IGNITION SYSTEM

CONTENTS

DESCRIPTION AND OPERATION

IGNITION SYSTEM

The ignition systems used on the 2.5L 4–cylinder and the 4.0L 6–cylinder engine are basically identical. Similarities and differences between the systems will be discussed.

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

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

POWERTRAIN CONTROL MODULE

The Powertrain Control Module (PCM) is located in the engine compartment (Fig. 1).

The ignition system is controlled by the PCM.

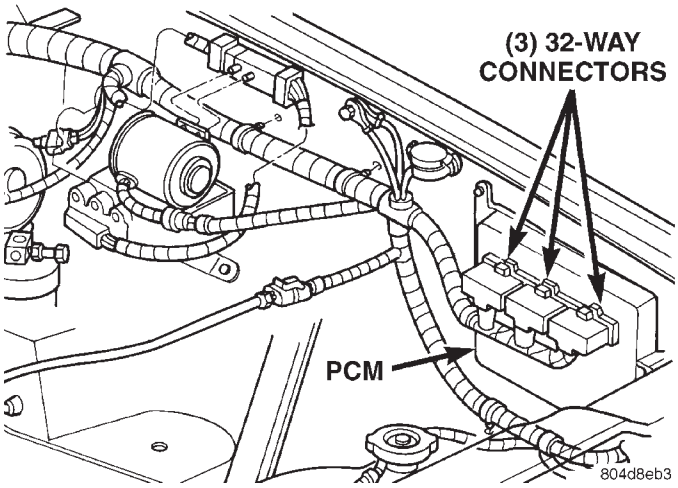


Fig. 1 Powertrain Control Module (PCM) Location

NOTE: Base ignition timing by rotation of distributor is not adjustable.

The PCM opens and closes the ignition coil ground circuit to operate the ignition coil. This is done to adjust ignition timing, both initial (base) and

DESCRIPTION AND OPERATION (Continued)

advance, and for changing engine operating conditions.

The amount of electronic spark advance provided by the PCM is determined by five input factors: engine coolant temperature, engine rpm, intake manifold temperature, manifold absolute pressure and throttle position.

DISTRIBUTOR

All engines are equipped with a camshaft driven mechanical distributor containing a shaft driven distributor rotor. All distributors are equipped with an internal camshaft position (fuel sync) sensor (Fig. 2). This sensor provides fuel injection synchronization and cylinder identification.

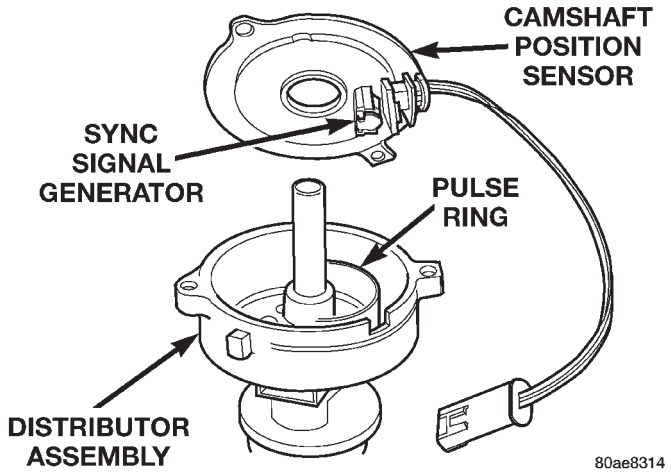


Fig. 2 Distributor and Camshaft Position Sensor-Typical

The distributors on both the 2.5L 4-cylinder and the 4.0L-6 cylinder engines do 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 on any of these engines.**

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

All engines use resistor type spark plugs. 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 milage may be cleaned and reused if not otherwise defective, carbon or oil fouled. Refer to the Spark Plug Condition section of this group.

SPARK PLUG CABLES

Spark plug cables are sometimes referred to as secondary ignition wires. These 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.

IGNITION COIL

Battery voltage is supplied to the ignition coil positive terminal 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 on any engine. 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.

AUTOMATIC SHUTDOWN (ASD) RELAY

As one of its functions, the ASD relay will supply battery voltage to the ignition coil. The ground circuit for the ASD relay is controlled by the Powertrain Control Module (PCM). The PCM regulates ASD relay operation by switching the ground circuit on-and-off.

CRANKSHAFT POSITION SENSOR

The crankshaft position sensor is mounted to the transmission bellhousing at the left/rear side of engine block (Fig. 3).

Engine speed and crankshaft position are provided through the crankshaft position sensor. The sensor generates pulses that are the input sent to the powertrain control module (PCM). The PCM interprets

DESCRIPTION AND OPERATION (Continued)

