IGNITION SYSTEM

CONTENTS

GENERAL INFORMATION

INTRODUCTION

This section describes the electronic ignition system for the 2.0L engines used in Neon vehicles.

The On-Board Diagnostics Section in Group 25 describes diagnostic trouble codes.

Group 0, Lubrication and Maintenance, contains general maintenance information for ignition related items. The Owner's Manual also contains maintenance information.

DESCRIPTION AND OPERATION

IGNITION SYSTEM

Ignition system operation and diagnostics, are identical for 2.0L Single Overhead Cam (SOHC) and 2.0L Duel Overhead Cam (DOHC) engines.

The major difference between the two engines is component location which affects the ignition system service procedures. There are various sensors that are in different locations due to a different cylinder head and intake manifold.

DESCRIPTION AND OPERATION (Continued)

The 2.0L engines use a fixed ignition timing system. The distributorless electronic ignition system is referred to as the Direct Ignition System (DIS).

Basic ignition timing is not adjustable. The Powertrain Control Module (PCM) determines spark advance. The system's three main components are the coil pack, crankshaft position sensor, and camshaft position sensor.

POWERTRAIN CONTROL MODULE

The Powertrain Control Module (PCM) regulates the ignition system (Fig. 1). The PCM supplies battery voltage to the ignition coil through the Auto Shutdown (ASD) Relay. The PCM also controls the ground circuit for the ignition coil. By switching the ground path for the coil on and off, the PCM adjusts ignition timing to meet changing engine operating conditions.

During the crank-start period the PCM maintains spark advance at 9° BTDC. During engine operation the following inputs determine the amount of spark advance provided by the PCM.

- Intake air temperature
- Coolant temperature
- Engine RPM
- Intake manifold vacuum
- Knock sensor

The PCM also regulates the fuel injection system. Refer to the Fuel Injection sections of Group 14.

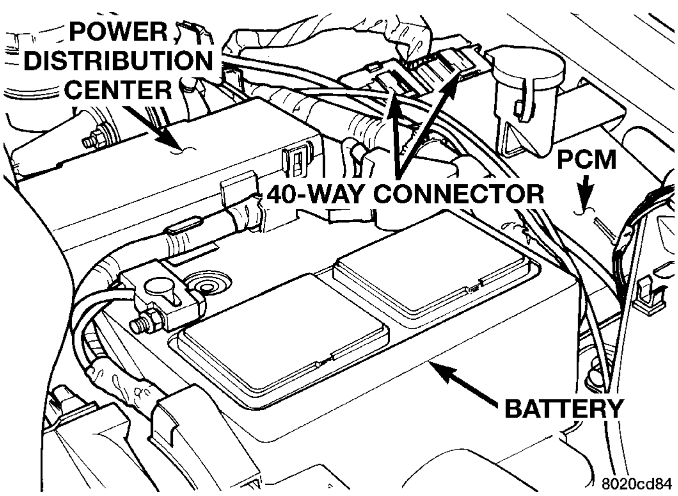


Fig. 1 Powertrain Control Module

SPARK PLUGS

The 2.0L engines uses resistor spark plugs. For spark plug identification and specifications, Refer to the Specifications section at the end of this group.

Remove the spark plugs and examine them for burned electrodes and fouled, cracked or broken porcelain insulators. Keep plugs arranged in the order in which they were removed from the engine. An isolated plug displaying an abnormal condition indicates that a problem exists in the corresponding cylinder. Replace spark plugs at the intervals recommended in Group 0.

Spark plugs that have low mileage may be cleaned and reused if not otherwise defective. Refer to the Spark Plug Condition section of this group. After cleaning, file the center electrode flat with a small point file or jewelers file. Adjust the gap between the electrodes (Fig. 2) to the dimensions specified in the chart at the end of this section.

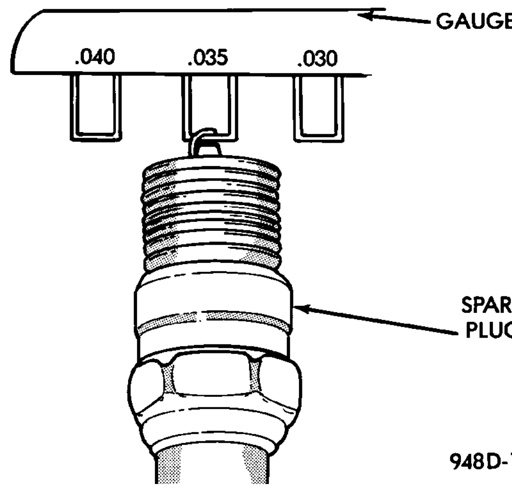


Fig. 2 Setting Spark Plug Electrode Gap

Always tighten spark plugs to the specified torque. Over tightening can cause distortion and change the spark plug gap. Tighten spark plugs to 28 N·m (20 ft. lbs.) torque.

SPARK PLUG CABLES

Spark plug cables are sometimes referred to as secondary ignition wires. The wires transfer electrical current from the coil pack to individual spark plugs at each cylinder. The resistor type, nonmetallic spark plug cables provide suppression of radio frequency emissions from the ignition system.

Check the spark plug cable connections for good contact at the coil and spark plugs. Terminals should be fully seated. The nipples and spark plug covers should be in good condition. Nipples should fit tightly on the coil. Spark plug boot should completely cover the spark plug hole in the cylinder head cover. Install the boot until the terminal snaps over the spark plug. A snap must be felt to ensure the spark plug cable terminal engaged the spark plug.

Loose cable connections will corrode, increase resistance and permit water to enter the coil towers. These conditions can cause ignition malfunction. Plastic clips in various locations protect the cables from damage. When the cables are replaced the clips must be used to prevent damage to the cables. The

DESCRIPTION AND OPERATION (Continued)

#1 cable must be routed under the PCV hose and clipped to the #2 cable.

ELECTRONIC IGNITION COILS

WARNING: THE DIRECT IGNITION SYSTEM GENERATES APPROXIMATELY 40,000 VOLTS. PERSONAL INJURY COULD RESULT FROM CONTACT WITH THIS SYSTEM.

The coil pack consists of 2 coils molded together. The coil pack is mounted on the valve cover (Fig. 3) or (Fig. 4). High tension leads route to each cylinder from the coil. The coil fires two spark plugs every power stroke. One plug is the cylinder under compression, the other cylinder fires on the exhaust stroke. Coil number one fires cylinders 1 and 4. Coil number two fires cylinders 2 and 3. The PCM determines which of the coils to charge and fire at the correct time.

The Auto Shutdown (ASD) relay provides battery voltage to the ignition coil. The PCM provides a ground contact (circuit) for energizing the coil. When the PCM breaks the contact, the energy in the coil primary transfers to the secondary causing the spark. The PCM will de-energize the ASD relay if it does not receive the crankshaft position sensor and camshaft position sensor inputs. Refer to Auto Shutdown (ASD) Relay—PCM Output, in this section for relay operation.

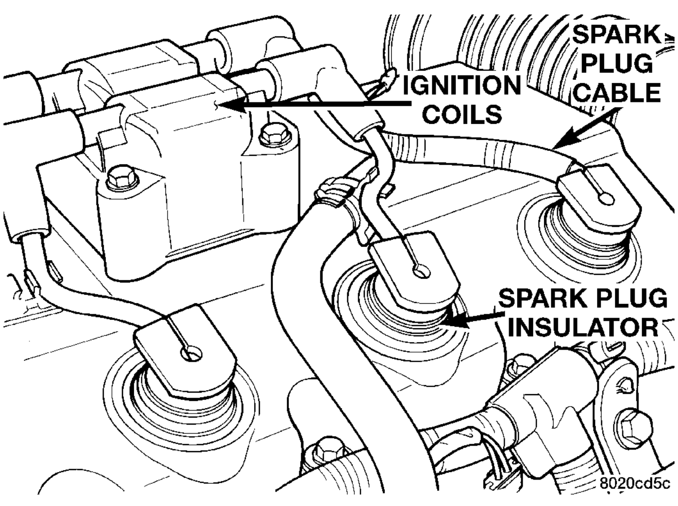


Fig. 3 Ignition Coil Pack—SOHC

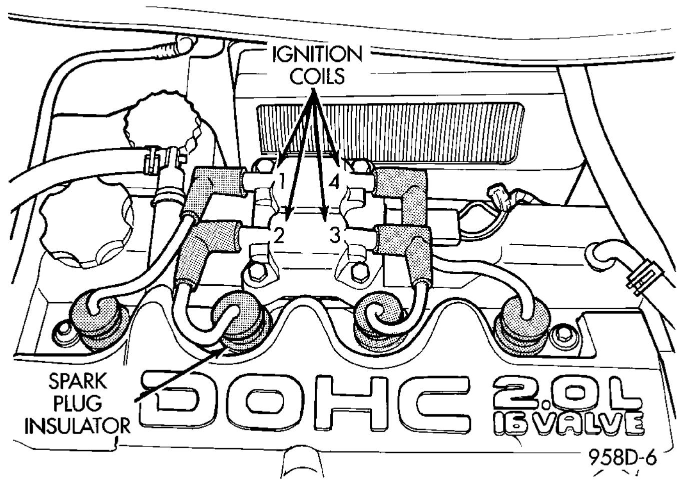


Fig. 4 Ignition Coil Pack—DOHC

AUTOMATIC SHUTDOWN RELAY

The Automatic Shutdown (ASD) relay supplies battery voltage to the fuel injectors, electronic ignition coil and the heating elements in the oxygen sensors.

A buss bar in the Power Distribution Center (PDC) supplies voltage to the solenoid side and contact side of the relay. The ASD relay power circuit contains a 20 amp fuse between the buss bar in the PDC and the relay. The fuse also protects the power circuit for the fuel pump relay and pump. The fuse is located in the PDC. Refer to Group 8W, Wiring Diagrams for circuit information.

The PCM controls the ASD relay by switching the ground path for the solenoid side of the relay on and off. The PCM turns the ground path off when the ignition switch is in the Off position. When the ignition switch is in On or Start, the PCM monitors the crankshaft and camshaft position sensor signals to determine engine speed and ignition timing (coil dwell). If the PCM does not receive crankshaft and camshaft position sensor signals when the ignition switch is in the Run position, it will de-energize the ASD relay.

The ASD relay is located in the PDC (Fig. 5). The inside top of the PDC cover has label showing relay and fuse identification.

