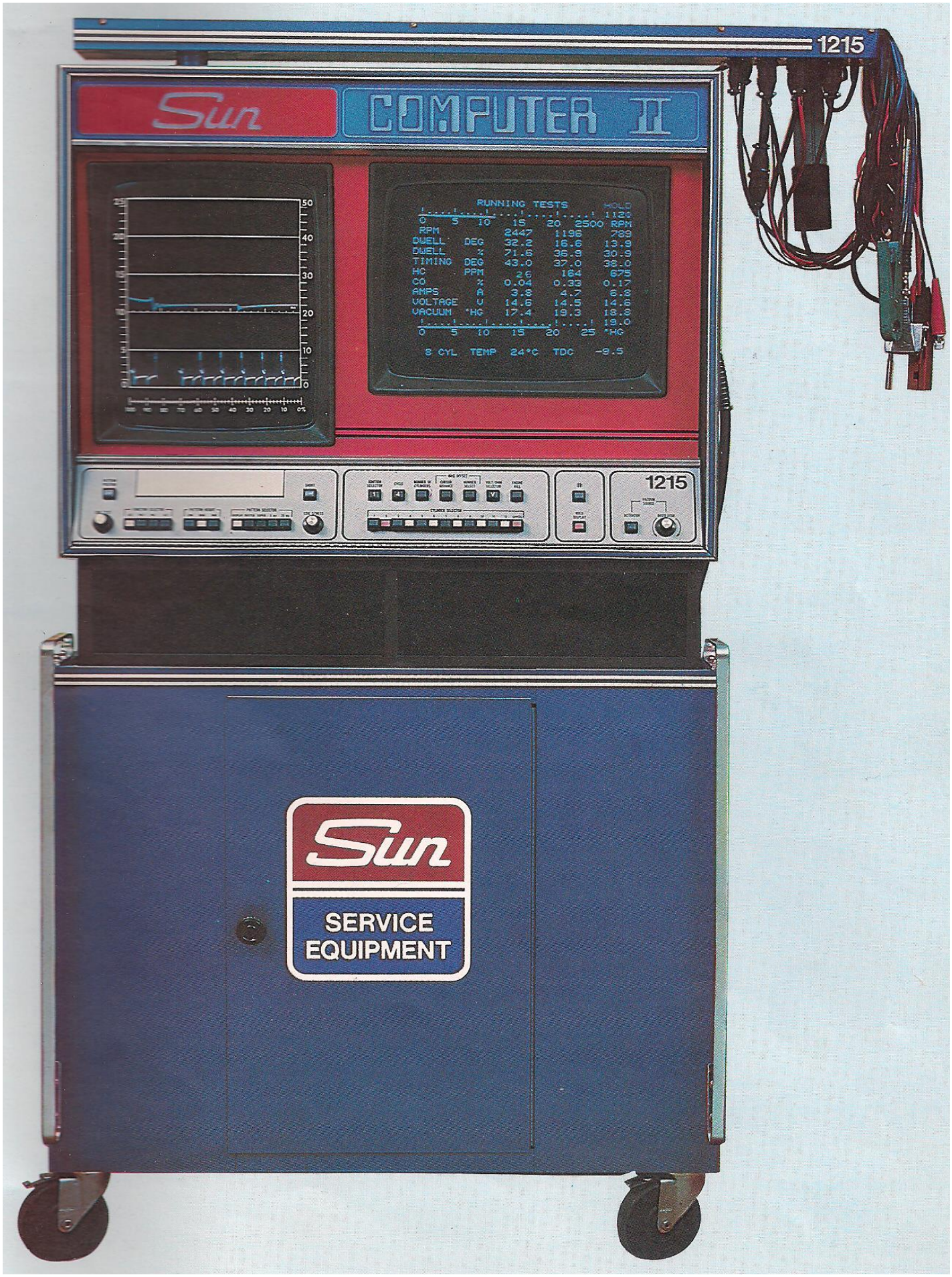
1215
Sun
COMPUTER II
RUNNING TESTS
HOLD
RPM 2447 1196 789
DWELL DEG 32.2 16.6 13.9
DWELL % 71.6 36.9 30.9
TIMING DEG 43.0 37.0 38.0
HC PPM 26 164 675
CO % 0.04 0.33 0.17
AMPS A 3.8 4.7 6.8
VOLTAGE V 14.6 14.5 14.6
VACUUM "HG 17.4 19.3 18.8
19.0
8 CYL TEMP 24°C TDC -9.5
1215
Sun
SERVICE
EQUIPMENT

COMPUTER II
SUN 1215
OPERATOR'S MANUAL

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FIGURE 1 — The SUN Computer II Tester consisting of an analog scope section (left), a digital display unit (right) and a pneumatic section (extreme right).

GENERAL INFORMATION

OPERATOR'S MANUAL

This manual will assist you to quickly become familiar with the SUN Computer II Tester. The GENERAL INFORMATION, TESTER OPERATION and AREA TESTING sections are your key to understanding your tester. The GENERAL INFORMATION section gives the location and function of each control. The TESTER OPERATION section gives the details on how the tester functions and the AREA TESTING section shows you how to connect the tester to the vehicle and how to perform a series of important tests that are used to check out an engine. These area tests are used to:

1. Determine overall engine performance prior to service work.

2. Determine what systems are failing and need further testing.

3. Determine if any important step was overlooked during service work by quality control testing after service work is completed.

Sun's specifications and other published materials along with the information in the remaining sections of this manual provide you with the detailed testing methods needed to thoroughly test a vehicle. Once you have become familiar with area testing, you can do detailed testing to check out any failure or malfunction detected during area testing.

DESCRIPTION

The tester is a complete scope diagnostic tester designed to meet the testing needs of the automotive industry with its highly sophisticated systems and components. The tester is computerized and self-calibrating and can display available test parameters in a programmed fashion along with the display of test data.

The tester uses two 19 inch scope screens to present all diagnostic information. One vertically mounted scope screen is an improved Sun analog ignition scope, having the capability of displaying ignition waveforms in the various advanced formats used by Sun. Two millisecond scales are provided for special testing. The second scope screen is mounted horizontally and is called the Digital Display Unit. This unit presents the digital test data on its screen in an easily readable format, eliminating the need for meters and gauges. For example, a vacuum bar graph gives the movements and fluctuations for test interpretation just as the pointer of a vacuum gauge.

SPECIAL FEATURES

The procedure for obtaining test data has been shortened and simplified. Three basic test pages are available. The first page is for Cranking and Static Tests. When an engine is started and the RPM increased to 1000 RPM, the tester automatically switches to the Running Page, where running tests are made. When the SHORT button is set to SHORT position, the tester will automatically display the Cylinder Analysis page, and test data for amps per cylinder taken during cranking will be displayed.

A cylinder power balance test can then be performed and test data will be displayed for Shorted RPM and Relative HC for each cylinder in the engine. Analysis of this page by the operator will provide useful information on the uniformity of the compression, ignition, and fuel distribution.

Three sets of data can be displayed on the RUNNING TEST page at the same time. For example, column one displays the latest updated data taken at high cruise. Column two could display data taken at low cruise speeds. Column three could display data taken at idle speed. Thus data taken in three different modes can be displayed simultaneously and reviewed as a history table of running tests.

A Remote Control Unit is one of the most useful features, permitting the operation of the tester from the driver's seat or from under the hood. This simplifies and speeds up testing procedures.

The tester contains a calibration page provided for checking and calibrating the tester and a Self Test page for checking the tester's electronic circuits and alpha-numerical character display.

Every fifth time the tester is cycled through the cranking and running test pages and back to the PROGRAM SET-UP page, a Self Test page will appear. SELF TEST IN PROGRESS appears at the top of page. After a few seconds, if everything is in order ALL IS IN ORDER appears, and the tester automatically advances to the PROGRAM SET-UP page. If a problem exists, the problem area is identified.

TESTER INFORMATION

The tester consists of three sections: the analog scope section, the digital display section, and the pneumatic section. The digital display section is the right section, the analog scope section is located to the left of the digital display section, and the pneumatic section is located at the right of the digital display section and uses the right corner of the digital display panel. See Figure 1.

