DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P06DA-P06DC

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P06DA

Engine Oil Pressure Control Solenoid Valve Control Circuit

DTC P06DB

Engine Oil Pressure Control Solenoid Valve Control Circuit Low Voltage

DTC P06DC

Engine Oil Pressure Control Solenoid Valve Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open / High Resistance	Short to Voltage	Signal Performance
Ignition	P0030, P0031, P0050, P0051, P0443, P0458, P0590, P06DA, P3401, P3403, P3425, P3427, P3441,	P06DA	-	-

cardiagn.com

	P3449, P3451			
Control	P06DB	P06DC	P06DC	P06DA

Circuit/System Description

The engine oil pressure control solenoid is a two port solenoid valve used to control engine oil pressure inside the mechanical engine oil pump. The ECM controls the commanded states of the engine oil pressure control solenoid with the following ECM input's.

- Engine Speed
- Engine Oil Temperature (calculated from the Engine Coolant Temperature Sensor)
- Engine Oil Pressure
- Engine Run Time

With the engine oil pressure control solenoid commanded Off, engine oil pressure is higher. When commanded On engine oil pressure is lower. The purpose of this diagnostic is to isolate an electrical problem with the engine oil pressure control solenoid or wiring.

Conditions for Running the DTC

- The system voltage is greater than 11 V.
- DTC P06DA, P06DB or P06DC runs continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match for a minimum of 0.25 s.

Action Taken When the DTC Sets

- DTC P06DA, P06DB and P06DC are Type B DTCs.
- ECM commands the engine oil pressure control solenoid valve OFF.
- ECM commands Reduced Engine Power.

Conditions for Clearing the MIL/DTC

- DTC P06DA, P06DB and P06DC are Type B DTC.

Reference Information

Schematic Reference

Engine Mechanical Schematics

Connector End View Reference

cardiagn.com

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the parameters listed below do not display Malfunction when commanding the Engine Oil Pressure Control Solenoid Valve ON and OFF with a scan tool.
   - Engine Oil Pressure Control Solenoid Valve Control Circuit Low Voltage Test Status
   - Engine Oil Pressure Control Solenoid Valve Control Circuit Open Test Status
   - Engine Oil Pressure Control Solenoid Valve Control Circuit High Voltage Test Status
   - **If Malfunction is displayed**

     Refer to Circuit/System Testing.

   - **If Malfunction is not displayed**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
   - **If any DTC sets**

     Refer to Circuit/System Testing.

   - **If the DTC does not set**
5. All OK.

Circuit/System Testing

NOTE: The engine oil pressure control solenoid harness connector is located on the front of the timing chain cover.

cardiagn.com

1. Ignition OFF, disconnect the harness connector X173, ignition ON.
2. Verify that a test lamp illuminates between the ignition circuit terminal 1 and ground, engine harness side.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF, remove the test lamp.

        NOTE: **An internal short in any component supplied by the fuse may cause the fuse to open and set a DTC when the component is activated.**

    2.
    3. Test for less than 2 ohms in the ignition circuit end to end.
        - If 2 ohms or greater, repair the open/high resistance in the circuit.
        - If less than 2 ohms verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF, remove the test lamp.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground in the circuit.
        - If infinite resistance, test all the components connected to fuse and replace as necessary.
    - **If the test lamp illuminates**
3. Verify that a test lamp does not illuminate between the ignition circuit terminal 1 and the control circuit terminal 2.
    - **If the test lamp illuminates**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K20 Engine Control Module.
    - **If the test lamp does not illuminate**
4. Remove the test lamp, command the Q44 Engine Oil Pressure Control Solenoid Valve ON with a scan tool.
5. Verify the scan tool Engine Oil Pressure Control Solenoid Valve Control Circuit High Voltage Test Status parameter displays OK.
    - **If OK is not displayed**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K20 Engine Control Module.
    - **If OK is displayed**

cardiagn.com

6. Install a 3 A fused jumper wire between the control circuit terminal 2 and the ignition circuit terminal 1.
7. Verify the scan tool Engine Oil Pressure Control Solenoid Valve Circuit High Voltage Test Status parameter is displaying Malfunction when commanding the Engine Oil Pressure Control Solenoid Valve ON and OFF with a scan tool.
    - **If Malfunction is not displayed**
    1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for less than 2 ohms in the control circuit end to end.
        - If 2 ohms or greater, repair the open/high resistance in the circuit.
        - If less than 2 ohms replace the K20 Engine Control Module.
    - **If Malfunction is displayed**
8. Test or replace the Q44 Engine Oil Pressure Control Solenoid Valve.

Component Testing

Static Test

1. Ignition OFF, disconnect the harness connector at the Q44 Engine Oil Pressure Control Solenoid Valve.
2. Test for 10-30 ohms between the control terminal 2 and the ignition voltage terminal 1.
    - **If not between 10.0-30.0 ohms**

      Replace the Q44 Engine Oil Pressure Control Solenoid Valve.

    - **If between 10.0-30.0 ohms**
3. Test for infinite resistance between each terminal and the Q44 Engine Oil Pressure Control Solenoid Valve housing.
    - **If not OL**

      Replace the Q44 Engine Oil Pressure Control Solenoid Valve.

    - **If OL**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Oil Pump Flow Control Solenoid Valve Replacement** for Q44 Engine Oil Pressure Control Solenoid Valve Replacement
- **Control Module References** for ECM replacement, programming and setup

cardiagn.com

DTC P06DD

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P06DD

Engine Oil Pressure Control Solenoid Valve Stuck Off

Circuit/System Description

The engine oil pressure control solenoid is a two port solenoid valve used to control engine oil pressure inside the mechanical engine oil pump. The ECM controls the commanded states of the engine oil pressure control solenoid with the following ECM input's.

- Engine Speed
- Engine Oil Temperature (calculated from the Engine Coolant Temperature Sensor)
- Engine Oil Pressure
- Engine Run Time

With the engine oil pressure control solenoid commanded Off, engine oil pressure is higher. When commanded On engine oil pressure is lower. The purpose of this diagnostic is to isolate either a stuck on or stuck off engine oil pressure control solenoid.

Conditions for Running the DTC

P06DD

- DTC P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0117, P0118, P0119, P0128, P0335, P0336, P0521, P0522, P0523, P06DA, P06DB, P06DC, P111E, P2227, P2228, P2229 or P2230 is not set.
- Engine speed within range of 1, 200 RPM to 2, 500 RPM.

Conditions for Setting the DTC

P06DD

Engine oil pressure is above or below a calibrated amount during the time the solenoid is changing from ON to OFF states.

Action Taken When the DTC Sets

cardiagn.com

P06DD

DTC P06DD is a Type B DTC.

Conditions for Clearing the DTC

P06DD

DTC P06DD is a Type B DTC.

Reference Information

Schematic Reference

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify correct engine oil level and condition. Refer to **Engine Mechanical Specifications** .
2. Engine Running, increase and maintain the engine speed at 1, 200 RPM.

   NOTE: Selecting the scan tool line graph function may make it easier to identify Engine Oil Pressure changes.

3. Verify the scan tool Engine Oil Pressure parameter changes greater than 30 kPa (4 PSI) when commanding the Engine Oil Pressure Control Solenoid On and Off.
   - **If the parameter does not change**

cardiagn.com

- **If the parameter changes**

4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
5. Verify the DTC does not set.
   - **If the DTC sets**

     Refer to **Oil Pressure Diagnosis and Testing**.

   - **If the DTC does not set**
6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Oil Pump Flow Control Solenoid Valve Replacement Oil Pump Flow Control Solenoid Valve Replacement.

SYMPTOMS - ENGINE MECHANICAL

Strategy Based Diagnostics

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables.
2. Review the system operations in order to familiarize yourself with the system functions. Refer to **Disassembled Views (6.2L LT1)** , **Disassembled Views (6.2L LT1 with Z52 Option)** , **Engine Content Specifications** , **Engine Component Description** , **Lubrication Description** , **Lubrication Description (with Z52 Option)** , **Camshaft Position Actuator and Solenoid Valve Description** and **Cylinder Deactivation (Active Fuel Management) System Description** .

All diagnosis on a vehicle should follow a logical process. Strategy based diagnostics is a uniform approach for repairing all systems. The diagnostic flow may always be used in order to resolve a system condition. The diagnostic flow is the place to start when repairs are necessary. For a detailed explanation, refer to **Strategy Based Diagnosis** .

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the engine. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect for the correct oil level, proper oil viscosity and correct filter application.
- Verify the exact operating conditions under which the concern exists. Note factors such as engine RPM, ambient temperature, engine temperature, amount of engine warm-up time and other specifics.

cardiagn.com

- Compare the engine sounds, if applicable, to a known good engine and make sure you are not trying to correct a normal condition.

Intermittent

Test the vehicle under the same conditions that the customer reported in order to verify the system is operating properly.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Base Engine Misfire without Internal Engine Noises**
- **Base Engine Misfire with Abnormal Internal Lower Engine Noises**
- **Base Engine Misfire with Abnormal Valve Train Noise**
- **Base Engine Misfire with Coolant Consumption**
- **Base Engine Misfire with Excessive Oil Consumption**
- **Engine Noise on Start-Up, but Only Lasting a Few Seconds**
- **Upper Engine Noise, Regardless of Engine Speed**
- **Lower Engine Noise, Regardless of Engine Speed**
- **Engine Noise Under Load**
- **Engine Will Not Crank - Crankshaft Will Not Rotate**
- **Coolant in Combustion Chamber**
- **Coolant in Engine Oil**
- **Cylinder Deactivation (Active Fuel Management) System Diagnosis**
- **Engine Compression Test**
- **Cylinder Deactivation (Active Fuel Management) System Compression Test**
- **Cylinder Leakage Test**
- **Oil Consumption Diagnosis**
- **Oil Pressure Diagnosis and Testing**
- **Cylinder Deactivation (Active Fuel Management) Valve Lifter Oil Manifold Diagnosis and Testing**
- **Camshaft Position Actuator and Solenoid Valve Diagnosis and Testing**
- **Oil Leak Diagnosis**
- **Crankcase Ventilation System Inspection/Diagnosis**
- **Drive Belt Chirping, Squeal and Whine Diagnosis**
- **Drive Belt Rumbling and Vibration Diagnosis**
- **Drive Belt Falls Off and Excessive Wear Diagnosis**
- **Drive Belt Tensioner Diagnosis**

cardiagn.com

Base Engine Misfire without Internal Engine Noises

Cause	Correction
High oil pressure	• Verify oil pressure. Refer to **Oil Pressure Diagnosis and Testing**. • Repair or replace damaged components as required.
Worn, damaged or improperly installed accessory drive belt - severe cracking, bumps or missing segments A misfire DTC may be present without an actual misfire condition.	• Inspect the accessory drive system components. • Repair or replace damaged components as required. Refer to **Drive Belt Replacement - Accessory** .
Worn, damaged or improperly installed accessory drive system components A misfire DTC may be present without an actual misfire condition.	• Inspect the accessory drive system components. • Repair or replace damaged components as required.
Damaged, loose or improperly installed crankshaft balancer A misfire DTC may be present without an actual misfire condition.	• Inspect the crankshaft balancer. • Repair or replace damaged components as required. Refer to **Crankshaft Balancer Replacement** .
Worn, damaged or improperly installed crankshaft reluctor wheel A worn or damaged crankshaft reluctor wheel can result in different symptoms depending on the severity and location of the wear or damage. • Systems with electronic communications, DIS or coil per cylinder and severe reluctor ring damage may exhibit periodic loss of crankshaft position, stop delivering a signal and then re-sync the crankshaft position. • Systems with electronic communication, DIS or coil per cylinder and slight reluctor ring damage may exhibit no loss of crankshaft position and no misfire may occur. However, a DTC P0300 may be set. • Systems with mechanical communications, high voltage switch and severe reluctor ring damage may cause additional pulses and effect fuel and spark delivery. A DTC P0300 or P0336 may be set.	• Inspect the crankshaft position sensor. • Inspect the crankshaft reluctor wheel. • Inspect the crankshaft. • Repair or replace damaged components as required.