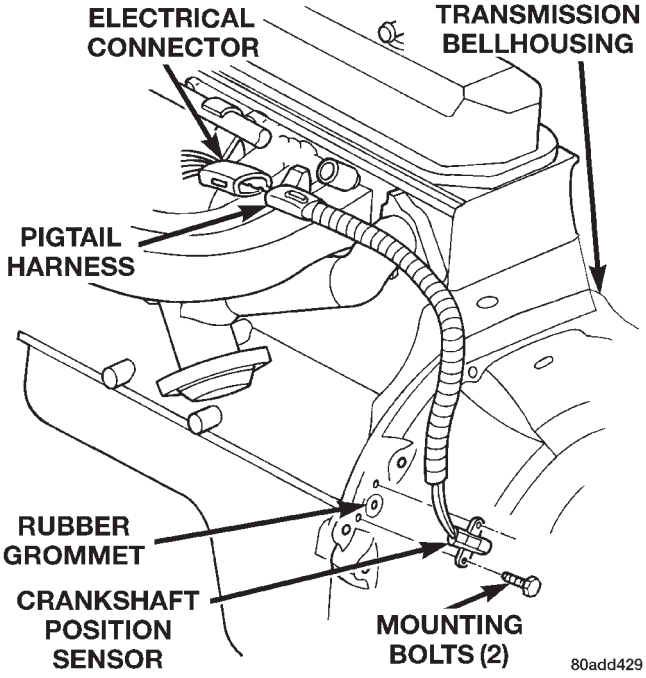


Fig. 3 Crankshaft Position Sensor—Typical

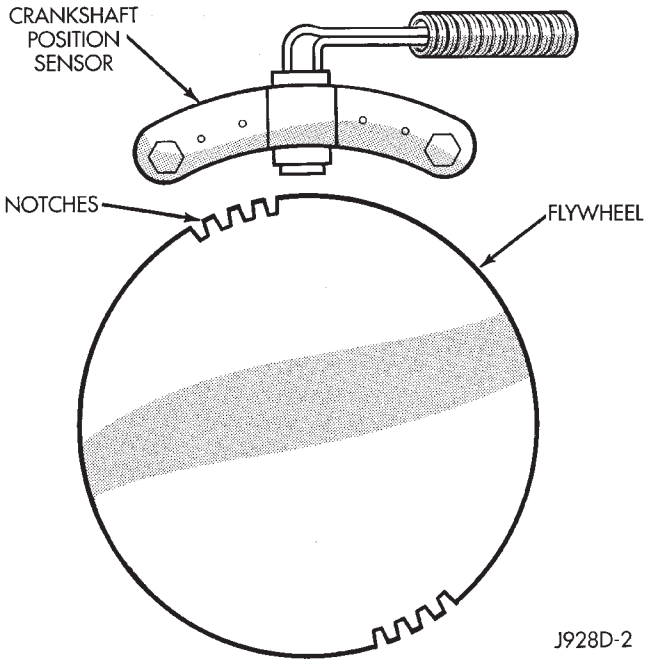


Fig. 4 Sensor Operation—2.5L 4-Cyl. Engine

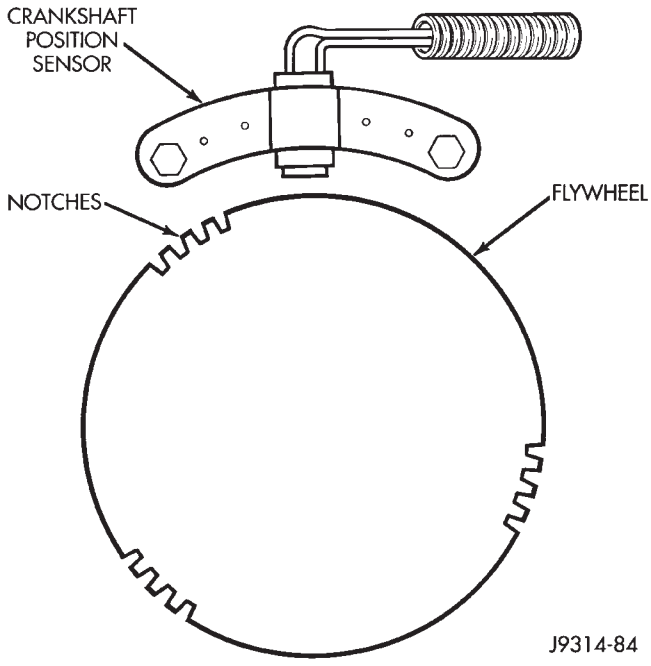


Fig. 5 Sensor Operation—4.0L 6-Cyl. Engine

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.

SENSOR OPERATION

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

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 crankshaft position sensor input.

CAMSHAFT POSITION SENSOR

The camshaft position sensor is located in the distributor on all engines.

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 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.

DESCRIPTION AND OPERATION (Continued)

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

The ignition switch is located on the steering column. The Key-In-Switch is located in the ignition switch module. For electrical diagnosis of the Key-In-Switch, refer to Group 8U, Chime/Buzzer Warning Systems. For removal/installation of either the key lock cylinder or ignition switch, refer to Ignition Switch and Key Cylinder in this group.

On vehicles equipped with an automatic transmission, a cable connects an interlock device within 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 is in the LOCKED or ACCESSORY position. The interlock device is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures. The shifter interlock cable can be adjusted or replaced. Refer to Group 21, Transmissions for procedures.

On vehicles equipped with a manual transmission, a lever is located on the steering column behind the ignition key lock cylinder. The lever must be operated to allow rotation of the ignition key lock cylinder. The lever mechanism is not serviced separately. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

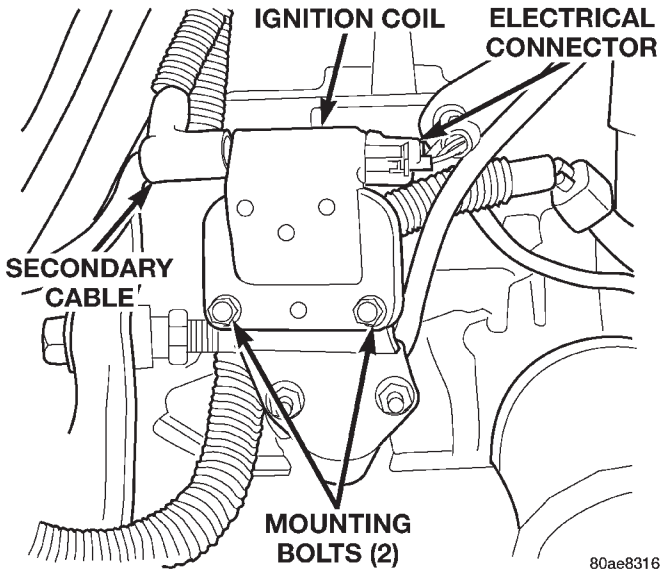


Fig. 6 Ignition Coil—2.5L Engine

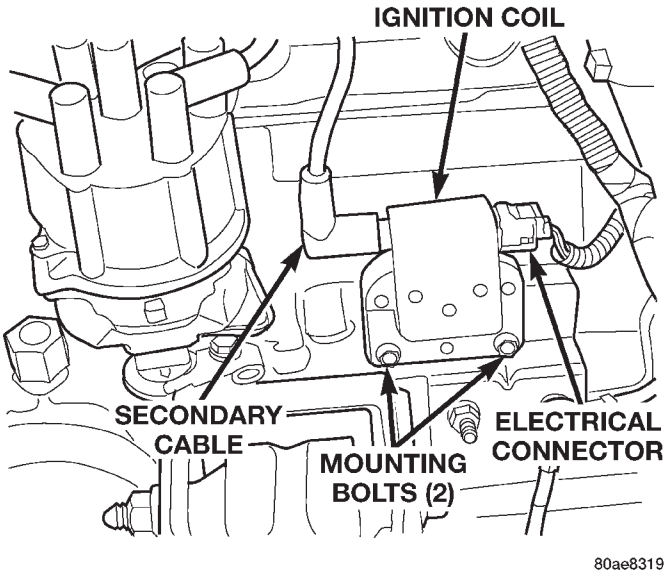


Fig. 7 Ignition Coil—4.0L Engine

DIAGNOSIS AND TESTING

IGNITION COIL TEST

To perform a complete test of the ignition coil and its circuitry, refer to the DRB scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the coil only, refer to the following:

The ignition coil (Fig. 6) or (Fig. 7) is designed to operate without an external ballast resistor.

Inspect the ignition coil for arcing. Test the coil according to coil tester manufacturer's instructions. Test the coil primary and secondary resistance. Replace any coil that does not meet specifications. Refer to the IGNITION COIL RESISTANCE chart.

IGNITION COIL RESISTANCE

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

DIAGNOSIS AND TESTING (Continued)

If the ignition coil is being replaced, the secondary spark plug cable must also be checked. Replace cable if it has been burned or damaged.

Arcing at the tower will carbonize the cable boot, which if it is connected to a new ignition coil, will cause the coil to fail.

If the secondary coil cable shows any signs of damage, it should be replaced with a new cable and new terminal. Carbon tracking on the old cable can cause arcing and the failure of a new ignition coil.

DISTRIBUTOR CAP

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.

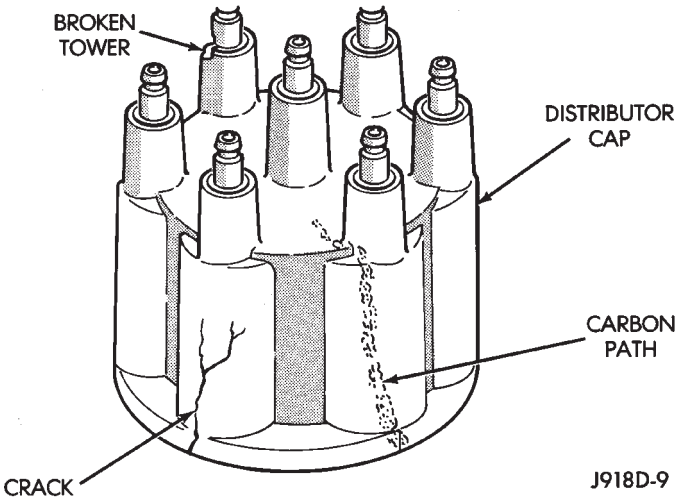


Fig. 8 Cap Inspection—External—Typical

DISTRIBUTOR ROTOR

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.

