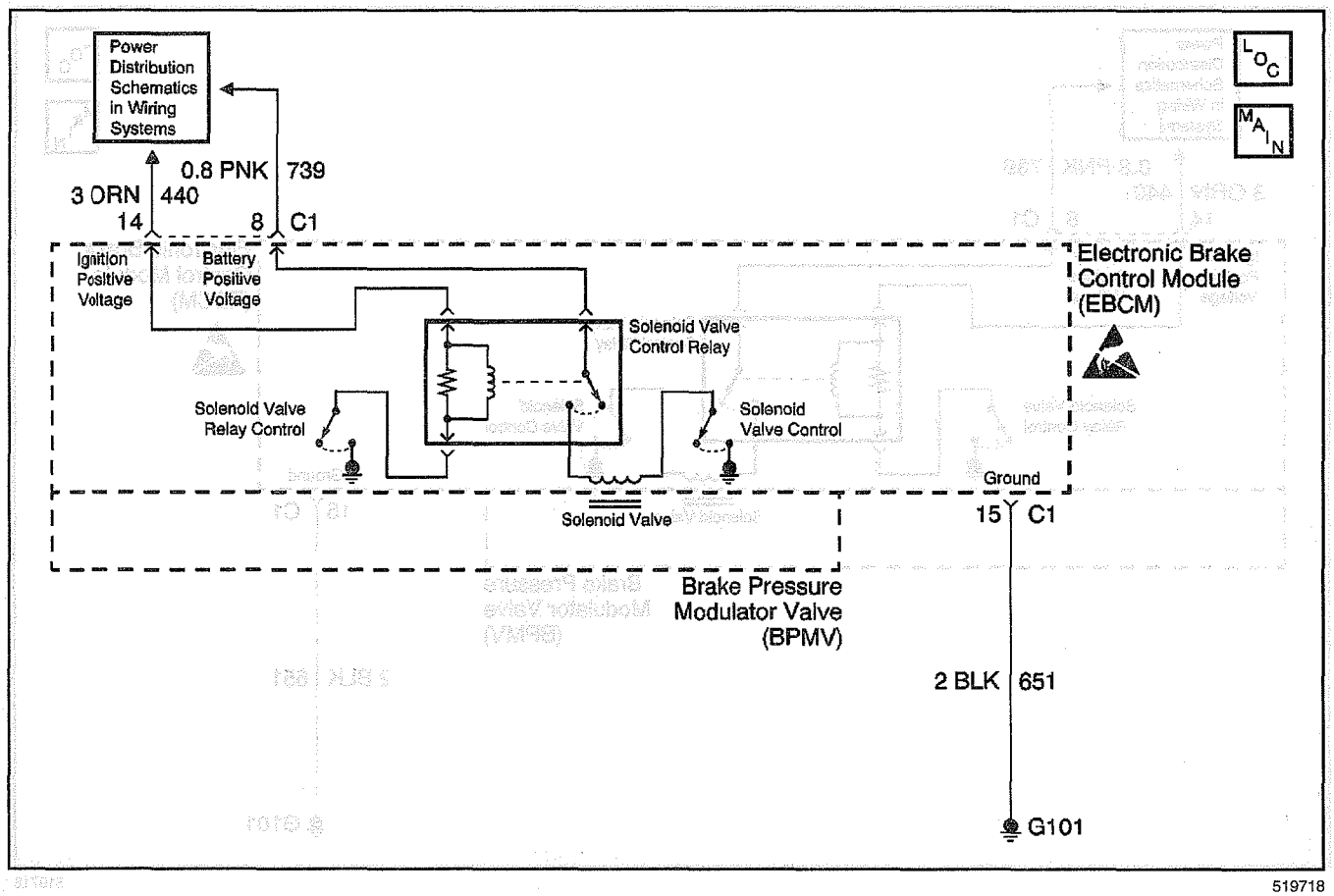
The numbers below refer to step numbers on the Diagnostic Table.

2. This step determines if the DTC is current.

DTC C0060 LF ABS Solenoid #1 Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the OFF position. 2. Install a scan tool. 3. Turn the ignition switch to the RUN position, engine off. 4. Using the scan tool run the Automated test. Does DTC C0060 reset as a current DTC?	—	*Go to Step 3*	Go to *A Diagnostic System Check - ABS*
3	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0065 LF ABS Solenoid #2 Circuit Malfunction



519718

Circuit Description

The Outlet valve solenoid circuits are supplied with battery power when the ignition is in the RUN position. The EBCM controls the valve functions by grounding the circuit when necessary.

Conditions for Setting the DTC

The EBCM senses a discrepancy such as an open, short to ground, or short to voltage in the circuit.

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- ABS/TCS disabled
- ABS/TCS Indicators are turned on.
- The Red BRAKE Warning Indicator turns on.

Conditions for Clearing the DTC

- Condition for DTC is no longer present and scan tool clear DTC function is used.
- 100 ignition cycles pass with no DTC detected.

Test Description

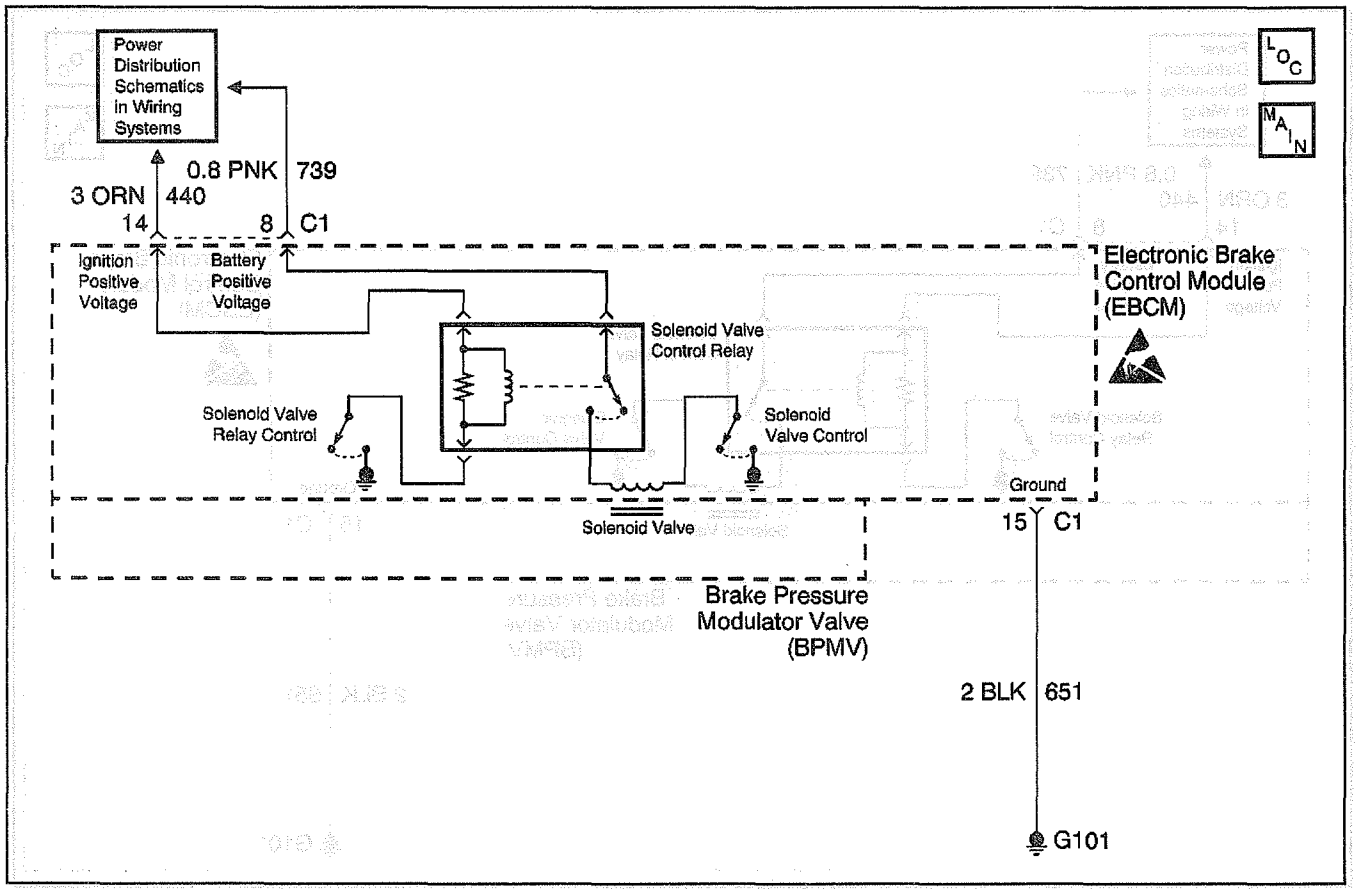
The numbers below refer to step numbers on the Diagnostic Table.

2. This step determines if the DTC is current.

DTC C0065 LF ABS Solenoid #2 Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the OFF position. 2. Install a scan tool. 3. Turn the ignition switch to the RUN position, engine off. 4. Using the scan tool run the Automated test. Does DTC C0065 reset as a current DTC?	—	*Go to Step 3*	Go to *A Diagnostic System Check - ABS*
3	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0070 RF ABS Solenoid #1 Circuit Malfunction



519718

Circuit Description

The Inlet valve solenoid circuits are supplied with battery power when the ignition is in the run position. The EBCM controls the valve functions by grounding the circuit when necessary.

Conditions for Setting the DTC

The EBCM senses a discrepancy such as an open, short to ground, or short to voltage in the circuit.

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- ABS/TCS disabled
- ABS/TCS Indicators are turned on.
- The Red BRAKE Warning Indicator turns on.

Conditions for Clearing the DTC

- Condition for DTC is no longer present and scan tool clear DTC function is used.
- 100 ignition cycles pass with no DTC detected.

Test Description

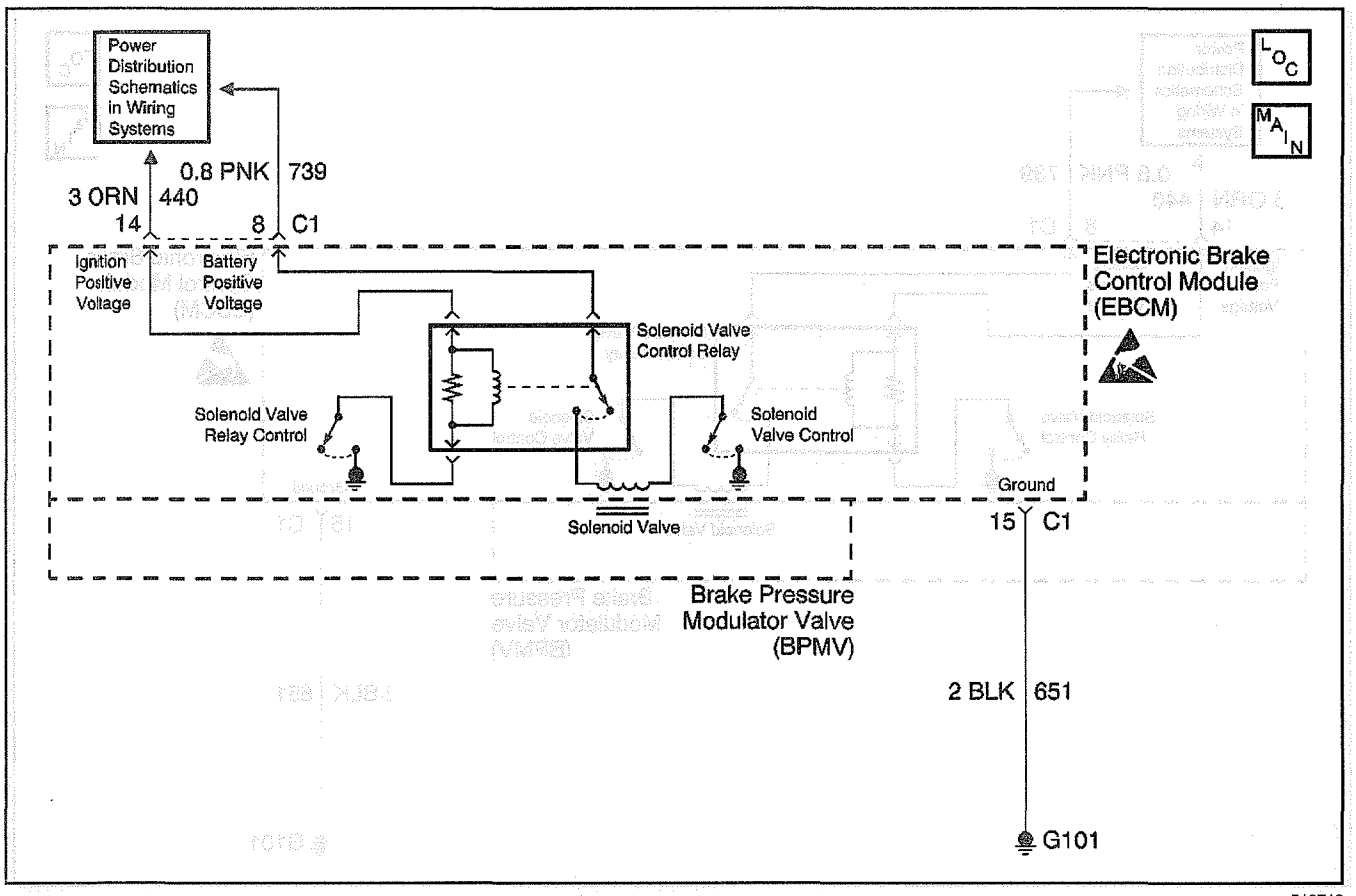
The numbers below refer to step numbers on the Diagnostic Table.

2. This step determines if the DTC is current.

DTC C0070 RF ABS Solenoid #1 Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the OFF position. 2. Install a scan tool. 3. Turn the ignition switch to the RUN position, engine off. 4. Using the scan tool run the Automated test. Does DTC C0070 reset as a current DTC?	—	*Go to Step 3*	Go to *A Diagnostic System Check - ABS*
3	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0075 RF ABS Solenoid #2 Circuit Malfunction



Circuit Description

The Outlet valve solenoid circuits are supplied with battery power when the ignition is in the RUN position. The EBCM controls the valve functions by grounding the circuit when necessary.

Conditions for Setting the DTC

The EBCM senses a discrepancy such as an open, short to ground, or short to voltage in the circuit.

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- ABS/TCS disabled
- ABS/TCS Indicators are turned on.
- The Red BRAKE Warning Indicator turns on.

Conditions for Clearing the DTC

- Condition for DTC is no longer present and scan tool clear DTC function is used.
- 100 ignition cycles pass with no DTC detected.

Test Description

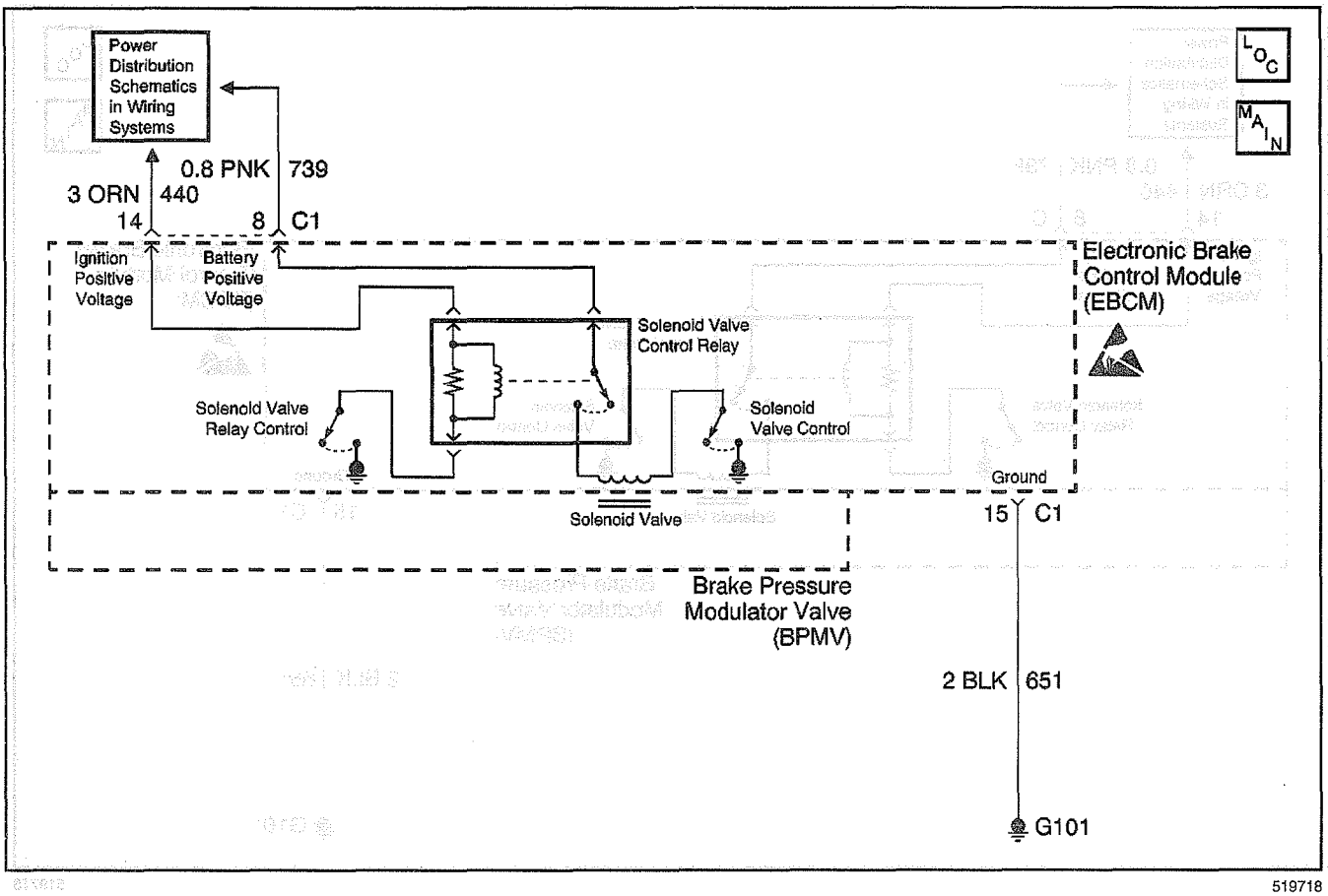
The numbers below refer to step numbers on the Diagnostic Table.

2. This step determines if the DTC is current.

DTC C0075 RF ABS Solenoid #2 Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	--	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the OFF position. 2. Install a scan tool. 3. Turn the ignition switch to the RUN position, engine off. 4. Using the scan tool run the Automated test. Does DTC C0075 reset as a current DTC?	—	*Go to Step 3*	Go to *A Diagnostic System Check - ABS*
3	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0080 LR ABS Solenoid #1 Circuit Malfunction



Circuit Description

The Inlet valve solenoid circuits are supplied with battery power when the ignition is in the run position. The EBCM controls the valve functions by grounding the circuit when necessary.

Conditions for Setting the DTC

The EBCM senses a discrepancy such as an open, short to ground, or short to voltage in the circuit.

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- ABS/TCS disabled
- ABS/TCS Indicators are turned on.
- The Red BRAKE Warning Indicator turns on.

Conditions for Clearing the DTC

- Condition for DTC is no longer present and scan tool clear DTC function is used.
- 100 ignition cycles pass with no DTC detected.

Test Description

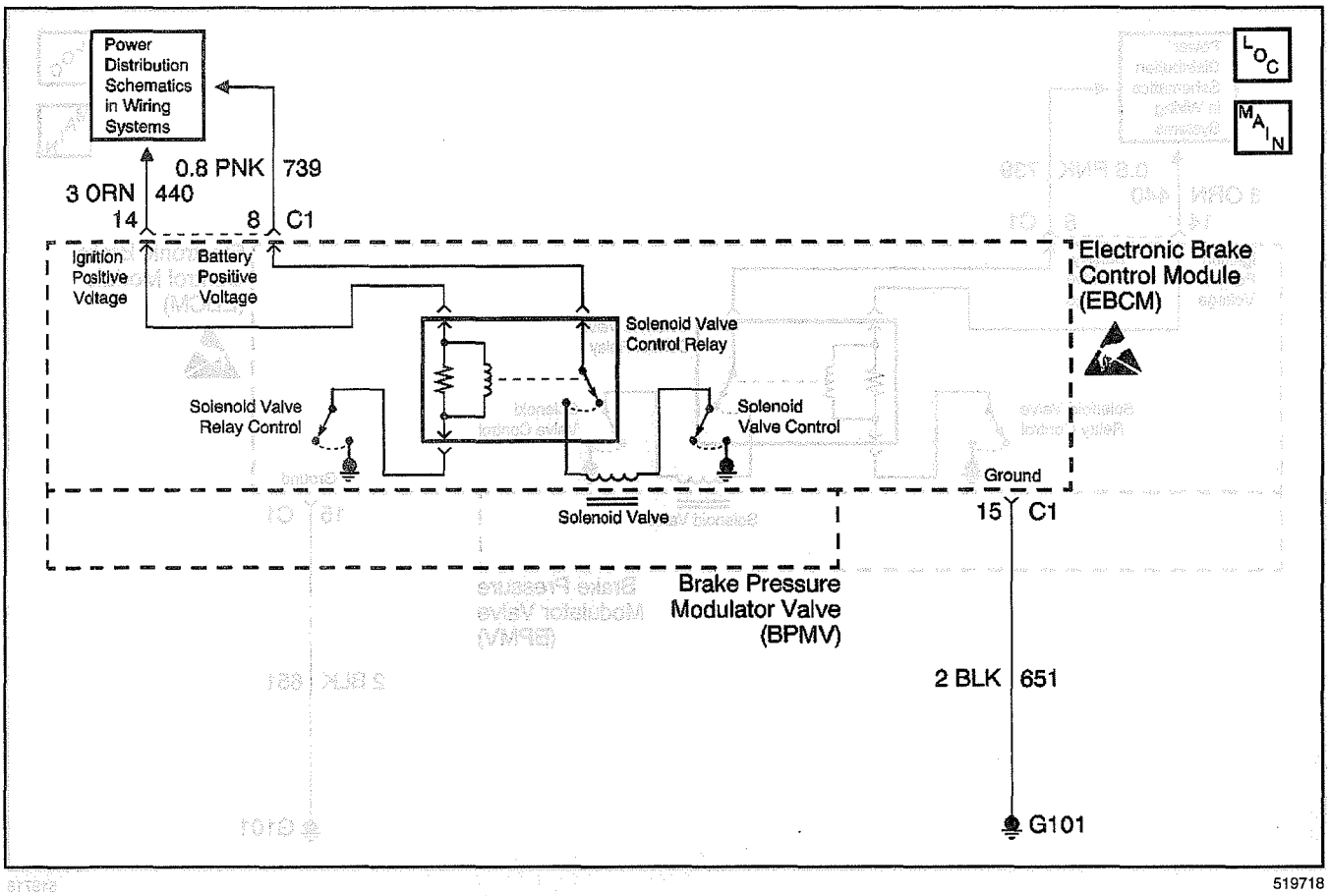
The numbers below refer to step numbers on the Diagnostic Table.

2. This step determines if the DTC is current.

DTC C0080 LR ABS Solenoid #1 Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the OFF position. 2. Install a scan tool. 3. Turn the ignition switch to the RUN position, engine off. 4. Using the scan tool run the Automated test. Does DTC C0080 reset as a current DTC?	—	*Go to Step 3*	Go to *A Diagnostic System Check - ABS*
3	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0085 LR ABS Solenoid #2 Circuit Malfunction



Circuit Description

The Outlet valve solenoid circuits are supplied with battery power when the ignition is in the RUN position. The EBCM controls the valve functions by grounding the circuit when necessary.

Conditions for Setting the DTC

The EBCM senses a discrepancy such as an open, short to ground, or short to voltage in the circuit.

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- ABS/TCS disabled
- ABS/TCS Indicators are turned on.
- The Red BRAKE Warning Indicator turns on.

Conditions for Clearing the DTC

- Condition for DTC is no longer present and scan tool clear DTC function is used.
- 100 ignition cycles pass with no DTC detected.

Test Description

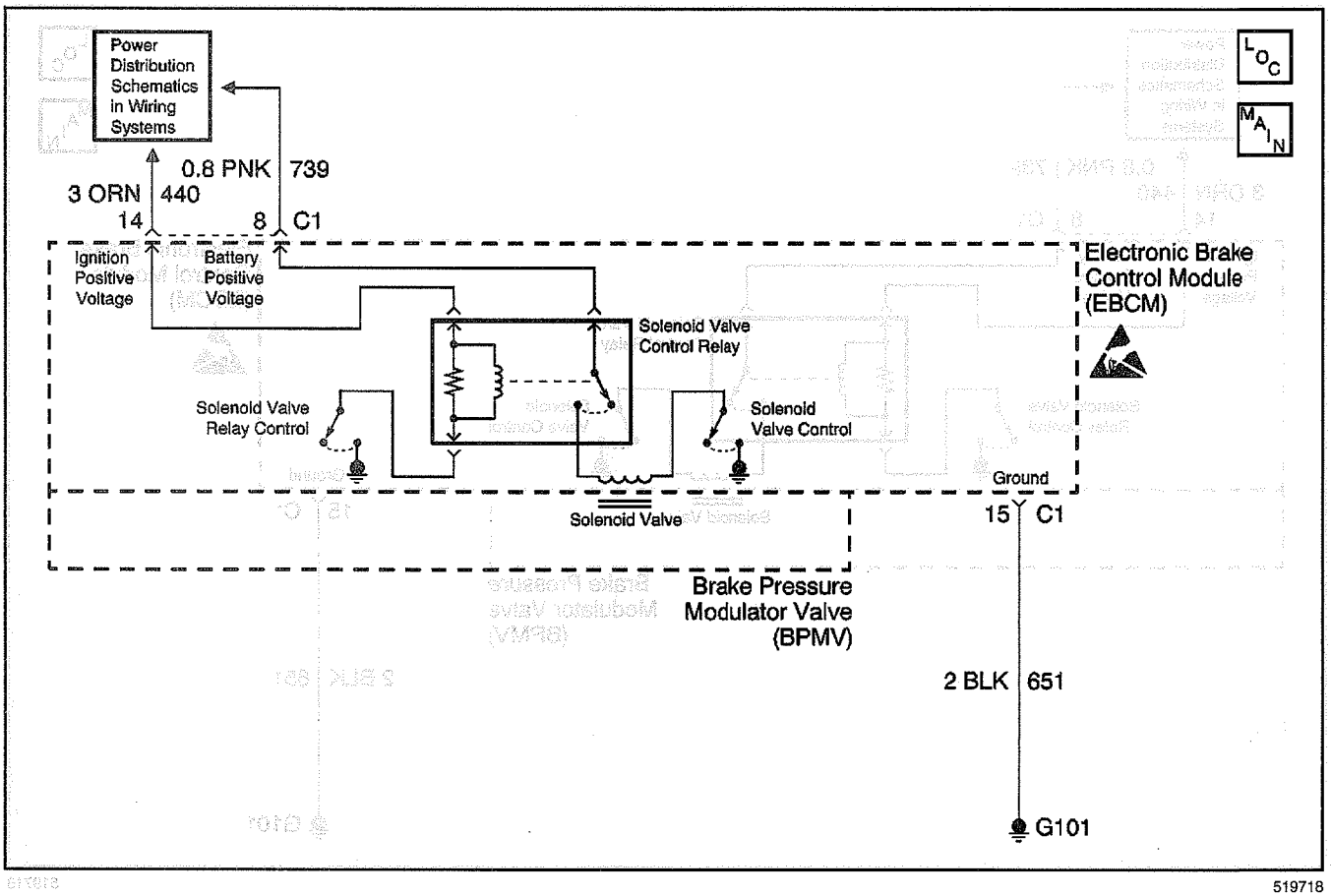
The numbers below refer to step numbers on the Diagnostic Table.

2. This step determines if the DTC is current.

DTC C0085 LR ABS Solenoid #2 Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the OFF position. 2. Install a scan tool. 3. Turn the ignition switch to the RUN position, engine off. 4. Using the scan tool run the Automated test. Does DTC C0085 reset as a current DTC?	—	*Go to Step 3*	Go to *A Diagnostic System Check - ABS*
3	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0090 RR ABS Solenoid #1 Circuit Malfunction



Circuit Description

The Inlet valve solenoid circuits are supplied with battery power when the ignition is in the run position. The EBCM controls the valve functions by grounding the circuit when necessary.

Conditions for Setting the DTC

The EBCM senses a discrepancy such as an open, short to ground, or short to voltage in the circuit.

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- ABS/TCS disabled
- ABS/TCS Indicators are turned on.
- The Red BRAKE Warning Indicator turns on.

Conditions for Clearing the DTC

- Condition for DTC is no longer present and scan tool clear DTC function is used.
- 100 ignition cycles pass with no DTC detected.

Test Description

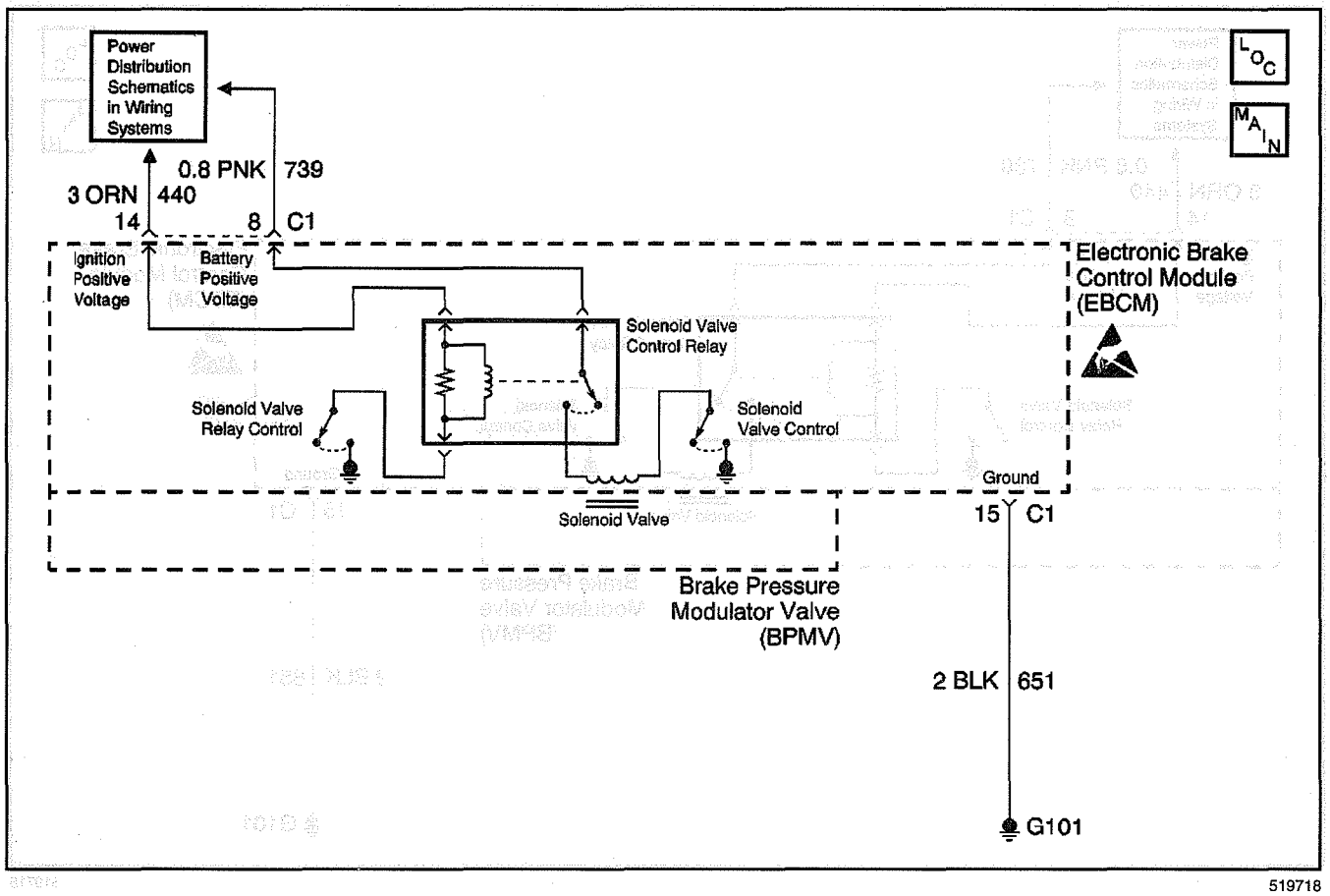
The numbers below refer to step numbers on the Diagnostic Table.

2. This step determines if the DTC is current.

DTC C0090 RR ABS Solenoid #1 Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the OFF position. 2. Install a scan tool. 3. Turn the ignition switch to the RUN position, engine off. 4. Using the scan tool run the Automated test. Does DTC C0090 reset as a current DTC?	—	*Go to Step 3*	Go to *A Diagnostic System Check - ABS*
3	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0095 RR ABS Solenoid #2 Circuit Malfunction



519718

Circuit Description

The Outlet valve solenoid circuits are supplied with battery power when the ignition is in the RUN position. The EBCM controls the valve functions by grounding the circuit when necessary.

Conditions for Setting the DTC

The EBCM senses a discrepancy such as an open, short to ground, or short to voltage in the circuit.

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- ABS/TCS disabled
- ABS/TCS Indicators are turned on.
- The Red BRAKE Warning Indicator turns on.

Conditions for Clearing the DTC

- Condition for DTC is no longer present and scan tool clear DTC function is used.
- 100 ignition cycles pass with no DTC detected.

Test Description

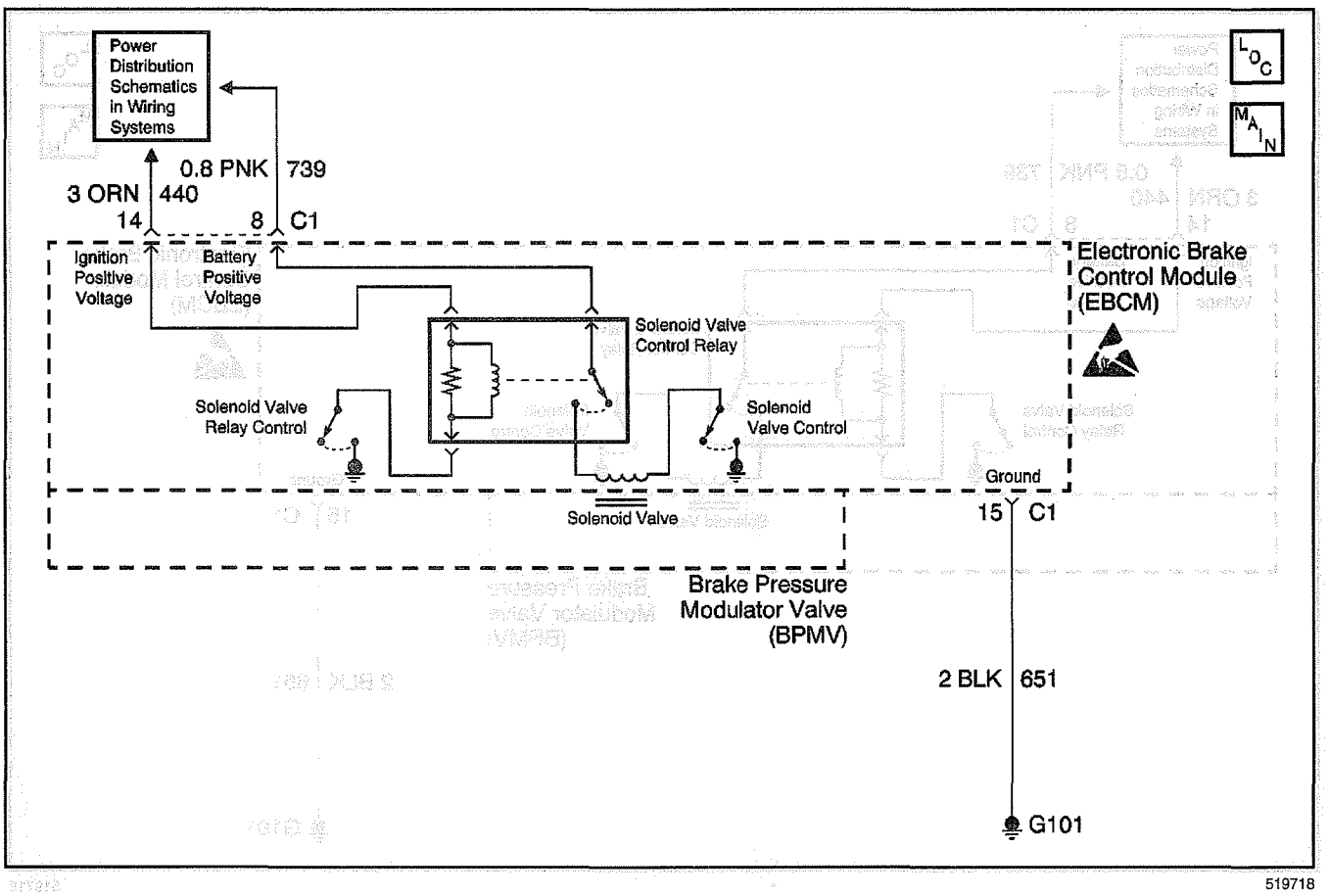
The numbers below refer to step numbers on the Diagnostic Table.

2. This step determines if the DTC is current.

DTC C0095 RR ABS Solenoid #2 Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the OFF position. 2. Install a scan tool. 3. Turn the ignition switch to the RUN position, engine off. 4. Using the scan tool run the Automated test. Does DTC C0095 reset as a current DTC?	—	*Go to Step 3*	Go to *A Diagnostic System Check - ABS*
3	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0100 Rear ABS Solenoid #1 Circuit Malfunction



Circuit Description

The Inlet valve solenoid circuit is supplied with battery power when the ignition is in the run position. The EBCM controls the valve functions by grounding the circuit when necessary.

Conditions for Setting the DTC

The EBCM senses a discrepancy such as an open, short to ground, or short to voltage in the circuit.

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- ABS/TCS disabled
- ABS/TCS Indicators are turned on.
- The Red BRAKE Warning Indicator turns on.

Conditions for Clearing the DTC

- Condition for DTC is no longer present and scan tool clear DTC function is used.
- 100 ignition cycles pass with no DTC detected.

Test Description

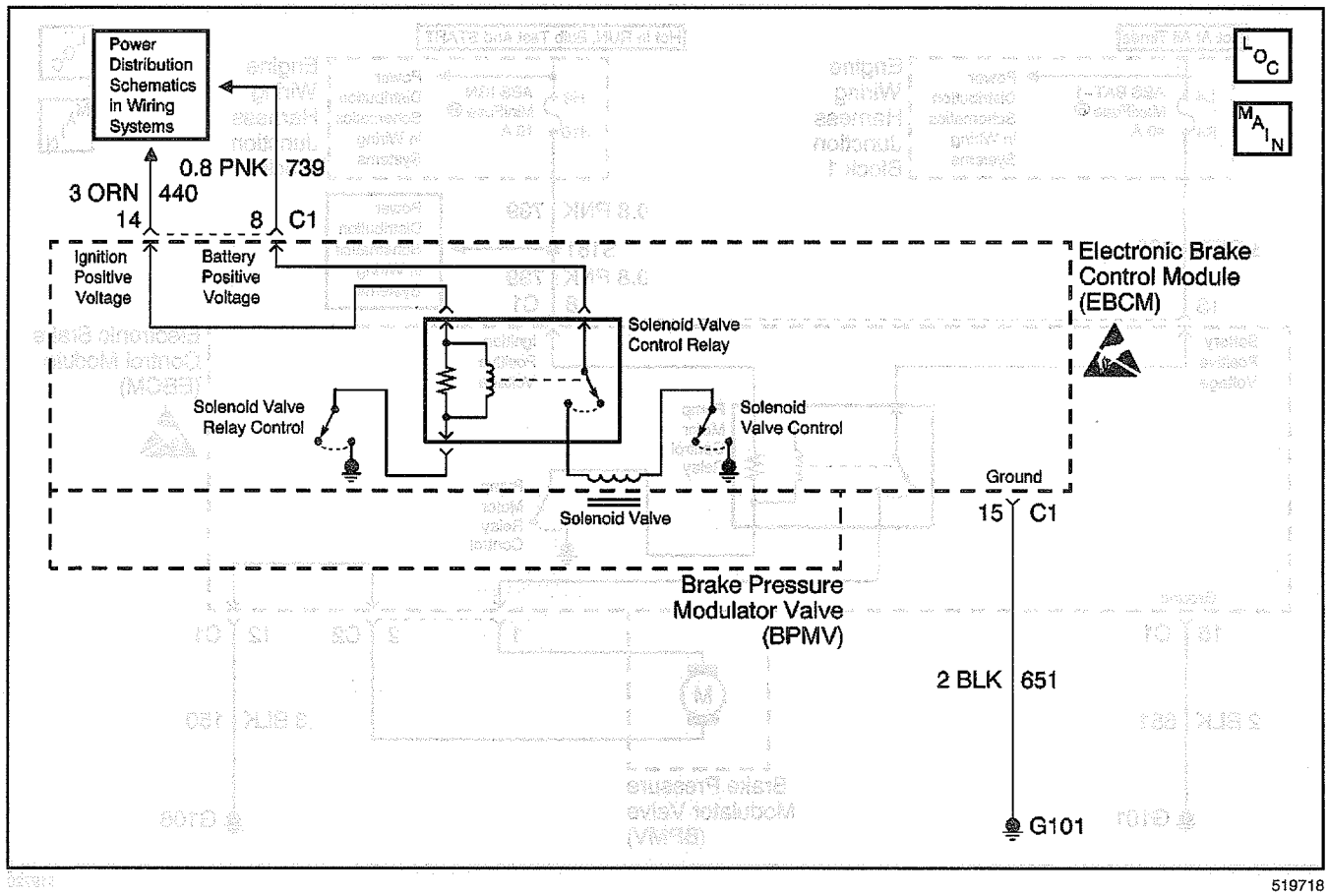
The numbers below refer to step numbers on the Diagnostic Table.

