

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).

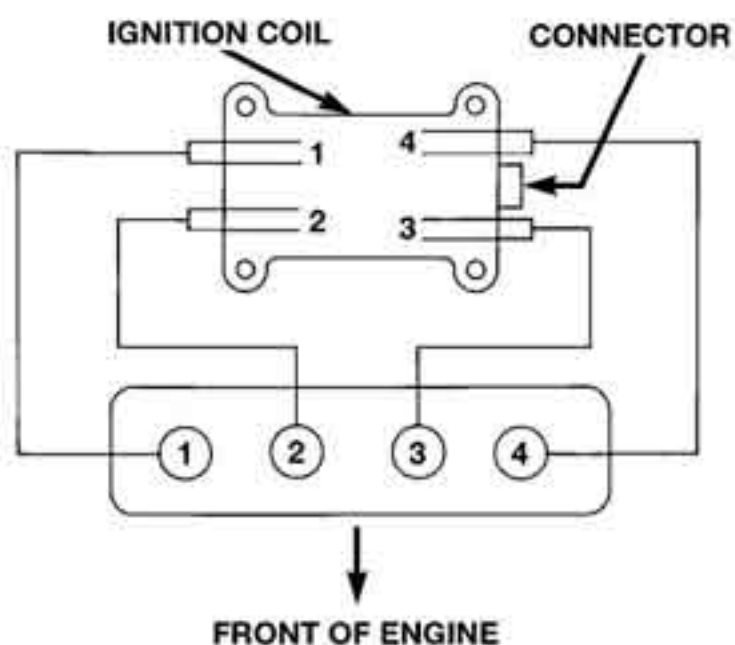
The distributorless ignition system used on these engines is referred to as the Direct Ignition System (DIS). The system's three main components are the coils, crankshaft position sensor, and camshaft position sensor. If equipped with the coil on plug ignition system it utilizes an ignition coil for 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—1.6/2.0L



FIRING ORDER 1-3-4-2

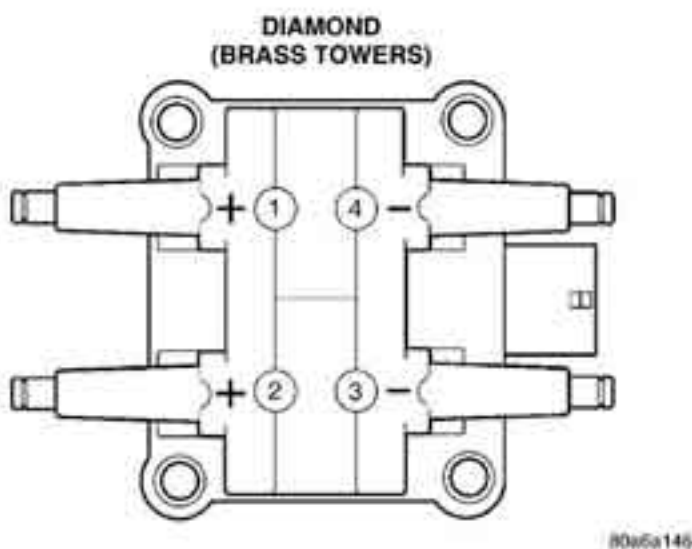
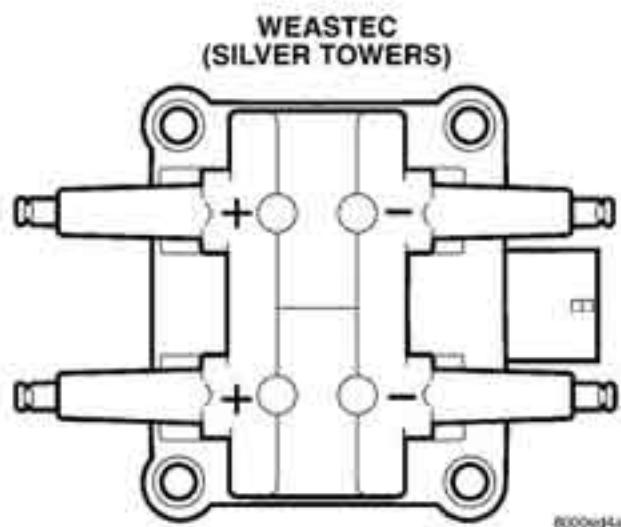
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TORQUE

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
2.0/2.4L Camshaft Position Sensor Screw	13		115
Cam Magnet/Target	3.6		32
2.0/2.4L Crankshaft Position Sensor Screw	9		80
1.6L Cam/Crank Sensor Screw	9		80
Coolant Temp. Sensor	18.6		165
Ignition Coil to Cyl. Head	11.8		105
Knock Sensor Bolt	22		195
2.0/2.4L Spark Plugs *	17.6 ±2	13 ±2	
1.6L Spark Plugs	27 ±2.7	20 ±2	
* Tapered seat plugs. Imperative that torque is NOT EXCEEDED.			

IGNITION CONTROL (Continued)**IGNITION COILS**

Engines	Coil Manufacture	Primary Resistance at 21°C-27°C (70°F-80°F)	Secondary Resistance at 21°C-27°C (70°F-80°F)
2.4L	Toyodenso/ Diamond	0.45 TO 0.65 Ohms	11,500 to 14,700 Ohms

SPARK PLUGS*Coil Polarity**Coil Polarity*

ENGINE	PLUG TYPE	ELECTRODE GAP
1.6L	RC9MCC	0.84 to 0.97 mm (0.033 to 0.038 in.)
2.4L	RE14MCC5	1.24 to 1.37 mm (0.048 to 0.053 in.)

SPARK PLUG CABLE RESISTANCE**1.6L**

CABLE	RESISTANCE
#1	2790 ohms— 8680 ohms
#2	2400 ohms— 7530 ohms
#3	3430 ohms— 10,600 ohms
#4	3680 ohms— 11,340 ohms

2.0L

CABLE	RESISTANCE
#1,#4	2900 ohms— 9000 ohms
#2,#3	2290 ohms— 7300 ohms

SPECIAL TOOLS - EXPORT*PROTECTIVE SLEEVE***AUTO SHUT DOWN RELAY****DESCRIPTION**

The relay is located in the Power Distribution Center (PDC). 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.

OPERATION

The ASD sense circuit (SBEC vehicles) or the engine switched battery (NGC vehicles) informs the PCM when the ASD relay energizes. A 12 volt signal at this input indicates to the PCM that the ASD has been activated. This input is also used to power certain drivers on NGC vehicles.

AUTO SHUT DOWN RELAY (Continued)

When energized, the ASD relay on SBEC vehicles supplies battery voltage to the fuel injectors, ignition coils and the heating element in each oxygen sensor.

When energized, the ASD relay on NGC vehicles provides power to operate the injectors, ignition coil, generator field, O₂ sensor heaters (both upstream and downstream), evaporative purge solenoid, EGR solenoid (if equipped) wastegate solenoid (if equipped), and NVLD solenoid (if equipped).

For both SBEC and NGC vehicles, the ASD relay also provides a sense circuit to the PCM for diagnostic purposes. If the PCM does not receive 12 volts from this input after grounding the control side of the ASD relay, it sets a Diagnostic Trouble Code (DTC). The PCM energizes the ASD any time there is an engine speed that exceeds a predetermined value (typically about 50 rpm). The ASD relay can also be energized after the engine has been turned off to perform an O₂ sensor heater test, if vehicle is equipped with OBD II diagnostics.

As mentioned earlier, the PCM energizes the ASD relay during an O₂ sensor heater test. This test is performed only after the engine has been shut off for SBEC vehicles. On NGC vehicles it checks the O₂ heater upon vehicle start. The PCM still operates internally to perform several checks, including monitoring the O₂ sensor heaters.

CAMSHAFT POSITION SENSOR

DESCRIPTION

On 2.0/2.4L engines the camshaft position sensor is mounted to the rear of the cylinder head (Fig. 1), (Fig. 2). On 1.6L engines it is mounted on the front side of the cylinder head.

OPERATION

The PCM sends approximately 5 volts to the Hall-effect sensor. This voltage is required to operate the Hall-effect chip and the electronics inside the sensor. The input to the PCM occurs on a 5 volt output reference circuit. A ground for the sensor is provided through the sensor return circuit. The PCM identifies camshaft position by registering the change from 5 to 0 volts, as signaled from the Camshaft Position sensor (Fig. 3).

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. As the target magnet rotates, the camshaft position sensor senses the change in polarity (Fig. 5) and (Fig. 4).

