IGNITION SYSTEM

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DESCRIPTION AND OPERATION

IGNITION SYSTEM

DESCRIPTION

Two different ignition systems are used. One type is used for the 2.5L 4–cylinder engine. The other is used for the 4.0L 6–cylinder engine.

OPERATION

2.5L 4–Cylinder Engine:

The ignition system is controlled by the Powertrain Control Module (PCM).

The ignition system consists of:

- Spark Plugs
- Ignition Coil
- Secondary Ignition Cables
- Distributor (contains rotor and camshaft position sensor)
- Powertrain Control Module (PCM)
- Crankshaft Position, Camshaft Position, Throttle Position and MAP Sensors

4.0L 6–Cylinder Engine:

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.

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

The ignition system is controlled by the Powertrain Control Module (PCM).

The ignition system consists of:

- Spark Plugs
- Ignition Coil(s)
- Powertrain Control Module (PCM)

DESCRIPTION AND OPERATION (Continued)

- Crankshaft Position Sensor
- Camshaft Position Sensor
- The MAP, TPS, IAC and ECT also have an effect on the control of the ignition system.

DISTRIBUTOR-2.5L ENGINE

DESCRIPTION

The 2.5L engine is equipped with a camshaft driven mechanical distributor (Fig. 1) containing a shaft driven distributor rotor. The distributor is also equipped with an internal camshaft position (fuel sync) sensor (Fig. 1).

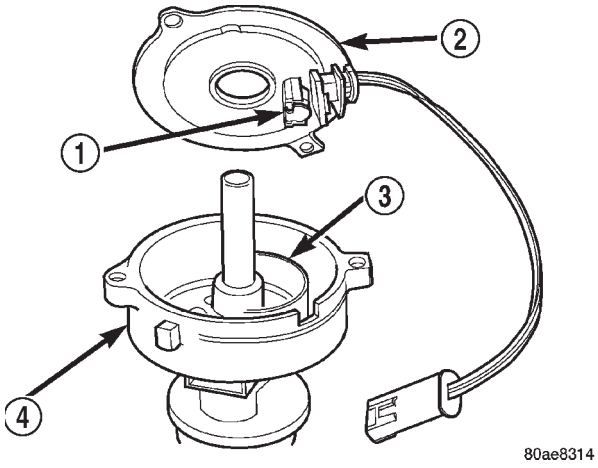


Fig. 1 Distributor and Camshaft Position Sensor-2.5L Engine

1 – SYNC SIGNAL GENERATOR
2 – CAMSHAFT POSITION SENSOR
3 – PULSE RING
4 – DISTRIBUTOR ASSEMBLY

OPERATION

The distributor does not have built in centrifugal or vacuum assisted advance. Base ignition timing and all timing advance is controlled by the Powertrain Control Module (PCM). Because ignition timing is controlled by the PCM, **base ignition timing is not adjustable.**

The distributor is locked in place by a fork with a slot located on the distributor housing base. The distributor holddown clamp bolt passes through this slot when installed. Because the distributor position is locked when installed, its rotational position can not be changed. **Do not attempt to modify the distributor housing to get distributor rotation. Distributor position will have no effect on ignition timing. The position of the distributor will determine fuel synchronization only.**

All distributors contain an internal oil seal that prevents oil from entering the distributor housing. The seal is not serviceable.

SPARK PLUGS

DESCRIPTION

Resistor type spark plugs are used.

Spark plug resistance values range 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.**

OPERATION

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

Always use the recommended torque when tightening spark plugs. Incorrect torque can distort the spark plug and change plug gap. It can also pull the plug threads and do possible damage to both the spark plug and the cylinder head.

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.

SPARK PLUG CABLES-2.5L ENGINE

DESCRIPTION

Spark plug cables are used only on the 2.5L engine. They are sometimes referred to as secondary ignition wires.

OPERATION

The spark plug cables transfer electrical current from the ignition coil(s) and/or distributor, 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.

DESCRIPTION AND OPERATION (Continued)

IGNITION COIL-2.5L ENGINE

DESCRIPTION

A single ignition coil is used with the 2.5L 4–cylinder engine. The coil is not oil filled. The coil windings are embedded in an epoxy compound. This provides heat and vibration resistance that allows the coil to be mounted on the engine.

OPERATION

The Powertrain Control Module (PCM) opens and closes the ignition coil ground circuit for ignition coil operation.

Battery voltage is supplied to the ignition coil positive terminal from the ASD relay. If the PCM does not see a signal from the crankshaft and camshaft sensors (indicating the ignition key is ON but the engine is not running), it will shut down the ASD circuit.

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.

IGNITION COIL—4.0L ENGINE

DESCRIPTION

A one-piece coil rail assembly containing three individual coils is used on the 4.0L 6–cylinder engine (Fig. 2). The coil rail must be replaced as one assembly. The bottom of the coil is equipped with 6 individual rubber boots (Fig. 2) 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. 3). One electrical connector (located at rear of coil) is used for all three coils.

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

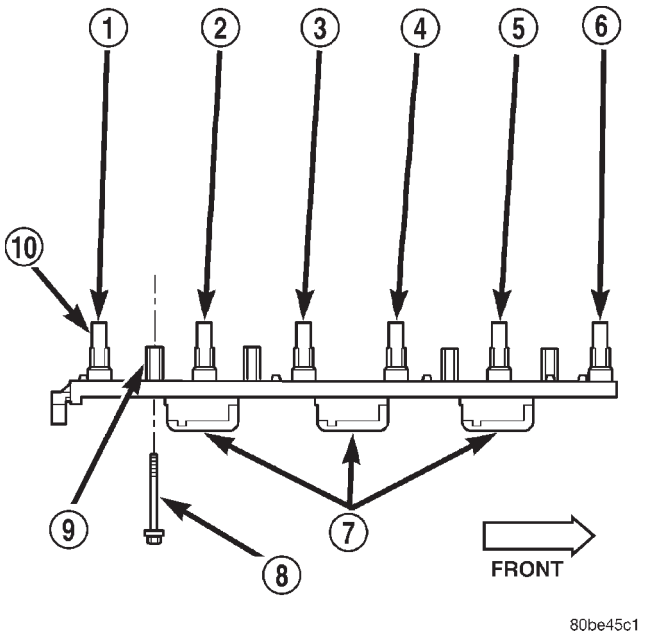


Fig. 2 Ignition Coil Assembly—4.0L 6–Cylinder Engine

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)

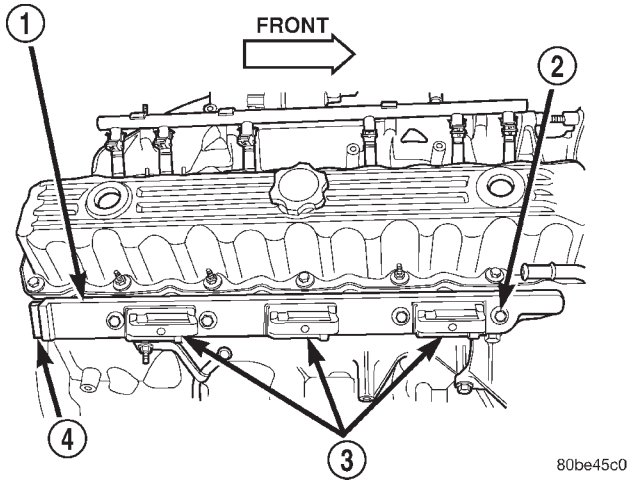


Fig. 3 Coil Location—4.0L Engine

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

DESCRIPTION AND OPERATION (Continued)

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.

CRANKSHAFT POSITION SENSOR

DESCRIPTION

The Crankshaft Position (CKP) sensor is located near the outer edge of the flywheel (starter ringear).

OPERATION

Engine speed and crankshaft position are provided through the CKP sensor. The sensor generates pulses that are the input sent to the Powertrain Control Module (PCM). The PCM interprets the sensor input to determine the crankshaft position. The PCM then uses this position, along with other inputs, to determine injector sequence and ignition timing.

The sensor is a hall effect device combined with an internal magnet. It is also sensitive to steel within a certain distance from it.

The flywheel/drive plate has groups of four notches at its outer edge. On 2.5L 4-cylinder engines there are two sets of notches (Fig. 4). On 4.0L 6-cylinder engines there are three sets of notches (Fig. 5).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM. For each engine revolution there are two groups of four pulses generated on 2.5L 4-cylinder engines. There are 3 groups of four pulses generated on 4.0L 6-cylinder engines.

The trailing edge of the fourth notch, which causes the pulse, is four degrees before top dead center (TDC) of the corresponding piston.

The engine will not operate if the PCM does not receive a CKP sensor input.

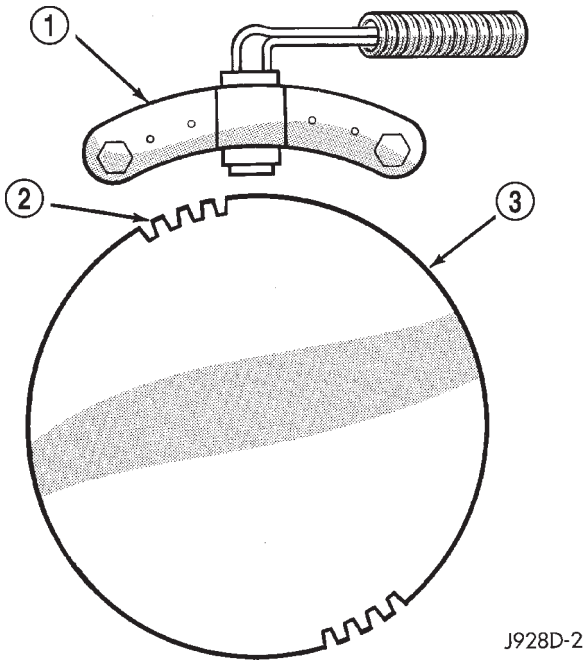


Fig. 4 Sensor Operation—2.5L 4-Cyl. Engine

1 – CRANKSHAFT POSITION SENSOR
2 – NOTCHES
3 – FLYWHEEL

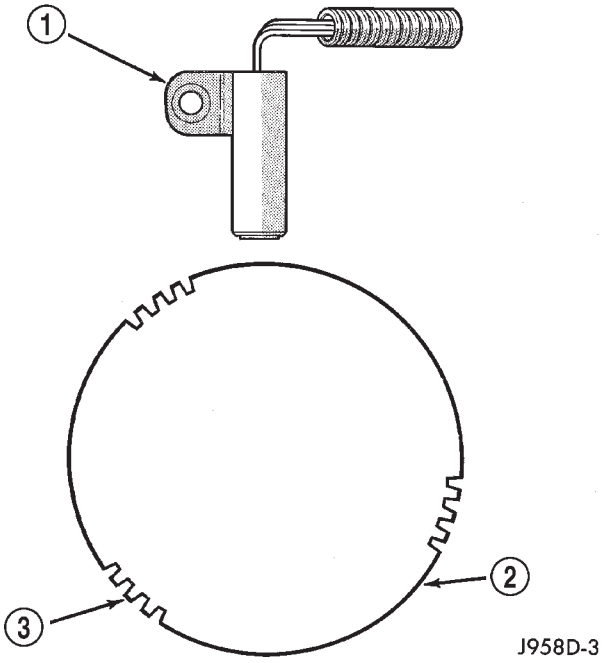


Fig. 5 Sensor Operation—4.0L 6-Cyl. Engine

1 – CRANKSHAFT POSITION SENSOR
2 – FLYWHEEL
3 – FLYWHEEL NOTCHES

CAMSHAFT POSITION SENSOR-2.5L ENGINE

DESCRIPTION

On the 2.5L 4–cylinder engine the Camshaft Position (CMP) sensor is located in the distributor.

