

7. Turn the ignition key OFF.
 8. Push the DIGITAL POWER Switch (9) OFF if testing is complete.
 9. Re-enable the ignition system by reversing the "Disabling Procedure."
- D. Test Results:
1. Normal
 - A. Cranking Engine voltage from Step 4 should approximately equal the voltage from Step 1 (within about 1 volt).
 - b. Key ON (RUN) position

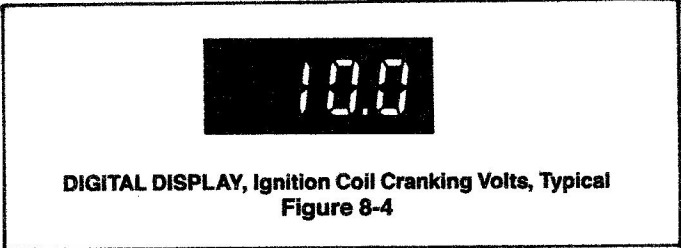
NOTE

The normal voltage reading at this connection will vary widely depending on whether the points are closed or open (completed circuit or open circuit). The purpose of this test is to confirm a voltage at this point; therefore, open or closed points do not matter.

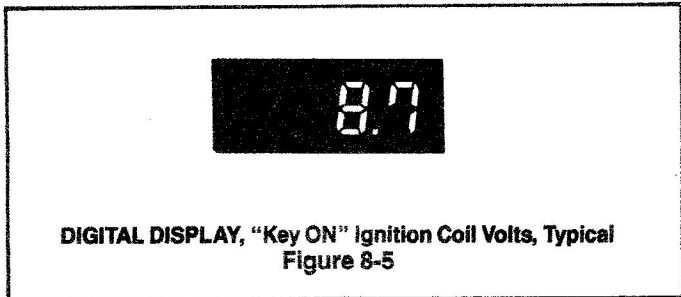
WARNING

If it is necessary to move the BLACK clip, do not use the carburetor or other fuel system components as a ground connection since a spark could ignite the gasoline vapors and cause a fire or an explosion.

4. Crank the engine for a few seconds. Record the voltage shown on the DIGITAL DISPLAY (6), Figure 8-4.



5. Release the key to the ON (RUN) position.
6. Record the voltage shown on the DIGITAL DISPLAY (6), Figure 8-5.



- 1) Breaker Point System
 - a) Points open—The voltage measured in Step 6 should approximately equal the voltage measured in Step 2.
 - b) Points closed—voltage approximately 6.0 to 9.0 volts
 - 2) Electronic Ignition Systems—voltage approximately 6.00 to 12.00 volts.
2. Abnormal—Cranking Engine
- The abnormal results listed below will direct you to the most likely problem areas. These test results may indicate a defect in the vehicle. Consult your vehicle service manual for the proper procedures to check these problem areas.
- Voltage significantly less than cranking voltage or "0" volts:
- a) Ballast bypass circuit not functioning—Consult your vehicle service manual and follow the instructions shown for troubleshooting this circuit. If those instructions refer to the use of an ohmmeter, see the OHMMETER section of this manual for use of the Analyzer's ohmmeter.

NOTE

There are a number of different methods used by vehicle manufacturers to internally bypass the ballast resistor during engine cranking. Depending on the system used, one or more of the following components and their associated wiring and connections may be involved in the circuit:

- 1) Starter relay
- 2) Starter solenoid
- 3) Ignition switch

- b) Breaker points not opening (closed constantly)
- c) Pigtail lead from distributor to ignition coil shorted

- to ground (Breaker Point Systems)
- d) Defective ignition coil (shorted turns—primary)
- e) Short in ignition system wiring—primary circuit of ignition coil
- 3. Abnormal—**Key ON (RUN) position** (all ignition types)
 - a) Ballast resistor defective (open) at “0” volts
 - b) No voltage to the battery side of the ballast resistor (open ignition feed circuit)
 - c) Resistance of ballast resistor increased in ohms (not open) at very low volts only

NOTE

Test the ballast resistor by using the OHMMETER position of the Sears Analyzer as described in the OHMMETER section, Chapter 10, of this manual. Although the ballast resistor can fail on its own, a defective ignition coil can cause failure also. If the ballast resistor has failed, it is advisable to test the ignition coil with the ohmmeter as described in the OHMMETER section of this manual. Make certain the ignition coil **primary** winding resistance is within the range specified by your vehicle service manual. A reading (in ohms) which is too low can cause the ballast resistor to burn out.

- d) Corroded or loose connections in ignition coil primary circuit
- e) Defective electronic ignition module (Electronic Ignition Systems Only)

8-3. PRIMARY COIL VOLTAGE (NON-BALLAST RESISTOR SYSTEMS).

NOTE

This test is necessary only if one or more of the following conditions exists:

- 1) Engine cranks but will not start
- 2) Engine cranks excessively before starting

Primary Coil Voltage is measured between the Positive (+) terminal of the ignition coil (or BAT terminal of the distributor on Integral Coil HEI systems) and engine ground. For the ignition coil to function efficiently, proper voltage must be present at this point during engine operation. This test checks primary coil voltage.

A. Preparation:

Disable the engine as explained in “Disabling Procedures” before continuing with this test.

B. Hookup Procedure:

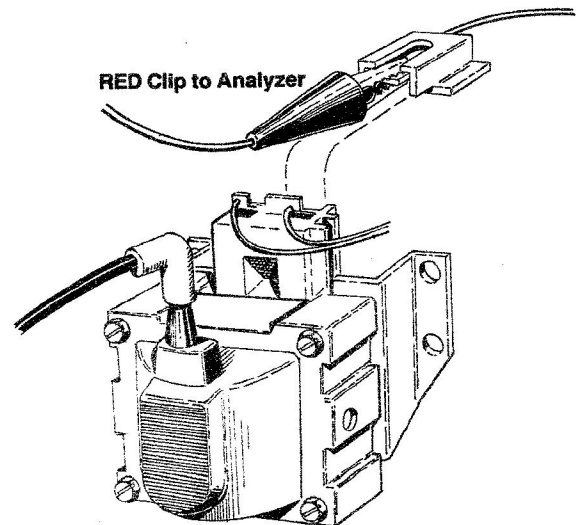
Figure 2-2 shows a hookup procedure for most of the leads on the Sears 21045 Analyzer. Only the test leads listed below are required for the **PRIMARY COIL VOLTAGE TEST** although the other leads may remain connected.

1. Insert the **WHITE VOLTS/OHMS (14)** connector into the **WHITE** socket on the Analyzer. Connect the **RED** clip to the **Positive (+)** battery terminal and the **BLACK** clip to the **Negative (-)** terminal.
 2. Set the **DIGITAL FUNCTION SELECTOR (7)** to **Volts**.
 3. Set the **DIGITAL RANGE SELECTOR (8)** to **200V**.
- C. Test Procedure:**
1. Turn the ignition key to the **ON (RUN)** position.
 2. Record the voltage shown on the **DIGITAL DISPLAY (6)**, Figure 8-6.

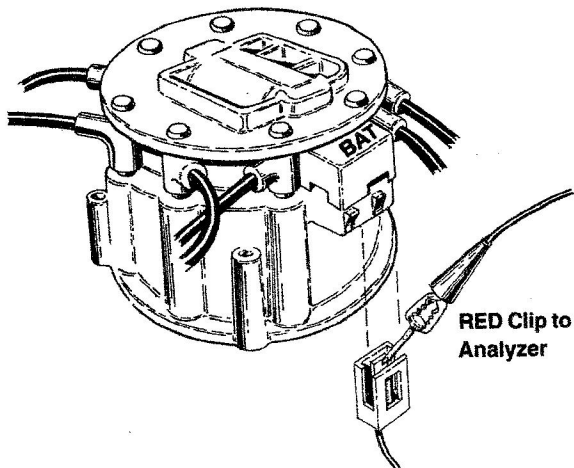


DIGITAL DISPLAY, “Key ON” Battery Volts, Typical Figure 8-6

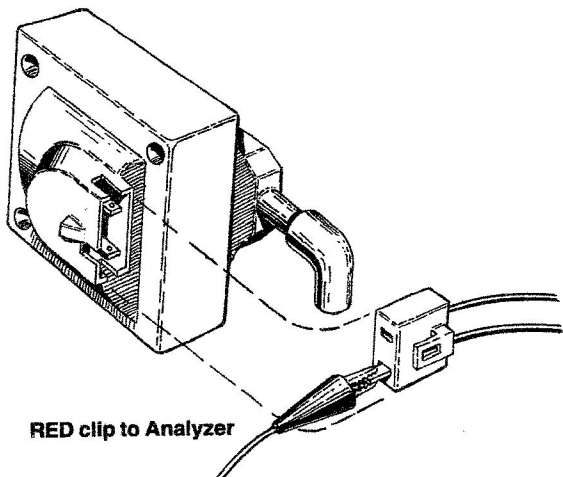
3. Turn the ignition key **OFF**.
4. Disconnect the **VOLTS/OHMS RED** clip from the **Positive (+)** terminal of the battery and connect it to the **Positive (+)** terminal of the ignition coil. See Figure 8-3 (Previous Section). In the case of the Delco-Remy HEI, connect the **RED** clip to the pink battery wire which feeds the **BAT** terminal on the distributor cap on the integral coil systems or the ignition coil on external coil systems. See Figures 8-7, 8-8, 8-9, and 8-10) Leave the **BLACK** clip connected to the **Negative (-)** battery terminal, or if necessary, move to a clean, secure ground connection.



