2010 GENERAL INFORMATION

Dangers, Warnings, and Cautions - Camaro

INTRODUCTION

DEFINITION OF DANGER, WARNING, CAUTION, AND NOTE

The diagnosis and repair procedures in a GM Service Manual contain both general and specific Dangers, Warnings, Cautions, Notes or 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. Dangers, Warnings, Cautions and Notes or 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 or death to the technician
- Damage to the vehicle
- Unnecessary vehicle repairs
- Unnecessary component replacement
- Improper repair or replacement of vehicle components.
- Any warning or caution that appears in this service category is referenced from the individual service categories.

DANGER Defined

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

- Serious bodily injury or death to the technician
- Serious bodily injury or death to other technicians in the workplace area

WARNING Defined

When encountering a WARNING, you will be asked to take a necessary action or not to take a prohibited action. If a WARNING 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

CAUTION Defined

CAUTIONS call special attention to a necessary action or to a prohibited action. If a CAUTION is not heeded,

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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

NOTE or IMPORTANT Defined

NOTE and IMPORTANT statements emphasize a necessary characteristic of a diagnostic or repair procedure. NOTE or 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

APPROVED EQUIPMENT FOR COLLISION REPAIR WARNING

WARNING: To avoid personal injury when exposed to welding flashes or to galvanized (Zinc Oxide) metal toxic fumes while grinding/cutting on any type of metal or sheet molded compound, you must work in a properly ventilated area, wearing an approved respirator, eye protection, earplugs, welding gloves, and protective clothing.

ASSISTANT DRIVING WARNING

WARNING: An assistant should drive the vehicle while the technician checks for the location of the reported condition. Otherwise, personal injury could result.

BATTERY DISCONNECT WARNING

WARNING: Unless directed otherwise, the ignition and start switch must be in the OFF or LOCK position, and all electrical loads must be OFF before servicing any electrical component. Disconnect the negative battery cable

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to prevent an electrical spark should a tool or equipment come in contact with an exposed electrical terminal. Failure to follow these precautions may result in personal injury and/or damage to the vehicle or its components.
For Vehicles equipped with OnStar® (UE1) with Back Up Battery:
The Back Up Battery is a redundant power supply to allow limited OnStar® functionality in the event of a main vehicle battery power disruption to the VCIM (OnStar®module). Do not disconnect the main vehicle battery or remove the OnStar® fuse with the ignition key in any position other than OFF. Retained accessory power (RAP) should be allowed to time out or be disabled (simply opening the driver door should disable RAP) before disconnecting power. Disconnecting power to the OnStar® module in any way while the ignition is On or with RAP activated may cause activation of the OnStar® Back-Up Battery (BUB) system and will discharge and permanently damage the back-up battery. Once the Back-Up Battery is activated it will stay on until it has completely discharged. The BUB is not rechargeable and once activated the BUB must be replaced.

BRAKE DUST WARNING

WARNING: 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 WARNING

WARNING: 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.

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CAMSHAFT POSITION ACTUATOR REMOVAL AND INSTALLATION WARNING

WARNING: Do not push or pull on the reluctor wheel of the camshaft position (CMP) actuator during removal or installation. The reluctor wheel is retained to the front of the CMP actuator by 3 roll pins. Pushing or pulling on the wheel may dislodge the wheel from the front of the actuator. The actuator return spring is under tension and may rotate the dislodged reluctor wheel, causing personal injury.

COLLISION SECTIONING WARNING

WARNING: Sectioning should be performed only in the recommended areas. Failure to do so may compromise the structural integrity of the vehicle and cause personal injury if the vehicle is in a collision.

CRACKED WINDOW WARNING

WARNING: If a window is cracked but still intact, crisscross the window with masking tape in order to reduce the risk of damage or personal injury.

DEFROSTER OUTLET WARNING

WARNING: If broken glass falls into the defroster outlets, it can be blown into the passenger compartment and cause personal injury.

EXHAUST SERVICE WARNING

WARNING: In order to avoid being burned, do not service the exhaust system while it is still hot. Service the system when it is cool.

EYE PROTECTION WARNING

WARNING: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.

FOAM SOUND DEADENERS WARNING

WARNING: Foam sound deadeners must be removed from areas within 152.4 mm (6 in) of where flame is to be used for body repairs. When reinstalling foam sound deadeners, avoid inhaling fumes as bodily injury may result.

FUEL PIPE FITTING WARNING

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WARNING: **Always apply a few drops of clean engine oil to the male pipe ends before connecting the 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 RAIL STOP BRACKET INSTALLATION WARNING

WARNING: **The fuel rail stop bracket must be installed onto the engine assembly. The stop bracket serves as a protective shield for the fuel rail in the event of a vehicle frontal crash. If the fuel rail stop bracket is not installed and the vehicle is involved in a frontal crash, fuel could be sprayed possibly causing a fire and personal injury from burns.**

GASOLINE/GASOLINE VAPORS WARNING

WARNING: **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.**

GLASS AND SHEET METAL HANDLING WARNING

WARNING: **When working with any type of glass or sheet metal with exposed or rough edges, wear approved safety glasses and gloves in order to reduce the chance of personal injury.**

HALOGEN BULB WARNING

WARNING: **Halogen bulbs contain gas under pressure. Handling a bulb improperly could cause it to shatter into flying glass fragments. To help avoid personal injury:**

- **Turn off the lamp switch and allow the bulb to cool before changing the bulb.**
- **Leave the lamp switch OFF until the bulb change is complete.**
- **Always wear eye protection when changing a halogen bulb.**
- **Handle the bulb only by its base. Avoid touching the glass.**
- **Keep dirt and moisture off the bulb.**
- **Properly dispose of the used bulb.**
- **Keep halogen bulbs out of the reach of children.**

HOT EXHAUST SYSTEM WARNING

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WARNING: **While engine is operating, the exhaust system will become extremely hot. To prevent burns avoid contacting a hot exhaust system.**

MOVING PARTS AND HOT SURFACES WARNING

WARNING: **Avoid contact with moving parts and hot surfaces while working around a running engine in order to prevent physical injury.**

PROTECTIVE GOGGLES AND GLOVE WARNING

WARNING: **Always wear protective goggles and gloves when removing exhaust parts as falling rust and sharp edges from worn exhaust components could result in serious personal injury.**

RELIEVING FUEL PRESSURE WARNING

WARNING: **Remove the fuel tank cap and relieve the fuel system pressure before servicing the fuel system in order to reduce the risk of personal injury. After you relieve the fuel system pressure, a small amount of fuel may be released when servicing the fuel lines, the fuel injection pump, or the connections. In order to reduce the risk of personal injury, cover the fuel system components with a shop towel before disconnection. This will catch any fuel that may leak out. Place the towel in an approved container when the disconnection is complete.**

ROAD TEST WARNING

WARNING: **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 and vehicle damage.**

SAFETY GLASSES AND COMPRESSED AIR WARNING

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

SAFETY GLASSES WARNING

WARNING: **Wear safety glasses in order to avoid eye damage.**

SERVICING ELECTRICAL COMPONENTS WARNING

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WARNING: **The ignition must be in the off position and all electrical loads must be turned off before servicing any electrical component. Failure to do so may result in personal injury or damage to the vehicle.**

SIR DEPLOYED INFLATOR MODULES ARE HOT WARNING

WARNING: **After deployment, the metal surfaces of the SIR component may be very hot. To help avoid a fire or personal injury:**

- **Allow sufficient time for cooling before touching any metal surface of the SIR component.**
- **Do not place the deployed SIR component near any flammable objects.**

SIR INFLATABLE MODULE DEPLOYMENT OUTSIDE VEHICLE WARNING

WARNING: **When you are deploying an inflator module for disposal, perform the deployment procedures in the order listed. Failure to follow the procedures in the order listed may result in personal injury.**

SIR INFLATOR MODULE DISPOSAL WARNING

WARNING: **In order to prevent accidental deployment and the risk of personal injury, do not dispose of an undeployed inflator module as normal shop waste. Undeployed inflator modules contain substances that could cause severe illness or personal injury if their sealed containers are damaged during disposal. Use the following deployment procedures to safely dispose of an undeployed inflator module. Failure to observe the following disposal methods may be a violation of federal, state, or local laws.**

SIR INFLATOR MODULE HANDLING AND STORAGE WARNING

WARNING: **When carrying an undeployed inflator module:**

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

When storing an undeployed inflator module:

- **Make sure the air bag opening points away from the surface on which the inflator module rests.**
- **Provide free space for the air bag to expand in case of an accidental deployment.**
- **When storing a steering column, do not rest the column with the air bag opening facing down and the column vertical. Lay the column**

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on its side.

Failure to observe these guidelines may result in personal injury.

SIR WARNING

WARNING: This vehicle is equipped with a Supplemental Inflatable Restraint (SIR) System. Failure to follow the correct procedure could cause the following conditions:

- Air bag deployment
- Personal injury
- Unnecessary SIR system repairs

In order to avoid the above conditions, observe the following guidelines:

- Refer to SIR Component Views in order to determine if you are performing service on or near the SIR components or the SIR wiring.
- If you are performing service on or near the SIR components or the SIR wiring, disable the SIR system. Refer to Disabling the SIR System.

WINDOW RETENTION WARNING

WARNING: When replacing stationary windows, use Urethane Adhesive Kit GM P/N 12346392 (Canadian P/N 10952983), or a urethane adhesive system meeting GM Specification GM3651G, 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 WARNING

WARNING: 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.

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- 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 at normal ride height.
  - Do not apply the brake with the brake rotors removed.
  - Do not place the transmission in PARK with the drive axles spinning.
  - Turn Off the ignition in order to stop the powertrain components from spinning.
- When running an engine in the work stall, use the exhaust removal system to prevent breathing dangerous gases.

BELT DRESSING CAUTION

CAUTION: 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.

BRAKE FLUID EFFECTS ON PAINT AND ELECTRICAL COMPONENTS CAUTION

CAUTION: Avoid spilling brake fluid onto painted surfaces, electrical connections, wiring, or cables. Brake fluid will damage painted surfaces and cause corrosion to electrical components. If any brake fluid comes in contact with painted surfaces, immediately flush the area with water. If any brake fluid comes in contact with electrical connections, wiring, or cables, use a clean shop cloth to wipe away the fluid.

CLEARCOAT/ULTRAVIOLET SCREENERS CAUTION

CAUTION: Removing more than 0.5 mils of the clearcoat can result in early paint failure. The clearcoat contains ultraviolet screeners. Do not finesse sand more than what is required to remove the defect.

COMPONENT FASTENER TIGHTENING CAUTION

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CAUTION: 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.

DISENGAGING CONNECTORS CAUTION

CAUTION: DO NOT use any mechanical device such as pliers or screwdrivers to disengage the connector. In order to prevent damage to the connector or harness wiring, both of the latches on the connector must be depressed with finger pressure only. When the latches are depressed the connector must then be pulled straight back without pulling on the wires in order to disengage. Failure to follow this procedure can lead to connector or wiring harness damage and failure.

ENGINE OIL COOLER DEBRIS CAUTION

CAUTION: If any malfunction is experienced which may cause debris to enter the oil supply, You must replace the engine oil cooler and hoses. Debris in the engine oil cooler and oil cooler hoses may be pulled back into the engine causing severe engine damage.

EXTERIOR TRIM EMBLEM REMOVAL CAUTION

CAUTION: Use a plastic, flat-bladed tool to prevent paint damage when removing an emblem/name plate.

FASTENER CAUTION

CAUTION: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. 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. When using fasteners that are threaded directly into plastic, use extreme care not to strip the mating plastic part(s). Use hand tools only, and do not use any kind of impact or power tools. Fastener should be hand tightened, fully seated, and not stripped.

FUEL AND EVAPORATIVE EMISSION HOSE/PIPE CONNECTION CLEANING CAUTION

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CAUTION: Clean all of the following areas before performing any disconnections in order to avoid possible contamination in the system:

- **The fuel pipe connections**
- **The hose connections**
- **The areas surrounding the connections**

HEATED OXYGEN SENSOR RESISTANCE LEARN RESET CAUTION

CAUTION: When replacing the HO2S perform the following:

- **A code clear with a scan tool, regardless of whether or not a DTC is set**
- **HO2S heater resistance learn reset with a scan tool, where available**

Perform the above in order to reset the HO2S resistance learned value and avoid possible HO2S failure.

MACHINED SURFACE DAMAGE CAUTION

CAUTION: Do not nick, scratch or damage the sealing surface. The sealing surface is a machined surface. Damage to the machined surface can cause leakage.

OXYGEN SENSOR CAUTION

CAUTION: Handle the oxygen sensors carefully in order to prevent damage to the component. Keep the electrical connector and the exhaust inlet end free of contaminants. Do not use cleaning solvents on the sensor. Do not drop or mishandle the sensor.

PIN REUSE CAUTION

CAUTION: Discard the pin. Replace with a NEW pin. Using an old pin may result in transmission damage.

RETAINING RING REUSE CAUTION

CAUTION: Do not reuse the retaining ring. Install a NEW retaining ring. Reusing the old retaining ring may cause damage to the clutch assembly.

SEALANT CAUTION

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CAUTION: Do not allow the RTV sealant to enter any blind threaded hole. RTV sealant that is allowed to enter a blind threaded hole can cause hydraulic lock of the fastener when the fastener is tightened. Hydraulic lock of a fastener can lead to damage to the fastener and/or the components. Hydraulic lock of a fastener can also prevent the proper clamping loads to be obtained when the fastener is tightened. Improper clamping loads can prevent proper sealing of the components allowing leakage to occur. Preventing proper fastener tightening can allow the components to loosen or separate leading to extensive engine damage.

SEAL REUSE CAUTION

CAUTION: Do not reuse the seals. Replace with NEW seals. Reusing old seals may cause transmission damage.

SILICON CONTAMINATION OF HEATED OXYGEN SENSORS CAUTION

CAUTION: Contamination of the oxygen sensor can result from the use of an inappropriate RTV sealant (not oxygen sensor safe) or excessive engine coolant or oil consumption. Remove the HO2S and visually inspect the portion of the sensor exposed to the exhaust stream in order to check for contamination. If contaminated, the portion of the sensor exposed to the exhaust stream will have a white powdery coating. Silicon contamination causes a high but false HO2S signal voltage (rich exhaust indication). The control module will then reduce the amount of fuel delivered to the engine, causing a severe driveability problem. Eliminate the source of contamination before replacing the oxygen sensor.

TEST PROBE CAUTION

CAUTION: Do not insert test equipment probes (DMM etc.) into any connector or fuse block terminal. The diameter of the test probes will deform most terminals. A deformed terminal will cause a poor connection, which will result in a system failure. Always use the J-35616 GM-Approved Terminal Test Kit in order to front probe terminals. Do not use paper clips or other substitutes to probe terminals.
When using the J-35616 GM-Approved Terminal Test Kit, ensure the terminal test adapter choice is the correct size for the connector terminal. Do not visually choose the terminal test adapter because some connector terminal cavities may appear larger than the actual terminal in the cavity. Using a larger terminal test adapter will damage the terminal. Refer to the J-35616 GM-Approved Terminal Test Kit label on the inside of the J-35616 GM-Approved Terminal Test Kit for the correct adapter along with the connector end view for terminal size.

TORQUE REACTION AGAINST TIMING DRIVE CHAIN CAUTION

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CAUTION: A wrench must be used on the hex of the camshaft when loosening or tightening in order to prevent component damage. Failure to prevent the torque reaction against the timing drive chain can lead to timing drive chain failure.

VALVE LIFTER PRIMING CAUTION

CAUTION: Ensure each valve lifter is filled with clean engine oil and the valve lifter does not tip over (plunger down) before the installation of the valve lifters. The loss of oil in the valve lifter lower pressure chamber or the dry stroking/cycling of the valve lifter plunger will allow air to travel into the high pressure chamber of the valve lifter. Air in the high pressure chamber of the valve lifter may not be purged causing extensive engine component damage.

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General Information - Camaro

INTRODUCTION

US ENGLISH/METRIC CONVERSION

US English	Multiply/ Divide by	Metric
In order to calculate US English measurement, divide by the number in the center column. In order to calculate metric measurement, multiply by the number in the center column.		
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
	16.387	cu cm
	0.0164	L
qt	0.9464	
gal	3.7854	
cu yd	0.764	cu m
Mass		
lb	0.4536	kg
ton	907.18	
	0.907	tonne (t)
Force		
kg F	9.807	newtons (N)
oz F	0.2780	
lb F	4.448	
Acceleration		
ft/s^2	0.3048	m/s^2
in/s^2	0.0254	
Torque		
lb in	0.11298	N.m
lb ft	1.3558	

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Power		
hp	0.745	kW
Pressure (Stress)		
inches of H2O	0.2488	kPa
inches of Mercury (Hg)	3.377	
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
Temperature		
(°F - 32) 5/9	=	°C
°F	=	(9/5 °C + 32)
Fuel Performance		
235.215/mpg	=	100 km/L

DECIMAL AND METRIC EQUIVALENTS

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

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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
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

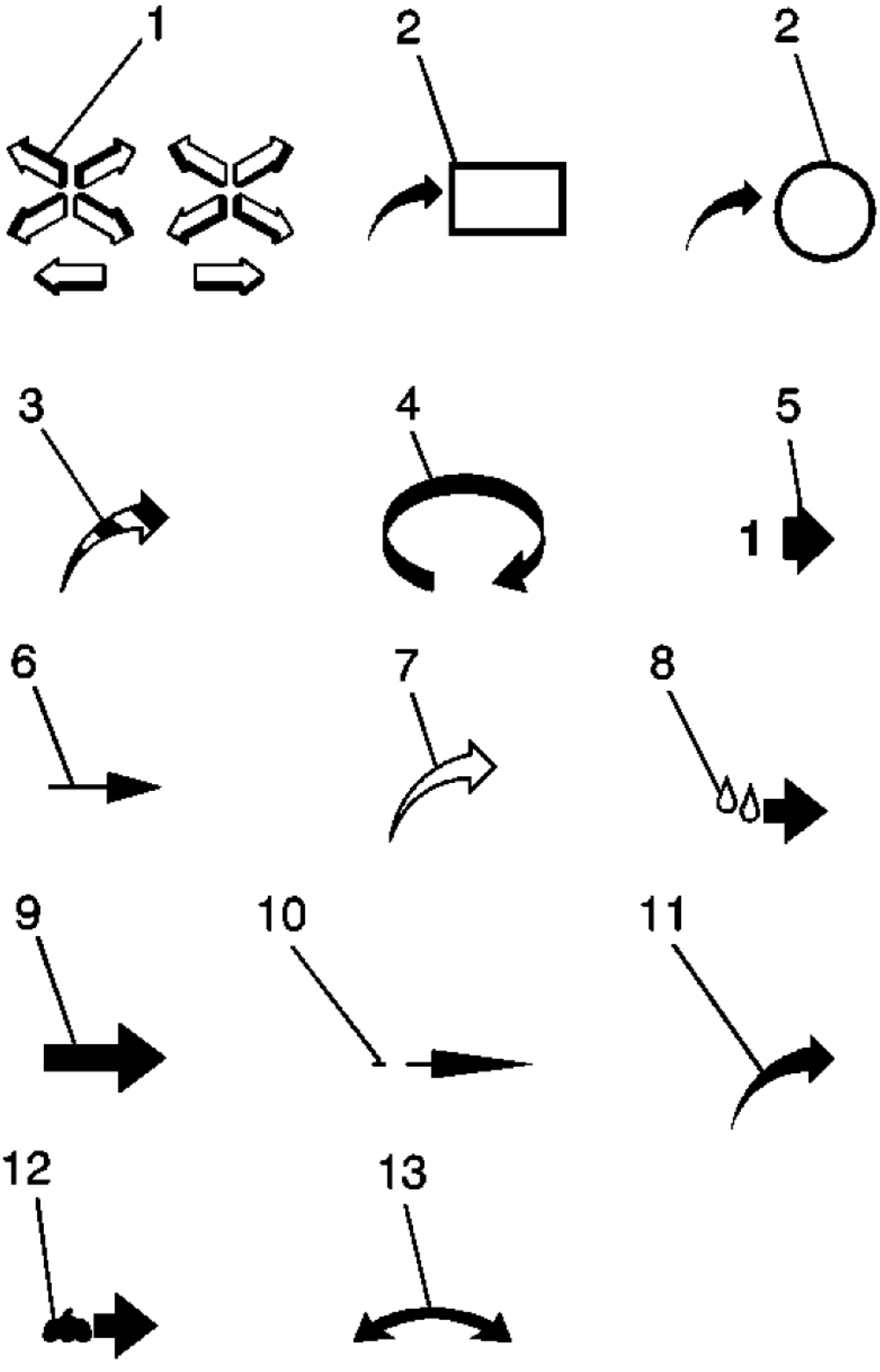
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	0.9375	23.8125
61/64	0.953125	24.20937
31/32	0.96875	24.60625
63/64	0.984375	25.00312
1	1.0	25.4

ARROWS AND SYMBOLS

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

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Fig. 1: Identifying Different Service Operations Symbols
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Front of Vehicle
2	View Detail
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
13	Multidirectional Arrow

CUSTOMER CONCERN VERIFICATION SHEETS

The GM Customer Concern Verification Sheets have been designed to improve communications between the service customer and the technician. The more clearly the technician understands the concern and its symptoms, the more likely the concern will be fixed right the first time.

The GM-wide Customer Concern Verification Sheets are available in DealerWorld. The Customer Concern Verification Sheets may be printed and reproduced locally.

TRAINING

Dealers

All U.S. Dealers participating in the Common Training Program can enroll through the Common Training System Website at https://www.gmtraining.com. Within the website, there are individual training paths that are designed to assist in planning the training needs for each individual. Technicians should advise their Service Manager of their training needs including course names and course numbers. Dealers who have questions about Common Training should contact the Common Training help desk at 1-888-748-2686. The help desk is available Monday through Friday, 8:00 am-8:00pm Eastern Standard Time, excluding holidays. For GM Access support, contact the GM Access Help Desk at 1-888-337-1010.

Fleets

GM Fleet customers with GM Warranty In-Shop agreements are able to participate in service technical training through Common Training/GM Service Technical College (STC).

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Assistance for all GM fleet customers using GM STC products and services is provided on the Internet via www.gmtraining.com using the "Contact Us" button on the site and/or the Common Training Help Desk at 1-888-748-2687. To order GM STC Training Materials, please contact the GM Training Materials Headquarters at 1-800-393-4831.

Most GM STC course materials have associated charges.

To purchase authentic GM STC Training Materials, contact the GM Training Materials Headquarters at 1-800-393-4831.

Non-GM Dealer Technicians

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

ACDelco courses are available at all approved GM Training Centers. Availability and schedules can be obtained by calling 1-800-825-5886 or contact us via the web at www.acdelcotechconnect.com and select the training button. Clinics are also offered through ACDelco Warehouse Distributors. Contract your dealer directly for more information.

VEHICLE, ENGINE AND TRANSMISSION ID AND VIN LOCATION, DERIVATIVE AND USAGE

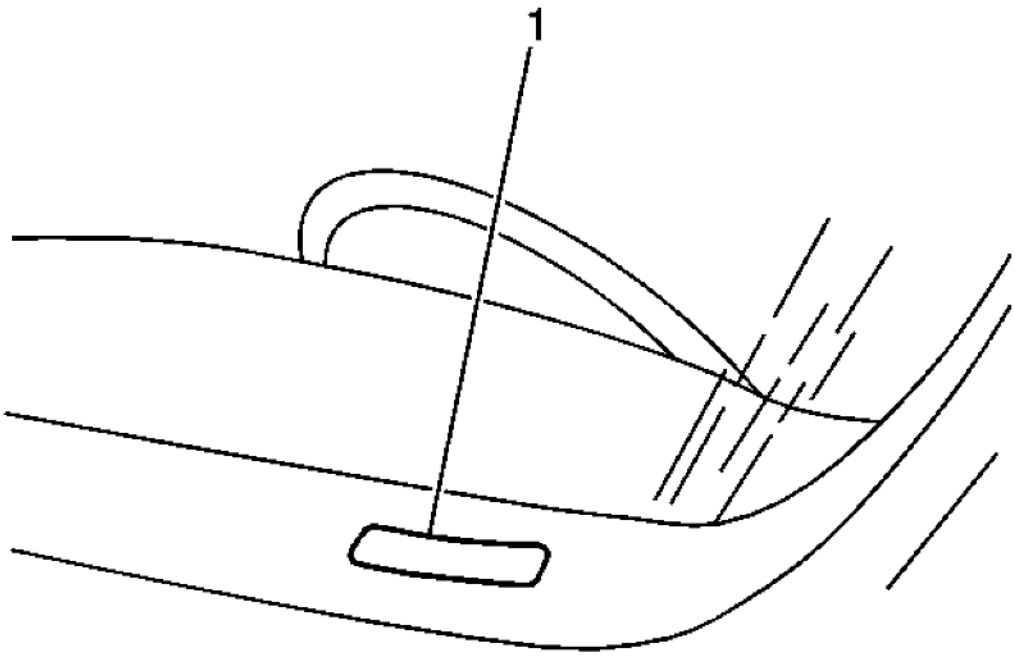


Fig. 2: View Of VIN Plate Location

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Courtesy of GENERAL MOTORS CORP.

Vehicle Identification Number (VIN) System

Position	Definition	Character	Description
The vehicle identification number (VIN) plate (1) is the legal identifier of the vehicle. The VIN plate is located on the upper left corner of the instrument panel (I/P) and can be seen through the windshield from the outside of the vehicle.			
1	Country of Origin	2	Canada
		6	Australia, Holden
2	Manufacturer	G	General Motors
3	Make	1	Chevrolet
4-5	Carline/Series	E/E	LS Coupe, Convertible, Chevrolet/GMX521/511
		E/F	1LT Coupe, Convertible, Chevrolet/GMX521/511, RS Pack
		E/G	2LT Coupe, Convertible, Chevrolet/GMX521/511, RS Pack
		E/H	3LT Convertible, Chevrolet/GMX511, RS Pack
		E/S	1SS Convertible, Chevrolet/GMX511, RS Pack
		E/T	2SS Convertible, Chevrolet/GMX511, RS Pack
		F/A	Camaro LS (Automatic)
		F/B	Camaro LT (Automatic)
		F/C	Camaro LT2 (Automatic)
		F/E	Camaro LS (Manual)
		F/F	Camaro LT (Manual)
		F/G	Camaro LT2 (Manual)
		F/J	Camaro SS (Automatic)
		F/K	Camaro 2SS (Automatic)
		F/S	Camaro SS (Manual)
		F/T	Camaro 2SS (Manual)
6	Body Style	1	Two Door Coupe
		3	Two Door Convertible
7	Restraint System	E	Active Manual Belts, Airbags - Driver and Passenger Front (1st row), Front Seat Side (1st row), Roof Side (All seating rows)
8	Engine Type	V	RPO LLT Engine - Gas, 6 Cylinder, 3.6L, SIDI, V6, Aluminum, 60 Degrees, GM
		W	RPO LS3 Engine - Gas, 8 Cylinder, 6.2L, SFI, Aluminum, HO, GM
		J	RPO L99 Engine - Gas, 8 Cylinder, 6.2L, SFI, Aluminum, GM

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9	Check Digit	-	Check Digit
10	Model Year	A	2010
11	Plant Location	9	Oshawa 1, Ontario, Canada
		X	Non Production/Non Saleable Build
12-17	Plant Sequence Number	-	Plant Sequence Number

VIN Derivative Characters

Position	Definition	Character	Description
All engines and transmissions are stamped with a partial vehicle identification number (VIN). This table identifies the different VIN derivative characters and their respective positions.			
1	Division	1	Chevrolet
2	Model Year	A	2010
3	Plant Location	9	Oshawa 1, Ontario, Canada
4-9	Plant Sequence Number	-	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 Positions

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

6L45/6L50/6L80/6L90 Transmission Transaxle ID and VIN Derivative Location

Refer to **Transmission Identification Information** .

3.6L RPO LTT Engine ID and VIN Derivative Location

Refer to **Engine Identification** .

6.2L RPO LS3/L99 Engine ID and VIN Derivative Location

Refer to **Engine Identification** .

VEHICLE CERTIFICATION, TIRE PLACARD, ANTI-THEFT, AND SERVICE PARTS ID LABEL

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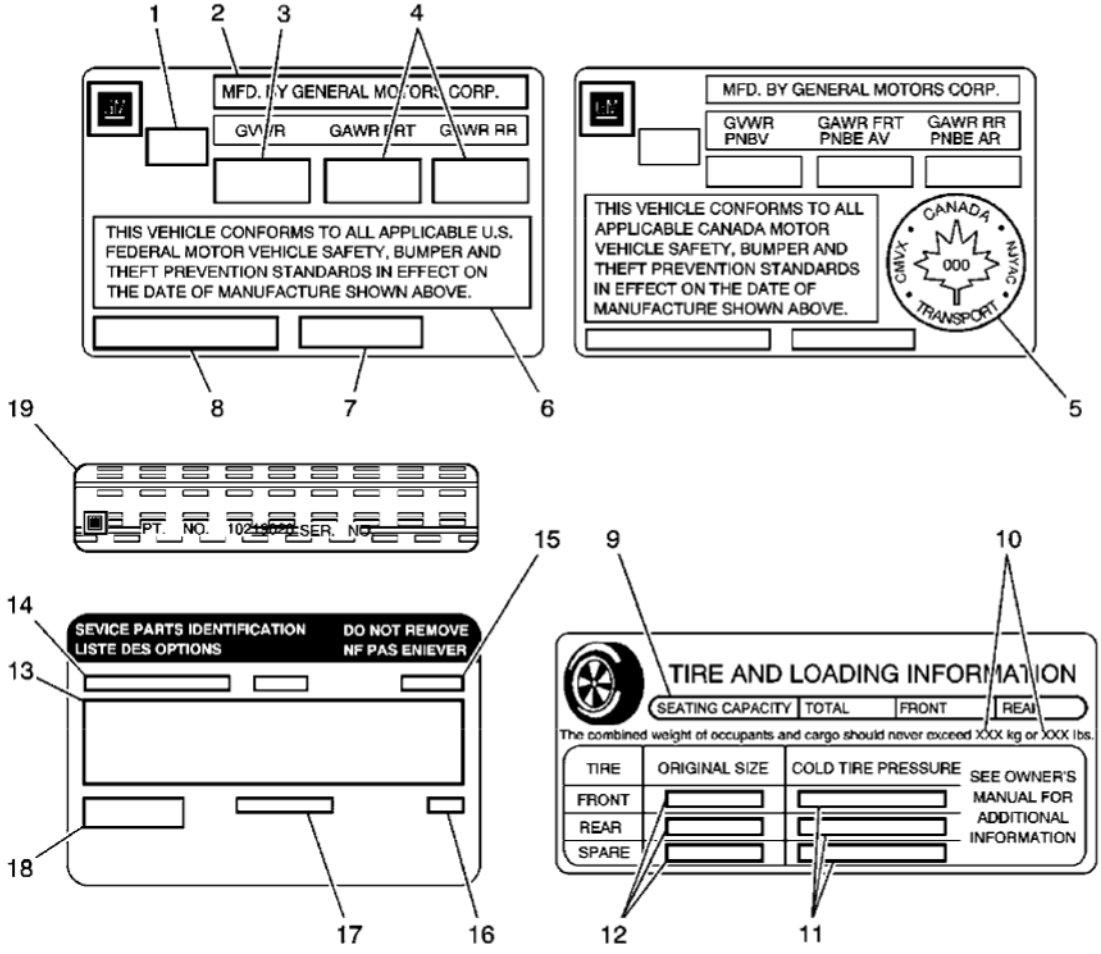


Fig. 3: Vehicle Certification, Tire Placard, Anti-Theft & Service Parts ID Labels
Courtesy of GENERAL MOTORS CORP.

Callout	Description
Vehicle Certification Label The vehicle certification label is located on the driver door and displays the following assessments: • Gross Vehicle Weight Rating (GVWR) • Gross Axle Weight Rating (GAWR), front and rear • The gross vehicle weight (GVW) is the weight of the vehicle and everything it carries. The GVW must not exceed the GVWR. Include the following items when figuring the GVW: ○ The base vehicle weight (factory weight) ○ The weight of all vehicle accessories ○ The weight of the driver and the passengers ○ The weight of the cargo	
1	Date of Manufacture (Mo/Yr)
2	Name of Manufacturer

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3	Gross Vehicle Weight Rating
4	Gross Axle Weight Rating (Front, Rear)
5	Canadian Safety Mark (w/RPO Z49)
6	Certification Statement
7	Vehicle Class Type (Pass Car, etc.)
8	Vehicle Identification Number
Tire Placard The tire placard label is located on the driver side B pillar and displays the following assessments:	
9	Specified Occupant Seating Positions
10	Maximum Vehicle Capacity Weight
11	Tire Pressure, Front, Rear, and Spare (Cold)
12	Original Equipment Tire Size
Service Parts ID Label The vehicle service parts identification label is located on the rear compartment floor. The label is use to help identify the vehicle original parts and options.	
13	Vehicle Option Content
14	Vehicle Identification Number
15	Engineering Model Number (Vehicle Division, Line and Body Style)
16	Interior Trim Level and Decor
17	Exterior (Paint Color) WA Number
18	Paint Technology
Anti-Theft Label	
19	The Federal law requires that General Motors label certain body parts on this 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. Labels are permanently affixed to an interior surface of the part. The label on the replacement part contains the letter R, the manufacturer's logo, and the DOT symbol. The anti-theft label must be covered before any painting, and rustproofing procedures, and uncovered after the procedures. Failure to follow the precautionary steps may result in liability for violation of the Federal Vehicle Theft Prevention Standard and possible suspicion to the owner that the part was stolen.

RPO CODE LIST

The following table provides the description of the RPO codes that are available on the vehicle. The vehicles RPO list is printed on the Service Parts Identification Label.

RPO	Description
01A	Trim Color Seat - Jet Black
01B	Trim Color Seat - Light Neutral
01S	Trim Color Seat - Medium Titanium
01T	Trim Color Seat - Bahia Orange
1AB	Trim Color Door Panel - Jet Black

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1AC	Trim Color Door Panel - Light Neutral
1AR	Trim Color Door Panel - Medium Titanium
1AS	Trim Color Door Panel - Graphite Silver/Ice Blue Piping
1AT	Trim Color Door Panel - Light Neutral Metallic/Ice Blue Piping
1AV	Trim Color Door Panel - Inferno Orange/Red Piping
1BV	Trim Color DR Panel Synergy Green/Ice Blue Piping
1LS	Package LS Option 1
1LT	Package LT Option 1
1SS	Package Option 17
2LT	Package LT Option 2
2SS	Package SS Option 2
3B6	Molding I/P Synergy Green/Ice Blue Piping
3BI	Molding I/P - Jet Black
3BJ	Molding I/P - Light Neutral
3BK	Molding I/P - Graphite Silver/Ice Blue Piping
3BO	Molding I/P - Light Neutral/Ice Blue Piping
3BP	Molding I/P - Inferno Orange/Red Piping
3BQ	Molding I/P - Medium Titanium
3CI	Molding I/P Inferno Orange, Polycarbonate
3CJ	Molding I/P Graphite Silver, Polycarbonate
3CK	Molding I/P LT Neutral, Polycarbonate
3LT	Package LT Option 3
4AA	Interior Trim - Jet Black
4AV	Interior Trim - Jet Black/Medium Titanium
4AW	Interior Trim - Jet Black/Light Neutral
4AX	Interior Trim - Jet Black/Inferno Orange
4B3	Interior Trim Jet Black/Synergy Green
4LT	Package LT Option 4
5LT	Package LT Option 5
5V5	Accessory Spoiler
6Y4	Tire and Wheel - Spare - Delete
AE4	Seat - Front Bucket, Sport
AEF	Window - Power Operated, Passenger, Express Up/Down
AG5	Adjuster Passenger Seat - Manual, 2 Way
AH3	Adjuster Front Seat - Manual, 4 Way, Driver
AL0	Sensor Indicator Inflatable Restraint, FRT PASS/CHILD Presence Detector
AMM	Adjuster Front Seat - Power, 6 Way, Driver
AP9	Net - Convenience
AT8	Restraint Provision - Child, Rear Seat, Rear Facing
ATG	Lock Control, Entry - Remote Entry, Standard Range
AX2	Key - Common, Vehicular Unique

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	Window - Power Operated-Express Driver Up/Down
AXJ	Vehicle Type - Passenger Car
AY0	Restraint System - Seat, Inflatable, Driver and Passenger Front, Seat Side, Roof Side
B2E	Sales - Spring Special Package
B34	Covering Front - Floor Mats, Carpeted Insert
B36	Covering - Floor Mat, Luggage Compartment
B3V	Test - Extended Water
B7W	Decal - Stripe, Cyber Gray
B7X	Decal - Stripe, Arctic White
BAG	Parts Package - Export
BD6	Molding Roof - Black
BD8	Molding Roof - Body Color
BSO	Identification Breaking
BTV	Control - Remote Engine Start
C2T	Decal Stripe, Orange
C2U	Decal Stripe, Silver
C3O	Decal Stripe, Black
C67	HVAC System - Air Conditioner Front, Electronic Controls
C93	Lamp INTR, Ambient
CF5	Roof - Sun, Glass, Sliding, Electric
CLS	Country - South America (Bolivia, Chile, Colombia, Ecuador, Peru, Uruguay, Venezuela)
CTH	Sales Camaro Transformers Special Edition
CU7	Country - Kuwait
CU8	Country - Saudi Arabia
CV3	Country - Mexico
CW2	Country - Gulf Areas (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, UAE)
CW4	Country - Caribbean (Antigua, Antilles, Bahamas, Barbados, Bermuda, Cay, Haiti, Dmincn, Jamaica, Nassau, S.M., Trinidad)
CZ1	Country - Central America (Beliz, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama)
D30	Color Override Approved Color & Trim Combinations (All Products)
D58	Spoiler RR - Delete
D75	Handle Outside Door - Body Color
D80	Spoiler - Rear End PNL
DAZ	Mirror Outside - Left and Right, Remote Control, Electric, Heated, Light Sensitive Left Side Only, ECE
DBW	Mirror Inside Rearview - Tilt, Vehicle Communication System CONT
DBX	Mirror Inside Rearview - Light Sensitive, Vehicle Communication System CONT
DCP	Processing - Directions and Connections Service Package

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DD1	Mirror Outside - Left and Right, Remote Control, Electric, Heated, Light Sensitive Left Side Only
DD8	Mirror Inside Rearview - Light Sensitive
DG7	Mirror Outside - Left and Right, Remote Control, Electric, Color
DNS	Equipment Supplier Installed
EAL	Trim Seat - Leather, Soleil Keisel, Mini Perf
EBQ	Trim Seat - Cloth, Sofia
EF7	Country - United States of America (USA)
EPP	Identification EPA MASS Certification
EXP	Export
FCP	Trim Door - Polypropylene
FCQ	Trim Door - Cloth, Sofia
FCR	Trim Door - Light Piped, Backpainted
FE2	Suspension System - Ride, Handling
FE3	Suspension System - Sport
FE9	Certification - Emission, Federal
G80	Axle Positraction Limited Slip
GAN	Primary Color - Exterior, Switchblade Silver Met (G)
GAP	Primary Color - Exterior, Imperial Blue Met (G)
GAQ	Primary Color - Exterior, Red Jewel Tintcoat (G)
GAZ	Primary Color - Exterior, Olympic White (G)
GBA	Primary Color - Exterior, Black (G)
GBD	Primary Color - Exterior, Aqua Blue Met (G)
GBV	Primary Color - Exterior, Cyber Gray Met (G)
GCN	Primary Color - Exterior, Victory Red
GCO	Primary Color - Exterior, SCO Yellow
GCR	Primary Color - Exterior, Inferno Orange Met
GHS	Primary Color - Exterior, Synergy Green Met
GM3	Axle Rear 3.45 Ratio
GW6	Axle Rear 3.27 Ratio
JL9	Brake System - Power, Front and Rear Disc, Antilock, Front and Rear Wheel
K05	Heater Engine - Block
KA1	Heater - Seat, Front
KAE	Knob Trans Shift,
KG4	Generator - 150 Amp
KI2	Knob - Transmission Control Lever, Polyurethane
KTB	Audio Interface - Wireless
L99	Engine - Gas, 8 Cylinder, 6.2L, SFI, Aluminum, GM
LHD	Vehicle Drive - Left Hand Drive
LLT	Engine - Gas, 6 Cylinder, 3.6L, SIDI, V6, Aluminum, 60 Degrees, GM
LS3	Engine - Gas, 8 Cylinder, 6.2L, SFI, Aluminum, HO, GM

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M10	Transmission - Manual 6 Speed, Tremec, 85mm, 3.01 1st, 0.84 5th, 0.57 6th, O/D
M97	Shifter Interlock - Brake, Trans
MN6	Merchandised Transmission - Manual 6 Speed Provisions
MTF	Provisions - Fire Extinguisher Mounting
MV5	Transmission - Manual 6 Speed, Aisin, 85mm, 4.475 1st, 0.752 6th, O/D
MX0	Merchandised Transmission - Auto Provisions, O/D
MYB	Transmission - Automatic 6 Speed, 6L50
MYC	Transmission - Automatic 6 Speed, HMD, 6L80
N10	Exhaust System - Dual
N34	Steering Wheel - Leather, 3 Spokes
N41	Steering - Power, Variable Ratio
N45	Steering Wheel - 3 Spokes
N65	Tire and Wheel - Spare, Space Saver, Steel
NB8	Emission Override California System
NB9	Emission Override Emissions Override, State-Specific
NC7	Emission Override Federal System
NE1	Certification - Emission, Geographically Restricted Registration for Vehicles Up to 14,000 lbs GVW
NT7	Emission System - Federal, Tier 2
NU2	Emission System - California, ULEV2
NU5	Emission System - Federal/California, Bin 4
NZK	Control - Steering Wheel, Cruise Control Switch
NZL	Control - Steering Wheel, Radio/Cruise Control, Redundant Controls
OSH	Plant Code - Oshawa 1, Ontario, Canada
P43	Inflater - Spare Tire - Delete
PZ3	Wheel - 18 x 7.5 Aluminum, Painted
PZ5	Wheel - 19 x 8, Aluminum, Painted
Q50	Wheel - 18 x 7.5, Steel
Q9B	Wheel - 19 x 8 Aluminium Bright
Q9J	Wheel - 20 x 8 Front and 20 x 9 Rear, Aluminum Polished
Q9K	Wheel - 20 x 8 Front and 20 x 9 Rear, Aluminum Painted
QAM	Tire All - P245/55R18-102T BW TL AL2
QOO	Tire All - P245/45R20 Front and 275/40R20 Rear
QZN	Tire All - P245/50R19-103W BW TL AL3
SBF	Restraint - Seat Belt, VAR 1
SF9	Accessory - Decal Package - Design 4
SGC	Processing Tire and Wheel Spare, Not Desired
SRJ	Model Conversion - Convenience and Connectivity Package
SRK	Model Conversion - Chevrolet 2LT
SRM	Model Conversion - Chevrolet 2SS

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SSG	Graphic - Switch Function Symbol
T3N	Lamp System - Daytime Running, Separate Cavity
T3U	Lamp - Front Fog
T3W	Lamp System - Daytime Running, Reduced Intensity Low Beam
T4A	Headlamps - Halogen
T4F	Headlamps - High Intensity Discharge
T83	Headlamps Control - Automatic On-Off
TB8	Headlamps Control - Right Rule of the Road
TCR	Handling Charge from Oshawa Plant, to Ground Effects LTD., Whitby ONT, Back to Oshawa Plant
TR7	Headlamps Control - Leveling System, Automatic, Static
U19	Speedometer - Instrument, Kilometers and Miles, Kilometer Odometer
U2J	Digital Audio System - S-Band, Not Installed
U2K	Digital Audio System - S-Band
U77	Antenna - Rear Window, Radio
UD4	Alarm - Vehicle Speed, 120 km/h
UD7	Sensor Indicator - Rear Parking Assist
UDC	Display Instrument - Driver Info Enhanced (One Color Graphic)
UE1	Communication System - Vehicle, GPS 1
UG1	Opener - Garage Door, Universal
UJ6	Tire Pressure Indicator - Low Tire Pressure
UL8	Frequencies - Saudi Arabian
UMN	Speedometer - Instrument, Miles and Kilometer, Miles Odometer
UMQ	Gauge - Auxiliary, Multifunction
UPF	Wireless Interface - Short Range, Voice REC
UQ3	Speaker System - Enhanced Audio
UQA	Speaker System - Premium Audio Branded with Amplifier
USR	Receptacle - USB
UTJ	Theft Deterrent - Electrical, Unauthorized Entry
UXQ	Gauge - Metric Package (Metric Read-Out Only)
UYE	Radio - AM/FM Stereo, CD-ROM, CAF, RSA, Music Navigator (GMNA Version)
UYI	Radio - AM/FM Stereo, CDX-ROM, CAF, RSA, Music Navigator (GME/ME/Taiwan Version)
V78	Vehicle Statement - Delete
V87	Vehicle Statement Gulf States Organization
V8C	Vehicle Statement Mexico
V8D	Vehicle Statement US
V8E	Vehicle Statement Canada
VAS	Accessory - Grille / Grille Inserts - Alternate Finish - Body Color
VBX	Language Label - Arabic
VC5	Label - Shipping, Except US, US Possessions, or Japan

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VJ2	Label, Export - Headlamp Adjust
VK3	License Plate Front - Front Mounting Package
VL2	Label, Spare - Caution, Compact Spare
VR5	Provisions Slow Vehicle Warning Triangle Mounting
VR6	Hook - Tie-Down Shipping
VRB	Accessory Cover - Vehicle, Outdoor, Red
VRU	Accessory Cover - Vehicle, Outdoor, Gray
VTD	Accessory Ground Effects Package
VVQ	Calibration - Daytime Running Lamps - Required
VVS	Calibration - Daytime Running Lamps - Not Required
VY7	Knob - Transmission Control Lever, Leather
VYO	Accessory Stripe Package, Rally Stripes - Orange
VYP	Accessory Stripe Package, Bonnet and Hockey Stripe - White
VYQ	Accessory Stripe Package, Bonnet and Hockey Stripe - Black
VYR	Accessory Stripe Package, Bonnet and Hockey Stripe - Gray
VYV	Accessory Shifter - Short Throw
VYW	Accessory Floor Mats - Premium Carpet
VYX	Accessory Engine Covers
VYY	Accessory Stripe Package, Rally Stripes - Cyber Gray
VYZ	Accessory Stripe Package, Rally Stripes - White
VZ3	Label - Mercury Disposal Notification
VZF	Accessory Stripe Package, Rally Stripes - Silver
VZG	Accessory Stripe Package, Rally Stripes - Black
VZN	Accessory Wheel, 21" Alloy, Polished
VZP	Accessory Wheel, 21" Alloy Painted
W1H	Sales Interior 'Accent' Trim Package
WRS	Merchandised Package - Rally Sport (RS)
WZI	Control - Steering Wheel
XL7	Frequencies Rating - 315 MHZ, Long Distance
XR5	Filter - Pollen
XW6	Paint Finish Metallic
YF5	Certification - Emission, California
YM8	Identification Limited Personalization Option (LPO)
Z49	Country - Canada
Z4Z	Merchandised Package - Indy Pace Car
Z5X	Mirror Provisions - Arabic Language

FASTENERS

Metric Fasteners

This vehicle provides fastener dimensions using the metric system. Most metric fasteners are approximate in

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diameter to equivalent English fasteners. Make replacements using fasteners 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 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.

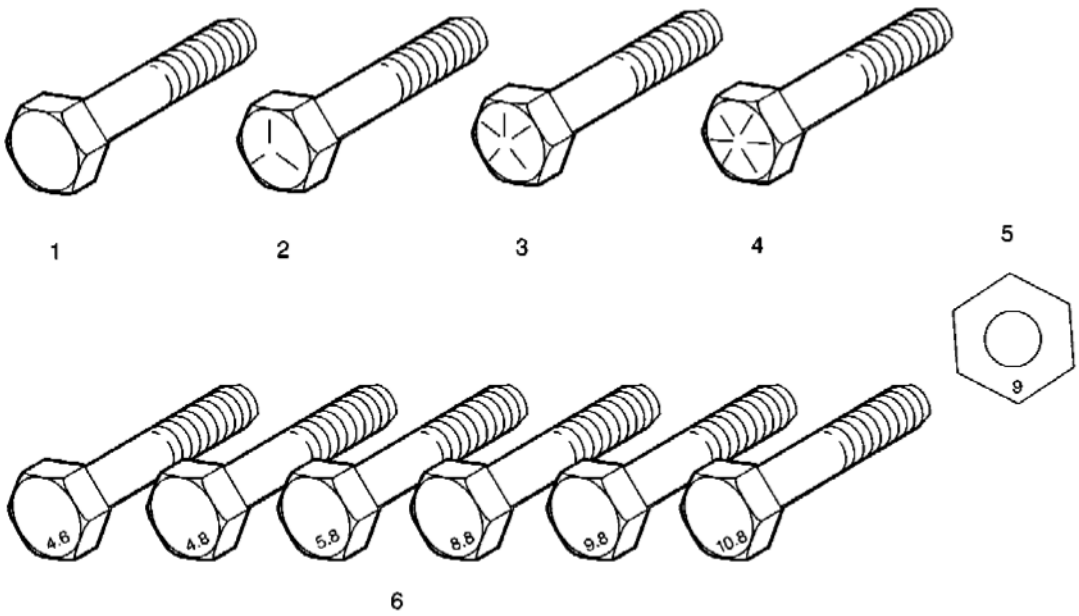


Fig. 4: Identifying Fastener Strength Marks
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
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

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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 in order to identify the strength class. The number of lines on the head of the bolt is 2 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 are designed to metric standards of countries other than the United States, and may exhibit the following:

- Lower 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 common sizes and pitches, except for special applications:

- M6.0 X 1
- M8 X 1.25
- M10 X 1.5
- M12 X 1.75
- M14 X 2.00
- M16 X 2.00

Prevailing Torque Fasteners

Prevailing torque fasteners create a thread interface between the fastener and the fastener counterpart in order to prevent the fastener from loosening.

All Metal Prevailing Torque Fasteners

These fasteners accomplish the thread interface by a designed distortion or deformation in the fastener.

Nylon Interface Prevailing Torque Fasteners

These fasteners accomplish the thread interface by the presence of a nylon material on the fastener threads.

Adhesive Coated Fasteners

These fasteners accomplish the thread interface by the presence of a thread-locking compound on the fastener threads. Refer to the appropriate repair procedure in order to determine if the fastener may be reused and the applicable thread-locking compound to apply to the fastener.

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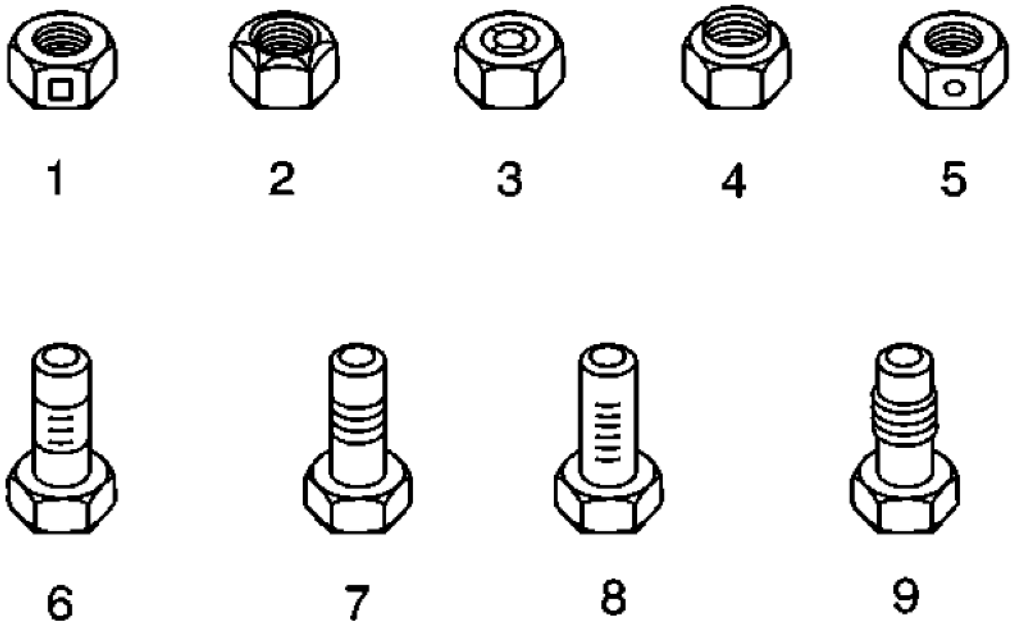


Fig. 5: Identifying Adhesive Coated Fasteners
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
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 fastener may be reused ONLY if:

- The fastener and the fastener counterpart are clean and not damaged
- There is no rust on the fastener
- The fastener develops the specified minimum torque against its counterpart prior to the fastener seating

Metric Prevailing Torque Fastener Minimum Torque Development

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Application	Specification	
	Metric	English
All Metal Prevailing Torque Fasteners		
• 6 mm	0.4 N.m	4 lb in
• 8 mm	0.8 N.m	7 lb in
• 10 mm	1.4 N.m	12 lb in
• 12 mm	2.1 N.m	19 lb in
• 14 mm	3 N.m	27 lb in
• 16 mm	4.2 N.m	37 lb in
• 20 mm	7 N.m	62 lb in
• 24 mm	10.5 N.m	93 lb in
Nylon Interface Prevailing Torque Fasteners		
• 6 mm	0.3 N.m	3 lb in
• 8 mm	0.6 N.m	5 lb in
• 10 mm	1.1 N.m	10 lb in
• 12 mm	1.5 N.m	13 lb in
• 14 mm	2.3 N.m	20 lb in
• 16 mm	3.4 N.m	30 lb in
• 20 mm	5.5 N.m	49 lb in
• 24 mm	8.5 N.m	75 lb in

English Prevailing Torque Fastener Minimum Torque Development

Application	Specification	
	Metric	English
All Metal Prevailing Torque Fasteners		
• 1/4 in	0.5 N.m	4.5 lb in
• 5/16 in	0.8 N.m	7.5 lb in
• 3/8 in	1.3 N.m	11.5 lb in
• 7/16 in	1.8 N.m	16 lb in
• 1/2 in	2.3 N.m	20 lb in
• 9/16 in	3.2 N.m	28 lb in
• 5/8 in	4 N.m	36 lb in
• 3/4 in	7 N.m	54 lb in
Nylon Interface Prevailing Torque Fasteners		
• 1/4 in	0.3 N.m	3 lb in

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• 5/16 in	0.6 N.m	5 lb in
• 3/8 in	1 N.m	9 lb in
• 7/16 in	1.3 N.m	12 lb in
• 1/2 in	1.8 N.m	16 lb in
• 9/16 in	2.5 N.m	22 lb in
• 5/8 in	3.4 N.m	30 lb in
• 3/4 in	5 N.m	45 lb in

THREAD INSERTS

General Purpose Thread Repair Kits.

These kits are available commercially.

Repair Procedure

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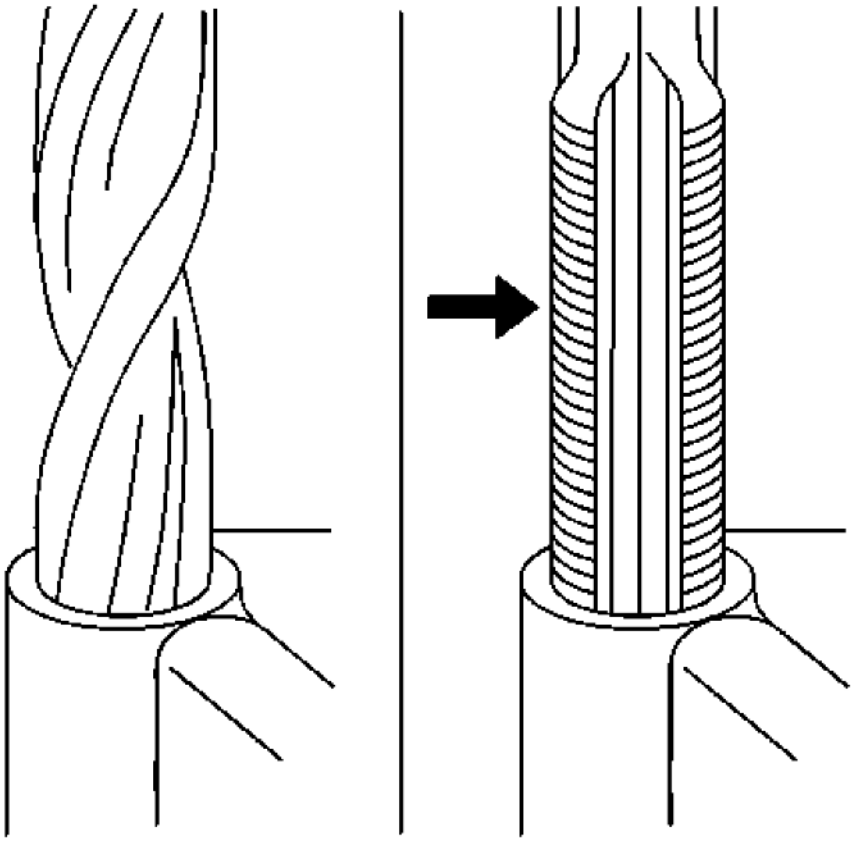


Fig. 6: Drilling & Tapping Damaged Threads
Courtesy of GENERAL MOTORS CORP.

WARNING: Refer to Safety Glasses Warning .

NOTE: 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.

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.

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3. Lubricate the tap with light engine oil. Tap the hole. Clean the threads.

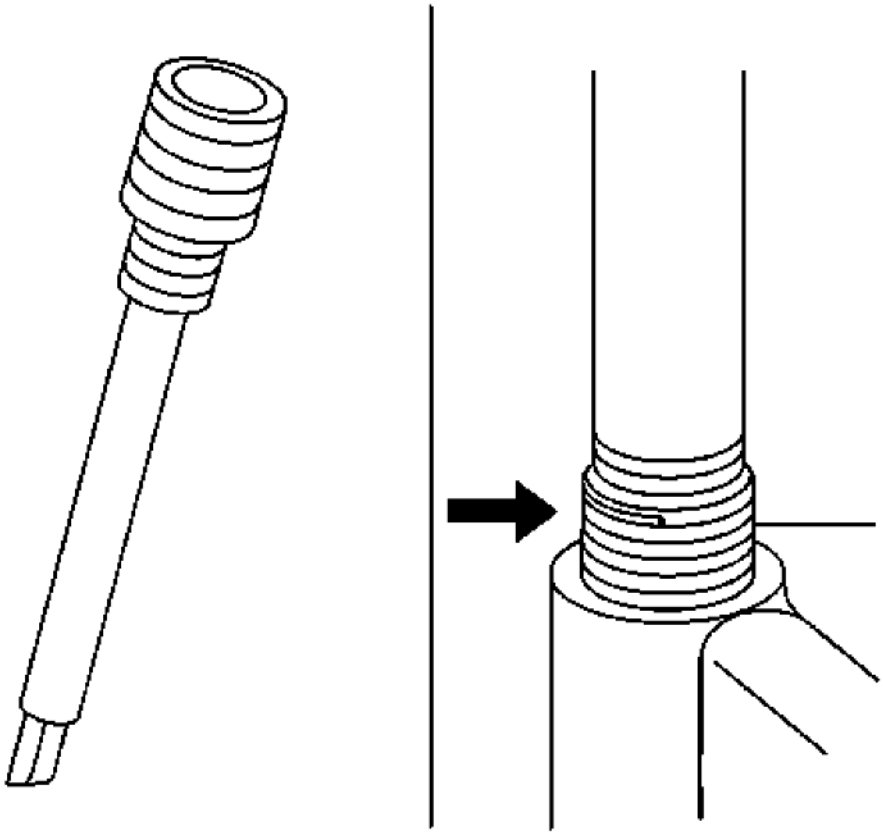


Fig. 7: View Of Thread Insert
Courtesy of GENERAL MOTORS CORP.

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

NOTE: 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

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Abbreviation	Meaning
A	
A	Ampere(s)
A/C	Air Conditioning
A/D	Analog to Digital
A/DFL	Air Deflector
A/F	Air/Fuel Ratio
A/T	Automatic Transmission/Transaxle
AAT	Ambient Air Temperature
ABS	Antilock Brake System, Absorber
Abv	Above
AC	Alternating Current
Acc	Access
ACC	Automatic Climate Control, Accumulator
Accel	Acceleration
Acclrm	Accelerometer
Acclrtm	Acceleration
Accum	Accumulator
Accy	Accessory
ACL	Air Cleaner
ACM	Air Conditioning Module
Acnt	Accent
Acsry	Accessory
Act	Actual
Actr	Actuator
ACTV	Activate
ACR4	Air Conditioning Refrigerant, Recovery, Recycling, Recharging
AD	Automatic Disconnect, Accommodated Device
Adap	Adapter
Adapt	Adaptive
Adapts	Adapters
Addt	Additive
ADG	Accommodated Device Gateway
Adhes	Adhesive
Adj	Adjust
Adjr	Adjuster
ADL	Automatic Door Lock
ADMIN	Administrative
Ads	Adsorber
ADS	Auxiliary Discriminating Sensor
Adv	Advanced

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	Alternative Fuel Engine Control Module
AFM	Active Fuel Management, Air Flow Meter
AFO	Alternative Fuel Operation
AFR	Air Fuel Ratio
Aft	After
AH	Active Handling
AHRS	Amp-Hours
AI	Air Inlet
AIR	Secondary Air Injection
Al	Aluminum
ALC	Automatic Level Control, Automatic Lamp Control
ALDL	Assembly Line Diagnostic Link
ALM	Automatic Level Module
ALS	All Seasons - A tire specification
Alt	Alternative, Altitude
AM/FM	Amplitude Modulation/Frequency Modulation
Amb	Ambient
Amm	Ammeter
Amp	Ampere, Amplifier
Ampf	Amplifier
Amps	Amperages
Amt	Armature
Anc	Anchor
Ant	Antenna
AP	Accelerator Pedal
APCM	Accessory Power Control Module
API	American Petroleum Institute
APLQ	Applique
APM	Accelerator Pedal Module, Accessory Power Module
APP	Accelerator Pedal Position
APPL	Application
Apr	April
APT	Adjustable Part Throttle
APU	Auxiliary Power Unit
APV	All Purpose Vehicle
ARS	Adaptive Receptive System
ASC	Anti-Slip Control
Asm	Assembly
ASM	Accelerator and Servo Control Module, Alarm Siren Module
ASR	Acceleration Slip Regulation
ASST	Assist

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	Automatic Transmission
ATA	Automatic Transmission Actuator
ATC	Automatic Transfer Case, Automatic Temperature Control, Automatic Traction Control, Axle Torque Capacity
ATCH	Attach
ATD	Allison Transmission Division
ATDC	After Top Dead Center
ATF	Automatic Transmission Fluid
ATS	Air Temperature Sensor
ATV	All Terrain Vehicle
ATSLC	Automatic Transmission Shift Lock Control
Aug	August
Auto	Automatic
Aux	Auxiliary
Avg	Average
A4WD	Automatic Four-Wheel Drive
AWD	All-Wheel Drive
AWG	American Wire Gauge
B	
B/C	BellCrank
B/JNT	Ball Joint
B/U	Back Up
B+	Battery Positive Voltage
BAI	Blower Air Inlet
BAL	Balance
BALR	Balancer
BARO	Barometric Pressure
BARR	Barrier
BAS	Belt Alternator System, Brake Apply Sensor
BATT	Battery
BBV	Brake Booster Vacuum
BCA	Bias Control Assembly
BCM	Body Control Module
BD	Board
BEC	Bus Electrical Center
BFC	Body Function Controller
BFL	Baffle
BHD	Bulkhead
BG	Beige
BHP	Brake Horsepower
BIW	Body In White

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BK	Black
BKG	Backing
BKL	Buckle
BKLT	Booklet
BKT	Bucket
BL	Bleed
BLK	Block, Black
BLO	Blower
Blts	Belts
BLU	Blue
BLW	Brake Lining Wear
Bn	Bank
BN	Brown
BOM	Bill Of Material
BP	Back Pressure
BPCM	Battery Pack Control Module
BPMV	Brake Pressure Modulator Valve
BPP	Brake Pedal Position
BPR	Bumper
BR	Brace
BRD	Braid
BRDR	Border
BRG	Bearing
BRK	Brake
BRKR	Breaker
BRKT	Bracket
BRN	Brown
BTCM	Brake Torque Control Module
BTDC	Before Top Dead Center
BTM	Battery Thermal Module
BTSI	Brake Transmission Shift Interlock
BTU	British Thermal Units
BU	Blue
C	
°C	Degrees Celsius
C/BAL	Counterbalance
C/CASE	Crankcase
C/LP	Courtesy Lamp
C/LTR	Cigarette Lighter
C/MBR	Crossmember
C/O	Carryover

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	Crossover
C/PLR	Center Pillar
C/SHF	Cross Shaft
C/VLV	Control Valve
CABT	Cabinet
CAC	Charge Air Cooler
CAFE	Corporate Average Fuel Economy
Cal	Calibration
Calc	Calculated
CALN	Calibration
CALR	Calibrator
Cam	Camshaft
CAN	Controller (Control) Area Network
CANC	Cancel
CAPAC	Capacitor
CARB	Carburetor, California Air Resources Board
CARR	Carrier
CASE	Crankshaft Angle Sense Error
Cass	Cassette
CAV	Cavity
CBL	Cable
CC	Coast Clutch, Climate Control
cm^3	Cubic Centimeters
CCM	Convenience Charge Module, Chassis Control Module, Central Control Module
CCOT	Cycling Clutch Orifice Tube
CCP	Climate Control Panel
CCW	Counter Clock-Wise
CD	Compact Disc
CD/PLYR	Compact Disc Player
CDX	Compact Disc Changer
CE	Commutator End
CEAB	Cold Engine Air Bleed
CEMF	Counter Electromotive Force
CEX	Cabin Heat Exchanger
CFM	Cubic Feet per Minute
CG	Center of Gravity
CHAN	Channel
CHAS	Chassis
CHEM	Chemical
CHK	Check

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CHMBR	Chamber
CHRG	Charge
CID	Cubic Inch Displacement
CIU	Charge Interface Unit
CKP	Crankshaft Position (Sensor)
Ckt	Circuit
C/LTR	Cigar Lighter
CL	Closed Loop, Clear, Clutch, Clamp
CLA	Clamp
CLER	Clearance
CLG	Cooling
CLK	Clock
CLNG	Cleaning
CLNR	Cleaner
CLPR	Caliper
CLR	Cooler, Color
CLSR	Closure
CLS	Coolant Level Switch
CLU	Clutch
CLV	Clevis
cm	Centimeter
CM/SHF	Camshaft
CMC	Compressor Motor Controller
Cmd	Command
Cmmd	Commanded
CMP	Camshaft Position, Component
CMPD	Compound
CMPR	Compressor
CMPRN	Compression
CMPTR	Computer
CNCT	Contact
CNDCT	Conductor
CNDSR	Condenser
CNG	Compressed Natural Gas
CNSL	Console
CNSTR	Canister
CNTNR	Container
CNTR	Counter
CO	Carbon Monoxide
CO2	Carbon Dioxide
COAX	Coaxial

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	Column
COLR	Collar
COMB	Combination
Combo	Combination
COML	Commercial
Comm	Communication
COMP	Compensator
Compl	Complete(d)
COMPT	Compartment
Cond	Condition
Config	Configuration
CONN	Connector
Const	Constant
CONT	Control
CONTAM	Contamination
CONV	Converter
COOL	Coolant
COR	Cornering
CORP	Corporation
COT	Cotter
CPA	Connector Position Assurance
CPLG	Coupling
CPLY	Capillary
CPN	Companion
CPP	Clutch Pedal Position
CPS	Childseat Positioning Sensor, Central Power Supply
CPSL	Capsule
CPT	Carpet
CPU	Central Processing Unit
CR	Cross, Cream
CR/SHF	Crankshaft
CRK	Crank
CRSN	Corrosion
CRT	Cathode Ray Tube
CRTC	Cathode Ray Tube Controller
CS	Charging System
CSFI	Central Sequential Fuel Injection
CSTG	Casting
CSTR	Cluster
CTD	Coated, Content Theft Deterrent
CTG	Coating

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	Catch
CTHR	Catcher
CTL	Central
CTLTC	Catalytic
CTN	Carton
CTP	Closed Throttle Position
CTR	Center
Ctrl	Control
CTSHF	Countershaft
Ctsy	Courtesy
CTUR	Contour
CUR	Current
CURT	Curtain
CUSH	Cushion
cu ft	Cubic Foot/Feet
cu in	Cubic Inch/Inches
CV	Constant Velocity
CVR	Cover
CVRSS	Continuously Variable Road Sensing Suspension
CVRTD	Continuously Variable Real Time Damping
CVT	Continuously Variable Transaxle, Continuously Variable Transmission
CWT	Counterweight
CYC	Cycle
Cyl	Cylinder(s)
D	
D	Drive, Dark
D/CVR	Dust Cover
D/EXH	Dual Exhaust
D/O	Double Offset
DA	Dash
DAB	Delayed Accessory Bus
dB	Decibels
dBA	Decibels on A-weighted Scale
dBm	Decibel Meter
DC	Direct Current, Duty Cycle
DCLR	Decelerate
DCM	Door Control Module
DDM	Driver Door Module
DDN	Deadener
DDS	Driver Door (smart) Switch
DE	Drive End

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	December
DEC	Digital Electronic Controller
Decel	Decelerate
Def	Defrost
DEFG	Defogger
Defog	Defogger
DEFR	Defroster
Deg	Degrees
Deg C	Degrees Celsius
DEHYDR	Dehydrator
Del	Delivered
DEL	Delete
DEPR	Depression
DERM	Diagnostic Energy Reserve Module
Des	Desired
DES	Data Encryption Standard
Desc	Description
DFCO	Deceleration Fuel Cut-Off
DFL	Deflector
DI	Distributor Ignition
Diag	Diagnostic
DIAG	Diagonal
DIAGN	Diaphragm
dia	Diameter
DIC	Driver Information Center
Diff	Differential
Dig	Digit
DIM	Dash Integration Module, Dimension
DIMR	Dimmer
DIR	Direct
Dis	Disable
DIS	Display
DISCH	Discharge
Discrim	Discriminate
DISCRM	Discriminating
Disp	Display
DISPL	Displacement
DISPR	Dispenser
DIST	Distance
DISTR	Distributor
DIV	Divider

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	Dark
DLC	Data Link Connector, Diamond Like Carbon, Diamond Like Coating
DLC (S/P)	Data Link Controller (Serial / Parallel)
DLVY	Delivery
DM	Dome
DMCM	Drive Motor Control Module
DMG	Damage
DMM	Digital Multi-meter
DMSDS	Drive Motor Speed and Direction Sensor
DMU	Drive Motor Unit
DN	Down
DNR	Dolby Noise Reduction
DNSHFT	Downshift
DOC	Document
DOHC	Dual Overhead Camshafts
Dol	Dolby
DPM	Driver Position Module
DPNR	Dampener
Dr	Door
DRL	Daytime Running Lights
DRN	Drain
DRP	Dynamic Rear Proportion
DRVN	Driven
Drvr	Driver
DSCC	Distance Sensing Cruise Control
DSCM	Drivers Seat Control Module
DSGN	Design
DSL	Diesel
DSM	Driver Seat Module
DSP	Digital Signal Process
DTC	Diagnostic Trouble Code
DTNT	Detent
DTRNT	Deterrent
DVD	Digital Versatile Disc
DVTR	Diverter
DWG	Drawing
Dwn	Down
E	
E&C	Entertainment & Comfort
E/GATE	End Gate
E/M	English/Metric

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	Each
EBC	Electronic Brake Control
EBCM	Electronic Brake Control Module
EBM	Electronic Brake Module
EBTCM	Electronic Brake and Traction Control Module
EC	Electrical Center, Engine Control
ECC	Electronic Climate Control
ECI	Extended Compressor at Idle
ECL	Engine Coolant Level
ECM	Engine Control Module, Electronic Control Module
Econ	Economy
ECS	Emission Control System
ECT	Engine Coolant Temperature
ECU	Electronic Control Unit
EEPROM	Electrically Erasable Programmable Read Only Memory
EEVIR	Evaporator Equalized Values in Receiver
EFE	Early Fuel Evaporation
EFI	Electronic Fuel Injection
EGR	Exhaust Gas Recirculation
EHA	Electo Hydrostatic Actuator
EHCU	Electric Hydraulic Control Unit
EGR TVV	Exhaust Gas Recirculation Thermal Vacuum Valve
EHPS	Electrohydraulic Power Steering
EI	Electronic Ignition
EJCTR	Ejector
EL	Elbow
ELAP	Elapsed
ELAS	Elastic
ELB	Emblem
ELC	Electronic Level Control
Elec	Electric
ELECT	Electrode
ELEK	Electronic
EMER	Emergency
EMF	Electromotive Force
EMI	Electromagnetic Interference
EMIS	Emission
EN	Evaporative Canister
ENG	Engine
ENGMT	Engagement
ENGY	Energy
ENGZR	