OPERATION

The 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 distributor shaft. The pulse ring rotates 180 degrees through the sync signal generator. Its signal is used in conjunction with the Crankshaft Position (CKP) sensor to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

DESCRIPTION AND OPERATION (Continued)

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—4.0L ENGINE

DESCRIPTION

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).

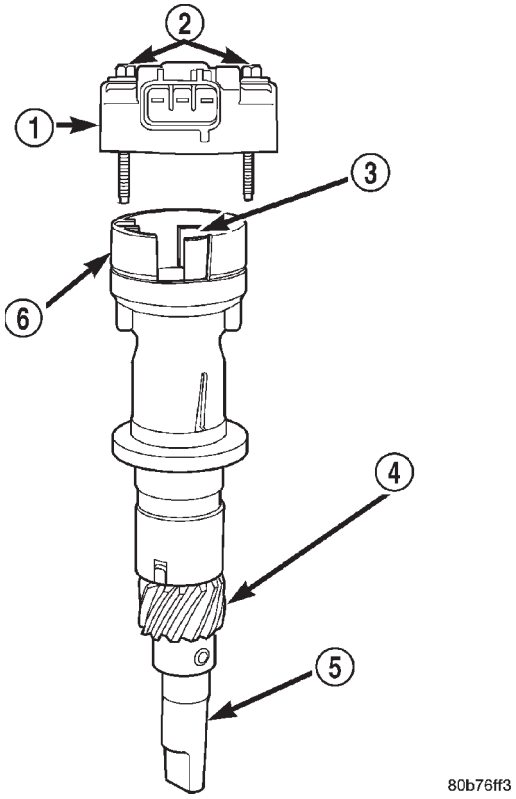


Fig. 6 CMP and Oil Pump Drive Shaft—4.0L Engine

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)

OPERATION

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. 6). 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.

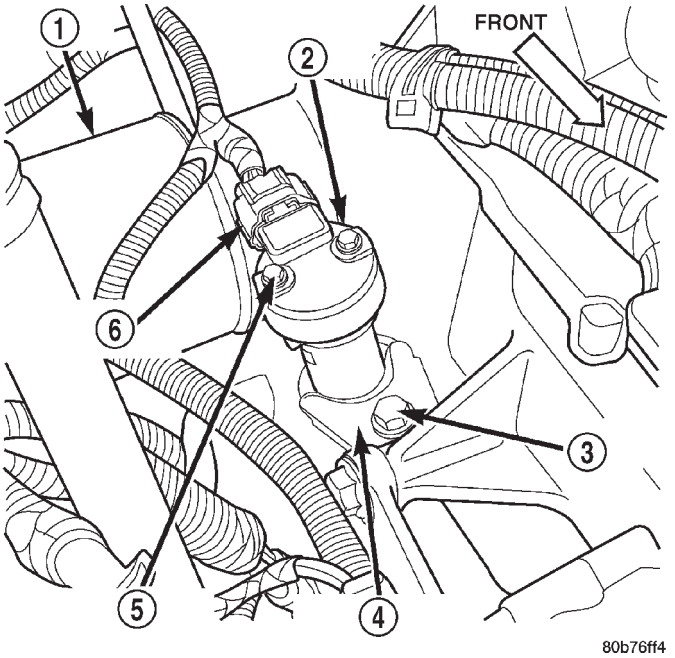


Fig. 7 CMP Location—4.0L Engine

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

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.

IGNITION SWITCH AND KEY LOCK CYLINDER

DESCRIPTION

The electrical ignition switch is located on the steering column. It is used as the main on/off switching device for most electrical components. The mechanical key lock cylinder is used to engage/disengage the electrical ignition switch.

DESCRIPTION AND OPERATION (Continued)

OPERATION

Vehicles equipped with an automatic transmission and a floor mounted shifter: a cable is used to connect the interlock device in the steering column assembly, to the transmission floor shift lever. This interlock device is used to lock the transmission shifter in the PARK position when the key lock cylinder is rotated to the LOCKED or ACCESSORY position. The interlock device within the steering column is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

If the ignition key is difficult to rotate to or from the LOCK or ACCESSORY position, it may not be the fault of the key cylinder or the steering column components. The brake transmission shift interlock cable may be out of adjustment. Refer to Brake Transmission Shift Interlock Cable Adjustment in Group 21, Transmissions for adjustment procedures.

Vehicles equipped with an automatic transmission and a steering column mounted shifter: an interlock device is located within the steering column. This interlock device is used to lock the transmission shifter in the PARK position when the key lock cylinder is in the LOCKED or ACCESSORY position. If it is difficult to rotate the key to or from the LOCK or ACCESSORY position, the interlock device within the steering column may be defective. This device is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

Vehicles equipped with a manual transmission and a floor mounted shifter: on certain models, a lever is located on the steering column behind the ignition key lock cylinder. The lever must be manually operated to allow rotation of the ignition key lock cylinder to the LOCK or ACCESSORY position. If it is difficult to rotate the key to the LOCK or ACCESSORY position, the lever mechanism may be defective. This mechanism is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

On other models, the ignition key cylinder must be depressed to allow it to be rotated into the LOCK or ACCESSORY position. If it is difficult to rotate the key to the LOCK or ACCESSORY position, the lock mechanism within the steering column may be defective. This mechanism is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

DIAGNOSIS AND TESTING

DISTRIBUTOR CAP-2.5L ENGINE

Remove the distributor cap and wipe it clean with a dry lint free cloth. Visually inspect the cap for cracks, carbon paths, broken towers or damaged rotor button (Fig. 8) or (Fig. 9). Also check for white deposits on the inside (caused by condensation entering the cap through cracks). Replace any cap that displays charred or eroded terminals. The machined surface of a terminal end (faces toward rotor) will indicate some evidence of erosion from normal operation. Examine the terminal ends for evidence of mechanical interference with the rotor tip.

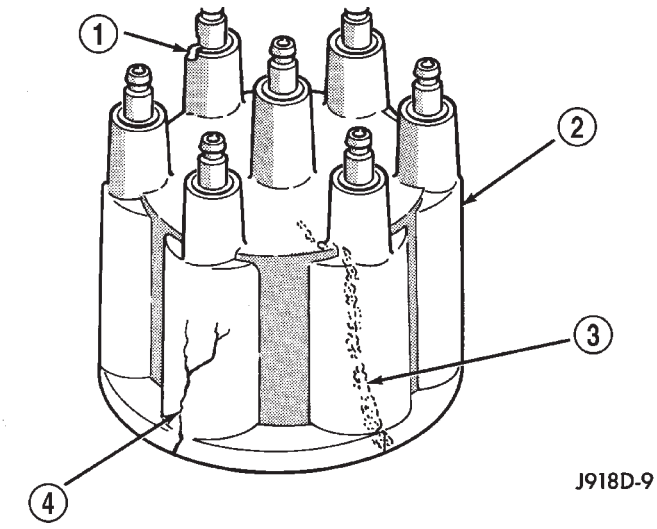


Fig. 8 Cap Inspection—External—Typical

1 – BROKEN TOWER
2 – DISTRIBUTOR CAP
3 – CARBON PATH
4 – CRACK

DISTRIBUTOR ROTOR-2.5L ENGINE

Visually inspect the rotor (Fig. 10) for cracks, evidence of corrosion or the effects of arcing on the metal tip. Also check for evidence of mechanical interference with the cap. Some charring is normal on the end of the metal tip. The silicone-dielectric-varnish-compound applied to the rotor tip for radio interference noise suppression, will appear charred. This is normal. **Do not remove the charred compound.** Test the spring for insufficient tension. Replace a rotor that displays any of these adverse conditions.

DIAGNOSIS AND TESTING (Continued)

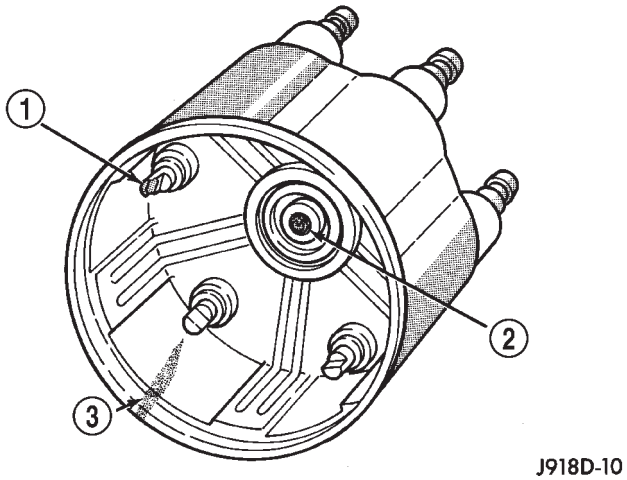


Fig. 9 Cap Inspection—Internal—Typical

1 – CHARRED OR ERODED TERMINALS
2 – WORN OR DAMAGED ROTOR BUTTON
3 – CARBON PATH

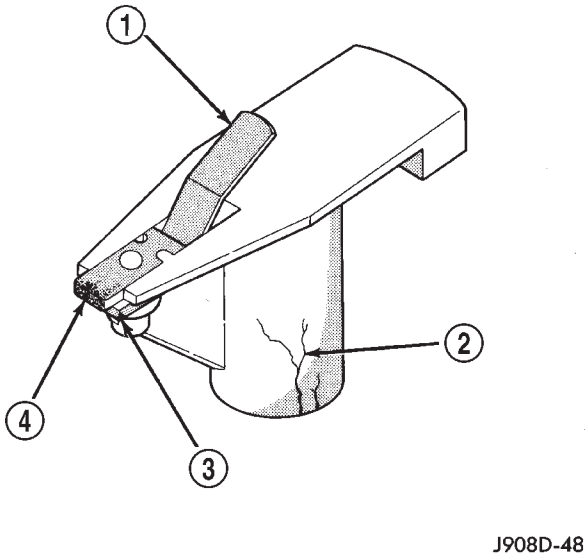


Fig. 10 Rotor Inspection—Typical

1 – INSUFFICIENT SPRING TENSION
2 – CRACKS
3 – EVIDENCE OF PHYSICAL CONTACT WITH CAP
4 – ROTOR TIP CORRODED

SPARK PLUG CABLES

TESTING

Check the spark plug cable connections for good contact at the coil(s), distributor cap towers, and spark plugs. Terminals should be fully seated. The insulators should be in good condition and should fit tightly on the coil, distributor and spark plugs. Spark plug cables with insulators that are cracked or torn must be replaced.

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

When testing secondary cables for damage with an oscilloscope, follow the instructions of the equipment manufacturer.

If an oscilloscope is not available, spark plug cables may be tested as follows:

CAUTION: Do not leave any one spark plug cable disconnected for longer than necessary during testing. This may cause possible heat damage to the catalytic converter. Total test time must not exceed ten minutes.

With the engine running, remove spark plug cable from spark plug (one at a time) and hold next to a good engine ground. If the cable and spark plug are in good condition, the engine rpm should drop and the engine will run poorly. If engine rpm does not drop, the cable and/or spark plug may not be operating properly and should be replaced. Also check engine cylinder compression.

With the engine not running, connect one end of a test probe to a good ground. Start the engine and run the other end of the test probe along the entire length of all spark plug cables. If cables are cracked or punctured, there will be a noticeable spark jump from the damaged area to the test probe. The cable running from the ignition coil to the distributor cap can be checked in the same manner. Cracked, damaged or faulty cables should be replaced with resistance type cable. This can be identified by the words ELECTRONIC SUPPRESSION printed on the cable jacket.