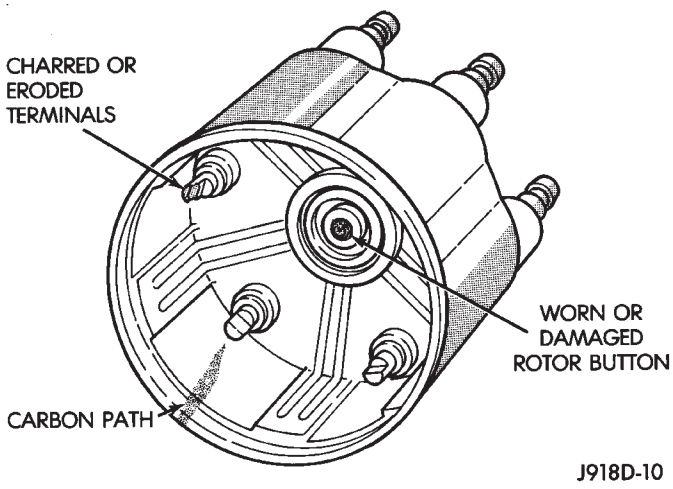


Fig. 9 Cap Inspection—Internal—Typical

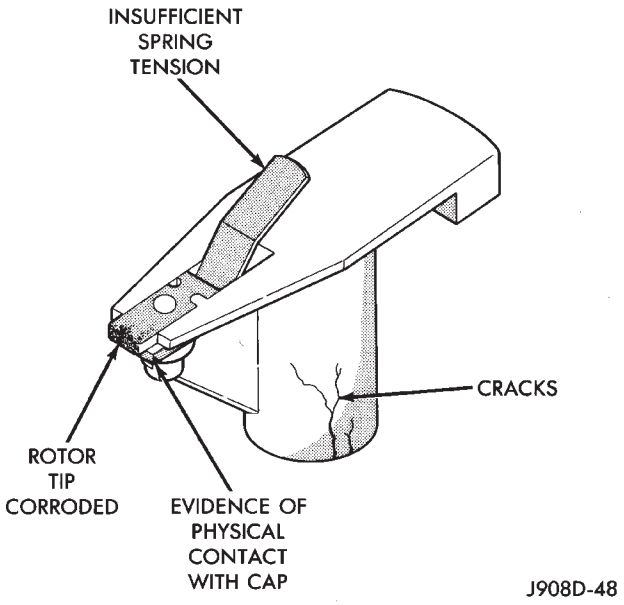


Fig. 10 Rotor Inspection—Typical

SPARK PLUG CABLES

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.

TESTING

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

DIAGNOSIS AND TESTING (Continued)

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 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.

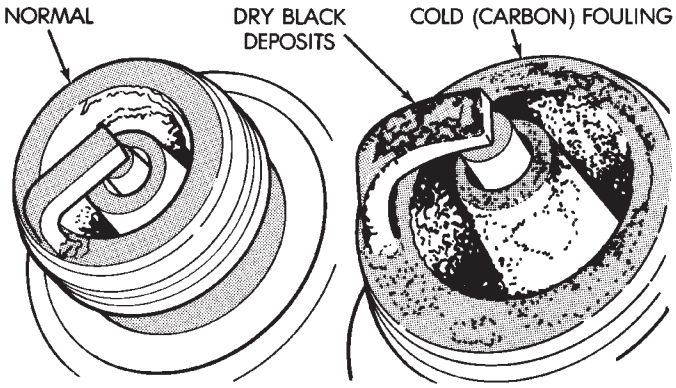


Fig. 11 Normal Operation and Cold (Carbon) Fouling

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).

DIAGNOSIS AND TESTING (Continued)

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.

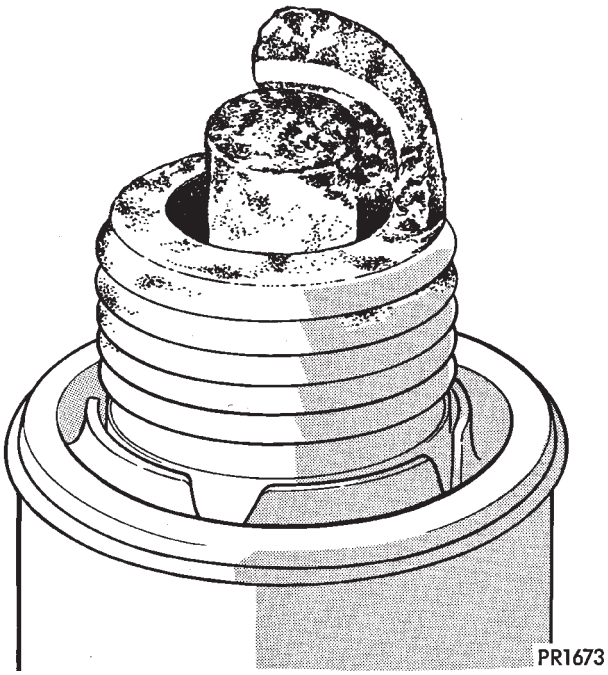


Fig. 12 Oil or Ash Encrusted

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.

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

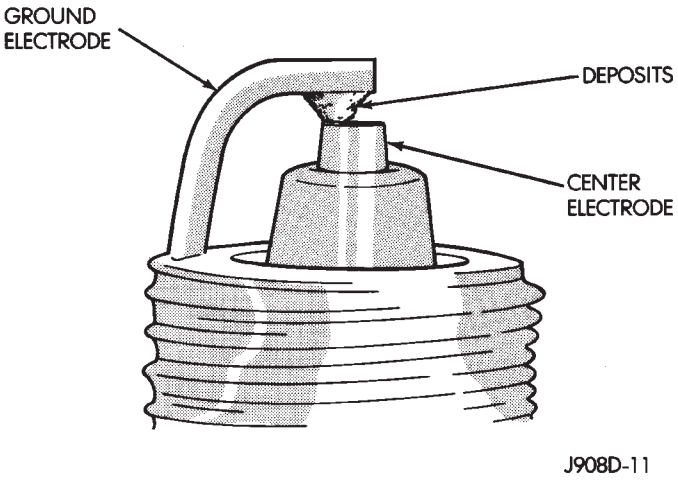


Fig. 13 Electrode Gap Bridging

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.

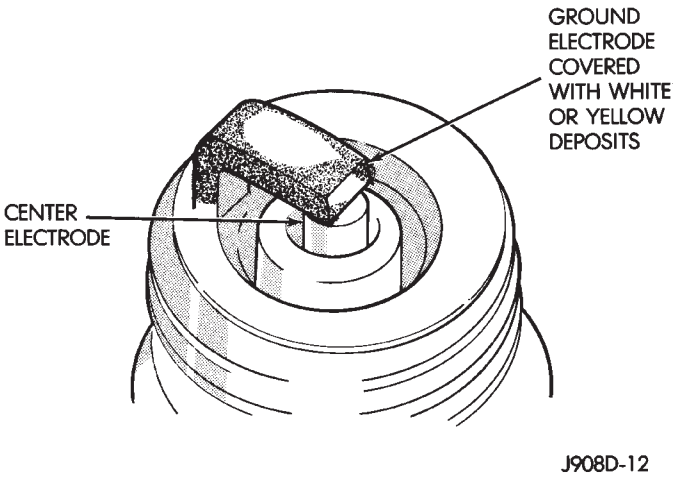


Fig. 14 Scavenger Deposits

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.

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.

DIAGNOSIS AND TESTING (Continued)

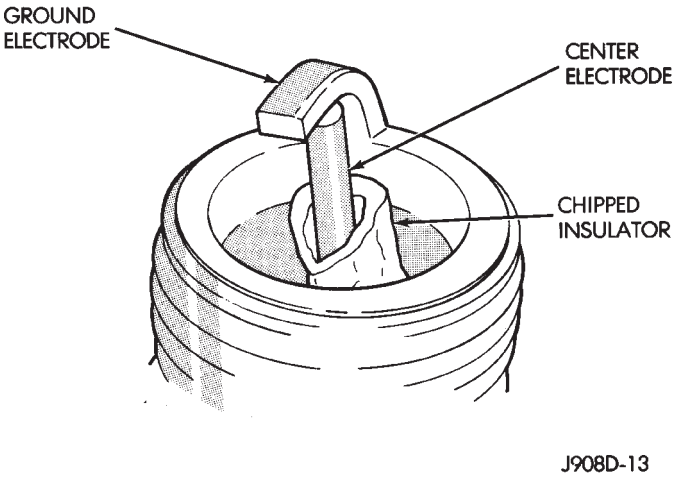


Fig. 15 Chipped Electrode Insulator

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.)

