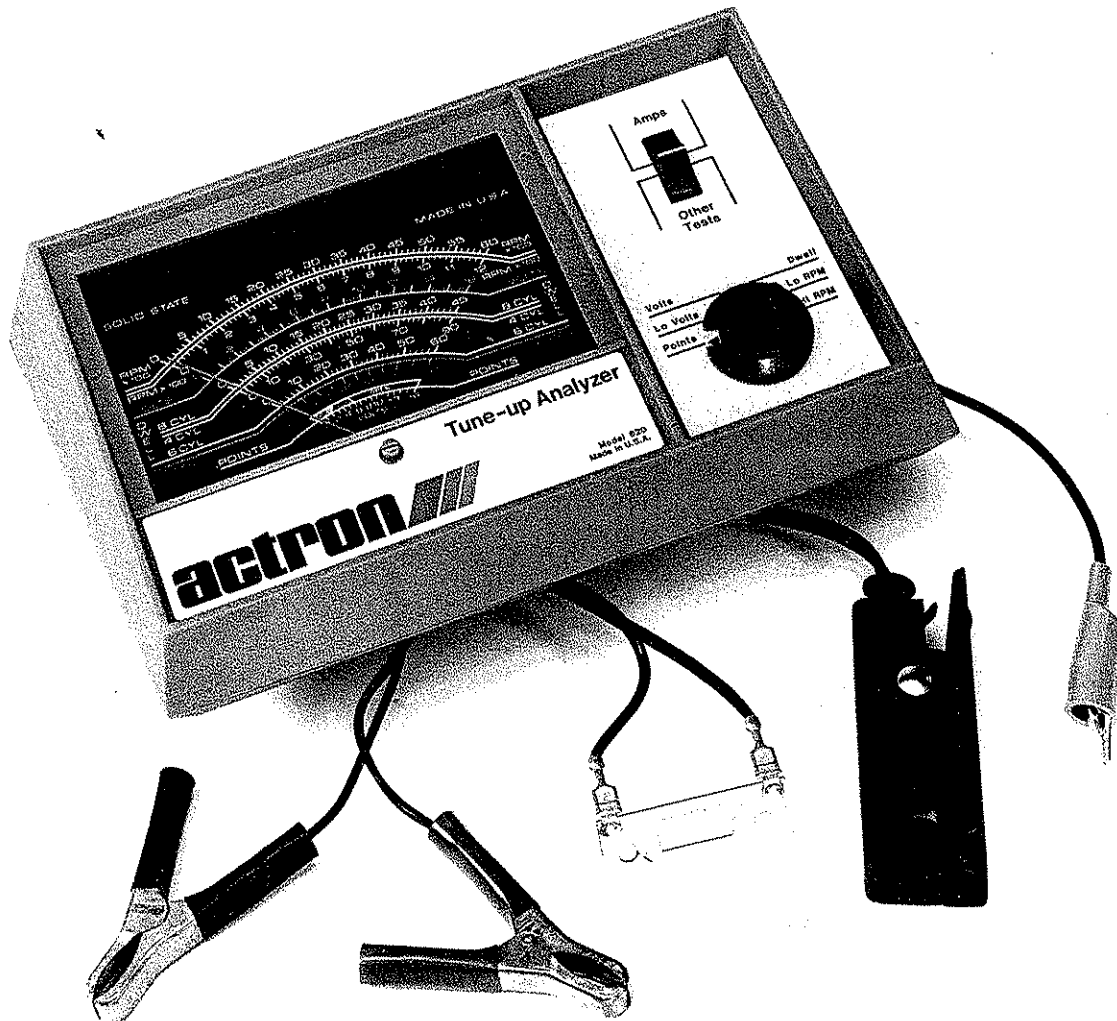


# actron



## INSTRUCTION MANUAL

# MODEL 620 TUNE-UP ANALYZER

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## IMPORTANT

The information in this manual will serve as a general guide for engine tune-up and charging system tests and adjustments.

CONSULT THE VEHICLE SERVICE MANUAL FOR SPECIFIC TUNE-UP INFORMATION AND TEST PROCEDURES. ALWAYS FOLLOW THE MANUFACTURER'S SPECIFICATIONS AND TEST PROCEDURES FOR ADJUSTING DWELL ANGLE, IDLE SPEED AND CHARGING SYSTEM OUTPUT, ESPECIALLY VEHICLES WITH MODERN ELECTRONIC IGNITION AND EMISSION CONTROLS. WE RECOMMEND THAT YOU DO NOT ATTEMPT TO SERVICE YOUR VEHICLE WITHOUT MANUFACTURER'S INSTRUCTIONS AVAILABLE FOR REFERENCE.

## SOURCES FOR SERVICE INFORMATION

The following is a list of publishers who have service manuals for your specific vehicle at nominal cost. Write to them for availability and prices, specifying the make, style, and model year of your vehicle

American Motors Corporation  
Distribution Services  
37200 Amrhein Road  
Livonia, Michigan 48150

Chrysler Corporation  
Dymet Distribution Service  
Service Publications  
20026 Progress Drive  
Strongsville, Ohio 44136

Ford Publication Department  
Helm Incorporated  
Post Office Box 07150  
Detroit, Michigan 48207

Buick  
Tuar Company  
Post Office Box 354  
Flint, Michigan 48501

Oldsmobile  
Lansing Lithographers  
Post Office Box 23188  
Lansing, Michigan 48909

Cadillac, Chevrolet, Pontiac  
Helm Incorporated  
Post Office Box 07130  
Detroit, Michigan 48207

### OTHER SOURCES — NONFACTORY

#### Domestic and Import Cars

Chilton Book Company  
Chilton Way  
Radnor, PA 19089

Cordura Publications  
Mitchell Manuals, Inc.  
Post Office Box 26260  
San Diego, CA 92126

Motor's Auto Repair Manual  
Hearst Company  
250 W. 55th Street  
New York, N.Y. 10019

## RULES FOR SAFE AUTOMOTIVE TESTING — READ CAREFULLY —

TO PREVENT ACCIDENTS THAT COULD RESULT IN SERIOUS INJURY AND/OR DAMAGE TO YOUR VEHICLE OR TEST EQUIPMENT, CAREFULLY FOLLOW THESE SAFETY RULES AND TEST PROCEDURES.

### SAFETY EQUIPMENT

#### Fire Extinguisher

Never work on your car without having a suitable fire extinguisher handy. A 5-lb. or larger CO<sub>2</sub> or dry chemical unit specified for gasoline/chemical/electrical fires is recommended.

#### Fireproof Container

Rags and flammable liquids should be stored only in fireproof, closed metal containers. A gasoline soaked rag should be allowed to dry thoroughly outdoors before being discarded.

#### Safety Goggles

We recommend wearing safety goggles when working on your car to protect your eyes from battery acid, gasoline and dust and dirt flying off moving engine parts.

**NOTE:** Never look directly into the carburetor throat while the engine is cranking or running as sudden backfire can cause burns.

#### LOOSE CLOTHING AND LONG HAIR (MOVING PARTS)

Be very careful not to get your hands, hair, or clothes near any moving parts such as fan blades, belts and pulleys or throttle and transmission linkages. Never wear neckties or loose clothing when working on your car.

#### JEWELRY

Never wear wrist watches, rings, or other jewelry when working on your car. You'll avoid the possibility of catching on moving parts or causing an electrical short circuit which could shock or burn you.

#### VENTILATION

The carbon monoxide in exhaust gas is highly toxic. To avoid asphyxiation, always operate vehicle in a well ventilated area. If vehicle is in an enclosed area, exhaust should be routed directly to the outside via leakproof exhaust hose.

#### SETTING THE BRAKE

Make sure that your car is in **park** or **neutral** and that the **parking brake is firmly set**.

**NOTE:** Some vehicles have an automatic release on the parking brake when the gear shift lever is removed from the **PARK** position. This feature must be disabled when it is necessary (for testing) to have the parking brake engaged when in the **DRIVE** position. Refer to your vehicle service manual for more information.

#### HOT SURFACES

Avoid contact with hot surfaces such as exhaust manifolds and pipes, mufflers (catalysts), the radiator and hoses. Never remove the radiator cap while the engine is hot as escaping coolant under pressure may seriously burn you.

#### SMOKING AND OPEN FLAMES

Never smoke while working on your car. Gasoline vapor is highly flammable, and the gas formed in a charging battery is explosive.

#### BATTERY

Do not lay tools or equipment on the battery. Accidentally grounding the "HOT" battery terminal can shock or burn you and damage wiring, the battery or your tools and testers.

Be careful of contact with battery acid. It can burn holes in your clothing and burn your skin or eyes.

When operating any test instrument from an auxiliary battery, connect a jumper wire between the negative terminal of the auxiliary battery and ground on the vehicle under test. When working in a garage or other enclosed area, auxiliary battery should be located at least 18 inches above the floor to minimize the possibility of igniting gasoline vapors.

#### HIGH VOLTAGE

High voltage—30,000-50,000 volts is present in the ignition coil, distributor cap, ignition wires, and spark plugs. When handling ignition wires while the engine is running, use insulated pliers to avoid a shock. While not lethal, a shock may cause you to jerk involuntarily and hurt yourself.

#### JACK

The jack supplied with the vehicle should be used only for changing wheels. Never crawl under car or run engine while vehicle is on a jack.

## GENERAL INSTRUCTIONS

### Connections For RPM, Dwell, Volts, Points, and AMPS Tests.

Connect the RED clip to the battery POSITIVE (+) terminal, then the BLACK clip to a secure ground connection on the engine, frame, or alternator bracket as shown in Figure 1. The BLACK clip should be the last connection made and the first to be disconnected. These two connections are necessary to measure VOLTS, DWELL, POINTS, HI RPM, and LO RPM.

Connect the INDUCTIVE PICK-UP clamp to spark plug wire number one (or any spark plug wire) to measure engine speed — HI RPM or LO RPM. The RED and BLACK clips must also be connected as shown in Figure 1.

Connect the GREEN clip to the distributor terminal on the ignition coil or TACH (tachometer) terminal on electronic ignition systems to measure DWELL or POINTS condition. The BLACK clip must also be connected as shown.

**NOTE:** The GREEN clip may also be used to measure voltage drops around the starting circuit as shown in Figure 35 or to measure other voltages up to 1.6 volts in the POINTS-LO VOLTS position.

Connect the AMPS CURRENT SHUNT to the alternator or generator as shown in Figure 37 to measure alternator or generator charging current.

#### CAUTION!

Avoid connecting directly to the Battery Negative Terminal in the event that hydrogen gases are present which could explode from sparking connections.

### TACHOMETER-ENGINE RPM MEASUREMENT PROCEDURE

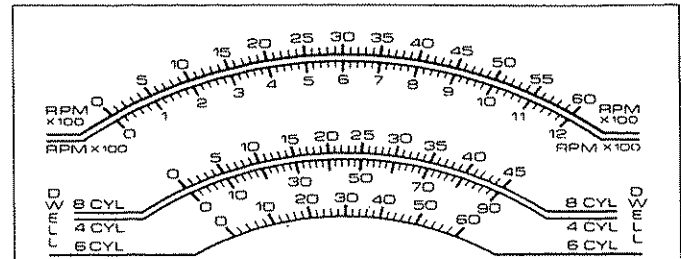
Connect the RED and BLACK leads of the TUNE-UP ANALYZER as shown in Figure 1. This supplies the power needed by the analyzer to operate.

