# IGNITION SYSTEMS 1G

## SECTION INDEX



# FOUR-CYLINDER ENGINE IGNITION SYSTEM



## GENERAL

The four-cylinder engine High Energy Ignition (HEI) System consists of the battery, the distributor with integral electronic module, the ignition coil, the ignition switch, the spark plugs, and the primary and secondary wiring. Refer to Chapter 1D—Batteries for battery information.

## HEI SYSTEM COMPONENTS

The High Energy Ignition System distributor combines all ignition components (except the ignition coil) into one unit (figs. 1G-1 and 1G-2). The external connections are for the ignition switch, tachometer, and spark plugs. The ignition switch terminal at the coil has full battery voltage applied when the ignition switch is in the RUN and START positions. There is no ballast resistor or resistance wire between the switch and distributor.

The ignition coil (fig. 1G-3) is attached to the cylinder block adjacent to the distributor.

The High Energy Ignition System functions basically the same as a conventional ignition system, but the electronic module and pickup coil replace the contact points.

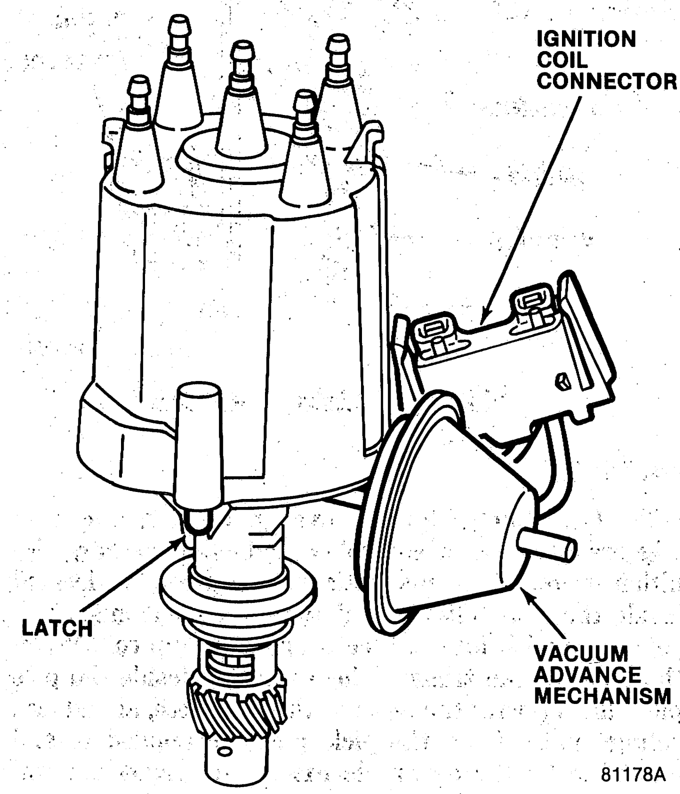



Fig. 1G-1 HEI Distributor

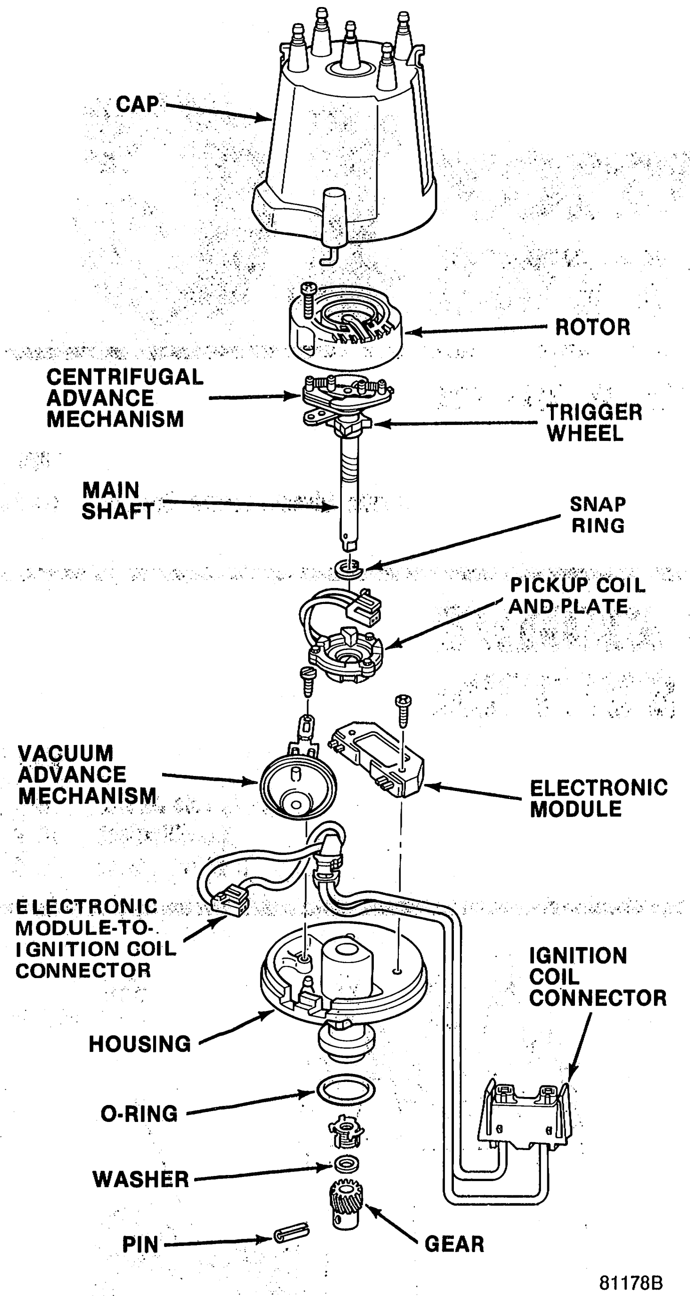



**Fig. 1G-2 HEI Distributor—Exploded View**

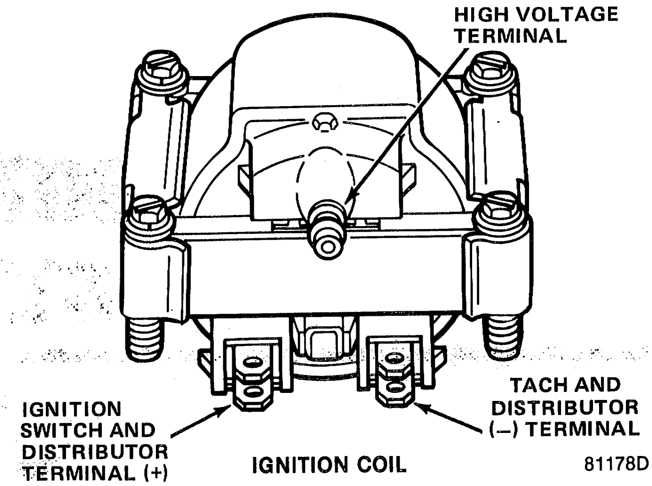



**Fig. 1G-3 HEI System Ignition Coil**

## Distributor

The High Energy Ignition system is a magnetic pulse triggered, transistor controlled, inductive discharge ignition system. The magnetic pickup assembly located inside the distributor contains a permanent magnet, a pole piece with internal teeth and a pickup coil. When the teeth of the trigger wheel rotating inside the pole piece line up with the teeth of the pole piece, an induced voltage pulse from the pickup coil is applied to and amplified by the electronic module to trigger the coil primary circuit. As the primary current decreases, a high voltage is induced in the ignition coil secondary winding, which is applied to the rotor and secondary wires to fire the spark plugs. The capacitor in the distributor is for radio interference noise suppression.

The magnetic pickup assembly mounted over the main bearing on the distributor housing is shifted by the vacuum control unit to provide vacuum advance. The trigger wheel is shifted about the shaft by conventional advance weights to provide centrifugal advance.

The electronic module automatically controls the dwell period, extending it as engine speed is increased. The HEI system also features a longer spark duration that is made possible by the increased amount of electromagnetic energy stored in the coil primary. This is desirable for igniting lean mixtures.

No periodic lubrication is required. Engine oil lubricates the lower bushing and an oil-filled reservoir provides lubrication for the upper bushing.

**NOTE:** *When conducting cylinder compression tests, disconnect ignition switch connecting wire (yellow) from HEI system.*

### Ignition Timing

Timing specifications are listed in Chapter 1A—General Service and Diagnosis and on the Emission Control Information label located in the engine compartment. When using a timing light, connect an adapter between the No. 1 spark plug and the No. 1 spark plug wire, or use a light with an inductive type pick-up. **Do not pierce the spark plug wire.** Once the insulation of a spark plug wire has been broken, the high voltage will cause arcing to the nearest ground, and the spark plug will not fire properly. Always refer to the Emission Control Information label when adjusting the timing. Refer to figure 1G-4 when loosening the distributor holddown clamp.

A magnetic timing probe socket is located on the timing gear cover for use with special electronic timing equipment. Figure 1G-5 depicts the typical magnetic

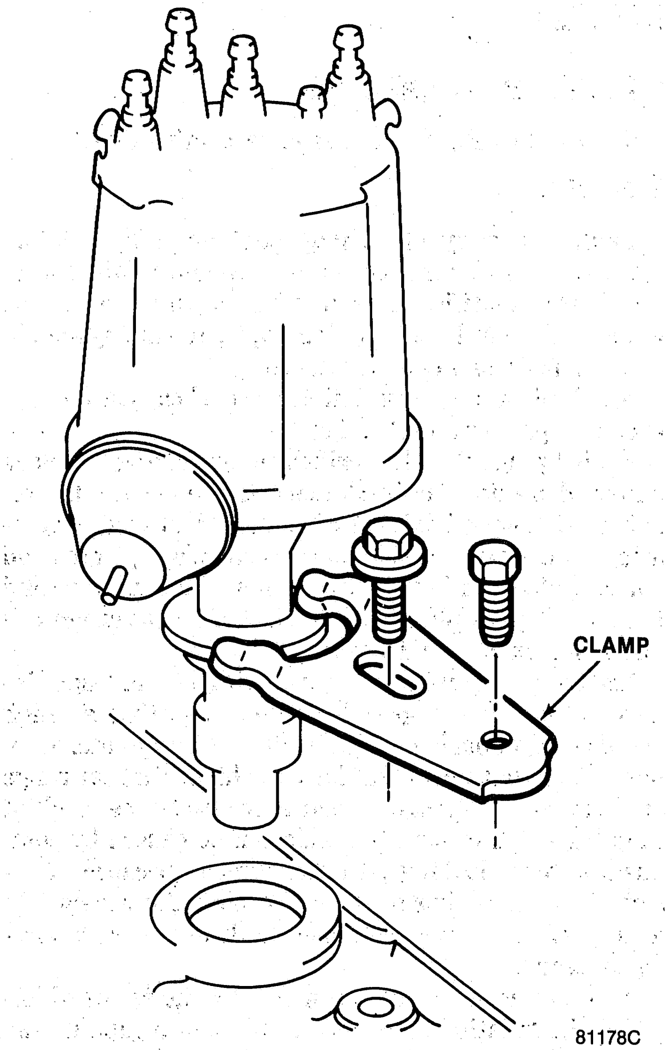



Fig. 1G-4 Distributor Holddown Clamp

timing probe socket. Consult the manufacturer's instructions for use of this type equipment.

## Ignition Coil

The ignition coil is oil filled and hermetically sealed. It has two windings wound on a soft iron core. The function of the ignition coil is to transform the battery voltage applied to the primary circuit to high voltage for the secondary circuit.

The ignition coil does not require special service other than maintaining the connector terminals clean.

## Secondary Wiring

The spark plug wiring used with the HEI system is a carbon impregnated cord conductor encased in an 0.3125-inch (8 mm) diameter silicone rubber jacket. The silicone rubber jacket will withstand very high temperatures and also provides an excellent insulator for the higher voltage provided by the HEI system. The silicone rubber spark plug boots form a tight seal around the

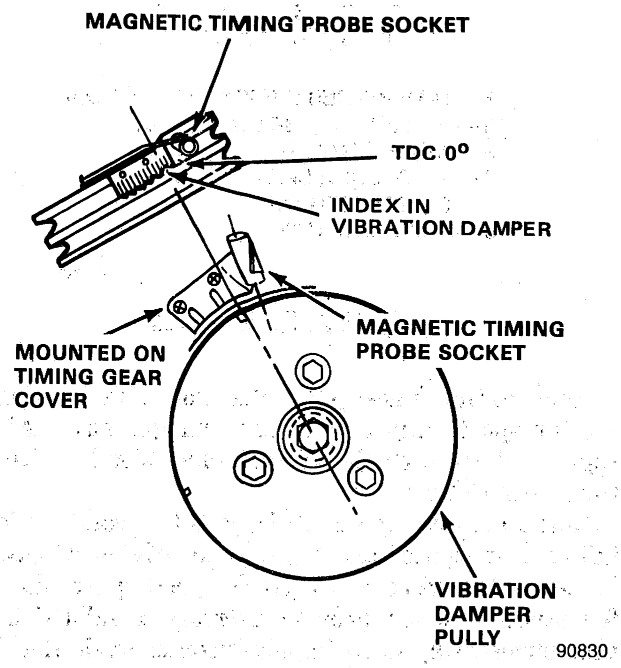



Fig. 1G-5 Magnetic Timing Probe Socket and Timing Degree Scale

plug. **The boot should be twisted 1/2 turn before removing.** Care should also be exercised when connecting a timing light or other test equipment. Do not force anything between the boot and wiring or through the silicone rubber jacket. Connections should be made in parallel using an adapter. DO NOT pull on the wire to remove. Pull on the boot or use a tool designed for this purpose.

## Spark Plugs

Resistor type, tapered seat spark plugs are used (fig. 1G-6). No gasket is used with tapered seat plugs. Refer to figure 1G-7 for an explanation of the spark plug code.

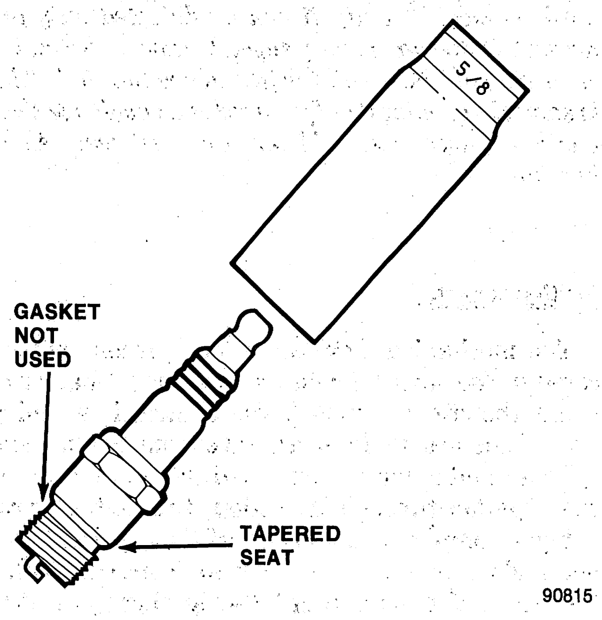
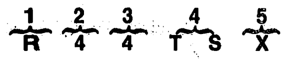



Fig. 1G-6 Tapered Seat Spark Plug




1 — R-INDICATES RESISTOR-TYPE PLUG.
2 — 4-INDICATES 14 mm THREADS.
3 — 4-HEAT RANGE.
4 — T-TAPERED SEAT.
S-EXTENDED TIP
5 — X-SPECIAL GAP.

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**Fig. 1G-7 Spark Plug Code**

Refer to the Tune-Up Specifications listed in Chapter 1A for spark plug application and gap sizes. Always replace plugs with the correct plug type listed in the tune-up specifications.

Normal engine operation is usually a combination of idling, slow-speed, and high-speed driving. Occasional high-speed driving is needed for good spark plug performance because it provides increased combustion heat that burns away deposits of carbon or oxide that have built up from frequent idling or continual stop-and-go driving.

The spark plugs are protected by insulating boots made of special heat-resistant silicone rubber that covers the spark plug terminal and extends downward over a portion of the porcelain insulator. These boots prevent arcing, which causes engine misfire. The dirt film that builds up on the exposed portion of the plug will not cause arcing.

**NOTE:** *Do not mistake corona discharge for arcing or as the result of a shorted insulator. Corona is a steady blue light haze appearing around the insulator, just above the shell crimp. It is the visible evidence of a high electrostatic voltage field and has no effect on ignition performance. Usually it can be detected only in darkness. This discharge may repel dust particles and leave a clear ring on the insulator just above the shell. This ring is sometimes mistakenly regarded as evidence that combustion gases have blown out between shell and insulator.*

## Ignition Switch

The mechanical key-controlled ignition switch is located in the steering column on the right-hand side just below the steering wheel. The electrical switching portion of the assembly is separate from the key and lock cylinder and is located on top of the column. Both function together through the action of the actuator rod.

For a complete explanation of the key and lock cylinder, and the actuator rod, refer to Chapter 2H—Steering Column. Refer to Chapter 3R—Lighting Systems for the detailed explanation of the electrical components.

# DIAGNOSIS

## HEI Distributor and Ignition Coil

Refer to Ignition System Troubleshooting Chart.

## Spark Plugs

Faulty or dirty plugs may perform well at idling speed, but at higher speeds they frequently fail. Faulty plugs are identified in a number of ways: poor fuel economy, power loss, loss of speed, hard starting and, in general, poor engine performance.

Spark plugs may also fail because of carbon fouling, excessive gap, or a broken insulator.

Fouled plugs may be verified by inspecting for black carbon deposits. The black deposits are usually the result of slow-speed driving when sufficient engine operating temperature is seldom reached. Worn pistons and rings, faulty ignition, an over-rich air/fuel mixture and the use of spark plugs with too low of a heat range will also result in carbon deposits.

Excessive gap wear, on plugs with low mileage, indicates that the engine has been operating at high speeds continuously or with loads that are greater than normal, or that plugs that have too high of a heat range are being used. Electrode wear may also be the result of the plug being overheated. This can be caused by combustion gases leaking past the threads because of insufficient tightening of the spark plug. An excessively lean air/fuel mixture will also result in abnormal electrode wear.

A broken lower insulator is usually the result of improper installation or carelessness when regapping the plug. Broken upper insulators usually result from a poor fitting wrench or an outside blow. A cracked insulator may not be evident immediately, but will as soon as oil or moisture penetrates the crack. The crack will usually be located just below the crimped part of the shell and may not be visible.