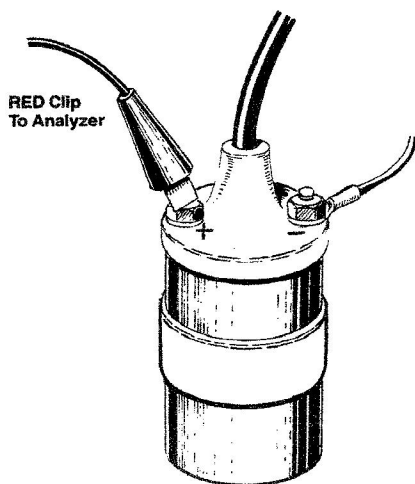
VOLTS/OHMS RED Clip, Primary Coil Voltage Test, Delco-Remy HEI System, External Coil Figure 8-7



VOLTS/OHMS RED Clip, Primary Coil Voltage Test,
Integral Coil System
Figure 8-8



VOLTS/OHMS RED Clip, Primary Coil Voltage Test,
Ford TFI (Thick Film Ignition) System
Figure 8-9



VOLTS/OHMS RED Clip, Primary Coil Voltage Test,
Typical Cylindrical Ignition Coil System
FIGURE 8-10

WARNING

If it is necessary to move the BLACK clip, do not use the carburetor or other fuel system components as a ground connection since a spark could ignite the gasoline vapors and cause a fire or an explosion.

5. Turn the key to the ON (RUN) position. Do not start the engine.
6. Record the voltage shown on the DIGITAL DISPLAY (6), Figure 8-11.



DIGITAL DISPLAY, "Key ON" Ignition Coil Volts, Typical
Figure 8-11

7. Turn the ignition key OFF.
 8. Re-enable the ignition system by reversing the Disabling Procedure.
 9. Push the DIGITAL POWER SWITCH (9) OFF if testing is complete.
- D. Test Results:
1. Normal: Key ON (RUN) position.
The voltage obtained in Step 2 should approximately equal the voltage obtained in Step 6.
 2. Abnormal: Key ON (RUN) position, low to "0" Volts.
 - a. Corroded or loose connections in ignition coil battery feed circuit
 - b. Defective electronic ignition module
 - c. Defective ignition coil

NOTE

If the battery feed wire was disconnected from the distributor cap or ignition coil on the HEI or TFI tests, Abnormal Results 2.b. and 2.c. do not apply to those systems.

8-4. Breaker Point Resistance Test (Breaker Point Systems Only). The BREAKER POINT RESISTANCE TEST checks the open/close (OFF/ON) switching action of the breaker points as well as associated wiring connections. For the ignition coil to function efficiently, there must be a good electrical contact made when the points are closed. This test checks that contact action.

A. Preliminary Checks:

1. Visual Inspection

Visually check the breaker points and associated wiring and connections. Check to see that the lead from the distributor to the Negative (-) terminal of the ignition coil is not damaged (nicked insulation etc.).

2. Component Tests

Several vehicle components should be checked before proceeding with the BREAKER POINT RESISTANCE TEST. 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. (Refer to Chapter 10, OHMMETER.) Check for high battery voltage while the engine is running. (See Charging System Voltage and Battery Charging Current Test in Chapter 7 of this manual.)

3. Correct any of the above problems and replace the breaker points if necessary. (It is generally advisable to replace the condenser when replacing the points.) If the breaker points pass the visual inspection test, proceed to the next step.
4. If the breaker points were replaced based on the above inspection, proceed to the Dwell Adjustment section of this manual and adjust Dwell. Check your vehicle service manual for specific installation and adjustment procedures. Check for a clean, tight connection from the distributor wire to the breaker points and condenser.

B. Preparation:

Disable the engine as explained in "Disabling Procedures, Breaker Point Systems Only".

C. Hookup Procedure:

Figure 2-2 shows a hookup procedure for most of the leads on the Sears 21045 Analyzer. Only the test leads listed below are required for the BREAKER POINT RESISTANCE TEST although the other leads may remain connected.

Insert the BLACK 3 pin POWER/POINTS/DWELL/C-3 (11) connector in the 3 pin BLACK socket on the Analyzer. Connect the RED clip to the Positive (+) battery terminal. Connect the GREEN clip to the Negative (-) ignition coil terminal. Connect the BLACK clip to a secure ground connection on the engine, frame, or alternator bracket. The BLACK clip should be the last connection made and the first to be disconnected.

WARNING

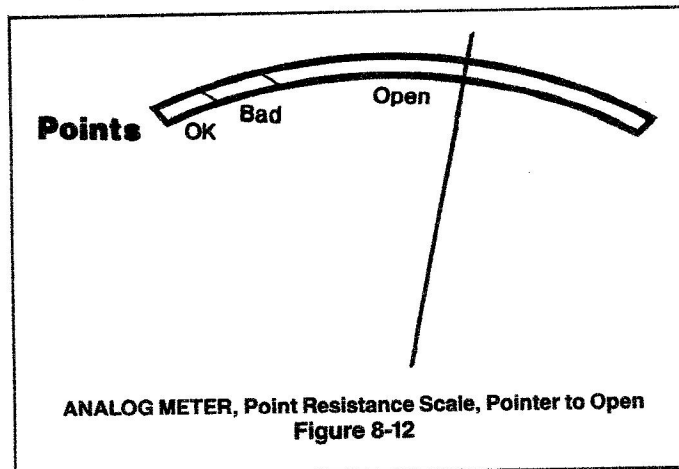
Avoid connecting the BLACK POWER clip directly to the battery Negative (-) terminal in the event that hydrogen gases are present which could explode from sparking connections.

D. Test Procedure:

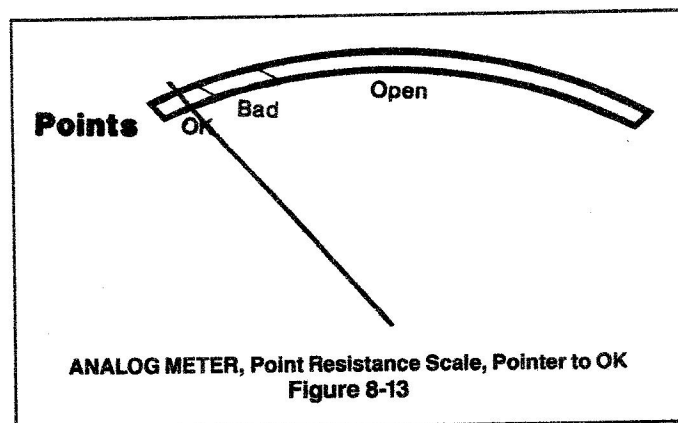
NOTE

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.

1. Turn the ignition key ON. If the meter reads full scale (right), the points are OPEN as shown in Figure 8-12.



2. 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 8-13. The points are now closed. Read the POINTS scale on the ANALOG METER (1).



E. Test Results:

1. Normal

- a. Meter reads in the OK zone of the Points scale.
- b. The Analyzer may indicate high point resistance on a new set of points until they have been run in the vehicle for a few miles and have been properly seated. This condition may be ignored as long as any defects discovered during the previous visual check have been corrected.

2. Abnormal

If the meter indicates in the BAD zone when the points are closed, the points may be defective or the following faults may exist:

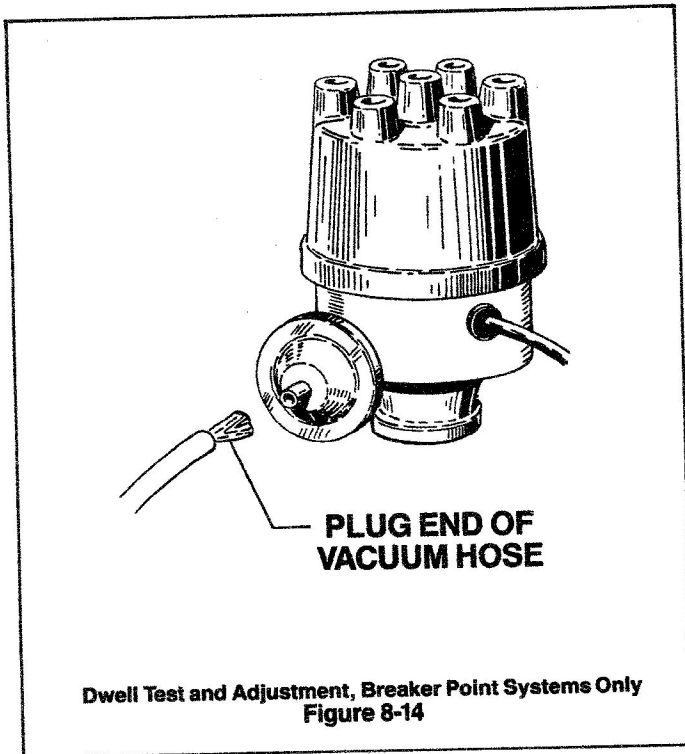
- a. Poor distributor ground
- b. Poor connection on the primary lead from the distributor to the ignition coil
- c. Defective distributor pigtail lead
- d. Misaligned points
- e. Poor points/plate ground inside distributor

Correct the defect and repeat the test.