Connect the INDUCTIVE PICK-UP clamp around one of the spark plug wires as shown in Figure 1. DO NOT CON-

NECT TO THE IGNITION COIL TOWER WIRE because erroneous engine speeds will be displayed on the analyzer.

Place the Slide Switch to the OTHER TESTS position.

Place the Function Selector Switch to the HI-RPM position.



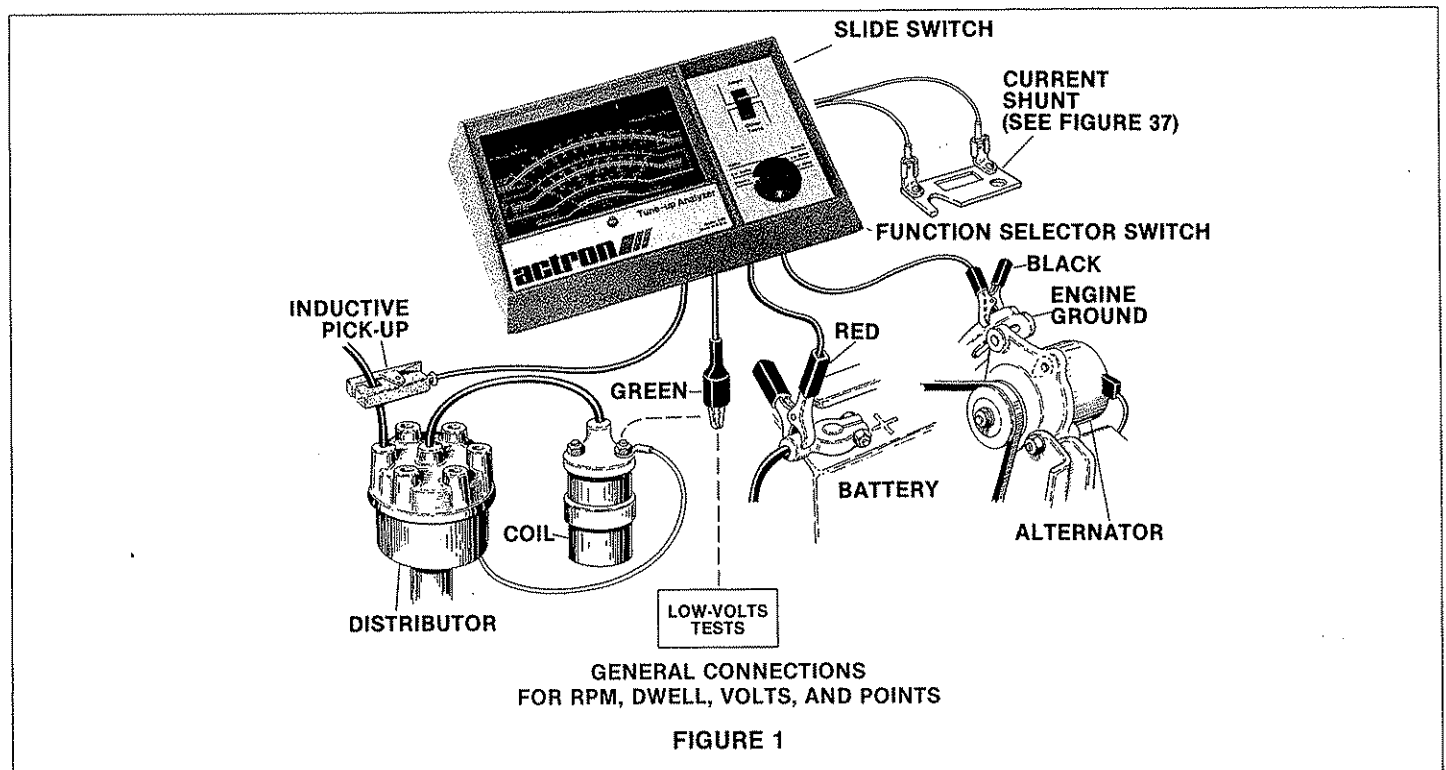
### RPM AND DWELL SCALES

FIGURE 2

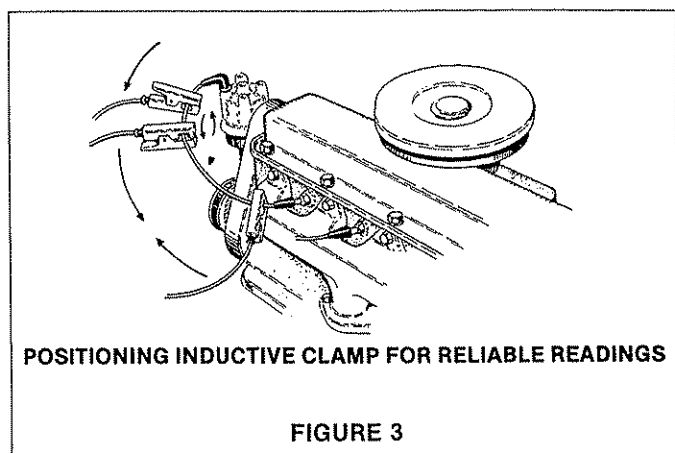
Start the engine and operate it at idle RPM. As illustrated in Figure 2, observe the upper RPM scale (0-60). Multiply the indicated number by 100 to obtain the actual engine speed in RPM. If the indicated speed is less than 1200 RPM, you may place the Function Selector Switch to the LO-RPM position. Then read the lower RPM scale (0-12) and multiply the indicated number by 100 to obtain the actual engine speed. It is good practice to always start with the highest range and switch down for better accuracy. This will prevent the meter pointer from bouncing off the end of the scale.

#### PRO-TIP

A defective ignition system may cause the tachometer to bounce around or show unsteady and intermittent readings. Low output spark voltage or defective ignition wires may be responsible. You may be able to steady the reading by sliding the INDUCTIVE CLAMP along the igni-



tion wire to a new location, or reversing the INDUCTIVE CLAMP on the wires as shown in Figure 3. If erratic read-



ings persist, move to another ignition wire in the event that the original one may be defective. Also, solid copper ignition wires radiate large amounts of radio frequency noise through the air which can interfere with the proper operation of the analyzer and other electronic equipment. Replace solid copper ignition wire with resistance wire if only for the tests described in this manual. See Figure 3.

## DWELL READINGS—GENERAL INSTRUCTIONS ELECTRONIC AND TRANSISTOR IGNITIONS

**NOTE:** This analyzer is not designed to be used on capacitive-discharge electronic ignition systems to measure DWELL. If so used, it may indicate incorrect dwell readings or may cause the engine to run roughly or stall. If you are in doubt as to the type of system you have, refer to your vehicle manual.

Due to the large number of different electronic ignition and computerized engine control systems being used on late model cars, it is essential that specific service information for the vehicle under test be obtained. Although dwell angle is not adjustable on electronic systems, the reading obtained is important and should be within the manufacturer's specified limits. If it is not, consult the vehicle manufacturer's service manuals for diagnostic procedures and possible component replacement instructions.

To measure the DWELL angle on electronic OR breaker point ignition systems, first set the Slide Switch to OTHER TESTS, and the FUNCTION SELECTOR Switch to HI RPM. Start the engine and operate it at the specified idle RPM. Set the FUNCTION SELECTOR Switch to LO RPM and verify that the idle RPM is in specification. If it is not, make the proper choke and idle speed adjustments on a fully-warmed engine.

Now, set the FUNCTION SELECTOR Switch to DWELL.

As illustrated in Figure 2, observe the Dwell Angle scale that corresponds to the number of cylinders of your engine; 4, 6, or 8.

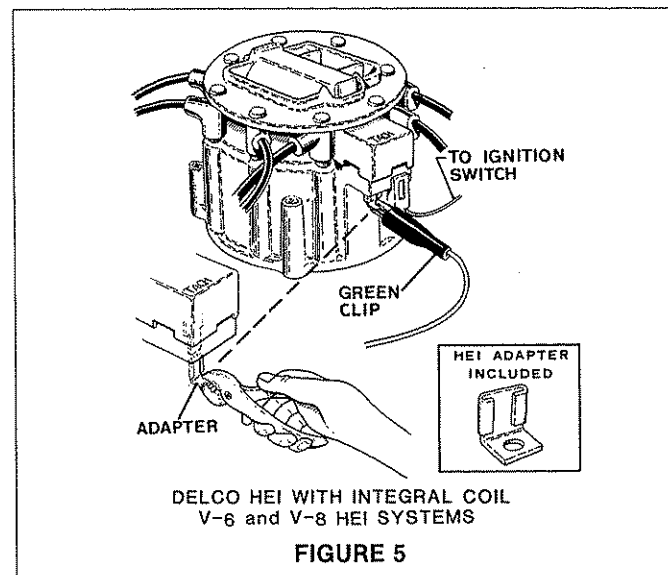
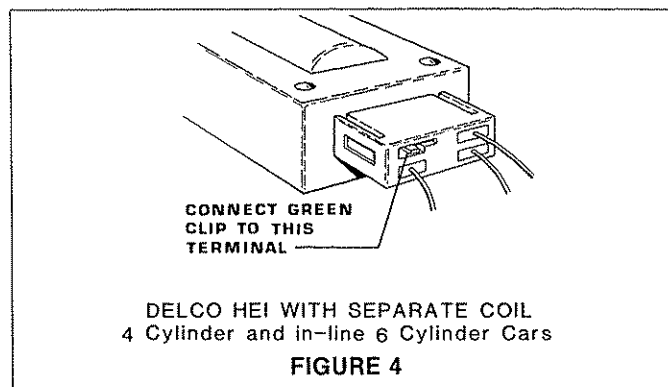
Compare the meter dwell angle reading with the manufacturer's specifications for the engine. If the reading is higher or lower than the recommended value, consult the owners manual, DIAGNOSTIC PROCEDURES, for your particular vehicle to correct the problem.

## DWELL CONNECTIONS TO GENERAL MOTORS DELCO HIGH ENERGY IGNITION SYSTEMS

On 4 cylinder and in-line 6 cylinder engines with a separate coil, connect the GREEN clip to the open TACH terminal as indicated in Figure 4. On the integral coil V-8 or V-6 HEI Systems, slide the adapter onto the TACH terminal as shown in Figure 5. Then connect the GREEN clip to the adapter.

The RED clip must be connected to the battery POSITIVE (+) terminal as shown in Figure 1.

The BLACK clip must be connected to a secure ground connection as shown in Figure 1.