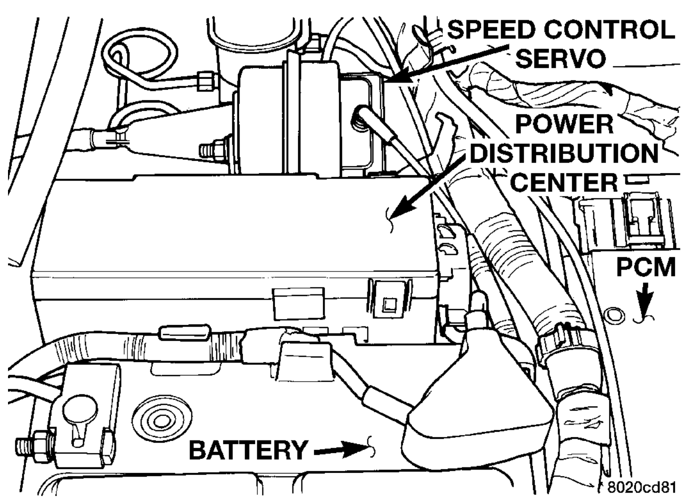


Fig. 5 Power Distribution Center (PDC)

CRANKSHAFT POSITION SENSOR

The PCM determines what cylinder to fire from the crankshaft position sensor input and the camshaft position sensor input. The second crankshaft counter-

DESCRIPTION AND OPERATION (Continued)

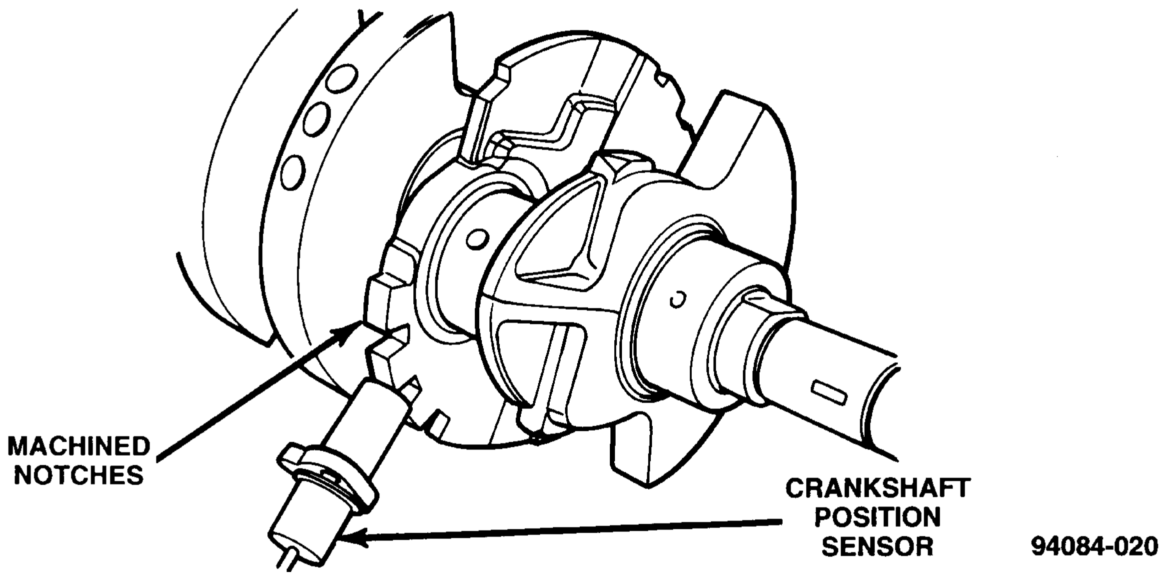


Fig. 6 Timing Reference Notches

weight has machined into it two sets of four timing reference notches including a 60 degree signature notch (Fig. 6). From the crankshaft position sensor input the PCM determines engine speed and crankshaft angle (position).

The notches generate pulses from high to low in the crankshaft position sensor output voltage. When a metal portion of the counterweight aligns with the crankshaft position sensor, the sensor output voltage goes low (less than 0.5 volts). When a notch aligns with the sensor, voltage goes high (5.0 volts). As a group of notches pass under the sensor, the output voltage switches from low (metal) to high (notch) then back to low.

If available, an oscilloscope can display the square wave patterns of each voltage pulse. From the frequency of the output voltage pulses, the PCM calculates engine speed. The width of the pulses represent the amount of time the output voltage stays high before switching back to low. The period of time the sensor output voltage stays high before switching back to low is referred to as pulse-width. The faster the engine is operating, the smaller the pulse-width on the oscilloscope.

By counting the pulses and referencing the pulse from the 60 degree signature notch, the PCM calculates crankshaft angle (position). In each group of timing reference notches, the first notch represents 69 degrees before top dead center (BTDC). The second notch represents 49 degrees BTDC. The third notch represents 29 degrees. The last notch in each set represents 9 degrees before top dead center BTDC.

The timing reference notches are machined at 20° increments. From the voltage pulse-width the PCM tells the difference between the timing reference notches and the 60 degree signature notch. The 60 degree signature notch produces a longer pulse-width than the smaller timing reference notches. If the camshaft position sensor input switches from high to low when the 60 degree signature notch passes under the crankshaft position sensor, the PCM knows cylinder number one is the next cylinder at TDC.

The crankshaft position sensor mounts to the engine block behind the generator, just above the oil filter (Fig. 7).

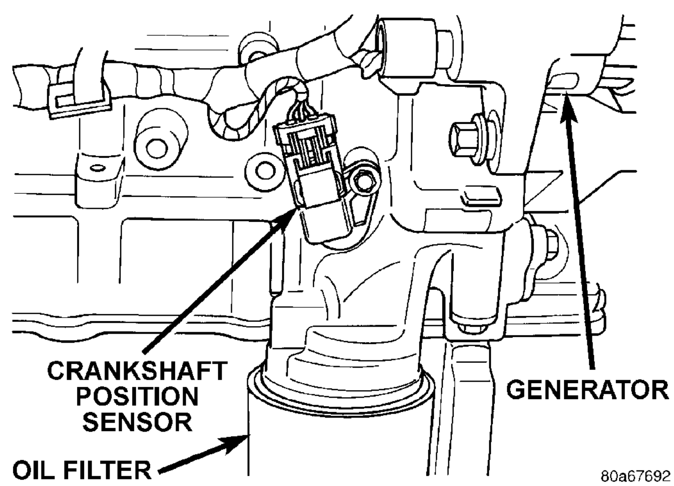


Fig. 7 Crankshaft Position Sensor

CAMSHAFT POSITION SENSOR

The PCM determines fuel injection synchronization and cylinder identification from inputs provided by the camshaft position sensor (Fig. 8) or (Fig. 9) and crankshaft position sensor. From the two inputs, the PCM determines crankshaft position.

The camshaft position sensor attaches to the rear of the cylinder head (Fig. 10). A target magnet

DESCRIPTION AND OPERATION (Continued)

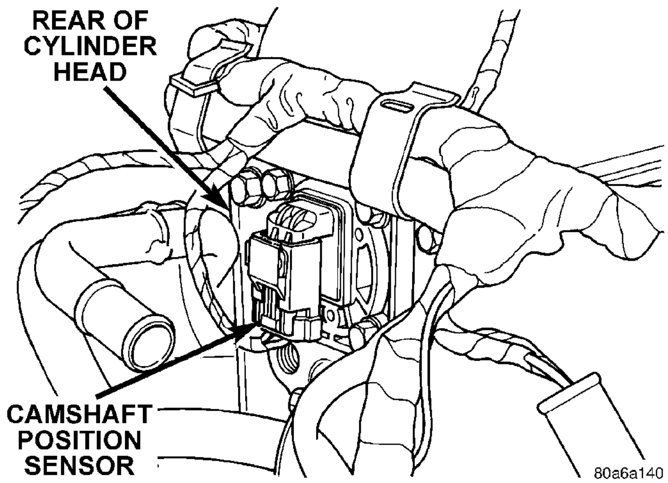


Fig. 8 Camshaft Position Sensor—SOHC

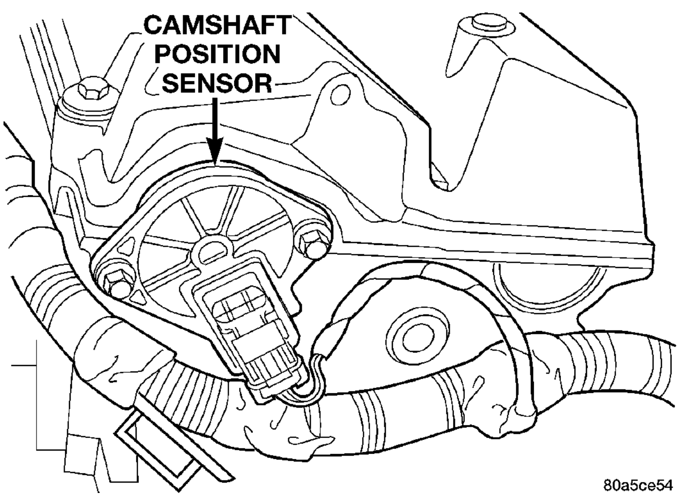


Fig. 9 Camshaft Position Sensor—DOHC

attaches to the rear of the camshaft and indexes to the correct position. The target magnet has four different poles arranged in an asymmetrical pattern. As the target magnet rotates, the camshaft position sensor senses the change in polarity (Fig. 11). The sensor input switches from high (5 volts) to low (0.30 volts) as the target magnet rotates. When the north pole of the target magnet passes under the sensor, the output switches high. The sensor output switches low when the south pole of the target magnet passes underneath.

The camshaft position sensor is mounted to the rear of the cylinder head. The sensor also acts as a thrust plate to control camshaft endplay on SOHC engines.

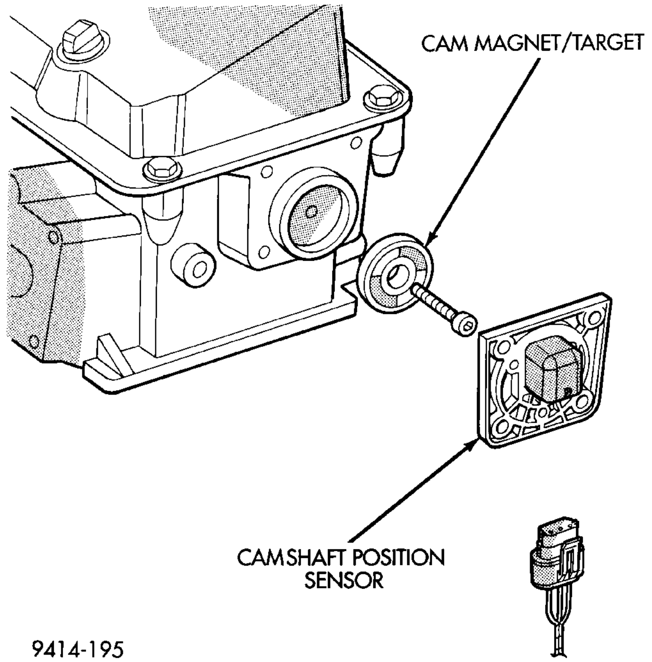


Fig. 10 Target Magnet —Typical

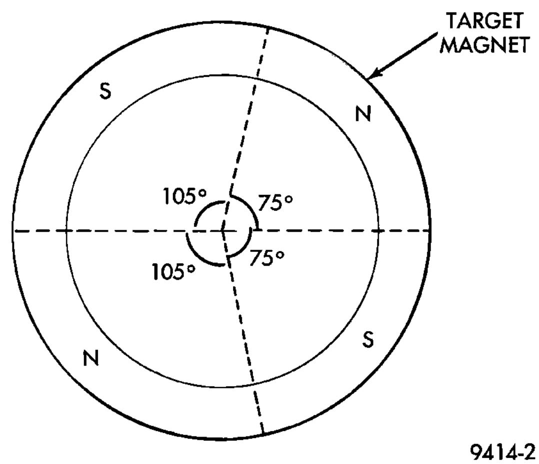


Fig. 11 Target Magnet Polarity

COMBINATION ENGINE COOLANT TEMPERATURE SENSOR

The coolant temperature sensor provides an input voltage to the PCM and a separate input voltage to the temperature gauge on the instrument panel. The PCM determines engine coolant temperature from the coolant temperature sensor. As coolant temperature varies, the coolant temperature sensor resistance changes resulting in a different input voltage to the PCM.

DESCRIPTION AND OPERATION (Continued)

When the engine is cold, the PCM will demand slightly richer air-fuel mixtures and higher idle speeds until normal operating temperatures are reached.

