

ENGINE PERFORMANCE AND TUNE-UP

TUNE-UP PROCEDURES

In order to extract the full measure of performance and economy from your engine it is essential that it is properly tuned at regular intervals. A regular tune-up will keep your Camaro's engine running smoothly and will prevent the annoying breakdowns and poor performance associated with an untuned engine.

A complete tune-up should be performed every 30,000 miles (48,000 km). This interval should be halved if the car is operated under severe conditions such as trailer towing, prolonged idling, start-and-stop driving, or if starting or running problems are noticed. It is assumed that the routine maintenance described in General Information & Maintenance has been kept up, as this will have a decided effect on the results of a tune-up. All of the applicable steps of a tune-up should be followed in order, as the result is a cumulative one.

If the specifications on the underhood tune-up sticker in the engine compartment of your car disagree with the "Tune-Up Specifications" chart in this Section, the figures on the sticker must be used. The sticker often reflects changes made during the production run.

SPARK PLUGS

A typical spark plug consists of a metal shell surrounding a ceramic insulator. A metal electrode extends downward through the center of the insulator and protrudes a small distance. Located at the end of the plug and attached to the side of the outer metal shell is the side electrode. The side electrode bends in at a 90 degree angle so that its tip is just past and parallel to the tip of the center electrode. The distance between these two electrodes (measured in thousandths of an inch or hundredths of a millimeter) is called the spark plug gap.

The spark plug does not produce a spark, but instead provides a gap across which the current can arc. The coil produces anywhere from 20,000 to 50,000 volts (depending on the type and application) which travels through the wires to the spark plugs. The current passes along the center electrode and jumps the gap to the side electrode, and in doing so, ignites the air/fuel mixture in the combustion chamber.

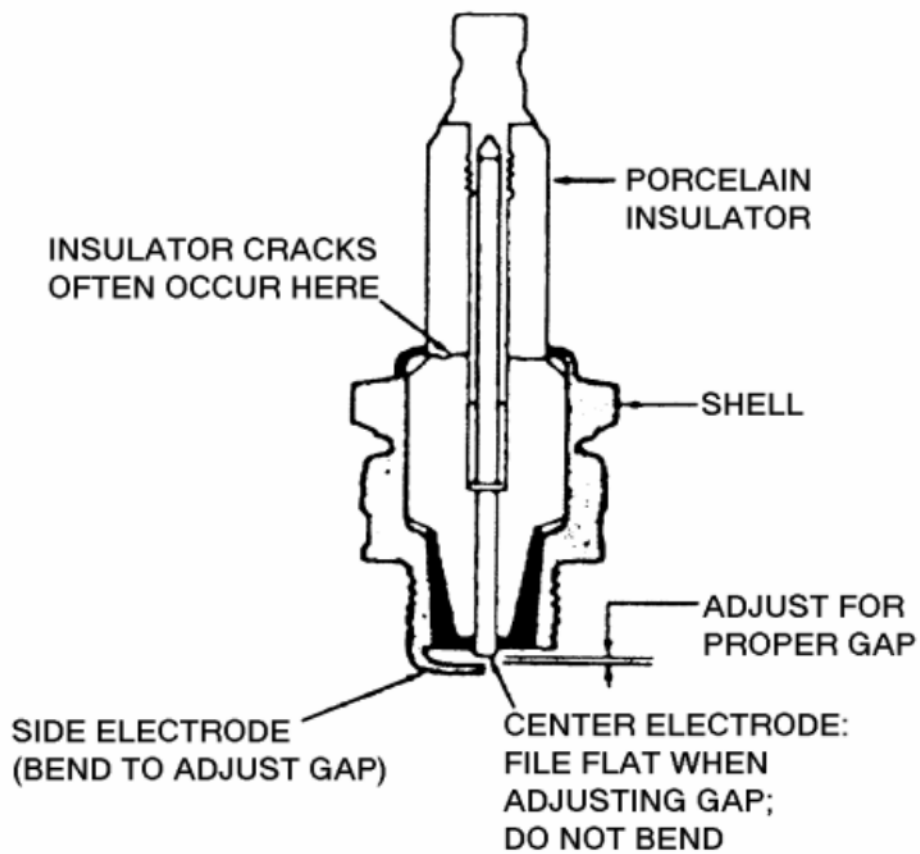


Fig. 1: Cross-section of a spark plug



Fig. 2: A variety of tools and gauges are needed for spark plug service

SPARK PLUG HEAT RANGE

Spark plug heat range is the ability of the plug to dissipate heat. The longer the insulator (or the farther it extends into the engine), the hotter the plug will operate; the shorter the insulator (the closer the electrode is to the block's cooling passages) the cooler it will operate. A plug that absorbs little heat and remains too cool will quickly accumulate deposits of oil and carbon since it is not hot enough to burn them off. This leads to plug fouling and consequently to misfiring. A plug that absorbs too much heat will have no deposits but, due to the excessive heat, the electrodes will burn away quickly and might possibly lead to preignition or other ignition problems. Preignition takes place when plug tips get so hot that they glow sufficiently to ignite the air/fuel mixture before the actual spark occurs. This early ignition will usually cause a pinging during low speeds and heavy loads.

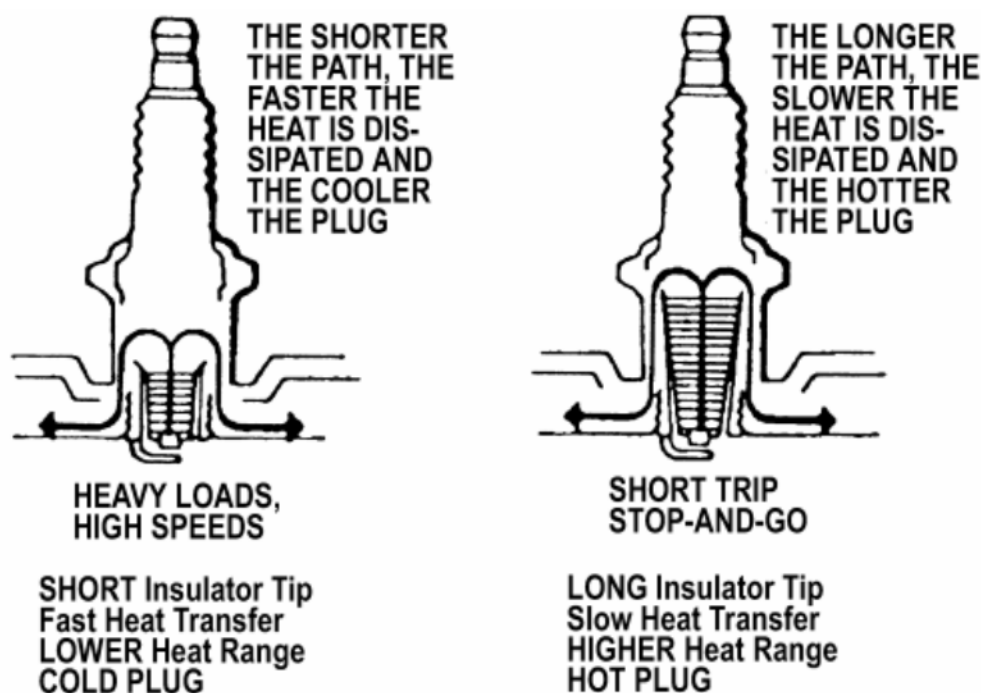


Fig. 3: Spark plug heat range

The general rule of thumb for choosing the correct heat range when picking a spark plug is: if most of your driving is long distance, high speed travel, use a colder plug; if most of your driving is stop and go, use a hotter plug. Original equipment plugs are generally a good compromise between the 2 styles and most people never have the need to change their plugs from the factory-recommended heat range.

REMOVAL & INSTALLATION

A set of spark plugs usually requires replacement after about 20,000-30,000 miles (32,000-48,000 km), depending on your style of driving. In normal operation plug gap increases about 0.001 in. (0.025mm) for every 2500 miles (4000 km). As the gap increases, the plug's voltage requirement also increases. It requires a greater voltage to jump the wider gap and about two to three times

as much voltage to fire the plug at high speeds than at idle. The improved air/fuel ratio control of modern fuel injection combined with the higher voltage output of modern ignition systems will often allow an engine to run significantly longer on a set of standard spark plugs, but keep in mind that efficiency will drop as the gap widens (along with fuel economy and power).

When you're removing spark plugs, work on one at a time. Don't start by removing the plug wires all at once, because, unless you number them, they may become mixed up. Take a minute before you begin and number the wires with tape.

1. Disconnect the negative battery cable, and if the vehicle has been run recently, allow the engine to thoroughly cool.
2. Carefully twist the spark plug wire boot to loosen it, then pull upward and remove the boot from the plug. Be sure to pull on the boot and not on the wire, otherwise the connector located inside the boot may become separated.
3. Using compressed air, blow any water or debris from the spark plug well to assure that no harmful contaminants are allowed to enter the combustion chamber when the spark plug is removed. If compressed air is not available, use a rag or a brush to clean the area.

Remove the spark plugs when the engine is cold, if possible, to prevent damage to the threads. If removal of the plugs is difficult, apply a few drops of penetrating oil or silicone spray to the area around the base of the plug, and allow it a few minutes to work.

4. Using a spark plug socket that is equipped with a rubber insert to properly hold the plug, turn the spark plug counterclockwise to loosen and remove the spark plug from the bore.

WARNING - Be sure not to use a flexible extension on the socket. Use of a flexible extension may allow a shear force to be applied to the plug. A shear force could break the plug off in the cylinder head, leading to costly and frustrating repairs.

To install:

5. Inspect the spark plug boot for tears or damage. If a damaged boot is found, the spark plug wire must be replaced.
6. Using a wire feeler gauge, check and adjust the spark plug gap. When using a gauge, the proper size should pass between the electrodes with a slight drag. The next larger size should not be able to pass while the next smaller size should pass freely.
7. Carefully thread the plug into the bore by hand. If resistance is felt before the plug is almost completely threaded, back the plug out and begin threading again. In small, hard to reach areas, an old spark plug wire and boot could be used as a threading tool. The boot will hold the plug while you twist the end of the wire and the wire is supple enough to twist before it would allow the plug to crossthread.

WARNING - Do not use the spark plug socket to thread the plugs. Always carefully thread the plug by hand or using an old plug wire to prevent the possibility of crossthreading and damaging the cylinder head bore.

8. Carefully tighten the spark plug. If the plug you are installing is equipped with a crush washer, seat the plug, then tighten about $\frac{1}{4}$ turn to crush the washer. If you are installing a tapered seat plug, tighten the plug to specifications provided by the vehicle or plug manufacturer.
9. Apply a small amount of silicone dielectric compound to the end of the spark plug lead or inside the spark plug boot to prevent sticking, then install the boot to the spark plug and push until it clicks into place. The click may be felt or heard, then gently pull back on the boot to assure proper contact.

INSPECTION & GAPPING

Check the plugs for deposits and wear. If they are not going to be replaced, clean the plugs thoroughly. Remember that any kind of deposit will decrease the efficiency of the plug. Plugs can be cleaned on a spark plug cleaning machine, which can sometimes be found in service stations, or you can do an acceptable job of cleaning with a stiff brush. If the plugs are cleaned, the electrodes must be filed flat. Use an ignition points file, not an emery board or the like, which will leave deposits. The electrodes must be filed perfectly flat with sharp edges; rounded edges reduce the spark plug voltage by as much as 50%.

Check spark plug gap before installation. The ground electrode (the L-shaped one connected to the body of the plug) must be parallel to the center electrode and the specified size wire gauge (please refer to the Tune-Up Specifications chart for details) must pass between the electrodes with a slight drag.

NEVER adjust the gap on a used platinum type spark plug.

Always check the gap on new plugs as they are not always set correctly at the factory. Do not use a flat feeler gauge when measuring the gap on a used plug, because the reading may be inaccurate. A round-wire type gapping tool is the best way to check the gap. The correct gauge should pass through the electrode gap with a slight drag. If you're in doubt, try one size smaller and one larger. The smaller gauge should go through easily, while the larger one shouldn't go through at all. Wire gapping tools usually have a bending tool attached. Use that to adjust the side electrode until the proper distance is obtained. Absolutely never attempt to bend the center electrode. Also, be careful not to bend the side electrode too far or too often as it may weaken and break off within the engine, requiring removal of the cylinder head to retrieve it.

