Back To Article

GENERAL INFORMATION

Anti-Lock Brake Safety Precautions

* PLEASE READ THIS FIRST *

This article is intended for general information purposes only. This information may not apply to all makes and models. If vehicle is equipped with Anti-Lock Brake System (ABS), refer to appropriate ANTI-LOCK BRAKE SYSTEM article in the BRAKES section for description, operation, depressurizing, testing, system bleeding, trouble shooting and servicing of specific system.

ANTI-LOCK BRAKE SAFETY PRECAUTIONS

WARNING: Failure to depressurize ABS could lead to physical injury.

- NEVER open a bleeder valve or loosen a hydraulic line while ABS is pressurized.
- NEVER disconnect or reconnect any electrical connectors while ignition is on. Damage to ABS control unit may result.
- **DO NOT** attempt to bleed hydraulic system without first referring to the appropriate ANTI-LOCK BRAKE SYSTEM article in the BRAKES section.
- Only use specially designed brake hoses/lines on ABS equipped vehicles.
- **DO NOT** tap on speed sensor components (sensor, sensor rings). Sensor rings must be pressed into hubs, NOT hammered into hubs. Striking these components can cause demagnetization or a loss of polarization, affecting the accuracy of the speed signal returning to the ABS control unit.
- **DO NOT** mix tire sizes. Increasing the width, as long as tires remain close to the original diameter, is acceptable. Rolling diameter must be identical for all 4 tires. Some manufacturers recommend tires of the same brand, style and type. Failure to follow this precaution may cause inaccurate wheel speed readings.
- **DO NOT** contaminate speed sensor components with grease. Only use recommended coating, when system calls for an anti-corrosion coating.
- When speed sensor components have been removed, ALWAYS check sensor-to-ring air gaps when applicable. These specifications can be found in each appropriate article.
- ONLY use recommended brake fluids. **DO NOT** use silicone brake fluids in an ABS equipped vehicle.
- When installing transmission devices (CB's, telephones, etc.) on ABS equipped vehicles, **DO NOT** locate the antenna near the ABS control unit (or any control unit).
- Disconnect all on-board computers, when using electric welding equipment.
- **DO NOT** expose the ABS control unit to prolonged periods of high heat (185 Â°F/85Â°C for 2 hours is generally considered a maximum limit).

cardiagn.com

Back To Article

GENERAL INFORMATION

Clutch Trouble Shooting

* PLEASE READ THIS FIRST *

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

ALL MODELS

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

CLUTCH TROUBLE SHOOTING

Problem & Possible Cause	Action
Clutch Chatters/Grabs	
Incorrect Pedal Adjustment	Adjust Free Play
Worn Input Shaft Spline	Replace Input Shaft
Binding Pressure Plate	Replace Pressure Plate
Binding Throw-Out Lever	Check Throw-Out Lever, Check Throw-Out Bearing, Check Bearing Retainer
Uneven Pressure Plate Contact With Flywheel	Align/Replace Worn Parts
Transmission Misaligned	Align Transmission
Worn Pressure Plate	Replace Clutch Assembly
Oil-Saturated Disc	Replace Clutch Assembly, Repair Oil Leak
Loose Engine Mounts	Replace Engine Mounts
Clutch Pedal Sticks Down	
Clutch Cable Binding	Replace Clutch Cable
Weak Pressure Plate Springs	Replace Clutch Assembly
Binding Clutch Linkage	Lubricate Linkage
Broken Clutch Pedal Return Spring	Replace Return Spring
Clutch Will Not Release	
Oil-Saturated Disc	Replace Clutch Assembly, Repair Oil Leak
Defective Disc Face	Replace Clutch Assembly
Disc Sticking on Input Shaft Splines	Replace Disc/Input Shaft
Binding Pilot Bearing	Replace Pilot Bearing
Faulty Clutch Master Cylinder	Replace Master Cylinder

Problem & Possible Cause	Action
Faulty Clutch Slave Cylinder	Replace Slave Cylinder
Blown Clutch Hose	Replace Hose
Sticky Throw-Out Bearing Sleeve	Clean/Lube Sleeve
Clutch Cable Binding	Replace Clutch Cable
Broken/Loose Bellhousing	Check Bellhousing
Rattling/Squeaking	
Broken Throw-Out Lever Return Spring	Replace Return Spring
Faulty Throw-Out Bearing	Replace Throw-Out Bearing
Faulty Clutch Disc	Replace Clutch Disc
Faulty Pilot Bearing	Replace Pilot Bearing
Worn Throw-Out Bearing	Replace Throw-Out Bearing
Dry Bearing Retainer Slide For Throw-Out Bearing Sleeve	Lubricate Slide
Slipping	
Faulty Pressure Plate	Replace Clutch Assembly
Worn Clutch Disc	Replace Clutch Assembly
Incorrect Alignment	Realign Clutch Assembly
Faulty Clutch Slave Cylinder	Replace Slave Cylinder
No Pedal Pressure	
Leaky Hydraulic System	Check Clutch Master Cylinder, Check Clutch Slave Cylinder
	Check Clutch Hose
Broken Clutch Cable	Replace Clutch Cable
Faulty Throw-Out Lever	Replace Throw-Out Lever
Broken Clutch Linkage	Repair Clutch Linkage
Noisy Clutch Pedal	
Faulty Safety Switch	Check/Replace Switch
Noisy Self-Adj. Ratchet	Replace Ratchet
Dry Throw-Out Bearing	Replace Throw-Out Bearing
Dry Pilot Bearing	Replace Pilot Bearing
Worn Input Shaft	Replace Input Shaft

cardiagn.com

Back To Article

GENERAL INFORMATION

Commonly Used Abbreviations

* PLEASE READ THIS FIRST *

NOTE: **This article is intended for general information purposes only. This information may not apply to all makes and models. Not all abbreviations are covered as manufacturers add new ones every day.**

"A"

A

Amperes

ABS

Anti-Lock Brakes

ABRS

Air Bag Restraint System

AC

Alternating Current

A/C

Air Conditioning

ACCS

A/C Cycling Switch

ACCUM

Accumulator

ACCY

Accessory

ACT

Air Charge Temperature Sensor

ADJ

Adjust or Adjustable

ADV

Advance

AFS

Airflow Sensor

cardiagn.com

AI

Air Injection

AIR or A.I.R.

Air Injection Reactor

AIS

Air Injection System

Alt.

Alternator or Altitude

Amp./amp/amps

Ampere

ASCS

Air Suction Control Solenoid

ASD

Auto Shutdown

ASDM

Air Bag System Diagnostic Module

ASV

Air Suction Valve

A/T

Automatic Transmission/Transaxle

ATC

Automatic Temperature Control

ATDC

After Top Dead Center

ATF

Automatic Transmission Fluid

ATS

Air Temperature Sensor

Aux.

Auxiliary

Avg.

Average

AXOD

cardiagn.com

Automatic Transaxle Overdrive (Ford Models Only)

"B"

BAC

By-Pass Air Control

BAP

Barometric Absolute Pressure Sensor

BARO

Barometric

Batt.

Battery

Bbl.

Barrel (Example: 4-Bbl.)

BCM

Body Control Module

BHP

Brake Horsepower

BMAP

Barometric and Manifold Absolute Pressure Sensor

BOO

Brake On-Off Switch

B/P

Backpressure

BPS

Barometric Pressure Sensor

BPT

Backpressure Transducer

BTDC

Before Top Dead Center

BTSI

Brake Transmission Shift Interlock

BTU

British Thermal Unit

BVSV

cardiagn.com

Bimetallic Vacuum Switching Valve

"C"

Â° C

Celsius (Degrees)

Calif.

California

CANP

Canister Purge

CARB

California Air Resources Board

CAT

Catalytic Converter

CB

Circuit Breaker

CBD

Closed Bowl Distributor

cc

cubic centimeter

CCC

Close Coupled Catalyst

CCC

Computer Command Control

CCD

Computer Controlled Dwell

CCOT

Cycling Clutch Orifice Tube

CCW

Counterclockwise

CDI

Capacitor Discharge Ignition

CEC

Computerized Engine Control

CID

cardiagn.com

Cubic Inch Displacement

cm

Centimeter

CMP

Camshaft Position Sensor

CO

Carbon Monoxide

CO_2

Carbon Dioxide

Cont.

Continued

CONV

Convertible

CP

Canister Purge

CKP

Crankshaft Position Sensor

CTS

Coolant Temperature Sensor

Cu. In.

Cubic Inch

CVC

Constant Vacuum Control

CV

Check Valve or Constant Velocity

CW

Clockwise

CYL or Cyl.

Cylinder

C^3 I

Computer Controlled Coil Ignition

C^4

Computer Controlled Catalytic Converter

cardiagn.com

"D"

"D"

Drive

DC

Direct Current Or Discharge

DDD

Dual Diaphragm Distributor

Def.

Defrost

Defog.

Defogger

DERM

Diagnostic Energy Reserve Module

DFI

Digital Fuel Injection

Diag.

Diagnostic

DTC

Diagnostic Trouble Code

DIC

Driver Information Center

DIS

Distributorless Ignition System

DIST

Distribution

DLC

Data Link Connector

DOC

Diesel Oxidation Catalyst

DOHC

Double Overhead Cam

DOT

Department of Transportation

cardiagn.com

DPF

Diesel Particulate Filter

DRB-II

Diagnostic Readout Box

DVOM

Digital Volt-Ohmmeter

"E"

EACV

Electric Air Control Valve

EATX

Electronic Automatic Transaxle

EBCM

Electronic Brake Control Module

EBL

Electronic Back Light

ECM

Engine Control Module

ECT

Engine Coolant Temperature Sensor

EDIS

Electronic Distributorless Ignition System

EEC

Electronic Engine Control

EECS

Evaporative Emission Control System

EEPROM

Electronically Erasable PROM

EFE

Early Fuel Evaporation

EGO

Exhaust Gas Oxygen Sensor

EGR

Exhaust Gas Recirculation

cardiagn.com

EOT

Engine Oil Temperature

ESA

Electronic Spark Advance

ESC

Electronic Spark Control

EST

Electronic Spark Timing

EVAP

Fuel Evaporative System

EVIC

Electronic Vehicle Information Center

EVP

EGR Valve Position Sensor

EWMA

Exponentially Weighted Moving Average (MODE 6)

Exc.

Except

"F"

Â° F

Fahrenheit (Degrees)

F/B

Fuse Block

Fed.

Federal

FI

Fuel Injection

FICU

Fuel Injection Control Unit

FIPL

Fuel Injector Pump Lever

FLI

Fuel Level Indicator

cardiagn.com

FPR-VSV

Fuel Pressure Regulator Vacuum Switching Valve

Ft. Lbs.

Foot Pounds

FWD

Front Wheel Drive

"G"

g

grams

Gals.

gallons

GND or GRND

Ground

"H"

HAC

High Altitude Compensation

HC

Hydrocarbons

H/D

Heavy Duty

HO2S

Heated Exhaust Gas Oxygen Sensor

Hg

Mercury

Hgt.

Height

HLDT

Headlight

HO

High Output

HO2S

Heated Oxygen Sensor

HP

cardiagn.com

High Performance

HSC

High Swirl Combustion

HSO

High Specific Output

HTR

Heater

Hz

Hertz (Cycles Per Second)

"I"

IAC

Idle Air Control

IACV

Idle Air Control Valve

IAT

Intake Air Temperature

IC

Integrated Circuit

ID

Identification

I.D.

Inside Diameter

IFS

Independant Front Suspension

IFS

Inertia Fuel Shutoff (Ford)

Ign.

Ignition

IMRC

Intake Manifold Runner Control

In.

Inches

INCH Lbs.

cardiagn.com

Inch Pounds

in. Hg

Inches of Mercury

Inj.

Injector

IP

Instrument Panel

IRS

Independant Rear Suspension

ISC

Idle Speed Control

IVD

Interactive Vehicle Dynamics (Ford)

IVSV

Idle Vacuum Switching Valve

"J"

J/B

Junction Block

"K"

KAPWR

Keep Alive Power

k/ohms

kilo-ohms (1000 ohms)

kg

Kilograms (weight)

kg/cm^2

Kilograms Per Square Centimeter

KM/H

Kilometers Per Hour

KOEO

Key On, Engine Off

KOER

cardiagn.com

Key On, Engine Running

KS

Knock Sensor

kW

Kilowatt

kV

Kilovolt

"L"

L

Liter

lbs. (Lbs. when used in table)

Pounds

LCD

Liquid Crystal Display

L/D

Light Duty

LDP

Leak Detection Pump (Part of EVAP system.)

LED

Light Emitting Diode

LH

Left Hand

"M"

mA

Milliamps

MA or MAF

Mass Airflow

MAFS

Mass Airflow Sensor

MAP

Manifold Absolute Pressure

MAT

Manifold Air Temperature

cardiagn.com

Mem.

Memory

MEM-CAL

Memory Calibration Chip

mfd.

Microfarads

MFI

Multiport Fuel Injection

MICU

Multiplex Integrated Control Unit (Acura/Honda)

MIL

Malfunction Indicator Light

MPI

Multi-Point (Fuel) Injection

mm

Millimeters

MPH

Miles Per Hour

mV

Millivolts

"N"

NA

Not Available

NAC

NOx Adsorber Catalyst

NCA

No Color Available (Wiring Diagrams)

NGS

New Generation Star

N.m

Newton Meter

No.

Number

cardiagn.com

Nos.

Numbers

NOx

Oxides of Nitrogen

"O"

O_2

Oxygen

OBD

On-Board Diagnostics

OC

Oxidation Catalyst

OD

Overdrive

O.D.

Outside Diameter

OHC

Overhead Camshaft

OSS

Output Speed Sensor

O/S

Oversize

oz.

Ounce

ozs.

Ounces

"P"

"P"

Park

P/C

Printed Circuit

PCM

Powertrain Control Module

cardiagn.com

PCS

Purge Control Solenoid

PC-SOL

Purge Control Solenoid

PCV

Positive Crankcase Ventilation

PFI

Port Fuel Injection

PGM-FI

Programmed Fuel Injection

PID

Parameter Identification

PIP

Profile Ignition Pick-up

PNP

Park Neutral Position Switch

P/N

Park/Neutral

PRNDL

Park Reverse Neutral Drive Low

PROM

Programmable Read-Only Memory

psi

Pounds Per Square Inch

P/S

Power Steering

PSPS

Power Steering Pressure Switch

PTC

Positive Temperature Coefficient

PTO

Power Take-Off

Pts.

cardiagn.com

Pints

Pwr.

Power

"Q"

Qts.

Quarts

"R"

RABS

Rear Anti-Lock Brake System

RECIRC

Recirculation

RH

Right Hand

RPM

Revolutions Per Minute

RWAL

Rear Wheel Anti-Lock Brake

RWD

Rear Wheel Drive

"S"

SAS

Steering Angle Sensor

SBC

Single Bed Converter

SBEC

Single Board Engine Controller

SDARS

Satellite Digital Audio Radio Service

SES

Service Engine Soon

SFI

Sequential (Port) Fuel Injection

cardiagn.com

SIL

Shift Indicator Light

SIR

Supplemental Inflatable Restraint

SOHC

Single Overhead Cam

SOL or Sol.

Solenoid

SPFI

Sequential Port Fuel Injection

SPK

Spark Control

SPOUT

Spark Output

SRI

Service Reminder Indicator

SRS

Supplemental Restraint System (Air Bag)

STAR

Self-Test Automatic Readout

STO

Self-Test Output

SUB-O_2

Sub Oxygen Sensor

Sw.

Switch

Sys.

System

"T"

TAB

Thermactor Air By-Pass

TAC

Throttle Actuator Module

cardiagn.com

TAD

Thermactor Air Diverter

TBC

Body Control Module (General Motors)

TBI

Throttle Body Injection

TCC

Torque Converter Clutch

TDC

Top Dead Center

Temp.

Temperature

TFI

Thick Film Ignition

THERMAC

Thermostatic Air Cleaner

TPM

Tire Pressure Monitor

TPMS

Tire Pressure Monitor System

TPS

Throttle Position Sensor/Switch

TS

Temperature Sensor

TV

Thermovalve

TWC

Three-Way Catalyst

"V"

V

Valve

Vac.

Vacuum

cardiagn.com

VAF

Vane Airflow

VAPS

Variable Assist Power Steering

VCC

Viscous Converter Clutch

VCRM

Variable Control Relay Module

VIN

Vehicle Identification Number

VM

Vacuum Modulator

Volt.

Voltage

VOM

Volt-Ohmmeter (Analog)

VRV

Vacuum Regulator Valve

VSS

Vehicle Speed Sensor

VSV

Vacuum Switching Valve

"W"

W/

With

W/O

Without

WAC

Wide Open Throttle A/C Switch

WOT

Wide Open Throttle

cardiagn.com

cardiagn.com

Back To Article

2018 GENERAL INFORMATION

Dangers, Warnings, And Cautions - Equinox & Terrain

INTRODUCTION

DEFINITION OF DANGER, WARNING, CAUTION, AND NOTE

The diagnosis and repair procedures in GM service information 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 information. 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, 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

Cardiagn.com

- 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. In addition when grinding aluminum components, always use an extraction system to remove high dust concentration due to risk of explosion.**

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 must be OFF with the key removed, and all electrical loads must be OFF before servicing any electrical component. Disconnect the negative battery cable 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 OnStarÂ® (UE1) with Back Up Battery:

The Back Up Battery is a redundant power supply to allow limited OnStarÂ® functionality in the event of a main vehicle battery power disruption to the VCIM (OnStarÂ® module). Do not disconnect the main vehicle battery or remove the OnStarÂ® fuse with the ignition key in any position other than OFF. Retained accessory power should be allowed to time out or be disabled (simply opening the driver door should disable retained accessory power) before disconnecting power. Disconnecting power to the OnStarÂ® module in any way while the ignition is On or with retained accessory power activated may cause activation of the OnStarÂ® Back-Up Battery 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 back-up battery is not rechargeable and once activated the back-up battery must be replaced.

BRAKE DUST WARNING

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

- **Do not grind brake linings.**

carmagn.com

- 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.

CLEANING SOLVENT WARNING

WARNING: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

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.

DIESEL/GASOLINE VAPORS WARNING

WARNING: Fuel/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.

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.

FUEL AND EVAPORATIVE EMISSION PIPE WARNING

carmagn.com

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

- Replace all nylon fuel pipes that are nicked, scratched or damaged during installation, do not attempt to repair the sections of the nylon fuel pipes
- Do not hammer directly on the fuel harness body clips when installing new fuel pipes. Damage to the nylon pipes may result in a fuel leak.
- Always cover nylon vapor pipes with a wet towel before using a torch near them. Also, never expose the vehicle to temperatures higher than 115Â°C (239Â°F) for more than one hour, or more than 90Â°C (194Â°F) for any extended period.
- Apply a few drops of clean engine oil to the male pipe ends before connecting fuel pipe fittings. This will ensure proper reconnection and prevent a possible fuel leak. (During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.)

FUEL PIPE FITTING WARNING

WARNING: Always apply a few drops of clean engine oil to the male pipe ends before connecting the fuel pipe fittings. This will ensure proper reconnection and prevent a possible fuel leak. Always replace O-rings.

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

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

LIFTGATE HYDRAULIC SYSTEM WARNING

WARNING: When a liftgate hydraulic system component is removed, installed or disconnected, provide alternate support to avoid the possibility of damage to the vehicle, liftgate hydraulic system, or personal injury.

cardesign.com

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.**

PARKING BRAKE AND DRIVE WHEELS WARNING

WARNING: **Apply the parking brake and block the drive wheels before performing this procedure in order to prevent bodily 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.**

R-1234YF PROPER SERVICE PROCEDURES WARNING

WARNING: ***For personal safety, proper service procedure and refrigerant handling guidelines reference the applicable SAE standards when servicing vehicles equipped with R-1234yf refrigerant systems. Reference SAE J639, SAE J2845, SAE J2842, SAE J2843 & SAE J2851. Failure to follow these precautions may cause personal injury and/or damage to the vehicle or its components.***

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.**

SAE J2913 CERTIFIED ELECTRONIC LEAK DETECTORS WARNING

WARNING: **Technicians must only use a SAE J2913 certified electronic leak detector when checking for leaks in an R-1234yf A/C refrigerant system. Other, non - certified, leak detection devices could serve as ignition sources in the presence of hydrocarbons or other flammable refrigerants. Failure to follow these precautions may cause personal injury and/or damage to the vehicle or its components.**

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.**

SAFETY GOGGLES AND FUEL WARNING

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

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 appropriate country, regional 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 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 Master Electrical Components List 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.**

TORQUE-TO-YIELD FASTENER WARNING

WARNING: **This vehicle is equipped with torque-to-yield or single use fasteners. Install a NEW torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fasteners could cause damage to the vehicle, component, or bodily injury.**

WINDOW RETENTION WARNING

WARNING: **When replacing stationary windows, use a urethane adhesive system meeting GM Specification, 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.**
  - **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.**

cardiagn.com

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.

CLEAN, DRY, LOW PRESSURE GAS SOURCE CAUTION

CAUTION: Use the Evaporative Emission (EVAP) System Tester GE 41413-A in order to provide a clean, dry, low pressure nitrogen gas source. Do not substitute any other pressurized source, gas or otherwise. Damage may result to the EVAP system, test equipment or cause a safety risk.

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.

COLLISION REPAIR ANCHORING CAUTION

CAUTION: Proper anchoring of the vehicle is required before pulling on the vehicle structure. The vehicle must be properly anchored at all four corners of the passenger compartment, to keep the HV battery pack from being damaged during the repair. Removal of the HV battery pack is recommended, if the vehicle can not be properly anchored.

COMPONENT FASTENER TIGHTENING CAUTION

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.

COMPRESSOR HOSE CLEARANCE TO THE EXHAUST GAS CIRCULATION PIPE CAUTION

CAUTION: The compressor hose must maintain a minimum clearance of 20 mm (0.8 in) from the exhaust gas recirculation (EGR) pipe. If this minimum clearance is not maintained, damage to the compressor hose may result.

CRANKSHAFT POSITION SENSOR RELUCTOR RING CAUTION

CAUTION: Do not allow the crankshaft position sensor reluctor ring to come into contact with external magnetic fields or sharp metal objects. Do not drop the crankshaft position sensor reluctor ring. Do not damage the rubberized encoder track. Failure to follow these precautions may cause damage to the component.

cardiagn.com

EN-47632 CLEANING TOOL ROTATION CAUTION

CAUTION: **Always rotate the EN-47632 cleaning tool in a clockwise direction. Counter-clockwise rotation of the cleaning tool could loosen the lower part of the cleaning tool which could fall into the combustion chamber. Failure to follow this caution could result in engine damage or disassembly to remove tool parts.**

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

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**

FUEL CONTAMINATION CAUTION

CAUTION: **Clean all fuel pipe and hose connections and surrounding areas before disassembling to avoid possible contamination of the fuel system. Spray the fuel pump module cam-lock ring tang with penetrating oil prior to attempting removal.**

HEATED OXYGEN AND OXYGEN SENSOR CAUTION

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

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

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

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

carsalagn.com

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

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

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.

HVAC MODULE DRAIN TUBE CAUTION

CAUTION: Always ensure the HVAC module drain tube and heater core tubes are properly installed and secure following a repair. Spillage of coolant can result in interior odors and damage to electronic components. Residual moisture/water or coolant can collect inside the HVAC module. The residual moisture/water or coolant should not contact electronic modules, electrical connections, wiring, cables or carpeting. Use clean and absorbent shop cloths to protect these components while removing and installing the HVAC module drain tube, heater core tubes, or the HVAC module. Moisture/water is a by-product of normal A/C system operation and can result in interior odors or corrosion/damage to electrical components.

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.

PIPE WRENCH POSITIONING CAUTION

CAUTION: The pipe wrench must be placed at the valve end of the steering gear and positioned up against the inner tie rod housing. Placing the pipe wrench

cardiagn.com

in any other location will cause damage to the steering gear.

R-1234YF REFRIGERANT EVAPORATOR CAUTION

CAUTION: Evaporators in vehicles equipped with R-1234yf refrigerant systems, shall never be repaired or replaced with one removed from another or salvage. Only new, SAE J2842 certified and labeled evaporator(s) shall be used as replacement parts. Failure to follow the above guidelines could result in EPA Penalties and/or fines.

SEALANT CAUTION

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-F GM Approved Terminal Release Tool Kit in order to front probe terminals. Do not use paper clips or other substitutes to probe terminals.

When using the J-35616-F GM Approved Terminal Release Tool 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-F GM Approved Terminal Release Tool Kit label on the inside of the J-35616-F GM Approved Terminal Release Tool Kit for the correct adapter along with the connector end view for terminal size.

THREE-WAY CATALYTIC CONVERTER DAMAGE CAUTION

cardiagn.com

CAUTION: **In order to avoid damaging the replacement three-way catalytic converter, correct the engine misfire or mechanical fault before replacing the three-way catalytic converter.**

TORQUE REACTION AGAINST TIMING DRIVE CHAIN CAUTION

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.**

TORQUE-TO-YIELD FASTENER CAUTION

CAUTION: **This vehicle is equipped with torque-to-yield or single use fasteners. Install a NEW torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.**

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.**

cardiagn.com

Back To Article

GENERAL INFORMATION

Drive Axle Noise Diagnosis

* PLEASE READ THIS FIRST *

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

UNRELATED NOISES

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

Some driveline trouble symptoms are also common to the engine, transmission, wheel bearings, tires and other parts of the vehicle. Make sure that cause of trouble actually is in the drive axle before adjusting, repairing, or replacing any parts.

NON-DRIVE AXLE NOISES

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

A few conditions can sound just like drive axle noise and have to be considered in pre-diagnosis. The 4 most common noises are exhaust, tires, CV/universal joints and trim moldings.

In certain conditions, the pitch of exhaust gases may sound like gear whine. At other times, it may be mistaken for a wheel bearing rumble.

Tires, especially radial and snow tires, can have a high-pitched tread whine or roar, similar to gear noise. Also, some non-standard tires with an unusual tread construction may emit a roar or whine.

Defective CV/universal joints may cause clicking noises or excessive driveline play that can be improperly diagnosed as drive axle problems.

Trim and moldings can also cause a whistling or whining noise. Ensure that none of these components are causing the noise before disassembling the drive axle.

GEAR NOISE

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

A "howling" or "whining" noise from the ring and pinion gear can be caused by an improper gear pattern, gear damage, or improper bearing preload. It can occur at various speeds and driving conditions, or it can be continuous.

Before disassembling axle to diagnose and correct gear noise, make sure that tires, exhaust, and vehicle trim have been checked as possible causes.

CHUCKLE

NOTE: **This is GENERAL information. This article is not intended to be specific**

carldiagn.com

to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

This is a particular rattling noise that sounds like a stick against the spokes of a spinning bicycle wheel. It occurs while decelerating from 40 MPH and usually can be heard until vehicle comes to a complete stop. The frequency varies with the speed of the vehicle.

A chuckle that occurs on the driving phase is usually caused by excessive clearance due to differential gear wear, or by a damaged tooth on the coast side of the pinion or ring gear. Even a very small tooth nick or a ridge on the edge of a gear tooth is enough to cause the noise.

This condition can be corrected simply by cleaning the gear tooth nick or ridge with a small grinding wheel. If either gear is damaged or scored badly, the gear set must be replaced. If metal has broken loose, the carrier and housing must be cleaned to remove particles that could cause damage.

KNOCK

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

This is very similar to a chuckle, though it may be louder, and occur on acceleration of deceleration. Knock can be caused by a gear tooth that is damaged on the drive side of the ring and pinion gears. Ring gear bolts that are hitting the carrier casting can cause knock. Knock can also be due to excessive end play in the axle shafts.

CLUNK

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

Clunk is a metallic noise heard when an automatic transmission is engaged in Reverse or Drive, or when throttle is applied or released. It is caused by backlash somewhere in the driveline, but not necessarily in the axle. To determine whether driveline clunk is caused by the axle, check the total axle backlash as follows:

1. Raise vehicle on a frame or twinpost hoist so that drive wheels are free. Clamp a bar between axle companion flange and a part of the frame or body so that flange cannot move.
2. On conventional drive axles, lock the left wheel to keep it from turning. On all models, turn the right wheel slowly until it is felt to be in drive condition. Hold a chalk marker on side of tire about 12" from center of wheel. Turn wheel in the opposite direction until it is again felt to be in drive condition.
3. Measure the length of the chalk mark, which is the total axle backlash. If backlash is one inch or less, clunk will not be eliminated by overhauling drive axle.

BEARING WHINE

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

Bearing whine is a high-pitched sound similar to a whistle. It is usually caused by malfunctioning pinion bearings. Pinion bearings operate at driveshaft speed. Roller wheel bearings may whine in a similar manner if they run completely dry of lubricant. Bearing noise will occur at all driving speeds. This distinguishes it from gear whine, which usually comes and goes as speed changes.

BEARING RUMBLE

NOTE: **This is GENERAL information. This article is not intended to be specific**

to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

Bearing rumble sounds like marbles being tumbled. It is usually caused by a malfunctioning wheel bearing. The lower pitch is because the wheel bearing turns at only about 1/3 of driveshaft speed.

CHATTER ON TURNS

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

This is a condition where the whole front or rear vibrates when vehicle is moving. The vibration is easily felt and heard. Extra differential thrust washers installed during axle repair can cause a condition of partial lock-up that creates the chatter.

AXLE SHAFT NOISE

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

Axle shaft noise is similar to gear noise and pinion bearing whine. Axle shaft bearing noise will normally distinguish itself from gear noise by occurring in all driving modes. Noise will persist with transmission in neutral while vehicle is moving at problem speed.

If vehicle displays this noise condition, remove suspect axle shafts and replace axle bearings. Re-evaluate vehicle for noise before removing any internal components.

VIBRATION

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

Vibration is a high-frequency trembling, shaking or grinding condition (felt or heard) that may be constant or variable in level and con occur during the total operating speed range of the vehicle.

The types of vibrations that can be felt in the vehicle can be divided into 3 main groups:

- Vibrations of various unbalanced rotating parts of the vehicle.
- Resonance vibrations of the body and frame structures caused by rotating of unbalance parts.
- Tip-in moans of resonance vibrations from stressed engine or exhaust system mounts or driveline flexing modes.

---

cardiagn.com

Back To Article

GENERAL INFORMATION

Electrostatic Discharge (ESD) Warning - Basic Information

* PLEASE READ THIS FIRST *

NOTE: **This article is intended for general information purposes only. Contents are generic in nature and all information may or may not apply to all vehicles.**

INTRODUCTION

NOTE: **This article is intended for general information purposes only. Contents are generic in nature and all information may or may not apply to all vehicles.**

All Electrostatic Discharge (ESD) sensitive components contain solid state circuits (transistors, diodes, semiconductors) that may become damaged when contacted with an electrostatic charge. The following information applies to all ESD sensitive devices. The ESD symbol shown in Fig. **Fig. 1** may be used on schematics to indicate which components are ESD sensitive. See **Fig. 1**. Although different manufactures may display different symbols to represent ESD sensitive devices, the handling and measuring precautions and procedures are the same.

cardiagn.com

cardiagn.com

Fig. 1: Sample ESD Symbol

HANDLING STATIC-SENSITIVE CIRCUITS/DEVICES

NOTE: **This article is intended for general information purposes only. Contents are generic in nature and all information may or may not apply to all vehicles.**

When handling an electronic part that is ESD sensitive, the technician should follow these guidelines to reduce any possible electrostatic charge build-up on the technician's body and the electronic part.

1. Always touch a known good ground source before handling the part. This should be repeated while handling the part and more frequently after sitting down from a standing position, sliding across the seat or walking a distance.
2. Avoid touching electrical terminals of the part, unless instructed by a diagnostic procedure.
3. DO NOT open the package of a new part until it is time to install the part.
4. Before removing the part from its package, ground the package to a known good ground source.

CHECKING STATIC-SENSITIVE CIRCUITS/DEVICES

NOTE: **This article is intended for general information purposes only. Contents are generic in nature and all information may or may not apply to all vehicles.**

1. Solid State circuits in electronic devices are shown greatly simplified in schematics. See **Fig. 2**. Due to the simplification of the electronic devices on the schematic, resistance measurements could be misleading or could lead to an electrostatic discharge. Always follow the recommended diagnostic procedure.

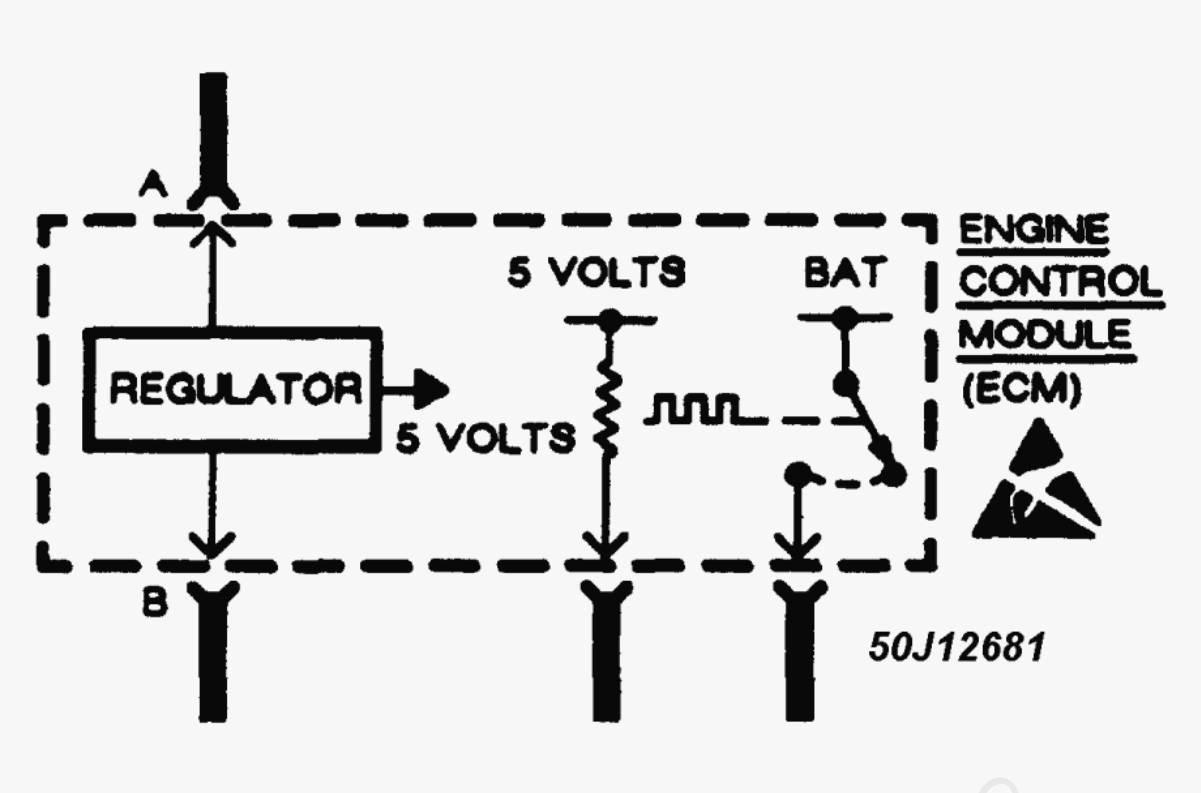


Fig. 2: Sample Schematic Showing Typical ESD Sensitive Device

2. Only measure resistance at the terminals of the devices when instructed by the recommended diagnostic procedure.
3. When using a voltmeter, be sure to connect the ground lead first.

cardiagn.com

Back To Article

GENERAL INFORMATION

Engine Displacement Conversion Table

CONVERSION TABLE

LITER/CID CONVERSION

Liter	CID
1.0	59
1.0	60
1.0	61
1.1	66
1.1	68
1.1	70
1.2	71
1.2	72
1.2	73
1.2	76
1.3	77
1.3	78
1.3	79
1.3	80
1.3	81
1.3	82
1.4	85
1.4	85
1.4	86
1.5	89
1.5	90
1.5	91
1.6	94
1.6	95
1.6	96
1.6	97
1.6	98
1.6	99
1.7	102
1.7	103
1.7	105
1.8	107
1.8	109
1.8	110
1.8	111
1.8	112
1.9	113
1.9	114
1.9	116
1.9	119
2.0	119
2.0	120
2.0	121

cardiagn.com

Liter	CID
2.0	122
2.1	125
2.1	126
2.1	128
2.1	129
2.1	130
2.1	131
2.2	132
2.2	133
2.2	134
2.2	135
2.2	136
2.2	137
2.3	138
2.3	140
2.3	141
2.3	143
2.4	143
2.4	144
2.4	145
2.4	146
2.4	147
2.4	149
2.5	150
2.5	151
2.5	152
2.5	153
2.6	155
2.6	156
2.6	157
2.6	158
2.6	159
2.7	162
2.7	163
2.7	164
2.7	167
2.8	168
2.8	170
2.8	171
2.8	173
2.9	174
2.9	179
3.0	180
3.0	181
3.0	182
3.0	183
3.0	184
3.1	191
3.1	192
3.2	193
3.2	194
3.2	195

cardigm.com

Liter	CID
3.2	196
3.2	197
3.2	198
3.3	199
3.3	200
3.3	201
3.3	204
3.4	206
3.4	207
3.4	209
3.5	210
3.5	211
3.5	212
3.5	213
3.5	214
3.5	215
3.6	219
3.6	220
3.7	225
3.7	226
3.7	229
3.8	229
3.8	230
3.8	231
3.8	232
3.8	234
3.8	238
3.9	239
3.9	240
3.9	241
4.0	241
4.0	242
4.0	243
4.0	244
4.1	250
4.1	252
4.2	255
4.2	258
4.3	259
4.3	260
4.3	262
4.3	263
4.3	266
4.4	266
4.4	267
4.4	268
4.5	273
4.5	274
4.5	276
4.6	278
4.6	279
4.6	281

cardomain.com

Liter	CID
4.6	283
4.7	284
4.7	285
4.7	287
4.7	289
4.8	290
4.8	292
4.9	300
4.9	301
4.9	302
5.0	302
5.0	304
5.0	305
5.0	307
5.1	310
5.2	315
5.2	318
5.3	326
5.4	327
5.4	328
5.4	330
5.5	334
5.5	335
5.6	340
5.6	343
5.7	345
5.7	348
5.7	350
5.8	351
5.8	352
5.9	359
5.9	360
5.9	361
5.9	362
6.0	366
6.0	368
6.1	370
6.1	372
6.2	379
6.2	381
6.3	383
6.4	389
6.4	390
6.4	392
6.5	396
6.6	400
6.6	401
6.6	402
6.6	403
6.7	410
6.8	412
6.8	413

cardomain.com

Liter	CID
6.8	414
6.8	415
6.9	420
6.9	421
7.0	425
7.0	426
7.0	427
7.0	428
7.0	429
7.0	430
7.1	432
7.2	440
7.4	454
7.5	455
7.5	460
7.6	462
8.0	488
8.2	500
8.8	534
8.8	537
8.8	538
8.9	540
9.0	549
9.1	555
9.3	568
9.3	570
9.6	588
9.8	600
9.9	605
10.0	611

carqueen.com

Back To Article

GENERAL INFORMATION

Engine Overhaul Procedures

* PLEASE READ THIS FIRST *

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

DESCRIPTION

Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of cleaning, inspection, and assembly processes are included.

ENGINE IDENTIFICATION

Engine may be identified from Vehicle Identification Number (VIN) stamped on a metal tab. Metal tab may be located in different locations depending on manufacturer. Engine identification number or serial number is located on cylinder block. Location varies with each manufacturer.

carmagn.com

INSPECTION PROCEDURES

* PLEASE READ THIS FIRST *

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

GENERAL

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Engine components must be inspected to meet manufacturer's specifications and tolerances during overhaul. Proper dimensions and tolerances must be met to obtain proper performance and maximum engine life.

Micrometers, depth gauges and dial indicator are used for checking tolerances during engine overhaul. Magnaflux, Magnaglo, dye-check, ultrasonic and x-ray inspection procedures are used for parts inspection.

MAGNETIC PARTICLE INSPECTION

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Magnaflux & Magnaglo

Magnaflux is an inspection technique used to locate material flaws and stress cracks. Component is subjected to a strong magnetic field. Entire component or a localized area can be magnetized. Component is coated with either a wet or dry material that contains fine magnetic particles.

Cracks which are outlined by the particles cause an interruption of magnetic field. Dry powder method of Magnaflux can be used in normal lighting and crack appears as a bright line.

Fluorescent liquid is used along with a Black light in the Magnaglo Magnaflux system. Darkened room is required for this procedure. The crack will appear as a glowing line. Complete demagnetizing of component upon completion is required on both procedures. Magnetic particle inspection applies to ferrous materials only.

PENETRANT INSPECTION

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Zyglo

The Zyglo process coats material with a fluorescent dye penetrant. Component is often warmed to expand cracks that will be penetrated by the dye. Using darkened room and Black light, component is inspected for cracks. Crack will glow brightly.

Developing solution is often used to enhance results. Parts made of any material, such as aluminum cylinder heads or plastics, may be tested using this process.

Dye Check

Penetrating dye is sprayed on the previously cleaned component. Dye is left on component for 5-45 minutes, depending upon material density. Component is then wiped clean and sprayed with a developing solution. Surface cracks will show up as a bright line.

ULTRASONIC INSPECTION

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process.**

Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

If an expensive part is suspected of internal cracking, ultrasonic testing is used. Sound waves are used for component inspection.

X-RAY INSPECTION

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

This form of inspection is used on highly stressed components. X-ray inspection may be used to detect internal and external flaws in any material.

PRESSURE TESTING

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Cylinder heads can be tested for cracks using a pressure tester. Pressure testing is performed by plugging all but one of the holes of cylinder head and injecting air or water into the open passage.

Leaks are indicated by the appearance of wet or damp areas when using water. When air is used, it is necessary to spray the head surface with a soap solution. Bubbles will indicate a leak. Cylinder head may also be submerged in water heated to specified temperature to check for cracks created during heat expansion.

CLEANING PROCEDURES

* PLEASE READ THIS FIRST *

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

GENERAL

NOTE: **Examples used in this article are general in nature and do not necessarily**

relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

All components of an engine do not have the same cleaning requirements. Physical methods include bead blasting and manual removal. Chemical methods include solvent blast, solvent tank, hot tank, cold tank and steam cleaning of components.

BEAD BLASTING

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Manual removal of deposits may be required prior to bead blasting, followed by some other cleaning method. Carbon, paint and rust may be removed using bead blasting method. Components must be free of oil and grease prior to bead blasting. Beads will stick to grease or oil soaked areas causing area not to be cleaned.

Use air pressure to remove all trapped residual beads from component after cleaning. After cleaning internal engine parts made of aluminum, wash thoroughly with hot soapy water. Component must be thoroughly cleaned as glass beads will enter engine oil resulting in bearing damage.

CHEMICAL CLEANING

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Solvent tank is used for cleaning oily residue from components. Solvent blasting sprays solvent through a siphon gun using compressed air.

The hot tank, using heated caustic solvents, is used for cleaning ferrous materials only. DO NOT clean aluminum parts such as cylinder heads, bearings or other soft metals using the hot tank. After cleaning, flush parts with hot water.

A non-ferrous part will be ruined and caustic solution will be diluted if placed in the hot tank. Always use eye protection and gloves when using the hot tank.

Use of a cold tank is for cleaning aluminum cylinder heads, carburetors and other soft metals. A less caustic and unheated solution is used. Parts may be left in the tank for several hours without damage. After cleaning, flush parts with hot water.

Steam cleaning, with boiling hot water sprayed at high pressure, is recommended as the final cleaning process when using either hot or cold tank cleaning.

cardiagn.com

COMPONENT CLEANING

* PLEASE READ THIS FIRST *

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

SHEET METAL PARTS

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Examples of sheet metal parts are rocker covers, front and side covers, oil pan and bellhousing dust cover. Glass bead blasting or hot tank may be used for cleaning.

Ensure all mating surfaces are flat. Deformed surfaces should be straightened. Check all sheet metal parts for cracks and dents.

INTAKE & EXHAUST MANIFOLDS

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Using solvent cleaning or bead blasting, clean manifolds for inspection. If intake manifold has an exhaust crossover, all carbon deposits must be removed. Inspect manifolds for cracks, burned or eroded areas, corrosion and damage to fasteners.

Exhaust heat and products of combustion cause threads of fasteners to corrode. Replace studs and bolts as necessary. On "V" type intake manifolds, sheet metal oil shield must be removed for proper cleaning and inspection. Ensure all manifold parting surfaces are flat and free of burrs.

CYLINDER HEAD REPLACEMENT

* PLEASE READ THIS FIRST *

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Cardiagn.com

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

REMOVAL

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Remove intake and exhaust manifolds and valve cover. Cylinder head and camshaft carrier bolts (if equipped) should be removed only when engine is cold. On many aluminum cylinder heads, removal while hot will cause cylinder head warpage. Mark rocker arm or overhead cam components for location.

Remove rocker arm components or overhead cam components. Components must be installed in original location. Individual design rocker arms may utilize shafts, ball-type pedestal mounts or no rocker arms. For all design types, wire components together and identify according to corresponding valve. Remove cylinder head bolts. Note length and location. Some applications require cylinder head bolts be removed in proper sequence to prevent cylinder head damage. See **Fig. 1**. Remove cylinder head.

INSTALLATION

carmagn.com

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Ensure all surfaces and head bolts are clean. Check that head bolt holes of cylinder block are clean and dry to prevent block damage when bolts are tightened. Clean threads with tap to ensure accurate bolt torque.

Install head gasket on cylinder block. Some manufacturers may recommend sealant be applied to head gasket prior to installation. Note that all holes are aligned. Some gasket applications may be marked so that certain area faces upward. Install cylinder head using care not to damage head gasket. Ensure cylinder head is fully seated on cylinder block.

Some applications require head bolts be coated with sealant prior to installation. This is done if head bolts are exposed to coolant passages. Some applications require head bolts be coated with light coat of engine oil.

Install head bolts. Head bolts should be tightened in proper steps and sequence to specification. See **Fig. 1**. Install remaining components. Tighten all bolts to specification. Adjust valves if required. See VALVE ADJUSTMENT.

NOTE: **Some manufacturers require that head bolts be retightened after specified amount of operation. This must be done to prevent head gasket failure.**

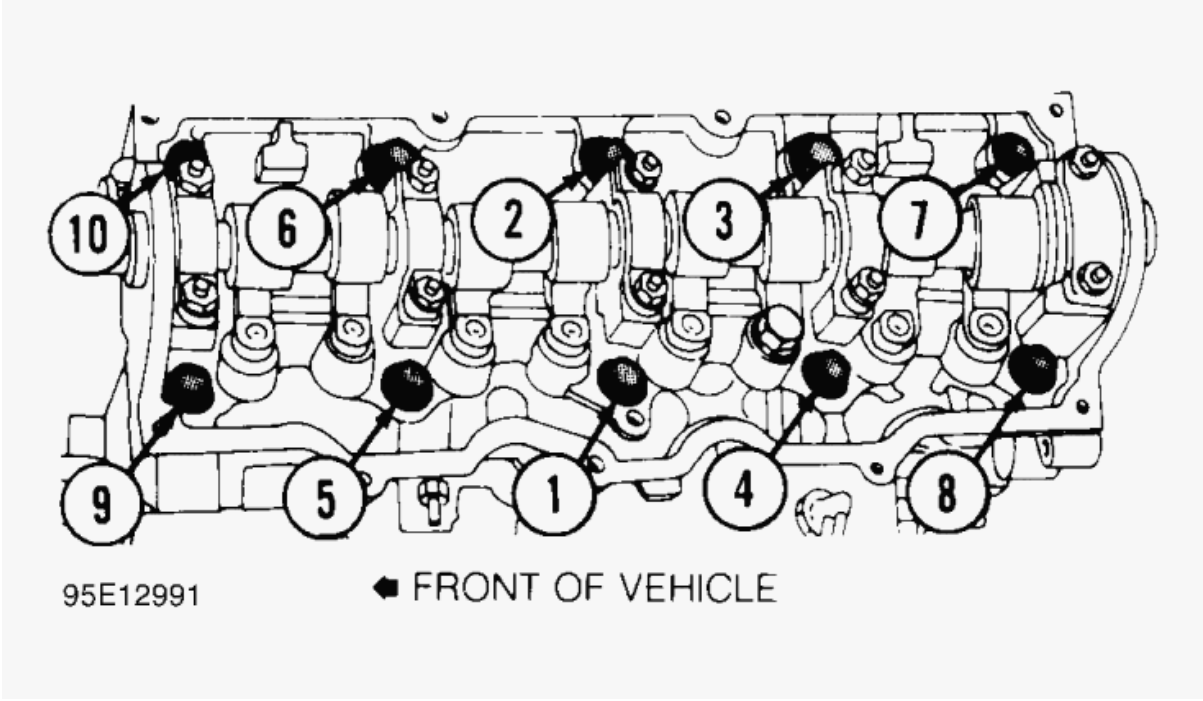


Fig. 1: Typical Cylinder Head Tightening or Loosening Sequence

VALVE ADJUSTMENT

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Engine specifications will indicate valve train clearance and temperature at which adjustment is to be made on most models. In most cases, adjustment will be made with a cold engine. In some cases, both a cold and a hot clearance will be given for maintenance convenience.

On some models, adjustment is not required. Rocker arms are tightened to specification and valve lash is automatically set. On some models with push rod actuated valve train, adjustment is made at push rod end of rocker arm while other models do not require adjustment.

Clearance will be checked between tip of rocker arm and tip of valve stem in proper sequence using a feeler gauge. Adjustment is made by rotating adjusting screw until proper clearance is obtained. Lock nut is then tightened. Engine will be rotated to obtain all valve adjustments to manufacturer's specifications.

Some models require hydraulic lifter to be bled down and clearance measured. Push rods of different length can be used to obtain proper clearance. Clearance will be checked between tip of rocker arm and tip of valve stem in proper sequence using a feeler gauge.

Overhead cam engines designed without rocker arms actuate valves directly on a cam follower. A hardened, removable disc is installed between the cam lobe and lifter. Clearance will be checked between cam heel and adjusting disc in proper sequence using a feeler gauge. Engine will be rotated to obtain all valve adjustments.

On overhead cam engines designed with rocker arms, adjustment is made at valve end of rocker arm. Ensure valve to be adjusted is riding on heel of cam on all engines. Clearance will be checked between tip of rocker arm and tip of valve stem in proper sequence using a feeler gauge. Adjustment is made by rotating adjusting screw until proper clearance is obtained. Lock nut is then tightened. Engine will be rotated to obtain all valve adjustments to manufacturer's specifications.

CYLINDER HEAD OVERHAUL

* PLEASE READ THIS FIRST *

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

CYLINDER HEAD DISASSEMBLY

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Mark valves for location. Using valve spring compressor, compress valve springs. Remove valve locks. Carefully release spring compressor. Remove retainer or rotator, valve spring, spring seat and valve. See Fig. 2.

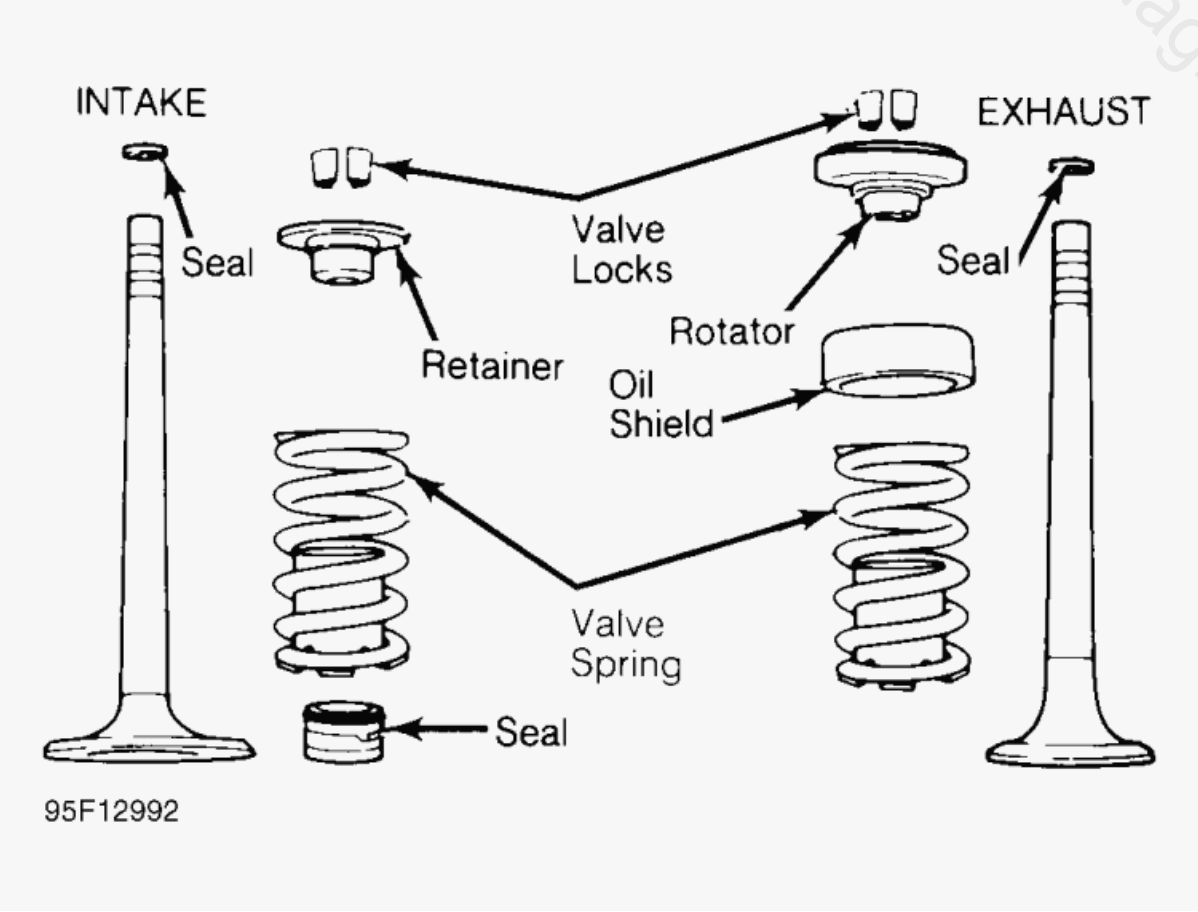


Fig. 2: Exploded View of Valve Assemblies

CYLINDER HEAD CLEANING & INSPECTION

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have**

been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Clean cylinder head and valve components using approved cleaning methods. Inspect cylinder head for cracks, damage or warped gasket surface. Place straightedge across gasket surface. Determine clearance at center of straightedge. Measure across both diagonals, longitudinal center line and across cylinder head at several points. See **Fig. 3**.

On cast iron cylinder heads, if warpage exceeds .003" (.08 mm) in a 6" span, or .006" (.15 mm) over total length, cylinder head must be resurfaced. On most aluminum cylinder heads, if warpage exceeds .002" (.05 mm) in any area, cylinder head must be resurfaced. Warpage specification may vary by manufacturer. If warpage exceeds specification on some cylinder heads, cylinder head must be replaced.

Cylinder head thickness should be measured to determine amount of material which can be removed before replacement is required. Cylinder head thickness must not be less than the manufacturer's specification.

If cylinder head required resurfacing, it may not align properly with intake manifold. On "V" type engines, misalignment is corrected by machining intake manifold surface that contacts cylinder head. Cylinder head may be machined on surface that contacts intake manifold. Using oil stone, remove burrs or scratches from all sealing surfaces.

cardiagn.com

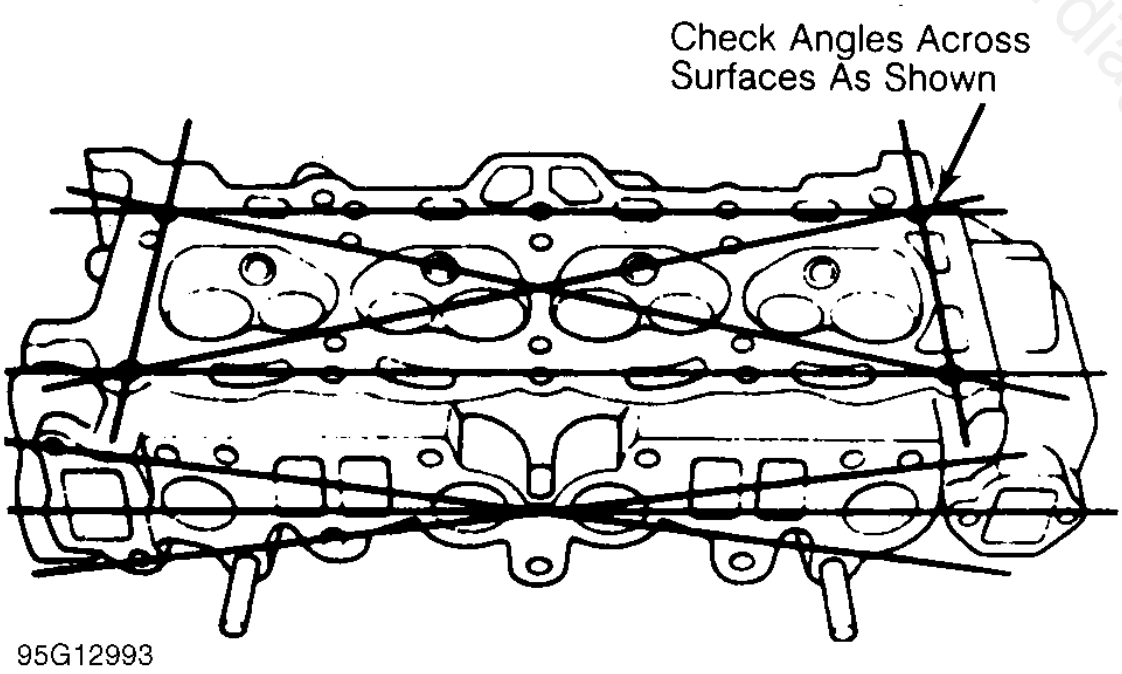


Fig. 3: Checking Cylinder Head for Warpage

VALVE SPRINGS

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Inspect valve springs for corroded or pitted valve spring surfaces which may lead to breakage. Polished spring ends caused by a rotating spring indicate that spring surge has occurred. Replace springs showing evidence of these conditions.

Inspect valve springs for squareness using a 90-degree straightedge. See **Fig. 4**. Replace valve spring if out-of-square exceeds manufacturer's specification.

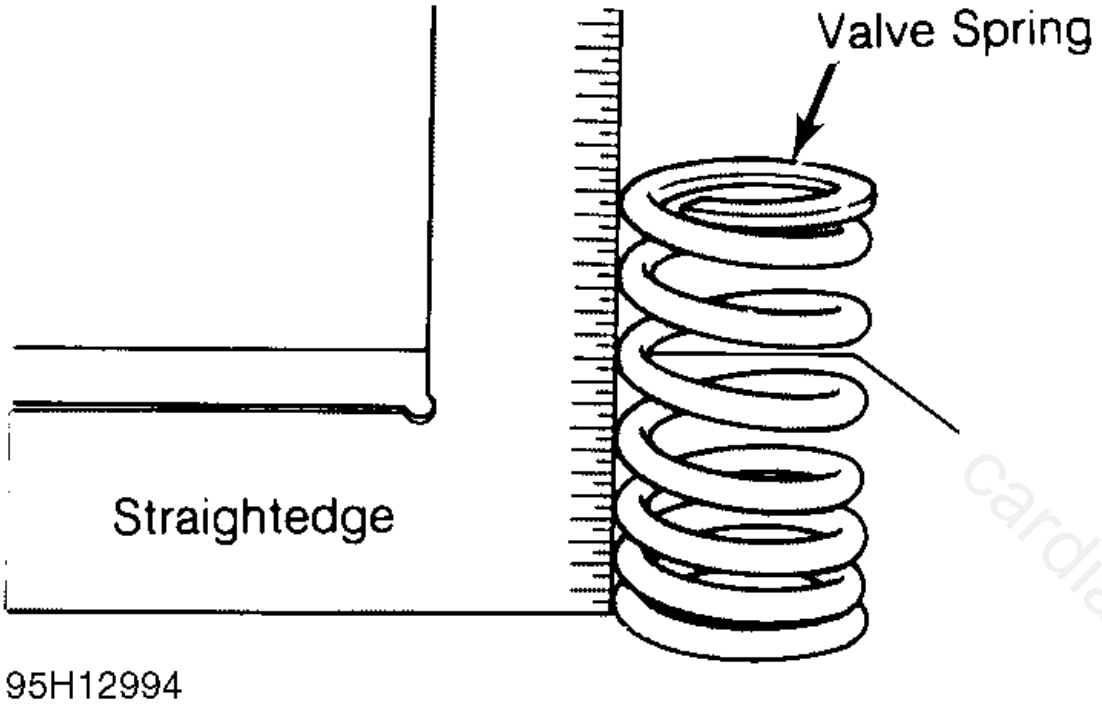
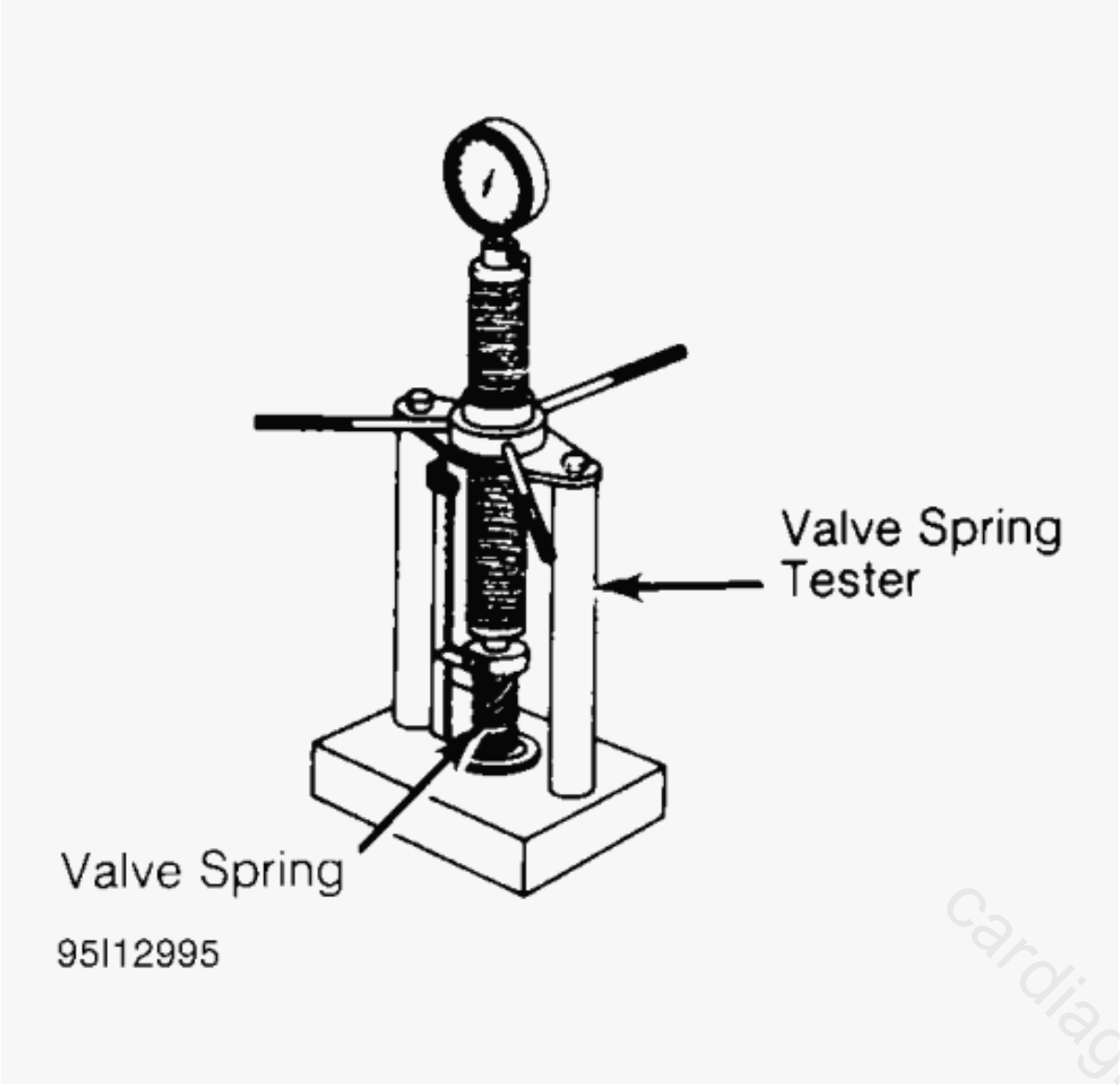


Fig. 4: Checking Valve Spring Squareness

Using vernier caliper, measure free length of all valve springs. Replace springs if not within specification. Using valve spring tester, test valve spring pressure at installed and compressed heights. See **Fig. 5**.

Usually compressed height is installed height minus valve lift. Replace valve spring if not within specification. It is recommended to replace all valve springs when overhauling cylinder head. Valve springs may need to be installed with color coded end or small coils at specified area according to manufacturer.

cardiagn.com



cardiagn.com

Fig. 5: Checking Valve Spring Pressure

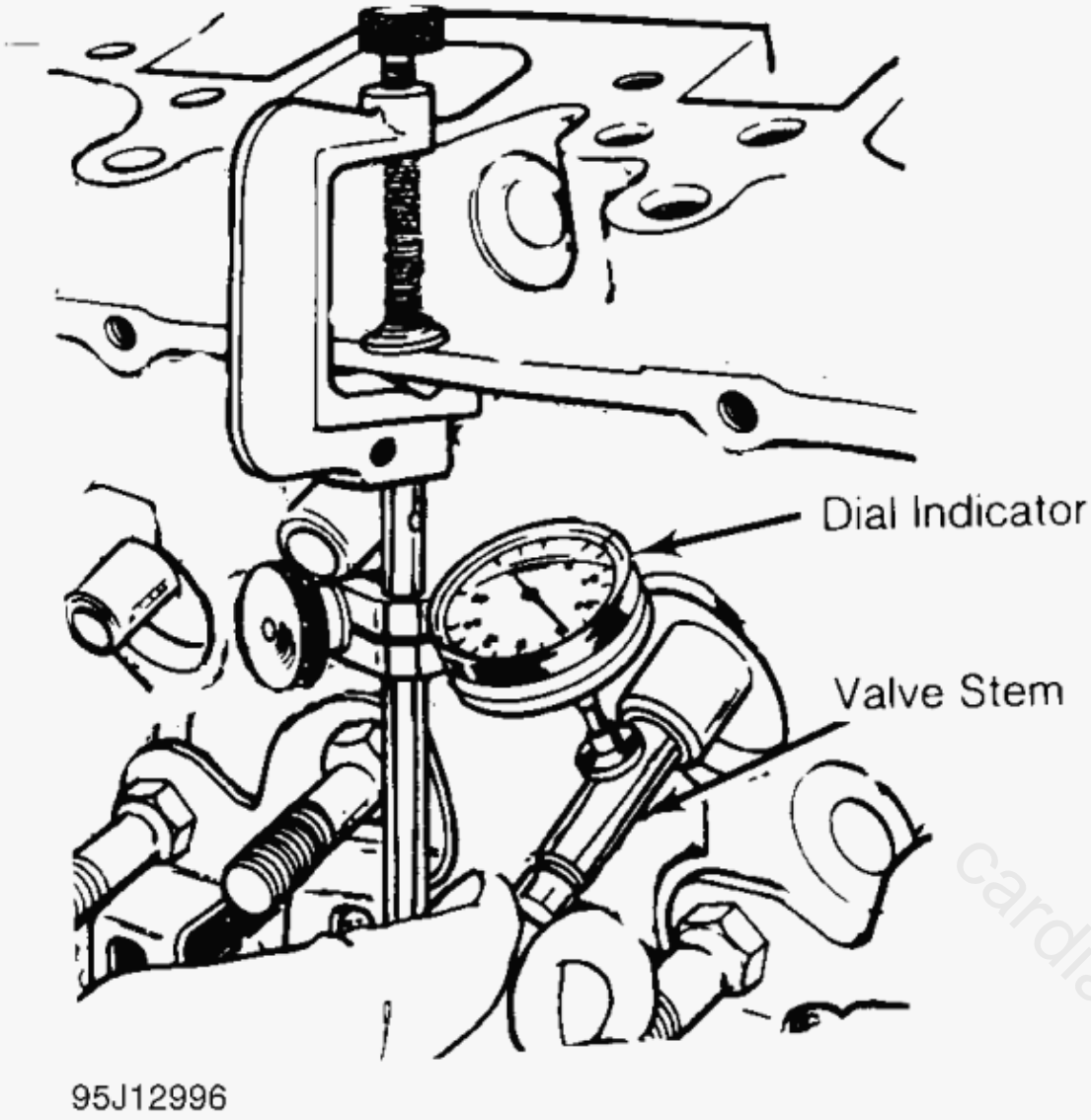
VALVE GUIDE

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Measuring Valve Guide Clearance

Check valve stem-to-guide clearance. Ensure valve stem diameter is within specification. Install valve in valve guide. Install dial indicator assembly on cylinder head with tip resting against valve stem just above valve guide. See **Fig. 6**.



cardiagn.com

Fig. 6: Measuring Valve Stem-to-Guide Clearance

Lower valve approximately 1/16" below valve seat. Push valve stem against valve guide as far as possible. Adjust dial indicator to zero. Push valve stem in opposite direction and note reading. Clearance must be within specification.

If valve guide clearance exceeds specification, valves with oversize stems may be used and valve guides are reamed to larger size or valve guide must be replaced. On some applications, a false guide is installed, then reamed to proper specification. Valve guide reamer set is used to ream valve guide to obtain proper clearance for new valve.

Reaming Valve Guide

Select proper reamer for size of valve stem. Reamer must be of proper length to provide clean cut through entire length of valve guide. Install reamer in valve guide and rotate to cut valve guide. See **Fig. 7**.

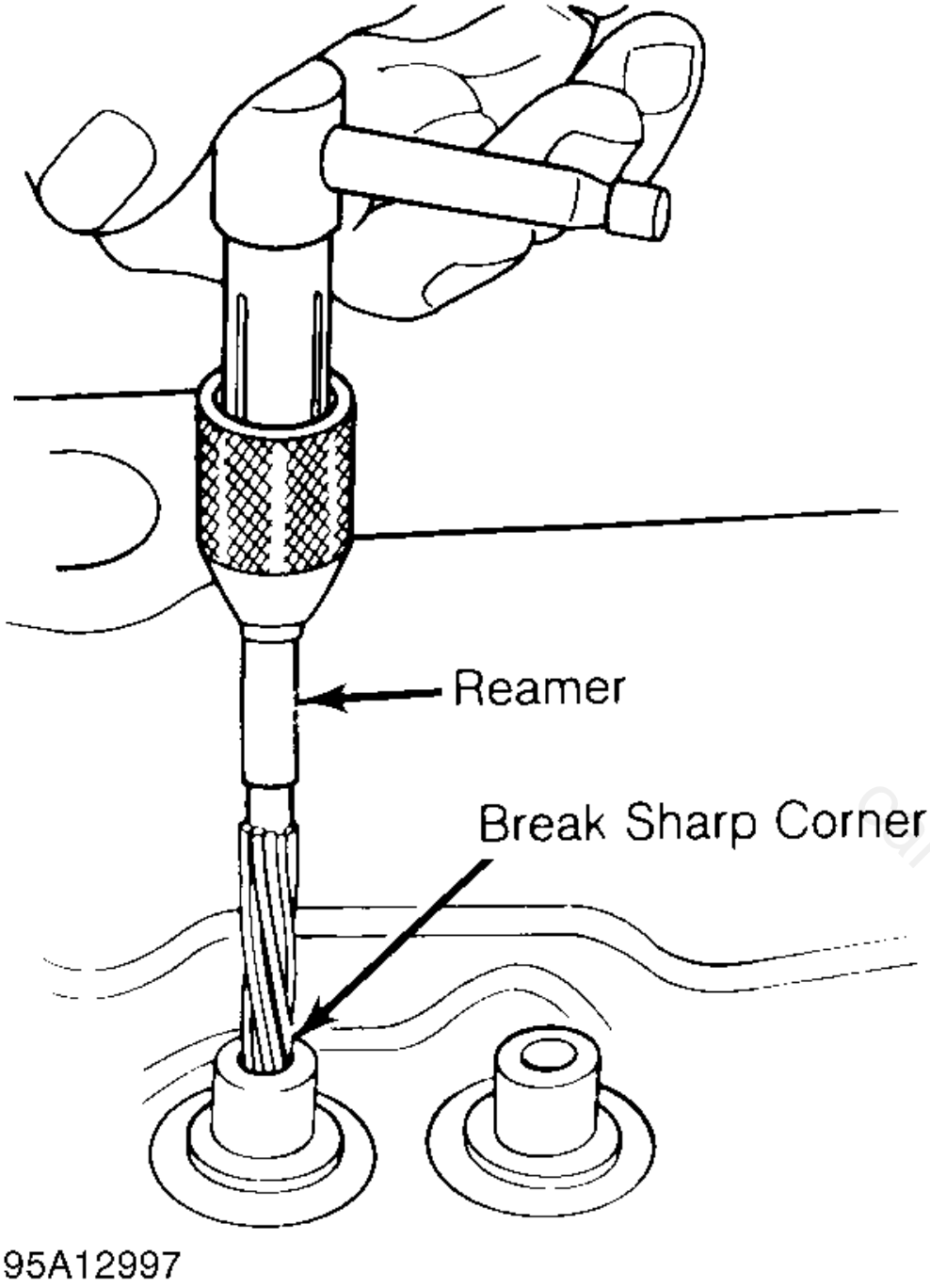


Fig. 7: Reaming Valve Guides

Replacing Valve Guide

Replace valve guide if clearance exceeds specification. Valve guides are either pressed, hammered or shrunk in place, depending upon cylinder head design and type of metal used.

Remove valve guide from cylinder head by pressing or tapping on a stepped drift. See **Fig. 8**. Once valve guide is installed, distance from cylinder head to top of valve guide must be checked. This distance must be within specification.

Aluminum heads are often heated before installing valve guide. Valve guide is sometimes cooled in dry ice prior to installation. Combination of a heated cylinder head and cooled valve guide ensures a tight guide fit upon assembly. The new guide must be reamed to specification.

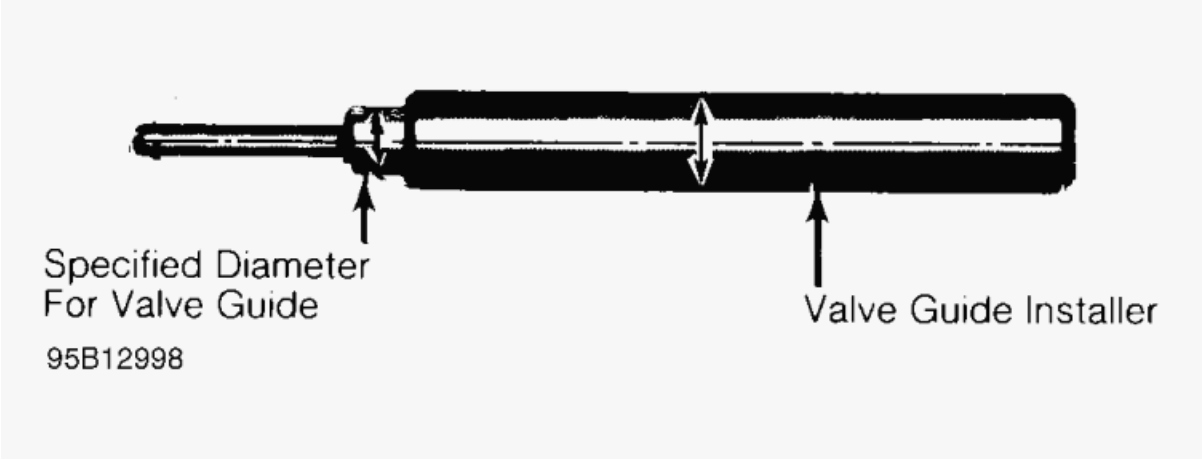


Fig. 8: Typical Valve Guide Remover & Installer

VALVES & VALVE SEATS

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Valve Grinding

Valve stem O.D. should be measured in several areas to indicate amount of wear. Replace valve if not within specification. Valve margin area should be measured to ensure that valve can be ground. See Fig. 9.

If valve margin is less than specification, the valves will be burned. Valve must be replaced. Due to minimum margin dimensions during manufacture, some new type valves cannot be reground. Some manufacturers use stellite coated valves that must NOT be machined. Valves can only be lapped into valve seat.

CAUTION: **Some valves are sodium filled. Extreme care must be used when disposing of damaged or worn sodium-filled valves.**

cardesign.com

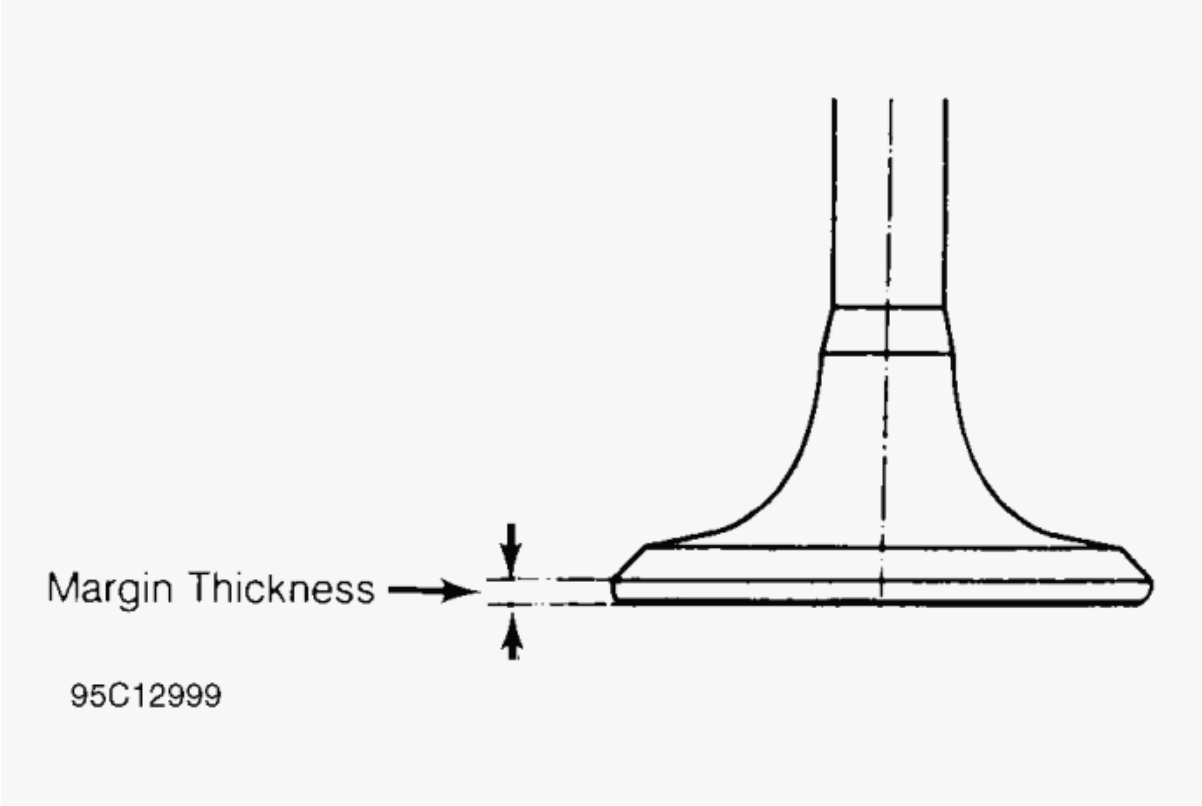


Fig. 9: Measuring Valve Head Margin

Resurface valve to proper angle specification using valve grinding machine. Follow manufacturer's instructions for valve grinding machine. Specifications may indicate a different valve face angle than seat angle. Measure valve margin after grinding. Replace valve if not within specification. Valve stem tip can be refinished using valve grinding machine.

Valve Lapping

During valve lapping of recently designed valves, be sure to follow manufacturer's recommendations. Surface hardening and materials used with some valves do not permit lapping. Lapping process will remove excessive amounts of the hardened surface.

Valve lapping is done to ensure adequate sealing between valve face and seat. Use either a hand drill or lapping stick with suction cup attached.

Moisten and attach suction cup to valve. Lubricate valve stem and guide. Apply a thin coat of fine valve grinding compound between valve and seat. Rotate lapping tool between the palms or with hand drill.

Lift valve upward off the seat and change position often. This is done to prevent grooving of valve seat. Lap valve until a smooth polished seat is obtained. Thoroughly clean grinding compound from components. Valve-to-valve seat concentricity should be checked. See **VALVE SEAT CONCENTRICITY**.

CAUTION: Valve guides must be in good condition and free of carbon deposits prior to valve seat grinding. Some engines contain an induction hardened valve seat. Excessive material removal will damage valve seats.

Valve Seat Grinding

Select coarse stone of correct size and angle for seat to be ground. Ensure stone is true and has a smooth surface. Select correct size pilot for valve guide dimension. Install pilot in valve guide. Lightly lubricate pilot shaft. Install stone on pilot. Move stone off and on the seat approximately 2 times per second during grinding operation.

Select a fine stone to finish grinding operation. Various angle grinding stones are used to center and narrow the valve seat as required. See **Fig. 10**.

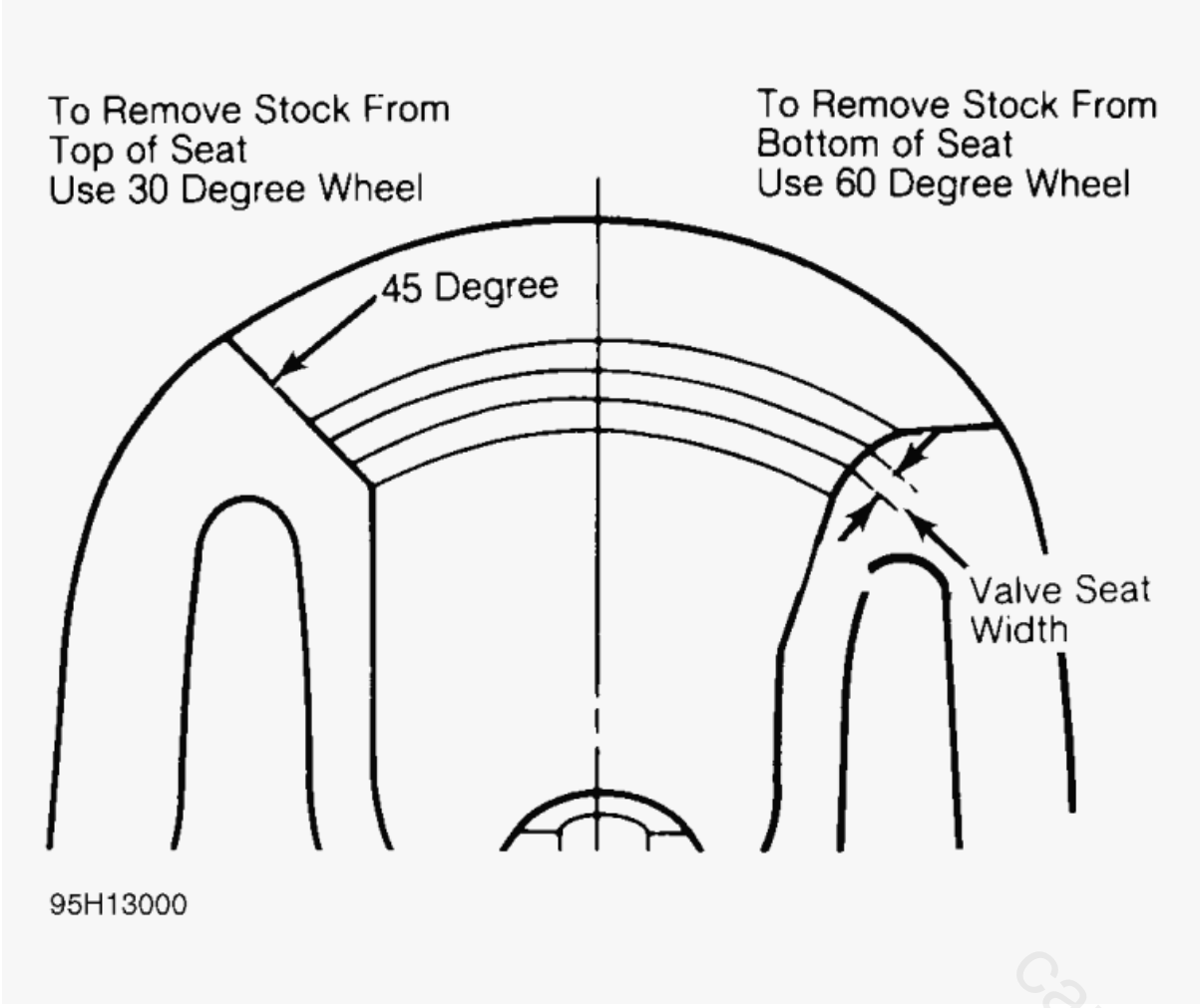


Fig. 10: Adjusting Valve Seat Width

Valve Seat Replacement

Replacement of valve seat inserts is done by cutting out the old insert and machining an oversize insert bore. Replacement oversize insert is usually cooled and the cylinder head is sometimes warmed. Valve seat is pressed into the head. This operation requires specialized machine shop equipment.

Valve Seat Concentricity

Using dial gauge, install gauge pilot in valve guide. Position gauge arm on the valve seat. Adjust dial indicator to zero. Rotate arm 360 degrees and note reading. Runout should not exceed specification.

To check valve-to-valve seat concentricity, coat valve face lightly with Prussian Blue dye. Install valve and rotate it on valve seat. If pattern is even and entire seat is coated at valve contact point, valve is concentric with the valve seat.

CYLINDER HEAD REASSEMBLY

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Valve Stem Installed Height

Valve stem installed height must be checked when new valves are installed or when valves or valve seats have been ground. Install valve in valve guide. Measure distance from tip of valve stem to spring seat. See **Fig. 11**. Distance must be within specification to allow sufficient clearance for valve operation.

cardiagn.com

Remove valve and grind valve stem tip if height exceeds specification. Valve tips are surface hardened. DO NOT remove more than .010" (.25 mm) from tip. Chamfer sharp edge of reground valve tip. Recheck valve stem installed height.

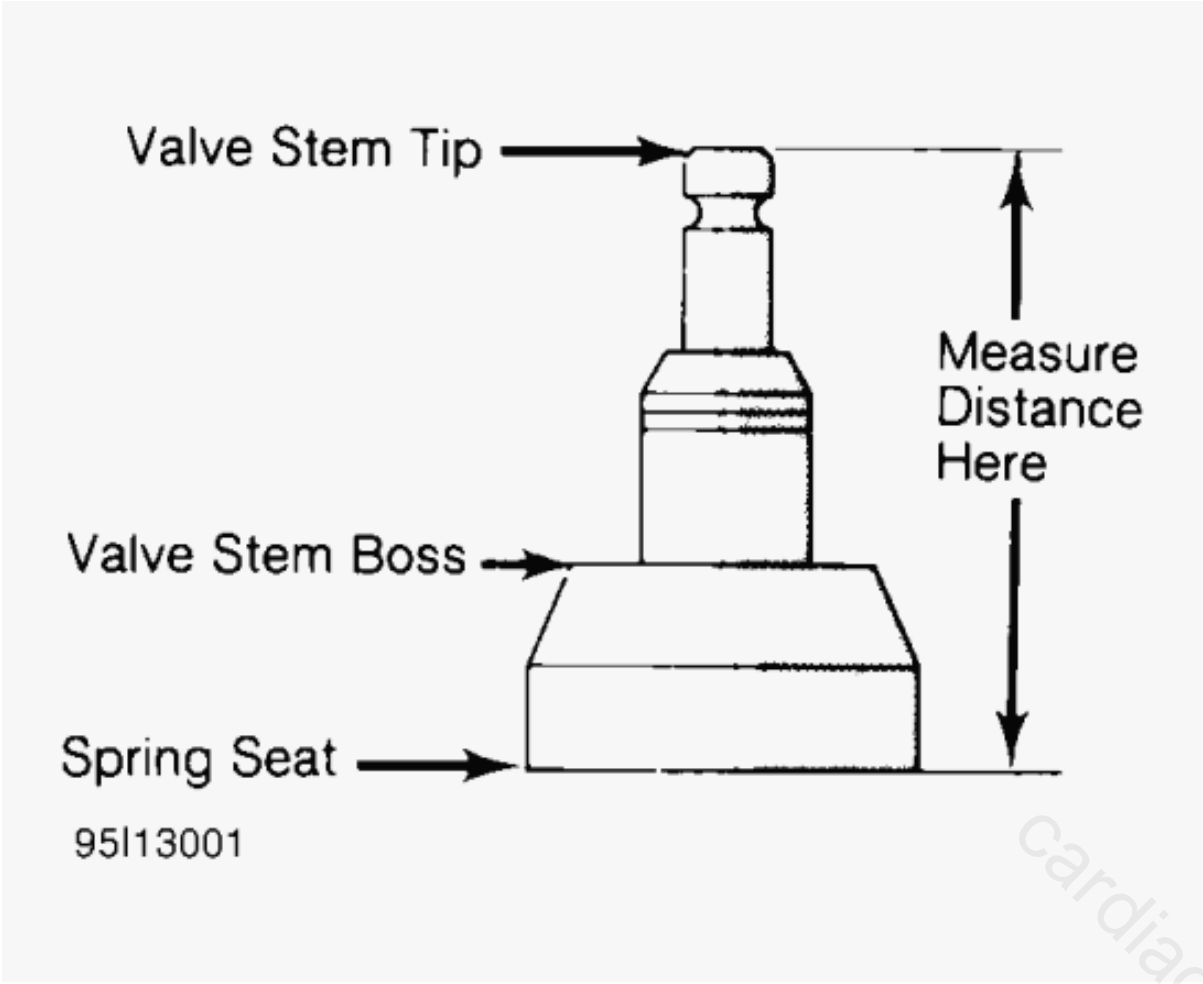


Fig. 11: Measuring Valve Stem Installed Height

VALVE STEM OIL SEALS

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Valve stem oil seals must be installed on valve stem. See **Fig. 2**. Seals are needed due to pressure differential at the ends of valve guides. Atmospheric pressure above intake guide, combined with manifold vacuum below guide, causes oil to be drawn into the cylinder.

Exhaust guides also have pressure differential created by exhaust gas flowing past the guide, creating a low pressure area. This low pressure area draws oil into the exhaust system.

Some manufacturers require that special color code or specified height valve stem oil seal be installed in designated area.

Replacement (On-Vehicle)

Mark rocker arm or overhead cam components for location. Remove rocker arm components or overhead cam components. Components must be installed in original location. Remove spark plugs. Valve stem oil seals may be replaced by holding valves against seats using air pressure.

cardiagn.com

Air pressure must be installed in cylinder using an adapter for spark plug hole. An adapter can be constructed by welding air hose connection to spark plug body with porcelain removed.

Rotate engine until piston is at top of stroke. Install adapter in spark plug hole. Apply a minimum of 140 psi (9.8 kg/cm^2) line pressure to adapter. Air pressure should hold valve closed. If air pressure does not hold valve closed, check for damaged or bent valve. Cylinder head must be removed for service.

Using valve spring compressor, compress valve springs. Remove valve locks. Carefully release spring compressor. Remove retainer or rotator and valve spring. Remove valve stem oil seal.

If oversize valves have been installed, oversize oil seals must be used. Coat valve stem with engine oil. Install protective sleeve over end of valve stem. Install new oil seal over valve stem and seat on valve guide. Remove protective sleeve. Install spring seat, valve spring and retainer or rotator. Compress spring and install valve locks. Remove spring compressor. Ensure valve locks are fully seated.

Install rocker arms or overhead cam components. Tighten all bolts to specification. Adjust valves if required. Remove adapter. Install spark plugs, valve cover and gasket.

VALVE SPRING INSTALLED HEIGHT

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Valve spring installed height should be checked during reassembly. Measure height from lower edge of valve spring to the upper edge. DO NOT include valve spring seat or retainer. Distance must be within specification. If valves and/or seats have been ground, a valve spring shim may be required to correct spring height. See Fig. 12.

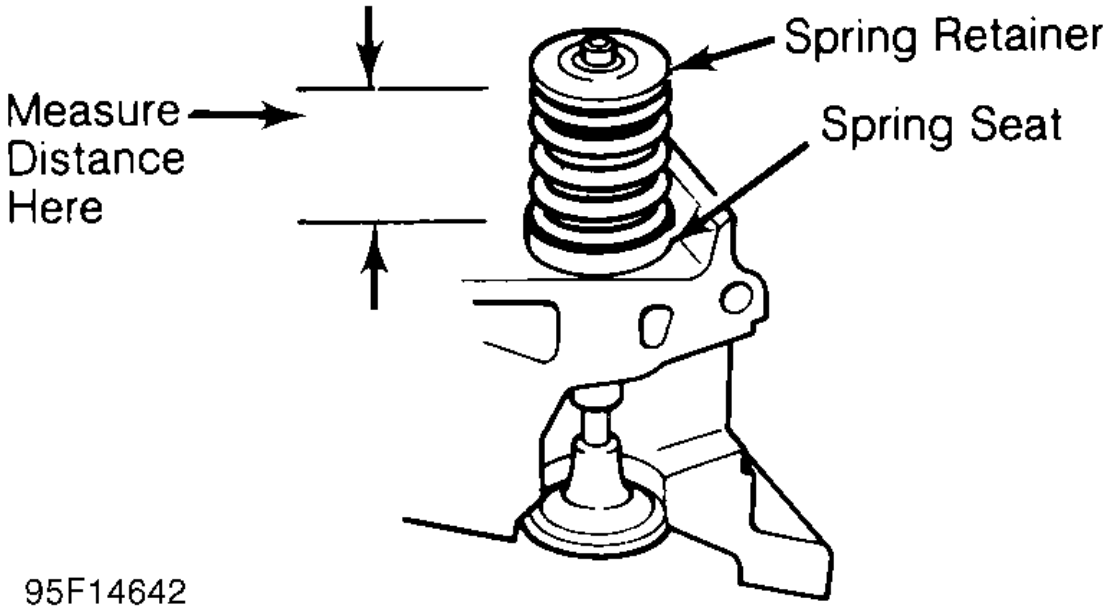


Fig. 12: Measuring Valve Spring Installed Height

ROCKER ARMS & ASSEMBLIES

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Rocker Studs

Rocker studs are either threaded or pressed in place. Threaded studs are removed by locking 2 nuts on the stud. Unscrew the stud by turning the jam nut. Coat new stud threads with Loctite and install. Tighten to specification.

Pressed-in stud can be removed using a stud puller. Ream stud bore to proper specification and press in a new oversize stud. Pressed-in studs are often replaced by cutting threads in the stud bore to accept a threaded stud.

Rocker Arms & Shafts

Mark rocker arms for location. Remove rocker arm retaining bolts. Remove rocker arms. Inspect rocker arms, shafts, bushings and pivot balls (if equipped) for excessive wear. Inspect rocker arms for wear in valve stem contact area. Measure rocker arm bushing I.D. Replace bushings if excessively worn.

The rocker arm valve stem contact point may be reground, using special fixture for valve grinding machine. Remove minimum amount of material as possible. Ensure all oil passages are clear. Install rocker arm components in original location. Ensure rocker arm is properly seated in push rod. Tighten bolts to specification. Adjust valves if required. See **VALVE ADJUSTMENT**.

PUSH RODS

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Remove rocker arms. Mark push rods for location. Remove push rods. Push rods can be steel or aluminum, solid or hollow. Hollow push rods must be internally cleaned to ensure oil passage to rocker arms is cleaned. Check push rods for damage, such as loose ends on steel tipped aluminum types.

Check push rod for straightness. Roll push rod on a flat surface. Using feeler gauge, check clearance at center. Replace push rod if bent. The push rod can also be supported at each end and rotated. A dial indicator is used to detect a bent area in the push rod.

Lubricate ends of push rod and install push rod in original location. Ensure push rod is properly seated in lifter. Install rocker arm. Tighten bolts to specification. Adjust valves if required. See **VALVE ADJUSTMENT**.

LIFTERS

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Hydraulic Lifters

Before replacing a hydraulic lifter for noisy operation, ensure noise is not caused by worn rocker arms or valve tips. Also ensure sufficient oil pressure exists. Hydraulic lifters must be installed in original location. Remove rocker arm assembly and push rod. Mark components for location. Some applications require intake manifold, cylinder head or lifter cover removal. Remove lifter retainer plate (if used). To remove lifters, use a hydraulic lifter remover or magnet. Different type lifters are used. See **Fig. 13**.

On sticking lifters, disassemble and clean lifter. DO NOT mix lifter components or positions. Parts are select-fitted and are not interchangeable. Inspect all components for wear. Note amount of wear in lifter body-to-camshaft contact area. Surface must have smooth and convex contact face. If wear is apparent, carefully inspect cam lobe.

Inspect push rod contact area and lifter body for scoring or signs of wear. If body is scored, inspect lifter bore for damage and lack of lubrication. On roller type lifters, inspect roller for flaking, pitting, loss of needle bearings and roughness during rotation.

Measure lifter body O.D. in several areas. Measure lifter bore I.D. Ensure components or oil clearance is within specification. Some models offer oversize lifters. Replace lifter if damaged.

If lifter check valve is not operating, obstructions may be preventing it from closing or valve spring may be broken. Clean or replace components as necessary.

Check plunger operation. Plunger should drop to bottom of the body by its own weight when assembled dry. If plunger is not free, soak lifter in solvent to dissolve deposits.

Lifter leak-down test can be performed on lifter. Lifter must be filled with special test oil. New lifters contain special test oil. Using lifter leak-down tester, perform leak-down test following manufacturer's instructions. If leak-down time is not within specifications, replace lifter assembly.

Lifters should be soaked in clean engine oil several hours prior to installation. Coat lifter base, roller (if equipped) and lifter body with ample amount of Molykote or camshaft lubricant. See **Fig. 13**. Install lifter in original location. Install remaining components. Valve lash adjustment is not required on most hydraulic lifters. Preload of hydraulic lifter is automatic. Some models may require adjustment.

NOTE: **Some manufacturers require that a crankcase conditioner be added to engine oil and engine operated for specified amount of time to aid in lifter break-in procedure if new lifters or camshaft are installed.**

cardesign.com

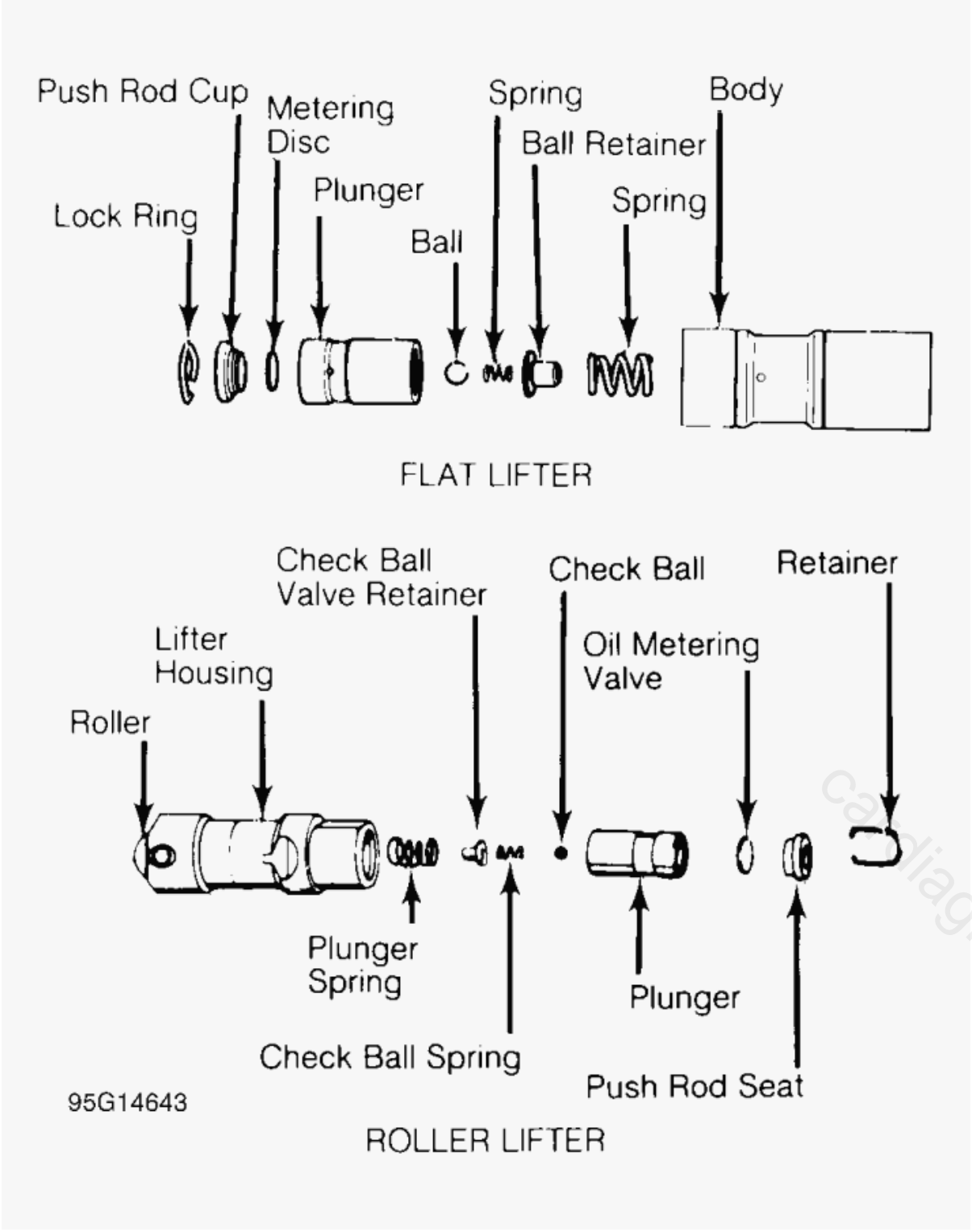


Fig. 13: Typical Hydraulic Valve Lifter Assemblies

Mechanical Lifters

Lifter assemblies must be installed in original locations. Remove rocker arm assembly and push rod. Mark components for location. Some applications require intake manifold or lifter cover removal. Remove lifter retainer plate (if used). To remove lifters, use lifter remover or magnet.

Inspect push rod contact area and lifter body for scoring or signs of wear. If body is scored, inspect lifter bore for damage and lack of lubrication. Note amount of wear in lifter body-to-camshaft contact area. Surface must have smooth and convex contact face. If wear is apparent, carefully inspect cam lobe.

Coat lifter base, roller (if equipped) and lifter body with ample amount of Molykote or camshaft lubricant. Install lifter in original location. Install remaining components. Tighten bolts to specification. Adjust valves. See **VALVE ADJUSTMENT**.

PISTONS, CONNECTING RODS & BEARINGS

*** PLEASE READ THIS FIRST ***

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

RIDGE REMOVAL

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Ridge in cylinder wall must be removed prior to piston removal. Failure to remove ridge prior to removing pistons will cause piston damage in piston ring lands or grooves.

With piston at bottom dead center, place rag in bore to trap metal chips. Install ridge reamer in cylinder bore. Adjust ridge reamer using manufacturer's instructions. Remove ridge using ridge reamer. DO NOT remove an excessive amount of material. Ensure ridge is completely removed.

PISTON & CONNECTING ROD REMOVAL

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Note top of piston. Some pistons may contain a notch, arrow or be marked FRONT. Piston must be installed in proper direction to prevent damage with valve operation.

Check that connecting rod and cap are numbered for cylinder location and which side of cylinder block the number faces. Proper cap and connecting rod must be installed together. Connecting rod cap must be installed on connecting rod in proper direction to ensure bearing lock procedure. Mark connecting rod and cap if necessary. Pistons must be installed in original location.

Remove cap retaining nuts or bolts. Remove bearing cap. Install tubing protectors on connecting rod bolts. This protects cylinder walls from scoring during removal. Ensure proper removal of ridge. Push piston and connecting rod from cylinder. Connecting rod boss can be tapped with a wooden dowel or hammer handle to aid in removal.

PISTON & CONNECTING ROD

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Disassembly

Using ring expander, remove piston rings. Remove piston pin retaining rings (if equipped). Note direction of piston installation on connecting rod. On pressed type piston pins, special fixtures and procedures according to manufacturer must be used to remove piston pins. Follow manufacturer's recommendations to avoid piston distortion or breakage.

Cleaning

Remove all carbon and varnish from piston. Pistons and connecting rods may be cleaned in cold type chemical tank. Using ring groove cleaner, clean all deposits from ring grooves. Ensure all deposits are cleaned from ring grooves to prevent ring breakage or sticking. DO NOT attempt to clean pistons with wire brush.

Inspection

Inspect pistons for nicks, scoring, cracks or damage in ring areas. Connecting rod should be checked for cracks using Magnaflux procedure. Piston diameter must be measured in manufacturer's specified area.

Using telescopic gauge and micrometer, measure piston pin bore of piston in 2 areas, 90 degrees apart. This is done to check diameter and out-of-round.

Install proper bearing cap on connecting rod. Ensure bearing cap is installed in proper location. Tighten bolts or nuts to specification. Using inside micrometer, measure inside diameter in 2 areas, 90 degrees apart.

Connecting rod I.D. and out-of-round must be within specification. Measure piston pin bore I.D. and piston pin O.D. All components must be within specification. Subtract piston pin diameter from piston pin bore in piston and connecting rod to determine proper fit.

Connecting rod length must be measured from center of crankshaft journal inside diameter to center of piston pin bushing using proper caliper. Connecting rods must be the same length. Connecting rods should be checked on an alignment fixture for bent or twisted condition. Replace all components which are damaged or not within specification.

PISTON & CYLINDER BORE FIT

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Ensure cylinder is checked for taper, out-of-round and properly honed prior to checking piston and cylinder bore fit. See **CYLINDER BLOCK**. Using dial bore gauge, measure cylinder bore.

Measure piston skirt diameter at 90 degree angle to piston pin at specified area by manufacturer. Subtract piston diameter from cylinder bore diameter to determine piston-to-cylinder clearance. Clearance must be within specification. Mark piston for proper cylinder location.

ASSEMBLING PISTON & CONNECTING ROD

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process.**

Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Install piston on connecting rod for corresponding cylinder. Ensure reference marking on top of piston corresponds with connecting rod and cap number. See **Fig. 14**.

Lubricate piston pin and install in connecting rod. Ensure piston pin retainers are fully seated (if equipped). On pressed type piston pins, follow manufacturer's recommended procedure to avoid distortion or breakage.

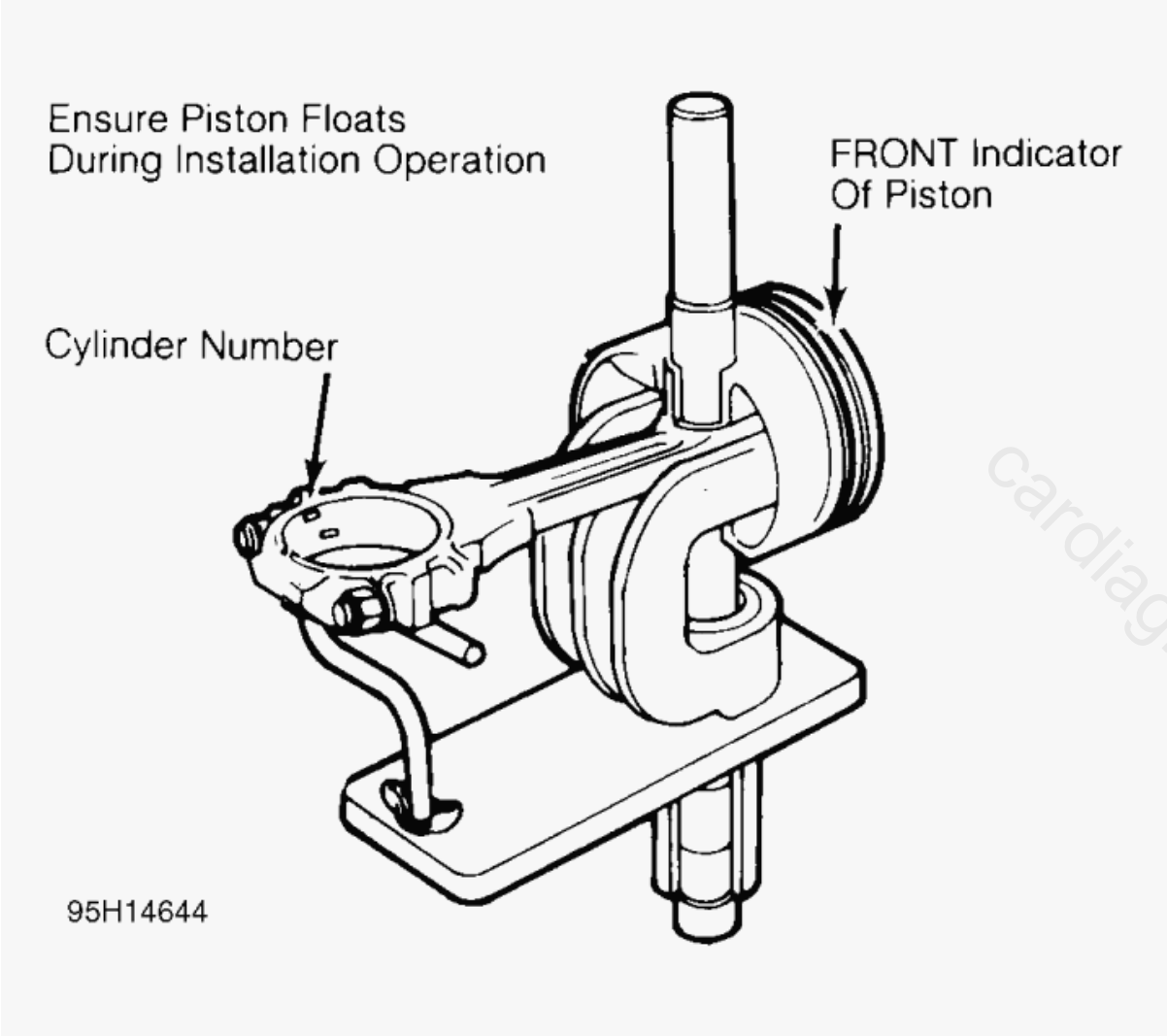


Fig. 14: Installing Typical Piston Pin

CHECKING PISTON RING CLEARANCES

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Piston rings must be checked for side clearance and end gap. To check end gap, install piston ring in cylinder in which it is to be installed. Using an inverted piston, push ring to bottom of cylinder in smallest cylinder diameter.

cardiagn.com

Using feeler gauge, check ring end gap. See **Fig. 15**. Piston ring end gap must be within specification. Ring breakage will occur if insufficient ring end gap exists.

Some manufacturers permit correcting insufficient ring end gap by using a fine file while other manufacturers recommend using another ring set. Mark rings for proper cylinder installation after checking end gap.

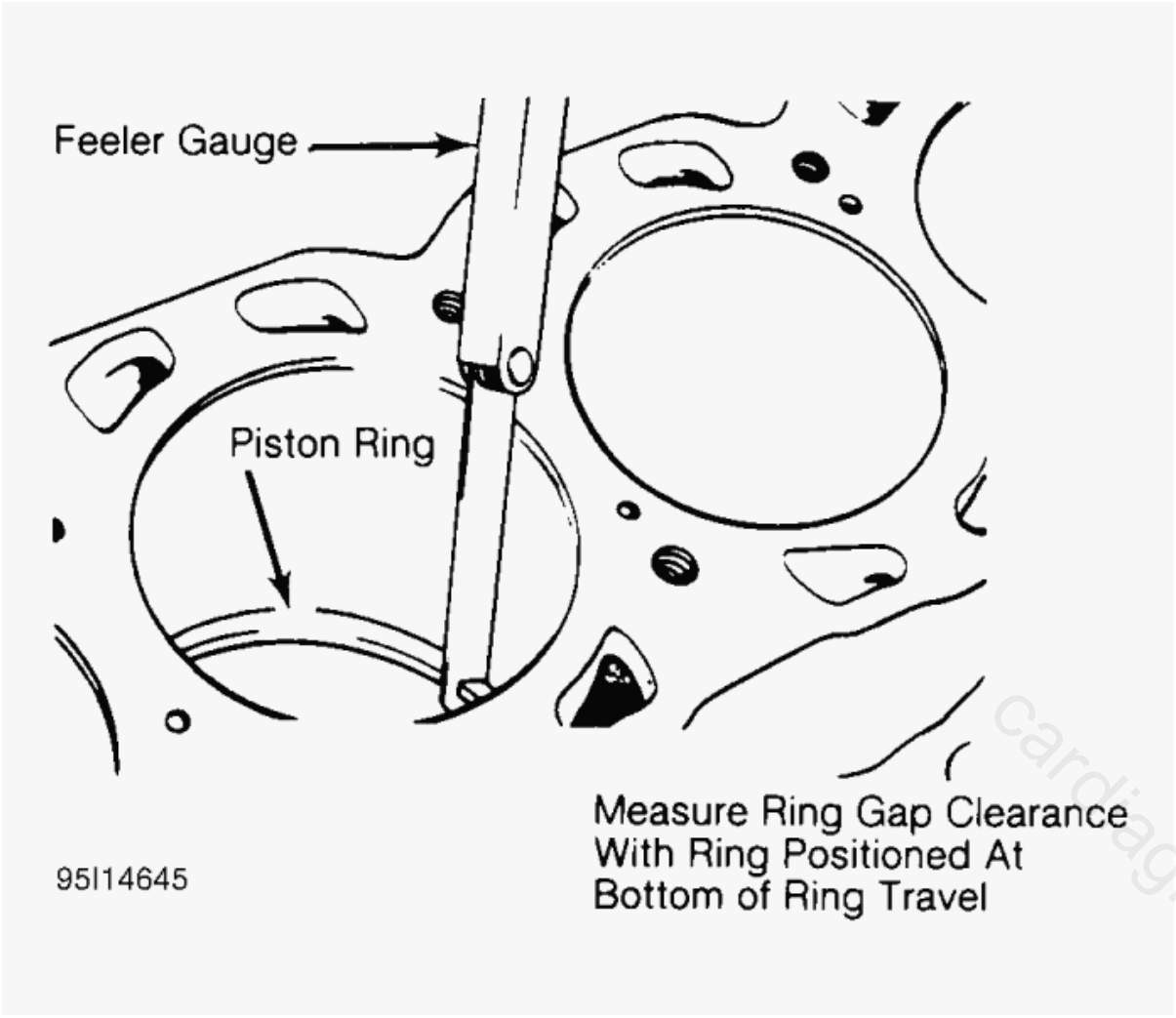


Fig. 15: Checking Piston Ring End Gap

For checking side clearance, install rings on piston. Using feeler gauge, measure clearance between piston ring and piston ring land. Check side clearance in several areas around piston. Side clearance must be within specification.

If side clearance is excessive, piston ring grooves can be machined to accept oversize piston rings (if available). Normal practice is to replace piston.

PISTON & CONNECTING ROD INSTALLATION

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Cylinders must be honed prior to piston installation. See **CYLINDER HONING** under CYLINDER BLOCK.

Install upper connecting rod bearings. Lubricate upper bearings with engine oil. Install lower bearings in rod caps. Ensure bearing tabs are properly seated. Position piston ring gaps according to manufacturer's

cardiagn.com

recommendations. See **Fig. 16**. Lubricate pistons, rings and cylinder walls.

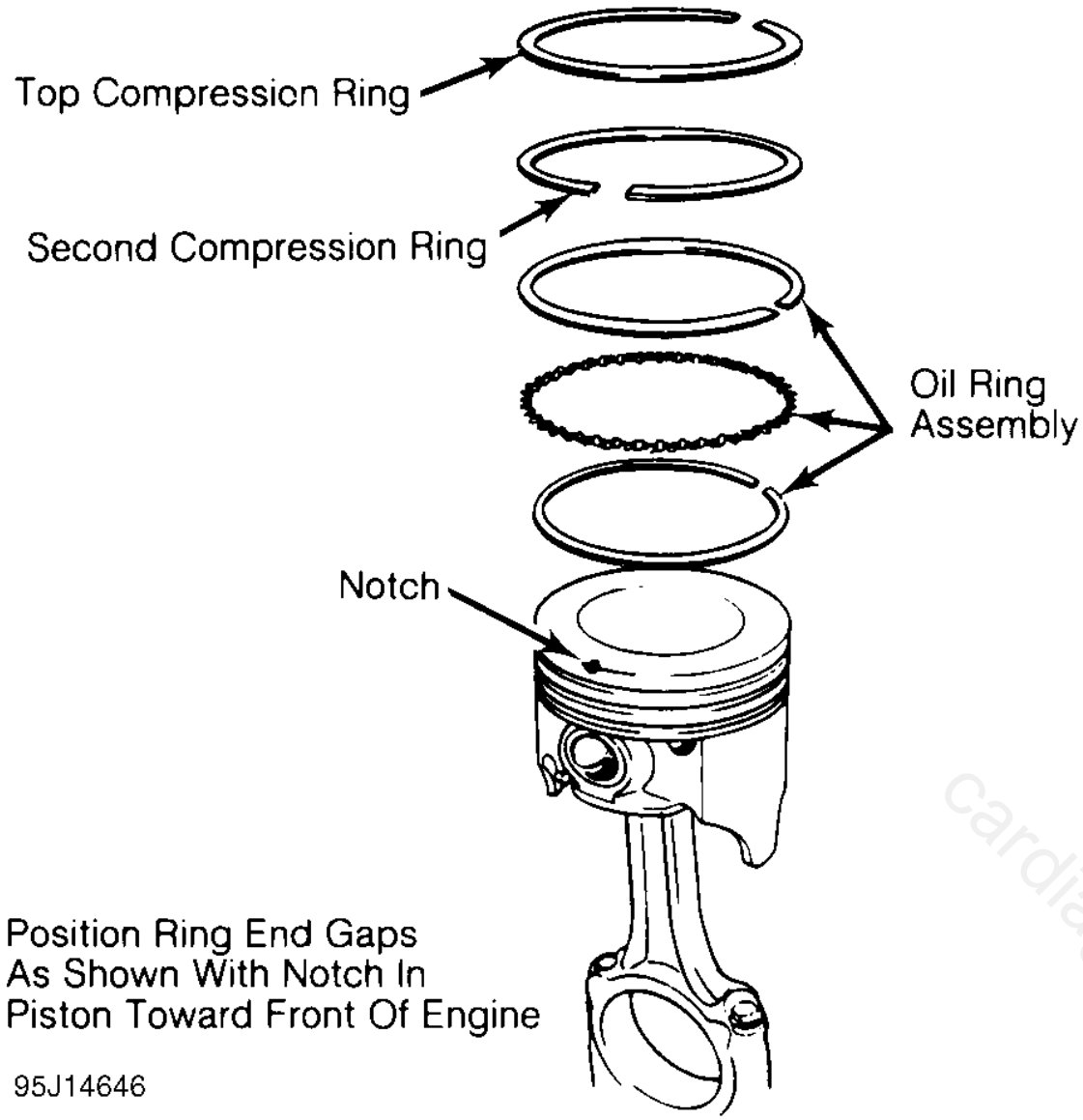


Fig. 16: Positioning Typical Piston Ring End Gap

Install ring compressor. Use care not to rotate piston rings. Compress rings with ring compressor. Install plastic tubing protectors over connecting rod bolts. Install piston and connecting rod assembly. Ensure piston notch, arrow or FRONT mark is toward front of engine. See **Fig. 17**.

cardiagn.com

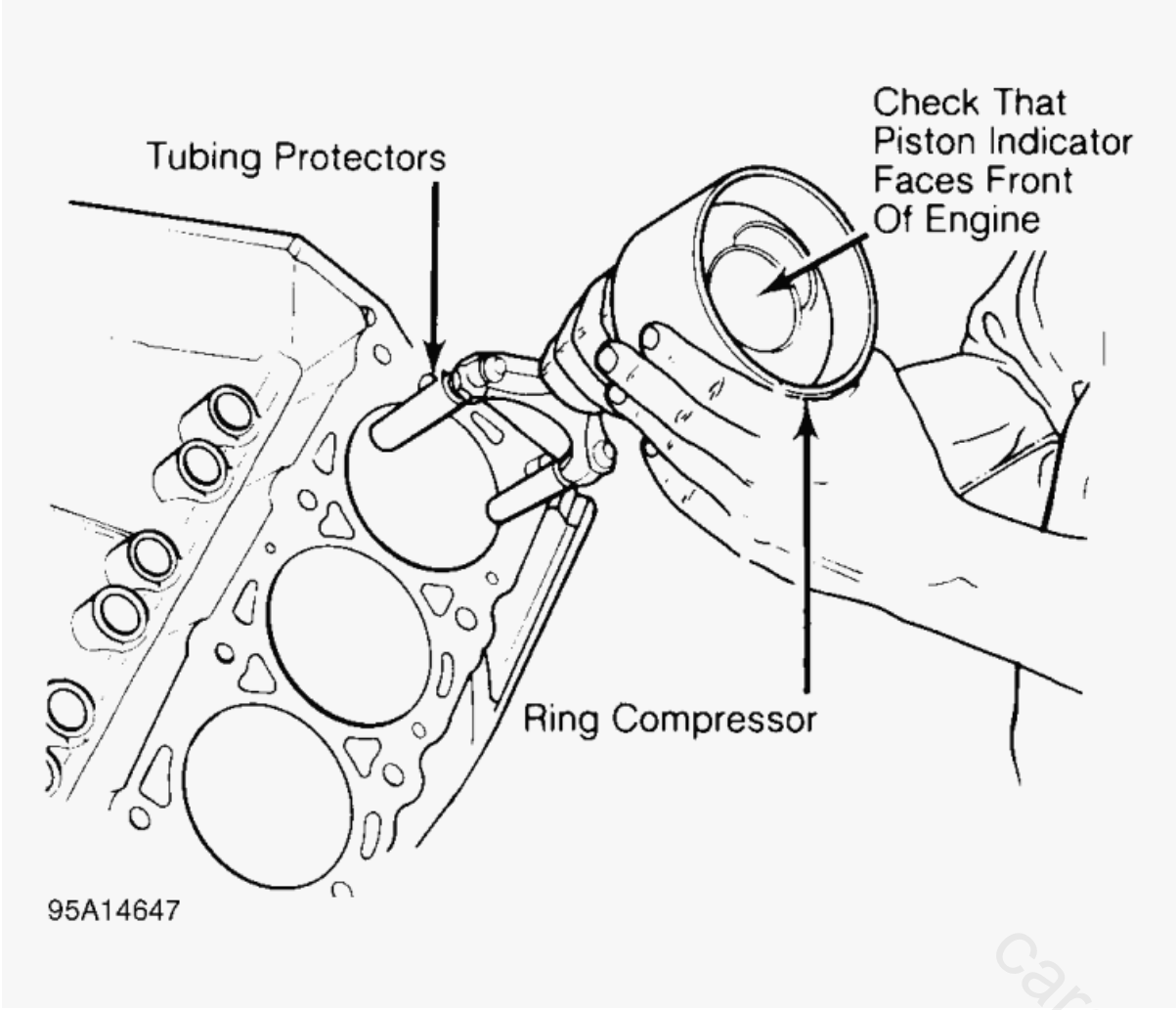


Fig. 17: Installing Piston & Connecting Rod Assembly

Carefully tap piston into cylinder until rod bearing is seated on crankshaft journal. Remove protectors. Install rod cap and bearing. Lightly tighten connecting rod bolts. Repeat procedure for remaining cylinders. Check bearing clearance. See **MAIN & CONNECTING ROD BEARING CLEARANCE**.

Once clearance is checked, lubricate journals and bearings. Install bearing caps. Ensure marks are aligned on connecting rod and cap. Tighten rod nuts or bolts to specification. Ensure rod moves freely on crankshaft. Check connecting rod side clearance. See **CONNECTING ROD SIDE CLEARANCE**.

CONNECTING ROD SIDE CLEARANCE

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Position connecting rod toward one side of crankshaft as far as possible. Using feeler gauge, measure clearance between side of connecting rod and crankshaft. See **Fig. 18**. Clearance must be within specification.

Check for improper bearing installation, wrong bearing cap or insufficient bearing clearance if side clearance is insufficient. Connecting rod may require machining to obtain proper clearance. Excessive clearance usually indicates excessive wear at crankshaft. Crankshaft must be repaired or replaced.

cardiagn.com

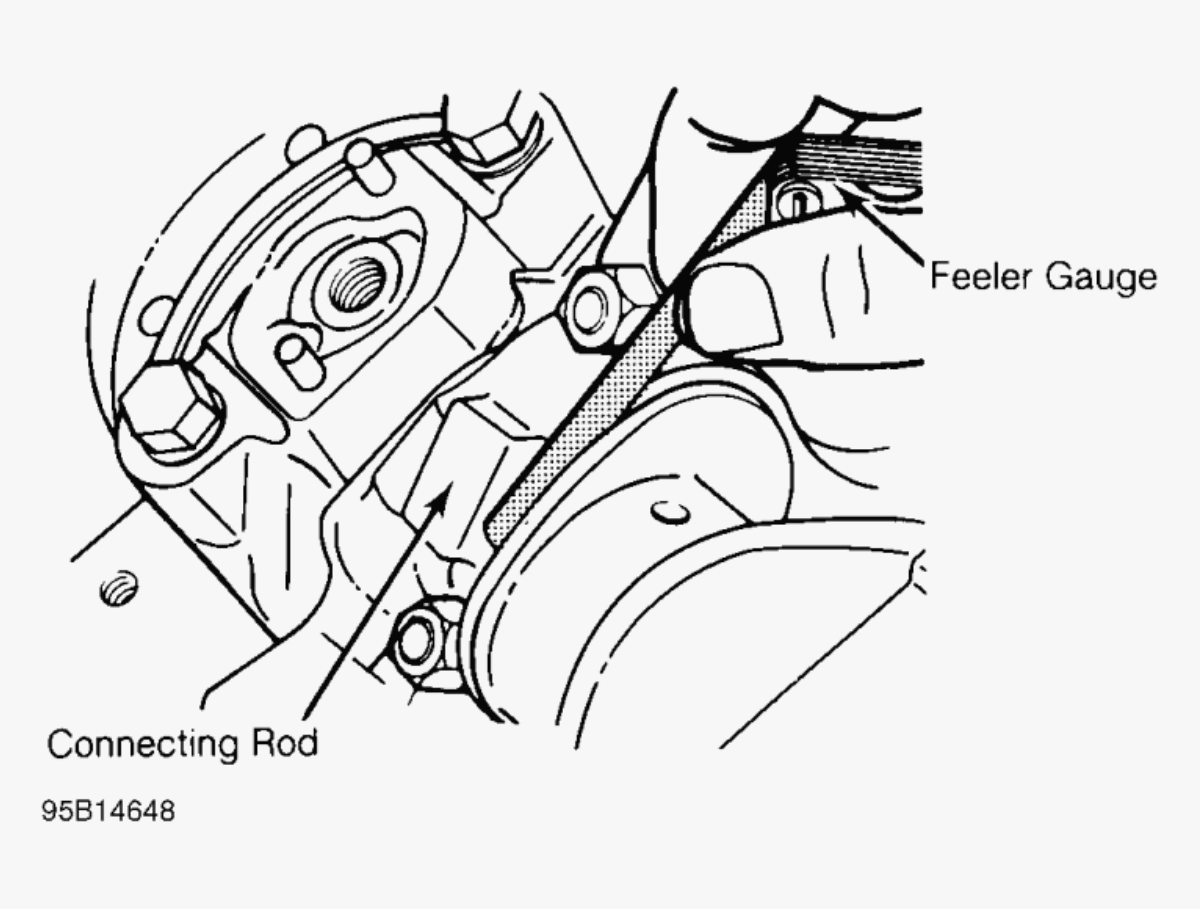


Fig. 18: Measuring Connecting Rod Side Clearance

MAIN & CONNECTING ROD BEARING CLEARANCE

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Plastigage Method

Plastigage method may be used to determine bearing clearance. Plastigage can be used with an engine in service or during reassembly. Plastigage material is oil soluble.

Ensure journals and bearings are free of oil or solvent. Oil or solvent will dissolve material and false reading will be obtained. Install small piece of Plastigage along full length of bearing journal. Install bearing cap in original location. Tighten bolts to specification.

CAUTION: **DO NOT rotate crankshaft while Plastigage is installed. Bearing clearance will not be obtained if crankshaft is rotated.**

Remove bearing cap. Compare Plastigage width with scale on Plastigage container to determine bearing clearance. See Fig. 19. Rotate crankshaft 90 degrees. Repeat procedure. This is done to check journal eccentricity. This procedure can be used to check oil clearance on both connecting rod and main bearings.

cardiagn.com

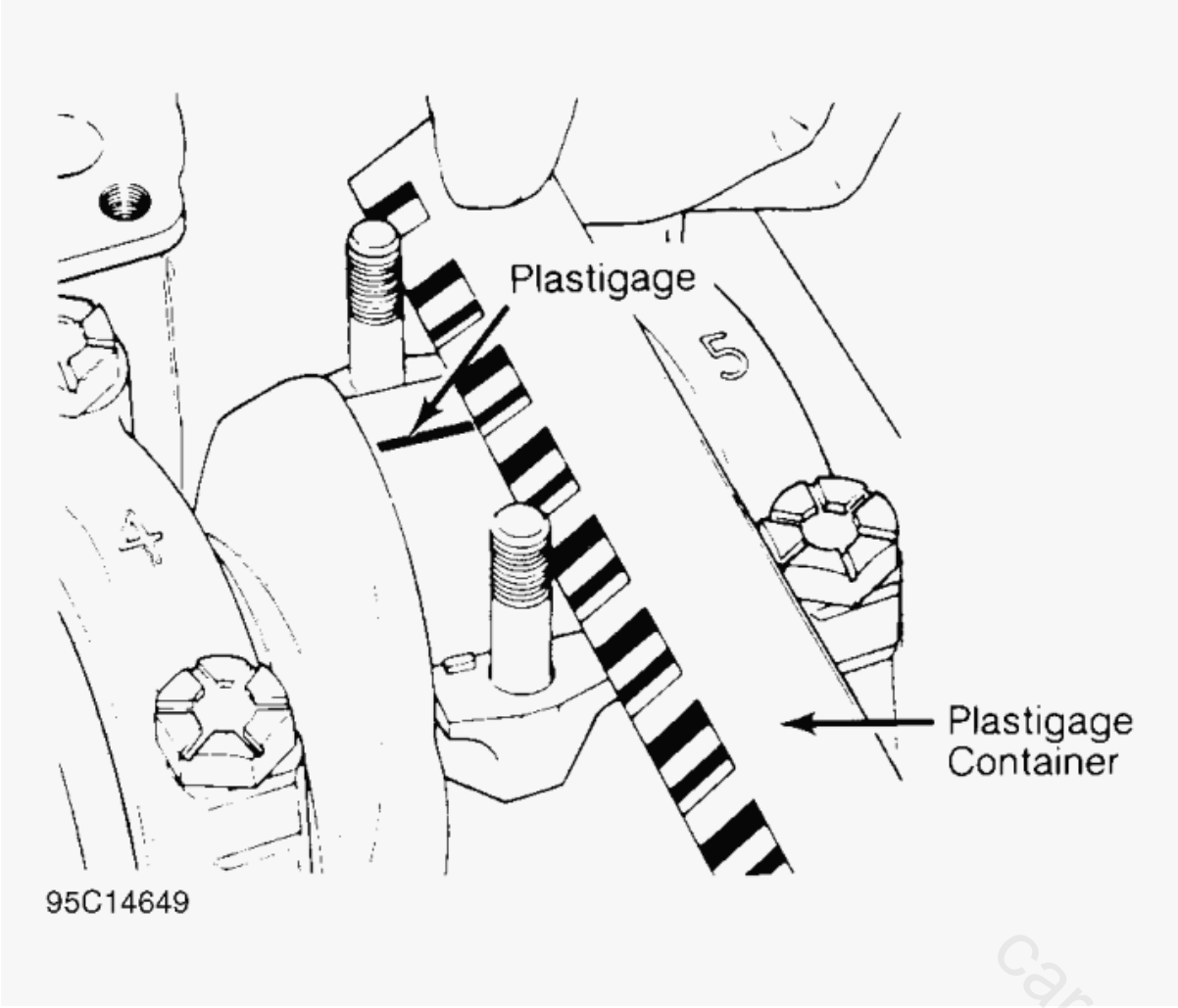


Fig. 19: Measuring Bearing Clearance

Micrometer & Telescopic Gauge Method

A micrometer is used to determine journal diameter, taper and out-of-round dimensions of the crankshaft. See **CLEANING & INSPECTION** under CRANKSHAFT & MAIN BEARINGS in this article.

With crankshaft removed, install bearings and caps in original location on cylinder block. Tighten bolts to specification. On connecting rods, install bearings and caps on connecting rods. Install proper connecting rod cap on corresponding rod. Ensure bearing cap is installed in original location. Tighten bolts to specification.

Using a telescopic gauge and micrometer or inside micrometer, measure inside diameter of connecting rod and main bearings bores. Subtract each crankshaft journal diameter from the corresponding inside bearing bore diameter. This is the bearing clearance.

CRANKSHAFT & MAIN BEARINGS

*** PLEASE READ THIS FIRST ***

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

REMOVAL

cardiagn.com

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Ensure all main bearing caps are marked for location on cylinder block. Some main bearing caps have an arrow stamped on them. The arrow must face timing belt or timing chain end of engine. Remove main bearing cap bolts. Remove main bearing caps. Carefully remove crankshaft. Use care not to bind crankshaft in cylinder block during removal.

CLEANING & INSPECTION

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Thoroughly clean crankshaft using solvent. Dry with compressed air. Ensure all oil passages are clear and free of sludge, rust, dirt and metal chips.

Inspect crankshaft for scoring and nicks. Inspect crankshaft for cracks using Magnaflux procedure. Inspect rear seal area for grooving or damage. Inspect bolt hole threads for damage. If pilot bearing or bushing is used, check pilot bearing or bushing fit in crankshaft. Inspect crankshaft gear for damaged or cracked teeth. Replace gear if damaged. Ensure oil passage plugs are tight (if equipped).

Using micrometer, measure all journals in 4 areas to determine journal taper, out-of-round and undersize. See **Fig. 20**. Some crankshafts can be reground to the next largest undersize, depending on the amount of wear or damage. Crankshafts with rolled fillet cannot be reground and must be replaced.

Cardiagn.com

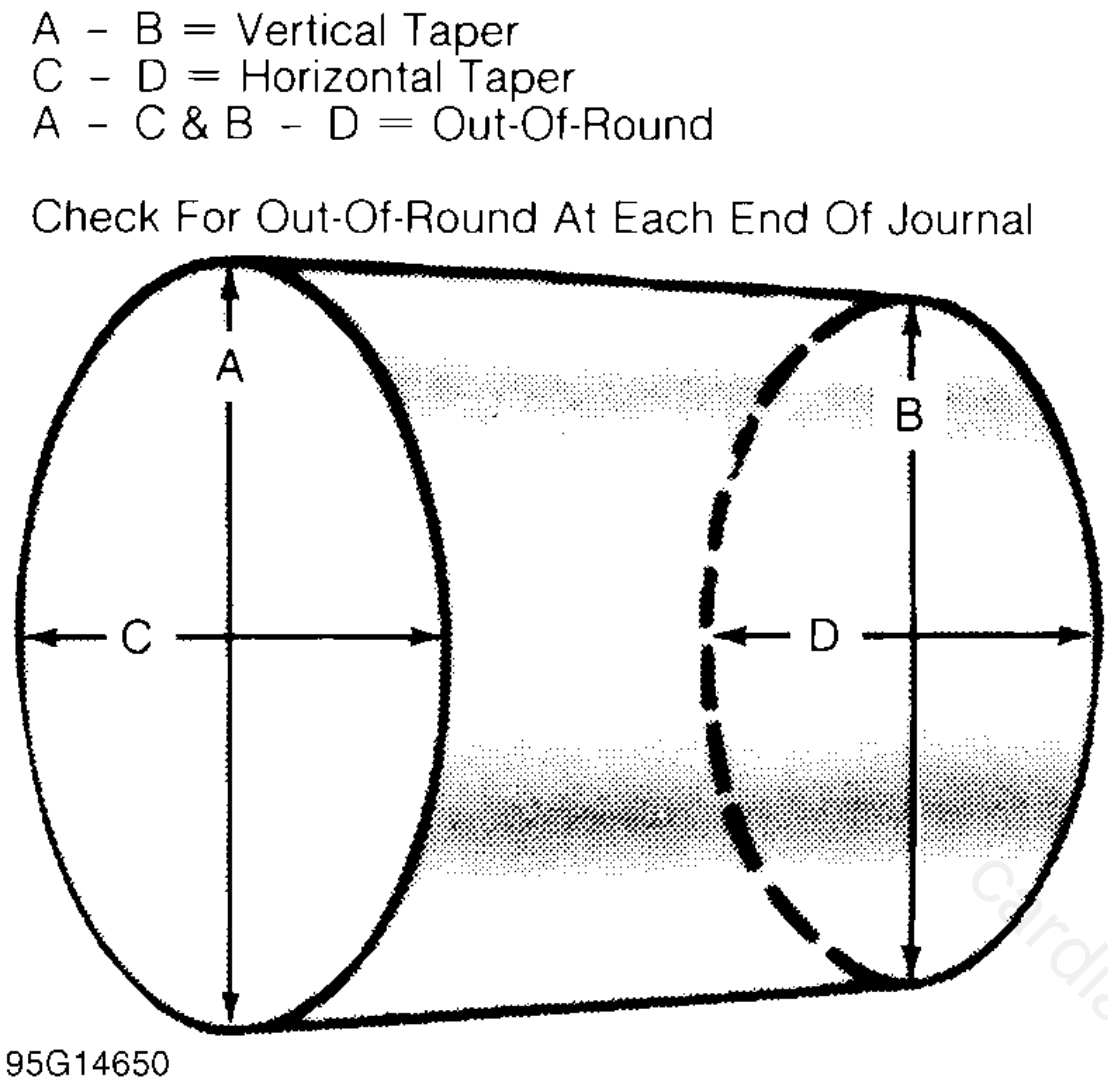
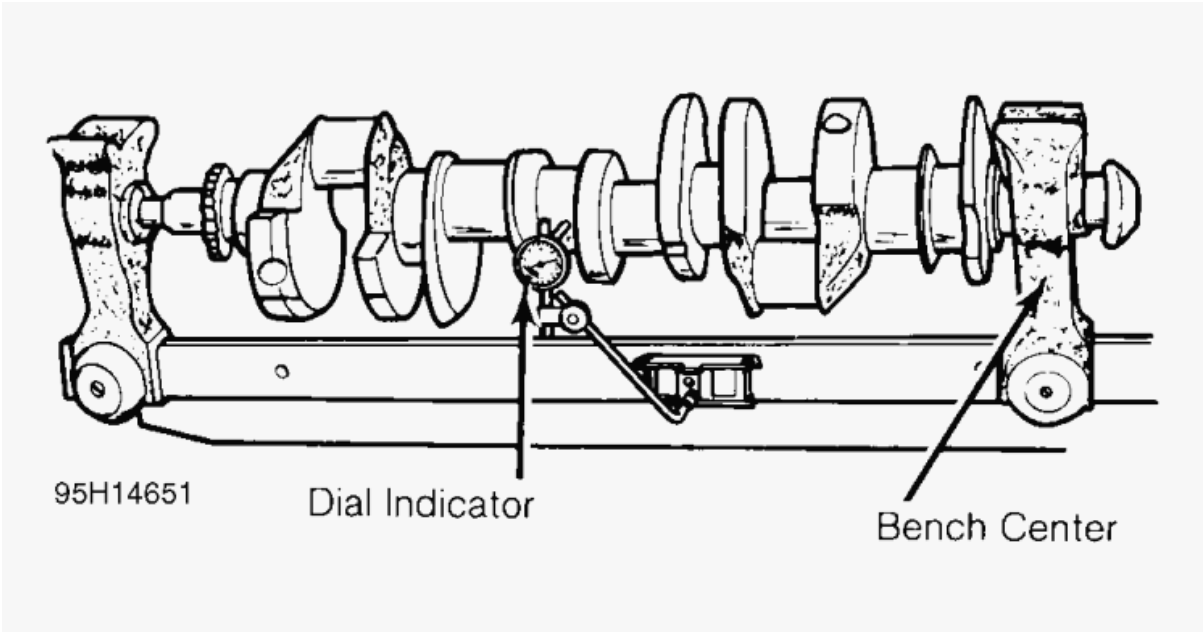


Fig. 20: Measuring Crankshaft Journals

Crankshaft journal runout should be checked. Install crankshaft in "V" blocks or bench center. Position dial indicator with tip resting on the main bearing journal area. See **Fig. 21**. Rotate crankshaft and note reading. Journal runout must not exceed specification. Repeat procedure on all main bearing journals. Crankshaft must be replaced if runout exceeds specification.



cardiagn.com

Fig. 21: Measuring Crankshaft Main Bearing Journal Runout

INSTALLATION

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Install upper main bearing in cylinder block. Ensure lock tab is properly located in cylinder block. Install bearings in main bearing caps. Ensure all oil passages are aligned. Install rear seal (if removed).

Ensure crankshaft journals are clean. Lubricate upper main bearings with clean engine oil. Carefully install crankshaft. Check each main bearing clearance using Plastigage method. See **MAIN & CONNECTING ROD BEARING CLEARANCE**.

Once clearance is checked, lubricate lower main bearing and journals. Install main bearing caps in original location. Install rear seal in rear main bearing cap (if removed). Some rear main bearing caps require sealant to be applied in corners to prevent oil leakage.

Install and tighten all bolts except thrust bearing cap to specification. Tighten thrust bearing cap bolts finger tight only. Some models require that thrust bearing be aligned. On most applications, crankshaft must be moved rearward then forward. Procedure may vary with manufacturer. Thrust bearing cap is then tightened to specification. Ensure crankshaft rotates freely. Crankshaft end play should be checked. See **CRANKSHAFT END PLAY**.

CRANKSHAFT END PLAY

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Dial Indicator Method

Crankshaft end play can be checked using dial indicator. Mount dial indicator on rear of cylinder block. Position dial indicator tip against rear of crankshaft. Ensure tip is resting against flat surface.

Pry crankshaft rearward. Adjust dial indicator to zero. Pry crankshaft forward and note reading. Crankshaft end play must be within specification. If end play is not within specification, check for faulty thrust bearing installation or worn crankshaft. Some applications offer oversize thrust bearings.

Feeler Gauge Method

Crankshaft end play can be checked using feeler gauge. Pry crankshaft rearward. Pry crankshaft forward. Using feeler gauge, measure clearance between crankshaft and thrust bearing surface. See **Fig. 22**.

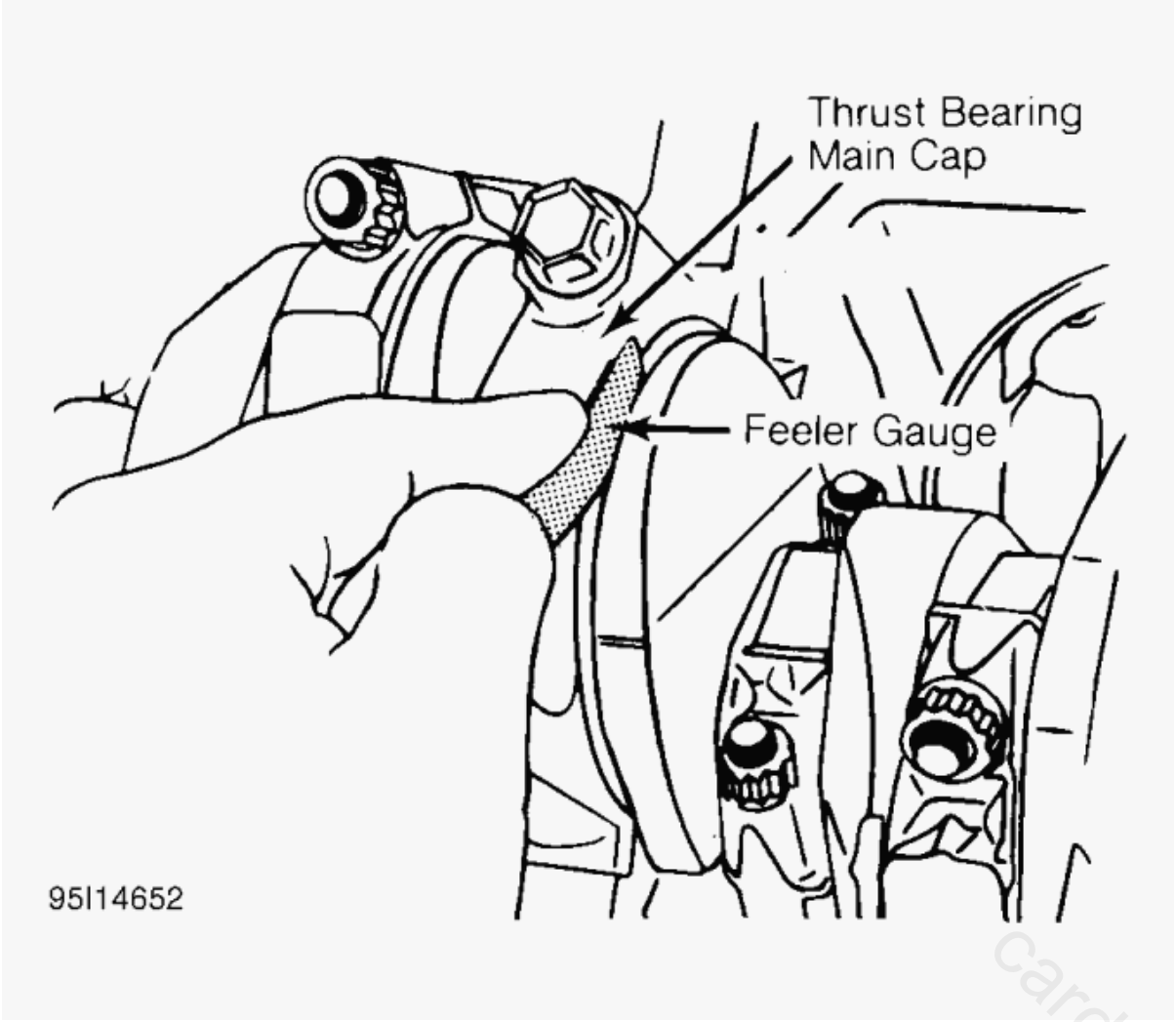


Fig. 22: Checking Crankshaft End Play

Crankshaft end play must be within specification. If end play is not within specification, check for faulty thrust bearing installation or worn crankshaft. Some applications offer oversize thrust bearings.

CYLINDER BLOCK

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Block Cleaning

Only cast cylinder blocks should be hot tank cleaned. Aluminum cylinder blocks should be cleaned using cold tank method. Cylinder block is cleaned in order to remove carbon deposits, gasket residue and water jacket scale. Remove oil gallery plugs, freeze plugs and cam bearings before cleaning block.

Block Inspection

Visually inspect the block. Check suspected areas for cracks using the Dye Penetrant inspection method. Block may be checked for cracks using the Magnaflux method.

Cracks are most commonly found at the bottom of cylinders, main bearing saddles, near expansion plugs and between cylinders and water jackets. Inspect lifter bores for damage. Inspect all head bolt holes for damaged threads. Threads should be cleaned using tap to ensure proper head bolt torque. Consult machine shop concerning possible welding and machining (if required).

cardiagn.com

Cylinder Bore Inspection

Inspect bore for scoring or roughness. Cylinder bore is dimensionally checked for out-of-round and taper using dial bore gauge. For determining out-of-round, measure cylinder parallel and perpendicular to the block center line. Difference in the 2 readings is the bore out-of-round. Cylinder bore must be checked at top, middle and bottom of piston travel area.

Bore taper is obtained by measuring bore at the top and bottom. If wear has exceeded allowable limits, block must be honed or bored to next available oversize piston dimension.

Cylinder Honing

Cylinder must be properly honed to allow new piston rings to properly seat. Cross-hatching at correct angle and depth is critical to lubrication of cylinder walls and pistons.

A flexible drive hone and power drill are commonly used. Drive hone must be lubricated during operation. Mix equal parts of kerosene and SAE 20W engine oil for lubrication.

Apply lubrication to cylinder wall. Operate cylinder hone from top to bottom of cylinder using even strokes to produce 45 degree cross-hatch pattern on the cylinder wall. DO NOT allow cylinder hone to extend below cylinder during operation.

Recheck bore dimension after final honing. Wash cylinder wall with hot soapy water to remove abrasive particles. Blow dry with compressed air. Coat cleaned cylinder walls with lubricating oil.

Deck Warpage

Check deck for damage or warped gasket surface. Place a straightedge across gasket surface of the deck. Using feeler gauge, measure clearance at center of straightedge. Measure across width and length of cylinder block at several points.

If warpage exceeds specifications, deck must be resurfaced. If warpage exceeds manufacturer's maximum tolerance for material removal, replace block.

NOTE: **Some manufacturers recommend that a total amount of material (cylinder head and cylinder block) can only be removed before components must be replaced.**

Deck Height

Distance from crankshaft center line to block deck is called the deck height. Measure and record front and rear main journals of crankshaft. To compute this distance, install crankshaft and retain with center main bearing and cap only. Measure distance from crankshaft journal to block deck, parallel to cylinder center line.

Add one half of main bearing journal diameter to distance from crankshaft journal to block deck. This dimension should be checked at front and rear of cylinder block. Both readings should be the same.

If difference exceeds specification, cylinder block must be repaired or replaced. Deck height and warpage should be corrected at the same time.

Main Bearing Bore & Alignment

For checking main bearing bore, remove all bearings from cylinder block and main bearing caps. Install main bearing caps in original location. Tighten bolts to specification. Using inside micrometer, measure main bearing bore in 2 areas 90 degrees apart. Determine bore size and out-of-round. If diameter is not within specification, block must be align-bored.

For checking alignment, place a straightedge along center line of main bearing saddles. Check for clearance between straightedge and main bearing saddles. Block must be align-bored if clearance exists.

Expansion Plug Removal

mardiagn.com

Drill hole in center of expansion plug. Remove with screwdriver or punch. Use care not to damage sealing surface.

Expansion Plug Installation

Ensure sealing surface is free of burrs. Coat expansion plug with sealer. Using wooden dowel or pipe of slightly smaller diameter, install expansion plug. Ensure expansion plug is evenly located.

Oil Gallery Plug Removal

Remove threaded oil gallery plugs using appropriate wrench. Soft press-in plugs are removed by drilling into plug and installing a sheet metal screw. Remove plug with slide hammer or pliers.

Oil Gallery Plug Installation

Ensure threads or sealing surface is clean. Coat threaded oil gallery plugs with sealer and install. Replacement soft press-in plugs are installed with a hammer and drift.

CAMSHAFT

*** PLEASE READ THIS FIRST ***

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

CLEANING & INSPECTION

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Clean camshaft with solvent. Ensure all oil passages are clear. Inspect cam lobes and bearing journals for pitting, flaking or scoring. Using micrometer, measure bearing journal O.D.

Support camshaft at each end with "V" blocks. Position dial indicator with tip resting on center bearing journal. Rotate camshaft and note camshaft runout reading. If reading exceeds specification, replace camshaft.

Check cam lobe lift by measuring base circle of camshaft using micrometer. Measure again at 90-degree angle to tip of cam lobe. Cam lift can be determined by subtracting base circle diameter from tip of cam lobe measurement.

Different lift dimensions are given for intake and exhaust cam lobes. Reading must be within specification. Replace camshaft if cam lobes or bearing journals are not within specification.

Inspect camshaft gear for chipped, eroded or damaged teeth. Replace gear if damaged. On camshafts using thrust plate, measure distance between thrust plate and camshaft shoulder. Replace thrust plate if not within specification.

CAMSHAFT BEARINGS

Cardiagn.com

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Removal & Installation

Remove camshaft rear plug. Camshaft bearing remover is assembled with shoulder resting against bearing to be removed according to manufacturer's instructions. Tighten puller nut until bearing is removed. Remove remaining bearings, leaving front and rear bearings until last. These bearings act as a guide for camshaft bearing remover.

To install new bearings, puller is rearranged to pull bearings toward the center of block. Ensure all lubrication passages of bearing are aligned with cylinder block. Coat new camshaft rear plug with sealant. Install camshaft rear plug. Ensure plug is even in cylinder block.

CAMSHAFT INSTALLATION

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Lubricate bearing surfaces and cam lobes with ample amount of Molykote or camshaft lubricant. Carefully install camshaft. Use care not to damage bearing journals during installation. Install thrust plate retaining bolts (if equipped). Tighten bolts to specification. On overhead camshafts, install bearing caps in original location. Tighten bolts to specification. On all applications, check camshaft end play.

CAMSHAFT END PLAY

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Using dial indicator, check camshaft end play. Position dial indicator on front of engine block or cylinder head. Position indicator tip against camshaft. Push camshaft toward rear of cylinder head or engine and adjust indicator to zero.

Move camshaft forward and note reading. Camshaft end play must be within specification. End play may be adjusted by relocating gear, shimming thrust plate or replacing thrust plate depending on each manufacturer.

TIMING CHAINS & BELTS

* PLEASE READ THIS FIRST *

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

TIMING CHAINS

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Timing chains will stretch during operation. Limits are placed upon amount of stretch before replacement is required. Timing chain stretch will alter ignition timing and valve timing.

To check timing chain stretch, rotate crankshaft to eliminate slack from one side of timing chain. Mark reference point on cylinder block. Rotate crankshaft in opposite direction to eliminate slack from remaining side of timing chain. Force other side of chain outward and measure distance between reference point and timing chain. See **Fig. 23**. Replace timing chain and gears if not within specification.

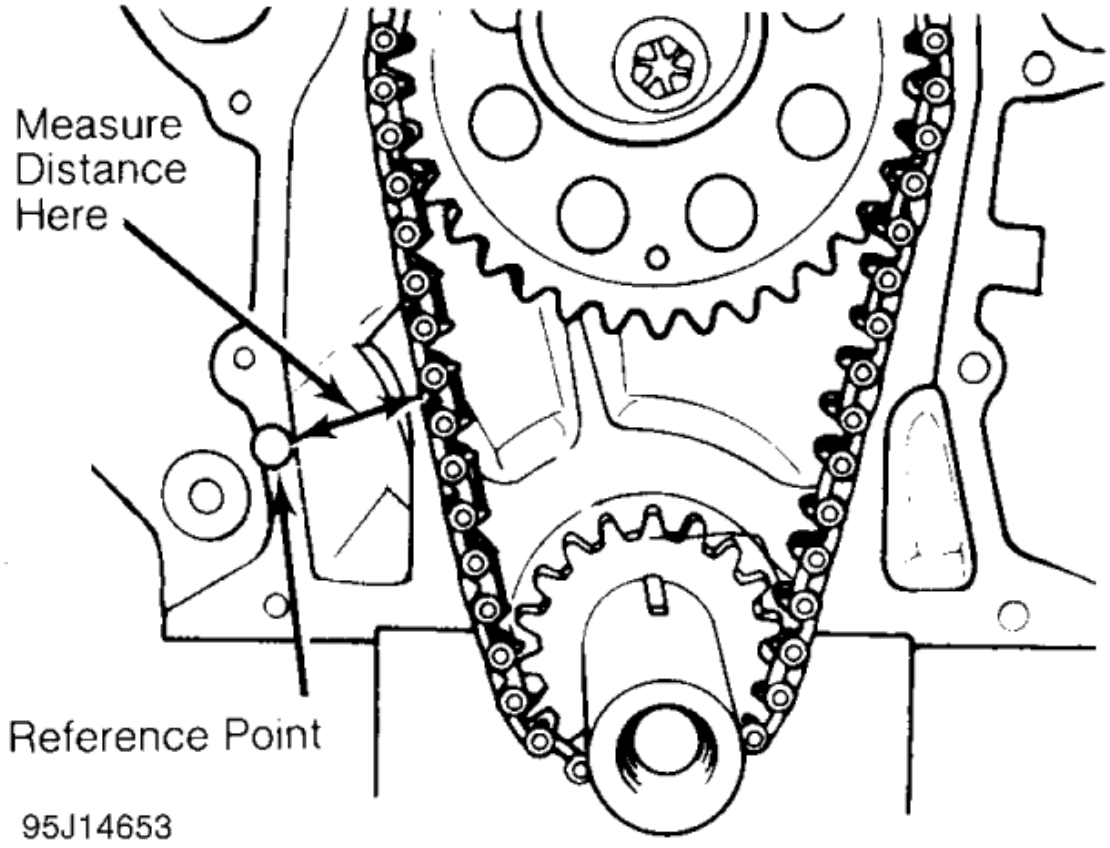


Fig. 23: Measuring Timing Chain Stretch

Timing chains must be installed so timing marks on camshaft gear and crankshaft gear are aligned according to manufacturer. See **Fig. 24**.

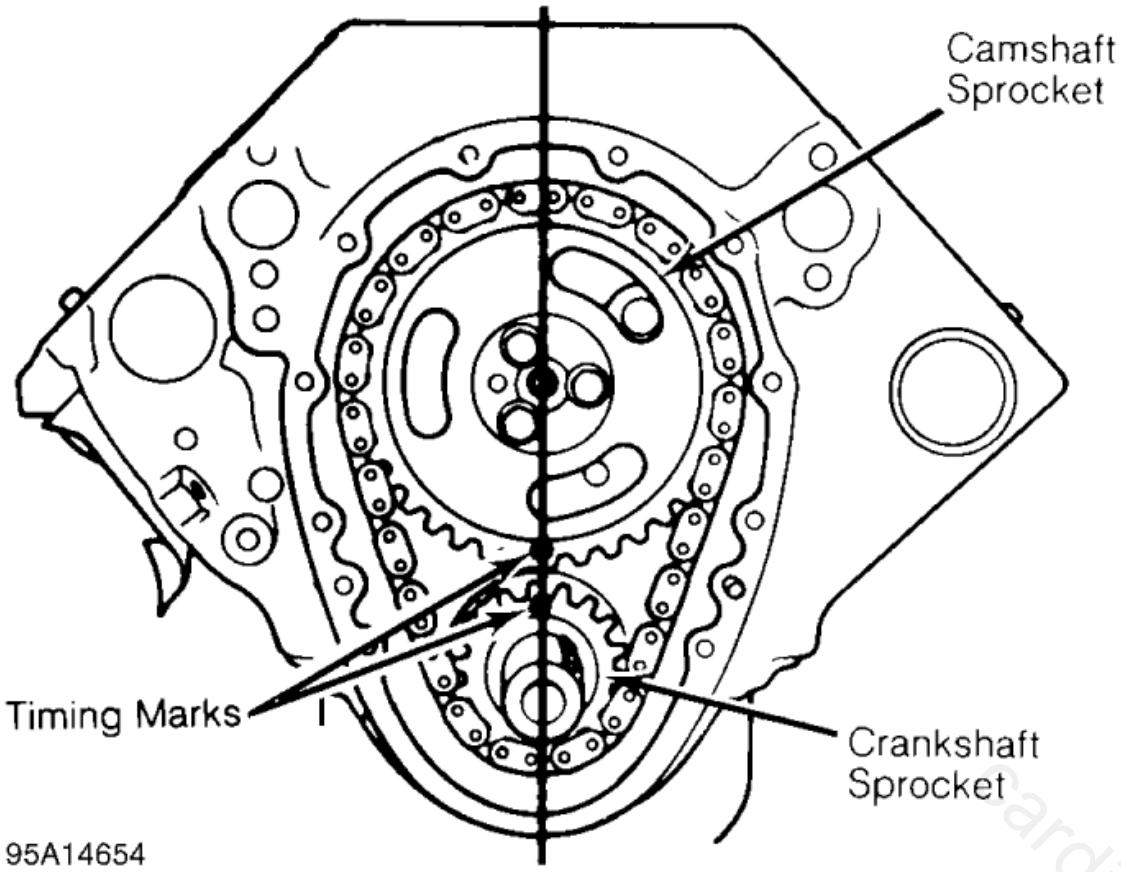


Fig. 24: Typical Gear Timing Mark Alignment

TIMING BELTS

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Cogged tooth belts are commonly used on overhead cam engines. Inspect belt teeth for rounded corners or cracking. Replace belt if it is cracked, damaged, missing teeth or oil soaked.

Used timing belt must be installed in original direction of rotation. Inspect all sprocket teeth for wear. Replace all worn sprockets. Sprockets are marked for timing purposes. Engine is positioned so that crankshaft sprocket mark will be upward. Camshaft sprocket is aligned with reference mark on cylinder head or timing belt cover and then timing belt can be installed. See **Fig. 25**.

eardiagn.com

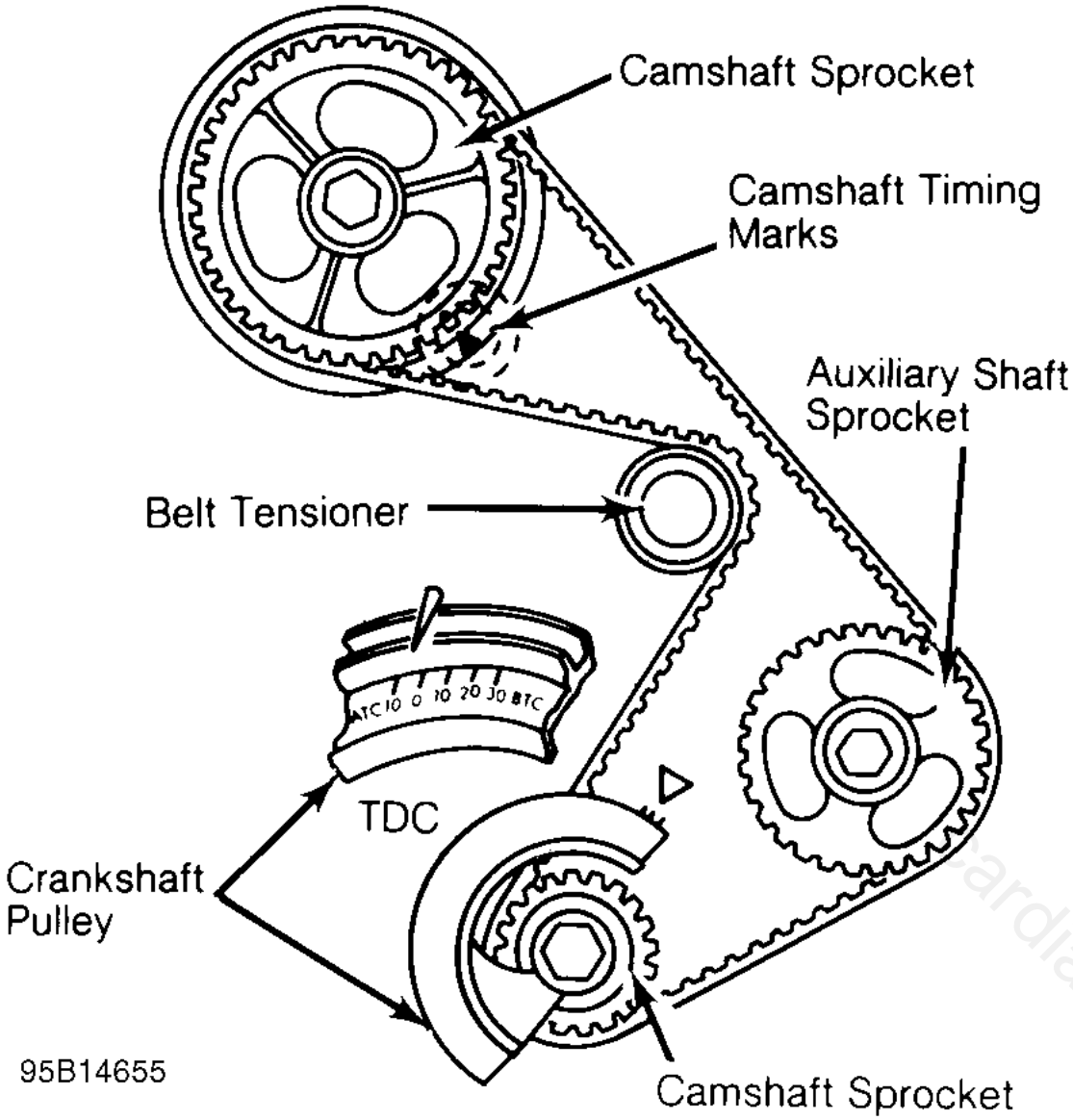


Fig. 25: Typical Camshaft Belt Sprocket Alignment

TENSION ADJUSTMENT

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

If guide rails are used with spring loaded tensioners, ensure at least half of original rail thickness remains. Spring loaded tensioner should be inspected for damage.

Ensure all timing marks are aligned. Adjust belt tension using manufacturer's recommendations. Belt tension may require checking using tension gauge. See **Fig. 26**.

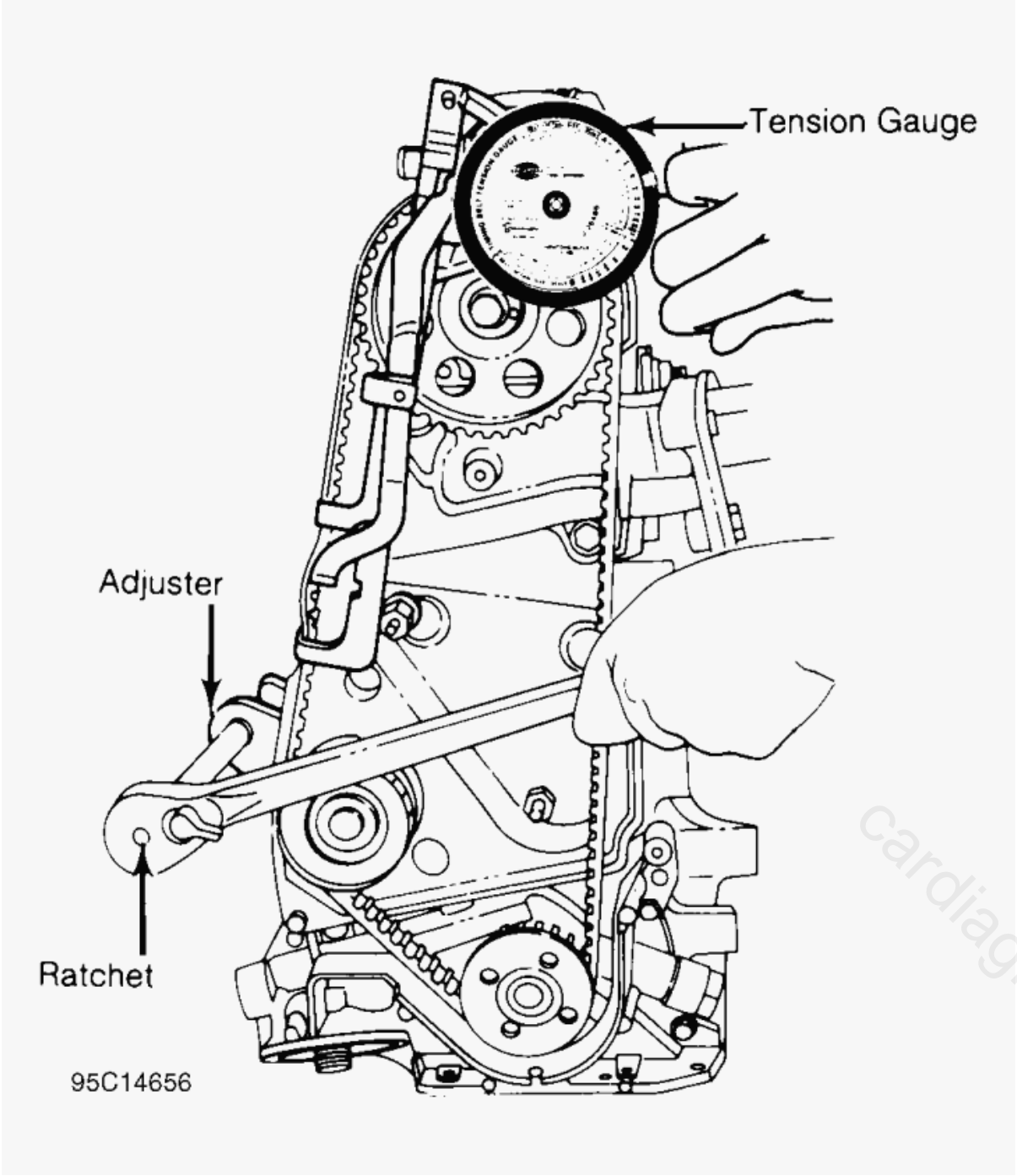


Fig. 26: Adjusting Typical Timing Belt Tension

TIMING GEARS

*** PLEASE READ THIS FIRST ***

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

TIMING GEAR BACKLASH & RUNOUT

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process.**

cardiagn.com

Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

On engines where camshaft gear operates directly on crankshaft gear, gear backlash and runout must be checked. To check backlash, install dial indicator with tip resting on tooth of camshaft gear. Rotate camshaft gear as far as possible. Adjust indicator to zero. Rotate camshaft gear in opposite direction as far as possible and note reading.

