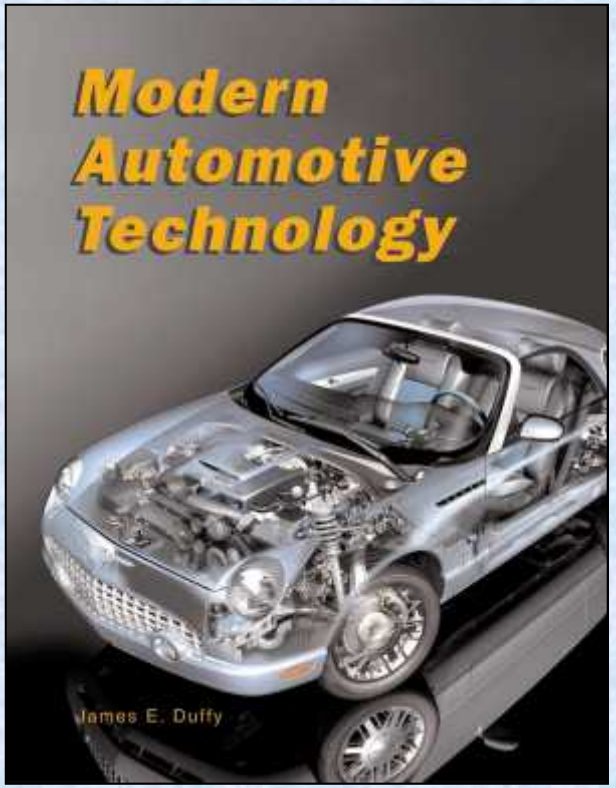
PowerPoint for

Modern Automotive Technology

by

Russell Krick



Publisher
The Goodheart-Willcox Co., Inc.
Tinley Park, Illinois

Chapter 36

Ignition System Problems, Testing, and Repair

Contents (19 Topics)

- Ignition system problem diagnosis
- Preliminary checks of ignition system
- Evaluating the symptoms
- Spark plug service
- Secondary wire service
- Distributor cap and rotor service
- Pickup coil service
- Contact point distributor service

Contents

- Dwell
- Ignition timing adjustment
- Testing centrifugal and vacuum distributor advance systems
- Removing the ignition distributor
- Rebuilding a distributor
- Ignition supply voltage test
- Ignition coil (coil pack) service

Contents

- Ignition switch service
- Ignition control module service
- Distributorless ignition system service
- Direct ignition system service

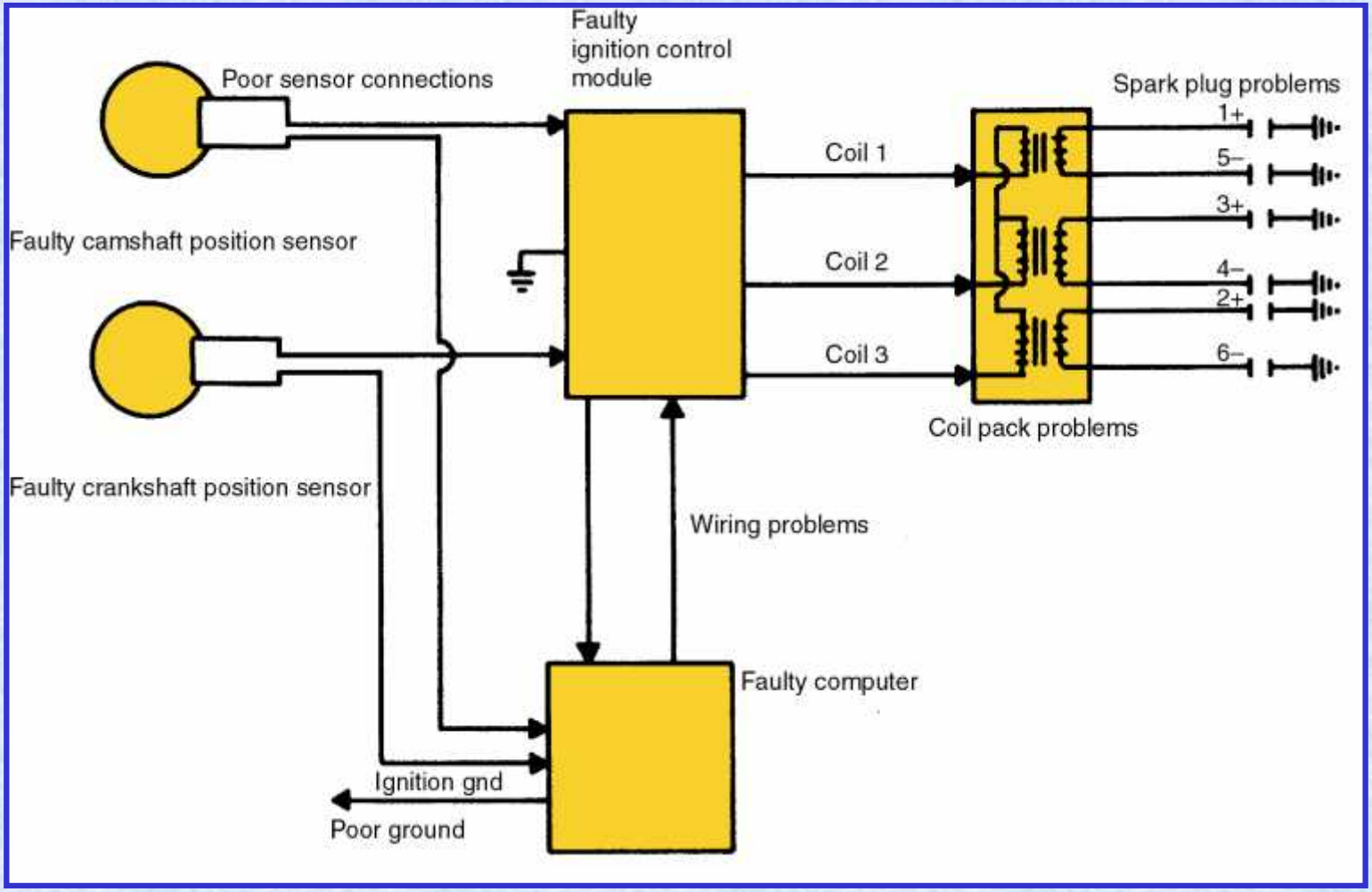
Ignition System Problem Diagnosis

- Diagnosis can be very challenging
- Ignition, fuel, emission, and electrical systems all work together
- Problems in one system may affect another system

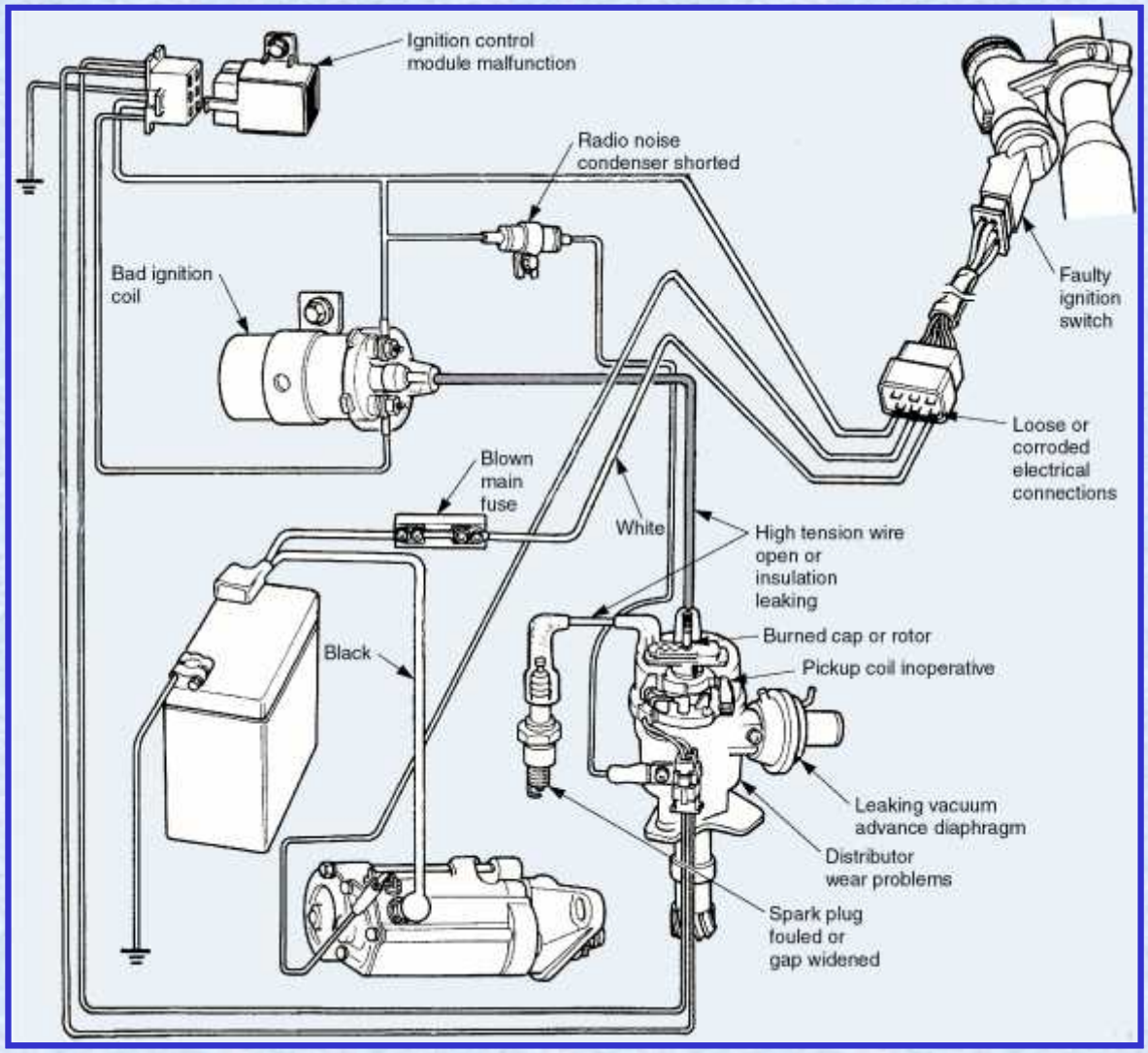
Preliminary Checks

- Perform a visual inspection
- Connect a scan tool; check for trouble codes and ignition-related problems
- Perform a spark test
- Check for dead cylinders, if suspected

Distributorless Ignition System Problems

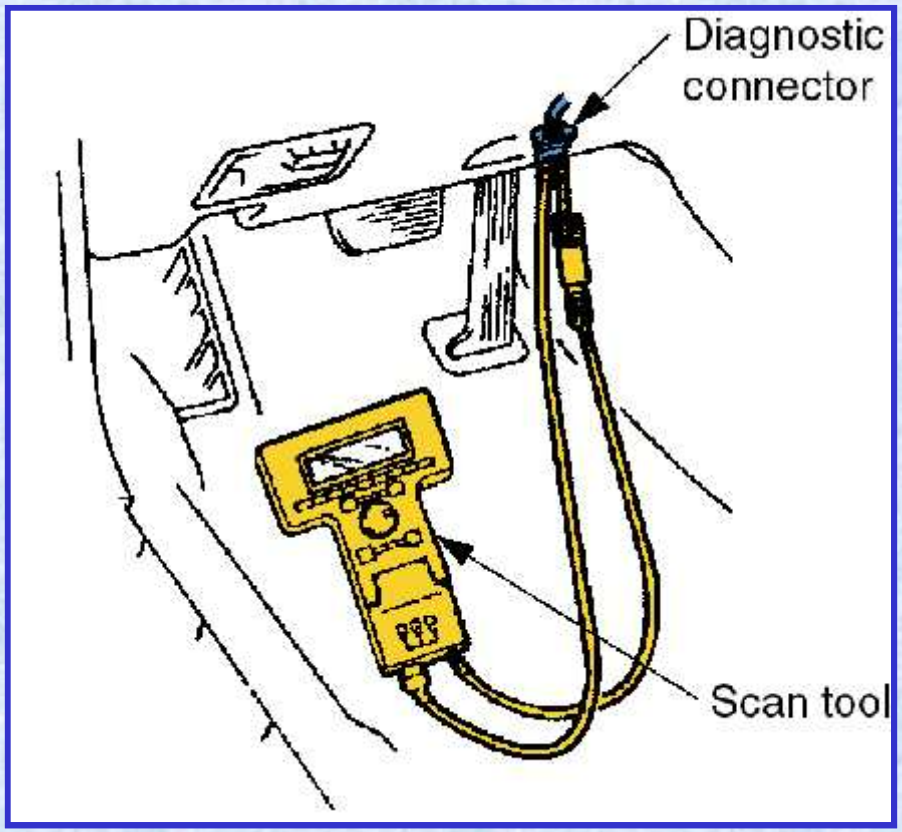


Distributor Ignition System Problems



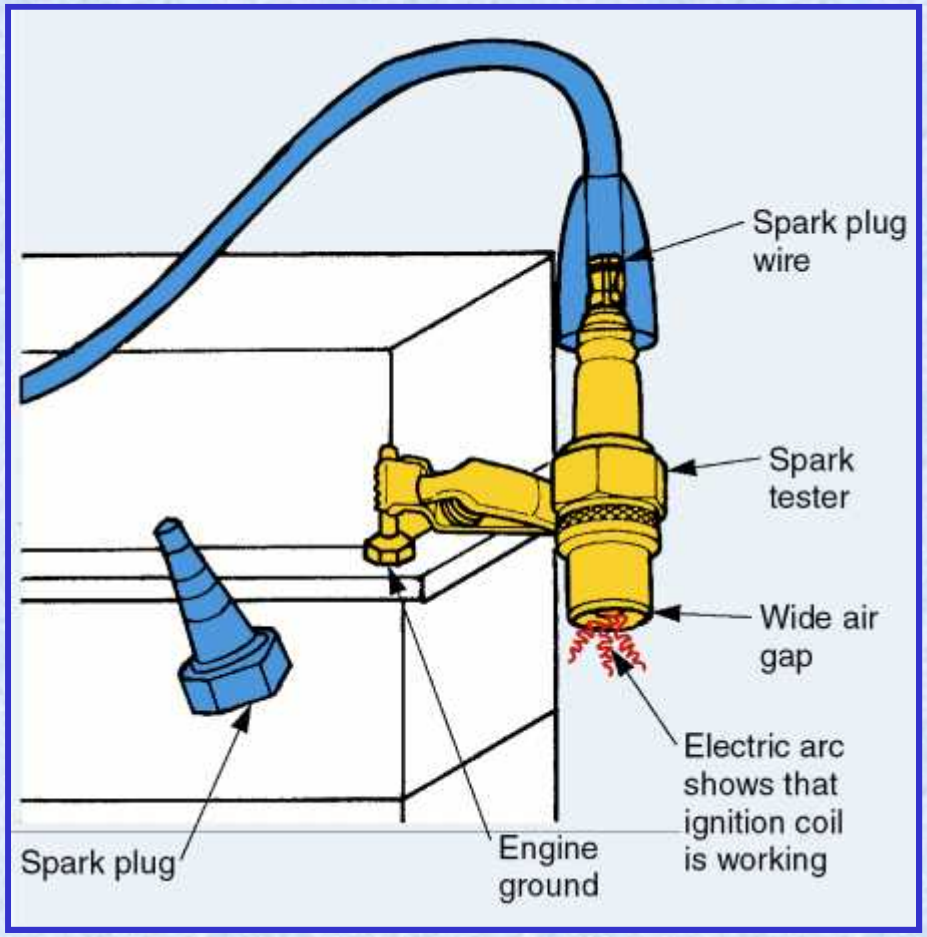
Connect a Scan Tool

The diagnostic connector (data link connector) may be under the dash or in the engine compartment



Perform Spark Test

No spark or a weak spark indicate ignition system troubles



Perform Spark Test

A bright arc should jump the gap

Checking for a Dead Cylinder

- Cylinder that is not burning fuel on the power stroke
- Causes:
  - ignition, fuel system, or mechanical problems
- Symptoms:
  - rough idle
  - exhaust “puffing” noise

Checking for a Dead Cylinder

- Disable one cylinder at a time
- Rpm should drop, and idle should be rough
- A dead cylinder will not change in speed or smoothness
- Some modern analyzers automatically check for dead cylinders

Evaluating the Symptoms

- Hand-held scope (oscilloscope)
  - VOM combined with an oscilloscope
  - checks computer inputs and outputs
- An engine analyzer contains several test units:
  - oscilloscope
  - dwell meter
  - tachometer
  - VOM

Hand-held Scope

Shows waveforms for advanced troubleshooting of the ignition system

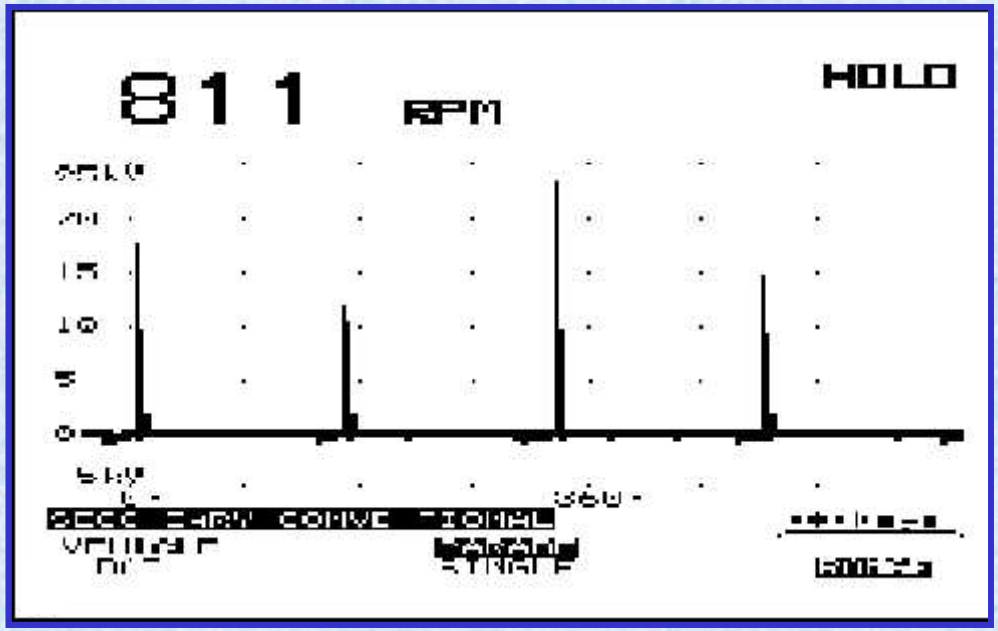
Engine Analyzer

Spark Plug Service

- Spark plugs can cause lack of power, poor fuel economy, or hard starting
- Tips can become coated with ash, oil, or deposits from fuel additives
- Electrodes can burn, widening the gap
- Use an oscilloscope for diagnosis
- Use misfire diagnostics on an OBD II vehicle

