# IGNITION CONTROL

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## IGNITION CONTROL

### DESCRIPTION

Two different ignition systems are used. One type of system is for the 4.0L 6–cylinder engine. The other is for the 4.7L V-8 engine.

### OPERATION

The 4.0L 6–cylinder engine uses a one-piece coil rail containing three independent coils. Although cylinder firing order is the same as 4.0L engines of previous years, spark plug firing is not. The 3 coils dual-fire the spark plugs on cylinders 1–6, 2–5 and/or 3–4. When one cylinder is being fired (on compression stroke), the spark to the opposite cylinder is being wasted (on exhaust stroke). The one-piece coil bolts directly to the cylinder head. Rubber boots seal the secondary terminal ends of the coils to the top of all 6 spark plugs. One electrical connector (located at the rear end of the coil rail) is used for all three coils.

The 4.7L V-8 engine uses 8 dedicated and individually fired coil for each spark plug. Each coil is mounted directly to the top of each spark plug. A separate electrical connector is used for each coil.

Because of coil design, spark plug cables (secondary cables) are not used on either engine. A **distributor is not used** with either the 4.0L or 4.7L engines.

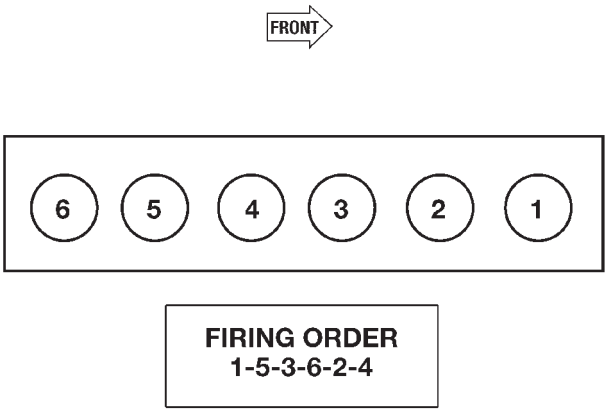
The ignition system is controlled by the powertrain control module (PCM) on all engines.

The ignition system consists of:

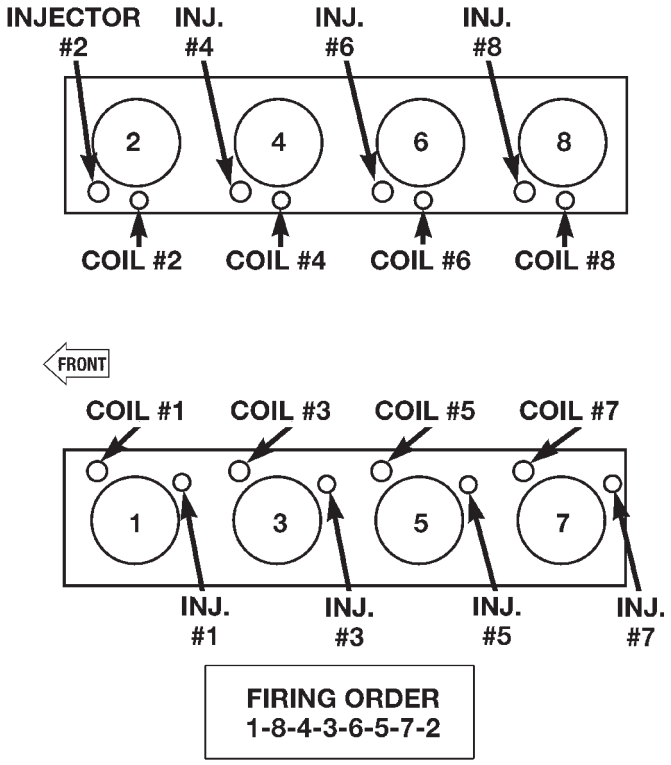
- Spark Plugs
- Ignition Coil(s)
- Powertrain Control Module (PCM)
- Crankshaft Position Sensor
- Camshaft Position Sensor
- The MAP, TPS, IAC and ECT also have an effect on the control of the ignition system.

## SPECIFICATIONS

### ENGINE FIRING ORDER—4.0L 6-CYLINDER ENGINE




### ENGINE FIRING ORDER—4.7L V-8 ENGINE




### IGNITION COIL RESISTANCE—4.0L ENGINE

| PRIMARY RESISTANCE 21-27°C (70-80°F) |
|---|
| 0.71 - 0.88 Ohms |

### IGNITION COIL RESISTANCE—4.7L V-8 ENGINE

| PRIMARY RESISTANCE 21-27°C (70-80°F) | SECONDARY RESISTANCE 21-27°C (70-80°F) |
|---|---|
| 0.6 - 0.9 Ohms | 6,000 - 9,000 Ohms |

### IGNITION TIMING

All ignition timing functions are controlled by the Powertrain Control Module (PCM). Mechanical adjustments are not needed and can't be made.

On the 4.0L 6–cylinder engine, do not attempt to rotate the oil pump drive to adjust timing. This adjustment is used for fuel synchronization after camshaft position sensor replacement.

SPECIFICATIONS (Continued)

## SPARK PLUGS

| ENGINE | PLUG TYPE | ELECTRODE GAP |
|---|---|---|
| 4.0L 6-CYL. | RC12ECC | 0.89 mm (.035 in.) |
| 4.7L V-8 | RC12MCC4 | 1.01 mm (.040 in.) |

## TORQUE - IGNITION SYSTEM

| DESCRIPTION | N-m | Ft. Lbs. | In. Lbs. |
|---|---|---|---|
| Crankshaft Position Sensor Bolts—4.0L Engine | 7 | | 60 |
| Crankshaft Position Sensor Bolt—4.7L V-8 Engine | 28 | 21 | |
| Camshaft Position Sensor–to–base bolts—4.0L Engine | 2 | | 15 |
| Camshaft Position Sensor Bolt—4.7L V-8 Engine | 12 | | 106 |
| Oil Pump Drive Hold-down Bolt—4.0L Engine | 23 | 17 | |
| Ignition Coil Rail Mounting Bolts—4.0L Engine | 29 | | 250 |
| Ignition Coil Mounting Nut—4.7L V-8 Engine | 8 | | 70 |
| Spark Plugs—4.0L Engine | 35-41 | 26-30 | |
| Spark Plugs—4.7L V-8 Engine | 27 | 20 | |

# AUTO SHUT DOWN RELAY

## DESCRIPTION

The 5–pin, 12–volt, Automatic Shutdown (ASD) relay is located in the Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

## OPERATION - PCM OUTPUT

The ASD relay supplies battery voltage (12+ volts) to the fuel injectors and ignition coil(s). With certain emissions packages it also supplies 12–volts to the oxygen sensor heating elements.

The ground circuit for the coil within the ASD relay is controlled by the Powertrain Control Module (PCM). The PCM operates the ASD relay by switching its ground circuit on and off.

The ASD relay will be shut–down, meaning the 12–volt power supply to the ASD relay will be de-activated by the PCM if:

- the ignition key is left in the ON position. This is if the engine has not been running for approximately 1.8 seconds.
- there is a crankshaft position sensor signal to the PCM that is lower than pre-determined values.

## OPERATION - ASD SENSE - PCM INPUT

A 12 volt signal at this input indicates to the PCM that the ASD has been activated. The relay is used to connect the oxygen sensor heater element, ignition coil and fuel injectors to 12 volt + power supply.

This input is used only to sense that the ASD relay is energized. If the Powertrain Control Module (PCM) does not see 12 volts at this input when the ASD should be activated, it will set a Diagnostic Trouble Code (DTC).

## REMOVAL

The ASD relay is located in the Power Distribution Center (PDC) (Fig. 1). Refer to label on PDC cover for relay location.

(1) Remove PDC cover.
(2) Remove relay from PDC.

AUTO SHUT DOWN RELAY (Continued)

(3) Check condition of relay terminals and PDC connector terminals for damage or corrosion. Repair if necessary before installing relay.

(4) Check for pin height (pin height should be the same for all terminals within the PDC connector). Repair if necessary before installing relay.

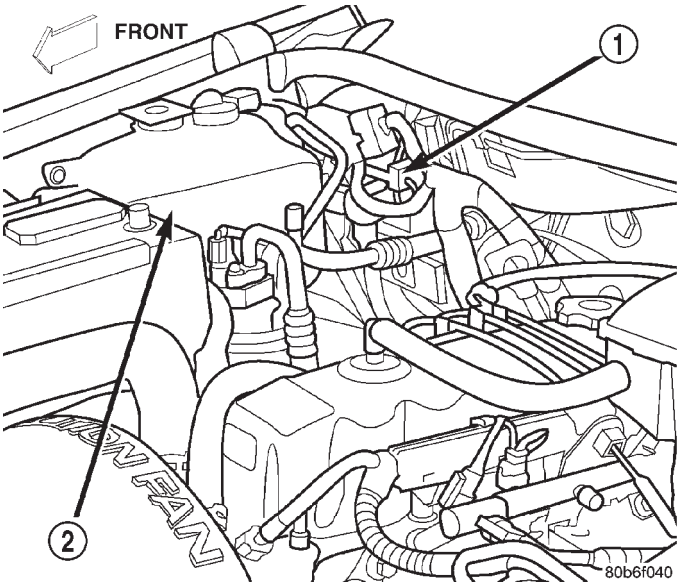



*Fig. 1 Power Distribution Center (PDC) Location*

1 - PCM
2 - COOLANT TANK

## INSTALLATION

The ASD relay is located in the Power Distribution Center (PDC) (Fig. 1). Refer to label on PDC cover for relay location.