Use an ohmmeter to test for open circuits, excessive resistance or loose terminals. Remove the distributor cap from the distributor. **Do not remove cables from cap.** Remove cable from spark plug. Connect ohmmeter to spark plug terminal end of cable and to corresponding electrode in distributor cap. Resistance should be 250 to 1000 Ohms per inch of cable. If not, remove cable from distributor cap tower and connect ohmmeter to the terminal ends of cable. If resistance is not within specifications as found in the SPARK PLUG CABLE RESISTANCE chart, replace the cable. Test all spark plug cables in this manner.

SPARK PLUG CABLE RESISTANCE

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

To test ignition coil-to-distributor cap cable, do not remove the cable from the cap. Connect ohmmeter to rotor button (center contact) of distributor cap and

DIAGNOSIS AND TESTING (Continued)

terminal at ignition coil end of cable. If resistance is not within specifications as found in the Spark Plug Cable Resistance chart, remove the cable from the distributor cap. Connect the ohmmeter to the terminal ends of the cable. If resistance is not within specifications as found in the Spark Plug Cable Resistance chart, replace the cable. Inspect the ignition coil tower for cracks, burns or corrosion.

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. 11). 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.

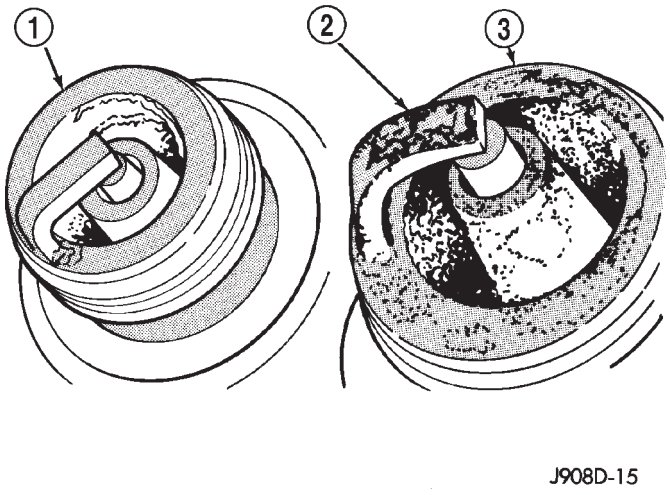


Fig. 11 Normal Operation and Cold (Carbon) Fouling

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

Some fuel refiners in several areas of the United States have introduced a manganese additive (MMT) for unleaded fuel. During combustion, fuel with MMT 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. 11). 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. 12), evaluate engine condition for the cause of oil entry into that particular combustion chamber.

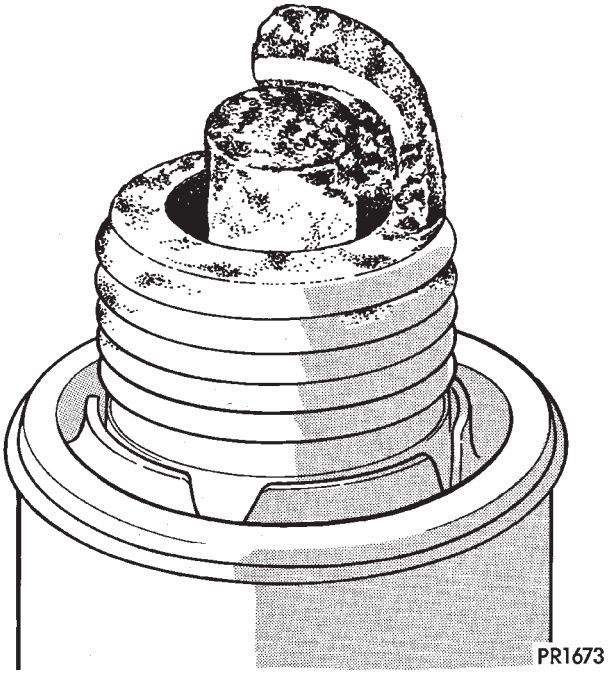


Fig. 12 Oil or Ash Encrusted

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. 13). This short circuits the electrodes. Spark plugs with electrode gap bridging can be cleaned using standard procedures.

DIAGNOSIS AND TESTING (Continued)

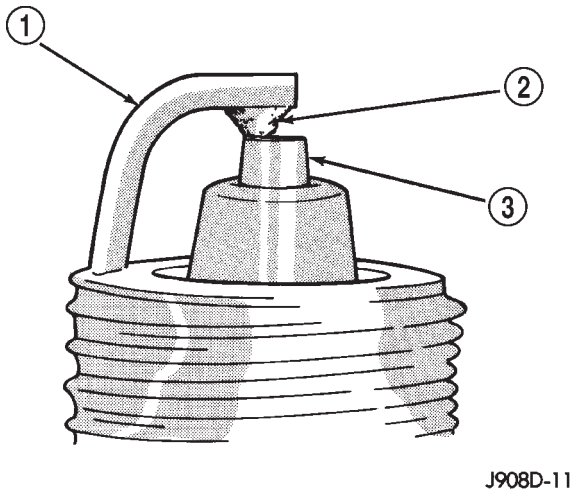


Fig. 13 Electrode Gap Bridging

1 – GROUND ELECTRODE
2 – DEPOSITS
3 – CENTER ELECTRODE

SCAVENGER DEPOSITS

Fuel scavenger deposits may be either white or yellow (Fig. 14). 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.

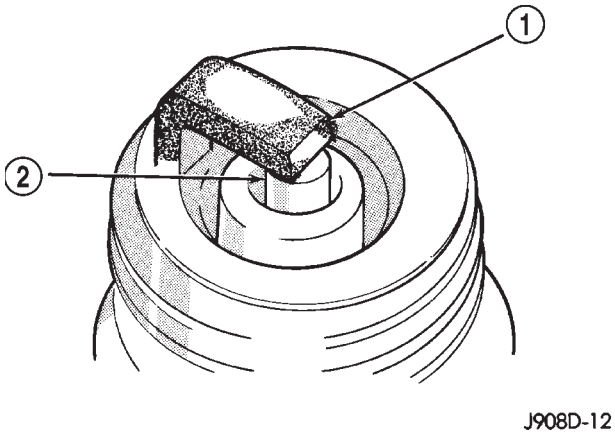


Fig. 14 Scavenger Deposits

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

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. 15). Spark plugs with this condition must be replaced.

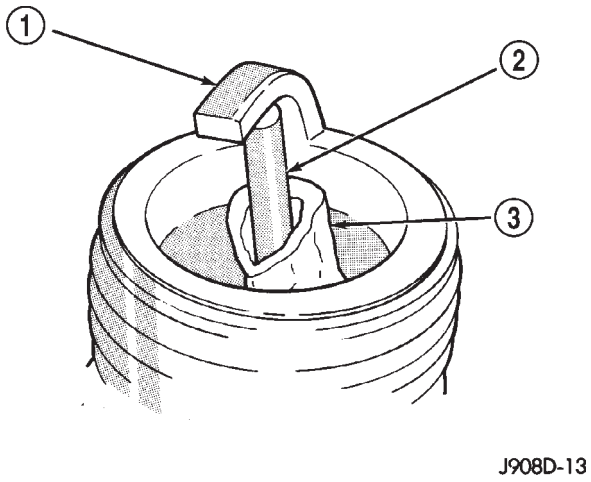


Fig. 15 Chipped Electrode Insulator

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

PREIGNITION DAMAGE

Preignition damage is usually caused by excessive combustion chamber temperature. The center electrode dissolves first and the ground electrode dissolves somewhat latter (Fig. 16). 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.)

SPARK PLUG OVERHEATING

Overheating is indicated by a white or gray center electrode insulator that also appears blistered (Fig. 17). 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.

IGNITION SWITCH AND KEY LOCK CYLINDER

ELECTRICAL DIAGNOSIS

For ignition switch electrical schematics, refer to Ignition Switch in Group 8W, Wiring Diagrams.

DIAGNOSIS AND TESTING (Continued)

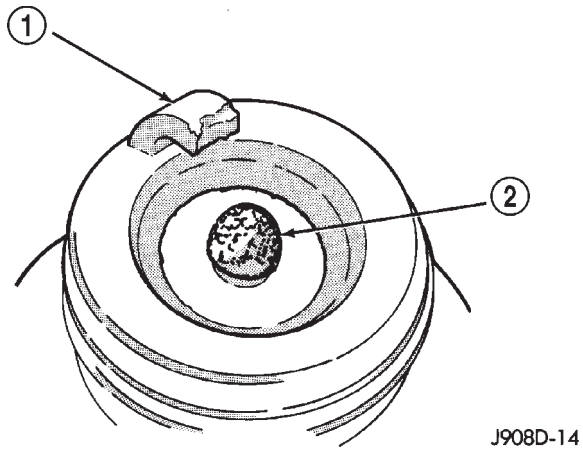


Fig. 16 Preignition Damage

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

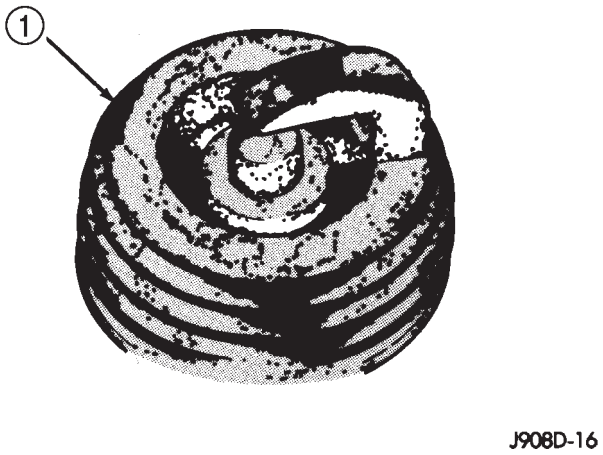


Fig. 17 Spark Plug Overheating

1 – BLISTERED WHITE OR GRAY COLORED INSULATOR

MECHANICAL DIAGNOSIS (KEY DIFFICULT TO ROTATE)

Vehicles equipped with an automatic transmission and a floor mounted shifter: a cable is used to connect the interlock device in the steering column assembly, to the transmission floor shift lever. This interlock device is used to lock the transmission shifter in the PARK position when the key lock cylinder is rotated to the LOCKED or ACCESSORY position. The interlock device within the steering column is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

If the ignition key is difficult to rotate to or from the LOCK or ACCESSORY position, it may not be the fault of the key cylinder or the steering column components. The brake transmission shift interlock cable may be out of adjustment. Refer to Brake Transmission Shift Interlock Cable Adjustment in Group 21, Transmissions for adjustment procedures.

Vehicles equipped with an automatic transmission and a steering column mounted shifter: an interlock device is located within the steering column. This interlock device is used to lock the transmission shifter in the PARK position when the key lock cylinder is in the LOCKED or ACCESSORY position. If it is difficult to rotate the key to or from the LOCK or ACCESSORY position, the interlock device within the steering column may be defective. This device is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

Vehicles equipped with a manual transmission and a floor mounted shifter: on certain models, a lever is located on the steering column behind the ignition key lock cylinder. The lever must be manually operated to allow rotation of the ignition key lock cylinder to the LOCK or ACCESSORY position. If it is difficult to rotate the key to the LOCK or ACCESSORY position, the lever mechanism may be defective. This mechanism is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

On other models, the ignition key cylinder must be depressed to allow it to be rotated into the LOCK or ACCESSORY position. If it is difficult to rotate the key to the LOCK or ACCESSORY position, the lock mechanism within the steering column may be defective. This mechanism is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

REMOVAL AND INSTALLATION

SPARK PLUG CABLES

REMOVAL

CAUTION: When disconnecting a high voltage cable from a spark plug or from the distributor cap, twist the rubber boot slightly (1/2 turn) to break it loose (Fig. 18). Grasp the boot (not the cable) and pull it off with a steady, even force.

INSTALLATION

Push the cable firmly onto the sparkplug.