SOHC

The coolant sensor threads into the end of the cylinder head, next to the camshaft position sensor (Fig. 12). New sensors have sealant applied to the threads.

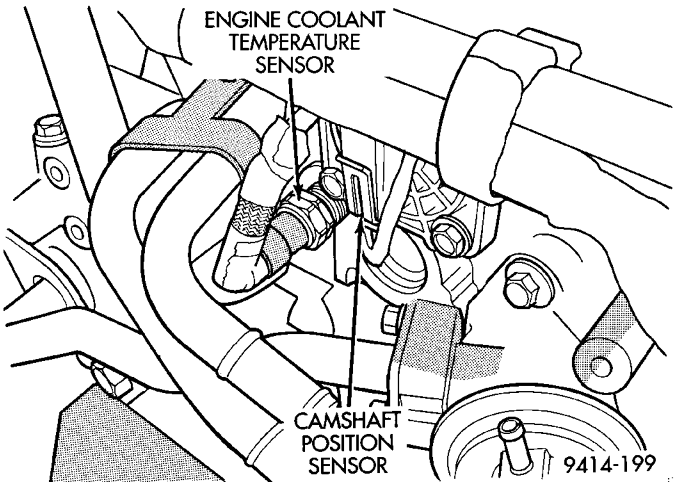


Fig. 12 Engine Coolant Temperature Sensor—SOHC

DOHC

The coolant sensor threads into the intake manifold next to the thermostat housing (Fig. 13). New sensors have sealant applied to the threads.

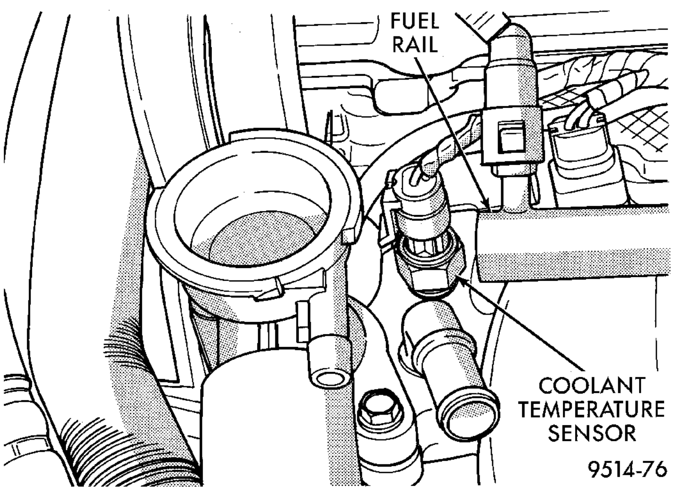


Fig. 13 Engine Coolant Temperature Sensor—DOHC

INTAKE AIR TEMPERATURE SENSOR

The intake air temperature sensor measures the temperature of the air as it enters the engine. The sensor supplies one of the inputs the PCM uses to determine injector pulse-width.

The MAP/Intake Air Temperature (IAT) sensor, located on the intake manifold, combines the MAP and Intake Air Temperature (IAT) functions into one sensor (Fig. 14) or (Fig. 15).

KNOCK SENSOR

The knock sensor threads into the side of the cylinder block in front of the starter motor. When the knock sensor detects a knock in one of the cylinders, it sends an input signal to the PCM. In response, the PCM retards ignition timing for all cylinders by a scheduled amount.

Knock sensors contain a piezoelectric material which constantly vibrates and sends an input voltage (signal) to the PCM while the engine operates. As the intensity of the crystal's vibration increase, the knock sensor output voltage also increases.

NOTE: Over or under tightening effects knock sensor performance, possibly causing improper spark control.

MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP)

The PCM supplies 5 volts to the MAP sensor. The MAP sensor function converts intake manifold pressure into voltage. The PCM monitors the MAP sensor output voltage. As vacuum increases, MAP sensor voltage decreases proportionately. Also, as vacuum decreases, MAP sensor voltage increases proportionately.

During cranking, before the engine starts running, the PCM determines atmospheric air pressure from the MAP sensor voltage. While the engine operates, the PCM determines intake manifold pressure from the MAP sensor voltage. Based on MAP sensor voltage and inputs from other sensors, the PCM adjusts spark advance and the air/fuel mixture.

The MAP/IAT sensor mounts to the intake manifold (Fig. 14) or (Fig. 15).

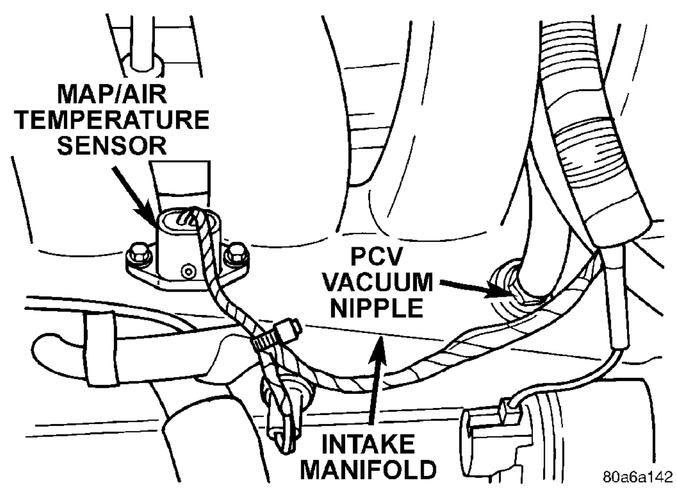


Fig. 14 MAP/IAT sensor—SOHC

DESCRIPTION AND OPERATION (Continued)

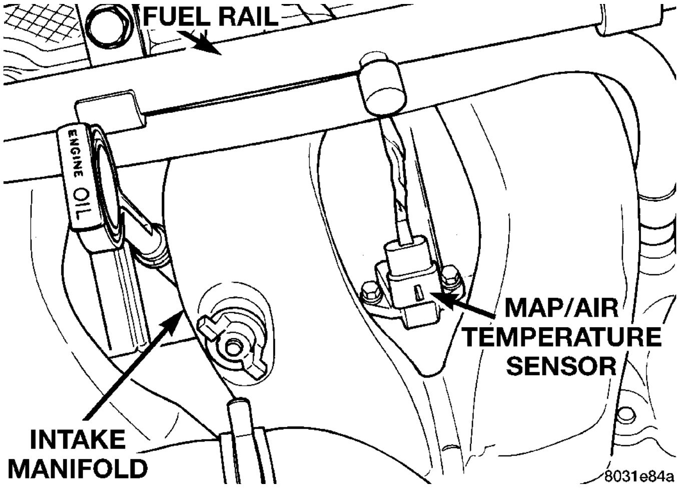


Fig. 15 MAP/IAT sensor—DOHC

THROTTLE POSITION SENSOR (TPS)

The TPS mounts to the side of the throttle body. The TPS connects to the throttle blade shaft. The TPS is a variable resistor that provides the Powertrain Control Module (PCM) with an input signal (voltage). The signal represents throttle blade position. As the position of the throttle blade changes, the resistance of the TPS changes.

The PCM supplies approximately 5 volts to the TPS. The TPS output voltage (input signal to the powertrain control module) represents throttle blade position. The TPS output voltage to the PCM varies from approximately 0.38 volts to 1.2 volts at minimum throttle opening (idle) to a maximum of 3.1 volts to 4.4 volts at wide open throttle.

Along with inputs from other sensors, the PCM uses the TPS input to determine current engine operating conditions. The PCM also adjusts fuel injector pulse width and ignition timing based on these inputs.

IGNITION SWITCH

In the RUN position, the ignition switch connects power from the Power Distribution Center (PDC) to a 30 amp fuse in the fuse block, back to a bus bar in the PDC. The bus bar feeds circuits for the Powertrain Control Module (PCM), duty cycle purge solenoid, EGR solenoid, and ABS system. The bus bar in the PDC feeds the coil side of the radiator fan relay, A/C compressor clutch relay, and the fuel pump relay. It also feeds the Airbag Control Module (ACM)

LOCK KEY CYLINDER

The lock cylinder is inserted in the end of the housing opposite the ignition switch. The ignition key rotates the cylinder to 5 different detents (Fig. 16):

- Accessory
- Off (lock)
- Unlock
- On/Run
- Start

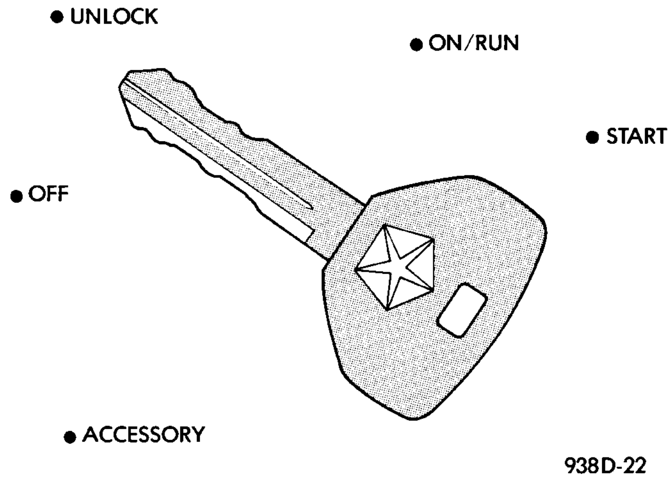


Fig. 16 Ignition Lock Cylinder Detents

IGNITION INTERLOCK

All vehicles equipped with automatic transaxles have an interlock system. The system prevents shifting the vehicle out of Park unless the ignition lock cylinder is in the Off, Run or Start position. In addition, the operator cannot rotate the key to the lock position unless the shifter is in the park position. On vehicles equipped with floor shift refer to Group 21 - Transaxle for Automatic Transmission Shifter/Ignition Interlock.

DIAGNOSIS AND TESTING

TESTING FOR SPARK AT COIL—2.0/2.4L

WARNING: THE DIRECT IGNITION SYSTEMS GENERATES APPROXIMATELY 40,000 VOLTS. PERSONAL INJURY COULD RESULT FROM CONTACT WITH THIS SYSTEM.

The coil pack contains independent coils. Each coil must be checked individually.

CAUTION: Spark plug wire damage may occur if the spark plug is moved more than 1/4 inch away from the engine ground.

CAUTION: Do not leave any one spark plug cable disconnected any longer than 30 seconds or possible heat damage to catalytic converter will occur.

CAUTION: Test must be performed at idle and in park only with the parking brake on.

DIAGNOSIS AND TESTING (Continued)

NOTE: New isolated engine valve cover may not provide adequate ground. Use engine block as engine ground.

Use a new spark plug and spark plug cable for the following test.

(1) Insert a new spark plug into the new spark plug boot. Ground the plug to the engine (Fig. 17). Do not hold with your hand.

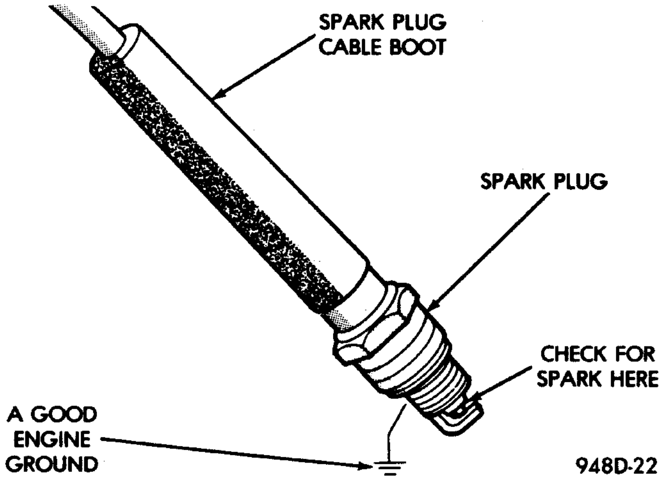


Fig. 17 Testing For Spark

(2) Starting with coil insulator #1, remove it from the DIS coil.