cardiagn.com

Damaged, improperly installed or restricted exhaust system, collapsed or dented pipes, plugged mufflers or malfunctioning catalytic converters A DTC may be present without an actual fault condition.	• Inspect the exhaust system components. • Repair or replace damaged components as required.
Worn, damaged or improperly installed vacuum hoses	• Inspect the vacuum system components. • Repair or replace damaged components as required.
Damaged or improperly installed MAP sensor, sealing grommet nicked, torn or missing	• Inspect the MAP sensor. • Repair or replace damaged components as required.
Damaged or improperly installed throttle body	• Inspect the throttle body. • Repair or replace damaged components as required.
Damaged or improperly installed intake manifold	• Inspect the intake manifold. • Repair or replace damaged components as required.
Damaged or improperly installed cylinder head Oil consumption may or may not cause the engine to misfire.	• Inspect the spark plugs. Refer to **Spark Plug Inspection** . • Verify engine compression. Refer to **Engine Compression Test**. • Inspect the cylinder heads. • Inspect the engine block. • Repair or replace damaged components as required.
Worn, damaged or loose valve rocker arm	• Inspect the valve rocker arms. • Repair or replace damaged components as required.
Worn, damaged or loose valve rotator	• Inspect the valve rotators. • Repair or replace damaged components as required.
Worn, damaged, loose or broken valve spring	• Inspect the valve springs. • Repair or replace damaged components as required.
Worn, damaged or stuck valve, carbon on the valve stem or valve seat	• Inspect the valves. • Inspect the valve guides. • Repair or replace damaged components as required.

cardiagn.com

	• Inspect the valve guides. • Inspect the valves. • Repair or replace damaged components as required.
Worn, damaged, loose or bent valve push rod	• Inspect the valve push rods. • Repair or replace damaged components as required.
Worn, damaged or dirty valve lifter	• Inspect the valve lifters. • Inspect the camshaft. • Repair or replace damaged components as required.
Worn or damaged camshaft lobe	• Inspect the camshaft. • Inspect the valve lifters. • Repair or replace damaged components as required.
Worn, damaged or loose timing chain and sprockets	• Inspect the timing chain and sprockets. • Repair or replace damaged components as required.
Worn, damaged or improperly installed piston Pistons must be installed with the mark or dimple, on the top of the piston, facing the front of the engine; piston pins must be centered in the connecting rod pin bore. Oil consumption may or may not cause the engine to misfire.	• Inspect the spark plugs. Refer to **Spark Plug Inspection** . • Verify engine compression. Refer to **Engine Compression Test**. • Inspect the cylinder bores. • Inspect the pistons. • Inspect the piston pins. • Inspect the connecting rods. • Repair or replace damaged components as required.

BASE ENGINE MISFIRE WITH ABNORMAL INTERNAL LOWER ENGINE NOISES

Base Engine Misfire with Abnormal Internal Lower Engine Noises

Cause	Correction
Abnormalities, such as severe cracking, bumps or missing areas in the accessory drive belt Abnormalities in the accessory drive system and/or components may cause engine RPM variations, noises similar to a faulty lower engine and also lead to a misfire condition. A	Replace the drive belt. Refer to **Drive Belt Replacement - Accessory** .

cardiagn.com

misfire condition.	
Worn, damaged or mis-aligned accessory drive components or excessive pulley runout A misfire code may be present without an actual misfire condition.	Inspect the components and repair or replace, as required.
Loose or improperly installed engine flywheel, engine flex plate or crankshaft balancer A misfire code may be present without an actual misfire condition.	Repair or replace the engine flywheel, flex plate, and/or balancer, as required. Refer to **Engine Flywheel Removal** and **Engine Flywheel Installation** or **Automatic Transmission Flex Plate Removal** and **Automatic Transmission Flex Plate Installation** or **Crankshaft Balancer Removal** and **Crankshaft Balancer Installation** .
Worn piston rings Oil consumption may or may not cause the engine to misfire.	1. Inspect the spark plugs for oil deposits. Refer to **Spark Plug Inspection** . 2. Inspect the cylinders for a loss of compression. Refer to **Engine Compression Test**. 3. Perform cylinder leak down and compression testing to determine the cause. Refer to **Cylinder Leakage Test**. 4. Repair or replace, as required.
Worn crankshaft thrust bearings Severely worn thrust surfaces on the crankshaft and/or thrust bearing may permit fore and aft movement of the crankshaft and create a DTC without an actual misfire condition.	Replace the crankshaft and bearings, as required.

BASE ENGINE MISFIRE WITH ABNORMAL VALVE TRAIN NOISE

Base Engine Misfire with Abnormal Valve Train Noise

Cause	Correction
Worn or loose rocker arms The rocker arm bearing end caps and/or needle bearings should be intact within the rocker arm assembly.	Replace the valve rocker arms, as required.
Worn or bent pushrods	• Replace the pushrods. • Inspect the top of the pistons for valve contact. If the top of the piston shows valve contact, replace the piston and pin assembly.
Stuck valves Carbon buildup on the valve stem can cause	Repair or replace, as required.

cardiagn.com

the valve to not close properly.	
Excessively worn or mis-aligned timing chain	Replace the timing chain and sprockets, as required.
Worn camshaft lobes	Replace the camshaft and valve lifters.
Sticking lifters	Replace, as required.
Cut or damaged oil pump screen O-ring seal which may cause aeration of the engine oil	Repair, as required. Refer to **Oil Pressure Diagnosis and Testing**.
Improper operation of the active fuel management system	Repair, as required. Refer to **Cylinder Deactivation (Active Fuel Management) System Diagnosis**.
Improper operation of the camshaft position (CMP) actuator and/or control system	Repair, as required. Refer to **Camshaft Position Actuator and Solenoid Valve Diagnosis and Testing**.

BASE ENGINE MISFIRE WITH COOLANT CONSUMPTION

Base Engine Misfire with Coolant Consumption

Cause	Correction
Faulty cylinder head gaskets and/or cracking or other damage to the cylinder heads and engine block cooling system passages Coolant consumption may or may not cause the engine to overheat.	1. Inspect for spark plugs saturated by coolant. Refer to **Spark Plug Inspection** . 2. Perform a cylinder leak down test. Refer to **Cylinder Leakage Test**. 3. Inspect the cylinder heads and engine block for damage to the coolant passages and/or a faulty head gasket. Refer to **Coolant in Combustion Chamber**. 4. Repair or replace, as required.

BASE ENGINE MISFIRE WITH EXCESSIVE OIL CONSUMPTION

Base Engine Misfire with Excessive Oil Consumption

Cause	Correction
Worn valves, valve guides and/or valve stem oil seals	1. Inspect the spark plugs for oil deposits. Refer to **Spark Plug Inspection** . 2. Repair or replace, as required.
Worn piston rings Oil consumption may or may not cause the engine to misfire.	1. Inspect the spark plugs for oil deposits. Refer to **Spark Plug Inspection** . 2. Inspect the cylinders for a loss of compression. Refer to **Engine Compression Test**. 3. Perform cylinder leak down and compression testing to determine the

cardiagn.com

	4. Repair or replace, as required.

ENGINE NOISE ON START-UP, BUT ONLY LASTING A FEW SECONDS

Engine Noise on Start-Up, but Only Lasting a Few Seconds

Cause	Correction
Fuel injector harness connectors are connected to the incorrect fuel injectors/cylinders	Relocate the fuel injector harness connectors, as necessary.
Abnormalities, such as severe cracking, bumps or missing areas in the accessory drive belt Abnormalities in the accessory drive system and/or components may cause engine RPM variations and lead to a misfire diagnostic trouble code (DTC). A misfire code may be present without an actual misfire condition.	Replace the drive belt. Refer to **Drive Belt Replacement - Accessory** .
Worn, damaged or mis-aligned accessory drive components or excessive pulley runout May lead to a misfire DTC. A misfire code may be present without an actual misfire condition.	Inspect the components and repair or replace, as required.
Loose or improperly installed engine flex plate or crankshaft balancer A misfire code may be present without an actual misfire condition.	Repair or replace the flex plate and/or balancer, as required. Refer to **Automatic Transmission Flex Plate Replacement** or **Crankshaft Balancer Replacement** .
Restricted exhaust system A severe restriction in the exhaust flow can cause significant loss of engine performance and may set a DTC. Possible causes of restrictions include collapsed or dented pipes or plugged mufflers and/or catalytic converters.	Repair or replace, as required.
Improperly installed or damaged vacuum hoses	Repair or replace, as required.
Improper sealing between the intake manifold and cylinder heads or throttle body	Replace the intake manifold, gaskets, cylinder heads, and/or throttle body, as required.
Improperly installed or damaged manifold absolute pressure (MAP) sensor The sealing grommet of the MAP sensor should not be torn or damaged.	Repair or replace the MAP sensor, as required.
Worn or loose rocker arms The rocker arm bearing end caps and/or needle bearings should be intact and in the proper position.	Replace the valve rocker arms, as required.
Worn or bent pushrods	• Replace the pushrods. • Inspect the top of the pistons for valve contact. If the top of the piston shows

cardiagn.com

	assembly.
Stuck valves Carbon buildup on the valve stem can cause the valve to not close properly.	Repair or replace, as required.
Excessively worn or mis-aligned timing chain	Replace the timing chain and sprockets, as required.
Worn camshaft lobes	Replace the camshaft and valve lifters.
Excessive oil pressure A lubrication system with excessive oil pressure may lead to excessive valve lifter pump-up and loss of compression.	1. Perform an oil pressure test. Refer to **Oil Pressure Diagnosis and Testing**. 2. Repair or replace the oil pump, as required.
Faulty cylinder head gaskets and/or cracking or other damage to the cylinder heads and engine block cooling system passages Coolant consumption may or may not cause the engine to overheat.	1. Inspect for spark plugs saturated by coolant. Refer to **Spark Plug Inspection** . 2. Inspect the cylinder heads, engine block, and/or head gaskets. Refer to **Coolant in Combustion Chamber**. 3. Repair or replace, as required.
Worn piston rings Oil consumption may or may not cause the engine to misfire.	1. Inspect the spark plugs for oil deposits. Refer to **Spark Plug Inspection** . 2. Inspect the cylinders for a loss of compression. Refer to **Engine Compression Test**. 3. Perform cylinder leak down and compression testing to identify the cause. Refer to **Cylinder Leakage Test**. 4. Repair or replace, as required.
A damaged crankshaft reluctor wheel A damaged crankshaft reluctor wheel can result in different symptoms depending on the severity and location of the damage. • Systems with electronic communications, DIS or coil per cylinder and severe reluctor ring damage may exhibit periodic loss of crankshaft position, stop delivering a signal and then sync the crankshaft position. • Systems with electronic communication, DIS or coil per cylinder and slight reluctor ring damage may exhibit no loss of crankshaft position and no misfire may occur. However, a P0300 DTC may be	Replace the sensor and/or crankshaft, as required.

cardiagn.com

• Systems with mechanical communications, high voltage switch and severe reluctor ring damage may cause additional pulses and effect fuel and spark delivery to the point of generating a P0300 DTC or P0336.	
Improper operation of the active fuel management system	Repair, as required. Refer to **Cylinder Deactivation (Active Fuel Management) System Diagnosis**.
Improper operation of the camshaft position (CMP) actuator and/or control system	Repair, as required. Refer to **Camshaft Position Actuator and Solenoid Valve Diagnosis and Testing**.