## DWELL CONNECTIONS TO GENERAL MOTORS CARS WITH DIAGNOSTIC CONNECTOR AND DELCO HIGH ENERGY IGNITION SYSTEMS

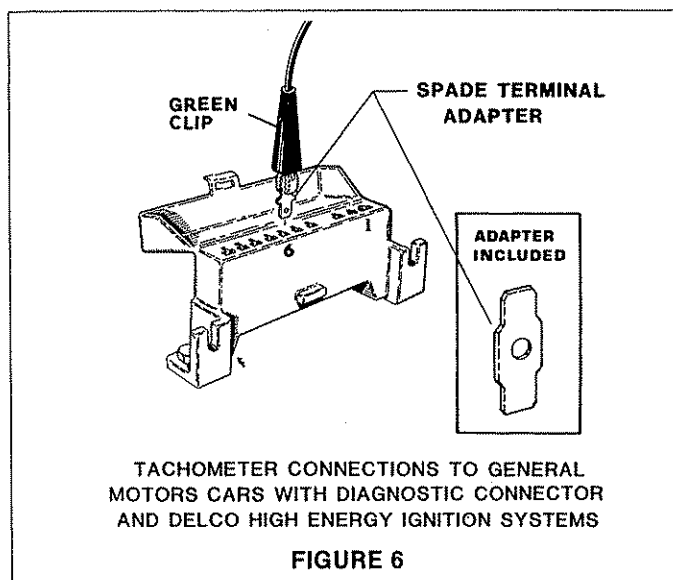
To make DWELL tests, locate the Engine Electrical Diagnostic Connector (usually near the left front fender). Open the cover and insert the adapter in socket number 6 as shown in Figure 6. Connect the GREEN clip to the spade terminal adapter.

The RED clip must be connected to the battery POSITIVE (+) terminal as shown in Figure 1.

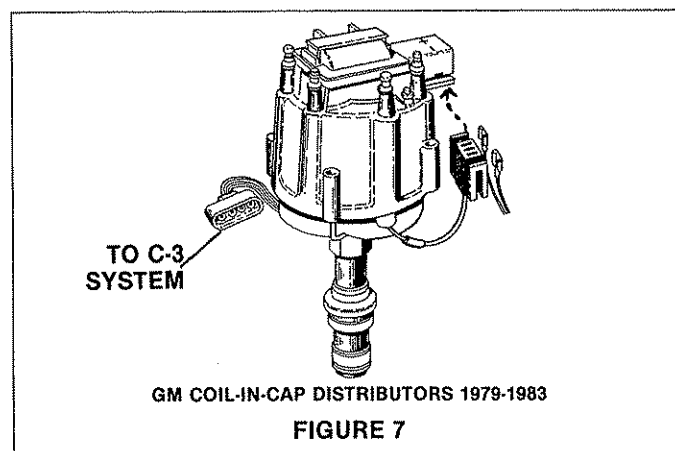
The BLACK clip must be connected to a secure ground connection as shown in Figure 1.

### 1979-1983 G.M. DISTRIBUTORS

Figures 7 and 8 illustrate two General Motors distributors used in 1979 to 1983 vehicles. The four terminal connector



plugs into the harness connected to the Computer Command Controller (C-3 system). Ignition timing is totally controlled by the C-3 system. There are no mechanical (centrifugal) or vacuum advance components used with these distributors.



Dwell and primary tachometer connections are the same as in previous years, but the following precautions must be observed:

#### CAUTION!

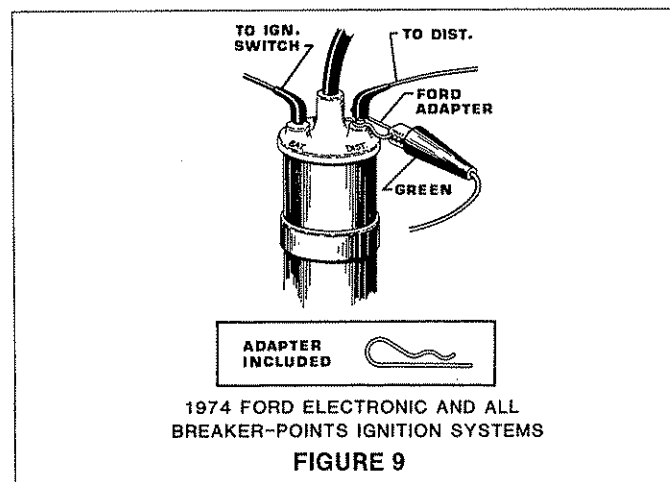
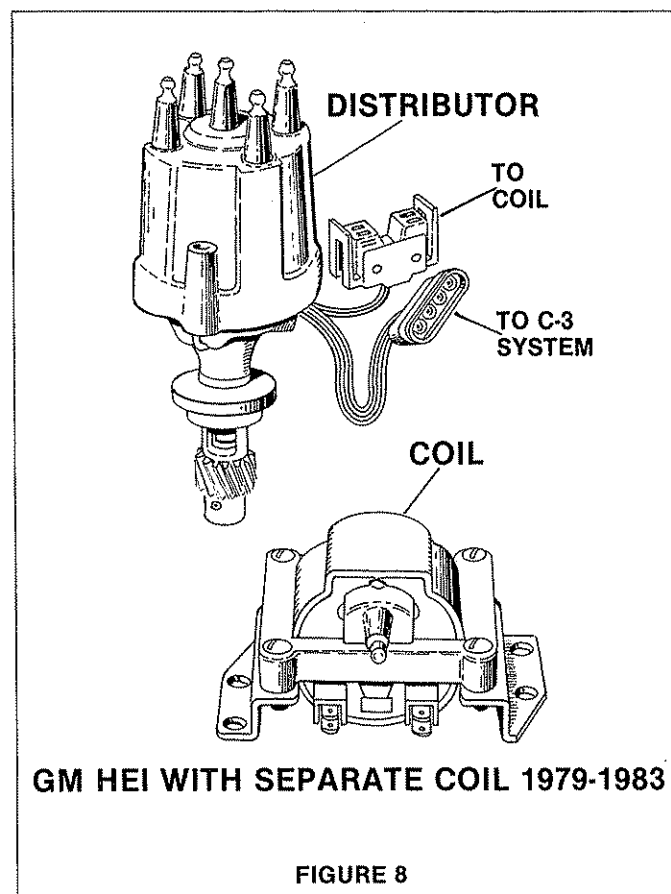
Some vehicles use a "tach filter". This is a small cylindrical capacitor connected between the engine harness and the distributor "tach" terminal (coil on the external coil system). If primary tach or dwell connections must be made to the vehicle and the diagnostic connector is not available, make certain that the connection is made to the **distributor side** of the "tach filter", **not the engine harness side**. Damage may result to C-3 system components if this procedure is not followed. Refer to the GM service manual for detailed diagnostic procedures and instructions.

### DWELL CONNECTIONS TO FORD ELECTRONIC IGNITION SYSTEMS AND FORD BREAKER POINT IGNITION SYSTEMS

#### FORD ELECTRONIC IGNITION SYSTEMS

On 1974 Ford Electronic ignition systems, connect as shown in Figure 9, using the Ford adapter as illustrated.

On 1975 and later Ford Electronic ignition systems, connect the GREEN clip to the wire terminal on the "DEC" or "TACH" side of the coil as shown in Figure 10.

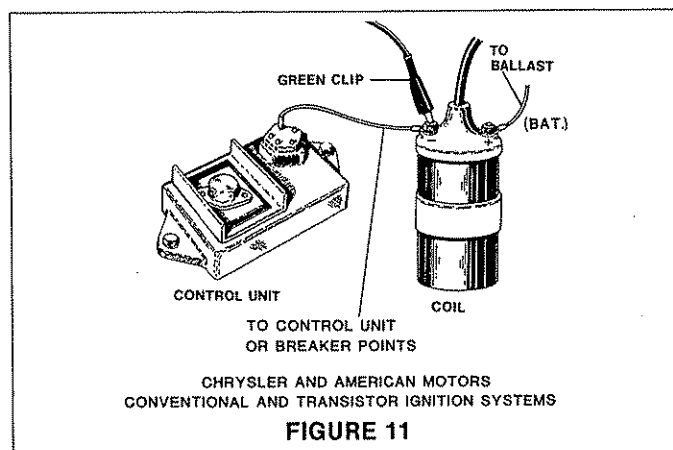
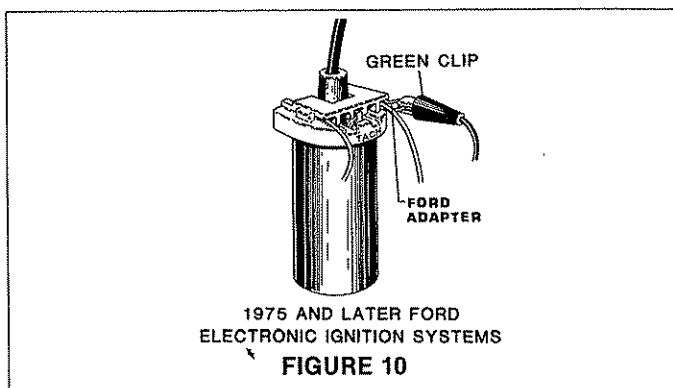


Connect the Red clip to the battery POSITIVE (+) terminal and the BLACK clip to a secure ground connection as shown in Figure 1.

#### FORD BREAKER-POINTS IGNITION SYSTEMS

Lift the distributor terminal and slide the FORD adapter clip in place as shown in Figure 9, then push the terminal down on it. Connect the GREEN Analyzer clip to the adapter. Remove when the tests are completed.

Connect the RED clip to the battery POSITIVE (+) Terminal, and the BLACK clip to a secure ground connection as shown in Figure 1.



### DWELL CONNECTIONS TO CHRYSLER AND AMERICAN MOTORS IGNITION SYSTEMS (BREAKER-POINT AND ELECTRONIC SYSTEMS)

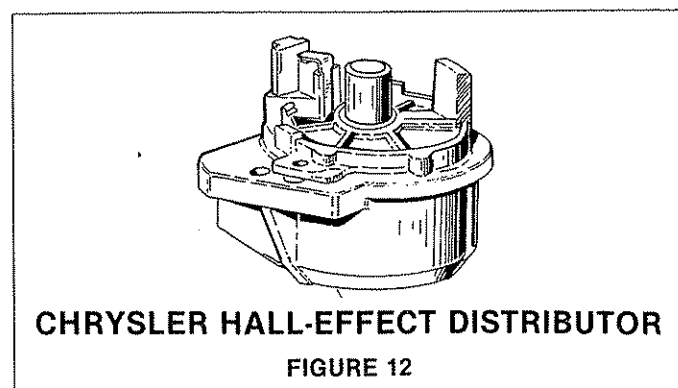
Connect the GREEN clip of the analyzer to the NEGATIVE (–) terminal of the ignition coil as shown in figure 11.

Connect the RED clip to the battery POSITIVE (+) terminal and the BLACK clip to a secure ground connection as shown in Figure 1.