2. This step determines if the DTC is current.

DTC C0100 Rear ABS Solenoid #1 Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the OFF position. 2. Install a scan tool. 3. Turn the ignition switch to the RUN position, engine off. 4. Using the scan tool run the Automated test. Does DTC C0100 reset as a current DTC?	—	*Go to Step 3*	Go to *A Diagnostic System Check - ABS*
3	Repace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0105 Rear ABS Solenoid #2 Circuit Malfunction



Circuit Description

The Outlet valve solenoid circuit is supplied with battery power when the ignition is in the run position. The EBCM controls the valve functions by grounding the circuit when necessary.

Conditions for Setting the DTC

The EBCM senses a discrepancy such as an open, short to ground, or short to voltage in the circuit.

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- ABS/TCS disabled
- ABS/TCS Indicators are turned on.
- The Red BRAKE Warning Indicator turns on.

Conditions for Clearing the DTC

- Condition for DTC is no longer present and scan tool clear DTC function is used.
- 100 ignition cycles pass with no DTC detected.

Test Description

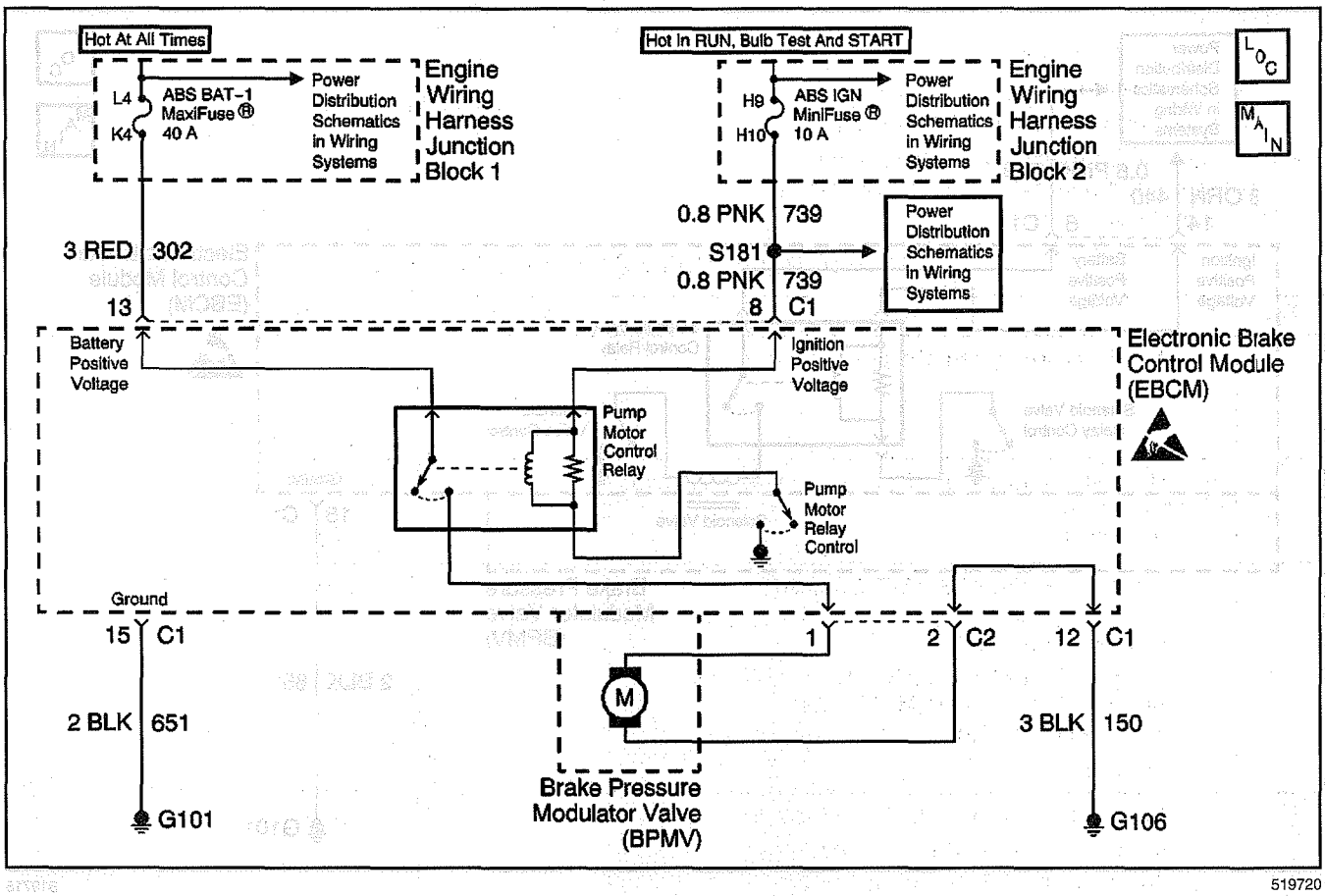
The numbers below refer to step numbers on the Diagnostic Table.

2. This step determines if the DTC is current.

DTC C0105 Rear ABS Solenoid #2 Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the OFF position. 2. Install a scan tool. 3. Turn the ignition switch to the RUN position, engine off. 4. Using the scan tool run the Automated test. Does DTC C0105 reset as a current DTC?	—	*Go to Step 3*	Go to *A Diagnostic System Check - ABS*
3	Repace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0110 Pump Motor Circuit Malfunction



519720

Circuit Description

The pump motor is an integral part of the BPMV, while the pump motor relay is integral to the EBCM. The pump motor relay is not engaged during normal system operation. When ABS or TCS operation is required the EBCM activates the pump motor relay and battery power is provided to the pump motor.

Conditions for Setting the DTC

- Pump motor voltage is not present 60 milliseconds after activation of the pump motor relay.
- Pump motor voltage is present for more than 2.5 seconds with no activation of the pump motor relay.
- Pump motor voltage is not present for 40 milliseconds after the pump motor relay is commanded off.

Action Taken When the DTC Sets

- A malfunction DTC stores.
- The ABS/TCS disables.
- The amber ABS/TCS indicator(s) turn on.
- The Red BRAKE Warning indicator turns on.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- 100 ignition cycles pass with no DTCs detected.

Important: After the DTC is cleared using ignition cycle default, the vehicle must be driven above 12 Km/h (8 mph) for the ABS/TCS indicator(s) to turn off.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness

- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If an intermittent malfunction exists refer to *Testing for Intermittent and Poor Connections* in Wiring Systems.

Test Description

The numbers below refer to step numbers on the diagnostic table.

4. This step checks for a short to ground in CKT 302.
10. This step checks for an open in CKT 302.

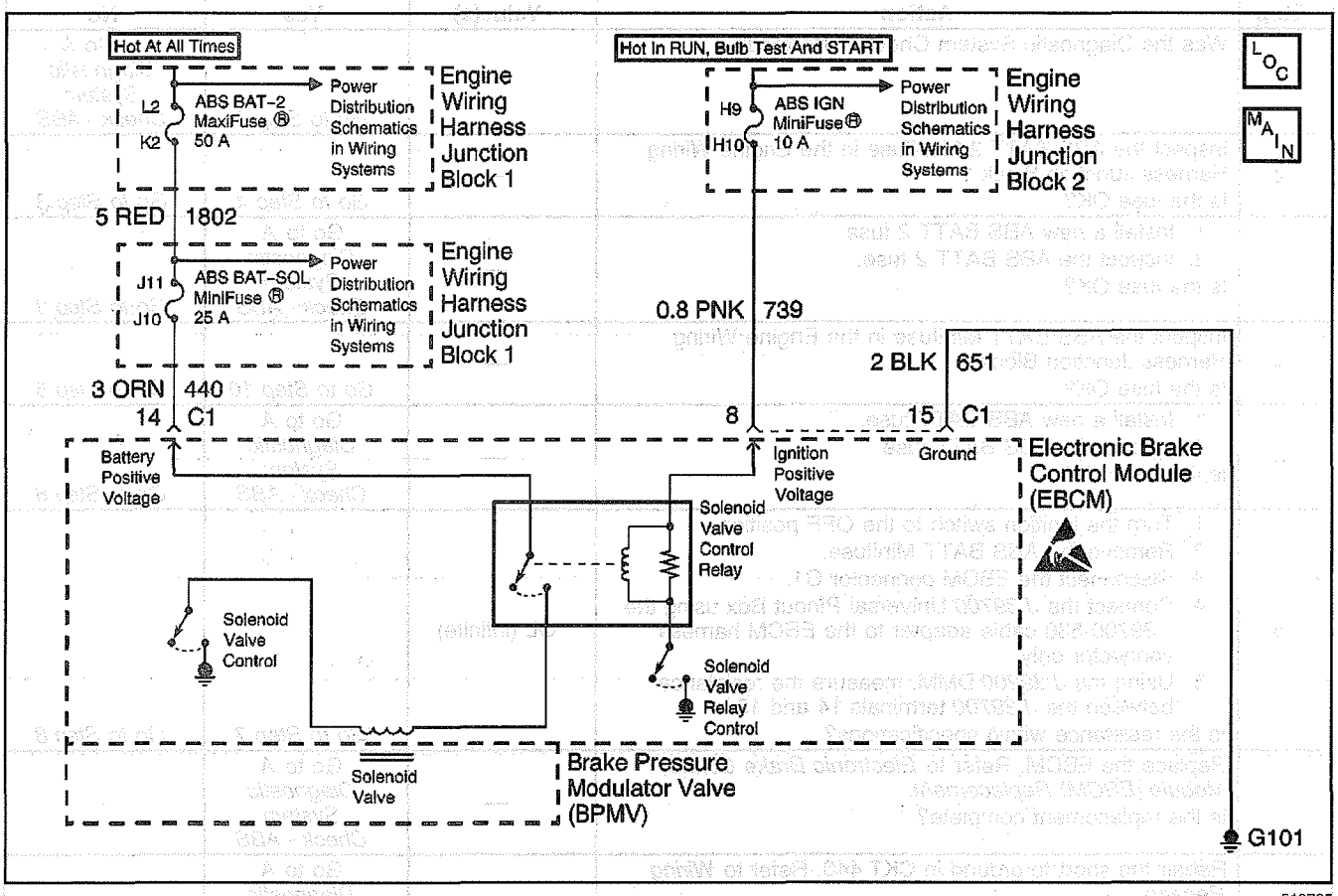
DTC C0110 Pump Motor Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Inspect the 40A ABS BATT 1 Maxifuse®, in the Underhood Electrical Center 1. Is the fuse OK?	—	*Go to Step 7*	*Go to Step 3*
3	1. Install a new 40A ABS BATT Maxifuse®. 2. Cycle the ignition switch from the OFF to RUN position, engine OFF. 3. Using a scan tool in ABS/TCS Special Functions attempt to run the AUTOMATED test. 4. Recheck the 40A ABS BATT 1 Maxifuse® fuse. Is the fuse OK?	—	*Go to Step 16*	*Go to Step 4*
4	1. Turn the Ignition switch to the OFF position. 2. Remove the 40A ABS BATT 1 Maxifuse®. 3. Disconnect the EBCM connector C1. 4. Connect the *J 39700* Universal Pinout Box using the J 39700-530 cable adapter to the EBCM harness connector only. 5. Using *J 39200* DMM, measure the resistance between terminals 13 and 15 of *J 39700*. Is the resistance within the range specified in the value(s) column?	OL (infinite)	*Go to Step 5*	*Go to Step 12*
5	1. Disconnect the EBCM pump motor connector C2. 2. Connect a 10A fused jumper wire between the pump motor connector C2 terminal 1 and battery voltage. 3. Connect a jumper wire between the pump motor connector C2 terminal 2 and ground. Only attempt to run the pump motor for 5 seconds. 4. Disconnect the jumper wires. 5. Inspect the 10A fuse in the jumper wire. Is the fuse OK?	—	*Go to Step 11*	*Go to Step 6*
6	Replace the BPMV. Refer to *Brake Pressure Modulator Valve (BPMV) Replacement*. Is the replacement complete?	—	*Go to Step 16*	—
7	1. Turn the Ignition switch to the OFF position. 2. Disconnect the EBCM connector C1. 3. Connect *J 39700* Universal Pinout Box using the J 39700-530 cable adaptor to the EBCM harness connector C1 only. 4. Using *J 39200* DMM, measure the resistance between terminals 12 and 15 of *J 39700*. Is the resistance within the range specified in the value(s) column?	0–5 Ω	*Go to Step 9*	*Go to Step 8*

DTC C0110 Pump Motor Circuit Malfunction (cont'd)

Step	Action	Value(s)	Yes	No
8	Repair CKT 150 for an open or high resistance. Refer to *Wiring Repairs.* Is the repair complete?	—	*Go to Step 16*	—
9	1. Install the fuse if removed. 2. Using *J 39200* DMM, measure the voltage at the 40A ABS BATT 1 Maxifuse® by probing between the fuse test terminals and a good ground. Is the voltage within the range specified in the value(s) column?	B+	*Go to Step 10*	Go to *Power Distribution Schematics* in Electrical Diagnosis
10	Using *J 39200* DMM, measure the voltage at terminal 13 of *J 39700.* Is the voltage within the range specified in the value(s) column?	B+	*Go to Step 14*	*Go to Step 13*
11	Replace EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
12	Repair short to ground in CKT 302. Refer to *Wiring Repairs.* Is the repair complete?	—	*Go to Step 16*	—
13	Repair open in CKT 302. Refer to *Wiring Repairs.* Is the repair complete?	—	*Go to Step 16*	—
14	1. Disconnect the EBCM pump motor connector C2. 2. Connect a 10A fused jumper wire between the pump motor connector C2 terminal 1 and B+. 3. Connect a jumper wire between the pump motor connector C2 terminal 2 and ground. Only attempt to run the pump motor for 5 seconds. 4. Disconnect the jumper wires. 5. Inspect the 10A fuse in the jumper wire. Is the fuse OK?	—	*Go to Step 15*	*Go to Step 6*
15	1. Zero the *J 39200* DMM leads. 2. Using *J 39200* DMM, measure the resistance between terminals 1 and 2 of the pump motor connector C2. Is the resistance within the range specified in the value(s) column?	0–4 Ω	*Go to Step 11*	*Go to Step 6*
16	1. Reconnect all previously disconnected components. 2. Using a scan tool clear the DTC. 3. Remove the scan tool from the DLC. 4. Carefully drive the vehicle above 12 Km/h (8 mph) for several minutes. Does the DTC reset as a current DTC?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*

DTC C0121 Valve Relay Circuit Malfunction



519725

Circuit Description

The solenoid valve relay supplies power to the solenoid valve coils in the EBCM. The solenoid valve relay, located in the EBCM, is activated whenever the ignition switch is in the RUN position and no faults are present. The solenoid valve relay remains engaged until the ignition is turned OFF or a failure is detected.

Conditions for Setting the DTC

- DTC C0121 will set anytime the solenoid valve relay is commanded on and the EBCM does not see battery voltage at the solenoid valves.
- DTC C0121 will set anytime the EBCM commands the solenoid valve relay off and battery voltage is still present at the solenoid valves.

Action Taken When the DTC Sets

- A malfunction DTC stores.
- The ABS/TCS disables.
- The amber ABS/TCS indicator(s) turn on.
- The Red BRAKE Warning indicator turns on.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- 100 ignition cycles pass with no DTCs detected.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness
- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If an intermittent malfunction exists refer to *Testing for Intermittent and Poor Connections* in Wiring Systems.
- The solenoid valve relay is an integral part of the EBCM and is not serviced separately.

Test Description

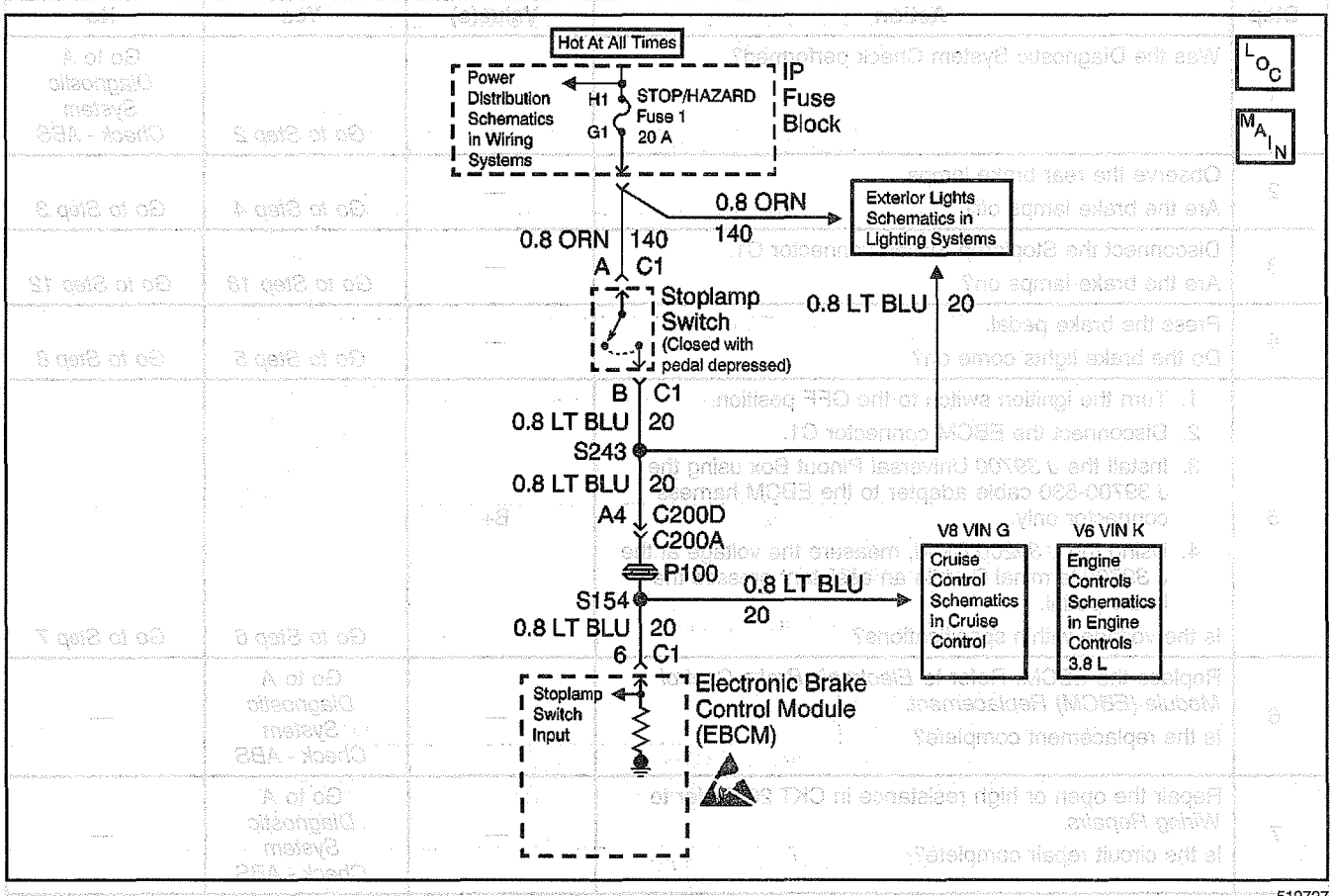
The numbers below refer to the step numbers on the diagnostic table.

6. This step checks for a short to ground in CKT 440.
13. This step checks for an open in CKT 440.

DTC C0121 Valve Relay Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Inspect the ABS BATT 2 Maxifuse in the Engine Wiring Harness Junction Block 1. Is the fuse OK?	—	*Go to Step 4*	*Go to Step 3*
3	1. Install a new ABS BATT 2 fuse. 2. Inspect the ABS BATT 2 fuse. Is the fuse OK?	—	Go to *A Diagnostic System Check - ABS*	*Go to Step 9*
4	Inspect the ABS BATT Minifuse in the Engine Wiring Harness Junction Block 1. Is the fuse OK?	—	*Go to Step 10*	*Go to Step 5*
5	1. Install a new ABS BATT fuse. 2. Inspect the ABS BATT fuse. Is the fuse OK?	—	Go to *A Diagnostic System Check - ABS*	*Go to Step 6*
6	1. Turn the ignition switch to the OFF position. 2. Remove the ABS BATT Minifuse. 3. Disconnect the EBCM connector C1. 4. Connect the *J 39700* Universal Pinout Box using the J 39700-530 cable adapter to the EBCM harness connector only. 5. Using the *J 39200* DMM, measure the resistance between the *J 39700* terminals 14 and 15. Is the resistance within specifications?	OL (infinite)	*Go to Step 7*	*Go to Step 8*
7	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
8	Repair the short to ground in CKT 440. Refer to *Wiring Repairs.* Is the circuit repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
9	Repair the short to ground in CKT 1802. Refer to *Wiring Repairs.* Is the circuit repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
10	Using the *J 39200* DMM, probe between the ABS BATT 2 fuse test terminals and a good ground in order to measure the voltage. Is the voltage within specifications?	B+	*Go to Step 11*	Go to *Power Distribution Schematics* in Electrical Diagnosis
11	Using the *J 39200* DMM, probe between the ABS BATT Minifuse test terminals and a good ground in order to measure the voltage. Is the voltage within specifications?	B+	*Go to Step 13*	*Go to Step 12*
12	Repair the open or high resistance in CKT 1802. Refer to *Wiring Repairs.* Is the circuit repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
13	1. Turn the ignition switch to the OFF position. 2. Disconnect the EBCM connector C1. 3. Connect the *J 39700* Universal Pinout Box using the J 39700-530 cable adapter to the EBCM harness connector only. 4. Turn the ignition switch to the RUN position, engine off. 5. Using the *J 39200* DMM, measure the voltage at terminal 14 of the *J 39700*. Is the voltage within specifications?	B+	*Go to Step 7*	*Go to Step 14*
14	Repair the open or high resistance in CKT 440. Refer to *Wiring Repairs.* Is the circuit repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0161 ABS/TCS Brake Switch Circuit Malfunction



519727

Circuit Description

The Stoplamp Switch is a normally open switch, when the brake pedal is depressed the EBCM will sense battery voltage. This allows the EBCM to determine the state of the brake lamps.

Conditions for Setting the DTC

- EBCM detects battery voltage at all times.
- EBCM never detects battery voltage from CKT 20.
- Both brake lamps are faulty.

Action Taken When the DTC Sets

- DTC C0161 is set.
- ABS and TCS remains active.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- 100 ignition cycles pass with no DTCs detected.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness
- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If an intermittent malfunction exists refer to *Testing for Intermittent and Poor Connections* in Wiring Systems.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

5. This step checks for voltage at the EBCM.

11. This step checks the Stoplamp switch.

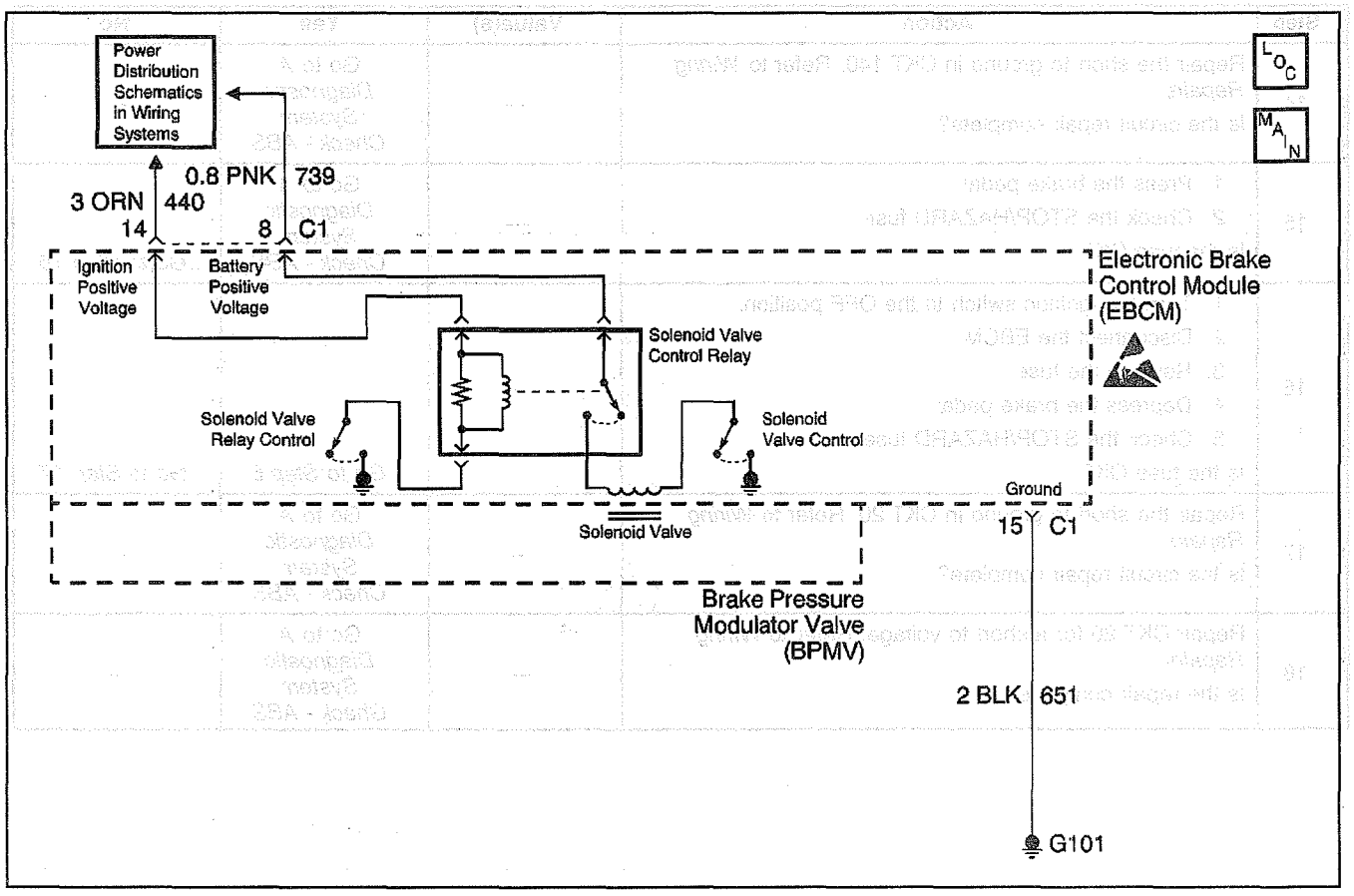
DTC C0161 ABS/TCS Brake Switch Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Observe the rear brake lamps. Are the brake lamps off?	—	*Go to Step 4*	*Go to Step 3*
3	Disconnect the Stoplamp Switch connector C1. Are the brake lamps on?	—	*Go to Step 18*	*Go to Step 12*
4	Press the brake pedal. Do the brake lights come on?	—	*Go to Step 5*	*Go to Step 8*
5	1. Turn the ignition switch to the OFF position. 2. Disconnect the EBCM connector C1. 3. Install the *J 39700* Universal Pinout Box using the J 39700-530 cable adapter to the EBCM harness connector only. 4. Using the *J 39200* DMM, measure the voltage at the *J 39700* terminal 6 while an assistant presses the brake pedal. Is the voltage within specifications?	B+	*Go to Step 6*	*Go to Step 7*
6	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
7	Repair the open or high resistance in CKT 20. Refer to *Wiring Repairs.* Is the circuit repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
8	Check the STOP/HAZARD fuse in the I/P Fuse Block. Is the fuse OK?	—	*Go to Step 9*	*Go to Step 13*
9	1. Disconnect the Stoplamp Switch connector C1. 2. Using the *J 39200* DMM, measure the voltage at the Stoplamp Switch harness connector terminal A. Is the voltage within specifications?	B+	*Go to Step 11*	*Go to Step 10*
10	Repair the open in CKT 140. Refer to *Wiring Repairs.* Is the circuit repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
11	Connect a fused jumper wire between the Stoplamp Switch harness connector terminals A and B. Do the brake lamps come on?	—	*Go to Step 12*	*Go to Step 7*
12	Adjust or repair the Stoplamp Switch as necessary. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
13	1. Replace the STOP/HAZARD fuse. (Do not press the brake pedal.) 2. Check the STOP/HAZARD fuse. Is the fuse OK?	—	*Go to Step 15*	*Go to Step 14*

DTC C0161 ABS/TCS Brake Switch Circuit Malfunction (cont'd)

Step	Action	Value(s)	Yes	No
14	Repair the short to ground in CKT 140. Refer to *Wiring Repairs.* Is the circuit repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
15	1. Press the brake pedal. 2. Check the STOP/HAZARD fuse. Is the fuse OK?	—	Go to *A Diagnostic System Check - ABS*	*Go to Step 16*
16	1. Turn the ignition switch to the OFF position. 2. Disconnect the EBCM. 3. Replace the fuse. 4. Depress the brake pedal. 5. Check the STOP/HAZARD fuse. Is the fuse OK?	—	*Go to Step 6*	*Go to Step 17*
17	Repair the short to ground in CKT 20. Refer to *Wiring Repairs.* Is the circuit repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
18	Repair CKT 20 for a short to voltage. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0166 TCS Priming Line Valve CKT Malfunction



519718

Circuit Description

The TCS Prime valve solenoid circuits are supplied with battery power when the ignition is in the RUN position. The EBCM controls the valve functions by grounding the circuit when necessary.

Conditions for Setting the DTC

The EBCM senses a discrepancy such as an open, short to ground, or short to voltage in the circuit.

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- ABS/TCS disabled
- ABS/TCS Indicators are turned on.
- The Red BRAKE Warning Indicator turns on.

Conditions for Clearing the DTC

- Condition for DTC is no longer present and scan tool clear DTC function is used.
- 100 ignition cycles pass with no DTC detected.

Test Description

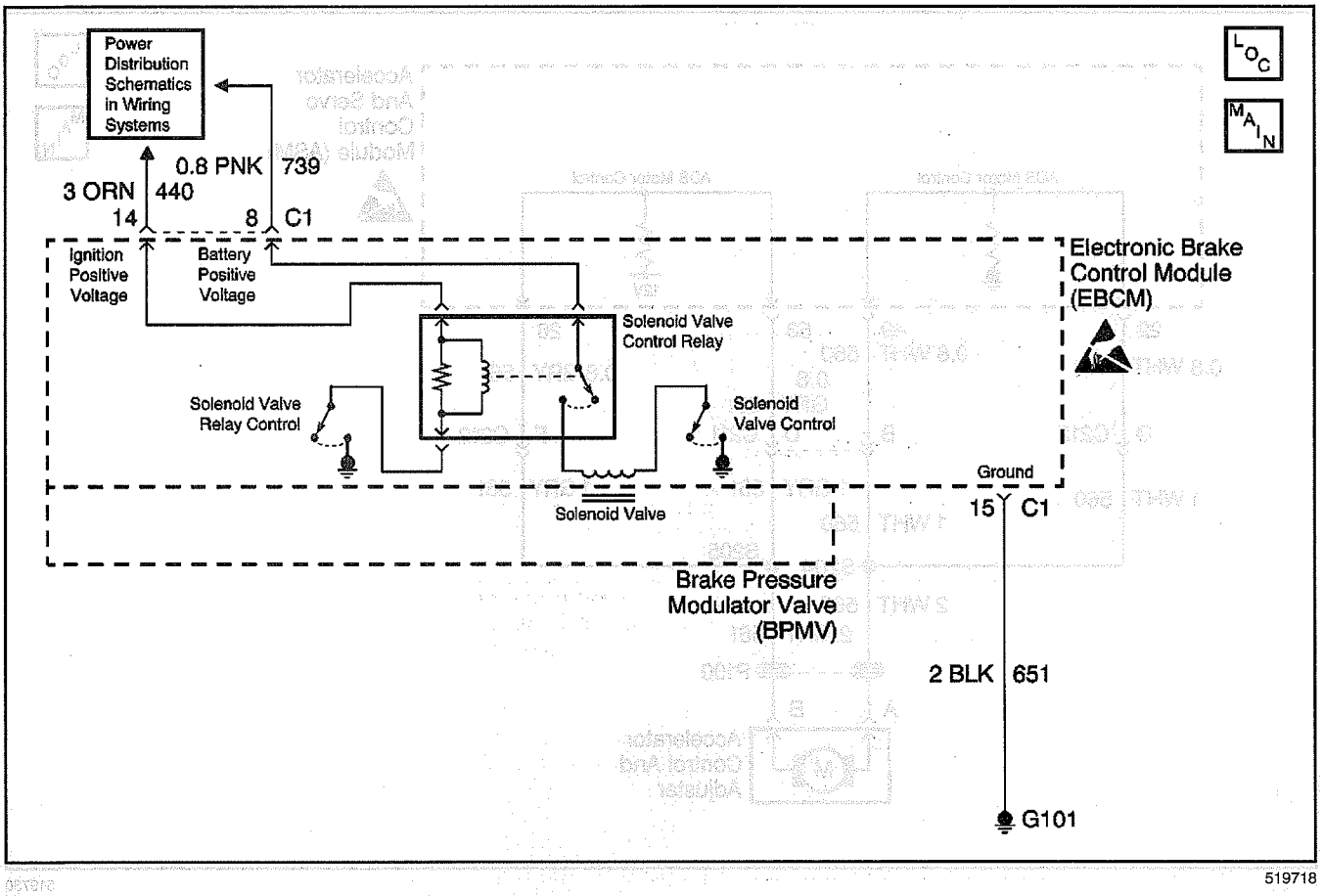
The numbers below refer to step numbers on the Diagnostic Table.

2. This step determines if the DTC is current.

DTC C0166 TCS Priming Line Valve CKT Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the OFF position. 2. Install a scan tool. 3. Turn the ignition switch to the RUN position, engine off. 4. Using the scan tool run the Automated test. Does DTC C0166 reset as a current DTC?	—	*Go to Step 3*	Go to *A Diagnostic System Check - ABS*
3	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0171 TCS Pilot Valve Circuit Malfunction



Circuit Description

The Master Cylinder Isolation valve solenoid circuits are supplied with battery power when the ignition is in the RUN position. The EBCM controls the valve functions by grounding the circuit when necessary.

Conditions for Setting the DTC

The EBCM senses a discrepancy such as an open, short to ground, or short to voltage in the circuit.

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- ABS/TCS disabled
- ABS/TCS Indicators are turned on.
- The Red BRAKE Warning Indicator turns on.

Conditions for Clearing the DTC

- Condition for DTC is no longer present and scan tool clear DTC function is used.
- 100 ignition cycles pass with no DTC detected.

Test Description

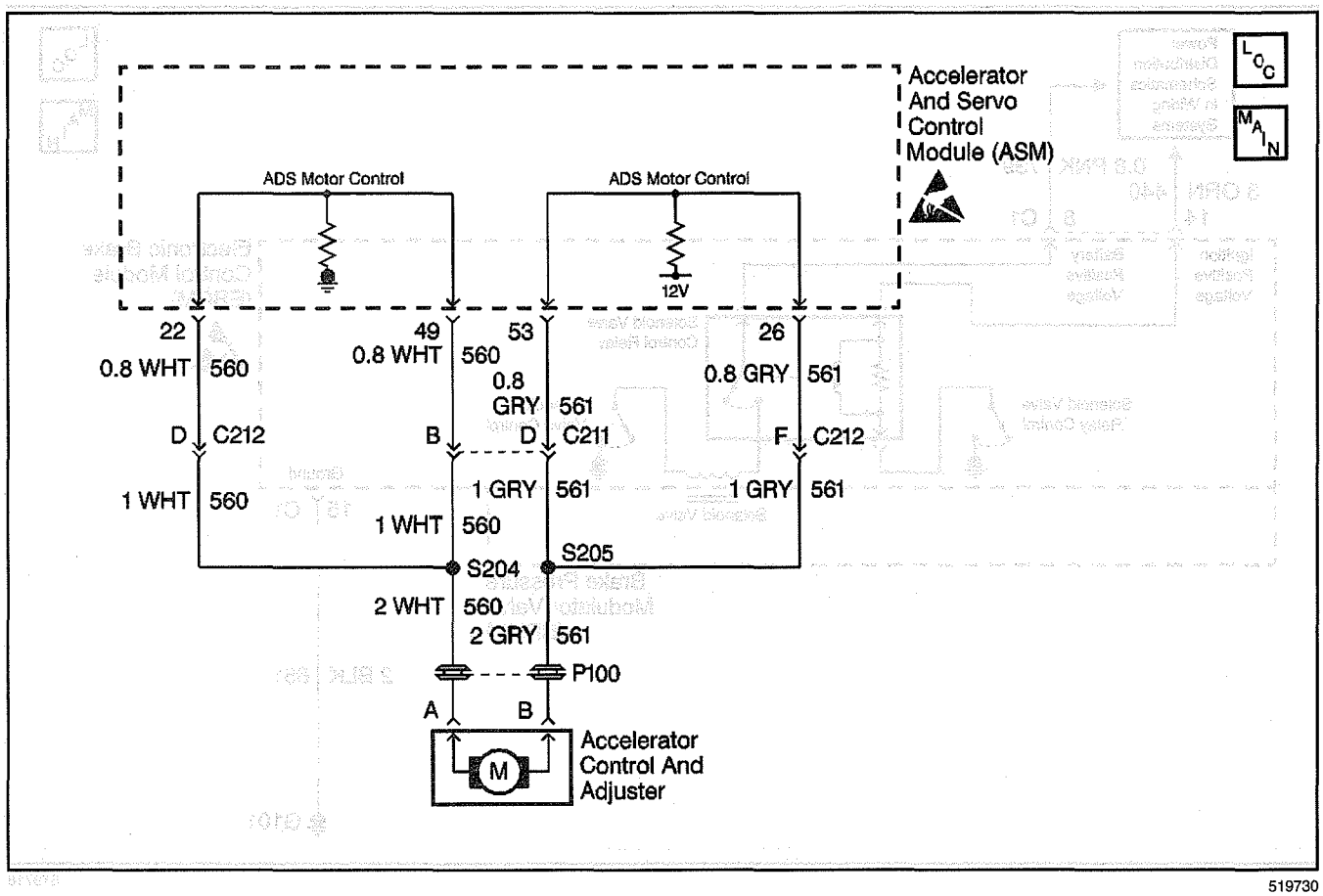
The numbers below refer to step numbers on the Diagnostic Table.