Test leads to the vehicle emerge from a test harness boom mounted to the top left side of the tester. The test harness boom is free to swivel through 150 degrees, permitting easy access to the test leads at the engine compartment of the vehicle.

ANALOG IGNITION SCOPE

This section of the Computer II contains an analog oscilloscope (See Figure 2) and the electronic circuitry and controls necessary for displaying primary and secondary ignition waveforms. It also has facilities for displaying special waveforms for testing alternators, regulators, electronic ignition systems and other electronic systems. In addition, this section provides the facilities for testing conventional, transistor, and capacitive discharge type ignition coils.

SCOPE FACE

The face of the scope is scaled to permit convenient measurements of ignition firing voltages, maximum coil voltages and ignition point dwell on engines with 2, 3, 4, 5, 6, 8 or 12 cylinders. The vertical scale (Figure 2,1) on the left edge of the tube provides a range of 0 to 25 which can be read as 0 to 25 volts or 0 to 25 KV depending on whether primary or secondary waveforms are being viewed. The vertical scale (Figure 2,2) on the right edge of the tube provides a range of 0 to 50 which in turn can be read as 0 to 500 volts in primary or 0 to 50 KV in secondary.

The horizontal millisecond scale (Figure 2,3) is used to measure the time in milliseconds of any portion of the waveform. The horizontal dwell scale is divided into increments of 2 percentage points from 0 to 100 (Figure 2,4). A new percent dwell scale is used because it can be applied to engines with any number of cylinders. Since dwell readings are presented on the digital display screen, this scale is for quick reference while viewing scope waveforms.

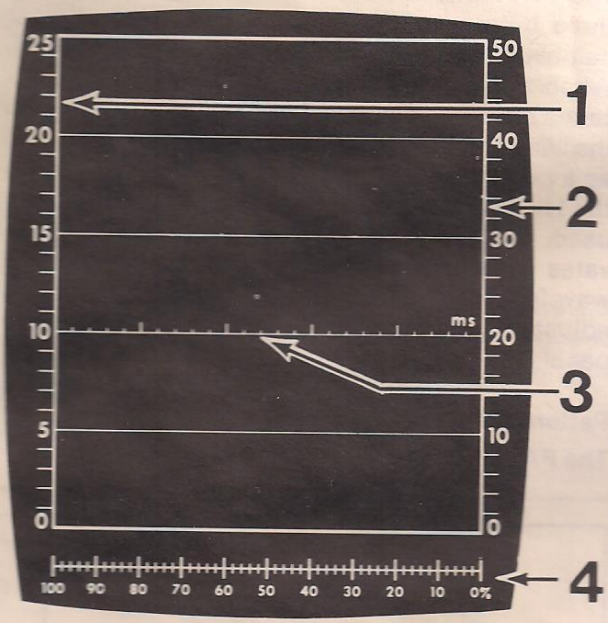


FIGURE 2 — Analog ignition scope.

SCOPE CONTROLS

The analog controls, located on the panel directly below the analog scope, provide a means of selecting the type of display desired. Directly behind a hinged panel (Figure 3,1) are six preset controls which provide adjustment of the scope BRIGHTNESS, the VERTICAL position of the waveform displayed, the HORIZONTAL position of the waveform, the LENGTH of the waveform, the HEIGHT of the waveform and the spacing between waveforms when they are displayed in the RASTER mode.

Coil Test

The COIL TEST rotary knob (Figure 3,2) has two positions, on and off. It is spring loaded to return

to the OFF position. For this test, the VOLT/OHM lead is connected to the coil test receptacle located on left side panel of the tester.

Function Selector

The FUNCTION SELECTOR (Figure 3,3) is a four button switch used to select the waveform that is to be displayed on the scope. The first button is pressed when secondary ignition waveforms are to be displayed. The second and third buttons are pressed for positive and negative primary waveforms. The fourth button is used to display special waveforms such as those from alternator diodes, voltage regulators, electronic ignition triggering coils, etc.

Pattern Height Control

The PATTERN HEIGHT control (Figure 3,4) is a three button control used to select the vertical height of the waveform displayed on the scope. When either primary or secondary ignition waveforms are being displayed and this control is set in the LOW position, the left hand 0 to 25 scale is used as a measuring device. When the control is set in the HIGH position, the right hand 0 to 50 scale is used. The VARIABLE position of the control activates a variable control for pattern height. The waveform produced in the VARIABLE position is adjusted with the HEIGHT knob on the scope panel.

Pattern Selector

The PATTERN SELECTOR (Figure 3,5) is a five button selector control which provides a means of selecting "how" an ignition waveform is to appear on the scope screen.

With the DISPLAY button depressed, all of the ignition waveforms appear in a horizontal row across the screen, with the #1 cylinder pattern at the left, and the others following to the right in the engine's firing order.

With the RASTER button depressed, all cylinder patterns are viewed at full screen width one above the other with the pattern of #1 cylinder at the bottom and the others evenly spaced above according to the engine's firing order.

With the SUPER (SUPERIMPOSED) button depressed, all cylinder patterns are placed one on top of the other.

With the 5 ms button depressed, the millisecond scale is read as a 5 ms scale. (Each major division is 1 ms, each minor division 0.2 ms.) With the 25 ms button depressed, the millisecond scale is read as a 25 ms scale. (Each major division is 5 ms, each minor division 1 ms.)

Coil Stress

The COIL STRESS knob (Figure 3,6) is used to set the stress level when performing the coil test. When the ignition coil is connected for the test, the COIL STRESS knob is turned clockwise until the stress level is reached as viewed on the scope.

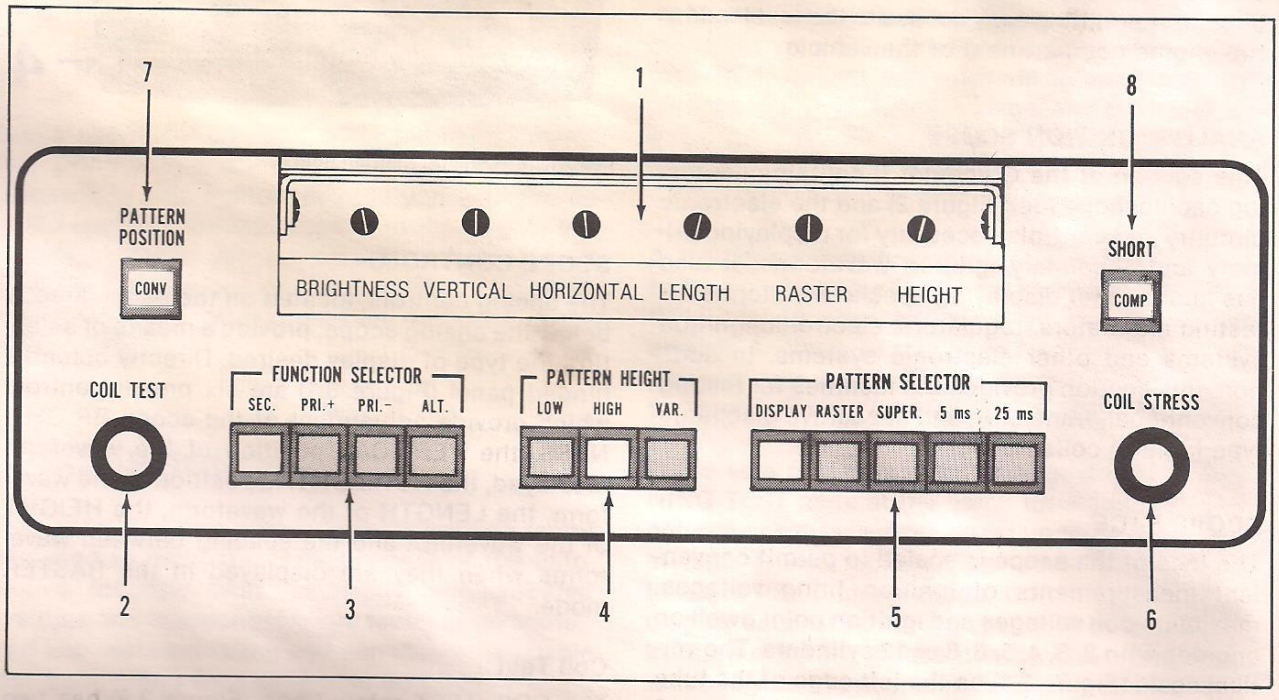


FIGURE 3 — Analog ignition scope controls.