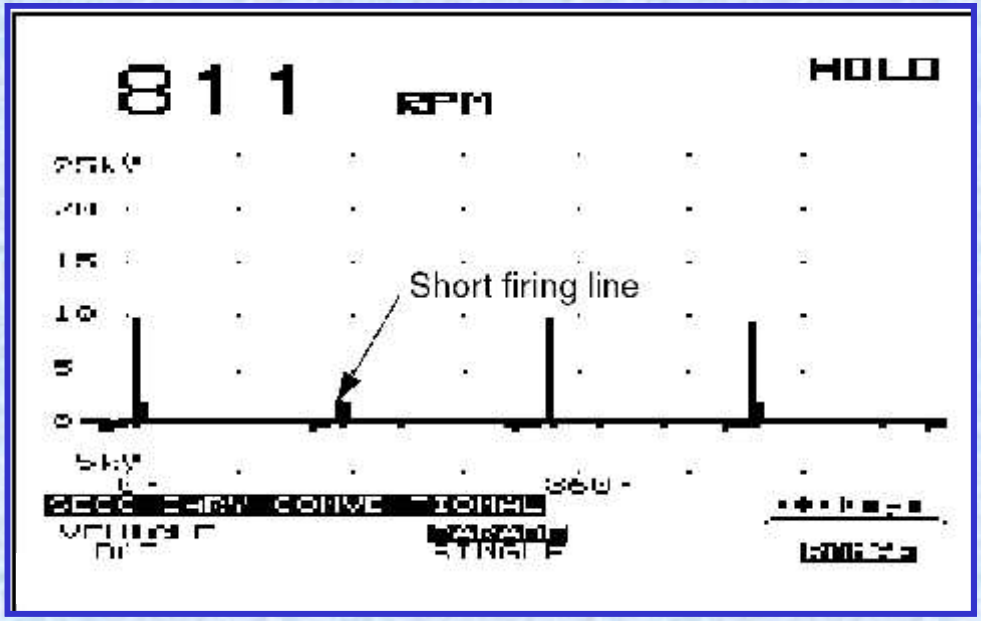
Secondary Patterns

Uneven firing lines caused by worn spark plugs



Secondary Patterns

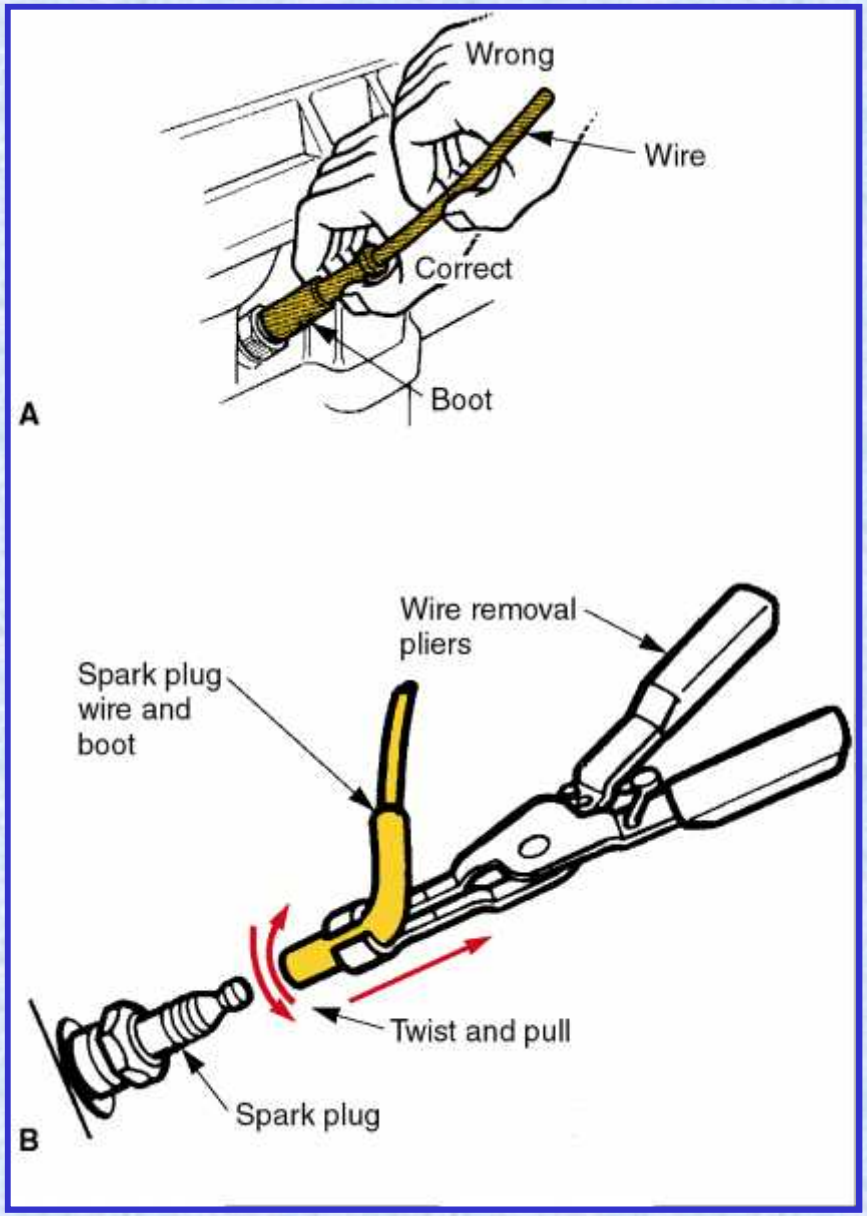
A short firing line caused by a fouled spark plug



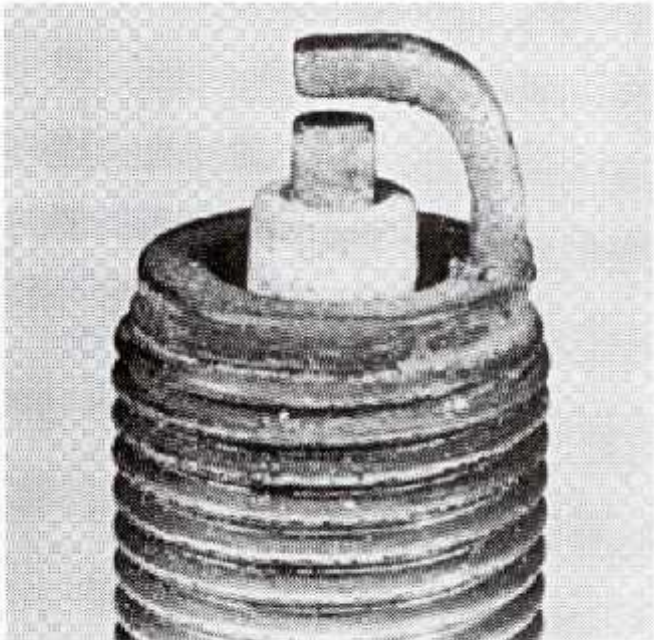
Spark Plug Removal

A. By hand

B. Using pliers



Normal Used Plug



Oil-Fouled Plug

Worn rings, scored cylinder,
leaking valve seals

Ash-Fouled Plug

Poor quality fuel or oil entering cylinder

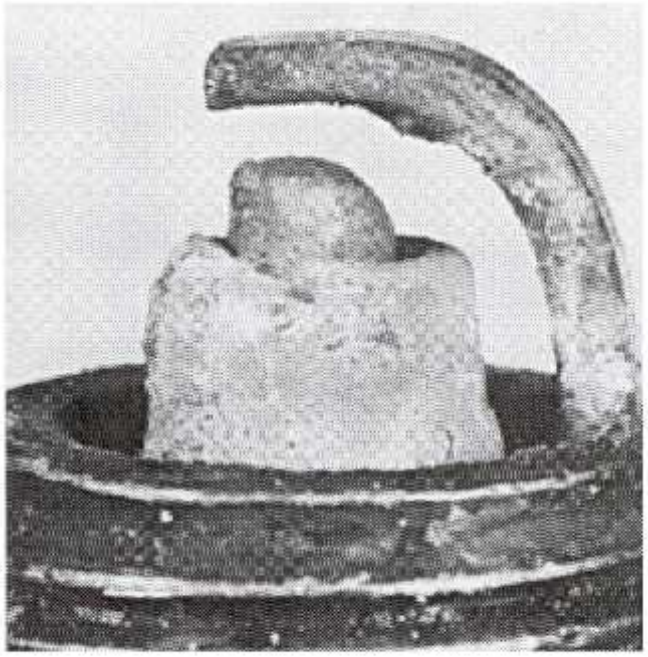
Carbon-Fouled Plug

Slow driving, heat range too cold, weak ignition, or rich mixture

Preignition Damage

Advanced timing, low octane fuel,
or heat range too hot

Normal Erosion



Old plug with prolonged use

Gapping Spark Plugs

Bend side electrode

Installing Spark Plugs

- Start plugs by hand
- Finish with a ratchet
- Torque to specification

Secondary Wire Service

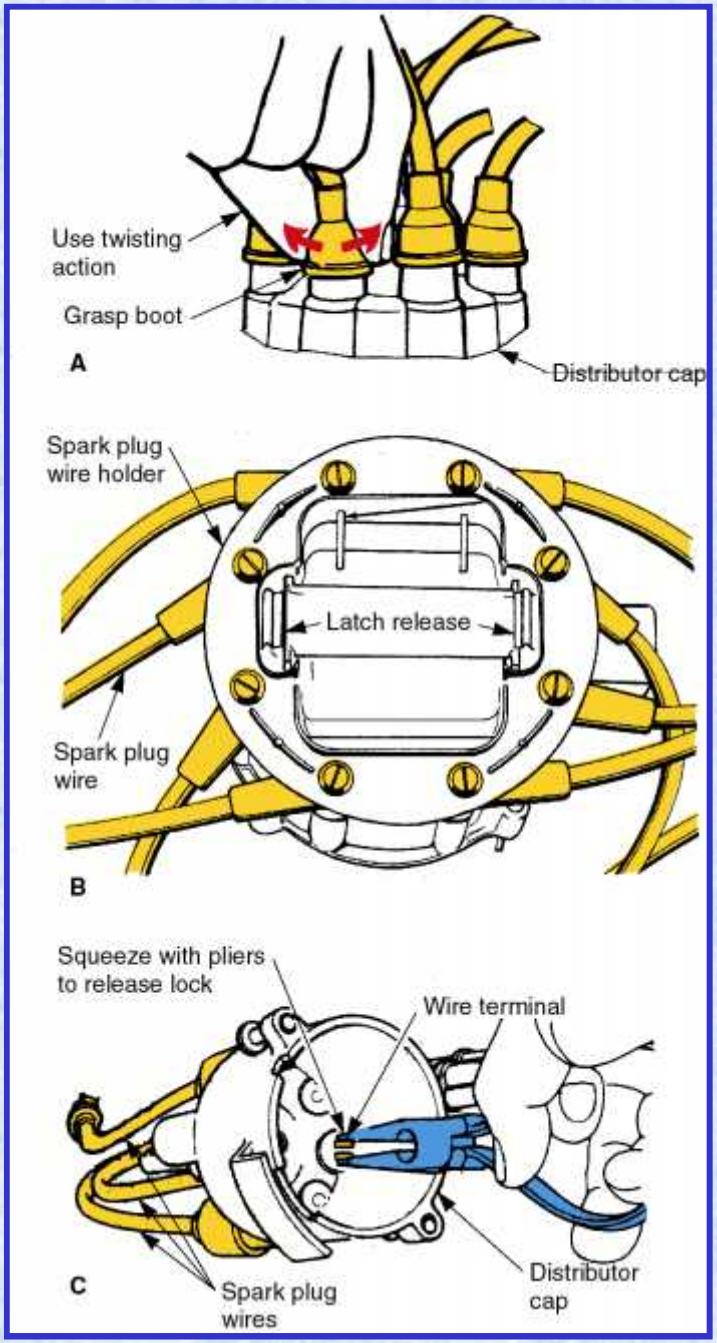
- Wire conductors become burned or broken
  - cause misfire or dead cylinders
- Insulation deteriorates
  - sparks jump to ground or another wire
  - causes misfire or dead cylinders

Spark Plug Wire Removal

A. Press fit

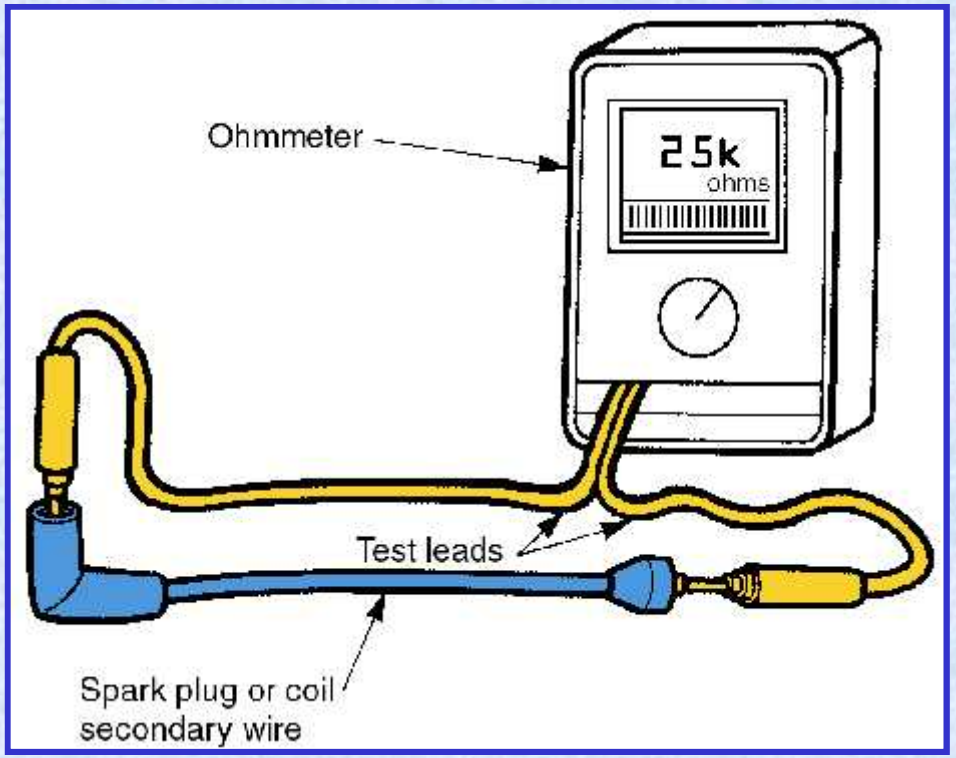
B. Large ring

C. Snap lock



Resistance Test

12,000 ohms per foot, or 50,000 ohms overall



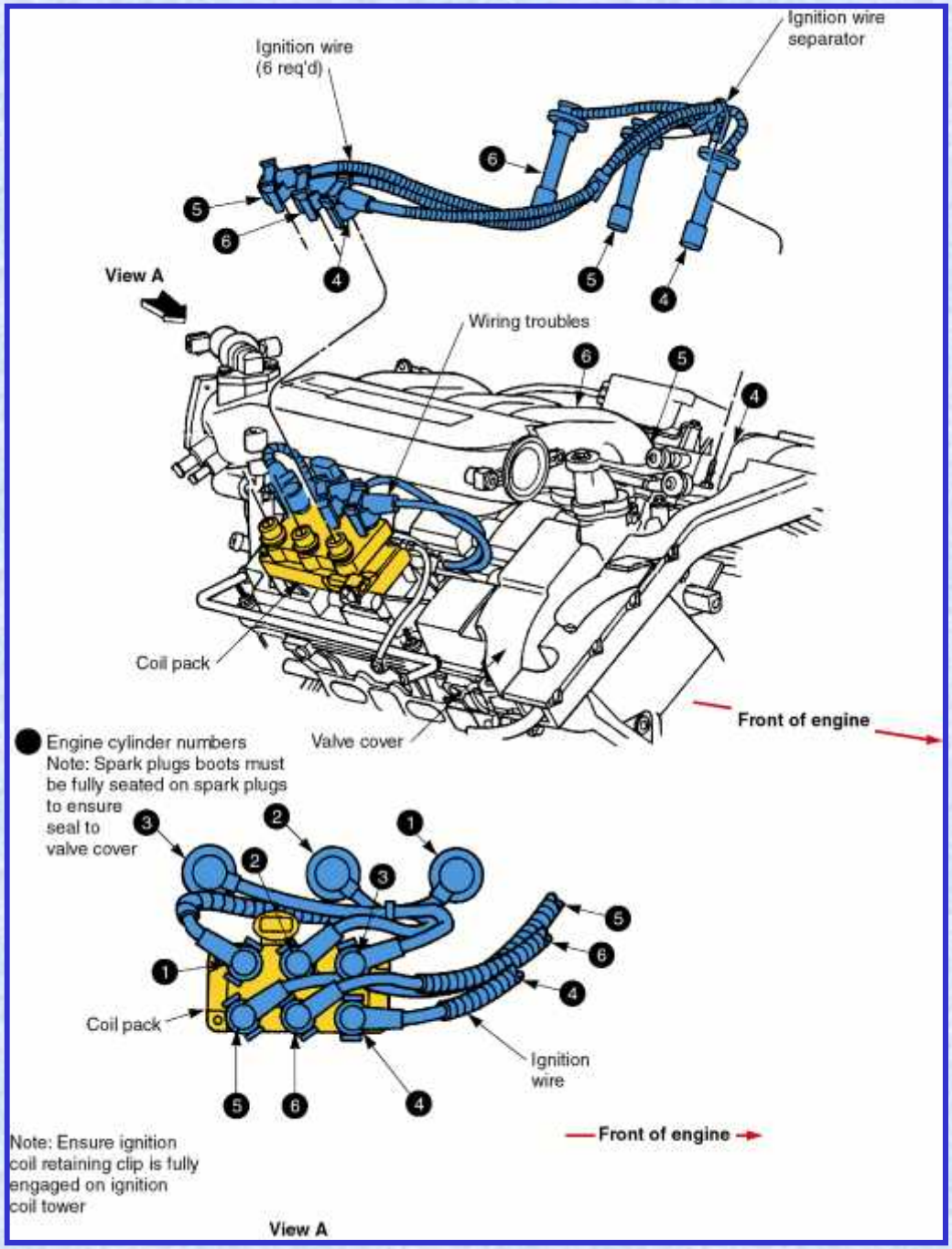
Insulation Test

- Check for sparks arcing through the insulation to ground or another wire
- Move a test light or grounded screwdriver along each wire
- If an arc jumps to probe, the insulation has broken down—replace the wires