2. This step determines if the DTC is current.

DTC C0171 TCS Pilot Valve Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the OFF position. 2. Install a scan tool. 3. Turn the ignition switch to the RUN position, engine off. 4. Using the scan tool run the Automated test. Does DTC C0171 reset as a current DTC?	—	*Go to Step 3*	Go to *A Diagnostic System Check - ABS*
3	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0181 Throttle Reduction Motor CKT Malfunction



519730

Circuit Description

Identifies an adjuster assembly motor circuit that is shorted to ground, shorted to voltage, or an open circuit. 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.

Conditions for Setting the DTC

DTC C0181 can set anytime the ignition switch is in the RUN position and the EBCM detects an open, short to ground, or a short to voltage.

Action Taken When the DTC Sets

- A malfunction DTC stores
- The TCS disables
- The amber TCS indicator turns on

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- 100 ignition cycles pass with no DTCs detected.

Diagnostic Aids

Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal-to-wiring connections
- Physical damage to the wiring harness

The following conditions may cause an intermittent malfunction:

- A poor connection
- Rubbed-through wire insulation
- A broken wire inside the insulation

If an intermittent malfunction exists refer to *Testing for Intermittent and Poor Connections* in Wiring Systems.

Test Description

The number(s) below refer to the step number(s) on the diagnostic table.

4. This step checks for a short to ground.
8. This step checks for an open.
14. This step checks for a short to voltage.

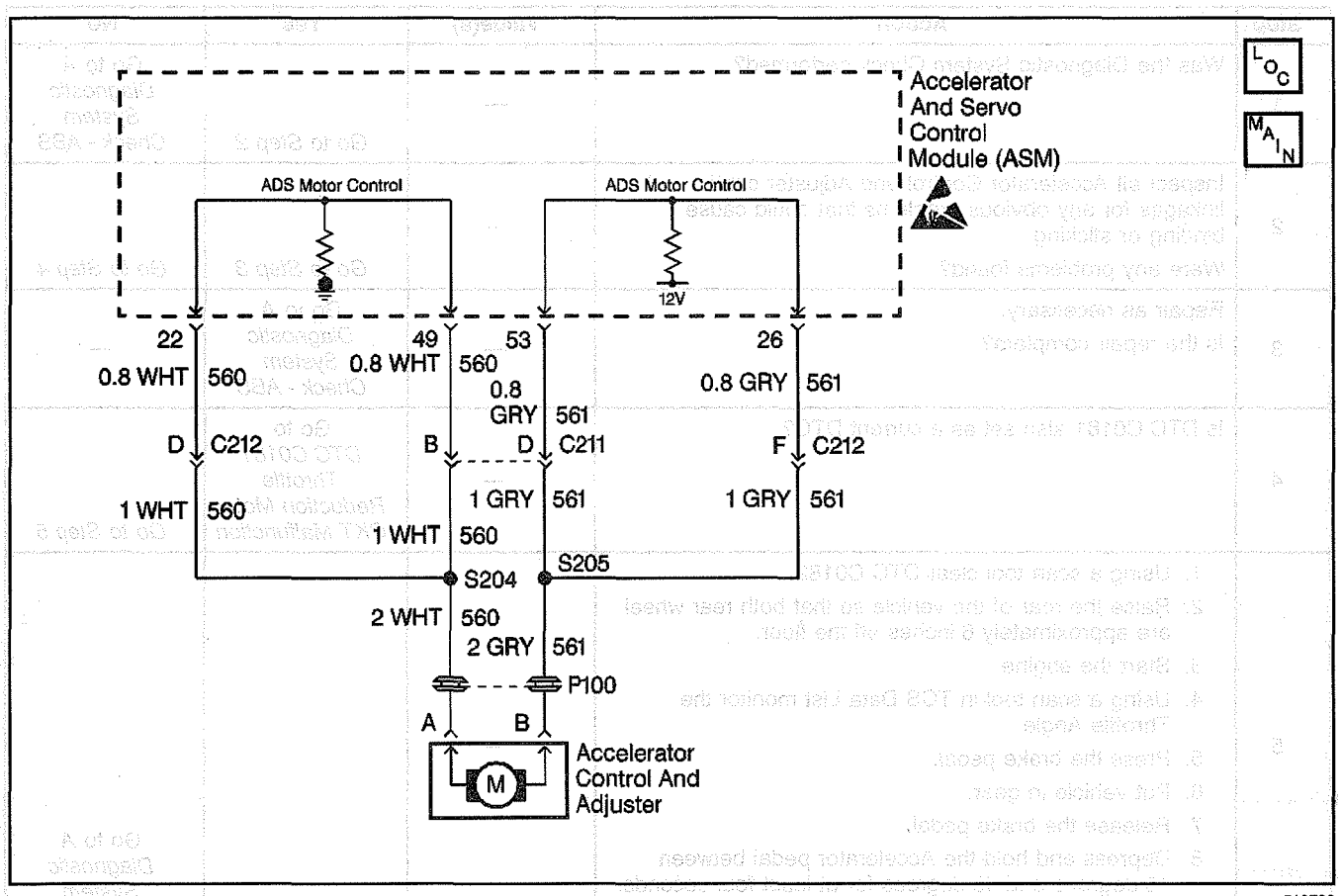
DTC C0181 Throttle Reduction Motor CKT Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the OFF position. 2. Disconnect the Accelerator Control and Adjuster connector. 3. Disconnect all cables from the Accelerator Control and Adjuster. 4. Rotate Adjuster by hand fully, then release and allow to return to the stop. Repeat this procedure three times. 5. Zero the leads on the *J 39200* DMM. 6. Using *J 39200* DMM, measure the resistance between the Accelerator Control and Adjuster connector terminals A and B. Is the resistance within the range specified in the value(s) column?	0.5–10Ω	*Go to Step 4*	*Go to Step 3*
3	Replace the Accelerator Control and Adjuster. Refer to *Adjuster Assembly Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
4	1. Disconnect the ASM harness connector. 2. Using *J 39200* DMM measure the resistance between the ASM harness connector terminals 22 and 28. Is the resistance within the range specified in the value(s) column?	OL (infinite)	*Go to Step 6*	*Go to Step 5*
5	Repair CKT 560 for a short to ground. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
6	Using *J 39200* DMM measure the resistance between the ASM harness connector terminals 26 and 28. Is the resistance within the range specified in the value(s) column?	OL (infinite)	*Go to Step 8*	*Go to Step 7*
7	Repair CKT 561 for a short to ground. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
8	Using the *J 39200* DMM, measure the resistance between the ASM harness connector terminal 22 and the Accelerator Adjuster harness connector terminal A. Is the resistance within the range specified in the value(s) column?	0–5Ω	*Go to Step 10*	*Go to Step 9*
9	Repair CKT 560 for an open. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0181 Throttle Reduction Motor CKT Malfunction (cont'd)

Step	Action	Value(s)	Yes	No
10	Using the *J 39200* DMM, measure the resistance between the ASM harness connector terminal 49 and the Accelerator Adjuster harness connector terminal A. Is the resistance within the range specified in the value(s) column?	0–5Ω	*Go to Step 11*	*Go to Step 9*
11	Using the *J 39200* DMM, measure the resistance between the ASM harness connector terminal 26 and the Accelerator Adjuster harness connector terminal B. Is the resistance within the range specified in the value(s) column?	0–5Ω	*Go to Step 13*	*Go to Step 12*
12	Repair CKT 561 for an open. Refer to *Wiring Repairs* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
13	Using the *J 39200* DMM, measure the resistance between the ASM harness connector terminal 53 and the Accelerator Adjuster harness connector terminal B. Is the resistance within the range specified in the value(s) column?	0–5Ω	*Go to Step 14*	*Go to Step 12*
14	1. Turn the ignition switch to the RUN position, engine off. 2. Using the *J 39200* DMM, measure the voltage at the ASM harness connector terminal 22. Is the voltage within the range specified in the value(s) column?	Above 1V	*Go to Step 15*	*Go to Step 16*
15	Repair CKT 560 for a short to voltage. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
16	Using the *J 39200* DMM, measure the voltage at the ASM harness connector terminal 26. Is the voltage within the range specified in the value(s) column?	Above 1V	*Go to Step 17*	*Go to Step 18*
17	Repair CKT 561 for a short to voltage. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
18	Replace the ASM. Refer to *Accelerator and Servo Control Module (ASM) Replacement.* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0182 Throttle Reduction Motor CKT Range Perf



519730

Circuit Description

The throttle position signal is used by the ASM to control the actual throttle position that is requested by the EBCM. The EBCM compares the Delivered throttle position sensor value that is sent from the ASM to the throttle position sensor value sent from the PCM over the Class 2 serial data line.

Conditions for Setting the DTC

DTC C0182 will set if the ASM delivers current greater than 18 amps to the Accelerator Control and Adjuster for more than three seconds without the cable adjuster reaching its desired position.

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- The TCS is disabled.

Conditions for Clearing the DTC

- Condition for DTC is no longer present and scan tool clear DTC function is used.
- 100 ignition cycles have passed with no DTCs detected.

Diagnostic Aids

If an intermittent malfunction exists refer to *Testing for Intermittent and Poor Connections* in Wiring Systems.

Test Description

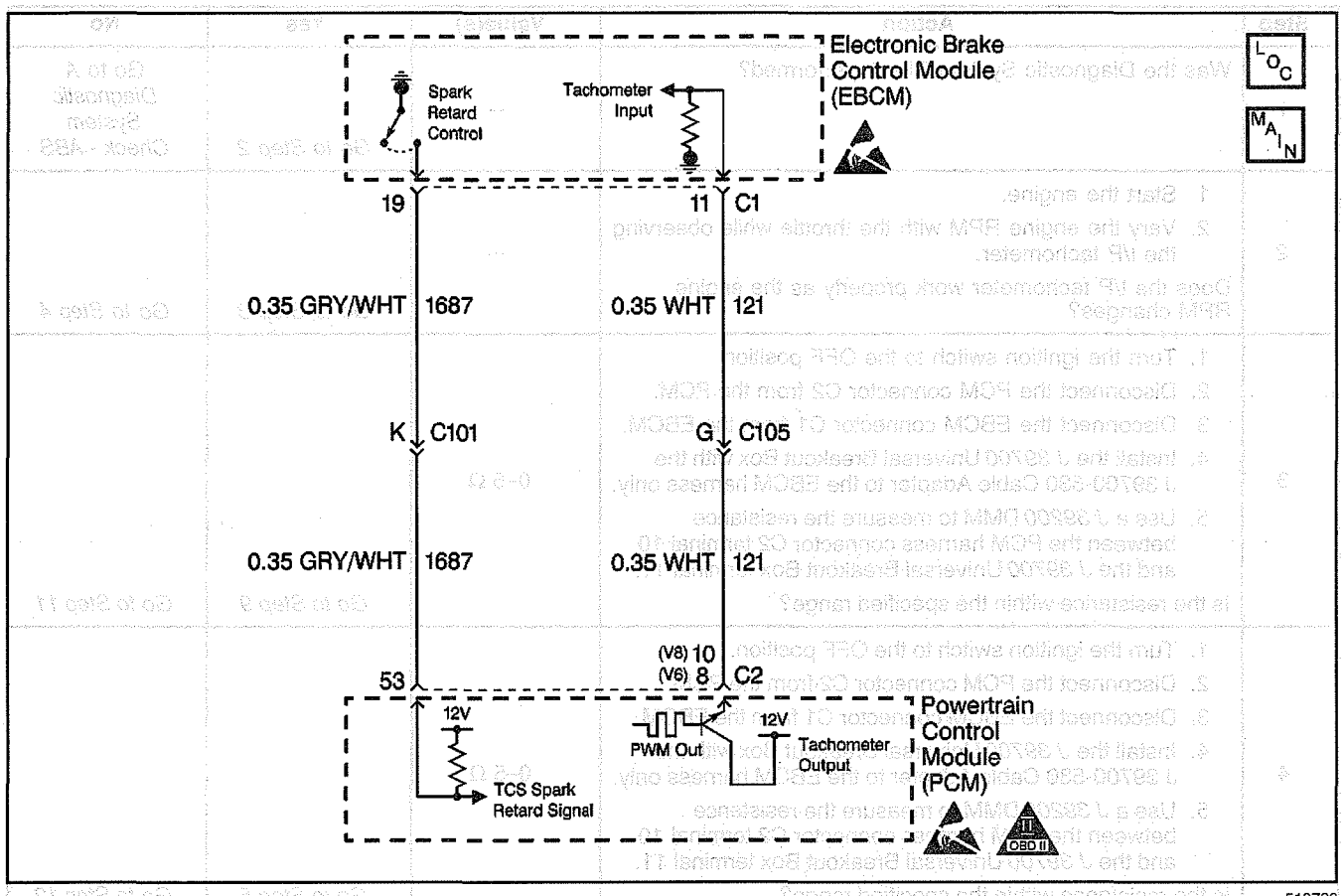
The number(s) below refer to the step number(s) on the diagnostic table.

4. This step checks if DTC C0181 is the cause for DTC C0182 for setting.
5. This step checks if DTC C0182 is a current fault.

DTC C0182 Throttle Reduction Motor CKT Range Perf

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Inspect all Accelerator Control and Adjuster cables and linkages for any obvious problems that could cause binding or sticking. Were any problems found?	—	*Go to Step 3*	*Go to Step 4*
3	Repair as necessary. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
4	Is DTC C0181 also set as a current DTC?	—	Go to *DTC C0181 Throttle Reduction Motor CKT Malfunction*	*Go to Step 5*
5	1. Using a scan tool clear DTC C0182. 2. Raise the rear of the vehicle so that both rear wheel are approximately 6 inches off the floor. 3. Start the engine. 4. Using a scan tool in TCS Data List monitor the Throttle Angle 5. Press the brake pedal. 6. Put vehicle in gear. 7. Release the brake pedal. 8. Depress and hold the Accelerator pedal between 15 degrees and 45 degrees for at least four seconds. Did DTC C0182 reset as a current DTC?	—	*Go to Step 6*	Go to *A Diagnostic System Check - ABS*
6	Replace the Accelerator Control and Adjuster. Refer to *Adjuster Assembly Replacement.* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0236 TCS RPM Signal Circuit Malfunction



Circuit Description

The RPM signal circuit provides the EBCM with an indication of engine RPM to help determine TCS control methods and rates when a TCS event takes place.

Conditions for Setting the DTC

The EBCM does not receive an RPM input signal after 1 second, after the engine has been started.

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- The TCS indicator is turned on.
- The TCS is disabled. ABS remains functional.

Conditions for Clearing the DTC

- The condition for DTC is no longer present and the scan tool Clear DTCs function is used.
- 100 drive cycles have passed with no DTCs detected.

Diagnostic Aids

Perform a thorough inspection of the wiring. Perform a thorough inspection of the connectors. Failure to carefully and fully inspect the wiring and the connectors may result in misdiagnosis. Misdiagnosis causes part replacement with reappearance of the malfunction.

Test Description

The number(s) below refer to the step number(s) on the diagnostic table.

2. If the instrument panel tachometer is working properly, the cause of the malfunction is most likely between S120 and the EBCM, or the EBCM itself.
10. At this point, the PCM is likely causing the malfunction. Refer to the appropriate OBD system check.

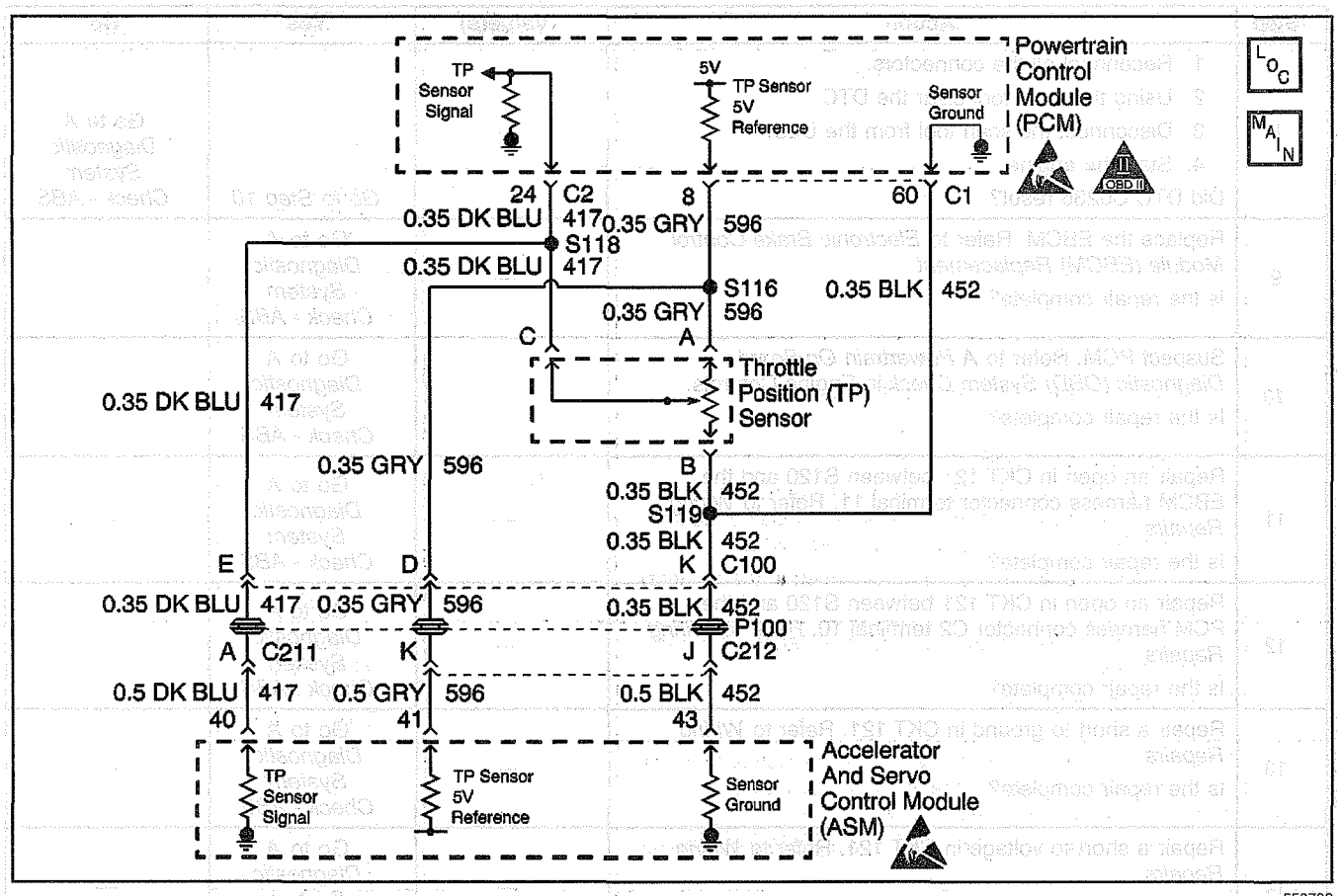
DTC C0236 TCS RPM Signal Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Start the engine. 2. Vary the engine RPM with the throttle while observing the I/P tachometer. Does the I/P tachometer work properly as the engine RPM changes?	—	*Go to Step 3*	*Go to Step 4*
3	1. Turn the ignition switch to the OFF position. 2. Disconnect the PCM connector C2 from the PCM. 3. Disconnect the EBCM connector C1 from the EBCM. 4. Install the *J 39700* Universal Breakout Box with the J 39700-530 Cable Adapter to the EBCM harness only. 5. Use a *J 39200* DMM to measure the resistance between the PCM harness connector C2 terminal 10 and the *J 39700* Universal Breakout Box terminal 11. Is the resistance within the specified range?	0–5 Ω	*Go to Step 9*	*Go to Step 11*
4	1. Turn the ignition switch to the OFF position. 2. Disconnect the PCM connector C2 from the PCM. 3. Disconnect the EBCM connector C1 from the EBCM. 4. Install the *J 39700* Universal Breakout Box with the J 39700-530 Cable Adapter to the EBCM harness only. 5. Use a *J 39200* DMM to measure the resistance between the PCM harness connector C2 terminal 10 and the *J 39700* Universal Breakout Box terminal 11. Is the resistance within the specified range?	0–5 Ω	*Go to Step 5*	*Go to Step 12*
5	Use a *J 39200* DMM to measure the resistance between the *J 39700* Universal Breakout Box terminal 11 and terminal 15. Is the resistance within the specified range?	OL (Infinite)	*Go to Step 6*	*Go to Step 13*
6	1. Turn the ignition switch to the RUN position 2. Use a *J 39200* DMM to measure the voltage between the *J 39700* Universal Breakout Box terminal 11 and terminal 15. Is the voltage within the specified range?	0–2 V	*Go to Step 7*	*Go to Step 14*
7	1. Inspect the PCM connector for the following: • Inspect for damage. • Inspect for poor terminal contact. • Inspect for corrosion. 2. Inspect the EBCM connector for the following: • Inspect for damage. • Inspect for poor terminal contact. • Inspect for corrosion. 3. Ensure both the PCM connector and the EBCM connector are properly retained when connected. Are the following signs present on either connector: • Is poor terminal contact present? • Is corrosion present? • Is damaged terminals present?	—	*Go to Step 15*	*Go to Step 8*

DTC C0236 TCS RPM Signal Circuit Malfunction (cont'd)

Step	Action	Value(s)	Yes	No
8	1. Reconnect all the connectors. 2. Using the scan tool clear the DTC. 3. Disconnect the scan tool from the DLC. 4. Start the engine. Did DTC C0236 reset?	—	*Go to Step 10*	Go to *A Diagnostic System Check - ABS*
9	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
10	Suspect PCM. Refer to *A Powertrain On Board Diagnostic (OBD) System Check* in Engine Controls. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
11	Repair an open in CKT 121 between S120 and the EBCM harness connector terminal 11. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
12	Repair an open in CKT 121 between S120 and the PCM harness connector C2 terminal 10. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
13	Repair a short to ground in CKT 121. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
14	Repair a short to voltage in CKT 121. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
15	Replace all the terminals or replace the connectors that exhibit signs of the following: • That exhibit signs of poor terminal contact. • That exhibit signs of corrosion. • That exhibit signs of damaged terminals. Refer to *Connector Repairs* in Electrical Diagnosis. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0237 TCS Throttle Position Signal Malfunction



Circuit Description

The throttle position signal is used by the ASM to control the actual throttle position that is requested by the EBCM.

Conditions for Setting the DTC

- DTC C0237 will set if the ASM is not receiving a reference voltage.
- DTC C0237 will set if the reference signal is outside of a specified range.

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- The TCS is disabled.
- The amber TCS indicator will turn on.

Conditions for Clearing the DTC

- Condition for DTC is no longer present and scan tool clear DTC function is used.
- 100 ignition cycles have passed with no DTCs detected.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- If an intermittent malfunction exists refer to *Inducing Intermittent Fault Conditions* in Wiring Systems.

Test Description

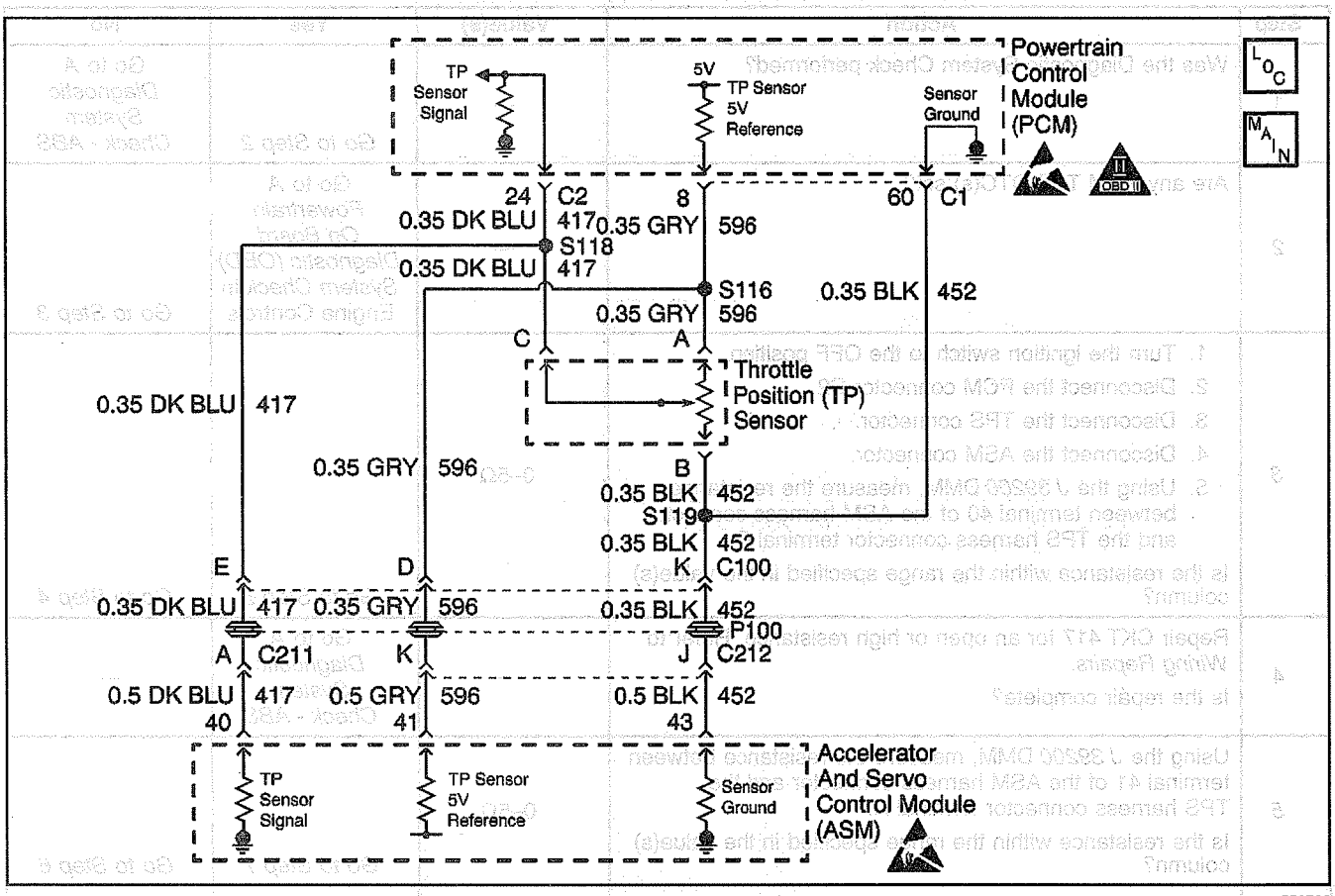
The number(s) below refer to the step number(s) on the diagnostic table.

3. This step checks for an open in CKT 417.
5. This step checks for an open in CKT 596.
7. This step checks for an open in CKT 452.

DTC C0237 TCS Throttle Position Signal Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Are any PCM TPS DTC(s) set?	—	Go to *A Powertrain On Board Diagnostic (OBD) System Check* in Engine Controls	*Go to Step 3*
3	1. Turn the ignition switch to the OFF position. 2. Disconnect the PCM connector C2. 3. Disconnect the TPS connector. 4. Disconnect the ASM connector. 5. Using the *J 39200* DMM, measure the resistance between terminal 40 of the ASM harness connector and the TPS harness connector terminal C. Is the resistance within the range specified in the value(s) column?	0–5Ω	*Go to Step 5*	*Go to Step 4*
4	Repair CKT 417 for an open or high resistance. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
5	Using the *J 39200* DMM, measure the resistance between terminal 41 of the ASM harness connector and the TPS harness connector terminal A. Is the resistance within the range specified in the value(s) column?	0–5Ω	*Go to Step 7*	*Go to Step 6*
6	Repair CKT 596 for an open or high resistance. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
7	Using the *J 39200* DMM, measure the resistance between terminal 43 of the ASM harness connector and the TPS harness connector terminal B. Is the resistance within the range specified in the value(s) column?	0–5Ω	*Go to Step 9*	*Go to Step 8*
8	Repair CKT 452 for an open or high resistance. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
9	Replace the ASM. Refer to *Accelerator and Servo Control Module (ASM) Replacement.* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0238 TCS TP Sensor Comparison Malfunction



Circuit Description

The throttle position signal is used by the ASM to control the actual throttle position that is requested by the EBCM. The EBCM compares the Delivered throttle position sensor value that is sent from the ASM to the throttle position sensor value sent from the PCM over the Class 2 serial data line.

Conditions for Setting the DTC

DTC C0238 will set if the EBCM detects a difference between the PCM throttle position and the throttle position sent from the ASM.

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- The TCS is disabled.

Conditions for Clearing the DTC

- Condition for DTC is no longer present and scan tool clear DTC function is used.
- 100 ignition cycles have passed with no DTCs detected.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- If an intermittent malfunction exists refer to *Testing for Intermittent and Poor Connections* in Wiring Systems.

Test Description

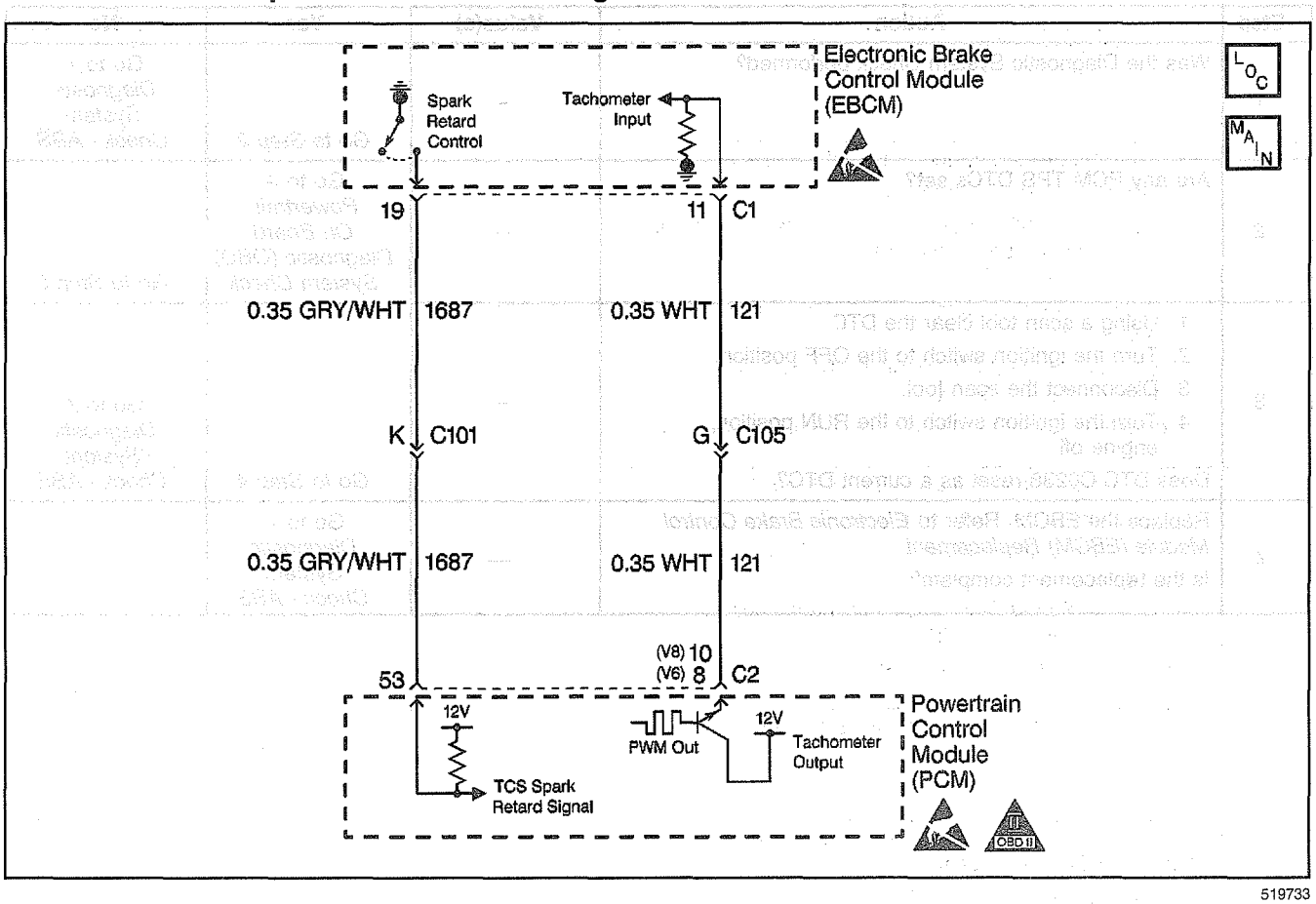
The number(s) below refer to the step number(s) on the diagnostic table.

2. This step checks if the PCM detected a fault.

DTC C0238 TCS TP Sensor Comparison Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Are any PCM TPS DTCs set?	—	Go to *A Powertrain On Board Diagnostic (OBD) System Check*	*Go to Step 3*
3	1. Using a scan tool clear the DTC. 2. Turn the ignition switch to the OFF position. 3. Disconnect the scan tool. 4. Turn the ignition switch to the RUN position, engine off. Does DTC C0238 reset as a current DTC?	—	*Go to Step 4*	Go to *A Diagnostic System Check - ABS*
4	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0239 TCS Spark Retard Monitoring Malfunction



519733

Circuit Description

Spark Retard is simultaneously controlled by the EBCM and the PCM. The PCM supplies a 12 volt pull up voltage. This voltage is monitored by the PCM, the EBCM requests spark retard by pulling the voltage low.

Conditions for Setting the DTC

DTC C0239 can be set anytime when the EBCM senses a short to ground, a short to battery voltage, or an open in CKT 1687.

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- The ABS/TCS is disabled.
- The Red BRAKE Warning indicator turn on.

Conditions for Clearing the DTC

- Condition for DTC is no longer present and scan tool clear DTC function is used.
- 100 ignition cycles have passed with no DTCs detected.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- If an intermittent malfunction exists refer to *Testing for Intermittent and Poor Connections* in Wiring Systems.

Test Description

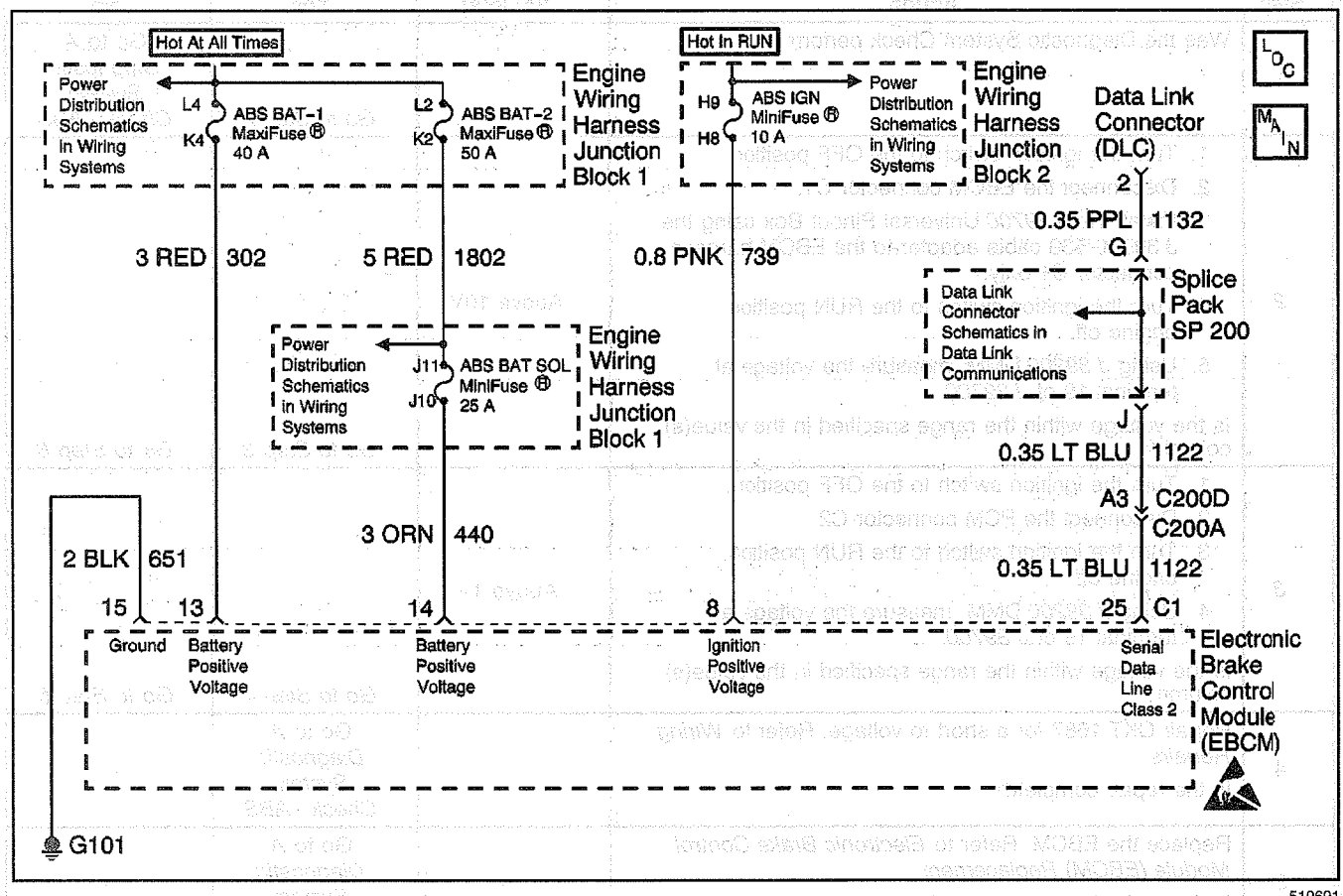
The number(s) below refer to the step number(s) on the diagnostic table.

2. This step checks for the pull up voltage from the PCM.
3. This step checks for a short to voltage.
6. This step checks for a short to ground.

DTC C0239 TCS Spark Retard Monitoring Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the OFF position. 2. Disconnect the EBCM connector C1. 3. Install the *J 39700* Universal Pinout Box using the J 39700-530 cable adapter to the EBCM harness connector C1 only. 4. Turn the ignition switch to the RUN position, engine off. 5. Using *J 39200* DMM, measure the voltage at terminal 19 of *J 39700*. Is the voltage within the range specified in the value(s) column?	Above 10V	*Go to Step 3*	*Go to Step 6*
3	1. Turn the ignition switch to the OFF position. 2. Disconnect the PCM connector C2. 3. Turn the ignition switch to the RUN position, engine off. 4. Using *J 39200* DMM, measure the voltage at terminal 19 of *J 39700*. Is the voltage within the range specified in the value(s) column?	Above 1V	*Go to Step 4*	*Go to Step 5*
4	Repair CKT 1687 for a short to voltage. Refer to *Wiring Repairs*. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
5	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement*. Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
6	1. Turn the ignition switch to the OFF position. 2. Disconnect the PCM connector C2. 3. Using *J 39200* DMM, measure the resistance between terminals 19 and 15 of *J 39700*. Is the resistance within the range specified in the value(s) column?	OL (infinite)	*Go to Step 8*	*Go to Step 7*
7	Repair CKT 1687 for a short to ground. Refer to *Wiring Repairs*. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
8	Using *J 39200* DMM, measure the resistance between terminal 19 of *J 39700* and terminal 53 of the PCM connector C2. Is the resistance within the range specified in the value(s) column?	0–5Ω	*Go to Step 10*	*Go to Step 9*
9	Repair CKT 1687 for an open. Refer to *Wiring Repairs*. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
10	Suspect the PCM. Refer to *A Powertrain On Board Diagnostic (OBD) System Check*. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0240 PCM Traction Control Not Allowed



519691

Circuit Description

The PCM monitors various parameters and will not allow traction control operation if any parameter falls below a specified value.