Broken lower insulators usually result from carelessness when regapping and are generally visible. This type of break may also result from the plug operating too "hot," which may occur during periods of extended high-speed operation or with heavy engine loads. When regapping a spark plug, always make the gap adjustment by bending the ground (side) electrode. Spark plugs with broken insulators should always be replaced. Spark plugs should be tightened with 15 to 25 foot-pounds (20 to 34 N•m) torque.

# ON-VEHICLE SERVICE

## HEI Distributor and Ignition Coil

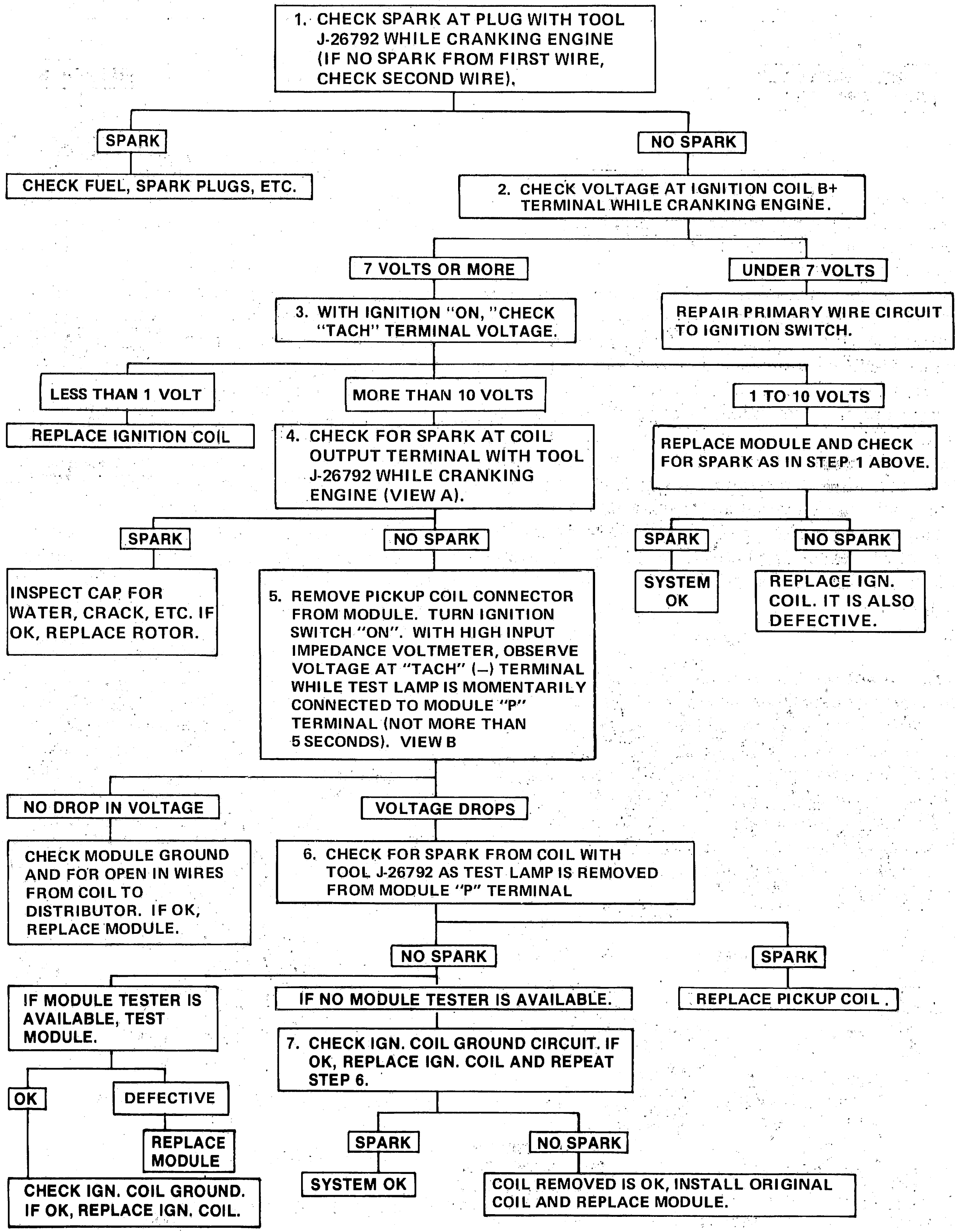
### Precautions and General Information

(1) When performing cylinder compression tests, disconnect ignition switch (BAT) wire at distributor.

## Ignition System Troubleshooting Chart

ENGINE WILL NOT START

NOTE: IF A TACHOMETER IS CONNECTED TO THE TACHOMETER TERMINAL, DISCONNECT IT BEFORE PROCEEDING WITH THE TEST.

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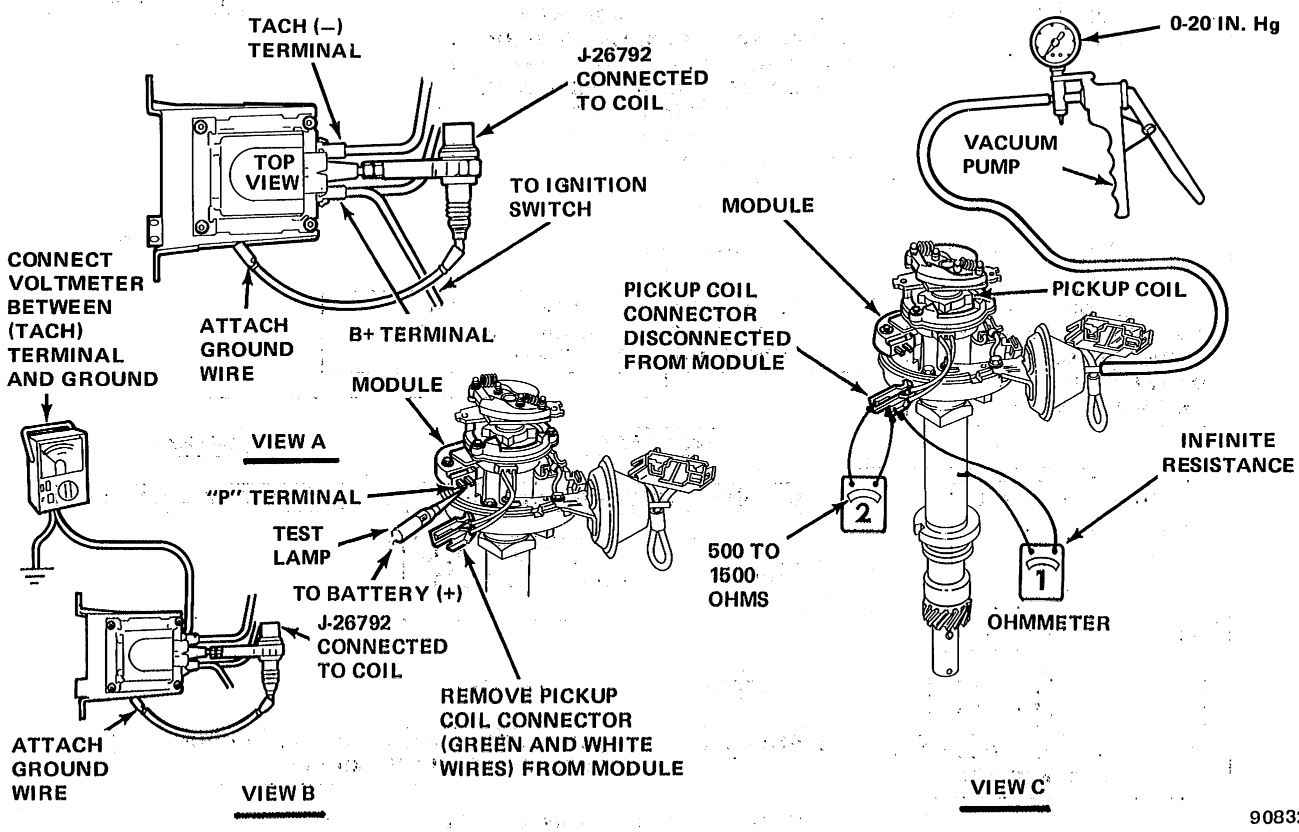
NOTE: REFER TO VIEWS A AND B.

## Ignition System Troubleshooting

**INTERMITTENT ENGINE OPERATION OR MISFIRE**

- CHECK SPARK AT TWO PLUG WIRES WITH TOOL J-26792
  - SPARK FROM ONE OR BOTH WIRES
    - CHECK PICKUP COIL WITH OHMMETER (VIEW C). REFER TO TESTING PICKUP COIL
      - DEFECTIVE
        - REPLACE
      - GOOD
        - CHECK FOR DWELL INCREASE FROM HIGH TO LOW RPM
          - DWELL INCREASE
            - TROUBLE NOT FOUND
              - CHECK FUEL, COIL AND PLUG WIRES, CAP AND PLUGS
          - DWELL DID NOT INCREASE
            - REPLACE ELECTRONIC MODULE
  - NO SPARK
    - CONTINUE WITH NO START PROCEDURE

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When disconnecting this connector **do not** use a screwdriver or tool to release locking tab because it may break.

(2) No periodic lubrication is required. Engine oil lubricates lower bushing and oil-filled reservoir provides lubrication for upper bushing.

(3) Tachometer (TACH) terminal is located opposite to ignition switch (BAT) terminal on ignition coil.

**CAUTION:** *The tachometer terminal must NEVER be connected to ground because damage to the electronic module and/or ignition coil can result.*

**NOTE:** *Some tachometers currently in use may NOT be compatible with the High Energy Ignition System. Consult the manufacturer of the tachometer if unsure.*

(4) Dwell is controlled by electronic module and cannot be manually adjusted.

(5) Centrifugal advance and vacuum advance mechanisms are similar to those used with conventional ignition systems.

(6) Insulating jacket material used to construct spark plug wires is very soft. It will withstand more heat and higher voltage, but is more susceptible to chafing and cutting. Spark plug wires must be routed correctly to prevent chafing or cutting. Refer to Spark Plug Wires. When removing spark plug wire from spark plug, twist boot on spark plug and pull **on boot** to remove wire, or use special tool designed to remove spark plug boots.

#### Distributor Replacement

(1) Disconnect distributor wire connector from ignition coil. Disconnect "pigtail" wires going to ignition switch and tachometer (if equipped).

(2) Remove distributor cap by turning two latches counterclockwise (requires "stubby" screwdriver). Move cap out of way.

(3) Remove vacuum hose from vacuum advance mechanism.

(4) Remove distributor holddown clamp bolt and clamp (fig. 1G-4).

(5) Note position of rotor, then pull distributor up until rotor stops turning counterclockwise and again note position of rotor.

**NOTE:** *To ensure correct installation position of the distributor, the distributor must be INSTALLED with the rotor correctly positioned as noted above.*

(6) If crankshaft was accidentally rotated after distributor was removed, use following procedure for installing distributor:

(a) Remove No. 1 spark plug.

(b) Place finger over No. 1 spark plug hole and crank engine slowly until compression is felt.

(c) Align timing mark on vibration damper at 0° on graduated degree scale on timing gear cover.

(d) Turn rotor to point between No. 1 and No. 8 spark plug towers on distributor cap.

(e) Install distributor cap and spark plug wires.

(f) Install distributor and connect wire connector to ignition coil.

(g) Connect ignition switch and tachometer (if equipped) wire connectors.

(h) Check distributor timing (refer to Ignition Timing).

**NOTE:** *When diagnosing the cause of an oil leak at the rear of the engine, inspect the gasket at the case of the distributor for damage.*

### Rotor Replacement

(1) Remove distributor cap as described in Distributor Replacement.

(2) Remove rotor. Rotor is retained by two screws and has a slot that fits over square lug on advance weight base so that rotor can be installed in only one position.

### Electronic Module Replacement

It is not necessary to remove the distributor from the engine to replace the module. Refer to figure 1G-8.

(1) Remove distributor cap and rotor.

(2) Remove two module attaching screws and lift module up.

(3) Disconnect pickup coil wire connector from module. (Observe wire colors because connectors must not be interchanged.) Disconnect wire harness connector.

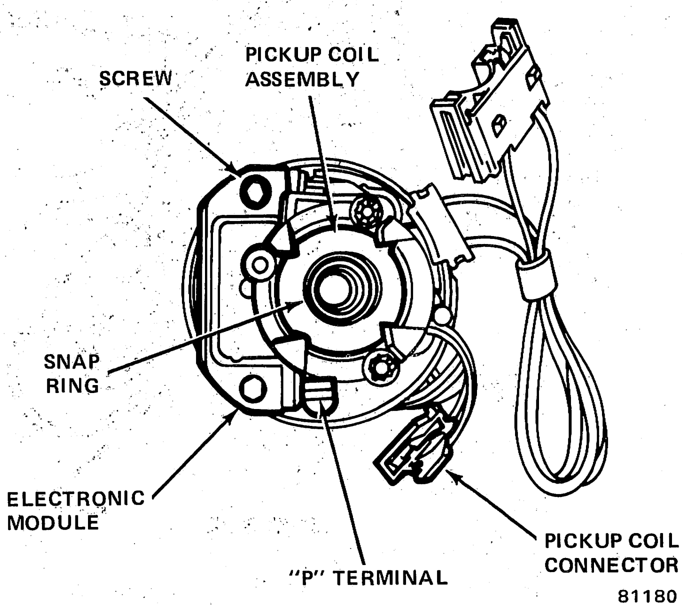


**Fig. 1G-8 Distributor Components**

(4) Do not wipe grease from module or distributor base if same module is to be installed. If replacement module is to be installed, package of silicone dielectric compound will be included with it. Spread compound on metal face of module and on distributor base where module seats. This compound is necessary for module insulation and cooling.

(5) To install, reverse removal procedure.

### PickUp Coil Assembly Replacement

(1) Remove distributor from engine. Scribe distributor shaft and gear so that they may be installed in same position.

(2) Drive out roll pin and remove gear.

(3) Remove distributor shaft with rotor and advance weights.

(4) Remove thin snap ring on top of pickup coil assembly, remove pickup coil wire connector from module, and remove pickup coil assembly. Do not remove three screws.

(5) To install, reverse removal procedure. Note alignment marks when installing gear.

### Vacuum Advance Mechanism Replacement

(1) Remove distributor cap and rotor. Refer to Rotor Replacement.

(2) Remove two vacuum advance unit attaching screws.

(3) Turn pickup coil clockwise and push rod end of vacuum advance mechanism down so that it will disengage and clear pickup coil plate.

(4) To install, reverse removal procedure.

### Ignition Coil Replacement

(1) Disconnect distributor wire harness connector from ignition coil. Disconnect coil-to-distributor high voltage wire. Twist boot one-half turn and pull on boot only to disconnect wire.

(2) Remove three coil attaching screws and remove ignition coil.

(3) To install, reverse removal procedure.

### Spark Plug and Ignition Coil Wire Replacement

Use care when removing spark plug wire boots from spark plugs. Twist the boot 1/2 turn before removing and pull on the **boot only** to remove the wire.

When replacing spark plug wires, route the wires correctly and secure in the proper retainers. Failure to route the wires properly can cause radio to have ignition noise, crossfiring of the plugs or short circuit the wires to ground.

Refer to figure 1G-9 for correct spark plug wire routing.

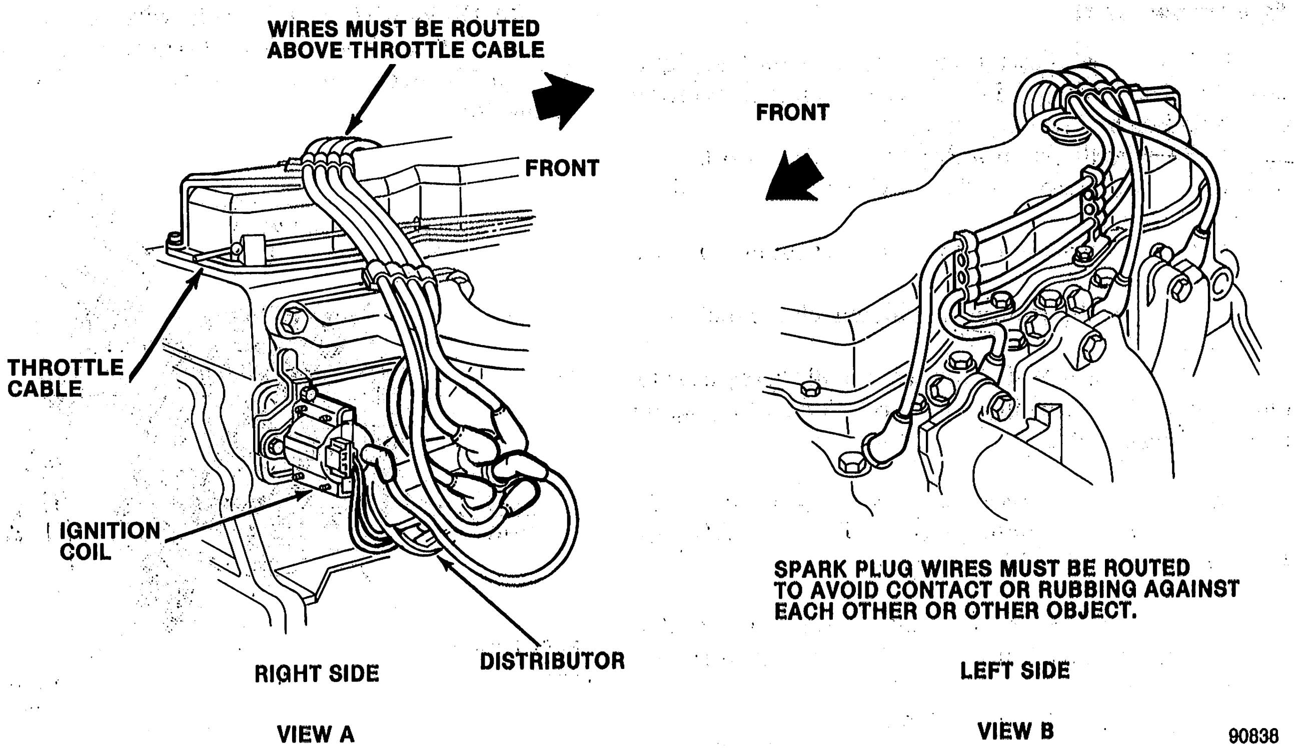


Fig. 1G-9 Spark Plug Wire Routing

## TEST PROCEDURES

The procedures listed below are for testing the ignition coil and each component of the distributor separately to identify defective components. The tests can be performed with the distributor and coil installed on the engine or on a repair bench.