Pattern Position

The PATTERN POSITION button (Figure 3,7) is a two position button with CONV (CONVENTIONAL) visible in the "out" position and SHIFT visible in the "in" position. The button is pushed for the "in" position and pushed again for the "out" position. When CONV is visible, the ignition patterns displayed will begin with a spark line on the left of the display pattern and a firing line at the right end of the pattern. When SHIFT is visible, the firing line from the right end of the pattern is shifted to the left to begin the first cylinder pattern. The SHIFT position can also be used in the RASTER display to shift the firing line to an intermediate position in the raster waveform.

Panel Short Button

The SHORT button (Figure 3,8) allows the selection of two button positions, COMP (COMPARE) and SHORT. With the SHORT button position appearing, the 12 buttons on the CYLINDER SELECTOR are used to short out the engine cylinders required to do a cylinder power balance test. With the COMPARE button position appearing, the 12 buttons on the CYLINDER SELECTOR are used to select display patterns on the scope.

The SHORT position is also used to transfer from the CRANKING/PINPOINT TESTS or RUNNING TESTS pages to the CYLINDER ANALYSIS page. Release of SHORT position will return the computer to the same page previously shown.

DIGITAL DISPLAY PANEL

The Digital Display Panel is located in the tester console just below the Digital Display screen.

Ignition Selector

The IGNITION SELECTOR (Figure 4,1) is a two position button with 1 and 2 screened on the "in" and "out" positions, respectively. Position #1 is used for most systems. The number 2 position is used for CD (Capacitive Discharge) ignition systems and systems requiring special triggering. This position provides various levels of primary triggering for systems which mistrigger in position 1. This includes systems with solid ignition wires and certain other systems such as Mercedes Benz, Renault and others.

Cycle Button

The CYCLE button (Figure 4,2) is a two position button with 2 and 4 screened on the "in" and "out" positions, respectively. It is used to select the type of ignition system being tested, and programs the tester for a 4 cycle or 2 cycle/rotary type ignition system.

Number of Cylinders

The NUMBER OF CYLINDERS button (Figure 4,3) is a push and release button that will advance to desired number of cylinders and display this number on the Digital Display screen.

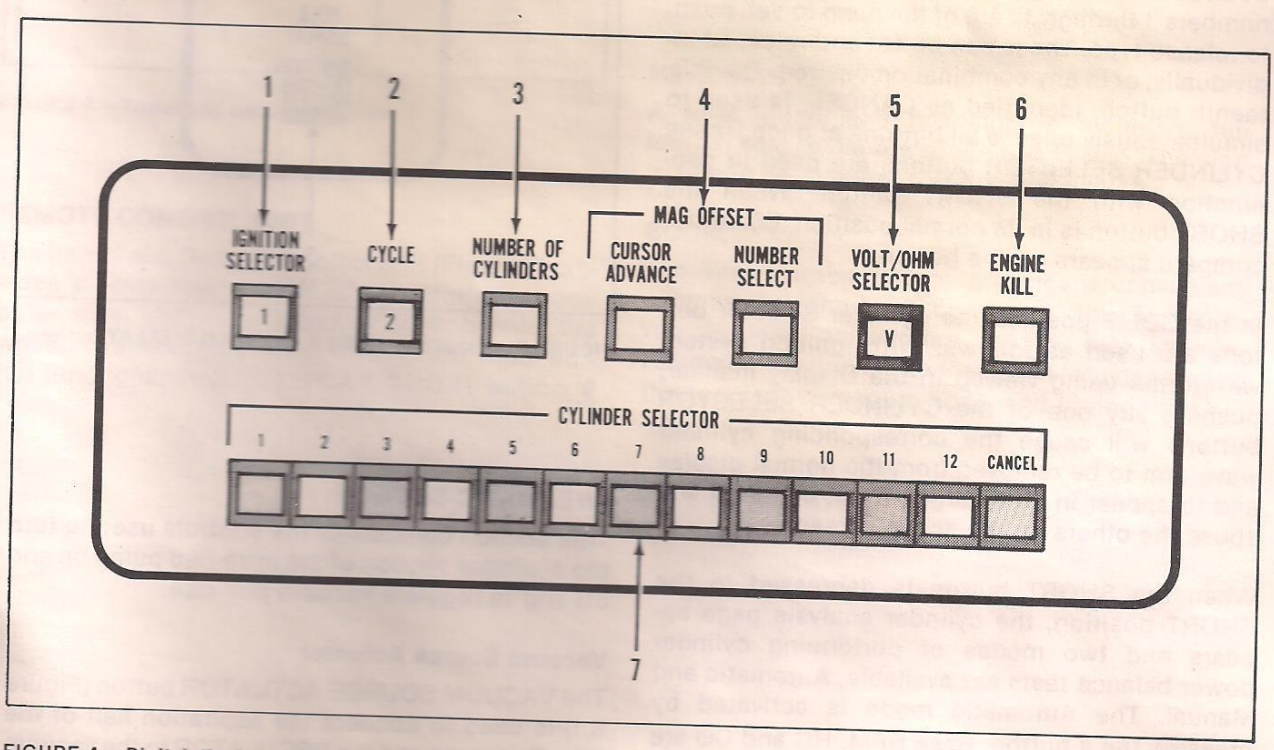


FIGURE 4 — Digital display section controls.

Magnetic Offset

The MAG OFFSET (Figure 4,4) contains two buttons, the CURSOR ADVANCE button and the NUMBER SELECT button. Both buttons are push and release buttons used for setting the magnetic offset angle.

Volt/Ohm Selector

The VOLT/OHM SELECTOR (Figure 4,5) is a two position button with the symbol for ohms and volts screened on the "in" and "out" positions respectively. It is used to select whether ohms or volts are to be measured.

Engine Kill

The ENGINE KILL button (Figure 4,6) is pressed to apply and pressed to release. It electronically shorts out the ignition system for all cylinders and disables the engine. This allows cranking tests to be performed without physically disabling the ignition system, this being especially useful on High Energy Ignition (HEI) systems. The KILL button also provides a quick means of stopping the engine should an unexpected emergency arise.

Cylinder Selector

At the bottom of the control panel is a series of thirteen buttons, identified as a CYLINDER SELECTOR (Figure 4,7). The buttons identified by numbers 1 through 12 are of the push-to-set, push-to-release type. These can be set and released individually, or in any combination desired. The thirteenth button, identified as CANCEL, is used to simultaneously release all buttons at once. These CYLINDER SELECTOR buttons are used in conjunction with the SHORT button. When the SHORT button is in its normal position, COMP for compare appears on the button.

In the COMP position the Cylinder Selector buttons are used as follows: With ignition system waveforms being viewed in the Display manner, pushing any one of the CYLINDER SELECTOR buttons will cause the corresponding cylinder waveform to be removed from the normal display and to appear in an enlarged form, centered and above the others on the scope screen.

When the SHORT button is depressed to the SHORT position, the cylinder analysis page appears and two modes of performing cylinder power balance tests are available, Automatic and Manual. The Automatic mode is activated by pressing the # button. Base RPM, HC and CO are displayed, then the shorted RPM for each cylinder is displayed. At the finish, HC Change for each cylinder is displayed.

When the manual mode is used the shorted RPM for each cylinder or group of cylinders is displayed and retained until the page is cleared by pressing the SHORT button to the compare mode.

SYMBOL # BUTTON

The SYMBOL # button (Figure 5,1) is located on the panel next to the Digital Display Panel. It has several functions depending on the page displayed and the position of the HOLD button.

HOLD DISPLAY BUTTON

The HOLD DISPLAY button (Figure 5,2) located under the # button, is a push to set and push to release button used to freeze the data displayed on the Digital Display Screen.