(3) Plug the test spark plug cable onto #1 coil tower. Make sure a good connection is made; there should be a click sound.

(4) Crank the engine and look for spark across the electrodes of the spark plug.

CAUTION: Always install the cable back on the coil tower after testing to avoid damage to the coil and catalytic converter.

(5) Repeat the above test for the remaining coils. If there is no spark during all cylinder tests, proceed to the Failure To Start Test.

(6) If one or more tests indicate irregular, weak, or no spark, proceed to Check Coil Test.

CHECK COIL TEST

NOTE: Coil one fires cylinders 1 and 4, coil two fires cylinders 2 and 3. Each coil tower is labeled with the number of the corresponding cylinder.

(1) Remove the ignition cables and measure the resistance of the cables. Resistance must be between ranges shown in chart in specifcation section in this group. Replace any cable not within tolerance.

(2) Disconnect the electrical connector from the coil pack.

(3) Measure the primary resistance of each coil. At the coil, connect an ohmmeter between the B+ pin and the pin corresponding to the cylinders in question (Fig. 18). Resistance on the primary side of each coil should be 0.45 - 0.65 ohm. Replace the coil if resistance is not within tolerance.

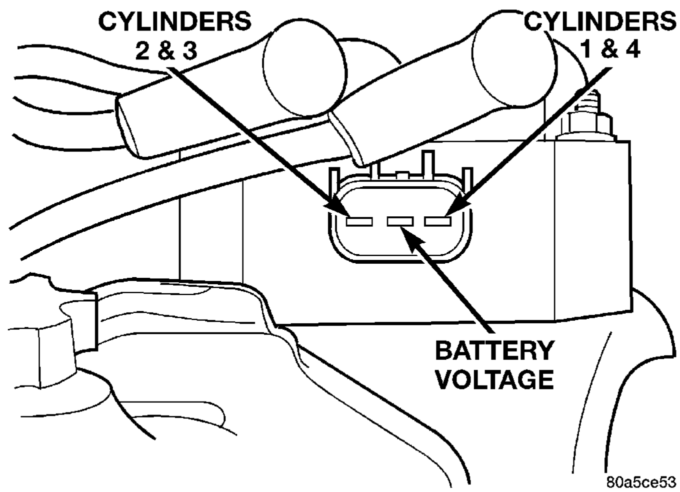


Fig. 18 Terminal Identification

(4) Remove ignition cables from the secondary towers of the coil. Measure the secondary resistance of the coil between the towers of each individual coil (Fig. 19). Secondary resistance should be 11,000 to 14,000 ohms. Replace the coil if resistance is not within tolerance.

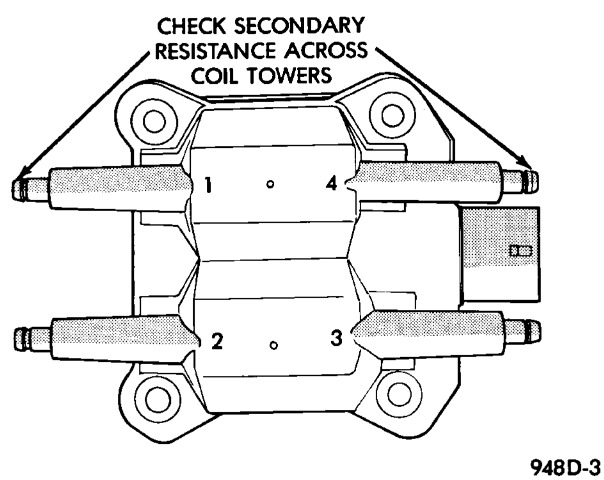


Fig. 19 Checking Ignition Coil Secondary Resistance

FAILURE TO START TEST—2.0/2.4L

This no-start test checks the camshaft position sensor and crankshaft position sensor.

Use the DRB scan tool to test the camshaft position sensor and the sensor circuits. Refer to the appropriate Powertrain Diagnostics Procedure Man-

DIAGNOSIS AND TESTING (Continued)

ual. Refer to the wiring diagrams section for circuit information.

The Powertrain Control Module (PCM) supplies 8 volts to the camshaft position sensor and crankshaft position sensor through one circuit. If the 8 volt supply circuit shorts to ground, neither sensor will produce a signal (output voltage to the PCM).

When the ignition key is turned and left in the On position, the PCM automatically energizes the Auto Shutdown (ASD) relay. However, the controller de-energizes the relay within one second because it has not received a camshaft position sensor signal indicating engine rotation.

During cranking, the ASD relay will not energize until the PCM receives a camshaft position sensor signal. Secondly, the ASD relay remains energized only if the controller senses a crankshaft position sensor signal immediately after detecting the camshaft position sensor signal.

(1) Check battery voltage. Voltage should approximately 12.66 volts or higher to perform failure to start test.

(2) Disconnect the harness connector from the coil pack (Fig. 20).

(3) Connect a test light to the B+ (battery voltage) terminal of the coil electrical connector and ground. The B+ wire for the DIS coil is the center terminal. **Do not spread the terminal with the test light probe.**

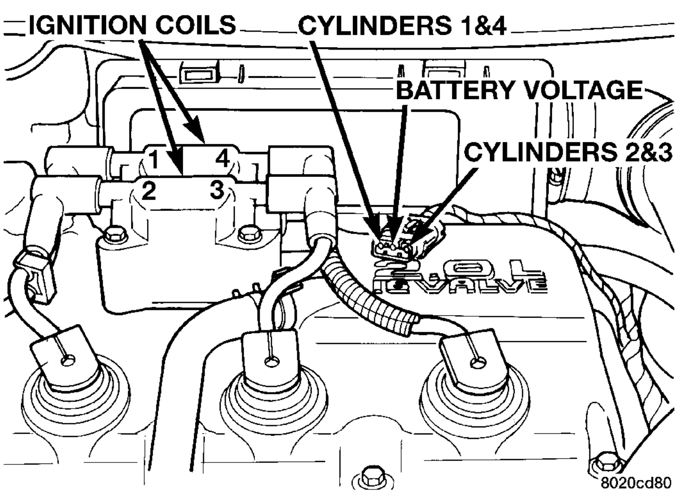


Fig. 20 Ignition Coil Engine Harness Connector

(4) Turn the ignition key to the **ON position.** The test light should flash On and then Off. **Do not turn the Key to off position, leave it in the On position** .

(a) If the test light flashes momentarily, the PCM grounded the ASD relay. Proceed to step 5.

(b) If the test light did not flash, the ASD relay did not energize. The cause is either the relay or one of the relay circuits. Use the DRB scan tool to test the ASD relay and circuits. Refer to the appropriate Powertrain Diagnostics Procedure Manual. Refer to the wiring diagrams section for circuit information.

(5) Crank the engine. (If the key was placed in the off position after step 4, place the key in the On position before cranking. Wait for the test light to flash once, then crank the engine.)

(6) If the test light momentarily flashes during cranking, the PCM is not receiving a crankshaft position sensor signal.

(7) If the test light did not flash during cranking, unplug the crankshaft position sensor connector. Turn the ignition key to the off position. Turn the key to the On position, wait for the test light to momentarily flash once, then crank the engine. If the test light momentarily flashes, the crankshaft position sensor is shorted and must be replaced. If the light did not flash, the cause of the no-start is in either the crankshaft position sensor/camshaft position sensor 8 volt supply circuit, or the camshaft position sensor output or ground circuits.

IGNITION TIMING PROCEDURE

The engines for this vehicle, use a fixed ignition system. The PCM regulates ignition timing. Basic ignition timing is not adjustable.

CAMSHAFT POSITION SENSOR AND CRANKSHAFT POSITION SENSOR

The output voltage of a properly operating camshaft position sensor or crankshaft position sensor switches from high (5.0 volts) to low (0.3 volts). By connecting an Moper Diagonostic System (MDS) and engine analyzer to the vehicle, technicians can view the square wave pattern.

ENGINE COOLANT TEMPERATURE SENSOR

Refer to Group 14, Fuel System for Diagnosis and Testing.

INTAKE AIR TEMPERATURE SENSOR

Refer to Group 14, Fuel System, for Diagnosis and Testing.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR TEST

Refer to Group 14, Fuel System for Diagnosis and Testing.

THROTTLE POSITION SENSOR

To perform a complete test of the this sensor and its circuitry, refer to the DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the throttle position sensor only, refer to the following:

The Throttle Position Sensor (TPS) can be tested with a digital voltmeter (DVM). The center terminal of the sensor is the output terminal. One of the other

DIAGNOSIS AND TESTING (Continued)

terminals is a 5 volt supply and the remaining terminal is ground.

Connect the DVM between the center and sensor ground terminal. Refer to Group 8W - Wiring Diagrams for correct pinout.

With the ignition switch in the ON position, check the output voltage at the center terminal wire of the connector. Check the output voltage at idle and at Wide-Open-Throttle (WOT). At idle, TPS output voltage should be approximately 0.38 volts to 1.2 volts. At wide open throttle, TPS output voltage should be approximately 3.1 volts to 4.4 volts. The output voltage should gradually increase as the throttle plate moves slowly from idle to WOT.

Check for spread terminals at the sensor and PCM connections before replacing the TPS.

SPARK PLUG CONDITION

NORMAL OPERATING CONDITIONS

The few deposits present will be probably light tan or slightly gray in color with most grades of commercial gasoline (Fig. 21). There will not be evidence of electrode burning. Gap growth will not average more than approximately 0.025 mm (.001 in) per 1600 km (1000 miles) of operation for non platinum spark plugs. Non-platnium spark plugs that have normal wear can usually be cleaned, have the electrodes filed and regapped, and then reinstalled.

CAUTION: Never attempt to file the electrodes or use a wire brush for cleaning platinum spark plugs. This would damage the platinum pads which would shorten spark plug life.

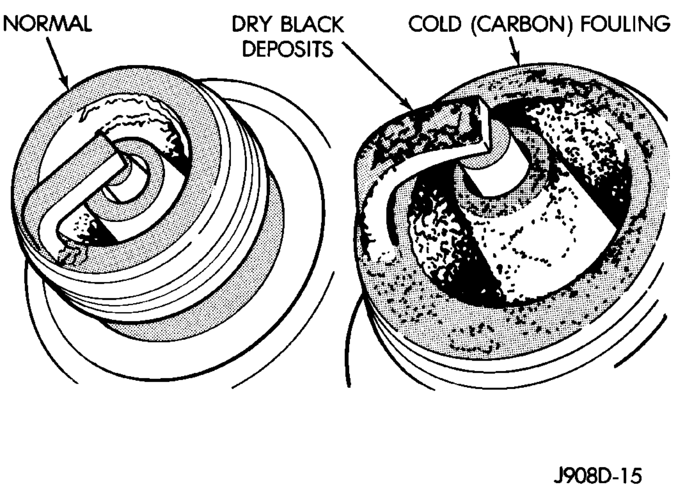


Fig. 21 Normal Operation and Cold (Carbon) Fouling

Some fuel refiners in several areas of the United States have introduced a manganese additive (MMT) for unleaded fuel. During combustion, fuel with MMT may coat the entire tip of the spark plug with a rust colored deposit. The rust color deposits can be misdiagnosed as being caused by coolant in the combustion chamber. Spark plug performance is not affected by MMT deposits.