### Testing Electronic Module

An approved electronic module tester must be used to test the module. Use Tester J-24642, or equivalent. Follow the manufacturer's instructions.

### Testing Pickup Coil

Identify the two pickup coil wires. **On most applications, these wires are one green and one white. The pickup coil connector must be disconnected from the module, then an ohmmeter is connected to one connector terminal and to the distributor housing. Next, the ohmmeter is connected to both connector terminals.**

(1) Connect vacuum pump to vacuum advance mechanism. If inoperative, replace mechanism.

(2) Connect ohmmeter (use mid scale) to either pickup coil connector terminal and distributor housing, operate vacuum pump and observe ohmmeter throughout vacuum range.

(3) Ohmmeter should indicate infinite resistance at all times. If not, replace pickup coil.

(4) Connect ohmmeter to both pickup coil connector terminals. Operate vacuum pump and observe ohmmeter throughout vacuum range, and also while flexing wires by hand to locate any intermittent defective connections at pickup coil and at terminals on ends of wires.

(5) Ohmmeter should indicate a constant resistance in 500-1500 ohm range at all times. If not, replace pickup coil.

**NOTE:** *Operation of the vacuum mechanism may cause a trigger wheel tooth and pickup coil pole piece to align and the ohmmeter pointer to deflect. This deflection should not be interpreted as the result of a faulty pickup coil.*

### Testing Ignition Coil

The ignition coil can be tested for shorted and open windings with an ohmmeter.

(1) Connect ohmmeter between positive (+) terminal and coil frame (ground). Use high resistance scale. Ohmmeter should indicate infinite resistance. If not replace coil.

(2) Connect ohmmeter between positive (+) and negative (-) terminals. Use low resistance scale. Ohmmeter should indicate zero (or nearly zero). If not, replace coil.

(3) Connect ohmmeter between negative (-) terminal and high voltage terminal. Use high resistance scale. Ohmmeter should indicate less than infinite resistance. If not, replace coil.

### Testing Centrifugal and Vacuum Advance Mechanisms

To test the centrifugal and vacuum advance with the distributor either on or off the vehicle, follow the test equipment manufacturer's instructions. Refer to Chapter 1A—General Service and Diagnosis for advance degrees specification. If the advance is not within limits, replace the shaft assembly or vacuum mechanism as required.

### Ignition Timing

(1) Refer to Emission Control Information label located in engine compartment and use specifications listed on label.

(2) With ignition off, connect timing light to No. 1 spark plug. Install adapter between spark plug wire and spark plug or use timing light with inductive type pickup. **DO NOT** pierce spark plug wire or attempt to insert jumper wire between boot and spark plug wire. Connect timing light power terminals according to manufacturer's instructions.

**WARNING:** *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(3) Start engine and aim timing light at timing degree scale. Index on vibration damper will line up with one timing degree mark. If change is necessary, loosen distributor holddown clamp bolt at base of distributor (fig. 1G-4). While observing scale with timing light, slightly rotate distributor until index aligns with correct timing degree mark. Tighten holddown bolt and recheck ignition timing.

(4) Turn off engine and remove timing light. Reconnect No. 1 spark plug wire, if removed.

## SPECIFICATIONS

### HEI System Schematic

### Distributor and Coil Specifications

| | |
|---|---|
| Distributor Pickup Coil Resistance | 500 to 1500 ohms |
| Ignition Coil | |
| Primary Resistance | Zero or nearly zero on Low Scale |
| Secondary Resistance | Less than infinite on High Scale |

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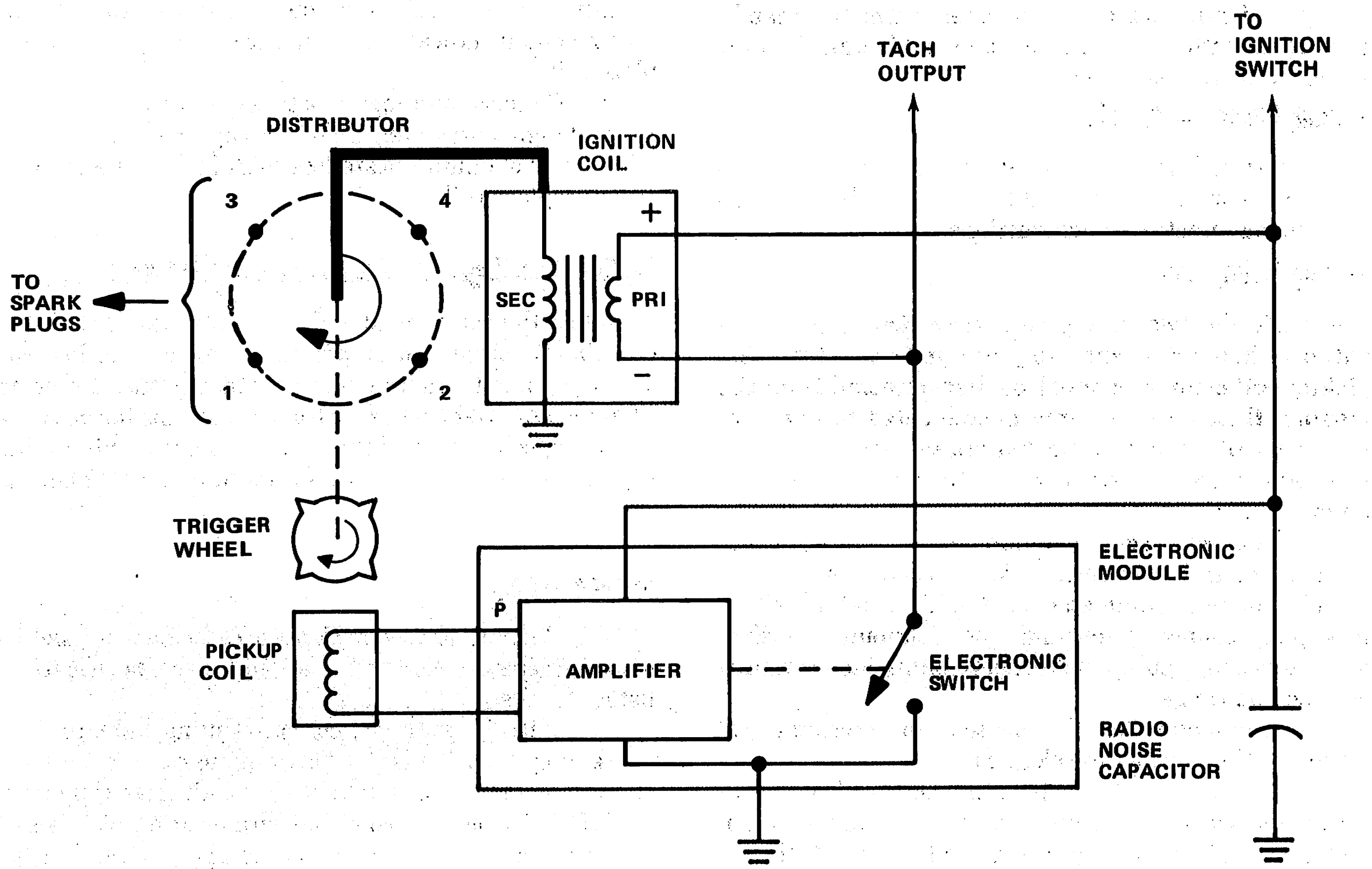
# SPECIFICATIONS

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## Torque Specifications

**Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-tightened item.**

| | USA (ft-lbs) | | Metric (N·m) | |
|---|---|---|---|---|
| | Service Set-To Torque | Service In-Use Recheck Torque | Service Set-To Torque | Service In-Use Recheck Torque |
| Distributor Clamp Screw | 17 | 15-20 | 23 | 20-27 |
| Spark Plugs | 11 | 7-15 | 15 | 9-20 |

**All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.**

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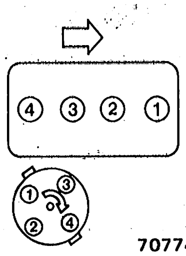
## Distributor Wiring Sequence and Engine Firing Order

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# SIX- AND EIGHT-CYLINDER ENGINE IGNITION SYSTEM



## GENERAL

The Solid State Ignition (SSI) system is used on all six- and eight-cylinder Jeep engines. This system is easily recognizable by the unique coil connector (fig. 1G-10). The electronic ignition control unit is housed in an unpainted metal container that has unique connectors (fig. 1G-11). The SSI system employs both vacuum (fig. 1G-12) and centrifugal advance mechanisms to advance the ignition timing the correct number of degrees during engine operation. Also, for six-cylinder engines with electronic feedback system, electronic ignition retard is provided via the electronic ignition control unit. This feature delays (retards) the activation of the electronic control unit's normal function a calibrated number of degrees based upon engine operating conditions (i.e., wide open throttle, high engine torque operating condition and cold engine operation).

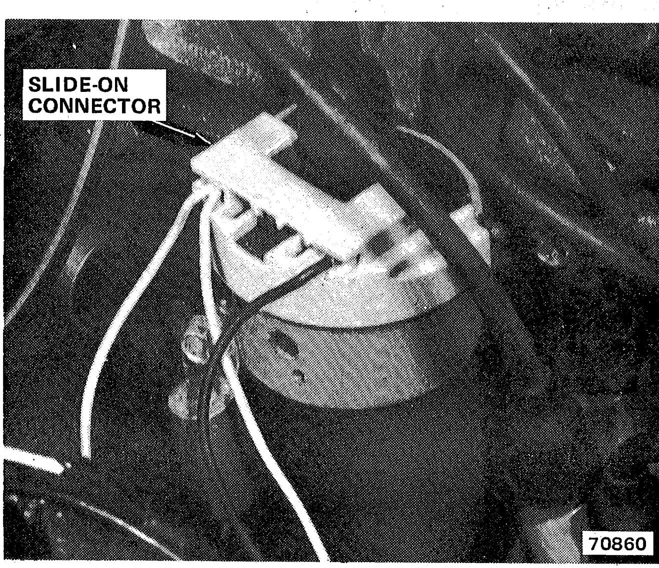


Fig. 1G-10 Coil Connector

## COMPONENTS

The SSI system consists of the following major components: ignition switch, electronic ignition control unit, ignition coil, primary resistance wire and bypass, distributor, secondary wires and spark plugs.

**NOTE:** *When disconnecting SSI system connectors, pull apart with firm, straight pull. Do not attempt to pry apart with a screwdriver. When connecting, press together firmly to overcome hydraulic pressure caused by the silicone dielectric compound.*

**NOTE:** *If connector locking tabs weaken or break off, do not replace associated component. Bind connectors together with tape or harness tie strap to assure good electrical connection.*

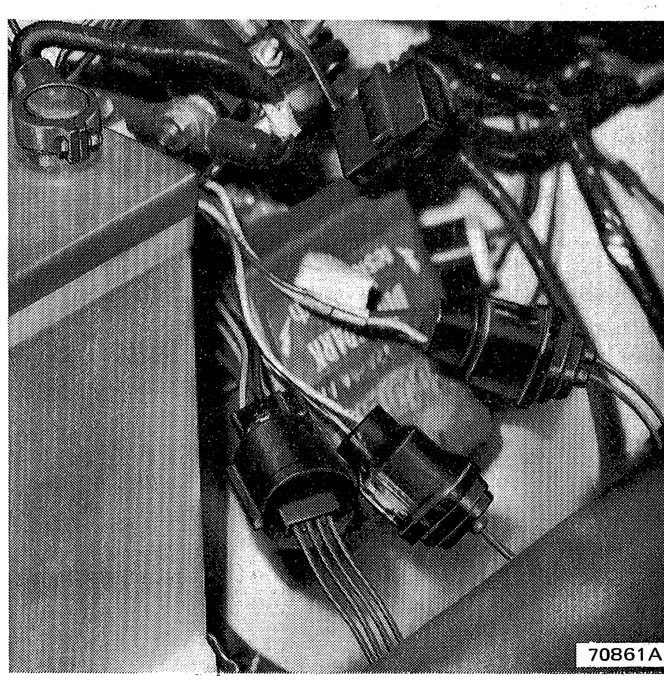


Fig. 1G-11 Electronic Ignition Control Unit

### Electronic Ignition Control Unit

The electronic ignition control unit is a solid-state, moisture-resistant module. The component parts are permanently sealed in a potting material to resist vibration and adverse environmental conditions. All connections are weatherproof. The control unit also incorporates reverse polarity and transient voltage protection.

**NOTE:** *The unit is not repairable and must be replaced as a unit if service is required.*

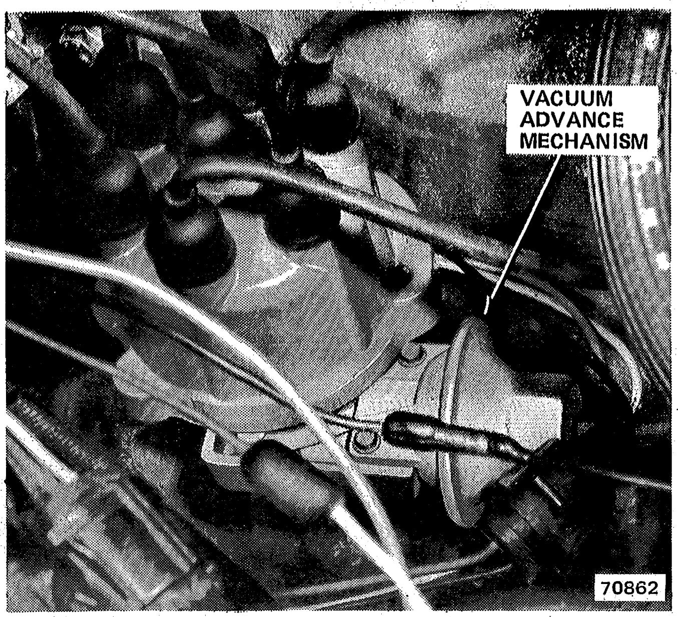


Fig. 1G-12 Distributor Vacuum Ignition Advance Mechanism

## Ignition Coil

The ignition coil is oil-filled and hermetically sealed (standard construction). The coil has two windings wound on a soft iron core. The primary winding consists of comparatively few turns of heavy gauge wire. The secondary winding consists of many turns of fine gauge wire.

The function of the ignition coil in the SSI system is to transform battery voltage applied to the primary winding to high voltage for the secondary circuit.

The ignition coil does not require special service other than maintaining the terminals and connectors clean and tight.

When an ignition coil is suspected of being defective, test it on the vehicle. A coil may break down after the engine has heated it to a high temperature. *It is important that the coil be at operating temperature when tested.* Perform the test according to the test equipment manufacturer's instructions.

### Ignition Coil Connector

The coil terminals and coil connector are of unique design (fig. 1G-10). The connector is removed from the coil by grasping both sides and pulling connector away from coil (fig. 1G-13).

When a tachometer is required for engine testing or tune-up, connect it using an alligator jaw-type connector as illustrated in figure 1G-14.

## Resistance Wire

A wire having 1.35 ± 0.05 ohms resistance is provided in the ignition wiring to supply less than full battery voltage to the ignition coil after the starter motor solenoid is deenergized. During engine starting, the resistance wire is bypassed and full battery voltage is applied to the coil. The bypass is accomplished at the I-terminal on the starter motor solenoid. The bypass switch is energized only while the starter motor circuit is in operation.

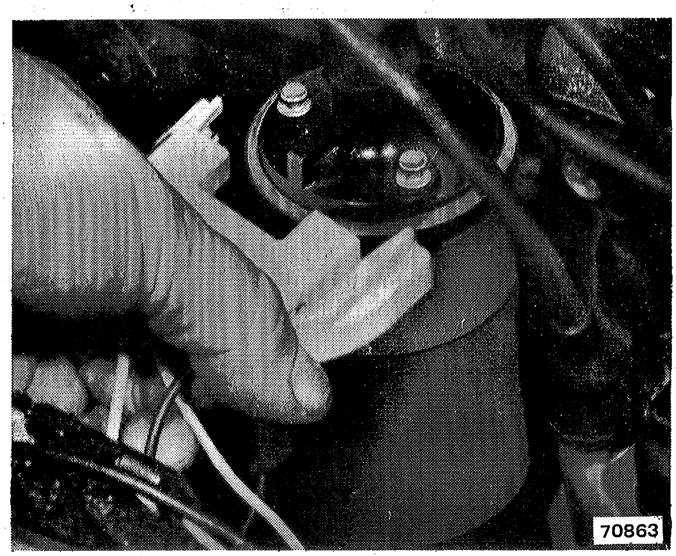


Fig. 1G-13 Removing Coil Connector

## Distributor

The distributor consists of three groups of components: pickup coil and trigger wheel, ignition advance mechanism, and cap and rotor.

### Pickup Coil and Trigger Wheel

Current flowing through the ignition coil primary winding creates an electromagnetic field around the

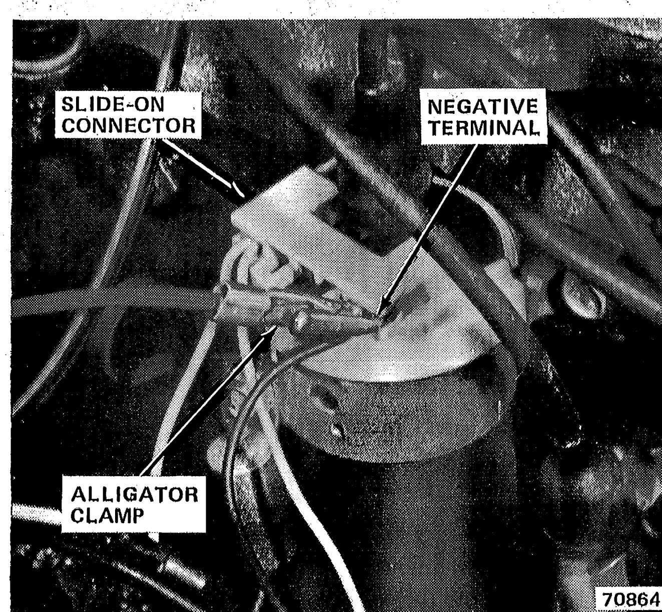


Fig. 1G-14 Tachometer Connection

primary and secondary windings. When the circuit is opened and current flow stops, the electromagnetic field collapses and induces high voltage into the secondary winding. The circuit is opened and closed electronically by the control unit. The distributor pickup coil and trigger wheel provide the input signal for the control unit.