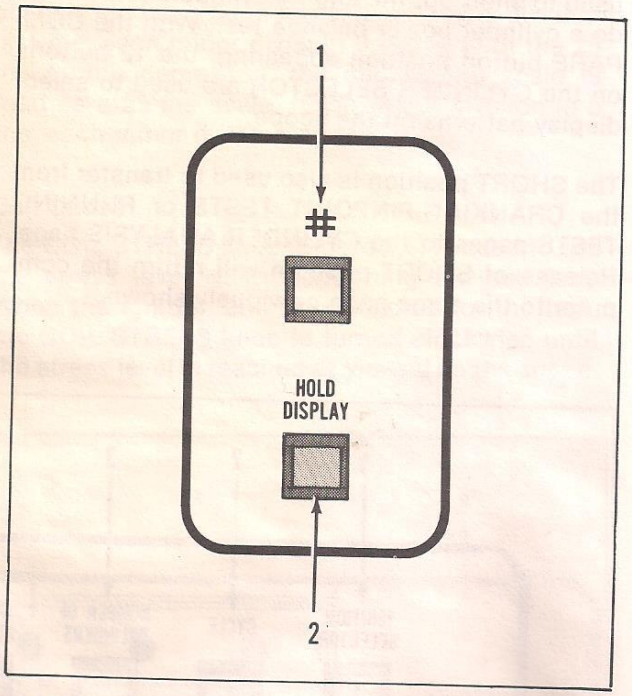


FIGURE 5 — Panel containing # and HOLD DISPLAY buttons.

PNEUMATIC SECTION

This section consists of the controls used to turn the aspirator section of the Infra-Red pump on and off and to regulate vacuum pull rate.

Vacuum Source Actuator

The VACUUM SOURCE ACTUATOR button (Figure 6,1) is used to connect the aspiration half of the Infra-Red pump and the REGULATOR to the vacuum

system. This button is a two position push button, press to connect and press again to disconnect. When ACTUATOR button is in, VACUUM SOURCE flashes on the screen indicating that any vacuum data is coming from the vacuum pump and not engine vacuum. When tester vacuum source is not being used, the REGULATOR should be fully counterclockwise and ACTUATOR should be out (off).

Vacuum Source Regulator

The VACUUM SOURCE REGULATOR knob (Figure 6,2) allows the vacuum pulled by the vacuum pump to be adjusted.

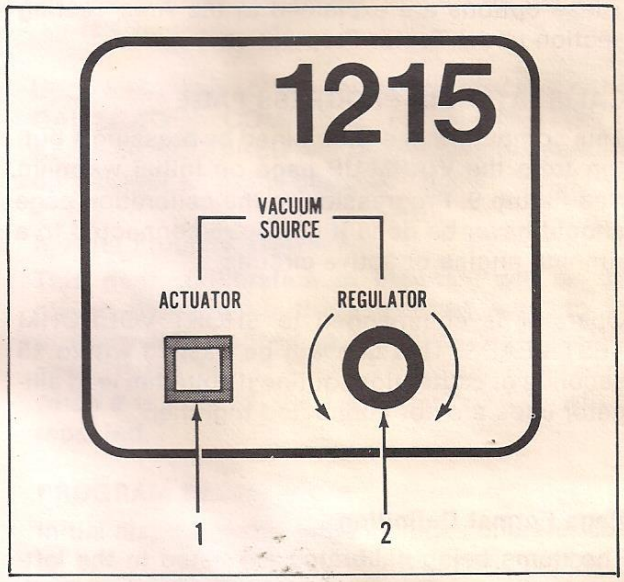


FIGURE 6 — Pneumatic section controls.

REMOTE CONTROL UNIT

The hand held, Remote Control Unit (Figure 7) provides a convenient means of operating the computer from under the hood or from behind the wheel. The Remote Control Unit controls four button functions: HOLD DISPLAY, SHORT button, # button, and ENGINE KILL button operations. The Remote Control Unit is plugged into the left end side panel of the tester.

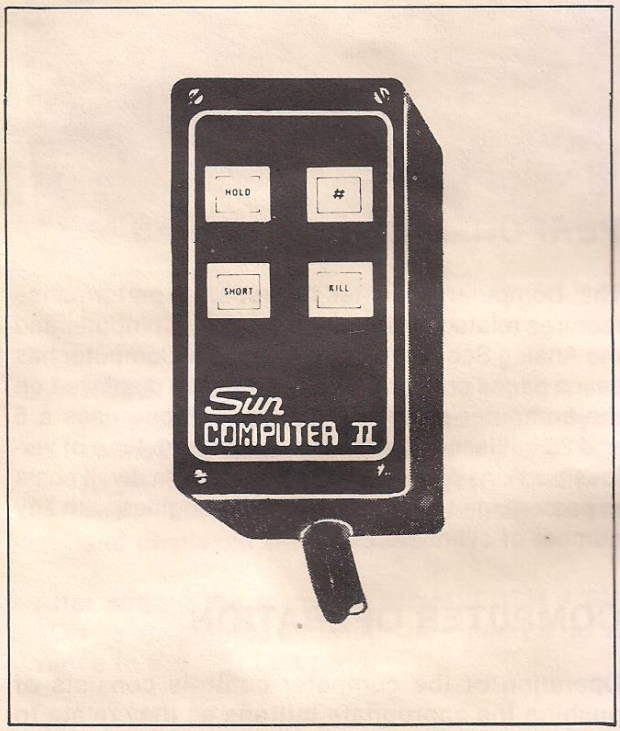


FIGURE 7 — The Remote Control Unit.

HEADSIGN

A fully illuminated headsign is mounted, full length, across the top of the headframe. The sign is turned on by means of a power switch.

BOOM

The Test Harness Boom provides a convenient overhead method of conveying the tester-to-vehicle lead assemblies to the test vehicle. Hangers are attached to the boom for suspending the test leads, vacuum hose, and timing light.

TESTER OPERATION

PERFORMANCE FEATURES

The Computer II Tester has special performance features related to the Digital Display Computer and the Analog Scope. The Digital Display Computer has seven pages or formats of data that are displayed on the computer screen. The Analog Scope uses a 5 and 25 millisecond scale to measure the time of various portions of the waveform and has a dwell scale in percentage to measure dwell on engines with any number of cylinders.

COMPUTER OPERATION

Operation of the computer controls consists of pushing the appropriate buttons as they relate to seven pages. The first page to be displayed is the Warm-up Page (Figure 8). When the tester is turned on, the first four lines of the Warm-up Page will appear on the screen. After 15 minutes of warm-up time, the last two lines are displayed informing the operator that Warm-up is complete and requesting him to push the # button.

If the operator does not wish to wait the warm-u
period, there are other options which allow him t
use the tester before the 15 minute period is ove
These options are explained in the Area Testin
section under Tester Preparation.

CALIBRATION IN PROGRESS PAGE

This computer page is obtained by pressing # bu
ton from the WARM-UP page on initial warm-u
See Figure 9. Progression to the calibration pag
should never be done if leads are connected to
running engine or active circuits.

Operator is commanded to SHORT VOLT/OHM
TEST LEADS. This cue will be flashed within 1
seconds of calibration routine if volt/ohm lead alli
gator clips are not connected together.

Page Format Definition

The items being calibrated are listed in the left-
hand column. The computer will check or cali-
brate each item using internal standards and dis-
play the results, either GOOD or SERVICE RE-
QUIRED or NOT CALIBRATED.

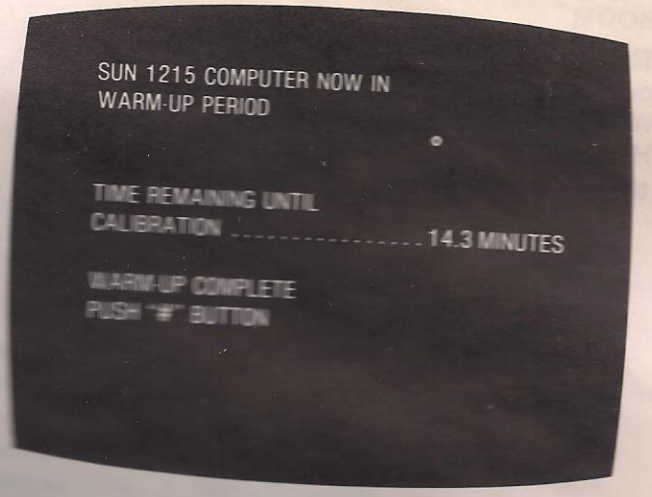


FIGURE 8—The first display shown on the Digital Display screen.