8-5. Dwell Test And Adjustment (Breaker Point Systems Only or Transistorized Systems which Use Breaker Points). Dwell in the ignition system is defined as the amount of time the breaker points are closed during an ignition firing cycle. Dwell is measured in degrees. For the ignition system to perform efficiently, ignition dwell must be within manufacturer's specifications. Consult your underhood vehicle emission control label or vehicle service manual for the dwell specification for your vehicle.

A. Preparation:

Before performing the DWELL TEST AND ADJUSTMENT PROCEDURE, read the vehicle emission control label or the vehicle service manual to determine what should be done with the vacuum hoses 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 8-14 and the end plugged with a plastic golf "tee" or other plug.



B. Hookup Procedure:

Figure 2-2 shows a hookup procedure for most of the leads on the Sears 21045 Analyzer. Only the test leads listed below are required for the DWELL TEST AND ADJUSTMENT PROCEDURE although the other leads may remain connected.

1. Insert the BLACK 3 pin POWER/POINTS/DWELL/C-3 (11) connector in the 3 pin BLACK socket on the Analyzer. Connect the RED clip to the Positive (+) battery terminal. Connect the GREEN clip to the Negative (-) ignition coil terminal. Connect the BLACK clip to a secure ground connection on the engine, frame, or alternator bracket. The BLACK clip should be the last connection made and the first to be disconnected.

WARNING

Avoid connecting the BLACK POWER clip directly to the battery Negative (-) terminal in the event that hydrogen gases are present which could explode from sparking connections.

2. Insert the BLUE RPM (13) connector into the BLUE socket of the Analyzer. Clamp the RPM pickup around the No. 1 spark plug wire. The clamp must completely enclose the spark plug wire. See Figure 7-2.
3. Turn the ANALOG FUNCTION SELECTOR (4) to RPM.
4. Turn the ANALOG RANGE SELECTOR (3) to LOW (1200 RPM).
5. Turn the DIGITAL FUNCTION SELECTOR (7) to DWELL.
6. Turn the DIGITAL RANGE SELECTOR (8) to 4 cylinders, 6 cylinders or 8 cylinders to match the vehicle under test.

NOTE

If you have NOT installed new points and wish only to check dwell, proceed to the Test Procedure section below. If new points are to be installed, consult the vehicle service manual for installation instructions and then refer to the appropriate adjustment procedure following the Test Results section in this chapter.

C. Test Procedure:

1. Start the engine and allow it to warm up (upper radiator hose hot).
2. Operate the engine at curb idle OR the speed specified by the vehicle emission control label or the vehicle service manual for measuring dwell. Check the RPM on the ANALOG METER (1).

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 RPM pickup along the ignition wire to a new location, or reversing the RPM pickup on the wire as shown in Figure 7-6. If erratic readings persist, move to another ignition wire in the event that the original one may be defective since the RPM pickup can be connected to any spark plug lead. 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.

3. Record the dwell as read on the DIGITAL DISPLAY (6), Figure 8-15.

30.0

DIGITAL DISPLAY, Dwell Reading, Typical
Figure 8-15

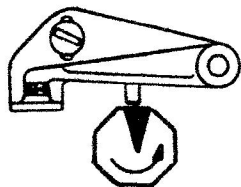
NOTE

There is a direct relationship between dwell and timing. However, it is only a one way relationship. If you change the dwell angle of the breaker points, you will automatically change the ignition timing. Changing the timing, though, has no effect on the dwell angle. FOR THIS REASON, IT IS IMPORTANT TO RE-CHECK THE TIMING WHENEVER THE DWELL ANGLE HAS BEEN ADJUSTED.

D. Test Results:

1. Normal: Dwell is within manufacturer's specifications. See Figure 8-16.

30.0



TYPICAL DWELL
8 CYL. ENGINE

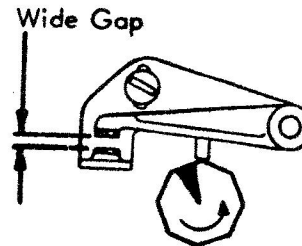
Typical Normal Dwell Results
Figure 8-16

2. Abnormal

The abnormal results listed below will direct you to the most likely problem areas. These test results may indicate a defect in the vehicle. Consult your vehicle service manual for the proper procedures to check these problem areas.

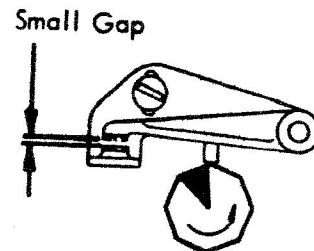
If dwell is not within manufacturer's specifications, Figure 8-17, then proceed with the appropriate adjustment procedure as shown below.

20.0



SMALL DWELL ANGLE
CAUSES POOR HIGH SPEED
PERFORMANCE

40.0



LARGE DWELL ANGLE
CAUSES POINTS TO BURN

Typical Abnormal Dwell Results (8 Cylinder Engine)
Figure 8-17

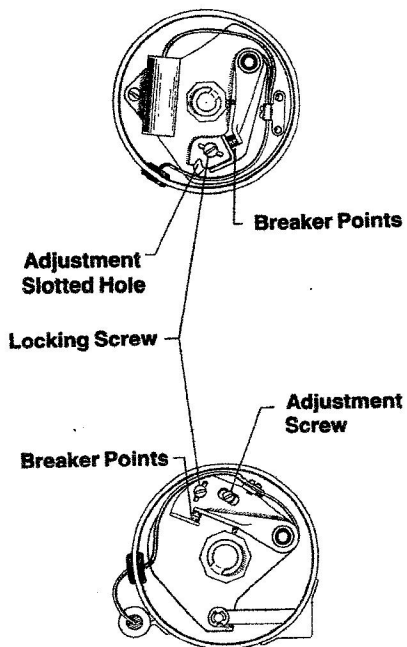
E. Adjustment Procedure (All Except Delco-Remy Sliding Window Type Distributors)

1. Consult the vehicle service manual for exact breaker points installation procedures, and follow the adjustment instructions below.
2. Remove the coil wire from the center tower of the distributor cap and ground the wire by connecting the loose end to the engine or frame with the jumper wire supplied.
3. Remove the distributor cap and rotor.
4. Connect a remote starter switch such as the Sears 161.2175 to the vehicle or have an assistant crank the engine for you in Step 5.
5. With the ignition switch ON and the engine cranking, observe the reading on the DIGITAL DISPLAY (6), Figure 8-18



DIGITAL DISPLAY, Dwell Reading, Typical Engine Cranking
Figure 8-18

6. 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 the locking screw and recheck dwell while cranking the engine. Repeat the procedure if necessary. See Figure 8-19.



Dwell Adjustment
(All except Delco-Remy Sliding Window Distributors)
Figure 8-19

7. Reassemble the distributor and recheck the dwell reading with the engine operating at idle speed. Repeat steps 6 and 7 if necessary.

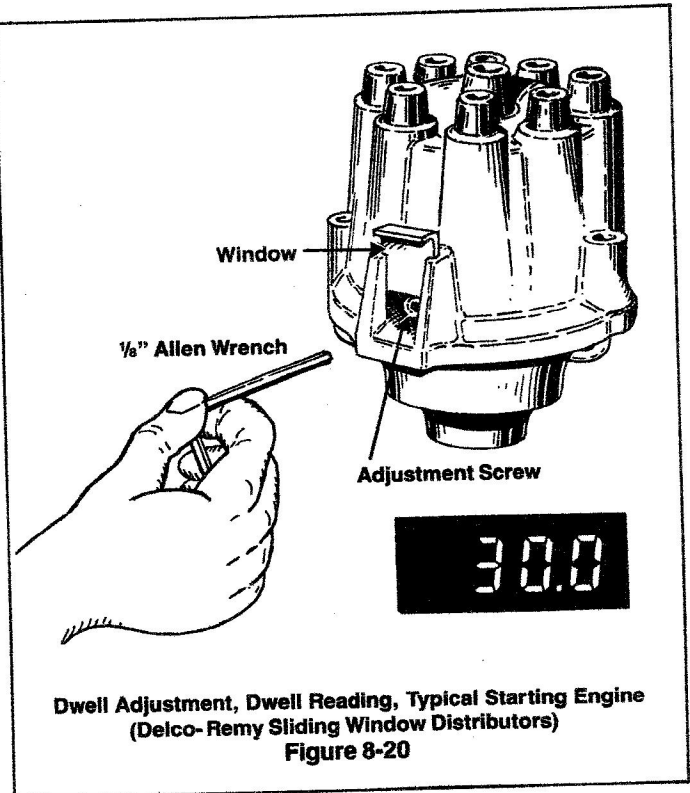
NOTE

Dwell adjustment will affect engine RPM and timing. Readjust timing and idle speed if necessary and double check the dwell reading. Repeat as necessary to obtain the proper setting.