The trigger wheel, mounted on the distributor shaft, has one tooth for each engine cylinder. The wheel is mounted so that the teeth rotate past the pickup coil one at a time.

The pickup coil, a coil of fine gauge wire mounted on a permanent magnet, has a magnetic field that is intensified by the presence of ferrous metal. The pickup coil reacts to the trigger wheel teeth as they pass. As a trigger wheel tooth approaches and passes the pole piece of the pickup coil, it reduces the reluctance (compared to air) to the magnetic field and increases field strength. Field strength decreases as the tooth moves away from the pole piece. This build-up and reduction of field strength induces an alternating current into the pickup coil, which triggers the control unit. The control unit opens and closes the coil primary circuit according to the position of the trigger wheel teeth.

There are no contacting surfaces between the trigger wheel and pickup coil. Because there is no wear, the dwell angle requires no adjustment. The dwell angle is determined electronically by the control unit and is nonadjustable. When the ignition coil primary circuit is switched open, an electronic timer in the control unit keeps the circuit open only long enough for the electromagnetic field to collapse and the induced voltage to discharge. It then automatically closes the coil primary circuit. The period of time the circuit is closed is referred to as *dwell.*

### Ignition Advance

Efficient engine operation requires each spark to occur at the correct instant. Varying engine speed or engine load requires the spark to occur either earlier or later than it does for constant speed and load operation.

Centrifugal (mechanical) advance is controlled by engine speed. Flyweights connected to the distributor shaft are thrown outward by centrifugal force. Higher engine rpm throws the weights further out. Calibrated-rate springs are used to control this movement. The outward motion of the flyweights causes the rotor and trigger wheel to be advanced on the distributor shaft several degrees in the direction of normal rotation. This is referred to as *centrifugal ignition advance.*

When the engine is operating with a light load, the carburetor throttle plates restrict airflow. This causes a relatively lean mixture to enter the combustion chambers. Ignition must occur earlier because the lean mixture requires a longer time to burn. The vacuum ignition advance mechanism is used for this purpose. When carburetor ported or manifold vacuum is high, the vacuum advance mechanism moves the pickup coil several degrees opposite to the direction the distributor is rotating. This causes the pickup coil to react to the presence of trigger wheel teeth earlier. This is referred to as *vacuum ignition advance.* With low vacuum operating conditions, such as wide open throttle acceleration, a spring in the vacuum unit pushes the pickup coil back to a position of no advance.

### Cap and Rotor

The central tower on the distributor cap is connected directly to the high voltage at the ignition coil. The current flows through the spring-loaded contact on the rotor to the carbon button in the cap. The rotor tip aligns with a contact in the cap that corresponds to the cylinder to be ignited just as the ignition coil output high voltage is applied to the rotor. In this way, each spark plug is "fired" in turn.

## OPERATION

The control unit is activated when the ignition switch is in the Start or On position (fig. 1G-15). The primary circuit is closed and current flows through the coil primary winding. When the engine begins turning the distributor, the trigger wheel teeth rotate past the pickup coil. As each tooth aligns with the pickup coil, the resulting pulse triggers the control unit and it closes the primary circuit. A high voltage is then induced in the ignition coil secondary winding and current flows to the distributor cap and rotor. The rotor connects the high voltage to the proper spark plug. The timing of the ignition is constantly changed by the vacuum and centrifugal advance mechanisms according to engine operation.

## DIAGNOSIS

For diagnostic purposes, ignition system problems are considered in three categories: complete failure, intermittent failure and spark knock (pre-ignition).

**Complete failure** is always a no-ignition situation. The engine will not start. If a complete failure occurs when the engine is operating, it will not restart.

**Intermittent failure** is temporary. The engine may not start on the first try, but will eventually start. If an intermittent failure occurs when the engine is operating, it may falter and possibly stop. If it stalls, it will restart and will continue to operate intermittently.

**Spark knock** (pre-ignition) is not actually an ignition system failure. The engine will start and will continue to operate. If not corrected, spark knock can cause extensive internal engine component damage.

### Complete Failure Diagnosis

The first step to perform is a thorough visual inspection for obvious defects.

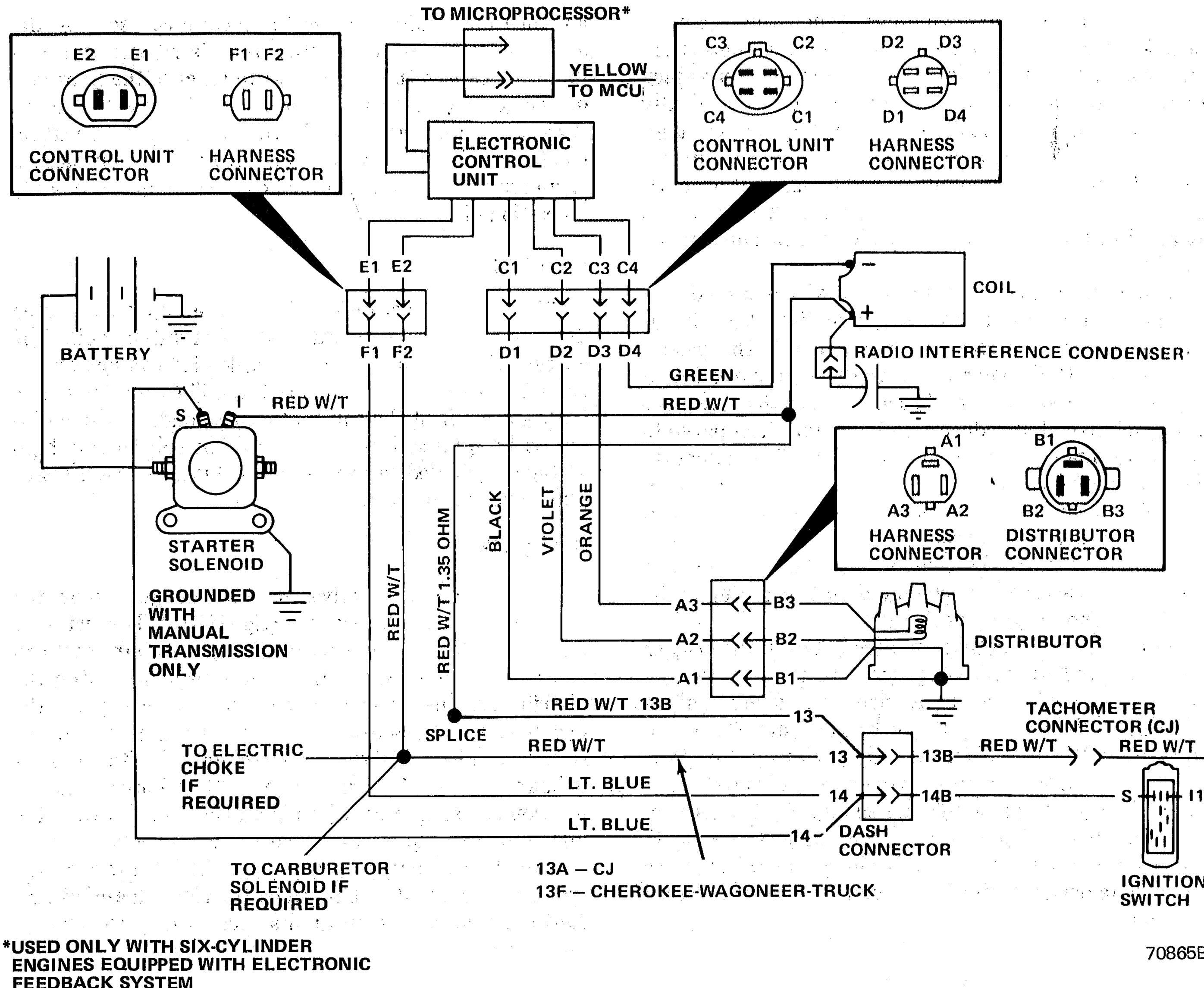


**Fig. 1G-15 SSI System Schematic**

The next step in diagnosing a failure is to identify the circuit—primary or secondary—at fault.

The primary circuit consists of:

- ignition switch,
- battery-to-ignition coil wiring,
- ignition coil primary winding,
- all wires connected to the electronic ignition control unit and distributor pickup coil,
- electronic ignition control unit, and
- distributor.

The secondary circuit consists of:

- ignition coil secondary winding,
- all high voltage wires connected to the distributor cap, coil and spark plugs,
- distributor cap,
- distributor rotor, and
- spark plugs.

### Secondary Circuit Diagnosis

**CAUTION:** *When disconnecting a high voltage wire from a spark plug or the distributor cap, twist the rubber boot slightly to break it loose. Grasp the boot, not the wire, and pull off with steady, even force.*

(1) Disconnect ignition coil wire from center tower of distributor cap. Use insulated pliers to hold wire terminal approximately 1/2 inch from cylinder block, head or intake manifold.

**WARNING:** *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(2) Rotate engine with starter motor and observe wire terminal for arc.

(a) If no arc occurs, proceed with step (5).

(b) If arc occurs, proceed with step (3).

**CAUTION:** *Do not remove wires from spark plugs for cylinders 1 or 5 of a six-cylinder engine or for cylinders 3 or 4 of an eight-cylinder engine when performing this test, otherwise pickup coil may be damaged.*

(3) Connect ignition coil wire to distributor cap. Remove wire from one spark plug.

(4) Use insulated pliers to hold wire 1/2 inch from engine cylinder head or block while rotating engine with starter motor. Observe wire terminal for arc.

(a) If arc occurs, inspect for fuel system problems or incorrect ignition timing.

(b) If no arc occurs, inspect for defective rotor or distributor cap, or defective spark plug wires.

(5) If no arc occurs from ignition coil wire terminal, test coil secondary winding resistance. It should not exceed 10,000 ohms. Replace if required.

(6) Read following notes and proceed to SSI System Diagnosis and Repair Simplification (DARS) Chart 1.

**NOTE:** *The DARS charts are organized to permit testing of the primary sub-circuit separately and in the most logical sequence. When the problem is located, it is not necessary to perform additional tests.*

**NOTE:** *If a particular component or sub-circuit is suspected, locate the applicable DARS Chart and follow the procedures outlined. If no particular component or sub-circuit is suspected, begin with Chart 1 and proceed from chart to chart until the problem is located.*

**NOTE:** *Do not perform Chart 4 tests until after Chart 1 tests have been completed.*

## Intermittent Failure Diagnosis

Intermittent failure may be caused by loose or corroded terminals, defective or missing components, poor ground connections or defective wiring. Refer to the Service Diagnosis chart.

**Service Diagnosis**

| Condition | Possible Cause | Correction |
|---|---|---|
| ENGINE FAILS TO START (NO SPARK AT PLUGS) | (1) No voltage to ignition system. | (1) Check battery, ignition switch and wiring. Repair as required. |
| | (2) Electronic Control Unit ground wires inside distributor open, loose or corroded. | (2) Clean, tighten or repair as required. |
| | (3) Primary wiring connectors not fully engaged. | (3) Clean and fully engage connectors. |
| | (4) Ignition coil open or shorted. | (4) Test coil. Replace if faulty. |
| | (5) Electronic Control Unit defective. | (5) Replace Electronic Control Unit. |
| | (6) Cracked distributor cap. | (6) Replace cap. |
| | (7) Defective rotor. | (7) Replace rotor. |
| ENGINE BACKFIRES BUT FAILS TO START | (1) Incorrect ignition timing. | (1) Check timing. Adjust as required. |
| | (2) Moisture in distributor. | (2) Dry cap and rotor. |
| | (3) Distributor cap faulty. | (3) Check cap for loose terminals, cracks and dirt. Clean or replace as required. |
| | (4) Ignition wires not connected in correct firing order. | (4) Connect in correct order. |
| ENGINE RUNS ONLY WITH KEY IN START POSITION | (1) Open in resistance wire or excessive resistance. | (1) Replace resistance wire and harness assembly. |
| ENGINE CONTINUES TO RUN WITH KEY OFF | (1) Defective starter motor solenoid. | (1) Replace solenoid. |
| | (2) Shorted diode in alternator warning lamp circuit. | (2) Replace diode. |

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**Service Diagnosis (Continued)**

| Condition | Possible Cause | Correction |
|---|---|---|
| ENGINE DOES NOT OPERATE SMOOTHLY AND/OR ENGINE MISFIRES AT HIGH SPEED | (1) Spark plugs fouled or faulty. | (1) Clean and gap plugs. Replace as required. |
| | (2) Ignition wires faulty (including electronic retard). | (2) Check wires. Replace as required. |
| | (3) Spark advance system(s) faulty. | (3) Check operation. Repair as required. |
| | (4) S-terminal shorted to starter S-terminal in solenoid. | (4) Replace solenoid. |
| | (5) Trigger wheel pin missing. | (5) Install pin. |
| | (6) Ignition wires not connected in correct firing order. | (6) Connect wires correctly. |
| | (7) Two plug wires of consecutive firing cylinders routed next to each other. | (7) Re-route plug wires away from each other. |
| EXCESSIVE FUEL CONSUMPTION | (1) Incorrect ignition timing. | (1) Check timing. Adjust as required. |
| | (2) Spark advance system(s) faulty. | (2) Check operation. Repair as required. |
| | (3) MCU (microprocessor) faulty. | (3) Test system. Repair as required. |
| ERRATIC TIMING ADVANCE | (1) Faulty vacuum advance mechanism. | (1) Check operation. Replace if required. |
| | (2) Centrifugal advance weights sticking. | (2) Remove dirt, corrosion. |
| TIMING NOT AFFECTED BY VACUUM | (1) Defective vacuum advance mechanism. | (1) Replace vacuum advance mechanism. |
| | (2) Vacuum advance mechanism adjusting screw too far counterclockwise. | (2) Turn screw clockwise to bring advance within specifications (Chapter 1A). |
| | (3) Pickup coil pivot corroded. | (3) Clean pivot. |
| INTERMITTENT OPERATION | (1) Loose or corroded terminals. | (1) Tighten terminals, remove corrosion, apply electrical grease. |
| | (2) Defective pickup coil. | (2) Perform pickup coil test. |
| | (3) Defective control unit. | (3) Perform control unit tests. |
| | (4) Loose ground connector in distributor. | (4) Clean and tighten ground connection. |
| | (5) Wires to distributor shorted together or to ground. | (5) Check for frayed, pinched, or burned wires. |
| | (6) Trigger wheel pin missing. | (6) Install new pin. |

70866B

## SSI SYSTEM DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHART

Note: Refer to Chapter A – General Information for details on how to use this DARS chart.

# IGNITION COIL PRIMARY CIRCUIT

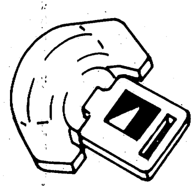
## FUNCTION: PROVIDES BATTERY FEED TO COIL AND COIL GROUND

## Chart 1

**STEP — SEQUENCE — RESULT**

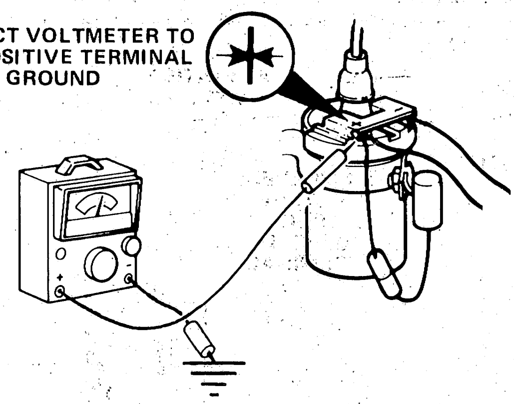
### Step 1

REFER TO FIGURE 1G-15 FOR SCHEMATIC



- TURN IGNITION ON

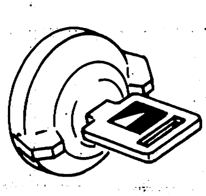
- CONNECT VOLTMETER TO COIL POSITIVE TERMINAL AND TO GROUND



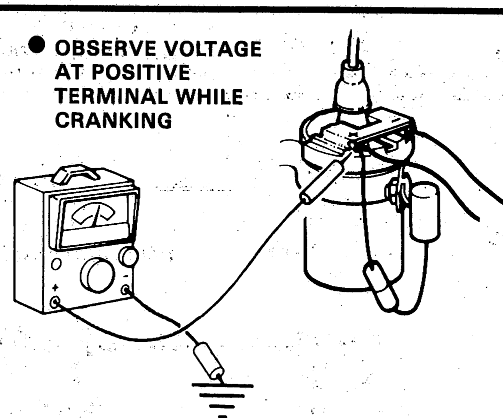
- VOLTAGE ACCEPTABLE (6V ± .5V) — OK → 2
- VOLTAGE NOT ACCEPTABLE (BATTERY VOLTAGE) — NOT OK → 4
- VOLTAGE NOT ACCEPTABLE (BELOW 6V) — NOT OK → DISCONNECT CAPACITOR WIRE TERMINAL →
  - VOLTAGE ACCEPTABLE (6V ± .5V) — OK → REPLACE CAPACITOR → STOP
  - VOLTAGE NOT ACCEPTABLE — NOT OK → 6