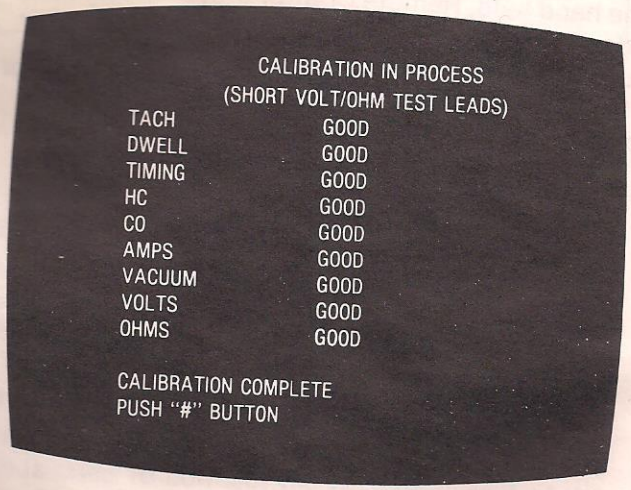


FIGURE 9—Calibration page where all items check satisfactory.

Items, after which "SERVICE REQUIRED" has appeared and has not been serviced, will have asterisks displayed instead of test data on the test pages.

Operator is also informed of high or low line voltage conditions on this page should they exist. LINE VOLTAGE HIGH or LINE VOLTAGE LOW will appear at bottom of the page if line voltage is above 132 or below 108 Volts AC, respectively. Tester may not be as accurate with high or low line voltage—especially with low line voltage. Check line voltage and correct before calling the Sun Representative for service.

NOTE: Vacuum processor will not calibrate if the vacuum source ACTUATOR on the panel is ON.

Upon completion of the calibration process, either CALIBRATION COMPLETE, PUSH # BUTTON or SERVICE REQUIRED will be displayed depending on whether all items checked "good" or not.

Moving Program Forward

This page (Calibration In Process) will be displayed until the # button is pushed, whereby the program is advanced to the PROGRAM SET-UP page. If the HOLD DISPLAY button is selected when # is pushed, the calibration routine will be repeated.

PROGRAM SET-UP PAGE

Initial display of this page includes operator cues to select ignition type, engine type, number of cylinders and magnetic offset (Figure 10).

The magnetic timing offset is set using the CURSOR ADVANCE and the NUMBER SELECT button. Minimum operator requirement is to set the NUMBER OF CYLINDERS button to match the engine being tested and advance the cursor through the hundredths digit and off the screen if magnetic timing is not being used or if the offset angle is zero.

Upon returning to this page after initial setup, the cursor or the number of cylinders does not require being reset.

The timing advance control on the Timing Light will not function if the Magnetic Pickup is used or if automatically sensed European systems are being tested. If it is necessary to use the Timing Light when the Magnetic Pickup is in place in the engine, removing the Magnetic Pickup from the engine will activate the timing advance control on the Timing Light.

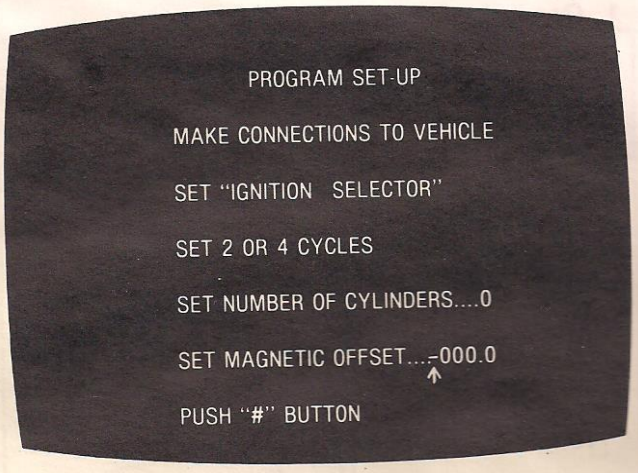


FIGURE 10—Program set-up page instructs operator to connect leads and set controls.

NOTE: The number of cylinders and the magnetic timing offset is set on this page only and cannot be manually changed on any other page. European magnetic systems with 0° and −20° offsets are automatically sensed and displayed when present.

After setting the magnetic offset, PUSH # BUTTON is displayed, allowing the operator to advance to the first test page.

Use Of Offset Angle

The Magnetic Timing Probe (where applicable) can be used in place of the conventional timing light. In place of observing the crankshaft timing marks to determine initial timing and timing advance, the probe will display this information digitally on the screen.

The magnetic probe picks up a signal which indicates engine Top Dead Center. The trigger pickup indicates where the #1 spark plug fires. Tester electronics then uses this information to provide a digital readout of the exact engine timing at any moment at any speed.

The list of Domestic made cars equipped for magnetic timing cannot be compiled with 100% accuracy, especially on older cars.

To check a car for a magnetic probe holder, refer to the 1977 and on Sun specification cards. The timing mark illustration shows the probe holder and location on engines so equipped.

Using this information and the application chart following, the probe holder for any vehicle so equipped can be located. Domestic made cars and some imports equipped for Magnetic Timing are as follows:

Tester Operation

1. **General Motors Corp.**
   Oldsmobile — 1974 up
   Cadillac — 1975 up
   Chevette — 1976 up
   All Divisions— 1977 with a few exceptions
   All Divisions— 1978 and 1979 except Pontiac 4 cylinder
   All Divisions— 1980 All GM Model X cars
2. **Chrysler Corp.**
   1976 — 400 CID engines
   1977 — 400 and 440 CID engines
   1978 — All
   1979 — All
3. **Ford Motor Co.**
   All — 1975, '76, '77, '78, '79 California Vehicles
   1978 Lincoln Versailles and all 2.3 liter engines
   1979 All engines with EEC Control system
4. **American Motors and Jeep**
   1977 — Some Models
   1978 — All Models
   1979 — All Models
5. **Import Vehicles**
   Some import vehicles have built in magnetic TDC sensors connected to a test harness adapter. These vehicles use a 20° offset angle.

   The 0°/20° Auto position of the Manual-Auto selector switch is for future use on these vehicles.

Connect the Magnetic Pickup probe to the vehicles as follows:

1. Mount the Magnetic Pickup probe adapter as follows:
   a. American Motors and General Motors—no adapter needed.
   b. Chrysler Products—(1) **Early type** for horseshoe shaped holder, use Adapter C-1.
      Position adapter in timing bracket on timing cover as shown in Figure 11. (2) **Late type** for insert type holder, insert Adapter C-2 in timing bracket on timing chain cover. See Figure 12.
   c. Ford—(except 2300 cc engine) insert special Ford Probe Mounting Adapter F-1 in timing bracket on timing chain cover (V-8, V-6 and L-6 engines so equipped). See Figure 13.
   d. Ford 2300 cc engine—remove the threaded 13 mm hex plug from the left rear of the engine and screw the special Ford Probe Mounting Adapter F-2 in the opening (finger tight). See Figure 14.

      CAUTION: Make sure that the probe and lead assembly is clear of fan, pulleys, etc.
2. Insert the Magnetic Pickup probe in the holder so that the probe tip is in contact with the engine vibration dampener (except 2300 cc Ford Engine).
3. On the 2300 cc engine, insert probe in opening provided until the lock ring on the probe contacts the adapter. This permits the probe to enter to the proper depth.

   NOTE: Any adapters used must be removed after testing is completed.

Determining Offset Angle

The offset angles for domestic vehicles are as follows:

American Motors is minus (–) 9.5°.
Chrysler is minus (–) 10.0°.
Ford is minus (–) 135°, except 2300 cc engine is minus (–) 52.5°.
General Motors is minus (–) 9.5°.

