IGNITION CONTROL

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IGNITION CONTROL

DESCRIPTION - IGNITION SYSTEM

NOTE: All engines use a fixed ignition timing system. Basic ignition timing is not adjustable. All spark advance is determined by the Powertrain Control Module (PCM).

The ignition system used on these engines is referred to as the Direct Ignition System (DIS). The system's three main components are the coils, crankshaft position sensor, and camshaft position sensor. If equipped with the coil on plug ignition system it utilizes an ignition coil for every cylinder, it is mounted directly over the each spark plug.

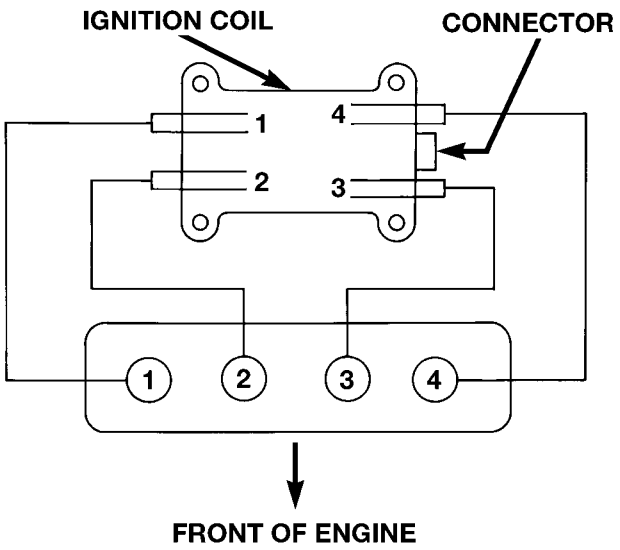
OPERATION - IGNITION SYSTEM

The crankshaft position sensor and camshaft position sensor are hall effect devices. The camshaft position sensor and crankshaft position sensor generate pulses that are inputs to the PCM. The PCM determines engine position from these sensors. The PCM calculates injector sequence and ignition timing from crankshaft & camshaft position. For a description of both sensors, refer to Camshaft Position Sensor and Crankshaft Position Sensor.

IGNITION CONTROL (Continued)

SPECIFICATIONS

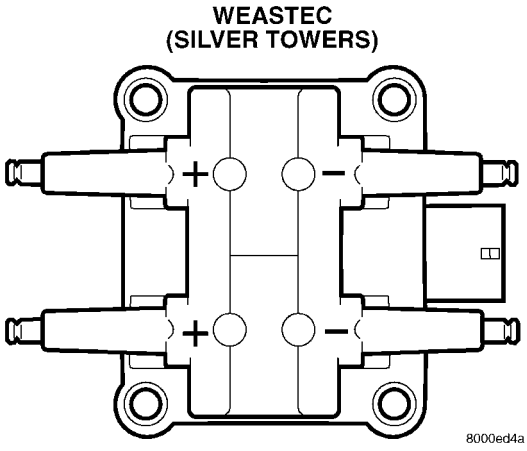
FIRING ORDER - 2.0/2.4/2.4 TURBO



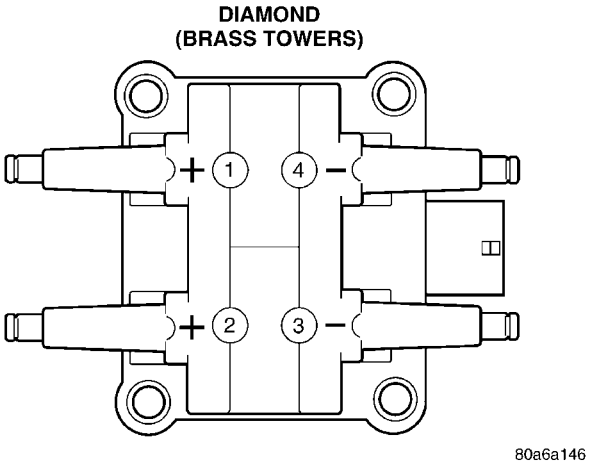
FIRING ORDER 1-3-4-2 8008a549

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	11,500 to 13,500 Ohms
Diamond (Brass Towers)	0.53 to 0.65 Ohms	10,900 to 14,700 Ohms



Coil Polarity



Coil Polarity

IGNITION CONTROL (Continued)

SPARK PLUG CABLE RESISTANCE

1.6L

CABLE	RESISTANCE
#1	2746 ohms— 8533 ohms
#2	2532 ohms— 7352 ohms
#3	3386 ohms— 10,453 ohms
#4	3632 ohms— 11,191 ohms

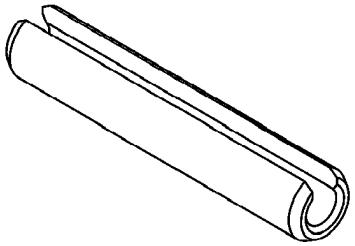
2.0/2.4L

CABLE	RESISTANCE
#1, #2, #3, #4	2280 ohms— 7290 ohms

2.4L TURBO

CABLE	RESISTANCE
#1,#2, #3	2280 ohms— 7290 ohms
#4	2686 ohms— 8062 ohms

SPECIAL TOOLS - EXPORT



PROTECTIVE SLEEVE

AUTOMATIC SHUT DOWN RELAY

DESCRIPTION

The ASD relay is located in the PDC (Fig. 1). The inside top of the PDC cover has label showing relay and fuse identification.

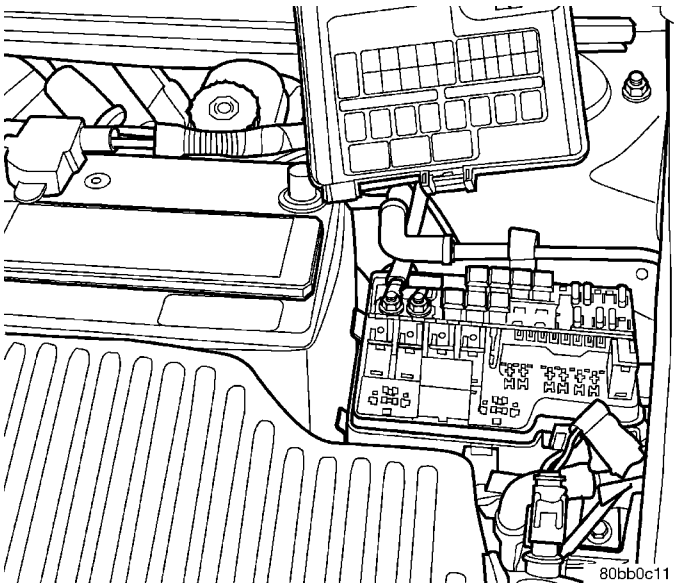


Fig. 1 Power Distribution Center (PDC)

OPERATION

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 fuse also protects the power circuit for the fuel pump relay and pump. The fuse is located in the PDC. Refer to the 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.