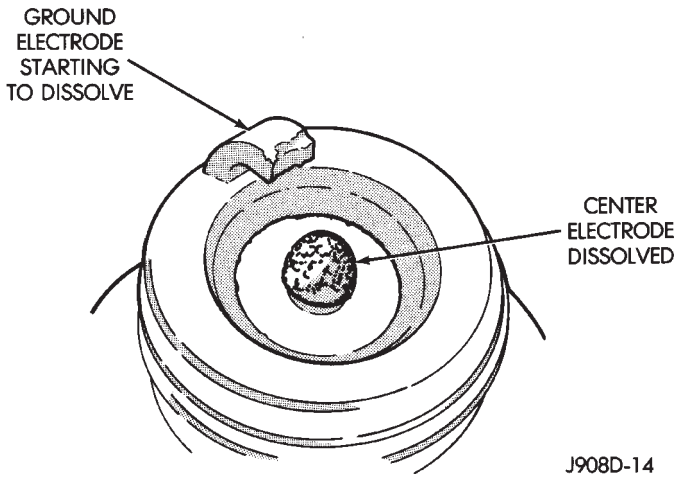


Fig. 16 Preignition Damage

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.

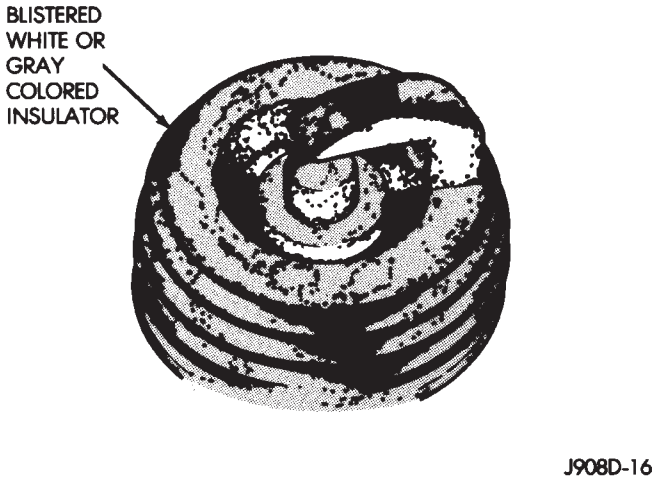


Fig. 17 Spark Plug Overheating

REMOVAL AND INSTALLATION

SPARK PLUG CABLE 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.

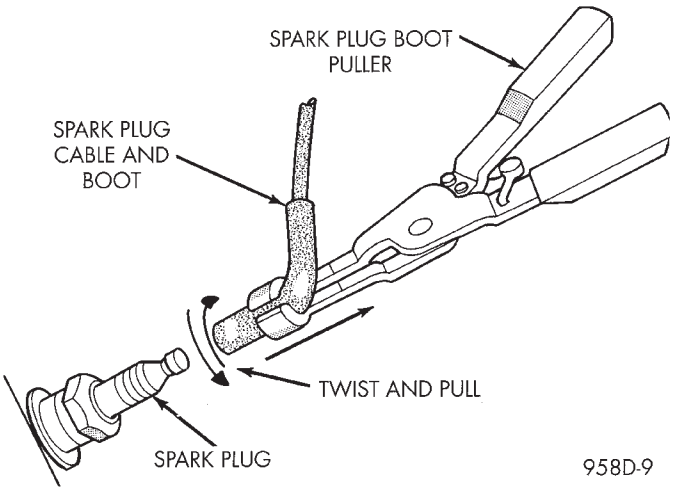


Fig. 18 Cable Removal

SPARK PLUGS

PLUG REMOVAL

(1) 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

REMOVAL AND INSTALLATION (Continued)

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 in the Diagnostics/Service Procedures section of this group.

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.**

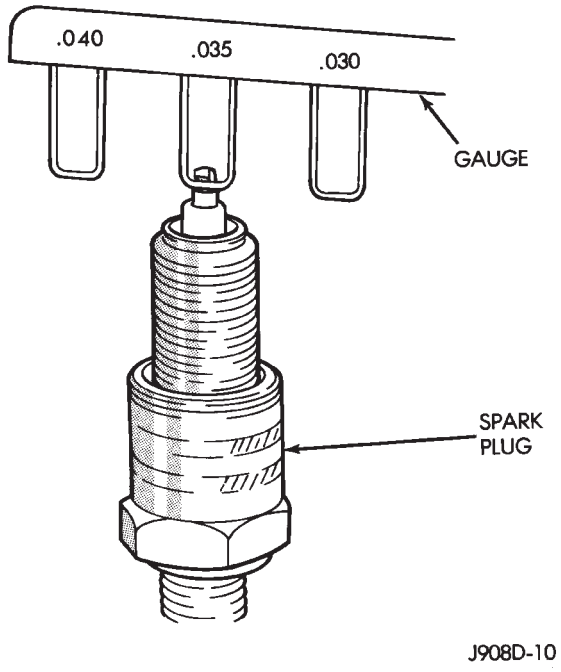


Fig. 19 Setting Spark Plug Gap—Typical

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) Install spark plug cables over spark plugs.

IGNITION COIL

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

REMOVAL

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).

On the 4.0L 6-cylinder engine, the ignition coil is mounted to a bracket on side of engine (to front of distributor) (Fig. 21).

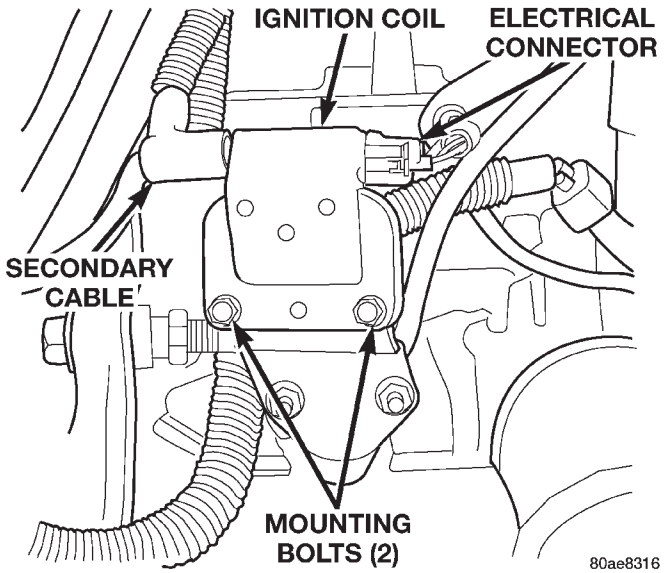


Fig. 20 Ignition Coil—2.5L Engine

(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.

REMOVAL AND INSTALLATION (Continued)

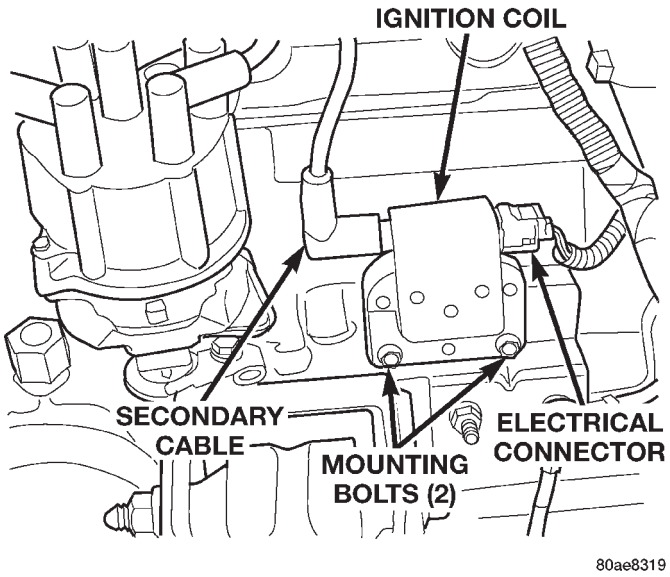


Fig. 21 Ignition Coil—4.0L Engine

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.

CRANKSHAFT POSITION SENSOR

The crankshaft position sensor is mounted to the transmission bellhousing at the left/rear side of engine block (Fig. 22) or (Fig. 23).