### 1982 to 1984 CHRYSLER DISTRIBUTORS

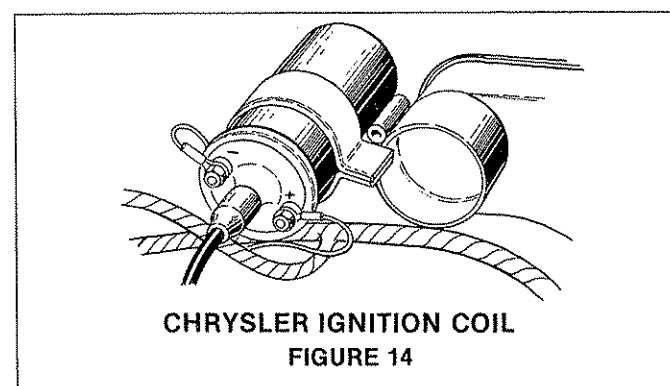
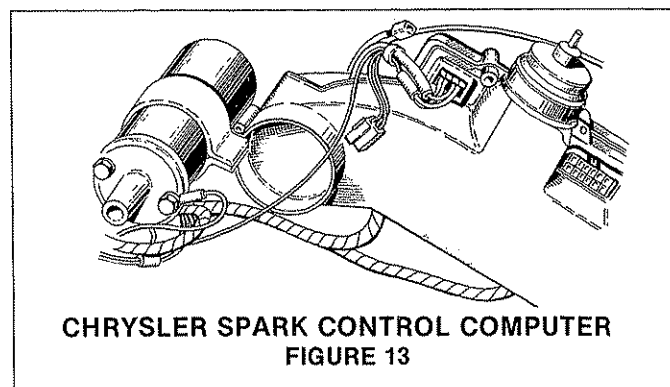
Figures 12, 13, and 14 illustrate ignition system components of the "Electronic Fuel Control System" as used on the Chrysler 1.7 and 2.2 liter 4-cylinder front wheel drive cars.

The 2.6 liter 4-cylinder engine has both centrifugal and vacuum advance mechanisms mounted to the distributor (not shown). It is an electronic ignition with a pickup coil and an "I.C." ignitor mounted in the distributor. The igni-



tion coil is externally mounted and is similar in appearance to other Chrysler coils.

The six and eight cylinder rear wheel drive Chrysler cars for 1982 to 1984 use reluctor-type ignition trigger units and look similar to earlier Chrysler models. The six and eight cylinder engine ignition coils look like figures 11 and 14 (but have a different mounting bracket since they are engine mounted). Fuel delivery and ignition timing are electronically controlled for both of these engines.



Connect the GREEN clip of the analyzer to the NEGATIVE (–) terminal of the ignition coil as shown in Figure 11.

Connect the RED clip to the battery POSITIVE (+) terminal and the BLACK clip to a secure ground connection as shown in Figure 1.

**CAUTION:** Some Chrysler products use a "positive-locking" terminal electrode spark plug wire. As shown by Figure 15, these plug wires can only be removed from inside the distributor cap. Damage may result to components if other means of removal are attempted.

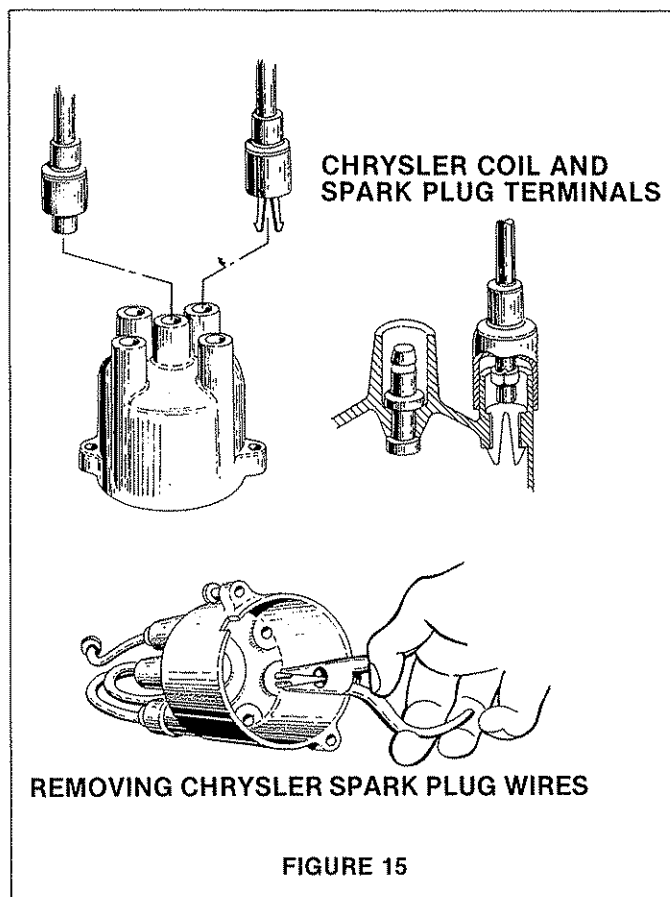
### BREAKER POINTS RESISTANCE TEST

(This procedure is not for electronic ignition systems).

During engine tune-ups or repair, this test should be done before adjusting the engine timing or DWELL.

**NOTE:** Remove the distributor cap and inspect the breaker points. Properly adjusted breaker points become light gray in color in normal use. If they are blued, blackened or pitted, they have exceeded their normal life, or excessive current has been present in the primary circuit. Check for excessively low coil resistance (shorted turns), and low ballast resistor value. Check for high battery voltage while the en-

gine is running. Correct any of the above problems and replace the breaker points if necessary. If the breaker points pass the visual inspection test, proceed to the next step.



1. Turn the engine OFF. The test leads must be connected as shown in Figure 1; GREEN clip to "DIST."
2. Set the Slide Switch to OTHER TESTS position.
3. Set the FUNCTION SELECTOR SWITCH to the POINTS position.
4. Replace the distributor cap and REMOVE THE HIGH TENSION LEAD FROM THE CENTER OF THE DISTRIBUTOR CAP AND GROUND IT BY CONNECTING THE LOOSE END TO THE ENGINE OR FRAME.

**NOTE:** When testing a vehicle with dual points, alternately block one set of points open with a piece of insulating material while the other set is being tested.

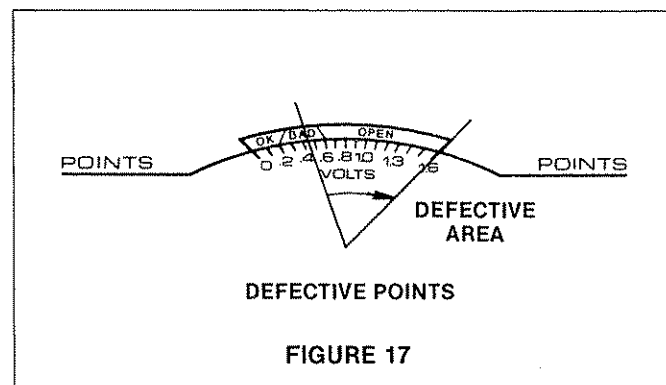
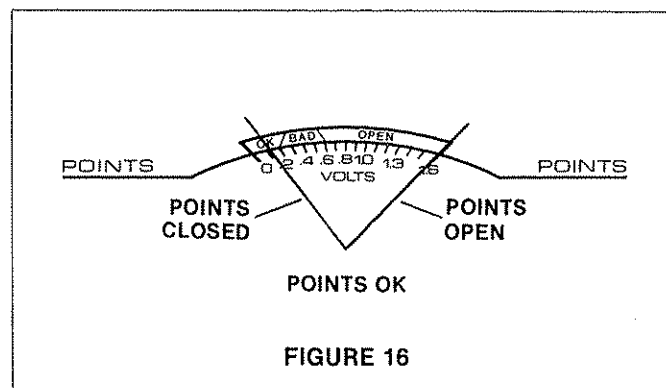
5. TURN THE IGNITION KEY ON. If the meter reads full scale (right), the points are OPEN as shown in Figure 16. Crank the engine a fraction of a revolution at a time until the meter reads in the left hand area of the scale, as shown in Figure 16. The points are now closed.

#### 6. TEST RESULTS

If the meter indicates in the BAD AREA when the points are closed, as shown in Figure 17, the points may be defective or the following faults may exist:

- Poor distributor ground.
- Poor connection on the primary lead from the distributor to the ignition coil.
- Defective distributor pigtail lead.
- Misaligned points.
- Poor points/plate ground inside distributor.

Correct the defect and repeat the test.

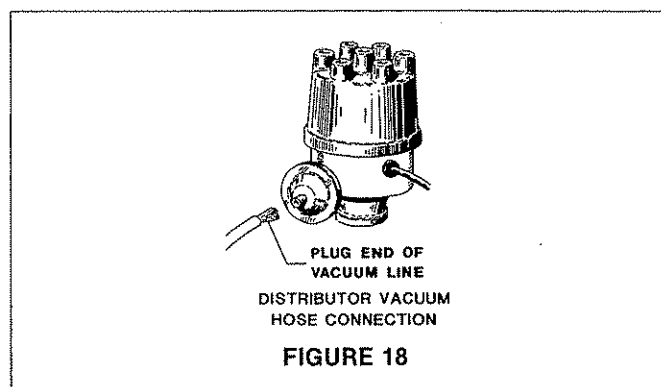


The points are satisfactory if the meter indicates in the OK area.

### BREAKER-POINTS-DWELL TEST AND ADJUSTMENT

**NOTE:** This test and adjustment procedure is performed on cars with conventional breaker-points ignition systems and transistorized ignition systems with breaker points such as some after-market units. This procedure is not to be used on vehicles equipped with various all-electronic ignition systems or capacitive-discharge systems.

Before performing the DWELL TEST and ADJUSTMENT procedure, read the vehicle's owner's manual or the engine compartment decal to determine what should be done with the vacuum hose connected to the distributor and the various advance/retard solenoids. Most often, the vacuum hose must be disconnected from the distributor as shown in Figure 18 and the end plugged with a plastic golf "tee" or other plug.

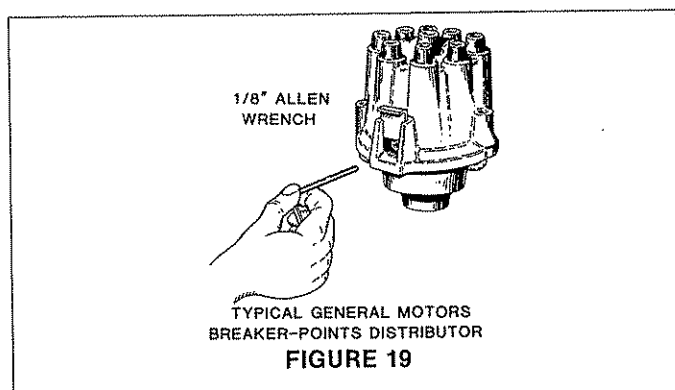




## DWELL MEASUREMENTS

Refer to Figure 2 for identification of the RPM and DWELL Scales. Set the Slide Switch to OTHER TESTS position and the FUNCTION SELECTOR Switch to HI RPM. Start the engine and operate it at the specified idle RPM. Set the FUNCTION SELECTOR Switch to LO-RPM. Verify that the idle RPM is within manufacturer's specifications. If it is not, make the proper choke and idle speed adjustments on a fully-warmed engine.