The PCM determines fuel injection synchronization and cylinder identification from inputs provided by

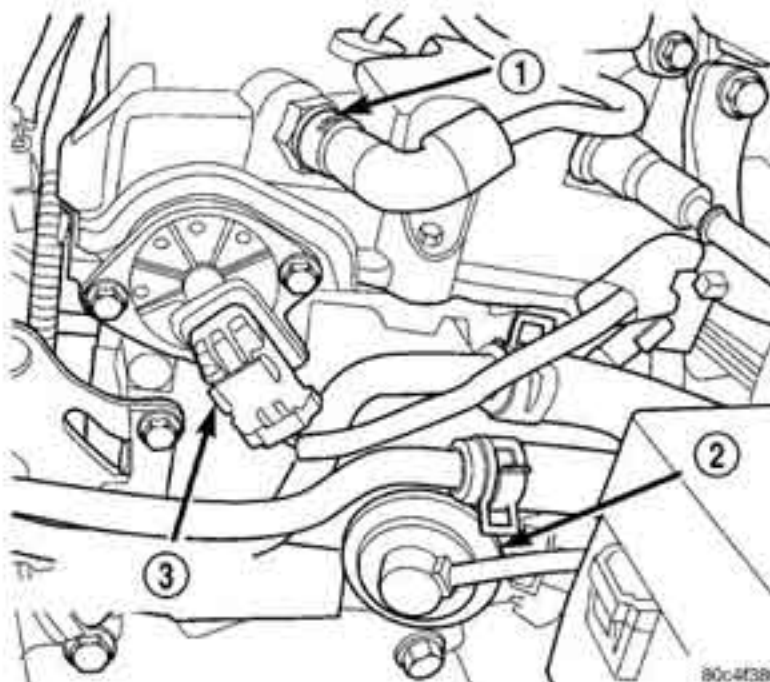


Fig. 1 Camshaft Position Sensor - 2.0/2.4L DOHC

- 1 - PCV VALVE
- 2 - EGR VALVE
- 3 - CAMSHAFT POSITION SENSOR

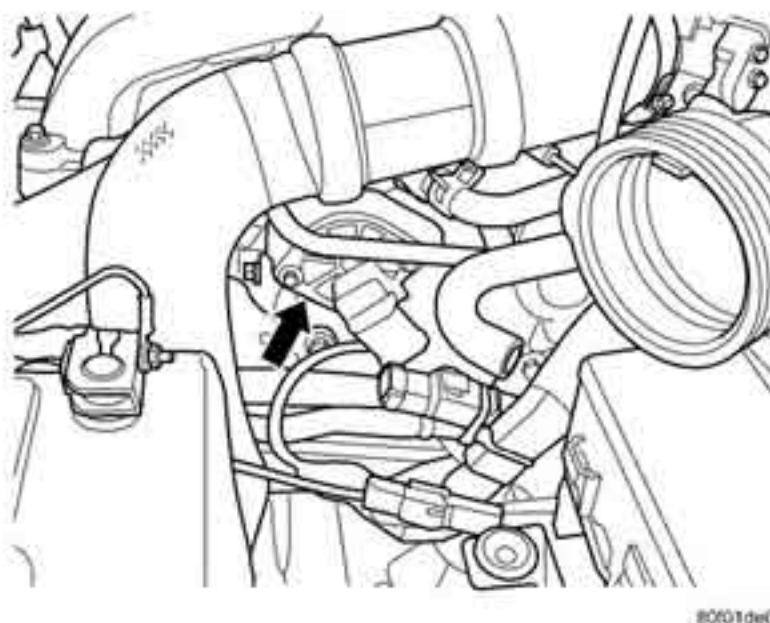
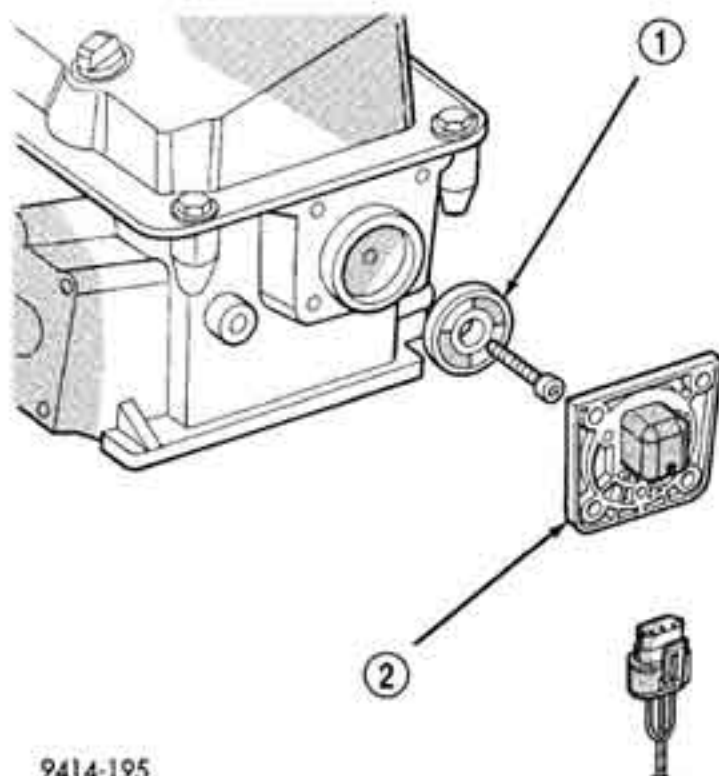


Fig. 2 CAMSHAFT POSITION SENSOR - 2.4L TURBO

the camshaft position sensor (Fig. 1) and crankshaft position sensor. From the two inputs, the PCM determines crankshaft position.

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.

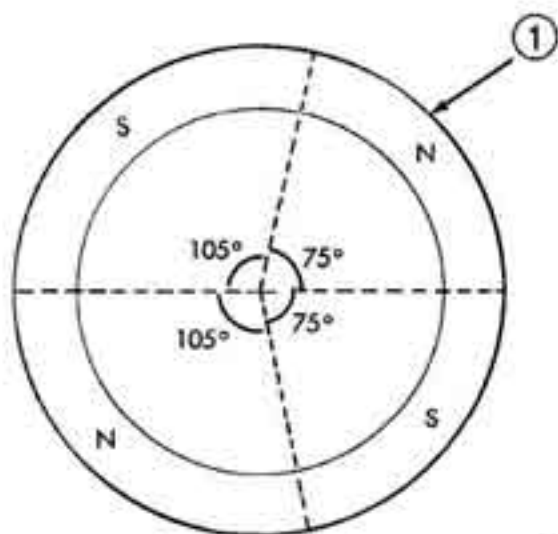
On 1.6L a raised platform on the cam sprocket serves as a target. When the sensor detects the step, the input voltage from the sensor to the PCM

CAMSHAFT POSITION SENSOR (Continued)

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Fig. 3 Target Magnet - Typical

- 1 - CAM MAGNET/TARGET
2 - CAMSHAFT POSITION SENSOR



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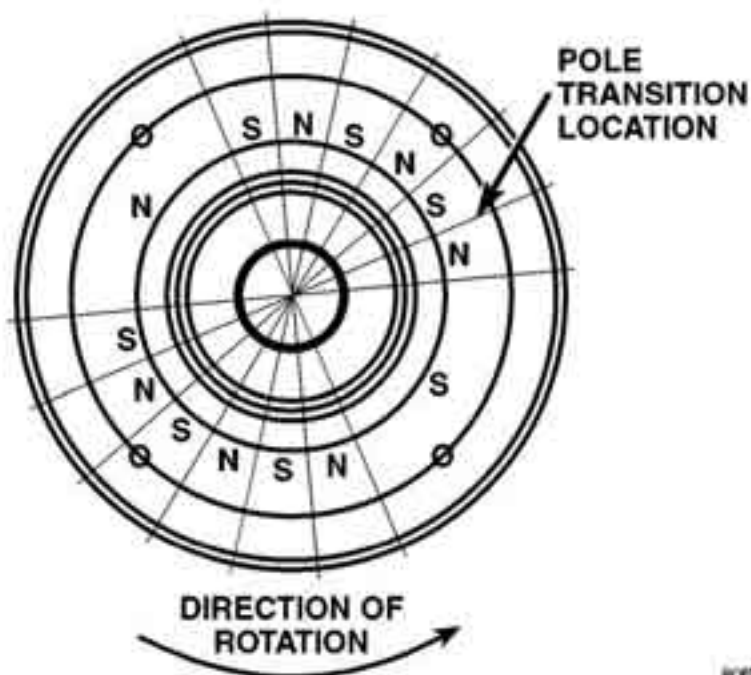
Fig. 4 Target Magnet Polarity

- 1 - TARGET MAGNET

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).