To determine timing gear runout, mount dial indicator with tip resting on face edge of camshaft gear. Adjust indicator to zero. Rotate camshaft gear 360 degrees and note reading. If backlash or runout exceeds specification, replace camshaft and/or crankshaft gear.

REAR MAIN OIL SEAL INSTALLATION

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

One-Piece Type Seal

For one-piece type oil seal installation, coat block contact surface of seal with sealer if seal is not factory coated. Ensure seal surface is free of burrs. Lubricate seal lip with engine oil and press seal into place using proper oil seal installer. See Fig. 27.

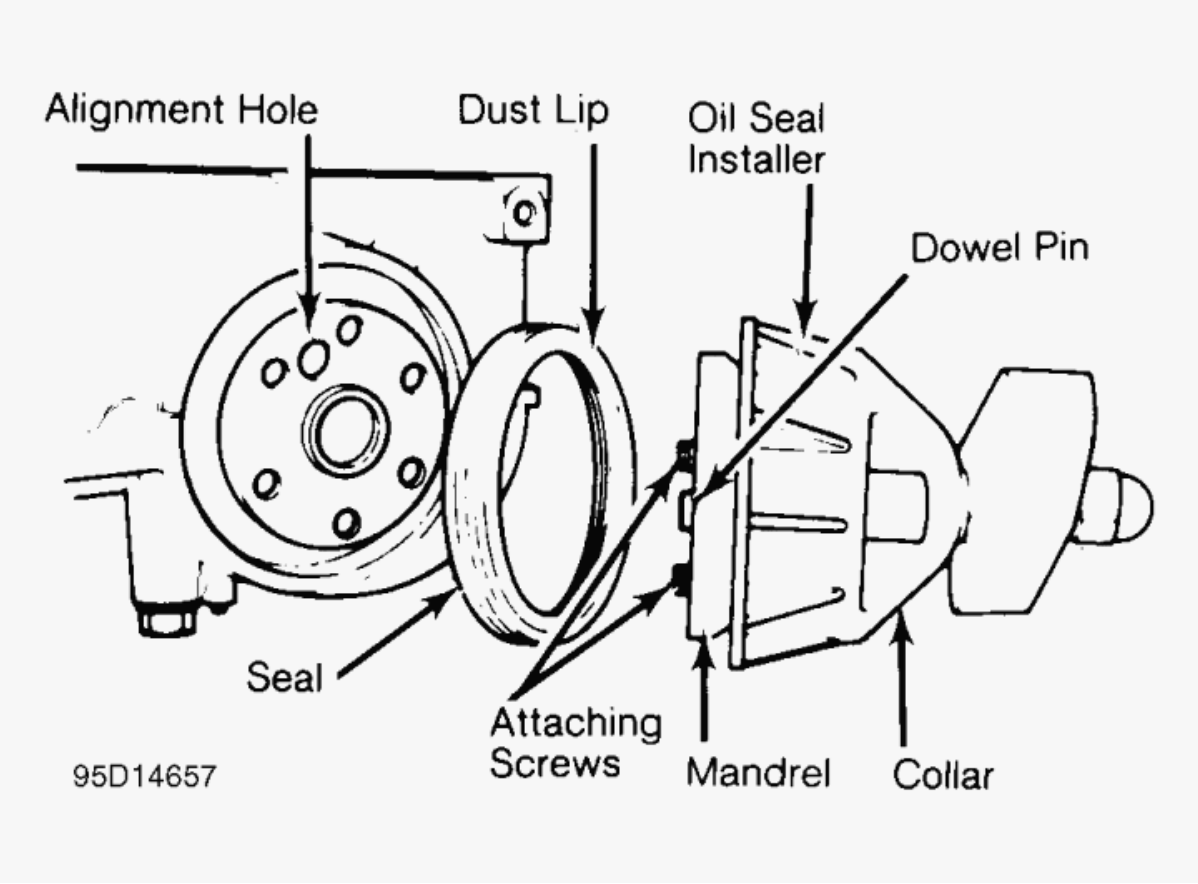


Fig. 27: Installing Typical One-Piece Oil Seal

Rope Type Seal

For rope type rear main oil seal installation, press seal lightly into seat area. Using seal installer, fully seat seal in bearing cap or cylinder block.

Trim seal ends even with cylinder block parting surface. Some applications require sealer to be applied on main bearing cap before installing. See **Fig. 28**.

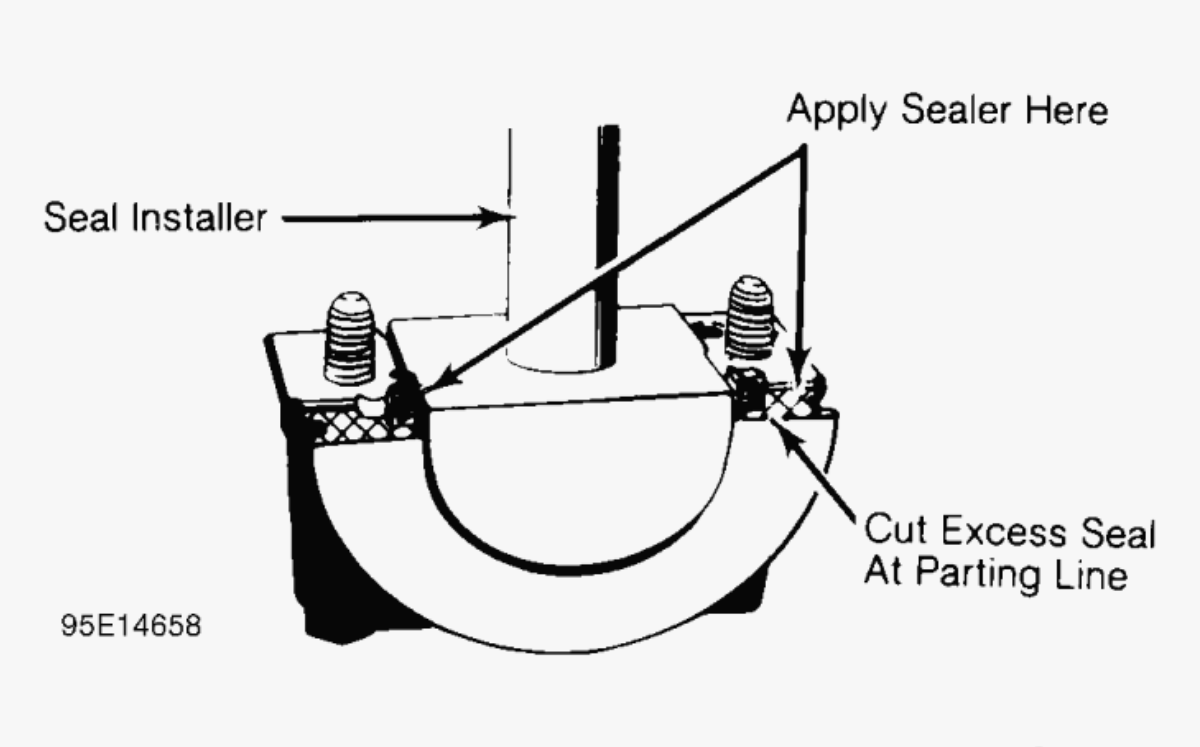


Fig. 28: Installing Typical Rope Seal

cardiagn.com

Split-Rubber Type Seal

Follow manufacturer's procedures when installing split-rubber type rear main oil seals. Installation procedures vary with manufacturer and engine type. See **Fig. 29**.

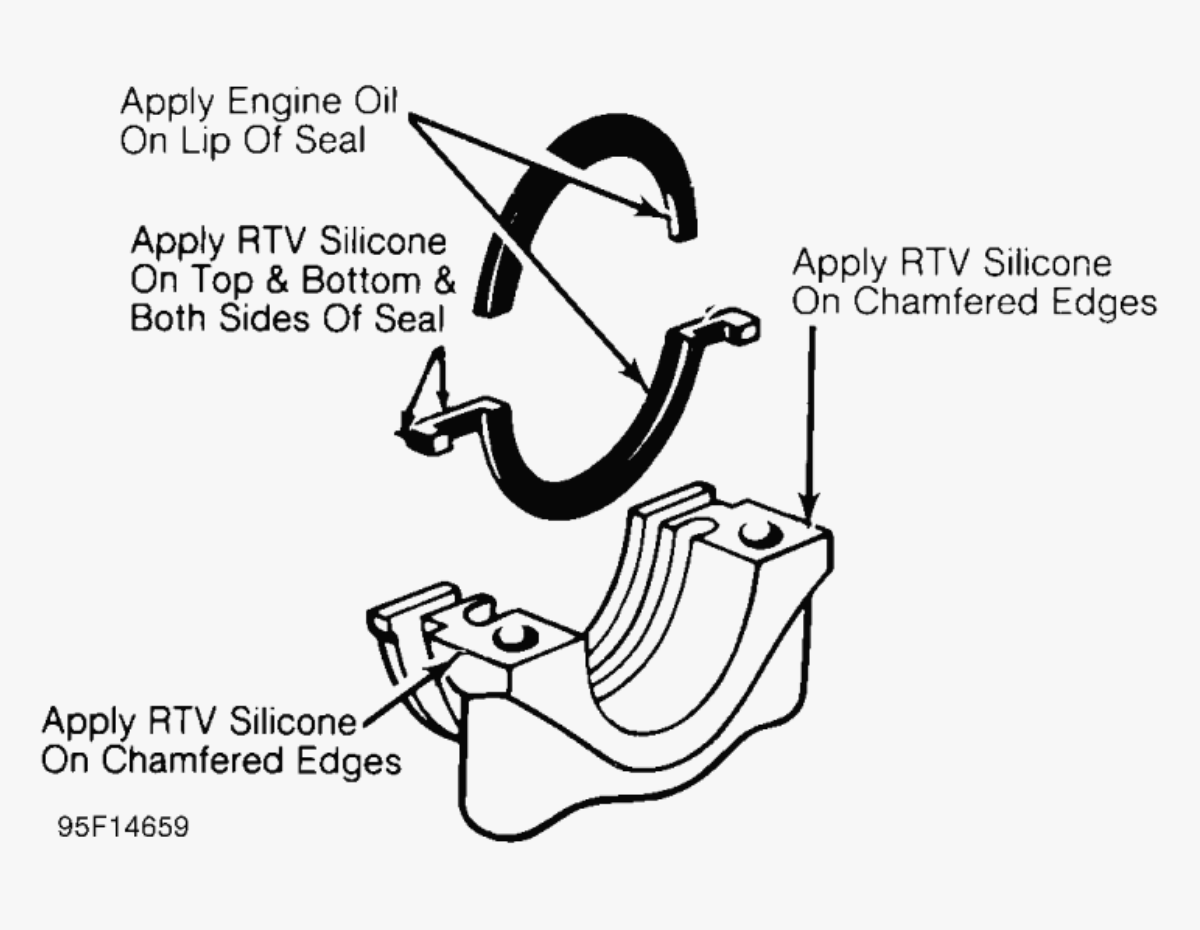


Fig. 29: Installing Typical Split-Rubber Seal

OIL PUMP

*** PLEASE READ THIS FIRST ***

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

ROTOR TYPE

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Mark oil pump rotor locations before removing. See **Fig. 30**. Remove outer rotor and measure thickness and diameter. Measure inner rotor thickness. Inspect shaft for scoring or wear. Inspect rotors for pitting or damage. Inspect cover for grooving or wear. Replace worn or damaged components.

Measure outer rotor-to-body clearance. Replace pump assembly if clearance exceeds specification. Measure clearance between rotors. See **Fig. 31**. Replace shaft and both rotors if clearance exceeds specification.

Install rotors in pump body. Position straightedge across pump body. Using feeler gauge, measure clearance between rotors and straightedge. Pump cover wear is measured using a straightedge and feeler gauge. Replace pump if clearance exceeds specification.

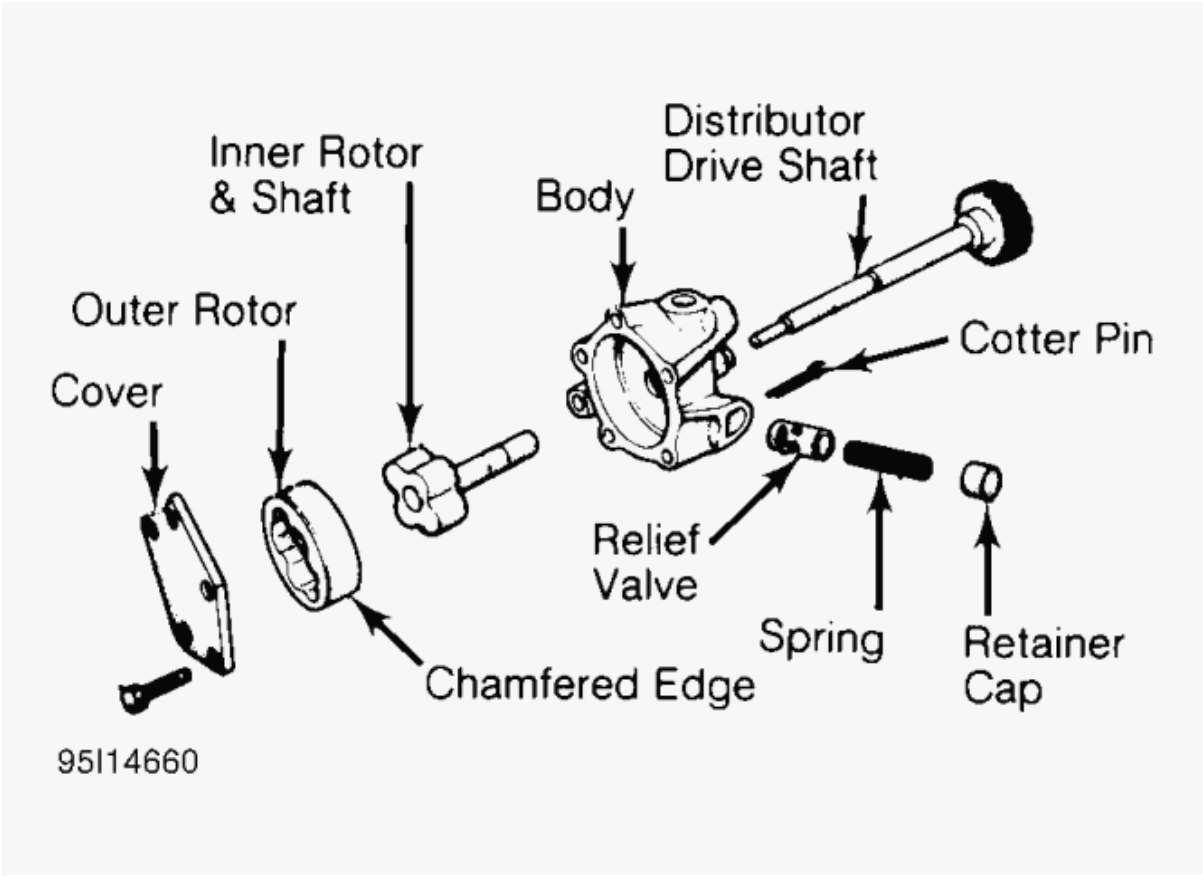


Fig. 30: Typical Rotor Type Oil Pump

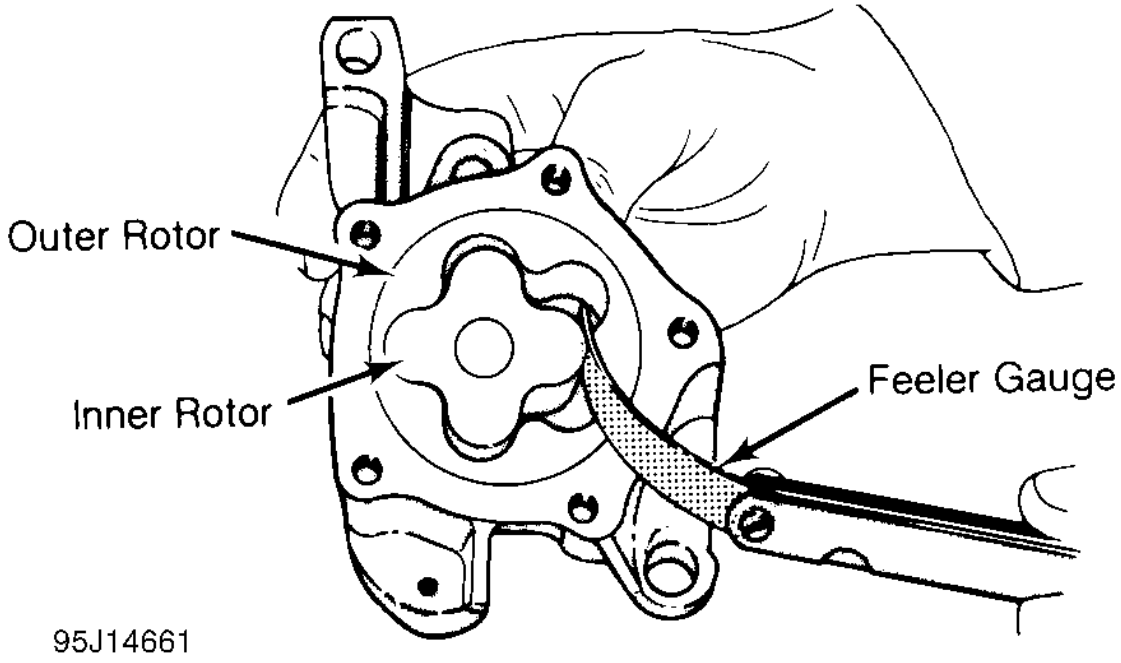


Fig. 31: Measuring Rotor Clearance

GEAR TYPE

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Mark oil pump gear location before removing. See Fig. 32. Remove gears from pump body. Inspect gears for pitting or damage. Inspect cover for grooving or wear. Measure gear diameter and length. Measure gear housing cavity depth and diameter. See Fig. 33. Replace worn or damaged components.

Pump cover wear is measured using a straightedge and feeler gauge. Replace pump or components if warpage or wear exceeds specification, or mating surface of pump cover is scratched or grooved.

cardiagn.com

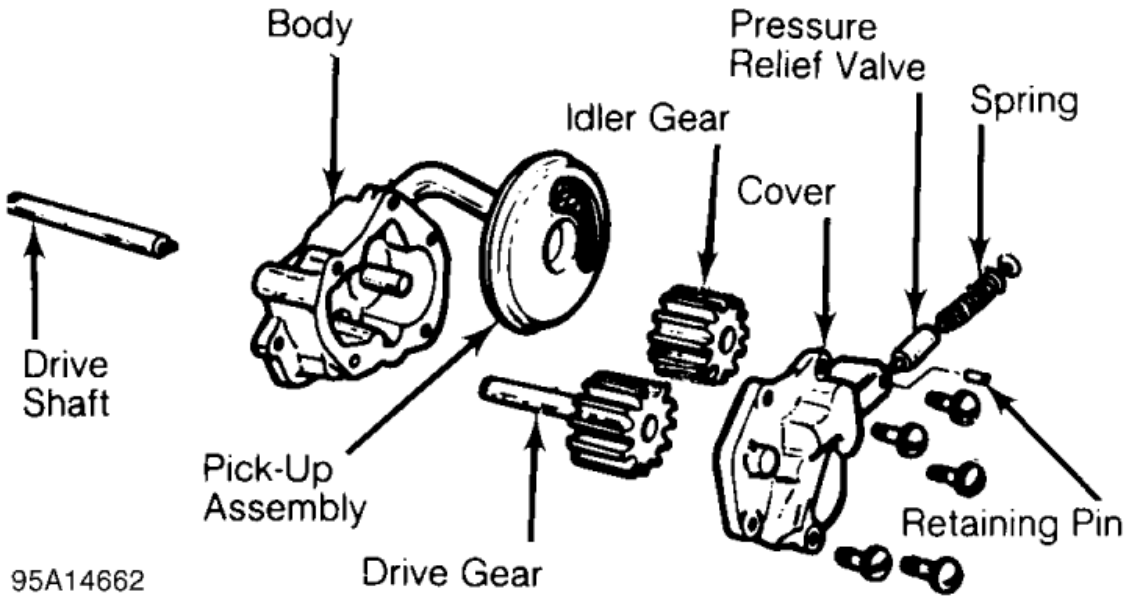


Fig. 32: Typical Gear Type Oil Pump

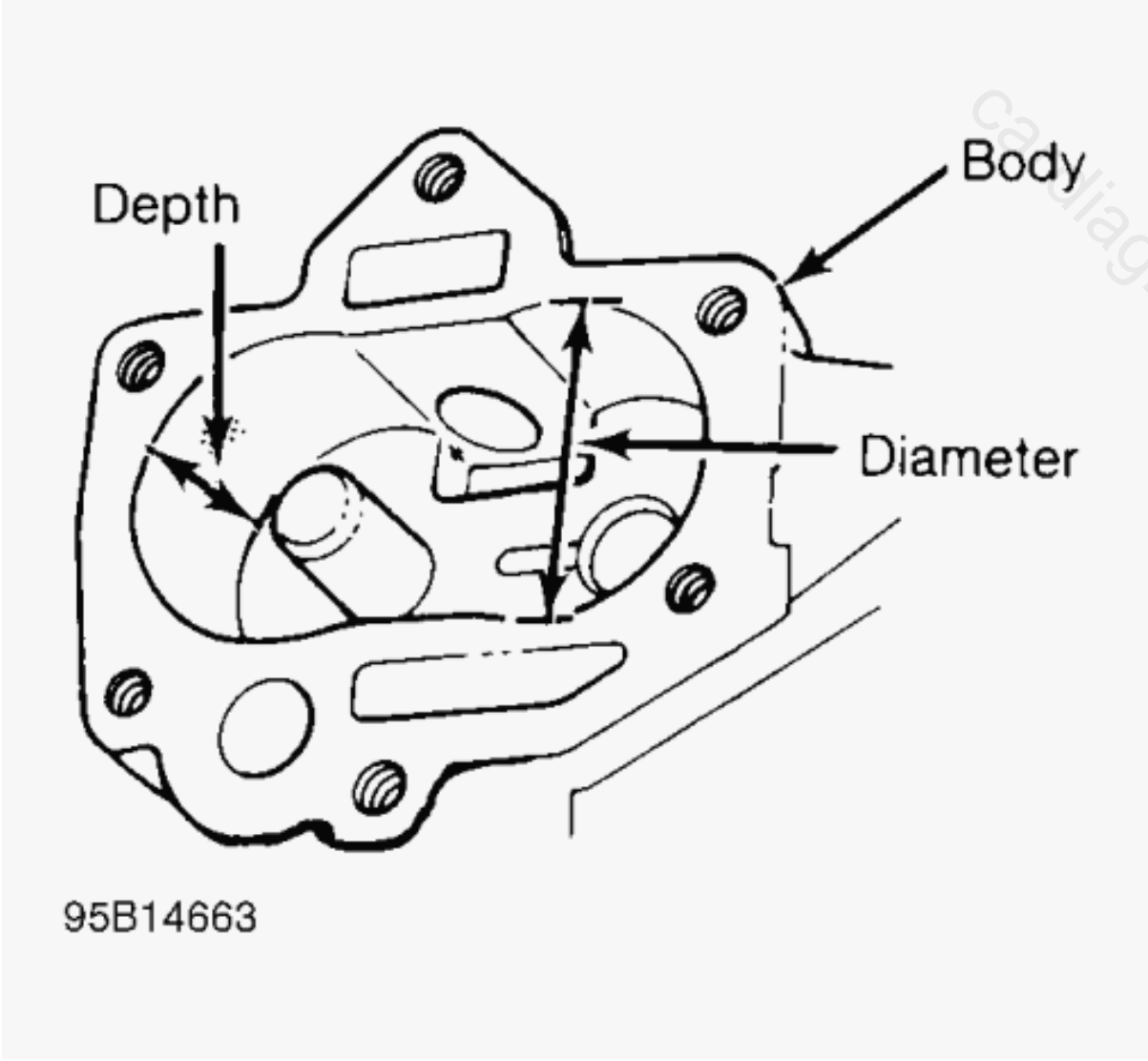


Fig. 33: Measuring Oil Pump Gear Cavity

BREAK-IN PROCEDURE

*** PLEASE READ THIS FIRST ***

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

ENGINE PRE-OILING

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Pre-oil engine prior to operation to prevent engine damage. Lightly oiled oil pump will cavitate unless oil pump cavities are filled with engine oil or petroleum jelly.

Engine pre-oiling can be done using pressure oiler (if available). Connect pressure oiler to cylinder block oil passage such as oil pressure sending unit. Operate pressure oiler long enough to ensure correct amount of oil has filled crankcase. Check oil level while pre-oiling.

If pressure oiler is not available, disconnect ignition system. Remove oil pressure sending unit and replace with oil pressure test gauge. Using starter motor, rotate engine starter until gauge shows normal oil pressure for several seconds. DO NOT crank engine for more than 30 seconds to avoid starter motor damage. Ensure oil pressure has reached the most distant point from the oil pump.

NOTE: **If new lifters or camshaft are installed, some manufacturers require that a crankcase conditioner be added to engine oil. The engine should be operated for specified amount of time to aid in lifter break-in procedure.**

INITIAL START-UP

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Start engine and operate engine at low speed while checking for coolant, fuel and oil leaks. Stop engine. Recheck coolant and oil level. Adjust if necessary.

CAMSHAFT

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Break-in procedure is required when new or reground camshaft has been installed. Operate and maintain engine speed between 1500-2500 RPM for approximately 30 minutes. Procedure may vary due to manufacturer's recommendations.

PISTON RINGS

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Piston rings require a break-in procedure to ensure seating of rings to cylinder walls. Serious damage may occur to rings if correct procedures are not followed.

Extremely high piston ring temperatures are obtained during break-in process. If rings are exposed to excessively high RPM or high cylinder pressures, ring damage can occur. Follow piston ring manufacturer's recommended break-in procedure.

FINAL ADJUSTMENTS

cardiagn.com

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Check or adjust ignition timing and dwell (if applicable). Adjust valves (if necessary). Adjust idle speed and mixture. Retighten cylinder heads (if required). If cylinder head or block is aluminum, retighten bolts when engine is cold. Follow the engine manufacturer's recommended break-in procedure and maintenance schedule for new engines.

NOTE: **Some manufacturers require that head bolts be retightened after specified amount of operation. This must be done to prevent head gasket failure.**

Back To Article

GENERAL INFORMATION

Engine Performance Diagnostic Routine Outline

* PLEASE READ THIS FIRST *

NOTE: **This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the ENGINE PERFORMANCE category.**

WHERE DOES DRIVEABILITY DIAGNOSIS START?

PERFORM BASIC INSPECTION

NOTE: **This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the ENGINE PERFORMANCE category.**

1. Verify Customer Complaint
2. Check for Relevant Technical Service Bulletins (TSBs)
3. Perform Visual Inspection **(See Basic Diagnostic Procedures)**
4. Test Engine Sub-Systems **(See Basic Diagnostic Procedures)**
    - Mechanical Condition (Compression)
    - Ignition Output
    - Fuel Delivery
5. Check Air Induction System For Leaks
6. Check & Adjust Basic Engine Settings**(See On-Vehicle Adjustments)**
    - Ignition Timing
    - Idle Speed

CHECK FOR TROUBLE CODES

NOTE: **This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the ENGINE PERFORMANCE category.**

1. Check for Diagnostic Trouble Codes (DTCs).**(See Self-Diagnostics)**
2. Repair cause of DTCs.
3. Clear PCM memory and repeat self-test.

DIAGNOSE SYMPTOM

NOTE: **This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the ENGINE PERFORMANCE category.**

1. If no self-diagnostics available, or no trouble codes present, identify symptom.
2. See trouble shooting procedure to identify problem. **(See Trouble Shooting - No Codes)**

TEST SYSTEM

NOTE: **This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the ENGINE PERFORMANCE category.**

cardiagn.com

1. Perform required tests. **(See Systems & Component Testing)**
2. Verify complaint is repaired.

---

cardiagn.com

Back To Article

GENERAL INFORMATION

Engine Performance Safety Precautions

- Always refer to Emission Decal in engine compartment before servicing vehicle. If manual and decal differ, always use decal specifications.
- Do not allow or create a condition of misfire in more than one cylinder for an extended period of time. Damage to converter may occur due to loading converter with unburned air/fuel mixture.
- Always turn ignition off and disconnect negative battery cable BEFORE disconnecting or connecting computer or other electrical components.
- DO NOT drop or shock electrical components such as computer, airflow meter, etc.
- DO NOT use fuel system cleaning compounds that are not recommended by the manufacturer. Damage to gaskets, diaphragm materials and catalytic converter may result.
- Before performing a compression test or cranking engine using a remote starter switch, disconnect coil wire from distributor and secure it to a good engine ground, or disable ignition.
- Before disconnecting any fuel system component, ensure fuel system pressure is released.
- Use a shop towel to absorb any spilled fuel to prevent fire.
- DO NOT create sparks or have an open flame near battery.
- If any fuel system components such as hoses or clamps are replaced, ensure they are replaced with components designed for fuel system use.
- Always reassemble throttle body components with new gaskets, "O" rings and seals.
- If equipped with an inertia switch, DO NOT reset switch until fuel system has been inspected for leaks.
- Wear safety goggles when drilling or grinding.
- Wear proper clothing which protects against chemicals and other hazards.

sandiagn.com

Back To Article

GENERAL INFORMATION

English-Metric Conversion Chart

METRIC CONVERSIONS

Metric conversions are making life more difficult for the mechanic. In addition to increasing the number of tools required, metric-dimensioned nuts and bolts are used alongside English components in many new vehicles. The mechanic has to decide which tool to use, slowing down the job. The tool problem can be solved by trial and error, but some metric conversions aren't so simple.

Converting temperature, lengths or volumes requires a calculator and conversion charts, or else a very nimble mind. Conversion charts are only part of the answer though, because they don't help you "think" metric, or "visualize" what you are converting. The following examples are intended to help you "see" metric sizes:

LENGTH

Meters are the standard unit of length in the metric system. The smaller units are 10ths (decimeter), 100ths (centimeter), and 1000ths (millimeter) of a meter. These common examples might help you to visualize the metric units:

- A meter is slightly longer than a yard (about 40 inches).
- An aspirin tablet is about one centimeter across (.4 inches).
- A millimeter is about the thickness of a dime.

cardiaca.com

VOLUME

The metric weight system is based on the gram, with the most common unit being the kilogram (1000 grams). Our comparable units are ounces and pounds:

- A kilogram is about 2.2 pounds.
- A kilogram is about 2.2 pounds.

TORQUE

Torque is somewhat complicated. The term describes the amount of effort exerted to turn something. A chosen unit of weight or force is applied to a lever of standard length. The resulting leverage is called torque. In our standard system, we use the weight of one pound applied to a lever a foot long, resulting in the unit called a foot-pound. A smaller unit is the inch-pound (the lever is one inch long). Metric units include the meter kilogram (lever one meter long with a kilogram of weight applied) and the Newton-meter (lever one meter long with force of one Newton applied). Some conversions are:

- A meter kilogram is about 7.2 foot pounds.
- A foot pound is about 1.4 Newton-meters.
- A centimeter kilogram (cmkg) is equal to .9 inch pounds.

PRESSURE

Pressure is another complicated measurement. Pressure is described as a force or weight applied to a given area. Our common unit is pounds per square inch. Metric units can be expressed in several ways. One is the kilogram per square centimeter (kg/cm^2). Another unit of pressure is the Pascal (force of one Newton on an area of one square meter), which equals about 4 ounces on a square yard. Since this is a very small amount of pressure, we usually see the kiloPascal, or kPa (1000 Pascals). Another common automotive term for pressure is the bar (used by German manufacturers), which equals 10 Pascals. Thoroughly confused? Try the examples below:

- Atmospheric pressure at sea level is about 14.7 psi.

- Atmospheric pressure at sea level is about 1 bar.
- Atmospheric pressure at sea level is about 1 kg/cm^2 .
- One pound per square inch is about 7 kPa.

CONVERSION FACTORS

CONVERSION FORMULA

To Convert	To	Multiply By
LENGTH		
Millimeters (mm)	Inches	.03937
Inches	Millimeters	25.4
Meters (M)	Inches	39.37
Meters (M)	Feet	3.28084
Feet	Meters	.3048
Kilometers (Km)	Miles	.62137
AREA		
Square Centimeters (cm^2)	Square Inches	.155
Square Inches	Square Centimeters	6.45159
VOLUME		
Cubic Centimeters	Cubic Inches	.06103
Cubic Inches	Cubic Centimeters	16.38703
Liters	Cubic Inches	61.025
Cubic Inches	Liters	.01639
Liters	Quarts	1.05672
Quarts	Liters	.94633
Liters	Pints	2.11344
Pints	Liters	.47317
Liters	Ounces	33.81497
Ounces	Liters	.02957
WEIGHT		
Grams	Ounces	.03527
Ounces	Grams	28.34953
Kilograms	Pounds	2.20462
Pounds	Kilograms	.45359
WORK		
Centimeter Kilograms	Inch Pounds	.8676
Pounds/Sq. Inch	Kilograms/Sq. Centimeter	.07031
Bar	Pounds/Sq. Inch	14.504
Pounds/Sq. Inch	Bar	.06895
Atmosphere	Pounds/Sq. Inch	14.696
Pounds/Sq. Inch	Atmosphere	.06805
TEMPERATURE		
Centigrade Degrees	Fahrenheit Degrees	$(C\hat{A}°x^9/_5)+32$
Fahrenheit Degrees	Centigrade Degrees	$(F\hat{A}°-32)x^5/_9$

EQUIVALENCIES

Inches	Decimals	mm
1/64	.016	.397
1/32	.031	.794
3/64	.047	1.191
1/16	.063	1.588
5/64	.078	1.984

Inches	Decimals	mm
3/32	.094	2.381
7/64	.109	2.778
1/8	.125	3.175
9/64	.141	3.572
5/32	.156	3.969
11/64	.172	4.366
3/16	.188	4.763
13/64	.203	5.159
7/32	.219	5.556
15/64	.234	5.953
1/4	.250	6.350
17/64	.266	6.747
9/32	.281	7.144
19/64	.297	7.541
5/16	.313	7.938
21/64	.328	8.334
11/32	.344	8.731
23/64	.359	9.128
3/8	.375	9.525
25/64	.391	9.992
13/32	.406	10.319
27/64	.422	10.716
7/16	.438	11.113
29/64	.453	11.509
15/32	.469	11.906
31/64	.484	12.303
1/2	.500	12.700
33/64	.516	13.097
17/32	.531	13.494
35/64	.547	13.891
9/16	.563	14.288
37/64	.578	14.684
19/32	.594	15.081
39/64	.609	15.478
5/8	.625	15.875
41/64	.641	16.272
21/32	.656	16.669
43/64	.672	17.066
11/16	.687	17.463
45/64	.703	17.859
23/32	.719	18.256
47/64	.734	18.653
3/4	.750	19.050
49/64	.766	19.447
25/32	.781	19.844
51/64	.797	20.241
13/16	.813	20.638
53/64	.828	21.034
27/32	.844	21.431
55/64	.859	21.828
7/8	.875	22.225
57/64	.891	22.622

carbon.com

Inches	Decimals	mm
29/32	.906	23.019
59/64	.922	23.416
15/16	.938	23.813
61/64	.953	24.209
31/32	.969	24.606
63/64	.984	25.003
1	1.000	25.400

Release September 2019

cardiagn.com

Back To Article

GENERAL INFORMATION

Gear Tooth Contact Patterns

* PLEASE READ THIS FIRST *

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

INSPECTION

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

Wipe lubricant from internal parts. Rotate gears and inspect for wear or damage. Mount dial indicator to housing and check backlash at several points around ring gear. Backlash must be within specification at all points. If no defects are found, check gear tooth pattern contact.

NOTE: **Drive pattern should be well centered on ring gear teeth. Coast pattern should be centered, but may be slightly toward toe of ring gear teeth.**

GEAR TOOTH CONTACT PATTERN

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

1. Paint ring gear teeth with marking compound. Wrap cloth or rope around drive pinion flange to act as brake. Rotate gear until clear contact pattern is obtained.
2. Contact pattern will indicate whether correct pinion bearing mounting shim has been installed and if drive gear backlash has been set properly. Backlash between drive gear pinion must be maintained within specified limits until correct tooth pattern is obtained.

ADJUSTMENTS

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

GEAR BACKLASH & PINION SHIM CHANGES

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

1. With no change in backlash, moving pinion further from ring gear moves drive pattern toward heel and top of tooth, and moves coast pattern toward toe and top of tooth.
2. With no change in backlash, moving pinion closer to ring gear moves drive pattern toward toe and bottom of tooth, and moves coast pattern toward heel and bottom of tooth.
3. With no change in pinion shim thickness, an increase in backlash moves ring gear further from pinion. Both drive and coast patterns move toward heel and top of tooth.
4. With no change in pinion shim thickness, a decrease in backlash moves ring gear closer to pinion gear. Both drive and coast patterns move toward toe and bottom of tooth.

cardiagn.com

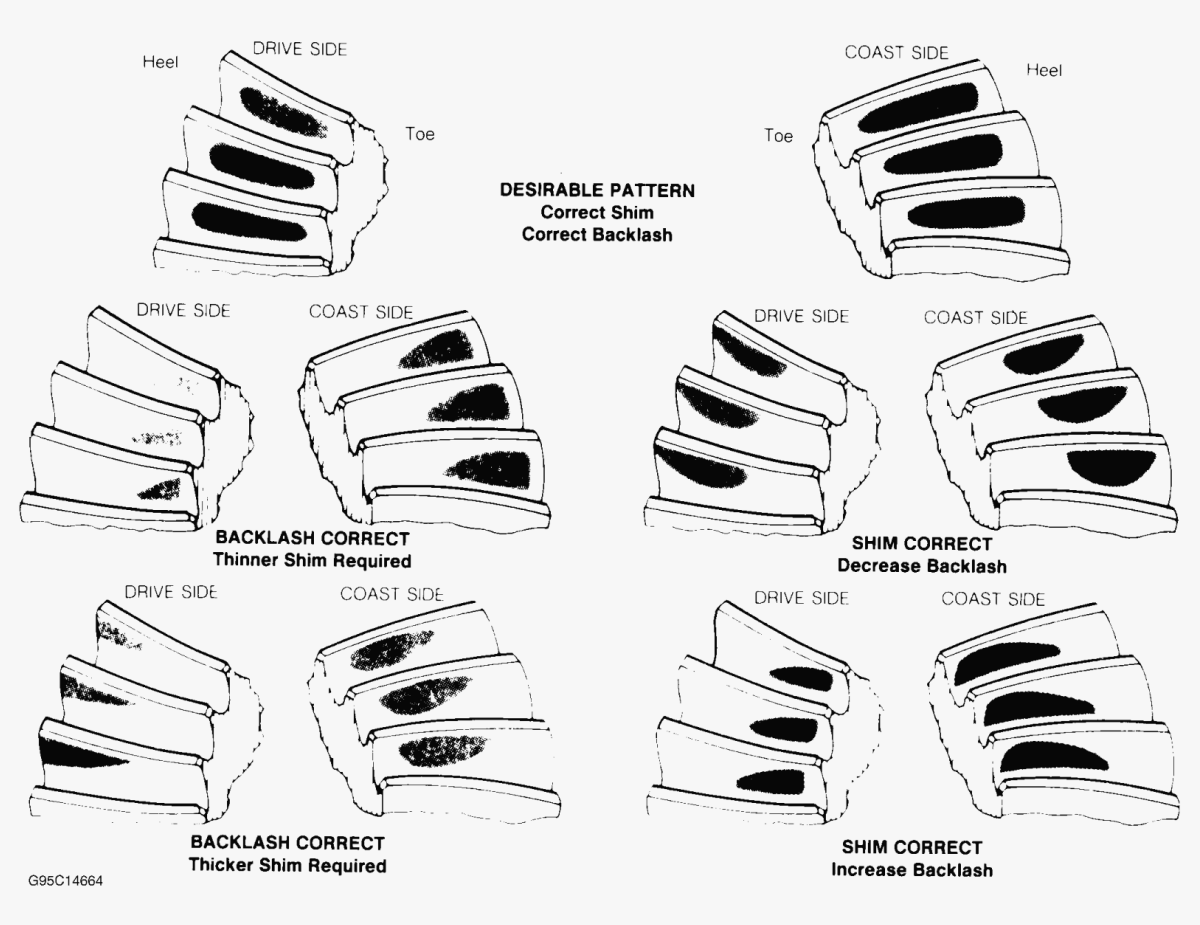


Fig. 1: Drive Axle Gear Tooth Patterns

cardiagn.com

Back To Article

GENERAL INFORMATION

General Cooling System Service

* PLEASE READ THIS FIRST *

This article is generic in nature and all information does not apply to all vehicles including those without a liquid cooling system. For vehicle specific information, see the appropriate articles in the ENGINE category.

DESCRIPTION

The liquid cooling system consists of a radiator, water pump, thermostat, electric or belt-driven cooling fan, pressure cap, heater, and various connecting hoses and cooling passages in the engine block and cylinder head.

MAINTENANCE

DRAINING

Remove radiator cap and open heater control valve to maximum heat position. Open drain cocks or remove plugs in bottom of radiator and engine block. In-line engines usually have one plug or drain cock, while "V" type engines have 2, one in each bank of cylinders.

FLUSHING

CAUTION: **Some manufacturers use an aluminum and plastic radiator. Flushing solution must be compatible with aluminum.**

Radiator

Connect flushing gun to water outlet of radiator. Disconnect water inlet hose. To prevent flooding engine, use a hose connected to radiator inlet. Use air in short bursts to prevent damage to radiator. Continue flushing until water runs clear.

Engine Block

To flush engine, remove thermostat. Connect flushing gun to water outlet of radiator. Use air in short bursts to prevent damage to radiator. Continue flushing until water runs clear.

REFILLING

To prevent air from being trapped in engine block, engine should be running when refilling cooling system. After system is full, continue running engine until thermostat is open, then recheck fill level. Do not overfill system.

TESTING

THERMOSTAT

1. Remove and inspect thermostat for corrosion and proper seating of valve. If okay, suspend thermostat and thermometer in a 50/50 mixture of coolant and water. See Fig. 1. DO NOT allow thermostat or thermometer to touch bottom or container. Heat water until thermostat begins to open.
2. Read temperature on thermometer. This is the initial opening temperature and should be within specification. Continue heating water until thermostat is fully open and note temperature. This is the fully open temperature. If either reading is not to specification, replace thermostat.

cardiagn.com

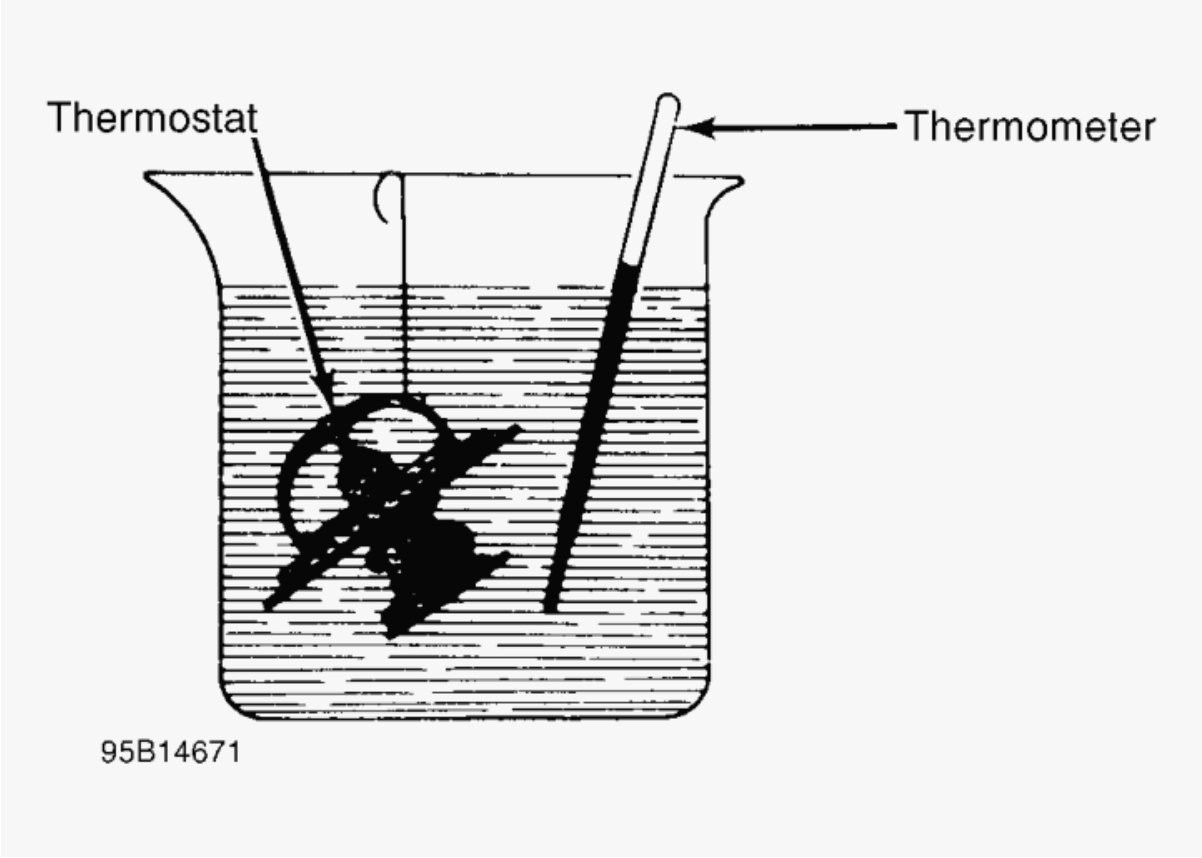


Fig. 1: Testing Thermostat in Coolant/Water Solution

PRESSURE TESTING

A pressure tester is used to check both radiator cap and complete cooling system. Follow pressure tester manufacturer instructions and test components as follows:

Radiator Cap

Visually inspect radiator cap. If cap looks okay, connect pressure tester to cap. See **Fig. 2**. Pressurize tester to full radiator cap specification. Replace cap if it fails to hold pressure.

carmagn.com

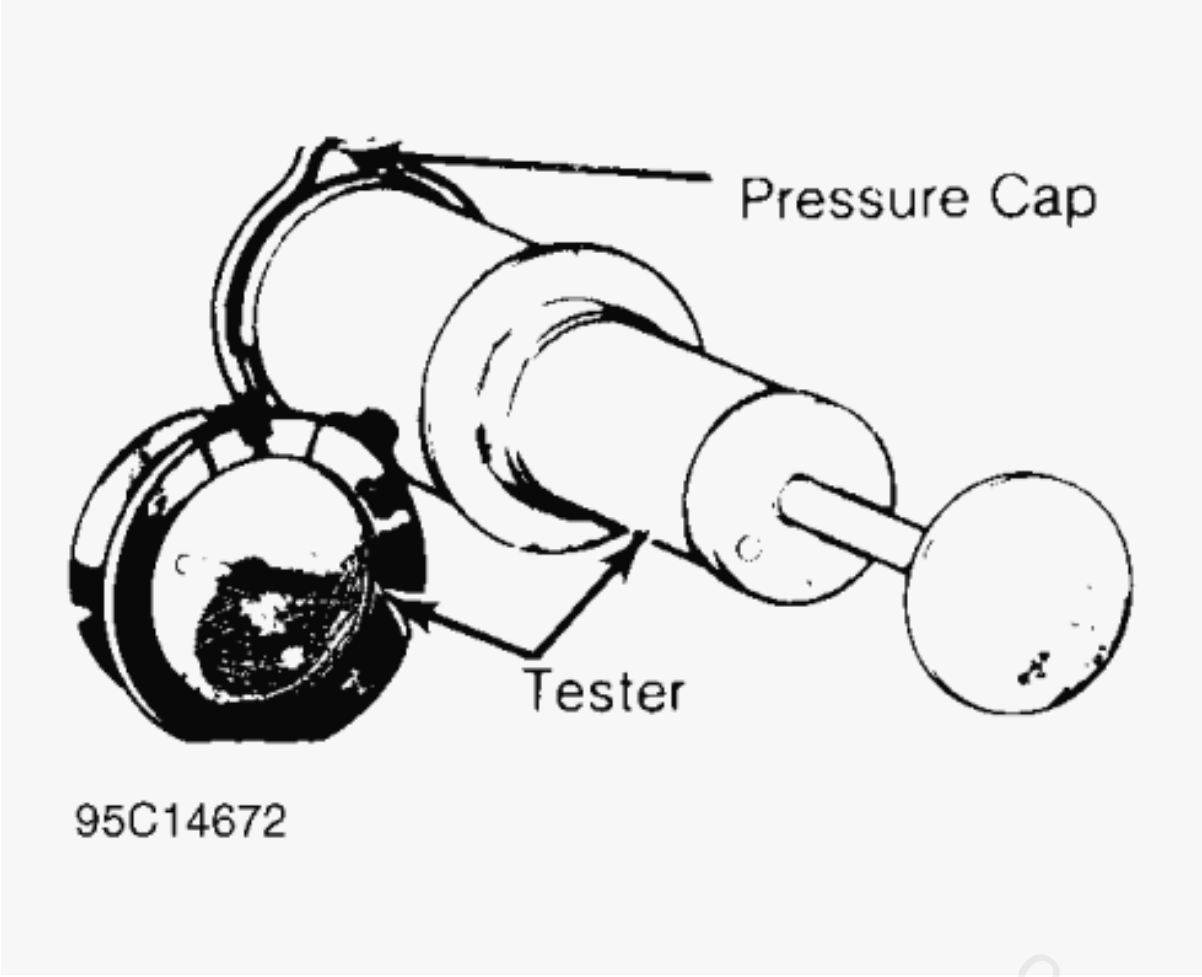


Fig. 2: Pressure Testing Radiator Cap

Cooling System

1. Turn ignition off and allow engine to cool. Ensure radiator if filled to correct level. Remove cap and attach pressure tester to radiator. Pressurize tester to full radiator rating specification.
2. If pressure drops, check for external leaks. If no leaks are found, start engine and allow to idle. If pressure builds up immediately, check cylinder head and block for cracks. If pressure does not build up immediately, go to next step.

   CAUTION: DO NOT allow excess pressure to build in cooling system or damage may result.

3. Using pressure tester, pump cooling system up to pressure specified on radiator cap. If pump gauge pointer vibrates, compression or combustion leak into cooling system is indicated. Isolate leak by shorting each spark plug wire to cylinder block. Gauge pointer vibration will stop or decrease when leaking cylinder is shorted.

---

cardiagn.com

Back To Article

INTRODUCTION

ARROWS AND SYMBOLS

The arrows and symbols shown below are used in service information to indicate position of vehicle, direction, and location.

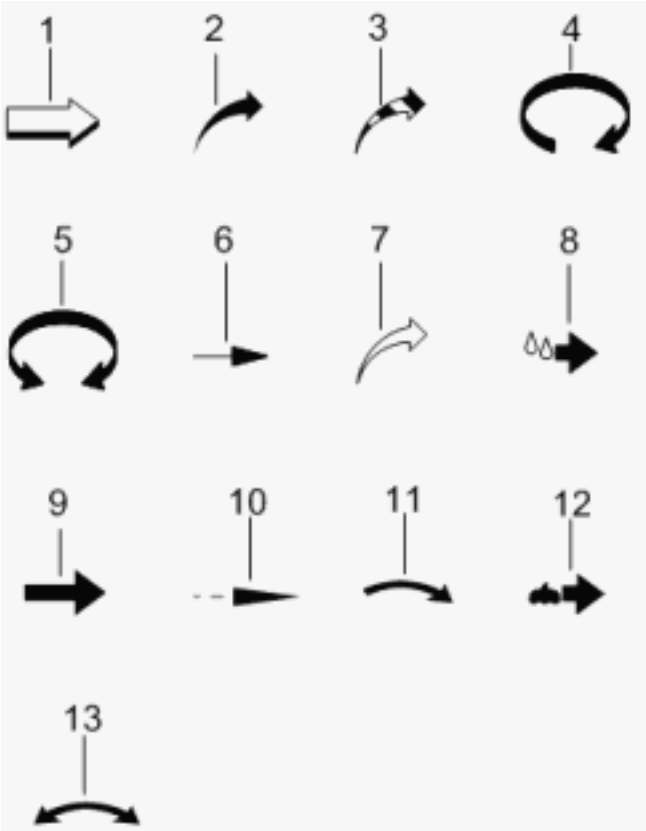


Fig. 1: Arrows and Symbols
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front of Vehicle Arrow - Direction of arrow may vary.
2	View Detail Arrow - Direction of arrow may vary.
3	Ambient Air Mixed with Another Gas or Indicate Temperature Change Arrow - Direction of arrow may vary.
4	Motion or Direction Single Arrow
5	Motion or Direction Double Arrow
6	Dimension Arrow - Used for showing a dimension.
7	Ambient/Clean Air Flow or Cool Air Flow Arrow - Direction of arrow may vary.
8	Lubrication Point Arrow - Oil or Fluid
9	Task Related Arrow - Used to show task related location.
10	Sectioning Arrow - Used to show sectioning.
11	Motion Arrow - Direction of arrow may vary.
12	Lubrication Point Arrow - Grease or Petroleum Jelly
13	Multidirectional Arrow

ACRONYMS AND UNITS

cardiagn.com

Acronyms

Acronym	Meaning	Definition
2WD	Two-Wheel Drive	Indicates that a vehicle has 2 driven wheels OR that a 4WD vehicle uses only 2 wheels for propulsion. So it can be the description of a vehicle configuration OR the operational mode of the drivetrain.
4WD	Four-Wheel Drive	Four-wheeled vehicle with a drivetrain that allows all four wheels to receive power from the engine simultaneously which provides better control on various surfaces. Can be used to describe the configuration of the vehicle OR as the operational mode of the drivetrain. 4WD vehicles usually can turn 2 wheels off to be in a 2WD mode. See also AWD.
A/C	Air Conditioning	The cooling and dehumidification of indoor air for thermal comfort.
A/D	Analog to Digital	Used in context of converting electrical analog signals to digital signals.
ABS	Antilock Braking System	System on motor vehicles which prevents the wheels from locking while braking which helps the driver maintain control in heavy braking conditions.
AC	Alternating Current	An electrical current whose magnitude and direction vary cyclically.
AGM	Absorbent Glass Mat	the AGM battery uses a very absorbent micro fiberglass material to trap the gas generated during discharge and recharge.
AM	Amplitude Modulation	Method of impressing data onto an alternating-current (AC) carrier waveform.
APP	Accelerator Pedal Position	A pedal that controls the throttle valve.
AWD	All-Wheel Drive	All-wheel-drive systems are designed to function on all types of surfaces, both on- and off-road, and most of them cannot be switched off. This can also be called full-time four wheel drive. See also 4WD.
AWG	American Wire Gauge	American wire gauge is a standardized wire gauge system used since 1857 predominantly in the United States for the diameters of round, solid, nonferrous, electrically conducting wire. E.g. a wire of AWG10 has a diameter of 2.588mm, AWG20 corresponds to a diameter of 0.812mm.
B+	Battery Positive Voltage	The electrical potential on the positive terminal of the battery.
BARO	Barometric Pressure	Atmospheric pressure as measured by a barometer.
BCM	Body Control Module	This module supplies vehicle occupants with visual and audible information and controls various vehicle functions,
BECM	Battery Energy Control Module	Control module used to regulate the battery voltage.
BPP	Brake Pedal Position	Position of the foot pedal that moves a piston in the master brake cylinder.
CAN	Controller Area Network	Serial data connection between control modules by Bosch
CCM	Chassis Control Module	The module that controls various vehicle functions on the Chassis, like Engine/Trans Mount, Active Grille Air Shutter, Load Leveling, etc•••

Acronym	Meaning	Definition
CD	Compact Disc	A small optical disk on which data such as music, text, or graphic images is digitally encoded.
CNG	Compressed Natural Gas	This a substitute for gasoline or diesel fuel. It is made by compressing natural gas (which is mainly composed by methane (CH4), in a percentage range of 70% to 98%)
CO	Carbon Monoxide	This is a product of the incomplete combustion of carbon-containing compounds, at room temperature this is a gas. It consists of one carbon atom covalently bonded to one oxygen atom.
CO2	Carbon Dioxide	Chemical compound composed of two oxygen atoms covalently bonded to a single carbon atom.
CPA	Connector Position Assurance	Part of an electrical connector that prevents the connector from moving out of its socket. Usually needs to be pressed to unlock the connector when disconnecting it.
CPP	Clutch Pedal Position	A lever operated with the foot that controls the coupling that connects or disconnects driving and driven parts of a driving mechanism.
CV	Constant Velocity	Used in conjunction with CV joints, which connect two shafts at an angle while both shafts always have the same rotational speed without variations.
CVT	Continuously Variable Transmission	A transmission in which the ratio of the rotational speeds of two shafts, as the input shaft and output shaft of a vehicle or other machine, can be varied continuously within a given range, providing an infinite number of possible ratios which improves fuel economy.
D	Drive	D on the transmission gear selector lever.
DAB	Digital Audio Broadcast	Technology for broadcasting of audio using digital radio (carries information via digital signal) transmission.
DC	Direct Current	Continuous current, constant flow of electric charge.
DLC	Data Link Connector	This is an electronic connector typically located underneath the driver's side dashboard, just above the pedals. The connector has 16 pins.
DMM	Digital Multimeter	Electronic measuring instrument that combines several functions in one unit. The most basic instruments include an ammeter, voltmeter, and ohmmeter.
DOHC	Dual Overhead Camshaft	Dual overhead camshafts (DOHC) are higher performance engines, they produce more power, and can run at higher speeds because they allow an engine to have four valves per cylinder. Each camshaft operates two of the valves, one camshaft handles the intake valves, and one handles the exhaust valves
DPF	Diesel Particulate Filter	Device designed to remove diesel particulate matter or soot from the exhaust gas of a diesel engine.
DRL	Daytime Running Lamps	White lights mounted on the front of an automobile that automatically switch on when the key is turned and are intended for daytime use, to increase the visibility of the automobile.
DSCC	Distance Sensing Cruise Control	A type of cruise control that automatically maintains the distance between vehicles.

Acronym	Meaning	Definition
DSP	Digital Signal Processor	A specialized microprocessor designed specifically for digital signal processing, generally in real-time computing.
DTC	Diagnostic Trouble Code	An electronic signal stored in an automotive computer, indicating the presence of a fault detected by that computer.
DVD	DVD	A popular optical disc storage media format the size of a CD. Used mainly for movies but also for data. DVD has no spelled out version (officially it does not mean Digital Video Disc or Digital Versatile Disc, it just means DVD).
EBCM	Electronic Brake Control Module	This module contains a microprocessor and software for antilock braking system operation.
ECM	Engine Control Module	This electronic module works with a vehicle's sensors and engine control devices to insure that the engine operates at maximum efficiency and performance. It performs three vital functions. Receives electronic signals from engine sensors. Analyzes the data and makes an engine performance decision (based on the pre-set parameters within the unit). Sends an "output command" to an actuator that adjusts engine performance.
ECT	Engine Coolant Temperature	A measure of how hot or cold the fluid which flows through the engine in order to prevent its overheating, transferring the heat produced by the device to other devices that utilize or dissipate it.
EEPROM	Electrically Erasable Programmable Read-Only Memory	A non-volatile storage chip used in computers and other devices to store small amounts of volatile data, e.g. calibration tables or device configuration.
EGR	Exhaust Gas Recirculation	Is an NOx (nitrogen oxide and nitrogen dioxide) reduction technique used in most gasoline and diesel engines. EGR works by recirculating a portion of an engine's exhaust gas back to the engine cylinders.
EMI	Electromagnetic Interference	Electromagnetic interference (also called radio frequency interference) is a disturbance that affects an electrical circuit due to either electromagnetic conduction or electromagnetic radiation emitted from an external source.
ESD	Electrostatic Discharge	The sudden and momentary electric current that flows between two objects at different electrical potentials.
EV	Electric Vehicle	A category of vehicles that only have an electric drive system.
EVAP	Evaporative Emission	A system that controls the fuel fumes in the fuel tank.
FM	Frequency Modulation	In telecommunication this is a way to convey information over a carrier wave by varying its frequency.
FWD	Front-Wheel Drive	A form of engine/transmission layout used in motor vehicles, where the engine drives the front wheels only.
GMLAN	General Motors Local Area Network	A local-area network is a computer network covering a small geographic area, like a home or vehicle. This specific type of LAN connects several controllers inside the vehicle and was developed by General Motors.

Acronym	Meaning	Definition
GPS	Global Positioning System	Satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense.
GSM	Global System for Mobile Communications	Globally accepted standard for digital cellular communication.
GVW	Gross Vehicle Weight	Maximum total weight of a road vehicle or trailer that is loaded, including the weight of the vehicle itself plus fuel, passengers, cargo, and trailer tongue weight.
HD	Heavy Duty	Robust design to accommodate large work loads.
HID	High Intensity Discharge	A type of light that produces a bright light by using gas filled bulbs. (gas is usually mercury, metal halide, and high-pressure sodium) Uses very little battery power and is a very "cool" light.
HO2S	Heated Oxygen Sensor	Heated oxygen sensors have an internal heater circuit that brings the sensor up to operating temperature more quickly than an unheated sensor. An oxygen sensor must be hot (about 600 - 650Â°F) before it will generate a voltage signal. The hot exhaust from the engine will provide enough heat to bring an O2 sensor up to operating temperature.
HVAC	Heating Ventilation Air Conditioning	This system is sometimes referred to as climate control. Ventilation air ducts installed throughout a vehicle that supply conditioned air to a room through rectangular or round outlet vents.
I^2C	Inter-Integrated Circuit	Serial data connection between Integrated Circuits (microchips) inside a control module invented by Phillips
IAT	Intake Air Temperature	Temperature of the air entering intake air flow system of the engine.
ICE	Internal Combustion Engine	An engine in which the combustion of fuel and an oxidizer (typically air) occurs in a confined space called a combustion chamber.
ID	Identification	Number or Code that identifies a component or control module. Can be written on the part or be transmitted on a bus or via radio.
ISP	Internet Service Provider	A company that furnishes corporations and individual consumers with various services, mainly access to the Internet.
ISS	Input Shaft Speed	Rotational speed of the input shaft of a transmission.
LAN	Local Area Network	Standard network connection PC's.
LCD	Liquid Crystal Display	A thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector.
LED	Light Emitting Diode	Small light bulbs that fit easily into an electrical circuit they do not have a filament that will burn out, and they do not get especially hot. They are illuminated solely by the movement of electrons in a semiconductor material.
LIN	Local Interconnect Network	Computer networking bus system used within automotive network architectures. Similar to CAN, but cheaper and less powerful.
LPG	Liquefied Petroleum Gas	A mixture of mainly propane and butane, produced commercially and stored under pressure to keep it in a liquid state.
MAF	Mass Air Flow	The amount of air drawn into the engine

Acronym	Meaning	Definition
MAP	Manifold Absolute Pressure	Pressure in the engine intake system after the throttle valve referenced to a perfect vacuum.
MDI	Multiple Diagnostics Interface	A device used by GM dealers that enables a PC to communicate with the control modules in a vehicle.
MIL	Malfunction Indicator Lamp	An indicator of the internal status of a car engine.
MOST	Media Oriented Systems Transport	Serial communication bus to transmit audio and video information.
N	Neutral	A state of the transmission in which it is not engaged.
NiMH	Nickel Metal Hydride	A type of rechargeable battery that uses a hydrogen absorbing alloy for the negative electrode.
NOx	Nitrogen Oxides	Refers to any of the following oxygen compounds of nitrogen or a mixture of them. Nitric Oxide, Nitrogen dioxide, Nitrous Oxide, Dinitrogen trioxide, Dinitrogen tetroxide, Dinitrogen pentoxide.
O2	Oxygen	A colorless, odorless, tasteless, gaseous chemical element with the chemical symbol O and atomic number 8.
O2S	Oxygen Sensor	An electronic device that measures the proportion of oxygen (O2) in the gas or liquid being analyzed.
OBD	On-Board Diagnostic	A generic term referring to a vehicle's self-diagnostic and reporting capability.
OEM	Original Equipment Manufacturer	A producer that provides a product to its customers, who proceed to modify or bundle it before distributing it to their customers.
OSS	Output Shaft Speed	Rotational speed of the output shaft of a transmission.
P	Park	A state in which the transmission is set so one can leave the vehicle.
PCB	Printed Circuit Board	A thin plate on which chips and other electronic components are placed.
PCM	Powertrain Control Module	A control module that features the functions of both, the engine and the transmission control module.
PCMCIA	Personal Computer Memory Card Industry Association	An international standards body and trade association with over 100 member companies that was founded in 1989 to establish standards for Integrated Circuit cards and to promote interchangeability among mobile computers where ruggedness, low power, and small size were critical.
PIN	Personal Identification Number	A secret numeric password shared between a user and a system that can be used to authenticate the user to the system.
PPE	Personal Protective Equipment	Protective clothing, helmets, goggles, or other garment designed to protect the wearer's body from injury.
PRNDL	Park, Reverse, Neutral, Drive, Low	Park, Reverse, Neutral, Drive, Low (automatic transmission positions).
PTC	Positive Temperature Coefficient	Refers to materials that experience an increase in electrical resistance when their temperature is raised.

Acronym	Meaning	Definition
PTO	Power Take-Off	A splined driveshaft, usually on a tractor or truck that can be used to provide power to an attachment or separate machine. This mechanism allows implements to draw energy from the tractor's engine.
PVC	Polyvinyl Chloride	A thermoplastic copolymer.
PWM	Pulse Width Modulation	Square shaped type of signal that carries the information in the ratio between on and off times.
R	Reverse	Rearward: directed or moving toward the rear;
RAM	Random Access Memory	A type of computer data storage. It today takes the form of integrated circuits that allow the stored data to be accessed in any order.
RCT	Radiator Coolant Temperature	This is the heat intensity of the radiator coolant measured in degrees. The radiator is a part of the cooling system that removes the engine heat. Coolant is a mixture of water and antifreeze (ethylene glycol) which lowers the freezing point of the water in the coolant system, this fluid also picks up heat from the engine and transfers it to the air.
RDS	Radio Data System	A standard from the European Broadcasting Union for sending small amounts of digital information using conventional FM radio broadcasts.
RF	Radio Frequency	A frequency or rate of oscillation within the range of about 3 Hz and 300 GHz. This range corresponds to frequency of alternating current electrical signals used to produce and detect radio waves.
ROM	Read-Only Memory	A class of storage media used in computers and other electronic devices. Data stored in ROM cannot be modified.
RPO	Regular Production Option	A three digit/letter code given to parts, assemblies, and systems originally installed on the vehicle. These RPO codes designate options and are assigned by General Motors.
RSA	Rear Seat Audio	An auxiliary set of controls that operate the main audio system from the rear seat. Rear passengers can also operate a different media source than the front passengers.
RWD	Rear-Wheel Drive	A common engine/transmission layout in which the engine is in the front of the vehicle, but the front mid-engine, rear mid-engine and rear engine layouts are also used.
SCV	Speed Controlled Volume	The volume control is set for a desired sound level in the vehicle as the vehicle increases its speed, the sound level is adjusted.
SDM	Sensing and Diagnostic Module	The name given to air bag modules used in General Motors vehicles.
SIM	Subscriber Identity Module	Part of a removable smart card Integrated Circuit Card. This is used for mobile cellular telephone devices such as mobile computers and mobile phones. SIM cards securely store the service-subscriber key used to identify a subscriber. The SIM card allows users to change phones by simply removing the SIM card from one mobile phone and inserting it into another mobile phone or broadband telephony device.

mitsubishi-diagram.com

Acronym	Meaning	Definition
SIR	Supplemental Inflatable Restraint	Technical term for the air bag. Air bag is a stretchable membrane, which inflates during an automobile accident to provide cushioning to the passenger's head and torso to prevent injury to the passengers.
SPI	Serial Peripheral Interface	This is an interface that enables the serial (one bit at a time) exchange of data between two devices. An SPI operates in full duplex mode. This means that data can be transferred in both directions at the same time. It is a standard bus technology like CAN or I2C.
SPS	Service Programming System	System that enables repair facilities to update the software in control modules.
SUV	Sport Utility Vehicle	A passenger vehicle which combines the towing capacity of a pickup truck with the passenger-carrying space of a minivan.
SVS	Service Vehicle Soon	Indicator lamp or symbol for a malfunction related to a vehicle component or system.
TA	Traffic Announcement	Message spoken on radio regarding the movement of vehicles or pedestrians through an area or along a route. The buttons on radios that enable this announcements are also often labeled TA.
TAC	Throttle Actuator Control	A motor which moves the engine throttle plate or valve, controlled by the engine control module. A throttle plate limits the amount of air entering a internal combustion gasoline engine.
TAP	Transmission Adaptive Pressure	The transmission control module learns each component's characteristics and adjusts fluid pressure accordingly.
TCC	Torque Converter Clutch	Resides in a torque converter to connect an engine to an automatic transmission. The clutch is applied when conditions are correct to achieve a 1:1 ratio of engine crankshaft to transmission input shaft.
TCM	Transmission Control Module	A module that controls electronic automatic transmissions. It uses sensors from the vehicle as well as data provided by the Engine Control Module to calculate how and when to change gears in the vehicle for optimum performance, fuel economy and shift quality.
TDC	Top Dead Center	The piston is in its highest position relative to the combustion chamber.
TIS	Techline Information System	The PC-based global dealership diagnostic software that provides the technician the ability to reference the most recent service information via the service department's computer.
TPA	Terminal Position Assurance	An additional locking mechanism inside an electric connector that holds the pins in place.
TV	Television	A telecommunication system for broadcasting and receiving moving pictures and sound over a distance.
USB	Universal Serial Bus	A type of communication bus connection between a computer and a peripheral device.
VCI	Vehicle Communications Interface	A diagnostic tool that communicates to modules of multiple communication protocols in a vehicle by converting vehicle serial data into PC serial data communication.
VIN	Vehicle Identification Number	Used by manufacturers to uniquely identify motor vehicles using 17 characters.

Acronym	Meaning	Definition
VSCM	Vehicle Stability Control Module	This module uses information from several sensors to detect a loss of vehicle traction, then works with the antilock brake system to apply individual brakes to help keep the vehicle on its intended path.
VSS	Vehicle Speed Sensor	Sends data regarding how fast the car is traveling at the moment of driving. It is designed to be able to record the rate at which the vehicle's crankshaft is spinning.
WOT	Wide Open Throttle	When the throttle blade or valve is at its maximum open position, allowing maximum air to enter an internal combustion gasoline engine.
WLAN	Wireless Local Area Network	Standard to transmit digital data via radio frequency.
XM	XM (Satellite Radio)	XM Satellite Radio Holdings (XM) is one of two satellite radio services in the United States and Canada. XM provides pay-for-service radio, analogous to cable television. Its service includes 73 different music channels, 39 news, sports, talk, and entertainment channels, 21 regional traffic and weather channels and 23 play-by-play sports channels (2008).
XML	Extensible Markup Language	A markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable.

Units

Unit	Meaning	Definition
m^2	Square Meter	Area
A	Ampere	Electrical
Ah	Ampere Hour	Electrical
C	Coulomb	Electrical
dBm	Decibel Meter	Electrical
dBmV	Decibel Millivolt	Electrical
mV/DIV	Millivolts per Division	Electrical
mV/s	Millivolts per Second	Electrical
Ω	Ohm	Electrical
V	Volt	Electrical
V/DIV	Volts per Division	Electrical
V/ms	Volts per Millisecond	Electrical
W	Watt	Electrical
mm^3 /stroke	Cubic Millimeters per Stroke	Flow
gal/h	Gallons per Hour	Flow
g/s	grams per second	Flow
g/stroke	Grams per Stroke	Flow
kg/100km	Kilograms per 100 Kilometer	Flow
kg/h	Kilograms per Hour	Flow
km/L	kilometer/liter	Flow
L/100km	Liters per 100 Kilometers	Flow
L/h	Liters per Hour	Flow
L/min	Liters per Minute	Flow
MPG	Miles per Gallon	Flow
mg/s	Milligrams per Second	Flow
mg/stroke	Milligrams per stroke	Flow
ft	feet	Length

Unit	Meaning	Definition
in	Inch	Length
m	Meter	Length
mi	Mile	Length
bar	Bar	Mechanical
bar/min	Bars per Minute	Mechanical
in. H2O	Inches of Water	Mechanical
in. H2O/s	Inches of Water per second	Mechanical
kPa/s	Kilopascals per Second	Mechanical
N	Newton	Mechanical
N.m	Newton Meter	Mechanical
Pa	Pascal	Mechanical
Pa/s	Pascals per Second	Mechanical
lb ft	Pound Foot	Mechanical
PSI	Pound-Force per Square Inch	Mechanical
Counts	Counts	Misc.
Cycles	Cycles	Misc.
dB	Decibel	Misc.
Â°	Degree	Misc.
Â°C	Degree Centigrade	Misc.
Â°CA	Degree Crankshaft Angle	Misc.
Â°F	Degree Fahrenheit	Misc.
Â°/s	Degree per Second	Misc.
Hz	Hertz	Misc.
kbit/s	Kilobit per second	Misc.
lx	Lux	Misc.
ppm	Parts per Million	Misc.
%	Percent	Misc.
%/min	Percents per Minute	Misc.
%/sec	Percents per Second	Misc.
Pulses	Pulses	Misc.
:1	Ratio	Misc.
RPM	Revolutions per Minute	Misc.
Steps	Steps	Misc.
W/m^2	Watts per Square Meter	Misc.
g	g (Acceleration)	Movement
km/h	Kilometers per Hour	Movement
m/s	Meters per Second	Movement
m/s^3	Meters per Second Cubed	Movement
m/s^2	Meters per Second Squared	Movement
MPH	Miles per Hour	Movement
mm/s	Millimeters per Second	Movement
d	Day	Time
h	Hour	Time
hh:mm:ss	Hour:Minute:Second	Time
ms/DIV	Milliseconds per Division	Time
min	Minute	Time
s	Second	Time
s/DIV	Seconds per Division	Time
yy-mm-dd	Year-Month-Day (2 digits)	Time
yyyy-mm-dd	Year-Month-Day (4 digits, preferred)	Time
m^3	Cubic Meter	Volume

cardiagn.com

Unit	Meaning	Definition
gal	Gallon	Volume
L	Liter	Volume
mL	milliliters	Volume
US gal	US Gallon	Volume
US pt	US Pint	Volume
US qt	US Quart	Volume
kg	Kilogram	Weight

GRAPHIC COLORS AND GRAPHIC SYMBOLS

Graphic Colors - General

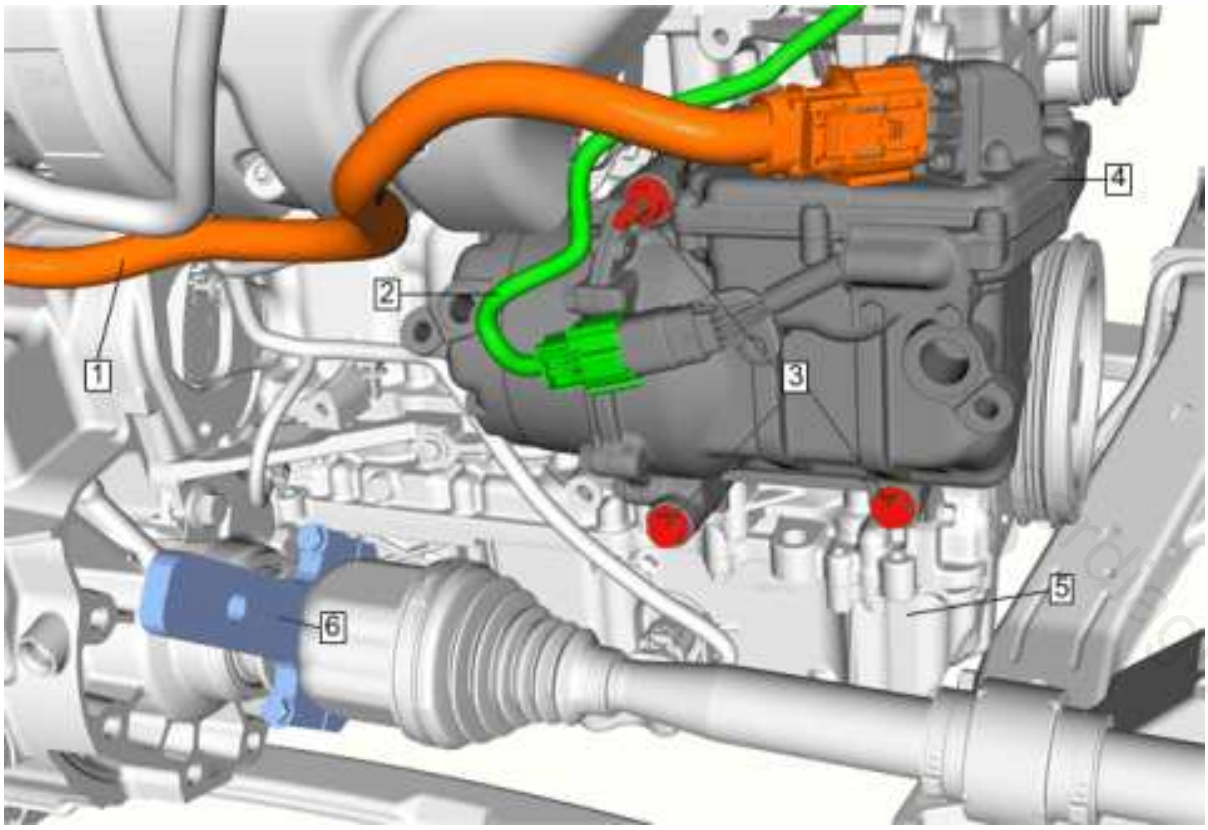


Fig. 2: Graphic Colors - General
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Orange - High voltage electrical connectors and harnesses being removed or installed.
2	Green - Electrical connectors and harnesses being removed or installed.
3	Red - Fasteners being removed or installed.
4	Dark Gray - Standout color that shows the component being removed or installed.
5	Light Gray - Background detail to show component location.
6	Light Blue - Special tool being used.

Graphic Symbols - Collision Repair

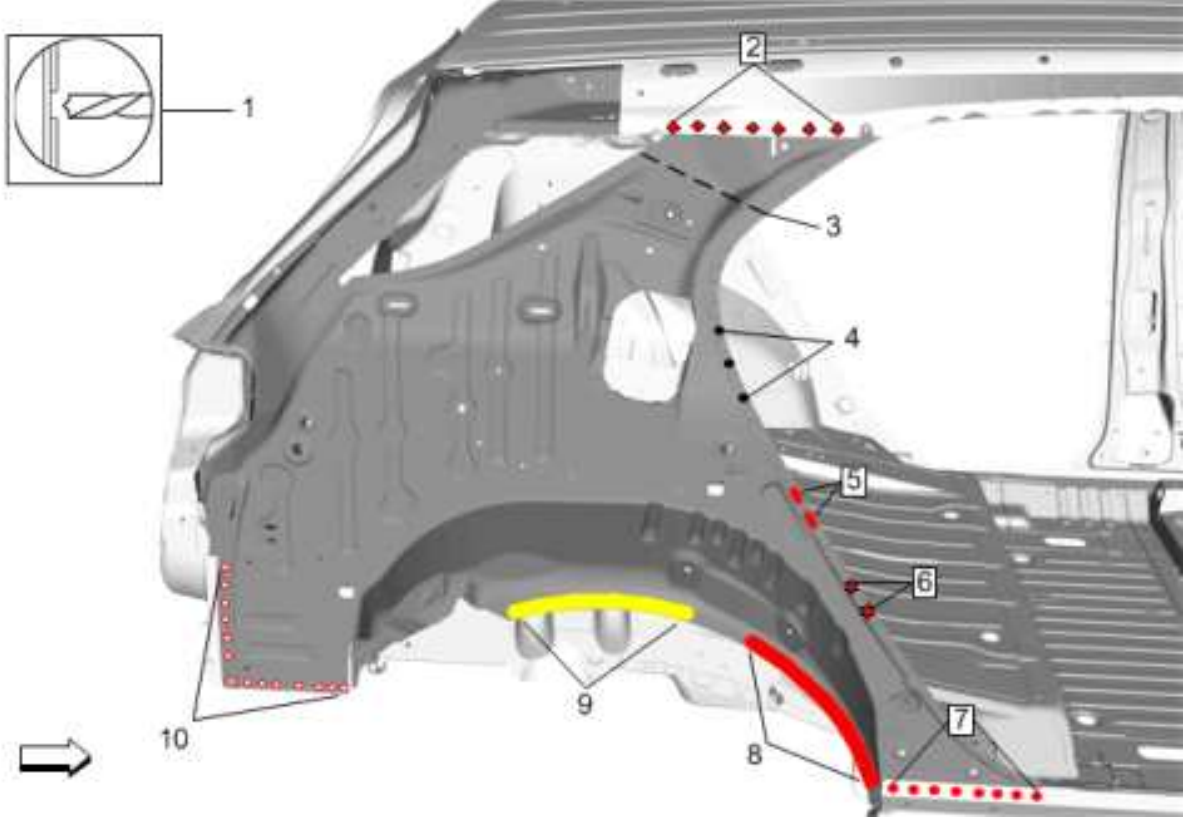


Fig. 3: Graphic Symbols - Collision Repair
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drill through top layer of material only
2	Structural Rivet
3	Sectioning Location
4	Drill Hole
5	Mig Braze Slot
6	Self-Piercing Rivet
7	Mig/Mag Plug Weld
8	Adhesive
9	Apply Heat
10	Resistance Spot Weld

Cardiagn.com

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.

TRAINING

Dealers

All U.S. GM Dealers participating in the Center of Learning / GM Service Technical College (STC) Programs can enroll through the Center of Learning website at https://www.centerlearning.com. Within the website, there are individual training paths that are designed to assist in planning the training needs for each individual and their job role. Dealers who have questions about Center of Learning Training should contact the Center of Learning help desk at 1-888-748-2687. The help desk is available Monday through Friday, 8:00 am - 9:00 pm 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 the Center of Learning/GM Service Technical College (STC).

Assistance for GM fleet registered customers using GM STC training is provided by the Center of Learning help desk at 1-888-748-2687. The help desk is available Monday through Friday, 8:00 am - 9:00 pm Eastern Standard Time, excluding holidays. For GM Access support, contact the GM Access Help Desk at 1-888-337-1010.

Most GM STC course materials have associated charges.

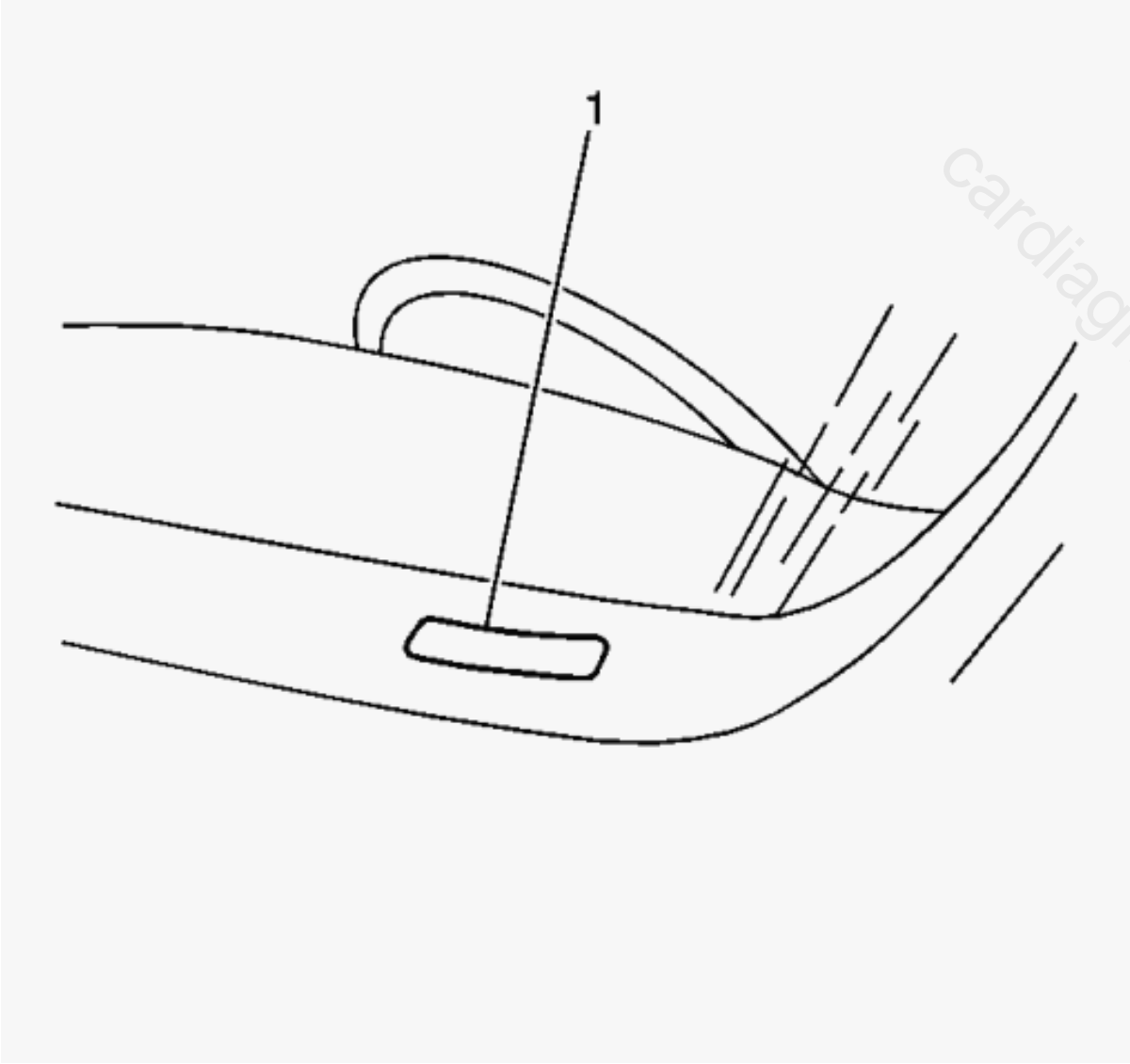
To purchase authentic GM STC Training Materials, contact the GM Training Materials Headquarters at 1-800-393-4831.

Non-GM Dealer Technicians

Technician training for non-GM dealers is available through ACDelco. This training is for ACDelco PSC and Fleet program members employed in the automotive or truck service industry.

ACDelco courses are available at approved GM STC Training Centers. Availability and schedules can be obtained by calling 1-800-825-5886 (prompt 1) or contact us via the web at www.acdelcotechconnect.com and select the Training tab. Seminars are also offered through the ACDelco Warehouse Distribution channel. Contact your Local ACDelco representative or distributor directly for more information.

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



cardiagn.com

Fig. 4: View Of VIN Plate Location
Courtesy of GENERAL MOTORS COMPANY

Position	Definition	Character	Description

Position	Definition	Character	Description
Vehicle Identification Number (VIN) System The VIN plate (1) is the legal identifier of the vehicle. The VIN plate is located on the upper left corner of the instrument panel and can be seen through the windshield from the outside of the vehicle.			
1	Country of Origin	2	Canada
		3	Mexico
2	Manufacturer	G	General Motors
3	Vehicle Brand/Type	N	Chevrolet MPV
		K	GMC MPV
4	GVWR/Brake System/Body Style	A	4, 001-5, 000 lbs/Hydraulic/Four Door Cab/Utility
5 6	Line/Chassis/Series	X/G	Equinox L FWD
		X/H	Equinox LS FWD
		X/J	Equinox LT FWD (1LT)
		X/K	Equinox LT FWD (2LT)
		X/L	Equinox LT FWD (3LT)
		X/M	Equinox Premier FWD (1LT)
		X/N	Equinox Premier FWD (2LT)
		X/P	Equinox Premier FWD (3LT)
		X/R	Equinox LS AWD
		X/S	Equinox LT AWD (1LT)
		X/T	Equinox LT AWD (2LT)
		X/U	Equinox LT AWD (3LT)
		X/V	Equinox Premier AWD (1LT)
		X/W	Equinox Premier AWD (2LT)
		X/X	Equinox Premier AWD (3LT)
		X/9	Equinox (Non US, Non Canada)
		L/L	GMC Terrain SL FWD
		L/M	GMC Terrain SLE FWD
		L/N	GMC Terrain SLE FWD Diesel
		L/P	GMC Terrain SLT FWD
		L/R	GMC Terrain SLT FWD Diesel
		L/S	GMC Terrain Denali FWD
		L/T	GMC Terrain SLE AWD
		L/U	GMC Terrain SLE AWD Diesel
		L/V	GMC Terrain SLT AWD
		L/W	GMC Terrain SLT AWD Diesel
		L/X	GMC Terrain Denali AWD
		L/8	GMC Terrain (Export only)
7	Restraint System	D	AJG - Active Manual Belts, Airbags - Driver and Passenger Front (1st row), and Front Seat Side (1st row)
		E	AY0/AYC - Active Manual Belts, Airbags - Driver and Passenger Front (1st row), Front Seat Side (1st row), Roof Side (All seating rows)
8	Engine Type	U	LH7 - Engine Diesel, UREA, 4 Cylinder, 1.6L, L4, CRI, DOHC, VGT, ALUM
		V	LYX - Engine Gas, 4 Cylinder, L4, 1.5L, DI, DOHC, VVT, FGT, TURBO, ALUM, GEN 1

mydiagn.com

Position	Definition	Character	Description
		X	LTG - Engine Gas, 4 Cylinder, 2.0L, SIDI, L4, ALUM DOHC, VVT, DCVCP TURBO, E0 - E100, ALUM
		8	LVL - Engine Diesel, 4 Cylinder, 1.6L, CRI, DOHC, VGT, 103KW
		9	LWW - Engine Diesel, 4 Cylinder, 1.6L, L4, VGT, DOHC, ALUM, A16DTH GEN 1
9	Check Digit	-	Check Digit
10	Model Year	J	2018
11	Plant Location	6	CAMI (When VIN position 1 is "2" (Canada)
		L	San Luis Potosi (When VIN position 1 is "2" (Canada), When VIN position 1 is "3" (Mexico)
		S	Ramos Arizpe (When VIN position 1 is "3" (Mexico)
12 - 17	Plant Sequence Number	-	Plant Sequence Number

6T40 (MNH, MNK) or 6T45 (MHG) Transmission ID and VIN Derivative Location

Refer to **Transmission Identification Information** .

9T45 (M3U) or 9T50 (M3D, M3H) Transmission ID and VIN Derivative Location

Refer to **Transmission Identification Information** .

1.5L (LYX) Engine ID and VIN Derivative Location

Refer to **Engine Identification** .

1.6L (LH7) Diesel Engine ID and VIN Derivative Location

Refer to **Engine Identification** .

2.0L (LTG) Engine ID and VIN Derivative Location

Refer to **Engine Identification** .

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

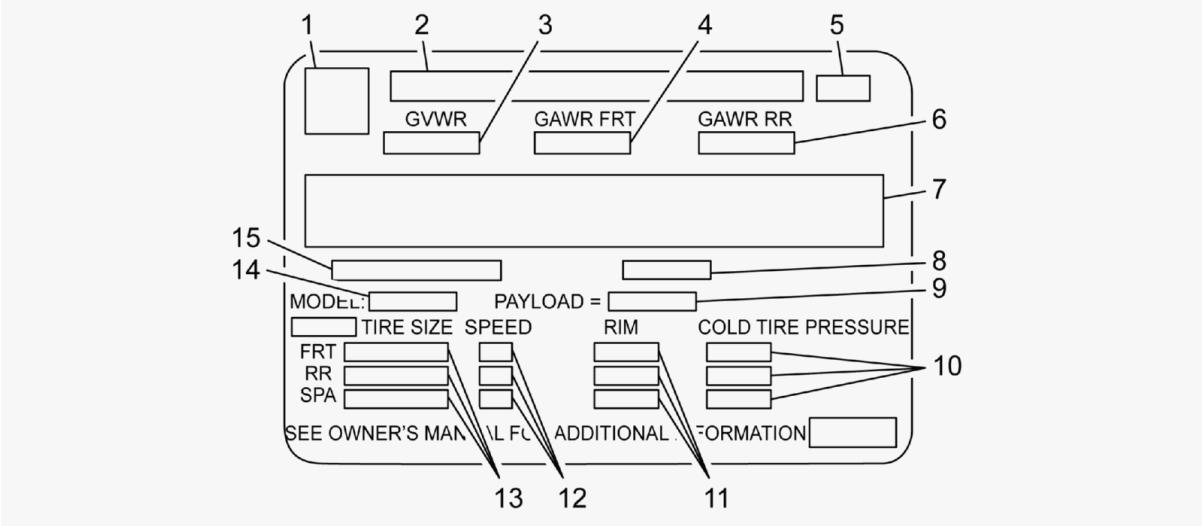


Fig. 5: Vehicle Certification Label
Courtesy of GENERAL MOTORS COMPANY

cardiagn.com

Vehicle Certification Label

Callout	Description
1	Logo
2	Name of Manufacturer
3	Maximum Gross Vehicle Weight Rating (GVWR)
4	Maximum Gross Axle Weight Rating (GAWR) - Front
5	Final Date of Manufacture (Month and Year MM/YY) Date of manufacture callout C is to reflect the date that the vehicle is counted as built. In those cases where a replacement label is needed, the replacement label should reflect the actual build date not the date of replacement.
6	Maximum Gross Axle Weight Rating (GAWR) - Rear
7	Certification Statement
8	Vehicle Class Type (Pass Car, etc.)
9	Payload
10	Tire Pressure, Front, Rear, and Spare (Cold)
11	Original Tire Rim Size
12	Tire Speed Rating
13	Original Equipment Tire Size
14	Engineering Model Number
15	Vehicle Identification Number (VIN)

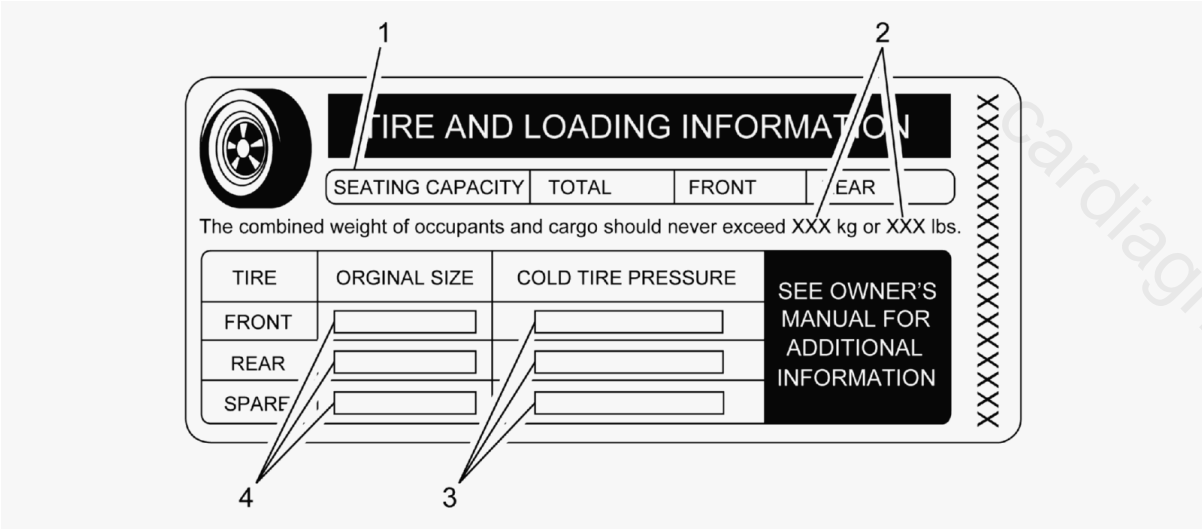


Fig. 6: Tire Placard
Courtesy of GENERAL MOTORS COMPANY

Tire Placard

Callout	Description
1	Specified Occupant Seating Positions
2	Maximum Vehicle Capacity Weight
3	Tire Pressure, Front, Rear, and Spare (Cold)
4	Original Equipment Tire Size

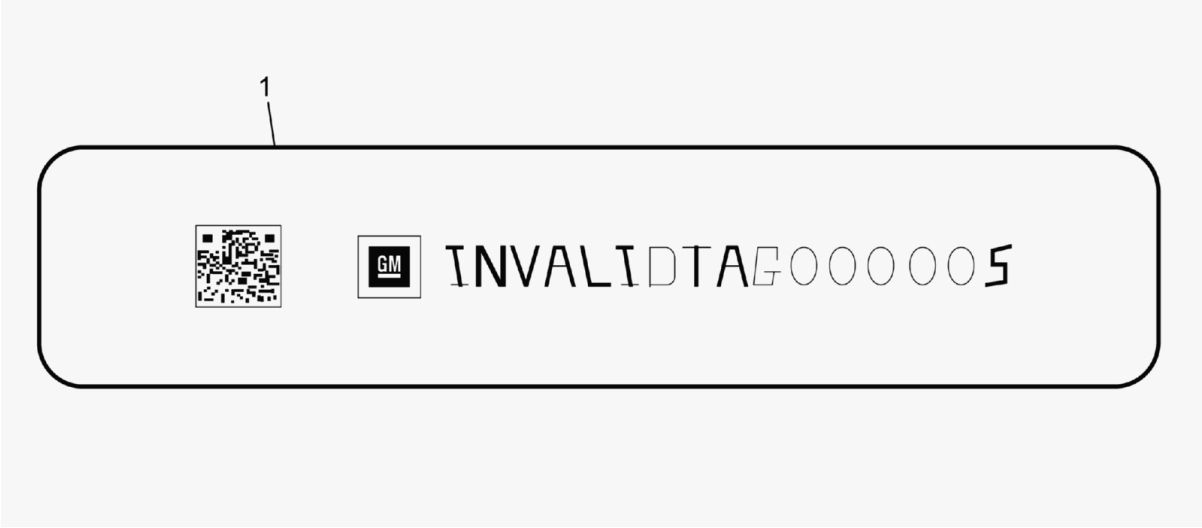


Fig. 7: Anti-Theft Label
Courtesy of GENERAL MOTORS COMPANY

Anti-Theft Label

Callout	Description
1	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, 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.

Service Parts ID Label

This label is located on the inside of the glove box and contains the Vehicle Identification Number (VIN), the model designation, the paint information, production options, and special equipment.

RPO CODE LIST

The following table provides the description of the Regular Production Option (RPO) codes that are available on the vehicle. The vehicle's RPO list is printed on the Service Parts Identification Label.

RPO	Description
2SA	PACKAGE-SL OPTION 1
3SA	PACKAGE-SLE OPTION 1
3SB	PACKAGE-SLE OPTION 2
4AA	INTERIOR TRIM-JET BLACK
4EC	INTERIOR TRIM-ARTEMIS/VY LT PLATINUM
4EL	INTERIOR TRIM-JET BLACK/BRANDY
4GO	WHEEL SPARE-17 X 4.0, BT, STEEL, DESIGN 1
4HL	INTERIOR TRIM-BRANDY
4HM	INTERIOR TRIM-MED ASH GRAY (D2UC)
4SA	PACKAGE-SLT OPTION 1
4SB	PACKAGE-SLT OPTION 2
53M	INTERIOR TRIM-JET BLACK/BRANDY DENIM
5A7	WHEEL SPARE-NONE
5CW	TIRE ALL-225/65R17 SL 102V BW AL3 VAR2
5CX	TIRE ALL-225/65R17 SL 102H BW ALS VAR1
5CY	TIRE ALL-225/65R17 SL 102H BW ALS VAR2
5KE	ACCESSORY-MOLDING KIT - EXTERIOR

RPO	Description
5LE	ACCESSORY-GARAGE DOOR OPENER
5SA	PACKAGE-DENALI OPTION 1
5Y3	ACCESSORY-TOW BALL - TRAILER HITCH
62R	INTERIOR TRIM CONFIG-LEATHER, LEVEL 3, JET BLACK / BRANDY
6K5	SALES PACKAGE-CONVENIENCE II
9L3	TIRE SPARE-NONE
A45	MEMORY-SEAT ADJUSTER, MIRROR, POWER, DRIVER, PERSONALIZATION
A9U	SEAT BACK-ONE-TOUCH FOLDING
ACO	IDENTIFICATION-ACCESSORY CATALOG OFFERING
ADT	ADJUSTER PASS ST-POWER, MULTI-DIRECTIONAL, RECLINER MANUAL
AED	WINDOW REG PASS DR-POWER OPERATED, EXPRESS DOWN
AEQ	WINDOW REG REAR DR-POWER OPERATED, EXPRESS DOWN
AG1	ADJUSTER FRT ST-POWER, MULTI-DIRECTIONAL, DRIVER
AG2	ADJUSTER PASS ST-POWER, MULTI-DIRECTIONAL
AG6	ADJUSTER PASS ST-MANUAL, 4 WAY
AJC	RESTRAINT-HEAD, FRT SEAT, UP/DOWN ADJUSTMENT
AKK	WINDSHIELD STYLE-ACOUSTIC PVB
AKO	WINDOW TYPE-PRIVACY
AKP	WINDOW TYPE-SOLAR ABSORBING
AL0	SENSOR INDICATOR-INFLATABLE RESTRAINT, FRT PASS/CHILD PRESENCE DETECTOR
AL9	LUMBAR DRIVER-SEAT, POWER, 2 WAY
AP9	NET-CONVENIENCE
AR9	SEAT-FRT BKT, DELUXE
ASV	EQUIPMENT-SENSOR AIR MOISTURE & W/S TEMP
AT9	LUMBAR PASSENGER-SEAT, POWER, 2 WAY
ATH	LOCK CONTROL, ENTRY-REMOTE ENTRY, EXTENDED RANGE, PASSIVE ENTRY, ALL DOORS
AU3	LOCK CONTROL-SIDE DR, ELEC
AXG	WINDOW REG DRVR DR-POWER OPERATED, EXPRESS UP/DOWN
AXP	VEHICLE TYPE-MULTI-PURPOSE PASSENGER VEHICLE
AY0	RESTRAINT SYSTEM-SEAT, INFLATABLE, DRIVER & PASS FRT, SEAT SIDE, ROOF SIDE
B26	SALES PACKAGE-SAFETY PACKAGE VAR. 1
B34	COVERING FRT-FLOOR MATS, CARPETED INSERT
B35	COVERING REAR-FLOOR MATS, CARPETED INSERT
B86	MOLDING B/S-BODY COLOR
B87	MOLDING B/S-BLACK
BAG	PARTS PKG-EXPORT
BGP	SALES PACKAGE-SAFETY PACKAGE VAR. 2
BTM	SWITCH-ENGINE START, KEYLESS
BTT	ALARM-REMOTE PANIC
BTV	REMOTE START-ENGINE
C32	HEATER-HEATING/DEFROSTER SYSTEM, REINFORCED, ELECTRIC
C3M	GVW RATING-2200 KG
C3U	ROOF-SUN, GLASS, SLIDING, ELEC, TRANSPARENT GLASS FIXED
C4P	HVAC SYSTEM-AIR CONDITIONER FRT, SEMIAUTOMATIC, ELECTRONIC CONTROLS
CAV	ACCESSORY-TRAY - TRUNK/CARGO AREA
CG6	ORNAMENTATION-EXTR, NAMEPLATE, VAR 1

cardiagn.com

RPO	Description
CGY	COVER-CARGO, FABRIC
CJ2	HVAC SYSTEM-AIR CONDITIONER FRT, AUTO TEMP CONT, AUX TEMP CONT
CK2	COUNTRY-YEMEN
CNI	GVW RATING-2100 KG
CNQ	GVW RATING-2025 KG
CNX	ORNAMENTATION-NAME PLATE "TD"
CU7	COUNTRY-KUWAIT
CU8	COUNTRY-SAUDI ARABIA
CV3	COUNTRY-MEXICO
CV4	COUNTRY-ISRAEL
CV8	COUNTRY-IRAQ
CX9	COUNTRY-LEBANON
CY2	COUNTRY-JORDAN
D31	MIRROR I/S R/V-TILT
D3S	COUNTRY-QATAR
D4C	COUNTRY-BAHRAIN
D5P	COUNTRY-UNITED ARABIC EMIRATES
D6K	SEAT BACK-FOLDING, FLAT, PASSENGER SIDE
D75	HANDLE O/S DOOR-BODY COLOR
D7A	HANDLE O/S DOOR-BODY COLOR, CHROME STRIP
DD8	MIRROR I/S R/V-LT SENSITIVE
DEU	MIRROR PROVISION HSG-HOUSING, BLACK MEET KETTLE MET
DLF	MIRROR O/S-LH & RH, RC, ELEC, HEAT, MAN FOLD, FLAT/DRVR, CNVXPASS
DP6	MIRROR PROVISIONS-HOUSING, PAINTED
DP9	MIRROR PROVISIONS-HOUSING, CHROME
DPK	MIRROR PROVISIONS-HOUSING, BLACK
DWK	MIRROR O/S-LH & RH, RC, ELEC, HEAT, FLAT/DRVR, MANFOLD, CNVX/PASS, TURN SIG IND
DWL	MIRROR O/S-LH & RH, RC, ELEC, HEAT, FLAT/DRVR, MANFOLD, CNVX/PASS, TURN SIG IND, LT SENS
E22	HANDLE-ASSIST, RR
E27	HANDLE-ASSIST, PASS
E28	HANDLE-ASSIST
E6H	COUNTRY-OMAN
EA1	POCKET-FRONT SEAT BACK, LH
EA2	POCKET-FRONT SEAT BACK, RH
EF7	COUNTRY-UNITED STATES OF AMERICA (USA)
EPH	TRANS RANGE SEL SYS-ELECTRONIC
EPM	MODEL CONVERSION-ALL WHEEL DRIVE
F48	CHASSIS DRIVE LINE-ALL WHEEL DRIVE (AWD)/FOUR WHEEL DRIVE(4WD), DRIVER SELECT
FE9	CERTIFICATION-EMISSION, FEDERAL
FHB	RATIO-TRANSAXLE FINAL DRIVE 3.47
FHO	VEHICLE FUEL-GASOLINE E10
FHX	VEHICLE FUEL-DIESEL B20
FJM	RATIO-TRANSAXLE FINAL DRIVE 3.50
FJW	VEHICLE FUEL-GASOLINE E15
FWD	CHASSIS DRIVE LINE-FRONT WHEEL DRIVE (FWD)
FX3	RIDE AND HANDLING-AUTOMATIC ELECTRONIC CONTROLLED
FX6	RATIO-TRANSAXLE FINAL DRIVE 3.87
FXK	RATIO-TRANSAXLE FINAL DRIVE 2.89

mydiagn.com

RPO	Description
FXP	RATIO-TRANSAXLE FINAL DRIVE 3.17
G1W	PRIMARY COLOR-EXTERIOR, ABALONE WHITE TRICOAT(140X)
G35	PRIMARY COLOR-EXTERIOR, BLUE STEEL MET-1 (424C)
G63	PROVISIONS-LUGGAGE CARRIER, ROOF
G7Q	PRIMARY COLOR-EXTERIOR, SON OF A GUN GRAY MET (139X)
G8K	PRIMARY COLOR-EXTERIOR, COPPERTINO MET-1 (444C)
G8U	PRIMARY COLOR-EXTERIOR, KIMONO MET-1 (449C)
G9K	PRIMARY COLOR-EXTERIOR, SATIN STEEL GRAY MET-3 (464C)
GAN	PRIMARY COLOR-EXTERIOR, SWITCHBLADE SILVER MET (G) 636R
GAZ	PRIMARY COLOR-EXTERIOR, SUMMIT WHITE (G) 8624
GB8	PRIMARY COLOR-EXTERIOR, BLACK MEET KETTLE MET (384A)
GBA	PRIMARY COLOR-EXTERIOR, BLACK (G) 8555
GGC	GRILLE-CUSTOM
GGQ	PRIMARY COLOR-BURNING HOT MET(425B)
GJB	PRIMARY COLOR-EXTERIOR, MINERAL MET (433B)
GMU	PRIMARY COLOR-EXTERIOR, PEPPERDUST MET-2 (441B)
GNA	CHASSIS EQUIP FRONT-STRUT ASM
GND	CHASSIS EQUIP REAR-REAR AXLE, 4-LINK, NON-ISOLATED
GPJ	PRIMARY COLOR-GLORY RED TINT-2 (434B)
H0Y	INTERIOR TRIM CONFIG-LEATHER, LEVEL 1, JET BLACK
H17	INTERIOR TRIM CONFIG-LEATHER, LEVEL 1, MED ASH GRAY
H1T	INTERIOR TRIM CONFIG-CLOTH, LEVEL 1, JET BLACK
H1Y	INTERIOR TRIM CONFIG-LEATHER, LEVEL 2, JET BLACK
H2U	INTERIOR TRIM CONFIG-LEATHER, LEVEL 3, JET BLACK
H72	INTERIOR TRIM CONFIG-CLOTH, LEVEL 1, MED ASH GRAY
HQJ	INTERIOR TRIM CONFIG-CLOTH, LEVEL 1, JET BLACK/BRANDY DENIM
HQK	INTERIOR TRIM CONFIG-LEATHER, LEVEL 2, MED ASH GRAY (D2UC)
HR4	INTERIOR TRIM CONFIG-LEATHER, LEVEL 1, BRANDY
HS4	INTERIOR TRIM CONFIG-LEATHER, LEVEL 2, ARTEMIS/VY LT PLATINUM
I18	ENGINEERING YEAR-2018
IO5	RADIO-INFOTAINMENT SYSTEM - UPLEVEL HMI, ENHANCED CONNECTIVITY
IO6	RADIO-INFOTAINMENT SYSTEM - UPLEVEL HMI, ENHANCED CONNECTIVITY, EMBEDDED NAVIGATION
IOB	RADIO-INFOTAINMENT SYSTEM - MIDLEVEL HMI, MIDLEVEL CONNECTIVITY
IOR	RADIO-INFOTAINMENT SYSTEM - 3.X LOW HMI, MIDLEVEL CONNECTIVITY 3.X
IOS	RADIO-INFOTAINMENT SYSTEM - 3.X MID/HIGH HMI, ENHANCED CONNECTIVITY, VOICE RECOGNITION, MID SD NAV CAPABLE
IOT	RADIO-INFOTAINMENT SYSTEM - 3.X MID/HIGH HMI, ENHANCED CONNECTIVITY, VOICE RECOGNITION, PREMIUM SD NAV
IOU	RADIO-INFOTAINMENT SYSTEM - 3.X MID/HIGH HMI, ENHANCED CONNECTIVITY, VOICE RECOGNITION, MID SD NAV
J17	BRAKE SYSTEM-POWER, FRT DISC 17" & RR DISC 16", ABS
J1Z	MODEL CONVERSION-INTERNET MODEL
J60	BRAKE SYSTEM-POWER, FRT & RR DISC, ABS, 16"
J71	BRAKE PARKING-POWER OPERATED
JHD	CONTROL-HILL DESCENT, GEAR HOLD

RPO	Description
JJ2	BRAKE LINING-BRAKE NOISE AND DUST PERFORMANCE
JNK	PROVISIONS-TOW HOOKS
K05	HEATER ENG-BLOCK
K13	EXHAUST-FILTER EXHAUST SYSTEM, PARTICLE
K34	CRUISE CONTROL-AUTOMATIC, ELECTRONIC
K4C	CHARGER-INDUCTIVE PORTABLE WIRELESS DEVICE
KA1	HEATER SEAT FRT-DRVR & PASS
KA6	HEATER SEAT-REAR
KB7	SHIFT CONTROL-MANUAL SHIFT, AUTOMATIC TRANSMISSION
KC5	RECEPTACLE-ELECTRICAL, ACCESSORY
KC8	RECEPTACLE-ELECTRICAL, LOAD COMPARTMENT
KI2	KNOB-TRANS CONT LEVER, POLYURETHANE
KI6	RECEPTACLE-ELECTRICAL, FRT CONSOLE RR 110 VOLT
KI7	RECEPTACLE-ELECTRICAL, FRT CONSOLE RR 230 VOLT
KL9	ENG CONTROL-STOP/START SYS, CONVENTIONAL AT, CONVENTIONAL MT OR BRAKE RELEASE LATE RESTART
KPA	RECEPTACLE-ELECTRICAL, FRT CONSOLE RR
KPK	HEATER-OIL PAN
KRV	REFRIGERANT-LOW GWP
KTI	KIT, TIRE-INFLATOR
KU1	VENTILATED SEAT DRVR-FRONT
KU3	VENTILATED SEAT PASS-FRONT
LH7	ENGINE-DIESEL, UREA, 4 CYL, 1.6L, L4, CRI, DOHC, VGT, ALUM
LHD	VEHICLE DRIVE-LEFTHAND DRIVE
LTG	ENGINE-GAS, 4 CYL, 2.0L, SIDI, L4, ALUM DOHC, VVT, DCVCP, TURBO, E0-E100, ALUM
LYX	ENGINE-GAS, 4 CYL, L4, 1.5L, DI, DOHC, VVT, FGT, TURBO, ALUM, GEN 1
M3D	TRANSMISSION-AUTO 9 SPD, 9T50 GEN 1
M3H	TRANSMISSION-AUTO 9 SPD, 9T50, ETRS GEN 1
M3U	TRANSMISSION-AUTO 9 SPD, 9T45, ETRS GEN 1
MAH	MARKETING AREA-US, PUERTO RICO/USVI
MAM	MARKETING AREA-MIDDLE EAST
MBC	MARKETING AREA-CANADA
MBI	MARKETING AREA-ISRAEL
MCR	RECEPTACLE-MEMORY CARD
MCX	MARKETING AREA-MEXICO
MCZ	PORT, MULTI ELEK DEV-USB
MHG	TRANSMISSION-AUTO 6 SPD, HMD, GM, BAS+, 6T45, HYBRID, FWD
MM1	MERCHANDISED TRANS-AUTO EQUIPMENT
MNH	TRANSMISSION-AUTO 6 SPD, 6T40, GEN3, VAR1
N34	STEERING WHEEL-LEATHER, 3 SPOKES
N43	STEERING WHEEL-4 SPOKES, DELUXE
N52	STEERING WHEEL-3 SPOKES, DELUXE
NB5	EXHAUST SYSTEM-SINGLE
NDE	EXHAUST-SELECTIVE CATALYTIC REDUCTION SYSTEM
NE1	CERTIFICATION-EMISSION, GEOGRAPHICALLY RESTRICTED REGISTRATION FOR VEHICLES UP TO 14, 000 LBS GVW (USE 2003 MDL YR
NE8	EVAPORATIVE SYSTEM-LEVEL 3 EMISSIONS
NGT	PLANT CODE-INGERSOLL, ONT, CANADA (CAMI)
NKC	NOISE CONTROL-ACTIVE NOISE CANCELLATION, ENGINE
NTB	EMISSION SYSTEM-FEDERAL, TIER 3

Carmanah.com

RPO	Description
NUB	EMISSION SYSTEM-CALIFORNIA, ULEV70
NUC	EMISSION SYSTEM-CALIFORNIA, ULEV50
NUF	EMISSION SYSTEM-CALIFORNIA, ULEV125
NWO	TAILPIPE-DUAL EXPOSED, W/BRIGHT TIPS
PJH	WHEEL-19 X 7.5, J, ALUMINUM, DESIGN #6
PS1	SALES PACKAGE-COMFORT
Q8E	JACK-MECHANICAL, W/TOOLS
QCL	TIRE SPARE-T125/70R17 SL 98M BW SPR
RDI	ACCESSORY-KEYLESS ENTRY
RIA	ACCESSORY-FLOOR LINER - CONTOURED
RIK	ACCESSORY-BADGE - EXTERIOR, PACKAGE, DESIGN 1
RJA	TIRE SPARE-T135/70R16 SL 100M BW SPR
RM2	TIRE ALL-225/60R18 SL 100V BW AL3
RR0	TIRE ALL-235/50R19 SL 99H BW AL3
RSB	WHEEL-17 X 7.0, J, ALUMINUM, DESIGN 1
RSX	WHEEL-18 X 7.0, J, ALUMINUM, DESIGN 1
RT7	WHEEL-19 X 7.5, J, ALUMINUM, DESIGN 1
RUB	TIRE ALL-225/60R18 SL 100H BW AL3
RV6	WHEEL-18 X 7.0, J, ALUMINUM, DESIGN 2
RVG	ACCESSORY-ADAPTER - TRAILER HARNESS
RVX	ACCESSORY-BALL MOUNT - TRAILER HITCH
RVZ	WHEEL SPARE-16 X 4.0, T, STEEL, DESIGN 1
RWP	ACCESSORY-CABLE - PORTABLE MUSIC PLAYER
RWS	ACCESSORY-FLOOR MATS - CARPET
RWU	ACCESSORY-CARGO AREA ORGANIZER - COLLAPSIBLE
RYT	ACCESSORY-FIRST AID KIT
RZ8	ACCESSORY-ADAPTER - TRAILER HARNESS - 7 TO 13 PIN
RZ9	ACCESSORY-GRILLES/GRILLE INSERT - ALTERNATE DESIGN 1
RZA	WHEEL-19 X 7.5, J, ALUMINUM, DESIGN 2
S08	ACCESSORY-HIGHWAY SAFETY KIT
S1V	ACCESSORY-HEADPHONES - RSE
S44	ACCESSORY-LOCKING PIN - TRAILER HITCH
S47	ACCESSORY-LUG NUTS
S4X	ACCESSORY-MIRROR COVERS/SKULL CAPS - ALTERNATE FINISH - PAINTED
S6P	ACCESSORY-REMOTE START KIT
S6Q	ACCESSORY-ROADSIDE ASSISTANCE PACKAGE
S6W	ACCESSORY-SEAT COVER - MUDDER (PROTECTIVE)
SAL	PLANT CODE-RAMOS ARIZPE, MEXICO
SAO	ACCESSORY-SMOKERS PACKAGE
SD5	ACCESSORY-TIRE PRESSURE MONITOR
SDE	ACCESSORY-TRAILER HITCH - REMOVABLE
SDI	ACCESSORY-TRIANGLE - REFLECTIVE
SFE	ACCESSORY-WHEEL LOCKS
SFZ	ACCESSORY-EMBLEM - EXTERIOR - DESIGN 1
SIF	ACCESSORY-RSE - PORTABLE MEDIA CONNECTIVITY PACKAGE
SIL	ACCESSORY-RSE - PORTABLE MEDIA CONNECTIVITY PKG - W/INTEGRATED POWER
SN7	ACCESSORY-WHEEL - 19 X 7.5 - J - ALUMINUM - DESIGN 1
SN8	ACCESSORY-WHEEL - 19 X 7.5 - J - ALUMINUM - DESIGN 2
SPM	PLANT CODE-SAN LUIS POTOSI, MEXICO

RPO	Description
SR2	ACCESSORY-RSE - DUAL HEADREST DISPLAY W/WIRELESS CONNECTIVITY
SR3	ACCESSORY-RSE - DUAL HEADREST DISPLAY W/WIRELESS CONNECTIVITY & DVD
T3S	LAMP-DAYTIME RUNNING, SEPARATE CAVITY, LED
T3U	LAMP FRT FOG-FRT FOG
T44	ALARM-OVERSPEED WARNING, ACOUSTICAL
T4A	HEADLAMPS-HALOGEN
T4F	HEADLAMPS-HIGH INTENSITY DISCHARGE
T4L	HEADLAMPS-LED
T74	CONTROL, HEADLAMPS-AUTOMATIC, DELAY
T83	CONTROL, HEADLAMPS-AUTOMATIC ON-OFF
TB4	BODY EQUIPMENT-LIFT GATE (MANUAL)
TB5	BODY EQUIPMENT-LIFT GATE (POWER)
TC2	BODY EQUIPMENT-LIFT GATE, POWER, HANDS FREE
TDM	MODE-TEEN DRIVER SETTINGS
TFK	ALARM-SEAT BELT WARNING
TQ5	HEADLAMP HIGH BEAM-AUTO CONTROL
TSQ	LAMP PACKAGE-INTERIOR, DELUXE
U05	HORN-DUAL
U19	SPEEDOMETER-INST, KILO & MILES, KILO ODOMETER
U2J	DIGITAL AUDIO SYSTEM-S-BAND - NONE
U2K	DIGITAL AUDIO SYSTEM-S-BAND
U2L	RECEPTION-HD
U68	DISPLAY-DRIVER INFO CENTER
U80	DISPLAY-COMPASS
U91	ANTENNA-SHORT, ROOF, RADIO
UC3	CONTROL-STEERING WHEEL, RADIO & PHONE, REDUNDANT CONTROLS
UD7	PARK ASSIST-REAR
UDC	DISPLAY INSTRUMENT-DRIVER INFO ENHANCED (ONE COLOR GRAPHIC)
UDD	DISPLAY INSTRUMENT-DRIVER INFO ENHANCED (MULTI COLOR STANDARD GRAPHIC)
UE0	COMMUNICATION SYSTEM-VEHICLE - NONE
UE1	COMMUNICATION SYSTEM-VEHICLE, ONSTAR
UE4	SENSOR INDICATOR-FOLLOWING DISTANCE
UEU	SENSOR INDICATOR-FORWARD COLLISION ALERT
UFG	SENSOR INDICATOR-REAR CROSS TRAFFIC ALERT
UFQ	PARK ASSIST-FRONT, REAR, LATERAL-FRONT (SEMIAUTOMATIC STEERING ADVANCED PARKING AID)
UG1	OPENER-GARAGE DOOR, UNIVERSAL
UGE	LAMP-RR TAIL, LED
UHG	INDICATOR-SEAT BELT WARNING, DRIVER
UHH	INDICATOR-SEAT BELT WARNING, PASSENGER
UHX	LANE ACTIVE SAFETY-KEEP ASSIST
UHY	COLL IMMINENT BRK-LOW SPEED, VEH FWD MOVEMENT, BRAKE PREFILL, INTEGRATED BRAKE ASSIST
UJM	TIRE PRESS INDICATOR-MANUAL LEARN
UKC	SIDE ACTIVE SAFETY-OBSTACLE DETECTION ENHANCED
UMN	SPEEDOMETER-INST, MILES & KILO, MILES ODOMETER
UPG	WIRELESS INTERFACE-SHORT RANGE
UQA	SPEAKER SYSTEM-PREMIUM AUDIO, BRANDED AMPLIFIER

Cardiagn.com

RPO	Description
US2	VEHICLE VIN-NON-SALEABLE, 0777 SERIES (DO NOT USE UNLESS AUTHORIZED BY DN)
USR	RECEPTACLE-USB
USS	RECEPTACLE-USB CHARGE PORT
UST	RECEPTACLE-DUAL USB, SINGLE AUX
UTJ	THEFT DETERENT-ELECTRICAL, UNAUTHORIZED ENTRY
UVC	VISION-REAR VIEW, MONO, ANALOG
UVD	STEERING WHEEL HEAT-MANUAL
UVH	VISION-360 VIEW, MONO, ANALOG
UZ6	SPEAKER SYSTEM-6, PREMIUM
V2P	LUGGAGE CARRIER-RF RAIL
V87	VEHICLE STATEMENT-GULF STATES ORGANIZATION
V8C	VEHICLE STATEMENT-MEXICO
V8D	VEHICLE STATEMENT-US
V8E	VEHICLE STATEMENT-CANADA
V8I	VEHICLE STATEMENT-ISRAEL
V92	TRAILER PROVISIONS-
V9V	MERCHANDISED PKG-TERRAIN DENALI
VAT	ACCESSORY-GRILLE / GRILLE INSERTS - ALTERNATE FINISH - CHROME
VAV	ACCESSORY-FLOOR MATS - ALL WEATHER
VEX	KIT-SAFETY
VG1	PROTECTOR-UNDERHOOD COMPOUND, CORROSION PREVENTIVE, WATER BASED, CLEAR
VK3	LICENSE PLATE FRONT-FRT MOUNTING PKG
VK8	HOLDER-EYEGLASSES
VKU	ACCESSORY-MIRROR CAPS - CHROME
VLI	ACCESSORY-MAT - TRUNK / CARGO AREA
VLL	ACCESSORY-CROSS RAILS - ROOF RACK - REMOVABLE
VPH	VEHICLE PREPARATION-OVERSEAS DELIVERY
VQK	ACCESSORY-SPLASH GUARDS - CUSTOM MOLDED
VR2	TRAILER HITCH-FACTORY INSTALLED
VR6	HOOK-TIE-DN SHPG
VRS	ACCESSORY-CARGO SECURITY SHADE
VTB	ACCESSORY-PROTECTOR - REAR BUMPER
VTI	SHUTTERS-FRONT GRILLE, ACTIVE, UPR
VV4	COMMUNICATION EQUIP-MOBILE INTERNET CONNECTIVITY
VXW	ACCESSORY-ASSIST STEPS - MOLDED
VY7	KNOB-TRANS CONT LEVER, LEATHER
VYW	ACCESSORY-FLOOR MATS - PREMIUM CARPET - DESIGN 1
W2D	ACCESSORY-CARGO NET
W39	ORNAMENTATION-LETTERING, "CHEVROLET" - NONE
W9E	ORNAMENTATION-LETTERING, RR - NONE
WBL	SALES PACKAGE-SPORT
WCI	ORNAMENTATION-LETTERING "2.0T"(UPPER-CASE T) RR
WD8	SEAT RR-SPLIT BACK, FOLDING, CTR ARMREST, NO PASS THROUGH
WH6	ACCESSORY-CARGO NET - FLOOR MOUNTED
WMJ	VIN MODEL YEAR-2018
WPR	SALES PACKAGE-ADVANCED SAFETY 1
WPZ	SALES PACKAGE-LT INFOTAINMENT
XBF	ACCESSORY-TIRE ALL-235/50R19 SL 99H BW AL3 VAR 1

mydiagram.com

RPO	Description
XL7	FREQUENCIES RATING-315 MHZ, LONG DISTANCE
XL8	FREQUENCIES RATING-433 MHZ
Y29	SALES PACKAGE-NAVIGATION AND AUDIO
Y3I	SALES PACKAGE-NAVIGATION SYSTEM PACKAGE, VAR.1
Y3W	SALES PACKAGE-PREMIUM INFOTAINMENT
Y67	DISPLAY-REMINDER PACKAGE
YF5	CERTIFICATION-EMISSION, CALIFORNIA
YM8	IDENTIFICATION-LIMITED PERSONALIZATION OPTION (LPO)
Z49	COUNTRY-CANADA
Z4K	ORNAMENTATION-LETTERING "PREMIER"
Z5X	MIRROR PROVISIONS-ARABIC LANGUAGE
ZP5	SEATING ARRANGEMENT-5 PASS
ZQ2	SALES PACKAGE-DRIVER CONVENIENCE
ZQ3	SALES PACKAGE-DRIVER CONVENIENCE II

FASTENERS

Metric Fasteners

This vehicle provides fastener dimensions using the metric system. Most metric fasteners are approximate in 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 PosidriveÂ® or Type 1A cross-recess identifies a metric cross-recess screw. For best results, use a Type 1A cross-recess screwdriver, or equivalent, in PosidriveÂ® 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.

Fastener Strength Identification

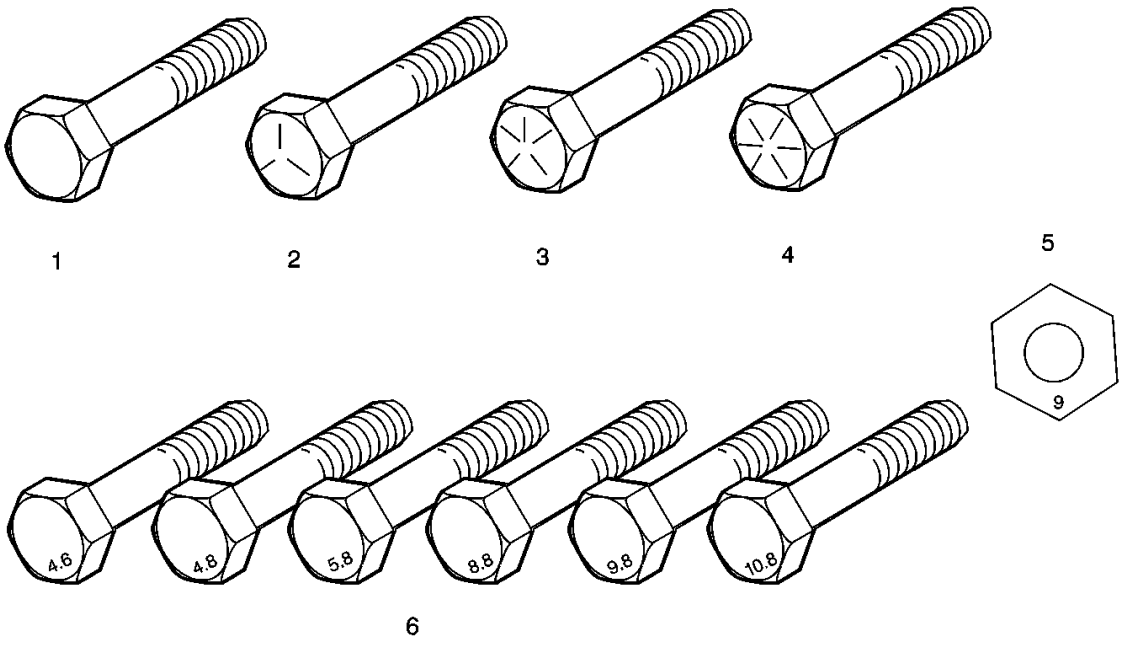


Fig. 8: Identifying Fastener Strength Marks
Courtesy of GENERAL MOTORS COMPANY

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 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

cardiagn.com

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

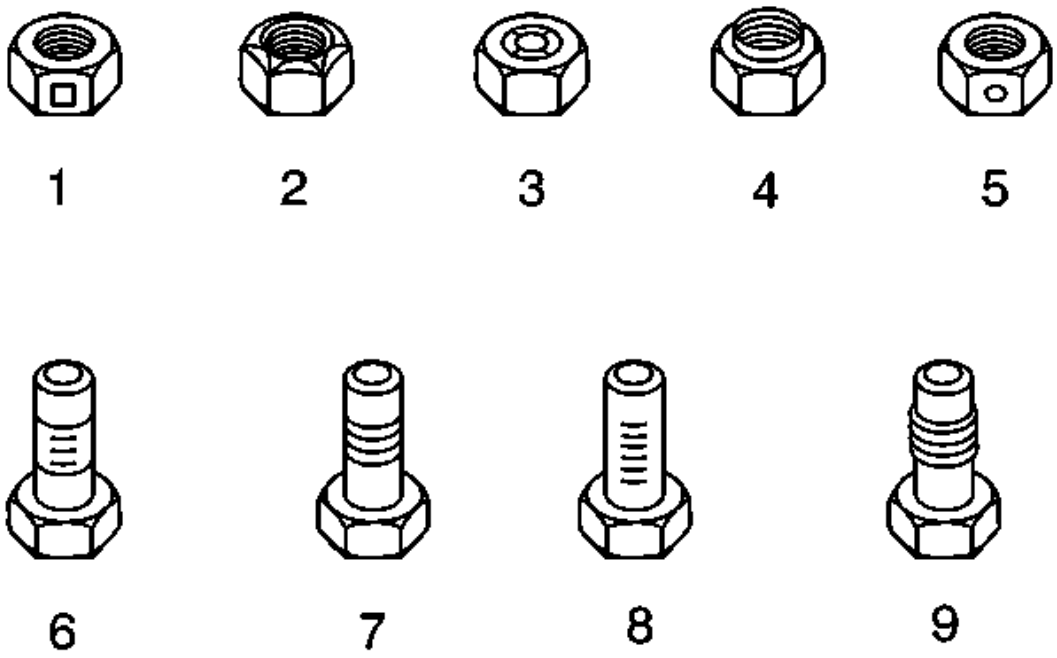
These fasteners accomplish the thread interface by a designed distortion or deformation in the fastener.

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.



cardiagn.com

Fig. 9: Identifying Adhesive Coated Fasteners
Courtesy of GENERAL MOTORS COMPANY

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

Application	Specification	
	Metric	English
All Metal Prevailing Torque Fasteners		

Application	Specification	
	Metric	English
• 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

cardiagn.com

Application	Specification	
	Metric	English
• 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	62 lb in
Nylon Interface Prevailing Torque Fasteners		
• 1/4 in	0.3 N.m	3 lb in
• 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

cardiagn.com

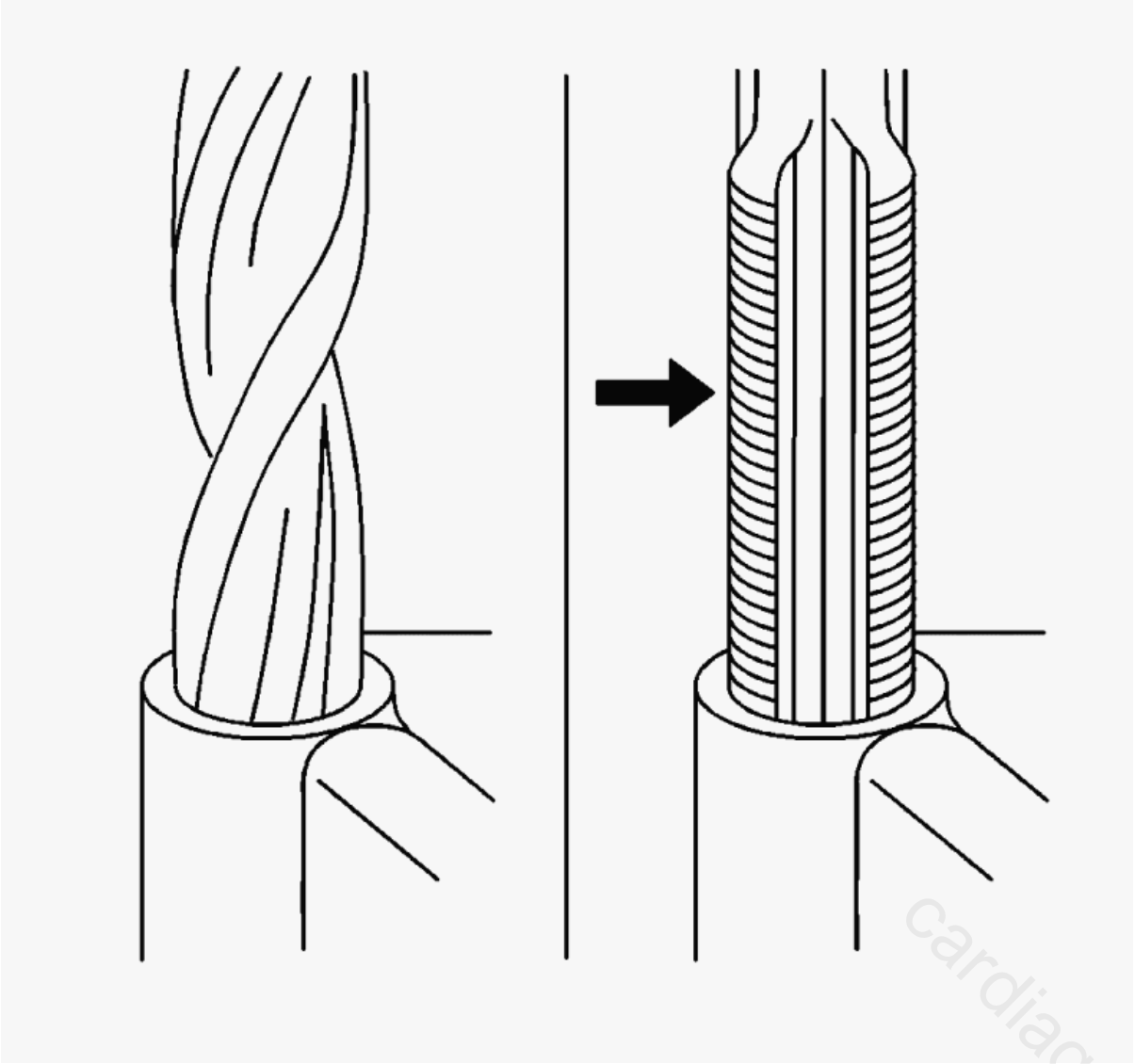


Fig. 10: Drilling & Tapping Damaged Threads
Courtesy of GENERAL MOTORS COMPANY

WARNING: **Refer to Safety Glasses Warning .**

NOTE: **Refer to the thread repair kit manufacturer 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.
3. Lubricate the tap with light engine oil. Tap the hole. Clean the threads.

cardiagn.com

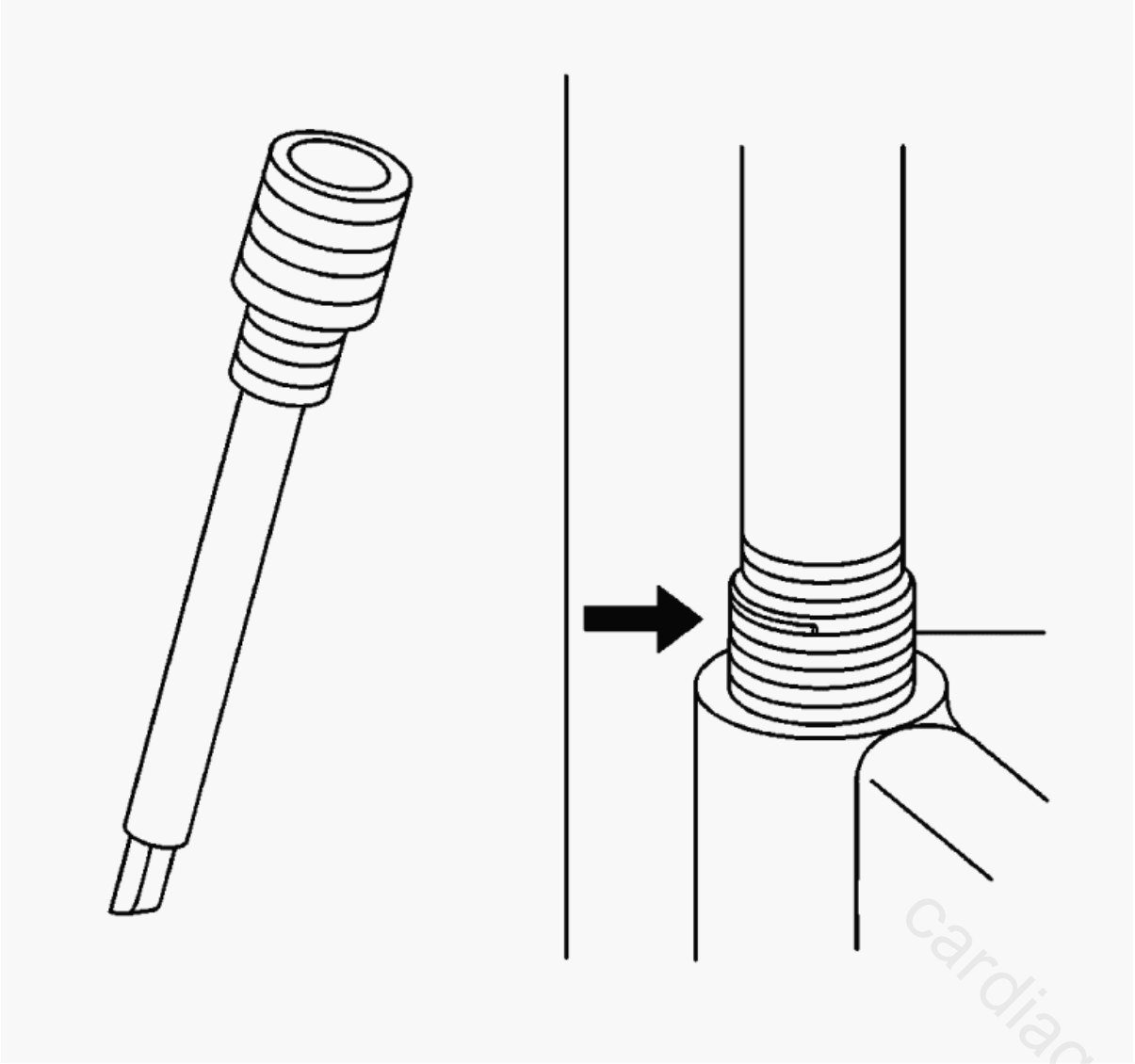


Fig. 11: View Of Thread Insert
Courtesy of GENERAL MOTORS COMPANY

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.

REGISTERED AND NON-REGISTERED TRADEMARKS

Listed below are Registered Trademarks (Â®) or Non-Registered Trademarks (™) which may appear in this service information.

A
ACÂ®
ACCUTURNÂ®
ACDelcoÂ®
Active Fuel Management™
AcuzincÂ®
AirbankÂ®
AllisonÂ®
AMMCOÂ®
AUTOFUSEÂ®
AUTOTRACÂ®

cardiagn.com

B
BendixÂ®
BluetoothÂ®
BON-AMIÂ®
BoschÂ®
BoseÂ®
C
CaterpillarÂ®
CATÂ®
C-QuamÂ®
D
DelcoÂ®
Delco BoseÂ®
Delco ElectronicsÂ®
Delco FreedomÂ®
Delco LOC IIÂ®
Delco MoraineÂ®
Delco RemyÂ®
Delco SoundÂ®
Delco SupremeÂ®
Delco TechÂ®
DELCOREÂ®
DelphiÂ®
DEX-COOLÂ®
DEXOILÂ®
DEXRONÂ®
DEXSTEER™
DNRÂ®
DolbyÂ®
DRÂ®
DuracellÂ®
DuraguardÂ®
DurastopÂ®
Duramax™
E
Eaton CorporationÂ®
EMDÂ®
ETRÂ®
F
FLO-LITEÂ®
G
General MotorsÂ®
GMÂ®
GM Goodwrench ServiceÂ®
GM OptikleenÂ®
GM Parts™
GM PassÂ®
GM UltraliteÂ®
GMACÂ®
GoodwrenchÂ®
GTPÂ®
H
Homelink™

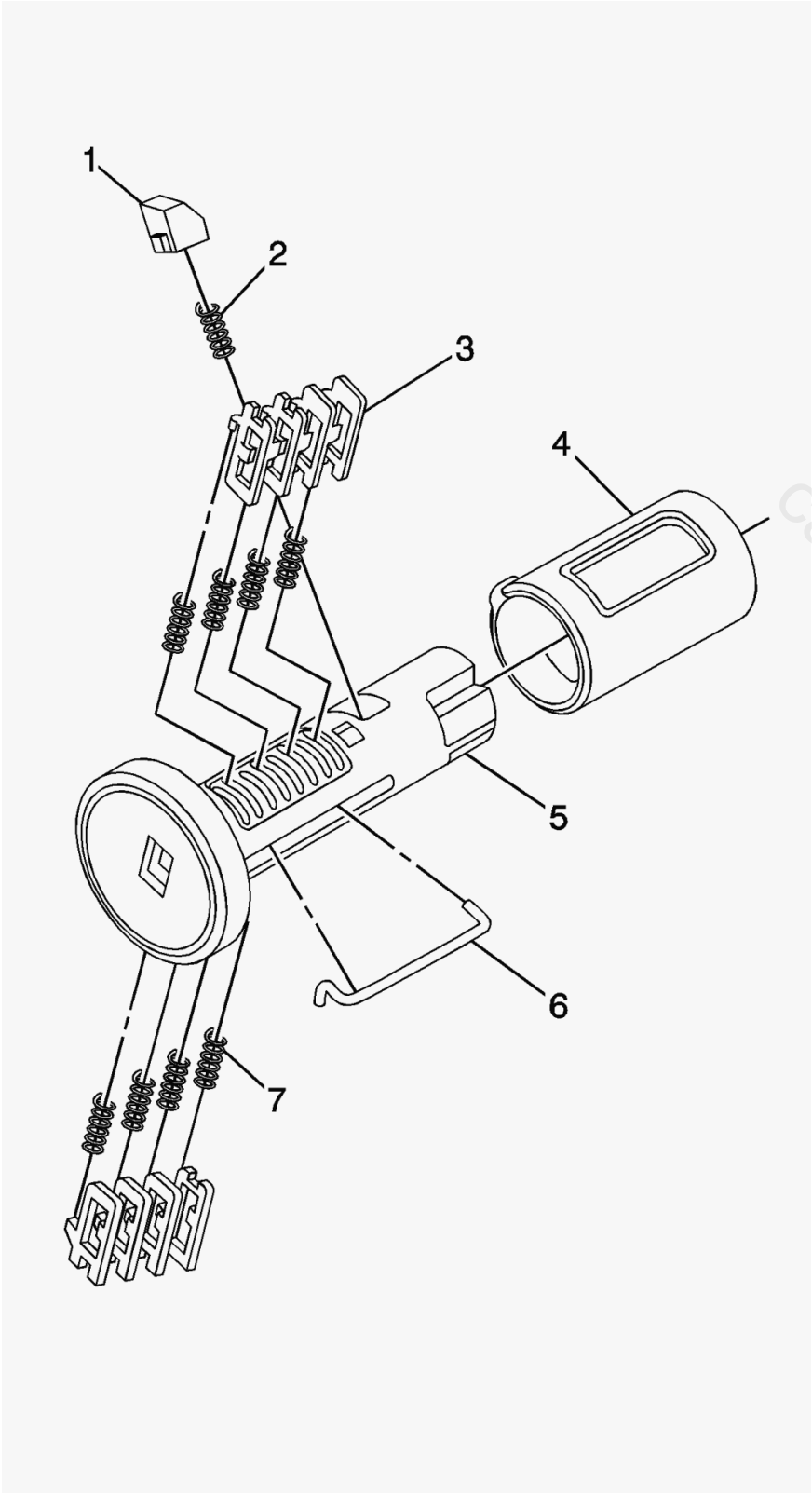
cardiagn.com

HYDRA-MATICÂ®
I
IlluminationÂ®
INSTA-TRACÂ®
IntuneÂ®
L
LOCTITE™
Lord Fusor™
M
MAGNASTEERÂ®
MaxifuseÂ®
MetripackÂ®
MicropackÂ®
MinifuseÂ®
Mr GoodwrenchÂ®
N
NorthstarÂ®
O
OnStarÂ®
OptikleenÂ®
P
PASS-KEYÂ®
PASS-KEYIIÂ®
PASSLOCK™
PK3Â®
PozidrivÂ®
ProÂ®
Q
Quad 4Â®
R
RAINSENSE™
Rapid FireÂ®
S
ScotchBrite™
Scotchguard™
SignalsÂ®
Sikkens™
Soft-RayÂ®
Solar-RayÂ®
StabilitrakÂ®
SunrayceÂ®
SuperlubeÂ®
SycloneÂ®
T
Tech 2Â®
TechlineÂ®
TeflonÂ®
TefzelÂ®
Theft-IÂ®
TheftlockÂ®
TiltmasterÂ®
TORXÂ®
TransjelÂ®

cardiagn.com

TransguideÂ®
Twilight SentinelÂ®
U
UltraliteÂ®
V
VelcroÂ®
W
Weatherpack™

LOCK CYLINDER CODING - IGNITION



cardiagn.com

Fig. 12: Lock Cylinder Coding - Ignition
Courtesy of GENERAL MOTORS COMPANY

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 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 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 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.

LIFTING AND JACKING THE VEHICLE

NOTE: **The use of a LOW PROFILE LIFT ARMS SYSTEM may be required to avoid unwanted contact with the vehicle's body and structure depending on lifting equipment used. Refer to the manufacture's recommendation for their applications of low profile lift arms system for their lifting equipment.**

cardiagn.com

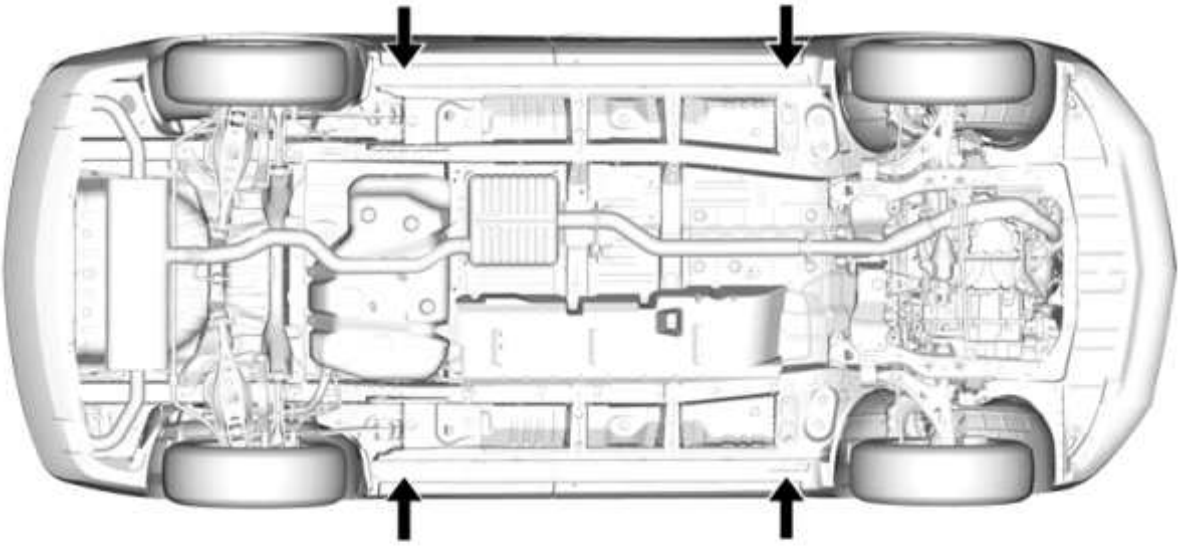


Fig. 13: Lift Points
Courtesy of GENERAL MOTORS COMPANY

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.**
- **When performing work in the engine compartment or under the vehicle, ensure that the hood is fully open, or opened to its secondary latch. When the hood is opened to the secondary latch, the vehicle will disable the remote start features from the key fob and OnStar mobile app. Failure to open the hood, or open the hood to the secondary latch while doing a repair in the engine compartment or under the vehicle can result in inadvertent vehicle starting which could result in personal injury or damage to a vehicle.**

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 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 rocker panel front molding, as shown.

Rear Lift Pads

When lifting the vehicle with a frame-contact lift, place the rear lift pads on the rocker panel rear molding, 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.

Rear of Vehicle

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

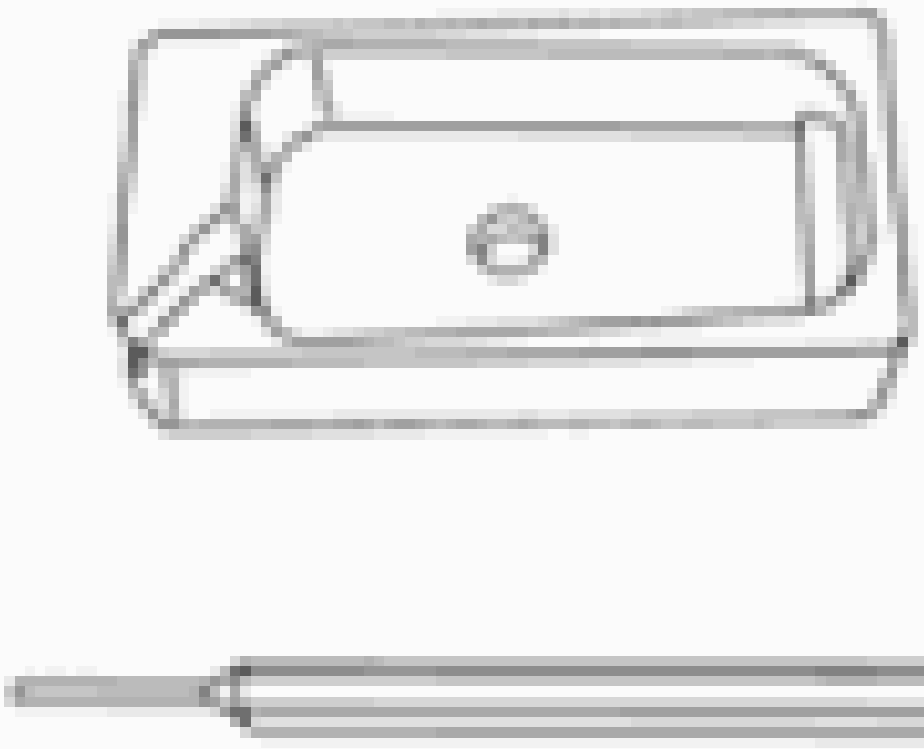
Place the service jack pad in the same location as shown for the rear lift pads.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description

cardiagn.com

Illustration	Tool Number/ Description
	BO-51098 Flip Key Blade Fixture

SPECIAL TOOLS ORDERING INFORMATION

Special Tools

The special service tools shown in this service information that have product numbers beginning with J, BO, GE, CH, DT, EN, EL, SA, OR KM are available for worldwide distribution.

US, Canada and Caribbean only:

NOTE: **For Special Service tools only - see different location below for diagnostic tools & equipment.**

Bosch Automotive Service Solutions

28635 Mound Road

Warren

MI

48092-3499

U.S.A

Phone: 1-800-GM-TOOLS

Monday through Friday

8:00 am - 7:00 pm Eastern Standard Time

arojagn.com

Fax: 1-800-578-7375 or 586-578-7321

gmspecialservicetools.service-solutions.com

Mexico, Including Central America:

Bosch Automotive Service Solutions

Mitla No. 442 Col. Vertiz Narvarte

03600 Mexico City

Mexico

Phone: +5255 2595 1630

Fax: +5255 2595 1639

Inquiries can be sent to: herramientas@service-solutions.com

South America, Excluding Brazil:

Bosch Automotive Service Solutions

Mitla No. 442 Col. Vertiz Narvarte

03600 Mexico City

Mexico

Phone: +5255 2595 1630

Fax: +5255 2595 1639

Inquiries can be sent to: herramientas@service-solutions.com

Brazil:

Bosch Automotive Service Solutions

Av. Maria Coelho de Aguiar, 573 - G10

05805-000 Sαo Paulo

Brasil

Phone: +55 11 5851-7477

Fax: +55 11 5853-7479

Inquiries can be sent to: ferramentas@service-solutions.com

Korea, Thailand, Vietnam, Laos, Cambodia:

Robert Bosch Korea Ltd, Service Solution

689-17 Geumjeong-dong, Gunpo-si, Gyeonggi-do, 435-862

Korea

Phone: 82-31-457-9520

sales.korea@servicesolutions.com

Fax: 82-31-427-9522

cardiagn.com

Greater China, SGM

Bosch Automotive Service Solutions China

333 Fuquan Road North IBP, Changning District

Shanghai 200335 P.R.

Phone: 86-21-22182668

sales.cn@service-solutions.com

Fax: 0086 21 2218 2677

Australia:

Bosch Automotive Service Solutions Australia

1555 Centre Road,

Clayton

Vic. 3168

Phone: 1300 783 031

Fax: (3) 9541 6138

Inquiries can be sent to: customerservice.au@service-solutions.com

Iberica S.A.

Dealers based in Spain, Portugal and Canary Islands:

Bosch Automotive Service Solutions Europe

Nave 72 (Nudo Oeste), 19004 Guadalajara,

Spain

Phone: 34 949 208 337

Fax: 34 949 208 327

shop.service-solutions.com

Europe GmbH

Dealers based in The Netherlands, Belgium and Luxemburg:

Bosch Automotive Service Solutions Europe

Albert Tijsstraat 12, 6471 WX Kerkrade,

Netherlands

Phone: 31 -45 567 8870

Fax: 31-45 567 8871

shop.service-solutions.com

United Kingdom Limited

Dealers based in UK:

cardiagn.com

Bosch Automotive Service Solutions Europe

Ironstone Way; Brixworth, Northants, NN6 9UD,

Great Britain

Phone: 44 -1327 303 400

Fax: 44 -1327 303 499

shop.service-solutions.com

Italy

Dealers based in Italy:

Bosch Automotive Service Solutions Europe

Via provinciale, 12, 43038 Sala Baganza-PR,

Italy

Phone: 39 -521 837 508

Fax: 39 - 521 335 385

shop.service-solutions.com

Tech 2, MDI Diagnostic Tools and Accessories, Dealer Equipment

US and Canada

Dealer Equipment and Services

5775 Enterprise Drive

Warren

MI, U.S.A

48092-3463

Phone: 1-800-GM-TOOLS

Monday through Friday

8:00 am - 6:00 pm EST

Fax: 1-586-578-7205

www.GMDEsolutions.net (US only) or www.des-canada.ca (Canada only)

cardiagn.com

Back To Article

GENERAL INFORMATION

Manual Transmission Trouble Shooting

* PLEASE READ THIS FIRST *

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

INTRODUCTION

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

There are many times when the transmission is incorrectly blamed for shifting problems or noises that are actually caused by other reasons. Shift difficulties are frequently caused by conditions outside of the transmission or transaxle. Typical conditions include: shift linkage, shift cables, alignment of engine to transmission, worn engine mounts or clutch problems. Drive train noises may come from many sources such as tires, road surfaces, wheel bearings, differentials, engine or exhaust system. Repairing or overhauling transmission will not cure these problems.

No manufacturer makes a perfectly quiet transmission. Gear rollover noise is present in most constant mesh transmissions and will tend to disappear when the clutch is disengaged or transmission is placed in gear. If clutch is properly adjusted, clutch release bearing noise will disappear when release bearing is moved enough to slide release bearing away from pressure plate.

Trouble shooting can be helped by driving vehicle on a smooth level road to help eliminate tire and body noise. Note whether noise occurs on acceleration, coasting, deceleration or steady driving conditions. Some problems may only occur when transmission is either hot or cold. Gear lubricant that is too thick can cause hard shifting on cold mornings before engine is warm and vehicle has been driven.

MANUAL TRANSMISSION/TRANSAXLE TROUBLE SHOOTING

Condition	Possible Cause
Noisy In Forward Gears	Low Gear Oil Level, Loose Bellhousing Bolts, Worn Bearings Or Gears
Clunk On Deceleration (FWD Only)	Loose Engine Mounts, Worn Inboard CV Joints, Worn Differential Pinion Shaft, Oversized Side Gear Hub Counterbore in Case
Gear Clash When Shifting Forward Gears	Clutch Out Of Alignment, Shift Linkage Damaged Or Out Of Adjustment, Gears Or Synchronizers Damaged, Low Gear Oil Level
Transmission Noisy When Moving (RWD Only); Quiet In Neutral With Clutch Engaged	Worn Rear Output Shaft Bearing
Gear Rattle	Worn Bearings, Worn Gear Oil, Low Gear Oil, Worn Gears
Steady Ticking At Idle (Increases With RPM)	Broken Tooth On A Gear
Gear Clash When Shifting Forward Gears	Worn Or Broken Synchronizers, Faulty Clutch
Loud Whine In Reverse	Normal Condition (1)
Noise When Stepping On Clutch	Faulty Release Bearing, Worn Pilot Bearing
Ticking Or Screeching As Clutch Is Engaged	Faulty Release Bearing, Uneven Pressure Plate Fingers
Click Or Snap When Clutch Is Engaged	Worn Clutch Fork, Worn Pivot Ball, Worn Or Broken Front Bearing Retainer

Condition	Possible Cause
Transmission Shifts Hard	Clutch Not Releasing, Incorrect Gear Oil, Shift Mechanism Binding, Clutch Installed Backward
Will Not Shift Into One Gear, Shifts Into All Others	Bent Shift Fork, Worn Detent Balls
Locked Into Gear, Cannot Shift	Clutch Adjustment, Worn Detent Balls
Transmission Jumps Out Of Gear	Pilot Bearing Worn, Bent Shift Fork, Worn Gear Teeth Or Face, Excessive Gear Train End Play, Worn Synchronizers, Missing Detent Ball Spring, Shift Mechanism Worn Or Out Of Adjustment, Engine Or Transmission Mount Bolts Loose, Transmission Not Aligned
Shift Lever Rattle	Worn Detents Or Shift Lever, Worn Shift Fork, Worn Synchronizer Sleeves
Shift Lever Hops Under Acceleration	Worn Engine Or Transmission Mounts
(1) Most units use spur cut gears in Reverse and are naturally noisy.	

cardiagn.com

Back To Article

GENERAL INFORMATION

Parasitic Load Explanation & Test Procedures

* PLEASE READ THIS FIRST *

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

GENERAL INFORMATION

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

The term Parasitic Load refers to electrical devices that continue to use or draw current after the ignition switch is turned to OFF position. This small amount of continuous battery draw is expressed in milliamps (mA). On Chrysler vehicles, a typical Parasitic Load should be no more than 30 milliamps (0.030 amps). On Ford Motor Co. and General Motors vehicles produced after 1980, a typical Parasitic Load should be no more than 50 milliamps (0.050 amps).

Vehicles produced since 1980 have memory devices that draw current with ignition off for as long as 20 minutes before shutting down the Parasitic Drain. When Parasitic Load exceeds normal specifications, the vehicle may exhibit dead battery and no-start condition.

Follow test procedure for checking Parasitic Loads to completion. A brief overview of a suggested test procedure is included along with some typical Parasitic Load specifications. Refer to GENERAL MOTORS PARASITIC LOAD TABLE chart.

TESTING FOR PARASITIC LOAD

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

CAUTION: **Always turn ignition off when connecting or disconnecting battery cables, battery chargers or jumper cables. DO NOT turn test switch to OFF position (which causes current to run through ammeter or vehicle electrical system).**

NOTE: **Memory functions of various accessories must be reset after the battery is reconnected.**

The battery circuit must be opened to connect test switch (shunt) and ammeter into the circuit. When a battery cable is removed, timer circuits within the vehicle computer are interrupted and immediately begin to discharge. If in doubt about the condition of the ammeter fuse, test it with an ohmmeter prior to beginning test. An open fuse will show the same reading (00.00) as no parasitic drain. Begin test sequence with the meter installed and on the 10-amp scale. Select lower scale to read parasitic draw.

CHRYSLER IGNITION OFF DRAW (IOD) TEST

To test for excessive IOD, verify that all electrical accessories are OFF. Turn off all lights, remove ignition key, and close all doors and decklid. If the vehicle is equipped with electronic accessories (illuminated entry, automatic load leveler, body computer, or high line radio), allow the system to automatically shut off (time out), up to 3 minutes.

cardiagn.com

1. Raise the hood and disconnect both battery cables, negative first.

CAUTION: IOD greater than 3 amps may damage millampmeter.

2. Reconnect the negative cable and connect a typical 12-volt test light (low wattage bulb) between the positive cable clamp and the positive battery post. Remove the engine compartment lamp bulb. If the test light does not light, proceed to step 3. If the test light does light, proceed to step, 4. The test light will indicate IOD greater than 3 amps. After higher amperage IOD has been corrected, proceed to step 3.
3. ith 12-volt test light still connected (not lit), connect an ammeter (milliampere scale) between the positive cable clamp and the positive battery post, disconnect test light, refer to instructions provided with ammeter being used. A reading of 30 milliamperes or less indicates normal electrical draw. If ammeter reads more than 30 milliamperes, excessive IOD must be corrected.
4. Locate the fuse panel and remove fuses or circuit breakers one at a time, and observe ammeter after each fuse or circuit breaker is removed. If test light goes out and the reading drops below 30 milliamperes when a certain fuse or circuit breaker is removed, that circuit may have a defect.
5. If IOD is detected after all fuses and circuit breakers have been removed, disconnect the 60-way connector at the Single Module Engine Control (SMEC), located outboard of the battery.
6. If excessive IOD is detected after all fused circuits and SMEC have been verified, disconnect the B+ terminal from the alternator. If reading drops below 30 milliamperes, reinstall all fuses and circuit breakers, reconnect B+ terminal at alternator, reconnect battery, and perform alternator diagnostics.
7. Install engine compartment lamp bulb.

TEST PROCEDURE USING TEST SWITCH

1. Turn ignition off. Remove negative battery terminal cable. Install Disconnect Tool (J-38758) test switch male end to negative battery cable. Turn test switch knob to OFF position (current through meter). Install negative battery cable to the female end of test switch.
2. Turn test switch knob to ON position (current through switch). Road test vehicle with vehicle accessories on (radio, air conditioner, etc). After road test, turn ignition switch to LOCKED position and remove key. Connect ammeter terminals to test switch terminals. See **Fig. 1**. Select 10-amp scale.
3. Turn off all electrical accessories. Turn off interior lights, underhood lamp, trunk light, illuminated entry, etc. To avoid damaging ammeter or obtaining a false meter reading, all accessories must be off before turning test switch knob to OFF position.
4. Turn test switch knob to OFF position to allow current to flow through ammeter. If meter reads wrong polarity, turn test switch to ON position and reverse leads. Turn test switch to OFF position. Observe current reading. If reading is less than 2 amps, turn test switch to ON position to keep electrical circuits powered-up.
5. Select low amp scale. Switch lead to the correct meter position. Turn test switch to OFF position and compare results to normal current draw. See **GENERAL MOTORS PARASITIC LOAD TABLE (MILLIAMPS)**. If current draw is unusually high for the vehicle's overall electrical system, remove system fuses one at a time until current draw returns to normal.
6. Turn test switch to ON position each time door is opened or fuse is removed. Turn switch to OFF position to read current draw value through meter. When the cause of excessive current drain has been located and repaired, remove test switch and reconnect negative battery cable to the negative battery terminal.

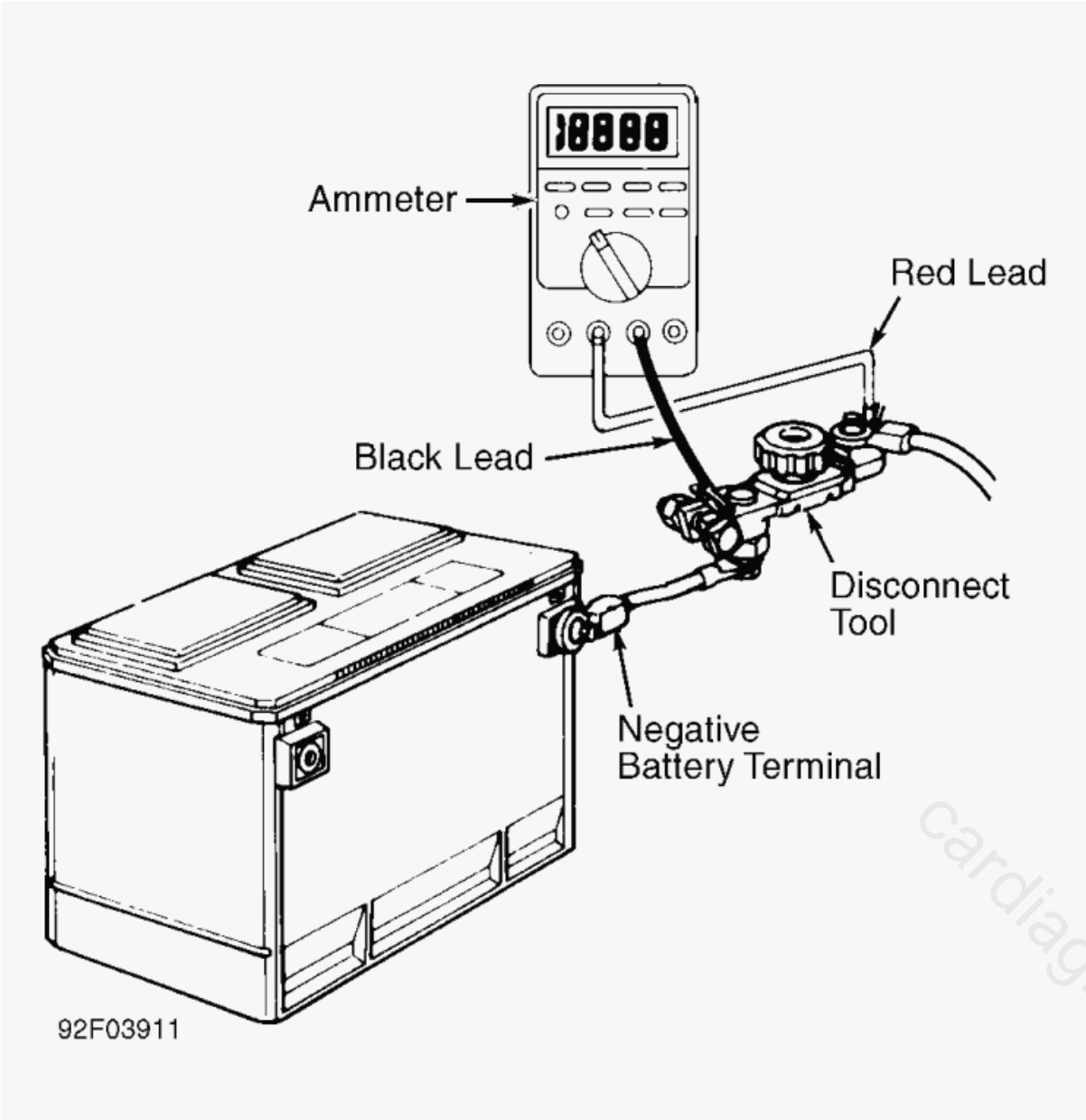
INTERMITTENT PARASITIC LOAD PROBLEMS

Intermittent parasitic load can occur because of a memory device that does not power down with ignition off. With an intermittent parasitic load, battery draw can be greater than 1.0 amp.