SPARK PLUGS

PLUG REMOVAL

On the 4.0L 6–cylinder engine the spark plugs are located below the coil rail assembly. To gain access to

REMOVAL AND INSTALLATION (Continued)

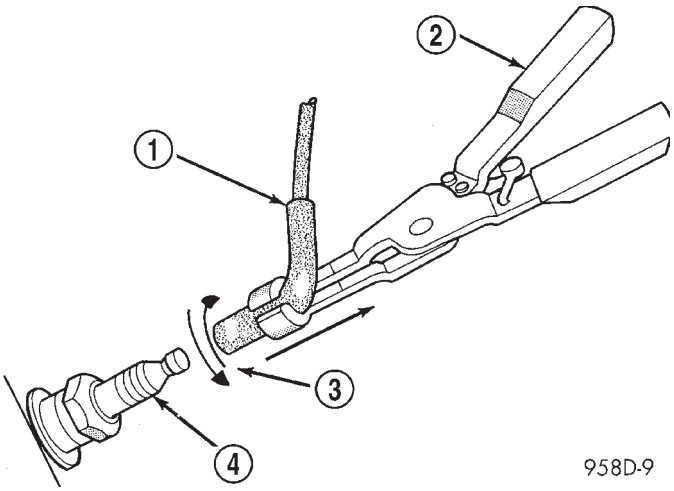


Fig. 18 Cable Removal

1 – SPARK PLUG CABLE AND BOOT
2 – SPARK PLUG BOOT PULLER
3 – TWIST AND PULL
4 – SPARK PLUG

any/all spark plug(s), refer to Ignition Coil-4.0L Engine Removal/Installation.

(1) 2.5L 4–Cylinder Engine: Always remove spark plug or ignition coil cables by grasping at the cable boot (Fig. 18). Turn the cable boot 1/2 turn and pull straight back in a steady motion. Never pull directly on the cable. Internal damage to cable will result.

(2) Prior to removing the spark plug, spray compressed air around the spark plug hole and the area around the spark plug. This will help prevent foreign material from entering the combustion chamber.

(3) Remove the spark plug using a quality socket with a rubber or foam insert.

(4) Inspect the spark plug condition. Refer to Spark Plugs Conditions.

PLUG CLEANING

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

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.

PLUG GAP ADJUSTMENT

Check the spark plug gap with a gap gauge tool. If the gap is not correct, adjust it by bending the ground electrode (Fig. 19). **Never attempt to adjust the gap by bending the center electrode.**

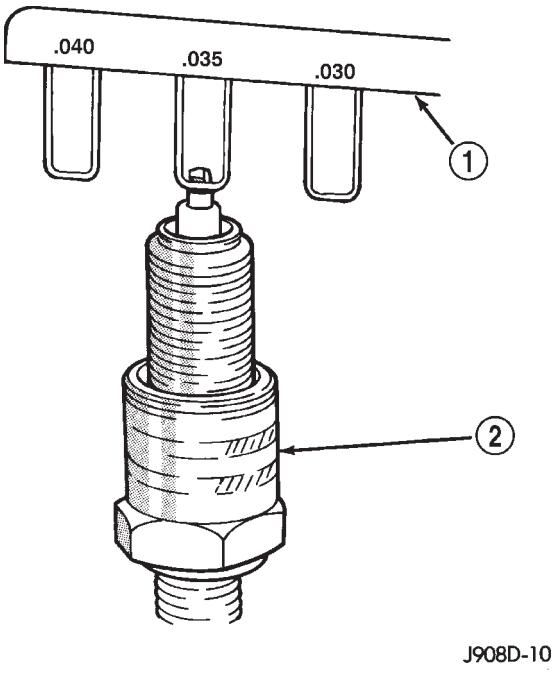


Fig. 19 Setting Spark Plug Gap—Typical

1 – GAUGE
2 – SPARK PLUG

SPARK PLUG GAP

- 2.5L 4-Cylinder Engine Spark Plug Gap:.89 mm (.035 in).
- 4.0L 6-Cylinder Engine Spark Plug Gap:.89 mm (.035 in).

PLUG INSTALLATION

Always tighten spark plugs to the specified torque. Over tightening can cause distortion. This may result in a change in the spark plug gap, or a cracked porcelain insulator.

When replacing the spark plug and ignition coil cables, route the cables correctly and secure them in the appropriate retainers. Failure to route the cables properly can cause the radio to reproduce ignition noise. It could cause cross ignition of the spark plugs, or short circuit the cables to ground.

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

(2) Tighten the spark plugs to 35-41 N·m (26-30 ft. lbs.) torque.

(3) 2.5L 4–Cylinder Engine: Install spark plug cables over spark plugs.

(4) 4.0L 6–Cylinder Engine: Install coil rail. Refer to Ignition Coil-4.0L Engine Removal/Installation.

REMOVAL AND INSTALLATION (Continued)

IGNITION COIL—2.5L ENGINE

REMOVAL

The ignition coil is an epoxy filled type. If the coil is replaced, it must be replaced with the same type.

On the 2.5L 4-cylinder engine, the ignition coil is mounted to a bracket on side of engine (to rear of distributor) (Fig. 20).

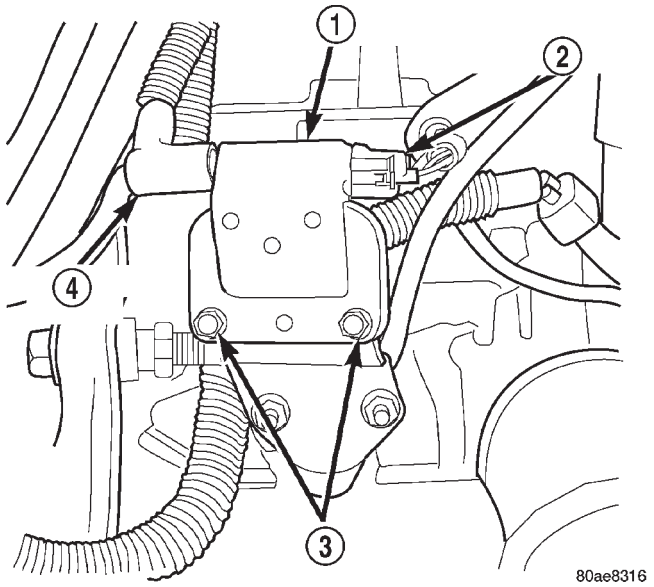


Fig. 20 Ignition Coil—2.5L Engine

1 – IGNITION COIL
2 – ELECTRICAL CONNECTOR
3 – MOUNTING BOLTS (2)
4 – SECONDARY CABLE

(1) Disconnect ignition coil secondary cable from ignition coil.

(2) Disconnect engine harness connector from ignition coil.

(3) Remove ignition coil mounting bolts (nuts are used on back side of bracket on some coils).

(4) Remove coil from vehicle.

INSTALLATION

(1) Install ignition coil to bracket on cylinder block with mounting bolts (and nuts if equipped). If equipped with nuts and bolts, tighten to 11 N·m (100 in. lbs.) torque. If equipped with bolts only, tighten to 5 N·m (50 in. lbs.) torque.

(2) Connect engine harness connector to coil.

(3) Connect ignition coil cable to ignition coil.

IGNITION COIL—4.0L ENGINE

REMOVAL

A one-piece coil rail assembly containing three individual coils is used on the 4.0L engine (Fig. 21). The coil rail must be replaced as one assembly. The bottom of the coil is equipped with 6 individual rubber boots (Fig. 21) 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. 22).

(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. 23). After slide tab has been positioned outwards, push in on secondary release lock (Fig. 23) on side of connector and pull connector from coil.

(5) Remove coil from vehicle.

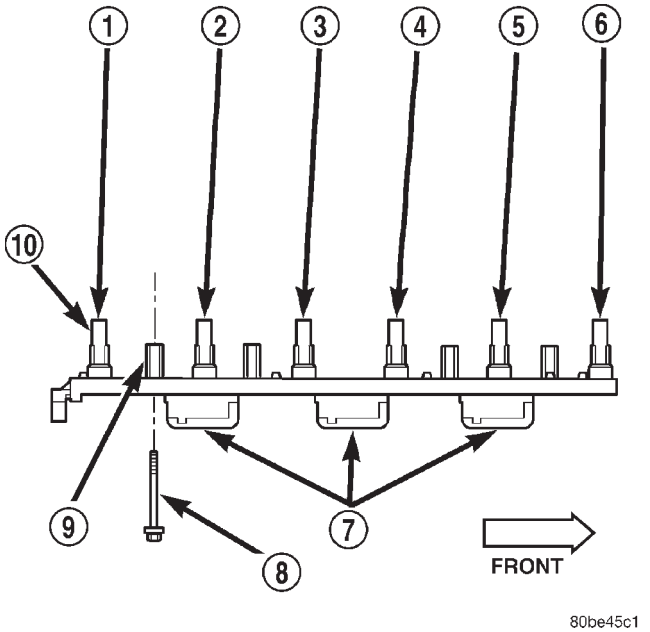


Fig. 21 Ignition Coil Assembly—4.0L 6–Cylinder Engine

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)

REMOVAL AND INSTALLATION (Continued)

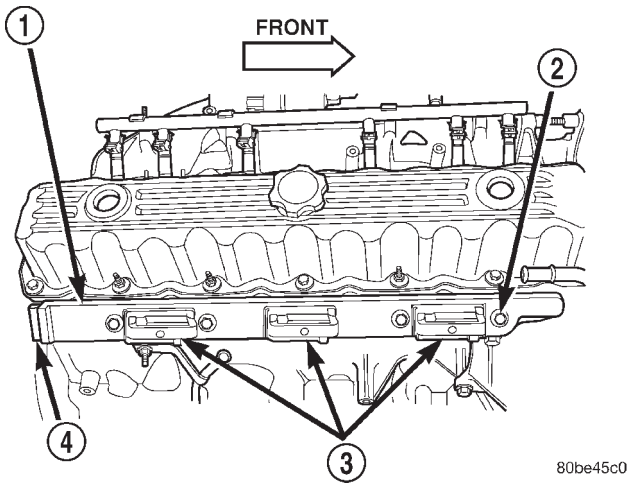


Fig. 22 Ignition Coil Rail Location—4.0L 6–Cylinder Engine

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

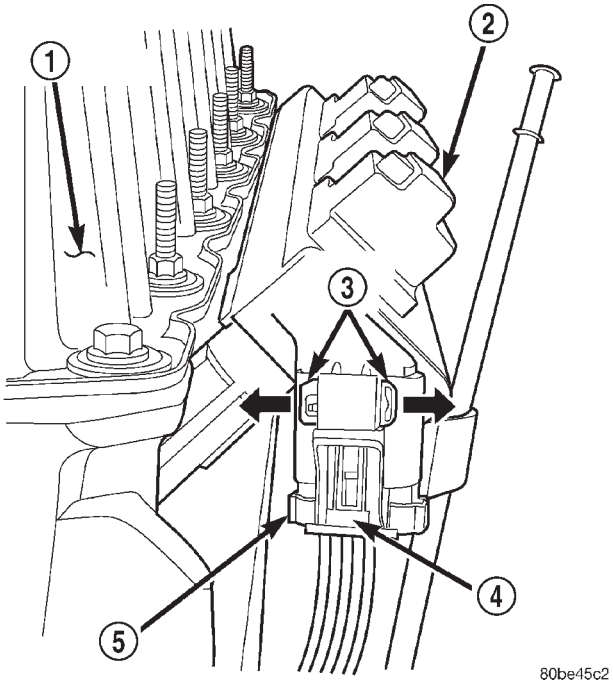


Fig. 23 Ignition Coil Electrical Connector—4.0L 6–Cylinder Engine

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. 23) for a positive lock.

(4) Connect negative battery cable to battery.