REMOVAL**REMOVAL - 2.0/2.4L**

- (1) Remove the air cleaner lid, disconnect the inlet air temperature sensor and makeup air hose.
- (2) Remove the negative battery cable.



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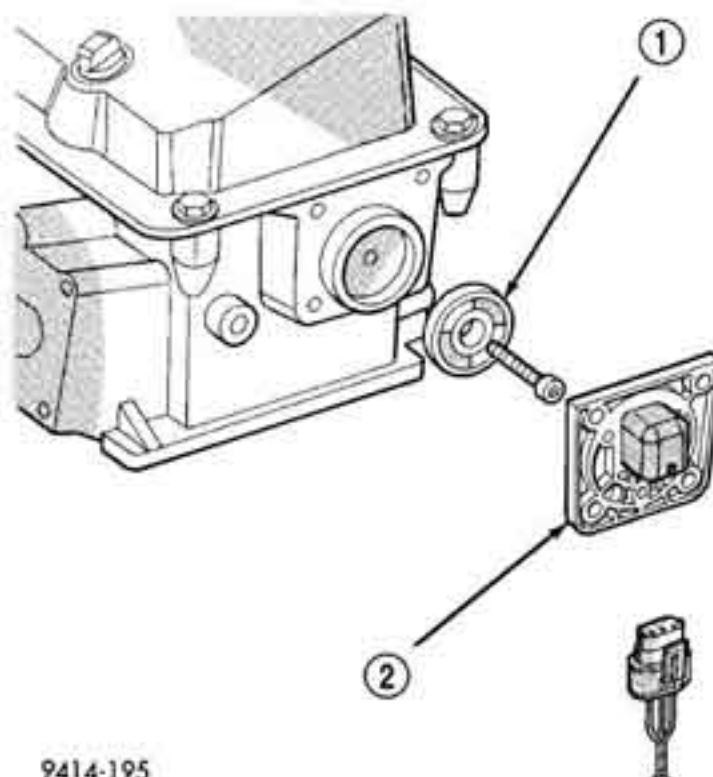
Fig. 5 Target Magnet Polarity - NGC

- 1 - TARGET MAGNET

(3) Disconnect electrical connector from camshaft position sensor.

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

(5) Loosen screw attaching target magnet to rear of camshaft (Fig. 6).



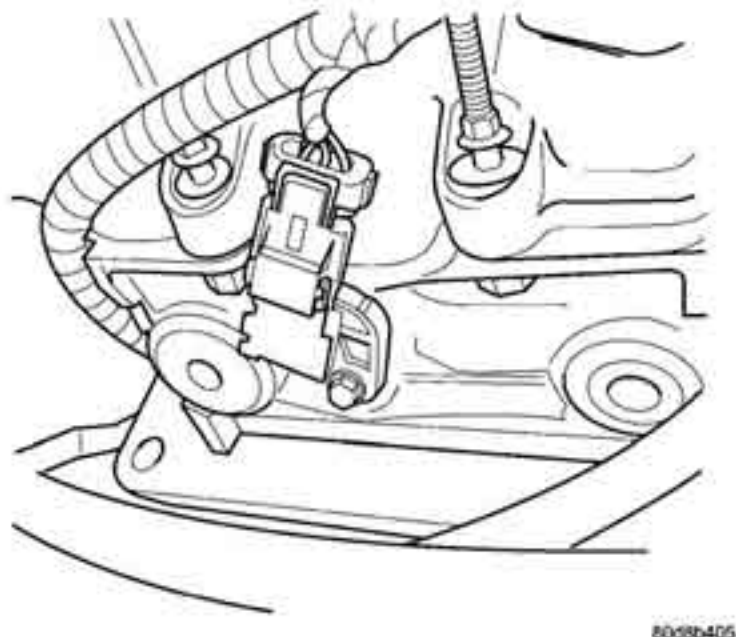
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Fig. 6 Target Magnet Removal/Installation

- 1 - CAM MAGNET/TARGET
2 - CAMSHAFT POSITION SENSOR

CAMSHAFT POSITION SENSOR (Continued)**REMOVAL - 1.6L**

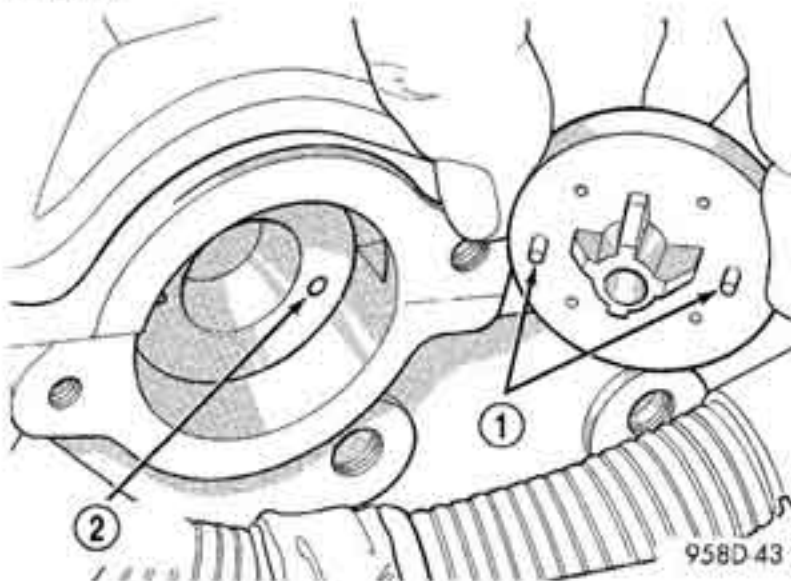
- (1) Disconnect the negative battery cable.
- (2) Relocate the power steering return hose.
- (3) Disconnect the electrical connector from the camshaft sensor.
- (4) Remove 1 screws from sensor.
- (5) Remove sensor (Fig. 7).



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Fig. 7 CAMSHAFT SENSOR LOCATION**INSTALLATION****INSTALLATION - 2.0/2.4L**

The target magnet has locating dowels that fit into machined locating holes in the end of the camshaft (Fig. 8).



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Fig. 8 Target Magnet Installation

- 1 - LOCATING DOWELS
2 - LOCATING HOLES (2)

- (1) Install target magnet in end of camshaft. Tighten mounting screw to 3.6 N·m (32 ±5 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 ±15 in. lbs.) torque.
- (3) Carefully attach electrical connector to camshaft position sensor. Installation at an angle may damage the sensor pins.
- (4) Install the negative battery cable.
- (5) Install the air cleaner lid, connect the inlet air temperature sensor and makeup air hose.

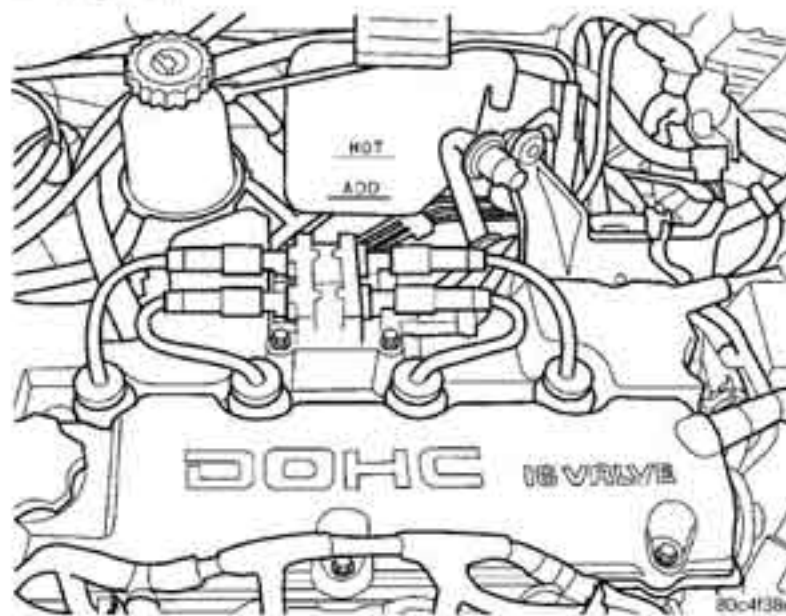
INSTALLATION - 1.6L

- (1) Install sensor to cylinder head (Fig. 7).
- (2) Tighten screws to 9 N·m (80 in. lbs.).
- (3) Connect the electrical connector to the sensor.
- (4) Relocate the power steering return line.
- (5) Connect the negative battery cable