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	Energizer
ENV	Envelope
EOP	Engine Oil Pressure
EOS	Exhaust Oxygen Sensor
EOT	Engine Oil Temperature
EPA	Environmental Protection Agency
EPR	Exhaust Pressure Regulator
EPROM	Erasable Programmable Read Only Memory
EPS	Electric Power Steering
EQ	Equalizer
EQLZR	Equalizer
EQUIP	Equipped
ESB	Expansion Spring Brake
ESC	Electronic Suspension Control
ESCUT	Escutcheon
ESD	Electrostatic Discharge
ESM	Electronic Steering Module
ESN	Electronic Serial Number
ESO	Engine Shut Off
Est	Estimated
ETC	Electronic Throttle Control, Electronic Temperature Control, Electronic Timing Control
ETCC	Electronic Touch Climate Control
ETR	Electronically Tuned Receiver (Radio)
ETS	Enhanced Traction System, Enhanced Traction System
EV	Electric Vehicle
Evap	Evaporator
EVAP	Evaporative Emission
EVO	Electronic Variable Orifice
EVPR	Evaporator
EX	Exhaust
EXCH	Exchanger
EXH	Exhaust
EXPDG	Expanding
EXPN	Expansion
Ext	Extended
EXT	External
EXTN	Extension
EXTR	Exterior
EYLT	Eyelet
F	

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°F	Degrees Fahrenheit
F	Fahrenheit
F/AXL	Front Axle
F/CMPT	Front Compartment
F/D	Front of Dash
F/END	Front End
F/FDR	Front Fender
F/FLR	Front Floor
F/GA	Fuel Gauge
F/IDL	Fuel Idle
F/INJN	Fuel Injection
F/INJR	Fuel Injector
F/PMP	Fuel Pump
F/RST	Foot Rest
F/SEAT	Front Seat
F/TNK	Fuel Tank
F/TOP	Folding Top
F4WD	Full-time Four Wheel Drive
FAC	Facing
FACT	Factor
FC	Fan Control
Fdbk	Feedback
Feb	February
FDC	Fuel Data Center
FED	Federal All United States except California
FEDS	Fuel Enable Data Stream
FEIC	Fuel Economy Integrated Counter
FET	Field Effect Transistor
FEX	Front End heat exchanger
FF	Flexible Fuel
FFH	Fuel-Fired Heater
FFV	Flexible Fuel Vehicle
FI	Fuel Injection
FICM	Fuel Injector Control Module
FIL	Filler
FILA	Filament
Filt	Filter
FIN	Financial, Finish
FL	Front Left
FLDG	Folding
FLEX	Flexible

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	Flange
FLMBTY	Flammability
Flr	Floor
FLSHR	Flasher
FLTR	Filter
FLYWHL	Flywheel
FM	Frequency Modulation
FMVSS	Federal U.S. Motor Vehicle Safety Standards
FNA	Functional Name Address
FNM	Functional Name Modifier
FORG	Forging
FP	Fuel Pump
FR	Front Right
Freq	Frequency
FRICT	Friction
FRM	Frame
FRM/U	Frame Unit
Frnt	Front
FRP	Fuel Rail Pressure
FRT	Front
FSCM	Fuel System Control Module
ft	Foot/Feet
FT	Fuel Trim
FTG	Fitting
ft-lb	Foot-Pounds
FTP	Fuel Tank Pressure
FV	Front View
Fwd	Forward
F4WD	Full Time Four Wheel Drive
4WAL	Four Wheel Antilock
4WD	Four Wheel Drive
FW	Flat Wire
FWD	Front Wheel Drive, Forward
FWS	Front Wheel Spoiler
G	
g	Grams, Gravitational Acceleration
G/MLDG	Garnish Molding
G/NUT	Gearnut
GA	Gauge
GAL	Gallery
gal	Gallon

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	Garnish
gas	Gasoline
GCW	Gross Combination Weight
GD	Gold
GDE	Guide
Gen	Generator
GL	Gear Lubricant
GLZ	Glaze
GM	General Motors
GM SPO	General Motors Service Parts Operations
GN	Green
Gnd	Ground
GOV	Governor
GOVT	Government
GPDS	Global Product Description System
GPM	Gallons Per Minute
GPS	Global Positioning System
GR	Gear
GRL	Grille
GRN	Green
GROM	Grommet
GRP	Group
GRV	Groove
GRVD	Grooved
GRY	Gray
GS	Garage Shift, Gold Stripe
GTR	Gutter
GUSS	Gusset
GVAR	Gross Vehicle Axle Rating
GVDP	Global Vehicle Development Process
GVL	Gravel
GVW	Gross Vehicle Weight
GVWR	Gross Vehicle Weight Rating (at ground)
GY	Gray
H	
H	Hydrogen
H/C	High Compression
H/PLR	Hinge Pillar
H/PRF	High Performance
H/RST	Head Restraint
H/SHLD	Heat Shield

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	Hardware
H2O	Water
HARN	Harness
HC	Hydrocarbons
HCM	Heating Control Module, HVAC Control Module
HCP	Hybrid Control Processor
HD	Heavy Duty, Head
HDC	Heavy Duty Cooling
HDL	Handle
HDLNG	Headlining
HDLP	Headlamp
HDR	Header
HDV	Heavy Duty Vehicle
HDW	Hardware
HE	Hinge
HEV	Hybrid Electric Vehicle
hex	Hexagon, Hexadecimal
Hg	Mercury
Hi	High
Hi Alt	High Altitude
HID	High Intensity Discharge (headlamps)
Hist	History
HLDR	Holder
HNGR	Hanger
HO2S	Heated Oxygen Sensor
HOLDN	Hold Down
Horiz	Horizontal
HP	Horsepower
HPL	High Pressure Liquid
HPM	Hybrid Power Module
HPS	High Performance System
HPV	High Pressure Vapor
HPVS	Heat Pump Ventilation System
Hr	Hour
hrdw	Hardware
Hrs	Hours
HSG	Housing
HT	Heat
HTCM	HVAC Thermal Control Module
HTD	Heated
Htr	Heater

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	Head Up Display
HV	High Voltage, Hybrid Vehicle
HVAC	Heater Ventilation Air Conditioning
HVACM	Heater Vent Air Conditioning Module
HVIL	High Voltage Interlock Loop
HVM	Heater Vent Module
HVY	Heavy
HW	Heated Windshield
HWY	Highway
HYD	Hydraulic
Hz	Hertz
I	
I/M	Inspection & Maintenance
I/O	In/Out, Input/Output
I/P	Instrument Panel
I/PEC	Instrument Panel Electrical Center
I/S	Inside
IA	Intake Air
IAC	Idle Air Control
IAT	Intake Air Temperature
IC	Integrated Circuit, Ignition Control
ICCS	Integrated Chassis Control System
ICDX	Integrated Compact Disc Changer
ICM	Ignition Control Module
ICS	Integrated Chassis System
ID	Identification, Inside Diameter, Identifier
IDI	Integrated Direct Ignition
IEA	Impact Energy Absorber
IFF	Injection Fuel Filter
IGBT	Insulated Gate Bipolar Transistor
ign	Ignition
ILC	Idle Load Compensator
Illum	Illumination
IMDX	Integrated Mini Disc Changer
Immo	Immobilizer
IMP	Impact
IMRC	Intake Manifold Runner Control
IMT	Intake Manifold Tuning
In	Inch/Inches
Inadv	Inadvertent
Inc	Increment

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	Incandescent
INCLR	Intercooler
IND	Indictor
Infl	Inflatable
INFLR	Inflator
Info	Information
Init	Initial
Inj	Injector
INJN	Injection
INJR	Injector
INL	Inlet
INR	Inner
INS	Insert
INSL	Insulator
INSP	Inspection
inst	Instantaneous, Instant
INST	Instrument
INSTL	Install
INSTR	Instruction
Int	Interior
INT	Intake
IP	Instrument Panel
IPC	Instrument Panel Cluster
IPCM	Instrument Panel Cluster Module
IPG	Instrument Panel Glove box
IPL	Instrument Panel, Lower
IPM	Instrument Panel Module
IPR	Instrument Panel Retainer
IPU	Instrument Panel, Upper
IRVM	Inside Rear View Mirror
IRVSM	Inside Rear View Sensing Mirror
ISC	Idle Speed Control
ISCM	Idle Speed Control Motor
ISG	Idle Speed Governor
ISM	Input Switch Module
Iso	Isolation
ISO	International Standards Organization
ISP	Integrated Spark Plug, Internet Service Provider
ISS	Input Speed Shaft, Input Shaft Speed
ITCM	Integrated Transmission Control Module
IVED	Integrated Vehicle Electrical Design

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	Integration Vehicle Engineering Release
K	
K/UP	Kick Up
KAM	Keep Alive Memory
KDD	Keyboard Display Driver
Kg	Kilogram
Kg/h	Kilograms per Hour
KHz	Kilohertz
km	Kilometer
Km/h	Kilometers per Hour
Km/l	Kilometers per Liter
KNU	Knuckle
kPa	Kilopascals
KS	Knock Sensor
kV	Kilovolts
L	
L	Liter, Light, Low
L/GATE	Lift Gate
L/PLR	Lock Pillar
L/SLIP	Limited Slip
L4	Four Cylinder Engine, In-Line
L6	Six-Cylinder Engine, In-Line
LAB	Laboratory
LAM	Laminate
LAT	Latch
LATL	Lateral
lb	Pound
lb ft	Pound Feet Torque
lb in	Pound Inch Torque
LBL	Label
LBS. FT.	pounds foot
LBS. IN.	pounds inch
LCD	Liquid Crystal Display
LCG	Lacing
LCM	Lighting Control Module
LD	Light Duty
LDCL	Left Door Closed Locking
LDCM	Left Door Control Module
LDGV	Ledge
LDM	Lamp Driver Module
Lduty	Light Duty

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	Light Emitting Diode
LEV	Low Emissions Vehicle
LF	Left Front
LFTR	Lifter
LGM	Lift Gate Module
LGT	Light
LGTDNL	Longitudinal
LIC	License
LIMS	Limit
LIQ	Liquid
LK	Lock
LKG	Locking
LMD	Left Mid Door
LMTNG	Limiting
LNG	Lining
LNKG	Linkage
LNR	Liner
Lo	Low
LOC	Location
LOCR	Locator
LP	Lamp
LPG	Liquefied Petroleum Gas (Propane)
LPS	Low Pressure Sensor
LPTW	Low Tire Pressure Warning
lm	Lumens
LR	Left Rear
LRD	Left Rear Door
Lrn	Learn
Lt	Left
LT	Light Truck, Long Term, Lead Time
LTPI	Low Tire Pressure Indicator
LTPW	Low Tire Pressure Warning
LTPWS	Low Tire Pressure Warning System
LTR	Letter
LUB	Lubricant
LUGG	Luggage
LUV	Louver
Lvl	Level
LVL	Level
LVLG	Leveling
LVR	Lever

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	Long Wheel Base
LWR	Lower
M	
M/C	Mixture Control
M/CYL	Master Cylinder
M/FUNC	Multifunction
M/PORT	Multiport
M/T	Manual Transmission
M/TRNS	Manual Transmission
MAF	Mass Air Flow
MAFS	Mass Air Flow Sensor
MAG	Magnetic
MAINT	Maintenance
Malf	Malfunction
MALL	Multifunction Alarm Lighting and Locking
Man	Manual
MANIF	Manifold
Manufact	Manufactures
MAP	Manifold Absolute Pressure
MAPS	Manifold Absolute Pressure Sensor
Mar	March
MAS	Master
MAT	Manifold Absolute Temperature, Manifold Air Temperature
MATL	Material
MATLSPEC	Material Specification
Max	Maximum
MBOM	Manufacturing Bill Of Materials
MCHG	Machining
MCU	Microprocessor Control Unit
MD	Mini Disk
MDL	Module
MDP	Manifold Differential Pressure
MDX	Mini Disk Changer
Med	Medium
MEDLN	Medallion
Mem	Memory
MET	Metal
MFI	Multiport Fuel Injection
Mgmt	Management
mi	Miles
MIC	Microphone

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	Midrange
MIL	Malfunction Indicator Lamp, Military
min	Minimum
Min	Minute
MIN	Mobile Identification Number
MIR	Mirror
MIX	Mixture
MKR	Marker
mL	Milliliter
mm	Millimeter
mm3	cubic millimeter
mmhg	millimeters of Mercury
MMM	Memory Mirror Module
Mod	Module
MOD	Modulator
Mon, MON	Monitor
MOT	Motor
MPG	Miles per Gallon
MPH	Miles per Hour
ms	Millisecond
MSEC	Millisecond
Msg	Message
MSM	Memory Seat Module
MST	Manifold Surface Temperature
MSTRE	Moisture
MSVA	Magnetic Steering Variable Assist, Magnasteer®
MT	Manual Transmission/Transaxle, Mount
MTG	Mounting
Mtr	Motor
MTR	Meter
MTRG	Metering
MUFF	Muffler
Mult	Multiple
Mux	Multiplex(-ing, -or)
MV	Megavolt
mV	Millivolt
N	
N	Neutral
N/PLT	Name Plate
NA	Natural
NAES	North American Export Sales

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	Navigation
Nb	Niobium
NC	Normally Closed
NDH	Navigation Display Head
NDL	Needle
NEG	Negative
NEU	Neutral
Ni	Nickel
NI	Neutral Idle
Ni-CD	Nickel-Cadmium
Ni-Ion	Nickel-Ion battery
NiMH	Nickel Metal Hydride
NIP	Nipple
NLGI	National Lubricating Grease Institute
N.m	Newton-meter Torque
NO	Normally Open
no.	Number
NOCONTAM	No contamination
Nov	November
NOx	Oxides of Nitrogen
NOZ	Nozzle
NPTC	National Pipe Thread Coarse
NPTF	National Pipe Thread Fine
NR	Noise Reduction
NTC	Notice
NOVRAM	Non-Volatile Random Access Memory
NV	Night Vision
NVRAM	Non-Volatile (static) Random Access Memory
O	
O/M	Owner's Manual
O2	Oxygen
O2S	Oxygen Sensor
OAT	Outside Air Temperature
OBD	On-Board Diagnostics
OBD II	On-Board Diagnostics Second Generation
OBPA	Off Board Programming Adapter
OC	Oxidation Catalytic
OCC	Occupant
OCS	Opportunity Charge Station
Oct	October
OD	Outside Diameter

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	Output Drive Module
ODO	Odometer
OE	Original Equipment
OEM	Original Equipment Manufacturer
OG	Orange
OHC	Overhead Camshaft
ohms	Ohm
OL	Open Loop, Out of Limits
OM	Owners Manual
ONS	OnStar
ORC	Oxidation Reduction Catalytic
Orig	Original
ORN	Orange
ORVR	On-Board Refueling Vapor Recovery
OSC	Oxygen Storage Capacity
OSRVM	Out Side Rear View Mirror
OSS	Output Shaft Speed
Overtemp	Overtemperature
oz	Ounce(s)
P	
P	Park
P/B	Power Brake
P/BUT	Push-button
P/GR	Pinion gear
P/N	Part Number
P/S	Power steering
P/SEAT	Passenger seat
P/W	Power window
PA	Public address
PAG	Polyalkylene Glycol
PAIR	Pulsed Air Injection Reactor
PARK	Parking
Parms	Parameters
PASG	Passage
PASS, PSGR	Passenger
PASS-Key®	Personalized Automotive Security System
PATT	Pattern
PC	Pressure Control
PCB	Printed Circuit Board
PCM	Powertrain Control Module
PCMCIA	Personal Computer Memory Card International (or Industry)

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	Association
PCS	Pressure Control Solenoid
PCV	Positive Crankcase Ventilation
PDIF	Pressure Differential
PDM	Passenger Door Module
PDS	Passenger Door Switch
PEB	Power Electronics Bay
PED	Pedal
Perf	Performance
Phn	Phone
PID	Parameter Identification
PILO	Pillow
PIM	Power Inverter Module
PIN	Personal Identification Number
PIT	Pitman
PIV	Pivot
PK	Pink
PKG	Package
PKT	Pocket
PLGR	Plunger
PLL	Phase Locked Loop
PLNM	Plenum
PLNT	Planetary
PLR	Pillar
PLT	Plate
PLTF	Platform
PLYR	Player
PM	Permanent Magnet Generator
PMV	Pressure Modulator Valve
PN	Part Number
PNDLM	Pendulum
PNK	Pink
PNL	Panel
PNP	Park/Neutral Position
PNT	Pointer
POA	Pilot Operated Absolute Valve
POS	Positive, Position
POT	Potentiometer Variable Resistor
PPAH	Parallel Power Assist Hybrid
PPL	Purple
PPM	Parts per Million
PRS	

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	Passenger Presence Sensing
PREDLVY	Predelivery
PRES	Present
PRESS	Pressure
PRESS REG	Pressure Regulator
Preten	Pretensioner
Prev	Previous
PREV	Preventive
PRGM	Program
PRIM	Primary
PRNDL	Park, Reverse, Neutral, Drive, Low
PROC	Process
PROCD	Procedure
Prog	Program
PROGMR	Programmer
PROM	Programmable Read Only Memory
PROP	Propeller
PROPN	Proportion
PROTN	Protection
PROTR	Protector
PROTV	Protective
PS	Power Steering
PSA	Power Switch Assembly
PSC	Power Steering Controller
PSCM	Power Steering Control Module, Passenger Seat Control Module, Power Seat Control Module
PSD	Power Sliding Door
Psgr	Passenger
PSI	Pounds per Square Inch
psia	Pounds per Square Inch Absolute
PSIG	Pounds per Square Inch Gauge
PSIR	Passenger Supplemental Inflatable Restraint
PSIV	Passive
PSM	Passenger Seat Module
PSP	Power Steering Pressure
PSTN	Piston
pt	Pint
PTC	Positive Temperature Coefficient
PTCM	Powertrain Control Module
PTO	Power Take-Off
PU	Purple

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PUB	Pick Up Box
PUBX	Pickup box
PUL	Pulley
PULDN	Pull-down
PW	Power Windows
PWM	Pulse Width Modulated
PWR	Power
PWRT	Powertrain
PZM	Platform Zone Module
Q	
Q/PNL	Quarter Panel
Q/WDO	Quarter Window
QDM	Quad Driver Module
qt	Quart(s)
QTR	Quarter
R	
R	Reverse
R/AXL	Rear Axle
R/CMPT	Rear Compartment
R/CON	Remote Control
R/D	Rear Door
R/END	Rear End
R/FLR	Rear Floor
R/FDR	Rear Fender
R/GR	Rear Gear
R/MLDG	Reveal Molding
R/Q	Rear Quarter
R/RL	Roof Rail
R/SEAT	Rear Seat
R/TOP	Removable Top
R/WDO	Rear Window
R-12	Refrigerant-12
R-134a	Refrigerant-134a
RAC	Remote Accessory Control(ler)
RAD	Radiator
RAM	Random Access Memory, Non-permanent memory device, memory contents are lost when power is removed.
Ran	Random
RAP	Retained Accessory Power
RAV	Remote Activation Verification
RBND	Rebound

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RCC	Rear Climate Control
RCPT	Receptacle
RCVG	Receiving
RCVR	Receiver
RCVY	Recovery
RCDLR	Remote Control Door Lock Receiver
RD	Red
RDCM	Right Door Control Module
RDCN	Reduction
RDCR	Reducer
RDG	Reading
RDM	Rear Door Module
RDO	Radio
RDS	Radio Display System
Rec	Receive
Recep	Receptable
Recirc	Recirculation
Recl	Recline
RECL	Recliner
RECRG	Recirculating
Ref	Reference
REFL	Reflector
REFLTY	Reflectivity
Refrig	Refrigeration
REFRIG	Refrigerant
REG	Regulator or Regulated
Regen	Regeneration or Regenerate
REINF	Reinforcement
REL	Release
REM	Remote
REMAN	Remanufacture
REPL	Replace
Req	Requisition
REQ	Request
REQT	Requirement
RES	Resistor
Resist	Resistance
RESO	Resonator
RESV	Reserve
Resync	Resynchronize
RET	Retainer

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	Retractor
Rev	Reverse
REVBR	Reverberator
REVLDT	Revalidation
REX	Rear Exchanger
RIM	Rear Integration Module
RF	Right Front, Radio Frequency, Roof
RFA	Remote Function Actuation
RFI	Radio Frequency Interference
RFWS	Right Front Wheel Speed
RGTRN	Registration
RH	Right Hand
RIM	Radio Interface Module, Rear Integration Module
RIV	Rivet
RKE	Remote Keyless Entry
RKR	Rocker
RL	Rail
RLF	Relief
RLR	Roller
RLY	Relay
RMD	Right Mid Door
RND	Round
ROM	Read Only Memory, Permanent memory device, memory contents are retained when power is removed.
ROS	Roll Over Sensor
ROT	Rotor
RPA	Rear Parking Assist
RPM	Revolutions per Minute Engine Speed
RPO	Regular Production Option
RPR	Repair
RPRT	Report
RR	Right Rear, Rear
RRD	Rear Right Door
RSA	Rear Seat Audio
RSG	Radio Speaker Grill
RSR	Riser
RSS	Road Sensing Suspension
RST	Restraint
RSTN	Restriction
RSTR	Restrictor
RSVR	Reservoir

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RT	Right
RTC	Real Time Clock
RTD	Real Time Damping
RTN	Return
RTT	Reconfigurable Telltale
RTV	Room Temperature Vulcanizing Sealer
RU	Rust
RVC	Regulated Voltage Control (sometimes Controller)
RVHSM	Rear Vented Heated Seat Module
RVL	Reveal
RVS	Remote Vehicle Start
RWAL	Rear Wheel Antilock
RWD	Rear Wheel Drive
RWS	Rear Wheel Steering
S	
s	Second(s)
S/ABS	Shock absorber
S/D	Side door
S/GR	Steering Gear
S/KNU	Steering Knuckle
S/LP	Stop lamp
S/MBR	Side member
S/PNL	Side panel
S/RL	Side rail
S/S	Sunshade
S/STR	Sealing strip
S/W	Software
SAE	Society of Automotive Engineers
SAF	Safety
SAS	Steering Angle Sensor
SBM	Standard Body Module
SC	Supercharger, Sports Coupe
SCAV	Scavenging
SCB	Supercharger Bypass
SCE	Source
SCLCM	Steering Column Lock Control Module
SCM	Seat Control Module
SCRN	Screen
SCTR	Sector
SCV	Speed Controlled Volume
SDL	Serial Data Link

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	Sensing and Diagnostic Module
SDR	Sender
Sec	Second(s)
SECD	Secondary
SECT	Section
SEL	Selector
SEN	Sensor
SEO	Special Equipment Option
Sep	September
SEP	Separator
Seq	Sequence
SEQ	Sequential
Ser	Serial
SERV	Service
SF	Spot face
SFI	Sequential Multiport Fuel Injection
SGM	Shanghai General Motors
SH	Sheet
SHF	Shaft
SHFT	Shift
SHK	Shock
SHKL	Shackle
SHLD	Shield
SHLDR	Shoulder
SHLF	Shelf
SHPG	Shipping
SHRD	Shroud
SI	Side, Spark Ignition
SI	System International Modern Version of Metric System
SIAB	Side Impact Air Bag
SIG	Signal
SIL	Silencer
SIR	Supplemental Inflatable Restraint
SIS	Side Impact Sensor
SK	Skirt
SLA	Short/Long Arm Suspension
SLDG	Sliding
SLDR	Solder
SLEV	Sleeve
SM	Small
SMCC	Stepper Motor Cruise Control

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	Snubber
SND	Sound
SNFR	Snuffer
SO2	Sulfur Dioxide
SOC	Socket
SOH	State Of Health
SOL	Solenoid
SOLV	Solvent
SP	Splice Pack
S/P	Series/Parallel
SPA	Spare
SPCHG	Supercharger
SPCR	Spacer
SPD	Speed
SPDL	Spindle
SPEC	Specification
SPECD	Specified
SPEEDO	Speedometer
SPH	Splash
SPHER	Spherical
SPI	Serial Peripheral Interface
SPKR	Speaker
SPKT	Sprocket
SPLG	Spark plug
SPLP	Spot Lamp
SPLR	Spoiler
SPLTR	Splitter
SPLY	Supply
SPO	Service Parts Operations
SPR	Spring
SPS	Service Programming System, Speed Signal
SPWELD	Specified welds
sq ft, ft^2	Square Foot/Feet
sq in, in^2	Square Inch/Inches
SR	Silver
SRC	Service Ride Control
SRI	Service Reminder Indicator
SRS	Supplemental Restraint System
SRV	Servo
SS	Shift Solenoid, Speed Signal, Super Sport
SSE	Super Sport Edition

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SSR	Super Sports Roadster
SSS (S3)	Speed Sensitive Steering
SSV	Shift Solenoid Valve
ST	Scan Tool, Seat
STA	Stationary
STAB	Stabilizer
STAT	Stator
STCHG	Stitching
STD	Standard
Stdby	Standby
STFNR	Stiffener
STID	Station Identification Station ID
STKR	Striker
STL	Service Transmission Lamp
STNR	Strainer
STOR	Storage
STOW	Stowage
STPL	Staple
STR	Strip
STRG	Steering
STRGR	Stringer
STRP	Strap
STRPE	Stripe
STRTR	Starter
S4WD	Selectable Four-Wheel Drive
SUC	Suction
SUP	Supplement
SUPPR	Suppressor
SUPT	Support
SURF	Surface
SUSP	Suspension
SUV	Sport Utility Vehicle
SV	Side view
SVS	Service Vehicle Soon
Sw	Switch
SWB	Short Wheel Base
SWC	Steering Wheel Controls
Switz	Switzerland
SWIV	Swivel
SWPS	Steering Wheel Position Sensor
SYN	Synchronizer

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	Synchronize
SYS	System
T	
T&T	Tilt & telescope
T/BLK	Terminal block
T/CV	Torque converter
T/GA	Temperature gauge
T/LP	Tail lamp
T/PLYR	Tape player
T/PNL	Trim panel
T/SIG	Turn signal
T/V	Throttle valve
TA	Traffic Announcement
TAC	Throttle Actuator Control
TACH	Tachometer
TACM	Throttle Actuator Control Module
TAP	Transmission Adaptive Pressure, Throttle Adaptive Pressure, Tapping
TARP	Tarpaulin
TAS	Trap Alert System
TAV	Transmission Adaptive Volume
TBC	Truck Body Controller
TBI	Throttle Body Fuel Injection
TC	Turbocharger, Transmission Control
TCC	Torque Converter Clutch
TCCM	Transfer Case Control Module
TCM	Traction Control Module, Transmission Control Module
TCS	Traction Control System
TCSCM	Transfer Case Shift Control Module
TDC	Top Dead Center
TEL	Telephone
Tele	Telescope
TEMP	Temperature
TEMPL	Template
TENS	Tension
TENSR	Tensioner
TERM	Terminal
TFP	Transmission Fluid Pressure
TFT	Transmission Fluid Temperature
THD	Thread
THERM	Thermostat
THM	Turbo Hydra-Matic

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	Thinner
THR	Thrust
THROT	Throttle
TIM	Tire Inflation Monitoring, Tire Inflation Module
TIS	Techline Information System
TK	Tank
TL	Tubeless, Teal
TLA	Tail Lamp
TLSCP	Telescope
TMG	Timing
TMPRY	Temporary
TN	Tan
TOC	Transmission Oil Cooler
TOL	Tolerance
TORQ	Torque
TORS	Torsion
TP	Throttle Position
TPA	Terminal Positive Assurance
TPIM	Traction Power Inverter Module
TPM	Tire Pressure Monitoring, Tire Pressure Monitor
TQ	Torque, Turquoise
TR	Transmission Range, Trim
Trac	Traction
TRACT	Traction
TRANS	Transmission
Transp	Transponder
Transx	Transaxle
TRFER	Transfer
Trk	Truck
TRK	Track
TRLR	Trailer
TRUN	Trunnion
TSD	Time speed distance
TSS	Turbine Shaft Speed
TSTR	Tester
TT	Tell Tail lamp, Tube type
TTM	Tilt & Telescope Module
TUMB	Tumbler
TUN	Tunnel
TURB	Turbine
TURBO	Turbocharger

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	Throttle Valve
TVRS	Television and Radio Suppression
TVV	Thermal Vacuum Valve
TWC	Three Way Converter Catalytic
TWR	Tower
Twtr	Tweeter
TWC+OC	Three Way + Oxidation Converter Catalytic
TXV	Thermal Expansion Valve
U	
U/B	Underbody
U/HOOD	Underhood
U/SEAT	Underseat
U/V	Under vehicle
UART	Universal Asynchronous Receiver Transmitter
UBEC	Underhood Bussed Electrical Center
U/H	Underhood
U/HEC	Underhood Electrical Center
U-joint	Universal Joint
UJT	Universal joint
UND	Under
Unlk	Unlock
UPR	Upper
UPSHFT	Upshift
UTD	Universal Theft Deterrent
UV	Ultraviolet
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
VCIM	Vehicle Communication Interface Mode
VCM	Vehicle Control Module
V dif	Voltage Difference
VDOT	Variable Displacement Orifice Tube
VDV	Vacuum Delay Valve
vel	Velocity
VES	Variable Effort Steering
VF	Vacuum Fluorescent
VIO	Violet

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	Vehicle Identification Number
VLR	Voltage Loop Reserve
VMV	Vacuum Modulator Valve
VR	Voltage Regulator
V ref	Voltage Reference
VSES	Vehicle Stability Enhancement System
VSS	Vehicle Speed Sensor
VT	Violet
W	
w/	With
W/B	Wheel Base
WH	White
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)
YE	Yellow
YEL	Yellow

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Soft-Ray®
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Stabilitrak®
Sunrayce®
Superlube®
Syclone®
T
Tech 2®
Techline®
Teflon®
Tefzel®
Theft-I®
Theftlock®
Tiltmaster®
TORX®
Transjel®
Transguide®
Twilight Sentinel®
U
Ultralite®
V
Velcro®
W
Weatherpack™

DOOR LOCK AND IGNITION LOCK FOLDING AND NON-FOLDING KEY CUTTING

High Security keys are available from the service parts system.

Obtain the key code from the security card or from the GM Dealer World, Parts, Key Code Look Up system.

If you have the key code and access to a Triax-E., BD Laser or other code key cutting machine from the GM Dealer Equipment Catalog, you may cut a new key.

If you have the original key and access to a Matrix S, BD Laser or other key duplicating machine, you may duplicate the key.

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If you do not have a high security key cutting machine, order the side cut key from the service parts system. Include the key code in the NOTE field. Indicate the timing and the method of the shipment.

Inspect the new key operation in the lock cylinder. Ensure the new key operates effectively.

INSTRUMENT PANEL COMPARTMENT DOOR LOCK CYLINDER CODING

The internal lock cylinder only uses 4 of the 8 cut positions, 5-8. The tumbler positions are on both sides, are not self-retaining, and are not snap in.

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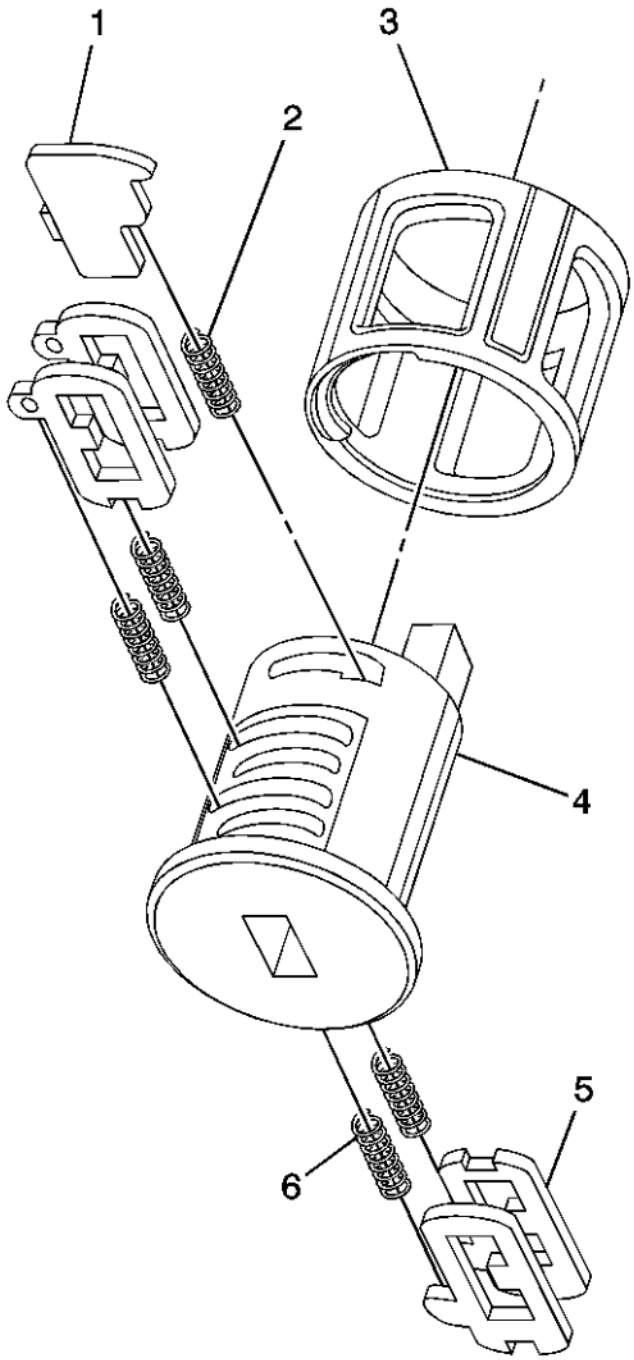


Fig. 8: Instrument Panel Compartment Door Lock Cylinder Components
Courtesy of GENERAL MOTORS CORP.

NOTE: **All lock cylinders for side milled keys have right and left tumblers. The**

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location of the tooth of the tumbler determines whether it is right of left. Illustrations in this procedure show the right tumblers on the top and the left tumblers on the bottom. All tumblers are marked 1R, 1L, 2R, or 2L. The number being cut depth and the letter meaning right or left.

1. Hold the instrument panel (I/P) cylinder assembly (4) so the side with the tumbler spring pocket located closest to the head of the cylinder is facing up. This side of the cylinder uses left tumbler.
2. Insert the tumbler spring (6) into each of the 2 spring pockets of the cylinder assembly. This side uses left tumblers.
3. The first tumbler (5) to be loaded (closest to the head of the cylinder) will be the fifth key cut position, which is the fifth number in the key code. Install the tumbler in the slot over the spring. Install the remaining tumblers following the key code and same process, pressing the tumblers in place until they are secure.
4. Rotate the cylinder assembly. Insert the tumbler spring (6) into each of the spring pockets of the cylinder assembly. This side uses right tumblers.
5. The first tumbler (5) to be loaded will be the sixth key cut position, the sixth number in the key code. Install the first tumbler in the slot over the spring. Install the remaining tumblers following the key code and same process, pressing the tumblers in place until they are secure.
6. Inspect for correct loading of the tumblers by inserting the key into the cylinder. All tumblers should drop flush with the lock cylinder body diameter.
7. Insert the sleeve (3) into the cylinder, the inner sleeve slot must be oriented to the head cylinder side. Rotate the sleeve until the slot match with the tab.
8. Insert the retainer spring (2) into the pocket and the tumbler retainer (1) over the spring. Make sure the tumbler retainer is properly seated and cannot pull out.
9. Lightly lubricate the outside surface in the tumbler area of the lock body and down the key slot using the provided grease. Insert and extract the key 5 times to lubricate the keyway.
10. When the key is removed, the lock should stay together.
11. Insert the key and function the lock 3 times to distribute the grease inside the sleeve.
12. Verify the key position for inserting the lock into the I/P compartment door.

FRONT SIDE DOOR LOCK CYLINDER CODING (FREE WHEELING)

Special Tools

BO-49753: Assembly Tool

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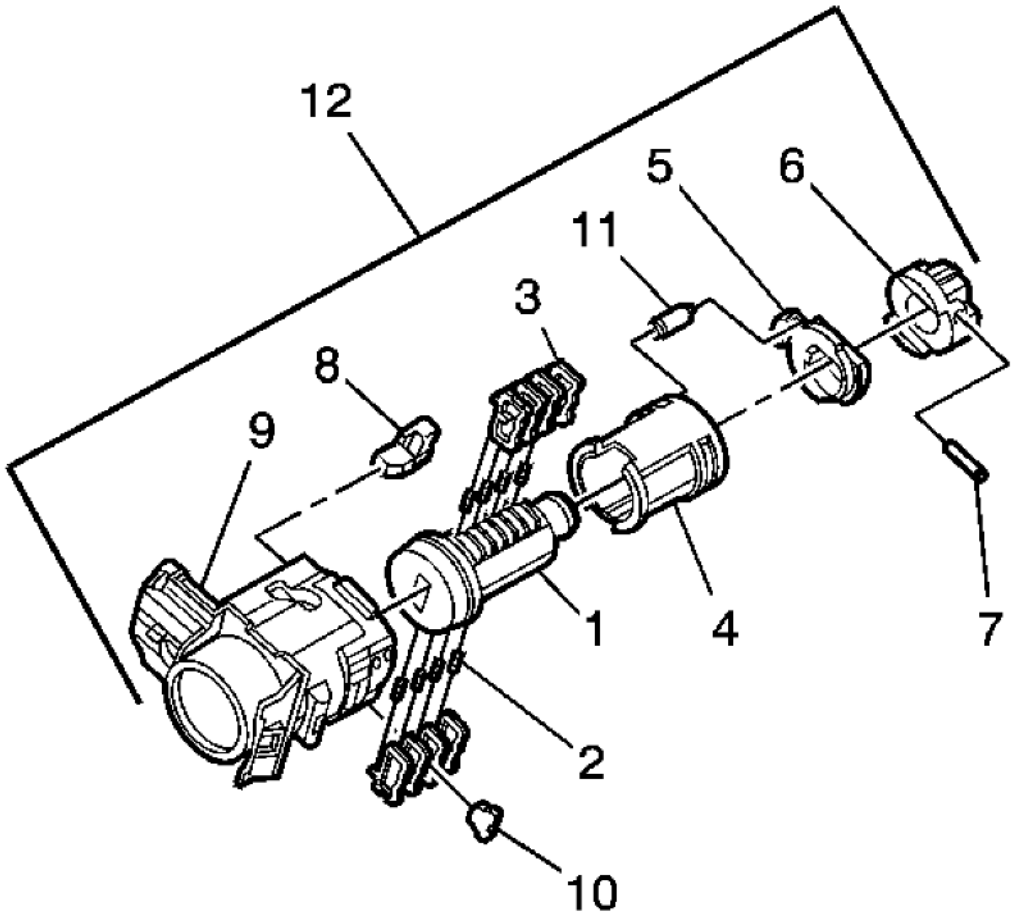


Fig. 9: Identifying Lock Components
Courtesy of GENERAL MOTORS CORP.

The door lock cylinder uses 8 of the 8 cut positions. The tumbler positions are staggered from side to side, 4 on one side and 4 on the other, are not self-retaining, and are not snap in.

NOTE: All lock cylinders for side milled keys have right and left tumblers. The location of the tooth of the tumbler determines whether it is right of left. Illustrations in this procedure show the right tumblers on the top and the left tumblers on the bottom. All tumblers are marked 1R, 1L, 2R, or 2L. The number being cut depth and the letter meaning right or left.

1. Hold the door lock cylinder (1) so the side with the 4 tumbler spring pockets faces up, pocket nearest to the cylinder head.
2. Insert the tumbler springs (2) into the 4 spring pockets. This side uses left tumblers.

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3. Install the tumbler (3) for key cut position one in the slot nearest to the front of the lock cylinder. Install the remaining tumblers, key cut positions 3, 5, and 7, following the key code and same process. Press the tumblers in place until they are secure.
4. Check the correct loading of the tumblers by inserting the key into the cylinder. All tumblers should be flush with the lock cylinder body.
5. Turn the cylinder so the side with the 4 tumbler spring wells faces up. This side uses right tumblers.
6. Insert the tumbler springs into the 4 spring pockets.
7. The first tumbler closest to the front of the lock cylinder to be loaded will be the second key cut position, the second number in the key code. Install the remaining tumblers for the key cut positions 4, 6, and 8. Press the tumblers in place until they are secure.
8. Check the correct loading of the tumblers by inserting the key into the cylinder. All tumblers should be flush with the lock cylinder body.
9. Insert the key and lightly lubricate the cylinder body diameter and tumbler surfaces and a small amount in the head of the cylinder using the supplied grease.
10. Insert the sleeve (4) onto the cylinder assembly.
11. Insert the clutch (5) and driver (6) onto the cylinder (1).

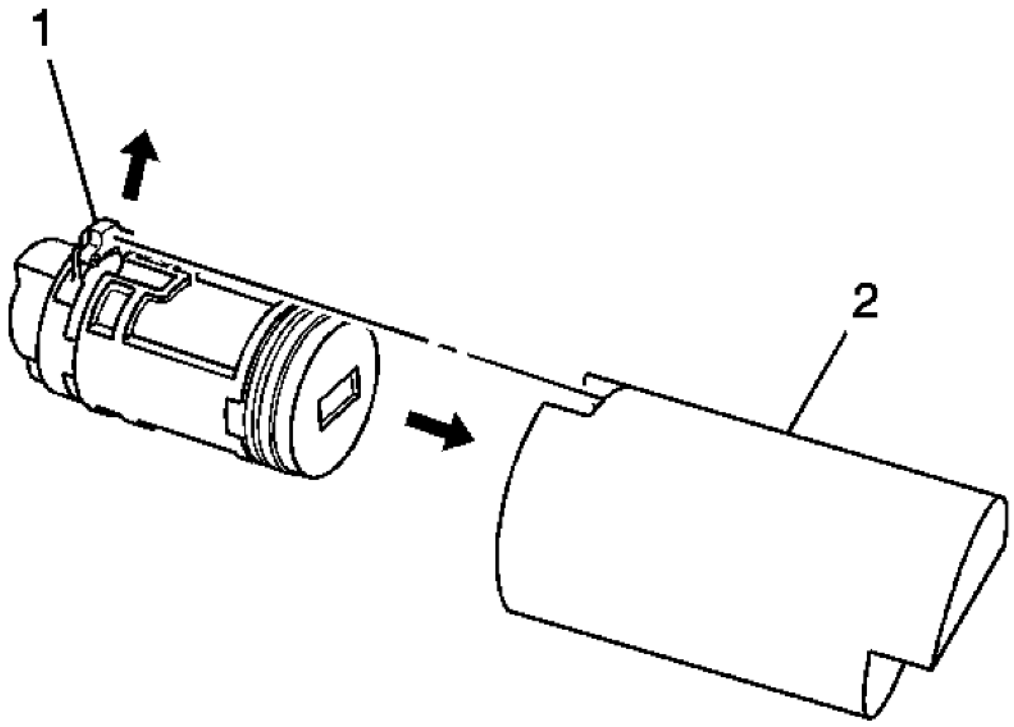


Fig. 10: Loading Cylinder Into Special Tool

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Courtesy of GENERAL MOTORS CORP.

12. Load the cylinder into the **BO-49753:** assembly tool so that the clutch (1) indexes with the notch in the opening of the tool (2).

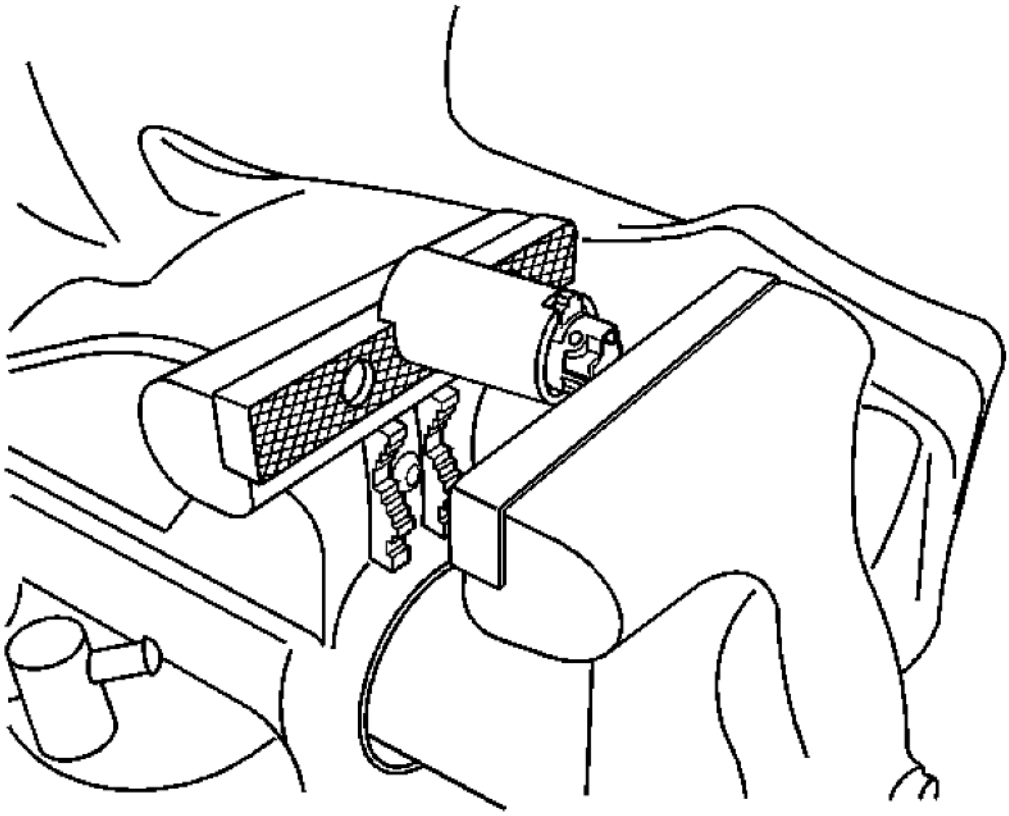


Fig. 11: Loading Assembly Tool Into Vice
Courtesy of GENERAL MOTORS CORP.

13. Load the assembly tool with the lock cylinder into a vice and tighten the vice ONLY enough to hold the tool and lock the cylinder in place.

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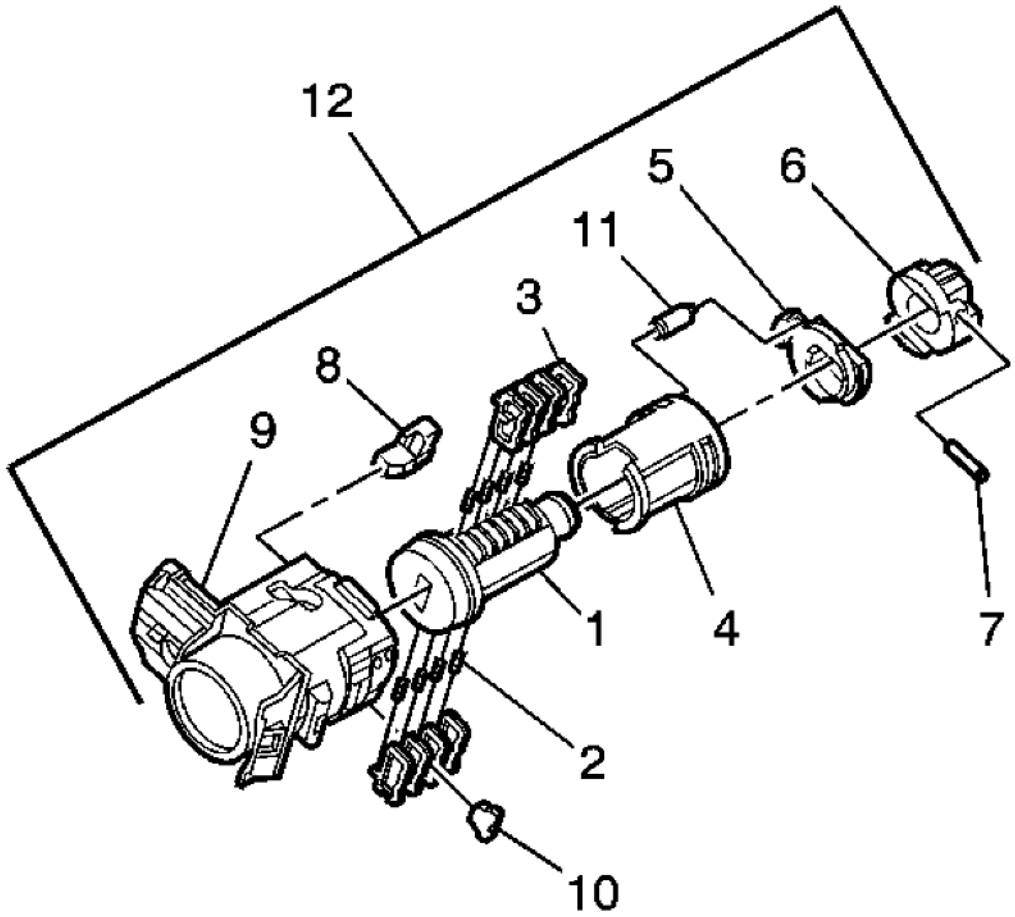


Fig. 12: Identifying Lock Components
Courtesy of GENERAL MOTORS CORP.

14. Insert the roll pin (7) into the driver (6) and install it using a 1/16 inch pin punch.
15. Insert the buffer (8) in the case (9), verify the buffer is properly seated.
16. Install the free wheel pin (11) in the sleeve (4) and clutch (5) and insert the assembly into the case (9).
17. With the lock cylinder assembly installed in the case (9), install the retainer (10) and stake the retainer in place using a small punch and hammer to peen the case material onto the exposed ends of the installed retainer (10).
18. Insert the key into the lock and function the lock to check for proper assembly and smooth operation.

LOCK CYLINDER CODING - IGNITION

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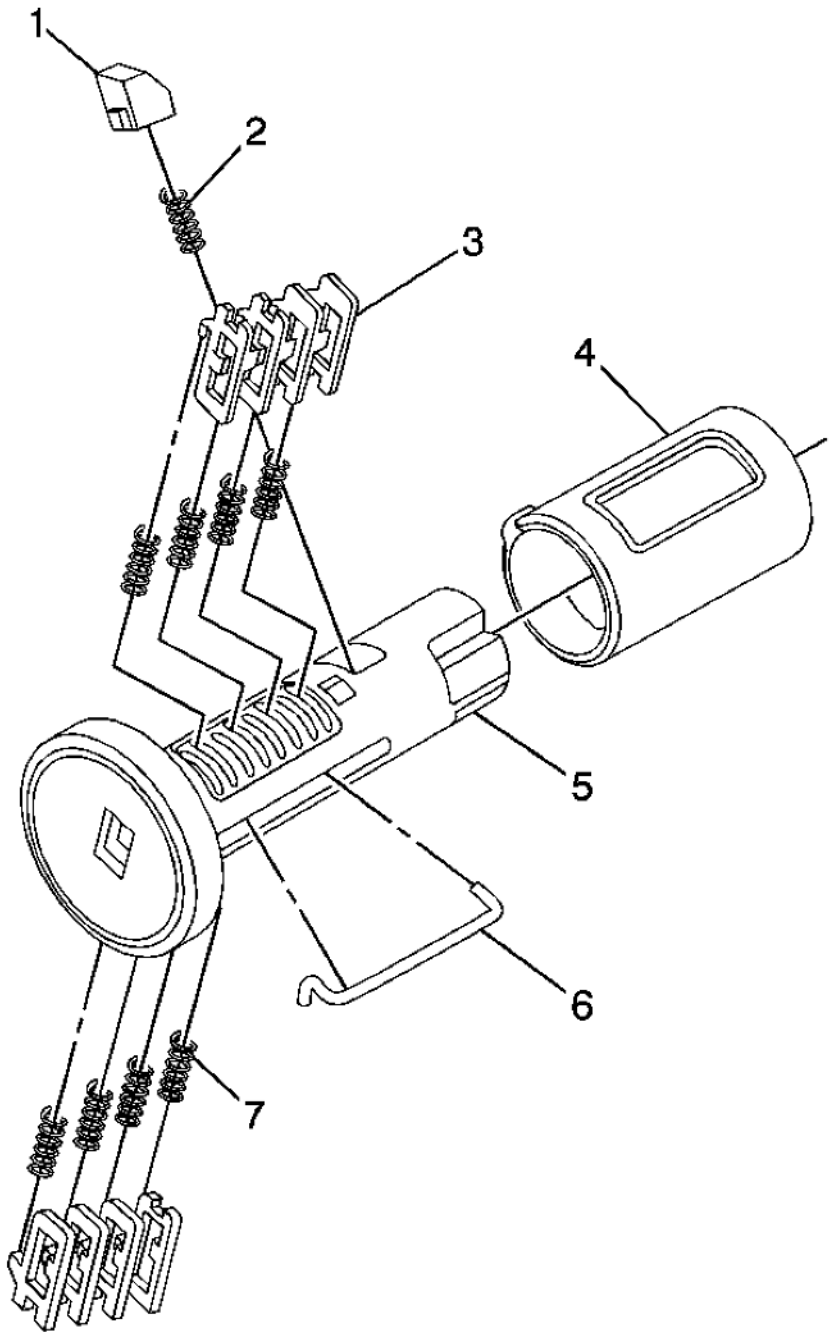


Fig. 13: Ignition Lock Cylinder Components
Courtesy of GENERAL MOTORS CORP.

The ignition lock cylinder uses 8 key cut positions, 1-8. The ignition cylinder tumblers (3) are located on alternate sides of the cylinder (5). They are not snap-in and are not self-retaining. It follows the key code with

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the first tumbler being the first depth of the key code, closest to the head of the key.

NOTE: All lock cylinders for side milled keys have right and left tumblers. The location of the tooth of the tumbler determines whether it is right of left. Illustrations in this procedure show the right tumblers on the top and the left tumblers on the bottom. All tumblers are marked 1R, 1L, 2R, or 2L. The number being cut depth and the letter meaning right or left.

1. Hold the ignition cylinder assembly (5) so the side with the tumbler spring pocket located closest to the head of the cylinder is facing up.
2. Insert the tumbler spring (7) into each of the 4 spring pockets of the cylinder assembly. This side of the cylinder used left tumblers.
3. The first tumbler (3) to be loaded will be the first key cut position, which is the first number in the key code. Install the tumbler in the slot over the spring. Install the remaining right tumblers following the key code and same process, pressing the tumblers in place until they are secure.
4. Rotate the cylinder assembly. Insert the tumbler spring into each of the spring pockets of the cylinder assembly. This side of the cylinder used right tumblers.
5. The first tumbler (3) to be loaded will be the second key cut position, the second number in the key code. Install the first tumbler in the slot over the spring. Install the remaining left tumblers following the key code and same process, pressing the tumblers in place until they are secure.
6. Inspect for correct loading of the tumblers by inserting the key into the cylinder. All tumblers should drop flush with the lock cylinder body diameter.
7. With the key in the cylinder assembly insert the round connector (6), insert the retainer spring (2) in the retainer slot located in the cylinder assembly. Insert the retainer (1) lining it up in the slot over the spring. Depress the retainer and hold.
8. Insert the cylinder into the sleeve (4) as shown in the print. Make sure the actuator stays located properly in the cylinder.
9. When the key is removed, the lock should stay together.
10. Lightly lubricate the outside surface in the tumbler area of in the lock body and down the key slot using the provided grease. Insert and extract the key 5 times to lubricate the keyway.
11. Insert the key and function the lock 3 times to distribute the grease inside the sleeve.
12. Verify the key position for inserting the lock into the column.

REAR COMPARTMENT LID LOCK CYLINDER CODING

The door lock cylinder uses 8 of the 8 cut positions, 1-8. The tumbler positions are staggered from side to side, 4 on one side and 4 on the other, are not self-retaining, and are not snap in.

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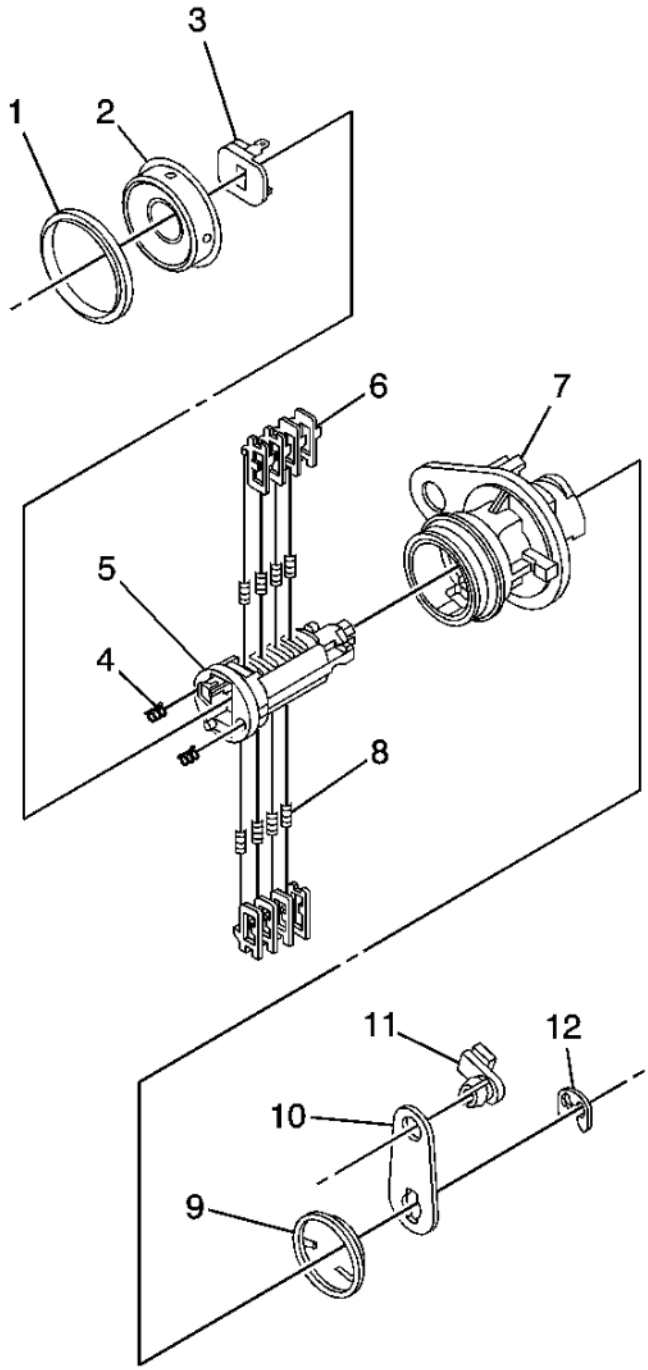


Fig. 14: Rear Compartment Lid Lock Cylinder Components
Courtesy of GENERAL MOTORS CORP.

NOTE: **All lock cylinders for side milled keys have right and left tumblers. The**

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location of the tooth of the tumbler determines whether it is right of left. Illustrations in this procedure show the right tumblers on the top and the left tumblers on the bottom. All tumblers are marked 1R, 1L, 2R, or 2L. The number being cut depth and the letter meaning right or left.

1. Hold the cylinder (5) so the side with the 4 tumbler spring pockets nearest the cylinder head faces up. This side uses left tumblers.
2. Insert the tumbler springs (8) into the 4 spring pockets.
3. Install the tumbler (6) for key cut position one in the slot nearest to the front of the lock cylinder. Install the remaining tumblers, key cut positions 3, 5, and 7, following the key code and same process. Press the tumblers in place until they are secure.
4. Check the correct loading of the tumblers by inserting the key into the cylinder. All tumblers should be flush with the lock cylinder body.
5. Turn the cylinder so the opposite side spring pockets faces up. This side uses the right tumbler.
6. Insert the tumbler springs into the 4 spring pockets.
7. The first tumbler closest to the front of the lock cylinder to be loaded will be the second key cut position, the second number in the key code. Install the remaining tumblers for the key cut positions 4, 6, and 8. Press the tumblers in place until they are secure.
8. Check the correct loading of the tumblers by inserting the key into the cylinder. All tumblers should be flush with the lock cylinder body.
9. Insert the key and lightly lubricate the cylinder body diameter and tumbler surfaces and a small amount in the head of the cylinder using the supplied grease.
10. Install 2 springs (4) into the 2 spring pockets in the head of the lock cylinder.
11. Holding the tumblers snap the shutter assembly (3) onto the cylinder.
12. Insert the cylinder into the case assembly (7) and install the cap (2) and the gasket double (1) around the cap.
13. Add the torsion spring (9).
14. Insert the rod clip (11) in the lever (10) and place it in the cylinder assembly.
15. Insert the E-clip (12) to securely hold the lever to the cylinder.
16. Insert the key into the lock and rotate it to check for proper assembly and smooth operation.

LIFTING AND JACKING THE VEHICLE

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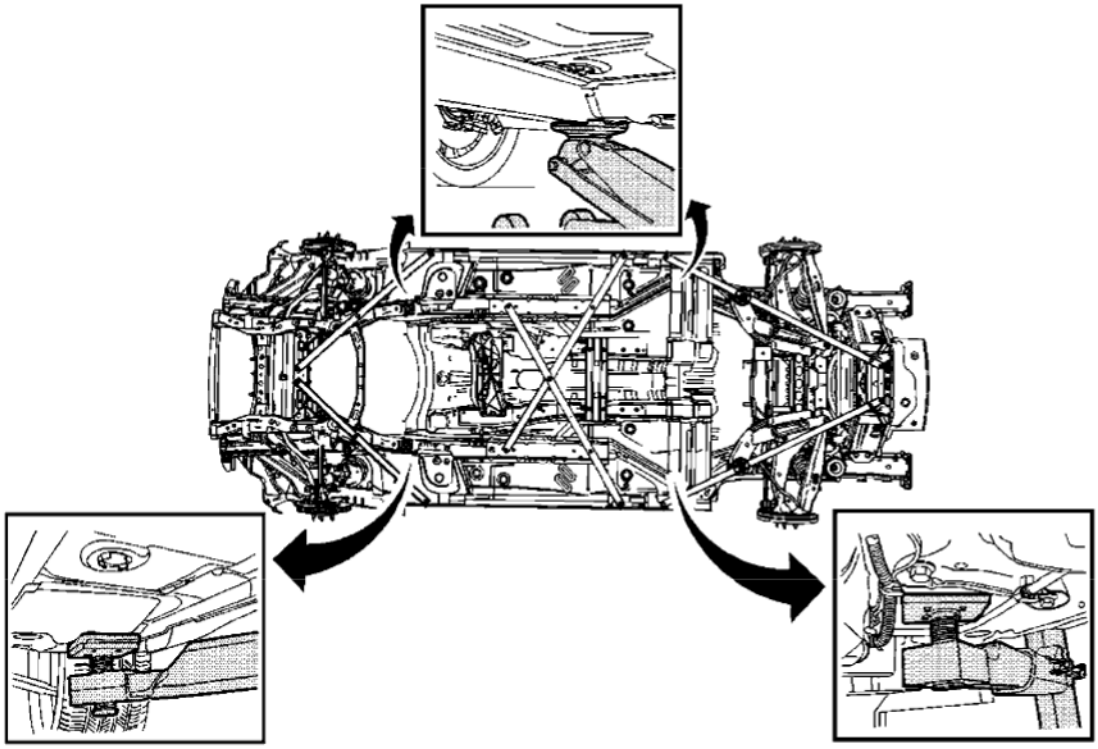


Fig. 15: Lifting & Jacking Points
Courtesy of GENERAL MOTORS CORP.

WARNING: 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 and strap the vehicle to the hoist.

WARNING: To avoid any vehicle damage, serious personal injury or death, always use the jackstands to support the vehicle when lifting the vehicle with a jack.

CAUTION: Perform the following steps before beginning any vehicle lifting or jacking procedure:

- **Remove or secure all of the vehicle contents in order to avoid any shifting or any movement that may occur during the vehicle lifting or jacking procedure.**
- **The lifting equipment or the jacking equipment weight rating must meet or exceed the weight of the vehicle and any vehicle contents.**
- **The lifting equipment or the jacking equipment must meet the operational standards of the lifting equipment or jacking equipment**

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manufacturer.

- **Perform the vehicle lifting or jacking procedure on a clean, hard, dry, level surface.**
- **Perform the vehicle lifting or jacking procedure only at the identified lift points. DO NOT allow the lifting equipment or jacking equipment to contact any other vehicle components.**

Failure to perform the previous steps could result in damage to the lifting equipment or the jacking equipment, the vehicle, and/or the vehicle contents.

Vehicle Lifting - Frame Contact Lift

Front Lift Pads

When lifting the vehicle with a frame-contact lift, place the front lift pads on the front lower brackets, inboard of the rocker pinch weld flange and outboard of the front frame rail, at the torque box location, as shown.

Rear Lift Pads

When lifting the vehicle with a frame-contact lift, place the rear lift pads on the rear frame rail, at the torque box location, as shown.

Vehicle Jacking

CAUTION: When you are jacking the vehicle at the front locations, be certain that the jack or the jack lift pad does not contact the front fascia, front fascia air dam, or the front fenders. If such contact occurs, vehicle damage may result. When jacking at selected front locations additional clearance may be required for the jacking points.

NOTE: When you are lifting a vehicle with a service jack, block the wheels at the opposite end from which you are lifting. Use jack stands to provide additional support.

Front of Vehicle

When using a service jack under the front of the vehicle use one of the following locations:

- Place the service jack pad in the same location as shown for the front lift pads.
- Under the front frame crossmember, as shown.

Rear of Vehicle

NOTE: Place jackstands ONLY under strong and stable vehicle structures.

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When using a service jack under the rear of the vehicle place the jack pad on the rocker panel flange, at the torque box location, as shown.

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TRACTION CONTROL, 4WD, & AWD

Chevrolet - 1980-11

* PLEASE READ THIS FIRST *

Placing a non-compatible vehicle on a single-axle dynamometer could result in a safety hazard to technicians and damage to vehicle. Vehicles which use All-Wheel Drive (AWD) or traction control may not be clearly marked. Use common sense and take all necessary precautions when placing any vehicle on the dynamometer. Determine between full-time 4WD and All-Wheel Drive (AWD) for testing purposes. The following tables include information related to full-time 4WD and AWD vehicles, and how to disable the traction control system (if disengageable).

WARNING: DO NOT operate vehicle on a 2-wheel dynamometer if the DO NOT TEST column is marked.

CHEVROLET - CARS

Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test
Camaro							
1994-02	...	X	...	...	...	X (1)	...
2010-11	...	X	...	...	...	X (9)	...
Caprice							
2011	...	X	...	...	...	X (7)	...
Cavalier							
1995-00	X	...	...	...	...	X (2)	...
2001-05	X	...	...	...	...	X (3)	...
Cobalt							
2007-10	X	...	...	...	...	X (4)	...
Corvette							
1992-97	...	X	...	...	...	X (5)	...
1998-04	...	X	...	...	...	X (10)	...
2005-11	...	X	...	...	...	X (10) (11)	...
Cruze							
2011	X	...	...	...	...	X (8)	...
Impala							
2000-11	X	...	...	...	...	X (6)	...
Malibu							
2004-07 (& 2008	X	...	...	...	...	X (7)	...

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Classic)							
2008-11	X	...	...	...	...	X (12)	...
Monte Carlo							
2000-07	X	...	...	...	...	X (8)	...
Volt							
2011	X	...	...	...	...	X (13)	X

(1) Press ASR button, located on console. ASR OFF indicator light will illuminate when system is disabled.

(2) ETS system will not operate when A/T selector is in 1 or 2 position. ETS indicator light will stay on when system is disabled.

(3) Traction control is disabled when transaxle is in 1st or 2nd gear only. TRAC OFF indicator light will illuminate when system is disabled.

(4) To turn the ETS off, shift to L (Low) or R (Reverse). The ETS indicator/warning light will come on and stay on and the TRACTION OFF message will be displayed when the gear shift is in L (Low).

(5) Press sliding car icon on the console. The TCS indicator will illuminate when system is disabled.

(6) Press TRAC OFF button on left side of dash. Chime will sound. SERVICE TRACTION SYSTEM indicator light will illuminate when system is disabled.

(7) Press TC button near A/C-heater controls or in front of the shift lever. Indicator light will illuminate when system is disabled.

(8) Press TRAC ON/OFF button on instrument panel or center console. TRACTION CONTROL indicator light will illuminate when system is disabled.

(9) Press and hold the TCS/StabiliTrak button until the Traction Control Off light and the StabiliTrak Off light come on in the instrument panel cluster. The TCS/StabiliTrak button is located in front of the shift lever.

(10) The TCS Switch allows the driver to shut off the TCS and Active Handling (RPO JL4 - if equipped), by pressing and releasing the switch. If the vehicle is equipped with Active Handling, the TCS switch can be pressed and held for 5 seconds; this places the system in Competitive driving mode. Competitive driving mode turns the TCS off but still allows Active Handling to be active. The switch is located in the center console.

(11) If the Tire Pressure Monitor (TPM) system detects a flat tire and the Driver Information Center (DIC) displays TIRE FLAT, or if the TPM system is malfunctioning and the DIC displays SERVICE TIRE MONITOR, the Active Handling System cannot be turned off by the driver. If the Active Handling System is off, it will be turned back on automatically.

(12) The ESC/TCS button is located on the instrument panel. Press the ESC/TCS button to disable both traction control and ESC. TRACTION OFF and ESC OFF messages will appear, and the ESC/TCS light will be on solid.

(13) Manufacturer does not provide a method to disable Traction Control.

CHEVROLET - TRUCKS

Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test

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Astro							
1990-05 (AWD)	...	...	...	...	(1)	...	...
Avalanche							
2002	...	X	...	...	...	X (2)	...
2003-11	...	...	X (4)	...	...	X (3)	...
Blazer (2002-05 Jimmy Canadian)							
1980-94	...	X	X (4)	...	...	...	...
1995-05 (4WD)	...	X	X (4)	...	...	...	...
1995-98 (AWD)	...	...	...	...	X (1)	...	...
Colorado							
2004-11	...	X	X (4)	...	...	X (3)	...
Chevy Express/Cutaway/RV							
2004-10	...	X	...	...	...	X (9)	...
2011	...	X	...	...	...	X (10)	...
2003-11 (AWD)	...	...	...	...	X	...	X
Equinox							
2005-11 (AWD)	...	...	...	...	X	...	X
2005-11 (FWD)	X	...	...	...	...	X (9)	...
HHR							
2008-10	X	...	...	...	...	X (7)	...
K10-30 & K1500-3500 Series							
1980-00	...	X	X (4)	...	...	...	...
LUV							
1980-82	...	X	X (4)	...	...	...	...
Silverado (All Configurations)							
1999-11	...	X	X (4)	...	...	X (7)	...
2003-05 (AWD)	...	...	...	...	X	...	X
SSR							
2003-06	...	X	...	...	...	X (5)	...
Suburban							
1980-99	...	X	X (4)	...	...	...	...
2000-11	...	X	X (4)	...	...	X (3)	...
Tahoe							

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1995-99	...	X	X (4)	...	...	...	...
2000-11	...	X	X (4)	...	...	X (3)	...
Tracker							
1998-04	...	X	X (4)	...	...	...	...
TrailBlazer							
2002-09	...	X	X (4)	...	...	X (8)	...
2006-09 (AWD)	...	...	...	...	X	...	X
Traverse							
2009-10 (AWD)	...	...	...	...	X	...	X
2009-11	X	...	...	...	...	X (8)	X
T10 & T15 Pickup							
1982-01	...	X	X (4)	...	...	...	...
Uplander & Montana SV6							
2006-08 (AWD)	...	...	...	...	X	...	X
Venture							
1997-05	X	...	...	...	...	X (8)	...
2002-05 (AWD)	...	...	...	...	X	...	X

(1) All wheel drive is optional.

(2) Press switch with sliding car icon, located left of steering wheel on instrument panel. TRACTION OFF will illuminate when system is disabled.

(3) Traction Assist (TAS) or Traction Control (TCS) can be turned off by pressing TAS or TCS button on instrument panel. TCS light on instrument panel will illuminate.

(4) 4WD With Shift Lever Selector - Shift transfer case to 2WD or 2H mode. 4WD With A/T or M/T Push Button Shift Selector - Press button on instrument panel to select 2HI position. Switch indicator light will flash until new position is active. Indicator light will stay on.