Conditions for Setting the DTC

The PCM detects a malfunction and then causes TCS shut down until the malfunction has been corrected

Action Taken When the DTC Sets

- A DTC C0240 is stored
- The TCS is disabled
- The TRAC OFF indicator is turned on
- If the TCS is again allowed to function, the indicator will be turned off but the DTC will be stored

Conditions for Clearing the DTC

- The condition for the DTC is no longer present and the scan tool clear DTC function is used
- 100 ignition cycles have passed with no DTCs detected

Test Description

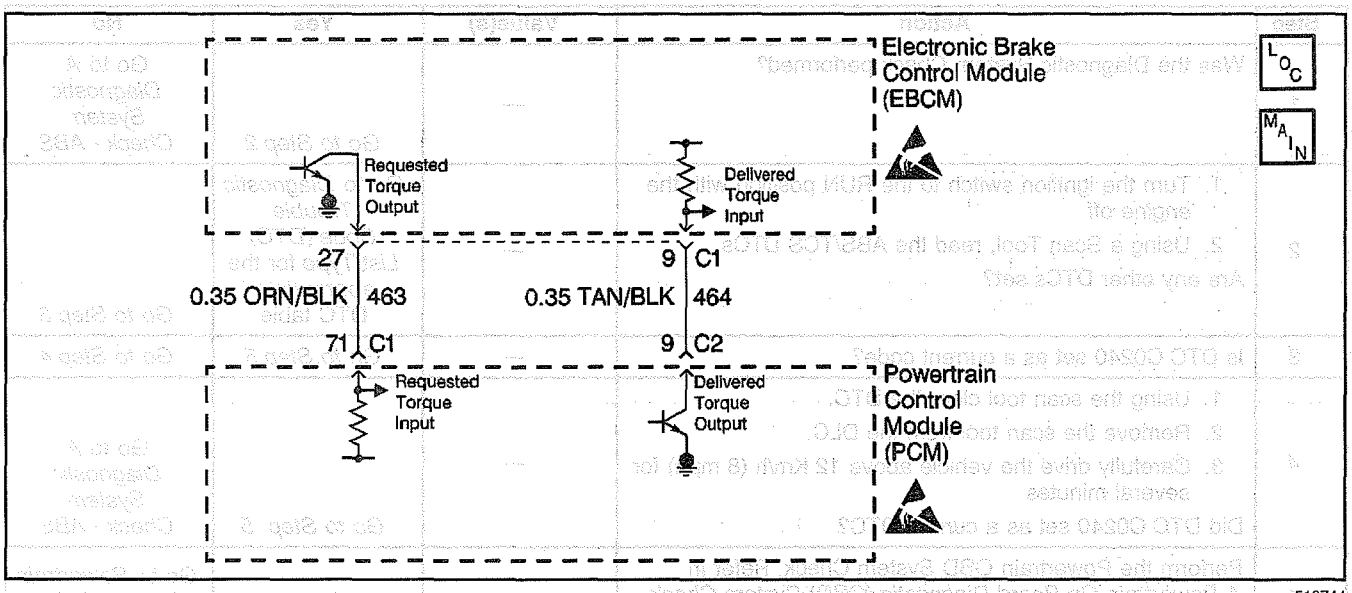
The numbers below refer to the step numbers on the diagnostic table.

4. This step checks if DTC C0240 resets.

DTC C0240 PCM Traction Control Not Allowed

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the RUN position with the engine off. 2. Using a Scan Tool, read the ABS/TCS DTCs. Are any other DTCs set?	—	Go to *Diagnostic Trouble Code (DTC) List/Type* for the appropriate DTC table	*Go to Step 3*
3	Is DTC C0240 set as a current code?	—	*Go to Step 5*	*Go to Step 4*
4	1. Using the scan tool clear the DTC. 2. Remove the scan tool from the DLC. 3. Carefully drive the vehicle above 12 Km/h (8 mph) for several minutes. Did DTC C0240 set as a current DTC?	—	*Go to Step 5*	Go to *A Diagnostic System Check - ABS*
5	Perform the Powertrain OBD System Check. Refer in *A Powertrain On Board Diagnostic (OBD) System Check.* Did the vehicle pass the OBD System Check?	—	Go to Diagnostic Aids	Go to *Powertrain Control Module Diagnosis*

DTC C0241 PCM Indicated Requested Torque Malf



Circuit Description

Traction Control is simultaneously controlled by the EBCM and the ECM. The EBCM sends a requested torque message via a Pulse Width Modulated (PWM) signal to the ECM requesting a desired engine torque level for proper Traction Control system operation. The PCM supplies the pull up voltage.

Conditions for Setting the DTC

- If a defective requested torque signal is detected by the PCM, a message is broadcasted back to the EBCM via class 2.
- DTC C0241 can be set anytime when ignition voltage is present and the EBCM detects the first class 2 message of a defective requested torque signal from the PCM.

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- The TCS is disabled.
- The TRAC OFF indicator is turned on. The ABS remains functional.

Conditions for Clearing the DTC

- Condition for DTC is no longer present and scan tool clear DTC function is used.
- 100 ignition cycles have passed with no DTC(s) detected.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- If an intermittent malfunction exists, refer to *Checking Aftermarket Accessories* in Wiring Systems.
- Possible causes for DTC C0241 to set:
  - Open in the circuit 463.
  - Circuit 463 shorted to ground or voltage.
  - Communication problem.
  - Circuit 463 has a wiring problem, terminal corrosion, or poor connections.
  - PCM not receiving information from the EBCM.

Test Description

The numbers below refer to step numbers on the diagnostic table.

4. This step checks for the proper requested torque value received at the PCM. This value is in percent of torque.
5. This step checks for the proper requested torque value sent from the EBCM. This value is in newton meters of torque.
7. This step checks for the presence of a pull-up voltage from the PCM.

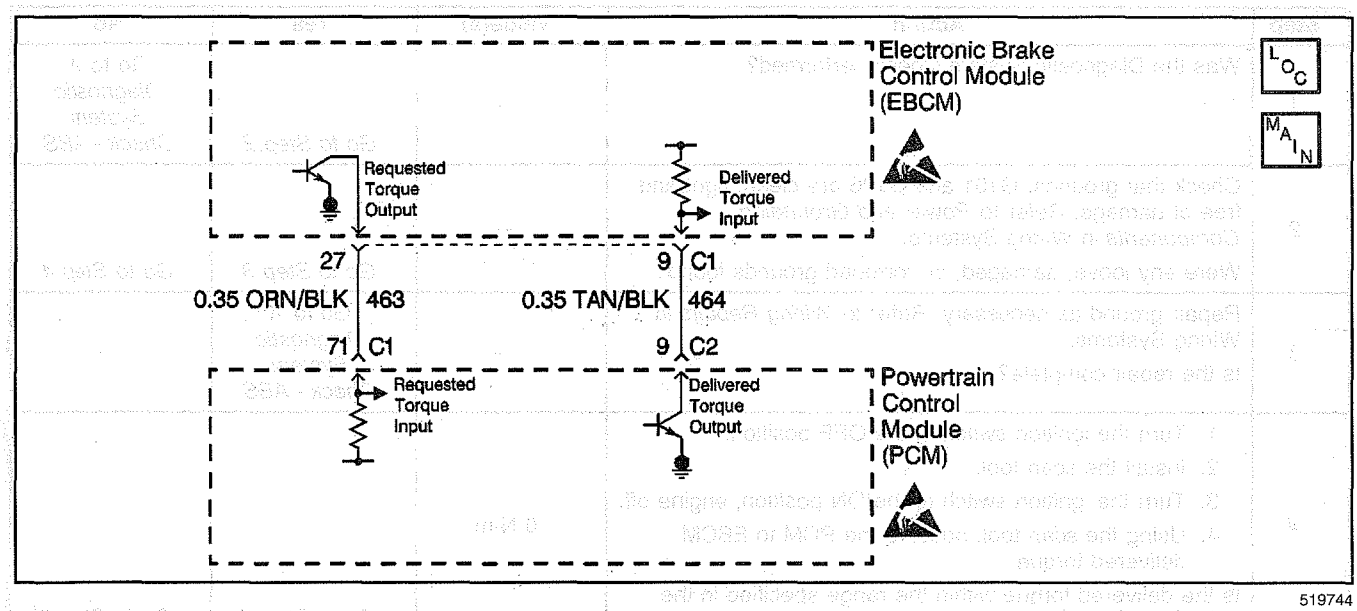
DTC C0241 PCM Indicated Requested Torque Malf

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to *Step 2*	Go to *A Diagnostic System Check - ABS*
2	Check that ground, G101 and G106 is clean, tight and free of damage. Refer to *Power and Grounding Components* in Wiring Systems. Were any loose, damaged, or corroded grounds found?	—	*Go to Step 3*	*Go to Step 4*
3	Repair ground as necessary. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
4	1. Turn the ignition switch to the OFF position. 2. Install the scan tool. 3. Start the engine. 4. Use the scan tool to select Engine 2 Data Display in Powertrain. 5. Using the scan tool, observe the Traction Control Desired Torque. Is the desired torque within the range specified in the value(s) column?	80–95 %	*Go to Step 5*	*Go to Step 7*
5	1. Turn the engine off. 2. Turn the ignition switch to the run position, engine off. 3. Using the scan tool, select ABS/TCS Data Display. 4. Observe the EBCM to PCM Requested Torque. Is the requested torque within the range specified in the value(s) column?	0 N·m	*Go to Step 13*	*Go to Step 6*
6	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
7	1. Turn the ignition switch to the OFF position. 2. Disconnect the EBCM connector. 3. Install *J 39700* Universal Pinout Box using the J 39700-530 cable adapter to the EBCM harness connector. 4. Turn the ignition switch to the RUN position, engine off. 5. Using *J 39200* DMM, measure the voltage between terminals 27 and 15 of *J 39700.* Is the voltage within the range specified in the value(s) column?	4.5-5.5 V	*Go to Step 6*	*Go to Step 10*
8	1. Turn the ignition switch to the OFF position. 2. Disconnect the PCM connector C1. 3. Turn the ignition switch to the RUN position, engine off. 4. Using *J 39200* DMM, measure the voltage between terminals 27 and 15 of *J 39700.* Is the voltage within the range specified in the value(s) column?	Greater than 1V	*Go to Step 9*	*Go to Step 10*

DTC C0241 PCM Indicated Requested Torque Malf (cont'd)

Step	Action	Value(s)	Yes	No
9	Repair CKT 463 for a short to voltage. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
10	1. Turn the ignition switch to the OFF position. 2. Using *J 39200* DMM, measure the resistance between *J 39700* terminals 27 and 15. Is the resistance within the range specified in the value(s) column?	OL (infinite)	*Go to Step 12*	*Go to Step 11*
11	Repair CKT 463 for a short to ground. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
12	1. Turn the ignition switch to the OFF position. 2. Using *J 39200* DMM, measure the resistance between terminal 27 of *J 39700* and the PCM connector C2 terminal 71. Is the resistance within the range specified in the value(s) column?	0–2 Ω	*Go to Step 13*	*Go to Step 14*
13	Suspect PCM. Refer to *A Powertrain On Board Diagnostic (OBD) System Check* in Engine Controls. Is the Repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
14	Repair CKT 463 for an open. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0244 PWM Delivered Torque Malfunction



Circuit Description

Traction Control is simultaneously controlled by the EBCM and the PCM. The PCM sends a DELIVERED TORQUE message via a Pulse Width Modulated (PWM) signal to the EBCM confirming the delivered torque level for proper Traction Control system operation. The EBCM supplies the pull up voltage.

Conditions for Setting the DTC

DTC C0244 can be set anytime when ignition voltage is present. A malfunction exists if the PWM signal is out of range or no signal is received for a period of 2 seconds.

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- The TCS is disabled.
- The TRAC OFF indicator is turned on. The ABS remains functional.

Conditions for Clearing the DTC

- Condition for DTC is no longer present and scan tool clear DTC function is used.
- 100 ignition cycles have passed with no DTC(s) detected.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- If an intermittent malfunction exists refer to *Checking Aftermarket Accessories* in Wiring Systems.
- Possible causes for DTC C0244 to set:
  - Open in CKT 464.
  - CKT 464 shorted to ground or voltage.
  - Communication frequency problem.
  - Communication duty cycle problem.
  - CKT 464 has a wiring problem, terminal corrosion, or poor connections.
  - EBCM not receiving information from the PCM.

Test Description

The numbers below refer to step numbers on the diagnostic table.

4. This step checks for proper torque value in N·m.
6. This step checks for the presence of a pull-up voltage from the EBCM.

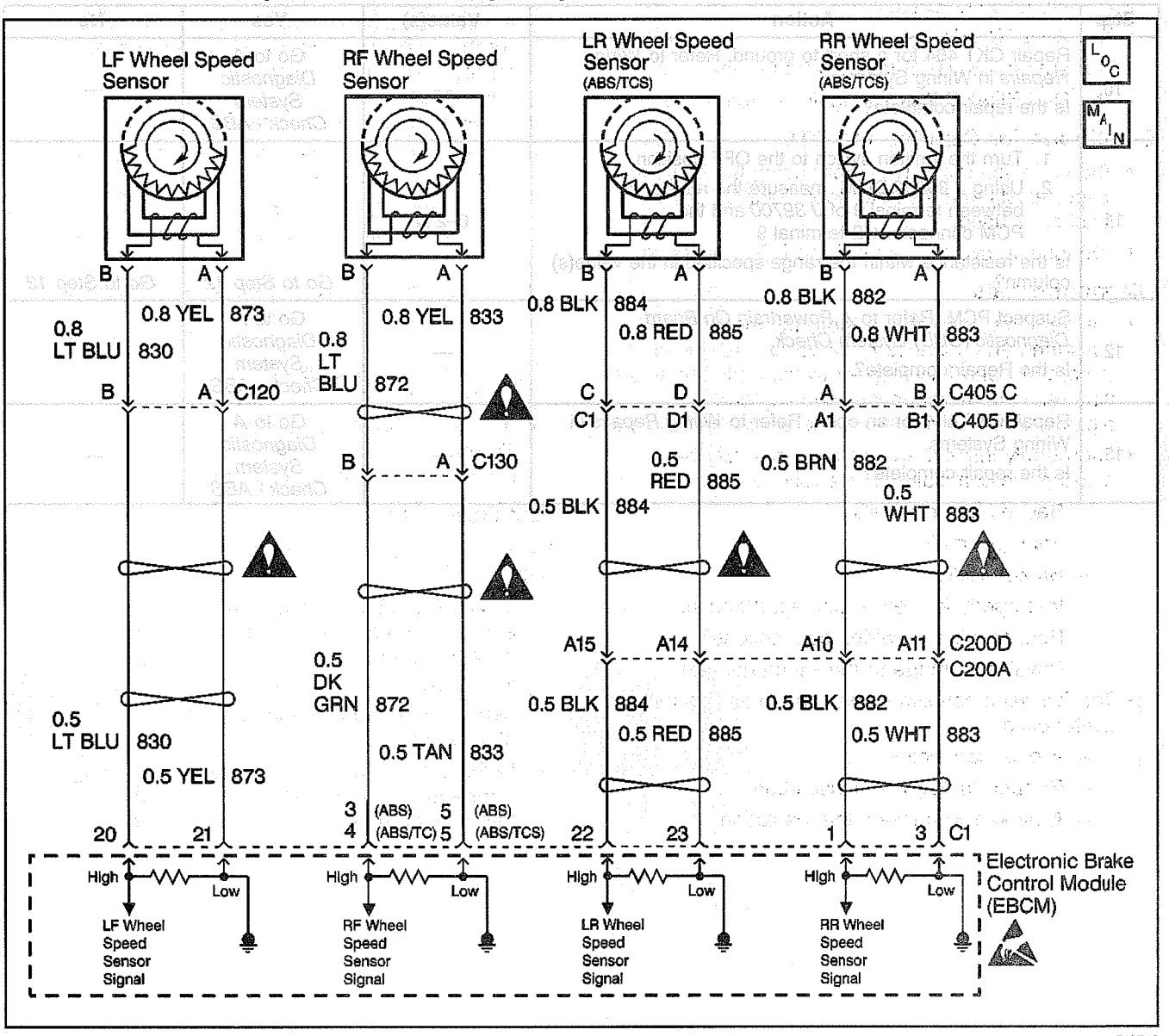
DTC C0244 PWM Delivered Torque Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Check that grounds, G101 and G106 are clean, tight and free of damage. Refer to *Power and Grounding Components* in Wiring Systems. Were any loose, damaged, or corroded grounds found?	—	*Go to Step 3*	*Go to Step 4*
3	Repair ground as necessary. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
4	1. Turn the ignition switch to the OFF position. 2. Install the scan tool. 3. Turn the ignition switch to the ON position, engine off. 4. Using the scan tool, observe the PCM to EBCM delivered torque. Is the delivered torque within the range specified in the value(s) column?	0 N·m	*Go to Step 5*	*Go to Step 6*
5	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
6	1. Turn the ignition switch to the OFF position. 2. Disconnect the PCM connector C2. 3. Disconnect the EBCM connector. 4. Install *J 39700* Universal Pinout Box using the J 39700-530 cable adapter to the EBCM harness connector and the EBCM connector. 5. Turn the ignition switch to the ON position, engine off. 6. Using *J 39200* DMM, measure the voltage between terminals 9 and 15 of *J 39700.* Is the voltage within the range specified in the value(s) column?	Battery Volts	*Go to Step 7*	*Go to Step 9*
7	1. Turn the ignition switch to the OFF position. 2. Disconnect the *J 39700-25* cable adapter from the EBCM leaving the cable adapter connected to the EBCM harness only. 3. Turn the ignition switch to the ON position, engine off. 4. Using *J 39200* DMM, measure the voltage between terminals 9 and 15 of *J 39700.* Is the voltage within the range specified in the value(s) column?	Greater than 1V	*Go to Step 8*	*Go to Step 11*
8	Repair CKT 464 for a short to voltage. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
9	1. Turn the ignition switch to the OFF position. 2. Using *J 39200* DMM, measure the resistance between *J 39700* terminals 9 and 15. Is the resistance within the range specified in the value(s) column?	OL (infinite)	*Go to Step 5*	*Go to Step 10*

DTC C0244 PWM Delivered Torque Malfunction (cont'd)

Step	Action	Value(s)	Yes	No
10	Repair CKT 464 for a short to ground. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
11	1. Turn the ignition switch to the OFF position. 2. Using *J 39200* DMM, measure the resistance between terminal 9 of *J 39700* and the PCM connector C2 terminal 9. Is the resistance within the range specified in the value(s) column?	0–2 Ω	*Go to Step 12*	*Go to Step 13*
12	Suspect PCM. Refer to *A Powertrain On Board Diagnostic (OBD) System Check.* Is the Repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
13	Repair CKT 464 for an open. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0245 Wheel Speed Sensor Frequency Error



519748

Circuit Description

The speed sensors used on the front of this vehicle are multiple pole and the rear uses a single pole magnetic pickup. This sensor produces an AC signal that the EBCM uses the frequency from to calculate the wheel speed.

Conditions for Setting the DTC

- The EBCM detects a deviation between the left and right rear wheel speeds of greater than 6 km/h (3.75 mph) at a vehicle speed of less than 100 km/h (62 mph) on vehicles equipped with TCS.
- The EBCM detects a deviation between the left and right front wheel speeds of greater than 10 km/h (6.25 mph) at a vehicle speed of less than 100 km/h (62 mph).
- The EBCM detects a deviation between the left and right rear wheel speeds of greater than 6 percent of the vehicle speed at greater than 100 km/h (62 mph) on vehicles equipped with TCS.
- The EBCM detects a deviation between the left and right front wheel speeds of greater than 4 km/h plus 6 percent of the vehicle speed at greater than 100 km/h (62 mph).

This DTC will set when the EBCM cannot specifically identify which wheel speed sensor is causing the malfunction. If the EBCM can identify the specific wheel speed sensor causing the malfunction, DTC C0245 will become a history DTC, and the DTC associated with the sensor (DTC C0036, DTC C0041, DTC C0046, DTC C0051, or DTC C0056) will be set concurrent with DTC C0245.

Action Taken When the DTC Sets

- A malfunction DTC stores.
- The ABS/TCS disables.
- The amber ABS/TCS indicator(s) turn on.
- The Red BRAKE Warning indicator turn on.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- 100 ignition cycles pass with no DTCs detected.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness
- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If the customer's comments reflect that the amber ABS/TCS indicator is on only during moist environmental conditions (rain, snow, vehicle wash), inspect all the wheel speed sensor circuitry for signs of water intrusion. If the DTC is not current, clear all DTCs and simulate the effects of water intrusion by using the following procedure:
  1. Spray the suspected area with a five percent saltwater solution.

     Add two teaspoons of salt to twelve ounces of water to make a five percent saltwater solution.
  2. Test drive the vehicle over various road surfaces (bumps, turns, etc.) above 40 km/h (25 mph) for at least 30 seconds.
  3. If the DTC returns, replace the suspected harness.
- If an intermittent malfunction exists refer to Troubleshooting Procedures Cell 4 in Electrical Diagnosis for further diagnosis.

Test Description

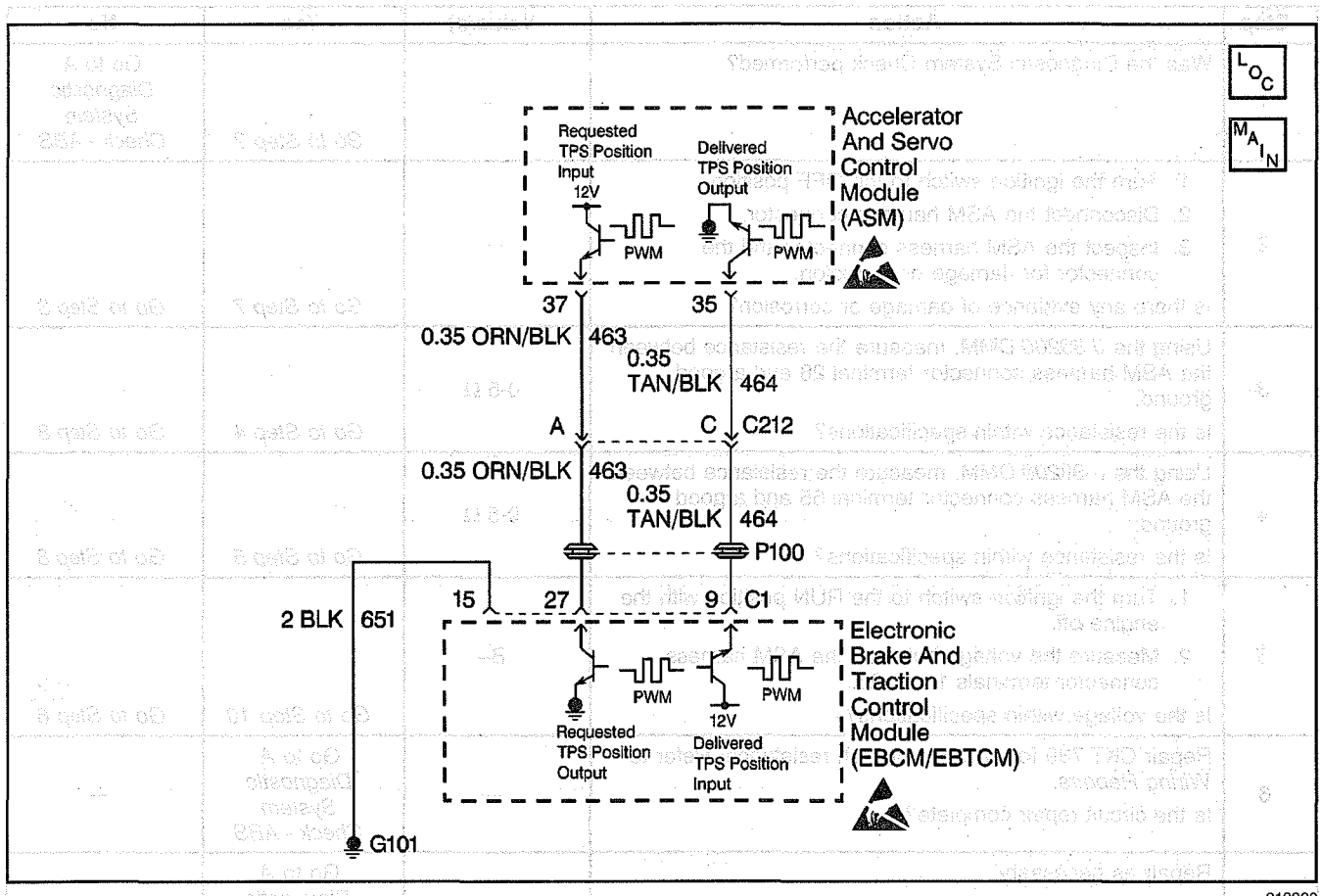
The numbers below refer to step numbers on the diagnostic table.

2. If DTC C0245 is a history code, this step checks if a specific Wheel Speed Circuit Malfunction DTC is set concurrently with DTC C0245.
7. This step checks if the wheel speed sensor harness is routed in close proximity to the spark plug wires.
9. In this step, if the scan tool can record any erroneous wheel speed sensor signals, diagnose that sensor(s) first.

DTC C0245 Wheel Speed Sensor Frequency Error

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Is the following DTC(s) set concurrently with a history DTC C0245? • DTC C0036 • DTC C0041 • DTC C0046 • DTC C0051 • DTC C0056	—	Go to DTC *Diagnostic Trouble Code (DTC) List/Type*	*Go to Step 3*
3	Inspect the WSS for physical damage. Is physical damage of the WSS evident?	—	*Go to Step 4*	*Go to Step 5*
4	Replace the WSS. Is the replacement complete?	—	*Go to Step 14*	—
5	Inspect the jumper harness for physical damage. Is physical damage of the jumper harness evident?	—	*Go to Step 6*	*Go to Step 7*
6	Replace the jumper harness. Is the replacement complete?	—	*Go to Step 14*	—
7	Check for Proper routing of the wheel speed sensor harness. Check that the wheel speed sensor harness is routed away from the spark plug wires. Is the wheel speed sensor harness properly routed?	—	*Go to Step 9*	*Go to Step 8*
8	Reroute the wheel speed sensor harness away from the spark plug wires. Is the reroute complete?	—	*Go to Step 14*	—
9	1. Install a scan tool. 2. Turn the ignition switch to the RUN position. 3. Set the scan tool to Snap Shot Auto Trigger mode and monitor the wheel speed sensors. 4. Carefully drive the vehicle above 12 Km/h (8 mph) for several minutes Did the scan tool trigger on any of the wheel speed sensors?	—	*Go to Step 10*	*Go to Step 11*
10	Note which wheel speed sensor triggered the scan tool. Follow the appropriate Wheel Speed Sensor Malfunction DTC table for the wheel speed sensor that triggered. Refer to DTC Table. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
11	1. Reconnect all previously disconnected components. 2. Using a scan tool clear the DTC. 3. Remove the scan tool from the DLC. 4. Carefully drive the vehicle above 12 Km/h (8 mph) for several minutes. Does the DTC reset as a current DTC?	—	*Go to Step 13*	*Go to Step 12*
12	Malfunction is intermittent. Inspect all connectors and harnesses for damage that may result in an open or high resistance when connected. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
13	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
14	1. Reconnect all previously disconnected components. 2. Using a scan tool clear the DTC. 3. Remove the scan tool from the DLC. 4. Carefully drive the vehicle above 12 Km/h (8 mph) for several minutes. Does the DTC reset as a current DTC?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*

DTC C0266 ADS Controller Malfunction



213300

Circuit Description

This circuit monitors the Delivered Trottle Position Input for proper operation.

Conditions for Setting the DTC

DTC C0266 can set anytime the ignition is in the RUN position and the EBCM does not recieve a Delivered Throttle Position Input.

Action Taken When the DTC Sets

- The TCS is disabled
- The traction control indicator is turned on

Conditions for Clearing the DTC

- The condition for the DTC is no longer present and the scan tool clear DTC function is used
- 100 ignition cycles have passed with no DTCs detected

Diagnostic Aids

- Thoroughly inspect the wiring and the connectors. Failure to carefully and fully inspect the wiring and the connectors can result in misdiagnosis. Misdiagnosis may cause replacement of parts without repairing the malfunction.
- If an intermittent malfunction exists, refer to *Inducing Intermittent Fault Conditions* in Electrical Diagnosis.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3. This step checks for a good ground.
5. This step checks for proper voltage.

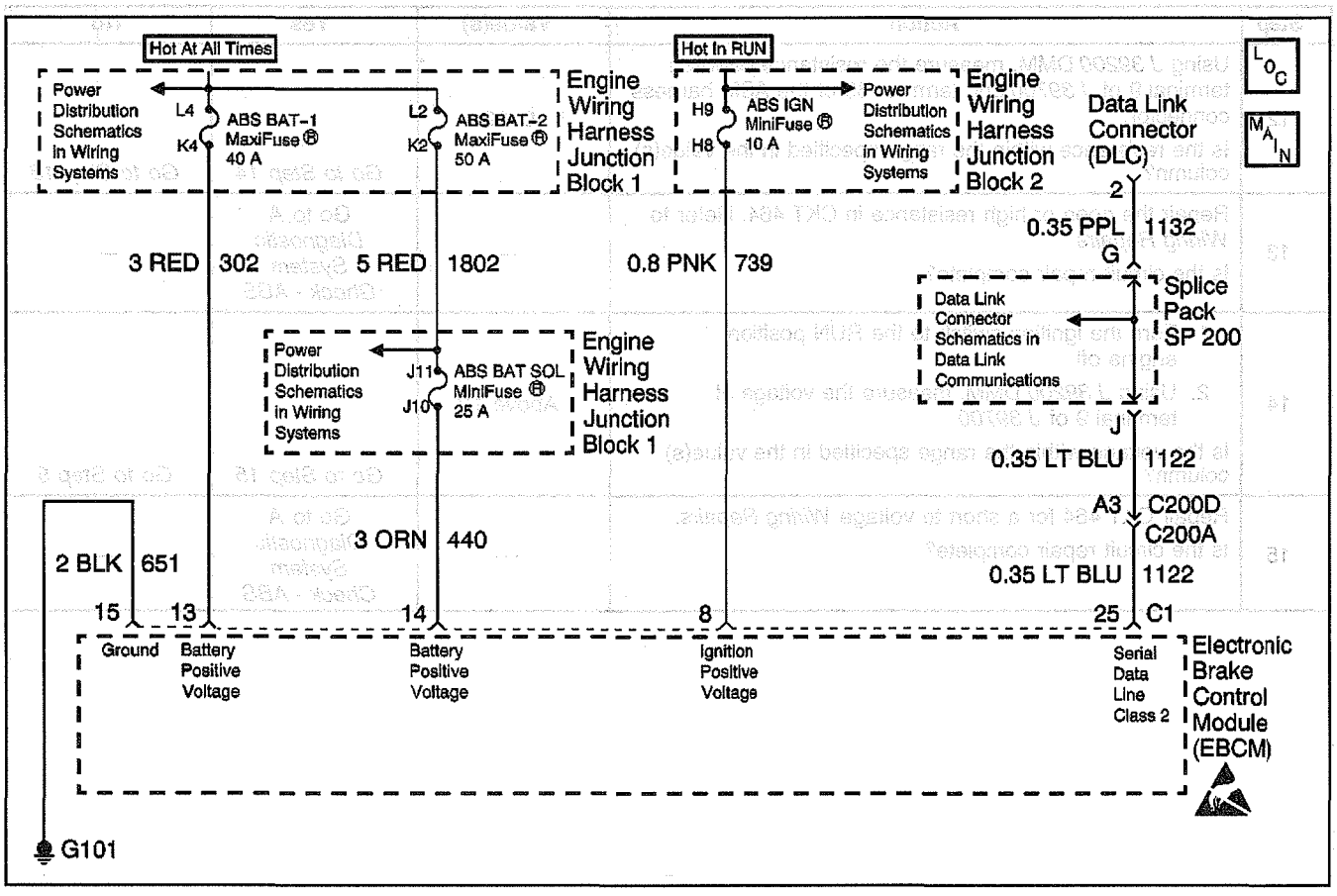
DTC C0266 ADS Controller Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the OFF position. 2. Disconnect the ASM harness connector. 3. Inspect the ASM harness connector and the connector for damage or corrosion. Is there any evidence of damage or corrosion?	—	*Go to Step 7*	*Go to Step 3*
3	Using the *J 39200* DMM, measure the resistance between the ASM harness connector terminal 28 and a good ground. Is the resistance within specifications?	0-5 Ω	*Go to Step 4*	*Go to Step 8*
4	Using the *J 39200* DMM, measure the resistance between the ASM harness connector terminal 55 and a good ground. Is the resistance within specifications?	0-5 Ω	*Go to Step 5*	*Go to Step 8*
5	1. Turn the ignition switch to the RUN position with the engine off. 2. Measure the voltage between the ASM harness connector terminals 1 and 28. Is the voltage within specifications?	B+	*Go to Step 10*	*Go to Step 6*
6	Repair CKT 739 for an open or high resistance. Refer to *Wiring Repairs.* Is the circuit repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
7	Repair as necessary. Are the repairs complete?	—	Go to *A Diagnostic System Check - ABS*	—
8	Repair the open or high resistance in CKT 151. Refer to *Wiring Repairs.* Is the circuit repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
9	Replace the ASM. Refer to *Accelerator and Servo Control Module (ASM) Replacement.* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
10	1. Turn the ignition switch to the OFF position. 2. Disconnect the EBCM connector C1. 3. Install the *J 39700* Universal Pinout Box using the J39700-530 cable adapter to the EBCM harness connector C1 only. 4. Using *J 39200* DMM, measure the resistance between terminals 9 and 15 of *J 39700.* Is the resistance within the range specified in the value(s) column?	OL (infinite)	*Go to Step 12*	*Go to Step 11*
11	Repair CKT 464 for a short to ground. Refer to *Wiring Repairs.* Is the circuit repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0266 ADS Controller Malfunction (cont'd)

Step	Action	Value(s)	Yes	No
12	Using *J 39200* DMM, measure the resistance between terminal 9 of *J 39700* and terminal 35 of the ASM harness connector. Is the resistance within the range specified in the value(s) column?	0–5Ω	*Go to Step 14*	*Go to Step 13*
13	Repair the open or high resistance in CKT 464. Refer to *Wiring Repairs.* Is the circuit repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
14	1. Turn the ignition switch to the RUN position, engine off. 2. Using *J 39200* DMM, measure the voltage at terminal 9 of *J 39700.* Is the voltage within the range specified in the value(s) column?	Above 1V	*Go to Step 15*	*Go to Step 9*
15	Repair CKT 464 for a short to voltage *Wiring Repairs.* Is the circuit repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0550 ECU Malfunction



519691

Circuit Description

This DTC identifies a malfunction within the EBCM.

Conditions for Setting the DTC

DTC C0550 is set when an internal EBCM malfunction exists.

Action Taken When the DTC Sets

- A malfunction DTC stores.
- The ABS/TCS disables.
- The amber ABS/TCS indicator(s) turn on.
- The Red BRAKE Warning indicator turn on.

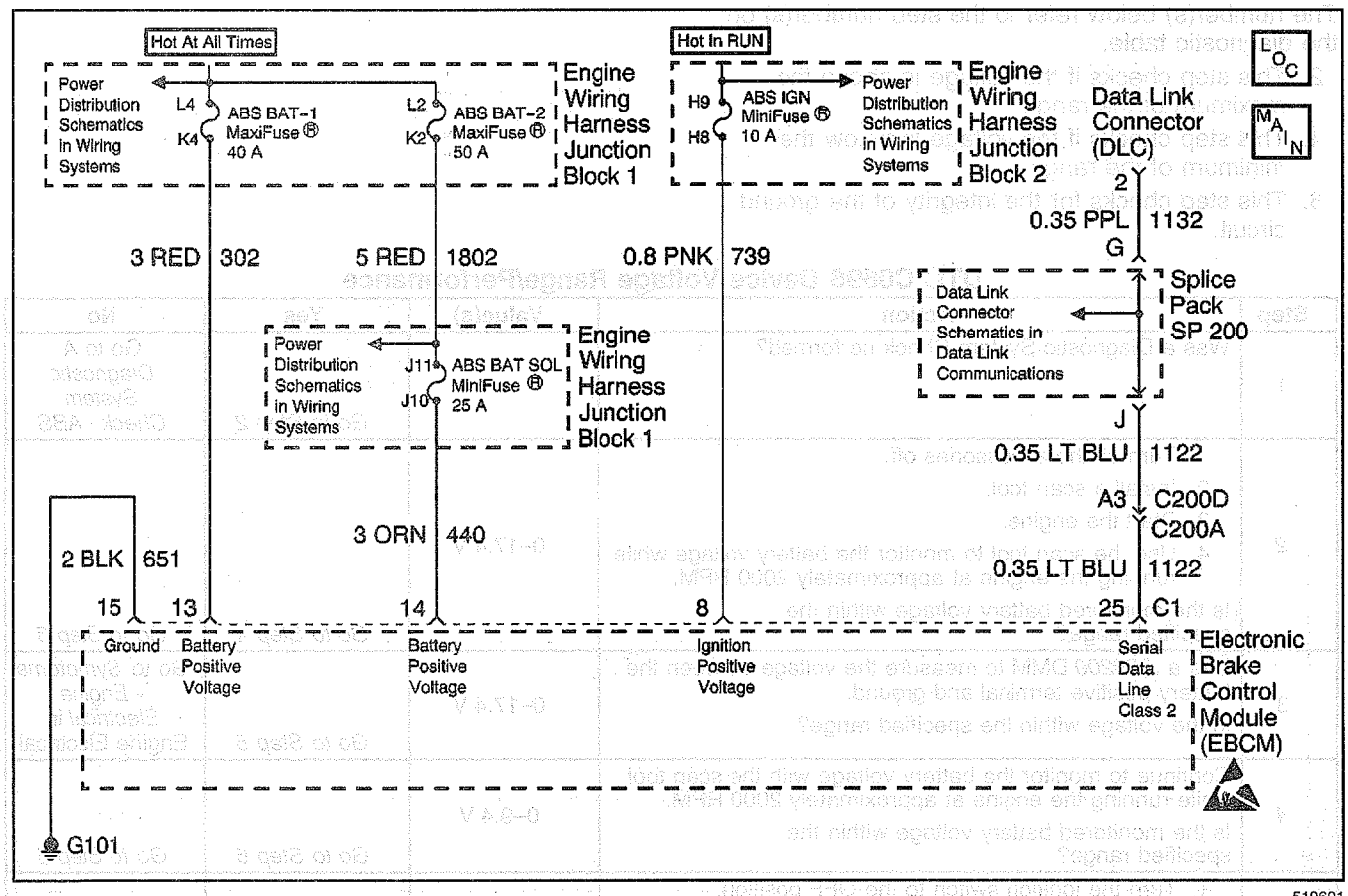
Conditions for Clearing the DTC

- Condition for DTC is no longer present and scan tool clear DTC function is used.
- 100 ignition cycles pass with no DTCs detected.

DTC C0550 ECU Malfunction

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Are any other DTC(s) present besides C0550?	—	Go to DTC Table	*Go to Step 3*
3	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0896 Device Voltage Range/Performance



519691

Circuit Description

The EBCM is required to operate within a specified range of voltage to function properly. During ABS and TCS operation, there are current requirements that will cause the voltage to drop. Because of this, voltage is monitored out of ABS/TCS control to indicate a good charging system condition, and also during ABS/TCS control when voltage may drop significantly. The EBCM also monitors for high voltage conditions which could damage the EBCM.

Conditions for Setting the DTC

- The EBCM operating voltage falls below 9.4 volts out of ABS/TCS control, or 8.8 volts during ABS/TCS control.
- The EBCM operating voltage rises above 17.4 volts.
- The low voltage or the high voltage is detected for more than 500 milliseconds with the vehicle speed above 6 km/h (3.6 mph).

Action Taken When the DTC Sets

- A malfunction DTC is stored.
- The ABS and the Traction Control indicators are turned on.
- The ABS/TCS is disabled.
- The Red BRAKE Warning indicator turns on.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present, the scan tool Clear DTCs function is used.
- 100 ignition cycles have passed with no DTCs detected.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness
- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If an intermittent malfunction exists refer to *Inducing Intermittent Fault Conditions* in Electrical Diagnosis for further diagnosis.