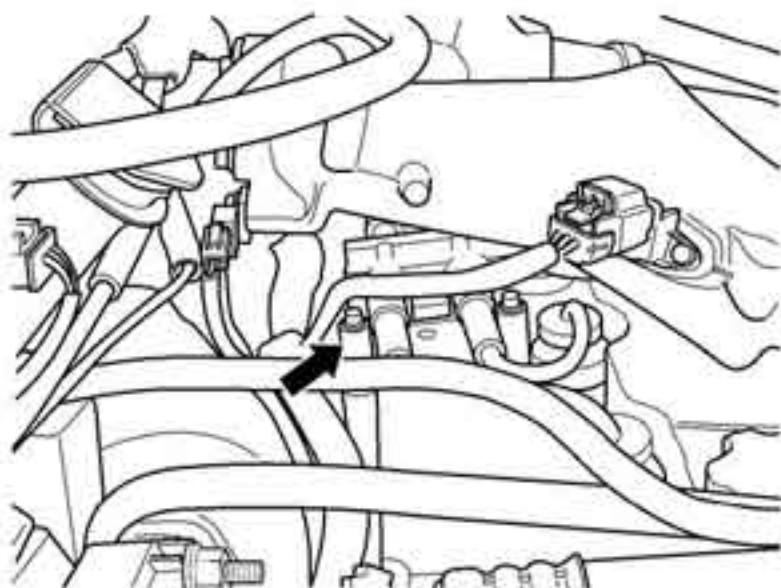
IGNITION COIL**DESCRIPTION**

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. 9) or (Fig. 10).

**Fig. 9 Ignition Coil Pack—2.0/2.4L****OPERATION**

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

IGNITION COIL (Continued)

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Fig. 10 IGNITION COIL LOCATION - 2.4L TURBO

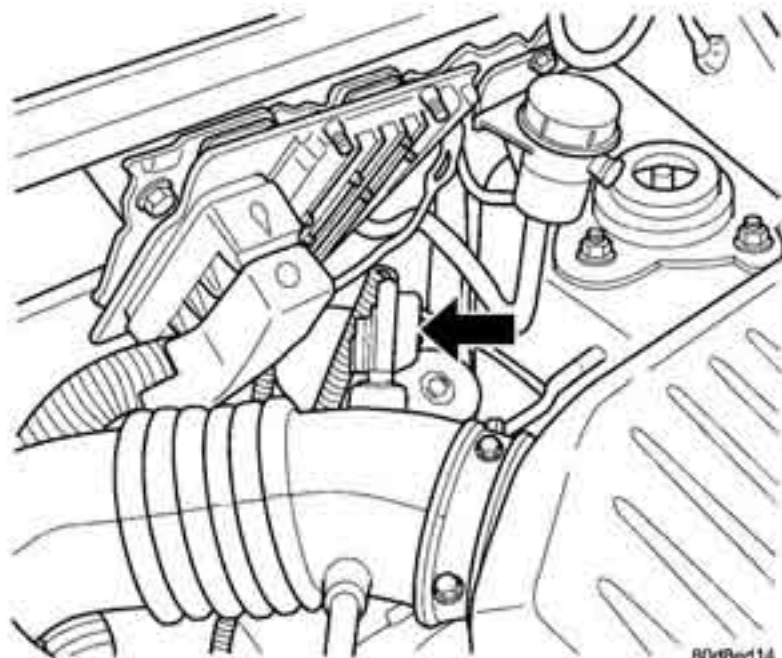
High tension leads route to each cylinder from the coil. The coil fires two spark plugs every power stroke. One plug is the cylinder under compression, the other cylinder fires on the exhaust stroke. Coil number one fires cylinders 1 and 4. Coil number two fires cylinders 2 and 3. The PCM determines 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.

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 were removed.

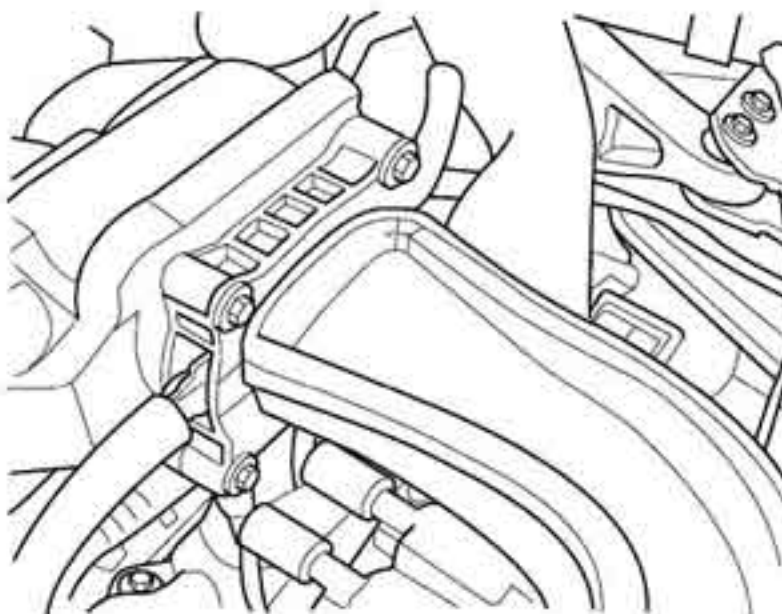
- (1) Remove air cleaner assembly cover and disconnect the inlet air temperature sensor (Fig. 11).
- (2) Disconnect the negative battery cable.



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Fig. 11 INLET AIR TEMP. SENSOR

- (3) Disconnect the electrical connector at the throttle body.
- (4) Remove the purge hose from throttle body.
- (5) Remove the 4 bolts from the upper to lower manifold (Fig. 12).



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Fig. 12 UPPER MANIFOLD BOLTS

IGNITION COIL (Continued)

(6) Remove the 2 bolts to the upper manifold to struts (Fig. 13) and (Fig. 14).

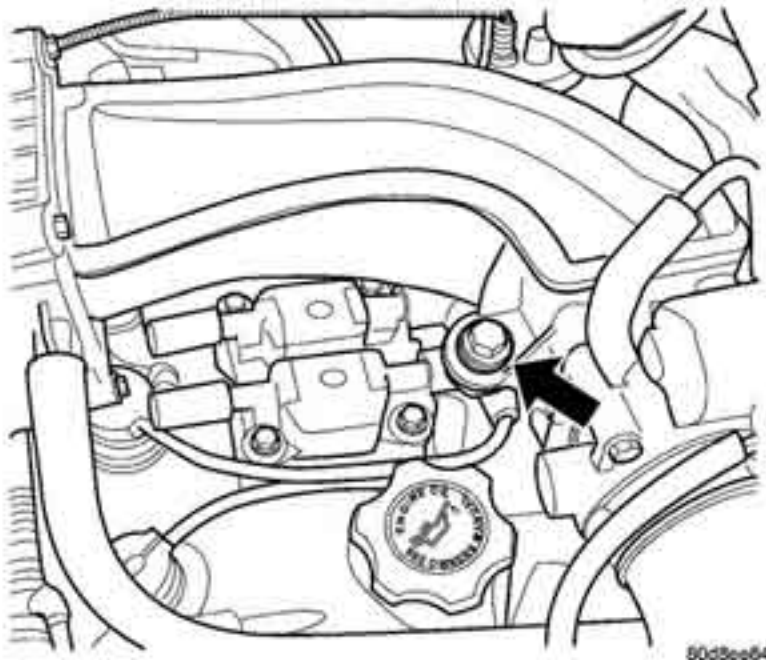


Fig. 13 FRONT STRUT BOLTS UPPER INTAKE

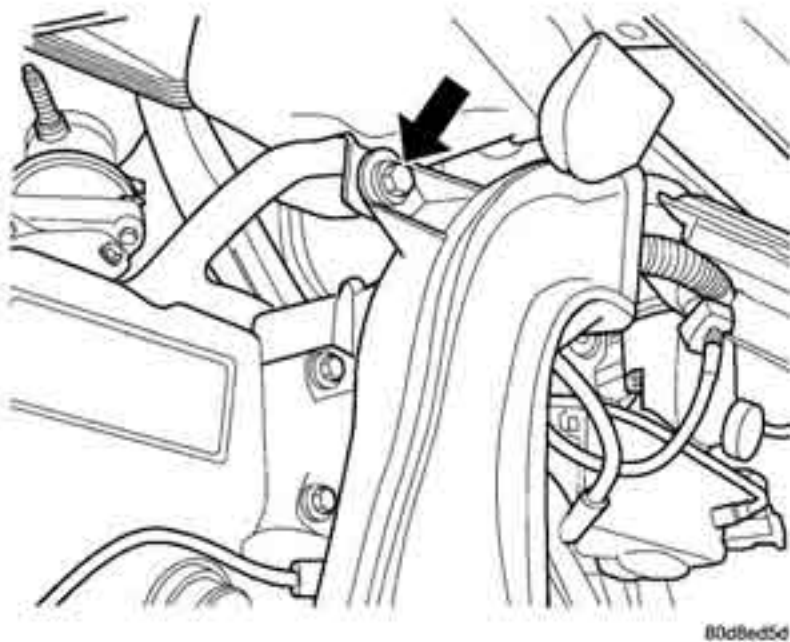


Fig. 14 REAR STRUT BOLTS UPPER INTAKE

(7) Remove the PCV hose and the brake booster hose from the upper manifold

(8) Remove the 4 bolts from the ignition coil (Fig. 15).