To find an intermittent problem requires that an ammeter and Disconnect Tool (J-38758) test switch be connected and left in the circuit. See **Fig. 1**. Road test vehicle. After road test, turn ignition off and remove key.

Monitor the milliamps scale for 15-20 minutes after ignition is turned off. This allows monitoring memory devices to determine if they time out and stop drawing memory current. The test switch is

needed to protect ammeter when the vehicle is started.



cardiagn.com

Fig. 1: Connecting Kent-Moore Disconnect Tool (J-38758)
Courtesy of GENERAL MOTORS CORP.

GENERAL MOTORS PARASITIC LOAD

Component	Normal Draw	Maximum Draw	Time-Out (Minutes)
Anti-Theft System	0.4	1.0	.....
Auto Door Lock	1.0	1.0	.....
Body Control Module	3.6	12.4	20
Central Processing System	1.6	2.7	20
Electronic Control Module	5.6	10.0	.....
Electronic Level Control	2.0	3.3	20
Heated Windshield Module	0.3	0.4	.....
HVAC Power Module	1.0	1.0	.....
Illuminated Entry	1.0	1.0	1
Light Control Module	0.5	1.0	.....
Oil Level Module	0.1	0.1	.....
Multi-Function Chime	1.0	1.0	.....

Component	Normal Draw	Maximum Draw	Time-Out (Minutes)
Pass Key Decoder Module	0.75	1.0	.....
Power Control Module	5.0	7.0	.....
Retained Accessory Power	3.8	3.8	.....
Radio	7.0	8.0	15
Twilight Sentinel Module	1.0	1.0	.....
Voltage Regulator	1.4	2.0	.....

DIODE CHECK & SOLENOID TEST

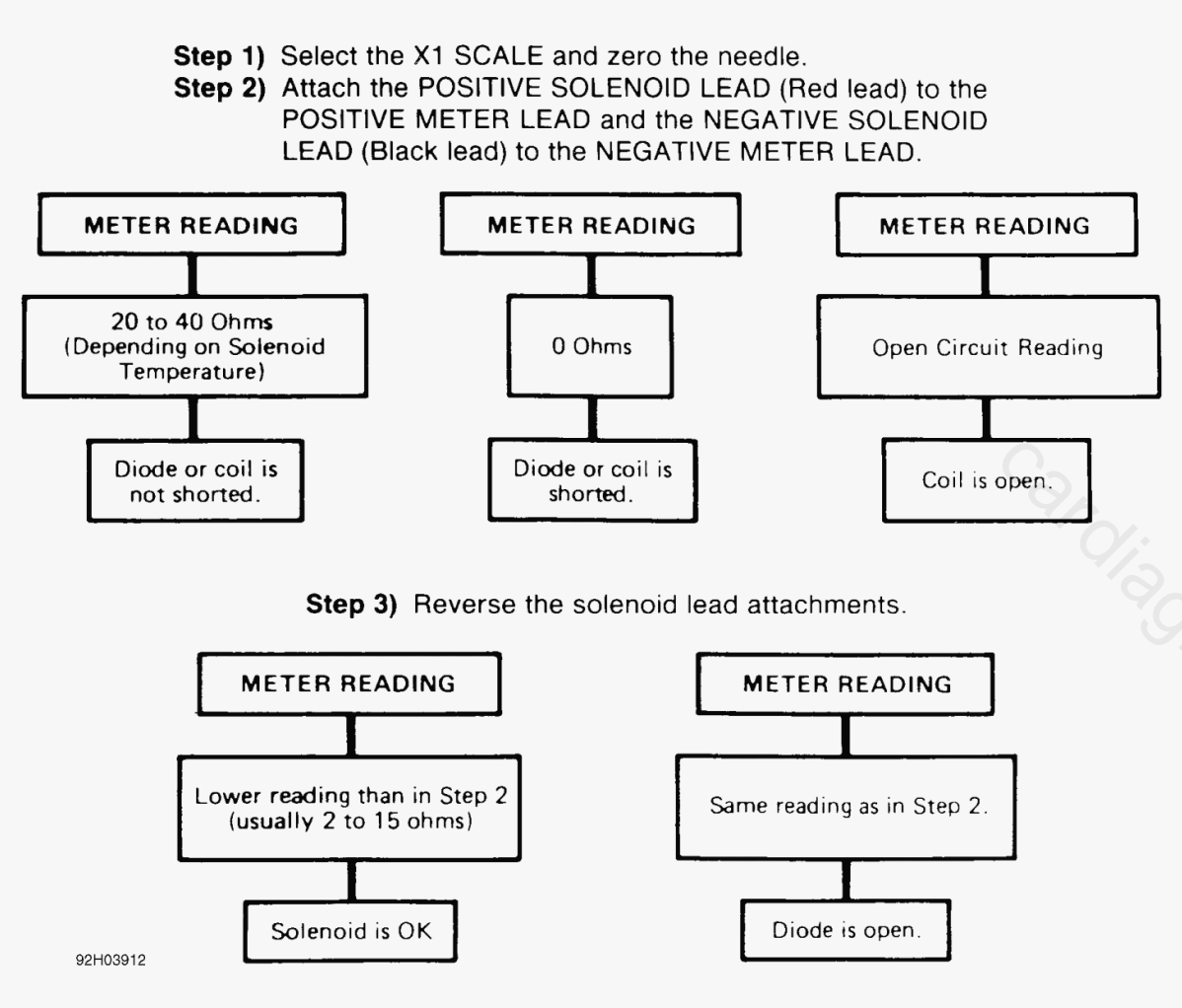


Fig. 2: Diode Check & Solenoid Test
Courtesy of GENERAL MOTORS CORP.

QUAD DRIVER TEST

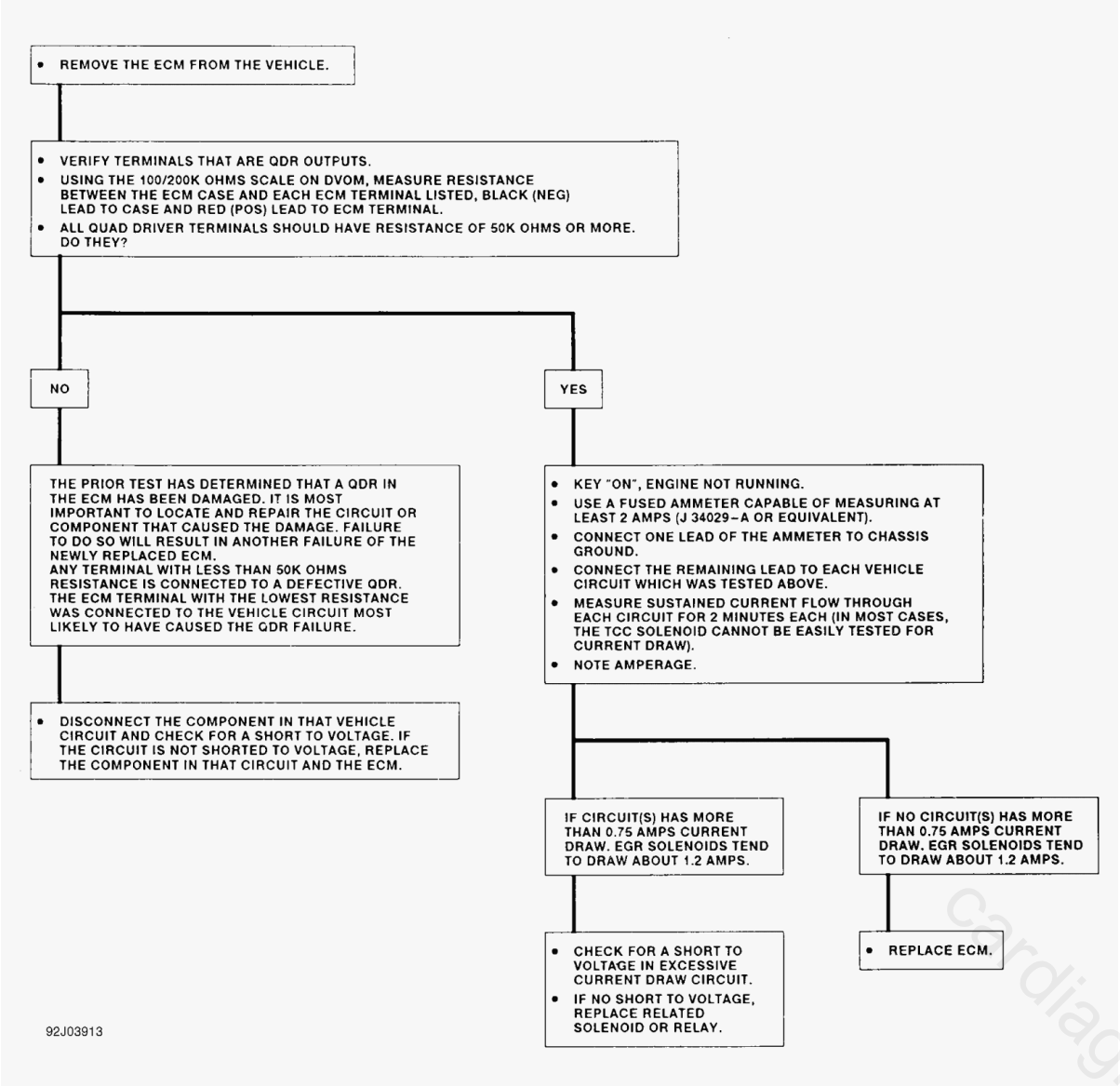
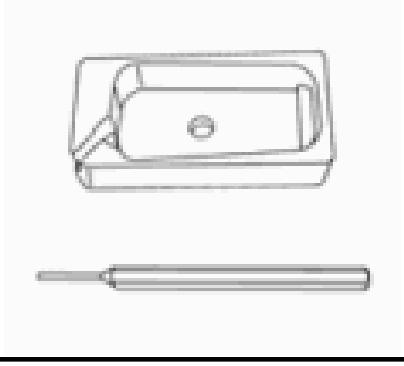


Fig. 3: Quad Driver Test
Courtesy of GENERAL MOTORS CORP.

cardiagn.com

Back To Article

SPECIAL TOOLS AND EQUIPMENT

Illustration	Tool Number/Description
	BO-51098 Flip Key Blade Fixture

cardiagn.com

Back To Article

GENERAL INFORMATION

State Emission Standards - Gasoline

ALASKA

NOTE: **Because of frequent revisions in state emission standards, the emission standards listed in this article should only be used as a guide.**

NOTE: **As of March 1, 2012, Alaska is not testing for tailpipe emissions.**

ALASKA EMISSION STANDARDS - ANCHORAGE & FAIRBANKS (2-SPEED IDLE TEST)

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Passenger Cars (1)		
1968-71	1000 (5.0)	1000 (4.0)
1972-74	1000 (4.0)	1000 (3.0)
1975-80	1000 (2.0)	1000 (2.0)
1981-83	1000 (1.0)	1000 (1.0)
1984-93	750 (1.0)	750 (1.0)
1994-	200 (0.5)	200 (0.5)
Light & Medium Duty Trucks (1)		
1968-72	1000 (5.0)	1000 (4.0)
1973-78	1000 (4.0)	1000 (3.0)
1979-83	1000 (2.0)	1000 (2.0)
1984-93	750 (1.0)	750 (1.0)
1994-	220 (0.5)	220 (0.5)
Heavy Duty Vehicles (2)		
1968-73	1000 (5.0)	1000 (5.0)
1974-93	1000 (4.0)	1000 (4.0)
1994-	220 (1.0)	220 (1.0)
(1) 8500 GVWR or less.		
(2) 8500 GVWR or more.		

ARIZONA

NOTE: **Curb idle only test are for vehicles with full-time 4WD, non-defeatable traction control and motorcycles. Curb idle and loaded cruise tests are performed on 1967-80 light-duty gasoline powered vehicles and all heavy-duty gasoline powered vehicles.**

ARIZONA EMISSION STANDARDS - PHOENIX AREA (CURB IDLE & LOADED CRUISE TESTS)

Application (1)	Idle HC ppm (CO %)	(2) Loaded/Cruise HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)		
1967-71 4-Cyl. Or Less	500 (5.50)	500 (4.20)
1967-71 More Than 4-Cyl.	450 (5.00)	450 (3.75)
1972-74 4-Cyl. Or Less	400 (5.50)	400 (4.20)
1972-74 More Than 4-Cyl.	400 (5.00)	400 (3.75)
1975-78 4-Cyl. Or Less	250 (2.20)	250 (1.65)
1975-78 More Than 4-Cyl.	250 (2.00)	250 (1.50)
Light Duty Vehicles (8500 GVWR Or Less)		
1979 4-Cyl. Or Less	220 (2.20)	220 (1.65)
1979 More Than 4-Cyl.	220 (2.20)	220 (1.50)
1980	220 (1.20)	220 (1.20)
1981 & Newer	220 (1.20)	.....
Light Duty Trucks (6000 GVWR Or Less)		
1967-80	(3)	(3)
Light Duty Trucks (6001-8500 GVWR)		
1967-74	(3)	(3)
1975-78	350 (4.00)	350 (3.00)
1979 4-Cyl. Or Less	220 (2.20)	220 (1.65)
1979 More Than 4-Cyl.	220 (2.00)	220 (1.50)
1980	220 (1.20)	220 (1.20)
1981 & Newer	220 (1.20)	.....
Heavy Duty Trucks (Greater Than 8500 GVWR)		
1967-74	(3)	(3)
1975-78	350 (4.00)	350 (3.00)
1979 & Newer	300 (4.00)	300 (3.00)
Motorcycles		
1967 & Newer	1800 (5.50)	.....

(1) 4-stroke engines only.

(2) Except AWD, non-defeatable traction control and motorcycles.

(3) Same as light duty vehicles.

ARIZONA EMISSION STANDARDS - PHOENIX AREA (IM147 TEST)

Application	HC gpm (CO gpm)	NOx gpm

cardiagn.com

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles		
1981-82	3.0 (25.0)	3.5
1983-85	2.4 (20.0)	3.5
1986-89	1.6 (15.0)	2.5
1990-93	1.0 (12.0)	2.5
1994 & Newer	0.8 (12.0)	2.0
Light Trucks (6000 GVWR Or Less)		
1981-85	4.0 (40.0)	5.5
1986-89	3.0 (25.0)	4.5
1990-93	2.0 (20.0)	4.0
1994 & Newer	1.6 (20.0)	3.0
Light Duty Trucks (6000-8500 GVWR)		
1981-85	4.4 (48.0)	7.0
1986-87	4.0 (40.0)	5.5
1988-89	3.0 (25.0)	5.5
1990-93	3.0 (25.0)	5.0
1994 & Newer	2.4 (25.0)	4.0

cardiagn.com

NOTE: **Curb idle test only for 1967-80 light-duty gasoline vehicles, all vehicles with full-time 4WD and/or non-defeatable traction control and motorcycles. Curb idle and loaded cruise tests are performed on all 1981 and later vehicles except those with full-time 4WD and/or non-defeatable traction control.**

ARIZONA EMISSION STANDARDS - TUCSON AREA (CURB IDLE & LOADED CRUISE TESTS)

Application (1)	Idle HC ppm (CO %)	(2) Loaded/Cruise HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)		
1967-71 4-Cyl. Or Less	500 (5.50)	.....
1967-71 More Than 4-Cyl.	450 (5.00)	.....
1972-74 4-Cyl. Or Less	400 (5.50)	.....
1972-74 More Than 4-Cyl.	400 (5.00)	.....
1975-78 4-Cyl. Or Less	250 (2.20)	.....

Application (1)	Idle HC ppm (CO %)	Loaded/Cruise (2) HC ppm (CO %)
1975-78 More Than 4-Cyl.	250 (2.00)	.....
Light Duty Vehicles (8500 GVWR Or Less)		
1979 4-Cyl. Or Less	220 (2.20)	.....
1979 More Than 4-Cyl.	220 (2.20)	.....
1980	220 (1.20)	.....
1981 & Newer	220 (1.20)	220 (1.20)
Light Duty Trucks (6000 GVWR Or Less)		
1967-80	(3)	(3)
Light Duty Trucks (6001-8500 GVWR)		
1967-74	(3)	(3)
1975-78	350 (4.00)	.....
1979 4-Cyl. Or Less	220 (2.20)	.....
1979 More Than 4-Cyl.	220 (2.00)	.....
1980	220 (1.20)	.....
1981 & Newer	220 (1.20)	220 (1.20)
Heavy Duty Trucks (Greater Than 8500 GVWR)		
1967-74	(3)	(3)
1975-78	350 (4.00)	.....
1979-80	300 (4.00)	.....
1981 & Newer	300 (4.00)	300 (3.00)
Motorcycles		
1967 & Newer	1800 (5.50)	.....

(1) 4-stroke engines only.

(2) Except AWD, non-defeatable traction control and motorcycles.

(3) Same as light duty vehicles.

CALIFORNIA

CALIFORNIA EMISSION STANDARDS ASM TESTS

Specific vehicle cutpoints are available on the California BAR web site at www.bar.ca.gov under the Industry tab, then Cutpoints Application.

cardiagn.com

ESC	MODEL YEAR GROUP	VEHICLE TYPE (by GVWR and LVW)					PASS/FAIL EMISSION STANDARD						GROSS POLLUTER STANDARD					
							ASM 5015			ASM 2525			ASM 5015			ASM 2525		
		PC	LDT1	LDT2	MDV		HC	CO	NO	HC	CO	NO	HC	CO	NO	HC	CO	NO
1	1974-	X	X	X		A	235.4	2.56	1301.5	185.4	2.36	1161.5	435.4	4.26	2659.3	385.4	4.06	2459.3
						B	436041.7	4453.19	1192593.0	436041.7	4453.19	1192593.0	436041.7	4453.19	1703703.7	436041.7	4453.19	1703703.7
2	1975-1980	X				A	123.0	0.91	1016.3	90.3	0.71	876.3	315.3	2.51	2051.9	265.3	2.31	1851.9
						B	273316.7	1362.96	1043519.0	273316.7	1362.96	1043519.0	273316.7	1362.96	1490740.7	273316.7	1362.96	1490740.7
3	1981-1983	X				A	63.2	0.64	850.0	42.1	0.44	680.0	253.1	2.14	1844.4	192.4	1.94	1644.4
						B	234259.3	1064.81	894444.5	212963.0	1064.81	894444.5	234259.3	1064.81	1277777.8	212963.0	1064.81	1277777.8
4	1984-1986	X				A	67.0	0.52	850.0	42.1	0.32	680.0	242.4	2.02	1744.4	192.4	1.82	1544.4
						B	212963.0	979.63	894444.5	212963.0	979.63	894444.5	212963.0	979.63	1277777.8	212963.0	979.63	1277777.8
5	1987-1992	X				A	57.0	0.48	608.0	31.7	0.32	547.0	231.7	1.98	1729.6	181.7	1.82	1529.6
						B	191666.7	851.85	596296.3	191666.7	979.63	596296.3	191666.7	851.85	851851.9	191666.7	979.63	851851.9
6	1993-1995	X				A	59.0	0.29	617.1	24.3	0.23	547.0	234.3	1.79	1759.3	184.3	1.73	1559.3
						B	89951.3	724.07	271314.8	89951.3	851.85	596296.3	128501.9	724.07	553703.7	128501.9	851.85	553703.7
7	1996-2000	X				A	16.8	0.29	260.0	0.5	0.23	547.0	234.3	1.79	1759.3	184.3	1.73	1559.3
						B	128501.9	724.07	596296.3	128501.9	851.85	596296.3	128501.9	724.07	553703.7	128501.9	851.85	553703.7
8	2001-2003	X				A	16.8	0.29	260.0	0.5	0.23	547.0	234.3	1.79	1759.3	184.3	1.73	1559.3
						B	128501.9	724.07	596296.3	128501.9	851.85	596296.3	128501.9	724.07	553703.7	128501.9	851.85	553703.7
9	2004+	X				A	16.8	0.29	260.0	0.5	0.23	547.0	234.3	1.79	1759.3	184.3	1.73	1559.3
						B	128501.9	724.07	596296.3	128501.9	851.85	596296.3	128501.9	724.07	553703.7	128501.9	851.85	553703.7
10	1975-1978		X			A	139.4	1.08	1320.9	105.0	0.88	1180.9	330.0	2.58	2487.0	280.0	2.38	2287.0
						B	225000.0	2025.00	745370.4	225000.0	2025.00	745370.4	225000.0	2025.00	1064814.8	225000.0	2025.00	1064814.8
11	1979-1983		X			A	139.4	0.88	1315.7	80.0	0.68	1175.7	320.0	2.38	2479.6	255.0	2.18	2279.6
						B	225000.0	2025.00	596296.3	150000.0	2025.00	596296.3	225000.0	2025.00	851851.9	150000.0	2025.00	851851.9
12	1984-1987		X			A	91.3	0.41	945.0	63.1	0.50	840.0	280.0	1.71	1850.0	230.0	1.80	1700.0
						B	150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0	150000.0	1725.00	750000.0	150000.0	2250.00	1500000.0
13	1988-1992		X			A	83.0	0.27	875.0	63.1	0.43	735.0	270.0	1.57	1600.0	220.0	1.73	1400.0
						B	150000.0	1725.00	525000.0	150000.0	1875.00	525000.0	150000.0	1725.00	750000.0	150000.0	1875.00	750000.0
14	1993-1995		X			A	68.3	0.30	377.0	33.3	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
						B	78750.0	1350.00	525000.0	78750.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
15	1996-2000		X			A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
						B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
16	2001-2003		X			A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
						B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
17	2004+		X			A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
						B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
18	1975-1978			X		A	139.4	1.08	1320.9	105.0	0.88	1180.9	330.0	2.58	2487.0	280.0	2.38	2287.0
						B	225000.0	2025.00	745370.4	225000.0	2025.00	745370.4	225000.0	2025.00	1064814.8	225000.0	2025.00	1064814.8
19	1979-1983			X		A	139.4	0.88	1315.7	80.0	0.68	1175.7	320.0	2.38	2479.6	255.0	2.18	2279.6
						B	225000.0	2025.00	596296.3	150000.0	2025.00	596296.3	225000.0	2025.00	851851.9	150000.0	2025.00	851851.9
20	1984-1987			X		A	91.3	0.41	945.0	63.1	0.50	840.0	280.0	1.71	1850.0	230.0	1.80	1700.0
						B	150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0	150000.0	1725.00	750000.0	150000.0	2250.00	1500000.0
21	1988-1992			X		A	83.0	0.27	875.0	63.1	0.43	735.0	270.0	1.57	1600.0	220.0	1.73	1400.0
						B	150000.0	1725.00	525000.0	150000.0	1875.00	525000.0	150000.0	1725.00	750000.0	150000.0	1875.00	750000.0
22	1993-1995			X		A	68.3	0.30	377.0	33.3	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
						B	78750.0	1350.00	525000.0	78750.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
23	1996-2000			X		A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
						B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
24	2001-2003			X		A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
						B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
25	2004+			X		A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
						B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
26	1978-				X	A	173.3	2.90	1703.3	123.3	2.70	1563.3	423.3	5.40	3233.3	373.3	5.20	3033.3
						B	583333.3	3500.00	1633333.3	583333.3	3500.00	1633333.3	583333.3	3500.00	2333333.3	583333.3	3500.00	2333333.3
27	1979-1983				X	A	139.4	0.88	1315.7	80.0	0.68	1175.7	320.0	2.38	2479.6	255.0	2.18	2279.6
						B	225000.0	2025.00	596296.3	150000.0	2025.00	596296.3	225000.0	2025.00	851851.9	150000.0	2025.00	851851.9
28	1984-1987				X	A	91.3	0.41	945.0	63.1	0.50	840.0	280.0	1.71	1850.0	230.0	1.80	1700.0
						B	150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0	150000.0	1725.00	750000.0	150000.0	2250.00	1500000.0
29	1988-1992				X	A	83.0	0.27	875.0	63.1	0.43	735.0	270.0	1.57	1600.0	220.0	1.73	1400.0
						B	150000.0	1725.00	525000.0	150000.0	1875.00	525000.0	150000.0	1725.00	750000.0	150000.0	1875.00	750000.0
30	1993-1995				X	A	83.0	0.30	875.0	60.0	0.70	735.0	300.0	1.60	1750.0	250.0	2.00	1550.0
						B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	750000.0	150000.0	1500.00	750000.0
31	1996-2000				X	A	71.2	0.30	875.0	60.0	0.70	735.0	300.0	1.60	1750.0	250.0	2.00	1550.0
						B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	750000.0	150000.0	1500.00	750000.0
32	2001-2003				X	A	71.2	0.30	875.0	60.0	0.70	735.0	300.0	1.60	1750.0	250.0	2.00	1550.0
						B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	750000.0	150000.0	1500.00	750000.0
33	2004+				X	A	71.2	0.30	875.0	60.0	0.70	735.0	300.0	1.60	1750.0	250.0	2.00	1550.0
						B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	750000.0	150000.0	1500.00	750000.0

Fig. 1: California Emission Standards - Enhanced & Partially Enhanced Program Areas - Light & Medium Duty Vehicles (ASM Test)

ESC	MODEL YEAR GROUP	VEHICLE TYPE (by GVWR and LVW)						PASS/FAIL EMISSION STANDARD						GROSS POLLUTER STANDARD					
								ASM 5015			ASM 2525			ASM 5015			ASM 2525		
		PC	LDT1	LDT2	MDV	HDV		HC	CO	NO	HC	CO	NO	HC	CO	NO	HC	CO	NO
46	1978-					X	A	243.8	3.92	2615.8	199.8	3.92	2770.8	594.9	7.29	4970.0	605.4	7.57	5375.4
							B	583333.3	3500.00	1633333.3	583333.3	3500.00	1633333.3	583333.3	3500.00	1633333.3	583333.3	3500.00	1633333.3
47	1979 - 1983					X	A	205.5	2.16	2250.6	106.0	1.95	2400.6	454.2	6.62	4231.1	338.1	6.54	4657.2
							B	225000.0	2025.00	596296.3	150000.0	2025.00	596296.3	225000.0	2025.00	596296.3	150000.0	2025.00	596296.3
48	1984 - 1987					X	A	143.0	1.60	2162.5	78.0	1.80	1975.0	307.5	6.67	4238.5	250.0	6.48	3989.5
							B	150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0	150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0
49	1988 - 1992					X	A	105.0	1.01	2112.5	78.0	1.24	2062.5	300.0	5.87	3865.9	250.0	4.98	3929.9
							B	150000.0	1725.00	525000.0	150000.0	1875.00	525000.0	150000.0	1725.00	525000.0	150000.0	1875.00	525000.0
50	1993 - 1995					X	A	105.0	0.49	1912.5	75.0	1.22	1862.5	300.0	2.61	3825.0	250.0	3.49	3929.9
							B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0
51	1996 - 2000					X	A	105.0	0.49	1662.5	75.0	1.16	1462.5	300.0	2.61	3325.0	250.0	3.32	3085.9
							B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0
52	2001+					X	A	105.0	0.49	1662.5	75.0	1.16	1462.5	300.0	2.61	3325.0	250.0	3.32	3085.9
							B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0

Fig. 2: California Emission Standards - Enhanced & Partially Enhanced Program Areas - Heavy Duty Vehicles (ASM Test)

LEGEND

ESC - Emission Standard Category
GVWR - Manufacture's Gross Vehicle Weight Rating
LVW - Loaded Vehicle Weight
PC - Passenger Car
LDT1 - Light-Duty Truck up through 3750 LVW and GVWR no greater than 6000 lbs.
LDT2 - Light-Duty Truck greater than 3750 LVW and GVWR no greater than 6000 lbs.
MDV - Medium-Duty Vehicle, GVWR from 6001 to 8500 lbs.
HC - Hydrocarbon, ppm
CO - Carbon Monoxide, %

NO - Nitric Oxide, ppm

PASS/FAIL EMISSION STANDARDS = A+B / VTW

PASS/FAIL STANDARDS - Emission standards used to determine if a vehicle passes the emission inspection. A vehicle passes if the emission levels are equal to or less than the standards for HC, CO and NO for ASM 5015 and ASM 2525.

GROSS POLLUTER STANDARDS - Emission standards used to designate a vehicle as a gross polluter. A vehicle is designated as a gross polluter if the emission levels at the time of the initial inspection, before repairs are greater than the gross polluter standards for HC, CO or NO for ASM 5015 or ASM 2525.

NOTE: **If test data on emission pass/fail rates or gross polluter identification rates indicate adjustments are required, the emission standards may be increased or decreased by the bureau by 30% or by the following tolerances, or standards may be set for any specific vehicle and engine configuration which the bureau determines has excessive errors of commission of omission, whichever is necessary to comply with Section 44001.5 of the Health and Safety Code.**

COLORADO

COLORADO EMISSION STANDARDS - ENHANCED PROGRAM (IM240)

Application	HC gpm	CO gpm	NOx gpm
Passenger Cars			
1982	3.5	45	5.0
1983	3.5	30	4.5
1984	3.0	30	4.5
1985	2.5	20	4.5
1986	2.5	20	4.5
1987	2.5	20	4.0
1988 & 1989	2.0	20	4.0
1990	2.0	20	3.5
1991	1.5	20	3.5
1992	1.5	15	3.5
1993	1.5	15	3.5
1994	1.2	15	3.0
1995	1.2	15	2.5
1996	1.2	15	2.0
1997	1.2	15	2.0
1998 & Newer	1.2	15	1.5
Light Duty Vehicles			
1982	6.0	65	6.0
1983	6.0	65	6.0
1984	5.0	55	6.0
1985	4.5	45	6.0
1986	4.0	40	6.0
1987	3.5	30	5.5
1988 & 1989	3.0	25	5.0
1990	3.0	25	5.0
1991	2.5	25	4.5
1992	2.5	25	4.5
1993	2.5	25	4.5
1994	2.0	20	4.0
1995	2.0	20	4.0

carplan.com

Application	HC gpm	CO gpm	NOx gpm
1996	1.2	15	3.5
1997	1.2	15	3.0
1998	1.2	15	2.0
1999 & Newer	1.2	15	2.0

COLORADO EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm	CO %
Passenger Cars & Light Duty Trucks		
1970 & Earlier	1000	3.5
1971	1000	3.0
1972	1000	3.0
1973	1000	3.0
1974	1000	3.0
1975	600	2.0
1976	600	2.0
1977	400	1.5
1978	400	1.5
1979	400	1.5
1980	400	1.5
1981 & Newer	220	1.2
Heavy Duty Trucks (6000 GVWR Or Greater)		
1967 Or Earlier	1500	7.0
1968-69	1200	6.5
1969	1200	6.5
1970	1000	5.5
1971	1000	5.5
1972	1000	5.5
1973	1000	5.5
1974	1000	5.5
1975	1000	5.5
1976	1000	5.5
1977	1000	5.5
1978	1000	5.5
Heavy Duty Trucks (8501 GVWR Or Greater)		
1979	800	4.0
1980	800	3.5
1981	600	3.0
1982	600	3.0
1983	600	3.0
1984	600	3.0
1985	600	3.0
1986 & Newer	300	2.0

CONNECTICUT

CONNECTICUT EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO)
10,000 GVWR Or Less	
1979	250 (2.1)
1980	225 (2.0)
1981-82	200 (1.2)
1983	175 (1.0)

carclean.com

Application	HC ppm (CO)
1984-87	150 (1.0)
1988 & Newer	125 (1.0)

DELAWARE

DELAWARE EMISSION STANDARDS - KENT, NEW CASTLE & SUSSEX COUNTIES (IDLE TEST)

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1968-70	900 (9.0)
1971-74	600 (6.0)
1975-79	400 (4.0)
1980	220 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6001-8500 GVWR)	
1970-72	900 (9.0)
1973-78	600 (6.0)
1979-83	400 (4.0)
1984 & Newer	220 (1.2)

DISTRICT OF COLUMBIA

DISTRICT OF COLUMBIA EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles & Trucks (26000 GVWR Or Less)	
1968-70	1250 (11.0)
1971-74	1200 (9.0)
1975-79	600 (6.5)
1980	300 (1.5)
1981 & Newer	220 (1.2)

GEORGIA

NOTE: **The Georgia program incorporates original U.S. EPA recommended start-up ASM2525 and ASM5015 standards for 1995 and older model year vehicles. Refer to appropriate model year range in appropriate table. See U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS.**

GEORGIA EMISSION STANDARDS - 2-SPEED IDLE TEST

Application (1)	HC ppm (CO %)
1979	500 (5.0)
1980	350 (3.5)
1981-83	250 (1.5)
1984 & Newer	220 (1.2)
(1) 8500 GVWR or less.	

IDAHO

IDAHO EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles	
8500 GVWR Or Less	
1965-74	900 (5.0)

Application	HC ppm (CO %)
1975-79	700 (3.0)
1980	400 (1.5)
1981 & Newer	220 (1.2)
Heavy Duty Trucks	
8501 GVWR Or More	
1965-74	900 (6.0)
1975-80	700 (5.0)
1981 & Newer	500 (3.0)

ILLINOIS

ILLINOIS EMISSION STANDARDS - IM240 TEST

Application	HC gpm	CO gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1981-82	2.00	60.0
1983-87	2.00	30.0
1988-95	0.80	15.0
1996 & Newer	0.60	10.0
Light Duty Trucks (6000 GVWR Or Less)		
1981-83	7.50	100.0
1984-87	3.20	80.0
1988-95	1.60	40.0
1996 & Newer (3750 LVW Or More) (1)	0.80	13.0
1996 & Newer (3750 LVW Or Less) (1)	0.60	10.0
Light Duty Trucks (6001-6500 GVWR)		
1981-83	7.50	100.0
1984-87	3.20	80.0
1988-95	1.60	40.0
1996 & Newer (5750 ALVW Or More)	0.80	15.0
1996 & Newer (5750 ALVW Or Less)	0.80	13.0
(1) Loaded Vehicle Weight (LVW) is vehicle curb weight plus 300 lbs.		

ILLINOIS EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Passenger Vehicles (6000 GVWR Or Less)	
1968-71	900 (9.0)
1972-74	800 (8.0)
1975-77	700 (7.0)
1978-79	600 (6.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)
Light Duty Vehicles (8000 GVWR Or Less)	
1968-71	900 (9.0)
1972-74	800 (8.0)
1975-78	700 (7.0)
1979-80	600 (6.0)
1981-83	300 (3.0)
1984 & Newer	220 (1.2)
Heavy Duty Vehicles (8001 GVWR Or More)	
1968-71	1500 (9.5)
1972-78	900 (9.0)
1979-84	700 (7.0)

Cardiagn.com

Application	HC ppm (CO %)
1985 & Newer	300 (3.0)

INDIANA

INDIANA EMISSION STANDARDS - IM93 TEST

Application	HC gpm (CO gpm)	NOx (gpm)
Passenger Cars		
1981-82	2.0 (60)	3.0
1983-86	2.0 (30)	3.0
1987-90	1.4 (20)	3.0
1991-95	0.8 (15)	2.5
1996 & Newer	0.6 (10)	2.5
Light Duty Trucks (6000 GVWR Or Less)		
1981-83	5.0 (80)	7.0
1984-86	3.2 (70)	7.0
1987-90	2.2 (55)	3.5
1991-95	1.6 (40)	3.0
1996 & Newer	0.8 (20)	3.0
Light Duty Trucks (6001-8500 GVWR)		
1981-83	5.0 (80)	7.0
1984-86	3.2 (70)	7.0
1987-90	2.2 (55)	5.0
1991-96	1.6 (40)	4.5
1997 & Newer	0.8 (20)	4.5
Heavy Duty Trucks (8501-9000 GVWR)		
1981-82	7.5 (100)	8.0
1983-84	6.0 (100)	8.0
1985-86	5.0 (75)	8.0
1987-90	3.0 (60)	8.0
1991-97	2.4 (40)	8.0
1998 & Newer	2.0 (30)	6.0

INDIANA EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Passenger Cars	
1976-79	350 (3.5)
1980	250 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1976-78	500 (5.0)
1979-83	350 (3.5)
1984 & Newer	220 (1.2)
Medium Duty Trucks (6001-8500 GVWR)	
1976-78	500 (5.0)
1979-83	350 (3.5)
1984 & Newer	220 (1.2)

KENTUCKY

NOTE: **Currently, there is no emission testing in Kentucky.**

cardiagn.com

KENTUCKY EMISSION STANDARDS - BOONE, CAMPBELL & KENTON COUNTIES (IDLE TEST)

Application	HC ppm (CO)
Passenger Cars (Automobiles)	
1968	950 (8.5)
1969	900 (8.5)
1970	850 (8.1)
1972	800 (8.0)
1973	800 (7.8)
1974	800 (7.6)
1975	700 (7.5)
1976	700 (6.5)
1977	650 (6.3)
1978	600 (5.5)
1979	600 (4.5)
1980	250 (2.5)
1981 & Newer	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1968	1300 (8.0)
1969	1200 (8.0)
1970-71	1100 (8.0)
1972-73	1000 (7.8)
1974	950 (7.8)
1975	900 (7.0)
1976-77	700 (7.0)
1978	700 (6.3)
1979	450 (5.5)
1980	450 (4.0)
1981	350 (1.7)
1982 & Newer	220 (1.2)
Light Duty Trucks (6001-10,000 GVWR)	
1969	1500 (9.0)
1970	1100 (8.0)
1971	1000 (8.0)
1972-75	950 (7.5)
1976	900 (7.5)
1977	850 (7.5)
1978	700 (6.0)
1979	650 (5.5)
1980	550 (5.0)
1981	450 (4.0)
1982	400 (2.5)
1983	350 (2.0)
1984	220 (1.5)
1985 & Newer	220 (1.2)
Heavy Duty Trucks (10,001-18,000 GVWR)	
1968	1500 (9.0)
1969-70	1300 (8.5)
1971	1200 (8.5)
1972-76	1000 (7.0)
1977-80	900 (6.5)
1982-83	400 (3.0)
1984 & Newer	250 (1.5)

CarMan.com

MARYLAND

MARYLAND EMISSION STANDARDS - IM240 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1984-87	1.80 (30.0)	2.8
1988-90	1.40 (30.0)	2.5
1991-93	1.00 (20.0)	2.2
1994-95	0.90 (20.0)	2.1
Light Duty Trucks (6000 GVWR Or Less)		
1984-87	2.80 (80.0)	5.8
1988-90	2.40 (80.0)	3.0
1991-93	2.00 (60.0)	2.7
1994-95	1.80 (60.0)	2.6
Light Duty Trucks (6001-8500 GVWR)		
1984-87	2.90 (80.0)	6.6
1988-90	2.40 (80.0)	4.2
1991-93	2.00 (60.0)	4.0
1994-95	1.80 (60.0)	3.7
Heavy Duty Trucks (8501-9999 GVWR)		
1984	5.80 (100.0)	7.7
1985-86	4.70 (80.0)	7.7
1987	3.00 (80.0)	7.7
1988-90	2.60 (80.0)	7.0
1991-97	2.50 (60.0)	5.5
1998 & Newer	2.20 (60.0)	4.0

cardiagn.com

MARYLAND EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1977	500 (6.0)
1978	430 (5.5)
1979	400 (4.0)
1980	220 (1.7)
1981 & Newer	220 (1.2)
Light Duty Trucks (6001-9999 GVWR)	
1977	580 (7.0)

Application	HC ppm (CO %)
1978	550 (6.7)
1979	470 (5.0)
1980	350 (5.0)
1981	250 (3.0)
1982	220 (2.5)
1983	220 (1.5)
1984 & Newer	220 (1.2)
Heavy Duty Trucks (10,000-26,000 GVWR)	
1977-78	650 (7.0)
1979	650 (6.5)
1980-82	500 (6.0)
1983	500 (3.5)
1984-85	440 (3.0)
1986	280 (2.5)
1987 & Newer	220 (1.2)

MASSACHUSETTS

MASSACHUSETTS EMISSION STANDARDS - MA31 TEST

Application	HC gpm (CO gpm)	NOx gpm
Passenger Cars		
1984-90	2.0 (30)	3.0
1991-95	1.2 (20)	2.5
1996 & Newer	0.8 (13)	2.0
Light Duty Trucks (6000 GVWR Or Less)		
1984-87	3.2 (80)	7.0
1988-1990	3.2 (80)	3.5
1991-95	2.4 (60)	3.0
1996 & Newer (3750 LVW (1) Or Less)	0.8 (15)	2.0
1996 & Newer (3751 LVW (1) Or Greater)	1.0 (20)	2.5
Light Duty Trucks (6001-8500 GVWR)		
1984-87	3.2 (80)	7.0
1988-90	3.2 (80)	5.0
1991-95	2.4 (60)	4.5
1996 & Newer (5750 ALVW (2) Or Less)	1.0 (20)	2.5
1996 & Newer (5751 ALVW (2) Or Greater)	2.4 (60)	4.0
Heavy Duty Trucks (8501-10,000 Or Greater)		
1984-87	3.2 (80)	7.0
1988-90	3.2 (80)	5.0
1991-95	2.4 (60)	4.5
1996 & Newer	2.4 (60)	4.0

(1) Loaded Vehicle Weight (LVW).

(2) Adjusted Loaded Vehicle Weight (ALVW).

MASSACHUSETTS EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
All Vehicles	
1984-86	220 (0.80)
1987 & Newer	100 (0.60)

cardiagn.com

MISSOURI

MISSOURI EMISSION STANDARDS - JEFFERSON, ST. CHARLES & ST. LOUIS COUNTIES - IM240 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1981-82	0.80 (30.0)	2.0
1983-95	0.80 (15.0)	2.0
1996 & Newer	0.60 (10.0)	1.5
Light Duty Trucks (6000 GVWR Or Less)		
1981-83	3.40 (70.0)	4.5
1984-87	1.60 (40.0)	4.5
1988-95	1.60 (40.0)	2.5
1996 & Newer (Less Than 3750 LVW)	0.80 (13.0)	1.8
1996 & Newer (3750 LVW Or Less)	0.60 (10.0)	1.5
Light Duty Trucks (6001-8500 GVWR)		
1981-83	3.4 (70.0)	4.5
1984-87	1.6 (40.0)	4.5
1988-95	1.60 (40.0)	3.5
1996 & Newer (5750 ALVW Or Less)	0.80 (13.0)	1.8
1996 & Newer (5750 ALVW Or More)	0.80 (15.0)	2.0

cardiagn.com

MISSOURI EMISSION STANDARDS - FRANKLIN, JEFFERSON, ST. CHARLES & ST. LOUIS COUNTIES - IDLE TEST

Application (1)	HC ppm (CO %)
1971-74	700 (7.0)
1975-79	600 (6.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)
(1) 8500 GVWR or less.	

MISSOURI EMISSION STANDARDS - FRANKLIN, JEFFERSON, ST. CHARLES & ST. LOUIS COUNTIES - REMOTE SENSING CLEAN SCREEN TEST

Application (1)	HC ppm (CO %)	NOx ppm
All Vehicles (8500 GVWR Or Less)		
1971 & Newer	200 (0.5)	2000
(1) 8500 GVWR or less.		

NEVADA

NEVADA EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1968-69	800 (4.0)
1970-74	700 (3.5)
1975-78	500 (2.5)
1979-80	500 (2.0)
1981 & Newer	220 (1.2)
Heavy Duty Vehicles (8501 GVWR Or More)	
1968-69	1400 (7.0)
1970-78	1400 (6.0)
1979	1000 (5.0)
1980	1000 (4.0)
1981 & Newer	1000 (3.5)

NEW JERSEY

NOTE: **The New Jersey program incorporates original U.S. EPA recommended start-up ASM5015 standards for 1981 and newer model year vehicles. Refer to appropriate model year range in appropriate table. See U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS.**

NEW JERSEY EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)		
1967 & Earlier	1400 (8.5)	.....
1968-70	700 (7.0)	.....
1971-74	500 (5.0)	.....
1975-80	300 (3.0)	.....
1981 & Newer	220 (1.2)	100 (0.5)
Heavy Duty Vehicles (8501 GVWR Or Greater)		
1967 & Earlier	1400 (8.5)	.....
1968-70	1200 (8.5)	.....
1971-74	700 (6.0)	.....
1975-78	500 (4.0)	.....
1979 & Earlier	300 (3.0)	.....

NEW MEXICO

NEW MEXICO EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)		
1975-78	500 (5.0)	500 (5.0)
1979-80	400 (4.0)	400 (4.0)
1981-85	220 (1.2)	220 (1.2)
1986-90	200 (1.2)	200 (1.2)
1991-95	180 (1.2)	180 (1.2)
Light Duty Trucks (6001-8000 GVWR)		
1975-78	600 (6.0)	600 (6.0)
1979-80	600 (4.5)	600 (4.5)
1981-82	400 (2.7)	400 (3.0)
1983-88	300 (1.2)	300 (3.0)

Cardiagn.com

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
1989-95	220 (1.2)	220 (1.2)
Medium Duty Trucks (8001-10,000 GVWR)		
1975 & Newer	650 (6.5)	650 (6.5)

NEW YORK

NEW YORK EMISSION STANDARDS - IM240 TEST

Application	HC gpm Composite	HC gpm Phase 2	CO gpm Composite	CO gpm Phase 2	NOx gpm Both
Light Duty Vehicles					
1981-82	0.80	0.50	30.0	24.0	2.0
1983-95	0.80	0.50	15.0	12.0	2.0
1996 & Newer	0.60	0.40	10.0	8.0	1.5
Light Duty Trucks (6000 GVWR Or Less)					
1981-83	3.40	2.00	70.0	56.0	4.5
1984-87	1.60	1.00	40.0	32.0	4.5
1988-95	1.60	1.00	40.0	32.0	2.5
1996 & Newer (3750 LVW Or Less)	0.60	0.40	10.0	8.0	1.5
1996 & Newer (3751 LVW Or More)	0.80	0.50	13.0	10.0	1.8
Light Duty Trucks (6501-8500 GVWR)					
1981-83	3.40	2.00	70.0	56.0	4.5
1984-87	1.60	1.00	40.0	32.0	4.5
1988-95	1.60	1.00	40.0	32.0	3.5
1996 & Newer (5750 ALVW Or Less)	0.80	0.50	13.0	10.0	1.8
1996 & Newer (5751 ALVW Or More)	0.80	0.50	15.0	12.0	2.0

NEW YORK EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1978	300 (3.0)
1979-80	300 (2.5)
1981 & Newer	220 (1.2)
Heavy Duty Vehicles (8501 GVWR Or More)	
1978	600 (4.5)
1979 & Newer	300 (3.0)

NORTH CAROLINA

NORTH CAROLINA EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1977	450 (4.5)
1978-79	350 (3.5)
1980	250 (2.0)
1981 & Newer	250 (1.2)
Heavy Duty Trucks (8501 GVWR Or More)	
1977-78	500 (5.0)
1979 & Newer	400 (4.0)

OHIO

NOTE: **The Ohio program incorporates original U.S. EPA recommended start-up ASM2525 standards for all model year vehicles. Refer to appropriate model year range in appropriate table. See U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS.**

OHIO EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
1978	350 (4.0)
1979	275 (3.0)
1980	230 (2.0)
1981 & Newer	220 (1.2)

OREGON

OREGON EMISSION STANDARDS - METROPOLITAN PORTLAND ENHANCED AREA - BAR31

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Passenger Cars		
1981-82	2.0 (64)	3.70
1983-89	2.0 (32)	3.70
1990-95	1.2 (30)	3.00
1996 & Newer	OBD-II Test	OBD-II Test
Light Duty Trucks (6000 GVWR Or Less)		
1981-83	8.5 (149)	8.32
1984-87	4.0 (85)	8.32
1988-89	4.0 (85)	4.62
1990-95	2.4 (80)	3.75
1996 & Newer	OBD-II Test	OBD-II Test
Light Duty Trucks (6001-8500 GVWR)		
1981-83	8.5 (149)	8.32
1984-87	4.0 (85)	8.32
1988-89	4.0 (85)	6.47
1990-95	2.4 (80)	5.25
1996 & Newer	OBD-II Test	OBD-II Test

OREGON EMISSION STANDARDS - METROPOLITAN PORTLAND & ROGUE VALLEY AREA BASIC TEST - 2-SPEED IDLE TEST

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Light Duty Passenger Cars (6000 GVWR Or Less)		
1975-80 (No Catalyst)	300 (2.5)	-
1975-80 (Catalyst)	220 (1.0)	-
1981 & Newer (All)	220 (1.0)	220 (1.0)
1975 & Newer (2-Stroke)	n/a (7.0)	-
Light Duty Trucks (6001-8500 GVWR)		
1975-78 (All)	350 (2.5)	-
1979-80 (No Catalyst)	300 (2.5)	-
1979-80 (Catalyst)	220 (1.0)	-
1981 & Newer (All)	220 (1.0)	220 (1.0)
1996 & Newer (3750 LVW Or Less)	0.9 (20)	2.25

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Heavy Duty Trucks (8501 GVWR Or More)		
1975-78 (Carbureted)	500 (4.0)	n/a (3.0)
1975-78 (Fuel Injection)	500 (4.0)	-
1979-84 (Carbureted)	350 (3.0)	n/a (3.0)
1979-84 (Fuel Injection)	350 (3.0)	-
1985 & Newer (No Catalyst)	350 (3.0)	n/a (3.0)
1985 & Newer (W/Catalyst)	220 (1.0)	220 (1.0)

OREGON EMISSION STANDARDS - METROPOLITAN PORTLAND & ROGUE VALLEY AREA BASIC TEST - EXHAUST OPACITY TEST

Application	Opacity % @ Idle	Opacity % @ High Idle
1975 & Newer		
2-Cycle Engines	20	.....
Gasoline Engines	0	0

PENNSYLVANIA

NOTE: **The Pennsylvania (in Philadelphia area) program incorporates original U.S. EPA recommended start-up ASM5015 standards for 1981 and newer model year vehicles. Refer to appropriate model year range in appropriate table. See U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS.**

PENNSYLVANIA EMISSION STANDARDS - PITTSBURGH & OLDER PHILADELPHIA VEHICLES - IDLE TEST

Application	HC ppm (CO %)
6000 GVWR Or Less	
1975-79	400 (4.0)
1980	300 (3.0)
1981-92	220 (1.2)
1993 & Newer	130 (1.0)
6001-9000 GVWR	
1975-78	650 (6.0)
1979	400 (4.0)
1980	300 (3.0)
1981-92	220 (1.2)
1993 & Newer	180 (1.0)

RHODE ISLAND

RHODE ISLAND EMISSION STANDARDS - RI2000 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles		
1974 & Earlier	15.92 (132.44)	14.92
1975-76	6.74 (96.21)	9.92
1977-79	6.74 (96.21)	6.59
1980	2.25 (45.48)	6.59

Application	HC gpm (CO gpm)	NOx gpm
1981-82	2.25 (45.48)	3.25
1983-95	2.25 (23.74)	3.25
1996 & Newer	1.84 (16.50)	2.42
Light Duty Trucks (6000 GVWR Or Less)		
1975 & Earlier	16.94 (175.92)	14.92
1975-78	8.78 (117.95)	9.92
1979-83	7.55 (103.45)	7.42
1984-87	3.88 (59.97)	7.42
1988-90	3.88 (59.97)	4.09
1991-95	3.88 (59.97)	4.09
1996 & Newer (3750 LVW Or Less)	1.84 (16.50)	2.42
1996 & Newer (3751 LVW Or More)	2.25 (20.84)	2.92
Light Duty Trucks (6001-8500 GVWR)		
1974 & Earlier	16.94 (175.92)	14.92
1975-78	8.78 (117.95)	9.92
1979-83	7.55 (103.45)	7.42
1984-87	3.88 (59.97)	7.42
1989-90	3.88 (59.97)	5.75
1991-95	3.88 (59.97)	5.75
1996 & Newer (5750 LVW Or Less)	2.25 (20.84)	2.92
1996 & Newer (5751 LVW or More)	5.51 (23.74)	3.25

RHODE ISLAND EMISSION STANDARDS - 2-SPEED IDLE TEST

Application Idle (1)	HC ppm (CO %)
1967 & Earlier	800 (7.0)
1968-74	700 (6.0)
1975-78	300 (3.0)
1979-80	300 (2.5)
1981 & Newer	220 (1.2)
(1) 8500 GVWR or less.	

TENNESSEE

TENNESSEE EMISSION STANDARDS - MEMPHIS - IDLE TEST

Application	HC ppm (CO %)

cardiagn.com

Application	HC ppm (CO %)
Light Duty Vehicles (9000 GVWR Or Less)	
1971 & Older	900 (8.9)
1972-74	700 (8.2)
1975-79	600 (7.5)
1980	400 (4.7)
1981 & Newer	220 (1.2)
Heavy Duty Trucks (9001-25,999 GVWR)	
1971 & Older	1000 (8.9)
1972-74	1000 (8.2)
1975-79	1000 (8.0)
1980	800 (6.0)
1981 & Newer	400 (4.0)

TENNESSEE EMISSION STANDARDS - DAVIDSON & NASHVILLE COUNTIES - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1975-77	500 (5.0)
1978-79	400 (4.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)
Medium Duty Trucks (6001-8500 GVWR)	
1975-77	750 (6.5)
1978-79	600 (6.0)
1980	400 (4.5)
1981 & Newer	400 (4.0)

TENNESSEE EMISSION STANDARDS - FOUR COUNTY AREA SURROUNDING NASHVILLE - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1975-77	500 (5.0)
1978-79	400 (4.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)
Medium Duty Trucks (6001-8500 GVWR)	
1975-77	750 (6.5)
1978-79	600 (6.0)
1980	400 (4.5)
1981 & Newer	400 (4.0)

TEXAS

NOTE: **The Texas program incorporates original U.S. EPA recommended start-up ASM2525 and ASM5015 standards for 1995 and newer model year vehicles. Refer to appropriate model year range in appropriate table. See U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS.**

TEXAS EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1979	600 (6.0)
1980	400 (4.0)
1981 & Newer	220 (1.2)

Application	HC ppm (CO %)
Heavy Duty Vehicles (8501 GVWR Or More)	
1979-81	700 (7.0)
1982-84	500 (5.0)
1985 & Newer	300 (3.0)

UTAH

UTAH EMISSION STANDARDS - DAVIS COUNTY - DC98 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1989-90	2.00 (30)	3.0
1991-95	1.2 (20)	2.5
Light Duty Trucks (6000 GVWR Or Less)		
1989-90	3.2 (80)	3.5
1991-95	2.4 (60)	3.0
Light Duty Trucks (6001-8500 GVWR)		
1989-90	3.2 (80)	5.0
1991-95	2.4 (60)	4.5

UTAH EMISSION STANDARDS - DAVIS COUNTY - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1968-69	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981-95	220 (1.2)
Light Duty Vehicles (6001-8500 GVWR)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979	500 (3.0)
1980	300 (2.0)
1981-95	220 (1.2)
Heavy Duty Vehicles (8501 GVWR Or More)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979-80	1000 (4.0)
1981 & Newer	800 (3.5)

NOTE: **The Salt Lake County program incorporates California style ASM2525 and ASM5015 standards for 1968 and newer model year vehicles; however, actual cutpoints are unique to this program and current information is not available at this time.**

UTAH EMISSION STANDARDS - SALT LAKE COUNTY - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1968-69	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)

Application	HC ppm (CO %)
1980	300 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1968-99	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6001-8500 GVWR)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
Heavy Duty Trucks (8500 GVWR Or More)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979-80	1000 (4.0)
1981 & Newer	800 (3.5)

UTAH EMISSION STANDARDS - UTAH & WEBER COUNTIES - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1968-69	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981-95	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1968-99	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6001-8500 GVWR)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
Heavy Duty Trucks (8500 GVWR Or More)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979-80	1000 (4.0)
1981 & Newer	800 (3.5)

VIRGINIA

NOTE: **The Virginia program incorporates original U.S. EPA recommended start-up ASM2525 and ASM5015 standards for 1981 and newer model year**

vehicles. Refer to appropriate model year range in appropriate table. See U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS.

VIRGINIA EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
8500 GVWR Or Less	
1975-90	400 (4.0)
1980	220 (2.0)
1981-89	220 (1.2)
1990-95	125 (1.0)
1996 & Newer	100 (0.75)
8501-10,000 GVWR	
1975-79	400 (4.0)
1980	220 (2.0)
1981-90	220 (1.2)
1991-96	150 (1.0)
1997 & Newer	125 (0.75)

WASHINGTON

WASHINGTON EMISSION STANDARDS - ASM2525 TEST

Application	HC ppm (CO %)
1980 & Earlier (Light-Duty Vehicles)	
1750 GVWR	400 (4.2)
1875 GVWR	380 (4.0)
2000 GVWR	350 (3.8)
2125 GVWR	340 (3.6)
2250 GVWR	320 (3.4)
2375 GVWR	300 (3.2)
2500 GVWR	290 (3.0)
2625 GVWR	270 (2.9)
2750 GVWR	260 (2.8)
2875 GVWR	250 (2.7)
3000 GVWR	240 (2.6)
3125 GVWR	230 (2.5)
3250 GVWR	220 (2.4)
3375 GVWR	220 (2.3)
3500 GVWR	210 (2.2)
3625 GVWR	200 (2.1)
3750 Or Greater GVWR (Passenger Cars Only)	200 (2.1)
3750 Or Greater GVWR (Light Duty Trucks)	300 (2.5)
1981 & Newer (Light-Duty Vehicles)	
1750 GVWR	250 (1.8)
1875 GVWR	240 (1.7)
2000 GVWR	220 (1.6)
2125 GVWR	210 (1.5)
2250 GVWR	200 (1.5)
2375 GVWR	190 (1.4)
2500 GVWR	180 (1.3)
2625 GVWR	180 (1.3)
2750 GVWR	171 (1.2)
2875 GVWR	160 (1.2)
3000 GVWR	160 (1.1)
3125 GVWR	150 (1.1)

Application	HC ppm (CO %)
3250 GVWR	150 (1.0)
3375 GVWR	150 (1.0)
3500 GVWR	150 (1.0)
3625 GVWR	150 (1.0)
3750 Or Greater GVWR (Passenger Cars Only)	150 (1.0)
3750 Or Greater GVWR (Light Duty Trucks)	300 (2.5)

WASHINGTON EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	Idle/2500 RPM HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1980 & Earlier	600 (3.0)
1981 & Newer	220 (1.2)
Heavy Duty Trucks (8500 GVWR Or More)	
1981 & Newer	400 (3.0)

WISCONSIN

WISCONSIN EMISSION STANDARDS - IM240 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1968-72	7.0 (120)	7.0
1973-74	7.0 (120)	6.0
1975-76	3.0 (65)	6.0
1977-79	3.0 (65)	4.0
1980	2.0 (60)	4.0
1981-82	2.0 (60)	3.0
1983-86	2.0 (30)	3.0
1987-93	0.8 (15)	2.0
1991-95	0.8 (15)	2.0
1996 & Newer	0.6 (10)	1.5
Light Duty Trucks (6000 GVWR Or Less)		
1968-72	7.0 (120)	7.0
1973-74	7.0 (120)	6.0
1975-78	4.0 (80)	6.0
1979-83	3.4 (70)	4.5
1984-86	3.2 (70)	4.5
1987	1.6 (40)	4.5
1988-95	1.6 (40)	2.5
1996 & Newer (3750 LVW Or Less)	0.6 (10)	1.5
1996 & Newer (3751 LVW Or More)	0.8 (13)	1.8
Light Duty Trucks (6001-8500 GVWR)		
1968-72	7.0 (120)	7.0
1973-74	7.0 (120)	6.0
1975-78	4.0 (80)	6.0
1979-83	3.4 (70)	4.5
1984-86	3.2 (70)	4.5
1988-96	1.6 (40)	3.5
1997 & Newer (5750 ALVW Or Less)	0.8 (13)	1.8
1997 & Newer (5751 ALVW Or More)	0.8 (15)	2.0
Heavy Duty Trucks (8501-10,000 GVWR)		

cardiagn.com

Application	HC gpm (CO gpm)	NOx gpm
1968-69	20.0 (200)	15.0
1970-73	10.0 (175)	10.0
1974-78	10.0 (150)	10.0
1979-84	7.5 (100)	8.0
1985-86	5.0 (80)	8.0
1987-90	2.0 (40)	6.0
1991-97	2.0 (40)	5.0
1998 & Newer	2.0 (30)	4.0
Heavy Duty Trucks (10,001 GVWR or More)		
1968-69	24.0 (250)	30.0
1970-73	13.0 (175)	20.0
1974-78	13.0 (150)	20.0
1979-84	11.5 (150)	16.0
1985-86	10.0 (150)	16.0
1987-90	3.5 (70)	11.0
1991-97	3.5 (70)	9.0
1998 & Newer	3.5 (60)	7.0

WISCONSIN EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Passenger Cars	
1968-71	800 (8.0)
1972-74	550 (7.0)
1975-77	450 (5.5)
1978	350 (4.0)
1979	275 (3.0)
1980	230 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1968-71	800 (8.0)
1972-74	700 (7.0)
1975-77	500 (6.0)
1978	450 (5.0)
1979	300 (3.0)
1980	275 (2.5)
1981-84	250 (2.0)
1985 & Newer	220 (1.2)
Light Duty Trucks (6001-8500 GVWR)	
1968-69	1450 (9.0)
1970-71	800 (8.0)
1972-74	700 (7.0)
1975-77	550 (6.5)
1978	450 (5.5)
1979	300 (3.0)

carDiagn.com

Application	HC ppm (CO %)
1980	275 (2.5)
1981-84	250 (2.0)
1985 & Newer	220 (1.2)
Heavy Duty Trucks (8501 GVWR Or More)	
1968-71	1500 (9.5)
1972-78	900 (9.0)
1979-84	700 (7.0)
1985 & Newer	300 (3.0)

U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS

U.S. EPA ASM EMISSION STANDARDS - 1968-72 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4990
1875	1052 (7.56)	4990	1034 (9.90)	4990
2000	992 (7.14)	4990	975 (9.90)	4990
2125	938 (6.75)	4990	921 (9.66)	4990
2250	887 (6.40)	4990	872 (9.14)	4990
2375	841 (6.07)	4990	827 (8.67)	4990
2500	800 (5.78)	4990	786 (8.25)	4990
2625	761 (5.51)	4990	748 (7.85)	4990
2750	726 (5.26)	4990	714 (7.50)	4772
2875	695 (5.03)	4892	683 (7.17)	4556
3000	666 (4.83)	4680	654 (6.87)	4359
3125	639 (4.64)	4488	628 (6.60)	4180
3250	615 (4.47)	4311	604 (6.35)	4016
3375	593 (4.31)	4150	583 (6.13)	3866
3500	573 (4.17)	4002	563 (5.92)	3728
3625	554 (4.04)	3867	544 (5.73)	3602
3750	537 (3.91)	3741	527 (5.55)	3485
3875	521 (3.80)	3625	512 (5.39)	3377
4000	506 (3.70)	3517	497 (5.24)	3276
4125	492 (3.60)	3416	484 (5.09)	3182
4250	479 (3.51)	3321	471 (4.96)	3094
4375	467 (3.42)	3230	459 (4.83)	3010
4500	455 (3.34)	3145	447 (4.71)	2930
4625	444 (3.26)	3063	436 (4.60)	2854
4750	433 (3.18)	2983	425 (4.49)	2780
4875	423 (3.11)	2907	415 (4.38)	2709
5000	412 (3.03)	2833	405 (4.28)	2540
5125	402 (2.97)	2760	395 (4.18)	2573
5250	393 (2.90)	2690	386 (4.08)	2507
5375	383 (2.83)	2621	376 (3.98)	2443
5500	374 (2.77)	2554	367 (3.89)	2381
5625	365 (2.70)	2489	359 (3.80)	2321
5750	357 (2.64)	2426	350 (3.71)	2262
5875	348 (2.59)	2366	342 (3.62)	2206
6000	341 (2.53)	2308	334 (3.54)	2152
6125	333 (2.48)	2254	327 (3.47)	2102
6250	326 (2.43)	2204	320 (3.40)	2056

carmanual.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
6375	320 (2.39)	2159	314 (3.34)	2014
6500	315 (2.35)	2119	309 (3.28)	1977
6625	310 (2.32)	2087	304 (3.23)	1947
6750	307 (2.29)	2062	301 (3.20)	1924
6875	305 (2.28)	2046	299 (3.17)	1909
7000	304 (2.27)	2040	298 (3.17)	1904
7125 Or More	304 (2.27)	2045	298 (3.17)	1904

U.S. EPA ASM EMISSION STANDARDS - 1973-74 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4980
1875	1052 (7.56)	4990	1034 (9.90)	4906
2000	992 (7.14)	4919	975 (9.90)	4838
2125	938 (6.75)	4853	921 (9.66)	4776
2250	887 (6.40)	4792	872 (9.14)	4720
2375	841 (6.07)	4736	827 (8.67)	4668
2500	800 (5.78)	4685	786 (8.25)	4620
2625	761 (5.51)	4639	748 (7.85)	4577
2750	726 (5.26)	4596	714 (7.50)	4374
2875	695 (5.03)	4484	683 (7.17)	4176
3000	666 (4.83)	4290	654 (6.87)	3996
3125	639 (4.64)	4114	628 (6.60)	3832
3250	615 (4.47)	3952	604 (6.35)	3681
3375	593 (4.31)	3804	583 (6.13)	3544
3500	573 (4.17)	3669	563 (5.92)	3418
3625	554 (4.04)	3544	544 (5.73)	3302
3750	537 (3.91)	3429	527 (5.55)	3195
3875	521 (3.80)	3323	512 (5.39)	3096
4000	506 (3.70)	3224	497 (5.24)	3003
4125	492 (3.60)	3131	484 (5.09)	2917
4250	479 (3.51)	3044	471 (4.96)	2836
4375	467 (3.42)	2961	459 (4.83)	2759
4500	455 (3.34)	2883	447 (4.71)	2686
4625	444 (3.26)	2807	436 (4.60)	2616
4750	433 (3.18)	2735	425 (4.49)	2549
4875	423 (3.11)	2665	415 (4.38)	2483
5000	412 (3.03)	2597	405 (4.28)	2420
5125	402 (2.97)	2530	395 (4.18)	2359
5250	393 (2.90)	2466	386 (4.08)	2298
5375	383 (2.83)	2403	376 (3.98)	2240
5500	374 (2.77)	2341	367 (3.89)	2183
5625	365 (2.70)	2282	359 (3.80)	2127
5750	357 (2.64)	2224	350 (3.71)	2074
5875	348 (2.59)	2168	342 (3.62)	2022
6000	341 (2.53)	2116	334 (3.54)	1973
6125	333 (2.48)	2066	327 (3.47)	1927
6250	326 (2.43)	2020	320 (3.40)	1884
6375	320 (2.39)	1979	314 (3.34)	1846

carcraft.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
6500	315 (2.35)	1943	309 (3.28)	1813
6625	310 (2.32)	1913	304 (3.23)	1785
6750	307 (2.29)	1890	301 (3.20)	1764
6875	305 (2.28)	1875	299 (3.17)	1750
7000	304 (2.27)	1870	298 (3.17)	1745
7125 Or More	304 (2.27)	1874	298 (3.17)	1745

U.S. EPA ASM EMISSION STANDARDS - 1975-76 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (3.92)	4990	761 (5.45)	4980
1875	729 (3.70)	4990	717 (5.14)	4906
2000	688 (3.49)	4919	676 (4.85)	4838
2125	650 (3.31)	4853	638 (4.58)	4776
2250	615 (3.13)	4792	604 (4.34)	4720
2375	583 (2.98)	4736	573 (4.12)	4668
2500	554 (2.83)	4685	544 (3.91)	4620
2625	528 (2.70)	4639	518 (3.73)	4577
2750	503 (2.58)	4596	495 (3.56)	4374
2875	481 (2.47)	4484	473 (3.41)	4176
3000	461 (2.37)	4290	453 (3.27)	3996
3125	443 (2.28)	4114	435 (3.14)	3832
3250	426 (2.20)	3952	419 (3.02)	3681
3375	411 (2.12)	3804	404 (2.91)	3544
3500	397 (2.05)	3669	390 (2.82)	3418
3625	384 (1.99)	3544	377 (2.73)	3302
3750	372 (1.93)	3429	365 (2.64)	3195
3875	361 (1.87)	3323	355 (2.57)	3096
4000	351 (1.82)	3224	345 (2.49)	3003
4125	341 (1.77)	3131	335 (2.43)	2917
4250	332 (1.73)	3044	326 (2.36)	2836
4375	323 (1.68)	2961	318 (2.31)	2759
4500	315 (1.64)	2883	310 (2.25)	2686
4625	308 (1.61)	2807	302 (2.19)	2616
4750	300 (1.57)	2735	295 (2.14)	2549
4875	293 (1.53)	2665	288 (2.09)	2483
5000	286 (1.50)	2597	281 (2.04)	2420
5125	279 (1.46)	2530	274 (2.00)	2359
5250	272 (1.43)	2466	267 (1.95)	2298
5375	266 (1.40)	2403	261 (1.90)	2240
5500	259 (1.37)	2341	255 (1.86)	2183
5625	253 (1.34)	2282	248 (1.82)	2127
5750	247 (1.31)	2224	243 (1.78)	2074
5875	241 (1.28)	2168	237 (1.74)	2022
6000	236 (1.25)	2116	232 (1.70)	1973
6125	231 (1.23)	2066	227 (1.66)	1927
6250	226 (1.20)	2020	222 (1.63)	1884
6375	222 (1.18)	1979	218 (1.60)	1846
6500	218 (1.16)	1943	214 (1.57)	1813

cardiffun.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
6625	215 (1.15)	1913	211 (1.55)	1785
6750	213 (1.14)	1890	209 (1.54)	1764
6875	211 (1.13)	1875	207 (1.52)	1750
7000	211 (1.12)	1870	207 (1.52)	1745
7125 Or More	211 (1.12)	1874	206 (1.52)	1745

U.S. EPA ASM EMISSION STANDARDS - 1977-79 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (3.92)	4990	761 (5.45)	4950
1875	729 (3.70)	4990	717 (5.14)	4655
2000	688 (3.49)	4707	676 (4.85)	4384
2125	650 (3.31)	4441	638 (4.58)	4136
2250	615 (3.13)	4197	604 (4.34)	3909
2375	583 (2.98)	3974	573 (4.12)	3701
2500	554 (2.83)	3771	544 (3.91)	3512
2625	528 (2.70)	3585	518 (3.73)	3339
2750	503 (2.58)	3416	495 (3.56)	3181
2875	481 (2.47)	3261	473 (3.41)	3037
3000	461 (2.37)	3120	453 (3.27)	2906
3125	443 (2.28)	2992	435 (3.14)	2787
3250	426 (2.20)	2874	419 (3.02)	2677
3375	411 (2.12)	2767	404 (2.91)	2577
3500	397 (2.05)	2668	390 (2.82)	2486
3625	384 (1.99)	2578	377 (2.73)	2401
3750	372 (1.93)	2494	365 (2.64)	2323
3875	361 (1.87)	2417	355 (2.57)	2251
4000	351 (1.82)	2345	345 (2.49)	2184
4125	341 (1.77)	2277	335 (2.43)	2122
4250	332 (1.73)	2214	326 (2.36)	2063
4375	323 (1.68)	2154	318 (2.31)	2007
4500	315 (1.64)	2096	310 (2.25)	1953
4625	308 (1.61)	2042	302 (2.19)	1903
4750	300 (1.57)	1989	295 (2.14)	1854
4875	293 (1.53)	1938	288 (2.09)	1806
5000	286 (1.50)	1889	281 (2.04)	1760
5125	279 (1.46)	1840	274 (2.00)	1715
5250	272 (1.43)	1793	267 (1.95)	1672
5375	266 (1.40)	1747	261 (1.90)	1629
5500	259 (1.37)	1703	255 (1.86)	1587
5625	253 (1.34)	1659	248 (1.82)	1547
5750	247 (1.31)	1617	243 (1.78)	1508
5875	241 (1.28)	1577	237 (1.74)	1471
6000	236 (1.25)	1539	232 (1.70)	1435
6125	231 (1.23)	1503	227 (1.66)	1401
6250	226 (1.20)	1469	222 (1.63)	1371
6375	222 (1.18)	1439	218 (1.60)	1343
6500	218 (1.16)	1413	214 (1.57)	1318
6625	215 (1.15)	1391	211 (1.55)	1298

cardigan.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
6750	213 (1.14)	1374	209 (1.54)	1283
6875	211 (1.13)	1364	207 (1.52)	1273
7000 Or More	211 (1.12)	1360	207 (1.52)	1269

U.S. EPA ASM EMISSION STANDARDS - 1980 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	291 (2.78)	4990	282 (3.64)	4950
1875	275 (2.63)	4990	266 (3.43)	4655
2000	260 (2.48)	4707	252 (3.24)	4384
2125	246 (2.35)	4441	239 (3.06)	4136
2250	234 (2.23)	4197	227 (2.90)	3909
2375	223 (2.12)	3974	216 (2.76)	3701
2500	212 (2.02)	3771	206 (2.62)	3512
2625	203 (1.92)	3585	197 (2.50)	3339
2750	194 (1.84)	3416	189 (2.39)	3181
2875	187 (1.76)	3261	181 (2.29)	3037
3000	180 (1.69)	3120	174 (2.19)	2906
3125	173 (1.63)	2992	168 (2.11)	2787
3250	167 (1.57)	2874	162 (2.03)	2677
3375	162 (1.52)	2767	157 (1.96)	2577
3500	157 (1.47)	2668	152 (1.89)	2486
3625	152 (1.42)	2578	148 (1.84)	2401
3750	148 (1.38)	2492	144 (1.78)	2323
3875	144 (1.34)	2417	140 (1.73)	2251
4000	140 (1.31)	2345	137 (1.68)	2184
4125	137 (1.27)	2277	133 (1.64)	2122
4250	134 (1.24)	2214	130 (1.60)	2063
4375	131 (1.21)	2154	127 (1.56)	2007
4500	128 (1.18)	2096	124 (1.52)	1953
4625	125 (1.15)	2042	122 (1.48)	1903
4750	122 (1.13)	1989	119 (1.45)	1854
4875	120 (1.10)	1938	117 (1.42)	1806
5000	117 (1.08)	1889	114 (1.38)	1760
5125	115 (1.05)	1840	112 (1.35)	1715
5250	112 (1.03)	1793	110 (1.32)	1672
5375	110 (1.01)	1747	107 (1.29)	1629
5500	108 (0.99)	1703	105 (1.26)	1587
5625	106 (0.97)	1659	103 (1.24)	1547
5750	104 (0.94)	1617	101 (1.21)	1508
5875	102 (0.92)	1577	99 (1.18)	1471
6000	100 (0.91)	1539	97 (1.16)	1435
6125	98 (0.89)	1503	95 (1.13)	1401
6250	96 (0.87)	1469	94 (1.11)	1371
6375	95 (0.86)	1439	92 (1.09)	1343
6500	93 (0.84)	1413	91 (1.08)	1318
6625	92 (0.83)	1391	90 (1.06)	1298
6750	91 (0.82)	1374	89 (1.05)	1283
6875	91 (0.82)	1364	89 (1.04)	1273

carcraft.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
7000	91 (0.82)	1360	88 (1.04)	1269
7125 Or More	90 (0.81)	1360	88 (1.04)	1269

U.S. EPA ASM EMISSION STANDARDS - 1981-82 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	291 (2.78)	2272	282 (3.64)	2114
1875	275 (2.63)	2181	266 (3.43)	1991
2000	260 (2.48)	2058	252 (3.24)	1877
2125	246 (2.35)	1944	239 (3.06)	1774
2250	234 (2.23)	1839	227 (2.90)	1678
2375	223 (2.12)	1744	216 (2.76)	1592
2500	212 (2.02)	1657	206 (2.62)	1512
2625	203 (1.92)	1577	197 (2.50)	1440
2750	194 (1.84)	1504	189 (2.39)	1374
2875	187 (1.76)	1438	181 (2.29)	1313
3000	180 (1.69)	1378	174 (2.19)	1258
3125	173 (1.63)	1323	168 (2.11)	1208
3250	167 (1.57)	1273	162 (2.03)	1163
3375	162 (1.52)	1227	157 (1.96)	1121
3500	157 (1.47)	1184	152 (1.89)	1082
3625	152 (1.42)	1146	148 (1.84)	1047
3750	148 (1.38)	1110	144 (1.78)	1014
3875	144 (1.34)	1077	140 (1.73)	984
4000	140 (1.31)	1046	137 (1.68)	956
4125	137 (1.27)	1017	133 (1.64)	930
4250	134 (1.24)	990	130 (1.60)	905
4375	131 (1.21)	964	127 (1.56)	882
4500	128 (1.18)	939	124 (1.52)	859
4625	125 (1.15)	916	122 (1.48)	838
4750	122 (1.13)	893	119 (1.45)	818
4875	120 (1.10)	872	117 (1.42)	798
5000	117 (1.08)	850	114 (1.38)	778
5125	115 (1.05)	830	112 (1.35)	760
5250	112 (1.03)	810	110 (1.32)	741
5375	110 (1.01)	790	107 (1.29)	723
5500	108 (0.99)	771	105 (1.26)	706
5625	106 (0.97)	752	103 (1.24)	689
5750	104 (0.94)	734	101 (1.21)	673
5875	102 (0.92)	717	99 (1.18)	657
6000	100 (0.91)	701	97 (1.16)	642
6125	98 (0.89)	685	95 (1.13)	628
6250	96 (0.87)	671	94 (1.11)	615
6375	95 (0.86)	658	92 (1.09)	604
6500	93 (0.84)	647	91 (1.08)	593
6625	92 (0.83)	638	90 (1.06)	585
6750	91 (0.82)	631	89 (1.05)	578
6875	91 (0.82)	626	89 (1.04)	574
7000	91 (0.82)	624	88 (1.04)	573

carmanual.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
7125 Or More	90 (0.81)	625	88 (1.04)	573

U.S. EPA ASM EMISSION STANDARDS - 1983-90 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	291 (1.64)	2272	282 (1.83)	2114
1875	275 (1.55)	2181	266 (1.72)	1991
2000	260 (1.47)	2058	252 (1.63)	1877
2125	246 (1.39)	1944	239 (1.54)	1774
2250	234 (1.31)	1839	227 (1.47)	1678
2375	223 (1.26)	1744	216 (1.39)	1592
2500	212 (1.20)	1657	206 (1.33)	1512
2625	203 (1.15)	1577	197 (1.27)	1440
2750	194 (1.10)	1504	189 (1.21)	1374
2875	187 (1.05)	1438	181 (1.16)	1313
3000	180 (1.01)	1378	174 (1.12)	1258
3125	173 (0.98)	1323	168 (1.08)	1208
3250	167 (0.94)	1273	162 (1.04)	1163
3375	162 (0.91)	1227	157 (1.00)	1121
3500	157 (0.88)	1184	152 (0.97)	1082
3625	152 (0.86)	1146	148 (0.94)	1047
3750	148 (0.83)	1110	144 (0.92)	1014
3875	144 (0.81)	1077	140 (0.89)	984
4000	140 (0.79)	1046	137 (0.87)	956
4125	137 (0.77)	1017	133 (0.85)	930
4250	134 (0.75)	990	130 (.83)	905
4375	131 (0.74)	964	127 (0.81)	882
4500	128 (0.72)	939	124 (0.79)	859
4625	125 (0.70)	916	122 (0.77)	838
4750	122 (0.69)	893	119 (0.76)	818
4875	120 (0.67)	872	117 (0.74)	798
5000	117 (0.66)	850	114 (0.73)	778
5125	115 (0.65)	830	112 (0.71)	760
5250	112 (0.63)	810	110 (0.70)	741
5375	110 (0.62)	790	107 (0.68)	723
5500	108 (0.61)	771	105 (0.67)	706
5625	106 (0.59)	752	103 (0.65)	689
5750	104 (0.58)	734	101 (0.64)	673
5875	102 (0.57)	717	99 (0.63)	657
6000	100 (0.56)	701	97 (0.62)	642
6125	98 (0.55)	685	95 (0.61)	628
6250	96 (0.54)	671	94 (0.60)	615
6375	95 (0.53)	658	92 (0.59)	604
6500	93 (0.52)	647	91 (0.58)	593
6625	92 (0.52)	638	90 (0.57)	585
6750	91 (0.51)	631	89 (0.57)	578
6875	91 (0.51)	626	89 (0.56)	574
7000	91 (0.51)	624	88 (0.56)	573
7125	90 (0.51)	625	88 (0.56)	573

carofun.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
7250 Or More	90 (0.50)	625	88 (0.56)	573

U.S. EPA ASM EMISSION STANDARDS - 1991-95 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	224 (1.26)	1819	216 (1.22)	1642
1875	212 (1.19)	1713	205 (1.16)	1547
2000	201 (1.13)	1616	194 (1.09)	1460
2125	191 (1.07)	1527	184 (1.04)	1380
2250	182 (1.02)	1446	175 (0.99)	1307
2375	173 (0.97)	1372	167 (0.94)	1240
2500	166 (0.93)	1304	160 (0.90)	1179
2625	159 (0.89)	1242	153 (0.86)	1123
2750	152 (0.85)	1186	147 (0.82)	1072
2875	146 (0.82)	1134	141 (0.79)	1026
3000	141 (0.79)	1088	136 (0.76)	984
3125	136 (0.76)	1045	132 (0.73)	945
3250	132 (0.73)	1006	127 (0.71)	910
3375	128 (0.71)	970	123 (0.69)	878
3500	124 (0.69)	937	120 (0.67)	848
3625	120 (0.67)	907	117 (0.65)	821
3750	117 (0.65)	879	114 (0.63)	796
3875	114 (0.63)	853	111 (0.61)	773
4000	112 (0.62)	829	108 (0.60)	751
4125	109 (0.60)	807	106 (0.58)	731
4250	107 (0.59)	786	103 (0.57)	712
4375	104 (0.58)	766	101 (0.56)	694
4500	102 (0.57)	747	99 (0.55)	677
4625	100 (0.55)	728	97 (0.54)	661
4750	98 (0.54)	711	95 (0.53)	645
4875	96 (0.53)	694	93 (0.52)	630
5000	94 (0.52)	677	92 (0.51)	615
5125	93 (0.51)	661	90 (0.50)	600
5250	91 (0.50)	646	88 (0.49)	586
5375	89 (0.49)	631	86 (0.48)	573
5500	87 (0.48)	616	85 (0.47)	559
5625	86 (0.47)	601	83 (0.46)	546
5750	84 (0.46)	587	82 (0.45)	534
5875	83 (0.45)	574	80 (0.44)	522
6000	81 (0.44)	561	79 (0.44)	510
6125	80 (0.44)	549	78 (0.43)	499
6250	79 (0.43)	538	76 (0.42)	489
6375	77 (0.42)	528	75 (0.42)	480
6500	76 (0.42)	519	74 (0.41)	473
6625	76 (0.41)	512	74 (0.41)	466
6750	75 (0.41)	507	73 (0.41)	461
6875	75 (0.40)	503	73 (0.40)	458
7000 Or More	74 (0.40)	502	72 (0.40)	457

cardiagn.com

U.S. EPA ASM EMISSION STANDARDS - 1994 & NEWER + TIER 1 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	142 (0.80)	1212	136 (0.77)	1095
1875	134 (0.75)	1142	129 (0.73)	1031
2000	127 (0.71)	1077	123 (0.69)	973
2125	121 (0.68)	1018	116 (0.66)	920
2250	115 (0.64)	964	111 (0.62)	871
2375	109 (0.61)	915	106 (0.59)	827
2500	105 (0.59)	869	101 (0.57)	786
2625	100 (0.56)	828	97 (0.54)	749
2750	96 (0.54)	791	93 (0.52)	715
2875	92 (0.52)	756	89 (0.50)	684
3000	89 (0.50)	725	86 (0.48)	656
3125	86 (0.48)	696	83 (0.46)	630
3250	83 (0.46)	670	80 (0.45)	607
3375	81 (0.45)	647	78 (0.43)	585
3500	78 (0.44)	625	76 (0.42)	566
3625	76 (0.42)	605	74 (0.41)	547
3750	74 (0.41)	586	72 (0.40)	531
3875	72 (0.40)	569	70 (0.39)	515
4000	71 (0.39)	553	68 (0.38)	501
4125	69 (0.38)	538	67 (0.37)	487
4250	67 (0.37)	524	65 (0.36)	475
4375	66 (0.36)	510	64 (0.35)	463
4500	65 (0.36)	498	63 (0.35)	440
4625	63 (0.35)	486	61 (0.34)	440
4750	62 (0.34)	474	60 (0.33)	430
4875	61 (0.34)	463	59 (0.33)	420
5000	60 (0.33)	452	58 (0.32)	410
5125	58 (0.32)	441	57 (0.31)	400
5250	57 (0.32)	431	56 (0.31)	391
5375	56 (0.31)	420	55 (0.30)	382
5500	55 (0.30)	410	54 (0.30)	373
5625	54 (0.30)	401	53 (0.29)	364
5750	53 (0.29)	391	52 (0.29)	356
5875	52 (0.29)	383	51 (0.28)	348
6000	51 (0.28)	374	50 (0.28)	340
6125	50 (0.28)	366	49 (0.27)	333
6250	50 (0.27)	359	48 (0.27)	326
6375	49 (0.27)	352	48 (0.26)	320
6500	48 (0.26)	346	47 (0.26)	315
6625	48 (0.26)	341	46 (0.26)	311
6750	47 (0.26)	338	46 (0.26)	307
6875	47 (0.26)	335	46 (0.25)	305
7000 Or More	47 (0.25)	335	46 (0.25)	305

U.S. EPA ASM EMISSION STANDARDS - 1968-72 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm

carplan.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4990
1875	1052 (7.56)	4990	1034 (9.90)	4990
2000	992 (7.14)	4990	975 (9.90)	4990
2125	938 (6.75)	4990	921 (9.66)	4990
2250	887 (6.40)	4990	872 (9.14)	4990
2375	841 (6.07)	4990	827 (8.67)	4990
2500	800 (5.78)	4990	786 (8.25)	4990
2625	761 (5.51)	4990	748 (7.85)	4990
2750	726 (5.26)	4990	714 (7.50)	4772
2875	695 (5.03)	4892	683 (7.17)	4556
3000	666 (4.83)	4680	654 (6.87)	4359
3125	639 (4.64)	4488	628 (6.60)	4180
3250	615 (4.47)	4311	604 (6.35)	4016
3375	593 (4.31)	4150	583 (6.13)	3866
3500	573 (4.17)	4002	563 (5.92)	3728
3625	554 (4.04)	3867	544 (5.73)	3602
3750	537 (3.91)	3741	527 (5.55)	3485
3875	521 (3.80)	3625	512 (5.39)	3377
4000	506 (3.70)	3517	497 (5.24)	3276
4125	492 (3.60)	3416	484 (5.09)	3182
4250	479 (3.51)	3321	471 (4.96)	3094
4375	467 (3.42)	3230	459 (4.83)	3010
4500	455 (3.34)	3145	447 (4.71)	2930
4625	444 (3.26)	3063	436 (4.60)	2854
4750	433 (3.18)	2983	425 (4.49)	2780
4875	423 (3.11)	2907	415 (4.38)	2709
5000	412 (3.03)	2833	405 (4.28)	2540
5125	402 (2.97)	2760	395 (4.18)	2573
5250	393 (2.90)	2690	386 (4.08)	2507
5375	383 (2.83)	2621	376 (3.98)	2443
5500	374 (2.77)	2554	367 (3.89)	2381
5625	365 (2.70)	2489	359 (3.80)	2321
5750	357 (2.64)	2426	350 (3.71)	2262
5875	348 (2.59)	2366	342 (3.62)	2206
6000	341 (2.53)	2308	334 (3.54)	2152
6125	333 (2.48)	2254	327 (3.47)	2102
6250	326 (2.43)	2204	320 (3.40)	2056
6375	320 (2.39)	2159	314 (3.34)	2014
6500	315 (2.35)	2119	309 (3.28)	1977
6625	310 (2.32)	2087	304 (3.23)	1947
6750	307 (2.29)	2062	301 (3.20)	1924
6875	305 (2.28)	2046	299 (3.17)	1909
7000	304 (2.27)	2040	298 (3.17)	1904
7125 Or More	304 (2.27)	2045	298 (3.17)	1904

U.S. EPA ASM EMISSION STANDARDS - 1973-74 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4980

carofun.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1875	1052 (7.56)	4990	1034 (9.90)	4906
2000	992 (7.14)	4919	975 (9.90)	4838
2125	938 (6.75)	4853	921 (9.66)	4776
2250	887 (6.40)	4792	872 (9.14)	4720
2375	841 (6.07)	4736	827 (8.67)	4668
2500	800 (5.78)	4685	786 (8.25)	4620
2625	761 (5.51)	4639	748 (7.85)	4577
2750	726 (5.26)	4596	714 (7.50)	4374
2875	695 (5.03)	4484	683 (7.17)	4176
3000	666 (4.83)	4290	654 (6.87)	3996
3125	639 (4.64)	4114	628 (6.60)	3832
3250	615 (4.47)	3952	604 (6.35)	3681
3375	593 (4.31)	3804	583 (6.13)	3544
3500	573 (4.17)	3669	563 (5.92)	3418
3625	554 (4.04)	3544	544 (5.73)	3302
3750	537 (3.91)	3429	527 (5.55)	3195
3875	521 (3.80)	3323	512 (5.39)	3096
4000	506 (3.70)	3224	497 (5.24)	3003
4125	492 (3.60)	3131	484 (5.09)	2917
4250	479 (3.51)	3044	471 (4.96)	2836
4375	467 (3.42)	2961	459 (4.83)	2759
4500	455 (3.34)	2883	447 (4.71)	2686
4625	444 (3.26)	2807	436 (4.60)	2616
4750	433 (3.18)	2735	425 (4.49)	2549
4875	423 (3.11)	2665	415 (4.38)	2483
5000	412 (3.03)	2597	405 (4.28)	2420
5125	402 (2.97)	2530	395 (4.18)	2359
5250	393 (2.90)	2466	386 (4.08)	2298
5375	383 (2.83)	2403	376 (3.98)	2240
5500	374 (2.77)	2341	367 (3.89)	2183
5625	365 (2.70)	2282	359 (3.80)	2127
5750	357 (2.64)	2224	350 (3.71)	2074
5875	348 (2.59)	2168	342 (3.62)	2022
6000	341 (2.53)	2116	334 (3.54)	1973
6125	333 (2.48)	2066	327 (3.47)	1927
6250	326 (2.43)	2020	320 (3.40)	1884
6375	320 (2.39)	1979	314 (3.34)	1846
6500	315 (2.35)	1943	309 (3.28)	1813
6625	310 (2.32)	1913	304 (3.23)	1785
6750	307 (2.29)	1890	301 (3.20)	1764
6875	305 (2.28)	1875	299 (3.17)	1750
7000	304 (2.27)	1870	298 (3.17)	1745
7125 Or More	304 (2.27)	1874	298 (3.17)	1745

U.S. EPA ASM EMISSION STANDARDS - 1975-78 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	843 (5.07)	4990	828 (7.26)	4980
1875	794 (4.78)	4990	780 (6.84)	4906

carofun.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2000	749 (4.51)	4919	736 (6.45)	4838
2125	707 (4.26)	4853	695 (6.10)	4776
2250	669 (4.04)	4792	658 (5.78)	4720
2375	635 (3.83)	4736	624 (5.48)	4668
2500	603 (3.65)	4685	593 (5.21)	4620
2625	574 (3.48)	4639	564 (4.96)	4577
2750	548 (3.32)	4596	539 (4.73)	4374
2875	524 (3.18)	4484	515 (4.53)	4176
3000	502 (3.05)	4290	493 (4.34)	3996
3125	482 (2.93)	4114	474 (4.17)	3832
3250	464 (2.82)	3952	456 (4.01)	3681
3375	447 (2.72)	3804	440 (3.87)	3544
3500	432 (2.63)	3669	424 (3.74)	3418
3625	418 (2.55)	3544	411 (3.62)	3302
3750	405 (2.47)	3429	398 (3.51)	3195
3875	393 (2.40)	3323	386 (3.40)	3096
4000	382 (2.33)	3224	375 (3.31)	3003
4125	371 (2.27)	3131	365 (3.22)	2917
4250	361 (2.21)	3044	355 (3.13)	2836
4375	352 (2.16)	2961	346 (3.05)	2759
4500	343 (2.11)	2883	337 (2.98)	2686
4625	335 (2.06)	2807	329 (2.90)	2616
4750	327 (2.01)	2735	321 (2.83)	2549
4875	319 (1.96)	2665	313 (2.77)	2483
5000	311 (1.92)	2597	305 (2.70)	2420
5125	304 (1.87)	2530	298 (2.64)	2359
5250	296 (1.83)	2466	291 (2.58)	2298
5375	289 (1.79)	2403	284 (2.51)	2240
5500	282 (1.75)	2341	277 (2.46)	2183
5625	276 (1.71)	2282	271 (2.40)	2127
5750	269 (1.67)	2224	264 (2.34)	2074
5875	263 (1.63)	2168	258 (2.29)	2022
6000	257 (1.60)	2116	252 (2.24)	1973
6125	251 (1.57)	2066	247 (2.19)	1927
6250	246 (1.54)	2020	242 (2.15)	1884
6375	242 (1.51)	1979	237 (2.11)	1846
6500	238 (1.48)	1943	233 (2.07)	1813
6625	234 (1.46)	1913	230 (2.04)	1785
6750	232 (1.45)	1890	227 (2.02)	1764
6875	230 (1.44)	1875	225 (2.00)	1750
7000	229 (1.43)	1870	225 (2.00)	1745
7125 Or More	229 (1.43)	1874	225 (2.00)	1745

U.S. EPA ASM EMISSION STANDARDS - 1979-83 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (4.31)	4990	761 (6.06)	4960
1875	729 (4.06)	4990	717 (5.70)	4738
2000	688 (3.83)	4778	676 (5.38)	4535

carofun.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2125	650 (3.63)	4578	638 (5.09)	4349
2250	615 (3.44)	4395	604 (4.82)	4179
2375	583 (3.26)	4228	573 (4.57)	4024
2500	554 (3.10)	4076	544 (4.35)	3881
2625	528 (2.96)	3936	518 (4.14)	3752
2750	503 (2.83)	3809	495 (3.95)	3579
2875	481 (2.71)	3669	473 (3.78)	3417
3000	461 (2.60)	3510	453 (3.62)	3270
3125	443 (2.50)	3366	435 (3.48)	3135
3250	426 (2.40)	3234	419 (3.35)	3012
3375	411 (2.32)	3113	404 (3.23)	2899
3500	397 (2.24)	3002	390 (3.12)	2796
3625	384 (2.17)	2900	377 (3.02)	2701
3750	372 (2.11)	2806	365 (2.93)	2614
3875	361 (2.05)	2719	355 (2.58)	2533
4000	351 (1.99)	2638	345 (2.77)	2457
4125	341 (1.94)	2562	335 (2.69)	2387
4250	332 (1.89)	2490	326 (2.62)	2320
4375	323 (1.84)	2423	318 (2.55)	2258
4500	315 (1.80)	2359	310 (2.49)	2198
4625	308 (1.76)	2297	302 (2.43)	2140
4750	300 (1.72)	2238	295 (2.37)	2085
4875	293 (1.68)	2180	288 (2.32)	2032
5000	286 (1.64)	2125	281 (2.26)	1980
5125	279 (1.60)	2070	274 (2.21)	1930
5250	272 (1.56)	2017	267 (2.16)	1881
5375	26 (1.53)	1966	261 (2.11)	1833
5500	259 (1.49)	1916	255 (2.06)	1786
5625	253 (1.46)	1867	248 (2.01)	1740
5750	247 (1.43)	1820	243 (1.96)	1697
5875	241 (1.40)	1774	237 (1.92)	1654
6000	236 (1.37)	1731	232 (1.88)	1614
6125	231 (1.34)	1690	227 (1.84)	1577
6250	226 (1.31)	1653	222 (1.80)	1542
6375	222 (1.29)	1619	218 (1.77)	1510
6500	218 (1.27)	1590	214 (1.74)	1483
6625	215 (1.25)	1565	211 (1.72)	1460
6750	213 (1.24)	1546	209 (1.70)	1443
6875	211 (1.23)	1534	207 (1.68)	1432
7000	211 (1.23)	1530	207 (1.68)	1428
7125 Or More	211 (1.22)	1531	206 (1.68)	1428

U.S. EPA ASM EMISSION STANDARDS - 1984-87 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	4990	381 (4.85)	4960
1875	368 (3.34)	4990	359 (4.57)	4738
2000	348 (3.16)	4778	339 (4.31)	4535
2125	329 (2.99)	4578	321 (4.08)	4349

cardiagn.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2250	312 (2.83)	4395	305 (3.86)	4179
2375	297 (2.69)	4228	290 (3.66)	4024
2500	283 (2.56)	4076	276 (3.48)	3881
2625	270 (2.44)	3936	263 (3.32)	3752
2750	258 (2.33)	3809	252 (3.17)	3579
2875	247 (2.23)	3669	241 (3.03)	3417
3000	237 (2.14)	3510	232 (2.91)	3270
3125	228 (2.06)	3366	223 (2.79)	3135
3250	220 (1.99)	3234	215 (2.69)	3012
3375	213 (1.92)	3113	208 (2.60)	2899
3500	206 (1.86)	3002	201 (2.51)	2796
3625	200 (1.80)	2900	195 (2.43)	2701
3750	194 (1.74)	2806	189 (2.36)	2614
3875	188 (1.69)	2719	184 (2.29)	2533
4000	183 (1.65)	2638	179 (2.22)	2457
4125	179 (1.61)	2562	175 (2.16)	2387
4250	174 (1.56)	2490	170 (2.11)	2320
4375	170 (1.53)	2423	166 (2.06)	2258
4500	166 (1.49)	2359	162 (2.01)	2198
4625	162 (1.46)	2297	159 (1.96)	2140
4750	159 (1.42)	2238	155 (1.91)	2085
4875	155 (1.39)	2180	152 (1.87)	2032
5000	152 (1.36)	2125	148 (1.82)	1980
5125	148 (1.33)	2070	145 (1.78)	1930
5250	145 (1.30)	2017	142 (1.74)	1881
5375	142 (1.27)	1966	139 (1.70)	1833
5500	139 (1.24)	1916	136 (1.66)	1786
5625	136 (1.12)	1867	133 (1.62)	1740
5750	133 (1.19)	1820	130 (1.59)	1697
5875	130 (1.16)	1774	127 (1.55)	1654
6000	127 (1.14)	1731	124 (1.52)	1614
6125	125 (1.11)	1690	122 (1.49)	1577
6250	123 (1.09)	1653	120 (1.46)	1542
6375	120 (1.07)	1619	118 (1.43)	1510
6500	119 (1.06)	1590	116 (1.41)	1483
6625	117 (1.04)	1565	114 (1.39)	1460
6750	116 (1.03)	1546	113 (1.37)	1443
6875	115 (1.02)	1534	113 (1.36)	1432
7000	115 (1.02)	1530	112 (1.36)	1428
7125 Or More	115 (1.02)	1531	112 (1.36)	1428

U.S. EPA ASM EMISSION STANDARDS - 1988-90 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	2725	381 (4.85)	2587
1875	368 (3.34)	2649	359 (4.57)	2435
2000	348 (3.16)	2499	339 (4.31)	2295
2125	329 (2.99)	2360	321 (4.08)	2167
2250	312 (2.83)	2232	305 (3.86)	2050

carofun.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2375	297 (2.69)	2115	290 (3.66)	1943
2500	283 (2.56)	2009	276 (3.48)	1845
2625	270 (2.44)	1912	263 (3.32)	1756
2750	258 (2.33)	1823	252 (3.17)	1675
2875	247 (2.23)	1742	241 (3.03)	1601
3000	237 (2.14)	1668	232 (2.91)	1533
3125	228 (2.06)	1601	223 (2.79)	1471
3250	220 (1.99)	1539	215 (2.69)	1415
3375	213 (1.92)	1483	208 (2.60)	1363
3500	206 (1.86)	1432	201 (2.51)	1316
3625	200 (1.80)	1384	195 (2.43)	1273
3750	194 (1.74)	1340	189 (2.36)	1233
3875	188 (1.69)	1300	184 (2.29)	1195
4000	183 (1.65)	1262	179 (2.22)	1161
4125	179 (1.61)	1227	175 (2.16)	1126
4250	174 (1.56)	1194	170 (2.11)	1098
4375	170 (1.53)	1162	166 (2.06)	1069
4500	166 (1.49)	1132	162 (2.01)	1042
4625	162 (1.46)	1104	159 (1.96)	1015
4750	159 (1.42)	1076	155 (1.91)	990
4875	155 (1.39)	1049	152 (1.87)	966
5000	152 (1.36)	1023	148 (1.82)	942
5125	148 (1.33)	998	145 (1.78)	919
5250	145 (1.30)	974	142 (1.74)	896
5375	142 (1.27)	950	139 (1.70)	874
5500	139 (1.24)	926	136 (1.66)	853
5625	136 (1.12)	904	133 (1.62)	832
5750	133 (1.19)	882	130 (1.59)	812
5875	130 (1.16)	860	127 (1.55)	793
6000	127 (1.14)	840	124 (1.52)	774
6125	125 (1.11)	822	122 (1.49)	757
6250	123 (1.09)	804	120 (1.46)	741
6375	120 (1.07)	788	118 (1.43)	727
6500	119 (1.06)	775	116 (1.41)	714
6625	117 (1.04)	763	114 (1.39)	704
6750	116 (1.03)	755	113 (1.37)	696
6875	115 (1.02)	749	113 (1.36)	691
7000 Or More	115 (1.02)	747	112 (1.36)	689

U.S. EPA ASM EMISSION STANDARDS - 1991-95 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	324 (2.78)	2272	315 (3.64)	2114
1875	306 (2.63)	2181	297 (3.43)	1991
2000	289 (2.48)	2058	281 (3.24)	1877
2125	274 (2.35)	1944	267 (3.06)	1774
2250	260 (2.23)	1839	253 (2.90)	1678
2375	247 (2.12)	1744	241 (2.76)	1592
2500	236 (2.02)	1657	230 (2.62)	1512

carofun.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2625	225 (1.92)	1577	219 (2.50)	1440
2750	216 (1.84)	1504	210 (2.39)	1374
2875	207 (1.76)	1438	210 (2.29)	1313
3000	199 (1.69)	1378	194 (2.19)	1258
3125	191 (1.63)	1323	186 (2.11)	1208
3250	185 (1.57)	1273	180 (2.03)	1163
3375	179 (1.52)	1227	174 (1.96)	1121
3500	173 (1.47)	1184	169 (1.89)	1082
3625	168 (1.42)	1146	164 (1.84)	1047
3750	163 (1.38)	1110	159 (1.78)	1014
3875	159 (1.34)	1077	155 (1.73)	984
4000	155 (1.31)	1046	151 (1.68)	956
4125	151 (1.27)	1017	147 (1.64)	930
4250	147 (1.24)	990	143 (1.60)	905
4375	144 (1.21)	964	140 (1.56)	882
4500	141 (1.18)	939	137 (1.52)	859
4625	137 (1.15)	916	134 (1.48)	838
4750	134 (1.13)	893	131 (1.45)	818
4875	132 (1.10)	872	128 (1.42)	798
5000	129 (1.08)	850	126 (1.38)	778
5125	126 (1.05)	830	123 (1.35)	760
5250	123 (1.03)	810	120 (1.32)	741
5375	121 (1.01)	790	118 (1.29)	723
5500	118 (0.99)	771	115 (1.26)	706
5625	116 (0.97)	752	113 (1.24)	689
5750	113 (0.94)	734	111 (1.21)	673
5875	111 (0.92)	717	108 (1.18)	657
6000	109 (0.91)	701	106 (1.16)	642
6125	107 (0.89)	685	104 (1.13)	628
6250	105 (.087)	671	102 (1.11)	615
6375	103 (0.86)	658	101 (1.09)	604
6500	102 (0.84)	647	99 (1.08)	593
6625	101 (0.83)	638	98 (1.06)	585
6750	100 (0.82)	631	97 (1.05)	578
6875	99 (0.82)	626	97 (1.04)	574
7000	99 (0.82)	624	96 (1.04)	573
7125 Or More	98 (0.81)	625	96 (1.04)	573

U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (3750 LVW OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	142 (0.80)	1212	136 (0.77)	1095
1875	134 (0.75)	1142	129 (0.73)	1031
2000	127 (0.71)	1077	123 (0.69)	973
2125	121 (0.68)	1018	116 (0.66)	920
2250	115 (0.64)	964	111 (0.62)	871
2375	109 (0.61)	915	106 (0.59)	827
2500	105 (0.59)	869	101 (0.57)	786
2625	100 (0.56)	828	97 (0.54)	749

Carofun.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2750	96 (0.54)	791	93 (0.52)	715
2875	92 (0.52)	756	89 (0.50)	684
3000	89 (0.50)	725	86 (0.48)	656
3125	86 (0.48)	696	83 (0.46)	630
3250	83 (0.46)	670	80 (0.45)	607
3375	81 (0.45)	647	78 (0.43)	585
3500	78 (0.44)	625	76 (0.42)	566
3625	76 (0.42)	605	74 (0.41)	547
3750	74 (0.41)	586	72 (0.40)	531
3875	72 (0.40)	569	70 (0.39)	515
4000	71 (0.39)	553	68 (0.38)	501
4125	69 (0.38)	538	67 (0.37)	487
4250	67 (0.37)	524	65 (0.36)	475
4375	66 (0.36)	510	64 (0.35)	463
4500	65 (0.36)	498	63 (0.35)	440
4625	63 (0.35)	486	61 (0.34)	440
4750	62 (0.34)	474	60 (0.33)	430
4875	61 (0.34)	463	59 (0.33)	420
5000	60 (0.33)	452	58 (0.32)	410
5125	58 (0.32)	441	57 (0.31)	400
5250	57 (0.32)	431	56 (0.31)	391
5375	56 (0.31)	420	55 (0.30)	382
5500	55 (0.30)	410	54 (0.30)	373
5625	54 (0.30)	401	53 (0.29)	364
5750	53 (0.29)	391	52 (0.29)	356
5875	52 (0.29)	383	51 (0.28)	348
6000	51 (0.28)	374	50 (0.28)	340
6125	50 (0.28)	366	49 (0.27)	333
6250	50 (0.27)	359	48 (0.27)	326
6375	49 (0.27)	352	48 (0.26)	320
6500	48 (0.26)	346	47 (0.26)	315
6625	48 (0.26)	341	46 (0.26)	311
6750	47 (0.26)	338	46 (0.26)	307
6875	47 (0.26)	335	46 (0.25)	305
7000 Or More	47 (0.25)	335	46 (0.25)	305

U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (3751 LVW OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	224 (1.26)	1819	216 (1.22)	1642
1875	212 (1.19)	1713	205 (1.16)	1547
2000	201 (1.13)	1616	194 (1.09)	1460
2125	191 (1.07)	1527	184 (1.04)	1380
2250	182 (1.02)	1446	175 (0.99)	1307
2375	173 (0.97)	1372	167 (0.94)	1240
2500	166 (0.93)	1304	160 (0.90)	1179
2625	159 (0.89)	1242	153 (0.86)	1123
2750	152 (0.85)	1186	147 (0.82)	1072
2875	146 (0.82)	1134	141 (0.79)	1026

carofun.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3000	141 (0.79)	1088	136 (0.76)	984
3125	136 (0.76)	1045	132 (0.73)	945
3250	132 (0.73)	1006	127 (0.71)	910
3375	128 (0.71)	970	123 (0.69)	878
3500	124 (0.69)	937	120 (0.67)	848
3625	120 (0.67)	907	117 (0.65)	821
3750	117 (0.65)	879	114 (0.63)	796
3875	114 (0.63)	853	111 (0.61)	773
4000	112 (0.62)	829	108 (0.60)	751
4125	109 (0.60)	807	106 (0.58)	731
4250	107 (0.59)	786	103 (0.57)	712
4375	104 (0.58)	766	101 (0.56)	694
4500	102 (0.57)	747	99 (0.55)	677
4625	100 (0.55)	728	97 (0.54)	661
4750	98 (0.54)	711	95 (0.53)	645
4875	96 (0.53)	694	93 (0.52)	630
5000	94 (0.52)	677	92 (0.51)	615
5125	93 (0.51)	661	90 (0.50)	600
5250	91 (0.50)	646	88 (0.49)	586
5375	89 (0.49)	631	86 (0.48)	573
5500	87 (0.48)	616	85 (0.47)	559
5625	86 (0.47)	601	83 (0.46)	546
5750	84 (0.46)	587	82 (0.45)	534
5875	83 (0.45)	574	80 (0.44)	522
6000	81 (0.44)	561	79 (0.44)	510
6125	80 (0.44)	549	78 (0.43)	499
6250	79 (0.43)	538	76 (0.42)	489
6375	77 (0.42)	528	75 (0.42)	480
6500	76 (0.42)	519	74 (0.41)	473
6625	76 (0.41)	512	74 (0.41)	466
6750	75 (0.41)	507	73 (0.41)	461
6875	75 (0.40)	503	73 (0.40)	458
7000 Or More	74 (0.40)	502	72 (0.40)	457

U.S. EPA ASM EMISSION STANDARDS - 1968-72 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4990
1875	1052 (7.56)	4990	1034 (9.90)	4990
2000	992 (7.14)	4990	975 (9.90)	4990
2125	938 (6.75)	4990	921 (9.66)	4990
2250	887 (6.40)	4990	872 (9.14)	4990
2375	841 (6.07)	4990	827 (8.67)	4990
2500	800 (5.78)	4990	786 (8.25)	4990
2625	761 (5.51)	4990	748 (7.85)	4990
2750	726 (5.26)	4990	714 (7.50)	4772
2875	695 (5.03)	4892	683 (7.17)	4556
3000	666 (4.83)	4680	654 (6.87)	4359
3125	639 (4.64)	4488	628 (6.60)	4180

carofun.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3250	615 (4.47)	4311	604 (6.35)	4016
3375	593 (4.31)	4150	583 (6.13)	3866
3500	573 (4.17)	4002	563 (5.92)	3728
3625	554 (4.04)	3867	544 (5.73)	3602
3750	537 (3.91)	3741	527 (5.55)	3485
3875	521 (3.80)	3625	512 (5.39)	3377
4000	506 (3.70)	3517	497 (5.24)	3276
4125	492 (3.60)	3416	484 (5.09)	3182
4250	479 (3.51)	3321	471 (4.96)	3094
4375	467 (3.42)	3230	459 (4.83)	3010
4500	455 (3.34)	3145	447 (4.71)	2930
4625	444 (3.26)	3063	436 (4.60)	2854
4750	433 (3.18)	2983	425 (4.49)	2780
4875	423 (3.11)	2907	415 (4.38)	2709
5000	412 (3.03)	2833	405 (4.28)	2640
5125	402 (2.97)	2760	395 (4.18)	2573
5250	393 (2.90)	2690	386 (4.08)	2507
5375	383 (2.83)	2621	376 (3.98)	2443
5500	374 (2.77)	2554	367 (3.89)	2381
5625	365 (2.70)	2489	359 (3.80)	2321
5750	357 (2.64)	2426	350 (3.71)	2262
5875	348 (2.59)	2366	342 (3.62)	2206
6000	341 (2.53)	2308	334 (3.54)	2152
6125	333 (2.48)	2254	327 (3.47)	2102
6250	326 (2.43)	2204	320 (3.40)	2056
6375	320 (2.39)	2159	314 (3.34)	2014
6500	315 (2.35)	2119	309 (3.28)	1977
6625	310 (2.32)	2087	304 (3.23)	1947
6750	307 (2.29)	2062	301 (3.20)	1924
6875	305 (2.28)	2046	299 (3.17)	1909
7000	304 (2.27)	2040	298 (3.17)	1904
7125 Or More	304 (2.27)	2045	298 (3.17)	1904

U.S. EPA ASM EMISSION STANDARDS - 1973-74 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4980
1875	1052 (7.56)	4990	1034 (9.90)	4906
2000	992 (7.14)	4919	975 (9.90)	4838
2125	938 (6.75)	4853	921 (9.66)	4776
2250	887 (6.40)	4792	872 (9.14)	4720
2375	841 (6.07)	4736	827 (8.67)	4668
2500	800 (5.78)	4685	786 (8.25)	4620
2625	761 (5.51)	4639	748 (7.85)	4577
2750	726 (5.26)	4596	714 (7.50)	4374
2875	695 (5.03)	4484	683 (7.17)	4176
3000	666 (4.83)	4290	654 (6.87)	3996
3125	639 (4.64)	4114	628 (6.60)	3832
3250	615 (4.47)	3952	604 (6.35)	3681

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3375	593 (4.31)	3804	583 (6.13)	3544
3500	573 (4.17)	3669	563 (5.92)	3418
3625	554 (4.04)	3544	544 (5.73)	3302
3750	537 (3.91)	3429	527 (5.55)	3195
3875	521 (3.80)	3323	512 (5.39)	3096
4000	506 (3.70)	3224	497 (5.24)	3003
4125	492 (3.60)	3131	484 (5.09)	2917
4250	479 (3.51)	3044	471 (4.96)	2836
4375	467 (3.42)	2961	459 (4.83)	2759
4500	455 (3.34)	2883	447 (4.71)	2686
4625	444 (3.26)	2807	436 (4.60)	2616
4750	433 (3.18)	2735	425 (4.49)	2549
4875	423 (3.11)	2665	415 (4.38)	2483
5000	412 (3.03)	2597	405 (4.28)	2420
5125	402 (2.97)	2530	395 (4.18)	2359
5250	393 (2.90)	2466	386 (4.08)	2298
5375	383 (2.83)	2403	376 (3.98)	2240
5500	374 (2.77)	2341	367 (3.89)	2183
5625	365 (2.70)	2282	359 (3.80)	2127
5750	357 (2.64)	2224	350 (3.71)	2074
5875	348 (2.59)	2168	342 (3.62)	2022
6000	341 (2.53)	2116	334 (3.54)	1973
6125	333 (2.48)	2066	327 (3.47)	1927
6250	326 (2.43)	2020	320 (3.40)	1884
6375	320 (2.39)	1979	314 (3.34)	1846
6500	315 (2.35)	1943	309 (3.28)	1813
6625	310 (2.32)	1913	304 (3.23)	1785
6750	307 (2.29)	1890	301 (3.20)	1764
6875	305 (2.28)	1875	299 (3.17)	1750
7000	304 (2.27)	1870	298 (3.17)	1745
7125 Or More	304 (2.27)	1874	298 (3.17)	1745

U.S. EPA ASM EMISSION STANDARDS - 1975-78 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	843 (5.07)	4990	828 (7.26)	4980
1875	794 (4.78)	4990	780 (6.84)	4906
2000	749 (4.51)	4919	736 (6.45)	4838
2125	707 (4.26)	4853	695 (6.10)	4776
2250	669 (4.04)	4792	658 (5.78)	4720
2375	635 (3.83)	4736	624 (5.48)	4668
2500	603 (3.65)	4685	593 (5.21)	4620
2625	574 (3.48)	4639	564 (4.96)	4577
2750	548 (3.32)	4596	539 (4.73)	4374
2875	524 (3.18)	4484	515 (4.53)	4176
3000	502 (3.05)	4290	493 (4.34)	3996
3125	482 (2.93)	4114	474 (4.17)	3832
3250	464 (2.82)	3952	456 (4.01)	3681
3375	447 (2.72)	3804	440 (3.87)	3544

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3500	432 (2.63)	3669	424 (3.74)	3418
3625	418 (2.55)	3544	411 (3.62)	3302
3750	405 (2.47)	3429	398 (3.51)	3195
3875	393 (2.40)	3323	386 (3.40)	3096
4000	382 (2.33)	3224	375 (3.31)	3003
4125	371 (2.27)	3131	365 (3.22)	2917
4250	361 (2.21)	3044	355 (3.13)	2836
4375	352 (2.16)	2961	346 (3.05)	2759
4500	343 (2.11)	2883	337 (2.98)	2686
4625	335 (2.06)	2807	329 (2.90)	2616
4750	327 (2.01)	2735	321 (2.83)	2549
4875	319 (1.96)	2665	313 (2.77)	2483
5000	311 (1.92)	2597	305 (2.70)	2420
5125	304 (1.87)	2530	298 (2.64)	2359
5250	296 (1.83)	2466	291 (2.58)	2298
5375	289 (1.79)	2403	284 (2.51)	2240
5500	282 (1.75)	2341	277 (2.46)	2183
5625	276 (1.71)	2282	271 (2.40)	2127
5750	269 (1.67)	2224	264 (2.34)	2074
5875	263 (1.63)	2168	258 (2.29)	2022
6000	257 (1.60)	2116	252 (2.24)	1973
6125	251 (1.57)	2066	247 (2.19)	1927
6250	246 (1.54)	2020	242 (2.15)	1884
6375	242 (1.51)	1979	237 (2.11)	1846
6500	238 (1.48)	1943	233 (2.07)	1813
6625	234 (1.46)	1913	230 (2.04)	1785
6750	232 (1.45)	1890	227 (2.02)	1764
6875	230 (1.44)	1875	225 (2.00)	1750
7000	229 (1.43)	1870	225 (2.00)	1745
7125 Or More	229 (1.43)	1874	225 (2.00)	1745

U.S. EPA ASM EMISSION STANDARDS - 1979-83 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (4.31)	4990	761 (6.06)	4960
1875	729 (4.06)	4990	717 (5.70)	4738
2000	688 (3.83)	4778	676 (5.38)	4535
2125	650 (3.63)	4578	638 (5.09)	4349
2250	615 (3.44)	4395	604 (4.82)	4179
2375	583 (3.26)	4228	573 (4.57)	4024
2500	554 (3.10)	4076	544 (4.35)	3881
2625	528 (2.96)	3936	518 (4.14)	3752
2750	503 (2.83)	3809	495 (3.95)	3579
2875	481 (2.71)	3669	473 (3.78)	3417
3000	461 (2.60)	3510	453 (3.62)	3270
3125	443 (2.50)	3366	435 (3.48)	3135
3250	426 (2.40)	3234	419 (3.35)	3012
3375	411 (2.32)	3113	404 (3.23)	2899
3500	397 (2.24)	3002	390 (3.12)	2796

carofun.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3625	384 (2.17)	2900	377 (3.02)	2701
3750	372 (2.11)	2806	365 (2.93)	2614
3875	361 (2.05)	2719	355 (2.58)	2533
4000	351 (1.99)	2638	345 (2.77)	2457
4125	341 (1.94)	2562	335 (2.69)	2387
4250	332 (1.89)	2490	326 (2.62)	2320
4375	323 (1.84)	2423	318 (2.55)	2258
4500	315 (1.80)	2359	310 (2.49)	2198
4625	308 (1.76)	2297	302 (2.43)	2140
4750	300 (1.72)	2238	295 (2.37)	2085
4875	293 (1.68)	2180	288 (2.32)	2032
5000	286 (1.64)	2125	281 (2.26)	1980
5125	279 (1.60)	2070	274 (2.21)	1930
5250	272 (1.56)	2017	267 (2.16)	1881
5375	26 (1.53)	1966	261 (2.11)	1833
5500	259 (1.49)	1916	255 (2.06)	1786
5625	253 (1.46)	1867	248 (2.01)	1740
5750	247 (1.43)	1820	243 (1.96)	1697
5875	241 (1.40)	1774	237 (1.92)	1654
6000	236 (1.37)	1731	232 (1.88)	1614
6125	231 (1.34)	1690	227 (1.84)	1577
6250	226 (1.31)	1653	222 (1.80)	1542
6375	222 (1.29)	1619	218 (1.77)	1510
6500	218 (1.27)	1590	214 (1.74)	1483
6625	215 (1.25)	1565	211 (1.72)	1460
6750	213 (1.24)	1546	209 (1.70)	1443
6875	211 (1.23)	1534	207 (1.68)	1432
7000	211 (1.23)	1530	207 (1.68)	1428
7125 Or More	211 (1.22)	1531	206 (1.68)	1428

U.S. EPA ASM EMISSION STANDARDS - 1984-87 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	4990	381 (4.85)	4960
1875	368 (3.34)	4990	359 (4.57)	4738
2000	348 (3.16)	4778	339 (4.31)	4535
2125	329 (2.99)	4578	321 (4.08)	4349
2250	312 (2.83)	4395	305 (3.86)	4179
2375	297 (2.69)	4228	290 (3.66)	4024
2500	283 (2.56)	4076	276 (3.48)	3881
2625	270 (2.44)	3936	263 (3.32)	3752
2750	258 (2.33)	3809	252 (3.17)	3579
2875	247 (2.23)	3669	241 (3.03)	3417
3000	237 (2.14)	3510	232 (2.91)	3270
3125	228 (2.06)	3366	223 (2.79)	3135
3250	220 (1.99)	3234	215 (2.69)	3012
3375	213 (1.92)	3113	208 (2.60)	2899
3500	206 (1.86)	3002	201 (2.51)	2796
3625	200 (1.80)	2900	195 (2.43)	2701

carofun.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3750	194 (1.74)	2806	189 (2.36)	2614
3875	188 (1.69)	2719	184 (2.29)	2533
4000	183 (1.65)	2638	179 (2.22)	2457
4125	179 (1.61)	2562	175 (2.16)	2387
4250	174 (1.56)	2490	170 (2.11)	2320
4375	170 (1.53)	2423	166 (2.06)	2258
4500	166 (1.49)	2359	162 (2.01)	2198
4625	162 (1.46)	2297	159 (1.96)	2140
4750	159 (1.42)	2238	155 (1.91)	2085
4875	155 (1.39)	2180	152 (1.87)	2032
5000	152 (1.36)	2125	148 (1.82)	1980
5125	148 (1.33)	2070	145 (1.78)	1930
5250	145 (1.30)	2017	142 (1.74)	1881
5375	142 (1.27)	1966	139 (1.70)	1833
5500	139 (1.24)	1916	136 (1.66)	1786
5625	136 (1.12)	1867	133 (1.62)	1740
5750	133 (1.19)	1820	130 (1.59)	1697
5875	130 (1.16)	1774	127 (1.55)	1654
6000	127 (1.14)	1731	124 (1.52)	1614
6125	125 (1.11)	1690	122 (1.49)	1577
6250	123 (1.09)	1653	120 (1.46)	1542
6375	120 (1.07)	1619	118 (1.43)	1510
6500	119 (1.06)	1590	116 (1.41)	1483
6625	117 (1.04)	1565	114 (1.39)	1460
6750	116 (1.03)	1546	113 (1.37)	1443
6875	115 (1.02)	1534	113 (1.36)	1432
7000	115 (1.02)	1530	112 (1.36)	1428
7125 Or More	115 (1.02)	1531	112 (1.36)	1428

U.S. EPA ASM EMISSION STANDARDS - 1988-90 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	4084	381 (4.85)	4005
1875	368 (3.34)	4054	359 (4.57)	3767
2000	348 (3.16)	3824	339 (4.31)	3548
2125	329 (2.99)	3609	321 (4.08)	3348
2250	312 (2.83)	3411	305 (3.86)	3165
2375	297 (2.69)	3231	290 (3.66)	2998
2500	283 (2.56)	3066	276 (3.48)	2845
2625	270 (2.44)	2916	263 (3.32)	2706
2750	258 (2.33)	2779	252 (3.17)	2579
2875	247 (2.23)	2654	241 (3.03)	2463
3000	237 (2.14)	2539	232 (2.91)	2357
3125	228 (2.06)	2435	223 (2.79)	2260
3250	220 (1.99)	2340	215 (2.69)	2172
3375	213 (1.92)	2253	208 (2.60)	2092
3500	206 (1.86)	2174	201 (2.51)	2018
3625	200 (1.80)	2100	195 (2.43)	1950
3750	194 (1.74)	2033	189 (2.36)	1887

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3875	188 (1.69)	1970	184 (2.29)	1829
4000	183 (1.65)	1912	179 (2.22)	1775
4125	179 (1.61)	1857	175 (2.16)	1724
4250	174 (1.56)	1806	170 (2.11)	1677
4375	170 (1.53)	1757	166 (2.06)	1632
4500	166 (1.49)	1711	162 (2.01)	1589
4625	162 (1.46)	1666	159 (1.96)	1548
4750	159 (1.42)	1624	155 (1.91)	1508
4875	155 (1.39)	1583	152 (1.87)	1470
5000	152 (1.36)	1542	148 (1.82)	1433
5125	148 (1.33)	1503	145 (1.78)	1397
5250	145 (1.30)	1465	142 (1.74)	1362
5375	142 (1.27)	1428	139 (1.70)	1327
5500	139 (1.24)	1392	136 (1.66)	1294
5625	136 (1.12)	1357	133 (1.62)	1261
5750	133 (1.19)	1323	130 (1.59)	1230
5875	130 (1.16)	1290	127 (1.55)	1199
6000	127 (1.14)	1259	124 (1.52)	1171
6125	125 (1.11)	1230	122 (1.49)	1144
6250	123 (1.09)	1203	120 (1.46)	1119
6375	120 (1.07)	1179	118 (1.43)	1096
6500	119 (1.06)	1158	116 (1.41)	1077
6625	117 (1.04)	1140	114 (1.39)	1060
6750	116 (1.03)	1127	113 (1.37)	1048
6875	115 (1.02)	1118	113 (1.36)	1040
7000 Or More	115 (1.02)	1115	112 (1.36)	1037

U.S. EPA ASM EMISSION STANDARDS - 1991-95 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	324 (2.78)	3631	315 (3.64)	3532
1875	306 (2.63)	3586	297 (3.43)	3323
2000	289 (2.48)	3383	281 (3.24)	3131
2125	274 (2.35)	3192	267 (3.06)	2955
2250	260 (2.23)	3018	253 (2.90)	2794
2375	247 (2.12)	2859	241 (2.76)	2646
2500	236 (2.02)	2714	230 (2.62)	2512
2625	225 (1.92)	2581	219 (2.50)	2389
2750	216 (1.84)	2460	210 (2.39)	2277
2875	207 (1.76)	2350	210 (2.29)	2175
3000	199 (1.69)	2249	194 (2.19)	2082
3125	191 (1.63)	2157	186 (2.11)	1997
3250	185 (1.57)	2073	180 (2.03)	1920
3375	179 (1.52)	1997	174 (1.96)	1849
3500	173 (1.47)	1926	169 (1.89)	1784
3625	168 (1.42)	1862	164 (1.84)	1724
3750	163 (1.38)	1802	159 (1.78)	1669
3875	159 (1.34)	1747	155 (1.73)	1618
4000	155 (1.31)	1695	151 (1.68)	1570

carofun.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4125	151 (1.27)	1647	147 (1.64)	1526
4250	147 (1.24)	1602	143 (1.60)	1484
4375	144 (1.21)	1559	140 (1.56)	1444
4500	141 (1.18)	1518	137 (1.52)	1406
4625	137 (1.15)	1479	134 (1.48)	1370
4750	134 (1.13)	1441	131 (1.45)	1336
4875	132 (1.10)	1405	128 (1.42)	1302
5000	129 (1.08)	1369	126 (1.38)	1269
5125	126 (1.05)	1335	123 (1.35)	1237
5250	123 (1.03)	1031	120 (1.32)	1206
5375	121 (1.01)	1269	118 (1.29)	1176
5500	118 (0.99)	1237	115 (1.26)	1147
5625	116 (0.97)	1206	113 (1.24)	1118
5750	113 (0.94)	1176	111 (1.21)	1090
5875	111 (0.92)	1147	108 (1.18)	1064
6000	109 (0.91)	1120	106 (1.16)	1039
6125	107 (0.89)	1094	104 (1.13)	1015
6250	105 (.087)	1070	102 (1.11)	993
6375	103 (0.86)	1049	101 (1.09)	973
6500	102 (0.84)	1030	99 (1.08)	956
6625	101 (0.83)	1014	98 (1.06)	941
6750	100 (0.82)	1003	97 (1.05)	931
6875	99 (0.82)	995	97 (1.04)	924
7000	99 (0.82)	992	96 (1.04)	921
7125 Or More	98 (0.81)	992	96 (1.04)	921

U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (5750 LVW OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	224 (1.26)	1819	216 (1.22)	1642
1875	212 (1.19)	1713	205 (1.16)	1547
2000	201 (1.13)	1616	194 (1.09)	1460
2125	191 (1.07)	1527	184 (1.04)	1380
2250	182 (1.02)	1446	175 (0.99)	1307
2375	173 (0.97)	1372	167 (0.94)	1240
2500	166 (0.93)	1304	160 (0.90)	1179
2625	159 (0.89)	1242	153 (0.86)	1123
2750	152 (0.85)	1186	147 (0.82)	1072
2875	146 (0.82)	1134	141 (0.79)	1026
3000	141 (0.79)	1088	136 (0.76)	984
3125	136 (0.76)	1045	132 (0.73)	945
3250	132 (0.73)	1006	127 (0.71)	910
3375	128 (0.71)	970	123 (0.69)	878
3500	124 (0.69)	937	120 (0.67)	848
3625	120 (0.67)	907	117 (0.65)	821
3750	117 (0.65)	879	114 (0.63)	796
3875	114 (0.63)	853	111 (0.61)	773
4000	112 (0.62)	829	108 (0.60)	751
4125	109 (0.60)	807	106 (0.58)	731

carofun.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4250	107 (0.59)	786	103 (0.57)	712
4375	104 (0.58)	766	101 (0.56)	694
4500	102 (0.57)	747	99 (0.55)	677
4625	100 (0.55)	728	97 (0.54)	661
4750	98 (0.54)	711	95 (0.53)	645
4875	96 (0.53)	694	93 (0.52)	630
5000	94 (0.52)	677	92 (0.51)	615
5125	93 (0.51)	661	90 (0.50)	600
5250	91 (0.50)	646	88 (0.49)	586
5375	89 (0.49)	631	86 (0.48)	573
5500	87 (0.48)	616	85 (0.47)	559
5625	86 (0.47)	601	83 (0.46)	546
5750	84 (0.46)	587	82 (0.45)	534
5875	83 (0.45)	574	80 (0.44)	522
6000	81 (0.44)	561	79 (0.44)	510
6125	80 (0.44)	549	78 (0.43)	499
6250	79 (0.43)	538	76 (0.42)	489
6375	77 (0.42)	528	75 (0.42)	480
6500	76 (0.42)	519	74 (0.41)	473
6625	76 (0.41)	512	74 (0.41)	466
6750	75 (0.41)	507	73 (0.41)	461
6875	75 (0.40)	503	73 (0.40)	458
7000 Or More	74 (0.40)	502	72 (0.40)	457

U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (5751 LVW OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	324 (2.78)	3178	315 (3.64)	3060
1875	306 (2.63)	3117	297 (3.43)	2879
2000	289 (2.48)	2941	281 (3.24)	2713
2125	274 (2.35)	2776	267 (3.06)	2561
2250	260 (2.23)	2625	253 (2.90)	2422
2375	247 (2.12)	2487	241 (2.76)	2295
2500	236 (2.02)	2361	230 (2.62)	2179
2625	225 (1.92)	2246	219 (2.50)	2073
2750	216 (1.84)	2142	210 (2.39)	1976
2875	207 (1.76)	2046	210 (2.29)	1888
3000	199 (1.69)	1959	194 (2.19)	1808
3125	191 (1.63)	1879	186 (2.11)	1734
3250	185 (1.57)	1806	180 (2.03)	1667
3375	179 (1.52)	1740	174 (1.96)	1606
3500	173 (1.47)	1679	169 (1.89)	1550
3625	168 (1.42)	1623	164 (1.84)	1498
3750	163 (1.38)	1571	159 (1.78)	1451
3875	159 (1.34)	1523	155 (1.73)	1407
4000	155 (1.31)	1479	151 (1.68)	1365
4125	151 (1.27)	1437	147 (1.64)	1327
4250	147 (1.24)	1398	143 (1.60)	1291
4375	144 (1.21)	1360	140 (1.56)	1257

carofach.com

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4500	141 (1.18)	1325	137 (1.52)	1224
4625	137 (1.15)	1291	134 (1.48)	1193
4750	134 (1.13)	1259	131 (1.45)	1163
4875	132 (1.10)	1227	128 (1.42)	1134
5000	129 (1.08)	1196	126 (1.38)	1106
5125	126 (1.05)	1167	123 (1.35)	1078
5250	123 (1.03)	1138	120 (1.32)	1051
5375	121 (1.01)	1109	118 (1.29)	1025
5500	118 (0.99)	1082	115 (1.26)	1000
5625	116 (0.97)	1055	113 (1.24)	975
5750	113 (0.94)	1029	111 (1.21)	951
5875	111 (0.92)	1004	108 (1.18)	928
6000	109 (0.91)	980	106 (1.16)	906
6125	107 (0.89)	958	104 (1.13)	886
6250	105 (.087)	937	102 (1.11)	867
6375	103 (0.86)	919	101 (1.09)	850
6500	102 (0.84)	902	99 (1.08)	835
6625	101 (0.83)	889	98 (1.06)	823
6750	100 (0.82)	879	97 (1.05)	813
6875	99 (0.82)	872	97 (1.04)	807
7000	99 (0.82)	870	96 (1.04)	805
7125 Or More	98 (0.81)	870	96 (1.04)	805

U. S. EPA REVISED FINAL ASM EMISSION STANDARDS (ASM5015 & ASM2525)

NOTE: **EPA has not published a revised final standards for High Altitude, Light Duty Trucks 2 (6000-8500 GVWR), or vehicles older than 1980 model year. EPA guidance as of February 2003 states that a program may choose to use combinations of the Original and the Revised Final Standards.**

U.S. EPA REVISED FINAL ASM EMISSION STANDARDS

Application	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
Passenger Cars				
1980	275 (1.3)	8500	500 (2.3)	4750
1981-82	275 (1.3)	3600	500 (2.3)	3500
1983-89	275 (1.1)	3600	500 (1.6)	3500
1990 & Newer	275 (1.1)	3600	300 (1.6)	3500
Light Duty Trucks (Less Than 6000 GVWR)				
1980-83	1140 (9.7)	14,145	340 (23.28)	32,200
1984-87	537 (5.4)	14,145	160 (12.96)	32,200
1988-95	537 (5.4)	7380	160 (12.96)	16,800

carDiagn.com

Application	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1996 & Newer	275 (1.1)	6150	82 (4.40)	14,000

U.S. EPA IM240 EMISSION STANDARDS

START-UP STANDARDS

Start-up standards should be used during the first 2 years of program operation. Tier 1 standards are recommended for all 1996 and newer vehicles and may be used for 1994 and newer vehicles certified to Tier 1 standards as well.

U.S. EPA IM240 HYDROCARBONS EMISSION START-UP STANDARDS

Application	Hydrocarbons (Grams/Mile)	
	Composite	Phase 2
Light Duty Vehicles		
1996 & Newer	0.80	0.50
1991-95	1.20	0.75
1983-90	2.00	1.25
1980-82	2.00	1.25
1975-79	7.50	5.00
1968-74	10.0	6.00
High Altitude Light Duty Vehicles		
1983-84	2.00	1.25
1982	2.00	1.25
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	0.80	0.50
1996 & Newer (More Than 3750 LVW)	1.00	0.63
1991-95	2.40	1.50
1984-90	3.20	2.00
1979-83	7.50	5.00
1975-78	8.00	5.00
1968-74	10.0	6.00
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1991 & Newer	3.00	2.00
1984-90	4.00	2.50
1982-83	8.00	5.00
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	1.00	0.63
1996 & Newer (More Than 5750 ALVW)	2.40	1.50
1991-95	2.40	1.50
1984-90	3.20	2.00
1979-83	7.50	5.00
1975-78	8.00	5.00
1968-74	10.0	6.00
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1991 & Newer	3.00	2.00
1984-90	4.00	2.50
1982-83	8.00	5.00
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	2.00	1.30
1987-97	3.00	1.90

carmanualsonline.com

Application	Hydrocarbons (Grams/Mile)	
Composite		Phase 2
1985-86	5.00	3.10
1979-84	6.00	3.80
1970-78	10.0	6.30
1969 & Earlier	20.0	12.50

U.S. EPA IM240 CARBON MONOXIDE EMISSION START-UP STANDARDS

Application	Carbon Monoxide (Grams/Mile)	
Composite		Phase 2
Light Duty Vehicles		
1996 & Newer	15.0	12.0
1991-95	20.0	16.0
1983-90	30.0	24.0
1980-82	60.0	48.0
1975-79	90.0	72.0
1968-74	150.0	120.0
High Altitude Light Duty Vehicles		
1983-84	60.0	48.0
1982	75.0	60.0
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	15.0	12.0
1996 & Newer (More Than 3750 LVW)	20.0	16.0
1991-95	60.0	48.0
1984-90	80.0	64.0
1979-83	100.0	80.0
1975-78	120.0	96.0
1968-74	150.0	120.0
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1991 & Newer	70.0	56.0
1984-90	90.0	72.0
1982-83	130.0	104.0
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	20.0	16.0
1996 & Newer (More Than 5750 ALVW)	60.0	48.0
1991-95	60.0	48.0
1984-90	80.0	64.0
1979-83	100.0	80.0
1975-78	120.0	96.0
1968-74	150.0	120.0
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1991 & Newer	70.0	56.0
1984-90	90.0	72.0
1982-83	130.0	104.0
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	30.0	24.0
1987-97	60.0	48.0
1985-86	75.0	60.0
1979-84	100.0	80.0
1974-78	150.00	120.0
1970-73	175.00	140.00

cadillacjn.com

Application	Carbon Monoxide (Grams/Mile)	
Composite		Phase 2
1969 & Earlier	200.0	160.0

U.S. EPA IM240 OXIDES OF NITROGEN EMISSION START-UP STANDARDS

Application	Oxides Of Nitrogen (Grams/Mile)	
Composite		Phase 2
Light Duty Vehicles		
1996 & Newer	2.0	2.0
1991-95	2.5	2.5
1981-90	3.0	3.0
1977-80	6.0	6.0
1973-76	9.0	9.0
1968-72	10.0	10.0
High Altitude Light Duty Vehicles		
1982-84	3.0	3.0
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	2.0	2.0
1996 & Newer (More Than 3750 LVW)	2.5	2.5
1991-95	3.0	3.0
1988-90	3.5	3.5
1979-87	7.0	7.0
1973-78	9.0	9.0
1968-72	10.0	10.0
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1991 & Newer	3.0	3.0
1988-90	3.5	3.5
1982-87	7.0	7.0
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	2.5	2.5
1996 & Newer (More Than 5750 ALVW)	4.0	4.0
1991-95	4.5	4.5
1988-90	5.0	5.0
1979-87	7.0	7.0
1973-78	9.0	9.0
1968-72	10.0	10.0
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1991 & Newer	4.5	4.5
1988-90	5.0	5.0
1982-87	7.0	7.0
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	4.0	4.0
1991-97	6.0	6.0
1979-90	8.0	8.0
1970-78	10.0	10.0
1969 & Earlier	15.0	15.0

FINAL STANDARDS

Final standards are recommended for vehicles tested in calendar years 1997 and later. Tier 1 standards are recommended for all 1996 and newer vehicles and may be used for 1994 and newer vehicles.

U.S. EPA IM240 HYDROCARBONS EMISSION FINAL STANDARDS

cardiagn.com

Application	Hydrocarbons (Grams/Mile)	
Composite		**Phase 2**
Light Duty Vehicles		
1996 & Newer	0.60	0.40
1980-95	0.80	0.50
1975-79	3.00	2.00
1968-74	7.00	4.50
High Altitude Light Duty Vehicles		
1982-84	1.20	0.75
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	0.60	0.40
1996 & Newer (More Than 3750 LVW)	0.80	0.50
1984-95	1.60	1.00
1979-83	3.40	2.00
1975-78	4.00	2.50
1968-74	7.00	4.50
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1988 & Newer	2.00	1.25
1984-87	2.00	1.25
1982-83	4.00	2.50
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	0.80	0.50
1996 & Newer (More Than 5750 ALVW)	0.80	0.50
1984-95	1.60	1.00
1979-83	3.40	2.00
1975-78	4.00	2.50
1968-74	7.00	4.50
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1988 & Newer	2.00	1.25
1984-87	2.00	1.25
1982-83	4.00	2.50
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	2.00	1.30
1987-97	2.00	1.30
1985-86	3.00	1.90
1979-84	5.00	3.10
1970-78	10.0	6.30
1969 & Earlier	20.0	12.50

U.S. EPA IM240 CARBON MONOXIDE EMISSION FINAL STANDARDS

Application	Carbon Monoxide (Grams/Mile)	
Composite		**Phase 2**
Light Duty Vehicles		
1996 & Newer	10.0	8.0
1983-95	15.0	12.0
1980-82	30.0	24.0
1975-79	65.0	52.0
1968-74	120.0	96.0
High Altitude Light Duty Vehicles		
1983-84	30.0	24.0
1982	45.0	36.0

cardiagn.com

Application	Carbon Monoxide (Grams/Mile)	
	Composite	Phase 2
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	10.0	8.0
1996 & Newer (More Than 3750 LVW)	13.0	10.0
1984-95	40.0	32.0
1979-83	70.0	56.0
1975-78	80.0	64.0
1968-74	120.0	96.0
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1988 & Newer	60.0	48.0
1984-87	60.0	48.0
1982-83	90.0	72.0
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	13.0	10.0
1996 & Newer (More Than 5750 ALVW)	15.0	12.0
1984-95	40.0	32.0
1979-83	70.0	56.0
1975-78	80.0	64.0
1968-74	120.0	96.0
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1984 & Newer	60.0	48.0
1982-83	90.0	72.0
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	30.0	24.0
1987-97	40.0	32.0
1985-86	50.0	40.0
1979-84	75.0	60.0
1974-78	150.0	120.0
1970-73	175.0	140.0
1969 & Earlier	200.0	160.0

U.S. EPA IM240 OXIDES OF NITROGEN EMISSION FINAL STANDARDS

Application	Oxides Of Nitrogen (Grams/Mile)	
	Composite	Phase 2
Light Duty Vehicles		
1996 & Newer	1.5	1.5
1981-95	2.0	2.0
1977-80	4.0	4.0
1973-76	6.0	6.0
1968-72	7.0	7.0
High Altitude Light Duty Vehicles		
1982-84	2.0	2.0
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	1.5	1.5
1996 & Newer (More Than 3750 LVW)	1.8	1.8
1988-95	2.5	2.5
1979-87	4.5	4.5
1973-78	6.0	6.0
1968-72	7.0	7.0
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		

carDiagn.com

Application	Oxides Of Nitrogen (Grams/Mile)	
	Composite	Phase 2
1988 & Newer	2.5	2.5
1982-87	4.5	4.5
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	1.8	1.8
1996 & Newer (More Than 5750 ALVW)	2.0	2.0
1988-95	3.5	3.5
1979-87	4.5	4.5
1973-78	6.0	6.0
1968-72	7.0	7.0
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1988 & Newer	3.5	3.5
1982-87	4.5	4.5
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	4.0	4.0
1991-97	5.0	5.0
1979-90	6.0	6.0
1970-78	10.0	10.0
1969 & Earlier	15.0	15.0

cardiagn.com

Back To Article

GENERAL INFORMATION

State Emission Standards

ARIZONA

NOTE: **Because of frequent revisions in state emission standards, the emission standards listed in this article should only be used as a guide.**

ARIZONA EMISSION STANDARDS - PHOENIX & TUCSON AREA (DIESEL OPACITY LOADED CRUISE TEST)

Application	Altitude (Feet)	Opacity (% For 10 Seconds)
Light Duty Vehicles (8500 GVWR Or Less)		
All Years	Less Than 2000	20 Or Less
Â Â	2001-4000	30 Or Less
Â Â	Greater Than 4000	40 Or Less

ARIZONA EMISSION STANDARDS - PHOENIX & TUCSON AREA (DIESEL J1667 SNAP IDLE TEST)

Application	Altitude (Feet)	Opacity (% For 10 Seconds)
Heavy Duty Vehicles (8500 GVWR Or Greater)		
1990 & Earlier	All	55
1991 & Newer	All	40

COLORADO

COLORADO EMISSION STANDARDS - DIESEL OPACITY

Application	Opacity %
14,000 GVWR Or Less	
Non-Turbo	40
Turbo	35
14,000 GVWR Or More	
Non-Turbo	35
Turbo	20

CONNECTICUT

CONNECTICUT EMISSION STANDARDS - DIESEL OPACITY

Application	Opacity %
10,000 GVWR Or Less	
1979 & Newer	20
26,000 GVWR Or More	
1974 & Earlier	70
1974-90	55
1991 & Newer	40

IDAHO

IDAHO EMISSION STANDARDS - DIESEL OPACITY

Application	Opacity %
All Weight Range	

cardiagn.com

Application	Opacity %
1965-74	70
1975-91	55
1992 & Newer	40

KENTUCKY

KENTUCKY EMISSION STANDARDS - BOONE, CAMPBELL & KENTON COUNTIES (DIESEL OPACITY)

Application	Opacity
18,000 GVWR Or Less	
All Years	10% @ Idle

MASSACHUSETTS

MASSACHUSETTS EMISSION STANDARDS - DIESEL OPACITY

Application	Opacity %
Light Duty (8500 GVWR Or Less)	
1984 & Newer	20
Light Duty (8501-10,000 GVWR Or Less)	
1984 & Newer	40
Heavy Duty Buses (10,000 GVWR Or More)	
1984-93	40
1994 & Newer	30
Heavy Duty Trucks (10,000 Or Less GVWR)	
1984-90	55
1991 & Newer	40

cardiagn.com

NEW YORK

NEW YORK EMISSION STANDARDS - DIESEL OPACITY TEST

Application	Opacity %
Heavy Duty Vehicles (8500 GVWR Or More)	
1973 & Earlier	70
1974-90	55
1991 & Newer	40

OHIO

OHIO EMISSION STANDARDS - DIESEL OPACITY TEST

Application	Opacity %
Light Duty Diesel	20

RHODE ISLAND

RHODE ISLAND EMISSION STANDARDS - DIESEL OPACITY TEST

Application	Opacity %
All Model Years (8500 GVWR Or Less)	20

UTAH

UTAH EMISSION STANDARDS - DAVIS COUNTY - DIESEL OPACITY TEST

Application	Opacity %
Light Duty Diesel - Turbo (16,000 GVWR Or Less)	30
Light Duty Diesel - Non-Turbo (16,000 GVWR Or Less)	35

Application	Opacity %
Heavy Duty Diesel (16,000 GVWR Or More)	70

UTAH EMISSION STANDARDS - SALT LAKE COUNTY - DIESEL OPACITY TEST

Application	Opacity %
All Model Years - Turbo (16,000 GVWR Or Less)	30
All Model Years - Non-Turbo (16,000 GVWR Or Less)	35
All Model Years (16,000 GVWR Or More)	70

UTAH EMISSION STANDARDS - UTAH COUNTY - DIESEL OPACITY TEST

Application	Opacity %
All Model Years - Turbo (16,000 GVWR Or Less)	30
All Model Years - Non-Turbo (16,000 GVWR Or Less)	35
All Model Years (16,000 GVWR Or More)	70

WASHINGTON

WASHINGTON EMISSION STANDARDS - DIESEL OPACITY TEST

Application	Opacity %
Light Duty Diesel (8500 GVWR Or Less)	
All Model Years	20
Heavy Duty Diesel (8500 GVWR Or More)	
1991 & Earlier	55
1992 & Newer	40

cardiagn.com

Back To Article

GENERAL INFORMATION

Symptom Check List Worksheets

* PLEASE READ THIS FIRST *

NOTE: **This article is intended for general information purposes only. It does not apply specifically to one make or model.**

PURPOSE

NOTE: **This article is intended for general information purposes only. It does not apply specifically to one make or model.**

WHY USE THE SYMPTOM CHECK LIST WORKSHEETS?

One of the most difficult and critical lines of communication is between the service customer and the technician. The clearer the technician understands the customer's concerns, the more likely the problem will be "fixed right the first time".

The Symptom Check List Worksheets in this article are designed to improve this communication. When used consistently, they can be helpful in reducing shop comebacks, increasing technician productivity, and producing satisfied customers. They also provide other benefits:

- Reduce "No Trouble Found" problems
- Increase customer involvement
- Customer perceive that "they really care and listen"
- Save time during peak write-up periods
- Reduce recontacting customers for additional information
- Improve night drop information
- Insure all the right questions are asked at write-up

cardiagn.com

MAKING THE WORKSHEETS A PART OF YOUR NORMAL ROUTINE

The following information contains ideas that may be helpful in forming habits that promote daily use of the Symptom Check Lists:

- HAVE THE SERVICE ADVISER FILL OUT THE FORM(S) WITH THE CUSTOMER WHENEVER POSSIBLE.
- Place them in your night drop for the customer to fill out, along with an instruction sheet to help them understand what to do.
- Hand out the worksheets to customers while they wait in line during the peak morning rush and ask them to fill it out. It will save time for all concerned and improve the quality of information received from the customer.
- Make sure it is attached to the hard copy when it goes to the technician.
- Place a copy with the final repair papers and review it with the customer at delivery.
- Put a new worksheet in the glovebox of all departing customers.
- Require that you personally see a copy of all worksheets filled out for shop comebacks.
- Hold a shop meeting to get employee buy-in and their ideas on how to make it effective in your shop.

There are many other ways to utilize the concept, but as with every other idea, successful implementation depends on employee involvement and buy-in.

SYMPTOM CHECK LIST WORKSHEETS

CONDENSED VERSION - ALL ON ONE PAGE

NOTE: **Have the service adviser fill out this form with the customer whenever possible.**

DRIVEABILITY WORKSHEET

(To Be Filled Out By Vehicle Owner)

Name: _____ **Date:** _____ **Make:** _____

Model: _____ **Year:** _____ **Engine:** _____ **Mileage:** _____

FAULT CHARACTERISTICS – SYMPTOMS – DESCRIPTION OF PROBLEM (Please Check All That Apply In All Categories)	
Starting Problems	☐ Will Not Crank ☐ Cranks, But Won't Start ☐ Starts, But Takes A Long Time
Engine Quits/ Running Problems	**Quits:** ☐ Right After Starting ☐ When Put Into Gear ☐ Right After Vehicle Comes To A Stop ☐ During Steady Speed Driving ☐ While Idling ☐ During Acceleration ☐ When Parking
Poor Idling Conditions	**Idle Speed:** ☐ Is Too Slow At All Times ☐ Is Too Slow With A/C On ☐ Is Too Fast ☐ Is Rough Or Uneven ☐ Fluctuates Up and Down
Poor Running Conditions	☐ Runs Rough ☐ Lacks Power ☐ Hesitates Or Stumbles On Acceleration ☐ Bucks and Jerks ☐ Engine Knocks, Pings, Rattles ☐ Backfires ☐ Poor Fuel Economy ☐ Misfires or Cuts Out ☐ Surges and/or Chuggles ☐ Dieseling or Run-On ☐ Engine Light Always On ☐ Engine Light On Sometimes ☐ Fuel, Gas, or Sulfur Smell
Auto. Transmission Problems	☐ Improper Shifting (early/late) ☐ Changes Gear Randomly On Its Own ☐ Vehicle Does Not Move When In Gear
Poor Handling	☐ Pulls To One Side ☐ Hard Steering ☐ Vehicle Shakes and/or Vibrates While Moving
Noise Problems	**Explain:**
Odor Problems	**Explain:**
Problem Frequency	☐ Always ☐ Often ☐ Occasionally
Usually Occurs	☐ Morning ☐ Afternoon ☐ Anytime
Engine Temp.	☐ Cold ☐ Warm ☐ Hot
Vehicle Speed	☐ Low ☐ Cruising ☐ High
Driving Conditions During Occurrence	☐ Short – Less Than 2 Miles ☐ 2-10 Miles ☐ Long – More Than 10 Miles ☐ Stop & Go ☐ While Turning ☐ While Braking ☐ At Gear Engagement ☐ With A/C Operating ☐ With Headlights On ☐ During Acceleration ☐ During Deceleration ☐ Mostly Downhill ☐ Mostly Uphill ☐ Mostly Level ☐ Mostly Curvy ☐ Rough Road
Driving Habits	☐ Drive Hard Before Engine Is Warmed ☐ Allow Engine To Warm ☐ Mostly City Driving ☐ Highway ☐ Park Vehicle Inside ☐ Outside **Drive Per Day:** ☐ Less Than 10 Miles ☐ 10-50 ☐ More Than 50 **Fuel Octane:** ☐ 87 ☐ 89 ☐ 91 ☐ More Than 91 **Brand:** _____ ☐ Gasohol ☐ Propane Conversion
Outside Weather	☐ Cold ☐ Warm ☐ Hot ☐ Wet/Rainy ☐ Fog ☐ Snow/Hail ☐ Dust/Dirt ☐ Dry ☐ Humid

cardiagn.com

Fig. 1: Entire Vehicle - Symptom Check List For Customer

FULL VERSION - ALL ON FOUR PAGES

NOTE: **Have the service adviser fill out these forms with the customer whenever possible.**

Dear Valued Customer:
Our goal is to fix your problem correctly and get you back on the road as soon as possible in the unlikely event you experience a problem with your vehicle. Help us identify the exact nature of the concern by taking a few moments to complete the appropriate section of this diagnostic worksheet. Thank you.

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO.:**

DIAGNOSTIC WORKSHEET

DRIVEABILITY - ENGINE - AUTOMATIC TRANSMISSION

SYMPTOM (CHECK ALL THAT APPLY)
ENGINE

- ☐ "Service Engine Soon"/"Malfunction Indicator Light" on
- ☐ Hard start/no start (cranks OK)
- ☐ Won't crank
- ☐ Engine stalls
- ☐ Engine miss
- ☐ Miss while driving
- ☐ Hesitates, stumbles or sags
- ☐ Rough idle
- ☐ Idle is too high ☐ Idle is too low
- ☐ Poor power/performance
- ☐ Surge or chuggle, buck - jerk - skip
- ☐ Poor gas mileage ☐ Highway ☐ City
- ☐ Pings, detonates
- ☐ Suphur, rotten egg odor
- ☐ Backfires (popping noise) - underhood/tailpipe
- ☐ Exhaust smoke ☐ Increased oil consumption
- ☐ Runs on after key is turned off
- ☐ Speed fluctuates without moving accelerator
- ☐ Engine noise (explain): _____

_____

_____

(whine, rattle, groan, clunk, etc)

- ☐ Other: _____

_____

_____

TRANSMISSION

- ☐ Does not shift properly ☐ Hard shift
- ☐ Will not shift ☐ Up ☐ Down
- ☐ Will not shift into overdrive
- ☐ Engine starts in other than "P" or "N"
- ☐ Noise (describe): _____

_____

_____

(whine, rattle, groan, clunk, buzz, etc.)

- ☐ Shifts into gear too early
- ☐ Overdrive doesn't work with speed control, but is otherwise OK
- ☐ Highway speed - shudder, surge, etc.
- ☐ Other: _____

_____

_____

EXPLAIN: _____

_____

_____

OPERATING CONDITIONS (CHECK ALL THAT APPLY)
HOW OFTEN DOES IT OCCUR? (Engine and/or Transmission)

- ☐ Always ☐ Few seconds ☐ Few minutes
- ☐ Few hours ☐ Few days ☐ Few weeks
- ☐ Few months ☐ Variable ☐ Only during event
- ☐ Every _____ to ___ miles ☐ Unknown
- ☐ Other (explain): _____
- ☐ Just started ☐ Getting better ☐ Getting worse
- ☐ Since new

WHEN DOES IT OCCUR? (Engine and/or Transmission)
When Engine Temperature is:

- ☐ Cold ☐ Warm ☐ Hot
- ☐ All the time ☐ Only during warmup

Weather Conditions:

- ☐ Very cold - below 0 degrees F ☐ Cold - 0 to 32 degrees F
- ☐ Cool - 32 to 60 degrees F ☐ Warm - 60 to 80 degrees F
- ☐ Hot - Above 80 degrees F ☐ Any environment
- ☐ Raining ☐ Dry ☐ Humid
- ☐ Snow/ice ☐ Wet roads ☐ Other (explain below)

Driving Conditions:

- ☐ Light throttle ☐ Medium throttle ☐ Hard throttle
- ☐ Starting ☐ At idle ☐ Decelerating
- ☐ Over bumps ☐ When shifting ☐ While turning
- ☐ Cruising steady at _____ MPH ☐ While braking
- ☐ Anytime ☐ Uphill ☐ Downhill
- ☐ Highway ☐ City/town ☐ Stop and go
- ☐ Between _____ MPH and _____ MPH
- ☐ Only with A/C or Defrost on

What Type of Fuel? **What Brand?** _____

- ☐ Regular UL ☐ Mid range UL ☐ Premium Unleaded
- ☐ Gasohol ☐ Ethanol ☐ Methanol
- ☐ Diesel #1 ☐ Diesel #2 ☐ Various brands

When Gear Selector is in:

- ☐ Park/Neutral ☐ Reverse ☐ Overdrive
- ☐ Drive/3 ☐ Drive/2 ☐ Drive/1

Between Gears:

- ☐ Park to R or D ☐ Rev/Drive ☐ First/Second
- ☐ Second/Third ☐ Third/Overdrive

50G15061

mitsudiagn.com

[Fig. 2: Symptom Check List - Page 1]

BRAKES - STEERING - SUSPENSION

SYMPTOM

- ☐ Vehicle pulls right - When _____
- ☐ Vehicle pulls left - When _____
- ☐ Steering wheel vibrates at ____ MPH
- ☐ Excessive play in steering
- ☐ Erratic steering when braking
- ☐ Poor steering wheel return after cornering
- ☐ Suspension bottoms out
- ☐ Leans or sways in corners
- ☐ Brake light on
- ☐ Traction control light on
- ☐ Uneven tire wear
- ☐ Sits uneven
- ☐ "Dog" tracks
- ☐ ABS light on
- ☐ Soft ride

Hard to steer

- ☐ Effort
- ☐ Wanders
- ☐ Steering wheel off center

Shimmy/vibration (check box below for location)

- ☐ Front
- ☐ Rear
- ☐ Don't know
- ☐ Seat
- ☐ Floor
- ☐ Other _____

Brake pedal

- ☐ Noise
- ☐ Pulses
- ☐ Squeaks
- ☐ Hard
- ☐ Mushy
- ☐ Excessive travel

WHEN DOES IT OCCUR?

- ☐ Cold days
- ☐ Hot days
- ☐ Wet/rain
- ☐ All the time
- ☐ Intermittent
- ☐ Parking manuevers
- ☐ At road speed
- ☐ Accelerating
- ☐ Decelerating

EXPLAIN: _____

SQUEAK - RATTLE - NOISE CONDITIONS

AREA OF NOISE

☐ Engine Compartment	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Front Suspension	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Rear Suspension	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Passenger Compartment	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Instrument Panel	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Doors	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Rear seat area	☐ Console	☐ Other _____		

NOISE SOUNDS LIKE

- ☐ Knocks
- ☐ Hard metal
- ☐ Light metal
- ☐ Roars
- ☐ Ticking
- ☐ Whine
- ☐ Squeaks
- ☐ Rattles
- ☐ Scraping
- ☐ Other _____

HOW OFTEN DOES IT OCCUR?

- ☐ Continuous
- ☐ Often
- ☐ Intermittent
- ☐ Just started
- ☐ Since new

WHEN DOES IT OCCUR?

- ☐ All the time
- ☐ Speed
- ☐ RPM
- ☐ Only moving
- ☐ On turns
- ☐ Braking
- ☐ Hard throttle
- ☐ Light throttle
- ☐ Decelerate
- ☐ Steady speed
- ☐ Idle in gear
- ☐ Idle out of gear
- ☐ Hot days
- ☐ Cold days
- ☐ Humid or rainy
- ☐ Temperature _____
- ☐ Heavy bumps
- ☐ Light bumps
- ☐ Smooth pavement

EXPLAIN: _____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:

VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50H15062

cardiagn.com

[Fig. 3: Symptom Check List - Page 2]

AIR CONDITIONING - HEATER - VENTILATION

SYSTEM OR AREA AFFECTED

☐ Air conditioner ☐ Heater ☐ Defroster ☐ Vent ☐ Bi-Level ☐ Fan/blower
☐ Max A/C ☐ Automatic Temperature Control ☐ Mix/blend ☐ Economy ☐ All

SYMPTOM

☐ Does not work ☐ Blows wrong temperature air ☐ No air comes out of vents ☐ Rapid cycling
☐ Noisy (explain) ☐ Broken ☐ Odor ☐ Air comes from wrong outlets ☐ Blows fuse
☐ Leaks ☐ Insufficient heat or cool ☐ Other (explain below)

WHEN DOES IT OCCUR?

☐ All the time ☐ Hot ☐ Cold ☐ Intermittent ☐ Right after startup
☐ When change controls only ☐ Other (explain below) ☐ Fan blower speed High / Med / Low

EXPLAIN: _____

_____

ELECTRICAL - RADIO - TAPE/CD PLAYER

SYMPTOM - MUSIC SYSTEM

☐ Does not work ☐ Noisy ☐ Static ☐ Won't load ☐ Won't eject ☐ Poor reception
☐ Controls do not work ☐ Blows fuse ☐ Other (explain below)

SYSTEM AFFECTED

☐ Radio only ☐ AM ☐ FM ☐ FM stereo ☐ Graphic equalizer
☐ Tape player ☐ CD player ☐ Whole system ☐ Steering wheel buttons ☐ Phone
☐ Speakers ☐ Front ☐ Rear ☐ Left ☐ Right
☐ Antenna ☐ Clock ☐ Radio or player controls ☐ Rear seat controls

ALL OTHER ELECTRICAL ITEMS OR ACCESSORIES
Please list the complaint accessory or item and check any applicable symptom(s) from the list that follows:

_____ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

_____ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

_____ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)

WHEN DOES IT OCCUR? ☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

☐ All the time ☐ Hot ☐ Cold ☐ Just after starting - malfunctions for a while
☐ Intermittent ☐ After runs for _____ minutes ☐ Rough roads or bumps only
☐ Other (explain below)

EXPLAIN: _____

_____

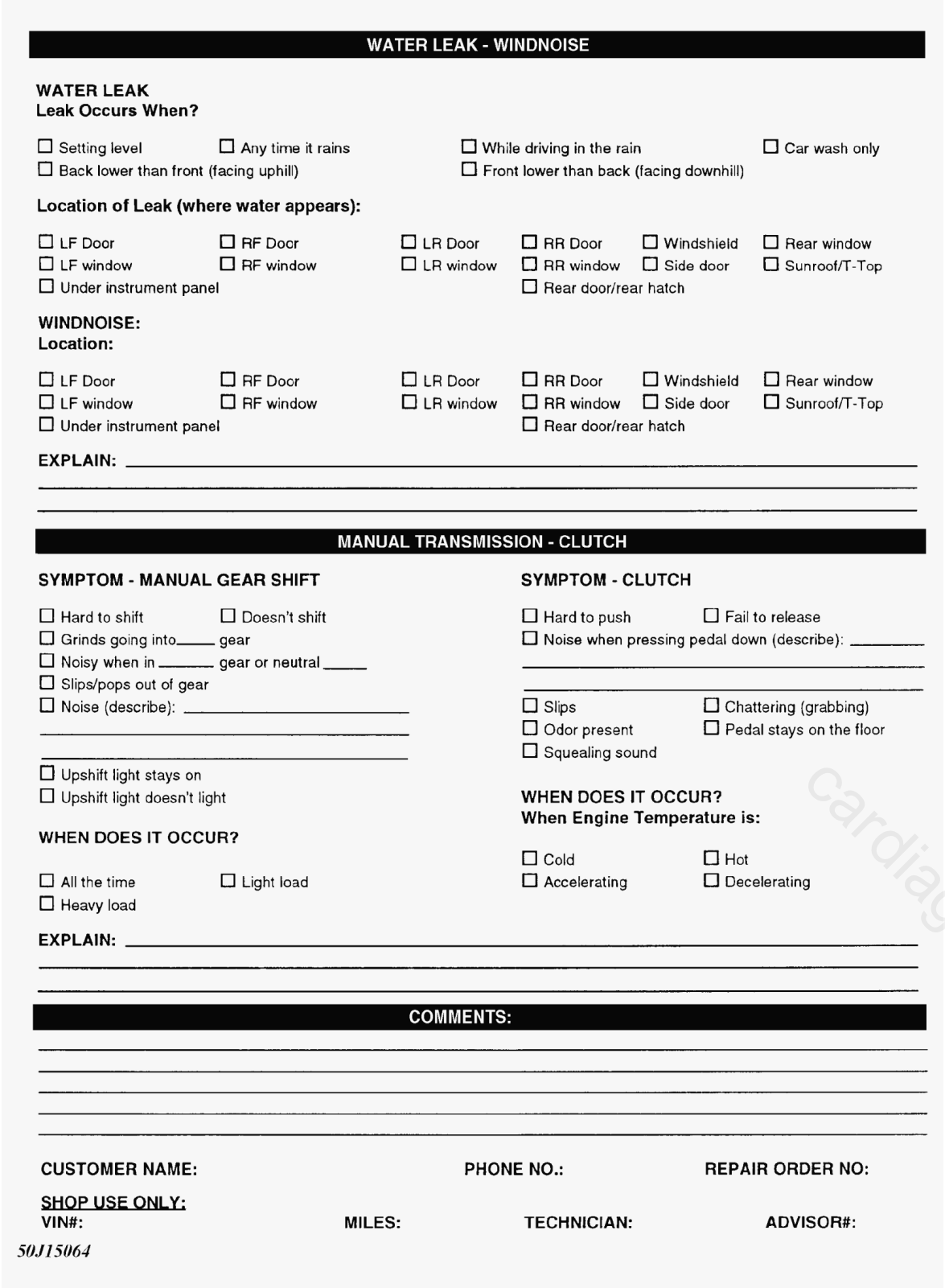
CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50I15063

cardiagn.com

Fig. 4: Symptom Check List - Page 3



WATER LEAK - WINDNOISE

WATER LEAK
Leak Occurs When?

☐ Setting level ☐ Any time it rains ☐ While driving in the rain ☐ Car wash only
☐ Back lower than front (facing uphill) ☐ Front lower than back (facing downhill)

Location of Leak (where water appears):

☐ LF Door ☐ RF Door ☐ LR Door ☐ RR Door ☐ Windshield ☐ Rear window
☐ LF window ☐ RF window ☐ LR window ☐ RR window ☐ Side door ☐ Sunroof/T-Top
☐ Under instrument panel ☐ Rear door/rear hatch

WINDNOISE:
Location:

☐ LF Door ☐ RF Door ☐ LR Door ☐ RR Door ☐ Windshield ☐ Rear window
☐ LF window ☐ RF window ☐ LR window ☐ RR window ☐ Side door ☐ Sunroof/T-Top
☐ Under instrument panel ☐ Rear door/rear hatch

EXPLAIN: _____

MANUAL TRANSMISSION - CLUTCH

SYMPTOM - MANUAL GEAR SHIFT

☐ Hard to shift ☐ Doesn't shift
☐ Grinds going into____ gear
☐ Noisy when in _____ gear or neutral _____
☐ Slips/pops out of gear
☐ Noise (describe): _____
☐ Upshift light stays on
☐ Upshift light doesn't light

WHEN DOES IT OCCUR?