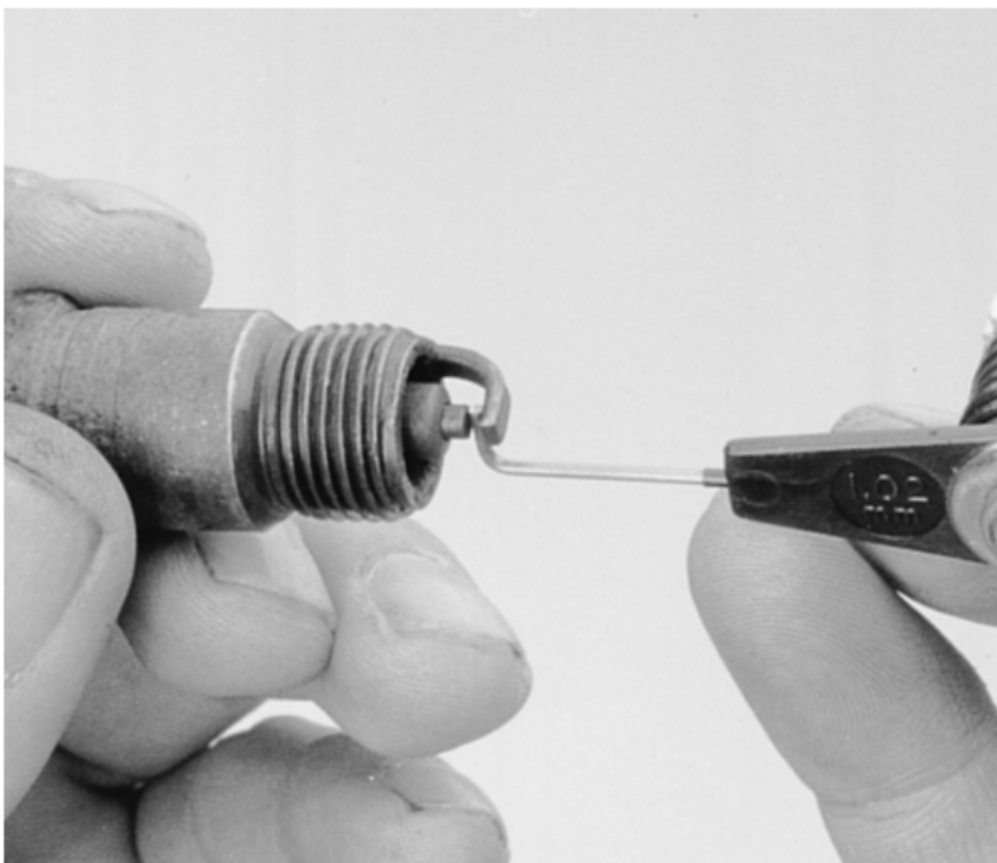


Fig. 4: Checking the spark plug gap with a feeler gauge

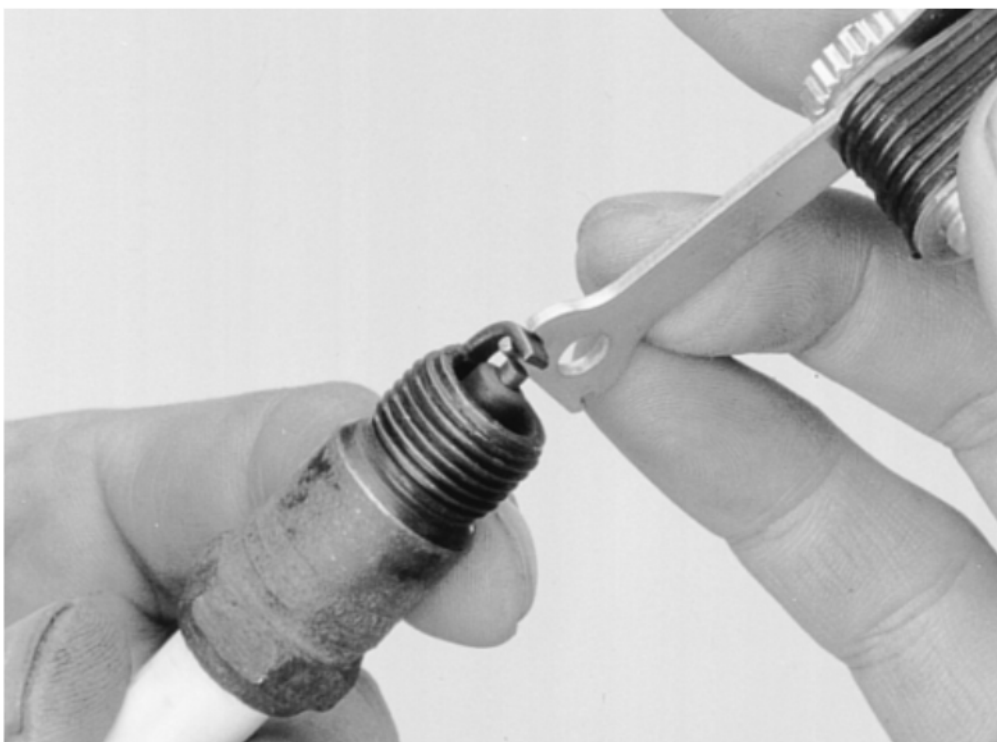


Fig. 5: Adjusting the spark plug gap

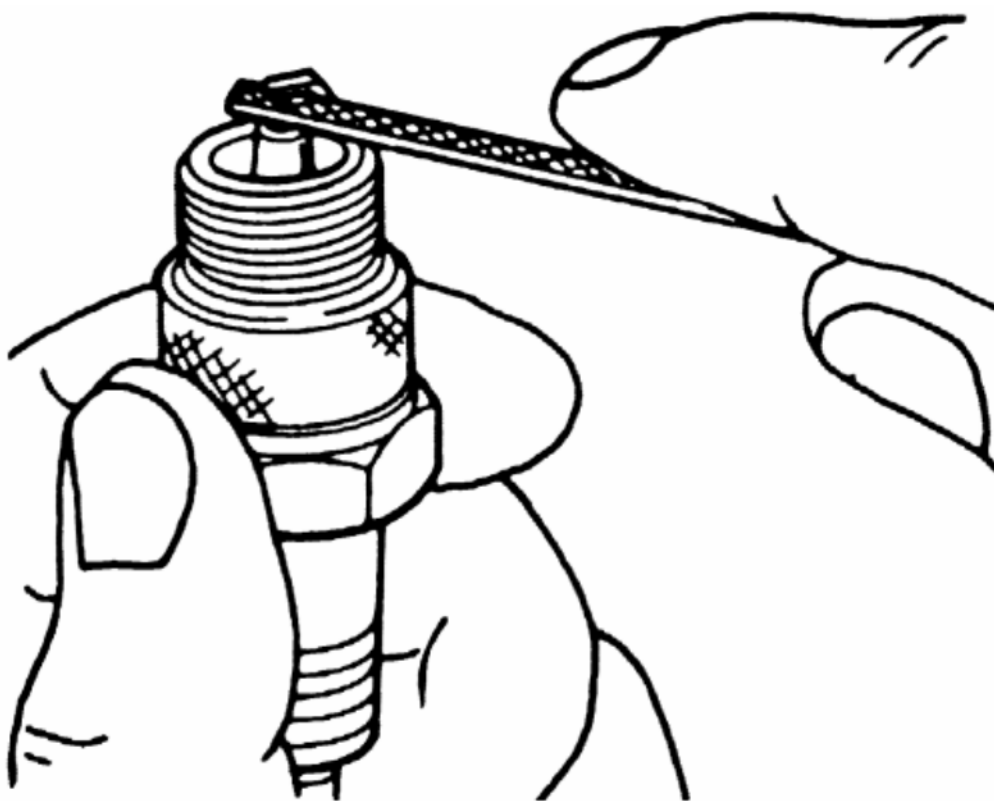


Fig. 6: If the standard plug is in good condition, the electrode may be filed flat -
WARNING: do not file platinum plugs



A normally worn spark plug should have light tan or gray deposits on the firing tip.



A carbon fouled plug, identified by soft, sooty, black deposits, may indicate an improperly tuned vehicle. Check the air cleaner, ignition components and engine control system.



This spark plug has been **left in the engine too long**, as evidenced by the extreme gap. Plugs with such an extreme gap can cause misfiring and stumbling accompanied by a noticeable lack of power.



An oil fouled spark plug indicates an engine with worn piston rings and/or bad valve seals allowing excessive oil to enter the chamber.



A physically damaged spark plug may be evidence of severe detonation in that cylinder. Watch that cylinder carefully between services, as a continued detonation will not only damage the plug, but could also damage the engine.



A bridged or almost bridged spark plug, identified by a build-up between the electrodes caused by excessive carbon or oil build-up on the plug.

Fig. 7: Inspect the spark plug to determine engine running conditions

SPARK PLUG WIRES

TESTING, REMOVAL & INSTALLATION

Every 15,000 miles (24,000 km), inspect the spark plug wires for burns, cuts, or breaks in the insulation. Check the boots and the nipples on the distributor cap. Replace any damaged wiring.

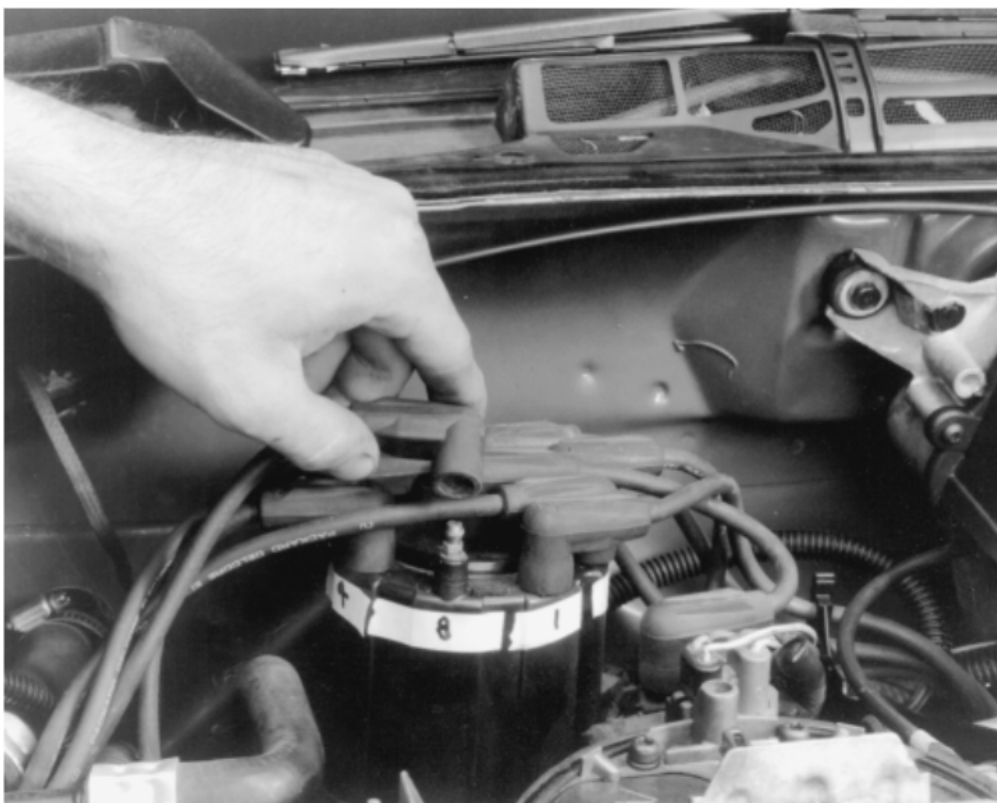


Fig. 1: Number the distributor cap towers to denote correct spark plug wire installation

Every 45,000 miles (72,000 km) or so, the resistance of the wires should be checked with an ohmmeter. Wires with excessive resistance will cause misfiring, and may make the engine difficult to start in damp weather. Generally, the useful life of the cables is 45,000-60,000 miles (72,000-96,000 km).

HEI Plug Wire Resistance Chart

Wire Length	Minimum	Maximum
0–15 inches	3000 ohms	10,000 ohms
15–25 inches	4000 ohms	15,000 ohms
25–35 inches	6000 ohms	20,000 ohms
Over 35 inches		25,000 ohms

Fig. 2: Use the spark plug wire length to determine the appropriate resistance

FIRING ORDERS

To avoid confusion, remove and tag the spark plug wires one at a time, for replacement.

If a distributor is not keyed for installation with only one orientation, it could have been removed previously and rewired. The resultant wiring would hold the correct firing order, but could change the relative placement of the plug towers in relation to the engine. For this reason it is imperative that you label all wires before disconnecting any of them. Also, before removal, compare the current wiring with the accompanying illustrations. If the current wiring does not match, make notes, to reflect how your engine is wired.

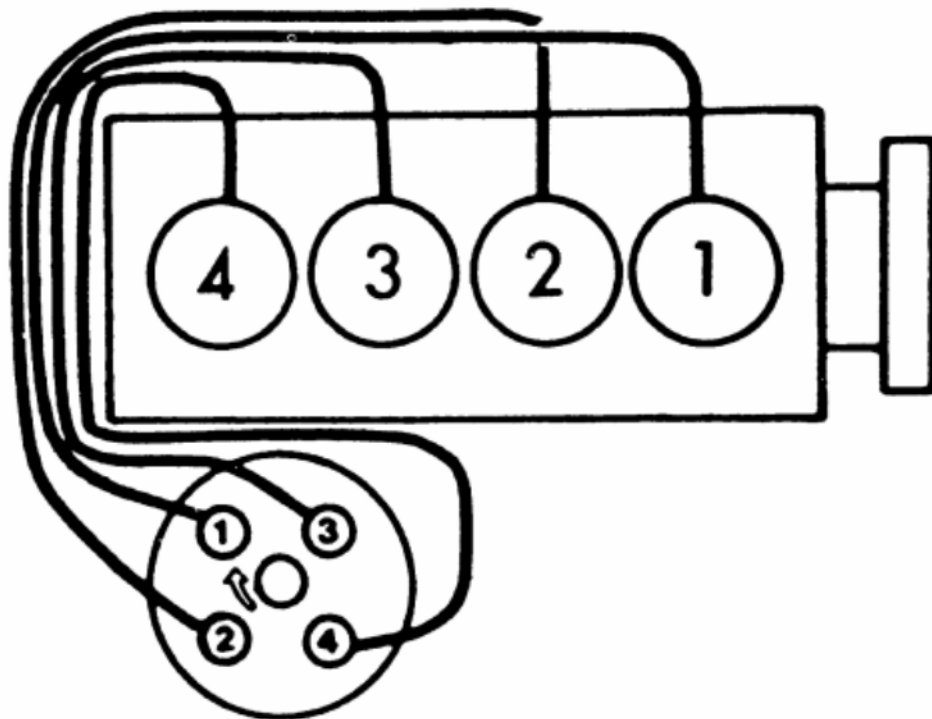


Fig. 1: 2.5L Engine - Engine firing order: 1-3-4-2- Distributor Rotation: Clockwise