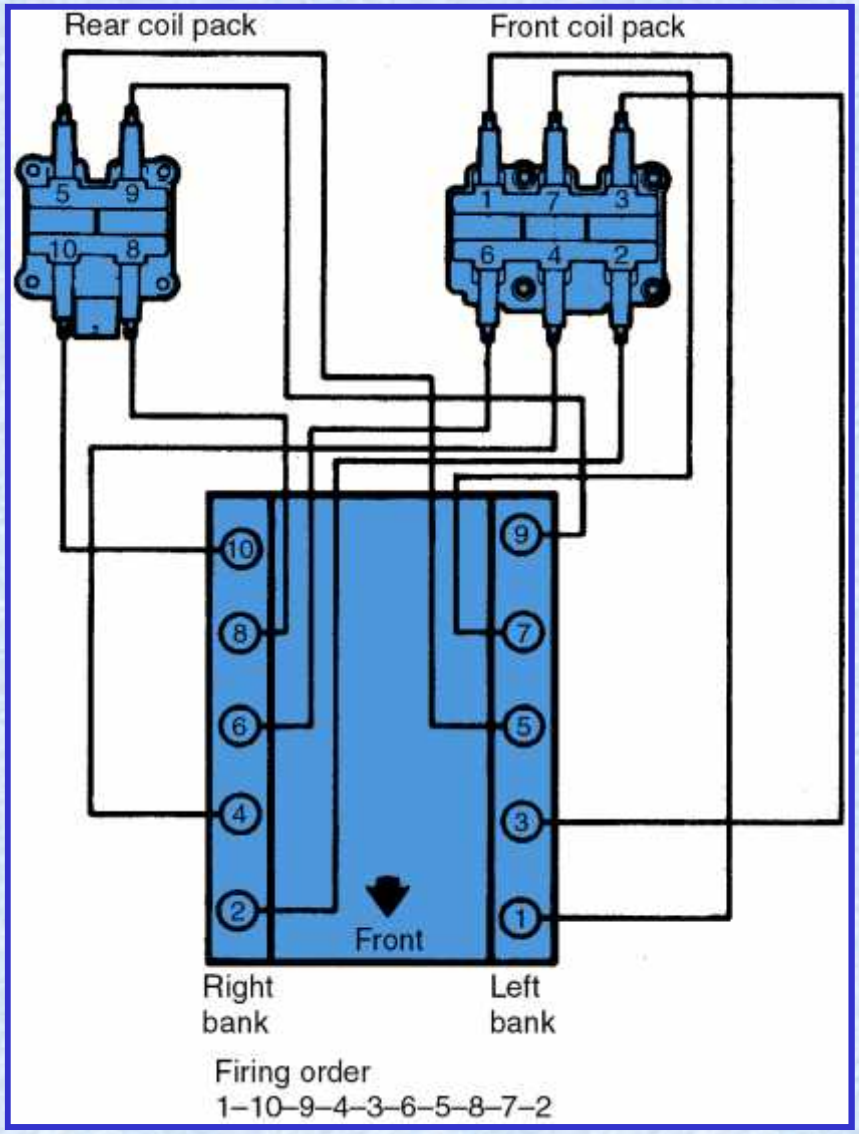
Wire Replacement

- Replace one wire at a time, if possible
- If all wires are removed, use the firing order and cylinder numbers to route the wires
- Use the factory routing

Wire Replacement (Distributor-less Ignition System)



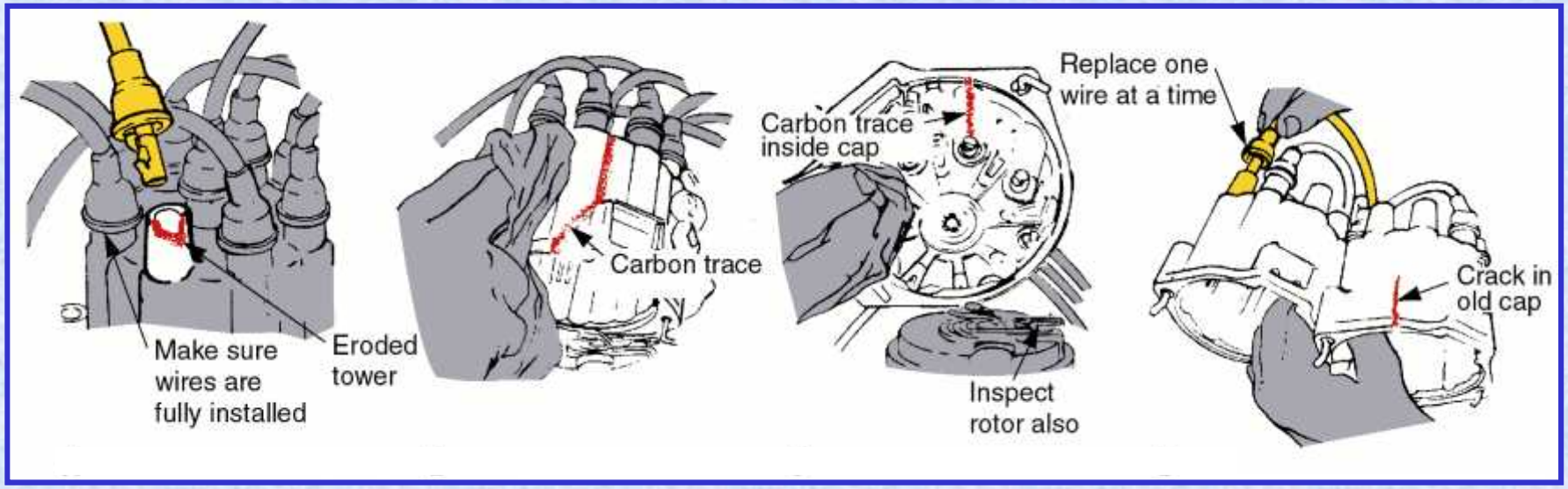
Wire Replacement (Distributor-less Ignition System)



Distributor Cap and Rotor Service

- A faulty cap or rotor can cause missing, backfiring, or other performance problems
- Cap and rotor problems:
  - eroded towers
  - carbon tracing
  - cracking
  - wear

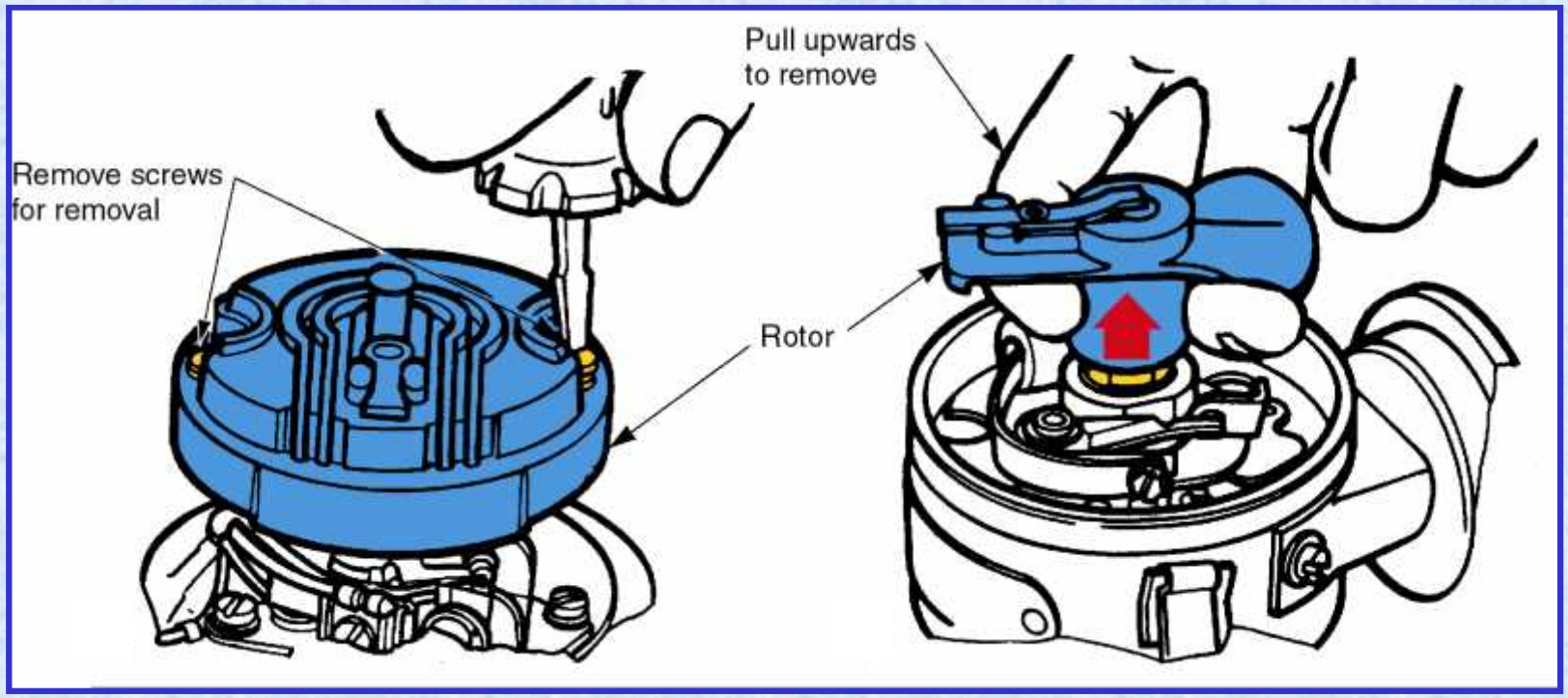
Cap and Rotor Problems



Replacement

- The rotor is held by screws or is press-fit
- The rotor is indexed to the distributor shaft by a notch
- The cap is secured by screws or spring-type clips
- The cap uses an alignment tab or notch

Rotor Removal



Screw type

Press-fit

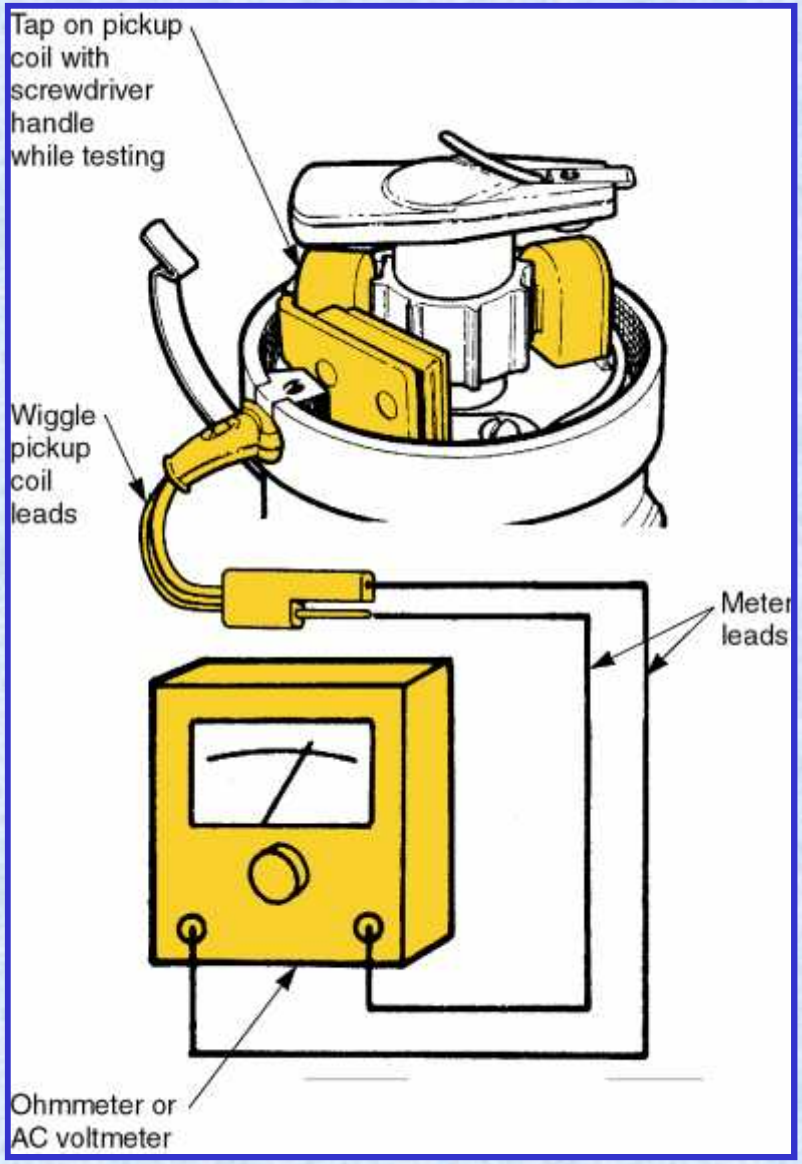
Pickup Coil Service

- Pickup coil problems can cause stalling, missing, no-start, or loss of power
- The windings or lead wires may break (open) or become shorted or grounded

Pickup Coil Testing

- Connect an ohmmeter or AC voltmeter to the leads
- Compare the resistance to specifications, usually 250 to 1500 ohms
- If using a voltmeter, crank the engine, and compare the output to specifications
  - usually 3 to 8 volts AC
- Wiggle the wires or lightly tap the coil during the test

Pickup Coil Resistance Test

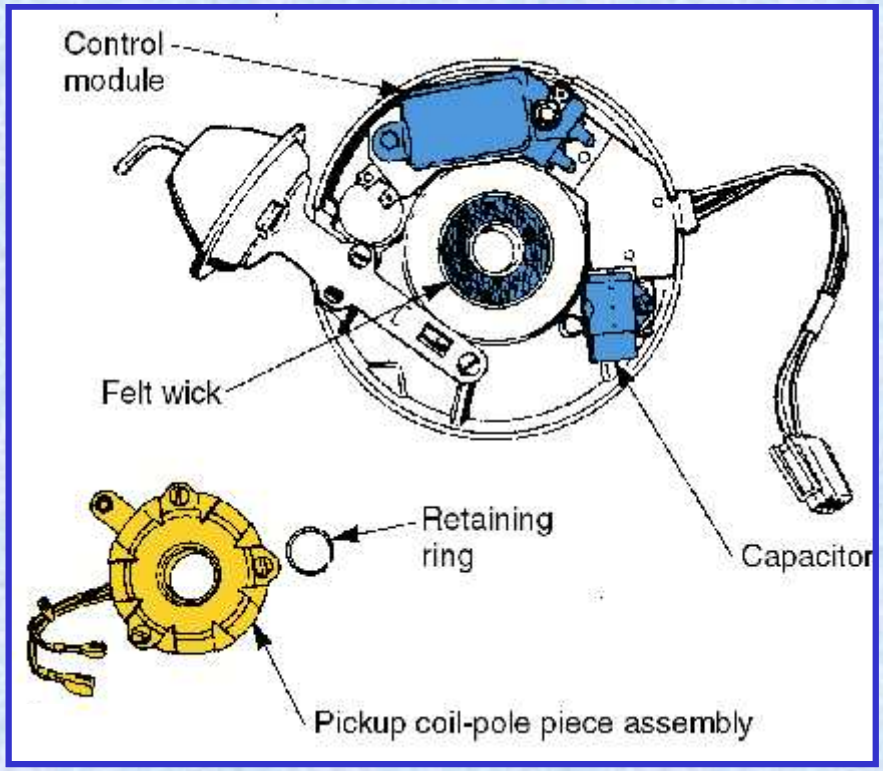


Testing Hall-Effect and Optical Sensors

- Use an oscilloscope to observe output waveforms
- Digital (square wave) patterns result