☐ All the time ☐ Light load
☐ Heavy load

SYMPTOM - CLUTCH

☐ Hard to push ☐ Fail to release
☐ Noise when pressing pedal down (describe): _____
☐ Slips ☐ Chattering (grabbing)
☐ Odor present ☐ Pedal stays on the floor
☐ Squealing sound

WHEN DOES IT OCCUR?
When Engine Temperature is:

☐ Cold ☐ Hot
☐ Accelerating ☐ Decelerating

EXPLAIN: _____

COMMENTS:

CUSTOMER NAME: PHONE NO.: REPAIR ORDER NO:

SHOP USE ONLY:
VIN#: MILES: TECHNICIAN: ADVISOR#:

50J15064

cardiagn.com

Fig. 5: Symptom Check List - Page 4

INDIVIDUAL SYSTEM-BASED CHECK LISTS

NOTE: **Have the service adviser fill out these forms with the customer whenever possible.**

DRIVEABILITY - ENGINE - AUTOMATIC TRANSMISSION

SYMPTOM (CHECK ALL THAT APPLY)
ENGINE

- ☐ "Service Engine Soon"/Malfunction Indicator Light" on
- ☐ Hard start/no start (cranks OK)
- ☐ Won't crank
- ☐ Engine stalls
- ☐ Engine miss
- ☐ Miss while driving
- ☐ Hesitates, stumbles or sags
- ☐ Rough idle
- ☐ Idle is too high ☐ Idle is too low
- ☐ Poor power/performance
- ☐ Surge or chuggle, buck - jerk - skip
- ☐ Poor gas mileage ☐ Highway ☐ City
- ☐ Ping, detonates
- ☐ Sulphur/rotten egg odor
- ☐ Backfires (popping noise) - underhood/tailpipe
- ☐ Exhaust smoke ☐ Increased oil consumption
- ☐ Runs on after key is turned off
- ☐ Speed fluctuates without moving accelerator
- ☐ Engine noise (explain): _____

(whine, rattle, groan, clunk, etc.)

- ☐ Other: _____

TRANSMISSION

- ☐ Does not shift properly ☐ Hard shift
- ☐ Will not shift ☐ Up ☐ Down
- ☐ Will not shift into overdrive
- ☐ Engine starts in other than "P" or "N"
- ☐ Noise (describe): _____

(whine, rattle, groan, clunk, buzz, etc.)

- ☐ Shifts into next gear too early
- ☐ Overdrive doesn't work with speed control, but is otherwise OK
- ☐ Highway speed - shudder, surge, etc.
- ☐ Other: _____

EXPLAIN: _____

OPERATING CONDITIONS (CHECK ALL THAT APPLY)
HOW OFTEN DOES IT OCCUR? (Engine &/or Transmission)

- ☐ Always ☐ Few Seconds ☐ Few minutes
- ☐ Few hours ☐ Few days ☐ Few weeks
- ☐ Few months ☐ Variable ☐ Only during event
- ☐ Every _____ to ____ miles ☐ Unknown
- ☐ Other (explain): _____
- ☐ Just started ☐ Getting better ☐ Getting worse
- ☐ Since new

WHEN DOES IT OCCUR? (Engine and/or Transmission)
When Engine Temperature is:

- ☐ Cold ☐ Warm ☐ Hot
- ☐ All the time ☐ Only during warmup

Weather Conditions:

- ☐ Very cold - below 0°F ☐ Cold - 0 to 32°F
- ☐ Cool - 32 to 60°F ☐ Warm - 60 to 80°F
- ☐ Hot - above 80°F ☐ Any environment
- ☐ Raining ☐ Dry ☐ Humid
- ☐ Snow/Ice ☐ Wet roads
- ☐ Other (explain): _____

Driving Conditions:

- ☐ Light throttle ☐ Medium throttle ☐ Hard throttle
- ☐ Starting ☐ At idle ☐ Decelerating
- ☐ Over bumps ☐ When shifting ☐ While turning
- ☐ Cruising - steady at MPH ☐ While braking
- ☐ Anytime ☐ Uphill ☐ Downhill
- ☐ Highway ☐ City/town ☐ Stop and go
- ☐ Between ____ MPH and _____ MPH
- ☐ Only with A/C or Defrost on

What Type of Fuel? What Brand?

- ☐ Regular UL ☐ Midrange UL ☐ Premium UL
- ☐ Gasohol ☐ Ethanol ☐ Methanol
- ☐ Diesel #1 ☐ Diesel #2 ☐ Various brands

When Gear Selector is in:

- ☐ Park/Neutral ☐ Reverse ☐ Overdrive
- ☐ Drive/3 ☐ Drive/2 ☐ Drive/1

Between Gears:

- ☐ Park to R or D ☐ Reverse/Drive ☐ First/Second
- ☐ Second/Third ☐ Third/Overdrive

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:

VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50H15054

cardiagn.com

Fig. 6: Engine Driveability & Automatic Transmission

BRAKES - STEERING - SUSPENSION

SYMPTOM

- ☐ Vehicle pulls right - When _____
- ☐ Vehicle pulls left - When _____
- ☐ Steering wheel vibrates at ____ MPH
- ☐ Excessive play in steering
- ☐ Erratic steering when braking
- ☐ Poor steering wheel return after cornering
- ☐ Suspension bottoms out
- ☐ Leans or sways in corners
- ☐ Brake light on
- ☐ Traction control light on
- ☐ Uneven tire wear
- ☐ Sits uneven
- ☐ "Dog" tracks
- ☐ ABS light on
- ☐ Soft ride

Hard to steer

- ☐ Effort
- ☐ Wanders
- ☐ Steering wheel off center

Shimmy/vibration (check box below for location)

- ☐ Front
- ☐ Rear
- ☐ Don't know
- ☐ Seat
- ☐ Floor
- ☐ Other _____

Brake pedal

- ☐ Noise
- ☐ Pulses
- ☐ Squeaks
- ☐ Hard
- ☐ Mushy
- ☐ Excessive travel

WHEN DOES IT OCCUR?

- ☐ Cold days
- ☐ Hot days
- ☐ Wet/rain
- ☐ All the time
- ☐ Intermittent
- ☐ Parking manuevers
- ☐ At road speed
- ☐ Accelerating
- ☐ Decelerating

EXPLAIN: _____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50C15059

cardiagn.com

Fig. 7: Brakes, Steering, & Suspension

AIR CONDITIONING - HEATER - VENTILATION

SYSTEM OR AREA AFFECTED

- ☐ Air conditioner
- ☐ Heater
- ☐ Defroster
- ☐ Vent
- ☐ Bi-Level
- ☐ Fan/blower
- ☐ Max A/C
- ☐ Automatic Temperature Control
- ☐ Mix/blend
- ☐ Economy
- ☐ All

SYMPTOM

- ☐ Does not work
- ☐ Blows wrong temperature air
- ☐ No air comes out of vents
- ☐ Rapid cycling
- ☐ Noisy (explain)
- ☐ Broken
- ☐ Odor
- ☐ Air comes from wrong outlets
- ☐ Blows fuse
- ☐ Leaks
- ☐ Insufficient heat or cool
- ☐ Other (explain below)

WHEN DOES IT OCCUR?

- ☐ All the time
- ☐ Hot
- ☐ Cold
- ☐ Intermittent
- ☐ Right after startup
- ☐ When change controls only
- ☐ Other (explain below)
- ☐ Fan blower speed High / Med / Low

EXPLAIN: _____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50A15057

Fig. 8: Air Conditioning, Heater & Ventilation

ELECTRICAL - RADIO - TAPE/CD PLAYER

SYMPTOM - MUSIC SYSTEM

☐ Does not work ☐ Noisy ☐ Static ☐ Won't load ☐ Won't eject ☐ Poor reception
☐ Controls do not work ☐ Blows fuse ☐ Other (explain below)

SYSTEM AFFECTED

☐ Radio only ☐ AM ☐ FM ☐ FM stereo ☐ Graphic equalizer
☐ Tape player ☐ CD player ☐ Whole system ☐ Steering wheel buttons ☐ Phone
☐ Speakers ☐ Front ☐ Rear ☐ Left ☐ Right
☐ Antenna ☐ Clock ☐ Radio or player controls ☐ Rear seat controls

ALL OTHER ELECTRICAL ITEMS OR ACCESSORIES
Please list the complaint accessory or item and check any applicable symptom(s) from the list that follows:

_____ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

_____ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

_____ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

WHEN DOES IT OCCUR?

☐ All the time ☐ Hot ☐ Cold ☐ Just after starting - malfunctions for a while
☐ Intermittent ☐ After runs for _____ minutes ☐ Rough roads or bumps only
☐ Other (explain below)

EXPLAIN: _____
_____
_____
_____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50B15058

cardiagn.com

Fig. 9: Electrical, Radio & Tape/CD Player

MANUAL TRANSMISSION - CLUTCH

SYMPTOM - MANUAL GEAR SHIFT

- ☐ Hard to shift
- ☐ Doesn't shift
- ☐ Grinds going into_____ gear
- ☐ Noisy when in _____ gear or neutral _____
- ☐ Slips/pops out of gear
- ☐ Noise (describe): _____
- ☐ Upshift light stays on
- ☐ Upshift light doesn't light

WHEN DOES IT OCCUR?

- ☐ All the time
- ☐ Light load
- ☐ Heavy load

SYMPTOM - CLUTCH

- ☐ Hard to push
- ☐ Fail to release
- ☐ Noise when pressing pedal down (describe): _____
- ☐ Slips
- ☐ Chattering (grabbing)
- ☐ Odor present
- ☐ Pedal stays on the floor
- ☐ Squealing sound

WHEN DOES IT OCCUR?
When Engine Temperature is:

- ☐ Cold
- ☐ Hot
- ☐ Accelerating
- ☐ Decelerating

EXPLAIN: _____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50J15056

cardiagn.com

Fig. 10: Manual Transmission & Clutch

SQUEAK - RATTLE - NOISE CONDITIONS

AREA OF NOISE

☐ Engine Compartment	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Front Suspension	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Rear Suspension	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Passenger Compartment	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Instrument Panel	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Doors	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Rear seat area	☐ Console	☐ Other _____		

NOISE SOUNDS LIKE

- ☐ Knocks
- ☐ Hard metal
- ☐ Light metal
- ☐ Roars
- ☐ Ticking
- ☐ Whine
- ☐ Squeaks
- ☐ Rattles
- ☐ Scraping
- ☐ Other _____

HOW OFTEN DOES IT OCCUR?

- ☐ Continuous
- ☐ Often
- ☐ Intermittent
- ☐ Just started
- ☐ Since new

WHEN DOES IT OCCUR?

- ☐ All the time
- ☐ Speed
- ☐ RPM
- ☐ Only moving
- ☐ On turns
- ☐ Braking
- ☐ Hard throttle
- ☐ Light throttle
- ☐ Decelerate
- ☐ Steady speed
- ☐ Idle in gear
- ☐ Idle out of gear
- ☐ Hot days
- ☐ Cold days
- ☐ Humid or rainy
- ☐ Temperature _____
- ☐ Heavy bumps
- ☐ Light bumps
- ☐ Smooth pavement

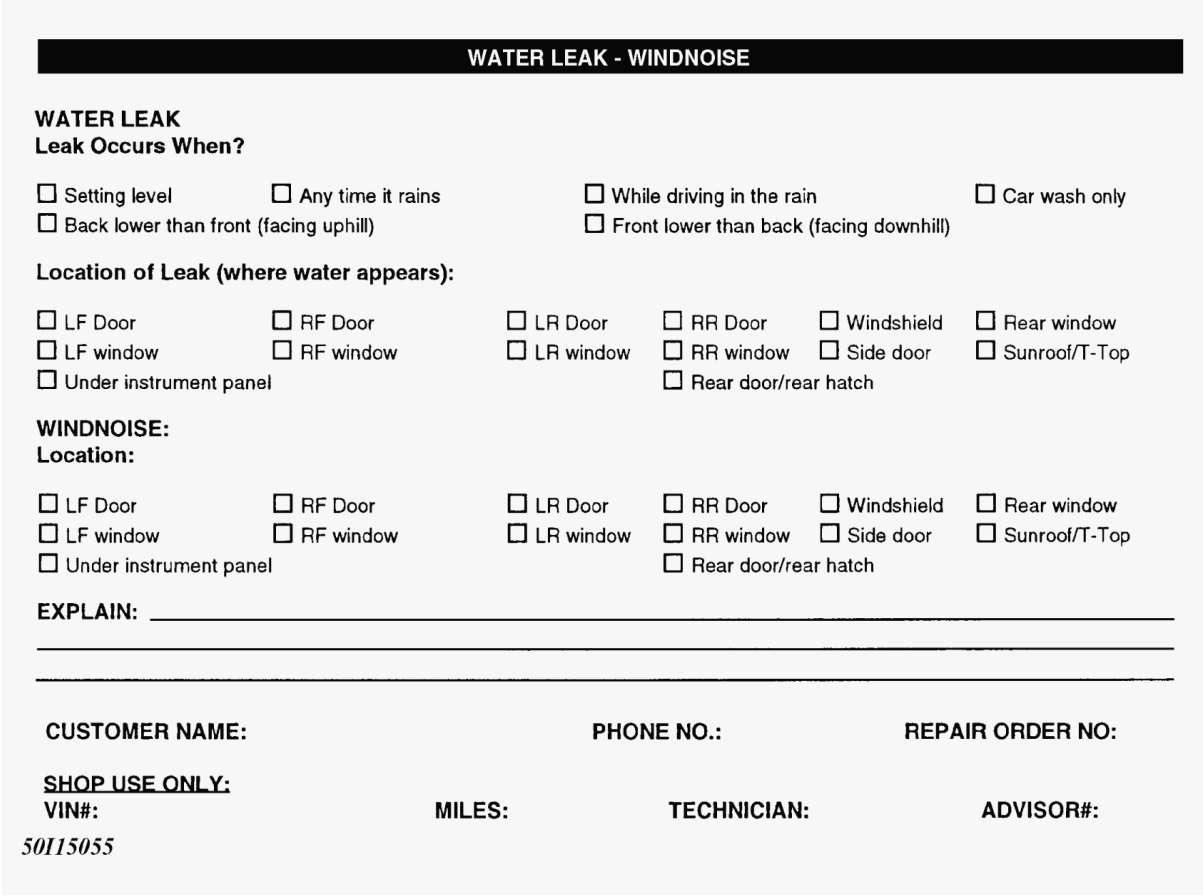
EXPLAIN: _____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50F15060

Fig. 11: Squeak, Rattle, & Noise Conditions



WATER LEAK - WINDNOISE

WATER LEAK
Leak Occurs When?

☐ Setting level ☐ Any time it rains ☐ While driving in the rain ☐ Car wash only
☐ Back lower than front (facing uphill) ☐ Front lower than back (facing downhill)

Location of Leak (where water appears):

☐ LF Door ☐ RF Door ☐ LR Door ☐ RR Door ☐ Windshield ☐ Rear window
☐ LF window ☐ RF window ☐ LR window ☐ RR window ☐ Side door ☐ Sunroof/T-Top
☐ Under instrument panel ☐ Rear door/rear hatch

WINDNOISE:
Location:

☐ LF Door ☐ RF Door ☐ LR Door ☐ RR Door ☐ Windshield ☐ Rear window
☐ LF window ☐ RF window ☐ LR window ☐ RR window ☐ Side door ☐ Sunroof/T-Top
☐ Under instrument panel ☐ Rear door/rear hatch

EXPLAIN: _____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50I15055

Fig. 12: Water Leak & Wind Noise

cardiagn.com

Back To Article

GENERAL INFORMATION

Trouble Shooting - Basic Procedures

* PLEASE READ THIS FIRST *

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

ACCESSORIES & ELECTRICAL

CHARGING SYSTEM TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

BASIC CHARGING SYSTEM TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Vehicle Will Not Start	
Dead battery	Check battery cells, alternator belt tension and alternator output
Loose or corroded battery connections	Check all charging system connections
Ignition circuit or switch malfunction	Check and replace as necessary
Alternator Light Stays On With Engine Running	
Loose or worn alternator drive belt	Check alternator drive tension and condition, See Belt Adjustment in TUNE-UP article in the TUNE-UP section
Loose alternator wiring connections	Check all charging system connections
Short in alternator light wiring	See Indicator Warning Lights in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Defective alternator stator or diodes	See Bench Tests in ALTERNATOR article

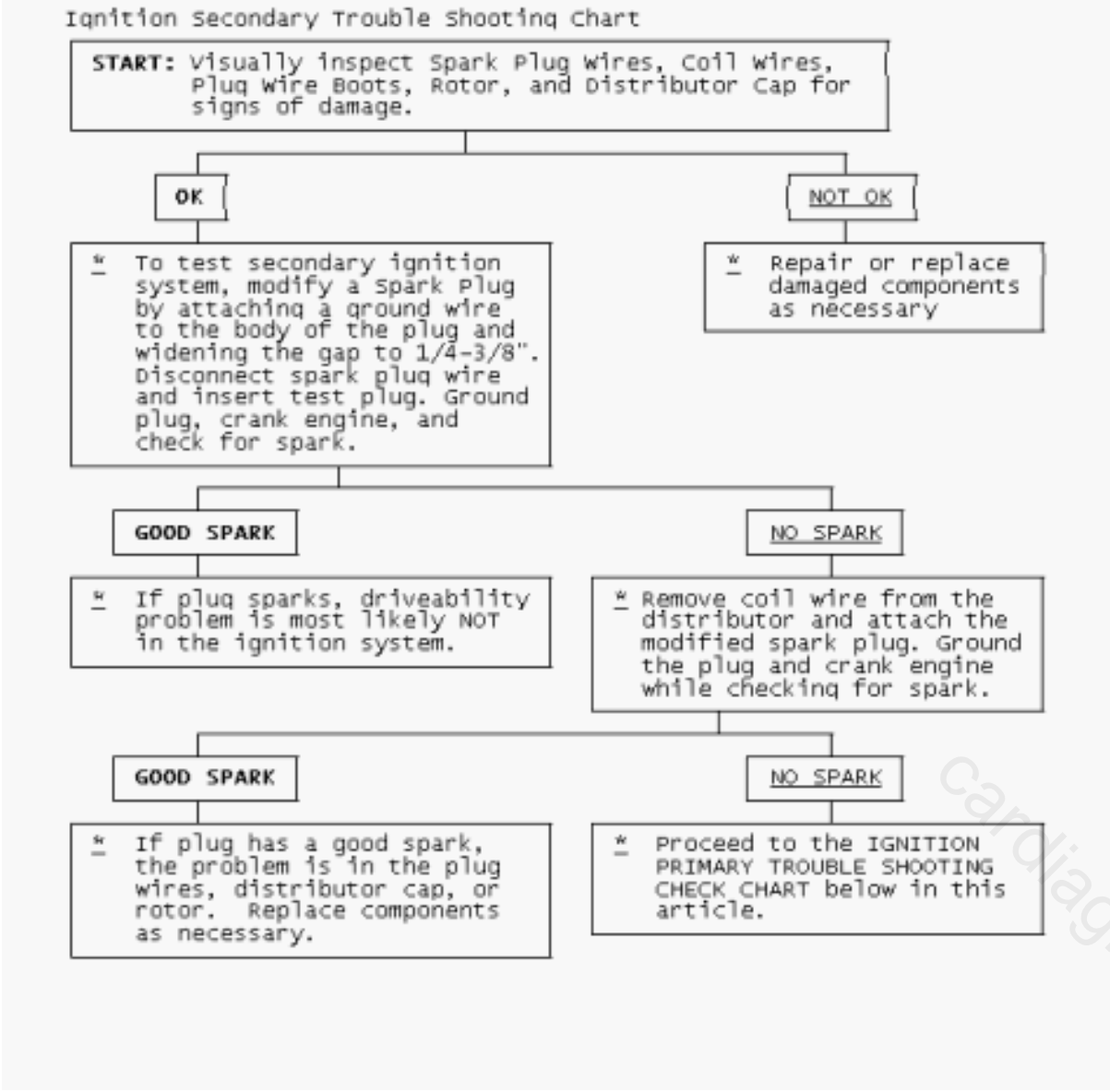
CONDITION & POSSIBLE CAUSE	CORRECTION
Defective regulator	See Regulator Check in ALTERNATOR article
Alternator Light Stays Off With Ignition Switch ON	
Blown fuse	See WIRING DIAGRAMS
Defective alternator	See Testing in ALTERNATOR article
Defective indicator light bulb or socket	See Indicator Warning Lights in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Alternator Light Stays OFF With Ignition Switch ON	
Short in alternator wiring	See On-Vehicle Tests in ALTERNATOR article
Defective rectifier bridge	See Bench Tests in ALTERNATOR article
Lights or Fuses Burn Out Frequently	
Defective alternator wiring	See On-Vehicle Tests in ALTERNATOR article
Defective regulator	See Regulator Check in ALTERNATOR article
Defective battery	Check and replace as necessary
Ammeter Gauge Shows Discharge	
Loose or worn drive belt	Check alternator drive belt tension and condition. See Belt Adjustment in TUNE-UP article in the TUNE-UP section
Defective wiring	Check all wires and wire connections
Defective alternator or regulator	See Bench Tests and On-Vehicle Tests in ALTERNATOR article
Defective ammeter, or improper ammeter wiring connection	See Testing in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Noisy Alternator	
Loose drive pulley	Tighten drive pulley attaching nut
Loose mounting bolts	Tighten all alternator mounting bolts
Worn or dirty bearings	See Bearing Replacement ALTERNATOR article
Defective diodes or stator	See Bench Test in ALTERNATOR article
Battery Does Stay Charged	
Loose or worn drive belt	Check alternator drive belt tension and condition. See Belt Adjustment in appropriate TUNE-UP article in the TUNE-UP section
Loose or corroded battery connections	Check all charging system connections

CONDITION & POSSIBLE CAUSE	CORRECTION
Loose alternator connections	Check all charging system connections
Defective alternator or battery	See On-Vehicle Tests and Bench Tests in ALTERNATOR article
Add-on electrical accessories exceeding alternator capacity	Install larger alternator
Battery Overcharged-Uses Too Much Water	
Defective battery	Check alternator output and repair as necessary
Defective alternator	See On-Vehicle Test and Bench Tests in ALTERNATOR article
Excessive alternator voltage	Check alternator output and repair as necessary

IGNITION SYSTEM TROUBLE SHOOTING

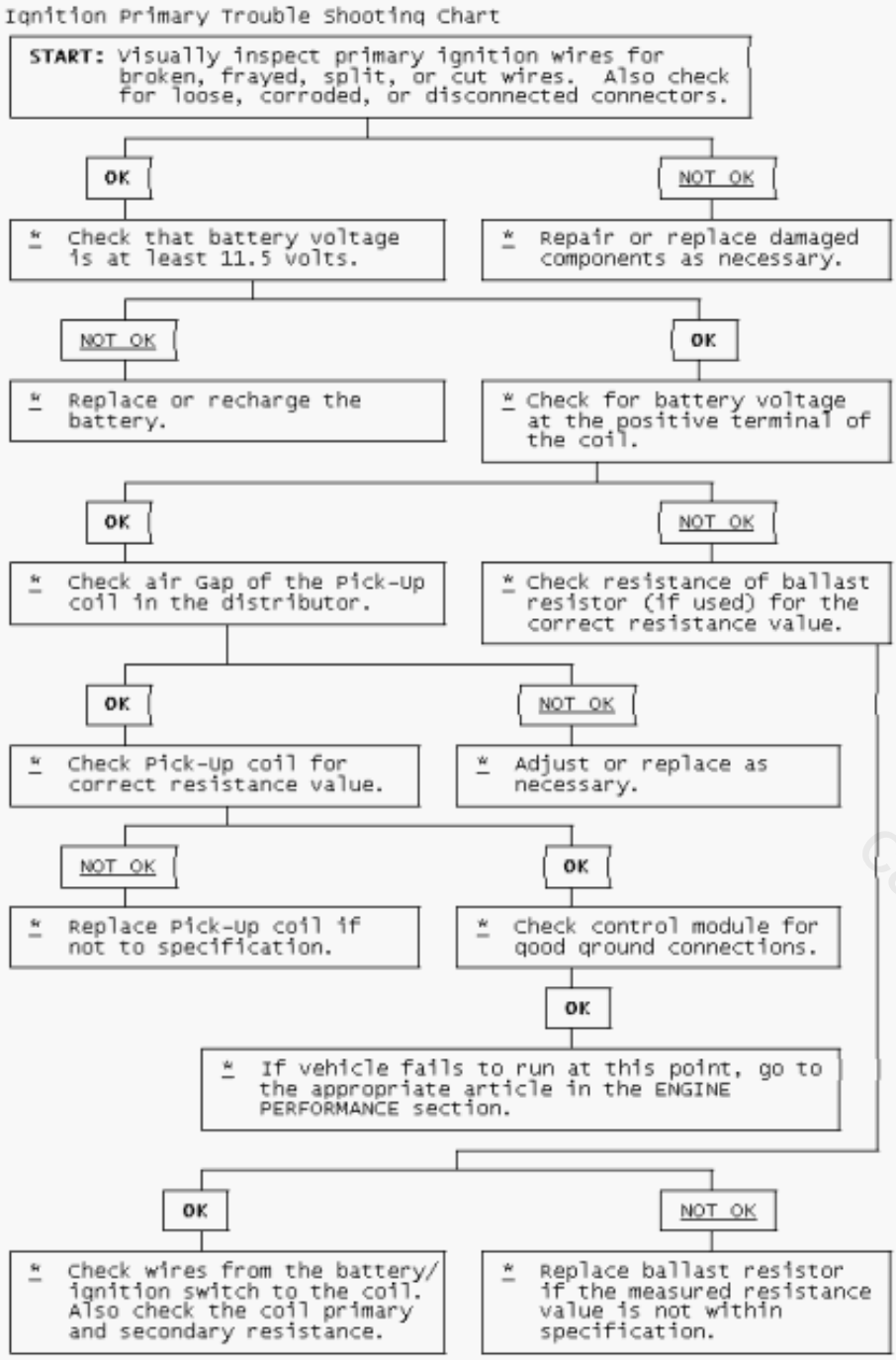
NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

cardiagn.com



cardiagn.com

Fig. 1: Ignition Secondary Trouble Shooting Chart



cardiagn.com

Fig. 2: Ignition Primary Trouble Shooting Chart

STARTER TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

BASIC STARTER TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Starter Fails to Operate	

CONDITION & POSSIBLE CAUSE	CORRECTION
Dead battery or bad connections between starter and battery	Check battery charge and all wires and connections to starter
Ignition switch faulty or misadjusted	Adjust or replace ignition switch
Open circuit between starter switch ignition terminal on starter relay	Check and repair wires and connections as necessary
Starter relay or starter defective	See Testing in STARTER article
Open solenoid pull-in wire	Testing in STARTER article
Starter Does Not Operate and Headlights Dim	
Weak battery or dead cell	Charge or replace battery as necessary
Loose or corroded battery connections	Check that battery connections are clean and tight
Internal ground in starter windings	See Testing in STARTER article
Grounded starter fields	See Testing in STARTERS
Armature rubbing on pole	See STARTER article shoes
Starter Turns but Engine Does Not Rotate	
Starter clutch slipping	See STARTER article
Broken clutch housing	See STARTER article
Pinion shaft rusted or dry	See STARTER article
Engine basic timing incorrect	See Ignition Timing in TUNE-UP article
Broken teeth on engine flywheel	Replace flywheel and check for starter pinion gear damage
Starter Will Not Crank Engine	
Faulty overrunning clutch	See STARTER article
Broken clutch housing	See STARTER article
Broken flywheel teeth	Replace flywheel and check for starter pinion gear damage
Armature shaft sheared or reduction gear teeth stripped	See STARTER article
Weak battery	Charge or replace battery as necessary
Faulty solenoid	See On-Vehicle Tests in STARTER article
Poor grounds	Check all ground connections for tight and clean connections
Ignition switch faulty or misadjusted	Adjust or replace ignition switch as necessary
Starter Cranks Engine Slowly	
Battery weak or defective	Charge or replace battery as necessary
Engine overheated	See ENGINE COOLING SYSTEM article
Engine oil too heavy	Check that proper viscosity oil is used

CONDITION & POSSIBLE CAUSE	CORRECTION
Poor battery-to-starter connections	Check that all between battery and starter are clean and tight
Current draw too low or too high	See Bench Tests in STARTER article
Bent armature, loose pole shoes screws or worn bearing	See STARTER article
Burned solenoid contacts	Replace solenoid
Faulty starter	Replace starter
Starter Engages Engine Only Momentarily	
Engine timing too far advanced	See Ignition Timing in TUNE-UP article
Overrunning clutch not engaging properly	Replace overrunning clutch. See STARTER article
Broken starter clutch	See STARTER article
Broken teeth on engine flywheel	Replace flywheel and check starter pinion gear for damage
Weak drive assembly thrust spring	See STARTER article
Weak hold-in coil	See Bench Tests in STARTER article
Starter Drive Will Not Engage	
Defective point assembly	See Testing in STARTER article
Poor point assembly ground	See Testing in STARTER article
Defective pull-in coil	Replace starter solenoid
Starter Relay Does Not Close	
Dead battery	Charge or replace battery as necessary
Faulty wiring	Check all wiring and connections leading to relay
Neutral safety switch faulty	Replace neutral safety switch
Starter relay faulty	Replace starter relay
Starter Drive Will Not Disengage	
Starter motor loose on mountings	Tighten starter attach bolts
Worn drive end bushing	See STARTER article
Damaged engine flywheel teeth	Replace flywheel and starter pinion gear for damage
Drive yolk return spring broken or missing	Replace return spring
Faulty ignition switch	Replace ignition switch
Insufficient clearance between winding leads to solenoid terminal and main contact in solenoid	Replace starter solenoid
Starter clutch not disengaging	Replace starter clutch
Ignition starter switch	Replace ignition switch contacts sticking
Starter Relay Operates but Solenoid Does Not	
Faulty solenoid switch, switch connections or relay	Check all wiring between relay and solenoid or replace relay or solenoid as necessary

carlsign.com

CONDITION & POSSIBLE CAUSE	CORRECTION
Broken lead or loose soldered connections	Repair wire or wire connections as necessary
Solenoid Plunger Vibrates When Switch is Engaged	
Weak battery	Charge or replace battery as necessary
Solenoid contacts corroded	Clean contacts or replace solenoid
Faulty wiring	Check all wiring leading to solenoid
Broken connections inside switch cover	Repair connections or replace solenoid
Open hold-in wire	solenoid
Low Current Draw	
Worn brushes or weak brush springs	Replace brushes or brush springs as necessary
High Pitched Whine During Cranking Before Engine Fires but Engine Fires and Cranks Normally	
Distance too great between starter pinion and flywheel	Align starter or check that correct starter and flywheel are being used
High Pitched Whine After Engine Fires With Key released. Engine Fires and Cranks Normally	
Distance too small between starter pinion and flywheel	Flywheel runout contributes to the intermittent nature

AIR CONDITIONING & HEAT

AIR CONDITIONING TROUBLE SHOOTING

WARNING: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

BASIC AIR CONDITIONING TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Compressor Not Working	Compressor clutch circuit open.
.....	Compressor clutch coil inoperative.
.....	Poor clutch ground connection.
.....	Fan belts loose.
.....	Thermostatic switch inoperative.
.....	Thermostatic switch not adjusted.
.....	Ambient temperature switch open.
.....	Superheat fuse blown.
Excessive Noise or Vibration	Missing or loose mounting bolts.
.....	Bad idler pulley bearings.
.....	Fan belts not tightened correctly.
.....	Compressor clutch contacting body.
.....	Excessive system pressure.
.....	Compressor oil level low.
.....	Damaged clutch bearings.
.....	Damaged reed valves.
.....	Damaged compressor.

Cardiagn.com

CONDITION	POSSIBLE CAUSE
Insufficient or No Cooling; Compressor Working	Expansion valve inoperative.
.....	Heater control valve stuck open.
.....	Low system pressure.
.....	Blocked condenser fins.
.....	Blocked evaporator fins.
.....	Vacuum system leak.
.....	Vacuum motors inoperative.
.....	Control cables improperly adjusted.
.....	Restricted air inlet.
.....	Mode doors binding.
.....	Blower motor inoperative.
.....	Temperature above system capacity.

HEATER SYSTEM TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

BASIC HEATER SYSTEM TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Insufficient, Erratic, or No Heat	Low Coolant Level
.....	Incorrect thermostat.
.....	Restricted coolant flow through core.
.....	Heater hoses plugged.
.....	Misadjusted control cable.
.....	Sticking heater control valve.
.....	Vacuum hose leaking.
.....	Vacuum hose blocked.
.....	Vacuum motors inoperative.
.....	Blocked air inlet.
.....	Inoperative heater blower motor.
.....	Oil residue on heater core fins.
.....	Dirt on heater core fins.
Too Much Heat	Improperly adjusted cables.
.....	Sticking heater control valve.
.....	No vacuum to heater control valve.
.....	Temperature door stuck open.
Air Flow Changes During Acceleration	Vacuum system leak.
.....	Bad check valve or reservoir.
Air From Defroster At All Times	Vacuum system leak.
.....	Improperly adjusted control cables.
.....	Inoperative vacuum motor.
Blower Does Not Operate Correctly	Blown fuse.
.....	Blower motor windings open.
.....	Resistors burned out.
.....	Motor ground connection loose.
.....	Wiring harness connections loose.

CONDITION	POSSIBLE CAUSE
.....	Blower motor switch inoperative.
.....	Blower relay inoperative.
.....	Fan binding or foreign object in housing.
.....	Fan blades broken or bent.

BRAKES

BRAKE SYSTEM TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

BRAKE SYSTEM TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Brakes Pull Left or Right	
Incorrect tire pressure	Inflate tires to proper pressure
Front end out of alignment	See WHEEL ALIGNMENT
Mismatched tires	Check tires sizes
Restricted brake lines or hoses	Check hose routing
Loose or malfunctioning caliper	See DISC BRAKES or BRAKE SYSTEM
Bent shoe or oily linings	See DRUM BRAKES or BRAKE SYSTEM
Malfunctioning rear brakes	See DRUM, DISC BRAKES or BRAKE SYSTEM
Loose suspension parts	See SUSPENSION
Noises Without Brakes Applied	
Front linings worn out	Replace linings
Dust or oil on drums or rotors	See DRUM, DISC BRAKES or BRAKE SYSTEM
Noises With Brakes Applied	
Insulator on outboard shoe damaged	See DISC BRAKES or BRAKE SYSTEM
Incorrect pads or linings	Replace pads or linings
Brake Rough, Chatters or Pulsates	
Excessive lateral runout	Check rotor runout
Parallelism not to specifications	Reface or replace rotor
Wheel bearings not adjusted	See SUSPENSION
Rear drums out-of-round	Reface or replace drums
Disc pad reversed, steel against rotor	Remove and reinstall pad
Excessive Pedal Effort	
Malfunctioning power unit	See POWER BRAKES or BRAKE SYSTEM
Partial system failure	Check fluid and pipes
Worn disc pad or lining	Replace pad or lining
Caliper piston stuck or sluggish	See DISC BRAKES or BRAKE SYSTEM

CONDITION & POSSIBLE CAUSE	CORRECTION
Master cylinder piston stuck	See MASTER CYLINDERS or BRAKE SYSTEM
Brake fade due to incorrect pads for linings	Replace pads or linings
Linings or pads glazed	Replace pads or linings
Worn drums	Reface or replace drums
Excessive Pedal Travel	
Partial brake system failure	Check fluid and pipes
Insufficient fluid in master cylinder	See MASTER CYLINDERS or BRAKE SYSTEM
Air trapped in system	See BRAKE BLEEDING or BRAKE SYSTEM
Rear brakes not adjusted	See Adjustments in DRUM BRAKES or BRAKE SYSTEM
Bent shoe or lining	See DRUM BRAKES or BRAKE SYSTEM
Plugged master cylinder cap	See MASTER CYLINDERS or BRAKE SYSTEM
Improper brake fluid	Replace brake fluid
Pedal Travel Decreasing	
Compensating port plugged	See MASTER CYLINDERS or BRAKE SYSTEM
Swollen cup in master cylinder	See MASTER CYLINDERS or BRAKE SYSTEM
Master cylinder piston not returning	See MASTER CYLINDERS or BRAKE SYSTEM
Weak shoe retracting springs	See DRUM BRAKES BRAKE SYSTEM
Wheel cylinder piston sticking	See DRUM BRAKES or BRAKE SYSTEM
Dragging Brakes	
Master cylinder pistons not returning	See MASTER CYLINDERS BRAKE SYSTEM
Restricted brake lines or hoses	Check line routing
Incorrect parking brake adjustment	See DRUM BRAKES BRAKE SYSTEM
Parking Brake cables frozen	See DRUM BRAKES BRAKE SYSTEM
Incorrect installation of inboard disc pad	Remove and replace correctly
Power booster output rod too long	See POWER BRAKE UNITS BRAKE SYSTEM
Brake pedal not returning freely	See DISC, DRUM BRAKES BRAKE SYSTEM
Brakes Grab or Uneven Braking Action	
Malfunction of combination valve	See CONTROL VALVE or BRAKE SYSTEM

CONDITION & POSSIBLE CAUSE	CORRECTION
Malfunction of power brake unit	See POWER BRAKE UNITS or BRAKE SYSTEM
Binding brake pedal	See DISC, DRUM BRAKES or BRAKE SYSTEM
Pulsation or Roughness	
Uneven pad wear caused by caliper	See DISC BRAKES or BRAKE SYSTEM
Uneven rotor wear	See DISC BRAKES or BRAKE SYSTEM
Drums out-of-round	Reface or replace drums

ENGINE MECHANICAL

COOLING SYSTEM TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

COOLING SYSTEM TROUBLE SHOOTING

CONDITION & POSSIBLE CAUSE	CORRECTION
Overheating	
Coolant Leak	Fill/Pressure Test System
A/C Condenser Fins Clogged	Remove/Clean Condenser
Radiator Fins Clogged	Remove/Clean Radiator
Thermostat Stuck Closed	Replace Thermostat
Clogged Cooling System Passages	Clean/Flush Cooling System
Water Pump Malfunction	Replace Water Pump
Fan Clutch Malfunction	Replace Fan Clutch
Retarded Ignition Timing	Reset Ignition Timing
Cooling Fan Malfunction	Test Cooling Fan/Circuit
Cooling Fan Motor Malfunction	Test Fan Motor
Cooling Fan Relay Malfunction	Test Fan Relay
Faulty Radiator Cap	Replace Radiator Cap
Broken/Slipping Fan Belt	Replace Fan Belt
Restricted Exhaust	Repair Exhaust System
Corrosion	
Impurities In Coolant	Clean/Flush System
Coolant Leakage	
Damaged hose	Replace Hose
Leaky Water Pump	Replace Water Pump
Damaged Radiator Seam	Replace/Repair Radiator
Leaky Thermostat Cover	Replace Thermostat Cover
Cylinder Head Problem	Check Head/Head Gasket
Leaky Freeze Plugs	Replace Freeze Plugs
Recovery System Inoperative	
Loose and/or Defective Radiator Cap	Replace Radiator Cap
Overflow Tube Clogged and/or Leaking	Repair Tube

CONDITION & POSSIBLE CAUSE	CORRECTION
Recovery Bottle Vent Restricted	Clean Vent
No Heater Core Flow	
Collapsed Heater Hose	Replace Heater Hose
Plugged Heater Core	Clean/Replace Heater Core
Faulty Heater Valve	Replace Heater Valve

GASOLINE ENGINE - MECHANICAL TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

BASIC GASOLINE ENGINE - MECHANICAL TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Lopes At Idle	
Intake manifold-to-head leaks	Replace manifold gasket, See ENGINES
Blown head gasket	Replace head gasket, See ENGINES
Worn timing gears, chain or sprocket	Replace gears, chain or sprocket
Worn camshaft lobes	Replace camshaft, See ENGINES
Overheated engine	Check cooling system, See COOLING
Blocked crankcase vent valve	Remove restriction
Leaking EGR valve	Repair leak and/or replace valve
Faulty fuel pump	Replace fuel pump
Engine Has Low Power	
Leaking fuel pump	Repair leak and/or replace fuel pump
Excessive piston-to-bore clearance	Install larger pistons, See ENGINES
Sticking valves or weak valve springs	Check valve train components, See ENGINES
Incorrect valve timing	Reset valve timing, See ENGINES
Worn camshaft lobes	Replace camshaft, See ENGINES
Blown head gasket	Replace head gasket. See ENGINES.
Clutch slipping	Adjust pedal and/or replace components, See ENGINES
Engine overheating	Check cooling system, See COOLING
Auto. Trans. pressure regulator valve faulty	Replace pressure regulator valve
Auto. Trans. fluid level too low	Add fluid as necessary

CONDITION & POSSIBLE CAUSE	CORRECTION
Improper vacuum diverter valve operation	Replace vacuum diverter valve
Vacuum leaks	Inspect vacuum system and repair as required
Leaking piston rings	Replace piston rings, See ENGINES
Faulty High Speed Operation	
Low fuel pump volume	Replace fuel pump
Leaking valves or worn	Replace valves and/or springs, See ENGINES
Incorrect valve timing	Reset valve timing,See ENGINES
Intake manifold restricted	Remove restriction
Worn distributor shaft	Replace distributor
Faulty Acceleration	
Improper fuel pump stroke	Remove pump and reset pump stroke
Incorrect ignition timing	Reset ignition timing, See TUNE-UP
Leaking valves	Replace valves, See ENGINES
Worn fuel pump diaphragm or piston	Replace diaphragm or piston
Intake Backfire	
Improper ignition timing	Reset ignition timing, See TUNE-UP
Faulty accelerator pump discharge	Replace accelerator pump
Improper choke operation	Check choke and adjust as required
Defective EGR valve	Replace EGR valve
Fuel mixture too lean	Reset air/fuel mixture, See TUNE-UP
Choke valve initial clearance too large	Reset choke valve initial clearance
Exhaust Backfire	
Vacuum leak	Inspect and repair vacuum system
Faulty vacuum diverter valve	Replace vacuum diverter valve
Faulty choke operation	Check choke and adjust as required
Exhaust system leak	repair exhaust system leak
Engine Detonation	
Ignition timing too far advanced	Reset ignition timing, See TUNE-UP
Faulty ignition system	Check ignition timing, See TUNE-UP
Spark plugs loose or faulty	Retighten or replace plugs
Fuel delivery system clogged	Inspect lines, pump and filter for clog
EGR valve inoperative	Replace EGR valve
PCV system inoperative	Inspect and/or replace hoses or valve
Vacuum leaks	Check vacuum system and repair leaks

CONDITION & POSSIBLE CAUSE	CORRECTION
Excessive combustion chamber deposits	Remove built-up deposits
Leaking, sticking or broken valves	Inspect and/or replace valves
External Oil Leakage	
Fuel pump improperly seated or worn gasket	Remove pump, replace gasket and seat properly
Oil pan gasket broken or pan bent	Straighten pan and replace gasket
Timing chain cover gasket broken	Replace timing chain cover gasket
Rear main oil seal worn	Replace rear main oil seal
Oil pan drain plug not seated properly	Remove and reinstall drain plug
Camshaft bearing drain hole blocked	Remove restriction
Oil pressure sending switch leaking	Remove and reinstall sending switch
Excessive Oil Consumption	
Worn valve stems or guides	Replace stems or guides, See ENGINES
Valve "O" ring seals damaged	Replace "O" ring seals, See ENGINES
Plugged oil drain back holes	Remove restrictions
Improper PCV valve operation	Replace PCV valve
Engine oil level too high	Remove excess oil
Engine oil too thin	Replace thicker oil
Valve stem oil deflectors damaged	Replace oil deflectors
Incorrect piston rings	Replace piston rings, See ENGINES
Piston ring gaps not staggered	Reinstall piston rings, See ENGINES
Insufficient piston ring tension	Replace rings, See ENGINES
Piston ring grooves or oil return	slots clogged Replace piston rings, See ENGINES
Piston rings sticking in grooves	Replace piston rings, See ENGINES
Piston ring grooves excessively worn	Replace piston and rings, See ENGINES
Compression rings installed upside down	Replace compression rings correctly, See ENGINES
Worn or scored cylinder walls	Rebore cylinders or replace block
Mismatched oil ring expander and rail	Replace oil ring expander and rail, See ENGINES
Intake gasket dowels too long	Replace intake gasket dowels
Excessive main or connecting rod bearing clearance	Replace main or connecting rod bearings, See ENGINES
No Oil Pressure	
Low oil level	Add oil to proper level
Oil pressure sender or gauge broken	Replace sender or gauge
Oil pump malfunction	Remove and overhaul oil pump, See ENGINES

CONDITION & POSSIBLE CAUSE	CORRECTION
Oil pressure relief valve sticking	Remove and reinstall valve
Oil pump passages blocked	Overhaul oil pump, See ENGINES
Oil pickup screen or tube blocked	Remove restriction
Loose oil inlet tube	Tighten oil inlet tube
Loose camshaft bearings	Replace camshaft bearings, See ENGINES
Internal leakage at oil passages	Replace block or cylinder head
Low Oil Pressure	
Low engine oil level	Add oil to proper level
Engine oil too thin	Remove and replace with thicker oil
Excessive oil pump clearance	Reduce oil pump clearance, See ENGINES
Oil pickup tube or screen blocked	Remove restrictions
Main, rod or cam bearing clearance excessive	Replace bearing to reduce clearance, See ENGINES
High Oil Pressure	
Improper grade of oil	Replace with proper oil
Oil pressure relief valve stuck closed	Eliminate binding
Oil pressure sender or gauge faulty	Replace sender or gauge
Noisy Main Bearings	
Inadequate oil supply	Check oil delivery to main bearings
Excessive main bearing clearance	Replace main bearings, See ENGINES
Excessive crankshaft end play	Replace crankshaft, See ENGINES
Loose flywheel or torque converter	Tighten attaching bolts
Loose or damaged vibration damper	Tighten or replace vibration damper
Crankshaft journals out-of-round	Re-grind crankshaft journals
Excessive belt tension	Loosen belt tension
Noisy Connecting Rods	
Excessive bearing clearance or missing bearing	Replace bearing, See ENGINES
Crankshaft rod journal out-of-round	Re-grind crankshaft journal
Misaligned connecting rod or cap	Remove rod or cap and realign
Incorrectly tightened rod bolts	Remove and re-tighten rod bolts
Noisy Pistons and Rings	
Excessive piston-to-bore clearance	Install larger pistons, See ENGINES
Bore tapered or out-of-round	Rebore block
Piston ring broken	Replace piston rings, See ENGINES
Piston pin loose or seized	Replace piston pin, See ENGINES
Connecting rods misaligned	Realign connecting rods

CONDITION & POSSIBLE CAUSE	CORRECTION
Ring side clearance too loose or tight	Replace with larger or smaller rings
Carbon build-up on piston	Remove carbon
Noisy Valve Train	
Worn or bent push rods	Replace push rods, See ENGINES
Worn rocker arms or bridged pivots	Replace push rods, See ENGINES
Dirt or chips in valve lifters	Remove lifters and remove dirt/chips
Excessive valve lifter leak-down	Replace valve lifters, See ENGINES
Valve lifter face worn	Replace valve lifters, See ENGINES
Broken or cocked valve springs	Replace or reposition springs
Too much valve stem-to-guide clearance	Replace valve guides, See ENGINES
Valve bent	Replace valve, See ENGINES
Loose rocker arms	Retighten rocker arms, See ENGINES
Excessive valve seat run-out	Reface valve seats, See ENGINES
Missing valve lock	Install new valve lock
Excessively worn camshaft lobes	Replace camshaft, See ENGINES
Plugged valve lifter oil holes	Eliminate restriction or replace lifter
Faulty valve lifter check ball	Replace lifter check ball, See ENGINES
Rocker arm nut installed upside down	Remove and reinstall correctly
Valve lifter incorrect for engine	Remove and replace valve lifters
Faulty push rod seat or lifter plunger	Replace plunger or push rod
Noisy Valves	
Improper valve lash	Re-adjust valve lash, See ENGINES
Worn or dirty valve lifters	Clean and/or replace lifters
Worn valve guides	Replace valve guides, See ENGINES
Excessive valve seat or face run-out	Reface seats or valve face
Worn camshaft lobes	Replace camshaft, See ENGINES
Loose rocker arm studs	Re-tighten rocker arm studs, See ENGINES
Bent push rods	Replace push rods, See ENGINES
Broken valve springs	Replace valve springs, See ENGINES
Burned,Sticking or Broken Valves	
Weak valve springs or warped valves	Replace valves and/or springs, See ENGINES

CONDITION & POSSIBLE CAUSE	CORRECTION
Improper lifter clearance	Re-adjust clearance or replace lifters
Worn guides or improper guide clearance	Replace valve guides, See ENGINES
Out-of-round valve seats or improper seat width	Re-grind valve seats
Gum deposits on valve stems, seats or guide	Remove deposits
Improper spark timing	Re-adjust spark timing
Broken Pistons/Rings	
Undersize pistons	Replace with larger pistons, See ENGINES
Wrong piston rings	Replace with correct rings, See ENGINES
Out-of-round cylinder bore	Re-bore cylinder bore
Improper connecting rod alignment	Remove and realign connecting rods
Excessively worn ring grooves	Replace pistons, See ENGINES
Improperly assembled piston pins	Re-assemble pin-to-piston, See ENGINES
Insufficient ring gap clearance	Install new rings, See ENGINES
Engine overheating	Check cooling system
Incorrect ignition timing	Re-adjust ignition timing, See TUNE-UP
Excessive Exhaust Noise	
Leaks at manifold to head, or to pipe	Replace manifold or pipe gasket
Exhaust manifold cracked or broken	Replace exhaust manifold, See ENGINES

ENGINE PERFORMANCE

CARBURETOR TROUBLE SHOOTING:

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

BASIC COLD START SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start	
Choke not closing	Check choke operation, see FUEL SYSTEMS
Choke linkage bent	Check linkage, see FUEL SYSTEM
Engine Starts, Then Dies	
Choke vacuum kick setting too wide	Check setting and adjust see, FUEL SYSTEMS
Fast idle RPM too low	Reset RPM to specification, see TUNE-UP
Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEMS

CONDITION & POSSIBLE CAUSE	CORRECTION
Vacuum leak	Inspect vacuum system for leaks
Low fuel pump outlet	Repair or replace pump, see FUEL SYSTEMS
Low carburetor fuel level	Check float setting see FUEL SYSTEM
Engine Quits Under Load	
Choke vacuum kick setting incorrect	Reset vacuum kick setting,see FUEL SYSTEMS
Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEM
Incorrect hot fast idle speed RPM	Reset fast idle RPM, see TUNE-UP
Engine Starts, Runs Up, Then Idles, Slowly With Black Smoke	
Choke vacuum kick set too narrow	Reset vacuum kick, see FUEL SYSTEMS
Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEMS
Hot fast idle RPM too low	Reset fast idle RPM, see TUNE-UP

BASIC HOT START SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start	
Engine flooded	Allow fuel to evaporate

BASIC COLD ENGINE DRIVEABILITY SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Stalls in Gear	
Choke vacuum kick setting incorrect	Reset choke vacuum kick, see FUEL SYSTEMS
Fast idle RPM incorrect	Reset fast idle RPM, see TUNE-UP
Fast idle cam index incorrect	Reset fast idle cam see FUEL SYSTEMS
Acceleration Sag or Stall	
Defective choke control switch	Replace choke control switch
Choke vacuum kick setting incorrect	Reset choke vacuum kick see, FUEL SYSTEMS
Float level incorrect (too low)	Adjust float level, FUEL SYSTEMS
Accelerator pump defective	Repair or replace pump see FUEL SYSTEMS
Secondary throttles not closed	Inspect lockout adjustment, see FUEL SYSTEMS
Sag or Stall After Warmup	
Defective choke control switch	Replace choke control switch, see FUEL SYSTEMS
Defective accelerator pump	Replace pump, see FUEL SYSTEMS
Float level incorrect (too low)	Adjust float level, see FUEL SYSTEMS
Backfiring & Black Smoke	

CONDITION & POSSIBLE CAUSE	CORRECTION
Plugged heat crossover system	Remove restriction

BASIC WARM ENGINE DRIVEABILITY SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Hesitation With Small Amount of Gas Pedal Movement	
Vacuum leak	Inspect vacuum lines
Accelerator pump weak or inoperable	Replace pump, see FUEL SYSTEMS
Float level setting too low	Reset float level, see,FUEL SYSTEMS
Metering rods sticking or binding	Inspect and/or replace rods, see FUEL SYSTEMS
Carburetor idle or transfer system plugged	Inspect system and remove restriction
Frozen or binding heated air inlet	Inspect heated air door for binding
Hesitation With Heavy Gas Pedal Movement	
Defective accelerator pump	Replace pump, see FUEL SYSTEMS
Metering rod carrier sticking or binding	Remove restriction
Large vacuum leak	Inspect vacuum system and repair leak
Float level setting too low	Reset float level, see FUEL SYSTEMS
Defective fuel pump, lines or filter	Inspect pump, lines and filter
Air door setting incorrect	Adjust air door setting, see FUEL

DIESEL ENGINE TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

NOTE: **Diesel engines mechanical diagnosis is the same as gasoline engines for items such as noisy valves, bearings, pistons, etc. The following trouble shooting covers only items pertaining to diesel engines.**

BASIC DIESEL ENGINE TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Crank	
Bad battery connections or dead batteries	Check connections and/or replace batteries
Bad starter connections or bad starter	Check connections and/or replace starter
Engine Cranks Slowly, Won't Start	
Bad battery connections or dead batteries	Check connections and/or replace batteries
Engine oil too heavy	Replace engine oil
Engine Cranks Normally, But Will Not Start	
Glow plugs not functioning	Check glow plug system, see FUEL SYSTEMS

CONDITION & POSSIBLE CAUSE	CORRECTION
Glow plug control not functioning	Check controller, see FUEL SYSTEMS
Fuel not injected into cylinders	Check fuel injectors, see FUEL SYSTEMS
No fuel to injection pump	Check fuel delivery system
Fuel filter blocked	Replace fuel filter
Fuel tank filter blocked	Replace fuel tank filter
Fuel pump not operating	Check pump operation and/or replace pump
Fuel return system blocked	Inspect system and remove restriction
No voltage to fuel solenoid	Check solenoid and connections
Incorrect or contaminated fuel	Replace fuel
Incorrect injection pump timing	Re-adjust pump timing, see FUEL SYSTEMS
Low compression	Check valves, pistons, rings, see ENGINES
Injection pump malfunction	Inspect and/or replace injection pump
Engine Starts, Won't Idle	
Incorrect slow idle adjustment	Reset idle adjustment, see TUNE-UP
Fast idle solenoid malfunctioning	Check solenoid and connections
Fuel return system blocked	Check system and remove restrictions
Glow plugs go off too soon	See glow plug diagnosis in FUEL SYSTEMS
Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
No fuel to injection pump	Check fuel delivery system
Incorrect or contaminated fuel	Replace fuel
Low compression	Check valves, piston, rings, see ENGINES
Injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
Fuel solenoid closes in RUN position	Check solenoid and connections
Engines Starts/Idles Rough W/out Smoke or Noise	
Incorrect slow idle adjustment	Reset slow idle, see TUNE-UP
Injection line fuel leaks	Check lines and connections
Fuel return system blocked	Check lines and connections
Air in fuel system	Bleed air from system
Incorrect or contaminated fuel	Replace fuel
Injector nozzle malfunction	Check nozzles, see FUEL SYSTEMS
Engines Starts and Idles Rough W/out Smoke or Noise, But Clears After Warm-Up	
Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
Engine not fully broken in	Put more miles on engine
Air in system	Bleed air from system

CONDITION & POSSIBLE CAUSE	CORRECTION
Injector nozzle malfunction	Check nozzles, see FUEL SYSTEMS
Engine Idles Correctly, Misfires Above Idle	
Blocked fuel filter	Replace fuel filter
Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
Incorrect or contaminated fuel	Replace fuel
Engine Won't Return To Idle	
Fast idle adjustment incorrect	Reset fast idle, see TUNE-UP
Internal injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
External linkage binding	Check linkage and remove binding
Fuel Leaks On Ground	
Loose or broken fuel line	Check lines and connections
Internal injection pump seal leak	Replace injection pump, see FUEL SYSTEMS
Cylinder Knocking Noise	
Injector nozzles sticking open	Test injectors, see FUEL SYSTEMS
Very low nozzle opening pressure	Test injectors and/or replace
Loss of Engine Power	
Restricted air intake	Remove restriction
EGR valve malfunction	Replace EGR valve
Blocked or damaged exhaust system	Remove restriction and/or replace components
Blocked fuel tank filter	Replace filter
Restricted fuel filter	Remove restriction and/or replace filter
Block vent in gas cap	Remove restriction and/or replace cap
Tank-to-injection pump fuel supply blocked	Check fuel lines and connections
Blocked fuel return system	Remove restriction
Incorrect or contaminated fuel	Replace fuel
Blocked injector nozzles	Check nozzle for blockage, see FUEL SYSTEMS
Low compression	Check valves, rings, pistons, see ENGINES
Loud Engine Noise With Black Smoke	
Basic timing incorrect	Reset timing, see FUEL SYSTEMS
EGR valve malfunction	Replace EGR valve
Internal injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
Incorrect injector pump housing pressure	Check pressure, see FUEL SYSTEMS
Engine Overheating	
Cooling system leaks	Check cooling system and repair leaks
Belt slipping or damaged	Check tension and/or replace belt

CONDITION & POSSIBLE CAUSE	CORRECTION
Thermostat stuck closed	Remove and replace thermostat, see ENGINE COOLING
Head gasket leaking	Replace head gasket
Oil Light on at Idle	
Low oil pump pressure	Check oil pump operation, see ENGINES
Oil cooler or line restricted	Remove restriction and/or replace cooler
Engine Won't Shut Off	
Injector pump fuel solenoid does not return fuel valve to OFF position	Remove and check solenoid and replace if needed

VACUUM PUMP DIAGNOSIS

CONDITION & POSSIBLE CAUSE	CORRECTION
Excessive Noise	
Loose pump-to-drive assembly screws	Tighten screws
Loose tube on pump assembly	Tighten tube
Valves not functioning properly	Replace valves
Oil Leakage	
Loose end plug	Tighten end plug
Bad seal crimp	Remove and re-crimp seal

FUEL INJECTION TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

BASIC FUEL INJECTION TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start (Cranks Normally)	
Cold start valve inoperative	Test valve and circuit
Poor connection;vacuum or wiring	Check vacuum and electrical connections
Contaminated fuel	Test fuel for water or alcohol
Defective fuel pump relay or circuit	Test relay and wiring
Battery too low	Charge and test battery
Low fuel pressure	Test pressure regulator and fuel pump, check for restricted lines and filters
No distributor reference pulses	Repair ignition system as necessary
Open coolant temperature sensor circuit	Test sensor and wiring
Shorted W.O.T. switch in T.P.S.	Disconnect W.O.T. switch, engine should start
Defective ECM	Replace ECM
Fuel tank residual pressure valve leaks	Test for fuel pressure drop after shut down
Hard Starting	

CONDITION & POSSIBLE CAUSE	CORRECTION
Disconnected hot air tube to air cleaner	Reconnect tube and test control valve
Defective Idle Air Control (IAC) valve	Test valve operation and circuit
Shorted, open or misadjusted T.P.S.	Test and adjust or replace T.P.S.
EGR valve open	Test EGR valve and control circuit
Poor Oxygen sensor signal	Test for shorted or circuit
Incorrect mixture from PCV system	Test PCV for flow, check sealing of oil filter cap
Poor High Speed Operation	
Low fuel pump volume	Faulty pump or restricted fuel lines or filters
Poor MAP sensor signal	Test MAP sensor, vacuum hose and wiring
Poor Oxygen sensor signal	Test for shorted or open sensor or circuit
Open coolant temperature sensor circuit	Test sensor and wiring
Faulty ignition operation	Check wires for cracks or poor con- nections, test secondary voltage with oscilloscope
Contaminated fuel	Test fuel for water or alcohol
Intermittent ECM ground	Test ECM ground connection for resistance
Restricted air cleaner	Replace air cleaner
Restricted exhaust system	Test for exhaust manifold back pressure
Poor MAF sensor signal	Check leakage between sensor and manifold
Poor VSS signal	If tester for ALCL hook-up is available check that VSS reading matches speedometer
Ping or Knock on Acceleration	
Poor Knock sensor signal	Test for shorted or open sensor or circuit
Poor Baro sensor signal	Test for shorted or open sensor or circuit
Improper ignition timing	See VEHICLE EMISSION CONTROL LABEL (where applicable)
Check for engine overheating problems	Low coolant, loose belts or electric cooling fan inoperative

NOTE: **For additional electronic fuel injection trouble shooting information, see the appropriate article in the ENGINE PERFORMANCE section (not all vehicles have Computer Engine Control articles). Information is provided there for diagnosing fuel system problems on vehicles with electronic fuel injection.**

IGNITION SYSTEM TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

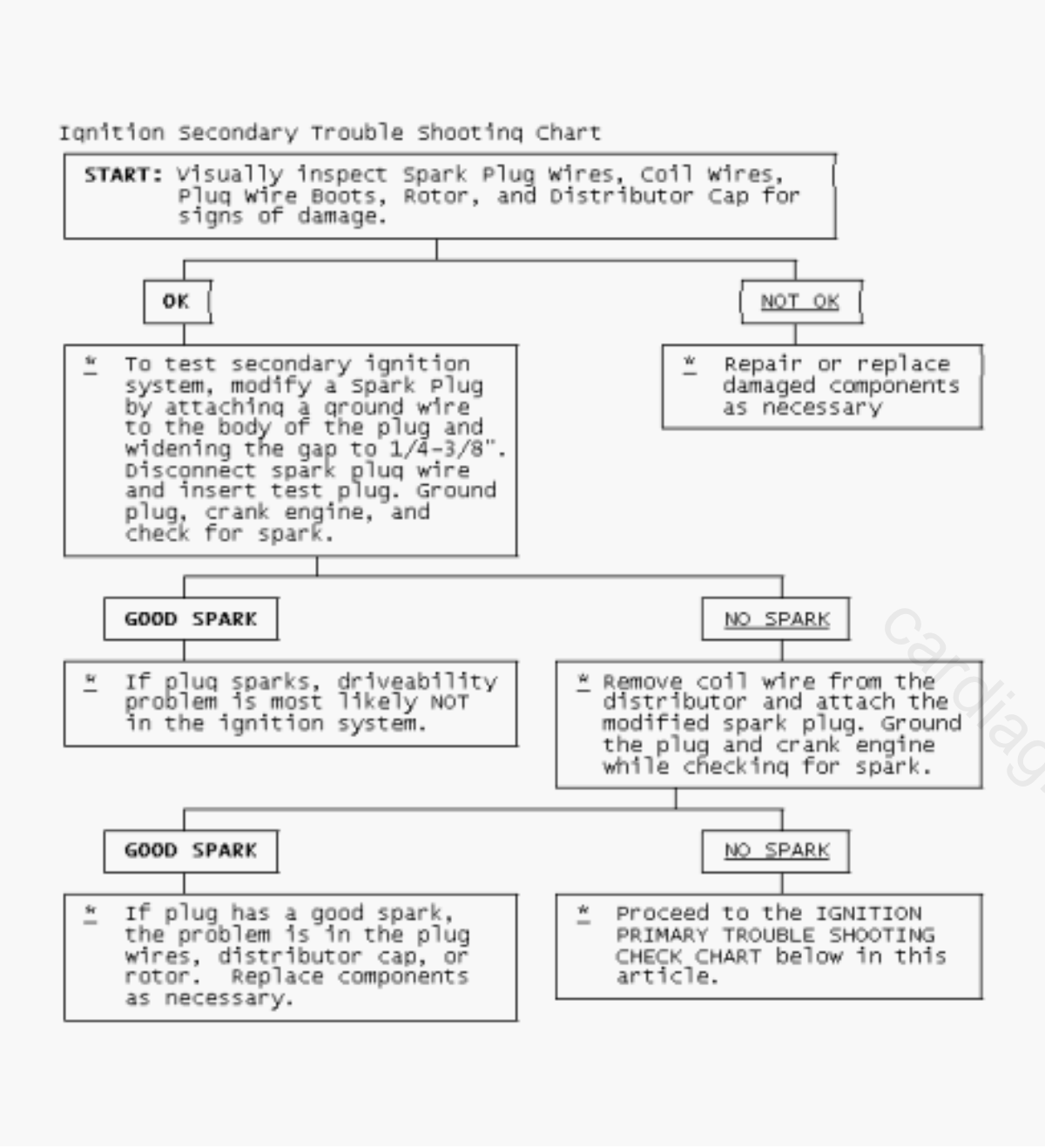
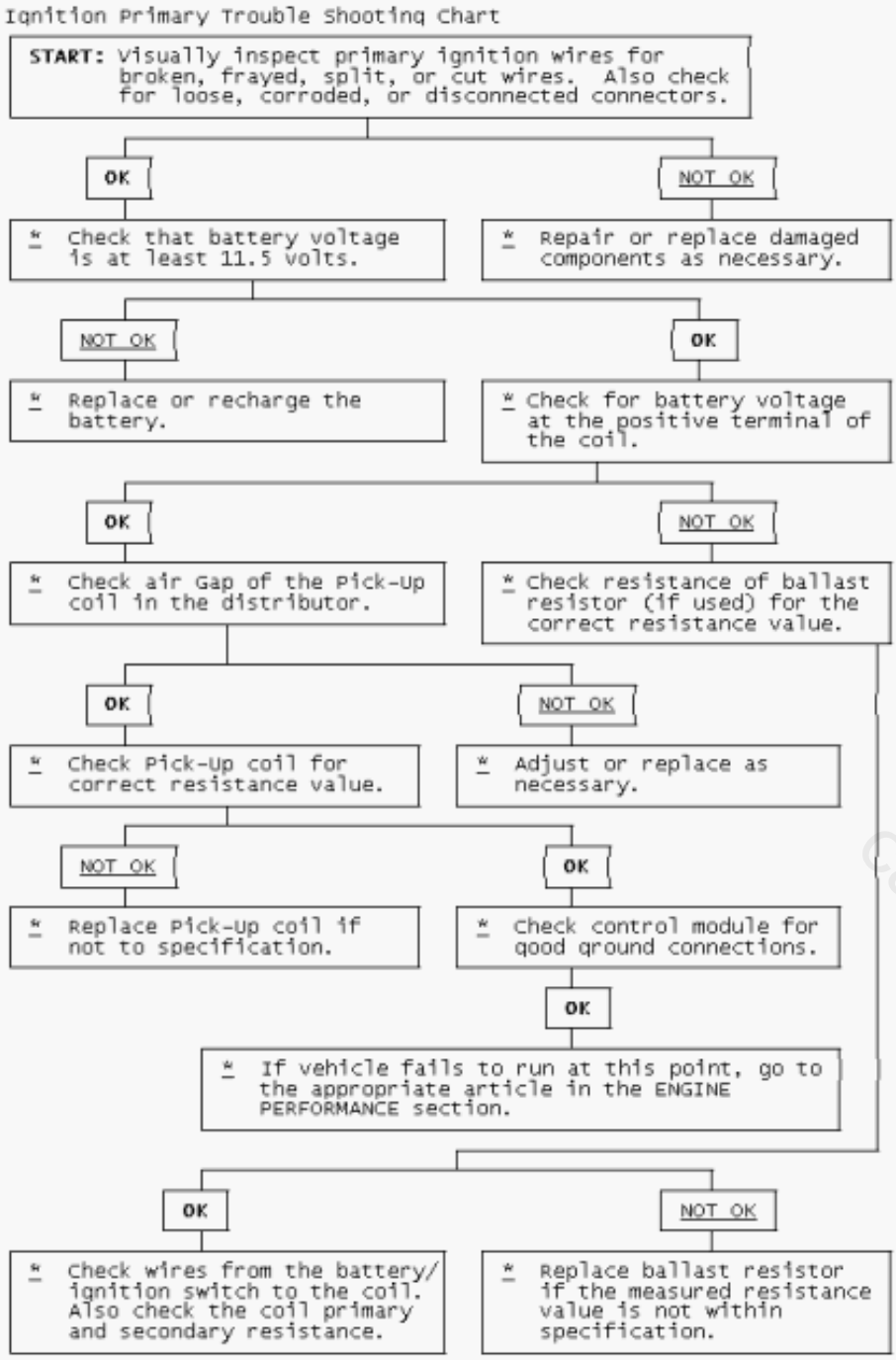


Fig. 3: Ignition Secondary Trouble Shooting Chart



cardiagn.com

Fig. 4: Ignition Primary Trouble Shooting Chart

STARTER TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

BASIC STARTER TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Starter Fails to Operate	

CONDITION & POSSIBLE CAUSE	CORRECTION
Dead battery or bad connections between starter and battery	Check battery charge and all wires and connections to starter
Ignition switch faulty or misadjusted	Adjust or replace ignition switch
Open circuit between starter switch ignition terminal on starter relay	Check and repair wires and connections as necessary
Starter relay or starter defective	See Testing in STARTER article
Open solenoid pull-in wire	See Testing in STARTER article
Starter Does Not Operate and Headlights Dim	
Weak battery or dead cell	Charge or replace battery as necessary
Loose or corroded battery connections	Check that battery connections are clean and tight
Internal ground in starter windings	See Testing in STARTER article
Grounded starter fields	See Testing in STARTERS
Armature rubbing on pole shoes	See STARTER article
Starter Turns but Engine Does Not Rotate	
Starter clutch slipping	See STARTER article
Broken clutch housing	See STARTER article
Pinion shaft rusted or dry	See STARTER article
Engine basic timing incorrect	See Ignition Timing in TUNE-UP article
Broken teeth on engine flywheel	Replace flywheel and check for starter pinion gear damage
Starter Will Not Crank Engine	
Faulty overrunning clutch	See STARTER article
Broken clutch housing	See STARTER article
Broken flywheel teeth	Replace flywheel and check for starter pinion gear damage
Armature shaft sheared or reduction gear teeth stripped	See STARTER article
Weak battery	Charge or replace battery as necessary
Faulty solenoid	See On-Vehicle Tests in STARTER article
Poor grounds	Check all ground connections for tight and clean connections
Ignition switch faulty or misadjusted	Adjust or replace ignition switch as necessary
Starter Cranks Engine Slowly	
Battery weak or defective	Charge or replace battery as necessary
Engine overheated	See ENGINE COOLING SYSTEM article
Engine oil too heavy	Check that proper viscosity oil is used

CONDITION & POSSIBLE CAUSE	CORRECTION
Poor battery-to-starter connections	Check that all between battery and starter are clean and tight
Current draw too low or too high	See Bench Tests in STARTER article
Bent armature, loose pole shoes screws or worn bearings	See STARTER article
Burned solenoid contacts	Replace solenoid
Faulty starter	Replace starter
Starter Engages Engine Only Momentarily	
Engine timing too far advanced	See Ignition Timing in TUNE-UP article
Overrunning clutch not engaging properly	Replace overrunning clutch. See STARTER article
Broken starter clutch	See STARTER article
Broken teeth on engine flywheel	Replace flywheel and check starter pinion gear for damage
Weak drive assembly thrust spring	See STARTER article
Weak hold-in coil	See Bench Tests in STARTER article
Starter Drive Will Not Engage	
Defective point assembly	See Testing in STARTER article
Poor point assembly ground	See Testing in STARTER article
Defective pull-in coil	Replace starter solenoid
Starter Relay Does Not Close	
Dead battery	Charge or replace battery as necessary
Faulty wiring	Check all wiring and connections leading to relay
Neutral safety switch faulty	Replace neutral safety switch
Starter relay faulty	Replace starter relay
Starter Drive Will Not Disengage	
Starter motor loose on mountings	Tighten starter attach bolts
Worn drive end bushing	See STARTER article
Damaged engine flywheel teeth	Replace flywheel and starter pinion gear for damage
Drive yolk return spring broken or missing	Replace return spring
Faulty ignition switch	Replace ignition switch
Insufficient clearance between winding leads to solenoid terminal and main contact in solenoid	Replace starter solenoid
Starter clutch not disengaging	Replace starter clutch
Ignition starter switch contacts sticking	Replace ignition switch
Starter Relay Operates but Solenoid Does Not	
Faulty solenoid switch, switch connections or relay	Check all wiring between relay and solenoid or replace relay or solenoid as necessary

carsdesign.com

CONDITION & POSSIBLE CAUSE	CORRECTION
Broken lead or loose soldered connections	Repair wire or wire connections as necessary
Solenoid Plunger Vibrates When Switch is Engaged	
Weak battery	Charge or replace battery as necessary
Solenoid contacts corroded	Clean contacts or replace solenoid
Faulty wiring	Check all wiring leading to solenoid
Broken connections inside switch cover	Repair connections or replace solenoid
Open hold-in wire	Replace solenoid
Low Current Draw	
Worn brushes or weak	Replace brushes or brush springs as necessary
High Pitched Whine During Cranking Before Engine Fires but Engine Fires and Cranks Normally	
Distance too great between starter pinion and flywheel	Align starter or check that correct starter and flywheel are being used
High Pitched Whine After Engine Fires With Key released. Engine Fires and Cranks Normally	
Distance too small between starter pinion and flywheel	Flywheel runout contributes to the intermittent nature

TUNE-UP TROUBLE SHOOTING - GAS ENGINE VEHICLES

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

BASIC SPARK PLUG TROUBLE SHOOTING CHARTS

CONDITION & POSSIBLE CAUSE	CORRECTION
Normal Spark Plug Condition	
Light Tan or Gray deposits	No Action
Electrode not burned or fouled	No Action
Gap tolerance not changed	No Action
Cold Fouling or Carbon Deposits	
Overrich air/fuel mixture	Adjust air/fuel mixture, see ENGINE PERFORMANCE section
Faulty choke	Replace choke assembly, see ENGINE PERFORMANCE section
Clogged air filter	Clean and/or replace air filter
Incorrect idle speed or dirty carburetor	Reset idle speed and/ or clean carburetor
Faulty ignition wires	Replace ignition wiring
Prolonged operation at idle	Shut engine off during long idle
Sticking valves or worn valve guide seals	Check valve train
Wet Fouling or Oil Deposits	

CONDITION & POSSIBLE CAUSE	CORRECTION
Worn rings and pistons	Install new rings and pistons
Excessive cylinder wear	Rebore or replace block
Excessive valve guide clearance	Worn or loose bearing
Gap Bridged	
Deposits in combustion chamber becoming fused to electrode	Clean combustion chamber of deposits
Blistered Electrode	
Engine overheating	Check cooling system
Wrong type of fuel	Replace with correct fuel
Loose spark plugs	Retighten spark plugs
Over-advanced ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Pre-Ignition or Melted Electrodes	
Incorrect type of fuel	Replace with correct fuel
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Burned valves	Replace valves
Engine Overheating	Check cooling system
Wrong type of spark plug, too hot	Replace with correct spark plug, see ENGINE PERFORMANCE
Chipped Insulators	
Severe detonation	Check for over-advanced timing or combustion
Improper gapping procedure	Re-gap spark plugs
Rust Colored Deposits	
Additives in unleaded fuel	Try different fuel brand
Water In Combustion Chamber	
Blown head gasket or cracked head	Repair or replace head or head gasket

NOTE: **Before diagnosing an electronic ignition system, ensure that all wiring is connected properly between distributor, wiring connector and spark plugs. Ignition problem will show up either as: Engine Will Not Start or Engine Runs Rough.**

BASIC ELECTRONIC IGNITION TROUBLE SHOOTING CHARTS

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start	
Open circuit between distributor and bulkhead connector	Repair circuit
Open circuit between bulkhead connector and ignition switch	Repair circuit
Open circuit between ignition switch and starter solenoid	Repair circuit
Engine Runs Rough	
Fuel lines leaking or clogged	Tighten fitting, remove restriction
Initial timing incorrect	Reset ignition timing see ENGINE PERFORMANCE
Centrifugal advance malfunction	Repair distributor advance
Defective spark plugs or wiring	Replace plugs or plug wiring
Component Failure	

CONDITION & POSSIBLE CAUSE	CORRECTION
Spark arc-over on cap, rotor or coil	Replace cap, rotor or or coil
Defective pick-up coil	Replace pick-up coil
Defective ignition coil	Replace ignition coil
Defective vacuum unit	Replace vacuum unit
Defective control module	Replace control module

BASIC ELECTRONIC IGNITION TROUBLE SHOOTING CHARTS - USING OSCILLOSCOPE PATTERNS

CONDITION & POSSIBLE CAUSE	CORRECTION
Firing Voltage Lines are the Same, but Abnormally High	
Retarded ignition timing	Reset ignition timing, see ENGINE PERFORMANCE section
Fuel mixture too lean	Readjust carburetor, see ENGINE PERFORMANCE
High resistance in coil wire	Replace coil wire
Corrosion in coil tower terminal	Clean and/or replace coil
Corrosion in distributor coil terminal	Clean and/or replace distributor cap
Firing Voltage Lines are the Same but Abnormally Low	
Fuel mixture too rich	Readjust carburetor, see ENGINE PERFORMANCE
Breaks in coil wire causing arcing	Replace coil wire
Cracked coil tower causing arcing	Replace coil
Low coil output	Replace coil
Low engine compression	Determine cause and repair
One or More, But Not All Firing Voltage Lines are Higher Than Others	
Carburetor idle mixture not balanced	Readjust carburetor, see ENGINE PERFORMANCE
EGR valve stuck open	Clean and/or replace valve
High resistance in spark plug wires	Replace spark plug wires
Cracked or broken spark plug insulator	Replace spark plugs
Intake vacuum leak	Repair leak
Defective spark plugs	Replace spark plugs
Corroded spark plug terminals	Replace spark plugs
One or More, But Not All Firing Voltage Lines Are Lower Than Others	
Curb idle mixture not balanced	Readjust carburetor, see ENGINE PERFORMANCE
Breaks in plug wires	Replace plug wires causing arcing
Cracked coil tower causing arcing	Replace coil
Low compression	Determine cause and repair
Defective spark plugs	Replace spark plugs
Corroded spark plugs	Replace spark plugs
Cylinders Not Firing	
Cracked distributor cap terminals	Replace distributor cap
Shorted spark plug wire	Determine cause and repair

CONDITION & POSSIBLE CAUSE	CORRECTION
Mechanical problem in engine	Determine cause and repair
Defective spark plugs	Replace spark plugs
Spark plugs fouled	Replace spark plugs

BASIC DRIVEABILITY PROBLEMS TROUBLE SHOOTING

CONDITION & POSSIBLE CAUSE	CORRECTION
Hard Starting	
Binding carburetor linkage	Eliminate binding
Binding choke linkage	Eliminate binding
Binding choke piston	Eliminate binding
Restricted choke vacuum	Check vacuum lines for blockage
Worn or dirty needle valve and seat	Clean carburetor, see ENGINE PERFORMANCE
Float sticking	Readjust or replace float see the ENGINE PERFORMANCE section
Incorrect choke adjustment	Reset choke adjustment see ENGINE PERFORMANCE
Defective coil	Replace coil
Improper spark plug gap	Regap spark plugs
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Detonation	
Over-advanced ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Defective spark plugs	Replace spark plugs
Fuel lines clogged	Clean fuel lines
EGR system malfunction	Check and repair EGR system
PCV system malfunction	Repair PCV system
Vacuum leaks	Check and repair vacuum system
Loose fan belts	Tighten or replace fan belts, see ENGINE PERFORMANCE
Restricted airflow	Remove restriction
Vacuum advance malfunction	Check distributor operation
Dieseling	
Binding carburetor linkage	Eliminate binding
Binding throttle linkage	Eliminate blinding
Binding choke linkage or fast idle cam	Eliminate binding
Defective idle solenoid	Replace idle solenoid see ENGINE PERFORMANCE
Improper base idle speed	Reset idle speed, see see ENGINE PERFORMANCE

CONDITION & POSSIBLE CAUSE	CORRECTION
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Incorrect idle mixture setting	Reset idle mixture, see ENGINE PERFORMANCE
Faulty Acceleration	
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Engine cold and choke too lean	Adjust choke and allow engine to warm-up
Defective spark plugs	Replace spark plugs
Defective coil	Replace coil
Faulty Low Speed Operation	
Clogged idle transfer slots	Clean idle transfer slots, see FUEL
Restricted idle air bleeds and passages	Disassemble and clean carburetor, see FUEL
Clogged air cleaner	Replace air filter
Defective spark plugs	Replace spark plugs
Defective ignition wires	Replace ignition wire see ENGINE PERFORMANCE
Defective distributor cap	Replace distributor cap
Faulty High Speed Operation	
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Defective distributor centrifugal advance	Replace advance mechanism
Defective distributor vacuum advance	Replace advance unit
Incorrect spark plugs or plug gap	Check gap and/or replace spark plugs
Faulty choke operation	Check choke and repair as required
Clogged vacuum passages	Remove restrictions
Improper size or clogged main jet	Check jet size and clean, see FUEL
Restricted air cleaner	Check filter and replace as necessary
Defective distributor cap, rotor or coil	Replace cap, rotor or coil
Misfire at All Speeds	
Defective spark plugs	Replace spark plugs
Defective spark plug wires	Replace spark plug wires
Defective distributor cap, rotor, or coil	Replace cap, rotor, or coil
Cracked or broken vacuum hoses	Replace vacuum hoses
Vacuum leaks	Repair vacuum leaks
Fuel lines clogged	Remove restriction
Hesitation	
Cracked or broken vacuum	Replace vacuum hoses hoses
Vacuum leaks	Repair Vacuum leaks
Binding carburetor linkage	Eliminate binding
Binding throttle linkage	Eliminate binding

CONDITION & POSSIBLE CAUSE	CORRECTION
Binding choke linkage or fast idle cam	Eliminate binding
Improper float setting	Readjust float setting, see FUEL
Cracked or broken ignition wires	Replace ignition wires
Rough Idle, Missing or Stalling	
Incorrect curb idle or fast idle speed	Reset idle speed, see see ENGINE PERFORMANCE
Incorrect basic timing	Reset ignition timing see ENGINE PERFORMANCE
Improper idle mixture adjustment	Reset idle mixture, see ENGINE PERFORMANCE
Improper feedback system operation	Check feedback system see ENGINE PERFORMANCE
Incorrect spark plug gap	Reset spark plug gap, see ENGINE PERFORMANCE
Moisture in ignition components	Dry components
Loose or broken ignition wires	Replace ignition wires
Damaged distributor cap or or rotor	Replace distributor cap or rotor
Faulty ignition coil	Replace ignition coil
Fuel filter clogged or worn	Replace fuel filter
Damaged idle mixture screw	Replace idle mixture screw, see FUEL
Improper fast idle cam adjustment	Reset fast idle cam adjustment, see TUNE-see ENGINE PERFORMANCE
Improper EGR valve operation	Replace EGR valve
Faulty PCV valve air flow	Replace PCV valve
Choke binding or improper choke setting	Reset choke or eliminate binding
Vacuum leak	Repair vacuum leak
Improper float bowl fuel level	Reset float adjustment, see FUEL
Clogged air bleed or idle passages	Clean carburetor passages, see FUEL
Clogged or worn air cleaner filter	Replace air filter
Faulty choke vacuum diaphragm	Replace diaphragm, see ENGINE PERFORMANCE
Exhaust manifold heat valve inoperative	Replace heat valve
Improper distributor spark advance	Check distributor operation
Leaking valves or valve components	Check and repair valvetrain
Improper carburetor mounting	Remove and remount carburetor
Excessive play in distributor shaft	Replace distributor
Loose or corroded wiring connections	Repair or replace as required

carmanual.com

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Surges	
Improper PCV valve airflow	Replace PCV valve
Vacuum leaks	Repair vacuum leaks
Clogged air bleeds	Remove restriction
EGR valve malfunction	Replace EGR valve
Restricted air cleaner filter	Replace air filter
Cracked or broken vacuum hoses	Replace vacuum hoses
Cracked or broken ignition wires	Replace ignition wires
Vacuum advance malfunction	Check unit and replace as necessary
Defective or fouled spark plugs	Replace spark plugs
Ping or Spark Knock	
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Distributor centrifugal or vacuum advance malfunction	Check operation and replace as necessary
Carburetor setting too lean	Readjust mixture setting, see ENGINE PERFORMANCE
Vacuum leak	Eliminate vacuum leak
EGR valve malfunction	Replace EGR valve
Poor Gasoline Mileage	
Cracked or broken vacuum	Replace vacuum hoses hoses
Vacuum leaks	Repair vacuum leaks
Defective ignition wires	Replace wires
Incorrect choke setting	Readjust setting, see ENGINE PERFORMANCE
Defective vacuum advance	Replace vacuum advance
Defective spark plugs	Replace spark plugs
Binding carburetor power piston	Eliminate binding
Dirt in carburetor jets	Clean and/or replace jets
Incorrect float adjustment	Readjust float setting, see FUEL
Defective power valve	Replace power valve, see ENGINE PERFORMANCE
Incorrect idle speed	Readjust idle speed
Engine Stalls	
Improper float level	Readjust float level
Leaking needle valve and seat	Replace needle valve and seat
Vacuum leaks	Eliminate vacuum leaks

VACUUM PUMP - DIESEL TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

NOTE: **Diesel engines mechanical diagnosis is the same as gasoline engines for items such as noisy valves, bearings, pistons, etc. The following trouble shooting covers only items pertaining to diesel engines.**

VACUUM PUMP (DIESEL) TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Excessive Noise	
Loose pump-to-drive assembly screws	Tighten screws
Loose tube on pump assembly	Tighten tube
Valves not functioning properly	Replace valves
Oil Leakage	
Loose end plug	Tighten end plug
Bad seal crimp	Remove and re-crimp seal

MANUAL TRANSMISSION

MANUAL TRANSMISSION TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

MANUAL TRANSMISSION/TRANSAXLE TROUBLE SHOOTING

Condition	Possible Cause
Noisy In Forward Gears	Low gear oil level, Loose bell housing bolts, Worn bearings or gears
Clunk On Deceleration (FWD Only)	Loose engine mounts, Worn inboard CV joints, Worn differential pinion shaft, Side gear hub counterbore in case worn oversize
Gear Clash When Shifting Forward Gears	Clutch Out Of Adjustment, Shift linkage damaged or out of adjustment, Gears or synchronizers damaged, Low gear oil level
Transmission Noisy When Moving (RWD Only) Quiet In Neutral With Clutch Engaged	Worn rear outputshaft bearing
Gear Rattle	Worn bearings, Wrong gear oil, Low gear oil, Worn gears
Steady Ticking At Idle (Increases With RPM)	Broken tooth on gear
Gear Clash When Shifting Forward Gears	Worn or broken synchronizers
Loud Whine In Reverse	Normal condition (1)
Noise When Stepping On Clutch	Bad release bearing, Worn pilot bearing
Ticking Or Screeching As Clutch Is Engaged	Faulty release bearing, Uneven pressure plate fingers
Click Or Snap When Clutch Is Engaged	Worn clutch fork, Worn or broken front bearing retainer
Transmission Shifts Hard	Clutch not releasing, Shift mechanism binding, Clutch installed backwards
Will Not Shift Into One Gear, Shifts Into All Others	Bent shift fork, Worn detent balls
Locked Into Gear, Cannot Shift	Clutch adjustment, Worn detent balls

Condition	Possible Cause
Transmission Jumps Out Of Gear	Pilot bearing worn, Bent shift fork, Worn gear teeth or face, Excessive gear train end play, Worn synchronizers, Missing detent ball spring, Shift mechanism worn or out of adjustment, Engine or transmission mount bolts loose or out of adjustment, Transmission not aligned
Shift Lever Rattle	Worn shift lever or detents, Worn shift forks, Worn synchronizers sleeve
Shift Lever Hops Under Acceleration	Worn engine or transmission mounts
(1) Most units use spur cut gears in reverse and are noisy	

POWERTRAIN

CLUTCH TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

BASIC CLUTCH TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Chattering or Grabbing	
Incorrect clutch adjustment	Adjust clutch
Oil, grease or glaze on facings	Disassemble and clean or replace
Loose "U" joint flange	See DRIVE AXLES article
Worn input shaft spline	Replace input shaft
Binding pressure plate	Replace pressure plate
Binding release lever	See CLUTCH article
Binding clutch disc hub	Replace clutch disc
Unequal pressure plate contact	Replace worn/misaligned components
Loose/bent clutch disc	Replace clutch disc
Incorrect transmission alignment	Realign transmission
Worn pressure plate, disc or flywheel	Replace damaged components
Broken or weak pressure springs	Replace pressure plate
Sticking clutch pedal	Lubricate clutch pedal & linkage
Incorrect clutch disc facing	Replace clutch disc
Engine loose in chassis	Tighten all mounting bolts
Failure to Release	
Oil or grease on clutch facings	Clean or replace clutch clutch disc
Incorrect release lever or pedal adjustment	See CLUTCH article
Worn or broken clutch facings	Replace clutch disc
Bent clutch disc or pressure plate	Replace damaged components
Clutch disc hub binding on input shaft	Clean or replace clutch disc and/or input shaft
Binding pilot bearing	Replace pilot bearing

CONDITION & POSSIBLE CAUSE	CORRECTION
Sticking release bearing sleeve	Replace release bearing and/or sleeve
Binding clutch cable	See CLUTCH article
Defective clutch master	Replace master cylinder
Defective clutch slave	Replace slave cylinder
Air in hydraulic system	Bleed hydraulic system
Rattling	
Weak or broken release lever spring	Replace spring and check alignment
Damaged pressure plate	Replace pressure plate
Broken clutch return spring	Replace return spring
Worn splines on clutch disc or input shaft	Replace clutch disc and/or input shaft
Worn clutch release bearing	Replace release bearing
Dry or worn pilot bearing	Lubricate or replace pilot bearing
Unequal release lever contact	Align or replace release lever
Incorrect pedal free play	Adjust free play
Warped or damaged clutch disc	Replace damaged components
Slipping	
Pressure springs worn or	Release pressure plate
Oily, greasy or worn facings	Clean or replace clutch disc
Incorrect clutch alignment	Realign clutch assembly
Warped clutch disc or pressure plate	Replace damaged components
Binding release levers or clutch pedal	Lubricate and/or replace release components
Squeaking	
Worn or damaged release	Replace release bearing
Dry or worn pilot or release bearing	Lubricate or replace assembly
Pilot bearing turning in crankshaft	Replace pilot bearing and/or crankshaft
Worn input shaft bearing	Replace bearing and seal
Incorrect transmission alignment	Realign transmission
Dry release fork between pivot	Lubricate release fork and pivot
Heavy and/or Stiff Pedal	
Sticking release bearing sleeve	Replace release bearing and/or sleeve
Dry or binding clutch pedal hub	Lubricate and align components
Floor mat interference with pedal	Lay mat flat in proper area
Dry or binding ball/fork pivots	Lubricate and align components
Faulty clutch cable	Replace clutch cable
Noisy Clutch Pedal	
Faulty interlock switch	Replace interlock switch
Self-adjuster ratchet noise	Lubricate or replace self-adjuster
Speed control interlock switch	Lubricate or replace interlock switch

CONDITION & POSSIBLE CAUSE	CORRECTION
Clutch Pedal Sticks Down	
Binding clutch cable	See CLUTCH article
Springs weak in pressure plate	Replace pressure plate
Binding in clutch linkage	Lubricate and free linkage
Noisy	
Dry release bearing	Lubricate or replace release bearing
Dry or worn pilot bearing	Lubricate or replace bearing
Worn input shaft bearing	Replace bearing
Transmission Click	
Weak springs in pressure	Replace pressure plate plate
Release fork loose on ball stud	Replace release fork and/or ball stud
Oil on clutch disc damper	Replace clutch disc
Broken spring in slave cylinder	Replace slave cylinder

DRIVE AXLE - NOISE DIAGNOSIS

Unrelated Noises

Some driveline trouble symptoms are also common to the engine, transmission, wheel bearings, tires, and other parts of the vehicle. Ensure cause of trouble actually is in the drive axle before adjusting, repairing, or replacing any of its parts.

Non-Drive Axle Noises

A few conditions can sound just like drive axle noise and have to be considered in pre-diagnosis. The 4 most common noises are exhaust, tires, CV/universal joints and wheel trim rings.

In certain conditions, the pitch of the exhaust gases may e gear whine. At other times, it may be mistaken for a wheel bearing rumble.

Tires, especially radial and snow, can have a high-pitched tread whine or roar, similar to gear noise. Also, some non-standard tires with an unusual tread construction may emit a roar or whine.

Defective CV/universal joints may cause clicking noises or excessive driveline play that can be improperly diagnosed as drive axle problems.

Trim and moldings also can cause a whistling or whining noise. Ensure none of these components are causing the noise before disassembling the drive axle.

Gear Noise

A "howling" or "whining" noise from the ring and pinion gear can be caused by an improper gear pattern, gear damage, or improper bearing preload. It can occur at various speeds and driving conditions, or it can be continuous.

Before disassembling axle to diagnose and correct gear ke sure that tires, exhaust, and vehicle trim have been checked as possible causes.

Chuckle

This is a particular rattling noise that sounds like a stick against the spokes of a spinning bicycle wheel. It occurs while decelerating from 40 MPH and usually can be heard until vehicle comes to a complete stop. The frequency varies with the speed of the vehicle.

A chuckle that occurs on the driving phase is usually caused ive clearance due to differential gear wear, or by a damaged tooth on the coast side of the pinion or ring gear. Even a very small tooth nick or a ridge on the edge of a gear tooth is enough the cause the noise.

cardiagn.com

This condition can be corrected simply by cleaning the gear tooth nick or ridge with a small grinding wheel. If either gear is damaged or scored badly, the gear set must be replaced. If metal has broken loose, the carrier and housing must be cleaned to remove particles that could cause damage.

Knock

This is very similar to a chuckle, though it may be louder, and occur on acceleration or deceleration. Knock can be caused by a gear tooth that is damaged on the drive side of the ring and pinion gears. Ring gear bolts that are hitting the carrier casting can cause knock. Knock can also be due to excessive end play in the axle shafts.

Clunk

Clunk is a metallic noise heard when an automatic transmission is engaged in Reverse or Drive, or when throttle is applied or released. It is caused by backlash somewhere in the driveline, but not necessarily in the axle. To determine whether driveline clunk is caused by the axle, check the total axle backlash as follows:

1. Raise vehicle on a frame or twinpost hoist so that drive wheels are free. Clamp a bar between axle companion flange and a part of the frame or body so that flange cannot move.
2. On conventional drive axles, lock the left wheel to keep it from turning. On all models, turn the right wheel slowly until it is felt to be in Drive condition. Hold a chalk marker on side of tire about 12" from center of wheel. Turn wheel in the opposite direction until it is again felt to be in Drive condition.
3. Measure the length of the chalk mark, which is the total axle backlash. If backlash is one inch or less, drive axle is not the source of clunk noise.

Bearing Whine

Bearing whine is a high-pitched sound similar to a whistle. It is usually caused by malfunctioning pinion bearings. Pinion bearings operate at drive shaft speed. Roller wheel bearings may whine in a similar manner if they run completely dry of lubricant. Bearing noise will occur at all driving speeds. This distinguishes it from gear whine, which usually comes and goes as speed changes.

Bearing Rumble

Bearing rumble sounds like marbles being tumbled. It is usually caused by a malfunctioning wheel bearing. The lower pitch is because the wheel bearing turns at only about 1/3 of drive shaft speed.

Chatter On Turns

This is a condition where the entire front or rear of vehicle vibrates when vehicle is moving. The vibration is plainly felt as well as heard. Extra differential thrust washers installed during axle repair can cause a condition of partial lock-up that creates this chatter.

Axle Shaft Noise

Axle shaft noise is similar to gear noise and pinion bearing whine. Axle shaft bearing noise will normally distinguish itself from gear noise by occurring in all driving modes (Drive, cruise, coast and float), and will persist with transmission in Neutral while vehicle is moving at problem speed.

If vehicle displays this noise condition, remove suspect parts, replace wheel seals and install a new set of bearings. Re-evaluate vehicle for noise before removing any internal components.

Vibration

Vibration is a high-frequency trembling, shaking or grinding condition (felt or heard) that may be constant or variable in level and can occur during the total operating speed range of the vehicle.

The types of vibrations that can be felt in the vehicle can d into 3 main groups:

- Vibrations of various unbalanced rotating parts of the vehicle.
- Resonance vibrations of the body and frame structures caused by rotating of unbalanced parts.

carmanualsign.com

- Tip-in moans of resonance vibrations from stressed engine or exhaust system mounts or driveline flexing modes.

DRIVE AXLE - RWD TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing. For definitions of listed noises or sounds, see DRIVE AXLE - NOISE DIAGNOSIS under POWERTRAIN.**

DRIVE AXLE (RWD) TROUBLE SHOOTING

CONDITION & POSSIBLE CAUSE	CORRECTION
Knocking or Clunking	
Differential Side Gear Clearance	Check Clearance
Worn Pinion Shaft	Replace Pinion Shaft
Axle Shaft End Play	Check End Play
Missing Gear Teeth	Check Differential/Replace Gear
Wrong Axle Backlash	Check Backlash
Misaligned Driveline	Realign Driveline
Clinking During Engagement	
Side Gear Clearance	Check Clearance
Ring and Pinion Backlash	Check Backlash
Worn/Loose Pinion Shaft	Replace Shaft/Bearing
Bad "U" Joint	Replace "U" Joint
Sticking Slip Yoke	Lube Slip Yoke
Broken Rear Axle Mount	Replace Mount
Loose Drive Shaft Flange	Check Flange
Click/Chatter On Turns	
Differential Side Gear Clearance	Check Clearance
Wrong Turn On Plates (1)	Replace Clutch Plates
Wrong Differential Lubricant (1)	Change Lubricant
Knock Or Click	
Flat Spot on Rear Wheel Bearing	Replace Wheel Bearing
Low Vibration At All Speeds	
Faulty Wheel Bearing	Replace Wheel Bearing
Faulty "U" Joint	Replace "U" Joint
Faulty Drive Shaft	Balance Drive Shaft
Faulty Companion Flange	Replace Flange
Faulty Slip Yoke Flange	Replace Flange
(1) Limited slip differential only.	

FWD AXLE SHAFTS & CV JOINTS TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

BASIC FWD AXLE SHAFTS & CV JOINTS TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Grease Leaks	CV boot torn or cracked
Clicking Noise on Cornering	Damaged outer CV
Clunk Noise on Acceleration	Damaged inner CV
Vibration or Shudder on Acceleration	Sticking, damaged or worn CV Misalignment or spring height

STEERING & SUSPENSION

MANUAL STEERING GEAR TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

BASIC MANUAL STEERING GEAR TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Rattle or Chucking Noise in Rack and Pinion	
Rack and pinion mounting bracket loose	Tighten all mounting bolts
Lack of/or incorrect lubricant	Correct as necessary
Steering gear mounting bolts loose	Tighten all mounting bolts
Excessive Play	
Front wheel bearing improperly adjusted	See FRONT SUSPENSION article
Loose or worn steering linkage	See STEERING LINKAGE article
Loose or worn steering gear shift	See MANUAL STEERING GEAR article
Steering arm loose on gear shaft	See MANUAL STEERING GEAR article
Steering gear housing bolts loose	Tighten all mounting bolts
Steering gear adjustment too loose	See MANUAL STEERING GEAR article
Steering arms loose on knuckles	Tighten and check steering linkage
Rack and pinion mounting loose	Tighten all mounting bolts
Rack and pinion out of adjustment	See adjustment in STEERING article
Tie rod end loose	Tighten and check steering linkage
Excessive Pitman shaft-to-ball nut lash	Repair as necessary
Poor Returnability	
Lack of lubricant in ball joint or linkage	Lubricate and service systems
Binding in linkage or ball joints	See STEERING LINKAGE and SUSPENSION article
Improper front end alignment	See WHEEL ALIGNMENT article
Improper tire pressure	Inflate to proper pressure
Tie rod binding	Inflate to proper pressure
Shaft seal rubbing shaft	See STEERING COLUMN article

CONDITION & POSSIBLE CAUSE	CORRECTION
Excessive Vertical Motion	
Improper tire pressure	Inflate to proper pressure
Tires, wheels or rotors out of balance	Balance tires then check wheels and rotors
Worn or faulty shock absorbers	Check and replace if necessary
Loose tie rod ends or steering	Tighten or replace if necessary
Loose or worn wheel bearings	See SUSPENSION article
Steering Pulls to One Side	
Improper tire pressure	Inflate to proper pressure
Front tires are different sizes	Rotate or replace if necessary
Wheel bearings not adjusted properly	See FRONT SUSPENSION article
Bent or broken suspension components	See FRONT SUSPENSION article
Improper wheel alignment	See WHEEL ALIGNMENT article
Brakes dragging	See BRAKES article
Instability	
Low or uneven tire pressure	Inflate to proper pressure
Loose or worn wheel bearings	See FRONT SUSPENSION article
Loose or worn idler arm bushing	See FRONT SUSPENSION article
Loose or worn strut bushings	See FRONT SUSPENSION article
Incorrect front wheel alignment	See WHEEL ALIGNMENT article
Steering gear not centered	See MANUAL STEERING GEARS article
Springs or shock	Check and replace if necessary
Improper cross shaft	See MANUAL STEERING GEARS article

POWER STEERING TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

BASIC POWER STEERING TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Rattle or Chucking Noise	
Pressure hoses touching engine parts	Adjust to proper clearance
Loose Pitman shaft	Adjust or replace if necessary
Tie rods ends or Pitman arm loose	Tighten and check system
Rack and pinion mounts loose	Tighten all mounting bolts

CONDITION & POSSIBLE CAUSE	CORRECTION
Free play in worm gear	See POWER STEERING GEAR article
Loose sector shaft or thrust bearing adjustment	See POWER STEERING GEAR
Free play in pot coupling	See STEERING COLUMN article
Worn shaft serrations	See STEERING COLUMN article
Growl in Steering Pump	
Excessive pressure in hoses	Restricted hoses, see POWER STEERING GEAR article
Scored pressure plates	See POWER STEERING GEAR article
Scored thrust plates or rotor	See POWER STEERING GEAR article
Extreme wear of cam ring	See POWER STEERING GEAR article
Rattle in Steering Pump	
Vanes not installed	See POWER STEERING PUMP article
Vanes sticking in rotor	See POWER STEERING PUMP article
Swish noise in Pump	
Defective flow control valve	See POWER STEERING PUMP article
Groan in Steering Pump	
Air in fluid	See POWER STEERING PUMP article
Poor pressure hose connection	Tighten and check, replace if necessary
Squawk When Turning	
Damper "O" ring on valve spool cut	See POWER STEERING PUMP article
Moan or Whine in Pump	
Pump shaft bearing scored	Replace bearing and fluid
Air in fluid or fluid level low	See POWER STEERING PUMP article
Hose or column grounded	Check and replace if necessary
Cover "O" ring missing or damaged	See POWER STEERING PUMP article
Valve cover baffle missing or damaged	See POWER STEERING PUMP article
Interference of components in pump	See POWER STEERING PUMP article
Loose or poor bracket alignment	Correct or replace if necessary
Hissing When Parking	
Internal leakage in steering gear	Check valved assembly first
Chirp in Steering Pump	
Loose or worn power steering belt	Adjust or replace if necessary
Buzzing When Not Steering	

CONDITION & POSSIBLE CAUSE	CORRECTION
Noisy pump	See POWER STEERING PUMP article
Free play in steering shaft bearing	See STEERING COLUMN article
Bearing loose on shaft serrations	See STEERING COLUMN article
Clicking Noise in Pump	
Pump slippers too long	See POWER STEERING PUMP article
Broken slipper springs	See POWER STEERING PUMP article
Excessive wear or nicked rotors	See POWER STEERING PUMP article
Damaged cam contour	See POWER STEERING PUMP article
Poor Return of Wheel	
Wheel rubbing against turn signal	See STEERING COLUMN SWITCHES article
Flange rubbing steering gear adjuster	See STEERING COLUMN article
Tight or frozen steering shaft bearing	See STEERING COLUMN article
Steering gear out of adjustment	See POWER STEERING GEAR article
Sticking or plugged spool valve	See POWER STEERING PUMP article
Improper front end alignment	See WHEEL ALIGNMENT article
Wheel bearings worn or loose	See FRONT SUSPENSION article
Ties rods or ball joints binding	Check and replace if necessary
Intermediate shaft joints binding	See STEERING COLUMN article
Kinked pressure hoses	Correct or replace if necessary
Loose housing head spanner nut	See POWER STEERING GEAR article
Damaged valve lever	See POWER STEERING GEAR article
Sector shaft adjusted too tight	See ADJUSTMENTS in POWER STEERING GEAR article
Worm thrust bearing adjusted too tight	See ADJUSTMENTS in POWER STEERING GEAR article
Reaction ring sticking in cylinder	See POWER STEERING GEAR article
Reaction ring sticking in housing head	See POWER STEERING GEAR article
Steering pump internal leakage	See POWER STEERING PUMP article
Steering gear-to-column misalignment	See STEERING COLUMN article
Lack of lubrication in linkage	Service front suspension

CONDITION & POSSIBLE CAUSE	CORRECTION
Lack of lubrication in ball joints	Service front suspension
Increased Effort When Turning Wheel Fast Foaming, Milky Power Steering Fluid, Low Fluid Level or Low Pressure	
High internal pump leakage	See POWER STEERING PUMP article
Power steering pump belt slipping	Adjust or replace if necessary
Low fluid level	Check and fill to proper level
Engine idle speed to low	Adjust to correct setting
Air in pump fluid system	See POWER STEERING PUMP article
Pump output low	See POWER STEERING PUMP article
Steering gear malfunctioning	See POWER STEERING GEAR article
Wheel Surges or Jerks	
Low fluid level	Check and fill to proper level
Loose fan belt	Adjust or replace if necessary
Insufficient pump pressure	See POWER STEERING PUMP article
Sticky flow control valve	See POWER STEERING PUMP article
Linkage hitting oil pan at full turn	Replace bent components
Kick Back or Free Play	
Air in pump fluid system	See POWER STEERING PUMP article
Worn poppet valve in steering gear	See POWER STEERING PUMP article
Excessive over center lash	See POWER STEERING GEAR article
Thrust bearing out of adjustment	See POWER STEERING GEAR article
Free play in pot coupling	See POWER STEERING PUMP article
Steering gear coupling loose on shaft	See POWER STEERING PUMP article
Steering disc mounting bolts loose	Tighten or replace if necessary
Coupling loose on worm shaft	Tighten or replace if necessary
Improper sector shaft adjustment	See POWER STEERING GEAR article
Excessive worm piston side play	See POWER STEERING GEAR article
Damaged valve lever	See POWER STEERING GEAR article
Universal joint loose	Tighten or replace if necessary
Defective rotary valve	See POWER STEERING GEAR article
No Power When Parking	

CONDITION & POSSIBLE CAUSE	CORRECTION
Sticking flow control valve	See POWER STEERING PUMP article
Insufficient pump pressure output	See POWER STEERING PUMP article
Excessive internal pump leakage	See POWER STEERING PUMP article
Excessive internal gear leakage	See POWER STEERING PUMP article
Flange rubs against gear adjust plug	See STEERING COLUMN article
Loose pump belt	Adjust or replace if necessary
Low fluid level	Check and add proper amount of fluid
Engine idle too low	Adjust to correct setting
Steering gear-to-column misaligned	See STEERING COLUMN article
No Power, Left Turn	
Left turn reaction seal "O" ring worn	See POWER STEERING GEAR article
Left turn reaction seal damaged/missing	See POWER STEERING GEAR article
Cylinder head "O" ring damaged	See POWER STEERING PUMP article
No Power, Right Turns	
Column pot coupling bottomed	See STEERING COLUMN article
Right turn reaction seal "O" ring worn	See POWER STEERING GEAR article
Right turn reaction seal damaged	See POWER STEERING GEAR article
Internal leakage through piston end plug	See POWER STEERING GEAR article
Internal leakage through side plugs	See POWER STEERING GEAR article
Lack of Effort in Turning	
Left and/or right reaction seal sticking in cylinder head	Replace, see POWER STEERING GEAR article
Wanders to One Side	
Front end alignment incorrect	See WHEEL ALIGNMENT article
Unbalanced steering gear valve	See POWER STEERING GEAR article
Low Pressure Due to Steering Pump	
Flow control valve stuck or inoperative	See POWER STEERING PUMP article
Pressure plate not flat against cam ring	See POWER STEERING PUMP article
Extreme wear of cam ring	Replace and check adjustments
Scored plate, thrust plate or rotor	See POWER STEERING PUMP article
Vanes not installed properly	See POWER STEERING PUMP article

CONDITION & POSSIBLE CAUSE	CORRECTION
Vanes sticking in rotor slots	See POWER STEERING PUMP article
Cracked/broken thrust or pressure plate	See POWER STEERING PUMP article

STEERING COLUMN TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

BASIC STEERING COLUMN TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Noise in Steering	
Coupling pulled apart	See STEERING COLUMNS article
Column not correctly aligned	See STEERING COLUMNS article
Broken lower joint	Replace joint
Horn contact ring not	See STEERING COLUMN article
Bearing not lubricated	See STEERING COLUMN article
Shaft snap ring not properly seated	Reseat or replace snap ring
Plastic spherical joint not lubricated	See STEERING COLUMN article
Shroud or housing loose	Tighten holding screws
Lock plate retaining ring not seated	See STEERING COLUMN article
Loose sight shield	Tighten holding screws
High Steering Shaft Effort	
Column assembly misaligned	See STEERING COLUMN article
Improperly installed dust shield	Adjust or replace
Tight steering universal joint	See STEERING COLUMN article
High Shift Effort	
Column is out of alignment	See STEERING COLUMN article
Improperly installed dust shield	Adjust or replace
Seals or bearings not lubricated	See STEERING COLUMNS article
Mounting bracket screws too long	Replace with new shorter screws
Burrs on shift tube	Remove burrs or replace tube
Lower bowl bearing assembled wrong	See STEERING COLUMN article
Shift tube bent or broken	Replace as necessary
Improper adjustment of shift levers	See STEERING COLUMN article
Improper Trans. Shifting	
Sheared shift tube joint	Replace as necessary

CONDITION & POSSIBLE CAUSE	CORRECTION
Sheared lower shaft lever	Replace as necessary
Improper shift lever adjustment	See STEERING COLUMN article
Improper gate plate adjustment	See STEERING COLUMN article
Excess Play in Column	
Instrument panel bracket bolts loose	Tighten bolts and check bracket
Broken weld nut on jacket	See STEERING COLUMN article
Instrument bracket capsule sheared	See STEERING COLUMN article
Column bracket/jacket bolts loose	Tighten bolts and check bracket
Steering Locks in Gear	
Release lever mechanism	See STEERING COLUMN article

SUSPENSION TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

BASIC SUSPENSION TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Front End Noise	
Loose or worn wheel	See Wheel Bearing Adjustment in SUSPENSION
Worn shocks or shock mountings	Replace struts or strut mountings
Worn struts or strut mountings	Replace struts or strut mountings
Loose or worn lower control arm	See SUSPENSION
Loose steering gear-to-frame bolts	See STEERING
Worn control arm bushings	See SUSPENSION
Ball joints not lubricated	Lubricate ball joints & see Ball Joint Checking in SUSPENSION
Front Wheel Shake, Shimmy, or Vibration	
Tires or wheels out of balance	Check tire balance
Incorrect wheel alignment	See WHEEL ALIGNMENT
Drive shaft unbalanced	Check drive shaft balance
Loose or worn wheel bearings	See WHEEL ALIGNMENT
Loose or worn tie rod ends	See SUSPENSION
Worn upper ball joints	See Ball Joint Checking in SUSPENSION
Worn shock absorbers	Replace shock absorbers
Worn strut bushings	Replace strut bushings
Car Pulls to One Side	

CONDITION & POSSIBLE CAUSE	CORRECTION
Mismatched or uneven tires	Check tire condition
Broken or sagging springs	See SUSPENSION
Loose or worn strut bushings	See SUSPENSION
Improper wheel alignment	See WHEEL ALIGNMENT
Improper rear axle alignment	Check rear axle alignment
Power steering gear unbalanced	See STEERING
Front brakes dragging	See BRAKES
Abnormal Tire Wear	
Unbalanced tires	Check tire balance & rotation
Sagging or broken springs	See SUSPENSION
Incorrect front end alignment	See WHEEL ALIGNMENT
Faulty shock absorbers	Replace chock absorbers
Scuffed Tires	
Toe-In incorrect	See WHEEL ALIGNMENT
Suspension arm bent or twisted	See appropriate SUSPENSION article
Springs Bottom or Sag	
Bent or broken springs	See SUSPENSION
Leaking or worn shock absorbers	Replace shock absorbers
Frame misalignment	Check frame for damage
Spring Noises	
Loose "U" Bolts	See SUSPENSION
Loose or worn bushings	See SUSPENSION
Worn or missing interliners	See SUSPENSION
Shock Absorber Noise	
Loose shock mountings	Check & tighten mountings
Worn bushings	Replace bushings
Air in system	Bleed air from system
Undercoating on shocks	Remove undercoating
Car Leans or Sways on Corners	
Loose stabilizer bar	See SUSPENSION
Faulty shocks or mountings	Replace shocks or mountings
Broken or sagging springs	See SUSPENSION
Shock Absorbers Leaking	
Worn seals or reservoir tube crimped	See SUSPENSION
Broken Springs	
Loose "U" bolts	See SUSPENSION
Inoperative shock absorbers	Replace shock absorbers

WHEEL ALIGNMENT TROUBLE SHOOTING

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

BASIC WHEEL ALIGNMENT TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Premature Tire Wear	
Improper tire inflation	Check tire pressure
Front alignment out of tolerance	See ALIGNMENT SPECS in WHEEL ALIGNMENT section
Suspension components worn	See SUSPENSION section
Steering system components worn	See STEERING section
Improper standing height	See WHEEL ALIGNMENT
Uneven or sagging springs	See SUSPENSION section
Bent wheel	See WHEEL ALIGNMENT
Improper torsion bar adjustment	See SUSPENSION section
Loose or worn wheel bearings	See WHEEL BEARING ADJ. in SUSPENSION section
Worn or defective shock	Replace shock absorbers
Tires out of balance	Check tire balance
Pulls to One Side	
Improper tire inflation	Check tire pressure
Brake dragging	See BRAKE section
Mismatched tires	See WHEEL ALIGNMENT
Broken or sagging spring	See SUSPENSION section
Broken torsion bar	See SUSPENSION section
Power steering valve not centered	See STEERING section
Front alignment out of tolerance	See WHEEL ALIGNMENT section
Defective wheel bearing	See WHEEL BEARINGS in SUSPENSION section
Uneven sway bar links	See SUSPENSION section
Frame bent	Check for frame damage
Steering system bushing worn	See STEERING section
Hard Steering	
Idler arm bushing too tight	See STEERING LINKAGE in STEERING section
Ball joint tight or seized	See SUSPENSION section
Steering linkage too tight	See STEERING LINKAGE in STEERING section
Power steering fluid low	Add proper amount of fluid
Power steering drive belt loose	See STEERING section
Power steering pump defective	See STEERING section
Steering gear out of adjustment	See STEERING section
Incorrect wheel alignment	See WHEEL ALIGNMENT
Damaged steering gear	See STEERING section
Damaged suspension	See SUSPENSION section
Bent steering knuckle or supports	See SUSPENSION section
Vehicle "Wanders"	
Strut rod or control arm bushing worn	See SUSPENSION section

CONDITION & POSSIBLE CAUSE	CORRECTION
Loose or worn wheel bearings	See WHEEL BEARINGS in SUSPENSION section
Improper tire inflation	Check tire pressure
Stabilizer bar missing or defective	See SUSPENSION section
Wheel alignment out of tolerance	See Adjustment in WHEEL ALIGNMENT section
Broken spring	See SUSPENSION section
Defective shock absorber	Replace shock absorbers
Worn steering & suspension components	See SUSPENSION section
Front End Shimmy	
Tire out of balance/round	Check tire balance
Excessive wheel runout	See WHEEL ALIGNMENT
Insufficient or improper caster	See WHEEL ALIGNMENT section
Worn suspension or steering components	See SUSPENSION section
Defective shock absorbers	Replace shock absorber
Wheel bearings worn or loose	See WHEEL BEARING ADJ. in SUSPENSION section
Power steering reaction Bracket loose	See STEERING section
Steering gear box (rack) mounting loose	See STEERING section
Steering gear adjustment loose	See STEERING section
Worn spherical joints	See SUSPENSION section
Toe-In Not Adjustable	
Lower control arm bent	See SUSPENSION section
Frame bent	Check frame for damage
Camber Not Adjustable	
Control arm bent	See SUSPENSION section
Frame bent	Check frame for damage
Hub & bearing not seated properly	See SUSPENSION section

mitsubishi-manuals.com

Back To Article

GENERAL INFORMATION

TROUBLE SHOOTING

* PLEASE READ THIS FIRST *

NOTE: **This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the ENGINE PERFORMANCE category.**

ENGINE PERFORMANCE

NOTE: **This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the ENGINE PERFORMANCE category.**

TUNE-UP TROUBLE SHOOTING

Problem & Possible Cause	Action
Carbon Fouled Plugs	
Clogged Air Filter	Replace Air Filter
Incorrect Idle Speed	Reset Idle Speed
Faulty Ignition Wiring	Replace Ignition Wiring
Sticky Valves/Worn Valve Seal	Check Valve Train
Fuel Injection Operation	Check Fuel Injection
Wet/Oil Fouled Plugs	
Worn Rings/Pistons	Overhaul/Replace Engine
Excessive Cylinder Wear	Overhaul/Replace Engine
Plug Gap Bridged	
Combustion Chamber Carbon Deposits	Clean Combustion Chamber
Blistered Electrode	
Engine Overheating	Check Cooling System
Loose Spark Plugs	Clean/Torque Plugs
Over-Advanced Timing	Reset Timing
Wrong Plug Heat Range	Install Correct Plug
Melted Electrodes	
Incorrect Timing	Reset Timing
Burned Valves	Replace Valves
Engine Overheating	Check Cooling System
Wrong Plug Heat Range	Install Correct Plug
Engine Won't Start	
Loose Connections	Check Connections
No Power	Check Fuses/Battery
Loose/Worn Timing Belt/Chain/Gears	Check Belt/Chain/Gears
Engine Runs Rough	
Leaky/Clogged Fuel Injectors	Repair Fuel Injectors

Problem & Possible Cause	Action
Leaky/Clogged Fuel Lines	Repair Fuel Lines
Clogged Fuel Filter	Replace Fuel Filter
Incorrect Timing	Reset Timing/Check Advance
Faulty Plugs/Wires	Replace Plugs/Wires
Uneven Compression	Overhaul/Replace Engine
Poor Acceleration	
Incorrect Ignition Timing	Reset Timing
Leaky Valves	Check Compression
Component Failure	
Spark Arcing	Replace Faulty Part
Defective Pick-Up Coil	Replace Pick-Up Coil
Defective Ignition Coil	Replace Ignition Coil
Defective Control Unit	Replace Control Unit
Ignition Diagnosis By Scope Pattern	
All Firing Lines Abnormally High	
Retarded Ignition Timing	Reset Ignition Timing
Lean Air/Fuel Mixture	Adjust Fuel Mixture
High Secondary Resistance	Repair Secondary Ignition
All Firing Lines Abnormally Low	
Rich Air/Fuel Mixture	Adjust Air/Fuel Mixture
Arcing Coil Wire	Replace Coil Wire
Cracked Coil	Replace Coil
Low Coil Output	Replace Coil
Low Compression	Check/Repair Engine
Several High Firing Lines	
Fuel Mixture Unbalanced	Check Fuel System
EGR Valve Stuck Open	Clean/Replace EGR Valve
High Plug Wire Resistance	Replace Plug Wire
Cracked/Broken Plugs	Replace Plugs
Intake Vacuum Leak	Repair Leak
Several Low Firing Lines	
Fuel Mixture Unbalanced	Adjust Fuel Mixture
Plug Wires Arcing	Replace Plug Wires
Cracked Coil Arcing	Replace Coil
Uneven Compression	Check/Repair Engine
Faulty Spark Plugs	Replace Plugs
Cylinders Not Firing	
Cracked Distributor Cap	Replace Cap

carmanual.com

Problem & Possible Cause	Action
Shorted Plug Wires	Replace Plug Wires
Mechanical Engine Fault	Check/Repair Engine
Spark Plugs Fouled	Replace Plugs
Carbon Track in Distributor Cap	Replace Cap
Hard Starting	
Defective Ignition Coil(s)	Replace Coil(s)
Fouled Spark Plugs	Replace Plugs
Incorrect Timing	Reset Ignition Timing

NOTE: **This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the ENGINE PERFORMANCE category.**

FUEL INJECTION TROUBLE SHOOTING

Problem & Possible Cause	Action
Cold Start Valve Inoperative	Test Cold Start Valve
Poor Vacuum/Electrical Connection	Repair Connections
Contaminated Fuel	Test Fuel for Water/Alcohol
Bad Fuel Pump Relay/Circuit	Test Relay/Wiring
Battery Voltage Low	Charge/Test Battery
Low Fuel Pressure	Test Press. Regulator/Pump
No Distributor Reference Pulse	Repair Ignition System
Coolant Temp. Sensor Defective	Test Temp. Sensor/Circuit
No Power To Injectors	Check Injector Fuse/Relay
Hard Starting	
Defective Idle Air Control (IAC)	Test IAC and Circuit
EGR Valve Open	Test EGR Valve/Control Circuit
Restricted Fuel Lines	Inspect/Replace Fuel Lines
Poor MAP Sensor Signal	Test MAP Sensor/Circuit
Engine Stalls During Parking Maneuver	Check P.S. Press. Switch
Rough Idle	
Dirty Fuel Injectors	Clean/Replace Injectors
Poor MAP Sensor Signal	Test MAP Sensor/Circuit
Intermittent Fuel Injector Operation	Check Harness Connectors
Erratic Vehicle Speed Sensor Inputs	Harness Too Close to Plug Wires
Poor O_2 Sensor Signal	Test O_2 Sensor/Circuit
Faulty PCV System	Check PCV Valve and Hoses
Poor Acceleration	
Weak Fuel Pump	Replace Fuel Pump

Problem & Possible Cause	Action
Dirty Fuel Injectors	Clean/Replace Injectors
Excessive Intake Valve Deposits	Clean Intake System
Poor High Speed Operation	
Low Fuel Pump Volume	Faulty Fuel Pump/Filter
Poor MAP Sensor Signal	Test Speed Sensor/Circuit
Acceleration Ping/Knock	
Faulty EGR System	Check EGR Valve and Hoses
Poor Knock Sensor Signal	Test Knock Sensor/Circuit
Poor Baro Sensor Signal	Test Baro Sensor/Circuit
Improper Ignition Timing	Adjust Timing
Engine Overheating	Check Cooling System
Poor Quality Fuel	Use Different Fuel
Carbon Build-Up	Decarbon Engine

cardiagn.com

Back To Article

INTRODUCTION

Mitchell1Â® obtains wiring diagrams and technical service bulletins, containing wiring diagram changes, from the domestic and import manufacturers. These are checked for accuracy and are all redrawn into a consistent format for easy use. All system wiring diagrams are available in color format and may be viewed and or printed in color or black and white, depending on your program settings and available printer hardware.

In the past, when cars were simpler, diagrams were simpler. All components were connected by wires, and diagrams seldom exceeded 4 pages in length. Today, some wiring diagrams require more than 16 pages. It would be impractical to expect a service technician to trace a wire from page 1 across every page to page 16.

Removing some of the wiring maze reduces eyestrain and time wasted searching across several pages. Today, the majority of Mitchell1Â® diagrams follow a much improved format, which permits space for internal switch details, and component and ground locations.

Components shown with a dashed line instead of a solid line indicate not all circuits are shown in this particular diagram (circuits shown in system diagrams are typically applicable to that system only). The remaining circuits connected to that component will be shown in the appropriate system that they apply to.

Today, the wiring diagram necessary to support a given repair procedure is included within that article or a link is provided to the appropriate SYSTEM WIRING DIAGRAM article. For example, the wiring diagram for a Ford EEC-IV system may be included in ENGINE PERFORMANCE and WIRING DIAGRAMS articles for Ford Motor Co. The wiring diagram for a cruise control system may be included in ACCESSORIES & EQUIPMENT section for the specific vehicle manufacturer, and the wiring diagram for an anti-lock brake system may be included in BRAKES and WIRING DIAGRAMS for the specific manufacturer.

WIRING DIAGRAMS contains all wiring diagrams not included in STARTING & CHARGING SYSTEMS and ACCESSORIES & EQUIPMENT. This includes: Data Link Connectors, Ground Distribution, Power Distribution, Engine Performance, Electric Cooling Fans, Anti-Lock Brakes, Electronic Suspension and Electronic Steering wiring diagrams. The Data Link Connectors wiring diagrams show the circuits by which the various on-board computers exchange information, and the diagnostic connectors used for diagnosis and their location. The Ground Distribution wiring diagrams show all vehicle ground points, their location, and the components common to those ground points. The Power Distribution wiring diagrams show the power feed circuits and the components common to those power feeds.

Wiring diagrams used to support the information in ACCESSORIES & EQUIPMENT are drawn in a "top-down" format. The diagrams are drawn with the power source at the top of the diagram and the ground point at the bottom of the diagram. Component locations are identified on the wiring diagrams. Any wires that do not connect directly to a component are identified on the diagram to indicate where they go.

WIRING DIAGRAM COLOR ABBREVIATIONS

COLOR ABBREVIATIONS

Color	Normal	Optional	Misc. Euro Models
Black	BLK	BK	B
Blue	BLU	BU	U
Brown	BRN	BN	N
Clear	CLR	CR	L

Color	Normal	Optional	Misc. Euro Models
Dark Blue	DK BLU	DK BU	-
Dark Green	DK GRN	DK GN	-
Green	GRN	GN	G
Gray	GRY	GY	S
Light Blue	LT BLU	LT BU	-
Light Green	LT GRN	LT GN	-
Orange	ORG	OG	O
Pink	PNK	PK	K
Purple	PPL	PL	P
Red	RED	RD	R
Tan	TAN	TN	-
Violet	VIO	VI	-
White	WHT	WT	W
Yellow	YEL	YL	Y

WIRING DIAGRAM SYMBOLS

cardiagn.com

NOTE: Standard wiring symbols are used on all wiring diagrams. The list below will help clarify any symbols that are not easily understood at a glance. Most components are labeled "Motor", "Switch" or "Relay" in addition to being drawn with the standard symbol.

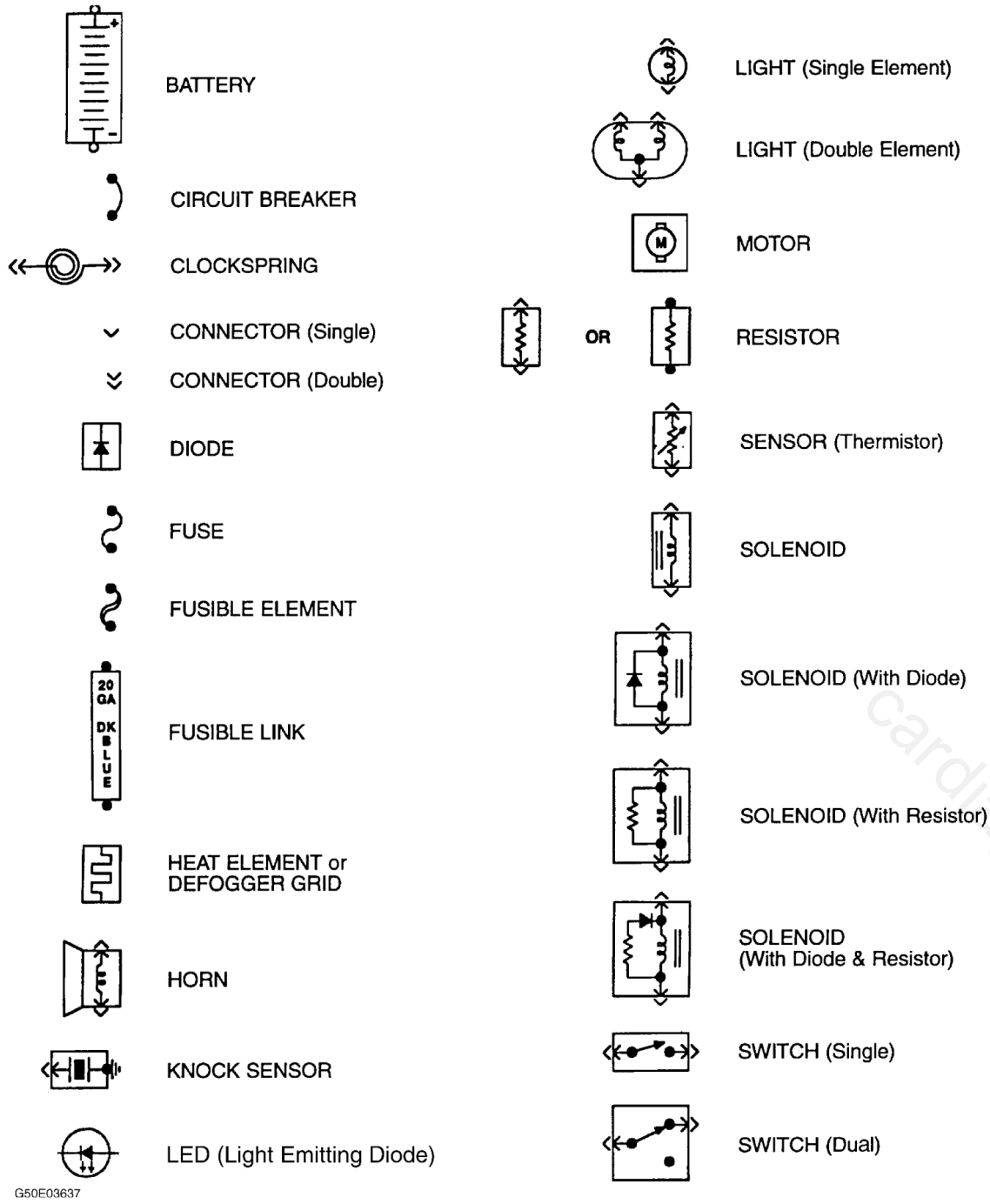
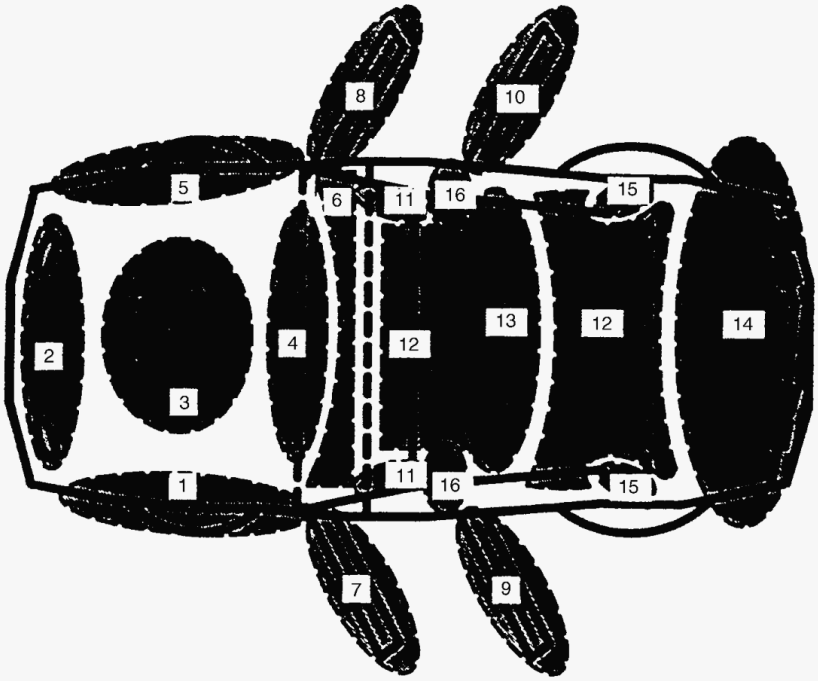


Fig. 1: Identifying Standard Wiring Diagram Symbols

WIRING DIAGRAM GROUND NUMBER LOCATIONS

NOTE: **The following illustration depicts standardized ground numbers and locations to be used in conjunction with Mitchell1's Â® wiring diagrams applying to 2001 and prior model years only. See Fig. 2. Wiring diagrams applying to newer model years depict manufacturer-specified ground numbers and locations. Do not utilize the illustration with 2002 and newer model year wiring diagrams.**

cardiagn.com



1) Left Fender
G100 ..... Front Of Fender
G102 ..... On Shock Tower
G104 ..... Rear Of Fender

2) Front of Vehicle
G106 ..... Behind Left Headlight
G107 ..... Behind Right Headlight
G108 ..... Left Radiator Support
G109 ..... Right Radiator Support

3) Engine
G110 ..... Left Front Of Engine
G111 ..... Left Front Behind Battery
G112 ..... Left Side Of Engine
G114 ..... Left Rear Of Engine
G115 ..... Rear Of Engine
G117 ..... Right Rear Of Engine
G119 ..... Right Front Of Engine
G120 ..... Right Side Of Engine
G125 ..... Front Of Engine
G127 ..... Left Underside Of Hood
G128 ..... Right Underside Of Hood
G129 ..... Top Center Of Transaxle

4) Safety Wall
G116 ..... Left Side Of Safety Wall
G121 ..... Center Of Safety Wall
G123 ..... Right Side Of Safety Wall

5) Right Fender
G101 ..... Front Of Fender
G103 ..... On Shock Tower
G105 ..... Rear Of Fender

6) Instrument Panel
G200 ..... Left Kick Panel
G201 ..... Right Side Of I/P
G202 ..... Left Side Of I/P
G203 ..... Right Kick Panel
G204 ... Left Rear Of Steering Support
G205 .. Right Rear Of Steering Support
G206 ..... Center Of I/P
G207 ..... Top Of Steering Column

7) Left Front Door
G500 ..... Left Front Door

8) Right Front Door
G600 ..... Right Front Door

9) Left Rear Door
G700 ..... Left Rear Door

10) Right Rear Door
G800 ..... Right Rear Door

11) "A" Pillars
G900 ..... Left "A" Pillar
G901 ..... Right "A" Pillar

12) Passenger Compartment
G300 ..... Below Left Front Seat
G301 ..... Below Right Front Seat
G302 ..... Below Center Console
G303 ..... Below Right Rear Seat
G304 ..... Below Left Rear Seat
G306 ..... Below Center Of Rear Seat
G307 ..... Below Right Rear Window
G309 ..... Left Front Door Sill
G310 ..... Behind Right Rear Seat
G311 ..... Center Of Rear Shelf
G312 ..... Behind Left Rear Seat

13) Roof
G902 ..... Left Front Of Roof
G903 ..... Right Front Of Roof
G906 ..... Left Rear Of Roof
G907 ..... Right Rear Of Roof
G908 ..... Center Front Of Roof
G909 ..... Center Rear Of Roof

14) Rear Of Vehicle
G400 ..... Left Front Side Of Trunk
G401 ..... Right Front Side Of Trunk
G402 ..... Left Rear Wheelwell
G403 ..... Right Rear Wheelwell
G404 ..... Left Rear Side Of Trunk
G405 ..... Right Rear Side Of Trunk
G406 ..... Center Rear Of Trunk Lid
G407 ..... Center Rear Of Trunk
G408 ..... Center Front Of Trunk
G409 ..... Rear Of Cargo Bed

15) "C" Pillars
G904 ..... Left "C" Pillar
G905 ..... Right "C" Pillar

16) "B" Pillars
G305 ..... Right "B" Pillar
G308 ..... Left "B" Pillar

G00027307

Fig. 2: Ground Numbers & Locations (2001 & Prior Model Years)

WIRING DIAGRAM COMPONENT LOCATIONS

When trying to locate a component in a wiring diagram and you don't know the specific system where it is located, use this handy component locator to find the system wiring diagram in which the component is located. Then, go to that system and locate the component within the wiring diagram.

For example, if you don't know the specific system in which the ignition switch is located, look up ignition switch in the wiring diagram component location tables and go to the appropriate wiring diagram(s) which contain either full or partial views of the ignition switch. The full view of the ignition switch is located in Power Distribution.

The first listing for the component will be the full or most complete view of the component. Additional listings will be partial views of the component. Not all components are used on all models.

All components will have a partial view in Ground Distribution and Power Distribution. Data Link Connectors show connecting circuits between modules. Alternate names for components may be listed in wiring diagram component locations tables.

WIRING DIAGRAM COMPONENT LOCATIONS

Component	Wiring Diagram
ABS Electronic Control Unit	Anti-Lock Brakes; Data Link Connectors
ABS Hydraulic Unit	Anti-Lock Brakes
Acceleration Sensor	Anti-Lock Brakes
Accessory Delay Relay	Power Windows
A/C Compressor Clutch Relay	Engine Performance
A/C Sensor	Engine Performance
A/C Pressure Switch	Engine Performance
Adaptive Lamp Control Module	Exterior Lights
Air Bag(s)	Air Bag Restraint System
Air Bag Module	Air Bag Restraint System
Air Bag Sensor(s)	Air Bag Restraint System
Air Injection Pump Relay	Engine Performance
Air Temperature Sensor	Overhead Console
Alternator (Generator)	Generators & Regulators
Anti-Theft Control Module	Anti-Theft System; Starters
Autolamp Control Relay	Headlight Systems; Daytime Running Lights
Automatic Shutdown (ASD) Relay	Engine Performance; Generators & Regulators
Autostick Switch	Engine Performance
Auxiliary Battery Relay	Generators & Regulators
Back-Up Lights	Back-Up Lights; Exterior Lights
Barometric (BARO) Pressure Sensor	Engine Performance
Battery	Power Distribution
Battery Temperature Sensor	Engine Performance
Body Control Module	Body Control Computer; Anti-Theft System; Daytime Running Lights; Engine Performance; Headlight Systems; Warning Systems
Boost Control Solenoid	Engine Performance
Boost Sensor	Engine Performance
Brake Fluid Level Switch	Analog Instrument Panels
Brake On/Off (BOO) Switch	Cruise Control Systems; Engine Performance; Shift Interlock Systems
Buzzer Module	Warning Systems
Camshaft Position (CMP) Sensor	Engine Performance
Central Control Module	Anti-Theft System
Clockspring	Air Bag Restraint System; Cruise Control Systems; Steering Column Switches
Clutch Pedal Position Switch	Starters
Clutch Start Switch	Starters
Combination Meter	Analog Instrument Panels
Constant Control Relay Module (CCRM)	Engine Performance; Electric Cooling Fans
Convenience Center	Power Distribution; Illumination/Interior Lights
Convertible Top Motor	Power Convertible Top
Convertible Top Switch	Power Convertible Top
Crankshaft Position (CKP) Sensor	Engine Performance
Cruise Control Module	Cruise Control Systems
Cruise Control Switch	Cruise Control Systems
Condenser Fan Relay(s)	Electric Cooling Fans
Data Link Connector (DLC)	Engine Performance
Daytime Running Lights Module	Daytime Running Lights; Exterior Lights
Defogger Relay	Rear Window Defogger
Diagnostic Energy Reserve Module (DERM)	Air Bag Restraint System
Discriminating Sensor (Air Bag)	Air Bag Restraint System

Component	Wiring Diagram
Distributor	Engine Performance
Door Lock Actuators	Power Door Locks; Remote Keyless Entry
Door Lock Relay(s)	Power Door Locks
Electrochromic Mirror	Power Mirrors
Electronic Level Control (ELC) Height Sensor	Electronic Suspension
Electronic Level Control (ELC) Module	Electronic Suspension
Engine Coolant Temperature (ECT) Sending Unit	Analog Instrument Panels
Engine Coolant Temperature (ECT) Sensor	Engine Performance
Engine Control Module	Engine Performance; Generators & Regulators; Starters
ETACS ECU	Warning Systems; Power Windows; Remote Keyless Entry
Evaporative (EVAP) Emissions Canister	Engine Performance
EVAP Canister Purge Solenoid	Engine Performance
EVAP Canister Vent Solenoid	Engine Performance
Exhaust Gas Recirculation (EGR) Valve	Engine Performance
Fuel Tank Vacuum Sensor	Engine Performance
Fog Lights	Headlight Systems; Daytime Running Lights
Fog Light Relay	Headlight Systems; Daytime Running Lights
Fuel Door Release Solenoid	Power Fuel Door Release
Fuel Gauge Sending Unit	Analog Instrument Panels
Fuel Injectors	Engine Performance
Fuel Pump	Engine Performance
Fuel Pump Relay	Engine Performance; Power Distribution
Fuse/Relay Block	Power Distribution
Fusible Links	Power Distribution; Generators & Regulators; Starters
Generator	Generators & Regulators; Engine Performance; Power Distribution
Generic Electronic Module (GEM)	Body Control Modules; Electronic Suspension
Glow Plug Relay	Engine Performance
Glow Plugs	Engine Performance
Grounds	Ground Distribution
Headlight Door Module	Headlight Doors
Headlight Relay	Headlight Systems; Daytime Running Lights
Headlights	Headlight Systems; Daytime Running Lights
Heated Oxygen Sensor(s) (HO2S)	Engine Performance
Heated Windshield Control Module	Heated Windshields
Height Sensor	Electronic Suspension
Horns	Steering Column Switches
Horn Relay	Steering Column Switches
Idle Air Control (IAC) Motor/Valve	Engine Performance
Ignition Coil(s)	Engine Performance
Ignition Key Lock Cylinder	Anti-Theft System
Ignition Module	Engine Performance
Ignition Switch	Power Distribution; Engine Performance; Generators & Regulators; Starters
Illuminated Entry Module	Illumination/Interior Lights
Illumination Lights	Illumination/Interior Lights
Impact Sensor	Air Bag Restraint System
Inertia Fuel Shutoff Switch	Engine Performance
Inhibit Relay	Starters

Component	Wiring Diagram
Instrument Cluster	Analog Instrument Panels
Intake Air Temperature (IAT) Sensor	Engine Performance
Interior Lights	Illumination/Interior Lights
Interlock Switch	Starters
Junction Block	Power Distribution
Keyless Entry Receiver	Remote Keyless Entry
Key Reminder Switch	Starters
Knock Sensor	Engine Performance
Lamp Control Module	Exterior Lights
License Plate Lamp	Exterior Lights
Lighting Control Module	Lighting Control Modules; Anti-Theft System; Daytime Running Lights; Headlight Systems
Lower Relay	Power Convertible Top
Malfunction Indicator Light (MIL)	Engine Performance; Instrument Panels
Manifold Absolute Pressure (MAP) Sensor	Engine Performance
Mass Airflow (MAF) Sensor	Engine Performance
Mega Fuse	Generators & Regulators
Memory Seat/Mirror Module	Memory Systems
Mirror Defogger	Rear Window Defogger
Moon Roof Motor	Power Moon Roof
Moon Roof Relay	Power Moon Roof
Multi-Function Control Module	Warning Systems
Neutral Safety Switch	Starters
Oil Level Switch	Engine Performance
Oil Pressure Switch/Sending Unit	Analog Instrument Panels; Engine Performance
Overhead Console	Overhead Console
Oxygen Sensor(s) (O2S)	Engine Performance
Parking Brake Switch	Analog Instrument Panels
Park Lights	Exterior Lights
Park/Neutral Position Switch	Starters; Engine Performance; Anti-Theft System; Body Control Module
Perimeter Lighting Control Relay	Exterior Lights
Power Amplifier	Power Antennas
Power Antenna Module	Power Antennas
Power Antenna Motor	Power Antennas
Power Distribution Center	Power Distribution; Generators & Regulators; Starters
Power Door Lock Motors	Power Door Locks
Power Mirror Motors	Power Mirrors; Memory Systems
Power Sliding Door Controller	Power Sliding Side Door
Power Seat Motors	Power Seats; Memory Systems
Power Steering Pressure Switch	Engine Performance
Power Top Motor	Power Convertible Top
Power Top Relay(s)	Power Convertible Top
Powertrain Control Module	Engine Performance; Analog Instrument Panels; Cruise Control Systems; Data Link Connectors; Generators & Regulators; Starters
Power Window Motors	Power Windows
Power Window Relay(s)	Power Windows
Radiator Fan Motor(s)	Electric Cooling Fans
Radiator Fan Relay(s)	Engine Performance; Electric Cooling Fans;
Rainsense Module	Wiper/Washer Systems
Raise Relay	Power Convertible Top

Component	Wiring Diagram
Remote Anti-Theft Personality (RAP) Module	Anti-Theft System; Starters; Warning Systems
Seat Belt Pretensioners	Air Bag Restraint System
Seat Belt Retractor Solenoid	Passive Restraints
Seat Belt Switch	Air Bag Restraint System; Passive Restraints
Shift Interlock Solenoid	Shift Interlock Systems
Shift Lock Actuator	Shift Interlock Systems
Side Marker Lights	Exterior Lights
SIR Coil Assembly (Clockspring)	Air Bag Restraint System
Slip Ring (Clockspring)	Air Bag Restraint System; Steering Column Switches
SRS Control Module	Air Bag Restraint System
Starter Motor	Starters
Starter Interrupt Relay	Starters
Starter Solenoid	Starters
Starter Relay	Starters
Steering Wheel Position Sensor	Anti-Lock Brakes
Stoplights	Exterior Lights
Stoplight Switch	Engine Performance; Cruise Control Systems; Anti-Lock Brakes
Sun Roof ECU	Power Sun Roof
Sun Roof Motor	Power Sun Roof
Sun Roof Position Sensor	Power Sun Roof
Taillights	Exterior Lights
Throttle Position (TP) Sensor	Engine Performance
Torque Converter Clutch Solenoid/Switch	Engine Performance
Traction Control Switch	Anti-Lock Brakes
Trailer Tow Connector	Exterior Lights
Trailer Tow Relay	Exterior Lights
Transmission/Transaxle	Engine Performance
Transmission Control Module (TCM)	Engine Performance; Starters
Transmission Range Sensor	Starters; Back-Up Lights; Engine Performance
Transmission Range Switch	Back-Up Lights; Engine Performance; Anti-Theft System
Turn Signal Flasher	Exterior Lights
Turn Signal Lights	Exterior Lights
Twilight Sentinel Switch	Headlight Systems; Daytime Running Lights
Vapor Canister Leak Detection Pump	Engine Performance
Vehicle Control Module (VCM)	Engine Performance
Vehicle Dynamic Module	Electronic Suspension
Vehicle Speed Control Servo	Cruise Control Systems
Vehicle Speed Sensor	Data Link Connectors; Analog Instrument Panels; Cruise Control Systems; Electronic Suspension
Voltage Regulator	Generators & Regulators
Water-In-Fuel Sensor	Engine Performance; Analog Instrument Panels
Wheel Speed Sensors	Anti-Lock Brakes
Window Timer Module	Power Convertible Top
Windshield Intermittent Wiper Relay	Wiper/Washer Systems
Windshield Washer Motor	Wiper/Washer Systems
Wiper Motor	Wiper/Washer Systems

cardiagn.com

Back To Article

DESCRIPTION AND OPERATION

PROACTIVE ALERTS DESCRIPTION AND OPERATION

Proactive Alert System Overview

NOTE: **The customer must enroll their vehicle in this program through the OnStar web site or with an OnStar advisor to receive Proactive Alerts. When the customer enrolls their vehicle they select their notification preferences (email address and/or text message). They also identify their preferred service provider which is often the selling dealer.**

This system was also utilized on some 2015 & 2016 models. The operation of those systems is covered by a separate service bulletin.

This system collects and stores specific system performance data each ignition cycle. The data is then transmitted via the cellular system when the ignition switch has been in Run or Accessory power mode for six minutes. The transmitted data is stored off board the vehicle and analyzed by special algorithms to detect degraded performance. When monitored system performance degrades to predetermined levels, the off board system sends a Proactive Alert Identifier. The affected system is identified within the alert.

When a Proactive Alert is active:

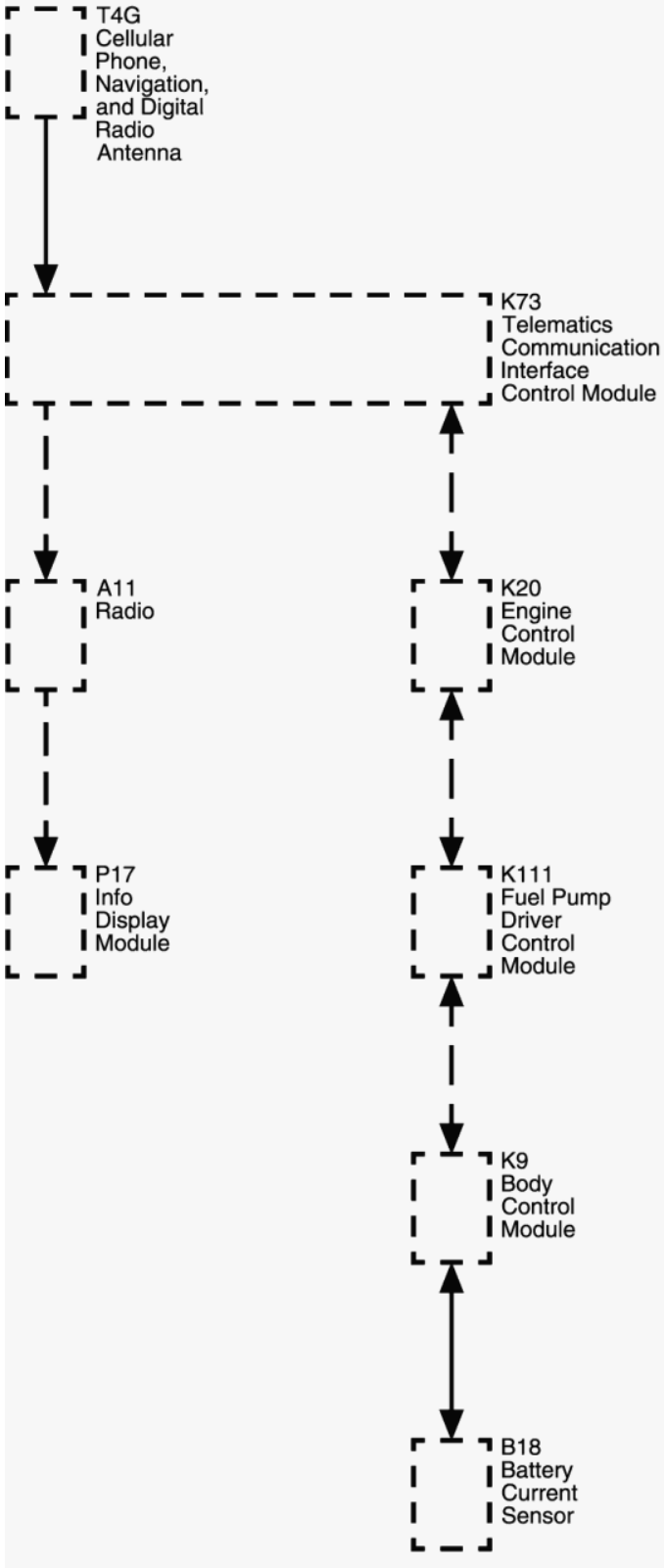
- E-mail and/or Text Message is sent to the customer
- E-mail is sent to the preferred service provider (Customer Experience Manager at GM Dealers)
- Message back to the vehicle through the cellular system

When the vehicle receives this identifier it is stored in the K73 Telematics Communication Interface Module. When stored, the K73 Telematics Communication Interface Module requests a specific identifier to display on the radio and to play an audio message. Each identifier is displayed/played one time only when vehicle is next started. If there is no performance improvement detected before seven days and then again at fourteen days, the system will send a reminder which contains the same identifier as the original.

When the collected data indicates component performance is normal again, no reminder alerts are sent and the system continues to monitor as before the active alert.

Proactive alert identifiers stored in the K73 Telematics Communication Interface Module can only be cleared using a scan tool. The identifiers do not clear due to key cycles or mileage. Some vehicles could come in that have an identifier stored that was addressed earlier. Ask the customer if they can produce the E-mail and check the date it was sent if you suspect that it is not active. Also, the identifier will not be retained if the K73 Telematics Communication Interface Module is replaced.

carfdiagn.com



cardiagn.com

Fig. 1: Proactive Alert System Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
T4G	T4G Cellular Phone, Navigation, and Digital Radio Antenna
K73	K73 Telematics Communication Interface Control Module
A11	A11 Radio
P17	P17 Info Display Module
K20	K20 Engine Control Module
K111	K111 Fuel Pump Driver Control Module
K9	K9 Body Control Module
B18	B18 Battery Current Sensor

- Telematics Communication Interface Control Module
- Cellular Antenna

- Radio
- Display Module (if equipped)
- Body Control Module
- Engine Control Module
- Fuel Pump Driver Control Module
- Battery Current Sensor
- Off-board Vehicle Database

---

cardiagn.com

Back To Article

2018 GENERAL INFORMATION

Vehicle Diagnostic Information - Diagnostic Information And Procedures - Equinox & Terrain

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 steps are numbered, you are not required to complete every step 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 to Repair and verify the Fix. Refer to the steps listed below for the correct Strategy Based Diagnosis.

NOTE: **For additional information on the following steps refer to the corresponding numbered paragraphs listed below.**

1. Understand and verify the customers concern.
2. Verify the vehicle is not operating as designed:
    - **If the vehicle is operating as designed review the suggestions listed below:**
    - Check Identical Vehicle
    - Customer Misunderstanding of System - Explain operation to customer or refer to owner's manual or service information
    - Customer dissatisfaction - Submit a Field Product Report
    - **Go to next step: If the vehicle is not operating as designed**
3. Perform preliminary checks - Visual inspections and operational
    - **If the customers concern is found, refer to step 7**
    - **Go to next step: If the customers concern is not found**
4. Perform the Diagnostic System Check - Vehicle, determine the diagnostic service category to perform.
    - **If the customers concern is found, refer to step 7**
    - **Go to next step: If the customers concern is not found**
5. Check for related Bulletins, Recalls and Preliminary Information.
    - **If the customers concern is found, refer to step 7**
    - **Go to next step: If the customers concern is not found**
6. Follow the diagnostic path listed below:
    1. Current DTC - Follow DTC Diagnostics
    2. Symptom no DTC - Follow Symptom Diagnostics
    3. No published diagnostic - Analyze and develop diagnostics or call Technical Assistance
    4. Intermittent/History DTC - See diagnostic detail below
7. Isolate the root cause then repair and verify the fix.
8. Re-examine the concern.
    - **If the vehicle is not repaired, refer to step 1**
    - **Go to next step: If the vehicle is repaired**
9. All OK.

Additional Information

cardiagn.com

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's manual or service information 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 information wiring 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.

          North America - 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 blank CCVS can be found in GM Global Connect under Service, Service Forms.

        - Follow the suggestions on **Testing for Intermittent Conditions and Poor Connections** .
        - Use a tool with data capturing capabilities like scan tool, digital multi-meter, or (if available) a vehicle data recorder.
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.

DIAGNOSTIC PROCEDURE INSTRUCTIONS

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

DTC Descriptor

Lists all DTCs and descriptors that are diagnosed within the procedure.

If the DTC supports symptom bytes they will either be listed with the DTC or there will be a link to the symptom byte list.

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 DTCs and symptoms apply for the subsystem being diagnosed.

All DTCs and symptoms shown in this table are not necessarily diagnosed during this procedure.

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

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0117	P0118, P0119	P0118*, P0119	P0128, P111E
Low Reference	-	P0118, P0119	-	P0128
* Internal control module or component damage may occur if the circuit shorts to B+.				

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

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine = Idling - At normal operating temperature. **Parameter Normal Range:** 88 to 105Â°C (190 to 221Â°F)			
Signal	140Â°C (248Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)
Low Reference	-	-40Â°C (-40Â°F)	-

Circuit/System Description

Circuit/System Description identifies circuits, components, and describes how the 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 conditions that must be present in order to fail the diagnostic and when to set the DTC.

Actions 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 to assist the technician in finding and repairing a vehicle condition.

Reference Information

Reference Information includes links providing additional information to be used with the diagnostic procedure.

For example:

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

Circuit/System Verification

The Circuit/System Verification, when supported, needs to be performed prior to the Circuit/System Testing. It will determine the following conditions:

- If a higher priority concern needs to be addressed first (E.g. other DTCs)
- If other conditions are present (E.g. low fluid level)
- If the condition is current
- If the condition is intermittent
- If the system is all OK

NOTE: **Any diagnostic step that asks if a DTC is "set" refers to a Set, Current, Present, Active DTC status. This does not include any other DTC status. For example History, Not Run, Passed and Failed.**

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. The verification is used to assist the technician in determining whether a condition is current, intermittent, or not present (All OK). When a condition is determined to be intermittent a technician can use the **Testing for Intermittent Conditions and Poor Connections** link in Electrical Information Reference for additional testing information.

The technician should be able to identify if the fault is occurring on the input (signal) circuit or on the output (control) circuit when applicable.

Component Codes

cardiagn.com

The component codes are a language independent method of identifying a common component between different areas in the service information. The component codes work regardless on how the actual component name was translated.

The component codes used on the wiring schematics will have the base code with an extension to identify location or quantity. For example the ABS wheel speed sensors are identified on the schematic with a base code (B5) and a location extension (LF, RF, LR, and RR) as seen below:

- B5LF Wheel Speed Sensor - Left Front
- B5RF Wheel Speed Sensor - Right Front
- B5LR Wheel Speed Sensor - Left Rear
- B5LR Wheel Speed Sensor - Left Rear

The diagnostic procedures will use the base code (B5) for a wheel speed sensor but may or may not use the extension identifying location (LF, RF, LR, and RR).

Example:

Disconnect the harness connector at the appropriate B5 Wheel Speed Sensor.

Or

Disconnect the appropriate electrical connector: B5 Wheel Speed Sensor

This is done so the diagnostic procedure can be common for all four wheel speed sensors and not have to take into account part location or quantity.

When the diagnostic states "the appropriate" it is up to the technician to identify which component is being diagnosed either by the symptom (Driver's door lock is inoperative) or the DTC descriptor (DTC C0585 04: Left Rear Door Latch Circuit Open).

carsdiagn.com

Circuit/System Testing

NOTE: **Performing the Circuit/System Verification category first will aid in determining if a vehicle condition currently exists.**

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 NOT achieved, the Right Repair Arrow below the failed test will identify what actions need to take place. If the result of a numbered test step is achieved, the normal flow is to proceed to the next numbered test step, as indicated by the Down Pass Arrow.

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

When testing for individual circuit faults, the technician is expected to perform terminal inspections such as connection surfaces and terminal tension at both the harness and the component or control module. When a condition is determined to be intermittent a technician can use the **Testing for Intermittent Conditions and Poor Connections** , or **Circuit Testing** link in Electrical Information Reference for additional information.

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

Component Testing

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

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

Repair Instructions

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

All links to repair, replacement, or programming 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 the Diagnostic Repair Verification.

DIAGNOSTIC SYSTEM CHECK INSTRUCTIONS

The following is an overview of instructions for the general information and 13 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 13 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 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 Wiring 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 Wiring Schematics , and Harness Routing Views for technicians to reference ground locations and which ground circuits may be related to the customer concern.
- All connectors/terminals fully seated in the area of concern. 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 - INDEX** 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 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's manual or service information 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 power mode 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 power mode master and back-up power mode 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 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 Vehicle DTC Information function. 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 5 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 was built with that option, we provide a link to the **Data Link References** , document where Regular Production Options (RPOs) are listed next to the names of optional ECU's 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 POWER MODE 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 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

Cardiagn.com

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
    - 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

cardiagn.com

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 information 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.

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

- The 12 V battery is fully charged and cables are clean and tight. Refer to **Battery Inspection/Test** .
- Fuses are not open. Refer to Power Distribution Wiring 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 Wiring Schematics , and Harness Routing Views .
- All connectors/terminals fully seated in the area of concern. Refer to **COMPONENT CONNECTOR END VIEWS - INDEX** .
- 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**.

    - **Go to next step: If the symptom is not a mechanical concern**

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**

carsdiagn.com

store DTC and Freeze Frame/Failure Records to the scan tool.

4. VEHICLE POWER UP VERIFICATION - Ignition/Vehicle - On Verify the vehicle powers up.
   - **If the vehicle does not power up**

     Refer to **Power Mode Mismatch** .
   - **Go to next step: If the vehicle powers up**
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** .
   - **Go to next step: If the scan tool communicates with any control module**
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**.
   - **Go to next step: If no DTC of this type is set**
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 vehicle is built with a control module that is not communicating**

     Refer to **Data Link References** .
   - **Go to next step: If all control modules the vehicle is built with are communicating**
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**.
   - **Go to next step: If no DTC of this type is set**

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 each scan tool Power Mode data parameter while cycling through all power modes. Verify all Power Mode data parameters match the actual ignition switch/push button switch selection.
   - **If any Power Mode data parameter does not match**

     Refer to **Power Mode Mismatch** .
   - **Go to next step: If all Power Mode data parameters match**
10. PROACTIVE ALERT IDENTIFIERS - The technician is asked in this step to verify there are no Proactive Alert Identifiers set. These identifiers are displayed on the scan tool and will only appear when the OnStar subscription is active and the customer has opted into the Proactive Alert service.
    - **If any Proactive Alert Identifier is set**

carsdiagn.com

Refer to: **Proactive Alerts List**

- **Go to next step: If no Proactive Alert Identifier is set**

11. 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**.

    - **Go to next step: If the engine cranks and runs**
12. 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 or Configuration or Software Performance DTCs
      3. Component related DTCs
      4. System related DTCs
      5. Any remaining DTCs

    - **Go to next step: If no other DTCs are set**
13. 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**.

    - **Go to next step: If the customer concern is not related to inspection/maintenance testing**
14. 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

- 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 malfunction on the second consecutive ignition cycle, the control module records the operating conditions at the time of the malfunction. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

- The following applies to misfire DTCs:

Carediagn.com

- 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% 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% 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 warmup cycles, if no malfunctions are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

carmagn.com

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.
- 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 warmup cycles, if no malfunctions are reported by this or any other non emission related diagnostic.
- Clear the DTC with a scan tool.

DIAGNOSTIC TROUBLE CODE (DTC) LIST - VEHICLE

This master list includes all applicable diagnostic trouble codes in alphanumeric order.