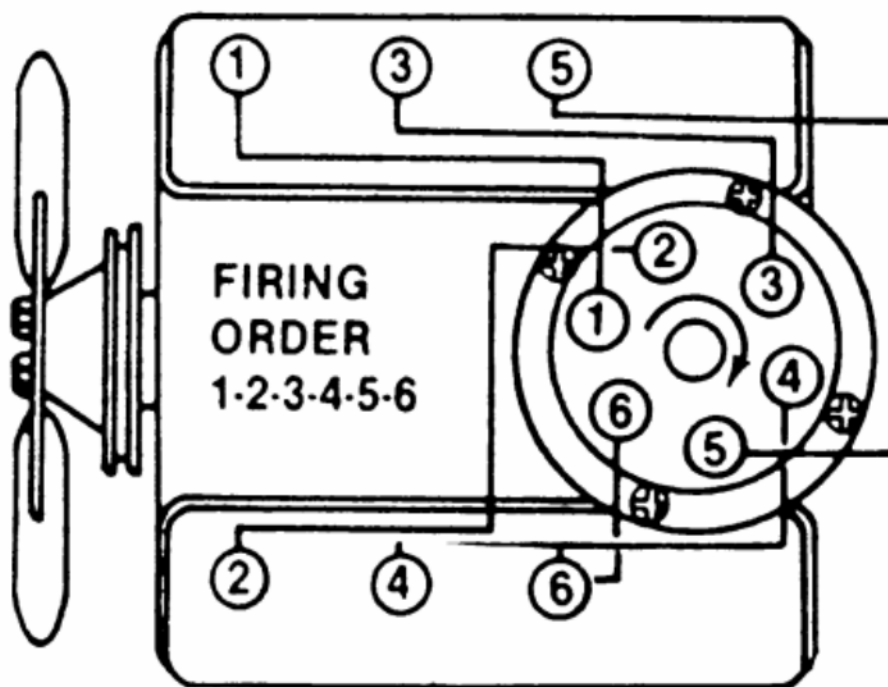


Fig. 2: 2.8L Engine - Engine firing order: 1-2-3-4-5- Distributor Rotation: Clockwise

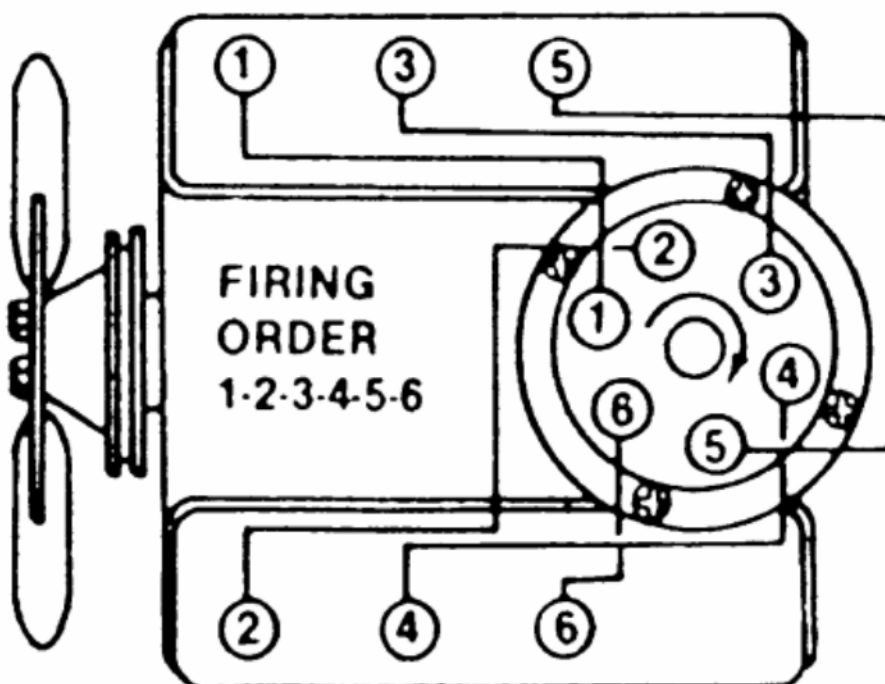


Fig. 3: 3.1L Engine - Engine firing order: 1-2-3-4-5-6- Distributor Rotation: Clockwise

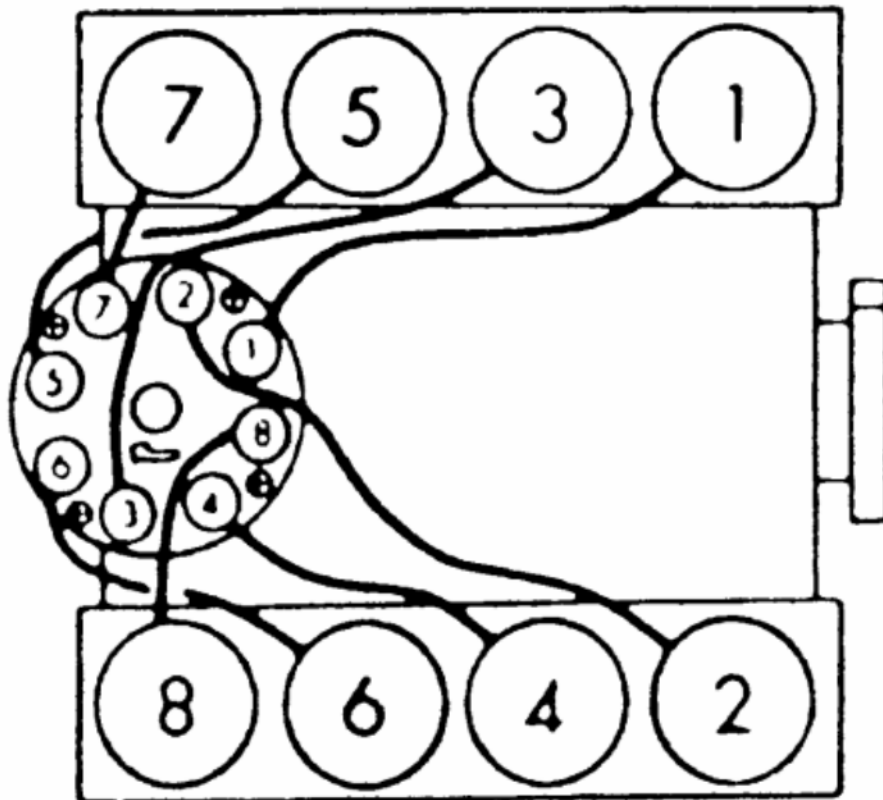


Fig. 4: 5.0L and 5.7L (VIN 8) Engines - Engine firing order: 1-8-4-3-6-5-7-2-
Distributor Rotation: Clockwise

It should be remembered that resistance is also a function of length; the longer the wire, the greater the resistance. Thus, if the wires on your car are longer than the factory originals, resistance will be higher, quite possibly outside these limits.

When installing new wires, replace them one at a time to avoid mix-ups. If it becomes necessary to remove all of the wires from the distributor cap or coil packs at one time, take the time to label the distributor cap/coil pack towers to denote the cylinder number of the wire for that position. When this is done, incorrect positioning of wires can more easily be avoided. Start by replacing the longest one first. Route the wire over the same path as the original and secure in place.

ELECTRONIC IGNITION SYSTEM

GENERAL INFORMATION

The High Energy Ignition (HEI) system controls the fuel combustion by providing a spark to ignite the compressed air/fuel mixture at the correct time. To provide improved engine performance, fuel economy, and control of exhaust emissions, the engine control module (ECM) controls distributor spark advance (timing) with an ignition control system.

The distributor may have an internal, or external ignition coil. To be certain of the type coil used for your vehicle, visually inspect the ignition system. If the ignition coil is inside the distributor cap, it connects through a resistance brush to the rotor. If your vehicle is equipped with an external ignition coil, it connects to the rotor through a high tension wire.

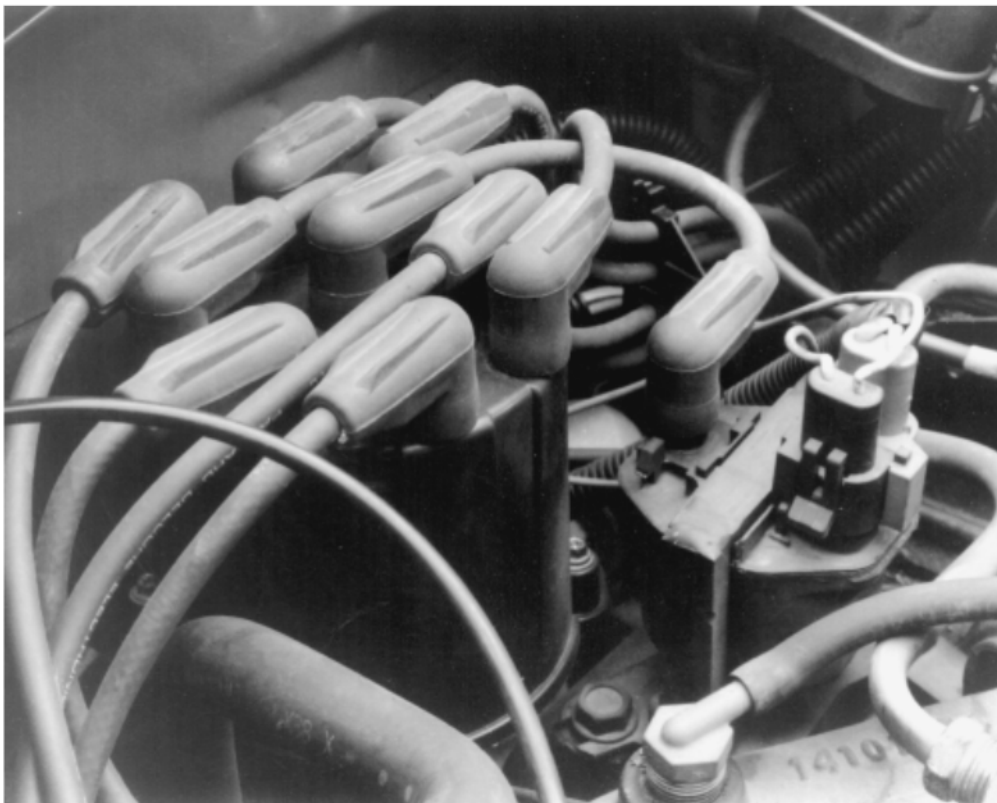


Fig. 1: Distributor with exterior ignition coil - 1987 vehicle shown

The distributor contains the ignition control module, and the magnetic triggering device. The magnetic pickup assembly contains a permanent magnet, a pole piece with internal "teeth", and a pickup coil (not to be confused with the ignition coil).

All spark timing changes are done electronically by the engine control module (ECM) which monitors information from various engine sensors. The ECM computes the desired spark timing and then signals the distributor ignition module to change the timing accordingly. No vacuum or mechanical advance systems are used.

In the HEI system, as in other electronic ignition systems, the breaker points have been replaced with an electronic switch - a transistor - which is located within the ignition module. This switching transistor performs the same function the points did in a conventional ignition system; it simply turns the coil's primary current on and off at the correct time. Essentially, electronic and conventional ignition systems operate on the same principle.

The module which houses the switching transistor is controlled (turned on and off) by a magnetically generated impulse induced in the pickup coil. When the teeth of the rotating timer align with the teeth of the pole piece, the induced voltage in the pickup coil signals the electronic module to open the coil primary circuit. The primary current then decreases, and a high voltage is induced in the ignition coil secondary windings, which is then directed through the rotor and high voltage leads (spark plug wires) to fire the spark plugs.

In essence, the pickup coil module system simply replaces the conventional breaker points and condenser. The condenser found within the distributor is for radio suppression purposes only and has nothing to do with the ignition process. The ignition module automatically controls the dwell period, increasing it with increasing engine speed. Since dwell is controlled in this manner, it cannot be adjusted. The module itself is non-adjustable/non-repairable and must be replaced if found defective.

SYSTEM PRECAUTIONS

Before proceeding with troubleshooting, take note of the following precautions:

TIMING LIGHT USE

Care should be exercised when connecting a timing light or other pick-up equipment. Do not force anything between the boots and wiring, or through the silicone jacket. Connections should be made in parallel using an adapter. Inductive pickup timing lights are the best kind to use with the ignition systems covered by this information.

SPARK PLUG WIRES

The plug wires used with these systems are of a different construction than conventional wires. When replacing them, make sure you get the correct wires, since conventional wires will not carry the voltage. Also, handle the wires carefully to avoid cracking or splitting them, and NEVER pierce the wires.

TACHOMETER USE

Not all tachometers will operate or indicate correctly when used on an HEI or C³I system. While some tachometers may give a reading, this does not necessarily mean the reading is correct. In addition, some tachometers hook up differently from others. If you cannot figure out whether or not your tachometer will work on your car, check with the tachometer manufacturer.

The tachometer terminal should never be allowed to touch ground, as damage to the computer control module and/or ignition coil assembly can result.

CONNECTORS

When disengaging connectors, do not use a screwdriver or other tool to release the locking tab, as this might break the connector.

SYSTEM TESTERS

Instruments designed specifically for testing HEI or C³I systems are available from several tool manufacturers. Some of these will even test the module itself. However, the tests given in the following section will require only an ohmmeter and a voltmeter.

TESTING

The symptoms of a defective component within the HEI or C³I system are exactly the same as those you would encounter in a conventional system. Some of these symptoms are:

- Hard or no starting
- Rough Idle
- Poor fuel economy
- Engine misses under load or while accelerating

PRELIMINARY CHECKS

If you suspect a problem in your ignition system, there are certain preliminary checks which you should carry out before you begin to check the electronic portions of the system. First, it is extremely important to make sure the vehicle battery is in a good state of charge. A defective or poorly charged battery will cause the various components of the ignition system to read incorrectly when they are being tested. Second, make sure all wiring connections are clean and tight, not only at the battery, but also at the distributor cap (if so equipped), ignition coil, camshaft and/or crankshaft sensors (if so equipped) and at the control module.