(1) Install relay to PDC.

(2) Install cover to PDC.

# CAMSHAFT POSITION SENSOR

## DESCRIPTION - 4.0L

The Camshaft Position Sensor (CMP) on the 4.0L 6–cylinder engine is bolted to the top of the oil pump drive shaft assembly (Fig. 2). The sensor and drive shaft assembly is located on the right side of the engine near the oil filter (Fig. 3).

## DESCRIPTION - 4.7L

The Camshaft Position Sensor (CMP) on the 4.7L V–8 engine is bolted to the front/top of the right cylinder head (Fig. 4).

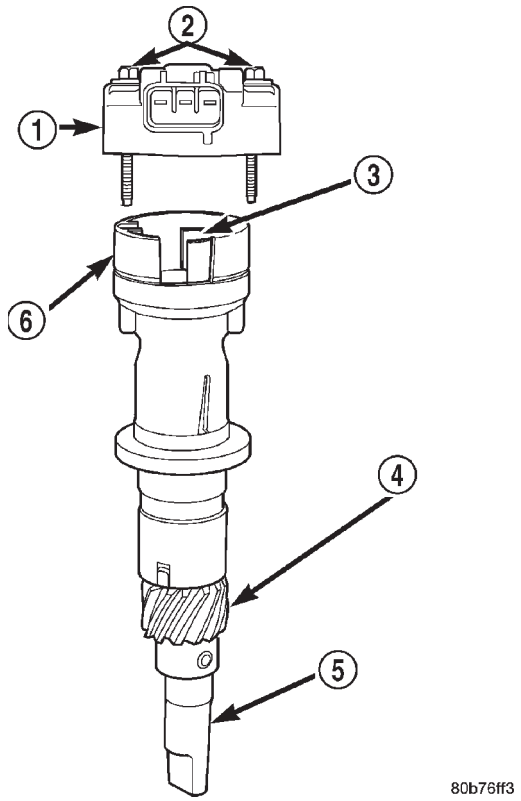



*Fig. 2 CMP and Oil Pump Drive Shaft—4.0L Engine*

1 - CAMSHAFT POSITION SENSOR
2 - MOUNTING BOLTS (2)
3 - PULSE RING
4 - DRIVE GEAR (TO CAMSHAFT)
5 - OIL PUMP DRIVESHAFT
6 - SENSOR BASE (OIL PUMP DRIVESHAFT ASSEMBLY)

## OPERATION - 4.0L

The CMP sensor contains a hall effect device called a sync signal generator to generate a fuel sync signal. This sync signal generator detects a rotating pulse ring (shutter) on the oil pump drive shaft (Fig. 2). The pulse ring rotates 180 degrees through the sync signal generator. Its signal is used in conjunction with the crankshaft position sensor to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

When the leading edge of the pulse ring (shutter) enters the sync signal generator, the following occurs: The interruption of magnetic field causes the voltage to switch high resulting in a sync signal of approximately 5 volts.

When the trailing edge of the pulse ring (shutter) leaves the sync signal generator, the following occurs: The change of the magnetic field causes the sync signal voltage to switch low to 0 volts.

CAMSHAFT POSITION SENSOR (Continued)

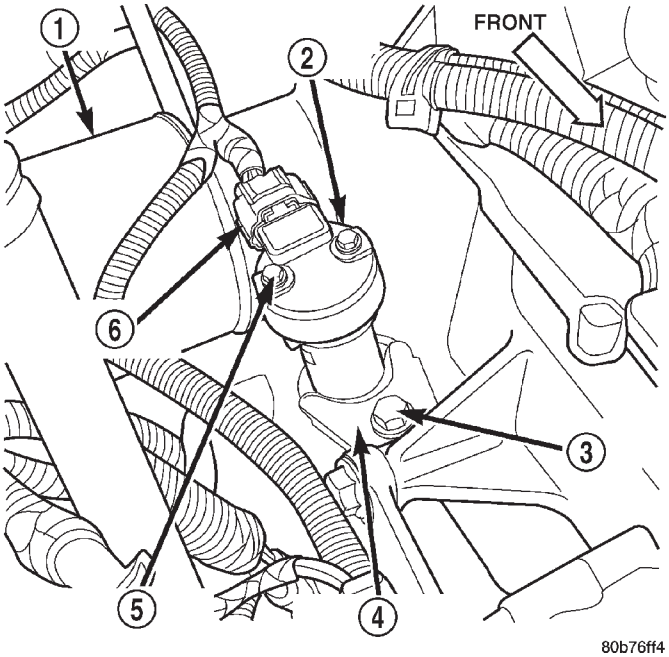



*Fig. 3 CMP Location—4.0L Engine*

1 - OIL FILTER
2 - CAMSHAFT POSITION SENSOR
3 - CLAMP BOLT
4 - HOLD-DOWN CLAMP
5 - MOUNTING BOLTS (2)
6 - ELEC. CONNECTOR

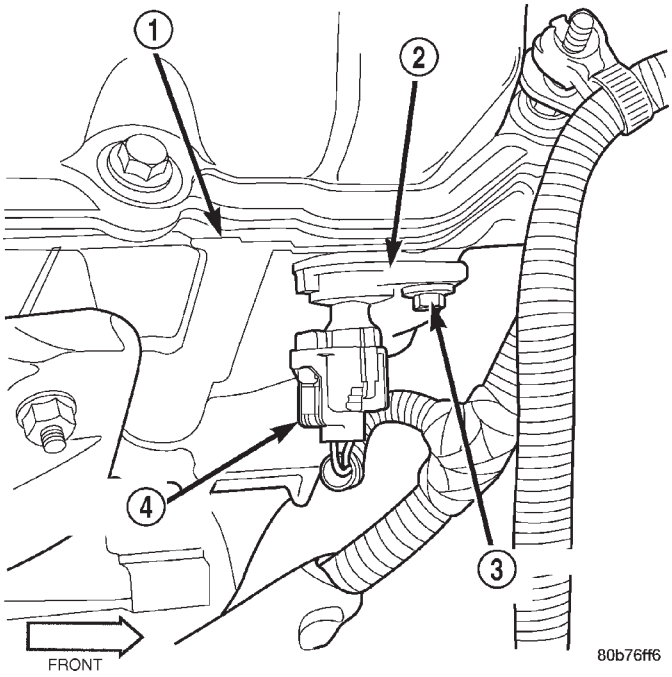



*Fig. 4 CMP Location—4.7L Engine*

1 - RIGHT CYLINDER HEAD
2 - CAMSHAFT POSITION SENSOR
3 - MOUNTING BOLT
4 - ELEC. CONNECTOR

## OPERATION - 4.7L

The CMP sensor contains a hall effect device called a sync signal generator to generate a fuel sync signal. This sync signal generator detects notches located on a tonewheel. The tonewheel is located at the front of the camshaft for the right cylinder head (Fig. 5). As the tonewheel rotates, the notches pass through the sync signal generator. The pattern of the notches (viewed counter-clockwise from front of engine) is: 1 notch, 2 notches, 3 notches, 3 notches, 2 notches 1 notch, 3 notches and 1 notch. The signal from the CMP sensor is used in conjunction with the crankshaft position sensor to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

## REMOVAL - 4.0L

The Camshaft Position Sensor (CMP) on the 4.0L 6–cylinder engine is bolted to the top of the oil pump drive shaft assembly (Fig. 6). The sensor and drive shaft assembly is located on the right side of the engine near the oil filter (Fig. 7).

The rotational position of oil pump drive determines fuel synchronization only. It does not determine ignition timing.

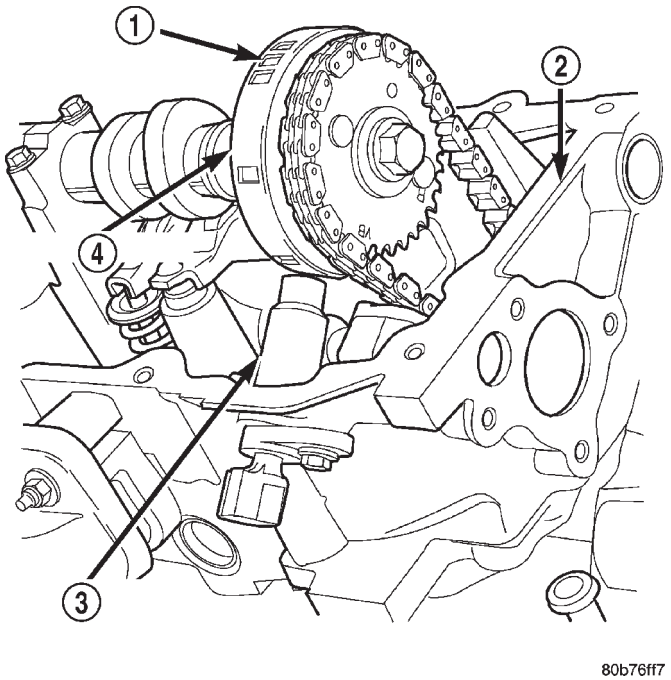



*Fig. 5 CMP Sensor and Tonewheel—4.7L Engine*

1 - NOTCHES
2 - RIGHT CYLINDER HEAD
3 - CAMSHAFT POSITION SENSOR
4 - TONEWHEEL

CAMSHAFT POSITION SENSOR (Continued)

**NOTE: Do not attempt to rotate the oil pump drive to modify ignition timing.**

**Two different procedures** are used for removal and installation. The first procedure will detail removal and installation of the sensor only. The second procedure will detail removal and installation of the sensor and oil pump drive shaft assembly. The second procedure is to be used if the engine has been disassembled.