CRANKSHAFT POSITION (CKP) SENSOR

REMOVAL

The crankshaft position (CKP) sensor is mounted to the transmission bellhousing at the left/rear side of the engine block.

The sensor may be mounted to the transmission with one of the following three different configurations:

- with one bolt (Fig. 24). If sensor is equipped with one mounting bolt, **it is adjustable.**.
- with two nuts (Fig. 25).
- with two bolts (Fig. 26).

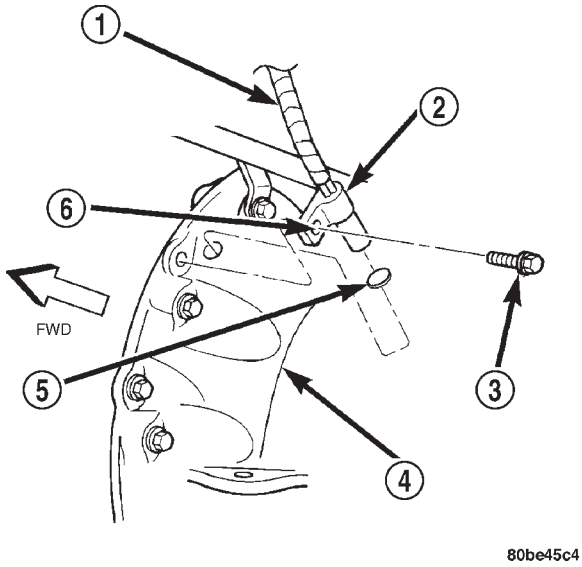


Fig. 24 Crankshaft Position Sensor—One-Bolt Mounting

1 – SENSOR PIGTAIL
2 – CRANKSHAFT POSITION SENSOR
3 – MOUNTING BOLT
4 – TRANSMISSION HOUSING
5 – PAPER SPACER
6 – SLOTTED HOLE

REMOVAL AND INSTALLATION (Continued)

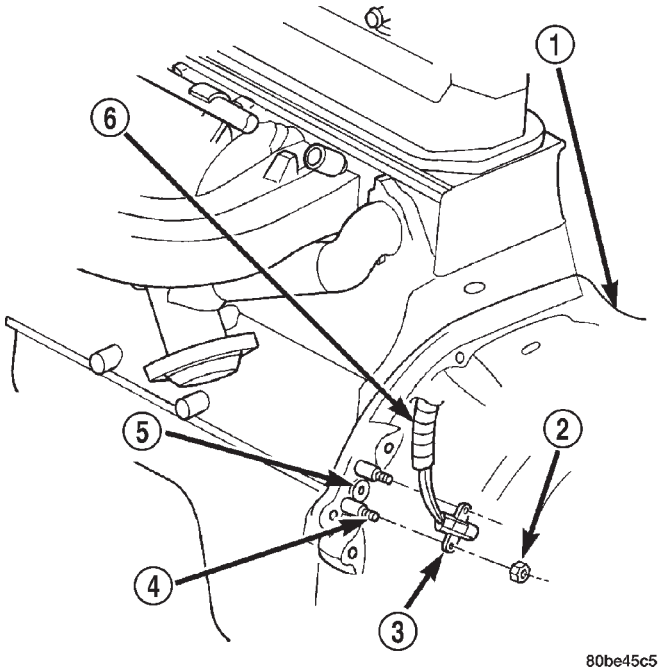


Fig. 25 Crankshaft Position Sensor—Two-Nut Mounting

1 – TRANSMISSION BELLHOUSING
2 – MOUNTING NUTS (2)
3 – CRANKSHAFT POSITION SENSOR
4 – MOUNTING STUDS (2)
5 – RUBBER GROMMET
6 – SENSOR PIGTAIL

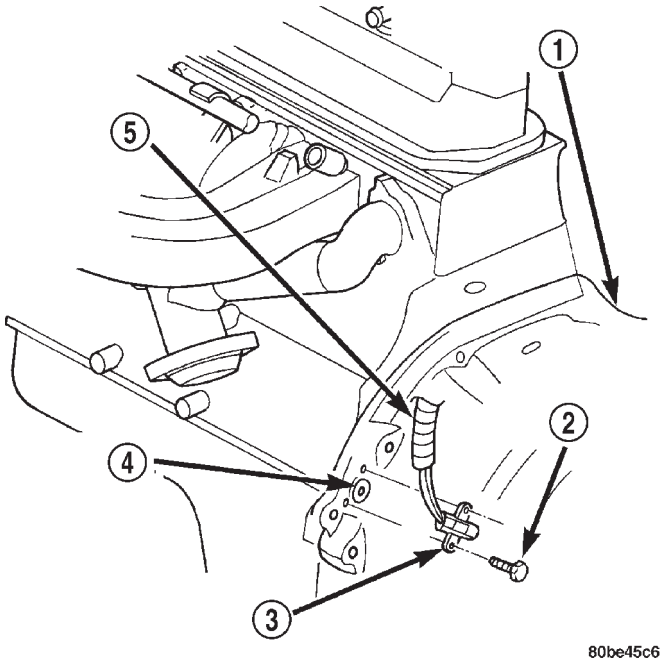


Fig. 26 Crankshaft Position Sensor—Two-Bolt Mounting

1 – TRANSMISSION BELLHOUSING
2 – MOUNTING BOLTS (2)
3 – CRANKSHAFT POSITION SENSOR
4 – RUBBER GROMMET
5 – SENSOR PIGTAIL

(1) Near left-rear side of engine, disconnect sensor pigtail harness (electrical connector) from main electrical harness connector. These connectors are attached to a bracket which is attached to the left-front side of the transmission.

(2) Depending upon application, remove either sensor mounting bolt(s) or nuts.

(3) Remove sensor from engine.

INSTALLATION

Sensor With 2–Bolt Mounting:

(1) Install sensor flush against opening in transmission housing.

(2) Install and tighten two sensor mounting bolts to 19 N·m (14 ft. lbs.) torque. The two sensor mounting bolts are specially machined to correctly space unit to flywheel. Do not attempt to install any other bolts.

Sensor With 2–Nut Mounting:

(3) Install and tighten two sensor mounting nuts to 19 N·m (14 ft. lbs.) torque.

Sensor With One-Bolt Mounting:

New replacement sensors will be equipped with a paper spacer glued to bottom of sensor. If installing (returning) a **used** sensor to vehicle, a new paper spacer must be installed to bottom of sensor. This spacer will be ground off the first time engine is started. If spacer is not used, sensor will be broken the first time engine is started.

(4) New Sensors: Be sure paper spacer is installed to bottom of sensor. If not, obtain spacer PN05252229.

(5) Used Sensors: Clean bottom of sensor and install spacer PN05252229.

(6) Install sensor into transmission bellhousing hole.

(7) Push sensor against flywheel/drive plate. With sensor pushed against flywheel/drive plate, tighten mounting bolt to 7 N·m (60 in. lbs.) torque.

(8) Connect sensor pigtail harness electrical connector to main wiring harness connector.

CAMSHAFT POSITION SENSOR—2.5L ENGINE

On 2.5L engines, the camshaft position sensor is located in the distributor (Fig. 27).

REMOVAL

Distributor removal is not necessary to remove camshaft position sensor.

(1) Disconnect negative battery cable at battery.

(2) Remove distributor cap from distributor (two screws).

(3) Disconnect camshaft position sensor wiring harness from main engine wiring harness.

REMOVAL AND INSTALLATION (Continued)

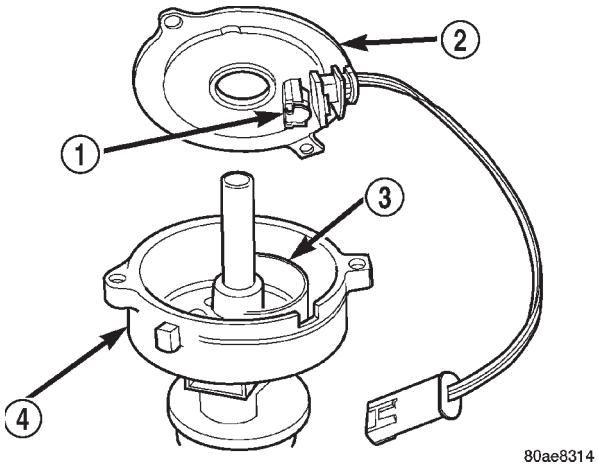


Fig. 27 Camshaft Position Sensor—2.5L Engine

1 – SYNC SIGNAL GENERATOR
2 – CAMSHAFT POSITION SENSOR
3 – PULSE RING
4 – DISTRIBUTOR ASSEMBLY

(4) Remove distributor rotor from distributor shaft.
(5) Lift camshaft position sensor assembly from distributor housing (Fig. 27).

INSTALLATION

(1) Install camshaft position sensor to distributor. Align sensor into notch on distributor housing.
(2) Connect wiring harness.
(3) Install rotor.
(4) Install distributor cap. Tighten mounting screws.

CAMSHAFT POSITION SENSOR—4.0L ENGINE

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. 28). The sensor and drive shaft assembly is located on the right side of the engine near the oil filter (Fig. 29).

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

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

Two different procedures are needed 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.

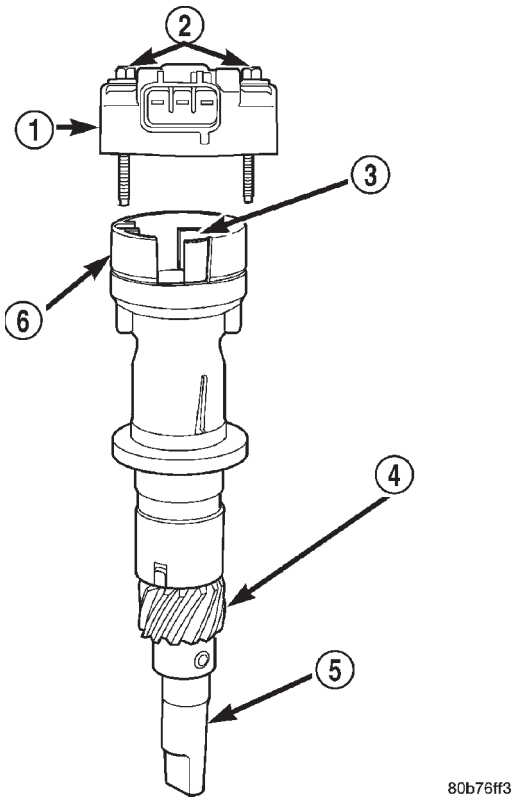


Fig. 28 CMP and Oil Pump Drive Shaft—4.0L Engine

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)

REMOVAL—SENSOR ONLY

(1) Disconnect electrical connector at CMP sensor (Fig. 29).
(2) Remove 2 sensor mounting bolts (Fig. 28) or (Fig. 29).
(3) Remove sensor from oil pump drive.

INSTALLATION—SENSOR ONLY

(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.

REMOVAL—OIL PUMP DRIVE AND SENSOR

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. 29).
(2) Remove 2 sensor mounting bolts (Fig. 28) or (Fig. 29).
(3) Remove sensor from oil pump drive.