Since the only difference between these ignition systems lies before the spark plug wiring, it is important to check the secondary ignition circuit first. If the secondary circuit checks out properly (there is spark), then the engine condition is probably not the fault of the ignition system. To check the secondary ignition system, perform a simple spark test. Remove one of the plug wires and insert some sort of extension in the plug socket. An old spark plug with the ground electrode removed makes a good extension. Hold the wire and extension using an insulated tool (NOT BY HAND) about $\frac{1}{4}$ in. (6mm) away from the block and crank the engine. If a normal spark occurs, then the problem is most likely not in the ignition system. Check for fuel system problems, or fouled spark plugs.

If, however, there is no spark or a weak spark, then further ignition system testing will have to be done. Troubleshooting techniques fall into various categories, depending on the nature of the problem and the system being tested. Categories will include symptoms such as the engine cranks, but will not start or the engine runs rough.

HEI SYSTEM

When testing the HEI system, there are 2 major categories of problems, (1) Engine cranks, but will not start or (2) Engine runs, but runs rough or cuts out.

If the engine will not start, perform a spark test as described earlier. This will narrow the problem area down considerably. If no spark occurs, check for the presence of normal battery voltage at the battery (*BAT*) terminal on the ignition coil. The ignition switch must be in the *ON* position for this test. Either a voltmeter or a test light wire may be used for this test. Connect the test light wire to ground and the probe end to the *BAT* terminal at the coil. If the light comes on, you have voltage to the distributor and/or spark plug wires. If the light fails to come on, this indicates an open circuit in the ignition primary wiring leading to the distributor. In this case, you will have to check wiring continuity back to the ignition switch using a test light. If there is battery voltage at the *BAT* terminal, but no spark at the plugs, then the problem probably lies within the distributor assembly.

If, on the other hand, the engine starts, but runs roughly or cuts out, make sure the plug wires are in good shape first. There should be no obvious cracks or breaks. You can check the plug wires with an ohmmeter, but do not pierce the wires with a probe. Check the chart for the correct plug wire resistance. If the plug wires are OK, remove the cap assembly and check for moisture, cracks, chips, or carbon tracks, or any other high voltage leads or failures. Replace the cap if any defects are found. Make sure the timer wheel rotates when the engine is cranked.

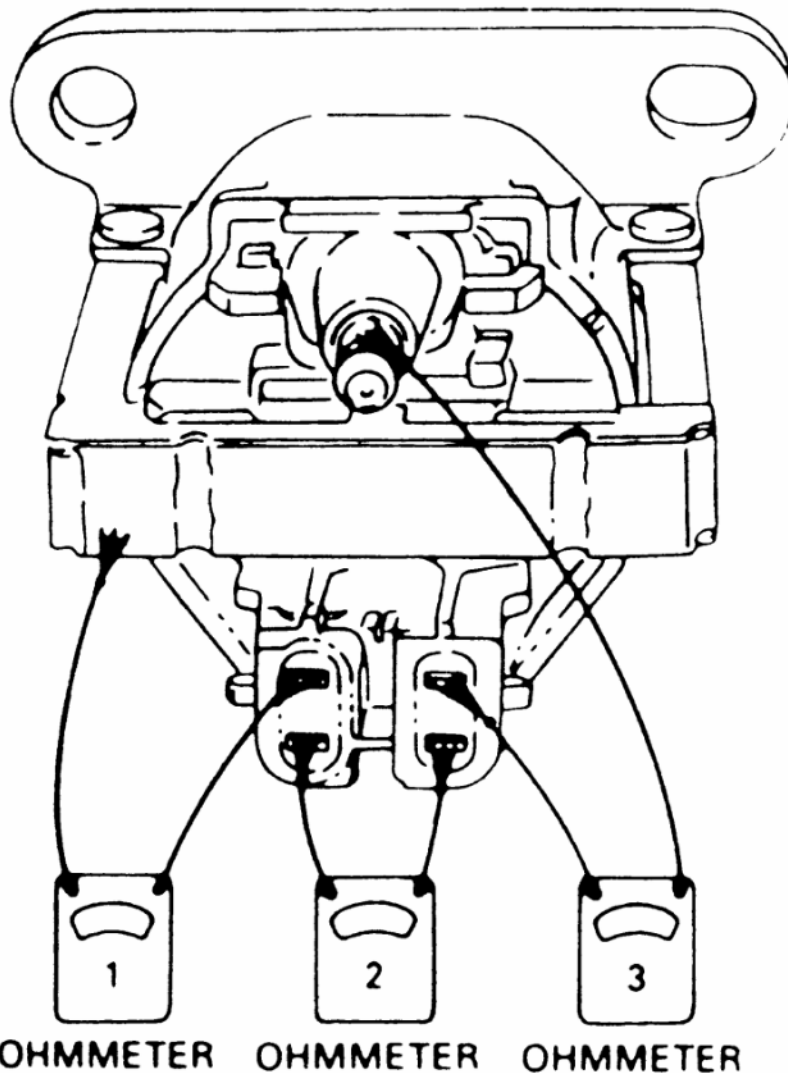
If the trouble has been narrowed down to the units within the distributor, the following tests can help pinpoint the defective component. An ohmmeter with both high and low ranges should be used. These tests are made with the cap assembly removed and the battery wire disconnected. If a tachometer is connected to the *TACH* terminal, disconnect it before making these tests.

IGNITION COIL

EXTERNALLY MOUNTED

1. Disconnect the coil wires and set the ohmmeter on the high scale.
2. Connect the ohmmeter to the ignition coil as illustrated in Step 1 of the accompanying figure.
3. The ohmmeter should read near infinite or very high.

TESTING IGNITION COIL



CHECK IGNITION COIL WITH OHMMETER FOR OPENS AND GROUNDS:

STEP 1. — USE HIGH SCALE. SHOULD READ VERY HIGH (INFINITE). IF NOT, REPLACE COIL.

STEP 2. — USE LOW SCALE. SHOULD READ VERY LOW OR ZERO. IF NOT, REPLACE COIL.

STEP 3. — USE HIGH SCALE. SHOULD NOT READ INFINITE. IF IT DOES, REPLACE COIL.

Fig. 1: Testing external ignition coil

4. Next, set the ohmmeter to the low scale and connect test leads as illustrated in Step 2 of the accompanying figure.
5. The reading should be very low or zero.
6. Now set the ohmmeter on the high scale and connect test leads as illustrated in Step 3 of the accompanying figure. The ohmmeter should not read infinity.

7. If any results of the 3 tests listed above do not agree with the desired readings, replace the ignition coil.

INTERNALLY MOUNTED

1. Connect an ohmmeter between the *TACH* and *BAT* terminals on the ignition coil. The primary coil resistance should be less than ohms;.
2. To check the coil secondary resistance, connect an ohmmeter between the high tension terminal and the *BAT* terminal. Note the reading. Connect the ohmmeter between the high tension terminal and the *TACH* terminal. Note the reading. The resistance in both cases should be 6,000-30,000 ω . Be sure to test between the high tension terminal and both the *BAT* and *TACH* terminals.
3. Replace the coil only if the readings in Step 1 and Step 2 are infinite.

These resistance checks will not disclose shorted coil windings. This condition can only be detected with scope analysis or a suitably designed coil tester. If these instruments are unavailable, replace the coil with a known good coil as a final coil test.

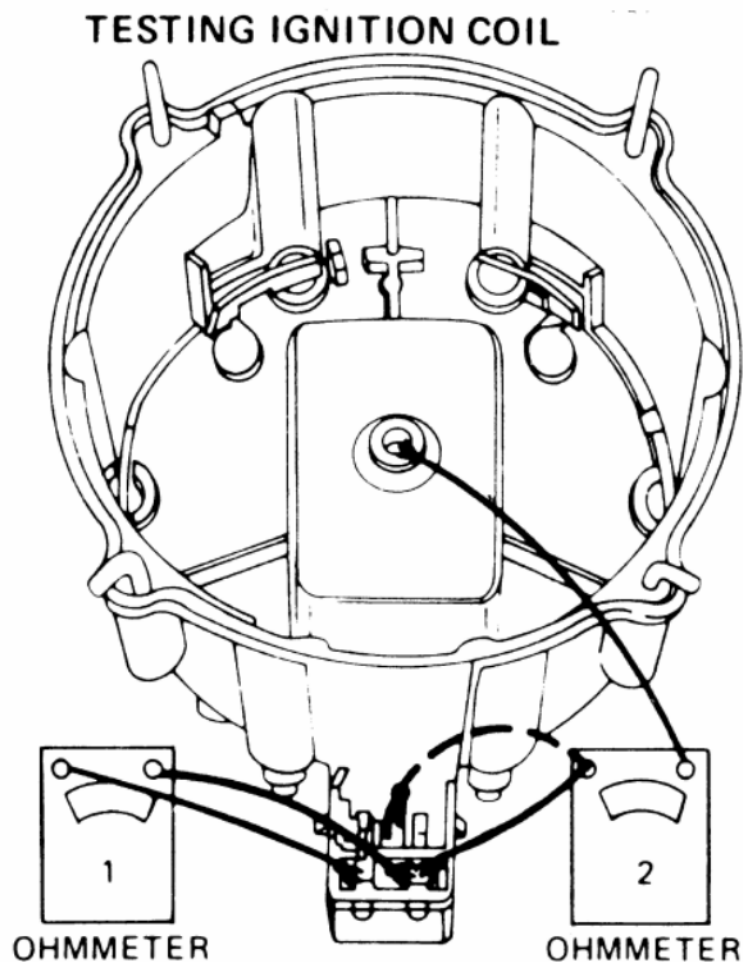


Fig. 2: Testing internally mounted ignition coil

PICKUP COIL

1. To test the pickup coil, first disconnect the white and green module leads. Set the ohmmeter on the high scale and connect it between a ground and either the white or green lead. Any resistance measurement less than infinity requires replacement of the pickup coil.

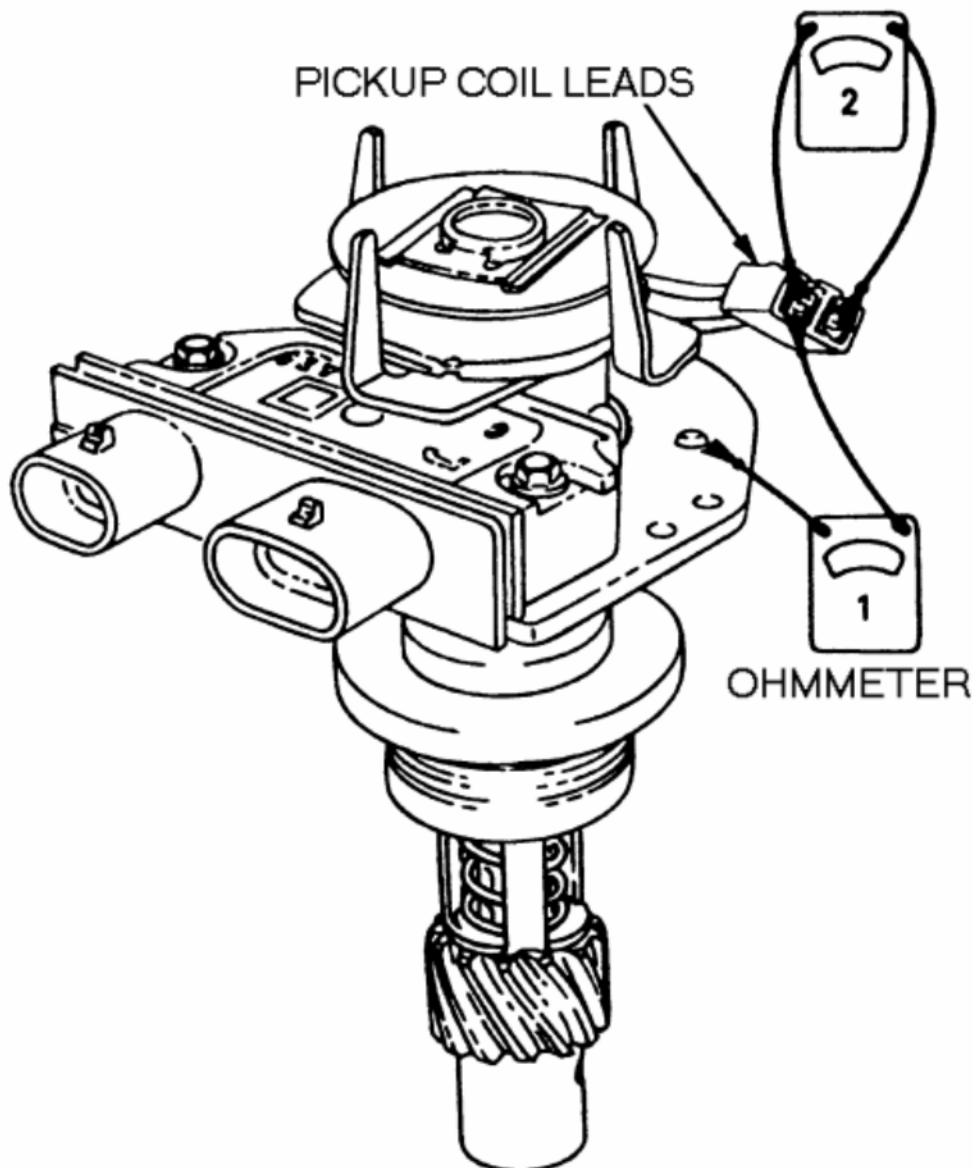


Fig. 3: Testing Pickup coil - Test 1 should read infinite at all times. Test 2 should read a steady value of 500-1500 ohms.

2. Pickup coil continuity is tested using an ohmmeter (on low range) between the white and green leads. Normal resistance is 500-1,500 ω . If a vacuum unit is used, move the vacuum advance arm while performing this test. This will detect any break in coil continuity. Such a condition can cause intermittent misfiring. Replace the pickup coil if the reading is outside the specified limits.

3. If no defects have been found at this time, and you still have a problem, then the module will have to be checked. If you do not have access to a module tester, the only possible alternative is a substitution test. If the module fails the substitution test, replace it.

COMPONENT REPLACEMENT

CAUTION - When handling secondary spark plug leads with the engine running or starting, insulated pliers must be used and care exercised to prevent a possible electrical shock.

