

IGNITION SYSTEM

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DESCRIPTION AND OPERATION

IGNITION SYSTEM

DESCRIPTION

NOTE: The 2.0L engine 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 2.0L engine is referred to as the Direct Ignition System (DIS). **Basic ignition timing is not adjustable.** The system's three main components are the coil pack, crankshaft position sensor, and camshaft position sensor.

OPERATION

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 crankshaft position from these sensors. The PCM calculates injector sequence and ignition timing from crankshaft position. For a description of both sensors, refer to Camshaft Position Sensor and Crankshaft Position Sensor in this section.

SPARK PLUGS RESISTER

DESCRIPTION

All engines use resistor spark plugs. They have resistance values ranging from 6,000 to 20,000 ohms when checked with at least a 1000 volt spark plug tester.

Do not use an ohm meter to check the resistance of the spark plugs. This will give an inaccurate reading.

Refer to the Specifications section for gap and type of spark plug.

SPARK PLUG CABLES

DESCRIPTION

Spark Plug cables are sometimes referred to as secondary ignition wires. They transfer electrical current from the coil pack (2.0L), 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 distributor cap towers and at the 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 and distributor cap towers and spark plug cover should fit tight around spark plug insulators. Loose cable connections can cause ignition malfunctions by per-

DESCRIPTION AND OPERATION (Continued)

mitting water to enter the towers, corroding, and increasing resistance. **To maintain proper sealing at the terminal connections, the connections should not be broken unless testing indicates high resistance, an open circuit or other damage.**

Clean high tension cables with a cloth moistened with a non-flammable solvent and wipe dry. Check for brittle or cracked insulation. 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.

ELECTRONIC IGNITION COIL

DESCRIPTION

The coil pack consists of 2 coils molded together. The coil pack is mounted on the valve cover (Fig. 1). High tension leads route to each cylinder from the coil.

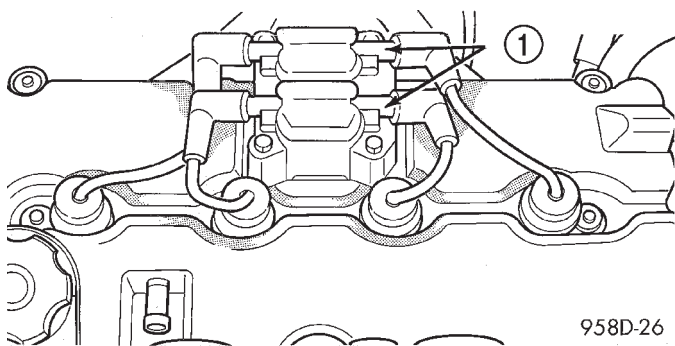


Fig. 1 Ignition Coil Pack—2.4L Engine

1 – IGNITION COILS

OPERATION

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

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 Shut-

down (ASD) Relay—PCM Output, in this section for relay operation.

AUTOMATIC SHUTDOWN RELAY

DESCRIPTION

The ASD relay is located in the PDC (Fig. 2). The inside top of the PDC cover has a label showing relay and fuse identification.

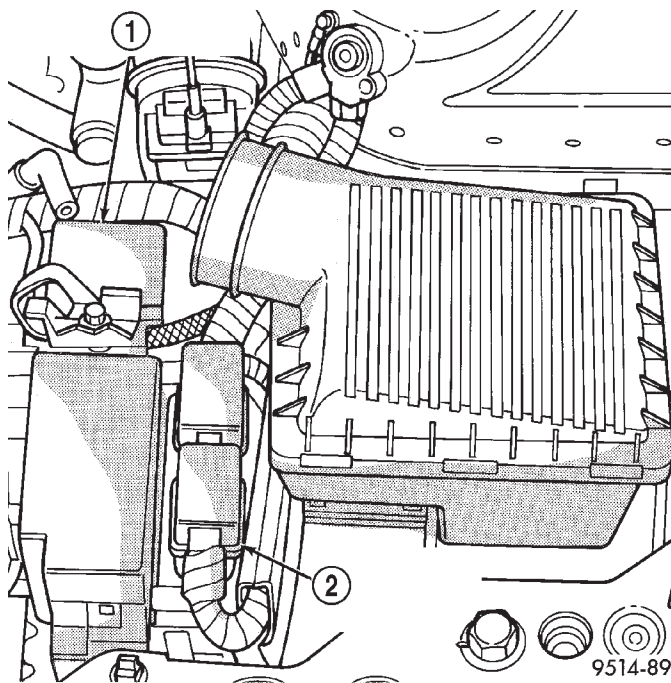


Fig. 2 Power Distribution Center (PDC)

1 – POWER DISTRIBUTION CENTER
2 – POWERTRAIN CONTROL MODULE

OPERATION

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

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 unless the O2 Heater Monitor test is being run. Refer to the On-Board Diagnostics in the Emission Control section. When the ignition switch is in On or Start, the PCM momentarily turns on the ASD relay. While the relay is on 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

DESCRIPTION AND OPERATION (Continued)

sensor signals when the ignition switch is in the Run position, it will de-energize the ASD relay.

ELECTRONIC IGNITION COIL**DESCRIPTION**

The coil pack consists of 2 coils molded together. The coil pack is mounted on the valve cover (Fig. 3). High tension leads route to each cylinder from the coil.

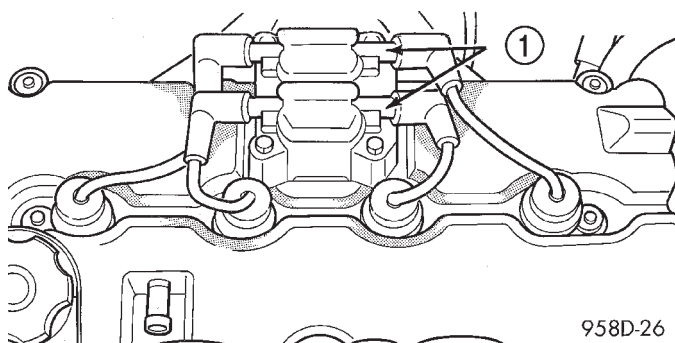


Fig. 3 Ignition Coil Pack—2.0L Engine

1 – IGNITION COILS

OPERATION

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

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.