Test Description

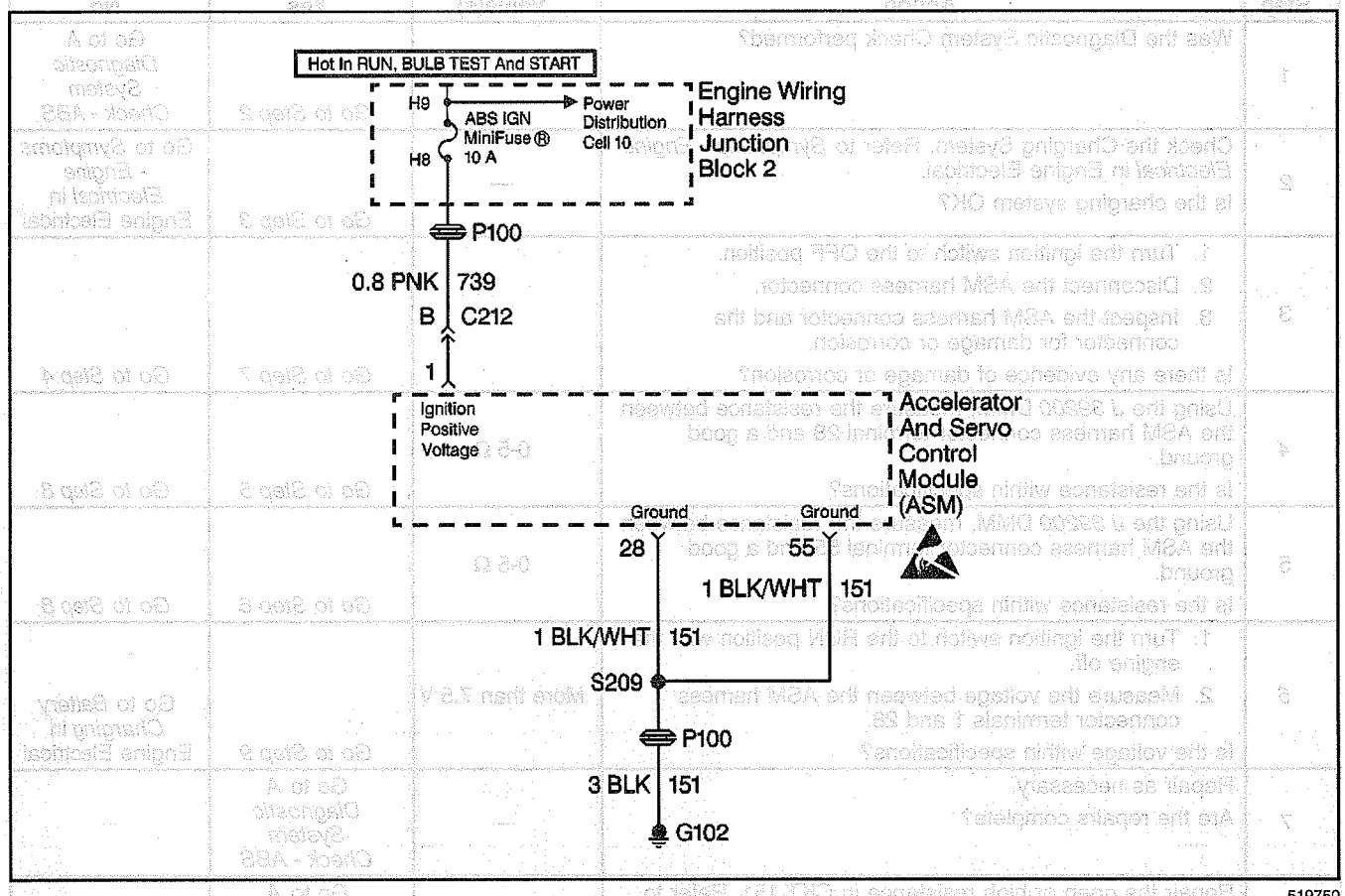
The number(s) below refer to the step number(s) on the diagnostic table.

2. This step checks if the voltage is above the maximum of the range.
4. This step checks if the voltage is below the minimum of the range.
6. This step checks for the integrity of the ground circuit.

DTC C0896 Device Voltage Range/Performance

Step	Action	Value(s)	Yes	No
1	Was a Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn all the accessories off. 2. Install a scan tool. 3. Start the engine. 4. Use the scan tool to monitor the battery voltage while running the engine at approximately 2000 RPM. Is the monitored battery voltage within the specified range?	0–17.4 V	*Go to Step 4*	*Go to Step 3*
3	Use a *J 39200* DMM to measure the voltage between the battery positive terminal and ground. Is the voltage within the specified range?	0–17.4 V	*Go to Step 5*	Go to *Symptoms - Engine Electrical* in Engine Electrical
4	Continue to monitor the battery voltage with the scan tool while running the engine at approximately 2000 RPM. Is the monitored battery voltage within the specified range?	0–9.4 V	*Go to Step 6*	*Go to Step 5*
5	1. Turn the ignition switch to the OFF position. 2. Disconnect the scan tool if still connected. 3. Test drive the vehicle above 6 km/h (3.5 mph). Did DTC C0896 reset?	—	*Go to Step 10*	Go to *A Diagnostic System Check - ABS*
6	1. Turn the ignition switch to the OFF position. 2. Disconnect the EBCM connector C1. 3. Install the *J 39700* Universal Pinout Box with the J 39700-530 Cable Adapter to the EBCM harness connector C1 only. 4. Use a *J 39200* DMM to measure the resistance between the *J 39700* terminal 15 and a good ground. Is the resistance within the specified range?	0-5Ω	*Go to Step 8*	*Go to Step 7*
7	Repair open or high resistance in CKT 651. Refer to *Wiring Repairs.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
8	1. Turn the ignition switch to the RUN position. 2. Use a *J 39200* DMM to measure the voltage between the *J 39700* terminal 8 and 15. Is the voltage within the specified range?	Above 9.4 Volts	*Go to Step 9*	Go to *Symptoms - Engine Electrical* in Engine Electrical
9	1. Turn the ignition switch to the OFF position. 2. Reconnect the EBCM connector C1. 3. Disconnect the scan tool if the scan tool is still connected. 4. Test drive the vehicle above 6 km/h (3.5 mph). Did DTC C0896 reset?	—	*Go to Step 10*	Go to *A Diagnostic System Check - ABS*
10	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—

DTC C0901 Device #2 Voltage Low



Circuit Description

This circuit monitors the voltage level available to the ASM. If the voltage drops below 7.5 volts, full performance of the traction control system cannot be guaranteed.

Conditions for Setting the DTC

DTC C0901 can set anytime the ignition is in the RUN position and ignition voltage is less than 7.5 volts

Action Taken When the DTC Sets

- The TCS is disabled
- The traction control indicator is turned on

Conditions for Clearing the DTC

- The condition for the DTC is no longer present and the scan tool clear DTC function is used
- 100 ignition cycles have passed with no DTCs detected

Diagnostic Aids

- Thoroughly inspect the wiring and the connectors. Failure to carefully and fully inspect the wiring and the connectors can result in misdiagnosis. Misdiagnosis may cause replacement of parts without repairing the malfunction.
- Inspect for other low voltage conditions.
- Test the charging system. Refer to *Symptoms - Engine Electrical* in Engine Electrical.
- The following conditions are other possible causes of low system voltage:
  - A charging system malfunction
  - Excessive parasitic drain
  - A weak battery
  - A faulty system ground
- If an intermittent malfunction exists, refer to *Inducing Intermittent Fault Conditions* in Electrical Diagnosis.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4. This step checks for a good ground.
6. This step checks for proper voltage.

DTC C0901 Device #2 Voltage Low

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Check the Charging System. Refer to *Symptoms - Engine Electrical* in Engine Electrical. Is the charging system OK?	—	*Go to Step 3*	Go to *Symptoms - Engine Electrical* in Engine Electrical
3	1. Turn the ignition switch to the OFF position. 2. Disconnect the ASM harness connector. 3. Inspect the ASM harness connector and the connector for damage or corrosion. Is there any evidence of damage or corrosion?	—	*Go to Step 7*	*Go to Step 4*
4	Using the *J 39200* DMM, measure the resistance between the ASM harness connector terminal 28 and a good ground. Is the resistance within specifications?	0-5 Ω	*Go to Step 5*	*Go to Step 8*
5	Using the *J 39200* DMM, measure the resistance between the ASM harness connector terminal 55 and a good ground. Is the resistance within specifications?	0-5 Ω	*Go to Step 6*	*Go to Step 8*
6	1. Turn the ignition switch to the RUN position with the engine off. 2. Measure the voltage between the ASM harness connector terminals 1 and 28. Is the voltage within specifications?	More than 7.5 V	*Go to Step 9*	Go to *Battery Charging* in Engine Electrical
7	Repair as necessary. Are the repairs complete?	—	Go to *A Diagnostic System Check - ABS*	—
8	Repair the open or high resistance in CKT 151. Refer to *Wiring Repairs.* Is the circuit repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
9	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—

Symptoms

Important: The following steps must be completed before using the symptom tables.

1. Perform the *A Diagnostic System Check - ABS* before using the Symptom Tables in order to verify that all of the following are true:
   - There are no DTCs set.
   - The control module(s) can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to *ABS Description.*

Visual/Physical Inspection

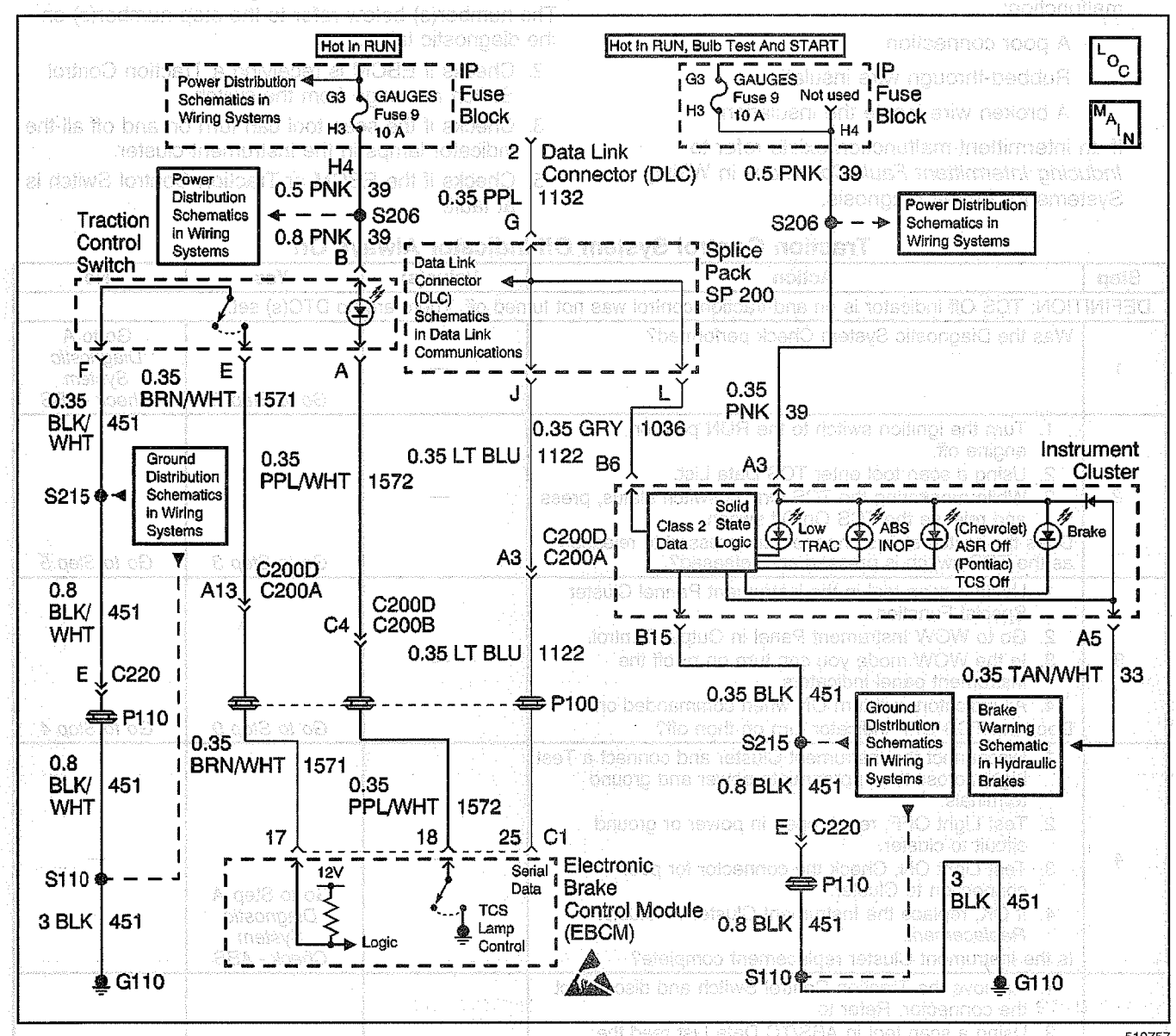
- Inspect for aftermarket devices which could affect the operation of the antilock brake system. Refer to *Checking Aftermarket Accessories.*
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the master cylinder reservoir for the proper fluid level.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- *Traction Control System Off Indicator Always On*
- *Traction Control System Off Indicator Inoperative*
- *Acceleration Slip Regulation Indicator Always On*
- *Acceleration Slip Regulation Indicator Inoperative*
- *No Communication with EBCM*
- *ABS Indicator Always On*
- *ABS Indicator Inoperative*
- *Low Traction Indicator Always On*
- *Low Traction Indicator Inoperative*

Traction Control System Off Indicator Always On



519757

Circuit Description

The TCS OFF Indicator is controlled by the EBCM by sending class 2 messages to the Instrument Panel Cluster (IPC). It is turned on when the EBCM sets a DTC that turns on the TCS OFF indicator. It is also turned on or off when the Control Switch is pressed. The Electronic Brake Control Module (EBCM) supplies 12 volts to the Traction Control Switch, when the TCS switch is depressed the EBCM sees the voltage go low, and that the TCS switch state has changed. When the EBCM receives that a switch state has changed it turns on or off the Traction Control and sends a message to the IPC to turn on or off the TCS OFF indicator depending on its previous state.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness

- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If an intermittent malfunction exists refer to *Inducing Intermittent Fault Conditions* in Wiring Systems for further diagnosis.

Test Description

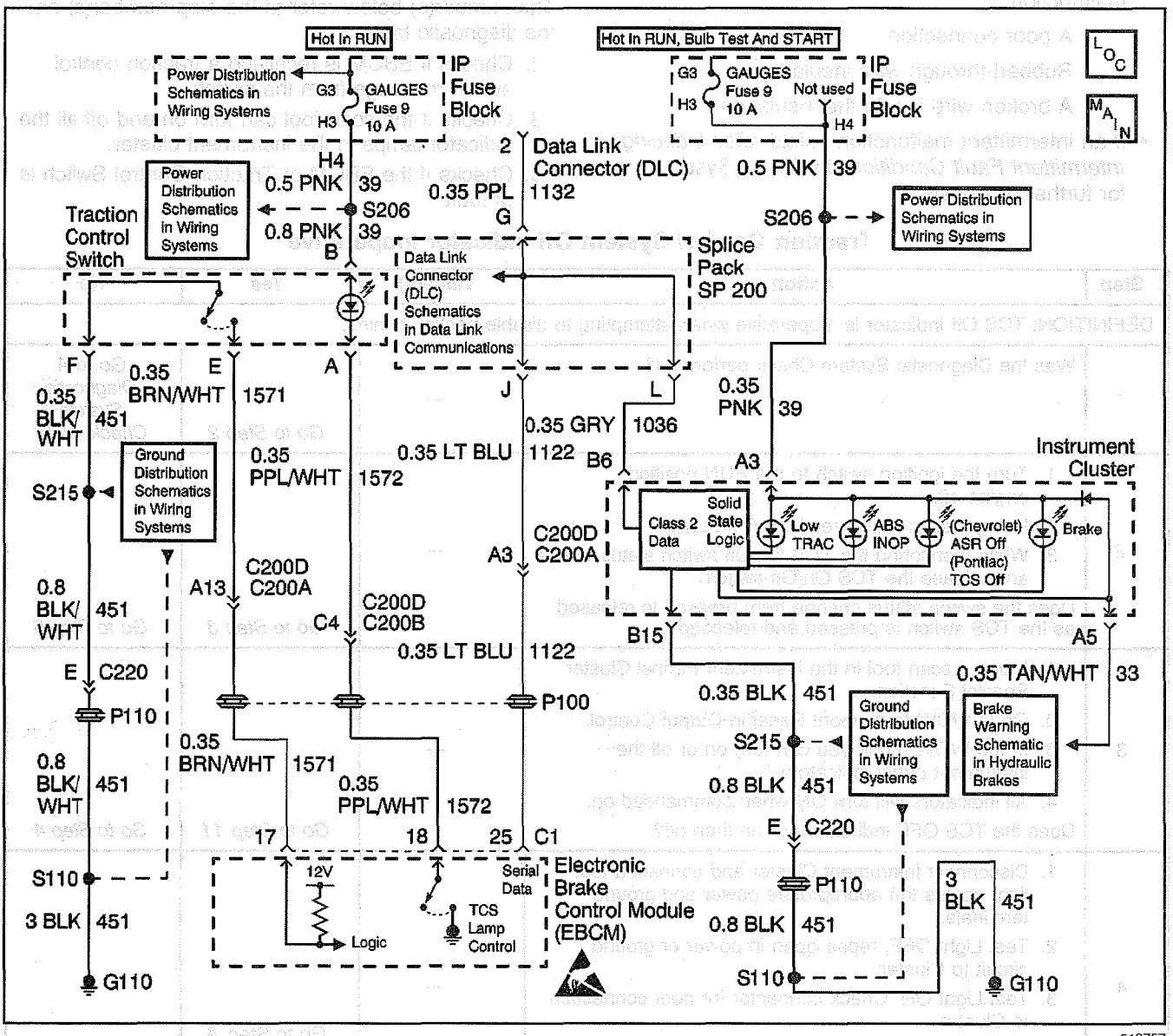
The number(s) below refer to the step number(s) on the diagnostic table.

2. Checks if EBCM is receiving a Traction Control Switch message from the switch.
3. Checks if the scan tool can turn on and off all the indicator lamps in the instrument cluster.
5. Checks if the EBCM or Traction Control Switch is at fault.

Traction Control System Off Indicator Always On

Step	Action	Value(s)	Yes	No
DEFINITION: TCS Off indicator is on and traction control was not turned off. There are no DTC(s) set.				
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the RUN position, engine off. 2. Using a scan tool enter TCS Data List. 3. While monitoring the TCS On/Off switch status, press and release the TCS On/Off switch. Does the switch status change from pressed to released as the TCS switch is pressed and released?	—	*Go to Step 3*	*Go to Step 5*
3	1. Using a scan tool in the instrument Pannel Cluster Special Function. 2. Go to WOW Instrument Panel in Output Control. 3. In the WOW mode you can turn on or off the instrument panel indicators. 4. All indicators will turn ON when commanded on. Does the TCS OFF indicator turn on then off?	—	*Go to Step 9*	*Go to Step 4*
4	1. Disconnect the Instrument Cluster and connect a Test Light across the appropraiate power and ground terminals. 2. Test Light OFF, repair open in power or ground circuit to cluster. 3. Test Light ON, Check the connector for poor connection to Cluster. 4. If OK, replace the Instrument Cluster *IP Cluster Replacement.* Is the Instrument Cluster replacement complete?	—	Go to Step *A Diagnostic System Check - ABS*	—
5	1. Remove the Traction Control Switch and disconnect the connector. Refer to 2. Using a scan tool in ABS/TC Data List read the TCS Switch Status. 3. With the Traction Control Switch disconnected. Does the TCS Switch status read released?	—	*Go to Step 6*	*Go to Step 7*
6	Replace the Traction Control Switch. Refer to *Traction Control Switch Replacement (Chevrolet)* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
7	1. Turn the ignition switch to the OFF position. 2. Using *J 39200* DMM, measure the resistance between the Traction Control Switch harness connector terminal E and a known good ground. Is the resistance within the range specified in the value(s) column?	OL (Infinite)	*Go to Step 9*	*Go to Step 8*
8	Repair CKT 1571 for a short to ground. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
9	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—

Traction Control System Off Indicator Inoperative



519757

Circuit Description

The TCS OFF Indicator is controlled by the EBCM by sending class 2 messages to the Instrument Panel Cluster (IPC). It is turned on when the EBCM sets a DTC that turns on the TCS OFF indicator. It is also turned on or off when the Traction Control Switch is pressed. The Electronic Brake Control Module (EBCM) supplies 12 volts to the Traction Control Switch, when the TCS switch is depressed the EBCM sees the voltage go low, and that the TCS switch state has changed. When the EBCM receives that a switch state has changed it turns on or off the Traction Control and sends a message to the IPC to turn on or off the TCS OFF indicator depending on its previous state.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness

- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If an intermittent malfunction exists refer *Inducing Intermittent Fault Conditions* in Wiring System for further diagnosis.

Test Description

The number(s) below refer to the step number(s) on the diagnostic table.

2. Checks if EBCM is receiving a traction control switch message from the switch.
3. Checks if the scan tool can turn on and off all the indicator lamps in the instrument cluster.
5. Checks if the EBCM or Traction Control Switch is at fault.

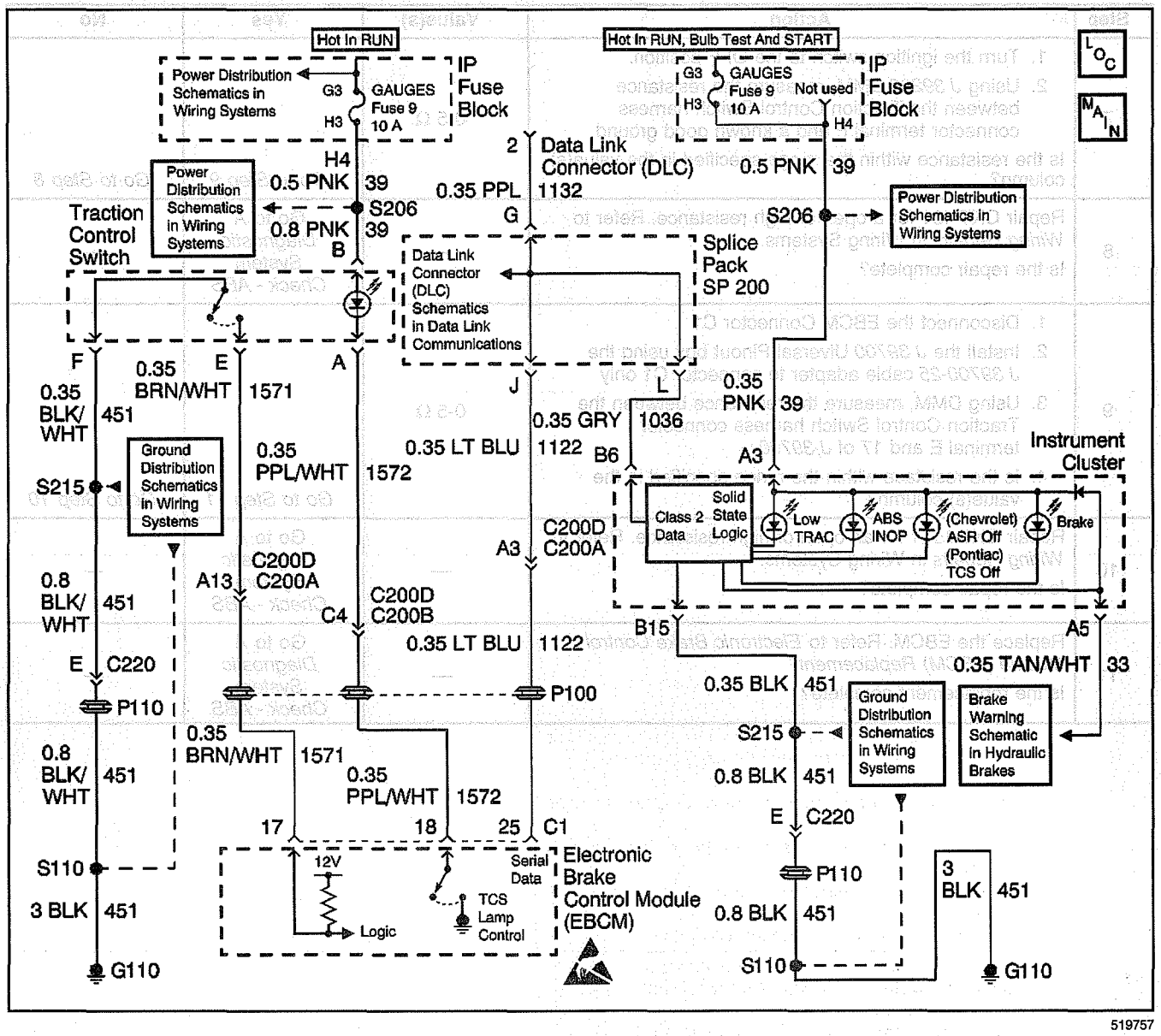
Traction Control System Off Indicator Inoperative

Step	Action	Value(s)	Yes	No
DEFINITION: TCS Off indicator is Inoperative when attempting to disable traction control.				
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the RUN position, engine off. 2. Using a scan tool enter TCS Data List. 3. While monitoring the TCS On/Off switch status, press and release the TCS On/Off switch. Does the switch status change from pressed to released as the TCS switch is pressed and released?	—	*Go to Step 3*	*Go to Step 5*
3	1. Using a scan tool in the instrument Pannel Cluster Special Function. 2. Go to WOW Instrument Panel in Output Control. 3. In the WOW mode you can turn on or off the instrument panel indicators. 4. All indicators will turn ON when commanded on. Does the TCS OFF indicator turn on then off?	—	*Go to Step 11*	*Go to Step 4*
4	1. Disconnect Instrument Cluster and connect a test light across the appropraiate power and ground terminals. 2. Test Light OFF, repair open in power or ground circuit to Cluster. 3. Test Light ON, Check connector for poor connection to Cluster. 4. If OK, replace the Instrument Cluster *IP Cluster Replacement.* Is the instrument cluster replacement complete?	—	Go to Step *A Diagnostic System Check - ABS*	—
5	1. Remove the traction control switch and disconnect the connector. Refer to *Traction Control Switch Replacement (Chevrolet)* 2. Using a scan tool in ABS/TC Data List read the TCS Switch Status. 3. Connect a jumper wire between terminals E and F of the Traction Control Switch harness connector. Does the TCS Switch status read pressed with the jumper wire connected?	—	*Go to Step 6*	*Go to Step 7*
6	Replace the Traction Control Switch. Refer to *Traction Control Switch Replacement (Chevrolet).* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—

Traction Control System Off Indicator Inoperative (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Turn the ignition switch to the OFF position. 2. Using *J 39200* DMM, measure the resistance between the Traction Control Switch harness connector terminal F and a known good ground. Is the resistance within the range specified in the value(s) column?	0-5 Ω	*Go to Step 9*	*Go to Step 8*
8	Repair CKT 451 for a open or high resistance. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
9	1. Disconnect the EBCM Connector C1 2. Install the *J 39700* Uiversal Pinout box using the *J 39700-25* cable adapter to connector C1 only 3. Using DMM, measure the resistance between the Traction Control Switch harness connector terminal E and 17 of *J 39700* 4. Is the resistace within the range specified in the value(s) column?	0-5 Ω	*Go to Step 11*	*Go to Step 10*
10	Repair CKT 1571 for an open or high resistance. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
11	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—

Acceleration Slip Regulation Indicator Always On



Circuit Description

The ASR OFF Indicator is controlled by the EBCM by sending class 2 messages to the Instrument Panel Cluster (IPC). It is turned on when the EBCM sets a DTC that turns on the ASR OFF indicator. It is also turned on or off when the Accelerator Slip Regulation (ASR) Switch is pressed. The Electronic Brake Control Module (EBCM) supplies 12 volts to the ASR Switch, when the ASR switch is depressed the EBCM sees the voltage go low, and that the ASR switch state has changed. When the EBCM receives that a switch state has changed it turns on or off the ASR and sends a message to the IPC to turn on or off the ASR OFF indicator depending on its previous state.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness

- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If an intermittent malfunction exists refer to *Inducing Intermittent Fault Conditions* in Wiring System for further diagnosis.

Test Description

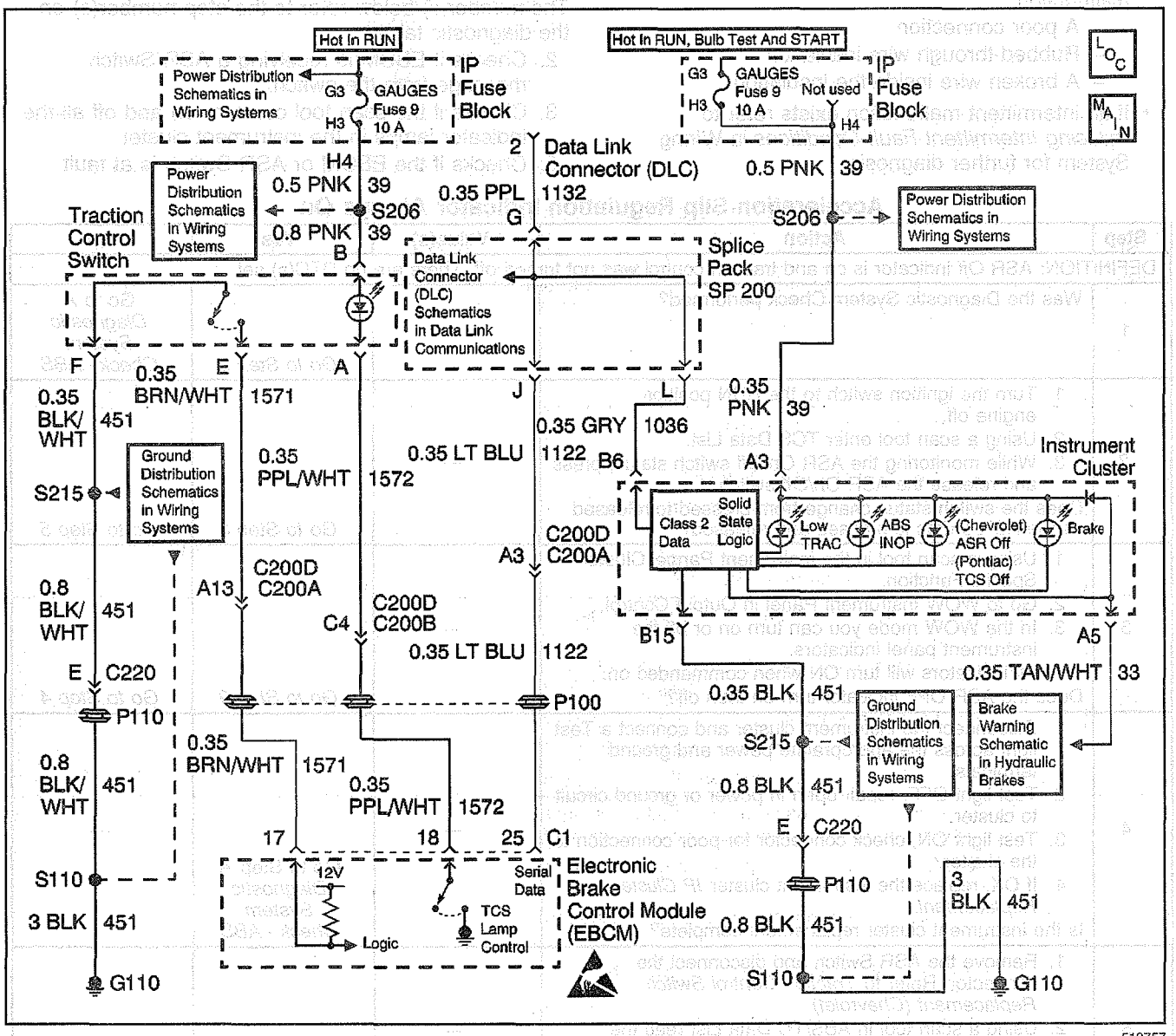
The number(s) below refer to the step number(s) on the diagnostic table.

2. Checks if EBCM is receiving a ASR Switch message from the switch.
3. Checks if the scan tool can turn on and off all the indicator lamps in the instrument cluster.
5. Checks if the EBCM or ASR Switch is at fault.

Acceleration Slip Regulation Indicator Always On

Step	Action	Value(s)	Yes	No
DEFINITION: ASR Off indicator is on and traction control was not turned off. There are no DTC(s) set.				
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the RUN position, engine off. 2. Using a scan tool enter TCS Data List. 3. While monitoring the ASR On/Off switch status, press and release the ASR On/Off switch. Does the switch status change from pressed to released as the ASR switch is pressed and released?	—	*Go to Step 3*	*Go to Step 5*
3	1. Using a scan tool in the instrument Pannel Cluster Special Function. 2. Go to WOW Instrument Panel in Output Control. 3. In the WOW mode you can turn on or off the instrument panel indicators. 4. All indicators will turn ON when commanded on. Does the ASR OFF indicator turn on then off?	—	*Go to Step 9*	*Go to Step 4*
4	1. Disconnect the instrument cluster and connect a Test light across the appropraiate power and ground terminals. 2. Test light OFF, repair open in power or ground circuit to cluster. 3. Test light ON, check connector for poor connection to the cluster. 4. If OK, replace the instrument cluster *IP Cluster Replacement.* Is the instrument cluster replacement complete?	—	Go to Step *A Diagnostic System Check - ABS*	—
5	1. Remove the ASR Switch and disconnect the connector. Refer to *Traction Control Switch Replacement (Chevrolet).* 2. Using a scan tool in ABS/TC Data List read the TCS Switch Status. 3. With the ASR Switch disconnected. Does the TCS switch status read released?	—	*Go to Step 6*	*Go to Step 7*
6	Replace the ASR Switch. Refer to *Traction Control Switch Replacement (Chevrolet).* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
7	1. Turn the ignition switch to the OFF position. 2. Using *J 39200* DMM, measure the resistance between the ASR switch harness connector terminal E and a known good ground. Is the resistance within the range specified in the value(s) column?	OL (Infinite)	*Go to Step 9*	*Go to Step 8*
8	Repair CKT 1571 for a short to ground. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
9	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—

Acceleration Slip Regulation Indicator Inoperative



519757

Circuit Description

The ASR OFF Indicator is controlled by the EBCM by sending class 2 messages to the Instrument Panel Cluster (IPC). It is turned on when the EBCM sets a DTC that turns on the ASR OFF indicator. It is also turned on or off when the Accelerator Slip Regulation (ASR) Switch is pressed. The Electronic Brake Control Module (EBCM) supplies 12 volts to the ASR Switch, when the ASR switch is depressed the EBCM sees the voltage go low, and that the ASR switch state has changed. When the EBCM receives that a switch state has changed it turns on or off the ASR and sends a message to the IPC to turn on or off the ASR OFF indicator depending on its previous state.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness

- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If an intermittent malfunction exists refer to *Inducing Intermittent Fault Conditions* in Wiring Systems for further diagnosis.

Test Description

The number(s) below refer to the step number(s) on the diagnostic table.

2. Checks if EBCM is receiving a ASR switch message from the switch.
3. Check if the scan tool can turn on and off the indicator lamps in the instrument cluster.
5. Checks if the EBCM or ASR Switch is at fault.

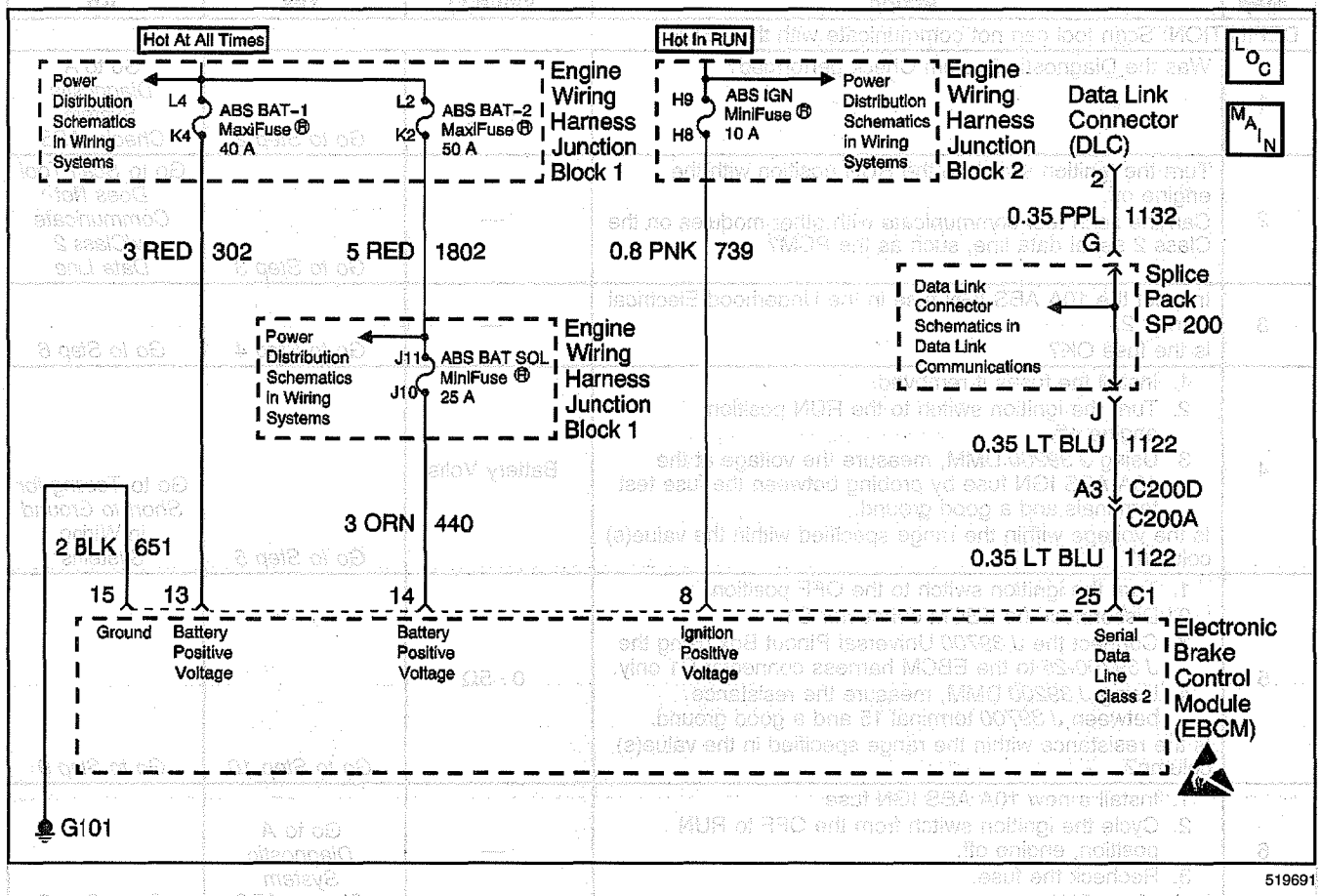
Acceleration Slip Regulation Indicator Inoperative

Step	Action	Value(s)	Yes	No
DEFINITION: ASR Off indicator is inoperative when attempting to disable traction control. There are no DTC(s) set.				
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Turn the ignition switch to the RUN position, engine off. 2. Using a scan tool enter TCS Data List. 3. While monitoring the TCS On/Off switch status, press and release the ASR On/Off switch. Does the switch status change from pressed to released as the ASR switch is pressed and released?	—	*Go to Step 3*	*Go to Step 5*
3	1. Using a scan tool in the Instrument Pannel Cluster Special Function. 2. Go to WOW Instrument Panel in Output Control. 3. In the WOW mode you can turn on or off the instrument panel indicators. 4. All indicators will turn ON when commanded on. Does the ASR OFF indicator turn on then off?	—	*Go to Step 11*	*Go to Step 4*
4	1. Disconnect instrument cluster and connect a test light across the appropraiate power and ground terminals. 2. Test light OFF, repair open in power or ground circuit to cluster. 3. Test light ON, check connector for poor connection to Cluster. 4. If OK, replace the instrument cluster *IP Cluster Replacement.* Is the instrument cluster replacement complete?	—	Go to Step *A Diagnostic System Check - ABS*	—
5	1. Remove the ASR switch and disconnect the connector. Refer to *Traction Control Switch Replacement (Chevrolet)* 2. Using a scan tool in ABS/TC Data List read the TCS switch status. 3. Connect a jumper wire between terminals E and F of the ASR Switch harness connector. Does the TCS switch status read pressed with the jumper wire connected?	—	*Go to Step 6*	*Go to Step 7*
6	Replace the ASR switch. Refer to *Traction Control Switch Replacement (Chevrolet)* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—

Acceleration Slip Regulation Indicator Inoperative (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Turn the ignition switch to the OFF position. 2. Using *J 39200* DMM, measure the resistance between the ASR switch harness connector terminal F and a known good ground. Is the resistance within the range specified in the value(s) column?	0-5 Ω	*Go to Step 9*	*Go to Step 8*
8	Repair CKT 451 for a open or high resistance. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
9	1. Disconnect the EBCM Connector C1 2. Install the *J 39700* Universal Pinout box using the *J 39700-25* cable adapter to connector C1 only. 3. Using DMM, measure the resistance between the ASR switch harness connector terminal E and 17 of *J 39700* 4. Is the resistace within the range specified in the value(s) column?	0-5 Ω	*Go to Step 11*	*Go to Step 10*
10	Repair CKT 1571 for an open or high resistance. Refer to *Wiring Repairs* in Wiring Systems. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
11	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—

No Communication with EBCM



519691

Circuit Description

The Class 2 serial data line allows all the modules on the line to transmit information to each other as needed. Each module is assigned an ID and all the information sent out on the line is assigned a priority by which it is received. When the ignition switch is turned to the run position each module begins to send and receive information. Each module on the Class 2 serial data line knows what information it needs to send out and what information it should be receiving. What the modules do not know is which module is supposed to send them the information. This information is only learned after the module has received the information it needs along with the ID of the module that sent the information. This information is then remembered until the ignition switch is truned off.