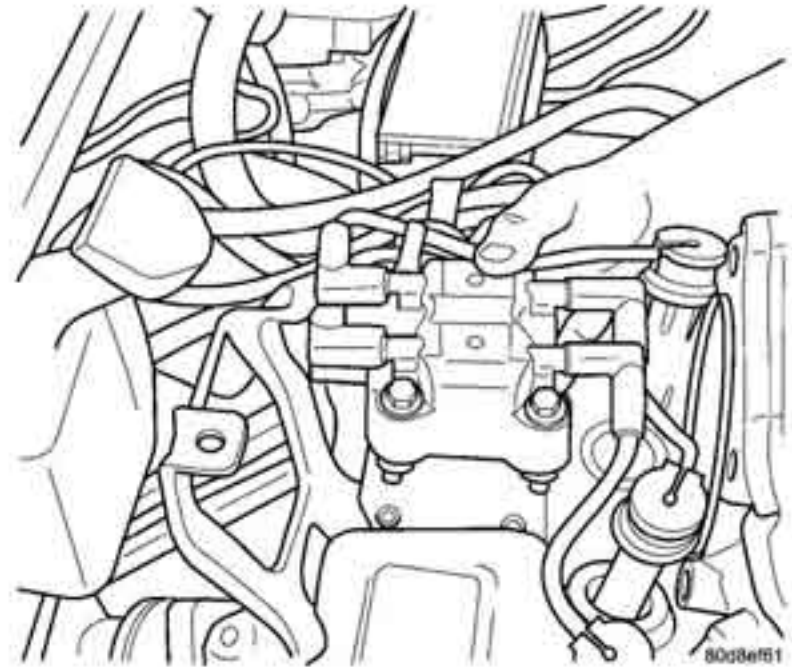


Fig. 15 IGNITION COIL

(9) Remove the spark plug cables from the ignition coil.

REMOVAL - 2.0/2.4L

The electronic ignition coil pack attaches directly to the valve cover (Fig. 16).

- (1) Remove the negative battery cable.
- (2) Disconnect electrical connector from coil pack.
- (3) Remove coil pack mounting nuts.
- (4) Remove coil pack.

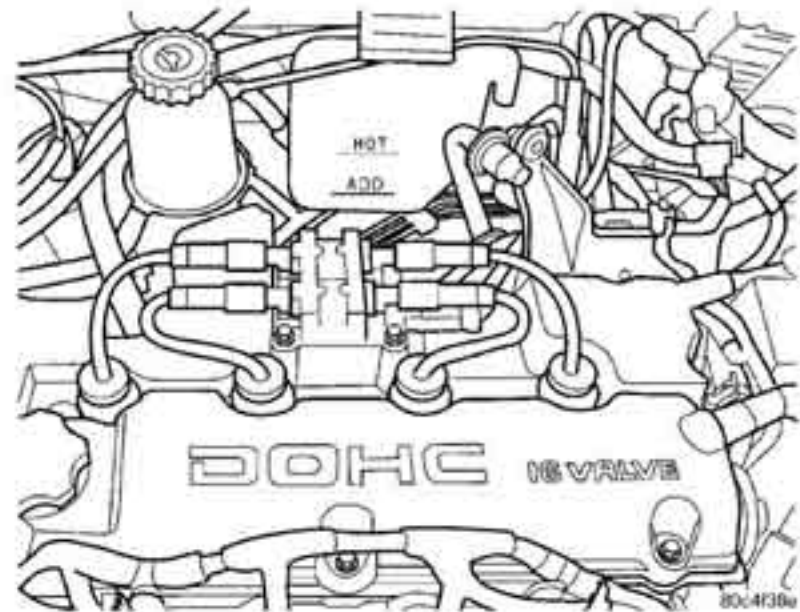
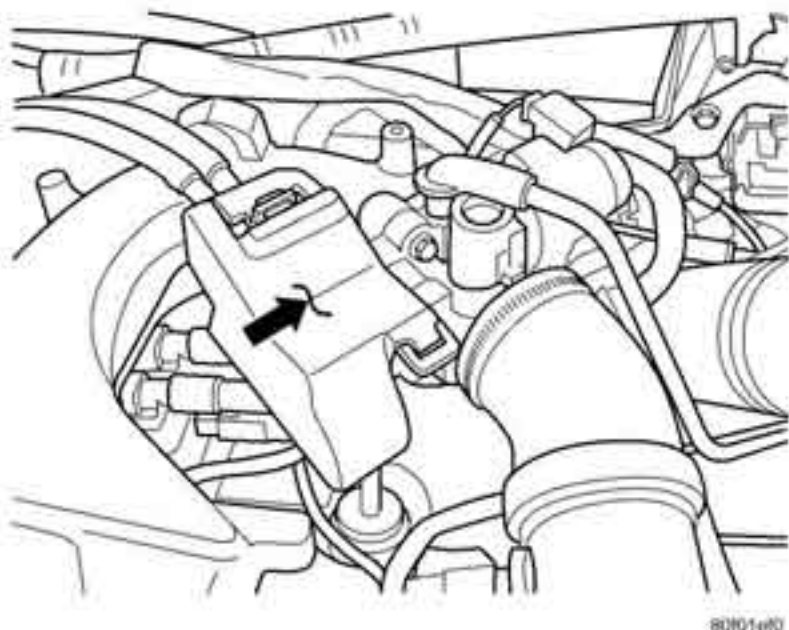


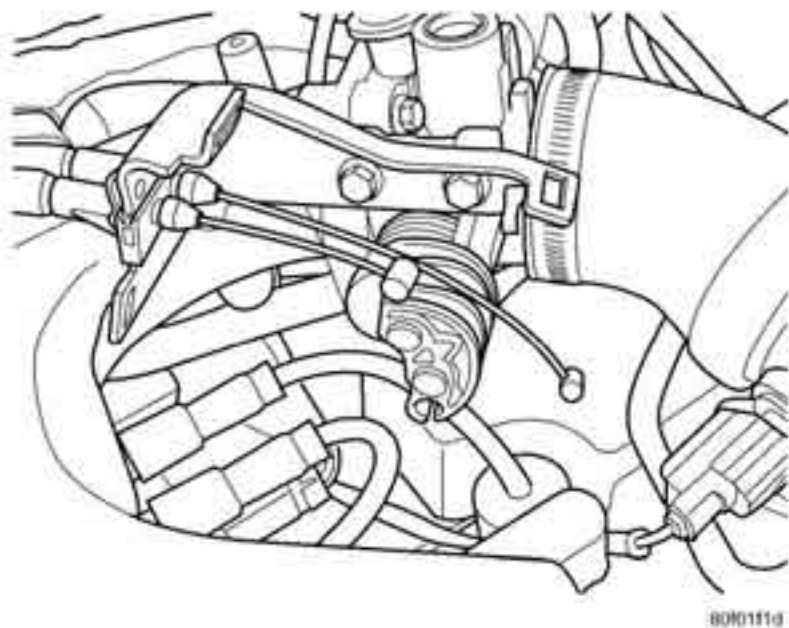
Fig. 16 Electronic Ignition Coil Pack—2.4L

IGNITION COIL (Continued)**REMOVAL - 2.4L TURBO**

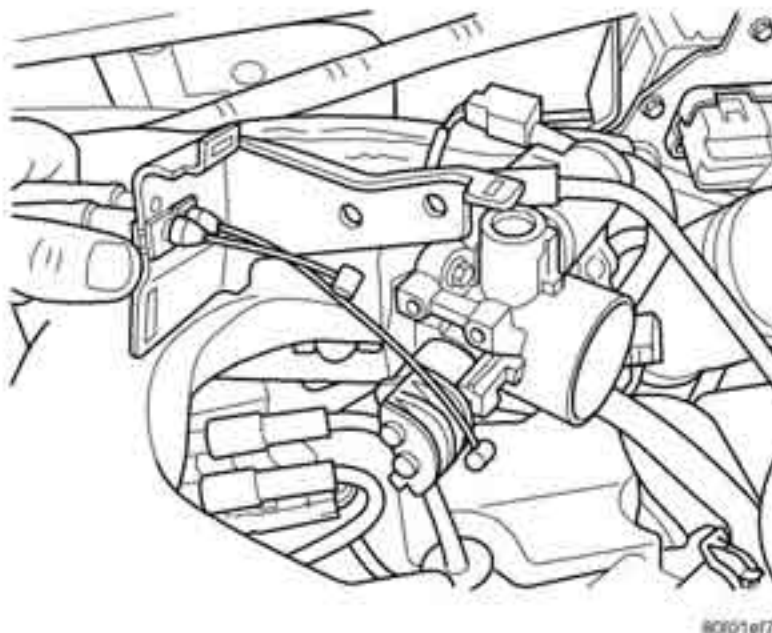
- (1) Disconnect the negative battery cable.
- (2) Remove the throttle control shield (Fig. 17).