CAMSHAFT POSITION SENSOR—2.0L**DESCRIPTION**

The camshaft position sensor attaches to the rear of the cylinder head (Fig. 5). A target magnet attaches to the rear of the camshaft and indexes to

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

OPERATION

The PCM determines fuel injection synchronization and cylinder identification from inputs provided by the camshaft position sensor (Fig. 4) and crankshaft position sensor. From the two inputs, the PCM determines crankshaft position.

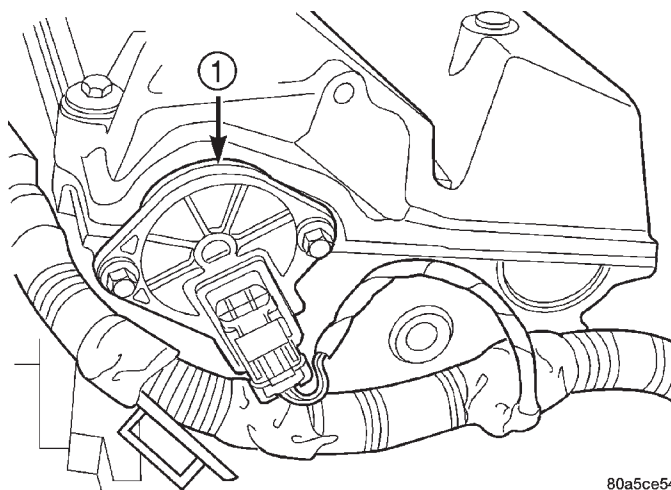


Fig. 4 Camshaft Position Sensor—2.0L DOHC

1 – CAMSHAFT POSITION SENSOR

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. 6). 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.

KNOCK SENSOR**DESCRIPTION**

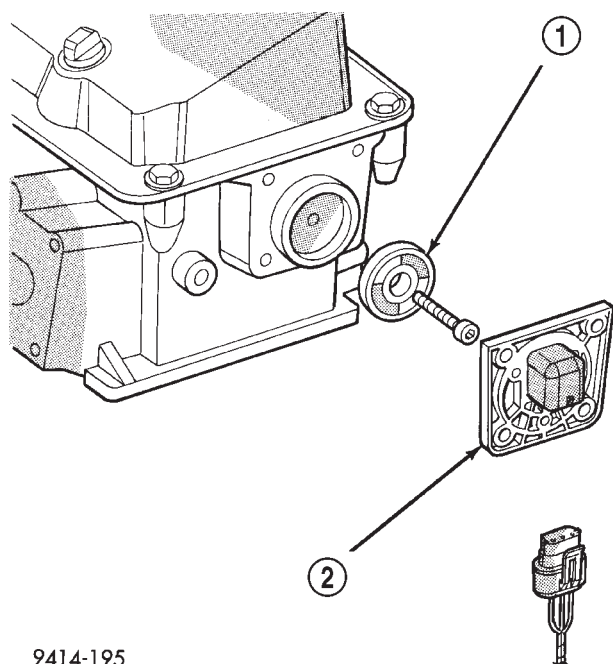
The knock sensor threads into the cylinder block.

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.

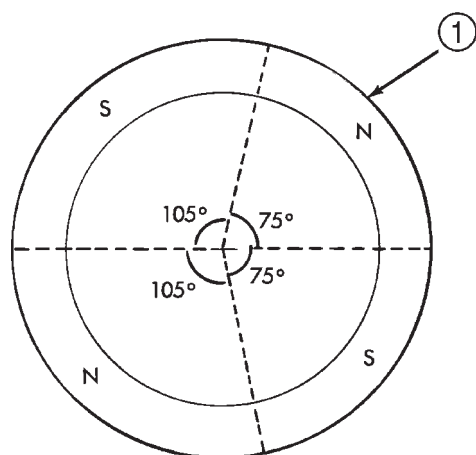
DESCRIPTION AND OPERATION (Continued)



9414-195

Fig. 5 Target Magnet—Typical

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



9414-2

Fig. 6 Target Magnet Polarity

- 1 - TARGET MAGNET

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

LOCK KEY CYLINDER**DESCRIPTION**

The lock cylinder is inserted in the end of the housing opposite the ignition switch.

OPERATION

The ignition key rotates the cylinder to 5 different detents (Fig. 7) :

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

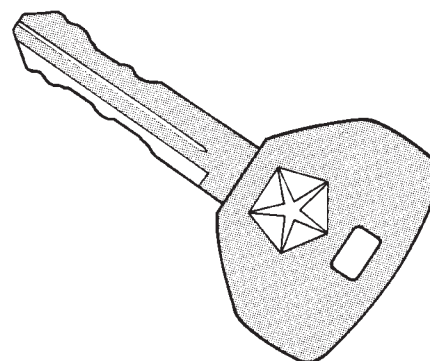
● UNLOCK

● ON/RUN

● START

● OFF

● ACCESSORY



938D-22

Fig. 7 Ignition Lock Cylinder Detents**IGNITION INTERLOCK****OPERATION**

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 the - Transaxle for Automatic Transmission Shifter/Ignition Interlock.

REMOVAL AND INSTALLATION**SPARK PLUG CABLES - 2.0L**

Clean high tension cables with a cloth moistened with a non- flammable solvent. Wipe the cables dry. Check for brittle or cracked insulation.

Resistance cables are identified by the words **Electronic Suppression**.

REMOVAL

Disconnect the cable from the ignition coil first.