AUTOMATIC SHUT DOWN RELAY (Continued)

REMOVAL

The relay is located in the Power Distribution Center (PDC) (Fig. 2). The PDC is located next to the battery in the engine compartment. For the location of the relay within the PDC, refer to the PDC cover for location. Check electrical terminals for corrosion and repair as necessary.

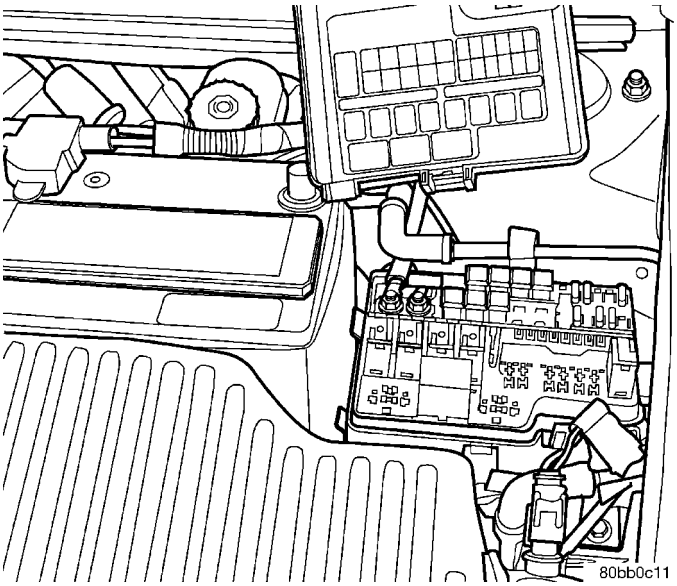


Fig. 2 Power Distribution Center (PDC)

CAMSHAFT POSITION SENSOR

DESCRIPTION

On 2.0/2.4L engines the camshaft position sensor attaches to the rear of the cylinder head. On 1.6L engines it is mounted on the front side of the cylinder head. The PCM determines fuel injection synchronization and cylinder identification from inputs provided by the camshaft position sensor (Fig. 3) and crankshaft position sensor. From the two inputs, the PCM determines crankshaft position.

OPERATION

The PCM sends approximately 5 volts to the hall affect sensor. This voltage is required to operate the hall effect chip and the electronics inside the sensor. A ground for the sensor is provided through the sensor return circuit. The input to the PCM occurs on a 5 volt output reference circuit.

On 2.0/2.4L engines a target magnet attaches to the rear of the camshaft and indexes to the correct position. The target magnet has fourteen different poles arranged in an asymmetrical pattern (Fig. 4). As the target magnet rotates, the camshaft position sensor senses the change in polarity (Fig. 5). The sensor output switch switches from high (5.0 volts) to low (0.5 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.

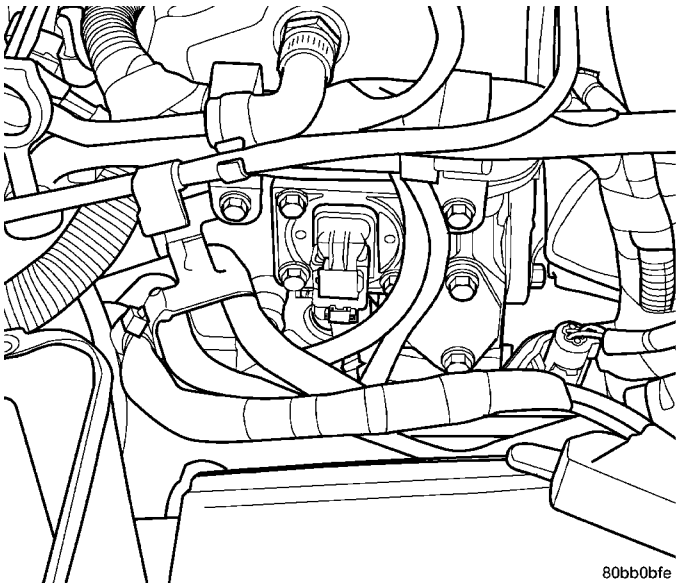


Fig. 3 Camshaft

On 1.6L a raised platform on the cam sprocket serves as a target. When the sensor detects the step, the input voltage from the sensor to the PCM switches from high (5 volts) to low (0.3 volts). As the step returns away from the sensor, the input voltage switches back to high (5 volts).

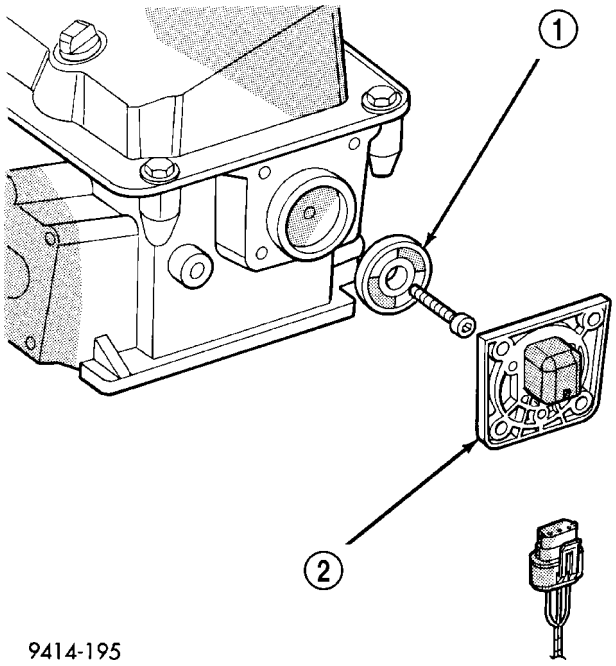


Fig. 4 Target Magnet—Typical

1 - CAM MAGNET/TARGET
2 - CAMSHAFT POSITION SENSOR

CAMSHAFT POSITION SENSOR (Continued)