UPPER ENGINE NOISE, REGARDLESS OF ENGINE SPEED

Upper Engine Noise, Regardless of Engine Speed

Cause	Correction
Low oil pressure	1. Perform an oil pressure test. Refer to **Oil Pressure Diagnosis and Testing**. 2. Repair or replace, as required.
Loose and/or worn valve rocker arm attachments	1. Inspect the valve rocker arm, bolt and pedestal. 2. Repair or replace, as required.
Worn or damaged valve rocker arm	1. Inspect the rocker arm for wear or missing needle bearings 2. Replace the valve rocker arms, as required.
Bent or damaged push rod	Inspect the following components and replace, as required: • The valve rocker arm • The valve push rod • The valve lifter • The valve lifter guide • The piston Inspect the top of the pistons for valve contact. If the top of the piston shows valve contact, replace the piston and pin assembly.
Improper lubrication to the valve rocker arms	Inspect the following components and repair or replace, as required:

cardiagn.com

	• The valve rocker arm • The valve push rod • The valve lifter • The oil filter bypass valve • The oil pump and pump screen • Improper operation of the active fuel management oil pressure relief valve • The engine block oil galleries
Broken valve spring	Replace the valve spring and spring shim.
Worn or dirty valve lifters	Replace the valve lifters, as required.
Active fuel management valve lifter with a broken spring	Replace the valve lifters, as required.
Improper operation of the camshaft position (CMP) actuator and/or control system	Repair, as required. Refer to **Camshaft Position Actuator and Solenoid Valve Diagnosis and Testing**.
Stretched or broken timing chain and/or damaged sprocket teeth	Replace the timing chain and sprockets.
Worn engine camshaft lobes	1. Inspect the engine camshaft lobes. 2. Replace the camshaft and valve lifters, as required.
Worn valve guides or valve stems	Inspect the following components and repair, as required: • The valves • The valve guides
Stuck valves Carbon on the valve stem or valve seat may cause the valve to stay open.	Inspect the following components and repair, as required: • The valves • The valve guides
Cut or damaged oil pump screen O-ring seal which may cause aeration of the engine oil	Repair, as required. Refer to **Oil Pressure Diagnosis and Testing**.

LOWER ENGINE NOISE, REGARDLESS OF ENGINE SPEED

Lower Engine Noise, Regardless of Engine Speed

Cause	Correction
Low oil pressure	1. Perform an oil pressure test. Refer to **Oil Pressure Diagnosis and Testing**. 2. Repair or replace damaged components, as required.

cardiagn.com

Abnormalities such as severe cracking, bumps or missing areas in the accessory drive belt and/or misalignment of system components.	1. Inspect the accessory drive system. 2. Repair or replace, as required.
Loose or damaged crankshaft balancer	1. Inspect the crankshaft balancer. 2. Repair or replace, as required.
Detonation or spark knock	Verify the correct operation of the ignition controls system. Refer to **Symptoms - Engine Mechanical**.
Loose torque converter bolts	1. Inspect the torque converter bolts and flex plate. 2. Repair or replace, as required.
Loose or damaged flywheel or flex plate	Repair or replace the flywheel or flex plate.
Oil pump screen loose, damaged or restricted	1. Inspect the oil pump screen. 2. Repair or replace, as required.
Excessive piston-to-cylinder bore clearance	1. Inspect the piston and cylinder bore. 2. Repair, as required.
Excessive piston pin-to-bore clearance	1. Inspect the piston, pin and connecting rod. 2. Replace the piston and pin as an assembly, as required.
Excessive connecting rod bearing clearance	Inspect the following components and repair, as required: • The connecting rod bearings • The connecting rods • The crankshaft • The crankshaft journals
Excessive crankshaft bearing clearance	Inspect the following components and repair, as required: • The crankshaft bearings • The crankshaft journals
Incorrect piston, piston pin and connecting rod installation Pistons must be installed with the mark or dimple on the top of the piston facing the front of the engine. Piston pins must be centered in the connecting rod pin bore.	1. Verify the pistons, piston pins and connecting rods are installed correctly. Refer to **Piston, Connecting Rod and Bearing Installation** . 2. Repair, as required.

ENGINE NOISE UNDER LOAD

cardiagn.com

Cause	Correction
Low oil pressure	1. Perform an oil pressure test. Refer to **Oil Pressure Diagnosis and Testing**. 2. Repair or replace as required.
Detonation or spark knock	1. Verify the correct operation of the ignition controls. Refer to **Diagnostic System Check - Vehicle** . 2. Repair or replace damaged components as required.
Worn, damaged or improperly installed engine flywheel	1. Inspect the engine flywheel. 2. Inspect the engine flywheel bolts. 3. Inspect the torque converter. 4. Inspect the torque converter bolts. 5. Inspect the crankshaft. 6. Repair or replace damaged components as required.
Worn, damaged or improperly installed torque converter	1. Inspect the torque converter. 2. Inspect the torque converter bolts. 3. Inspect the engine flywheel. 4. Repair or replace damaged components as required.
Worn, damaged or improperly installed pistons-Pistons must be installed with the mark or dimple, on the top of the piston, facing the front of the engine Piston pins must be centered in the connecting rod pin bore.	1. Inspect the cylinder bores. 2. Inspect the pistons. 3. Inspect the piston pins. 4. Inspect the connecting rods. 5. Repair or replace damaged components as required.
Worn, damaged or improperly installed connecting rod bearing	1. Inspect the connecting rods. 2. Inspect the connecting rod bearings. 3. Inspect the crankshaft connecting rod journals. 4. Repair or replace damaged components as required.
Worn, damaged or improperly installed crankshaft bearing	1. Inspect the crankshaft bearings. 2. Inspect the crankshaft journals. 3. Repair or replace damaged components as required.

ENGINE WILL NOT CRANK - CRANKSHAFT WILL NOT ROTATE

cardiagn.com

Engine Will Not Crank - Crankshaft Will Not Rotate

Cause	Correction
Seized accessory drive system component	1. Remove accessory drive belts. 2. Rotate crankshaft by hand at the balancer or flywheel location.
Hydraulically locked cylinder • Coolant/antifreeze in cylinder • Oil in cylinder • Fuel in cylinder	1. Remove spark plugs and check for fluid. 2. Inspect for broken head gasket. 3. Inspect for cracked engine block or cylinder head. 4. Inspect for a sticking fuel injector.
Seized automatic transmission torque converter	1. Remove the torque converter bolts. 2. Rotate crankshaft by hand at the balancer or flywheel location.
Seized manual transmission	1. Disengage the clutch. 2. Rotate crankshaft by hand at the balancer or flywheel location.
Broken timing chain and/or gears	• Inspect timing chain and gears. • Repair as required.
Seized balance shaft	• Inspect balance shaft. • Repair as required.
Material in cylinder • Broken valve • Piston material • Foreign material	• Inspect cylinder for damaged components and/or foreign materials. • Repair or replace as required.
Seized crankshaft or connecting rod bearings	• Inspect crankshaft and connecting rod bearings. • Repair as required.
Bent or broken connecting rod	• Inspect connecting rods. • Repair as required.
Broken crankshaft	• Inspect crankshaft. • Repair as required.

COOLANT IN COMBUSTION CHAMBER

Coolant in Combustion Chamber

Cause	Correction
DEFINITION: Excessive white smoke and/or coolant type odor coming from the exhaust pipe	

cardiagn.com

or a faulty thermostat may lead to an "overtemperature" condition which may cause engine component damage. 1. A slower than normal cranking speed may indicate coolant entering the combustion chamber. Refer to **Engine Will Not Crank - Crankshaft Will Not Rotate**. 2. Remove the spark plugs and inspect for spark plugs saturated by coolant or coolant in the cylinder bore. 3. Inspect by performing a cylinder leak-down test. During this test, excessive air bubbles within the coolant may indicate a faulty gasket or damaged component. 4. Inspect by performing a cylinder compression test. Two cylinders "side-by-side" on the engine block, with low compression, may indicate a failed cylinder head gasket. Refer to **Engine Compression Test**.	
Cracked intake manifold or failed gasket	Replace the components as required.
Faulty cylinder head gasket	Replace the head gasket and components as required. Refer to **Cylinder Head Cleaning and Inspection** and **Cylinder Head Replacement - Left Side** or **Cylinder Head Replacement - Right Side** .
Warped cylinder head	Machine the cylinder head to the proper flatness, if applicable and replace the cylinder head gasket. Refer to **Cylinder Head Cleaning and Inspection** .
Cracked cylinder head	Replace the cylinder head and gasket.
Cracked cylinder liner or engine block	Replace the components as required.
Cylinder head or engine block porosity	Replace the components as required.

COOLANT IN ENGINE OIL

Coolant in Engine Oil

Cause	Correction
DEFINITION: Foamy or discolored oil or an engine oil "overfill" condition may indicate coolant entering the engine crankcase. Low coolant levels, an inoperative cooling fan or a faulty thermostat may lead to an "overtemperature" condition which may cause engine component damage. Contaminated engine oil and oil filter should be changed. 1. Inspect the oil for excessive foaming or an overfill condition. Oil diluted by coolant may not properly lubricate the crankshaft bearings and may lead to component damage. Refer to **Lower Engine Noise, Regardless of Engine Speed**. 2. Inspect by performing a cylinder leak-down test. During this test, excessive air bubbles within the cooling system may indicate a faulty gasket or damaged component. 3. Inspect by performing a cylinder compression test. Two cylinders "side-by-side" on the engine block with low compression may indicate a failed cylinder head gasket. Refer to **Engine Compression Test**.	
Faulty external engine oil cooler	Replace the components as required.

cardiagn.com

Faulty cylinder head gasket	Replace the head gasket and components as required. Refer to **Cylinder Head Cleaning and Inspection** and **Cylinder Head Replacement - Left Side** or **Cylinder Head Replacement - Right Side** .
Warped cylinder head	Machine the cylinder head to proper flatness, if applicable and replace the cylinder head gasket. Refer to **Cylinder Head Cleaning and Inspection** .
Cracked cylinder head	Replace the cylinder head and gasket.
Cracked cylinder liner or engine block	Replace the components as required.
Cylinder head, block or manifold porosity	Replace the components as required.

CYLINDER DEACTIVATION (ACTIVE FUEL MANAGEMENT) SYSTEM DIAGNOSIS

1. Measure the engine oil level. Fill, as required.
2. Using the scan tool, inspect for diagnostic codes within the engine control module (ECM). Refer to **Diagnostic System Check - Vehicle** . Repair, as required.
3. Verify proper engine oil pressure and operation of the active fuel management oil pressure relief valve. Refer to **Oil Pressure Diagnosis and Testing**.
4. Verify proper operation of the active fuel management system components. Refer to **Cylinder Deactivation (Active Fuel Management) System Compression Test**.
5. Remove the valve lifter oil manifold. Refer to **Valve Lifter Oil Manifold Replacement** .
6. Verify proper operation of the valve lifter oil manifold. Refer to **Cylinder Deactivation (Active Fuel Management) Valve Lifter Oil Manifold Diagnosis and Testing**.
7. Replace the active fuel management valve lifters, as required. Both intake and exhaust lifters should be replaced in pairs. Refer to **Valve Lifter Replacement** .

ENGINE COMPRESSION TEST

1. Charge the battery if the battery is not fully charged.
2. Disable the ignition system.
3. Disable the fuel injection system by removing the injector fuse or removing the injector electrical connectors.
4. Remove all spark plugs.
5. Turn the ignition to the ON position.
6. Depress the accelerator pedal to position the throttle plate wide open.
7. Start with the compression gauge at zero and crank the engine through 4 compression strokes, 4 puffs.
8. Measure the compression for each cylinder. Record the readings.
9. If a cylinder has low compression, inject approximately 15 ml (1 tablespoon) of engine oil into the combustion chamber through the spark plug hole. Measure the compression again and

cardiagn.com

10. The minimum compression in any 1 cylinder should not be less than 70 percent of the highest cylinder. No cylinder should read less than 690 kPa (100 psi). For example, if the highest pressure in any 1 cylinder is 1 035 kPa (150 psi), the lowest allowable pressure for any other cylinder would be 725 kPa (105 psi). (1 035 x 70% = 725) (150 x 70% = 105).
    - Normal - Compression builds up quickly and evenly to the specified compression for each cylinder.
    - Piston Rings Leaking - Compression is low on the first stroke. Compression builds up with the following strokes, but does not reach normal. Compression improves considerably when you add oil.
    - Valves Leaking - Compression is low on the first stroke. Compression usually does not build up on the following strokes. Compression does not improve much when you add oil.
    - If 2 adjacent cylinders have lower than normal compression and injecting oil into the cylinders does not increase the compression, the cause may be a head gasket leaking between the cylinders.

CYLINDER DEACTIVATION (ACTIVE FUEL MANAGEMENT) SYSTEM COMPRESSION TEST

The Cylinder Deactivation (Active Fuel Management) System Compression Test is a functional test of the valve lifter oil manifold and valve lifters. Using a compression gauge, the technician can monitor the specific cylinders ability to go into and out of active fuel management as commanded by the scan tool. The actual pressure values on the compression gauge are not as critical as is observing the on-off switching action of the solenoid and valve lifters.