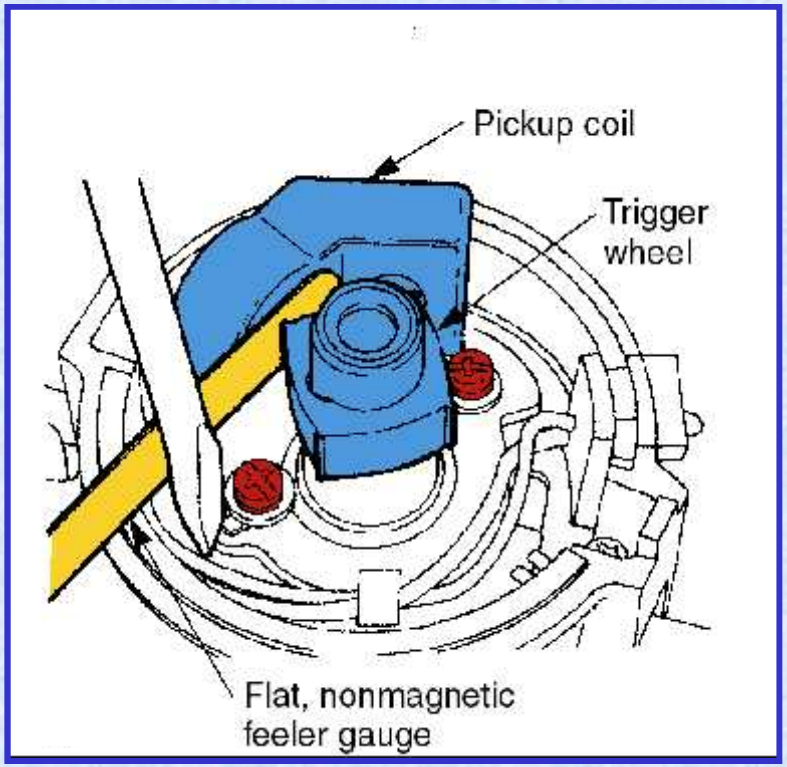
Pickup Coil Replacement

Shaft removal may be necessary



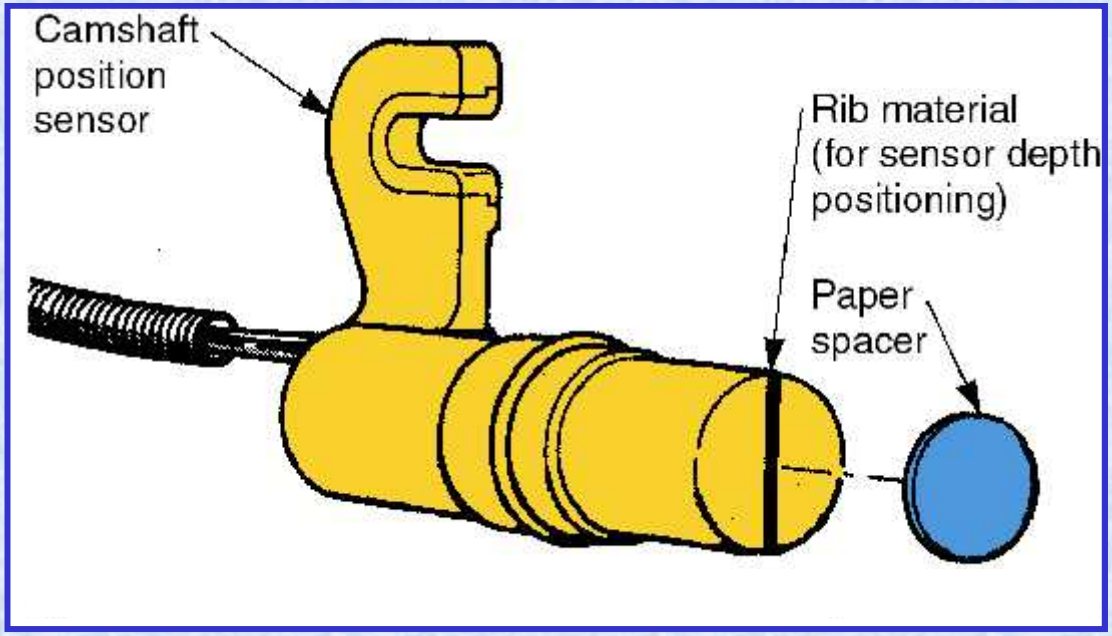
Pickup Coil Replacement

Air gap adjustment



Pickup Coil Replacement

A paper spacer sets this crankshaft position sensor air gap



Contact Point Distributor Service

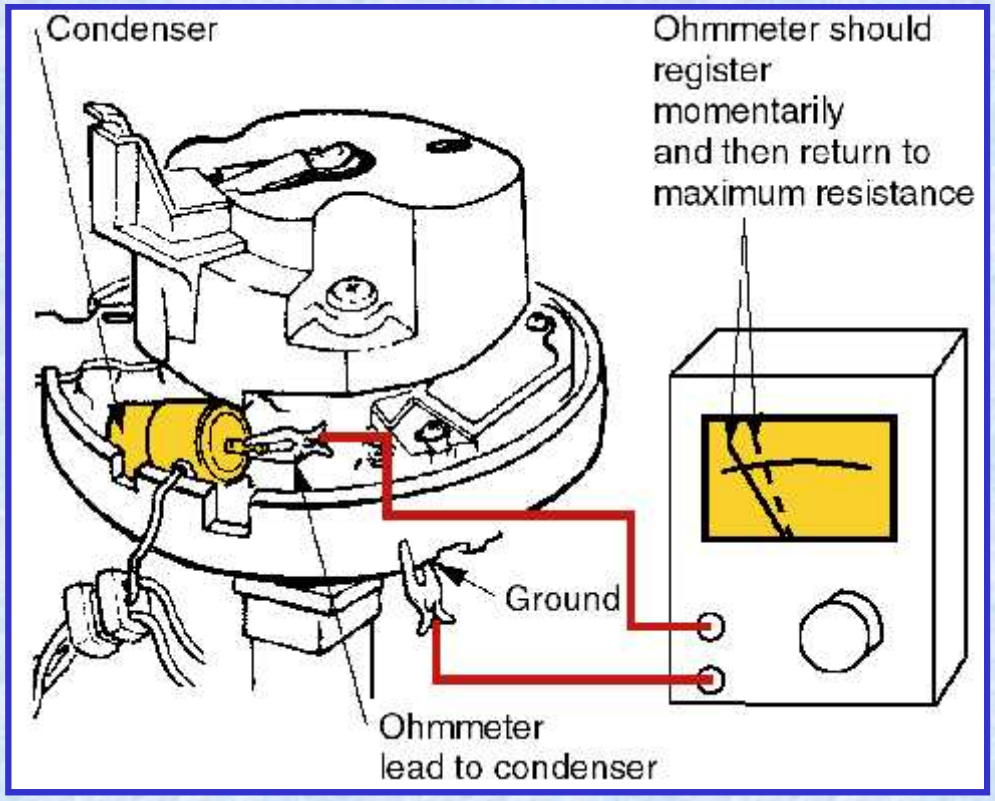
- Burned, pitted, misaligned, or worn points can cause no start, missing, or loss of power
- A condenser may leak (electrically), become open, or short to ground

Testing Points

- Perform a visual inspection for burned or pitted contacts or a worn rubbing block
- Measure point resistance
- Connect an ohmmeter between the positive point lead and ground
- Compare to specifications
- If the resistance is too high, replace the points

Testing a Condenser

A continuous reading indicates a faulty condenser

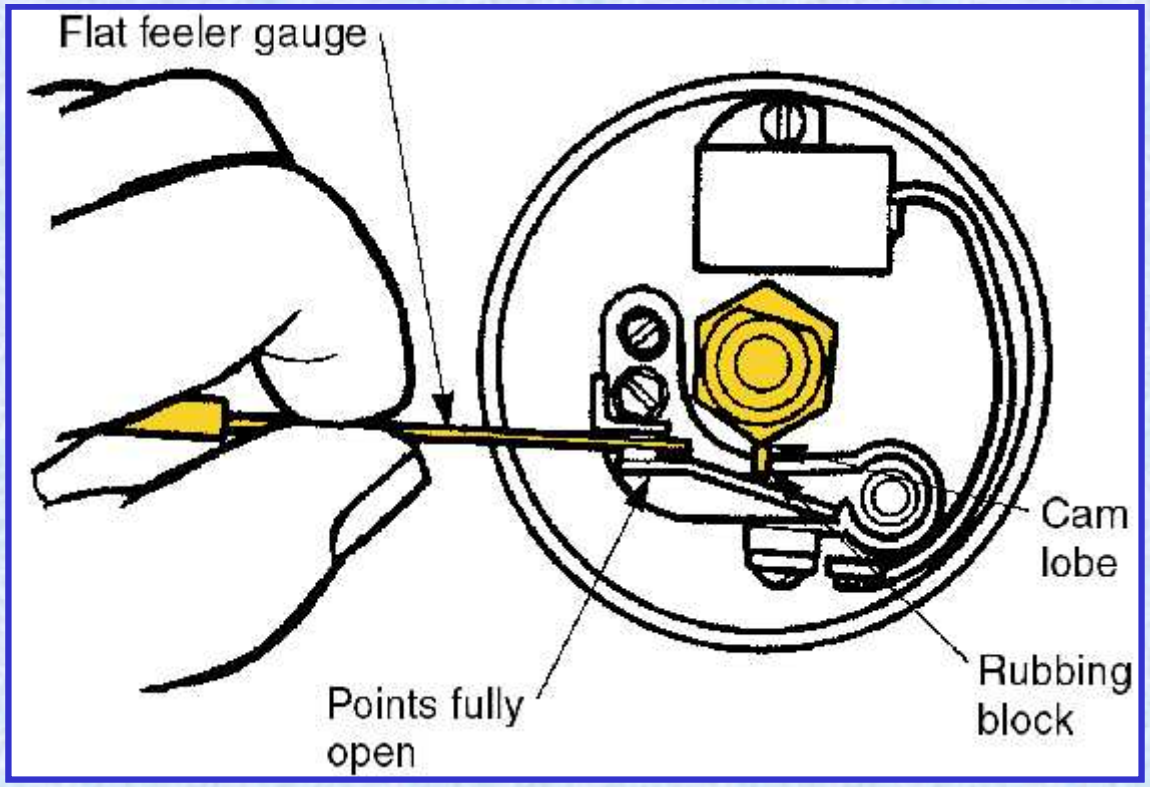


Adjusting Points

- Use a feeler gauge or tach-dwell meter
- When using a feeler gauge, set the point gap to specifications with the points fully open
- When using a tach-dwell meter, crank the engine with the meter leads connected between the coil's negative terminal and ground
- Adjust the point gap while cranking

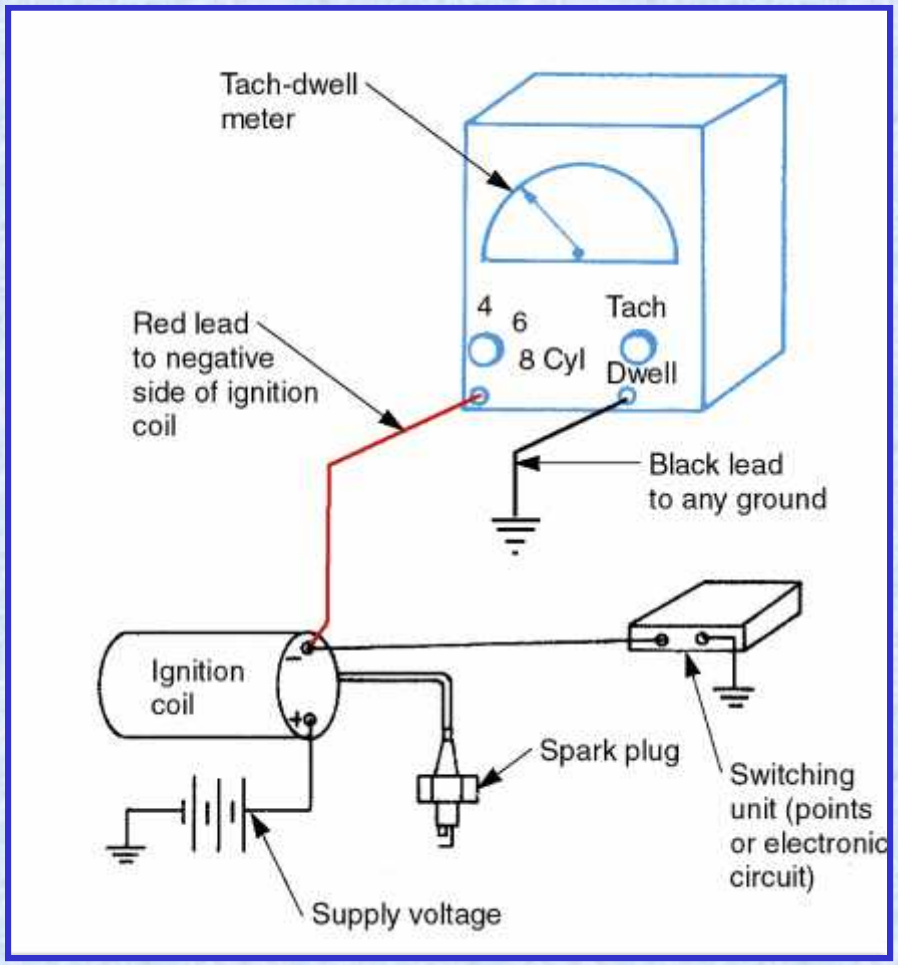
Adjusting Points

Feeler gauge method



Tach-Dwell Meter

Measures dwell on contact point and some electronic ignition systems



Dwell

- Specifications vary:
  - 8 cylinder engine—usually 30º dwell
  - fewer cylinders—more dwell time
- Fixed dwell
  - dwell should remain the same at all speeds
- Variable dwell
  - ignition control module increases dwell at high speed

Current-Limiting Module

- The module allows high current through coil primary until a strong magnetic field builds
- Once the coil becomes saturated (magnetic field is strong), the module reduces primary current flow

Ignition Timing Adjustment

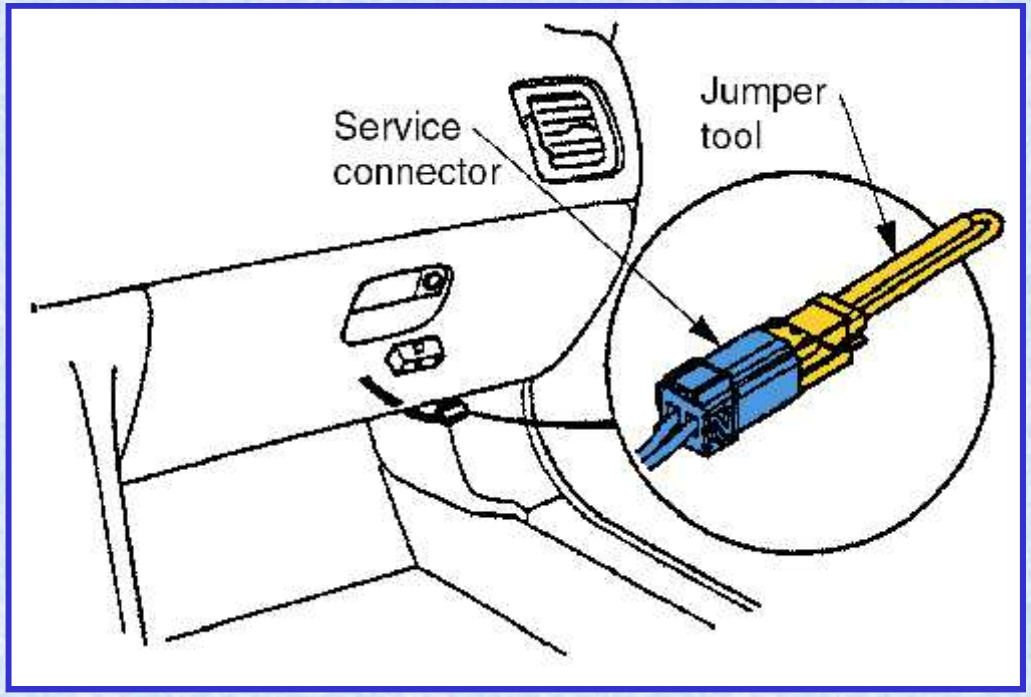
- Applies to distributor ignition engines
- May be adjusted by rotating the distributor
- Timing is too advanced:
  - may cause engine knock or ping
- Timing is too retarded:
  - may cause lack of power

Base Timing

- Ignition timing without computer-controlled advance
- May be checked by disconnecting a connector in the computer's wiring harness or by jumping across specific pins on a service connector
- The connector may be near the distributor or in the passenger compartment