DTC	Diagnostic Procedure
B0000	Antilock Brake System - **DTC B0000**
B000A	Wiring Systems and Power Management - **DTC B000A**
B0012	Supplemental Restraints - **DTC B0012 or B0013**
B0013	Supplemental Restraints - **DTC B0012 or B0013**
B0014	Supplemental Restraints - **DTC B0014, B0021, B0031, or B0038**
B0015	Supplemental Restraints - **DTC B0015, B001A, B001B, or B0022**

DTC	Diagnostic Procedure
B0016	Supplemental Restraints - **DTC B0016, B0018, B0023, or B0025**
B0018	Supplemental Restraints - **DTC B0016, B0018, B0023, or B0025**
B0019	Supplemental Restraints - **DTC B0019 or B0020**
B001A	Supplemental Restraints - **DTC B0015, B001A, B001B, or B0022**
B001B	Supplemental Restraints - **DTC B0015, B001A, B001B, or B0022**
B0020	Supplemental Restraints - **DTC B0019 or B0020**
B0021	Supplemental Restraints - **DTC B0014, B0021, B0031, or B0038**
B0022	Supplemental Restraints - **DTC B0015, B001A, B001B, or B0022**
B0023	Supplemental Restraints - **DTC B0016, B0018, B0023, or B0025**
B0025	Supplemental Restraints - **DTC B0016, B0018, B0023, or B0025**
B0031	Supplemental Restraints - **DTC B0014, B0021, B0031, or B0038**
B0038	Supplemental Restraints - **DTC B0014, B0021, B0031, or B0038**
B0052	Supplemental Restraints - **DTC B0052**
B0071	Supplemental Restraints - **DTC B0071**
B0072	Seat Belts - **DTC B0072 or B0073**
B0073	Seat Belts - **DTC B0072 or B0073**
B0081	Supplemental Restraints - **DTC B0081 (Inflatable Restraint Sensing and Diagnostic Module)** **DTC B0081 (Passenger Presence Module)**
B0082	Seat Belts - **DTC B0082**
B0083	Supplemental Restraints - **DTC B0083 or B0084**
B0084	Supplemental Restraints - **DTC B0083 or B0084**
B0085	Supplemental Restraints - **DTC B0085 or B0088**
B0086	Supplemental Restraints - **DTC B0086 or B0087**
B0087	Supplemental Restraints - **DTC B0086 or B0087**
B0088	Supplemental Restraints - **DTC B0085 or B0088**
B0163	HVAC - Automatic - **DTC B0163 or B0183**
B0183	HVAC - Automatic - **DTC B0163 or B0183**
B018A	HVAC - Automatic - **DTC B018A, B048C, B048F, or B1395**
B0193	HVAC - Automatic - **DTC B0193**
B0193	HVAC - Manual - **DTC B0193**
B0223	HVAC - Automatic - **DTC B0223, B0233, B023A, B0408, or B0418**
B0223	HVAC - Manual - **DTC B0223, B0233, B023A, or B0408**
B0233	HVAC - Automatic - **DTC B0223, B0233, B023A, B0408, or B0418**
B0233	HVAC - Manual - **DTC B0223, B0233, B023A, or B0408**
B023A	HVAC - Automatic - **DTC B0223, B0233, B023A, B0408, or B0418**
B023A	HVAC - Manual - **DTC B0223, B0233, B023A, or B0408**
B0283	Fixed and Moveable Windows - **DTC B0283**
B0408	HVAC - Automatic - **DTC B0223, B0233, B023A, B0408, or B0418**
B0408	HVAC - Manual - **DTC B0223, B0233, B023A, or B0408**
B0418	HVAC - Automatic - **DTC B0223, B0233, B023A, B0408, or B0418**
B048C	HVAC - Automatic - **DTC B018A, B048C, B048F, or B1395**
B048D	HVAC - Automatic - **DTC B048D**
B048D	HVAC - Manual - **DTC B048D**
B048F	HVAC - Automatic - **DTC B018A, B048C, B048F, or B1395**
B0550	Displays and Gauges - **DTC B0550**
B0560	Active Noise Cancellation - **DTC B0560**
B0560	Cellular, Entertainment, and Navigation - **DTC B0560**
B059A	Seat Belts - **DTC B059A**
B067F	Supplemental Restraints - **DTC B067F or B0680**
B0680	Supplemental Restraints - **DTC B067F or B0680**
B071F	Displays and Gauges - **DTC B071F**
B0931	Displays and Gauges - **DTC B0931**

cardiagn.com

DTC	Diagnostic Procedure
B094B	Driver Assistance Systems - **DTC B094B or B094C**
B094C	Driver Assistance Systems - **DTC B094B or B094C**
B094D	Driver Assistance Systems - **DTC B094D or B094E**
B094E	Driver Assistance Systems - **DTC B094D or B094E**
B0954	Parking Assistance Systems - **DTC B0954-B0961, B096C, or B096D**
B0955	Parking Assistance Systems - **DTC B0954-B0961, B096C, or B096D**
B0956	Parking Assistance Systems - **DTC B0954-B0961, B096C, or B096D**
B0957	Parking Assistance Systems - **DTC B0954-B0961, B096C, or B096D**
B0958	Parking Assistance Systems - **DTC B0954-B0961, B096C, or B096D**
B0959	Parking Assistance Systems - **DTC B0954-B0961, B096C, or B096D**
B0960	Parking Assistance Systems - **DTC B0954-B0961, B096C, or B096D**
B0961	Parking Assistance Systems - **DTC B0954-B0961, B096C, or B096D**
B0967	Parking Assistance Systems - **DTC B0967 or B0968**
B0968	Parking Assistance Systems - **DTC B0967 or B0968**
B096B	Parking Assistance Systems - **DTC B096B**
B096C	Parking Assistance Systems - **DTC B0954-B0961, B096C, or B096D**
B096D	Parking Assistance Systems - **DTC B0954-B0961, B096C, or B096D**
B097B	Wiring Systems and Power Management - **DTC B097B**
B097C	Wiring Systems and Power Management - **DTC B097C**
B0987	Driver Assistance Systems - **DTC B0987 (Chevrolet) DTC B0987 (GMC)**
B0997	Cellular, Entertainment, and Navigation - **DTC B0997**
B1000	Data Communications - **DTC B1000**
B1001	Data Communications - **DTC B1001**
B1001	Supplemental Restraints - **DTC B1001**
B1011	Driver Assistance Systems - **DTC B1011**
B1015	Driver Assistance Systems - **DTC B1015**
B1015	Parking Assistance Systems - **DTC B1015**
B1019	Vehicle Access - **DTC B1019**
B1019	Supplemental Restraints - **DTC B1019**
B101D	Data Communications - **DTC B101D**
B101D	Driver Assistance Systems - **DTC B101D (Frontview Camera Module or Frontview Camera - Windshield)**
B101E	Data Communications - **DTC B101E**
B1024	Cellular, Entertainment, and Navigation - **DTC B1024**
B1025	Cellular, Entertainment, and Navigation - **DTC B1025, B1035, B1045 or B1055 (without UQA/UZ6) DTC B1025, B1045, B1065, B1075, B1085, B1095 Or B1105 (UQA with IO5/IO6) DTC B1025, B1035, B1045 Or B1055 (UZ6) DTC B1025, B1045, B1065, B1085, B1095, B1105 Or B1115 (UQA with IOS/IOT/IOU)**
B1035	Cellular, Entertainment, and Navigation - **DTC B1025, B1035, B1045 or B1055 (without UQA/UZ6) DTC B1025, B1035, B1045 Or B1055 (UZ6)**
B1045	Cellular, Entertainment, and Navigation - **DTC B1025, B1035, B1045 or B1055 (without UQA/UZ6) DTC B1025, B1045, B1065, B1075, B1085, B1095 Or B1105 (UQA with IO5/IO6) DTC B1025, B1035, B1045 Or B1055 (UZ6) DTC B1025, B1045, B1065, B1085, B1095, B1105 Or B1115 (UQA with IOS/IOT/IOU)**
B1055	Cellular, Entertainment, and Navigation - **DTC B1025, B1035, B1045 or B1055 (without UQA/UZ6) DTC B1025, B1035, B1045 Or B1055 (UZ6)**
B1065	Cellular, Entertainment, and Navigation - **DTC B1025, B1045, B1065, B1075, B1085, B1095 Or B1105 (UQA with IO5/IO6) DTC B1025, B1045, B1065, B1085, B1095, B1105 Or B1115 (UQA with IOS/IOT/IOU)**
B1075	Cellular, Entertainment, and Navigation - **DTC B1025, B1045, B1065, B1075, B1085, B1095 Or B1105 (UQA with IO5/IO6)**
B1085	Cellular, Entertainment, and Navigation - **DTC B1025, B1045, B1065, B1075, B1085, B1095 Or B1105 (UQA with IO5/IO6) DTC B1025, B1045, B1065, B1085, B1095, B1105 Or B1115 (UQA with IOS/IOT/IOU)**

cardiagn.com

DTC	Diagnostic Procedure
B1095	Cellular, Entertainment, and Navigation - **DTC B1025, B1045, B1065, B1075, B1085, B1095 Or B1105 (UQA with IO5/IO6) DTC B1025, B1045, B1065, B1085, B1095, B1105 Or B1115 (UQA with IOS/IOT/IOU)**
B1105	Cellular, Entertainment, and Navigation - **DTC B1025, B1045, B1065, B1075, B1085, B1095 Or B1105 (UQA with IO5/IO6) DTC B1025, B1045, B1065, B1085, B1095, B1105 Or B1115 (UQA with IOS/IOT/IOU)**
B1115	Cellular, Entertainment, and Navigation - **DTC B1025, B1045, B1065, B1085, B1095, B1105 Or B1115 (UQA with IOS/IOT/IOU)**
B123E	Cellular, Entertainment, and Navigation - **DTC B123E**
B124B	Cellular, Entertainment, and Navigation - **DTC B124B (IO5/IO6) DTC B124B (IOB) DTC B124B (IOR) DTC B124B (IOS/IOT/IOU)**
B124C	Cellular, Entertainment, and Navigation - **DTC B124C (IO5/IO6) DTC B124C (IOS/IOT/IOU)**
B124F	Cellular, Entertainment, and Navigation - **DTC B124F**
B124F	Displays and Gauges - **DTC B124F**
B125A	Cellular, Entertainment, and Navigation - **DTC B125A**
B125C	Cellular, Entertainment, and Navigation - **DTC B125C**
B125E	Cellular, Entertainment, and Navigation - **DTC B125E**
B1265	Cellular, Entertainment, and Navigation - **DTC B1265**
B126E	Active Noise Cancellation - **DTC B126E, B126F, B127C, or B127D (IOR)**
B126F	Active Noise Cancellation - **DTC B126E, B126F, B127C, or B127D (IOR)**
B126F	Active Noise Cancellation - **DTC B1277, B127C, B127D, or B126F (without IOR)**
B1271	Cellular, Entertainment, and Navigation - **DTC B1271**
B1277	Active Noise Cancellation - **DTC B1277, B127C, B127D, or B126F (without IOR)**
B1277	Cellular, Entertainment, and Navigation - **DTC B1277 (IO5/IO6) DTC B1277 (IOS/IOT/IOU) DTC B1277 (IOR)**
B127B	Image Display Cameras - **DTC B127B (IOB/IOR/IOS/IOT/IOU) DTC B127B (IO5/IO6 without MAH/MBC)**
B127C	Cellular, Entertainment, and Navigation - **DTC B127C (IOS/IOT/IOU)**
B127C	Active Noise Cancellation - **DTC B126E, B126F, B127C, or B127D (IOR)**
B127C	Active Noise Cancellation - **DTC B1277, B127C, B127D, or B126F (without IOR)**
B127D	Active Noise Cancellation - **DTC B126E, B126F, B127C, or B127D (IOR)**
B127D	Active Noise Cancellation - **DTC B1277, B127C, B127D, or B126F (without IOR)**
B127E	Cellular, Entertainment, and Navigation - **DTC B127E (IO5/IO6 without MAH/MBC) DTC B127E (IOB) DTC B127E (IOS/IOT/IOU/IOR) DTC B127E (IO5/IO6 with MAH/MBC)**
B1287	Cellular, Entertainment, and Navigation - **DTC B1287**
B1325	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
B1327	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
B1328	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
B1330	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
B133B	Image Display Cameras - **DTC B133B**
B1370	Wiring Systems and Power Management - **DTC B1370**

cardiagn.com

DTC	Diagnostic Procedure
B1370	Wiring Systems and Power Management - **DTC B1370, B1380, or B1441**
B1380	Wiring Systems and Power Management - **DTC B1370, B1380, or B1441**
B1390	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
B1395	Lighting - **DTC B1395**
B1395	HVAC - Automatic - **DTC B018A, B048C, B048F, or B1395**
B1395	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
B1400	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
B1405	Parking Assistance Systems - **DTC B1405**
B1405	Power Seats - **DTC B1405, B1825, B2355, B2365, or B2375**
B1410	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
B1415	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
B1424	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
B1425	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
B1439	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
B1441	Wiring Systems and Power Management - **DTC B1370, B1380, or B1441**
B1445	Wiring Systems and Power Management - **DTC B1445**
B1446	Cellular, Entertainment, and Navigation - **DTC B1446 or B1447 (IO5/IO6/IOB)** **DTC B1446 or B1447 (IOU/IOS/IOT/IOR)**
B1447	Cellular, Entertainment, and Navigation - **DTC B1446 or B1447 (IO5/IO6/IOB)** **DTC B1446 or B1447 (IOU/IOS/IOT/IOR)**
B1448	Wiring Systems and Power Management - **DTC B1448**
B144A	Wiring Systems and Power Management - **DTC B144A**
B144B	Wiring Systems and Power Management - **DTC B144B**
B144D	Wiring Systems and Power Management - **DTC B144D**
B1451	Wiring Systems and Power Management - **DTC B1451**
B1474	Vehicle Access - **DTC B1474 or B3849**
B147E	Wiring Systems and Power Management - **DTC B147E or B147F**
B147F	Wiring Systems and Power Management - **DTC B147E or B147F**
B1480	Lighting - **DTC B1480**
B1516	12 V Starting and Charging - **DTC B1516**

DTC	Diagnostic Procedure
B1517	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
B151A	12 V Starting and Charging - **DTC B151A**
B1527	12 V Starting and Charging - **DTC B1527**
B1534	Vehicle Access - **DTC B1534 or B1535**
B1535	Vehicle Access - **DTC B1534 or B1535**
B153A	Vehicle Access - **DTC B153A**
B153E	Vehicle Access - **DTC B153E**
B153F	Vehicle Access - **DTC B153F**
B154A	Mirrors - **DTC B154A or B154B**
B154B	Mirrors - **DTC B154A or B154B**
B172E	Driver Assistance Systems - **DTC B172E or B172F**
B172F	Driver Assistance Systems - **DTC B172E or B172F**
B1735	Power Seats - **DTC B1735, B1740, B1745, B1750, B1755, B1760, B1815, or B1820**
B1740	Power Seats - **DTC B1735, B1740, B1745, B1750, B1755, B1760, B1815, or B1820**
B1745	Power Seats - **DTC B1735, B1740, B1745, B1750, B1755, B1760, B1815, or B1820**
B1750	Power Seats - **DTC B1735, B1740, B1745, B1750, B1755, B1760, B1815, or B1820**
B1755	Power Seats - **DTC B1735, B1740, B1745, B1750, B1755, B1760, B1815, or B1820**
B1760	Power Seats - **DTC B1735, B1740, B1745, B1750, B1755, B1760, B1815, or B1820**
B1815	Power Seats - **DTC B1735, B1740, B1745, B1750, B1755, B1760, B1815, or B1820**
B1820	Power Seats - **DTC B1735, B1740, B1745, B1750, B1755, B1760, B1815, or B1820**
B1825	Power Seats - **DTC B1405, B1825, B2355, B2365, or B2375**
B191A	Seat Heating and Cooling - **DTC B191A or B191B**
B191B	Seat Heating and Cooling - **DTC B191A or B191B**
B2355	Power Seats - **DTC B1405, B1825, B2355, B2365, or B2375**
B2365	Power Seats - **DTC B1405, B1825, B2355, B2365, or B2375**
B2375	Power Seats - **DTC B1405, B1825, B2355, B2365, or B2375**
B243A	Seat Heating and Cooling - **DTC B243A or B243B**
B243B	Seat Heating and Cooling - **DTC B243A or B243B**
B2455	Cellular, Entertainment, and Navigation - **DTC B2455 (IO5/IO6/IOB)** **DTC B2455 (IOR/IOU/IOT/IOS)**
B2462	Cellular, Entertainment, and Navigation - **DTC B2462 (IO5/IO6 with UE1)** **DTC B2462 (IO5/IO6 without UE1)** **DTC B2462 (without IO5/IO6)**
B2470	Cellular, Entertainment, and Navigation - **DTC B2470**
B2476	Cellular, Entertainment, and Navigation - **DTC B2476 or B2482**
B2482	Cellular, Entertainment, and Navigation - **DTC B2476 or B2482**
B2494	Vehicle Access - **DTC B2494 (Without TB5)** **DTC B2494 (With TB5)**
B2495	Vehicle Access - **DTC B2495 or B24A0**
B24A0	Vehicle Access - **DTC B2495 or B24A0**
B2530	Lighting - **DTC B2530**
B2545	Lighting - **DTC B2545**
B255F	Lighting - **DTC B255F**
B256A	Lighting - **DTC B256A**
B2575	Lighting - **DTC B2575 or B2699 (T4A/T4L)** **DTC B2575 or B2699 (T4F)**

cardiagn.com

DTC	Diagnostic Procedure
B257A	Lighting - **DTC B257A**
B2580	Lighting - **DTC B2580**
B25F8	Lighting - **DTC B25F8**
B260D	Lighting - **DTC B260D or B260E**
B260E	Lighting - **DTC B260D or B260E**
B2610	Lighting - **DTC B2610**
B2615	Lighting - **DTC B2615**
B2625	Lighting - **DTC B2625**
B2645	Lighting - **DTC B2645**
B2699	Lighting - **DTC B2575 or B2699 (T4A/T4L)** **DTC B2575 or B2699 (T4F)**
B269A	HVAC - Automatic - **DTC B269A, B269C, or B269D**
B269A	HVAC - Manual - **DTC B269A, B269C, or B269D**
B269C	HVAC - Automatic - **DTC B269A, B269C, or B269D**
B269C	HVAC - Manual - **DTC B269A, B269C, or B269D**
B269D	HVAC - Automatic - **DTC B269A, B269C, or B269D**
B269D	HVAC - Manual - **DTC B269A, B269C, or B269D**
B270A	Shift Lock Control - **DTC B270A (Without KL9)** **DTC B270A (With KL9)**
B273A	Antilock Brake System - **DTC B273A** **DTC B273A**
B2740	Lighting - **DTC B2740**
B2750	Horns and Pedestrian Alerts - **DTC B2750**
B2755	Power Seats - **DTC B2755 or B2765**
B2765	Power Seats - **DTC B2755 or B2765**
B2955	Immobilizer - **DTC B2955**
B297B	Vehicle Access - **DTC B297B or B297C**
B297C	Vehicle Access - **DTC B297B or B297C**
B2A00	Electronic Transmission Range Select - **DTC B2A00**
B3006	Bolted Exterior Body Panels and Closures - **DTC B3006**
B302A	Immobilizer - **DTC B302A**
B3031	Immobilizer - **DTC B3031**
B3055	Immobilizer - **DTC B3055**
B305C	Immobilizer - **DTC B305C**
B305D	Remote Functions - **DTC B305D**
B305E	Wiring Systems and Power Management - **DTC B305E**
B3060	Immobilizer - **DTC B3060**
B3101	Remote Functions - **DTC B3101**
B3105	Remote Functions - **DTC B3105**
B3106	Remote Functions - **DTC B3106**
B3109	Remote Functions - **DTC B3109-B3113**
B310D	Remote Functions - **DTC B310D-B310F**
B310E	Remote Functions - **DTC B310D-B310F**
B310F	Remote Functions - **DTC B310D-B310F**
B3110	Remote Functions - **DTC B3109-B3113**
B3111	Remote Functions - **DTC B3109-B3113**
B3112	Remote Functions - **DTC B3109-B3113**
B3113	Remote Functions - **DTC B3109-B3113**
B3119	Remote Functions - **DTC B3119**
B3120	Remote Functions - **DTC B3120**
B3121	Remote Functions - **DTC B3121**
B3122	Remote Functions - **DTC B3122**
B3123	Remote Functions - **DTC B3123**
B3124	Remote Functions - **DTC B3124**
B3125	Vehicle Access - **DTC B3125, B3130, or B3135**

cardiagn.com

DTC	Diagnostic Procedure
B3130	Vehicle Access - **DTC B3125, B3130, or B3135**
B3135	Vehicle Access - **DTC B3125, B3130, or B3135**
B3140	Vehicle Access - **DTC B3140, B3145, B3150, or B3155**
B3145	Vehicle Access - **DTC B3140, B3145, B3150, or B3155**
B3150	Vehicle Access - **DTC B3140, B3145, B3150, or B3155**
B3155	Vehicle Access - **DTC B3140, B3145, B3150, or B3155**
B316B	Fixed and Moveable Windows - **DTC B316B, B317A, B318A, or B319A**
B317A	Fixed and Moveable Windows - **DTC B316B, B317A, B318A, or B319A**
B318A	Fixed and Moveable Windows - **DTC B316B, B317A, B318A, or B319A**
B319A	Fixed and Moveable Windows - **DTC B316B, B317A, B318A, or B319A**
B3205	Fixed and Moveable Windows - **DTC B3205**
B323A	Vehicle Access - **DTC B323A-B323C**
B323B	Vehicle Access - **DTC B323A-B323C**
B323C	Vehicle Access - **DTC B323A-B323C**
B3245	Vehicle Access - **DTC B324A or B3245**
B324A	Vehicle Access - **DTC B324A or B3245**
B3410	Lighting - **DTC B3410 or B3420**
B3415	Lighting - **DTC B3415**
B3420	Lighting - **DTC B3410 or B3420**
B3435	Lighting - **DTC B3435 or B3440**
B3440	Lighting - **DTC B3435 or B3440**
B356A	Driver Assistance Systems - **DTC B356A (Chevrolet) DTC B356A (GMC)**
B3596	Lighting - **DTC B3596**
B3600	Lighting - **DTC B3600**
B3622	Secondary and Configurable Customer Controls - **DTC B3622**
B3650	Lighting - **DTC B3650**
B3664	Sunroof - **DTC B3664**
B3697	Sunroof - **DTC B3697**
B369B	Sunroof - **DTC B369B**
B369D	Sunroof - **DTC B369D**
B370A	Wipers and Washers - **DTC B370A**
B370B	Wipers and Washers - **DTC B370B**
B3715	Wipers and Washers - **DTC B3715 or B3875**
B3794	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
B3806	Lighting - **DTC B3806**
B380A	Lighting - **DTC B380A or B380B**
B380B	Lighting - **DTC B380A or B380B**
B3811	Wipers and Washers - **DTC B3811**
B3849	Vehicle Access - **DTC B1474 or B3849**
B384A	Vehicle Access - **DTC B384A**
B3873	Wipers and Washers - **DTC B3873**
B3875	Wipers and Washers - **DTC B3715 or B3875**
B3881	Lighting - **DTC B3881 or B3882**
B3882	Lighting - **DTC B3881 or B3882**
B3883	Lighting - **DTC B3883**
B3884	Lighting - **DTC B3884**
B389A	Immobilizer - **DTC B389A**
B3902	Immobilizer - **DTC B3902**
B390F	Image Display Cameras - **DTC B390F**
B3920	Power Seats - **DTC B3920**
B3924	Immobilizer - **DTC B3924, B3925, B3926, B3927, B3928**

cardiagn.com

DTC	Diagnostic Procedure
B3925	Immobilizer - **DTC B3924, B3925, B3926, B3927, B3928**
B3926	Immobilizer - **DTC B3924, B3925, B3926, B3927, B3928**
B3927	Immobilizer - **DTC B3924, B3925, B3926, B3927, B3928**
B3928	Immobilizer - **DTC B3924, B3925, B3926, B3927, B3928**
B3933	HVAC - Automatic - **DTC B3933**
B3933	HVAC - Manual - **DTC B3933**
B3935	Immobilizer - **DTC B3935**
B393B	HVAC - Automatic - **DTC B393B**
B393B	HVAC - Manual - **DTC B393B**
B3948	Lighting - **DTC B3948 or B3949**
B3949	Lighting - **DTC B3948 or B3949**
B3950	Lighting - **DTC B3950 or B3951**
B3951	Lighting - **DTC B3950 or B3951**
B395A	Image Display Cameras - **DTC B395A**
B395B	Image Display Cameras - **DTC B395B**
B395C	Image Display Cameras - **DTC B395C**
B396A	Vehicle Access - **DTC B396A**
B396C	Vehicle Access - **DTC B396C**
B396D	Vehicle Access - **DTC B396D**
B396E	Vehicle Access - **DTC B396E**
B3976	Immobilizer - **DTC B3976**
B3978	Immobilizer - **DTC B3978, B3979, B3980, B3981, B3982**
B3979	Immobilizer - **DTC B3978, B3979, B3980, B3981, B3982**
B3980	Immobilizer - **DTC B3978, B3979, B3980, B3981, B3982**
B3981	Immobilizer - **DTC B3978, B3979, B3980, B3981, B3982**
B3982	Immobilizer - **DTC B3978, B3979, B3980, B3981, B3982**
B3984	Immobilizer - **DTC B3984**
B399A	Image Display Cameras - **DTC B399A**
B399B	Image Display Cameras - **DTC B399B**
B399C	Image Display Cameras - **DTC B399C**
B399D	Image Display Cameras - **DTC B399D**
C0035	Antilock Brake System - **DTC C0035, C0040, C0045, or C0050**
C0040	Antilock Brake System - **DTC C0035, C0040, C0045, or C0050**
C0045	Antilock Brake System - **DTC C0035, C0040, C0045, or C0050**
C0050	Antilock Brake System - **DTC C0035, C0040, C0045, or C0050**
C0060	Antilock Brake System - **DTC C0060, C0065, C0070, C0075, C0080, C0085, C0090, C0095, C0121, C0141, C0146, C0151 Or C0156**
C0065	Antilock Brake System - **DTC C0060, C0065, C0070, C0075, C0080, C0085, C0090, C0095, C0121, C0141, C0146, C0151 Or C0156**
C0070	Antilock Brake System - **DTC C0060, C0065, C0070, C0075, C0080, C0085, C0090, C0095, C0121, C0141, C0146, C0151 Or C0156**
C0075	Antilock Brake System - **DTC C0060, C0065, C0070, C0075, C0080, C0085, C0090, C0095, C0121, C0141, C0146, C0151 Or C0156**
C0080	Antilock Brake System - **DTC C0060, C0065, C0070, C0075, C0080, C0085, C0090, C0095, C0121, C0141, C0146, C0151 Or C0156**
C0085	Antilock Brake System - **DTC C0060, C0065, C0070, C0075, C0080, C0085, C0090, C0095, C0121, C0141, C0146, C0151 Or C0156**
C0090	Antilock Brake System - **DTC C0060, C0065, C0070, C0075, C0080, C0085, C0090, C0095, C0121, C0141, C0146, C0151 Or C0156**
C0095	Antilock Brake System - **DTC C0060, C0065, C0070, C0075, C0080, C0085, C0090, C0095, C0121, C0141, C0146, C0151 Or C0156**
C0110	Antilock Brake System **DTC C0110**

cardiagn.com

DTC	Diagnostic Procedure
C0121	Antilock Brake System - **DTC C0060, C0065, C0070, C0075, C0080, C0085, C0090, C0095, C0121, C0141, C0146, C0151 Or C0156**
C0131	Antilock Brake System - **DTC C0131**
C0141	Antilock Brake System - **DTC C0060, C0065, C0070, C0075, C0080, C0085, C0090, C0095, C0121, C0141, C0146, C0151 Or C0156**
C0146	Antilock Brake System - **DTC C0060, C0065, C0070, C0075, C0080, C0085, C0090, C0095, C0121, C0141, C0146, C0151 Or C0156**
C0151	Antilock Brake System - **DTC C0060, C0065, C0070, C0075, C0080, C0085, C0090, C0095, C0121, C0141, C0146, C0151 Or C0156**
C0156	Antilock Brake System - **DTC C0060, C0065, C0070, C0075, C0080, C0085, C0090, C0095, C0121, C0141, C0146, C0151 Or C0156**
C0161	Antilock Brake System **DTC C0161**
C0176	Power Steering - **DTC C0176**
C0179	Antilock Brake System - **DTC C0179**
C0186	Antilock Brake System - With KSG/UGN - **DTC C0186, C018B, C0196, C019B, C027E, or C0287 (With KSG/UGN)**
C0186	Antilock Brake System - Without KSG/UGN - **DTC C0186, C0196, or C0287 (Without KSG/UGN)**
C018B	Antilock Brake System - **DTC C0186, C018B, C0196, C019B, C027E, or C0287 (With KSG/UGN)**
C0196	Antilock Brake System - Without KSG/UGN - **DTC C0186, C0196, or C0287 (Without KSG/UGN)**
C0196	Antilock Brake System - With KSG/UGN - **DTC C0186, C018B, C0196, C019B, C027E, or C0287 (With KSG/UGN)**
C019B	Antilock Brake System - **DTC C0186, C018B, C0196, C019B, C027E, or C0287 (With KSG/UGN)**
C025E	Hydraulic Brakes - **DTC C025E**
C025F	Antilock Brake System - **DTC C025F, C0274, C0275, or C0280**
C0267	Hydraulic Brakes - **DTC C0267**
C026E	Antilock Brake System - **DTC C026E**
C0273	Hydraulic Brakes - **DTC C0273**
C0274	Antilock Brake System - **DTC C025F, C0274, C0275, or C0280**
C0275	Antilock Brake System - **DTC C025F, C0274, C0275, or C0280**
C0277	Lighting - **DTC C0277 or C0890**
C027E	Antilock Brake System - **DTC C0186, C018B, C0196, C019B, C027E, or C0287 (With KSG/UGN)**
C0280	Antilock Brake System - **DTC C025F, C0274, C0275, or C0280**
C0287	Antilock Brake System - Without KSG/UGN - **DTC C0186, C0196, or C0287 (Without KSG/UGN)**
C0287	Antilock Brake System - With KSG/UGN - **DTC C0186, C018B, C0196, C019B, C027E, or C0287 (With KSG/UGN)**
C028F	Park Brake - **DTC C028F**
C0293	Park Brake - **DTC C0293**
C0297	Lighting - **DTC C0297**
C0299	Hydraulic Brakes - **DTC C0299**
C0407	Rear Drive Axle - **DTC C0407**
C0460	Power Steering - **DTC C0460**
C0475	Power Steering - **DTC C0475**
C047A	Power Steering - **DTC C047A**
C0545	Power Steering - **DTC C0545**
C0550	Data Communications - **DTC C0550**
C0561	Antilock Brake System - **DTC C0561**
C0569	Antilock Brake System - **DTC C0569**
C0569	Power Steering - **DTC C0569**

cardiagn.com

DTC	Diagnostic Procedure
C0569	Tire Pressure Monitoring - **DTC C0569**
C056D	Data Communications - **DTC C056D**
C056D	Power Steering - **DTC C056D (Power Steering Control Module)**
C056E	Park Brake - **DTC C056E**
C056E	Data Communications - **DTC C056E**
C056E	Power Steering - **DTC C056E (Power Steering Control Module)**
C0750	Tire Pressure Monitoring - **DTC C0750, C0755, C0760, or C0765**
C0755	Tire Pressure Monitoring - **DTC C0750, C0755, C0760, or C0765**
C0760	Tire Pressure Monitoring - **DTC C0750, C0755, C0760, or C0765**
C0765	Tire Pressure Monitoring - **DTC C0750, C0755, C0760, or C0765**
C0775	Tire Pressure Monitoring - **DTC C0775**
C0800	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
C0805	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
C0870	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
C0880	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
C0890	Lighting - **DTC C0277 or C0890**
C0895	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
C0899	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
C0900	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
C1201	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
C1201	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**

mydiagn.com

DTC	Diagnostic Procedure
C1201	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
C122F	Rear Drive Axle - **DTC C122F**
C1244	Rear Drive Axle - **DTC C1244, C1245, or C124B**
C1245	Rear Drive Axle - **DTC C1244, C1245, or C124B**
C124B	Rear Drive Axle - **DTC C1244, C1245, or C124B**
C124F	Antilock Brake System - **DTC C124F, C1250, or C1251**
C1250	Antilock Brake System - **DTC C124F, C1250, or C1251**
C1251	Antilock Brake System - **DTC C124F, C1250, or C1251**
C1252	Antilock Brake System - **DTC C1252, C1253, C1254**
C1253	Antilock Brake System - **DTC C1252, C1253, C1254**
C1254	Antilock Brake System - **DTC C1252, C1253, C1254**
C1260	Rear Drive Axle - **DTC C1260-C1267**
C1261	Rear Drive Axle - **DTC C1260-C1267**
C1262	Rear Drive Axle - **DTC C1260-C1267**
C1263	Rear Drive Axle - **DTC C1260-C1267**
C1264	Rear Drive Axle - **DTC C1260-C1267**
C1265	Rear Drive Axle - **DTC C1260-C1267**
C1266	Rear Drive Axle - **DTC C1260-C1267**
C1267	Rear Drive Axle - **DTC C1260-C1267**
C1280	Park Brake - **DTC C1280 or C1281**
C1281	Park Brake - **DTC C1280 or C1281**
C1282	Rear Drive Axle - **DTC C1282**
C1290	Rear Drive Axle - **DTC C1290, C1291, C1292, C1293, C1295**
C1291	Rear Drive Axle - **DTC C1290, C1291, C1292, C1293, C1295**
C1292	Rear Drive Axle - **DTC C1290, C1291, C1292, C1293, C1295**
C1293	Rear Drive Axle - **DTC C1290, C1291, C1292, C1293, C1295**
C1295	Rear Drive Axle - **DTC C1290, C1291, C1292, C1293, C1295**
C1296	Rear Drive Axle - **DTC C1296**
C1586	Park Brake - **DTC C1586**
C1587	Park Brake - **DTC C1587**
C1588	Park Brake - **DTC C1588**
P0010	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0010, P0011, P0013, P0014, P2088, P2089, P02090, Or P2091**
P0010	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0010, P0013, or P2088-P2091**
P0011	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0010, P0011, P0013, P0014, P2088, P2089, P02090, Or P2091**
P0011	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0011 or P0014**
P0013	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0010, P0011, P0013, P0014, P2088, P2089, P02090, Or P2091**
P0013	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0010, P0013, or P2088-P2091**
P0014	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0010, P0011, P0013, P0014, P2088, P2089, P02090, Or P2091**
P0014	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0011 or P0014**
P0016	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0016 or P0017**
P0016	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0016**
P0016	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0016 or P0017**
P0017	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0016 or P0017**

cardiagn.com

DTC	Diagnostic Procedure
P0017	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0016 or P0017**
P0030	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, P0141, P103B, or P103C**
P0030	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0030-P0032, P0036-P0038, P0054, P0135, P0141, P103B, or P103C**
P0031	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, P0141, P103B, or P103C**
P0031	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0030-P0032, P0036-P0038, P0054, P0135, P0141, P103B, or P103C**
P0032	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, P0141, P103B, or P103C**
P0032	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0030-P0032, P0036-P0038, P0054, P0135, P0141, P103B, or P103C**
P0033	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0033-P0035**
P0033	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0033-P0035**
P0034	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0033-P0035**
P0034	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0033-P0035**
P0035	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0033-P0035**
P0035	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0033-P0035**
P0036	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, P0141, P103B, or P103C**
P0036	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0030-P0032, P0036-P0038, P0054, P0135, P0141, P103B, or P103C**
P0037	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, P0141, P103B, or P103C**
P0037	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0030-P0032, P0036-P0038, P0054, P0135, P0141, P103B, or P103C**
P0038	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, P0141, P103B, or P103C**
P0038	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0030-P0032, P0036-P0038, P0054, P0135, P0141, P103B, or P103C**
P003A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P003A**
P0045	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0045, P0047, or P0048**
P0046	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0046, P2598, or P2599**
P0047	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0045, P0047, or P0048**
P0048	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0045, P0047, or P0048**
P0053	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, P0141, P103B, or P103C**
P0054	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0030-P0032, P0036-P0038, P0054, P0135, P0141, P103B, or P103C**
P0054	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, P0141, P103B, or P103C**
P0068	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0068 or P1101**
P0068	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0068 or P1101**
P0070	Displays and Gauges - **DTC P0070**
P0071	Displays and Gauges - **DTC P0071-P0074**
P0072	Displays and Gauges - **DTC P0071-P0074**
P0073	Displays and Gauges - **DTC P0071-P0074**
P0074	Displays and Gauges - **DTC P0071-P0074**
P007B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P007B**
P007C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P007C-P007E**
P007D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P007C-P007E**
P007E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P007C-P007E**

Carmanuals.com

DTC	Diagnostic Procedure
P0087	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0087, P0089, P228C, P228D, or P2293**
P0089	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0089, P00C6, P228C, P228D, or P2C1E-P2C20**
P0089	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0089, P00C6, P228C, or P228D**
P0089	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0087, P0089, P228C, P228D, or P2293**
P0090	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0090-P0092, P00C8, P00C9, or P00CA**
P0090	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0090-P0092, P00C8, P00C9, or P00CA**
P0090	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0090, P0091, or P0092**
P0091	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0090-P0092, P00C8, P00C9, or P00CA**
P0091	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0090-P0092, P00C8, P00C9, or P00CA**
P0091	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0090, P0091, or P0092**
P0092	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0090-P0092, P00C8, P00C9, or P00CA**
P0092	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0090-P0092, P00C8, P00C9, or P00CA**
P0092	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0090, P0091, or P0092**
P0096	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0096 or P0111**
P0096	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0096 or P0111**
P0096	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0096 or P0111**
P0097	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0097-P0099 or P00F4-P00F6**
P0097	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0097, P0098, or P0099**
P0097	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0097, P0098, or P0099**
P0098	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0097-P0099 or P00F4-P00F6**
P0098	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0097, P0098, or P0099**
P0098	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0097, P0098, or P0099**
P0099	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0097-P0099 or P00F4-P00F6**
P0099	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0097, P0098, or P0099**
P0099	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0097, P0098, or P0099**
P00C6	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0089, P00C6, P228C, P228D, or P2C1E-P2C20**
P00C6	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0089, P00C6, P228C, or P228D**
P00C7	Engine Controls and Fuel - 1.5L (LYX) - **DTC P00C7**
P00C7	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P00C7**
P00C7	Engine Controls and Fuel - 2.0L (LTG) - **DTC P00C7**
P00C8	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0090-P0092, P00C8, P00C9, or P00CA**
P00C8	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0090-P0092, P00C8, P00C9, or P00CA**
P00C9	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0090-P0092, P00C8, P00C9, or P00CA**
P00C9	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0090-P0092, P00C8, P00C9, or P00CA**
P00CA	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0090-P0092, P00C8, P00C9, or P00CA**
P00CA	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0090-P0092, P00C8, P00C9, or P00CA**

Cardiagn.com

DTC	Diagnostic Procedure
P00E9	Engine Controls and Fuel - 1.5L (LYX) - **DTC P00E9**
P00E9	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P00E9**
P00E9	Engine Controls and Fuel - 2.0L (LTG) - **DTC P00E9**
P00EA	Engine Controls and Fuel - 1.5L (LYX) - **DTC P00EA-P00EC**
P00EA	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P00EA-P00EC**
P00EA	Engine Controls and Fuel - 2.0L (LTG) - **DTC P00EA-P00EC**
P00EB	Engine Controls and Fuel - 1.5L (LYX) - **DTC P00EA-P00EC**
P00EB	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P00EA-P00EC**
P00EB	Engine Controls and Fuel - 2.0L (LTG) - **DTC P00EA-P00EC**
P00EC	Engine Controls and Fuel - 1.5L (LYX) - **DTC P00EA-P00EC**
P00EC	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P00EA-P00EC**
P00EC	Engine Controls and Fuel - 2.0L (LTG) - **DTC P00EA-P00EC**
P00F4	Engine Controls and Fuel - 1.5L (LYX) - **DTC P00F4-P00F6**
P00F4	Engine Controls and Fuel - 2.0L (LTG) - **DTC P00F4-P00F6**
P00F4	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0097-P0099 or P00F4-P00F6**
P00F5	Engine Controls and Fuel - 1.5L (LYX) - **DTC P00F4-P00F6**
P00F5	Engine Controls and Fuel - 2.0L (LTG) - **DTC P00F4-P00F6**
P00F5	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0097-P0099 or P00F4-P00F6**
P00F6	Engine Controls and Fuel - 1.5L (LYX) - **DTC P00F4-P00F6**
P00F6	Engine Controls and Fuel - 2.0L (LTG) - **DTC P00F4-P00F6**
P00F6	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0097-P0099 or P00F4-P00F6**
P00FF	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1700, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9**
P0101	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0101**
P0101	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0101**
P0101	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0101**
P0102	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0102 or P0103**
P0102	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0102 or P0103**
P0102	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0102 or P0103**
P0103	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0102 or P0103**
P0103	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0102 or P0103**
P0103	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0102 or P0103**
P0106	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0106**
P0106	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0106**
P0106	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0106**
P0107	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0107 or P0108**
P0107	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0107 or P0108**
P0107	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0107 or P0108**
P0108	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0107 or P0108**
P0108	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0107 or P0108**
P0108	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0107 or P0108**
P0111	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0096 or P0111**
P0111	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0096 or P0111**
P0111	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0096 or P0111**
P0112	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0112, P0113, or P0114**
P0112	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0112, P0113, or P0114**
P0112	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0112, P0113, or P0114**
P0113	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0112, P0113, or P0114**
P0113	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0112, P0113, or P0114**

autodiagn.com

DTC	Diagnostic Procedure
P0113	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0112, P0113, or P0114**
P0114	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0112, P0113, or P0114**
P0114	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0112, P0113, or P0114**
P0114	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0112, P0113, or P0114**
P0117	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0117, P0118, or P0119**
P0117	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0117, P0118, or P0119**
P0117	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0117, P0118, or P0119**
P0118	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0117, P0118, or P0119**
P0118	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0117, P0118, or P0119**
P0118	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0117, P0118, or P0119**
P0119	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0117, P0118, or P0119**
P0119	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0117, P0118, or P0119**
P0119	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0117, P0118, or P0119**
P0121	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135**
P0121	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135**
P0122	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135**
P0122	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135**
P0123	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135**
P0123	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135**
P0128	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0128**
P0128	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0128**
P0128	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0128**
P0131	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0131, P0132, P0137, or P0138**
P0131	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0131, P0132, P015A, P015B, P223C, or P223E**
P0132	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0131, P0132, P0137, or P0138**
P0132	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0131, P0132, P015A, P015B, P223C, or P223E**
P0133	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271**
P0135	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0030-P0032, P0036-P0038, P0054, P0135, P0141, P103B, or P103C**
P0135	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, P0141, P103B, or P103C**
P0137	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0137, P0138, P013A, P013B, P013E, P013F, P2270, or P2271**
P0137	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0131, P0132, P0137, or P0138**
P0138	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0137, P0138, P013A, P013B, P013E, P013F, P2270, or P2271**
P0138	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0131, P0132, P0137, or P0138**
P013A	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271**
P013A	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0137, P0138, P013A, P013B, P013E, P013F, P2270, or P2271**
P013B	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271**
P013B	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0137, P0138, P013A, P013B, P013E, P013F, P2270, or P2271**

cardiagn.com

DTC	Diagnostic Procedure
P013E	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271**
P013E	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0137, P0138, P013A, P013B, P013E, P013F, P2270, or P2271**
P013F	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271**
P013F	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0137, P0138, P013A, P013B, P013E, P013F, P2270, or P2271**
P0141	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0030-P0032, P0036-P0038, P0054, P0135, P0141, P103B, or P103C**
P0141	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, P0141, P103B, or P103C**
P015A	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0131, P0132, P015A, P015B, P223C, or P223E**
P015A	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271**
P015B	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0131, P0132, P015A, P015B, P223C, or P223E**
P015B	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271**
P0171	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0171 or P0172**
P0171	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0171 or P0172**
P0171	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0171 or P0172**
P0172	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0171 or P0172**
P0172	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0171 or P0172**
P0172	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0171 or P0172**
P0181	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0181-P0184**
P0182	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0181-P0184**
P0182	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0182, P0183, P0187, P0188, P111F, P126E, or P126F**
P0183	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0181-P0184**
P0183	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0182, P0183, P0187, P0188, P111F, P126E, or P126F**
P0184	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0181-P0184**
P0187	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0182, P0183, P0187, P0188, P111F, P126E, or P126F**
P0188	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0182, P0183, P0187, P0188, P111F, P126E, or P126F**
P018B	Engine Controls and Fuel - 1.5L (LYX) - **DTC P018B-P018D**
P018B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P018B-P018D**
P018B	Engine Controls and Fuel - 2.0L (LTG) - **DTC P018B-P018D**
P018C	Engine Controls and Fuel - 1.5L (LYX) - **DTC P018B-P018D**
P018C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P018B-P018D**
P018C	Engine Controls and Fuel - 2.0L (LTG) - **DTC P018B-P018D**
P018D	Engine Controls and Fuel - 1.5L (LYX) - **DTC P018B-P018D**
P018D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P018B-P018D**
P018D	Engine Controls and Fuel - 2.0L (LTG) - **DTC P018B-P018D**
P0191	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0191 or P0192**
P0191	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0191, P0192, or P0193**
P0191	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0191 or P0192**
P0192	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0191 or P0192**
P0192	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0191, P0192, or P0193**
P0192	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0191 or P0192**
P0193	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0191, P0192, or P0193**

cardiagn.com

DTC	Diagnostic Procedure
P01CB	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P01CB-P01CF or P01D0-P01D2**
P01CC	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P01CB-P01CF or P01D0-P01D2**
P01CD	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P01CB-P01CF or P01D0-P01D2**
P01CE	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P01CB-P01CF or P01D0-P01D2**
P01CF	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P01CB-P01CF or P01D0-P01D2**
P01D0	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P01CB-P01CF or P01D0-P01D2**
P01D1	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P01CB-P01CF or P01D0-P01D2**
P01D2	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P01CB-P01CF or P01D0-P01D2**
P01F0	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P01F0**
P0201	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0201	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0201-P0204**
P0201	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0202	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0202	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0201-P0204**
P0202	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0203	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0203	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0201-P0204**
P0203	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0204	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0204	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0201-P0204**
P0204	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P020A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P020A-P020D**
P020B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P020A-P020D**
P020C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P020A-P020D**
P020D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P020A-P020D**
P0216	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0216**
P0222	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135**
P0222	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135**
P0223	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135**

DTC	Diagnostic Procedure
P0223	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135**
P0231	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0231, P0232, or P023F**
P0231	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0231, P0232, or P023F**
P0232	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0231, P0232, or P023F**
P0232	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0231, P0232, or P023F**
P0234	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0234 or P0299**
P0234	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0234, P0299, or P2263**
P0234	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0234 or P0299**
P0236	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0236**
P0236	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0236**
P0237	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0237 or P0238**
P0237	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0237 or P0238**
P0238	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0237 or P0238**
P0238	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0237 or P0238**
P023F	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0231, P0232, or P023F**
P023F	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0231, P0232, or P023F**
P0243	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0243, P0245, or P0246**
P0243	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0243, P0245, or P0246**
P0245	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0243, P0245, or P0246**
P0245	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0243, P0245, or P0246**
P0246	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0243, P0245, or P0246**
P0246	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0243, P0245, or P0246**
P0261	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0261, P0262, P0264, P0265, P0267, P0268, P0270, or P0271**
P0261	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0261	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0262	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0261, P0262, P0264, P0265, P0267, P0268, P0270, or P0271**
P0262	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0262	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0263	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0263, P0266, P0269, or P0272**
P0264	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0261, P0262, P0264, P0265, P0267, P0268, P0270, or P0271**
P0264	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0264	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0265	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0261, P0262, P0264, P0265, P0267, P0268, P0270, or P0271**
P0265	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**

autodiagn.com

DTC	Diagnostic Procedure
P0265	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0266	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0263, P0266, P0269, or P0272**
P0267	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0261, P0262, P0264, P0265, P0267, P0268, P0270, or P0271**
P0267	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0267	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0268	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0261, P0262, P0264, P0265, P0267, P0268, P0270, or P0271**
P0268	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0268	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0269	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0263, P0266, P0269, or P0272**
P026A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P026A**
P0270	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0261, P0262, P0264, P0265, P0267, P0268, P0270, or P0271**
P0270	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0270	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0271	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0261, P0262, P0264, P0265, P0267, P0268, P0270, or P0271**
P0271	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0271	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P0272	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0263, P0266, P0269, or P0272**
P0299	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0234 or P0299**
P0299	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0234, P0299, or P2263**
P0299	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0234 or P0299**
P02CC	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P02CC-P02D3**
P02CD	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P02CC-P02D3**
P02CE	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P02CC-P02D3**
P02CF	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P02CC-P02D3**
P02D0	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P02CC-P02D3**
P02D1	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P02CC-P02D3**
P02D2	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P02CC-P02D3**
P02D3	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P02CC-P02D3**
P02E0	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P02E0, P02E2, P02E3, P02EB, P122B, P122C, or P1425**
P02E1	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P02E1, P02E4, or P02E5**

cardiagn.com

DTC	Diagnostic Procedure
P02E2	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P02E0, P02E2, P02E3, P02EB, P122B, P122C, or P1425**
P02E3	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P02E0, P02E2, P02E3, P02EB, P122B, P122C, or P1425**
P02E4	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P02E1, P02E4, or P02E5**
P02E5	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P02E1, P02E4, or P02E5**
P02E8	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P02E8, P02E9, or P16A0-P16A2**
P02E9	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P02E8, P02E9, or P16A0-P16A2**
P02EB	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P02E0, P02E2, P02E3, P02EB, P122B, P122C, or P1425**
P0300	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0300-P0304**
P0300	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0300-P0304**
P0300	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0300**
P0301	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0300-P0304**
P0301	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0300-P0304**
P0302	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0300-P0304**
P0302	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0300-P0304**
P0303	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0300-P0304**
P0303	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0300-P0304**
P0304	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0300-P0304**
P0304	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0300-P0304**
P0315	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0315**
P0315	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0315**
P0315	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0315**
P0324	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0324-P0333, P06B6, or P06B7**
P0324	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0324, P0326, P0331, P06B6, or P06B7**
P0325	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0324-P0333, P06B6, or P06B7**
P0325	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0325, P0327, P0328, P0330, P0332, or P0333**
P0326	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0324-P0333, P06B6, or P06B7**
P0326	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0324, P0326, P0331, P06B6, or P06B7**
P0327	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0324-P0333, P06B6, or P06B7**
P0327	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0325, P0327, P0328, P0330, P0332, or P0333**
P0328	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0324-P0333, P06B6, or P06B7**
P0328	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0325, P0327, P0328, P0330, P0332, or P0333**
P0329	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0324-P0333, P06B6, or P06B7**
P0330	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0324-P0333, P06B6, or P06B7**
P0330	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0325, P0327, P0328, P0330, P0332, or P0333**
P0331	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0324-P0333, P06B6, or P06B7**
P0331	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0324, P0326, P0331, P06B6, or P06B7**
P0332	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0324-P0333, P06B6, or P06B7**
P0332	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0325, P0327, P0328, P0330, P0332, or P0333**
P0333	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0324-P0333, P06B6, or P06B7**
P0333	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0325, P0327, P0328, P0330, P0332, or P0333**

cardiagn.com

DTC	Diagnostic Procedure
P0335	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0335 or P0336**
P0335	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0335 or P0336**
P0335	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0335 or P0336**
P0336	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0335 or P0336**
P0336	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0335 or P0336**
P0336	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0335 or P0336**
P0340	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0340, P0341, P0365, or P0366**
P0340	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0340 or P0341**
P0340	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0340, P0341, P0365, or P0366**
P0341	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0340, P0341, P0365, or P0366**
P0341	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0340 or P0341**
P0341	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0340, P0341, P0365, or P0366**
P034A	Engine Controls and Fuel - 1.5L (LYX) - **DTC P034A or P034B**
P034A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P034A or P034B**
P034A	Engine Controls and Fuel - 2.0L (LTG) - **DTC P034A or P034B**
P034B	Engine Controls and Fuel - 1.5L (LYX) - **DTC P034A or P034B**
P034B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P034A or P034B**
P034B	Engine Controls and Fuel - 2.0L (LTG) - **DTC P034A or P034B**
P0351	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P0351	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P0352	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P0352	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P0353	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P0353	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P0354	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P0354	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P0365	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0340, P0341, P0365, or P0366**
P0365	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0340, P0341, P0365, or P0366**
P0366	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0340, P0341, P0365, or P0366**
P0366	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0340, P0341, P0365, or P0366**
P037A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P037A, P037B, or P0381**
P037B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P037A, P037B, or P0381**
P037E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P037E or P037F**
P037F	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P037E or P037F**
P0381	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P037A, P037B, or P0381**
P0401	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0401 or P0402**
P0402	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0401 or P0402**
P0403	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0403, P0490, P1402, P1407, or P140F**
P0404	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0404-P0406**
P0405	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0404-P0406**
P0406	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0404-P0406**
P0407	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0407, P0408, P046E, or P046F**
P0408	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0407, P0408, P046E, or P046F**

.com

DTC	Diagnostic Procedure
P040B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P040B-P040E or P041B-P041E**
P040C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P040B-P040E or P041B-P041E**
P040D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P040B-P040E or P041B-P041E**
P040E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P040B-P040E or P041B-P041E**
P041B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P040B-P040E or P041B-P041E**
P041C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P040B-P040E or P041B-P041E**
P041D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P040B-P040E or P041B-P041E**
P041E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P040B-P040E or P041B-P041E**
P0420	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0420**
P0420	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0420**
P0421	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0421**
P042E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P042E or P042F**
P042F	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P042E or P042F**
P0442	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0442**
P0442	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0442**
P0443	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0443, P0458, or P0459**
P0443	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0443, P0458, or P0459**
P0446	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0446**
P0446	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0446**
P0449	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0449, P0498, or P0499**
P0449	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0449, P0498, or P0499**
P0451	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0451-P0454**
P0451	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0451-P0454**
P0452	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0451-P0454**
P0452	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0451-P0454**
P0453	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0451-P0454**
P0453	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0451-P0454**
P0454	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0451-P0454**
P0454	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0451-P0454**
P0455	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0455**
P0455	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0455**
P0458	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0443, P0458, or P0459**
P0458	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0443, P0458, or P0459**
P0459	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0443, P0458, or P0459**
P0459	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0443, P0458, or P0459**
P0461	Displays and Gauges - **DTC P0461-P0464, P2066, P2067, or P2068 (AWD with Diesel Engine)** **DTC P0461-P0464, P2066, P2067, or P2068 (AWD with Gasoline engine)**
P0462	Displays and Gauges - **DTC P0461-P0464, P2066, P2067, or P2068 (AWD with Diesel Engine)** **DTC P0461-P0464, P2066, P2067, or P2068 (AWD with Gasoline engine)**
P0463	Displays and Gauges - **DTC P0461-P0464, P2066, P2067, or P2068 (AWD with Diesel Engine)** **DTC P0461-P0464, P2066, P2067, or P2068 (AWD with Gasoline engine)**

Cardiagn.com

DTC	Diagnostic Procedure
P0464	Displays and Gauges - **DTC P0461-P0464, P2066, P2067, or P2068 (AWD with Diesel Engine)** **DTC P0461-P0464, P2066, P2067, or P2068 (AWD with Gasoline engine)**
P046E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0407, P0408, P046E, or P046F**
P046F	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0407, P0408, P046E, or P046F**
P0480	Engine Heating and Cooling - **DTC P0480, P0691, or P0692**
P0490	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0403, P0490, P1402, P1407, or P140F**
P0496	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0496**
P0496	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0496**
P0498	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0449, P0498, or P0499**
P0498	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0449, P0498, or P0499**
P0499	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0449, P0498, or P0499**
P0499	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0449, P0498, or P0499**
P049D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P049D**
P0506	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0506 or P0507**
P0506	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0506 or P0507**
P0506	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0506 or P0507**
P0507	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0506 or P0507**
P0507	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0506 or P0507**
P0507	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0506 or P0507**
P050D	Engine Controls and Fuel - 1.5L (LYX) - **DTC P050D**
P050F	Hydraulic Brakes - **DTC P050F**
P0513	Immobilizer - **DTC P0513**
P0521	Displays and Gauges - **DTC P0521, P0522, or P0523**
P0522	Displays and Gauges - **DTC P0521, P0522, or P0523**
P0523	Displays and Gauges - **DTC P0521, P0522, or P0523**
P0531	HVAC - Automatic - **DTC P0531, P0532, or P0533**
P0531	HVAC - Manual - **DTC P0531, P0532, or P0533**
P0532	HVAC - Automatic - **DTC P0531, P0532, or P0533**
P0532	HVAC - Manual - **DTC P0531, P0532, or P0533**
P0533	HVAC - Automatic - **DTC P0531, P0532, or P0533**
P0533	HVAC - Manual - **DTC P0531, P0532, or P0533**
P053A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P053A-P053C**
P053B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P053A-P053C**
P053C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P053A-P053C**
P0545	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0545, P0546, P2032, P2033, P242C, or P242D**
P0546	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0545, P0546, P2032, P2033, P242C, or P242D**
P054E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P054E or P054F**
P054F	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P054E or P054F**
P0556	Hydraulic Brakes - **DTC P0556, P0557, or P0558**
P0557	Hydraulic Brakes - **DTC P0556, P0557, or P0558**
P0558	Hydraulic Brakes - **DTC P0556, P0557, or P0558**
P0560	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**

cardiagn.com

DTC	Diagnostic Procedure
P0561	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
P0562	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
P0563	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
P0564	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P0565	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P0567	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P0568	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P056C	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P0571	Cruise Control - **DTC P0571**
P0572	Cruise Control - **DTC P0572 or P0573**
P0573	Cruise Control - **DTC P0572 or P0573**
P0575	Cruise Control - **DTC P0575**
P057B	Engine Controls and Fuel - 1.5L (LYX) - **DTC P057B-P057E**
P057B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P057B-P057E**
P057B	Engine Controls and Fuel - 2.0L (LTG) - **DTC P057B-P057E**
P057C	Engine Controls and Fuel - 1.5L (LYX) - **DTC P057B-P057E**
P057C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P057B-P057E**
P057C	Engine Controls and Fuel - 2.0L (LTG) - **DTC P057B-P057E**
P057D	Engine Controls and Fuel - 1.5L (LYX) - **DTC P057B-P057E**
P057D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P057B-P057E**
P057D	Engine Controls and Fuel - 2.0L (LTG) - **DTC P057B-P057E**
P057E	Engine Controls and Fuel - 1.5L (LYX) - **DTC P057B-P057E**
P057E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P057B-P057E**
P057E	Engine Controls and Fuel - 2.0L (LTG) - **DTC P057B-P057E**
P0580	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P0581	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P058A	12 V Starting and Charging - **DTC P058A-P058F, P16D4-P16D6, P16DC-P16DF, or P16E1-P16E3**
P058B	12 V Starting and Charging - **DTC P058A-P058F, P16D4-P16D6, P16DC-P16DF, or P16E1-P16E3**
P058C	12 V Starting and Charging - **DTC P058A-P058F, P16D4-P16D6, P16DC-P16DF, or P16E1-P16E3**
P058D	12 V Starting and Charging - **DTC P058A-P058F, P16D4-P16D6, P16DC-P16DF, or P16E1-P16E3**
P058E	12 V Starting and Charging - **DTC P058A-P058F, P16D4-P16D6, P16DC-P16DF, or P16E1-P16E3**
P058F	12 V Starting and Charging - **DTC P058A-P058F, P16D4-P16D6, P16DC-P16DF, or P16E1-P16E3**
P059F	Bumpers and Fascias - **DTC P059F or P151E**

cardiagn.com

DTC	Diagnostic Procedure
P05CC	Engine Controls and Fuel - 2.0L (LTG) - **DTC P05CC or P05CE**
P05CE	Engine Controls and Fuel - 2.0L (LTG) - **DTC P05CC or P05CE**
P0601	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**
P0601	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**
P0601	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P064D, P16F3, or P262B**
P0601	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F3, P262B, or P30D6-P30DD**
P0601	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0601-P0604 or P062F**
P0601	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0601-P0604, P0606, P062F, P16F3, or P16FB**
P0602	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**
P0602	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**
P0602	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P064D, P16F3, or P262B**
P0602	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F3, P262B, or P30D6-P30DD**
P0602	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0601-P0604 or P062F**
P0602	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0601-P0604, P0606, P062F, P16F3, or P16FB**
P0603	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0601-P0604 or P062F**
P0603	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**
P0603	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**
P0603	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P064D, P16F3, or P262B**
P0603	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F3, P262B, or P30D6-P30DD**
P0603	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0601-P0604 or P062F**
P0603	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0601-P0604, P0606, P062F, P16F3, or P16FB**
P0604	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0601-P0604 or P062F**
P0604	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**
P0604	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**
P0604	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P064D, P16F3, or P262B**
P0604	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F3, P262B, or P30D6-P30DD**
P0604	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0601-P0604 or P062F**
P0604	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0601-P0604, P0606, P062F, P16F3, or P16FB**
P0605	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F3, P262B, or P30D6-P30DD**

DTC	Diagnostic Procedure
P0606	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F3, P262B, or P30D6-P30DD**
P0606	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**
P0606	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**
P0606	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P064D, P16F3, or P262B**
P0606	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0601-P0604, P0606, P062F, P16F3, or P16FB**
P0607	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F3, P262B, or P30D6-P30DD**
P060A	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F3, P262B, or P30D6-P30DD**
P060B	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F3, P262B, or P30D6-P30DD**
P060C	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F3, P262B, or P30D6-P30DD**
P0610	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F3, P262B, or P30D6-P30DD**
P0611	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
P0615	12 V Starting and Charging - **DTC P0615, P0616, or P0617 (KL9)** **DTC P0615, P0616, or P0617 (Without KL9)**
P0616	12 V Starting and Charging - **DTC P0615, P0616, or P0617 (KL9)** **DTC P0615, P0616, or P0617 (Without KL9)**
P0617	12 V Starting and Charging - **DTC P0615, P0616, or P0617 (KL9)** **DTC P0615, P0616, or P0617 (Without KL9)**
P0621	12 V Starting and Charging - **DTC P0621**
P0622	12 V Starting and Charging - **DTC P0622**
P0627	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0627-P0629**
P0627	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0627-P0629**
P0627	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0627-P0629**
P0628	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0627-P0629**
P0628	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0627-P0629**
P0628	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0627-P0629**
P0629	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0627-P0629**
P0629	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0627-P0629**
P0629	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0627-P0629**
P062B	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**
P062B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**
P062B	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P064D, P16F3, or P262B**
P062D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P062D or P062E**
P062E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P062D or P062E**
P062F	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0601-P0604 or P062F**
P062F	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0601-P0604, P0606, P062F, P16F3, or P16FB**
P062F	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**

cardiagn.com

DTC	Diagnostic Procedure
P062F	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**
P062F	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P064D, P16F3, or P262B**
P062F	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F3, P262B, or P30D6-P30DD**
P0630	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**
P0630	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**
P0630	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P064D, P16F3, or P262B**
P0633	Immobilizer - **DTC P0633**
P0634	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0634**
P0641	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0641, P0651, P0697, P06A3, or P06D2**
P0641	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0641, P0651, P0697, or P06A3**
P0641	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0641, P0651, P0697, P06A3, or P06D2**
P0645	HVAC - Automatic - **DTC P0645, P0646, or P0647**
P0645	HVAC - Manual - **DTC P0645, P0646, or P0647**
P0646	HVAC - Automatic - **DTC P0645, P0646, or P0647**
P0646	HVAC - Manual - **DTC P0645, P0646, or P0647**
P0647	HVAC - Automatic - **DTC P0645, P0646, or P0647**
P0647	HVAC - Manual - **DTC P0645, P0646, or P0647**
P064D	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P064D, P16F3, or P262B**
P0650	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0650, P263A, or P263B**
P0650	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0650, P263A, or P263B**
P0650	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0650, P263A, or P263B**
P0651	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0641, P0651, P0697, P06A3, or P06D2**
P0651	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0641, P0651, P0697, or P06A3**
P0651	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0641, P0651, P0697, P06A3, or P06D2**
P0654	Displays and Gauges - **DTC P0654 (with LTG or LYX) DTC P0654 (with LVL, LH7, or LWW)**
P0658	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0658 or P0659**
P0658	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0658 or P0659**
P0658	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0658, P0659, P2727, P2729, P2730, P2736, P2738, P2739, P2826, P2827, P282F, or P2830**
P0659	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0658 or P0659**
P0659	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0658 or P0659**
P0667	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0667, P0668, or P0669**
P0668	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0667, P0668, or P0669**
P0669	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0667, P0668, or P0669**
P066A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P066A-P066F, P0671-P0674, P067A, or P067B**

Cardiagn.com

DTC	Diagnostic Procedure
P066B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P066A-P066F, P0671-P0674, P067A, or P067B**
P066C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P066A-P066F, P0671-P0674, P067A, or P067B**
P066D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P066A-P066F, P0671-P0674, P067A, or P067B**
P066E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P066A-P066F, P0671-P0674, P067A, or P067B**
P066F	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P066A-P066F, P0671-P0674, P067A, or P067B**
P0671	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P066A-P066F, P0671-P0674, P067A, or P067B**
P0672	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P066A-P066F, P0671-P0674, P067A, or P067B**
P0673	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P066A-P066F, P0671-P0674, P067A, or P067B**
P0674	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P066A-P066F, P0671-P0674, P067A, or P067B**
P067A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P066A-P066F, P0671-P0674, P067A, or P067B**
P067B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P066A-P066F, P0671-P0674, P067A, or P067B**
P0685	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0685-P0687, P0689, P0690, or P1682**
P0685	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0685-P0687, P0689, P0690, or P1682**
P0685	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0685-P0687, P0689, P0690, or P1682**
P0686	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0685-P0687, P0689, P0690, or P1682**
P0686	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0685-P0687, P0689, P0690, or P1682**
P0686	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0685-P0687, P0689, P0690, or P1682**
P0687	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0685-P0687, P0689, P0690, or P1682**
P0687	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0685-P0687, P0689, P0690, or P1682**
P0687	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0685-P0687, P0689, P0690, or P1682**
P0689	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0685-P0687, P0689, P0690, or P1682**
P0689	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0685-P0687, P0689, P0690, or P1682**
P0689	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0685-P0687, P0689, P0690, or P1682**
P0690	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0685-P0687, P0689, P0690, or P1682**
P0690	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0685-P0687, P0689, P0690, or P1682**
P0690	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0685-P0687, P0689, P0690, or P1682**
P0691	Engine Heating and Cooling - **DTC P0480, P0691, or P0692**
P0692	Engine Heating and Cooling - **DTC P0480, P0691, or P0692**
P0697	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0641, P0651, P0697, P06A3, or P06D2**

Cardiagn.com

DTC	Diagnostic Procedure
P0697	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0641, P0651, P0697, or P06A3**
P0697	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0641, P0651, P0697, P06A3, or P06D2**
P069E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1700, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9**
P06A3	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0641, P0651, P0697, P06A3, or P06D2**
P06A3	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0641, P0651, P0697, or P06A3**
P06A3	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0641, P0651, P0697, P06A3, or P06D2**
P06AC	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P06AC, P06AD, or P06AE**
P06AD	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P06AC, P06AD, or P06AE**
P06AE	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P06AC, P06AD, or P06AE**
P06B6	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0324-P0333, P06B6, or P06B7**
P06B6	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0324, P0326, P0331, P06B6, or P06B7**
P06B7	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0324-P0333, P06B6, or P06B7**
P06B7	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0324, P0326, P0331, P06B6, or P06B7**
P06D2	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0641, P0651, P0697, P06A3, or P06D2**
P06D2	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0641, P0651, P0697, P06A3, or P06D2**
P06DA	Engine Mechanical - 1.5L (LYX) - **DTC P06DA-P06DE**
P06DA	Engine Mechanical - 1.6L (LH7) Diesel - **DTC P06DA-P06DE**
P06DA	Engine Mechanical - 2.0L (LTG) - **DTC P06DA-P06DC**
P06DB	Engine Mechanical - 1.5L (LYX) - **DTC P06DA-P06DE**
P06DB	Engine Mechanical - 1.6L (LH7) Diesel - **DTC P06DA-P06DE**
P06DB	Engine Mechanical - 2.0L (LTG) - **DTC P06DA-P06DC**
P06DC	Engine Mechanical - 1.5L (LYX) - **DTC P06DA-P06DE**
P06DC	Engine Mechanical - 1.6L (LH7) Diesel - **DTC P06DA-P06DE**
P06DC	Engine Mechanical - 2.0L (LTG) - **DTC P06DA-P06DC**
P06DD	Engine Mechanical - 1.5L (LYX) - **DTC P06DA-P06DE**
P06DD	Engine Mechanical - 1.6L (LH7) Diesel - **DTC P06DA-P06DE**
P06DD	Engine Mechanical - 2.0L (LTG) - **DTC P06DD or P06DE**
P06DE	Engine Mechanical - 1.5L (LYX) - **DTC P06DA-P06DE**
P06DE	Engine Mechanical - 1.6L (LH7) Diesel - **DTC P06DA-P06DE**
P06DE	Engine Mechanical - 2.0L (LTG) - **DTC P06DD or P06DE**
P06EC	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1700, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9**
P06ED	Displays and Gauges - **DTC P06ED (with LTG or LYX)** **DTC P06ED (with LVL, LH7, or LWW)**
P06EE	Displays and Gauges - **DTC P06EE (with LTG or LYX)** **DTC P06EE (with LVL, LH7, or LWW)**
P0700	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0700**
P0700	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0700**

carsdiagn.com

DTC	Diagnostic Procedure
P0700	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1700, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9**
P0703	Cruise Control - **DTC P0703**
P0707	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0707, P0708, P2802, P2803, or P2805**
P0708	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0707, P0708, P2802, P2803, or P2805**
P0711	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0711-P0713**
P0711	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0711-P0713**
P0712	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0711-P0713**
P0712	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0711-P0713**
P0713	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0711-P0713**
P0713	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0711-P0713**
P0716	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0716, P0717, P07BF, or P07C0**
P0716	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0716, P0717, P07BF, or P07C0**
P0717	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0716, P0717, P07BF, or P07C0**
P0717	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0716, P0717, P07BF, or P07C0**
P0721	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0721-P0723, P077C, or P077D**
P0722	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0721-P0723, P077C, or P077D**
P0722	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0722, P0723, P077C, or P077D**
P0723	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0721-P0723, P077C, or P077D**
P0723	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0722, P0723, P077C, or P077D**
P073D	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P073D	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1772, P1773, P1778, P1787, P1789, P17F3, P187F, or P188A (with M3H)**
P073E	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P073E	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1772, P1773, P1778, P1787, P1789, P17F3, P187F, or P188A (with M3H)**
P0741	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0741 or P0742**
P0741	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0741, P2817, or P2818**
P0742	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0741 or P0742**
P0746	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0746 or P0747**
P0747	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0746 or P0747**
P0751	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0751 or P0752**

cardiagn.com

DTC	Diagnostic Procedure
P0752	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0751 or P0752**
P0776	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0776 or P0777**
P0776	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0776 or P0777**
P0777	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0776 or P0777**
P0777	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0776 or P0777**
P077C	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0721-P0723, P077C, or P077D**
P077C	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0722, P0723, P077C, or P077D**
P077D	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0721-P0723, P077C, or P077D**
P077D	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0722, P0723, P077C, or P077D**
P0796	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0796 or P0797**
P0796	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0796 or P0797**
P0797	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0796 or P0797**
P0797	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0796 or P0797**
P07B3	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P07B4	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P07B5	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P07B7	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P07B9	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**

Cardiagn.com

DTC	Diagnostic Procedure
P07BA	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P07BB	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P07BD	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P07BE	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P07BF	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0716, P0717, P07BF, or P07C0**
P07BF	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0716, P0717, P07BF, or P07C0**
P07C0	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0716, P0717, P07BF, or P07C0**
P07C0	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0716, P0717, P07BF, or P07C0**
P07E4	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P07E4	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1772, P1773, P1778, P1787, P1789, P17F3, P187F, or P188A (with M3H)**
P07E5	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P07E5	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1772, P1773, P1778, P1787, P1789, P17F3, P187F, or P188A (with M3H)**
P0800	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1700, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9**
P0815	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0815, P0816, or P0826**
P0815	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0815, P0816, or P0826**
P0816	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0815, P0816, or P0826**
P0816	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0815, P0816, or P0826**
P0826	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0815, P0816, or P0826**

carsdiagn.com

DTC	Diagnostic Procedure
P0826	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0815, P0816, or P0826**
P0850	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0850-P0852**
P0851	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0850-P0852**
P0851	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0851**
P0852	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0850-P0852**
P0856	Antilock Brake System - **DTC P0856**
P08CA	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P08CA or P08CB**
P08CB	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P08CA or P08CB**
P0960	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P0961	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0961-P0963**
P0962	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0961-P0963**
P0962	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P0963	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0961-P0963**
P0963	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P0964	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P0965	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0965-P0967**
P0966	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0965-P0967**
P0966	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P0967	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0965-P0967**
P0967	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P0968	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P0969	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0969-P0971**
P0970	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0969-P0971**
P0970	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P0971	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0969-P0971**
P0971	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P0973	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0973 or P0974**
P0974	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P0973 or P0974**
P0AC4	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1700, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9**

DTC	Diagnostic Procedure
P1000	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1000	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1000	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1001	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1001	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1001	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1002	12 V Starting and Charging - DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A

diagn.com

DTC	Diagnostic Procedure
P1003	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1003	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1003	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1004	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE
P1005	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P1005
P1007	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P1007 or P129D
P1008	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1008	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1008	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B

-diagn.com

DTC	Diagnostic Procedure
P1009	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1009	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1009	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P100A	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P100A	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P100A	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P100C	12 V Starting and Charging - DTC P100C or P100D
P100D	12 V Starting and Charging - DTC P100C or P100D
P100E	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B

DTC	Diagnostic Procedure
P100E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P100E	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P1015	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1015-P1019 or P101A**
P1016	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1015-P1019 or P101A**
P1017	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1015-P1019 or P101A**
P1018	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1015-P1019 or P101A**
P1019	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1015-P1019 or P101A**
P101A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1015-P1019 or P101A**
P1029	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1029-P102B**
P102A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1029-P102B**
P102B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1029-P102B**
P103B	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0030-P0032, P0036-P0038, P0054, P0135, P0141, P103B, or P103C**
P103B	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, P0141, P103B, or P103C**
P103C	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0030-P0032, P0036-P0038, P0054, P0135, P0141, P103B, or P103C**
P103C	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, P0141, P103B, or P103C**
P103D	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P103D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P103D	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**

DTC	Diagnostic Procedure
P103E	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P103E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P103E	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P103F	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P103F or P1040**
P1040	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P103F or P1040**
P1048	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1048, P1049, or P2047-P2049**
P1049	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1048, P1049, or P2047-P2049**
P1050	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1050**
P1051	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1051 or P1052**
P1052	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1051 or P1052**
P105A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P105A**
P1089	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1089**
P10B6	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P10B6	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**

ca-diagn.com

DTC	Diagnostic Procedure
P10B6	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10B7	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10B7	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10B7	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10B8	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10B8	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10B8	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B

DTC	Diagnostic Procedure
P10B9	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10B9	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10B9	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10BF	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10BF	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10BF	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10C6	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B

DTC	Diagnostic Procedure
P10C6	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10C6	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10C7	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10C7	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10C7	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10C8	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10C8	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B

mydiagn.com

DTC	Diagnostic Procedure
P10C8	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10D1	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P10D1
P10D5	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P10D5
P10D6	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P10D6-P10D8
P10D7	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P10D6-P10D8
P10D8	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P10D6-P10D8
P10F5	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10F5	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P10F5	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1100	Displays and Gauges - DTC P1100
P1100	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1100	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B

DTC	Diagnostic Procedure
P1100	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P1101	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0068 or P1101**
P1101	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0068 or P1101**
P1103	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P1103	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P1103	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P111E	Engine Controls and Fuel - 1.5L (LYX) - **DTC P111E**
P111E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P111E**
P111E	Engine Controls and Fuel - 2.0L (LTG) - **DTC P111E**
P111F	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0182, P0183, P0187, P0188, P111F, P126E, or P126F**
P113B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P113B-P113D**
P113C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P113B-P113D**
P113D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P113B-P113D**
P115E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P115F	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P1160	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P116A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P116B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**

carsdiagn.com

DTC	Diagnostic Procedure
P116C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P116D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P116E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P116F	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P1176	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1176 or P1177**
P1177	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1176 or P1177**
P1178	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1178 or P1179**
P1179	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1178 or P1179**
P117A	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P117A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P117A	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P118B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P118B**
P118E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P118E, P118F, or P1196**
P118F	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P118E, P118F, or P1196**
P1192	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P1193	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P1194	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P1196	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P118E, P118F, or P1196**
P119A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**

mydiagn.com

DTC	Diagnostic Procedure
P119B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P119C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P119D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P119E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P119F	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P11BE	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P11BF	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P11C0	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P11C5	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P11C6	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P11C7	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P11C8	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P11CC	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P11D0	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P11D1	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P11D2	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P11D3	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P11D5	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P11D8	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**

DTC	Diagnostic Procedure
P11D9	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE
P11DA	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE
P11DB	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211
P11DC	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE
P11FC	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE
P11FD	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE
P11FE	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE
P11FF	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE
P11FF	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P11FF	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P11FF	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1200	Displays and Gauges - DTC P1200
P1200	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B

mydiagn.com

DTC	Diagnostic Procedure
P1200	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1200	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P122B	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P02E0, P02E2, P02E3, P02EB, P122B, P122C, or P1425
P122C	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P02E0, P02E2, P02E3, P02EB, P122B, P122C, or P1425
P122D	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P122D
P1248	Engine Controls and Fuel - 1.5L (LYX) - DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157
P1248	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P1248-P124B
P1248	Engine Controls and Fuel - 2.0L (LTG) - DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157
P1249	Engine Controls and Fuel - 1.5L (LYX) - DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157
P1249	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P1248-P124B
P1249	Engine Controls and Fuel - 2.0L (LTG) - DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157
P124A	Engine Controls and Fuel - 1.5L (LYX) - DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157
P124A	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P1248-P124B
P124A	Engine Controls and Fuel - 2.0L (LTG) - DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157
P124B	Engine Controls and Fuel - 1.5L (LYX) - DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157
P124B	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P1248-P124B
P124B	Engine Controls and Fuel - 2.0L (LTG) - DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157
P1255	Engine Controls and Fuel - 1.5L (LYX) - DTC P1255
P1255	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P1255
P1255	Engine Controls and Fuel - 2.0L (LTG) - DTC P1255
P126E	Engine Controls and Fuel - 1.5L (LYX) - DTC P0182, P0183, P0187, P0188, P111F, P126E, or P126F
P126F	Engine Controls and Fuel - 1.5L (LYX) - DTC P0182, P0183, P0187, P0188, P111F, P126E, or P126F

cardiagn.com

DTC	Diagnostic Procedure
P127C	Engine Controls and Fuel - 1.5L (LYX) - **DTC P127C, P128A-P128D, P128F, P16E4, or P16E5**
P127C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P127C or P127D**
P127C	Engine Controls and Fuel - 2.0L (LTG) - **DTC P127C, P128A-P128D, P128F, P16E4, or P16E5**
P127D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P127C or P127D**
P128A	Engine Controls and Fuel - 1.5L (LYX) - **DTC P127C, P128A-P128D, P128F, P16E4, or P16E5**
P128A	Engine Controls and Fuel - 2.0L (LTG) - **DTC P127C, P128A-P128D, P128F, P16E4, or P16E5**
P128B	Engine Controls and Fuel - 1.5L (LYX) - **DTC P127C, P128A-P128D, P128F, P16E4, or P16E5**
P128B	Engine Controls and Fuel - 2.0L (LTG) - **DTC P127C, P128A-P128D, P128F, P16E4, or P16E5**
P128C	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P128C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P128C	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P128C	Engine Controls and Fuel - 1.5L (LYX) - **DTC P127C, P128A-P128D, P128F, P16E4, or P16E5**
P128C	Engine Controls and Fuel - 2.0L (LTG) - **DTC P127C, P128A-P128D, P128F, P16E4, or P16E5**
P128D	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P128D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**

DTC	Diagnostic Procedure
P128D	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P128D	Engine Controls and Fuel - 1.5L (LYX) - DTC P127C, P128A-P128D, P128F, P16E4, or P16E5
P128D	Engine Controls and Fuel - 2.0L (LTG) - DTC P127C, P128A-P128D, P128F, P16E4, or P16E5
P128E	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P128E	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P128E	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P128F	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P128F	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B

DTC	Diagnostic Procedure
P128F	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P128F	Engine Controls and Fuel - 1.5L (LYX) - **DTC P127C, P128A-P128D, P128F, P16E4, or P16E5**
P128F	Engine Controls and Fuel - 2.0L (LTG) - **DTC P127C, P128A-P128D, P128F, P16E4, or P16E5**
P129B	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
P129C	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
P129D	Engine Controls and Fuel - 1.5L (LYX) - **DTC P129D**
P129D	Engine Controls and Fuel - 2.0L (LTG) - **DTC P129D**
P129D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1007 or P129D**
P129E	Engine Controls and Fuel - 1.5L (LYX) - **DTC P129E or P12A8**
P129E	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P129E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P129E	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P129F	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P129F**
P12A6	Engine Controls and Fuel - 1.5L (LYX) - **DTC P12A6**
P12A6	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P12A6**
P12A6	Engine Controls and Fuel - 2.0L (LTG) - **DTC P12A6**
P12A8	Engine Controls and Fuel - 1.5L (LYX) - **DTC P129E or P12A8**

mydiagn.com

DTC	Diagnostic Procedure
P12A8	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P12A8	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P12A8	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1307	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P1307-P130A
P1308	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P1307-P130A
P1309	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P1307-P130A
P130A	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P1307-P130A
P130F	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P130F	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P130F	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P135A	Engine Controls and Fuel - 1.5L (LYX) - DTC P135A
P135A	Engine Controls and Fuel - 2.0L (LTG) - DTC P135A

cardiagn.com

DTC	Diagnostic Procedure
P135C	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P135C	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P135C	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P135D	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P135D	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P135D	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P135E	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B

mydiagn.com

DTC	Diagnostic Procedure
P135E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P135E	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P135F	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P135F	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P135F	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P1400	Engine Controls and Fuel - 1.5L (LYX) - **DTC P1400**
P1400	Engine Controls and Fuel - 2.0L (LTG) - **DTC P1400**
P1402	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0403, P0490, P1402, P1407, or P140F**
P1407	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0403, P0490, P1402, P1407, or P140F**
P140B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P140B or P140C**
P140C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P140B or P140C**
P140F	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0403, P0490, P1402, P1407, or P140F**
P1424	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1424**
P1425	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P02E0, P02E2, P02E3, P02EB, P122B, P122C, or P1425**
P1428	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1428 or P142A**
P142A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1428 or P142A**
P142B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P142B-P142F or P1435**
P142B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P142B-P142F, P1435, or P1436**

DTC	Diagnostic Procedure
P142C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P142B-P142F or P1435**
P142C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P142B-P142F, P1435, or P1436**
P142D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P142B-P142F or P1435**
P142D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P142B-P142F, P1435, or P1436**
P142E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P142B-P142F or P1435**
P142E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P142B-P142F, P1435, or P1436**
P142F	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P142B-P142F or P1435**
P142F	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P142B-P142F, P1435, or P1436**
P1434	Displays and Gauges - **DTC P1434**
P1435	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P142B-P142F or P1435**
P1435	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P142B-P142F, P1435, or P1436**
P1436	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1436**
P1436	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P142B-P142F, P1435, or P1436**
P1436	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P1436	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P1436	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P143A	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**

mydiagn.com

DTC	Diagnostic Procedure
P143A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P143A	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P143B	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P143B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P143B	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P143E	Displays and Gauges - **DTC P143E**
P144E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P144E or P144F**
P144F	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P144E or P144F**
P1472	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P1472	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**

DTC	Diagnostic Procedure
P1472	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P1474	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1474-P1479, P147B, or P1488**
P1475	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1474-P1479, P147B, or P1488**
P1476	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1474-P1479, P147B, or P1488**
P1477	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1474-P1479, P147B, or P1488**
P1478	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1474-P1479, P147B, or P1488**
P1479	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1474-P1479, P147B, or P1488**
P147B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1474-P1479, P147B, or P1488**
P1488	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1474-P1479, P147B, or P1488**
P14A0	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P14A0	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P14A0	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P14B6	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**

mydiagn.com

DTC	Diagnostic Procedure
P14B6	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P14B6	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P14BD	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P14BD	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P14BD	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P14CD	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P14CD	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B

DTC	Diagnostic Procedure
P14CD	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P14CE	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P14CE	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P14CE	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P14D4	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P14D4	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P14D4	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B

mydiagn.com

DTC	Diagnostic Procedure
P14D5	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P14D5	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P14D5	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P14D6	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P14D6	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P14D6	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P150C	Engine Controls and Fuel - 1.5L (LYX) - DTC P150C
P150C	Engine Controls and Fuel - 2.0L (LTG) - DTC P150C
P150C	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B

DTC	Diagnostic Procedure
P150C	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P150C	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1513	Antilock Brake System - DTC P1513
P1516	Engine Controls and Fuel - 1.5L (LYX) - DTC P1516, P2101, P2119, or P2176
P1516	Engine Controls and Fuel - 2.0L (LTG) - DTC P1516, P2101, P2119, or P2176
P151A	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P151A	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P151A	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P151D	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P151D	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B

DTC	Diagnostic Procedure
P151D	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P151E	Bumpers and Fascias - DTC P059F or P151E
P153C	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P153C	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P153C	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P153D	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P153D	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P153D	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P155A	Cruise Control - Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C

mitchellaon.com

DTC	Diagnostic Procedure
P155B	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P155C	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P155D	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P155D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P155D	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P155E	12 V Starting and Charging - **DTC P155E, P155F, or P156E**
P155F	12 V Starting and Charging - **DTC P155E, P155F, or P156E**
P156A	HVAC - Automatic - **DTC P156A-P156C**
P156B	HVAC - Automatic - **DTC P156A-P156C**
P156C	HVAC - Automatic - **DTC P156A-P156C**
P156D	12 V Starting and Charging - **DTC P156D**
P156D	Wiring Systems and Power Management - **DTC P156D**
P156E	12 V Starting and Charging - **DTC P155E, P155F, or P156E**
P157A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P157A**
P158A	Cruise Control - **DTC P158A**
P1591	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P1591	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**

.diagn.com

DTC	Diagnostic Procedure
P1591	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P159F	Secondary and Configurable Customer Controls - DTC P159F, P15A0, or P15A1
P15A0	Secondary and Configurable Customer Controls - DTC P159F, P15A0, or P15A1
P15A1	Secondary and Configurable Customer Controls - DTC P159F, P15A0, or P15A1
P15A3	12 V Starting and Charging - DTC P15A3
P15AE	12 V Starting and Charging - DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A
P15AF	12 V Starting and Charging - DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A
P15E2	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P15E2	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P15E2	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P15F2	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B

mitsubishi-4wd.com

DTC	Diagnostic Procedure
P15F2	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P15F2	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P15F6	Driver Assistance Systems - DTC P15F6
P15F7	Driver Assistance Systems - DTC P15F7
P15F8	Antilock Brake System - DTC P15F8
P15F9	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P15F9	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P15F9	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P15FA	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P15FA	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B

DTC	Diagnostic Procedure
P15FA	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P15FB	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P15FB	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P15FB	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P15FD	Antilock Brake System - **DTC P15FD**
P15FF	12 V Starting and Charging - **DTC P15FF**
P161E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P161E**
P162B	Immobilizer - **DTC P162B**
P162C	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P1631	Immobilizer - **DTC P1631**
P163A	Engine Controls and Fuel - 1.5L (LYX) - **DTC P163A**
P163A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P163A**
P163A	Engine Controls and Fuel - 2.0L (LTG) - **DTC P163A**
P163B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P163B**
P1649	Immobilizer - **DTC P1649**
P165C	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**

diagn.com

DTC	Diagnostic Procedure
P165C	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P165C	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P166F	12 V Starting and Charging - DTC P166F
P167F	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P167F	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P167F	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1682	Engine Controls and Fuel - 1.5L (LYX) - DTC P0685-P0687, P0689, P0690, or P1682
P1682	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P0685-P0687, P0689, P0690, or P1682
P1682	Engine Controls and Fuel - 2.0L (LTG) - DTC P0685-P0687, P0689, P0690, or P1682
P16A0	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P02E8, P02E9, or P16A0-P16A2
P16A0	Engine Controls and Fuel - 1.5L (LYX) - DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135
P16A0	Engine Controls and Fuel - 2.0L (LTG) - DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135
P16A1	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC P02E8, P02E9, or P16A0-P16A2
P16A1	Engine Controls and Fuel - 1.5L (LYX) - DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135

DTC	Diagnostic Procedure
P16A1	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135**
P16A2	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P02E8, P02E9, or P16A0-P16A2**
P16A2	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135**
P16A2	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135**
P16A7	Engine Controls and Fuel - 1.5L (LYX) - **DTC P16A7, P16AF, or P16B3**
P16A7	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P16A7, P16AF, or P16B3**
P16A7	Engine Controls and Fuel - 2.0L (LTG) - **DTC P16A7, P16AF, or P16B3**
P16AF	Engine Controls and Fuel - 1.5L (LYX) - **DTC P16A7, P16AF, or P16B3**
P16AF	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P16A7, P16AF, or P16B3**
P16AF	Engine Controls and Fuel - 2.0L (LTG) - **DTC P16A7, P16AF, or P16B3**
P16B3	Engine Controls and Fuel - 1.5L (LYX) - **DTC P16A7, P16AF, or P16B3**
P16B3	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P16A7, P16AF, or P16B3**
P16B3	Engine Controls and Fuel - 2.0L (LTG) - **DTC P16A7, P16AF, or P16B3**
P16D4	12 V Starting and Charging - **DTC P058A-P058F, P16D4-P16D6, P16DC-P16DF, or P16E1-P16E3**
P16D5	12 V Starting and Charging - **DTC P058A-P058F, P16D4-P16D6, P16DC-P16DF, or P16E1-P16E3**
P16D6	12 V Starting and Charging - **DTC P058A-P058F, P16D4-P16D6, P16DC-P16DF, or P16E1-P16E3**
P16D7	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P16D7-P16D9**
P16D8	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P16D7-P16D9**
P16D9	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P16D7-P16D9**
P16DC	12 V Starting and Charging - **DTC P058A-P058F, P16D4-P16D6, P16DC-P16DF, or P16E1-P16E3**
P16DD	12 V Starting and Charging - **DTC P058A-P058F, P16D4-P16D6, P16DC-P16DF, or P16E1-P16E3**
P16DE	12 V Starting and Charging - **DTC P058A-P058F, P16D4-P16D6, P16DC-P16DF, or P16E1-P16E3**
P16DF	12 V Starting and Charging - **DTC P058A-P058F, P16D4-P16D6, P16DC-P16DF, or P16E1-P16E3**
P16E1	12 V Starting and Charging - **DTC P058A-P058F, P16D4-P16D6, P16DC-P16DF, or P16E1-P16E3**
P16E2	12 V Starting and Charging - **DTC P058A-P058F, P16D4-P16D6, P16DC-P16DF, or P16E1-P16E3**
P16E3	12 V Starting and Charging - **DTC P058A-P058F, P16D4-P16D6, P16DC-P16DF, or P16E1-P16E3**
P16E4	Engine Controls and Fuel - 1.5L (LYX) - **DTC P127C, P128A-P128D, P128F, P16E4, or P16E5**
P16E4	Engine Controls and Fuel - 2.0L (LTG) - **DTC P127C, P128A-P128D, P128F, P16E4, or P16E5**
P16E5	Engine Controls and Fuel - 1.5L (LYX) - **DTC P127C, P128A-P128D, P128F, P16E4, or P16E5**
P16E5	Engine Controls and Fuel - 2.0L (LTG) - **DTC P127C, P128A-P128D, P128F, P16E4, or P16E5**
P16E8	Wiring Systems and Power Management - **DTC P16E8**

cardiagn.com

DTC	Diagnostic Procedure
P16E8	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P16E8	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P16E8	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P16E9	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F3, P262B, or P30D6-P30DD**
P16F0	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F3, P262B, or P30D6-P30DD**
P16F3	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0601-P0604, P0606, P062F, P16F3, or P16FB**
P16F3	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**
P16F3	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**
P16F3	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P064D, P16F3, or P262B**
P16F4	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P16F4	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1772, P1773, P1778, P1787, P1789, P17F3, P187F, or P188A (with M3H)**
P16FB	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0601-P0604, P0606, P062F, P16F3, or P16FB**
P16FF	Engine Controls and Fuel - 1.5L (LYX) - **DTC P16FF**
P16FF	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**

cardiagn.com

DTC	Diagnostic Procedure
P16FF	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P16FF	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P171A	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - DTC P171A-P171C
P171A	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - DTC P171A-P171C
P171B	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - DTC P171A-P171C
P171B	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - DTC P171A-P171C
P171C	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - DTC P171A-P171C
P171C	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - DTC P171A-P171C
P171D	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - DTC P171D
P171D	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - DTC P171D
P173A	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P173B	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P173C	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P173D	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P173E	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P173F	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P174B	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P174C	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P174D	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P175E	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - DTC P175E
P175F	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - DTC P175F
P175F	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B

DTC	Diagnostic Procedure
P175F	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P175F	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1761	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - DTC P1761
P1761	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - DTC P1761
P1761	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1761	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1761	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1762	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P1762	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B

carmanualsign.com

DTC	Diagnostic Procedure
P1762	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P1769	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P176B	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P176B-P176D, P178F, P17C4, or P17D3**
P176C	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P176B-P176D, P178F, P17C4, or P17D3**
P176D	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P176B-P176D, P178F, P17C4, or P17D3**
P1771	Electronic Transmission Range Select - **DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8**
P1772	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P1772	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1772, P1773, P1778, P1787, P1789, P17F3, P187F, or P188A (with M3H)**
P1773	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P1773	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1772, P1773, P1778, P1787, P1789, P17F3, P187F, or P188A (with M3H)**
P1774	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P1775	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P1775**
P1775	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P1775	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**

carsdiagn.com

DTC	Diagnostic Procedure
P1775	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P1778	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P1778	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1772, P1773, P1778, P1787, P1789, P17F3, P187F, or P188A (with M3H)**
P177A	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P1787	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P1789	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P1789	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1772, P1773, P1778, P1787, P1789, P17F3, P187F, or P188A (with M3H)**
P178A	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P178B	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P178C	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P178D	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P178E	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P178F	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P176B-P176D, P178F, P17C4, or P17D3**
P179B	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**

cardiagn.com

DTC	Diagnostic Procedure
P179B	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P179B	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P17AA	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P17AB	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P17AC	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P17AD	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P17AE	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P17B0	12 V Starting and Charging - DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A
P17B1	12 V Starting and Charging - DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A
P17B2	12 V Starting and Charging - DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A
P17B3	Wiring Systems and Power Management - DTC P17B3 or P17B4
P17B4	Wiring Systems and Power Management - DTC P17B3 or P17B4
P17B5	Wiring Systems and Power Management - DTC P17B5
P17B6	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P17B7	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P17B8	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P17B9	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P17BA	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P17BB	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P17BC	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P17BD	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8

DTC	Diagnostic Procedure
P17BF	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P17C4	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - DTC P176B-P176D, P178F, P17C4, or P17D3
P17C8	Electronic Transmission Range Select - DTC P173A-P173F, P174B-P174D, P1771, P17AA-P17AE, P17B6-P17B9, P17BA-P17BD, P17BF, or P17C8
P17CF	Electronic Transmission Range Select - DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)
P17D3	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - DTC P176B-P176D, P178F, P17C4, or P17D3
P17D5	Electronic Transmission Range Select - DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)
P17D7	Electronic Transmission Range Select - DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB
P17D8	Electronic Transmission Range Select - DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB
P17D9	Electronic Transmission Range Select - DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB
P17DA	Electronic Transmission Range Select - DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB
P17DB	Electronic Transmission Range Select - DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB
P17DC	Electronic Transmission Range Select - DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB
P17DD	12 V Starting and Charging - DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A
P17DE	12 V Starting and Charging - DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A

DTC	Diagnostic Procedure
P17DF	12 V Starting and Charging - DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A
P17E0	Electronic Transmission Range Select - DTC P17E0-P17E2
P17E1	Electronic Transmission Range Select - DTC P17E0-P17E2
P17E2	Electronic Transmission Range Select - DTC P17E0-P17E2
P17E3	Electronic Transmission Range Select - DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB
P17E4	Electronic Transmission Range Select - DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB
P17E5	Electronic Transmission Range Select - DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB
P17E6	Electronic Transmission Range Select - DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB
P17E7	Electronic Transmission Range Select - DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB
P17E8	Electronic Transmission Range Select - DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB
P17E9	Electronic Transmission Range Select - DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB
P17EA	Electronic Transmission Range Select - DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB

DTC	Diagnostic Procedure
P17EB	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P17EC	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P17ED	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P17EE	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P17EF	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P17F0	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P17F3	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P17F3	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P17F5	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P17F5-P17F7, P17FA-P17FC, or P17FF**
P17F6	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P17F5-P17F7, P17FA-P17FC, or P17FF**
P17F7	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P17F5-P17F7, P17FA-P17FC, or P17FF**
P17F8	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**

DTC	Diagnostic Procedure
P17F9	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P17FA	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P17F5-P17F7, P17FA-P17FC, or P17FF**
P17FB	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P17F5-P17F7, P17FA-P17FC, or P17FF**
P17FC	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P17F5-P17F7, P17FA-P17FC, or P17FF**
P17FD	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P17FE	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P17FF	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P17F5-P17F7, P17FA-P17FC, or P17FF**
P1803	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P1805	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P1806	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P1807	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P180C	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**

cardiagn.com

DTC	Diagnostic Procedure
P180D	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P180E	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P180F	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P1812	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P182E	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P182E or P1915**
P1861	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P1869	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P186A	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P186B	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P186C	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**

cardiagn.com

DTC	Diagnostic Procedure
P186D	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P187D	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P187D, P18E7, or P18E8**
P187E	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P187E, P18AA-P18AE, P27EC, or P27F0**
P187F	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P187F	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1772, P1773, P1778, P1787, P1789, P17F3, P187F, or P188A (with M3H)**
P188A	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1769, P1772-P1774, P1778, P177A, P1787, P1789, P178A-P178E, P17CF, P17D5, P17F3, P187F, or P188A (with MHG)**
P188A	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P16F4, P1772, P1773, P1778, P1787, P1789, P17F3, P187F, or P188A (with M3H)**
P188B	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P188B**
P189C	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P189C**
P189C	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P189C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P189C	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P189D	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18A2	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P18A2 or P18A4**
P18A4	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P18A2 or P18A4**

DTC	Diagnostic Procedure
P18A8	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P18A8**
P18AA	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P187E, P18AA-P18AE, P27EC, or P27F0**
P18AB	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P187E, P18AA-P18AE, P27EC, or P27F0**
P18AC	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P187E, P18AA-P18AE, P27EC, or P27F0**
P18AD	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P187E, P18AA-P18AE, P27EC, or P27F0**
P18AE	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P187E, P18AA-P18AE, P27EC, or P27F0**
P18CB	Parking Assistance Systems - **DTC P18CB**
P18CC	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18CD	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18CE	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18CF	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18D0	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18D1	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18D2	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**

DTC	Diagnostic Procedure
P18D3	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18D4	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18D5	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18D6	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18D7	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18D8	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18D9	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18DA	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18DB	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**

DTC	Diagnostic Procedure
P18DC	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18DD	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18E0	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18E1	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18E6	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18E7	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P187D, P18E7, or P18E8**
P18E8	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P187D, P18E7, or P18E8**
P18E9	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18EA	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P18EB	Electronic Transmission Range Select - **DTC P07B3-P07B5, P07B7, P07B9, P07BA, P07BB, P07BD, P07BE, P17D7-P17D9, P17DA-P17DC, P17E3-P17E9, P17EA-P17EF, P17F0, P17F3, P17F8, P17F9, P17FD, P17FE, P1803, P1805-P1807, P180C-P180F, P1812, P1861, P1869, P186A-P186D, P189D, P18CC-P18CF, P18D0-P18D9, P18DA-P18DD, P18E0, P18E1, P18E6, P18E9, P18EA, or P18EB**
P1915	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P182E or P1915**
P1B12	Antilock Brake System - **DTC P1B12**
P1E00	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1700, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9**

DTC	Diagnostic Procedure
P1E19	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
P1E1A	12 V Starting and Charging - **DTC B1325, B1327, B1328, B1330, B1390, B1395, B1400, B1410, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560-P0563, P0611, P1002, P129B, P129C, P15AE, P15AF, P17B0-P17B2, P17DD-P17DF, P1E19, or P1E1A**
P2002	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2002**
P2006	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2006 or P200A**
P2008	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2008-P2010**
P2009	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2008-P2010**
P200A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2006 or P200A**
P200C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P200C**
P2010	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2008-P2010**
P2015	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2015-P2017**
P2016	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2015-P2017**
P2017	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2015-P2017**
P2032	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0545, P0546, P2032, P2033, P242C, or P242D**
P2033	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0545, P0546, P2032, P2033, P242C, or P242D**
P203C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P203C or P203D**
P203D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P203C or P203D**
P2047	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1048, P1049, or P2047-P2049**
P2048	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1048, P1049, or P2047-P2049**
P2049	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1048, P1049, or P2047-P2049**
P204B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P204B**
P204C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P204C or P204D**
P204D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P204C or P204D**
P205B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P205B-P205D**
P205C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P205B-P205D**
P205D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P205B-P205D**
P205E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P205E**
P2066	Displays and Gauges - **DTC P0461-P0464, P2066, P2067, or P2068 (AWD with Diesel Engine) DTC P0461-P0464, P2066, P2067, or P2068 (AWD with Gasoline engine)**
P2067	Displays and Gauges - **DTC P0461-P0464, P2066, P2067, or P2068 (AWD with Diesel Engine) DTC P0461-P0464, P2066, P2067, or P2068 (AWD with Gasoline engine)**
P2068	Displays and Gauges - **DTC P0461-P0464, P2066, P2067, or P2068 (AWD with Diesel Engine) DTC P0461-P0464, P2066, P2067, or P2068 (AWD with Gasoline engine)**
P206B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P206B-P206D**
P206C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P206B-P206D**
P206D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P206B-P206D**
P2081	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2081, P2085, P242E, P2472, or P2484**
P2085	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2081, P2085, P242E, P2472, or P2484**
P2088	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0010-P0014 or P2088-P2091**
P2088	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0010, P0013, or P2088-P2091**

carsdiagn.com

DTC	Diagnostic Procedure
P2089	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0010-P0014 or P2088-P2091**
P2089	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0010, P0013, or P2088-P2091**
P208A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P208A, P208C, or P208D**
P208C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P208A, P208C, or P208D**
P208D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P208A, P208C, or P208D**
P2090	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0010-P0014 or P2088-P2091**
P2090	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0010, P0013, or P2088-P2091**
P2091	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0010-P0014 or P2088-P2091**
P2091	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0010, P0013, or P2088-P2091**
P2096	Engine Controls and Fuel - 1.5L (LYX) - **DTC P2096 or P2097**
P2096	Engine Controls and Fuel - 2.0L (LTG) - **DTC P2096 or P2097**
P2097	Engine Controls and Fuel - 1.5L (LYX) - **DTC P2096 or P2097**
P2097	Engine Controls and Fuel - 2.0L (LTG) - **DTC P2096 or P2097**
P20B9	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P20B9-P20BF or P20C0-P20C5**
P20BA	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P20B9-P20BF or P20C0-P20C5**
P20BB	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P20B9-P20BF or P20C0-P20C5**
P20BC	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P20B9-P20BF or P20C0-P20C5**
P20BD	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P20B9-P20BF or P20C0-P20C5**
P20BE	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P20B9-P20BF or P20C0-P20C5**
P20BF	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P20B9-P20BF or P20C0-P20C5**
P20C0	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P20B9-P20BF or P20C0-P20C5**
P20C1	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P20B9-P20BF or P20C0-P20C5**
P20C2	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P20B9-P20BF or P20C0-P20C5**
P20C3	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P20B9-P20BF or P20C0-P20C5**
P20C4	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P20B9-P20BF or P20C0-P20C5**
P20C5	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P20B9-P20BF or P20C0-P20C5**
P20E8	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P20E8 or P20E9**
P20E9	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P20E8 or P20E9**
P20EE	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P20EE, P249D, or P249E**
P20F8	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P20F8**
P2101	Engine Controls and Fuel - 1.5L (LYX) - **DTC P1516, P2101, P2119, or P2176**
P2101	Engine Controls and Fuel - 2.0L (LTG) - **DTC P1516, P2101, P2119, or P2176**
P2119	Engine Controls and Fuel - 1.5L (LYX) - **DTC P1516, P2101, P2119, or P2176**
P2119	Engine Controls and Fuel - 2.0L (LTG) - **DTC P1516, P2101, P2119, or P2176**
P2122	Engine Controls and Fuel - 1.5L (LYX) - **DTC P2122, P2123, P2127, P2128, or P2138**
P2122	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2122, P2123, P2127, P2128, or P2138**
P2122	Engine Controls and Fuel - 2.0L (LTG) - **DTC P2122, P2123, P2127, P2128, or P2138**

Cardiagn.com

DTC	Diagnostic Procedure
P2123	Engine Controls and Fuel - 1.5L (LYX) - **DTC P2122, P2123, P2127, P2128, or P2138**
P2123	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2122, P2123, P2127, P2128, or P2138**
P2123	Engine Controls and Fuel - 2.0L (LTG) - **DTC P2122, P2123, P2127, P2128, or P2138**
P2127	Engine Controls and Fuel - 1.5L (LYX) - **DTC P2122, P2123, P2127, P2128, or P2138**
P2127	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2122, P2123, P2127, P2128, or P2138**
P2127	Engine Controls and Fuel - 2.0L (LTG) - **DTC P2122, P2123, P2127, P2128, or P2138**
P2128	Engine Controls and Fuel - 1.5L (LYX) - **DTC P2122, P2123, P2127, P2128, or P2138**
P2128	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2122, P2123, P2127, P2128, or P2138**
P2128	Engine Controls and Fuel - 2.0L (LTG) - **DTC P2122, P2123, P2127, P2128, or P2138**
P2135	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135**
P2135	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135**
P2138	Engine Controls and Fuel - 1.5L (LYX) - **DTC P2122, P2123, P2127, P2128, or P2138**
P2138	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2122, P2123, P2127, P2128, or P2138**
P2138	Engine Controls and Fuel - 2.0L (LTG) - **DTC P2122, P2123, P2127, P2128, or P2138**
P2147	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2147, P2148, P2150, or P2151**
P2147	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P2147	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P2148	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2147, P2148, P2150, or P2151**
P2148	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P2148	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P214E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P214E**
P2150	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2147, P2148, P2150, or P2151**
P2150	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P2150	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P2151	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2147, P2148, P2150, or P2151**

Cardiagn.com

DTC	Diagnostic Procedure
P2151	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P2151	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P2153	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P2153	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P2154	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P2154	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P2156	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P2156	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P2157	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P2157	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157**
P2176	Engine Controls and Fuel - 1.5L (LYX) - **DTC P1516, P2101, P2119, or P2176**
P2176	Engine Controls and Fuel - 2.0L (LTG) - **DTC P1516, P2101, P2119, or P2176**
P2199	Engine Controls and Fuel - 1.5L (LYX) - **DTC P2199**
P2199	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2199**
P2199	Engine Controls and Fuel - 2.0L (LTG) - **DTC P2199**
P219A	Engine Controls and Fuel - 1.5L (LYX) - **DTC P219A**
P219A	Engine Controls and Fuel - 2.0L (LTG) - **DTC P219A**
P21CB	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P21CB**
P2202	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P2203	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P2205	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P2206	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P2207	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P2208	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**

mydiagn.com

DTC	Diagnostic Procedure
P2209	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P220A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P220A or P220B**
P220B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P220A or P220B**
P2210	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P2211	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P115E, P115F, P1160, P116A-P116F, P1192-P1194, P119A-P119C, P11C5, P11C6, P11CC, P11D3, P11DB, P2202, P2203, or P2205-P2211**
P2227	Engine Controls and Fuel - 1.5L (LYX) - **DTC P2227-P2230**
P2227	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2227-P2230**
P2227	Engine Controls and Fuel - 2.0L (LTG) - **DTC P2227-P2230**
P2228	Engine Controls and Fuel - 1.5L (LYX) - **DTC P2227-P2230**
P2228	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2227-P2230**
P2228	Engine Controls and Fuel - 2.0L (LTG) - **DTC P2227-P2230**
P2229	Engine Controls and Fuel - 1.5L (LYX) - **DTC P2227-P2230**
P2229	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2227-P2230**
P2229	Engine Controls and Fuel - 2.0L (LTG) - **DTC P2227-P2230**
P2230	Engine Controls and Fuel - 1.5L (LYX) - **DTC P2227-P2230**
P2230	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2227-P2230**
P2230	Engine Controls and Fuel - 2.0L (LTG) - **DTC P2227-P2230**
P223C	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0131, P0132, P015A, P015B, P223C, or P223E**
P223E	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0131, P0132, P015A, P015B, P223C, or P223E**
P2261	Engine Controls and Fuel - 1.5L (LYX) - **DTC P2261**
P2261	Engine Controls and Fuel - 2.0L (LTG) - **DTC P2261**
P2263	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0234, P0299, or P2263**
P2264	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2264**
P2270	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0137, P0138, P013A, P013B, P013E, P013F, P2270, or P2271**
P2270	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271**
P2271	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0137, P0138, P013A, P013B, P013E, P013F, P2270, or P2271**
P2271	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271**
P227B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P227B**
P227C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P227C-P227E**
P227D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P227C-P227E**
P227E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P227C-P227E**
P228A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P228A or P228B**
P228B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P228A or P228B**
P228C	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0089, P00C6, P228C, P228D, or P2C1E-P2C20**
P228C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0087, P0089, P228C, P228D, or P2293**
P228C	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0089, P00C6, P228C, or P228D**
P228D	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0089, P00C6, P228C, P228D, or P2C1E-P2C20**
P228D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0087, P0089, P228C, P228D, or P2293**

cardiagn.com

DTC	Diagnostic Procedure
P228D	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0089, P00C6, P228C, or P228D**
P2293	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0087, P0089, P228C, P228D, or P2293**
P2294	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2294-P2296**
P2295	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2294-P2296**
P2296	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2294-P2296**
P2297	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2297 or P2A00**
P22A0	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P22A1	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P22A3	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P22A4	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P22A5	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P22A6	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P22A7	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P22A8	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P22A9	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P22FE	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P1004, P119D-P119F, P11BE, P11BF, P11C0, P11C7, P11C8, P11D0-P11D2, P11D5, P11D8, P11D9, P11DA, P11DC, P11FC-P11FF, P22A0, P22A1, P22A3-P22A9, or P22FE**
P2300	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P2300	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P2301	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P2301	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P2303	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P2303	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P2304	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P2304	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P2306	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**

mydiagn.com

DTC	Diagnostic Procedure
P2306	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P2307	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P2307	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P2309	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P2309	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P2310	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P2310	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310**
P242C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0545, P0546, P2032, P2033, P242C, or P242D**
P242D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0545, P0546, P2032, P2033, P242C, or P242D**
P242E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2081, P2085, P242E, P2472, or P2484**
P244A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P244A**
P244C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P244C**
P2452	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2452 or P2454-P2456**
P2453	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2453**
P2454	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2452 or P2454-P2456**
P2455	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2452 or P2454-P2456**
P2456	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2452 or P2454-P2456**
P2457	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2457**
P2459	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2459**
P245A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P245A-P245D**
P245B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P245A-P245D**
P245C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P245A-P245D**
P245D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P245A-P245D**
P2463	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2463**
P2472	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2081, P2085, P242E, P2472, or P2484**
P2484	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2081, P2085, P242E, P2472, or P2484**
P248A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P248A-P248D**
P248B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P248A-P248D**
P248C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P248A-P248D**
P248D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P248A-P248D**
P249D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P20EE, P249D, or P249E**
P249E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P20EE, P249D, or P249E**
P24A5	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P24A5**
P24B0	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P24B0-P24B6, P24C7, P24D0, or P24D1**
P24B1	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P24B0-P24B6, P24C7, P24D0, or P24D1**
P24B2	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P24B0-P24B6, P24C7, P24D0, or P24D1**
P24B3	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P24B0-P24B6, P24C7, P24D0, or P24D1**

carsdiagn.com

DTC	Diagnostic Procedure
P24B4	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P24B0-P24B6, P24C7, P24D0, or P24D1**
P24B5	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P24B0-P24B6, P24C7, P24D0, or P24D1**
P24B6	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P24B0-P24B6, P24C7, P24D0, or P24D1**
P24C7	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P24B0-P24B6, P24C7, P24D0, or P24D1**
P24D0	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P24B0-P24B6, P24C7, P24D0, or P24D1**
P24D1	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P24B0-P24B6, P24C7, P24D0, or P24D1**
P250A	Displays and Gauges - **DTC P250A (with LTG)** **DTC P250A (with LH7)**
P2534	Wiring Systems and Power Management - **DTC P2534 or P2535**
P2535	Wiring Systems and Power Management - **DTC P2534 or P2535**
P2537	Wiring Systems and Power Management - **DTC P2537**
P2544	Engine Controls and Fuel - 1.5L (LYX) - **DTC P2544**
P2544	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2544**
P2544	Engine Controls and Fuel - 2.0L (LTG) - **DTC P2544**
P2544	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P2544	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P2544	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P2561	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1700, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9**
P2564	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2564 or P2565**
P2565	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2564 or P2565**
P257D	Bolted Exterior Body Panels and Closures - **DTC P257D-P257F**
P257E	Bolted Exterior Body Panels and Closures - **DTC P257D-P257F**
P257F	Bolted Exterior Body Panels and Closures - **DTC P257D-P257F**
P2598	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0046, P2598, or P2599**
P2599	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0046, P2598, or P2599**
P25A2	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1700, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9**

DTC	Diagnostic Procedure
P25A9	Engine Mechanical - 1.6L (LH7) Diesel - **DTC P25A9, P25AA, or P25AB**
P25AA	Engine Mechanical - 1.6L (LH7) Diesel - **DTC P25A9, P25AA, or P25AB**
P25AB	Engine Mechanical - 1.6L (LH7) Diesel - **DTC P25A9, P25AA, or P25AB**
P25AC	Engine Mechanical - 1.6L (LH7) Diesel - **DTC P25AC or P25AD**
P25AD	Engine Mechanical - 1.6L (LH7) Diesel - **DTC P25AC or P25AD**
P25AF	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1700, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9**
P25BD	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P25BD**
P25C9	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1700, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9**
P25CA	Engine Controls and Fuel - 1.5L (LYX) - **DTC P25CA-P25CC**
P25CB	Engine Controls and Fuel - 1.5L (LYX) - **DTC P25CA-P25CC**
P25CC	Engine Controls and Fuel - 1.5L (LYX) - **DTC P25CA-P25CC**
P2600	Engine Heating and Cooling - **DTC P2600-P2603**
P2601	Engine Heating and Cooling - **DTC P2600-P2603**
P2602	Engine Heating and Cooling - **DTC P2600-P2603**
P2603	Engine Heating and Cooling - **DTC P2600-P2603**
P2618	Engine Controls and Fuel - 1.5L (LYX) - **DTC P2618**
P2618	Engine Controls and Fuel - 2.0L (LTG) - **DTC P2618 or P2619**
P2619	Engine Controls and Fuel - 2.0L (LTG) - **DTC P2618 or P2619**
P2627	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2627 or P2628**
P2628	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2627 or P2628**
P262B	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F3, P262B, or P30D6-P30DD**
P262B	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**
P262B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B**
P262B	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0601-P0604, P0606, P062B, P062F, P0630, P064D, P16F3, or P262B**
P2635	Engine Controls and Fuel - 1.5L (LYX) - **DTC P2635**
P2635	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2635**
P2635	Engine Controls and Fuel - 2.0L (LTG) - **DTC P2635**
P263A	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0650, P263A, or P263B**
P263A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0650, P263A, or P263B**
P263A	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0650, P263A, or P263B**
P263B	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0650, P263A, or P263B**
P263B	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P0650, P263A, or P263B**
P263B	Engine Controls and Fuel - 2.0L (LTG) - **DTC P0650, P263A, or P263B**
P2670	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2670 or P2671**
P2670	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P2671	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2670 or P2671**
P2671	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P2687	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2687-P2689**
P2688	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2687-P2689**
P2689	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2687-P2689**
P268A	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P268A**
P268C	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P268C-P268F**

cardiagn.com

DTC	Diagnostic Procedure
P268D	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P268C-P268F**
P268E	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P268C-P268F**
P268F	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P268C-P268F**
P26C8	Engine Controls and Fuel - 1.5L (LYX) - **DTC P26C8**
P26C8	Engine Controls and Fuel - 2.0L (LTG) - **DTC P26C8**
P26C8	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1700, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9**
P26C9	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1700, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9**
P26E4	12 V Starting and Charging - **DTC P26E4-P26E6**
P26E5	12 V Starting and Charging - **DTC P26E4-P26E6**
P26E6	12 V Starting and Charging - **DTC P26E4-P26E6**
P2714	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P2714 or P2715**
P2714	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P2714 or P2715**
P2715	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P2714 or P2715**
P2715	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P2714 or P2715**
P2718	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P2719	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P2719-P2721**
P2720	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P2719-P2721**
P2720	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P2721	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P2719-P2721**
P2721	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P2723	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P2723 or P2724**
P2723	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P2723 or P2724**
P2724	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P2723 or P2724**
P2724	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P2723 or P2724**
P2727	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0658, P0659, P2727, P2729, P2730, P2736, P2738, P2739, P2826, P2827, P282F, or P2830**
P2728	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P2728-P2730**
P2729	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P2728-P2730**
P2729	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0658, P0659, P2727, P2729, P2730, P2736, P2738, P2739, P2826, P2827, P282F, or P2830**
P2730	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P2728-P2730**
P2730	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0658, P0659, P2727, P2729, P2730, P2736, P2738, P2739, P2826, P2827, P282F, or P2830**
P2731	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P2731-P2733**
P2732	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P2731-P2733**
P2733	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P2731-P2733**

DTC	Diagnostic Procedure
P2736	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0658, P0659, P2727, P2729, P2730, P2736, P2738, P2739, P2826, P2827, P282F, or P2830**
P2738	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0658, P0659, P2727, P2729, P2730, P2736, P2738, P2739, P2826, P2827, P282F, or P2830**
P2739	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0658, P0659, P2727, P2729, P2730, P2736, P2738, P2739, P2826, P2827, P282F, or P2830**
P2762	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P2762, P2763, or P2764**
P2763	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P2762, P2763, or P2764**
P2764	Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG) - **DTC P2762, P2763, or P2764**
P27A7	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P27A7-P27AE**
P27A8	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P27A7-P27AE**
P27A9	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P27A7-P27AE**
P27AA	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P27A7-P27AE**
P27AB	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P27A7-P27AE**
P27AC	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P27A7-P27AE**
P27AD	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P27A7-P27AE**
P27AE	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P27A7-P27AE**
P27EB	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P27EB, P27ED, or P27EE**
P27EC	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P187E, P18AA-P18AE, P27EC, or P27F0**
P27ED	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P27EB, P27ED, or P27EE**
P27EE	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P27EB, P27ED, or P27EE**
P27EF	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P27EF, P27F1, or P27F2**
P27F0	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P187E, P18AA-P18AE, P27EC, or P27F0**
P27F1	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P27EF, P27F1, or P27F2**
P27F2	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P27EF, P27F1, or P27F2**
P2802	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0707, P0708, P2802, P2803, or P2805**
P2803	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0707, P0708, P2802, P2803, or P2805**
P2805	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0707, P0708, P2802, P2803, or P2805**
P2812	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P2814	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P2815	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P2817	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0741, P2817, or P2818**
P2818	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0741, P2817, or P2818**

cardiagn.com

DTC	Diagnostic Procedure
P281B	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P281D	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P281E	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0960, P0962-P0964, P0966-P0968, P0970, P0971, P2670, P2671, P2718, P2720, P2721, P2812, P2814, P2815, P281B, P281D, or P281E**
P2820	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P2820 or P2821**
P2821	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P2820 or P2821**
P2826	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0658, P0659, P2727, P2729, P2730, P2736, P2738, P2739, P2826, P2827, P282F, or P2830**
P2827	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0658, P0659, P2727, P2729, P2730, P2736, P2738, P2739, P2826, P2827, P282F, or P2830**
P282F	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0658, P0659, P2727, P2729, P2730, P2736, P2738, P2739, P2826, P2827, P282F, or P2830**
P2830	Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H) - **DTC P0658, P0659, P2727, P2729, P2730, P2736, P2738, P2739, P2826, P2827, P282F, or P2830**
P2A00	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2297 or P2A00**
P2ADA	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2ADA-P2ADD**
P2ADB	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2ADA-P2ADD**
P2ADC	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2ADA-P2ADD**
P2ADD	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2ADA-P2ADD**
P2BAA	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC P2BAA**
P2C1E	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0089, P00C6, P228C, P228D, or P2C1E-P2C20**
P2C1F	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0089, P00C6, P228C, P228D, or P2C1E-P2C20**
P2C20	Engine Controls and Fuel - 1.5L (LYX) - **DTC P0089, P00C6, P228C, P228D, or P2C1E-P2C20**
P3051	12 V Starting and Charging - **DTC P3051, P3053, or P3055**
P3052	12 V Starting and Charging - **DTC P3052, P3054, or P3056**
P3053	12 V Starting and Charging - **DTC P3051, P3053, or P3055**
P3054	12 V Starting and Charging - **DTC P3052, P3054, or P3056**
P3055	12 V Starting and Charging - **DTC P3051, P3053, or P3055**
P3056	12 V Starting and Charging - **DTC P3052, P3054, or P3056**
P305B	Wiring Systems and Power Management - **DTC P305B or P305C**
P305C	Wiring Systems and Power Management - **DTC P305B or P305C**
P305D	12 V Starting and Charging - **DTC P305D or P305E**
P305E	12 V Starting and Charging - **DTC P305D or P305E**
P308D	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**

cardiagn.com

DTC	Diagnostic Procedure
P308D	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P308D	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P30B4	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P30B4	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P30B4	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P30B5	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P30B5	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B

DTC	Diagnostic Procedure
P30B5	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P30BC	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P30BC	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P30BC	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P30BD	Engine Controls and Fuel - 1.5L (LYX) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P30BD	Engine Controls and Fuel - 1.6L (LH7) Diesel - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B
P30BD	Engine Controls and Fuel - 2.0L (LTG) - DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B

diagn.com

DTC	Diagnostic Procedure
P30D5	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P30D5	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P30D5	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P30DE	Engine Controls and Fuel - 1.5L (LYX) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P30DE	Engine Controls and Fuel - 1.6L (LH7) Diesel - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
P30DE	Engine Controls and Fuel - 2.0L (LTG) - **DTC C1201, P1000, P1001, P1003, P1008, P1009, P100A, P100E, P103D, P103E, P10B6-P10B9, P10BF, P10C6-P10C8, P10F5, P1100, P1103, P117A, P11FF, P1200, P128C-P128F, P129E, P12A8, P130F, P135C-P135F, P1436, P143A, P143B, P1472, P14A0, P14B6, P14BD, P14CD, P14CE, P14D4-P14D6, P150C, P151A, P151D, P153C, P153D, P155D, P1591, P15E2, P15F2, P15F9, P15FA, P15FB, P165C, P167F, P16E8, P16FF, P175F, P1761, P1762, P1775, P179B, P189C, P2544, P308D, P30B4, P30B5, P30BC, P30BD, P30D5, P30DE, P3168, P3169, or P316B**
U0020	Data Communications - **DTC U0020**
U0028	Data Communications - **DTC U0028**
U0029	Data Communications - **DTC U0029**
U0073	Data Communications - **DTC U0073 or U2100**
U0074	Data Communications - **DTC U0074**
U0076	Data Communications - **DTC U0076**
U0077	Data Communications - **DTC U0077**
U0078	Data Communications - **DTC U0078**
U007B	Data Communications - **DTC U007B**
U007C	Data Communications - **DTC U007C**

DTC	Diagnostic Procedure
U007D	Data Communications - **DTC U007D**
U0100-U02FF	Data Communications - **DTC U0100-U02FF**
U010C	Data Communications - **DTC U010C, U010E, U029D, U029E, or U02A3**
U010E	Data Communications - **DTC U010C, U010E, U029D, U029E, or U02A3**
U01B0	Data Communications - **DTC U01B0**
U029D	Data Communications - **DTC U010C, U010E, U029D, U029E, or U02A3**
U029E	Data Communications - **DTC U010C, U010E, U029D, U029E, or U02A3**
U02A3	Data Communications - **DTC U010C, U010E, U029D, U029E, or U02A3**
U0300-U0336	Data Communications - **DTC U0300-U0336**
U0400-U05FF	Data Communications - **DTC U0400-U05FF**
U1026	Data Communications - **DTC U1026**
U1340-U135F	Data Communications - **DTC U1340-U135F**
U1500-U15FF	Data Communications - **DTC U1500-U15FF**
U1653	Data Communications - **DTC U1653**
U1814	Data Communications - **DTC U1814**
U1833	Data Communications - **DTC U1833**
U183A	Data Communications - **DTC U183A**
U183E	Data Communications - **DTC U183E**
U184A	Data Communications - **DTC U184A**
U184C	Data Communications - **DTC U184C**
U18A2	Data Communications - **DTC U18A2**
U18A6	Data Communications - **DTC U18A6**
U18A7	Data Communications - **DTC U18A7**
U18AA	Data Communications - **DTC U18AA**
U18AF-U18B4	Data Communications - **DTC U18AF-U18B4**
U18B9-U18BF	Data Communications - **DTC U18B9-U18BF**
U18C6	Data Communications - **DTC U18C6**
U18CC	Data Communications - **DTC U18CC**
U18D1	Data Communications - **DTC U18D1**
U18D2	Data Communications - **DTC U18D2**
U18D3	Data Communications - **DTC U18D3**
U2098	Data Communications - **DTC U2098**
U2099	Data Communications - **DTC U2099**
U2100	Data Communications - **DTC U0073 or U2100**
U2101	Data Communications - **DTC U2101**
U2160-U2231	Data Communications - **DTC U2160-U2231**
U2409	Data Communications - **DTC U2409**
U240D	Data Communications - **DTC U240D**
U240E	Data Communications - **DTC U240E**
U240F	Data Communications - **DTC U240F**
U2410	Data Communications - **DTC U2410**
U2411	Data Communications - **DTC U2411**
U2500-U25FF	Data Communications - **DTC U2500-U25FF**
U2616	Data Communications - **DTC U2616**

cardiagn.com

DTC	Diagnostic Procedure
U3000	Data Communications - DTC U3000
U3012	Data Communications - DTC U3012

SYMPTOM BYTE LIST

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
(00 - 0F) General Electrical Failures This category includes standard wiring failure modes (for example, shorts and opens), direct current (DC) quantities related by Ohm's Law and quantities related to amplitude, frequency or rate of change, and wave shape.		
00	-	This sub type is used for failures that cannot be assigned to a specific sub type. No additional information is available.
01	Short to Battery	This sub type is used for failures where the Electronic Control Unit measures vehicle system (battery positive) potential for greater than a specified time period or when some other value is expected.
02	Short to Ground	This sub type is used for failures where the Electronic Control Unit measures ground (battery negative) potential for greater than a specified time period or when some other value is expected.
03	Low Voltage	This sub type is used for failures where the Electronic Control Unit measures a voltage below a specified range but not necessarily a short to ground.
04	Open	This sub type is used for failures where the Electronic Control Unit determines an open circuit via lack of bias voltage, low current flow, no change in state of an input in response to an output, etc.
05	High Voltage/Open	This sub type is used for failures where the condition detected by the Electronic Control Unit is the same for either indicated failure mode.
06	Low Voltage/Open	This sub type is used for failures where the condition detected by the Electronic Control Unit is the same for either indicated failure mode.
07	High Voltage	This sub type is used for failures where the Electronic Control Unit measures a voltage above a specified range but not necessarily a short to battery.
08	Performance - Signal Invalid	This sub type is used for failures where the value of the signal is not plausible given the operating conditions.
09	Too Fast Transitions	This sub type is used for failures where the signal transitions more quickly than is reasonably allowed.
0A	Too Slow Transitions	This sub type is used for failures where the signal transitions more slowly than is reasonably allowed.
0B	High Current	This sub type is used for failures where the Electronic Control Unit measures current flow above a specified range.

cardiagn.com

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
0C	Low Current	This sub type is used for failures where the Electronic Control Unit measures current flow below a specified range.
0D	High Resistance	This sub type is used for failures where the Electronic Control Unit infers a circuit resistance above a specified range.
0E	Low Resistance	This sub type is used for failures where the Electronic Control Unit infers a circuit resistance below a specified range.
0F	Signal Erratic	This sub type is used for failures where the signal is momentarily implausible (not long enough for Signal Invalid) or discontinuous.
(10 - 1F) Additional General Electrical Failures This category includes the overflow from category 0.		
10	-	Currently not used.
11	High Input	This sub type is used for failures where some circuit quantity is above a specified range.
12	Low Input	This sub type is used for failures where some circuit quantity is below a specified range.
13	Low Voltage/High Temperature	This sub type is used for failures where a temperature sensor with a negative temperature coefficient detects a voltage below a specified range.
14	High Voltage/Low Temperature	This sub type is used for failures where a temperature sensor with a negative temperature coefficient detects a voltage above a specified range.
15	Performance - Signal Rising Time Failure	This sub type is used for failures where the signal rise time is outside a specified range.
16	Performance - Signal Falling Time Failure	This sub type is used for failures where the signal fall time is outside a specified range.
17	Performance - Signal Shape/Waveform Failure	This sub type is used for failures where the shape of the signal (plot of the amplitude with respect to time) is not correct (for example, improper circuit impedance.)
18	Low Signal Amplitude	This sub type is used for failures where the Electronic Control Unit measures a signal voltage below a specified range but not necessarily a short to ground (for example, gain too low).
19	High Signal Amplitude	This sub type is used for failures where the Electronic Control Unit measures a signal voltage above a specified range but not necessarily a short to battery (for example, gain too high).
1A	Performance - Bias Level Out of Range	This sub type is used for failures where the Electronic Control Unit applies a bias voltage to a circuit upon which is superimposed a signal voltage (for example, Oxygen Sensor Circuit.)

carlagn.com

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
1B	Signal Cross Coupled	This sub type is used for failures where the Electronic Control Unit detects a circuit shorted to another circuit when both circuits are controlled by the Electronic Control Unit.
1C	-	Currently not used.
1D	-	Currently not used.
1E	-	Currently not used.
1F	Erratic	This sub type is used for failures where the Electronic Control Unit momentarily detects one of the conditions defined above but not long enough to set a specific sub type.
(20 - 2F) FM/PWM Failures This category includes faults related to Frequency Modulated (FM) and Pulse Width Modulated (PWM) inputs and outputs of the Electronic Control Unit and faults where position is determined by counts.		
20	-	Currently not used.
21	Incorrect Period	This sub type is used for failures where the Electronic Control Unit measures an incorrect duration for one cycle of the output.
22	Too Short Low-Time	This sub type is used for failures where the Electronic Control Unit detects the low pulse is too narrow with respect to time.
23	Too Long Low-Time	This sub type is used for failures where the Electronic Control Unit detects the low pulse is too wide with respect to time.
24	Too Short High-Time	This sub type is used for failures where the Electronic Control Unit detects the high pulse is too narrow with respect to time.
25	Too Long High-Time	This sub type is used for failures where the Electronic Control Unit detects the high pulse is too wide with respect to time.
26	Low Frequency	This sub type is used for failures where the Electronic Control Unit detects too few cycles in a given time period.
27	High Frequency	This sub type is used for failures where the Electronic Control Unit detects too many cycles in a given time period.
28	Incorrect Frequency	This sub type is used for failures where the Electronic Control Unit measures an incorrect number of cycles in a given time period.
29	Too Few Pulses	This sub type is used for failures where the Electronic Control Unit measures too few pulses (for example, position is calibrated in counts from one extreme to the other).
2A	Too Many Pulses	This sub type is used for failures where the Electronic Control Unit measures too many pulses (for example, position is calibrated in counts from one extreme to the other).
2B	Missing Reference	This sub type is used for failures where the Electronic Control Unit does not detect a reference for a signal circuit or a group of signal circuits.
2C	-	Currently not used.

obdiagun.com

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
2D	-	Currently not used.
2E	-	Currently not used.
2F	-	Currently not used.
(30 - 3F) Electronic Control Unit Internal Failures This category includes faults related to memory, software, and internal electrical circuitry; requiring component replacement.		
30	-	Currently not used.
31	Internal Checksum Error	This sub type is used by the Electronic Control Unit to indicate an incorrect checksum calculation where memory type is not specified.
32	General Memory Malfunction	This sub type is used by the Electronic Control Unit to indicate a memory failure where memory type is not specified.
33	Special Memory Malfunction	This sub type is used by the Electronic Control Unit to indicate a memory failure where the specific memory type is not defined in this category.
34	RAM Malfunction	This sub type is used by the Electronic Control Unit to indicate a Random Access Memory (RAM) failure.
35	ROM Malfunction	This sub type is used by the Electronic Control Unit to indicate a Read Only Memory (ROM) failure.
36	EEPROM Performance/Malfunction	This sub type is used by the Electronic Control Unit to indicate an Electrically Erasable Programmable Read Only Memory (EEPROM) failure.
37	Software Malfunction	This sub type is used by the Electronic Control Unit to indicate a failure in the execution of operational software
38	Supervision Software Malfunction	This sub type is used by the Electronic Control Unit to indicate a loop time error in the execution of the operational software.
39	Internal Malfunction	This sub type is used by the Electronic Control Unit to indicate the detection of an internal circuit failure.
3A	Incorrect Component Installed	This sub type is used by the Electronic Control Unit to indicate a mismatch between the hardware connected to the Electronic Control Unit and the hardware expected by the Electronic Control Unit.
3B	Self-Test Malfunction	This sub type is used by the Electronic Control Unit to indicate a sensor self-test failure launched by an Electronic Control Unit command.
3C	Internal Communication Malfunction	This sub type is used by the Electronic Control Unit to indicate loss of an internal communication line, for example, between microprocessors in a dual microprocessor configuration.
3D	-	Currently not used.
3E	-	Currently not used.
3F	-	Currently not used.

obdiagn.com

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
(40 - 4F) Electronic Control Unit Programming Failures This category includes faults related to operational software, calibrations, and options; remedied by programming the Electronic Control Unit.		
40	-	Currently not used.
41	Not Programmed	This sub type is used to indicate that only boot software is present in the Electronic Control Unit.
42	Calibration Not Programmed	This sub type is used to indicate that operational software is present but calibration data is not.
43	EEPROM Incorrect Programming	This sub type is used to indicate an EEPROM error that may be remedied by reprogramming the module.
44	Security Access Not Activated	This sub type is used to indicate that programming was attempted without unlocking the Electronic Control Unit.
45	Variant Not Programmed	This sub type is used to indicate the need to enter (program) the sub system option content.
46	Configuration Not Programmed	This sub type is used to indicate the need to enter (program) the vehicle option content.
47	VIN Not Programmed	This sub type is used to indicate the need to enter (program) the vehicle identification number (VIN).
48	Security Code Not Programmed	This sub type is used to indicate the need to enter (program) the theft/security code.
49	RAM Incorrect Programming	This sub type is used by the Electronic Control Unit to indicate a Random Access Memory (RAM) error remedied by reprogramming.
4A	Programming Checksum Error	This sub type is used by the Electronic Control Unit to indicate an incorrect checksum calculation where memory type is not specified.
4B	Calibration Not Learned	This sub type is used by the Electronic Control Unit to indicate that a password, operational range, etc. for a sensor or actuator must be learned by the Electronic Control Unit.
4C	DTC Memory Full	This sub type is used by the Electronic Control Unit to indicate that more DTCs have been detected than can be accommodated by the memory allocated for DTC storage.
4D	Stack Overflow	This subtype is used by the Electronic Control Unit to indicate that more memory has been used in a stack than is allocated to a program.
4E	-	Currently not used.
4F	-	Currently not used.
(50 - 5F) Algorithm Based Failures This category includes faults based on comparing two or more input parameters for plausibility or comparing a single parameter to itself with respect to time.		
50	-	Currently not used.
51	-	Currently not used.
52	-	Currently not used.

carlabn.com

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
53	Low Temperature	This sub type is used for failures where the Electronic Control Unit calculates a low temperature condition based upon the duration of certain operating parameters.
54	High Temperature	This sub type is used for failures where the Electronic Control Unit calculates a high temperature condition based upon the duration of certain operating parameters.
55	Too Few Transitions	This sub type is used for failures where the Electronic Control Unit monitors a parameter over time within specified limits and detects fewer than the expected number of transitions.
56	Too Many Transitions	This sub type is used for failures where the Electronic Control Unit monitors a parameter over time within specified limits and detects more than the expected number of transitions.
57	-	Currently not used.
58	Performance	This sub type is used for failures where the Electronic Control Unit does not see the expected change to a parameter or group of parameters in response to a particular event.
59	Protection Time-Out	This sub type is used for failures where the Electronic Control Unit detects a function is active for greater than a specified time period.
5A	Not Plausible	This sub type is used for failures where the Electronic Control Unit compares two or more input parameters for plausibility.
5B	-	Currently not used.
5C	-	Currently not used.
5D	-	Currently not used.
5E	-	Currently not used.
5F	-	Currently not used.
(60 - 6F) Mechanical Failures This category includes faults detected by inappropriate motion in response to an Electronic Control Unit controlled output.		
60	-	Currently not used.
61	Stuck	This sub type is used for failures where the Electronic Control Unit does not detect any motion in response to energizing a motor, solenoid, relay, etc.
62	Stuck Open	This sub type is used for failures where the Electronic Control Unit does not detect any motion upon commanding the operation of a motor, solenoid, relay, etc., to close some piece of equipment.
63	Stuck Closed	This sub type is used for failures where the Electronic Control Unit does not detect any motion upon commanding the operation of a motor, solenoid, relay, etc., to open some piece of equipment.

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
64	Slip Detected	This sub type is used for failures where the Electronic Control Unit detects excessive duration to command a motor, solenoid, relay, etc., to move a piece of equipment to a desired position.
65	Emergency Position Not Achievable	This sub type is used for failures where the Electronic Control Unit is unable to command a motor, solenoid, relay, etc., to move a piece of equipment to the emergency position.
66	Incorrect Mounting	This sub type is used for failures where the server detects incorrectly mounted components, for example, acceleration sensor showing a position error of 90Â°.
67	Incorrect Assembly	This sub type is used for failures where the control module has detected that the component has been incorrectly installed (for example, hydraulic pipes crossed over, circuits cross wired) or polarity errors.
68	-	Currently not used.
69	-	Currently not used.
6A	-	Currently not used.
6B	-	Currently not used.
6C	-	Currently not used.
6D	-	Currently not used.
6E	-	Currently not used.
6F	-	Currently not used.
(70 - 7F) Bus Signal/Message Failures This category includes faults related to bus hardware and signal integrity. This category is also used when the physical input for a signal is located in one Electronic Control Unit and another Electronic Control Unit diagnoses the circuit.		
70	-	Currently not used.
71	Invalid Data	This sub type is used by the Electronic Control Unit to indicate a signal was received with the corresponding validity bit equal to Invalid or post processing of the signal determines it is invalid.
72	Message Counter Incorrect	This sub type is used by the Electronic Control Unit to indicate a signal was received without the corresponding rolling count value being properly updated.
73	Parity Error	This sub type is used by the Electronic Control Unit to indicate a message was processed with an incorrect parity calculation.
74	Bus Signal Checksum Error	This sub type is used by the Electronic Control Unit to indicate a message was processed with an incorrect protection (checksum) calculation.
75	Serial Data Link High Input	This sub type is used for failures where some circuit quantity, reported via serial data, is above a specified range.
76	Serial Data Link Low Input	This sub type is used for failures where some circuit quantity, reported via serial data, is below a specified range.
77	-	Currently not used.
78	-	Currently not used.

cardiagn.com

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
79	-	Currently not used.
7A	-	Currently not used.
7B	-	Currently not used.
7C	-	Currently not used.
7D	-	Currently not used.
7E	-	Currently not used.
7F	Bus Signal Erratic	This sub type is used for failures where the signal, reported via serial data, is momentarily implausible or discontinuous.
(80 - FF) Reserved Unique System Specific - See specific diagnostic procedures for symptom byte information if these symptom bytes are used.		

SYMPTOMS - VEHICLE

Body Repair

- **Symptoms - Active Grille Air Shutter**
- **Symptoms - Bolted Exterior Body Panels and Closures**

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 - Rear Differential Carrier

Driver Information and Entertainment

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

Engine

- **Symptoms - Engine Electrical**
- **Symptoms - Cruise Control**
- **Symptoms - Engine Controls** - 1.5L (LYX) Engine
- **Symptoms - Engine Controls** - 1.6L Diesel (LH7) Engine
- **Symptoms - Engine Controls** - 2.0L (LTG) Engine
- **Symptoms - Engine Cooling**
- **Symptoms - Engine Mechanical** - 1.5L (LYX) Engine

cardiagn.com

- Symptoms - Engine Mechanical - 1.6L Diesel (LH7) Engine
- Symptoms - Engine Mechanical - 2.0L (LTG) Engine
- Symptoms - Engine Exhaust

General Information

Symptoms - Vibration Diagnosis and Correction

HVAC

- Symptoms - Heating, Ventilation, and Air Conditioning
- Symptoms - HVAC Systems - Automatic
- Symptoms - HVAC Systems - Manual

Power and Signal Distribution

- Symptoms - Data Communications
- Symptoms - Mobile Device Wireless Charger
- Symptoms - Power Outlets
- Symptoms - Wiring Systems

Roof

Symptoms - Roof

Safety and Security

- Symptoms - Driver Assistance Systems
- Symptoms - Immobilizer
- Symptoms - Parking Assistance Systems
- 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

Suspension

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

Transmission

- Symptoms - Automatic Transmission - 6T40 (MNH MNK) or 6T45 (MHG)
- Symptoms - Automatic Transmission - 9T45 (M3U) or 9T50 (M3D M3H)
- Symptoms - Automatic Transmission Shift Lock Control
- Symptoms - Power Transfer Unit Case

ENGINE DOES NOT CRANK

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

cardiagn.com

- Starter Solenoid Does Not Click (Without KL9) Starter Solenoid Does Not Click (KL9)
- Starter Solenoid Clicks, Engine Does Not Crank (Without KL9) Starter Solenoid Clicks, Engine Does Not Crank (KL9)
- 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 - 1.5L (LYX) Engine
- Engine Cranks But Does Not Run - 1.6L Diesel (LH7) Engine
- Engine Cranks But Does Not Run - 2.0L (LTG) Engine

INSPECTION/MAINTENANCE SYSTEM CHECK

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

- Inspection/Maintenance System Check - 1.5L (LYX) Engine
- Inspection/Maintenance System Check - 2.0L (LTG) Engine

DIAGNOSTIC REPAIR VERIFICATION

NOTE: **After a repair has been made, some DTCs require the ignition to be turned Off and then back On before the scan tool function will clear the DTC.**

1. Ignition/Vehicle - Off
2. Install any components or connectors that have been removed or replaced during diagnosis.
3. Perform any adjustment, programming or setup procedures that are required when a component or module is removed or replaced.
4. Ignition - On/Vehicle - In Service Mode
5. Perform the following action: Clear the DTCs.
6. Ignition/Vehicle - Off - For greater than 60 s
7. Perform the Circuit/System Verification and verify the result ends with an All OK. - If available

   or

   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 set. If the DTC sets or another DTC is present - Refer to: Diagnostic Trouble Code (DTC) List - Vehicle

   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 - Refer to: Symptoms - Vehicle

PROACTIVE ALERTS LIST

This master list includes all applicable Proactive Alert Identifiers in alphanumeric order.

Proactive alert identifiers are stored in the K73 Telematics Communication Interface Module and can only be cleared using a scan tool.

Proactive Alert Service Message	Diagnostic Procedure
SAC001	12 V Starting and Charging - Proactive Alert Identifier SAC001
SAC002	12 V Starting and Charging - Proactive Alert Identifier SAC002

carmanualsdiagn.com

Proactive Alert Service Message	Diagnostic Procedure
SAC003	12 V Starting and Charging - **Proactive Alert Identifier SAC003**
SAC004	12 V Starting and Charging - **Proactive Alert Identifier SAC004**
SAC005	12 V Starting and Charging - **Proactive Alert Identifier SAC005**

cardiagn.com

Back To Article

SPECIFICATIONS

A11 RADIO: SCAN TOOL INFORMATION

Radio Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Ignition ON		
Battery Voltage	Varies	The scan tool displays volts. This is the voltage at the input to the radio via high speed GMLAN.
System Power Mode	Run	The scan tool displays Off, Accessory, Run or Crank Request. This is the vehicle power mode status as received by the radio.
Date	Varies	The scan tool displays the current date set in the radio.
Time	Varies	The scan tool displays the current time set in the radio in 24 hour format HHMMSS
Radio Band	Varies	The scan tool displays AM, AM High Definition, FM, FM High Definition, Digital Audio broadcast, or XM. This is the broadcast radio band currently selected.
Audio Source Status	Varies	This parameter displays the currently selected audio source
Current FM Frequency	Varies	When tuned to an FM station, the scan tool displays the currently selected frequency in MHz
Current AM Frequency	Varies	When tuned to an AM station, the scan tool displays the currently selected frequency in kHz
Volume Control	Varies	The scan tools displays the current volume setting in counts.
Mute Status	Off	The scan tool displays On or Off. This is the currently selected audio mute mode.
Surround Sound	Varies	The scan tool displays On or Off. This is the currently selected surround sound mode.
Equalizer Preset	Varies	The scan tool displays the currently selected preset equalizer mode
Radio Power Button	On	The scan tool displays On or Off. This is the currently selected radio power mode.
Remote CD	Varies based on vehicle equipment	The scan tool displays Present or Not Present. This parameter displays present when the infotainment system is equipped with the remote cd player.
Rear Seat Entertainment	Varies based on vehicle equipment	The scan tool displays Present or Not Present. This parameter displays present when the infotainment system is equipped with the rear seat entertainment system.
Remote Enable Circuit	On	The scan tool displays On or Off. This is the current state of the remote enable output as commanded by the radio.
Front 3.5 mm AUX Input	Varies	The scan tool displays Present or Not Present. This parameter displays Present when a device is connected to the front auxiliary input jack.

Parameter	Expected Value	Definition
Rear 3.5 mm AUX Input	Varies	The scan tool displays Present or Not Present. This parameter displays Present when a device is connected to the rear auxiliary input jack.
Front USB Receptacle	Varies	The scan tool displays Present or Not Present. This parameter displays Present when a front USB receptacle is present.
Rear USB Receptacle	Varies	The scan tool displays Present or Not Present. This parameter displays Present when a rear USB receptacle is present.
Front SD Card Receptacle	Varies	The scan tool displays Present or Not Present. This parameter displays Present when a front SD card receptacle is present.
Rear SD Card Receptacle	Varies	The scan tool displays Present or Not Present. This parameter displays Present when a rear SD card receptacle is present.
Radio Theft Lock Status	Unlocked	The scan tool displays Locked or Unlocked. This is the state of the theft lock system.
Theft Lock Armed	VIN Learned	The scan tool displays VIN Learned or No VIN. This is the state of the VIN programming in the radio.
Test Bench Mode	Inactive	The scan tool displays Active or Inactive. This is the state of the test bench mode.
Valet Mode	Inactive	The scan tool displays Active or Inactive. This is the state of the valet mode.
XM Subscription Status	Varies	This parameter displays the country and type of XM service.
High Definition Signal	Varies	The scan tool displays Present or Not Present. This parameter displays Present when a high definition signal is being received.
Digital Audio Signal	Varies	The scan tool displays Present or Not Present. This parameter displays Present when a digital audio signal is being received.
Alternative Frequency Status	Varies	The scan tool displays Active or Inactive. This parameter displays Active if the radio is using an alternative frequency for a radio station broadcasting simultaneously from two different stations.
Last Working MOST ID of Node 1 (Master)	Radio	The scan tool displays the name of the ECU in the MOST BUS Node 1 position that was assigned when the MOST BUS was operational without any faults.
Last Working MOST ID of Node 2	Varies based on vehicle equipment	The scan tool displays the name of the ECU in the MOST BUS Node 2 position that was assigned when the MOST BUS was operational without any faults.
Last Working MOST ID of Node 3	Varies based on vehicle equipment	The scan tool displays the name of the ECU in the MOST BUS Node 3 position that was assigned when the MOST BUS was operational without any faults.
Last Working MOST ID of Node 4	Varies based on vehicle equipment	The scan tool displays the name of the ECU in the MOST BUS Node 4 position that was assigned when the MOST BUS was operational without any faults.
Last Working MOST ID of Node 5	Varies based on vehicle equipment	The scan tool displays the name of the ECU in the MOST BUS Node 5 position that was assigned when the MOST BUS was operational without any faults.

cardiagn.com

Parameter	Expected Value	Definition
Last Working MOST ID of Node 6	Varies based on vehicle equipment	The scan tool displays the name of the ECU in the MOST BUS Node 6 position that was assigned when the MOST BUS was operational without any faults.
Last Working MOST ID of Node 7	Varies based on vehicle equipment	The scan tool displays the name of the ECU in the MOST BUS Node 7 position that was assigned when the MOST BUS was operational without any faults.
Last Working MOST ID of Node 8	Varies based on vehicle equipment	The scan tool displays the name of the ECU in the MOST BUS Node 8 position that was assigned when the MOST BUS was operational without any faults.
Last Working MOST ID of Node 9	Varies based on vehicle equipment	The scan tool displays the name of the ECU in the MOST BUS Node 9 position that was assigned when the MOST BUS was operational without any faults.
Surrogate MOST Master Node Upstream Position	Numeric	This parameter becomes available when DTC U0028 is current. The number identified is the device furthest upstream from the radio communicating on the MOST BUS when a communication fault is present.
Number of MOST Communication Breaks	Numeric	The number displayed increments each time the MOST BUS cannot communicate successfully.
Number of MOST Configuration Status Messages	Numeric	The number displayed increments each time a MOST BUS configuration status message is sent. A configuration status message is sent when the MOST BUS is initiated, including during or following a communication break.
Number of Short Term MOST Communication Breaks	Numeric	The number displayed increments each time the MOST BUS was temporarily unable to communicate successfully.
Diagnostic Data Identifier	Varies	The scan tool displays the 4 character alphanumeric device ID.
VIN Digits 2-17	Varies	The scan tool displays the learned VIN digits 2-17.
Manufacturer Enable Counter	0	The scan tool displays the counter value. This counter is used for manufacturing purposes only.
Boot Software Part Number	Varies	The scan tool displays the boot software ID number.
Diagnostic Data Identifier	Varies	Identifies a supplier and system specific data stream used by diagnostic testers to interpret a diagnostic data stream.
Calibration Part Number 1	Varies	The scan tool displays the software module ID 1.
Calibration Part Number 2	Varies	The scan tool displays the software module ID 2.
Calibration Part Number 3	Varies	The scan tool displays the software module ID 3.
Calibration Part Number 4	Varies	The scan tool displays the software module ID 4.
Calibration Part Number 5	Varies	The scan tool displays the software module ID 5.
Calibration Part Number 6	Varies	The scan tool displays the software module ID 6.
Calibration Part Number 7	Varies	The scan tool displays the software module ID 7.
Calibration Part Number 8	Varies	The scan tool displays the software module ID 8.
Calibration Part Number 9	Varies	The scan tool displays the software module ID 9.
Calibration Part Number 10	Varies	The scan tool displays the software module ID 10.
End Model Part Number	Varies	The scan tool displays the end model part number.

.mydiagn.com

Parameter	Expected Value	Definition
XM Electronic Serial Number	Varies	Identifies the integrated XM module serial number, if equipped.
HD Decoder Electronic Serial Number	Varies	Identifies the integrated HD decoder serial number, if equipped.
XM Firmware Version and Date	Varies	Identifies the XM module software version and release date, if equipped.
HD Decoder System Version	Varies	Identifies the HD decoder software version, if equipped.

Radio Scan Tool Output Controls

Scan Tool Output Control	Description
Active AM/FM Antenna	This output control will command the Active AM/FM Antenna ON and OFF.
Satellite Antenna	This output control will command the Satellite Antenna ON and OFF.
Digital Audio Broadcast Antenna Power	This output control will command the Digital Audio Broadcast Antenna ON and OFF.
MOST Communication Enable Circuit	This output control will command the MOST Communication Enable Circuit ON and OFF.
MOST Bus Diagnostic Starting Point	This output control will initiate the MOST Bus Diagnostic Starting Point Display.
Erase Valet Mode Code	This output control will command the Erase Valet Mode Code function.
Control Module Reset	This output control will command the reset of the Control Module.

A26 HVAC CONTROLS: SCAN TOOL INFORMATION

HVAC Controls Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Vehicle in Service Mode			
Backlight Dimming	-	Varies	The scan tool displays % from 0 - 100 depending on the backlight dimming level.
Base Model Part Number	-	Varies	Base Model Part Number is the part number for the hardware without software and calibrations.
Battery Voltage	-	Varies	The scan tool displays V. This is the current battery voltage.
Boot Software Number	-	Varies	The scan tool displays the boot software ID number.
Calibration Part Number 1	-	Varies	The scan tool displays the software calibration part number 1.
Calibration Part Number 2	-	Varies	The scan tool displays the software calibration part number 2.
Calibration Part Number 3	-	Varies	The scan tool displays the software calibration part number 3.
Diagnostic Data Identifier	-	Varies	The scan tool displays the 4 character alphanumeric device ID.

cardiagn.com

Parameter	System State	Expected Value	Description
Driver HVAC Temperature Display	-	Varies	The scan tool displays Â°C (Â°F). This is the currently selected temperature setting.
Driver Seat Heating/Venting/Cooling Level	Driver Seat Heating/Venting/Cooling OFF	No LEDs activated.	The scan tool displays No LED Activated when the drivers seat heating/venting/cooling is OFF. When the seat is activated, the scan tool displays 1 LED Activated, 2 LEDs Activated, or 3 LEDs Activated depending on the selected level.
Driver Seat Heating/Venting/Cooling Mode	Driver Seat Heating/Venting/Cooling OFF	No LEDs activated.	The scan tool displays No LED Activated when the drivers seat heating/venting/cooling is OFF. When the seat is activated, the scan tool displays 1 LED Activated, 2 LEDs Activated, or 3 LEDs Activated depending on the selected level.
End Model Part Number	-	Varies	End Model Part Number is the part number for the hardware of the control module with software and calibrations.
HVAC Controls	No HVAC buttons active	No Button Pressed	The scan tool displays No Button Pressed or Button Pressed. Button Pressed is displayed when any HVAC button is activated.
	Any HVAC button active	Button Pressed	
HVAC Controls Dimming Level	-	Varies	The scan tool displays % from 0 - 100 depending on the backlight dimming level.
HVAC Display Dimming Level	-	Varies	The scan tool displays % from 0 - 100 depending on the display dimming level.
HVAC Indicator Dimming Level	-	Varies	The scan tool displays % from 0 - 100 depending on the indicator dimming level.
Left Temperature Knob Position	-	Varies	The scan tool displays counts from 0 - 255, indicating the current temperature knob setting.
Passenger HVAC Temperature Display	-	Varies	The scan tool displays Â°C (Â°F). This is the currently selected temperature setting.

.com

Parameter	System State	Expected Value	Description
Passenger Seat Heating/Venting/Cooling Level	Passenger Seat Heating/Venting/Cooling OFF	No LEDs activated.	The scan tool displays No LED Activated when the passenger seat heating/venting/cooling is OFF. When the seat is activated, the scan tool displays 1 LED Activated, 2 LEDs Activated, or 3 LEDs Activated depending on the selected level.
Passenger Seat Heating/Venting/Cooling Mode	Passenger Seat Heating/Venting/Cooling OFF	No LEDs activated.	The scan tool displays No LED Activated when the passenger seat heating/venting/cooling is OFF. When the seat is activated, the scan tool displays 1 LED Activated, 2 LEDs Activated, or 3 LEDs Activated depending on the selected level.
Programming Date	-	Varies	The scan tool displays the date the module was last programmed.
Right Temperature Knob Position	-	Varies	The scan tool displays counts from 0 - 255, indicating the current temperature knob setting.
System Power Mode	-	Run	The scan tool displays: Off, Accessory, Run, or Crank indicating the current vehicle power mode.

B174W FRONTVIEW CAMERA: SCAN TOOL INFORMATION

Front View Camera Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Engine OFF/Lane Departure Warning ON			
System Voltage	-	Varies	The scan tool displays the system voltage depending of the current battery voltage.
System Power Mode	-	Varies	The scan tool displays Off, Accessory, Running, Cranking or Undefined. This is the state of the ignition switch.
Power Mode Controlled by Backup Device	-	Varies	The scan tool displays Off, Accessory, Running or Cranking depending of the current power mode.
Frontview Camera System Status	-	Varies	The scan tool displays Normal, Malfunction or Undefined depending on the state of the lane departure warning system.
Frontview Camera Calibration Status	-	Varies	The scan tool displays Not Calibrated, Calibrated, Dynamically Calibrated or Undefined. This is the current state of the calibration.

Parameter	System State	Expected Value	Description
Frontview Camera Learn Mode Status	-	Varies %	The scan tool displays varies percentage between 0 - 100% depending on the state of the frontview camera learn mode.
Lane Departure Warning Status	-	Varies	The scan tool displays Off, Disabled, Not Ready to Assist, Ready to Assist, Malfunction, Unknown or Undefined depending on the state of the lane departure warning system.
Lane Departure Warning Switch Status	-	On	The scan tool displays On or Off depending on the state of the lane departure warning switch.
Lane Departure Warning Indicator Status	-	Varies	The scan tool displays Off, On, Malfunction, Unknown or Undefined depending on the state of the lane departure warning system.
Forward Collision Alert Function Status	-	Varies	The scan tool displays Off, On, Malfunction, Unknown or Undefined depending on the state of the lane departure warning system.
Intelligent Light Ranging Status	-	Varies	The scan tool displays Off, Disabled, Malfunction, Enabled, Unknown or Undefined depending on the state of the intelligent light ranging system.
Automatic High Beam Activation Status	-	Varies	The scan tool displays Disabled, Enabled or Undefined depending on the state of the automatic high beam assist system.
Following Distance Indicator Status	-	Varies	The scan tool displays Off, Disabled, Not Ready to Assist, Ready to Assist or Undefined depending on the state of the following distance indicator status.
Frontview Camera Disable History 1 - 4	-	Varies	The scan tool displays Empty, Lane Departure Warning Indicator Malfunction, Lane Departure Warning Switch Malfunction, Sensors Obstructed, Accelerator Pedal Position Out of Range, Driven Wheel Speed Signal Invalid, Non-Driven Wheel Speed Invalid, Brake Pedal Moderate Travel Signal Invalid, Brake Pedal Initial Travel Position Achieved, Lost Communication with Steering Wheel Angle Sensor Module, Invalid Data Received From Steering Wheel Angle Sensor Module, Forward Collision Alert Switch Malfunction, Clutch Pedal Position (CPP) Sensor Performance, Transmission Gear Engaged, Acceleration Sensor Longitudinal Signal, Invalid Data Received From Yaw Rate Sensor Module, Power Mode Controlled by Backup Device, System Power Mode, Overvoltage, Undervoltage or Undefined depending on the history data of the frontview camera disable history.

manuals.vwvortex.com

Front View Camera Module Scan Tool Output Controls

Output Control	Description
Clear Disable History Data	The frontview camera control module clears all disable history buffers when commanded from the scan tool.
Forward Collision Alert Switch	The frontview camera control module switches the forward collision alert system to Near, Medium or Far when commanded from the scan tool.
High Beams	The frontview camera control module switches the high beams On or Off when commanded from the scan tool.
Lane Departure Warning Indicator	The frontview camera control module switches the lane departure warning indicator On or Off when commanded from the scan tool.
Lane Departure Warning Switch	The frontview camera control module switches the lane departure warning system On or Off when commanded from the scan tool.
Vehicle Direction Camera Learn	The frontview camera control module initializes the service point calibration of the frontview camera and switches into the learn mode when commanded from the scan tool.

B218L SIDE OBJECT SENSOR MODULE - LEFT: SCAN TOOL INFORMATION

Scan Tool Output Controls

Output Control	Description
Object Detection Alert Indicators	When commanded by the scan tool, the module will provide power to illuminate the side blind zone indicators in appropriate outside rear view mirror. The outside rear view mirror indicator will illuminate.
Rear Cross Traffic Audible Alert	When commanded by the scan tool, the module will send a signal to the audio system to turn on the rear cross traffic audible alert signal. The audio system will beep.
Rear Cross Traffic Haptic Alert	When commanded by the scan tool, the module will send a signal to the memory seat module to turn on the rear cross traffic haptic alert. The driver's seat will vibrate.
Rear Cross Traffic Visual Alert	When commanded by the scan tool, the module will turn on the rear cross traffic alert indicators on infotainment display. The infotainment display will illuminate with the appropriate rear cross traffic alert.

B218R SIDE OBJECT SENSOR MODULE - RIGHT: SCAN TOOL INFORMATION

Scan Tool Output Controls

Output Control	Description
Object Detection Alert Indicators	When commanded by the scan tool, the module will provide power to illuminate the side blind zone indicators in appropriate outside rear view mirror. The outside rear view mirror indicator will illuminate.
Rear Cross Traffic Audible Alert	When commanded by the scan tool, the module will send a signal to the audio system to turn on the rear cross traffic audible alert signal. The audio system will beep.
Rear Cross Traffic Haptic Alert	When commanded by the scan tool, the module will send a signal to the memory seat module to turn on the rear cross traffic haptic alert. The driver's seat will vibrate.
Rear Cross Traffic Visual Alert	When commanded by the scan tool, the module will turn on the rear cross traffic alert indicators on infotainment display. The infotainment display will illuminate with the appropriate rear cross traffic alert.

K9 BODY CONTROL MODULE: SCAN TOOL INFORMATION

Body Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Definition
Operating Conditions: Ignition ON, Vehicle in Park, All Doors Closed			

carmanual.com

Parameter	System State	Expected Value	Definition
5 V Ignition Switch	-	Accessory/Key Out	The scan tool displays Off, Accessory, Run, or Crank. This parameter displays the ignition switch mode.
Accent Lighting 1 Command	-	Varies	This parameter displays the interior lighting ambient 1 command as a percentage.
Accent Lighting 2 Command	-	Varies	This parameter displays the interior lighting ambient 2 command as a percentage.
Accessory	-	Active	The scan tool displays Active or Inactive.
Accessory Power Mode Indicator Command	-	Varies	This parameter displays ignition switch accessory LED PWM command as a percentage.
Accessory Relay Command	-	Active	The scan tool displays Active or Inactive.
Accessory/Retained Accessory Power Relay Command	-	Active	The scan tool displays Active or Inactive. This parameter displays the retained accessory power relay status.
All Doors Lock Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the door lock status.
Ambient Light Sensor	-	Varies	The scan tool displays volts. This parameter displays the ambient light sensor signal voltage.
Ambient Light Status	-	Night	The scan tool displays Unknown, Night, or Day. This parameter displays the ambient light level status.
Automatic Headlamps Disable Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the headlamp disable switch status.
Automatic Transmission Manual Shift Switch	-	Off	The scan tool displays Off or On. This parameter displays the transmission tap up tap down switch status.
Backup Lamps Relay Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the backup lamps relay status.
Battery Current Sensor	-	Varies	The scan tool displays the battery current in amperes.
Battery Low at Start	-	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the battery level is low when the vehicle starts.
Battery Reconnect Detected	-	No	The scan tool displays No or Yes when a battery disconnect/reconnect event has been detected.
Battery Voltage	-	Varies	The scan tool displays the current battery voltage.
BCM-Controlled Charging Voltage	-	Active	The scan tool displays Active or Inactive.

carsalon.com

Parameter	System State	Expected Value	Definition
BCM-Requested Charging Voltage Reduction	-	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the BCM has detected a low battery voltage condition.
Boot Software Part Number	-	Varies	The scan tool displays the boot software part number.
Brake Lamp Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the brake lamp command status.
Brake Pedal Applied	-	Inactive	The scan tool displays Active or Inactive.
Brake Pedal Initial Travel Position Achieved	-	No	The scan tool displays No or Yes.
Brake Pedal Position Sensor	-	Varies	This displays Counts. This numeric value is the current brake pedal position.
Brake Pedal Position Sensor High Voltage During Learn	-	No	The scan tool displays No or Yes.
Brake Pedal Position Sensor Learn	-	No	The scan tool displays No or Yes. This parameter displays Yes when the brake pedal position sensor has learned.
Brake Pedal Position Sensor Learned Home Position	-	Yes	The scan tool displays No or Yes. This parameter displays Yes when the brake pedal position sensor has learned the home position.
Brake Pedal Position Sensor Learned Released Position	-	Yes	The scan tool displays No or Yes. This parameter displays Yes when the brake pedal position sensor has learned the released position.
Brake Pedal Position Sensor Learned Released Position	-	Varies	The scan tool displays volts.
Brake Pedal Position Sensor Learned Released Position	-	Varies	The scan tool displays percentage.
Brake Pedal Position Sensor Low Voltage During Learn	-	No	The scan tool displays No or Yes.
Brake Pedal Position Sensor Move During Learn	-	No	The scan tool displays No or Yes. This parameter displays the brake pedal sensor learn status.
Brake Pedal Position Sensor Pulled Up from Home Position	-	No	The scan tool displays No or Yes.
Brake Pedal Position Sensor Reference	-	Varies	The scan tool displays the brake pedal position as voltage value. This parameter displays the current brake pedal position sensor reference.
Brake Pedal Pulled Up from Home Position	-	No	The scan tool displays No or Yes.
Brake Pedal Pulled Up from Released Position	-	No	The scan tool displays No or Yes.
Brake Transmission Shift Interlock Solenoid Actuator	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the remote start diagnostic status history.

Parameter	System State	Expected Value	Definition
Brake Transmission Shift Interlock Solenoid Actuator Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the last remote start diagnostic status history.
Calculated Brake Pedal Position	-	Varies	The scan tool displays volts.
Calculated Brake Pedal Position	-	Varies	The scan tool displays percentage.
Calibration Part Number 1-20	-	Varies	The scan tool displays the software module calibration part number.
Center Brake Lamp Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the center brake lamp status.
Center Stop Lamp Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the center stop lamp status.
Central Door Lock Switch on Center Console/Passenger Door Lock Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver door lock switch status.
Child Security Lock Indicator Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the child security lock indicator command status.
Child Security Lock Motors Command	-	Inactive	The scan tool displays Active or Inactive.
Child Security Lock/Window Lockout Switch	-	Inactive	The scan tool displays Active or Inactive.
Child Security Lock/Window Lockout Switch Indicator Command	-	Inactive	The scan tool displays Active or Inactive.
Content Theft Deterrent Alarm Status	-	Disarmed	The scan tool displays Off, Armed, or Disarmed. This parameter displays the content theft alarm status.
Content Theft Deterrent Disarmed Until Vehicle Closed	-	No	The scan tool displays No or Yes. This parameter displays the content theft deterrent system status.
Content Theft Deterrent Mode	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Content Theft Deterrent Trigger History 1-3	-	None	The scan tool displays None, Driver door, Passenger door, Left rear door, Right rear door, Rear closure, Midgate, Tonneau Cover, Hood, Ignition Voltage, Intrusion, Inclination, Telematics enhanced service alarm, Battery reconnect detected, Unauthorized PWM change, Security Indicates Tamper, or Glass Breakage. This parameter displays the content theft deterrent trigger history status.

carsdiagn.com

Parameter	System State	Expected Value	Definition
Courtesy Lamps Duty Cycle Command	-	Varies	This parameter displays the interior lights dimming command as a percentage.
Crank Abort	-	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Cruise Charging Set Level	-	Varies	This parameter displays cruise charging set level.
Cruise Control Switch Status	-	OFF	The scan tool displays CANCEL, OFF, ON, RESUME, SET or ERROR. This parameter displays the cruise control switch status.
Current Content Theft Deterrent Trigger	-	None	The scan tool displays None, Driver door, Passenger door, Left rear door, Right rear door, Rear closure, Midgate, Tonneau Cover, Hood, Ignition Voltage, Intrusion, Inclination, Telematics enhanced service alarm, Battery reconnect detected, Unauthorized PWM change, Security Indicates Tamper, Glass Breakage. This parameter displays the content theft deterrent current alarm trigger.
Current Driver	-	1-8	This parameter displays the current driver in vehicle.
Disable Battery Saver Relay Command	-	Inactive	The scan tool displays Active or Inactive.
Dome Lamp Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the dome lamp switch status.
Door Lock Switch	-	Inactive	The scan tool displays Active or Inactive.
Driver Door Ajar Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver door Ajar switch status.
Driver Door Key Unlock Switch	-	Inactive	The scan tool displays Active or Inactive.
Driver Door Lock Switch	-	Inactive	The scan tool displays Active or Inactive.
Driver Door Unlatch Command	-	Inactive	The scan tool displays Active or Inactive.
Driver Door Unlock Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver door unlock command status.
Driver Seat Heating Switch	-	Inactive	The scan tool displays Active or Inactive.
Driver Seat Heating/Venting/Cooling Mode	-	Off	The scan tool displays On or Off.
Driver Seat Ventilation Switch	-	Inactive	The scan tool displays Active or Inactive.
Driver Window Learned	-	Yes	The scan tool displays No or Yes.

carfiagn.com

Parameter	System State	Expected Value	Definition
Driver Window Main Control Down Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver window main control down switch input status.
Driver Window Main Control Express Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver window switch express input status.
Driver Window Main Control Up Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver window switch UP input status.
Driver Window Motor Mode	-	Local Switch Overridden	The scan tool displays Down, Express Down, Express, Up, Error, Inhibit, or Local Switch Overridden. This parameter displays the driver window motor mode status.
Driver Window Motor Reversing Status	-	No	The scan tool displays No or Yes.
Driver Window Motor Sensing System Fault Status	-	No	The scan tool displays No or Yes.
Driver Window Motor Undervoltage Status	-	No	The scan tool displays No or Yes.
Enable Battery Saver Relay Command	-	Inactive	The scan tool displays Active or Inactive.
End Model Part Number	-	Varies	This parameter displays the end model part number.
Engine Stalled	-	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Environment Identification	-	Unknown	The parameter displays the vehicle environment identification successful status.
Front Fog Lamps Relay Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the front fog lamp relay status.
Front Fog Lamps Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the front fog lamp switch status.
Front Passenger Window Main Control Down Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the front passenger window down switch status.
Front Passenger Window Main Control Express Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger window switch express input status.
Front Passenger Window Main Control Up Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger window switch UP input status.

carfdiagn.com

Parameter	System State	Expected Value	Definition
Front Tire Pressure on Placard	-	Varies	The scan tool displays kPa or PSI. This parameter displays the specified tire pressure placard information programmed in the BCM for tire pressure monitoring.
Fuel Economy Mode Inhibited - Low Charging Voltage	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the fuel economy mode status.
Generator Regulator Setpoint	-	Varies	The scan tool displays percentage.
Glove Box Unlatch Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the instrument panel compartment release switch status.
Hazard Lamps Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the hazard lamps switch status.
Hazard Lamps Switch Backlight Command	-	Varies	The scan tool displays percentage. This parameter displays hazard switch backlight level PWM command status.
Headlamps On Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the headlamp on switch status.
Headlamps Flash Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the headlamps flash to pass switch status.
Headlamp Washer Relay Command	-	Inactive	The scan tool displays Active or Inactive.
High Beam Select Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the high beam switch status.
High Beam Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the high beam command status.
Hood Ajar Switch	-	Inactive	This parameter display the remote start diagnostic status history or the last remote start diagnostic status history.
Hood Ajar Switch Signal 1	-	Inactive	This parameter display the remote start diagnostic status history or the last remote start diagnostic status history.
Hood Position	-	CLOSED	The scan tool displays CLOSED, AJAR, or OPENED. This parameter displays the hood position.
Horn Relay Command	-	Inactive	The scan tool displays Active or Inactive.
Horn Switch	-	Inactive	The scan tool displays Active or Inactive.
Idle Boost Level 2-3 Counter	-	Varies	This parameter displays the state of the idle boost level as counts.
Idle Charging Set Level	-	Varies	This parameter displays idle charging set level.
Ignition Mode Switch Dimming Command	-	Varies	The scan tool displays percentage.

carsalign.com

Parameter	System State	Expected Value	Definition
Ignition Switch Reference	-	Varies	This parameter displays the ignition switch voltage reference.
Ignition Switch Signal Voltage	-	Varies	This parameter displays the ignition switch signal voltage.
Ignition Switch Status	-	Inactive	This parameter displays the ignition switch status.
Immobilizer Allows Engine To Start	-	Unknown	The scan tool displays Unknown, Incorrect, Not Allowed, or Valid. This parameter displays the immobilizer status.
Immobilizer Automatic Learn Timer	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the automatic learn timer status.
Immobilizer Environment Device 1-4	-	Unknown	The scan tool displays Incorrect, Correct, Not Received, Not Programmed or Unknown. This parameter displays the immobilizer source status.
Immobilizer Password Learn	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the password learn status.
Immobilizer Password Learn Scan Tool Delay	-	Varies	This parameter displays the auto learn timer status.
Immobilizer Security Code Accepted	-	No	The scan tool displays No or Yes.
Immobilizer Security Code Lockout	-	No	The scan tool displays No or Yes.
Immobilizer Security Code Programmed	-	Yes	The scan tool displays No or Yes.
In Park Switch Status	-	On	The scan tool displays On or Off. This parameter displays the park switch status.
Inadvertent Load Command	-	Active	The scan tool displays Active or Inactive.
Indicator Dimming Duty Cycle Command	-	Varies	The scan tool displays percentage. This parameter displays indicator lighting PWM command status.
Interior/Courtesy Lighting Master Switch	-	Door	The scan tool displays Door or other lighting switch status.
Interior Trunk Lid/Liftgate Window Unlatch Switch	-	Inactive	The scan tool displays Active or Inactive.
Key Capture Solenoid Actuator	-	Active	The scan tool display Active or Inactive. This parameter displays column lock input status.
Key Fob 1-4 Battery Status	-	OK	The scan tool displays OK or other key fob battery status. This parameter displays the key fob battery status.