1. Measure the engine oil level. Fill, as required.
2. Perform the Diagnostic System Check - Vehicle. Refer to **Diagnostic System Check - Vehicle** .
3. Disable the ignition system for the cylinder to be tested, by disconnecting the electrical wire harness to the ignition coil.
4. Disable the fuel injection system for the cylinder to be tested, by disconnecting the electrical wire harness to the fuel injector.
5. Remove the spark plug and wire for the cylinder to be tested.
6. Install a 0-1 378 kPa (0-200 psi) compression gauge.
7. Start the engine.
8. Using the scan tool output controls, command the solenoid ON, for the cylinder to be deactivated.
9. Depress the Schrader valve on the compression gauge, in order to release the pressure and zero the gauge. With the engine running and the cylinder in active fuel management mode, the compression reading should be less than 172 kPa (25 psi).
10. Using the scan tool, de-energize the solenoid while observing the reading on the compression gauge. With the engine running and the cylinder NOT in active fuel management mode, the compression gauge reading should increase quickly to greater than 345 kPa (50 psi).

IMPORTANT: Only 1 cylinder can be tested at a time. When testing has been completed

cardiagn.com

on a specific cylinder, the wire harness electrical connectors, spark plug and spark plug wire must be installed prior to testing of each additional cylinder.

11. Test each of the 4 active fuel management cylinders, 1 at a time. If the readings are not within specifications, remove and test the valve lifter oil manifold, as required. Refer to **Valve Lifter Oil Manifold Replacement** and **Cylinder Deactivation (Active Fuel Management) Valve Lifter Oil Manifold Diagnosis and Testing**.
12. If the compression test has been performed and all active fuel management cylinders are operating within specifications, the active fuel management system is performing as designed and no repairs are required.
13. Clear the diagnostic trouble codes (DTCs) with a scan tool.

ENGINE BALANCING

During the powertrain build process, balance weights may be added to the crankshaft balancer and/or manual transmission flywheel, as required.

In order to maintain engine/clutch assembly balance, it may be necessary to install or remove balance weights as detailed below:

Crankshaft Balancer

- Existing balancer onto existing engine: It is not necessary to mark the balancer prior to removal. The balancer is positioned by a key located in the front of crankshaft.
- New balancer onto an existing engine: Install the same size balance weights into the new balancer in the same location as the old balancer. Refer to **Crankshaft Balancer Cleaning and Inspection** .

Engine Flywheel

- The clutch discs and pressure plate are a balanced assembly and not available separately. The pressure plate mounts or locates, onto the six flywheel dowel pins. If the pressure plate is not aligned properly onto the dowel pins and tightened down, the pins may bend and the plate may be incorrectly positioned, which will affect component balance.
- Existing flywheel, clutch and pressure plate onto the existing engine: Pressure plate position to flywheel must be marked prior to removal and installed to the original position. Flywheel position to crankshaft should be marked prior to removal because the bolt patterns on the flywheel and crankshaft are asymmetrical. Marking the flywheel will aid in installation of the flywheel on the extisting engine.
- Existing flywheel, clutch and pressure plate onto a new engine: Pressure plate position to flywheel must be marked prior to removal and installed to the original position. Flywheel position to crankshaft should be marked prior to removal because the bolt patterns on the flywheel and crankshaft are asymmetrical. Marking the flywheel will aid in installation of the flywheel on the new engine. Do not remove balance weights from flywheel, if applicable.

cardiagn.com

- New flywheel onto an existing engine: Install the same size balance weights into the new flywheel in the same location as the old flywheel.
- New flywheel, clutch and pressure plate onto a new engine: Do not install balance weights.

CYLINDER LEAKAGE TEST

Special Tools

J 35667-A Cylinder Head Leakdown Tester or equivalent

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

NOTE: **A leakage test may be performed in order to measure cylinder/combustion chamber leakage. High cylinder leakage may indicate one or more of the following conditions:**

- **Worn or burnt valves**
- **Broken valve springs**
- **Stuck valve lifters**
- **Incorrect valve lash**
- **Damaged piston**
- **Worn piston rings**
- **Worn or scored cylinder bore**
- **Damaged cylinder head gasket**
- **Cracked or damaged cylinder head**
- **Cracked or damaged engine block**

WARNING: **Refer to Battery Disconnect Warning .**

1. Disconnect the battery ground negative cable.
2. Remove the spark plugs. Refer to **Spark Plug Replacement** .
3. Rotate the crankshaft to place the piston in the cylinder being tested at top dead center (TDC) of the compression stroke.
4. Install the **J 35667-A** tester or equivalent.

NOTE: **It may be necessary to hold the crankshaft balancer bolt to prevent the crankshaft from rotating.**

5. Apply shop air pressure to the **J 35667-A** tester and adjust according to the manufacturers instructions.

cardiagn.com

excessive and may require component service. In excessive leakage situations, inspect for the following conditions:

- Air leakage noise at the throttle body or air inlet hose that may indicate a worn or burnt intake valve or a broken valve spring.
- Air leakage noise at the exhaust system tailpipe that may indicate a worn or burnt exhaust valve or a broken valve spring.
- Air leakage noise from the crankcase, oil level indicator tube or oil fill tube that may indicate worn piston rings, a damaged piston, a worn or scored cylinder bore, a damaged engine block or a damaged cylinder head.
- Air bubbles in the cooling system may indicate a damaged cylinder head or a damaged cylinder head gasket.

7. Perform the leakage test on the remaining cylinders and record the values.

OIL CONSUMPTION DIAGNOSIS

Oil Consumption Diagnosis

Checks	Causes
Excessive oil consumption, not due to leaks, is the use of 1 L (1 qt) or more of engine oil within 3 200 kilometers (2, 000 miles).	
Preliminary	The causes of excessive oil consumption may include the following conditions: • External oil leaks Refer to **Oil Leak Diagnosis**. • Incorrect oil level or improper reading of the oil level indicator With the vehicle on a level surface, run the engine for a few minutes, allow adequate drain down time, 2-3 minutes and measure for the correct engine oil level. • Improper oil viscosity Refer to the vehicle owners manual and use the recommended SAE grade and viscosity for the prevailing temperatures. • Continuous high speed driving and/or severe usage • Crankcase ventilation system restrictions or malfunctioning components Refer to **Crankcase Ventilation System Inspection/Diagnosis**.

cardiagn.com

	• Worn valve guides and/or valve stems • Worn or improperly installed valve stem oil seals Refer to **Spark Plug Inspection** . • Piston rings broken, worn or not seated properly Allow adequate time for the rings to seat. Replace worn piston rings, as necessary. Refer to **Cylinder Leakage Test**. • Piston and rings improperly installed or not fitted to the cylinder bore Refer to **Lower Engine Noise, Regardless of Engine Speed**.

OIL PRESSURE DIAGNOSIS AND TESTING

Special Tools

- **EN-21867** Pressure Gauge
- **EN-21867-850** Active Fuel Management Oil Pressure Adapter

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

1. With the vehicle on a level surface, run the vehicle for a few minutes. Allow adequate drain down time, 2-3 minutes and measure the oil level.
2. If required, add the recommended grade engine oil and fill the crankcase until the oil level measures full on the oil level indicator.
3. Run the engine briefly, 10-15 seconds and verify low or no oil pressure on the vehicle gauge or light.
4. Listen for a noisy valve train or a knocking noise.
5. Inspect for the following conditions:
    - Oil diluted by water or glycol antifreeze

      Refer to **Coolant in Engine Oil**.

    - Foamy oil, which may be caused by a cut or damaged oil pump screen O-ring seal

cardiagn.com

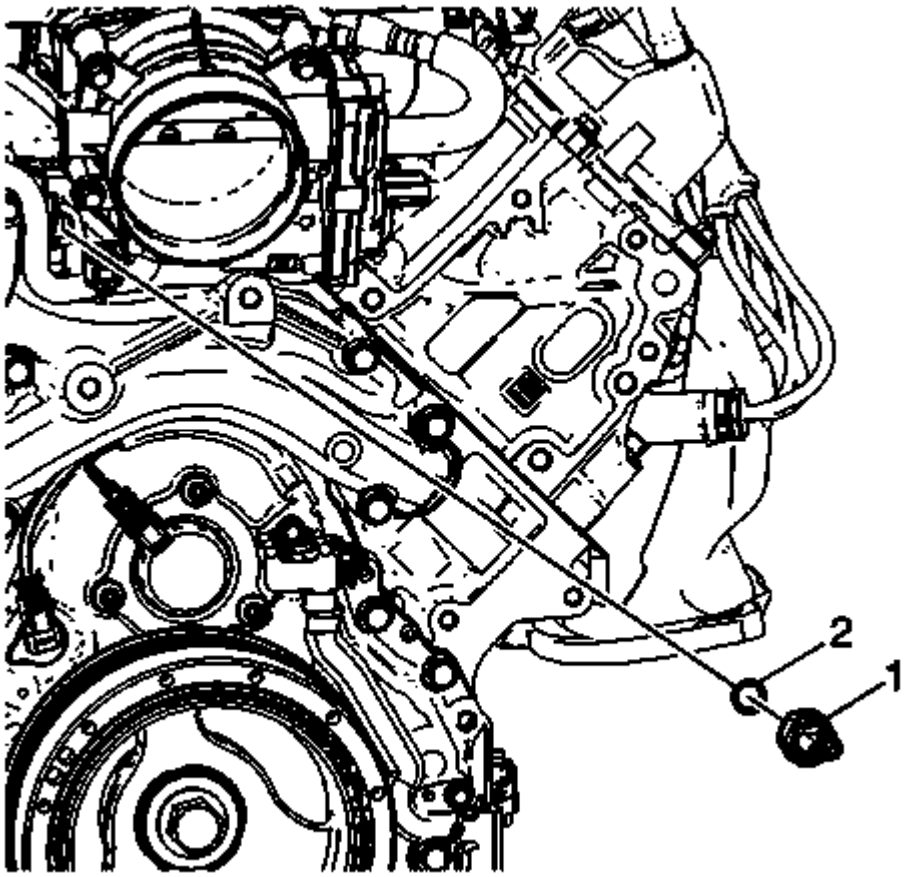

Fig. 1: Oil Pressure Sensor And Seal
Courtesy of GENERAL MOTORS COMPANY

6. Remove the oil pressure sensor (1) and seal (2).

cardiagn.com

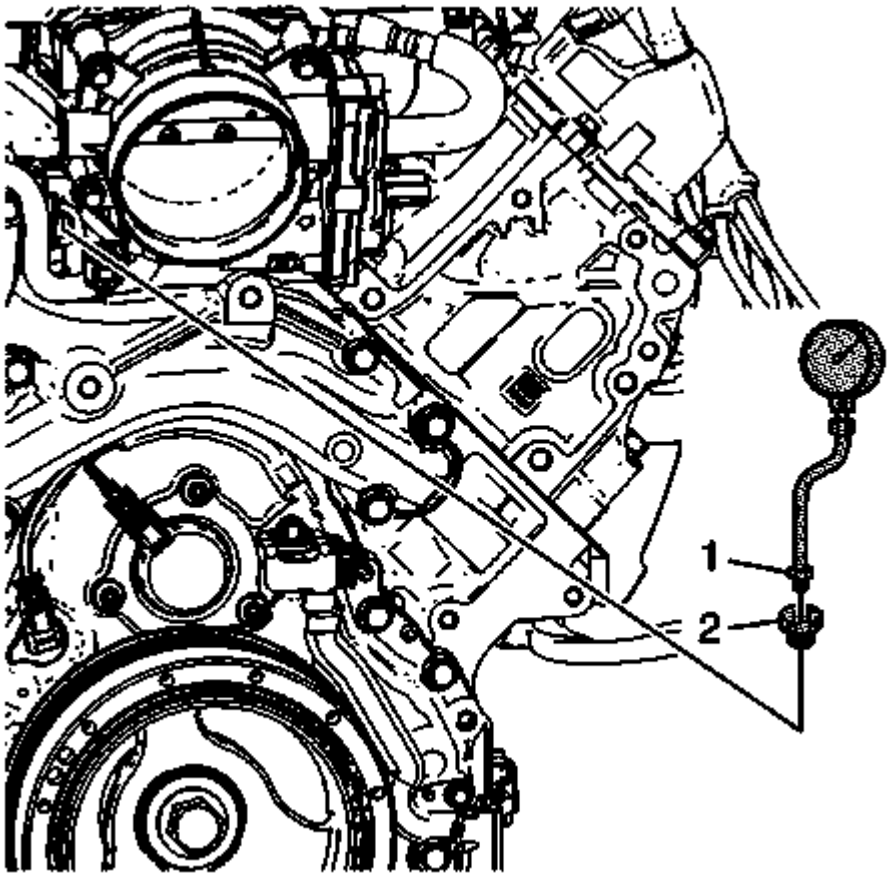

Fig. 2: Active Fuel Management Oil Pressure Adapter And Pressure Gauge
Courtesy of GENERAL MOTORS COMPANY

7. Install the **EN-21867-850** active fuel management oil pressure adapter (2) and **EN-21867** pressure gauge (1) or equivalent.
8. Run the engine until the engine reaches normal operating temperature and measure the engine oil pressure.
9. Compare the readings to **Engine Mechanical Specifications** .
10. If the engine oil pressure is below specifications, inspect the engine for 1 or more of the following conditions:
    - Valve lifter oil manifold filter plugged or damaged. Refer to **Valve Lifter Oil Manifold Cleaning and Inspection** .
    - Check if the engine oil cooler or oil cooler lines are plugged or damaged.
    - Oil pump worn or dirty. Refer to **Oil Pump Cleaning and Inspection** .
    - Oil pump-to-engine block bolts loose. Refer to **Oil Pump Installation** , **Oil Pump Installation (with Z52 Option)** .
    - Oil pump screen loose, plugged or damaged.
    - Oil pump screen O-ring seal missing or damaged.
    - Excessive debris in the oil pan and/or oil filter (possibly indicating internal engine

cardiagn.com

damage).