COLD FOULING (CARBON FOULING)

Cold fouling is sometimes referred to as carbon fouling because the deposits that cause cold fouling are basically carbon (Fig. 21). A dry, black deposit on one or two plugs in a set may be caused by sticking valves or misfire conditions. Cold (carbon) fouling of the entire set may be caused by a clogged air cleaner.

Cold fouling is normal after short operating periods. The spark plugs do not reach a high enough operating temperature during short operating periods. **Replace carbon fouled plugs with new spark plugs.**

FUEL FOULING

A spark plug that is coated with excessive wet fuel is called fuel fouled. This condition is normally observed during hard start periods. **Clean fuel fouled spark plugs with compressed air and reinstall them in the engine.**

OIL FOULING

A spark plug that is coated with excessive wet oil is oil fouled. In older engines, wet fouling can be caused by worn rings or excessive cylinder wear. Break-in fouling of new engines may occur before normal oil control is achieved. **Replace oil fouled spark plugs with new ones.**

OIL OR ASH ENCRUSTED

If one or more plugs are oil or ash encrusted, evaluate the engine for the cause of oil entering the combustion chambers (Fig. 22). Sometimes fuel additives can cause ash encrustation on an entire set of spark plugs. **Ash encrusted spark plugs can be cleaned and reused.**

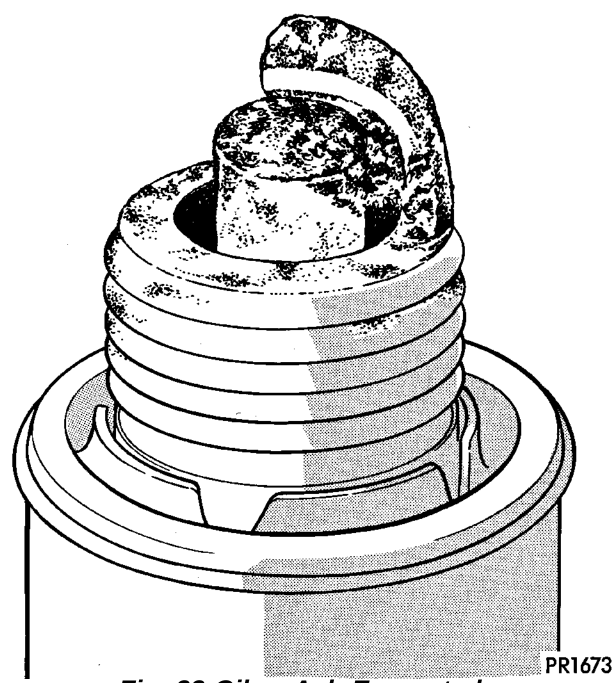


Fig. 22 Oil or Ash Encrusted

DIAGNOSIS AND TESTING (Continued)

HIGH SPEED MISS

When replacing spark plugs because of a high speed miss condition; **wide open throttle operation should be avoided for approximately 80 km (50 miles) after installation of new plugs.** This will allow deposit shifting in the combustion chamber to take place gradually and avoid plug destroying splash fouling shortly after the plug change.

ELECTRODE GAP BRIDGING

Loose deposits in the combustion chamber can cause electrode gap bridging. The deposits accumulate on the spark plugs during continuous stop-and-go driving. When the engine is suddenly subjected to a high torque load, the deposits partially liquefy and bridge the gap between the electrodes (Fig. 23). This short circuits the electrodes. **Spark plugs with electrode gap bridging can be cleaned and reused.**

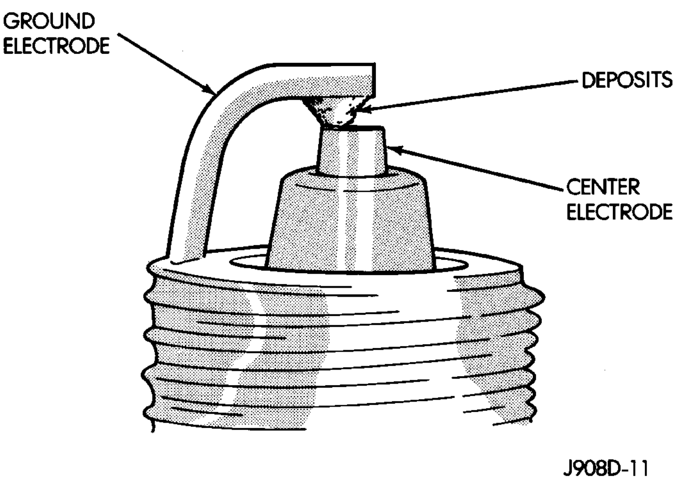


Fig. 23 Electrode Gap Bridging

SCAVENGER DEPOSITS

Fuel scavenger deposits may be either white or yellow (Fig. 24). They may appear to be harmful, but are a normal condition caused by chemical additives in certain fuels. These additives are designed to change the chemical nature of deposits and decrease spark plug misfire tendencies. Notice that accumulation on the ground electrode and shell area may be heavy but the deposits are easily removed. **Spark plugs with scavenger deposits can be considered normal in condition, cleaned and reused.**

CHIPPED ELECTRODE INSULATOR

A chipped electrode insulator usually results from bending the center electrode while adjusting the spark plug electrode gap. Under certain conditions, severe detonation also can separate the insulator from the center electrode (Fig. 25). **Spark plugs with chipped electrode insulators must be replaced.**

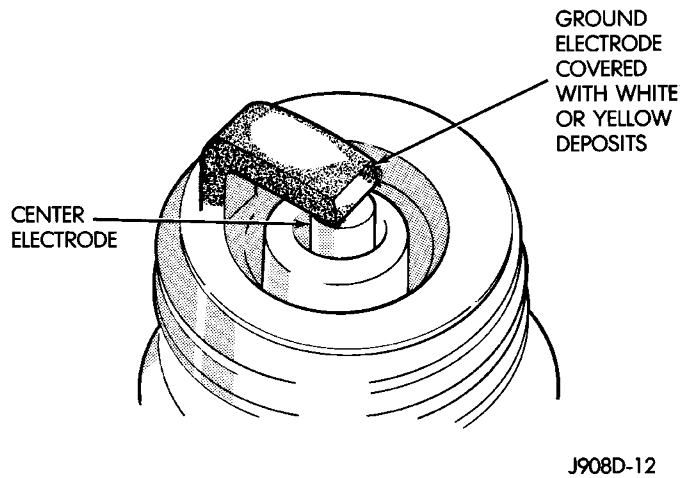


Fig. 24 Scavenger Deposits

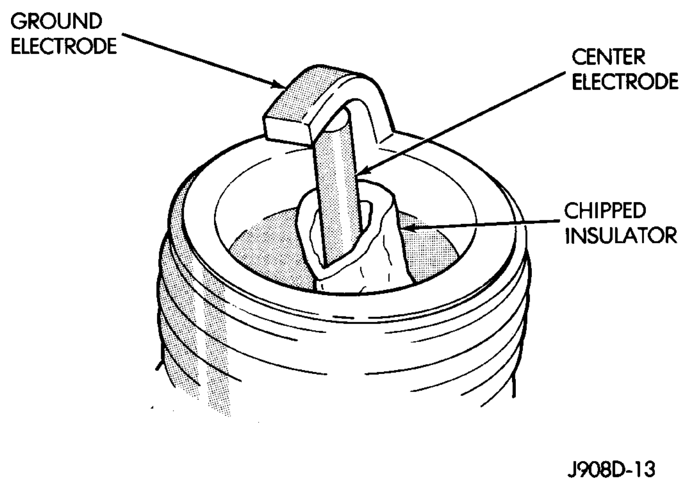


Fig. 25 Chipped Electrode Insulator

PREIGNITION DAMAGE

Excessive combustion chamber temperature can cause preignition damage. First, the center electrode dissolves and the ground electrode dissolves somewhat later (Fig. 26). Insulators appear relatively deposit free. Determine if the spark plugs are the correct type, as specified on the VECI label, or if other operating conditions are causing engine overheating.

SPARK PLUG OVERHEATING

Overheating is indicated by a white or gray center electrode insulator that also appears blistered (Fig. 27). The increase in electrode gap will be considerably in excess of 0.001 in per 1000 miles of operation. This suggests that a plug with a cooler heat range rating should be used. Over advanced ignition timing, detonation and cooling system malfunctions also can cause spark plug overheating.

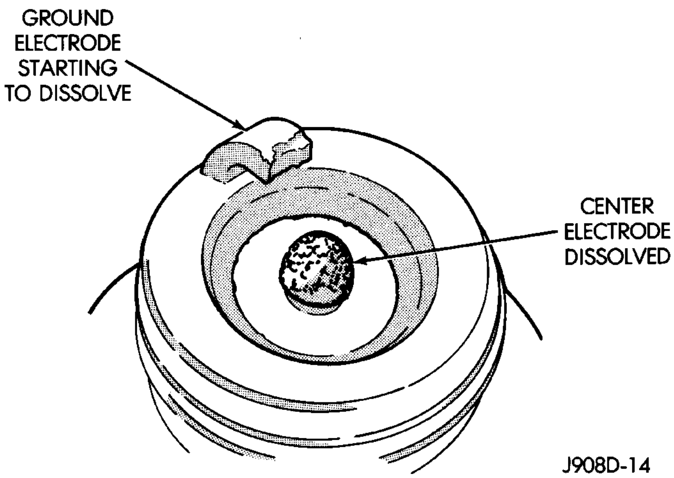


Fig. 26 Preignition Damage

Fig. 27 Spark Plug Overheating

REMOVAL AND INSTALLATION

POWERTRAIN CONTROL MODULE (PCM)

The PCM attaches to the inner fender panel next to the washer fluid bottle on the driver's side (Fig. 28).

REMOVAL

(1) Disconnect negative cable from battery.
(2) Remove positive cable from battery.
(3) Remove the washer bottle neck from the rubber grommet.
(4) Remove screws attaching PCM to body.
(5) Lift PCM up and disconnect two 40-way connectors.

INSTALLATION

(1) Attach two 40-way connectors to PCM.
(2) Install PCM. Tighten mounting screws to 6.75 N·m±1 N·m (60 in. lbs.± 10 in. lbs.) torque.
(3) Install washer bottle neck into the rubber grommet.

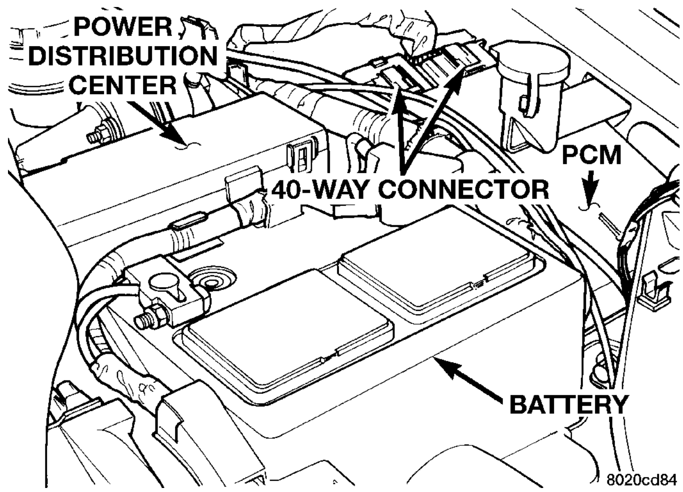


Fig. 28 Powertrain Control Module

(4) Connect positive cable to battery.
(5) Connect negative cable to battery.