### Step 2

- TURN IGNITION SWITCH TO START



- OBSERVE VOLTAGE AT POSITIVE TERMINAL WHILE CRANKING



- VOLTAGE ACCEPTABLE (BATTERY VOLTAGE) — OK → STOP
- VOLTAGE NOT ACCEPTABLE (LESS THAN BATTERY VOLTAGE) — NOT OK → 3

80699A

# Chart 1

| STEP | SEQUENCE | RESULT |
|---|---|---|

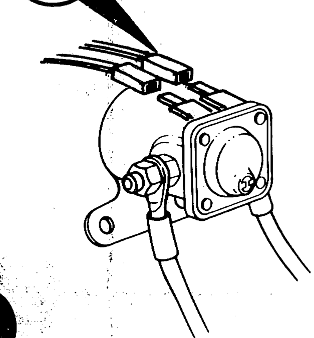
## 3

- CHECK FOR SHORT OR OPEN IN WIRE ATTACHED TO STARTER SOLENOID I-TERMINAL
- CHECK SOLENOID AS OUTLINED IN CHAPTER 1F

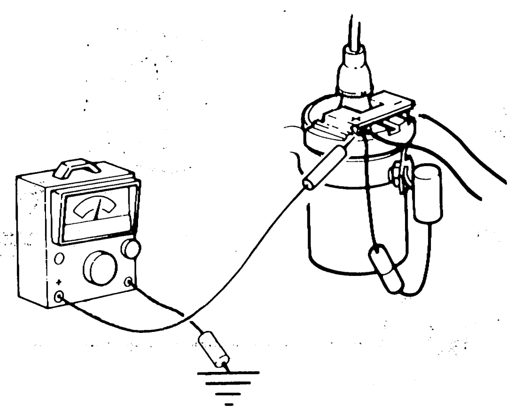
REPAIR AS REQUIRED → STOP

## 4

DISCONNECT WIRE FROM STARTER SOLENOID I-TERMINAL



- IGNITION REMAINS ON
- OBSERVE VOLTAGE AT COIL POSITIVE TERMINAL



VOLTAGE DROPS TO 6V ± .5V — OK → REPLACE STARTER SOLENOID → STOP

VOLTAGE REMAINS AT BATTERY VOLTAGE — NOT OK → CONNECT JUMPER BETWEEN COIL NEGATIVE TERMINAL AND GROUND
- VOLTAGE DROPS TO 6V ± .5V — OK → 5
- VOLTAGE DOES NOT DROP — NOT OK → REPAIR DEFECTIVE RESISTANCE WIRE → 2

## 5

CHECK:
- CONTINUITY BETWEEN COIL NEGATIVE TERMINAL AND CONNECT TERMINAL D4
- DI TO GROUND

CONTINUITY OK — OK → REPLACE CONTROL UNIT → STOP

CONTINUITY NOT OK — NOT OK → LOCATE AND REPAIR OPEN → 2

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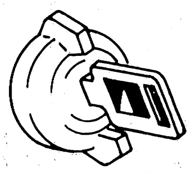
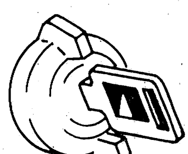
# Chart 1

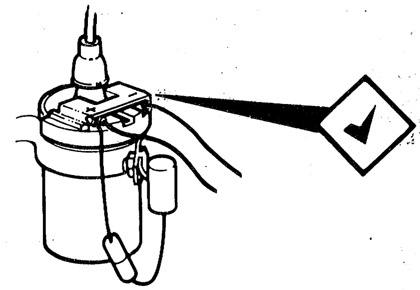
| STEP | SEQUENCE | RESULT |
|---|---|---|
| 6 | ● TURN IGNITION OFF  CONNECT OHMMETER BETWEEN COIL POSITIVE TERMINAL AND DASH CONNECTOR 13 → RESISTANCE TOO HIGH (1.40 OHMS OR MORE) → REPAIR RESISTANCE WIRE | STOP |
| | RESISTANCE ACCEPTABLE (1.35 ± .05 OHMS) | 7 |
| 7 |  ● IGNITION REMAINS OFF. CONNECT OHMMETER BETWEEN DASH CONNECTOR 13 AND IGNITION SWITCH TERMINAL I1 | |
| | RESISTANCE ACCEPTABLE (LESS THAN 0.1 OHM) → REPLACE IGNITION SWITCH OR REPAIR SWITCH WIRE FROM BATTERY | STOP |
| | RESISTANCE TOO HIGH (MORE THAN 0.1 OHM) → CHECK: ● POOR TERMINAL CONNECTIONS AT DASH CONNECTOR OR IGNITION SWITCH ● DEFECTIVE WIRING → REPAIR DEFECT | STOP |

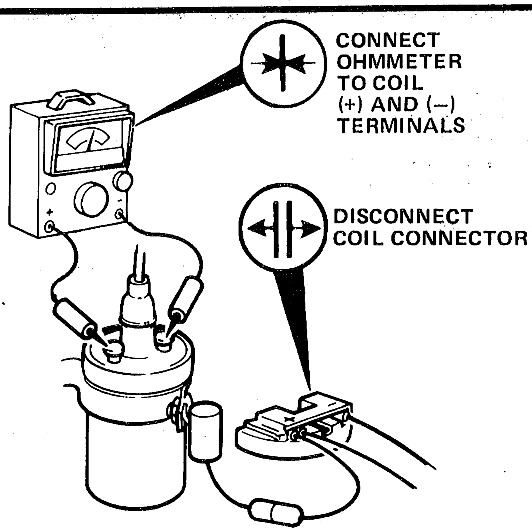
80699C

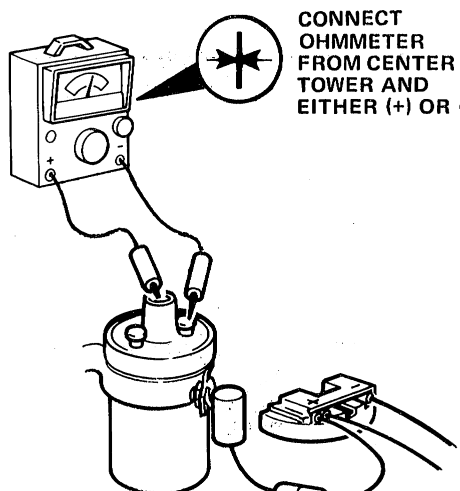
# COIL TEST

**Chart 2**

| STEP | SEQUENCE | RESULT |
|---|---|---|
| 1 | INSPECT COIL FOR OIL LEAKS, OTHER EXTERIOR DAMAGE, AND CARBON TRACKS | OK → 2<br>NOT OK → REPLACE COIL → STOP |
| 2 | CONNECT OHMMETER TO COIL (+) AND (–) TERMINALS<br>DISCONNECT COIL CONNECTOR | OK: RESISTANCE ACCEPTABLE (1.13 TO 1.23 OHMS AT 75°F OR 24°C) (1.5 OHMS AT 200°F OR 93°C) → 3<br>NOT OK: RESISTANCE NOT WITHIN LIMITS → REPLACE COIL → STOP |
| 3 | CONNECT OHMMETER FROM CENTER TOWER AND EITHER (+) OR (–) | OK: RESISTANCE ACCEPTABLE (7700 - 9300 OHMS @ 75°F OR 24°C) (12,000 OHMS @ 200°F OR 93°C) → STOP<br>NOT OK: RESISTANCE NOT WITHIN LIMITS → REPLACE COIL → STOP |







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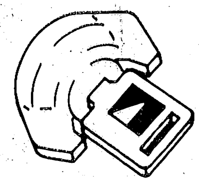
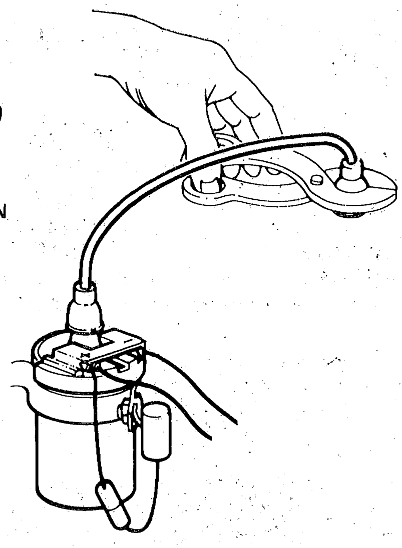
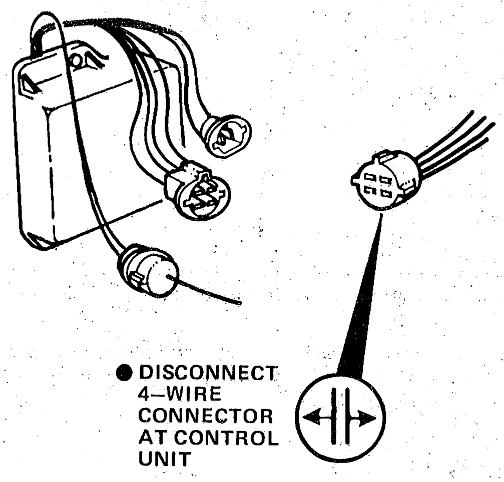
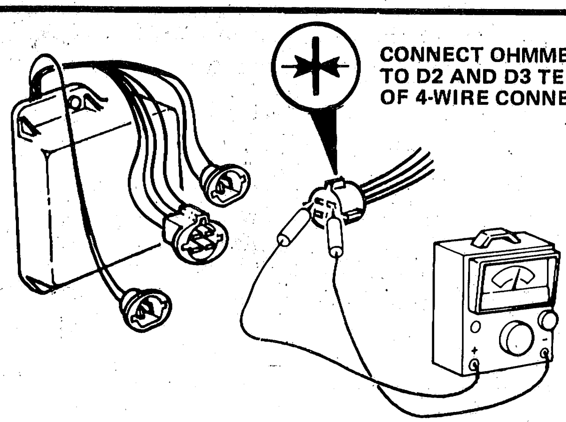
# SENSOR CHECK AND CONTROL UNIT CHECK

## Chart 3

| STEP | SEQUENCE | RESULT |
|---|---|---|
| 1 |  ● TURN IGNITION ON  ● DISCONNECT COIL WIRE FROM CENTER TOWER OF DISTRIBUTOR AND HOLD 1/2 - INCH FROM ENGINE WITH INSULATED PLIERS  ● DISCONNECT 4—WIRE CONNECTOR AT CONTROL UNIT | SPARK AT COIL WIRE (NORMAL) → 2<br>NO SPARK → 5 |
| 2 |  CONNECT OHMMETER TO D2 AND D3 TERMINALS OF 4-WIRE CONNECTOR | OK — OHMMETER INDICATES 400-800 OHMS (NORMAL) → 6<br>NOT OK — OHMMETER DOES NOT INDICATE 400 - 800 OHMS → 3 |
| 3 | ● DISCONNECT AND RECONNECT 3 - WIRE CONNECTOR AT DISTRIBUTOR | OK — OHMMETER NOW INDICATES 400 - 800 OHMS → 6<br>NOT OK — OHMMETER REMAINS OUTSIDE 400 - 800 OHMS → DISCONNECT 3 - WIRE CONNECTOR AT DISTRIBUTOR → 4 |

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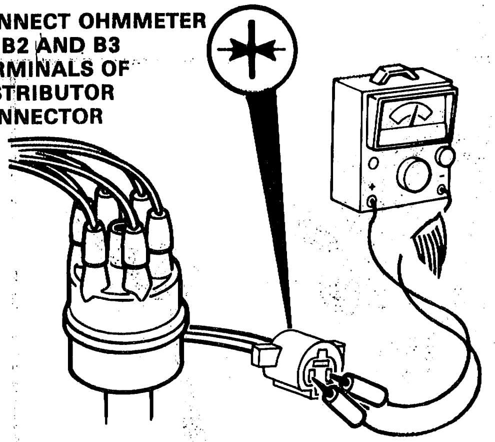
# Chart 3

**STEP** | **SEQUENCE** | **RESUL.**

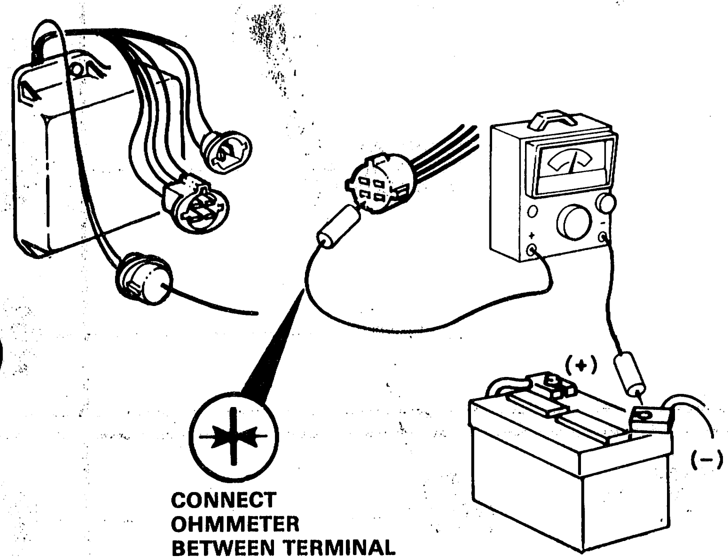
## 4



CONNECT OHMMETER TO B2 AND B3 TERMINALS OF DISTRIBUTOR CONNECTOR

- OK: OHMMETER INDICATES 400 - 800 OHMS → REPAIR OR REPLACE HARNESS BETWEEN 3 - WIRE AND 4 - WIRE CONNECTOR → STOP
- NOT OK: OHMMETER DOES NOT INDICATE 400 - 800 OHMS → REPLACE PICKUP COIL → STOP

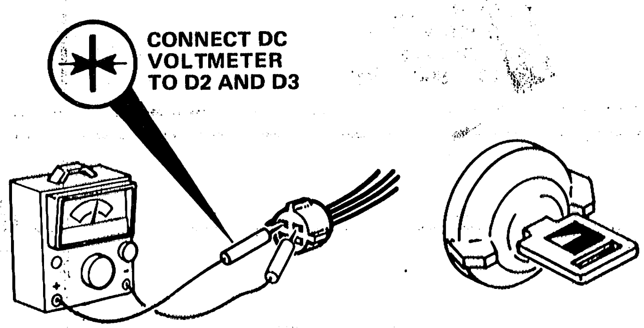
## 5




CONNECT OHMMETER BETWEEN TERMINAL D1 AND BATTERY NEGATIVE TERMINAL

- OK: OHMMETER INDICATES ZERO (NOT ABOVE 0.002 OHM) → 2
- NOT OK: OHMMETER INDICATES ABOVE 0.002 OHM → LOCATE AND REPAIR SOURCE OF BAD GROUND → STOP
  - GROUND CABLE RESISTANCE
  - DISTRIBUTOR–TO–BLOCK RESISTANCE
  - GROUND SCREW IN DISTRIBUTOR TO D1 TERMINAL

## 6



CONNECT DC VOLTMETER TO D2 AND D3

CRANK ENGINE

- OK: VOLTMETER FLUCTUATES, INDICATING PROPER PICKUP COIL AND TRIGGER WHEEL OPERATION → STOP
- NOT OK: VOLTMETER DOES NOT FLUCTUATE → LOCATE AND REPAIR FAULT → STOP
  - DEFECTIVE TRIGGER WHEEL
  - DISTRIBUTOR NOT TURNING
  - MISSING TRIGGER WHEEL PIN

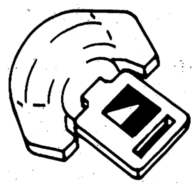
80699F

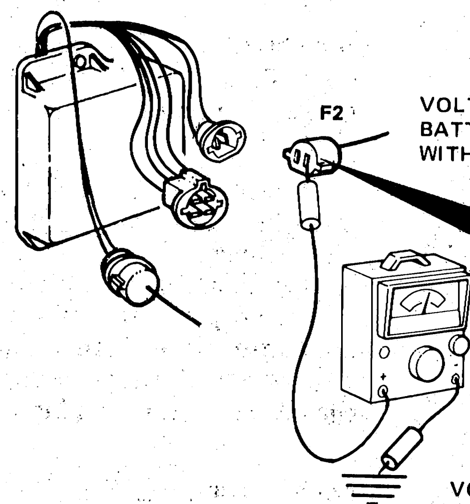
# IGNITION FEED TO ELECTRONIC CONTROL UNIT

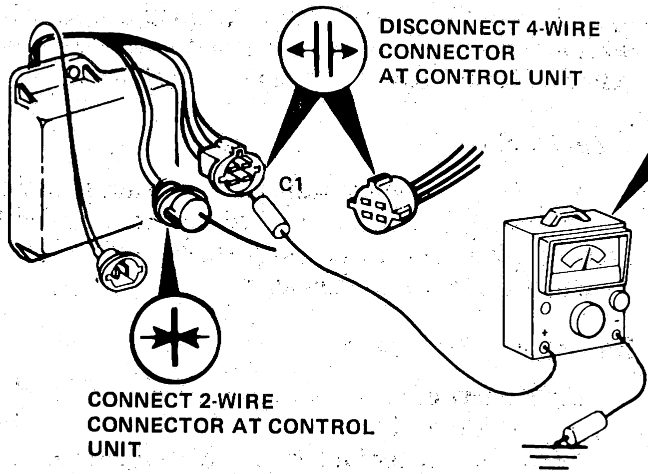
NOTE: DO NOT PERFORM CHART 4 WITHOUT PERFORMING CHART 1

## Chart 4

| STEP | SEQUENCE | RESULT |
|---|---|---|
| 1 | ● TURN IGNITION ON. UNPLUG 2-WIRE CONNECTOR AT MODULE AND CONNECT VOLTMETER BETWEEN TERMINAL F-2 AND GROUND. OK: VOLTMETER INDICATES BATTERY VOLTAGE WITHIN 0.2V. → REPLACE CONTROL UNIT | 3 |
| | NOT OK: VOLTMETER DOES NOT INDICATE BATTERY VOLTAGE WITHIN 0.2V | 2 |
| 2 | LOCATE AND REPAIR CAUSE OF VOLTAGE REDUCTION: ● CORRODED DASH CONNECTOR ● IGNITION SWITCH → OK: SPARK AVAILABLE AT COIL WIRE | STOP |
| | NOT OK: SPARK NOT AVAILABLE AT COIL WIRE → REPLACE CONTROL UNIT | STOP |
| 3 | DISCONNECT 4-WIRE CONNECTOR AT CONTROL UNIT. CONNECT 2-WIRE CONNECTOR AT CONTROL UNIT. CONNECT AMMETER BETWEEN TERMINAL C1 AND GROUND. OK: AMMETER INDICATES 1 AMP ± 0.1 | STOP |
| | NOT OK: AMMETER INDICATES HIGHER OR LOWER CURRENT → REPLACE MODULE | STOP |



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## Engine Spark Knock (Pre-Ignition) Diagnosis

Spark knock (pre-ignition) can be attributed to several factors. The most common are ambient air conditions, such as air temperature, density and humidity.