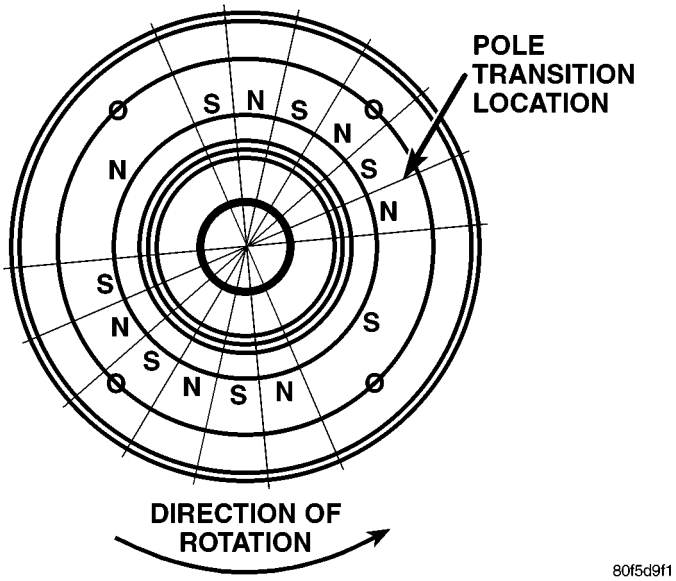


Fig. 5 Target Magnet Polarity

1 - TARGET MAGNET

The sensor also acts as a thrust plate to control camshaft endplay.

REMOVAL

REMOVAL - 1.6L

(1) Disconnect the negative battery cable.

(2) Relocate the fuel line and radiator over flow hose (Fig. 6) and (Fig. 7).

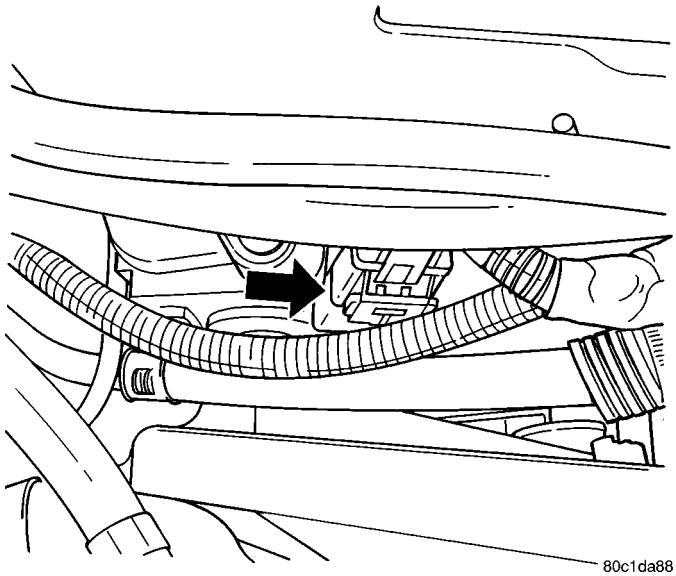


Fig. 6 CAMSHAFT POSITION SENSOR LOCATION

(3) Disconnect the electrical connector from the camshaft sensor.

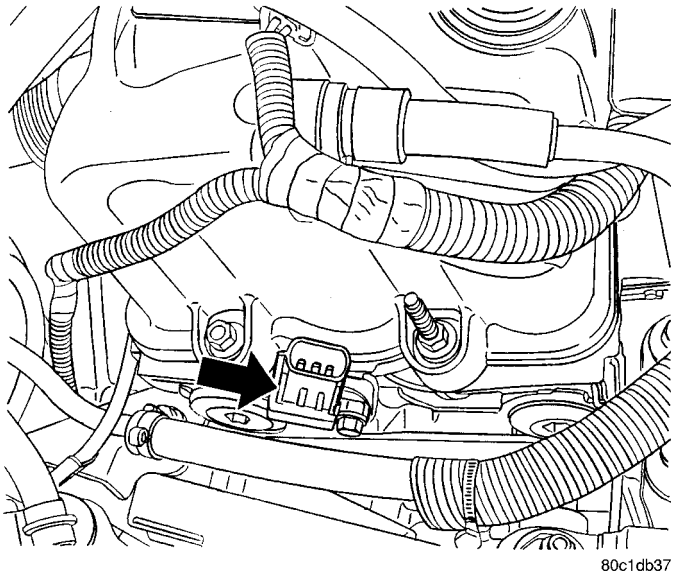


Fig. 7 CAMSHAFT ACCESS

(4) Remove the 2 bolts from the powersteering reservoir and relocate.

(5) Remove 1 screws from sensor.

(6) Remove sensor (Fig. 8).

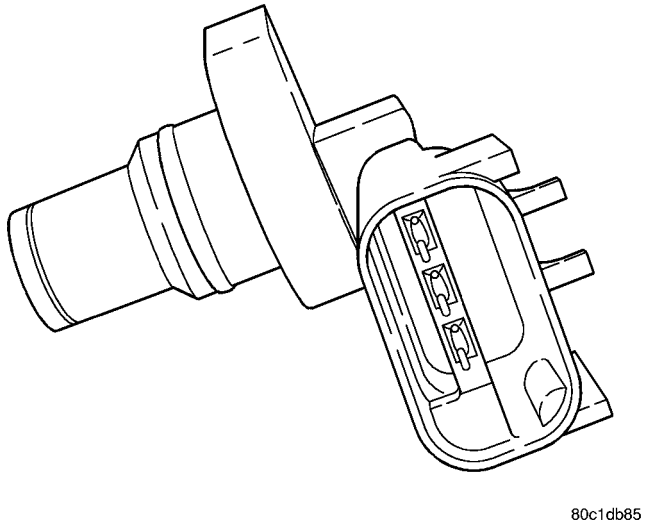


Fig. 8 CAMSHAFT POSITION SENSOR

REMOVAL - 2.0L

The camshaft position sensor is mounted to the rear of the cylinder head (Fig. 9).