- Malfunctioning oil pump pressure relief valve. Refer to **DTC P06DA-P06DC** or **DTC P06DD**.
- Excessive bearing clearance and/or bearing damage. Refer to **Crankshaft and Bearing Cleaning and Inspection** and **Camshaft and Bearings Cleaning and Inspection** .
- Cracked, porous or restricted oil galleries.
- Oil gallery plugs missing or incorrectly installed. Refer to **Engine Block Plug Installation** .

CYLINDER DEACTIVATION (ACTIVE FUEL MANAGEMENT) VALVE LIFTER OIL MANIFOLD DIAGNOSIS AND TESTING

Special Tools

- **EN-46999** Active Fuel Management Tester
- **EN-46999-18** Active Fuel Management Tester Air Adapter
- **EN-46999-20** Active Fuel Management Tester Harness - Small Block V8

For equivalent regional tools, refer to **Special Tools**

NOTE:

- **A minimum shop air source of 206 kPa (30 psi) is required for manifold testing.**
- **A water bleed is located on the side of the EN-46999 tester. Occasionally, depress the valve in order to remove excess water from the tool.**

cardiagn.com

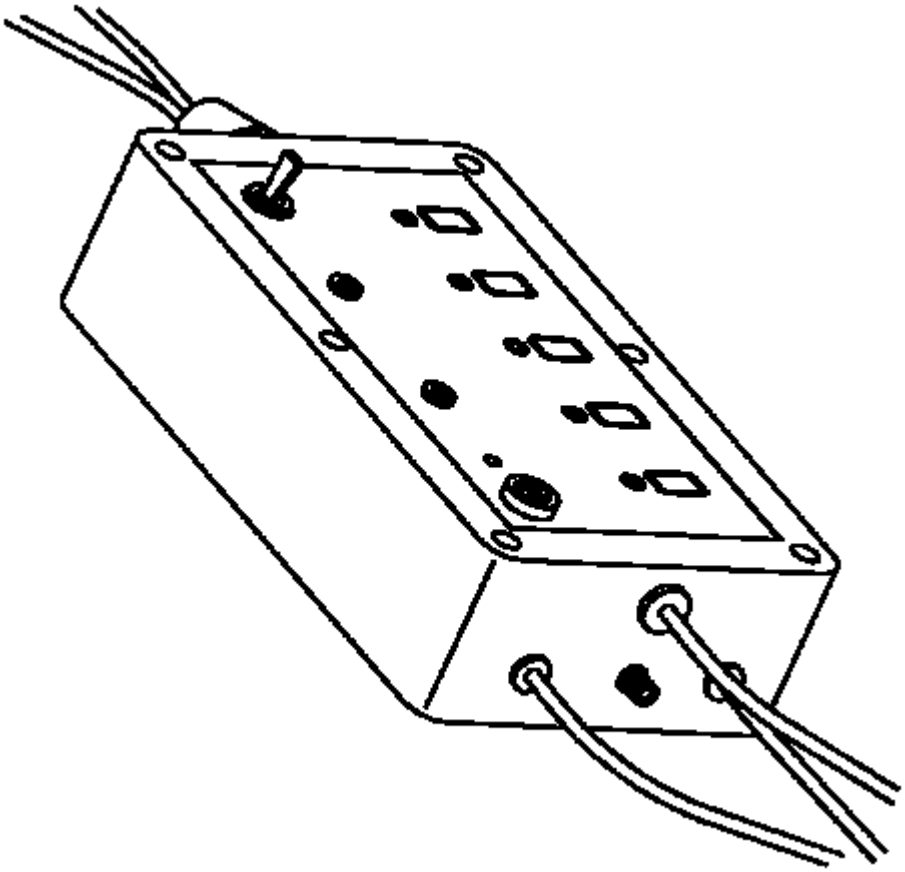

Fig. 3: Identifying Displacement On-Demand Tester
Courtesy of GENERAL MOTORS COMPANY

The manifold bench test provides a maximum 206 kPa (30 psi) of filtered shop air to the manifold and will test each solenoid/valve for the following conditions:

- Proper operation
- A stuck open condition - constant air flow
- A stuck closed condition - no air flow
- A flow restriction within the manifold

1. Individually depress each of the buttons 1-4 on the **EN-46999** tester in order to activate each of the solenoid/valves. When activating each solenoid/valve, a loud click should be heard from the solenoid and an increased amount of air will exit the outlet ports.
    - Button 1 will energize the solenoid/valve 1 for engine cylinder number 1.
    - Button 2 will energize the solenoid/valve 2 for engine cylinder number 4.
    - Button 3 will energize the solenoid/valve 3 for engine cylinder number 6.
    - Button 4 will energize the solenoid/valve 4 for engine cylinder number 7.

cardiagn.com

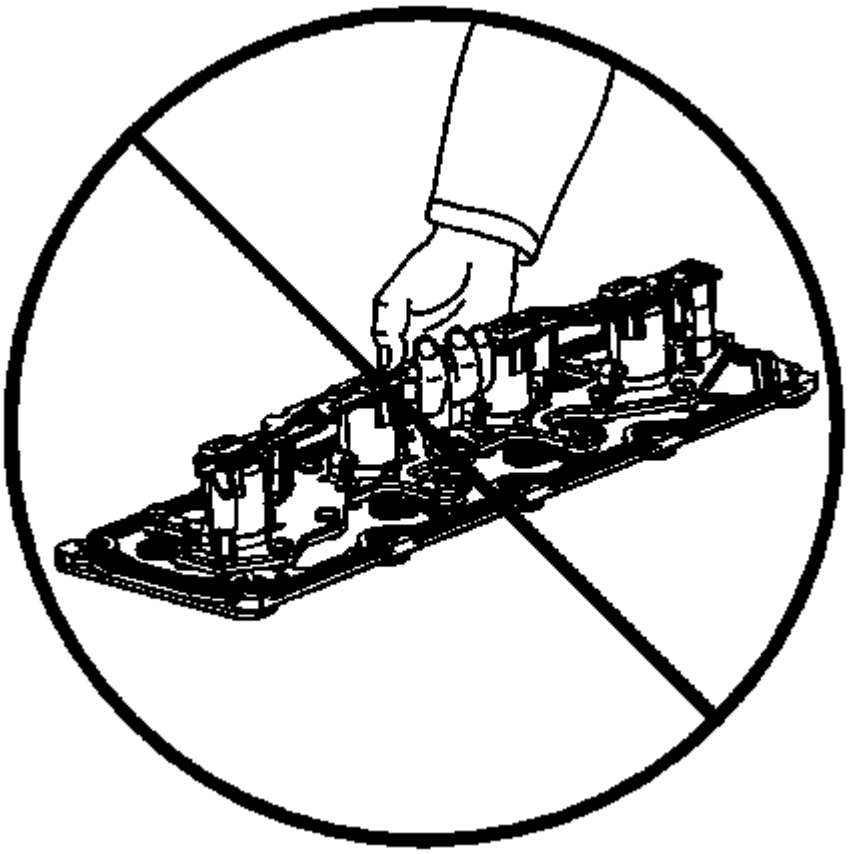

Fig. 4: Valve Lifter Oil Manifold
Courtesy of GENERAL MOTORS COMPANY

2. Do not lift the manifold assembly by the electrical lead frame.

cardiagn.com

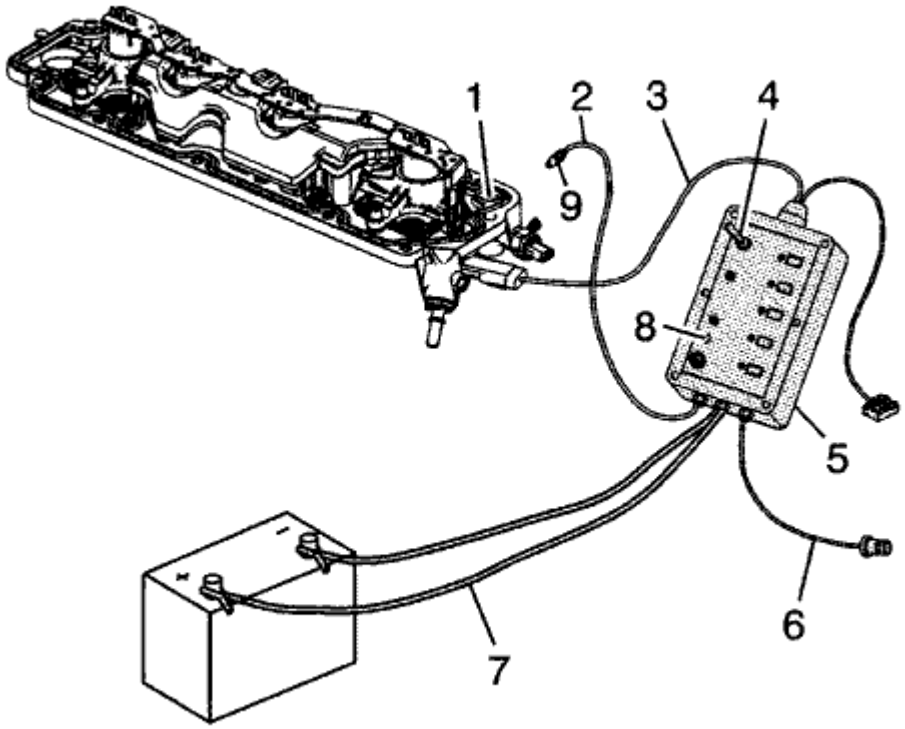

Fig. 5: Active Fuel Management Tester Air Adapter , Air Out Hose And Air Supply Switch
Courtesy of GENERAL MOTORS COMPANY

3. Connect **EN-46999-18** active fuel management tester air adapter (9) to the air out hose (2) of the **EN-46999** tester (5). This will make it possible to connect an air nozzle fitted with a standard 1/4 in NPT female air fitting. Verify the air supply switch (4) is in the off position.
4. Connect the air out hose (6) of the **EN-46999** tester (5) to a shop air source.
5. Connect the 12 volt power supply connectors (7) of the **EN-46999** tester (5) to a 12 volt power supply. Verify the Power light (8) on the tool is illuminated. If the light on the tool is not illuminated when connected to a 12 volt power supply, test and/or replace the 3 amp fuse.
6. Connect the **EN-46999-20** active fuel management tester harness - small block V8 (3) to the tester. Connect **EN-46999-20** active fuel management tester harness - small block V8 to the electrical connector of the manifold.
7. Connect an air nozzle fitted with a tapered rubber tip to **EN-46999-18** active fuel management tester air adapter (9). Hold the tip of the air nozzle in the oil passage directly below the Valve Lifter Oil Manifold Oil Filter (1).