The cables insulate the spark plugs and cover the top of the spark plug tubes (Fig. 3). To remove the cables, lightly grasp the top of the cable. Rotate the insulator 90° and pull straight up. **Ensure the #1 and #4 cables run under the #2 and #3 ignition**

REMOVAL AND INSTALLATION (Continued)

coil towers. Keep #4 cable away from the oil fill cap.

INSTALLATION

Ensure the #1 and #4 cables run under the #2 and #3 ignition coil towers. Keep #4 cable away from the oil fill cap.

Rotate the insulator 90° and push straight down. Connect the cable to the ignition coil.

SPARK PLUGS – 2.0L

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.

REMOVAL

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.

(4) Install spark plug cable to coil.

IGNITION COIL – 2.0L

The electronic ignition coil pack attaches directly to the valve cover (Fig. 8).

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.

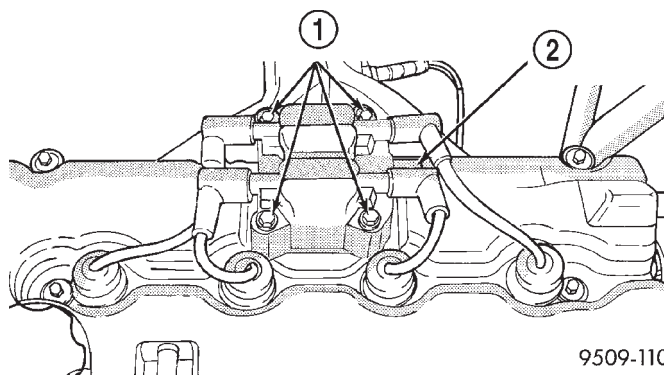


Fig. 8 Electronic Ignition Coil Pack—2.0L

- 1 – IGNITION COIL FASTENERS
2 – ELECTRICAL CONNECTOR

AUTOMATIC SHUTDOWN RELAY

The relay is located in the Power Distribution Center (PDC) (Fig. 9). The PDC is located 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.

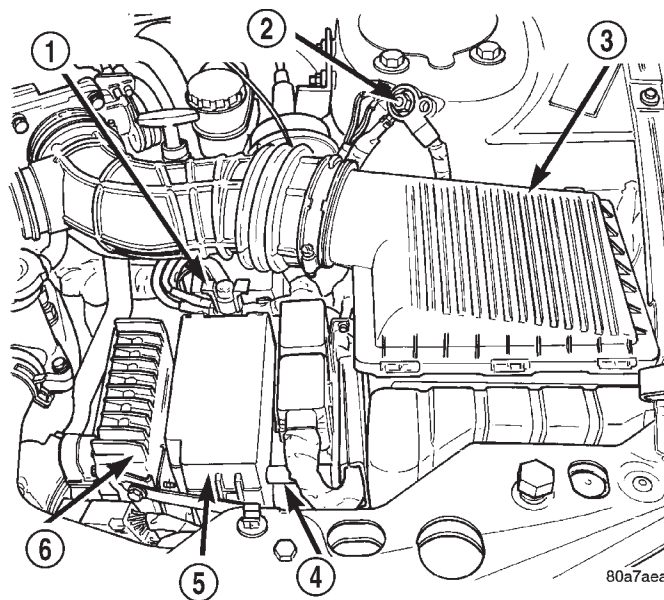


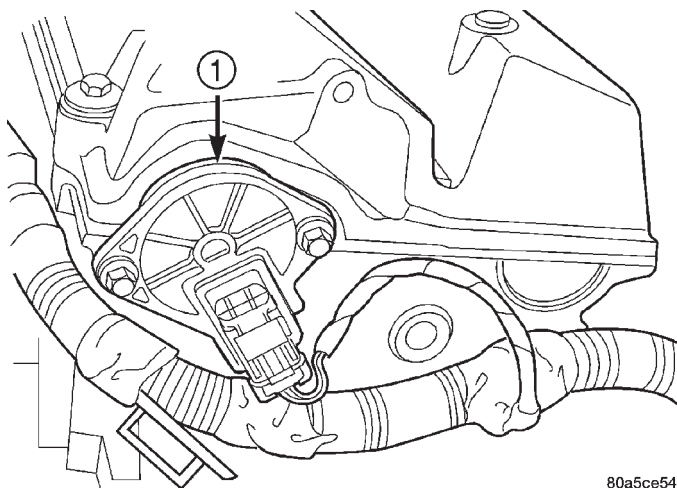
Fig. 9 Power Distribution Center (PDC)

- 1 – BATTERY POSITIVE
2 – BATTERY GROUND
3 – AIR CLEANER
4 – PCM
5 – PDC
6 – TCM

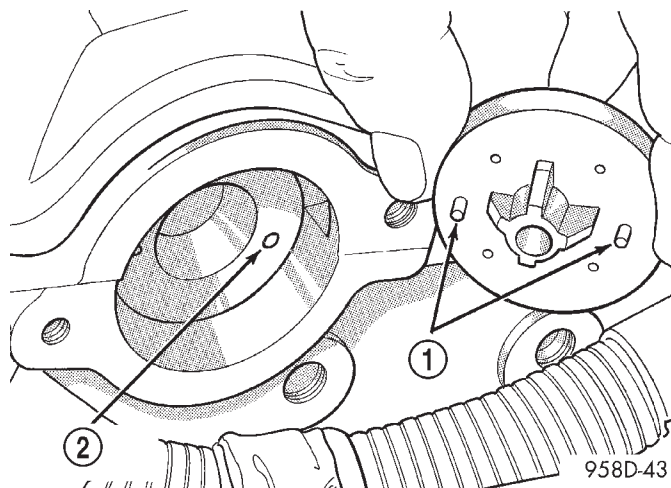
CAMSHAFT POSITION SENSOR—DOHC

The camshaft position sensor is mounted to the rear of the cylinder head (Fig. 10).