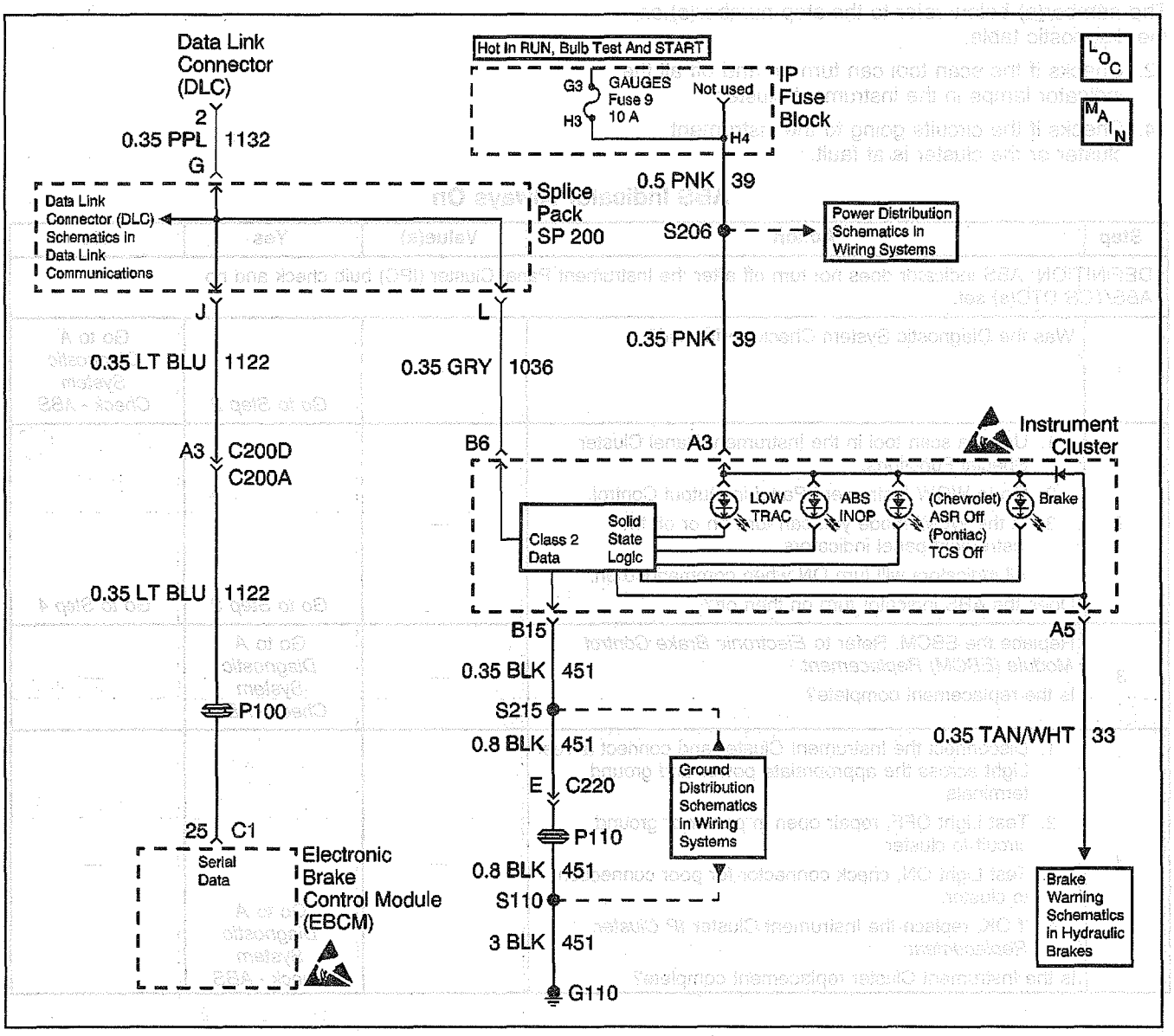
Diagnostic Aids

- Thoroughly inspect the wiring and the connectors. Failure to carefully and fully inspect the wiring and the connectors can result in misdiagnosis. Misdiagnosis may cause replacement of parts without repairing the malfunction.
- If an intermittent malfunction exists, refer to *Inducing Intermittent Fault Conditions* in wiring system.

No Communication with EBCM

Step	Action	Value(s)	Yes	No
DEFINITION: Scan tool can not communicate with the EBCM.				
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	Turn the Ignition switch to the RUN position with the engine off. Can the scan tool communicate with other modules on the Class 2 serial data line, such as the PCM?	—	*Go to Step 3*	Go to *Scan Tool Does Not Communicate w/Class 2 Data Line*
3	Inspect the 10A ABS IGN fuse in the Underhood Electrical Center 2. Is the fuse OK?	—	*Go to Step 4*	*Go to Step 6*
4	1. Install the fuses if removed. 2. Turn the ignition switch to the RUN position, engine off. 3. Using *J 39200* DMM, measure the voltage at the 10A ABS IGN fuse by probing between the fuse test terminals and a good ground. Is the voltage within the range specified within the value(s) column?	Battery Volts	*Go to Step 5*	Go to *Testing for Short to Ground* in Wiring Systems
5	1. Turn the ignition switch to the OFF position. 2. Disconnect the EBCM connector C1. 3. Connect the *J 39700* Universal Pinout Box using the *J 39700-25* to the EBCM harness connector C1 only. 4. Using *J 39200* DMM, measure the resistance between *J 39700* terminal 15 and a good ground. Is the resistance within the range specified in the value(s) column?	0 - 5Ω	*Go to Step 10*	*Go to Step 9*
6	1. Install a new 10A ABS IGN fuse. 2. Cycle the ignition switch from the OFF to RUN position, engine off. 3. Recheck the fuse. Is the fuse OK?	—	Go to *A Diagnostic System Check - ABS*	*Go to Step 7*
7	1. Turn the ignition switch to the OFF position. 2. Remove the 10A ABS IGN fuse. 3. Disconnect the EBCM connector C1. 4. Connect the *J 39700* Universal Pinout Box using the *J 39700-25* to the EBCM harness connector C1 only. 5. Using *J 39200* DMM, measure the resistance between terminals 8 and 15 of *J 39700*. Is the resistance within the range specified in the value(s) column?	OL (infinite)	*Go to Step 12*	*Go to Step 8*
8	Repair CKT 739 for a short to ground. Refer to *Wiring Repairs*. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
9	Repair CKT 651 or G101 for an open or high resistance. Refer to *Wiring Repairs*. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
10	1. Turn the ignition switch to the RUN position, engine off. 2. Using *J 39200* DMM, measure the voltage between *J 39700* terminals 8 and 15. Is the voltage within the range specified in the value(s) column?	Battery Volts	*Go to Step 12*	*Go to Step 11*
11	Repair CKT 739 for an open. Refer to *Wiring Repairs*. Is the repair complete?	—	Go to *A Diagnostic System Check - ABS*	—
12	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement*. Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—

ABS Indicator Always On



519763

Circuit Description

The Instrument Panel Cluster (IPC) turns the ABS Indicator on during the IPC bulb check for approximately 3 seconds when the ignition switch is turned to the ON position. If the EBCM sets a Diagnostic Trouble Code (DTC) the EBCM sends a class 2 message to the IPC to command the ABS Indicator on.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness
- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If an intermittent malfunction exists refer to *Inducing Intermittent Fault Conditions* in Wiring Systems.

Test Description

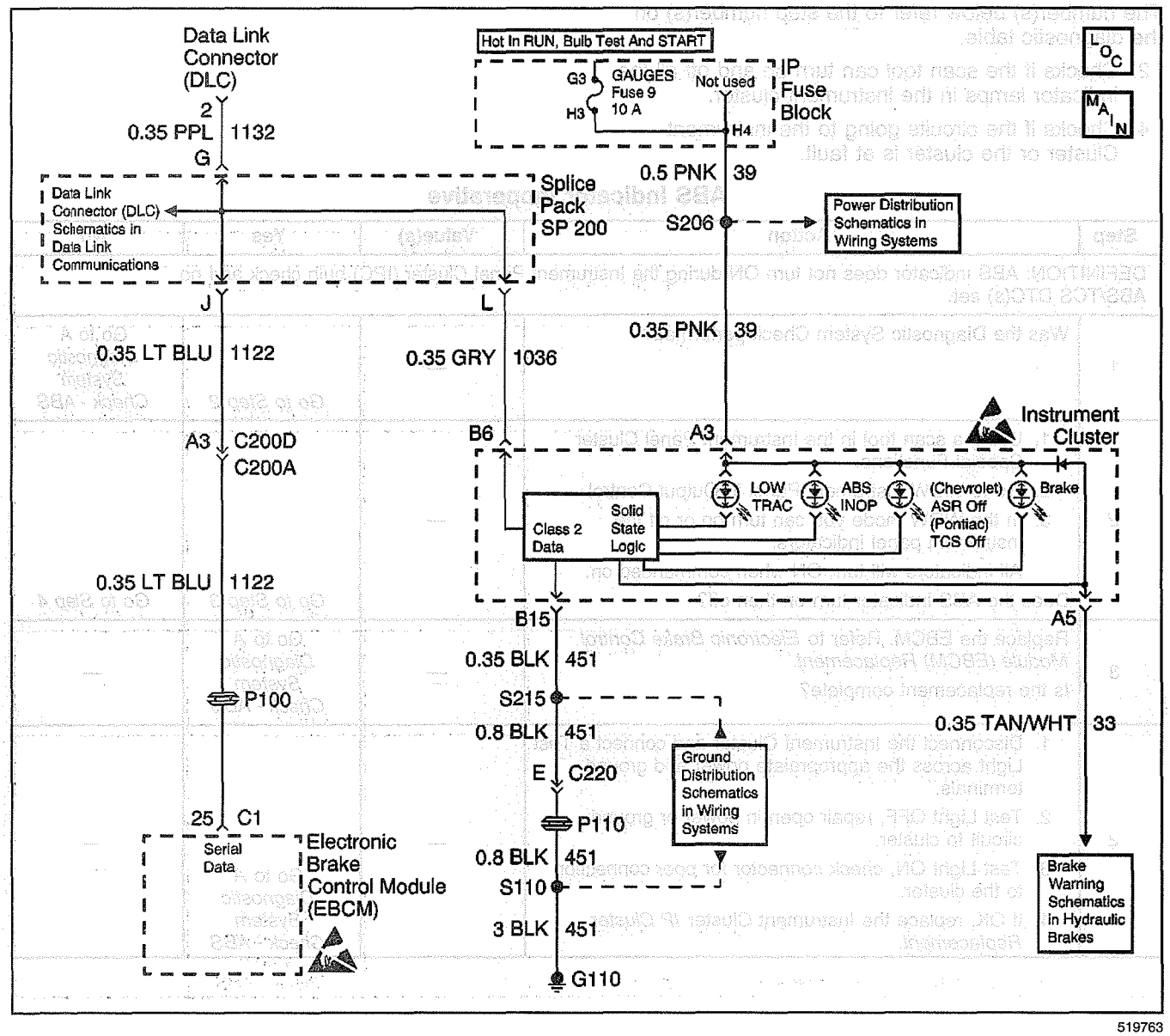
The number(s) below refer to the step number(s) on the diagnostic table.

2. Checks if the scan tool can turn on and off all the indicator lamps in the instrument cluster.
4. Checks if the circuits going to the instrument cluster or the cluster is at fault.

ABS Indicator Always On

Step	Action	Value(s)	Yes	No
DEFINITION: ABS indicator does not turn off after the Instrument Panel Cluster (IPC) bulb check and no ABS/TCS DTC(s) set.				
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Using a scan tool in the Instrument Panel Cluster Special Functions. 2. Go to WOW Instrument Panel in Output Control. 3. In the WOW mode you can turn on or off the instrument panel indicators. All indicators will turn ON when commanded on. Does the ABS indicator turn on then off?	—	*Go to Step 3*	*Go to Step 4*
3	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
4	1. Disconnect the Instrument Cluster and connect a Test Light across the appropraiate power and ground terminals. 2. Test Light OFF, repair open in power or ground circuit to cluster 3. Test Light ON, check connector for poor connection to cluster. 4. If OK, replace the Instrument Cluster *IP Cluster Replacement* Is the Instrument Cluster replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—

ABS Indicator Inoperative



519763

Circuit Description

The Instrument Panel Cluster (IPC) turns the ABS Indicator on during the IPC bulb check for approximately 3 seconds when the ignition switch is turned to the ON position. If the EBCM sets a Diagnostic Trouble Code (DTC) the EBCM sends a class 2 message to the IPC to command the ABS Indicator on.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness
- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If an intermittent malfunction exists refer to *Inducing Intermittent Fault Conditions* in Wiring Systems.

Test Description

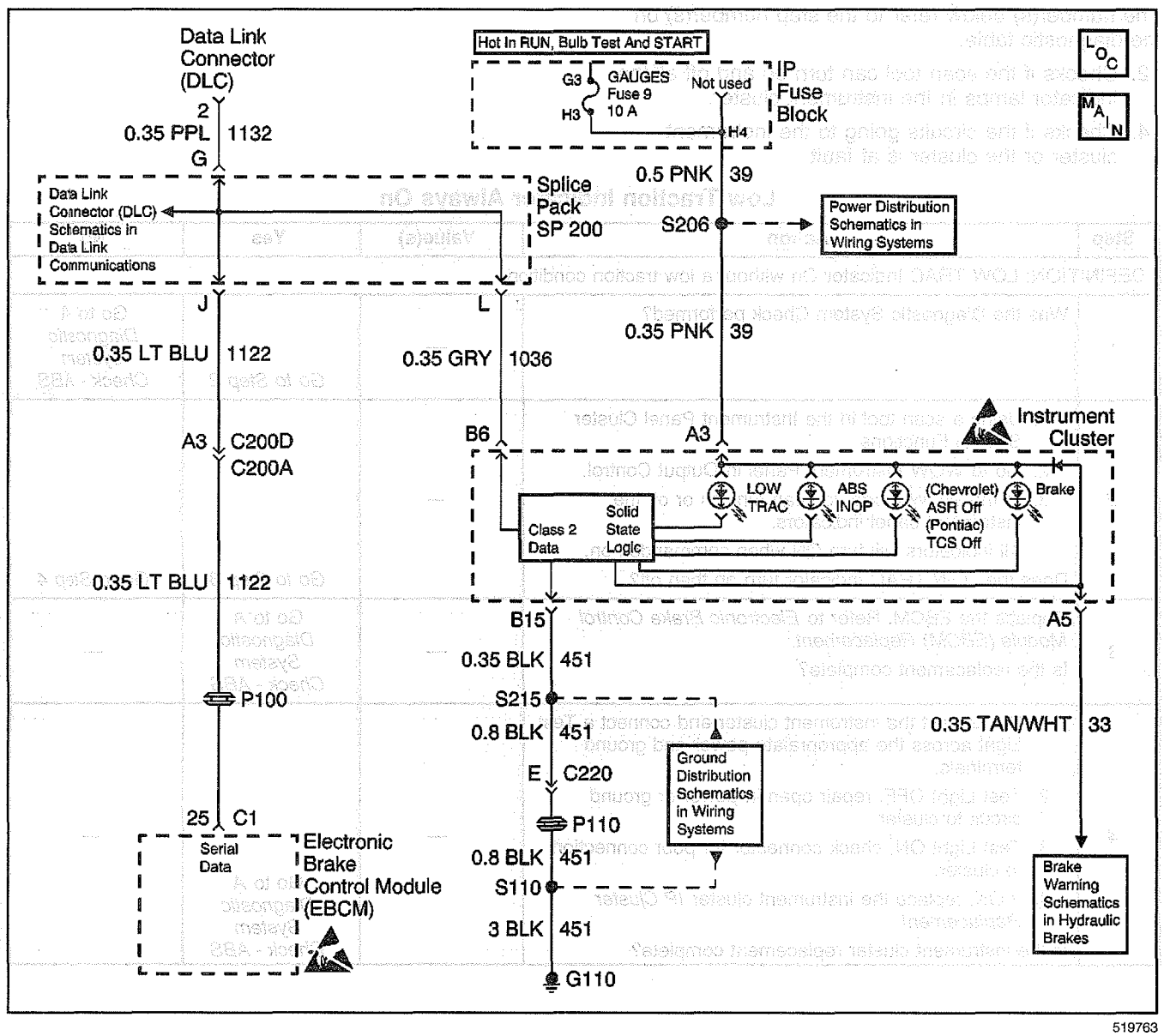
The number(s) below refer to the step number(s) on the diagnostic table.

2. Checks if the scan tool can turn on and off all the indicator lamps in the instrument cluster.
4. Checks if the circuits going to the instrument Cluster or the cluster is at fault.

ABS Indicator Inoperative

Step	Action	Value(s)	Yes	No
DEFINITION: ABS indicator does not turn ON during the Instrument Panel Cluster (IPC) bulb check and no ABS/TCS DTC(s) set.				
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Using a scan tool in the Instrument Panel Cluster Special Functions. 2. Go to WOW Instrument Panel in Output Control. 3. In the WOW mode you can turn on or off the instrument panel indicators. All indicators will turn ON when commanded on. Does the ABS Indicator turn on then off?	—	*Go to Step 3*	*Go to Step 4*
3	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
4	1. Disconnect the Instrument Cluster and connect a Test Light across the appropraiate power and ground terminals. 2. Test Light OFF, repair open in power or ground circuit to cluster. 3. Test Light ON, check connector for poor connection to the cluster. 4. If OK, replace the Instrument Cluster *IP Cluster Replacement.*	—	Go to *A Diagnostic System Check - ABS*	—

Low Traction Indicator Always On



519763

Circuit Description

The Instrument Panel Cluster (IPC) turns the LOW TRAC Indicator on during the IPC bulb check for approximately 3 seconds when the ignition switch is turned to the ON position. If the EBCM sets a Diagnostic Trouble Code (DTC) the EBCM sends the IPC the command to turn the LOW TRAC Indicator on.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness
- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If an intermittent malfunction exists refer to *Inducing Intermittent Fault Conditions* in Electrical Diagnosis for further diagnosis.

Test Description

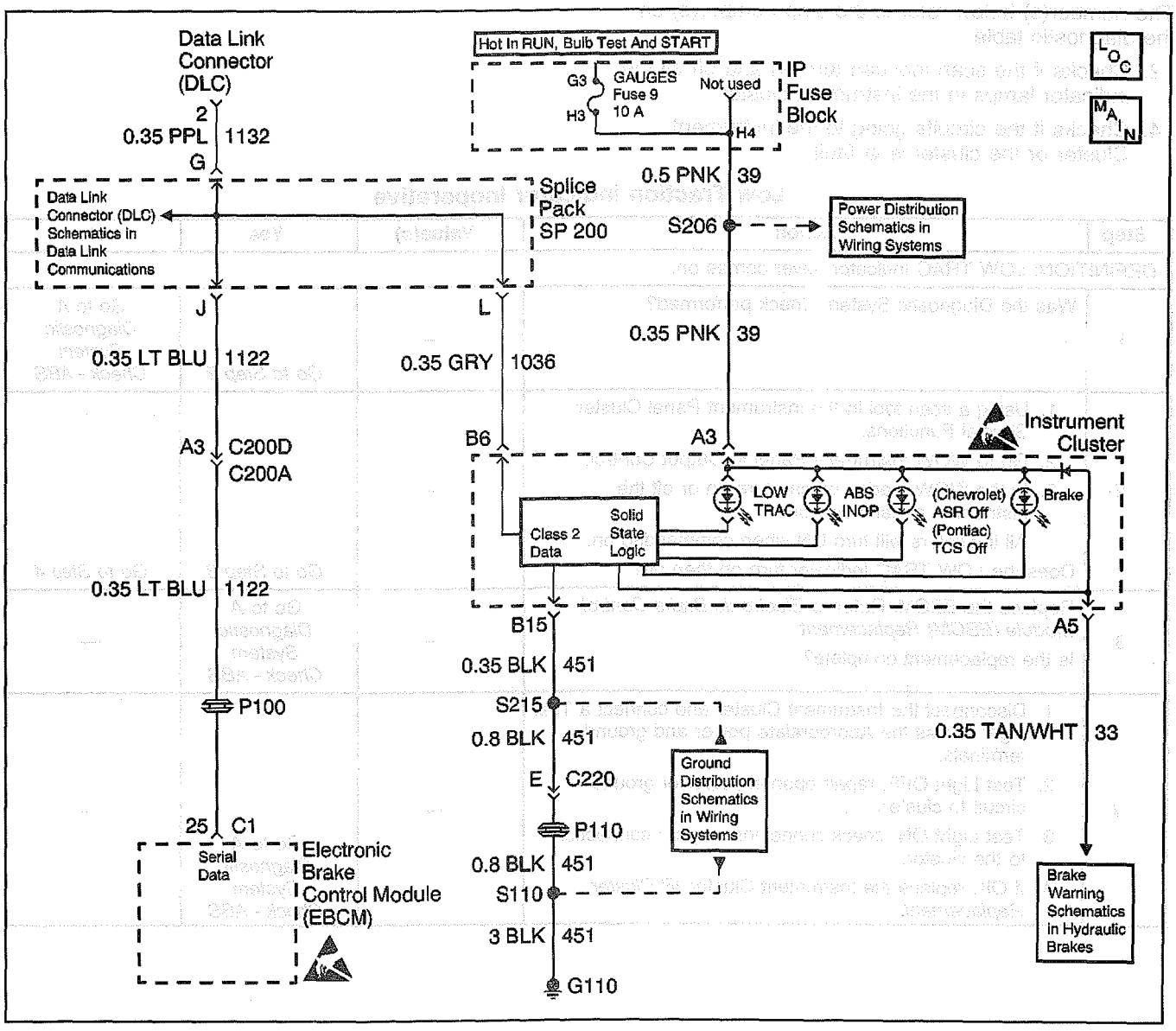
The number(s) below refer to the step number(s) on the diagnostic table.

2. Checks if the scan tool can turn on and off all the indicator lamps in the instrument cluster.
4. Checks if the circuits going to the instrument cluster or the cluster is at fault.

Low Traction Indicator Always On

Step	Action	Value(s)	Yes	No
DEFINITION: LOW TRAC Indicator On without a low traction condition.				
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Using a scan tool in the Instrument Panel Cluster Special Functions. 2. Go to WOW Instrument Panel in Output Control. 3. In the WOW mode you can turn on or off the instrument panel indicators. All indicators will turn ON when commanded on. Does the LOW TRAC Indicator turn on then off?	—	*Go to Step 3*	*Go to Step 4*
3	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
4	1. Disconnect the instrument cluster and connect a Test Light across the appropraiate power and ground terminals. 2. Test Light OFF, repair open in power or ground circuit to cluster 3. Test Light ON, check connector for poor connection to cluster. 4. If OK, replace the instrument cluster *IP Cluster Replacement* Is the instrument cluster replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—

Low Traction Indicator Inoperative



519763

Circuit Description

The Instrument Panel Cluster (IPC) turns the LOW TRAC Indicator on during the IPC bulb check for approximately 3 seconds when the ignition switch is turned to the ON position. If the EBCM sets a Diagnostic Trouble Code (DTC) the EBCM sends the IPC the command to turn the LOW TRAC Indicator on.

Diagnostic Aids

- It is very important that a thorough inspection of the wiring and connectors be performed. Failure to carefully and fully inspect wiring and connectors may result in misdiagnosis, causing part replacement with reappearance of the malfunction.
- Thoroughly inspect any circuitry that may be causing the complaint for the following conditions:
  - Backed out terminals
  - Improper mating
  - Broken locks
  - Improperly formed or damaged terminals
  - Poor terminal-to-wiring connections
  - Physical damage to the wiring harness
- The following conditions may cause an intermittent malfunction:
  - A poor connection
  - Rubbed-through wire insulation
  - A broken wire inside the insulation
- If an intermittent malfunction exists refer to *Inducing Intermittent Fault Conditions* in Wiring System for further diagnosis.

Test Description

The number(s) below refer to the step number(s) on the diagnostic table.

2. Checks if the scan tool can turn on and off all the indicator lamps in the instrument cluster.
4. Checks if the circuits going to the instrument Cluster or the cluster is at fault.

Low Traction Indicator Inoperative

Step	Action	Value(s)	Yes	No
DEFINITION: LOW TRAC Indicator never comes on.				
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to *A Diagnostic System Check - ABS*
2	1. Using a scan tool in the Instrument Panel Cluster Special Functions. 2. Go to WOW Instrument Panel in Output Control. 3. In the WOW mode you can turn on or off the instrument panel indicators. All indicators will turn ON when commanded on. Does the LOW TRAC Indicator turn on then off?	—	*Go to Step 3*	*Go to Step 4*
3	Replace the EBCM. Refer to *Electronic Brake Control Module (EBCM) Replacement.* Is the replacement complete?	—	Go to *A Diagnostic System Check - ABS*	—
4	1. Disconnect the Instrument Cluster and connect a Test Light across the Appropraiate power and ground terminals. 2. Test Light OFF, repair open in power or ground circuit to cluster. 3. Test Light ON, check connector for poor connection to the cluster. 4. If OK, replace the Instrument Cluster *IP Cluster Replacement.*	—	Go to *A Diagnostic System Check - ABS*	—

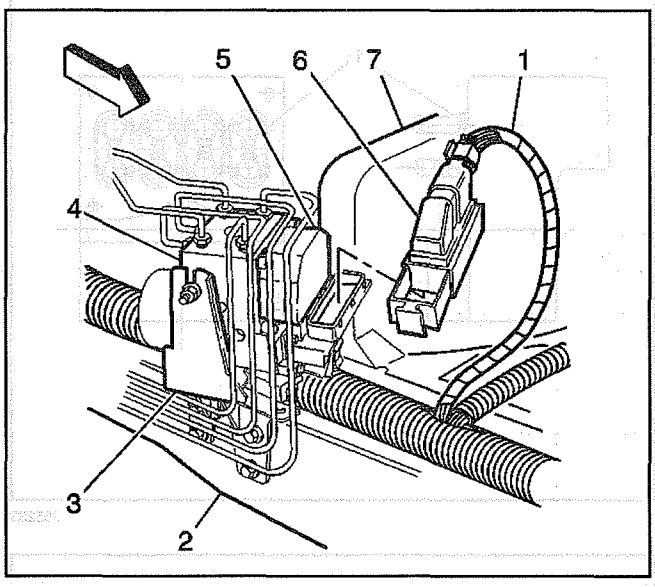
Repair Instructions

Electronic Brake Control Module (EBCM) Replacement

Removal Procedure

Notice: To prevent equipment damage, never connect or disconnect the wiring harness connection from the EBCM with the ignition switch in the ON position.

1. Turn the ignition switch to the OFF position.
2. Pull out lock tab from the EBCM harness connector.
3. Disconnect the EBCM harness connector (6).



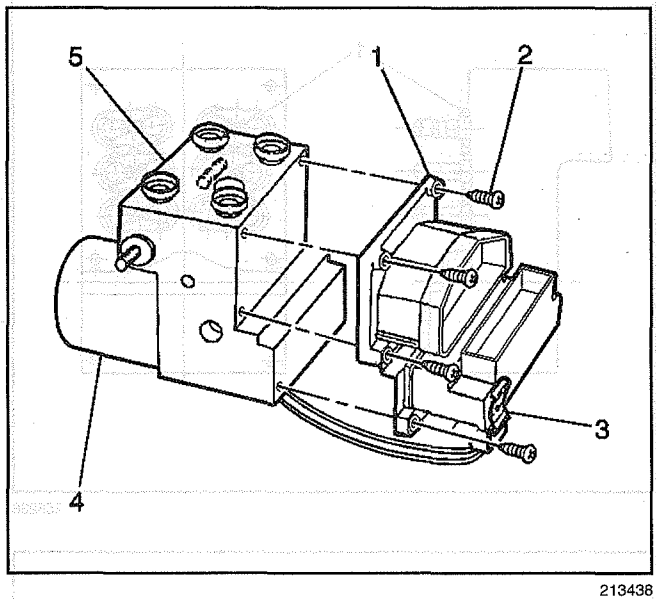
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4. Disconnect the pump motor connector (3) at the bottom of the EBCM.
5. Remove the six EBCM to BPMV screws (2) and discard.

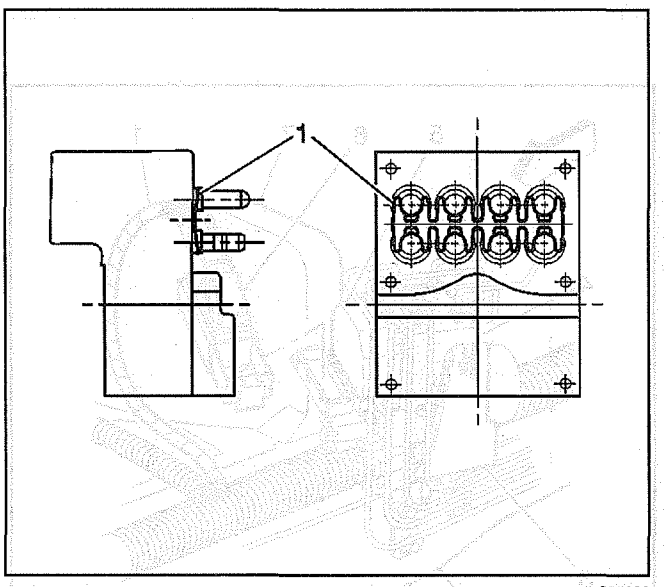
Important: Be careful not to damage seal. Do not pry apart using a tool.

Important: Care must be taken not to damage the solenoid valves when the EBCM is removed from the BPMV.

6. Separate the EBCM (1) from the BPMV (5) by gently pulling apart until separated.



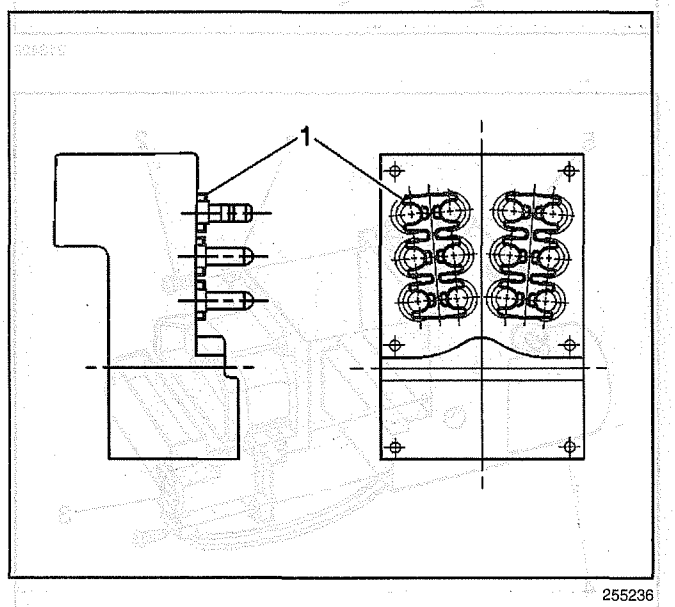
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Important: Note the location and the orientation of the wave spring in order to aid during installation.

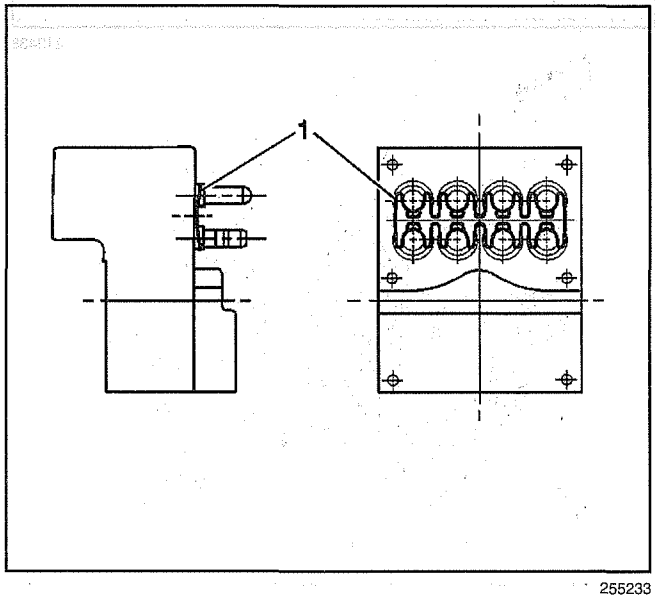
7. If equipped with ABS only, remove one wave spring (1) between the EBCM and BPMV and discard.



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Important: Note the location and the orientation of the wave spring in order to aid during installation.

8. If equipped with ABS/TCS remove two wave springs (1) between the EBCM and BPMV and discard.



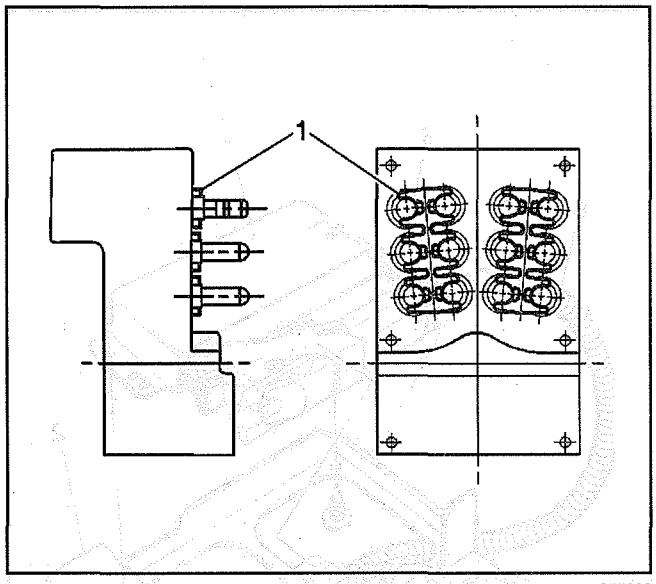
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Installation Procedure

Important: Only the new wave spring(s) and screws supplied with the new EBCM should be used.

1. Clean the BPMV gasket surface with alcohol using a clean rag.
2. If equipped with ABS only, install one wave spring (1) between the EBCM and BPMV. Use location and orientation noted during removal.

3. If equipped with ABS/TCS, install two wave springs (1) between the EBCM and BPMV. Use locations and orientation noted during removal.



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Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the EBCM (1) to the BPMV (5).

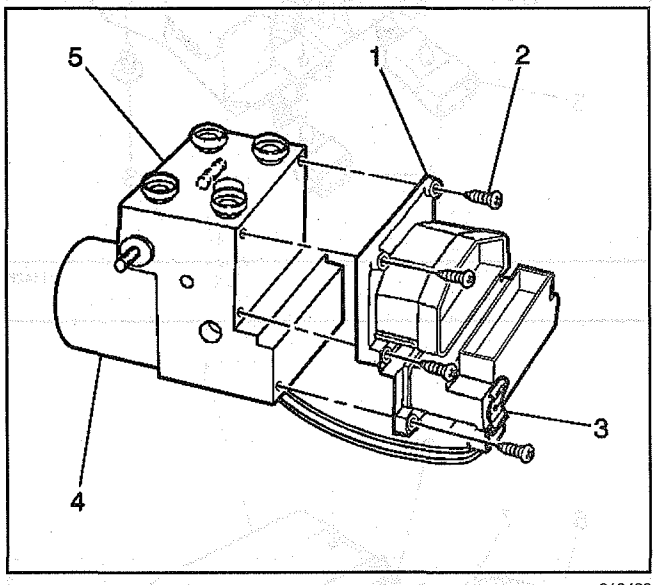
   Tighten

   Tighten the top four mounting screws (2) to 2.9 N·m (26 lb in.). Tighten screws in an X pattern.

   Tighten

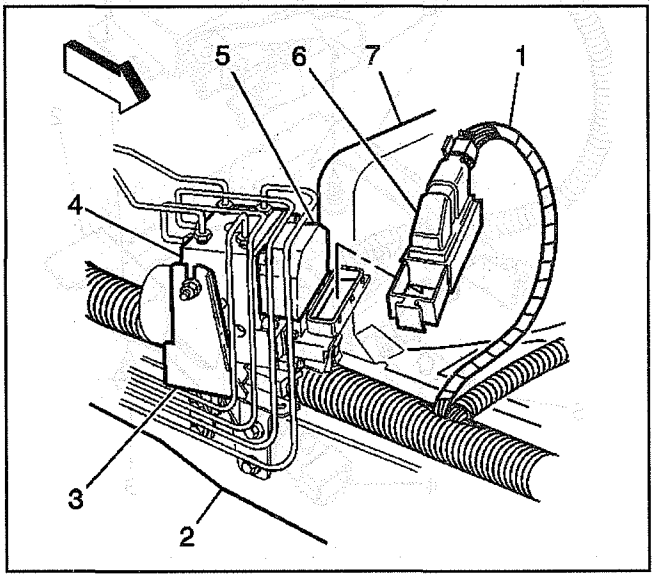
   Tighten the bottom two mounting screws (2) to 2.9 N·m (26 lb. in.).