Entry Of Offset Angle

To enter a MAG OFFSET angle, determine the correct offset angle for the vehicle being tested. The CURSOR ADVANCE is pointing to the negative (–) sign in the initial display (– 000.00). Press the NUMBER SELECT button once if a positive number is desired. However, at this time only negative offset angles are used.

The offset number is entered by pressing the CURSOR ADVANCE button the number of times it takes to place it under the position where a number is to be entered. Then, hold the NUMBER SELECT button in until the correct number is displayed. Proceeding from left to right in this manner while taking the decimal point into account, enter each digit as required. After the complete number is entered, move CURSOR ADVANCE off the screen.

NOTE: If a mistake is made, move CURSOR ADVANCE off the screen and back to the beginning to start the entering process again. Also, the magnetic offset angle will appear on the screen only when the probe is being used.

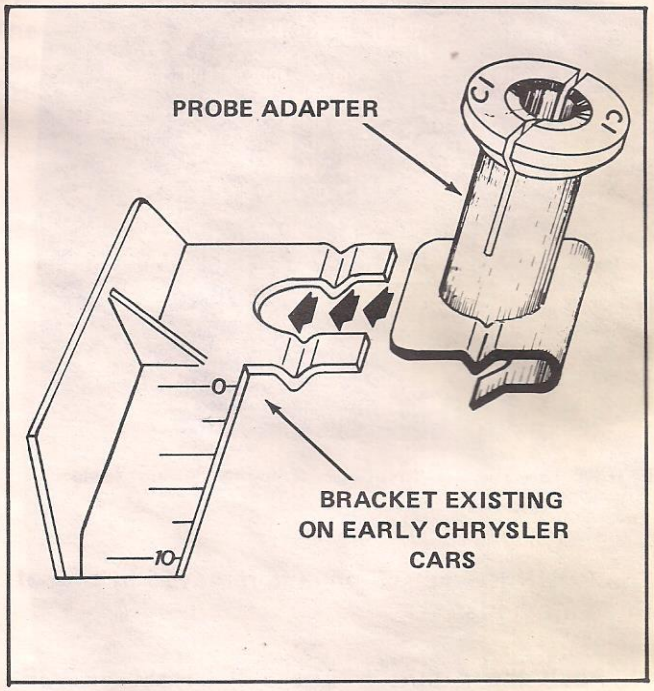


FIGURE 11—Adapter for early Chrysler cars.

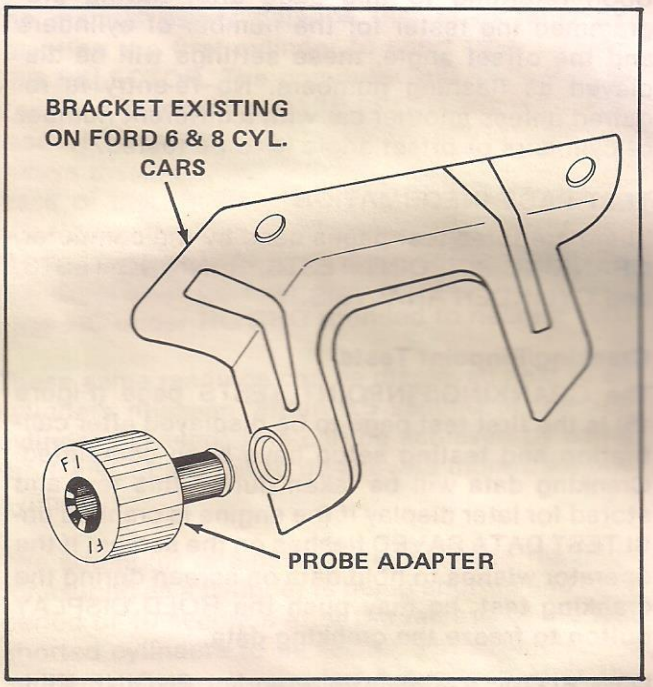


FIGURE 13—Adapter for Ford cars except 2300 cc engine.

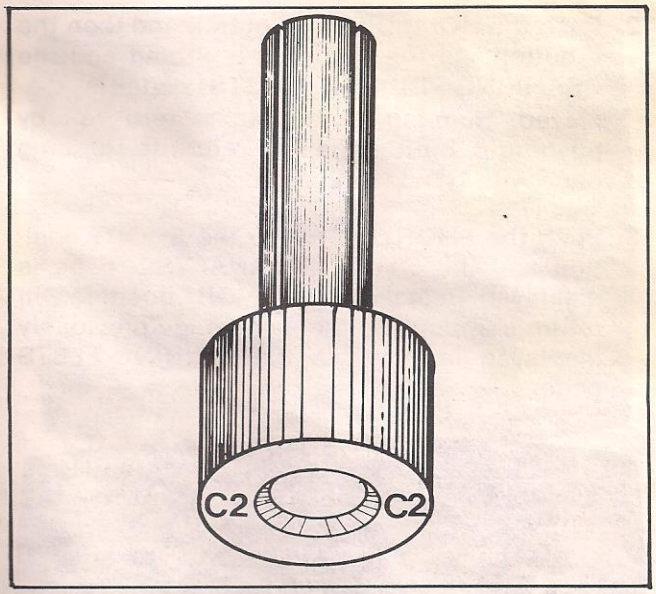


FIGURE 12—Adapter for late Chrysler cars.

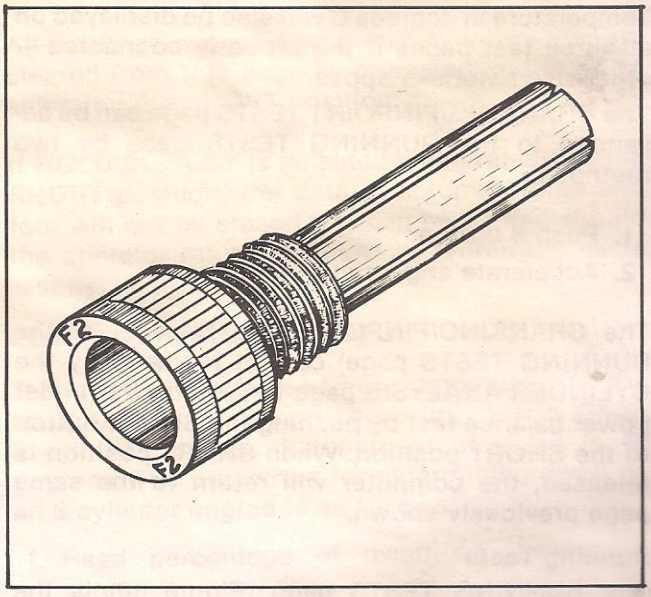


FIGURE 14—Adapter for Ford cars with 2300 cc engine.

Tester Operation

Upon returning to this page after having programmed the tester for the number of cylinders and the offset angle, these settings will be displayed as flashing numbers. No re-entry is required unless another car with a different number of cylinders or offset angle is to be tested.

TEST PAGE INFORMATION

There are three test pages used by the computer, CRANKING/PINPOINT TESTS, RUNNING TESTS, and CYLINDER ANALYSIS.

Cranking/Pinpoint Tests

The CRANKING/PINPOINT TESTS page (Figure 15) is the first test page to be displayed after calibration and testing setup have been completed. Cranking data will be taken during this test and stored for later display if the engine is cranked until TEST DATA SAVED flashes on the screen. If the operator wishes to hold data on screen during the cranking test, he may push the HOLD DISPLAY button to freeze the cranking data.

LOW FLOW, VAC SOURCE and/or ENGINE KILL will flash on screen as status indication that Infra-Red and vacuum power source are not functioning correctly and ENGINE KILL button is in effect. Temperature in degrees C will also be displayed on all three test pages if the probe is connected — otherwise asterisks appear.

The CRANKING/PINPOINT TESTS page can be advanced to the RUNNING TESTS page by two methods.