(1) Remove brake booster hose and electrical connector from holders on end of cylinder head cover and reposition.

(2) Disconnect electrical connectors from camshaft position sensor.

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

CAMSHAFT POSITION SENSOR (Continued)

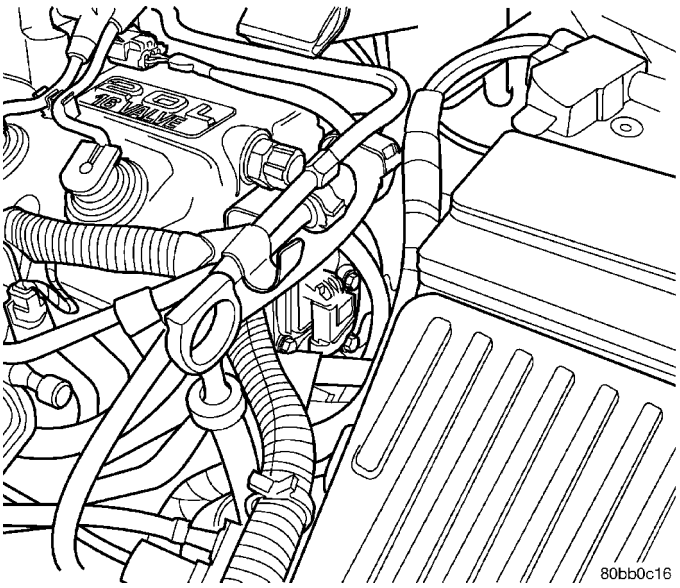


Fig. 9 Camshaft Position Sensor Location

(4) Loosen screw attaching target magnet to rear of camshaft (Fig. 10).

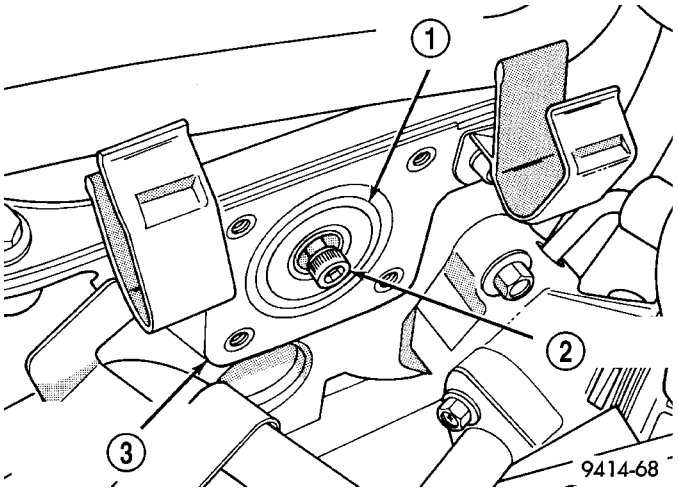


Fig. 10 Target Magnet Removal/Installation

1 - TARGET MAGNET
2 - MOUNTING BOLT
3 - REAR OF CYLINDER HEAD

INSTALLATION

INSTALLATION - 1.6L

(1) Install sensor to cylinder head (Fig. 8).

(2) Tighten screws to 9 N·m (80 in. lbs.).

(3) Connect the electrical connector to the sensor (Fig. 7).

(4) Relocate and install the 2 bolts to the power-steering reservoir.

(5) Relocate the fuel line and radiator over flow hose (Fig. 6).

(6) Connect the negative battery cable

INSTALLATION - 2.0L

The camshaft position sensor is mounted to the rear of the cylinder head (Fig. 9).

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. Over torquing could cause cracks in magnet. If magnet cracks replace it.

(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 camshaft position sensor.

IGNITION COIL

DESCRIPTION

The coil pack consists of 2 coils molded together. The coil pack is mounted on the valve cover (Fig. 11).

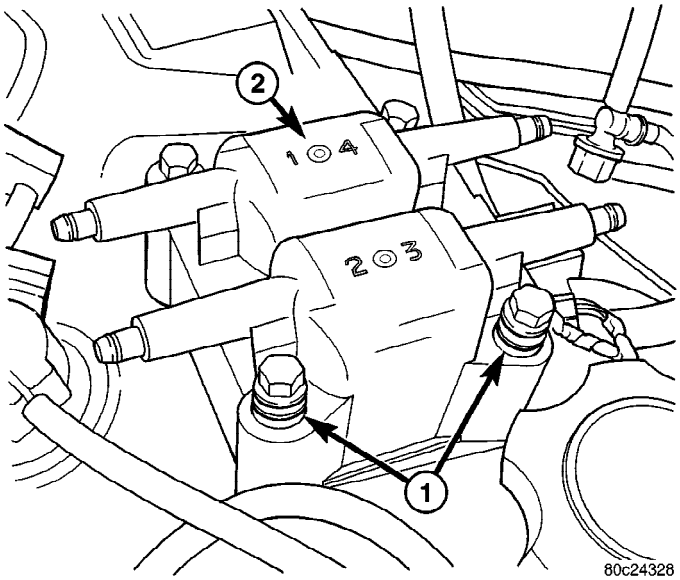


Fig. 11 Ignition Coil Pack

1 - RUBBER INSULATORS
2 - COIL

OPERATION

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

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

IGNITION COIL (Continued)

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.

REMOVAL

REMOVAL - 1.6L

NOTE: The 1.6L is attached with a rubber isolator system. Care must be exercised in retaining all the pieces and reinstalling in the order they where removed.

The electronic ignition coil pack attaches directly to the valve cover (Fig. 12).

(1) Disconnect the negative battery cable.

(2) Remove the 4 spark plug cables, twist the cables to remove.

(3) Remove the 4 bolts.