An internal oil seal is used in the drive shaft housing that prevents engine oil at the bottom of the sensor. The seal is not serviceable.

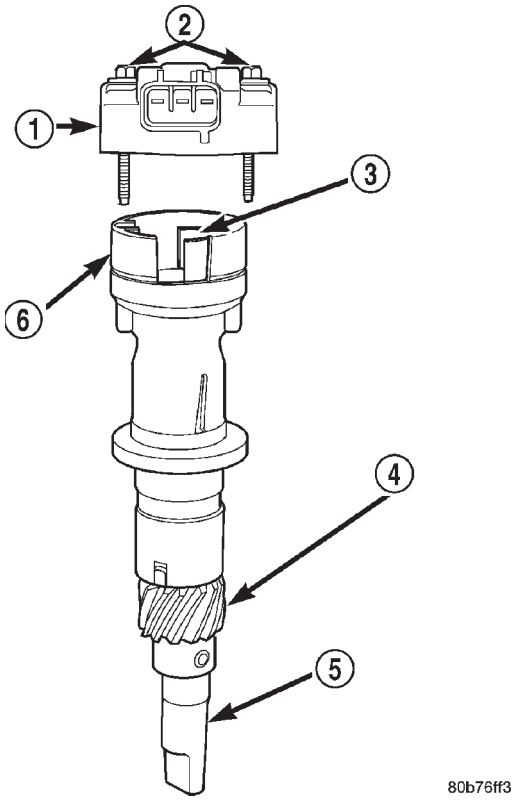



***Fig. 6 CMP and Oil Pump Drive Shaft - 4.0L Engine***

1 - CAMSHAFT POSITION SENSOR
2 - MOUNTING BOLTS (2)
3 - PULSE RING
4 - DRIVE GEAR (TO CAMSHAFT)
5 - OIL PUMP DRIVESHAFT
6 - SENSOR BASE (OIL PUMP DRIVESHAFT ASSEMBLY)

## SENSOR ONLY - 4.0L

(1) Disconnect electrical connector at CMP sensor (Fig. 7).

(2) Remove 2 sensor mounting bolts (Fig. 6) or (Fig. 7).

(3) Remove sensor from oil pump drive.

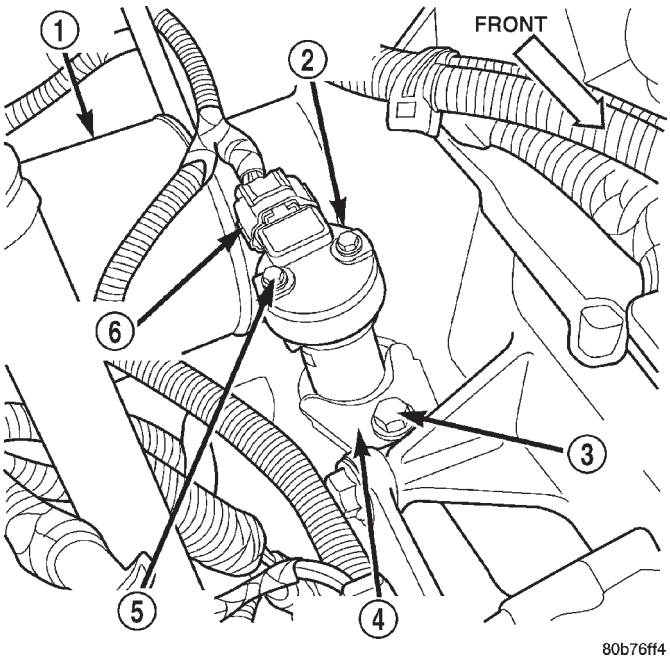



***Fig. 7 CMP Location - 4.0L Engine***

1 - OIL FILTER
2 - CAMSHAFT POSITION SENSOR
3 - CLAMP BOLT
4 - HOLD-DOWN CLAMP
5 - MOUNTING BOLTS (2)
6 - ELEC. CONNECTOR

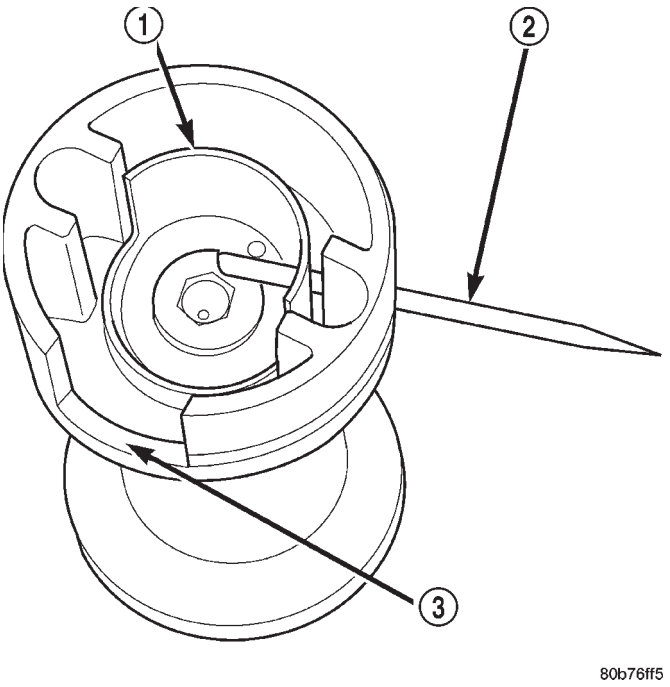



***Fig. 8 CMP Pulse Ring Alignment - 4.0L Engine***

1 - PULSE RING (SHUTTER)
2 - TOOTHPICK
3 - SENSOR BASE (OIL PUMP DRIVESHAFT ASSEMBLY)

CAMSHAFT POSITION SENSOR (Continued)

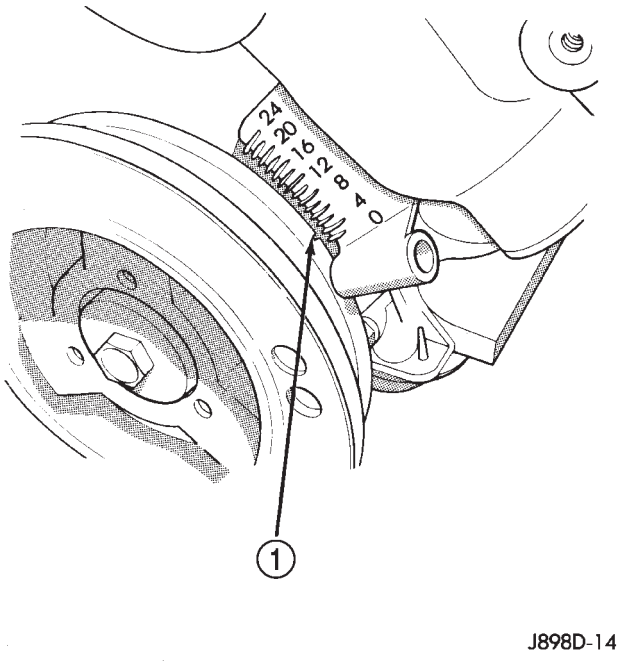



*Fig. 9 Align Timing Marks - 4.0L Engine*

1 - CRANKSHAFT VIBRATION DAMPER TIMING MARK

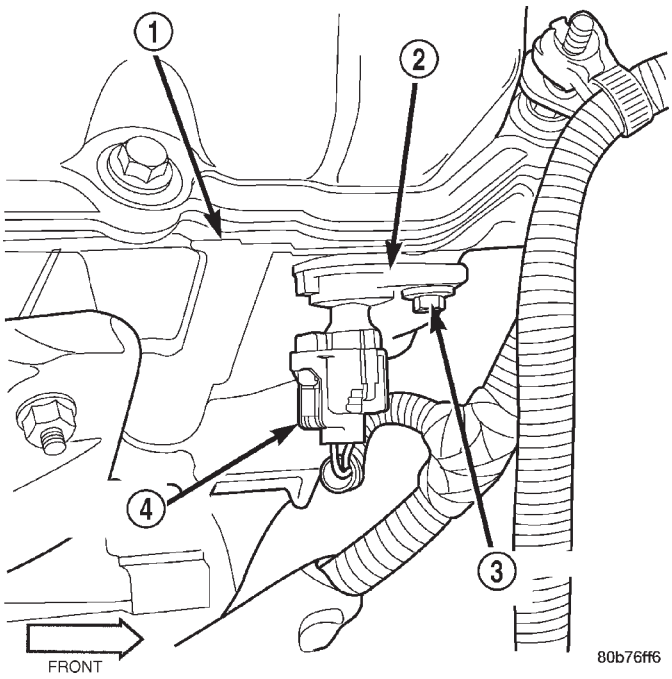



*Fig. 10 CMP Location—4.7L Engine*

1 - RIGHT CYLINDER HEAD
2 - CAMSHAFT POSITION SENSOR
3 - MOUNTING BOLT
4 - ELEC. CONNECTOR

## OIL PUMP DRIVE AND SENSOR - 4.0L

**If the CMP and oil pump drive are to be removed and installed, do not allow engine crankshaft or camshaft to rotate. CMP sensor relationship will be lost.**

(1) Disconnect electrical connector at CMP sensor (Fig. 7).