8. Turn the Analyzer OFF if the testing is complete.
- F. Adjustment Procedure (Delco-Remy, Sliding Window Type Distributors)—Starting Engine
1. Start the engine and allow it to warm up (until upper radiator hose is hot). If the engine will not start, pro-

ceed to Step G-1 below.

2. Lift the metal slide cover as shown in Figure 8-20. Insert a $\frac{1}{8}$ " Allen wrench in the adjusting screw socket.
3. Observe the DIGITAL DISPLAY (6) and adjust the dwell to specification by turning the Allen wrench, Figure 8-20.



NOTE

Dwell adjustment will affect engine RPM and timing. Readjust timing and idle speed if necessary and double check the dwell reading. Repeat as necessary to obtain the proper setting.

4. Turn the Analyzer OFF if testing is complete.

- G. Adjustment Procedure (Delco-Remy, Sliding Window Type Distributors)—Non-Starting Engine
1. If the engine will not start, have an assistant crank the engine for you or use a Remote Starter such as the Sears 161.2175.
 2. Lift the metal slide cover as shown in Figure 8-20. Insert a $\frac{1}{8}$ " Allen wrench in the adjusting screw socket.
 3. Observe the DIGITAL DISPLAY (6) while the engine is cranking and adjust the dwell to specification by turning the Allen wrench. CAUTION: the engine may start as you approach the correct dwell angle. See Figure 8-20.
 4. Once the engine starts, allow it to warm up and check and make final adjustment as outlined in Steps F1-3 of the previous procedure (F. Starting Engine).

NOTE

Dwell adjustment will affect engine RPM and timing. Readjust timing and idle speed if necessary and double check the dwell reading. Repeat as necessary to obtain the proper setting.

5. Turn the Analyzer OFF if testing is complete.

8-6. Dwell Variation (Breaker Point Ignition Only). In order for the ignition system and engine to perform at peak efficiency, dwell variation should be minimal from curb idle to high speed. This procedure checks for excessive dwell variation.

A. Preparation:

Before performing the DWELL VARIATION TEST, read the vehicle emission control label or vehicle service manual to determine what should be done with the vacuum hoses 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 8-14 and the end plugged with a plastic golf "tee" or other plug.

B. Hookup Procedure:

Figure 2-2 shows a hookup procedure for most of the leads on the Sears 21045 Analyzer. Only the test leads listed below are required for the DWELL VARIATION TEST although the other leads may remain connected.

1. Insert the BLACK 3 pin POWER/POINTS/DWELL/C-3 (11) connector in the 3 pin BLACK socket on the Analyzer. Connect the RED clip to the Positive (+) battery terminal. Connect the GREEN clip to the Negative (-) ignition coil terminal. Connect the BLACK clip to a secure ground connection on the engine, frame, or alternator bracket. The BLACK clip should be the last connection made and the first to be disconnected.

WARNING

Avoid connecting the BLACK POWER clip directly to the battery Negative (-) terminal in the event that hydrogen gases are present which could explode from sparking conditions.

2. Insert the BLUE RPM (13) connector into the BLUE socket of the Analyzer. Clamp the RPM pickup around the No. 1 spark plug wire. The clamp must completely enclose the spark plug wire, Figure 7-2.
3. Turn the ANALOG FUNCTION SELECTOR (4) to RPM.
4. Turn the ANALOG RANGE SELECTOR (3) to High (6000 RPM).
5. Turn the DIGITAL FUNCTION SELECTOR (7) to Dwell.
6. Turn the DIGITAL RANGE SELECTOR (8) to 4 cylinders, 6 cylinders or 8 cylinders to match the vehicle under test.

C. Test Procedure:

1. Remove and plug the distributor vacuum hose connection as shown in Figure 8-14, or as directed in the vehicle service manual.
2. Start the engine, operate it at curb idle, and allow the engine to warm up (upper radiator hose hot).

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 RPM pickup along the ignition wire to a new location, or reversing the RPM pickup on the wires as shown in Figure 7-6. If erratic readings persist, move to another ignition wire in the event that the original one may be defective since the RPM pickup can be connected to any spark plug lead. 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.

3. Record the reading on the DIGITAL DISPLAY (6), Figure 8-21



DIGITAL DISPLAY, Dwell Idle Reading, Typical
Figure 8-21

4. Slowly raise the engine speed to approximately 1500 RPM and observe the DIGITAL DISPLAY (6), Figure 8-22. Record the reading at 1500 RPM.



DIGITAL DISPLAY, 1500 RPM, Typical Dwell Reading
Figure 8-22

5. Slowly return the engine speed to curb idle and record the reading on the DIGITAL DISPLAY (6).
6. Stop the engine.
7. Turn the Analyzer OFF if testing is complete.

D. Test Results:

1. Normal
 - a. The dwell difference between idle and 1500 RPM should not exceed 3.0 degrees.

b. When the engine speed is returned to idle, dwell should be the same as the first curb idle (or very close).

2. Abnormal

The abnormal results listed below will direct you to the most likely problem areas. These test results may indicate a defect in the vehicle. Consult your vehicle service manual for the proper procedures to check these problem areas.

If the dwell difference between idle and 1500 RPM exceeds 3 degrees or repeated idle dwell readings are not the same, then there may be:

- a. Excessive wear in the breaker point mounting plate, plate bushings, and related distributor parts.
- b. Excessive wear of distributor cam or distributor shaft.

NOTE

Some distributors have an offset breaker plate (often Ford and Chrysler). If the vacuum advance hose is left connected, dwell variation can be significantly greater than 3 degrees. In these cases, remove the vacuum advance hose before proceeding with this test.

NOTE

Engine timing and dwell share a direct relationship. For example, increasing dwell by two degrees (2°) retards timing by two degrees (2°) and decreasing dwell by two degrees (2°) advances timing by two degrees (2°). Timing must be adjusted **after** every dwell adjustment but **before** idle speed or mixture adjustments are made. Adjusting timing does **NOT** affect dwell. Do **NOT** make dwell adjustments after initial timing adjustments.

Section 2. Secondary Circuit.

The Secondary Circuit of the Ignition System consists of the secondary winding of the ignition coil; coil tower wire (external coil systems only); distributor cap; distributor rotor; spark plug wires and spark plugs. The following series of tests will completely check the operation of this system and these items.

CAUTION

Some vehicle manufacturers advise the technician not to disconnect the coil tower wire or selected spark plug wires while the engine is running or being cranked by the starter. Personal injury or damage to ignition system electronics may result. Consult the vehicle service manual to see if this caution applies to your vehicle and to see if any other specific engine cautions affect the following procedures.

Preparation:

The amount of secondary voltage developed is based on the overall condition of the Electrical System and the primary circuit of the Ignition System. It is recommended that the following tests be performed (if not already done) before proceeding to the secondary circuit tests which follow:

1. Cranking System Test—Voltage Check only, Chapter 6.
2. Charging System Voltage—Voltage Check only, Chapter 7.
3. Primary Coil Voltage for ballast and non-ballast resistor equipped systems, Chapter 8.
4. Breaker Point Resistance, Chapter 8.
5. Dwell Test, Chapter 8.

8-7 Cranking Coil Output Test.

NOTE

This test is necessary only if the vehicle will not start, or the engine cranks excessively before starting. Omit this test on Integral Coil Systems.

This test measures the coil tower wire output voltage when it is disconnected from the distributor cap and the engine is cranking. Sufficient voltage under these conditions helps insure that the engine will start quickly without excessive cranking which could run down the battery.

A. Hookup Procedure:

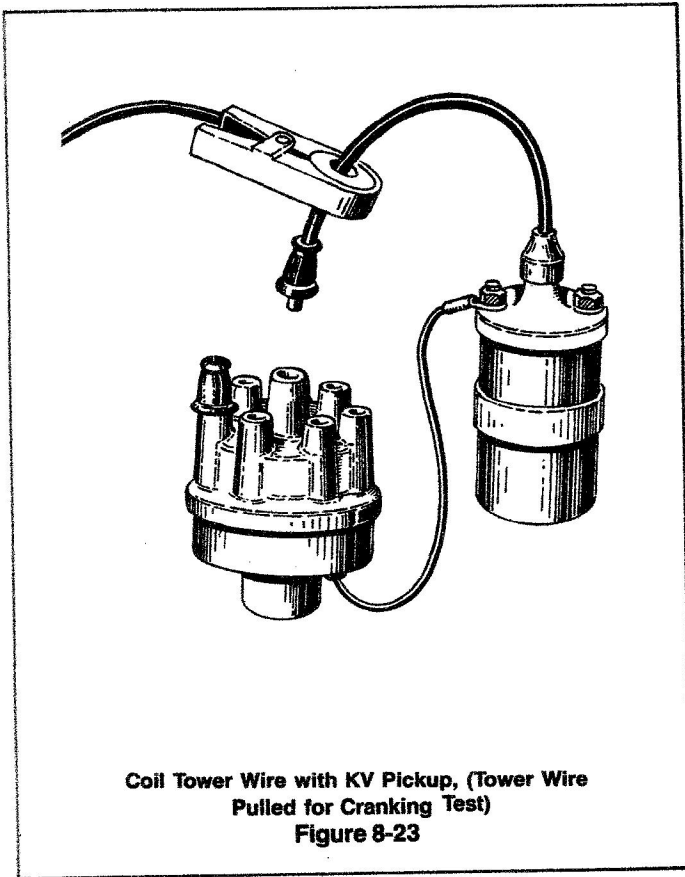
Figure 2-2 shows a hookup procedure for most of the leads on the Sears 21045 Analyzer. Only the test leads listed below are required for the **CRANKING COIL OUTPUT TEST** although the other leads may remain connected.