HEI SYSTEM

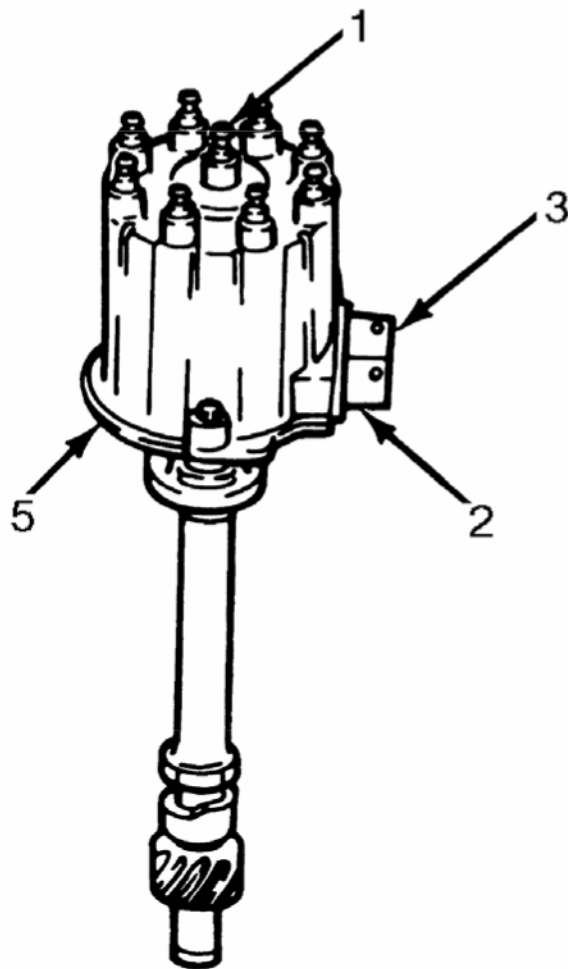
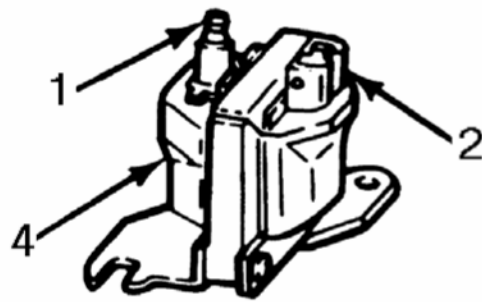
IGNITION COIL

EXTERNALLY MOUNTED

1. Disconnect the negative battery cable.
2. Disconnect the ignition coil wire from the coil. Do so by pulling on the boot of the wire while twisting it.
3. Disconnect the harness connector from the ignition coil.
4. Remove the coil mounting screws and the ignition coil. If necessary, drill out and remove the rivets holding the coil to the bracket.

To install:

5. Place the ignition coil in position on the mounting bracket and install the mounting screws.
6. Reconnect the harness connectors to the ignition coil. Confirm that the harness connectors are firmly attached to the coil.
7. Install the secondary coil wire to the coil tower.
8. Connect the negative battery cable.



1. Secondary ignition coil wire connector
2. Primary ignition coil wire connector
3. 4 terminal connector
4. Ignition coil
5. Distributor

Fig. 1: Distributor with external ignition coil

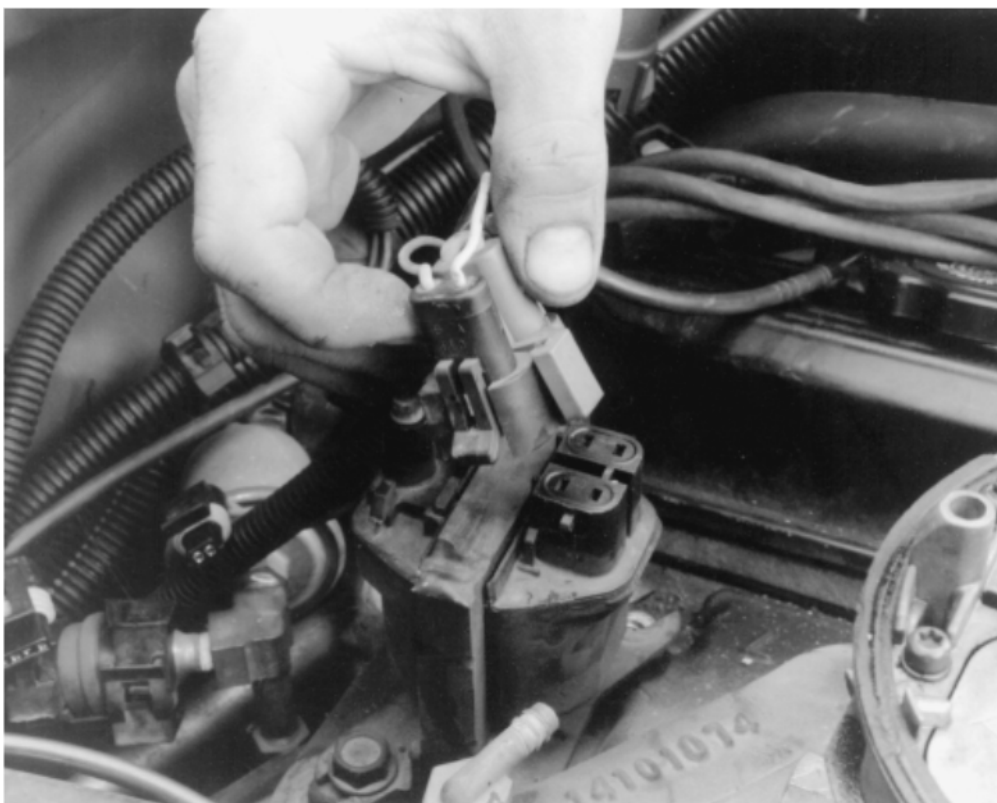


Fig. 2: Release the locking tab and remove the harness connector from the coil

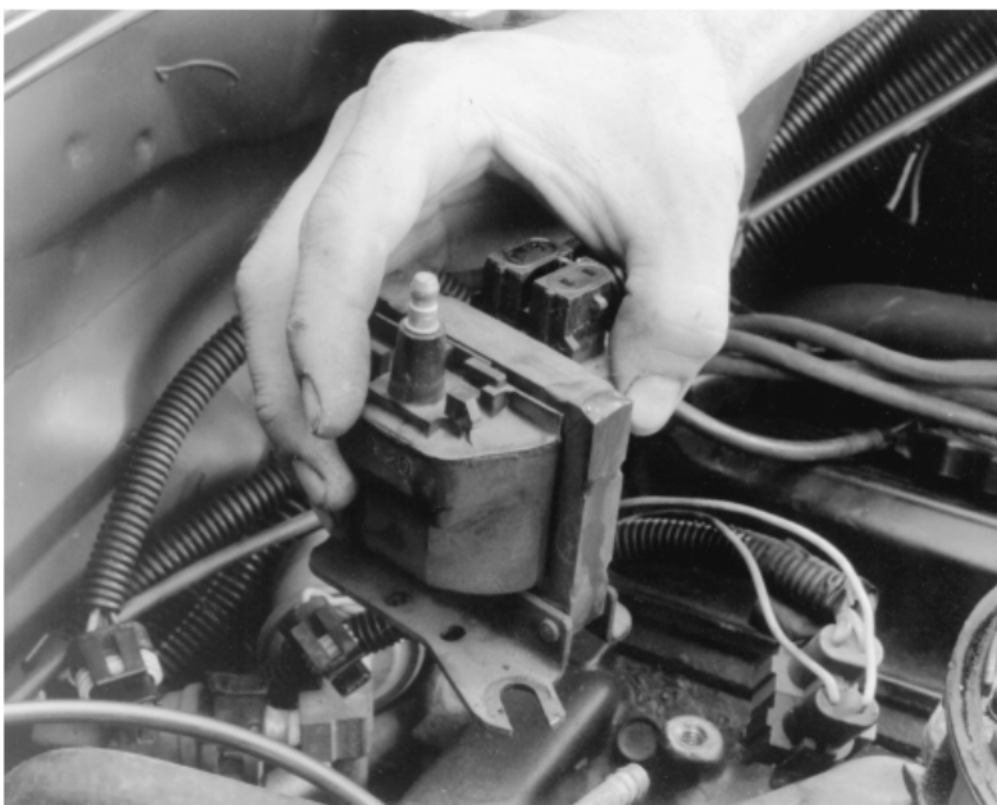


Fig. 3: With the mounting screw(s) removed, lift the coil from the engine compartment

INTERNALLY MOUNTED

1. Disconnect the negative battery cable.
2. Remove the cover and wire retainer.
3. Disconnect the battery feed wire and coil connections from the cap.
4. Remove the coil cover attaching screws and cover.
5. Remove the coil attaching screws and lift the coil assembly from the distributor cap.

To install:

6. Position the ignition coil and the leads into the cap. Be certain that the resistor brush, ground lead and seal are properly positioned.
7. Install the mounting screws.
8. Install the coil cover and retainers. Reconnect the feed wires and coil connections to the cap.
9. Install the cover and wire retainer. Reconnect the negative battery cable.

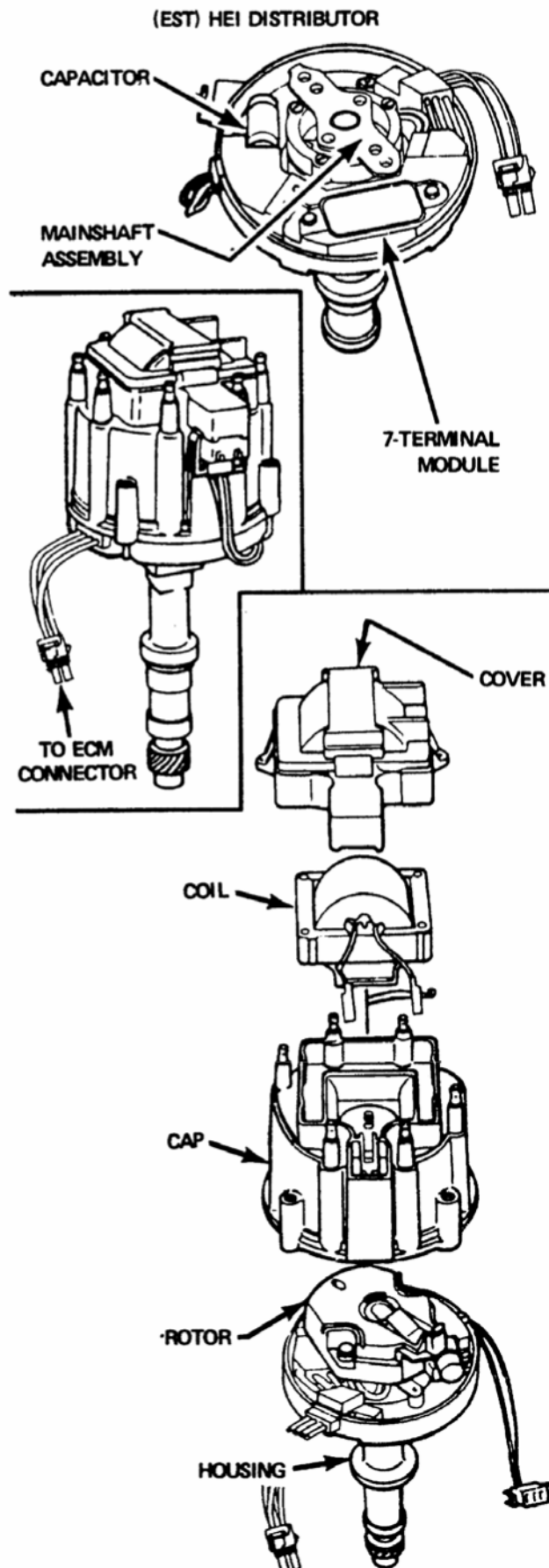


Fig. 4: Distributor and related components with internal ignition coil

DISTRIBUTOR CAP

1. If removing the ignition wires at the cap, take a moment to label the spark plug wire positioning for each cylinder, at each tower. This will avoid improper wire placement during assembly.
2. Disconnect the ignition switch wire from the distributor cap. Also disconnect the tachometer wire, if so equipped.
3. Release the coil connectors from the cap.
4. Remove the distributor cap by turning the four latches (the L4 distributor has 2 latches) counterclockwise.
5. Remove the cap. Installation is the reverse of removal. Be sure you get the ignition and tachometer wires connected to the correct terminals.



Fig. 5: Release the retainers on the distributor cap by turning them counterclockwise

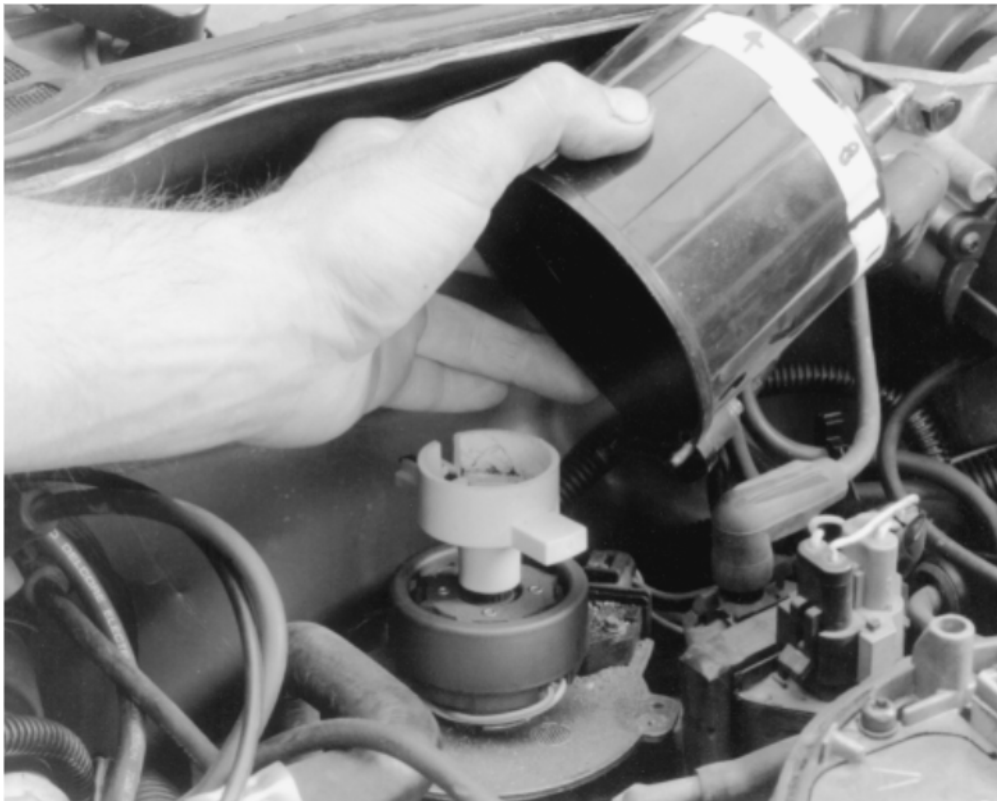


Fig. 6: Removing the distributor cap. Notice that all towers on cap are labeled with the corresponding engine cylinder number.