(5) Information from manufacturer is not available.

(6) Press TRACTION ASSIST switch located on dashboard, left of steering wheel. TRACTION OFF indicator light will illuminate when system is disabled.

(7) Press the StabiliTrak/TCS button (sliding car icon), located near shift lever or below climate controls. TRAC OFF indicator light will illuminate when system is disabled.

(8) Press traction control switch located on instrument panel or center console. When the TCS is turned off, the StabiliTrak light goes on, and an appropriate traction control off message will be displayed on the DIC.

(9) Press the StabiliTrak button (located on the instrument panel) for more than five seconds to turn off StabiliTrak and TCS. The StabiliTrak light comes on the instrument panel cluster when the system is turned off.

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(10) Press the StabiliTrak button (located on the instrument panel) once to turn off the Traction Control System (TCS). Press and hold the StabiliTrak button for more than five seconds to turn off StabiliTrak and TCS. The StabiliTrak light comes on the instrument panel cluster when the system is turned off.

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2010 GENERAL INFORMATION

Vehicle Diagnostic Information - Camaro

DIAGNOSTIC INFORMATION AND PROCEDURES

STRATEGY BASED DIAGNOSIS

The goal of Strategy Based Diagnosis 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 Diagnosis 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 Understand and Verify the Customer's Concern. The final step of your diagnostic process should be Repair and verify the Fix. Refer to the following chart for the correct Strategy Based Diagnosis.

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Fig. 1: Strategy Based Diagnosis Flow Chart
Courtesy of GENERAL MOTORS CORP.

1. Understand and Verify the Customer's Concern: The first part of this step is to obtain as much information as possible from the customer. Are there aftermarket accessories on the vehicle? When does the condition occur? Where does the condition occur? How long does the condition last? How often does the condition occur? In order to verify the concern, the technician should be familiar with the normal operation of the system and refer to the owner or service manual for any information needed.
2. Vehicle Operating as Designed: This condition exists when the vehicle is found to operate normally. The condition described by the customer may be normal. Compare with another like vehicle that is operating normally under the same conditions described by the customer. Explain your findings and the operation of the system to the customer. If the customer is dissatisfied submit a Field Product Report.
3. Preliminary Checks: Conduct a thorough visual inspection. Review the service history. Detect unusual sounds or odors. Gather diagnostic trouble code (DTC) information in order to achieve an effective repair.
4. Perform Published Diagnostic System Check- Vehicle: The **Diagnostic System Check - Vehicle** verifies the proper operation of the system. This will lead the technician in an organized approach to diagnostics and identify what category of diagnostic to perform.
5. Check for related Bulletins, Recalls and Preliminary Information (PI).
6. Diagnostic categories:
    1. Current DTC: Follow the designated DTC diagnostic in order to make an effective repair. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**.
    2. Symptom - No DTC: Select the appropriate symptom diagnostic. Follow the diagnostic steps or suggestions in order to complete the repair. Refer to **Symptoms - Vehicle**.
    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, or corrosives (road salt, battery acid, oil or other fluids). Utilize the wiring diagrams, system description and operation, and system circuit description.
    4. Intermittent/History DTC: An intermittent condition is one that does not occur continuously, may be difficult to duplicate, and will only occur when certain conditions are met. Generally, an intermittent is caused by faulty electrical connections and wiring, malfunctioning components, electromagnetic/radio frequency interference, driving conditions, or aftermarket equipment. The following approaches/tools may prove to be beneficial in locating and repairing an intermittent condition or history DTC.
        - Combining technicians knowledge with the available service information.
        - Evaluate the symptoms and conditions described by the customer on the **Customer Concern Verification Sheets** .
        - Follow the suggestions on **Testing for Intermittent Conditions and Poor Connections** .
        - Use the available scan tool, digital multi-meter, or **J 42598** with data capturing capabilities.
7. Isolate the Root Cause then Repair and Verify Fix: After isolating the root cause, make the repairs and validate for the correct operation by performing the **Diagnostic Repair Verification**. Verifying that the DTC or symptom has been corrected may involve road testing the vehicle.
8. Re-examine the Concern: If a technician cannot successfully find or isolate the concern, a re-evaluation is necessary. Re-verify the concern. The concern could be an intermittent or normal condition.

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DIAGNOSTIC PROCEDURE INSTRUCTIONS

The following is an overview of instructions for all 16 categories which may be included in a diagnostic procedure.

Diagnostic Instructions

A link to the **Diagnostic System Check - Vehicle** is provided here. This procedure should be performed prior to performing other diagnostic procedures, as this prevents misdiagnosis where there are integrated system dependencies.

A link to the **Strategy Based Diagnosis** is provided here. This provides an overview on how a technician should diagnose a vehicle.

A link to the **Diagnostic Procedure Instructions** is provided here. This information is an overview of instructions for all 16 categories which may be included in a diagnostic procedure.

DTC Descriptor

Describes what DTCs are diagnosed in this procedure. The DTC number, with Symptom Description when applicable, and descriptor are written out.

Diagnostic Fault Information

The diagnostic Fault Information table identifies each circuit that makes up an electrical subsystem and the associated circuit faults. DTCs and symptoms are listed in the table for all circuit fault modes. This information can be used to diagnose an electrical fault, or as a quick visual aid showing how the different symptoms and DTCs apply for the subsystem being diagnosed.

Even though all the DTCs and symptoms are shown in this table it does not mean they will all be diagnosed in the same procedure.

An example table from an engine coolant temperature (ECT) procedure:

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
ECT Sensor Signal	P0117	P0118	P0118	P0125, P0128
ECT Low Reference	-	P0118	P0118	P0125, P0128

Typical Scan Tool Data

The Typical Scan Tool Data table identifies a scan tool data parameter and its value in reference to potential circuit faults.

An example table from an ECT procedure:

ECT Sensor Temperature - PCM

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Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running **Parameter Normal Range:** -32 to +130°C (-26 to +275°F)			
ECT Signal	140°C (284°F)	-40°C (-40°F)	-40°C (-40°F)
Low Reference	-	-40°C (-40°F)	-40°C (-40°F)[1]
[1] Internal ECM damage may occur if shorted to B+			

Circuit/System Description

Circuit/System Description identifies how a circuit/system normally functions.

Conditions for Running the DTC

Conditions for Running the DTC, identifies what conditions must be present to allow the diagnostic to run.

Conditions for Setting the DTC

Conditions for Setting the DTC, identifies the condition(s) that must be present in order to fail the diagnostic and when to set the DTC.

Action Taken When the DTC Sets

Actions Taken When the DTC sets, identifies the default actions taken when a control module sets a DTC.

Conditions for Clearing the DTC

Conditions for Clearing the DTC, identifies the conditions that must be met in order to clear the DTC.

Diagnostic Aids

Diagnostic Aids are suggestions which explain other methods to diagnose the condition. It also provides unique information about the system used to assist the technician in finding and repairing a vehicle condition.

Reference Information

Reference Information includes links providing additional information for the diagnostic procedure.

For example:

- Schematic Reference
- Connector End View Reference
- Description and Operation
- Electrical Information Reference
- DTC Type Reference
- Scan Tool Reference

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- Special Tools Required

Circuit/System Verification

The diagnostic format does not force a technician to any of the 3 diagnostic categories (Circuit/System Verification, Circuit/System Testing and Component Testing). However, performing the Circuit/System Verification category first, aids in determining if a vehicle condition is current. This category also serves to route the technician to another diagnostic procedure which should be performed first; for example, a DTC with a higher priority.

Circuit/System Verification is a non-intrusive procedure outlining how to verify that a system or a portion of a system is functioning correctly. During the verification process, the vehicle is kept intact and tested as a complete system. This verification is used to assist the technician in determining whether a condition is current or intermittent. When a condition is determined to be intermittent, a technician can use the link in Electrical Information Reference: **Testing for Intermittent Conditions and Poor Connections** .

The technician should be able to identify if the fault is occurring on the input circuit - signal or on the output circuit - control when applicable. The technician will need to decide from the verification results if the system is working correctly or if further diagnosis needs to be performed in either Circuit/System Testing and/or Component Testing.

Circuit/System Testing

The diagnostic format does not force a technician to any of the 3 diagnostic categories (Circuit/System Verification, Circuit/System Testing and Component Testing). However, beginning with the Circuit/System Verification category aids in determining if a vehicle condition is current.

Circuit/System Testing is a step by step, positive-flow, testing sequence which allows the technician to perform each test step, in sequence, until a fault is detected. If the result of a numbered test step is achieved, the normal flow is to proceed to the next numbered test step. If the result of a numbered test step is NOT achieved, the repair arrow bullet (-->) below that test will identify what actions need to take place.

Intrusive diagnostics are performed to locate the system fault. System harness connections are disconnected from the module or component to test individual circuit functions. The module or component will be used to assist in verifying the circuit function. When a test does not pass, the repair steps (-->) will indicate what circuit faults to test. For example, short to voltage, short to ground or open/high resistance.

When testing for individual circuit faults, the technician is expected to include terminal inspections such as connection surfaces and terminal tension at both the harness and component/module. Additionally, a technician can use the links in Electrical Information Reference: **Testing for Intermittent Conditions and Poor Connections** or **Circuit Testing** .

The control modules and components will also be diagnosed during these test steps. A retest of a control module or component should always be performed before replacement. For example, re-connect all components and modules and retest the system to verify the condition still exists before replacing modules or components.

Component Testing

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The diagnostic format does not force a technician to any of the 3 diagnostic categories (Circuit/System Verification, Circuit/System Testing and Component Testing). However, beginning with the Circuit/System Verification category aids in determining if a vehicle condition is current.

Component Testing can offer static and/or dynamic component tests. These tests can be used to verify if a component is operating correctly to avoid unnecessary replacement.

Testing modules in this category will not be offered. In most cases, the module is used to verify the harness circuits in the Circuit/System Testing category and a retest of the module should always be performed before replacement.

Repair Procedures

Repair Instructions provides a link to **Diagnostic Repair Verification**. This link describes how to verify the vehicle is repaired.

All links to Repair or Replacement procedures are located here.

Repair Verification

Repair Verification describes how to verify the vehicle is repaired when additional instructions are needed beyond what is in Diagnostic Repair Verification.

DIAGNOSTIC SYSTEM CHECK INSTRUCTIONS

The following is an overview of instructions for the general information and 14 step System Verification included in the Diagnostic System Check - Vehicle procedure.

Diagnostic Instructions

A link to **Strategy Based Diagnosis** is provided as an overview on how a technician should diagnose a vehicle.

A link to the Diagnostic System Check Instructions is provided. This provides an overview of instructions and examples for the general information and 14 step System Verification included in the Diagnostic System Check - Vehicle procedure. The examples in this document are intended to give the technician a general idea of what the test step is referring to. They are not intended to list every possible condition or situation.

Diagnostic Systems Check steps are listed by priority to guide the technician to the appropriate diagnostic procedure to correct the customer concern. There are many ways to determine the priority of diagnosing a vehicle concern. Some faults can cause customer perceived symptoms in areas unrelated to the fault. Using an example from the System Check, after reading DTCs, the technician is asked to verify there are no Electronic Control Unit Internal Performance Faults present. It is important that any internal performance issues are addressed prior to continuing through the System Check. There is no benefit addressing other DTCs that could be set due to an internal fault to a control module. If the fault is present, performing the diagnostic procedure for that fault will likely correct the customer perceived concern and possibly eliminate other DTCs that may be set.

Not all steps of the Diagnostic System Check have to be performed. The Diagnostic System Check tries to prioritize the test steps with the highest priority faults first. The technician is then lead to another document to

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do the actual diagnosis or repair. The strategy is to repair higher level faults that may be the cause of other system or component level symptoms. Additionally, the Diagnostic System Check can only be used for a single fault at a time. If additional faults are present, the technician must perform the diagnostic system check for each concern until all customer concerns are corrected.

Once a repair has been completed, General Motors diagnostic strategy is to always have the technician verify that the customer concern has been corrected. This is to prevent comebacks and to ensure customer satisfaction with their dealership experience. Therefore a link has been provided to **Diagnostic Repair Verification** procedure for the technician to verify the customer concern has been corrected.

There are some assumptions made when General Motors prepares service information. They include the following areas which are presumed to function as designed:

- The 12-volt battery is fully charged. General Motors assumes the majority of vehicles brought in for repair will be able to start and be driven into the service stall. If the vehicle has a dead battery, it is slow cranking or for any other reason the technician feels the customer concern may be battery related, a link is provided to **Battery Inspection/Test** . This procedure will guide the technician through inspecting and verifying the battery functions properly.
- Fuses should not be open. General Motors does not call out in diagnostic procedures to verify a fuse. The technician is expected to find an open fuse when the diagnostic test step states to check for an open circuit condition. Therefore a link has been provided to **Power Distribution Schematics** and **Electrical Center Identification Views** for technicians to reference power sources and fuse locations if they feel there may be loss of power due to an open fuse condition.
- Ground circuits are clean, tight, and in the correct location. General Motors assumes that the original ground circuits have not been compromised. The technician is expected to find a poor ground connection when the diagnostic test step states to test the ground circuit for an open/high resistance. Therefore a link has been provided to **Ground Distribution Schematics** and **Harness Routing Views** for technicians to reference ground locations and which ground circuits may be related to the customer concern.
- All connections/connectors are fully seated. General Motors assumes that all connections are properly installed. The technician is expected to find an open or poor connection when the diagnostic test step asks to test the circuit for an open/high resistance. Therefore a link has been provided to **Component Connector End Views** for technicians to reference which connections may be related to the customer concern.
- There are no aftermarket devices that affect the operation of the system. General Motors can only author diagnostic and repair information for vehicle systems and components that are original equipment or genuine GM Accessories. Aftermarket equipment can negatively affect original equipment operation and lead a technician's diagnosis of a concern in the wrong direction. Therefore a link has been provided to **Checking Aftermarket Accessories** that guides a technician through the possible causes of vehicle problems related to aftermarket accessories.
- The scan tool powers up. General Motors assumes that power is available at the Data Link Connector and the scan tool will power on. Therefore a link has been provided to **Scan Tool Does Not Power Up** if the technician finds that the scan tool does not power on.

Diagnostic System Check

1. VERIFY CUSTOMER CONCERN-This step is to obtain as much information as possible from the customer. Are there aftermarket accessories on the vehicle? When does the condition occur? Where does

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the condition occur? How long does the condition last? How often does the condition occur? Review the service history of the vehicle for previous repairs that could help diagnose the current concern.

Now that the technician understands the customer concern, they should validate the concern on the vehicle. In order to verify the concern, the technician should be familiar with the normal operation of the system and refer to the owner or service manual for any information needed. Inspect the visible system components for obvious damage or conditions that could cause the concern. Conduct a thorough visual inspection. Detect unusual sounds or odors.

The condition described by the customer may be normal. If the technician finds the vehicle to operate normally, compare with another like vehicle that is operating normally, under the same conditions described by the customer. If this is the case, explain your findings and the operation of the system to the customer. If the customer is dissatisfied, submit a Field Product Report.

2. BULLETIN SEARCH-By searching for related bulletins, recall/field actions and preliminary information documents, a procedure for a known field issue may resolve the customer concern with little or no diagnosis necessary saving the technician diagnostic time.
3. MECHANICAL CONCERNS-This step is designed to take the technician directly to a list of symptom diagnostic procedures. The technician is asked to verify the symptoms exhibited by the system are mechanical in nature and not related to an electrical system, see some examples below. If the technician feels the concern could be related to an electrical system, they should continue through the Diagnostic System Check to verify the electrical functionality of vehicle. If the technician feels the concern is exclusively related to a mechanical system, a link to **Symptoms - Vehicle** is provided to select the appropriate symptom diagnostic procedure for the customer concern.

   Examples:

   - Brake noise or diagnosing irregular pad wear
   - Water leak diagnosis
   - Engine or transmission fluid leak diagnosis
   - Manual window or door lock diagnosis
   - Vehicle vibration diagnosis
   - Exhaust noise or leak diagnosis
4. VEHICLE POWER UP VERIFICATION-The technician is asked in this step to turn the ignition key ON and verify that the vehicle powers up. The technician should look for clues that multiple vehicle systems are receiving vehicle powermode messages, such as the cluster waking up, the radio powers on, the HVAC blower is operational, windshield wipers turn on, etc, with the key ON. This would be a rare condition as both the powermode master and back-up powermode master would have to be inoperable, however, if the vehicle does not power up, a link to **Power Mode Mismatch** is provided.
5. CONTROL MODULE COMMUNICATION and DTC CHECK-The technician is asked in this step to record the following three pieces of data on the Repair Order; any control module that the scan tool determined is not communicating, any DTC and symptom byte set current or history, and the control module that has set the DTC.

   This is considered a setup step for the rest of the Diagnostic System Check. The technician is not expected to do anything other than record the three pieces of data provided by the scan tool on the Repair

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Order. This provides the information needed to complete the rest of the diagnostic system check.

To complete this step, the technician is asked to utilize the scan tool function called Vehicle DTC Information located in Vehicle Control Systems. This function will query every possible control module on the vehicle requesting all DTCs. During the DTC query, the scan tool will try to establish communication with each control module. If the scan tool can communicate with the control module during the DTC request, it will display PRESENT and provide the number of DTCs set in the control module. If the scan tool cannot communicate with a control module, it will only display NOT COMMUNICATING. Since the scan tool cannot determine if a given control module should be present or not, the technician is asked in a future step to verify that the vehicle was not built with control modules listed as NOT COMMUNICATING.

If the scan tool cannot establish communications with ALL of the vehicles control modules, a link to **Data Link References** is provided. A faulty control module or fault with the serial data circuit can cause no communication with all of the control modules on the vehicle. If any control module communicates on the serial data circuit, continue through the Diagnostic System check, as a future step will address any specific non communicating or group of non communicating control modules.

Once the scan tool has completed the routine, the technician should review each control module that has set a DTC and document them on the Repair Order. When reviewing the DTCs, the technician should take notice if any DTCs are powertrain related, and if so, navigate in the scan tool to the Powertrain area and utilize the Capture Info function. This will upload any Freeze Frame/Failure Records stored in the control module to the scan tool in case the data is lost from the control module. As an example, if the technician commands a Clear DTCs function on a powertrain controller, all diagnostic information stored in the controller is erased. This includes Freeze Frame/Failure Records and Inspection/Maintenance System Status indicators, if required for your region.

6. CONTROL MODULE INTERNAL PERFORMANCE FAULTS-The technician is asked to review the DTCs recorded in step 4 and verify there are no control module internal performance faults set current. This type of fault may be the cause of other symptoms or DTCs displayed by the vehicle. By addressing this fault first, the technician may find the other concerns are resolved. The technician should always follow the diagnostic procedure for these types of faults prior to replacing any control module. If the technician finds a control module has an internal performance fault, a link is provided to **Diagnostic Trouble Code (DTC) List - Vehicle** to select the appropriate DTC diagnostic procedure.

   Examples:

   - B1000 Electronic Control Unit Performance
   - B101D ECU Hardware Performance
   - C0550 Electronic Control Unit Performance
   - C056D ECU Hardware Performance
   - C0570 Auxiliary Electronic Control Unit Performance
   - P0606 Control Module Internal Performance
   - P0607 Control Module Performance
7. CONTROL MODULE COMMUNICATION VERIFICATION-This step is used to ensure the control modules that are NOT COMMUNICATING were not built on the vehicle. To understand if the vehicle

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was built with that option, we provide a link to the **Data Link References** document where Regular Production Options (RPOs) are listed next to ECU names and can be compared to those the vehicle was built with. If the technician determines that a control that is NOT COMMUNICATING should be present, the technician is asked to follow the appropriate diagnostic procedure listed in the **Data Link References** document.

8. COMMUNICATION and POWERMODE FAULTS-This step is asking the technician to look for communication DTCs or DTCs related to control modules powering up based on power mode, communication enable or wake-up circuits. See in the below table some examples of the DTCs the technician should diagnose prior to continuing through the Diagnostic System Check. The technician should review the list of DTCs recorded in step 4 and verify that none of these type of DTCs are present. If so, the technician is referred to the **Diagnostic Trouble Code (DTC) List - Vehicle** to select the appropriate DTC diagnostic procedure.

   Examples:

   - U0140 Lost Communication With Body Control Module
   - U0164 Lost Communication With HVAC Control Module
   - U0170 Lost Communication With Passenger Presence Detection Module
   - U0402 Invalid Data Received From Transmission Control Module
   - U0452 Invalid Data Received From Inflatable Restraint Sensing and Diagnostic Module
   - U1814 Powertrain High Speed Communication Enable Circuit
   - B1428 Ignition Switched Power Run/Crank Relay Circuit
   - B137B Accessory Power Module Wake Up Circuit
   - C0897 Control Module Power Moding
   - P2536 Ignition Accessory Switch Circuit

9. POWER MODE VERIFICATION-This step verifies the Power Mode Master is receiving the proper output state of the ignition switch. The technician should use the main power mode input, this being either the ignition key or, on vehicles equipped with Passive Entry Passive Start, the push button switch. The test should not be performed using a key fob, if the MIL is illuminated the powertrain controller may disable this input. The technician is asked to perform the test with the driver door open. This ensures the retained accessory power mode is inactive during this test which could result in different scan tool readings. The technician is only asked to verify the current Power Mode parameter in the power mode data display list. If the parameter does not match the actual ignition switch position, a link is provided to perform the **Power Mode Mismatch** diagnostic procedure.
10. ENGINE CRANK and RUN VERIFICATION-Here the technician is asked to verify that the engine cranks and runs. The technician should use the main power mode input, this being either the ignition key or, on vehicles equipped with Passive Entry Passive Start, the push button switch, to complete this step. The test should not be performed using a key fob, if the MIL is illuminated the powertrain controller may disable this input. The technician should know at this point whether the engine cranks and runs without having to actually performing this test step. One of the follow has probably already occurred and this step can be skipped: The technician drove the vehicle into the stall or verified when checking the Crank and Run parameter in step 8. If the technician has not already somehow verified the engine cranks in previous steps, the technician should perform this test step. Regardless of how this step was performed, if the engine does not crank, a link is provided to **Engine Does Not Crank** or if the engine cranks but does not run, a link is provided to **Engine Cranks But Does Not Run** for the technician to choose the correct

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diagnostic procedure for the actual engine application being used.

11. REMAINING DTC REVIEW-Here the technician is asked to review any remaining DTCs that were not addressed in previous steps. The technician is asked first to verify there are no control module supply voltage, system voltage or 5V circuit DTCs present. Control modules, systems or components with insufficient or zero voltage can cause one or multiple symptoms to exist on the vehicle. Control module voltage issues could also be the cause of failures during a programming event. The technician should correct voltage issues prior to addressing any programming or configuration DTCs. The technician should then check for any ECU programming, setup or configuration DTCs. By programming software or configuring a control module, the technician could correct the customer concern unobtrusively. The remaining DTCs, which are usually specific system or component faults, are diagnosed last. They can include ECU input and output circuit DTCs or individual circuit faults that usually cause single symptoms or failure modes on the vehicle and can be fixed following the proper DTC diagnostic procedure. In general, the technician should think about what DTCs or faults could be caused by another DTC or fault. A failed sensor may set a component DTC and then the system may set a DTC indicating the system cannot operate properly. By correcting the sensor fault, the system may now operate properly and the system level DTC will transition to history. Refer to the examples within each category below to understand the differences between these DTCs. If DTCs of these type are current, the technician is referred to **Diagnostic Trouble Code (DTC) List - Vehicle** to choose the correct DTC diagnostic procedure.
    1. Voltage DTCs
        - B1325 Device Power 1 Circuit
        - C0875 Device Voltage Reference Input 2 Circuit
        - C1001 Adaptive Cruise Control Indicators Supply Voltage Circuit
        - P0641 5-Volt Reference Circuit
        - P0787 Downshift Timing Solenoid Control Circuit Low Voltage
    2. Programming, Setup, Configuration or Software Performance DTCs
        - B3943 Steering Column Lock has Not Learned Column Integration Module
        - B101E ECU Software Performance
        - B1019 System Configuration Error
        - C0558 Calibration Data Not Programmed
        - P0630 VIN Not Programmed or Mismatched - Powertrain Control Module (PCM)
    3. Component related DTCs
        - B0013 Driver Frontal Deployment Loop Stage 2
        - B0163 Passenger Compartment Temp Sensor Circuit
        - C0045 Left Rear Wheel Speed Sensor Circuit
        - P0565 Cruise Control Switch Circuit
        - P0751 1-2 Shift Solenoid (SS) Valve Performance
    4. System related DTCs
        - B1010 System Sensors Data Mismatch
        - C0176 System Thermal Error
        - C0561 System Disabled Information Stored

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- P1564 Vehicle Acceleration Too High - Cruise Control Disabled
- P1625 Transmission Control Module (TCM) System Reset

5. Any other remaining DTCs-The technician should diagnose and correct any other DTCs that are left that were not from the categories above.

12. EMISSION RELATED INSPECTION/MAINTENANCE TESTING CONCERNS-Several regions require that a vehicle pass on-board diagnostic system tests and the inspection/maintenance emission tests in order to renew license plates or vehicle registration. This is accomplished by viewing the Inspection/Maintenance System Status display on a scan tool. Using a scan tool, the technician can observe the Inspection/Maintenance System Status in order to verify that the vehicle meets the criteria that comply with the local area requirements. If inspection and maintenance checks are required in your region, and the customer concern is related to not passing an Inspection/Maintenance test, a link is provided to **Inspection/Maintenance System Check** where the technician can choose the appropriate Inspection/Maintenance System Check for the actual engine application being used.
13. SYMPTOM DIAGNOSIS-At this step, the diagnostics are assuming that the only information the technician has available to diagnose the customer concern are symptoms of a problem. There are no DTCs set current or history. There may be a Driver Information Center display message or a system indicator to aid in identifying the root cause. The technician should evaluate the symptoms and conditions described by the customer and perform the symptoms diagnostics for the area of customer concern. A link is provided to **Symptoms - Vehicle** which contains a list of all symptoms related to this service manual publication.

DIAGNOSTIC STARTING POINT - VEHICLE

Begin the system diagnosis with **Diagnostic System Check - Vehicle**. The Diagnostic System Check - Vehicle will provide a complete strategy to locate and repair a mechanical or electrical vehicle fault. Not following this strategy may cause additional diagnostic time and/or misdiagnosis.

The Diagnostic System Check - Vehicle will provide the following strategy:

- When to verify the customer concern and identify related bulletins, recalls and preliminary information
- When to identify a control module that is not communicating, a control module that has set a DTC, and the DTC diagnostic priority
- When to address power mode concerns
- When to verify the engine cranks and runs
- When to diagnose symptom related concerns

DIAGNOSTIC SYSTEM CHECK - VEHICLE

Diagnostic Instructions

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic System Check Instructions** provides an overview of each diagnostic step.
- Continue through the Diagnostic System Check until you are directed to follow a particular diagnostic or repair procedure. Once a repair has been completed, perform the **Diagnostic Repair Verification** and verify the customer concern has been corrected.

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The diagnostic procedures within this manual are developed on the assumption that the following areas function as designed:

- The 12V battery is fully charged and cables are clean and tight. Refer to **Battery Inspection/Test** .
- Fuses are not open. Refer to **Power Distribution Schematics** and **Electrical Center Identification Views** .
- Ground circuits for the area of customer concern are clean, tight, and in the correct location. Refer to **Ground Distribution Schematics** and **Harness Routing Views** .
- All connections/connectors for the area of concern are fully seated. Refer to **Component Connector End Views** .
- There are no aftermarket devices that affect the operation of the system. Refer to **Checking Aftermarket Accessories** .
- The scan tool powers up. Refer to **Scan Tool Does Not Power Up** .

Diagnostic System Check

1. VERIFY CUSTOMER CONCERN-Understand and validate the customer concern. Inspect the visible system components for obvious damage or conditions that may cause the concern.
2. BULLETIN SEARCH-Check for related bulletins, recall/field actions and preliminary information.
3. MECHANICAL CONCERNS-Verify the symptom is not exclusively a mechanical concern.
    - If the symptom is exclusively a mechanical concern, refer to **Symptoms - Vehicle**.
4. VEHICLE POWER UP VERIFICATION-Ignition ON, verify the vehicle powers up.
    - If the vehicle does not power up, refer to **Power Mode Mismatch** .

NOTE: Do not clear any DTCs unless instructed to do so by a diagnostic procedure. If any DTC is Powertrain related, select Capture Info to store DTC and Freeze Frame/Failure Records to the Scan Tool.

5. CONTROL MODULE COMMUNICATION and DTC CHECK-Using a scan tool, perform the Vehicle DTC Information function and verify at least one control module communicates with the scan tool. Record on the Repair Order the following information:
    - Any control module that is not communicating.
    - Any DTC, including symptom byte, and the control module that has set the DTC.
    - If the scan tool does not communicate with any control module on the vehicle, refer to **Data Link References** .
6. CONTROL MODULE INTERNAL PERFORMANCE FAULTS-Verify there are no current control module Internal Hardware Performance DTCs set.
    - If any DTC of this type is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle**.
7. CONTROL MODULE COMMUNICATION VERIFICATION-Verify the vehicle is built with any control module listed as not communicating, refer to **Data Link References** . All control modules should be communicating, as equipped.
    - If the scan tool does not communicate with one or more control modules refer to **Data Link References** .

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8. COMMUNICATION and POWERMODE FAULTS-Verify there are no current control module Power Mode or Communication DTCs set.
    - If any DTC of this type is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle**.

NOTE: **The engine may start during this test. Ensure the vehicle is out of gear and the parking brake is applied. Turn the engine OFF as soon as the crank power mode parameter has been observed.**

9. POWER MODE VERIFICATION-Driver door open, observe the scan tool Power Mode parameter while cycling the ignition switch through all the power modes. Verify the current Power Mode parameter matches the actual ignition switch positions.
    - If the Power Mode parameter does not match the actual ignition switch positions, refer to **Power Mode Mismatch** .
10. ENGINE CRANK and RUN VERIFICATION-Verify that the engine cranks and runs.
    - If the engine does not crank, refer to **Engine Does Not Crank**.
    - If the engine does not run, refer to **Engine Cranks But Does Not Run**.
11. REMAINING DTC REVIEW-Verify there are no other DTCs set.
    - If other DTCs are set, diagnose them in the order listed below. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**.
        1. Voltage DTCs
        2. Programming, Setup, Configuration or Software Performance DTCs
        3. Component related DTCs
        4. System related DTCs
        5. Any remaining DTCs
12. EMISSION RELATED INSPECTION/MAINTENANCE TESTING CONCERNS-If inspection and maintenance checks are required in your region, verify the customer concern is not related to inspection/maintenance testing.
    - If the customer concern is related to inspection/maintenance testing, refer to **Inspection/Maintenance System Check**.
13. SYMPTOM DIAGNOSIS-Diagnose any remaining customer concern. Refer to **Symptoms - Vehicle**.

POWERTRAIN DIAGNOSTIC TROUBLE CODE (DTC) TYPE DEFINITIONS

Emissions Related DTCs

Action Taken When the DTC Sets - Type A

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Action Taken When the DTC Sets - Type B

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- The control module illuminates the MIL on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

- The following applies to misfire DTCs:
  - If the control module detects a low level or an emission level misfire condition during 2 consecutive trips, the control module illuminates the MIL.
  - If the control module detects a high level or catalyst damaging misfire, the control module flashes the MIL at a rate of once per second.
  - If the control module detects a misfire during 2 non-consecutive trips, the stored conditions are compared with the current conditions. The control module illuminates the MIL when the following conditions occur:
    - The engine load is within 20 percent of the previous test that failed.
    - The engine speed is within 375 RPM of the previous test that failed.
    - The engine coolant temperature is in the same range of the previous test that failed.
- The following applies to fuel trim DTCs:
  - If the control module detects a fuel trim condition during 2 consecutive trips, the control module illuminates the MIL.
  - If the control module detects a fuel trim condition during 2 non-consecutive trips, the stored conditions are compared with the current conditions. The control module illuminates the MIL when the following conditions occur:
    - The engine load is within 20 percent of the previous test that failed.
    - The engine speed is within 375 RPM of the previous test that failed.
    - The engine coolant temperature is in the same range of the previous test that failed.

Conditions for Clearing the MIL/DTC - Type A or Type B

- The control module turns OFF the MIL after 4 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Non-Emissions Related DTCs

Action Taken When the DTC Sets - Type C

- The control module stores the DTC information into memory when the diagnostic runs and fails.

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- The MIL will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC - Type C

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- Clear the DTC with a scan tool.

Action Taken When the DTC Sets - Type D

- The control module will take default actions but no DTC will be stored in Failure Records.
- The MIL or SVS will not illuminate.

Conditions for Clearing the DTC - Type D

Clear the DTC with a scan tool.

DIAGNOSTIC TROUBLE CODE (DTC) LIST - VEHICLE

DTC	DTC Descriptor	Module That Sets the DTC	Diagnostic Procedure
B0012	Driver Frontal Deployment Loop Stage 1	SDM	**DTC B0012 or B0013**
B0013	Driver Frontal Deployment Loop Stage 2	SDM	**DTC B0012 or B0013**
B0014	Driver Side Deployment Loop	SDM	**DTC B0014-B0045**
B0015	Driver Seat Belt Pretensioner Deployment Loop	SDM	**DTC B0014-B0045**
B0016	Left Roof Rail Deployment Loop 1	SDM	**DTC B0014-B0045**
B0019	Passenger Frontal Deployment Loop Stage 1	SDM	**DTC B0014-B0045**
B0020	Passenger Frontal Deployment Loop Stage 2	SDM	**DTC B0014-B0045**
B0021	Passenger Side Deployment Loop	SDM	**DTC B0014-B0045**
B0022	Passenger Seat Belt Pretensioner Deployment Loop	SDM	**DTC B0014-B0045**
B0023	Right Roof Rail Deployment Loop 1	SDM	**DTC B0014-B0045**
B0052	Deployment Commanded	SDM	**DTC B0052**

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B0074	Passenger Occupant Classification Sensor	Passenger Presence Detection Module	**DTC B0074**
B0079	Driver Seat Position Sensor Circuit	SDM	**DTC B0079 or B0080**
B0080	Passenger Seat Position Sensor Circuit	SDM	**DTC B0079 or B0080**
B0081	Passenger Presence Detection Module	Passenger Presence Detection Module, SDM	**DTC B0081 (SDM)** or **DTC B0081 (Passenger Presence Detection Module)**
B0083	Front End Sensor 1	SDM	**DTC B0083-B0088**
B0084	Front End Sensor 2	SDM	**DTC B0083-B0088**
B0085	Left Front Side Impact Sensor	SDM	**DTC B0083-B0088**
B0086	Right Front Side Impact Sensor	SDM	**DTC B0083-B0088**
B0158	Ambient Air Temperature Sensor Circuit	Instrument Cluster	**DTC B0158**
B0193	Front Blower Motor Speed Circuit	HVAC Control Module	**DTC B0193**
B0223	Recirculate Position Command 1 Circuit	HVAC Control Module	**DTC B0223, B0233, B023A, or B0408**
B0233	Air Flow Control Circuit	HVAC Control Module	**DTC B0223, B0233, B023A, or B0408**
B023A	HVAC Actuators Supply Voltage	HVAC Control Module	**DTC B0223, B0233, B023A, or B0408**
B0283	Electric Rear Defrost Circuit	HVAC Control Module	**DTC B0283**
B0408	Main Temperature Control Circuit	HVAC Control Module	**DTC B0223, B0233, B023A, or B0408**
B0550	Odometer Circuit	BCM	**DTC B0550**
B0685	Security System Indicator Circuit	BCM	**DTC B0685**
B0958	Parking Aid Rear Sensor Left Corner Circuit	Parking Assist Control Module	**DTC B0958, B0959, B0960, or B0961**
B0959	Parking Aid Rear Sensor Left Middle Circuit	Parking Assist Control Module	**DTC B0958, B0959, B0960, or B0961**
B0960	Parking Aid Rear Sensor Right Middle Circuit	Parking Assist Control Module	**DTC B0958, B0959, B0960, or B0961**
B0961	Parking Aid Rear Sensor Right Corner Circuit	Parking Assist Control Module	**DTC B0958, B0959, B0960, or B0961**
B1000	Electronic Control Unit	-	**DTC B1000**
B1001	Option Configuration	-	**DTC B1001**
		SDM	**DTC B1001**
	Vehicle Identification Number	Object Alarm	

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B1015	Information Malfunction	Module	**DTC B1015**
B1019	System Configuration Error	SDM	**DTC B1019**
B101D	ECU Hardware	-	**DTC B101D**
B101E	ECU Software	-	**DTC B101E**
B1020	Auxiliary Electronic Control Unit Performance	Radio	**DTC B1020**
B1025	Left Front Audio Output Circuit	Radio	**DTC B1025, B1035, B1045, or B1055**
B1035	Right Front Audio Output Circuit	Radio	**DTC B1025, B1035, B1045, or B1055**
B1045	Left Rear Audio Output Circuit	Radio	**DTC B1025, B1035, B1045, or B1055**
B1055	Right Rear Audio Output Circuit	Radio	**DTC B1025, B1035, B1045, or B1055**
B125C	Satellite Antenna 1 Circuit	Radio	**DTC B125C**
B1271	Theft Protection Active	Radio	**DTC B1271**
B1278	Left Auxiliary Input Signal Circuit	Multimedia Player Interface Module	**DTC B1278 or B1279**
B1279	Right Auxiliary Input Signal Circuit	Multimedia Player Interface Module	**DTC B1278 or B1279**
B1287	Amplifier Control Signal Circuit	Radio	**DTC B1287**
B1325	Device Power Circuit	Instrument Cluster, Parking Assist Control Module, Radio, SDM	**DTC B1325**
B1370	Control Module Ignition On and Start Circuit	BCM	**DTC B1370-B1379, B1380-B1389, or B1440-B1443**
B1380	Control Module Ignition Accessory Circuit	BCM	**DTC B1370-B1379, B1380-B1389, or B1440-B1443**
B138A	Control Module Voltage Reference Output Circuit	Parking Assist Control Module	**DTC B138A**
B1405	Control Module Voltage Reference Output 2 Circuit	Parking Assist Control Module	**DTC B1405**
B1420	Device Voltage Circuit	Instrument Cluster	**DTC B1420**
B1441	Control Module Ignition Off, Run, and Start Circuit	BCM	**DTC B1370-B1379, B1380-B1389, or B1440-B1443**
B1445	Control Module Voltage Output Circuit	BCM	**DTC B1445**
B1446	Replace Backup Power Source	Communication Interface Module	**DTC B1446 or B1447**
B1447	Backup Power Source	Communication Interface	**DTC B1446 or B1447**

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		Module	
B144B	RUN/CRNK Relay Circuit	BCM	**DTC B144B**
B1516	Battery Current Sensor	BCM	**DTC B1516**
B1517	Battery Voltage	BCM	**DTC B1517**
B151A	Low Battery Capacity Detected	BCM	**DTC B151A**
B1527	High Parasitic Load Detected	BCM	**DTC B1527**
B1529	Control Module Voltage Reference Output 5 Circuit	BCM	**DTC B1529**
B1925	Left Seat Cushion Heater Sensor Circuit	Heated Seat Module	**DTC B1925 or B2170**
B2170	Right Seat Cushion Heater Sensor Circuit	Heated Seat Module	**DTC B1925 or B2170**
B2345	Front Seat Heater Disable Circuit	Heated Seat Module	**DTC B2345**
B2425	Left Seat Cushion Heater Circuit	Heated Seat Module	**DTC B2425 or B2430**
B242A	Seat Heaters Common Circuit	Heated Seat Module	**DTC B242A**
B2430	Right Seat Cushion Heater Circuit	Heated Seat Module	**DTC B2425 or B2430**
B2455	Cellular Phone Microphone Circuit	Communication Interface Module	**DTC B2455**
B2462	Global Positioning System Antenna Malfunction	Communication Interface Module	**DTC B2462 (Communication Interface Module)**
B2470	Cellular Phone Antenna Circuit	Communication Interface Module	**DTC B2470**
B2476	Cellular Phone Select Service Switch	Communication Interface Module	**DTC B2476 or B2482**
B2482	Cellular Phone Select Service Switch Range/Performance	Communication Interface Module	**DTC B2476 or B2482**
B2485	Wireless Communication Antenna Circuit (Bluetooth)	Communication Interface Module	**DTC B2485**
B2530	Front Fog Lamps Control Circuit	BCM	**DTC B2530**
B2545	Backup Lamps Control Circuit	BCM	**DTC B2545**
B2560	Cargo Lamp Control Circuit	BCM	**DTC B2560**
B2575	Headlamps Control Circuit	BCM	**DTC B2575 or B2699**
B257A	Headlamp Switch Input Signals Mismatch	BCM	**DTC B257A**

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B257B	Lighting Control Switch Signal	BCM	**DTC B257B**
B2580	Headlamp High Beam Control Circuit	BCM	**DTC B2580**
B2585	Left Park Lamps Control Circuit	BCM	**DTC B2585 or B3867**
B258A	Low Beam Control Circuit	BCM	**DTC B258A**
B2600	Left Daytime Running Lamps Control Circuit	BCM	**DTC B2600 or B2605**
B2605	Right Daytime Running Lamps Control Circuit	BCM	**DTC B2600 or B2605**
B2610	Passenger Compartment Dimming 1 Circuit	BCM	**DTC B2610**
B2615	Passenger Compartment Dimming 2 Circuit	BCM	**DTC B2615**
B2645	Ambient Light Sensor Circuit	BCM	**DTC B2645**
B2652	Passenger Compartment Dimming 3 Circuit	BCM	**DTC B2652**
B2699	Right Headlamp Control Circuit	BCM	**DTC B2575 or B2699**
B270A	Park Lock Solenoid Control Circuit	BCM	**DTC B270A**
B2730	Interior Trunk Lid Unlatch Switch Circuit	BCM	**DTC B2730**
B2745	Traction Control Switch Circuit	BCM	**DTC B2745**
B2750	Horn Relay Secondary Circuit	BCM	**DTC B2750**
B2955	Security Sensor Data Circuit Malfunction	BCM	**DTC B2955**
B3006	Hood Ajar Circuit	BCM	**DTC B3006**
B302A	Telematic Requested Immobilization	Theft Deterrent Module	**DTC B302A**
B3031	Security System Controller In Learn Mode	BCM	**DTC B3031**
B3055	No Transponder Modulation or No Transponder	BCM	**DTC B3055**
B3060	Unprogrammed Transponder Identification Code Received	BCM	**DTC B3060**
B3101	Keyless Entry Data Link Circuit	BCM	**DTC B3101**
B3105	Keyless Entry System Key Fobs	BCM	**DTC B3105**
B3106	Keyless Entry Data Link	BCM	**DTC B3106**
B3109	Keyless Entry Transmitter 1 Battery	BCM	**DTC B3109-B3113**
B3110	Keyless Entry Transmitter 2 Battery	BCM	**DTC B3109-B3113**
B3111	Keyless Entry Transmitter 3 Battery	BCM	**DTC B3109-B3113**

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B3112	Keyless Entry Transmitter 4 Battery	BCM	**DTC B3109-B3113**
B3113	Keyless Entry Transmitter 5 Battery	BCM	**DTC B3109-B3113**
B310D	Keyless Entry Transmitter 6 Battery	BCM	**DTC B310D-B310F**
B310E	Keyless Entry Transmitter 7 Battery	BCM	**DTC B310D-B310F**
B310F	Keyless Entry Transmitter 8 Battery	BCM	**DTC B310D-B310F**
B3125	Driver Door Only Unlock Circuit	BCM	**DTC B3125, B3130, or B3135**
B3130	All Doors Unlock Circuit	BCM	**DTC B3125, B3130, or B3135**
B3135	All Doors Lock Circuit	BCM	**DTC B3125, B3130, or B3135**
B3140	Driver Unlock Switch Circuit	BCM	**DTC B3140 or B3150**
B3150	Driver Lock Switch Circuit	BCM	**DTC B3140 or B3150**
B316B	Driver Window Switch	BCM	**DTC B316B or B317A**
B317A	Passenger Window Switch	BCM	**DTC B316B or B317A**
B3205	Driver Window Motor Circuit	BCM	**DTC B3205 or B3210**
B3210	Passenger Window Motor Circuit	BCM	**DTC B3205 or B3210**
B3265	Trunk Lid Unlatch Output Circuit	BCM	**DTC B3265**
B3567	Info Display Select Switch Circuit	Instrument Cluster	**DTC B3567**
B3596	Hazard Lamps Request Circuit	BCM	**DTC B3596**
B3622	Steering Wheel Controls Signal Circuit	BCM	**DTC B3622**
B3650	High Beam Request Signal Circuit	BCM	**DTC B3650**
B3664	Sunroof Position Select Switch High Signal Circuit	Sunroof Module	**DTC B3664**
B3697	Sunroof Actuator	Sunroof Module	**DTC B3697**
B3715	Windshield Wiper Relay Circuit	BCM	**DTC B3715 or B3875**
B3794	Cruise Control Function Request Circuit	BCM	**DTC B3794**
B3806	High Beam and Headlamp Flash Select Circuit	BCM	**DTC B3806**
B3810	Headlamp Washer Relay Circuit	BCM	**DTC B3810**
B3867	Right Park Lamps Control Circuit	BCM	**DTC B2585 or B3867**
B3873	Front Washer Relay Circuit	BCM	**DTC B3873**
B3875	Windshield Wiper High Speed Relay Circuit	BCM	**DTC B3715 or B3875**
B3881	Tail Lamp Circuit	BCM	**DTC B3881 or B3882**
B3882	Right Tail Lamp Circuit	BCM	**DTC B3881 or B3882**
B3883	License Plate Lamp Circuit	BCM	**DTC B3883**

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B3884	Center High Mounted Brake Lamp Circuit	BCM	**DTC B3884**
B3902	Incorrect Immobilizer Identifier Received	-	**DTC B3902**
B3933	Air Conditioning Evaporator Temperature Sensor Circuit	HVAC Control Module	**DTC B3933**
B3935	Transponder Authentication Error	BCM	**DTC B3935**
B3948	Left Front Turn Signal Circuit	BCM	**DTC B3948 or B3949**
B3949	Right Front Turn Signal Circuit	BCM	**DTC B3948 or B3949**
B3950	Left Rear Turn Signal Circuit	BCM	**DTC B3950 or B3951**
B3951	Right Rear Turn Signal Circuit	BCM	**DTC B3950 or B3951**
B3976	Unconfigured Transponder	BCM	**DTC B3976**
B3984	Device 1 Environment Identifier Not Programmable	-	**DTC B3984**
C0035	Left Front Wheel Speed Sensor Circuit	EBCM	**DTC C0035-C0050**
C0040	Right Front Wheel Speed Sensor Circuit	EBCM	**DTC C0035-C0050**
C0045	Left Rear Wheel Speed Sensor Circuit	EBCM	**DTC C0035-C0050**
C0050	Right Rear Wheel Speed Sensor Circuit	EBCM	**DTC C0035-C0050**
C0060	Left Front Dump Solenoid Valve Circuit	EBCM	**DTC C0060-C0095, C0121, C0141, C0146, C0151, or C0156**
C0065	Left Front Isolation Solenoid Valve Circuit	EBCM	**DTC C0060-C0095, C0121, C0141, C0146, C0151, or C0156**
C0070	Right Front Dump Solenoid Valve Circuit	EBCM	**DTC C0060-C0095, C0121, C0141, C0146, C0151, or C0156**
C0075	Right Front Isolation Solenoid Valve Circuit	EBCM	**DTC C0060-C0095, C0121, C0141, C0146, C0151, or C0156**
C0080	Left Rear Dump Solenoid Valve Circuit	EBCM	**DTC C0060-C0095, C0121, C0141, C0146, C0151, or C0156**
C0085	Left Rear Isolation Solenoid Valve Circuit	EBCM	**DTC C0060-C0095, C0121, C0141, C0146, C0151, or C0156**
C0090	Right Rear Dump Solenoid Valve Circuit	EBCM	**DTC C0060-C0095, C0121, C0141, C0146, C0151, or C0156**
C0095	Right Rear Isolation Solenoid Valve Circuit	EBCM	**DTC C0060-C0095, C0121, C0141, C0146, C0151, or C0156**
C0110	Pump Motor Circuit	EBCM	**DTC C0110**
C0121	Valve Relay Circuit	EBCM	**DTC C0060-C0095, C0121, C0141, C0146, C0151, or C0156**
C0131	Antilock Braking System Pressure Circuit	EBCM	**DTC C0131**
	Front Prime Solenoid Valve		**DTC C0060-C0095, C0121, C0141,**

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C0141	Circuit	EBCM	**C0146, C0151, or C0156**
C0146	Front Isolation Solenoid Valve Circuit	EBCM	**DTC C0060-C0095, C0121, C0141, C0146, C0151, or C0156**
C0151	Rear Prime Solenoid Valve Circuit	EBCM	**DTC C0060-C0095, C0121, C0141, C0146, C0151, or C0156**
C0156	Rear Isolation Solenoid Valve Circuit	EBCM	**DTC C0060-C0095, C0121, C0141, C0146, C0151, or C0156**
C0161	Antilock Braking System Brake Sensor Circuit	EBCM	**DTC C0161**
C0186	Lateral Acceleration Sensor Circuit	EBCM	**DTC C0186, C0196, or C019B**
C0196	Yaw Rate Signal	EBCM	**DTC C0186, C0196, or C019B**
C019B	Yaw Rate Signal	EBCM	**DTC C0186, C0196, or C019B**
C0242	Engine Control Module Indicated Traction Control Malfunction	ECM	**DTC C0242 or P0856**
C0245	Wheel Speed Sensor Frequency	EBCM	**DTC C0245**
C0267	Low Brake Fluid Indicated	EBCM	**DTC C0267**
C0277	Brake Pedal Position Sensor Circuit	BCM	**DTC C0277 or C0890**
C0280	Stability System Active Too Long	EBCM	**DTC C0280**
C0297	Brake Applied Output Circuit	BCM	**DTC C0297**
C0550	Electronic Control Unit	-	**DTC C0550**
C0569	System Configuration Malfunction	BCM	**DTC C0569**
C056D	Electronic Control Unit Hardware	-	**DTC C056D**
C056E	Electronic Control Unit Software	-	**DTC C056E**
C0710	Steering Position Signal	EBCM	**DTC C0710**
C0750	Left Front Tire Pressure Sensor	BCM	**DTC C0750, C0755, C0760, or C0765**
C0755	Right Front Tire Pressure Sensor	BCM	**DTC C0750, C0755, C0760, or C0765**
C0760	Left Rear Tire Pressure Sensor	BCM	**DTC C0750, C0755, C0760, or C0765**
C0765	Right Rear Tire Pressure Sensor	BCM	**DTC C0750, C0755, C0760, or C0765**
C0775	Tire Pressure Monitoring System Sensors Malfunction	BCM	**DTC C0775**
C078A	Tire Pressure Indicator Module Internal Malfunction	Tire Pressure Sensor Locator Module	**DTC C078A**
C0800	Device Power 1 Circuit Voltage	EBCM	**DTC C0800**
C0890	Control Module Voltage Reference Output 3 Circuit	BCM	**DTC C0277 or C0890**
P0008	Engine Position System Performance Bank 1	ECM	**DTC P0008 or P0009**
P0009	Engine Position System Performance Bank 2	ECM	**DTC P0008 or P0009**

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P000A	Intake Camshaft Position System Slow Response Bank 1	ECM	**DTC P000A-P000D, P0011, P0014, P0021, or P0024**
P000B	Exhaust Camshaft Position System Slow Response Bank 1	ECM	**DTC P000A-P000D, P0011, P0014, P0021, or P0024**
P000C	Intake Camshaft Position System Slow Response Bank 2	ECM	**DTC P000A-P000D, P0011, P0014, P0021, or P0024**
P000D	Exhaust Camshaft Position System Slow Response Bank 2	ECM	**DTC P000A-P000D, P0011, P0014, P0021, or P0024**
P0010	Intake Camshaft Position Actuator Solenoid Valve Control Circuit Bank 1	ECM	**DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094, or P2095** for the 2.8L, 3.0L, 3.2L, or 3.6L engines
	Camshaft Position Actuator Solenoid Valve Control Circuit		**DTC P0010** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0011	Intake Camshaft Position System Performance Bank 1	ECM	**DTC P000A-P000D, P0011, P0014, P0021, or P0024** for the 2.8L, 3.0L, 3.2L, or 3.6L engines
	Camshaft Position System Performance		**DTC P0011** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0013	Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Bank 1	ECM	**DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094, or P2095**
P0014	Exhaust Camshaft Position System Performance Bank 1	ECM	**DTC P000A-P000D, P0011, P0014, P0021, or P0024**
P0016	Crankshaft Position - Intake Camshaft Position Not Plausible Bank 1	ECM	**DTC P0016, P0017, P0018, or P0019** for the 2.8L, 3.0L, 3.2L, or 3.6L engines
	Crankshaft Position - Camshaft Position Not Plausible		**DTC P0016** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0017	Crankshaft Position - Exhaust Camshaft Position Not Plausible Bank 1	ECM	**DTC P0016, P0017, P0018, or P0019**
P0018	Crankshaft Position - Intake Camshaft Position Not Plausible Bank 2	ECM	**DTC P0016, P0017, P0018, or P0019**
P0019	Crankshaft Position - Exhaust Camshaft Position Not Plausible Bank 2	ECM	**DTC P0016, P0017, P0018, or P0019**
P0020	Intake Camshaft Position Actuator Solenoid Valve Control Circuit Bank 2	ECM	**DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094, or P2095**
P0021	Intake Camshaft Position System Performance Bank 2	ECM	**DTC P000A-P000D, P0011, P0014, P0021, or P0024**
P0023	Exhaust Camshaft Position Actuator Solenoid Valve Control	ECM	**DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092,**

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	Circuit Bank 2		**P2093, P2094, or P2095**
P0024	Exhaust Camshaft Position System Performance Bank 2	ECM	**DTC P000A-P000D, P0011, P0014, P0021, or P0024**
P0030	HO2S Heater Control Circuit Bank 1 Sensor 1	ECM	**DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057, or P0058** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0030, P0036, P0050, P0053, P0054, P0056, P0059, P0060, P0135, P0141, P0155, or P0161** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0031	HO2S Heater Control Circuit Low Voltage Bank 1 Sensor 1	ECM	**DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057, or P0058**
P0032	HO2S Heater Control Circuit High Voltage Bank 1 Sensor 1	ECM	**DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057, or P0058**
P0036	HO2S Heater Control Circuit Bank 1 Sensor 2	ECM	**DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057, or P0058** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0030, P0036, P0050, P0053, P0054, P0056, P0059, P0060, P0135, P0141, P0155, or P0161** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0037	HO2S Heater Control Circuit Low Voltage Bank 1 Sensor 2	ECM	**DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057, or P0058**
P0038	HO2S Heater Control Circuit High Voltage Bank 1 Sensor 2	ECM	**DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057, or P0058**
P0050	HO2S Heater Control Circuit Bank 2 Sensor 1	ECM	**DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057, or P0058** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0030, P0036, P0050, P0053, P0054, P0056, P0059, P0060, P0135, P0141, P0155, or P0161** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0051	HO2S Heater Control Circuit Low Voltage Bank 2 Sensor 1	ECM	**DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057, or P0058**
	HO2S Heater Control Circuit		**DTC P0030, P0031, P0032, P0036,**

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P0052	High Voltage Bank 2 Sensor 1	ECM	**P0037, P0038, P0050, P0051, P0052, P0056, P0057, or P0058**
P0053	HO2S Heater Resistance Bank 1 Sensor 1	ECM	**DTC P0030, P0036, P0050, P0053, P0054, P0056, P0059, P0060, P0135, P0141, P0155, or P0161**
P0054	HO2S Heater Resistance Bank 1 Sensor 2	ECM	**DTC P0030, P0036, P0050, P0053, P0054, P0056, P0059, P0060, P0135, P0141, P0155, or P0161**
P0056	HO2S Heater Control Circuit Bank 2 Sensor 2	ECM	**DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057, or P0058** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0030, P0036, P0050, P0053, P0054, P0056, P0059, P0060, P0135, P0141, P0155, or P0161** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0057	HO2S Heater Control Circuit Low Voltage Bank 2 Sensor 2	ECM	**DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057, or P0058**
P0058	HO2S Heater Control Circuit High Voltage Bank 2 Sensor 2	ECM	**DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057, or P0058**
P0059	HO2S Heater Resistance Bank 2 Sensor 1	ECM	**DTC P0030, P0036, P0050, P0053, P0054, P0056, P0059, P0060, P0135, P0141, P0155, or P0161**
P0060	HO2S Heater Resistance Bank 2 Sensor 2	ECM	**DTC P0030, P0036, P0050, P0053, P0054, P0056, P0059, P0060, P0135, P0141, P0155, or P0161**
P0068	Throttle Body Airflow Performance	ECM	**DTC P0068 or P0121**
P0087	Fuel Rail Low Pressure	ECM	**DTC P0087, P0088, or P0089**
P0088	Fuel Rail High Pressure	ECM	**DTC P0087, P0088, or P0089**
P0089	Fuel Pressure Regulator Performance	ECM	**DTC P0087, P0088, or P0089**
P0090	Fuel Pressure Regulator Control Circuit	ECM	**DTC P0090, P0091, or P0092**
P0091	Fuel Pressure Regulator Control Circuit Low Voltage	ECM	**DTC P0090, P0091, or P0092**
P0092	Fuel Pressure Regulator Control Circuit High Voltage	ECM	**DTC P0090, P0091, or P0092**
P0100	Mass Air Flow Sensor Circuit	ECM	**DTC P0100-P0103**
P0101	Mass Air Flow Sensor Circuit Performance	ECM	**DTC P0101** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or

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			DTC P0101 or P1101 for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0102	Mass Air Flow Sensor Circuit Low Frequency	ECM	**DTC P0100-P0103** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0102 or P0103** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0103	Mass Air Flow Sensor Circuit High Frequency	ECM	**DTC P0100-P0103** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0102 or P0103** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0106	Manifold Absolute Pressure Sensor Performance	ECM	**DTC P0106**
P0107	Manifold Absolute Pressure Sensor Circuit Low Voltage	ECM	**DTC P0107 or P0108**
P0108	Manifold Absolute Pressure Sensor Circuit High Voltage	ECM	**DTC P0107 or P0108**
P0111	Intake Air Temperature Sensor Performance	ECM	**DTC P0111-P0113**
P0112	Intake Air Temperature Sensor Circuit Low Voltage	ECM	**DTC P0111-P0113** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0112 or P0113** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0113	Intake Air Temperature Sensor Circuit High Voltage	ECM	**DTC P0111-P0113** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0112 or P0113** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0116	Engine Coolant Temperature Sensor Performance	ECM	**DTC P0116 (w/LLT)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0116** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0117	Engine Coolant Temperature Sensor Circuit Low Voltage	ECM	**DTC P0117 or P0118 (w/LLT)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0117 or P0118** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0118	Engine Coolant Temperature Sensor Circuit High Voltage	ECM	**DTC P0117 or P0118 (w/LLT)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0117 or P0118** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
	Engine Coolant Temperature		

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P0119	Sensor Circuit Intermittent	ECM	**DTC P0119 (w/LLT)**
P0120	Throttle Position Sensor 1 Circuit	ECM	**DTC P0120, P0122, P0123, P0220, P0222, P0223, or P2135**
P0121	Throttle Position Sensor 1 Performance	ECM	**DTC P0121-P0123 or P0221-P0223** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0068 or P0121** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0122	Throttle Position Sensor 1 Circuit Low Voltage	ECM	**DTC P0121-P0123 or P0221-P0223** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0120, P0122, P0123, P0220, P0222, P0223, or P2135** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0123	Throttle Position Sensor 1 Circuit High Voltage	ECM	**DTC P0121-P0123 or P0221-P0223** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0120, P0122, P0123, P0220, P0222, P0223, or P2135** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0128	Engine Coolant Temperature Below Thermostat Regulating Temperature	ECM	**DTC P0128 (w/LLT)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0128** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0130	HO2S Circuit Closed Loop Performance Bank 1 Sensor 1	ECM	**DTC P0130 or P0150**
P0131	HO2S Circuit Low Voltage Bank 1 Sensor 1	ECM	**DTC P0131 or P0151** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0131, P0132, P0137, P0138, P0151, P0152, P0157, or P0158** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0132	HO2S Circuit High Voltage Bank 1 Sensor 1	ECM	**DTC P0132 or P0152** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0131, P0132, P0137, P0138, P0151, P0152, P0157, or P0158** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0133	HO2S Slow Response Bank 1 Sensor 1	ECM	**DTC P0133 or P0153 (w/LLT)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0133, P013A-P013F, P014A, P014B, P0153, P1133, or P1153** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
			DTC P0134 or P0154 for the 2.8L, 3.0L,

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P0134	HO2S Circuit Insufficient Activity Bank 1 Sensor 1	ECM	3.2L, or 3.6L engines or **DTC P0134, P0140, P0154, or P0160** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0135	HO2S Heater Performance Bank 1 Sensor 1	ECM	**DTC P0135, P0141, P0155, or P0161** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0030, P0036, P0050, P0053, P0054, P0056, P0059, P0060, P0135, P0141, P0155, or P0161** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0137	HO2S Circuit Low Voltage Bank 1 Sensor 2	ECM	**DTC P0137, P0138, P0140, P0157, P0158, or P0160** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0131, P0132, P0137, P0138, P0151, P0152, P0157, or P0158** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0138	HO2S Circuit High Voltage Bank 1 Sensor 2	ECM	**DTC P0137, P0138, P0140, P0157, P0158, or P0160** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0131, P0132, P0137, P0138, P0151, P0152, P0157, or P0158** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P013A	HO2S Slow Response Rich to Lean Bank 1 Sensor 2	ECM	**DTC P013A, P013C, P013E, or P014A** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0133, P013A-P013F, P014A, P014B, P0153, P1133, or P1153** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P013B	HO2S Slow Response Lean to Rich Bank 1 Sensor 2	ECM	**DTC P0133, P013A-P013F, P014A, P014B, P0153, P1133, or P1153**
P013C	HO2S Slow Response Rich to Lean Bank 2 Sensor 2	ECM	**DTC P013A, P013C, P013E, or P014A** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0133, P013A-P013F, P014A, P014B, P0153, P1133, or P1153** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P013D	HO2S Slow Response Lean to Rich Bank 2 Sensor 2	ECM	**DTC P0133, P013A-P013F, P014A, P014B, P0153, P1133, or P1153**
P013E	HO2S Delayed Response Rich to Lean Bank 1 Sensor 2	ECM	**DTC P013A, P013C, P013E, or P014A** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0133, P013A-P013F, P014A, P014B, P0153, P1133, or P1153** for the

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			4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P013F	HO2S Delayed Response Lean to Rich Bank 1 Sensor 2	ECM	**DTC P0133, P013A-P013F, P014A, P014B, P0153, P1133, or P1153**
P0140	HO2S Circuit Insufficient Activity Bank 1 Sensor 2	ECM	**DTC P0137, P0138, P0140, P0157, P0158, or P0160** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0134, P0140, P0154, or P0160** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0141	HO2S Heater Performance Bank 1 Sensor 2	ECM	**DTC P0135, P0141, P0155, or P0161** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0030, P0036, P0050, P0053, P0054, P0056, P0059, P0060, P0135, P0141, P0155, or P0161** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P014A	HO2S Delayed Response Rich to Lean Bank 2 Sensor 2	ECM	**DTC P013A, P013C, P013E, or P014A** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0133, P013A-P013F, P014A, P014B, P0153, P1133, or P1153** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P014B	HO2S Delayed Response Lean to Rich Bank 2 Sensor 2	ECM	**DTC P0133, P013A-P013F, P014A, P014B, P0153, P1133, or P1153**
P0150	HO2S Circuit Closed Loop Performance Bank 2 Sensor 1	ECM	**DTC P0130 or P0150**
P0151	HO2S Circuit Low Voltage Bank 2 Sensor 1	ECM	**DTC P0131 or P0151** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0131, P0132, P0137, P0138, P0151, P0152, P0157, or P0158** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0152	HO2S Circuit High Voltage Bank 2 Sensor 1	ECM	**DTC P0132 or P0152** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0131, P0132, P0137, P0138, P0151, P0152, P0157, or P0158** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0153	HO2S Slow Response Bank 2 Sensor 1	ECM	**DTC P0133 or P0153 (w/LLT)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0133, P013A-P013F, P014A, P014B, P0153, P1133, or P1153** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
			DTC P0134 or P0154 for the 2.8L, 3.0L,

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P0154	HO2S Circuit Insufficient Activity Bank 2 Sensor 1	ECM	3.2L, or 3.6L engines or **DTC P0134, P0140, P0154, or P0160** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0155	HO2S Heater Performance Bank 2 Sensor 1	ECM	**DTC P0135, P0141, P0155, or P0161** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0030, P0036, P0050, P0053, P0054, P0056, P0059, P0060, P0135, P0141, P0155, or P0161** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0157	HO2S Circuit Low Voltage Bank 2 Sensor 2	ECM	**DTC P0137, P0138, P0140, P0157, P0158, or P0160** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0131, P0132, P0137, P0138, P0151, P0152, P0157, or P0158** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0158	HO2S Circuit High Voltage Bank 2 Sensor 2	ECM	**DTC P0137, P0138, P0140, P0157, P0158, or P0160** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0131, P0132, P0137, P0138, P0151, P0152, P0157, or P0158** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0160	HO2S Circuit Insufficient Activity Bank 2 Sensor 2	ECM	**DTC P0137, P0138, P0140, P0157, P0158, or P0160** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0134, P0140, P0154, or P0160** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0161	HO2S Heater Performance Bank 2 Sensor 2	ECM	**DTC P0135, P0141, P0155, or P0161** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0030, P0036, P0050, P0053, P0054, P0056, P0059, P0060, P0135, P0141, P0155, or P0161** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0171	Fuel Trim System Lean Bank 1	ECM	**DTC P0171, P0172, P0174, or P0175**
P0172	Fuel Trim System Rich Bank 1	ECM	**DTC P0171, P0172, P0174, or P0175**
P0174	Fuel Trim System Lean Bank 2	ECM	**DTC P0171, P0172, P0174, or P0175**
P0175	Fuel Trim System Rich Bank 2	ECM	**DTC P0171, P0172, P0174, or P0175**
			DTC P018B-P018D for the 2.8L, 3.0L, 3.2L, or 3.6L engines

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P018B	Fuel Pressure Sensor Performance	ECM	or **DTC P018B-P018D** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P018C	Fuel Pressure Sensor Circuit Low Voltage	ECM	**DTC P018B-P018D** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P018B-P018D** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P018D	Fuel Pressure Sensor Circuit High Voltage	ECM	**DTC P018B-P018D** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P018B-P018D** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0191	Fuel Rail Pressure Sensor Performance	ECM	**DTC P0191**
P0192	Fuel Rail Pressure Sensor Circuit Low Voltage	ECM	**DTC P0192 or P0193**
P0193	Fuel Rail Pressure Sensor Circuit High Voltage	ECM	**DTC P0192 or P0193**
P0196	Engine Oil Temperature Sensor Performance	ECM	**DTC P0196, P0197, or P0198**
P0197	Engine Oil Temperature Sensor Circuit Low Voltage	ECM	**DTC P0196, P0197, or P0198** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0197 or P0198** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0198	Engine Oil Temperature Sensor Circuit High Voltage	ECM	**DTC P0196, P0197, or P0198** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0197 or P0198** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0201	Cylinder 1 Injector Control Circuit	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0201, P0202, P0203, P0204, P0205, P0206, P0207, or P0208** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0202	Cylinder 2 Injector Control Circuit	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D** for the 2.8L, 3.0L, 3.2L, or 3.6L

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			engines or **DTC P0201, P0202, P0203, P0204, P0205, P0206, P0207, or P0208** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0203	Cylinder 3 Injector Control Circuit	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0201, P0202, P0203, P0204, P0205, P0206, P0207, or P0208** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0204	Cylinder 4 Injector Control Circuit	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0201, P0202, P0203, P0204, P0205, P0206, P0207, or P0208** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0205	Cylinder 5 Injector Control Circuit	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0201, P0202, P0203, P0204, P0205, P0206, P0207, or P0208** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0206	Cylinder 6 Injector Control Circuit	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0201, P0202, P0203, P0204, P0205, P0206, P0207, or P0208** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0207	Cylinder 7 Injector Control Circuit	ECM	**DTC P0201, P0202, P0203, P0204, P0205, P0206, P0207, or P0208**

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P0208	Cylinder 8 Injector Control Circuit	ECM	**DTC P0201, P0202, P0203, P0204, P0205, P0206, P0207, or P0208**
P0218	Transmission Fluid Overtemperature	TCM	**DTC P0218**
P0219	Engine Overspeed Condition	ECM	**DTC P0219**
P0220	Throttle Position Sensor 2 Circuit	ECM	**DTC P0120, P0122, P0123, P0220, P0222, P0223, or P2135**
P0221	Throttle Position Sensor 2 Performance	ECM	**DTC P0121-P0123 or P0221-P0223**
P0222	Throttle Position Sensor 2 Circuit Low Voltage	ECM	**DTC P0121-P0123 or P0221-P0223** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0120, P0122, P0123, P0220, P0222, P0223, or P2135** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0223	Throttle Position Sensor 2 Circuit High Voltage	ECM	**DTC P0121-P0123 or P0221-P0223** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0120, P0122, P0123, P0220, P0222, P0223, or P2135** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0230	Fuel Pump Relay Control Circuit	Fuel Pump Control Module	**DTC P0230**
P0231	Fuel Pump Control Circuit Low Voltage	Fuel Pump Control Module	**DTC P0231, P0232, or P023F** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0231, P0232, or P023F** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0232	Fuel Pump Control Circuit High Voltage	Fuel Pump Control Module	**DTC P0231, P0232, or P023F** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0231, P0232, or P023F** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P023F	Fuel Pump Control Circuit	Fuel Pump Control Module	**DTC P0231, P0232, or P023F** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0231, P0232, or P023F** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P025A	Fuel Pump Control Module Enable Circuit	Fuel Pump Control Module	**DTC P025A** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P025A** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0261	Cylinder 1 Injector Control Circuit	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277,**

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	Low Voltage		**P2146, P2149, P2152, P2155, P216A, or P216D**
P0262	Cylinder 1 Injector Control Circuit High Voltage	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D**
P0264	Cylinder 2 Injector Control Circuit Low Voltage	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D**
P0265	Cylinder 2 Injector Control Circuit High Voltage	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D**
P0267	Cylinder 3 Injector Control Circuit Low Voltage	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D**
P0268	Cylinder 3 Injector Control Circuit High Voltage	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D**
P0270	Cylinder 4 Injector Control Circuit Low Voltage	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D**
P0271	Cylinder 4 Injector Control Circuit High Voltage	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D**
P0273	Cylinder 5 Injector Control Circuit Low Voltage	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D**
P0274	Cylinder 5 Injector Control Circuit High Voltage	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or**

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			P216D
P0276	Cylinder 6 Injector Control Circuit Low Voltage	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D**
P0277	Cylinder 6 Injector Control Circuit High Voltage	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D**
P029D	Cylinder 1 Injector Leak Detected	ECM	**DTC P029D, P02A1, P02A5, P02A9, P02AD, or P02B1**
P02A1	Cylinder 2 Injector Leak Detected	ECM	**DTC P029D, P02A1, P02A5, P02A9, P02AD, or P02B1**
P02A5	Cylinder 3 Injector Leak Detected	ECM	**DTC P029D, P02A1, P02A5, P02A9, P02AD, or P02B1**
P02A9	Cylinder 4 Injector Leak Detected	ECM	**DTC P029D, P02A1, P02A5, P02A9, P02AD, or P02B1**
P02AD	Cylinder 5 Injector Leak Detected	ECM	**DTC P029D, P02A1, P02A5, P02A9, P02AD, or P02B1**
P02B1	Cylinder 6 Injector Leak Detected	ECM	**DTC P029D, P02A1, P02A5, P02A9, P02AD, or P02B1**
P0300	Engine Misfire Detected	ECM	**DTC P0300-P0306** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0300-P0308** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0301	Cylinder 1 Misfire Detected	ECM	**DTC P0300-P0306** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0300-P0308** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0302	Cylinder 2 Misfire Detected	ECM	**DTC P0300-P0306** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0300-P0308** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0303	Cylinder 3 Misfire Detected	ECM	**DTC P0300-P0306** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0300-P0308** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0304	Cylinder 4 Misfire Detected	ECM	**DTC P0300-P0306** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or