(2) Remove 2 sensor mounting bolts (Fig. 6) or (Fig. 7).

(3) Remove sensor from oil pump drive.

(4) Before proceeding to next step, mark and note rotational position of oil pump drive in relationship to engine block. After installation, the CMP sensor should face rear of engine 0°.

(5) Remove hold-down bolt and clamp (Fig. 7).

(6) While pulling assembly from engine, note direction and position of pulse ring (Fig. 6). After removal, look down into top of oil pump and note direction and position of slot at top of oil pump gear.

(7) Remove and discard old oil pump drive-to-engine block gasket.

## REMOVAL - 4.7L

The Camshaft Position Sensor (CMP) on the 4.7L V–8 engine is bolted to the front/top of the right cylinder head (Fig. 10).

It is easier to remove/install sensor from under vehicle.

(1) Raise and support vehicle.

(2) Disconnect electrical connector at CMP sensor (Fig. 10).

(3) Remove sensor mounting bolt (Fig. 10).

(4) Carefully pry sensor from cylinder head in a rocking action with two small screwdrivers. **Some 4.7L engines are equipped with a sensor spacer shim. If equipped, this shim will be located at sensor bolt hole between cylinder head and sensor mounting tang (TSB W08–18–00). Save this shim for sensor installation.**

(5) Check condition of sensor o-ring.

## INSTALLATION - 4.0L

### SENSOR ONLY - 4.0L

The Camshaft Position Sensor (CMP) on the 4.0L 6–cylinder engine is bolted to the top of the oil pump drive shaft assembly (Fig. 6). The sensor and drive shaft assembly is located on the right side of the engine near the oil filter (Fig. 7).

(1) Install sensor to oil pump drive.

(2) Install 2 sensor mounting bolts and tighten to 2 N·m (15 in. lbs.) torque.

(3) Connect electrical connector to CMP sensor.

### OIL PUMP DRIVE AND SENSOR - 4.0L

(1) Clean oil pump drive mounting hole area of engine block.

(2) Install new oil pump drive-to-engine block gasket.

CAMSHAFT POSITION SENSOR (Continued)

(3) Temporarily install a toothpick or similar tool through access hole at side of oil pump drive housing. Align toothpick into mating hole on pulse ring (Fig. 8).

(4) Install oil pump drive into engine while aligning into slot on oil pump. Rotate oil pump drive back to its original position and install hold-down clamp and bolt. Finger tighten bolt. Do not do a final tightening of bolt at this time.

(5) If engine crankshaft or camshaft has been rotated, such as during engine tear-down, CMP sensor relationship must be reestablished.

(a) Remove ignition coil rail assembly. Refer to Ignition Coil Removal/Installation.

(b) Remove cylinder number 1 spark plug.

(c) Hold a finger over the open spark plug hole. Rotate engine at vibration dampener bolt until compression (pressure) is felt.

(d) Slowly continue to rotate engine. Do this until timing index mark on vibration damper pulley aligns with top dead center (TDC) mark (0 degree) on timing degree scale (Fig. 9). Always rotate engine in direction of normal rotation. Do not rotate engine backward to align timing marks.

(e) Install oil pump drive into engine while aligning into slot on oil pump. If pump drive will not drop down flush to engine block, the oil pump slot is not aligned. Remove oil pump drive and align slot in oil pump to shaft at bottom of drive. Install into engine. Rotate oil pump drive back to its original position and install hold-down clamp and bolt. Finger tighten bolt. Do not do a final tightening of bolt at this time.

(f) Remove toothpick from housing.

(6) Install sensor to oil pump drive. After installation, the CMP sensor should face rear of engine 0°.

(7) Install 2 sensor mounting bolts and tighten to 2 N·m (15 in. lbs.) torque.

(8) Connect electrical connector to CMP sensor.

(9) If removed, install spark plug and ignition coil rail.

To verify correct rotational position of oil pump drive, the DRB scan tool must be used.

**WARNING: WHEN PERFORMING THE FOLLOWING TEST, THE ENGINE WILL BE RUNNING. BE CAREFUL NOT TO STAND IN LINE WITH THE FAN BLADES OR FAN BELT. DO NOT WEAR LOOSE CLOTHING.**

(10) Connect DRB scan tool to data link connector. The data link connector is located in passenger compartment, below and to left of steering column.

(11) Gain access to SET SYNC screen on DRB.

(12) Follow directions on DRB screen and start engine. Bring to operating temperature (engine must be in “closed loop” mode).

(13) With engine running at **idle speed**, the words IN RANGE should appear on screen along with 0°. This indicates correct position of oil pump drive.

(14) If a plus (+) or a minus (-) is displayed next to degree number, and/or the degree displayed is not zero, loosen but do not remove hold-down clamp bolt. Rotate oil pump drive until IN RANGE appears on screen. Continue to rotate oil pump drive until achieving as close to 0° as possible.

The degree scale on SET SYNC screen of DRB is referring to fuel synchronization only. **It is not referring to ignition timing.** Because of this, do not attempt to adjust ignition timing using this method. Rotating oil pump drive will have no effect on ignition timing. All ignition timing values are controlled by powertrain control module (PCM).

(15) Tighten hold-down clamp bolt to 23 N·m (17 ft. lbs.) torque.

### INSTALLATION - 4.7L

The Camshaft Position Sensor (CMP) on the 4.7L V–8 engine is bolted to the front/top of the right cylinder head (Fig. 10).

(1) Clean out machined hole in cylinder head.

(2) Apply a small amount of engine oil to sensor o-ring.

(3) Install sensor into cylinder head with a slight rocking action. Do not twist sensor into position as damage to o-ring may result.

**CAUTION: Before tightening sensor mounting bolt, be sure sensor is completely flush to cylinder head. If sensor is not flush, damage to sensor mounting tang may result.**

(4) Install mounting bolt and tighten to 12 N·m (106 in. lbs.) torque.

(5) Connect electrical connector to sensor.

(6) Lower vehicle.

## COIL RAIL

### DESCRIPTION

A one-piece coil rail assembly containing three individual coils is used on the 4.0L 6–cylinder engine (Fig. 11). The coil rail must be replaced as one assembly. The bottom of the coil is equipped with 6 individual rubber boots (Fig. 11) to seal the 6 spark plugs to the coil. Inside each rubber boot is a spring. The spring is used for a mechanical contact between the coil and the top of the spark plug. These rubber boots and springs are a permanent part of the coil and are not serviced separately.

(1) The coil is bolted directly to the cylinder head (Fig. 12). One electrical connector (located at rear of coil) is used for all three coils.

COIL RAIL (Continued)

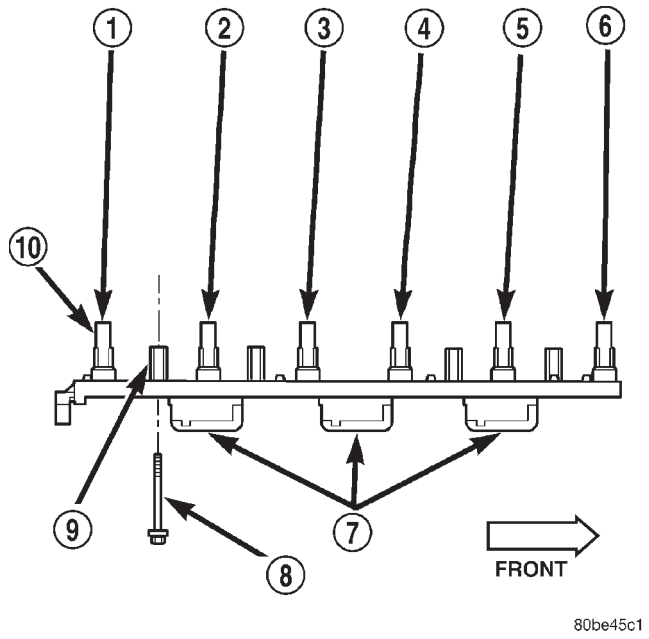



***Fig. 11 Ignition Coil Assembly—4.0L 6–Cylinder Engine***

1 - CYL. #6
2 - CYL. #5
3 - CYL. #4
4 - CYL. #3
5 - CYL. #2
6 - CYL. #1
7 - COILS (3)
8 - MOUNTING BOLTS (4)
9 - BOLT BASES (4)
10 - RUBBER BOOTS (6)