5. Connect the pump motor connector (3) to the bottom of the EBCM.

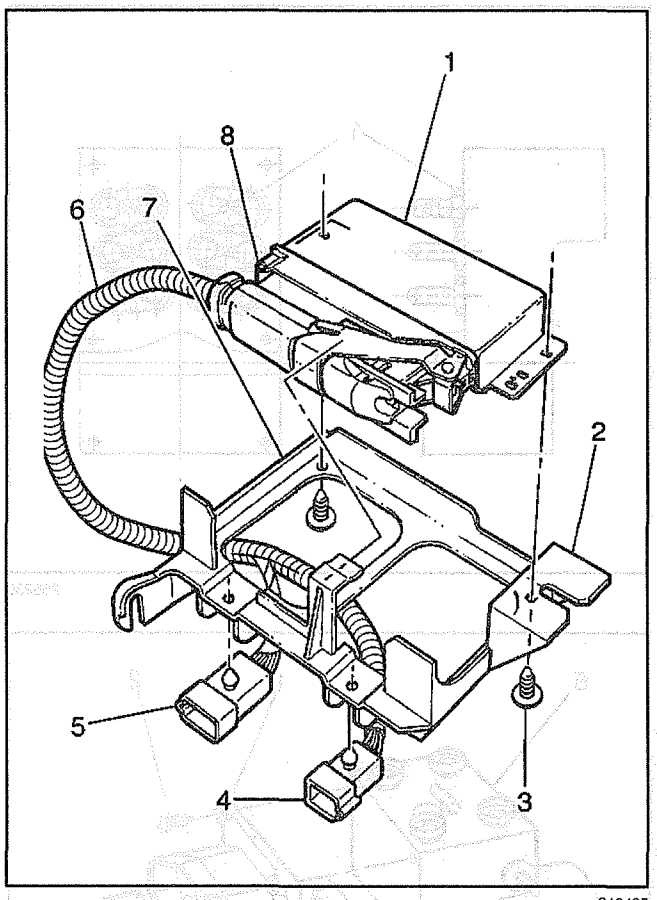


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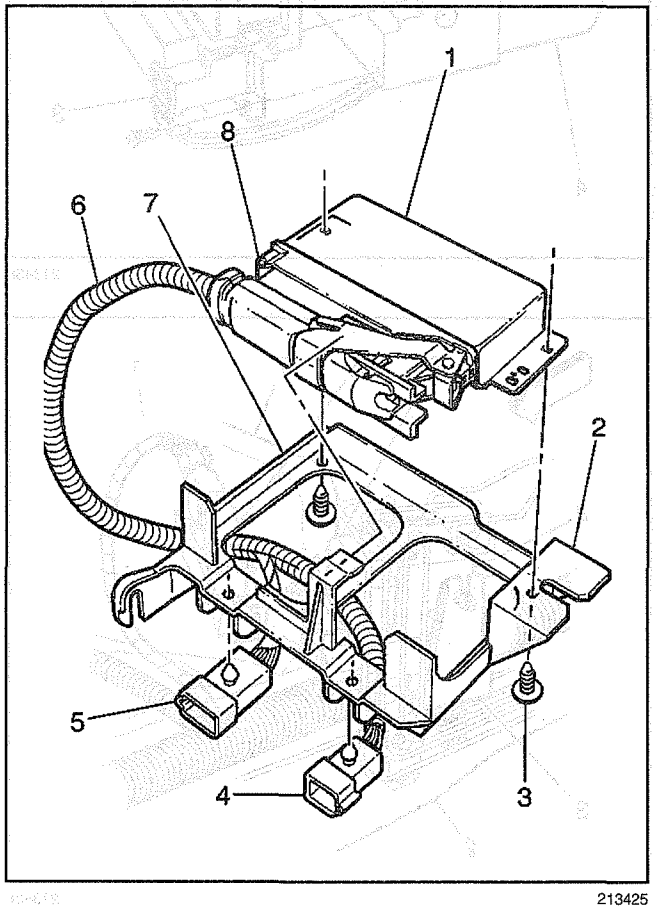
6. Connect the EBCM harness connector. Push in lock tab.
7. Turn the ignition switch to the RUN position, engine off.
8. Perform the *A Diagnostic System Check - ABS*



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Accelerator and Servo Control Module (ASM) Replacement

Removal Procedure

1. Disconnect the fasteners on the lower sound insulator panel under the steering column.
2. Remove the lower sound insulator panel from the vehicle.
3. Remove the left side kick panel on vehicles equipped with a manual transmission.
4. Remove the bolt attaching the ASM bracket to the upper I/P.
5. Remove the push in retainer attaching the ASM bracket to the side wall.
6. Remove the ASM bracket along with the ASM from the mounting place (1,2).
7. Disconnect the ASM harness connector).
8. Remove the ASM to ASM bracket mounting screws (3).
9. Remove the ASM and ASM bracket from the vehicle (1,2).

Installation Procedure

1. Install the ASM to the ASM mounting bracket (1,2).
2. Install the ASM to ASM bracket screws (3).
3. Connect the ASM harness connector.
4. Install the ASM and ASM bracket in the mounting place.
5. Install the push in retainer attaching the ASM bracket to the side wall.
6. Install the bolt attaching the ASM bracket to the upper I/P.
7. Install the left side kick panel on vehicles equipped with a manual transmission.
8. Install the lower sound insulator panel in the vehicle.
9. Install the fasteners on the lower sound insulator panel under the steering column.

Brake Pressure Modulator Valve (BPMV) Replacement

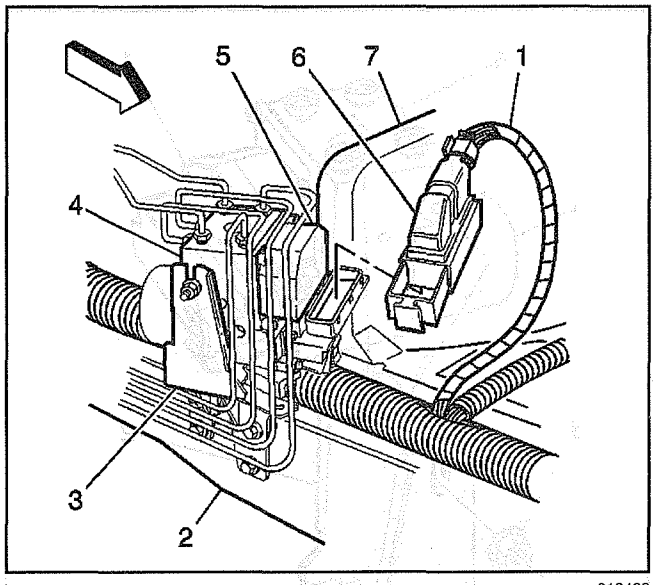
Removal Procedure

Caution: For safety reasons, the Brake Pressure Modulator Valve (BPMV) must not be repaired, the complete unit must be replaced. With the exception of the EBCM/EBTCM, no screws may be loosened. If screws are loosened, it will not be possible to get the brake circuits leak-tight and personal injury may result.

1. Turn the ignition switch to the OFF position.
2. Disconnect the EBCM harness connector (6).

Important: Note the locations of the brake pipes in order to aid in installation.

3. Disconnect the brake pipes from the BPMV.

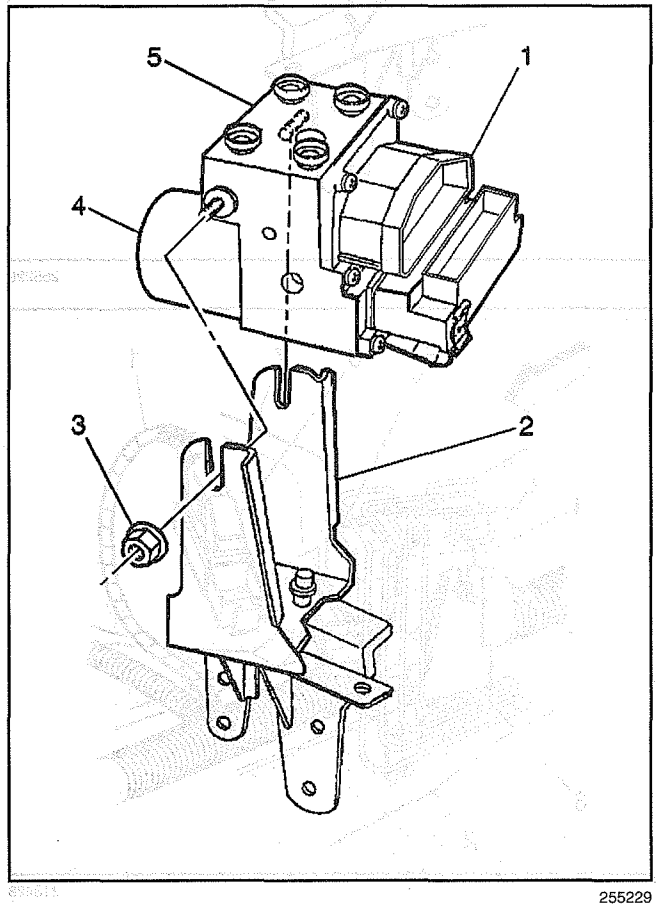


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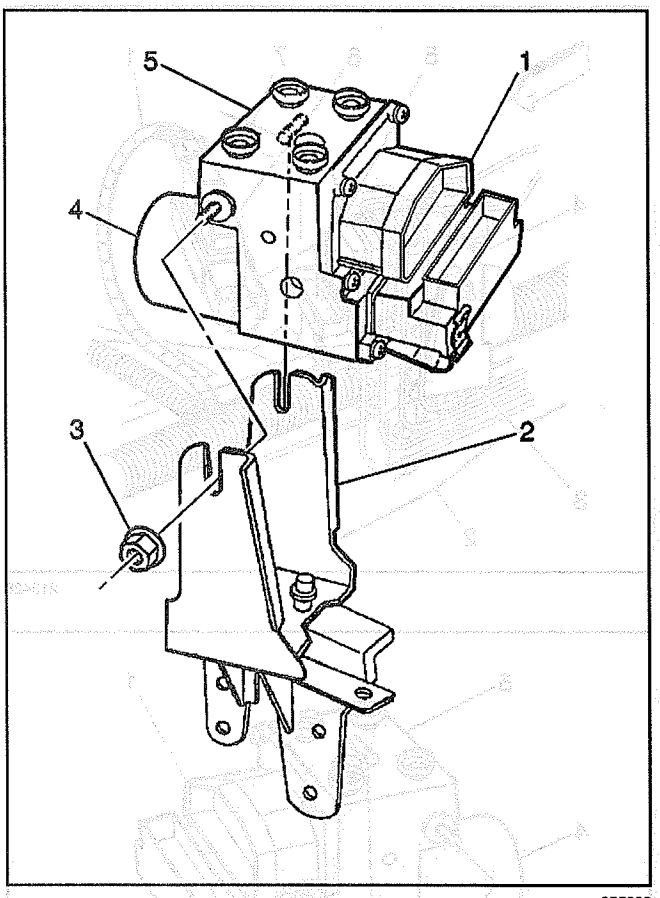
4. Remove the two nuts that connect the BPMV to the BPMV bracket (3).

Notice: When removing the brake pressure modulator valve, protect the vehicle exterior from possible brake fluid spillage. Brake fluid can cause damage to painted surfaces.

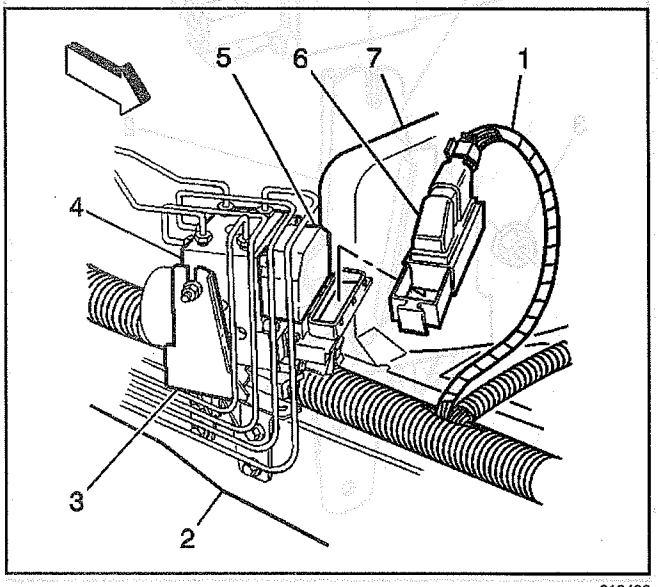
5. Remove the BPMV and EBCM as an assembly from the vehicle (5).



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Installation Procedure

Important: If a new BPMV is being installed, remove the shipping plugs from the valve openings in the compartment during the next step.

Important: Use the locations noted during removal.

1. Install BPMV and EBCM as an assembly into the BPMV bracket (2).
2. Install the two BPMV bracket nuts (3).

   Tighten

   Tighten the two BPMV to BPMV bracket nuts to 12 N·m (8 lb ft.)

Caution: Make sure brake pipes are correctly connected to brake pressure modulator valve. If brake pipes are switched by mistake, wheel lockup will occur and personal injury may result. The only two ways this condition can be detected are by using a Scan Tool or by doing an Antilock stop.

3. Install the brake pipes on to the BPMV.

   Tighten

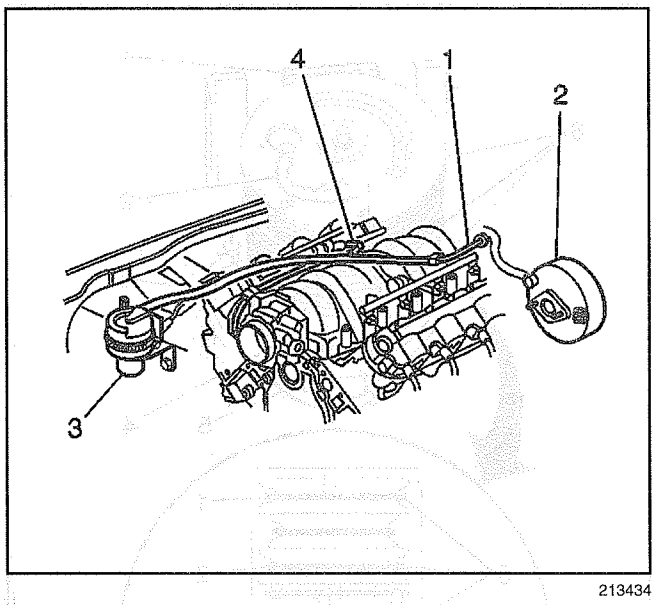
   Tighten the brake pipe fittings to 15 N·m (11 lb ft).
4. Connect the EBCM harness connector (6).
5. Turn the ignition switch to the RUN position, engine off.
6. Perform the *A Diagnostic System Check - ABS*

Adjuster Assembly Replacement

Removal Procedure

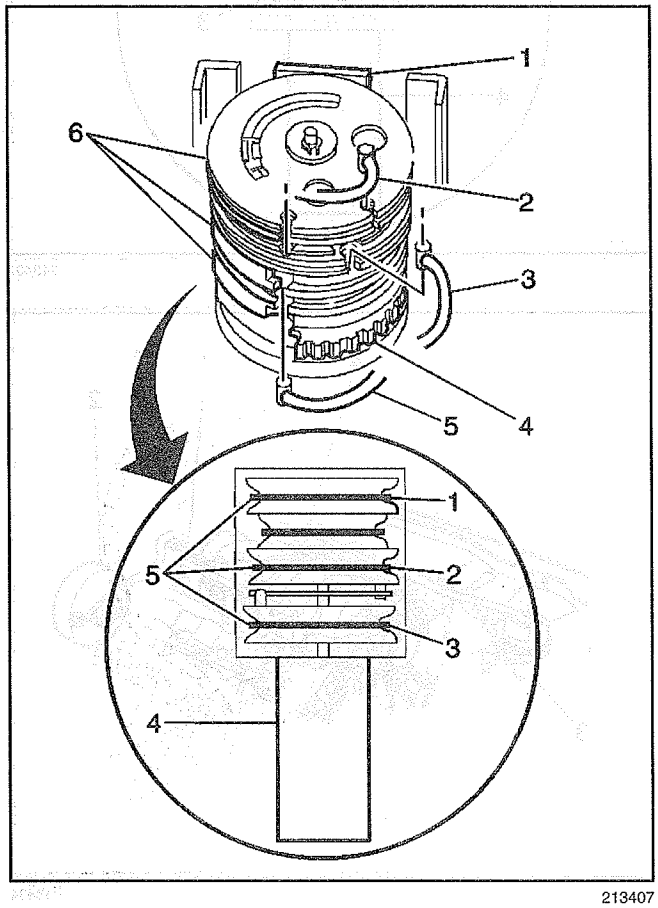
Important: The adjuster assembly cables must always be adjusted each time the adjuster assembly is removed and/or replaced to ensure optimum system performance. Refer to *Cable Adjustment Procedure*.

1. Remove the adjuster assembly splash cover.
2. Remove the cable cam cover.
3. Disconnect the adjuster assembly electrical connector.
4. Remove the nuts attaching the adjuster assembly to the bracket.

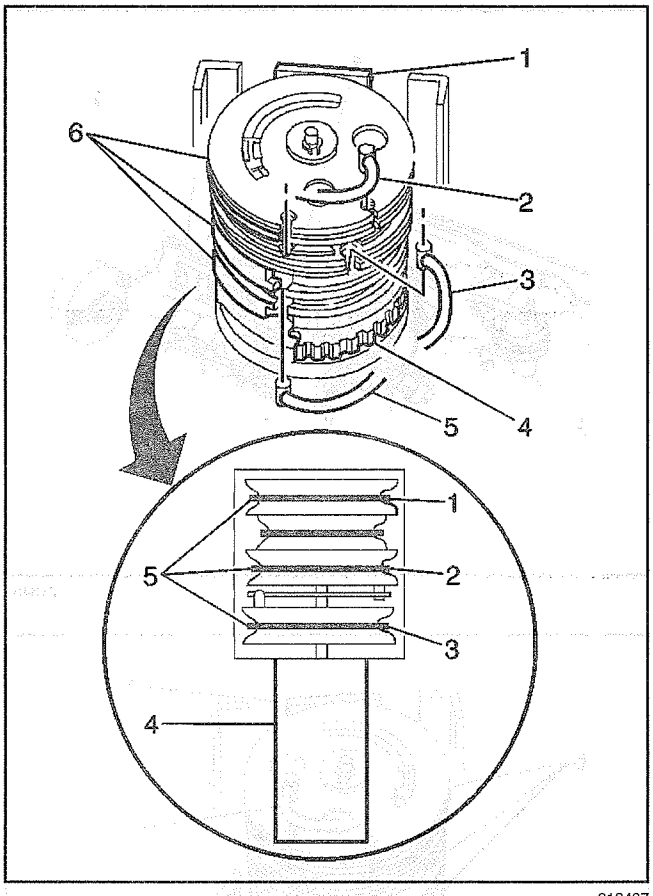


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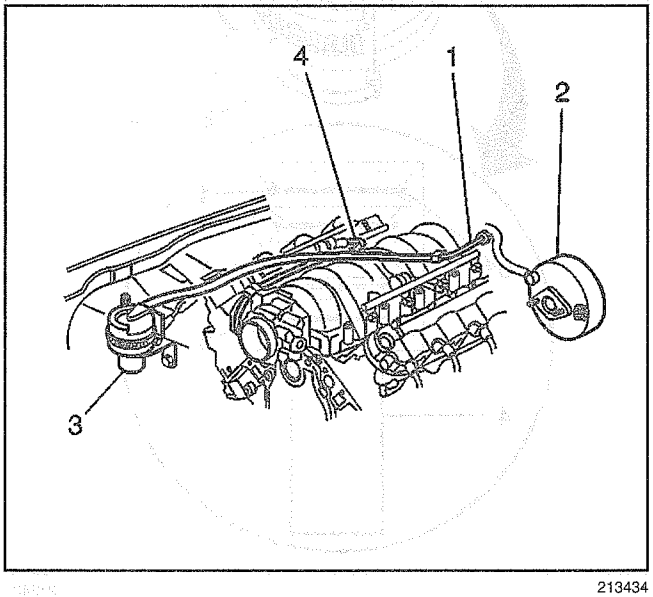
5. Remove the cables from the adjuster assembly.



213407



213407



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Installation Procedure

1. Install the cables to the adjuster assembly.
2. Install the adjuster assembly to the mounting bracket (3).
3. Install the adjuster assembly attaching nuts.

   Tighten

   Tighten the adjuster assembly attaching nuts to 25 N·m (18 lb ft).
4. Connect the adjuster assembly electrical connector.
5. Adjust the adjuster assembly cables. Refer to *Cable Adjustment Procedure*
6. Install the cable cam cover.
7. Install the adjuster assembly splash cover.

Cable Adjustment Procedure

The throttle body, accelerator pedal, and cruise control cables must be fully installed before making adjustments.

1. Remove the throttle body lever cover.
2. Unlock the throttle body cable and cruise control cable adjuster (1).
3. Hold throttle body lever firmly at stop/idle position.
4. Pull the throttle body cable assembly just rearward of the adjuster lock to remove slack from cable.

Important: Do not disturb cable after removing slack.

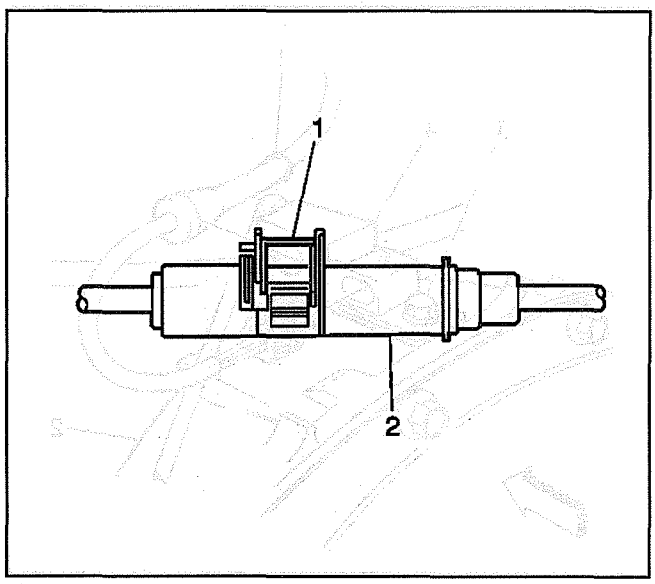
5. Lock the throttle body cable adjuster (1).
6. Hold throttle body lever firmly at stop/idle position.
7. Pull the cruise control cable assembly just rearward of the adjuster lock to remove slack from cable.

Important: Do not disturb cable after removing slack.

8. Lock the throttle body cable adjuster (1).

Important: Cables should never be adjusted so tight that tension from the cable will not allow the throttle to close completely. If the cable is adjusted to tight, the cable will prevent the engine from returning to idle and will cause unstable idle quality.

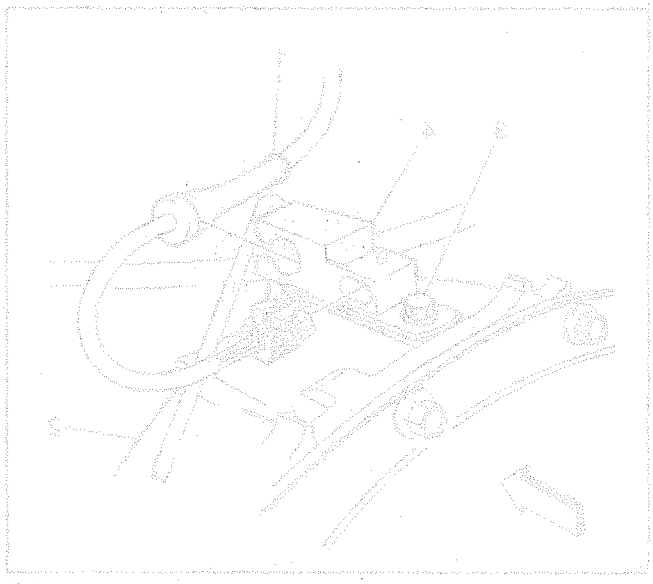
Using a scan tool check the throttle angle. When the accelerator is fully depressed the throttle angle should read 100 percent. When the accelerator is released the throttle angle should read 0 percent. If proper results are not obtained check cables for kinks or damage and repeat procedure.

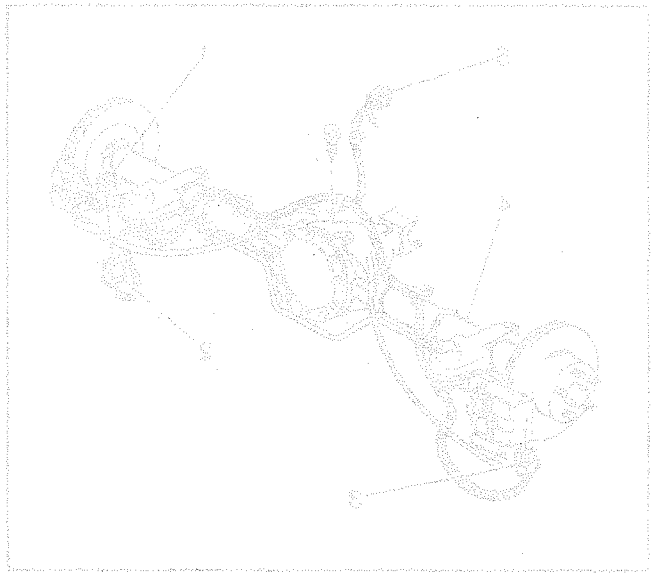


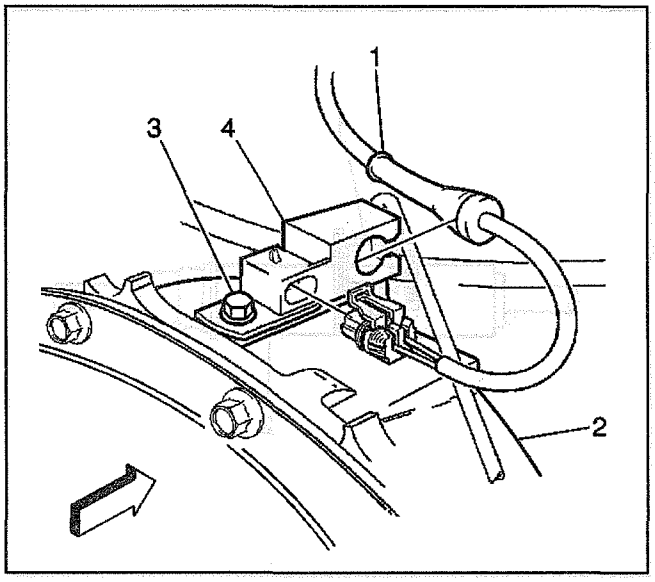
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Wheel Speed Sensor Replacement (Front)

1. Refer to *Wheel Bearing/Hub Replacement - Front* in Front Suspension.
2. After the replacement procedure is complete refer to *A Diagnostic System Check - ABS*.





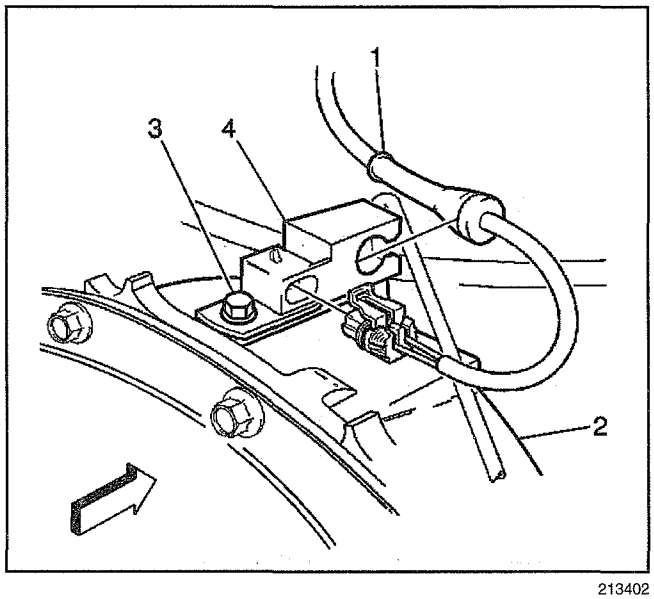


213402

Wheel Speed Sensor Replacement (With out Tractional Control)

Removal Procedure

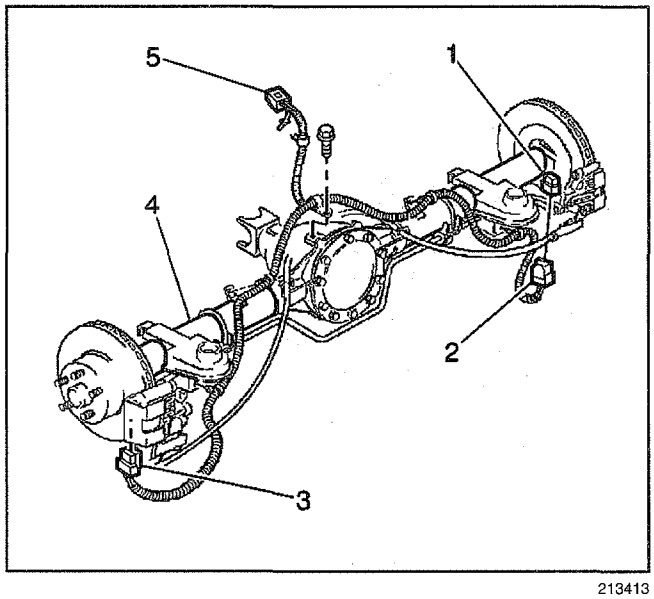
1. Remove the wheel speed sensor connector.
2. Clean all dirt and debris from sensor housing/sensor interface area.
3. Remove the Wheel Speed Sensor bolt (3).
4. Remove the Wheel Speed Sensor (4).



213402

Installation Procedure

1. Install the Wheel Speed Sensor (4).
2. Install the Wheel Speed Sensor mounting bolt (3).
   Tighten
   Tighten the bolt to 10 N·m (89 lb.in)
3. Install the wheel speed sensor connector.



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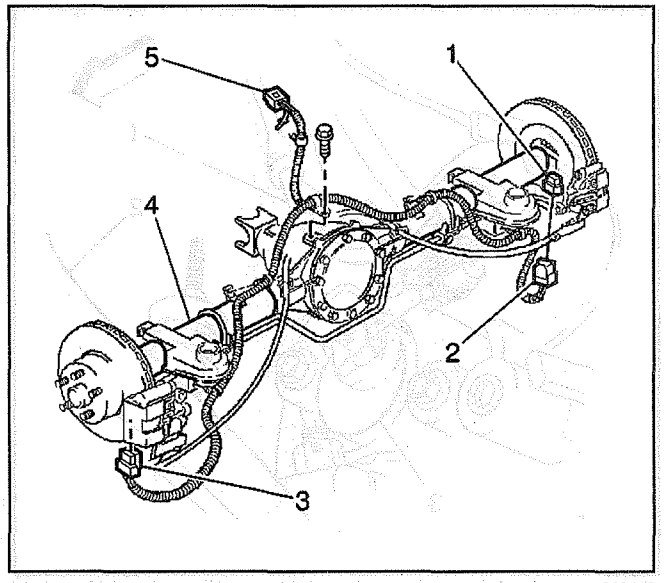
Wheel Speed Sensor Replacement (With Traction Control)

Removal Procedure

1. Remove the wheel speed sensor connector (2).
2. Clean all dirt and debris from sensor housing/sensor interface area.
3. Remove the Wheel Speed Sensor attaching bolt.
4. Remove the Wheel Speed Sensor (1).

Installation Procedure

1. Install the Wheel Speed Sensor (1).
2. Install the Wheel Speed Sensor attaching bolt.
   Tighten
   Tighten the bolt to 10 N·m (89 lb.in)
3. Install the wheel speed sensor connector (2).

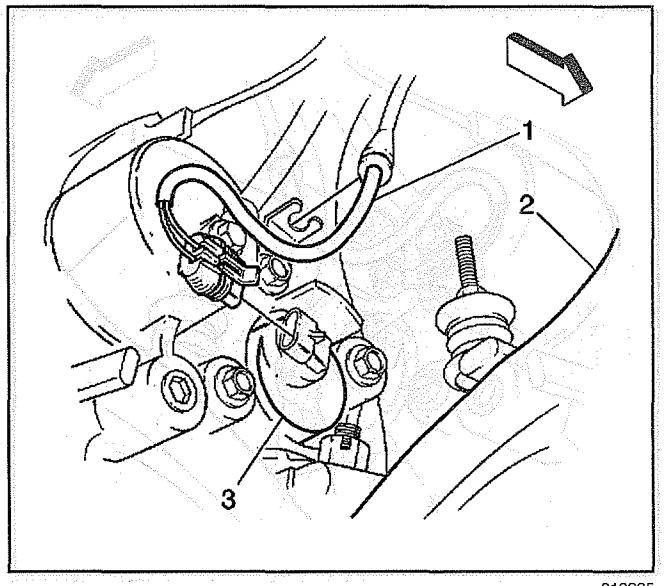


213413

Wheel Speed Sensor Jumper Harness Replacement (Front Right)

Removal Procedure

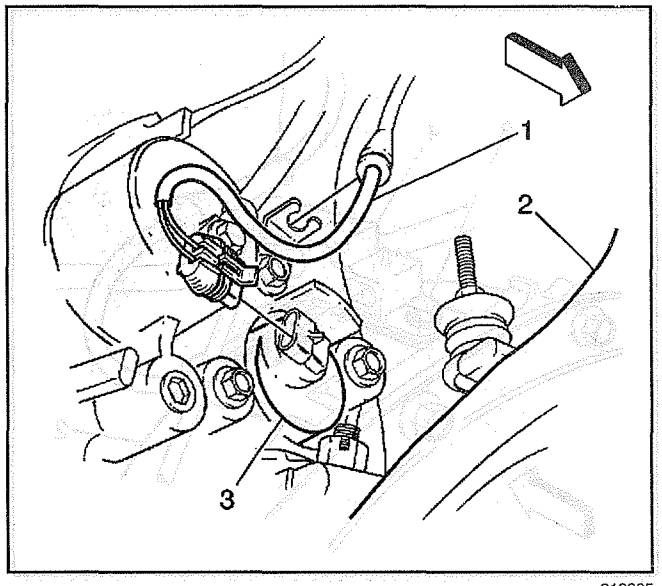
1. Remove the wheel speed sensor connector.
2. Remove the jumper harness from the retaining clip.
3. Remove the grommet retainer at the inner fender.
4. Remove the harness cover from the right strut tower.
5. Remove the upper jumper harness connector.
6. Pull the grommet through inner fender pass-thru and remove jumper harness.



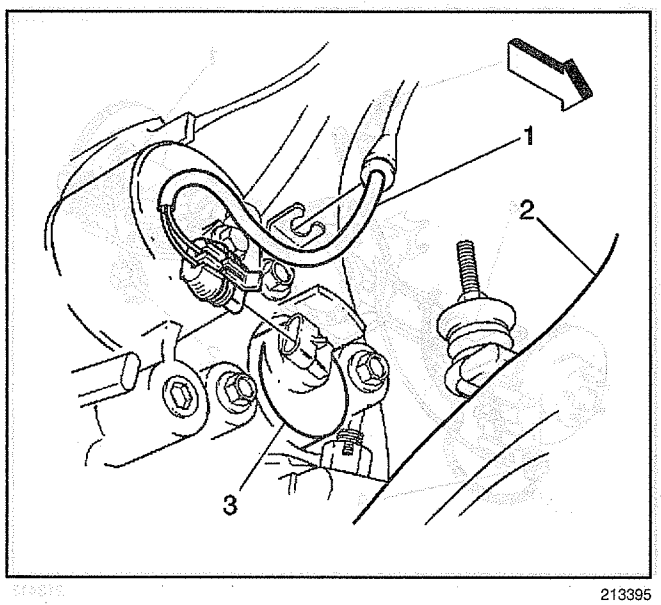
213395

Installation Procedure

1. Route the new jumper harness through inner fender pass-thru.
2. Install the upper jumper harness connector.
3. Install the harness cover on the right strut tower.
4. Install the grommet retainer at the inner fender.
5. Install the jumper harness from the retaining clip.
6. Install the wheel speed sensor connector.



213395

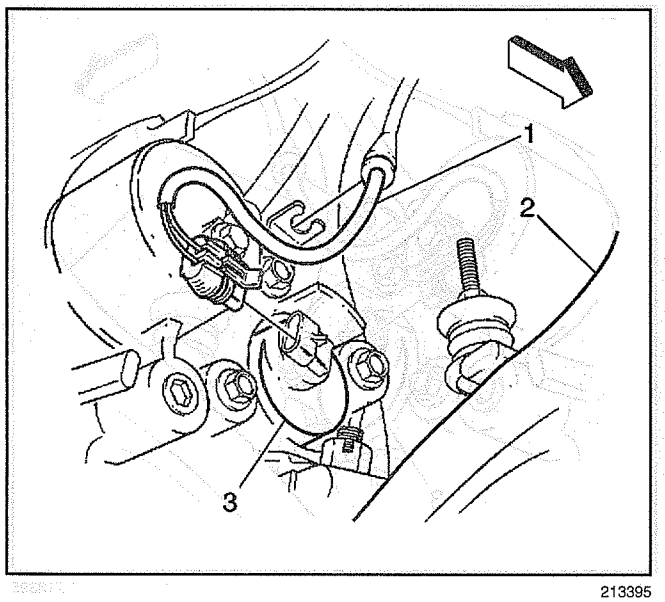


213395

Wheel Speed Sensor Jumper Harness Replacement (Front Left)

Removal Procedure

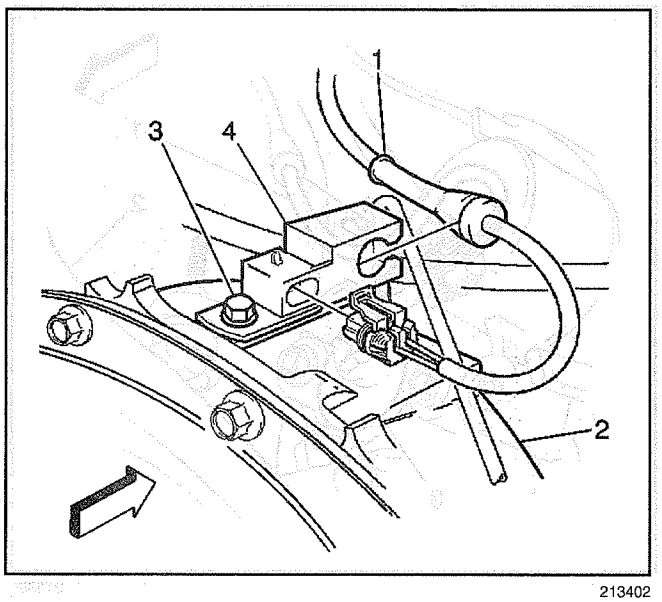
1. Remove the wheel speed sensor connector.
2. Remove the jumper harness from the retaining clip.
3. Remove the grommet retainer at the inner fender.
4. Remove the transmission cable retainer and various harnesses from restraints at left strut tower to access jumper harness connector.
5. Remove the upper jumper harness connector.
6. Pull the grommet through inner fender pass-thru and remove jumper harness.



213395

Installation Procedure

1. Route the new jumper harness through inner fender pass-thru.
2. Install the upper jumper harness connector.
3. Install the transmission cable retainer and various harnesses to restraints that may have been disconnected to access jumper harness.
4. Install the grommet retainer at the inner fender.
5. Install the jumper harness from the retaining clip.
6. Install the wheel speed sensor connector.



213402

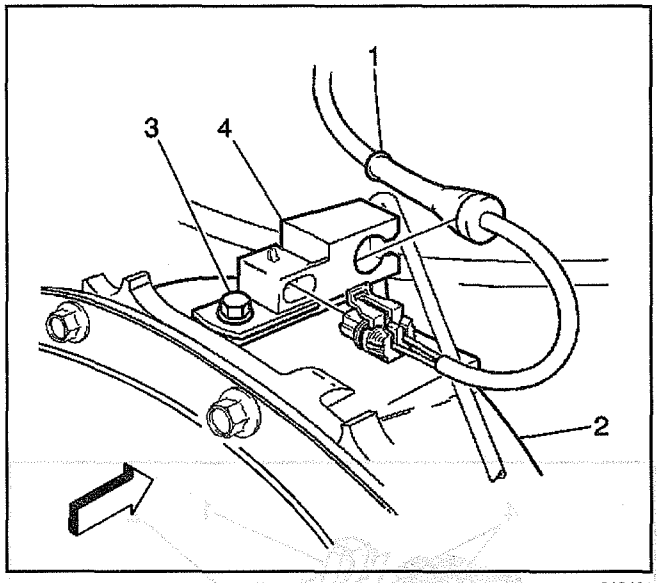
Wheel Speed Sensor Jumper Harness Replacement (Rear with out Traction Control)

Removal Procedure

1. Remove the wheel speed sensor connector.
2. Remove the rear wheel speed sensor jumper harness grommet from retainer (1).
3. Remove the upper harness connector from rear body pass-thru connector.

Installation Procedure

1. Install the upper harness connector from rear body pass-thru connector.
2. Install the rear wheel speed sensor jumper harness grommet from retainer (1).
3. Install the wheel speed sensor connector.