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			DTC P0300-P0308 for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0305	Cylinder 5 Misfire Detected	ECM	**DTC P0300-P0306** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0300-P0308** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0306	Cylinder 6 Misfire Detected	ECM	**DTC P0300-P0306** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0300-P0308** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0307	Cylinder 7 Misfire Detected	ECM	**DTC P0300-P0308**
P0308	Cylinder 8 Misfire Detected	ECM	**DTC P0300-P0308**
P0315	Crankshaft Position System Variation Not Learned	ECM	**DTC P0315**
P0324	Knock Sensor Module Performance	ECM	**DTC P0324** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0324, P0325, P0326, P0327, P0328, P0330, P0332, or P0333** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0325	Knock Sensor Circuit Bank 1	ECM	**DTC P0324, P0325, P0326, P0327, P0328, P0330, P0332, or P0333**
P0326	Knock Sensor Performance Bank 1	ECM	**DTC P0326, P0327, P0328, P0331, P0332, or P0333** for the 2.8L, 3.0L, 3.2L, or 3.6L engines
	Knock Sensor Performance		**DTC P0324, P0325, P0326, P0327, P0328, P0330, P0332, or P0333** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0327	Knock Sensor Circuit Low Voltage Bank 1	ECM	**DTC P0326, P0327, P0328, P0331, P0332, or P0333** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0324, P0325, P0326, P0327, P0328, P0330, P0332, or P0333** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0328	Knock Sensor Circuit High Voltage Bank 1	ECM	**DTC P0326, P0327, P0328, P0331, P0332, or P0333** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0324, P0325, P0326, P0327, P0328, P0330, P0332, or P0333** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0330	Knock Sensor Circuit Bank 2	ECM	**DTC P0324, P0325, P0326, P0327, P0328, P0330, P0332, or P0333**

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P0331	Knock Sensor Performance Bank 2	ECM	**DTC P0326, P0327, P0328, P0331, P0332, or P0333**
P0332	Knock Sensor Circuit Low Voltage Bank 2	ECM	**DTC P0326, P0327, P0328, P0331, P0332, or P0333** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0324, P0325, P0326, P0327, P0328, P0330, P0332, or P0333** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0333	Knock Sensor Circuit High Voltage Bank 2	ECM	**DTC P0326, P0327, P0328, P0331, P0332, or P0333** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0324, P0325, P0326, P0327, P0328, P0330, P0332, or P0333** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0335	Crankshaft Position Sensor Circuit	ECM	**DTC P0335, P0336, or P0338** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0335** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0336	Crankshaft Position Sensor Performance	ECM	**DTC P0335, P0336, or P0338** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0336** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0338	Crankshaft Position Sensor Circuit High Duty Cycle	ECM	**DTC P0335, P0336, or P0338**
P0340	Camshaft Position Sensor Circuit	ECM	**DTC P0340**
P0341	Intake Camshaft Position Sensor Performance Bank 1	ECM	**DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392, or P0393** for the 2.8L, 3.0L, 3.2L, or 3.6L engines
	Camshaft Position Sensor Performance		**DTC P0341** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0342	Intake Camshaft Position Sensor Circuit Low Voltage Bank 1	ECM	**DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392, or P0393**
P0343	Intake Camshaft Position Sensor Circuit High Voltage Bank 1	ECM	**DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392, or P0393**
P0346	Intake Camshaft Position Sensor Performance Bank 2	ECM	**DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392, or P0393**
P0347	Intake Camshaft Position Sensor	ECM	**DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368,**

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	Circuit Low Voltage Bank 2		**P0391, P0392, or P0393**
P0348	Intake Camshaft Position Sensor Circuit High Voltage Bank 2	ECM	**DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392, or P0393**
P0351	Ignition Coil 1 Control Circuit	ECM	**DTC P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, or P2316 (w/LLT)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0351-P0358** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0352	Ignition Coil 2 Control Circuit	ECM	**DTC P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, or P2316 (w/LLT)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0351-P0358** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0353	Ignition Coil 3 Control Circuit	ECM	**DTC P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, or P2316 (w/LLT)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0351-P0358** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0354	Ignition Coil 4 Control Circuit	ECM	**DTC P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, or P2316 (w/LLT)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0351-P0358** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0355	Ignition Coil 5 Control Circuit	ECM	**DTC P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, or P2316 (w/LLT)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0351-P0358** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
			DTC P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, or P2316

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P0356	Ignition Coil 6 Control Circuit	ECM	**(w/LLT)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0351-P0358** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0357	Ignition Coil 7 Control Circuit	ECM	**DTC P0351-P0358**
P0358	Ignition Coil 8 Control Circuit	ECM	**DTC P0351-P0358**
P0366	Exhaust Camshaft Position Sensor Performance Bank 1	ECM	**DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392, or P0393**
P0367	Exhaust Camshaft Position Sensor Circuit Low Voltage Bank 1	ECM	**DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392, or P0393**
P0368	Exhaust Camshaft Position Sensor Circuit High Voltage Bank 1	ECM	**DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392, or P0393**
P0391	Exhaust Camshaft Position Sensor Performance Bank 2	ECM	**DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392, or P0393**
P0392	Exhaust Camshaft Position Sensor Circuit Low Voltage Bank 2	ECM	**DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392, or P0393**
P0393	Exhaust Camshaft Position Sensor Circuit High Voltage Bank 2	ECM	**DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392, or P0393**
P0420	Catalyst System Low Efficiency Bank 1	ECM	**DTC P0420 or P0430** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0420 or P0430** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0430	Catalyst System Low Efficiency Bank 2	ECM	**DTC P0420 or P0430** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0420 or P0430** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0442	Evaporative Emission System Small Leak Detected	ECM	**DTC P0442** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0442** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0443	Evaporative Emission Purge Solenoid Valve Control Circuit	ECM	**DTC P0443, P0458, or P0459** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0443 or P0449** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
			DTC P0446 for the 2.8L, 3.0L, 3.2L, or

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P0446	Evaporative Emissions Vent System Performance	ECM	3.6L engines or **DTC P0446** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0449	Evaporative Emission Vent Solenoid Valve Control Circuit	ECM	**DTC P0449, P0498, or P0499** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0443 or P0449** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0450	Fuel Tank Pressure Sensor Circuit	ECM	**DTC P0450 or P0451**
P0451	Fuel Tank Pressure Sensor Performance	ECM	**DTC P0450 or P0451** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0451-P0454** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0452	Fuel Tank Pressure Sensor Circuit Low Voltage	ECM	**DTC P0452 or P0453** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0451-P0454** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0453	Fuel Tank Pressure Sensor Circuit High Voltage	ECM	**DTC P0452 or P0453** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0451-P0454** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0454	Fuel Tank Pressure Sensor Circuit Intermittent	ECM	**DTC P0451-P0454**
P0455	Evaporative Emission System Large Leak Detected	ECM	**DTC P0455 or P0497** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0455** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0458	Evaporative Emission Purge Solenoid Valve Control Circuit Low Voltage	ECM	**DTC P0443, P0458, or P0459**
P0459	Evaporative Emission Purge Solenoid Valve Control Circuit High Voltage	ECM	**DTC P0443, P0458, or P0459**
P0461	Fuel Level Sensor Performance	ECM	**DTC P0461-P0463, P2066, P2067, or P2068**
P0462	Fuel Level Sensor Circuit Low Voltage	ECM	**DTC P0461-P0463, P2066, P2067, or P2068**
P0463	Fuel Level Sensor Circuit High Voltage	ECM	**DTC P0461-P0463, P2066, P2067, or P2068**
P0464	Fuel Level Sensor 1 Circuit Intermittent	ECM	**DTC P0464**

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P0480	Cooling Fan Relay 1 Control Circuit	ECM	**DTC P0480, P0481, P0691, P0692, P0693, or P0694 (w/V6-LLT)** with V6-LLT engine or **DTC P0480 or P0481** without V6-LLT engine
P0481	Cooling Fan Relay 2 Control Circuit	ECM	**DTC P0480, P0481, P0691, P0692, P0693, or P0694 (w/V6-LLT)** with V6-LLT engine
	Cooling Fan Relays 2 and 3 Control Circuit		**DTC P0480 or P0481** without V6-LLT engine
P0496	Evaporative Emission System Flow During Non-Purge	ECM	**DTC P0496** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0496** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0497	Evaporative Emission System No Flow During Purge	ECM	**DTC P0455 or P0497**
P0498	Evaporative Emission Vent Solenoid Valve Control Circuit Low Voltage	ECM	**DTC P0449, P0498, or P0499**
P0499	Evaporative Emission Vent Solenoid Valve Control Circuit High Voltage	ECM	**DTC P0449, P0498, or P0499**
P0501	Vehicle Speed Sensor Performance	ECM	**DTC P0501 or P0502**
P0502	Vehicle Speed Sensor Circuit Low Voltage	ECM	**DTC P0501 or P0502** for the Aisin AY6 transmission or **DTC P0502 or P0503** for the Tremec 6-Speed transmission
P0503	Vehicle Speed Sensor Circuit Intermittent	ECM	**DTC P0502 or P0503**
P0506	Idle Speed Low	ECM	**DTC P0506, P0507, or P050A (Without LF1)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0506 or P0507** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0507	Idle Speed High	ECM	**DTC P0506, P0507, or P050A (Without LF1)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0506 or P0507** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
	Cold Start Idle Air Control		**DTC P0506, P0507, or P050A (Without**

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P050A	System Performance	ECM	**LF1)**
P0513	Immobilizer Key Incorrect	ECM	**DTC P0513**
P0521	Engine Oil Pressure Sensor Performance	ECM	**DTC P0521, P0522, or P0523**
P0522	Engine Oil Pressure Sensor Circuit Low Voltage	ECM	**DTC P0521, P0522, or P0523**
P0523	Engine Oil Pressure Sensor Circuit High Voltage	ECM	**DTC P0521, P0522, or P0523**
P0532	Air Conditioning Refrigerant Pressure Sensor Circuit Low Voltage	ECM	**DTC P0532 or P0533**
P0533	Air Conditioning Refrigerant Pressure Sensor Circuit High Voltage	ECM	**DTC P0532 or P0533**
P0556	Brake Booster Pressure Sensor Performance	ECM	**DTC P0556, P0557, or P0558**
P0557	Brake Booster Pressure Sensor Circuit Low Voltage	ECM	**DTC P0556, P0557, or P0558**
P0558	Brake Booster Pressure Sensor Circuit High Voltage	ECM	**DTC P0556, P0557, or P0558**
P0562	System Voltage Low	ECM, Fuel Pump Control Module	**DTC P0562**
		TCM	**DTC P0562 or P0563**
P0563	System Voltage High	ECM, Fuel Pump Control Module	**DTC P0563**
		TCM	**DTC P0562 or P0563**
P0564	Cruise Control Multifunction Switch Circuit	BCM	**DTC P0564, P0567, or P0568**
P0567	Cruise Control Resume Switch Circuit	BCM	**DTC P0564, P0567, or P0568**
P0568	Cruise Control Set Switch Circuit	BCM	**DTC P0564, P0567, or P0568**
P0571	Cruise Control Brake Switch Circuit	BCM	**DTC P0571**
P0572	Brake Switch Circuit 1 Low Voltage	ECM	**DTC P0572 or P0573**
P0573	Brake Switch Circuit 1 High Voltage	ECM	**DTC P0572 or P0573**
P0575	Cruise Control Switch Signal Circuit	ECM	**DTC P0575**
			DTC P0601-P0604, P0606, P167D, or P2610 (ECM, LLT) for the 2.8L, 3.0L, 3.2L, or 3.6L engines

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P0601	Control Module Read Only Memory	ECM	or **DTC P0601, P0602, P0603, P0604, P0606, P0607, P060D, P062F, or P2610 (ECM)** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
		Fuel Pump Control Module	**DTC P0601-P0604, P0606, or P062F** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0601-P0604, P0606, or P062F** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
	Transmission Control Module Read Only Memory	TCM	**DTC P0601-P0604 or P062F**
P0602	Control Module Not Programmed	ECM	**DTC P0601-P0604, P0606, P167D, or P2610 (ECM, LLT)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0601, P0602, P0603, P0604, P0606, P0607, P060D, P062F, or P2610 (ECM)** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
		Fuel Pump Control Module	**DTC P0601-P0604, P0606, or P062F** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0601-P0604, P0606, or P062F** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
	Transmission Control Module Not Programmed	TCM	**DTC P0601-P0604 or P062F**
P0603	Control Module Long Term Memory Reset	ECM	**DTC P0601-P0604, P0606, P167D, or P2610 (ECM, LLT)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0601, P0602, P0603, P0604, P0606, P0607, P060D, P062F, or P2610 (ECM)** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
		Fuel Pump Control Module	**DTC P0601-P0604, P0606, or P062F** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0601-P0604, P0606, or P062F** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
	Transmission Control Module Long Term Memory Reset	TCM	**DTC P0601-P0604 or P062F**
			DTC P0601-P0604, P0606, P167D, or

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P0604	Control Module Random Access Memory Performance	ECM	**P2610 (ECM, LLT)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0601, P0602, P0603, P0604, P0606, P0607, P060D, P062F, or P2610 (ECM)** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
		Fuel Pump Control Module	**DTC P0601-P0604, P0606, or P062F** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0601-P0604, P0606, or P062F** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
	Transmission Control Module Random Access Memory	TCM	**DTC P0601-P0604 or P062F**
P0606	Control Module Internal Performance	ECM	**DTC P0601-P0604, P0606, P167D, or P2610 (ECM, LLT)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0601, P0602, P0603, P0604, P0606, P0607, P060D, P062F, or P2610 (ECM)** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
		Fuel Pump Control Module	**DTC P0601-P0604, P0606, or P062F** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0601-P0604, P0606, or P062F** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0607	Control Module Performance	ECM	**DTC P0601, P0602, P0603, P0604, P0606, P0607, P060D, P062F, or P2610 (ECM)**
P060D	Control Module Accelerator Pedal Position System Circuitry Performance	ECM	**DTC P0601, P0602, P0603, P0604, P0606, P0607, P060D, P062F, or P2610 (ECM)**
P0615	Starter Relay Control Circuit	ECM	**DTC P0615, P0616, or P0617**
P0616	Starter Relay Control Circuit Low Voltage	ECM	**DTC P0615, P0616, or P0617**
P0617	Starter Relay Control Circuit High Voltage	ECM	**DTC P0615, P0616, or P0617**
P0621	Generator L-Terminal Circuit	ECM	**DTC P0621**
P0622	Generator F-Terminal Circuit	ECM	**DTC P0622**
P0625	Generator F-Terminal Circuit Low Voltage	ECM	**DTC P0625 or P0626**
P0626	Generator F-Terminal Circuit High Voltage	ECM	**DTC P0625 or P0626**

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P0627	Fuel Pump Enable Circuit	ECM	**DTC P0627-P0629**
P0628	Fuel Pump Enable Circuit Low Voltage	ECM	**DTC P0627-P0629**
P0629	Fuel Pump Enable Circuit High Voltage	ECM	**DTC P0627-P0629**
P062B	Control Module Fuel Injector Control Performance	ECM	**DTC P062B**
P062F	Control Module Long Term Memory Performance	ECM	**DTC P0601, P0602, P0603, P0604, P0606, P0607, P060D, P062F, or P2610 (ECM)**
		Fuel Pump Control Module	**DTC P0601-P0604, P0606, or P062F** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0601-P0604, P0606, or P062F** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
	Transmission Control Module Long Term Memory Performance	TCM	**DTC P0601-P0604 or P062F**
P0633	Immobilizer Key Not Programmed	ECM	**DTC P0633**
P0634	Transmission Control Module Overtemperature	TCM	**DTC P0634**
P0638	Throttle Actuator Control Command Performance	ECM	**DTC P0638, P2100, P2101, or P2119**
P0641	5-Volt Reference 1 Circuit	ECM	**DTC P0641-P0643, P0651-P0653, or P0697-P0699 (ECM)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0641 or P0651 (ECM)** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
	5-Volt Reference Circuit	Fuel Pump Control Module	**DTC P0641 or P06A6** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0641 or P06A6** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0642	5-Volt Reference 1 Circuit Low Voltage	ECM	**DTC P0641-P0643, P0651-P0653, or P0697-P0699 (ECM)**
P0643	5-Volt Reference 1 Circuit High Voltage	ECM	**DTC P0641-P0643, P0651-P0653, or P0697-P0699 (ECM)**
P0645	Air Conditioning Compressor Clutch Relay Control Circuit	ECM	**DTC P0645, P0646, or P0647**
P0646	Air Conditioning Compressor Clutch Relay Control Circuit Low Voltage	ECM	**DTC P0645, P0646, or P0647**
	Air Conditioning Compressor		

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P0647	Clutch Relay Control Circuit High Voltage	ECM	**DTC P0645, P0646, or P0647**
P064A	Fuel Pump Control Module Performance	Fuel Pump Control Module	**DTC P1255 or P064A** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P1255 or P064A** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0650	Malfunction Indicator Lamp Control Circuit	ECM	**DTC P0650** or the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0650** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0651	5-Volt Reference 2 Circuit	ECM	**DTC P0641-P0643, P0651-P0653, or P0697-P0699 (ECM)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0641 or P0651 (ECM)** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0652	5-Volt Reference 2 Circuit Low Voltage	ECM	**DTC P0641-P0643, P0651-P0653, or P0697-P0699 (ECM)**
P0653	5-Volt Reference 2 Circuit High Voltage	ECM	**DTC P0641-P0643, P0651-P0653, or P0697-P0699 (ECM)**
P0658	Solenoid High Control Circuit Group 1 Low Voltage	TCM	**DTC P0658 or P0659**
P0659	Solenoid High Control Circuit Group 1 High Voltage	TCM	**DTC P0658 or P0659**
P0667	Transmission Control Module Temperature Sensor Performance	TCM	**DTC P0667, P0668, or P0669**
P0668	Transmission Control Module Temperature Sensor Circuit Low Voltage	TCM	**DTC P0667, P0668, or P0669**
P0669	Transmission Control Module Temperature Sensor Circuit High Voltage	TCM	**DTC P0667, P0668, or P0669**
P0685	Engine Controls Ignition Relay Control Circuit	ECM	**DTC P0685, P0686, P0687, P0689, or P0690 (LE0/LLT/LY7)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0685 or P0690** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0686	Engine Controls Ignition Relay Control Circuit Low Voltage	ECM	**DTC P0685, P0686, P0687, P0689, or P0690 (LE0/LLT/LY7)**
P0687	Engine Controls Ignition Relay Control Circuit High Voltage	ECM	**DTC P0685, P0686, P0687, P0689, or P0690 (LE0/LLT/LY7)**
P0689	Engine Controls Ignition Relay Feedback Circuit Low Voltage	ECM	**DTC P0685, P0686, P0687, P0689, or P0690 (LE0/LLT/LY7)** f

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P0690	Engine Controls Ignition Relay Feedback Circuit High Voltage	ECM	**DTC P0685, P0686, P0687, P0689, or P0690 (LE0/LLT/LY7)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0685 or P0690** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0691	Cooling Fan Relay 1 Control Circuit Low Voltage	ECM	**DTC P0480, P0481, P0691, P0692, P0693, or P0694 (w/V6-LLT)**
P0692	Cooling Fan Relay 1 Control Circuit High Voltage	ECM	**DTC P0480, P0481, P0691, P0692, P0693, or P0694 (w/V6-LLT)**
P0693	Cooling Fan Relay 2 Control Circuit Low Voltage	ECM	**DTC P0480, P0481, P0691, P0692, P0693, or P0694 (w/V6-LLT)**
P0694	Cooling Fan Relay 2 Control Circuit High Voltage	ECM	**DTC P0480, P0481, P0691, P0692, P0693, or P0694 (w/V6-LLT)**
P0697	5-Volt Reference 3 Circuit	ECM	**DTC P0641-P0643, P0651-P0653, or P0697-P0699 (ECM)**
P0698	5-Volt Reference 3 Circuit Low Voltage	ECM	**DTC P0641-P0643, P0651-P0653, or P0697-P0699 (ECM)**
P0699	5-Volt Reference 3 Circuit High Voltage	ECM	**DTC P0641-P0643, P0651-P0653, or P0697-P0699 (ECM)**
P069E	Fuel Pump Control Module Requested MIL Illumination	Fuel Pump Control Module	**DTC P069E** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P069E** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P06A6	5-Volt Reference Performance	Fuel Pump Control Module	**DTC P0641 or P06A6** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0641 or P06A6** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P06AC	Transmission Control Module Power Up Temperature Sensor Performance	TCM	**DTC P06AC, P06AD, or P06AE**
P06AD	Transmission Control Module Power Up Temperature Sensor Circuit Low Voltage	TCM	**DTC P06AC, P06AD, or P06AE**
P06AE	Transmission Control Module Power Up Temperature Sensor Circuit High Voltage	TCM	**DTC P06AC, P06AD, or P06AE**
P0700	Transmission Control Module Requested MIL Illumination	TCM	**DTC P0700** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0700** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P0703	Brake Switch Circuit 2	ECM	**DTC P0703**

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P0711	Transmission Fluid Temperature Sensor Performance	TCM	**DTC P0711, P0712, or P0713**
P0712	Transmission Fluid Temperature Sensor Circuit Low Voltage	ECM	**DTC P0712 or P0713** for the Aisin AY6 transmission or **DTC P0712 or P0713** for the Tremec 6-Speed transmission
		TCM	**DTC P0711, P0712, or P0713**
P0713	Transmission Fluid Temperature Sensor Circuit High Voltage	ECM	**DTC P0712 or P0713** for the Aisin AY6 transmission or **DTC P0712 or P0713** for the Tremec 6-Speed transmission
		TCM	**DTC P0711, P0712, or P0713**
P0716	Input Speed Sensor Performance	TCM	**DTC P0716 or P0717**
P0717	Input Speed Sensor Circuit Low Voltage	TCM	**DTC P0716 or P0717**
P0722	Output Speed Sensor Circuit Low Voltage	TCM	**DTC P0722 or P0723**
P0723	Output Speed Sensor Circuit Intermittent	TCM	**DTC P0722 or P0723**
P0741	Torque Converter Clutch - Stuck Off	TCM	**DTC P0741 or P0742**
P0742	Torque Converter Clutch - Stuck On	TCM	**DTC P0741 or P0742**
P0751	Shift Solenoid 1 Valve Performance - Stuck Off	TCM	**DTC P0751 or P0752**
P0752	Shift Solenoid 1 Valve Performance - Stuck On	TCM	**DTC P0751 or P0752**
P0756	Shift Solenoid 2 Valve Performance - Stuck Off	TCM	**DTC P0756**
P0776	Clutch Pressure Control Solenoid 2 - Stuck Off	TCM	**DTC P0776 or P0777**
P0777	Clutch Pressure Control Solenoid 2 - Stuck On	TCM	**DTC P0776 or P0777**
P0796	Clutch Pressure Control Solenoid 3 - Stuck Off	TCM	**DTC P0796 or P0797**
P0797	Clutch Pressure Control Solenoid 3 - Stuck On	TCM	**DTC P0796 or P0797**
P0801	Reverse Lockout Solenoid Control Circuit	ECM	**DTC P0801**
P0806	Clutch Pedal Position Sensor Circuit Performance	ECM	**DTC P0806** for the Aisin AY6 transmission or **DTC P0806** for the Tremec 6-Speed

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			transmission
P0807	Clutch Pedal Position Sensor Circuit Low Voltage	ECM	**DTC P0807 or P0808** for the Aisin AY6 transmission or **DTC P0807 or P0808** for the Tremec 6-Speed transmission
P0808	Clutch Pedal Position Sensor Circuit High Voltage	ECM	**DTC P0807 or P0808** for the Aisin AY6 transmission or **DTC P0807 or P0808** for the Tremec 6-Speed transmission
P080A	Clutch Pedal Position Not Learned	ECM	**DTC P080A** for the Aisin AY6 transmission or **DTC P080A** for the Tremec 6-Speed transmission
P080C	Skip Shift Solenoid Control Circuit Low Voltage	ECM	**DTC P080C or P080D**
P080D	Skip Shift Solenoid Control Circuit High Voltage	ECM	**DTC P080C or P080D**
P0815	Upshift Switch Circuit	TCM	**DTC P0815, P0816, P0826, or P1876**
P0816	Downshift Switch Circuit	TCM	**DTC P0815, P0816, P0826, or P1876**
P0826	Up and Down Shift Switch Circuit	TCM	**DTC P0815, P0816, P0826, or P1876**
P0842	Transmission Fluid Pressure Switch 1 Circuit Low Voltage	TCM	**DTC P0842 or P0843**
P0843	Transmission Fluid Pressure Switch 1 Circuit High Voltage	TCM	**DTC P0842 or P0843**
P0850	Park/Neutral Position Switch Circuit	ECM	**DTC P0850-P0852**
P0851	Park/Neutral Position Switch Circuit Low Voltage	ECM	**DTC P0850-P0852**
P0852	Park/Neutral Position Switch Circuit High Voltage	ECM	**DTC P0850-P0852**
P0856	Traction Control Torque Request Circuit	ECM	**DTC C0242 or P0856**
P0872	Transmission Fluid Pressure Switch 3 Circuit Low Voltage	TCM	**DTC P0872 or P0873**
P0873	Transmission Fluid Pressure Switch 3 Circuit High Voltage	TCM	**DTC P0872 or P0873**
P0877	Transmission Fluid Pressure Switch 4 Circuit Low Voltage	TCM	**DTC P0877 or P0878**
P0878	Transmission Fluid Pressure Switch 4 Circuit High Voltage	TCM	**DTC P0877 or P0878**
P0961	Line Pressure Control Solenoid System Performance	TCM	**DTC P0961-P0963**

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P0962	Line Pressure Control Solenoid Control Circuit Low Voltage	TCM	**DTC P0961-P0963**
P0963	Line Pressure Control Solenoid Control Circuit High Voltage	TCM	**DTC P0961-P0963**
P0965	Clutch Pressure Control Solenoid 2 System Performance	TCM	**DTC P0965-P0967**
P0966	Clutch Pressure Control Solenoid 2 Control Circuit Low Voltage	TCM	**DTC P0965-P0967**
P0967	Clutch Pressure Control Solenoid 2 Control Circuit High Voltage	TCM	**DTC P0965-P0967**
P0969	Clutch Pressure Control Solenoid 3 System Performance	TCM	**DTC P0969-P0971**
P0970	Clutch Pressure Control Solenoid 3 Control Circuit Low Voltage	TCM	**DTC P0969-P0971**
P0971	Clutch Pressure Control Solenoid 3 Control Circuit High Voltage	TCM	**DTC P0969-P0971**
P0973	Shift Solenoid 1 Control Circuit Low Voltage	TCM	**DTC P0973 or P0974**
P0974	Shift Solenoid 1 Control Circuit High Voltage	TCM	**DTC P0973 or P0974**
P0976	Shift Solenoid 2 Control Circuit Low Voltage	TCM	**DTC P0976 or P0977**
P0977	Shift Solenoid 2 Control Circuit High Voltage	TCM	**DTC P0976 or P0977**
P0989	Transmission Fluid Pressure Switch 5 Circuit Low Voltage	TCM	**DTC P0989 or P0990**
P0990	Transmission Fluid Pressure Switch 5 Circuit High Voltage	TCM	**DTC P0989 or P0990**
P1101	Intake Air Flow System Performance	ECM	**DTC P0101 or P1101**
P1133	HO2S Insufficient Switching Bank 1 Sensor 1	ECM	**DTC P0133, P013A-P013F, P014A, P014B, P0153, P1133, or P1153**
P1153	HO2S Insufficient Switching Bank 2 Sensor 1	ECM	**DTC P0133, P013A-P013F, P014A, P014B, P0153, P1133, or P1153**
P1255	Fuel Pump Control Module Driver Over-temperature	Fuel Pump Control Module	**DTC P1255 or P064A** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P1255 or P064A** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P1258	Engine Coolant Overtemperature - Protection Mode Active	ECM	**DTC P1258** or **DTC P1258**
P1380	Misfire Detected - Rough Road	ECM	**DTC P1380 (w/o LF1)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or

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	Data Not Available		**DTC P1380 or P1381** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P1381	Misfire Detected and No Communication With Brake Control Module	ECM	**DTC P1380 or P1381**
P1400	Cold Start Emission Reduction Control System	ECM	**DTC P1400**
P1516	Throttle Actuator Control Module Throttle Actuator Position Performance	ECM	**DTC P1516, P2101, P2119, or P2176**
P1551	Throttle Valve Rest Position Not Reached During Learn	ECM	**DTC P1551**
P162B	Remote Vehicle Speed Limiting Signal Message Counter Incorrect	ECM	**DTC P162B**
P1631	Immobilizer Fuel Enable Signal Not Correct	ECM	**DTC P1631**
P1648	Immobilizer Security Code Incorrect	ECM, BCM	**DTC P1648**
P1649	Immobilizer Security Code Not Programmed	ECM	**DTC P1649**
P167D	Control Module Ignition Coil Internal Circuit	ECM	**DTC P0601-P0604, P0606, P167D, or P2610 (ECM, LLT)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines
P1682	Ignition 1 Switch Circuit 2	ECM	**DTC P1682**
P1751	Shift Valve 1 Performance	TCM	**DTC P1751**
P1761	Up and Down Shift Switch Signal Circuit	TCM	**DTC P1761**
P182E	Internal Mode Switch - Invalid Range	TCM	**DTC P182E or P1915**
P1876	Up and Down Shift Enable Switch Circuit	TCM	**DTC P0815, P0816, P0826, or P1876**
P1915	Internal Mode Switch Does Not Indicate Park/Neutral During Start	TCM	**DTC P182E or P1915**
P2066	Fuel Level Sensor 2 Performance	ECM	**DTC P0461-P0463, P2066, P2067, or P2068**
P2067	Fuel Level Sensor 2 Circuit Low Voltage	ECM	**DTC P0461-P0463, P2066, P2067, or P2068**
P2068	Fuel Level Sensor 2 Circuit High Voltage	ECM	**DTC P0461-P0463, P2066, P2067, or P2068**
P2088	Intake Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Bank 1	ECM	**DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094, or P2095**
P2089	Intake Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage Bank 1	ECM	**DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094, or P2095**

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P2090	Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Bank 1	ECM	**DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094, or P2095**
P2091	Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage Bank 1	ECM	**DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094, or P2095**
P2092	Intake Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Bank 2	ECM	**DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094, or P2095**
P2093	Intake Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage Bank 2	ECM	**DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094, or P2095**
P2094	Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Bank 2	ECM	**DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094, or P2095**
P2095	Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage Bank 2	ECM	**DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094, or P2095**
P2096	Post Catalyst Fuel Trim System Low Limit Bank 1	ECM	**DTC P2096 or P2098**
P2097	Post Catalyst Fuel Trim System High Limit Bank 1	ECM	**DTC P2097 or P2099**
P2098	Post Catalyst Fuel Trim System Low Limit Bank 2	ECM	**DTC P2096 or P2098**
P2099	Post Catalyst Fuel Trim System High Limit Bank 2	ECM	**DTC P2097 or P2099**
P2100	Throttle Actuator Control Motor Control Circuit	ECM	**DTC P0638, P2100, P2101, or P2119**
P2101	Throttle Actuator Position Performance	ECM	**DTC P0638, P2100, P2101, or P2119** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P1516, P2101, P2119, or P2176** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P2105	Throttle Actuator Control System - Forced Engine Shutdown	ECM	**DTC P2105**
P2119	Throttle Closed Position Performance	ECM	**DTC P0638, P2100, P2101, or P2119** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P1516, P2101, P2119, or P2176** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P2120	Accelerator Pedal Position Sensor 1 Circuit	ECM	**DTC P2120, P2122, P2123, P2125, P2127, P2128, or P2138**
			DTC P2122, P2123, P2127, P2128, or

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P2122	Accelerator Pedal Position Sensor 1 Circuit Low Voltage	ECM	**P2138** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P2120, P2122, P2123, P2125, P2127, P2128, or P2138** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P2123	Accelerator Pedal Position Sensor 1 Circuit High Voltage	ECM	**DTC P2122, P2123, P2127, P2128, or P2138** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P2120, P2122, P2123, P2125, P2127, P2128, or P2138** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P2125	Accelerator Pedal Position Sensor 2 Circuit	ECM	**DTC P2120, P2122, P2123, P2125, P2127, P2128, or P2138**
P2127	Accelerator Pedal Position Sensor 2 Circuit Low Voltage	ECM	**DTC P2122, P2123, P2127, P2128, or P2138** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P2120, P2122, P2123, P2125, P2127, P2128, or P2138** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P2128	Accelerator Pedal Position Sensor 2 Circuit High Voltage	ECM	**DTC P2122, P2123, P2127, P2128, or P2138** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P2120, P2122, P2123, P2125, P2127, P2128, or P2138** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P2135	Throttle Position Sensor 1-2 Correlation	ECM	**DTC P0120, P0122, P0123, P0220, P0222, P0223, or P2135**
P2138	Accelerator Pedal Position Sensor 1-2 Correlation	ECM	**DTC P2122, P2123, P2127, P2128, or P2138** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P2120, P2122, P2123, P2125, P2127, P2128, or P2138** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P2146	Cylinder 1 Injector High Control Circuit	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D**
P2149	Cylinder 2 Injector High Control Circuit	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or**

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			P216D
P2152	Cylinder 3 Injector High Control Circuit	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D**
P2155	Cylinder 4 Injector High Control Circuit	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D**
P216A	Cylinder 5 Injector High Control Circuit	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D**
P216D	Cylinder 6 Injector High Control Circuit	ECM	**DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2146, P2149, P2152, P2155, P216A, or P216D**
P2176	Minimum Throttle Position Not Learned	ECM	**DTC P2176** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P1516, P2101, P2119, or P2176** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P2177	Fuel Trim System Lean at Cruise or Acceleration Bank 1	ECM	**DTC P2177, P2179, P2187, or P2189 (LLT)**
P2178	Fuel Trim System Rich at Cruise or Acceleration Bank 1	ECM	**DTC P2178, P2180, P2188, or P2190 (LLT)**
P2179	Fuel Trim System Lean at Cruise or Acceleration Bank 2	ECM	**DTC P2177, P2179, P2187, or P2189 (LLT)**
P2180	Fuel Trim System Rich at Cruise or Acceleration Bank 2	ECM	**DTC P2178, P2180, P2188, or P2190 (LLT)**
P2187	Fuel Trim System Lean at Idle Bank 1	ECM	**DTC P2177, P2179, P2187, or P2189 (LLT)**
P2188	Fuel Trim System Rich at Idle Bank 1	ECM	**DTC P2178, P2180, P2188, or P2190 (LLT)**
P2189	Fuel Trim System Lean at Idle Bank 2	ECM	**DTC P2177, P2179, P2187, or P2189 (LLT)**
P2190	Fuel Trim System Rich at Idle Bank 2	ECM	**DTC P2178, P2180, P2188, or P2190 (LLT)**
P219A	Fuel Trim Cylinder Balance Bank 1	ECM	**DTC P219A or P219B**

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P219B	Fuel Trim Cylinder Balance Bank 2	ECM	**DTC P219A or P219B**
P2227	Barometric Pressure Sensor Performance	ECM	**DTC P2227, P2228, or P2229 (LLT)**
P2228	Barometric Pressure Sensor Circuit Low Voltage	ECM	**DTC P2227, P2228, or P2229 (LLT)**
P2229	Barometric Pressure Sensor Circuit High Voltage	ECM	**DTC P2227, P2228, or P2229 (LLT)**
P2232	HO2S Signal Circuit Shorted to Heater Circuit Bank 1 Sensor 2	ECM	**DTC P2232 or P2235**
P2235	HO2S Signal Circuit Shorted to Heater Circuit Bank 2 Sensor 2	ECM	**DTC P2232 or P2235**
P2270	HO2S Signal Stuck Lean Bank 1 Sensor 2	ECM	**DTC P2270 or P2272** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P2270 or P2272** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P2271	HO2S Signal Stuck Rich Bank 1 Sensor 2	ECM	**DTC P2271 or P2273** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P2271 or P2273** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P2272	HO2S Signal Stuck Lean Bank 2 Sensor 2	ECM	**DTC P2270 or P2272** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P2270 or P2272** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P2273	HO2S Signal Stuck Rich Bank 2 Sensor 2	ECM	**DTC P2271 or P2273** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P2271 or P2273** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P2300	Ignition Coil 1 Control Circuit Low Voltage	ECM	**DTC P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, or P2316 (w/LLT)**
P2301	Ignition Coil 1 Control Circuit High Voltage	ECM	**DTC P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, or P2316 (w/LLT)**
P2303	Ignition Coil 2 Control Circuit Low Voltage	ECM	**DTC P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, or P2316 (w/LLT)**
	Ignition Coil 2 Control Circuit		**DTC P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309,**

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P2304	High Voltage	ECM	**P2310, P2312, P2313, P2315, or P2316 (w/LLT)**
P2306	Ignition Coil 3 Control Circuit Low Voltage	ECM	**DTC P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, or P2316 (w/LLT)**
P2307	Ignition Coil 3 Control Circuit High Voltage	ECM	**DTC P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, or P2316 (w/LLT)**
P2309	Ignition Coil 4 Control Circuit Low Voltage	ECM	**DTC P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, or P2316 (w/LLT)**
P2310	Ignition Coil 4 Control Circuit High Voltage	ECM	**DTC P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, or P2316 (w/LLT)**
P2312	Ignition Coil 5 Control Circuit Low Voltage	ECM	**DTC P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, or P2316 (w/LLT)**
P2313	Ignition Coil 5 Control Circuit High Voltage	ECM	**DTC P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, or P2316 (w/LLT)**
P2315	Ignition Coil 6 Control Circuit Low Voltage	ECM	**DTC P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, or P2316 (w/LLT)**
P2316	Ignition Coil 6 Control Circuit High Voltage	ECM	**DTC P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, or P2316 (w/LLT)**
P2534	Ignition 1 Switch Circuit Low Voltage	Fuel Pump Control Module	**DTC P2534** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P2534** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
		TCM	**DTC P2534**
P2544	Transmission Torque Request Circuit	ECM	**DTC P2544** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P2544** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
	Vehicle Dynamics System Torque		

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P2548	Request Signal Message Counter Incorrect	ECM	**DTC P2548**
P258A	Vacuum Pump Relay Control Circuit	ECM	**DTC P258A-P258D**
P258B	Vacuum Pump Performance	ECM	**DTC P258A-P258D**
P258C	Vacuum Pump Relay Control Circuit Low Voltage	ECM	**DTC P258A-P258D**
P258D	Vacuum Pump Relay Control Circuit High Voltage	ECM	**DTC P258A-P258D**
P2610	Control Module Ignition Off Timer Performance	ECM	**DTC P0601-P0604, P0606, P167D, or P2610 (ECM, LLT)** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P0601, P0602, P0603, P0604, P0606, P0607, P060D, P062F, or P2610 (ECM)** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P2635	Fuel Pump Flow Performance	Fuel Pump Control Module	**DTC P2635** for the 2.8L, 3.0L, 3.2L, or 3.6L engines or **DTC P2635** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
P2636	Fuel Transfer Pump Flow Insufficient	ECM	**DTC P2636**
P2714	Clutch Pressure Control Solenoid 4 - Stuck Off	TCM	**DTC P2714 or P2715**
P2715	Clutch Pressure Control Solenoid 4 - Stuck On	TCM	**DTC P2714 or P2715**
P2719	Clutch Pressure Control Solenoid 4 System Performance	TCM	**DTC P2719-P2721**
P2720	Clutch Pressure Control Solenoid 4 Control Circuit Low Voltage	TCM	**DTC P2719-P2721**
P2721	Clutch Pressure Control Solenoid 4 Control Circuit High Voltage	TCM	**DTC P2719-P2721**
P2723	Clutch Pressure Control Solenoid 5 - Stuck Off	TCM	**DTC P2723 or P2724**
P2724	Clutch Pressure Control Solenoid 5 - Stuck On	TCM	**DTC P2723 or P2724**
P2728	Clutch Pressure Control Solenoid 5 System Performance	TCM	**DTC P2728-P2730**
P2729	Clutch Pressure Control Solenoid 5 Control Circuit Low Voltage	TCM	**DTC P2728-P2730**
P2730	Clutch Pressure Control Solenoid 5 Control Circuit High Voltage	TCM	**DTC P2728-P2730**
	Torque Converter Clutch Pressure		

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P2762	Control Solenoid System Performance	TCM	**DTC P2762, P2763, or P2764**
P2763	Torque Converter Clutch Pressure Control Solenoid Control Circuit High Voltage	TCM	**DTC P2762, P2763, or P2764**
P2764	Torque Converter Clutch Pressure Control Solenoid Control Circuit Low Voltage	TCM	**DTC P2762, P2763, or P2764**
P3400	Cylinder Deactivation System Performance	ECM	**DTC P3400**
P3401	Cylinder 1 Deactivation Solenoid Control Circuit	ECM	**DTC P3401, P3425, P3441, or P3449**
P3425	Cylinder 4 Deactivation Solenoid Control Circuit	ECM	**DTC P3401, P3425, P3441, or P3449**
P3441	Cylinder 6 Deactivation Solenoid Control Circuit	ECM	**DTC P3401, P3425, P3441, or P3449**
P3449	Cylinder 7 Deactivation Solenoid Control Circuit	ECM	**DTC P3401, P3425, P3441, or P3449**
U0001	High Speed CAN Communication Bus	-	**DTC U0001**
U0002	High Speed CAN Bus	-	**DTC U0002**
U0020	Low Speed CAN Communication Bus Performance	-	**DTC U0020**
U0073	Control Module Communication Bus Off	-	**DTC U0073 or U2100**
U0074	Control Module Communication Bus B Off	-	**DTC U0074**
U0100 - U0299	Lost Communication With XXX Control Module	-	**DTC U0100-U02FF**
U0301	Software Incompatibility with Engine Control Module	-	**DTC U0300-U0336**
U0315	Software Incompatibility with Electronic Brake Control Module	-	**DTC U0300-U0336**
U0400 - U05FF	Invalid Data Received	-	**DTC U0400-U05FF**
U1500 - U15BF	Inter-Device Dedicated Bus	-	**DTC U1500-U15BF**
U1814	Powertrain Wake Up Communication Circuit	BCM	**DTC U1814**
U18B9	Primary High Speed CAN Bus Subnet Configuration List	-	**DTC U18B9-U18BF**
U18BF	Secondary High Speed CAN Bus Subnet Configuration List	-	**DTC U18B9-U18BF**
U2099	High Speed Communication	BCM	**DTC U2099**

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	Enable Circuit		
U2100	Controller Area Network Bus Communication	-	**DTC U0073 or U2100**
U2101	Controller Area Network Bus Maximum Configuration List	-	**DTC U2101**
U2103	Fewer Controllers On Bus Than Programmed	-	**DTC U2103**
U2105 - U2199	Lost Communication With XXX Control Module	-	**DTC U2105-U2199**

SYMPTOMS - VEHICLE

Body Systems

- **Symptoms - Fixed and Moveable Windows**
- **Symptoms - Horns**
- **Symptoms - Lighting**
- **Symptoms - Mirrors**
- **Symptoms - Vehicle Access**
- **Symptoms - Wiper/Washer Systems**

Brakes

- **Symptoms - Antilock Brake System**
- **Symptoms - Hydraulic Brakes**
- **Symptoms - Park Brake**

Driveline/Axle

- **Symptoms - Locking/Limited Slip Rear Axle**
- **Symptoms - Propeller Shaft**
- **Symptoms - Rear Drive Axle**

Driver Information and Entertainment

- **Symptoms - Cellular Communication**
- **Symptoms - Displays and Gauges**
- **Symptoms - Entertainment**
- **Symptoms - Secondary and Configurable Customer Controls**

Engine

- **Symptoms - Cruise Control**
- **Symptoms - Engine Controls** for the 2.8L, 3.0L, 3.2L, or 3.6L engines

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- **Symptoms - Engine Controls** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines
- **Symptoms - Engine Cooling**
- **Symptoms - Engine Electrical**
- **Symptoms - Engine Exhaust**
- **Symptoms - Engine Mechanical** for the 2.8L, 3.0L, 3.2L, or 3.6L engines
- **Symptoms - Engine Mechanical** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engines

General Information

Symptoms - Vibration Diagnosis and Correction

HVAC

Symptoms - HVAC Systems - Manual

Power and Signal Distribution

- **Symptoms - Data Communications**
- **Symptoms - Power Outlets**
- **Symptoms - Wiring Systems**

Roof

Symptoms - Roof

Safety and Security

- **Symptoms - Immobilizer**
- **Symptoms - Object Detection**
- **Symptoms - Remote Functions**
- **Symptoms - Seat Belts**
- **Symptoms - SIR**
- **Symptoms - Theft Deterrent**

Seats

- **Symptoms - Power Seats**
- **Symptoms - Seat Heating and Cooling**

Steering

- **Symptoms - Power Steering System**
- **Symptoms - Steering Wheel and Column**

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Suspension

- **Symptoms - Suspension General Diagnosis**
- **Symptoms - Tire Pressure Monitoring**

Transmission

- **Symptoms - Automatic Transmission**
- **Symptoms - Automatic Transmission Shift Lock Control**
- **Symptoms - Clutch**
- **Symptoms - Manual Transmission** for the Aisin AY6 transmission
- **Symptoms - Manual Transmission** for the Tremec 6-Speed transmission

ENGINE DOES NOT CRANK

Refer to the appropriate diagnostic procedure below for the symptom observed.

- **Starter Solenoid Does Not Click**
- **Starter Solenoid Clicks, Engine Does Not Crank**
- **Engine Cranks Slowly**

ENGINE CRANKS BUT DOES NOT RUN

Refer to the appropriate diagnostic procedure below for the vehicle being serviced.

- **Engine Cranks But Does Not Run** for the 2.8L, 3.0L, 3.2L, or 3.6L engine
- **Engine Cranks But Does Not Run** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engine

INSPECTION/MAINTENANCE SYSTEM CHECK

Refer to the appropriate diagnostic procedure below for the vehicle being serviced.

- **Inspection/Maintenance System Check** for the 2.8L, 3.0L, 3.2L, or 3.6L engine
- **Inspection/Maintenance System Check** for the 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L engine

DIAGNOSTIC REPAIR VERIFICATION

1. Install any components or connectors that have been removed or replaced during diagnosis.
2. Perform any adjustment, programming or setup procedures that are required when a component or module is removed or replaced.
3. Clear the DTCs.
4. Ignition OFF, all vehicle systems OFF, this may take up to 2 minutes.
5. If the repair was related to a DTC, duplicate the Conditions for Running the DTC and use the Freeze Frame/Failure Records, if applicable, in order to verify the DTC does not reset. If the DTC resets or

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another DTC is present, refer to the **Diagnostic Trouble Code (DTC) List - Vehicle** and perform the appropriate diagnostic procedure.

Or

If the repair was symptom related, duplicate the conditions under which the customer concern occurred to verify the repair. If the customer concern reoccurs or another symptom is present, return to **Symptoms - Vehicle** and perform the appropriate symptom diagnostic.

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2010 GENERAL INFORMATION

Vibration Diagnosis and Correction - Camaro

SPECIFICATIONS

TIRE AND WHEEL RUNOUT SPECIFICATIONS

Application	Specification	
	Metric	English
Tire and Wheel Assembly - Lateral and Radial		
• Off-Vehicle	1.27 mm	0.050 in
• On-Vehicle	1.52 mm	0.060 in
Wheel, Aluminum		
• Lateral	0.762 mm	0.030 in
• Radial	0.762 mm	0.030 in
Wheel, Steel		
• Lateral	1.143 mm	0.045 in
• Radial	1.015 mm	0.040 in
Wheel Hub/Axle Flange - Guideline	0.132 mm	0.0052 in
Wheel Stud - Guideline	0.25 mm	0.010 in

PROPELLER SHAFT RUNOUT SPECIFICATIONS

Application	Front Runout		Center Runout		Rear Runout		Stub Shaft Runout	
	Metric	English	Metric	English	Metric	English	Metric	English
1 Piece Propeller Shaft - Guideline	1.17 mm	0.046 in	1.27 mm	0.050 in	1.40 mm	0.055 in	-	-
1 Piece Aluminum Graphite Propeller Shaft - Guideline	1.17 mm	0.046 in	-	-	1.40 mm	0.055 in	-	-
2 Piece System Front Propeller Shaft with Slip Yoke - Guideline	0.76 mm	0.030 in	0.76 mm	0.030 in	0.71 mm	0.028 in	-	-

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2 Piece System Front Propeller Shaft with Stub Shaft - Guideline	0.76 mm	0.030 in	0.76 mm	0.030 in	-	-	0.13 mm	0.005 in
2 Piece System Rear Propeller Shaft with Slip Yoke - Guideline	0.71 mm	0.028 in	0.76 mm	0.030 in	0.89 mm	0.035 in	-	-
2 Piece System Rear Propeller Shaft with Stub Shaft - Guideline	-	-	0.76 mm	0.030 in	0.89 mm	0.035 in	0.13 mm	0.005 in
These guidelines apply only to propeller systems with 2 or 3 U-joints.								

DRIVELINE RUNOUT SPECIFICATIONS

Application	Specification	
	Metric	English
Differential Pinion Input Shaft or Flange Pilot	0.05 mm	0.002 in
Torque Tube Input Flange	0.20 mm	0.008 in
Transmission or Transfer Case Output Flange	0.20 mm	0.008 in
These guidelines apply only to propeller shaft systems with a constant velocity (CV) joint, rubber coupling, or bolt-on U-joint yoke.		

DIAGNOSTIC INFORMATION AND PROCEDURES

VIBRATION ANALYSIS - ROAD TESTING

Special Tools

- **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2
- **GE-38792-VS:** Vibrate Software

For equivalent regional tools, refer to **Special Tools and Equipment**.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

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5: Obtaining rotational speed for the components rotating at tire/wheel speed is critical to systematically eliminating specific vehicle component groups. These component rotational speeds can be generated by using the **GE-38792-A:** Vibrate Software, or through calculating them manually.

14:

NOTE: Be certain to OBSERVE for disturbances that match the customer's description FIRST, then look at the GE-38792-A: Electronic Vibration Analyzer (EVA) 2 frequency which corresponds with that disturbance.

17: Accelerate to a speed high enough above the speed of the disturbance to allow for the time needed to shift into NEUTRAL and for the engine to decrease in RPM to idle speed, before coasting down through the disturbance range.

18: This test will either eliminate or confirm the engine as a contributing cause of the customer concern.

Step	Action	Yes	No
WARNING: Refer to Road Test Warning .			
1	Did you review the Diagnostic Starting Point - Vibration Diagnosis?	Go to **Step 2**	Go to **Diagnostic Starting Point - Vehicle**
2	Did the customer concern indicate that the vibration occurs ONLY while the vehicle is standing still?	Go to **Step 6**	Go to **Step 3**
3	Visually inspect the tire and wheel assemblies, steering components and suspension components for any possible faults. Are the tire and wheel assemblies, steering components and suspension components in good working condition?	Go to **Step 5**	Go to **Step 4**
4	**NOTE:** **Do NOT operate the vehicle until the faults are corrected.** Correct the faults with the tire and wheel assemblies, steering components, and/or the suspension components before proceeding.Did you correct the faults with the tire and wheel assemblies, steering components, and/or the suspension components?	Go to **Step 5**	Go to **Step 3**
5	1. Obtain the drive axle final drive ratio. 2. If the **GE-38792-VS:** software, IS available, obtain the transmission gear ratios. 3. If the **GE-38792-VS:** software is NOT available, take note of the tire size on each axle, then calculate the tire rotational speed for each size tire used and calculate the propeller shaft		-

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	rotational speed, if equipped. Refer to **Component Rotational Speed Calculation**. Did you obtain the powertrain ratios for use with the **GE-38792-VS:** software, or calculate the component rotational speeds, if **GEJ-38792-VS:** software is NOT available?	Go to **Step 6**	
6	1. Install a scan tool. 2. With the scan tool, bring up the Powertrain Control Module data list and select Engine Speed. Is the scan tool operating properly?	Go to **Step 7**	Go to **Diagnostic System Check - Vehicle**
7	Using the **GE-38792-A:** EVA 2, is the preferred method for gathering necessary vibration frequency data. If the **GE-38792-A:** EVA 2 is not available, the necessary vibration frequency data will have to be obtained based on symptoms observed during testing. Review **Symptoms - Vibration Diagnosis and Correction** to become familiar with the possible frequency ranges. Review Symptoms - Vibration Diagnosis and Correction, as necessary throughout the remainder of diagnostics. Is the **GE-38792-A:** EVA 2 available for use?	Go to **Step 8**	Go to **Step 9**
8	Install the **GE-38792-A:** EVA 2. Is the **GE-38792-A:** EVA 2 operating properly?	Go to **Step 9**	Go to **Electronic Vibration Analyzer (EVA) Description and Operation**
9	Did the customer concern indicate that the vibration occurs ONLY while the vehicle is standing still?	Go to **Vibration Analysis - Engine**	Go to **Step 10**
10	Did the customer concern indicate that the vibration occurs ONLY during heavy acceleration at launch?	Go to **Step 11**	Go to **Step 14**
	1. Install the **GE-38792-A:** EVA 2 sensor, if available, to the pinion area of the drive axle. Route the sensor lead wire clear of rotating parts and loosely secure the wire clear of moving parts. If it is not possible to install the **GE-38792-A:** EVA 2 sensor, if available, to the drive axle, install the sensor to an exposed portion of the floor panel or seat track in the area that the customer noted is most respondent to the vibration. 2. Select a smooth, level road.		

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11	3. With the vehicle at a stand-still, apply the regular brake and place the transmission in the lowest forward gear. **NOTE:** **Do not accelerate to the point of causing the drive wheels to squeal, slip or hop - this would obscure the results of the test.** 4. Release the regular brakes and accelerate aggressively to 32 km/h (20 mph). 5. Observe the vehicle for disturbances that match the customer's description and note the following conditions: • The vibration frequency reading, if detected by the **GE-38792-A:** EVA • The feel and/or sound of the disturbance 6. If a reading could not be obtained by the **GE-38792-A:** EVA 2, move the **GE-38792-A:** EVA 2 sensor, if available, to another part that is respondent to the vibration and repeat steps 3-5. Were you able to duplicate the customer's concern?	Go to **Step 12**	Go to **Step 14**
12	Is the vehicle primary driveline configuration rear wheel drive?	Go to **Step 13**	Go to **Step 14**
13	Is the vehicle equipped with a solid drive axle?	Go to **Vibration Analysis - Driveline**	Go to **Vibration Analysis - Hub and/or Axle Input**
14	1. Install the **GE-38792-A:** EVA 2 sensor, if available, to the component identified by the customer as most respondent to the vibration. If no component was identified, install the **GE-38792-A:** EVA 2 sensor, if available, to the steering column. You may have to move the sensor to other locations later. 2. Select a smooth, level road and slowly accelerate the vehicle up to highway speed. 3. Observe the vehicle for disturbances that match the customer's description and note the following conditions: • The vehicle speed • The engine RPM • The transmission gear range and the specific gear		

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	• The vibration frequency reading, if detected by the **GE-38792-A:** EVA 2 • The feel and/or sound of the disturbance 4. If the vibration seems to excite a particular component of the vehicle more than the steering column, then move the **GE-38792-A:** EVA 2 sensor, if available, onto that component and repeat steps 2 and 3. Were you able to duplicate the customer's concern?	Go to **Step 17**	Go to **Step 15**
15	Is the vehicle equipped with selectable four-wheel or all-wheel drive?	Go to **Step 16**	Go to **Step 17**
16	1. With the **GE-38792-A:** EVA 2 sensor still installed in the same position, activate/engage all-wheel drive. 2. Select a smooth, level road and slowly accelerate the vehicle up to highway speed. 3. Observe the vehicle for disturbances that match the customer's description and note the following conditions: • The vehicle speed • The engine RPM • The transmission gear range and the specific gear • The vibration frequency reading, if detected by the **GE-38792-A:** EVA 2 • The feel and/or sound of the disturbance 4. If the vibration seems to excite a particular component of the vehicle more than the steering column, then move the **GE-38792-A:** EVA 2 sensor, if available, onto that component and repeat steps 2 and 3. Were you able to duplicate the customer's concern?	Go to **Step 17**	Go to **Vibration Diagnostic Aids**
17	1. Accelerate the vehicle to a speed higher than the speed at which the disturbance occurs. **NOTE:** **If the vehicle is equipped with a continuously variable type automatic transmission, let the vehicle coast to a stop before shifting back into gear.** 2. Shift the vehicle into NEUTRAL and allow the		

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	vehicle to coast down through the disturbance range. Does the disturbance still occur while coasting-down in NEUTRAL?	Go to **Step 19**	Go to **Step 18**
18	1. Select a smooth, level road and slowly accelerate the vehicle up to the speed at which the disturbance occurs. 2. Decelerate and safely downshift by one gear range. 3. Operate the vehicle at the same VEHICLE SPEED at which the disturbance occurs. Does the same disturbance still occur while going the same vehicle speed in a lower gear range?	Go to **Vibration Analysis - Hub and/or Axle Input**	Go to **Vibration Analysis - Engine**
19	If the **GE-38792-A:** EVA 2 is not available, refer to **Symptoms - Vibration Diagnosis and Correction**. Did the **GE-38792-A:** EVA 2 detect a dominant frequency?	Go to **Step 20**	Go to **Symptoms - Vibration Diagnosis and Correction**
20	1. If the **GE-38792-VS:** software IS available, use the drive axle final drive ratio, the specific transmission gear ratio, and the engine RPM to make a comparison to the dominant frequency reading recorded. 2. If the **GE-38792-VS:** software is NOT available, compare the dominant frequency reading recorded to the component rotational data which you calculated previously. Does the frequency data clearly fall within the tire/wheel parameters ONLY?	Go to **Vibration Analysis - Tire and Wheel**	Go to **Step 21**
21	Does the frequency data clearly fall within the propeller shaft parameters ONLY?	Go to **Vibration Analysis - Driveline**	Go to **Step 22**
22	Is the vehicle equipped with a solid drive axle?	Go to **Symptoms - Vibration Diagnosis and Correction**	Go to **Vibration Analysis - Hub and/or Axle Input**

COMPONENT ROTATIONAL SPEED CALCULATION

Special Tools

GE-38792-A: Electronic Vibration Analyzer (EVA) 2

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For equivalent regional tools, refer to **Special Tools and Equipment**.

Tire Rotational Speed

Determining Tire Revolutions Per Second at 8 km/h (5 mph) - Using EVA

Tire and wheel assembly rotational speed can be obtained through using the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2. Perform the following steps using the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2 to obtain the rotational speed at 8 km/h (5 mph). Use the Enter key to advance and the Exit key to backup.

1. On the Main Menu screen, select Auto Mode.
2. On the Suspected Source screen, select Vehicle Speed.
3. On the Tire Info Source screen, select Manual Entry.
4. On the Tire Width screen, enter the specific width of the tires.

   For example: For a P275/55R20 tire, enter 275.

5. On the Aspect Ratio screen, enter the specific aspect ratio of the tires.

   For example: For a P275/55R20 tire, enter 0.55.

6. On the Rim Diameter screen, enter the specific rim diameter size.

   For example: For a P275/55R20 tire, enter 20.0.

7. On the Driveshaft Configuration screen, enter FWD, even if the vehicle is a rear wheel drive.
8. The next screen will display the tire size just entered for confirmation.

   For example: 275 0.55 20.0 - Front Wheel Drive. If the tire size displayed is correct, press Enter.

9. On the Vehicle Speed Units screen, press Enter, disregard mph or km/h.
10. Press the Exit key several times slowly while watching the backwards progression of the screens. Stop at the Tire Info Source screen.
11. On the Tire Info Source screen, select RPS at 5 mph.
12. The next screen will display the revolutions per second (RPS) at 8 km/h (5 mph) for that specific tire size.

    For example: The P275/55R20 will display 0.90 RPS.

Calculating Tire Revolutions Per Second at 8 km/h (5 mph) - Without EVA

If the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2 is not available, the tire and wheel assembly rotational speed can be calculated approximately by performing the following steps.

1. Convert the rim diameter size from inches to centimeters.

   For example: For a P275/55R20 tire, the rim diameter of 20 in X 2.54 converts to 50.80 cm.

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2. Calculate the radius of the rim by dividing the rim diameter by 2.

   For example: For a P275/55R20 tire, the rim diameter of 20 in converted to 50.80 cm divided by 2 = rim radius 25.40 cm.

3. Calculate the approximate tire sidewall height by multiplying the specific tire tread width by the aspect ratio, then reduce 7 percent from the amount by multiplying by 93 percent to approximate load on the tire reducing the sidewall height.

   For example: For a P275/55R20 tire, tread width 275 mm X aspect ratio as a decimal 0.55 = 151 mm X 0.93 = approximate sidewall height 140.43 mm.

4. Convert the calculated approximate tire sidewall height from millimeters to centimeters.

   For example: For a P275/55R20 tire, approximate sidewall height 140.43 mm converts to 14.04 cm.

5. Calculate the approximate tire and wheel assembly radius by adding the rim radius and approximate sidewall height, both in cm.

   For example: For a P275/55R20 tire, rim radius 25.40 cm + 14.04 cm = approximate tire and wheel assembly radius 39.44 cm.

6. Calculate the approximate circumference of the tire and wheel assembly by multiplying 2 X pi, or 6.283185 X the approximate tire and wheel assembly radius.

   For example: For a P275/55R20 tire, 6.283185 X approximate tire and wheel assembly radius 39.44 cm = approximate tire and wheel assembly circumference 247.809 cm.

7. Calculate the approximate revolutions per kilometer by dividing the number of cm in 1 km, 100,000 cm by the approximate tire and wheel assembly circumference.

   For example: For a P275/55R20 tire, 100,000 cm divided by approximate tire and wheel assembly circumference 247.809 cm = approximate revolutions per kilometer 403.537.

8. Calculate the approximate revolutions per second (RPS), or Hz, by dividing the approximate revolutions per kilometer by the number of seconds to travel 1 km at a speed of 8 km per hour, 450 seconds.

   For example: For a P275/55R20 tire, approximate revolutions per kilometer 403.537 divided by the number of seconds to travel 1 km at a speed of 8 km per hour, 450 seconds = approximate RPS, or Hz 0.897 rounded to 0.90.

Calculating Tire Revolutions Per Second, or Hz at Concern Speed

A size P235/75R15 tire rotates ONE complete revolution per second (RPS), or 1 Hz, at a vehicle speed of 8 km/h (5 mph). This means that at 16 km/h (10 mph), the same tire will make 2 complete revolutions in one second, 2 Hz, and so on.

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1. Determine the rotational speed of the tires in revolutions per second (RPS), or Hertz (Hz), at 8 km/h (5 mph), based on the size of the tires. Refer to the preceding Tire Rotational Speed information.

   For example: According to the Tire Rotational Speed information, a P275/55R20 tire makes 0.90 revolutions per second, or Hz at a vehicle speed of 8 km/h (5 mph). This means that for every increment of 8 km/h (5 mph) in vehicle speed, the tire rotation increases by 0.90 revolutions per second, or Hz.

2. Determine the number of increments of 8 km/h (5 mph) that are present, based on the vehicle speed km/h (mph) at which the disturbance occurs.

   For example: Assume that a disturbance occurs at a vehicle speed of 96 km/h (60 mph). A speed of 96 km/h (60 mph) has 12 INCREMENTS of 8 km/h (5 mph):

   96 km/h (60 mph) divided by 8 km/h (5 mph) = 12 increments

3. Determine the rotational speed of the tires in revolutions per second, or Hz, at the specific vehicle speed km/h (mph) at which the disturbance occurs.

   For example: To determine the tire rotational speed at 96 km/h (60 mph), multiply the number of increments of 8 km/h (5 mph) by the revolutions per second, or Hz, for one increment:

   12 (increments) X 0.90 Hz = 10.80 Hz, rounded to 11 Hz

   NOTE: **If the GE-38792-A: Electronic Vibration Analyzer (EVA) 2 is not available, compare the calculated rotational speed to the frequency range associated with the symptoms of the vibration concern. Refer to Symptoms - Vibration Diagnosis and Correction.**

4. Compare the rotational speed of the tires at the specific vehicle speed at which the disturbance occurs, to the dominant frequency recorded on the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2 during testing. If the frequencies match, then a first-order disturbance related to the rotation of the tire/wheel assemblies is present.

   If the frequencies do not match, then the disturbance may be related to a higher order of tire/wheel assembly rotation.

5. To compute higher order tire/wheel assembly rotation related disturbances, multiply the rotational speed of the tires at the specific vehicle speed at which the disturbance occurs, by the order number:

   11 Hz X 2, for second order = 22 Hz second-order tire/wheel assembly rotation related

   11 Hz X 3, for third order = 33 Hz third-order tire/wheel assembly rotation related

   If any of these computations match the frequency of the disturbance, a disturbance of that particular order, relating to the rotation of the tire/wheel assemblies and/or driveline components, also rotating at the same speed, is present.

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Calculating Propeller Shaft Revolutions Per Second, or Hz at Concern Speed

1. Determine the first order rotational speed of the propeller shaft system in revolutions per second, or Hz, based on the first-order rotational speed of the tire/wheel assemblies and the drive axle, or axles final drive ratio or ratios.

   11 Hz X 3.42 drive axle final drive ratio = 37.62 Hz, rounded to 38 Hz, first-order propeller shaft rotation related

2. Compare the rotational speed of the propeller shafts at the specific vehicle speed at which the disturbance occurs, to the dominant frequency recorded on the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2 during testing. If the frequencies match, then a first-order disturbance related to the rotation of the propeller shaft is present.

   If the frequencies do not match, then the disturbance may be related to the second-order of propeller shaft rotation.

3. To compute a second order propeller shaft rotation related disturbance, multiply the first order rotational speed of the propeller shaft at the specific vehicle speed at which the disturbance occurs, by the order number of 2:

   38 Hz X 2, for second order = 76 Hz second-order propeller shaft rotation related

   If the computation matches the frequency of the disturbance, a disturbance relating to the second-order rotation of the propeller shaft is present.

Component Rotational Speed Worksheet

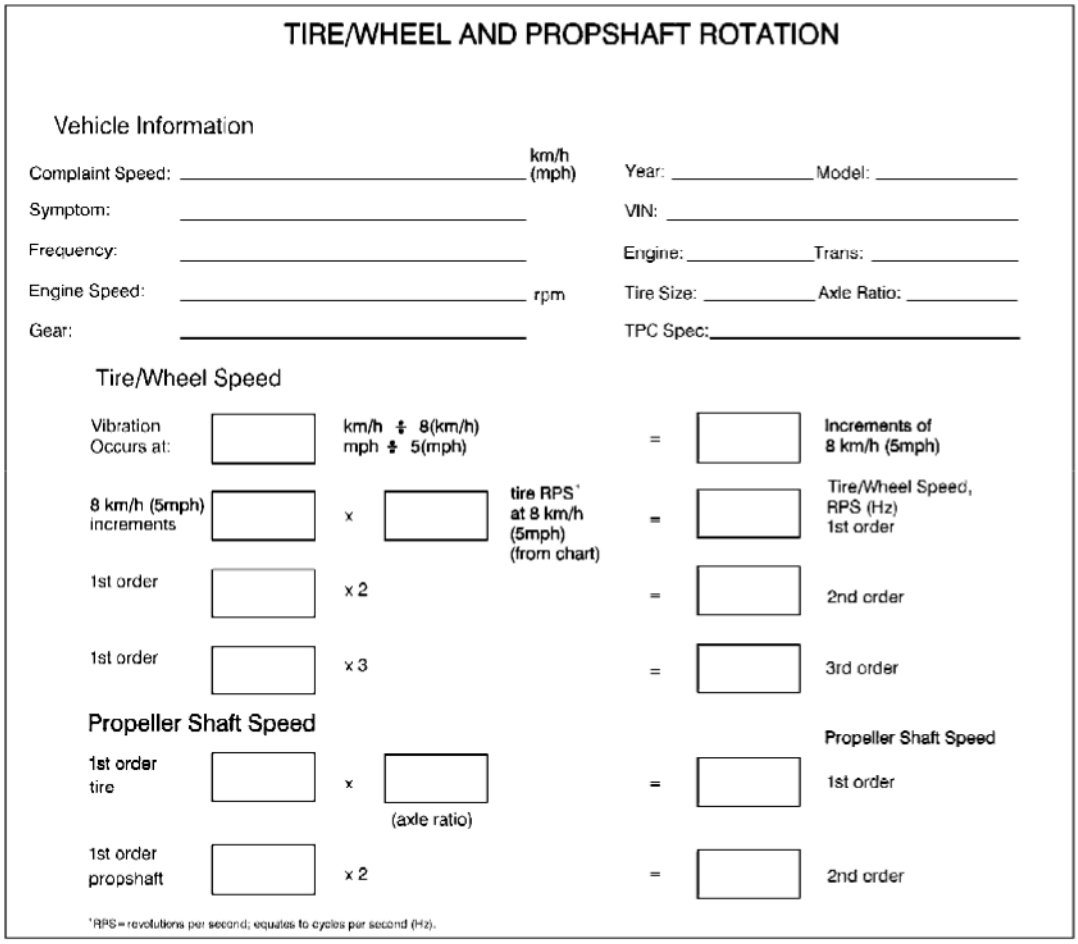
Utilize the following worksheet as an aid in calculating the first, second and third order of tire/wheel assembly rotational speed and the first and second order of propeller shaft rotational speed related disturbances that may be present in the vehicle.

If after completing the Tire/Wheel Rotation Worksheet, the frequencies calculated do NOT match the dominant frequency of the disturbance recorded during testing, either recheck the data, or attempt to rematch the figures allowing for 11/2-8 km/h (1-5 mph) of speedometer error.

If the possible tire/wheel assembly and/or propeller shaft rotational speed related frequencies still do not match the dominant frequency of the disturbance, the disturbance is most likely torque/load sensitive.

If after completing the Tire/Wheel Rotation Worksheet, one of the frequencies calculated DOES match the dominant frequency of the disturbance, the disturbance is related to the rotation of that component group - tire/wheel assembly or propeller shaft related.

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TIRE/WHEEL AND PROPSHAFT ROTATION

Vehicle Information

Complaint Speed: _____ km/h (mph)
Year: _____ Model: _____
Symptom: _____
VIN: _____
Frequency: _____
Engine: _____ Trans: _____
Engine Speed: _____ rpm
Tire Size: _____ Axle Ratio: _____
Gear: _____
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

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

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

Fig. 1: Tire/Wheel Rotation Worksheet
Courtesy of GENERAL MOTORS CORP.

VIBRATION ANALYSIS - TIRE AND WHEEL

Test Description

The numbers below refer to the step numbers in the diagnostic table:

4: A build-up of foreign material on a tire and wheel assembly and/or a damaged, abnormally or excessively worn tire and wheel assembly could cause a vibration disturbance.

6: Tire and wheel assemblies that exhibit excessive runout when measured while mounted on the vehicle, may or may not be contributing to, or causing a vibration disturbance. On-vehicle runout, if present, could contribute to, or cause a vibration disturbance, but the cause of the on-vehicle runout may not be the tire and wheel assemblies.

7: Tire and wheel assemblies that exhibit excessive runout when measured off of the vehicle could cause a vibration disturbance.

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9: Tire and wheel assemblies that exhibit marginal runout-within acceptable limits, but close to the maximum-when measured off of the vehicle could still be contributing to a vibration disturbance, if its mating hub/axle flange also exhibits marginal runout. When the tire and wheel assembly and the hub axle flange are mounted to each other, the combined stack-up of their marginal amounts of runout could combine to produce an excessive amount of runout, which could cause a vibration disturbance.

14: Brake rotors and/or brake drums, if equipped, that exhibit excessive imbalance could contribute to, or possibly cause a vibration disturbance.

15: A hub/axle flange and/or wheel studs that exhibit excessive runout could cause a vibration disturbance.

16: When the tire and wheel assembly and the hub axle flange are mounted to each other, the combined stack-up of their marginal amounts of runout could combine to produce an excessive amount of runout, which could cause a vibration disturbance. Match-mounting or vectoring the tire and wheel assembly to the hub/axle flange will modify the amount of combined runout.

18: Force variation may be present in a tire and wheel assembly that exhibited acceptable balance and runout. Force variation, if present, could contribute to, or cause a vibration disturbance.

20: Vibration disturbances could be affected by, or possibly caused by, components that are susceptible to steering input and/or torque-load input.

22: On-vehicle balancing, or finish-balancing can be used to reduce small amounts of imbalance which may be present as a result of the combined stack-up of the tire and wheel assembly with other components which may exhibit marginal balance.