REMOVAL AND INSTALLATION (Continued)

**Fig. 10 Camshaft Position Sensor Location—DOHC**

1 – CAMSHAFT POSITION SENSOR

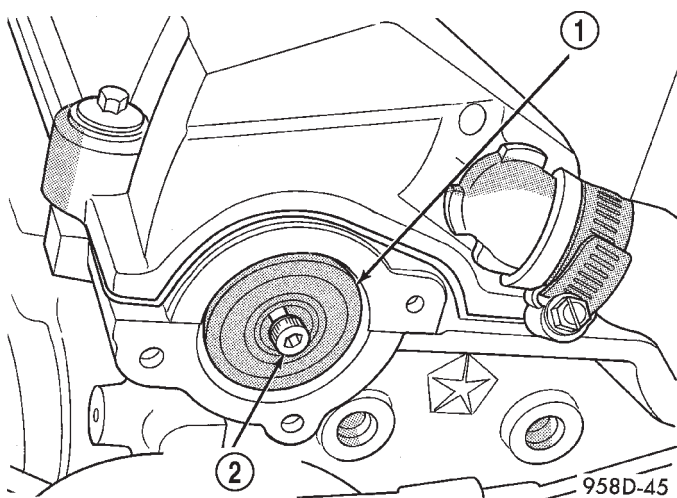
**Fig. 12 Target Magnet Installation**

1 – LOCATING DOWELS

2 – LOCATING HOLES (2)

REMOVAL

- (1) Remove filtered air tube from the throttle body and air cleaner housing.
- (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. 11).

**Fig. 11 Target Magnet Removal/Installation**

1 – TARGET MAGNET

2 – MOUNTING BOLT

INSTALLATION

The target magnet has locating dowels that fit into machined locating holes in the end of the camshaft (Fig. 12).

- (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 $\pm$ 1 (25 in. lbs. $\pm$ 5) torque.

CRANKSHAFT POSITION SENSOR – 2.0 L

The crankshaft position sensor mounts to the engine block behind the generator, just above the oil filter (Fig. 13).

REMOVAL

- (1) Disconnect electrical connector from crankshaft position sensor.
- (2) Remove sensor mounting screw. Remove sensor.

INSTALLATION

- (1) Reverse procedure for installation.

IGNITION SWITCH

The ignition switch attaches to the lock cylinder housing on the end opposite the lock cylinder (Fig. 14). For ignition switch terminal and circuit identification, refer to Group 8W, Wiring Diagrams.

REMOVAL

- (1) Disconnect negative cable from auxiliary jumper terminal on driver's side strut tower.
- (2) Remove fuse panel cover from left end of instrument panel. Remove screw holding end of instrument panel top cover (Fig. 15).
- (3) Pull center bezel off (Fig. 16).
- (4) Remove screws holding instrument panel top cover to center of instrument panel (Fig. 17).

REMOVAL AND INSTALLATION (Continued)