cardiagn.com

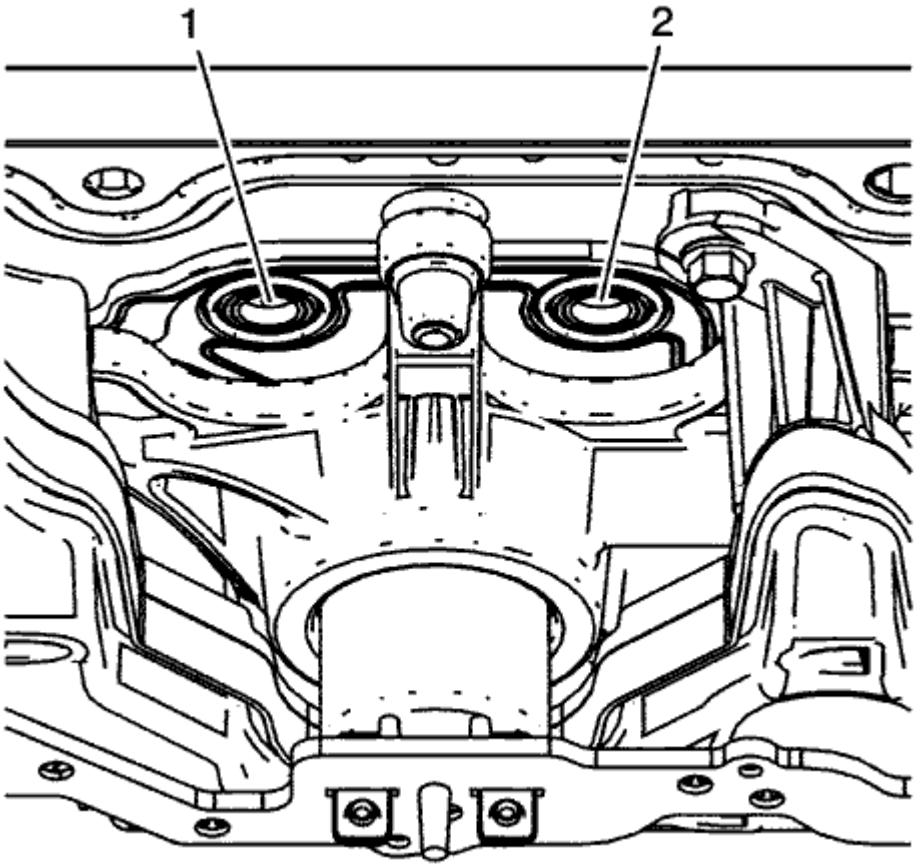

Fig. 6: Turning Air Supply Switch Of EN-46999 Tester To ON Position
Courtesy of GENERAL MOTORS COMPANY

8. Turn the air supply switch of the **EN-46999** tester to the ON position. With the air supply connected to the manifold assembly and the solenoid/valves in the closed position, a limited amount of air will exit from the outlet ports (1, 2) of the manifold.

cardiagn.com

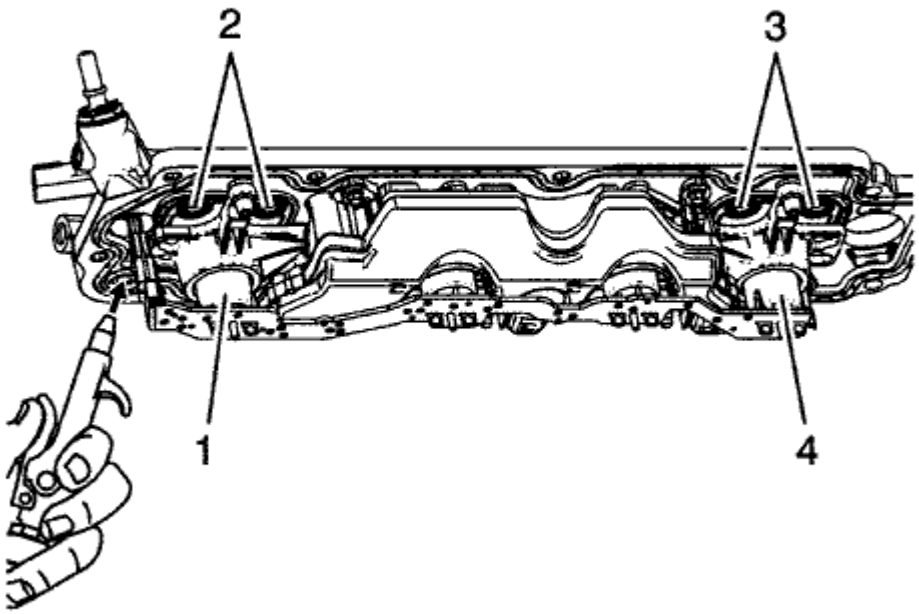

Fig. 7: Depressing Button Number 1 On Tool To Activate Solenoid/Valve 1
Courtesy of GENERAL MOTORS COMPANY

NOTE: The manifold must be tested in the proper position to ensure the solenoid/valves operate as designed.

9. Position the manifold assembly onto a bench at a 45 degree angle in order to test solenoid/valves 1 and 4.
10. Depress button number 1 on the tool to activate solenoid/valve 1. With button 1 depressed, the solenoid/valve (1) should open, allowing an increased amount of air to exit the outlet ports (2) of the manifold.
11. Depress button number 4 on the tool to activate solenoid/valve 4. With button 4 depressed, the solenoid/valve (4) should open, allowing an increased amount of air to exit the outlet ports (3) of the manifold.

cardiagn.com

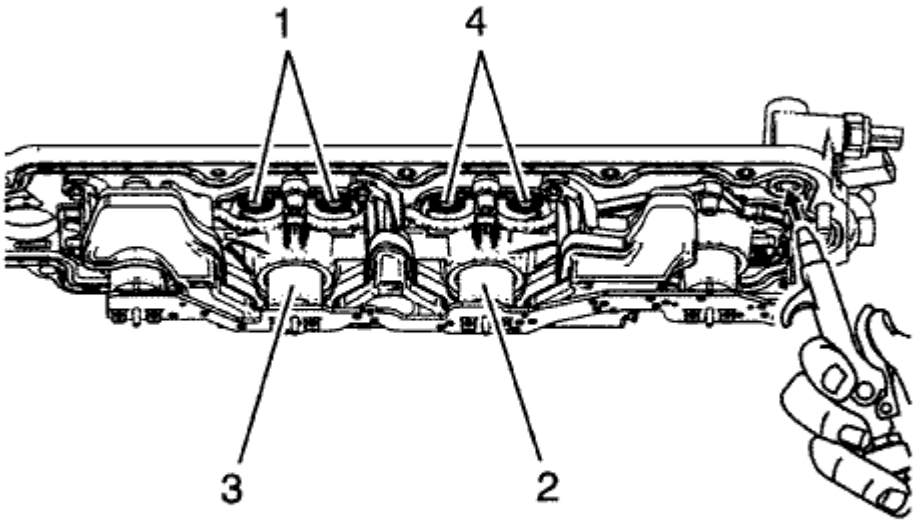

Fig. 8: Repositioning Manifold Assembly Onto A Bench At A 45 Degree Angle
Courtesy of GENERAL MOTORS COMPANY

12. Reposition the manifold assembly onto a bench at a 45 degree angle in order to test solenoid/valves 2 and 3.
13. Depress button number 2 on the tool to activate solenoid/valve 2. With button 2 depressed, the solenoid/valve (2) should open, allowing an increased amount of air to exit the outlet ports (4) of the manifold.
14. Depress button number 3 on the tool to activate solenoid/valve 3. With button 3 depressed, the solenoid/valve (3) should open, allowing an increased amount of air to exit the outlet ports (1) of the manifold.
15. When the test is completed, turn the air source switch on the **EN-46999** tester to the off position and disconnect the tool from the 12 volt power supply and shop air source. Disconnect air nozzle.
16. If after testing, it has been determined that one or more of the solenoid/valves is not functioning properly, replace the manifold as an assembly.
17. If after testing, it has been determined that the solenoid/valves are functioning properly, replace the valve lifters as required. Both intake and exhaust lifters should be replaced in pairs.

CAMSHAFT POSITION ACTUATOR AND SOLENOID VALVE DIAGNOSIS AND TESTING

cardiagn.com

1. Measure the engine oil level. Fill, as required.
2. Using the scan tool, inspect for diagnostic codes within the engine control module (ECM). Refer to **Diagnostic System Check - Vehicle** . Repair, as required.
3. Verify proper engine oil pressure and operation of the active fuel management oil pressure relief valve. Refer to **Oil Pressure Diagnosis and Testing**.
4. Inspect the CMP actuator solenoid valve for proper operation. Refer to **Camshaft Position Actuator Solenoid Valve Inspection** .
    - If valve inspection confirms proper movement of the spool, replace the CMP actuator and CMP valve.
    - If valve inspection confirms improper movement of the spool, replace only the CMP valve.
5. Verify proper operation of the CMP actuator control system. Refer to **Diagnostic System Check - Vehicle** .

ENGINE OIL LEVEL SENSOR DIAGNOSIS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Engine Oil Level Sensor Signal	2	1	-
Engine Oil Level Sensor Ground	-	1	-
1. DIC message Engine Oil Level Low always ON 2. DIC message Engine Oil Level Low always OFF			

Typical Scan Tool Data

Engine Oil Level Switch

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON **Parameter Normal Range:** OK			
Engine Oil Level Sensor/Switch Signal	OK	Low	OK
Engine Oil Level Sensor/Switch Ground	-	Low	-

Circuit/System Description

The engine oil level sensor/switch is normally-closed with proper engine oil level. The switch opens

cardiagn.com

the engine oil level signal circuit when the ignition is ON and the engine is OFF. With the switch in the closed position, the ECM detects a low voltage on the signal circuit. With the switch in the open position, the ECM detects a high voltage on the signal circuit. When high voltage is detected on the signal circuit, the ECM will send a serial data message to the instrument panel cluster (IPC). The IPC will then display a message on the driver information center (DIC) or illuminate a low engine oil level lamp.

The following information determines the message sent from the ECM to the IPC:

- The Low Engine Oil Level message lamp is displayed only after the ECM detects a high voltage on the signal circuit for three consecutive ignition cycles, followed by an ignition OFF event from 15 minutes to greater than 50 minutes, depending on engine oil temperatures.
- The Low Engine Oil Level message is turned OFF when the ECM detects a low voltage on the signal circuit after an ignition OFF event for greater than 90 seconds, followed by an ignition ON event for less than 1 second.

Reference Information

Schematic Reference

- **Engine Mechanical Schematics**
- **Instrument Cluster Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Instrument Cluster Description and Operation**
- **Indicator/Warning Message Description and Operation**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

cardiagn.com

- **If not at proper level**

  Add oil as necessary.

- **If at proper level**

2. Ignition ON, verify the scan tool Engine Oil Level parameter reads OK.
   - **If not OK**

     Refer to Circuit/System Testing.

   - **If OK**
3. All OK.

Circuit/System Testing

NOTE: Verify proper engine oil level before continuing with diagnosis.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B35 Engine Oil Level Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the ground circuit terminal 1 and ground.
   - **If 5 ohms or greater**
     1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
     2. Test for less than 2 ohms in the ground circuit end to end.
        - If 2 ohms or greater, repair the open/high resistance in the circuit.
        - If less than 2 ohms, repair the open/high resistance in the ground connection.
   - **If less than 5 ohms**
3. Ignition ON.
4. Verify the scan tool Engine Oil Level Switch parameter reads Low.
   - **If the Engine Oil Level Switch parameter reads OK**
     1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
     2. Test for infinite resistance between the signal circuit terminal 2 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K20 Engine Control Module.
   - **If the Engine Oil Level Switch parameter reads Low**

NOTE: If a short to voltage is found on the signal circuit, the fuse in the 3A jumper wire will open.

5. Install a 3A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 1.
6. Verify the scan tool Engine Oil Level Switch parameter reads OK.

cardiagn.com

- **If the Engine Oil Level Switch parameter reads Low**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
   - If 1 V or greater, repair the short to voltage on the circuit.
   - If less than 1 V
3. Test for less than 2 ohms in the signal circuit end to end.
   - If 2 ohms or greater, repair the open/high resistance on the circuit.
   - If less than 2 ohms, replace the K20 Engine Control Module.