Base Timing Preparation

Jumping across special connector terminals to set base timing

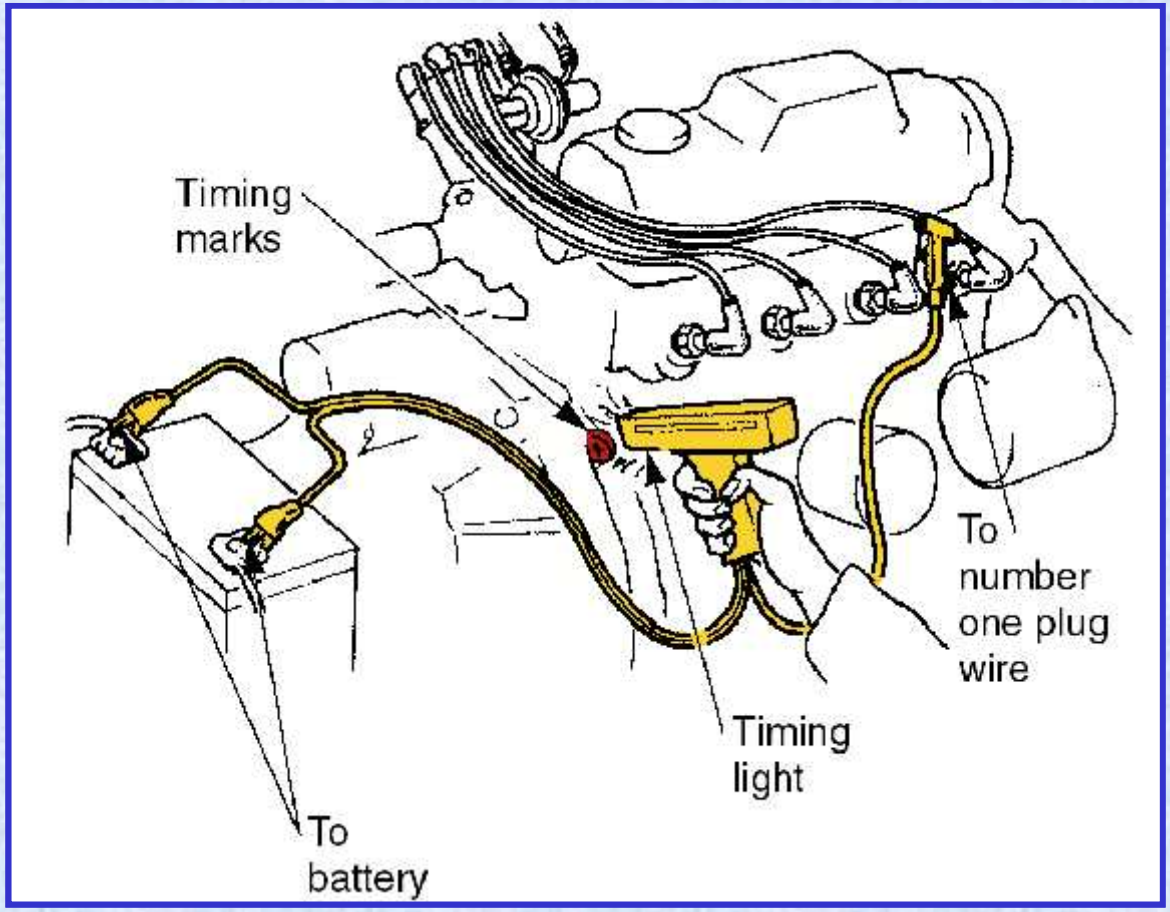


Measuring Timing

- Using a timing light is the most common method
- Connect the timing light to the battery and #1 spark plug wire
- Idle the engine in “base timing” or with the distributor vacuum hose disconnected, where applicable
- Aim the light at the timing marks on the engine

Timing Light

Timing Light Connection

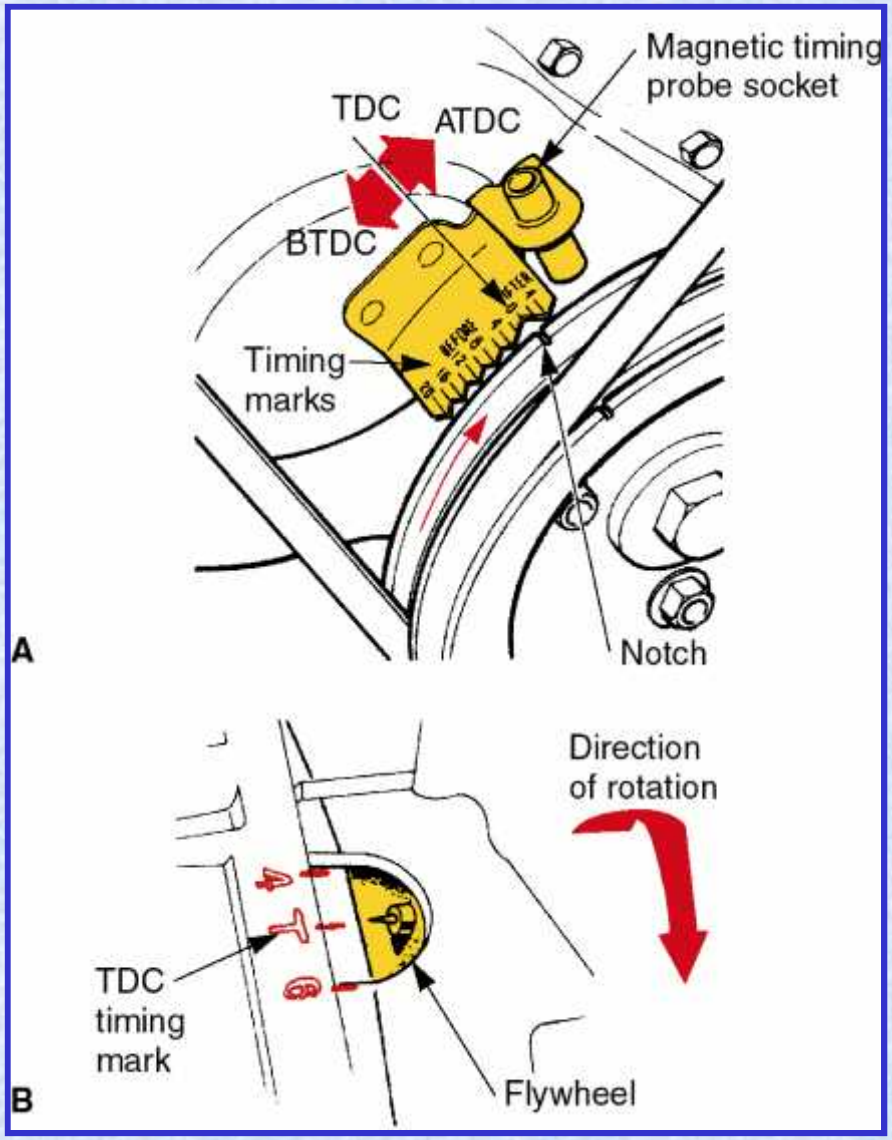


Timing Light Use

Timing Marks

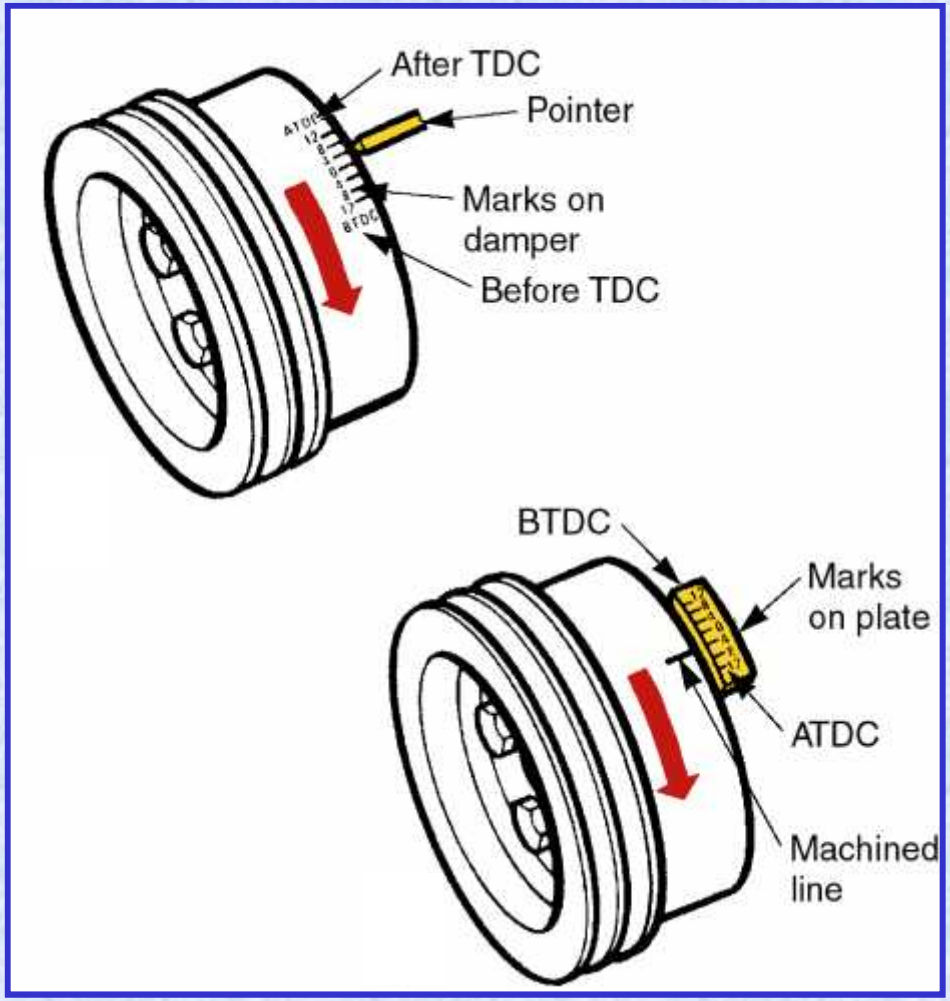
A. Front of engine

B. Clutch housing



Checking Timing

Marks should appear stationary

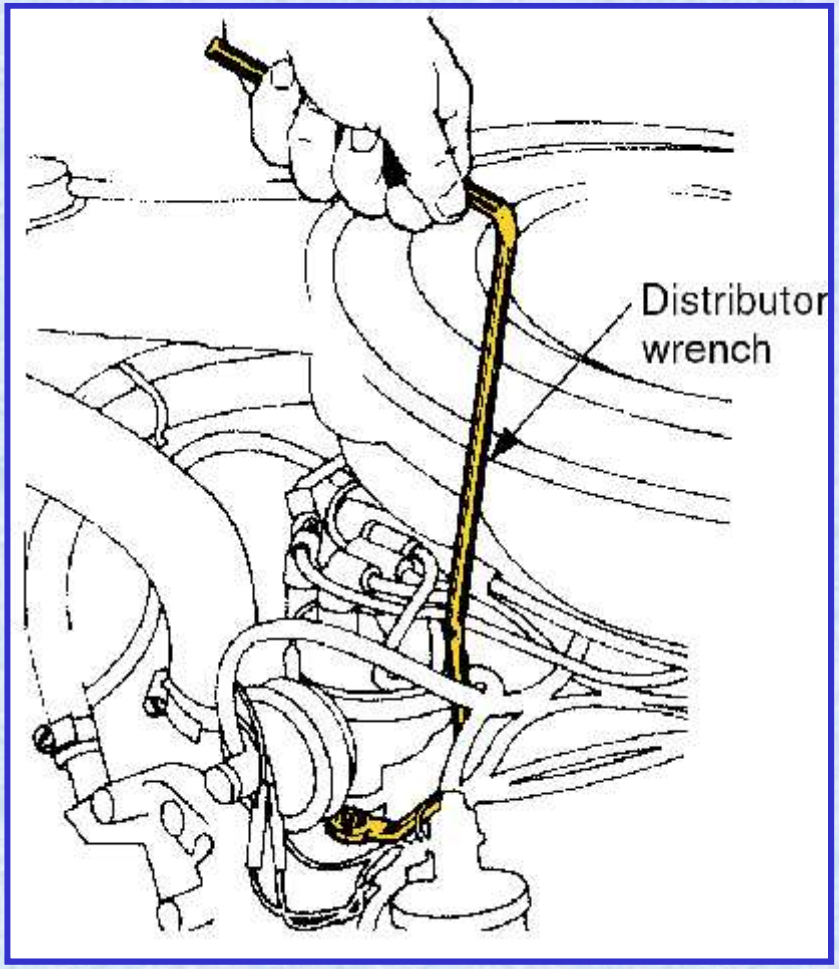


Timing Adjustment

- Loosen the distributor
- Remove the distributor vacuum hose
- Shine the timing light on the timing marks
- Turn the distributor until the marks line up
- Tighten the hold-down bolts