Step	Action	Yes	No
1	Has the Vibration Analysis - Road Testing table been completed?	Go to **Step 2**	Go to **Vibration Analysis - Road Testing**
2	Based on the Vibration Analysis - Road Testing table, is the concern first-order tire and wheel assembly related?	Go to **Step 4**	Go to **Step 3**
3	Based on the Vibration Analysis - Road Testing table, is the concern second-order, or higher-order tire and wheel assembly related?	Go to **Step 18**	Go to **Vibration Analysis - Road Testing**
4	Visually inspect the tire and wheel assemblies for the following: • Debris build-up, such as packed mud, undercoating, ice/snow buildup, road tar, etc. • Damage, abnormal or excessive wear Refer to **Tire and Wheel Inspection**. Do any of the tire and wheel assemblies exhibit any of the conditions listed?	Go to **Step 5**	Go to **Step 6**
	1. Remove the debris from the tire and wheel assemblies.		

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5	2. Replace the damaged, abnormally or excessively worn wheels or tires as necessary. Did you complete the repair or replacement?	Go to **Step 23**	-
6	Measure the on-vehicle runout of the tire and wheel assemblies. Refer to **Tire and Wheel Assembly Runout Measurement - On-Vehicle**. Does the runout measurement indicate a runout concern?	Go to **Step 7**	Go to **Step 12**
7	Measure the off-vehicle runout of the tire and wheel assemblies. Refer to **Tire and Wheel Assembly Runout Measurement - Off Vehicle**. Does the runout measurement indicate a runout concern?	Go to **Step 19**	Go to **Step 8**
8	Is the vehicle equipped with run-flat tires?	Go to **Step 12**	Go to **Step 9**
9	Are any of the tire and wheel assembly runout measurements marginal; within acceptable limits, but close to the maximum?	Go to **Step 10**	Go to **Step 15**
10	**NOTE:** **Ensure that each tire and wheel assembly that is match-mounted is properly balanced before reinstalling to the vehicle.** 1. Match-mount the tire-to-wheel for each tire and wheel assembly with marginal runout. Refer to **Tire-to-Wheel Match-Mounting (Vectoring)**. 2. Measure the runout of each match-mounted tire and wheel assembly. Refer to **Tire and Wheel Assembly Runout Measurement - Off Vehicle**. Were you able to significantly reduce the amount of tire and wheel assembly runout?	Go to **Step 11**	Go to **Step 19**
11	Re-measure the on-vehicle runout of the tire and wheel assemblies. Refer to **Tire and Wheel Assembly Runout Measurement - On-Vehicle**. Does the measurement indicate a runout concern?	Go to **Step 15**	Go to **Step 23**
12	Inspect the balance of the tire and wheel assemblies. Refer to **Tire and Wheel Assembly Balancing - Off Vehicle**. Are any or the tire and wheel assemblies out of balance?	Go to **Step 13**	Go to **Step 14**
13	Balance the tire and wheel assemblies as necessary. Refer to **Tire and Wheel Assembly Balancing - Off Vehicle**. Were you able to achieve balance?	Go to **Step 23**	Go to **Vibration Diagnostic Aids**

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14	1. Inspect the brake rotors and brake drums, if equipped, for damage. 2. Inspect the balance of the brake rotors and brake drums, if equipped. Refer to **Brake Rotor/Drum Balance Inspection**. 3. Replace brake rotors and/or brake drums, if equipped, that are damaged and/or out of balance. Did you find and correct a condition?	Go to **Step 23**	Go to **Step 17**
15	1. Measure the runout of the hub/axle flanges and the wheel studs, if equipped. 2. Inspect the wheel bolts, if equipped, for straightness and damage. 3. Refer to **Hub/Axle Flange and Wheel Stud Runout Inspection**. 4. If the inspection procedure indicates a runout concern, replace the appropriate components: • Wheel studs, if equipped • Wheel bolts, if equipped • Wheel bearing/hub assembly Did you find and correct a condition?	Go to **Step 23**	Go to **Step 16**
16	1. Match-mount the tire and wheel assemblies-to-hub/axle flanges. Refer to **Tire and Wheel Assembly-to-Hub/Axle Flange Match-Mounting**. 2. Re-measure the on-vehicle runout of tire and wheel assemblies. Refer to **Tire and Wheel Assembly Runout Measurement - On-Vehicle**. Were you able to significantly reduce the amount of on-vehicle tire and wheel assembly runout?	Go to **Step 23**	Go to **Step 2**
17	Inspect for radial and lateral force variation. Refer to **Tire and Wheel Assembly Isolation Test**. Were you able to isolate one or more of the tire and wheel assemblies as the cause of the disturbance?	Go to **Step 19**	Go to **Step 20**
18	Inspect for radial and lateral force variation. Refer to **Tire and Wheel Assembly Isolation Test**. Were you able to isolate one or more of the tire and wheel assemblies as the cause of the disturbance?	Go to **Step 19**	Go to **Step 21**
19	Replace any tires and/or wheels that were isolated as the cause of the disturbance, as necessary. Did you complete the replacement?	Go to **Step 23**	-

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20	Perform the Vibration Analysis - Hub/Axle Input table. Refer to **Vibration Analysis - Hub and/or Axle Input**. Did you find and correct a condition?	Go to **Step 23**	Go to **Step 22**
21	Perform the Vibration Analysis - Hub/Axle Input table. Refer to **Vibration Analysis - Hub and/or Axle Input**. Did you find and correct a condition?	Go to **Step 23**	Go to **Vibration Diagnostic Aids**
22	Finish-balance the tire and wheel assemblies on-vehicle. Refer to **Tire and Wheel Assembly Balancing - On-Vehicle**. Did you complete the on-vehicle finish balancing?	Go to **Step 23**	-
23	1. Install or connect any components that were removed or disconnected during diagnosis. 2. Perform the Vibration Analysis - Road Testing table. Refer to **Vibration Analysis - Road Testing**. Is the vibration still present?	Go to **Step 2**	System OK

VIBRATION ANALYSIS - DRIVELINE

Step	Action	Yes	No
1	Has the Vibration Analysis - Road Testing table been completed?	Go to **Step 2**	Go to **Vibration Analysis - Road Testing**
2	Did you duplicate a vibration concern that occurs only during heavy acceleration at launch?	Go to **Step 3**	Go to **Step 4**
3	Is the vehicle equipped with a solid drive axle and at least 1 U-joint in the propeller shaft system?	Go to **Step 26**	Go to **Step 4**
4	Did you record frequency data from the **J-38792-A:** Electronic Vibration Analyzer (EVA) 2, during the Vibration Analysis - Road Testing procedure?	Go to **Step 5**	Go to **Step 10**
5	Based on the Vibration Analysis - Road Testing table, is the concern first order, sixth order, or a slightly higher multiple of first order driveline related?	Go to **Step 6**	Go to **Step 8**
6	Is the vehicle equipped with a rear mounted transaxle assembly?	Go to **Step 7**	Go to **Step 11**
7	Inspect the drive axle for proper operation. Refer to the Drive Axle diagnosis information. Did you find and correct a condition?	Go to **Step 32**	Go to **Step 2**
8	Based on the Vibration Analysis - Road Testing table, is the concern second order driveline related?	Go to **Step 9**	Go to **Step 10**
9	Does the vehicle driveline contain any U-joints?	Go to **Step 26**	Go to **Vibration Diagnostic Aids**
10	Based on the Vibration Analysis - Road Testing table, is the concern a noise that is not felt?	Go to **Vibration**	Go to **Vibration Analysis - Road**

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		Diagnostic Aids	Testing
11	1. Inspect the following components for wear and/or damage: • Inspect the propeller shafts for dents, damage, missing weights, and/or undercoating. • Inspect the U-joint, or joints, if equipped, for excessive wear, looseness, and/or damage. • Inspect the prop shaft constant velocity (CV) joint, or joints, if equipped, for excessive wear, looseness, and/or damage. • Inspect the prop shaft coupler assembly, or assemblies, if equipped, for excessive wear, looseness, and/or damage. • Inspect the prop shaft support bearing, if equipped, for damaged rubber components, worn bearings, looseness, and/or a deformed or cracked bracket. • Inspect the drive axle mounts, if equipped, for excessive wear, looseness, and/or damage. 2. Replace any of the components found to be worn or damaged. Did you find and correct a condition?	Go to **Step 32**	Go to **Step 12**
12	Attempt to duplicate the vibration in the stall. Refer to **Vibration in Service-Stall Test (Non-Torque Sensitive)**. Were you able to duplicate the vibration?	Go to **Step 16**	Go to **Step 13**
13	Perform the **Vibration in Service-Stall Test (Torque Sensitive)**. Were you able to duplicate the vibration?	Go to **Step 14**	Go to **Vibration Diagnostic Aids**
14	Is the vehicle front wheel drive with an all wheel drive system?	Go to **Step 15**	Go to **Vibration Diagnostic Aids**
15	1. Remove the propeller shaft. 2. Perform the **Vibration in Service-Stall Test (Torque Sensitive)**. Is the vibration still present?	Go to Transfer Case diagnosis information	Go to Drive Axle diagnosis information
16	Was the vibration most evident under the transmission or the transfer case, if equipped?	Go to **Step 17**	Go to **Step 20**
	1. If the driveline joint at the transmission or transfer case is a U-joint, measure the prop shaft		

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17	runout at the end closest to the transmission or transfer case. Refer to **Propeller Shaft Runout Measurement**. 2. If the driveline joint at the transmission or transfer case is a CV joint, measure the runout of the transmission or transfer case output flange. Refer to **Transfer Case Output Flange Runout Measurement**. 3. If the driveline joint at the transmission or transfer case is a coupler assembly, inspect the coupler assembly for excessive wear, looseness, missing or broken fasteners, and/or damage. Measure the runout of the transmission or transfer case output flange. Refer to **Transfer Case Output Flange Runout Measurement**. 4. Replace components as necessary. Did you find and correct a condition?	Go to **Step 19**	Go to **Step 18**
18	1. Inspect the powertrain mounts for the following: • Loose and/or missing fasteners • Improper alignment • Cracked, dry-rotted, and/or oil-soaked insulators • Twisted, broken, torn, and/or collapsed insulators • Bent, twisted, and/or deformed brackets 2. Replace the powertrain mounts as necessary. Did you find and correct a condition?	Go to **Step 19**	Go to **Step 20**
19	Perform the **Vibration in Service-Stall Test (Non-Torque Sensitive)**. Is the vibration still present?	Go to **Step 20**	Go to **Step 32**
	1. Inspect the prop shaft U-joint, or joints, if equipped, for excessive wear, looseness, and/or damage. 2. Inspect the prop shaft CV joint, or joints, if equipped, for excessive wear, looseness, and/or damage. 3. Inspect the prop shaft coupler assembly for excessive wear, looseness, broken or missing fasteners, and/or damage. 4. Inspect the prop shaft support bearing assembly, if equipped, for damaged rubber components,		

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20	worn bearings, and/or a deformed or cracked bracket. 5. If the driveline joint at the drive axle is a U-joint, measure the runout of the complete prop shaft, or shafts. Refer to **Propeller Shaft Runout Measurement**. 6. If the driveline incorporates a torque tube attached to the drive axle and the joint at the torque tube is a CV joint, coupler assembly, or bolt-on U-joint yoke, measure the runout of the torque tube input flange. Refer to **Torque Tube Input Flange Runout Measurement**. 7. Replace components as necessary. Did you find and correct a condition?	Go to **Step 21**	Go to **Step 22**
21	Perform the **Vibration in Service-Stall Test (Non-Torque Sensitive)**. Is the vibration still present?	Go to **Step 22**	Go to **Step 32**
22	1. Measure the runout of the drive axle pinion input flange or shaft: • If the driveline joint at the drive axle is a U-joint and if the U-joint yoke is Not a bolt-on type, refer to **Pinion Flange Runout Measurement** . • If the driveline joint at the drive axle is a U-joint and if the U-joint yoke IS a bolt-on type, refer to **Differential Pinion Input Shaft Runout Measurement** . • If the driveline incorporates a torque tube attached to the drive axle, refer to **Differential Pinion Input Shaft Runout Measurement** . • If the driveline joint at the drive axle is a coupler assembly or a CV joint, refer to **Differential Pinion Input Shaft Runout Measurement** . 2. For a direct-mount drive axle, inspect the mounts and/or bushings for excessive wear, looseness, and/or damage. 3. Replace excessively worn or damaged components as necessary. Did you find and correct a condition?	Go to **Step 23**	Go to **Step 24**
	Perform the **Vibration in Service-Stall Test (Non-**		

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23	**Torque Sensitive)**. Is the vibration still present?	Go to **Step 24**	Go to **Step 32**
24	Re-index the prop shaft. Perform the following steps: 1. Raise and support the vehicle. 2. Mark the position of the prop shaft to both the transmission or transfer case output shaft flange, and the drive axle input flange. 3. Remove the prop shaft. 4. Rotate the prop shaft 180 degrees to both of the flanges. 5. Reinstall the prop shaft. 6. Attempt to duplicate the vibration in the stall. Refer to the **Vibration in Service-Stall Test (Non-Torque Sensitive)**. Was the vibration reduced or eliminated?	Go to **Step 32**	Go to **Step 25**
25	Return the prop shaft to it's original position and balance the prop shaft. Refer to **Driveline System Balance Adjustment**. Were you able to balance the driveline system?	Go to **Step 32**	Go to **Vibration Diagnostic Aids**
26	1. Inspect the following components for wear and/or damage: • Inspect the prop shafts for dents, damage, missing weights, and/or undercoating. • Inspect the U-joint, or joints for excessive wear, looseness, and/or damage. • Inspect the prop shaft support bearing, if equipped, for damaged rubber components, worn bearings, looseness, and/or a deformed or cracked bracket. 2. Replace components as necessary. Did you find and correct a condition?	Go to **Step 32**	Go to **Step 27**
27	Is the drive axle a direct-mount?	Go to **Step 29**	Go to **Step 28**
28	1. Measure the vehicle trim height. 2. Adjust the vehicle trim height if necessary. Refer to the **Trim Height Inspection** . Did you find and correct a condition?	Go to **Step 32**	Go to **Step 29**
	1. Measure the prop shaft angles. Refer to **Driveline Working Angles Measurement**.		

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29	2. If necessary, adjust the prop shaft angles. Refer to **Driveline Working Angles Adjustment**. Did you find and correct a condition?	Go to **Step 32**	Go to **Step 30**
30	Does this prop shaft system have only 1 U-joint?	Go to **Vibration Diagnostic Aids**	Go to **Step 31**
31	1. Inspect the prop shafts for proper phasing. Refer to **Propeller Shaft Phasing Inspection**. 2. If necessary, correct the prop shaft phasing. Refer to **Propeller Shaft Phasing Correction**. Did you find and correct a condition?	Go to **Step 32**	Go to **Vibration Diagnostic Aids**
32	1. Install or connect any components that were removed or disconnected during diagnosis. 2. Perform the Vibration Analysis - Road Testing table. Refer to **Vibration Analysis - Road Testing**. Is the vibration still present?	Go to **Step 5**	System OK

VIBRATION ANALYSIS - HUB AND/OR AXLE INPUT

Test Description

The numbers below refer to the step numbers on the diagnostic table:

2: This test will determine the effect of turning input on the vibration.

6: This test will determine the effect of an initial heavy torque load on the vibration.

7: Damaged or worn wheel drive shafts may cause a noise or vibration that may be transferred into the passenger compartment.

8: Damaged or worn wheel bearings may cause a noise or vibration that may be transferred into the passenger compartment.

9: Damaged or worn suspension components may cause a noise or vibration that may be transferred into the passenger compartment.

10: Damaged or worn powertrain mounts and/or exhaust mounts may cause a noise or vibration that may be transferred into the passenger compartment.

11: Incorrect trim height may cause binding and/or interference between components that may produce a vibration.

Step	Action	Yes	No
WARNING: **Refer to Road Test Warning .**			
	Has the Vibration Analysis - Road Testing table been		Go to **Vibration**

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1	completed?	Go to **Step 2**	**Analysis - Road Testing**
2	1. Operate the vehicle at the speed of the vibration concern. 2. While maintaining the concern speed, drive the vehicle through slow, sweeping turns - first in one direction, then in the other direction. 3. Observe the vehicle for changes in the vibration disturbance. 4. Select a smooth, level surface, such as an empty parking lot or a remote road. 5. While maintaining the vehicle at the concern speed if possible, drive the vehicle through sharp turns; 360 degrees - first in one direction, then in the other direction. 6. Observe the vehicle for changes in the vibration disturbance. Did the characteristics of the vibration change significantly-become worse or go away-during these steps?	Go to **Step 3**	Go to **Step 6**
3	Did you hear a clicking noise and/or feel a shudder during these steps?	Go to **Step 7**	Go to **Step 4**
4	Did you hear a growling noise during these steps?	Go to **Step 8**	Go to **Step 5**
5	Did you hear a popping noise during these steps?	Go to **Step 9**	Go to **Step 13**
6	1. With the vehicle at a stand-still, apply the regular brake and place the transmission in the lowest forward gear. **NOTE:** **Do not accelerate to the point of causing the drive wheels to squeal, slip or hop, this would obscure the results of the test.** 2. Release the regular brakes and accelerate aggressively to 32 km/h (20 mph). 3. Observe the vehicle for changes in the vibration disturbance. Did you feel a shudder or shaking during these steps?	Go to **Step 7**	Go to **Vibration Diagnostic Aids**
7	1. Inspect the wheel drive shafts, if equipped, for damage, abnormal and/or excessive wear. 2. If the inspection indicated that a wheel drive shaft is damaged, abnormally and/or excessively worn,		

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	replace the shaft. Did you find and correct a condition?	Go to **Step 13**	Go to **Step 9**
8	1. Inspect the wheel bearings for wear and/or damage. Refer to the wheel bearing inspection procedure. 2. Replace any of the wheel bearings found to be worn and/or damaged. Did you find and correct a condition?	Go to **Step 13**	Go to **Step 12**
9	1. Inspect the following suspension components for wear, damage, looseness and/or possible contact with other vehicle components: • Struts/shock absorbers • Springs • Bushings • Insulators 2. Replace any of the suspension components found to be worn, damaged, loose and/or contacting other vehicle components. Did you find and correct a condition?	Go to **Step 13**	Go to **Step 10**
10	1. Inspect the powertrain mounts-engine, transmission, transfer case, and direct-mount differential, if equipped-and any powertrain braces for the following conditions: • Loose and/or missing fasteners • Improper alignment • Cracked, dry-rotted, and/or oil-soaked insulators • Twisted, broken, torn, and/or collapsed insulators • Bent, twisted, and/or deformed brackets 2. Replace powertrain mounts as necessary. 3. Inspect the exhaust system components for the following: • Loose and/or missing fasteners o Heat Shields o Joints and/or couplings: Nuts, bolts, studs, clamps, straps		

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	○ Bracket and/or insulator mounting • Inadequate clearance to body and/or chassis components Inspect with the exhaust system both COLD and HOT; in NEUTRAL, FORWARD and REVERSE gears • Improper alignment • Disconnected and/or missing insulators • Cracked, dry-rotted, and/or oil-soaked insulators • Stretched, twisted, broken, torn, and/or collapsed insulators • Bent, twisted, cracked, and/or deformed brackets 4. Repair, replace, and/or realign exhaust system components as necessary. Did you find and correct a condition?	Go to **Step 13**	Go to **Step 11**
11	Inspect the vehicle trim height and adjust as necessary. Refer to **Trim Height Inspection** . Did you find and correct a condition?	Go to **Step 13**	Go to **Step 12**
12	Is the vehicle primary driveline configuration rear wheel drive equipped with a direct-mount drive axle, or front wheel drive and equipped with all-wheel drive?	Go to **Vibration Analysis - Driveline**	Go to **Vibration Diagnostic Aids**
13	1. Install or connect any components that were removed or disconnected during diagnosis. 2. Perform the Vibration Analysis - Road Testing table. Refer to **Vibration Analysis - Road Testing**. Is the vibration still present?	Go to **Step 2**	System OK

VIBRATION ANALYSIS - ENGINE

Special Tools

GE-38792-VS: Electronic Vibration Analyzer (EVA) 2

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: If powertrain related DTCs are present, there may be a powertrain performance condition present

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which could be a contributing cause to the customer's concern.

5: Making comparisons of the customer's vehicle with an equally equipped, same model year and type, KNOWN GOOD vehicle will help determine if certain disturbances may be characteristic of a vehicle design.

Step	Action	Yes	No
WARNING: Refer to **Work Stall Test Warning** .			
1	Has the Vibration Analysis - Road Testing table been completed?	Go to **Step 2**	Go to **Vibration Analysis - Road Testing**
2	Using a scan tool, determine if any DTCs are set. Were any DTCs set?	Go to **Diagnostic Starting Point - Vehicle**	Go to **Step 3**
3	1. Block the front wheels. 2. Apply BOTH the service brakes and the park brake. 3. With the scan tool and the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2, if available, still installed, start the engine. 4. Place the transmission in NEUTRAL or PARK. 5. Slowly increase the engine RPM to the level at which the disturbance is most noticeable. 6. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2, if available. 7. Place the transmission in DRIVE. 8. Slowly increase the engine RPM to the level at which the disturbance is most noticeable. 9. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2, if available. 10. If no frequency data was obtained, or if the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2, is not available, place the transmission into REVERSE, then repeat steps 8 and 9. Reverse-loading of the powertrain may increase or change the characteristics of the vibration. Were you able to duplicate the customer's concern?	Go to **Step 4**	Go to **Vibration Diagnostic Aids**
	Did the **GE-38792-A:** Electronic Vibration Analyzer	Go to **Vibration**	

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4	(EVA) 2 detect a dominant frequency, or was a significant vibration present?	**Analysis - Engine/Accessory Isolation**	Go to **Step 5**
5	Compare the test results of the customer's vehicle to the results of the same tests run, at the same engine RPM, on an equally-equipped, same model year and type, KNOWN GOOD vehicle. Refer to **Vehicle-to-Vehicle Diagnostic Comparison**. 1. Install a scan tool into the known good vehicle. 2. Install the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2, if available, into the known good vehicle; place the sensor in exactly the same location as it was placed in the customer's vehicle. 3. Block the front wheels. 4. Apply BOTH the service brakes and the park brake. 5. Start the engine. 6. Place the transmission in NEUTRAL or PARK. 7. Slowly increase the engine RPM to the level at which the disturbance was most noticeable in the customer's vehicle. 8. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2, if available. 9. Place the transmission in DRIVE. 10. Slowly increase the engine RPM to the level at which the disturbance was most noticeable in the customer's vehicle. 11. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2, if available. 12. If no frequency data was obtained, or if the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2, is not available, place the transmission into REVERSE, then repeat steps 10 and 11. Reverse-loading of the powertrain may increase or change the characteristics of the vibration. Did both of the vehicles exhibit the same	Go to **Vibration**	Go to **Vibration Analysis - Engine/Accessory**

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	characteristics?	Diagnostic Aids	Isolation

ENGINE ORDER CLASSIFICATION

Engine First Order Classification

1. Convert the engine speed in revolutions per minute (RPM), recorded during duplication of the disturbance into Hertz, revolutions per second (RPS), by dividing the RPM by 60 seconds. Refer to the following example:

   1,200 RPM divided by 60 = 20 Hz (or RPS)

2. Compare the dominant frequency in Hz, recorded during duplication of the disturbance with the engine speed just converted into Hz, to determine if they are related.
3. If the dominant frequency in Hz, recorded during duplication of the disturbance and the engine speed, converted into Hz, ARE related, then an engine FIRST ORDER related disturbance is present. Engine first order disturbances are usually related to an imbalanced component. Refer to the Engine Order Related Disturbances table.
4. If the dominant frequency in Hz, recorded during duplication of the disturbance and the engine speed, converted into Hz, are NOT related, then determine if the disturbance is related to the engine's firing frequency. Proceed to Engine Firing Frequency Classification.

Engine Firing Frequency Classification

Engine firing frequency is a term used to describe the number of firing pulses (one firing pulse = one cylinder firing) that occur during ONE complete revolution of the crankshaft, multiplied by the number of crankshaft revolutions per second, Hz.

1. Calculate the engine firing frequency.
   - To determine the firing frequency of a 4-stroke engine during ONE complete revolution of the crankshaft, multiply the engine speed, converted into Hz, by HALF of the total number of cylinders in the engine.
   - For example: The engine speed, converted into Hz, was 20 Hz; if the vehicle was equipped with a V8 engine, 4 of the 8 cylinders would actually fire during ONE complete revolution of the crankshaft.
     - Multiply the converted engine speed (20 Hz) by 4 cylinders firing.

       20 Hz X 4 = 80 Hz

     - The engine firing frequency for a V8 engine at the original engine speed of 1,200 RPM, recorded during duplication of the disturbance, would be 80 Hz.
     - In like manner, a 6-cylinder engine would have a firing frequency of 60 Hz at the same engine speed of 1,200 RPM.

       20 Hz X 3 = 60 Hz

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2. Compare the dominant frequency in Hz, recorded during duplication of the disturbance with the engine firing frequency in Hz, just calculated, to determine if they are related.
3. If the dominant frequency in Hz, recorded during duplication of the disturbance and the engine firing frequency in Hz, just calculated ARE related, then an engine FIRING FREQUENCY related disturbance is present. Engine firing frequency disturbances are usually related to improper isolation of a component. Refer to the Engine Order Related Disturbances table.
4. If the dominant frequency in Hz, recorded during duplication of the disturbance and the engine firing frequency in Hz, just calculated are NOT related, then determine if the disturbance is related to another engine order classification. Proceed to Other Engine Order Classification.

Other Engine Order Classification

1. Multiply the engine speed, converted into Hz, recorded during duplication of the disturbance by different possible order-numbers, other than 1 (first order) or the number used to determine the firing frequency of the engine.
2. Compare the dominant frequency in Hz, recorded during duplication of the disturbance with the other possible engine orders just calculated, to determine if they are related.
3. If the dominant frequency in Hz, recorded during duplication of the disturbance and one of the other engine order frequencies in Hz, just calculated ARE related, then an engine related disturbance of that order is present. If an engine related disturbance is present that is NOT related to first order or firing frequency, then it could be related to an engine driven accessory system. Proceed to Engine Driven Accessories Related to Engine Order.

Engine Driven Accessories Related to Engine Order

Engine driven accessory systems can be related to specific engine orders depending upon the relationship of the accessory pulley diameter to the crankshaft pulley diameter. For example:

- If the crankshaft pulley measured 20 cm (8 in) in diameter and one of the engine driven accessory pulleys measured 10 cm (4 in) in diameter, then that accessory pulley would rotate 2 times for every one rotation of the crankshaft pulley. If that accessory system was not isolated properly, or was not operating properly, it would be identifiable as a 2nd order engine related disturbance.
- In like manner, if an engine driven accessory pulley measured 5 cm (2 in) in diameter, then that accessory pulley would rotate 4 times for every one rotation of the crankshaft pulley. If that accessory system was not isolated properly, or was not operating properly, it would be identifiable as a 4th order engine related disturbance.

Engine driven accessories that contribute to, are excited by, or are the sole cause of a disturbance are usually doing so because of improper isolation that causes a transfer path into the passenger compartment or to another major component of the vehicle body.

Using the **GE-38792-VS:** Vibrate Software, accurately measuring the diameters of the accessory pulleys and the crankshaft pulley, and performing the appropriate diagnostic procedures completely will lead to the specific accessory system which is either contributing to, or causing the customer's concern.

Engine Order Related Disturbances

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Engine Order	Engine Arrangement						
	L4 W/O Balance Shaft	**L4 With Balance Shaft**	**L5**	**L6**	**60 Degree V6**	**90 Degree V6 With Balance Shaft**	**90 Degre**
1/2 Order Torque Sensitive	Abnormal - Likely Single Cylinder Misfire	Abnormal - Likely Single Cylinder Misfire	Abnormal - Likely Single Cylinder Misfire	Abnormal - Likely Single Cylinder Misfire	Abnormal - Likely Single Cylinder Misfire and/or EGR/Fuel Variance	Abnormal - Likely Single Cylinder Misfire and/or EGR/Fuel Variance	Abnorm Likely Si Cylind Misfi
1st Order	Abnormal - Likely Component Imbalance	Abnormal - Likely Component Imbalance	Abnormal - Likely Component Imbalance	Abnormal - Likely Component Imbalance	Abnormal - Likely Component Imbalance	Abnormal - Likely Component Imbalance	Abnorm Likel Compor Imbala
11/2 Order Torque Sensitive	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Abnormal - Likely Bank to Bank EGR/Fuel Variance Possible Engine Driven Accessory Related	Abnormal - Likely Bank to Bank EGR/Fuel Variance Possible Engine Driven Accessory Related	Possib Engine D Access Relate
2nd Order Non Torque Sensitive	Characteristic of Engine Arrangement - Possible Powertrain Isolation Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Characteristic of Engine Arrangement - Possible Powertrain Isolation Related	Characteristic of Engine Arrangement - Possible Powertrain Isolation Related	Possib Engine D Access Relate
2nd Order Torque Sensitive	Characteristic - ENGINE FIRING FREQUENCY - Possible Powertrain Isolation Related Possible Engine Driven Accessory Related	Characteristic - ENGINE FIRING FREQUENCY - Possible Powertrain Isolation Related Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Abnorm Likely Ba Bank EGR/F Varian Possib Engine D Access Relate
			Characteristic - ENGINE FIRING FREQUENCY				

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2 1/2 Order Torque Sensitive	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	- Possible Powertrain Isolation Related Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possib Engine D Access Relate
3rd Order Torque Sensitive	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Characteristic - ENGINE FIRING FREQUENCY - Possible Powertrain Isolation Related Possible Engine Driven Accessory Related	Characteristic - ENGINE FIRING FREQUENCY - Possible Powertrain Isolation Related Possible Engine Driven Accessory Related	Characteristic - ENGINE FIRING FREQUENCY - Possible Powertrain Isolation Related Possible Engine Driven Accessory Related	Possib Engine D Access Relate
4th Order Torque Sensitive	Characteristic - Minimal Amount - of Engine Arrangement - Possible Powertrain Isolation Related Possible Engine Driven Accessory Related	Characteristic - Minimal Amount - of Engine Arrangement - Possible Powertrain Isolation Related Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Characte - ENGI FIRIN FREQUE - Possi Powertr Isolati Relate Possib Engine D Access Relate

VIBRATION ANALYSIS - ENGINE/ACCESSORY ISOLATION

Test Description

The numbers below refer to the step numbers on the diagnostic table.

5: A loose, damaged, misaligned, or defective powertrain insulator and/or bracket may create a transfer path into the passenger compartment.

6: A loose, damaged, misaligned, or defective exhaust system insulator and/or bracket may create a transfer path into the passenger compartment.

7: Incorrectly seated and/or aligned powertrain components and/or exhaust system components may create a transfer path into the passenger compartment.When loosening powertrain mounts in order to re-

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bed the powertrain observe the following:Do not loosen the mount bracket-to-engine bolts/nuts, do not loosen the mount bracket-to-vehicle frame bolts/nuts if mount brackets are used.Loosen the mount-to-mount bracket bolts/nuts if mount brackets are used, or loosen the mount-to-slotted holes in vehicle frame bolts/nuts if a direct-mount design is used.

8: Non-rotating engine driven accessory component systems can no longer produce a unique disturbance.

9: Non-rotating engine driven accessory components can no longer produce a unique disturbance. If a disturbance is still present, but the characteristics have been altered, it is possible that these component systems are acting as a transfer path for engine firing frequency or a first order engine disturbance.If a disturbance is still present, but the characteristics have NOT been altered, it is NOT likely that these component systems are acting as a transfer path for engine firing frequency or a first order engine disturbance.

10: If the mark placed on the face of an engine driven accessory pulley seems to stand still while running this test, then that accessory system is either responding to an existing frequency, such as engine firing pulses, or creating a disturbance.

11: A loose, damaged, misaligned, or defective engine driven accessory system insulator and/or bracket may create a transfer path into the passenger compartment.

12: Removing the engine driven accessory and bracket, or brackets from the engine allows a thorough inspection to determine if any conditions are present that may create a transfer path into the passenger compartment.

Step	Action	Yes	No
WARNING: Refer to **Work Stall Test Warning** .			
1	Were you sent here from the Vibration Analysis - Engine table?	Go to **Step 2**	Go to **Vibration Analysis - Engine**
2	Is the **GE-38792-VS:** Electronic Vibration Analyzer (EVA) 2, available?	Go to **Step 3**	Go to **Step 5**
3	1. Using the engine RPM and frequency data recorded for the customer's vehicle, determine the order of engine rotation to which the disturbance is related. 2. Determine the possible causes of the disturbance as it relates to a specific order of engine rotation. Refer to **Engine Order Classification**.Does the Engine Order Classification table indicate that the disturbance is of the same order as the engine firing frequency?	Go to **Step 5**	Go to **Step 4**
4	Does the Engine Order Classification table indicate that the disturbance is likely related to engine driven accessories?	Go to **Step 8**	Go to **Step 5**
	Inspect the powertrain mounts-engine, transmission, transfer case, and direct-mount drive axle, if equipped- and any powertrain braces for the following conditions:		

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5	• Loose and/or missing fasteners • Improper alignment • Cracked, dry-rotted, and/or oil-soaked insulators • Twisted, broken, torn, and/or collapsed insulators • Bent, twisted, and/or deformed brackets Realign or replace powertrain mounts as indicated by the inspection. Did you find and correct a condition?	Go to **Step 13**	Go to **Step 6**
6	Inspect the exhaust system components for the following: • Loose and/or missing fasteners ○ Heat Shields ○ Joints and/or couplings: Nuts, bolts, studs, clamps, straps ○ Bracket and/or insulator mounting • Inadequate clearance to body and/or chassis components Inspect with the exhaust system both COLD and HOT; in NEUTRAL, FORWARD and REVERSE gears • Improper alignment • Disconnected and/or missing insulators • Cracked, dry-rotted, and/or oil-soaked insulators • Stretched, twisted, broken, torn, and/or collapsed insulators • Bent, twisted, cracked, and/or deformed brackets Repair, replace, and/or realign exhaust system components as indicated by the inspection. Did you find and correct a condition?	Go to **Step 13**	Go to **Step 7**
	Perform the Powertrain Mount Balance Procedure if available or perform the following procedure to re-bed the powertrain: 1. Loosen, but do not remove, all powertrain mounts and exhaust system hangers.		

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7	2. Ensure that the exhaust flexible coupling, if equipped, moves freely. 3. Start the engine. 4. Settle the powertrain by shifting the transmission from DRIVE to REVERSE. 5. Place the transmission into NEUTRAL. 6. Turn OFF the ignition. 7. Tighten all of the loosened fasteners with the powertrain in a relaxed position. Did you complete the operation?	Go to **Step 13**	-
8	**CAUTION:** **Do not run the engine for longer than 60 seconds with the accessory drive belt, or belts removed, or overheating and/or damage may result.** 1. Remove the engine accessory drive belt, or belts. 2. Block the front wheels. 3. Apply BOTH the service brakes and the park brake. 4. With the scan tool still installed, start the engine. 5. Place the transmission in NEUTRAL or PARK. 6. Increase the engine RPM to the level recorded during duplication of the disturbance. 7. Allow the engine to idle, then place the transmission in DRIVE. 8. Increase the engine RPM to the level recorded during duplication of the disturbance. 9. Turn OFF the ignition. 10. Install the engine accessory drive belt, or belts. Was the disturbance significantly reduced or eliminated?	Go to **Step 10**	Go to **Step 9**
9	Were the characteristics of the disturbance altered but still present?	Go to **Step 11**	Go to **Step 15**
	1. Mark the face of the suspected accessory pulleys, including any related idler pulleys, near the outer edge with a paint mark. 2. Install the **GE-38792-VS:** Inductive Pickup Timing Light, to the **GE-38792-VS:** Electronic Vibration Analyzer (EVA) 2.		

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	For information on the use of the EVA features, refer to **Electronic Vibration Analyzer (EVA) Description and Operation**. 3. Block the front wheels. 4. Apply BOTH the service brakes and the park brake. 5. With the scan tool and the **GE-38792-VS:** Electronic Vibration Analyzer (EVA) 2, still installed, start the engine. 6. Select the Smart Strobe feature on the **GE-38792-VS:** Electronic Vibration Analyzer (EVA) 2. 7. Enter the recorded frequency of the disturbance as the initial frequency for strobe operation. 8. Have an assistant place the transmission in NEUTRAL or PARK. 9. Slowly increase the engine RPM to the level recorded during duplication of the disturbance, then maintain that speed.			
10	10. Using the **GE-38792-VS:** Inductive Pickup Timing Light, check each of the suspected accessory pulleys to determine if any of them is related to the frequency of the disturbance. Check each of the accessory systems, both engaged and under maximum load and disengaged or under minimum load. 11. Allow the engine to idle, then place the transmission in DRIVE. 12. Slowly increase the engine RPM to the level recorded during duplication of the disturbance, then maintain that speed closely. 13. Using the **GE-38792-VS:** Inductive Pickup Timing Light, check each of the suspected accessory pulleys to determine if any of them is related to the frequency of the disturbance. Check each of the accessory systems, both engaged and under maximum load and disengaged or under minimum load. 14. Turn OFF the ignition.			

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	Did you identify an engine driven accessory system as being related to the frequency of the disturbance?	Go to **Step 11**	Go to **Vibration Diagnostic Aids**
11	Inspect the components of the engine driven accessory system for the following: • Loose and/or missing fasteners ○ Heat Shields, if equipped ○ Joints and/or couplings: Nuts, bolts, studs, clamps, straps ○ Bracket and/or insulator mounting • Inadequate clearance to body and/or chassis components Inspect with the accessory system both under a LOAD and NOT loaded • Improper alignment • Bent or damaged pulleys • Disconnected and/or missing insulators • Cracked, dry-rotted, and/or oil-soaked component insulators • Stretched, twisted, broken, torn, and/or collapsed component insulators • Bent, twisted, cracked and/or deformed component brackets Repair, replace, and/or realign the engine driven accessory system components as indicated by the inspection. Did you find and correct a condition?	Go to **Step 13**	Go to **Step 12**
12	1. Remove the engine driven accessory and bracket, or brackets from the engine. 2. Thoroughly inspect the accessory bracket, or brackets, bolts/nuts/studs, and the accessory itself for signs of the following: Bent, twisted, cracked and/or deformed conditions 3. Replace any of the components found to exhibit any of these conditions.		

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	4. Reinstall the components to the engine. Did you find and correct a condition?	Go to **Step 13**	Go to **Step 17**
13	Check the vehicle to determine if the disturbance is now significantly reduced or eliminated. Perform the following steps: 1. Install a scan tool into the customer's vehicle. 2. Install the **GE-38792-VS:** Electronic Vibration Analyzer (EVA) 2, if available, into the customer's vehicle; place the sensor in exactly the same location as it was originally placed in the vehicle. 3. Block the front wheels. 4. Apply BOTH the service brakes and the park brake. 5. Start the engine. 6. Place the transmission in NEUTRAL or PARK. 7. Slowly increase the engine RPM to the level at which the disturbance was most noticeable. 8. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the **GE-38792-VS:** Electronic Vibration Analyzer (EVA) 2, if available. 9. Place the transmission in DRIVE. 10. Slowly increase the engine RPM to the level at which the disturbance was most noticeable. 11. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the **GE-38792-VS:** Electronic Vibration Analyzer (EVA) 2, if available. 12. If the disturbance has been significantly reduced or eliminated, confirm the results by placing the transmission into REVERSE, then repeat steps 10 and 11. Reverse-loading of the powertrain may increase or change the characteristics of the vibration. Has the disturbance been significantly reduced or eliminated?	Go to **Step 18**	Go to **Step 14**
14	Have you investigated powertrain isolation as a possible cause of the disturbance?	Go to **Step 15**	Go to **Step 5**
	Have you investigated engine driven accessories as a	Go to **Vibration**	

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15	possible cause of the disturbance?	**Analysis - Engine Balance**	Go to **Step 16**
16	Is the **GE-38792-VS:** Electronic Vibration Analyzer (EVA) 2 available?	Go to **Step 8**	Go to **Vibration Diagnostic Aids**
17	Replace the engine driven accessory component causing the disturbance. Did you complete the replacement?	Go to **Step 18**	-
18	1. Install or connect any components that were removed or disconnected during diagnosis. 2. Perform the Vibration Analysis - Road Testing table. Refer to **Vibration Analysis - Road Testing**. Is the disturbance still present?	Go to **Step 2**	System OK

VIBRATION ANALYSIS - ENGINE BALANCE

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4: If sufficient clearance exists to separate the transmission torque converter from the engine flywheel/flexplate, then further tests can be used to isolate the transmission from the engine.

5: An engine flywheel/flexplate that has excessive lateral runout, when combined with the mass of the transmission torque converter, can produce a disturbance.

6: An engine flywheel/flexplate that is loose at the engine crankshaft or that is cracked or damaged, when combined with the mass of the transmission torque converter, can produce a disturbance.

7: This step is designed to isolate the transmission from the engine to determine if the disturbance is related to the engine ONLY.

9: Re-indexing the transmission torque converter to the engine flywheel/flexplate alters the balance relationship between the torque converter and the rear of the engine.

11: Placing the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2 sensor onto the underside of the engine oil pan along the FRONT and the REAR edge allows for a determination to be made, which will help to narrow down the cause of the disturbance.

13: An engine flywheel that has excessive lateral runout, when combined with the extra mass of the clutch pressure plate and clutch driven plate, can produce a disturbance.

14: The clutch pressure plate and the engine flywheel are marked for proper indexing of the heavy-spot of one to the light-spot of the other. Improper indexing of the pressure plate to the flywheel can produce a disturbance.

15: An engine flywheel that is loose at the engine crankshaft or that is cracked, damaged and/or missing balance weights; and/or a clutch pressure plate and clutch driven plate that has loose springs, cracks, warpage, damage and/or missing balance weights - can produce a disturbance when their mass is combined.

16: An engine flywheel that is loose at the engine crankshaft or that is cracked, damaged and/or missing

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balance weights; and/or a clutch pressure plate and clutch driven plate that has loose springs, cracks, warpage, damage and/or missing balance weights - can produce a disturbance when their mass is combined.

17: Re-indexing the pressure plate to the engine flywheel alters the balance relationship between the pressure plate/flywheel assembly and the rear of the engine.

18: An engine flywheel/flexplate that is damaged, misaligned, and/or imbalanced, can produce a disturbance.

19: An engine crankshaft balancer that is damaged, misaligned, and/or imbalanced, can produce a disturbance.

Step	Action	Yes	No
WARNING: Refer to **Work Stall Test Warning** .			
1	Were you sent here from the Vibration Analysis - Engine/Accessory Isolation table?	Go to **Step 2**	Go to **Vibration Analysis - Engine/Accessory Isolation**
2	Is the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2, available?	Go to **Step 3**	Go to **Vibration Diagnostic Aids**
3	Is the vehicle equipped with a manual transmission?	Go to **Step 11**	Go to **Step 4**
4	1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Remove the flywheel/flexplate-to-torque converter bolts access cover, if equipped. 3. Determine if sufficient clearance exists to separate the transmission torque converter away from the engine flywheel/flexplate and safely secure the torque converter from accidentally engaging with the flywheel/flexplate. Is there sufficient clearance to separate and safely secure the transmission torque converter away from the engine flywheel/flexplate?	Go to **Step 5**	Go to **Step 11**
	1. With the flywheel/flexplate-to-torque converter access cover still removed, and with the vehicle still raised, mark the position of the transmission torque converter in relation to the engine flywheel/flexplate. 2. Disconnect the torque converter and move it away from the flywheel/flexplate. 3. Secure the transmission torque converter away from the engine flywheel/flexplate to avoid accidental engagement with the flywheel/flexplate.		

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5	4. Lower the vehicle, start the engine and allow the engine to idle. 5. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 6. Visually inspect the flywheel/flexplate for excessive lateral runout. 7. Lower the vehicle. 8. Turn OFF the ignition. Did the flywheel/flexplate exhibit excessive lateral runout?	Go to **Step 8**	Go to **Step 6**
6	1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Inspect the flywheel/flexplate for the following: • Looseness at the engine crankshaft • Cracks and/or damage • Missing balance weights Did the flywheel/flexplate exhibit any of the conditions listed?	Go to **Step 8**	Go to **Step 7**
7	1. With the transmission torque converter still secured away from the engine flywheel/flexplate to avoid accidental engagement with the flywheel/flexplate, lower the vehicle. 2. Block the front wheels. 3. Apply BOTH the service brakes and the park brake. 4. With the scan tool and the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2 still installed, start the engine. 5. Place the transmission in NEUTRAL or PARK. 6. Slowly increase the engine RPM to the level at which the disturbance is most noticeable. 7. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2. 8. Turn OFF the ignition. Has the disturbance been significantly reduced or eliminated?	Go to **Step 9**	Go to **Step 11**
	1. If the flywheel/flexplate is loose at the engine		

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8	crankshaft, tighten the flywheel/flexplate mounting bolts in sequence and to specification. 2. If the flywheel/flexplate is cracked, damaged, and/or has missing balance weights, replace the damaged flywheel/flexplate. Did you complete the tightening or replacement?	Go to **Step 20**	-
9	1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Re-index the transmission torque converter to the engine flywheel/flexplate, 120 degrees from its original position. 3. Reconnect the transmission torque converter to the engine flywheel/flexplate. 4. Lower the vehicle. 5. Block the front wheels. 6. Apply BOTH the service brakes and the park brake. 7. With the scan tool and the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2 still installed, start the engine. 8. Place the transmission in NEUTRAL or PARK. 9. Slowly increase the engine RPM to the level at which the disturbance is most noticeable. 10. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2. 11. If the disturbance is still noticeable, re-index the torque converter again to obtain the least amount of disturbance. Has the disturbance been significantly reduced or eliminated?	Go to **Step 20**	Go to **Step 10**
10	Replace the out-of-balance transmission torque converter. Did you complete the replacement?	Go to **Step 20**	-
	1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Position the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2 sensor onto the underside of the engine oil pan, along the FRONT edge. 3. Lower the vehicle.		

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11	4. Block the front wheels. 5. Apply BOTH the service brakes and the park brake. 6. With the scan tool and the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2, still installed, start the engine. 7. Place the transmission in NEUTRAL or PARK. 8. Slowly increase the engine RPM to the level at which the disturbance is most noticeable. 9. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2 from the underside of the engine oil pan. 10. Repeat steps 1 through 9, placing the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2 sensor onto the underside of the engine oil pan, along the REAR edge. Is the disturbance greater along the FRONT of the engine?	Go to **Step 19**	Go to **Step 12**
12	Is the vehicle equipped with an automatic transmission?	Go to **Step 18**	Go to **Step 13**
13	1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Remove the flywheel inspection cover. 3. Start the engine. Allow the engine to idle. 4. Visually inspect the engine flywheel clutch surface for excessive lateral runout. Does the engine flywheel clutch surface exhibit excessive lateral runout?	Go to **Step 18**	Go to **Step 14**
14	Inspect the clutch pressure plate to engine flywheel mounting for proper factory indexing. Is the clutch pressure plate properly indexed to the engine flywheel?	Go to **Step 16**	Go to **Step 15**
	1. Remove the clutch pressure plate and clutch driven plate from the engine flywheel. 2. Inspect the engine flywheel for the following: • Looseness at the engine crankshaft • Cracks, warpage and/or damage • Missing balance weights		

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15	3. Inspect the clutch pressure plate and clutch driven plate for the following: • Loose and/or damaged clutch driven plate damper springs • Loose and/or damaged clutch pressure plate diaphragm springs • Cracks, warpage and/or damage • Missing balance weights Do any of the above conditions exist?	Go to **Step 18**	Go to **Step 17**
16	1. Remove the clutch pressure plate and clutch driven plate from the engine flywheel. 2. Inspect the engine flywheel for the following: • Looseness at the engine crankshaft • Cracks, warpage and/or damage • Missing balance weights 3. Inspect the clutch pressure plate and clutch driven plate for the following: • Loose and/or damaged clutch driven plate damper springs • Loose and/or damaged clutch pressure plate diaphragm springs • Cracks, warpage and/or damage • Missing balance weights Do any of the above conditions exist?	Go to **Step 18**	Go to **Vibration Diagnostic Aids**
17	Re-index the pressure plate to the engine flywheel. Did you complete the re-indexing?	Go to **Step 20**	-
18	Replace the engine flywheel/flexplate. Did you complete the replacement?	Go to **Step 20**	-
19	Replace the engine crankshaft balancer. Did you complete the replacement?	Go to **Step 20**	-
	Check the vehicle to determine if the disturbance is now significantly reduced or eliminated. Perform the following steps: 1. Install or connect any components that were removed or disconnected during diagnosis. 2. Install a scan tool into the customer's vehicle. 3. Install the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2, if available, into the customer's vehicle; place the sensor in exactly		

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20	the same location as it was originally placed in the vehicle. 4. Block the front wheels. 5. Apply BOTH the service brakes and the park brake. 6. Start the engine. 7. Place the transmission in NEUTRAL or PARK. 8. Slowly increase the engine RPM to the level at which the disturbance was most noticeable. 9. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2, if available. 10. Place the transmission in DRIVE. 11. Slowly increase the engine RPM to the level at which the disturbance was most noticeable. 12. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2, if available. 13. If the disturbance has been significantly reduced or eliminated, confirm the results by placing the transmission into REVERSE, then repeat steps 11 and 12. Reverse-loading of the powertrain may increase or change the characteristics of the vibration. Has the disturbance been significantly reduced or eliminated?	Go to **Step 21**	Go to **Vibration Diagnostic Aids**
21	Perform the Vibration Analysis - Road Testing table. Refer to **Vibration Analysis - Road Testing**. Is the disturbance still present?	Go to **Vibration Diagnostic Aids**	System OK

VIBRATION DIAGNOSTIC AIDS

NOTE: If you have not reviewed the Diagnostic Starting Point - Vehicle and completed the Vibration Analysis tables as indicated, refer to Diagnostic Starting Point - Vehicle BEFORE proceeding.

The diagnostic information contained in this Diagnostic Aids section will help you determine the correct course of action to take for the following 4 main conditions. Refer to the appropriate condition from this list:

- **Vibration Diagnostic Aids - Vibration Intermittent or Not Duplicated**

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- **Vibration Diagnostic Aids - Vibration Duplicated, Component Not Identified**
- **Vibration Diagnostic Aids - Vibration Duplicated, Difficult to Isolate/Balance Component**
- **Vibration Diagnostic Aids - Vibration Duplicated, Appears to Be Potential Operating Characteristic**

VIBRATION DIAGNOSTIC AIDS - VIBRATION INTERMITTENT OR NOT DUPLICATED

NOTE: If you have not completed the Vibration Analysis tables as indicated and reviewed Vibration Diagnostic Aids, refer to Vibration Diagnostic Aids BEFORE proceeding.

If you have not been able to duplicate the vibration concern or have only been able to duplicate the concern intermittently, review the following information.

Most vibration concerns that cannot be duplicated are due to either specific conditions that are not present during the duplicating attempts, or due to not following the procedures designed to duplicate concerns properly and in the sequence indicated.

Specific Conditions Can Affect the Condition

Consider the following conditions which may not have been present while attempts were made to duplicate the vibration concern. Attempt to obtain more specific information from the customer as to the EXACT conditions that are present when they experience the vibration which they are concerned about. Attempt to duplicate the vibration concern again while recreating the EXACT conditions necessary, except those which pose a safety concern or are outside the boundaries of normal operating conditions, such as loading the vehicle beyond its designed weight ratings, etc.

Most attempts to duplicate a vibration concern are made after the vehicle has been driven to the repair facility and perhaps even sat inside the building for a time; the vehicle may be too warm to detect the concern during duplication efforts. The opposite could also occur; perhaps the vehicle has sat out in the cold for a time and fails to reach full operating temperatures during attempts to duplicate the concern.

Temperature, Ground-Out, Accessory Load

Flat Spots on Tires

Tires which have sat and been cool for a time can develop flat spots.

Irregular Wear on Tire Treads

Tires which have sat and been cool for a time will be stiffer and any irregular wear conditions will be more noticeable than they will be once the tires have warmed and softened.

Exhaust System Growth

Exhaust systems may exhibit a ground-out condition when cool which goes away once the system is hot. The opposite may be true that the exhaust system is fine when cool but a ground-out condition occurs once the

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system reaches operating temperatures. Exhaust systems can grow by 21/2-5 cm (1-2 in) when hot.

Engine-Driven Accessory Noises

NOTE: When a stethoscope equipped with a probe is used to assist in identifying possible vibrating components, the results must be compared to the sound quality of the same accessory, in a equally-equipped, same model year and type, KNOWN GOOD vehicle, and under the same conditions. Refer to Vehicle-to-Vehicle Diagnostic Comparison.

A stethoscope equipped with a probe can be used as an additional means to assist in identifying accessories which may be causing or contributing to a vibration concern.

- Belt Whipping

  An engine accessory drive belt, or belts could exhibit a whipping condition if a belt is deteriorating and deposits are building up on the underside of the belt.

- Loose Mounting Brackets or Component Ground-Out

  Engine-driven accessories such as a generator, a power steering pump, or an air conditioning compressor could exhibit noise conditions due to either loose mounting brackets or due to related components of the system in a ground-out condition during certain operation of that accessory system.

- Cold or Hot

  Accessories could exhibit noise conditions when cool which go away once they are fully warmed-up, or the opposite may be true.

- Load on an Accessory Component

  Accessories could exhibit a noise condition while under a heavy load - perhaps when combined with a cool or fully warmed-up condition.

- Bent or Misaligned Pulleys

  Bent or mis-aligned pulleys in one or more engine-driven accessory systems could contribute to a noise or vibration condition.

- Fluid Level in Accessory Systems

  Accessories could exhibit a noise condition due to an abnormal amount of fluid contained in the system of which the accessory is a part. For example:

  - An improper power steering fluid level could produce noises in the power steering system.
  - An improper air conditioning refrigerant level or an excessive amount of refrigerant oil could produce noises or possibly vibrations in the air conditioning system.

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- Incorrect Fluid Type in Accessory Systems

  Accessories could exhibit a noise condition due to the incorrect type of fluid contained in the system of which the accessory is a part.

Vehicle Payload

The vibration concern may only occur when the vehicle is carrying heavy payloads or towing a trailer; the vehicle may have been empty during duplication efforts.

Heavy Payload

The vehicle may have been empty during attempts to duplicate the vibration concern, but the customer may actually experience the vibration concern while the vehicle is carrying a large payload.

Trailer Towing

The customer may experience the vibration concern only while towing a trailer.

Roadway Selection

The selection of roadways used to perform the vibration duplication procedures is likely to be in the near vicinity of the repair facility and may not provide a road surface that is similar enough to the surface on which the customer usually drives the vehicle.

The customer may only experience the vibration on a particular roadway. Perhaps the roadway is overly crowned or is very bumpy or rough.

VIBRATION DIAGNOSTIC AIDS - VIBRATION DUPLICATED, COMPONENT NOT IDENTIFIED

NOTE: If you have not completed the Vibration Analysis tables as indicated and reviewed Vibration Diagnostic Aids, refer to Vibration Diagnostic Aids BEFORE proceeding.

Aftermarket Add-On Accessories

Aftermarket accessories which have been added to the vehicle can actually transmit and magnify INHERENT component rotational frequencies, if the accessories were not installed correctly.

An accessory should be installed in such a way that it is isolated from becoming a possible transfer path into the rest of the vehicle. For example, if a set of running boards has been installed improperly and they are sensitive to a particular frequency of a rotating component, the running boards could begin to respond to the frequency and actually create a disturbance once the amplitude of the frequency reaches a high enough point, probably at a higher vehicle speed.

If the same set of running boards were installed properly-isolated properly-the transfer path would be removed and the disturbance would no longer be present.

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VIBRATION DIAGNOSTIC AIDS - VIBRATION DUPLICATED, DIFFICULT TO ISOLATE/BALANCE COMPONENT

NOTE: If you have not completed the Vibration Analysis tables as indicated and reviewed Vibration Diagnostic Aids, refer to Vibration Diagnostic Aids BEFORE proceeding.

If you have duplicated the vibration concern but have had difficulty in balancing a component or isolating a component, refer to the following information.

Most vibration concerns are corrected or eliminated through correcting excessive runout of a component, correcting balance of a component, or isolating a component which has come into abnormal contact with another object/component.

Components which can generate a lot of energy and are experiencing excessive runout, imbalance, or ground-out can produce a vibration with a strong enough amplitude that the vibration can transmit to components which are closely related. This type of a condition is usually related to and sensitive to torque-load. The most likely system that could exhibit this type of a condition is the driveline.

Driveline Torque-Load Conditions

An drive axle that has internal conditions such as excessive runout of components, misalignment of components, imbalance, etc., can produce vibration concerns which may be transmitted into the propeller shaft, or shafts. This sort of a vibration occurrence can increase or decrease in severity based primarily upon torque-load, but can also be affected by cold or hot conditions.

The propeller shaft and other related components may or may not pass inspections for wear or damage, runout, alignment, etc., depending upon whether there is only one vibration source or more than one.

Difficult to System Balance the Driveline

If after following the Vibration Analysis - Driveline table you were instructed to system balance the driveline and you experienced difficulty in doing so while CAREFULLY following the procedures indicated-the EVA strobe readings seem to keep changing-then the axle differential to which the propeller shaft is attached should be suspected to have internal problems which are being transmitted to the propeller shaft. Refer to the drive axle diagnosis information, for internal axle diagnostics.

VIBRATION DIAGNOSTIC AIDS - VIBRATION DUPLICATED, APPEARS TO BE POTENTIAL OPERATING CHARACTERISTIC

NOTE: If you have not completed the Vibration Analysis tables as indicated and reviewed Vibration Diagnostic Aids, refer to Vibration Diagnostic Aids BEFORE proceeding.

Check Service Bulletins

If BOTH of the following statements are TRUE, then check service bulletins for the condition identified. If the

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condition has already been identified and investigated prior to this vehicle, and has been determined to be something that is not truly an operating characteristic or that perhaps is not design-intent, there will likely be adjustments or corrections identified which will address the condition.

- You CAREFULLY followed the steps indicated through reviewing the Diagnostic Starting Point - Vibration Diagnosis and completing the Vibration Analysis tables identified and you have duplicated the vibration concern.
- You have come to the conclusion through comparison with a very equally-equipped, same model year and type, KNOWN GOOD vehicle that the customer's concern is a condition that appears to be a potential operating characteristic of the vehicle.

SYMPTOMS - VIBRATION DIAGNOSIS AND CORRECTION

NOTE: Perform the following steps in sequence BEFORE using these symptom tables.

1. Begin the diagnosis of a vibration concern by reviewing **Diagnostic Starting Point - Vehicle** to become familiar with the diagnostic process used to properly diagnose vibration concerns.
2. Perform the **Vibration Analysis - Road Testing** table before using these symptom tables in order to duplicate and effectively diagnose the customer's concern.

Symptom Tables

Refer to a Vibration Analysis table as indicated in the following symptom tables, based on the most dominant characteristic of the customer's vibration concern, felt or heard, that is evident during the appropriate condition of the occurrence.

Vibration Symptoms that are Felt

Category	Description	Typical Frequency Range	Condition of Occurrence	Area of Focus
Shake	Can sometimes be seen or felt in the steering wheel, seat or console. Related terminology: shimmy, wobble, waddle, shudder, hop	5-20 Hz	Vehicle Speed Sensitive Still occurs during coast down in NEUTRAL	Go to **Vibration Analysis - Tire and Wheel**
			Vehicle Speed Sensitive Affected by torque/load	Go to **Vibration Analysis - Driveline**
			Vehicle Speed Sensitive Affected by steering input	Go to **Vibration Analysis - Hub and/or Axle Input**
			Engine Speed Sensitive	Go to **Vibration Analysis - Engine**
Roughness	Similar to the feeling of holding a jigsaw.	20-50 Hz	Vehicle Speed Sensitive Still occurs during coast down in NEUTRAL	Go to **Vibration Analysis - Tire and Wheel**
			Vehicle Speed Sensitive Affected by torque/load	Go to **Vibration Analysis - Driveline**
				Go to **Vibration**

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			Vehicle Speed Sensitive Affected by steering input	**Analysis - Hub and/or Axle Input**
			Engine Speed Sensitive	Go to **Vibration Analysis - Engine**
Buzz	Similar to the feeling of holding an electric razor. May be felt in the hands through the steering wheel, in the feet through the floor, or in the seat of the pants.	50-100 Hz	Vehicle Speed Sensitive Affected by torque/load	Go to **Vibration Analysis - Driveline**
			Vehicle Speed Sensitive Affected by steering input	Go to **Vibration Analysis - Hub and/or Axle Input**
			Engine Speed Sensitive	Go to **Vibration Analysis - Engine**
Tingling	May produce a "pins and needles" sensation or may put hands or feet "to sleep". Highest vibration frequency range that can still be felt.	Greater than 100 Hz	Vehicle Speed Sensitive Affected by torque/load	Go to **Vibration Analysis - Driveline**
			Vehicle Speed Sensitive Affected by steering input	Go to **Vibration Analysis - Hub and/or Axle Input**
			Engine Speed Sensitive	Go to **Vibration Analysis - Engine**

Vibration Symptoms that are Heard

Category	Description	Typical Frequency Range	Condition of Occurrence	Area of Focus
Boom	Usually heard as an interior noise similar to the noise of a bowling ball rolling down an alley, deep thunder, or a bass drum. • Related terminology - droning, growling, moaning, roaring, rumbling, humming • May not be accompanied by a perceptible vibration (roughness)	20-60 Hz	Vehicle Speed Sensitive Still occurs during coast down in NEUTRAL	Go to **Vibration Analysis - Tire and Wheel**
			Vehicle Speed Sensitive Affected by torque/load	Go to **Vibration Analysis - Driveline**
			Vehicle Speed Sensitive Affected by steering input	Go to **Vibration Analysis - Hub and/or Axle Input**
Moan or Drone	Similar to the sound of a bumblebee or blowing air across the top of a bottle. • Related terminology - humming, buzzing, resonance • May be accompanied by	60-120 Hz	Vehicle Speed Sensitive Affected by torque/load	Go to **Vibration Analysis - Driveline**
			Vehicle Speed Sensitive Affected by steering input	Go to **Vibration Analysis - Hub and/or Axle Input**

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	a perceptible vibration (buzz)		Engine Speed Sensitive	Go to **Vibration Analysis - Engine**
Howl	Similar to the sound of the wind howling.	120-300 Hz	Vehicle Speed Sensitive Affected by torque/load	Go to **Vibration Analysis - Driveline**
			Vehicle Speed Sensitive Affected by steering input	Go to **Vibration Analysis - Hub and/or Axle Input**
			Engine Speed Sensitive	Go to **Vibration Analysis - Engine**
Whine	Similar to the sound of mosquitoes, turbine engines, or vacuum cleaners.	300-500 Hz	Vehicle Speed Sensitive Affected by torque/load - 2WD mode	Go to Transmission diagnostic information
			Vehicle Speed Sensitive Affected by torque/load - 4WD mode	Go to Transfer Case diagnostic information

VEHICLE-TO-VEHICLE DIAGNOSTIC COMPARISON

Comparing the customer's vehicle to a KNOWN GOOD vehicle that is essentially identical will help determine if the customer's concern may be characteristic of a vehicle design. To arrive at a valid conclusion, the comparison must be performed under the same conditions, using the same criteria, on a vehicle that has the same option content as the customer's vehicle.

The comparison vehicle must match the customer's vehicle in the following areas:

- Model Year
- Make
- Model
- Body style
- Powertrain configuration
- Driveline configuration
- Final drive ratio
- Tire/wheel size and type
- Suspension package
- Trailering package
- GVW rating
- Performance options
- Luxury options

TIRE AND WHEEL INSPECTION

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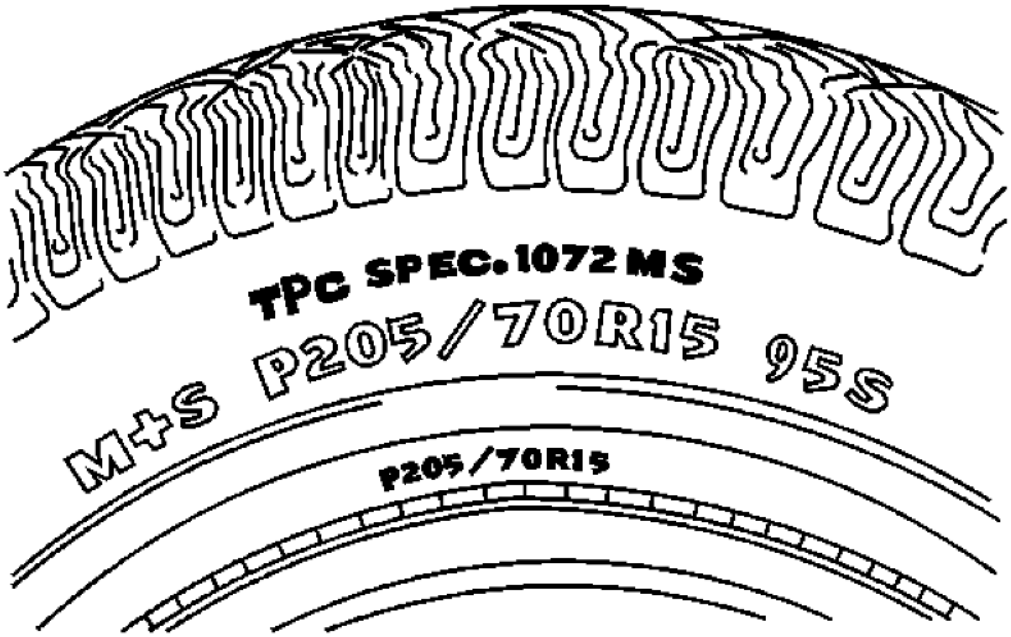


Fig. 2: Identifying Tire Performance Criteria (TPC) Rating Markings
Courtesy of GENERAL MOTORS CORP.

The tires on all new production 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.

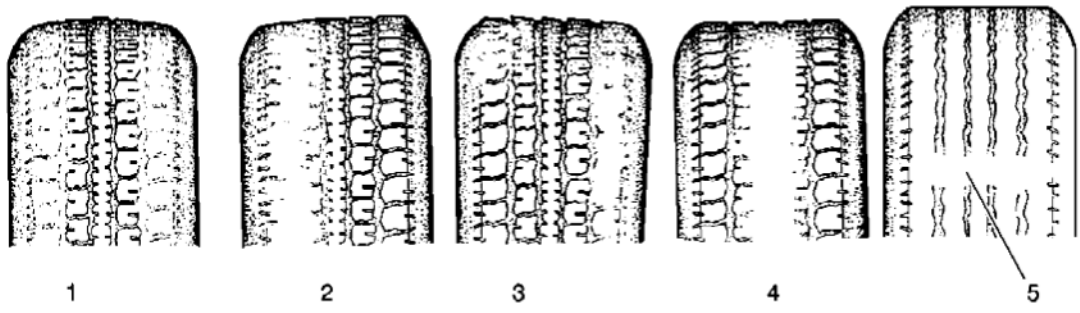


Fig. 3: Tire Wear
Courtesy of GENERAL MOTORS CORP.

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Callout	Component Name
1	Hard Cornering/Underinflation
2	Incorrect Alignment/Lack of Rotation
3	Incorrect Alignment/Non-uniform Tire
4	Heavy Acceleration/Over inflation
5	Wear Indicator

Inspect the tire and wheel assemblies for the following conditions:

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

  These conditions can cause tire growl, tire howl, slapping noises, and/or vibrations throughout the vehicle.

- Proper inflation to specifications for the vehicle
- Bulges in the sidewalls

  Do not confuse bulges, which are an abnormal condition, with normal ply splices which are commonly seen as indentations in the sidewall.

- Bent rim flanges

TIRE AND WHEEL ASSEMBLY RUNOUT MEASUREMENT - ON-VEHICLE

1. Raise and support the vehicle.
2. Closely inspect each tire for proper and even bead seating.
3. If any of the tire beads were not properly or evenly seated, reseat the tire bead, then proceed to step 4. Refer to **Tire and Wheel Removal and Installation** .

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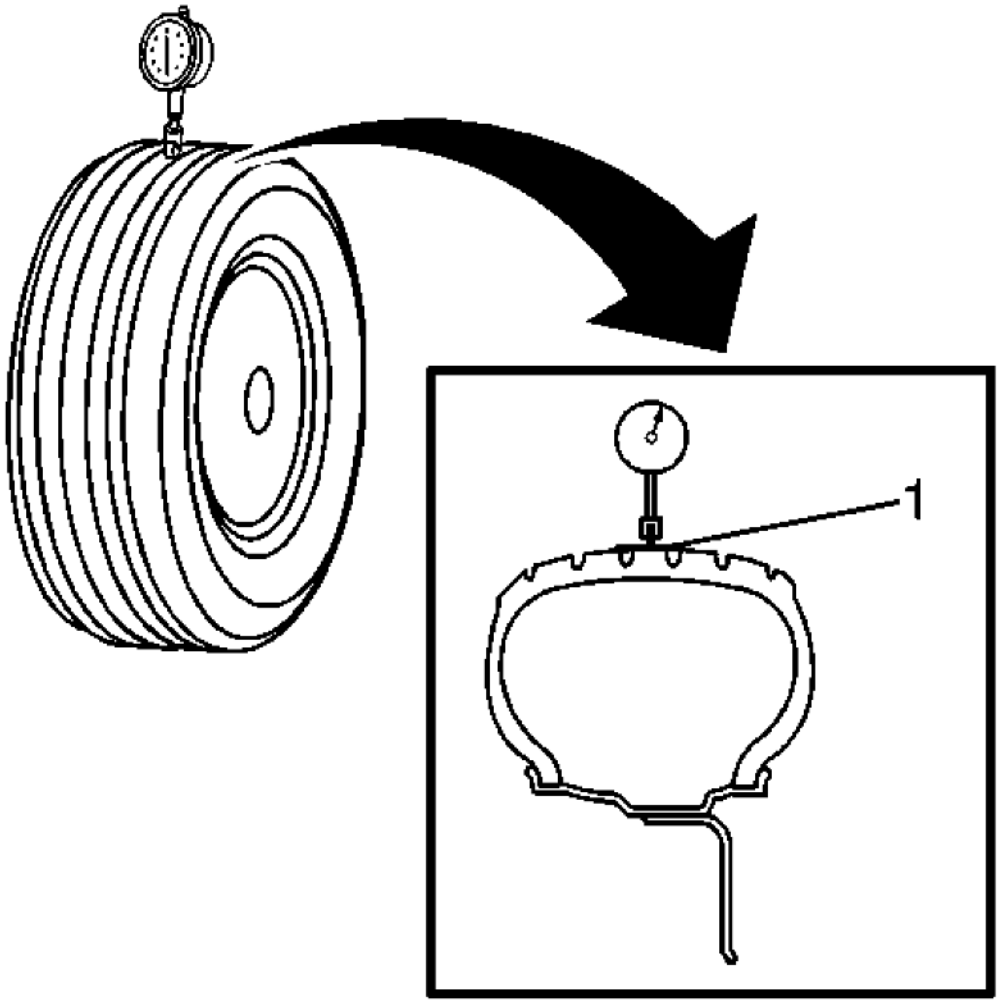


Fig. 4: Measuring Tire & Wheel Assembly Radial Runout
Courtesy of GENERAL MOTORS CORP.

4. Wrap the circumference of each tire with tape (1) in the center tread area.

   Wrapping the tread with tape allows for a smooth and accurate reading of radial runout to be obtained.

5. Position the dial indicator on the taped portion of the tire tread such that the dial indicator is perpendicular to the tire tread surface.
6. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot.
7. Set the dial indicator to zero at the low spot.

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8. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of radial runout.