Set the FUNCTION SELECTOR Switch to DWELL. Read the appropriate meter scale according to the number of cylinders (CYL). Compare the meter dwell angle reading in degrees with the manufacturer's specification for the engine. If the dwell reading is higher or lower than the manufacturer's specification, adjust the distributor points as illustrated in Figures 19 and 20 and described in the following sections.



screw socket and adjust the dwell by turning the wrench, as shown in Figure 19.

On Ford, Chrysler, American Motors and other distributors not equipped with a small metal access slide cover, perform the following steps while referring to Figure 20.

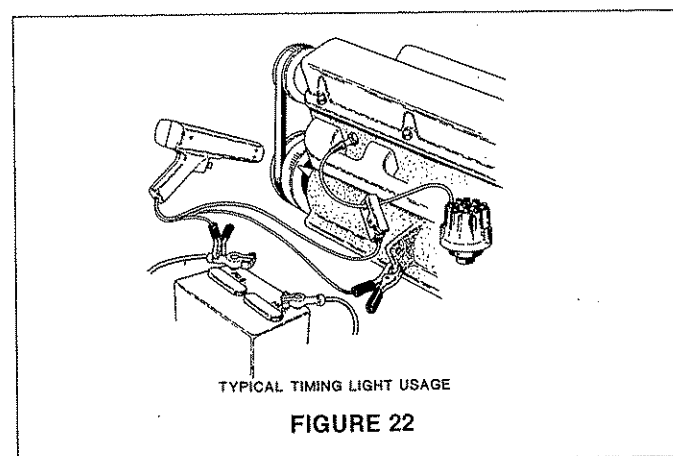
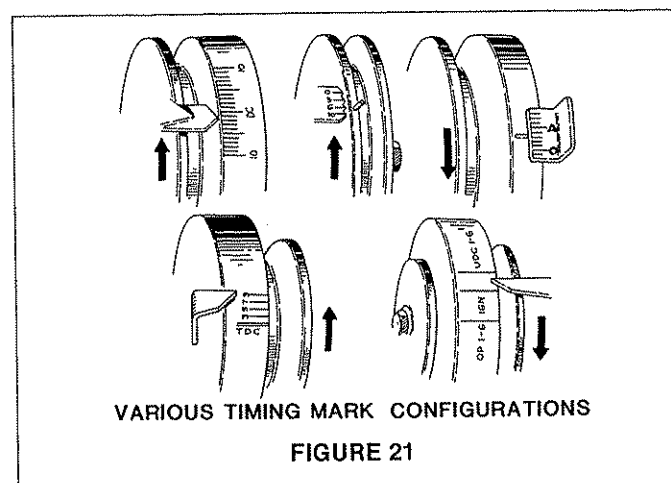
1. Remove coil wire from center tower of distributor cap and ground the wire by connecting the loose end to the engine or frame.
2. Remove the distributor cap and rotor.
3. Connect a remote starter switch to the vehicle or have an assistant crank the engine for you.
4. With ignition switch ON and engine cranking observe reading on the Dwell scale.
5. To adjust Dwell, loosen the locking screw slightly and adjust the point gap according to the procedure outlined in the vehicle's service manual. After adjustment, tighten locking screw, and recheck dwell while cranking engine. Repeat procedure if necessary. (Figure 20).
6. Reassemble distributor and recheck dwell reading with engine operating at idle speed. Repeat steps 5 and 6 if necessary.

## ENGINE TIMING

### GENERAL INSTRUCTIONS

The engine should be timed at each tune-up **after the dwell adjustment**, but before idle speed and mixture adjustments are made.

Check your owners manual for the location of the timing marks and the timing specifications. Refer to Figure 21. Then use a timing light to time the engine to specifications.



## DWELL ADJUSTMENT — CONVENTIONAL BREAKER POINT SYSTEM

On GM distributors with a small metal slide cover, lift the cover and insert a 1/8" Allen wrench in the adjusting

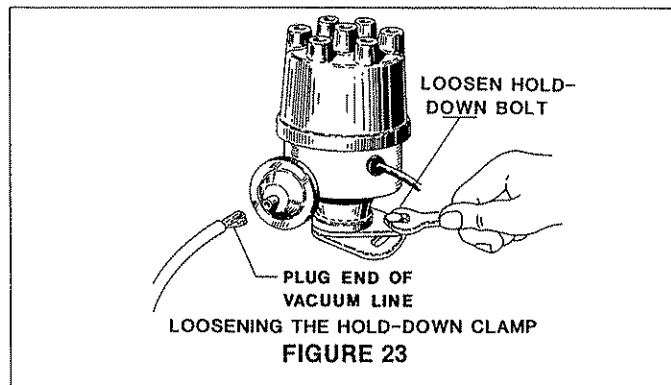
Connect the Timing Light to the battery and engine in accordance with the instructions supplied with the instrument or as shown in Figure 22.

Timing lights recommended are the Actron Die Cast Metal Chrome Plated Inductive Model L-204 and Plastic Inductive Model L-200—both accurate to 8000 RPM.

The Actron Model L-100, direct hook-up timing light, is accurate to 6000 RPM.

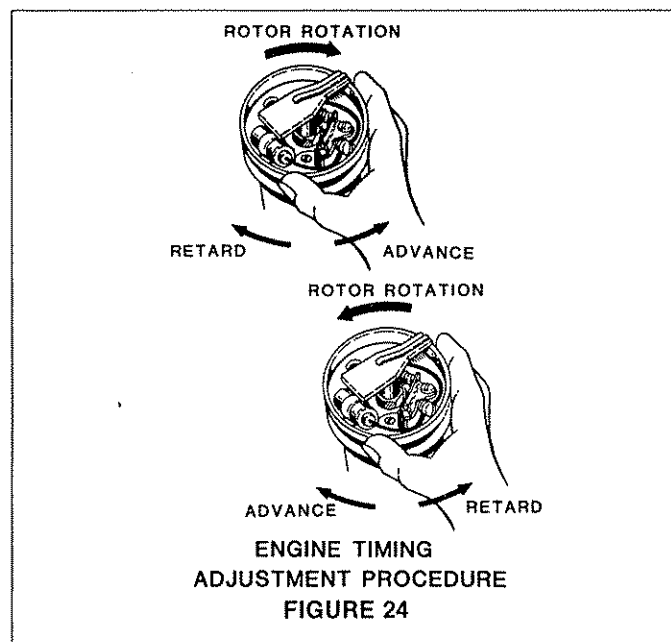
### PRELIMINARY

1. Check the distributor dwell angle and adjust to the manufacturer's specifications, if necessary, before timing the engine.
2. Clean the dirt from the timing marks and mark with chalk if difficult to see.
3. Disconnect the vacuum advance hose from the distributor and seal the end of the hose with tape or a plug as shown in Figure 23.



### PROCEDURE

1. Start the engine and allow it to warm up.
2. After the engine is warm, operate it at idling speed or the RPM specified in the vehicle manual.
3. Aim the timing light at the timing marks, press the switch to operate the timing light and observe the timing mark. The position of the timing mark must agree with the manufacturer's specification. If it does not, reset the timing as follows:



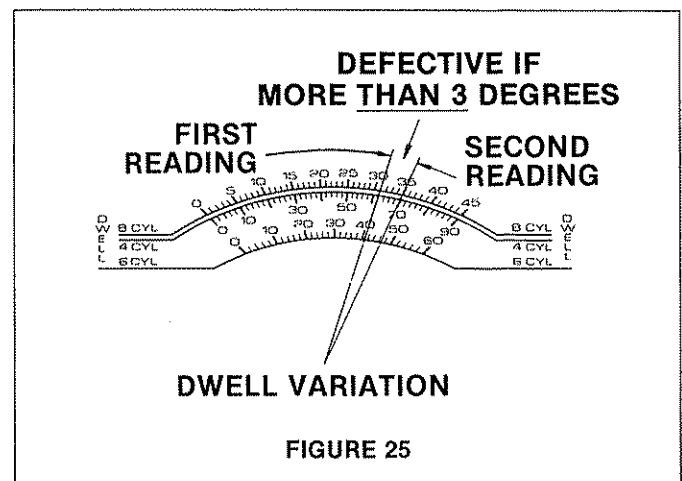
4. Loosen the distributor hold-down clamp JUST enough to permit rotating the distributor body by hand as shown in Figure 23.
5. Slowly turn the distributor in the correct direction as shown in Figure 24:
  - a. Against the rotor rotation to advance the timing.
  - b. With the rotor rotation to retard the timing.
6. Repeat Step 3.
7. When the specified mark is in line with the timing line, securely tighten the distributor hold-down clamp and recheck timing.
8. Check the idle RPM after the engine is timed and re-adjust to the manufacturer's specification if necessary.
9. Remove the plug from the vacuum hose and attach it to the distributor diaphragm connection.

### DWELL VARIATION TEST

Read the owner's manual or engine compartment decal and follow the instructions regarding vacuum line or advance-retard solenoid connections when checking DWELL angle. Usually, the vacuum hose must be disconnected from the distributor and plugged as shown in Figure 23.

Increase the engine speed from idle to about 1500 RPM and note the dwell angle. Return the engine speed to idle and again note the dwell angle.

If the difference between the two dwell angle readings is more than 3 degrees as shown in Figure 25, check for excessive wear in the breaker point plate and couplings or excessive wear in the distributor shaft gear and bushings.



### IDLE SPEED AND CARBURETOR ADJUSTMENT

1. The engine should be at normal operating temperature for this test. Many cars built in 1970 and later have idle mixing screw limiter caps that restrict adjustment. **On these cars the carburetor should be adjusted according to the procedure in the manufacturer's service manual.**
2. Shut the engine off and connect the test leads as shown in Figure 1 or for Electronic Ignition Systems and late model cars. Set the FUNCTION Selector Knob to the RPM position.
3. Consult the manufacturer's service manual for the location of the idle speed adjusting screw and the idle mixture adjusting screw (or screws). Make idle speed and mixture adjustments according to the procedure outlined in the service manual or as specified on the decal in the engine compartment.