REMOVAL AND INSTALLATION (Continued)

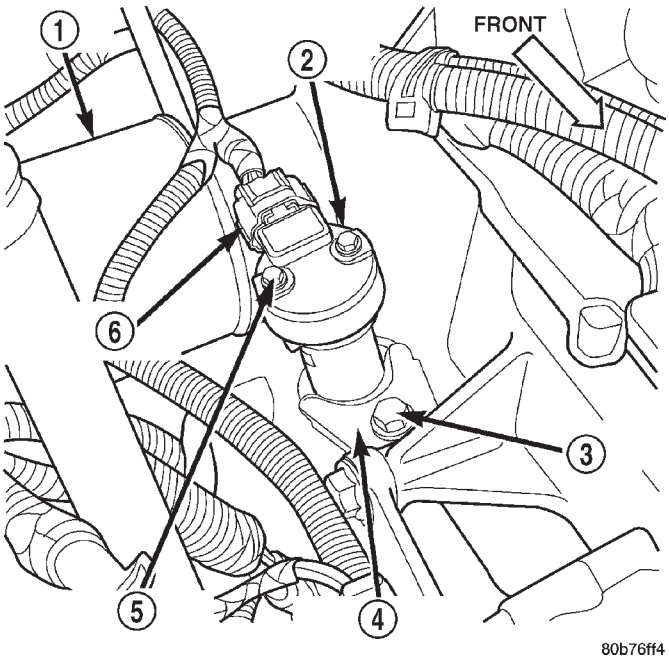


Fig. 29 CMP Location—4.0L Engine

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

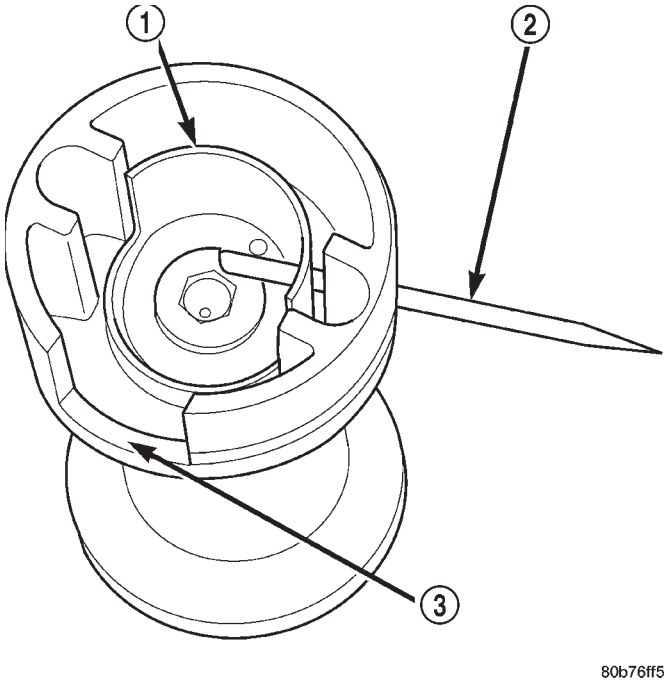


Fig. 30 CMP Pulse Ring Alignment—4.0L Engine

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

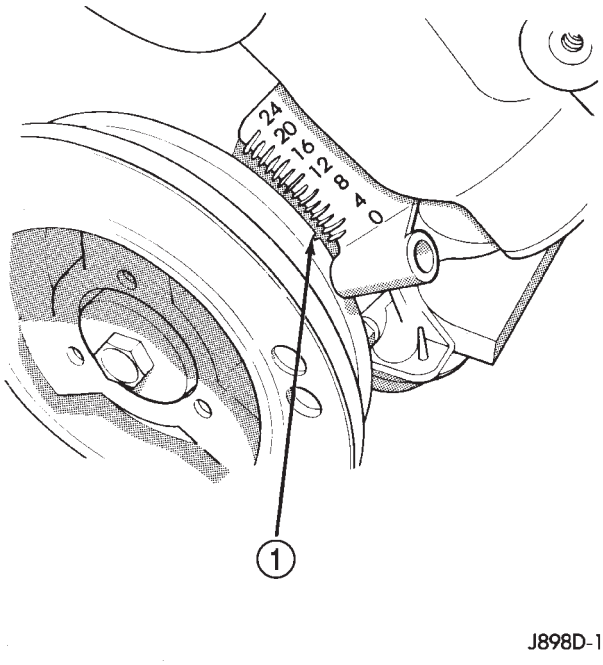


Fig. 31 Align Timing Marks—4.0L Engine

1 – CRANKSHAFT VIBRATION DAMPER TIMING MARK

(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. 29).

(6) While pulling assembly from engine, note direction and position of pulse ring (Fig. 28). 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.

INSTALLATION—OIL PUMP DRIVE AND SENSOR

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

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

(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. 30).

(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.

REMOVAL AND INSTALLATION (Continued)

(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. 31). 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.

DISTRIBUTOR—2.5L ENGINE

The distributor contains an internal oil seal that prevents oil from entering the distributor housing. The seal is not serviceable.

Factory replacement distributors are equipped with a plastic alignment pin already installed. The pin is located in an access hole on the bottom of the distributor housing (Fig. 32). It is used to temporarily lock the rotor to the cylinder number 1 position during installation. The pin must be removed after installing the distributor.

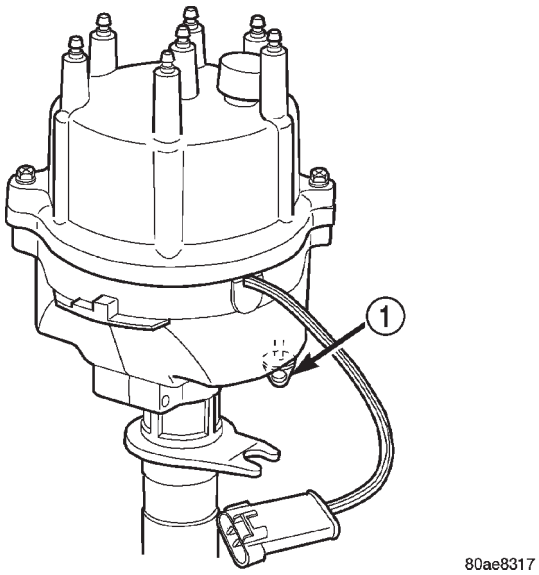


Fig. 32 Plastic Alignment Pin—2.5L Engine

1 – PLASTIC ALIGNMENT PIN

The camshaft position sensor is located in the distributor (Fig. 33). For removal/installation procedures, refer to Camshaft Position Sensor. Distributor removal is not necessary for sensor removal.

Refer to (Fig. 33) for an exploded view of the distributor.

A fork with a slot is supplied on the bottom of the distributor housing where the housing base seats against the engine block (Fig. 33). The centerline of the slot aligns with the distributor holddown bolt hole in the engine block. Because of the fork, the distributor cannot be rotated. Distributor rotation is not necessary as all ignition timing requirements are handled by the Powertrain Control Module (PCM).

The position of the distributor determines fuel synchronization only. It does not determine ignition timing.

REMOVAL AND INSTALLATION (Continued)

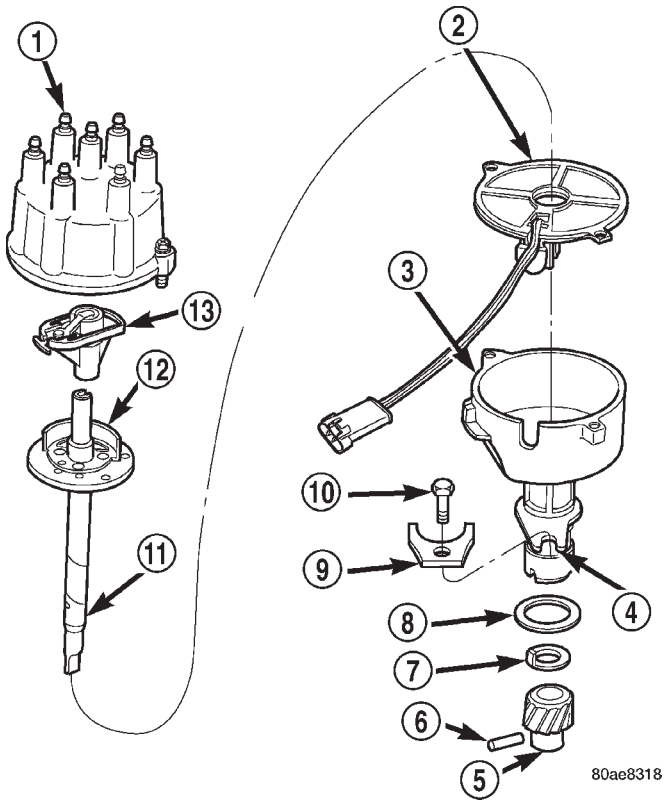


Fig. 33 Distributor—2.5L Engine—Typical

1 – CAP
2 – CAMSHAFT POSITION SENSOR
3 – HOUSING
4 – FORK WITH SLOT
5 – DRIVE GEAR
6 – ROLL PIN
7 – WASHER
8 – GASKET
9 – HOLDDOWN CLAMP
10 – HOLDDOWN BOLT
11 – SHAFT
12 – PULSE RING
13 – ROTOR

NOTE: Do not attempt to modify this fork to attain ignition timing.

REMOVAL

(1) Disconnect negative battery cable at battery.

(2) Disconnect coil secondary cable at coil.

(3) Remove distributor cap from distributor (2 screws). Do not remove cables from cap. Do not remove rotor.

(4) Disconnect distributor wiring harness from main engine harness.

(5) Remove cylinder number 1 spark plug.

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

(7) 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. 34). Always rotate engine in direction of normal rotation. Do not rotate engine backward to align timing marks.

(8) On models equipped with A/C, remove electrical cooling fan and shroud assembly from radiator. Refer to Group 7, Cooling System for procedures.

(9) This will provide room to turn engine crankshaft with a socket and ratchet using vibration damper bolt.

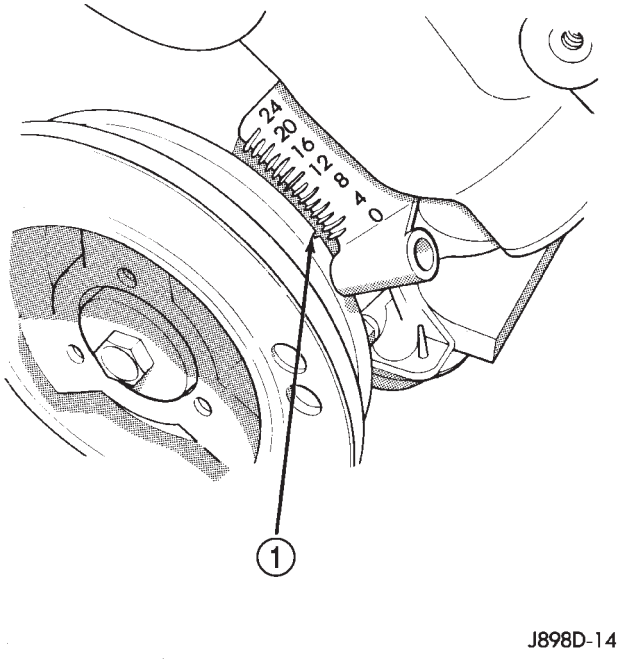


Fig. 34 Align Timing Marks—2.5L Engine

1 – CRANKSHAFT VIBRATION DAMPER TIMING MARK

(10) Remove distributor holddown bolt and clamp.

(11) Remove distributor from engine by slowly lifting straight up.

(12) Note that rotor will rotate slightly in a counterclockwise direction while lifting up distributor. The oil pump gear will also rotate slightly in a counterclockwise direction while lifting up distributor. This is due to the helical cut gears on distributor and camshaft.

(13) Note removed position of rotor during distributor removal. During installation, this will be referred to as the Pre-position.

(14) Observe slot in oil pump gear through hole on side of engine. It should be slightly before (counterclockwise of) 10 o'clock position (Fig. 35).

(15) Remove and discard the old distributor-to-engine block gasket.

