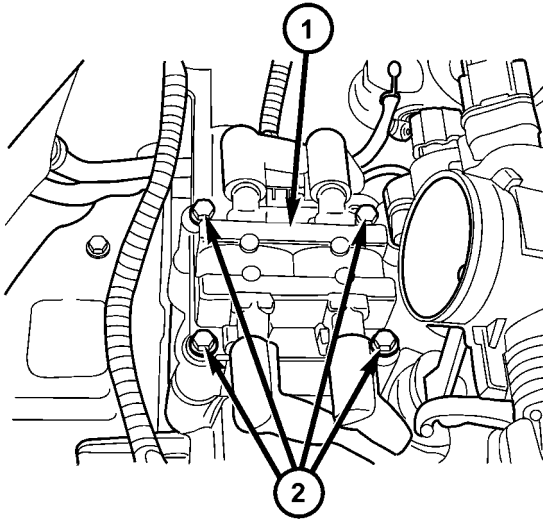


## IGNITION COIL - 2.4L

### DESCRIPTION - 2.4L

The coil assembly consists of 2 different coils molded together. The assembly is mounted to the top of the engine (Fig. 21).



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**Fig. 21 IGNITION COIL - 2.4L**

- 1 - IGNITION COIL  
2 - MOUNTING BOLTS (4)

### OPERATION - 2.4L

The coil fires two spark plugs simultaneously. One plug is under compression, the other plug fires on the exhaust stroke (lost spark). Coil number one fires cylinders 1 and 4, and coil number two fires cylinders 2 and 3.

The Auto Shutdown (ASD) relay provides battery voltage to the ignition coil. The PCM provides a ground contact (circuit) for energizing the coil(s). The PCM will de-energize the ASD relay if it does not receive the crankshaft position sensor and camshaft position sensor inputs.

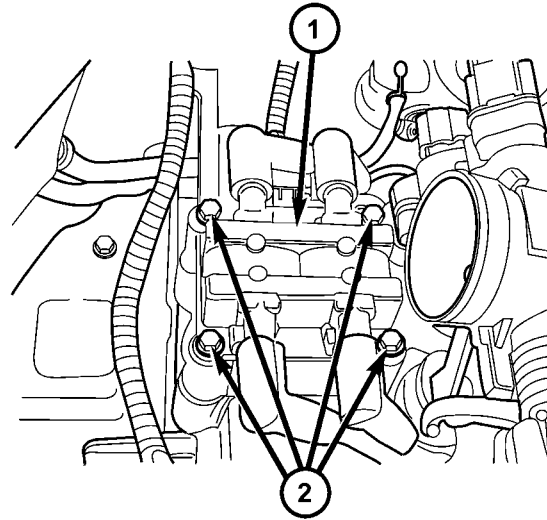
**Base ignition timing is not adjustable.** By controlling the coil ground circuit, the PCM is able to set the base timing and adjust the ignition timing advance. This is done to meet changing engine operating conditions.

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

Spark plug cables (secondary wires or cables) are used with the 2.4L engine.

### REMOVAL - 2.4L

- (1) Disconnect electrical connector at rear of coil.
- (2) Remove all secondary cables from coil.
- (3) Remove 4 coil mounting bolts (Fig. 22).
- (4) Remove coil from vehicle.



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**Fig. 22 IGNITION COIL - 2.4L**

- 1 - IGNITION COIL  
2 - MOUNTING BOLTS (4)

### INSTALLATION - 2.4L

- (1) Position coil to engine.
- (2) Install 4 mounting bolts. Refer to torque specifications.
- (3) Install secondary cables.
- (4) Install electrical connector at rear of coil.
- (5) Install air cleaner tube and housing.

## SPARK PLUG

### 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.

## SPARK PLUG (Continued)

Remove the spark plugs and examine them for burned electrodes and fouled, cracked or broken porcelain insulators. Keep plugs arranged in the order in which they were removed from the engine. A single plug displaying an abnormal condition indicates that a problem exists in the corresponding cylinder. Replace spark plugs at the intervals recommended in Group O, Lubrication and Maintenance