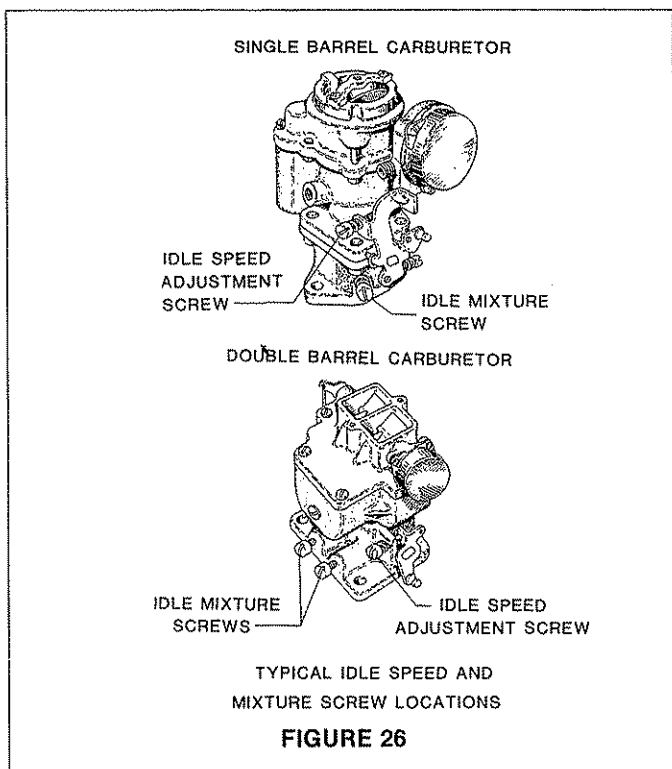
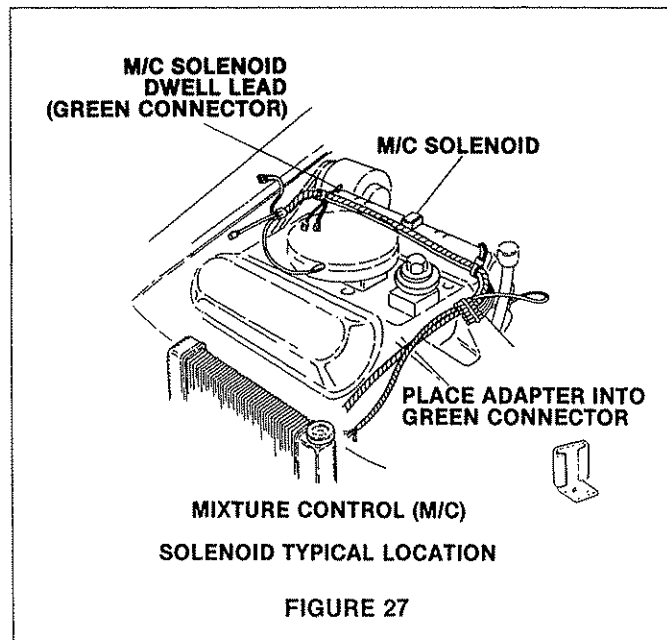


Figure 26 illustrates typical locations of the idle speed and idle mixture screws on single and multi-barrel carburetors.

4. Start the engine and turn the idle speed screw until specified idle speed is indicated.
5. On engines without exhaust emission control systems, turn the idle mixture screw in (lean) until the idle speed starts to decrease, then turn it back out (rich) just until the idle speed reaches a maximum. Further richening past this point will only waste fuel. This should be done slowly to allow engine speed to stabilize.
6. On multi-barrel carburetors, repeat this procedure on each idle mixture screw until the highest idle speed and smoothest operation is obtained. If the engine idle speed is now higher than the manufacturer's specification, turn the idle speed adjustment screw until the specified idle speed is indicated and readjust the mixture screws with the above procedure.
7. **NOTE:** On engines equipped with exhaust emission control systems, air injection pumps and positive crankcase ventilation, refer to the decal in the engine compartment or the owners manual for idle adjustment specifications.

### GENERAL MOTORS C-3 SYSTEM (Computer Command Control)

Introduced in 1978 on a limited number of California engines, the C-3 system is now standard equipment on most of the General Motors cars. The main function of the C-3 system is to maintain the carburetor air-fuel ratio at 14.7 to 1.0, the most efficient operating ratio. The electronic carburetor receives a dwell-type voltage signal from the Electronic Control Module (ECM) to maintain this air-fuel ratio under widely varying driving conditions. Your instrument can be used to check this voltage by reading the six-cylinder DWELL scale, 0-60°, and by performing the procedure in this section.



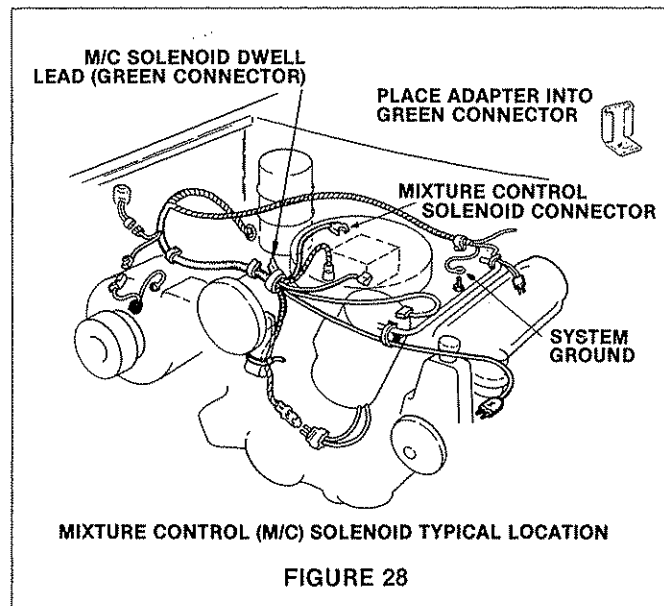
**IMPORTANT**—The C-3 System could be malfunctioning when any of the following conditions are noticed:

- A. The vehicle instrument panel "CHECK ENGINE" light illuminates.
- B. Poor engine performance which includes:
  1. Poor gas mileage
  2. Lack of response to throttle
  3. Hesitation, stalling, etc.

For complete C-3 system diagnostics, troubleshooting, and repair procedures we recommend that you obtain the specific service manual for your vehicle and engine combination.

### MODULATED CARBURETORS (M/C) SOLENOID CONNECTIONS

Refer to Figures 27 and 28 for location of components and connections.



These diagrams show the usual location of parts in a typical vehicle. When the actual vehicle or parts are different, see the service manual for additional help.

On G.M. cars equipped with the C-3 system, a small, green, single-contact DWELLMETER connector is normally provided to check the DWELL voltage to the carburetor (usually located under the hood near the right front fender wheel well, or near the carburetor, protruding from the wiring harness). DO NOT ALLOW LEADS TO TOUCH GROUND OR HOSES—THE HOSES MAY ALSO BE CONDUCTIVE.

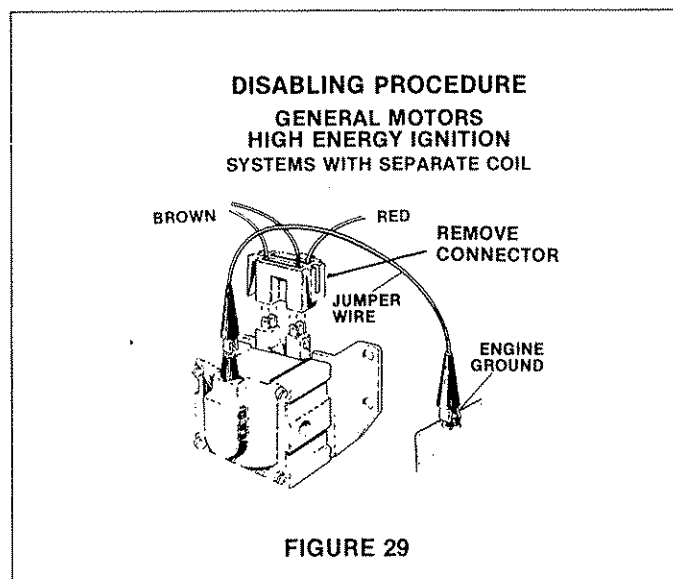
1. Use the adapter pin as shown in Figures 27 and 28. Connect the GREEN clip from your instrument to the adapter pin.
2. Connect the RED clip to the positive (+) battery terminal.
3. Connect the BLACK clip to a clean and secure ground such as the engine block.

## RESULTS:

TABLE I	
ENGINE CONDITION	DWELLMETER READINGS
1. Start Mode (cranking)	0°
2. Warm engine operation at idle or part-throttle with constant engine speed. See note below.	Constantly varying between 10° and 50° (higher engine speeds result in faster variations.)
3. Acceleration and deceleration (changing engine speed)	Constantly varying between 10° and 50° (DWELL variations may not be easily discernable on the DWELLMETER during rapid accelerations or decelerations but may be seen on slower changes in engine RPM)

**NOTE:** The input to the C-3 system which causes the constantly varying DWELL reading is an oxygen sensor mounted on the exhaust manifold working through the ECM. This sensor must typically be above 600° F to operate properly. Engine cooling, restart, or excessive idling could cause the sensor to go below 600° F in which case the DWELLMETER readings will be some FIXED value between 10° and 50°. This system may require three to four minutes to reach temperature after a restart or cooldown to resume the VARYING-DWELL operational mode. If the results of your testing don't agree with the table above, consult the vehicle service manual for further diagnostic procedures.

These diagrams show the usual location of parts in a typical vehicle. When the actual vehicle or parts are different, see the service manual for additional help.



4. Position the Switch Selector on your instrument to the DWELL position. All readings will be taken from the 6-cylinder DWELL scale (0-60°), regardless of the number of engine cylinders in the vehicle under test.

**NOTE:** The DWELLMETER should **not** cause a change in the engine operation when connected to the vehicles DWELLMETER connector. If there is reason to suspect that a change did occur, recheck your connections.

## PROCEDURE:

Read the dwellmeter under the engine conditions shown below. Table I is a typical C-3 System Performance Summary illustrating the DWELLMETER readings under the given engine conditions.

## VOLTS-PRELIMINARY CHECKS

The VOLTS switch position is used to test the cranking and charging volts in the vehicle.

CONSULT THE OPERATING MANUAL OF THE VEHICLE BEING TESTED FOR SPECIFIC VOLTAGE SPECIFICATIONS AND TEST PROCEDURES:

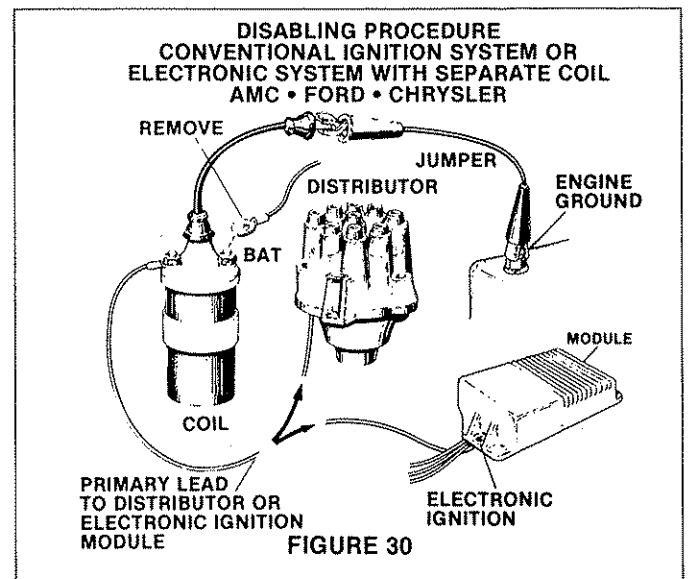
## SPECIFICATIONS:

The following information will serve as a general guide for making charging system tests.