Cardiagn.com

Parameter	System State	Expected Value	Definition
Key Fob 1-4 Function	-	Undefined	The scan tool displays Inactive, Lock, Unlock Driver Door, All Door Unlock, Release Rear Closure, Actuate Left Sliding Door, Actuate Right Sliding door, Panic Alarm, Release Fuel door, Actuate Power Windows, Actuate Folding Top, Start Engine, Stop Engine, Programmed, Locator Alarm, Close Liftgate, Open Liftgate, Stop Liftgate While Closing, Stop Liftgate While opening, Deadlock All Doors, Stop Liftgate Motion, Start Liftgate Motion, Stop Left Sliding Door Motion, Stop Right Sliding Door Motion, Comfort open, or Comfort close. This parameter displays the key fob function status.
Key Fob in Vehicle	-	Inactive	This parameter displays the current key fob in the vehicle.
Key In Cylinder Switch	-	Active	The scan tool displays Active or Inactive.
Key In Cylinder Switch/Key Fob in Vehicle	-	Yes	The scan tool displays No or Yes.
Key in Ignition Status	-	Inactive	The scan tool displays Key Out or Key In. This parameter displays the key in ignition status.
Key Part Number	-	Varies	This parameter displays the key part number.
Key Type	-	Master Key	The scan tool displays Unknown, Master Key, Valet Key, Fleet Key, or Unconfigured. This parameter displays the key type.
Last Door Lock Function	-	All Doors Lock	The scan tool displays NO Action, PC UNDB Lock, PC Unlock, Unlock, Unlock Driver, Unlock Passenger, Unlock Left Rear, Unlock Right Rear, Unlock Cargo Liftgate, Unlock Driver Side, Unlock Passenger Side, Unlock Non Driver, Unlock All, Lock All, DBL Lock, or UNDBL Lock.
LED Backlight Dimming Command	-	Varies	The scan tool displays as a percentage. This parameter displays LED backlight dimming PWM command status.
Left Brake Lamp Command	-	Varies	The scan tool displays percentage. This parameter displays left brake lamp command status.
Left Dedicated Daytime Running Lamp Command	-	Varies	The scan tool displays percentage. This parameter displays left dedicated daytime running lamp command status.
Left Front Tire Pressure	-	Varies	This parameter displays left front tire pressure in PSI.

carmanuals.com

Parameter	System State	Expected Value	Definition
Left Front Tire Pressure Sensor Identification	-	Varies	This parameter displays left front tire pressure sensor ID.
Left Front Tire Pressure Sensor Location Learned	-	Yes	The scan tool displays No or Yes. This parameter display tire pressure monitor system learned status.
Left Front Tire Pressure Sensor Mode	-	Learn Mode - Pressure Triggered	The scan tool parameter displays Learn Mode, Undefined, Remeasure Data Mode, Rolling Mode, Enter Off Mode, Exit Off Mode, or Learn Mode Pressure Triggered.
Left Front Tire Pressure Sensor Rolling Count	-	Varies	This parameter displays left front tire pressure sensor rolling count percentage.
Left Front Tire Pressure Status	-	Normal	The scan tool displays Unknown, Normal, Very Low Pressure, Low, Weak Signal, or High.
Left Front Turn Signal Bulb Out Feedback	-	Inactive	The scan tool displays Active or Inactive.
Left Front Turn Signal/Hazard Lamp Command	-	Inactive	The scan tool displays Active or Inactive.
Left Low Beam/Daytime Running Lamp Command	-	Varies	The scan tool displays percentage. This parameter displays left low beam/daytime running lamp status.
Left Park Lamps Command	-	Varies	The scan tool displays percentage. This parameter displays rear exterior lighting status.
Left Rear Child Security Lock Switch	-	Inactive	This parameter displays Active or Inactive.
Left Rear Door Ajar Switch	-	Inactive	This parameter displays Active or Inactive. This parameter displays the left rear door ajar switch status.
Left Rear Tire Pressure	-	Varies	This parameter displays left rear tire pressure in PSI.
Left Rear Tire Pressure Sensor Identification	-	Varies	This parameter displays left rear tire pressure sensor ID.
Left Rear Tire Pressure Sensor Location Learned	-	Yes	The scan tool displays No or Yes. This parameter displays tire pressure monitor system learned status.
Left Rear Tire Pressure Sensor Mode	-	Stationary	The scan tool displays Learn Mode, Undefined, Remeasure Data Mode, Rolling Mode, Enter Off Mode, Exit Off Mode, or Learn Mode Pressure Triggered.
Left Rear Tire Pressure Sensor Rolling Count	-	Varies	This parameter displays left rear tire pressure sensor rolling count percentage.
Left Rear Tire Pressure Status	-	Normal	The scan tool displays Unknown, Normal, Very Low Pressure, Low, Weak Signal, or High.
Left Rear Turn Signal Bulb Out Feedback	-	Inactive	The scan tool displays Active or Inactive. The parameter displays turn lamp outage status.

Parameter	System State	Expected Value	Definition
Left Rear Turn Signal/Hazard Lamp Command	-	Inactive	The scan tool displays Active or Inactive.
Left Rear Window Learned	-	Yes	The scan tool displays No or Yes.
Left Rear Window Main Control Down Switch	-	Inactive	The scan tool display Active or Inactive. This parameter displays driver window switch inputs.
Left Rear Window Main Control Express Switch	-	Inactive	The scan tool display Active or Inactive. This parameter displays driver window switch inputs.
Left Rear Window Main Control Up Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays driver window switch inputs.
Left Rear Window Motor Mode	-	Local Switch Overridden	The scan tool displays Down, Express, Up, Inhibit, or Local Switch Overridden.
Left Rear Window Switch at Door	-	Inactive	The scan tool displays Active or Inactive.
Left Stop Lamp Command	-	Varies	The scan tool display percentage.
Left Turn Signal Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the left turn signal switch status.
License Plate Lamps Command	-	Inactive	The scan tool displays Active or Inactive.
Load Reduction Level 2-3 Counter	-	Varies	The scan tool display as counts.
Low Beam Relay Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the headlamp low beam relay status.
Manufacturers Enable Counter	-	Varies	This parameter tool displays various counter values.
Master Keys Learned	-	Varies	This parameter displays the total number of master keys learned.
Module Diagnostic Address	-	Varies	This parameter displays module diagnostic address.
Number of Key Fobs In Vehicle	-	1	This parameter displays the number of fobs located in the vehicle.
Odometer	-	Varies	This parameter displays the vehicle mileage.
Outside Rear View Mirror Courtesy Lamp Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays front exterior lighting status.
Park Brake Switch	-	Active	The scan tool displays Active or Inactive. This parameter displays front exterior lighting status.
Park Lamps Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the parklamp switch is activated.
Passenger Door Ajar Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger door ajar switch status.

carmanualsign.com

Parameter	System State	Expected Value	Definition
Passenger Door Lock Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger door lock switch status.
Passenger Door Unlock Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger door unlock switch status.
Passenger Door(s) Unlatch Command	-	Inactive	The scan tool displays Active or Inactive.
Passenger Door(s) Unlock Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger door unlock status.
Passenger Seat Heating Switch	-	Inactive	The scan tool displays Active or Inactive.
Passenger Seat Heating/Venting/Cooling Mode	-	Off	The scan tool displays On or Off.
Passenger Seat Ventilation Switch	-	Inactive	The scan tool displays Active or Inactive.
Passenger Window Learned	-	Yes	The scan tool displays No or Yes. This parameter displays the passenger window learned status.
Passenger Window Motor Mode	-	Local Switch Overridden	The scan tool displays Down, Express, Up, Inhibit, or Local Switch Overridden.
Passenger Window Switch at Door	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger window switch status.
Pickup Bed Cargo Lamp Command	-	Varies	The scan tool displays percentage. This parameter displays pickup bed cargo lamp command status.
Previous Key Type	-	Unknown	This parameter displays previous driver identification device type.
Primary Key Status	-	Yes	The scan tool displays No or Yes.
Push Button Ignition Switch	-	Inactive	The scan tool displays Active or Inactive.
Push Button Ignition Switch Voltage	-	Varies	This parameter displays the push button ignition switch voltage.
Rain Sensor	-	Inactive	The scan tool displays Active or Inactive.
Rear Closure Ajar Switch	-	Active	The scan tool displays Active or Inactive.
Rear Closure Cylinder Lock Switch	-	Inactive	The scan tool displays Active or Inactive.
Rear Closure Cylinder Unlock Switch	-	Inactive	The scan tool displays Active or Inactive.
Rear Tire Pressure on Placard	-	Varies	This parameter displays the rear tire pressure in kPa or PSI. This parameter displays the specified tire pressure placard information programmed in the BCM for tire pressure monitoring.
Regulated Voltage Control Mode	-	Voltage	The scan tool displays voltage.

carsign.com

Parameter	System State	Expected Value	Definition
Remote Vehicle Start Attempts Exhausted	-	Varies	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history or remaining start attempts.
Remote Vehicle Start Crank Time	-	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Remote Vehicle Start Disabled by Driver	-	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Remote Vehicle Start Source	-	Ignition Switch Start	The scan tool displays Ignition Switch Start or Remote Vehicle Start.
Remote Vehicle Starts Exhausted	-	Varies	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history or remaining remote starts.
Right Brake Lamp Command	-	Varies	The scan tool display percentage. This parameter displays right brake lamp PWM command status.
Right Dedicated Daytime Running Lamp Command	-	Varies	The scan tool display percentage. This parameter displays right dedicated DRL PWM command status.
Right Front Tire Pressure	-	Varies	This parameter displays right front tire pressure in PSI.
Right Front Tire Pressure Sensor Identification	-	Varies	This parameter displays right front tire pressure sensor ID.
Right Front Tire Pressure Sensor Location Learned	-	Yes	The scan tool displays No or Yes.
Right Front Tire Pressure Sensor Mode	-	Stationary	The scan tool displays Learn Mode, Undefined, Remeasure Data Mode, Rolling Mode, Enter Off Mode, Exit Off Mode or Learn Mode Pressure Triggered.
Right Front Tire Pressure Sensor Rolling Count	-	Varies	This parameter displays right front tire pressure sensor rolling count percentage.
Right Front Tire Pressure Status	-	Normal	The scan tool displays Unknown, Normal, Very Low Pressure, Low, Weak Signal, or High.
Right Front Turn Signal Bulb Out Feedback	-	Inactive	The scan tool displays Active or Inactive.
Right Front Turn Signal/Hazard Lamp Command	-	Inactive	The scan tool displays Active or Inactive.
Right Low Beam/Daytime Running Lamp Command	-	Varies	The scan tool displays percentage. This parameter displays right low beam/daytime running lamp status.
Right Park Lamps Command	-	Varies	The scan tool displays percentage. This parameter displays rear exterior lighting status.

Parameter	System State	Expected Value	Definition
Right Rear Child Security Lock Switch	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Door Ajar Switch	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Tire Pressure	-	Varies	This parameter displays right rear tire pressure in PSI.
Right Rear Tire Pressure Sensor Identification	-	Varies	This parameter displays right rear tire pressure sensor ID.
Right Rear Tire Pressure Sensor Location Learned	-	Yes	The scan tool displays No or Yes.
Right Rear Tire Pressure Sensor Mode	-	Learn Mode - Pressure Triggered	The scan tool displays Learn Mode, Undefined, Remeasure Data Mode, Rolling Mode, Enter Off Mode, Exit Off Mode, or Learn Mode Pressure Triggered. This parameter displays the pressure sensor mode status.
Right Rear Tire Pressure Sensor Rolling Count	-	Varies	This parameter displays right rear tire pressure sensor rolling count percentage.
Right Rear Tire Pressure Status	-	Normal	The scan tool displays Unknown, Normal, Very Low Pressure, Low, Weak Signal or High. This parameter displays the right rear tire pressure status.
Right Rear Turn Signal Bulb Out Feedback	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Turn Signal/Hazard Lamp Command	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Window Main Control Down Switch	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Window Main Control Express Switch	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Window Main Control Up Switch	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Window Motor Mode	-	Local Switch Overridden	The scan tool displays Down, Express, Up, Inhibit, or Local Switch Overridden.
Right Rear Window Switch at Door	-	Inactive	The scan tool displays Active or Inactive.
Right Stop Lamp Command	-	Varies	The scan tool displays percentage.
Right Turn Signal Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the right turn signal switch status.
Run Abort	-	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Run Relay Command	-	Active	The scan tool displays Active or Inactive.
Run/Crank	-	Inactive	The scan tool displays Active or Inactive.
Run/Crank Relay Command	-	Active	The scan tool displays Active or Inactive.

carsalign.com

Parameter	System State	Expected Value	Definition
Run/Crank Power Mode Indicator Command	-	Varies	The scan tool displays percentage. This parameter displays ignition switch run LED PWM command status.
Secondary Key Status	-	No	The scan tool displays No or Yes.
Security Indicator Command	-	Varies	The scan tool displays percentage. This parameter displays security LED PWM command status.
Selected Front Tire Type	-	Standard Load	The scan tool displays No Tire Type, Metric Standard Load, Metric Extra Load, Load Range C, Load Range D, or Load Range E. This parameter displays the front tire type.
Selected Rear Tire Type	-	Standard Load	The scan tool displays No Tire Type, Metric Standard Load, Metric Extra Load, Load Range C, Load Range D, or Load Range E. This parameter displays the rear tire type.
Start-Up State of Charge	-	Varies	The scan tool displays percentage. This parameter displays startup state of charge status.
State of Charge	-	Varies	The scan tool displays percentage. This parameter displays state of charge status.
Sunroof Enabled	-	Active	The scan tool displays Active or Inactive.
Sunroof Motor Overtemperature	-	Inactive	The scan tool displays Active or Inactive.
Sunroof Not Learned	-	Inactive	The scan tool displays Active or Inactive.
Sunroof Position	-	Closed	The scan tool displays Closed, Open, Venting, Comfort Open, Closing, Opening. This parameter displays the current sunroof position.
Sunroof Remote Command	-	Inactive	The scan tool displays Sunroof Secure Close, Venting, Close, or Open. This parameter displays the last sunroof remote command.
Sunroof Slide Switch	-	Inactive	The scan tool displays Inactive, Express Open, Open, Express Close, Close, Short to Ground, Short to Battery, or Stuck. This parameter displays the sunroof slide switch status.
Sunroof Tilt Switch	-	Inactive	The scan tool displays Inactive, Open, Close, Short to Ground, Short to Battery or Stuck. This parameter displays the sunroof tilt switch status. When the switch experiences a malfunction Short to Ground, Short to Battery or Stuck will be displayed.
Sunroof/Sunshade Motor Overtemperature	-	Inactive	The scan tool displays Active or Inactive.

carfaun.com

Parameter	System State	Expected Value	Definition
Sunroof/Sunshade Switch	-	Inactive	The scan tool displays Inactive, Express Open, Open, Express Close, Close, Short to Ground, Short to Battery, or Stuck. This parameter displays the sunroof or sunshade switch status.
Sunshade Enabled	-	Active	The scan tool displays Active or Inactive.
Sunshade Not Learned	-	Inactive	The scan tool displays Active or Inactive.
Sunshade Position	-	Closed	The scan tool displays Ajar, Closed, Opened, Closing, or Opening. This parameter displays the sunshade position status.
Sunshade Remote Command	-	Inactive	The scan tool displays Close or Open. This parameter displays the last sunshade remote command.
Tamper Status	-	No	The scan tool displays No or Yes.
Telematics Enhanced Service Override Active	-	No	The scan tool displays No or Yes. This parameter displays vehicle theft deterrent system status.
Total Keys Learned	-	Varies	This parameter displays the number of keys learned.
Traction Control Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the traction control switch is active.
Transponder Authentication	-	Initializing	The scan tool displays Inactive, Initializing, ID Received, Password Received, Data Reception Complete, or Data Transmission Complete. This parameter displays the transponder key communication status.
Transponder Key Status	-	OK	The scan tool displays OK, LIN Bus Initialization Malfunction, Antenna Initialization Malfunction, Password Error, No Valid Key Detected, LIN Bus Communication Malfunction, or Antenna Malfunction. This parameter displays the transponder key communication error status.
Trunk Lamp Command	-	Varies	The scan tool displays as percentage.
Trunk Lid/Liftgate Window Exterior Unlatch Switch	-	Inactive	The scan tool displays Active or Inactive.
Trunk Lid/Liftgate Window Unlatch Command	-	Inactive	The scan tool displays Active or Inactive.
Valet Keys Learned	-	Varies	This parameter displays the number of valet keys learned.
Valet Mode Status	-	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.

manualagn.com

Parameter	System State	Expected Value	Definition
Valet switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the valet switch is on.
Vehicle Identification Number (VIN)	-	Varies	This parameter displays the vehicle identification number.
Window Lockout Switch	-	Inactive	The scan tool displays Active or Inactive.
Window Lockout Switch Indicator Command	-	Inactive	The scan tool displays Active or Inactive.
Windshield Washer Relay Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the windshield washer relay status.
Windshield Washer Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the windshield washer switch status.
Windshield Wiper Park Switch	-	Active	The scan tool displays Active or Inactive.
Windshield Wiper High Speed Relay Command	-	Inactive	The scan tool displays Active or Inactive.
Windshield Wiper High Speed Switch	-	Inactive	The scan tool displays Active or Inactive.
Windshield Wiper Motor Relay Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the windshield wiper relay status.
Windshield Wiper Stalled During Sweep	-	Inactive	The scan tool displays Active or Inactive.
Windshield Wiper Stalled in Park Position	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the windshield wiper stalled status.
Windshield Wiper Switch	-	Off	The scan tool displays Off, Delay 1, Delay 2, Delay 3, Delay 4, Delay 5, or Low. This parameter displays the windshield wiper switch status.

Body Control Module Scan Tool Output Controls

Scan Tool Output Control	Description
Accent Lighting 1	The BCM activates the accent lighting when you select On. The value should be 100%. All accent lighting should illuminate until commanded Off.
Accent Lighting 2	The BCM activates the accent lighting when you select On. The value should be 100%. All accent lighting should illuminate until commanded Off.
Accessory Power Mode Indicator	The BCM activates the accessory indicator when you select On. The value should be 100%. The yellow LED accessory indicator on start button should illuminate until commanded Off.
Accessory Power Relay	The BCM actuates the accessory power relay when you select On. The accessory power relay should turn on allowing specific vehicle functions to operate.

Scan Tool Output Control	Description
Accessory/Retained Accessory Power Relay	The BCM actuates the retained accessory power relay when you select On. The retained accessory power relay should turn on allowing specific vehicle functions to operate.
All Doors Lock	The BCM activates all doors lock when you select Lock. All doors should lock.
All Doors Lock/Unlock	The BCM activates all doors lock/unlock when you select Lock/Unlock.
Auxiliary Ignition Run Relay	The BCM controls the Ignition Run Coil Control circuit to turn it On and Off.
Backup Lamps	The BCM actuates the backup lamps relay when you select On. The backup lamps should illuminate until commanded Off. Engine must be running.
Battery Saver Relay	The BCM activates the battery saver relay when you select Enable. This command sets the low power mode relay in the state in which it does not supply power to the non-essential parts of the vehicle. This is used to prevent the battery from being depleted when the vehicle is not used for a long period of time.
Brake Pedal Position Sensor Learn	The BCM activates the brake pedal position sensor learn when you select Learn. The brake pedal position sensor learn procedure should start.
Brake Transmission Shift Interlock Solenoid Actuator	The BCM activates the transmission shift interlock solenoid actuator when you select On.
Brake Transmission Shift Interlock Indicator	The BCM activates the transmission range indicator when you select On. The transmission range indicator at the shifter should illuminate until commanded Off.
Center Brake Lamp	The BCM activates the center brake lamp when you select On. The center brake lamp should illuminate until commanded Off.
Center Stop Lamp	The BCM activates the center stop lamp when you select On. The center stop lamp should illuminate until commanded Off.
Child Security Lock Indicator	The BCM activates the child security lock indicator when you select On. The child security lock indicator should illuminate until commanded Off.
Child Security Lock Motors	The BCM actuates the child security door motor when you select Lock. The child security doors should lock.
Child Security Lock/Window Lockout Switch Indicator	The BCM activates the child security lock/window lockout switch indicator when you select On. The child security lock/window lockout switch indicator should illuminate until commanded Off.
Clear Driver Window Learned Values	When you select Clear the clear driver window learn procedure should start.
Clear Passenger Window Learned Values	When you select Clear the clear left rear window learn procedure should start.
Courtesy Lamps	The BCM activates the courtesy lamps when you select On. The value should be 100%. The courtesy lamps should illuminate until commanded Off.
Driver Door Unlatch	The BCM activates the output circuit to unlatch the driver door with a passive entry passive start when you select Unlatch. There is NO door handle on this type of vehicle to open the door. Instead, there is a pad that you press to unlatch the door.
Driver Door Unlock	The BCM pulses the driver door unlock motor when you select Unlock. The driver door should unlock.
Driver Window Motor	The BCM activates the driver window motor when you select Up/Down/Stop/Express Up/Express Down. The driver window should follow the appropriate command.

carlajn.com

Scan Tool Output Control	Description
Driver Window Motor Mode	The BCM activates the driver window motor when you select Up/Down/Stop/Express Up/Express Down. The driver window should follow the appropriate command.
Front Fog Lamps	The BCM actuates the front fog lamps relay when you select On. The front fog lamps relay should turn on.
Generator Regulator Setpoint	The BCM changes the output of the generator.
Hazard Lamps Switch Backlight	The BCM activates the hazard lamps switch when you select On. The value should be 100%. The hazard lamps switch backlight should illuminate until commanded Off.
High Beams	The BCM activates the high beam command when you select On. The high beam lights should illuminate. The headlamps have to be on.
Horn Relay	The BCM activates the horn when you select On. The horn should sound.
Inadvertent Load	The BCM activates the inadvertent load command when you select On. (It is an electronic request to shut down an electrical or electronic device that is drawing power from the battery at a time when there should be no activity, usually after the key has been removed from the ignition for a period of time.)
Incandescent Dimming	The BCM activates the incandescent light dimming when you select On. The values should be 100%. The incandescent light dimming should illuminate until commanded Off.
Indicator Dimming	The BCM activates the indicator dimming when you select On. The values should be 100%. The indicator should illuminate until commanded Off.
LED Backlight Dimming	The BCM activates the LED backlight dimming when you select On. The values should be 100%. The LED backlight dimming for control switches should illuminate until commanded Off.
Left Brake Lamp	The BCM activates the left brake lamp when you select On. The values should be 100%. The left brake lamp should illuminate until commanded Off.
Left Dedicated Daytime Running Lamp	The BCM activates the left dedicated daytime running lamp when you select ON. The value changes to 100%. The left daytime running lamp should illuminate.
Left Front Park Lamp	The BCM activates the left front park lamp when you select ON with a value of 100%. The left front park lamp should illuminate.
Left Front Park Lamp/Daytime Running Lamp	The BCM activates the left front park lamp/daytime running lamp when you select ON with a value of 100%. The left front park lamp/daytime running lamp should illuminate.
Left Front Turn Signal Lamp	The BCM activates the left front turn signal lamp when you select On. The left front turn signal lamp should illuminate until commanded Off.
Left Headlamp Lamp Low Beam	The BCM activates the left headlamp low beam when you select On. The values should be 100%. The left headlamp low beam should illuminate until commanded Off.
Left Park Lamps	The BCM activates the left park lamps when you select ON with a value of 100%. The left park lamps should illuminate.
Left Rear Park Lamp	The BCM activates the left rear park lamp when you select ON with a value of 100%. The left rear park lamp should illuminate.
Left Rear Stop/Park Lamp	The BCM activates the left rear stop/park lamp when you select ON with a value of 100%. The left rear stop/park lamp should illuminate.
Left Rear Turn Signal Lamp	The BCM activates the left rear turn signal lamp when you select On. The left rear turn signal lamp should illuminate until commanded Off.
Left Rear Turn Signal/Stop Lamp	The BCM activates the left rear turn signal/stop lamp when you select On. The left rear turn signal/stop lamp should illuminate until commanded Off.
Left Rear Window Motor	The BCM activates the left rear window motor when you select Up/Down/Stop/Express Down. The left rear window should follow the appropriate command.

Cardiagn.com

Scan Tool Output Control	Description
Left Stop Lamp	The BCM activates the left stop lamp when you select ON with a value of 100%. The left stop lamp should illuminate.
Left Trailer Turn Signal Lamp	The BCM activates the left trailer turn signal lamp when you select ON with a value of 100%. The left trailer turn signal lamp should illuminate.
License Plate Lamps	The BCM activates the license plate lamps when you select On. The license plate lights should turn on until commanded Off.
Liftgate Unlatch	The BCM actuates the rear compartment lid release actuator when you select Unlatch. The trunk or liftgate should open.
LIN Bus Device Identification Data	When you select Update the LIN Bus Device part number and calibration part number should be updated.
Low Beam Lamps	The BCM activates the low beam lamps when you select On. The low beam lamps should turn on.
Low Beam Relay	The BCM activates the low beams when you select On. The low beam lights should turn on.
Outside Rear View Mirror Courtesy Lamp	The BCM activates the outside rear view mirror courtesy lamp when you select On. The outside rear view mirror courtesy lamp (at the bottom) should illuminate.
Passenger Door(s) Unlatch	The BCM activates the output circuit to unlatch the passenger door with a passive entry passive start when you select Unlatch. There is NO door handle on this type of vehicle to open the door. Instead, there is a pad that you press to unlatch the door.
Passenger Door(s) Unlock	The BCM pulses the passenger door unlock motor when you select Unlock. The passenger door should unlock.
Passenger Window Motor	The BCM activates the passenger window motor when you select Up/Down/Stop/Express Up/Express Down. The passenger window should follow the appropriate command.
Pickup Bed Cargo Lamp	The BCM activates the pickup bed cargo lamp when you select On. The values should be 100%. The pickup bed cargo lamp should illuminate until commanded Off.
Rear Fog Lamp(s) Relay	The BCM activates the rear fog lamps when you select On. The rear fog lamps should turn on.
Right Brake Lamp	The BCM activates the right brake lamp when you select On. The value should be 100%. The right brake lamp should illuminate until commanded Off.
Right Dedicated Daytime Running Lamp	The BCM activates the right dedicated daytime running lamp when you select On. The value should be 100%. The right daytime running lamp should illuminate.
Right Front Park Lamp	The BCM activates the right front park lamp when you select ON with a value of 100%. The right front park lamp should illuminate.
Right Front Park Lamp/Daytime Running Lamp	The BCM activates the right front park lamp/daytime running lamp when you select ON with a value of 100%. The right front park lamp/daytime running lamp should illuminate.
Right Front Turn Signal Lamp	The BCM activates the right front turn signal lamp when you select On. The right front turn signal/hazard lamp should illuminate.
Right Headlamp Low Beam	The BCM activates the right headlamp low beam when you select On. The right headlamp low beam should illuminate.
Right Park Lamps	The BCM activates the right park lamps when you select ON with a value of 100%. The right park lamps should illuminate.
Right Rear Park Lamp	The BCM activates the right rear park lamp when you select ON with a value of 100%. The right rear park lamp should illuminate.
Right Rear Stop/Park Lamp	The BCM activates the right rear stop/park lamp when you select ON with a value of 100%. The right rear stop/park lamp should illuminate.
Right Rear Turn Signal Lamp	The BCM activates the right rear turn signal/hazard lamp when you select On. The right rear turn signal lamp should illuminate until commanded Off.

Cadillac.com

Scan Tool Output Control	Description
Right Rear Turn Signal/Stop Lamp	The BCM activates the right rear turn signal/stop lamp when you select On. The right rear turn signal/stop lamp should illuminate until commanded Off.
Right Rear Window Motor	The BCM activates the right rear window motor when you select Up/Down/Stop/Express Down. The right rear window should follow the appropriate command.
Right Stop Lamp	The BCM activates the right stop lamp when you select ON with a value of 100%. The right stop lamp should illuminate.
Right Trailer Turn Signal Lamp	The BCM activates the right trailer turn signal lamp when you select ON with a value of 100%. The right trailer turn signal lamp should illuminate.
Run Relay	The BCM actuates the run relay when you select On. The run relay should turn on.
Run/Crank Relay	The BCM actuates the run/crank relay when you select On. The run/crank relay should turn on.
Run/Start Power Mode Indicator	The BCM activates the run/start lamp when you select On. The value should be 100%. The green LED on engine start/stop button should illuminate until commanded Off.
Security Indicator	The BCM activates the security indicator command when you select On. The security indicator at center of dash (or at DRL sensor) should illuminate until commanded Off.
Stop Lamps	The BCM activates the stop lamps when you select ON with a value of 100%. The stop lamps should illuminate.
Tire Pressure Sensors Learn	The BCM activates the tire pressure sensor learn procedure when you select Learn.
Tire Type/Pressure Selection	When you select OK, you can change tire type and load range.
Trailer Backup Lamps	The BCM activates the trailer backup lamps when you select ON with a value of 100%. The trailer backup lamps should illuminate.
Trailer Park Lamps	The BCM activates the trailer park lamps when you select ON with a value of 100%. The trailer park lamps should illuminate.
Transmission Range Indicator	The BCM activates the transmission range indicator when you select On. The transmission range indicator at the shifter should illuminate until commanded Off.
Trunk Lamp	The BCM activates the trunk lamp when you select On. The value should be 100%. The trunk lamp should illuminate until commanded Off.
Trunk Lid Unlatch	The BCM activates the trunk lid unlatch when you select On. The trunk lid should unlatch.
Window Lockout Switch Indicator	The BCM activates the window lockout switch indicator when you select On. The window lockout switch indicator should illuminate until commanded Off.
Windshield Washer Relay	The BCM actuates the windshield washer relay when you select On. The windshield washer relay should turn on.
Windshield Wiper High Speed Relay	The BCM actuates the windshield wiper high speed relay when you select On. The windshield wiper high speed relay should turn on.
Windshield Wiper Motor Relay	The BCM actuates the windshield wiper motor relay when you select On. The windshield wiper motor relay should turn on.

K17 ELECTRONIC BRAKE CONTROL MODULE: SCAN TOOL INFORMATION

The Electronic Brake Control Module scan tool data parameters list contains all ABS related parameters that are available on the scan tool. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists.

Electronic Brake Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description

cardiagn.com

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON			
ABS Pump Motor Voltage	-	0 V	The scan tool displays 0 - 12 V depending on the commanded pump motor voltage.
Acceleration Sensor Longitudinal Signal	-	Varies	The scan tool displays 0 - 5 V depending on the vehicle's longitudinal acceleration.
Antilock Braking System	-	OK	The scan tool displays OK or Malfunction. Malfunction is displayed when the ABS is disabled.
Brake Booster Electric Vacuum Pump	-	On/Off	The scan tool displays On or Off. On is displayed when the electric vacuum pump motor is commanded On.
Brake Booster Vacuum Sensor Supply	-	4.8 - 5.2 V	The scan tool displays V. This is the voltage supplied to the brake booster vacuum sensor.
Brake Booster Vacuum Sensor	-	Varies	The scan tool displays kPa (PSI) depending on the vacuum applied to the brake booster.
Brake Fluid Level Sensor	-	OK	The scan tool displays OK when the brake fluid is at correct level and Low when the brake fluid is low.
Brake Pedal Position Sensor	Brake pedal released	Inactive	The scan tool displays Inactive or Active depending on the state of the brake pedal.
	Brake pedal applied	Active	
Brake Pressure Sensor	Brake pedal released	0 - 1 V	The scan tool displays 0 - 5 V depending on the applied hydraulic brake pressure.
	Brake pedal applied	1 - 5 V	
Delivered Torque	No Acceleration	0%	The scan tool displays 0 - 100% depending on the how much torque the engine is delivering.
	Acceleration	Varies	
Dynamic Rear Proportioning Status	-	OK	The scan tool displays OK or Malfunction. Malfunction is displayed when the dynamic rear proportioning system is disabled.
Engine Drag Control Status	-	OK	The scan tool displays OK or Malfunction. Malfunction is displayed when the engine drag control system is disabled.
Lateral Acceleration Signal	-	Varies	The scan tool displays 0 - 5 V depending on the vehicle's lateral acceleration.
Left Front Inlet Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the left front inlet solenoid valve is commanded ON.
Left Front Outlet Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the left front outlet solenoid valve is commanded ON.
Left Front Wheel Speed Sensor	-	0 km/h (0 MPH)	The scan tool displays km/h (MPH) depending on the current speed of the left front wheel speed sensor.

cardiagn.com

Parameter	System State	Expected Value	Description
Left Rear Inlet Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the left rear inlet solenoid valve is commanded ON.
Left Rear Outlet Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the left rear outlet solenoid valve is commanded ON.
Left Rear Wheel Speed Sensor	-	0 km/h (0 MPH)	The scan tool displays km/h (MPH) depending on the current speed of the left rear wheel speed sensor.
Panic Brake Assist Status	-	OK	The scan tool displays OK or Malfunction. Malfunction is displayed when the panic brake assist system is disabled.
Primary Isolation Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the isolation solenoid valve is commanded ON.
Primary Prime Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the prime solenoid valve is commanded ON.
Pump Motor Relay Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the pump motor is commanded ON.
Requested Torque	-	50%	The scan tool displays 0 - 100% depending on the how much torque is requested.
Right Front Inlet Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the right front inlet solenoid valve is commanded ON.
Right Front Outlet Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the right front outlet solenoid valve is commanded ON.
Right Front Wheel Speed Sensor	-	0 km/h (0 MPH)	The scan tool displays km/h (MPH) depending on the current speed of the right front wheel speed sensor.
Right Rear Inlet Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the right rear inlet solenoid valve is commanded ON.
Right Rear Outlet Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the right rear outlet solenoid valve is commanded ON.
Right Rear Wheel Speed Sensor	-	0 km/h (0 MPH)	The scan tool displays km/h (MPH) depending on the current speed of the right rear wheel speed sensor.
Secondary Isolation Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the isolation solenoid valve is commanded ON.

.mydiagn.com

Parameter	System State	Expected Value	Description
Secondary Prime Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the prime solenoid valve is commanded ON.
Steering Wheel Angle	Steering wheel in straight position	-5 to +5Â°	The scan tool displays Â°. This is the current position of the steering wheel angle sensor.
	Steering wheel turned left until stop	450 - 550Â°	
	Steering wheel turned right until stop	-550 to -450Â°	
System Voltage	-	11 - 14 V	The scan tool displays V. This is the current battery voltage.
Traction Control System	-	OK	The scan tool displays OK or Malfunction. Malfunction is displayed when traction control is disabled.
Traction Control System Status	-	Active	The scan tool displays Active or Inactive depending on the state of the traction control.
Yaw Rate Signal	-	Varies	The scan tool displays 0 - 5 V depending on the vehicle's yaw rate.

Electronic Brake Control Module Scan Tool Output Controls

Output Control	Description
ABS Left Front Solenoid Valves	Executes the left front ABS solenoids control function
ABS Left Rear Solenoid Valves	Executes the left rear ABS solenoids control function
ABS Pump Motor	Commands the ABS pump motor Increase or Decrease.
ABS Right Front Solenoid Valves	Executes the right front ABS solenoids control function
ABS Right Rear Solenoid Valves	Executes the right rear ABS solenoids control function
Automated Brake Bleed	This is used in order to bleed the ABS hydraulics.
Brake Booster Electric Vacuum Pump	Commands the electric vacuum pump motor ON or OFF.
Pressure Control Solenoid Valve	Commands the variable effort steering solenoid valve Increase or Decrease.
Traction Control Left Front Solenoid Valves	Executes the left front traction control solenoids control function
Traction Control Left Rear Solenoid Valves	Executes the left rear traction control solenoids control function
Traction Control Right Front Solenoid Valves	Executes the right front traction control solenoids control function
Traction Control Right Rear Solenoid Valves	Executes the right rear traction control solenoids control function

cardiagn.com

Back To Article

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	-	-
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	-	-

cardiagn.com

Application	Front Runout		Center Runout		Rear Runout		Stub Shaft Runout	
	Metric	English	Metric	English	Metric	English	Metric	English
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.								

DIAGNOSTIC INFORMATION AND PROCEDURES

VIBRATION DIAGNOSIS, STARTING POINT, AND CORRECTION

The information contained in this Vibration Diagnosis and Correction section is designed to cover various vehicle designs and configurations. Not all content will apply to all vehicles.

NOTE: **The following steps must be completed before using the analysis tables or the symptom tables.**

1. Perform the **Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)** table before using the other Vibration Analysis tables or the Symptom tables in order to effectively diagnose the customer's concern.

   The use of Vibration Analysis - Road Testing will first provide duplication of virtually any vibration concern and then identify the correct procedure for diagnosing the area of concern which has been duplicated.

2. Review the following Vibration Diagnostic Process.
3. Review the general descriptions to familiarize yourself with vibration theory and terminology, the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH), or the **EL-38792 - A** Electronic Vibration Analyzer (EVA) 2, and the **EL-38792 - VS** Vibrate Software. Reviewing this information will help you determine whether the condition described by the customer is a potential operating characteristic or not.

   Refer to the following:

   - **Vibration Theory and Terminology**
   - **Oscilloscope Diagnostic Kit Description and Operation**
   - **Electronic Vibration Analyzer (EVA) Description and Operation**
   - **Vibrate Software Description and Operation**
   - **Reed Tachometer Description**

Vibration Diagnostic Process

NOTE: **Using the following steps of the vibration diagnostic process will help you to effectively narrow-down and pin-point the search for the specific source of a vibration concern and to arrive at an accurate repair.**

1. Gather specific information on the customer's vibration concern.
2. Perform the road testing steps in sequence as identified in Vibration Analysis - Road Testing in order to duplicate the customer's concern and evaluate the symptoms of the concern under changing conditions. Observe what the vibration feels like and what it sounds like. Observe when the symptoms first appear, when they change, and when they cease.
3. Determine if the customer's vibration concern is truly an abnormal condition or something that is potentially an operating characteristic of the vehicle.
4. Systematically eliminate or "rule-out" possible vehicle systems.
5. Focus diagnostic efforts on the remaining vehicle system and systematically eliminate or "rule-out" possible components of that system.
6. Make a repair on the remaining component, or components, which have not been eliminated systematically, and must therefore be the cause of the vibration.
7. Verify that the customer's concern has been eliminated or at least brought to an acceptable level.
8. Again perform the road testing steps in sequence as identified in Vibration Analysis - Road Testing in order to verify that the vehicle did not have more than one vibration occurring.

carmanualsdiagn.com

Preliminary Visual/Physical Inspection

- Inspect for aftermarket equipment and modifications which could affect the operation of the vehicle rotating component systems.
- Inspect the easily accessible or visible components of the vehicle rotating component systems for obvious damage or conditions which could cause the symptom.
- Inspect the tire inflation pressures for the proper pressure.

Diagnostic Aids

Improper component routing or isolation, or components which are worn or faulty may be the cause of intermittent conditions that are difficult to duplicate. If the vibration concern could not be duplicated by following the steps of the Vibration Diagnostic Process, refer to **Vibration Diagnostic Aids**.

VIBRATION ANALYSIS - ROAD TESTING (EL-38792-A ELECTRONIC VIBRATION ANALYZER)

Special Tools

- **EL-38792-A** Electronic Vibration Analyzer
- **EL-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.

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 **EL-38792-VS** 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 EL-38792-A Electronic Vibration Analyzer frequency which corresponds with that disturbance.**

Proper location of the **EL-38792-A** Electronic Vibration Analyzer, sensor onto the component which is most excited by the vibration disturbance is critical to obtaining an accurate frequency reading.

This test will duplicate virtually any disturbance which occurs while the vehicle is in motion.

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**

Step	Action	Yes	No
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 **EL-38792-VS** Vibrate Software, IS available, obtain the transmission gear ratios. 3. If the **EL-38792-VS** Vibrate 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 rotational speed, if equipped. Refer to **Component Rotational Speed Calculation**. Did you obtain the powertrain ratios for use with the **EL-38792-VS** Vibrate Software, or calculate the component rotational speeds, if **EL-38792-VS** Vibrate 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 **EL-38792-A** Electronic Vibration Analyzer, is the preferred method for gathering necessary vibration frequency data. If the **EL-38792-A** Electronic Vibration Analyzer 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 **EL-38792-A** Electronic Vibration Analyzer available for use?	Go to **Step 8**	Go to **Step 9**
8	Install the **EL-38792-A** Electronic Vibration Analyzer. Is the **EL-38792-A** Electronic Vibration Analyzer 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**

cardiagn.com

Step	Action	Yes	No
11	1. Install the **EL-38792-A** Electronic Vibration Analyzer 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 **EL-38792-A** Electronic Vibration Analyzer 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. 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 **EL-38792-A** Electronic Vibration Analyzer • The feel and/or sound of the disturbance 6. If a reading could not be obtained by the **EL-38792-A** Electronic Vibration Analyzer, move the **EL-38792-A** Electronic Vibration Analyzer 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**

cardiagn.com

Step	Action	Yes	No
14	1. Install the **EL-38792-A** Electronic Vibration Analyzer sensor, if available, to the component identified by the customer as most respondent to the vibration. If no component was identified, install the **EL-38792-A** Electronic Vibration Analyzer 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 • The vibration frequency reading, if detected by the **EL-38792-A** Electronic Vibration Analyzer • 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 **EL-38792-A** Electronic Vibration Analyzer 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 **EL-38792-A** Electronic Vibration Analyzer 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 **EL-38792-A** Electronic Vibration Analyzer • 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 **EL-38792-A** Electronic Vibration Analyzer 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**

cardiagn.com

Step	Action	Yes	No
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 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 **EL-38792-A** Electronic Vibration Analyzer is not available, refer to **Symptoms - Vibration Diagnosis and Correction**. Did the **EL-38792-A** Electronic Vibration Analyzer detect a dominant frequency?	Go to **Step 20**	Go to **Symptoms - Vibration Diagnosis and Correction**
20	1. If the **EL-38792-VS** Vibrate 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 **EL-38792-VS** Vibrate 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**

VIBRATION ANALYSIS - ROAD TESTING (CH-51450-NVH OSCILLOSCOPE)

Special Tools

- **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH)
- **EL-47955** Multi Diagnostic Interface (MDI)

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

Test Description

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

NOTE: **Be certain to OBSERVE for disturbances that match the customers description FIRST, then look at the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) frequency which corresponds with that disturbance.**

12

Proper location of the **CH-51450-NVH** oscilloscope accelerometer onto the component which is most excited by the vibration disturbance is critical to obtaining an accurate frequency reading.

This test will duplicate virtually any disturbance which occurs while the vehicle is in motion.

15

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.

16

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 - Vehicle?	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	Obtain the drive axle final drive ratio.	Go to **Step 6**	-
6	Install the **CH-51450-NVH** Oscilloscope and the **EL-47955** MDI. Is the **CH-51450-NVH** Oscilloscope operating properly?	Go to **Step 7**	**Oscilloscope Diagnostic Kit Description and Operation**
7	Did the customer concern indicate that the vibration occurs ONLY while the vehicle is standing still?	Go to **Vibration Analysis - Engine**	Go to **Step 8**
8	Did the customer concern indicate that the vibration occurs ONLY during heavy acceleration at launch?	Go to **Step 9**	Go to **Step 12**

cardiagn.com

Step	Action	Yes	No
9	1. Install the **CH-51450-NVH-TA183** accelerometer to the pinion area of the drive axle. Route the accelerometer cable clear of rotating parts and loosely secure the wire clear of moving parts. If it is not possible to install the **CH-51450-NVH-TA183** accelerometer to the drive axle, install the accelerometer 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. 3. With the vehicle at a stand-still, apply the brake pedal 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 brake pedal and accelerate aggressively to 32 km/h (20 mph). 5. Observe the vehicle for disturbances that match the customers description and note the following conditions: • The vibration frequency reading, if detected, by the **CH-51450-NVH** Oscilloscope • The feel and/or sound of the disturbance 6. If a reading could not be obtained by the **CH-51450-NVH** Oscilloscope, move the **CH-51450-NVH-TA183** accelerometer to another part that is respondent to the vibration and repeat Steps 3-5. Were you able to duplicate the customer concern?	Go to **Step 10**	Go to **Step 12**
10	Is the vehicle primary driveline configuration rear wheel drive?	Go to **Step 11**	Go to **Step 12**
11	Is the vehicle equipped with a solid drive axle?	Go to **Vibration Analysis - Driveline**	Go to **Vibration Analysis - Hub and/or Axle Input**

cardiagn.com

Step	Action	Yes	No
12	1. Install the **CH-51450-NVH-TA183** accelerometer to the component identified by the customer as most respondent to the vibration. If no component was identified, install the **CH-51450-NVH-TA183** accelerometer to the drivers side right seat rail. 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 customers description and note the following conditions or take a snapshot using the **CH-51450-NVH** software: • The vehicle speed • The engine RPM • The transmission gear range and the specific gear • The vibration frequency reading, if detected, by the **CH-51450-NVH** Oscilloscope • The feel and/or the sound of the disturbance 4. If the vibration seems to excite a particular component of the vehicle more than the sear rail, move the **CH-51450-NVH-TA183** accelerometer onto that component and repeat Steps 2 and 3. Were you able to duplicate the customer concern?	Go to **Step 15**	Go to **Step 13**
13	Is the vehicle equipped with selectable four-wheel or all-wheel drive?	Go to **Step 14**	Go to **Step 15**
14	1. With the **CH-51450-NVH-TA183** accelerometer 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 customers description and note the following conditions or take a snapshot using the **CH-51450-NVH** software. • The vehicle speed • The engine RPM • The transmission gear range and the specific gear • The vibration frequency reading, if detected, by the **CH-51450-NVH** Oscilloscope • The feel and/or sound of the disturbance 4. If the vibration seems to excite a particular component of the vehicle more than the seat rail, then move the **CH-51450-NVH-TA183** accelerometer onto that component and repeat Step 2 and 3. Were you able to duplicate the customer concern?	Go to **Step 15**	Go to **Vibration Diagnostic Aids**

carsdiagn.com

Step	Action	Yes	No
15	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 vehicle to coast down through the disturbance range. Does the disturbance still occur while coasting down in NEUTRAL?	Go to **Step 17**	Go to **Step 16**
16	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**
17	If the **CH-51450-NVH** Oscilloscope is not available, refer to **Symptoms - Vibration Diagnosis and Correction**. Did the **CH-51450-NVH** Oscilloscope detect a dominant frequency?	Go to **Step 18**	Go to **Symptoms - Vibration Diagnosis and Correction**
18	Does the frequency data clearly fall within the tire/wheel parameters ONLY?	Go to **Vibration Analysis - Tire and Wheel**	Go to **Step 19**
19	Does the frequency data clearly fall within the propeller shaft parameters ONLY?	Go to **Vibration Analysis - Driveline**	Go to **Step 20**
20	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

- **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH)
- **EL-38792-A** Electronic Vibration Analyzer (EVA) 2
- **EL-47955** Multi Diagnostic Interface (MDI)

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

NOTE: **If using the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH), the component rotation is integrated into the tool. The diameter of the pulley will need to be measured and manually entered into the NVH software.**

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 **EL-38792-A** Electronic Vibration Analyzer (EVA) 2. Perform the following steps using the **EL-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 Ocilloscope or EVA

If the **EL-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.

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.

cardiagn.com

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.

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 EL-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 **EL-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.

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 **EL-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

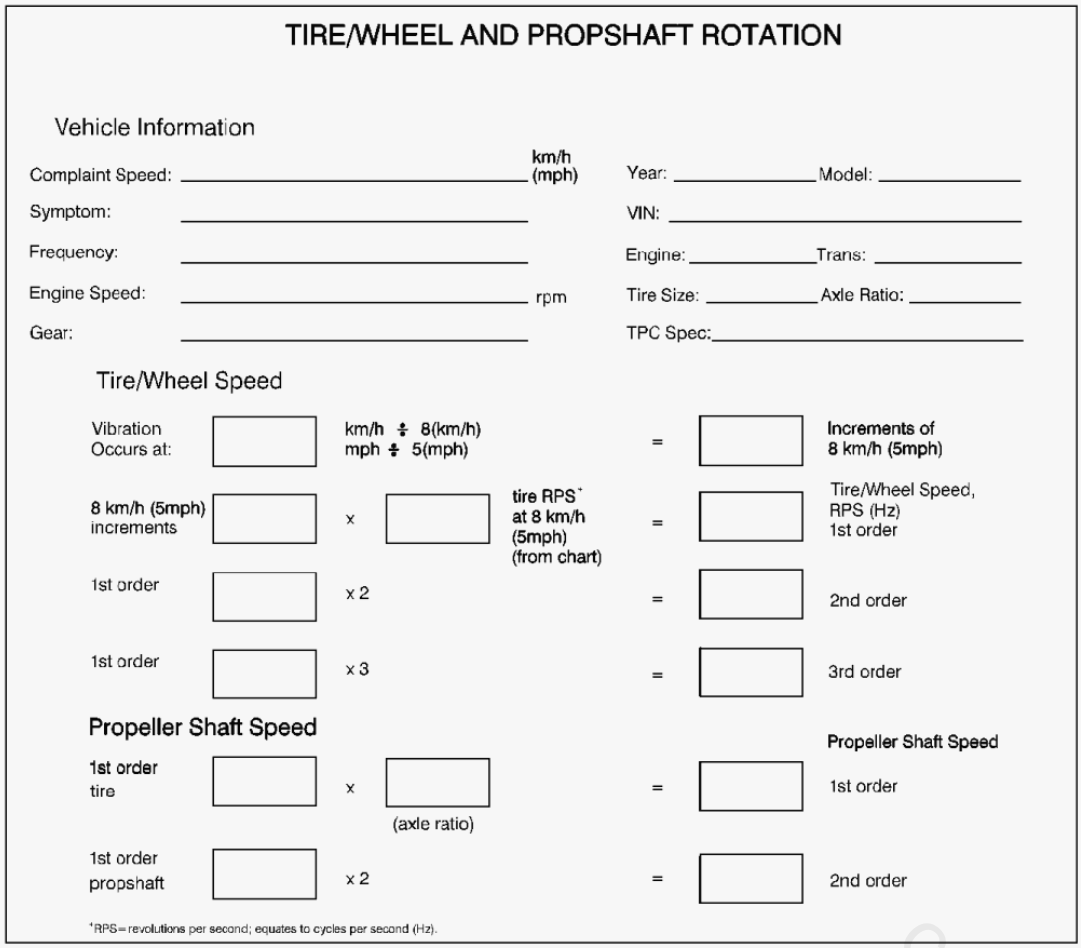
Utilize the following worksheet as an aid in calculating the first, second and third order of tire/wheel assembly rotational speed and the first and second order of propeller shaft rotational speed related disturbances that may be present in the vehicle.

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 1 1/2 - 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.

carglass.com



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).

cardiagn.com

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

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.

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 (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)**
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 (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)**
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**

Step	Action	Yes	No
5	1. Remove the debris from the tire and wheel assemblies. 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**
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**

cardiagn.com

Step	Action	Yes	No
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**	-
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 (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)**. Is the vibration still present?	Go to **Step 2**	System OK

VIBRATION ANALYSIS - DRIVELINE

Step	Action	Yes	No

Step	Action	Yes	No
1	Has the Vibration Analysis - Road Testing table been completed?	Go to **Step 2**	Go to **Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)**
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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-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 Diagnostic Aids**	Go to **Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)**

Step	Action	Yes	No
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**

cardiagn.com

Step	Action	Yes	No
17	1. If the driveline joint at the transmission or transfer case is a U-joint, measure the prop shaft 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**

cardiagn.com

Step	Action	Yes	No
20	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, 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**
23	Perform the **Vibration in Service-Stall Test (Non-Torque Sensitive)**. Is the vibration still present?	Go to **Step 24**	Go to **Step 32**

cardiagn.com

Step	Action	Yes	No
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**
29	1. Measure the prop shaft angles. Refer to **Driveline Working Angles Measurement**. 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**

cardiagn.com

Step	Action	Yes	No
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 (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)**. 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 .**			
1	Has the Vibration Analysis - Road Testing table been completed?	Go to **Step 2**	Go to **Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)**

Step	Action	Yes	No
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, 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**

cardiagn.com

Step	Action	Yes	No
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 • 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 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**

cardiagn.com

Step	Action	Yes	No
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 (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)**. Is the vibration still present?	Go to **Step 2**	System OK

VIBRATION ANALYSIS - ENGINE

Special Tools

- **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH), or
- **EL-38792-A** Electronic Vibration Analyzer (EVA) 2

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

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 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.

caradiagn.com

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 (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)**
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**

Step	Action	Yes	No
3	1. Block the front wheels. 2. Apply BOTH the service brakes and the park brake. 3. With the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) and the **EL-47955** Multi Diagnostic Interface (MDI), or the scan tool and the **EL-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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2, if available. 10. If no frequency data was obtained, or if the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-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**
4	Did the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2 detect a dominant frequency, or was a significant vibration present?	Go to **Vibration Analysis - Engine/Accessory Isolation**	Go to **Step 5**

cardiagn.com

Step	Action	Yes	No
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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2, if available. 12. If no frequency data was obtained, or if the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-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 characteristics?	Go to **Vibration Diagnostic Aids**	Go to **Vibration Analysis - Engine/Accessory 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)

cardiagn.com

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
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.

cardiagn.com

- 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 **EL-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

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 Degree V8**
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	Abnormal - Likely Single Cylinder Misfire
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	Abnormal - Likely Component Imbalance
1 1/2 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	Possible Engine Driven Accessory Related
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	Possible Engine Driven Accessory Related
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	Abnormal - Likely Bank to Bank EGR/Fuel Variance Possible Engine Driven Accessory Related
2 1/2 Order Torque Sensitive	Possible Engine Driven Accessory 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

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 Degree V8
			Possible Engine Driven Accessory Related				
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	Characteristic - ENGINE FIRING FREQUENCY - Possible Powertrain Isolation 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	
4th Order Torque Sensitive	Characteristic - Minimal Amount - of Engine Arrangement - Possible Powertrain Isolation 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	Characteristic - ENGINE FIRING FREQUENCY - Possible Powertrain Isolation Related
	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related					Possible Engine Driven Accessory Related

VIBRATION ANALYSIS - ENGINE/ACCESSORY ISOLATION

Special Tools

- **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH)
- **EL-38792-A** Electronic Vibration Analyzer (EVA) 2
- **EL-38792-25** Inductive Pickup Timing Light
- **EL-47955** Multi Diagnostic Interface MDI

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

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.

carldiagn.com

When loosening powertrain mounts in order to re-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.

12

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.

13

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

15

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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-38792-A** 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**

Step	Action	Yes	No
5	Inspect the powertrain mounts - engine, transmission, transfer case, and direct-mount drive axle, 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 Realign or replace powertrain mounts as indicated by the inspection. Did you find and correct a condition?	Go to **Step 15**	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 15**	Go to **Step 7**

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. 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 15**	-

cardiagn.com

Step	Action	Yes	No
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 13**	Go to **Step 17**
10	Is the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) being used for diagnosis?	Go to **Step 11**	Go to **Step 12**
11	1. Measure the diameter of the suspected accessory pulleys, including any related idler pulleys, and enter this information into the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH). 2. Block the front wheels. 3. Apply BOTH the service brakes and the park brake. 4. With the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) and the **EL-47955** Multi Diagnostic Interface MDI still installed, start the engine. 5. Have an assistant place the transmission in NEUTRAL or PARK. 6. Slowly increase the engine RPM to the level recorded during the duplication of the disturbance, then maintain that speed. The frequency of the suspected pulleys will show up on the Record and Analyze tab within the software. 7. Turn OFF the engine. Did you identify an engine driven accessory system as being related to the disturbance?	Go to **Step 13**	Go to **Vibration Diagnostic Aids**

cardiagn.com

Step	Action	Yes	No
12	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 **EN-38792-25** Inductive Pickup Timing Light, to the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2. 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 **EL-38792-A** Electronic Vibration Analyzer (EVA) 2, still installed, start the engine. 6. Select the Smart Strobe feature on the **EL-38792-A** 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. Using the **EL-38792-A** 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 **EL-38792-25** 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. Did you identify an engine driven accessory system as being related to the frequency of the disturbance?	Go to **Step 13**	Go to **Vibration Diagnostic Aids**

cardiagn.com

Step	Action	Yes	No

13	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 15**	Go to **Step 14**

14	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. 4. Reinstall the components to the engine. Did you find and correct a condition?	Go to **Step 15**	Go to **Step 19**

cardiagn.com

Step	Action	Yes	No
15	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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-38792-A** 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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-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. 11. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-38792-A** 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 20**	Go to **Step 16**
16	Have you investigated powertrain isolation as a possible cause of the disturbance?	Go to **Step 17**	Go to **Step 5**
17	Have you investigated engine driven accessories as a possible cause of the disturbance?	Go to **Vibration Analysis - Engine Balance**	Go to **Step 18**
18	Is the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2 available?	Go to **Step 8**	Go to **Vibration Diagnostic Aids**
19	Replace the engine driven accessory component causing the disturbance. Did you complete the replacement?	Go to **Step 20**	-

cardiagn.com

Step	Action	Yes	No
20	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 (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)**. Is the disturbance still present?	Go to **Step 2**	System OK

VIBRATION ANALYSIS - ENGINE BALANCE

Special Tools

- **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH)
- **EL-38792-A** Electronic Vibration Analyzer (EVA) 2
- **EL-47955** Multi Diagnostic Interface MDI

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

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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-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.

cardiagn.com

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 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
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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-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**

Step	Action	Yes	No
5	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. 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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) and the **EL-47955** Multi Diagnostic Interface MDI or the scan tool and the **EL-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 **EL-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**

cardiagn.com

Step	Action	Yes	No
8	1. If the flywheel/flexplate is loose at the engine 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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) and the **EL-47955** Multi Diagnostic Interface MDI or the scan tool and the **EL-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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-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**	-

cardiagn.com

Step	Action	Yes	No
11	1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Position the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) accelerometer or the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2 sensor onto the underside of the engine oil pan, along the FRONT edge. 3. Lower the vehicle. 4. Block the front wheels. 5. Apply BOTH the service brakes and the park brake. 6. With the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) and the **EL-47955** Multi Diagnostic Interface MDI or the scan tool and the **EL-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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2 from the underside of the engine oil pan. 10. Repeat steps 1 through 9, placing the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) accelerometer or the **EL-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**

cardiagn.com

Step	Action	Yes	No
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 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**	-

cardiagn.com

Step	Action	Yes	No
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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-38792-A** 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. 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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-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 (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)**. 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:

cardiagn.com

- Vibration Diagnostic Aids - Vibration Intermittent or Not Duplicated
- 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 system reaches operating temperatures. Exhaust systems can grow by 2 1/2 - 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.

- 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.

carfdiagn.com

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.

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

A 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 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. After verifying the vehicle and vehicle systems are functioning properly, proceed to **Vibration Diagnosis, Starting Point, and Correction** and attempt to duplicate the customer 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**
			Vehicle Speed Sensitive Affected by steering input	Go to **Vibration 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.	20 - 60 Hz	Vehicle Speed Sensitive Still occurs during coast down in NEUTRAL	Go to **Vibration Analysis - Tire and Wheel**

Category	Description	Typical Frequency Range	Condition of Occurrence	Area of Focus
	• Related terminology - droning, growling, moaning, roaring, rumbling, humming • May not be accompanied by a perceptible vibration (roughness)		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 a perceptible vibration (buzz)	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**
			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

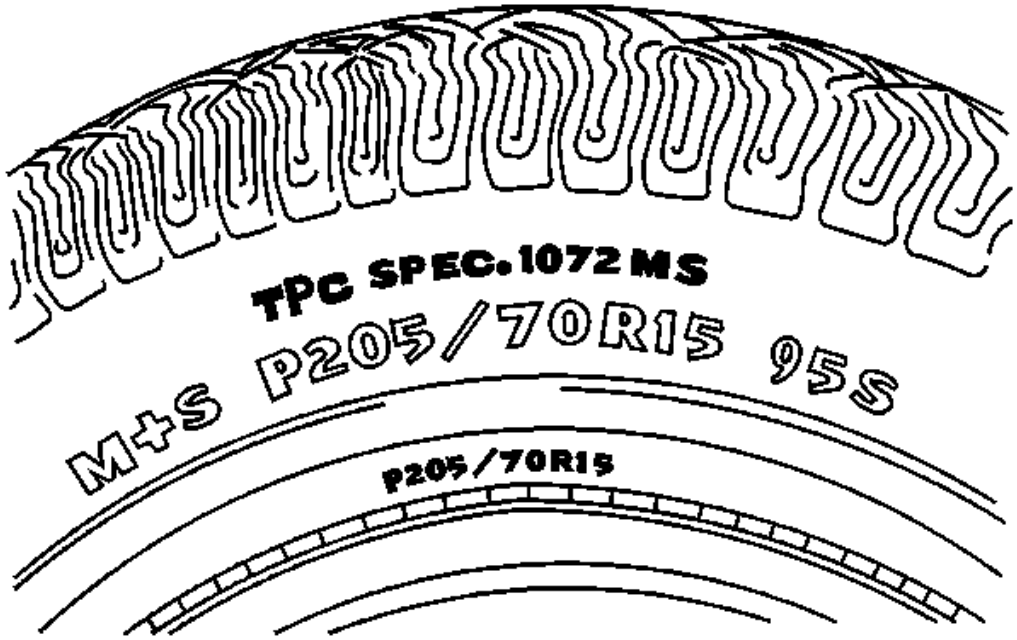


Fig. 2: Identifying Tire Performance Criteria (TPC) Rating Markings
Courtesy of GENERAL MOTORS COMPANY

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.

Tire Wear

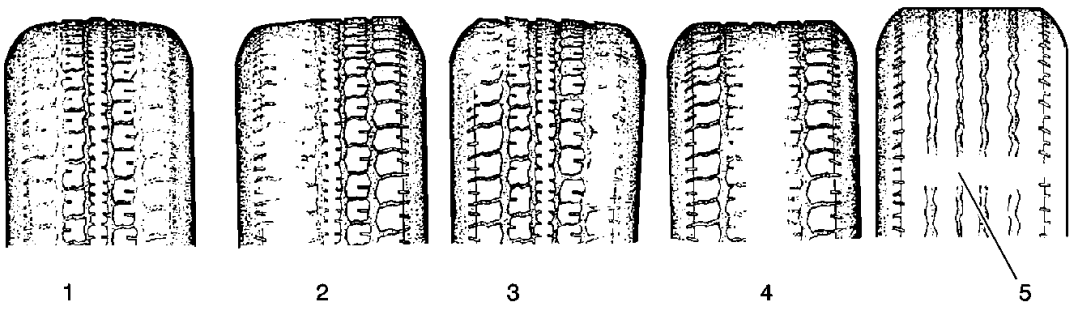


Fig. 3: Identifying Types Of Tire Wear
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Hard Cornering/Under inflation
2	Incorrect Alignment/Lack of Rotation
3	Incorrect Alignment/Non-uniform Tire

Callout	Component Name
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** .
4. Following the tire inflation placard on the drivers door, inspect and if necessary adjust the tire inflation pressures.

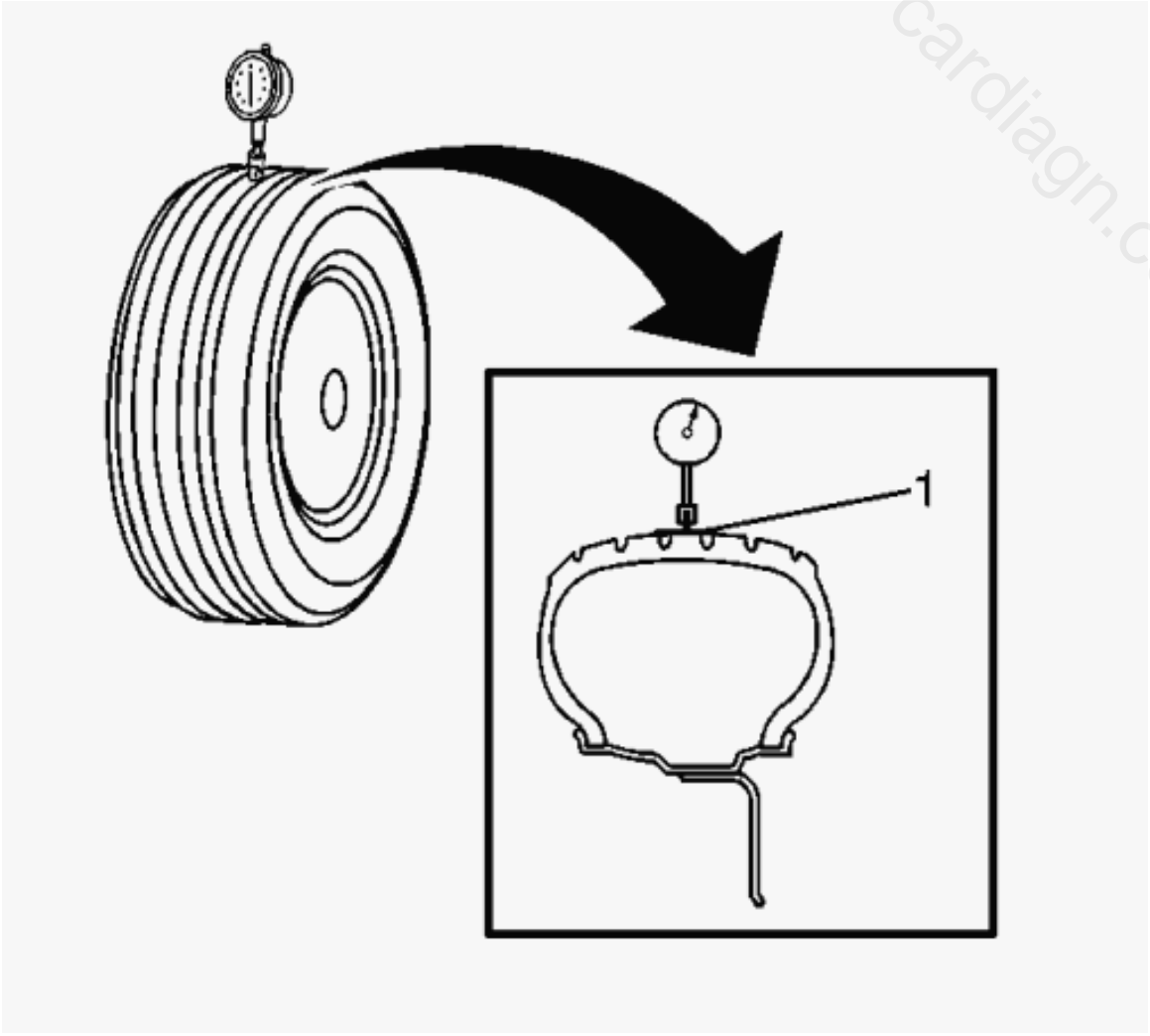


Fig. 4: Measuring Tire & Wheel Assembly Radial Runout
Courtesy of GENERAL MOTORS COMPANY

5. 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.

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

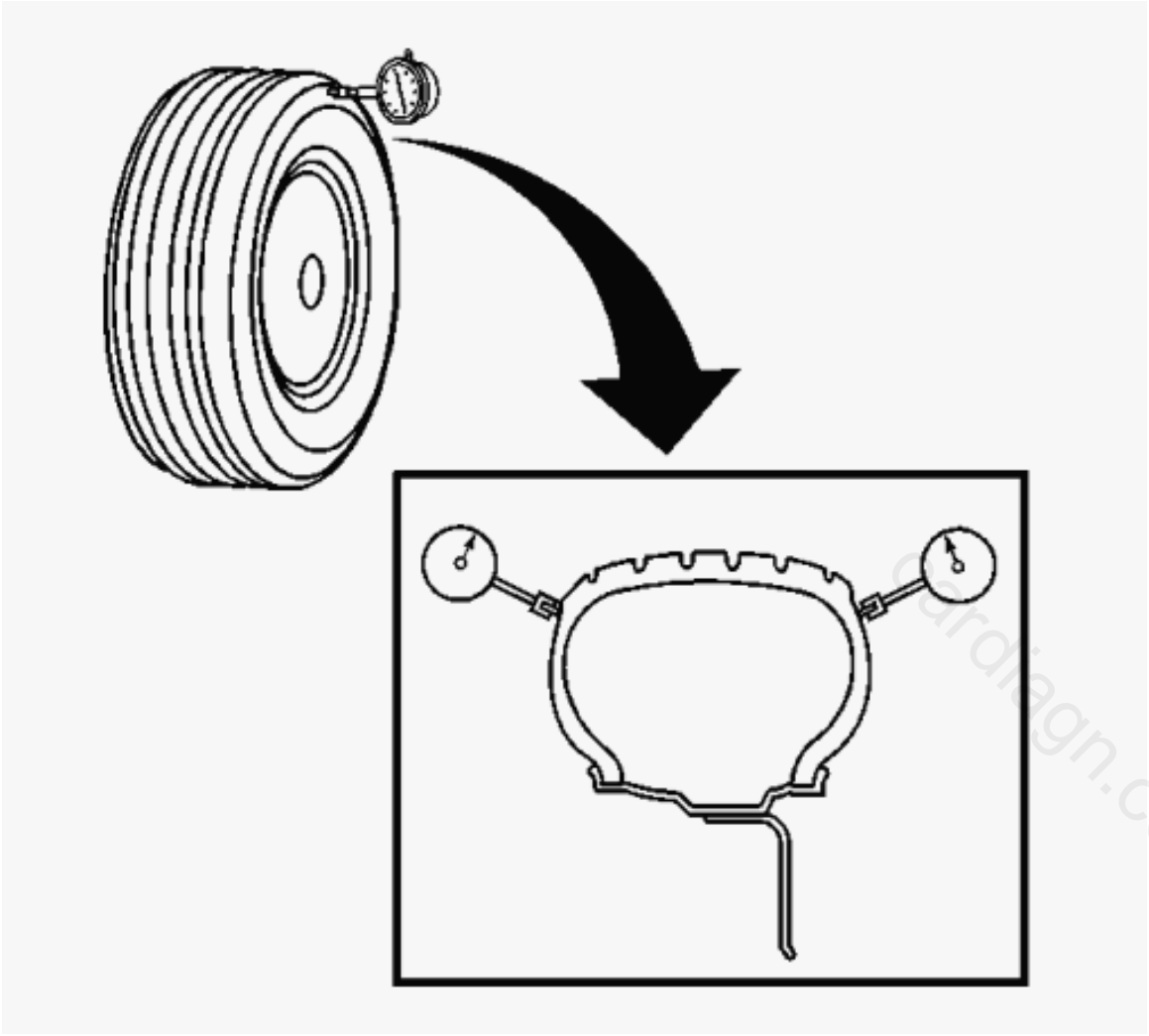


Fig. 5: Measuring Tire & Wheel Assembly Lateral Runout
Courtesy of GENERAL MOTORS COMPANY

10. 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.
11. 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.
12. Set the dial indicator to zero at the low spot.
13. 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)

14. Repeat steps 4 through 12 until all of the tire and wheel assembly radial and lateral runout measurements have been taken.
15. 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.

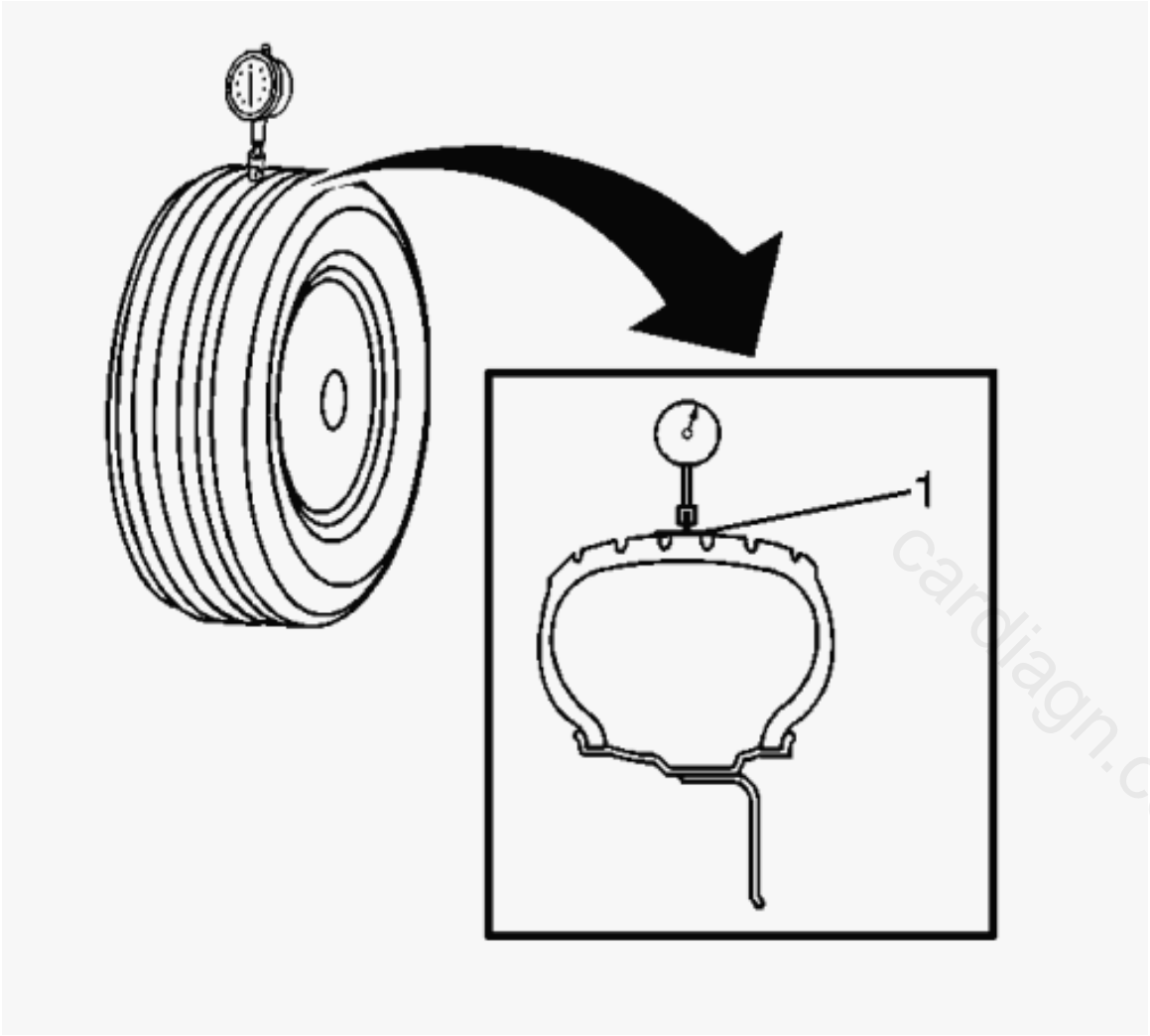


Fig. 6: Measuring Tire & Wheel Assembly Radial Runout
Courtesy of GENERAL MOTORS COMPANY

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.
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)

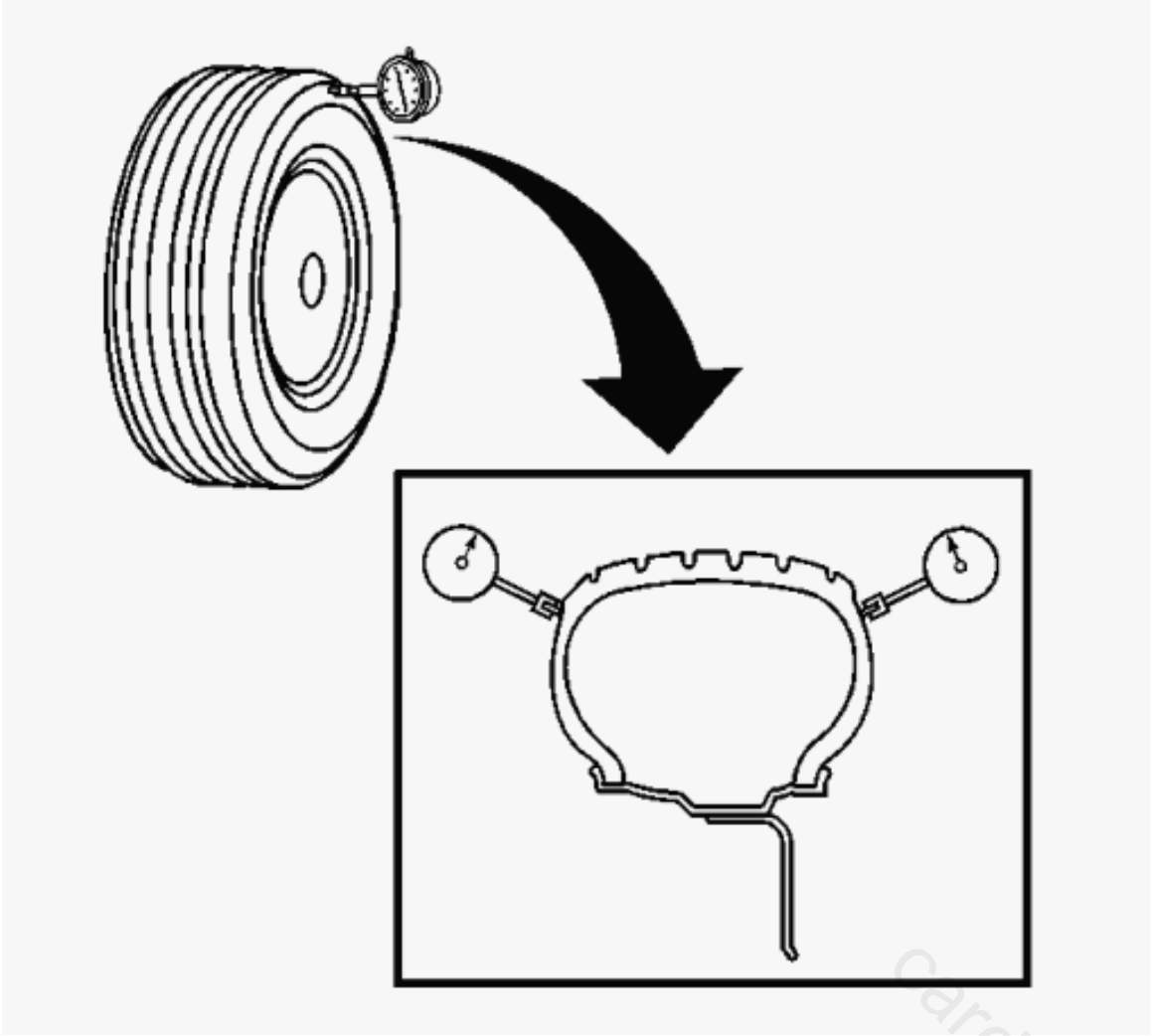


Fig. 7: Measuring Tire & Wheel Assembly Lateral Runout
Courtesy of GENERAL MOTORS COMPANY

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.
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.

cardiagn.com

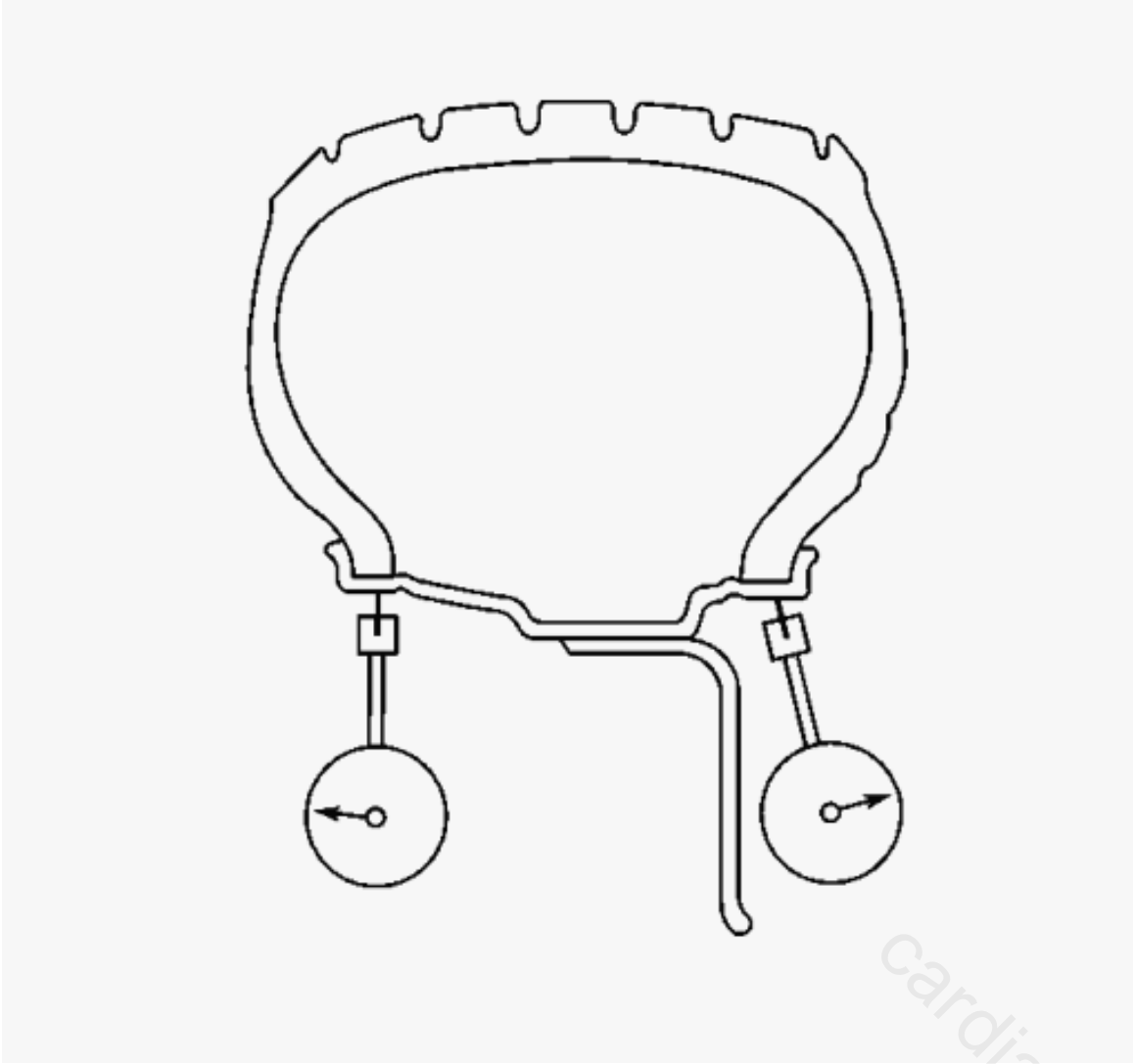


Fig. 8: Measuring Wheel Radial Runout (Off-Vehicle, Tire Mounted)
Courtesy of GENERAL MOTORS COMPANY

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.
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)

cardiagn.com

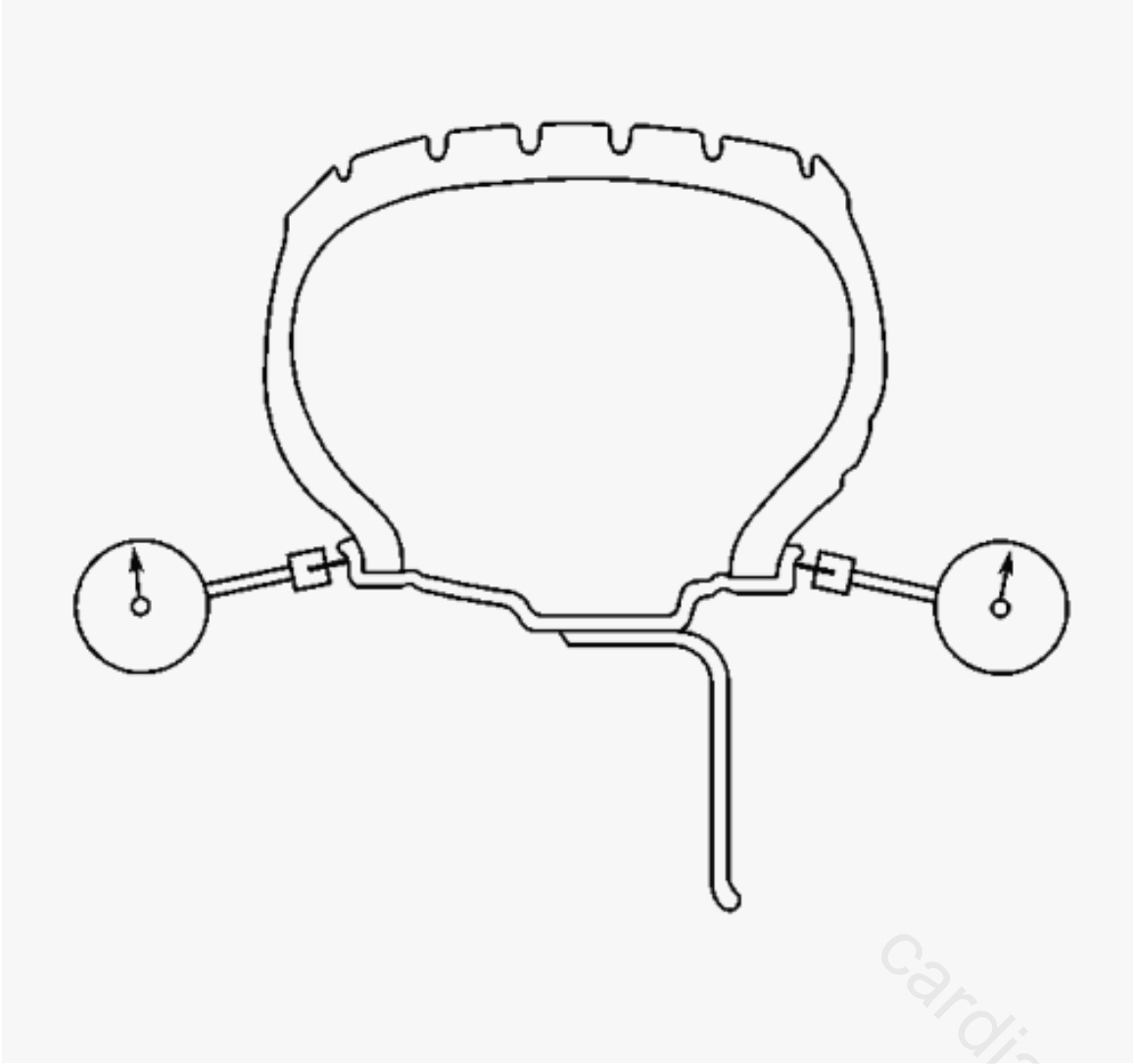


Fig. 9: Measuring Wheel Lateral Runout (Off-Vehicle, Tire Mounted)
Courtesy of GENERAL MOTORS COMPANY

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.

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.

cardiagn.com

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.
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.

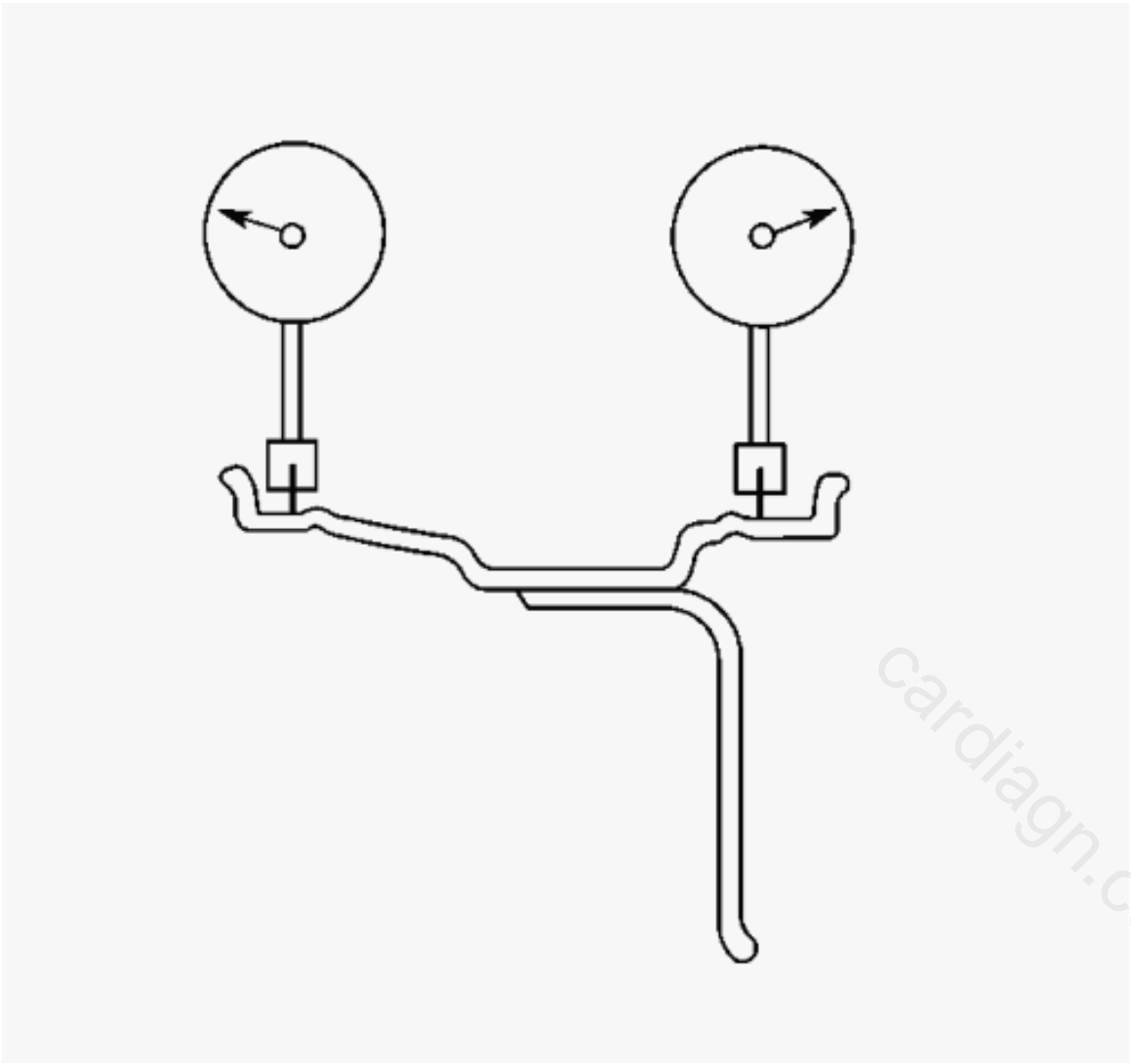

cardiagn.com

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

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.
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)

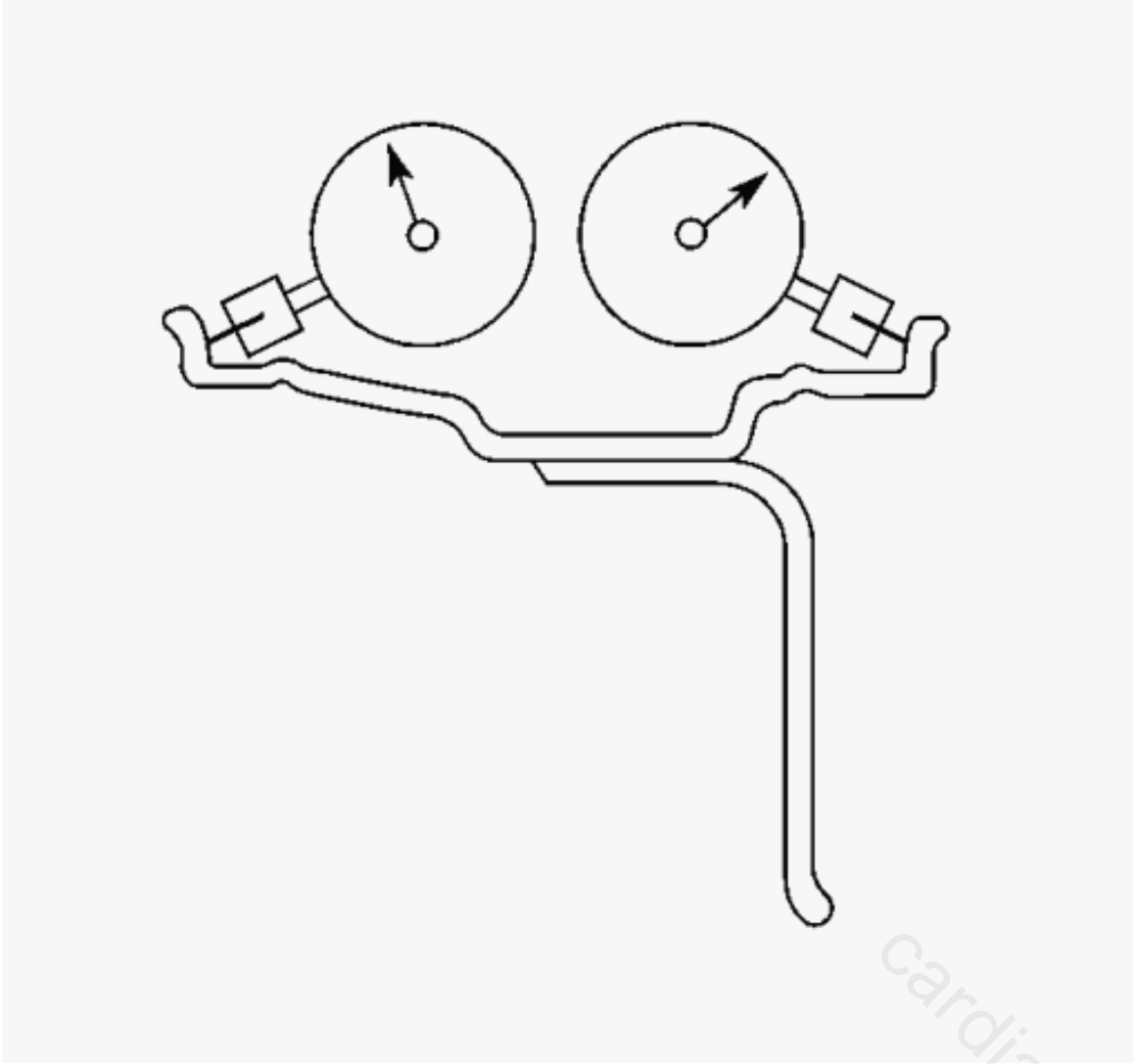


Fig. 11: Measuring Wheel Lateral Runout (Off-Vehicle, Tire Dismounted)
Courtesy of GENERAL MOTORS COMPANY

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.

cardiagn.com

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 .**

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.

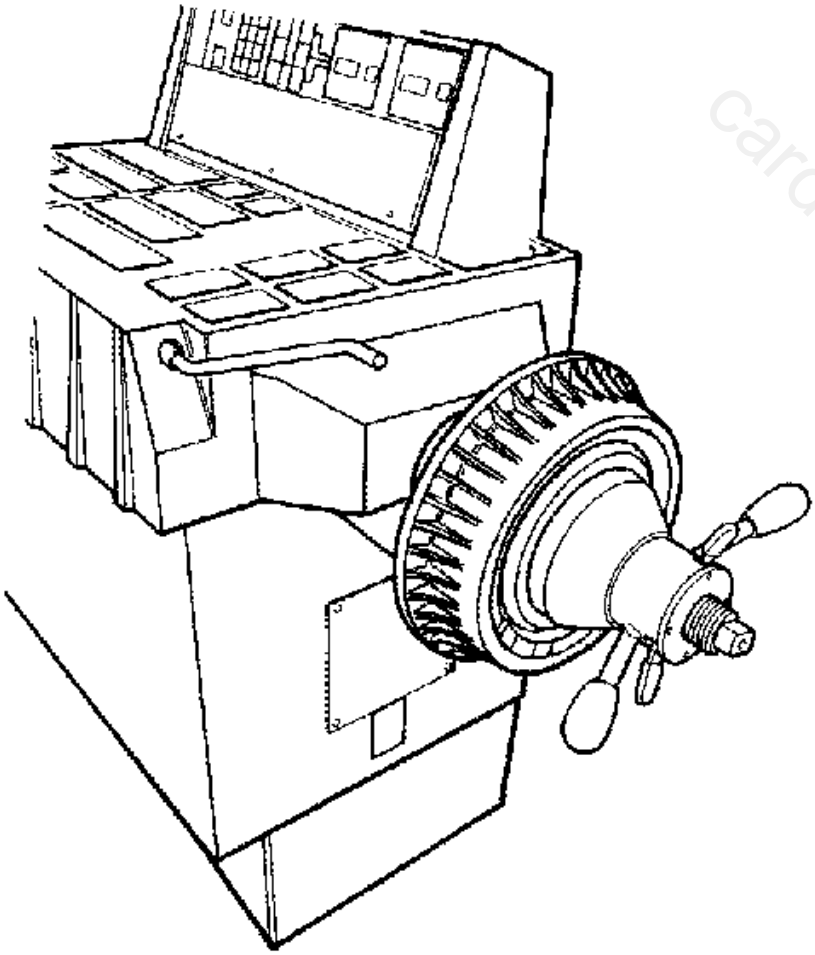


Fig. 12: Balancing Brake Drum
Courtesy of GENERAL MOTORS COMPANY

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.

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

cardiagn.com

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.

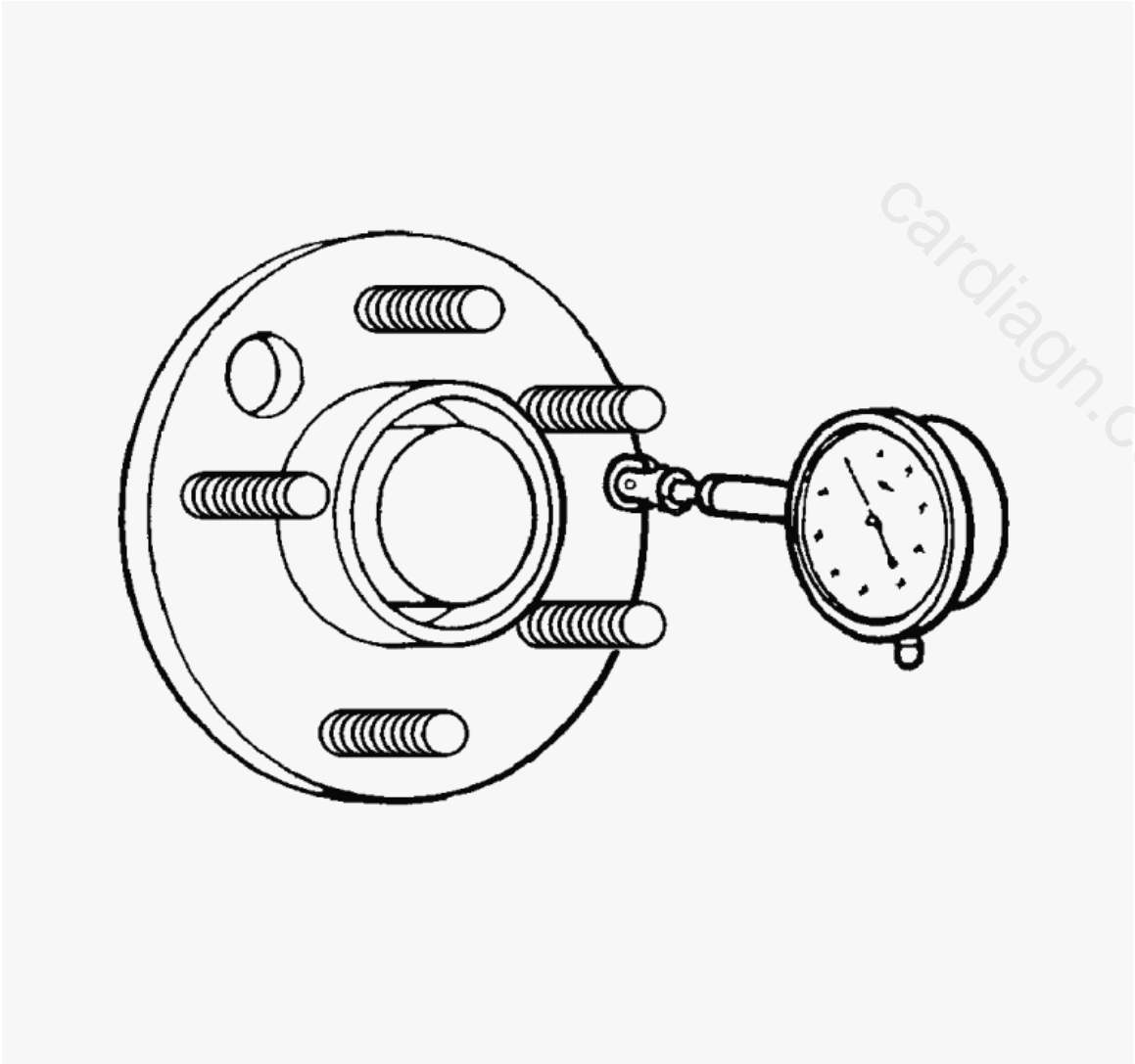

cardiagn.com

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

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.

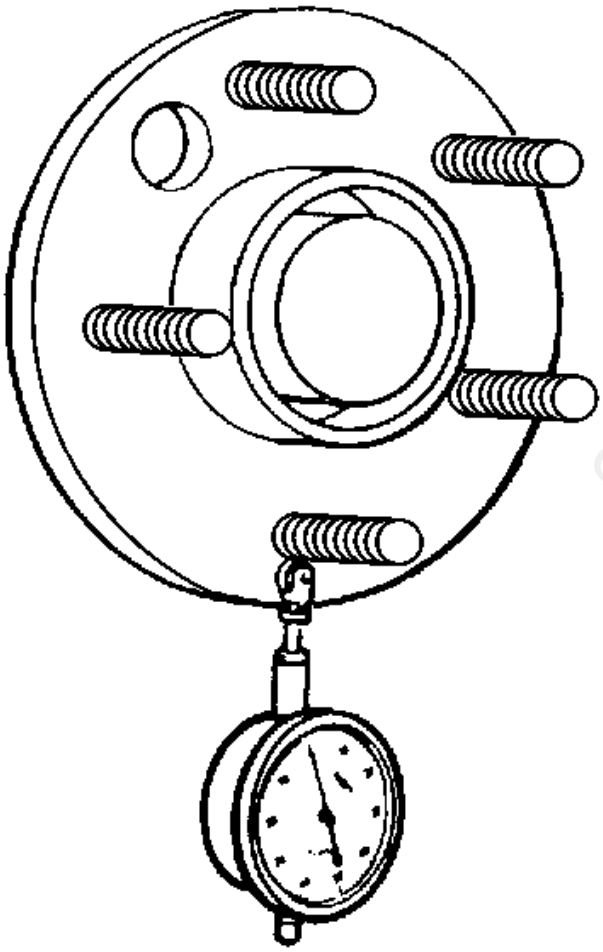


Fig. 14: Measuring Wheel Stud Runout
Courtesy of GENERAL MOTORS COMPANY

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.
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.

cardiagn.com

19. Inspect the threads and the tapered seat portion on each of the wheel bolts for damage.
20. Wheel bolts exhibiting 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

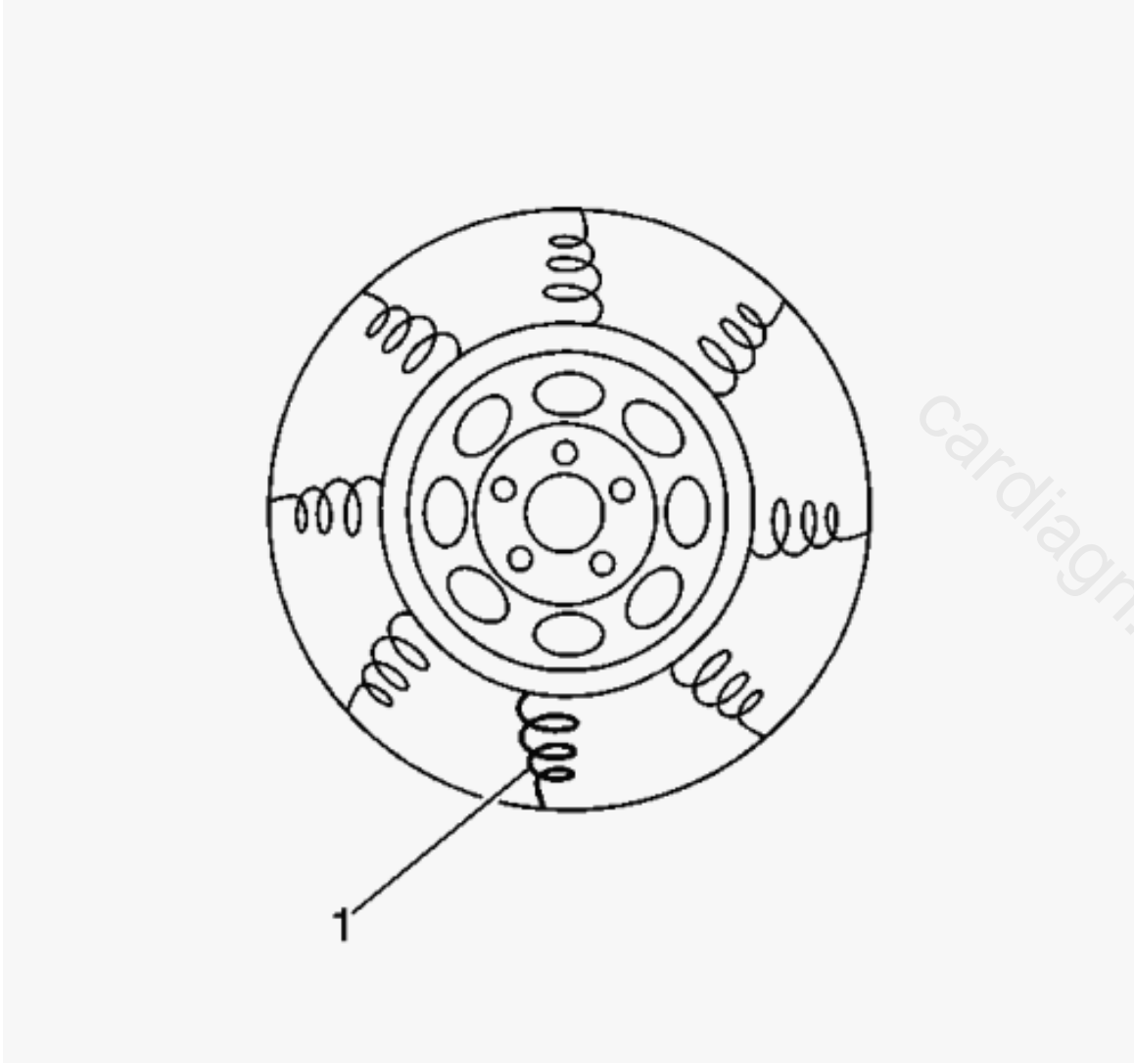


Fig. 15: Identifying Radial Force Variation
Courtesy of GENERAL MOTORS COMPANY

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 Variation

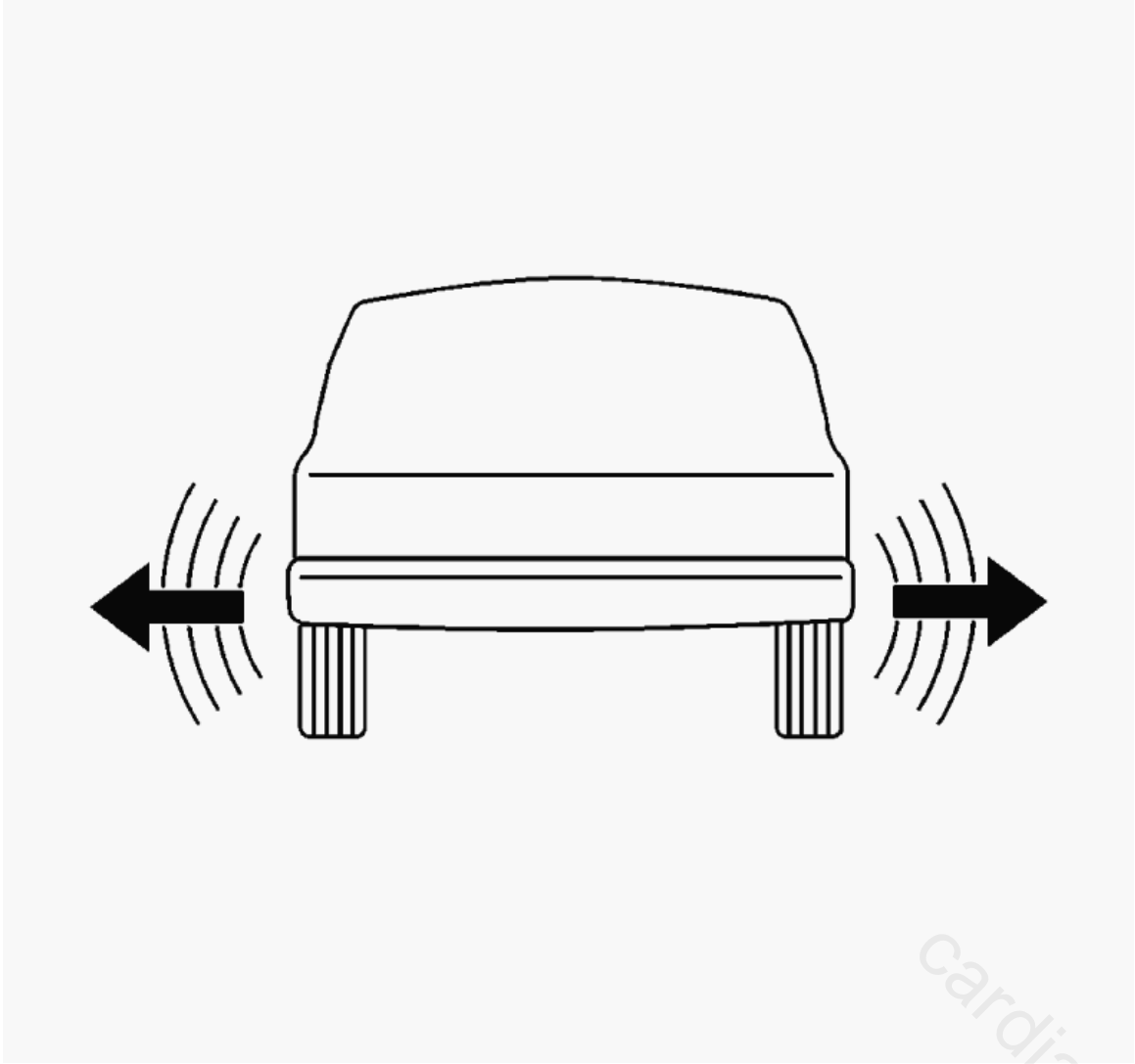


Fig. 16: Identifying Tire Wobble/Waddle
Courtesy of GENERAL MOTORS COMPANY

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 (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)**.
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 (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)**.
5. Continue the process of installing the original tire and wheel assemblies one at a time, then road testing 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**.

cardiagn.com

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

Special Tools

- **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or
- **EL-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 accelerometer of the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the vibration sensor of the **EL-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 accelerometer of the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the vibration sensor of the **EL-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 accelerometer of the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the vibration sensor of the **EL-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

- **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or
- **EL-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**

carddiagn.com

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 accelerometer of the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the vibration sensor of the **EL-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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-38792-A** EVA 2 reading during acceleration or deceleration.
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.

cardiagn.com

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

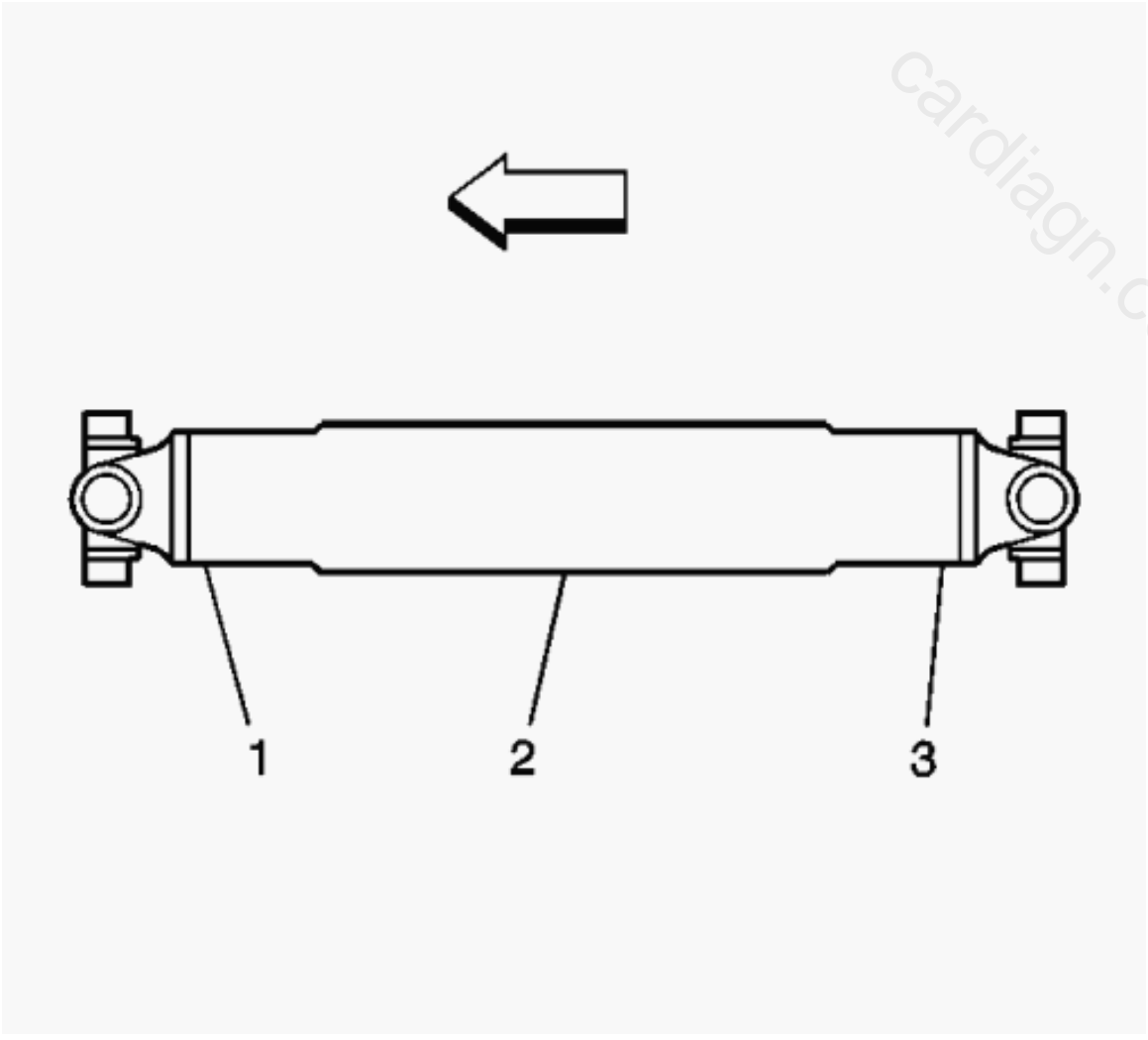
Special Tools

- **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.**



cardiagn.com

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

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 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.

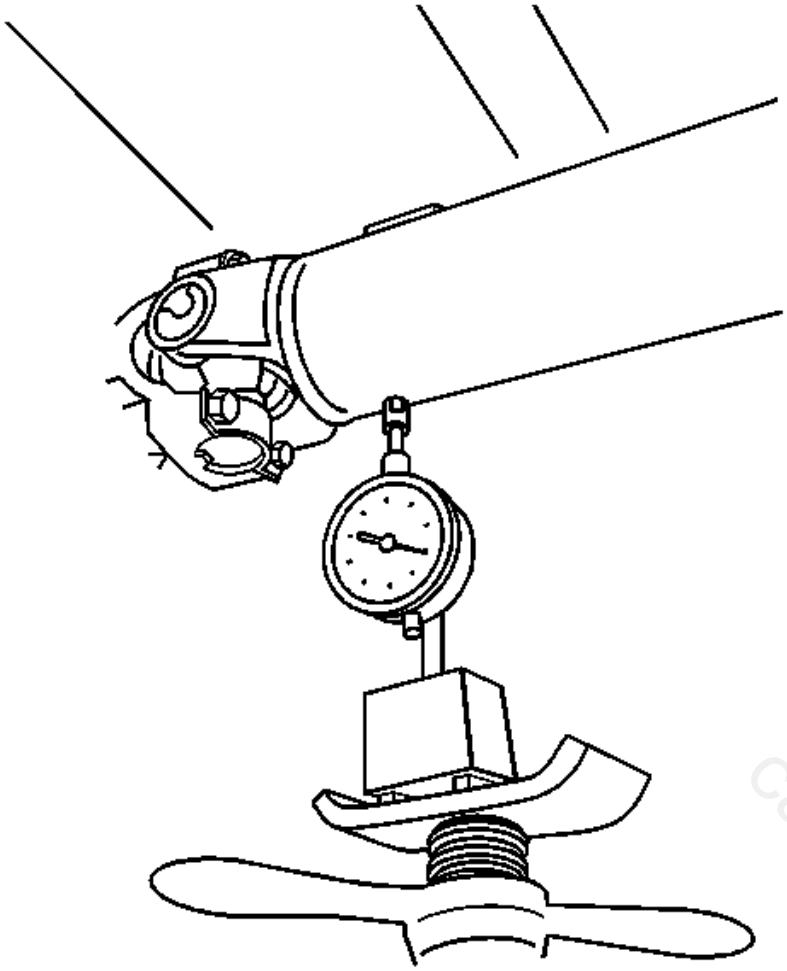


Fig. 18: Measuring Runout Of Propeller Shaft
Courtesy of GENERAL MOTORS COMPANY

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.

cardiagn.com

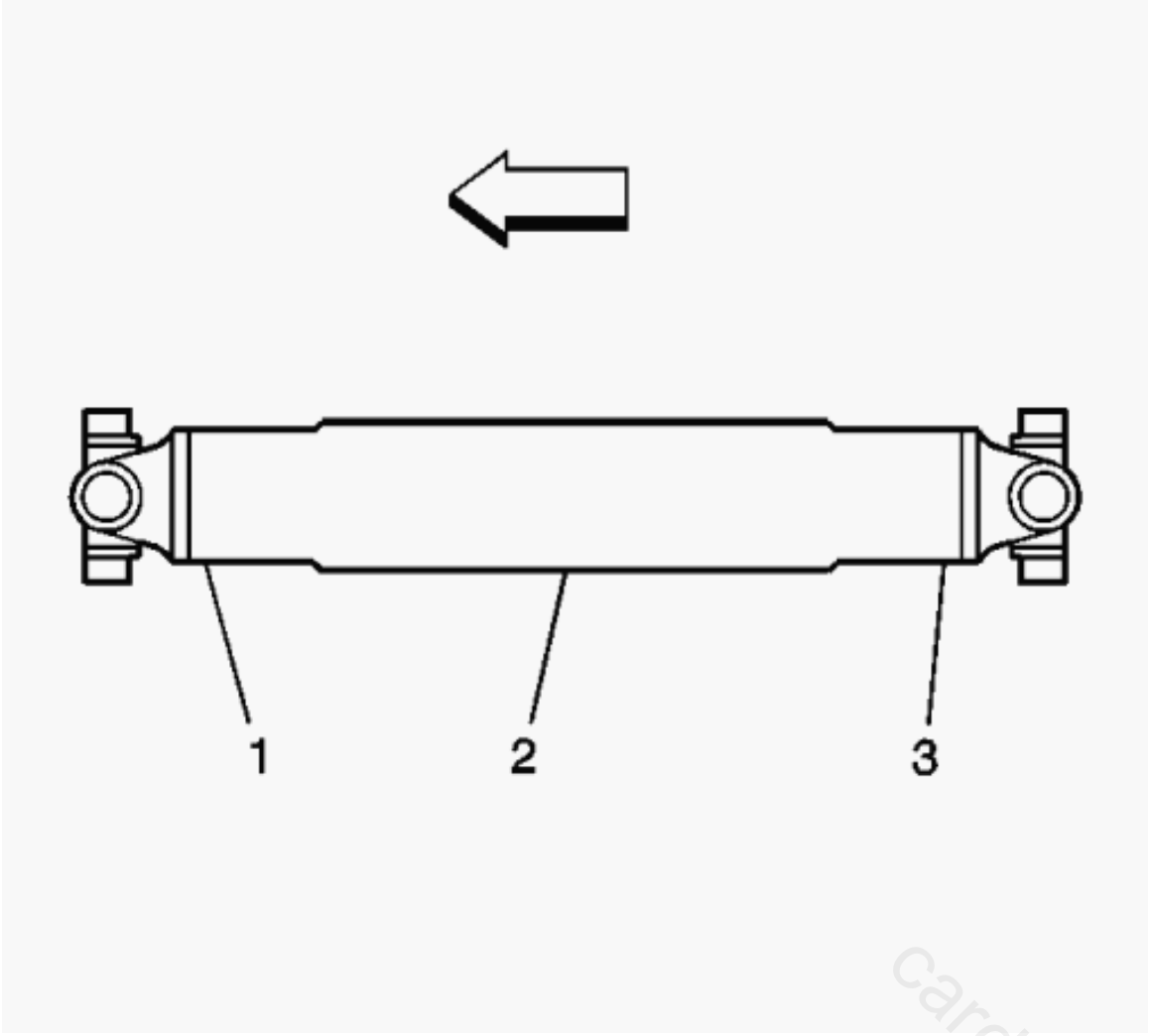


Fig. 19: Identifying Propeller Shaft Runout Measurement Points
Courtesy of GENERAL MOTORS COMPANY

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.

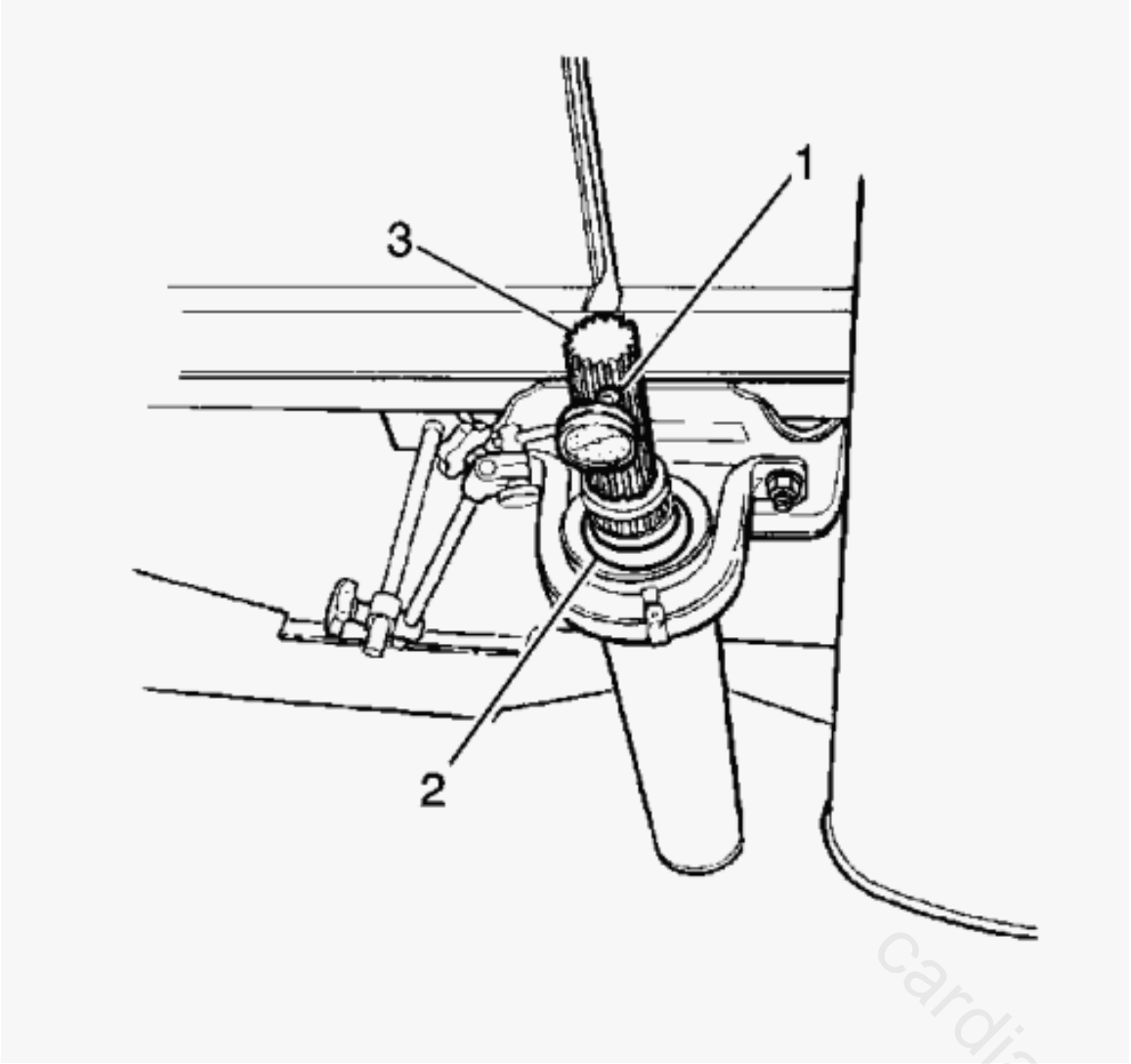


Fig. 20: Positioning Dial Indicator At Stub Shaft
Courtesy of GENERAL MOTORS COMPANY

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 (2) 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 (2) for loose or missing shims/washers if equipped. Reinstall 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. Refer to **Propeller Shaft Runout 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.

cardiagn.com

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**, 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.
        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
- **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.**

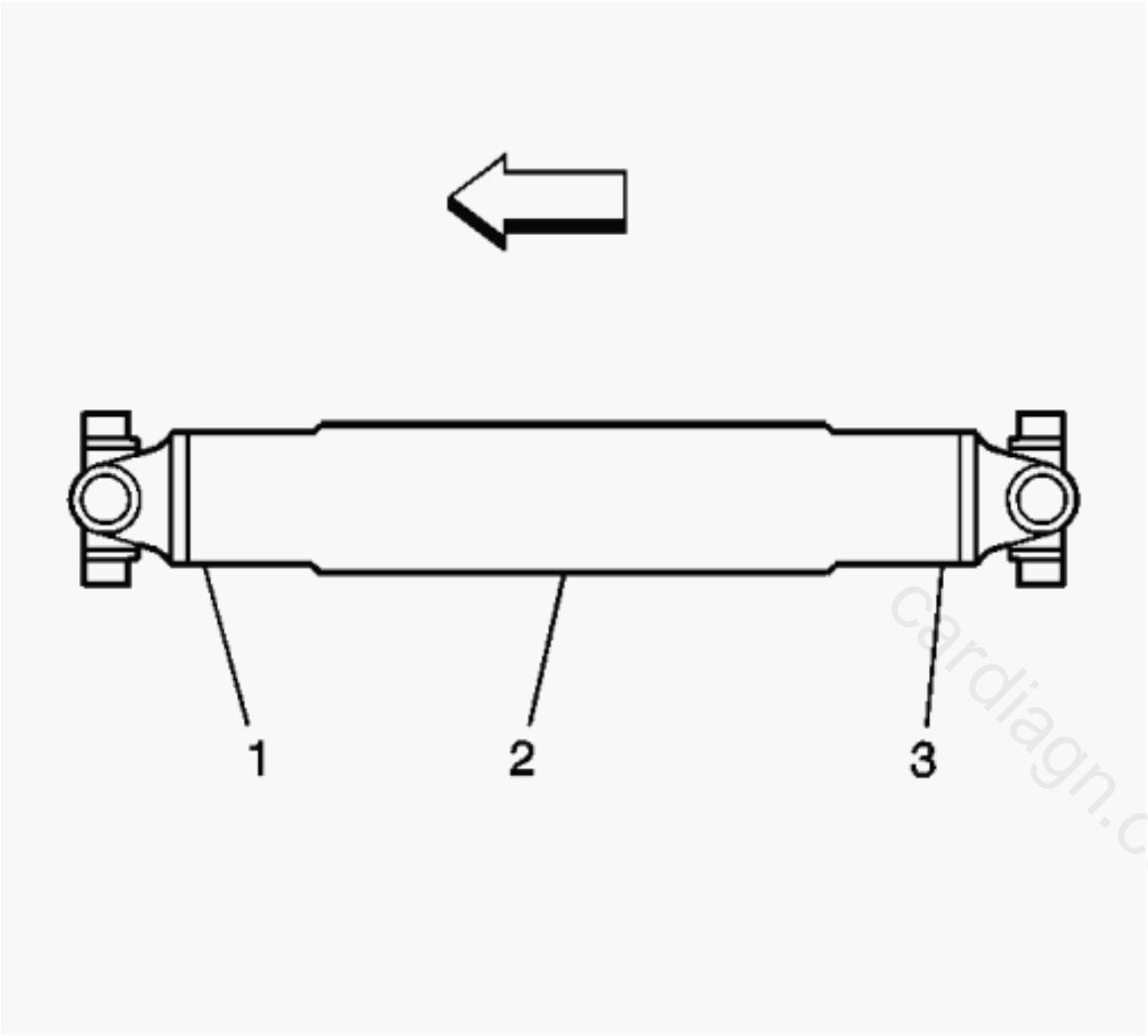


Fig. 21: Identifying Propeller Shaft Runout Measurement Points
Courtesy of GENERAL MOTORS COMPANY

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 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.

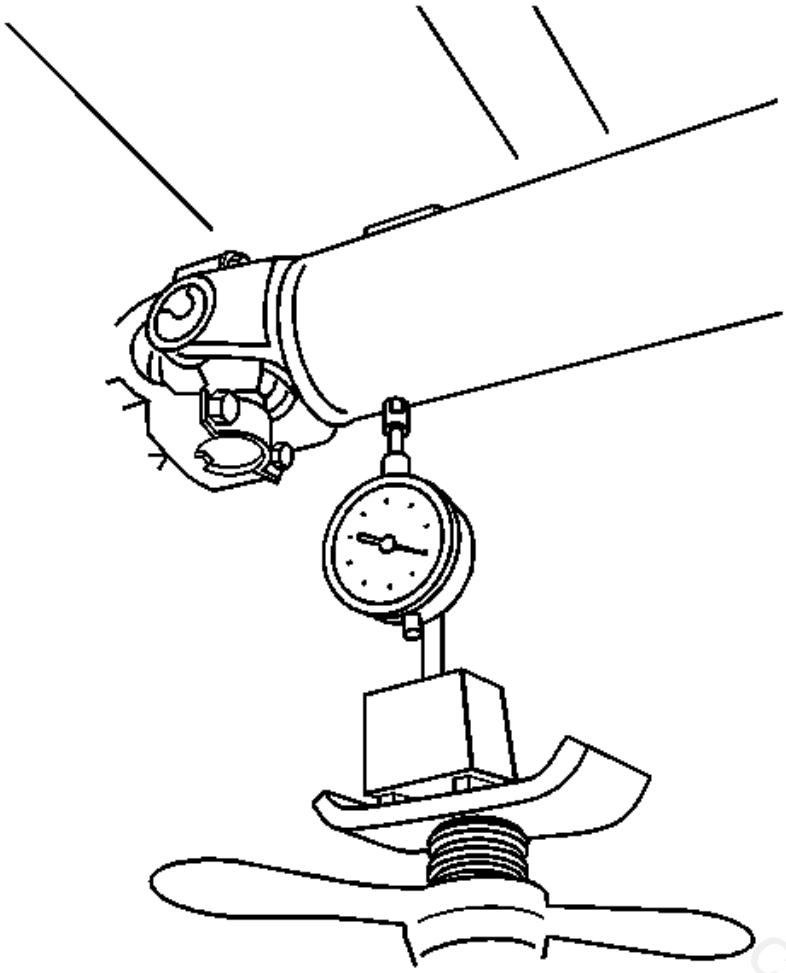


Fig. 22: Measuring Runout Of Propeller Shaft
Courtesy of GENERAL MOTORS COMPANY

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.

cardiagn.com

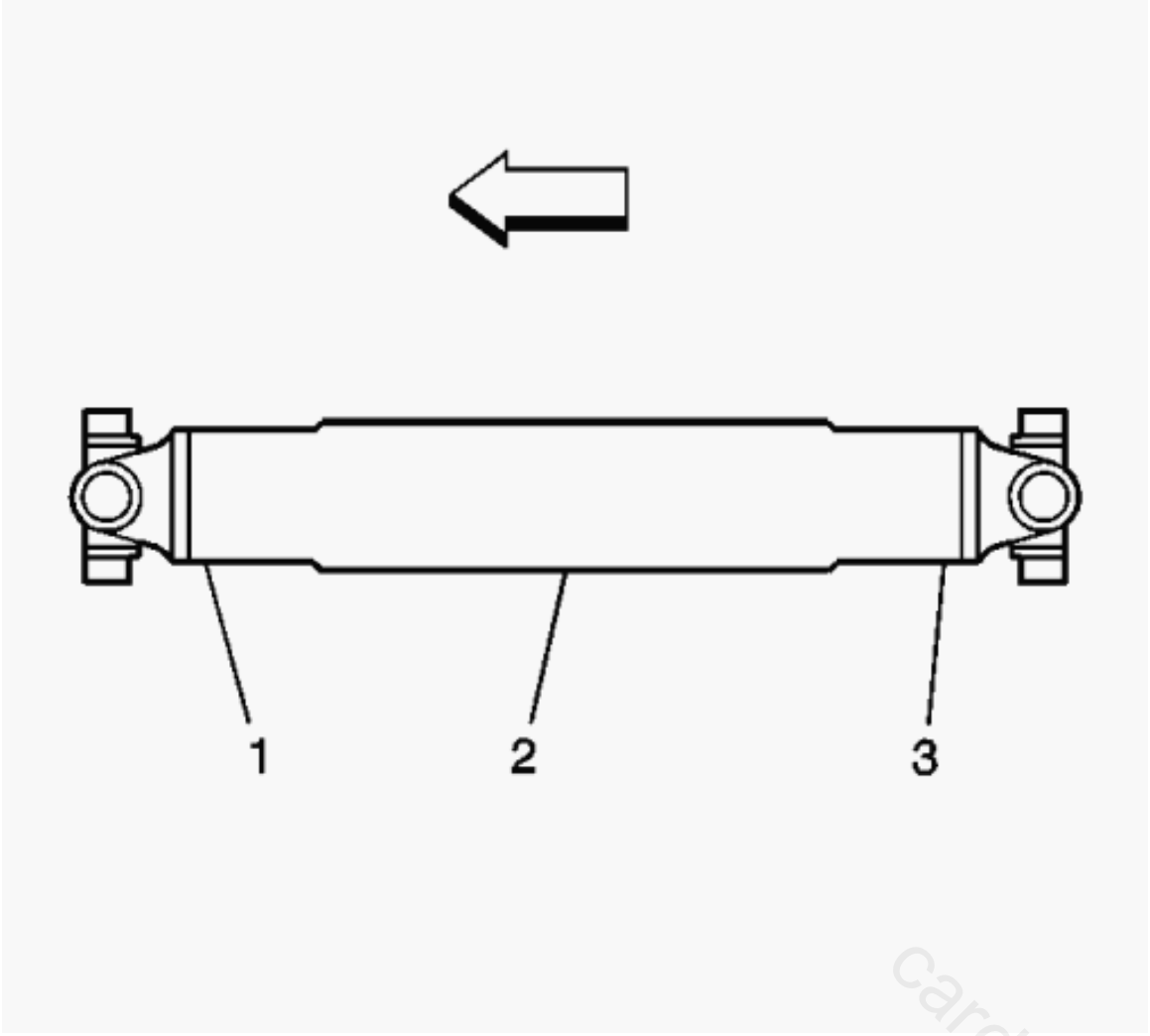


Fig. 23: Identifying Propeller Shaft Runout Measurement Points
Courtesy of GENERAL MOTORS COMPANY

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.

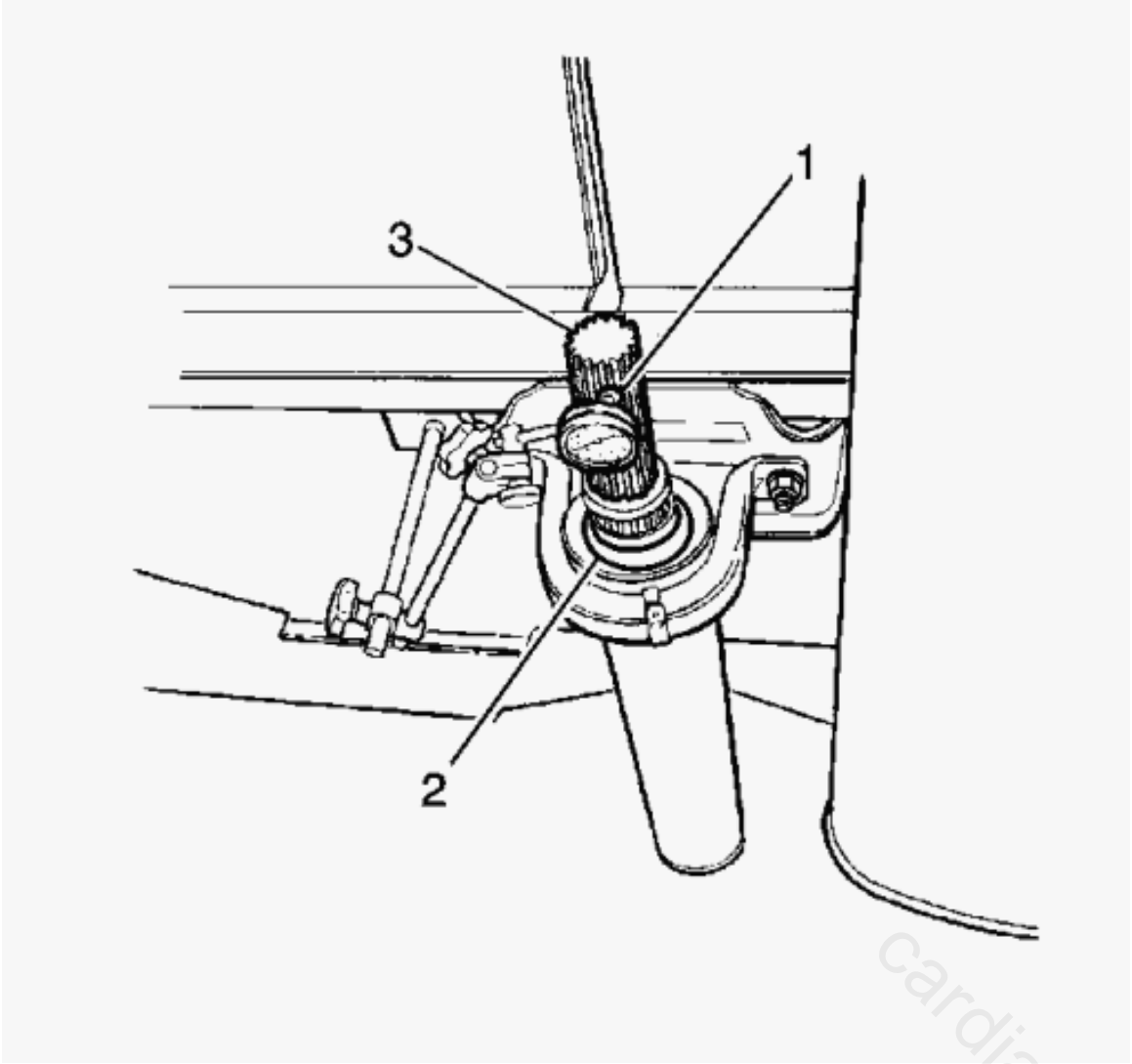


Fig. 24: Positioning Dial Indicator At Stub Shaft
Courtesy of GENERAL MOTORS COMPANY

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 (2) 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 (2) for loose or missing shims/washers if equipped. Reinstall 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. Refer to **Propeller Shaft Runout 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.

cardiagn.com

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 **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.
        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.

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**.

cardiagn.com

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

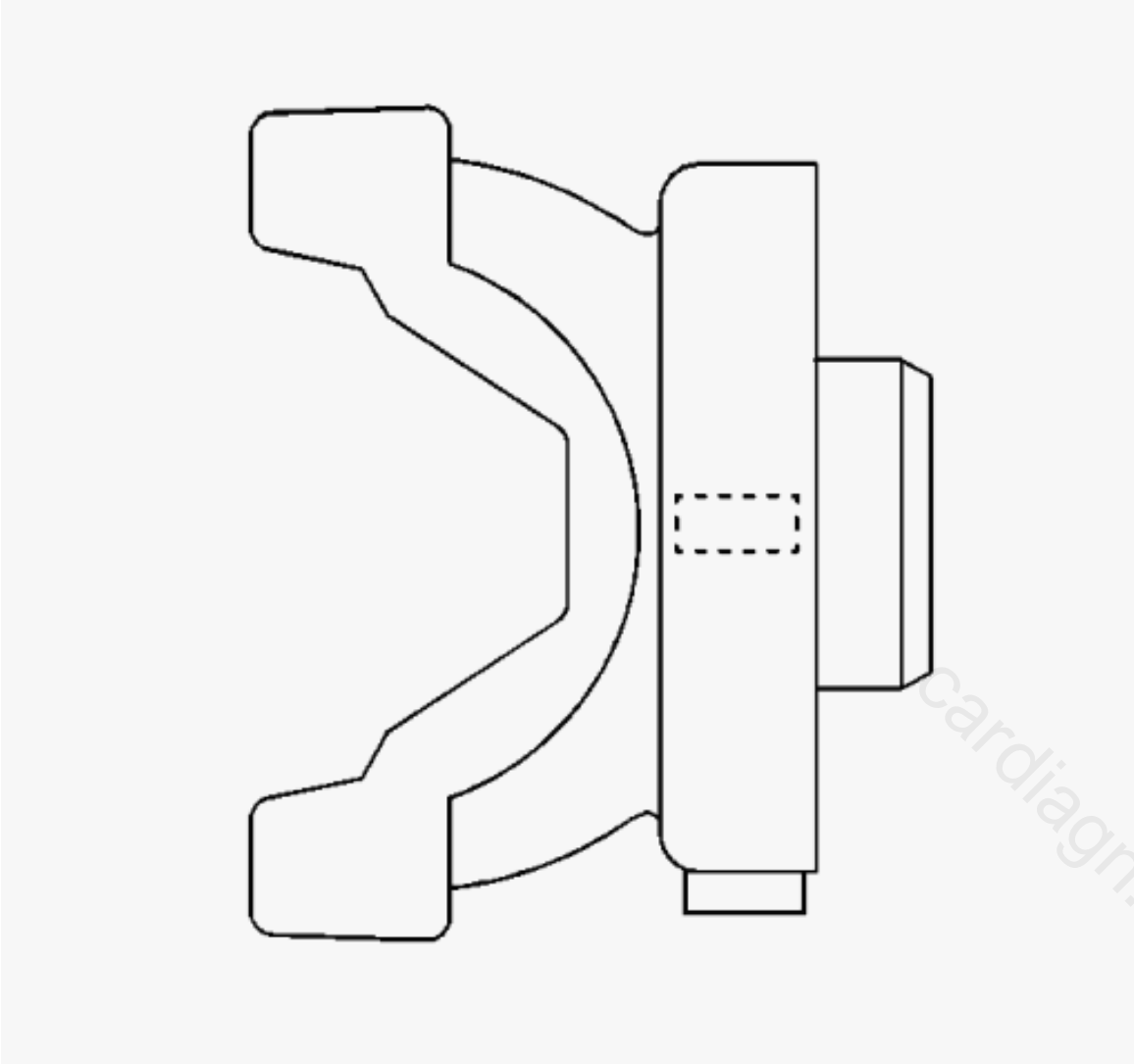


Fig. 25: Identifying Pinion Flange (Deflector Design)
Courtesy of GENERAL MOTORS COMPANY

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.

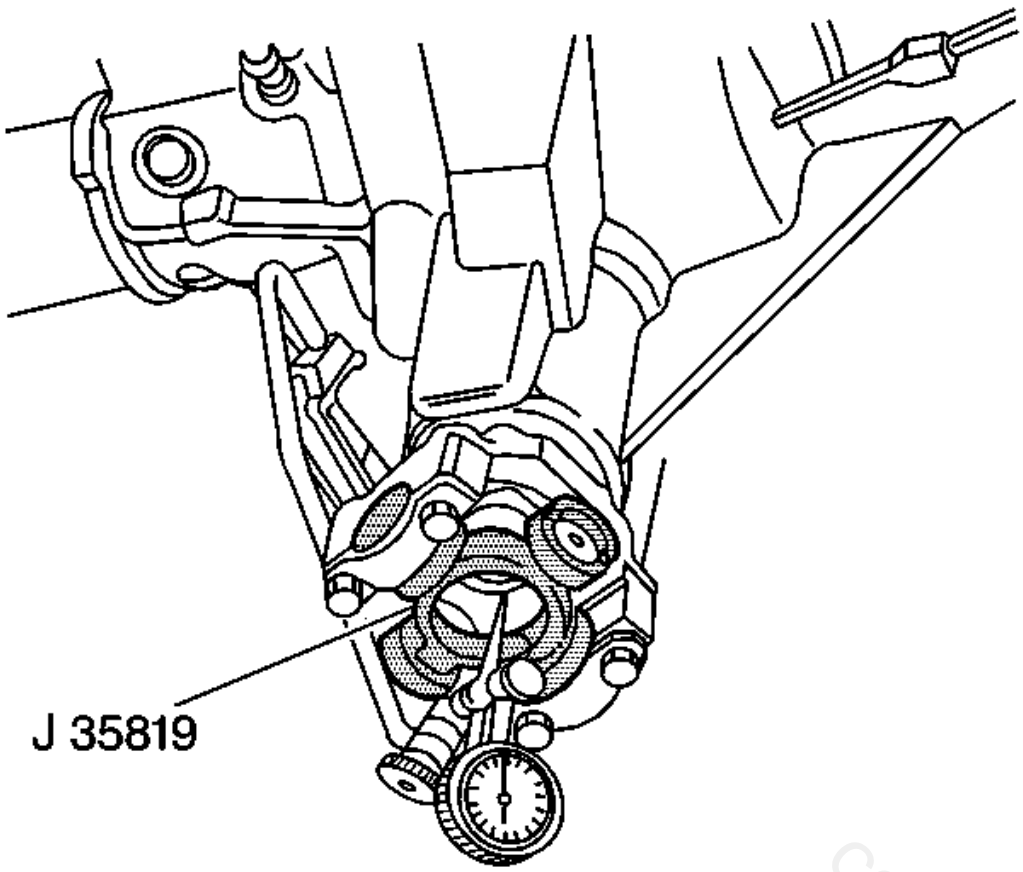


Fig. 26: Flange Runout Gauge
Courtesy of GENERAL MOTORS COMPANY

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.

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.

cardiagn.com

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

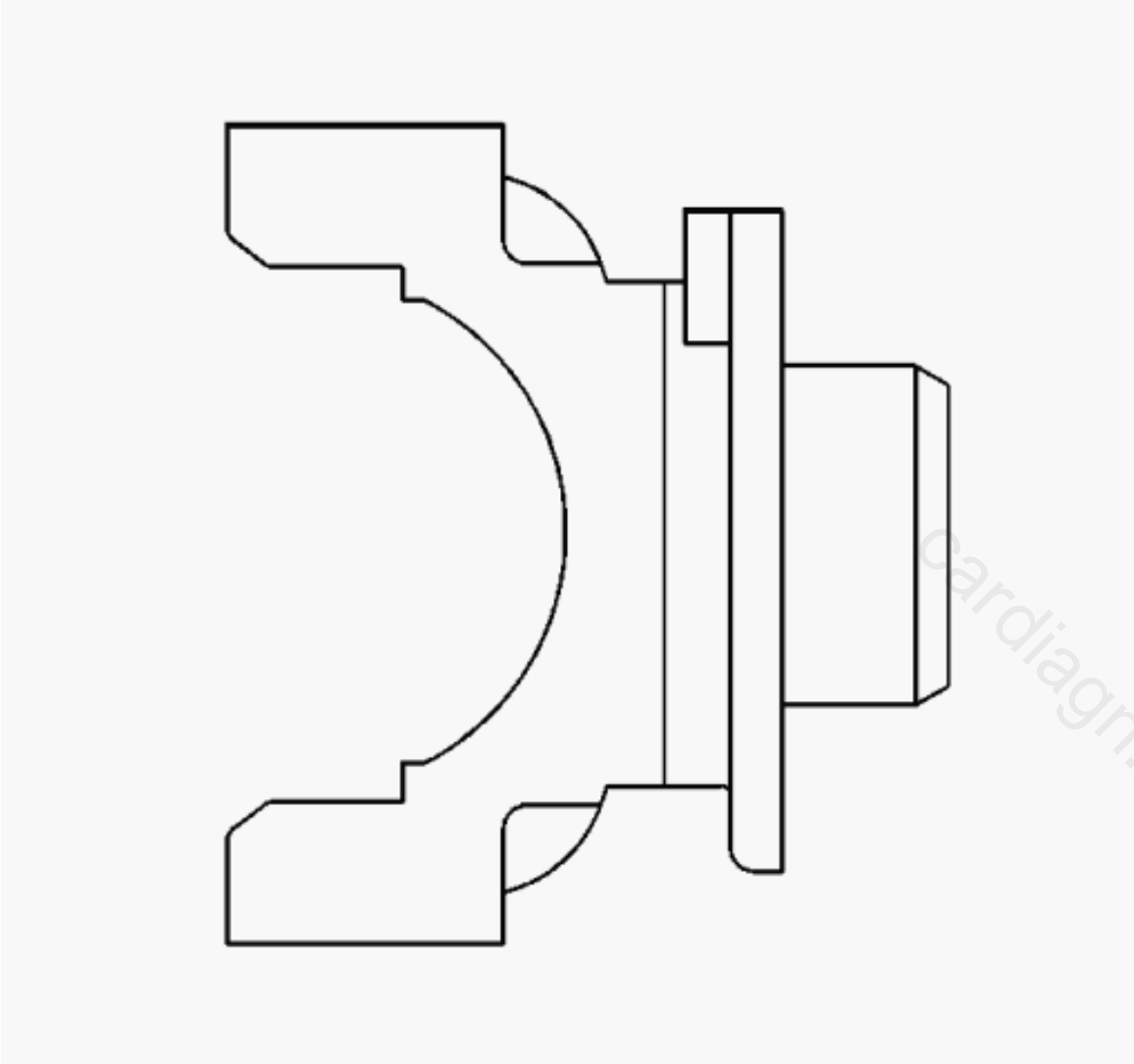

cardiagn.com

Fig. 27: Balance Weight On Pinion Flange Dust Slinger
Courtesy of GENERAL MOTORS COMPANY

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.

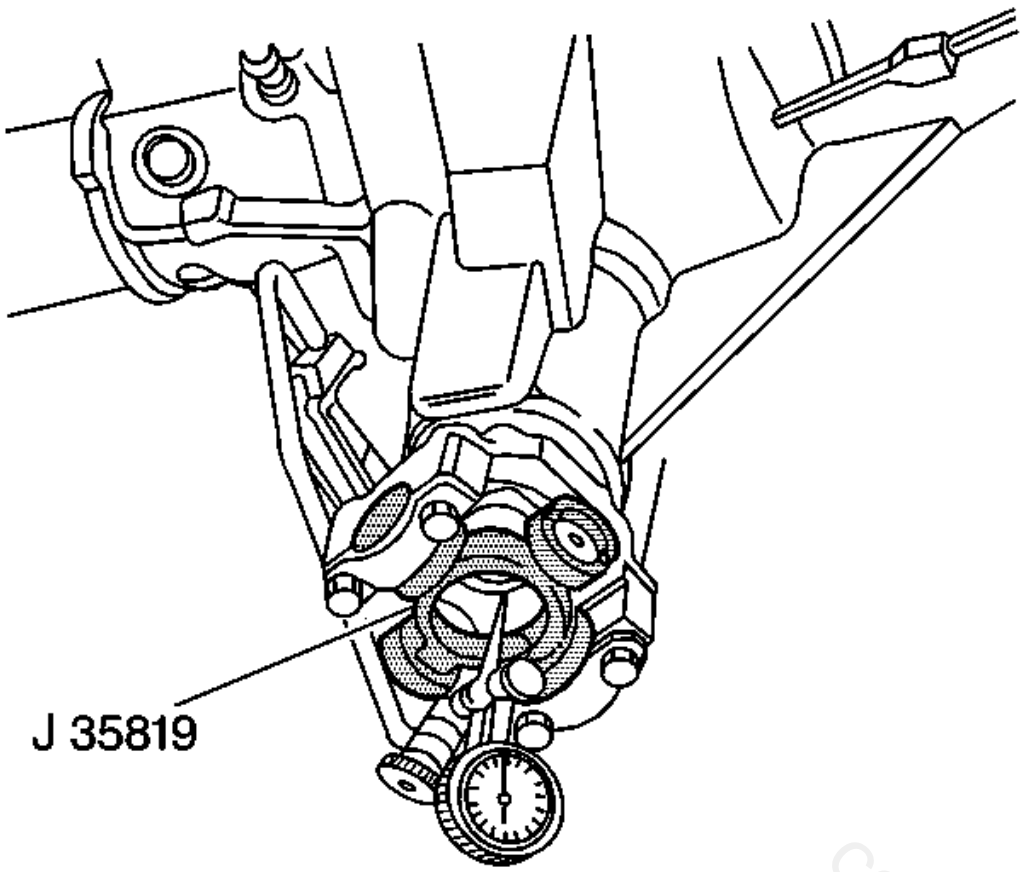


Fig. 28: Flange Runout Gauge
Courtesy of GENERAL MOTORS COMPANY

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.

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

cardiagn.com

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, bolt-on U-joint yoke, or strap style U-joint 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 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 propeller shaft 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. If equipped with a strap style U-joint flange, measure the differential pinion input shaft radial runout at the propeller shaft, as close to the flange as possible:
    1. Clean the surface of the propeller shaft just ahead of the input flange.
    2. Mount a dial indicator set, **GE-7872** Magnetic Base Dial Indicator Set, or equivalent, and position the dial indicator to contact a smooth area of the propeller shaft as close to the end of the shaft as possible.
7. Rotate the drive axle input shaft by hand to locate the low spot.
8. Set the dial indicator to zero on the low spot.
9. Rotate the shaft by hand and record the amount of radial runout.
10. If equipped with a constant velocity (CV) joint, rubber coupling, or bolt on U-joint yoke:
    1. Compare the runout of the shaft to the runout tolerance specifications guidelines.
    2. If the drive axle input shaft runout exceeds the specification, the flange requires replacement.
11. If equipped with a strap style U-joint flange:
    1. Remove the propeller shaft, rotate the shaft 180 degrees, and reinstall.
    2. Rotate the drive axle input shaft by hand to locate the low spot.
    3. Set the dial indicator to zero on the low spot.
    4. Rotate the shaft by hand and record the amount of radial runout.
    5. Compare the two radial runout measurements and if the difference exceeds the axle flange runout specification, the flange requires replacement.

cardiagn.com

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.**

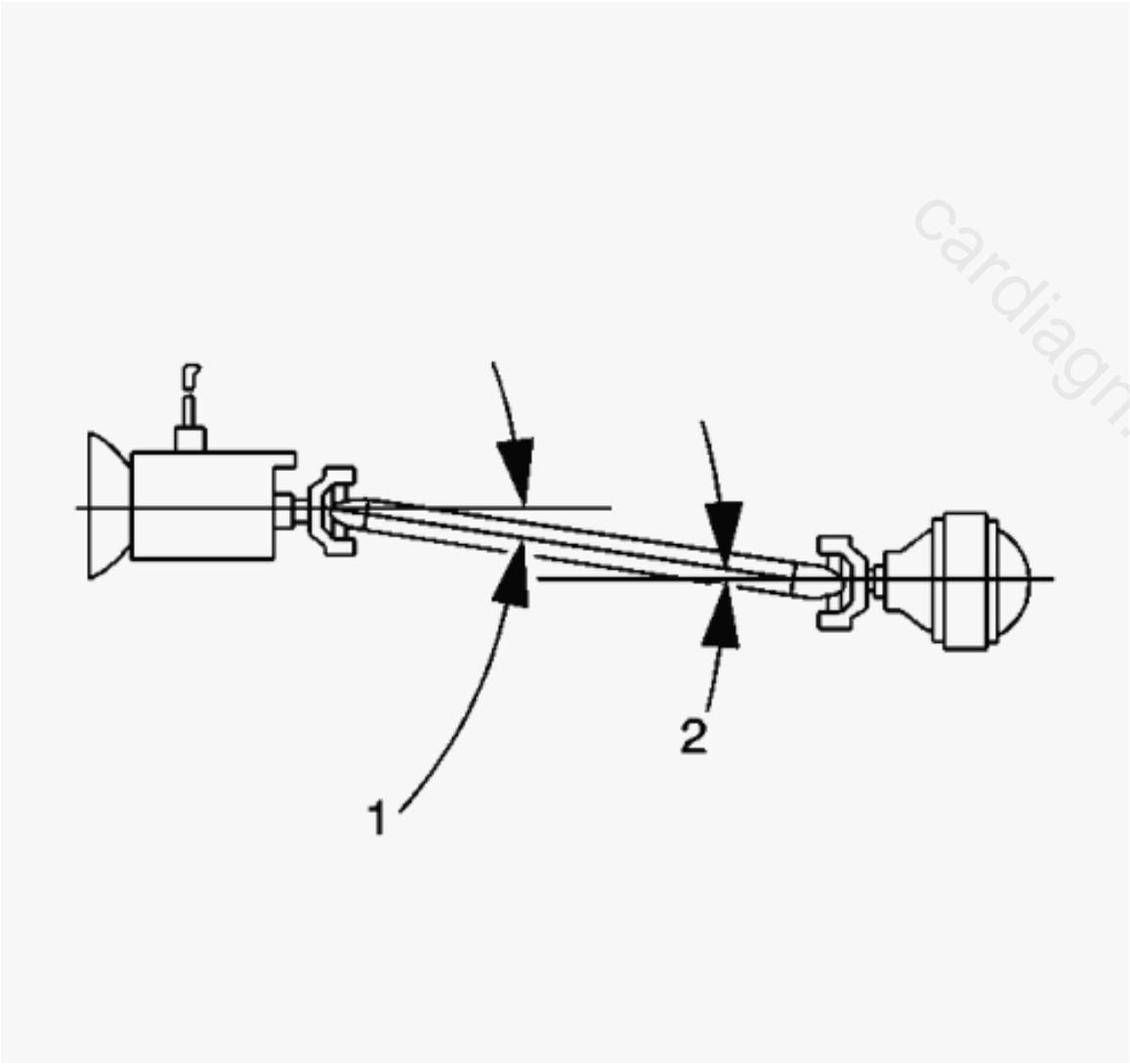


Fig. 29: Identifying Working Angles (One-Piece Propeller Shaft)
Courtesy of GENERAL MOTORS COMPANY

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

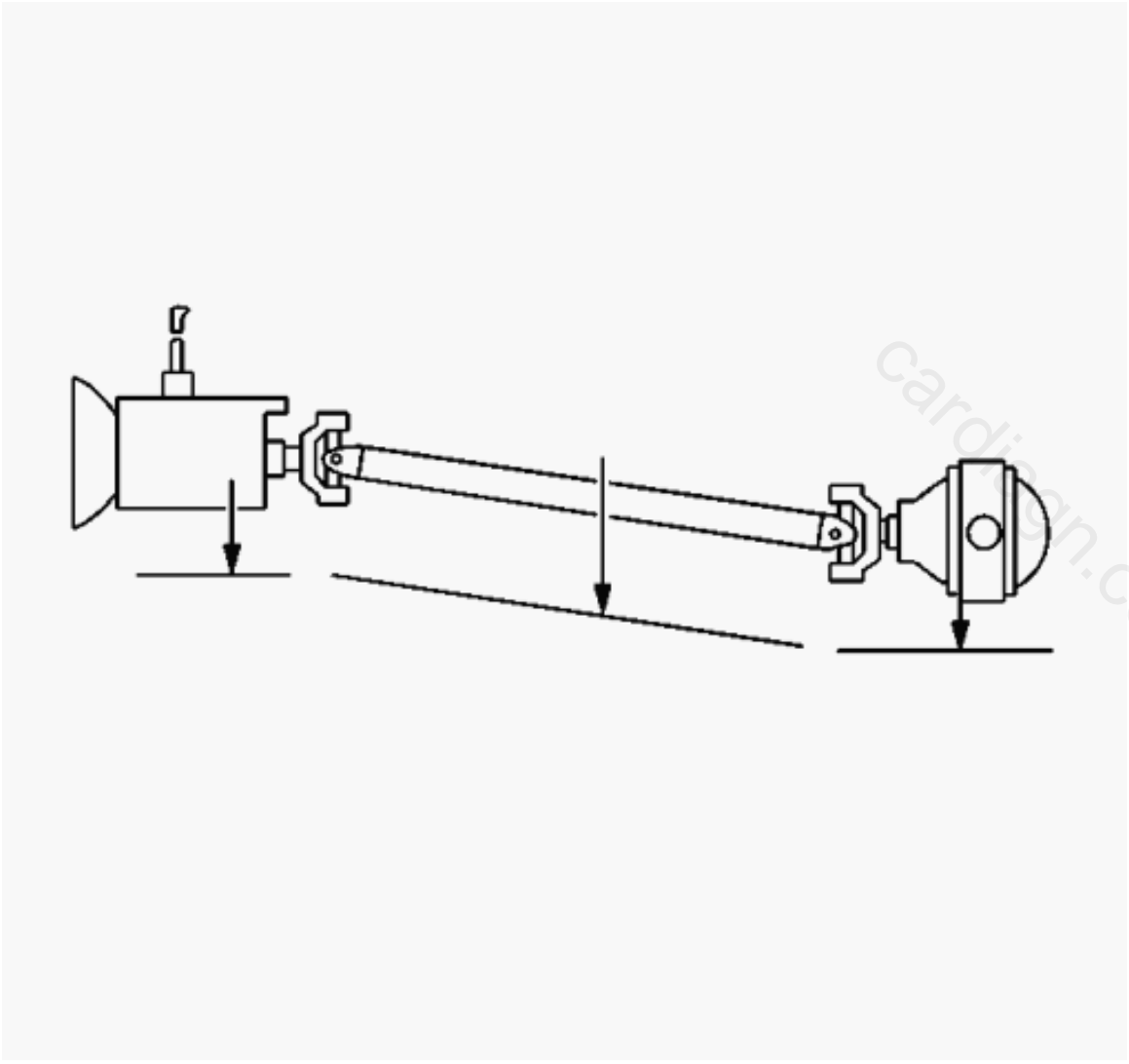


Fig. 30: Identifying Propeller Shaft Measurement Recording Points
Courtesy of GENERAL MOTORS COMPANY

- 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, 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.

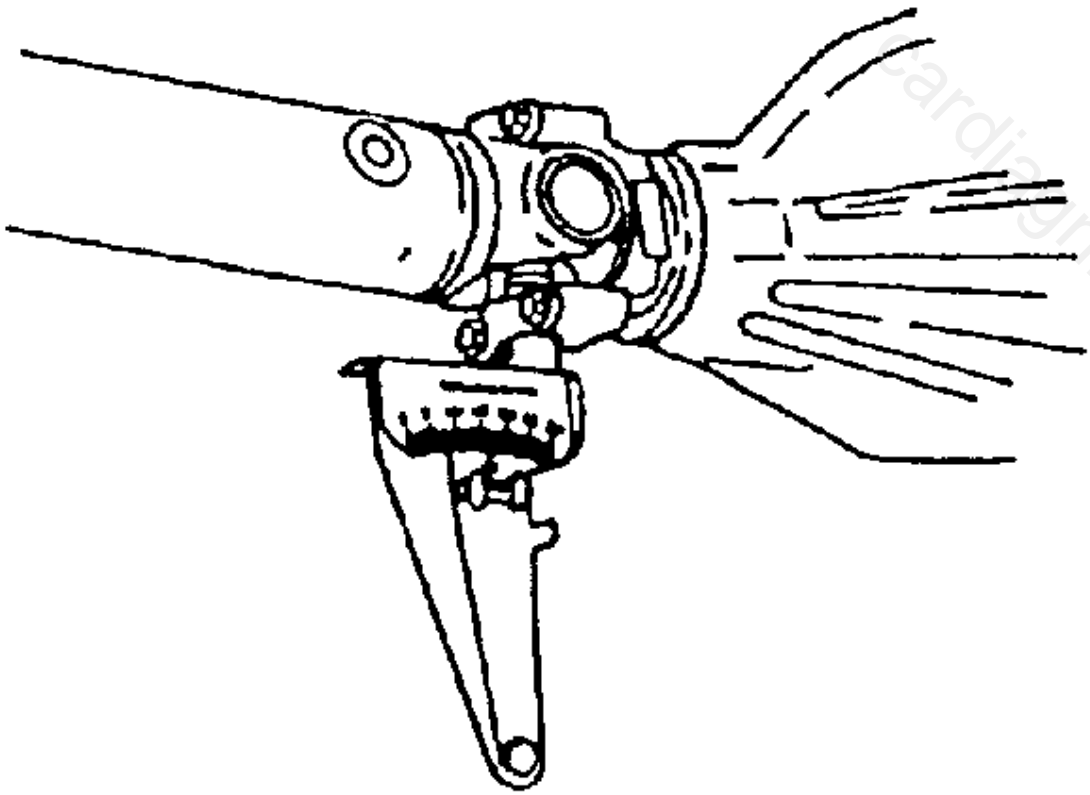


Fig. 31: Measuring Angle Of Drive Axle Pinion
Courtesy of GENERAL MOTORS COMPANY

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.

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.

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.

cardiagn.com

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.

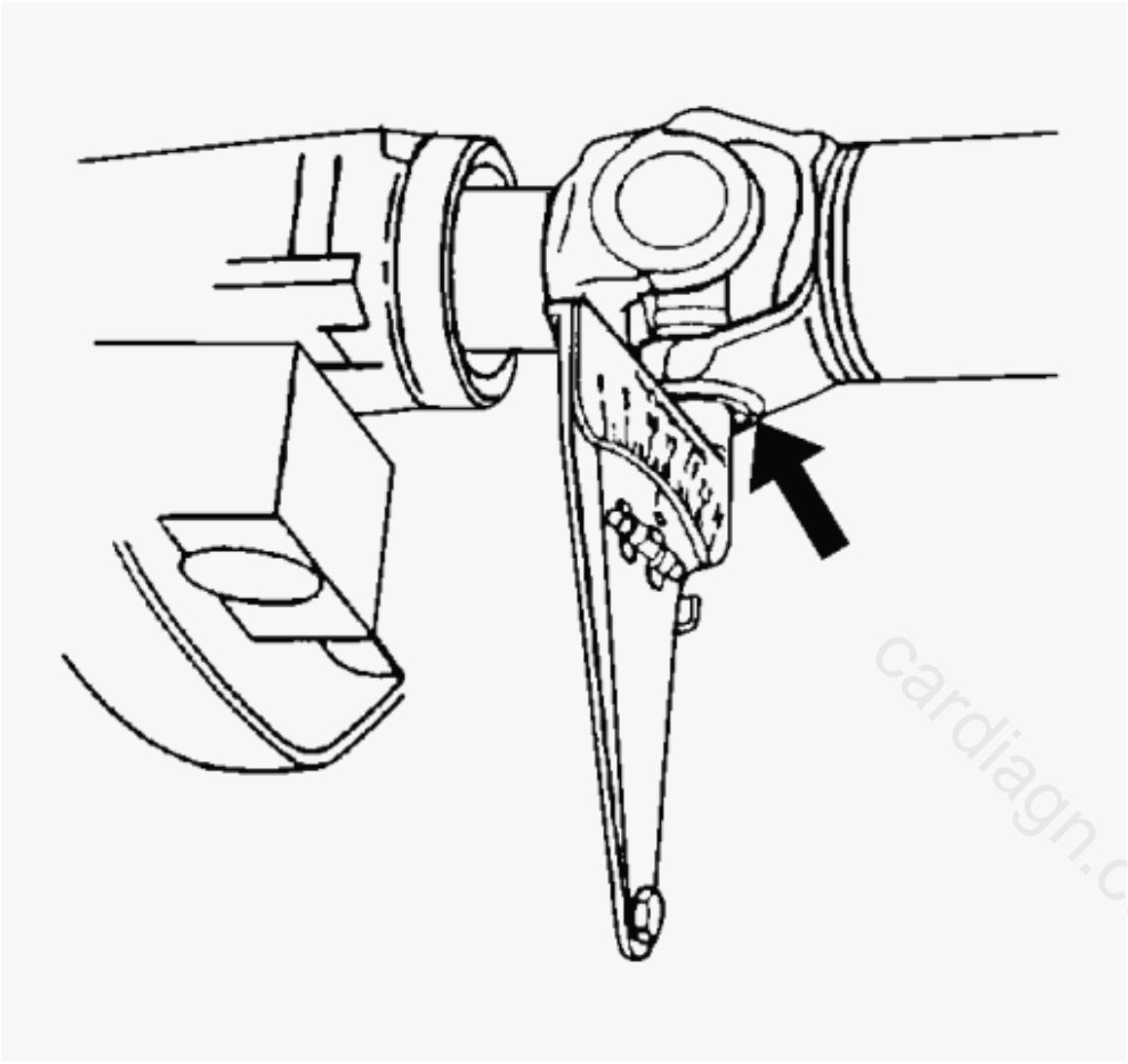


Fig. 32: Inspecting Rear Propeller Shaft For Proper Phasing
Courtesy of GENERAL MOTORS COMPANY

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.
    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.

cardiagn.com

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 recommendations, or perform the following test.