ROTOR

1. Disconnect the negative battery cable.
2. Remove the distributor cap.
3. Unscrew the two rotor attaching screws and then lift off the rotor.
4. For installation, make sure the rotor is positioned in the correct direction and tighten the retaining screws.

CAPACITOR

The capacitor, if equipped, is part of the ignition coil wire harness assembly. Since the capacitor is used only for radio noise suppression, it will seldom need replacement.

1. Disconnect the negative battery cable.
2. Remove the distributor cap and rotor.
3. Remove the capacitor attaching screws and unplug the connector from the module. Remove the module.

To install:

4. Plug the connector into the capacitor. Install the capacitor and secure in place using the mounting screws. Be sure the ground lead is under the screw.
5. Install the rotor and distributor cap.

6. Connect the negative battery cable.

MODULE

It is not necessary to remove the distributor from the vehicle.

1. Disconnect the negative battery cable.
2. Remove the distributor cap, rotor and pickup coil.
3. Remove the 2 module attaching screws and lift the module up. Remove the leads from the module, observing the colors on each lead. These leads can not be interchanged.

If the module is to be reused, do not wipe the grease from the module or the distributor base. If a new module is to be installed, a package of silicone grease will be included with it. Spread the grease on the metal face of the module and on the distributor base where the module seats. This grease is necessary for module cooling.

To install:

4. Install the module, tighten the retaining screws and connect the wiring.
5. Install the distributor rotor and distributor cap.
6. Connect the negative battery cable.

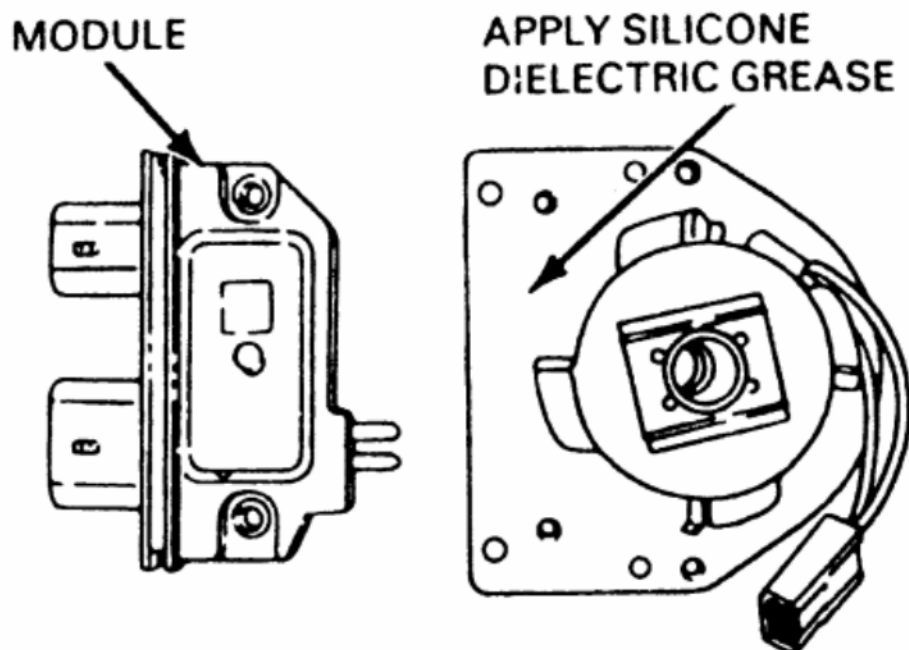


Fig. 7: Ignition coil module mounting - always coat the base with silicone dielectric grease.

PICKUP COIL

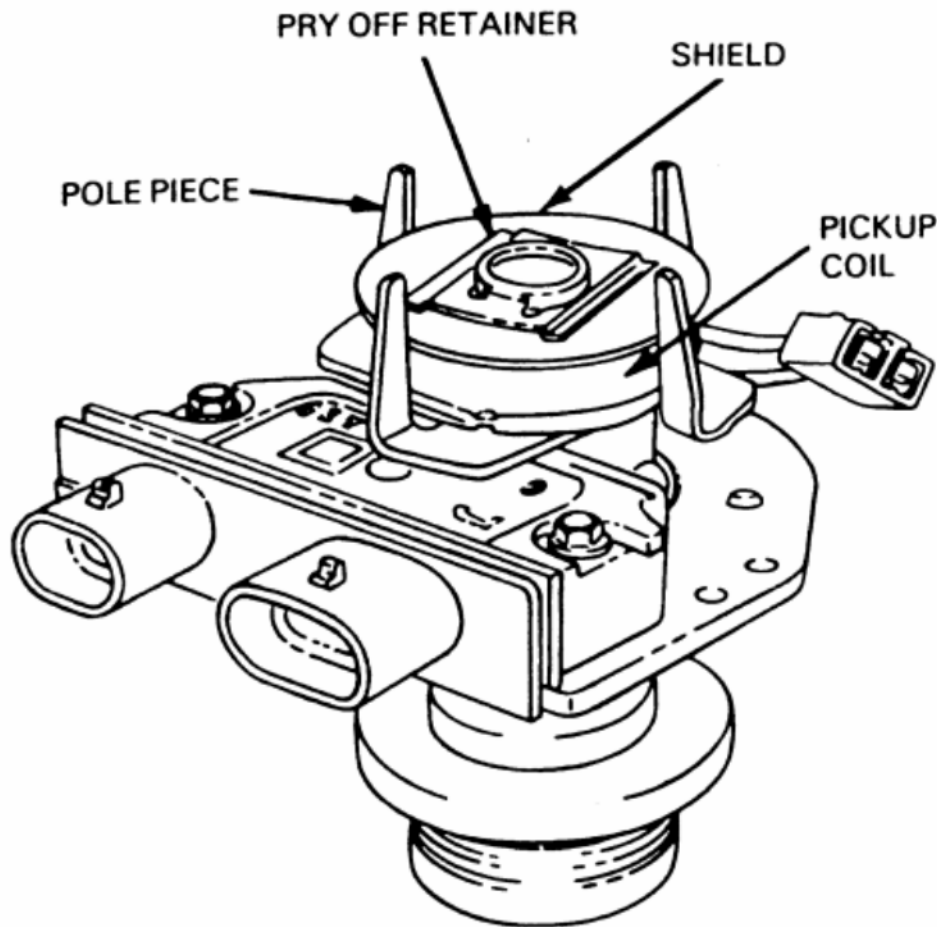


Fig. 8: Pickup coil and related components - distributor with external coil

1. Disconnect the negative battery cable.
2. Remove the distributor cap and then the rotor.
3. Remove 3 screws from the magnetic shield. Remove the magnetic shield and C-washer. Remove the magnet, pole piece and pickup coil.
4. Installation is the reverse of the removal procedure.

IGNITION TIMING DESCRIPTION

Ignition timing is the measurement, in degrees of crankshaft rotation, of the point at which the spark plugs fire in each of the cylinders. It is measured in degrees before or after Top Dead Center (TDC) of the compression stroke.

Because it takes a fraction of a second for the spark plug to ignite the mixture in the cylinder, the spark plug must fire a little before the piston reaches TDC. Otherwise, the mixture will not be completely ignited as the piston passes TDC and the full power of the explosion will not be used by the engine.

The timing measurement is given in degrees of crankshaft rotation before the piston reaches TDC (BTDC). If the setting for the ignition timing is 5° BTDC, the

spark plug must fire 5° before each piston reaches TDC. This only holds true, however, when the engine is at idle speed.

As the engine speed increases, the pistons go faster. The spark plugs have to ignite the fuel even sooner if it is to be completely ignited when the piston reaches TDC.

If the ignition is set too far advanced (BTDC), the ignition and expansion of the fuel in the cylinder will occur too soon and try to force the piston down while it is still traveling up. This causes engine ping. If the ignition spark is set too far retarded, after TDC (ATDC), the piston will have already passed TDC and started on its way down when the fuel is ignited. This will cause the piston to be forced down for only a portion of its travel, resulting in poor engine performance and lack of power.

When timing the engine, the Number 1 plug wire should be used to trigger the timing light. On engines where timing is adjustable, the notch for the No. 1 cylinder is usually scribed across all three edges of the double sheaf pulley. Another notch located 180° away from the No. 1 cylinder notch is scribed only across the center section of the pulley to make it distinguishable from the No. 1 cylinder notch.

There are two basic types of timing lights available. The first type of light operates from the car's battery. Two alligator clips connect to the battery terminals, while a third wire connects to the spark plug with an adapter or to the spark plug wire with an inductive pickup. This type of light is more expensive, but the xenon bulb provides a nice bright flash which can even be seen in sunlight. The second type replaces the battery source with 110-volt house current. Some timing lights have other functions built into them, such as dwell meters, tachometers, or remote starting switches. These are convenient, in that they reduce the tangle of wires under the hood, but may duplicate the functions of tools you already have.

Because this car uses electronic ignition, you should use a timing light with an inductive pickup. This pickup simply clamps around the Number 1 spark plug wire (in this case, the coil wire), eliminating the adapter. It is not susceptible to crossfiring or false triggering, which may occur with a conventional light due to the greater voltages produced by these systems.

ADJUSTMENT

When adjusting the timing, refer to the instructions on the emission control sticker inside the engine compartment. If the instructions on the label disagree with the procedure listed below, follow the instructions on the label.

1982-87 VEHICLES

1. Locate the timing marks on the crankshaft pulley and the front of the engine.

2. Clean off the marks and coat them with white paint or chalk, if necessary, so that they may be seen.
3. Run the engine until it reaches normal operating temperature, then shut off the engine.
4. With the ignition OFF, connect a tachometer to the distributor, and a timing light with an inductive pickup lead to the No. 1 spark plug wire.

WARNING - Never pierce a secondary ignition wire in order to connect a timing light. A pierced wire may lead to engine misfiring and driveability problems.

5. To properly set the ignition timing, the EST must be placed in the bypass mode.
 - a. On the 2.5L engine, refer to the emission control label for the procedure.

If the label is missing or unreadable, contact your Chevrolet dealer for a replacement.

- b. On 2.8L and 5.0L carbureted engines, disconnect the 4-wire EST connector at the distributor. (Fault code 42 may be set in ECM memory, and must be cleared once the procedure is completed). Proceed to Step 7.
 - c. On 2.8L, 5.0L and 5.7L fuel injected engines, with the engine RUNNING and all accessories off, use a jumper wire to connect diagnostic terminal B and ground terminal A of the 12-terminal Assembly Line Diagnostic Link (ALDL) usually located under the left side of the instrument panel. DO NOT disconnect the 4-wire EST connector at the distributor. Aim the timing light at the timing mark; the line on the balancer or pulley will line up with the timing mark. Increase engine speed and check for timing advance. If the timing still advances with engine speed, perform Step 6. If timing does not advance with engine speed, proceed to Step 7.

If timing advances with engine speed, it will be necessary to disconnect the single-wire Set Timing connector. (Fault code 42 may be set in ECM memory, and must be cleared once the procedure is completed).

6. Remove the jumper wire from the ALDL, and shut off the ignition. Disconnect the Set Timing connector, usually located under the plastic cover above the heater unit, in the engine compartment. (The wire in this connector is normally Tan/Black.)
 7. With the engine running and all accessories off, aim the light at the timing mark. The line on the balancer or pulley will line up with the timing mark. If a change in timing is necessary, loosen the hold-down clamp bolt at the base of the distributor. While observing the timing mark, rotate the distributor slightly until the line indicates the correct timing. Use the timing specification on the emission control label in the engine compartment. If this label is missing or damaged, refer to the Tune-Up Specifications chart in this Section.

8. Once the timing is set to specification, tighten the distributor hold-down clamp. Recheck the timing to make sure it did not change while the bolt was being tightened.
9. Remove the jumper wire from the ALDL connector, if applicable, with the engine still running. (Usually, if this is performed before the engine is shut off, no trouble codes will be stored.)
10. Turn the engine OFF, then remove the timing light and tachometer. Reconnect the number 1 spark plug wire, if disconnected.
11. Attach the 4-wire EST connector at the distributor, or reconnect the Set Timing connector, if applicable.
12. Check for fault code 42, and clear, if necessary, by disconnecting the negative battery cable for at least 30 seconds.

To prevent ECM damage, the key must be in the OFF position when disconnecting or reconnecting battery cables.

1988-90 VEHICLES

When adjusting the timing, refer to the instructions on the emission control sticker inside the engine compartment. If the instructions on the label disagree with the procedure listed below, follow the instructions on the label.