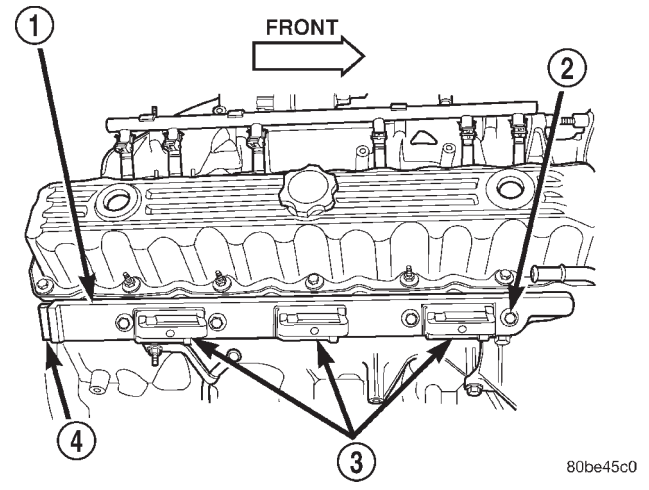



***Fig. 12 Coil Location—4.0L Engine***

1 - COIL RAIL
2 - COIL MOUNTING BOLTS (4)
3 - COIL
4 - COIL ELECTRICAL CONNECTION

## OPERATION

Although cylinder firing order is the same as 4.0L Jeep engines of previous years, spark plug firing is not. The 3 coils dual-fire the spark plugs on cylinders 1-6, 2-5 and/or 3-4. When one cylinder is being fired (on compression stroke), the spark to the opposite cylinder is being wasted (on exhaust stroke).

Battery voltage is supplied to the three ignition coils from the ASD relay. The Powertrain Control Module (PCM) opens and closes the ignition coil ground circuit for ignition coil operation.

**Base ignition timing is not adjustable.** By controlling the coil ground circuit, the PCM is able to set the base timing and adjust the ignition timing advance. This is done to meet changing engine operating conditions.

The ignition coil is not oil filled. The windings are embedded in an epoxy compound. This provides heat and vibration resistance that allows the ignition coil to be mounted on the engine.

Because of coil design, spark plug cables (secondary cables) are not used. The cables are integral within the coil rail.

## REMOVAL

A one-piece coil rail assembly containing three individual coils is used on the 4.0L engine (Fig. 13). The coil rail must be replaced as one assembly. The bottom of the coil is equipped with 6 individual rubber boots (Fig. 13) to seal the 6 spark plugs to the coil. Inside each rubber boot is a spring. The spring is used for an electrical contact between the coil and the top of the spark plug. These rubber boots and springs are a permanent part of the coil and are not serviced separately.

(1) Disconnect negative battery cable at battery.

(2) The coil is bolted directly to the cylinder head. Remove 4 coil mounting bolts (Fig. 14).

(3) Carefully pry up coil assembly from spark plugs. Do this by prying alternately at each end of coil until rubber boots have disengaged from all spark plugs. If boots will not release from spark plugs, use a commercially available spark plug boot removal tool. Twist and loosen a few boots from a few spark plugs to help remove coil.

(4) After coil has cleared spark plugs, position coil for access to primary electrical connector. Disconnect connector from coil by pushing slide tab outwards to right side of vehicle (Fig. 15). After slide tab has been positioned outwards, push in on secondary release lock (Fig. 15) on side of connector and pull connector from coil.

(5) Remove coil from vehicle.

COIL RAIL (Continued)

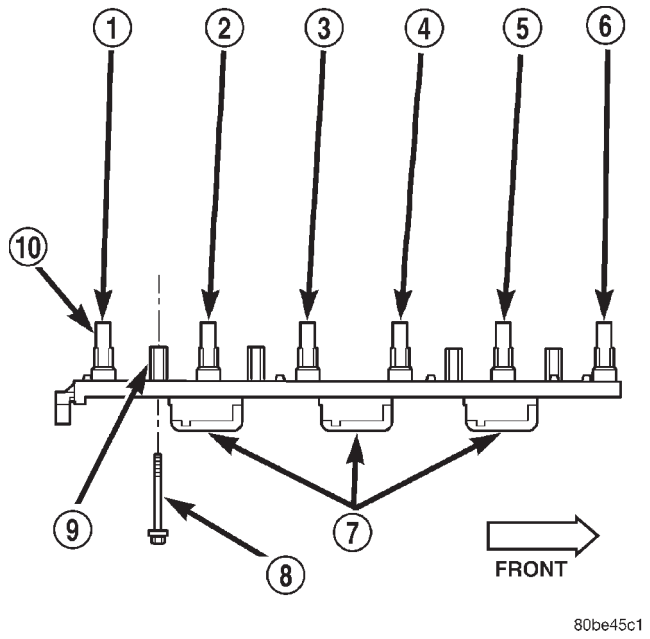



***Fig. 13 Ignition Coil Assembly—4.0L 6–Cylinder Engine***

1 - CYL. #6
2 - CYL. #5
3 - CYL. #4
4 - CYL. #3
5 - CYL. #2
6 - CYL. #1
7 - COILS (3)
8 - MOUNTING BOLTS (4)
9 - BOLT BASES (4)
10 - RUBBER BOOTS (6)

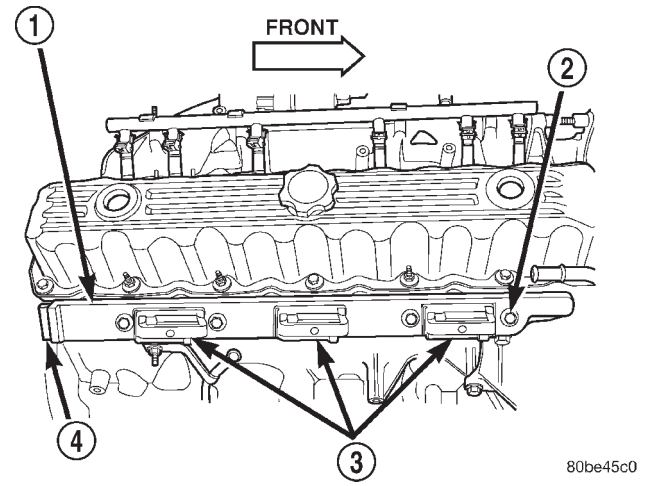



***Fig. 14 Ignition Coil Rail Location—4.0L 6–Cylinder Engine***

1 - COIL RAIL
2 - COIL MOUNTING BOLTS (4)
3 - COIL
4 - COIL ELECTRICAL CONNECTION

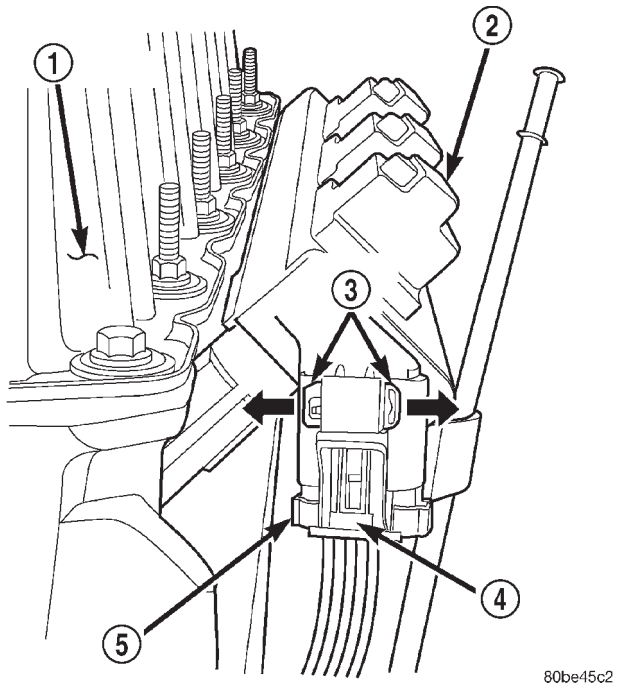



***Fig. 15 Ignition Coil Electrical Connector—4.0L 6–Cylinder Engine***

1 - REAR OF VALVE COVER
2 - COIL RAIL
3 - SLIDE TAB
4 - RELEASE LOCK
5 - COIL CONNECTOR

### INSTALLATION

(1) Position ignition coil rubber boots to all spark plugs. Push down on coil assembly until bolt bases have contacted cylinder head

(2) Install 4 coil mounting bolts. Loosely tighten 4 bolts just enough to allow bolt bases to contact cylinder head. Do a final tightening of each bolt in steps down to 29 N·m (250 in. lbs.) torque. Do not apply full torque to any bolt first.

(3) Connect engine harness connector to coil by snapping into position. Move slide tab towards engine (Fig. 15) for a positive lock.

(4) Connect negative battery cable to battery.