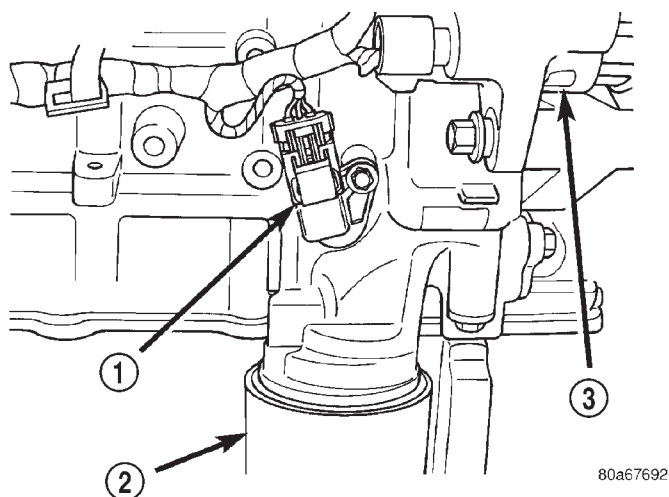


Fig. 13 Crankshaft Position Sensor—2.0L

- 1 - CRANKSHAFT POSITION SENSOR
- 2 - OIL FILTER
- 3 - GENERATOR

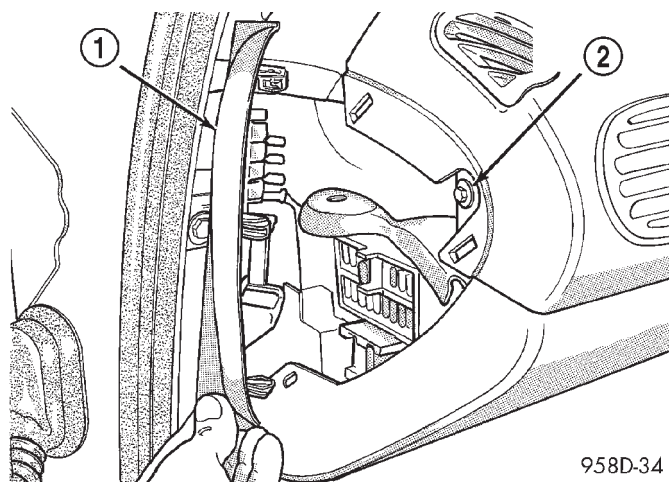


Fig. 15 Instrument Panel Top Cover—Left End

- 1 - FUSE PANEL COVER
- 2 - TOP COVER SCREW

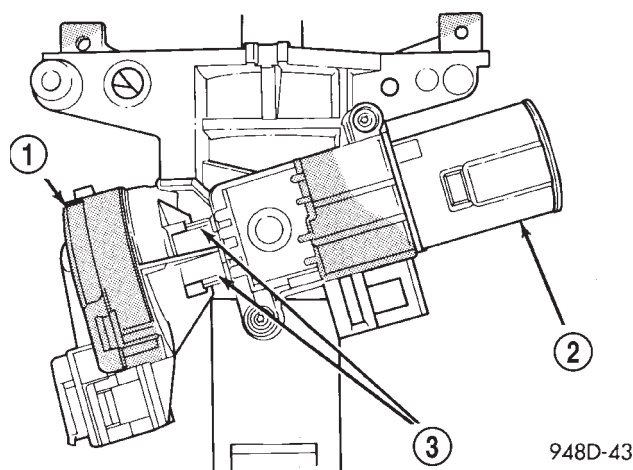


Fig. 14 Ignition Switch—Viewed From Below Column

- 1 - IGNITION SWITCH
- 2 - LOCK CYLINDER HOUSING
- 3 - RETAINING TABS

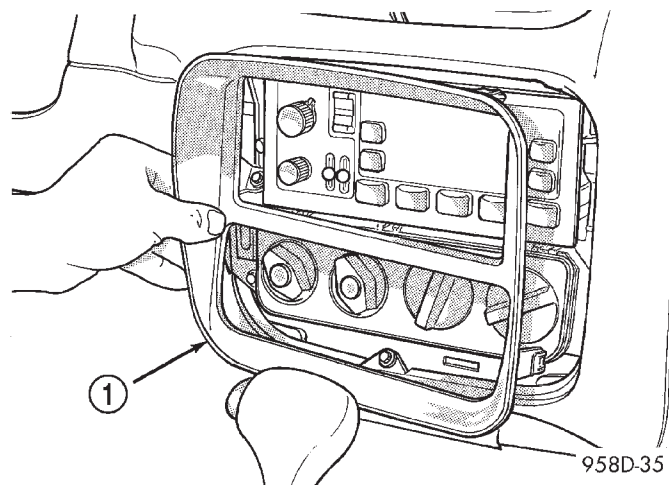


Fig. 16 Center Bezel

- 1 - CENTER BEZEL

(5) Pull instrument panel top cover up enough to gain access to knee bolster screws (Fig. 18).

(6) Remove lower knee bolster screws and knee bolster.

(7) Remove screws from lower steering column shroud (Fig. 19).