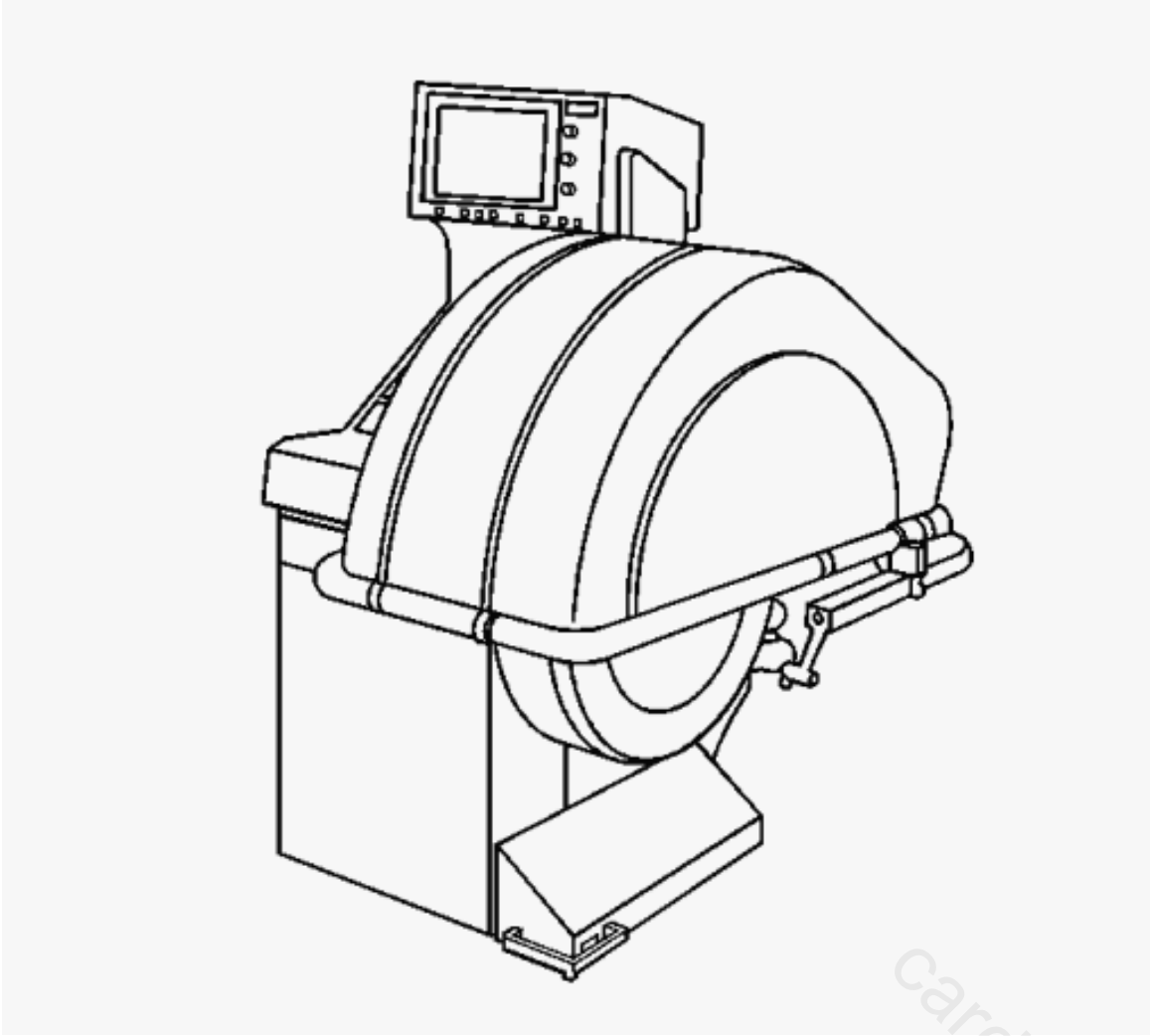


Fig. 33: View Of Tire & Wheel Assembly Balancer
Courtesy of GENERAL MOTORS COMPANY

cardiagn.com

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)

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

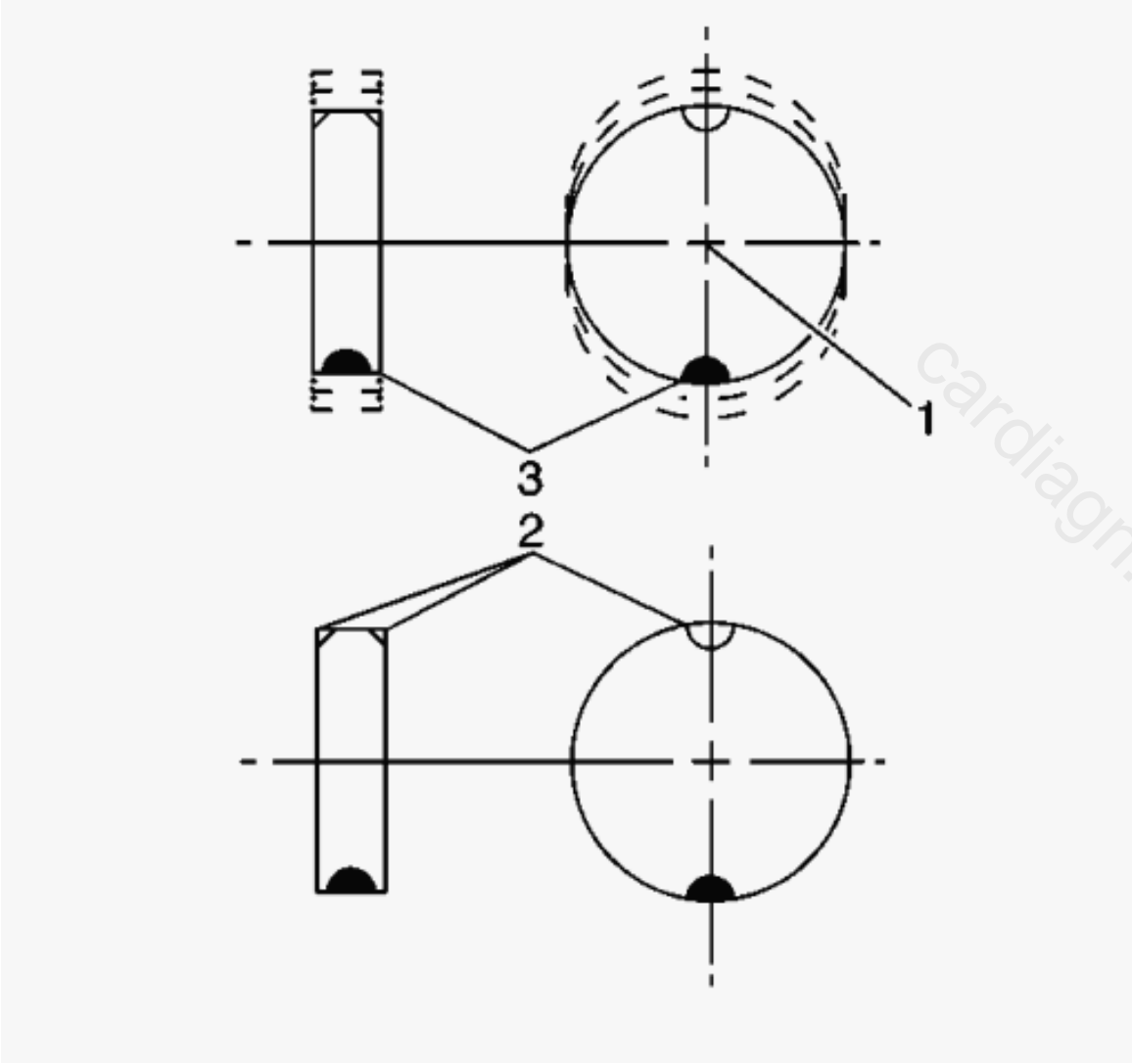


Fig. 34: View Of Static Balance
Courtesy of GENERAL MOTORS COMPANY

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.

Dynamic Balance

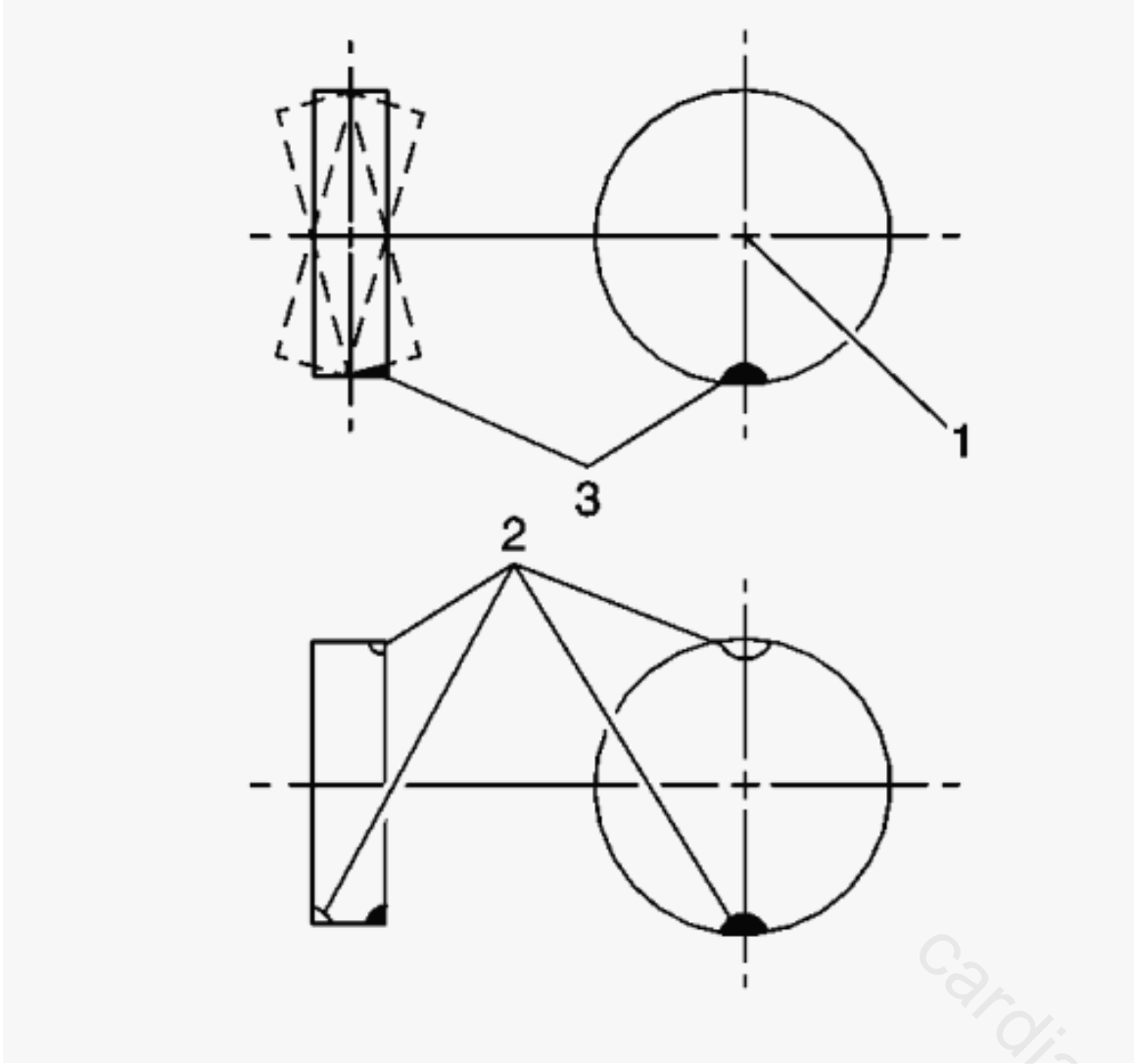


Fig. 35: View Of Dynamic Balance
Courtesy of GENERAL MOTORS COMPANY

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 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.**

cardiagn.com

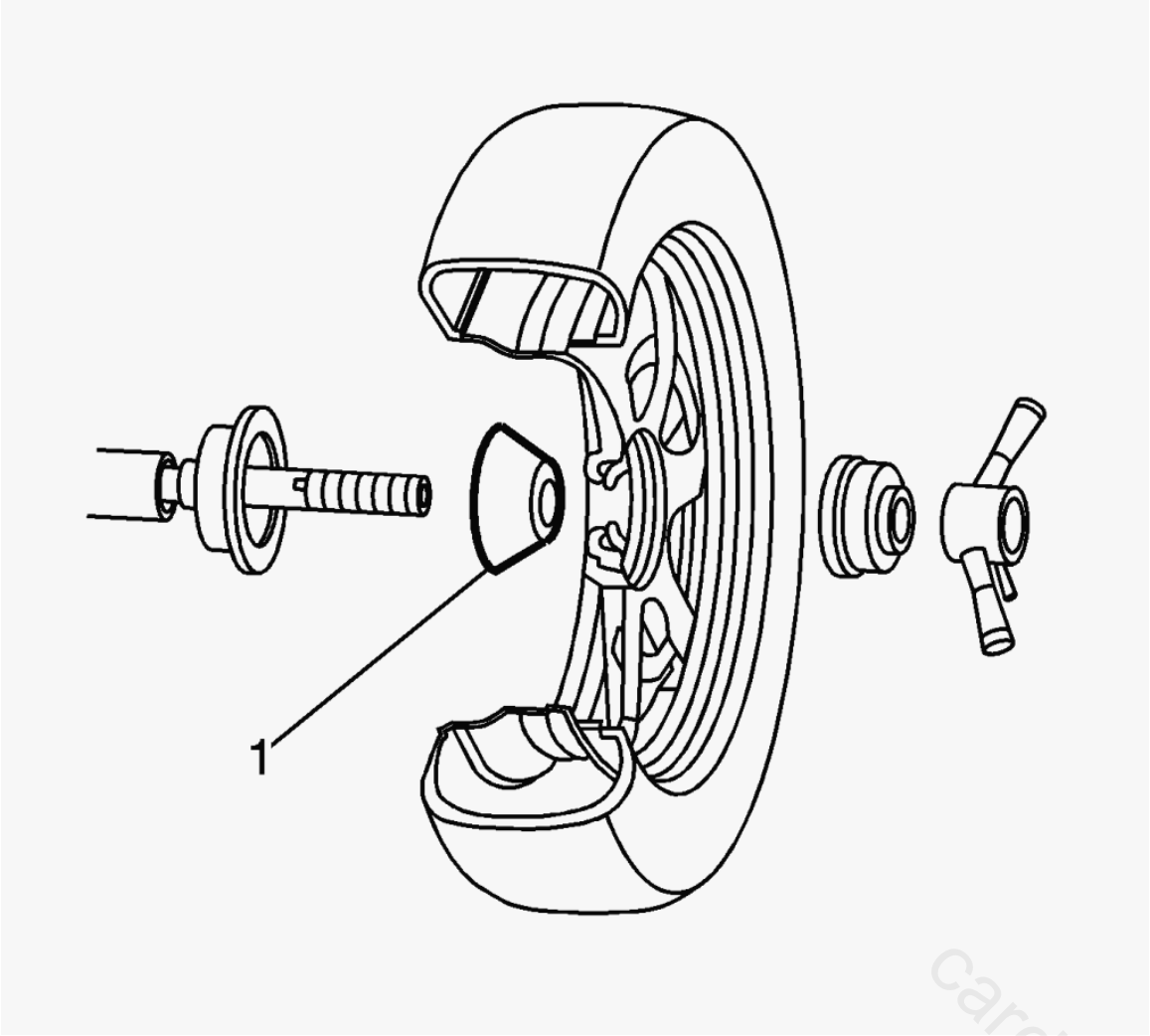


Fig. 36: Wheel Balancer Center Cone
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Carefully follow the wheel balancer manufacturers's instructions for proper mounting of the center cone (1).**

1. Raise and support the vehicle. **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. **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.

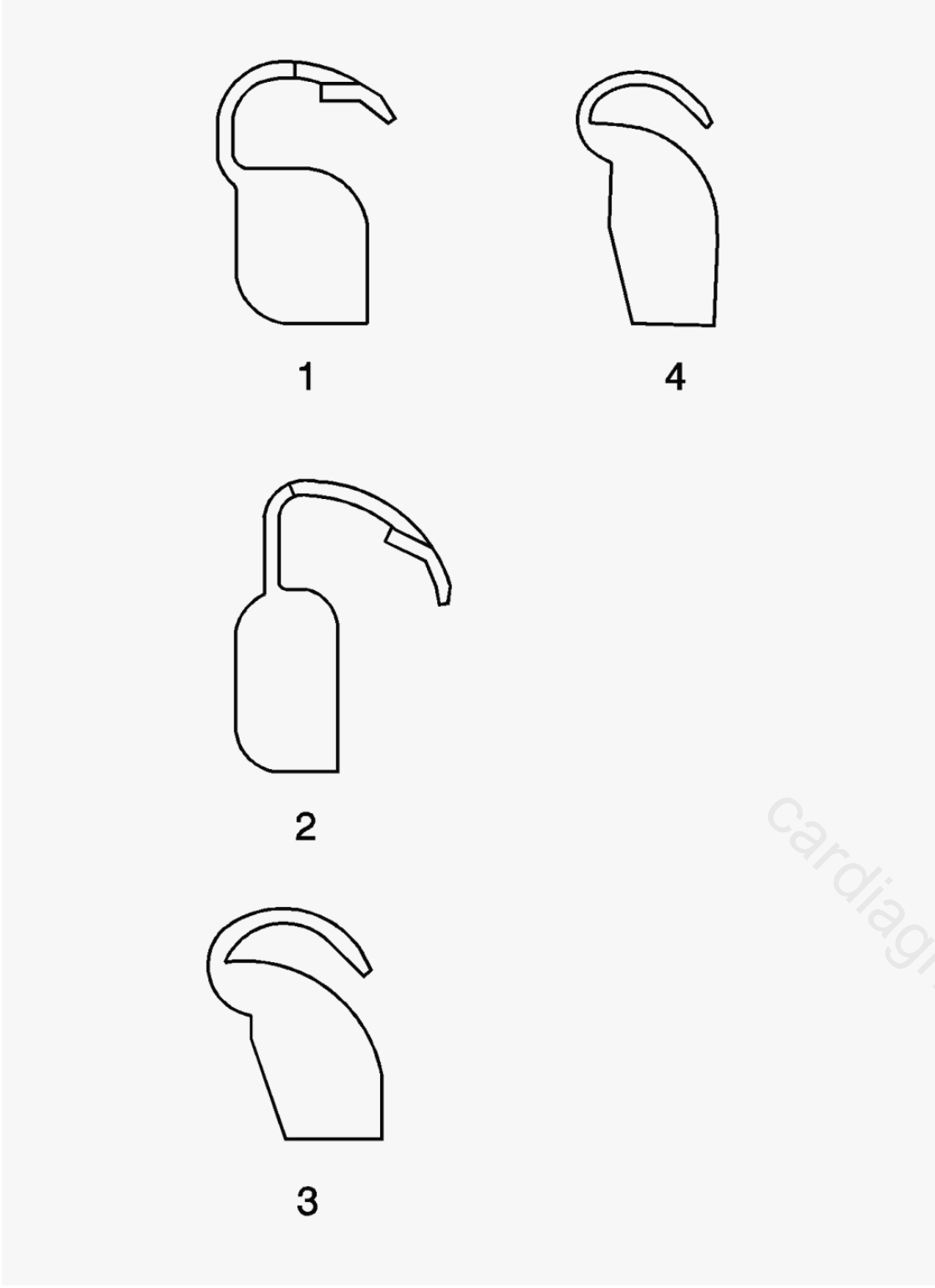
   Regard aftermarket wheels, especially those incorporating universal lug patterns, as potential sources of runout and mounting concerns.

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. **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



cardiagn.com

Fig. 37: Identifying Clip-On Wheel Weight Types
Courtesy of GENERAL MOTORS COMPANY

NOTE: **When balancing factory aluminum wheels with clip-on wheel balance weights, 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.

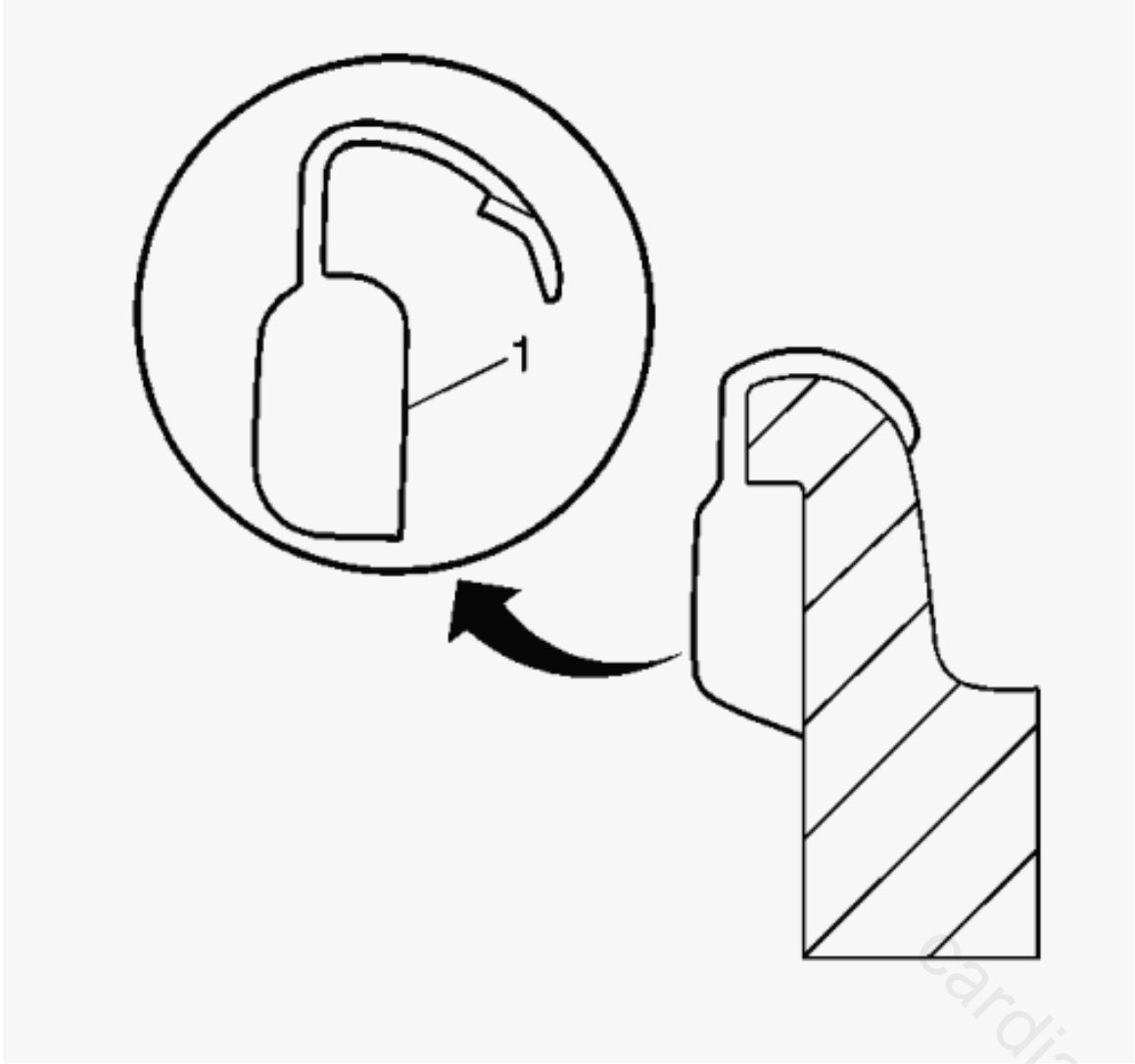


Fig. 38: Attaching Clip-On Wheel Weight
Courtesy of GENERAL MOTORS COMPANY

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

cardiagn.com

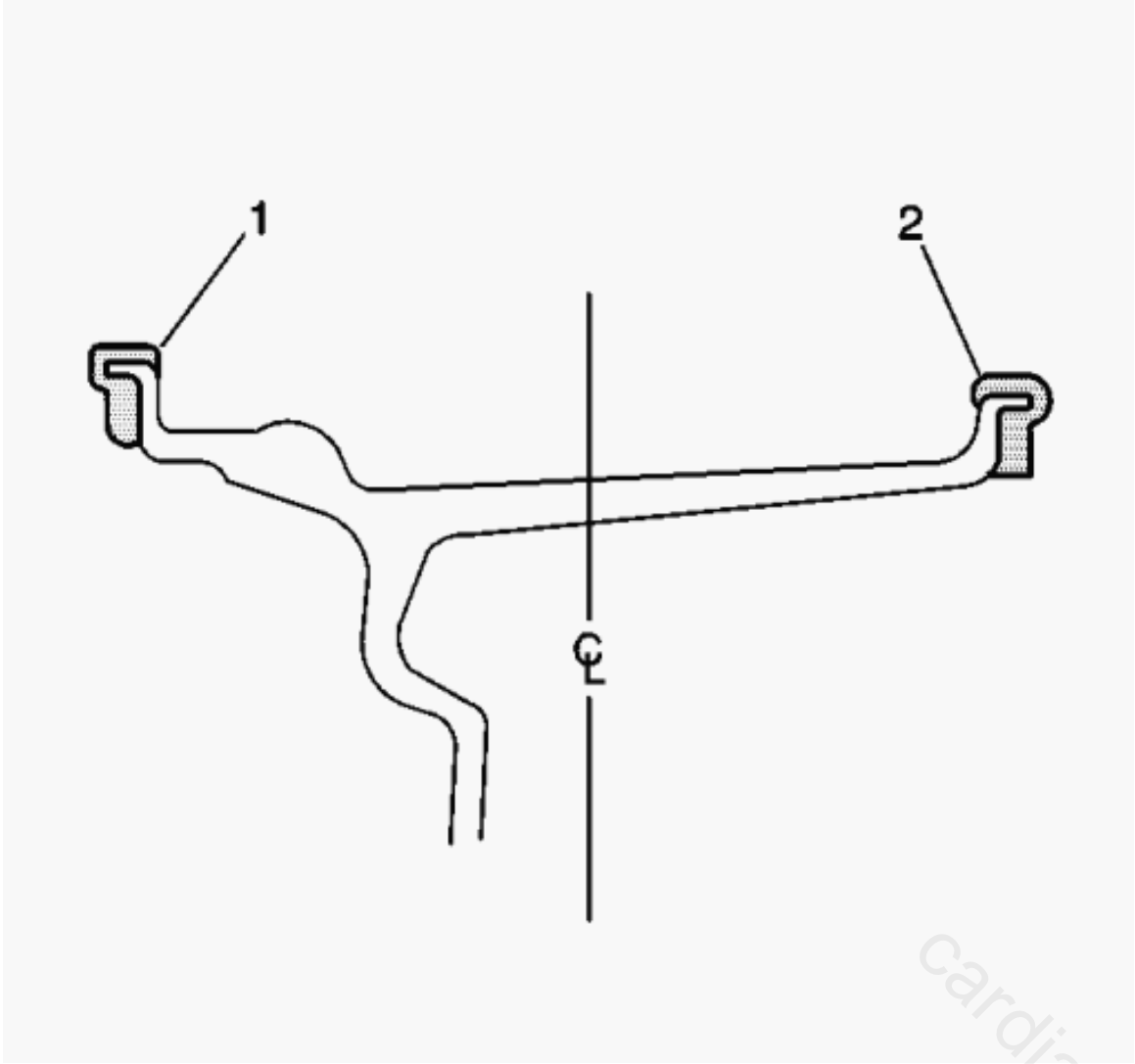


Fig. 39: Clip-On Weight Placement
Courtesy of GENERAL MOTORS COMPANY

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

cardiagn.com

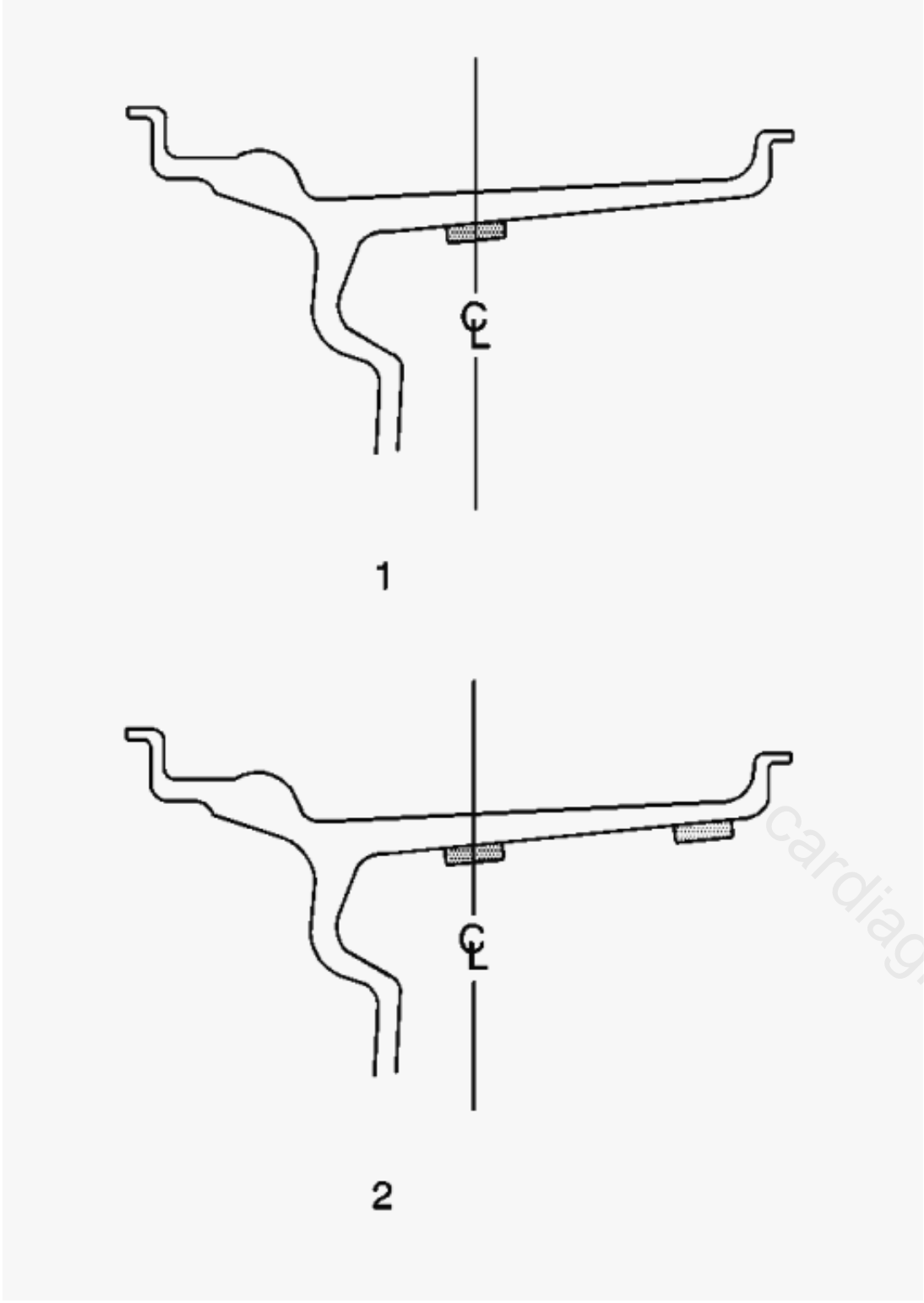


Fig. 40: Identifying Adhesive Weight Wheel Placement
Courtesy of GENERAL MOTORS COMPANY

NOTE: **When installing adhesive balance weights on flangeless wheels, do NOT install 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.**

cardiagn.com

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

EL-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 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 **EL-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 **EL-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)

cardiagn.com

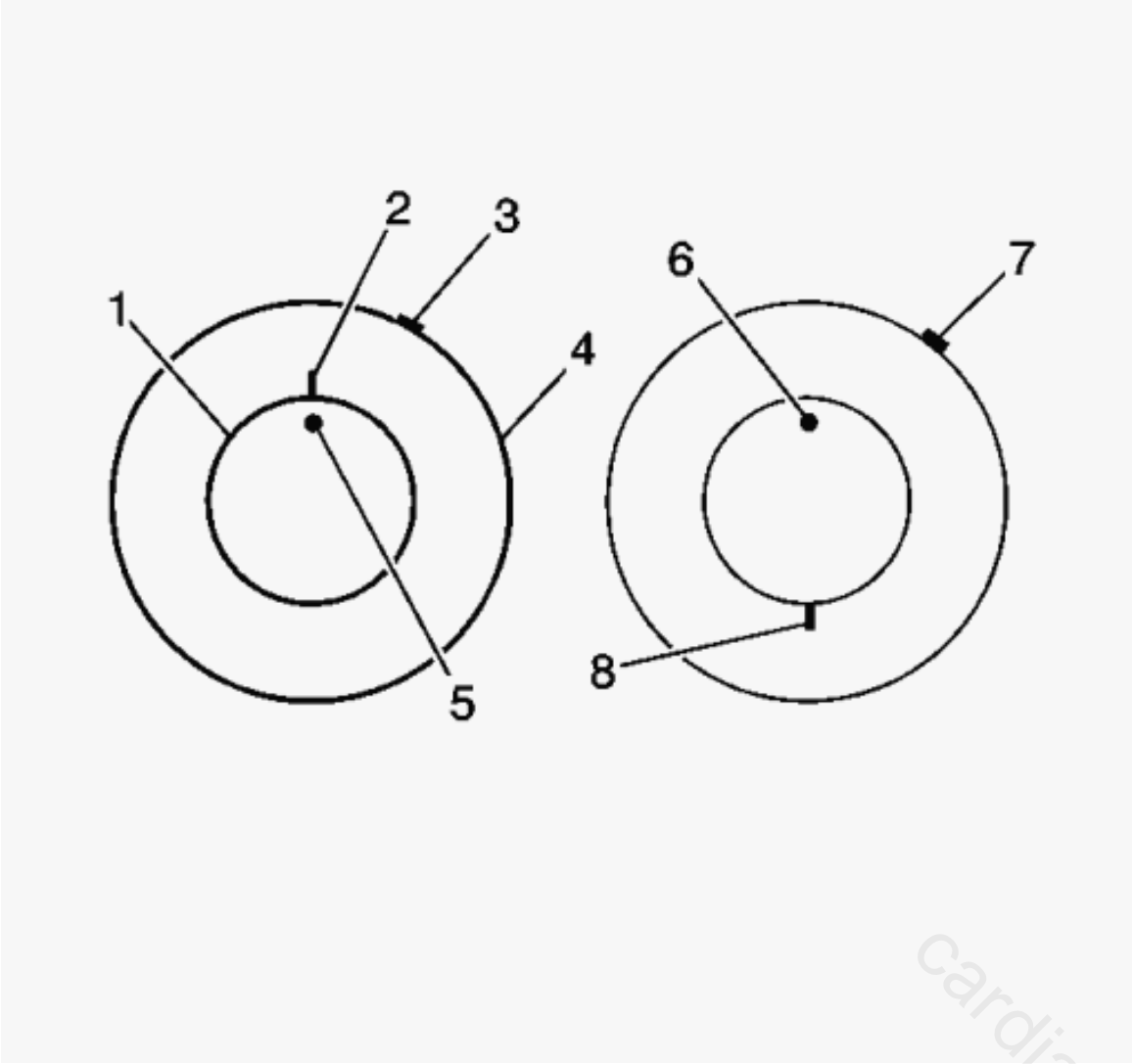


Fig. 41: View Of Tire-to-Wheel Match-Mounting
Courtesy of GENERAL MOTORS COMPANY

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.
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.

cardiagn.com

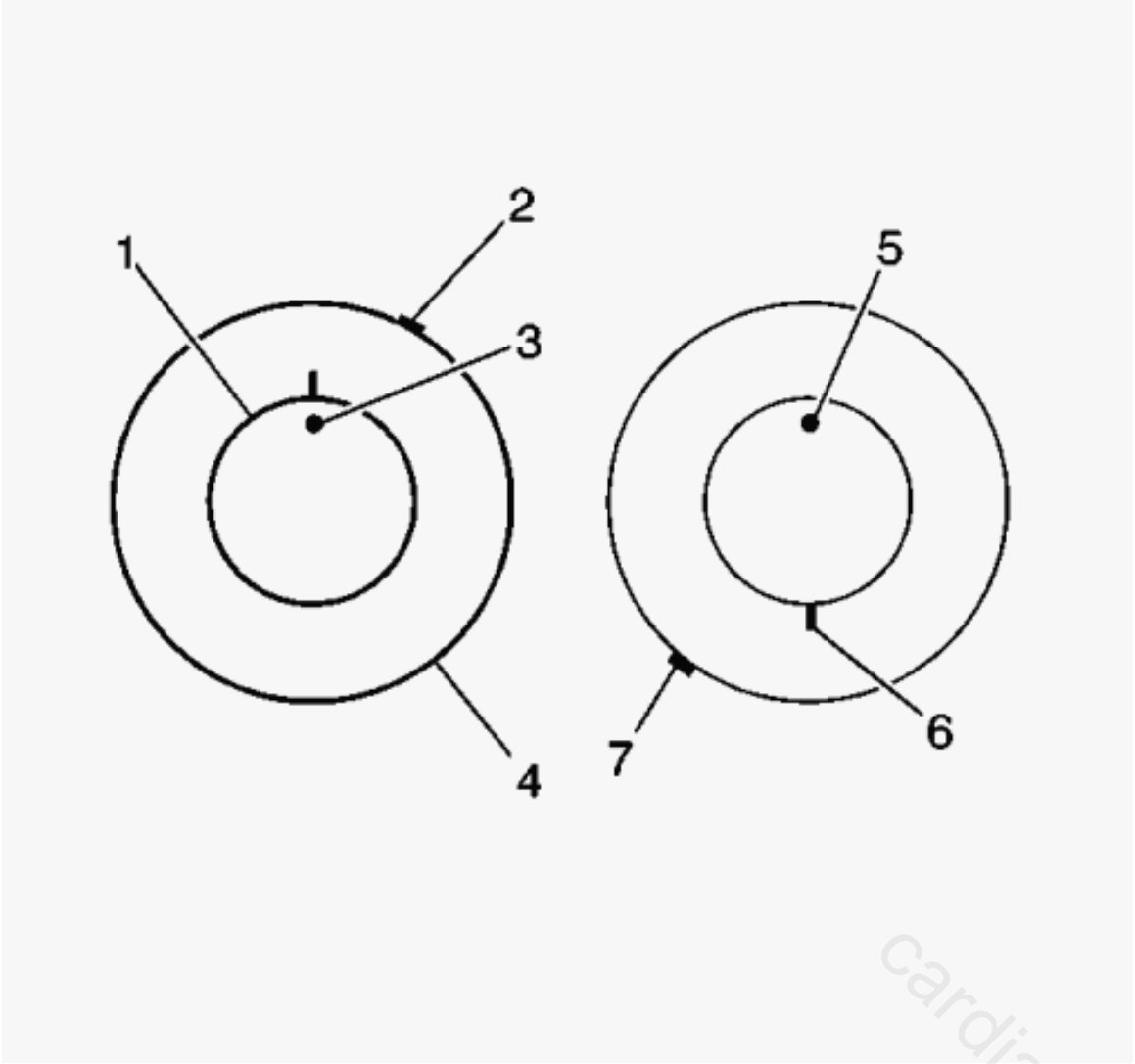


Fig. 42: View Of Match-Mounting Tire-To-Wheel
Courtesy of GENERAL MOTORS COMPANY

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.

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** .

cardiagn.com

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

Special Tools

- **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or
- **EL-38792-A** Electronic Vibration Analyzer (EVA) 2
- **EL-38792-20** 20-Foot Timing Light Power Cord Extension
- **EL-38792-25** Inductive Pickup Timing Light, or equivalent
- **EL-38792-27** 6-Foot EVA Power Cord Extension

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

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.

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 the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) is available, use the following procedure, Adjustment Procedure Using Oscilloscope. If the Oscilloscope is not available but the EVA 2 is available, use the second procedure, Adjustment Procedure Using EVA. If neither the Oscilloscope nor the EVA 2 is available, use the third procedure, Adjustment Procedure Without Oscilloscope or EVA.

Adjustment Procedure Using Oscilloscope

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.**

The balance procedure is integrated into the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) in its Driveline Balancing utility. There are two methods for balancing:

- Hose Clamp Method
- Pinion Flange Method (vehicles with rubber couplers on the propeller shaft)

The following is an overview of the two driveline balancing methods.

Hose Clamp Method

1. Raise and support the vehicle; ensure that the drive axle or axles are supported at ride height - vehicle body supported by suspension components. Refer to **Lifting and Jacking the Vehicle** .

2. Connect the Oscilloscope to the USB port of the computer using the blue USB cable, **CH-51450-M1106** .
3. Connect the Accelerometer **CH-51450-TA183** to the NVH Interface **CH-51450-TA148** .
4. Connect the NVH Interface to Channel B of the Oscilloscope using the **CH-51450-TA098** BNC to BNC cable.

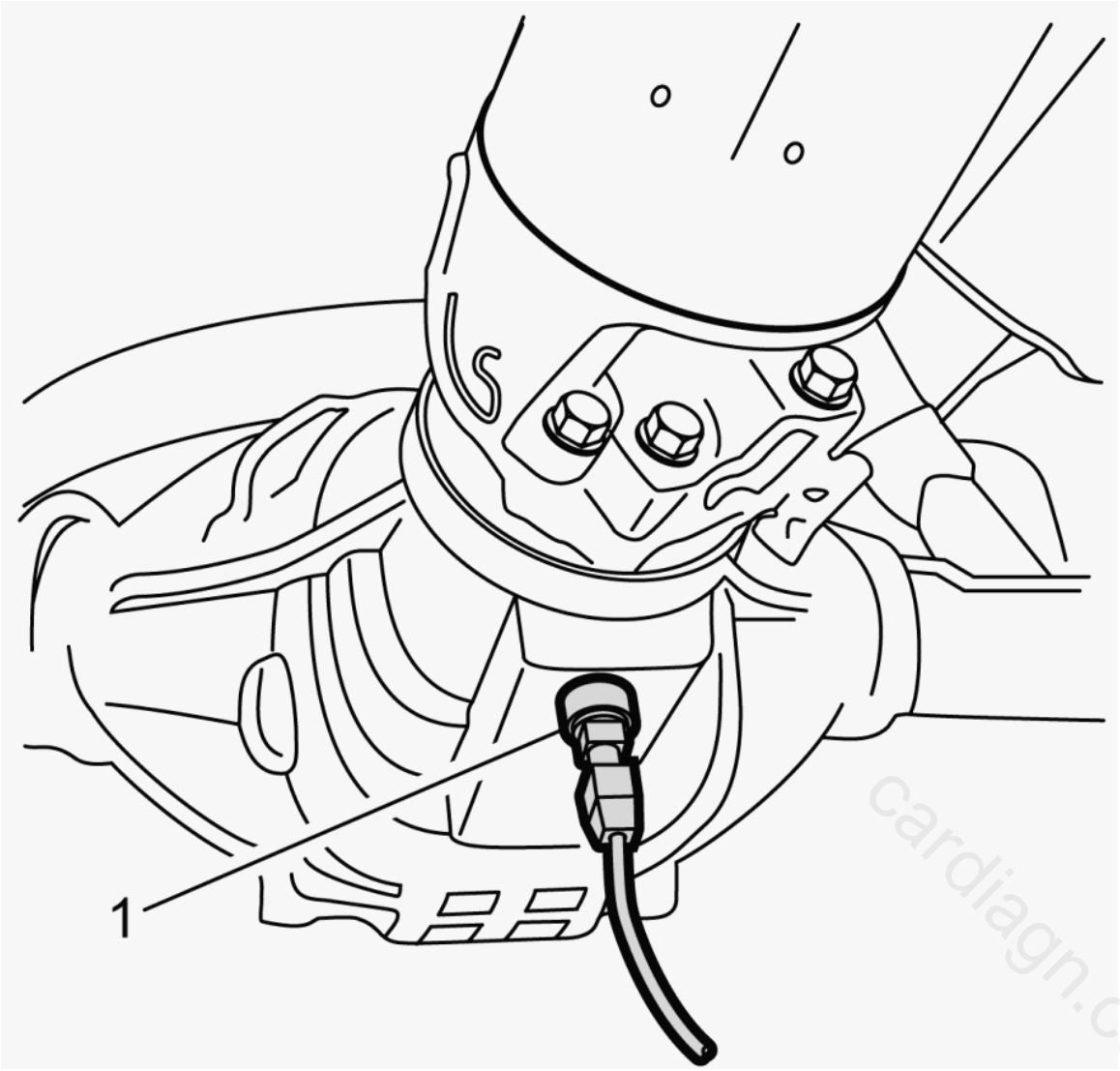


Fig. 43: Accelerometer
Courtesy of GENERAL MOTORS COMPANY

5. Mount the Accelerometer (1) to a suitable surface on the vehicle differential. If the differential case is non-ferrous, a steel washer can be glued on the differential case in order to secure the magnetic Accelerometer.

cardiagn.com

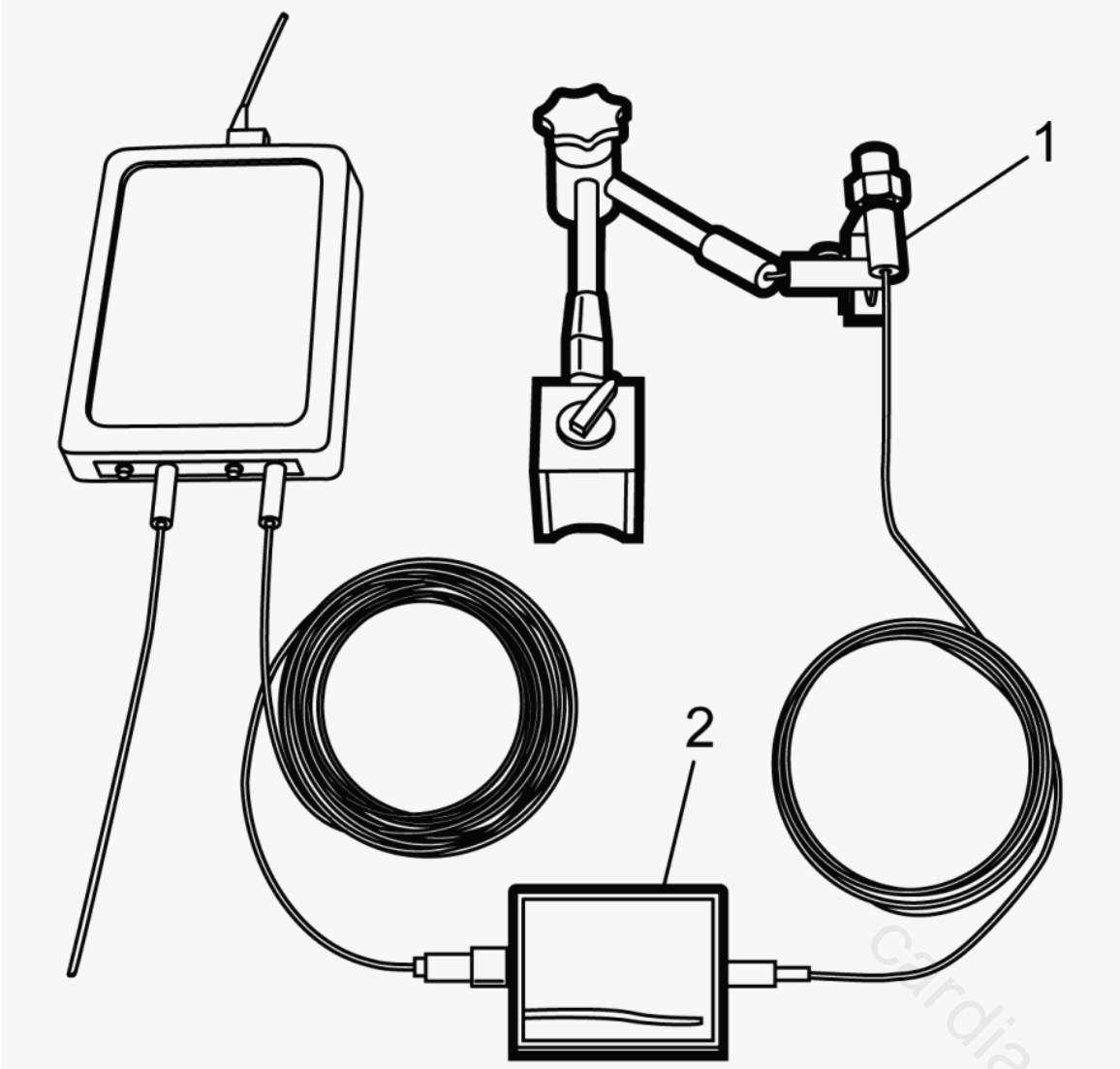


Fig. 44: Optical Sensor And Interface
Courtesy of GENERAL MOTORS COMPANY

6. Connect the Optical Sensor **CH-51450-TA186** (1) to the Optical Sensor Interface **CH-51450-TA185** (2).
7. Connect the Optical Sensor Interface to Channel D of the Oscilloscope using the **CH-51450-TA098** BNC to BNB cable.

cardiagn.com

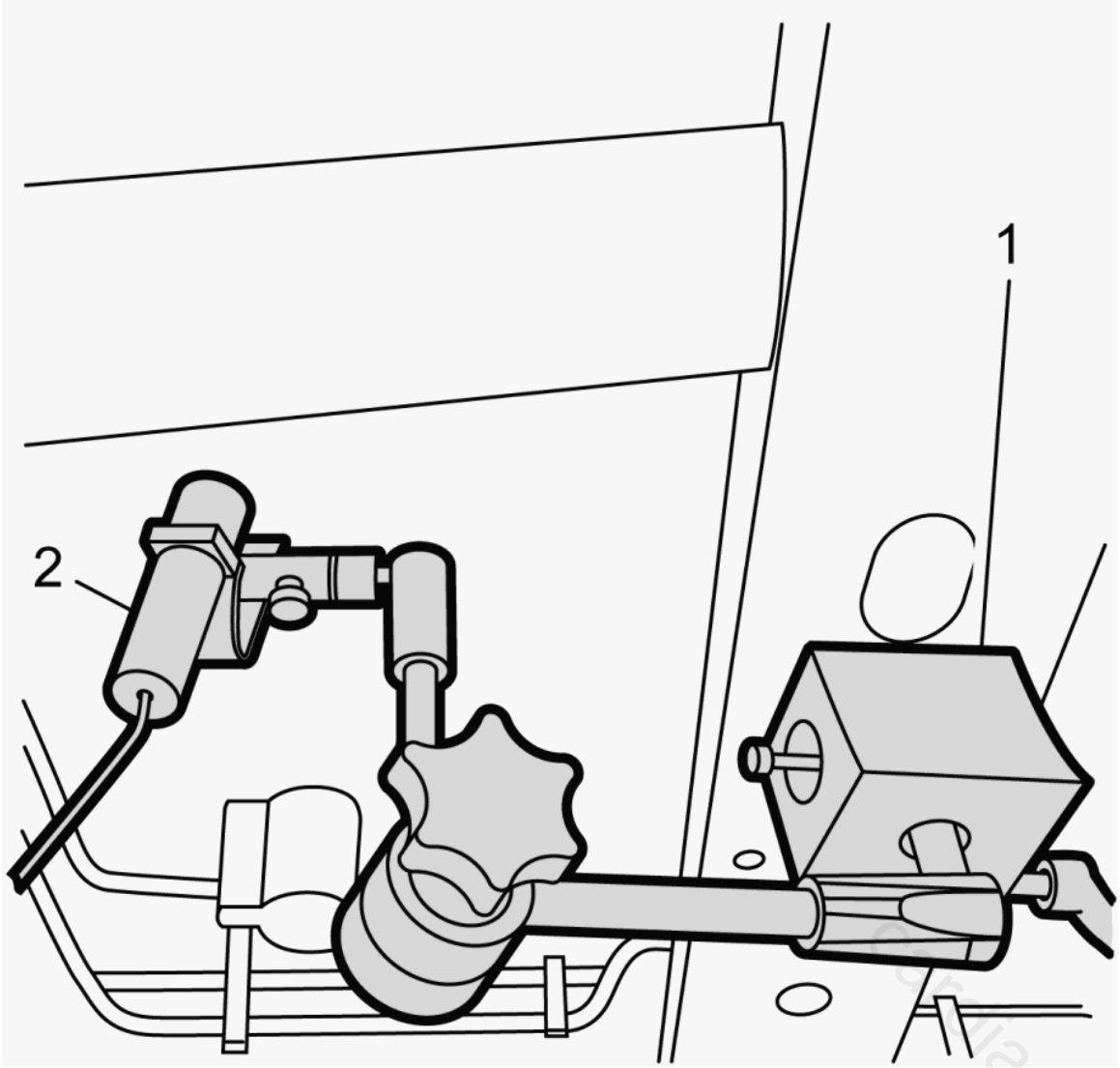


Fig. 45: Magnetic Mounting Fixture
Courtesy of GENERAL MOTORS COMPANY

8. Mount the Magnetic Mounting Fixture **CH-51450-TA187** (1) to a suitable surface on the vehicle underbody.
9. Place a 1/2 inch strip of reflective tape to the propeller shaft.
10. Focus the laser (2) on the reflective tape.
11. Install 2 hose clamps side by side to the propeller shaft near the differential, on an area clear of any factory balance weights.
12. Mark the excess band on the hose clamps.
13. Remove the hose clamps and trim the excess from the hose clamp bands.
14. Enter the weight of the hose clamp, in grams, into the balancing software.
15. To determine the weight of the hose clamp, use the following:
    - Cut the screw body off of the clamp, even with end of the screw.
    - Weigh the screw body on a gram scale (14 g is typical).
16. Measure the circumference of the propeller shaft near the hose clamps using the supplied ruler and enter that figure, in millimeters, into the balancing software.
17. Alternatively, enter the diameter, in millimeters, of the propeller shaft into the balancing software.
18. Before beginning the test, inspect for the following:
    - The vehicle is properly supported. Refer to **Lifting and Jacking the Vehicle** .
    - Remove any rocks or debris embedded in the tire treads.
    - Secure all test leads clear of rotating components.
    - Disable the ABS and traction control, if equipped.
    - Turn OFF the A/C, and any other accessories.
19. Determine a suitable propeller shaft speed.
    - Start the engine.
    - Place the transmission in the highest forward gear.

- Run the engine to highway speed, typically 104-112 km/h (65-70 mph).
- When the RPM can be held stable for longer than 3 seconds, the balancing software will capture and enter the propeller shaft speed.
- Alternatively, click the Edit Manually check box and enter the desired propeller shaft speed.
- Place the transmission in NEUTRAL.
- Turn OFF the engine.

20. Begin the propeller shaft balancing.

Initial Run

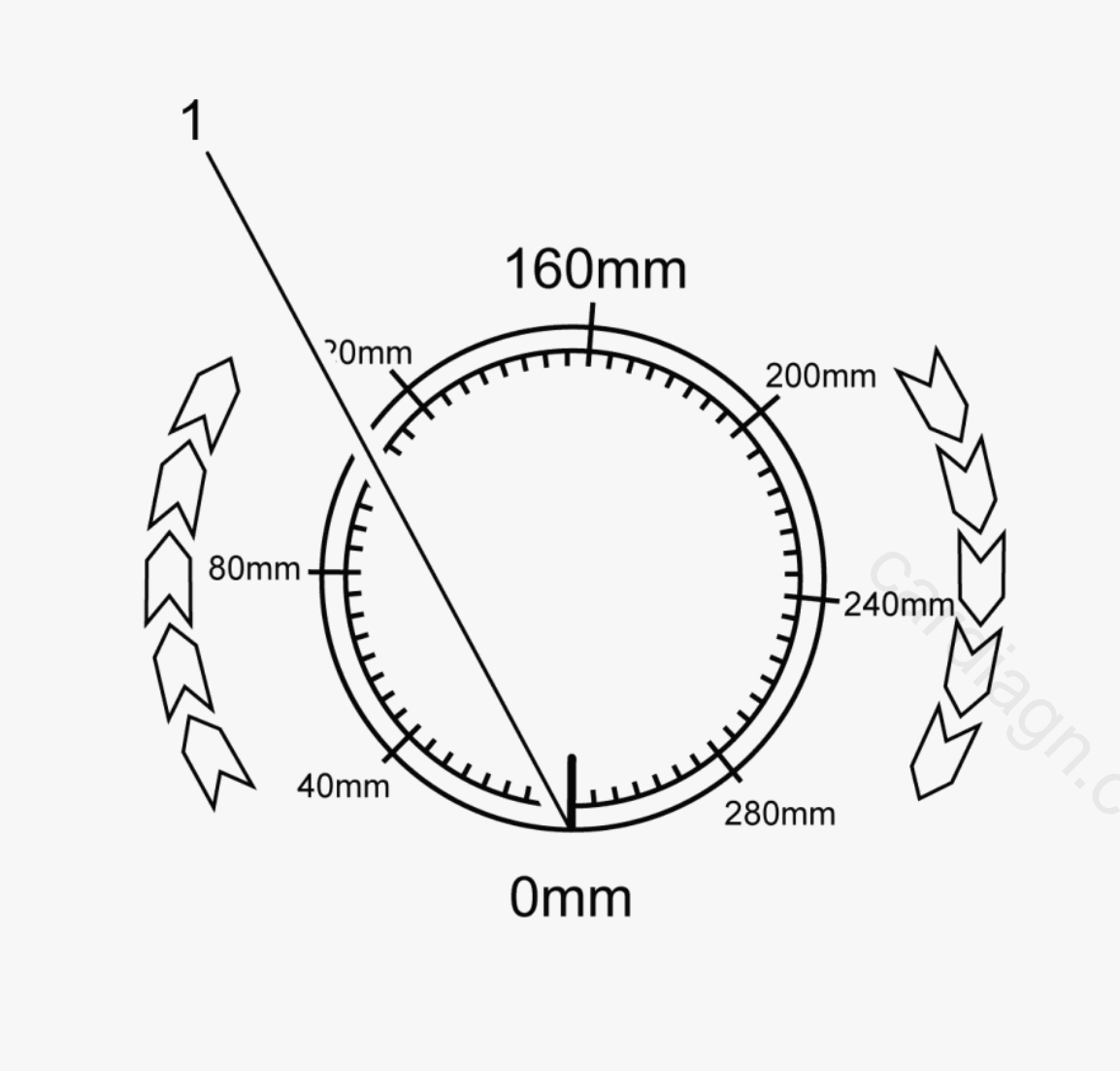


Fig. 46: 0 mm Mark
Courtesy of GENERAL MOTORS COMPANY

1. Place the first clamp on the propeller shaft near the differential.
2. Clearly mark the location of the clamp as reference for all remaining measurements.
3. Label the mark (1) as 0 mm.
4. Measure the distance specified by the software and place the second clamp next to the first clamp.
5. Measure the distance specified by the software and place the second clamp next to the first clamp.
6. Press the green Initial Run button to start the test.
7. Start the engine.
8. Place the transmission in the highest forward gear.
9. Accelerate the engine until the required speed is reached.
10. The RPM graph will highlight green when the RPM is within the specified range, and data will only be gathered while within this range.

21. When the Complete % bar graph is filled, place the transmission in NEUTRAL and turn OFF the engine.
22. Perform the first calibration run.

Calibration Run 1

1. Place both hose clamps at the 0 mm label.
2. Press the green Calibration Run 1 button.
3. Start the engine.
4. Place the transmission in the highest forward gear.
5. Accelerate the engine until the required speed is reached.

23. When the Complete % bar graph is filled, place the transmission in NEUTRAL and turn OFF the engine.
24. Perform the second calibration run.

Calibration Run 2

1. Measuring in the direction of forward propeller shaft rotation, mark the point as indicated on the balancing software.
2. Place both hose clamps at this mark.
3. Press the green Calibration Run 2 button.
4. Start the engine.
5. Place the transmission in the highest forward gear.
6. Accelerate the engine until the required speed is reached.

25. When the Complete % bar graph is filled, place the transmission in NEUTRAL and turn OFF the engine.
26. Perform the third calibration run.

Calibration Run 3

1. Measuring from the 0 mm mark in the direction of forward propeller shaft rotation, mark the point as indicated on the balancing software.
2. Place both hose clamps at this mark.
3. Press the green Calibration Run 3 button.
4. Start the engine.
5. Place the transmission in the highest forward gear.
6. Accelerate the engine until the required speed is reached.

27. When the Complete % bar graph is filled, place the transmission in NEUTRAL and turn OFF the engine.
28. Perform the final propeller shaft balancing.

Final Balance

1. Measure and mark the locations as indicated on the balancing software.
2. Place the hose clamps at these locations.
3. Press the green Verification button.
4. Start the engine.
5. Place the transmission in the highest forward gear.
6. Accelerate the engine until the required speed is reached.

29. When the Complete % bar graph is filled, place the transmission in NEUTRAL and turn OFF the engine.
30. The software will display the final imbalance.
31. If the imbalance exceeds the minimum requirement, the software will recommend removing the rear tire and wheel assemblies and, after securing the brake rotors or brake drums, restarting the test.

Pinion Flange Method

1. Raise and support the vehicle; ensure that the drive axle or axles are supported at ride height - vehicle body supported by suspension components. Refer to **Lifting and Jacking the Vehicle** .
2. Connect the Oscilloscope to the USB port of the computer using the blue USB cable, **CH-51450-M1106** .
3. Connect the Accelerometer **CH-51450-TA183** to the NVH Interface **CH-51450-TA148** .
4. Connect the NVH Interface to Channel B of the Oscilloscope using the **CH-51450-TA098** BNC to BNC cable.

cardiagn.com

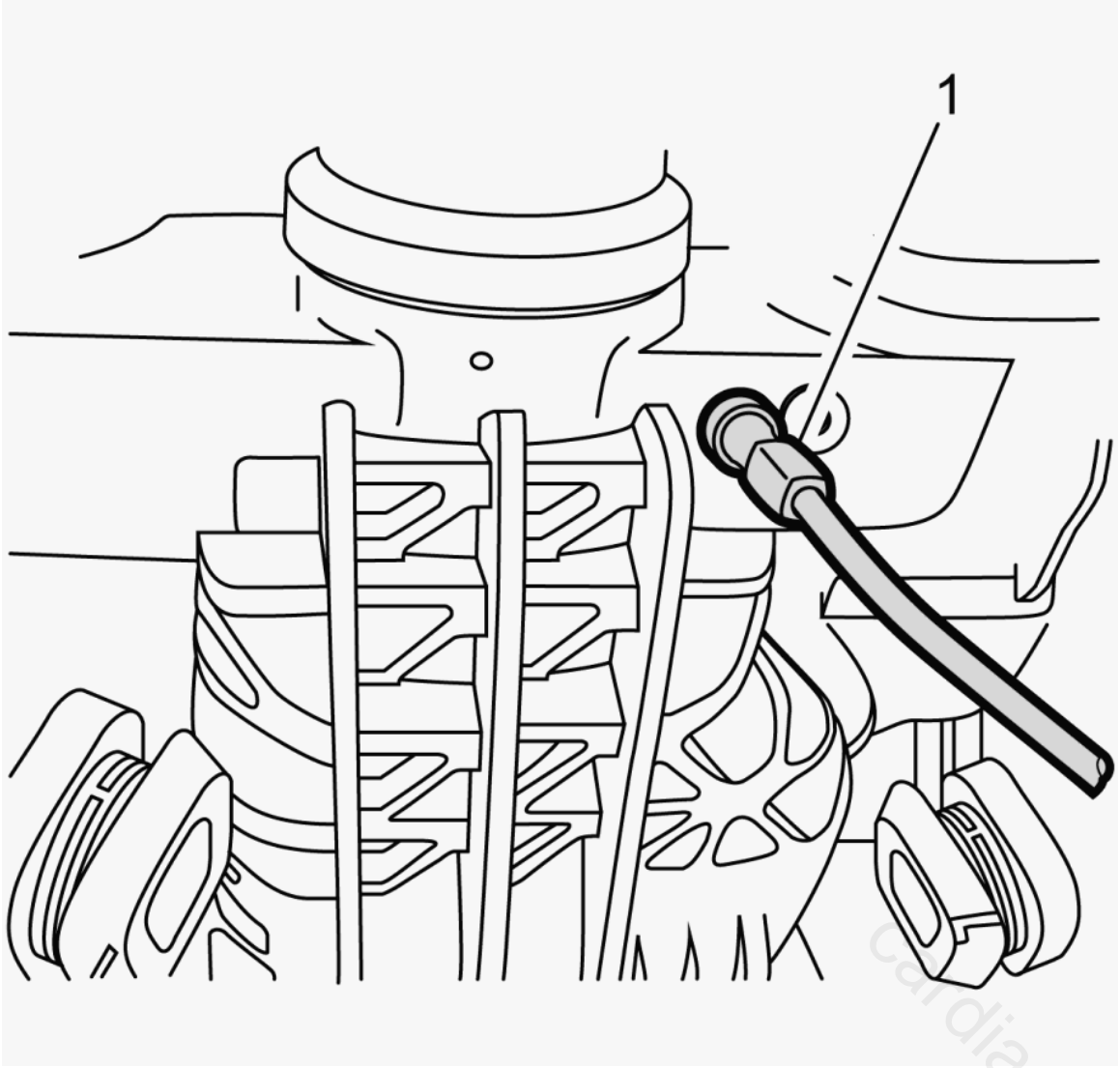


Fig. 47: Accelerometer
Courtesy of GENERAL MOTORS COMPANY

5. Mount the Accelerometer (1) to a suitable surface near the front of the differential. If the surface is non-ferrous, a steel washer can be glued to the surface in order to secure the magnetic Accelerometer.

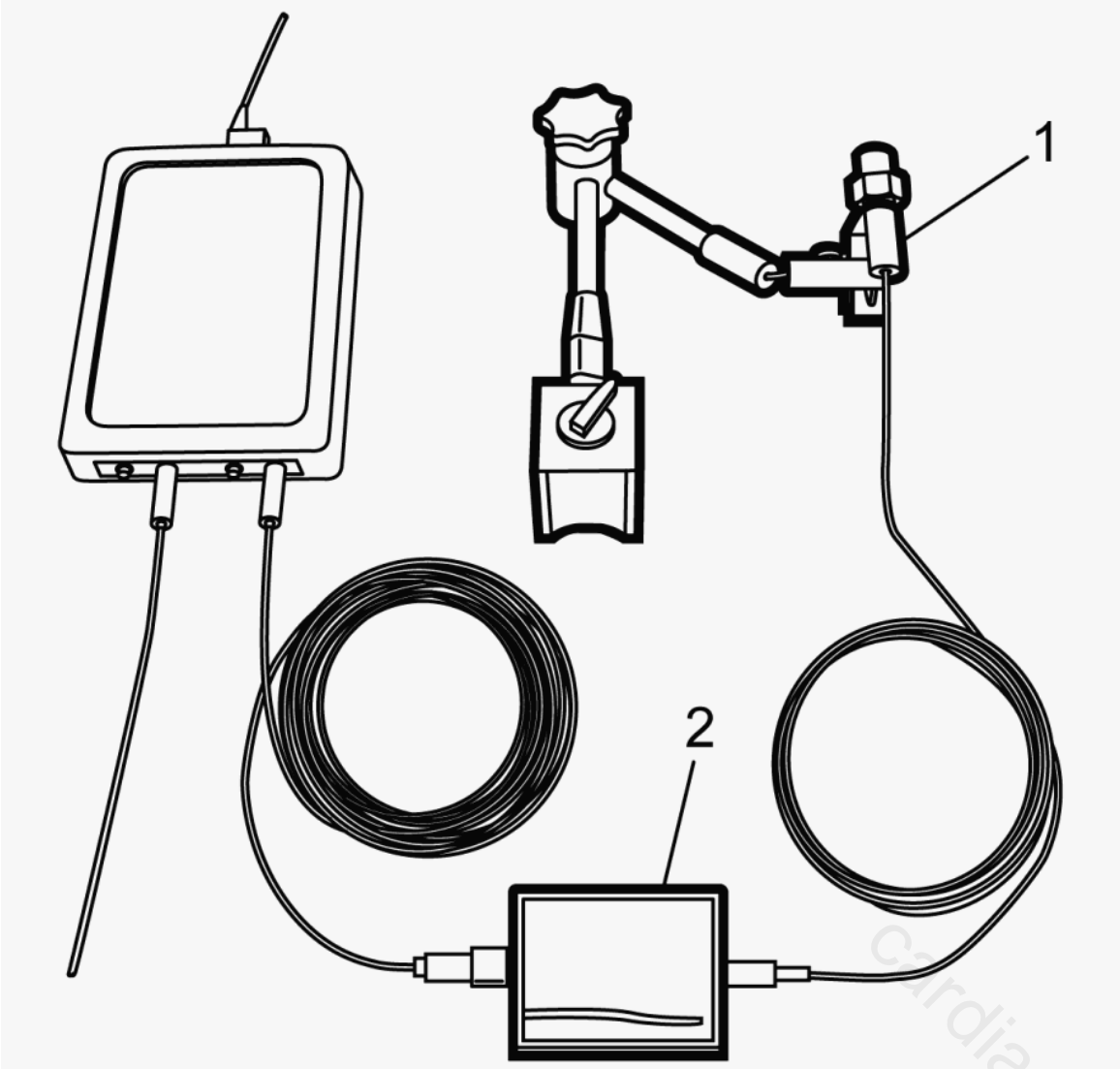


Fig. 48: Optical Sensor And Interface
Courtesy of GENERAL MOTORS COMPANY

6. Connect the Optical Sensor **CH-51450-TA186** (1) to the Optical Sensor Interface **CH-51450-TA185** (2).
7. Connect the NVH Interface to Channel D of the Oscilloscope using the **CH-51450-TA098** BNC to BNB cable.

cardiagn.com

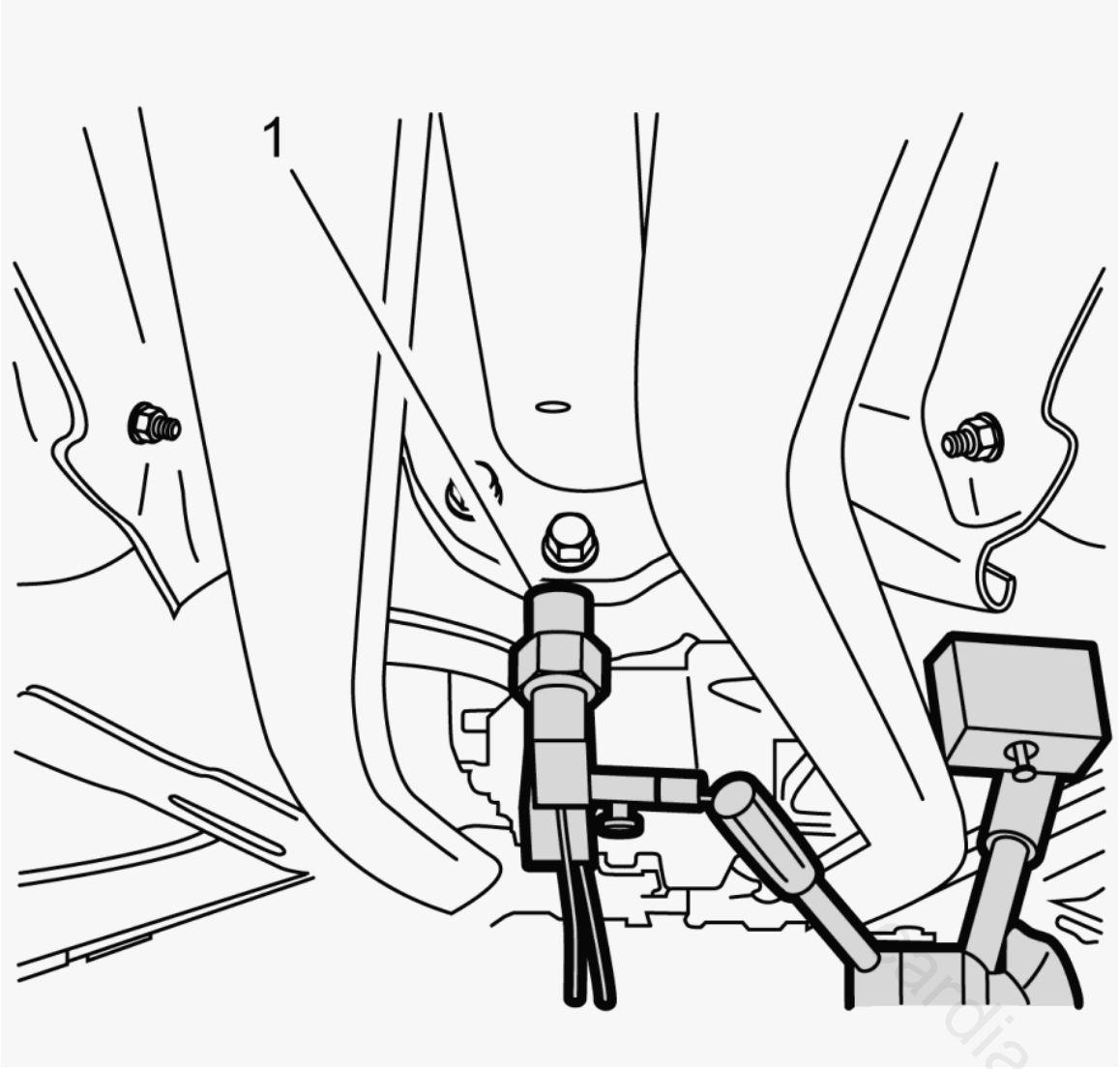


Fig. 49: Magnetic Mounting Fixture
Courtesy of GENERAL MOTORS COMPANY

8. Mount the Magnetic Mounting Fixture **CH-51450-TA187** (1) to a suitable surface on the vehicle underbody.
9. Place a 1/2 inch strip of reflective tape to the propeller shaft.
10. Focus the laser on the reflective tape.
11. Measure the circumference of the pinion flange bolt circle and enter that figure, in millimeters, into the balancing software.
12. Alternatively, enter the diameter, in millimeters, of the pinion flange into the balancing software.

ardiagn.com

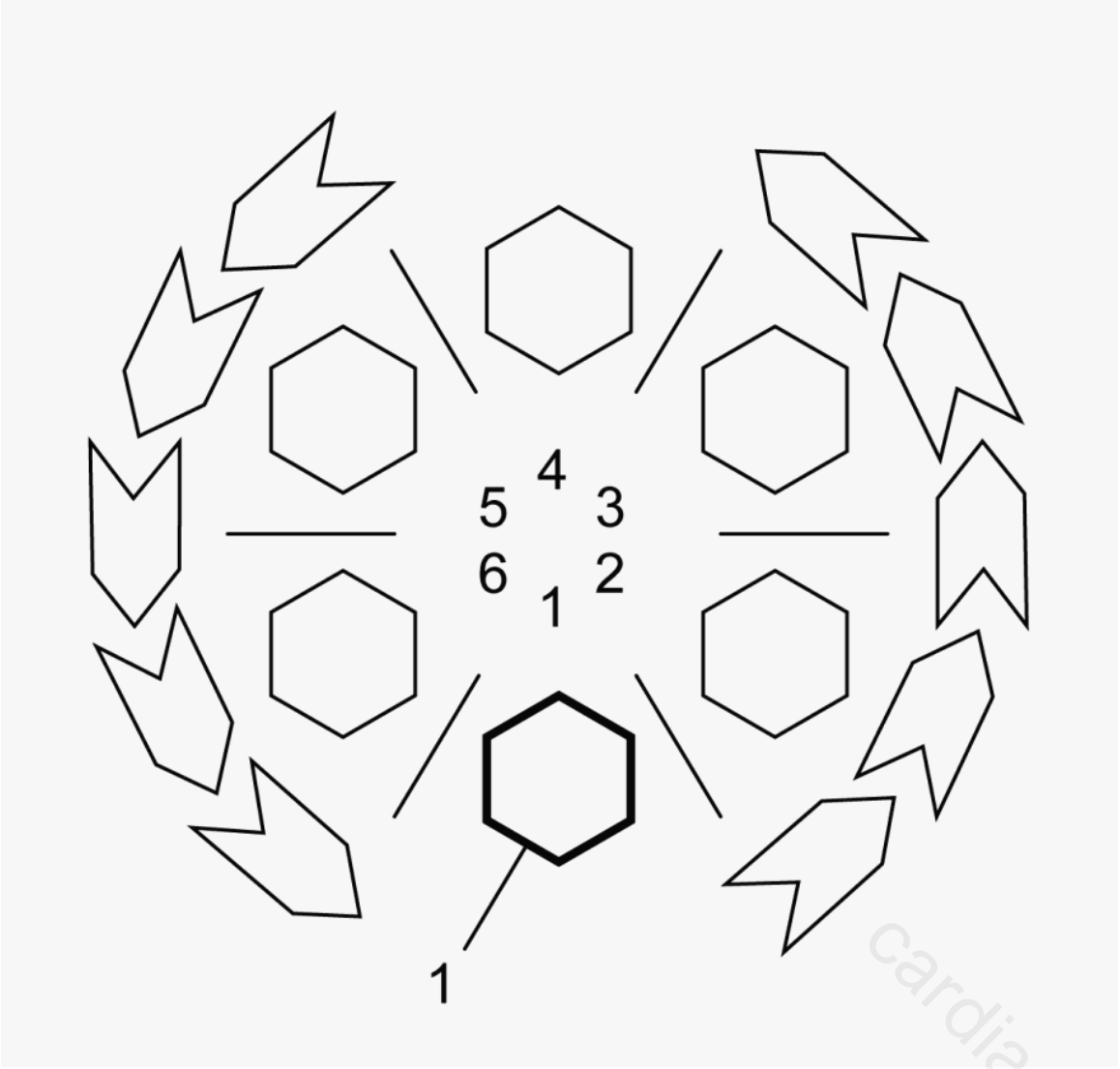


Fig. 50: Numbering Pinion Flange Bolts And/Or Studs
Courtesy of GENERAL MOTORS COMPANY

13. Enter the number of pinion flange bolts into the balancing software.
14. Number the pinion flange bolts and/or studs (1) in the direction of propeller shaft rotation.
15. Before beginning the test, inspect for the following:
    - The vehicle is properly supported. Refer to **Lifting and Jacking the Vehicle** .
    - Remove any rocks or debris embedded in the tire treads.
    - Secure all test leads clear of rotating components.
    - Disable the ABS and traction control, if equipped.
    - Turn OFF the A/C, and any other accessories.
16. Determine a suitable propeller shaft speed.
    - Start the engine.
    - Place the transmission in the highest forward gear.
    - Run the engine to highway speed, typically 104-112 km/h (65-70 mph).
    - When the RPM can be held stable for longer than 3 seconds, the balancing software will capture and enter the propeller shaft speed.
    - Alternatively, click the Edit Manually check box and enter the desired propeller shaft speed.
    - Place the transmission in NEUTRAL.
    - Turn OFF the engine.
17. Begin balancing the propeller shaft.

Initial Run

1. Press the green Initial Run button to start the test.

   An initial measurement of the propeller shaft will be taken.

cardiagn.com

2. Start the engine.
3. Place the transmission in the highest forward gear.
4. Accelerate the engine until the required speed is reached.
5. The RPM graph will highlight green when the RPM is within the specified range, and data will only be gathered while within this range.

18. When the Complete % bar graph is filled, place the transmission in NEUTRAL and turn OFF the engine.
19. Perform the first calibration run.

Calibration Run 1

1. Place 4.5 g of weight at location 1 by stacking 3 of the balancing weights (1.5 g each). The weights may be affixed to the front or the rear of the pinion flange.
2. Press the green Calibration Run 1 button.
3. Start the engine.
4. Place the transmission in the highest forward gear.
5. Accelerate the engine until the required speed is reached.

20. When the Complete % bar graph is filled, place the transmission in NEUTRAL and turn OFF the engine.
21. Perform the second calibration run.

Calibration Run 2

1. Remove the balancing weights from location 1.
2. Install the balancing weights at location 3.
3. Press the green Calibration Run 2 button.
4. Start the engine.
5. Place the transmission in the highest forward gear.
6. Accelerate the engine until the required speed is reached.

22. When the Complete % bar graph is filled, place the transmission in NEUTRAL and turn OFF the engine.
23. Perform the third calibration run.

Calibration Run 3

1. Remove the balancing weights from location 3.
2. Install the balancing weights at location 5.
3. Press the green Calibration Run 3 button.
4. Start the engine.
5. Place the transmission in the highest forward gear.
6. Accelerate the engine until the required speed is reached.

24. When the Complete % bar graph is filled, place the transmission in NEUTRAL and turn OFF the engine.
25. Perform the final propeller shaft balancing.

Final Balance

1. Remove the balancing weights from location 5.
2. Install the balancing washers to the location(s) indicated by the balancing software.
3. Press the green Verification button.
4. Start the engine.
5. Place the transmission in the highest forward gear.
6. Accelerate the engine until the required speed is reached.

26. When the Complete % bar graph is filled, place the transmission in NEUTRAL and turn OFF the engine..
27. The software will display the final imbalance.
28. If the imbalance exceeds the minimum requirement, the software will recommend removing the rear tire and wheel assemblies and, after securing the brake rotors or brake drums, and restarting the test.
29. If the test is to be restarted, remove all of the balancing weights.
30. The test can then be restarted by either of the following methods:

cardiagn.com

- Press the Initial Run button to restart the test.
- Press the Balancing button to enter the test through the setup wizard.

Adjustment Procedure Using 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. Refer to **Lifting and Jacking the Vehicle** .
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.

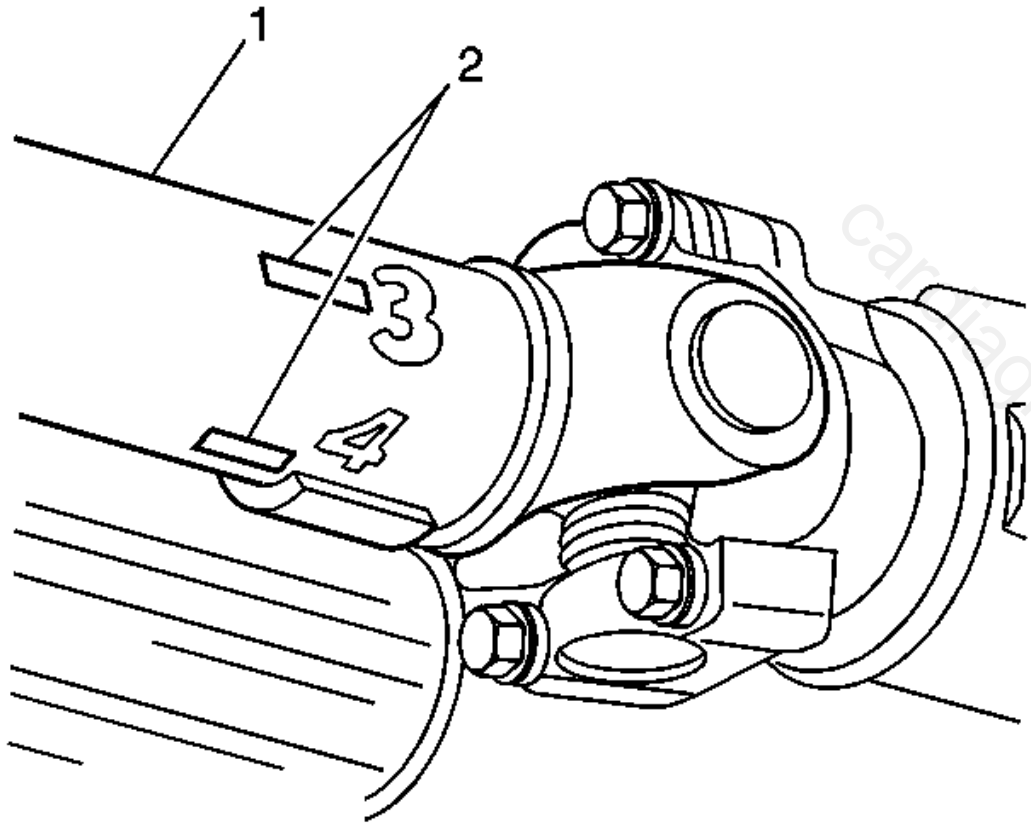


Fig. 51: Marking Circumference Of Propeller Shaft At Four Points 90 Degrees Apart
Courtesy of GENERAL MOTORS COMPANY

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 **EL-38792-A** EVA 2, the **EL-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 **EL-38792-A** EVA 2.
9. Mount the **EL-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 **EL-38792-A** EVA 2. Input B is not used with the strobe function.
11. Run the vehicle at the speed which causes the most vibration in the propeller shaft; observe the frequency readings displayed on the **EL-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 **EL-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 **EL-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 **EL-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, 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, 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, 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.

cardiagn.com

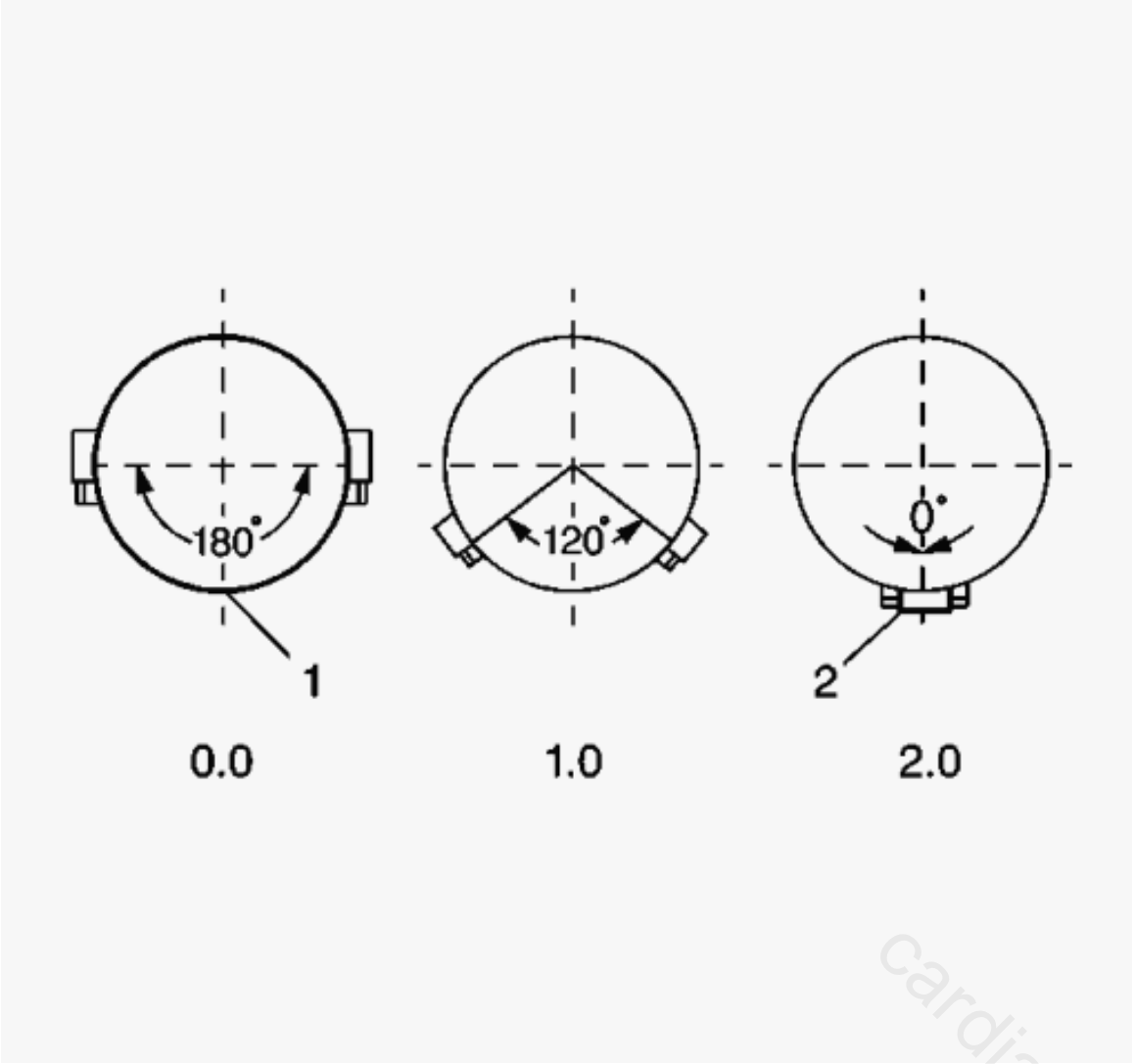


Fig. 52: Positioning Clamps On Propeller Shaft
Courtesy of GENERAL MOTORS COMPANY

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, 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 (1) - 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, 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 (2) 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 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, 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

cardiagn.com

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, 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 Oscilloscope or 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.
    - 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

carmagn.com

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 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.
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

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 are 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

cardiagn.com

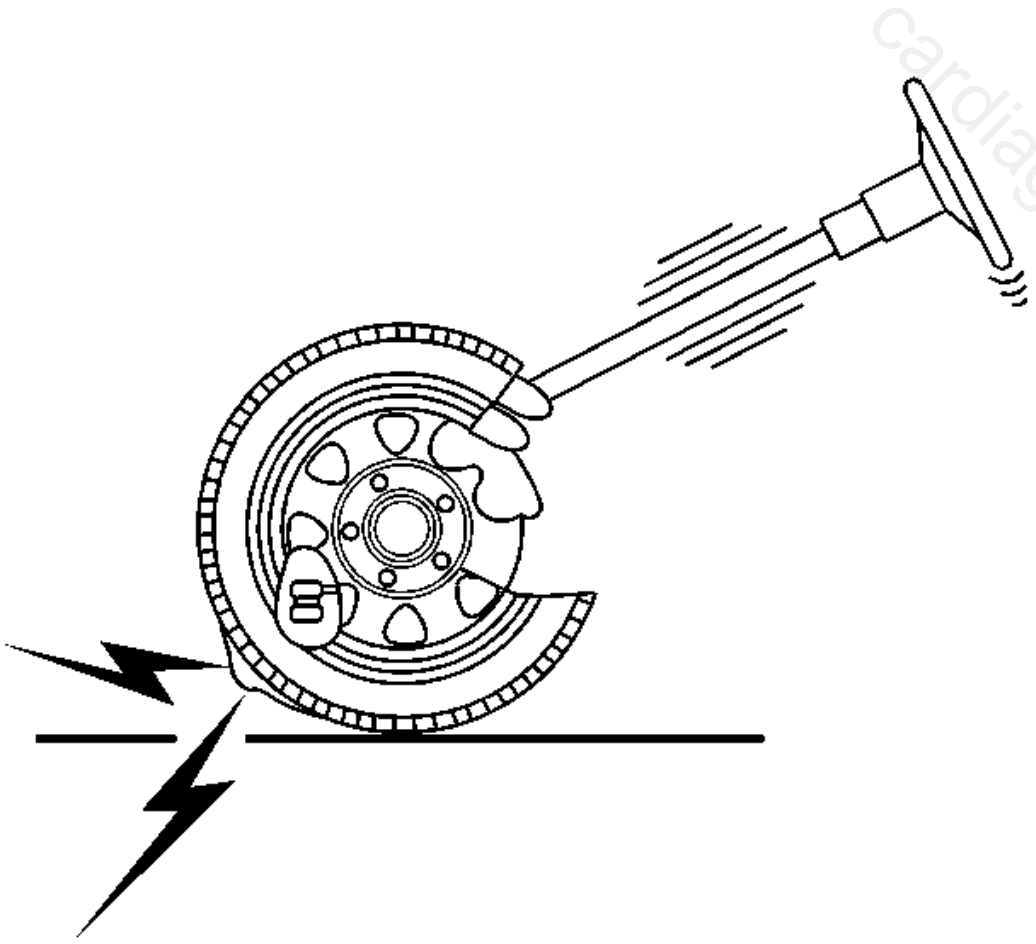
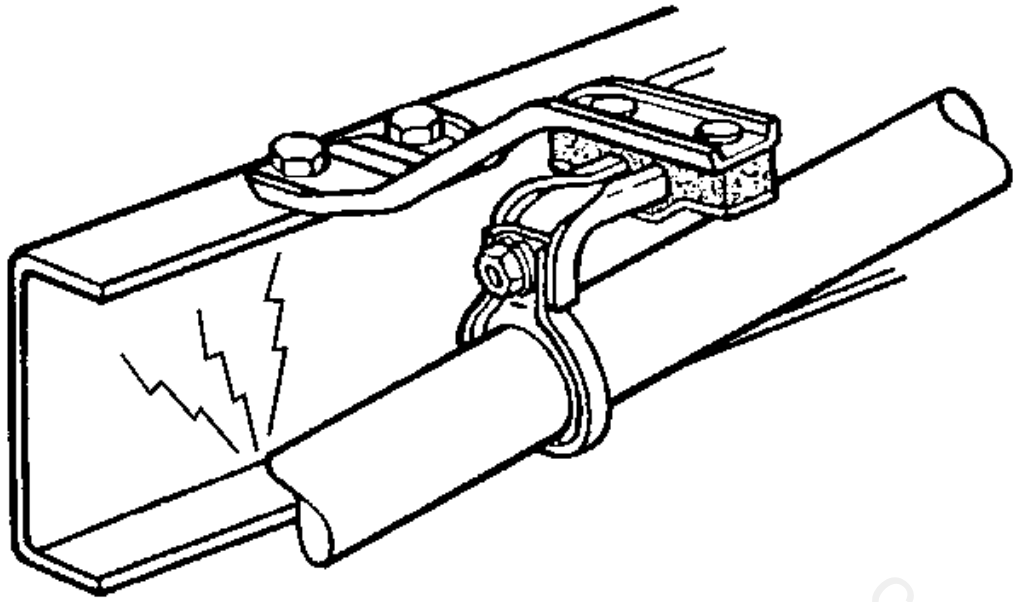


Fig. 53: Identifying Unbalanced Tire Vibration
Courtesy of GENERAL MOTORS COMPANY

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.



cardiagn.com

Fig. 54: Identifying Exhaust Pipe Noise
Courtesy of GENERAL MOTORS COMPANY

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:

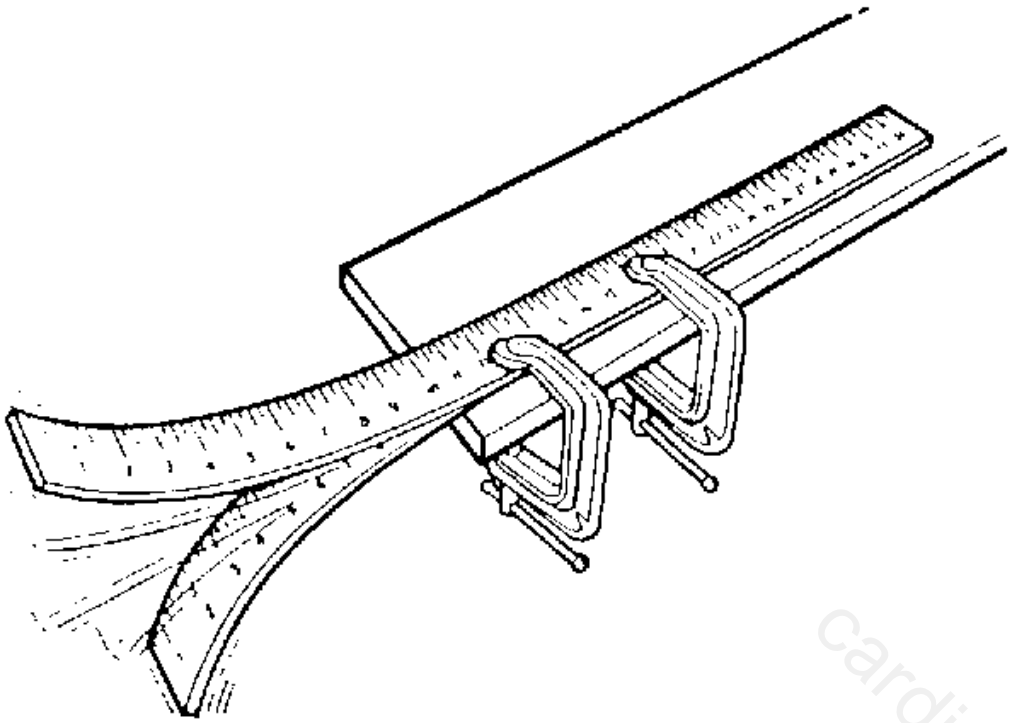
- The steering wheel
- The seat cushion
- The frame
- The IP

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:



cardiagn.com

Fig. 55: Demonstrating Vibration Theory
Courtesy of GENERAL MOTORS COMPANY

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

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

The cycle occurs over and over again at the same rate, or frequency. In this case, 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

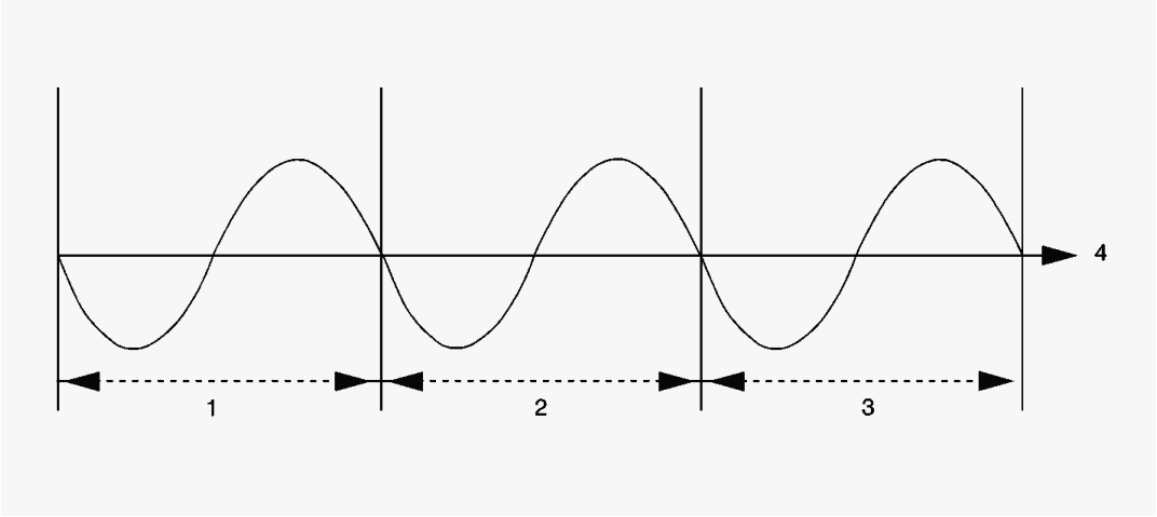
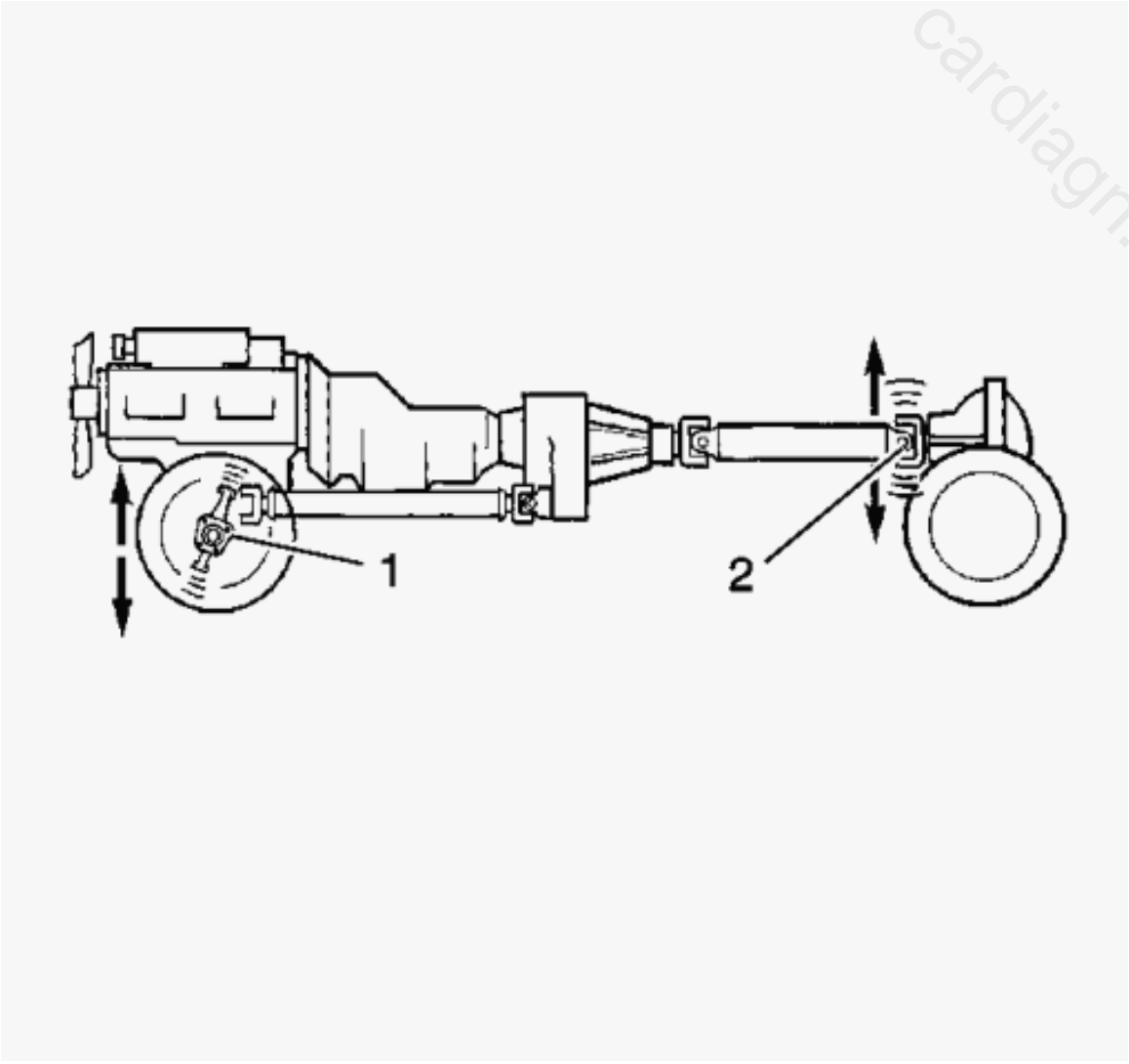


Fig. 56: Identifying Powertrain Vibration Cycles
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	1st Cycle
2	2nd Cycle
3	3rd Cycle
4	Time

Vibration Cycles in Powertrain Components



cardiagn.com

Fig. 57: Identifying Vibration Cycles In Powertrain Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

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

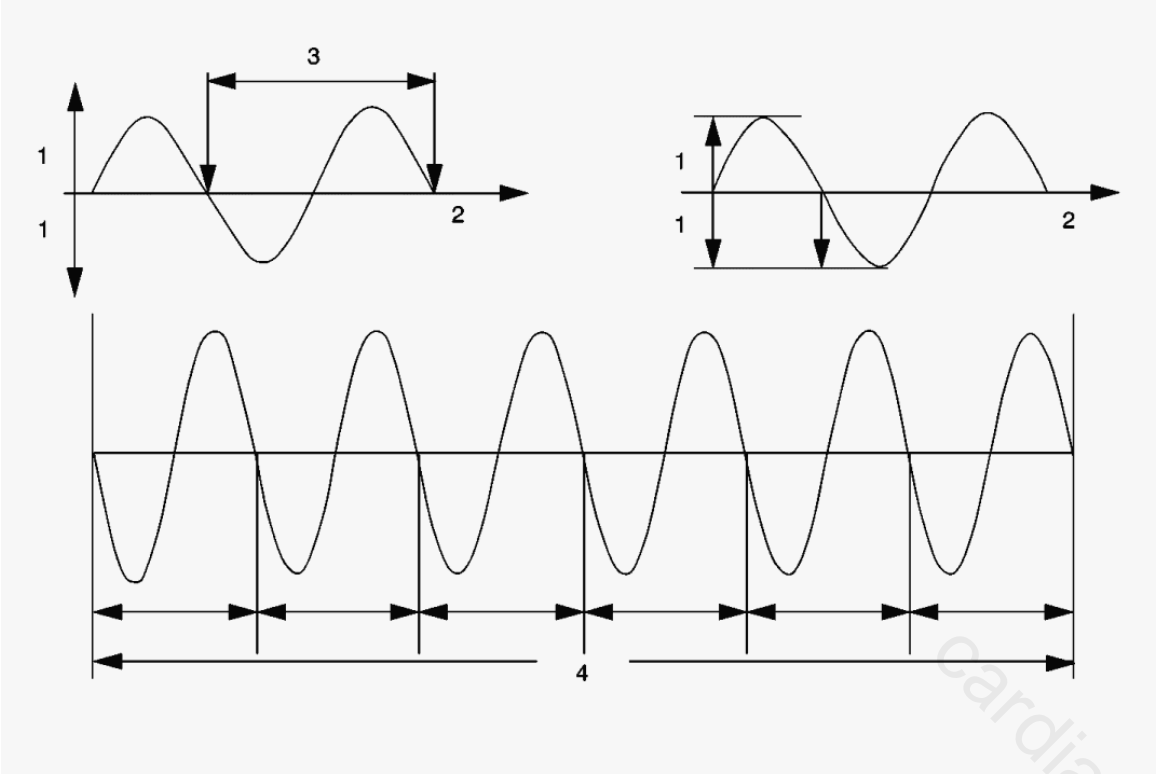


Fig. 58: Identifying Vibration Frequency
Courtesy of GENERAL MOTORS COMPANY

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

cardiagn.com

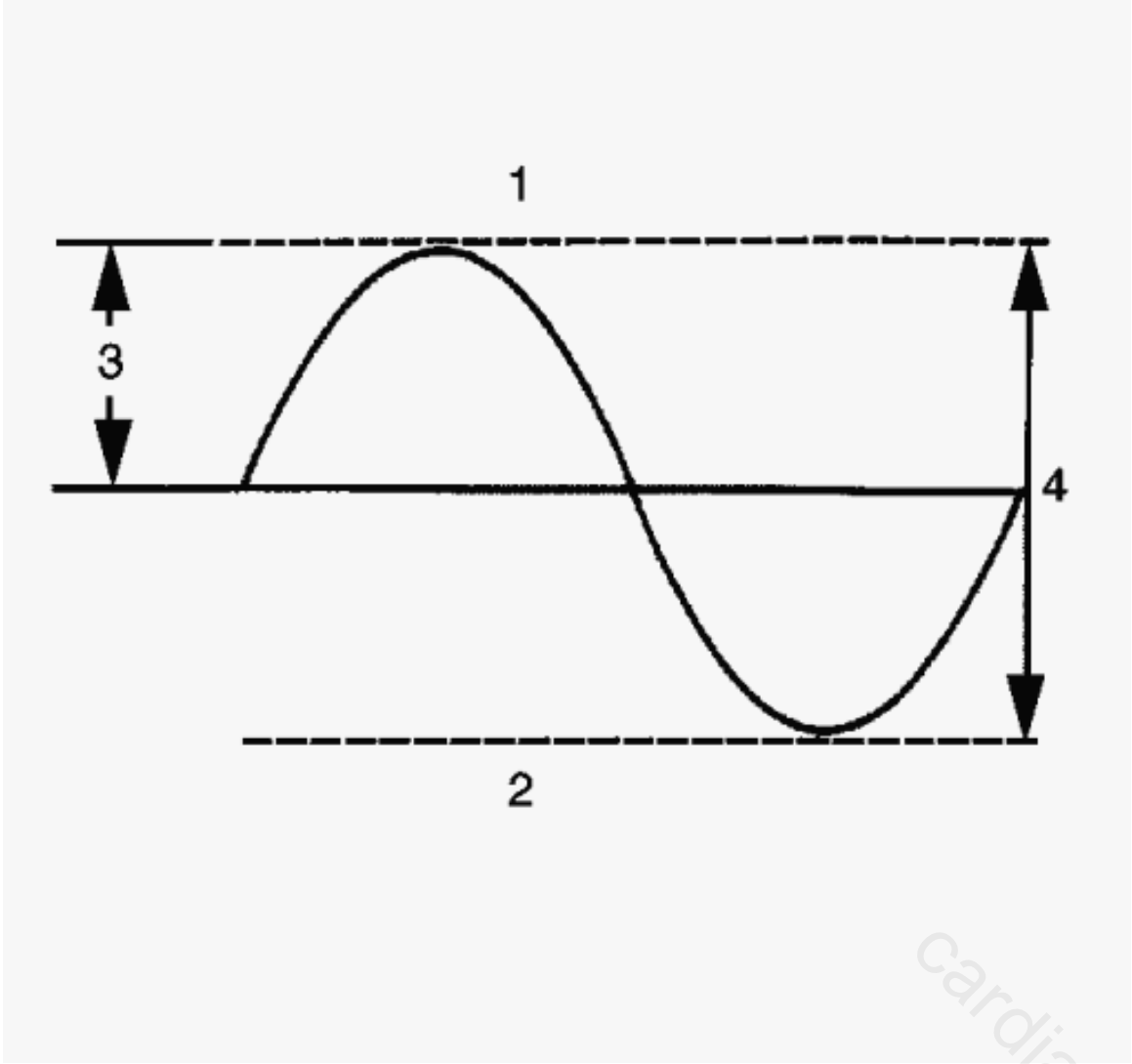


Fig. 59: Identifying Vibration Amplitude
Courtesy of GENERAL MOTORS COMPANY

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.

Forced Vibration

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

Centrifugal Force Due to an Imbalance

cardiagn.com

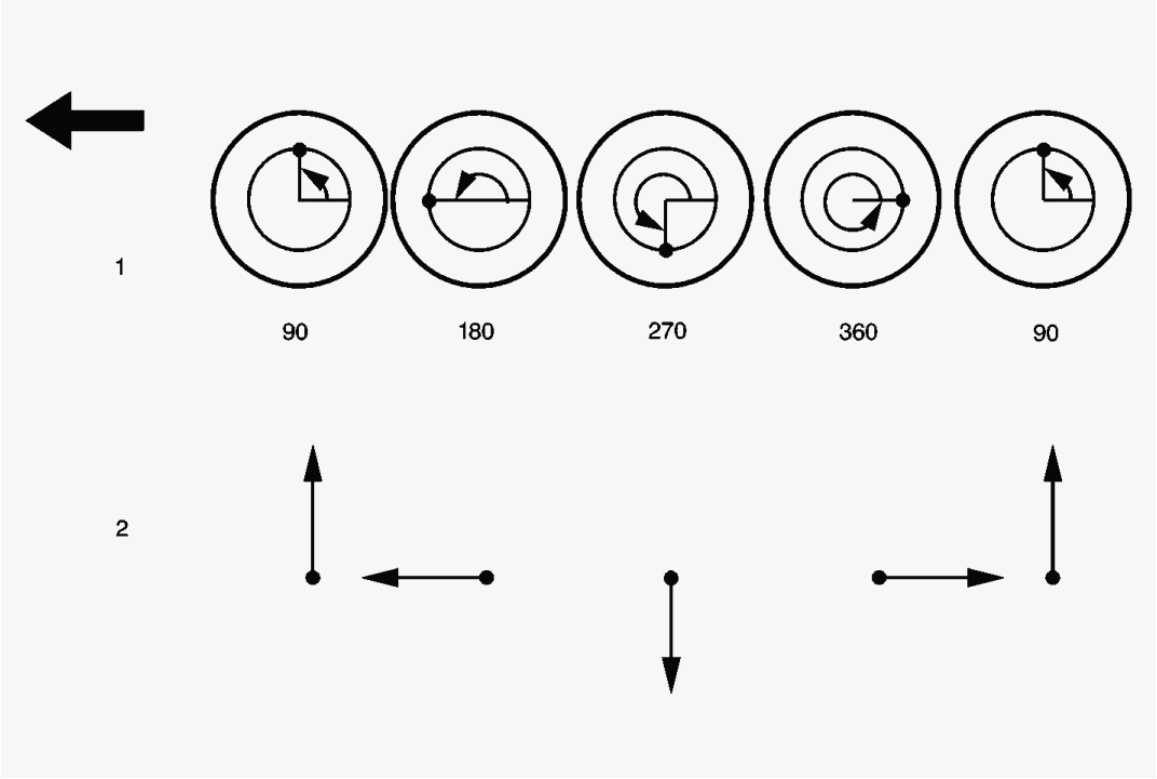


Fig. 60: Identifying Centrifugal Force Components
Courtesy of GENERAL MOTORS COMPANY

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.

Natural or Resonant Frequency

cardiagn.com

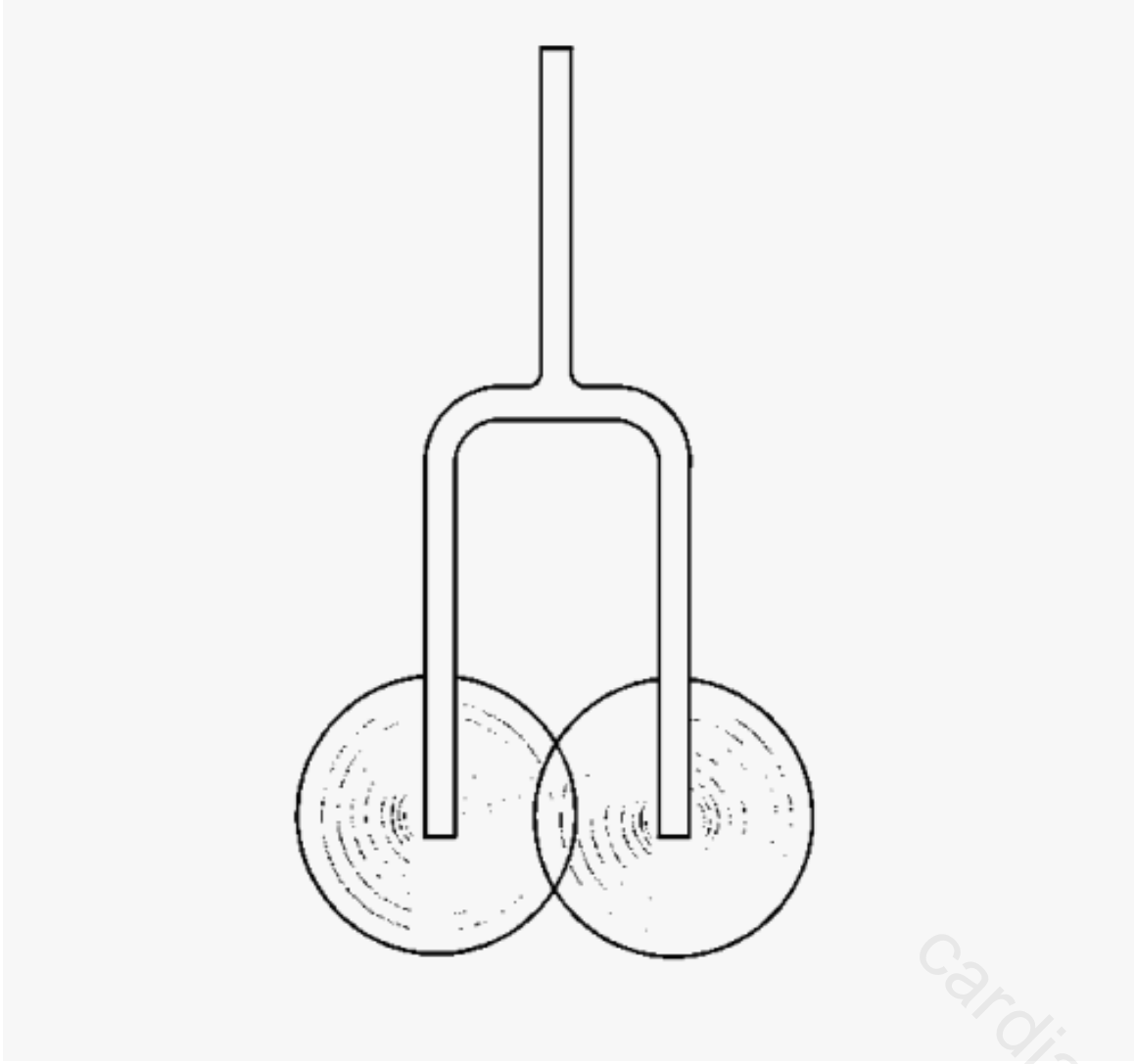


Fig. 61: View Of Natural Frequency
Courtesy of GENERAL MOTORS COMPANY

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 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

cardiagn.com

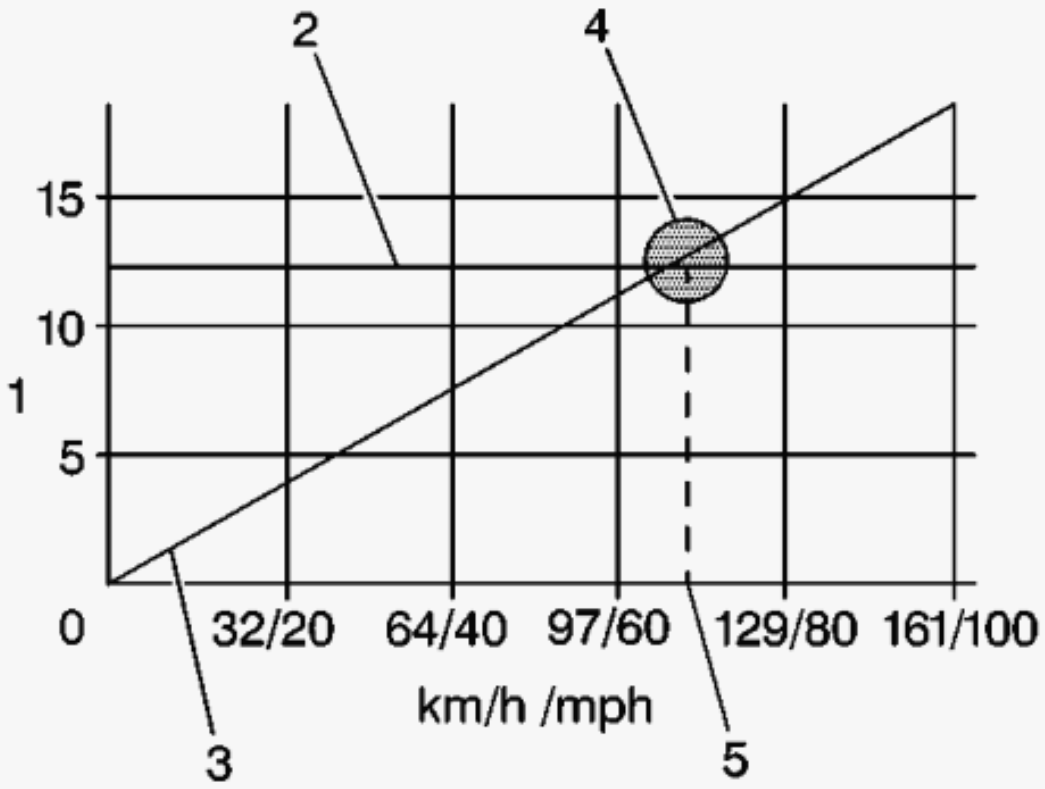


Fig. 62: Natural Frequency Of A Typical Automotive Front Suspension
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Frequency - cps
2	Suspension Frequency
3	Unbalanced Excitation
4	Point of Resonance
5	Problem Speed

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

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

Damping

cardiagn.com

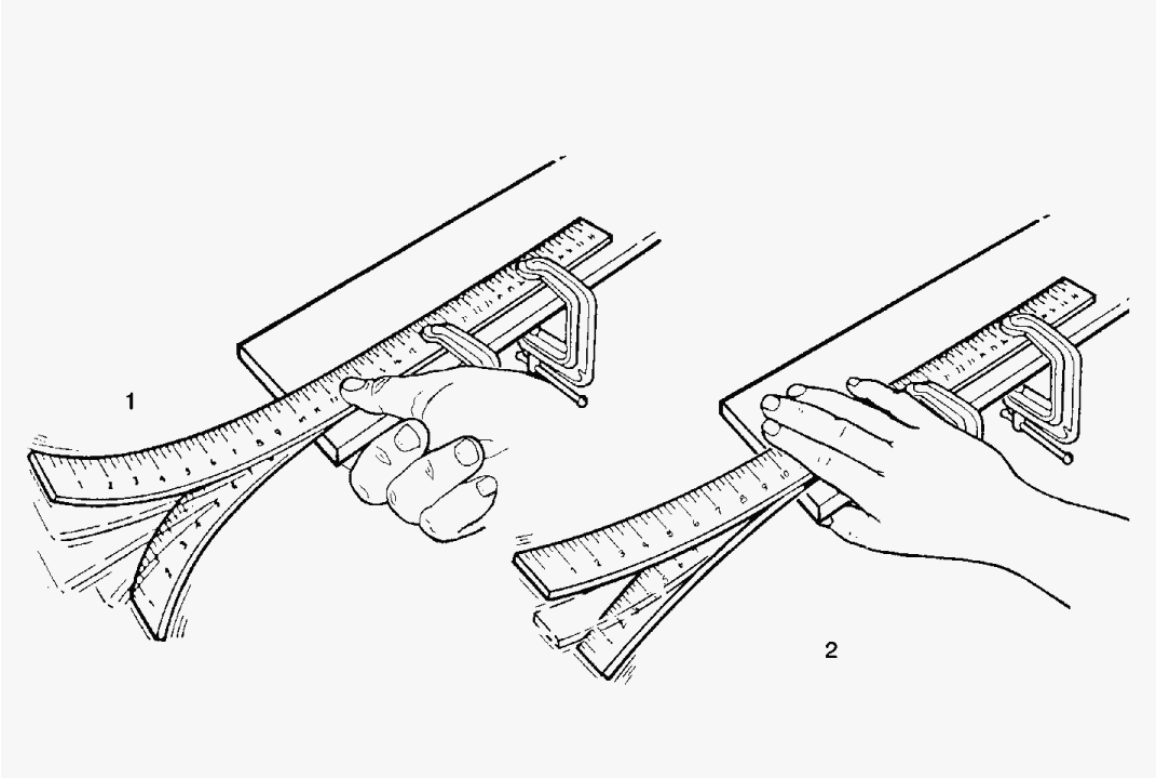


Fig. 63: Identifying Low & High Damping
Courtesy of GENERAL MOTORS COMPANY

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)

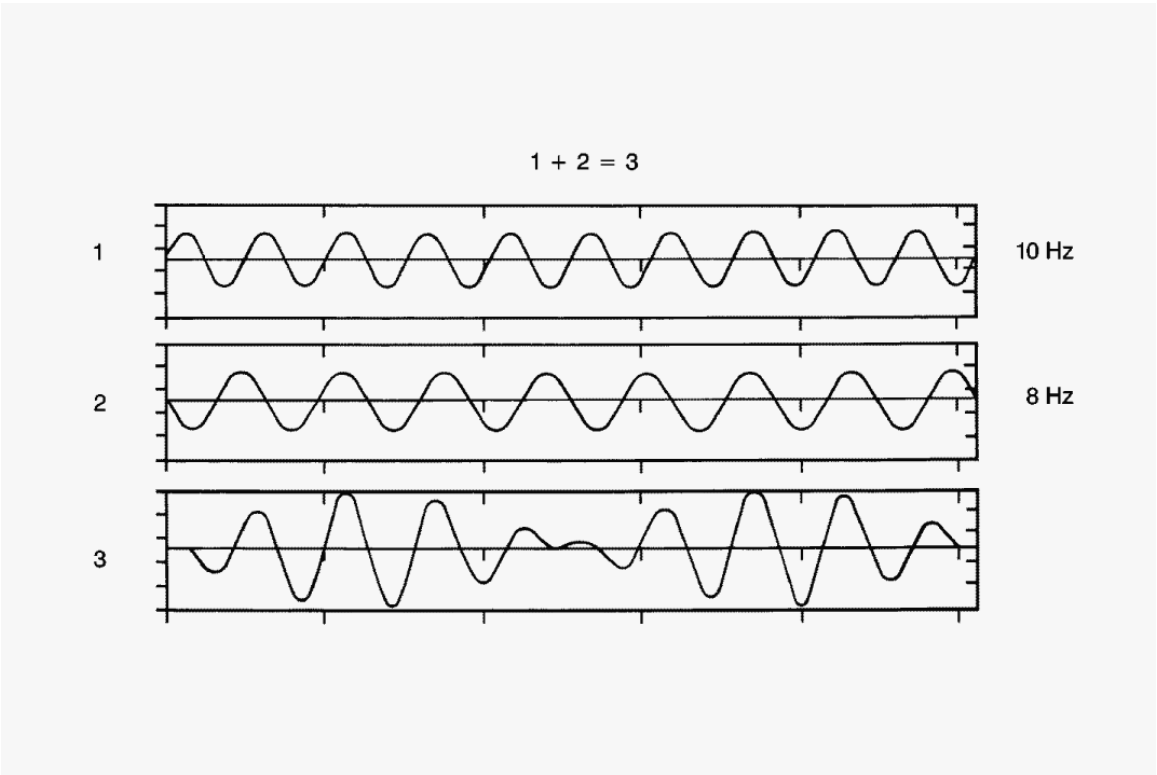


Fig. 64: Identifying Beating Or Phasing
Courtesy of GENERAL MOTORS COMPANY

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.

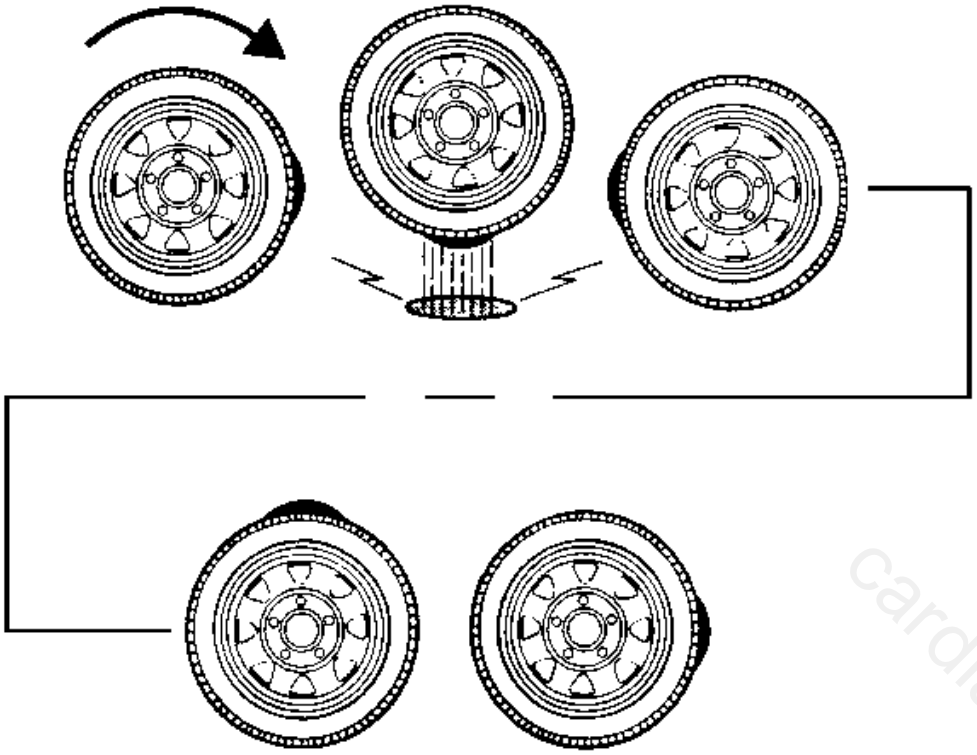


Fig. 65: Identifying First-Order Vibration
Courtesy of GENERAL MOTORS COMPANY

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.

cardiagn.com

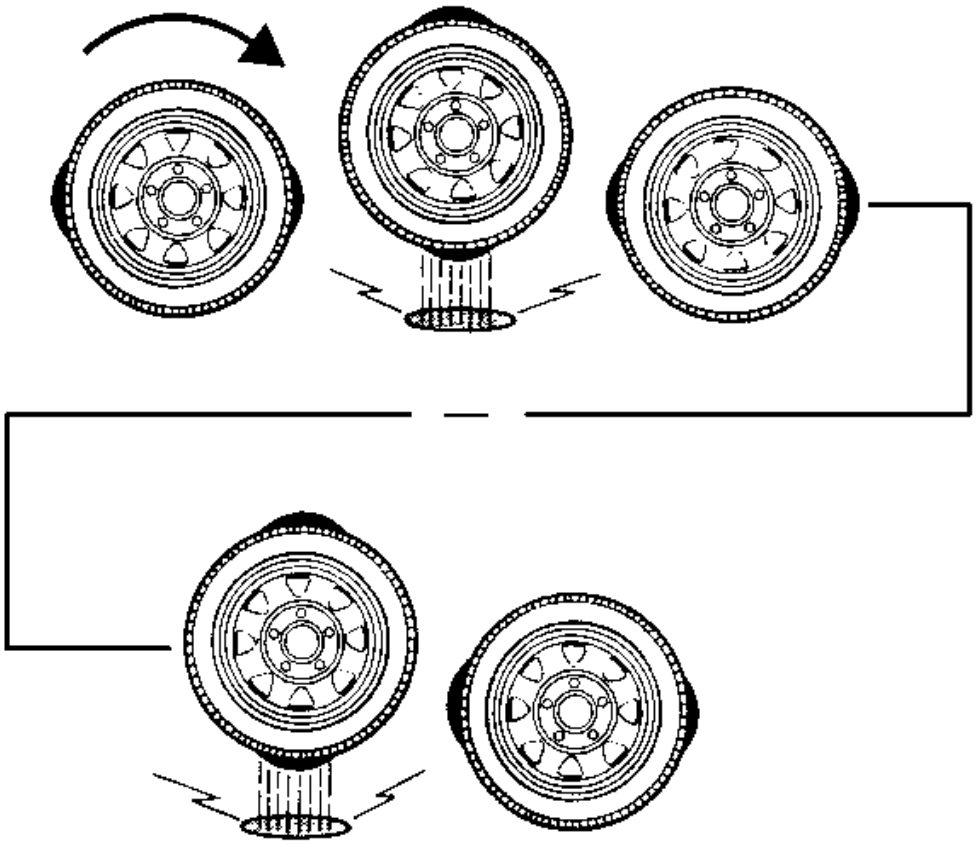


Fig. 66: Identifying Second-Order Vibration
Courtesy of GENERAL MOTORS COMPANY

cardiagn.com

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

- **EL-38792-25** Inductive Pickup Timing Light
- **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2)

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

The **EL-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 **EL-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 **EL-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 **EL-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 **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) vibration sensor (accelerometer) is critical to ensure that proper vibration readings are obtained by the **EL-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 EL-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 **EL-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 **EL-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 **EL-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

The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) uses a software cartridge, the GE-38792-60, which provides various information to the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2). The GE-38792-60 provides the **EL-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 EL-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 **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) Auto-Mode function. When selected, the **EL-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 **EL-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 **EL-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, **EL-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 **EL-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 **EL-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 **EL-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.

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

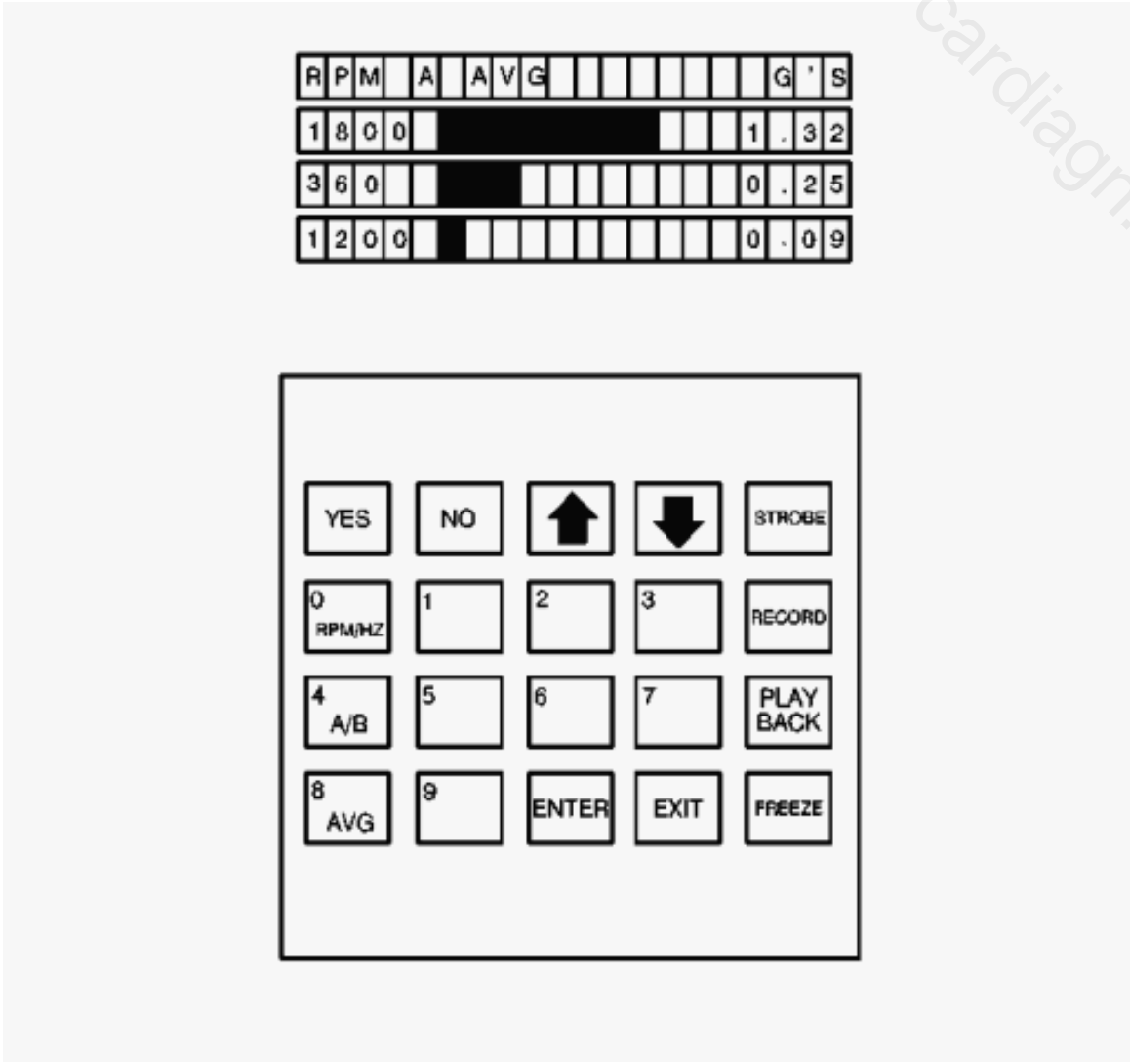


Fig. 67: View Of EVA Display
Courtesy of GENERAL MOTORS COMPANY

The most dominant input frequencies, up to three, received from the **EL-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 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.

OSCILLOSCOPE DIAGNOSTIC KIT DESCRIPTION AND OPERATION

Special Tools

- **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH)
- **EL-47966** Multi Diagnostic Interface MDI

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

The **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) is an automotive oscilloscope which receives input from an attached accelerometer and displays all input frequencies on a laptop or tablet computer. The vibration concern frequency(ies) are obtained through the use of the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) hardware, while vehicle component speed data is gathered through the **EL-47966** Multi Diagnostic Interface MDI. The MDI data is integrated into the Oscilloscope software so that vibration(s) can be tied to specific vehicle components based on their speed to determine the source of the vibration concern.

Oscilloscope Inputs

The **CH-51450-TA183** accelerometer incorporates a 3 m (9.8 ft) cord that allows the sensor to be placed on virtually any component of the vehicle where a vibration concern is felt. The accelerometer uses a self-powered NVH interface module. The NVH interface module uses a replaceable battery. Input B is the default port for a single accelerometer. The cord used to connect the NVH interface module to the **CH-51450-NVH** Oscilloscope is 5 m (16.4 ft) long.

Input D is used for the **CH-51450-TA186** optical tachometer sensor which is used during driveline balancing. It incorporates a 2.5 m (8.2 ft) cord and a 5 m (16.4 ft) cord.

There is also an optional microphone that can be used with the **CH-51450-NVH** Oscilloscope.

Oscilloscope Accelerometer Placement

Proper placement of the **CH-51450-TA183** accelerometer is critical to ensure that proper vibration readings are obtained by the **CH-51450-NVH** Oscilloscope. The accelerometer should be placed on the drivers side inboard seat track. Once a baseline reading has been taken, the accelerometer can be placed on the point of the customer concern to verify what the customer is hearing or feeling.

Oscilloscope Accelerometer-to-Component Attachment

NOTE: **The CH-51450-TA183 accelerometer must be attached to vehicle components in the manner indicated in order to achieve accurate frequency readings of the vibration disturbance.**

The accelerometer of the **CH-51450-NVH** Oscilloscope is designed to pick up disturbances which primarily occur in the vertical plane, since most vibrations are felt in that same up-and-down direction. The **CH-51450-TA183** accelerometer is therefore directionally sensitive, and must be attached to vehicle components such that the cord end 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 **CH-51450-TA183** accelerometer 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 the **CH-51450-TA096** magnet supplied with the sensor. For hard aluminum surfaces, a ferrous washer can be glued on using a cyanoacrylate (super glue) and then the magnet can be used.

NVH Software Set-up

Fig. 68: Identifying NVH Software Set-Up Display Screen
Courtesy of GENERAL MOTORS COMPANY

When the NVH software is first opened and the NVH tab is selected, there is a set-up wizard within the **CH-51450-NVH** NVH software which has a step-by-step guide to ensure the **CH-51450-NVH** Oscilloscope and MDI are connected correctly, and to input the vehicle information.

Oscilloscope NVH Display

The **CH-51450-NVH** Oscilloscope display consists of three tabs:

ca.diagn.com

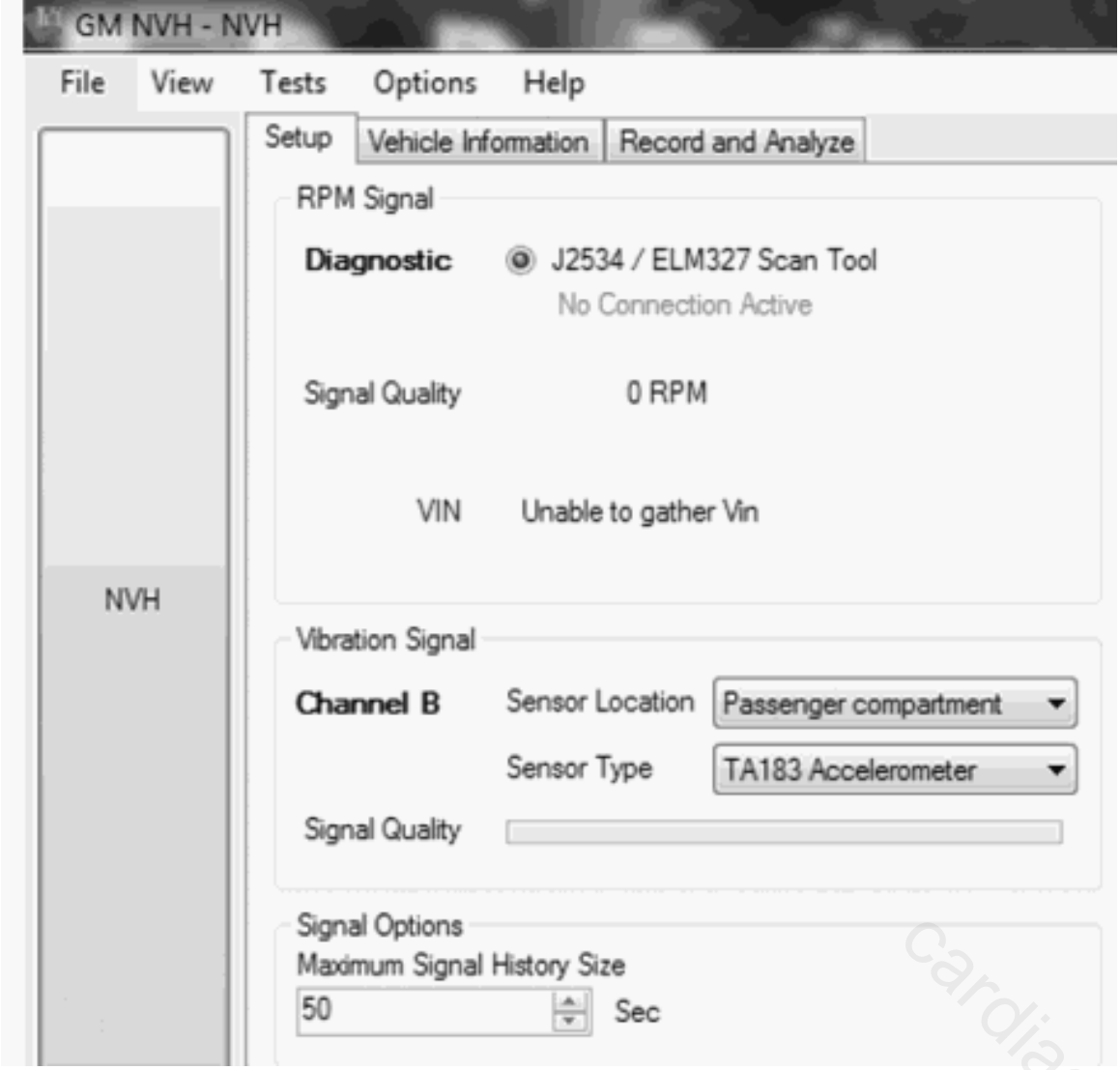


Fig. 69: Identifying Oscilloscope NVH Set-Up Display Screen
Courtesy of GENERAL MOTORS COMPANY

The first tab is set-up. The set-up information can be entered here if not already done through the set-up wizard. It can also be updated here, if necessary. A laptop or desktop computer, **EL-47966** Multi Diagnostic Interface MDI, **CH-51450-NVH** Oscilloscope, **CH-51450-TA148** NVH interface, and **CH-51450-TA183** accelerometer are needed to do a vibration analysis.

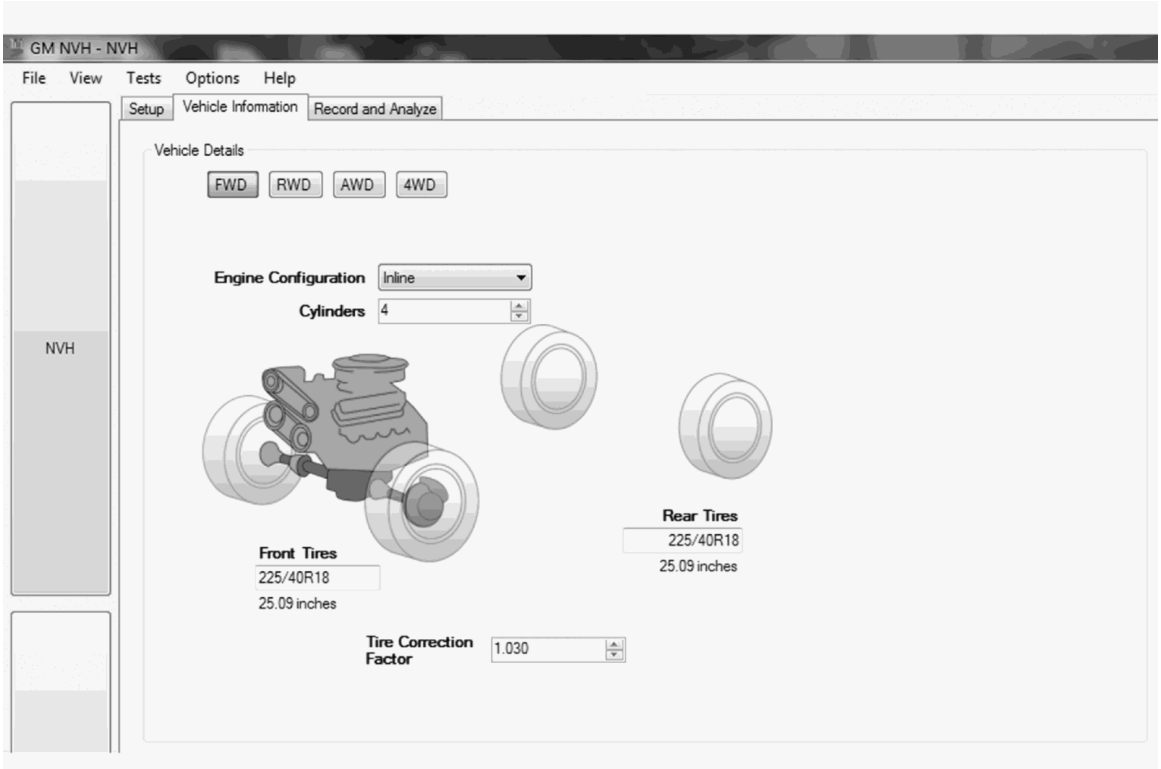


Fig. 70: Identifying Oscilloscope NVH Vehicle Information Display Screen
Courtesy of GENERAL MOTORS COMPANY

The second tab is vehicle information. The vehicle information can be entered here if not already done through the set-up wizard. It can also be updated here, if necessary.

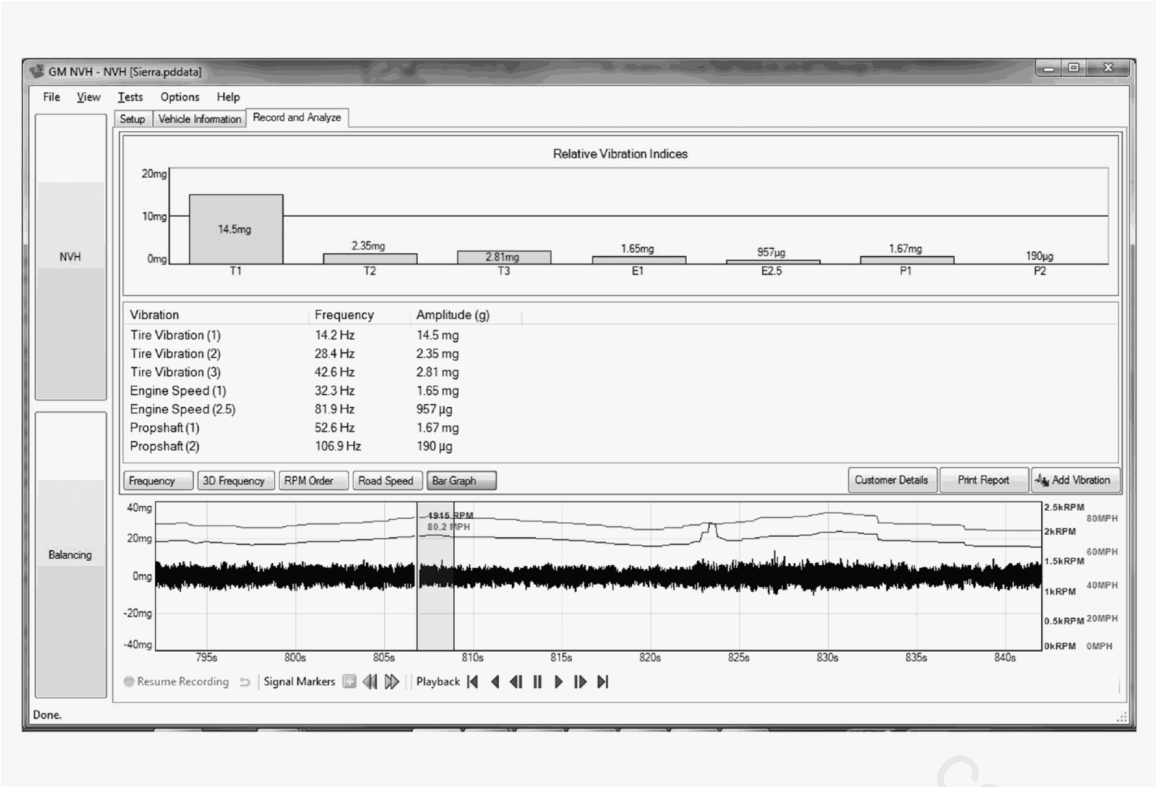


Fig. 71: Identifying Oscilloscope NVH Record And Analyze Display Screen
Courtesy of GENERAL MOTORS COMPANY

The third tab is the record and analyze tab. The standard display will show the known input frequencies received from the **CH-51450-TA183** accelerometer as a bar graph at the top of the screen. At the middle of the screen, the input frequencies are listed as text. The frequency(ies) are displayed in Hertz (Hz). If desired, the frequency(ies) can be displayed in RPM by clicking Options, then Advanced Options. The actual amplitude strength of each frequency is displayed and shown in g's of acceleration (expressed to the thousandth of a force of gravity, or "milli-g"). At the bottom of the screen, it also shows a plot of all frequency inputs along with engine speed in blue, and vehicle speed in red. The data can be saved in 50 second increments. The data can then be saved by clicking File, then Save. Files that are saved can then be loaded into the software by clicking File, then Load.

Oscilloscope Balancing

The **CH-51450-NVH** Oscilloscope with balancing software can be used to identify some rotating component/systems which exhibit imbalance IF the component rotational speed is the dominant frequency of the vibration concern. The **CH-51450-NVH** Oscilloscope is used with the **CH-51450-TA186** optical tachometer sensor. The optical tachometer sensor directly measures component rotational speed so a known weight can be added for a baseline reading. Then the oscilloscope will determine where to add a specific amount of weight to the component.

For example, the **CH-51450-NVH** Oscilloscope can be used to balance the driveline on rear wheel drive and all wheel drive vehicles. The methods that can be employed are a tuned weight approach for drivelines that use couplers and a dual hose clamp approach for drivelines that use CV or two-axis universal joints. The balancing process consists of the **CH-51450-TA186** optical tachometer sensor to directly read the driveline speed and software that directs where the weights should be placed depending on the type of driveline/propeller shaft being balanced.

Oscilloscope Balancing Software Set-up

Fig. 72: Identifying Oscilloscope Balancing Software Set-Up Display Screen
Courtesy of GENERAL MOTORS COMPANY

When the NVH software is first opened and the Balancing tab is selected, a pop-up box within the **CH-51450-NVH** balancing software will ask which type of balancing method is to be used. The two methods are pinion flange or hose clamp. Then either the wizard (which will walk through the connections and input data) or advanced configuration can be chosen to input the initial information and start the balancing procedure.

Oscilloscope Balancing Display

The propeller shaft balancing will consist of an initial run, three calibration runs, and a verification run. The software will walk through what is required for each run.

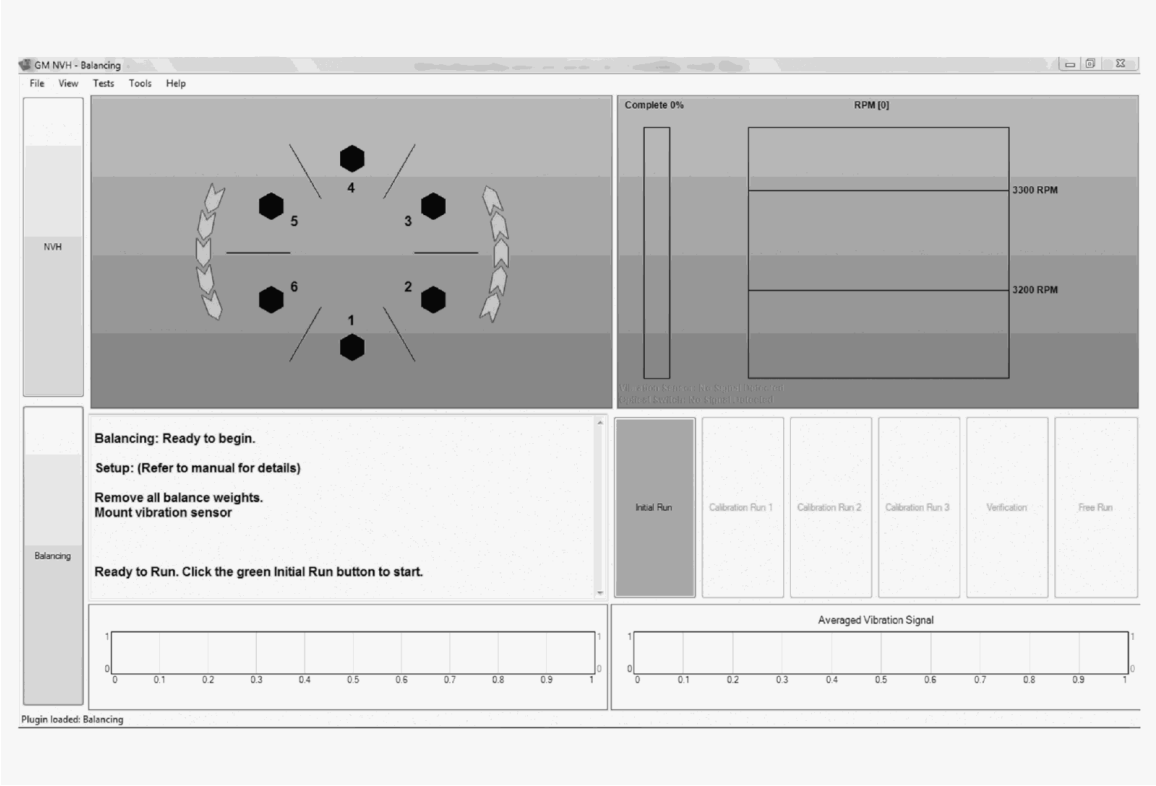


Fig. 73: Identifying Pinion Flange Balancing Screen
Courtesy of GENERAL MOTORS COMPANY

An example of the pinion flange balancing screen is shown above.

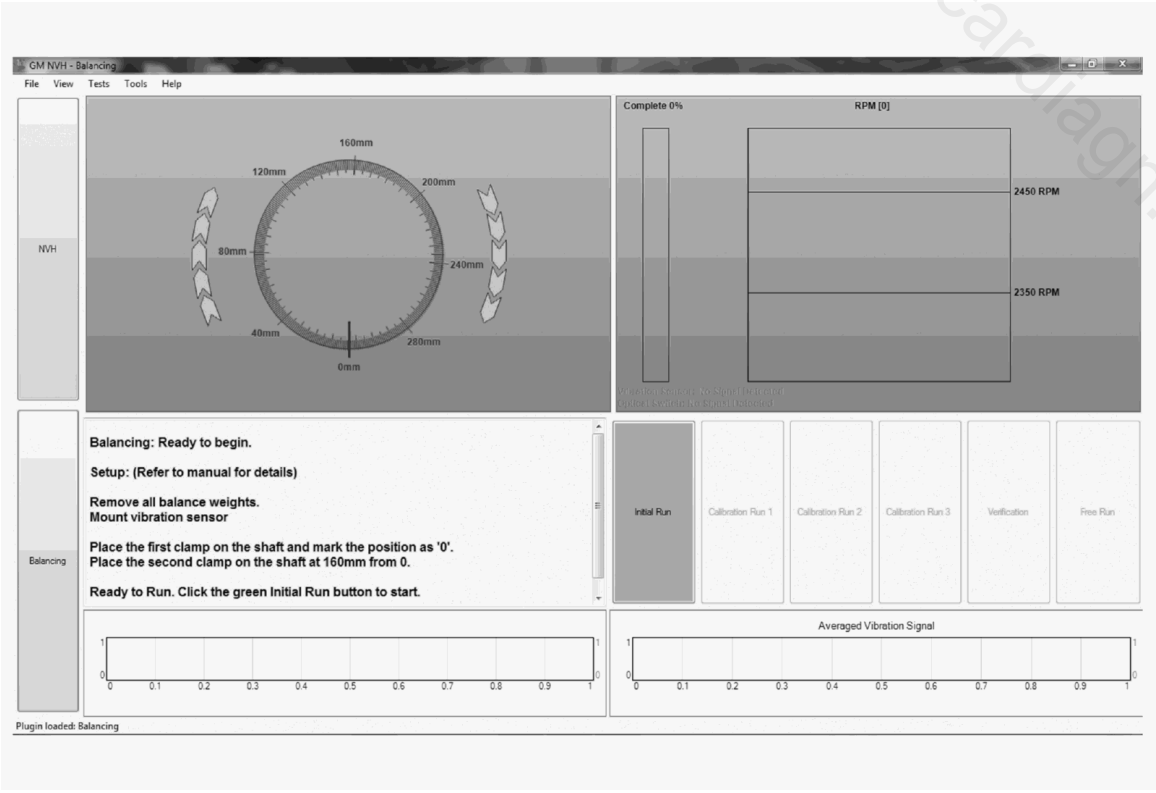


Fig. 74: Identifying Hose Clamp Balancing Screen
Courtesy of GENERAL MOTORS COMPANY

An example of the hose clamp balancing screen is shown above.

VIBRATE SOFTWARE DESCRIPTION AND OPERATION

The **EL-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 **EL-38792-A** Electronic Vibration Analyzer (EVA) 2, and a scan tool, to help in determining the source of a vibration concern. The **EL-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 **EL-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 **EL-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.

The **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) includes a version of the vibrate software within its help file.

REED TACHOMETER DESCRIPTION

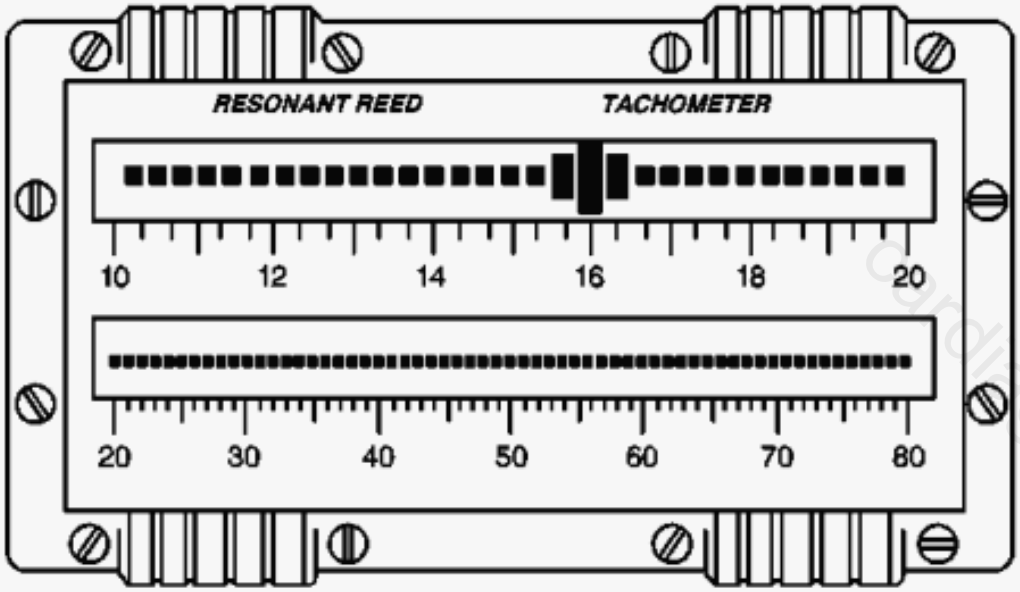


Fig. 75: Identifying Reed Tachometer
Courtesy of GENERAL MOTORS COMPANY

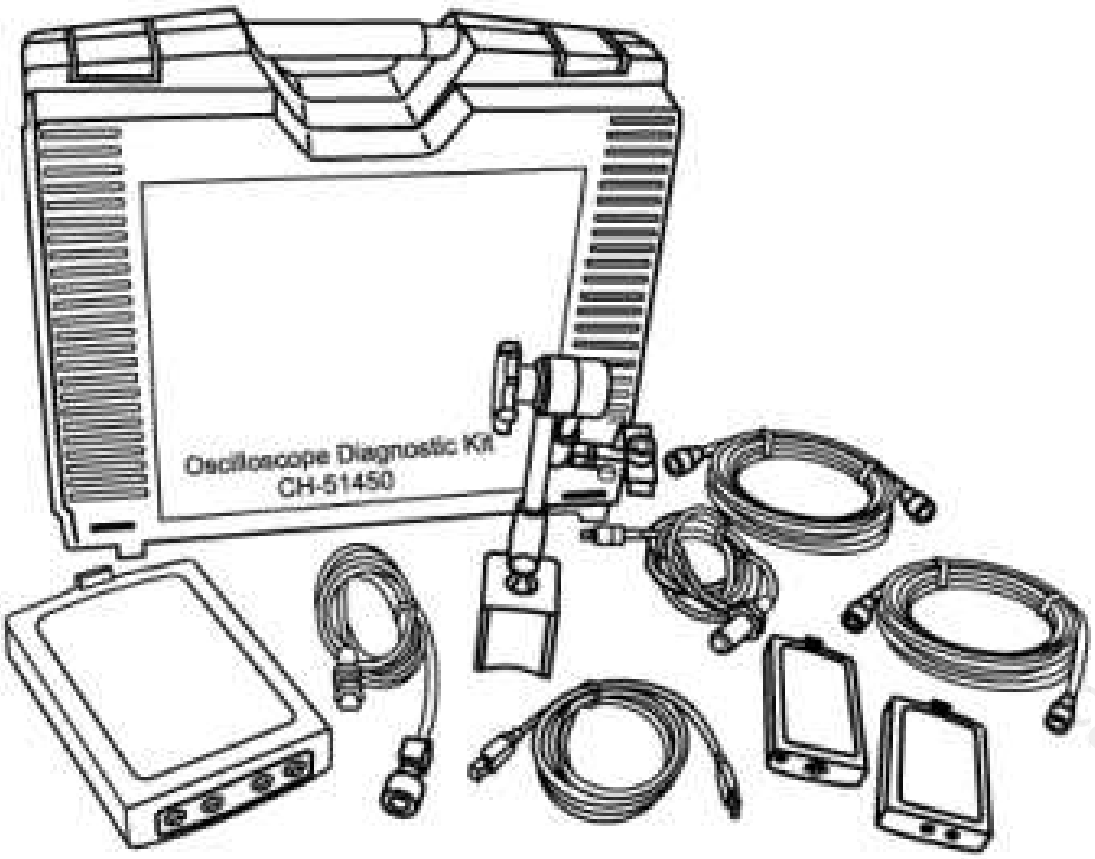
The reed tachometer consists of 2 rows of reeds arranged side-by-side. Each reed is tuned to vibrate or resonate when it is excited by a specific frequency. The reeds are arranged by their specific resonant frequency, increasing from left to right, ranging from 10 - 80 Hz. This arrangement allows for 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 **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2. The **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2 have been designed to overcome the shortcomings to the reed tachometer. Refer to **Oscilloscope Diagnostic Kit Description and Operation**, or **Electronic Vibration Analyzer (EVA) Description and Operation**.