- **High Underhood Air Temperature**
  Underhood air temperature is increased by the use of air conditioning (especially during long periods of idling), overloading (trailer pulling or operating in too high a gear), and the installation of accessories that restrict airflow.
- **Air Density**
  Air density increases as barometric pressure rises or as the air temperature decreases. A denser than normal mixture of air and fuel drawn into the cylinder has the same effect as increasing the engine compression ratio and this increases the possibility of spark knock.
- **Humidity**
  Low humidity increases the tendency for engine spark knock. High humidity decreases the tendency for spark knock.
- **Fuel Octane Rating**
  Fuels of an equivalent research octane rating may vary in their antiknock characteristics for a given engine. It may be necessary to retard the initial ignition timing (not more than 2 degrees from the specification) or select an alternate source of fuel.
- **Ignition Timing**
  Ignition timing should be checked to ensure it is adjusted to the specification.

**NOTE:** *The white paint mark on the timing degree scale identifies the specified ignition timing degrees at idle speed, it does not indicate TDC (Top Dead Center).*

- **Combustion Chamber Deposits**
  An excessive build-up of deposits in the combustion chamber may be caused by not using the recommended fuels and lubricants, prolonged engine idling or continuous low speed operation. These deposits can be reduced by the occasional use of Carburetor and Combustion Area Cleaner 8992352, or equivalent, or by operating the engine at high speeds.
- **Distributor Ignition Advance Mechanisms**
  The centrifugal (mechanical) and vacuum ignition advance mechanisms should be inspected to ensure they are operating correctly.
- **Exhaust Manifold Heat Valve**
  This is applicable to eight-cylinder engines only. If the heat valve sticks in the heat ON position, the intake manifold will be heated excessively.

# TEST PROCEDURES

## Primary and Secondary Circuit Electrical Tests

Refer to Diagnosis for electrical test procedures.

## Distributor Ignition Advance Tests

### Centrifugal (Mechanical) Ignition Advance Test

(1) Disconnect vacuum hose from vacuum advance mechanism and plug hose opening.

(2) Connect timing light to No. 1 spark plug and tachometer to ignition coil "tach" terminal (fig. 1G-14).

**WARNING:** *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(3) Start engine and observe timing degree scale and vibration damper index with timing light while engine is idling.

(4) Slowly increase engine speed to 2000 rpm. Timing should advance (increase in degrees BTDC) smoothly as engine speed increases. Refer to Chapter 1A—General Service and Diagnosis for centrifugal (mechanical) advance curve information.

### Vacuum Ignition Advance Test

**NOTE:** *Engine must be warmed up to normal operating temperature.*

(1) Connect vacuum hose to vacuum advance mechanism.

(2) Observe timing degree scale and vibration damper index with timing light while engine is idling.

(3) Slowly increase engine speed to 2000 rpm. With vacuum applied, ignition timing should advance sooner than with centrifugal advance alone. At 2000 rpm, vacuum advance should cause total advance to be more than with centrifugal advance alone. Refer to Chapter 1A—General Service and Diagnosis for vacuum advance curve information.

### Electronic Ignition Retard Test

If the vehicle (six-cylinder engine only) is equipped with electronic ignition retard and a feedback system, refer to Chapter 1J-Fuel Systems for test procedure.

## Ignition Coil Tests

The ignition coil can be tested on any conventional coil tester or with an ohmmeter. A coil tester is preferable because it can be used to detect faults that are impossible to detect with an ohmmeter.

### Primary Winding Resistance Test

(1) Remove connector from negative (-) and positive (+) terminals of coil.

(2) Set ohmmeter for low scale and adjust pointer to zero.

(3) Connect ohmmeter to coil negative (-) and positive (+) terminals. Resistance should be 1.13 to 1.23 ohms at 75°F (24°C). If coil temperature is above 200°F (93°C), 1.50 ohms is acceptable.

### Secondary Winding Resistance Test

(1) Remove high voltage ignition wire from high voltage terminal of ignition coil.

**NOTE:** *Ignition switch must be off.*

(2) Set ohmmeter for x1000 scale and adjust pointer to zero.

(3) Connect ohmmeter to brass contact in high voltage terminal and to either primary winding terminal. Resistance should be 7700 to 9300 ohms at 75°F (24°C). A maximum of 12,000 ohms is acceptable if coil temperature is 200°F (93°C) or more.

### Current Flow Test

(1) Remove connector from ignition coil.

(2) Depress plastic barb and withdraw positive (+) terminal wire from connector. Barb is visible from coil side of connector.

(3) Repeat for negative (-) terminal wire.

**CAUTION:** *Ensure ammeter current rating is sufficient for test.*

(4) Connect ammeter between coil positive (+) terminal and disconnected positive (+) terminal wire.

(5) Connect jumper wire from coil negative (-) terminal to known good engine ground.

(6) Turn ignition switch to ON position.

(7) Current flow should be approximately 7 amps and should not exceed 7.6 amps.

(8) If current flow is more than 7.6 amps, replace ignition coil.

(9) Leave ammeter connected to coil positive (+) terminal. Remove jumper wire from coil negative (-) terminal. Connect coil green wire to coil negative (-) terminal. Current flow should be approximately 4 amps.

If current flow is less than 3.5 amps, inspect for faulty connections in 4-wire (electronic control unit) and 3-wire (distributor) connectors or inadequate ground at ground screw inside distributor. If current flow is greater than 5 amps, the electronic control unit is defective.

**WARNING:** *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(10) Start engine. Normal current flow with engine operating is 2.0 to 2.4 amps. If current flow is not within specifications, electronic control unit is defective.

### Ignition Coil Output Tests

(1) Connect oscilloscope to ignition coil. Refer to test equipment manufacturer's instructions.

**WARNING:** *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(2) Start engine and observe secondary ignition voltage.

**CAUTION:** *Do not remove wires from spark plugs for cylinders 1 or 5 of a six-cylinder engine or cylinders 3 or 4 of an eight-cylinder engine when performing the next test because the pickup coil can be damaged.*

**CAUTION:** *Do not operate engine with spark plug disconnected for more than 30 seconds or catalytic converter can be damaged.*

(3) Remove one spark plug wire from distributor cap. Observe voltage applied to disconnected spark plug wire on oscilloscope. This voltage, referred to as open circuit output voltage, should be 24,000 volts (24 kV) minimum with engine speed of 1000 rpm.

## DISTRIBUTOR REPLACEMENT

### Removal

(1) Unfasten distributor cap retaining screws. Remove distributor cap with ignition coil and spark plug wires connected and position away from distributor.

(2) Disconnect distributor vacuum advance hose and plug hose opening.

(3) Disconnect distributor primary wire connector.

(4) Scribe mark on distributor housing in line with tip of rotor. Scribe mark on distributor housing near clamp and continue scribe mark on engine block in line with distributor mark. Note position of rotor and distributor housing in relation to surrounding engine parts as reference points for installing distributor.

(5) Remove distributor holddown bolt and clamp.

(6) Withdraw distributor carefully from cylinder block.

### Installation

(1) Clean distributor mounting area of block.

(2) Install replacement distributor mounting gasket in counterbore of engine block.

(3) Position distributor shaft in cylinder block. If engine crankshaft was not rotated while distributor was removed, perform the following procedure.

(a) Align rotor tip with mark scribed on distributor housing during removal. Turn rotor approximately 1/8-turn counterclockwise past scribe mark.

**CAUTION:** *Ensure that the distributor shaft fully engages the oil pump gear shaft. It may be necessary to slightly rotate the engine crankshaft while applying downward hand force on the distributor body to fully engage the distributor shaft with the oil pump drive gear shaft.*

(b) Slide distributor down into cylinder block. Align scribe mark on distributor housing with matching scribe mark on cylinder block.

**NOTE:** *It may be necessary to move the rotor and shaft slightly to start gear into mesh with camshaft gear and to engage oil pump drive tang, but rotor should align with scribe mark when distributor is down in place.*

(c) Install distributor holddown clamp, bolt and lockwasher, but do not tighten bolt.

(4) If engine crankshaft was rotated while distributor was removed, it will be necessary to establish timing accordingg to following procedure.

(a) Remove No. 1 spark plug. Hold finger over spark plug hole and rotate engine until compression pressure is felt. Slowly continue to rotate engine until timing index on vibration damper pulley aligns with top dead center (TDC) mark on timing degree scale. Always rotate engine in direction of normal rotation. Do not reverse rotate engine to align timing marks.

(b) Turn distributor shaft until rotor tip points in direction of No. 1 terminal in distributor cap. Turn rotor 1/8-turn counterclockwise past position of No. 1 terminal.

(c) Slide distributor shaft down into engine and position distributor vacuum advance mechanism in approximately same location (in relation to surrounding engine parts) as when removed. Align scribe mark on distributor housing with corresponding scribe mark on cylinder block.

**NOTE:** *It may be necessary to rotate the oil pump shaft with a long, flat-blade screwdriver to engage oil pump drive tang, but rotor should align with the position of No. 1 terminal when distributor shaft is down in place.*

(d) Install distributor holddown clamp, bolt and lockwasher, but do not tighten bolt.

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

(5) Install distributor cap (with ignition wires) on distributor housing. Ensure pickup coil wire rubber grommet in distributor housing aligns with depression in distributor cap and that cap fits on rim of distributor housing.

**NOTE:** *Two different diameter screws are used to retain distributor cap.*

(6) Apply Jeep Silicone Dielectric Compound, or equivalent, to connector terminal blades and cavitie Connect distributor primary circuit wire connecto Press firmly to overcome hydraulic pressure caused by silicone compound.

**NOTE:** *If connector locking tabs weaken or break off, bind connectors together with harness tie strap or tape to assure good electrical connection.*

**CAUTION:** *Do not puncture spark plug wires or boots to make connection. Use proper adapters.*

(7) Connect timing light to No. 1 spark plug.

**NOTE:** *The timing case cover has a socket adjacent to the timing degree scale for use with a magnetic timing probe. Ignition timing may be checked by inserting the probe through the hole until it rests on the vibration damper. The probe is calibrated to compensate for probe socket location, which is 9.5° ATDC. Eccentricity of the damper will properly space the magnetic probe. The timing degrees are indicated on a meter.*

**WARNING:** *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(8) Operate engine at specified rpm and observe vibration damper index and timing degree scale with timing light. Rotate distributor housing as needed to align timing index on vibration damper pulley with correct mark on timing degree scale. Refer to Chapter 1A—General Service and Diagnosis and Emission Control Information label for ignition timing procedure and specifications. When ignition timing is correct, tighten distributor holddown bolt and recheck timing to ensure it did not change.

(9) Disconnect timing light and connect vacuum hose to distributor vacuum advance mechanism.

## DISTRIBUTOR COMPONENT REPLACEMENT

When replacing the pickup coil, trigger wheel or vacuum advance mechanism, it is not necessary to remove the distributor from the engine. It is necessary to check ignition timing if the pickup coil or vacuum advance mechanism is replaced. Refer to figure 1G-16 for parts identification.

### Trigger Wheel and/or Pickup Coil

#### Removal

(1) Place distributor in appropriate holding devic if removed from engine.

(2) Remove cap.

(3) Remove rotor.

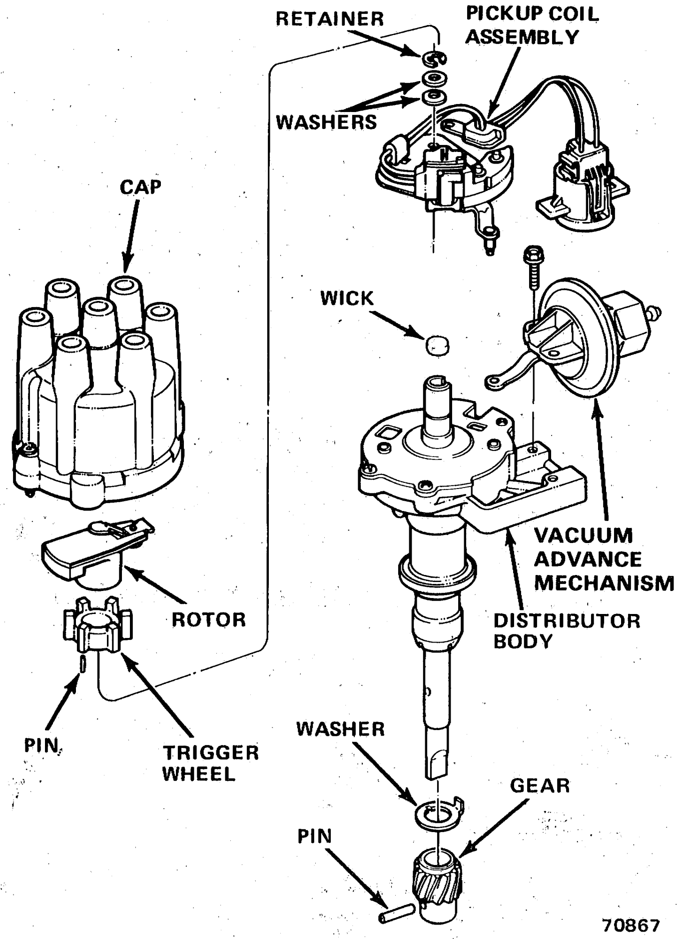


**Fig. 1G-16 SSI Distributor Components—Typical**

(4) Remove trigger wheel with trigger wheel puller J-28509, or equivalent. Use flat washer to prevent puller from contacting inner shaft. Alternately, two screwdrivers can be used to remove trigger wheel from shaft. Remove pin.

(5) Six-cylinder engine—remove pickup coil retainer and washers from pivot pin on base plate.

(6) Eight-cylinder engine—remove pickup coil snap ring from central shaft. Remove retainer from vacuum advance mechanism-to-pickup coil drive pin and move vacuum advance mechanism lever aside.

(7) Remove ground screw from harness tab.

(8) Lift pickup coil assembly from distributor housing.

(9) If vacuum advance mechanism is to be replaced, remove screws and lift unit out of distributor housing. Do not remove vacuum advance mechanism unless replacement is required.

#### Installation

(1) If vacuum advance mechanism was removed, install it on distributor housing with attaching screws.

**NOTE:** *If replacement vacuum advance mechanism is installed, refer to Vacuum Advance Mechanism for calibration procedure.*

(2) Position pickup coil assembly into distributor housing.

(3) Ensure pin on pickup coil is inserted into hole in vacuum advance mechanism link (six-cylinder engines). Attach vacuum advance mechanism lever and retainer to pickup coil pin (eight-cylinder engines).

(4) Install washers and retainer onto pivot pin to secure pickup coil assembly to base plate (six-cylinder engines). Install snap ring (eight-cylinder engines).

(5) Position wiring harness in slot in distributor housing. Install ground screw through tab and tighten.

(6) Install trigger wheel on shaft with hand pressure. Long portion of teeth must be upward. When trigger wheel and slot in shaft are properly aligned, use suitable drift and small hammer to tap pin into locating groove in trigger wheel and shaft. If distributor is not installed in engine, support shaft while installing trigger wheel pin.

(7) Install rotor. Install distributor cap.

### Vacuum Advance Mechanism

#### Removal

(1) Remove vacuum hose from vacuum advance mechanism.

(2) Six-cylinder engine—remove attaching screws and remove vacuum advance mechanism from distributor housing. It is necessary to tilt mechanism to disengage link from pickup coil pin protruding through distributor housing. It may be necessary to loosen base plate screws for necessary clearance.

(3) Eight-cylinder engine—remove distributor cap. Remove retainer from pickup coil pin. Remove attaching screws and lift vacuum advance mechanism from distributor housing.

#### Installation

(1) If replacement vacuum advance mechanism is to be installed, calibrate according to following procedure.

(a) Insert Allen wrench into vacuum hose fitting of original vacuum advance mechanism. Count number of **clockwise** turns necessary to bottom adjustment screw.

(b) Turn adjustment screw of replacement vacuum advance mechanism clockwise to bottom. Turn counterclockwise same number of turns counted in step (a).

(2) Six-cylinder engine—install vacuum advance mechanism on distributor housing. Ensure that vacuum advance link is engaged with pickup coil pin. Install retaining screws. Tighten base plate screws, if loosened.

(3) Eight-cylinder engine—install vacuum advance mechanism on distributor housing. Install retaining screws. Position vacuum advance lever onto pickup coil pin and install retainer. Install distributor cap.

(4) Check timing and adjust if required.
(5) Connect vacuum hose to vacuum advance mechanism.

## Rotor

Inspect the rotor during precision tune-ups as outlined in Chapter 1A—General Service and Diagnosis.

A unique feature of the SSI system is the silicone dielectric compound applied to the rotor blade during manufacture. Radio interference is greatly reduced by the presence of a small quantity of this dielectric on the rotor blade. After a few thousand miles, the dielectric becomes charred by the high voltage current carried by the rotor (fig. 1G-17). This is normal. Do not scrape the residue from the rotor blade.

When installing a replacement rotor, always apply a thin coat (0.01 to 0.12 inch) of AMC Silicone Dielectric Compound, or equivalent, to the tip of the rotor blade.