## IGNITION COIL

### DESCRIPTION

The 4.7L V–8 engine uses 8 dedicated, and individually fired coil (Fig. 16) for each spark plug. Each coil is mounted directly to the top of each spark plug (Fig. 17).

### OPERATION

Battery voltage is supplied to the 8 ignition coils from the ASD relay. The Powertrain Control Module

IGNITION COIL (Continued)

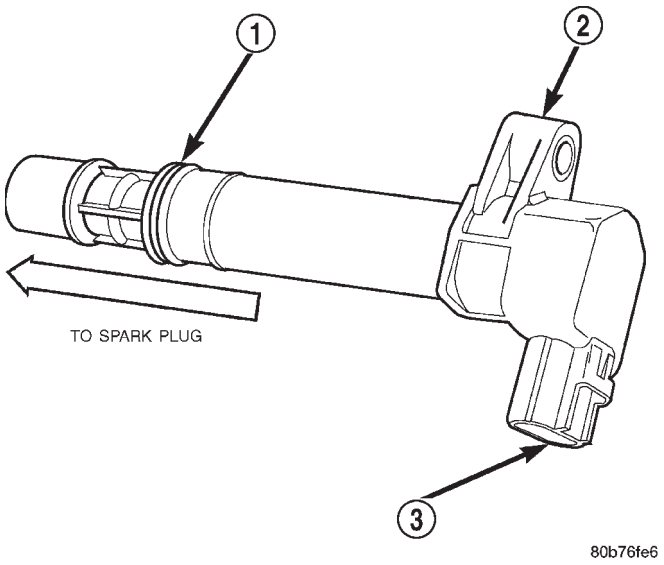



*Fig. 16 Ignition Coil—4.7L Engine*

1 - O-RING
2 - IGNITION COIL
3 - ELECTRICAL CONNECTOR

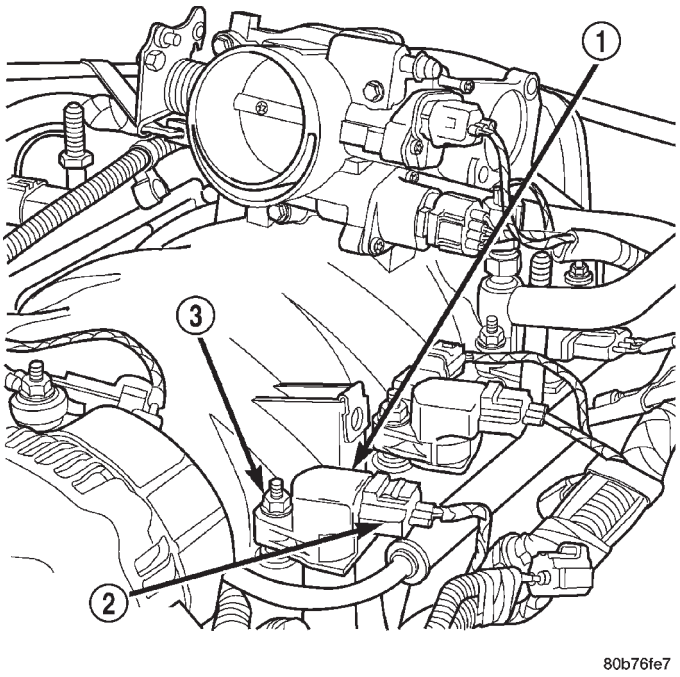



*Fig. 17 Ignition Coil Location—4.7L Engine*

1 - IGNITION COIL
2 - COIL ELECTRICAL CONNECTOR
3 - COIL MOUNTING STUD/NUT

(PCM) opens and closes each ignition coil ground circuit at a determined time for ignition coil operation.

**Base ignition timing is not adjustable.** By controlling the coil ground circuit, the PCM is able to set the base timing and adjust the ignition timing advance. This is done to meet changing engine operating conditions.

The ignition coil is not oil filled. The windings are embedded in an epoxy compound. This provides heat and vibration resistance that allows the ignition coil to be mounted on the engine.

Because of coil design, spark plug cables (secondary cables) are not used.

## REMOVAL

An individual ignition coil is used for each spark plug (Fig. 18). The coil fits into machined holes in the cylinder head. A mounting stud/nut secures each coil to the top of the intake manifold (Fig. 19). The bottom of the coil is equipped with a rubber boot to seal the spark plug to the coil. Inside each rubber boot is a spring. The spring is used for a mechanical contact between the coil and the top of the spark plug. These rubber boots and springs are a permanent part of the coil and are not serviced separately. An o-ring (Fig. 18) is used to seal the coil at the opening into the cylinder head.

(1) Depending on which coil is being removed, the throttle body air intake tube or intake box may need to be removed to gain access to coil.

(2) Disconnect electrical connector (Fig. 19) from coil by pushing downward on release lock on top of connector and pull connector from coil.

(3) Clean area at base of coil with compressed air before removal.

(4) Remove coil mounting nut from mounting stud (Fig. 19).

(5) Carefully pull up coil from cylinder head opening with a slight twisting action.

(6) Remove coil from vehicle.

IGNITION COIL (Continued)

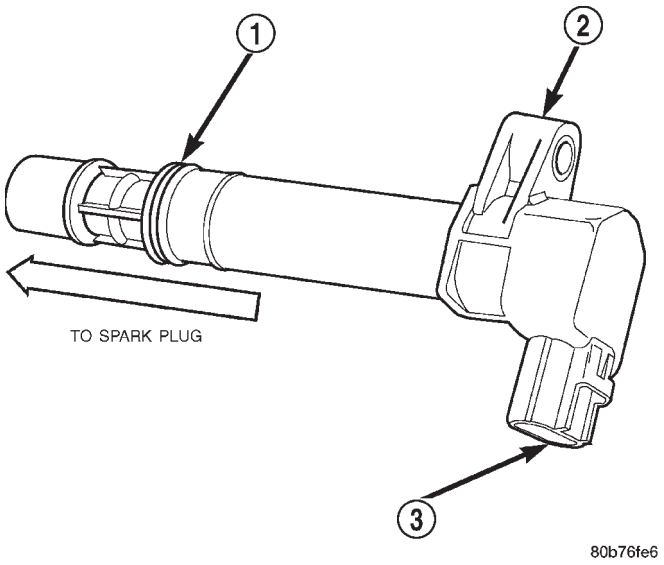



*Fig. 18 Ignition Coil—4.7L V–8*

1 - O-RING
2 - IGNITION COIL
3 - ELECTRICAL CONNECTOR

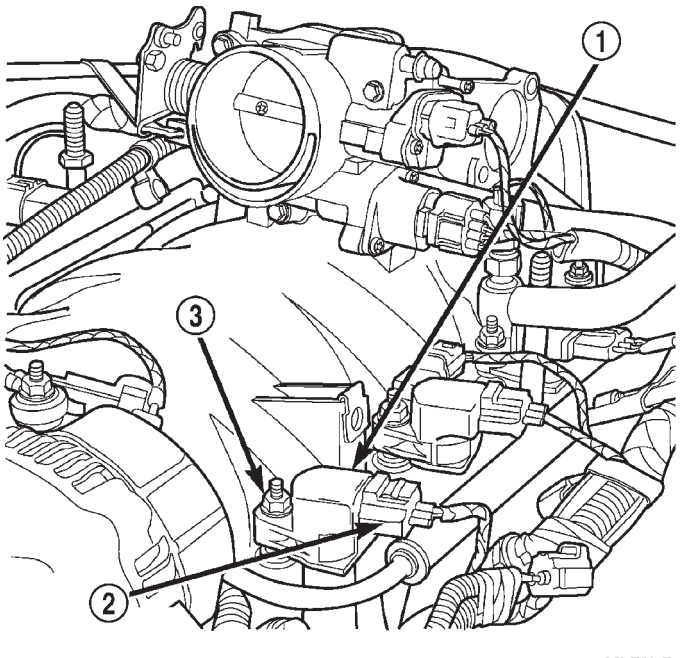



*Fig. 19 Ignition Coil*

1 - IGNITION COIL
2 - COIL ELECTRICAL CONNECTOR
3 - COIL MOUNTING STUD/NUT

## INSTALLATION

(1) Using compressed air, blow out any dirt or contaminants from around top of spark plug.

(2) Check condition of coil o-ring and replace as necessary. To aid in coil installation, apply silicone to coil o-ring.

(3) Position ignition coil into cylinder head opening and push onto spark plug. Do this while guiding coil base over mounting stud.

(4) Install mounting stud nut and tighten to 8 N·m (70 in. lbs.) torque.

(5) Connect electrical connector to coil by snapping into position.

(6) If necessary, install throttle body air tube or box.

# IGNITION COIL CAPACITOR

## DESCRIPTION

Two coil capacitors are used. One of them is located near the center of, and on the left side of the intake manifold (Fig. 20). The other capacitor is located near the center of, and on the right side of the intake manifold.