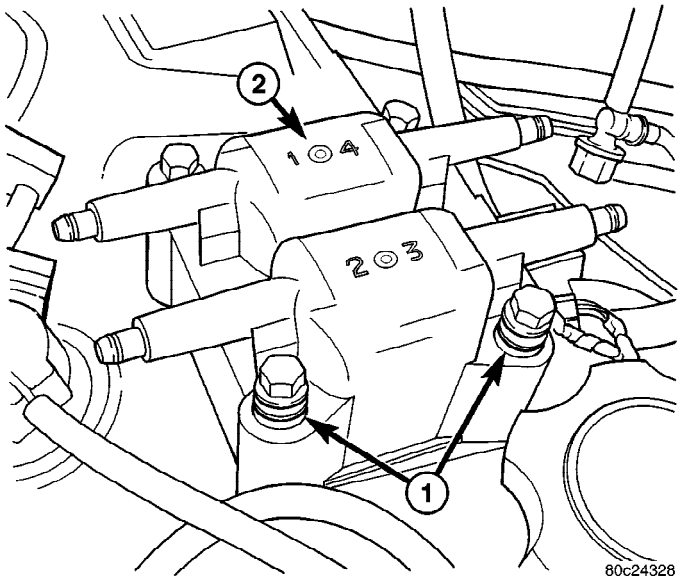


Fig. 12 IGNITION COIL

1 - RUBBER INSULATORS
2 - COIL

(4) Remove the coil.

(5) Remove the rubber insulators from the valve cover, they will be required for installation.

REMOVAL - 2.0L

The electronic ignition coil pack attaches directly to the valve cover (Fig. 14).

(1) Disconnect electrical connector from coil pack (Fig. 13).

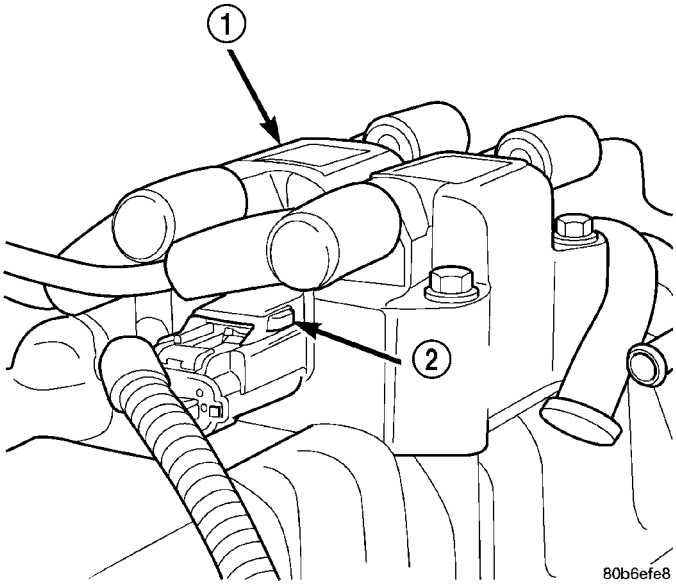


Fig. 13 Electronic Ignition Coil Connector

1 - COIL
2 - LOCKING TAB

(2) Remove coil pack mounting bolts.

(3) Remove coil pack.

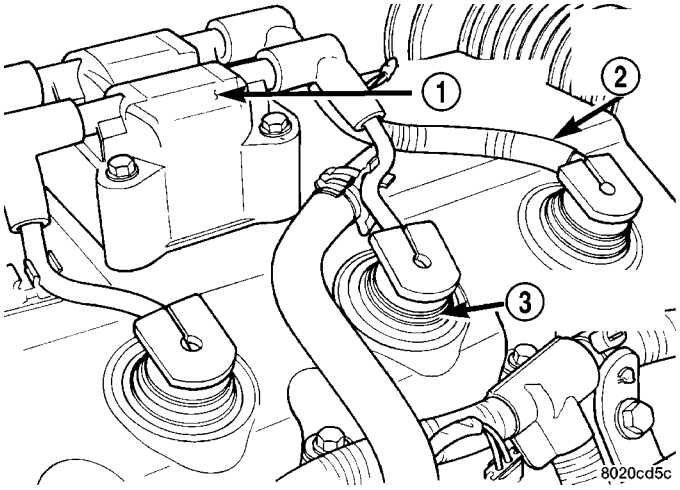


Fig. 14 Electronic Ignition Coil Pack

1 - IGNITION COILS
2 - SPARK PLUG CABLE
3 - SPARK PLUG INSULATOR

IGNITION COIL (Continued)

INSTALLATION

INSTALLATION - 1.6L

Make sure that the rubber insulators are in place both on the top and bottom of the coil bolts.

(1) Install coil and insulators (Fig. 15).

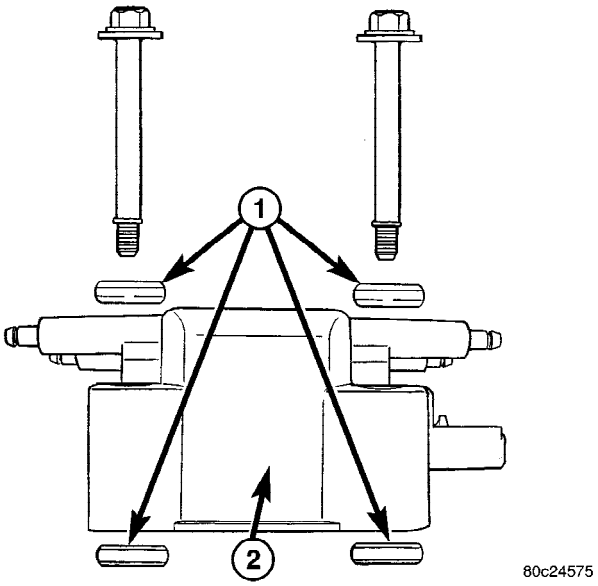


Fig. 15 RUBBER INSULATORS AND COIL

1 - Rubber Insulators
2 - Coil

(2) Tighten bolts to 12 N·m (105 ±20 in. lbs.).

(3) Install spark plug cables.

(4) Connect the negative battery cable.

INSTALLATION - 2.0L

The electronic ignition coil pack attaches directly to the valve cover (Fig. 14).

(1) Install coil pack on valve cover. Tighten the bolts to 11.8 N·m (105 ±20 in. lbs.).

(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.

(3) Connect the negative battery cable.

KNOCK SENSOR

DESCRIPTION

The knock sensor is bolted to the cylinder block. The knock sensor is designed to detect engine vibration that is caused by detonation or preignition.

OPERATION

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 increases, the knock sensor output voltage also increases.