On 2.5L 4-cylinder equipped with a manual transmission, the sensor is attached with two bolts. On 2.5L engines equipped with an automatic transmission, the sensor is attached with two nuts. All 4.0L 6-cylinder engines have the sensor attached with two bolts.

REMOVAL

Some model/engine combinations may require removal of air cleaner tubes for access to sensor.

(1) Remove air cleaner tube(s) at throttle body (if necessary).

(2) Near rear of intake manifold, disconnect pigtail harness (electrical connector) from main electrical harness.

(3) Depending upon application, remove either sensor mounting bolts or nuts.

(4) Remove sensor.

INSTALLATION

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

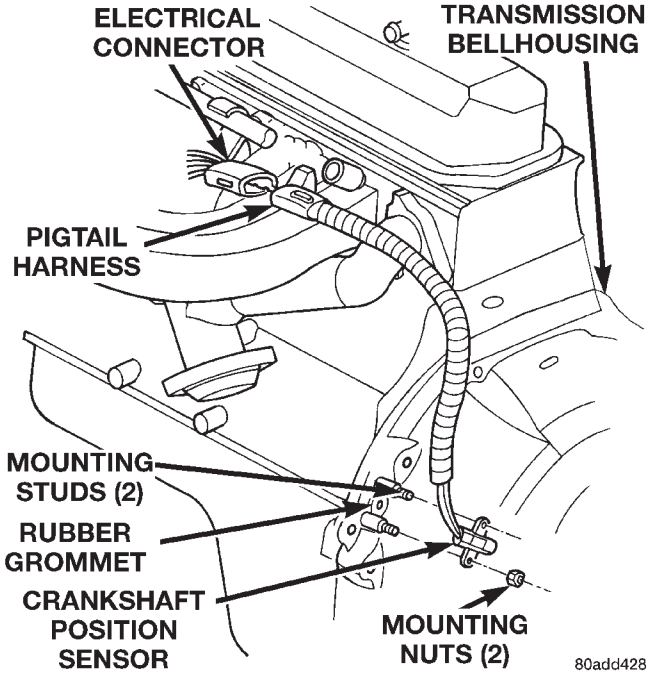


Fig. 22 Crankshaft Position Sensor—2.5L 4-Cyl. Engine With Auto. Trans.

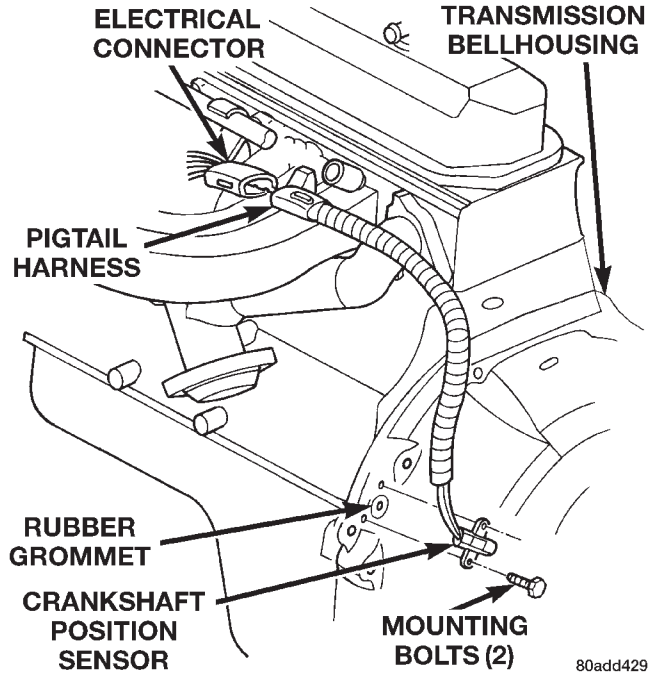


Fig. 23 Crankshaft Position Sensor—Except 2.5L 4-Cyl. Engine With Auto. Trans.

(2) 2.5L engines equipped with automatic transmission: Install and tighten two sensor mounting nuts to 19 N·m (14 ft. lbs.) torque.

(3) 2.5L engines equipped with manual transmission or any 4.0L engines: Install and tighten two sensor mounting bolts to 19 N·m (14 ft. lbs.) torque. **The two sensor mounting bolts are specially**

REMOVAL AND INSTALLATION (Continued)

machined to correctly space unit to flywheel. Do not attempt to install any other bolts.

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

(5) Install air cleaner tube to throttle body (if necessary).

CAMSHAFT POSITION SENSOR

The camshaft position sensor is located in the distributor (Fig. 24).

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.

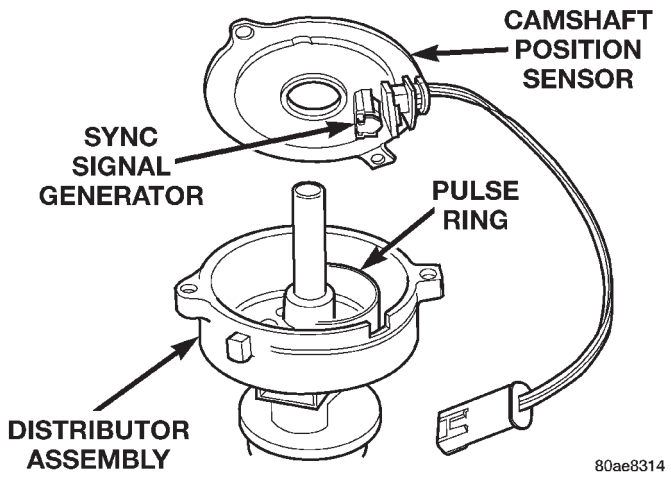


Fig. 24 Camshaft Position Sensor

(4) Remove distributor rotor from distributor shaft.

(5) Lift camshaft position sensor assembly from distributor housing (Fig. 24).

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.

DISTRIBUTOR

All distributors contain 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. 25). 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.

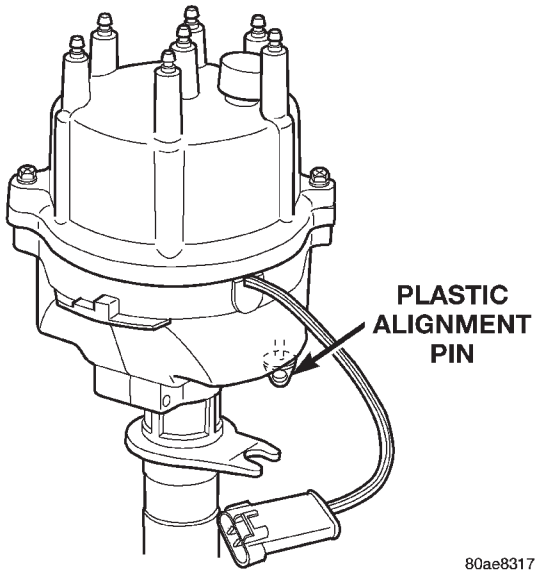


Fig. 25 Plastic Alignment Pin

The camshaft position sensor is located in the distributor on all engines (Fig. 26). For removal/installation procedures, refer to Camshaft Position Sensor. Distributor removal is not necessary for sensor removal.

Refer to (Fig. 26) 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. 26). 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.

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

REMOVAL—2.5L OR 4.0L ENGINE

(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.