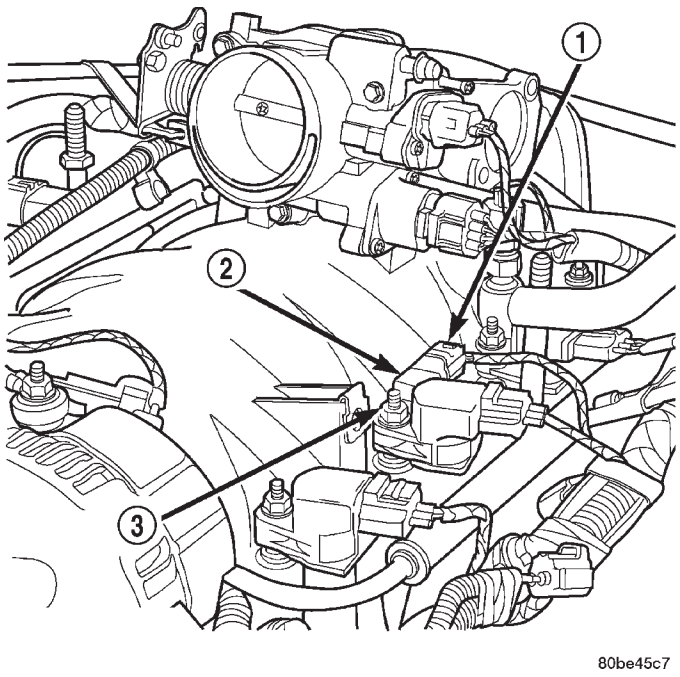



*Fig. 20 Coil Capacitor (Left Side Shown)*

1 - ELECTRICAL CONNECTOR
2 - COIL CAPACITOR
3 - MOUNTING NUT

## OPERATION

The 2 coil capacitors are used to prevent high-voltage spikes from interfering with the operation of certain powertrain sensors. They are also used to help prevent radio interference.

IGNITION COIL CAPACITOR (Continued)

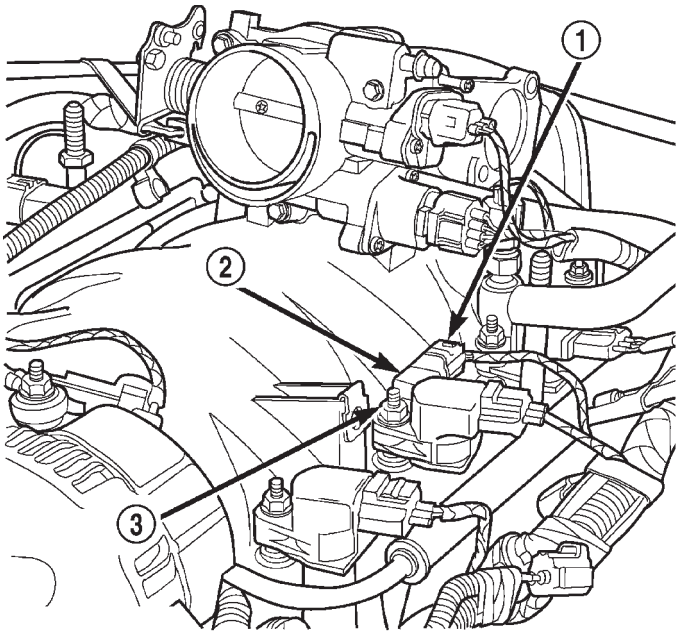
## REMOVAL

Two coil capacitors are used. One of them is located near the center of, and on the left side of the intake manifold (Fig. 21). The other capacitor is located near the center of, and on the right side of the intake manifold.

(1) Disconnect electrical connector at coil capacitor (Fig. 21).
(2) Remove mounting nut.
(3) Remove capacitor from mounting stud.

## INSTALLATION

(1) Position capacitor to manifold mounting stud.
(2) Install nut and tighten to 8 N·m (70 in. lbs.) torque.
(3) Connect electrical connector to capacitor (Fig. 21).




80be45c7

***Fig. 21 Coil Capacitor (Left Side Shown)***

1 - ELECTRICAL CONNECTOR
2 - COIL CAPACITOR
3 - MOUNTING NUT

# SPARK PLUG

## DESCRIPTION

Both the 4.0L 6–cylinder and the 4.7L V-8 engine use resistor type spark plugs. 4.7L V-8 engines are equipped with “fired in suppressor seal” type spark plugs using a copper core ground electrode.

Because of the use of an aluminum cylinder head on the 4.7L engine, spark plug torque is very critical.

To prevent possible pre-ignition and/or mechanical engine damage, the correct type/heat range/number spark plug must be used.

## OPERATION

Plugs on both engines 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 ohmmeter to check the resistance values of the spark plugs. Inaccurate readings will result.** 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. A single plug displaying an abnormal condition indicates that a problem exists in the corresponding cylinder. Replace spark plugs at the intervals recommended in Group O, Lubrication and Maintenance.

Spark plugs that have low mileage may be cleaned and reused if not otherwise defective, carbon or oil fouled. Also refer to Spark Plug Conditions.

**CAUTION: Never use a motorized wire wheel brush to clean the spark plugs. Metallic deposits will remain on the spark plug insulator and will cause plug misfire.**

## DIAGNOSIS AND TESTING - SPARK PLUG CONDITIONS

### NORMAL OPERATING

The few deposits present on the spark plug will probably be light tan or slightly gray in color. This is evident with most grades of commercial gasoline (Fig. 22). There will not be evidence of electrode burning. Gap growth will not average more than approximately 0.025 mm (.001 in) per 3200 km (2000 miles) of operation. Spark plugs that have normal wear can usually be cleaned, have the electrodes filed, have the gap set and then be installed.

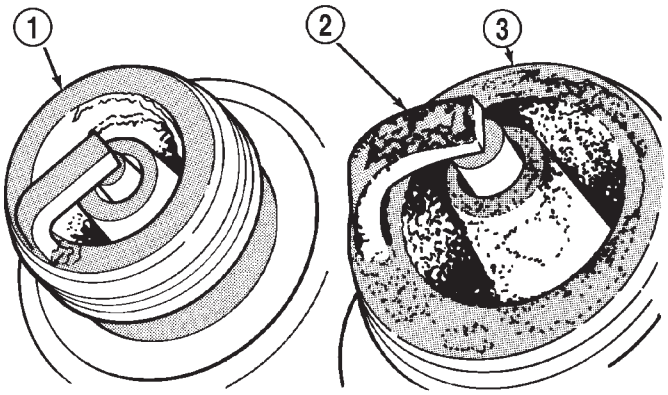



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***Fig. 22 Normal Operation and Cold (Carbon) Fouling***

1 - NORMAL
2 - DRY BLACK DEPOSITS
3 - COLD (CARBON) FOULING

SPARK PLUG (Continued)

Some fuel refiners in several areas of the United States have introduced a manganese additive (MMT) for unleaded fuel. During combustion, fuel with MMT causes the entire tip of the spark plug to be coated with a rust colored deposit. This rust color can be misdiagnosed as being caused by coolant in the combustion chamber. Spark plug performance may be affected by MMT deposits.

### COLD FOULING/CARBON FOULING

Cold fouling is sometimes referred to as carbon fouling. The deposits that cause cold fouling are basically carbon (Fig. 22). A dry, black deposit on one or two plugs in a set may be caused by sticking valves or defective spark plug cables. Cold (carbon) fouling of the entire set of spark plugs may be caused by a clogged air cleaner element or repeated short operating times (short trips).

### WET FOULING OR GAS FOULING

A spark plug coated with excessive wet fuel or oil is wet fouled. In older engines, worn piston rings, leaking valve guide seals or excessive cylinder wear can cause wet fouling. In new or recently overhauled engines, wet fouling may occur before break-in (normal oil control) is achieved. This condition can usually be resolved by cleaning and reinstalling the fouled plugs.

### OIL OR ASH ENCRUSTED

If one or more spark plugs are oil or oil ash encrusted (Fig. 23), evaluate engine condition for the cause of oil entry into that particular combustion chamber.

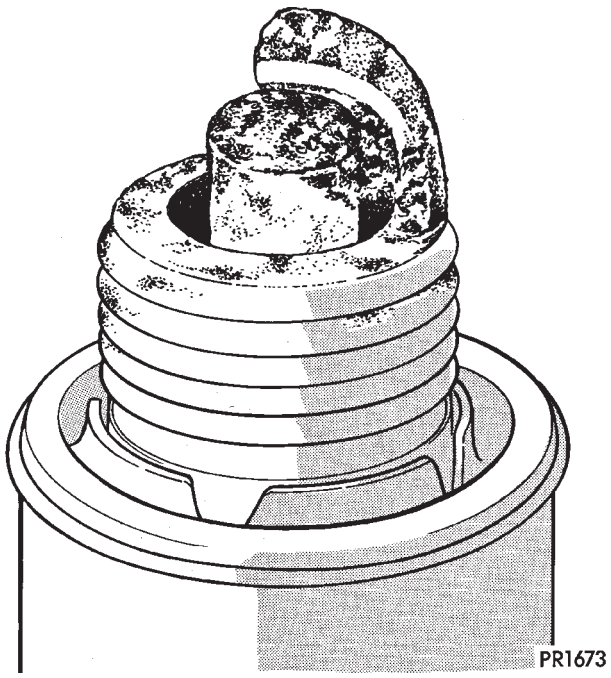


*Fig. 23 Oil or Ash Encrusted*

### ELECTRODE GAP BRIDGING

Electrode gap bridging may be traced to loose deposits in the combustion chamber. These deposits accumulate on the spark plugs during continuous stop-and-go driving. When the engine is suddenly subjected to a high torque load, deposits partially liquefy and bridge the gap between electrodes (Fig. 24). This short circuits the electrodes. Spark plugs with electrode gap bridging can be cleaned using standard procedures.