**Fig. 17 THROTTLE CONTROL SHIELD**

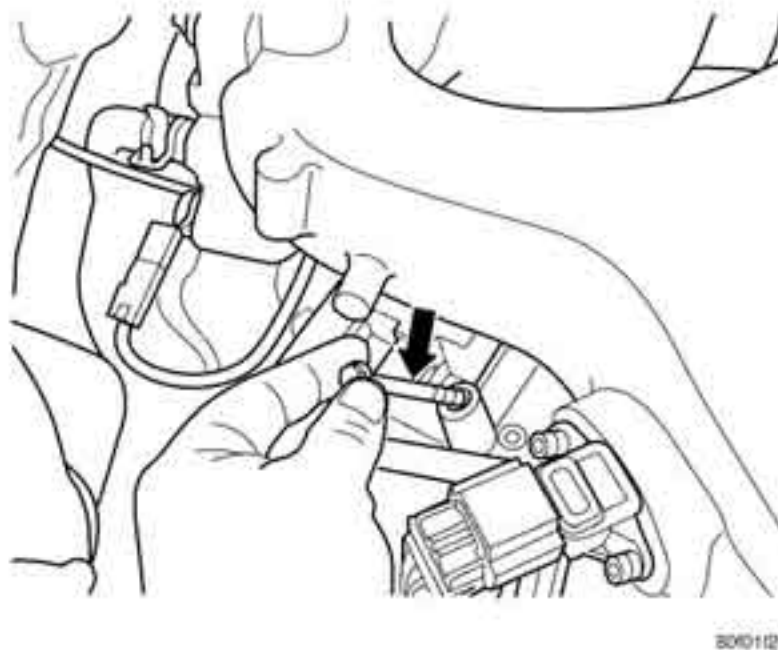
- (3) Remove the throttle cables from the throttle body lever (Fig. 18).

**Fig. 18 THROTTLE CABLES**

- (4) Remove the throttle cable bracket and relocate (Fig. 19).

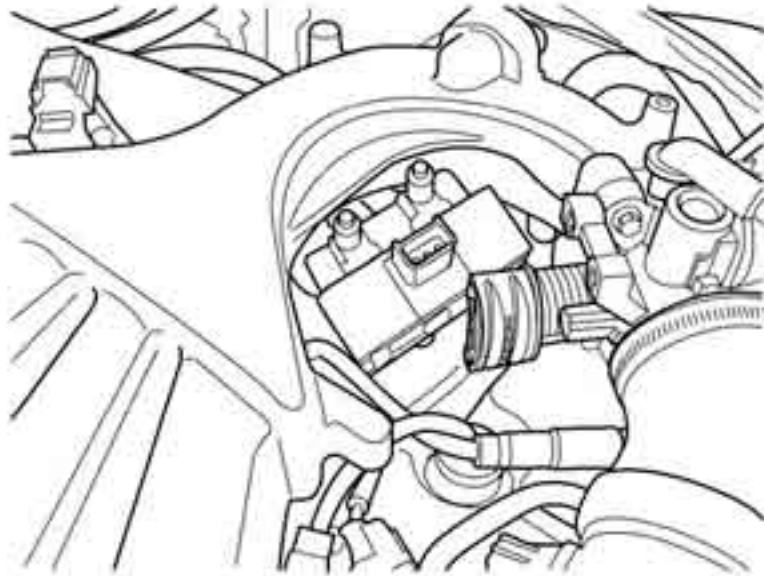
**Fig. 19 THROTTLE CABLE BRACKET**

- (5) Remove the spark plug cables from the ignition coil.
- (6) Unlock and disconnect the electrical connector from the ignition coil.
- (7) Remove bolts from ignition coil. Twist coil to remove 2 of the bolts (Fig. 20) from the coil before removing it from vehicle.

**Fig. 20 IGNITION COIL BOLT**

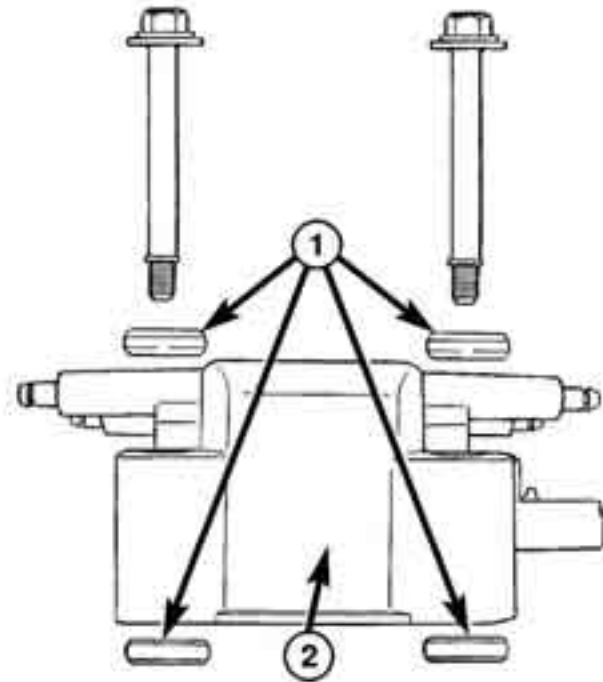
IGNITION COIL (Continued)

(8) Pull coil up (Fig. 21) and out by the throttle body side of the intake manifold (Fig. 22).



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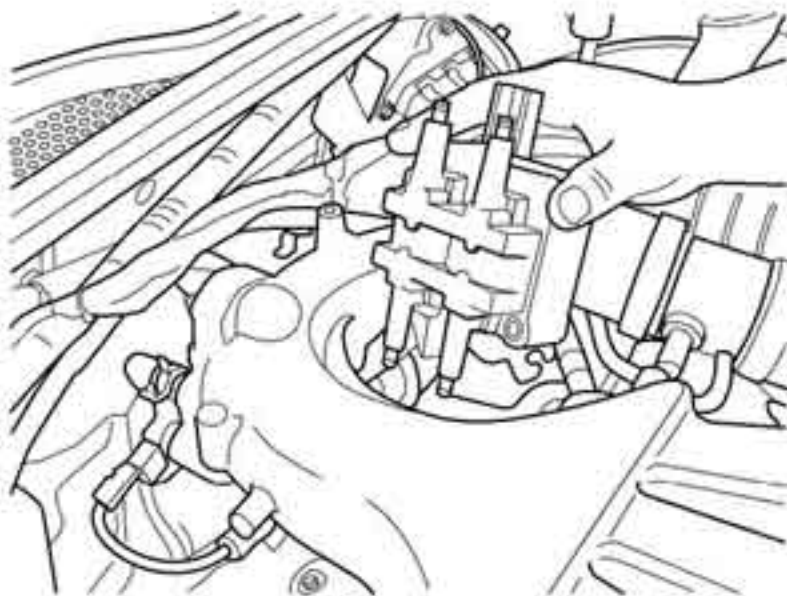
Fig. 21 IGNITION COIL REMOVAL/INSTALLATION



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Fig. 23 RUBBER INSULATORS AND COIL