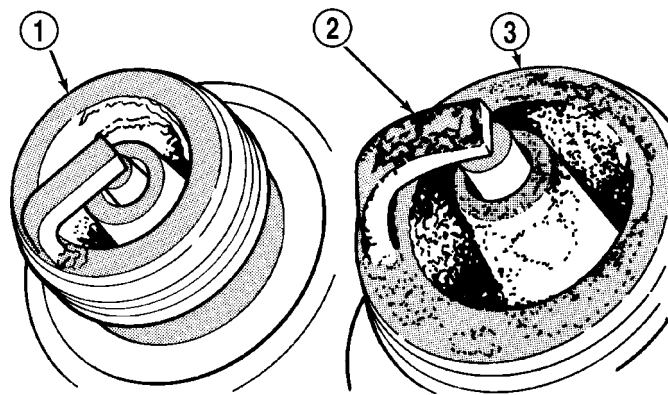
Spark plugs that have low mileage may be cleaned and reused if not otherwise defective, carbon or oil fouled. Also refer to Spark Plug Conditions.

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

## DIAGNOSIS AND TESTING - SPARK PLUG CONDITIONS

### NORMAL OPERATING

The few deposits present on the spark plug will probably be light tan or slightly gray in color. This is evident with most grades of commercial gasoline (Fig. 23). There will not be evidence of electrode burning. Gap growth will not average more than approximately 0.025 mm (.001 in) per 3200 km (2000 miles) of operation. Spark plugs that have normal wear can usually be cleaned, have the electrodes filed, have the gap set and then be installed.



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**Fig. 23 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

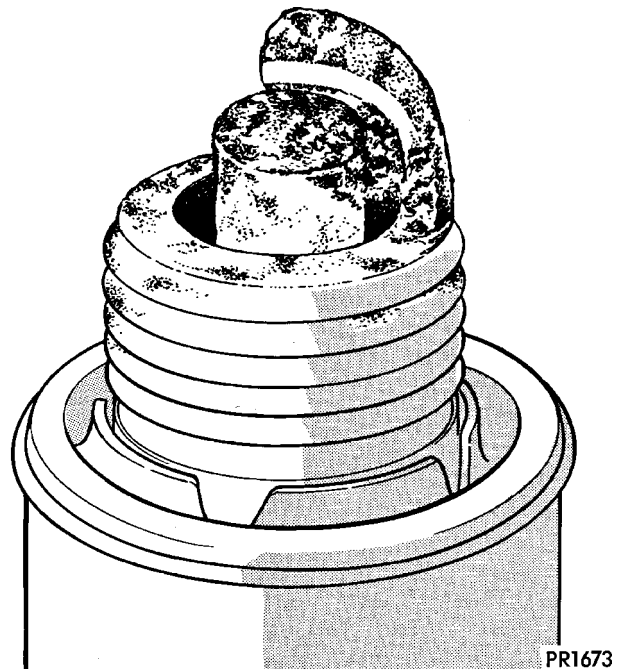
Cold fouling is sometimes referred to as carbon fouling. The deposits that cause cold fouling are basically carbon (Fig. 23). A dry, black deposit on one or two plugs in a set may be caused by sticking valves or defective spark plug cables. Cold (carbon) fouling of the entire set of spark plugs may be 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. 24), evaluate engine condition for the cause of oil entry into that particular combustion chamber.



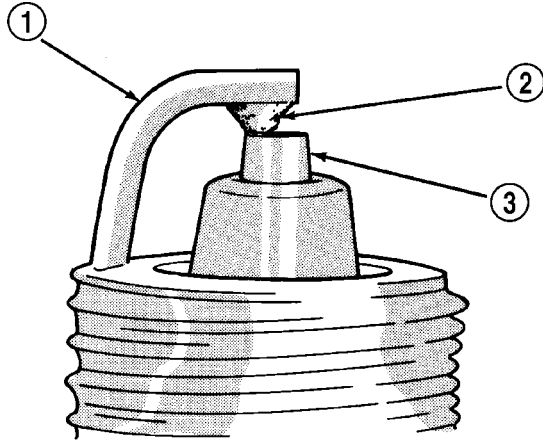
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**Fig. 24 Oil or Ash Encrusted**

SPARK PLUG (Continued)