REMOVAL AND INSTALLATION (Continued)

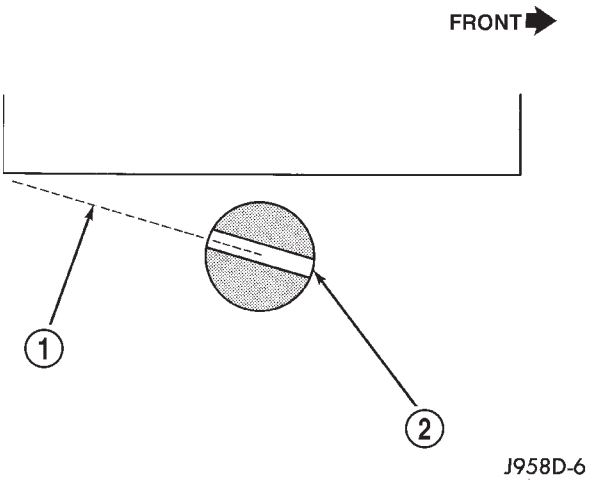


Fig. 35 Slot At 10 O'clock Position—2.5L Engine

1 – 10 0'CLOCK POSITION
2 – OIL PUMP SLOT

INSTALLATION

(1) If engine crankshaft has been rotated after distributor removal, cylinder number 1 must be returned to its proper firing stroke. Refer to previous REMOVAL Step 5 and Step 6. These steps must be done before installing distributor.

(2) Check position of slot on oil pump gear. On the 2.5L engine, it should be just slightly before (counterclockwise of) 10 o'clock position (Fig. 35). If not, place a flat blade screwdriver into oil pump gear and rotate it into proper position.

(3) Factory replacement distributors are equipped with a plastic alignment pin already installed (Fig. 32). This pin is used to temporarily hold rotor to cylinder number 1 firing position during distributor installation. If pin is in place, proceed to Step 8. If not, proceed to next step.

(4) If original distributor is to be reinstalled, such as during engine overhaul, the plastic pin will not be available. A 3/16 inch drift pin punch tool may be substituted for plastic pin.

(5) Remove camshaft position sensor from distributor housing. Lift straight up.

(6) Four different alignment holes are provided on plastic ring (Fig. 36). **Note that 2.5L and 4.0L engines have different alignment holes (Fig. 36).**

(7) Rotate distributor shaft and install pin punch tool through proper alignment hole in plastic ring (Fig. 36) and into mating access hole in distributor housing. This will prevent distributor shaft and rotor from rotating.

(8) Clean distributor mounting hole area of engine block.

(9) Install new distributor-to-engine block gasket (Fig. 33).

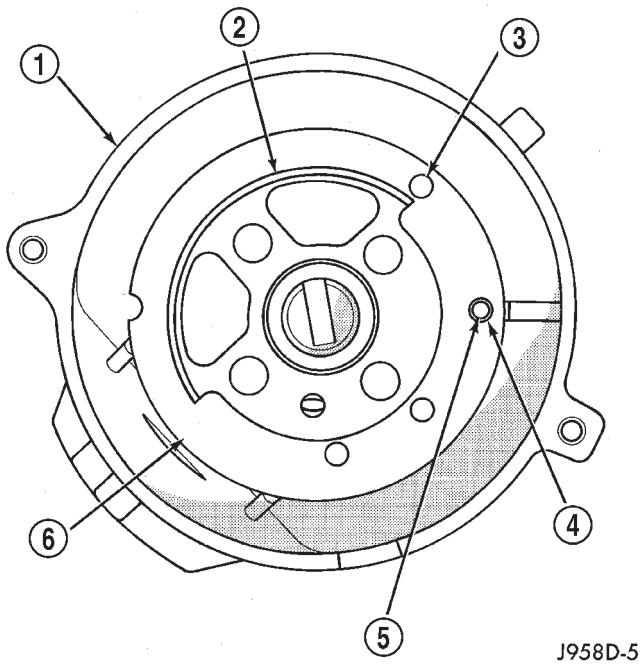


Fig. 36 Pin Alignment Holes—2.5L Engine

1 – DISTRIBUTOR HOUSING (TOP VIEW)
2 – PULSE RING
3 – 4.0L 6–CYLINDER ENGINE ALIGN. HOLE
4 – 2.5L 4–CYLINDER ENGINE ALIGN. HOLE
5 – MATING ACCESS HOLE IN DISTRIBUTOR HOUSING
6 – PLASTIC RING

(10) Install rotor to distributor shaft.

(11) Pre-position distributor into engine while holding centerline of base slot in 1 o'clock position (Fig. 37). Continue to engage distributor into engine. The rotor and distributor will rotate clockwise during installation. This is due to the helical cut gears on distributor and camshaft. When distributor is fully seated to engine block, the centerline of base slot should be aligned to clamp bolt mounting hole on engine (Fig. 38). The rotor should also be pointed slightly past (clockwise of) 3 o'clock position.

It may be necessary to rotate rotor and distributor shaft (very slightly) to engage distributor shaft with slot in oil pump gear. The same may have to be done to engage distributor gear with camshaft gear.

REMOVAL AND INSTALLATION (Continued)

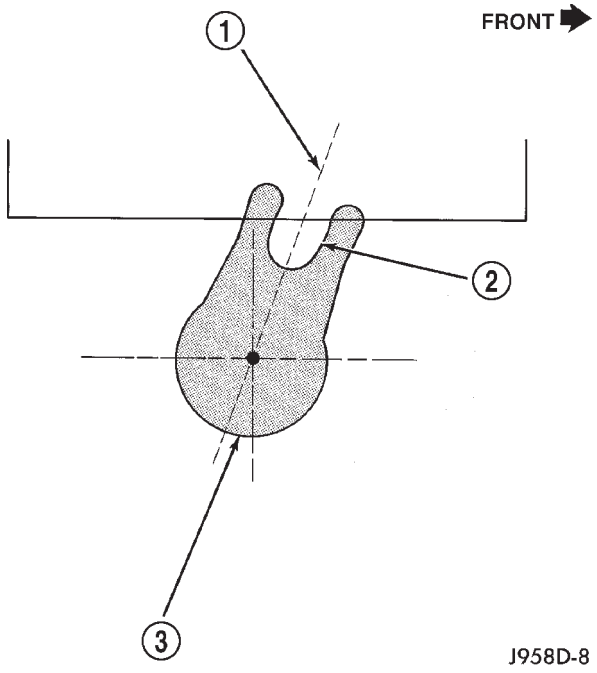


Fig. 37 Distributor Pre-position—2.5L Engine

1 – 1 O'CLOCK POSITION
2 – BASE SLOT
3 – DISTRIBUTOR BASE

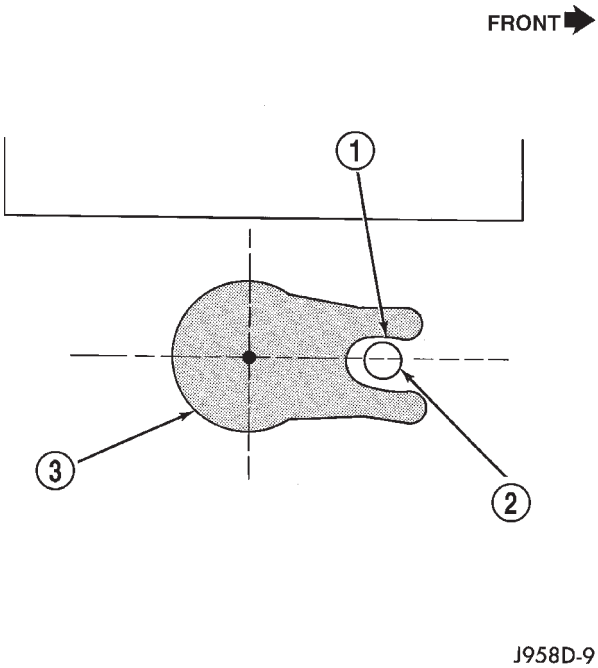


Fig. 38 Distributor Engaged Position—2.5L Engine

1 – DISTRIBUTOR BASE SLOT
2 – CLAMP BOLT MOUNTING HOLE (ON ENGINE)
3 – DISTRIBUTOR BASE

The distributor is correctly installed when:

- rotor is pointed at 3 o'clock position.
- plastic alignment pin (or pin punch tool) is still installed to distributor.
- number 1 cylinder piston is set at top dead center (TDC) (compression stroke).
- centerline of slot at base of distributor is aligned to centerline of distributor holddown bolt hole on engine. In this position, the holddown bolt should easily pass through slot and into engine.

No adjustments are necessary. Proceed to next step.

(12) Install distributor holddown clamp and bolt. Tighten bolt to 23 N·m (17 ft. lbs.) torque.

(13) Remove pin punch tool from distributor. Or, if plastic alignment pin was used, remove it straight down from bottom of distributor. Discard plastic pin.

(14) If removed, install camshaft position sensor to distributor. Align wiring harness grommet to notch in distributor housing.

(15) Install rotor.

CAUTION: If the distributor cap is incorrectly positioned on distributor housing, cap or rotor may be damaged when engine is started.

(16) Install distributor cap. Tighten distributor cap holddown screws to 3 N·m (26 in. lbs.) torque.

(17) If removed, install spark plug cables to distributor cap. For proper firing order, refer to Engine Firing Order.

(18) Connect distributor wiring harness to main engine harness.

(19) Connect battery cable to battery.

IGNITION SWITCH AND KEY CYLINDER

The ignition key must be in the key cylinder for cylinder removal. The key cylinder must be removed first before removing ignition switch.

KEY CYLINDER REMOVAL

(1) Disconnect negative battery cable at battery.

(2) If equipped with an automatic transmission, place shifter in PARK position.

(3) Rotate key to ON position.

(4) A release tang is located on bottom of key cylinder (Fig. 39).

(5) Position a small screwdriver or pin punch into tang access hole on bottom of steering column lower cover (Fig. 40).

(6) Push the pin punch up while pulling key cylinder from steering column.

REMOVAL AND INSTALLATION (Continued)

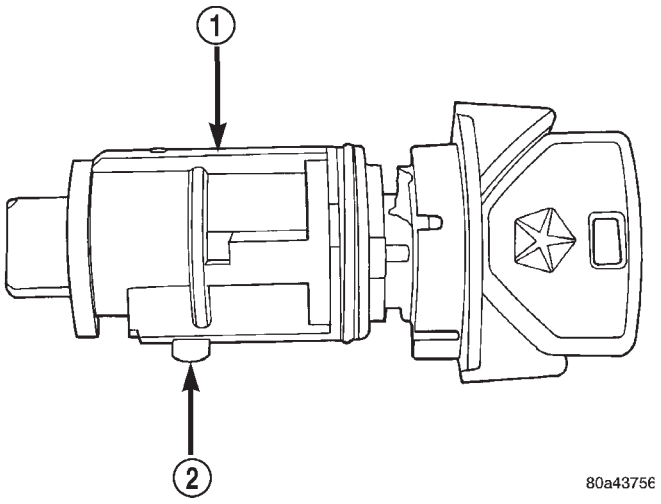


Fig. 39 Key Cylinder Release Tang

1 – KEY CYLINDER
2 – RELEASE TANG

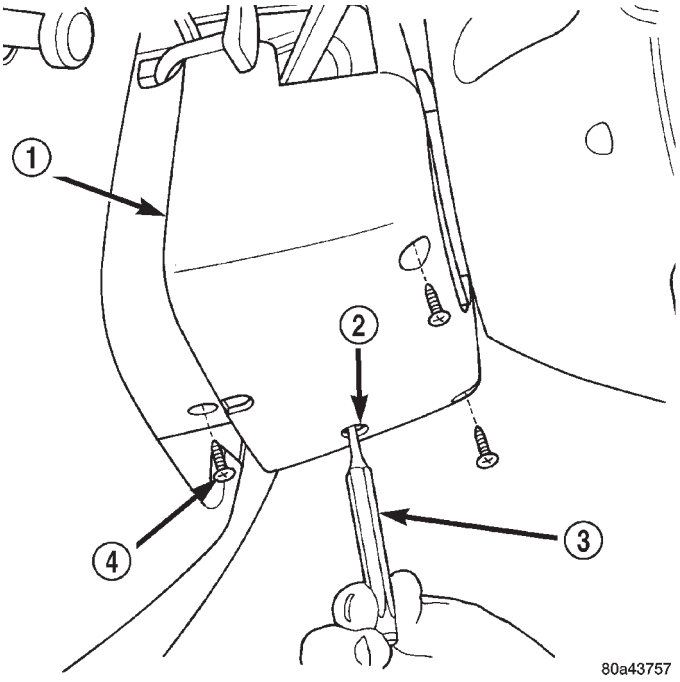


Fig. 40 Key Cylinder and Cover Removal

1 – LOWER COVER
2 – ACCESS HOLE
3 – PIN PUNCH
4 – COVER SCREWS (3)

IGNITION SWITCH REMOVAL

(1) Remove key cylinder. Refer to previous steps.