Loosening Distributor

A distributor wrench may be needed for bolts that are hard to reach

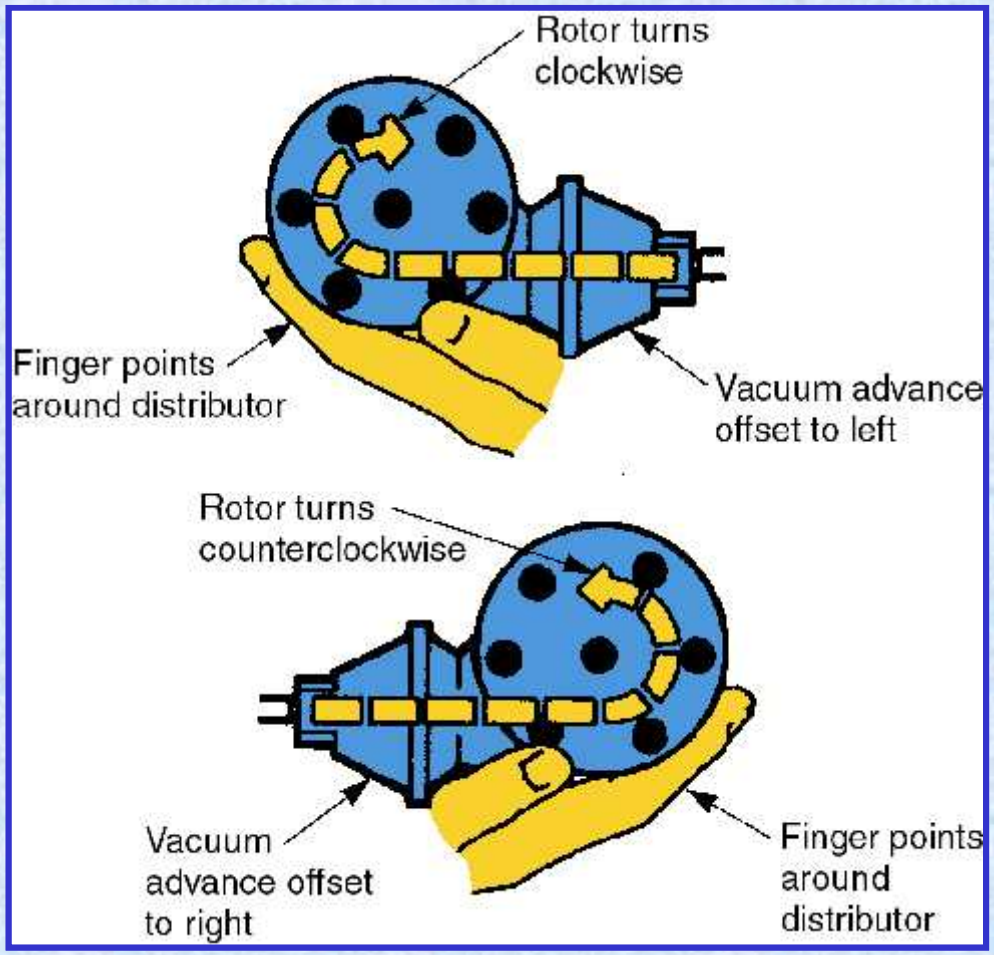


Adjusting Timing

Turn in the direction of rotation to retard

Turn against rotation to advance

Direction of Rotation

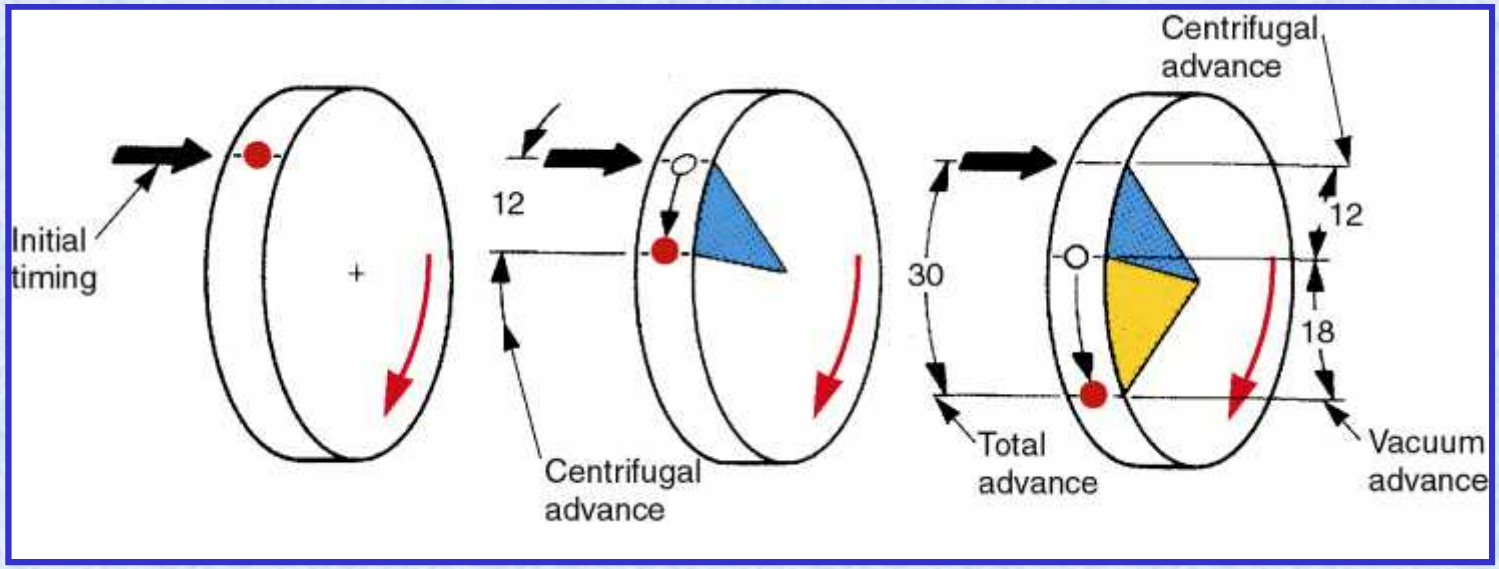


Testing Centrifugal and Vacuum Distributor Advance Systems

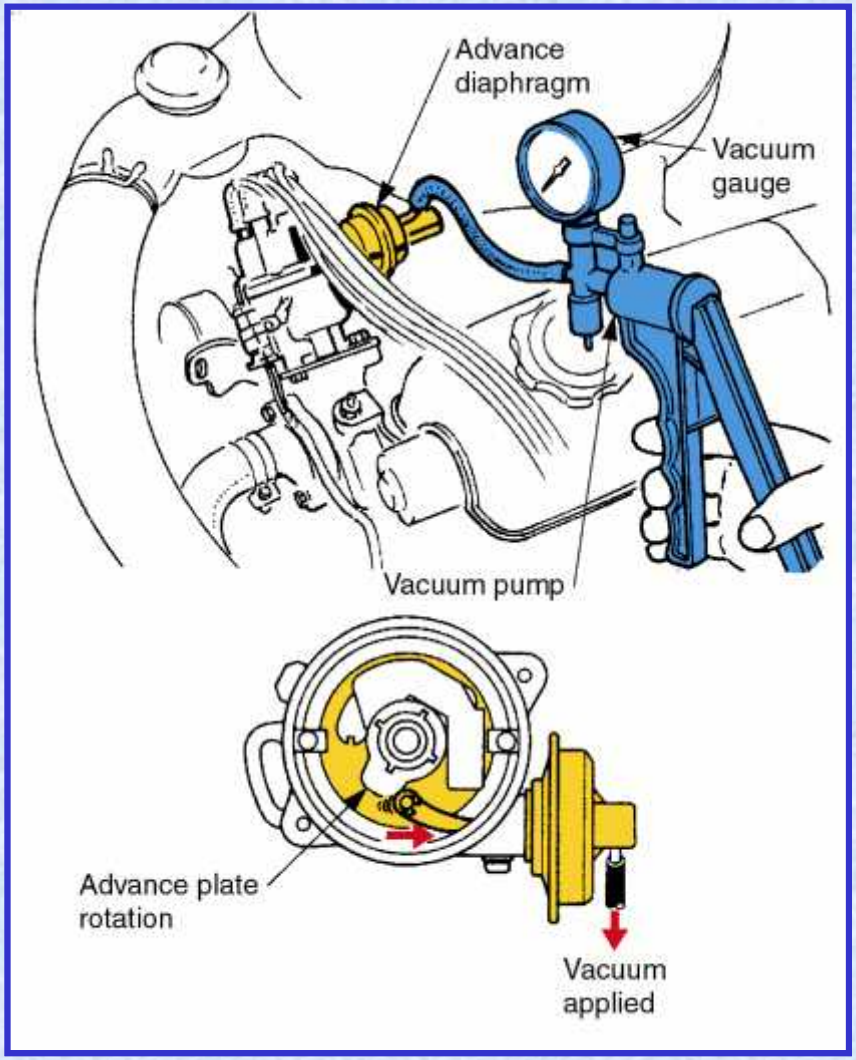
Checking Advance Mechanisms

- Check initial timing with the engine idling and the vacuum hose disconnected
- Increase the engine speed; the timing marks should show advancing timing
- At high rpm, reconnect the vacuum hose; the timing marks should show more advance
- Compare the readings to specifications

Checking Advance Mechanisms



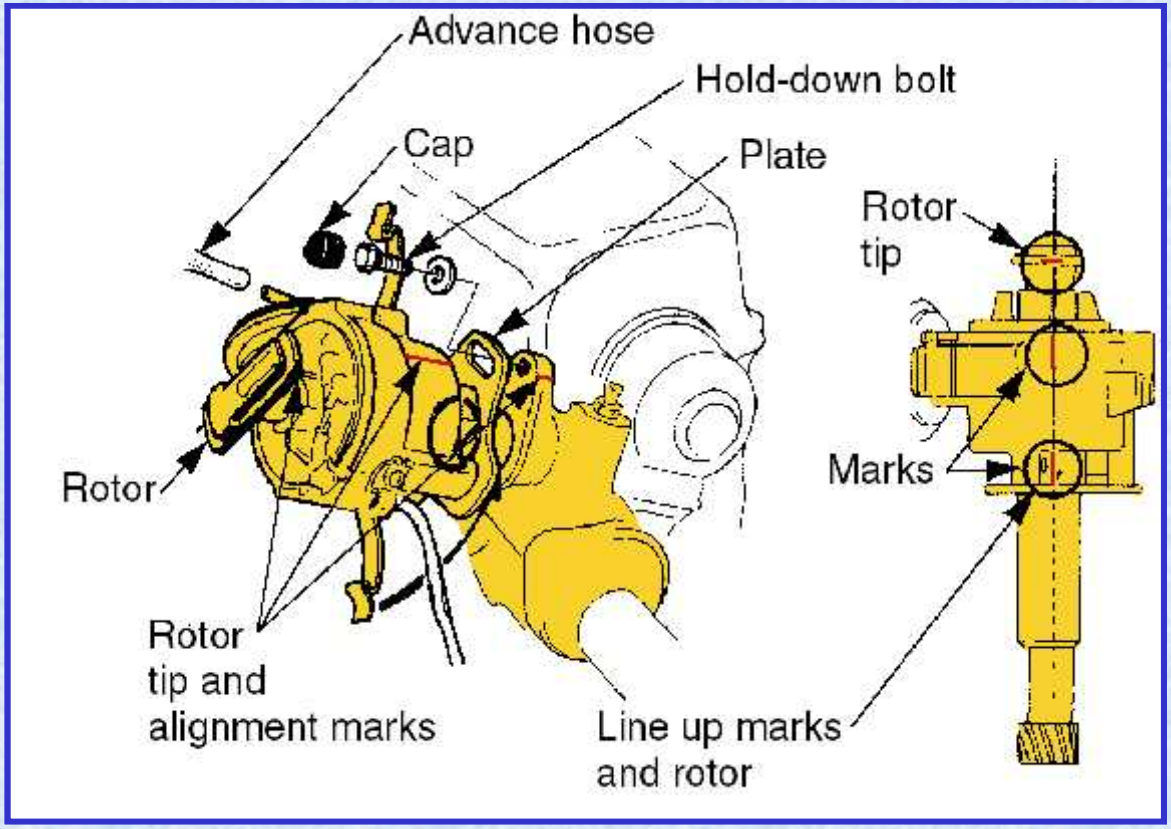
Testing a Vacuum Advance Diaphragm



Removing the Ignition Distributor

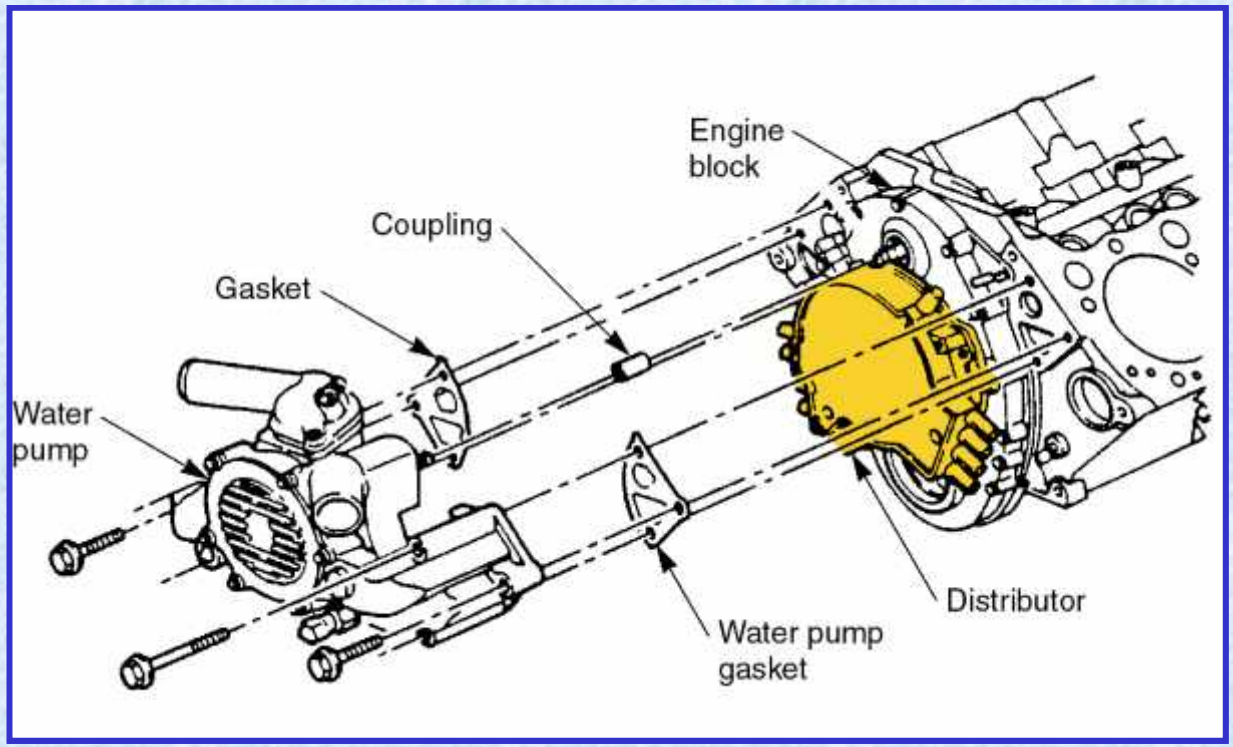
- Mark the position of the rotor tip on the distributor and engine
- When reinstalling, line up the rotor and the distributor with the marks
- Procedures vary; see the service manual