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



J908D-11

**Fig. 25 Electrode Gap Bridging**

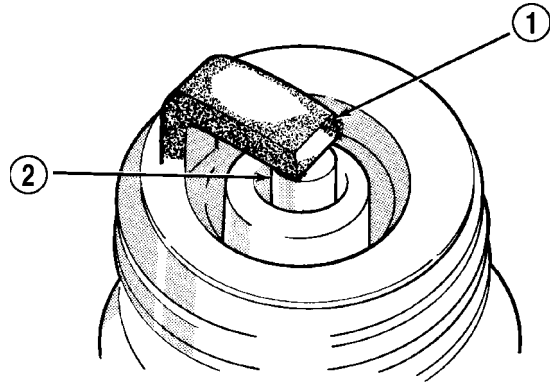
- 1 - GROUND ELECTRODE
- 2 - DEPOSITS
- 3 - CENTER ELECTRODE

**SCAVENGER DEPOSITS**

Fuel scavenger deposits may be either white or yellow (Fig. 26). They may appear to be harmful, but this is a normal condition caused by chemical additives in certain fuels. These additives are designed to change the chemical nature of deposits and decrease spark plug misfire tendencies. Notice that accumulation on the ground electrode and shell area may be heavy, but the deposits are easily removed. Spark plugs with scavenger deposits can be considered normal in condition and can be cleaned using standard procedures.

**CHIPPED ELECTRODE INSULATOR**

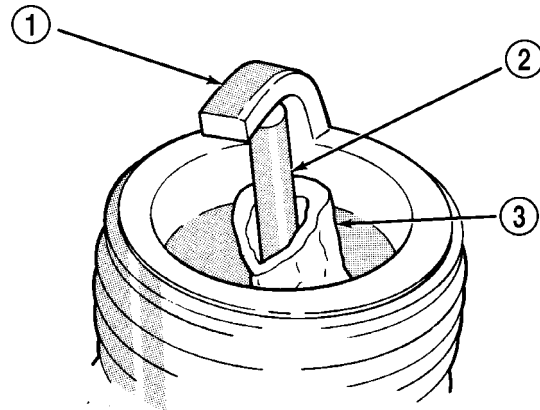
A chipped electrode insulator usually results from bending the center electrode while adjusting the spark plug electrode gap. Under certain conditions, severe detonation can also separate the insulator from the center electrode (Fig. 27). Spark plugs with this condition must be replaced.



J908D-12

**Fig. 26 Scavenger Deposits**

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



J908D-13

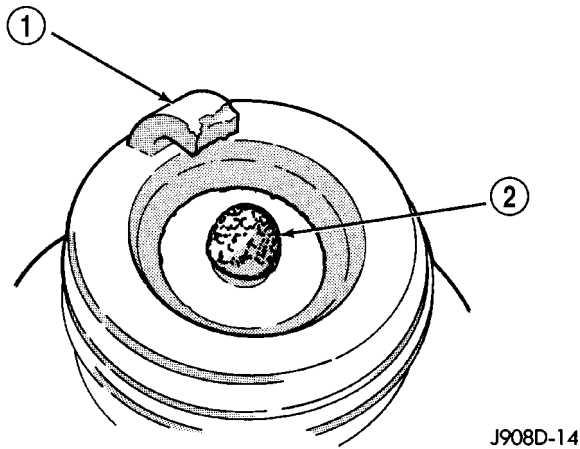
**Fig. 27 Chipped Electrode Insulator**

- 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. 28). 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 (Continued)



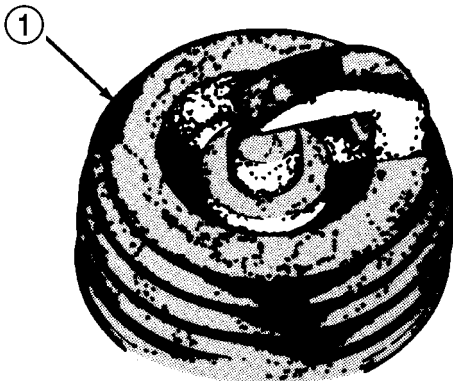
J908D-14

**Fig. 28 Preignition Damage**

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

**SPARK PLUG OVERHEATING**

Overheating is indicated by a white or gray center electrode insulator that also appears blistered (Fig. 29). 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.



J908D-16

**Fig. 29 Spark Plug Overheating**

- 1 - BLISTERED WHITE OR GRAY COLORED INSULATOR

**REMOVAL****2.4L**

If spark plug for #2 or #3 cylinder is being removed, throttle body must be removed. Refer to Throttle Body Removal.