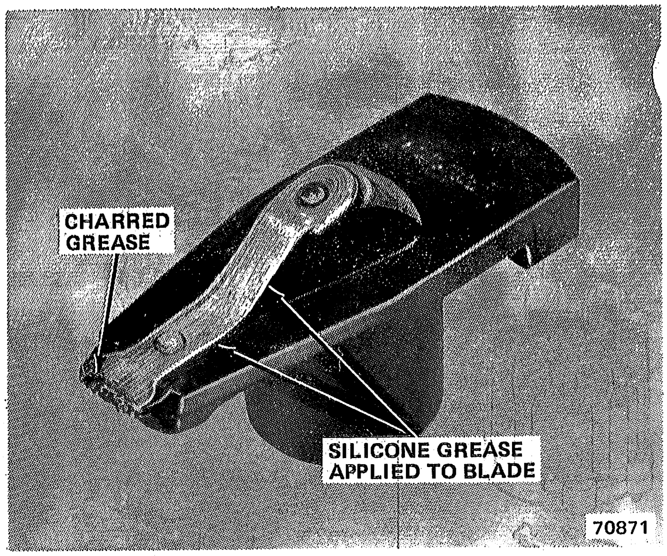


**Fig. 1G-17 Rotor Silicone Dielectric Compound Application**

# SPECIFICATIONS

### SSI Distributor and Ignition Coil Specifications

| | |
|---|---|
| Distributor Pickup Coil Resistance | 400 to 800 ohms @ 75°F (24°C) |
| Ignition Coil | |
| Primary Resistance | 1.13 to 1.23 ohms @ 75°F (24°C) |
| | 1.5 ohms @ 200°F (93°C) |
| Secondary Resistance | 7700 to 9300 ohms @ 75°F (24°C) |
| | 12,000 ohms @ 200°F (93°C) |
| Minimum Open Circuit Output at 1000 rpm | 24 kv |
| Spark Plugs | |
| Required Voltage at 1000 rpm | 5 to 16 kv |
| Maximum Variation Between Cylinders | 3 to 5 kv |

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### Torque Specifications

**Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-tightened item.**

| | USA (ft-lbs) | | Metric (N·m) | |
|---|---|---|---|---|
| | Service Set-To Torque | Service In-Use Recheck Torque | Service Set-To Torque | Service In-Use Recheck Torque |
| Distributor Clamp Screw | 13 | 10-18 | 18 | 13-24 |
| Spark Plugs | 28 | 22-33 | 38 | 30-45 |

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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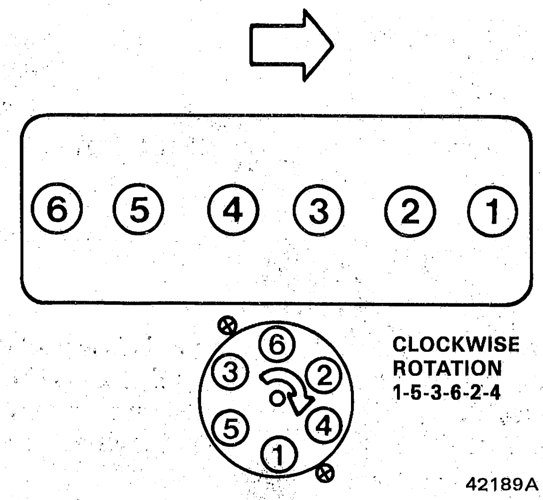
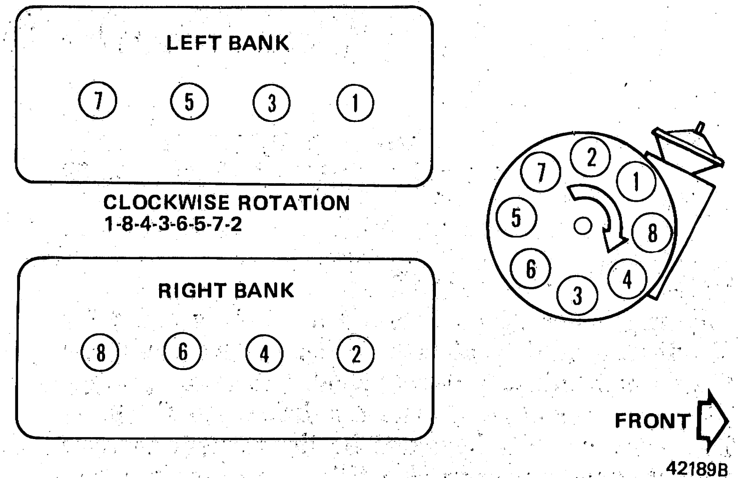
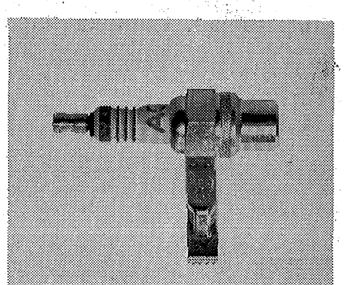



SIX CYLINDER ENGINE

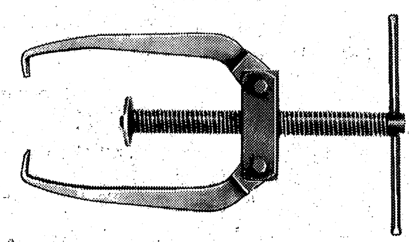



EIGHT CYLINDER ENGINE

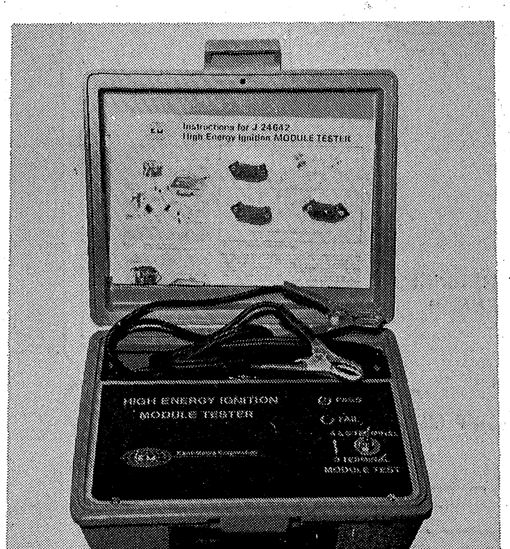
## Tools



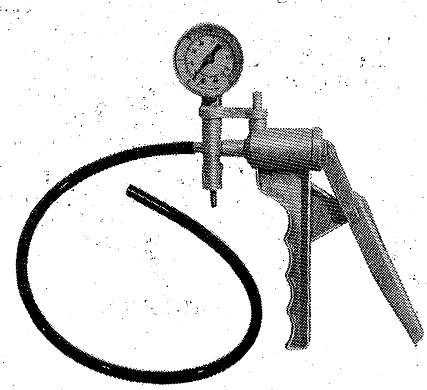
J-26792 HEI SPARK TESTER



J-28509 TRIGGER WHEEL PULLER




J-24642 HEI MODULE TESTER



J-23738 HAND OPERATED VACUUM PUMP

# VACUUM ADVANCE CONTROL SYSTEMS



## FOUR-CYLINDER ENGINE SYSTEM

Four-cylinder CJ engines use manifold vacuum for distributor ignition advance. A delay valve maintains the vacuum advance during sudden throttle openings when the coolant temperature is below 120°F (49°C). The delay valve is bypassed by the vacuum advance coolant temperature override (CTO) valve when the coolant temperature is above 120°F (49°C). Refer to figure 1G-18 for a diagram of the system.

### Vacuum Advance Coolant Temperature Override (CTO) Valve

The CTO valve is screwed into the thermostat housing to allow the thermal sensor to be in contact with the engine coolant. Depending on coolant temperature, the CTO valve (fig. 1G-19) permits manifold vacuum with the delay function or manifold vacuum without the delay function to control the distributor vacuum advance.

#### Operation

When the engine coolant temperature is below 120°F (49°C), manifold vacuum at port 1 is applied to port D. A hose connects port D with the distributor vacuum advance mechanism. The delay valve is in the circuit when the valve is in this position.

When the engine coolant temperature reaches 120°F (49°C), manifold vacuum at port 2 is also applied to port D but the delay valve is bypassed. This may be considered the normal operating mode. Refer to figure 1G-20.

#### Functional Test

(1) Disconnect vacuum hose from distributor vacuum advance mechanism. Connect vacuum gauge to vacuum hose.

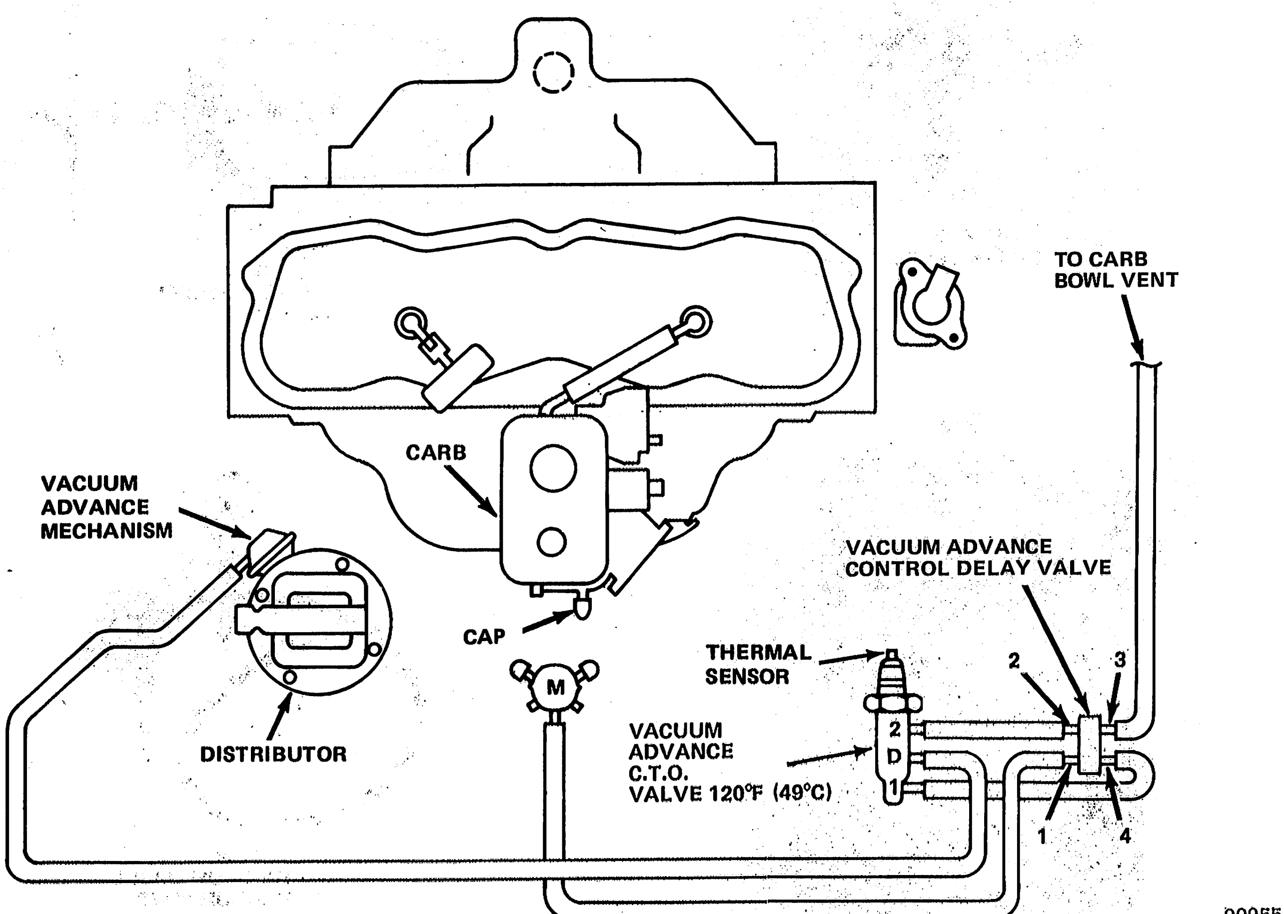



Fig. 1G-18 Vacuum Advance Control System—Four-Cylinder Engines

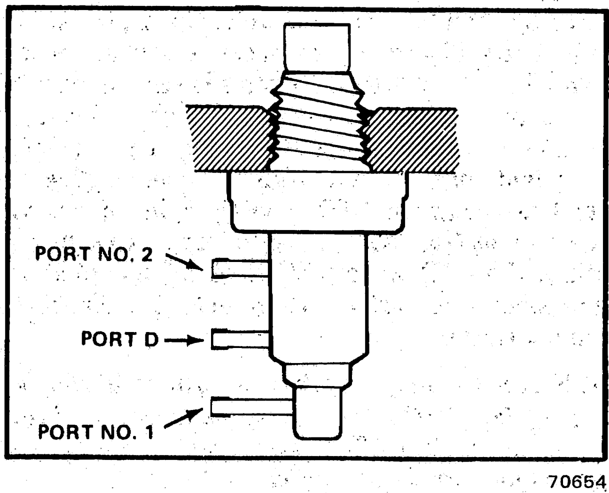



**Fig. 1G-19 Vacuum Advance CTO Valve**

**WARNING:** *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(2) Start engine.

(3) With engine coolant temperature below 120°F (49°C), manifold vacuum should be indicated on gauge.

(4) Disconnect vacuum hose from port 4 of delay valve and cap port (air-tight).

(5) Manifold vacuum should not be indicated on gauge with engine coolant temperature below 120°F (49°C).

(6) Allow engine coolant temperature to reach 120°F (49°C). Manifold vacuum should be indicated on gauge.

**NOTE:** *The 120°F (49°C) CTO valve switching temperature is a nominal value. The actual switching temperature may vary slightly from unit to unit.*

(7) Stop engine.

(8) Remove cap from port 4 of delay valve and connect vacuum hose.

(9) Remove gauge and connect vacuum hose to distributor vacuum advance mechanism.

(10) If defective, replace CTO valve.

### Vacuum Advance CTO Valve Replacement

**WARNING:** *If engine has been recently operated, use care to prevent scalding by hot coolant. System is pressurized.*

(1) Drain coolant from radiator until level is below CTO valve.

(2) Identify, tag and disconnect vacuum hoses from CTO valve.

(3) Place drain pan under engine directly below CTO valve.

(4) With 7/8-inch open end wrench, remove CTO valve from thermostat housing.

(5) Install replacement CTO valve.

(6) Connect vacuum hoses to valve.

(7) Install coolant.

**WARNING:** *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(8) Start engine and inspect for coolant leaks.

(9) Test CTO valve as outlined in Functional Test.

## Vacuum Advance Control Delay Valve

A vacuum advance control delay valve is added to the vacuum advance circuit to provide improved driveability when the engine is cold (fig. 1G-21). Ports 1 and 2, and ports 3 and 4 are connected internally.

When vacuum is greater at port 4 than at port 1 (e.g., sudden acceleration), air must flow through the orifice to equalize the pressure. This creates a momentary delay that prevents a sudden decrease in the vacuum advance. When the vacuum is greater at port 1 than at port 4, air flows freely through the unseated check valve and the pressure is instantly equalized.

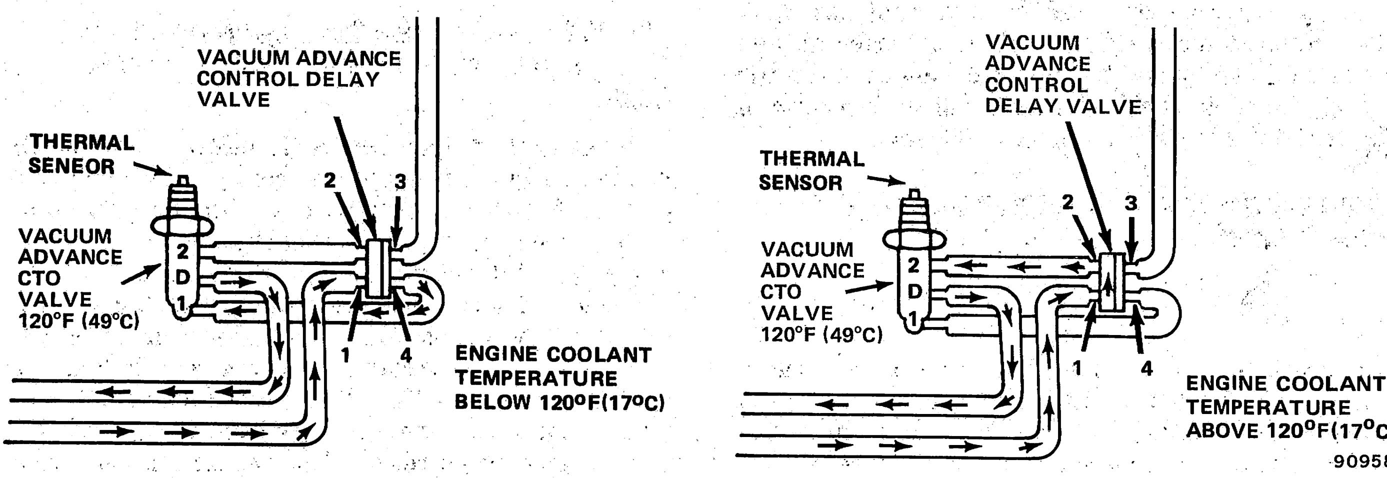



**Fig. 1G-20 Vacuum Advance Control System Operation**

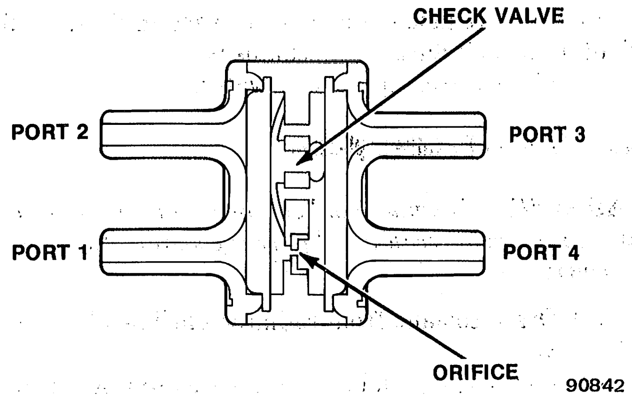



**Fig. 1G-21 Vacuum Advance Control Delay Valve**

### Functional Test

(1) Connect tee fitting at port 1 and port 4.
(2) Connect vacuum gauge to each tee fitting.

**WARNING:** *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(3) Start engine.
(4) Observe gauges. Vacuum should be equal.
(5) When throttle is suddenly depressed, vacuum at port 1 will instantly decrease but vacuum at port 4 should be maintained momentarily.
(6) Stop engine.
(7) If defective, replace delay valve.
(8) Remove gauges and tee fittings.

## VACUUM ADVANCE CONTROL SYSTEM—SIX- AND EIGHT-CYLINDER ENGINES

Manifold vacuum and carburetor ported vacuum are both used for the ignition vacuum spark advance mechanism with six- and eight-cylinder engines. On some engines, a coolant temperature override (CTO) valve determines the appropriate vacuum source, depending upon coolant temperature. On other engines, a nonlinear vacuum regulator (NLVR) valve combines manifold vacuum at idle speed and carburetor ported vacuum at a ratio that is proportional to the amount of throttle opening. Refer to the Emission Components charts in Chapter 1A for applicable engine application.