The voltage signal produced by the knock sensor increases with the amplitude of vibration. The PCM receives as an input the knock sensor voltage signal. If the signal rises above a predetermined level, the PCM will store that value in memory and retard ignition timing to reduce engine knock. If the knock sensor voltage exceeds a preset value, the PCM retards ignition timing for all cylinders. It is not a selective cylinder retard.

The PCM ignores knock sensor input during engine idle conditions. Once the engine speed exceeds a specified value, knock retard is allowed.

Knock retard uses its own short term and long term memory program.

Long term memory stores previous detonation information in its battery-backed RAM. The maximum authority that long term memory has over timing retard can be calibrated.

Short term memory is allowed to retard timing up to a preset amount under all operating conditions (as long as rpm is above the minimum rpm) except WOT. The PCM, using short term memory, can respond quickly to retard timing when engine knock is detected. Short term memory is lost any time the ignition key is turned off.

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

KNOCK SENSOR (Continued)

REMOVAL

REMOVAL - 1.6L

(1) Disconnect the negative battery cable.
(2) Remove the fuel rail cover (Fig. 16).

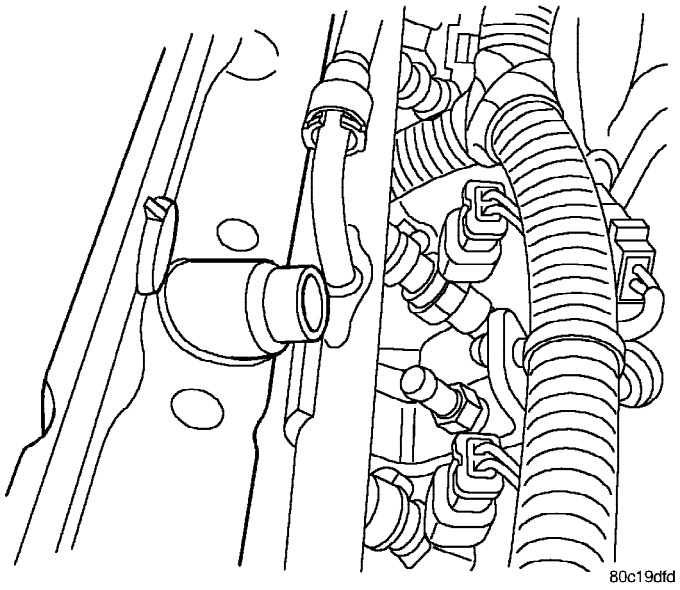


Fig. 16 FUEL RAIL COVER

(3) Locate the electrical connector (Fig. 17).

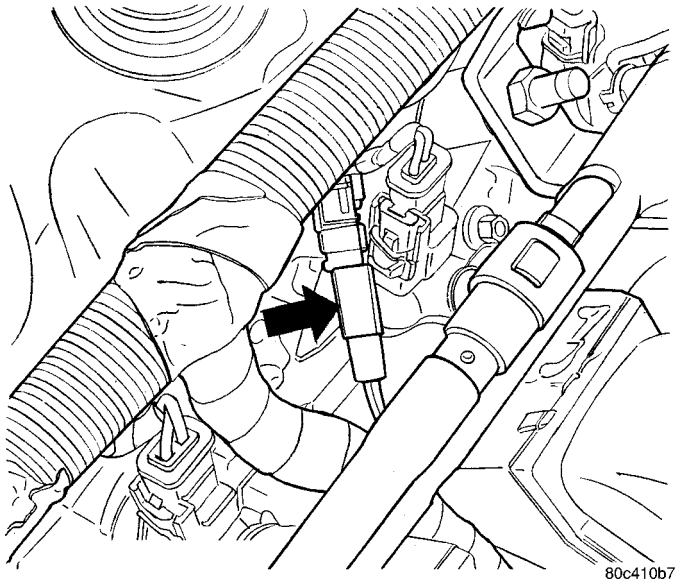


Fig. 17 CONNECTOR LOCATION

(4) Disconnect the electrical connector (Fig. 18).

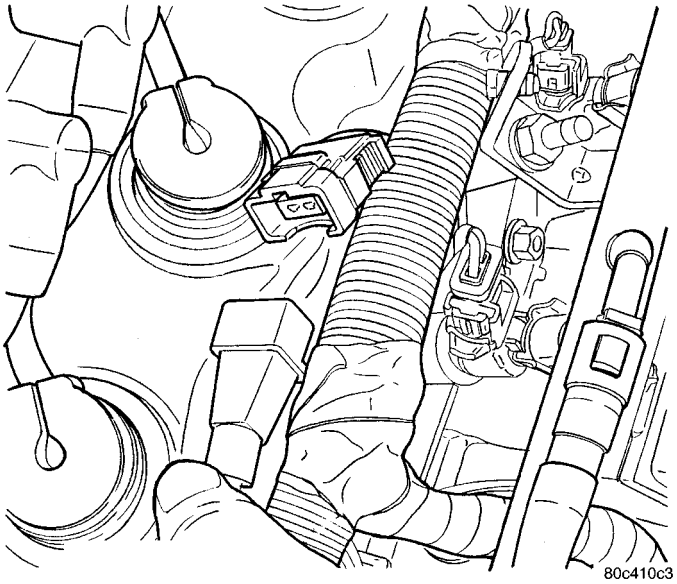


Fig. 18 ELECTRICAL CONNECTOR

(5) Remove the bolt holding the sensor (Fig. 19).

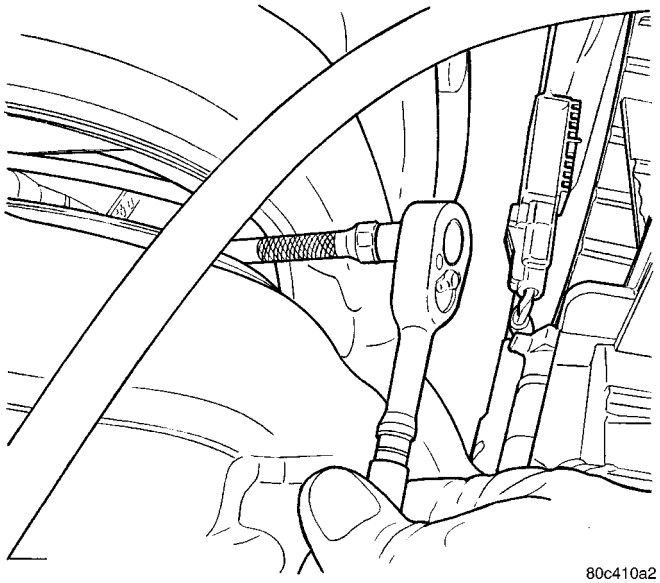


Fig. 19 KNOCK SENSOR

(6) Remove the sensor (Fig. 20).