1. Push # button.
2. Accelerate engine over 1000 rpm.

The CRANKING/PINPOINT TESTS page (or the RUNNING TESTS page) can be replaced by the CYLINDER ANALYSIS page to perform a cylinder power balance test by pushing the SHORT button to the SHORT position. When SHORT position is released, the computer will return to the same page previously shown.

Running Tests

The RUNNING TESTS page (Figure 16) is the second test page. Updated data is always displayed in column one unless the HOLD DISPLAY is used to freeze the data.

NOTE: The bar graphs are not frozen nor is the related data shown at the end of the bar graphs.

Upon release of the HOLD DISPLAY button, data on hold in column one is shifted to column two while any data stored in column two will be shifted to column three.

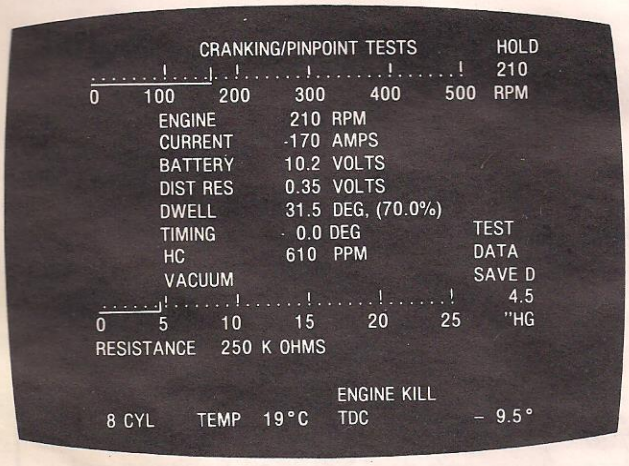


FIGURE 15—The first test page, cranking/pinpoint tests.

The RUNNING TESTS page is removed by one of three methods:

1. Push the # button. The PROGRAM SET-UP page is displayed to begin next vehicle test. However, every fifth test cycle the SELF TEST page appears.
2. Push the HOLD DISPLAY button and then the # button. All the test data is stored and the CRANKING/PINPOINT TESTS page is displayed. Running page data is retrieved by pushing # button again to return to Running page with HOLD button on.
3. Push the SHORT button to the SHORT position and the CYLINDER ANALYSIS page is displayed. Release of the SHORT position will return computer to the same page previously displayed (in this case, the RUNNING TESTS page).

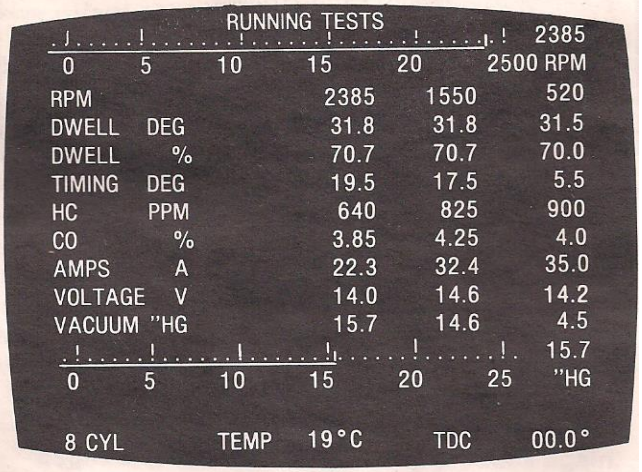


FIGURE 16—The second test page, running tests.

Cylinder Analysis Page

The CYLINDER ANALYSIS page is the third test page, and can only be selected by pushing the SHORT button to the SHORT position while the computer is in either of the other two test pages.

The following explanation applies to 8 cylinder test vehicles only (Figure 17). Twelve cylinder engines will be displayed as shown in Figure 18.

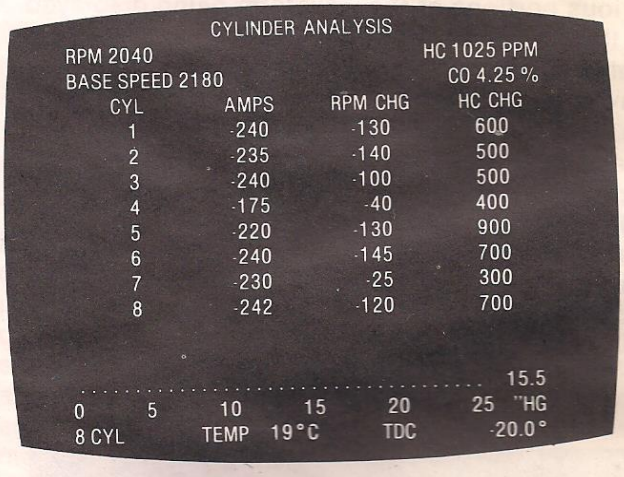


FIGURE 17—Display page for test vehicle with 8 cylinders or less.

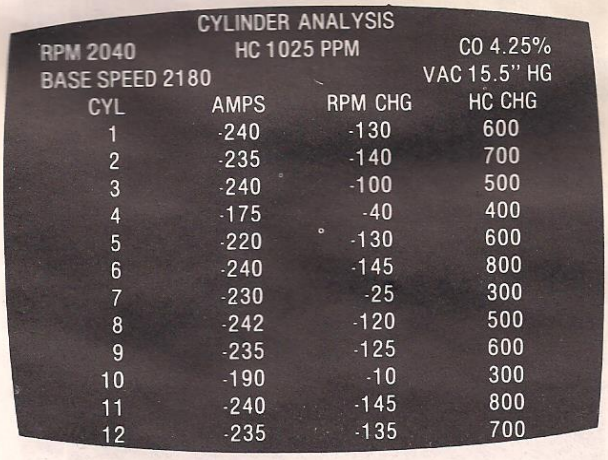


FIGURE 18—Display page for test vehicle with 12 cylinders.

Column one contains cylinder numbers. Column two contains current draw in Amps Per Cylinder. (On initial display this is stored data from cranking tests.) Columns three and four display RPM CHANGE and HC CHANGE respectively.

NOTE: If the TRIGGER PICKUP is not clamped around the No. 1 spark plug, the data in column two will have asterisks after them.

The operator may perform an **automatic** or a **manual** power balance test. The automatic power balance test is initiated by pushing the # button.

Manual Power Balance Test

The manual power balance test is initiated by selecting the first cylinder to short from CYLINDER SELECTOR. The computer will immediately store and display the BASE SPEED and store the base HC reading. The updated HC reading is always displayed but not the base HC. Upon release of the last shorted cylinder, the computer will display the difference between base RPM and the last shorted RPM reading under RPM CHG and the difference between the shorted HC to the base HC under HC CHG rounded to nearest 100.

These same readings can be displayed next to all cylinders released within 0.5 second of the last cylinder released. This can be achieved by using the CANCEL button to de-activate more than one cylinder.

The computer retains the original base readings for as long as a cylinder is being shorted and for a period of 10 seconds after the release of the last shorted cylinders to be tested. For example, if a second cylinder is shorted 5 seconds after the release of the last test cylinder, the same base will be retained. If more than 10 seconds elapse, new base readings will be taken.

All readings except AMPS (per cylinder) may be cleared from this page by releasing and then re-selecting the SHORT position.

If HOLD DISPLAY is selected when releasing the SHORT position, the data in columns three and four will not be erased and can be viewed should the operator return to this page within the same test cycle.

READING DWELL ON SCOPE

The dwell angle is read as a percentage of the total duration for one cylinder's firing cycle. On an 8 cylinder engine, 100 percent of dwell is 45 degrees. The procedure for determining dwell on an 8 cylinder engine is as follows:

1. Read percentage of dwell on the scope screen.
2. Multiply 45 degrees by the percentage of dwell read.
3. The product is the degrees of dwell.

EXAMPLE #1: If you read 50% dwell, multiply 45° by 0.50:

$$\begin{array}{r} 45^\circ \\ \times\ 0.5 \\ \hline 22.5^\circ \end{array}$$

22.5° is the dwell angle.

NOTE: Percentage must be converted to a decimal fraction during calculations.

EXAMPLE #2: If you read 40% dwell, multiply 45° by 0.40:

45°
0.4
18.0° is the dwell angle.