Before making VOLTS tests:

Check the fan belt—it should be tensioned according to the manufacturer's specifications.

Check the generator or alternator pulley and mounting bolts. They should be tight.



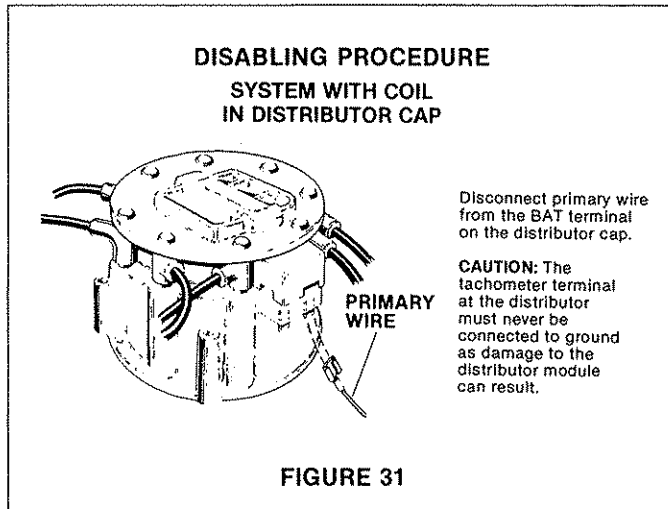
Make sure that the charging system wiring and the battery cables are in good condition and that connections are tight. Make sure the battery is clean and that the liquid level in each cell is above the plates.

The engine and all parts of the charging system should be at normal operating temperature before making any electrical tests. If the engine is cold, operate the engine at idle speed for at least 15 minutes before making any tests.

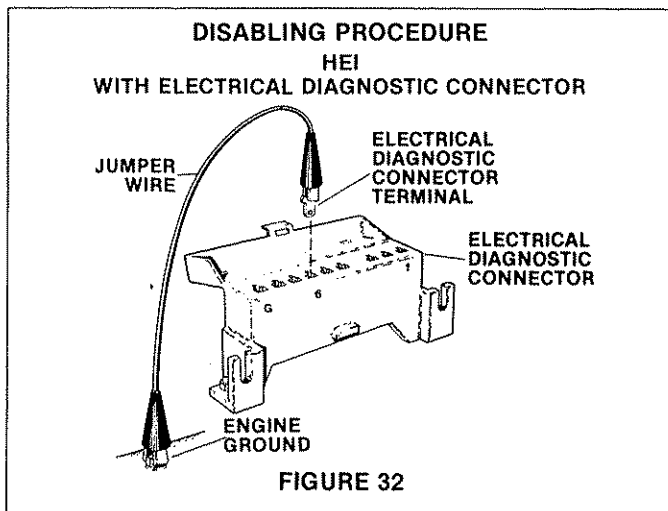
### CRANKING VOLTS TEST

1. To prevent the engine from starting while cranking on systems with a separate coil, remove the high tension lead from the center of the distributor cap and ground it by connecting the loose end to the engine or frame, as shown in Figures 29 and 30.

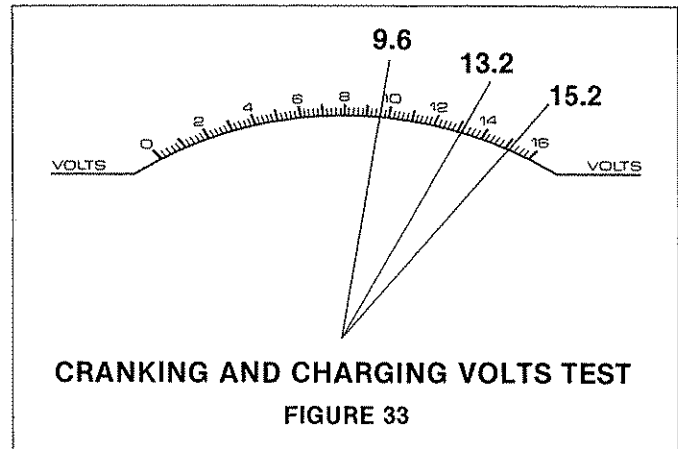
For systems with integral coil as shown in Figure 31, disconnect the primary wire from the "BAT" terminal on the distributor cap. **CAUTION:** The tachometer terminal at the distributor must never be connected to ground as damage to the distributor module can result.



For systems with an electrical diagnostic connector as shown in Figure 32, insert the GM diagnostic spade terminal No. 6 and connect a jumper wire between this terminal and a secure ground on the engine or frame. Do not connect the TACH terminal at the distributor to ground as damage to the distributor-ignition module can result.



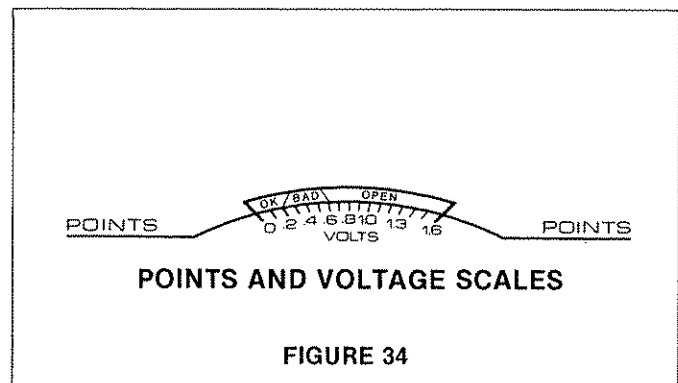
2. Connect the test leads as shown in Figure 1. Set the FUNCTION SELECTOR SWITCH to VOLTS and the slide switch to OTHER TESTS position. The RED clip must be connected to the battery POSITIVE(+) terminal and the BLACK clip to a secure ground connection as shown in Figure 1.
3. Operate the starter for 10 seconds and observe the cranking voltage on the 0-16 volts scale as shown in Figure 33. A steady reading of more than 9.6 volts indicates that the battery, cables and starter system are in good condition.

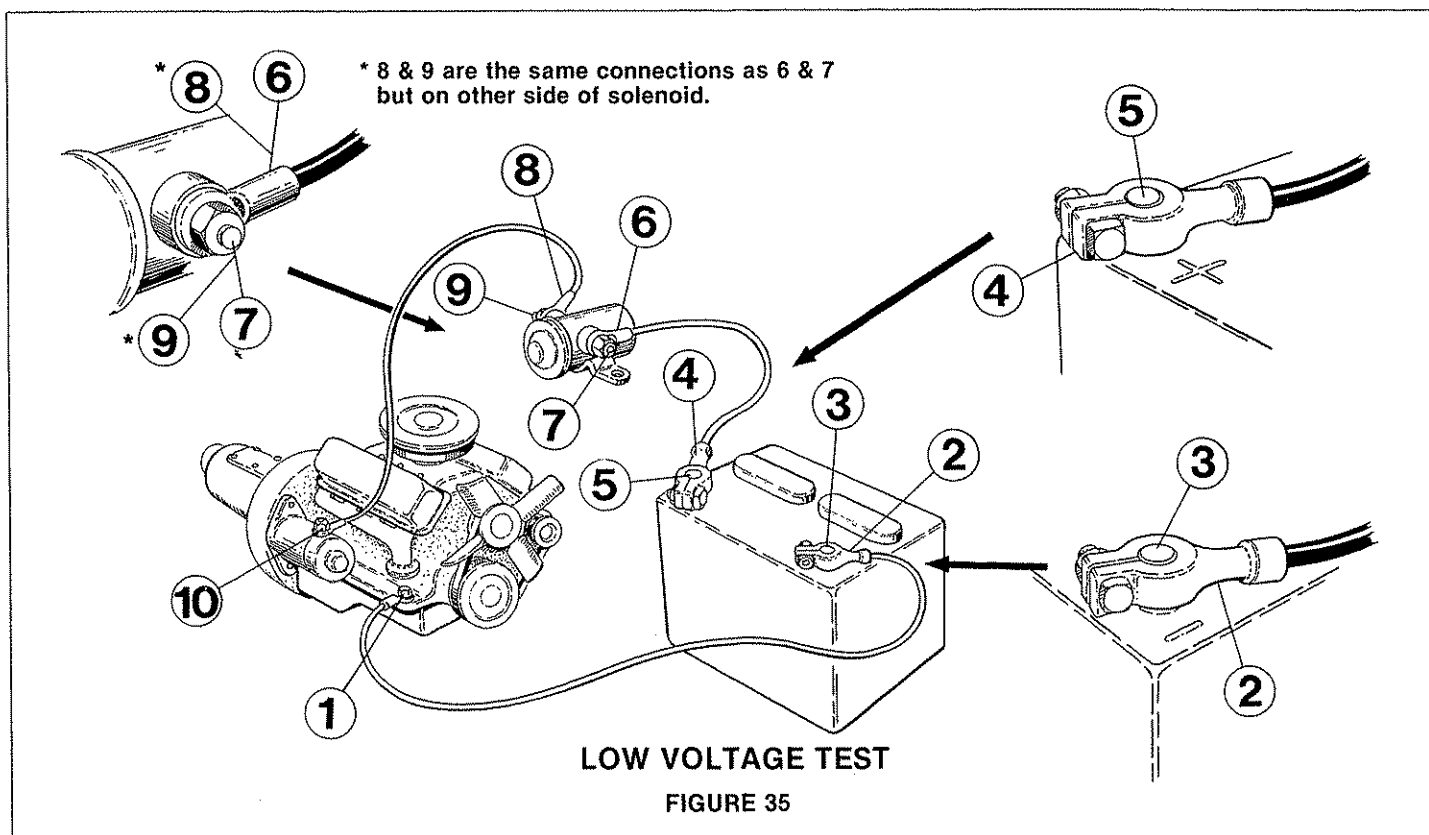


4. A reading below 9.6 volts could be caused by a battery that is defective or not fully charged. Fully charge the battery and repeat the test. If the reading is still below 9.6 volts, either the battery or starter is defective.
5. A fluctuating voltage reading is indicative of a defect in the starter or battery or in the battery-starter wiring circuit. Refer to Figure 35, LOW VOLTAGE TEST, for trouble shooting voltage drops in the battery-starter wiring circuit. Replace or repair any defective parts as required to restore cranking system to proper operation.
6. To restart the engine, replace the high tension lead to the center of the distributor cap, replace the wire to the "BAT" terminal of the integral coil distributor and remove the jumper wire from terminal 6 of the diagnostic connector.

### CHARGING SYSTEM VOLTS TEST

1. Connect the test leads as shown in Figure 1. Set the FUNCTION SELECTOR switch to the VOLTS position and the Slide Switch to OTHER TESTS position. The RED clip must be connected to the battery POSITIVE(+) terminal and the BLACK clip to a secure ground connection as shown in Figure 1.





2. Start the engine. Allow it to run for at least 5 minutes at 1500 to 2000 RPM. Observe the reading on the 0-16 volt scale as shown in Figure 33. The reading should gradually rise from about 12.5 volts (before starting) to 13.2 volts to 15.2 volts at the end of the 5 minutes, with or without the headlights and blower motor on.