- **If the Engine Oil Level Switch parameter reads OK**

7. Test or replace the B35 Engine Oil Level Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Engine Oil Level Indicator Switch Replacement (Without Z52)**
- **Control Module References** for the ECM replacement, programming and setup

ENGINE OIL TEMPERATURE SENSOR DIAGNOSIS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	1	2	2	-
Low Reference	-	2	-	-
1. Engine Oil Temperature Gauge High 2. Engine Oil Temperature Gauge Low				

Typical Scan Tool Data

Engine Oil Temperature Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine running at various operating conditions **Parameter Normal Range:**			
Signal	150°C (302°F)	-40°C (-40°F)	-40°C (-40°F)

cardiagn.com

Low Reference	-	-40°C (-40°F)	-

Circuit/System Description

The Engine Oil and Temperature Sensor is a variable resistor that measures the temperature of the engine oil. The Engine Control Module (ECM) supplies 5 V to the Engine Oil and Temperature Sensor signal circuit and supplies a ground to the low reference circuit.

Reference Information

Schematic Reference

-
- **Instrument Cluster Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Engine operating.
2. Verify the scan tool Engine Oil Temperature Sensor parameter is between -40 to +150°C (-40 to +302°F) and changes with engine temperature.
   - **If not between -38 to +148°C (-36 to +298°F) or does not change**

     Refer to Circuit/System Testing.

   - **If between -38 to +148°C (-36 to +298°F) and changes**
3. All OK.

Circuit/System Testing

NOTE: You must perform the Circuit/System Verification before proceeding with

cardiagn.com

Circuit/System Testing.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B35C Engine Oil Level and Temperature Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal C and ground.
    - **If 10 ohms or greater**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for less than 2 ohms in the low reference circuit end to end.
        - If 2 ohms or greater, repair the open/high resistance in the circuit.
        - If less than 2 ohms, replace the K20 Engine Control Module.
    - **If less than 10 ohms**
3. Ignition ON.
4. Verify the scan tool Engine Oil Temperature Sensor parameter is warmer than 148°C (298°F).
    - **If 148°C (298°F) or less**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the signal circuit terminal B and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K20 Engine Control Module.
    - **If warmer than 148°C (298°F)**
5. Install a 3A fused jumper between the signal circuit terminal B and the low reference circuit terminal C.
6. Verify the scan tool Engine Oil Temperature Sensor parameter is colder than -38°C (-36°F).
    - **If -38°C (-36°F) or colder**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1V between the signal circuit and ground.
        - If 1V or greater, repair the short to voltage on the circuit.
        - If less than 1V
    3. Ignition OFF.
    4. Test for less than 2 ohms in the signal circuit end to end.
        - If 2 ohms or greater, repair the open/high resistance in the circuit.
        - If less than 2 ohms, replace the K20 Engine Control Module.
    - **If warmer than -38°C (-36°F)**
7. Test or replace the B35C Engine Oil and Temperature Sensor.

Component Testing

1. Ignition OFF, remove the B35C Engine Oil Level and Temperature Sensor.

cardiagn.com

2. Test the B35C Engine Oil Level and Temperature Sensor by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the table and verify that the resistance is within 5% of the specification.
    - **If not within the specified range**

      Replace the B35C Engine Oil Level and Temperature Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

-
- **Control Module References** for the ECM replacement, programming and setup

OIL LEAK DIAGNOSIS

Oil Leak Diagnosis

Step	Action	Yes	No
IMPORTANT: **You can repair most fluid leaks by first visually locating the leak, repairing or replacing the component or by resealing the gasket surface. Once the leak is identified, determine the cause of the leak. Repair the cause of the leak as well as the leak itself.**			
1	1. Operate the vehicle until it reaches normal operating temperature. 2. Park the vehicle on a level surface, over a large sheet of paper or other clean surface. 3. Wait 15 minutes. 4. Inspect for drippings. Are drippings present?	Go to **Step 2**	System OK
2	Can you identify the type of fluid and the approximate location of the leak?	Go to **Step 10**	Go to **Step 3**
3	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Inspect for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to **Step 10**	Go to **Step 4**

cardiagn.com

4	surrounding components. 2. Operate the vehicle for several kilometers, miles, at normal operating temperature and at varying speeds. 3. Park the vehicle on a level surface, over a large sheet of paper or other clean surface. 4. Wait 15 minutes. 5. Identify the type of fluid and the approximate location of the leak. Can you identify the type of fluid and the approximate location of the leak?	Go to **Step 10**	Go to **Step 5**
5	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Inspect for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to **Step 10**	Go to **Step 6**
6	1. Completely clean the entire engine and surrounding components. 2. Apply an aerosol-type powder, baby powder, foot powder, etc., to the suspected area. 3. Operate the vehicle for several kilometers, miles, at normal operating temperature and at varying speeds. 4. Identify the type of fluid and the approximate location of the leak, from the discolorations in the powder surface. Can you identify the type of fluid and the approximate location of the leak?	Go to **Step 10**	Go to **Step 7**
7	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Inspect for leaks at the following locations: • Sealing surfaces • Fittings		

cardiagn.com

	Can you identify the type of fluid and the approximate location of the leak?	Go to **Step 10**	Go to **Step 8**
8	Use the **J 28428-E** High-Intensity Black Light Kit in order to identify the type of fluid and the approximate location of the leak. Refer to the manufacturer's instructions when using the tool. Can you identify the type of fluid and the approximate location of the leak?	Go to **Step 10**	Go to **Step 9**
9	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Inspect for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to **Step 10**	System OK
10	1. Inspect the engine for mechanical damage. Special attention should be shown to the following areas: • Higher than recommended fluid levels • Higher than recommended fluid pressures • Plugged or malfunctioning fluid filters or pressure bypass valves • Plugged or malfunctioning engine ventilation system • Improperly tightened or damaged fasteners • Cracked or porous components • Improper sealants or gaskets, where required • Improper sealant or gasket installation • Damaged or worn gaskets or seals • Damaged or worn sealing surfaces 2. Inspect the engine for customer modifications. Is there mechanical damage or customer modifications to the engine?	Go to **Step 11**	System OK
	Repair or replace all damaged or modified		

cardiagn.com

11	components. Does the engine still leak oil?	Go to **Step 1**	System OK

CRANKCASE VENTILATION SYSTEM INSPECTION/DIAGNOSIS

Crankcase Ventilation System Inspection/Diagnosis

Symptom	Correction
External oil leak	Inspect for any of the following conditions: • Restricted or kinked PCV hose or engine vent hose • Damaged, incorrect or incorrectly installed PCV hose • Excessive crankcase pressure
Rough Idle	Inspect for any of the following conditions: • Restricted or kinked PCV hose or engine vent hose • Leaking (damaged) PCV hose • Vacuum hoses worn or not properly installed
Stalling or slow idle speed	Inspect for any of the following conditions: • Restricted or kinked engine vent hose • Leaking (damaged) PCV hose
High idle speed	Inspect for a leaking (damaged) PCV hose
Sludge in the engine	Inspect for restricted or kinked PCV hose or engine vent hose

DRIVE BELT CHIRPING, SQUEAL AND WHINE DIAGNOSIS

Diagnostic Aids

- A chirping or squeal noise may be intermittent due to moisture on the drive belts or the pulleys. It may be necessary to spray a small amount of water on the drive belts in order to duplicate the customers concern. If spraying water on the drive belt duplicates the symptom, cleaning the belt pulleys may be the probable solution.
- If the noise is intermittent, verify the accessory drive components by varying their loads making sure they are operated to their maximum capacity. An overcharged A/C system, power steering system with a pinched hose or wrong fluid or a generator failing are suggested items to inspect.
- A chirping, squeal or whine noise may be caused by a loose or improper installation of a body or suspension component. Other items of the vehicle may also cause the noise.
- The drive belts will not cause a whine noise.

Test Description

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

cardiagn.com

The noise may not be engine related. This step is to verify that the engine is making the noise. If the engine is not making the noise do not proceed further with this table.

3

The noise may be an internal engine noise. Removing the drive belts one at a time and operating the engine for a brief period will verify the noise is related to the drive belt. When removing the drive belt the water pump may not be operating and the engine may overheat. Also DTCs may set when the engine is operating with the drive belts removed.

4

Inspect all drive belt pulleys for pilling. Pilling is the small balls or pills or it can be strings in the drive belt grooves from the accumulation of rubber dust.

6

Misalignment of the pulleys may be caused from improper mounting of the accessory drive component, incorrect installation of the accessory drive component pulley or the pulley bent inward or outward from a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across two or three pulleys. If a misaligned pulley is found refer to that accessory drive component for the proper installation procedure for that pulley.

10

Inspecting of the fasteners can eliminate the possibility that a wrong bolt, nut, spacer or washer was installed.

12

Inspecting the pulleys for being bent should include inspecting for a dent or other damage to the pulleys that would prevent the drive belt from not seating properly in all of the pulley grooves or on the smooth surface of a pulley when the back side of the belt is used to drive the pulley.

14

This test is to verify that the drive belt tensioner operates properly. If the drive belt tensioner is not operating properly, proper belt tension may not be achieved to keep the drive belt from slipping which could cause a squeal noise.

15

This test is to verify that the drive belt is not too long, which would prevent the drive belt tensioner from working properly. Also if an incorrect length drive belt was installed, it may not be routed properly and may be turning an accessory drive component in the wrong direction.

16

cardiagn.com

Misalignment of the pulleys may be caused from improper mounting of the accessory drive component, incorrect installation of the accessory drive component pulley or the pulley bent inward or outward from a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across two or three pulleys. If a misaligned pulley is found refer to that accessory drive component for the proper installation procedure for that pulley.

17

This test is to verify that the pulleys are the correct diameter or width. Using a known good vehicle compare the pulley sizes.

19

Replacing the drive belt when it is not damaged or there is not excessive pilling will only be a temporary repair.

Drive Belt Chirping, Squeal and Whine Diagnosis

Step	Action	Yes	No
CAUTION: **Refer to Belt Dressing Caution .** DEFINITION: The following items are indications of chirping: • A high pitched noise that is heard once per revolution of the drive belt or a pulley. • Chirping may occur on cold damp start-ups and will subside once the vehicle reaches normal operating temp. DEFINITION: The following items are indications of drive belt squeal: • A loud screeching noise that is caused by a slipping drive belt. This is unusual for a drive belt with multiple ribs. • The noise occurs when a heavy load is applied to the drive belt, such as an air conditioning compressor engagement snapping the throttle or slipping on a seized pulley or a faulty accessory drive component. DEFINITION: The following items are indications of drive belt whine: • A high pitched continuous noise. • The noise may be caused by an accessory drive component failed bearing.			
1	Did you review the Drive Belt Symptom operation and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Engine Mechanical**
2	Verify that there is a chirping, squeal or whine noise. Does the engine make the chirping squeal or		

cardiagn.com

	whine noise?	Go to **Step 3**	Aids
3	1. Remove the drive belt. If the engine has multiple drive belts, remove the belts one at a time and perform the test below each time a belt is removed. 2. Operate the engine for no longer than 30-40 seconds. 3. Repeat this test if necessary by removing the remaining belt(s). Does the chirping, squeal or whine noise still exist?	Go to **Symptoms - Engine Mechanical**	Go to **Step 4**
4	• If diagnosing a chirping noise, inspect for severe pilling exceeding 1/3 of the belt groove depth. • If diagnosing a squeal or whine noise, proceed to step 13. Do the belt grooves have pilling?	Go to **Step 5**	Go to **Step 6**
5	Clean the drive belt pulleys with a suitable wire brush. Did you complete the repair?	Go to **Step 20**	Go to **Step 6**
6	Inspect for misalignment of the pulleys. Are any of the pulleys misaligned?	Go to **Step 7**	Go to **Step 8**
7	Replace or repair any misaligned pulleys. Did you complete the repair?	Go to **Step 20**	Go to **Step 8**
8	Inspect for bent or cracked brackets. Did you find any bent or cracked brackets?	Go to **Step 9**	Go to **Step 10**
9	Replace any bent or cracked brackets. Did you complete the repair?	Go to **Step 20**	Go to **Step 10**
10	Inspect for improper, loose or missing fasteners. Did you find the condition?	Go to **Step 11**	Go to **Step 12**
11	**CAUTION:** **Refer to Fastener Caution .** 1. Tighten any loose fasteners. Refer to **Fastener Tightening Specifications** . 2. Replace any improper or missing fasteners.		

cardiagn.com

	Did you complete the repair?	Go to **Step 20**	Go to **Step 12**
12	Inspect for a bent pulley. Did you find the condition?	Go to **Step 18**	Go to **Step 13**
13	Inspect for an accessory drive component seized bearing or a faulty accessory drive component. If diagnosing a whine noise and the condition still exist, proceed to Diagnostic Aids. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 14**
14	Test the drive belt tensioner for proper operation. Refer to **Drive Belt Tensioner Diagnosis**. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 15**
15	Inspect for the correct drive belt length. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 16**
16	Inspect for misalignment of a pulley. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 17**
17	Inspect for the correct pulley size. Did you find and correct the condition?	Go to **Step 20**	Go to Diagnostic Aids
18	Replace the bent pulley. Did you complete the repair?	Go to **Step 20**	Go to **Step 19**
19	Replace the drive belt. Refer to **Drive Belt Replacement - Accessory** . Did you complete the repair?	Go to **Step 20**	Go to Diagnostic Aids
20	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

DRIVE BELT RUMBLING AND VIBRATION DIAGNOSIS

Diagnostic Aids

The accessory drive components can have an affect on engine vibration. Vibration from the engine operating may cause a body component or another part of the vehicle to make rumbling noise. Vibration can be caused by, but not limited to the air conditioning (A/C) system over charged, the power steering system restricted or the incorrect fluid or an extra load on the generator. To help identify an intermittent or an improper condition, vary the loads on the accessory drive components.