1. Insert the **BLACK 3 pin POWER/POINTS/DWELL/C-3 (11)** connector in the 3 pin **BLACK** socket on the Analyzer. Connect the **RED** clip to the Positive (+) battery terminal. Connect the **BLACK** clip to a secure ground connection on the engine, frame, or alternator bracket. The **BLACK** clip should be the last connection made and the first to be disconnected. (The **GREEN** clip is not used for this test.)

WARNING

Avoid connecting the **BLACK POWER** clip directly to the battery Negative (-) terminal in the event that hydrogen gases are present which could explode from sparking connections.

2. Insert the **WHITE VOLTS/OHMS (14)** connector into the **WHITE** socket on the Analyzer. Connect the **RED** clip to the Positive (+) battery terminal and the **BLACK** clip to the Negative (-) battery terminal.
3. Insert the **YELLOW KV (12)** connector into the **YELLOW** socket on the Analyzer. Clamp the **KV (Ignition Kilovolts)** pickup on the coil tower wire as shown



in Figure 8-23. The clamp should close completely around the wire. (See Figure 7-2.)

4. Set the ANALOG FUNCTION SELECTOR (4) to the KV position.
5. Set the ANALOG RANGE SELECTOR (3) to the High (60 KV) position.
6. Set the DIGITAL FUNCTION SELECTOR (7) to the Volts position.
7. Set the DIGITAL RANGE SELECTOR (8) to the 200 Volts position.

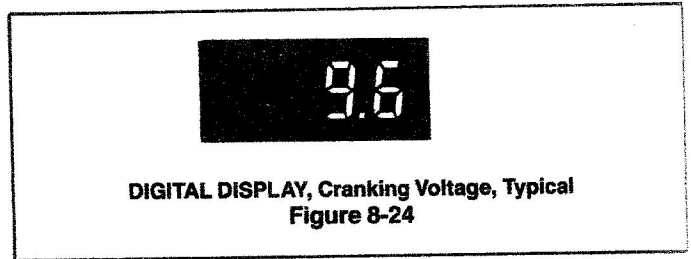
B. Test Procedure:

1. Disconnect the coil tower wire AT THE DISTRIBUTOR CAP and position the open end of this wire so that it is well away from any metal surface (ground) and well away from any fuel system components. See Figure 8-23.

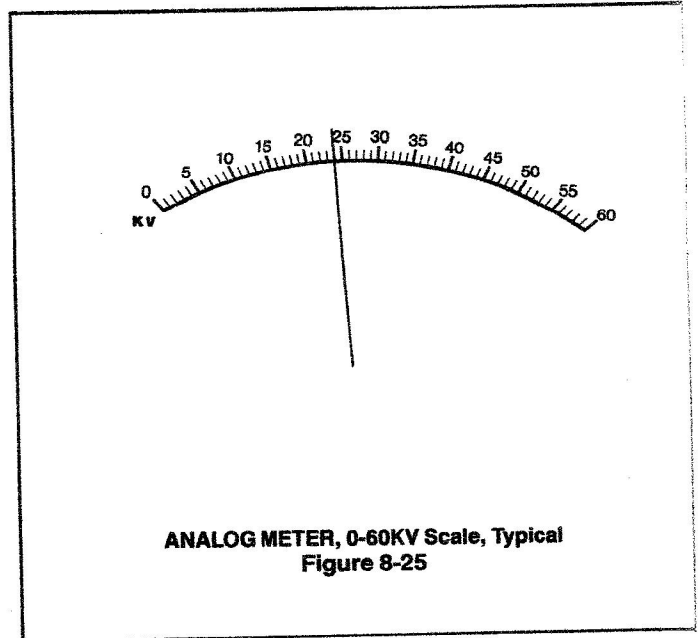
NOTE

If this wire arcs to ground during the test, test results will be incorrect.

2. Have an assistant crank the engine with the ignition key.
3. Observe the DIGITAL DISPLAY (6) for sufficient cranking voltage (typically 9.6 volts or more) as discussed in the Cranking System Test in this manual. See Figure 8-24.



4. Record the reading as shown on the ANALOG METER (1) 0 to 60 KV scale. See Figure 8-25.



5. Turn the ignition key OFF.
6. Reconnect the coil tower wire to the distributor cap.
7. Turn the Analyzer OFF if testing is complete.

C. Test Results:

1. Normal
 - a. Breaker Point and most Electronic Ignition Systems should indicate approximately 20 KV or higher at normal cranking voltage on the ANALOG METER (1) 0-60 KV scale.
 - b. High Energy Systems (Delco-Remy HEI, Ford Dura Spark, Ford TFI etc.) should indicate approximately 28-30 KV or higher at normal cranking voltage on the ANALOG METER (1) 0-60 KV scale.
2. Abnormal

The abnormal test results listed below will direct you to the most likely problem areas. These test results may indicate a defect in the vehicle. Consult your vehicle service manual for the proper procedures to check these problem areas.

 - a. Breaker Point and most Electronic Ignition Systems indicating significantly less than 20 KV at normal cranking voltage.
 - 1) Recheck Primary Circuit (Primary Coil Voltage, Breaker Point Resistance and Dwell)

- 2) Ignition Coil (See OHMMETER, Chapter 10, of this manual.)
 - 3) Electronic Ignition Module (if equipped)
- b. High Energy Systems
- 1) Recheck Primary Circuit (Primary Coil Voltage)
 - 2) Ignition Coil (See OHMMETER, Chapter 10, of this manual.)
 - 3) Electronic Ignition Module

8-8. Spark Plug Firing Voltage Test. The Spark Plug Firing Voltage Test measures the coil tower wire output voltage when the high voltage wires are connected to the spark plugs, distributor, and ignition coil. Excessively high or low voltages indicate problem areas which need to be resolved. Additional tests in this section also measure each individual spark plug wire voltage under the same dynamic conditions as the coil tower measurement.

A. Hookup Procedure (All External Coil Systems):

Figure 2-2 shows a hookup procedure for most of the leads on the Sears 21045 Analyzer. Only the test leads listed below are required for the SPARK PLUG FIRING VOLTAGE TEST although the other leads may remain connected.

1. Insert the BLACK 3 pin POWER/POINTS/DWELL/C-3 (11) connector in the 3 pin BLACK socket on the Analyzer. Connect the RED clip to the Positive (+) battery terminal. Connect the BLACK clip to a secure ground connection on the engine, frame, or alternator bracket. The BLACK clip should be the last connection made and the first to be disconnected. (The GREEN clip is not used for this test.)

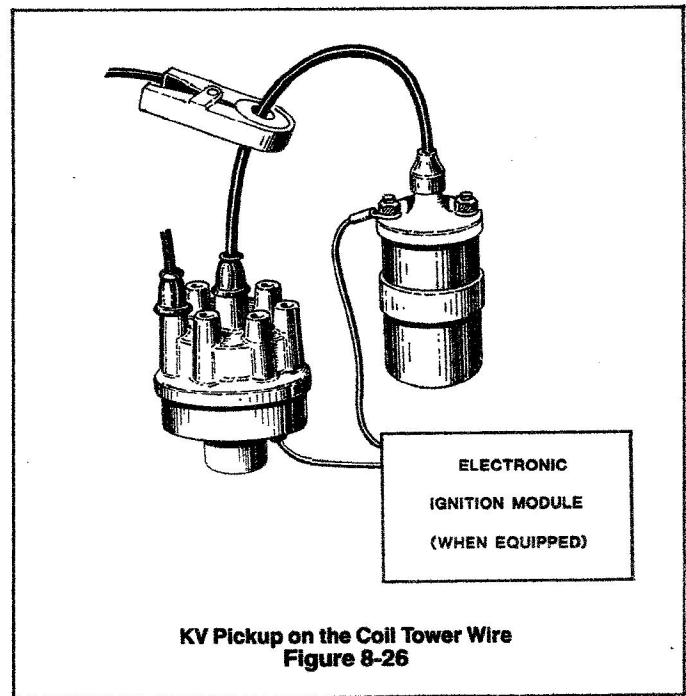
WARNING

Avoid connecting the BLACK POWER clip directly to the battery Negative (-) terminal in the event that hydrogen gases are present which could explode from sparking connections.