(2) Remove lower steering column cover screws and remove cover (Fig. 40).

(3) Remove ignition switch mounting screw (Fig. 43). Use tamper proof torx bit (Snap-On® SDMTR10 or equivalent) to remove the screw.

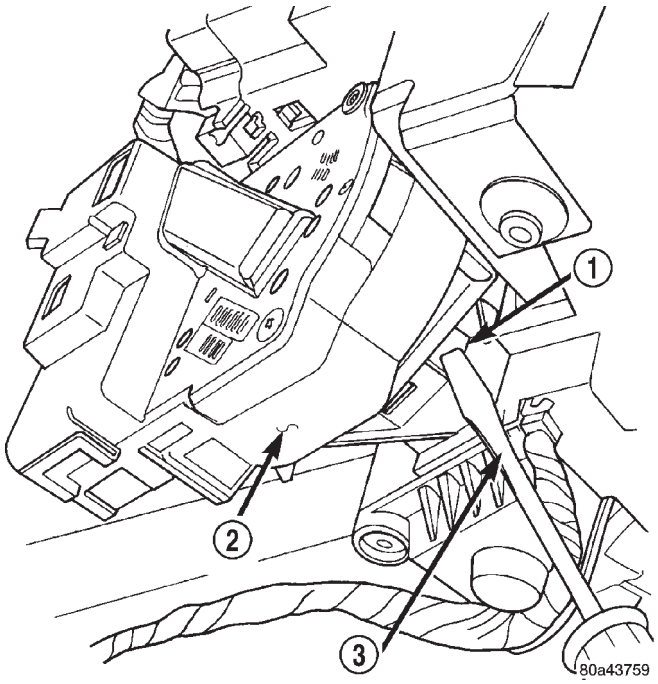


Fig. 41 Ignition Switch Lock Tab

1 – LOCK TAB
2 – IGNITION SWITCH
3 – SCREWDRIVER

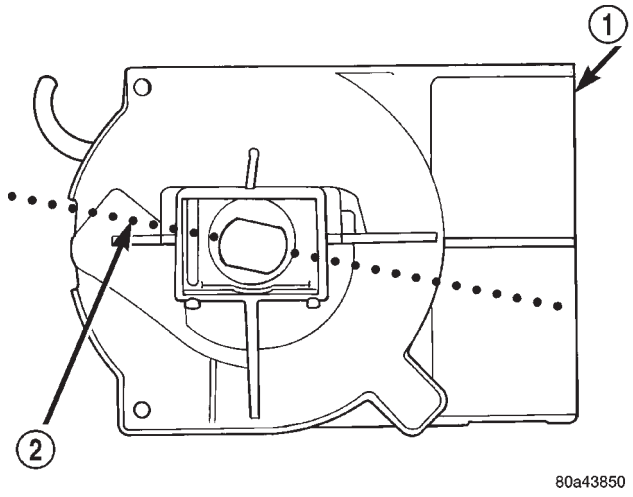


Fig. 42 Switch In ON Position

1 – IGNITION SWITCH
2 – ROTATE TO ON POSITION

(4) Using a small screwdriver, push on locking tab (Fig. 41) and remove switch from steering column.

(5) Disconnect two electrical connectors at rear of ignition switch (Fig. 43).

REMOVAL AND INSTALLATION (Continued)

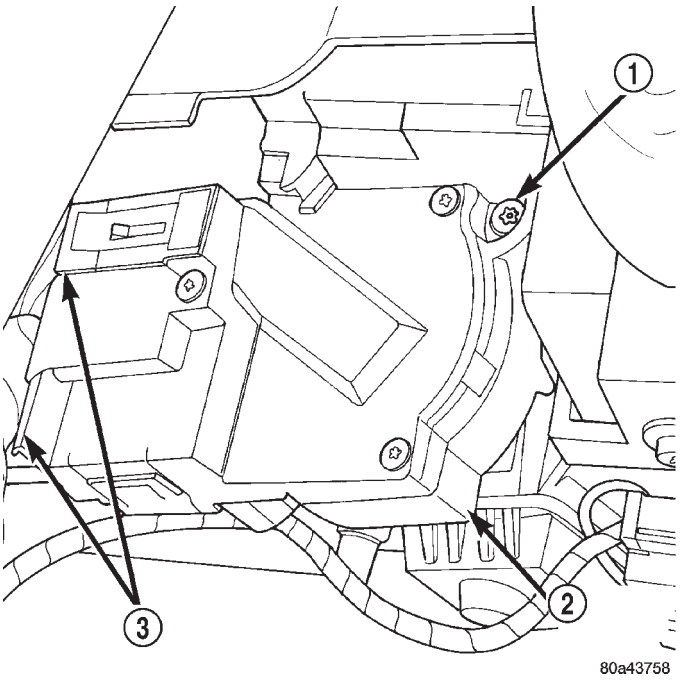


Fig. 43 Ignition Switch Removal/Installation

1 – TAMPER PROOF SCREW
2 – IGNITION SWITCH
3 – ELECTRICAL CONNECTORS

IGNITION SWITCH INSTALLATION

(1) Before installing ignition switch, rotate the slot in the switch to the ON position (Fig. 42).

(2) Connect two electrical connectors to rear of ignition switch. Make sure that locking tabs are fully seated into wiring connectors.

(3) Position switch to column and install tamper proof screw. Tighten screw to 3 N·m (26 in. lbs.).

(4) Install steering column lower cover.

KEY CYLINDER INSTALLATION

(1) If equipped with an automatic transmission, place shifter in PARK position.

(2) Position key cylinder into steering column as it would normally be in the ON position.

(3) Press key cylinder into column until it snaps into position.

(4) Check mechanical operation of switch. **Automatic Transmission:** Be sure transmission lever is locked in PARK position after key removal. If key is difficult to rotate or is difficult to remove, the shift lever-to-steering column cable may be out of adjustment or defective. Refer to Group 21, Transmission for procedures. **Manual Transmission:** Be sure key cannot be removed until release lever is operated. If key can be removed, release lever mechanism may be defective. Release lever mechanism is not serviced separately. If repair is necessary, the steering column must be replaced. Refer to Group 19, Steering for procedures.

(5) Connect negative cable to battery.

(6) Check electrical operation of switch.

SHIFTER/IGNITION INTERLOCK

REMOVAL/INSTALLATION

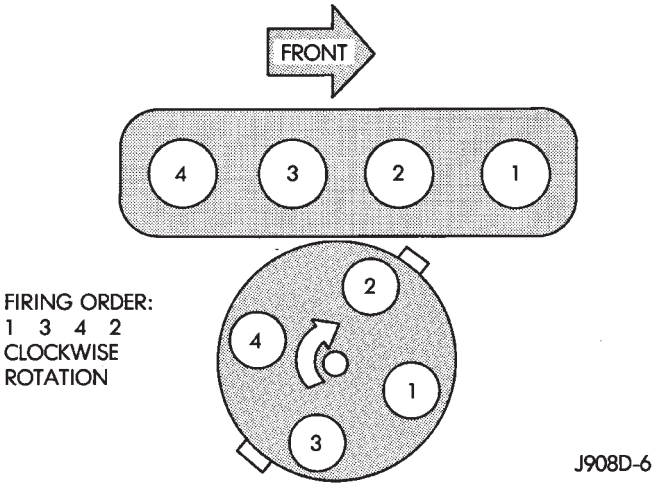
On models equipped with an automatic transmission, a cable connects the ignition switch with the floor shift lever. The shifter will be locked in the PARK position when the ignition key is in the LOCK or ACCESSORY positions. The cable can be adjusted or replaced. Refer to Group 21, Transmissions for procedures. The ignition interlock device within the steering column is not serviceable. If service is necessary, the steering column must be replaced. Refer to Group 19, Steering for procedures.

SPECIFICATIONS

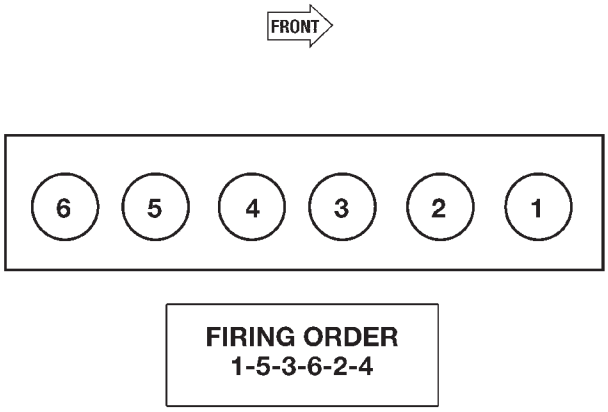
IGNITION TIMING

Ignition timing is not adjustable on any engine.

ENGINE FIRING ORDER—2.5L 4-CYLINDER ENGINE



ENGINE FIRING ORDER—4.0L 6-CYLINDER ENGINE



SPARK PLUGS

ENGINE	PLUG TYPE	ELECTRODE GAP
2.5L	RC12ECC	0.89 mm (0.035 in.)
4.0L	RC12ECC	0.89 mm (0.035 in.)

SPARK PLUG CABLE RESISTANCE

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

IGNITION COIL RESISTANCE—2.5L ENGINE

COIL MANUFACTURER	PRIMARY RESISTANCE @ 21-27°C (70-80°F)	SECONDARY RESISTANCE @ 21-27°C (70-80°F)
Diamond	0.97 - 1.18 Ohms	11,300 - 15,300 Ohms
Toyodenso	0.95 - 1.20 Ohms	11,300 - 13,300 Ohms

IGNITION COIL RESISTANCE—4.0L ENGINE

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

SPECIFICATIONS (Continued)

TORQUE CHART

DESCRIPTION	TORQUE
Camshaft Position Sensor–to–base bolts—4.0L	28 N·m (15 in. lbs.)
Crankshaft Position Sensor Bolts (sensor mounted with 2 bolts)	19 N·m (14 ft. lbs.)
Crankshaft Position Sensor Nuts (sensor mounted with 2 nuts)	19 N·m (14 ft. lbs.)
Crankshaft Position Sensor Bolt (sensor mounted with 1 bolt)	7 N·m (60 in. lbs.)
Distributor Hold Down Bolt—2.5L	23 N·m (17 ft. lbs.)
Distributor Cap Screws—2.5L	3 N·m (26 in. lbs.)
Ignition Coil Mounting (if tapped bolts are used)—2.5L	5 N·m (50 in. lbs.)
Ignition Coil Mounting (if nuts/bolts are used)—2.5L	11 N·m (100 in. lbs.)
Ignition Coil Rail Mounting Bolts—4.0L	29 N·m (250 in. lbs.)
Oil Pump Drive Hold-down Bolt—4.0L	23 N·m (17 ft. lbs.)
Spark Plugs (all engines)	41 N·m (30 ft. lbs.)