   Specification: Maximum tire and wheel assembly radial runout - measured on-vehicle: 1.52 mm (0.060 in)

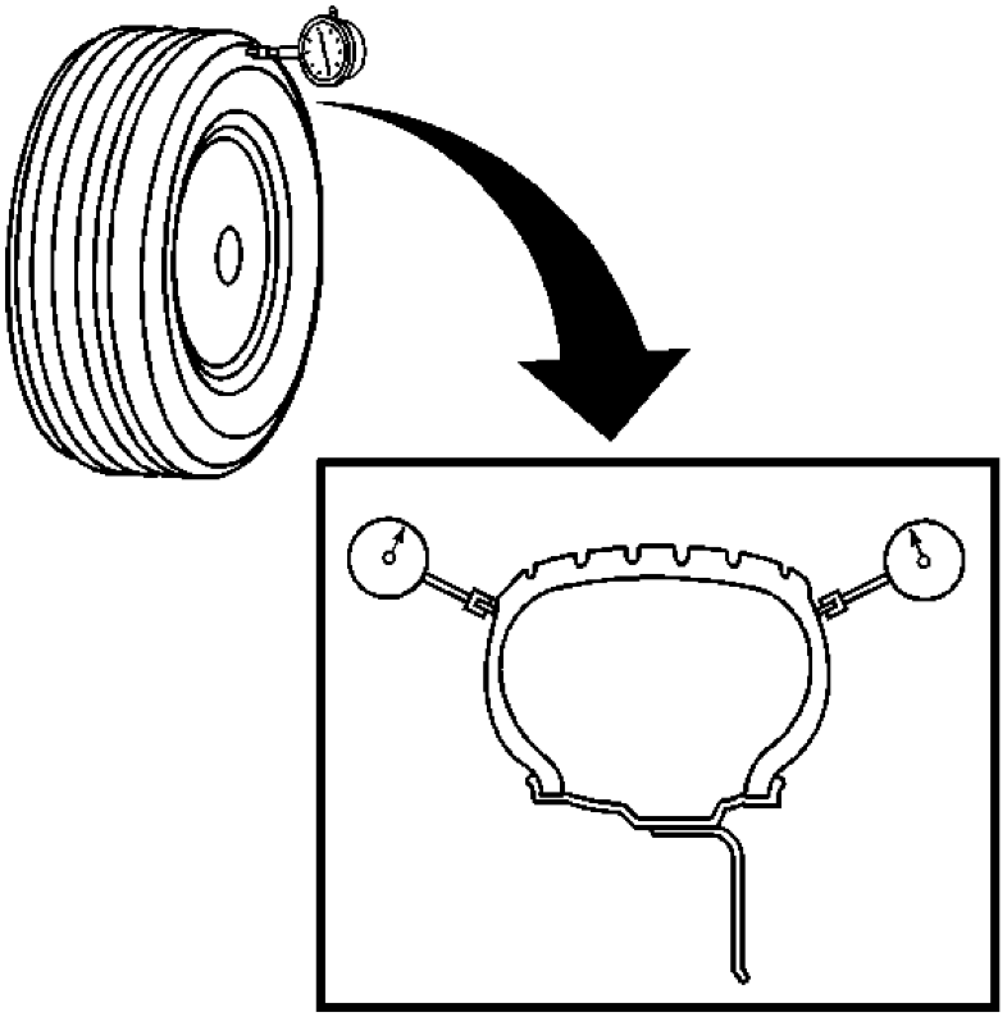


Fig. 5: Measuring Tire & Wheel Assembly Lateral Runout
Courtesy of GENERAL MOTORS CORP.

9. Position the dial indicator on a smooth portion of the tire sidewall, as close to the tread as possible, such that the dial indicator is perpendicular to the tire sidewall surface.

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10. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot. Ignore any jumps or dips due to sidewall splices.
11. Set the dial indicator to zero at the low spot.
12. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of lateral runout. Ignore any jumps or dips due to sidewall splices and attain an average runout measurement.

    Specification: Maximum tire and wheel assembly lateral runout - measured on-vehicle: 1.52 mm (0.060 in)

13. Repeat steps 4 through 12 until all of the tire and wheel assembly radial and lateral runout measurements have been taken.
14. Lower the vehicle.

TIRE AND WHEEL ASSEMBLY RUNOUT MEASUREMENT - OFF VEHICLE

1. Raise and support the vehicle.
2. Mark the location of the wheels to the wheel studs and mark the specific vehicle position on each tire and wheel - LF, LR, RF, RR.
3. Remove the tire and wheel assemblies from the vehicle.
4. Closely inspect each tire for proper and even bead seating.
5. If any of the tire beads were not properly or evenly seated, reseat the tire bead, then proceed to step 6. Refer to **Tire and Wheel Removal and Installation** .
6. Mount a tire and wheel assembly on a spin-type wheel balancer.

   Locate the tire and wheel assembly on the balancer with a cone through the back side of the center pilot hole.

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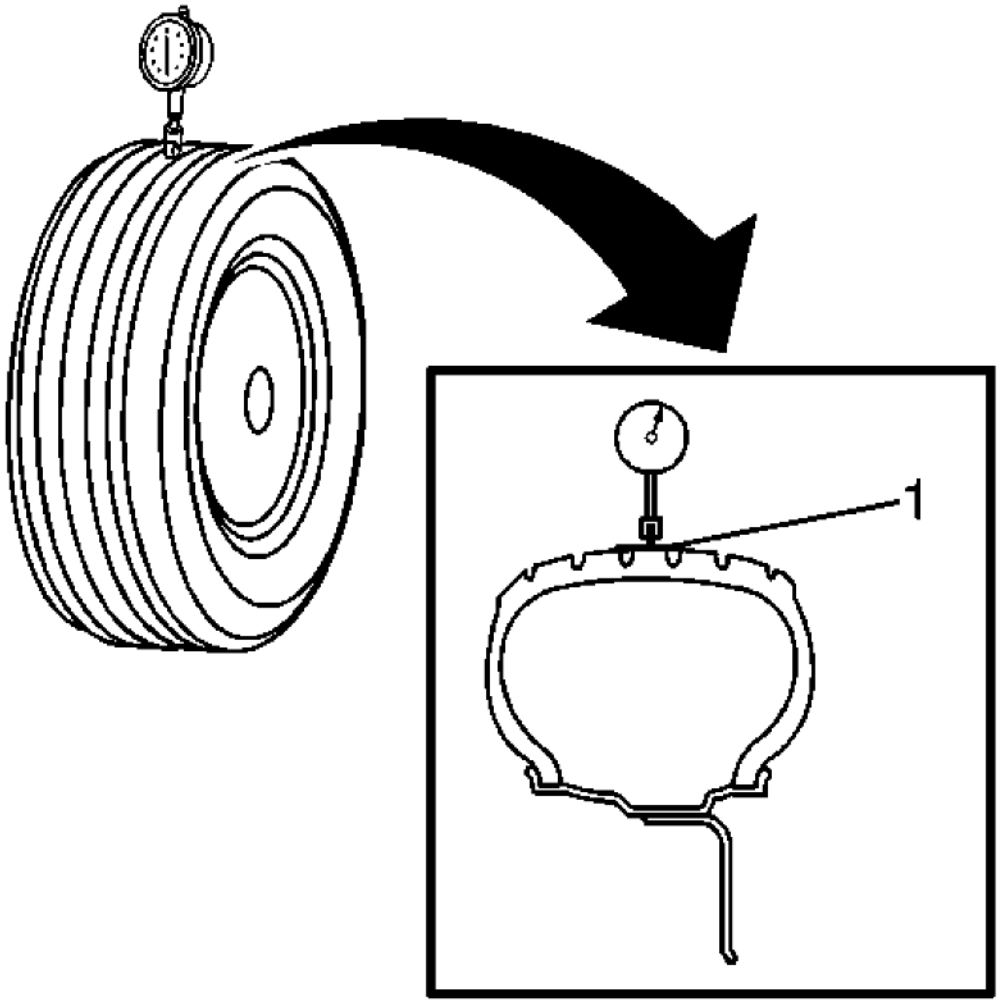


Fig. 6: Measuring Tire & Wheel Assembly Radial Runout
Courtesy of GENERAL MOTORS CORP.

7. Wrap the outer circumference of each tire with tape (1) in the center tread area.

   Wrapping the tread with tape allows for a smooth and accurate reading of radial runout to be obtained.

8. Position the dial indicator on the taped portion of the tire tread such that the dial indicator is perpendicular to the tire tread surface.
9. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot.
10. Set the dial indicator to zero at the low spot.

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11. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of radial runout.

    Specification: Maximum tire and wheel assembly radial runout - measured off-vehicle: 1.27 mm (0.050 in)

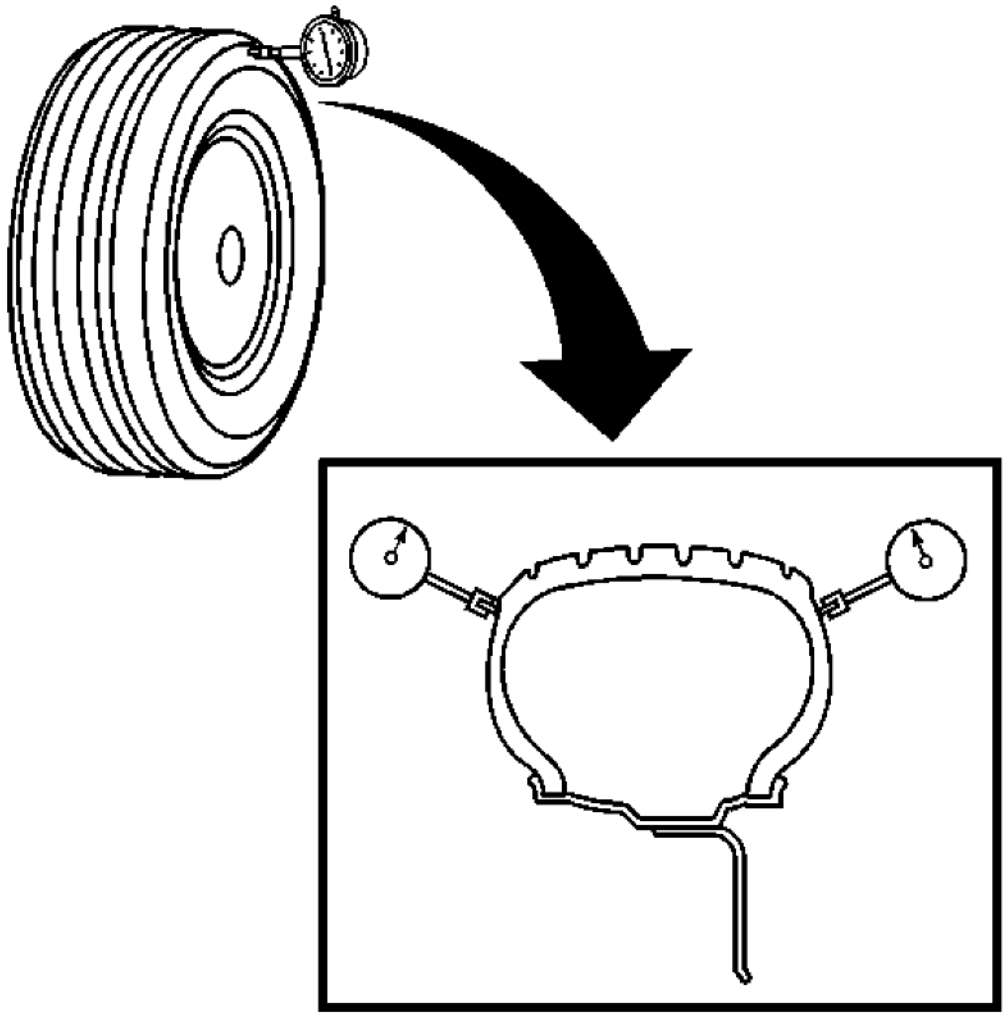


Fig. 7: Measuring Tire & Wheel Assembly Lateral Runout
Courtesy of GENERAL MOTORS CORP.

12. Position the dial indicator on a smooth portion of the tire sidewall, as close to the tread as possible, such that the dial indicator is perpendicular to the tire sidewall surface.

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13. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot. Ignore any jumps or dips due to sidewall splices.
14. Set the dial indicator to zero at the low spot.
15. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of lateral runout. Ignore any jumps or dips due to sidewall splices and attain an average runout measurement.

    Specification: Maximum tire and wheel assembly lateral runout - measured off-vehicle: 1.27 mm (0.050 in)

16. Repeat steps 6 through 15 until all of the tire and wheel assembly radial and lateral runout measurements have been taken.
17. If ANY of the tire and wheel assembly runout measurements were NOT within specifications, proceed to step 19.
18. If ALL of the tire and wheel assembly runout measurements WERE within specifications, then the off-vehicle tire and wheel assembly runout is considered acceptable.

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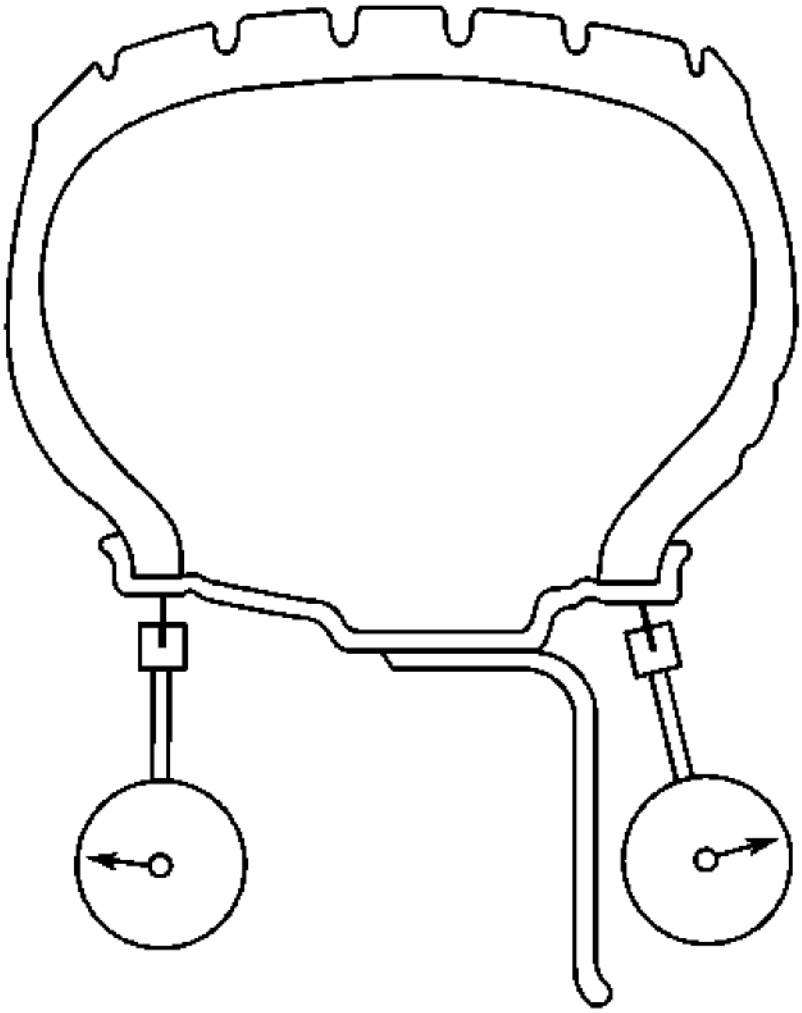


Fig. 8: Measuring Wheel Radial Runout (Off-Vehicle, Tire Mounted)
Courtesy of GENERAL MOTORS CORP.

19. Position the dial indicator on the horizontal outer surface of the wheel rim flange - with the tire still mounted - such that the dial indicator is perpendicular to the rim flange surface.

    Wheel runout should be measured on both the inboard and outboard rim flanges, unless wheel design will not permit. Ignore any jumps or dips due to paint drips, chips, or welds.

20. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot.
21. Set the dial indicator to zero at the low spot.

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22. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of wheel radial runout.

Specification:

- Maximum aluminum wheel radial runout - measured off-vehicle, tire mounted: 0.762 mm (0.030 in)
- Maximum steel wheel radial runout - measured off-vehicle, tire mounted: 1.015 mm (0.040 in)

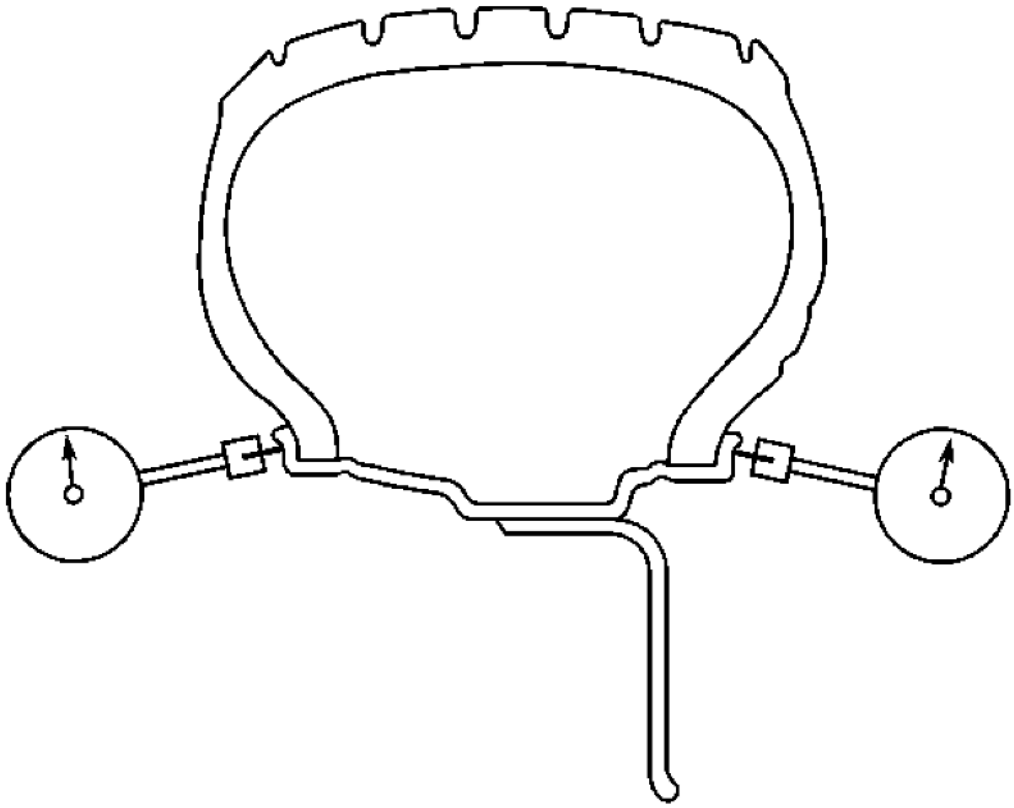


Fig. 9: Measuring Wheel Lateral Runout (Off-Vehicle, Tire Mounted)
Courtesy of GENERAL MOTORS CORP.

23. Position the dial indicator on the vertical outer surface of the wheel rim flange - with the tire still mounted - such that the dial indicator is perpendicular to the rim flange surface.

Wheel runout should be measured on both the inboard and outboard rim flanges, unless wheel design will not permit. Ignore any jumps or dips due to paint drips, chips, or welds.

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24. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot.
25. Set the dial indicator to zero at the low spot.
26. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of wheel lateral runout.

    Specification:

    - Maximum aluminum wheel lateral runout - measured off-vehicle, tire mounted: 0.762 mm (0.030 in)
    - Maximum steel wheel lateral runout - measured off-vehicle, tire mounted: 1.143 mm (0.045 in)

27. Repeat steps 19 through 26 until all of the wheel radial and lateral runout measurements have been taken on each of the - tire and wheel - assemblies with assembly runout measurements which were NOT within specifications.
28. If any of the wheel runout measurements were NOT within specifications, proceed to Measuring Wheel Runout - Tire Dismounted.
29. For any of the wheel runout measurements which WERE within specifications, while the - tire and wheel - assembly runout measurements were NOT within specifications, replace the tire, then balance the assembly. Refer to **Tire and Wheel Assembly Balancing - Off Vehicle**.
30. After replacement of any tires, always re-measure the runout of the affected tire and wheel assembly, or assemblies.
31. Using the matchmarks made prior to removal, install the tire and wheel assemblies to the vehicle.
32. Lower the vehicle.

Wheel Runout Measurement - Tire Dismounted

1. On the tire and wheel assembly, or assemblies with wheel runout measurements - tire mounted - which were NOT within specifications, mark each tire and wheel in relation to each other.
2. Dismount the tire from the wheel. Refer to **Tire Dismounting and Mounting** .
3. Mount the wheel on a spin-type wheel balancer.
4. Locate the wheel on the balancer with a cone through the back side of the center pilot hole.

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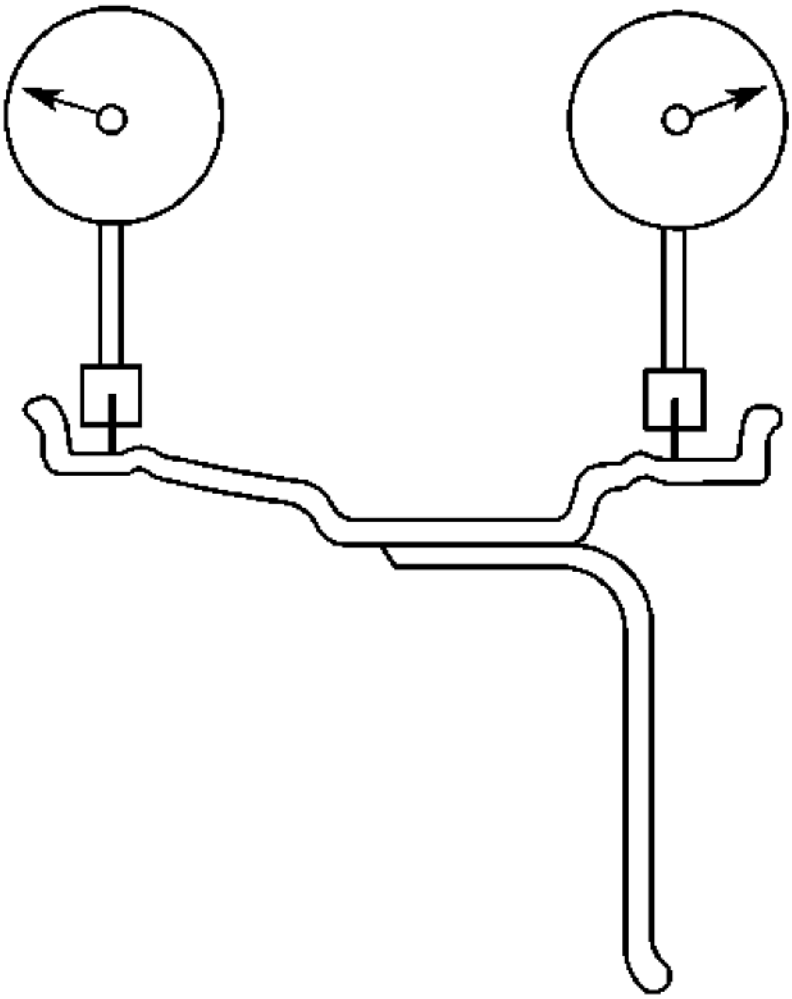


Fig. 10: Measuring Wheel Radial Runout (Off-Vehicle, Tire Dismounted)
Courtesy of GENERAL MOTORS CORP.

5. Position the dial indicator on the horizontal inner surface of the wheel rim flange - with the tire dismounted - such that the dial indicator is perpendicular to the rim flange surface.

   Wheel runout should be measured on both the inboard and outboard rim flanges. Ignore any jumps or dips due to paint drips, chips, or welds.

6. Slowly rotate the wheel one complete revolution in order to find the low spot.
7. Set the dial indicator to zero at the low spot.

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8. Slowly rotate the wheel one more complete revolution and measure the total amount of wheel radial runout.

Specification:

- Maximum aluminum wheel radial runout - measured off-vehicle, tire dismounted: 0.762 mm (0.030 in)
- Maximum steel wheel radial runout - measured off-vehicle, tire dismounted: 1.015 mm (0.040 in)

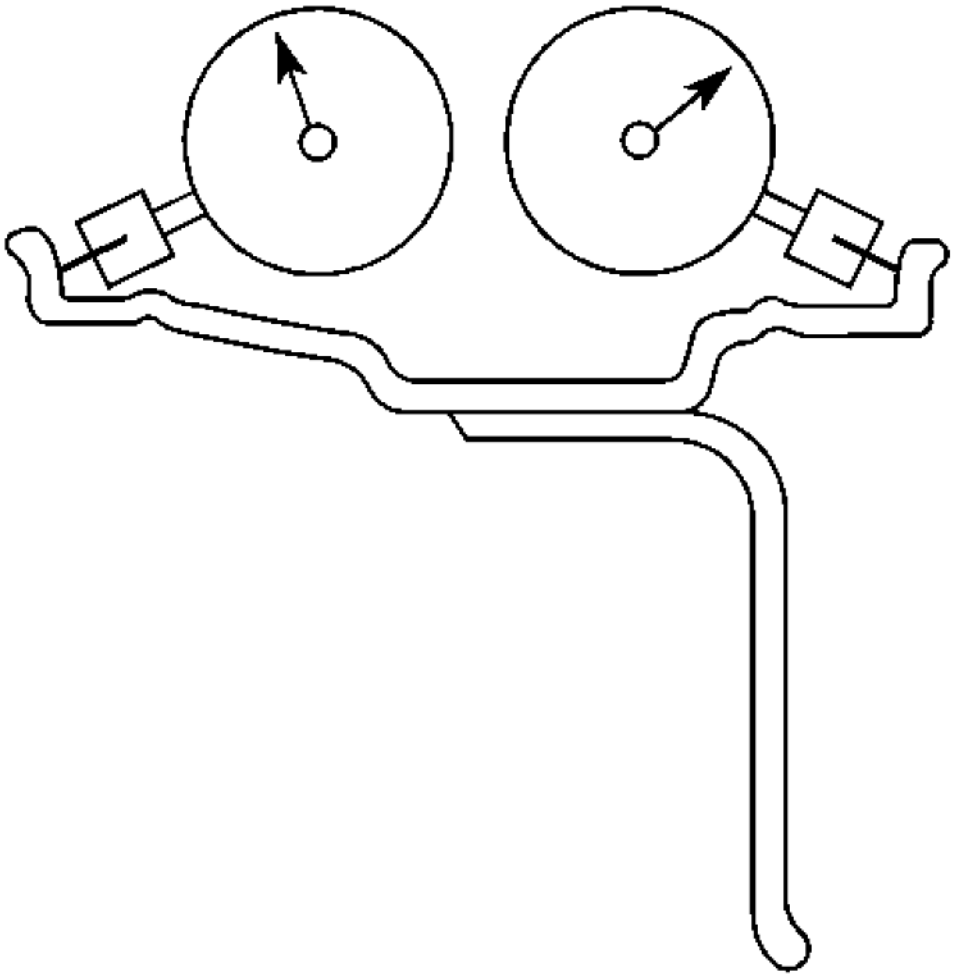


Fig. 11: Measuring Wheel Lateral Runout (Off-Vehicle, Tire Dismounted)
Courtesy of GENERAL MOTORS CORP.

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9. Position the dial indicator on the vertical inner surface of the wheel rim flange - with the tire dismounted - such that the dial indicator is perpendicular to the rim flange surface.

   Wheel runout should be measured on both the inboard and outboard rim flanges. Ignore any jumps or dips due to paint drips, chips, or welds.

10. Slowly rotate the wheel one complete revolution in order to find the low spot.
11. Set the dial indicator to zero at the low spot.
12. Slowly rotate the wheel one more complete revolution and measure the total amount of wheel lateral runout.

    Specification:

    - Maximum aluminum wheel lateral runout - measured off-vehicle, tire dismounted: 0.762 mm (0.030 in)
    - Maximum steel wheel lateral runout - measured off-vehicle, tire dismounted: 1.143 mm (0.045 in)

13. Repeat steps 2 through 12 until all of the wheel radial and lateral runout measurements - tire dismounted - have been taken on each wheel with runout measurements - tire mounted - which were NOT within specifications.
14. If any of the wheel runout measurements - tire dismounted - were NOT within specifications, replace the wheel.

    Always measure the runout of any replacement wheels.

15. For any of the wheel runout measurements which WERE within specifications, while the - tire and wheel - assembly runout measurements were NOT within specifications, replace the tire, then balance the assembly. Refer to **Tire and Wheel Assembly Balancing - Off Vehicle**.
16. Using the matchmarks made prior to dismounting the tire, or tires, mount the tire, or tires to the wheel, or wheels, then balance the assembly, or assemblies. Refer to **Tire and Wheel Assembly Balancing - Off Vehicle**.

    Always measure the runout of any of the tire and wheel assemblies which have had the tires dismounted and mounted.

17. Using the matchmarks made prior to removal, install the tire and wheel assemblies to the vehicle.
18. Lower the vehicle.

BRAKE ROTOR/DRUM BALANCE INSPECTION

1. Support the vehicle drive axle on a suitable hoist. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the tire and wheel assemblies from the drive axle. Refer to **Tire and Wheel Removal and Installation** .

WARNING: **Refer to Work Stall Test Warning .**

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3. Reinstall the wheel nuts in order to retain the brake rotors.
4. Run the vehicle at the concern speed while inspecting for the presence of the vibration.

CAUTION: Do not depress the brake pedal with the brake rotors and/or the brake drums removed, or with the brake calipers repositioned away from the brake rotors, or damage to the brake system may result.

5. If the vibration is still present, remove the rotors from the drive axle, then run the vehicle back to the concern speed.
6. If the vibration is eliminated when the brake rotors are removed from the drive axle, repeat the test with one rotor installed at a time. Replace the rotor that is causing or contributing to the vibration concern.

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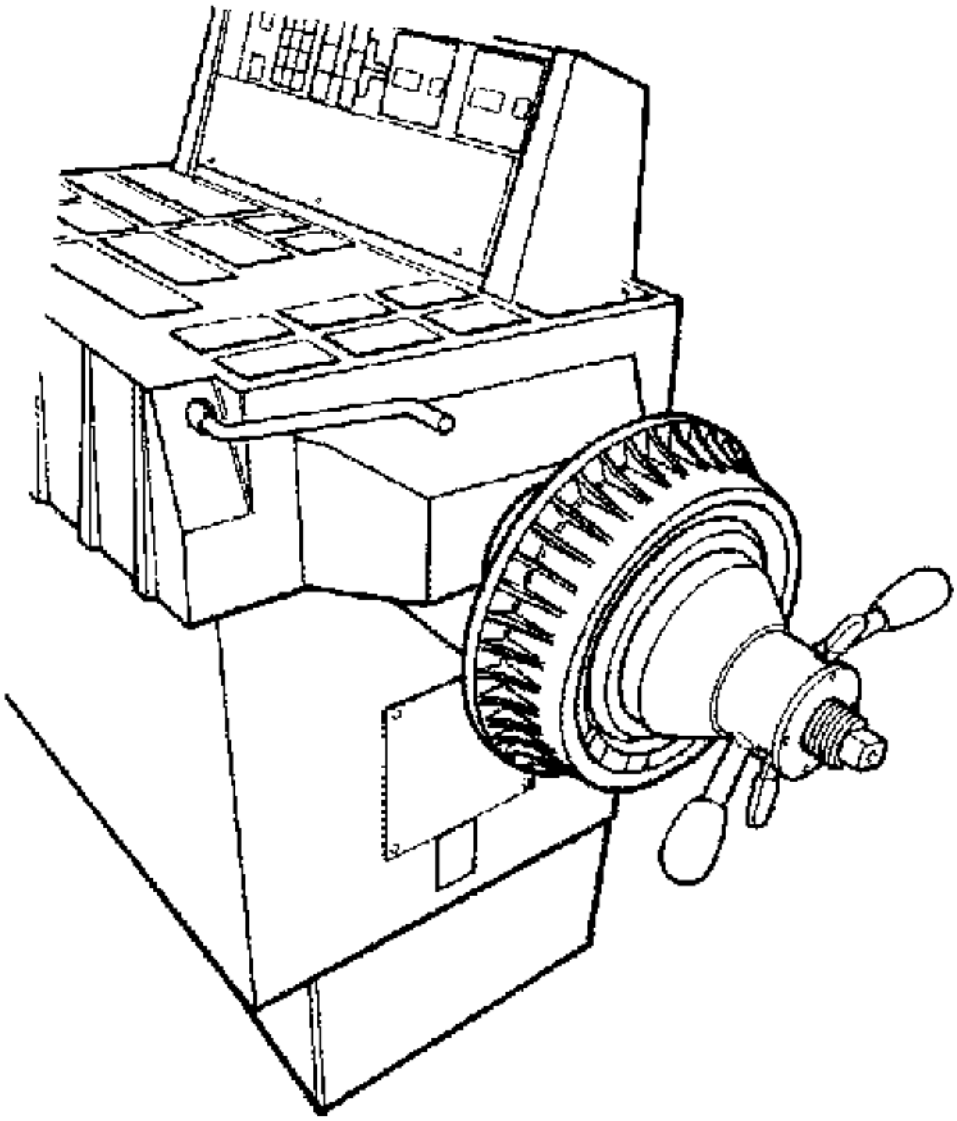


Fig. 12: Balancing Brake Drum
Courtesy of GENERAL MOTORS CORP.

7. If a brake rotor was replaced as a result of following the previous steps, or if necessary to confirm the results obtained during the previous steps, and/or to check the non-drive axle components, perform the following:
    1. Mount the brake rotor/drum on a balancer in the same manner as a tire and wheel assembly.

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NOTE: Check brake rotors/drums for static imbalance only; ignore the dynamic imbalance readings.

2. Inspect the rotor/drum for static imbalance.

There is not a set tolerance for brake rotor/drum static imbalance. However, any brake rotor/drum measured in this same manner which is over 21 g (3/4 oz) may have the potential to cause or contribute to a vibration. Rotors/drums suspected of causing or contributing to a vibration should be replaced. Any rotor/drum that is replaced should be checked for imbalance in the same manner.

HUB/AXLE FLANGE AND WHEEL STUD RUNOUT INSPECTION

Special Tools

GE-8001: Dial Indicator Set, or equivalent

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Mark the location of the wheels to the wheel studs and mark the specific vehicle position on each tire and wheel - LF, LR, RF, RR.
3. Remove the tire and wheel assemblies from the vehicle. Refer to **Tire and Wheel Removal and Installation** .
4. Remove the brake rotors and/or brake drums from the vehicle. Clean the mounting surfaces of the brake rotors, the brake drums, if equipped, and the hub/axle flanges of any loose debris, rust, and corrosion.

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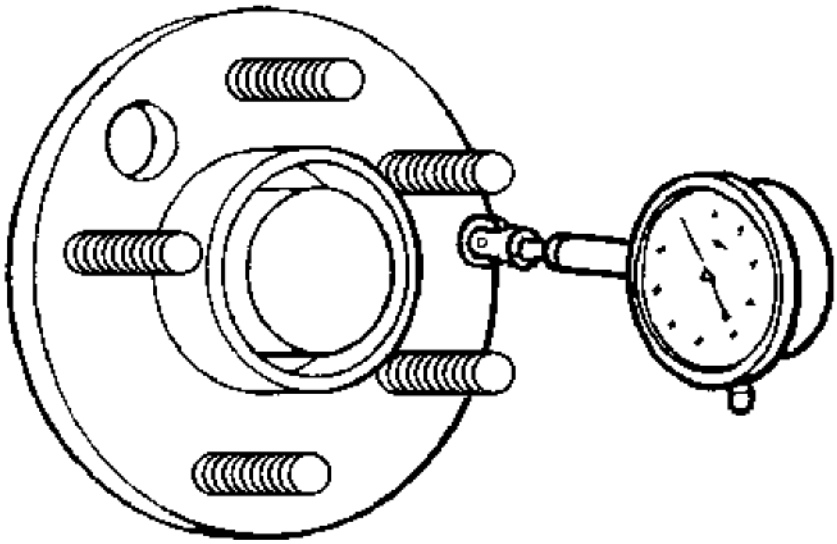


Fig. 13: Measuring Wheel Hub/Axle Flange Runout
Courtesy of GENERAL MOTORS CORP.

5. Position the **GE-8001:** Dial Indicator Set, or equivalent, on the machined surface of the wheel hub/axle flange outside of the wheel studs.
6. Rotate the hub one complete revolution in order to find the low spot.
7. Set the **GE-8001:** Dial Indicator Set, or equivalent, to zero at the low spot.
8. Rotate the hub one more complete revolution and measure the total amount of wheel hub/axle flange runout.

   Specification - Guideline: Wheel hub/axle flange runout tolerance guideline: 0.132 mm (0.005 in)

9. If the runout of the wheel hub/axle flange IS within specification and the vehicle is equipped with wheel studs, proceed to step 13.
10. If the runout of the wheel hub/axle flange IS within specification and the vehicle is equipped with wheel bolts, proceed to step 19.
11. If the runout of the wheel hub/axle flange is marginal, the wheel hub may or may not be the source of the disturbance.
12. If the runout of the wheel hub/axle flange is excessive, replace the wheel hub/axle flange. Measure the runout of the new wheel hub/axle flange.

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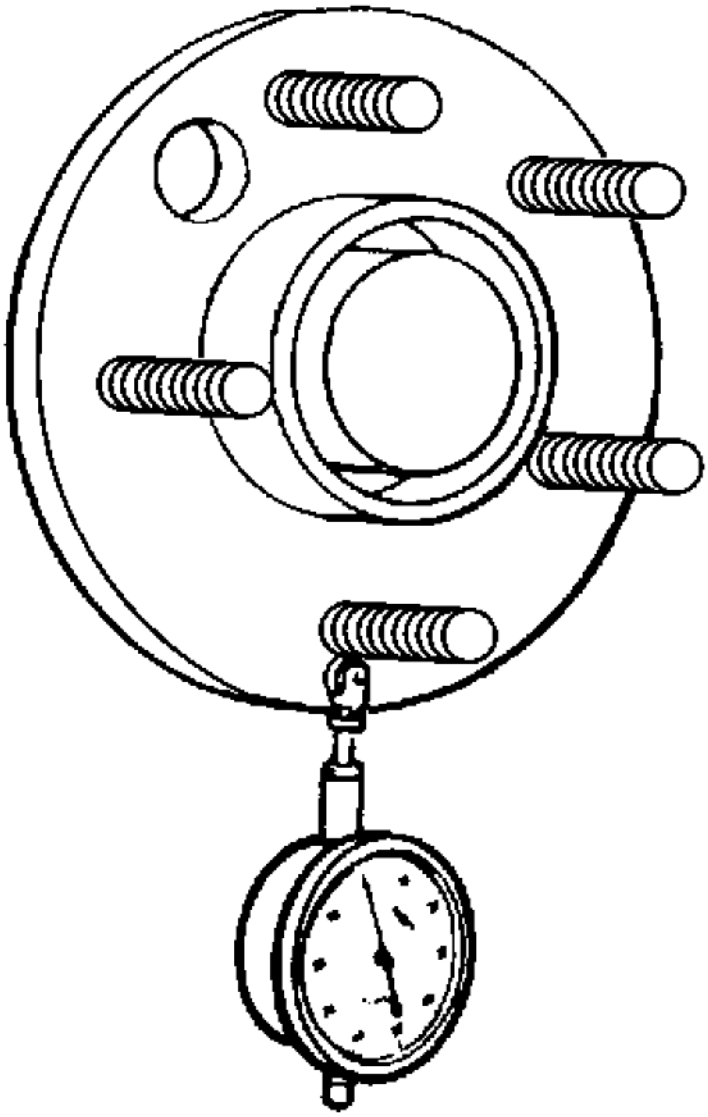


Fig. 14: Measuring Wheel Stud Runout
Courtesy of GENERAL MOTORS CORP.

13. Position the **GE-8001:** Dial Indicator Set, or equivalent, in order to contact the wheel mounting studs.

    Measure the stud runout as close to the flange as possible.

14. Turn the hub one complete revolution to register on each of the wheel studs.

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15. Zero the **GE-8001:** Dial Indicator Set, or equivalent, on the lowest stud.
16. Rotate the hub one more complete revolution and measure the total amount of wheel stud - stud circle - runout.

    Specification - Guideline: Wheel stud runout tolerance guideline: 0.254 mm (0.010 in)

17. If the runout of the wheel studs - stud circle - is marginal, the wheel studs may or may not be contributing to the disturbance.
18. If the runout of the wheel studs - stud circle - is excessive, replace the wheel studs as necessary. Measure the runout of the new wheel studs.
19. Inspect the threads and the tapered seat portion on each of the wheel bolts for damage.
20. Wheel bolts exibiting damaged threads and/or damaged tapered seats require replacement.
21. Place the threaded portion of each wheel bolt along a straight edge to inspect for straightness.
22. Wheel bolts that are not straight require replacement.

TIRE AND WHEEL ASSEMBLY ISOLATION TEST

Force Variation

Force variation refers to a radial or lateral movement of the tire and wheel assembly which acts much like runout, however, force variation has to do with variations in the construction of the tire. These variations in tire construction may actually cause vibration in a vehicle, even though the tire and wheel assembly runout and balance may be within specifications.

Radial Force Variation

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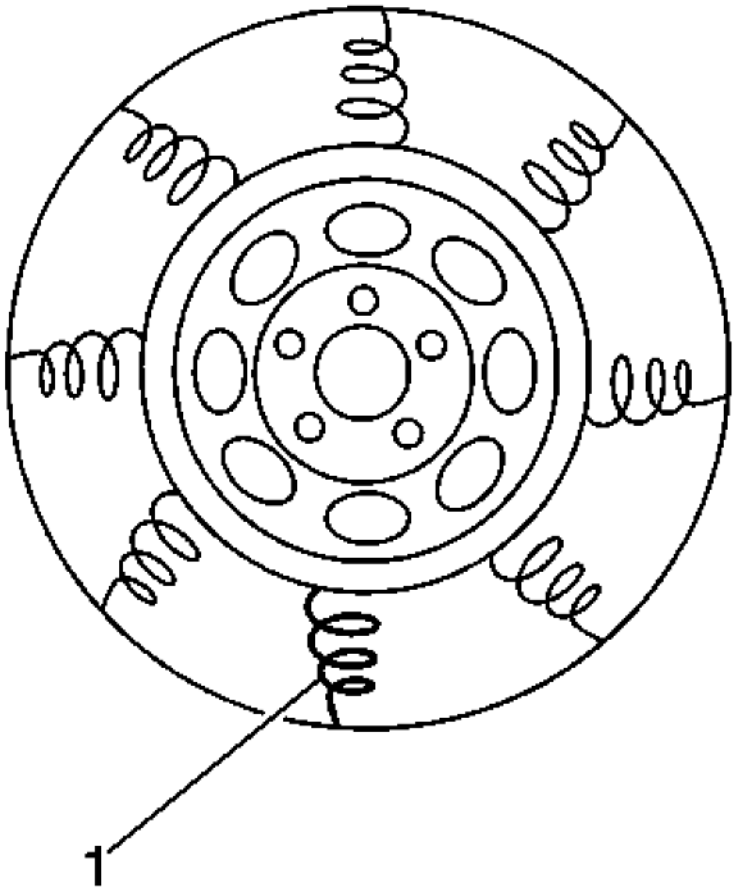


Fig. 15: Identifying Radial Force Variation
Courtesy of GENERAL MOTORS CORP.

Radial force variation refers to the difference in the stiffness of a tire sidewall as the tire rotates and contacts the road. Tire sidewalls have some stiffness due to splices in the different plies of the tire, but these stiffness differences do not cause a problem unless the force variation is excessive. Stiff spots (1) in a tire sidewall can deflect a tire and wheel assembly upward as the assembly contacts the road.

Lateral Force Runout

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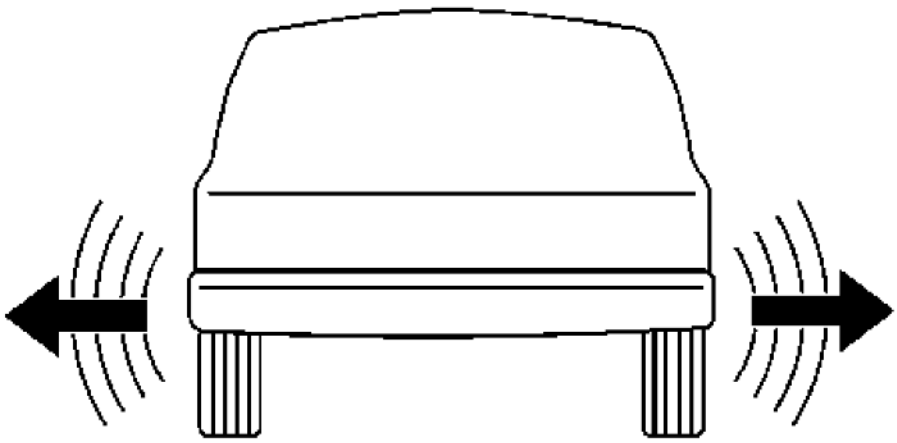


Fig. 16: Identifying Tire Wobble/Waddle
Courtesy of GENERAL MOTORS CORP.

Lateral force variation refers to the difference in the stiffness or conformity of the belts within a tire as the tire rotates and contacts the road. Tire belts may have some stiffness or conformity differences, but these differences do not cause a problem unless the force variation is excessive. These variations in the belts of the tire can deflect the vehicle sideways or laterally. A shifted belt inside a tire may cause lateral force variation.

In most cases where excessive lateral force variation exists, the vehicle will display a wobble or waddle at low speeds, 8-40 km/h (5-25 mph), on a smooth road surface.

Isolation Test Procedure

Perform the following test in order to determine if force variation is present in the vehicle.

1. Substitute a set of KNOWN GOOD, pre-tested tire and wheel assemblies of the same size and type for the suspected original assemblies. Refer to **Tire and Wheel Removal and Installation** .
2. Road test the vehicle to determine if the vibration is still present. Refer to **Vibration Analysis - Road Testing**.
3. If the vibration is still present while using the known good set of tire and wheel assemblies, then force variation is not the cause of the vibration.
4. If the vibration is eliminated when using the known good set of tire and wheel assemblies, install one of the original tire and wheel assemblies using the matchmarks made prior to removal. Refer to **Tire and Wheel Removal and Installation** . Road test the vehicle to determine if the vibration has returned. Refer to **Vibration Analysis - Road Testing**.
5. Continue the process of installing the original tire and wheel assemblies one at a time, then road testing

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the vehicle, until the tire and wheel assembly, or assemblies which is causing the vibration has been identified.

6. Replace the tire, or tires on the vibration-causing tire and wheel assembly, or assemblies, then balance the assembly, or assemblies. Refer to **Tire and Wheel Assembly Balancing - Off Vehicle**.

VIBRATION IN SERVICE-STALL TEST (NON-TORQUE SENSITIVE)

Special Tools

GE-38792-A: Electronic Vibration Analyzer (EVA) 2

For equivalent regional tools, refer to **Special Tools and Equipment**.

CAUTION: 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.

1. Turn the ignition ON but do not start the engine.
2. Place the transmission in NEUTRAL.
3. Raise and support the vehicle. Support the drive axle or axles at curb height. Refer to **Lifting and Jacking the Vehicle** .
4. Remove the tire and wheel assemblies from the vehicle. Refer to **Tire and Wheel Removal and Installation** .
5. Remove the brake rotors or drums, if equipped, from the drive axle or axles.
6. Inspect the propeller shaft or shafts. All propeller shafts should be free of undercoating before continuing.

CAUTION: Do not depress the brake pedal with the brake rotors and/or the brake drums removed, or with the brake calipers repositioned away from the brake rotors, or damage to the brake system may result.

7. Have an assistant start the engine.
8. Place the transmission in the highest forward gear.
9. Accelerate and decelerate the vehicle through the speed range at which the vibration was first noted during the Vibration Analysis-Road Testing procedure.
10. Record whether the vibration was present, and at what speed.
11. If the vibration is present, determine which end of the propeller shaft is vibrating the most. Hold the vibration sensor of the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2, up to the pinion nose and the transmission or transfer case tailshaft housing.
12. If the vehicle is equipped with a multiple-piece propeller shaft, hold the vibration sensor of the **GE-**

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38792-A: EVA 2 up to the propeller shaft support bearing assembly, or assemblies to inspect for vibration.

13. If the transmission or transfer case output shaft housing is vibrating, hold the vibration sensor of the **GE-38792-A:** EVA 2 up to the transmission crossmember under the transmission mount. If there is no vibration on the crossmember, then the transmission mount is working properly.
14. Record which end of the propeller shaft is vibrating the most, and how severe the vibration is. The inspection will be a reference by which to judge future progress.

VIBRATION IN SERVICE-STALL TEST (TORQUE SENSITIVE)

Special Tools

GE-38792-A: Electronic Vibration Analyzer (EVA) 2

For equivalent regional tools, refer to **Special Tools and Equipment**.

CAUTION: 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.

1. Turn the ignition ON but do not start the engine.
2. Place the transmission in NEUTRAL.
3. Raise and support the vehicle. Support the drive axle or axles at curb height. Refer to **Lifting and Jacking the Vehicle** .
4. Remove the tire and wheel assemblies from the vehicle. Refer to **Tire and Wheel Removal and Installation** .
5. Remove the brake rotors or drums, if equipped, from the drive axle or axles.
6. Hold the vibration sensor of the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2, against the pinion nose.

CAUTION: Do not depress the brake pedal with the brake rotors and/or the brake drums removed, or with the brake calipers repositioned away from the brake rotors, or damage to the brake system may result.

7. Have an assistant start the vehicle.
8. Place the transmission in the highest forward gear.
9. Accelerate and decelerate the vehicle through the speed range at which the vibration was first noted during the Vibration Analysis - Road Testing procedure.
10. If a vibration is present, note the **GE-38792-A:** EVA 2 reading during acceleration or deceleration.

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11. Note as to whether or not the pinion nose vibrates under load during acceleration or deceleration.
12. If the vibration is not reproduced, reinstall the brake rotors and/or drums and the wheel/tire assemblies to put an additional load on the system. Perform steps 7-11 and check the components again.
13. If the vibration is still not reproduced with rotors and/or drums reinstalled, lightly apply the brakes to further load the system while maintaining the vibration concern speed.
14. If the pinion nose vibrates under acceleration or deceleration, and other driveline components have been eliminated as a cause, the vibration may be an internal axle problem.

TRANSFER CASE OUTPUT FLANGE RUNOUT MEASUREMENT

Special Tools

GE-7872: Magnetic Base Dial Indicator Set, or equivalent

NOTE: This measurement procedure is intended to measure transmission or transfer case output flange runout for systems with a constant velocity (CV) joint, rubber coupling or bolt-on U-joint yoke at the transmission or transfer case.

1. Place the transmission in NEUTRAL.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. If equipped with a CV joint, measure the transmission or transfer case output flange radial runout on the machined surface of the prop shaft front CV joint housing, as close to the flange as possible:
    1. Clean the surface of the prop shaft front CV joint housing just rear of the transmission or transfer case output flange.
    2. Mount a dial indicator set, **GE-7872:** Magnetic Base Dial Indicator Set , or equivalent, and position the dial indicator to contact the prop shaft front CV joint housing as close to the transfer case output flange as possible.
4. If equipped with a rubber coupling or bolt-on U-joint yoke, measure the transfer case output flange radial runout on the machined surface of the flange pilot area:
    1. Mark the position of the prop shaft to the transmission or transfer case output flange.
    2. Separate the propshaft from the transmission or transfer case output flange.
    3. Clean the surface of the flange pilot area.
    4. Mount a dial indicator set, **GE-7872:** Magnetic Base Dial Indicator Set , or equivalent, and position the dial indicator to contact the pilot area as close to the end of the pilot as possible.
5. Rotate the transmission or transfer case output flange by hand to locate the low spot.
6. Set the dial indicator to zero on the low spot.
7. Rotate the flange or shaft by hand and record the amount of radial runout.
8. Compare the runout of the flange or shaft to the runout tolerance specifications guideline.
9. If the transmission or transfer case output flange runout exceeds the specification, the flange or shaft requires replacement.

PROPELLER SHAFT RUNOUT MEASUREMENT

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Special Tools

- **GE-7872:** Magnetic Base Dial Indicator Set, or equivalent
- **GE-8001:** Dial Indicator Set, or equivalent

For equivalent regional tools, refer to **Special Tools and Equipment**.

NOTE:

- **This measurement procedure is intended to measure propeller shaft runout for prop shaft systems with 2 or 3 U-joints only. This is not for prop systems with only 1 U-joint, or with only constant velocity (CV) joints, and/or coupler assemblies.**
- **When measuring runout of propeller shafts, do not include fluctuations on the dial indicator due to welds or surface irregularities.**
- **Always inspect the runout of any replacement propeller shaft.**

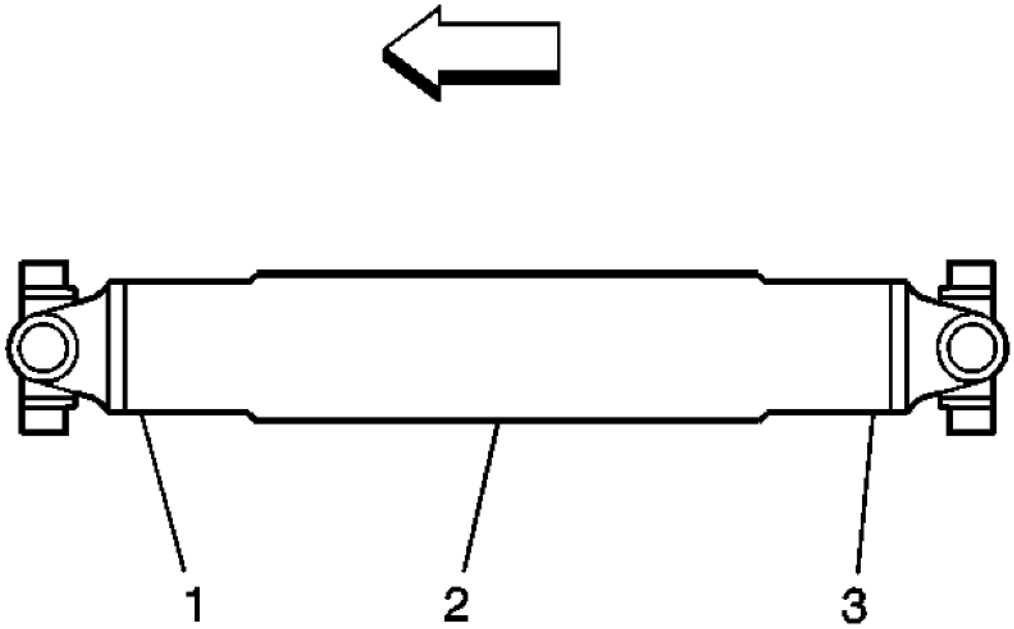


Fig. 17: Identifying Propeller Shaft Runout Measurement Points
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. On vehicles with solid axles, ensure that the drive axle is supported at ride height - vehicle body supported by suspension components. Ensure the wheels are free to rotate. Refer to **Lifting and Jacking the Vehicle** .

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2. Place the transmission in NEUTRAL.
3. Clean the circumference of the propeller shaft or shafts of any debris and/or undercoating along the front (1), center (2), and rear (3) positions.
4. Inspect the propeller shaft or shafts for dents, damage, and/or missing weights. Any propeller shaft that is dented or damaged requires replacement.

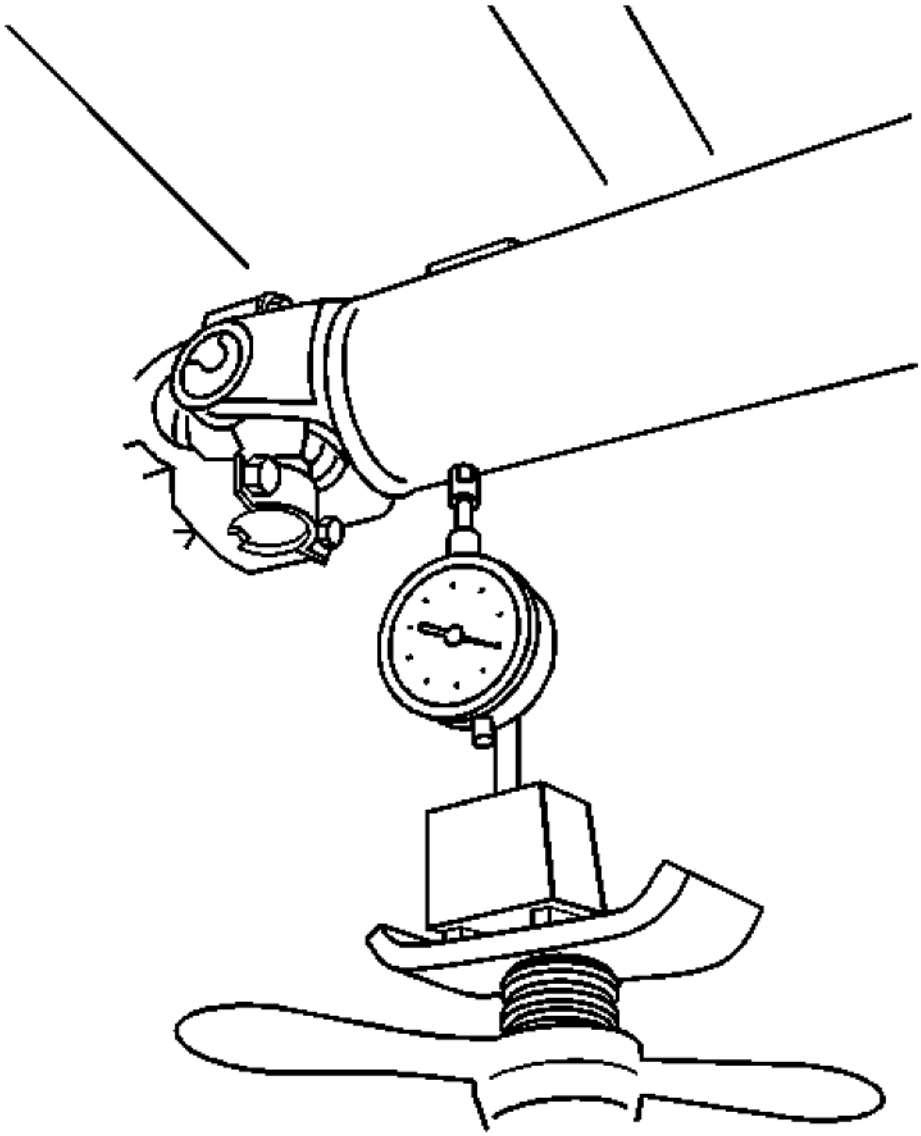


Fig. 18: Measuring Runout Of Propeller Shaft

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Courtesy of GENERAL MOTORS CORP.

5. For 1-piece and 2-piece prop systems, mount the **GE-7872:** Magnetic Base Dial Indicator Set, or equivalent, or the **GE-8001:** Dial Indicator Set, or equivalent, to the vehicle underbody or to a service stand positioned just clear of the U-joint yoke weld on the prop shaft.

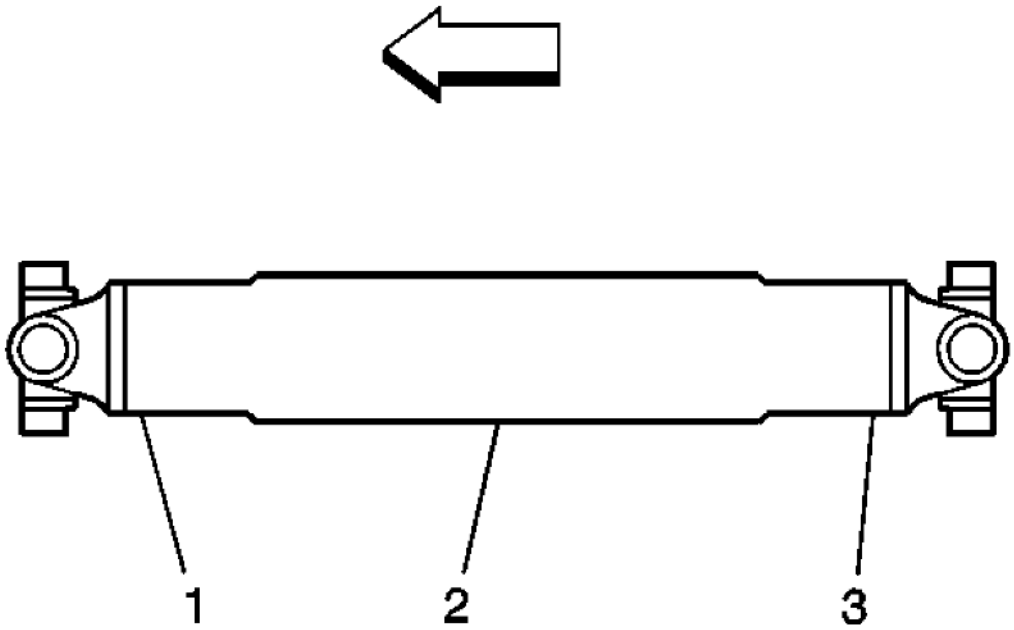


Fig. 19: Identifying Propeller Shaft Runout Measurement Points
Courtesy of GENERAL MOTORS CORP.

6. Rotate the drive axle pinion flange, torque tube input flange, transmission output, or transfer case output flange by hand while taking runout measurements of the prop shaft or shafts. The prop shaft will rotate more easily in one direction than in the other. If necessary, the tire and wheel assemblies and even the brake caliper assemblies can be positioned and supported aside, or the brake drums can be removed from the drive axle to provide easier rotation of the prop shaft or shafts.
7. For all prop systems, measure and record the runout at each U-joint welded yoke location (1, 3) and at the center (2) of each prop shaft.
8. For 1-piece prop systems, proceed to step 10.

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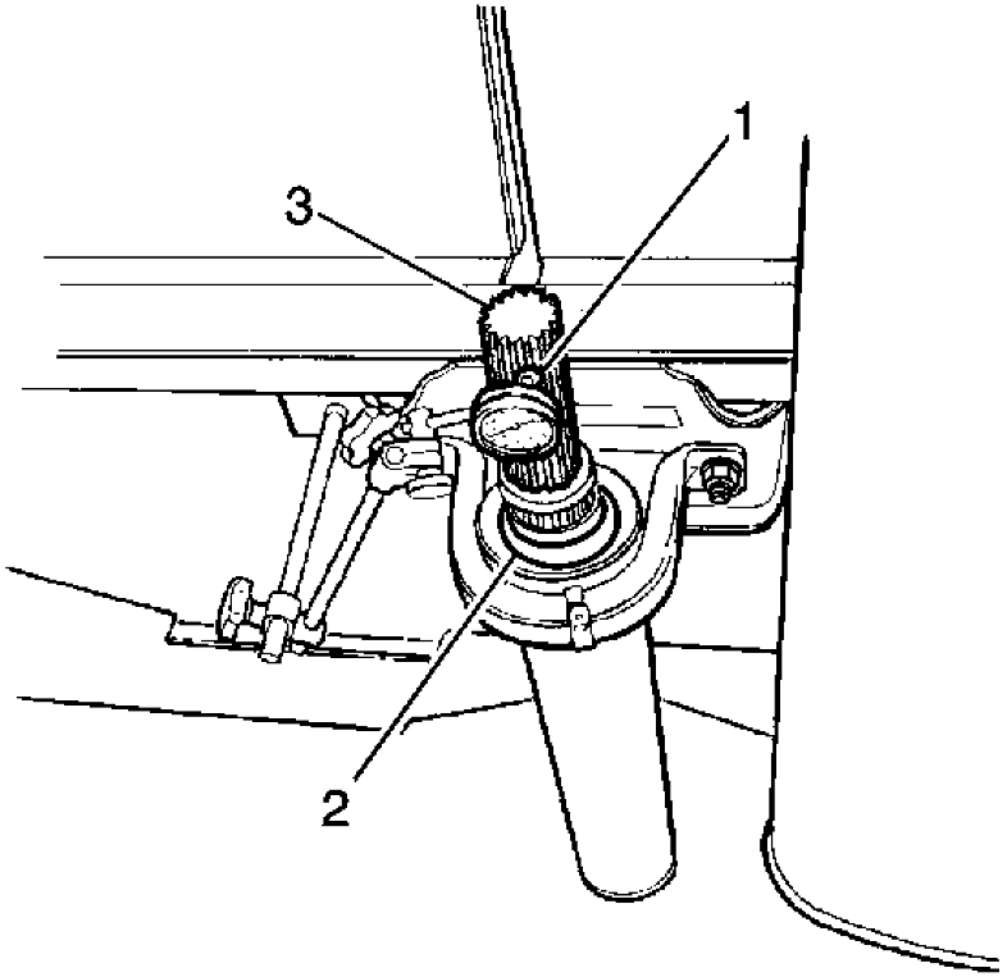


Fig. 20: Positioning Dial Indicator At Stub Shaft
Courtesy of GENERAL MOTORS CORP.

9. For 2-piece prop systems, perform the following inspections and measurement of the stub shaft:
    1. Mark the mating position for each end of the prop shaft containing the slip yoke, then remove the shaft.
    2. Inspect the prop shaft support bearing assembly (3) for damaged rubber components, worn bearing or bearings, or a damaged/cracked bracket which could be affecting the runout of the propeller shafts.
    3. If the support bearing assembly exhibited any of these conditions, it requires replacement before proceeding.
    4. Inspect the support bearing assembly (3) for loose or missing shims/washers if equipped. Reinstall

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correctly or replace any shims/washers as necessary to ensure proper alignment of the support bearing assembly.

5. Position the **GE-7872:** Magnetic Base Dial Indicator Set , or equivalent (1), or the **GE-8001:** Dial Indicator Set , or equivalent (1), approximately 13 mm (1/2 in) from the end of the stub shaft (3).
6. Record the runout measurement at the stub shaft splines.

10. Compare the prop shaft runout measurements recorded to the runout tolerance specifications.
11. If the prop system has a U-joint at the transmission or transfer case output flange, and if the prop shaft runout measurements exceed runout tolerance specifications for that prop shaft at that location, or at the stub shaft if part of the front shaft, perform the following:
    1. Inspect the deflection of the transmission or transfer case output shaft for indications of a worn or damaged bushing which could be affecting the runout of the prop shaft.

       A leaking transmission or transfer case output shaft seal may be an indication of an output shaft bushing concern.

    2. If the transmission or transfer case output shaft bushing is found to be worn or damaged, the bushing must be replaced before proceeding.
    3. If the transmission or transfer case output shaft bushing was replaced; re-measure and record the runout of the prop shaft at the same locations measured previously.
    4. Compare the prop shaft runout re-measurements recorded to the runout tolerance specifications.
    5. If the prop shaft runout re-measurements still exceed runout tolerances at the same location or at the stub shaft, if part of the front shaft, the prop shaft requires replacement before proceeding. Check the runout of the replacement prop shaft.
    6. If the transmission or transfer case output shaft bushing was not found to be worn or damaged, the prop shaft requires replacement before proceeding. Check the runout of the replacement prop shaft.
12. If the prop system has a U-joint at the drive axle pinion or torque tube input flange, and if the prop shaft runout measurements exceed runout tolerance specifications for that prop shaft at that location, or at the stub shaft if part of the rear shaft, perform the following:
    1. Mark the mating position for each end of the prop shaft, then remove the shaft from the pinion input, or torque tube input flange.
    2. Rotate the shaft 180 degrees from its original position.
    3. Reinstall the shaft to the pinion or torque tube input flange.
    4. Re-measure and record the runout of the shaft at the same locations measured previously.
    5. Compare the shaft runout re-measurements recorded to the runout tolerance specifications.
    6. If any of the runout re-measurements still exceed runout tolerances, perform the following:
        1. Inspect the pinion or torque tube input flange runout to determine if it is affecting the runout of the prop shaft. Refer to the appropriate procedure: **Torque Tube Input Flange Runout Measurement** , **Pinion Flange Runout Measurement** , or **Differential Pinion Input Shaft Runout Measurement** .
        2. If the pinion or torque tube input flange runout exceeds runout tolerances, the flange must be re-indexed or replaced to bring the runout within tolerances before proceeding.
        3. If the pinion or torque tube input flange was re-indexed or replaced, return the prop shaft to its original relationship when reinstalling the shaft to the flange.

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4. If the first measurement of pinion or torque tube input flange runout was within tolerances, the prop shaft requires replacement. Check the runout of the replacement prop shaft.
5. If the pinion or torque tube input flange was re-indexed or replaced, re-measure and record the runout of the shaft at the same locations measured previously.
6. Compare the shaft runout re-measurements recorded to the runout tolerance specifications.
7. If any of the runout re-measurements still exceed the runout tolerances, remove and rotate the shaft 180 degrees from it's original position to the pinion or torque tube input flange that has been re-indexed or replaced.
8. Reinstall the shaft then re-measure and record the runout of the shaft at the same locations measured previously.
9. Compare the shaft runout re-measurements recorded to the runout tolerance specifications.
10. If any of the shaft runout re-measurements still exceed the runout tolerances, the shaft requires replacement. Check the runout of the replacement prop shaft.

13. For 2-piece prop systems; if the prop shaft runout measurements at the welded yoke mating to the slip yoke exceed runout tolerance specifications for that prop shaft at that location, perform the following:
    1. If the stub shaft is keyed to ensure proper alignment of the slip yoke, then the prop shaft requires replacement.
    2. If the stub shaft is not keyed, mark the mating position for each end of the prop shaft, then remove the slip yoke from the stub shaft.
    3. Rotate the shaft 180 degrees from it's original position.
    4. Reinstall the slip yoke to the stub shaft.
    5. Re-measure and record the runout of the shaft at the welded yoke to slip yoke location.
    6. Compare the shaft runout re-measurements recorded to the runout tolerance specifications.
    7. If the prop shaft runout re-measurements still exceed runout tolerances at the welded yoke mating to slip yoke location, the prop shaft requires replacement. Check the runout of the replacement prop shaft.

TORQUE TUBE INPUT FLANGE RUNOUT MEASUREMENT

Special Tools

GE-7872: Magnetic Base Dial Indicator Set, or equivalent

NOTE: **This measurement procedure is intended to measure torque tube runout for systems with a constant velocity (CV) joint, rubber coupling or bolt-on U-joint yoke at the torque tube.**

1. Place the transmission in NEUTRAL.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. If equipped with a CV joint, measure the torque tube input flange radial runout on the machined surface of the prop shaft rear CV joint housing, as close to the flange as possible:
    1. Clean the surface of the prop shaft rear CV joint housing just ahead of the torque tube input flange.

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2. Mount a dial indicator set, **GE-7872:** Magnetic Base Dial Indicator Set , or equivalent, and position the dial indicator to contact the prop shaft rear CV joint housing as close to the torque tube input flange as possible.

4. If equipped with a rubber coupling or bolt-on U-joint yoke, measure the torque tube input flange radial runout on the machined surface of the flange pilot area:
    1. Mark the position of the prop shaft to the torque tube input flange.
    2. Separate the propshaft from the torque tube input flange.
    3. Clean the surface of the flange pilot area.
    4. Mount a dial indicator set, **GE-7872:** Magnetic Base Dial Indicator Set , or equivalent, and position the dial indicator to contact the pilot area as close to the end of the pilot as possible.
5. Rotate the torque tube input flange by hand to locate the low spot.
6. Set the dial indicator to zero on the low spot.
7. Rotate the flange by hand and record the amount of radial runout.
8. Compare the runout of the flange to the runout tolerance specifications guideline.
9. If the torque tube input flange runout exceeds the specification, the flange requires replacement.

PINION FLANGE RUNOUT MEASUREMENT

Special Tools

- **GE-8001:** Dial Indicator Set, or equivalent
- **J-23409:** Dial Indicator Extension, or equivalent
- **J-35819:** Flange Runout Gauge

For equivalent regional tools, refer to **Special Tools and Equipment**.

NOTE: This measurement procedure is intended to measure drive axle pinion flanges with 1-piece U-joint yokes only, not bolt-on yokes.

If equipped with a system balanced flange, use the following procedure, System Balanced Flange. If equipped with a non-system balanced flange, use the second procedure, Non-System Balanced Flange.

System Balanced Flange

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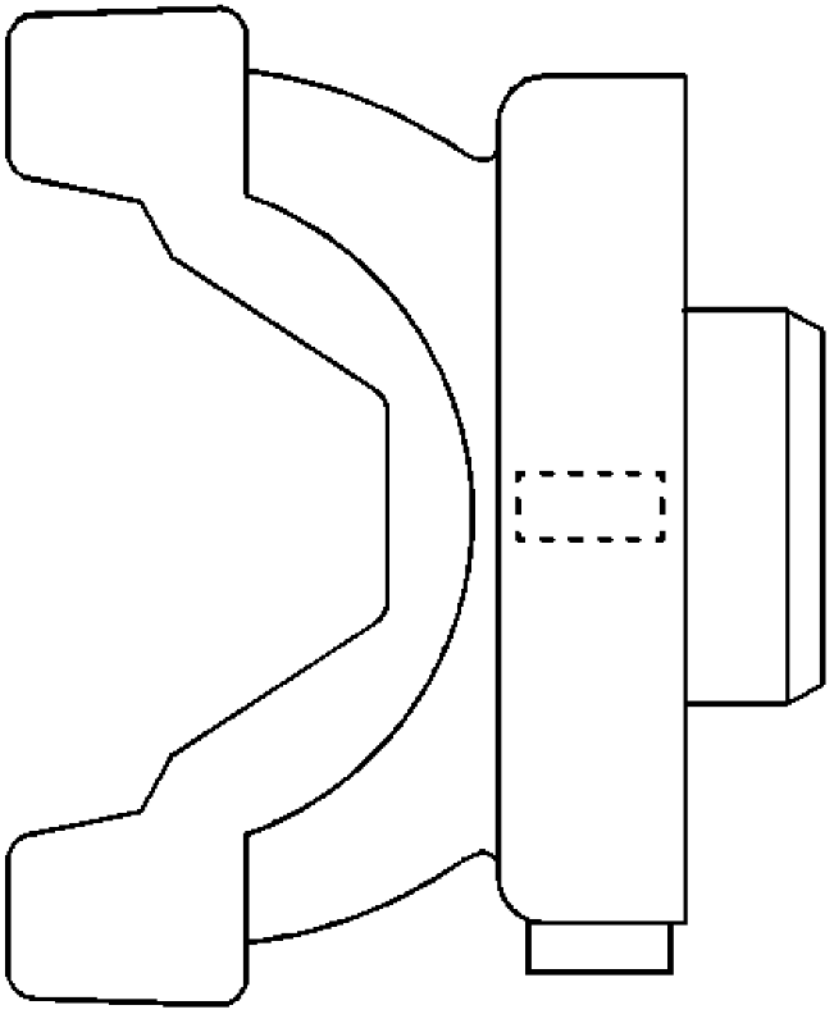


Fig. 21: Identifying Pinion Flange (Deflector Design)
Courtesy of GENERAL MOTORS CORP.