### Vacuum Advance Coolant Temperature Override (CTO) Valve—Standard Cooling System

#### General

On six- and eight-cylinder engines with a vacuum advance CTO valve, the distributor vacuum advance is controlled by carburetor ported vacuum after the engine coolant warms to a predetermined temperature. Warm-up driveability is improved by controlling the vacuum advance by manifold vacuum while the engine is cold. This is accomplished by the vacuum advance control system (fig. 1G-22). The CTO valve is screwed into the intake manifold coolant passage for six-cylinder engines, and into the thermostat housing or intake manifold coolant passage for eight-cylinder engines. A thermal sensor at the CTO valve tip is in contact with engine coolant (fig. 1G-23). Depending on coolant temperature, the CTO valve permits either manifold vacuum or carburetor ported vacuum to control distributor vacuum advance.

**NOTE:** *Some engine applications utilize a standard cooling system CTO valve in conjunction with a heavy-duty cooling system CTO valve. Refer to the Vacuum Diagrams for actual applications.*

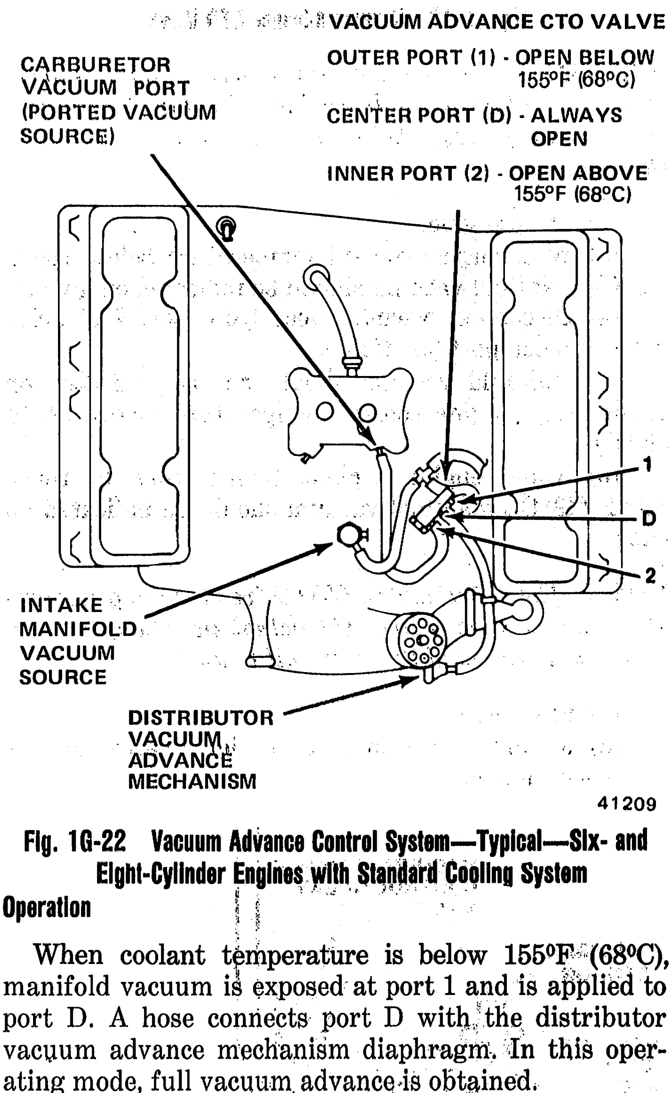



**Fig. 1G-22 Vacuum Advance Control System—Typical—Six- and Eight-Cylinder Engines with Standard Cooling System**

#### Operation

When coolant temperature is below 155°F (68°C), manifold vacuum is exposed at port 1 and is applied to port D. A hose connects port D with the distributor vacuum advance mechanism diaphragm. In this operating mode, full vacuum advance is obtained.

When engine coolant reaches 155°F (68°C), the valve is moved upward, blocking manifold vacuum at port 1. Carburetor ported vacuum is exposed at port 2 and is applied to port D. The distributor vacuum advance mechanism diaphragm is now controlled by ported vacuum. This may be regarded as the normal operating mode.

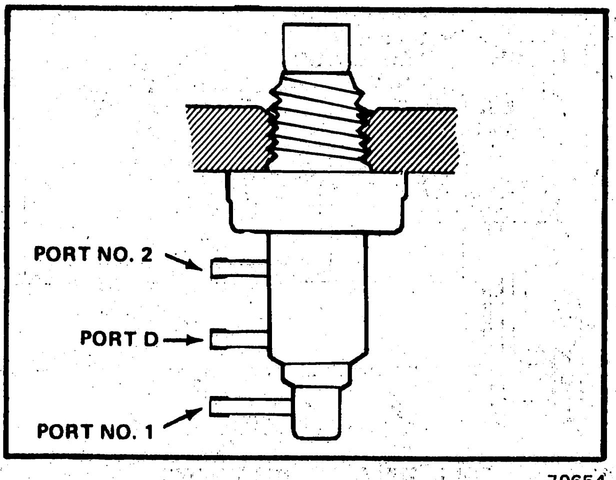



Fig. 1G-23 Vacuum Advance CTO Valve

#### Functional Test

Connect a vacuum gauge to the center port (D) of the CTO valve. Below 155°F (68°C) manifold vacuum should be indicated on the gauge. Above 155°F (68°C) carburetor ported vacuum should be indicated on gauge. Defective valves must be replaced.

**NOTE:** *Ported vacuum is not available with the throttle closed. Ported vacuum is only available when the throttle is opened to achieve an engine speed of approximately 1000 rpm.*

### Vacuum Advance Coolant Temperature Override (CTO) Valve—Heavy-Duty Cooling System

#### General

This is a single function valve that is utilized in conjunction with a heavy-duty cooling system to prevent overheating during high ambient temperature operating conditions. It is connected to the engine coolant passage in the same location as the CTO valve that is used with standard cooling systems.

**NOTE:** *Some engine applications utilize a heavy-duty cooling system CTO valve in conjunction with a standard cooling system CTO valve. Refer to Vacuum Diagrams for actual applications.*

#### Operation

When the coolant temperature is below the switching temperature (220°F [104°C]), ported vacuum is exposed at port 1 and applied to port D to allow ported vacuum to control the distributor vacuum advance. When the coolant temperature reaches 220°F (104°C), port 1 closes and port 2 is connected to port D to allow manifold vacuum to control the distributor vacuum advance. With manifold vacuum applied to the vacuum advance mechanism, engine idle speed is increased thereby improving engine cooling efficiency and reducing coolant boiling during idle speed engine operation.

#### Functional Test

(1) Connect vacuum gauge to port D (Dist) of heavy-duty cooling system CTO valve. Below 220°F (104°C), carburetor ported vacuum should be indicated on gauge.

(2) Above 220°F (104°C), port 1 (Carb) closes and port 2 (Manifold) is connected to port D (Dist). Manifold vacuum should now be indicated on gauge.

### Vacuum Advance CTO Valve Replacement—Six-Cylinder Engine

**WARNING:** *If engine has been recently operated, use care to prevent scalding by hot coolant. System is pressurized.*

(1) Drain coolant from radiator. Use clean container so that coolant can be reused.

(2) Identify, tag and disconnect vacuum hoses from CTO valve.

(3) Place drain pan under engine below CTO valve.

**WARNING:** *Use care to prevent scalding by hot coolant leaking from block when removing the valve.*

(4) Using 7/8-inch open end wrench, remove valve from intake manifold.

#### Installation—Six-Cylinder

(5) Install replacement CTO valve.

(6) Connect vacuum hoses to valve.

(7) Install coolant.

**NOTE:** *Remove temperature gauge sending unit from cylinder head to aid in venting air while filling the cooling system.*

### Vacuum Advance CTO Valve Replacement—Eight-Cylinder Engine

**WARNING:** *If engine has been recently operated, use care to prevent scalding by hot coolant. System is pressurized.*

(1) Drain coolant from radiator. Use clean container so coolant can be reused.

(2) Remove air cleaner assembly.

(3) Identify, tag and disconnect vacuum hoses from CTO valve.

(4) Using 7/8-inch open end wrench, remove CTO valve from thermostat housing (or intake manifold).

(5) Install replacement CTO valve in thermostat housing (or intake manifold).

(6) Connect vacuum hoses to valve.

(7) Install air cleaner assembly.

(8) Install coolant.

(9) Purge cooling system of air.

## Regulated Vacuum Advance Control System

### General

For all six- and eight-cylinder engines with a regulated vacuum advance control system, distributor vacuum advance is primarily controlled by regulated vacuum. The vacuum regulation is accomplished by the use of a non-linear vacuum regulator valve (fig. 1G-24). The ratio of the regulation (fig. 1G-25) is proportional to the engine torque and rpm.

**NOTE:** *The NLVR valve operates in conjunction with a CTO valve.*

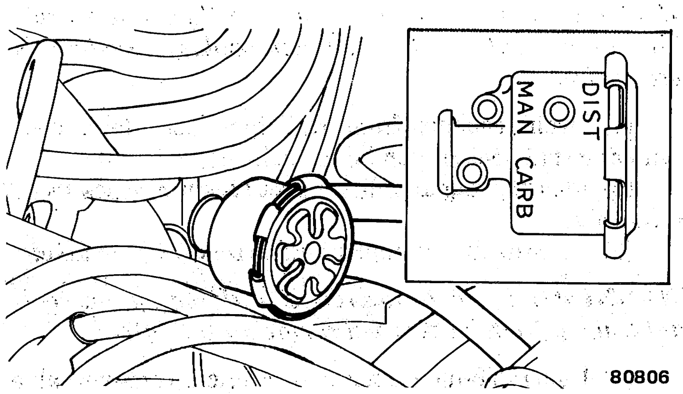



**Fig. 1G-24 Non-Linear Vacuum Regulator (NLVR) Valve**

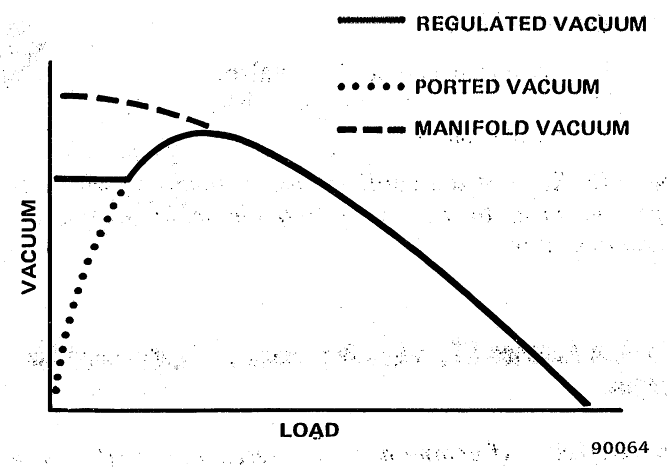



**Fig. 1G-25 Non-Linear Vacuum Regulator Valve Operation**

### Operation

The NLVR valve has two input ports (from manifold vacuum and carburetor ported vacuum sources) and one outlet port (to CTO valve). With no-torque or low-torque engine operating conditions, the NLVR valve provides regulated vacuum (fig. 1G-26). Under these conditions, manifold vacuum is high and ported vacuum is either non-existent or very low. The NLVR valve provides a vacuum level that is somewhere between the two vacuum levels. This is determined by the calibration of the valve. As engine torque increases and ported vacuum increases above the regulated value, the regulator valve switches to ported vacuum.

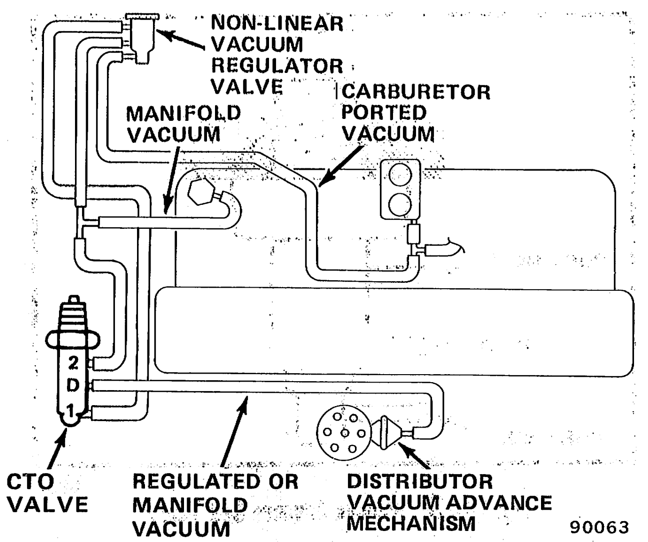



**Fig. 1G-26 Regulated Vacuum Advance Control System—Typical**

### Functional Test

Connect a vacuum gauge to the distributor port (D) of the NLVR valve. With the engine at idle speed, a vacuum level of approximately 7 in. Hg (24 kPa) should be indicated on the gauge. As the throttle is opened and engine speed increases, ported vacuum from the carburetor should be indicated on the vacuum gauge.

### Replacement

(1) Identify, tag and disconnect vacuum hoses. Remove NLVR valve.

(2) Connect vacuum hoses to replacement valve.

**NOTE:** *Ensure vacuum hoses are connected to correct valve ports.*

## Forward Delay Valve

Certain engines employ a one-way forward delay valve (fig. 1G-27) in the vacuum advance circuit to improve driveability and also reduce undesirable hydrocarbon (HC) emission.

The valve functions to delay the effects of sudden increases in vacuum during quick throttle closings and thereby prevent sudden ignition advance during engine deceleration.

### Functional Test

(1) Connect external vacuum source to port on black side of delay valve.

(2) Connect one end of 24-inch (60 cm) section of rubber hose to vacuum gauge and other end to port on colored side of valve.

(3) With elapsed time device in view and a constant 10 in. Hg (34 kPa) of vacuum applied, note time required for gauge pointer to move from 0 to 8 in. Hg (0 to 27 kPa).

(4) Compare time to acceptable time limits listed in Forward Delay Valve Time Limits chart.

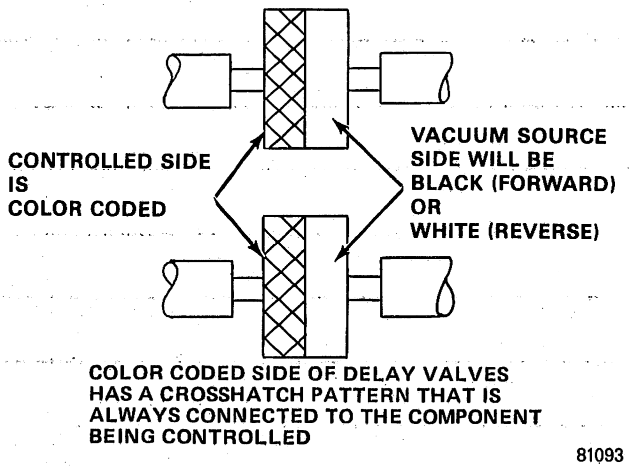



**Fig. 1G-27 Delay Valve Code**

**NOTE:** *While testing delay valves use care to prevent oil or other foreign material from entering vacuum ports.*

(5) Replace valve if it fails test, otherwise, install original with black side toward vacuum source.

**NOTE:** *In addition to the valves listed in the chart, certain engine applications employ a two-way delay valve. The body is orange and the minimum and maximum delay time limits are 0.2 to 0.4 seconds.*

**Forward Delay Valve Time Limits**

| Part Numbers | Time In Seconds | Color and Identification |
|---|---|---|
| 3230422 | 200 ± 40 | Black/Green |
| 3231118 | 100 ± 20 | Black/Yellow |
| 3231379 | 63.5 ± 13.5 | Black/White |
| 3235261 | 10 ± 2 | Black/Gray |
| 3236284 | 4 ± 0.8 | Black/Purple |
| 3237293 | 20 ± 4 | Black/Brown |
| 3239134 | 2 ± 0.5 | Black/Orange |
| NOTE: | | |
| Two Way Delay Valve | | |
| 3237255 | 2.0 ± 0.5 | Orange/Orange |
| Four-Part Reverse Delay Valve | | |
| 527011 | 8.0 ± 1.6 | Black/Blue |
| 547883 | 3.0 ± 0.6 | Black/Brown |

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## Reverse Delay Valve

Along with the forward delay valve, a reverse delay valve is used with certain engines to improve cold engine driveability and to reduce undesirable hydrocarbon (HC) emission.

When an engine is started, manifold vacuum applied to the distributor vacuum advance mechanism advances ignition timing. When the engine is accelerated manifold vacuum decreases causing the ignition timing to be retarded. To prevent the sudden retarding of ignition timing during acceleration, a one-way reverse delay valve is inserted in the vacuum line to delay the effects of the decrease in manifold vacuum.

### Functional Test

(1) Connect external vacuum source to port on white side of delay valve.

(2) Connect one end of 24-inch (60 cm) section of rubber hose to vacuum gauge and other end to port on colored side of valve.

(3) With elapsed time device in view and a constant 10 in. Hg (34 kPa) of vacuum applied, note time required for gauge pointer to move from 0 to 8 in. Hg (0 to 27 kPa).

(4) Compare time to acceptable time limits listed in Reverse Delay Valve Time Limits chart.

**Reverse Delay Valve Time Limits**

| Part Numbers | Time In Seconds | Color and Identification |
|---|---|---|
| 3235938 | 10 ± 2 | White/Gray |
| 3235939 | 20 ± 4 | White/Brown |
| 3236285 | 4 ± 0.8 | White/Purple |
| 3237131 | 375 ± 75 | White/Red |
| 3237141 | 100 ± 20 | White/Yellow |
| 3237184 | 15 ± 3 | White/Gold |
| 3239383 | 2 ± 0.5 | White/Orange |

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**NOTE:** *While testing delay valves use care to prevent oil or other foreign matter from entering vacuum ports.*

(5) Replace valve if it fails test, otherwise, install original valve with white side toward vacuum source.

## SPECIFICATIONS

**Vacuum Advance Control System Specifications**

| ENGINE | STANDARD COOLING | | HEAVY DUTY COOLING | |
|---|---|---|---|---|
| | 1 To D | 2 To D | 1 To D | 2 To D |
| 4-151 | Below 120°F (49°C) | Above 120°F (65°C) | ——— | ——— |
| 6-258 | Below 155°F (68°C) | Above 155°F (68°C) | Below 220°F (104°C) | Above 220°F (104°C) |
| 8-360 | Below 155°F (68°C) | Above 155°F (68°C) | Below 220°F (104°C) | Above 220°F (104°C) |

NOTE: TEMPERATURES ARE NOMINAL VALUES

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# NOTES