- (1) Remove air cleaner tube and housing.
- (2) Twist secondary cable at cylinder head to break loose at spark plug. Remove cable from plug.
- (3) Prior to removing spark plug, spray compressed air into cylinder head opening. This will help prevent foreign material from entering combustion chamber.
- (4) Remove spark plug from cylinder head using a quality socket with a rubber or foam insert.
- (5) Inspect spark plug condition. Refer to Spark Plug Conditions.

**4.0L**

On the 4.0L 6-cylinder engine the spark plugs are located below the coil rail assembly. To gain access to any/all spark plug(s), refer to Ignition Coil-4.0L Engine Removal/Installation.

- (1) 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.
- (2) Remove the spark plug using a quality socket with a rubber or foam insert.
- (3) Inspect the spark plug condition. Refer to Spark Plugs Conditions.

**CLEANING****CLEANING SPARK PLUGS**

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.

## SPARK PLUG (Continued)

**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.

**2.4L**

**CAUTION: Spark plug tightening on the 2.4L is torque critical. The plugs are equipped with tapered seats. Do not exceed 15 ft. lbs. torque.**

Special care should be taken when installing spark plugs into the cylinder head spark plug wells. Be sure the plugs do not drop into the plug wells as electrodes can be damaged.

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

- (1) Start the spark plug into the cylinder head by hand to avoid cross threading.
- (2) Tighten spark plugs. Refer to torque specifications.
- (3) Install throttle body (if necessary). Refer to Throttle Body Installation.
- (4) Install air cleaner tube and housing.

**4.0L**

Special care should be taken when installing spark plugs into the cylinder head spark plug wells. Be sure the plugs do not drop into the plug wells as electrodes can be damaged.

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

- (1) Start the spark plug into the cylinder head by hand to avoid cross threading.
- (2) Tighten spark plugs. Refer to torque specifications.
- (3) Install coil rail. Refer to Ignition Coil-4.0L Engine Removal/Installation.

**SPARK PLUG CABLE****DESCRIPTION**

Spark plug cables are used only on the 2.4L 4-cylinder engine. They are sometimes referred to as secondary ignition wires.

**OPERATION**

2.4L 4-cylinder engine only: 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 non-metallic construction. The cables provide suppression of radio frequency emissions from the ignition system.

**DIAGNOSIS AND TESTING****TESTING**

Check the spark plug cable connections for good contact at the coil(s) and spark plugs. Terminals should be fully seated. The insulators should be in good condition and should fit tightly on the coil 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. Cracked, damaged or faulty cables should be replaced with resistance type cable. This can be identified by the

## SPARK PLUG CABLE (Continued)

words ELECTRONIC SUPPRESSION printed on the cable jacket.

Use an ohmmeter to test for open circuits, excessive resistance or loose terminals. Remove the cable at ignition coil, and from spark plug. Connect ohmmeter to each end of cable. Resistance should be 250 to 1000 Ohms per inch 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.

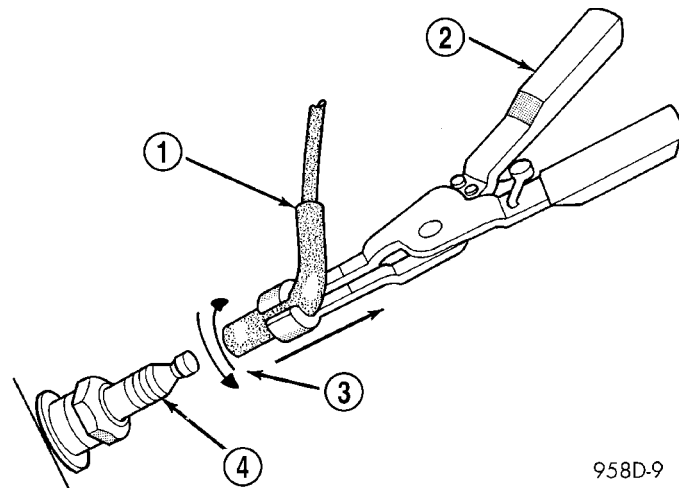
## SPARK PLUG CABLE RESISTANCE

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

## REMOVAL - 2.4L

**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. 30).

(1) Grasp the boot (not the cable) and pull it off with a steady, even force.



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Fig. 30 CABLE REMOVAL

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

## INSTALLATION

(1) Push the cable firmly onto the sparkplug.