System balanced drive axles utilize a deflector design on the pinion flange, that is able to hold system balance weights on its outside diameter.

1. Raise and support the vehicle, with the wheels free to rotate. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the propeller shaft from the pinion flange.

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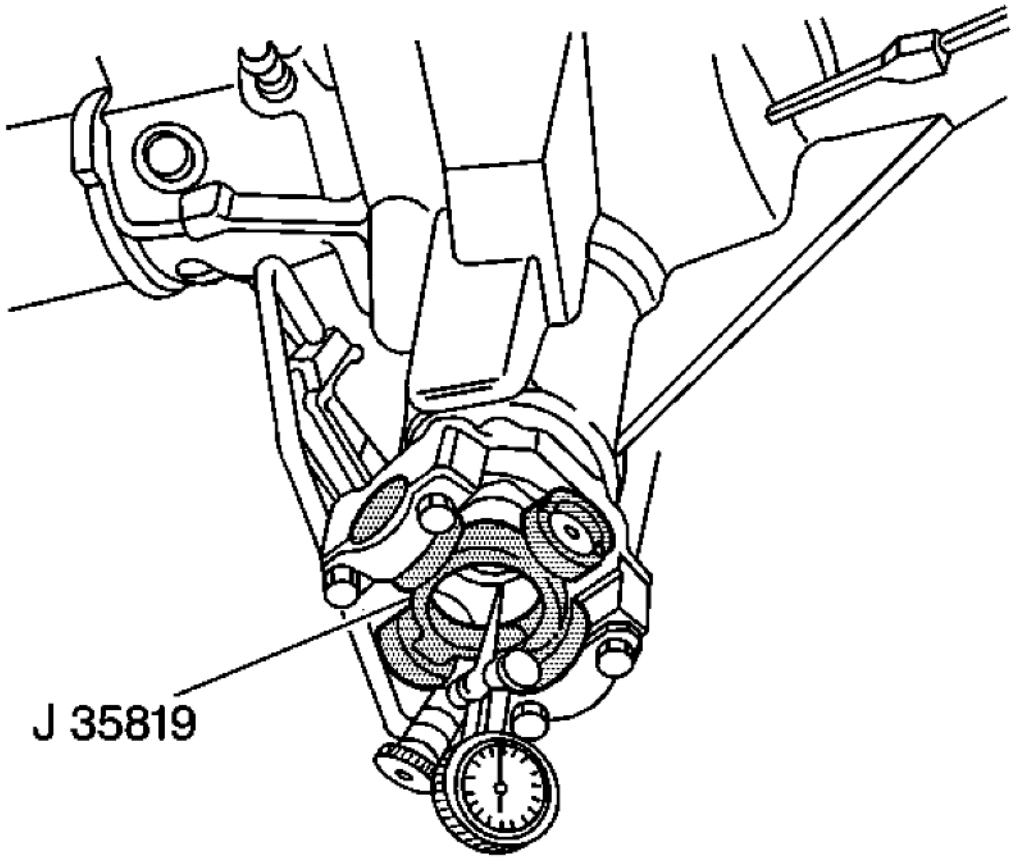


Fig. 22: Installing J 35819 To Pinion Flange
Courtesy of GENERAL MOTORS CORP.

3. Install the **J-35819:** Flange Runout Gauge to the pinion flange.
4. Assemble and install the **GE-8001:** Dial Indicator Set and the **J-23409:** Dial Indicator Extension to the drive axle and to the **J-35819:** Flange Runout Gauge.

NOTE: **The dial indicator will display inverted readings. You are measuring the inside diameter of the flange, not 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 flange 360 degrees and zero the dial indicator on the low spot.
6. Rotate the pinion flange again and record the total runout.

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NOTE: **All runout measurement tolerances provided are to be used as guidelines. The measurement tolerances provided and their effect on vibration correction may vary for each vehicle.**

7. If the system balanced pinion flange runout measurement is between 0.00-0.38 mm (0.00-0.015 in), the pinion flange is considered within acceptable runout limits.
8. If the system balanced pinion flange runout measurement exceeds 0.00-0.38 mm (0.00-0.015 in), the pinion flange must be re-indexed 180 degrees or replaced.

   If the drive axle utilizes a crush-type sleeve to achieve pinion bearing preload, the pinion flange can only be removed and installed 1 time before the crush-type sleeve must be replaced. Sleeve replacement requires removal and installation of the ring and pinion gear set. If there is evidence that the pinion has been removed and installed previously, replace the sleeve.

9. If the pinion flange has been re-indexed, re-measure the pinion flange runout.
10. If the runout re-measurement of the re-indexed pinion flange still exceeds the tolerance guidelines, the pinion flange requires replacement.

NOTE: **Inspect the runout of any replacement pinion flange.**

11. If the pinion flange was replaced, check the runout of the replacement pinion flange.

NOTE: **If the pinion flange was re-indexed or replaced, the driveline MUST be system balanced.**

12. If the pinion flange was re-indexed or replaced, system balance the driveline. Refer to **Driveline System Balance Adjustment**.

Non-System Balanced Flange

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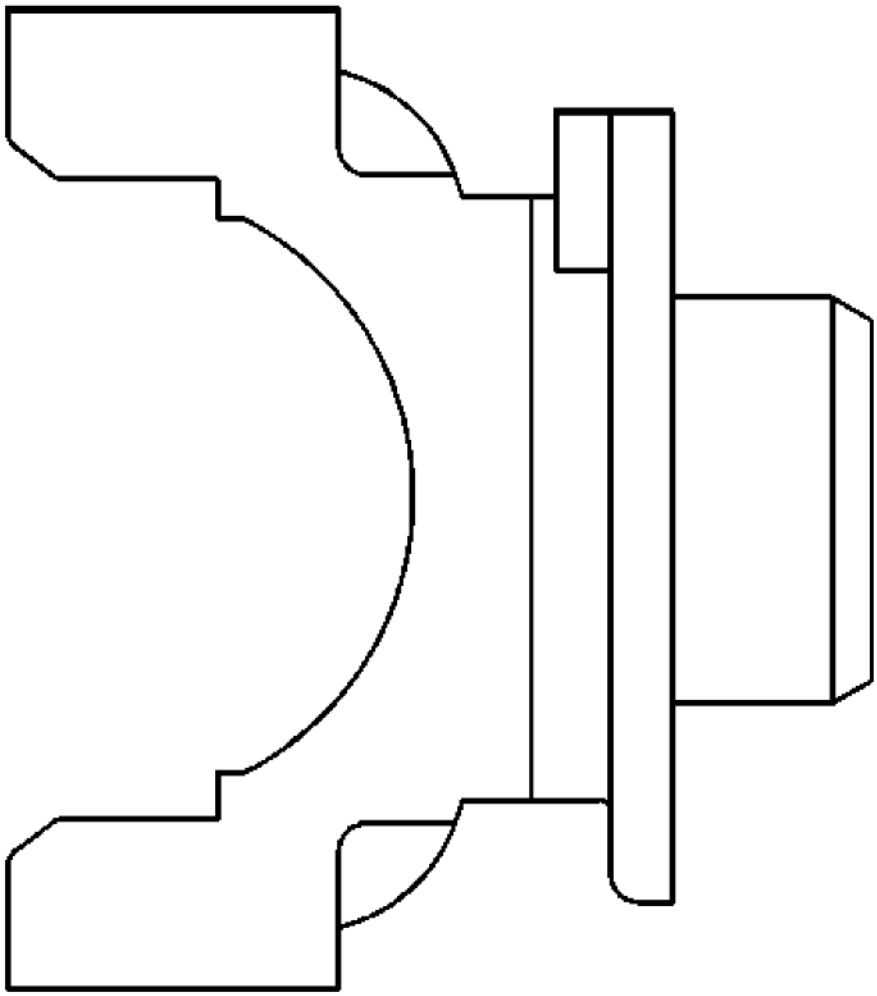


Fig. 23: Balance Weight On Pinion Flange Dust Slinger
Courtesy of GENERAL MOTORS CORP.

Drive axles that are non-system balanced use a pinion flange dust slinger design, that is able to hold a runout compensation weight on the face of the dust slinger.

1. Raise and support the vehicle, with the wheels free to rotate. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the propeller shaft from the pinion flange.

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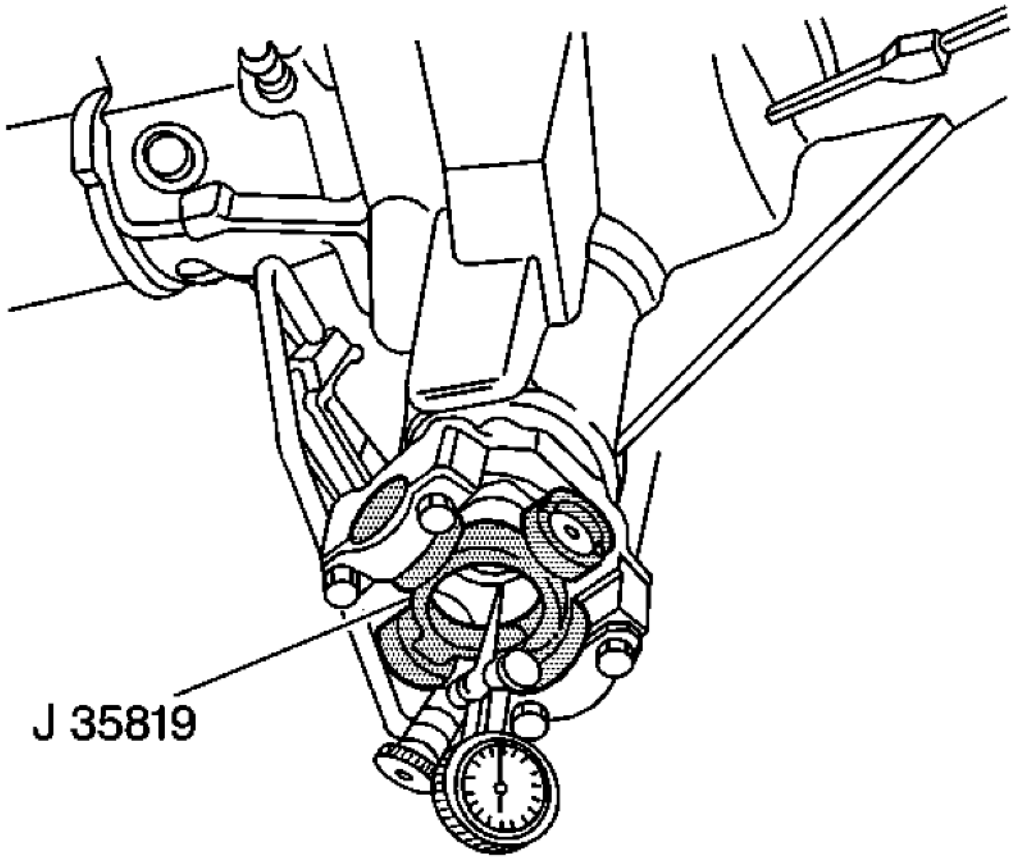


Fig. 24: Installing J 35819 To Pinion Flange
Courtesy of GENERAL MOTORS CORP.

3. Install the **J-35819:** Flange Runout Gauge to the pinion flange.
4. Assemble and install the **GE-8001:** Dial Indicator Set and the **J-23409:** Dial Indicator Extension to the drive axle and to the **J-35819:** Flange Runout Gauge.

NOTE: **The dial indicator will display inverted readings. You are measuring the inside diameter of the flange, not 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 flange 360 degrees and zero the dial indicator on the low spot.
6. Rotate the pinion flange again and record the total runout.

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NOTE: All runout measurement tolerances provided are to be used as guidelines. The measurement tolerances provided and their effect on vibration correction may vary for each vehicle.

7. If the pinion flange runout is 0.15 mm (0.006 in) or less, there should not be a runout compensation weight. If there is a compensation weight, remove the weight.
8. If the pinion flange runout is greater than 0.15 mm (0.006 in) but 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 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 and re-index the pinion flange until the runout is 0.25 mm (0.010 in) or less.

   If the drive axle utilizes a crush-type sleeve to achieve pinion bearing preload, the pinion flange can only be removed and installed 1 time before the crush-type sleeve must be replaced. Sleeve replacement requires removal and installation of the ring and pinion gear set. If there is evidence that the pinion has been removed and installed previously, replace the sleeve.

10. If after re-indexing the pinion flange, it is not possible to achieve runout of 0.25 mm (0.010 in) or less, the pinion flange requires replacement.

NOTE: Inspect the runout of any replacement pinion flange.

11. If the pinion flange was replaced, check the runout of the replacement pinion flange.

DIFFERENTIAL PINION INPUT SHAFT RUNOUT MEASUREMENT

Special Tools

GE-7872: Magnetic Base Dial Indicator Set, or equivalent

NOTE: This measurement procedure is intended to measure drive axle pinion input shaft runout for systems with a constant velocity (CV) joint, rubber coupling or bolt-on U-joint yoke at the drive axle

1. Place the transmission in NEUTRAL.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. If equipped with a CV joint, measure the drive axle pinion input shaft radial runout on the splined surface of the prop shaft rear CV joint housing, as close to the flange as possible:
   1. Clean the surface of the prop shaft rear CV joint housing just ahead of the torque tube input flange.
   2. Mount a dial indicator set, **GE-7872:** Magnetic Base Dial Indicator Set , or equivalent, and position the dial indicator to contact the prop shaft rear CV joint housing as close to the drive axle input flange as possible.
4. If equipped with a rubber coupling or bolt-on U-joint yoke, measure the differential pinion input shaft

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radial runout on the machined surface of the flange pilot area:

1. Mark the position of the prop shaft to the drive axle input flange.
2. Separate the propshaft from the drive axle input flange.
3. Clean the surface of the flange pilot area.
4. Mount a dial indicator set, **GE-7872:** Magnetic Base Dial Indicator Set , or equivalent, and position the dial indicator to contact the pilot area as close to the drive axle input flange as possible.

5. If equipped with a torque tube, measure the radial runout on the machined surface of the splined shaft:
   1. Remove the torque tube assembly from the vehicle.
   2. Clean the surface of the splined shaft.
   3. Mount a dial indicator set, **GE-7872:** Magnetic Base Dial Indicator Set , or equivalent, and position the dial indicator to contact the machined area as close to the end of the shaft as possible.
6. Rotate the drive axle input shaft by hand to locate the low spot.
7. Set the dial indicator to zero on the low spot.
8. Rotate the shaft by hand and record the amount of radial runout.
9. Compare the runout of the shaft to the runout tolerance specifications guidelines.
10. If the drive axle input shaft runout exceeds the specification, the flange requires replacement.

DRIVELINE WORKING ANGLES MEASUREMENT

Special Tools

- **J-23498-A:** Driveshaft Inclinometer, or equivalent
- **J-23498-20:** Driveshaft Inclinometer Adapter, or equivalent

NOTE: **This measurement procedure is intended to measure U-joints working angles only, not constant velocity (CV) joint or coupler assembly working angles.**

NOTE: **This procedure is intended to be used for vehicles where the following conditions are met:**

- **Vehicle trim heights are within specification guidelines.**
- **The vehicle exhibits no signs of aftermarket modifications that may affect driveline working angles.**
- **The vehicle exhibits no signs of accident damage which may affect the position of the drive axle, or axles, the propeller shaft support bearing, if equipped, or the transmission or transfer case, if equipped.**

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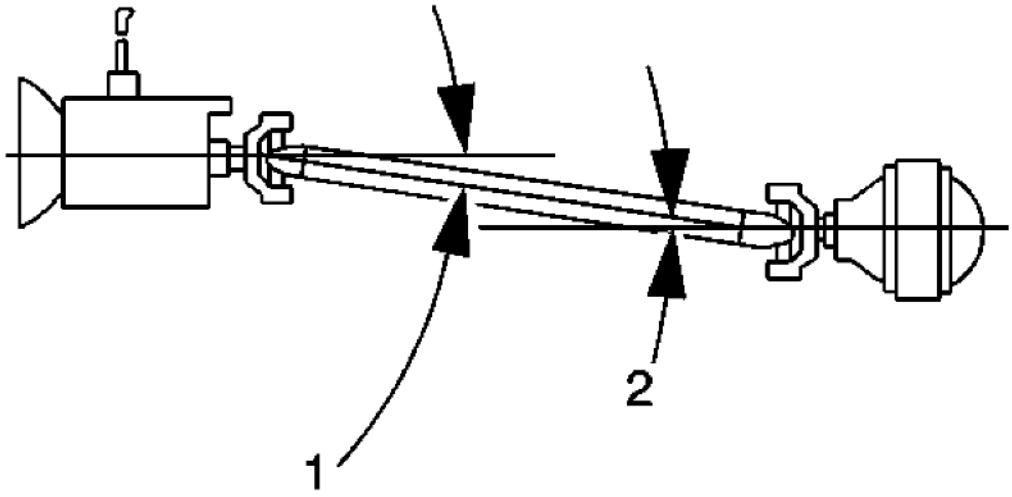


Fig. 25: Identifying Working Angles (One-Piece Propeller Shaft)
Courtesy of GENERAL MOTORS CORP.

The working angle of a U-joint is formed by the difference between the angles of any 2 shafts that intersect. Propeller shaft systems that have 1 U-joint have 1 working angle; systems with 2 U-joints have 2 working angles, and so on. In a typical 1-piece prop system with 2 U-joints, the working angles are front (1) and rear (2):

- The front working angle (1) is formed by the intersection of the transmission or transfer case output shaft and the prop shaft.
- The rear working angle (2) is formed by the intersection of the prop shaft and the drive axle pinion.

NOTE: When measuring and evaluating U-joint working angles, observe the following:

- No U-joint working angle should be equal to zero. An angle of 0 degrees will cause premature U-joint wear due to a lack of rotation of the needle bearings in the U-joint.
- No U-joint working angle should exceed 4 degrees.
- Prop systems containing only 1 U-joint: The U-joint working angle should be within the range specified in this procedure.
- Prop systems containing 2 or 3 U-joints: The 2 U-joint angles each formed with the prop shaft that contains 2 welded yokes are designed to cancel each other during operation. These 2 working, or cancelling U-joint angles should be equal to each other within the range specified in this procedure provide effective cancellation of the U-joints.
- Prop systems containing 3 U-joints: The U-joint angle formed by the prop shaft that contains only 1 welded yoke is an odd, or non-cancelled angle. This working angle should be within the range specified in this procedure.

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- Always orientate the **J-23498-A:** Driveshaft Inclinometer, or equivalent so that it faces the same side of the vehicle for each measurement taken.

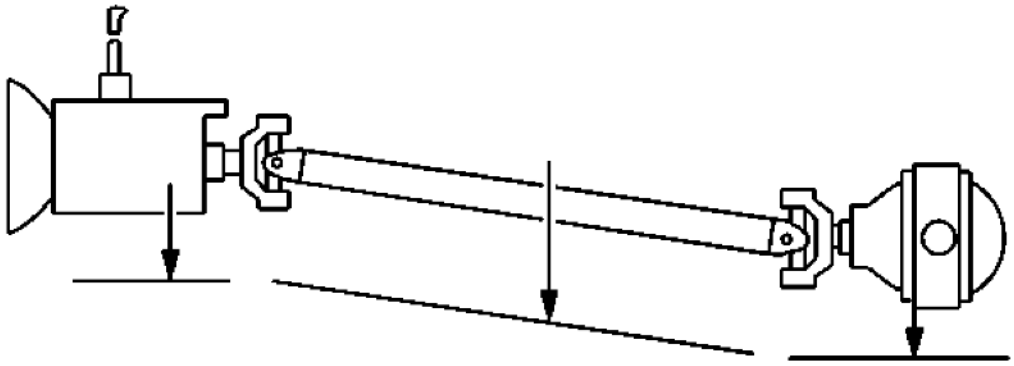


Fig. 26: Identifying Propeller Shaft Measurement Recording Points
Courtesy of GENERAL MOTORS CORP.

- Be sure to accurately record the measurements taken on a diagram, similar to the one shown.

Measurement Procedure

NOTE: If it is necessary to use the J-23498-20: Driveshaft Inclinometer Adapter, or equivalent adapter, first verify the accuracy of the J-23498-20: Driveshaft Inclinometer Adapter, or equivalent by inspecting the angle of an accessible joint using the J-23498-A: Driveshaft Inclinometer, or equivalent, then inspecting the same joint angle using the J-23498-20: Driveshaft Inclinometer Adapter, or equivalent.

1. For vehicles with solid axles, ensure that the vehicle has a full tank of fuel or the equivalent amount of weight in the correct location to simulate a full tank. The weight of 3.8 L (1 gal) of gasoline is approximately 2.8 kg (6.2 lb).
2. Raise and support the vehicle. On vehicles with solid axles, ensure that the drive axle is supported at ride height-vehicle body supported by suspension components. Suspension travel will not affect driveline angles on vehicles with direct-mounted drive axles. Ensure the wheels are free to rotate. Refer to **Lifting and Jacking the Vehicle** .
3. For vehicles with 2-piece prop shaft systems, inspect the lateral alignment of the propeller shafts before proceeding:
    1. From underneath the propeller shafts, look down the length of the shafts from front to rear. Inspect the alignment of the shafts to each other.
    2. From underneath the shafts, if the propeller shafts are not aligned to each other in a straight line,

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then the lateral alignment of the prop shafts needs to be adjusted before proceeding.

The propeller shaft support bearing assembly can be relocated slightly to one side in order to improve the alignment of the shafts. Ensure that you do not create a ground-out condition against the exhaust or any other component.

4. Place the transmission in NEUTRAL.
5. Clean any corrosion or foreign material from the U-joint bearing caps.
6. Remove any of the U-joint bearing cap snap rings that may interfere with the correct placement of the **J-23498-A:** Driveshaft Inclinometer, or equivalent.

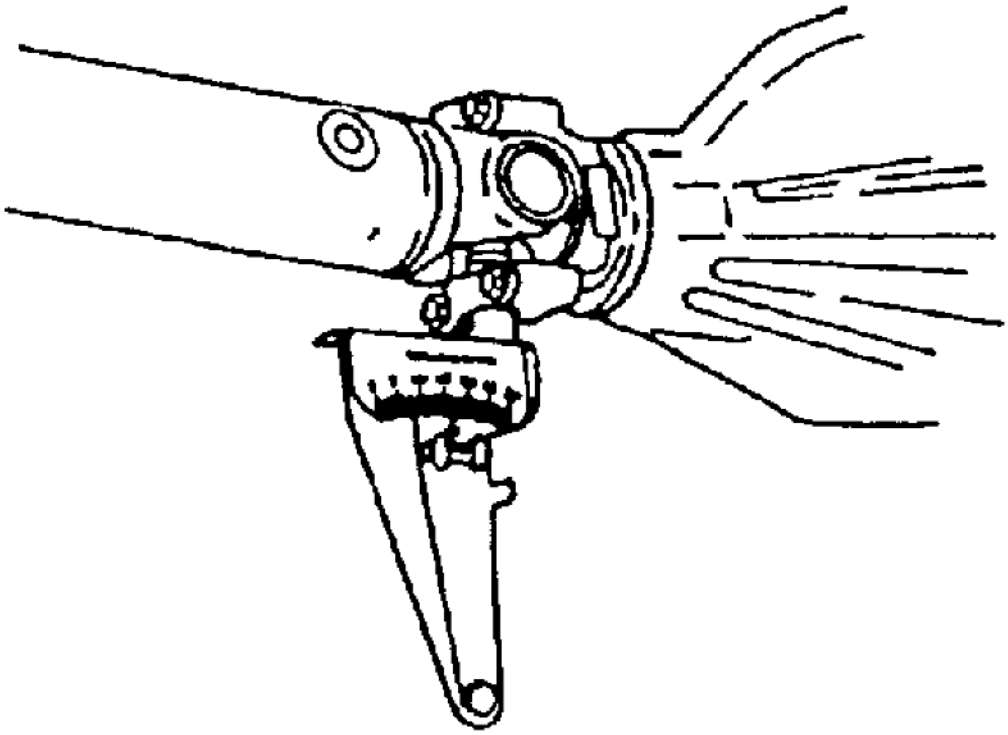


Fig. 27: Measuring Angle Of Drive Axle Pinion
Courtesy of GENERAL MOTORS CORP.

7. For all prop systems perform the first measurement:
    1. Rotate the prop shaft to align the rear-most yoke flanges vertically.
    2. Install the **J-23498-A:** Driveshaft Inclinometer, or equivalent to the lower U-joint bearing cap of the rear-most yoke. This yoke may be part of a prop shaft, torque tube input shaft, or a drive axle pinion shaft. Measure and record the angle of the shaft.

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8. For prop systems with 2 or 3 U-joints, perform this additional measurement:

   Without rotating the prop, install the **J-23498-A:** Driveshaft Inclinometer, or equivalent to the lower U-joint bearing cap of the forward-most, vertically-aligned yoke. This yoke may be part of a prop shaft, transmission output shaft, or a transfer case output shaft. Measure and record the angle of the shaft.

9. For all prop systems perform the second measurement:
   1. Rotate the prop shaft 1/4 turn to vertically align the flanges of the forward yoke that mates to the rear-most yoke.
   2. Install the **J-23498-A:** Driveshaft Inclinometer, or equivalent to the lower U-joint bearing cap of the forward mating yoke. This yoke may be part of a prop shaft, transmission output shaft, or a transfer case output shaft. Measure and record the angle of the shaft.
10. For prop systems with 3 U-joints, perform this additional measurement:

    Without rotating the prop, install the **J-23498-A:** Driveshaft Inclinometer, or equivalent to the lower U-joint bearing cap of the forward-most, vertically-aligned yoke. This yoke may be part of a transmission output shaft, or a transfer case output shaft. Measure and record the angle of the shaft.

11. Remove the **J-23498-A:** Driveshaft Inclinometer, or equivalent.
12. Install any U-joint bearing cap snap rings that were removed prior to installing the **J-23498-A:** Driveshaft Inclinometer, or equivalent.
13. Calculate the U-joint working angle at each intersection of two shafts.

    Subtract the smaller number from the larger to obtain the working angle. For example: If the drive axle pinion has an angle of 16 degrees and the connecting propeller shaft has an angle of 13 degrees, then the working angle of that intersection is 3 degrees.

14. For prop systems with 1 U-joint; compare the working angle to the following specification guideline:

    Specification Guideline: Prop systems containing only 1 U-joint: The U-joint working angle should be between 1/2 and 3/4 degrees.

15. For prop systems with 2 or 3 U-joints; compare the difference between the working angles of the cancelling U-joints to the following specification guidelines:

    Specification Guideline: Allowable range of difference between cancelling U-joint working angles: 0.25 to 1.0 degrees

16. For prop systems with 3 U-joints; compare the working angle of the odd, or non-cancelled U-joint to the following specification guideline:

    Specification Guideline: Prop systems containing 3 U-joints: The odd, or non-cancelled U-joint working angle should be between 1/10 and 1/2 degrees.

17. Any working angle that is not within the specification guidelines requires adjustment.

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PROPELLER SHAFT PHASING INSPECTION

Special Tools

J-23498-A: Driveshaft Inclinometer, or equivalent

NOTE: This inspection procedure is intended to inspect propeller shaft systems with 2 or 3 U-joints only.

Correct phasing of a propeller shaft refers to the relative alignment of the U-joint yoke flanges to each other to provide proper cancellation of the U-joints. The yokes should be directly aligned to within the range specified in this procedure.

1. Raise and support the vehicle. On vehicles with solid axles, ensure that the drive axle is supported at ride height-vehicle body supported by suspension components. Ensure the wheels are free to rotate. Refer to **Lifting and Jacking the Vehicle** .
2. Place the transmission in NEUTRAL.
3. Clean any corrosion or foreign material from the U-joint bearing caps.
4. Remove any of the U-joint bearing cap snap rings that may interfere with the correct placement of the **J-23498-A:** Driveshaft Inclinometer, or equivalent.

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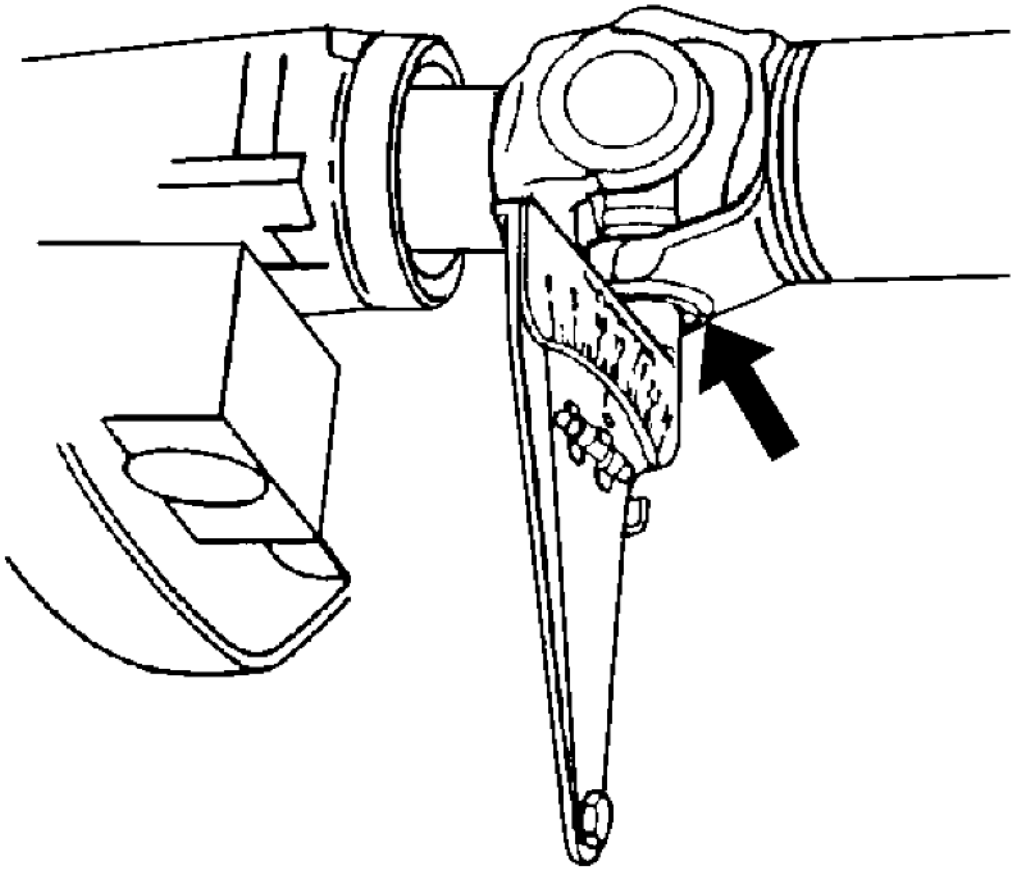


Fig. 28: Inspecting Rear Propeller Shaft For Proper Phasing
Courtesy of GENERAL MOTORS CORP.

5. Inspect the prop shaft for proper phasing.
    1. Rotate the prop shaft or shafts to align the shaft yoke flanges vertically.
    2. Install the **J-23498-A:** Driveshaft Inclinometer , or equivalent to the lower U-joint bearing cap of the rear U-joint of the shaft. The **J-23498-A:** Driveshaft Inclinometer , or equivalent should be aligned perpendicular to the propeller shaft.
    3. Set the indicator line on the **J-23498-A:** Driveshaft Inclinometer , or equivalent to 15, the horizontal reference.
    4. Rotate the propeller shaft slightly to center the bubble to the indicator. The U-joint is now vertical.
    5. Without disturbing the setting on the **J-23498-A:** Driveshaft Inclinometer , or equivalent, remove the **J-23498-A:** Driveshaft Inclinometer , or equivalent from the rear U-joint bearing cap.
    6. Install the **J-23498-A:** Driveshaft Inclinometer , or equivalent to the lower U-joint bearing cap of the front U-joint of the same shaft.

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7. Observe and record the reading of the front U-joint with the **J-23498-A:** Driveshaft Inclinometer , or equivalent still set to 15, the horizontal reference.

6. For prop systems with 3 U-joints, rotate the shafts 1/4 turn and repeat steps 5.1-5.7 for the other prop shaft.
7. If the difference between the front and rear U-joints of a welded yoke propeller shaft is 3 degrees or less, the propeller shaft is properly phased.
8. If the difference between the front and rear U-joints of a welded-yoke propeller shaft is greater than 3 degrees, the propeller shaft is either constructed improperly, or damaged from twisting. Refer to **Propeller Shaft Phasing Correction**.
9. If the difference between the welded yoke and slip yoke of a propeller shaft is 1.5 degrees or less, the prop shaft is properly phased.
10. If the difference between the welded yoke and slip yoke of a propeller shaft is greater than 1.5 degrees, the propeller shaft is either constructed improperly, or damaged from twisting. Refer to **Propeller Shaft Phasing Correction**.

REPAIR INSTRUCTIONS

TIRE AND WHEEL ASSEMBLY BALANCING - OFF VEHICLE

WARNING: 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.**

Tire and Wheel Assembly Balancer Calibration

Tire and wheel balancers can drift out of calibration over time, or can become inaccurate as a result of heavy use. There will likely not be any visual evidence that a calibration problem exists. If a balancer is not calibrated within specifications, and a tire and wheel assembly is balanced on that machine, the assembly may actually be imbalanced.

Tire and wheel assembly balancer calibration should be checked approximately every 2 weeks, if the machine is used frequently, and/or whenever the balance readings are questionable.

Tire and Wheel Assembly Balancer Calibration Test

NOTE: If the balancer fails any of the steps in this calibration test, the balancer should be calibrated according to the manufacturer's instructions. If the balancer cannot be calibrated, contact the manufacturer for assistance.

Inspect the calibration of the tire and wheel assembly balancer according to the manufacturer's

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recommendations, or perform the following test.

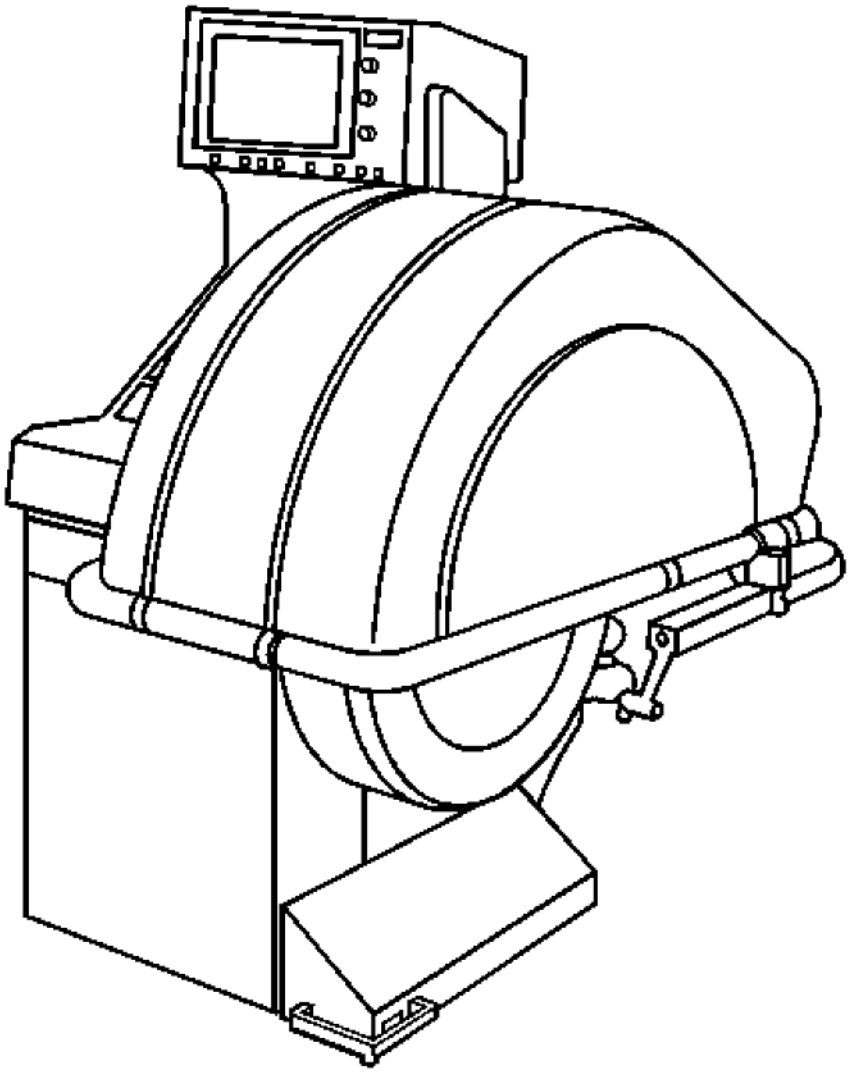


Fig. 29: View Of Tire & Wheel Assembly Balancer
Courtesy of GENERAL MOTORS CORP.

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

Specification: Zero within 7 g (1/4 oz)

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3. If the balancer is within the specification range, balance a tire and wheel assembly - that is within radial and lateral runout tolerances - to ZERO, using the same balancer.
4. After the tire and wheel assembly has been balanced, add an 85 g (3 oz) test weight to the wheel at any location.
5. Spin the tire and wheel assembly again. Note the readings.
    - In the static and dynamic modes, the balancer should call for 85 g (3 oz) of weight, 180 degrees opposite the test weight.
    - In the dynamic mode, the weight should be called for on the flange of the wheel opposite the test weight.
6. With the assembly imbalanced to 85 g (3 oz), cycle the balancer 5 times.
7. Inspect the balancer readings:

    Specification: Maximum variation: 7 g (1/4 oz)

8. Index the tire and wheel assembly on the balancer shaft, 90 degrees from the previous location.
9. Cycle the balancer with the assembly at the new location.
10. Inspect the balancer readings:

    Specification: Maximum variation: 7 g (1/4 oz)

11. Repeat steps 8 through 10 until the tire and wheel assembly has been cycled and checked at each of the 4 locations on the balancer shaft.

Tire and Wheel Assembly Balancing Guidelines

NOTE: **Tire and wheel assemblies which exhibit excessive runout can produce vibrations even if the assemblies are balanced.**
It is strongly recommended that the tire and wheel assembly runout be measured and corrected if necessary BEFORE the assemblies are balanced.

If the runout of the tire and wheel assemblies has not yet been measured, refer to **Tire and Wheel Assembly Runout Measurement - Off Vehicle** before proceeding.

There are 2 types of tire and wheel balance:

Static Balance

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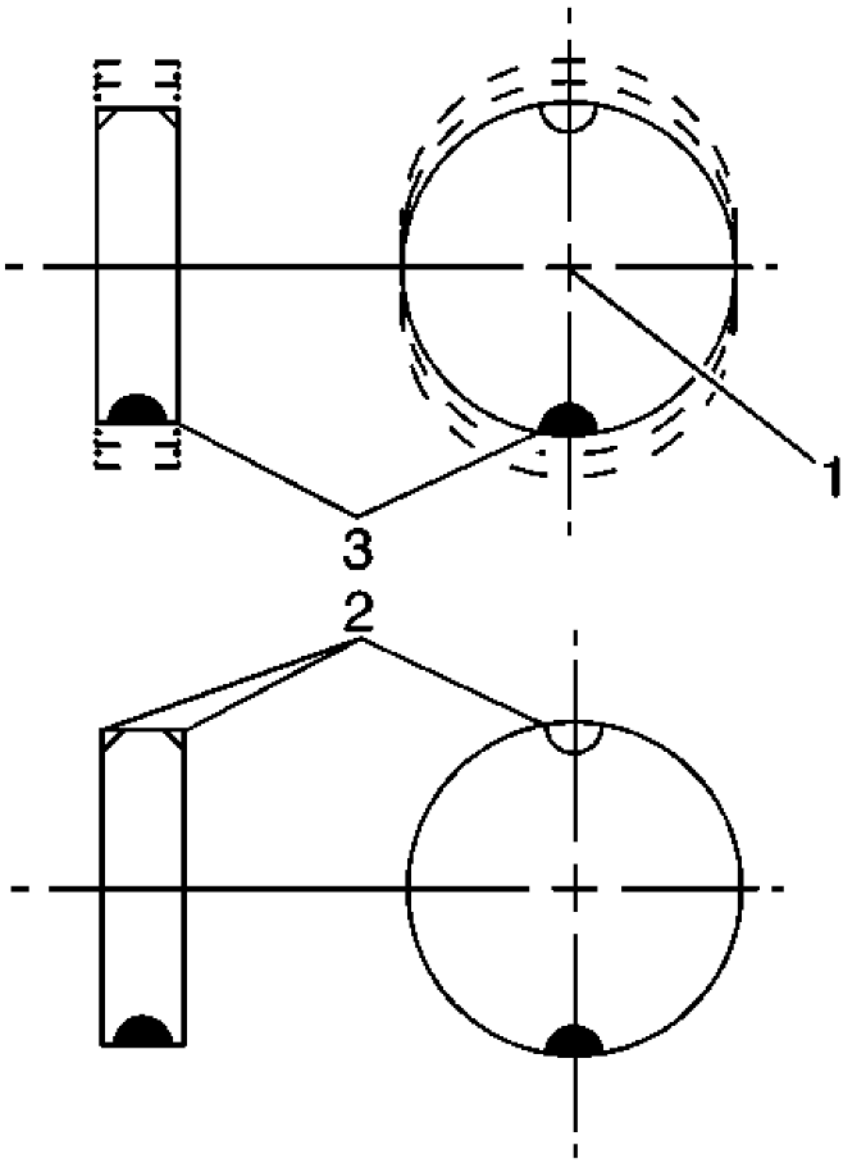


Fig. 30: View Of Static Balance
Courtesy of GENERAL MOTORS CORP.

Static balance is the equal distribution of weight around the wheel circumference. The wheel balance weights (2) are positioned on the wheel in order to offset the effects of a heavy spot (3). Wheels that have static imbalance can produce a bouncing action called tramp.

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Dynamic Balance

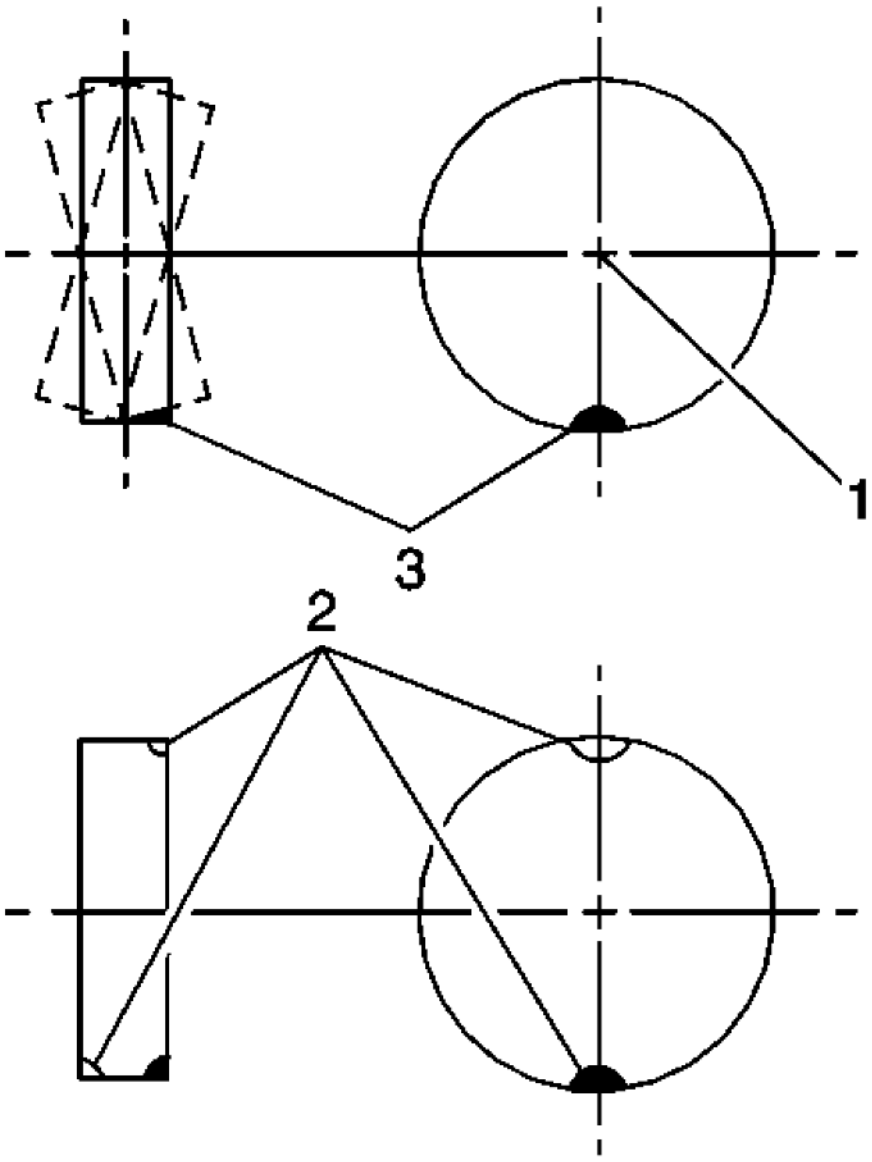


Fig. 31: View Of Dynamic Balance
Courtesy of GENERAL MOTORS CORP.

Dynamic balance is the equal distribution of weight on each side of the tire and wheel assembly centerline. The wheel balance weights (2) are positioned on the wheel in order to offset the effects of a heavy spot (3). Wheels

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that have dynamic imbalance have a tendency to move from side to side and can cause an action called shimmy.

Most off-vehicle balancers are capable of checking both types of balance simultaneously.

As a general rule, most vehicles are more sensitive to static imbalance than to dynamic imbalance; however, vehicles equipped with low profile, wide tread path, high performance tires and wheels are susceptible to small amounts of dynamic imbalance. As little as 14-21 g (1/2-3/4 oz) imbalance is capable of inducing a vibration in some vehicle models.

Balancing Procedure

NOTE: When balancing tire and wheel assemblies, use a known good, recently calibrated, off-vehicle, two-plane dynamic balancer set to the finest balance mode available.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Mark the location of the wheels to the wheel studs and mark the specific vehicle position on each tire and wheel - LF, LR, RF, RR.
3. Remove the tire and wheel assemblies one at a time and mount on a spin-type wheel balancer. Refer to **Tire and Wheel Removal and Installation** .
4. Carefully follow the wheel balancer manufacturer's instructions for proper mounting techniques to be used on different types of wheels.

   Regard aftermarket wheels, especially those incorporating universal lug patterns, as potential sources of runout and mounting concerns.

5. Be sure to use the correct type of wheel balance weights for the type of wheel rim being balanced. Be sure to use the correct type of coated wheel balance weights on aluminum wheels. Refer to Wheel Weight Usage.
6. Balance all four tire and wheel assemblies as close to zero as possible.
7. Using the matchmarks made prior to removal, install the tire and wheel assemblies to the vehicle. Refer to **Tire and Wheel Removal and Installation** .
8. Lower the vehicle.

Wheel Weight Usage

Tire and wheel assemblies can be balanced using either the static or dynamic method.

Clip-on Weights

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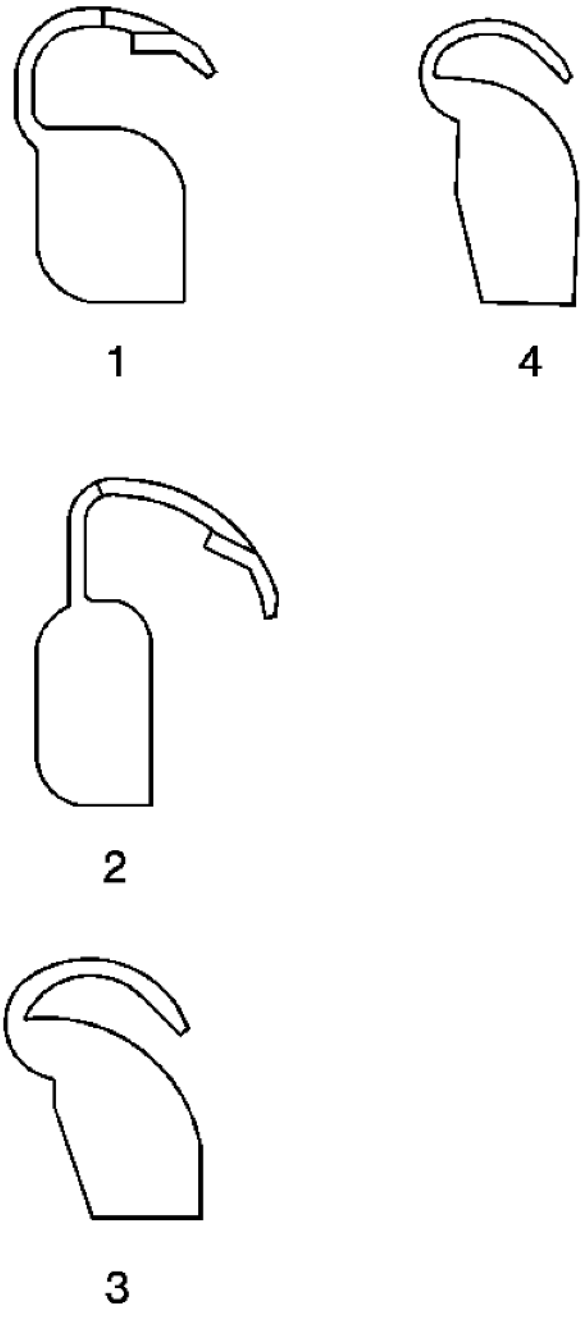


Fig. 32: Identifying Clip-On Wheel Weight Types
Courtesy of GENERAL MOTORS CORP.

NOTE: **When balancing factory aluminum wheels with clip-on wheel balance weights,**

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be sure to use special polyester-coated weights. These coated weights reduce the potential for corrosion and damage to aluminum wheels.

These coated weights reduce the potential for corrosion and damage to aluminum wheels.

- MC (1) and AW (2) series weights are approved for use on aluminum wheels.
- P (3) series weights are approved for use on steel wheels only.
- T (4) series coated weights are approved for use on both steel and aluminum wheels.

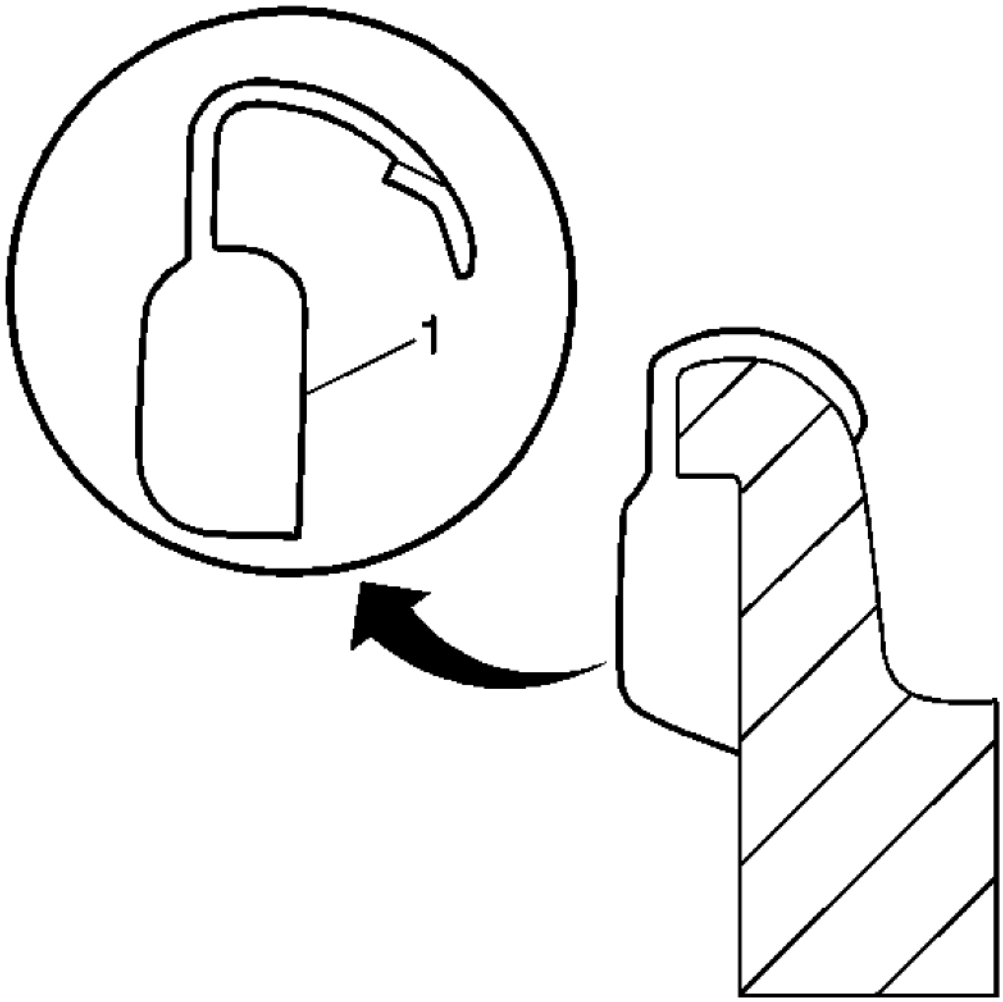


Fig. 33: Attaching Clip-On Wheel Weight
Courtesy of GENERAL MOTORS CORP.

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NOTE: Use a nylon or plastic-tipped hammer when installing coated clip-on wheel balance weights to minimize the possibility of damage to the polyester coating.

The contour and style of the wheel rim flange will determine which type of clip-on wheel weight (1) should be used. The weight should follow the contour of the rim flange. The weight clip should firmly grip the rim flange.

Wheel Weight Placement - Clip-on Weights

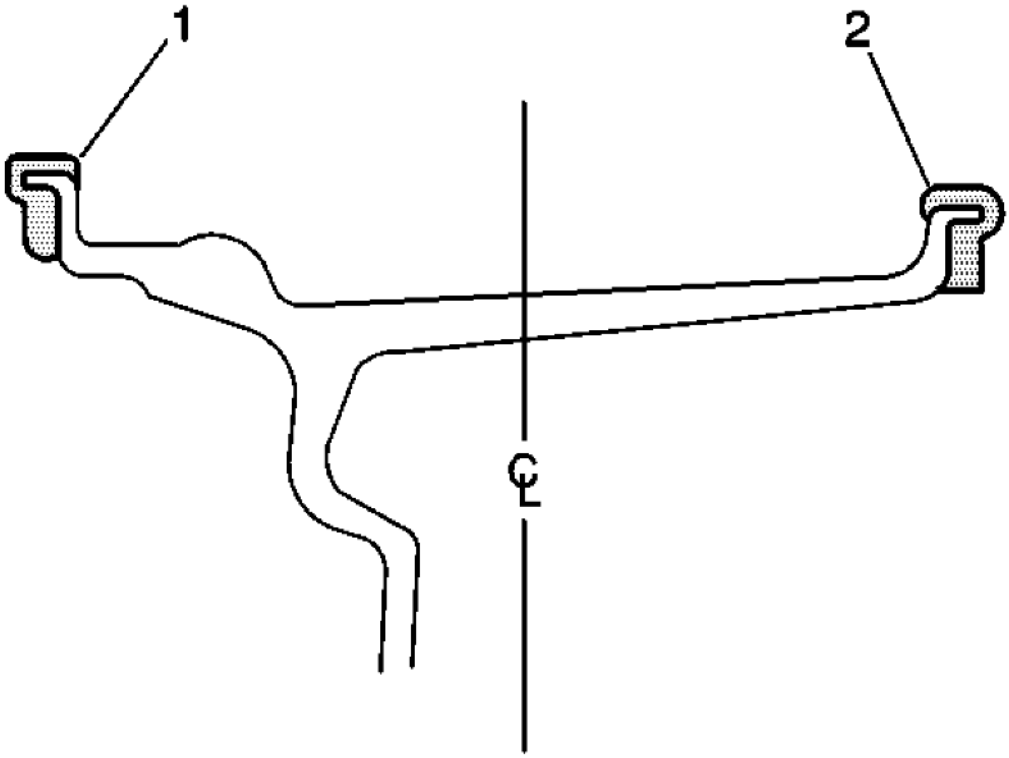


Fig. 34: View Of Wheel Weight Placement - Static Balancing
Courtesy of GENERAL MOTORS CORP.

When static balancing, locate the wheel balance weights on the inboard flange (2) if only 28 g (1 oz) or less is called for. If more than 28 g (1 oz) is called for, split the weights as equally as possible between the inboard (2) and outboard (1) flanges.

When dynamic balancing, locate the wheel balance weights on the inboard (2) and outboard (1) rim flanges at the positions specified by the wheel balancer.

Adhesive Weights

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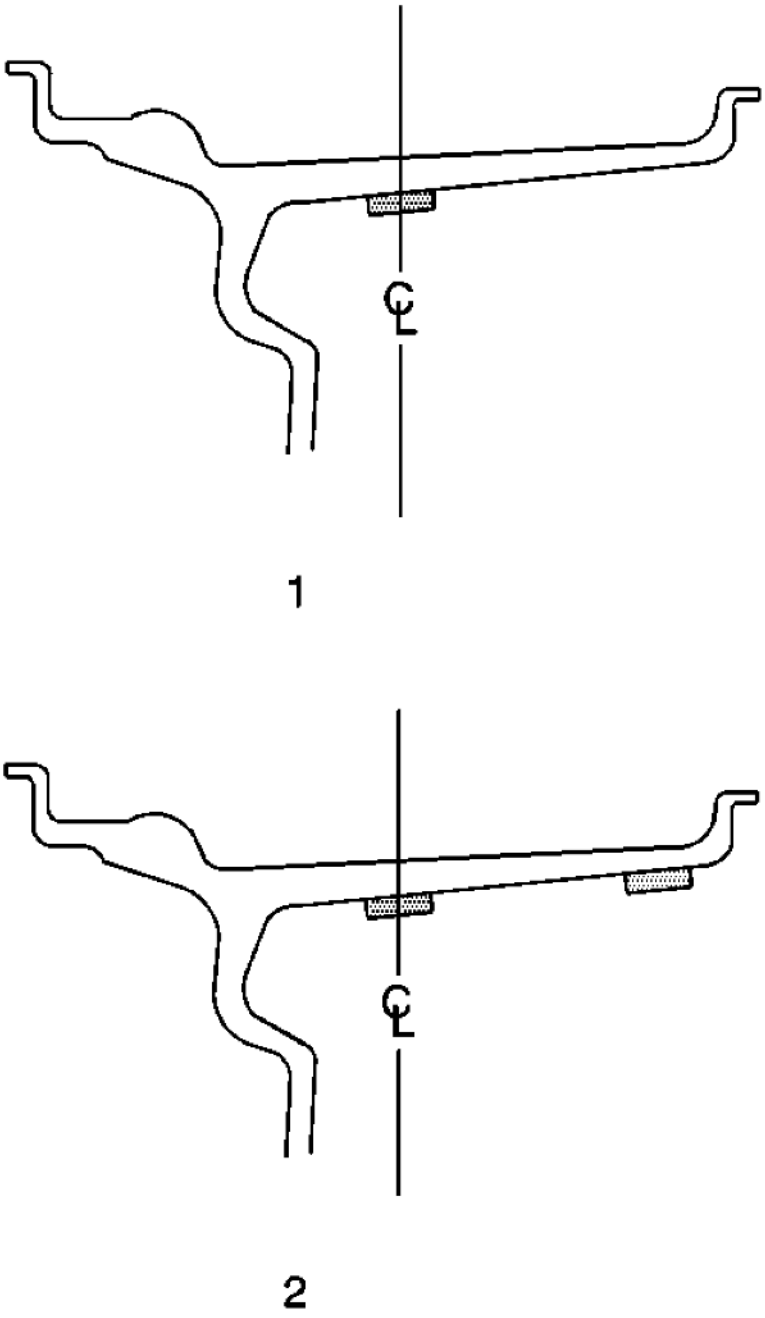


Fig. 35: Identifying Adhesive Weight Wheel Placement
Courtesy of GENERAL MOTORS CORP.

NOTE: **When installing adhesive balance weights on flangeless wheels, do NOT install**

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the weight on the outboard surface of the rim.

Adhesive wheel balance weights may be used on factory aluminum wheels. Perform the following procedure to install adhesive wheel balance weights.

1. Determine the correct areas for placement of the wheel weights on the wheel.
   - When static balancing, locate the wheel balance weights along the wheel centerline (1) on the inner wheel surface if only 28 g (1 oz) or less is called for. If more than 28 g (1 oz) is called for, split the weights as equally as possible between the wheel centerline and the inboard edge of the inner wheel surface (2).
   - When dynamic balancing, locate the wheel balance weights along the wheel centerline and the inboard edge of the inner wheel surface (2) at the positions specified by the wheel balancer.
2. Ensure that there is sufficient clearance between the wheel weights and brake system components.

NOTE: Do not use abrasives to clean any surface of the wheel.

3. Using a clean cloth or paper towel with a general purpose cleaner, thoroughly clean the designated balance weight attachment areas of any corrosion, overspray, dirt or any other foreign material.
4. To ensure there is no remaining residue, wipe the balance weight attachment areas again, using a clean cloth or paper towel with a mixture of half isopropyl alcohol and half water.
5. Dry the attachment areas with hot air until the wheel surface is warm to the touch.
6. Warm the adhesive backing on the wheel balance weights to room temperature.
7. Remove the protective covering from the adhesive backing on the back of the balance weights. DO NOT touch the adhesive surface.
8. Apply the wheel balance weights to the wheel, press into place with hand pressure.
9. Secure the wheel balance weights to the wheel with a 90 N (21 lb) force applied with a roller.

TIRE AND WHEEL ASSEMBLY BALANCING - ON-VEHICLE

Special Tools

GE-38792-A: Electronic Vibration Analyzer (EVA) 2

If after following the tire and wheel vibration diagnostic process, some amount of tire and wheel vibration is still evident, an on-vehicle high-speed spin balancer may be used to perform an on-vehicle balance in an attempt to finish balance the tire and wheel assemblies, wheel hubs, brake rotors, brake drums, if equipped, and wheel trim, if equipped, simultaneously. On-vehicle balancing can also compensate for minor amounts of residual runout encountered as a result of mounting the tire and wheel assembly on the vehicle, as opposed to the balance which was achieved on the off-vehicle balancer.

In order to perform an on-vehicle balancing procedure, carefully follow the on-vehicle balancer manufacturer's specific operating instructions and carefully consider the following information before proceeding:

- Vehicles equipped with low profile, wide tread path, high performance tires and wheels are susceptible to

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small amounts of dynamic imbalance.

- When performing an on-vehicle balance, great care must be taken when placing the wheel balance weights on the wheels. If the wheel balance weights are not placed accurately, they can actually induce dynamic imbalance and thus increase the severity of the vibration.
- Inspect the vehicle wheel bearings to ensure that they are in good condition.
- Thoroughly inspect all on-vehicle balancing equipment and ensure that it is fully within the manufacturer's recommended specifications.
- Do not remove the off-vehicle balance weights. The purpose of on-vehicle balance is to fine tune the assembly balance already achieved off-vehicle, not to start over.
- Leave all wheel trim installed whenever possible.
- If the on-vehicle balancer calls for more than 56 g (2 oz) of additional weight, split the weight between the inboard and outboard flanges of the wheel, so as not to upset the dynamic balance of the assembly achieved in the off-vehicle balance. For wheel balance weight information, refer to **Tire and Wheel Assembly Balancing - Off Vehicle**.
- If available, tape-off an area on top of the fenders and the quarter panels, then place the vibration sensor of the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2 on the fender or quarter panel above the specific tire and wheel assembly while it is being on-vehicle balanced.

  The **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2 will provide a visual indication of the amplitude of the vibration, and the effect that the on-vehicle balance has on it.

TIRE-TO-WHEEL MATCH-MOUNTING (VECTORING)

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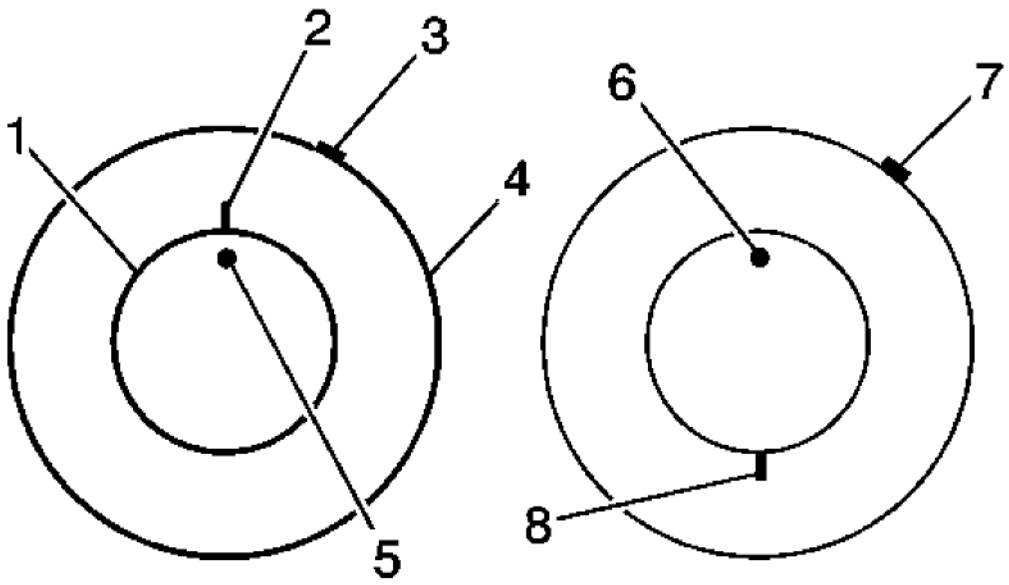


Fig. 36: View Of Tire-to-Wheel Match-Mounting
Courtesy of GENERAL MOTORS CORP.

NOTE: **After remounting a tire to a wheel or after replacing a tire and/or a wheel, remeasure the tire and wheel assembly runout in order to verify that the amount of runout has been reduced and brought to within tolerances. Ensure that the tire and wheel assembly is properly balanced before reinstalling to the vehicle.**

1. Mark the location of the high spot (3) on the tire as determined during the off-vehicle tire and wheel assembly runout measurement.
2. Place a reference mark (2) on the tire sidewall at the location of the valve stem (5).
   - Always refer to the valve stem as the 12 o'clock position.
   - Refer to the location of the high spot (3) by its clock position on the wheel, relative to the valve stem.
3. Mount the tire and wheel assembly on a tire machine and break down the bead. Do not dismount the tire from the wheel at this time.
4. Rotate the tire 180 degrees on the rim so that the valve stem reference mark (8) is now at the 6 o'clock position in relation to the valve stem (6). You may need to lubricate the bead in order to easily rotate the tire on the wheel.
5. Reinflate the tire and seat the bead properly.
6. Mount the assembly on the tire balancer and remeasure the runout. Mark the new location of the assembly runout high spot on the tire.

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7. If the assembly runout has been reduced and is within tolerance, no further steps are necessary. Balance the tire and wheel assembly, then install the assembly to the vehicle. Refer to the following:
   - **Tire and Wheel Assembly Balancing - Off Vehicle**
   - **Tire and Wheel Removal and Installation**
8. If the clock location of the high spot remained at or near the original clock location of the high spot (7) and the assembly runout has NOT been reduced, the wheel is the major contributor to the assembly runout concern.

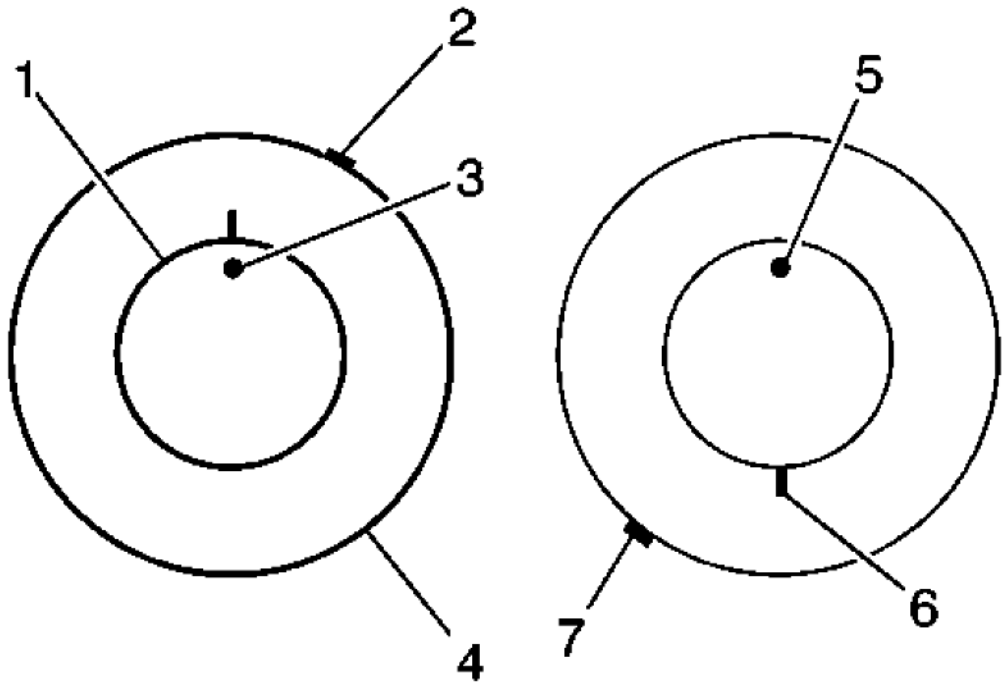


Fig. 37: View Of Match-Mounting Tire-To-Wheel
Courtesy of GENERAL MOTORS CORP.

9. If the clock location of the high spot has moved, however the assembly runout has NOT been reduced, perform the following steps:
   1. If the clock location of the high spot (7) is now at or near a position 180 degrees from the original clock location of the high spot, the tire is the major contributor to the assembly runout concern.
   2. If the clock location of the high spot is now in-between the 2 extremes, then both the tire and the wheel are both contributing to the assembly runout concern. Rotate the tire an additional 90 degrees in both the clockwise and the counterclockwise directions to obtain the lowest amount of assembly runout.

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TIRE AND WHEEL ASSEMBLY-TO-HUB/AXLE FLANGE MATCH-MOUNTING

NOTE: After remounting a tire and wheel assembly to a hub/axle flange, remeasure the tire and wheel assembly on-vehicle runout in order to verify that the amount of runout has been reduced and brought to within tolerances.

1. Mark the location of the high spot on the tire and wheel assembly as determined during the on-vehicle tire and wheel assembly runout measurement.
2. Place a reference mark on the wheel stud that is located closest to the wheel valve stem.
   - Always refer to the reference mark on the wheel stud as the 12 o'clock position.
   - Refer to the location of the high spot by its clock position on the tire and wheel assembly, relative to the marked wheel stud.
3. Remove the tire and wheel assembly from the hub/axle flange. Refer to **Tire and Wheel Removal and Installation** .
4. Rotate the tire and wheel assembly as close to 180 degrees as possible on the hub/axle flange, so that the wheel valve stem is now approximately at the 6 o'clock position in relation to the marked wheel stud.
5. Reinstall the wheel lug nuts to secure the tire and wheel assembly in the new position. Refer to **Tire and Wheel Removal and Installation** .
6. Remeasure the tire and wheel assembly on-vehicle runout. Mark the new location of the assembly on-vehicle runout high spot on the tire. Refer to **Tire and Wheel Assembly Runout Measurement - On-Vehicle**.
7. If the assembly on-vehicle runout has been reduced and is within tolerance, no further steps are necessary.
8. If the assembly runout has NOT been reduced, perform the following steps:
   1. If the clock location of the high spot remained at or near the original clock location of the high spot, the hub/axle flange and/or the brake rotor/drum mounting flange is the major contributor to the assembly on-vehicle runout concern.
   2. If the clock location of the high spot is now at or near a position 180 degrees from the original clock location of the high spot, the tire and wheel assembly is the major contributor to the assembly on-vehicle runout concern.
   3. If the clock location of the high spot is now in-between the 2 extremes, then both the tire and wheel assembly and the hub/axle flange are contributing to the assembly on-vehicle runout concern. Rotate the tire and wheel assembly as close to an additional 90 degrees as possible in both the clockwise and the counterclockwise directions to obtain the lowest amount of assembly on-vehicle runout.