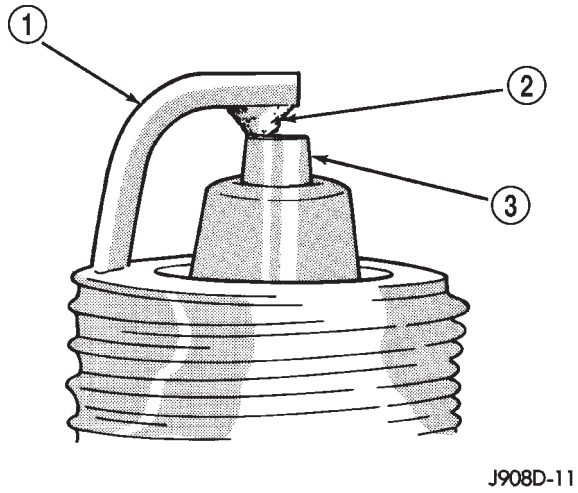


*Fig. 24 Electrode Gap Bridging*

1 - GROUND ELECTRODE
2 - DEPOSITS
3 - CENTER ELECTRODE

### SCAVENGER DEPOSITS

Fuel scavenger deposits may be either white or yellow (Fig. 25). They may appear to be harmful, but this is 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 and can be cleaned using standard procedures.

### 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 can also separate the insulator from the center electrode (Fig. 26). Spark plugs with this condition must be replaced.

### PRE-IGNITION DAMAGE

Pre-ignition damage is usually caused by excessive combustion chamber temperature. The center electrode dissolves first and the ground electrode dis-

SPARK PLUG (Continued)

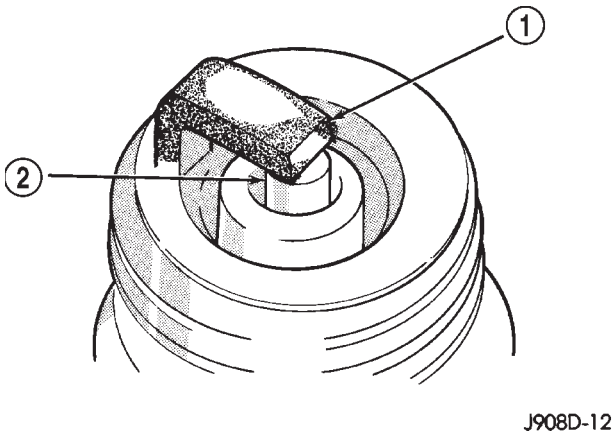


***Fig. 25 Scavenger Deposits***

1 - GROUND ELECTRODE COVERED WITH WHITE OR YELLOW DEPOSITS
2 - CENTER ELECTRODE

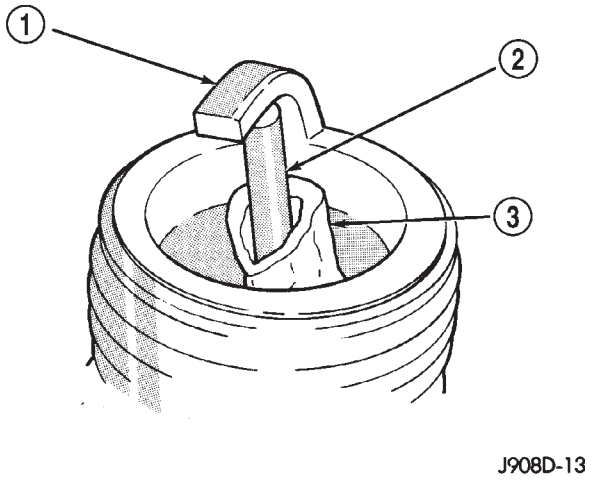


***Fig. 26 Chipped Electrode Insulator***

1 - GROUND ELECTRODE
2 - CENTER ELECTRODE
3 - CHIPPED INSULATOR

solves somewhat latter (Fig. 27). Insulators appear relatively deposit free. Determine if the spark plug has the correct heat range rating for the engine. Determine if ignition timing is over advanced or if other operating conditions are causing engine overheating. (The heat range rating refers to the operating temperature of a particular type spark plug. Spark plugs are designed to operate within specific temperature ranges. This depends upon the thickness and length of the center electrodes porcelain insulator.)

**CAUTION: If the engine is equipped with copper core ground electrode spark plugs, they must be replaced with the same type/number spark plug as the original. If another spark plug is substituted, pre-ignition will result.**

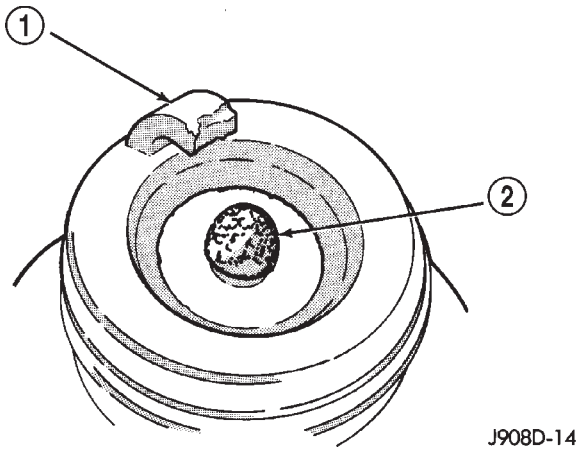


***Fig. 27 Pre-ignition Damage***

1 - GROUND ELECTRODE STARTING TO DISSOLVE
2 - CENTER ELECTRODE DISSOLVED

## SPARK PLUG OVERHEATING

Overheating is indicated by a white or gray center electrode insulator that also appears blistered (Fig. 28). The increase in electrode gap will be considerably in excess of 0.001 inch per 2000 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 can also cause spark plug overheating.

**CAUTION: If the engine is equipped with copper core ground electrode spark plugs, they must be replaced with the same type/number spark plug as the original. If another spark plug is substituted, pre-ignition will result.**


***Fig. 28 Spark Plug Overheating***

1 - BLISTERED WHITE OR GRAY COLORED INSULATOR

SPARK PLUG (Continued)

## REMOVAL

On the 4.0L 6–cylinder engine, the spark plugs are located below the coil rail assembly. On the 4.7L V–8 engine, each individual spark plug is located under each ignition coil.

(1) 4.0L 6–Cylinder Engine: Prior to removing spark plug, spray compressed air around spark plug hole and area around spark plug. This will help prevent foreign material from entering combustion chamber.

(2) 4.7L V–8 Engine: Prior to removing spark plug, spray compressed air around base of ignition coil at cylinder head. This will help prevent foreign material from entering combustion chamber.

(3) On the 4.0L engine the coil rail assembly must be removed to gain access to any/all spark plug. Refer to Ignition Coil Removal/Installation. On the 4.7L V-8 engine each individual ignition coil must be removed to gain access to each spark plug. Refer to Ignition Coil Removal/Installation.

(4) Remove spark plug from cylinder head using a quality socket with a rubber or foam insert. If equipped with a 4.7L V-8 engine, also check condition of coil o-ring and replace as necessary.

(5) Inspect spark plug condition. Refer to Spark Plug Conditions.

## CLEANING

The plugs may be cleaned using commercially available spark plug cleaning equipment. After cleaning, file center electrode flat with a small point file or jewelers file before adjusting gap.

**CAUTION: Never use a motorized wire wheel brush to clean spark plugs. Metallic deposits will remain on spark plug insulator and will cause plug misfire.**

## INSTALLATION

**CAUTION: The 4.7L V–8 engine is equipped with copper core ground electrode spark plugs. They must be replaced with the same type/number spark plug as the original. If another spark plug is substituted, pre-ignition will result.**

Special care should be taken when installing spark plugs into cylinder head spark plug wells. Be sure plugs do not drop into plug wells as ground straps may be bent resulting in a change in plug gap, or electrodes can be damaged.

Always tighten spark plugs to specified torque. Over tightening can cause distortion resulting in a change in spark plug gap or a cracked porcelain insulator.

(1) Start spark plug into cylinder head by hand to avoid cross threading.

(2) 4.0L 6–Cylinder Engine: Tighten spark plugs to 35-41 N·m (26-30 ft. lbs.) torque.

(3) 4.7L V–8 Engine: Tighten spark plugs to 27 N·m (20 ft. lbs.) torque.

(4) 4.7L V–8 Engine: Before installing coil(s), check condition of coil o-ring and replace as necessary. To aid in coil installation, apply silicone to coil o-ring.

(5) Install ignition coil(s). Refer to Ignition Coil Removal/Installation.