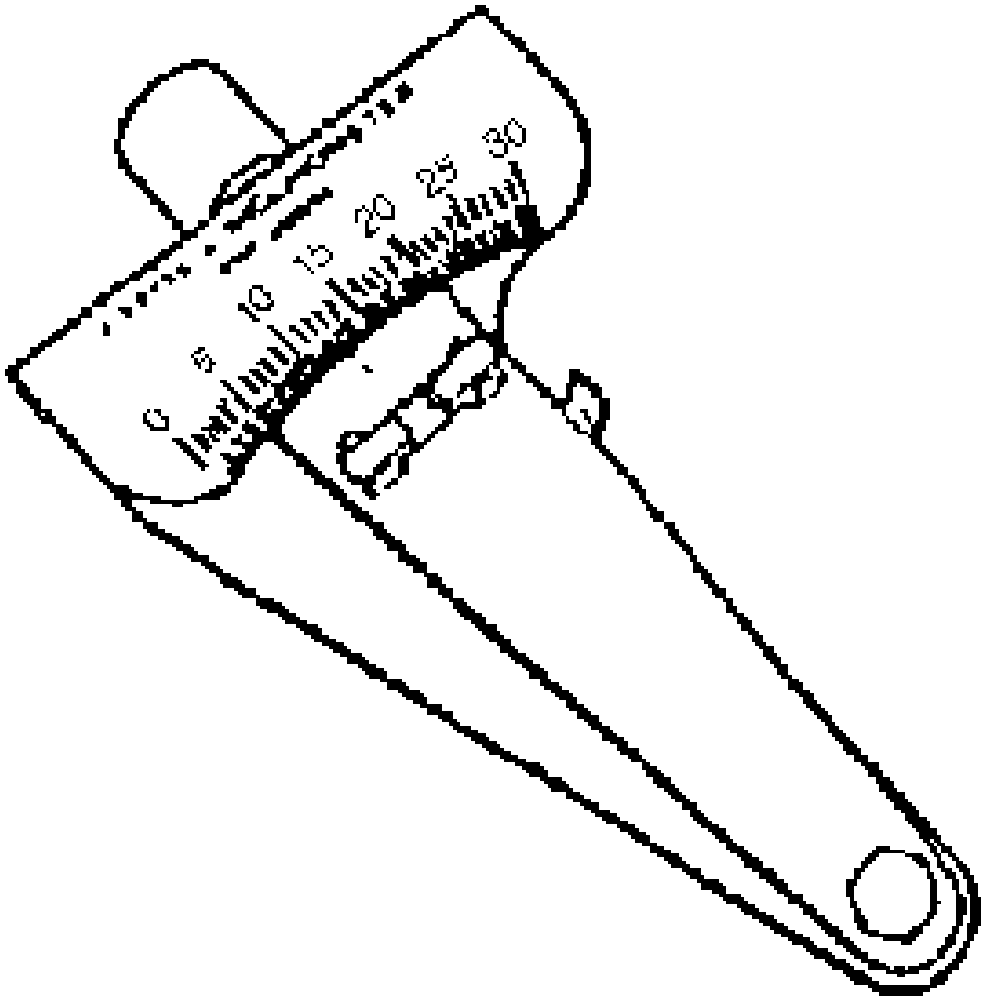
SPECIAL TOOLS AND EQUIPMENT

Illustration	Tool Number/Description
	CH 51450-NVH Oscilloscope Diagnostic Kit (w/NVH)
	DT 23409 J 23409 Dial Indicator Extension - 7 5/8 in

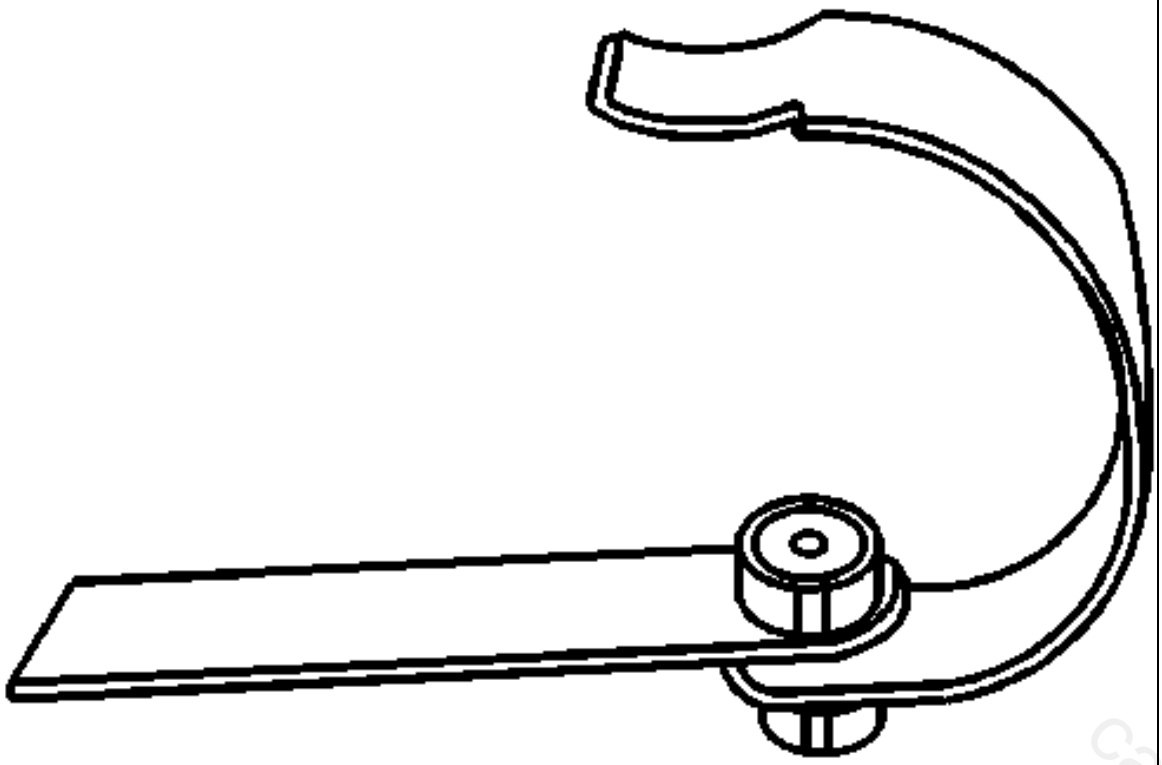
cardiagn.com

Illustration	Tool Number/Description

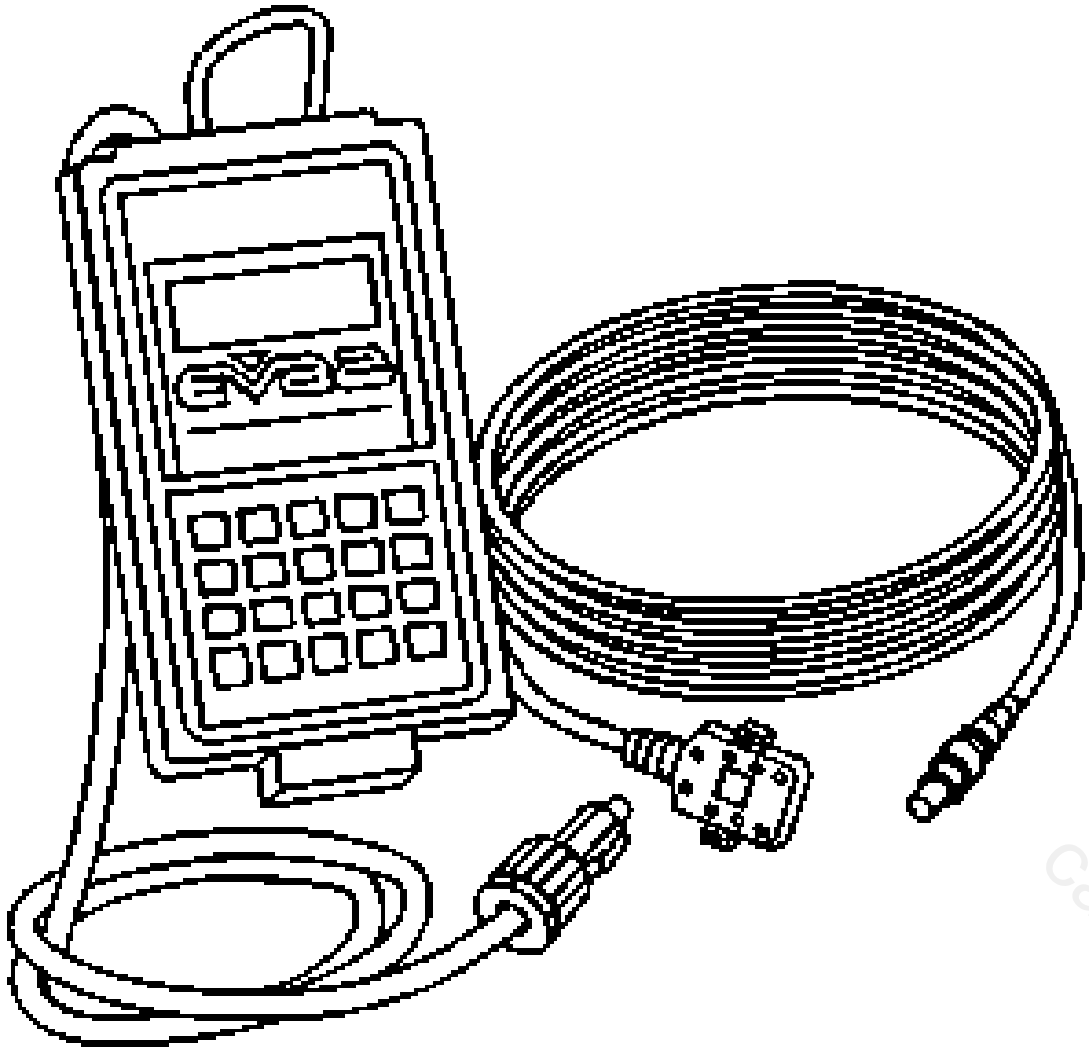
cardiagn.com

Illustration	Tool Number/Description
	DT 23498-A J 23498-A Driveshaft Inclinometer

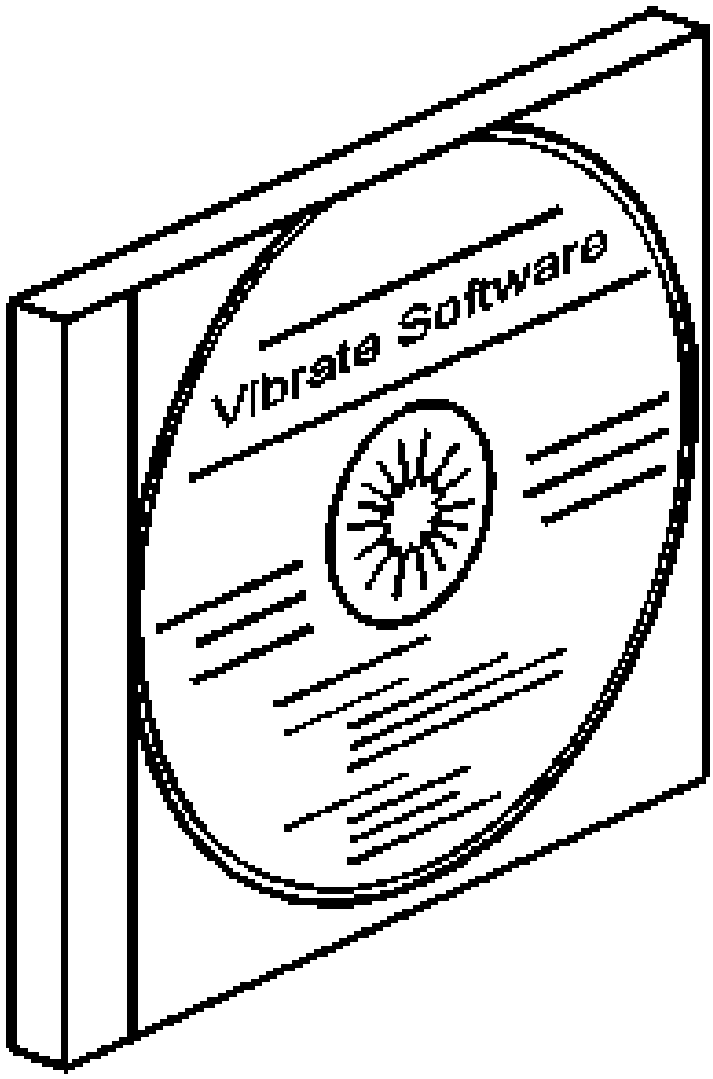
cardiagn.com

Illustration	Tool Number/Description
	DT 23498-20 J 23498-20 Driveshaft Inclinometer Adapter

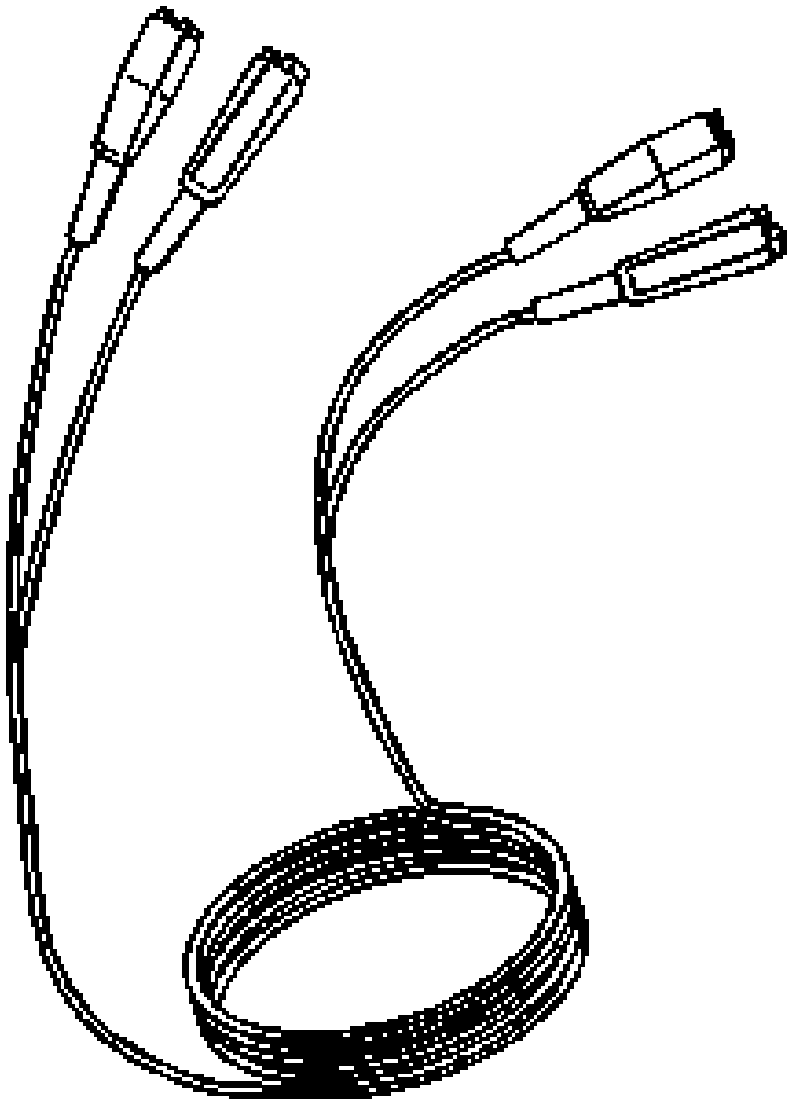
cardiagn.com

Illustration	Tool Number/Description
	EL 38792-A J 38792-A Electronic Vibration Analyzer 2

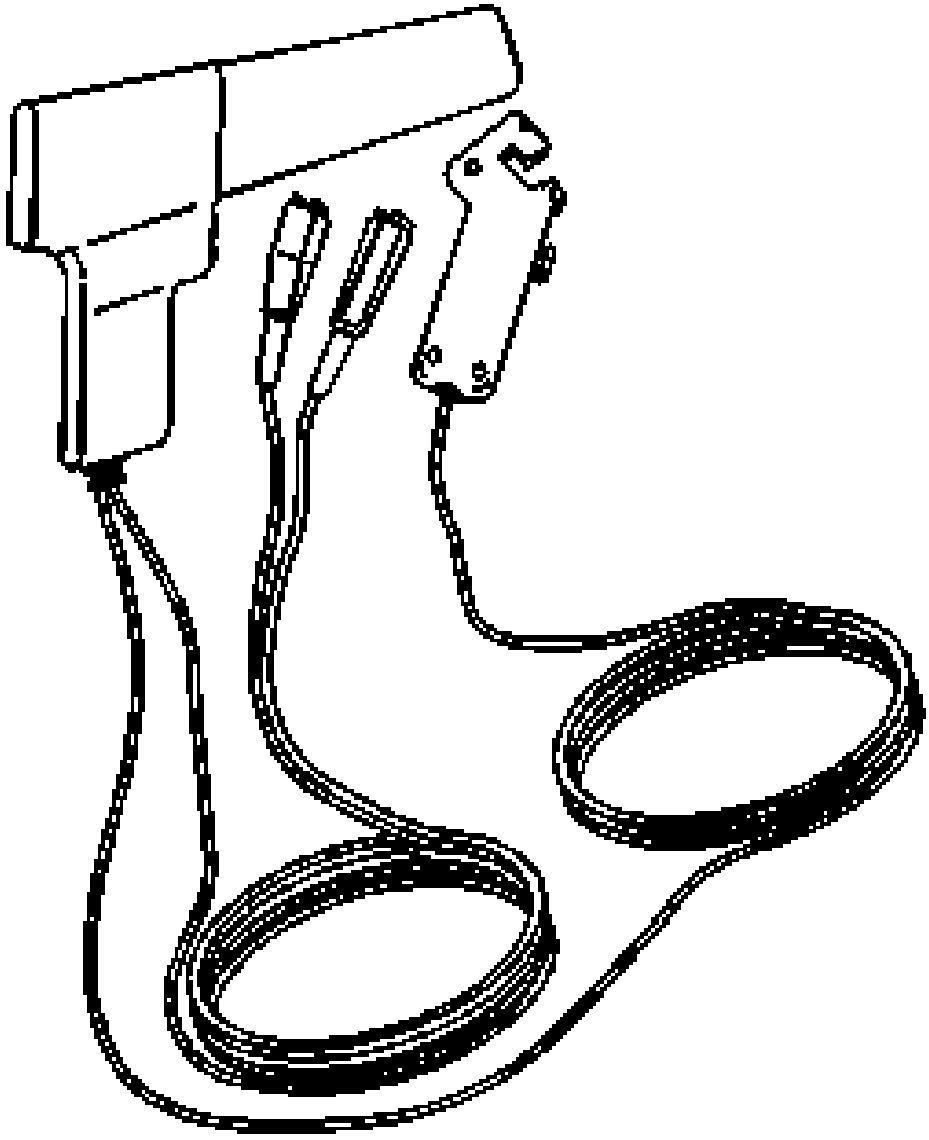
cardiagn.com

Illustration	Tool Number/Description
	EL 38792-VS J 38792-VS Vibrate Software

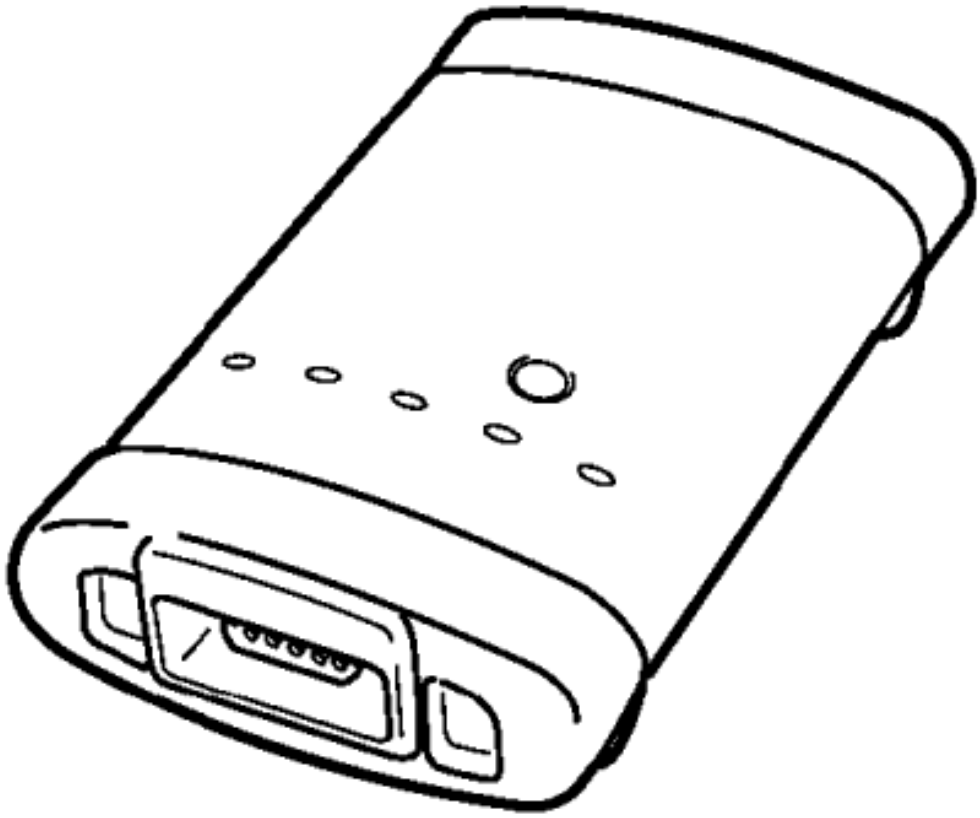
cardiagn.com

Illustration	Tool Number/Description
	EL 38792-20 J 38792-20 20-Foot Timing Light Power Cord Extension

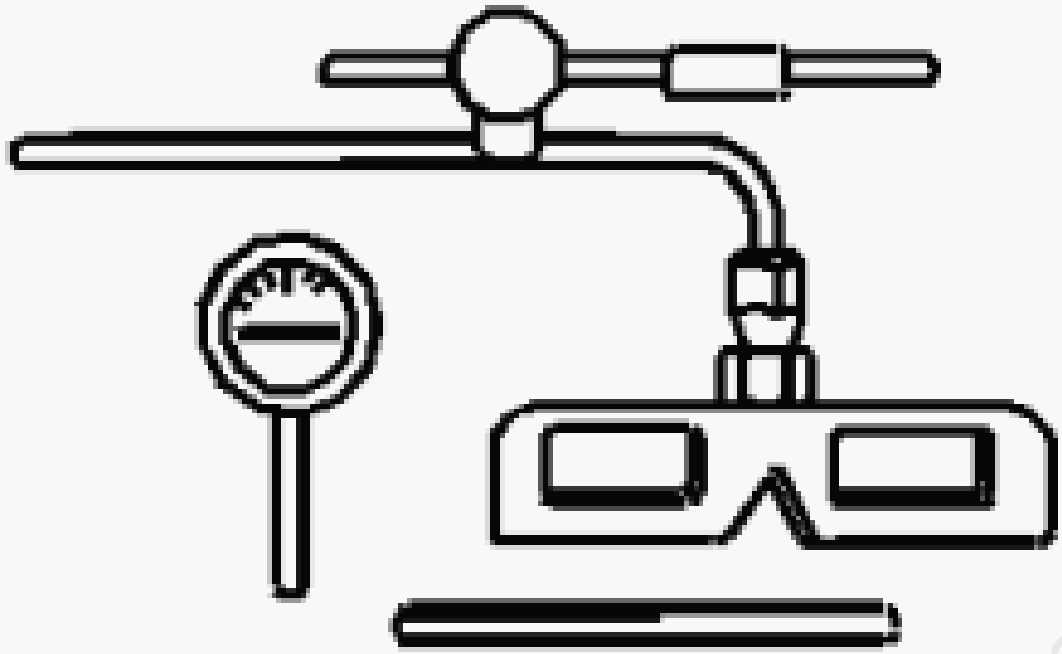
cardiagn.com

Illustration	Tool Number/Description
	EL 38792-25 J 38792-25 Inductive Pickup Timing Light

cardiagn.com

Illustration	Tool Number/Description
	EL 47955 J 2534 Multi Diagnostic Interface MDI
	GE 7872 J 7872 Magnetic Base Dial Indicator Set

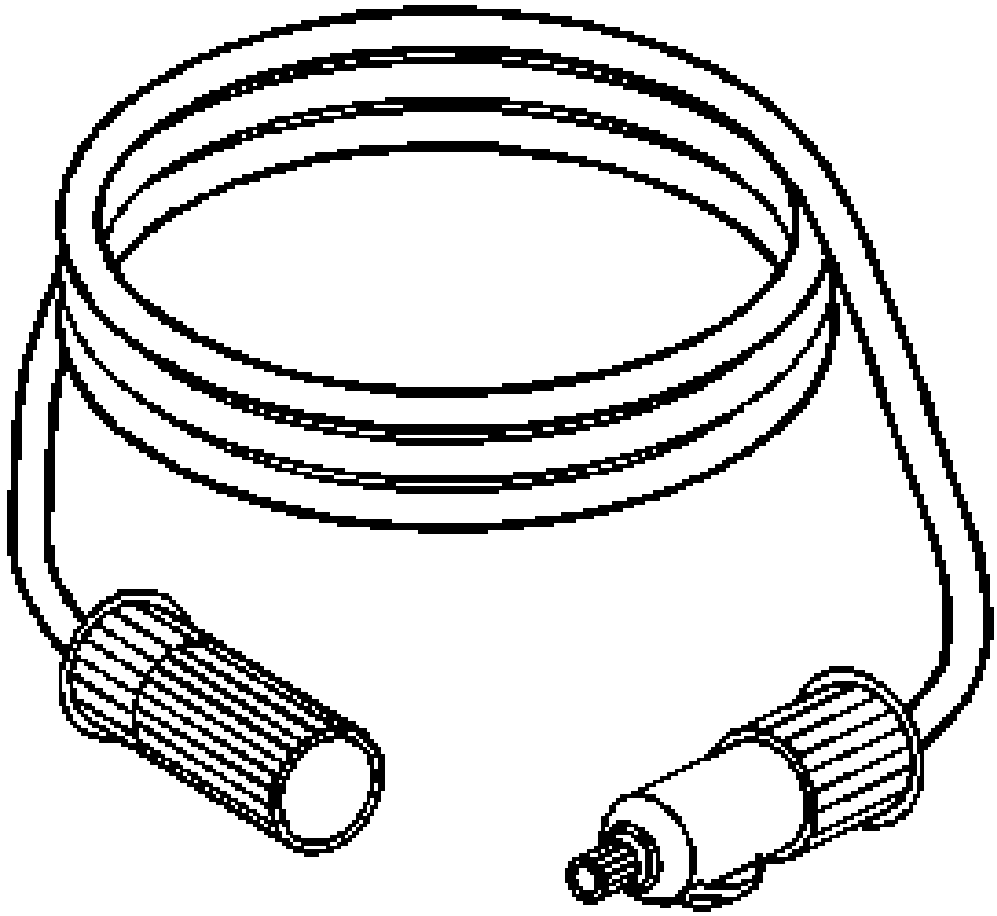
cardiagn.com

Illustration	Tool Number/Description
	

cardiagn.com

Illustration	Tool Number/Description
	GE 8001 J 8001 Dial Indicator Set

cardiagn.com

Illustration	Tool Number/Description
	J 38792-27 6-Foot EVA Power Cord Extension

cardiagn.com

Back To Article

GENERAL INFORMATION

Waveforms - Injector Pattern Tutorial

* PLEASE READ THIS FIRST *

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

PURPOSE OF THIS ARTICLE

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

Learning how to interpret injector drive patterns from a Lab Scope can be like learning ignition patterns all over again. This article exists to ease you into becoming a skilled injector pattern interpreter.

You will learn:

- How a DVOM and noid light fall short of a lab scope.
- The two types of injector driver circuits, voltage controlled & current controlled.
- The two ways injector circuits can be wired, constant ground/switched power & constant power/switched ground.
- The two different pattern types you can use to diagnose with, voltage & current.
- All the valuable details injector patterns can reveal.

carDiagn.com

SCOPE OF THIS ARTICLE

This is NOT a manufacturer specific article. All different types of systems are covered here, regardless of the specific year/make/model/engine.

The reason for such broad coverage is because there are only a few basic ways to operate a solenoid-type injector. By understanding the fundamental principles, you will understand all the major points of injector patterns you encounter. Of course there are minor differences in each specific system, but that is where a waveform library helps out.

If this is confusing, consider a secondary ignition pattern. Even though there are many different implementations, each still has a primary voltage turn-on, firing line, spark line, etc.

If specific waveforms are available in On Demand for the engine and vehicle you are working on, you will find them in the Engine Performance section under the Engine Performance category.

IS A LAB SCOPE NECESSARY?

INTRODUCTION

You probably have several tools at your disposal to diagnose injector circuits. But you might have questioned "Is a lab scope necessary to do a thorough job, or will a set of noid lights and a multifunction DVOM do just as well?"

In the following text, we are going to look at what noid lights and DVOMs do best, do not do very well, and when they can mislead you. As you might suspect, the lab scope, with its ability to look inside an active circuit, comes to the rescue by answering for the deficiencies of these other tools.

OVERVIEW OF NOID LIGHT

The noid light is an excellent "quick and dirty" tool. It can usually be hooked to a fuel injector harness fast and the flashing light is easy to understand. It is a dependable way to identify a no-pulse situation.

However, a noid light can be very deceptive in two cases:

- If the wrong one is used for the circuit being tested. Beware: Just because a connector on a noid light fits the harness does not mean it is the right one.
- If an injector driver is weak or a minor voltage drop is present.

Use the Right Noid Light

In the following text we will look at what can happen if the wrong noid light is used, why there are different types of noid lights (besides differences with connectors), how to identify the types of noid lights, and how to know the right type to use.

First, let's discuss what can happen if the incorrect type of noid light is used. You might see:

- A dimly flashing light when it should be normal.
- A normal flashing light when it should be dim.

A noid light will flash dim if used on a lower voltage circuit than it was designed for. A normally operating circuit would appear underpowered, which could be misinterpreted as the cause of a fuel starvation problem.

Here are the two circuit types that could cause this problem:

- Circuits with external injector resistors. Used predominately on some Asian & European systems, they are used to reduce the available voltage to an injector in order to limit the current flow. This lower voltage can cause a dim flash on a noid light designed for full voltage.
- Circuits with current controlled injector drivers (e.g. "Peak and Hold"). Basically, this type of driver allows a quick burst of voltage/current to flow and then throttles it back significantly for the remainder of the pulse width duration. If a noid light was designed for the other type of driver (voltage controlled, e.g. "Saturated"), it will appear dim because it is expecting full voltage/current to flow for the entire duration of the pulse width.

Let's move to the other situation where a noid light flashes normally when it should be dim. This could occur if a more sensitive noid light is used on a higher voltage/amperage circuit that was weakened enough to cause problems (but not outright broken). A circuit with an actual problem would thus appear normal.

Let's look at why. A noid light does not come close to consuming as much amperage as an injector solenoid. If there is a partial driver failure or a minor voltage drop in the injector circuit, there can be adequate amperage to fully operate the noid light BUT NOT ENOUGH TO OPERATE THE INJECTOR.

If this is not clear, picture a battery with a lot of corrosion on the terminals. Say there is enough corrosion that the starter motor will not operate; it only clicks. Now imagine turning on the headlights (with the ignition in the RUN position). You find they light normally and are fully bright. This is the same idea as noid light: There is a problem, but enough amp flow exists to operate the headlights ("noid light"), but not the starter motor ("injector").

How do you identify and avoid all these situations? By using the correct type of noid light. This requires that you understanding the types of injector circuits that your noid lights are designed for. There are three. They are:

- Systems with a voltage controlled injector driver. Another way to say it: The noid light is designed for a circuit with a "high" resistance injector (generally 12 ohms or above).
- Systems with a current controlled injector driver. Another way to say it: The noid light is designed for a circuit with a low resistance injector (generally less than 12 ohms) without an external injector resistor.
- Systems with a voltage controlled injector driver and an external injector resistor. Another way of saying it: The noid light is designed for a circuit with a low resistance injector (generally less than

12 ohms) and an external injector resistor.

NOTE: **Some noid lights can meet both the second and third categories simultaneously.**

If you are not sure which type of circuit your noid light is designed for, plug it into a known good car and check out the results. If it flashes normally during cranking, determine the circuit type by finding out injector resistance and if an external injector resistor is used. You now know enough to identify the type of injector circuit. Label the noid light appropriately.

Next time you need to use a noid light for diagnosis, determine what type of injector circuit you are dealing with and select the appropriate noid light.

Of course, if you suspect a no-pulse condition you could plug in any one whose connector fit without fear of misdiagnosis. This is because it is unimportant if the flashing light is dim or bright. It is only important that it flashes.

In any cases of doubt regarding the use of a noid light, a lab scope will overcome all inherent weaknesses.

OVERVIEW OF DVOM

A DVOM is typically used to check injector resistance and available voltage at the injector. Some techs also use it check injector on-time either with a built-in feature or by using the dwell/duty function.

There are situations where the DVOM performs these checks dependably, and other situations where it can deceive you. It is important to be aware of these strengths and weaknesses. We will cover the topics above in the following text.

cardiagn.com

Checking Injector Resistance

If a short in an injector coil winding is constant, an ohmmeter will accurately identify the lower resistance. The same is true with an open winding. Unfortunately, an intermittent short is an exception. A faulty injector with an intermittent short will show "good" if the ohmmeter cannot force the short to occur during testing.

Alcohol in fuel typically causes an intermittent short, happening only when the injector coil is hot and loaded by a current high enough to jump the air gap between two bare windings or to break down any oxides that may have formed between them.

When you measure resistance with an ohmmeter, you are only applying a small current of a few milliamps. This is nowhere near enough to load the coil sufficiently to detect most problems. As a result, most resistance checks identify intermittently shorted injectors as being normal.

There are two methods to get around this limitation. The first is to purchase an tool that checks injector coil windings under full load. The Kent-Moore J-39021 is such a tool, though there are others. The Kent-Moore costs around $240 at the time of this writing and works on many different manufacturer's systems.

The second method is to use a lab scope. Remember, a lab scope allows you to see the regular operation of a circuit in real time. If an injector is having an short or intermittent short, the lab scope will show it.

Checking Available Voltage At the Injector

Verifying a fuel injector has the proper voltage to operate correctly is good diagnostic technique. Finding an open circuit on the feed circuit like a broken wire or connector is an accurate check with a DVOM. Unfortunately, finding an intermittent or excessive resistance problem with a DVOM is unreliable.

Let's explore this drawback. Remember that a voltage drop due to excessive resistance will only occur when a circuit is operating? Since the injector circuit is only operating for a few milliseconds at a time, a DVOM will only see a potential fault for a few milliseconds. The remaining 90+% of the time the unloaded injector circuit will show normal battery voltage.

Since DVOMs update their display roughly two to five times a second, all measurements in between are averaged. Because a potential voltage drop is visible for such a small amount of time, it gets "averaged out", causing you to miss it.

Only a DVOM that has a "min-max" function that checks EVERY MILLISECOND will catch this fault consistently (if used in that mode). The Fluke 87 among others has this capability.

A "min-max" DVOM with a lower frequency of checking (100 millisecond) can miss the fault because it will probably check when the injector is not on. This is especially true with current controlled driver circuits. The Fluke 88, among others fall into this category.

Outside of using a Fluke 87 (or equivalent) in the 1 mS "min-max" mode, the only way to catch a voltage drop fault is with a lab scope. You will be able to see a voltage drop as it happens.

One final note. It is important to be aware that an injector circuit with a solenoid resistor will always show a voltage drop when the circuit is energized. This is somewhat obvious and normal; it is a designed-in voltage drop. What can be unexpected is what we already covered--a voltage drop disappears when the circuit is unloaded. The unloaded injector circuit will show normal battery voltage at the injector. Remember this and do not get confused.

Checking Injector On-Time With Built-In Function

Several DVOMs have a feature that allows them to measure injector on-time (mS pulse width). While they are accurate and fast to hookup, they have three limitations you should be aware of:

- They only work on voltage controlled injector drivers (e.g "Saturated Switch"), NOT on current controlled injector drivers (e.g. "Peak & Hold").
- A few unusual conditions can cause inaccurate readings.
- Varying engine speeds can result in inaccurate readings.

cardiagn.com

Regarding the first limitation, DVOMs need a well-defined injector pulse in order to determine when the injector turns ON and OFF. Voltage controlled drivers provide this because of their simple switch-like operation. They completely close the circuit for the entire duration of the pulse. This is easy for the DVOM to interpret.

The other type of driver, the current controlled type, start off well by completely closing the circuit (until the injector pintle opens), but then they throttle back the voltage/current for the duration of the pulse. The DVOM understands the beginning of the pulse but it cannot figure out the throttling action. In other words, it cannot distinguish the throttling from an open circuit (de-energized) condition.

Yet current controlled injectors will still yield a millisecond on-time reading on these DVOMs. You will find it is also always the same, regardless of the operating conditions. This is because it is only measuring the initial completely-closed circuit on-time, which always takes the same amount of time (to lift the injector pintle off its seat). So even though you get a reading, it is useless.

The second limitation is that a few erratic conditions can cause inaccurate readings. This is because of a DVOM's slow display rate; roughly two to five times a second. As we covered earlier, measurements in between display updates get averaged. So conditions like skipped injector pulses or intermittent long/short injector pulses tend to get "averaged out", which will cause you to miss important details.

The last limitation is that varying engine speeds can result in inaccurate readings. This is caused by the quickly shifting injector on-time as the engine load varies, or the RPM moves from a state of acceleration to stabilization, or similar situations. It too is caused by the averaging of all measurements in between DVOM display periods. You can avoid this by checking on-time when there are no RPM or load changes.

A lab scope allows you to overcome each one of these limitations.

Checking Injector On-Time With Dwell Or Duty

If no tool is available to directly measure injector millisecond on-time measurement, some techs use a simple DVOM dwell or duty cycle functions as a replacement.

While this is an approach of last resort, it does provide benefits. We will discuss the strengths and weaknesses in a moment, but first we will look at how a duty cycle meter and dwell meter work.

How A Duty Cycle Meter and Dwell Meter Work

All readings are obtained by comparing how long something has been OFF to how long it has been ON in a fixed time period. A dwell meter and duty cycle meter actually come up with the same answers using different scales. You can convert freely between them. See **RELATIONSHIP BETWEEN DWELL & DUTY CYCLE READINGS TABLE**.

The DVOM display updates roughly one time a second, although some DVOMs can be a little faster or slower. All measurements during this update period are tallied inside the DVOM as ON time or OFF time, and then the total ratio is displayed as either a percentage (duty cycle) or degrees (dwell meter).

For example, let's say a DVOM had an update rate of exactly 1 second (1000 milliseconds). Let's also say that it has been measuring/tallying an injector circuit that had been ON a total of 250 mS out of the 1000 mS. That is a ratio of one-quarter, which would be displayed as 25% duty cycle or 15Â° dwell (six-cylinder scale). Note that most duty cycle meters can reverse the readings by selecting the positive or negative slope to trigger on. If this reading were reversed, a duty cycle meter would display 75%.

Strengths of Dwell/Duty Meter

The obvious strength of a dwell/duty meter is that you can compare injector on-time against a known-good reading. This is the only practical way to use a dwell/duty meter, but requires you to have known-good values to compare against.

Another strength is that you can roughly convert injector mS on-time into dwell reading with some computations.

A final strength is that because the meter averages everything together it does not miss anything (though this is also a severe weakness that we will look at later). If an injector has a fault where it occasionally skips a pulse, the meter registers it and the reading changes accordingly.

Let's go back to figuring out dwell/duty readings by using injector on-time specification. This is not generally practical, but we will cover it for completeness. You NEED to know three things:

- Injector mS on-time specification.
- Engine RPM when specification is valid.
- How many times the injectors fire per crankshaft revolution.

The first two are self-explanatory. The last one may require some research into whether it is a bank-fire type that injects every 360Â° of crankshaft rotation, a bank-fire that injects every 720Â°, or an SFI that injects every 720Â°. Many manufacturers do not release this data so you may have to figure it out yourself with a frequency meter.

Here are the four complete steps to convert millisecond on-time:

1. Determine the injector pulse width and RPM it was obtained at. Let's say the specification is for one millisecond of on-time at a hot idle of 600 RPM.
2. Determine injector firing method for the complete 4 stroke cycle. Let's say this is a 360Â° bank-fired, meaning an injector fires each and every crankshaft revolution.
3. Determine how many times the injector will fire at the specified engine speed (600 RPM) in a fixed time period. We will use 100 milliseconds because it is easy to use. Six hundred crankshaft Revolutions Per Minute (RPM) divided by 60 seconds equals 10 revolutions per second. Multiplying 10 times .100 yields one; the crankshaft turns one time in 100 milliseconds. With exactly one crankshaft rotation in 100 milliseconds, we know that the injector fires exactly one time.
4. Determine the ratio of injector on-time vs. off-time in the fixed time period, then figure duty cycle and/or dwell. The injector fires one time for a total of one millisecond in any given 100 millisecond period. One hundred minus one equals 99. We have a 99% duty cycle. If we wanted to know the dwell (on 6 cylinder scale), multiple 99% times .6; this equals 59.4Â° dwell.

carmagn.com

Weaknesses of Dwell/Duty Meter

The weaknesses are significant. First, there is no one-to-one correspondence to actual mS on-time. No manufacturer releases dwell/duty data, and it is time-consuming to convert the mS on-time readings. Besides, there can be a large degree of error because the conversion forces you to assume that the injector(s) are always firing at the same rate for the same period of time. This can be a dangerous assumption.

Second, all level of detail is lost in the averaging process. This is the primary weakness. You cannot see the details you need to make a confident diagnosis.

Here is one example. Imagine a vehicle that has a faulty injector driver that occasionally skips an injector pulse. Every skipped pulse means that that cylinder does not fire, thus unburned O2 gets pushed into the exhaust and passes the O2 sensor. The O2 sensor indicates lean, so the computer fattens up the mixture to compensate for the supposed "lean" condition.

A connected dwell/duty meter would see the fattened pulse width but would also see the skipped pulses. It would tally both and likely come back with a reading that indicated the "pulse width" was within specification because the rich mixture and missing pulses offset each other.

This situation is not a far-fetched scenario. Some early GM 3800 engines were suffering from exactly this. The point is that a lack of detail could cause misdiagnosis.

As you might have guessed, a lab scope would not miss this.

RELATIONSHIP BETWEEN DWELL & DUTY CYCLE READINGS

Dwell Meter (2)	Duty Cycle Meter
1Â°	1%
15Â°	25%
30Â°	50%
45Â°	75%
60Â°	100%

(1) These are just some examples for your understanding. It is okay to fill in the gaps.

(2) Dwell meter on the six-cylinder scale.

THE TWO TYPES OF INJECTOR DRIVERS

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

OVERVIEW

There are two types of transistor driver circuits used to operate electric fuel injectors: voltage controlled and current controlled. The voltage controlled type is sometimes called a "saturated switch" driver, while the current controlled type is sometimes known as a "peak and hold" driver.

The basic difference between the two is the total resistance of the injector circuit. Roughly speaking, if a particular leg in an injector circuit has total resistance of 12 or more ohms, a voltage control driver is used. If less than 12 ohms, a current control driver is used.

It is a question of what is going to do the job of limiting the current flow in the injector circuit; the inherent "high" resistance in the injector circuit, or the transistor driver. Without some form of control, the current flow through the injector would cause the solenoid coil to overheat and result in a damaged injector.

VOLTAGE CONTROLLED CIRCUIT ("SATURATED SWITCH")

The voltage controlled driver inside the computer operates much like a simple switch because it does not need to worry about limiting current flow. Recall, this driver typically requires injector circuits with a total leg resistance of 12 or more ohms.

The driver is either ON, closing/completing the circuit (eliminating the voltage-drop), or OFF, opening the circuit (causing a total voltage drop).

Some manufacturers call it a "saturated switch" driver. This is because when switched ON, the driver allows the magnetic field in the injector to build to saturation. This is the same "saturation" property that you are familiar with for an ignition coil.

There are two ways "high" resistance can be built into an injector circuit to limit current flow. One method uses an external solenoid resistor and a low resistance injector, while the other uses a high resistance injector without the solenoid resistor. See the left side of Fig. **Fig. 1**.

In terms of injection opening time, the external resistor voltage controlled circuit is somewhat faster than the voltage controlled high resistance injector circuit. The trend, however, seems to be moving toward use of this latter type of circuit due to its lower cost and reliability. The ECU can compensate for slower opening times by increasing injector pulse width accordingly.

NOTE: **Never apply battery voltage directly across a low resistance injector. This will cause injector damage from solenoid coil overheating.**

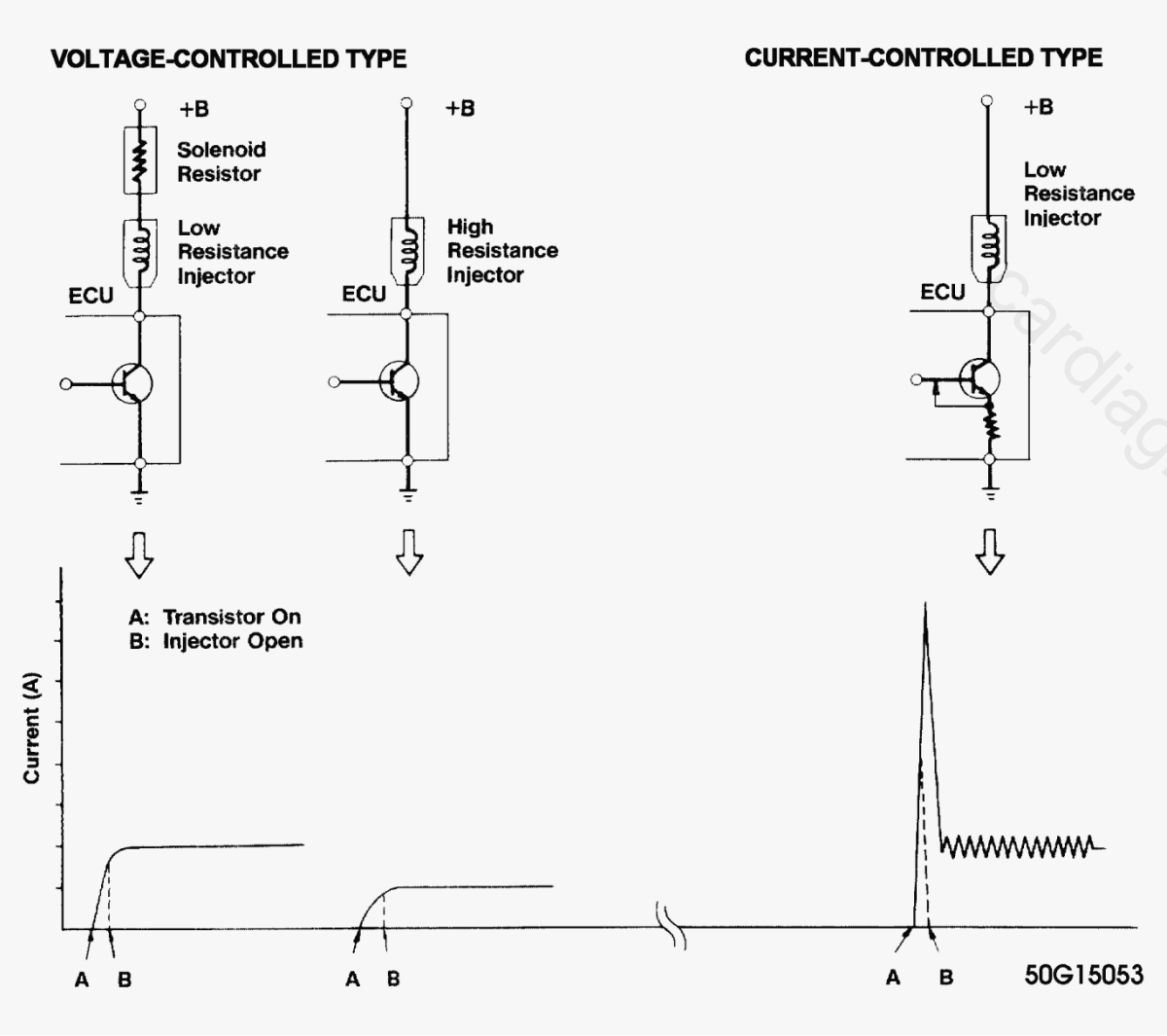


Fig. 1: Injector Driver Types - Current and Voltage

CURRENT CONTROLLED CIRCUIT ("PEAK & HOLD")

The current controlled driver inside the computer is more complex than a voltage controlled driver because as the name implies, it has to limit current flow in addition to its ON-OFF switching function. Recall, this driver typically requires injector circuits with a total leg resistance of less than 12 ohms.

Once the driver is turned ON, it will not limit current flow until enough time has passed for the injector pintle to open. This period is preset by the particular manufacturer/system based on the amount of current flow needed to open their injector. This is typically between two and six amps. Some manufacturers refer to this as the "peak" time, referring to the fact that current flow is allowed to "peak" (to open the injector).

Once the injector pintle is open, the amp flow is considerably reduced for the rest of the pulse duration to protect the injector from overheating. This is okay because very little amperage is needed to hold the injector open, typically in the area of one amp or less. Some manufacturers refer to this as the "hold" time, meaning that just enough current is allowed through the circuit to "hold" the already-open injector open.

There are a couple methods of reducing the current. The most common trims back the available voltage for the circuit, similar to turning down a light at home with a dimmer.

The other method involves repeatedly cycling the circuit ON-OFF. It does this so fast that the magnetic field never collapses and the pintle stays open, but the current is still significantly reduced. See the right side of Fig. **Fig. 1** for an illustration.

The advantage to the current controlled driver circuit is the short time period from when the driver transistor goes ON to when the injector actually opens. This is a function of the speed with which current flow reaches its peak due to the low circuit resistance. Also, the injector closes faster when the driver turns OFF because of the lower holding current.

NOTE: **Never apply battery voltage directly across a low resistance injector. This will cause injector damage from solenoid coil overheating.**

THE TWO WAYS INJECTOR CIRCUITS ARE WIRED

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

Like other circuits, injector circuits can be wired in one of two fundamental directions. The first method is to steadily power the injectors and have the computer driver switch the ground side of the circuit. Conversely, the injectors can be steadily grounded while the driver switches the power side of the circuit.

There is no performance benefit to either method. Voltage controlled and current controlled drivers have been successfully implemented both ways.

However, 95% percent of the systems are wired so the driver controls the ground side of the circuit. Only a handful of systems use the drivers on the power side of the circuit. Some examples of the latter are the 1970's Cadillac EFI system, early Jeep 4.0 EFI (Renix system), and Chrysler 1984-87 TBI.

INTERPRETING INJECTOR WAVEFORMS

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

INTERPRETING A VOLTAGE CONTROLLED PATTERN

NOTE: **Voltage controlled drivers are also known as "Saturated Switch" drivers. They typically require injector circuits with a total leg resistance of 12 ohms or more.**

NOTE: **This example is based on a constant power/switched ground circuit.**

- See **Fig. 2** for pattern that the following text describes.

Point "A" is where system voltage is supplied to the injector. A good hot run voltage is usually 13.5 or more volts. This point, commonly known as open circuit voltage, is critical because the injector will not get sufficient current saturation if there is a voltage shortfall. To obtain a good look at this precise point, you will need to shift your Lab Scope to five volts per division.

You will find that some systems have slight voltage fluctuations here. This can occur if the injector feed wire is also used to power up other cycling components, like the ignition coil(s). Slight voltage fluctuations are normal and are no reason for concern. Major voltage fluctuations are a different story, however. Major voltage shifts on the injector feed line will create injector performance problems. Look for excessive resistance problems in the feed circuit if you see big shifts and repair as necessary.

Note that circuits with external injector resistors will not be any different because the resistor does not affect open circuit voltage.

Point "B" is where the driver completes the circuit to ground. This point of the waveform should be a clean square point straight down with no rounded edges. It is during this period that current saturation of the injector windings is taking place and the driver is heavily stressed. Weak drivers will distort this vertical line.

Point "C" represents the voltage drop across the injector windings. Point "C" should come very close to the ground reference point, but not quite touch. This is because the driver has a small amount of inherent resistance. Any significant offset from ground is an indication of a resistance problem on the ground circuit that needs repaired. You might miss this fault if you do not use the negative battery post for your Lab Scope hook-up, so it is HIGHLY recommended that you use the battery as your hook-up.

The points between "B" and "D" represent the time in milliseconds that the injector is being energized or held open. This line at Point "C" should remain flat. Any distortion or upward bend indicates a ground problem, short problem, or a weak driver. Alert readers will catch that this is exactly opposite of the current controlled type drivers (explained in the next section), because they bend upwards at this point.

How come the difference? Because of the total circuit resistance. Voltage controlled driver circuits have a high resistance of 12+ ohms that slows the building of the magnetic field in the injector. Hence, no counter voltage is built up and the line remains flat.

On the other hand, the current controlled driver circuit has low resistance which allows for a rapid magnetic field build-up. This causes a slight inductive rise (created by the effects of counter voltage) and hence, the upward bend. You should not see that here with voltage controlled circuits.

Point "D" represents the electrical condition of the injector windings. The height of this voltage spike (inductive kick) is proportional to the number of windings and the current flow through them. The more current flow and greater number of windings, the more potential for a greater inductive kick. The opposite is also true. The less current flow or fewer windings means less inductive kick. Typically you should see a minimum 35 volts at the top of Point "D".

If you do see approximately 35 volts, it is because a zener diode is used with the driver to clamp the voltage. Make sure the beginning top of the spike is squared off, indicating the zener dumped the remainder of the spike. If it is not squared, that indicates the spike is not strong enough to make the zener fully dump, meaning the injector has a weak winding.

If a zener diode is not used in the computer, the spike from a good injector will be 60 or more volts.

Point "E" brings us to a very interesting section. As you can see, the voltage dissipates back to supply value after the peak of the inductive kick. Notice the slight hump? This is actually the mechanical injector pintle closing. Recall that moving an iron core through a magnetic field will create a voltage surge. The pintle is the iron core here.

This pintle hump at Point "E" should occur near the end of the downward slope, and not afterwards. If it does occur after the slope has ended and the voltage has stabilized, it is because the pintle is slightly sticking because of a faulty injector

If you see more than one hump it is because of a distorted pintle or seat. This faulty condition is known as "pintle float".

It is important to realize that it takes a good digital storage oscilloscope or analog lab scope to see this pintle hump clearly. Unfortunately, it cannot always be seen.

carsdiagn.com

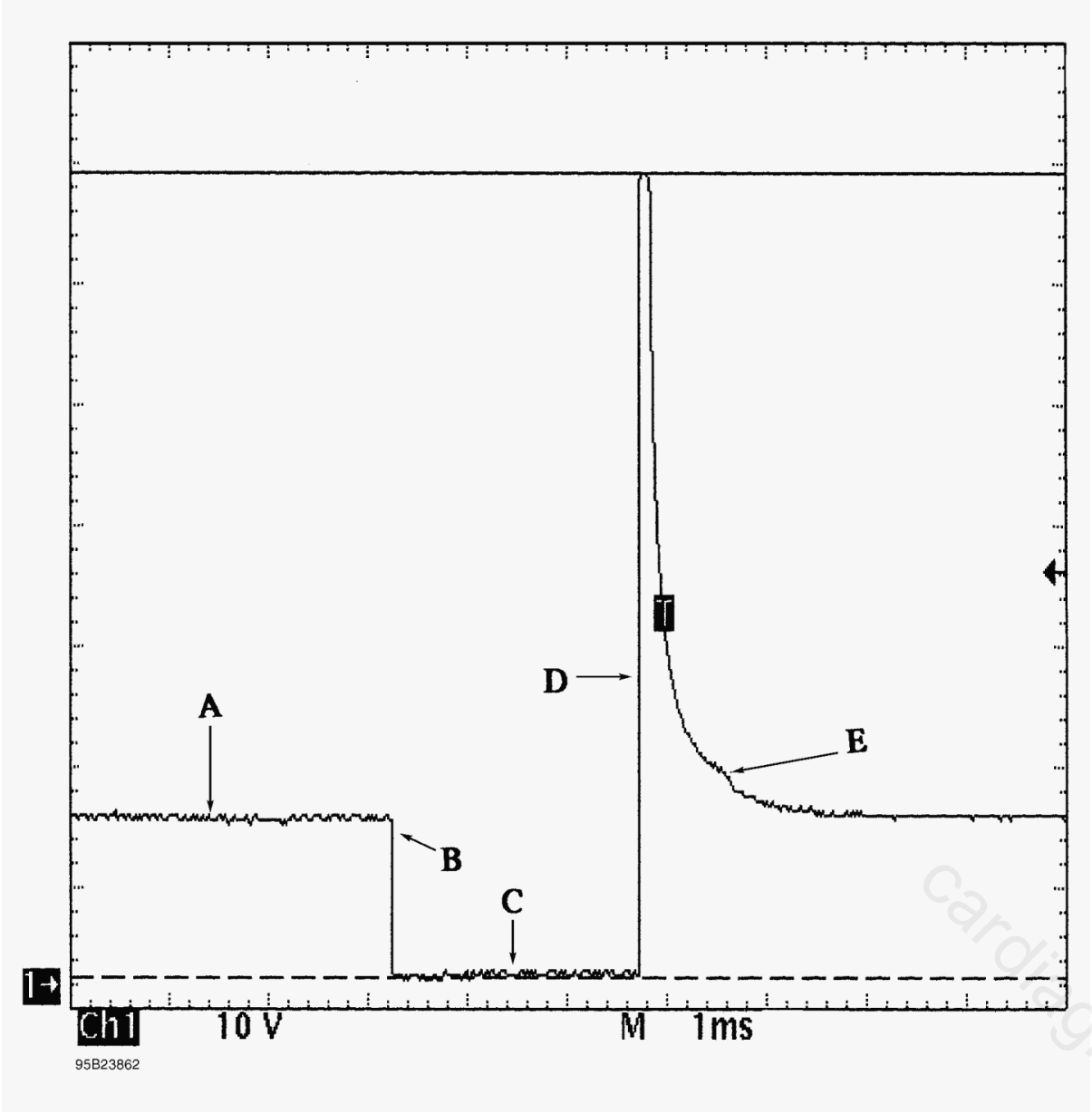


Fig. 2: Identifying Voltage Controlled Type Injector Pattern

INTERPRETING A CURRENT CONTROLLED PATTERN

NOTE: **Current controlled drivers are also known as "Peak and Hold" drivers. They typically require injector circuits with a total leg resistance with less than 12 ohm.**

NOTE: **This example is based on a constant power/switched ground circuit.**

- See Fig. 3 for pattern that the following text describes.

Point "A" is where system voltage is supplied to the injector. A good hot run voltage is usually 13.5 or more volts. This point, commonly known as open circuit voltage, is critical because the injector will not get sufficient current saturation if there is a voltage shortfall. To obtain a good look at this precise point, you will need to shift your Lab Scope to five volts per division.

You will find that some systems have slight voltage fluctuations here. This could occur if the injector feed wire is also used to power up other cycling components, like the ignition coil(s). Slight voltage fluctuations are normal and are no reason for concern. Major voltage fluctuations are a different story, however. Major voltage shifts on the injector feed line will create injector performance problems. Look for excessive resistance problems in the feed circuit if you see big shifts and repair as necessary.

Point "B" is where the driver completes the circuit to ground. This point of the waveform should be a clean square point straight down with no rounded edges. It is during this period that current saturation of the injector windings is taking place and the driver is heavily stressed. Weak drivers will distort this vertical line.

cardiagn.com

Point "C" represents the voltage drop across the injector windings. Point "C" should come very close to the ground reference point, but not quite touch. This is because the driver has a small amount of inherent resistance. Any significant offset from ground is an indication of a resistance problem on the ground circuit that needs repaired. You might miss this fault if you do not use the negative battery post for your Lab Scope hook-up, so it is HIGHLY recommended that you use the battery as your hook-up.

Right after Point "C", something interesting happens. Notice the trace starts a normal upward bend. This slight inductive rise is created by the effects of counter voltage and is normal. This is because the low circuit resistance allowed a fast build-up of the magnetic field, which in turn created the counter voltage.

Point "D" is the start of the current limiting, also known as the "Hold" time. Before this point, the driver had allowed the current to free-flow ("Peak") just to get the injector pintle open. By the time point "D" occurs, the injector pintle has already opened and the computer has just significantly throttled the current back. It does this by only allowing a few volts through to maintain the minimum current required to keep the pintle open.

The height of the voltage spike seen at the top of Point "D" represents the electrical condition of the injector windings. The height of this voltage spike (inductive kick) is proportional to the number of windings and the current flow through them. The more current flow and greater number of windings, the more potential for a greater inductive kick. The opposite is also true. The less current flow or fewer windings means less inductive kick. Typically you should see a minimum 35 volts.

If you see approximately 35 volts, it is because a zener diode is used with the driver to clamp the voltage. Make sure the beginning top of the spike is squared off, indicating the zener dumped the remainder of the spike. If it is not squared, that indicates the spike is not strong enough to make the zener fully dump, meaning there is a problem with a weak injector winding.

If a zener diode is not used in the computer, the spike from a good injector will be 60 or more volts.

At Point "E", notice that the trace is now just a few volts below system voltage and the injector is in the current limiting, or the "Hold" part of the pattern. This line will either remain flat and stable as shown here, or will cycle up and down rapidly. Both are normal methods to limit current flow. Any distortion may indicate shorted windings.

Point "F" is the actual turn-off point of the driver (and injector). To measure the millisecond on-time of the injector, measure between points "C" and "F". Note that we used cursors to do it for us; they are measuring a 2.56 mS on-time.

The top of Point "F" (second inductive kick) is created by the collapsing magnetic field caused by the final turn-off of the driver. This spike should be like the spike on top of point "D".

Point "G" shows a slight hump. This is actually the mechanical injector pintle closing. Recall that moving an iron core through a magnetic field will create a voltage surge. The pintle is the iron core here.

This pintle hump at Point "E" should occur near the end of the downward slope, and not afterwards. If it does occur after the slope has ended and the voltage has stabilized, it is because the pintle is slightly sticking. Some older Nissan TBI systems suffered from this.

If you see more than one hump it is because of a distorted pintle or seat. This faulty condition is known as "pintle float".

It is important to realize that it takes a good digital storage oscilloscope or analog lab scope to see this pintle hump clearly. Unfortunately, it cannot always be seen.

carmagn.com

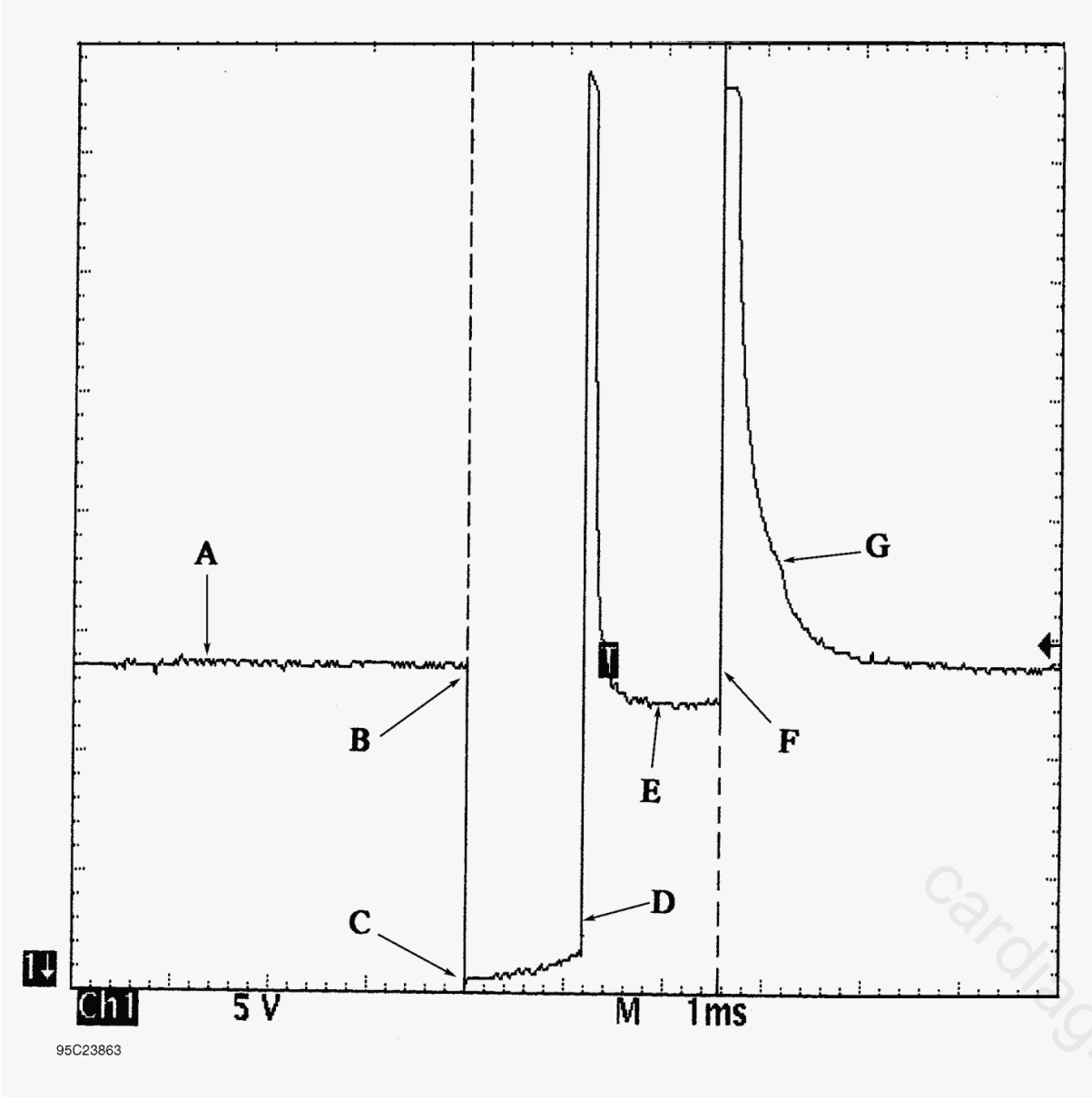


Fig. 3: Identifying Current Controlled Type Injector Pattern

CURRENT WAVEFORM SAMPLES

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

EXAMPLE #1 - VOLTAGE CONTROLLED DRIVER

The waveform pattern shown in Fig. Fig. 4 indicate a normal current waveform from a Ford 3.0L V6 VIN [U] engine. This voltage controlled type circuit pulses the injectors in groups of three injectors. Injectors No. 1, 3, and 5 are pulsed together and cylinders 2, 4, and 6 are pulsed together. The specification for an acceptable bank resistance is 4.4 ohms. Using Ohm's Law and assuming a hot run voltage of 14 volts, we determine that the bank would draw a current of 3.2 amps.

However this is not the case because as the injector windings become saturated, counter voltage is created which impedes the current flow. This, coupled with the inherent resistance of the driver's transistor, impedes the current flow even more. So, what is a known good value for a dynamic current draw on a voltage controlled bank of injectors? The waveform pattern shown below indicates a good parallel injector current flow of 2 amps. See Fig. 4.

Note that if just one injector has a resistance problem and partially shorts, the entire parallel bank that it belongs to will draw more current. This can damage the injector driver.

The waveform pattern in Fig. Fig. 5 indicates this type of problem with too much current flow. This is on other bank of injectors of the same vehicle; the even side. Notice the Lab Scope is set on a one amp

cardiagn.com

per division scale. As you can see, the current is at an unacceptable 2.5 amps.

It is easy to find out which individual injector is at fault. All you need to do is inductively clamp onto each individual injector and compare them. To obtain a known-good value to compare against, we used the good bank to capture the waveform in Fig. **Fig. 6**. Notice that it limits current flow to 750 milliamps.

The waveform shown in Fig. **Fig. 7** illustrates the problem injector we found. This waveform indicates an unacceptable current draw of just over one amp as compared to the 750 milliamp draw of the known-good injector. A subsequent check with a DVOM found 8.2 ohms, which is under the 12 ohm specification.

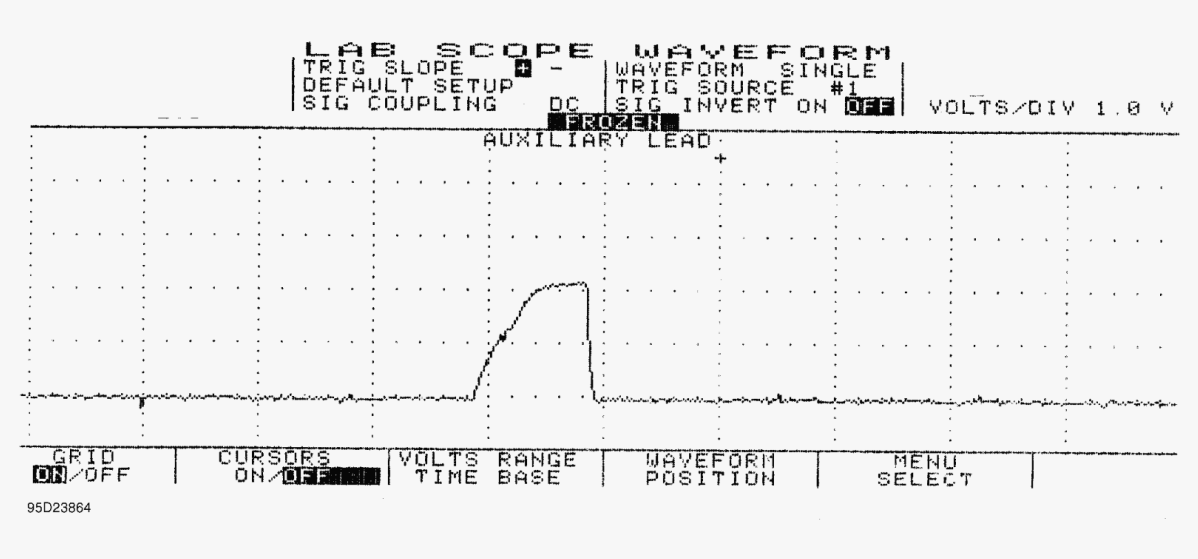


Fig. 4: Injector Bank w/Normal Current Flow - Current Pattern

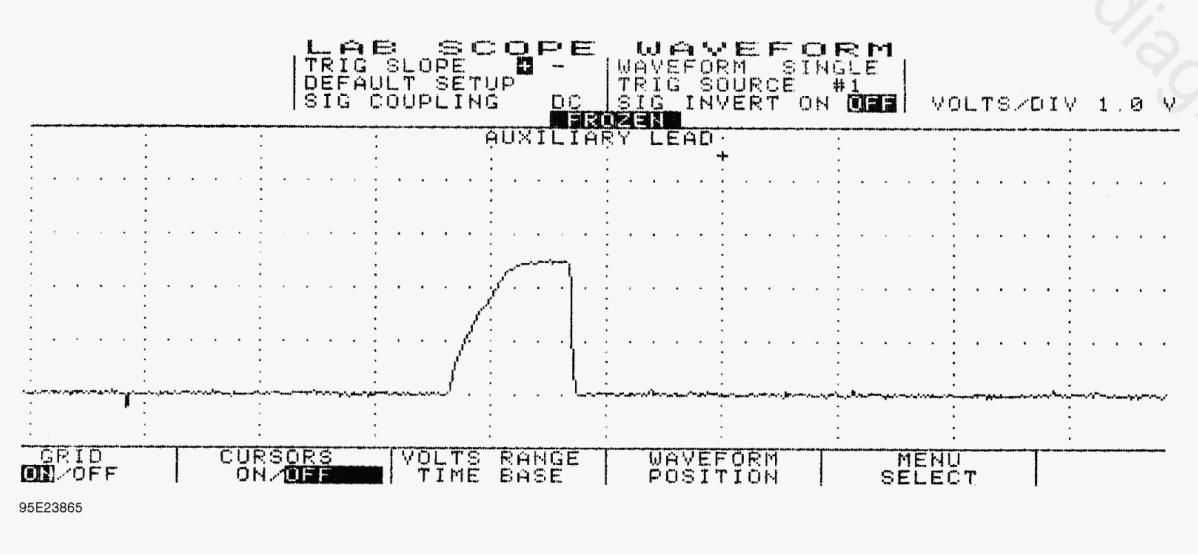


Fig. 5: Injector Bank w/Excessive Current Flow - Current Pattern

cardiagn.com

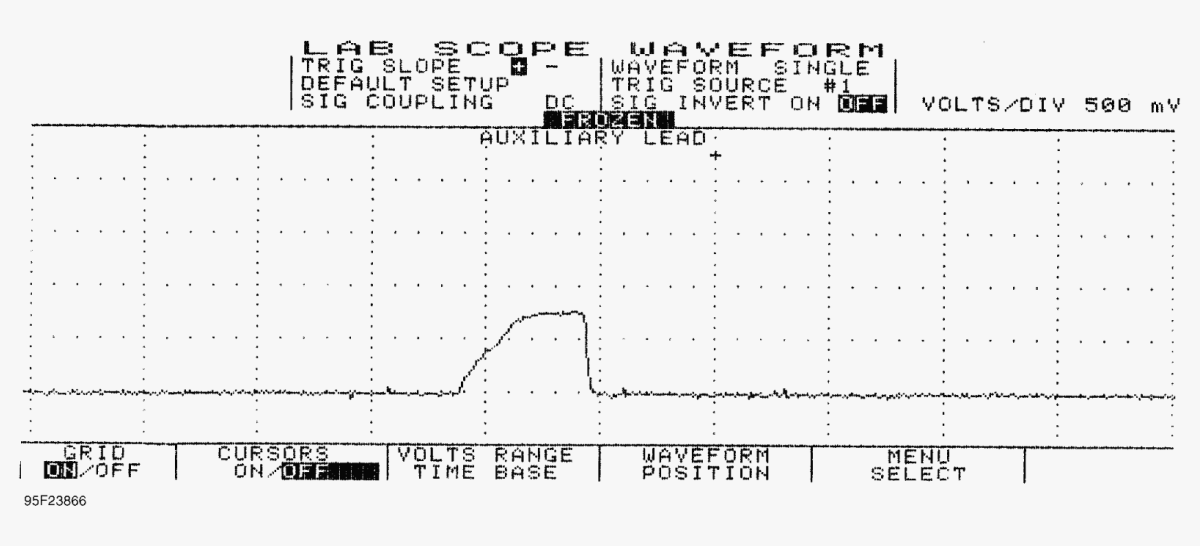


Fig. 6: Single Injector w/Normal Current Flow - Current Pattern

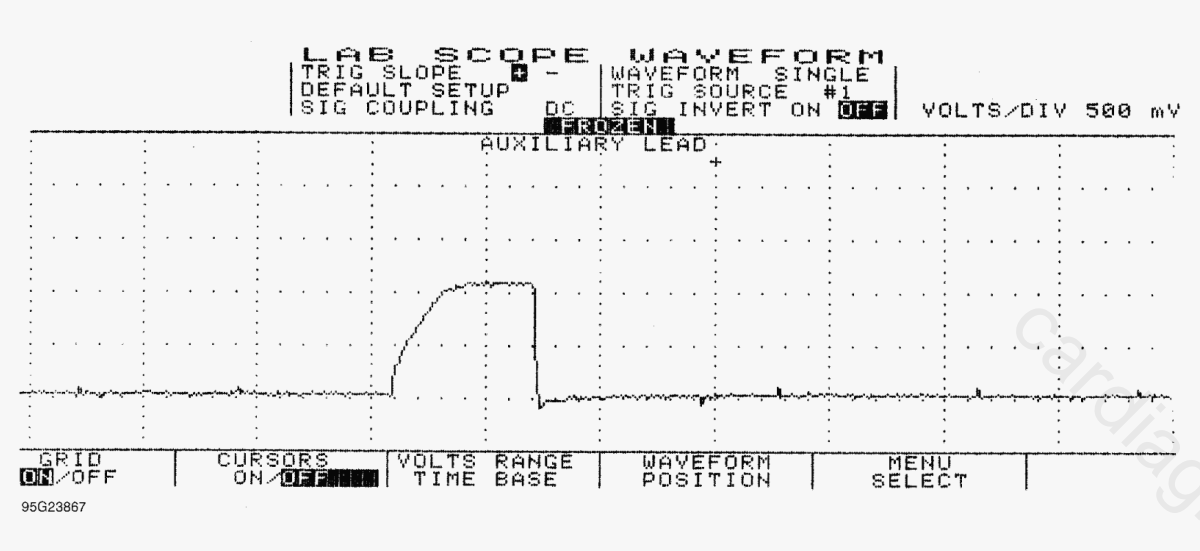


Fig. 7: Single Injector w/Excessive Current Flow - Current Pattern

EXAMPLE #2 - VOLTAGE CONTROLLED DRIVER

This time we will look at a GM 3.1L V6 VIN [T]. Fig. **Fig. 8** shows the 1, 3, 5 (odd) injector bank with the current waveform indicating about a 2.6 amp draw at idle. This pattern, taken from a known good vehicle, correctly stays at or below the maximum 2.6 amps current range. Ideally, the current for each bank should be very close in comparison.

Notice the small dimple on the current flow's rising edge. This is the actual injector opening or what engineers refer to as the "set point." For good idle quality, the set point should be uniform between the banks.

When discussing Ohm's Law as it pertains to this parallel circuit, consider that each injector has specified resistance of 12.2 ohms. Since all three injectors are in parallel the total resistance of this parallel circuit drops to 4.1 ohms. Fourteen volts divided by four ohms would pull a maximum of 3.4 amps on this bank of injectors. However, as we discussed in **EXAMPLE #1** above, other factors knock this value down to roughly the 2.6 amp neighborhood.

Now we are going to take a look at the even bank of injectors; injectors 2, 4, and 6. See **Fig. 9**. Notice this bank peaked at 1.7 amps at idle as compared to the 2.6 amps peak of the odd bank (Fig. **Fig. 8**). Current flow between even and odd injectors banks is not uniform, yet it is not causing a driveability problem. That is because it is still under the maximum amperage we figured out earlier. But be aware this vehicle could develop a problem if the amperage flow increases any more.

Checking the resistance of this even injector group with a DVOM yielded 6.2 ohms, while the odd injector group in the previous example read 4.1 ohms.

cardiagn.com

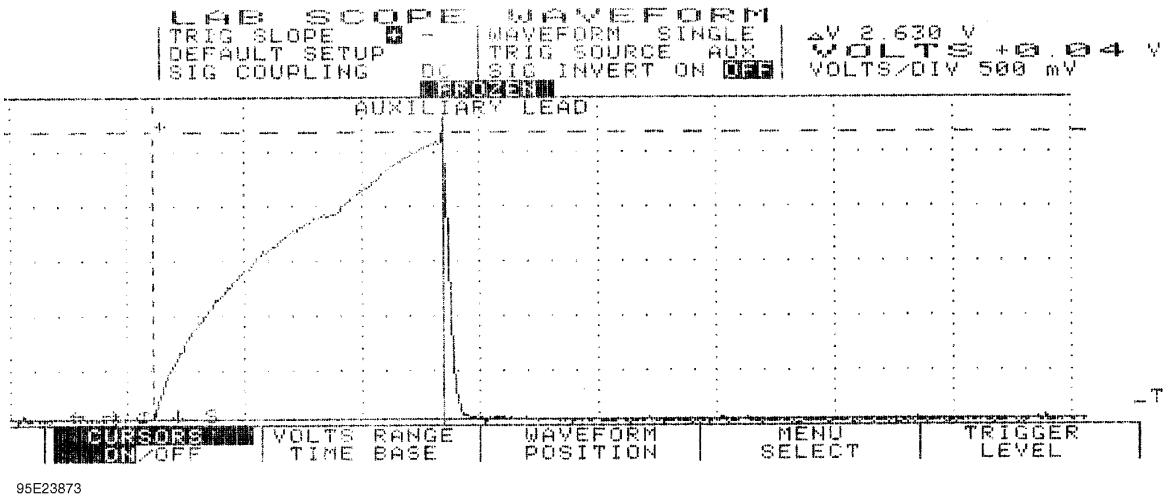


Fig. 8: Injector Odd Bank w/Normal Current Flow - Current Pattern

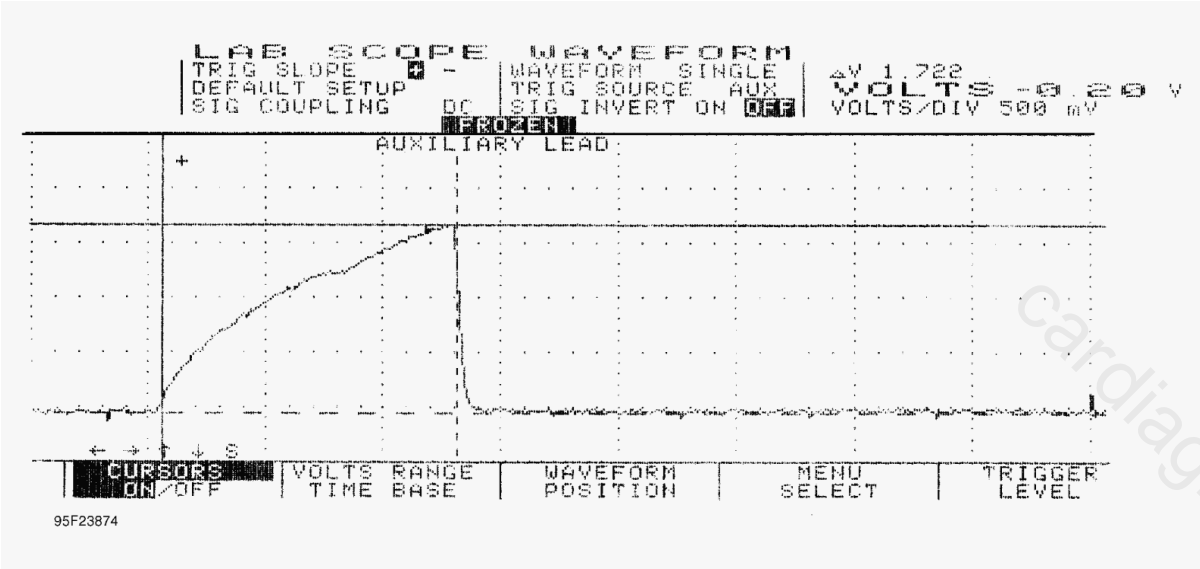


Fig. 9: Injector Even Bank w/Normal Current Flow - Current Pattern

EXAMPLE #3 - VOLTAGE CONTROLLED DRIVER

Example #3 is of a Ford 5.0L V8 SEFI. Fig. **Fig. 10** shows a waveform of an individual injector at idle with the Lab Scope set on 200 milliamps per division. Notice the dimple in the rising edge. This dimple indicates the actual opening of the injector (set point) occurred at 400 milliamps and current peaked at 750 milliamps. This is a good specification for this engine.

The next waveform pattern in Fig. **Fig. 11** shows an abnormality with another injector. With the Lab Scope set on 500 milliamps per division, you can see that the current waveform indicates a 1200 milliamp draw. This is a faulty injector.

Abnormally low resistance injectors create excessive current draw, causing rough idle, and possible computer driver damage.

cardiagn.com

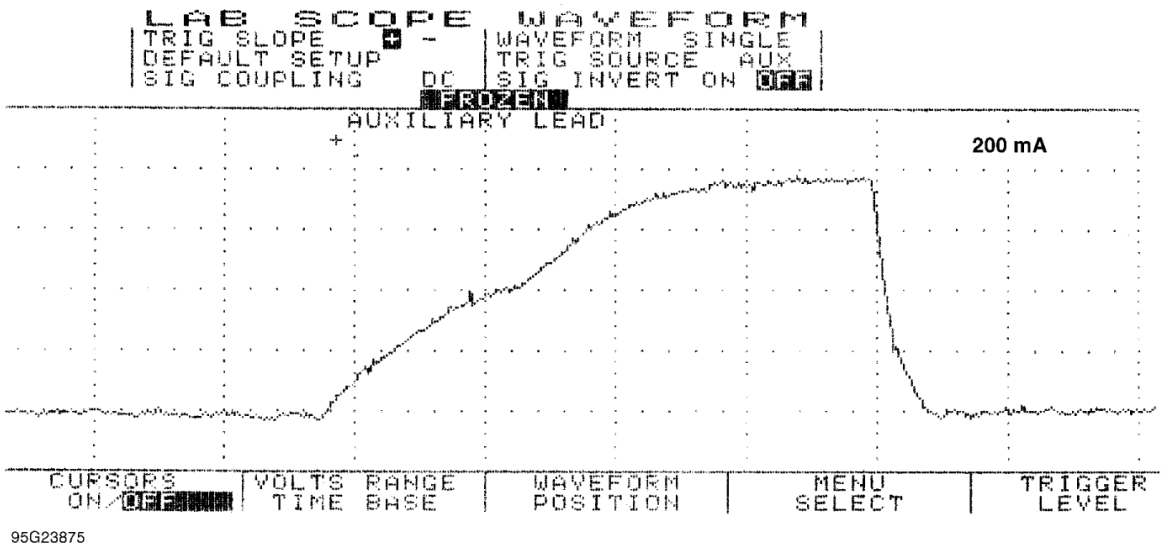


Fig. 10: Single Injector w/Normal Current Flow - Current Pattern

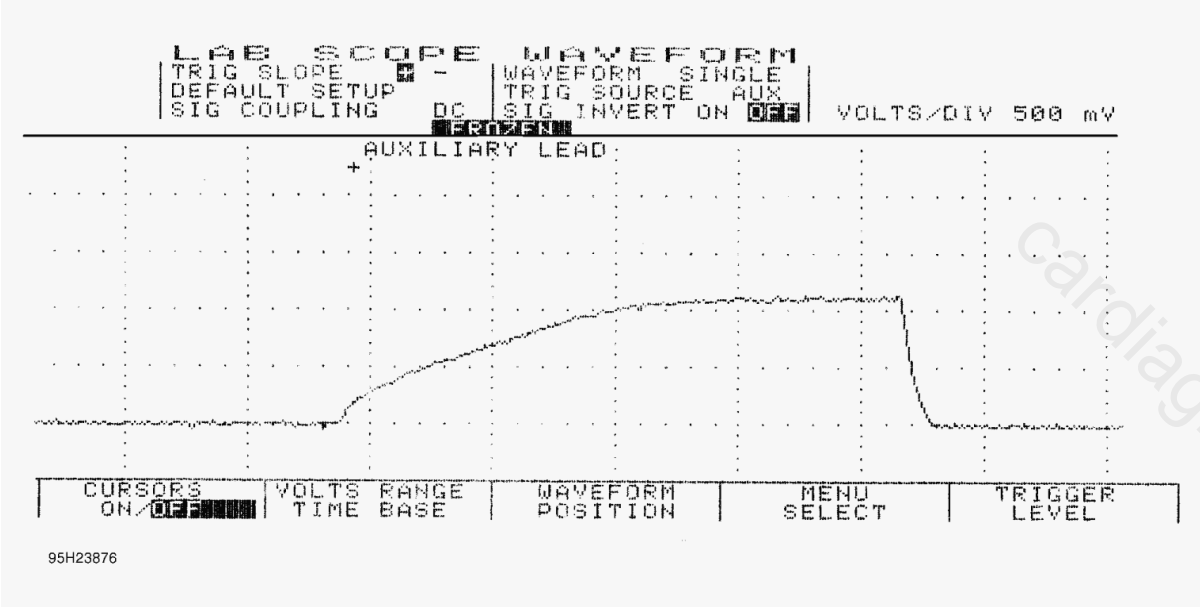


Fig. 11: Single Injector w/Excessive Current Flow - Current Pattern

EXAMPLE #4 - CURRENT CONTROLLED DRIVER

Example #4 is of a Ford 4.6L SEFI VIN [W]. See **Fig. 12** for the known-good waveform pattern. This Ford system is different from the one above in **EXAMPLE #3** as it peaks at 900 milliamps and the actual opening of the injector (set point) is just below 600 milliamps.

This is offered as a comparison against the Ford pattern listed above, as they are both Ford SEFI injectors but with different operating ranges. The point is that you should not make any broad assumptions for any manufacturer.

cardiagn.com

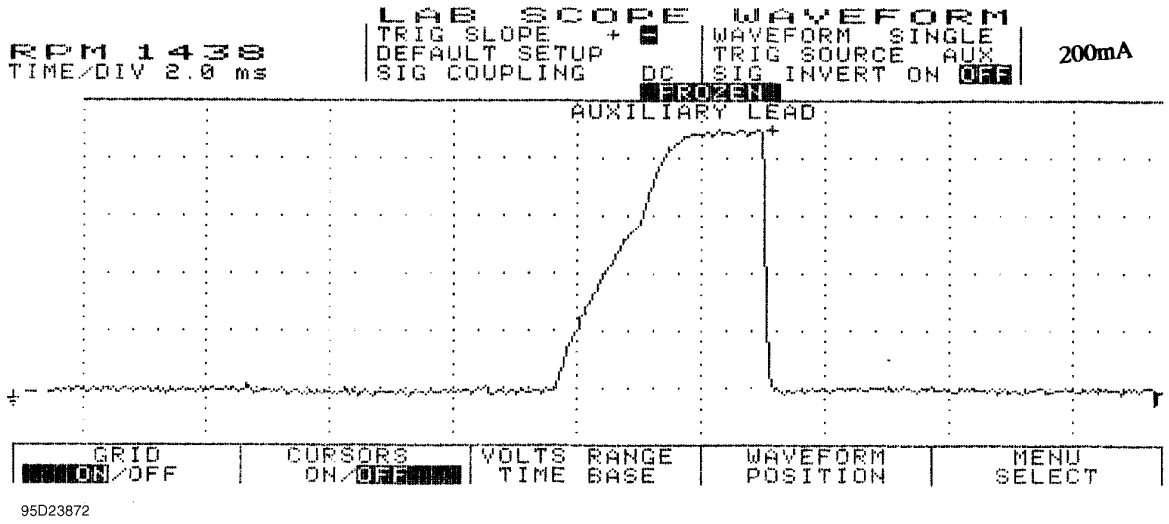


Fig. 12: Single Injector w/Normal Current Flow - Current Pattern

EXAMPLE #5 - CURRENT CONTROLLED DRIVER

The known-good waveform in Fig. **Fig. 13** is from a Chrysler 3.0L V6 PFI VIN [3]. It is a perfect example of the peak and hold theory. The waveform shows a 1-amp per division current flow, ramping to 4 amps and then decreasing to 1-amp to hold the injector open.

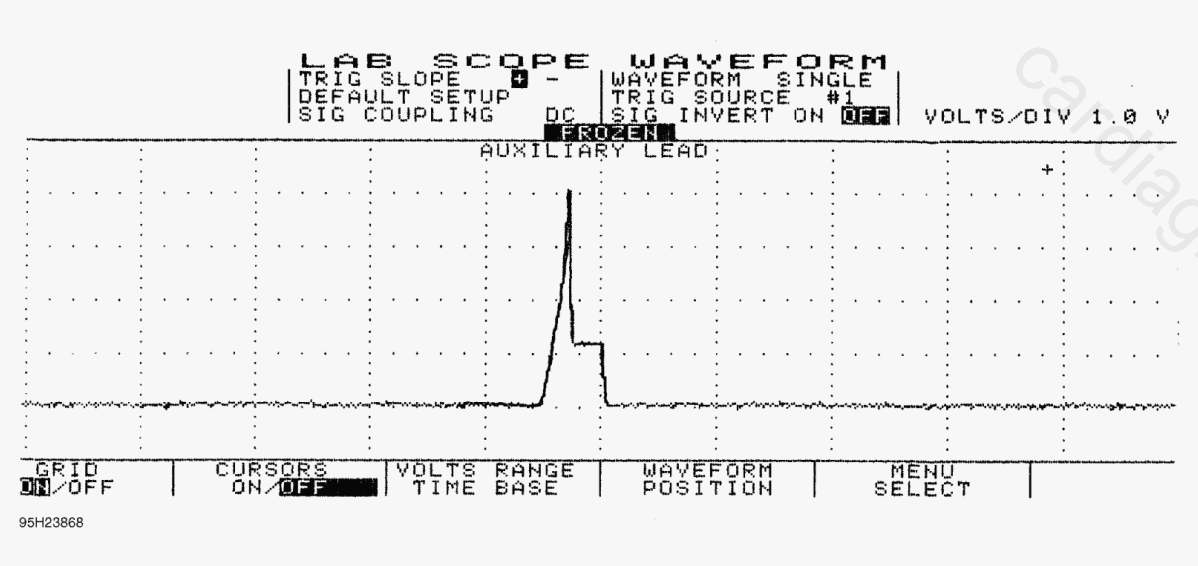


Fig. 13: Injector Bank w/Normal Current Flow - Current Pattern

EXAMPLE #6 - CURRENT CONTROLLED DRIVER

This next known-good waveform is from a Ford 5.0L V8 CFI VIN [F]. See **Fig. 14**. The pattern, which is set on a 250 milliamps scale, indicates a 1.25 amp peak draw and a hold at 350 milliamps.

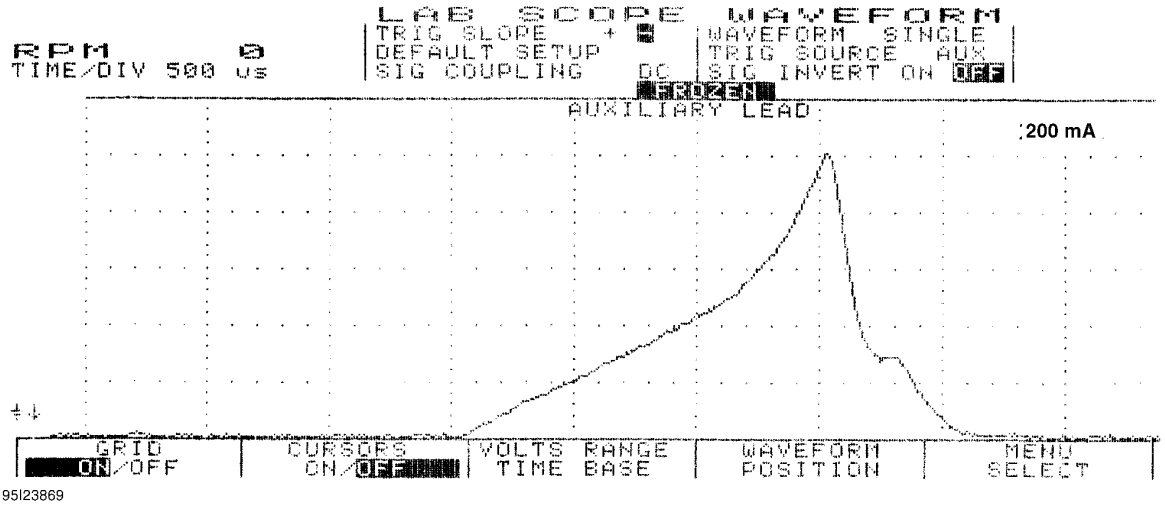


Fig. 14: Single Injector w/Normal Current Flow - Current Pattern

EXAMPLE #7 - CURRENT CONTROLLED DRIVER

The known-good current controlled type waveform in Fig. **Fig. 15** is from a GM 2.0L TBI VIN [1]. With the lab scope set at 2 amps per division, notice that this system peaks at 4 amps and holds at 1 amp.

The next waveform is from the same type of engine, except that it shows a faulty injector. See **Fig. 16**. Notice that the current went to almost 5 amps and stayed at 1 amp during the hold pattern. Excessive amounts of current flow from bad injectors are a common source of intermittent computer shutdown. Using a current waveform pattern is the most accurate method of pinpointing this problem.

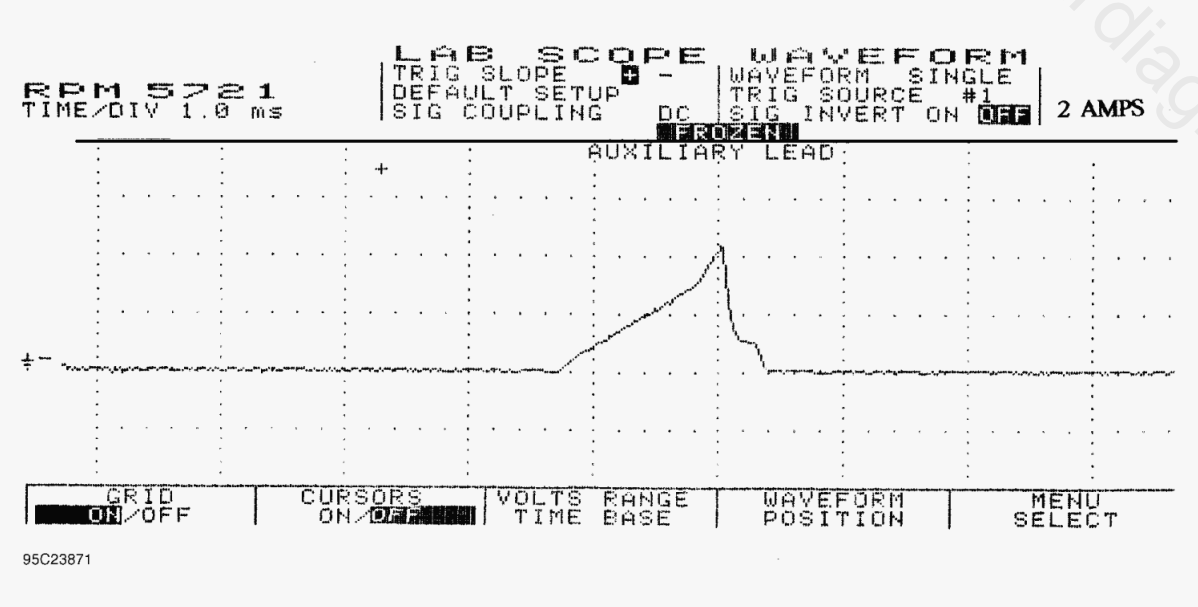


Fig. 15: Single Injector w/Normal Current Flow - Current Pattern

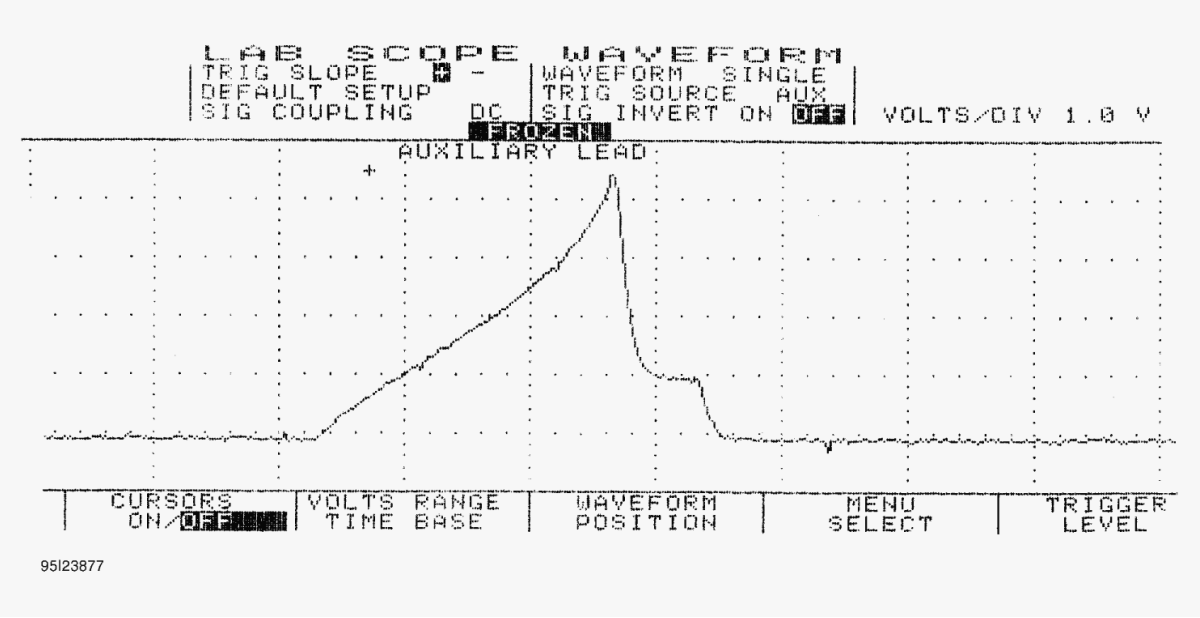
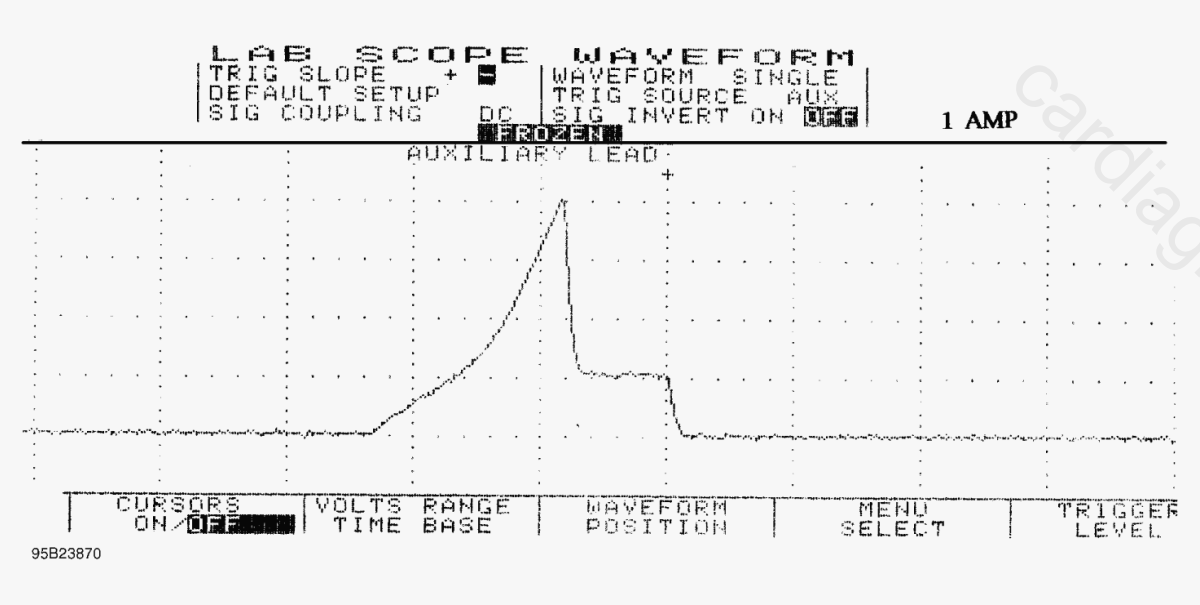


Fig. 16: Single Injector w/Excessive Current Flow - Current Pattern

EXAMPLE #8 - CURRENT CONTROLLED DRIVER

This known-good CPI system waveform from a GM 4.3L V6 CPI VIN [W] peaks at 4 amps and holds at 1-amp. See **Fig. 17** for waveform.



cardiagn.com

Fig. 17: Single Injector w/Normal Current Flow - Current Pattern

VOLTAGE WAVEFORM SAMPLES

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

EXAMPLE #1 - VOLTAGE CONTROLLED DRIVER

These two known-good waveform patterns are from a Ford 4.6L V8 VIN [W]. Fig. **Fig. 18** illustrates the 64 volt inductive kick on this engine, indicating no clamping is occurring. The second pattern, Fig. **Fig. 19**, was taken during hot idle, closed loop, and no load.

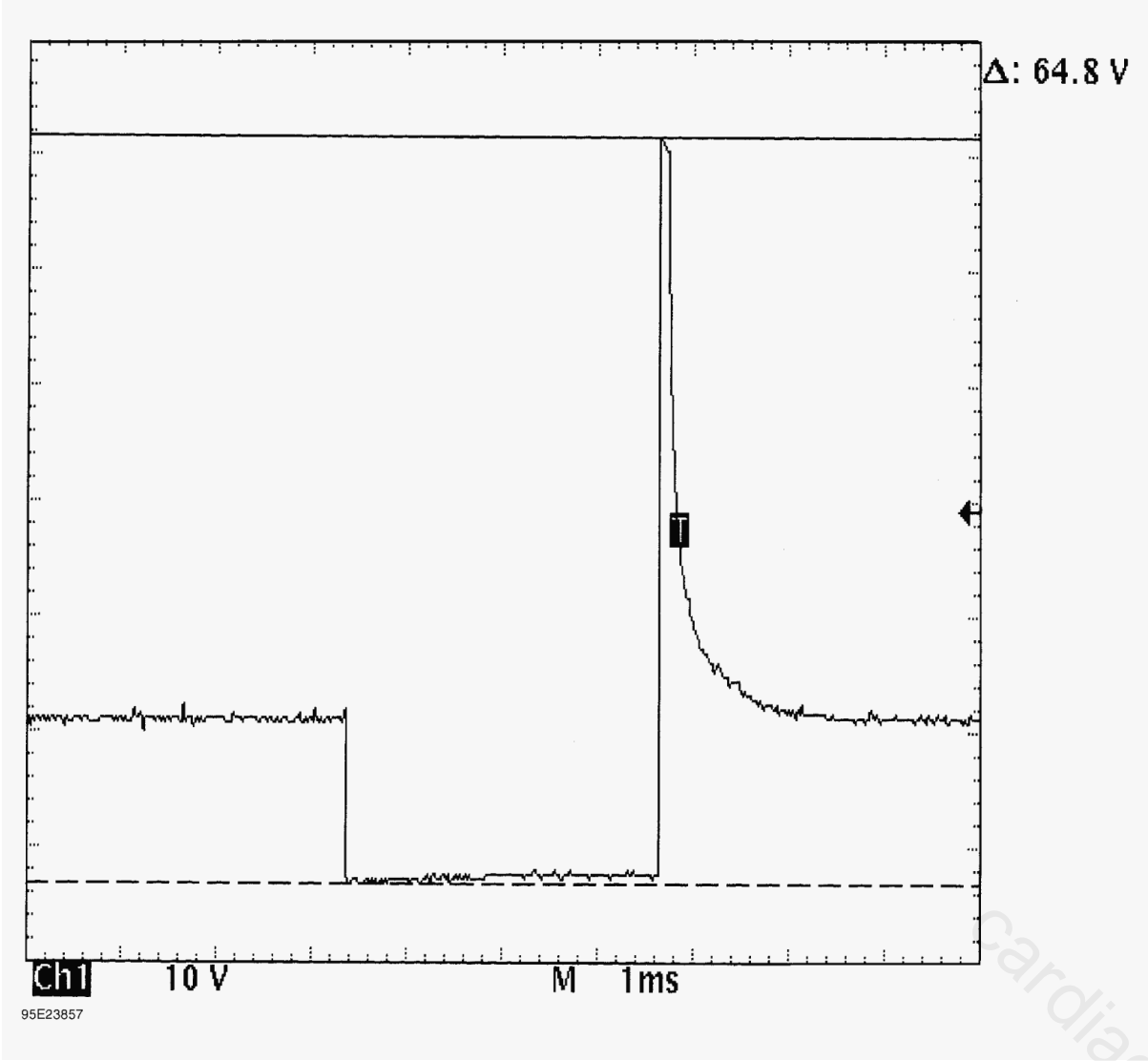


Fig. 18: Injector Bank - Known Good - Voltage Pattern

.cardiagn.com

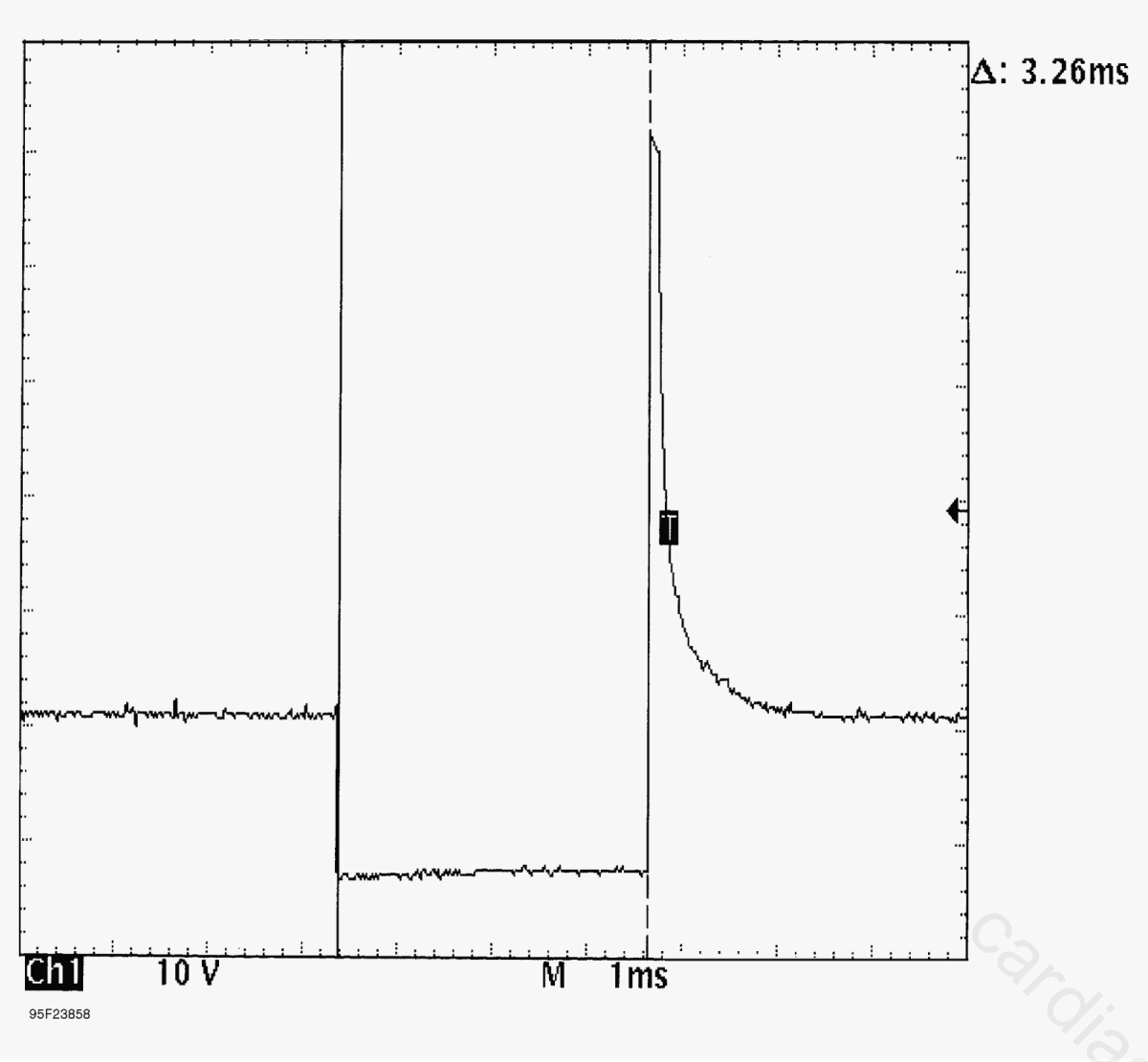


Fig. 19: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #2 - VOLTAGE CONTROLLED DRIVER

The known-good waveform pattern in Fig. **Fig. 20** is from a GM 3.8L V6 PFI VIN [3]. It was taken during hot idle, closed loop and no load.

cardiagn.com

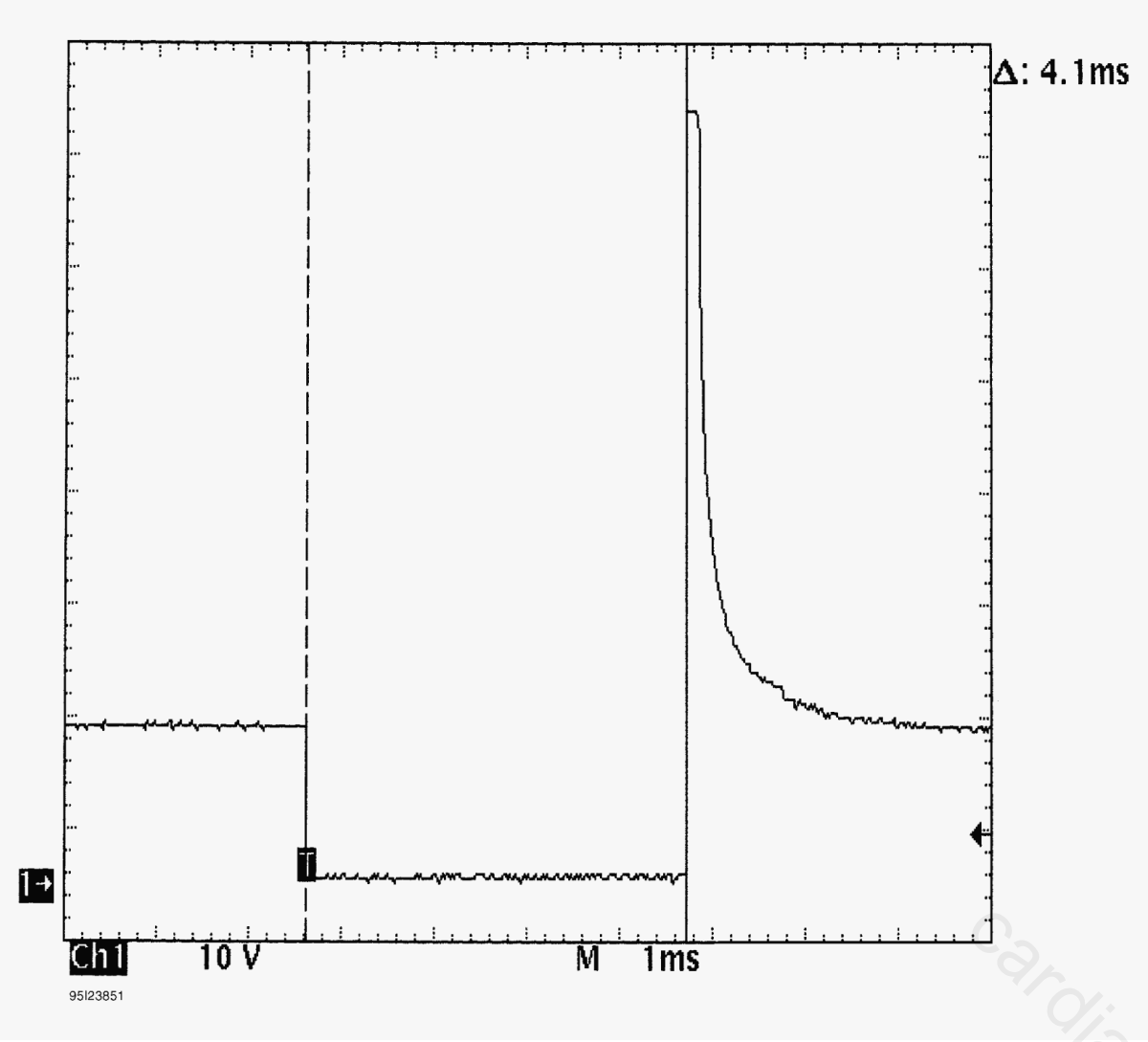


Fig. 20: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #3 - VOLTAGE CONTROLLED DRIVER

This known-good waveform pattern, Fig. **Fig. 21**, is from a GM 5.0L V8 TPI VIN [F]. It was taken during hot idle, closed loop and no load.

cardiagn.com

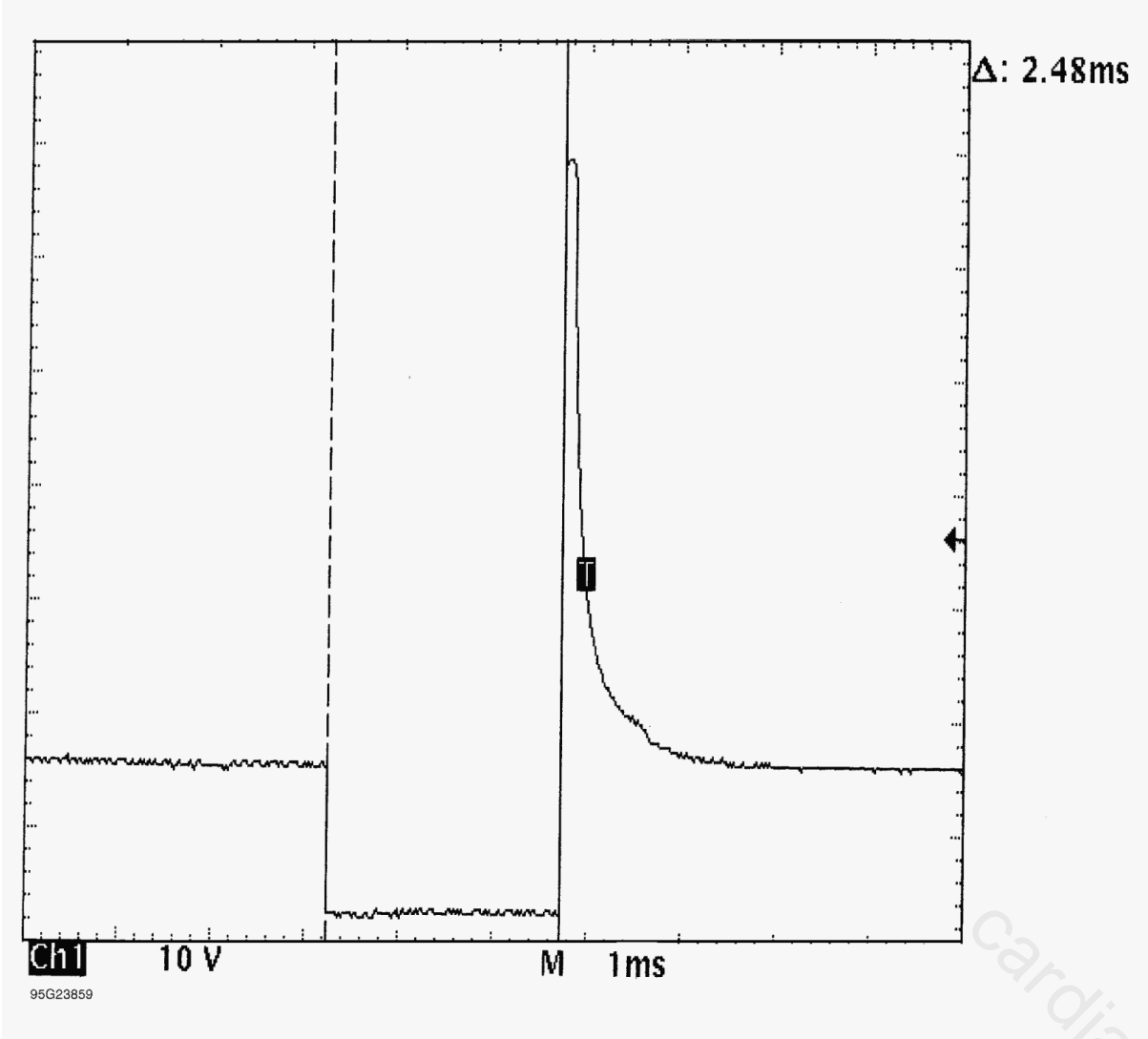


Fig. 21: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #4 - CURRENT CONTROLLED DRIVER

From 1984 to 1987, Chrysler used this type injector drive on their TBI-equipped engines. See **Fig. 22** for a known-good pattern. Instead of the ground side controlling the injector, Chrysler permanently grounds out the injector and switches the power feed side. Most systems do not work this way.

These injectors peak at 6 amps of current flow and hold at 1 amp.

cardiagn.com

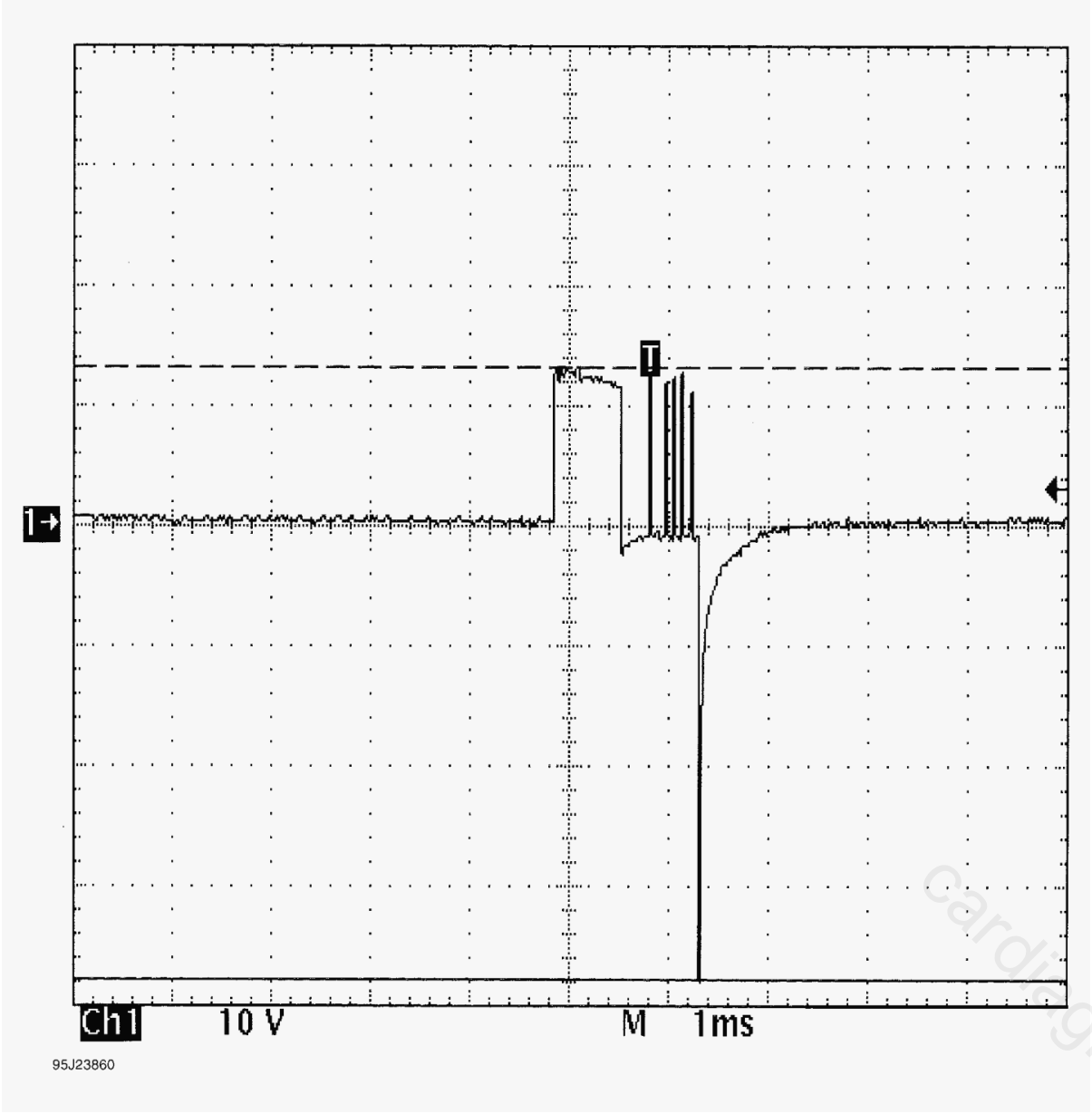
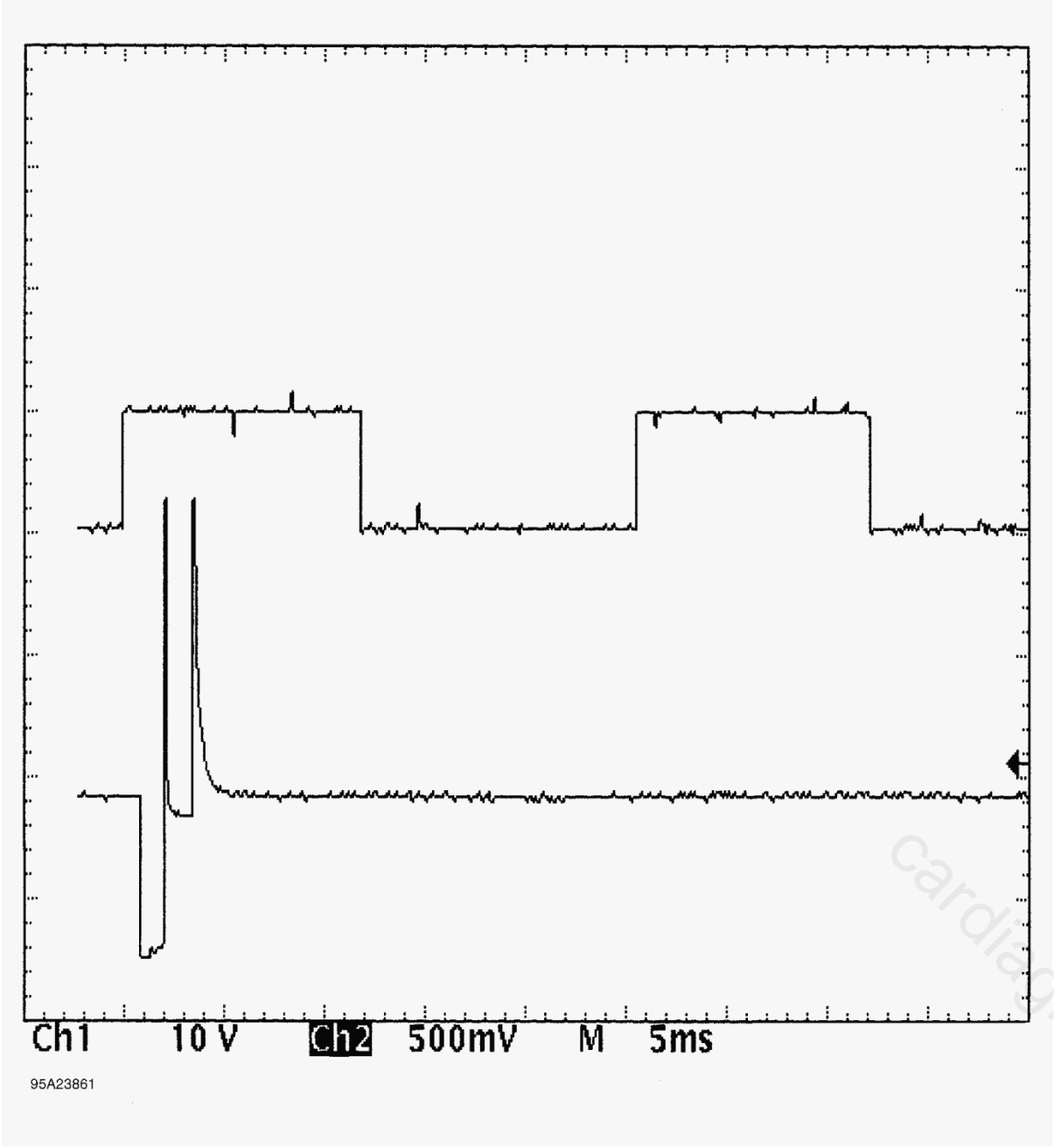


Fig. 22: Single Injector - Known Good - Voltage Pattern

EXAMPLE #5 - CURRENT CONTROLLED DRIVER

These two known-good waveform patterns are from a Chrysler 3.0L V6 VIN [3]. The first waveform, Fig. **Fig. 23**, is a dual trace pattern that illustrates how Chrysler uses the rising edge of the engine speed signal to trigger the injectors. The second waveform, Fig. **Fig. 24**, was taken during hot idle, closed loop, and no load.

cardiagn.com



cardiagn.com

Fig. 23: Injector Bank - Known Good - Voltage Pattern

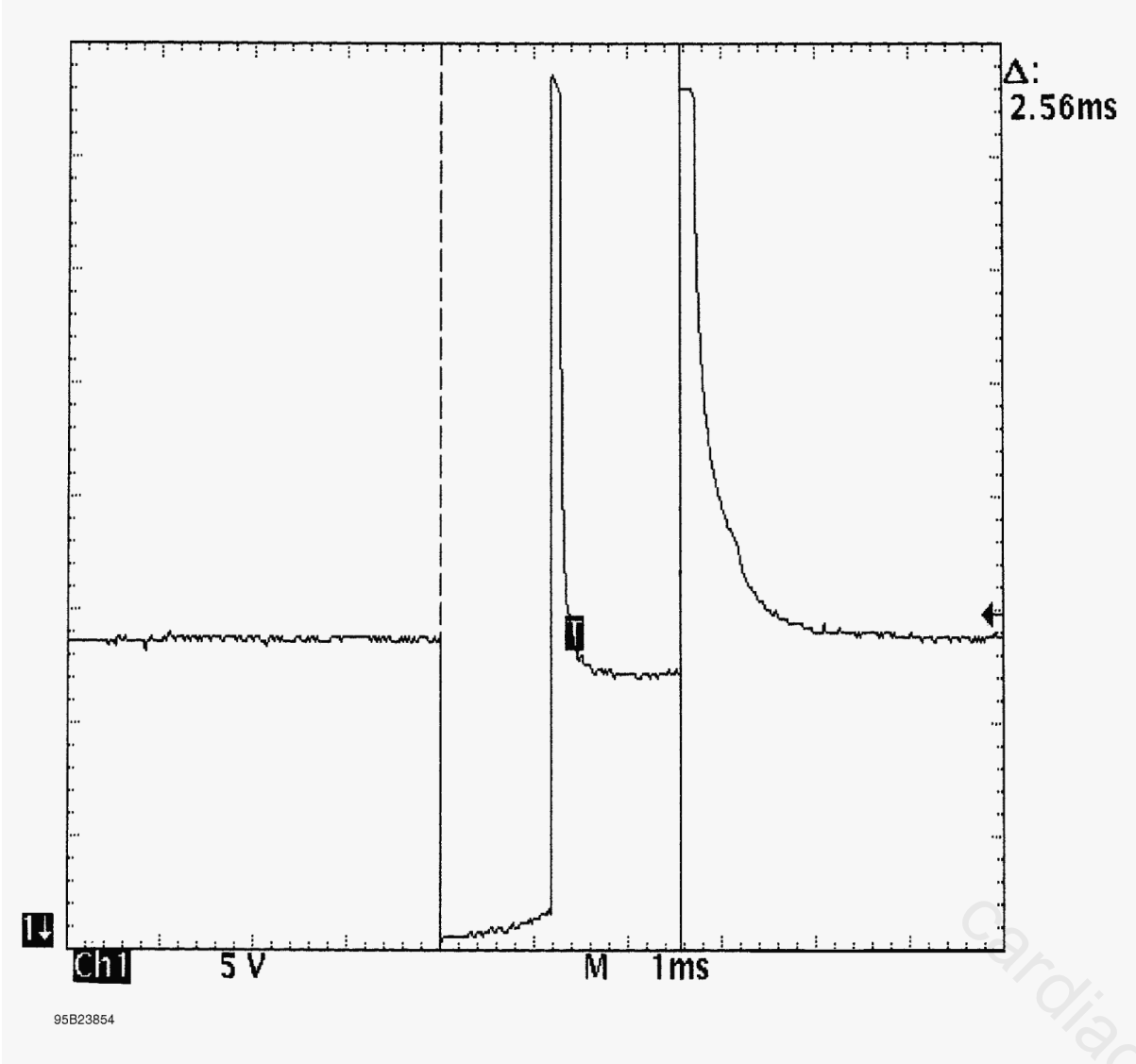


Fig. 24: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #6 - CURRENT CONTROLLED DRIVER

This known-good pattern from a Ford 3.0L V6 PFI VIN [U] illustrates that a zener diode inside the computer is used to clamp the injector's inductive kick to 35-volts on this system. See **Fig. 25**.

Cardiagn.com

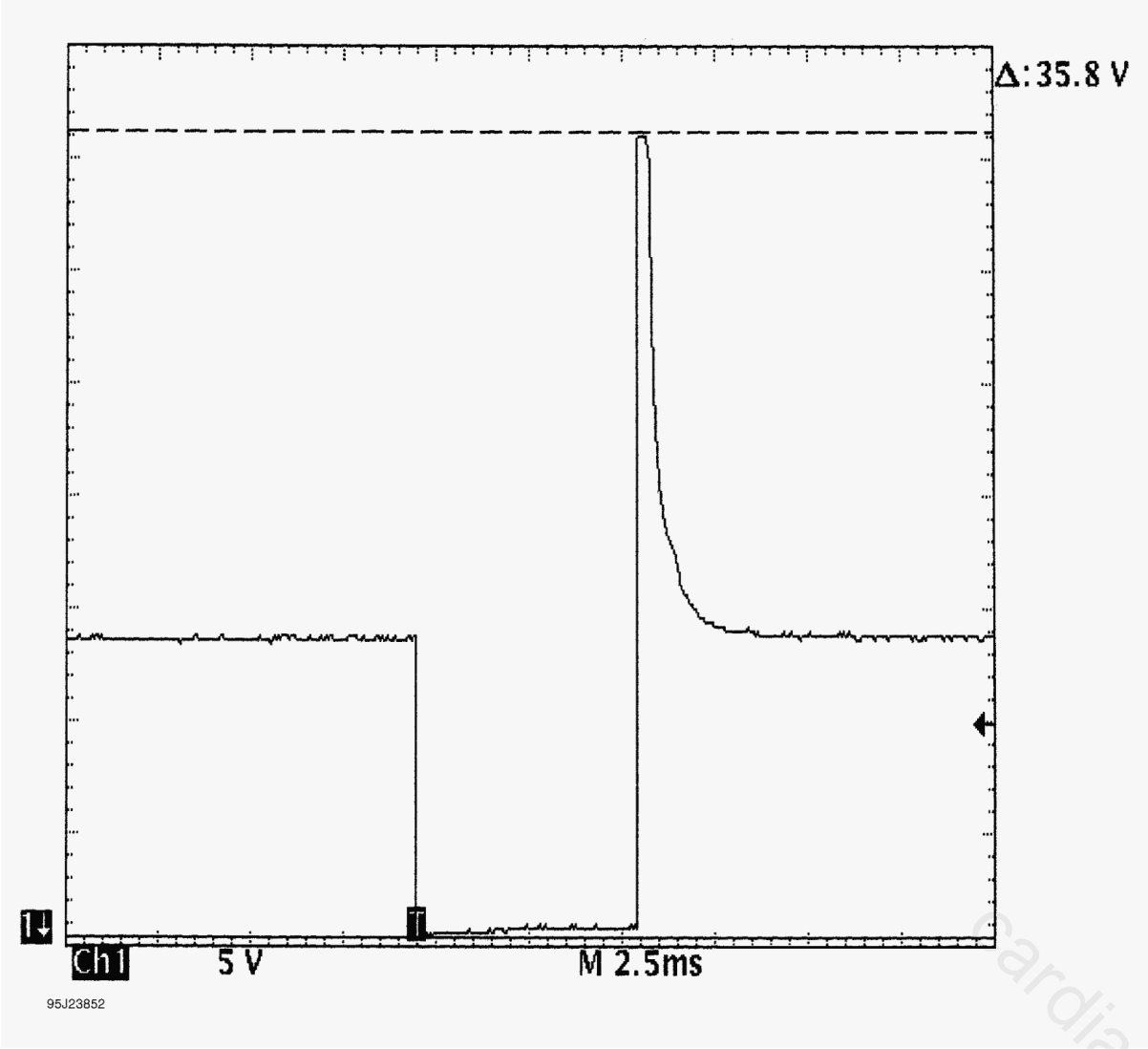


Fig. 25: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #7 - CURRENT CONTROLLED DRIVER

This known-good waveform from a Ford 5.0L V8 CFI VIN [F] was taken during hot idle, closed loop, and no load. See **Fig. 26**.

cardiagn.com

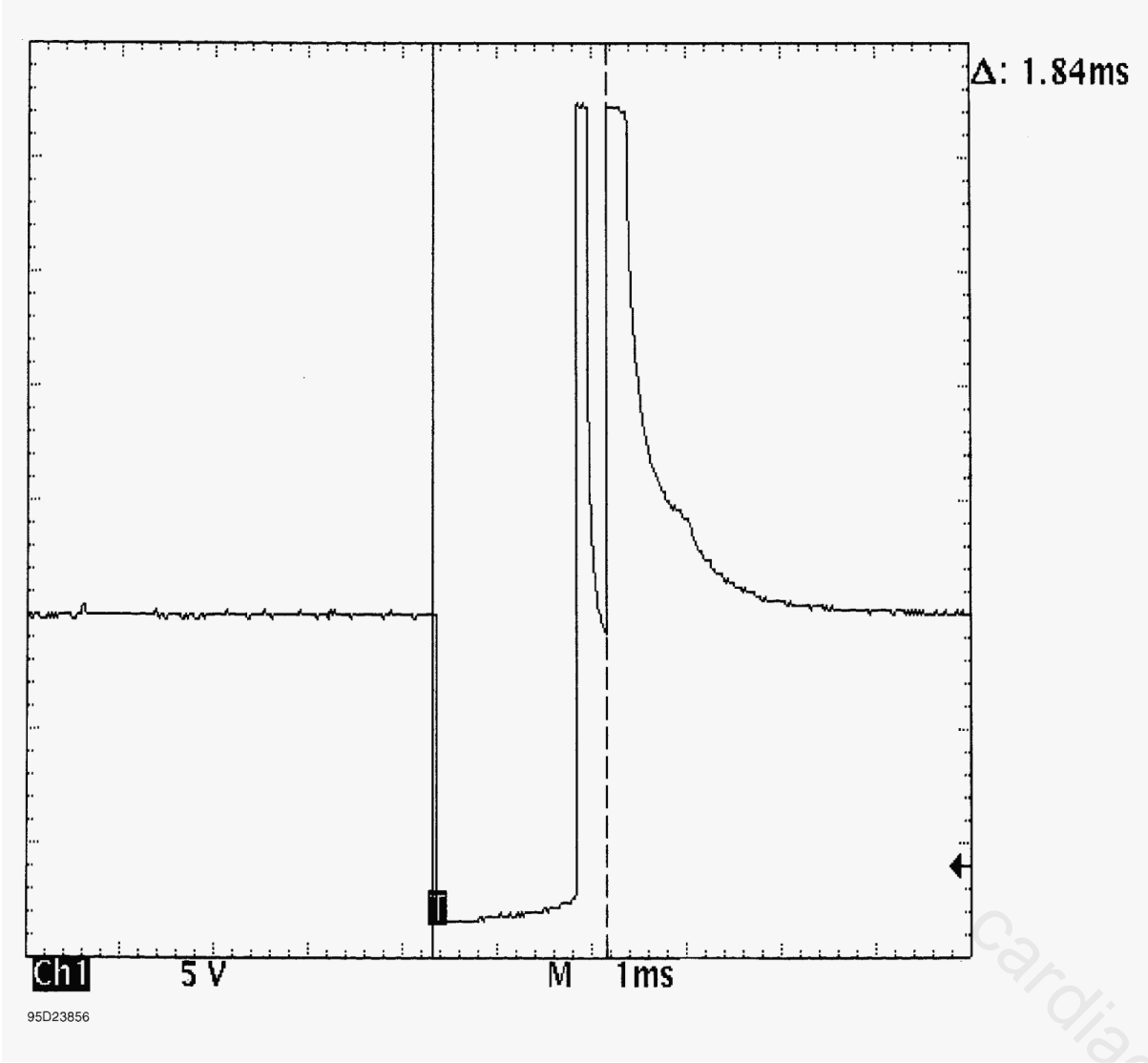


Fig. 26: Single Injector - Known Good - Voltage Pattern

EXAMPLE #8 - CURRENT CONTROLLED DRIVER

These two known-good waveform patterns are from a GM 2.0L In-Line 4 VIN [1]. Fig. **Fig. 27** illustrates the 78 volt inductive spike that indicates a zener diode is not used. The second waveform, Fig. **Fig. 28**, was taken during hot idle, closed loop, and no load.

cardiagn.com

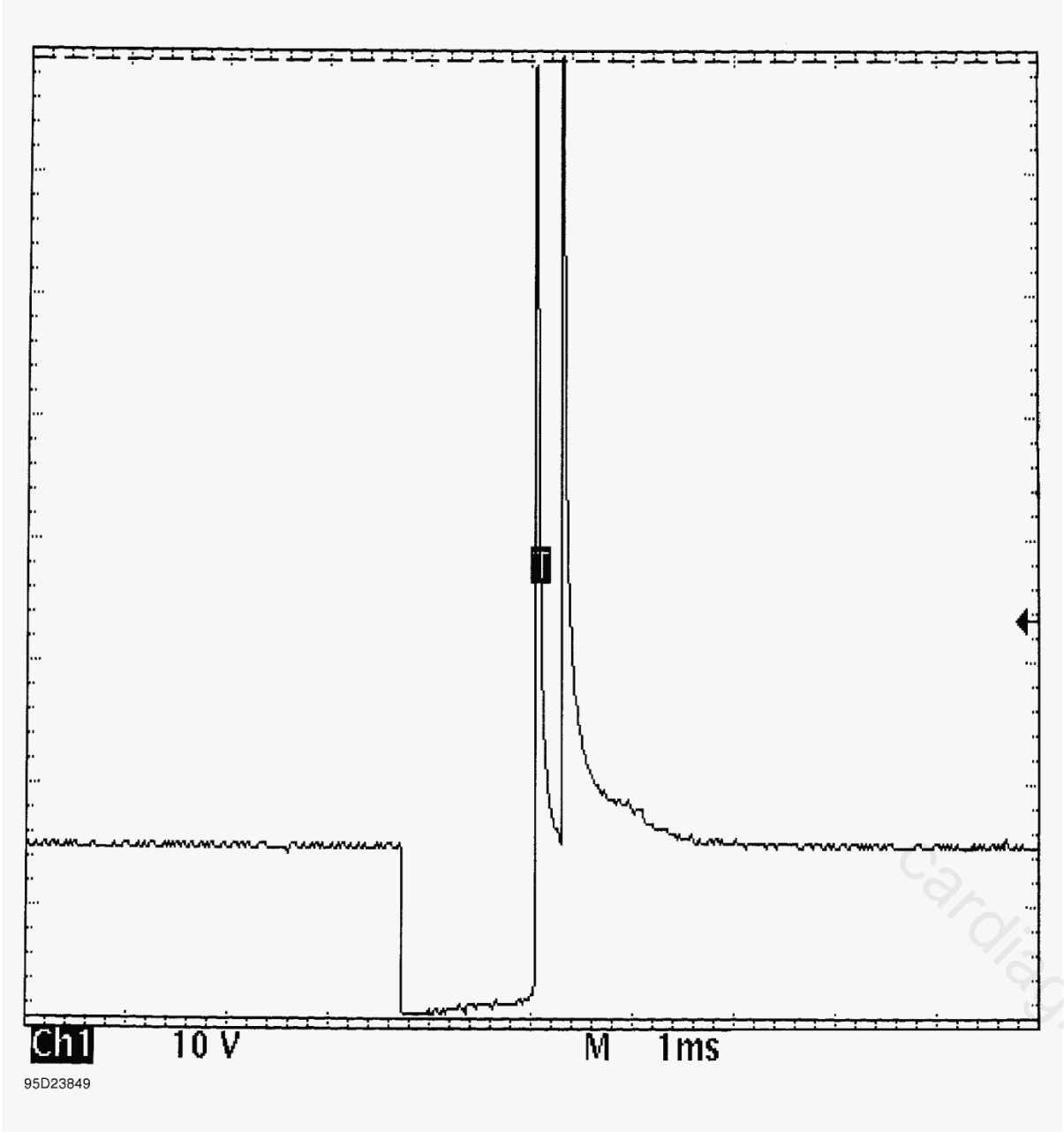


Fig. 27: Single Injector - Known Good - Voltage Pattern

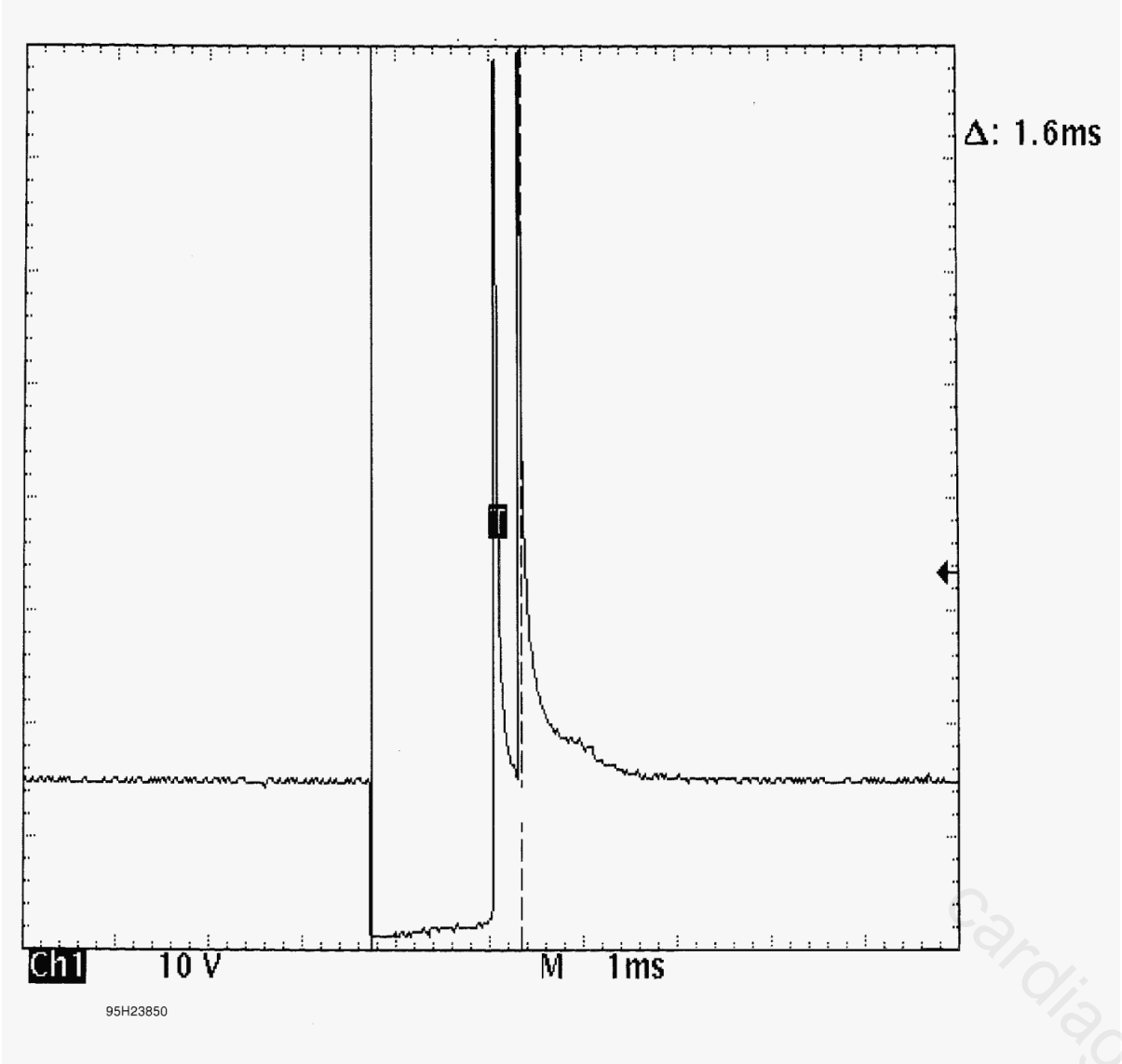


Fig. 28: Single Injector - Known Good - Voltage Pattern

.cardiagn.com

Back To Article

GENERAL INFORMATION

Wheel Alignment Theory & Operation

* PLEASE READ THIS FIRST *

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

PRE-ALIGNMENT INSTRUCTIONS

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

GENERAL ALIGNMENT CHECKS

Before adjusting wheel alignment, check the following:

- Each axle uses tires of same construction and tread style, equal in tread wear and overall diameter. Verify that radial and axial runout is not excessive. Inflation should be at manufacturer's specifications.
- Steering linkage and suspension must not have excessive play. Check for wear in tie rod ends and ball joints. Springs must not be sagging. Control arm and strut rod bushings must not have excessive play. See **Fig. 1**.

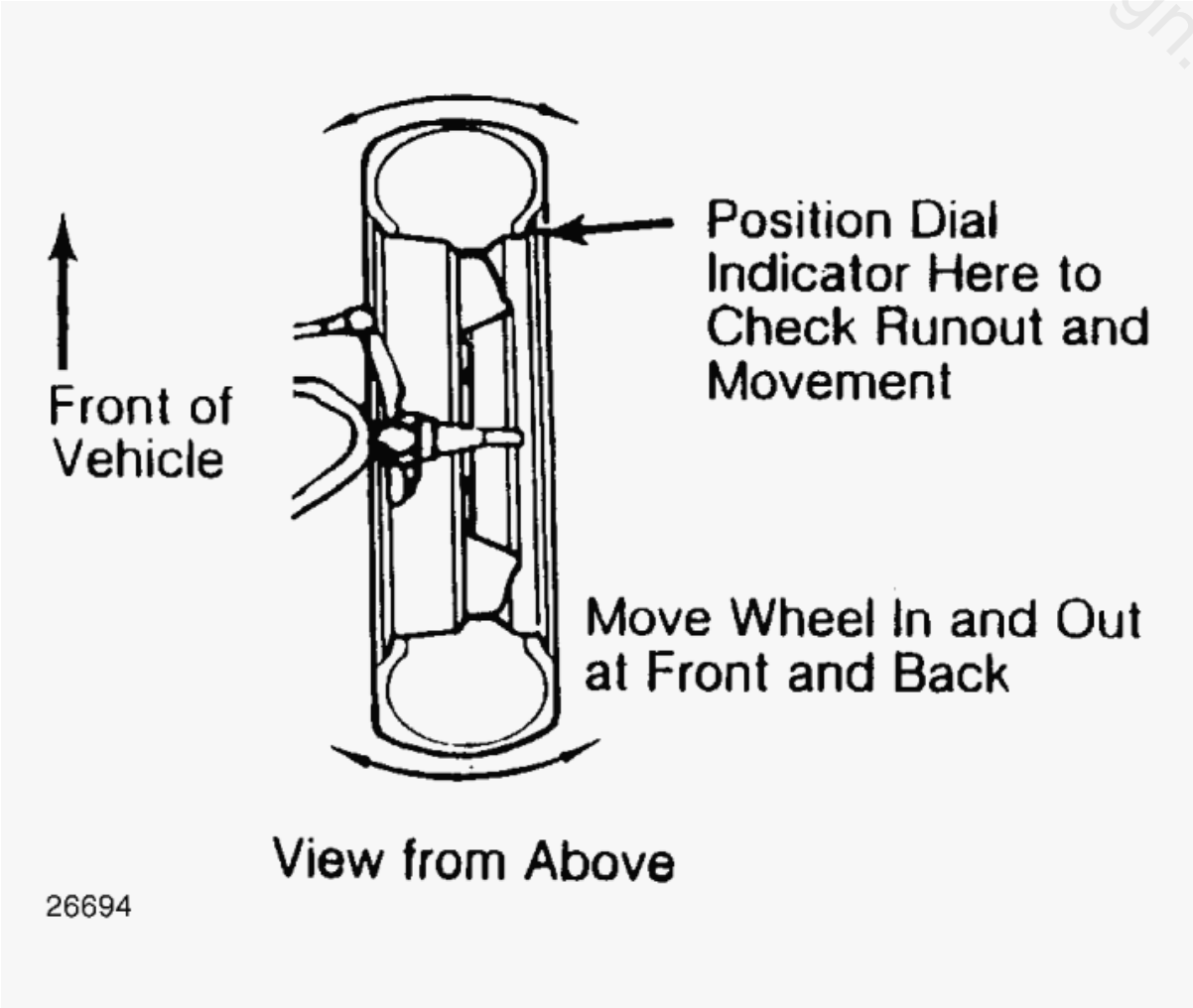


Fig. 1: Checking Steering Linkage

carbiagn.com

- Vehicle must be on level floor with full fuel tank, no passenger load, spare tire in place and no load in trunk. Bounce front and rear end of vehicle several times. Confirm vehicle is at normal riding height.
- Steering wheel must be centered with wheels in straight ahead position. If required, shorten one tie rod adjusting sleeve and lengthen opposite sleeve (equal amount of turns). See **Fig. 2**.
- Wheel bearings should have the correct preload and lug nuts must be tightened to manufacturer's specifications. Adjust camber, caster and toe-in using this sequence. Follow instructions of the alignment equipment manufacturer.

CAUTION: **DO NOT attempt to correct alignment by straightening parts. Damaged parts MUST be replaced.**

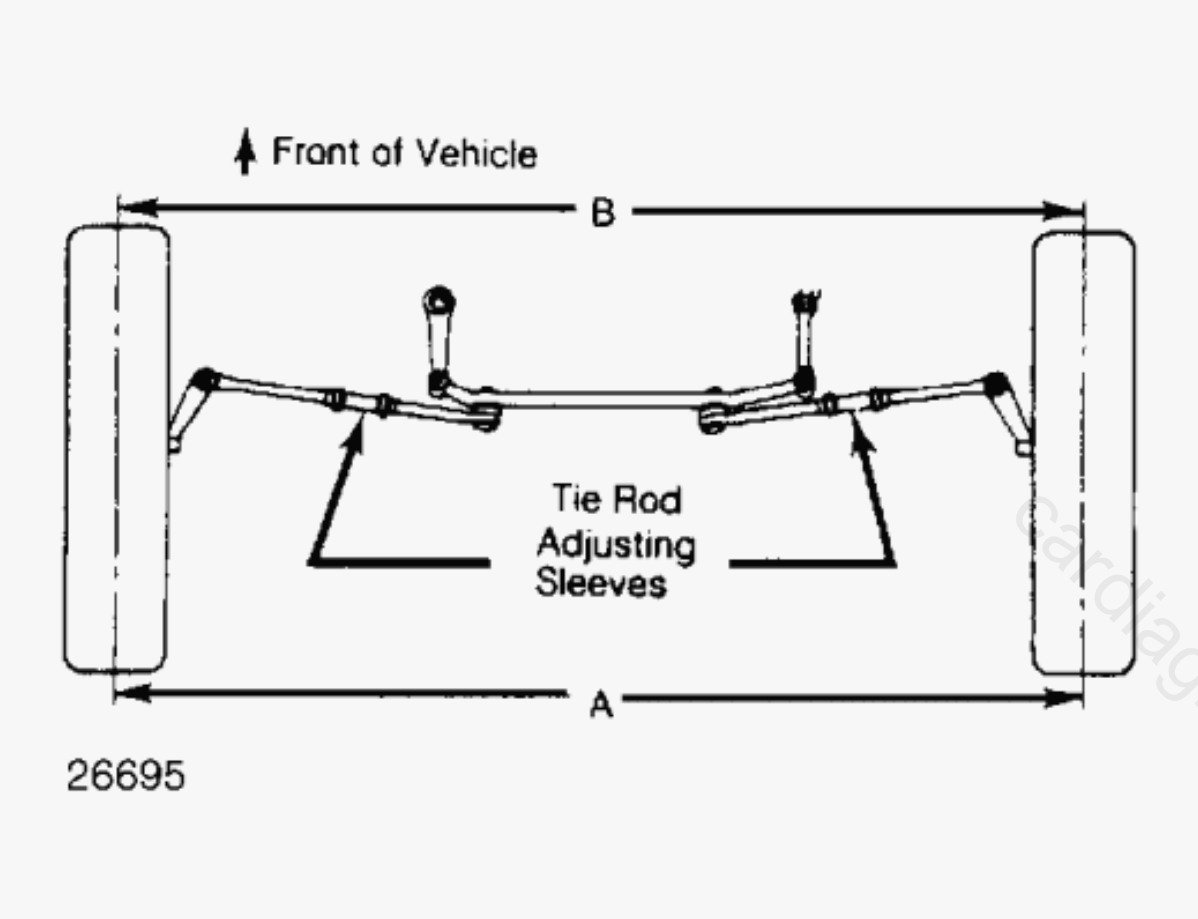


Fig. 2: Adjusting Tie Rod Sleeves (Top View)

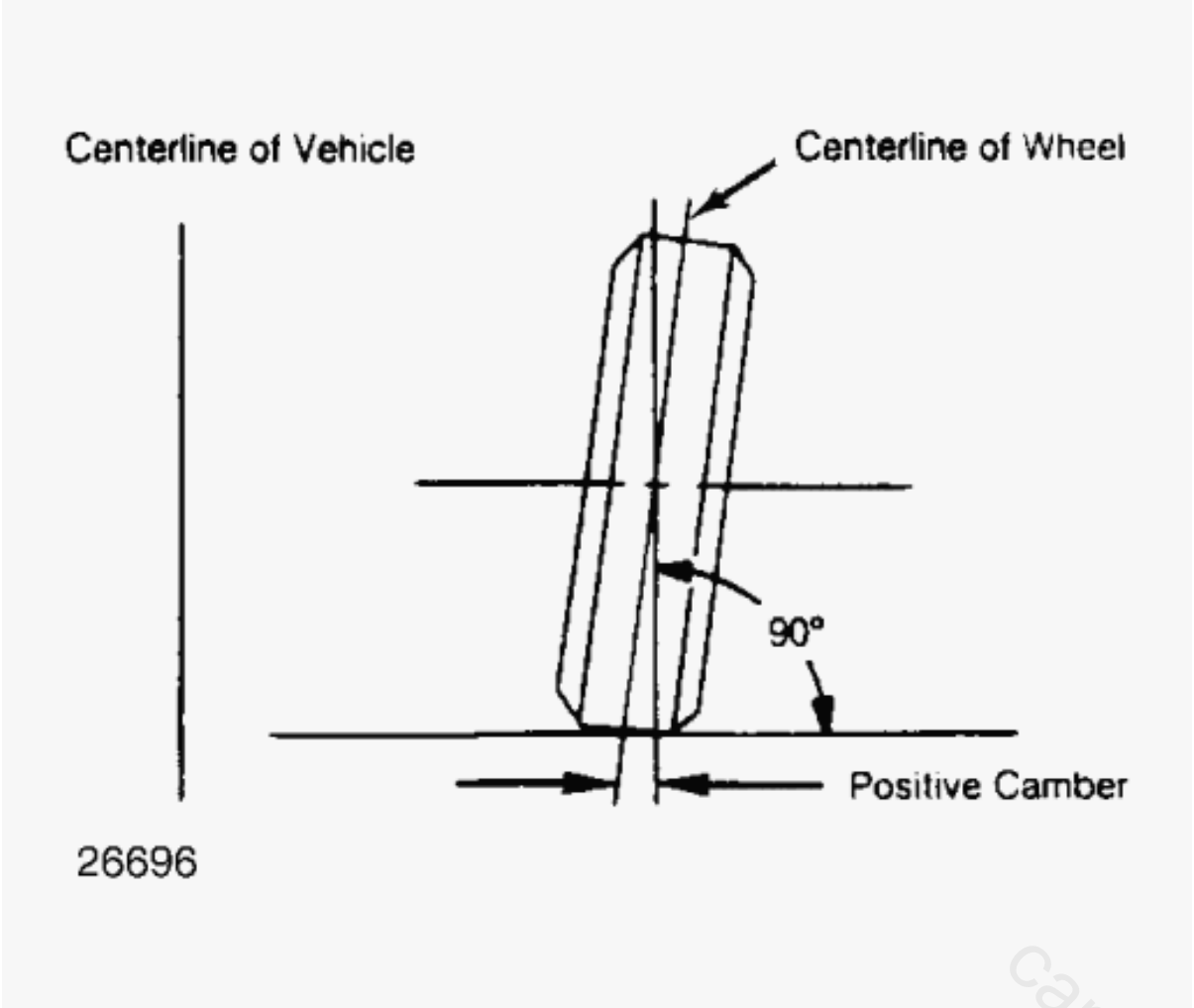
ADJUSTMENTS

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

CAMBER

1. Camber is the tilting of the wheel, outward at either top or bottom, as viewed from front of vehicle. See **Fig. 3**.
2. When wheels tilts outward at the top (from centerline of vehicle), camber is positive. When wheels tilt inward at top, camber is negative. Amount of tilt is measured in degrees from vertical.

carojagn.com



cardiagn.com

Fig. 3: Determining Camber Angle

CASTER

1. Caster is tilting of front steering axis either forward or backward from vertical, as viewed from side of vehicle. See **Fig. 4**.
2. When axis is tilted backward from vertical, caster is positive. This creates a trailing action on front wheels. When axis is tilted forward, caster is negative, causing a leading action on front wheels.

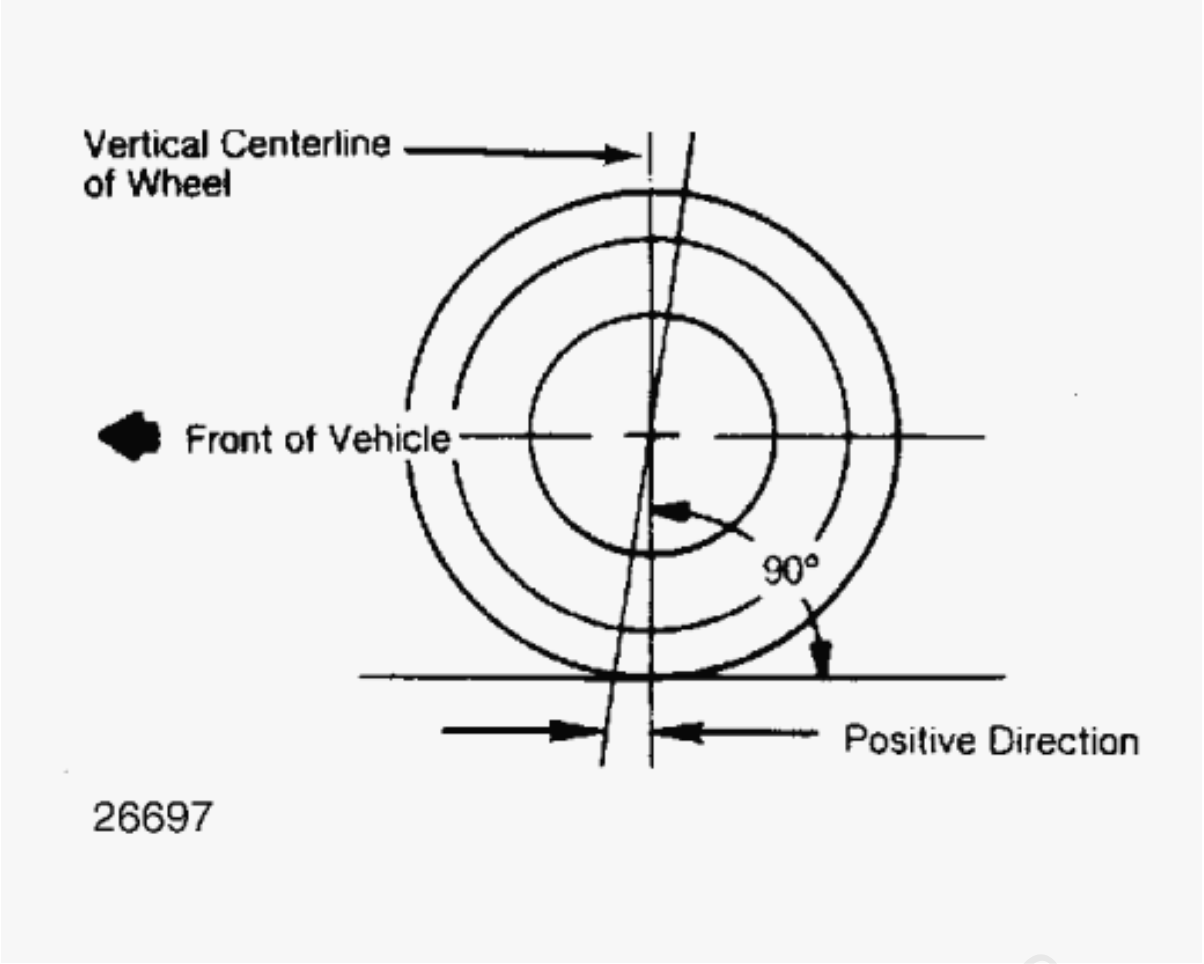


Fig. 4: Determining Caster Angle

TOE-IN ADJUSTMENT

Toe-in is the width measured at the rear of the tires subtracted by the width measured at the front of the tires at about spindle height. A positive figure would indicate toe-in and a negative figure would indicate toe-out. If the distance between the front and rear of the tires is the same, toe measurement would be zero. To adjust:

1) Measure toe-in with front wheels in straight ahead position and steering wheel centered. To adjust toe-in, loosen clamps and turn adjusting sleeve or adjustable end on right and left tie rods. See **Fig. 2** and **Fig. 5** .

2) Turn equally and in opposite directions to maintain steering wheel in centered position. Face of tie rod end must be parallel with machined surface of steering rod end to prevent binding.

3) When tightening clamps, make certain that clamp bolts are positioned so there will be no interference with other parts throughout the entire travel of linkage.

cardiagn.com

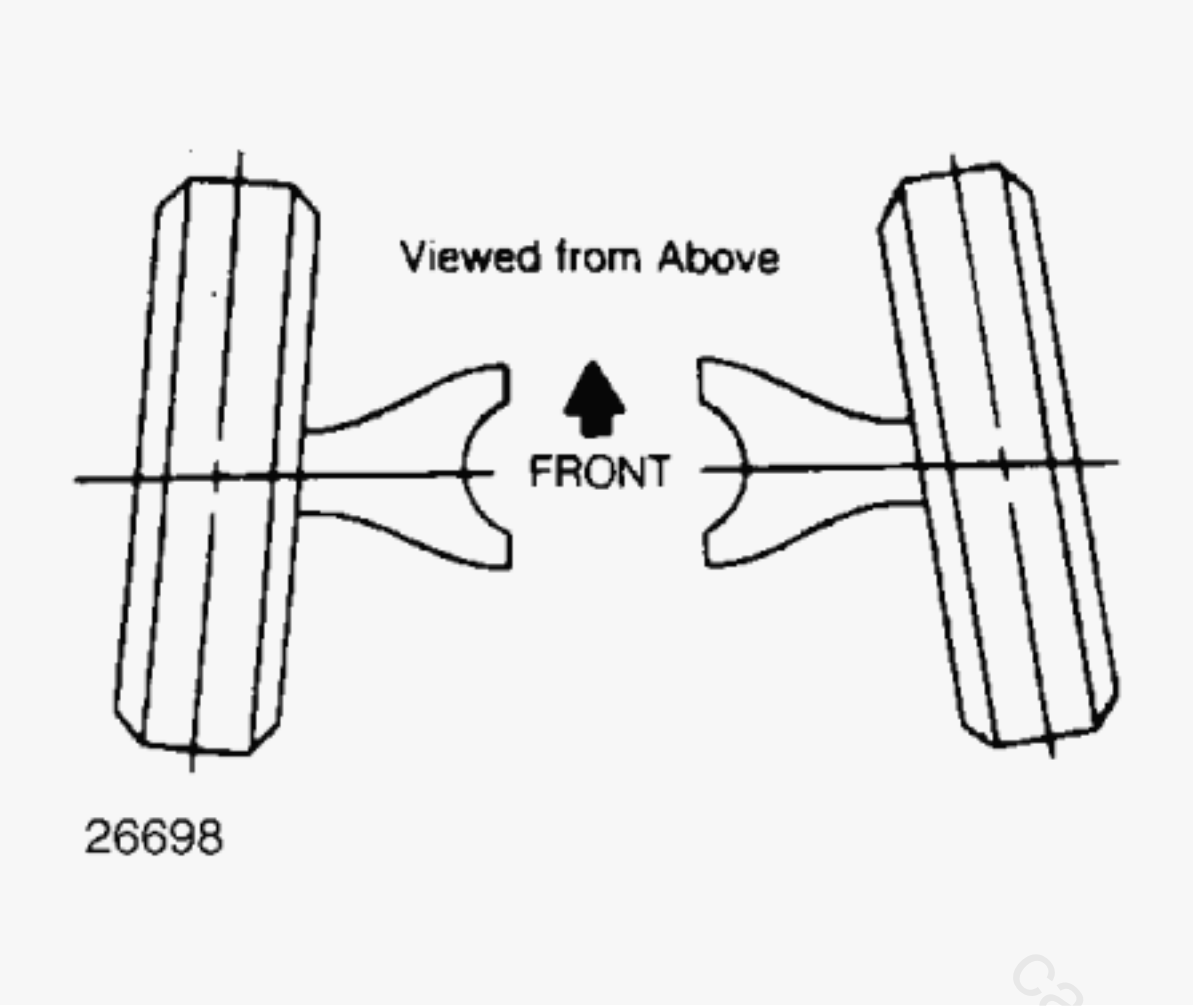


Fig. 5: Wheel Toe-In (Dimension A Less Dimension B)

TOE-OUT ON TURNS

1. Toe-out on turns (turning radius) is a check for bent or damaged parts, and not a service adjustment. With caster, camber, and toe-in properly adjusted, check toe-out with weight of vehicle on wheels.
2. Use a full floating turntable under each wheel, repeating test with each wheel positioned for right and left turns. Incorrect toe-out generally indicates a bent steering arm. Replace arm, if necessary, and recheck wheel alignment.

STEERING AXIS INCLINATION

1. Steering axis inclination is a check for bent or damaged parts, and not a service adjustment. Vehicle must be level and camber should be properly adjusted. See **Fig. 6**.
2. If camber cannot be brought within limits and steering axis inclination is correct, steering knuckle is bent. If camber and steering axis inclination are both incorrect by approximately the same amount, the upper and lower control arms are bent.

cardiagn.com

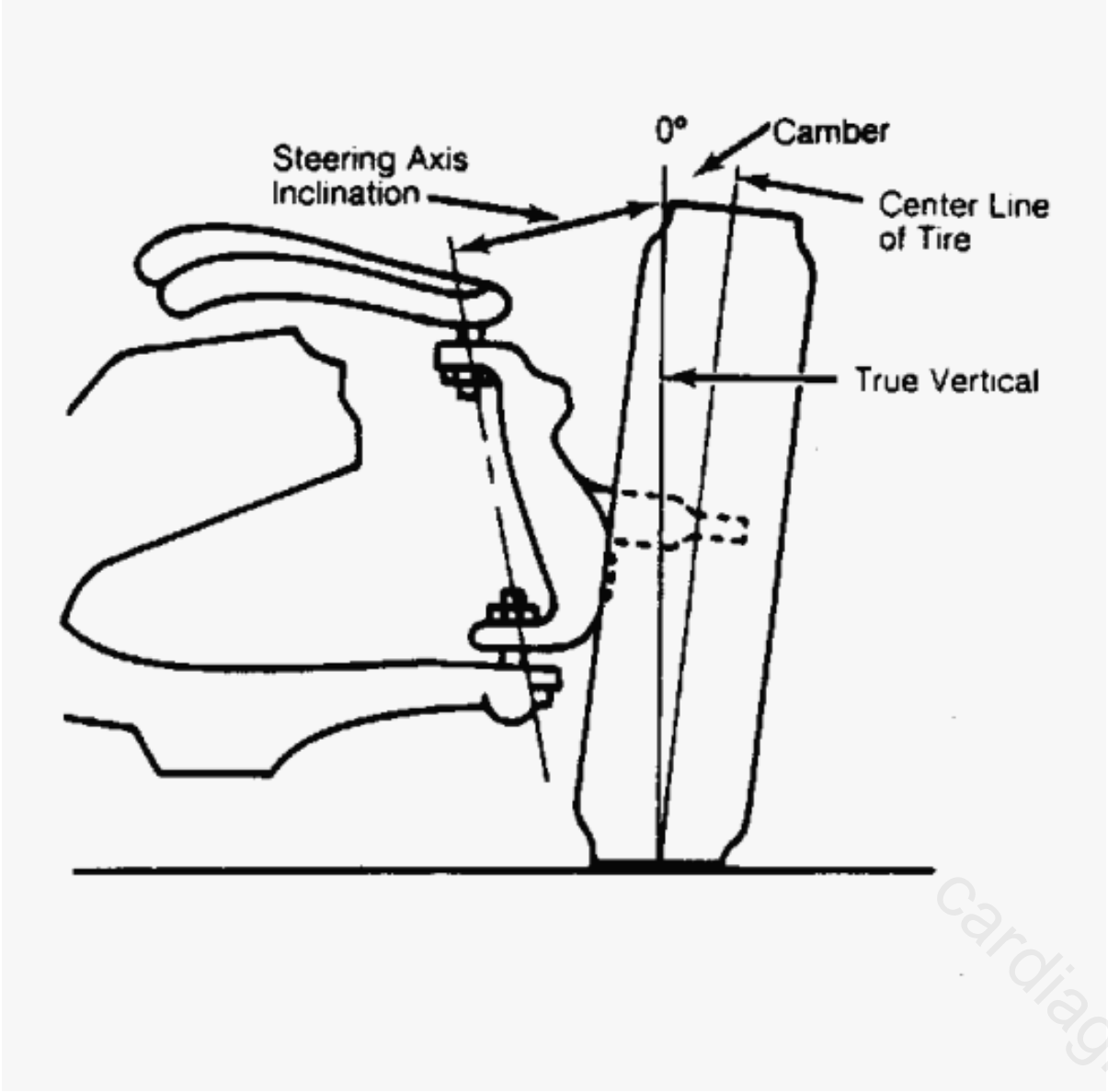


Fig. 6: Checking Steering Axis Inclination

cardiagn.com