DRIVELINE SYSTEM BALANCE ADJUSTMENT

This procedure is designed to fine-tune the balance of a propeller shaft while it is mounted in the vehicle. Small amounts of residual imbalance which could be present in other related driveline system components could be compensated for as a result of performing this procedure. The end result of properly fine-tuning a propeller shaft balance may be either a significant reduction or an elimination of a vibration disturbance that is related to the first-order rotation of a propeller shaft.

Fine-tuning the balance of a propeller shaft can aid in achieving a more balanced total driveline system.

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NOTE: The runout of the propeller shaft to be balanced and the runout of the components that the propeller shaft mates to must be within tolerances before an attempt should be made to perform this procedure.

If **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2 is available, use the following procedure, Adjustment Procedure Using EVA. If the EVA 2 is not available, use the second procedure, Adjustment Procedure Without EVA.

Adjustment Procedure Using EVA

Special Tools

- **EL-38792-20:** 20-Foot Timing Light Power Cord Extension
- **EL-38792-25:** Inductive Pickup Timing Light, or equivalent
- **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2
- **GE-38792-27:** 6-Foot EVA Power Cord Extension

For equivalent regional tools, refer to **Special Tools and Equipment**.

CAUTION: Do not depress the brake pedal with the brake rotors and/or the brake drums removed, or with the brake calipers repositioned away from the brake rotors, or damage to the brake system may result.

1. Raise and support the vehicle; ensure that the drive axle or axles are supported at ride height - vehicle body supported by suspension components.
2. With the tire and wheel assemblies, and the brake rotors and/or brake drums removed from the drive axle, or axles, start the engine and turn OFF all engine accessories.
3. Place the transmission in forward gear.
4. Run the vehicle at the speed which causes the most vibration in the propeller shaft; observe which end of the propeller shaft exhibits the greatest amount of vibration disturbance.
5. Turn the engine OFF to slow and stop the rotation of the propeller shaft.

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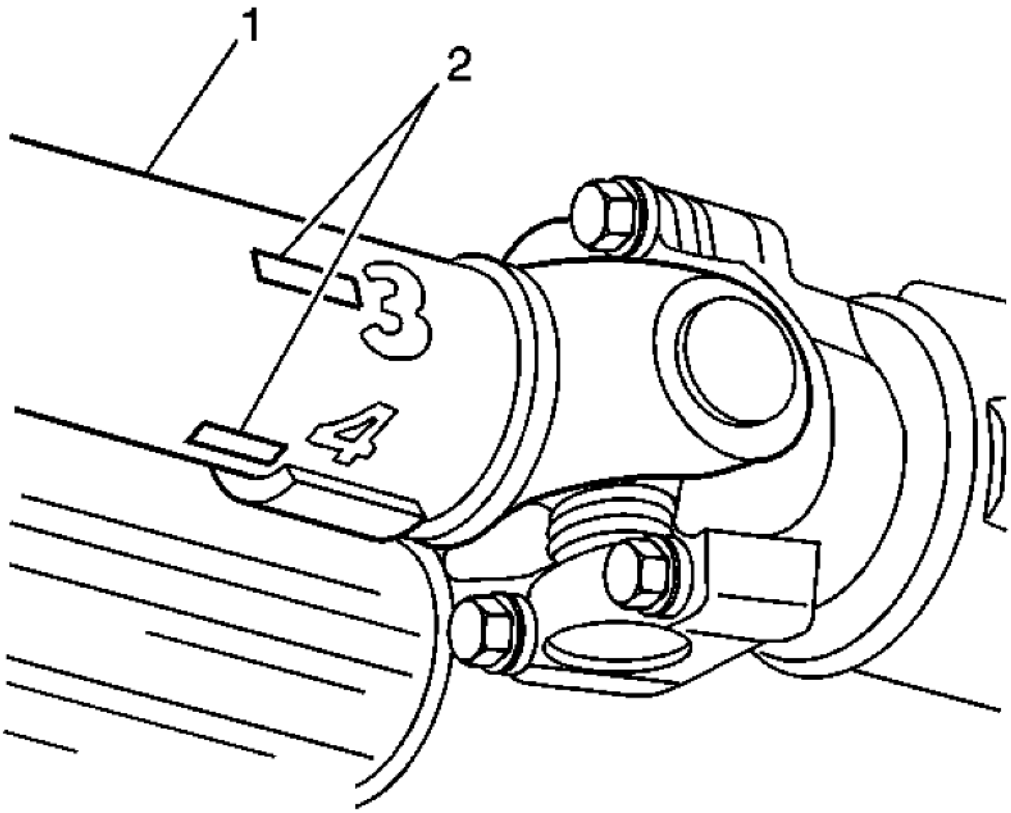


Fig. 38: Marking Circumference Of Propeller Shaft
Courtesy of GENERAL MOTORS CORP.

6. Mark the circumference of the propeller shaft (1) to be balanced at four points 90 degrees apart (2), nearest the end that exhibited the greatest amount of vibration. Number the marks 1-4.
7. Install the **GE-38792-A:** EVA 2, the **GE-38792-27:** 6-Foot EVA Power Cord Extension, the **EL-38792-25:** Inductive Pickup Timing Light, or equivalent, and the **EL-38792-20:** 20-foot extension to the vehicle.
8. Connect the clip of the **EL-38792-25:** Inductive Pickup Timing Light, or equivalent, onto the trigger wire of the **GE-38792-A:** EVA 2.
9. Mount the **GE-38792-A:** EVA 2 vibration sensor to the bottom of the driveline component nearest to the end of the propeller shaft that exhibited the greatest amount of vibration.

   Ensure that the side of the sensor marked UP faces upward and that the sensor is positioned as close to horizontal as possible.

10. Plug the vibration sensor cord into Input A of the **GE-38792-A:** EVA 2. Input B is not used with the strobe function.

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11. Run the vehicle at the speed which causes the most vibration in the propeller shaft; observe the frequency readings displayed on the **GE-38792-A:** EVA 2.

NOTE: Do NOT continue with fine-tuning the balance of a propeller shaft if the dominant frequency displayed is not related to the first-order rotational speed of the propeller shaft.

12. Verify that the dominant frequency displayed on the **GE-38792-A:** EVA 2 matches the recorded frequency of the vibration concern.
13. Record the amplitude reading of the dominant frequency displayed.
14. Using the strobe function of the **GE-38792-A:** EVA 2, select the correct filter range to use for the balance adjustment, so that the dominant frequency would be near the middle of the filter range. Use the full range filter only as a last resort if one of the specific range filters will not cover the frequency adequately.
15. The **GE-38792-A:** EVA 2 display will show the dominant frequency, the amplitude and the selected filter range.
16. Aim the **EL-38792-25:** Inductive Pickup Timing Light, or equivalent, or equivalent, at the marks placed on the propeller shaft. When activated, the strobe effect will appear to freeze the marks placed on the rotating propeller shaft. Record which of the numbered marks appears to be at the bottom of the propeller shaft, or the 6 o'clock position. This position identifies the light spot of the propeller shaft.
17. Turn the engine OFF to slow and stop the rotation of the propeller shaft.
18. Install a band-type hose clamp as a weight, with the head of the clamp directly on the light spot.
19. Run the vehicle at the speed which causes the most vibration in the propeller shaft.
20. Using the **EL-38792-25:** Inductive Pickup Timing Light, or equivalent, or equivalent, observe the positioning of the marks placed on the propeller shaft.
21. If the marks on the propeller shaft now appear to move erratically, compare the current amplitude of the vibration frequency to the original amplitude recorded previously.

    If the amplitude has decreased from the amplitude recorded, the balance achieved may be sufficient and the vehicle should be road tested to determine the effect on the vibration concern.

22. If the clamp head over the original light spot, is now near the top of the propeller shaft, within 180 degrees - near or below the 12 o'clock position - of the original position at the bottom of the propeller shaft - 6 o'clock position - the position of the weight needs adjusting. Perform the following steps:
    1. Move the position of the clamp head toward the 6 o'clock position.
    2. Using the **EL-38792-25:** Inductive Pickup Timing Light, or equivalent , or equivalent, recheck the positioning of the propeller shaft marks.
    3. If necessary, continue to move the position of the clamp head toward the 6 o'clock position and recheck progress until an improvement in balance is achieved.

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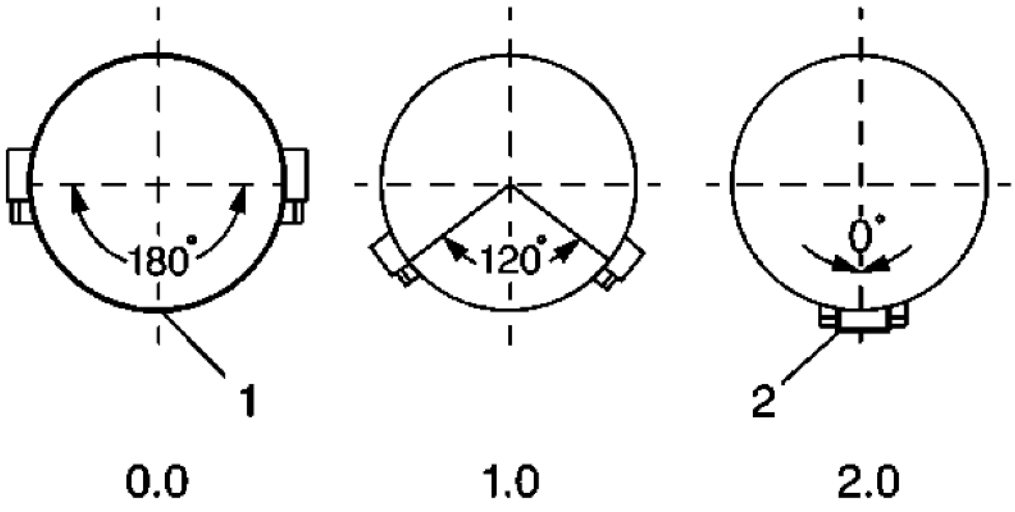


Fig. 39: Positioning Clamps On Propeller Shaft
Courtesy of GENERAL MOTORS CORP.

23. If the clamp head over the original light spot, is still positioned at the bottom of the propeller shaft - 6 o'clock position - additional weight is required. Perform the following steps:
    1. Add a second clamp to the propeller shaft, next to the first clamp and with the clamp heads aligned.
    2. Using the **EL-38792-25:** Inductive Pickup Timing Light, or equivalent , or equivalent, recheck the positioning of the propeller shaft marks.
    3. If the clamp heads over the original light spot, are now 90-180 degrees - at or above the 9 o'clock or the 3 o'clock positions - from the original position at the bottom of the propeller shaft - 6 o'clock position - less total weight is required. Proceed to step 23.4.
    4. Move the position of the clamp heads an equal distance on either side of the light spot between 1 and 120 degrees apart from each other to reduce the total amount of weight in relation to the light spot.
    5. Using the **EL-38792-25:** Inductive Pickup Timing Light, or equivalent , or equivalent, recheck the positioning of the propeller shaft marks.
    6. If necessary, continue to move the position of the clamp heads an equal distance on either side of the light spot to a maximum of 120 degrees apart from each other, until the greatest improvement to balance is achieved.
    7. If improvement has been made to the balance of the propeller shaft, but the balance is still not satisfactory, still more total weight may be required. Perform the following steps:
        1. Add a third clamp to the propeller shaft, next to the first and second clamps and with the clamp head directly on the light spot.
        2. Move the position of the first and second clamp heads an equal distance on either side of the light spot between 1 and 120 degrees apart from each other to arrive at a total amount of

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weight greater than two weights, but less than three weights in relation to the light spot.

3. Using the **EL-38792-25:** Inductive Pickup Timing Light, or equivalent , or equivalent, recheck the positioning of the propeller shaft marks.
4. If necessary, continue to move the position of the first and second clamp heads an equal distance on either side of the light spot to a maximum of 120 degrees apart from each other, until the greatest improvement to balance is achieved.

8. If a third clamp was used on the propeller shaft and sufficient balance could still not be achieved, the propeller shaft requires replacement.

24. If the clamp head over the original light spot is now 90-180 degrees - at or above the 9 o'clock or the 3 o'clock positions - from the original position at the bottom of the propeller shaft - 6 o'clock position - less total weight is required. Perform the following steps:
    1. Add a second clamp to the propeller shaft, next to the first clamp and with the clamp heads aligned.
    2. Move the position of the clamp heads an equal distance on either side of the light spot between 120 and 180 degrees apart from each other to reduce the total amount of weight in relation to the light spot.
    3. Using the **EL-38792-25:** Inductive Pickup Timing Light, or equivalent , or equivalent, recheck the positioning of the propeller shaft marks.
    4. If necessary, continue to move the position of the clamp heads an equal distance on either side of the light spot to a maximum of 180 degrees apart from each other, but not less than 120 degrees apart, until the greatest improvement to balance is achieved.
25. If the marks on the propeller shaft now appear to move erratically, compare the current amplitude of the vibration frequency to the original amplitude recorded previously.

    If the amplitude has decreased from the amplitude recorded, the balance achieved may be sufficient and the vehicle should be road tested to determine the effect on the vibration concern.

Adjustment Procedure Without EVA

CAUTION: Do not depress the brake pedal with the brake rotors and/or the brake drums removed, or with the brake calipers repositioned away from the brake rotors, or damage to the brake system may result.

1. Raise and support the vehicle; ensure that the drive axle, or axles are supported at ride height - vehicle body supported by suspension components.
2. With the tire and wheel assemblies, and the brake rotors and/or brake drums removed from the drive axle or axles, start the engine and turn OFF all engine accessories.
3. Place the transmission in forward gear.
4. Run the vehicle at the speed which causes the most vibration in the propeller shaft; observe which end of the propeller shaft exhibits the greatest amount of vibration disturbance.
5. Carefully hold a piece of chalk up to the end of the propeller shaft in order to just make contact as the shaft rotates.
6. Turn the engine OFF to slow and stop the rotation of the propeller shaft.
7. Observe the location of the chalk mark on the propeller shaft.

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- If the chalk mark circles the entire propeller shaft after the first attempt, remove the mark from the shaft and repeat steps 2 through 7; touch the chalk more gently to the propeller shaft.
- If the chalk mark circles the entire propeller shaft after the second attempt, runout of the propeller shaft may not be the cause of the disturbance. Proceed to step 16.
- If the chalk mark is only on a small portion of the propeller shaft, the mark identifies the heavy spot of the propeller shaft. The heavy spot of the propeller shaft will deflect downward during rotation. Place a small mark on the shaft 180 degrees, directly opposite the heavy spot, and identify the mark as the light spot. Proceed to step 8.

8. Install a band-type hose clamp to the propeller shaft as a weight, with the head of the clamp directly on the light spot, or 180 degrees, directly opposite the heavy spot.
9. Observe the amount of disturbance to the propeller shaft.
   - If the amount of disturbance to the propeller shaft appears to be significantly reduced, the balance achieved may be sufficient and the vehicle should be road tested to determine the effect on the vibration concern. The head of the clamp can be moved very slightly, if necessary to refine the balance achieved.
   - If the amount of disturbance to the propeller shaft appears to be almost unchanged or even increased, proceed to step 10.
10. Add a second clamp to the propeller shaft, next to the first clamp and with the clamp heads aligned.
11. Observe the amount of disturbance to the propeller shaft.
    - If the amount of disturbance to the propeller shaft appears to be significantly reduced, the balance achieved may be sufficient and the vehicle should be road tested to determine the effect on the vibration concern. The head of the clamps can be moved very slightly an equal distance apart on either side of the light spot, or moved slightly while still aligned, if necessary to refine the balance achieved.
    - If the amount of disturbance to the propeller shaft appears to be almost unchanged or even increased, proceed to step 12.
12. Move the position of the clamp heads an equal distance on either side of the light spot between 1 and 120 degrees apart from each other to reduce the total amount of weight in relation to the light spot.
13. Observe the amount of disturbance to the propeller shaft.
    - If the amount of disturbance to the propeller shaft appears to be significantly reduced, the balance achieved may be sufficient and the vehicle should be road tested to determine the effect on the vibration concern. If necessary, continue to move the position of the clamp heads an equal distance on either side of the light spot to a maximum of 120 degrees apart from each other, until the greatest amount of reduction in the vibration disturbance is achieved.
    - If the amount of disturbance to the propeller shaft appears to be almost unchanged or even increased, proceed to step 14.
14. Add a third clamp to the propeller shaft, next to the first and second clamps and with the head of the clamp directly on the light spot.
15. Observe the amount of disturbance to the propeller shaft.
    - If the amount of disturbance to the propeller shaft appears to be significantly reduced, the balance achieved may be sufficient and the vehicle should be road tested to determine the effect on the vibration concern. If necessary, continue to move the position of the first and second clamp heads an equal distance on either side of the light spot to a maximum of 120 degrees apart from each

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other, until the greatest amount of reduction in the vibration disturbance is achieved.

- If the amount of disturbance to the propeller shaft appears to be almost unchanged or even increased after a third clamp was used on the propeller shaft, the propeller shaft likely requires replacement.

16. If the heavy spot of the propeller shaft could not be identified, install a band-type hose clamp to the propeller shaft as a weight, with the head of the clamp directly in-line with an existing factory-installed weight.
17. Observe the amount of disturbance to the propeller shaft.
    - If the amount of disturbance to the propeller shaft appears to be significantly reduced, the balance achieved may be sufficient and the vehicle should be road tested to determine the effect on the vibration concern. The head of the clamp can be moved very slightly, if necessary to refine the balance achieved.
    - If the amount of disturbance to the propeller shaft appears to be almost unchanged or even increased, proceed to step 18.
18. Move the head of the clamp 180 degrees, directly opposite the factory-installed weight.
19. Observe the amount of disturbance to the propeller shaft.
    - If the amount of disturbance to the propeller shaft appears to be significantly reduced, the balance achieved may be sufficient and the vehicle should be road tested to determine the effect on the vibration concern. The head of the clamp can be moved very slightly, if necessary to refine the balance achieved.
    - If the amount of disturbance to the propeller shaft appears to be almost unchanged or even increased, the propeller shaft may require replacement.

DRIVELINE WORKING ANGLES ADJUSTMENT

NOTE: This procedure is intended to be used for vehicles where the following conditions are met:

- **Vehicle trim heights are within specification guidelines.**
- **The vehicle exhibits no signs of aftermarket modifications that may affect driveline working angles.**
- **The vehicle exhibits no signs of accident damage which may affect the position of the drive axle, or axles, the propeller shaft support bearing, if equipped, or the transmission or transfer case, if equipped.**

Drive axle wind-up may cause a launch shudder condition even when all of the driveline working angles are within specifications. Drive axle wind-up occurs when heavy torque during acceleration causes the pinion nose to pivot upward. Excessively worn or damaged axle mounting components and/or overloading or unevenly loading the vehicle may contribute to a launch shudder condition.

1. For solid axles equipped with a leaf spring suspension, inspect the leaf springs, mount bushings, and mounting hardware for excessive wear or damage.
2. For solid axles equipped with a non-leaf spring suspension, inspect the suspension links and link mounts and/or bushings for excessive wear or damage.

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3. For direct-mount axles, inspect any axle mount brackets for damage and inspect the axle mounts and/or bushings for excessive wear or damage.
4. Inspect the structure to which the suspension attaches to ensure no deformities or damage exists.
5. Inspect the propeller shaft support bearing assembly for damaged rubber components, worn bearings, and/or a deformed/cracked bracket.
6. Inspect the propeller shaft support bearing assembly and mounting bracket, if equipped, for loose or missing shims. Reinstall correctly or replace any shims as necessary to ensure proper alignment of the support bearing assembly.
7. Inspect the structure to which the support bearing assembly attaches to ensure no deformities or damage exists.
8. Inspect any transmission or transfer case mount bracket or brackets for damage and inspect the mount or mounts for excessive wear, damage, and/or deformities.
9. Inspect the structure to which the transmission or transfer case attaches to ensure no deformities or damage exists.
10. Repair or replace parts as indicated by the inspections.
11. If excessively worn or damaged parts were repaired or replaced, re-measure the driveline working angles and road test the vehicle to ensure proper operation of the driveline system.

PROPELLER SHAFT PHASING CORRECTION

One Piece Propeller Shaft Phasing Correction

An out of phase single-piece propeller shaft is very unusual. If the phasing inspection procedure revealed that prop shaft is not phased correctly, the welded yokes are in the wrong position, or the shaft is damaged due to twisting and the propeller shaft requires replacement to restore proper cancellation of the U-joints.

Multiple-Piece Propeller Shaft Phasing Correction

1. If the phasing inspection procedure revealed that a prop shaft is not phased correctly to the mating slip yoke, the end yoke is welded on in the wrong position, the slip yoke is mis-aligned to the stub shaft, or the shaft is damaged due to twisting.
2. If the shaft if visibly damaged, it requires replacement.
3. If the shaft exhibits no visual physical defects or damage, perform the following:
    1. Remove the slip yoke from the stub shaft to determine if it is possible to reinstall the slip yoke in a different position on the stub shaft.
    2. If the stub shaft is keyed to ensure proper alignment of the stub shaft and the slip yoke, then the propeller shafts require replacement to restore proper cancellation of the U-joints.
    3. If the stub shaft is not keyed, attempt to re-align the front shaft and slip yoke to each other. Repeat the inspection procedure to confirm the results.
    4. If proper phasing cannot be obtained, the propeller shaft requires replacement to restore proper cancellation of the U-joints.

DESCRIPTION AND OPERATION

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VIBRATION THEORY AND TERMINOLOGY

Vibration Theory

The designs and engineering requirements of vehicles have undergone drastic changes over the last several years.

Vehicles are stiffer and provide more isolation from road input than they did previously. The structures of today's stiffer vehicles are less susceptible to many of the vibrations which could be present in vehicles of earlier designs, however, vibrations can still be detected in a more modern vehicle if a transfer path is created between a rotating component and the body of the vehicle.

There are not as many points of isolation from the road in many vehicles today. If a component produces a strong enough vibration, it may overcome the existing isolation and the component needs to be repaired or replaced.

The presence/absence of unwanted noise and vibration is linked to the customer's perception of the overall quality of the vehicle.

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

- A rotating component
- The engine combustion process firing impulses

Rotating components will cause vibrations when excessive imbalance or runout is present. 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.

Rotating components will cause a vibration concern when they not properly isolated from the passenger compartment: Engine firing pulses can be detected as a vibration if a motor mount is collapsed.

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 does not mean the source of 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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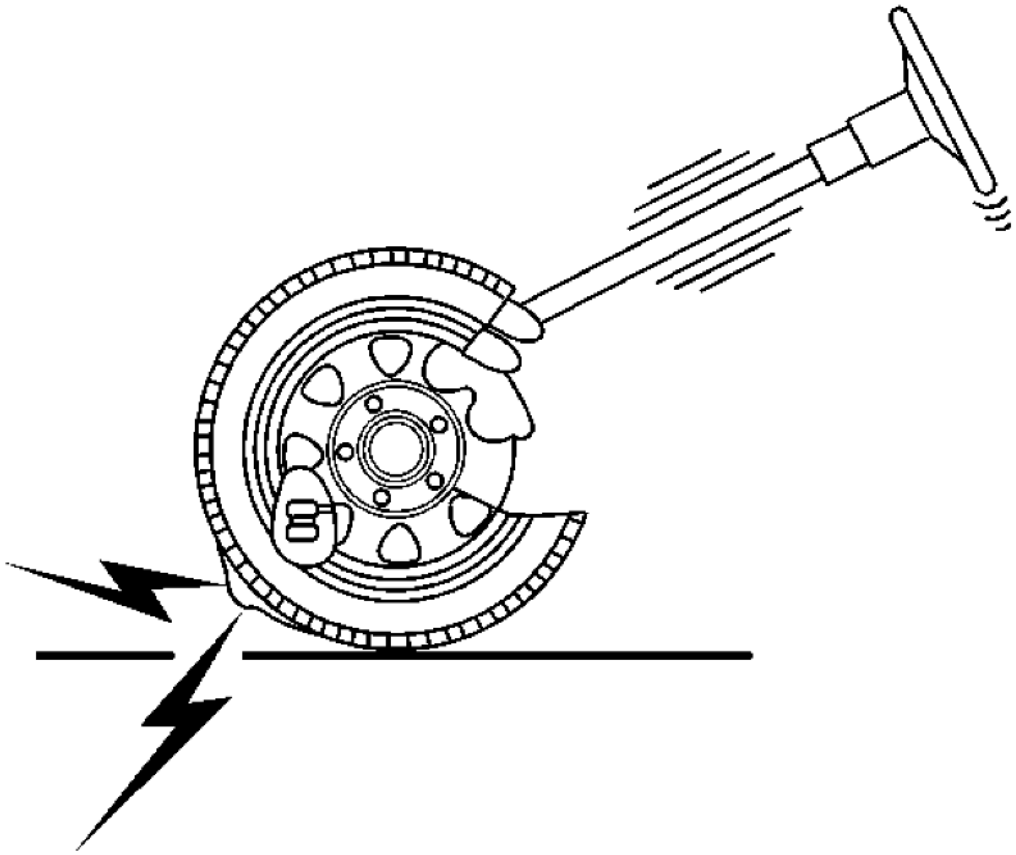


Fig. 40: Identifying Unbalanced Tire Vibration
Courtesy of GENERAL MOTORS CORP.

In the preceding picture, the source 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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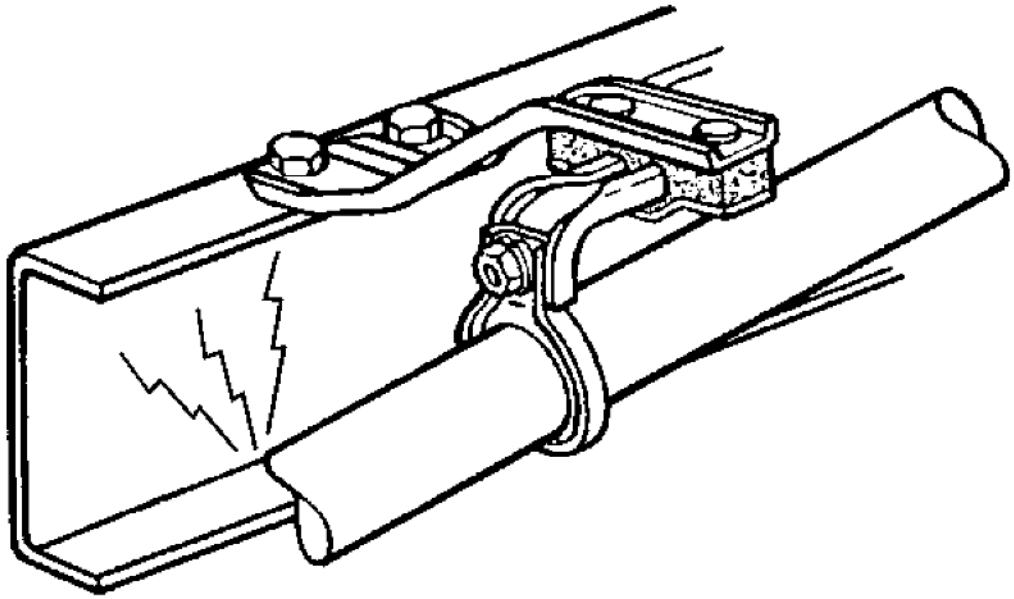


Fig. 41: Identifying Exhaust Pipe Noise
Courtesy of GENERAL MOTORS CORP.

Vibration can also produce noise. As an example, consider a vehicle that has an exhaust pipe 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.

Basic Vibration Terminology

The following are the 2 primary components of vibration diagnosis:

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

The repetitive up and down or back and forth movement of a component cause most customer vibration complaints. The following are the common components that vibrate:

- The steering wheel
- The seat cushion
- The frame
- The IP

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Vibration diagnosis involves the following simple outline:

1. Measure the repetitive motion and assign a value to the measurement in cycles per second or cycles per minute.
2. Relate the frequency back on terms of 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:

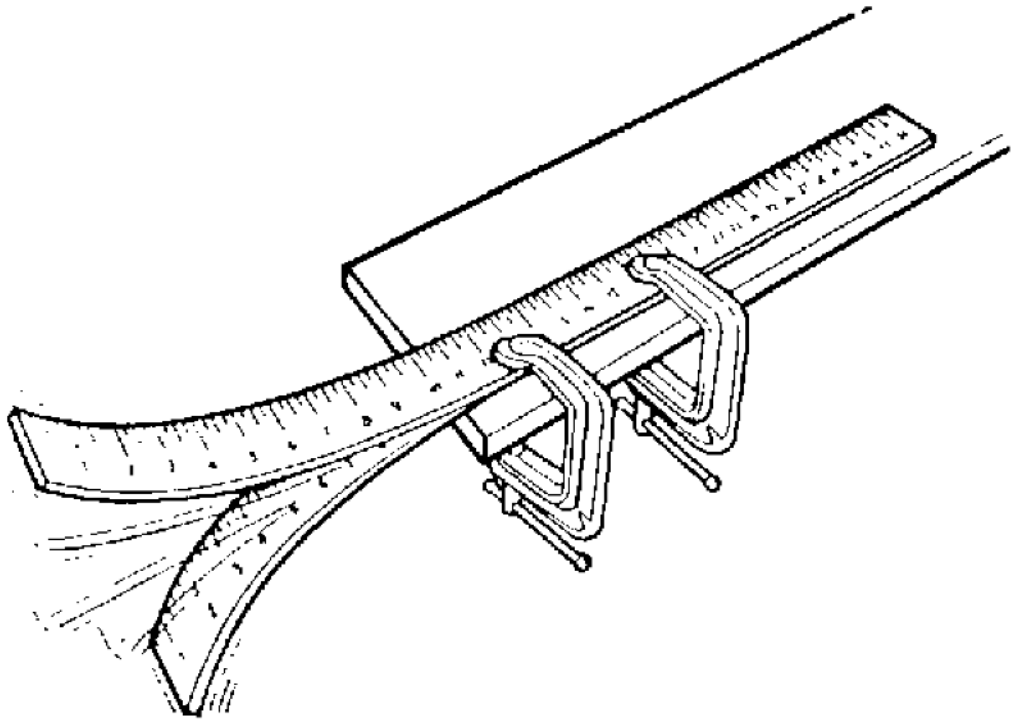


Fig. 42: Demonstrating Vibration Theory
Courtesy of GENERAL MOTORS CORP.

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.

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The cycle occurs over and over again at the same rate, or frequency. In this case, about 10 cycles in one 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 have also found a specific amount of motion, or amplitude, in the total travel of the yardstick from the very top to the very bottom. 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 (1,800 cycles per minute).

Cycle

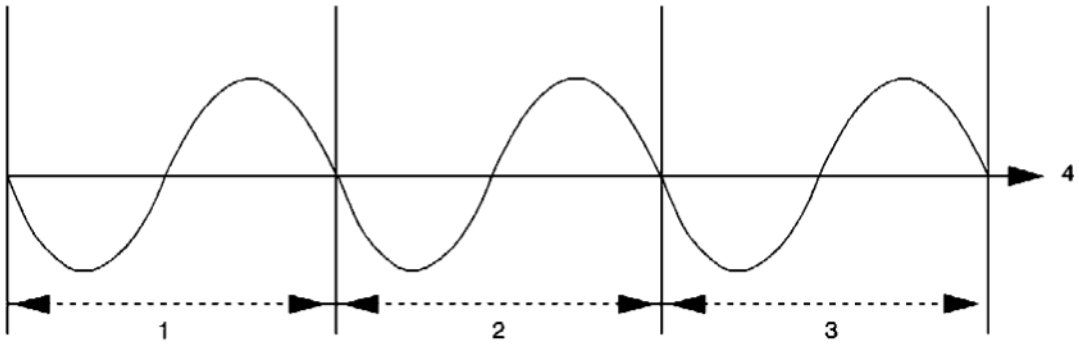


Fig. 43: Identifying Powertrain Vibration Cycles
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	1st Cycle
2	2nd Cycle
3	3rd Cycle
4	Time

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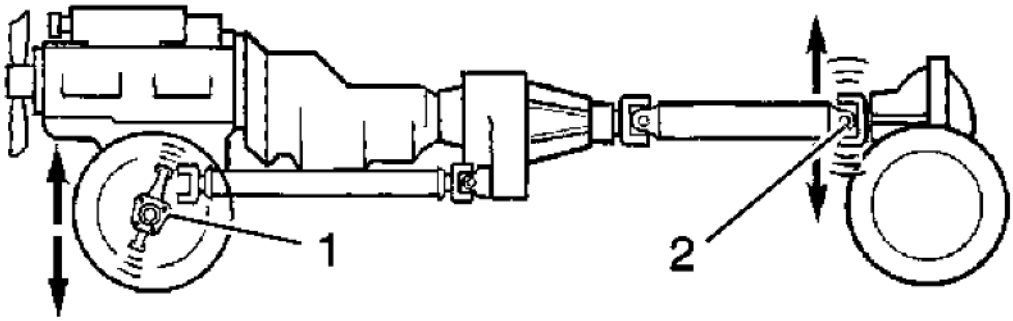


Fig. 44: Vibration Cycles in Powertrain Components
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
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, as thus, so does a cycle. All vibrations consist of repetitive cycles.

Frequency

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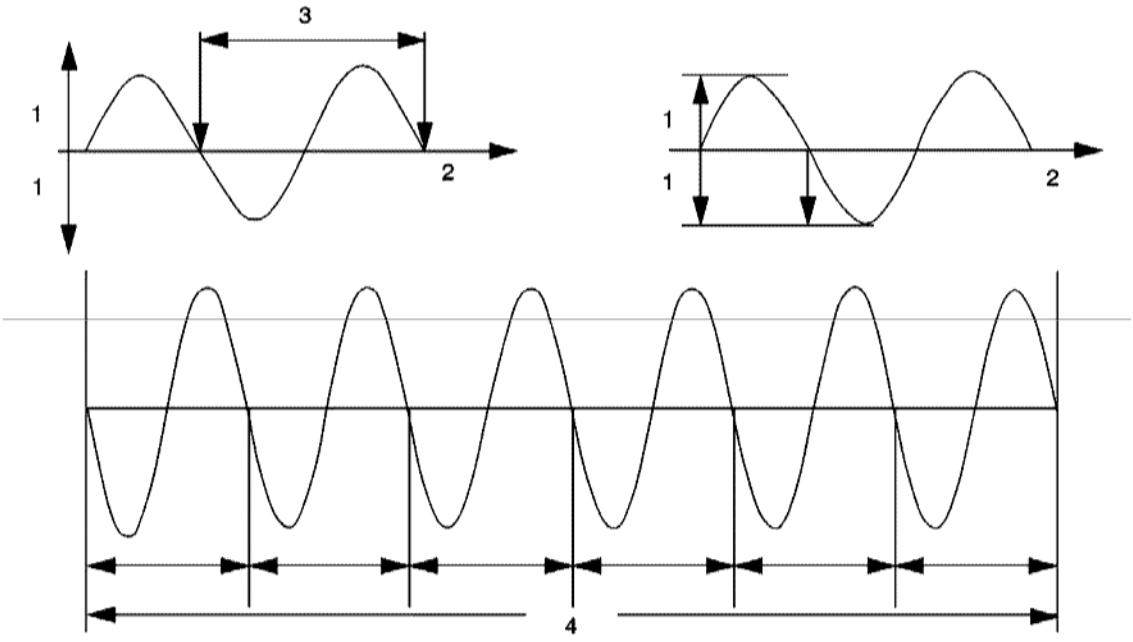


Fig. 45: Identifying Vibration Frequency
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
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 1 second. Thus, frequency is expressed in cycles per second.

The proper term for cycles per seconds is Hertz (Hz). This is the most common way to measure frequency. Multiply the Hertz by 60 to get the cycles or revolutions per minute (RPM).

Amplitude

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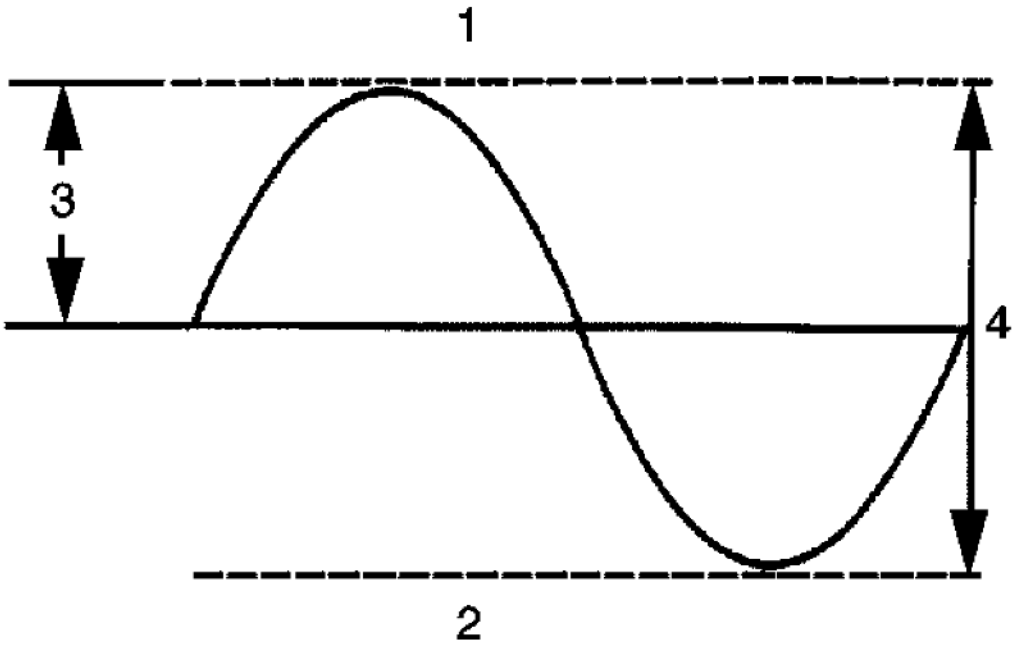


Fig. 46: Identifying Vibration Amplitude
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
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, we are referring it to 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.

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Forced Vibration

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

Centrifugal Force Due to an Imbalance

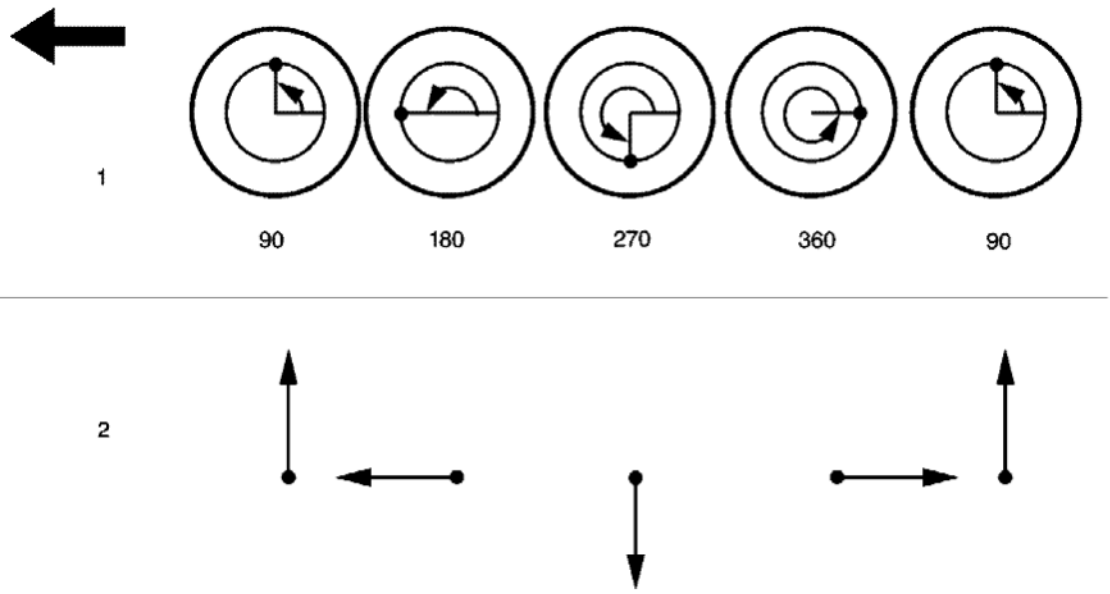


Fig. 47: Identifying Centrifugal Force
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
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 is the imbalance in the tire. The string is the tire, wheel, and suspension assembly. As the vehicle speed increases, the disturbing force of the unbalanced tire can be felt 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.

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Natural or Resonant Frequency

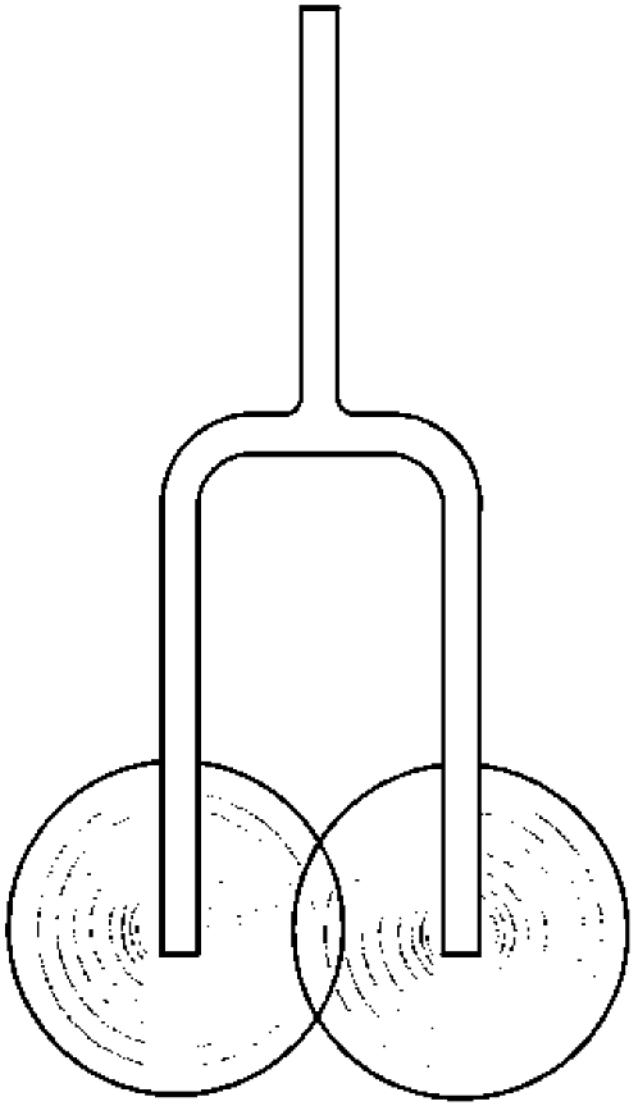


Fig. 48: View Of Natural Frequency
Courtesy of GENERAL MOTORS CORP.

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 the mounts, have a tendency to vibrate at certain frequencies. This

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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 the natural frequency. Conversely, the greater the mass, the lower the natural frequency.

Resonance

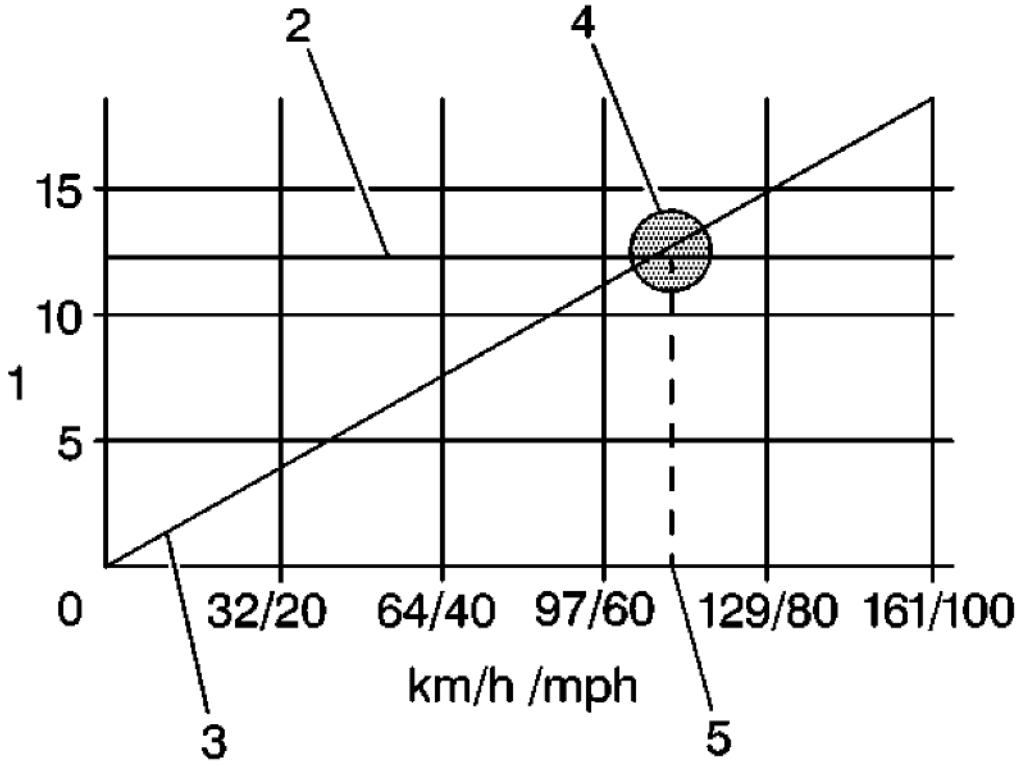


Fig. 49: Identifying Natural Frequency Of A Typical Automotive Front Suspension
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Frequency - cps
2	Suspension Frequency
3	Unbalanced Excitation
4	Point of Resonance
5	Problem Speed

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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 the vibration may be felt above and below the problem speed, the vibration may be felt the most at the point of resonance.

Damping

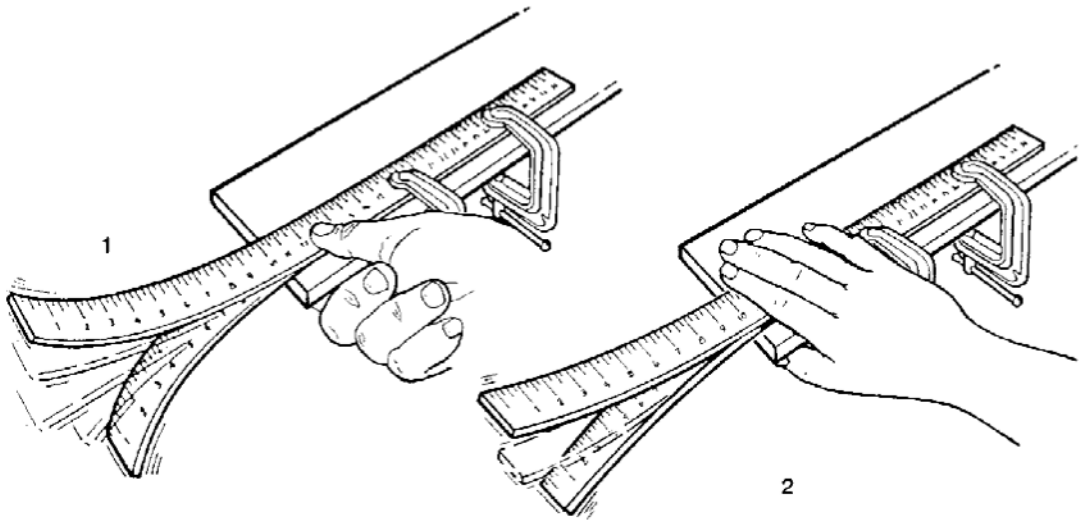


Fig. 50: Identifying Low & High Damping
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
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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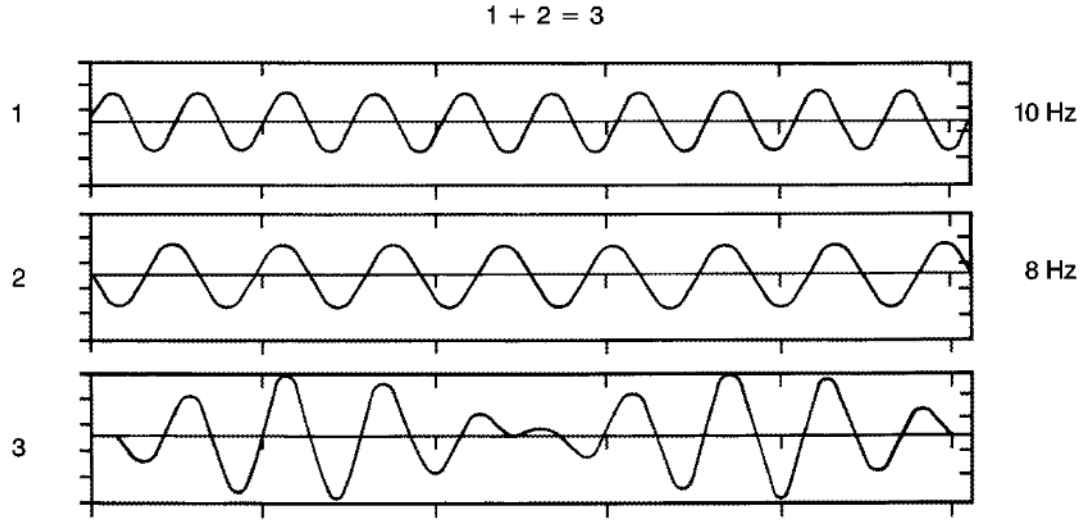


Fig. 51: Identifying Beating Or Phasing
Courtesy of GENERAL MOTORS CORP.

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 2 vibrating forces are adding to each other's amplitude. However, 2 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 1 revolution of a rotating component.

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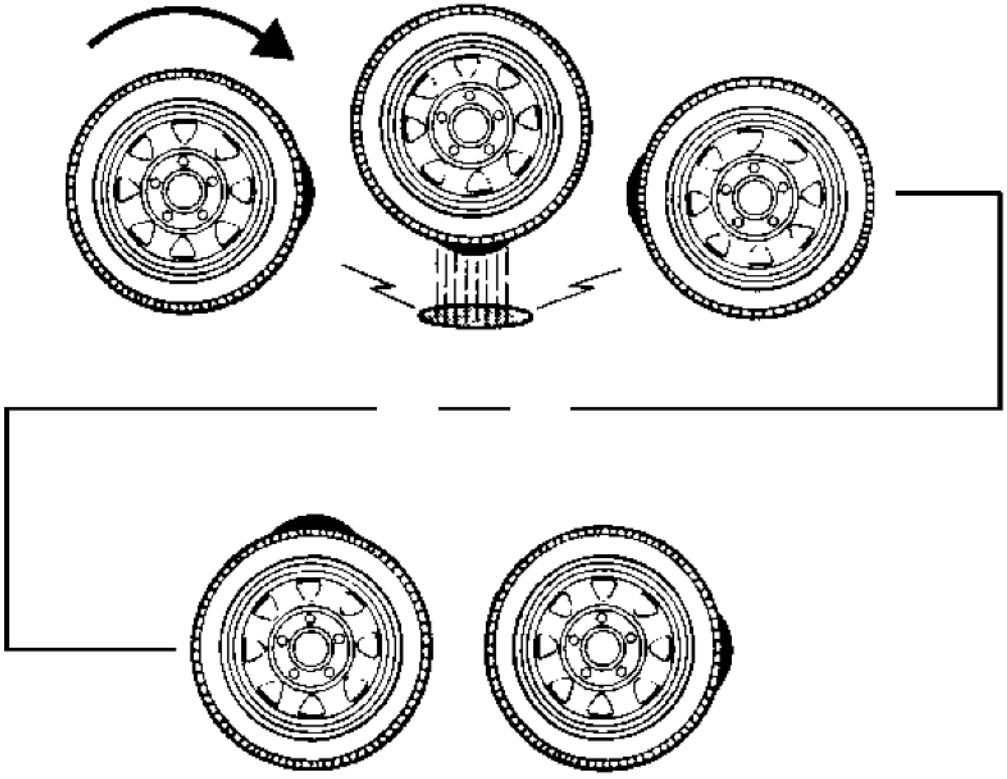


Fig. 52: Identifying First-Order Vibration
Courtesy of GENERAL MOTORS CORP.

For example, a tire with 1 high spot would create a disturbance once for every revolution of the tire. This is called first-order vibration.

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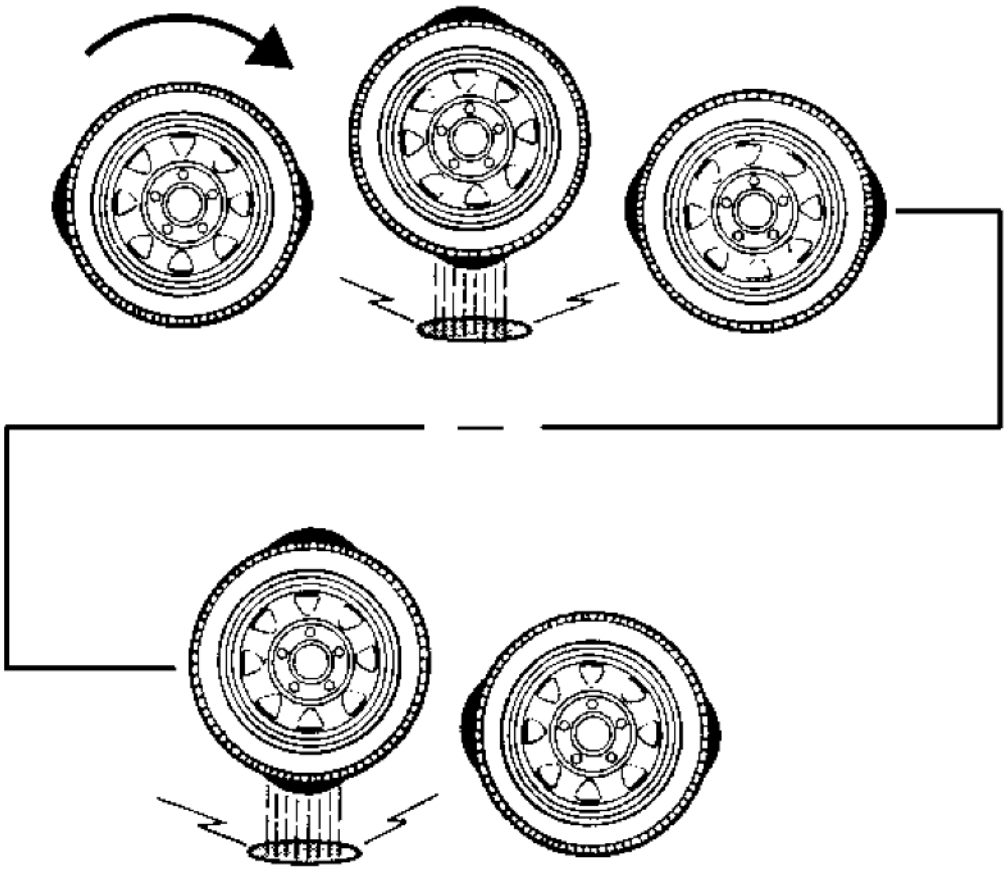


Fig. 53: Identifying Second-Order Vibration
Courtesy of GENERAL MOTORS CORP.

An oval-shaped tire with 2 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. Due to centrifugal force, an unbalanced component will always create at least a first-order vibration.

ELECTRONIC VIBRATION ANALYZER (EVA) DESCRIPTION AND OPERATION

Special Tools

- **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2)
- **GE-38792-25:** Inductive Pickup Timing Light

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For equivalent regional tools, refer to cell **Special Tools and Equipment**.

The **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2), is a 12-volt powered hand-held device, similar to a scan tool, which receives input from an attached vibration sensor or accelerometer and displays the most dominate input frequency(ies) (up to three) on its liquid crystal display. The vibration concern frequency(ies) are obtained through the use of the **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2) while following the Vibration Analysis Diagnostic Tables. The frequency(ies) obtained, when applied to the Vibration Analysis Diagnostic Tables, are used as a primary input to help determine the source of the vibration concern.

EVA Vibration Sensor

The **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2) vibration sensor incorporates a 6.1 m (20 ft) cord, that allows the sensor to be placed on virtually any component of the vehicle where a vibration concern is felt.

The **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2) contains 2 sensor input ports which can be activated individually to allow for 2 individual vibration sensor inputs. The vibration sensors can then be placed in 2 different locations in the vehicle and their individual inputs can be read without having to stop a test, move the sensor and resume the test. The use of 2 vibration sensors can help in more quickly finding and recording an accurate frequency of the vibration concern, and in more quickly making comparisons between 2 different areas of a single component, or a vehicle system, during the diagnostic process.

EVA Vibration Sensor Placement

Proper placement of the **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2) vibration sensor (accelerometer) is critical to ensure that proper vibration readings are obtained by the **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2). The vibration sensor should be placed on the specific vehicle component identified as being the most respondent to the vibration. If no component has been identified, install the sensor to the steering column as a starting point.

EVA Vibration Sensor-to-Component Attachment

NOTE: The GE-38792-A: Electronic Vibration Analyzer 2 (EVA 2) vibration sensor must be attached to vehicle components in the manner indicated in order to achieve accurate frequency readings of the vibration disturbance.

The vibration sensor of the **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2) is designed to pickup disturbances which primarily occur in the vertical plane, since most vibrations are felt in that same up-and-down direction. The **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2) vibration sensor is therefore directional sensitive and must be attached to vehicle components such that the side of the sensor marked UP is always facing upright and the sensor body is as close to horizontal as possible. The sensor must be installed in the exact same position each time tests are repeated or comparisons are made to other vehicles.

The **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2) vibration sensor can be attached to vehicle components in various ways. For non-ferrous surfaces, such as the shroud of a steering column, the sensor can be attached using putty, or hook and loop fasteners. For ferrous surfaces, the sensor can be attached using a magnet supplied with the sensor.

EVA Software Cartridge

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The **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2) uses a software cartridge, the GE-38792-60, which provides various information to the **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2). The GE-38792-60 provides the **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2) with an additional feature which can be selected and utilized to assist in diagnosing vibration concerns.

NOTE: The Auto-Mode function of the GE-38792-A: Electronic Vibration Analyzer 2 (EVA 2) cartridge, GE-38792-60, is designed to be used in SUPPORT of the Vibration Analysis Diagnostic Tables ONLY.

This support-feature is available through the **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2) Auto-Mode function. When selected, the **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2) will prompt the user to select which one of 2 vehicle systems (vehicle speed or engine speed), is the SUSPECTED source of the vibration concern. Using the inputted vehicle data parameters along with the most dominate vibration frequency obtained, it will identify a SUSPECTED source of the vibration concern, such as first-order tire and wheel. This can be a useful feature when used in conjunction with the Vibration Analysis Diagnostic Tables, to confirm results obtained through the diagnostic process.

EVA Smart Strobe Function

The **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2) can be used to identify some rotating components/systems which exhibit imbalance IF the component rotational speed is the dominant frequency of the vibration concern. The **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2) is equipped with a strobe light trigger wire which can be used with an inductive pickup timing light, **GE-38792-25:** Inductive Pickup Timing Light, or equivalent included with the GE-38792-25-KIT, or available separately. Using the Smart Strobe function enables the user to input the vibration frequency to which the strobe will flash. By marking the suspected rotating component, such as a pulley, adjusting the strobe frequency to match the dominant vibration frequency at the engine RPM noted during diagnosis, and then operating the engine at that specific RPM, the mark on the object will appear to be stationary if that object is imbalanced.

EVA Strobe Balancing Function

The **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2) can be used to identify the light spot on a propeller shaft IF the propeller shaft rotational speed is the dominant frequency of the vibration concern. The **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2) is equipped with a strobe light trigger wire which can be used with an inductive pickup timing light, **GE-38792-25:** Inductive Pickup Timing Light, or equivalent included with the J-38792-25-KIT, or available separately, and in conjunction with the **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2) vibration sensor to identify the light spot on a propeller shaft and to help in making a determination as to when propeller shaft balance is obtained.

Averaging/Non-Averaging Modes

The EVA provides 2 modes of displaying the most dominate frequencies which the EVA vibration sensor (accelerometer) detects; averaging and non-averaging (instantaneous).

The averaging mode uses multiple vibration samples taken over a period of time and then displays the most dominant frequencies which have been averaged-out. Using the averaging mode minimizes the distractions caused by a sudden vibration frequency being displayed that is not related to the concern vibration, such as from pot holes or from uneven road surfaces.

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The non-averaging (instantaneous) mode is more sensitive to vibration disturbances than the averaging mode. Using the non-averaging mode will generate instantaneous frequency displays which are not averaged across multiple samples over a period of time; the specific vibration frequencies that occur at a specific moment during diagnostic testing will be displayed at that moment. The non-averaging (instantaneous) mode is useful when measuring a vibration disturbance that exists for only a short period of time or during acceleration/deceleration testing.

When operating the EVA in the averaging mode along with the Auto Mode, "A" will be displayed along the top of the screen to the left of the vibration sensor input port being used. When operating the EVA in the averaging mode and the Manual Mode, "AVG" will be displayed along the top center of the screen.

When operating the EVA in the non-averaging (instantaneous) mode along with the Auto Mode, "I" will be displayed along the top of the screen to the left of the vibration sensor input port being used. When operating the EVA in the non-averaging (instantaneous) mode and the Manual Mode, the top center of the screen will be blank.

EVA Display

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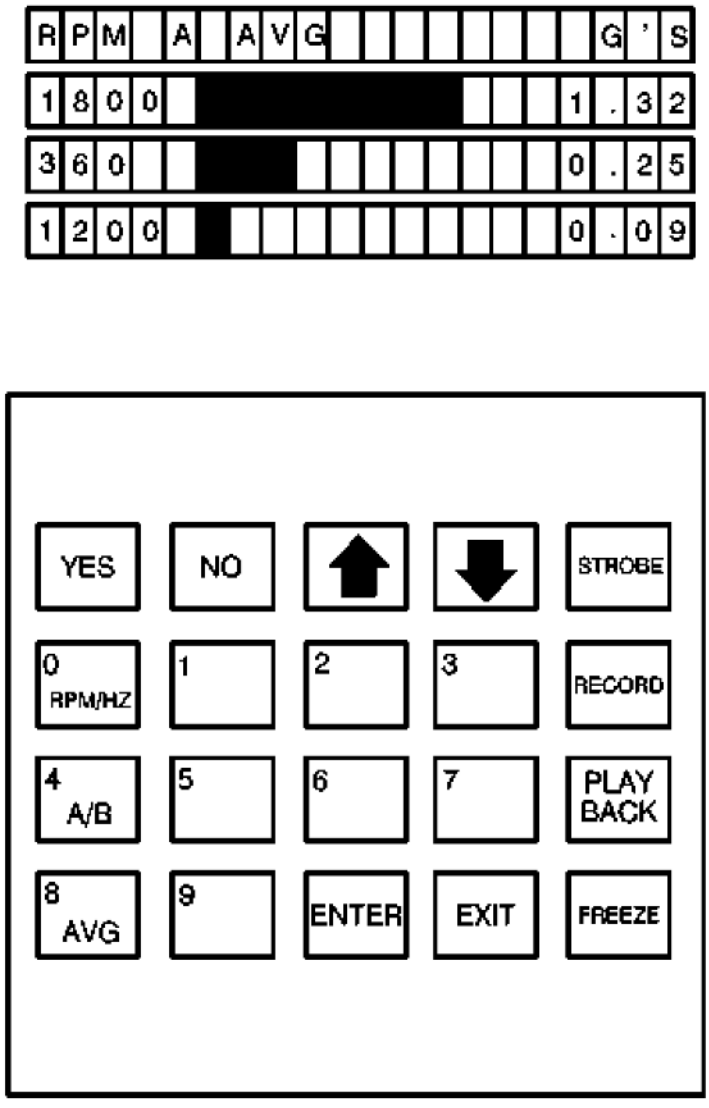


Fig. 54: View Of EVA Display
Courtesy of GENERAL MOTORS CORP.

The most dominant input frequencies, up to three, received from the **GE-38792-A:** Electronic Vibration Analyzer 2 (EVA 2) vibration sensor, are displayed in descending order of amplitude strength.

The frequency readings are displayed along the left side of the screen, followed to the right by either a bar graph or the suspected source of the vibration - depending upon the mode selected, then the amplitude reading for each frequency along the right side of the screen. The top row of the screen indicates the units of measure being

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displayed for the frequencies along the left side and for the amplitudes along the right side. The top row also indicates the vibration sensor input port which was selected on the keypad (A or B) and which mode was selected: averaging or non-averaging (instantaneous).

The frequency(ies) can be displayed in either revolutions per minute (RPM) or revolutions per second; Hertz (Hz). The selected display type (RPM or Hz) will be indicated at the left side of the screen, above the frequency readings.

When the AUTO MODE function is not in use, a bar graph is displayed next to each frequency to provide a quick visual indication of the relative amplitude strength.

When the AUTO MODE function is being used, the suspected source of the vibration is displayed next to each frequency to provide support to the diagnostic process.

The actual amplitude strength of each frequency is displayed at the right side of the screen and shown in G's-of-acceleration force.

VIBRATE SOFTWARE DESCRIPTION AND OPERATION

The **GE-38792-VS:** Vibrate Software, is a computer software program which is designed to be used in support of the Vibration Analysis diagnostic tables, along with the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2, and a scan tool, to help in determining the source of a vibration concern. The **GE-38792-VS:** Vibrate Software is designed to provide quick calculations and produce a chart of the rotational speeds and frequency ranges for specific vehicle systems and components, based upon vehicle data parameters inputted by the user.

The **GE-38792-VS:** Vibrate Software uses the vehicle data parameters, such as axle ratio, number of engine cylinders, etc. to create the base chart, depicting the relationships of the various vehicle systems and/or components. The chart view can be modified to show data related to vehicle speed only, engine speed only, or both vehicle speed and engine speed. The user can then plot the dominant frequency reading obtained on the **GE-38792-A:** Electronic Vibration Analyzer (EVA) 2 which correlates with the vibration concern, and the engine RPM obtained on a scan tool which correlates with the concern. Once these pieces of data are correctly plotted, the chart will point to the source of the vibration concern, which should confirm the results obtained through the Vibration Analysis diagnostic tables.

REED TACHOMETER DESCRIPTION

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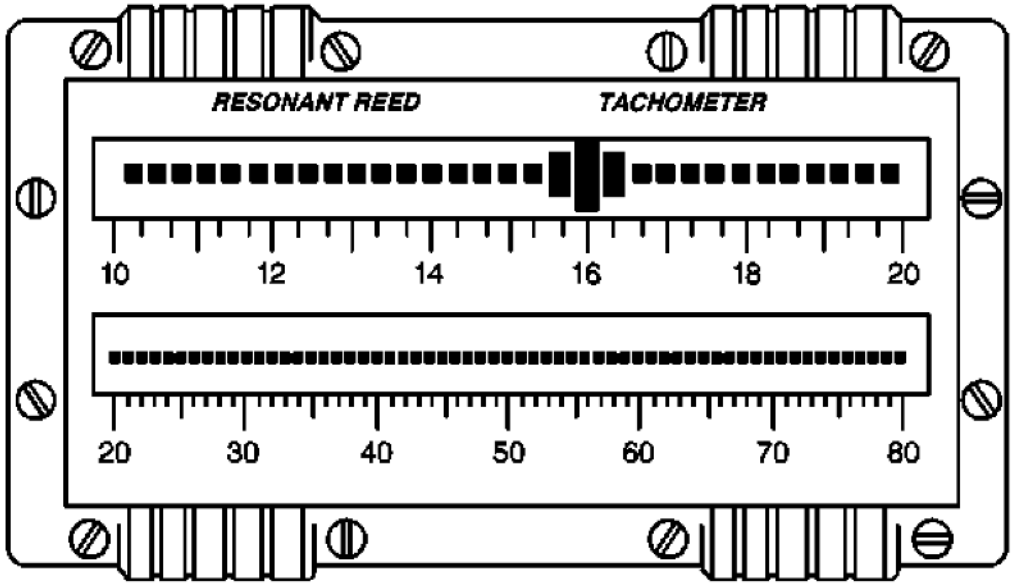


Fig. 55: Identifying Reed Tachometer
Courtesy of GENERAL MOTORS CORP.

The reed tachometer consists of 2 rows of reeds arranged side-by-side. Each reed is tuned to vibrate or resonate when it is excited by a specific frequency. The reeds are arranged by their specific resonant frequency, increasing from left to right, ranging from 10-80 Hz. This arrangement allows for a visual display of the most dominate frequencies which fall within this range.

The reed tachometer can be a helpful diagnostic tool, however it is extremely sensitive to external inputs that are not related to the vibration concern, such as rough road surfaces, etc., and it is difficult to master its use. Due to these conditions, the reed tachometer has limited diagnostic capability.

Due to the limited diagnostic capability, limited availability and increasing costs of the reed tachometer, it is NOT recommended as the primary tool to use in diagnosing a vibration concern.

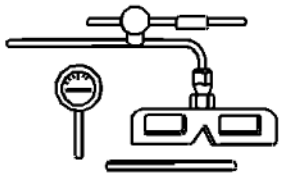
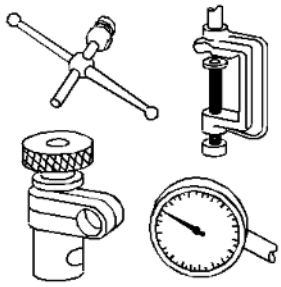
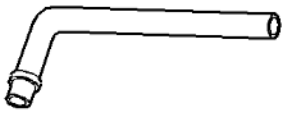
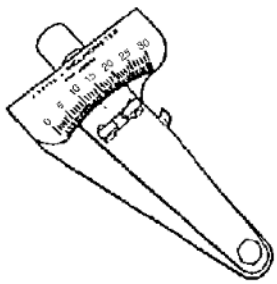
When diagnosing a vibration concern, use the **J-38792-A:** Electronic Vibration Analyzer (EVA) 2. The **J-38792-A:** Electronic Vibration Analyzer (EVA) 2 has been designed to overcome the shortcomings to the reed tachometer. Refer to **Electronic Vibration Analyzer (EVA) Description and Operation**.

SPECIAL TOOLS AND EQUIPMENT

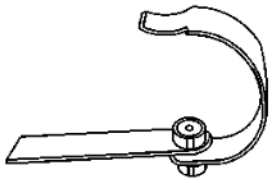
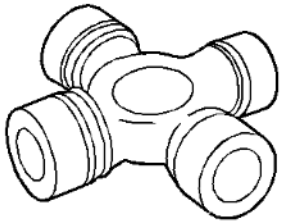
SPECIAL TOOLS AND EQUIPMENT

Illustration	Tool Number/Description

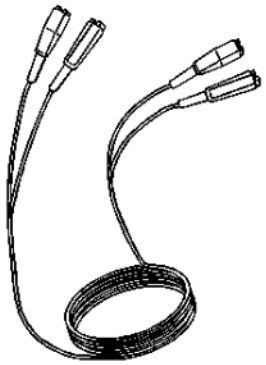
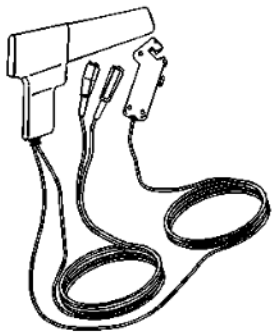
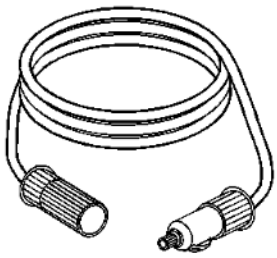
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	J 7872 Magnetic Base Dial Indicator Set
	J 8001 Dial Indicator Set
	J 23409 Dial Indicator Extension - 7 5/8 in
	J 23498-A Driveshaft Inclinometer
	J 23498-20 Driveshaft Inclinometer Adapter

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	J 35819 Flange Runout Gauge
	J 38792-A Electronic Vibration Analyzer 2
	J 38792-VS Vibrate Software

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	J 38792-20 20-Foot Timing Light Power Cord Extension
	J 38792-25 Inductive Pickup Timing Light
	J 38792-27 6-Foot EVA Power Cord Extension

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