(8) Pull lower shroud to clear ignition cylinder and key release, if equipped (Fig. 20).

(9) Hold tilt wheel lever down and slide lower shroud forward to remove it from column (Fig. 21).

(10) Tilt wheel to full down position and remove upper steering column shroud.

(11) Remove screws holding multi-function switch to lock housing (Fig. 22).

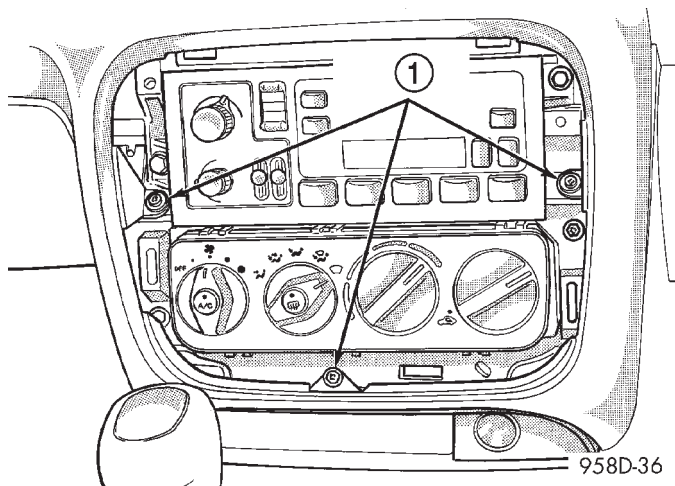
(12) Place key cylinder in RUN position. Depress lock cylinder retaining tab and remove key cylinder (Fig. 23).

(13) Disconnect electrical connectors from ignition switch (Fig. 24) and (Fig. 25).

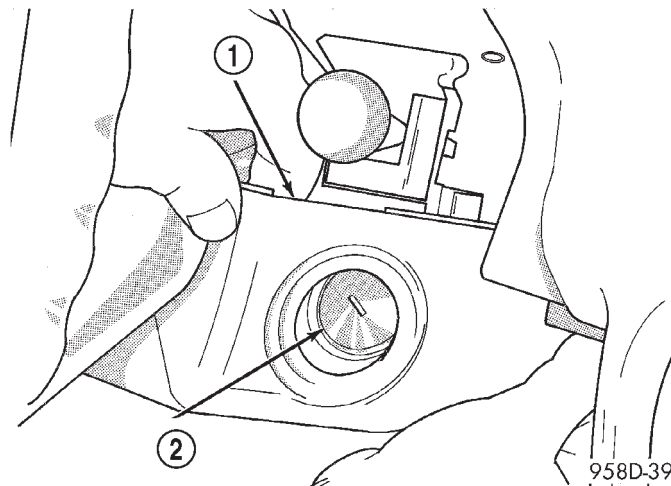
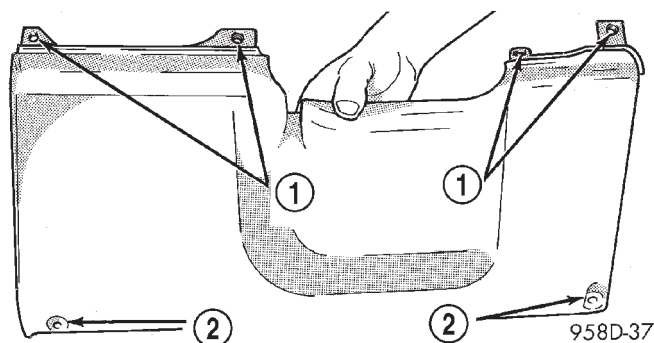
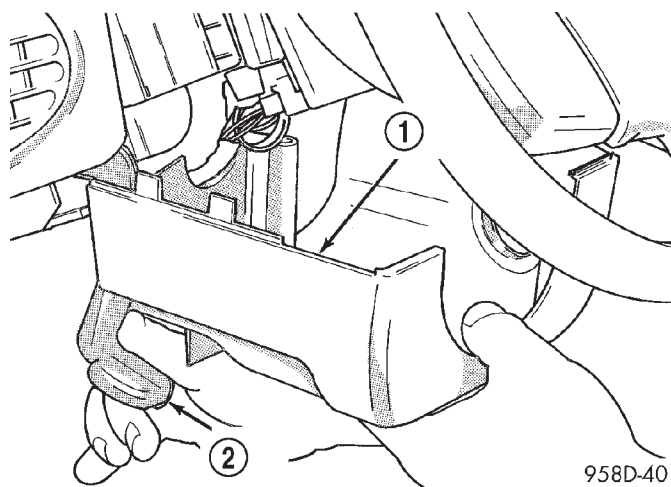
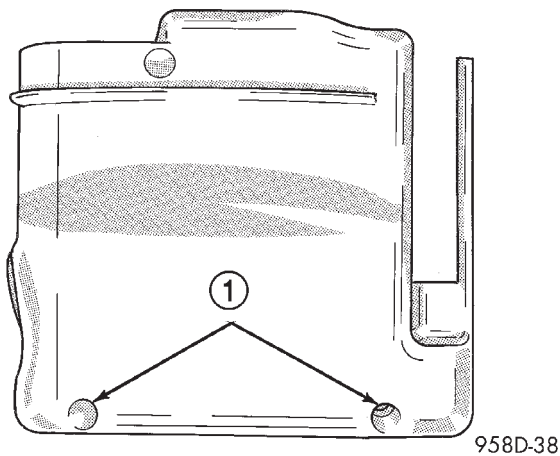
(14) Remove ignition switch mounting screw (Fig. 24) with a #10 Torx® tamper proof bit.