REMOVAL AND INSTALLATION (Continued)

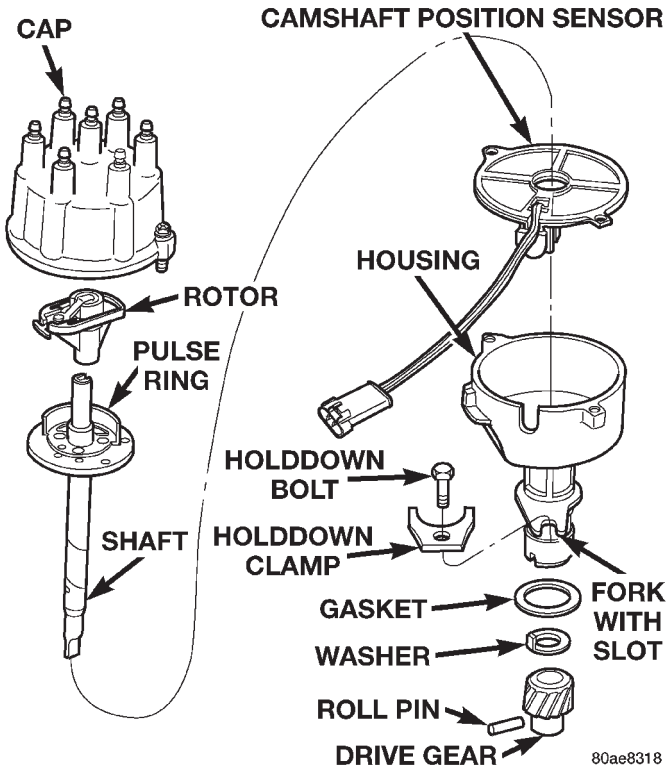


Fig. 26 Distributor—2.5L Or 4.0L Engines—Typical

(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. 27). 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.

(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) **2.5L 4-Cylinder Engine:** Observe slot in oil pump gear through hole on side of engine. It should

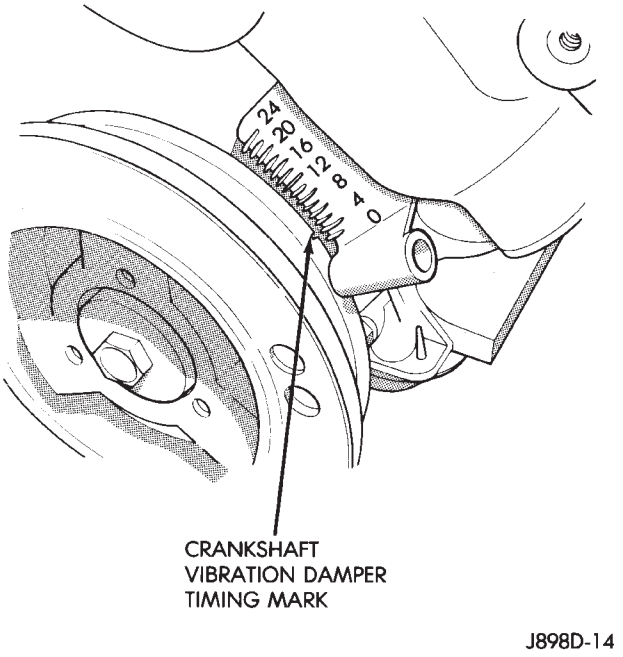


Fig. 27 Align Timing Marks

be slightly before (counterclockwise of) 10 o'clock position (Fig. 28).

(15) **4.0L 6-Cylinder Engine:** Observe slot in oil pump gear through hole on side of engine. It should be slightly before (counterclockwise of) 11 o'clock position (Fig. 29).

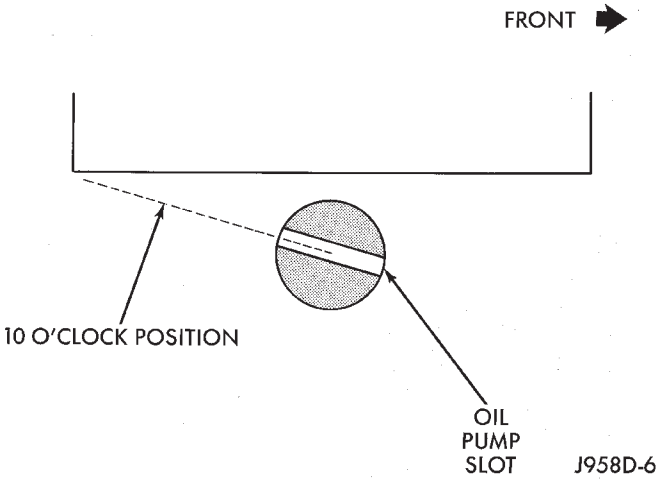


Fig. 28 Slot At 10 O'clock Position—2.5L Engine

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

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.

REMOVAL AND INSTALLATION (Continued)

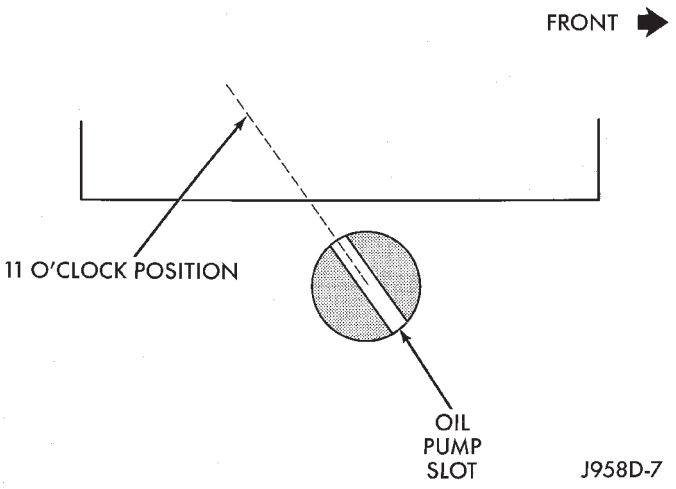


Fig. 29 Slot At 11 O'clock Position—4.0L Engine

(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. 28). On the 4.0L engine, it should be just slightly before (counterclockwise of) 11 o'clock position (Fig. 29). 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. 25). 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. 30). **Note that 2.5L and 4.0L engines have different alignment holes (Fig. 30).**

(7) Rotate distributor shaft and install pin punch tool through proper alignment hole in plastic ring (Fig. 30) 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. 26).

(10) Install rotor to distributor shaft.

(11) **2.5L 4-Cylinder Engine:** Pre-position distributor into engine while holding centerline of base slot in 1 o'clock position (Fig. 31). 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.

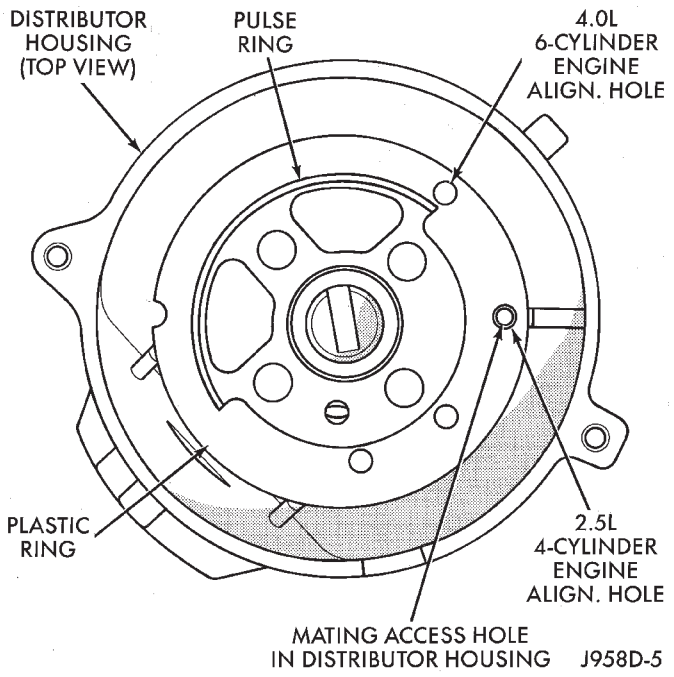


Fig. 30 Pin Alignment Holes

When distributor is fully seated to engine block, the centerline of base slot should be aligned to clamp bolt mounting hole on engine (Fig. 32). The rotor should also be pointed slightly past (clockwise of) 3 o'clock position.

4.0L 6-Cylinder Engine: Pre-position distributor into engine while holding centerline of base slot in 1 o'clock position (Fig. 31). 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. 33). The rotor should also be pointed at 5 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.

The distributor is correctly installed when:

- rotor is pointed at 3 o'clock position (2.5L engine), or at 5 o'clock position (4.0L engine).
- 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.