The drive belt may have a rumbling condition that can not be seen or felt. Sometimes replacing the drive belt may be the only repair for the symptom.

If replacing the drive belt, completing the diagnostic table and the noise is only heard when the drive belts are installed, there might be an accessory drive component with a failure. Varying the load on the different accessory drive components may aid in identifying which component is causing the rumbling noise.

Test Description

cardiagn.com

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

2

This test is to verify that the symptom is present during diagnosing. Other vehicle components may cause a similar symptom.

3

This test is to verify that one of the drive belts is causing the rumbling noise or vibration. Rumbling noise may be confused with an internal engine noise due to the similarity in the description. Remove only one drive belt at a time if the vehicle has multiple drive belts. When removing the drive belts the water pump may not be operating and the engine may overheat. Also DTCs may set when the engine is operating with the drive belts removed.

4

Inspecting the drive belts is to ensure that they are not causing the noise. Small cracks across the ribs of the drive belt will not cause the noise. Belt separation is identified by the plys of the belt separating and may be seen at the edge of the belt or felt as a lump in the belt.

5

Small amounts of pilling is normal condition and acceptable. When the pilling is severe the drive belt does not have a smooth surface for proper operation.

9

Inspecting of the fasteners can eliminate the possibility that the wrong bolt, nut, spacer or washer was installed.

11

This step should only be performed if the water pump is driven by the drive belt. Inspect the water pump shaft for being bent. Also inspect the water pump bearings for smooth operation and excessive play. Compare the water pump with a known good water pump.

12

Accessory drive component brackets that are bent, cracked or loose may put extra strain on that accessory component causing it to vibrate.

Drive Belt Rumbling and Vibration Diagnosis

Step	Action	Yes	No
CAUTION: **Refer to Belt Dressing Caution .**			

cardiagn.com

DEFINITION: The following items are indications of drive belt rumbling:

- A low pitch tapping, knocking or thumping noise heard at or just above idle.
- Heard once per revolution of the drive belt or a pulley.
- Rumbling may be caused from:
  - Pilling, the accumulation of rubber dust that forms small balls (pills) or strings in the drive belt pulley groove
  - The separation of the drive belt
  - A damaged drive belt

DEFINITION: The following items are indications of drive belt vibration:

- The vibration is engine-speed related.
- The vibration may be sensitive to accessory load.

1	Did you review the Drive Belt Symptom operation and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Engine Mechanical**
2	Verify that there is a rumbling noise or that the vibration is engine related. Does the engine make the rumbling noise or vibration?	Go to **Step 3**	Go to Diagnostic Aids
3	**NOTE:** **If the engine has multiple drive belts, remove the belts one at a time and perform the test below each time a belt is removed.** 1. Remove the drive belt. 2. Operate the engine for no longer than 30-40 seconds. 3. Repeat this test if necessary by removing the remaining belt(s). Does the rumbling or vibration still exist?	Go to **Symptoms - Engine Mechanical** or **Vibration Analysis - Engine**	Go to **Step 4**
4	Inspect the drive belts for wear, damage, separation, sections of missing ribs and debris build-up. Did you find any of these conditions?	Go to **Step 7**	Go to **Step 5**
5	Inspect for severe pilling of more than 1/3 of the drive belt pulley grooves. Did you find severe pilling?	Go to **Step 6**	Go to **Step 7**
6	1. Clean the drive belt pulleys using a suitable wire brush. 2. Reinstall the drive belts. Refer to **Drive**		

cardiagn.com

	Belt Replacement - Accessory . Did you correct the condition?	Go to **Step 8**	Go to **Step 7**
7	Install a new drive belt. Refer to **Drive Belt Replacement - Accessory** . Did you complete the replacement?	Go to **Step 8**	Go to **Step 9**
8	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 9**
9	Inspect for improper, loose or missing fasteners. Did you find any of these conditions?	Go to **Step 10**	Go to **Step 11**
10	**CAUTION:** **Refer to Fastener Caution .** 1. Tighten any loose fasteners. Refer to **Fastener Tightening Specifications** . 2. Replace improper or missing fasteners. Did you complete the repair?	Go to **Step 13**	Go to **Step 11**
11	Inspect for a bent water pump shaft. Refer to **Water Pump Replacement** . Did you find and correct the condition?	Go to **Step 13**	Go to **Step 12**
12	Inspect for bent or cracked brackets. Did you find and correct the condition?	Go to **Step 13**	Go to Diagnostic Aids
13	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

DRIVE BELT FALLS OFF AND EXCESSIVE WEAR DIAGNOSIS

Diagnostic Aids

If the drive belt repeatedly falls off the drive belt pulleys, this is because of pulley misalignment.

An extra load that is quickly applied or released by an accessory drive component may cause the drive belt to fall off the pulleys. Verify the accessory drive components operate properly.

If the drive belt is the incorrect length, the drive belt tensioner may not keep the proper tension on the drive belt.

Excessive wear on a drive belt is usually caused by an incorrect installation or the wrong drive belt for the application.

Minor misalignment of the drive belt pulleys will not cause excessive wear, but will probably cause the drive belt to make a noise or to fall off.

cardiagn.com

Excessive misalignment of the drive belt pulleys will cause excessive wear but may also make the drive belt fall off.

Test Description

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

2

This inspection is to verify the condition of the drive belt. Damage may have occurred to the drive belt when the drive belt fell off. The drive belt may have been damaged, which caused the drive belt to fall off. Inspect the belt for cuts, tears, sections of ribs missing or damaged belt plys.

4

Misalignment of the pulleys may be caused from improper mounting of the accessory drive component, incorrect installation of the accessory drive component pulley or the pulley bent inward or outward from a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across two or three pulleys. If a misaligned pulley is found refer to that accessory drive component for the proper installation procedure of that pulley.

5

Inspecting the pulleys for being bent should include inspecting for a dent or other damage to the pulleys that would prevent the drive belt from not seating properly in all of the pulley grooves or on the smooth surface of a pulley when the back side of the belt is used to drive the pulley.

6

Accessory drive component brackets that are bent or cracked will let the drive belt fall off.

7

Inspection of the fasteners can eliminate the possibility that a wrong bolt, nut, spacer or washer was installed. Missing, loose or the wrong fasteners may cause pulley misalignment from the bracket moving under load. Over tightening of the fasteners may cause misalignment of the accessory component bracket.

13

The inspection is to verify the drive belt is correctly installed on all of the drive belt pulleys. Wear on the drive belt may be caused by mis-positioning the drive belt by one groove on a pulley.

14

The installation of a drive belt that is too wide or too narrow will cause wear on the drive belt. The drive belt ribs should match all of the grooves on all of the pulleys.

cardiagn.com

15

This inspection is to verify the drive belt is not contacting any parts of the engine or body while the engine is operating. There should be sufficient clearance when the drive belt accessory drive components load varies. The drive belt should not come in contact with an engine or a body component when snapping the throttle.

Drive Belt Falls Off and Excessive Wear Diagnosis

Step	Action	Yes	No
CAUTION: **Refer to Belt Dressing Caution .** DEFINITION: The drive belt falls off the pulleys or may not ride correctly on the pulleys.DEFINITION: Wear at the outside ribs of the drive belt due to an incorrectly installed drive belt.			
1	Did you review the Drive Belt Symptom operation and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Engine Mechanical**
2	• If diagnosing excessive wear, proceed to step 13. • If diagnosing a drive belt that falls off, inspect for a damaged drive belt. Did you find the condition?	Go to **Step 3**	Go to **Step 4**
3	Install a new drive belt. Refer to **Drive Belt Replacement - Accessory** . Does the drive belt continue to fall off?	Go to **Step 4**	System OK
4	Inspect for misalignment of the pulleys. Did you find and repair the condition?	Go to **Step 12**	Go to **Step 5**
5	Inspect for a bent or dented pulley. Did you find and repair the condition?	Go to **Step 12**	Go to **Step 6**
6	Inspect for a bent or a cracked bracket. Did you find and repair the condition?	Go to **Step 12**	Go to **Step 7**
7	Inspect for improper, loose or missing fasteners. Did you find loose or missing fasteners?	Go to **Step 8**	Go to **Step 9**
8	**CAUTION:** **Refer to Fastener Caution .** 1. Tighten any loose fasteners. Refer to **Fastener Tightening Specifications** . 2. Replace improper or missing fasteners. Does the drive belt continue to fall off?	Go to **Step 9**	System OK
	Test the drive belt tensioner for operating		

cardiagn.com

9	correctly. Refer to **Drive Belt Tensioner Diagnosis**. Does the drive belt tensioner operate correctly?	Go to **Step 11**	Go to **Step 10**
10	Replace the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement - Accessory** . Does the drive belt continue to fall off?	Go to **Step 11**	System OK
11	Inspect for failed drive belt idler and drive belt tensioner pulley bearings. Did you find and repair the condition?	Go to **Step 12**	Go to Diagnostic Aids
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 13**
13	Inspect the drive belt for the proper installation. Refer to **Drive Belt Tensioner Replacement - Accessory** . Did you find this condition?	Go to **Step 16**	Go to **Step 14**
14	Inspect for the proper drive belt. Did you find this condition?	Go to **Step 16**	Go to **Step 15**
15	Inspect for the drive belt rubbing against a bracket, hose or wiring harness. Did you find and repair the condition?	Go to **Step 17**	Go to Diagnostic Aids
16	Replace the drive belt. Refer to **Drive Belt Replacement - Accessory** . Did you complete the replacement?	Go to **Step 17**	-
17	Operate the system in order to verify the repair. Did you correct the condition?	System OK	-

DRIVE BELT TENSIONER DIAGNOSIS

Drive Belt Tensioner Diagnosis

Step	Action	Yes	No
1	Remove the drive belt. Refer to **Drive Belt Replacement - Accessory** . Inspect the drive belt tensioner pulley. Is the drive belt tensioner pulley loose or misaligned?	Go to **Step 4**	Go to **Step 2**
2	Rotate the drive belt tensioner. Does the tensioner rotate without any unusual resistance or binding?	Go to **Step 3**	Go to **Step 4**
3	1. Use a torque wrench in order to measure the torque required to move the tensioner off of the stop. 2. Use a torque wrench on a known good tensioner in order to measure the torque required to move the tensioner off of the		

cardiagn.com

	Is the first torque reading within 10% of the second torque reading?	System OK	Go to **Step 4**
4	Replace the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement - Accessory** . Is the repair complete?	System OK	-

cardiagn.com