SPARK PLUG SERVICE

Failure to route the cables properly could cause the radio to reproduce ignition noise, cross ignition of the spark plugs or short circuit the cables to ground.

REMOVAL

REMOVE CABLES FROM COIL FIRST.

Always remove the spark plug cable by grasping the top of the spark plug insulator, turning the boot 1/2 turn and pulling straight up in a steady motion.
(1) Remove the spark plug using a quality socket with a rubber or foam insert.
(2) Inspect the spark plug condition. Refer to Spark Plug Condition in this section.

INSTALLATION

(1) To avoid cross threading, start the spark plug into the cylinder head by hand.
(2) Tighten spark plugs to 28 N·m (20 ft. lbs.) torque.
(3) Install spark plug insulators over spark plugs. Ensure the top of the spark plug insulator covers the upper end of the spark plug tube.
Reconnect to coil.

SPARK PLUG CABLE SERVICE

Failure to route the cables properly could cause the radio to reproduce ignition noise, cross ignition of the spark plugs or short circuit the cables to ground.

REMOVAL

Remove spark plug cable from coil frist.

Always remove the spark plug cable by grasping the top of the spark plug insulator, turning the boot 1/2 turn and pulling straight up in a steady motion.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

Install spark plug insulators over spark plugs. Ensure the top of the spark plug insulator covers the upper end of the spark plug tube.The connect the other end to coil pack. On **SOHC** engines, be sure that dual plastic clip holds #1,#2 cables off of valve cover and that PCV hose plastic clip holds #3 cable away from metal PCV clamp and edge of air duct. On **DOHC** , be sure that the plastic clip on PCV hose is positioned so that cable clip is beneath hose, and that #1 cable is snapped into this clip to protect it from metal PCV clamp.

SPARK PLUG TUBES

The spark plugs tubes are pressed into the cylinder head. Sealant is applied to the end of the tube before installation. For engine information, refer to Group 9, Engines.

IGNITION COIL

SOHC/DOHC

The electronic ignition coil pack attaches directly to the valve cover (Fig. 29) or (Fig. 30).

REMOVAL

(1) Disconnect electrical connector from coil pack.
(2) Remove coil pack mounting nuts.
(3) Remove coil pack.

INSTALLATION

(1) Install coil pack on valve cover.
(2) Transfer spark plug cables to new coil pack. The coil pack towers are numbered with the cylinder identification. Be sure the ignition cables snap onto the towers.

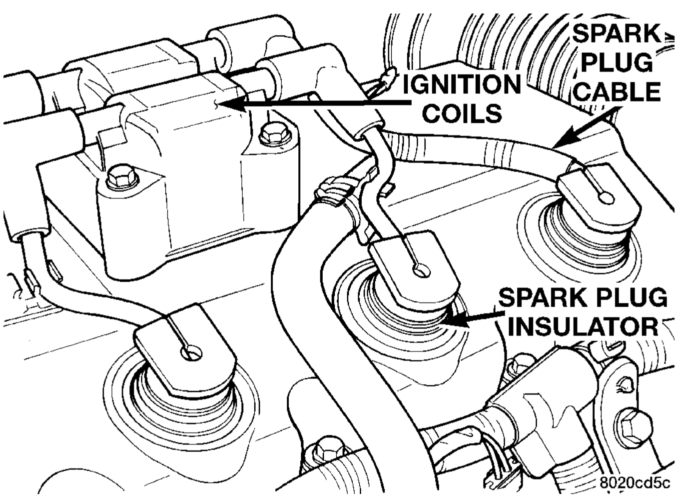


Fig. 29 Electronic Ignition Coil Pack—SOHC

AUTOMATIC SHUTDOWN RELAY

The relay is located in the Power Distribution Center (PDC) (Fig. 31). The PDC is located next to the battery in the engine compartment. For the location

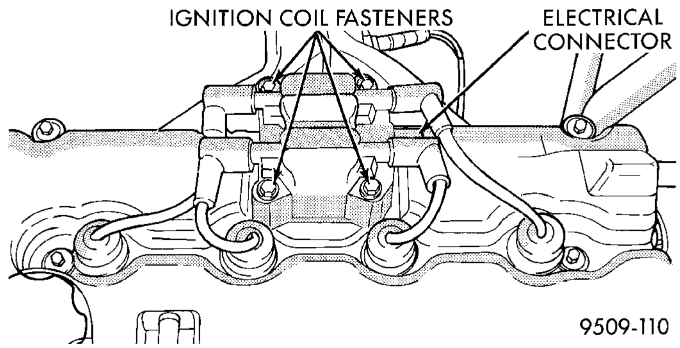


Fig. 30 Electronic Ignition Coil Pack—DOHC

of the relay within the PDC, refer to the PDC cover for location. Check electrical terminals for corrosion and repair as necessary.

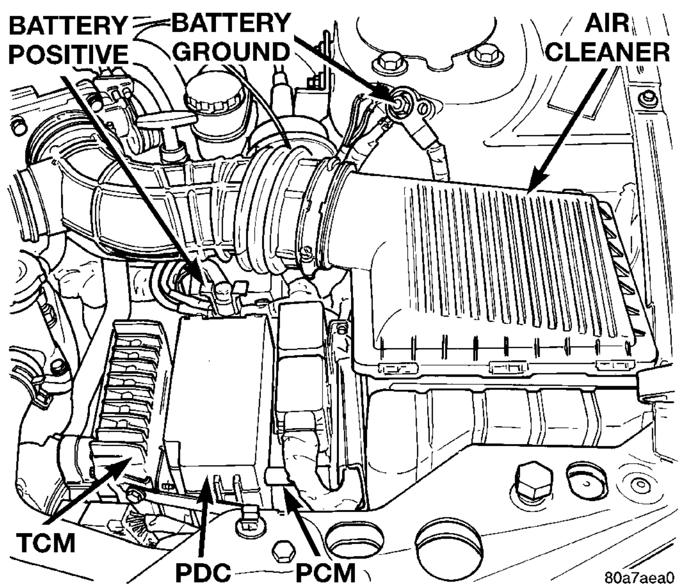


Fig. 31 Power Distribution Center (PDC)

CAMSHAFT POSITION SENSOR—SOHC

The camshaft position sensor is mounted to the rear of the cylinder head (Fig. 32).

REMOVAL

(1) Disconnect the filtered air tube from the throttle body and air cleaner housing. Remove filtered air tube.
(2) Remove the air cleaner inlet tube.
(3) Disconnect electrical connectors from engine coolant sensor and camshaft position sensor.
(4) Remove brake booster hose and electrical connector from holders on end of cylinder head cover.
(5) Remove camshaft position sensor mounting screws. Remove sensor.
(6) Loosen screw attaching target magnet to rear of camshaft (Fig. 33).

REMOVAL AND INSTALLATION (Continued)

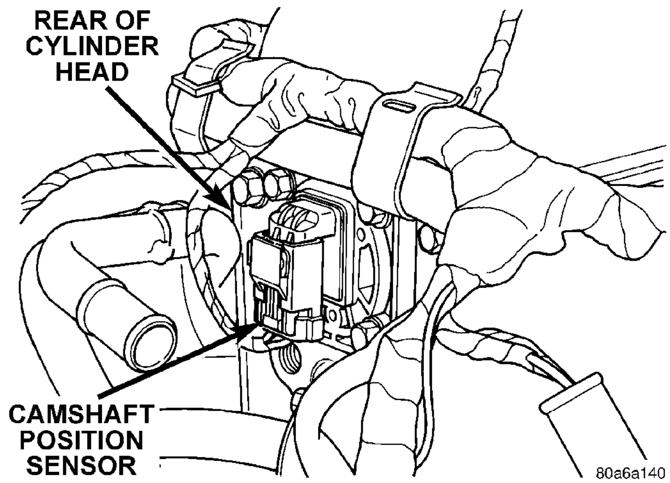


Fig. 32 Camshaft Position Sensor Location—SOHC

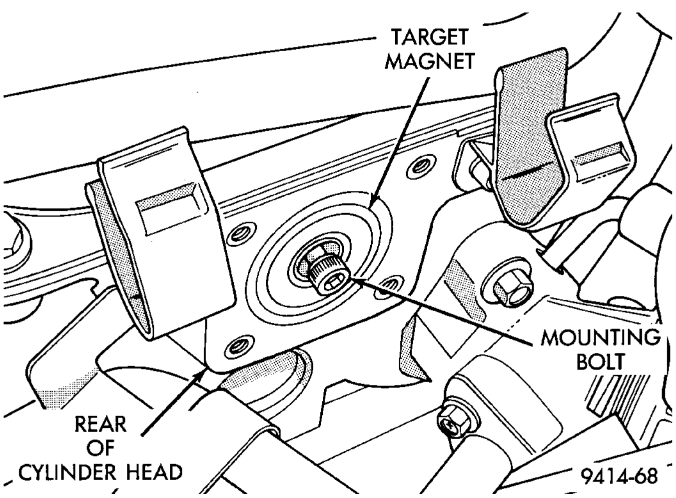


Fig. 33 Target Magnet Removal/Installation

INSTALLATION

The target magnet has two locating dowels that fit into machined locating holes in end of the camshaft.

(1) Install target magnet in end of camshaft. Tighten mounting screw to 3.4 N·m (30 in. lbs.) torque.

(2) Install camshaft position sensor. Tighten sensor mounting screws to 9 N·m (80 in. lbs.) torque.

(3) Place brake booster hose and electrical harness in holders on end of valve cover.

(4) Attach electrical connectors to coolant temperature sensor and camshaft position sensor.

(5) Install air cleaner inlet tube and filtered air tube.

CAMSHAFT POSITION SENSOR—DOHC

The camshaft position sensor is mounted to the rear of the cylinder head (Fig. 34).

REMOVAL

(1) Remove filtered air tube from the throttle body and air cleaner housing.

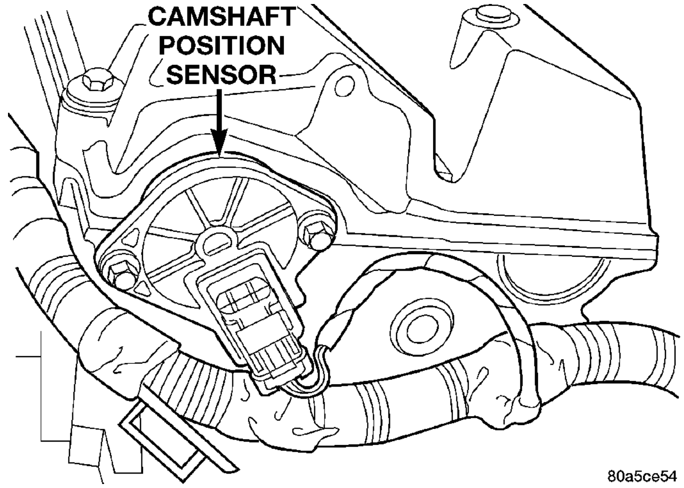


Fig. 34 Camshaft Position Sensor Location—DOHC

(2) Disconnect electrical connector from camshaft position sensor.

(3) Remove camshaft position sensor mounting screws. Remove sensor.

(4) Loosen screw attaching target magnet to rear of camshaft (Fig. 35).