(15) Depress retaining tabs (Fig. 14) and pull ignition switch from steering column.

REMOVAL AND INSTALLATION (Continued)

**Fig. 17 Instrument Panel Top Cover—Center**

1 - TOP COVER SCREWS

**Fig. 20 Remove Lower Shroud From Ignition Cylinder**1 - LOWER SHROUD
2 - KEY CYLINDER**Fig. 18 Knee Bolster Attaching Points**1 - KNEE BOLSTER SCREW LOCATIONS UNDER TOP COVER
2 - LOWER SCREW LOCATIONS**Fig. 21 Lower Shroud Removal**1 - LOWER SHROUD
2 - TILT LEVER**Fig. 19 Lower Steering Column Shroud Screw Locations**

1 - LOWER STEERING COLUMN SHROUD SCREW LOCATIONS

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. 26). Install mounting screw (Fig. 24).

(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)

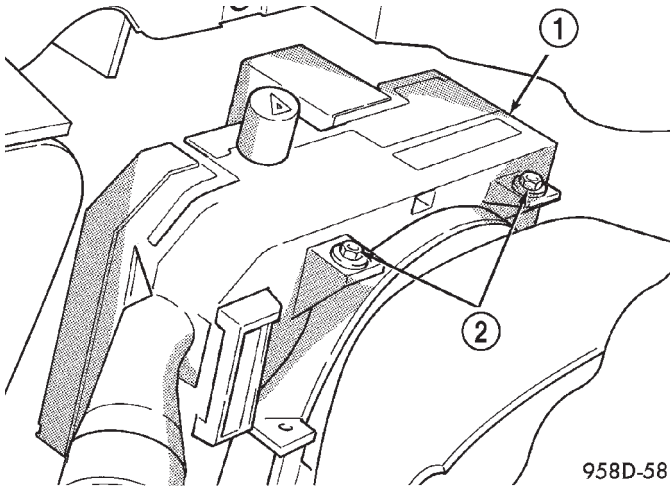


Fig. 22 Multi-Function Switch Removal/Installation

- 1 - MULTI-FUNCTION SWITCH
- 2 - ATTACHING SCREWS

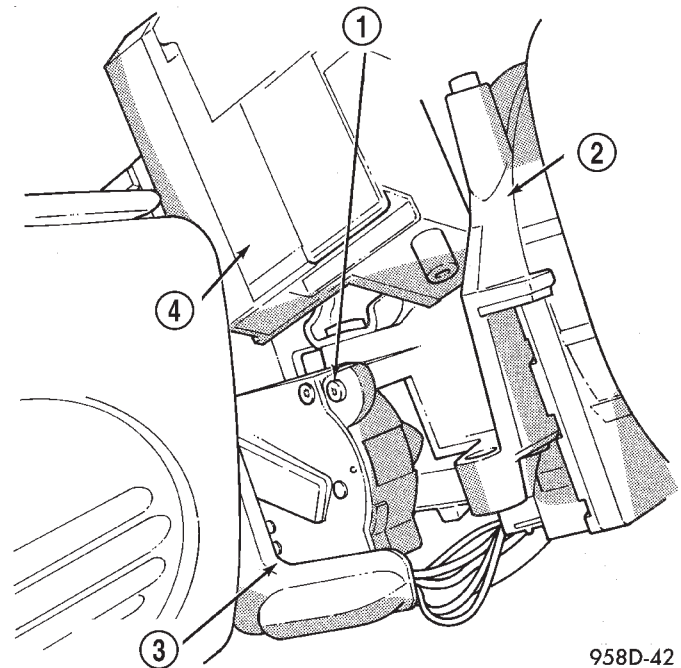


Fig. 24 Ignition Switch

- 1 - ATTACHING/GROUNDING SCREW
- 2 - LOCK HOUSING
- 3 - IGNITION SWITCH
- 4 - MULTI-FUNCTION SWITCH

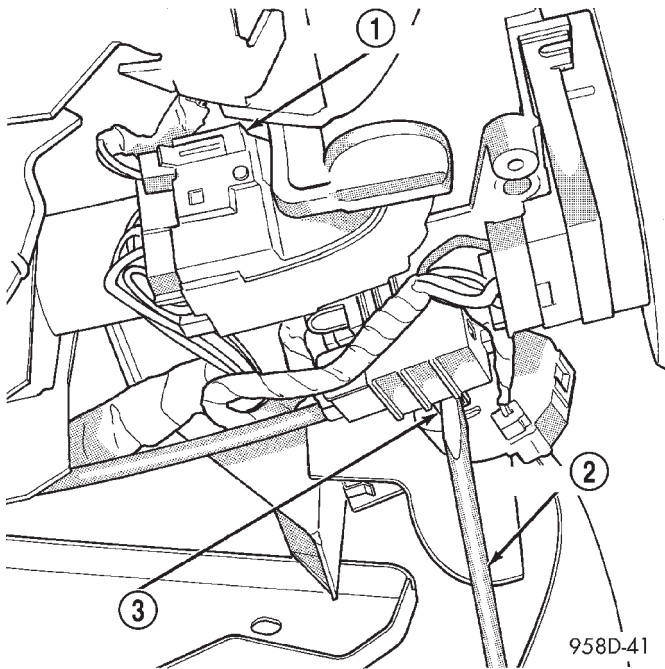


Fig. 23 Lock Cylinder Removal

- 1 - IGNITION SWITCH
- 2 - SCREWDRIVER
- 3 - LOCK CYLINDER RETAINING TAB

LOCK KEY CYLINDER

REMOVAL

- (1) Disconnect negative cable from auxillary jumper terminal.
- (2) Remove upper steering column shroud.
- (3) Pull lower shroud down far enough to access lock cylinder retaining tab.

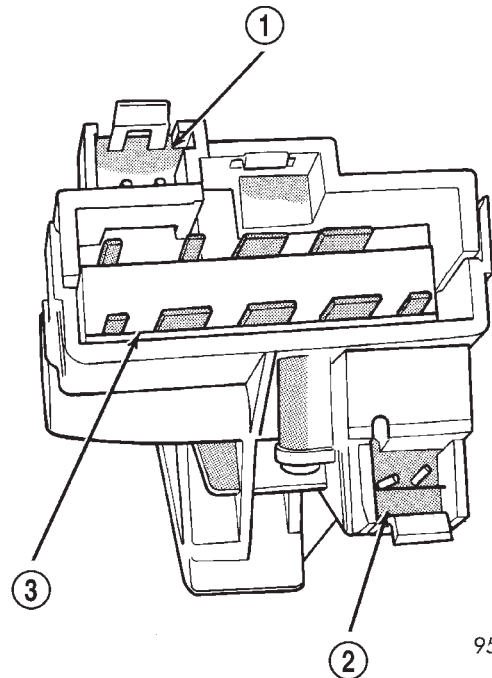
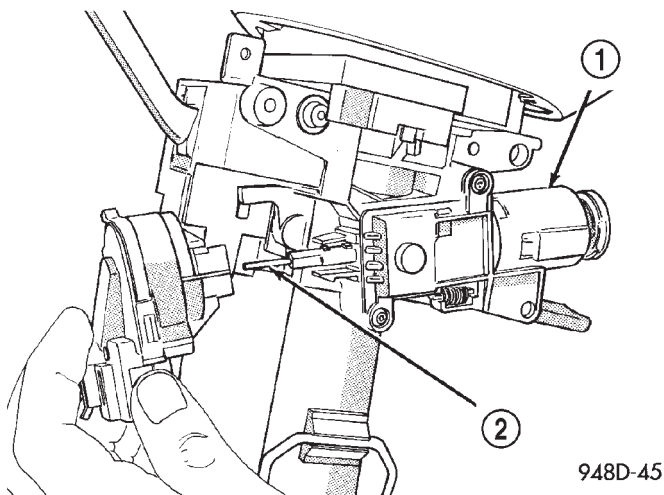


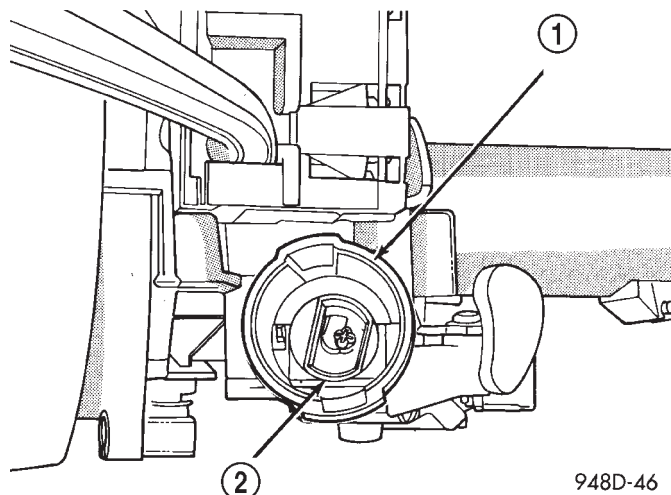
Fig. 25 Ignition Switch Connectors

- 1 - KEY IN SWITCH
- 2 - PRNDL SWITCH
- 3 - IGNITION SWITCH

REMOVAL AND INSTALLATION (Continued)