2. Insert the BLUE RPM (13) connector into the BLUE socket of the Analyzer. Clamp the RPM pickup around the No. 1 spark plug wire. The clamp must completely enclose the spark plug wire. See Figure 7-2.
3. Insert the YELLOW KV (12) connector into the YELLOW socket on the Analyzer. Clamp the KV (Ignition Kilovolts) pickup on the coil tower wire as shown in Figure 8-26. The clamp should close completely around the wire. For connection of the KV pickup for Integral Coil Systems, see Test Procedures, Integral Coil Systems, Figure 8-28.
4. Set the ANALOG FUNCTION SELECTOR (4) to RPM.
5. Set the ANALOG RANGE SELECTOR (3) to Low (1200 RPM).

B. Test Procedure (External Coil Systems):

1. Start the engine and operate it at curb idle until it is fully warm (upper radiator hose hot).

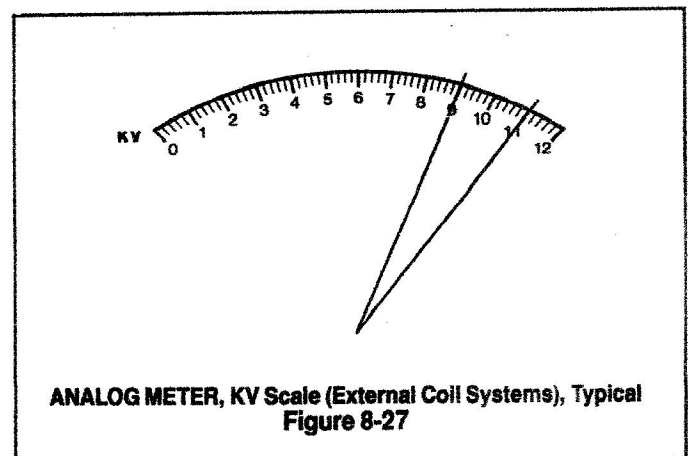


2. Set the ANALOG RANGE SELECTOR (3) to the High (60 KV) position and the ANALOG FUNCTION SELECTOR (4) to the KV position.
3. Observe the ANALOG METER (1) reading on the 0-60 KV scale. If it is less than 12 KV, turn the ANALOG RANGE SELECTOR (3) to the Low (12 KV) position.
4. Read the selected KV scale and record the average reading obtained. See Figure 8-27.

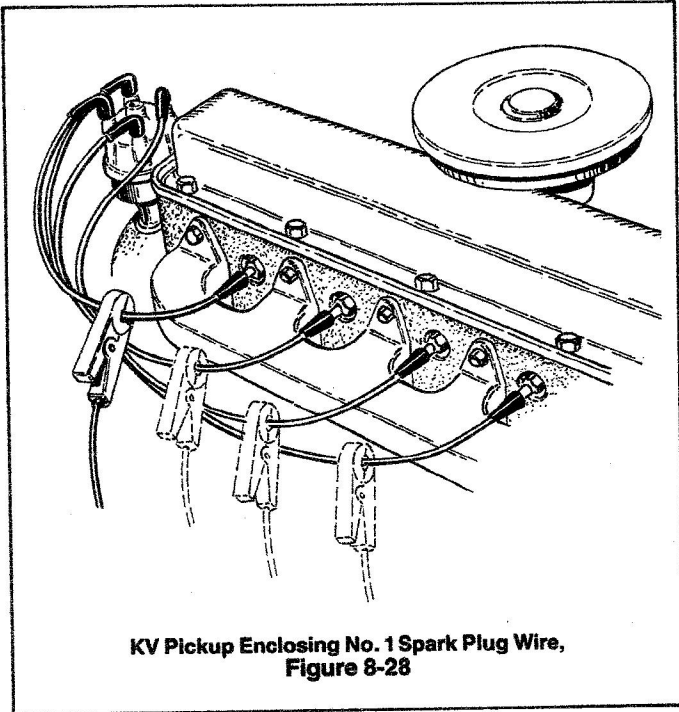
NOTE

The Analyzer often indicates only the highest spark plug firing voltages on the Kilovolts scale since it averages the spark plug firings of all cylinders. Individual spark plug firing voltages may be obtained by using the method outlined below. This procedure will help to pinpoint problems in individual cylinders.

C. Test Procedure (Integral Coil Systems/Individual Spark Plug Voltage Measurement):



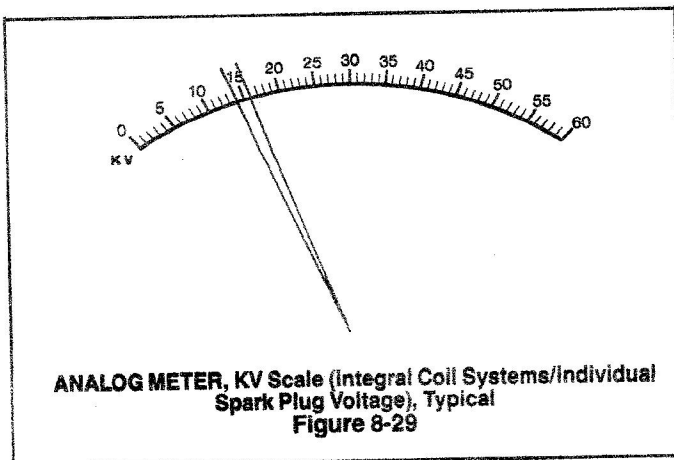
1. Start the engine and operate it at curb idle until it is warm (upper radiator hose hot).
2. Set the ANALOG RANGE SELECTOR (3) to the High (60 KV) position and the ANALOG FUNCTION SELECTOR (4) to the KV position.
3. Clamp the KV pickup around the No. 1 spark plug wire. The clamp must completely enclose the wire. See Figure 8-28. If the reading on the 60 KV scale is below 12 KV, turn the ANALOG RANGE SELECTOR (3) to the Low (12 KV) position.



4. Move the KV pickup to each plug wire and record the results. If necessary, change the setting of the ANALOG RANGE SELECTOR (3) for each plug wire as explained in Step 3 before recording the reading on the ANALOG METER (1) KV scale. See Figure 8-29.

D. Test Results:

1. Normal



NOTE

Normal Test Results can vary widely from engine to engine. Many factors influence spark plug firing voltage. Some of the more common ones are:

1. Spark Plug Gap (wider gap - higher firing voltage).
2. Air/Fuel Mixture (leaner mixtures - higher firing voltages; richer mixtures - lower firing voltages) Emission control regulations and economy requirements have led to leaner air/fuel mixtures. Therefore, properly tuned late model engines will have relatively high spark plug firing voltages when compared with older engines.
3. Engine conditions (oil fouling, low compression, etc.)

- a. Spark Plug Firing Voltage normally falls within a range of 5 to 15 Kilovolts. Refer to your vehicle service manual if a more specific range is required.
- b. On the individual spark plug firing voltage test, all plugs should fire within 3 to 4 KV of each other.

2. Abnormal

The abnormal test results listed below will direct you to the most likely problem areas. These test results may indicate a defect in the vehicle. Consult your vehicle service manual for the proper procedures to check these problem areas.

- a. Firing voltages nearly the same but abnormally high may be caused by:
 - 1) Retarded ignition timing
 - 2) Lean fuel mixture (See "Carburetors, Mixture Adjustment," Chapter 9 in this manual.)
 - 3) Worn or widely gapped spark plugs
 - 4) Large rotor gap
 - 5) High resistance in coil wire
 - 6) Corrosion in the coil tower terminal
 - 7) Corrosion in the distributor cap coil wire terminal
- b. Firing voltages nearly the same but abnormally low may be caused by:
 - 1) Advanced ignition timing
 - 2) Rich fuel mixture (See "Carburetors, Mixture Adjustment," Chapter 9 in this manual.)
 - 3) Closely gapped spark plugs
 - 4) Damaged coil cable insulation causing arcing to ground
 - 5) Cracked coil wire tower in distributor cap
 - 6) Cracked tower in coil causing arcing to ground
 - 7) Low coil output (See "Coil Reserve Test" in Chapter 8 of this manual.)
- c. One or more firing voltages much higher than the others may be caused by:
 - 1) Carburetor idle mixture not properly balanced—2 or 4 barrel carburetors only (See "Carburetors, Mixture Adjustment," Chapter 9 in this manual.)
 - 2) Defective spark plug
 - 3) Vacuum leak

- 4) Defective spark plug wire(s)
- 5) Corroded spark plug wire terminal caused by improper seating on terminal
- d. One or more firing voltages low may be caused by:
 - 1) Carburetor idle mixture not properly balanced—2 or 4 barrel carburetors only (See “Carburetors, Mixture Adjustment” Chapter 9 in this manual.)
 - 2) Shorted spark plug
 - 3) Spark plug fouled

NOTE

If a spark plug has fouled, see your vehicle service manual for appropriate test procedures for this problem.

- 4) Cracked tower in distributor cap resulting in arcing to ground
- 5) Damaged spark plug wire insulation causing arcing to ground
- e. One or more cylinders not firing may be caused by:
 - 1) Cracked distributor cap terminal
 - 2) Shorted spark plug wire
 - 3) Defective spark plug

8-9. Spark Plugs Under Load Test. The SPARK PLUGS UNDER LOAD VOLTAGE TEST measures the coil tower wire output voltage when the high voltage wires are connected to the spark plugs, distributor, and ignition coil, and the engine is “snap-accelerated.” When the engine has this kind of load applied, the firing voltage of the spark plugs increases. The following test will check for the proper voltage increase. Perform this test AFTER correcting any defects discovered during the SPARK PLUG FIRING VOLTAGE TEST.