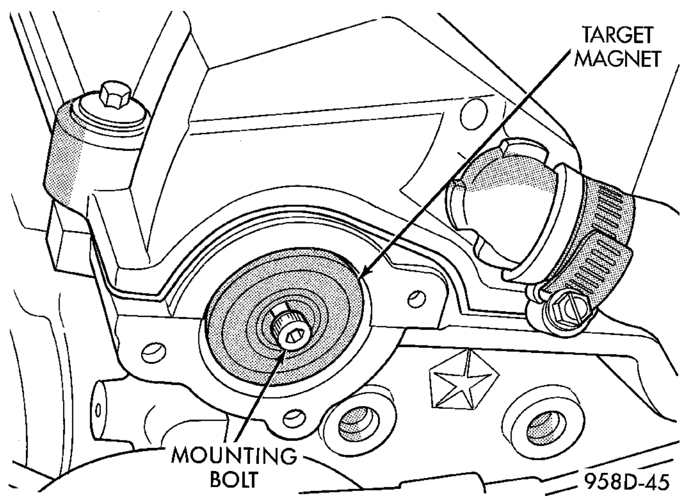


Fig. 35 Target Magnet Removal/Installation

INSTALLATION

The target magnet has locating dowels that fit into machined locating holes in the end of the camshaft (Fig. 36).

(1) Install target magnet in end of camshaft. Tighten mounting screw to 3 N·m (30 in. lbs.) torque.

(2) Install camshaft position sensor. Tighten sensor mounting screws to 9 N·m (80 in. lbs.) torque.

(3) Carefully attach electrical connector to camshaft position sensor. Installation at an angle may damage the sensor pins.

(4) Install filtered air tube. Tighten clamps to 3 N·m ±1 (25 in. lbs. ±5) torque.

REMOVAL AND INSTALLATION (Continued)

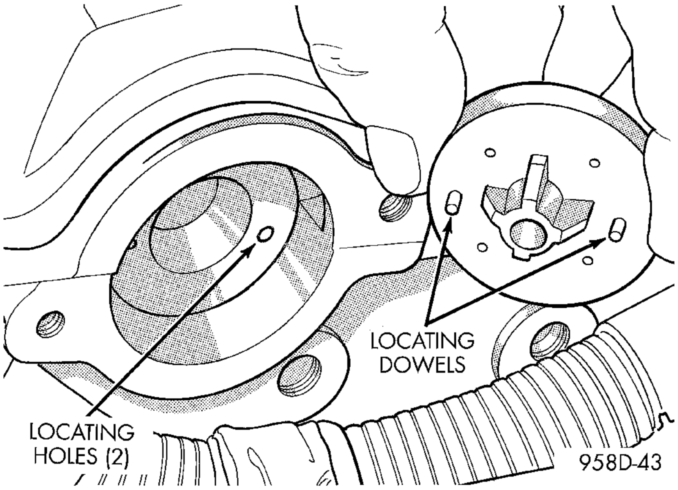


Fig. 36 Target Magnet Installation

CRANKSHAFT POSITION SENSOR

The crankshaft position sensor mounts to the engine block behind the generator, just above the oil filter (Fig. 37).

REMOVAL

(1) Disconnect electrical connector from crankshaft position sensor.

(2) Remove sensor mounting screw. Remove sensor.

INSTALLATION

Reverse procedure for installation.

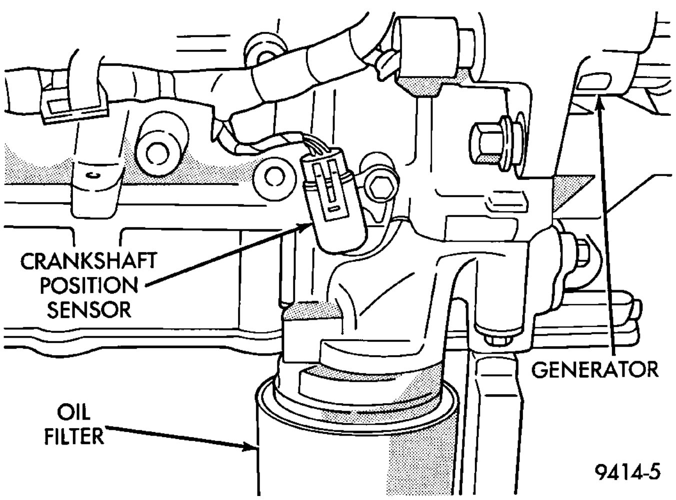


Fig. 37 Crankshaft Position Sensor

COMBINATION ENGINE COOLANT TEMPERATURE SENSOR—SOHC

The combination engine coolant sensor is located at the rear of the cylinder head next to the camshaft position sensor (Fig. 38). New sensors have sealant applied to the threads.

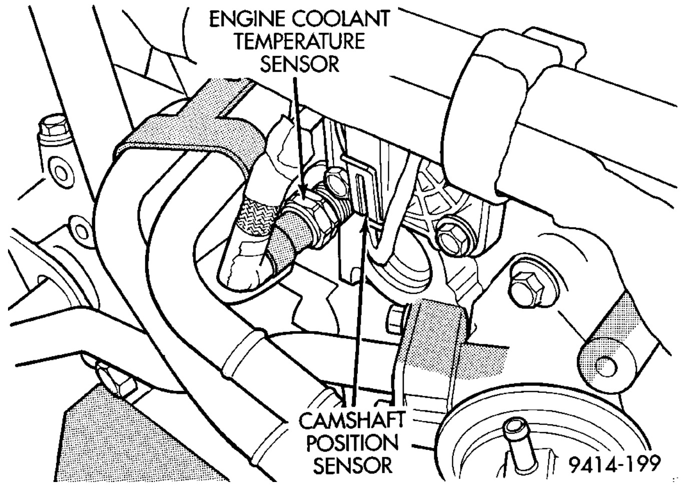


Fig. 38 Engine Coolant Temperature Sensor

REMOVAL

(1) With the engine cold, drain the cooling system until coolant level drops below sensor. Refer to Group 7, Cooling System.

(2) Disconnect coolant sensor electrical connector.

(3) Remove coolant sensor

INSTALLATION

(1) Install coolant sensor. Tighten sensor to 18.6 N·m (165 in. lbs.) torque.

(2) Attach electrical connector to sensor.

(3) Fill cooling system. Refer to Group 7, Cooling System.

COMBINATION ENGINE COOLANT TEMPERATURE SENSOR—DOHC

The coolant sensor threads into the intake manifold next to the thermostat housing (Fig. 39). New sensors have sealant applied to the threads.

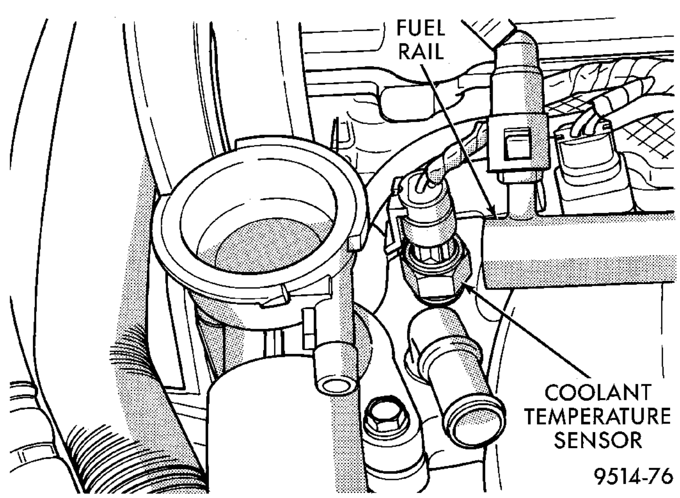


Fig. 39 Engine Coolant Temperature Sensor—DOHC

REMOVAL AND INSTALLATION (Continued)

REMOVAL

(1) With the engine cold, drain coolant until level drops below cylinder head. Refer to Group 7, Cooling System.

(2) Disconnect coolant sensor electrical connector.

(3) Remove coolant sensor.

INSTALLATION

(1) Install coolant sensor. Tighten sensor to 18.6 N·m (165 in. lbs.) torque.

(2) Attach electrical connector to sensor.

(3) Fill cooling system. Refer to Group 7, Cooling System.

MAP/IAT SENSOR—SOHC

Refer to Group 14, Fuel Injection Section for Removal/Installation.

MAP/IAT SENSOR—DOHC

Refer to Group 14, Fuel Injection Section for Removal/Installation..

THROTTLE POSITION SENSOR

Refer to Group 14, Fuel Injection Section, for Removal/Installation.

IGNITION SWITCH

The ignition switch attaches to the lock cylinder housing on the end opposite the lock cylinder (Fig. 40). For ignition switch terminal and circuit identification, refer to Group 8W, Wiring Diagrams.

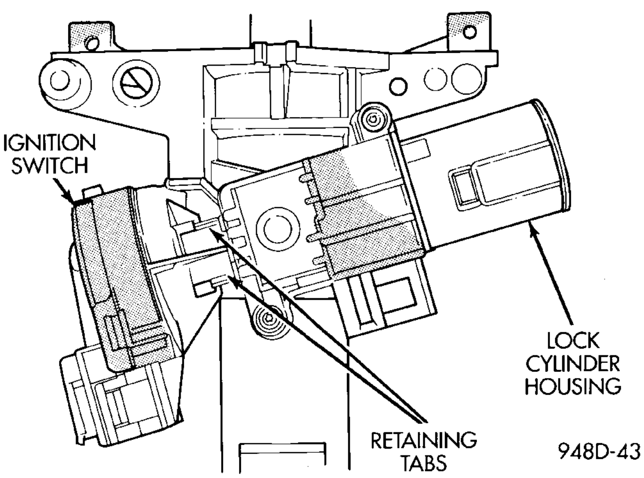


Fig. 40 Ignition Switch—Viewed From Below Column

REMOVAL

(1) Disconnect negative cable from battery.

(2) Place key cylinder in RUN position. Through the hole in the lower shroud, depress lock cylinder retaining tab and remove key cylinder (Fig. 41).

(3) Remove upper and lower shrouds from steering column.

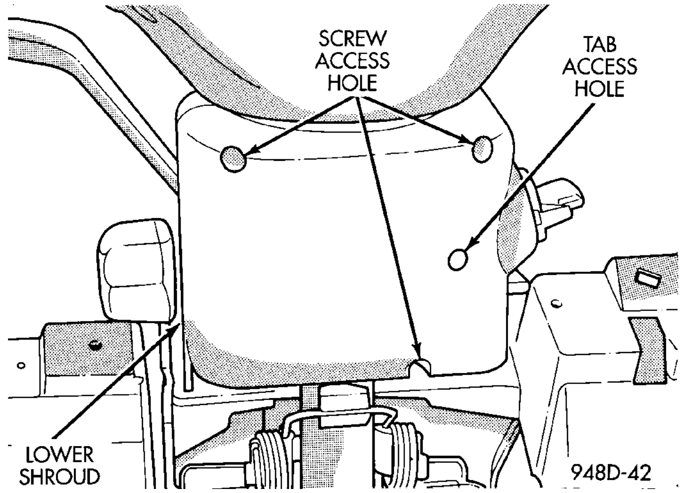


Fig. 41 Steering Column Shrouds

(4) Disconnect electrical connectors from ignition switch.

(5) Remove ignition switch mounting screw (Fig. 42) with a #10 Torx® bit.