1. Locate the timing marks on the crankshaft pulley and the front of the engine.
2. Clean off the marks and coat them with white paint or chalk, so that they may be easily seen.
3. Run the engine until it reaches normal operating temperature, then shut off the engine.
4. With the ignition OFF, connect a tachometer to the distributor, and a timing light with an inductive pickup lead to the No. 1 spark plug wire.

WARNING - Never pierce a secondary ignition wire in order to connect a timing light. A pierced wire may lead to engine misfiring and driveability problems.

5. Start the engine. With the engine running and all accessories off, use a jumper wire to connect diagnostic terminal *B* and ground terminal *A* of the 12-terminal Assembly Line Diagnostic Link (ALDL), located under the instrument panel.

If jumping the ALDL terminals does not prevent timing advance, the EST bypass wire will have to be disconnected instead.

6. Aim the timing light at the timing mark. The line on the balancer or pulley will line up with the timing mark. If a change in timing is necessary, loosen the hold-down clamp bolt at the base of the distributor. While observing the timing mark, rotate the distributor slightly until the line indicates the correct timing. Use the timing specification on the emission control label in the engine compartment. If this label is missing or damaged, refer to the Tune-Up Specifications chart in this Section.

7. Once the timing is set to specification, tighten the distributor hold-down clamp. Recheck the timing to make sure it did not change while the bolt was being tightened.
8. With the engine still running, unground the diagnostic terminal. (Ungrounding the diagnostic terminal while the engine is still running will usually prevent trouble codes from being stored.)
9. Turn the engine OFF and remove the timing light and tachometer. Reconnect the number 1 spark plug wire, if disconnected.

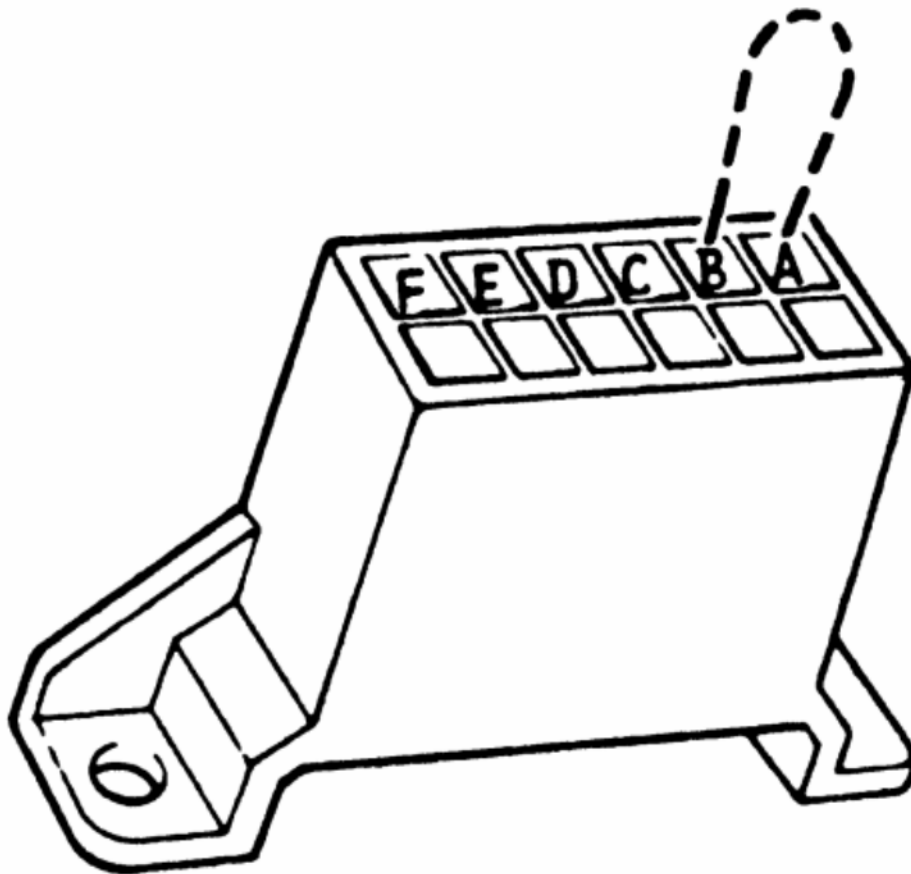


Fig. 1: Grounding the diagnostic terminal in order to set ignition timing

1991-92 VEHICLES

When adjusting the timing, refer to the instructions on the emission control sticker inside the engine compartment. If the instructions on the label disagree with the procedure listed below, follow the instructions on the label.

1. Locate the timing marks on the crankshaft pulley and the front of the engine.
2. Clean off the marks and coat them with white paint or chalk, if necessary, so that they may be seen.
3. Run the engine until it reaches normal operating temperature, then shut off the engine.
4. With the ignition OFF, connect a tachometer to the distributor, and the pickup lead of an inductive timing light to the No. 1 spark plug wire.

Connect the timing light power leads according to the manufacturer's instructions.

WARNING - Never pierce a secondary ignition wire in order to connect a timing light. A pierced wire may lead to engine misfiring and driveability problems.

5. Start the engine. With the engine running at normal operating temperature and all accessories OFF, disconnect the EST bypass connector.

An ECM code will be set when the EST bypass connector is disconnected.

6. Aim the timing light at the timing mark. The line on the balancer or pulley will line up with the timing mark. If a change in timing is necessary, loosen the hold-down clamp bolt at the base of the distributor. While observing the timing mark, rotate the distributor slightly until the line indicates the correct timing. Use the timing specification on the emission control label in the engine compartment. If this label is missing or damaged, refer to the Tune-Up Specifications chart in this Section.
7. Tighten the distributor hold-down bolt and recheck the ignition timing to make sure the distributor was not moved when the bolt was tightened.
8. Turn the engine OFF and remove the timing light and tachometer. Reconnect the number 1 spark plug wire, if disconnected.
9. Connect the EST bypass connector, then check for and clear the ECM code by disconnecting the negative battery cable for at least 30 seconds.

To prevent ECM damage, the key must be in the OFF position when disconnecting or reconnecting battery cables.

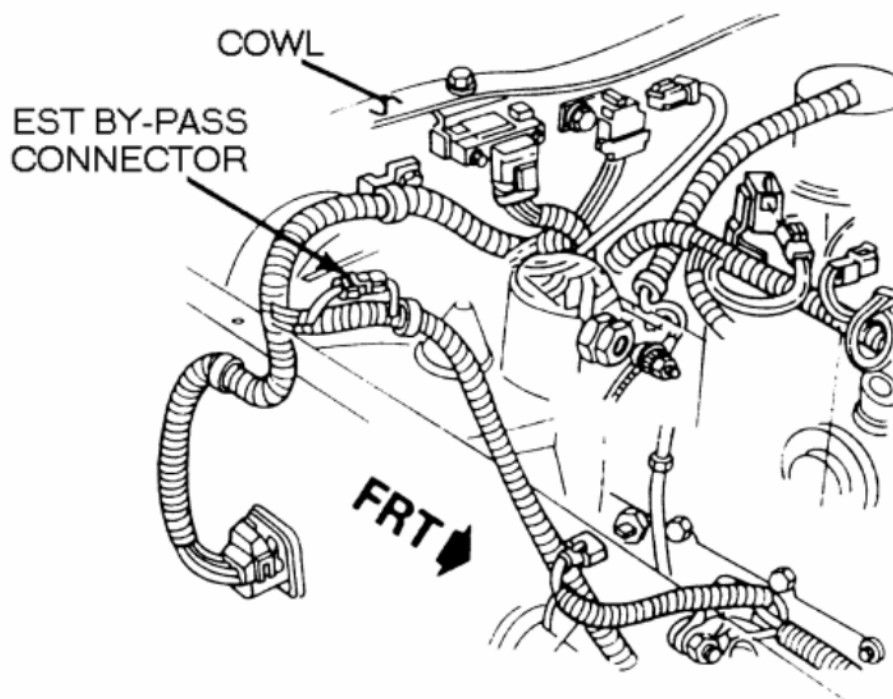


Fig. 2: EST bypass connector

VALVE LASH

All models utilize a hydraulic valve lifter system to obtain zero lash. No periodic adjustment is necessary. An initial adjustment is required anytime that the lifters are removed or the valve train is disturbed. This procedure is covered in Engine & Engine Overhaul .

IDLE SPEED AND MIXTURE ADJUSTMENTS

Mixture adjustments are factory set and sealed; no adjustment attempt should be made, except by an authorized GM dealer or reputable shop equipped with the necessary equipment.

IDLE SPEED

2-BBL CARBURETOR

WITHOUT AIR CONDITIONING

The engine must be running in "Closed Loop" mode (engine fully warmed) when making all idle speed adjustments. In this mode, the oxygen sensor affects control of the fuel delivery.

1. Refer to the emission label on the vehicle and prepare the engine for adjustments (set the timing). Remove the air cleaner and set the parking brake. Connect a tachometer to the distributor connector.
2. Place the transmission in *DRIVE* for automatic transmission, or *NEUTRAL* for manual transmission; make sure that the solenoid is energized.
3. Open the throttle slightly to allow the solenoid plunger to extend. Adjust the curb idle speed to the specified rpm by turning the solenoid screw.
4. De-energize the solenoid by disconnecting the electrical lead.
5. Set the basic idle speed rpm by turning the idle speed screw. After adjustment, reconnect the solenoid electrical lead.
6. Remove the tachometer and install the air cleaner.

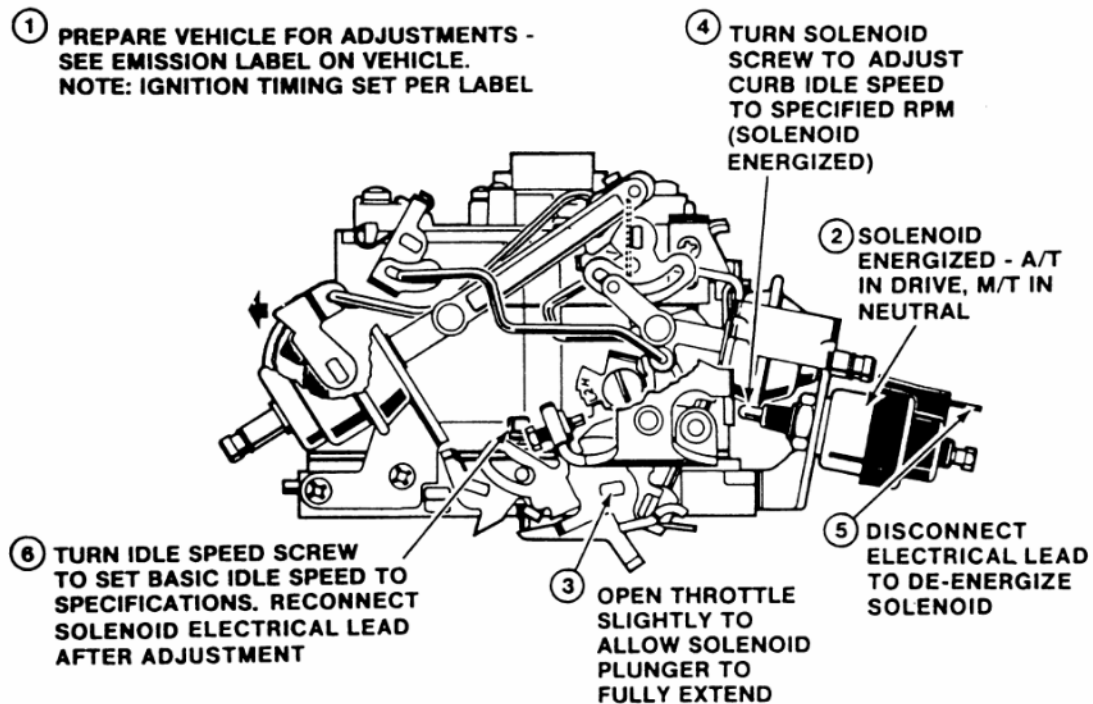


Fig. 1: Idle speed adjustments - 2-bbl carburetor (without air conditioning)

WITH AIR CONDITIONING

The engine must be running in "Closed Loop" mode (engine fully warmed) when making all idle speed adjustments. In this mode, the oxygen sensor affects control of the fuel delivery.

1. Refer to the emission label on the vehicle and prepare the engine for adjustments (set the timing). Remove the air cleaner and set the parking brake. Connect a tachometer to the distributor connector.
2. Place the transmission in *DRIVE* for automatic transmission, or *NEUTRAL* for manual transmission. Turn the air conditioning *OFF* and set the curb idle speed by turning the idle speed screw.
3. Disconnect the electrical lead at the A/C compressor, then turn the A/C switch *ON*.
4. With the solenoid energized, open the throttle slightly to allow the solenoid plunger to extend.
5. Turn the solenoid screw to adjust to the specified rpm. After adjustment, reconnect the A/C compressor lead and turn the air conditioning *OFF*.
6. Remove the tachometer and install the air cleaner.