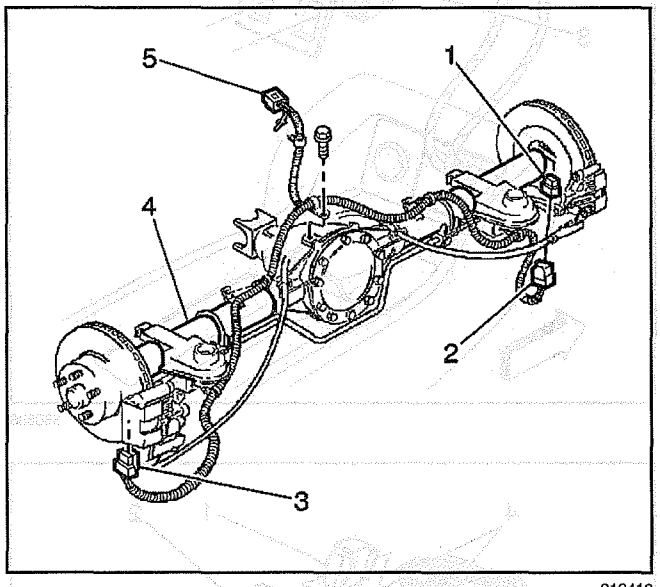


213402

Wheel Speed Sensor Jumper Harness Replacement (Rear with Traction Control)

Removal Procedure

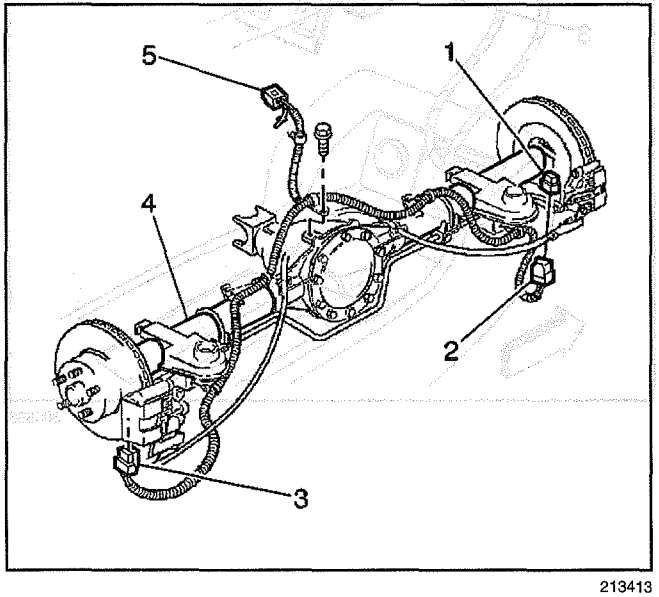
1. Remove the wheel speed sensor connectors (2,3).
2. Remove the jumper harness grommet from the retainer.
3. Remove the upper jumper harness connector from the rear body pass-thru connector.



213413

Installation Procedure

1. Install the upper jumper harness connector from the rear body pass-thru connector.
2. Install the jumper harness grommet to the retainer.
3. Install the wheel speed sensor connectors (2,3).



213413

Wheel Speed Sensor Ring Replacement (With out Traction Control)

The rear wheel speed sensor reluctor ring is located in the differential case. If the reluctor ring is determined to be damaged and must be replaced refer to Differential case in Rear Axle.

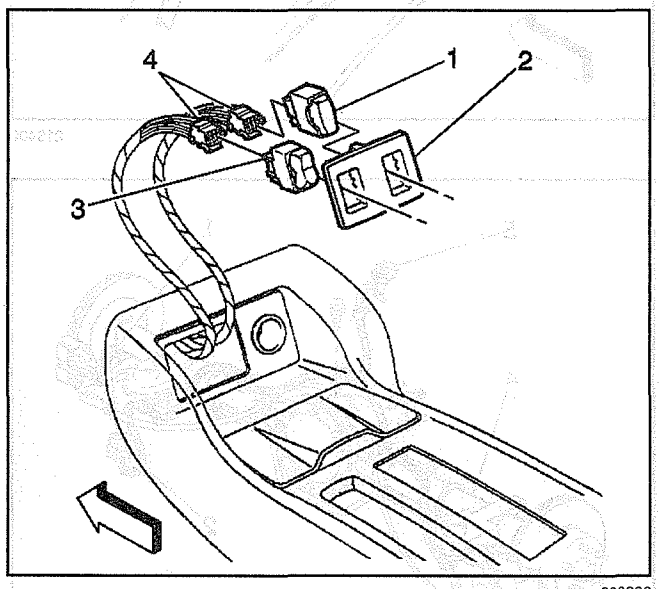
Wheel Speed Sensor Ring Replacement (With Traction Control)

The rear wheel speed sensor reluctor rings are an integral part of the rear axle shafts. If it has been determined they must be replaced refer to Axle Shaft in Rear Axle.

Traction Control Switch Replacement (Pontiac)

Removal Procedure

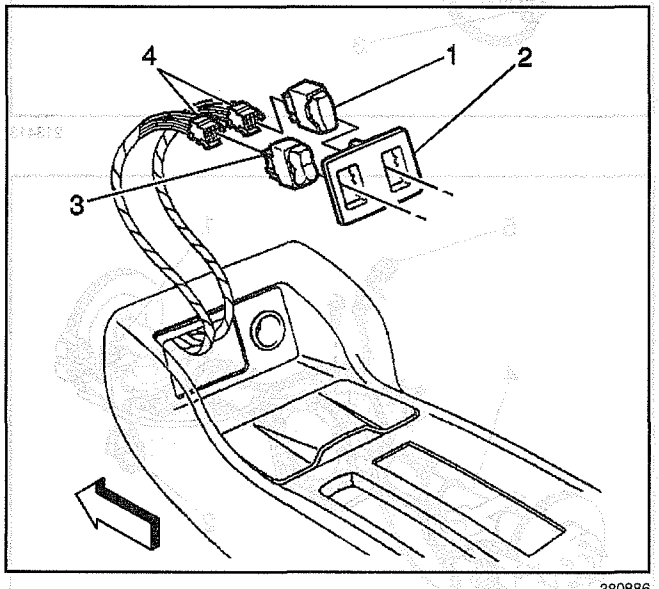
1. Unsnap the front floor console accessory trim plate (2).
2. Electrical connector from the traction control switch (4).
3. Electrical connector from the convertible top switch (3), if equipped.
4. Unsnap the traction control switch (1) from the front floor console accessory trim plate (2).



380886

Installation Procedure

1. Traction control switch (1) to the front floor console accessory trim plate (2).
2. Electrical connector to the convertible top switch (3), if equipped.
3. Electrical connector to the traction control switch (1).
4. Front floor console accessory trim plate (2).

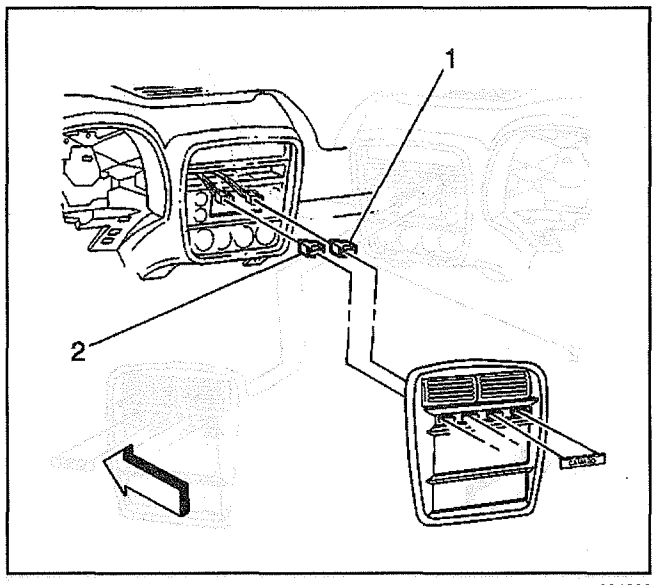


380886

Traction Control Switch Replacement (Chevrolet)

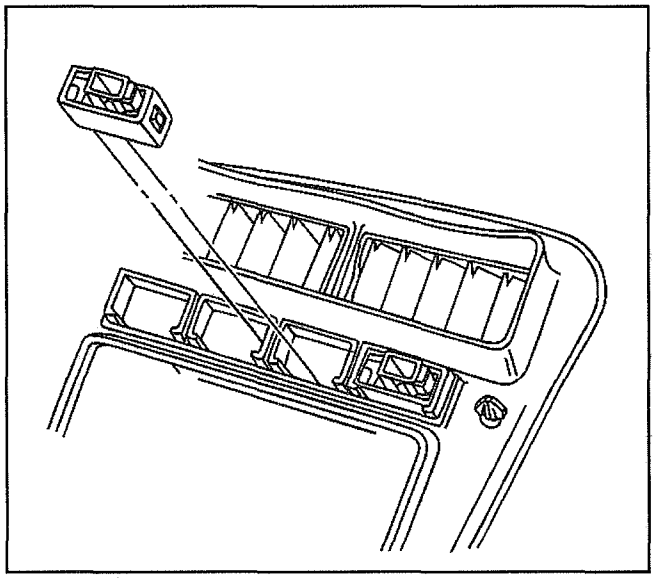
Removal Procedure

1. Unsnap the I/P accessory trim plate.
2. Disconnect the electrical connector from the fog lamp switch (2).
3. Disconnect the electrical connector from the traction control switch (1).



294806

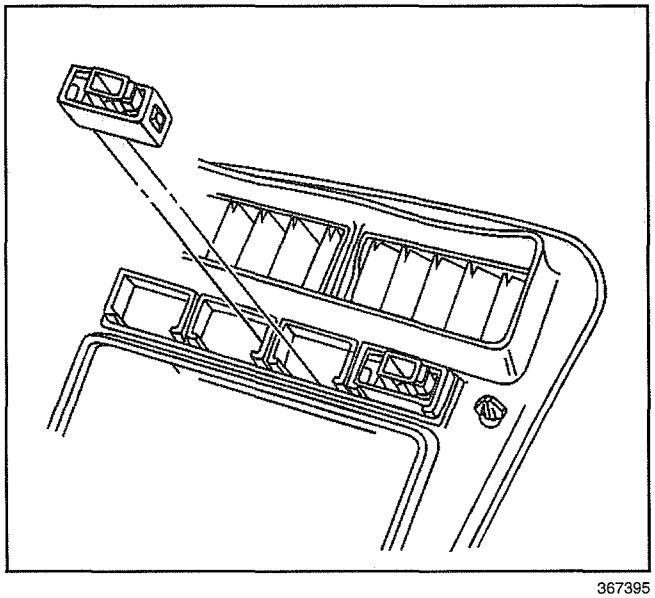
4. Unsnap the traction control switch from the I/P accessory trim plate.



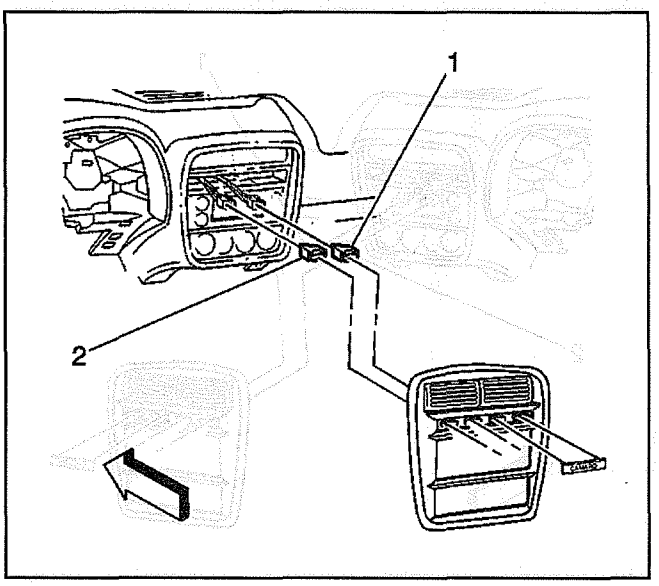
367395

Installation Procedure

1. Install the traction control switch to the I/P accessory trim plate.
2. Connect the electrical conector to the traction control switch.
3. Traction control switch to the instrument panel accessory trim plate (1).

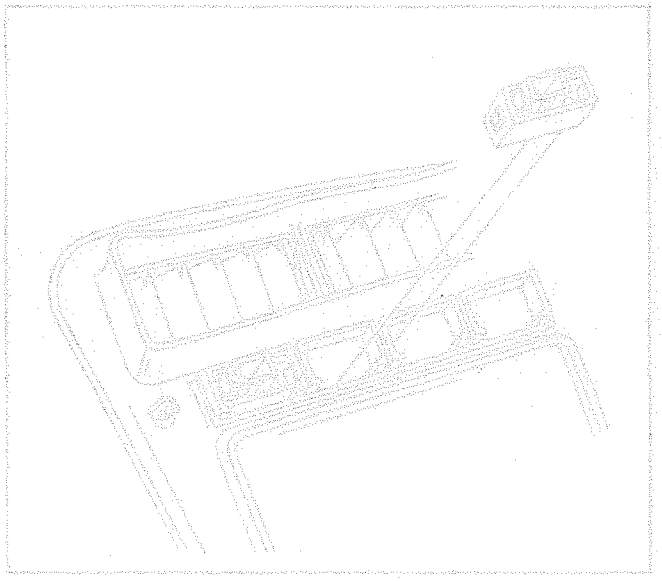


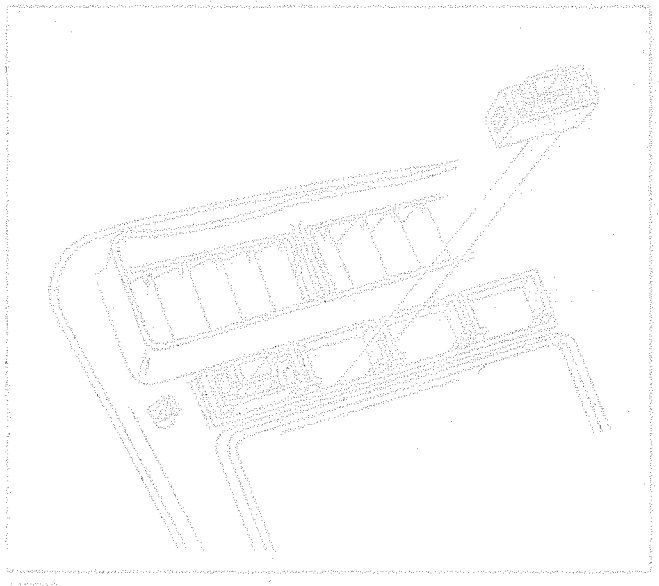
367395



294806

4. Install the I/P accessory trim plate.





Description and Operation

Service Precautions

ABS/TCS System Service Precautions

Observe the following general precautions during any ABS/TCS service. Failure to adhere to these precautions may result in ABS/TCS system damage.

1. Unplug the EBCM/EBTCM harness connector before performing electric welding procedures.
2. Carefully note the routing of the ABS/TCS wiring and wiring components during removal. The ABS/TCS components are extremely sensitive to EMI (electromagnetic interference). Proper mounting is critical during component service.
3. Do not use a quick charger for engine starting or for battery charging with the battery still connected. Brake failure or ABS/TCS component damage may result.
4. Disconnect the battery with the ignition off.
5. Disconnect the EBCM/EBTCM connector with the ignition off.
6. Do not attempt to repair the BPMV or any other non serviceable ABS/TCS components where noted in this section. Many ABS/TCS components are serviceable by component replacement only.
7. Do not hang the suspension components from the WSS cables. The cables may be damaged.
8. Do not subject the EBCM/EBTCM to temperatures of more than 85°C (184°F).
9. Do not use petroleum based fluids in the master cylinder. Do not use any containers previously used for petroleum based fluids. Petroleum causes swelling and distortion of the rubber components in the hydraulic brake system, resulting in water entering the system and lowering the fluid boiling point.
10. Inspect the ABS/TCS system after service using a scan tool.

General System Description

The purpose of the Bosch 5.3 Antilock Brake System (ABS) is to minimize wheel slip during heavy braking. The Bosch 5.3 performs this function by monitoring the speed of each wheel and controlling the brake fluid pressure to each wheel independently during a braking event. This allows the driver to retain directional stability and better steering capability.

The Traction Control System (TCS) also monitors rear wheel speed and compares the speed to the speed of the front wheel. If excessive rear wheel speed is detected in either rear wheels the TCS will be activated.

Abbreviations and Definitions

ABS: Antilock Brake System

ASM: Accelerator and Servo Control Module

B+: Battery Voltage

BPMV: Brake Pressure Modulator Valve

CKT: Circuit

DLC: Data Link Connector

DTC: Diagnostic Trouble Code

DMM: Digital Multimeter

EBCM: Electronic Brake Control Module

EBD: Electronic Brakeforce Distribution

EBTCM: Electronic Brake and Traction Control Module

IPC: Instrument Panel Cluster

PCM: Powertrain Control Module

TCS: Traction Control System

WSS: Wheel Speed Sensor

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, Refer to General Electrical Diagnosis Procedures in Wiring Systems. 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 (amperes) 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 Digital Multimeter (DMM) *J 39200*, and be familiar with the meter controls and how to use them correctly.
- You should be able to measure voltage, resistance and current.
- You should know how to use jumper wires to bypass components for testing circuits.

Important: When measuring the resistance to ground of circuit or component, make sure to use a solid, unpainted chassis ground or the negative battery terminal.

ABS Description

Brake Pressure Modulator Valve (BPMV)

The Brake Pressure Modulator Valve (BPMV) mounted on the left side of the engine compartment, provides brake fluid modulation for each of the individual wheel circuits as required during Antilock braking. During the Antilock mode, the BPMV can maintain or reduce brake fluid pressure independent of the pressure generated in the master cylinder. The BPMV does not provide more pressure than is applied by the master cylinder during braking.

The BPMV supplies Electronic Brakeforce Distribution (EBD). This function takes the place of the proportioning valve(s).

With the exception of the EBCM/EBTCM, the Brake Pressure Modulator Valve (BPMV) is an integral, non-serviceable component. The BPMV should never be disassembled.

If the vehicle is not equipped with traction control the BPMV uses a three circuit configuration with a front-rear split. Individual circuits are provided for the left front and right front wheels, and the rear wheels use one circuit.

If the vehicle is equipped with traction control the BPMV uses a four circuit configuration with a front-rear split. Individual circuits are provided for the left front and right front wheels, and left rear and right rear wheels.

The BPMV consists of several other components which are described as follows:

Pump Motor

The BPMV contains a motor driven recirculation pump. The pump serves two purposes: 1) During ABS Reduce Pressure events, it transfers fluid from the brake calipers back to the master cylinder; and 2) During traction control, it transfers fluid from the master cylinder reservoir to the rear brake calipers. The pump and motor are located within the BPMV and are not serviced separately.

ABS Valves

The ABS valves decrease or maintain brake fluid pressure at the individual wheel circuits. If the vehicle is not equipped with traction control there are three Inlet, and three Outlet solenoid valves. If the vehicle is equipped with traction control there are four Inlet, and four Outlet solenoid valves. The solenoid valves maintain, increase, or decrease brake fluid pressure to the individual wheel circuits. The EBCM/EBTCM commands the valves to their correct position during an antilock or traction event. During antilock mode, the pressure in each hydraulic circuit can be held or released by activating the appropriate valves. The normal state of the inlet valves is open, while the normal state of the Outlet valves is closed. This allows direct master cylinder pressure to the brakes during normal braking. The ABS valves are located within the BPMV and are not serviced separately.

TCS Master Cylinder Isolation Valves

If the vehicle is equipped with Traction Control there is one TCS Master Cylinder Isolation Valve within the BPMV. This valves isolates the master cylinder so the pump motor can build brake fluid pressure for the rear brakes during a traction event.

TCS Prime Valves

If the vehicle is equipped with Traction Control there is one TCS prime valve within the BPMV. This valves allow the pump to draw fluid from the master cylinder reservoir, through the compensating ports in the master cylinder bore.

Electronic Brake And Traction Control Module

The EBCM/EBTCM performs the following primary functions:

- Detects wheel slip tendencies
- Detects wheel speed differences
- Controls the brake system while in the antilock or traction control mode
- Controls the Electronic Brakeforce Distribution (EBD)
- Monitors the system for proper electrical operation

The EBCM/EBTCM also controls the display of the ABS and traction control DTCs while in diagnostic mode. The EBCM/EBTCM continuously checks the speed of each wheel in order to determine if any wheel is beginning to slip. If a wheel slip tendency is detected, the EBCM/EBTCM commands the appropriate valve positions to modulate the brake fluid pressure in some or all of the hydraulic circuits. This action prevents wheel slip and provides optimum braking. The EBCM/EBTCM continues to control pressure in the individual hydraulic circuits until a slipping tendency is no longer present. The EBCM/EBTCM continuously monitors the ABS/TCS for proper operation. If an error is detected, the EBCM/EBTCM can disable the ABS/TCS and turn on the ABS or TCS OFF Indicators in the IPC.

Wheel Speed Sensors

A wheel speed sensor is located at each front wheel bearing assembly. If the vehicle is equipped with traction control a wheel speed sensor is located at each rear wheel bearing assembly. If the vehicle is not equipped with traction control then a single rear wheel speed sensor is located in the differential housing. The sensors use AC voltage in order to transmit wheel speed information to the EBCM/EBTCM. Passing a toothed sensor ring past a stationary sensor causes the magnetic induction that generates the voltage. A pair of wires carries the signal to the EBCM/EBTCM. The wheel speed sensors are located in their respective assemblies and are not adjustable.

Traction Control System ON/OFF Switch

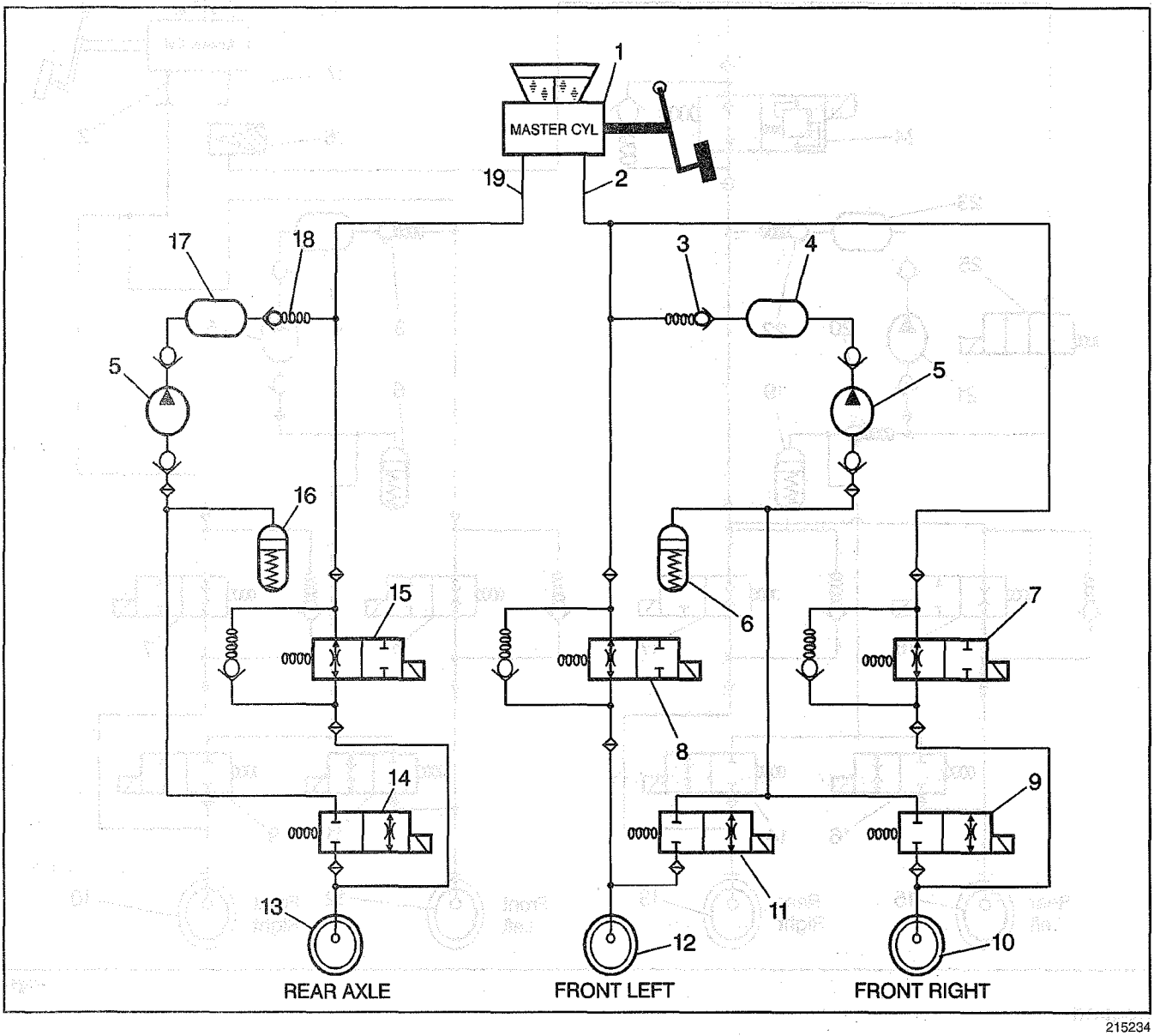
The Traction Control On/Off Switch is a momentary on switch that allows the driver to shut off the TCS for personal or diagnostic reasons. Turning the switch to off places the TCS in the passive mode while maintaining ABS functions. With the TCS system on, pressing the switch disables the TCS and the TRACTION OFF indicator turns on.

Stoplamp Switch

The stoplamp switch is an input to the EBCM/EBTCM. The EBCM/EBTCM uses the stoplamp switch in order to tell when the brake pedal is being applied.

ABS Operation

ABS BPMV Hydraulic Flow

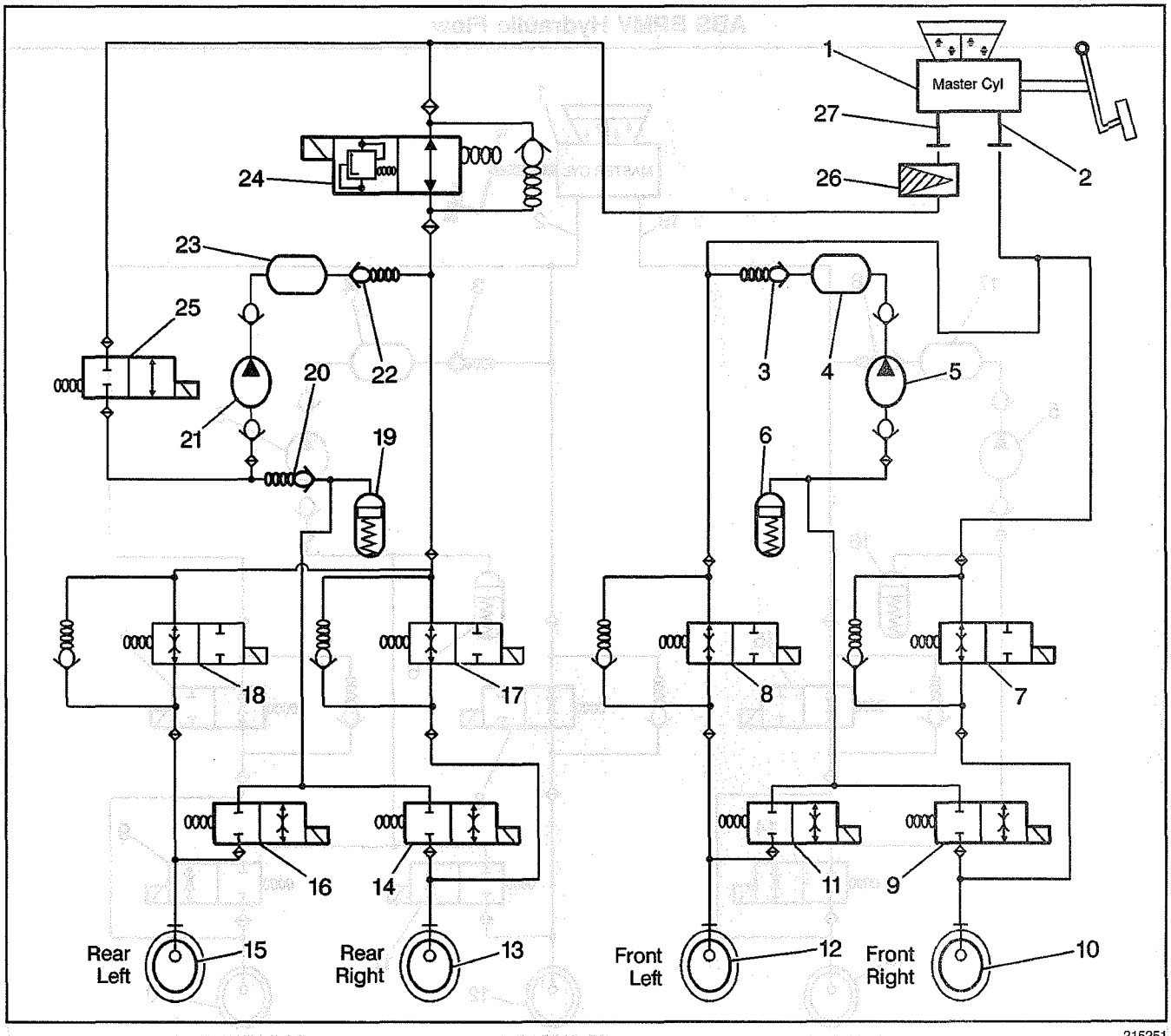


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Legend

(1) Master Cylinder
(2) Front Brake Pipe
(3) Check Valve
(4) Damping Chamber
(5) Pump
(6) Pressure Accumulator
(7) Right Front Inlet Valve
(8) Left Front Inlet Valve
(9) Right Front Outlet Valve
(10) Right Front Rotor
(11) Left Front Outlet Valve
(12) Left Front Rotor
(13) Rear Rotors
(14) Rear Outlet Valve
(15) Rear Inlet Valve
(16) Pressure Accumulator
(17) Damping Chamber
(18) Check Valve

ABS/TCS BPMV Hydraulic Flow



Legend

(1) Master Cylinder
(2) Front Brake Pipes
(3) Check Valve
(4) Damping Chamber
(5) Pump
(6) Pressure Accumulator
(7) Right Front Inlet Valve
(8) Left Front Inlet Valve
(9) Right Front Outlet Valve
(10) Right Front Rotor
(11) Left Front Outlet Valve
(12) Left Front Rotor
(13) Right Rear Rotor
(14) Right Rear Outlet Valve
(15) Left Rear Rotor
(16) Left Rear Outlet Valve
(17) Right Rear Inlet Valve
(18) Left Rear Inlet Valve
(19) Pressure Accumulator
(20) Check Valve
(21) Pump
(22) Check Valve
(23) Damping Chamber
(24) Isolation Valve
(25) Prime Valve
(26) Internal Damper
(27) Rear Brake Pipes

Antilock Brake System

When wheel slip is noted during a brake application, the ABS will enter Antilock mode. During Antilock braking, hydraulic pressure in the individual wheel circuits is controlled to prevent any wheel from slipping. If the vehicle is equipped with traction control a separate hydraulic line and specific solenoid valves are provided for each wheel. If the vehicle is not equipped with traction control then both front wheels have a seperate hydraulic line and specific solenoid valves, the rear wheels have only one hydraulic line controlled by one set of solenoid valves. The ABS can decrease, hold, or increase hydraulic pressure to each wheel brake. However, it cannot increase hydraulic pressure above the amount which is transmitted by the master cylinder during braking.

During Antilock braking, a series of rapid pulsation's will be felt in the brake pedal. These pulsation's are caused by the rapid changes in position of the individual solenoid valves as they respond to their desired wheel speed. This pedal pulsation is present during Antilock braking and will stop when normal braking is resumed or when the vehicle comes to a stop. A ticking or popping noise may also be heard as the solenoid valves rapidly cycle. During Antilock braking on dry pavement, the tires may make intermittent chirping noises as they approach slipping. These noises and pedal pulsation's should be considered normal during Antilock operation.

Vehicles equipped with ABS may be stopped by applying normal force to the brake pedal. Brake pedal operation during normal braking should be no different than previous systems. Maintaining a constant force on the pedal will provide the shortest stopping distance while maintaining vehicle stability.

Pressure Hold

When the EBCM senses the wheel slip, the EBCM closes the Inlet valve and keeps the Outlet valve closed in the BPMV in order to isolate the system. This holds the pressure steady on the brake so that the hydraulic pressure does not increase or decrease.

Pressure Decrease

If during the pressure hold mode the EBCM still senses wheel slip, the EBCM will decrease the pressure to the brake. The Inlet valve is left closed and the Outlet valve is opened. The excess fluid is stored in the accumulator until the return pump can return the fluid to the master cyclinder.

Pressure Increase

If during the pressure hold or the pressure decrease mode the EBCM senses that the wheel speed is too fast, the EBCM will increase the pressure to the brake. The Inlet is opened and the Outlet valve is closed. The increased pressure comes from the master cylinder and is related to the pressure applied to the brake pedal.

Traction Control

Traction control will not have any effect on the operation of the vehicle until the control module detects one or both of the rear wheels rotating faster than the front wheels. At this time the Electronic Brake and Traction Control Module (EBCM) will request the Powertrain Control Module (PCM) to retard timing. If the EBCM continues to detect the rear wheel are rotating faster than the front it will request the ASM to reduce the throttle angle. The last measure taken to control the rear wheel is for the EBCM to apply the rear brakes, thus reducing torque to the rear wheels. Once the rear wheels begin to rotate at the same speed as the front wheels, the system will return full control to the driver. During Traction Control mode, if the brake is applied to only one rear wheel, most of the torque from the engine will be directed to the other rear wheel which will improve the traction of the vehicle.

The braking is accomplished by closing the TCS Master Cylinder Isolating Valve, this isolates the master cylinder from the rest of the system. The TCS Prime valve opens to allow the pump to get brake fluid to build pressure for braking. The drive wheel circuit solenoids are energized as needed to allow for pressure hold, pressure increase, or pressure decrease.

The TCS may be deactivated by the driver if desired. In order to deactivate the TCS with the engine running, depress the TCS On/Off switch. The system will remain deactivated until the ignition switch is cycled, or the switch is pressed again.

Tires with ABS/TCS

The compact spare tire rotates faster than the others. The EBCM compensates for this faster rotation. Refer to Tires and Wheels in Suspension for information on replacement tires.

Replacement Tires

The tire size is important for the performance of the ABS/TCS. The replacement tires should be the same size load range and construction as the original tires. Replace the tires in axle sets and only with tires of the same tire performance criteria specification number. Use of any other tire size or type may seriously affect ABS/TCS operation. For information on replacement tires for this vehicle, Refer to Tires and Wheels in Suspension.

BRAKE Warning Indicator

The red BRAKE Indicator in the instrument cluster will illuminate to warn the driver of conditions in the brake system which may result in reduced braking ability. The red BRAKE indicator will also illuminate when the park brake is applied. The BRAKE warning Indicator will stay illuminated until the condition has been repaired, or the park brake is released. Refer to *Brake System Testing* in Hydraulic Brakes.

ABS Indicator

The ABS is located in the instrument cluster and will illuminate if a malfunction in the ABS is detected by the Electronic Brake and Traction Control Module (EBCM). The ABS Indicator informs the driver that a condition exists which results in turning off the Antilock brake and traction control function if equipped. If only the ABS Indicator is on, normal braking with full power assist is available. If the BRAKE and Antilock Indicators are on, a problem may exist in the hydraulic brake system. Refer to *Brake System Testing* in Hydraulic Brakes. Conditions for the Antilock Indicator to turn on are as follows:

1. ABS malfunction detected. As previously described, the ABS Indicator turns on when a problem has been found in the ABS. The ABS Indicator indicates that the ABS and TCS if equipped have been disabled.
2. Instrument Panel Cluster bulb check. When the ignition is turned to RUN, the ABS Indicator will turn on for approximately three seconds and then turn off.
   - Illumination of the BRAKE warning Indicator may indicate reduced braking ability.
   - Illumination of the ABS Indicator without the BRAKE warning Indicator on indicates only that Antilock braking is no longer available. Power assisted braking without Antilock control is still available.
   - Refer to *Brake System Testing* in Hydraulic Brakes for diagnosis of any condition which causes the BRAKE warning Indicator to illuminate.

ASR Indicator (Chevrolet)

The ASR Indicator (Chevrolet only) is located in the instrument cluster and will illuminate if a malfunction in the traction control system is detected by the Electronic Brake and Traction Control Module (EBCM). The ASR Indicator informs the driver that a condition exists which results in turning off traction. Conditions for the ASR Indicator to turn on are as follows:

1. Traction control malfunction detected. As previously described, the ASR Indicator turns on when a problem has been found in the traction control system. The ASR Indicator indicates that traction control has been disabled.
2. Instrument Panel Cluster bulb check. When the ignition is turned to RUN, the ASR Indicator will turn on for approximately three seconds and then turn off.

TCS Off Indicator (Pontiac)

The TCS Off Indicator (Pontiac only) is located in the instrument cluster and will illuminate if a malfunction in the traction control system is detected by the Electronic Brake and Traction Control Module (EBCM). The TCS Off Indicator informs the driver that a condition exists which results in turning off traction. Conditions for the TCS Off Indicator to turn on are as follows:

1. Traction control malfunction detected. As previously described, the TCS Off Indicator turns on when a problem has been found in the traction control system. The TCS Off Indicator indicates that traction control has been disabled.
2. Instrument Panel Cluster bulb check. When the ignition is turned to RUN, the TCS Off Indicator will turn on for approximately three seconds and then turn off.

Low Trac Indicator

The Low Trac Indicator is located in the instrument cluster and will illuminate when the EBCM detects a low traction condition. Conditions for the Low Trac Indicator to turn on are as follows:

1. Instrument Panel Cluster bulb check. When the ignition is turned to RUN, the ASR Indicator will turn on for approximately three seconds and then turn off.
2. The EBCM detects an antilock braking condition.
3. The EBCM detects a traction control condition.

Special Tools and Equipment

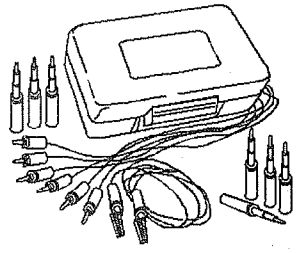
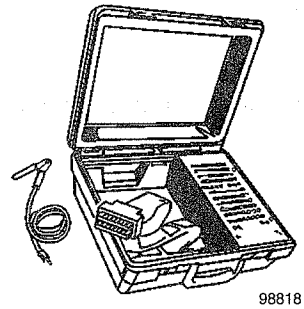
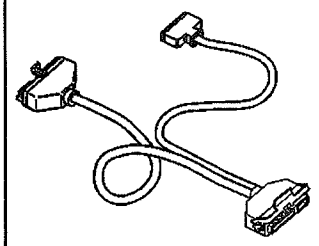
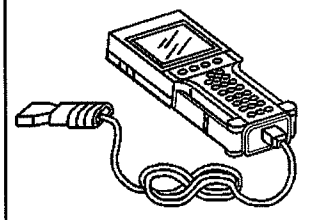
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 3430	J 39200 Digital Multimeter
 98818	J 39700 Universal Pinout Box

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 39438	Tech 2 Scan Tool

BLANK

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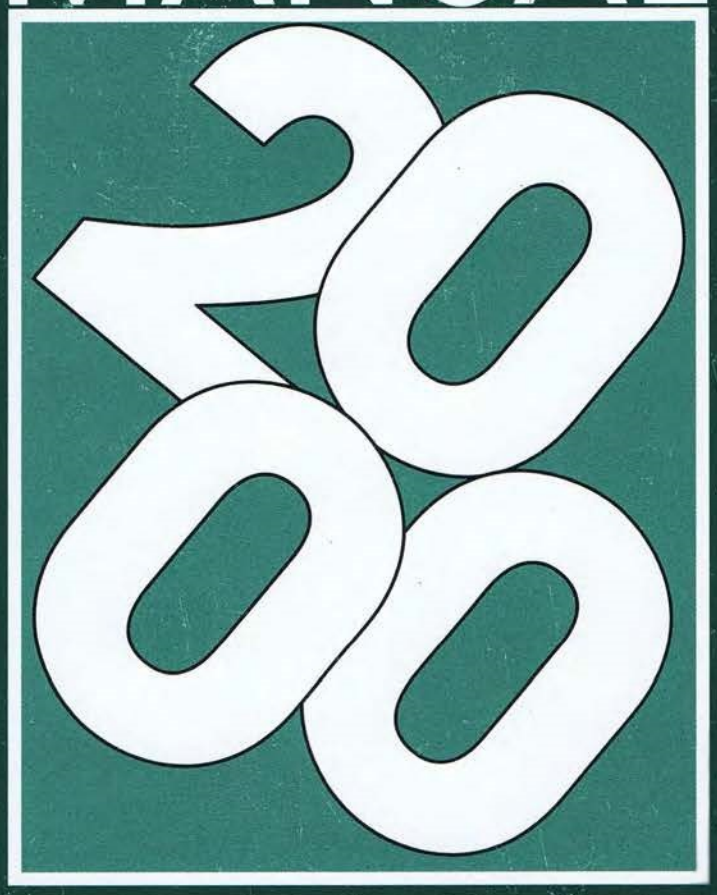
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