Distributor Removal

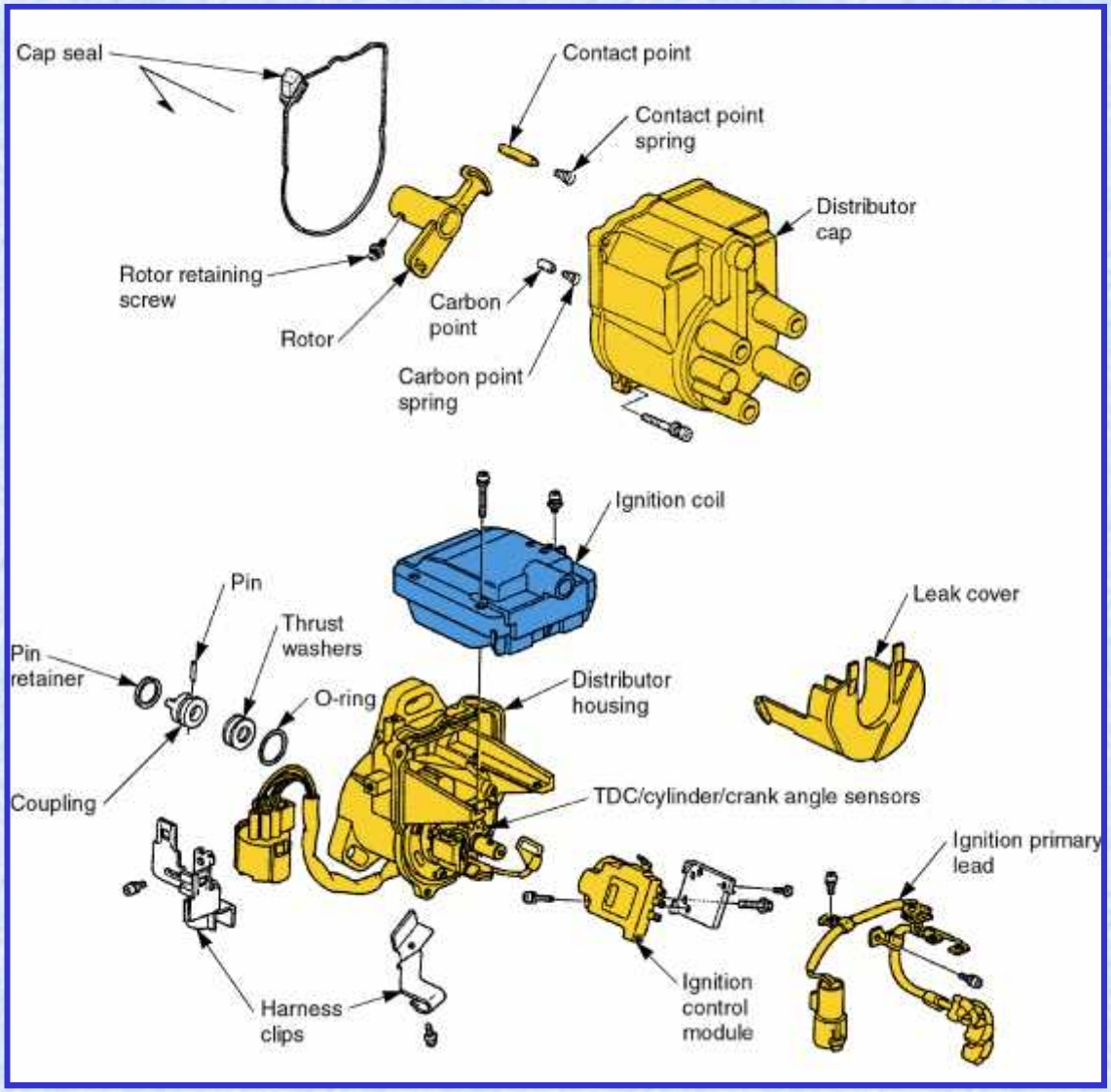


Distributor Removal

Water pump removal is needed to service this distributor

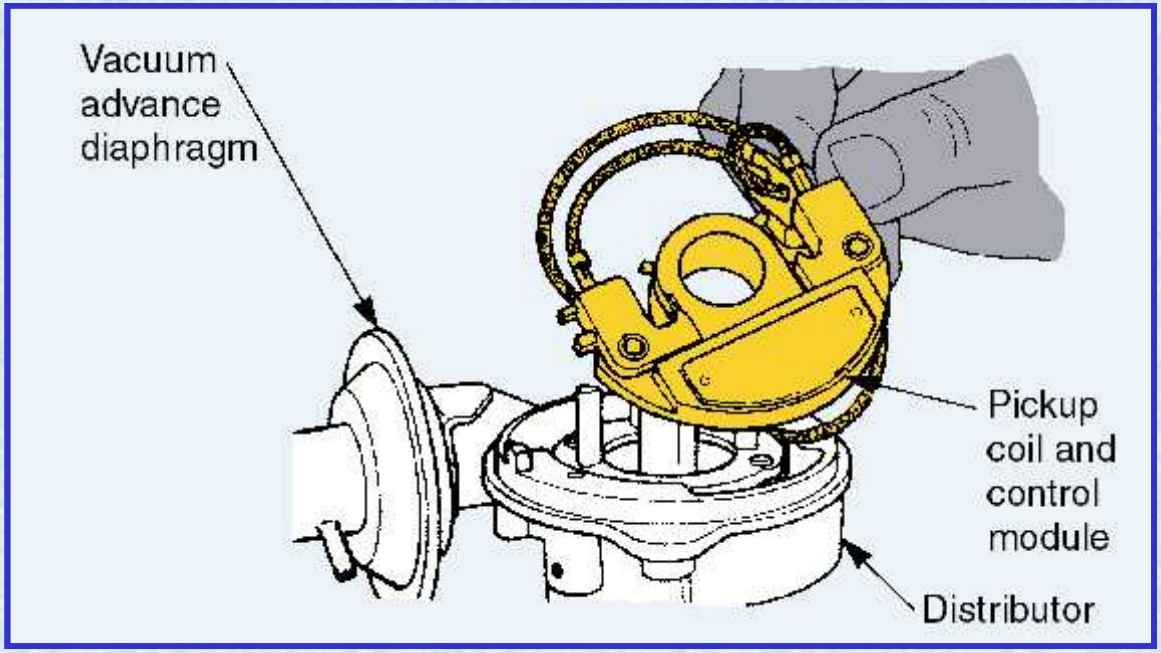


Rebuilding a Distributor



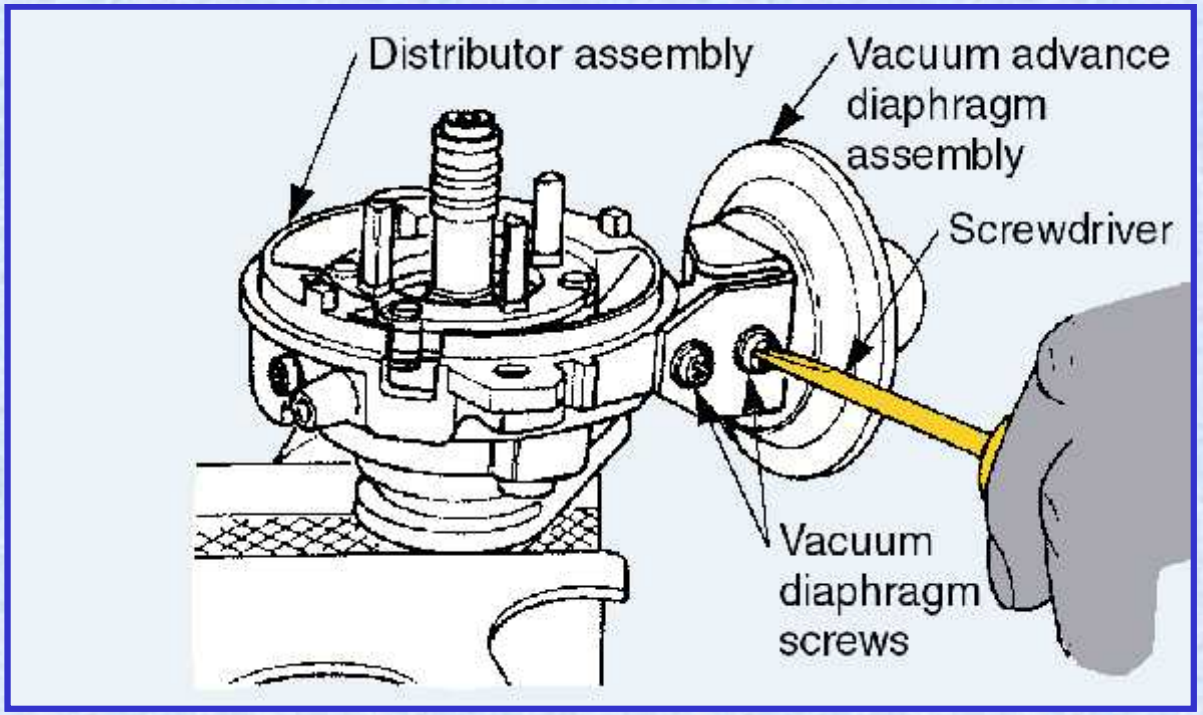
Distributor Disassembly

Remove the cap, pickup coil, and control unit



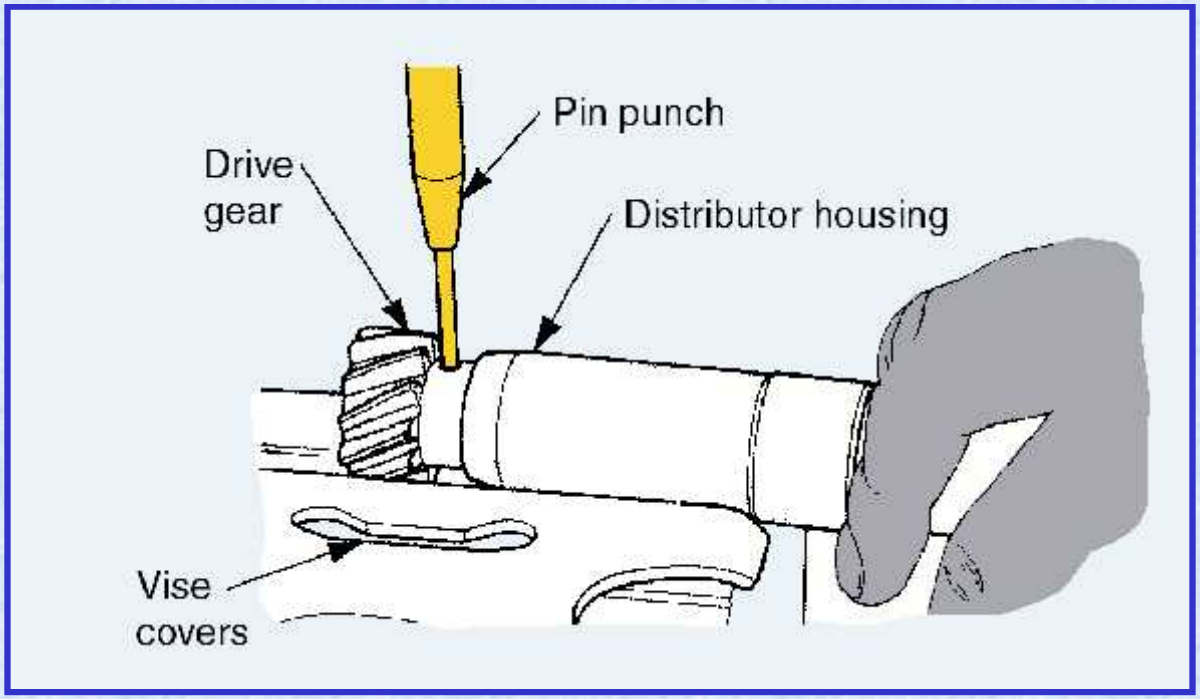
Distributor Disassembly

Remove the vacuum diaphragm



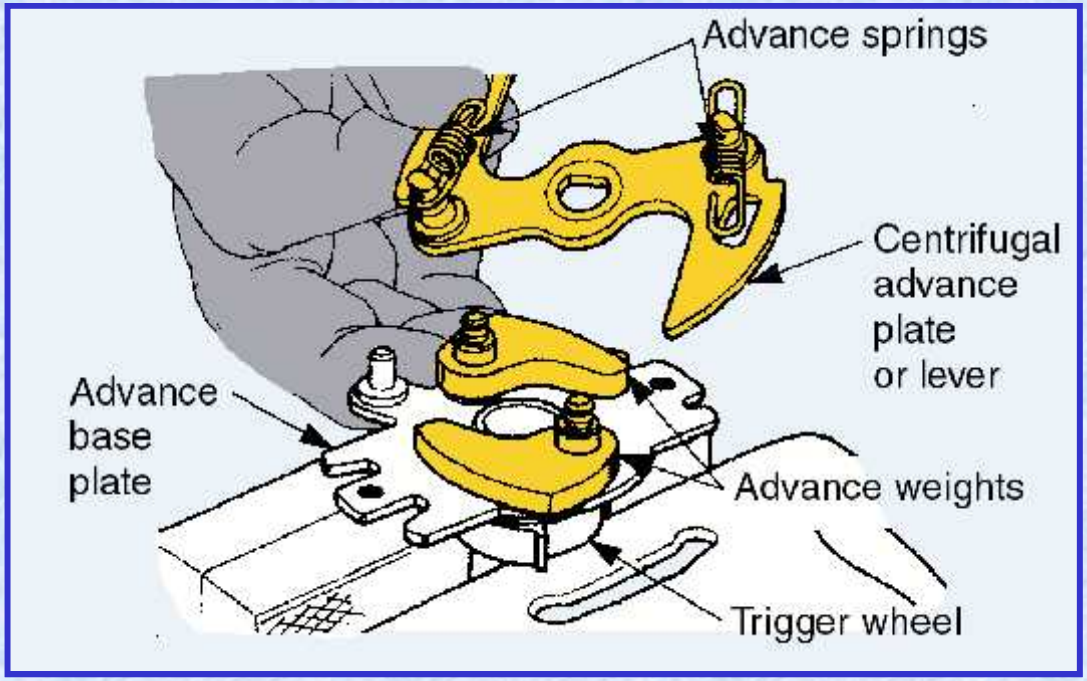
Distributor Disassembly

Remove the drive gear

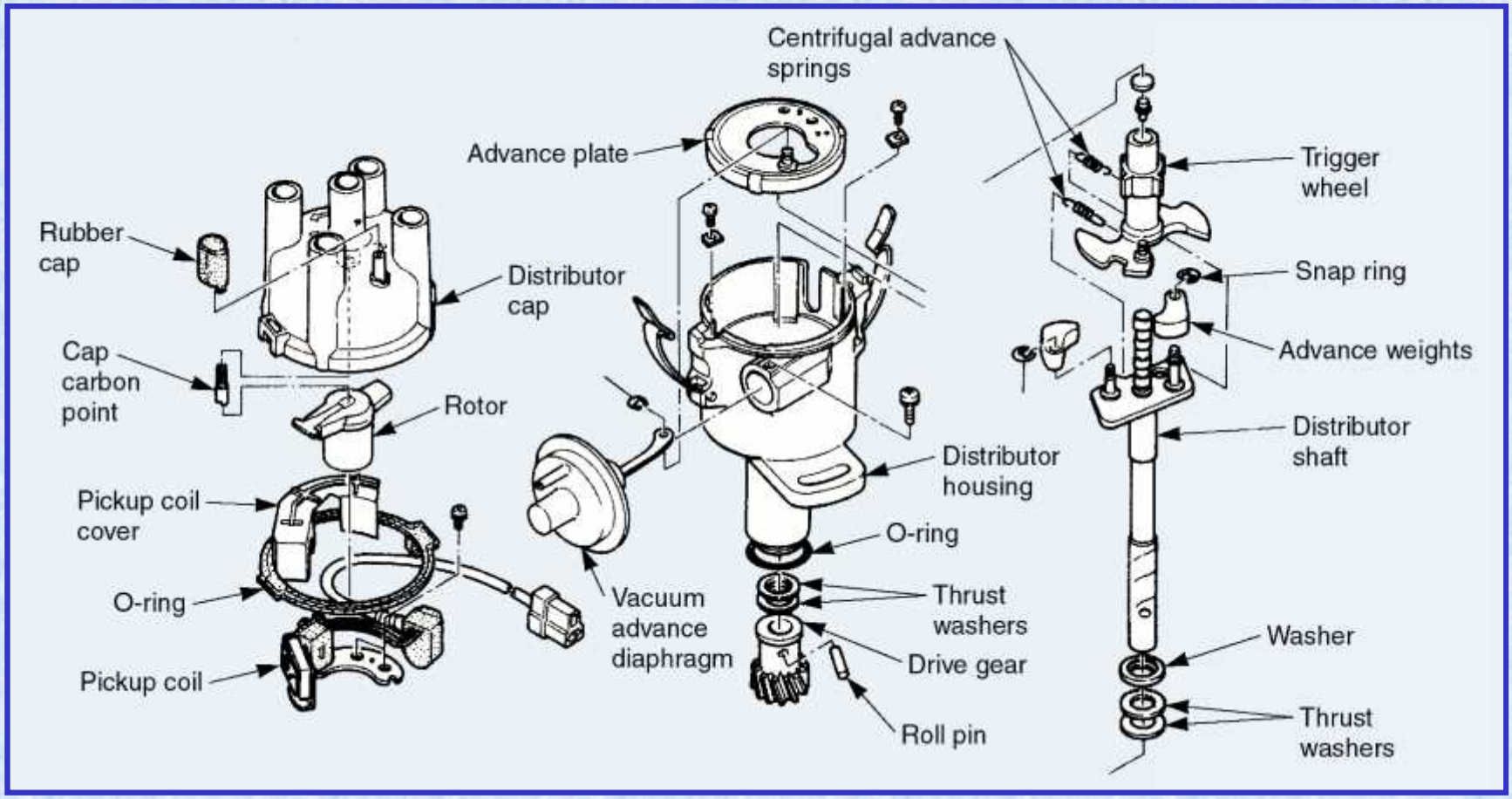


Distributor Disassembly

Disassemble the advance mechanism



Distributor



Distributor Installation

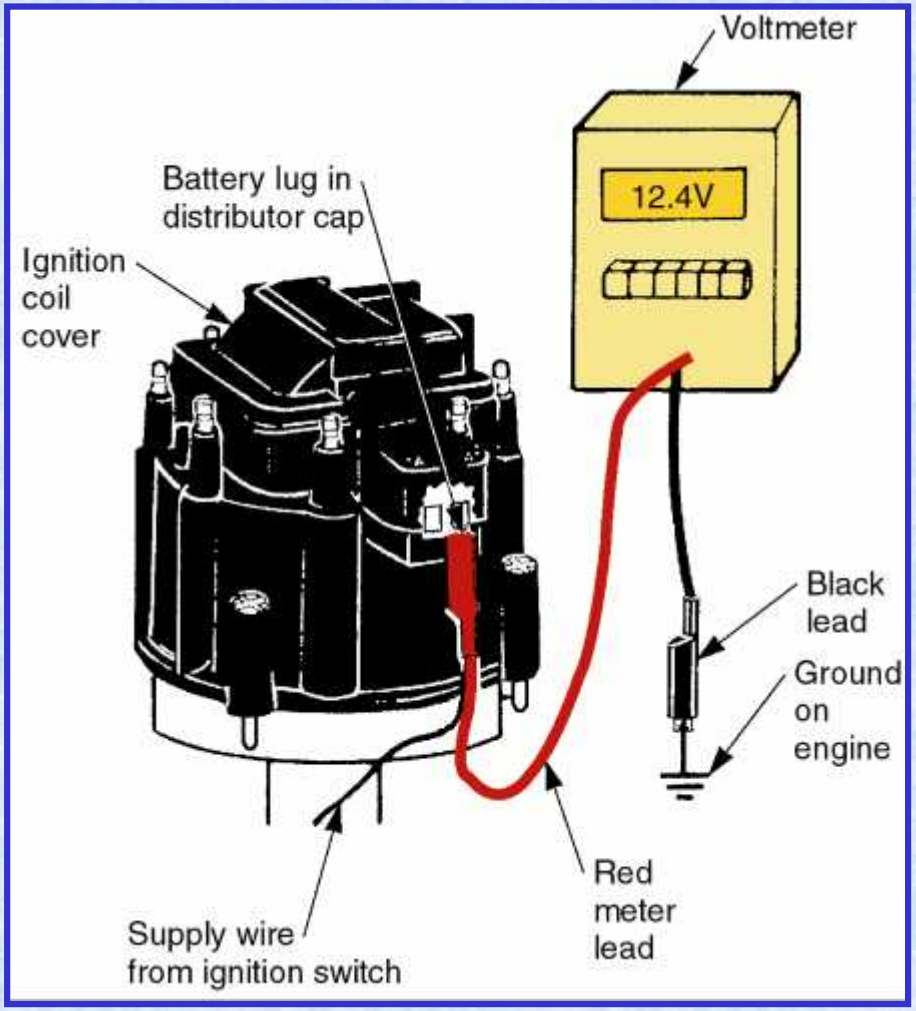
- When reinstalling, line up the rotor and the distributor with the marks
- If the engine has been rotated:
  - remove the #1 spark plug
  - crank the engine until you feel air blow from the hole
  - slowly turn the crankshaft to TDC
  - install the distributor so the rotor points toward the #1 cap terminal

Ignition Supply Voltage Test

- Checks the circuit between the battery positive and the coil
- Connect a test light to the coil's positive terminal
- The test light should glow when cranking and with the ignition on
- If the test light doesn't glow, the circuit is open

Ignition Supply Voltage Test

This system applies full battery voltage to the coil



Ignition Coil (Coil Pack) Service

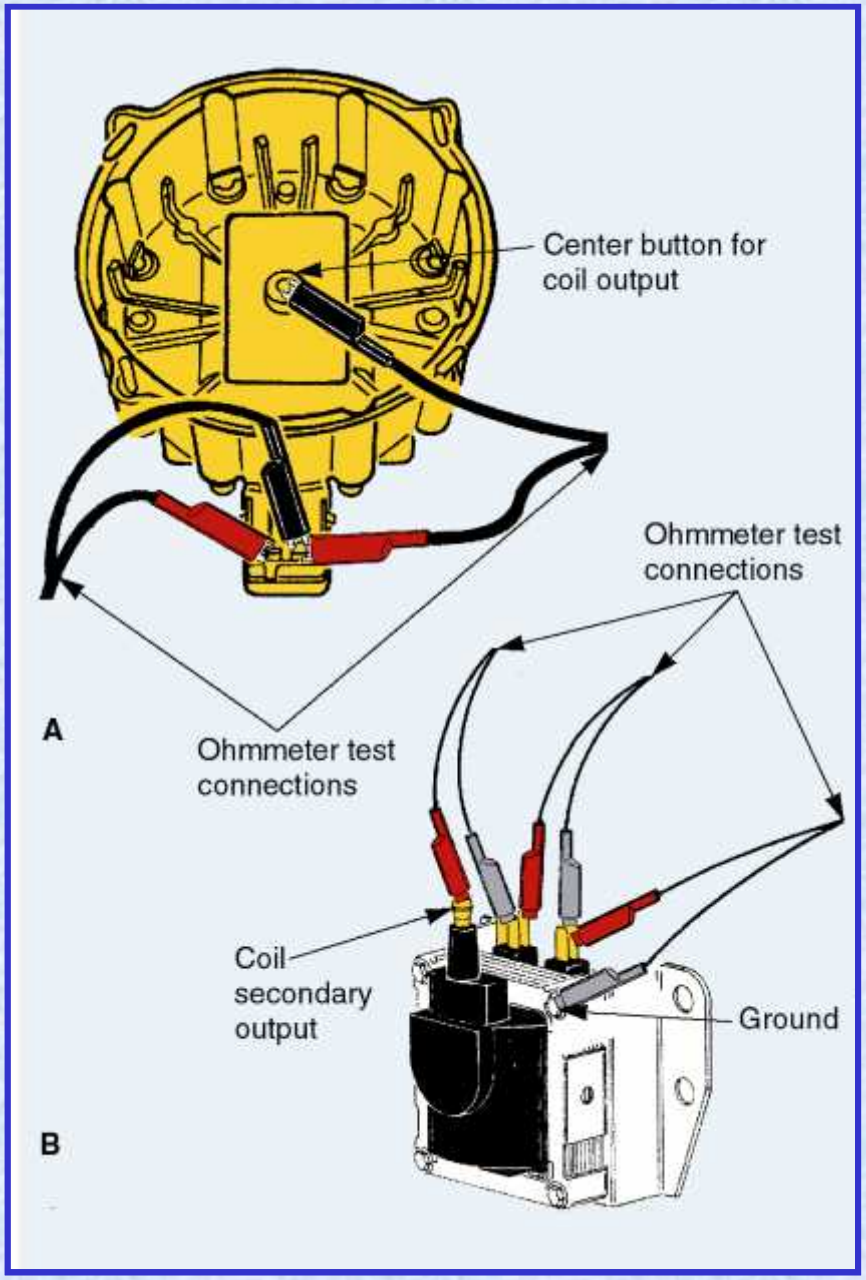
- A faulty coil can cause no spark, or a weak or intermittent spark
- The windings can break, causing an open circuit
- A bad coil pack may affect 2 cylinders