Readings lower than 13.2 indicate either a worn out battery, defective generator or alternator or defective or improperly adjusted voltage regulator.

Readings above 15.2 are indicative of a defective or improperly adjusted voltage regulator.

Replace, repair or adjust the defective part as required.

## LOW VOLTAGE TEST

The POINTS scale is also a 0-1.6 volt range as shown in Figure 34. This scale is useful for checking voltage drops in the vehicle's electrical system.

Set the FUNCTION SELECTOR SWITCH to the LO VOLTS position, and the Slide Switch to OTHER TESTS position. Use the GREEN and BLACK clips for these tests.

Corroded or loose connections and frayed or broken cables can cause hard starting. To test for these conditions, disable the ignition system to prevent starting as described on pages 10 and 11. Refer to Figure 35 and connect one clip at point 1 and the other at point 2. Set the Ignition Switch to the START position for 15 seconds or less while observing the LO VOLTS scale with engine cranking. Allow the Starter Motor to cool for about 30 seconds. Then repeat the above procedure alternately connecting the clips at points 2 and 3, 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9, and 9 and 10. During this test, no reading should be higher than 0.2 Volts. If a reading greater than 0.2 Volts is observed during any of these

tests, check the cable or connections or solenoid involved, clean and tighten the connections, and replace the cables or solenoid when necessary.

If the meter reads to the left of zero during any of the above tests, reverse the position of the GREEN and BLACK clips.

## AMPS TEST — ALTERNATOR OUTPUT

**NOTE:** The following procedure applies to generators as well as alternators.

The alternator output should be checked if the voltage reading was below 13.2 Volts in the CHARGING SYSTEM VOLTS TEST, or if the battery requires frequent charging with a portable charger.

### CAUTION!

To avoid damage to the charging system, observe the following precautions:

- Do not reverse connection to the alternator.
- Do not short across or ground any of the terminals in the charging circuit except as directed by the vehicle manufacturer's instructions.
- NEVER operate the alternator with the output terminal disconnected.
- When connecting a charger or booster battery to the car battery, see the vehicle manufactures Battery Charging Section of the manual.

Trouble in the charging system will show up as one or more of the following conditions:

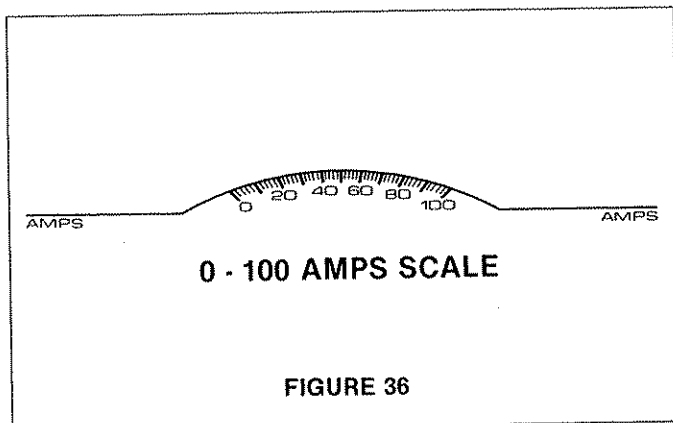
- A. Faulty indicator lamp or voltmeter operation on the vehicle instrument panel.
- B. An undercharged battery as evidenced by slow cranking or low hydrometer reading (dark dot on top of sealed battery with visual hydrometer).
- C. An overcharged battery as evidenced by excessive spewing of electrolyte from the vent, hot battery, or bubbling electrolyte, sometimes accompanied by a foul, pungent odor when excessively overcharged.

## PRELIMINARY CHECKS

1. Inspect the alternator drive belt for wear and proper tension. Replace cracked and glazed belts.
2. The undercharged battery condition can be caused by accessories left on for extended times with the engine off. Make certain all accessories are off.
3. Check the firewall connectors and the battery connections for tightness and cleanliness at the battery, starter motor, engine ground and alternator.
4. Set the TUNE-UP ANALYZER Slide Switch to the OTHER TESTS position. Set the FUNCTION SELECTOR switch to the VOLTS position. With the ignition switch either ON or OFF, and all wiring harness leads connected, connect the RED clip of the Analyzer to the BAT + (battery) terminal of the alternator and the BLACK clip to engine ground. A zero reading indicates an open wire between the battery and the alternator. Repair as necessary.

If steps 1 through 4 check OK, test the Alternator as follows:

5. Set the Slide Switch on the TUNE-UP ANALYZER to the AMPS position. Set the FUNCTION SELECTOR Switch to the VOLTS position. When making measurements, observe the test reading on the 0 to 100 AMPS scale as shown in Figure 36. If the meter reads backwards during this test, reverse the leads on the shunt as shown in Figure 37.

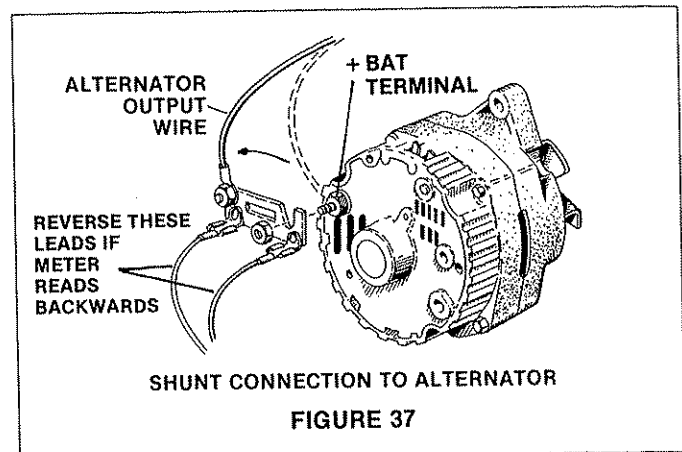


**FIGURE 36**

6. Consult your vehicle manual for the correct method of disconnecting the regulator in order to check the alternator's full output. When the regulator is disconnected, the circuit must be bypassed in order to observe the alternator output. (See vehicle manual). The large number of different systems available on modern vehicles does not allow all of them to be described in a manual of this type. Please consult the specific service manual for your automobile for this procedure.

## CONNECTIONS

7. Remove the NEGATIVE (-) battery cable from the battery terminal. This will eliminate the danger of shorting the battery with the tool used to perform Step 8.
8. Consult the service manual for the vehicle being tested for the location of the alternator output terminal, (BAT +) and remove the proper cable from the output terminal as discussed in the service manual. Connect the SHUNT between this cable and the output terminal as shown in Figure 37. Make certain these connections are tight. The slotted side of the SHUNT should be connected to the output (BAT +) terminal of the alternator. Reconnect the Negative (-) cable to the battery that was removed in Step 7.



## TEST PROCEDURE

9. At this point, follow the manufacturer's instructions for testing the alternator output. In most cases, the instructions will require that the engine be operated at 2000 RPM with all lights, radio, and other accessories operating (and in some cases, with an external carbon pile load connected to the battery) to obtain maximum current output from the alternator.

## TEST RESULTS

10. If the ampere output is within 10 amps of the rated output stamped on the alternator frame or within 10 amps of the value specified in the manual under given test conditions, the alternator is not defective. Recheck steps 1 through 4.
11. If the ampere output is not within 10 amps of rated output, perform the "Full Fielding Test" (forced full alternator output test) as described in your vehicle service manual.
12. If the ampere output is within 10 amps of the specified output after performing Step 11, test the field winding of the alternator and the voltage regulator with approved testers, as described in your service manual.
13. If the ampere output is not within 10 amps of the specified output, check the field winding, diodes, rectifiers, and stator as described in your vehicle service manual.
14. Disconnect the battery NEGATIVE cable before removing the SHUNT. Reconnect the alternator output to the alternator output terminal (BAT +). Reconnect the battery NEGATIVE cable.

## FREQUENTLY USED TUNE-UP INFORMATION

VEHICLE	IDLE RPM	DWELL ANGLE	TIMING	TUNE-UP KIT #	SPARK PLUG TYPE	SPARK PLUG GAP SETTING

## OTHER APPLICATIONS

- **Foreign Cars** — Due to the large number of different ignition systems found on import cars, it is not possible to cover all applications in a manual of this type. We recommend consulting a service manual for your particular vehicle and follow the procedures outlined by the vehicle manufacturers.

- **Mazda Rotary Engine**

The Mazda has two separate sets of breaker points and two ignition coils. Each set of points must be adjusted individually for dwell angle, normally 55° to 57°. (Consult your vehicle service manual for exact specifications.)

Readings for both Tach and Dwell are the same as for a 4 cylinder engine. When using the Model 620 TUNE-UP ANALYZER, multiply the TACHOMETER Scales by 100 to obtain the actual engine speed in RPM. To measure DWELL angle, read the 4 cylinder DWELL angle scale directly.

## REPLACEMENT PARTS

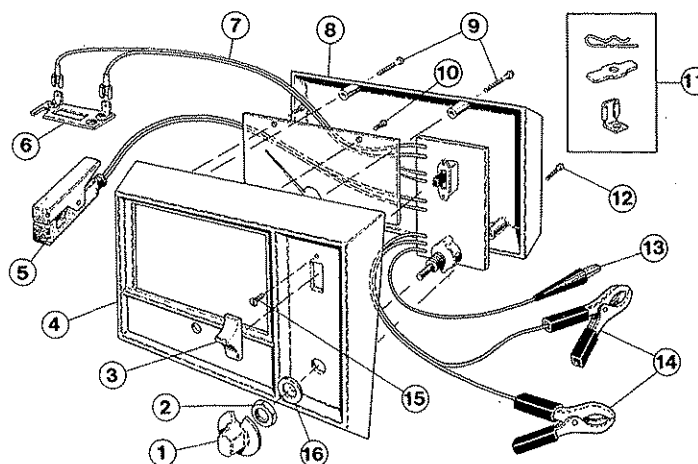


FIGURE 38

KEY NUMBER	PART NUMBER	DESCRIPTION
1	450-129	KNOB, FUNCTION SELECTOR SWITCH
2	290-102	HEX NUT, 3/8-32 x 1/2
3	450-133	CAP, GLAMOUR
4	400-983	TOP, CASE
5	38-797	INDUCTIVE CLAMP ASSEMBLY
6	1000-252	CURRENT SHUNT ASSEMBLY
7	38-728	CABLE ASSEMBLY, CURRENT SHUNT
8	400-985	BOTTOM, CASE
9	270-119	SCREWS, PAN HEAD, 6-20 x 1-3/8 (2)
10	270-120	SCREWS, PAN HEAD, 6-20 x 3/8 (4)
11	1000-425	ADAPTOR KIT
12	270-118	SCREWS, PAN HEAD, 6-20 x 7/8 (2)
13	38-729	COIL CABLE
14	38-727	BATTERY CABLE
15	260-182	SCREW, FLAT HEAD, 6-32 x 1/4 (1)
16	210-105	WASHER, FLAT, 3/8 ID x 5/8 OD (1)
*	2-174501	INSTRUCTION MANUAL (Not Illustrated)