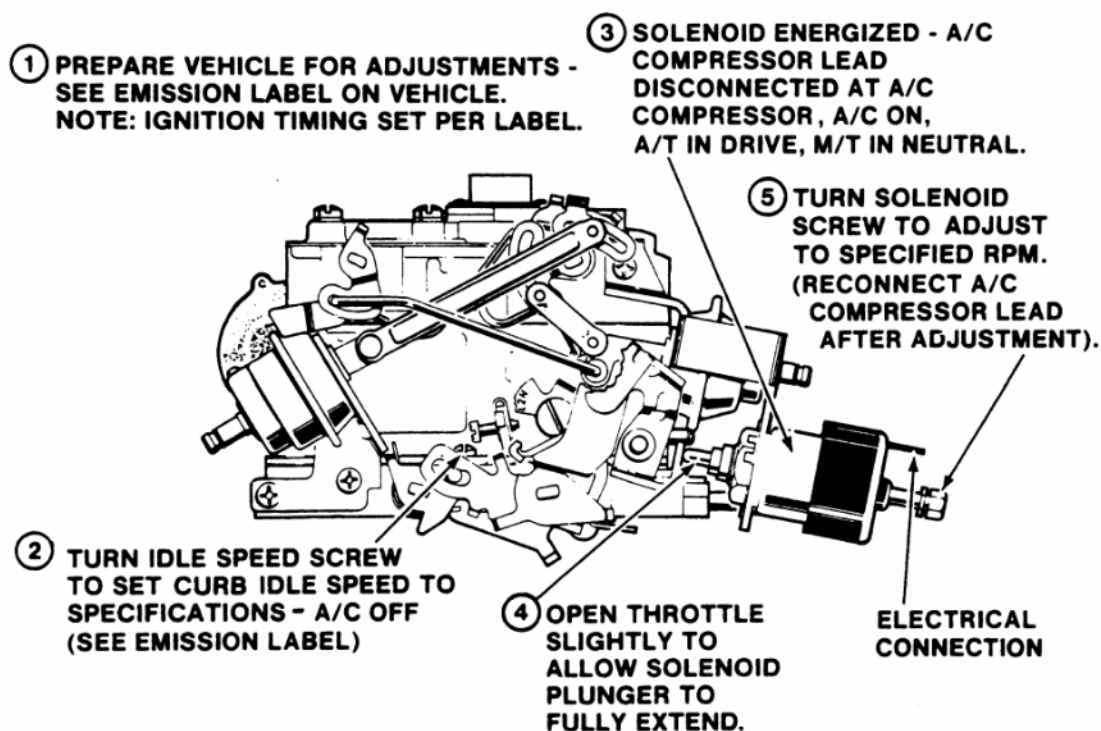


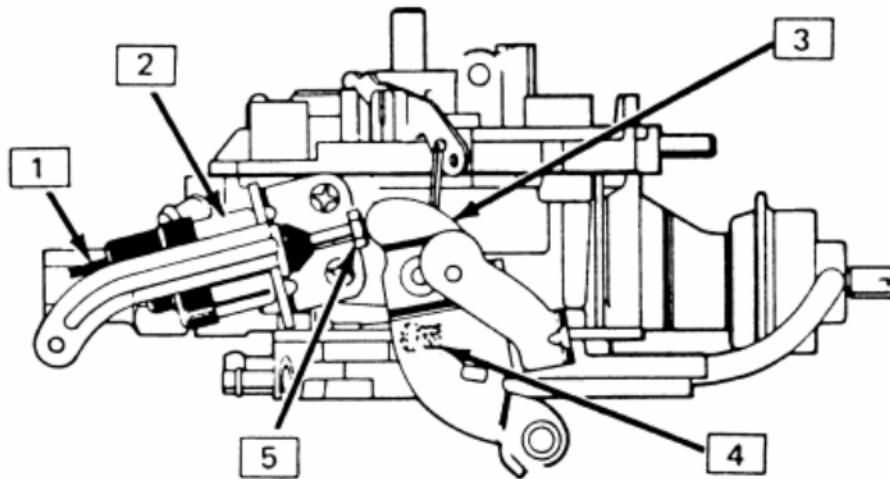
Fig. 2: Idle speed adjustments - 2-bbl carburetor (with air conditioning)

4-BBL CARBURETOR

WITHOUT AIR CONDITIONING

The engine must be running in "Closed Loop" mode (engine fully warmed) when making all idle speed adjustments. In this mode, the oxygen sensor affects control of the fuel delivery.

1. Refer to the emission label on the vehicle and prepare the engine for adjustments (set the timing). Set the parking brake. Connect a tachometer to the distributor connector.
2. Place the transmission in *DRIVE* for automatic transmission, or *NEUTRAL* for manual transmission.
3. De-energize the idle speed solenoid by disconnecting the electrical lead.
4. Set the basic idle speed rpm by turning the idle speed screw.
5. Connect a jumper wire from a 12-volt power supply to the solenoid.
6. Open the throttle partially to ensure that the solenoid plunger is fully extended, and allow the throttle lever to close on the plunger.
7. Turn the solenoid plunger to adjust to the specified rpm. After adjustment, disconnect the jumper wire and reconnect the solenoid electrical lead.
8. Remove the tachometer and install the air cleaner.



- 1** ELECTRICAL CONNECTOR
- 2** IDLE SPEED SOLENOID
- 3** THROTTLE LEVER
- 4** IDLE SPEED SCREW
- 5** PLUNGER

Fig. 3: Idle speed adjustments - 4-bbl carburetor

WITH AIR CONDITIONING

The engine must be running in "Closed Loop" mode (engine fully warmed) when making all idle speed adjustments. In this mode, the oxygen sensor affects control of the fuel delivery.

1. Refer to the emission label on the vehicle and prepare the engine for adjustments (set the timing). Set the parking brake. Connect a tachometer to the distributor connector.
2. Place the transmission in *DRIVE* for automatic transmission, or *NEUTRAL* for manual transmission. Turn the air conditioning *OFF*.
3. De-energize the idle speed solenoid by disconnecting the electrical lead.
4. Set the basic idle speed rpm by turning the idle speed screw. After adjustment, reconnect the solenoid electrical lead.
5. Disconnect the electrical lead from the A/C compressor and turn the A/C switch *ON*.
6. Open the throttle partially to ensure that the solenoid plunger is fully extended, and allow the throttle lever to close on the plunger.
7. Turn the solenoid plunger to adjust to the specified rpm. After adjustment, reconnect the A/C compressor lead and turn the air conditioning *OFF*.
8. Remove the tachometer and install the air cleaner.

SPECIFICATIONS CHARTS

GASOLINE ENGINE TUNE-UP SPECIFICATIONS

Year	Engine ID/VIN	Engine Displacement Liters (cc)	Spark Plugs Gap (in.)	Ignition Timing (deg.)		Fuel Pump (psi)	Idle Speed (rpm)		Valve Clearance	
				MT	AT		MT	AT	In.	Ex.
1982	2	2.5 (2475)	0.060	8B	8B	9-13	775	500	Hyd.	Hyd.
	1	2.8 (2835)	0.045	10B	10B	4-6.5	850	700	Hyd.	Hyd.
	7	5.0 (5011)	0.045	—	6B	9-13	—	500	Hyd.	Hyd.
	H	5.0 (5011)	0.045	6B	6B	4-6.5	750	575	Hyd.	Hyd.
1983	2	2.5 (2475)	0.060	8B	8B	9-13	775	500	Hyd.	Hyd.
	1	2.8 (2835)	0.045	10B	10B	4-6.5	850	700	Hyd.	Hyd.
	7	5.0 (5011)	0.045	—	6B	9-13	—	500	Hyd.	Hyd.
	H	5.0 (5011)	0.045	6B	6B	4-6.5	750	575	Hyd.	Hyd.
1984	2	2.5 (2475)	0.060	8B	8B	9-13	775	500	Hyd.	Hyd.
	1	2.8 (2835)	0.045	10B	10B	4-6.5	850	700	Hyd.	Hyd.
	H	5.0 (5011)	0.045	6B	6B	4-6.5	750	575	Hyd.	Hyd.
	G	5.0 (5011)	0.045	6B	6B	4-6.5	750	550	Hyd.	Hyd.
1985	2	2.5 (2475)	0.060	8B	8B	9-13	775	500	Hyd.	Hyd.
	S	2.8 (2835)	0.045	10B	10B	6-8	600	500	Hyd.	Hyd.
	G	5.0 (5011)	0.045	6B	6B	9-13	750	550	Hyd.	Hyd.
	H	5.0 (5011)	0.045	6B	6B	9-13	750	550	Hyd.	Hyd.
	F	5.0 (5011)	0.045	—	6B	9-13	—	500	Hyd.	Hyd.
1986	2	2.5 (2475)	0.060	8B	8B	9-13	775	500	Hyd.	Hyd.
	S	2.8 (2835)	0.045	10B	10B	40-47	600	500	Hyd.	Hyd.
	G	5.0 (4999)	0.045	6B	6B	9-13	750	550	Hyd.	Hyd.
	H	5.0 (4999)	0.045	6B	6B	9-13	750	550	Hyd.	Hyd.
	F	5.0 (4999)	0.045	—	6B	40-47	—	500	Hyd.	Hyd.
1987	S	2.8 (2835)	0.045	10B	10B	40-47	700	700	Hyd.	Hyd.
	H	5.0 (4999)	0.035	6B	6B	9-13	500	500	Hyd.	Hyd.
	F	5.0 (4999)	0.035	6B	6B	41-47	500	500	Hyd.	Hyd.
	8	5.7 (5737)	0.035	6B	6B	41-47	450	400	Hyd.	Hyd.
1988	S	2.8 (2835)	0.045	10B	10B	40-47	700	700	Hyd.	Hyd.
	F	5.0 (5011)	0.035	6B	6B	40-47	700	700	Hyd.	Hyd.
	E	5.0 (5011)	0.035	6B	6B	9-13	700	700	Hyd.	Hyd.
	8	5.7 (5733)	0.035	6B	6B	40-47	700	700	Hyd.	Hyd.
1989	S	2.8 (2835)	0.045	10B	10B	41-47	700	700	Hyd.	Hyd.
	7	3.8 (3786)	0.035	—	⊙	34-40	—	⊙	Hyd.	Hyd.
	F	5.0 (5011)	0.035	6B	6B	41-47	700	700	Hyd.	Hyd.
	E	5.0 (5011)	0.035	6B	6B	9-13	700	700	Hyd.	Hyd.
	8	5.7 (5733)	0.035	6B	6B	41-47	700	700	Hyd.	Hyd.
1990	T	3.1 (3136)	0.045	10B	10B	41-47	⊙	⊙	Hyd.	Hyd.
	F	5.0 (5011)	0.035	6B	6B	41-47	600	600	Hyd.	Hyd.
	E	5.0 (5011)	0.035	—	—	9-13	600	600	Hyd.	Hyd.
	8	5.7 (5733)	0.035	6B	6B	41-47	600	600	Hyd.	Hyd.

GASOLINE ENGINE TUNE-UP SPECIFICATIONS

Year	Engine ID/VIN	Engine Displacement Liters (cc)	Spark Plugs Gap (in.)	Ignition Timing (deg.)		Fuel Pump (psi)	Idle Speed (rpm)		Valve Clearance	
				MT	AT		MT	AT	In.	Ex.
1991	T	3.1 (3136)	0.045	10B	10B	41-47	675	675	Hyd.	Hyd.
	F	5.0 (5011)	0.035	—	—	41-47	600	600	Hyd.	Hyd.
	E	5.0 (5011)	0.035	6B	6B	9-13	600	600	Hyd.	Hyd.
	8	5.7 (5733)	0.035	6B	6B	41-47	600	600	Hyd.	Hyd.
1992	T	3.1 (3136)	0.045	10B	10B	9-13	675	675	Hyd.	Hyd.
	F	5.0 (5011)	0.035	—	—	41-47	600	600	Hyd.	Hyd.
	E	5.0 (5011)	0.035	6B	6B	9-13	600	600	Hyd.	Hyd.
	8	5.7 (5733)	0.035	6B	6B	41-47	600	600	Hyd.	Hyd.

NOTE: The Vehicle Emission Control Information label often reflects specification changes made during production. The label figures must be used if they differ from those in this chart.

B—Before Top Dead Center

Hyd.—Hydraulic

Troubleshooting Basic Starting System Problems

Problem	Cause	Solution
Starter motor rotates engine slowly	- Battery charge low or battery defective - Defective circuit between battery and starter motor - Low load current - High load current	- Charge or replace battery - Clean and tighten, or replace cables - Bench-test starter motor. Inspect for worn brushes and weak brush springs. - Bench-test starter motor. Check engine for friction, drag or coolant in cylinders. Check ring gear-to-pinion gear clearance.
Starter motor will not rotate engine	- Battery charge low or battery defective - Faulty solenoid - Damaged drive pinion gear or ring gear - Starter motor engagement weak - Starter motor rotates slowly with high load current - Engine seized	- Charge or replace battery - Check solenoid ground. Repair or replace as necessary. - Replace damaged gear(s) - Bench-test starter motor - Inspect drive yoke pull-down and point gap, check for worn end bushings, check ring gear clearance - Repair engine
Starter motor drive will not engage (solenoid known to be good)	- Defective contact point assembly - Inadequate contact point assembly ground - Defective hold-in coil	- Repair or replace contact point assembly - Repair connection at ground screw - Replace field winding assembly
Starter motor drive will not disengage	- Starter motor loose on flywheel housing - Worn drive end bushing - Damaged ring gear teeth - Drive yoke return spring broken or missing	- Tighten mounting bolts - Replace bushing - Replace ring gear or driveplate - Replace spring
Starter motor drive disengages prematurely	- Weak drive assembly thrust spring - Hold-in coil defective	- Replace drive mechanism - Replace field winding assembly
Low load current	- Worn brushes - Weak brush springs	- Replace brushes - Replace springs

Troubleshooting Basic Charging System Problems

Problem	Cause	Solution
Noisy alternator	• Loose mountings • Loose drive pulley • Worn bearings • Brush noise • Internal circuits shorted (High pitched whine)	• Tighten mounting bolts • Tighten pulley • Replace alternator • Replace alternator • Replace alternator
Squeal when starting engine or accelerating	• Glazed or loose belt	• Replace or adjust belt
Indicator light remains on or ammeter indicates discharge (engine running)	• Broken belt • Broken or disconnected wires • Internal alternator problems • Defective voltage regulator	• Install belt • Repair or connect wiring • Replace alternator • Replace voltage regulator/alternator
Car light bulbs continually burn out—battery needs water continually	• Alternator/regulator overcharging	• Replace voltage regulator/alternator
Car lights flare on acceleration	• Battery low • Internal alternator/regulator problems	• Charge or replace battery • Replace alternator/regulator
Low voltage output (alternator light flickers continually or ammeter needle wanders)	• Loose or worn belt • Dirty or corroded connections • Internal alternator/regulator problems	• Replace or adjust belt • Clean or replace connections • Replace alternator/regulator