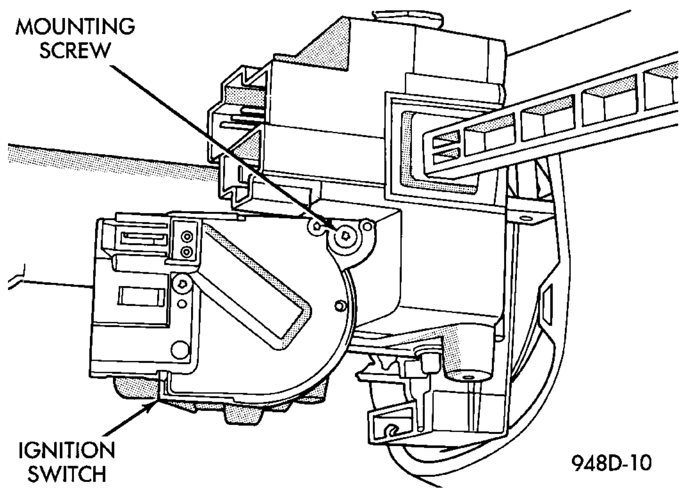


Fig. 42 Ignition Switch Mounting Screw

(6) Depress retaining tabs (Fig. 43) and pull ignition switch from steering column.

INSTALLATION

(1) Ensure the ignition switch is in the RUN position and the actuator shaft in the lock housing is in the RUN position.

(2) Carefully install the ignition switch. The switch will snap over the retaining tabs (Fig. 44). Install mounting screw (Fig. 42).

(3) Install electrical connectors to ignition switch.

(4) Install upper and lower shrouds.

(5) Install key cylinder (cylinder retaining tab will depress only in the RUN position).

(6) Connect negative cable to battery.

(7) Check for proper operation of ignition switch and key-in warning switch.

REMOVAL AND INSTALLATION (Continued)

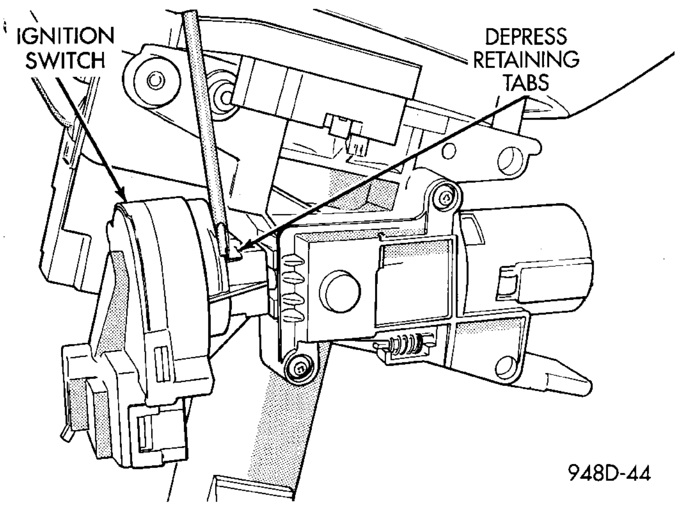


Fig. 43 Removing Ignition Switch

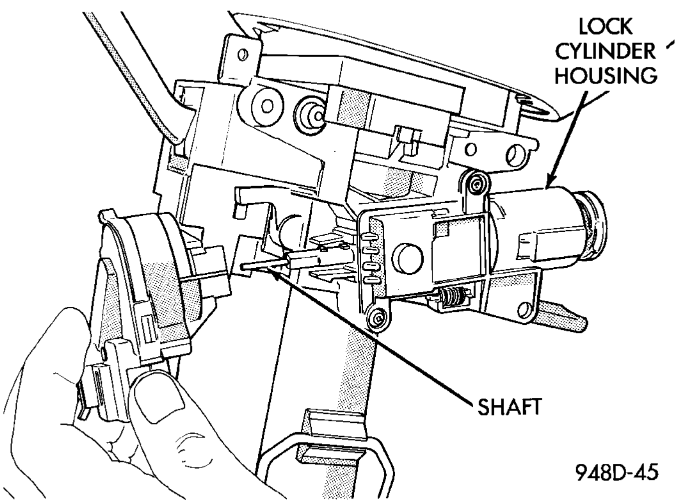


Fig. 44 Ignition Switch Installation

LOCK KEY CYLINDER

The lock cylinder is inserted in the end of the housing opposite the ignition switch. The ignition key rotates the cylinder to 5 different detentes (Fig. 45):

- Accessory
- Off (lock)
- Unlock
- On/Run
- Start

REMOVAL

(1) Disconnect negative cable from battery.

(2) Place key cylinder in RUN position. Through the hole in the lower shroud, depress lock cylinder retaining tab and remove key cylinder.

INSTALLATION

(1) Install key in lock cylinder. Turn key to run position (retaining tab on lock cylinder can be depressed).

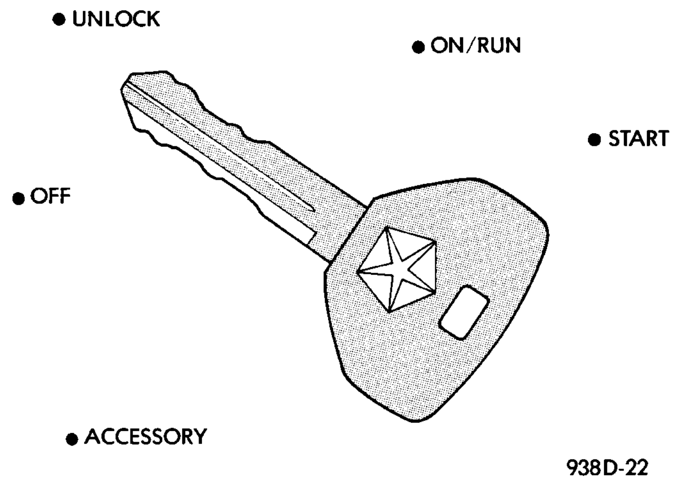


Fig. 45 Ignition Lock Cylinder Detentes

(2) The shaft at the end of the lock cylinder aligns with the socket in the end of the housing. To align the socket with the lock cylinder, ensure the socket is in the Run position (Fig. 46).

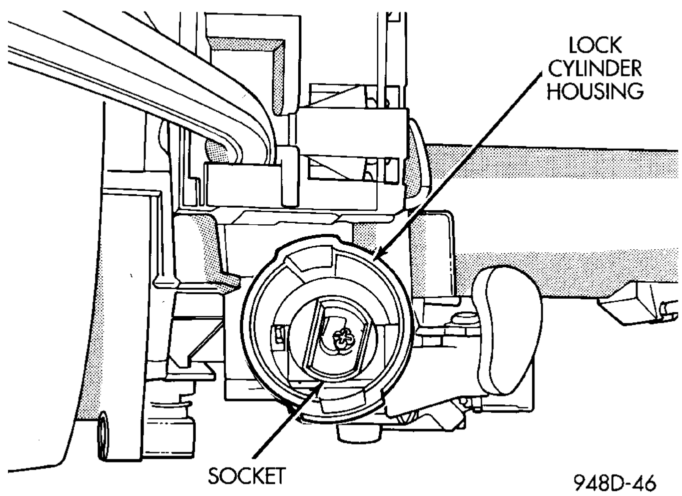


Fig. 46 Socket in Lock Cylinder Housing

(3) Align the lock cylinder with the grooves in the housing. Slide the lock cylinder into the housing until the tab sticks through the opening in the housing.

(4) Turn the key to the Off position. Remove the key.

(5) Connect negative cable to battery.

IGNITION INTERLOCK

Refer to Group 21, Transaxle for Shifter/Ignition Interlock Service.

LOCK CYLINDER HOUSING

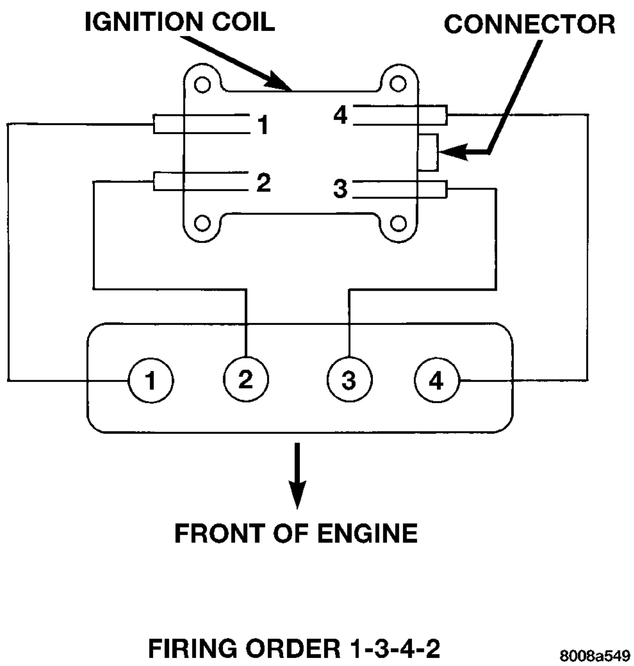
Refer to Steering Column in Group 19, Steering, for Lock Cylinder Housing Service.

SPECIFICATIONS

VECI LABEL

If anything differs between the specifications found on the Vehicle Emission Control Information (VECI) label and the following specifications, use specifications on VECI label. The VECI label is located in the engine compartment.

FIRING ORDER—2.0L



TORQUE SPECIFICATION

DESCRIPTION	TORQUE
Camshaft Position Sensor Screw	9 N·m (80 in. lbs.)
SOHC Cam Magnet/Target	3.4 N·m (30 in. lbs.)
DOHC Cam Magnet/Target	3 N·m (30 in. lbs.)
Crankshaft Position Sensor Screw	9 N·m (80 in. lbs.)
Coolant Temp. Sensor	18.6 N·m (165 in. lbs.)
Ignition Coil to Cyl. Head	22 N·m (200 in. lbs.)
Ignition Coil Bracket Nuts	22 N·m (200 in. lbs.)
Knock Sensor	10 N·m (90 in. lbs.)
MAP/IAT Sensor Plastic Manifold	2 N·m (20 in. lbs.)
MAP/IAT Sensor Aluminum Manifold	3 N·m (30 in. lbs.)
Spark Plugs	28 N·m (20 ft. lbs.)

SPARK PLUG CABLE RESISTANCE—SOHC

CABLE	RESISTANCE
#1,#4	3500 ohms—4900 ohms
#2,#3	2950 ohms—4100 ohms

SPARK PLUG CABLE RESISTANCE—DOHC

CABLE	RESISTANCE
#1,#4	3050 ohms—4250 ohms
#2,#3	2300 ohms—3300 ohms

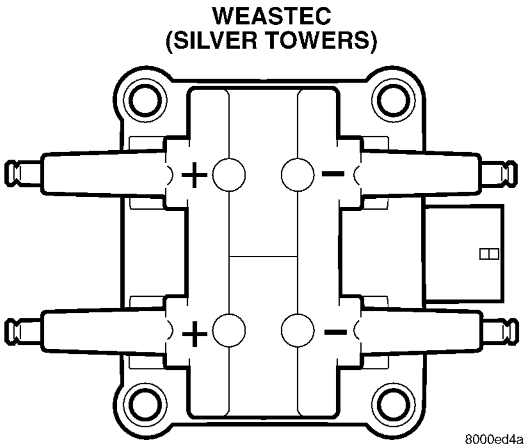
SPARK PLUG

Engine	Spark Plug	Gap	Thread Size
2.0L	RC9YC	0.033 TO 0.038	14mm (3/4 in.) reach

IGNITION COIL

Coil Manufacture	Primary Resistance at 21°C-27°C (70°F-80°F)	Secondary Resistance at 21°C-27°C (70°F-80°F)
Weastec (Steel Towers)	0.45 to 0.65 Ohms	7,000 to 15,800 Ohms

SPECIFICATIONS (Continued)



Coil Polarity