KNOCK SENSOR (Continued)

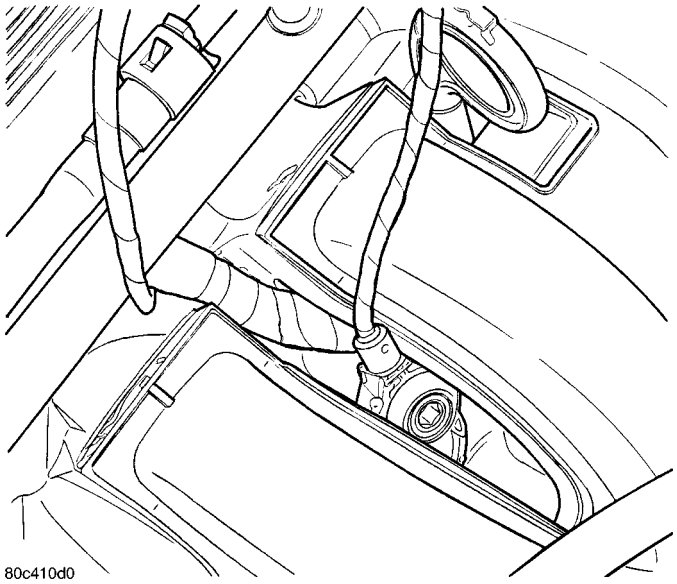


Fig. 20 KNOCK SENSOR REMOVAL/INSTALLATION

REMOVAL - 2.0/2.4/2.4 TURBO/2.4L SRT-4

The knock sensor bolts into the side of the cylinder block in front of the starter under the intake manifold (Fig. 21).

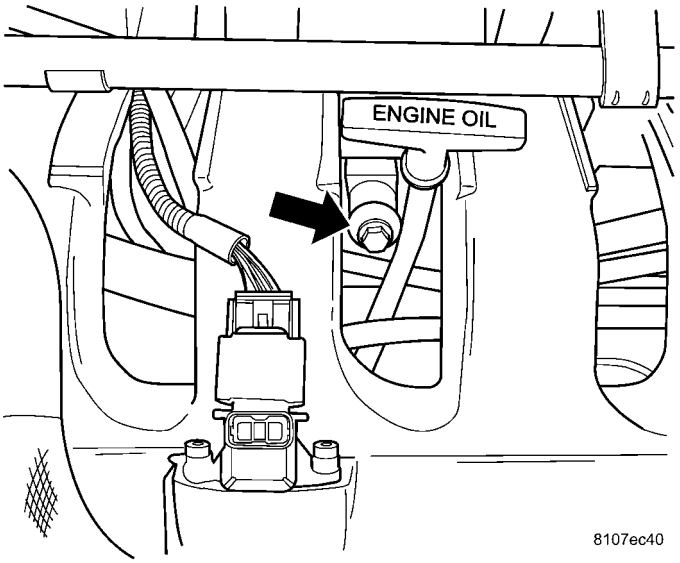


Fig. 21 KNOCK SENSOR LOCATION

(1) Disconnect the negative battery cable.
(2) Disconnect electrical connector from knock sensor (Fig. 22).
(3) Remove the bolt holding the knock sensor
(4) Remove the knock sensor (Fig. 23).

REMOVAL - 2.0L

The knock sensor bolts into the side of the cylinder block in front of the starter under the intake manifold.

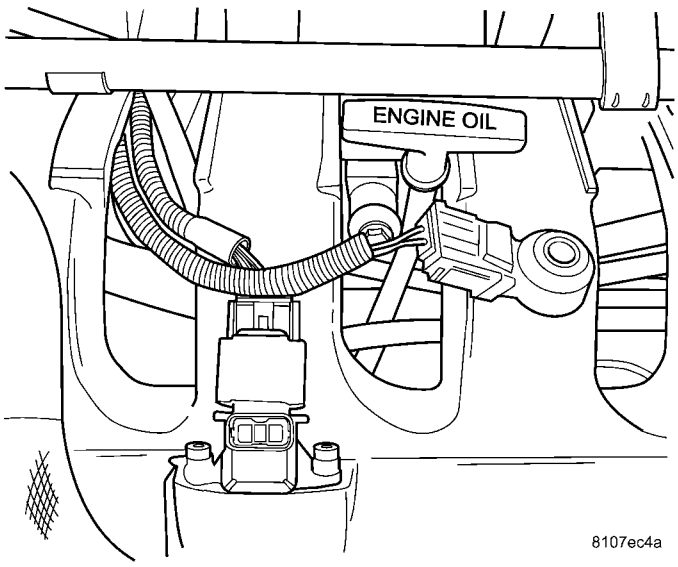


Fig. 22 KNOCK SENSOR REMOVED

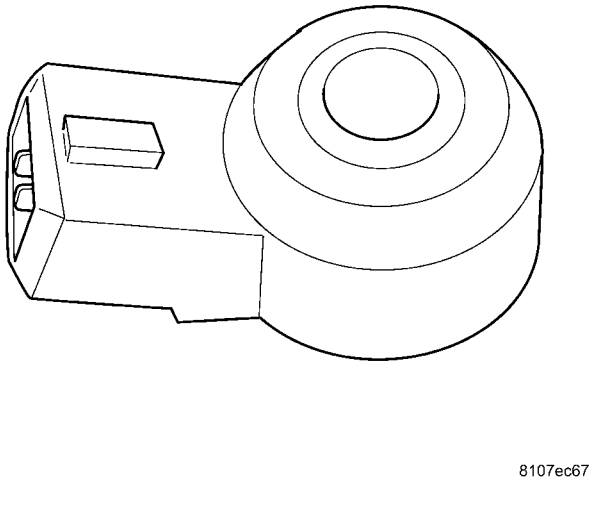


Fig. 23 KNOCK SENSOR

(1) Disconnect electrical connector from knock sensor.
(2) Use a crow foot socket to remove the knock sensors.