A. Hookup Procedure (All External Coil Systems):

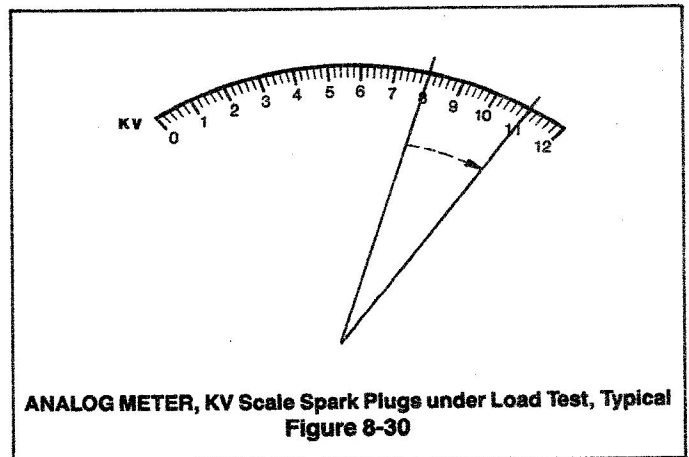
Figure 2-2 shows a hookup procedure for most of the leads on the Sears 21045 Analyzer. Only the test leads listed below are required for the SPARK PLUGS UNDER LOAD TEST although the other leads may remain connected.

1. Insert the BLACK 3 pin POWER/POINTS/DWELL/C-3 (11) connector in the 3 pin BLACK socket on the Analyzer. Connect the RED clip to the Positive (+) battery terminal. Connect the BLACK clip to a secure ground connection on the engine, frame, or alternator bracket. The BLACK clip should be the last connection made and the first to be disconnected. (The GREEN clip is not used for this test.)

WARNING

Avoid connecting the BLACK POWER clip directly to the battery Negative (-) terminal in the event that hydrogen gases are present which could explode from sparking connections.

2. Insert the BLUE RPM (13) connector into the BLUE socket of the Analyzer. Clamp the RPM pickup around the No. 1 spark plug wire. The clamp must completely enclose the spark plug wire. See Figure 7-2.
 3. Insert the YELLOW KV (12) connector into the YELLOW socket on the Analyzer. Clamp the KV (Ignition Kilovolts) pickup on the coil tower wire as shown in Figure 8-26. (Previous Section) The clamp should close completely around the wire.
 4. Set the ANALOG FUNCTION SELECTOR (4) to RPM.
 5. Set the ANALOG RANGE SELECTOR (3) to Low (1200 RPM).
- B. Test Procedure:**
1. Start the engine and operate it at curb idle until it is fully warm (upper radiator hose hot).
 2. Set the ANALOG RANGE SELECTOR (3) to the High (60 KV) position and the ANALOG FUNCTION SELECTOR (4) to the KV position.
 3. Observe the meter reading on the 0-60 KV scale. If it is less than 9 KV, turn the ANALOG RANGE SELECTOR (3) to the Low (12 KV) position.
 4. Briefly snap accelerate the engine while observing the appropriate KV scale. See Figure 8-30



5. Return the engine to curb idle and turn it OFF.
 6. Turn the Analyzer OFF if testing is complete.
- C. Test Results:**
1. Normal

The KV reading should increase 3 to 4 KV during snap acceleration.
 2. Abnormal
 - a. When the KV reading increases significantly more than 3-4 KV, this may be caused by a faulty spark plug condition.
 - b. When the KV reading increases much less than 3 KV, this may be caused by a faulty spark plug condition.

Consult your vehicle service manual for the proper diagnostic procedures to check these problem areas.

8-10. Coil Reserve Voltage Test. To ensure a reliable spark at the plugs under all engine operating conditions, the ignition coil is designed to produce more voltage than is

required to fire the spark plugs. The following tests measure the maximum output voltage of the ignition coil when one spark plug is disconnected. This ensures that the ignition coil has enough reserve voltage capability to fire the spark plugs under all engine operating conditions.

A. Hookup Procedure (All External Coil Systems):

Figure 2-2 shows a hookup procedure for most of the leads for the Sears 21045 Analyzer. Only the test leads listed below are required for the COIL RESERVE VOLTAGE TEST although the other leads may remain connected.

1. Insert the BLACK 3 pin POWER/POINTS/DWELL/C-3 (11) connector in the 3 pin BLACK socket on the Analyzer. Connect the RED clip to the Positive (+) battery terminal. Connect the BLACK clip to a secure ground connection on the engine, frame, or alternator bracket. The BLACK clip should be the last connection made and the first to be disconnected. (The GREEN clip is not used for this test.)

WARNING

Avoid connecting the BLACK POWER clip directly to the battery Negative (-) terminal in the event that hydrogen gases are present which could explode from sparking connections.

2. Insert the BLUE RPM (13) connector into the BLUE socket of the Analyzer. Clamp the RPM pickup around the No. 1 spark plug wire. The clamp must completely enclose the spark plug wire. See Figure 7-2
3. Insert the YELLOW KV (12) connector into the YELLOW socket on the Analyzer. Clamp the KV (Ignition Kilovolts) pickup on the coil tower wire as shown in Figure 8-26. (Previous Section) The clamp should close completely around the wire. For connection of the KV pickup for Integral Coil Systems, see "Hookup Procedures, Integral Coil Systems," previous section.
4. Set the ANALOG FUNCTION SELECTOR (4) to RPM.
5. Set the ANALOG RANGE SELECTOR (3) to Low (1200 RPM).

CAUTION

Selection of spark plug wires to be disconnected is critical on Ford and Motorcraft equipped Electronic Ignition Systems. Unless properly selected, damage to the ignition system electronics may result.

Do not disconnect:

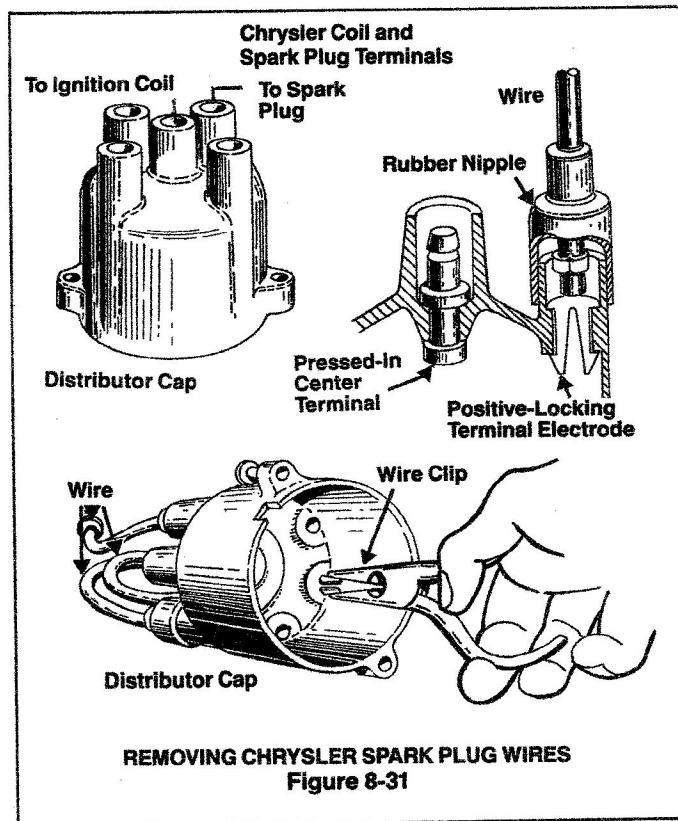
- V-8 engines: No. 1 or No. 8 spark plug wire
- V-6 engines: No. 1 or No. 4 spark plug wire
- I-6 engines: No. 3 or No. 5 spark plug wire
- 4-Cylinder Engines: No. 1 or No. 3 spark plug wire

CAUTION

Some Chrysler products use a "positive-locking" terminal electrode spark plug wire. As shown by Figure 8-31, these plug wires can only be removed from inside the distributor cap. Damage may result to components if other means of removal are attempted.

B. Test Procedure (All External Coil Systems):

1. Start the engine and operate it at curb idle until it is fully warm (upper radiator hose hot).
2. Set the ANALOG FUNCTION SELECTOR (4) to the KV position.
3. Set the ANALOG RANGE SELECTOR (3) to the High (60 KV) position.