1 - Rubber Insulators
2 - Coil

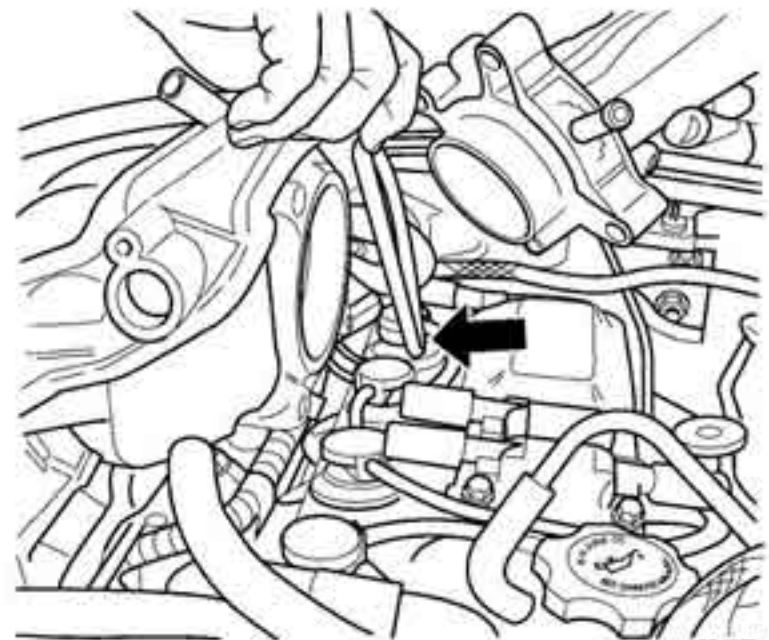


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Fig. 22 IGNITION COIL REMOVED

INSTALLATION**INSTALLATION - 1.6L**

- (1) Install coil and insulators (Fig. 23).
- (2) Tighten bolts to 12 N·m (105 ±20 in. lbs.).
- (3) Install gasket to upper intake manifold (Fig. 24) and (Fig. 25).
- (4) Install the 4 bolts from the upper to lower manifold (Fig. 12).
- (5) Install the 2 bolts to the upper manifold to struts (Fig. 13) and (Fig. 14).
- (6) Install the PCV hose and the brake booster hose to the upper manifold



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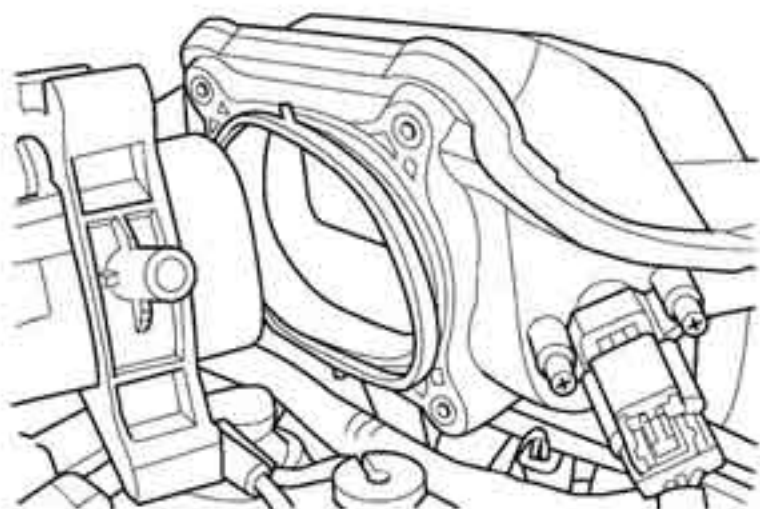
Fig. 24 UPPER INTAKE GASKET

- (7) Install the purge hose to throttle body.
- (8) Connect the electrical connector to throttle body.
- (9) Connect the negative battery cable.
- (10) Install air cleaner assembly cover and connect the inlet air temperature sensor (Fig. 11).

INSTALLATION- 2.0/2.4L

The electronic ignition coil pack attaches directly to the valve cover (Fig. 16).

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

IGNITION COIL (Continued)

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Fig. 25 UPPER INTAKE GASKET INPLACE

(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) Install the negative battery cable.

INSTALLATION - 2.4L TURBO

(1) Install the coil on throttle body side of the intake manifold (Fig. 22), rotate down past the throttle body to the valve cover (Fig. 21).

(2) Connect and lock the electrical connector to the ignition coil.

(3) Install bolts to ignition coil. Twist coil to install 2 of the bolts (Fig. 20) to the coil after installing it to vehicle.

(4) Install the spark plug cables to the ignition coil.

(5) Install the throttle cable bracket (Fig. 19).

(6) Install the throttle cables to the throttle body lever (Fig. 18).

(7) Install the throttle control shield (Fig. 17).

(8) Connect the negative battery cable.

NOTE: Check and make sure that throttle body and attachments will not contact ignition cables.

IGNITION COIL CAPACITOR**REMOVAL - 2.4L TURBO**

(1) Disconnect the negative battery cable.

(2) Remove the electrical connector from the ignition coil capacitor (Fig. 26).

(3) Remove mounting bolt and remove capacitor (Fig. 26).



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Fig. 26 COIL CAPACITOR - 2.4L TURBO**INSTALLATION - 2.4L TURBO**

(1) Install coil capacitor and mounting bolt and tighten to 11.8 N·m (105 in. lbs.).

(2) Connect the electrical connector.

(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 SENSOR (Continued)

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.

REMOVAL**REMOVAL - 1.6L**

- (1) Remove air cleaner assembly cover.
- (2) Disconnect the negative battery cable.
- (3) Disconnect the electrical connector for the sensor (Fig. 27) (Fig. 28).

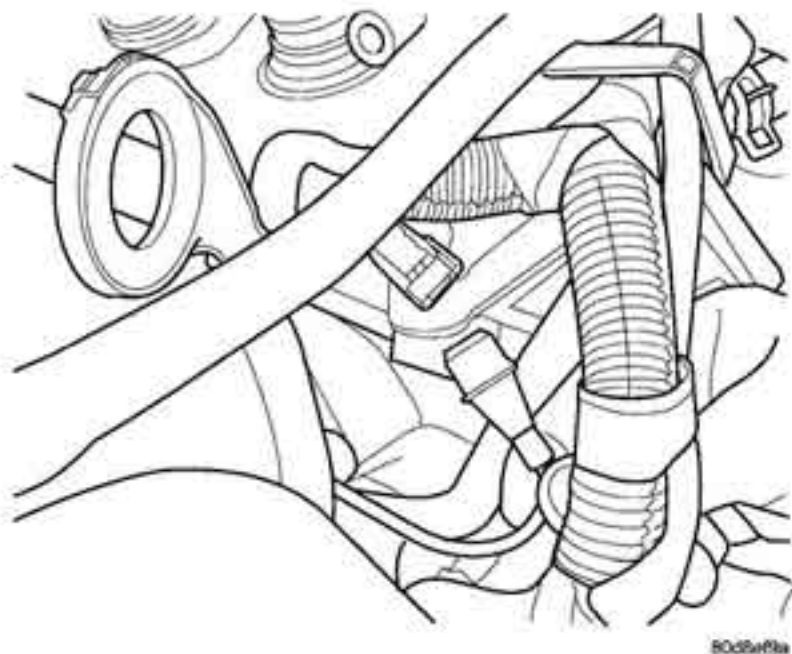


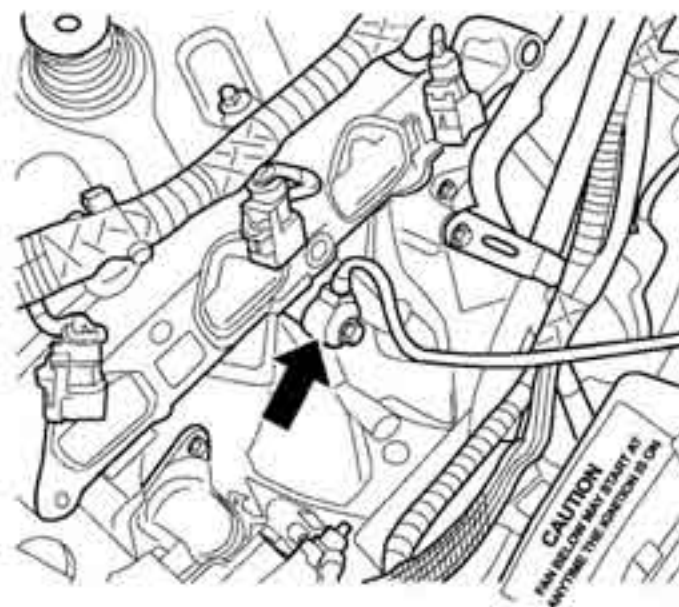
Fig. 27 WIRING CONNECTOR

- (4) Remove knock sensor. The knock sensor is located under the intake manifold (Fig. 28).