REMOVAL AND INSTALLATION (Continued)

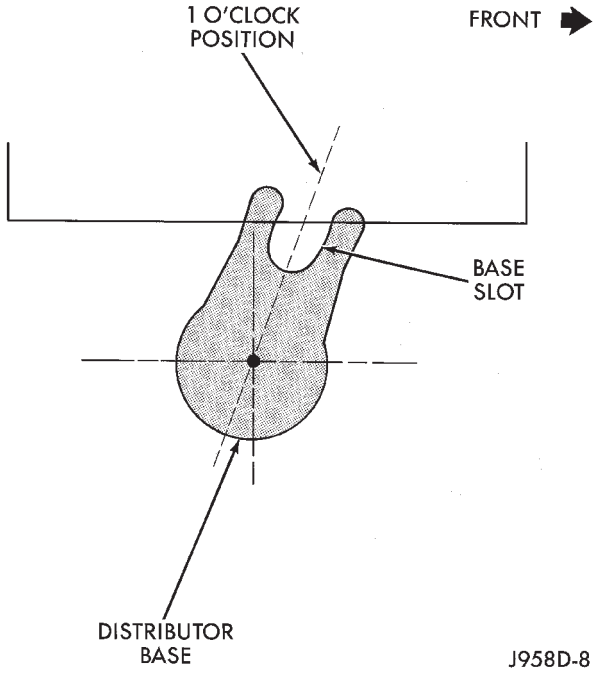


Fig. 31 Distributor Pre-position—All Engines

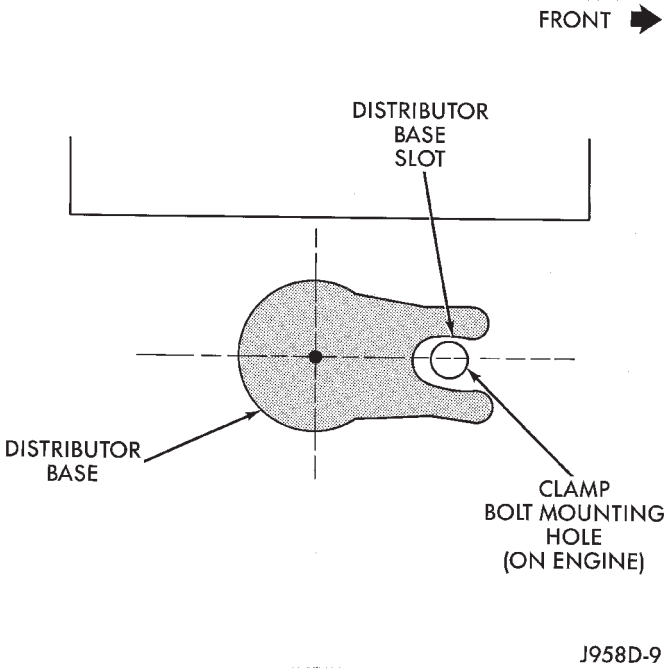


Fig. 32 Distributor Engaged Position—2.5L 4-Cylinder Engine

(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.

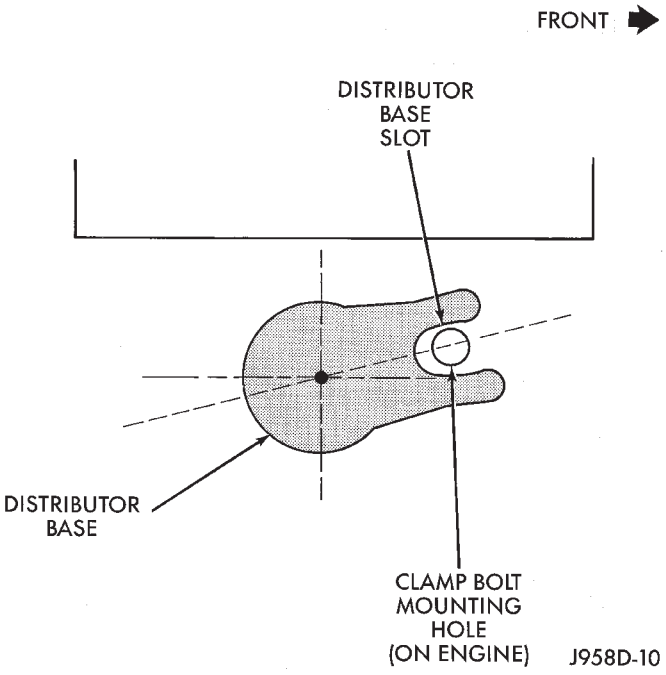


Fig. 33 Distributor Engaged Position—4.0L 6-Cylinder Engine

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 Specifications section at the end of this group. See 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. 34).

(5) Position a small screwdriver or pin punch into tang access hole on bottom of steering column lower cover (Fig. 35).

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

REMOVAL AND INSTALLATION (Continued)

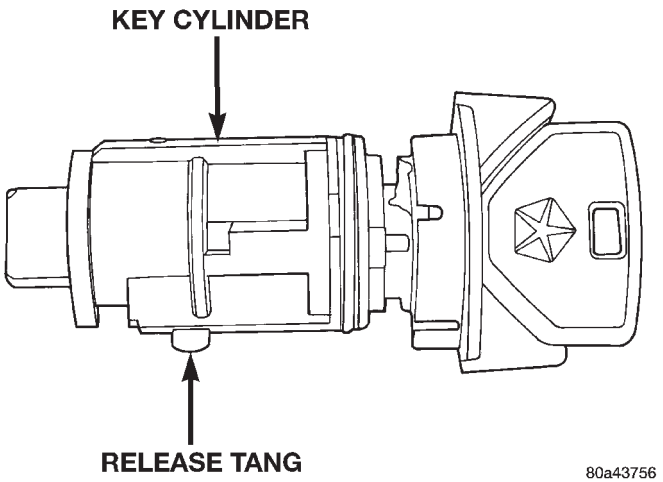


Fig. 34 Key Cylinder Release Tang

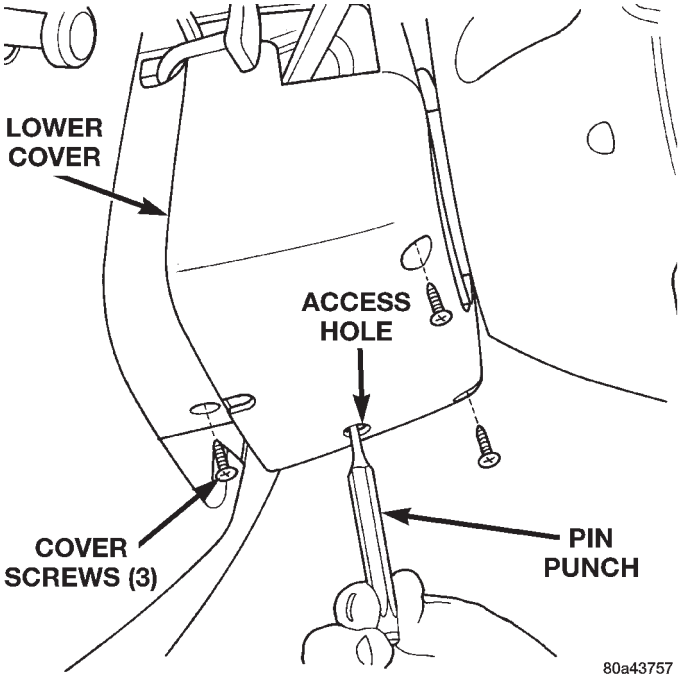


Fig. 35 Key Cylinder and Cover Removal

IGNITION SWITCH REMOVAL

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

(2) Remove lower steering column cover screws and remove cover (Fig. 35).

(3) Remove ignition switch mounting screw (Fig. 38). Use tamper proof torx bit (Snap-On® SDMTR10 or equivalent) to remove the screw.

(4) Using a small screwdriver, push on locking tab (Fig. 36) and remove switch from steering column.