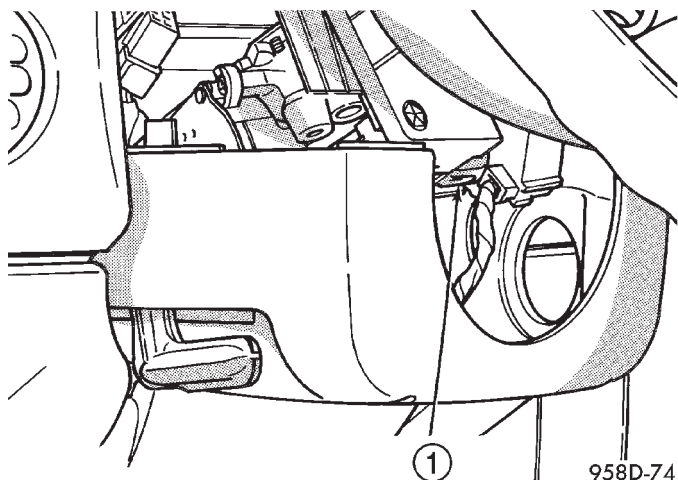
**Fig. 26 Ignition Switch Installation**

- 1 - LOCK CYLINDER HOUSING
2 - SHAFT

**Fig. 28 Socket in Lock Cylinder Housing**

- 1 - LOCK CYLINDER HOUSING
2 - SOCKET

(4) Place key cylinder in RUN position. Depress retaining tab and remove key cylinder (Fig. 27).

**Fig. 27 Lock Cylinder Retaining Tab**

- 1 - LOCK CYLINDER RETAINING TAB

INSTALLATION

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

(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. 28).

(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) Install steering column shrouds.

(6) Connect negative cable to auxiliary battery terminal on shock tower.

IGNITION INTERLOCK

Refer to the Transaxle section for Shifter/Ignition Interlock Service.

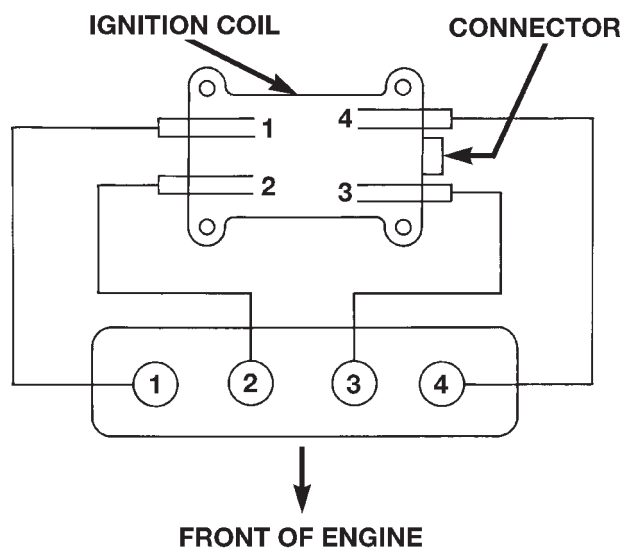
LOCK CYLINDER HOUSING

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

SPECIFICATIONS**VEHICLE EMISSION CONTROL INFORMATION LABEL****DESCRIPTION**

All models have a Vehicle Emission Control Information (VECI) Label. Chrysler permanently attaches the label in the engine compartment. It cannot be removed without defacing information and destroying the label.

The label contains the vehicle's emission specifications and vacuum hose routings. All hoses must be connected and routed according to the label.

SPECIFICATIONS (Continued)**FIRING ORDER****FIRING ORDER 1-3-4-2*****FIRING ORDER—2.0L***

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TORQUE SPECIFICATION

DESCRIPTION	TORQUE
Air Inlet tube Clamp	3 N·m (25 in. lbs.)
Camshaft Position Sensor Screw . .	12 N·m (105 in. lbs.)
Coolant Sensor—2.0L	27 N·m (20 ft. lbs.)
Crankshaft Position Sensor Screw .	12 N·m (105 in. lbs.)
Coolant Temp. Sensor	18.6 N·m (165 in. lbs.)
EGR Tube to Intake	11 N·m (95 in. lbs.)
Ignition Coil to Cyl. Head—2.0L . .	12 N·m (105 in. lbs.)
IAT Sensor—2.0L	11.5 N·m (100 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—2.0L

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

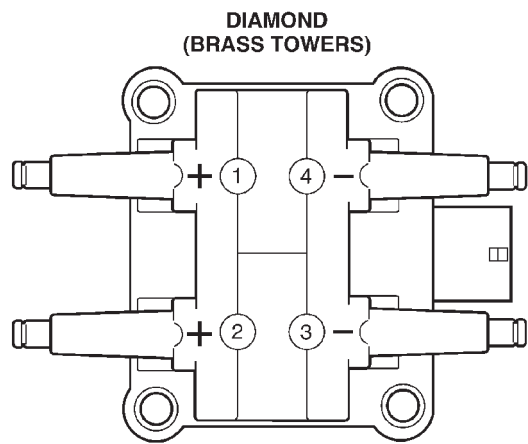
SPARK PLUGS

Engine	Spark Plug	Gap	Thread Size
2.0L	RC12YC5	0.048 TO 0.053	14mm (3/4 in.) reach

IGNITION COILS

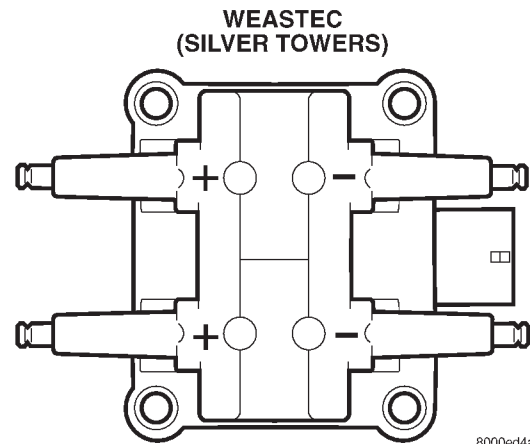
Engines	Coil Manufacture	Primary Resistance at 21°C-27°C (70°F-80°F)	Secondary Resistance at 21°C-27°C (70°F-80°F)
2.0L	Toyodenso/ Diamond	0.51 TO 0.61 Ohms	11,500 to 13,500 Ohms

SPECIFICATIONS (Continued)



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Coil Polarity



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Coil Polarity