INSTALLATION

INSTALLATION - 1.6L

(1) Install the sensor (Fig. 20).
(2) Install knock sensor (Fig. 19). Tighten knock sensor bolt to 22 N·m (195 in. lbs.) torque. **Over or under tightening effects knock sensor performance resulting in possible improper spark control.**
(3) Locate the electrical connector (Fig. 17).

KNOCK SENSOR (Continued)

(4) Connect the heretical connector (Fig. 18).
(5) Install the fuel rail cover (Fig. 16).
(6) Connect the negative battery cable.

INSTALLATION - 2.0/2.4/2.4 TURBO/2.4L SRT-4

The knock sensor bolts into the side of the cylinder block in front of the starter under the intake manifold.

(1) Install knock sensor (Fig. 23). Tighten knock sensor bolt to 22 N·m (195 in. lbs.) torque. **Over or under tightening effects knock sensor performance, possibly causing improper spark control.**

(2) Attach electrical connector to knock sensor (Fig. 22).

(3) Connect the negative battery cable.

INSTALLATION - 2.0L

The knock sensor bolts into the side of the cylinder block in front of the starter.

(1) Install knock sensor. Tighten knock sensor bolt to 22 N·m (195 in. lbs.) torque. **Over or under tightening effects knock sensor performance, possibly causing improper spark control.**

(2) Attach electrical connector to knock sensor.

SPARK PLUG

DESCRIPTION

The engines uses resistor spark plugs. For spark plug identification and specifications, refer to Specifications.

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.

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. 24) to the dimensions specified in the chart at the end of this section by bending the ground electrode (just above the attachment weld) with the appropriate tool.

Never apply any force between the electrode or damage to the center electrode assembly will result.

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

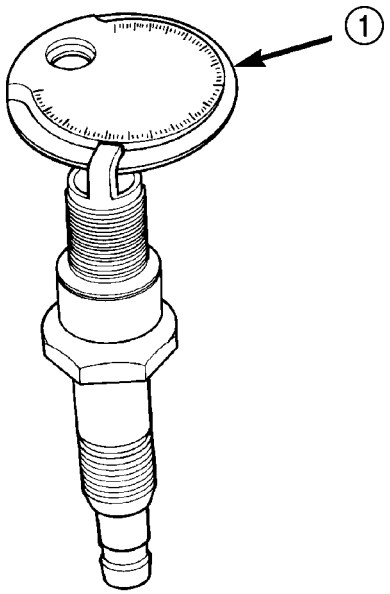


Fig. 24 Checking Spark Plug Electrode Gap

1 - TAPER GAUGE

REMOVAL

REMOVAL - 1.6L

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.

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 and special tool # 8448 (Fig. 25) on the extention to keep from damageing the spark plug tubes in the cylinder head and valve cover.

(2) Inspect the spark plug condition.

REMOVAL - 2.0/2.4L

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.

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.

SPARK PLUG (Continued)

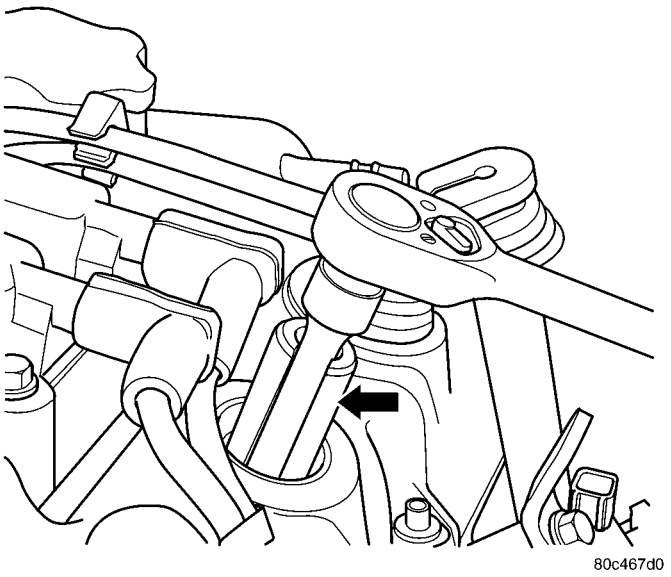


Fig. 25 SPECIAL TOOL # 8448

INSTALLATION

INSTALLATION - 1.6L

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.

(1) To avoid cross threading, start the spark plug into the cylinder head by hand.

(2) Use special tool 8448 (Fig. 25) to install and tighten the spark plug. 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.

(4) Reconnect to coil.

INSTALLATION - 2.0/2.4L

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.

(1) To avoid cross threading, start the spark plug into the cylinder head by hand.

(2) Tighten spark plugs to 17.6 N·m +/- 2 (13 +/- 2 ft. lbs.) torque.

WARNING: The tapered seat plugs for this application are torque-critical! It is imperative that 17.6 N·m +/- 2 (13 +/- 2 ft. lbs.) is NOT exceeded!

(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.

(4) Reconnect to coil.

SPARK PLUG CABLE

DESCRIPTION

Spark Plug cables are sometimes referred to as secondary ignition wires. The wires transfer electrical current from the ignition coil pack to individual spark plugs at each cylinder. The resistive spark plug cables are of nonmetallic construction. The 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 insulators should be in good condition and should fit tightly on the coil, and spark plugs. Spark plug cables with insulators that are cracked or torn must be replaced.

Clean Spark Plug cables with a cloth moistened with a non-flammable solvent. Wipe the cables dry. Check for brittle or cracked insulation. The spark plug cables and spark plug boots are made from high temperature materials.

REMOVAL

REMOVAL - 1.6L

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.

Remove spark plug cable 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.

REMOVAL - 2.0/2.4L

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.

Remove spark plug cable 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.

INSTALLATION - 2.0/2.4L

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. Install spark plug insulators over spark plugs. Ensure the top of the spark plug insulator covers the upper end of the spark plug tube, then connect the other end to coil pack.