REMOVAL - 2.0/2.4L

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

- (1) Disconnect the negative battery cable.



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Fig. 28 KNOCK SENSOR

- (2) Disconnect electrical connector from knock sensor.
- (3) Remove the bolt holding the knock sensor
- (4) Remove the knock sensor

INSTALLATION**INSTALLATION - 1.6L**

(1) Install the knock sensor (Fig. 28) 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.**

- (2) Connect the electrical connector for the sensor (Fig. 27).
- (3) Connect the negative battery cable.
- (4) Install air cleaner assembly cover.

INSTALLATION - 2.0/2.4L

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

- (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.
- (3) Connect the negative battery cable.

SPARK PLUG

REMOVAL

REMOVAL - 1.6L

- (1) Remove air cleaner assembly cover (Fig. 11).
- (2) Disconnect the negative battery cable.
- (3) Disconnect the electrical connector at the throttle body.
- (4) Remove the purge hose from throttle body.
- (5) Remove the 4 bolts from the upper to lower manifold (Fig. 12).
- (6) Remove the 2 bolts to the upper manifold to struts (Fig. 13) and (Fig. 14).
- (7) Remove the PCV hose and the brake booster hose from the upper manifold
- (8) Remove the 4 bolts from the ignition coil.
- (9) Remove the spark plug cables from the ignition coil.

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.

- (10) Remove the spark plug using a quality socket with a rubber or foam insert and special tool # 8448 (Fig. 29) on the extension to keep from damaging the spark plug tubes in the cylinder head and valve cover.

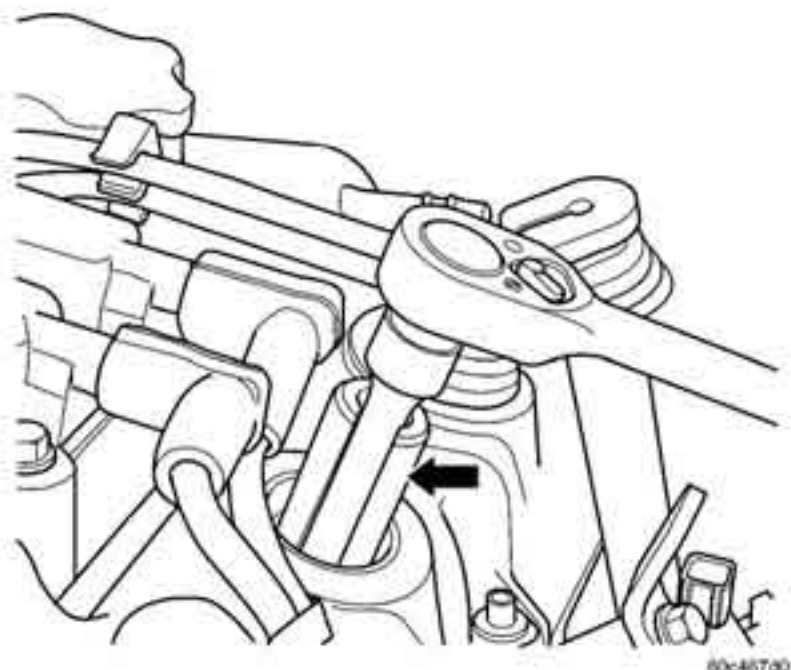


Fig. 29 SPECIAL TOOL # 8448

- (11) 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.

NOTE: REMOVE cables from coil first before removing spark plug insulator.

Special care should be used when installing spark plugs in the 2.4L cylinder head spark plug wells. Be sure the plugs do not drop into the wells, damage to the electrodes can occur.

Always tighten spark plugs to the specified torque. Over tightening can cause distortion resulting in a change in the spark plug gap. Overtightening can also damage the cylinder head.

- (1) Remove the air cleaner lid, disconnect the inlet air sensor and makeup air hose.
- (2) Disconnect the negative battery cable.
- (3) Remove the upper intake manifold, refer to the Engine section for more information.
- (4) Disconnect the cable from the ignition coil first. Always remove the spark plug cable by grasping the top of the spark plug insulator, rotate the boot 90° and pulling straight up in a steady motion.
- (5) Remove the spark plug using a quality socket with a rubber or foam insert.
- (6) Inspect the spark plug condition.

REMOVAL - 2.4L TURBO

Special care should be used when installing spark plugs in the 2.4L cylinder head spark plug wells. Be sure the plugs do not drop into the wells, damage to the electrodes can occur.

NOTE: REMOVE cables from the coil first before removing spark plug insulator.

- (1) Disconnect the negative battery cable.
- (2) Unlock and disconnect the MAP sensor electrical connector.
- (3) Remove the throttle control shield.
- (4) Disconnect the cable from the ignition coil first. Always remove the spark plug insulator, rotate the boot 90° and pulling straight up in a steady motion.
- (5) Remove the spark plug using a quality socket with a rubber or foam insert (Fig. 30).
- (6) Inspect the spark plug condition.

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.

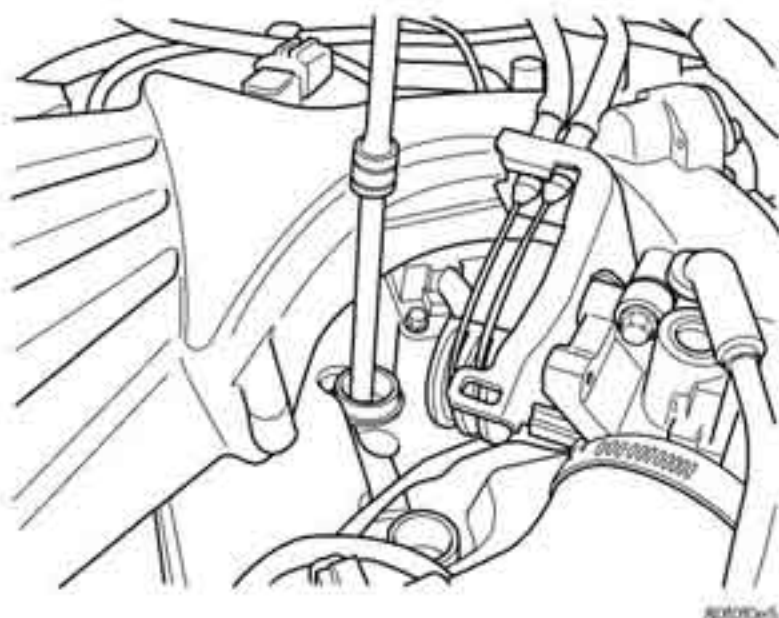
SPARK PLUG (Continued)

Fig. 30 SPARK PLUG REMOVAL/INSTALLATION - 2.4L TURBO

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

(2) Use special tool # 8448 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 cables to coil.

(5) Install the 4 bolts from the upper to lower manifold (Fig. 12).

(6) Install the 2 bolts to the upper manifold to struts (Fig. 13) and (Fig. 14).

(7) Install the PCV hose and the brake booster hose to the upper manifold

(8) Install the purge hose to throttle body.

(9) Connect the electrical connector to throttle body.

(10) Connect the negative battery cable.

(11) Install air cleaner assembly cover and inlet air temperature sensor (Fig. 11).

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.

NOTE: REMOVE cables from coil first before removing spark plug insulator.

Special care should be used when installing spark plugs in the 2.4L cylinder head spark plug wells. Be sure the plugs do not drop into the wells, damage to the electrodes can occur.

Always tighten spark plugs to the specified torque. Over tightening can cause distortion resulting in a change in the spark plug gap. Overtightening can also damage the cylinder head.

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

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!

(2) Tighten spark plugs to 17.6 +/- 2 N·m (13 +/- 2 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) Install spark plug cable to coil.

(5) Install the upper intake manifold, refer to the Engine section for more information

(6) Connect the negative battery cable.

(7) Install the air cleaner lid and connect the inlet air temperature sensor and makeup hose.

INSTALLATION - 2.4L TURBO

Special care should be used when installing spark plugs in the 2.4L cylinder head spark plug wells. Be sure the plugs do not drop into the wells, damage to the electrodes can occur.

NOTE: INSTALL cables to the spark plug first before installing them to the ignition coil.

(1) Install the spark plug using a quality socket with a rubber or foam insert. Tighten plus to N·m 17.6 ±2 (13 ±2 ft. lbs.). DO NOT OVER TIGHTEN, it is imperative that the torque is NOT EXCEEDED.

(2) Install the throttle control shield.

(3) Connect and lock the MAP sensor electrical connector.

(4) Connect the negative battery cable.

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

SPARK PLUG CABLE (Continued)

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**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. 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.

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.