Ignition Coil Testing

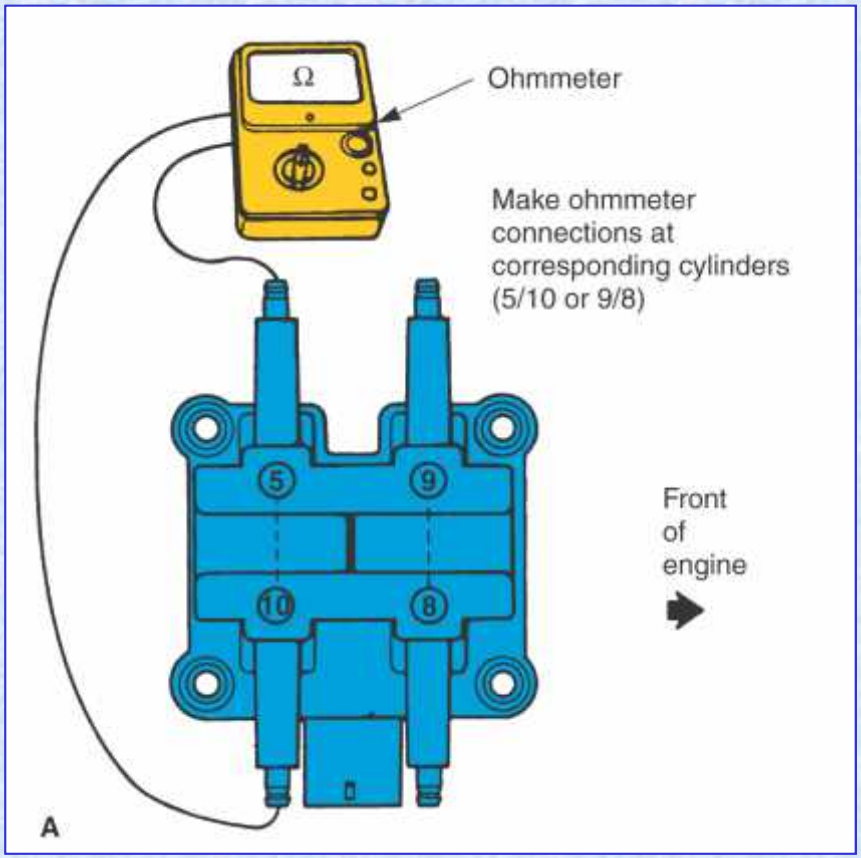
- Measure the resistance of both the primary and secondary windings
- Compare to specifications, usually about 1 ohm for the primary and 10,000 ohms for the secondary

Coil Testing

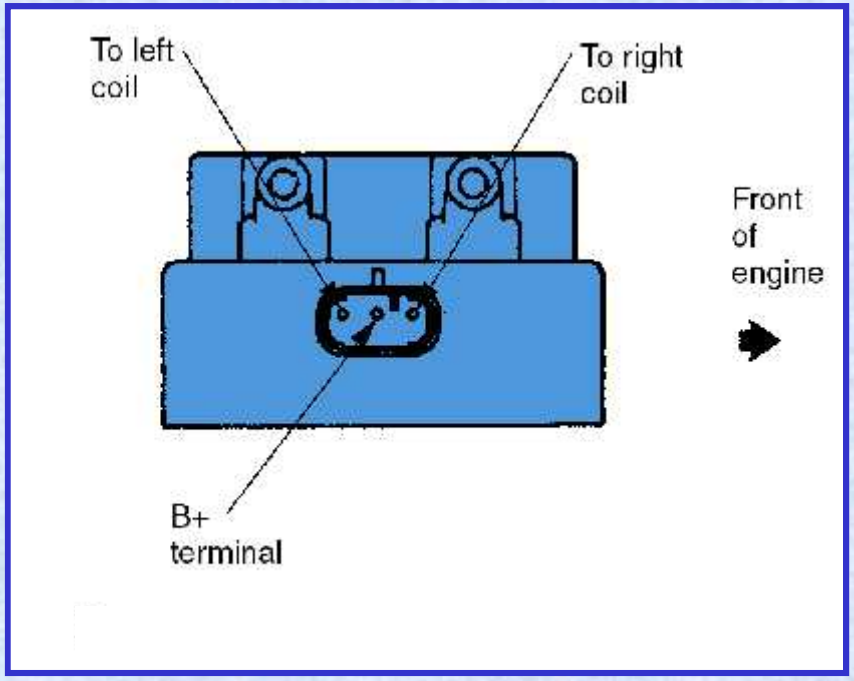
A. Unitized distributor
B. External coil



Coil Pack Testing

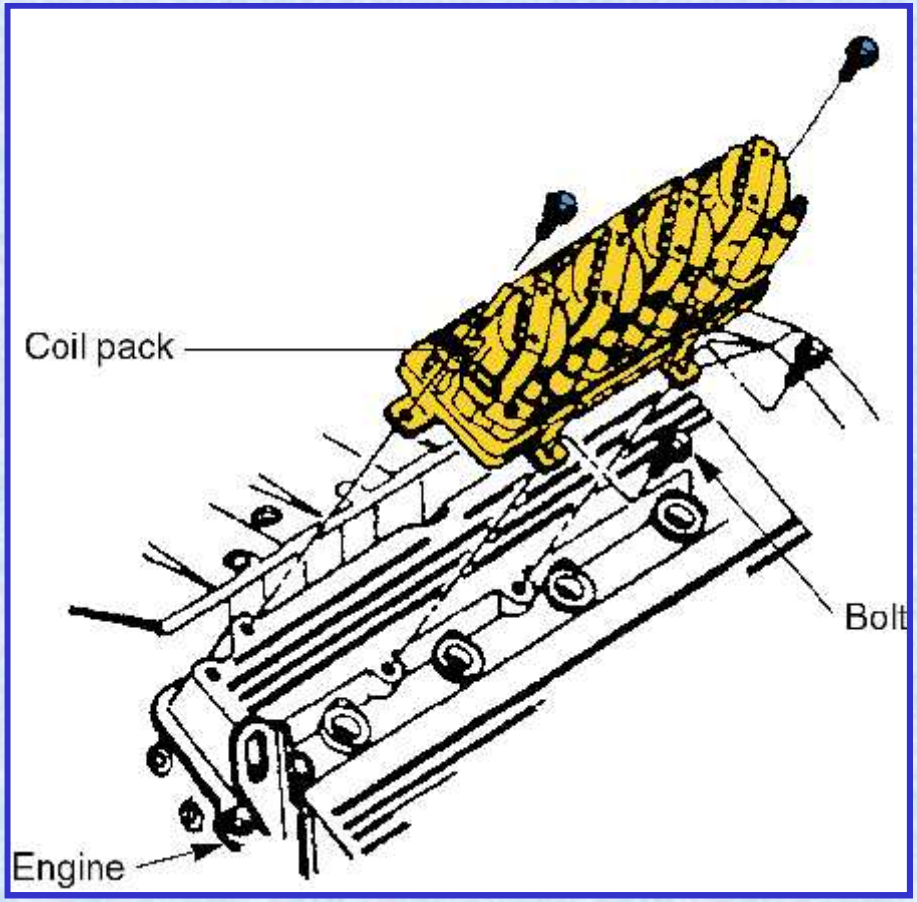


Secondary resistance



Primary resistance

Replacing a Coil Pack



Ignition Switch Service

- A faulty ignition switch can cause several conditions:
  - a no-crank or no-start condition
  - the engine may fail to shut off when switched off
  - the starter may not disengage when the ignition key is returned to “run”

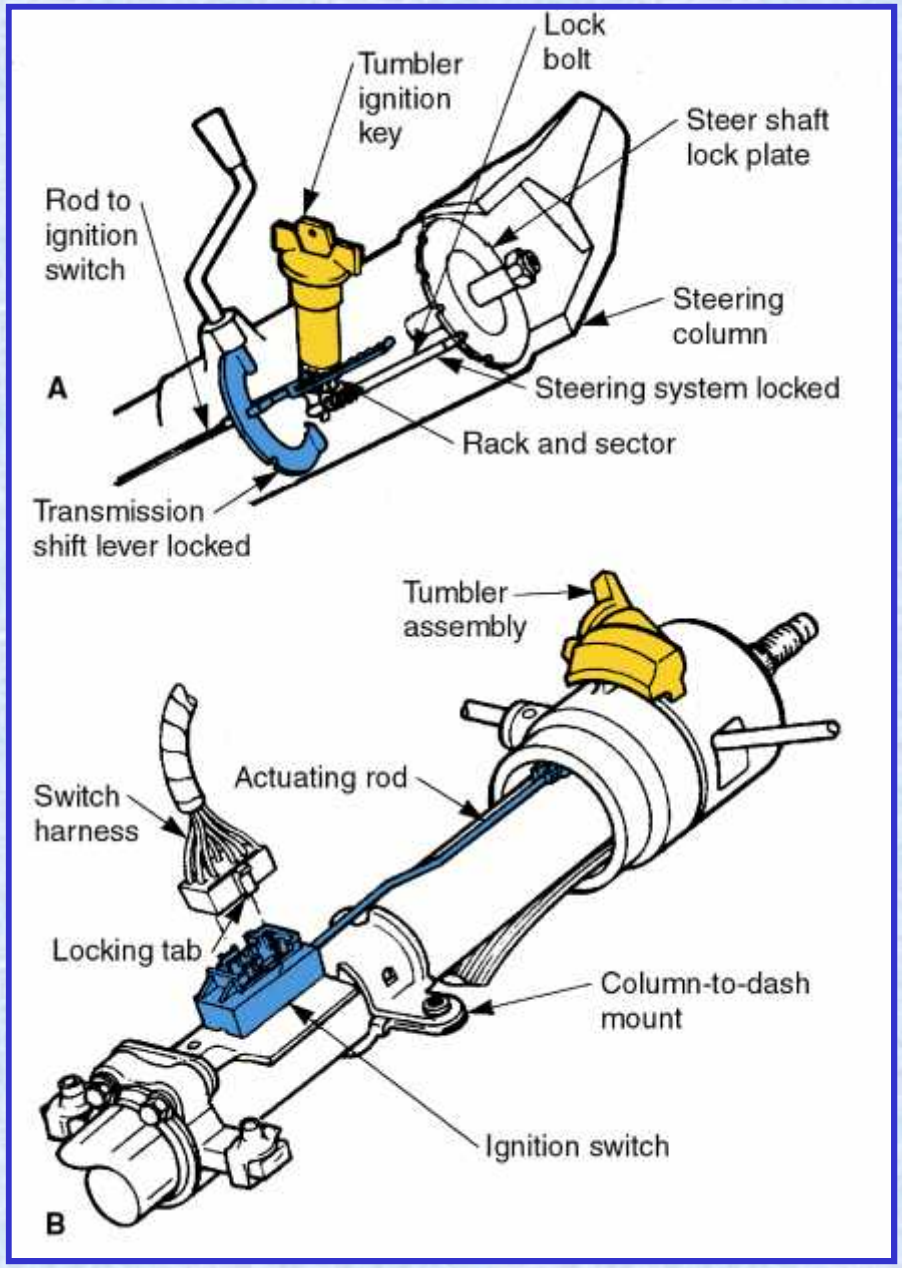
Ignition Switch Testing

- Connect a grounded test light to switch ***start*** terminal and ***run*** terminals
- In the ***run*** position, the light should glow when touched on the ***run*** terminal
- In the ***off*** position, neither terminal should make the light glow

Replacing the Ignition Switch

A. Lock mechanism

B. Drop the column to access the switch

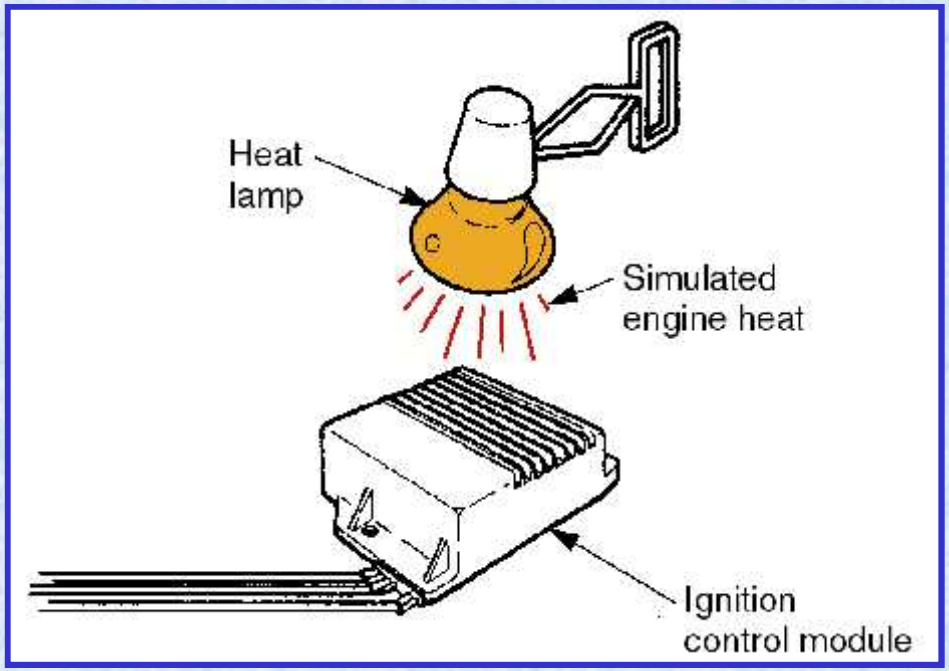


Ignition Control Module Service

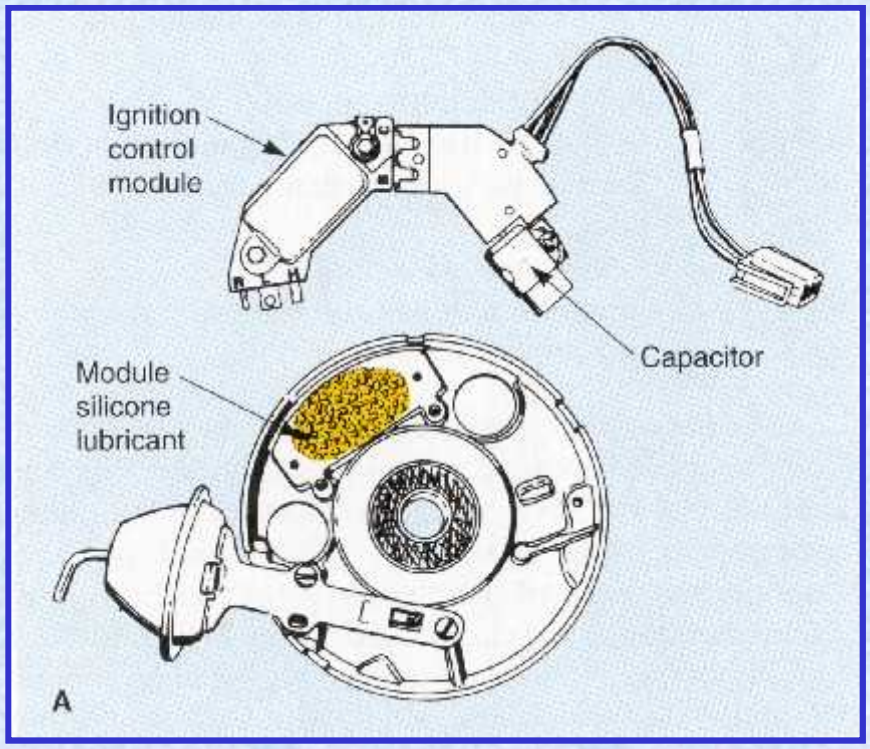
- A faulty ignition control module can cause engine stalling when hot, a no-start condition, or a miss
- Often, it is the last component in the ignition system checked, after others are verified

Testing an Ignition Control Module

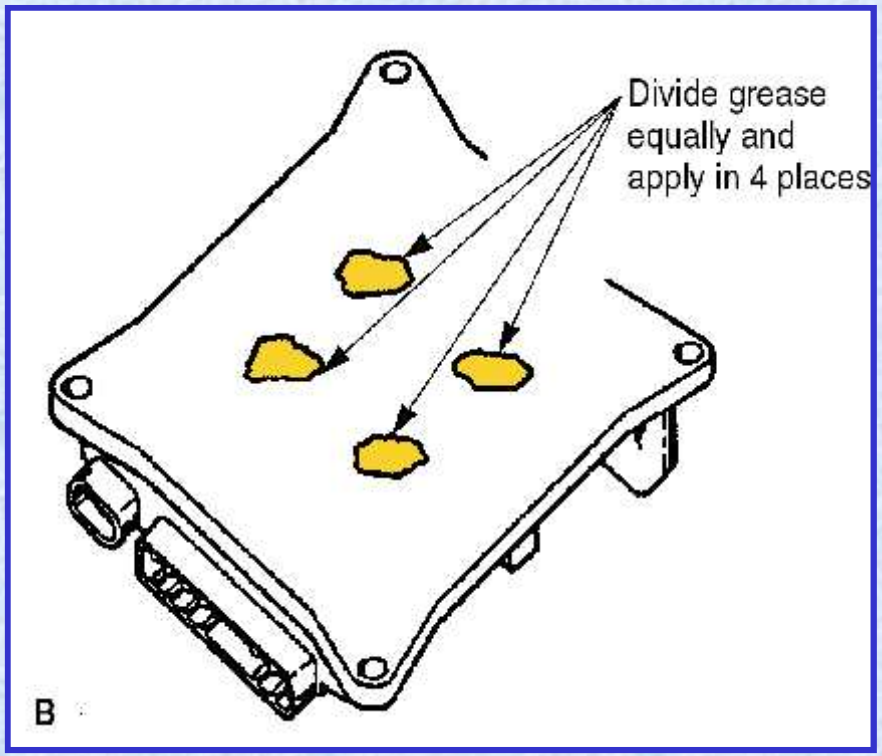
Simulating engine heat to cause failure



Installing an Ignition Control Module



Distributor-mounted module



Heat sink–mounted module

Distributorless Ignition System Service

- A faulty coil can kill two cylinders
- If two dead cylinders correspond to a specific coil, test that coil

Knock Sensor Service

- Connect a scan tool
- Run the engine to operating temperature
- Raise the engine speed above idle
- Lightly tap the engine block or head to simulate an engine knock
- Watch the scan tool data to verify the knock sensor input, or timing retard

Direct Ignition System Service

- Remove the coil cover and install temporary spark plug wires between the coils and plugs
- This allows test equipment to be used
- If a cylinder is not performing, test the ignition coil of the affected cylinder

Direct Ignition Tests