(5) Disconnect two electrical connectors at rear of ignition switch (Fig. 38).

IGNITION SWITCH INSTALLATION

(1) Before installing ignition switch, rotate the slot in the switch to the ON position (Fig. 37).

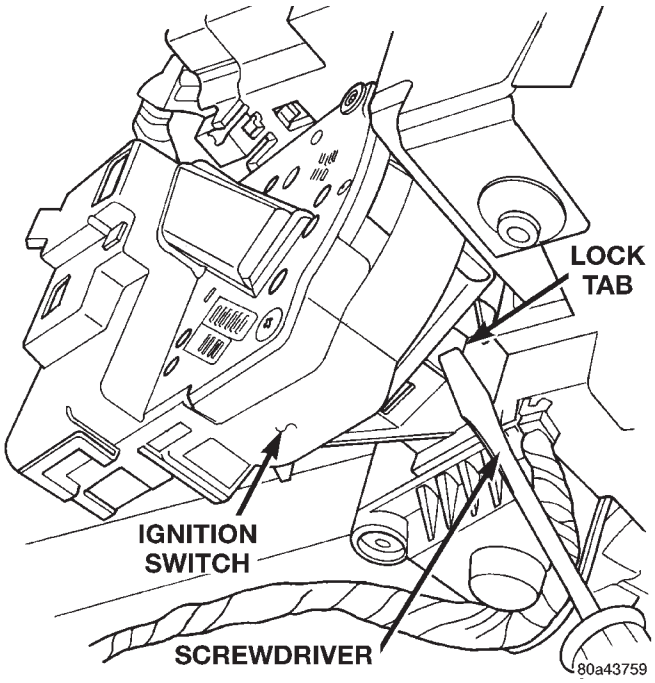


Fig. 36 Ignition Switch Lock Tab

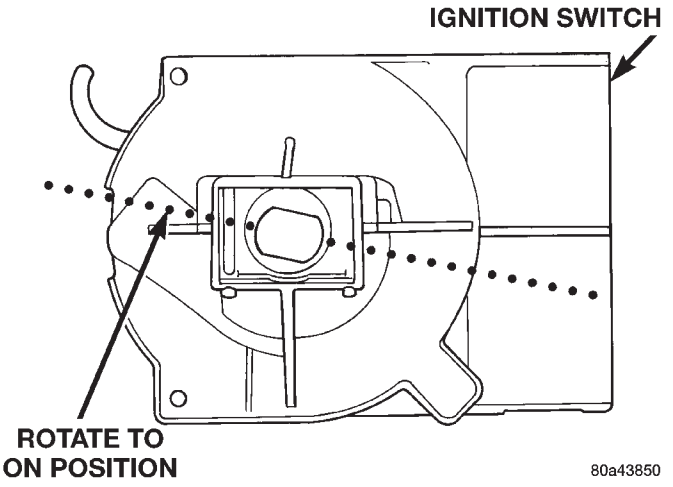


Fig. 37 Switch In ON Position

(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

REMOVAL AND INSTALLATION (Continued)

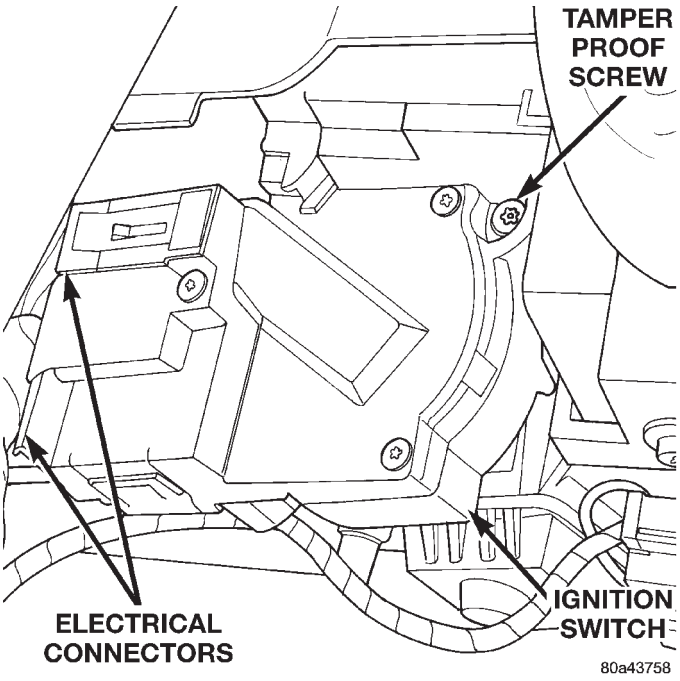


Fig. 38 Ignition Switch Removal/Installation

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

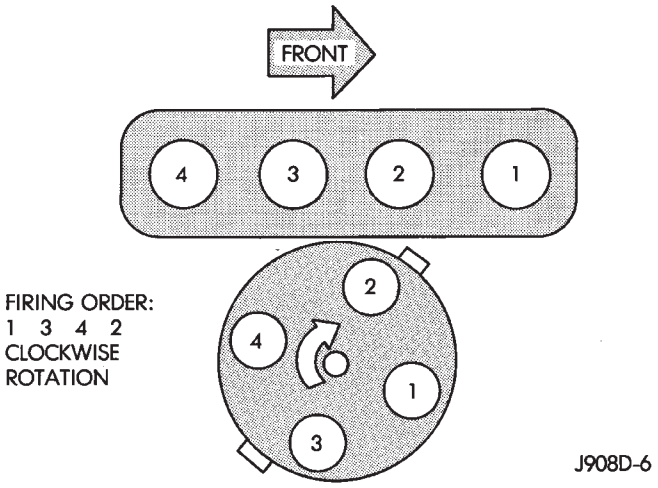
On models equipped with an automatic transmission, a cable connects the ignition switch with the floor shift lever. The shifter will be locked in the PARK position when the ignition key is in the LOCK or ACCESSORY positions. The cable can be adjusted or replaced. Refer to Group 21, Transmissions for 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

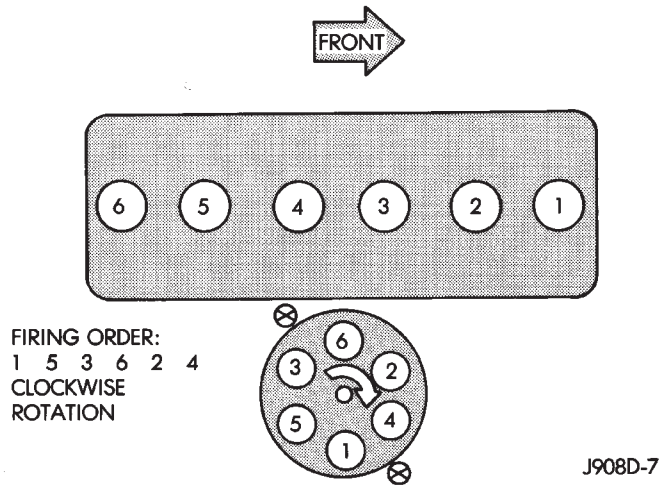
IGNITION TIMING

Ignition timing is not adjustable on any engine. Refer to Ignition Timing in the Diagnostics/Service Procedures section of this group for more information.

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/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

SPECIFICATIONS (Continued)

IGNITION COIL RESISTANCE

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

TORQUE CHART

DESCRIPTION	TORQUE
Crankshaft Position Sensor Mounting Bolts	19 N·m (14 ft. lbs.)
Crankshaft Position Sensor Mounting Nuts	19 N·m (14 ft. lbs.)
Distributor Hold Down Bolt	23 N·m (17 ft. lbs.)
Ignition Coil Mounting (if tapped bolts are used)	5 N·m (50 in. lbs.)
Ignition Coil Mounting (if nuts/ bolts are used)	11 N·m (100 in. lbs.)
Powertrain Control Module (PCM) Mounting Screws	1 N·m (9 in. lbs.)
Spark Plugs (all engines)	41 N·m (30 ft. lbs.)