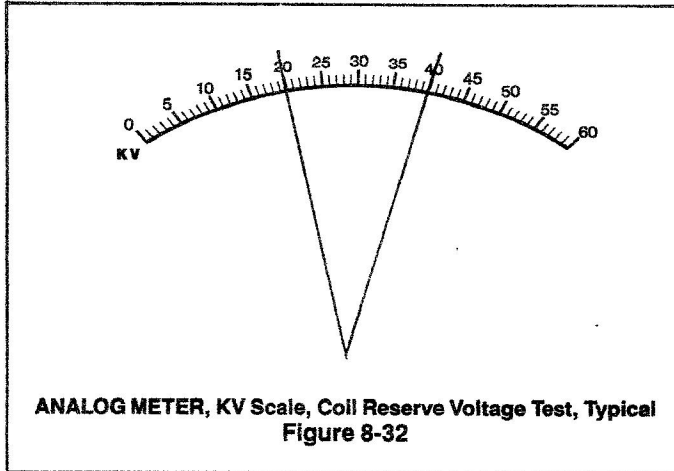


4. Using a pair of insulated ignition wire pliers, disconnect any properly selected spark plug wire with boot at the spark plug end, except the wire leading to the No. 1 spark plug. Do not leave a plug wire disconnected for more than a few seconds at a time on a catalytic converter equipped vehicle (overheating of the converter may occur and possibly damage it). For proper test results, do NOT allow the removed plug wire to arc to ground.

WARNING

Do not let sparks occur near the carburetor or other fuel system components as a spark could ignite the gasoline vapors and cause a fire or explosion.

5. Record the reading as shown on the ANALOG METER (1) 60 KV scale. See Figure 8-32.



C. Test Results:

1. Normal

- Breaker Point Systems should produce a reading of approximately 20 KV minimum.
- Electronic Ignition Systems should produce a reading of 24-26 KV minimum with the following exceptions:
 - Ford Duraspark, approximately 28 KV minimum
 - Ford Thick Film Integrated Ignition, approximately 40 KV minimum
 - Delco-Remy High Energy Ignition, approximately 35 KV minimum

2. Abnormal

The abnormal test results listed below will direct you to the most likely problem areas. These test results may indicate a defect in the vehicle. Consult your vehicle service manual for the proper procedures to check these problem areas.

Coil Reserve (output) significantly below specifications:

- Perform Primary Ignition Circuit checks as described in your vehicle service manual and the Primary Coil Voltage, Breaker Point Resistance and Dwell Adjustment portions of this manual (Chapter 8).
- Perform Ignition Coil checks with an OHMMETER as described in the OHMMETER, Ignition Coil Testing portion of this manual (Chapter 10) and any other checks recommended by your vehicle service manual.

D. Hookup Procedure (Integral Coil Systems):

Follow the Hookup Procedure for All External Coil Systems except connect the KV (12) clamp to a plug wire which can be easily removed at the spark plug end. Do not use the No. 1 spark plug wire.

E. Test Procedure:

- Start the engine and operate it at curb idle until it is fully warm (upper radiator hose hot).
- Set the ANALOG FUNCTION SELECTOR (4) to the KV position.
- Set the ANALOG RANGE SELECTOR (3) to the High (60 KV) position.

- Use a pair of insulated ignition wire pliers to remove the selected spark plug wire at the spark plug end (the one with the KV clamp on it). Do not remove the No. 1 plug wire. Do not leave a plug wire disconnected for more than a few seconds at a time on a catalytic converter equipped vehicle (overheating of the converter may occur and possibly damage it). For proper test results, do NOT allow the removed plug wire to arc to ground.

WARNING

Do not let sparks occur near the carburetor or other fuel system components as a spark could ignite the gasoline vapors and cause a fire or explosion.

- Record the reading as shown on the ANALOG METER (1) 60 KV scale. See Figure 8-32.

F. Test Results:

1. Normal

The Delco-Remy High Energy Ignition should produce a reading of approximately 35 KV minimum.

2. Abnormal

The abnormal test results listed below will direct you to the most likely problem areas. These test results may indicate a defect in the vehicle. Consult your vehicle service manual for the proper procedures to check these problem areas.

When the Coil Reserve (output) is significantly below specifications:

- Perform Primary Ignition Circuit checks as described in your vehicle service manual and the Primary Coil Voltage portion of this manual (Chapter 8).
- Perform Ignition Coil checks with an ohmmeter as described in the OHMMETER, Ignition Coil Testing portion of this manual (Chapter 10) and any other checks recommended by your vehicle service manual.

8-11. Secondary Insulation Test. The SECONDARY INSULATION TEST is performed only AFTER satisfactory results have been obtained from the COIL RESERVE TEST. The SECONDARY INSULATION TEST checks for good voltage insulation throughout the secondary portion of the ignition system which includes the high tension wires, distributor, and coil. Satisfactory insulation ensures that the coil voltage will be delivered to the spark plugs and fire them reliably. Voltage which leaks through spark plug wires to ground will cause misfiring of the spark plug on the defective wire. The following tests will check the insulation in the secondary system.

A. Hookup Procedure (External Coil Systems Only):

Figure 2-2 shows a hookup procedure for most of the leads on the Sears 21045 Analyzer. Only the test leads listed below are required for the SECONDARY INSULATION TEST although the other leads may remain connected.

1. Insert the BLACK 3 pin POWER/POINTS/DWELL/C-3 (11) connector in the 3 pin BLACK socket on the Analyzer. Connect the RED clip to the Positive (+) battery terminal. Connect the BLACK clip to a secure ground connection on the engine, frame, or alternator bracket. The BLACK clip should be the last connection made and the first to be disconnected. (The GREEN clip is not used for this test.)

WARNING

Avoid connecting the BLACK POWER clip directly to the battery Negative (-) terminal in the event that hydrogen gases are present which could explode from sparking connections.

2. Insert the BLUE RPM (13) connector into the BLUE socket of the Analyzer. Clamp the RPM pickup around the No. 1 spark plug wire. The clamp must completely enclose the spark plug wire. See Figure 7-2.
 3. Insert the YELLOW KV (12) connector into the YELLOW socket on the Analyzer. Clamp the KV (Ignition Kilovolts) pickup on the coil tower wire as shown in Figure 8-26. (Previous Section) The clamp should close completely around the wire.
 4. Set the ANALOG FUNCTION SELECTOR (4) to RPM.
 5. Set the ANALOG RANGE SELECTOR (3) to Low (1200 RPM).
- B. Test Procedure (External Coil Systems Only):
1. Start the engine and operate it at curb idle until it is fully warm (upper radiator hose hot).
 2. Set the ANALOG FUNCTION SELECTOR (4) to KV and the ANALOG RANGE SELECTOR (3) to the High (60 KV) position.

CAUTION

Selection of spark plug wires to be disconnected is critical on Ford and Motorcraft equipped Electronic Ignition Systems. Unless properly selected, damage to the ignition system electronics may result.

Do not disconnect:

- V-8 engines: No. 1 or No. 8 spark plug wire
- V-6 engines: No. 1 or No. 4 spark plug wire
- I-6 engines: No. 3 or No. 5 spark plug wire
- 4-Cylinder engines: No. 1 or No. 3 spark plug wire

3. Use a pair of insulated ignition wire pliers to remove each plug wire at the spark plug end one at a time, except the No. 1 spark plug wire or those listed in the Ford CAUTION. Do not leave a plug wire disconnected for more than a few seconds at a time on a catalytic converter equipped vehicle (overheating of the converter may occur and possibly damage it). For

proper test results, do NOT allow the removed plug wire to arc to ground.

CAUTION

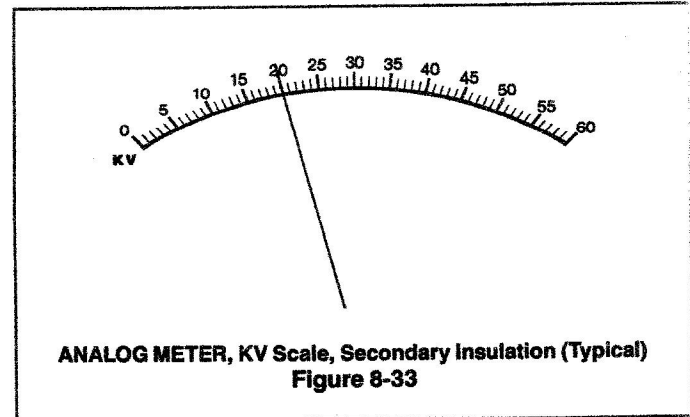
Some Chrysler products use a "positive-locking" terminal electrode spark plug wire. As shown by Figure 8-31, these plug wires can only be removed from inside the distributor cap. Damage may result to components if other means of removal are attempted.

WARNING

Do not let sparks occur near the carburetor or other fuel system components as a spark could ignite the gasoline vapors and cause a fire or explosion.

Move plug wires as little as possible out of normal operating position. Check for arcing which may indicate insulation breakdown.

4. Record the reading as shown on the 60 KV scale of the ANALOG METER (1) with the plug wire disconnected. See Figure 8-33.



C. Test Results (External Coil Systems Only):

1. Normal
 - a. All readings are approximately 20 KV or higher.
 - b. No obvious insulation breakdown (no sparking along plug wires, connectors, boots, coil tower etc.) is visible.
2. Abnormal

The abnormal test results listed below will direct you to the most likely problem areas. These test results may indicate a defect in the vehicle. Consult your vehicle service manual for the proper procedures to check these problem areas.

 - a. One or more readings are significantly below 20 KV.
 - b. Obvious sparking along plug wires, connectors, boots, etc.
 - c. Cracks or carbon tracking of the:
 - 1) Coil tower