By knowing 100% of dwell for a given engine, any percentage of dwell read on the scope screen can be converted to dwell degrees by multiplying percentage read times 100% engine dwell in degrees. 100% dwell for all test engines are:

12 cylinder engine = 30 degrees
8 cylinder engine = 45 degrees
6 cylinder engine = 60 degrees
5 cylinder engine = 72 degrees
4 cylinder engine = 90 degrees
3 cylinder engine = 120 degrees
2 cylinder engine = 180 degrees

READING MS SCALES

The millisecond scales are used to measure the various portions of the waveform being displayed on the scope screen. When the 5 ms button is depressed, just that portion of the waveform is displayed which takes place in 5 milliseconds (Figure 19). The main divisions of the scale represents one millisecond. When the 25 ms button is depressed, the total length of the waveform is normally displayed, and its total length and any portion therein can be measured (Figure 20). The main division of the 25 ms scale are 5 milliseconds each with subdivisions equaling one millisecond.

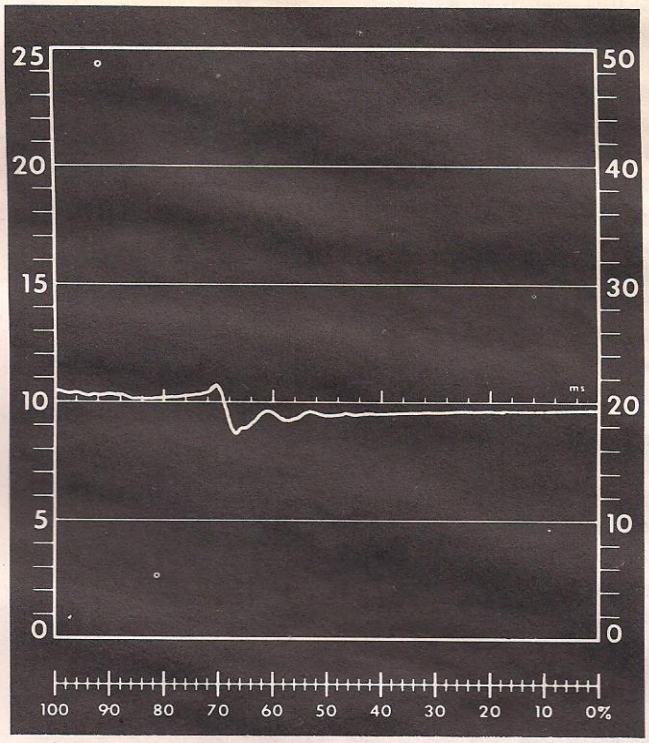


FIGURE 19—HEI ignition waveform shown on 5 ms scale.

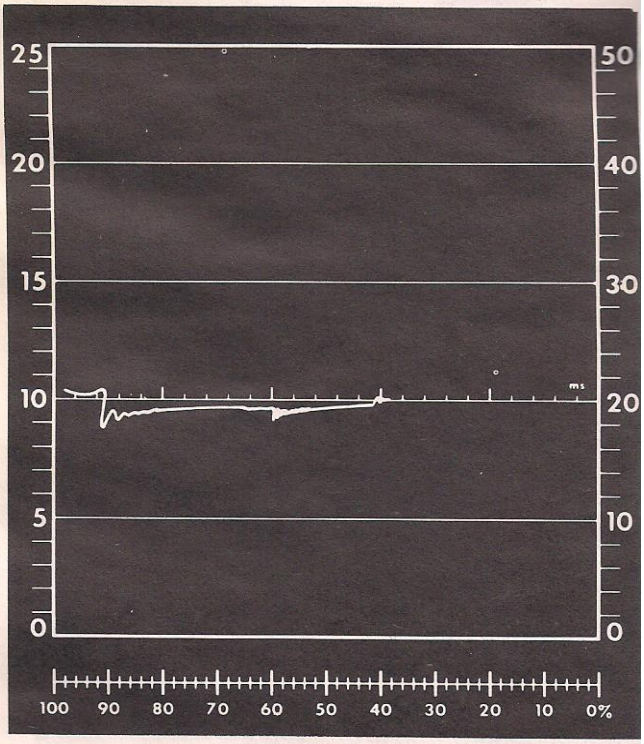


FIGURE 20—HEI ignition waveform shown on 25 ms scale.

AREA TESTING

AREA TESTING PROCEDURE

The factual information obtained from a systematized series of tests, when compared with specifications and known standards, provides an accurate picture of an engine's condition. This series of tests to determine the true condition of the engine by testing the engine systems is called area testing. When the true conditions of an engine's operating systems are determined, the mechanic has little trouble knowing what service or what further detailed testing to perform.

TESTER PREPARATION

1. Plug tester POWER CORD into proper AC outlet (see nameplate on tester).
2. Turn on AC power to tester. Tester headframe will light, and the first four lines of the Warm-up page will appear.
3. Set scope FUNCTION SELECTOR to SEC, PATTERN HEIGHT to HIGH and PATTERN SELECTOR to 5 ms.
4. Set Remote Control Unit and all remaining panel buttons to off or **out** position. Set vacuum REGULATOR control to fully counterclockwise position.
5. Two procedures can be followed concerning the Warm-up page:

   a. Operate tester with HC and CO calibrated. After 15 minutes, the last two lines of Warm-up page are displayed. After 3 minutes of warm-up time, the program may be advanced to the CALIBRATION IN PROGRESS page as an option by pressing the # button.

   b. Operate tester without HC and CO readings. Push # button and proceed directly to calibration page. The tester will calibrate all test parameters except HC and CO. HC and CO calibration is skipped and NOT CALIBRATED will appear opposite HC and CO. Tester is now usable except HC and CO will have stars displayed instead of data.

TESTER CALIBRATION

1. After the warm-up period has passed, press the # button and the CALIBRATION IN PROGRESS page appears.
2. Connect the Red Twinflex VOLT/OHM test lead clips together. A flashing message, SHORT VOLT/OHM TEST LEADS, is a reminder when the leads are not connected.

   NOTE: To obtain proper calibration, it is important that the test leads and the vacuum hose are <u>not</u> connected to a running engine at the time of calibration.

   The computer will calibrate each testing mechanism listed on this page, and display GOOD or SERVICE REQUIRED opposite the testing units. Operator is also informed of high or low line voltage or LOW FLOW of infrared unit on this page should they exist.
3. Correct any conditions which are preventing the computer from calibrating the test items indicating SERVICE REQUIRED, unless testing of these items are not to be performed in a particular test cycle. The Service Required condition may be caused by leads being connected to a running engine.

   NOTE: Test items after which SERVICE REQUIRED has appeared, will have asterisks displayed in place of any readings on the test page.
4. Push # button, and PROGRAM SET-UP page will appear.

   NOTE: To recalibrate tester, press HOLD button and press the # button, whereupon calibration will be repeated.

Area Testing

USING REMOTE CONTROL UNIT

The Remote Control buttons #, SHORT, HOLD, and KILL have the same function as the panel buttons.

When using the Remote Control the SHORT and HOLD buttons must be set to the OFF or OUT positions on the tester panel.

To switch back to panel controls, the Remote Control SHORT and HOLD buttons must be off.

POSITION SCOPE CONTROLS

1. Adjust BRIGHTNESS control as desired.
2. Adjust VERTICAL control so that scope trace line rests on scope zero line.
3. Adjust HORIZONTAL control to align the left end of the scope trace with the left edge (0-25 KV line) of the scope screen.
4. Adjust the LENGTH control to align the right end of the scope trace with the right edge (0-50 KV line) of the scope screen.

   NOTE: To adjust LENGTH control, engine must be running.

5. The RASTER control is not adjusted at this time. Adjust RASTER when necessary during testing.
6. Adjust HEIGHT control fully clockwise—only used in VARIABLE position setting.

TESTING PROCEDURE

For best results use the Sun Computer II Engine Performance Test Report form. Enter specifications, perform specified tests, and enter test results for evaluation when finished. Except for alternator check and optional timing advance test, all tests can be run, engine stopped, and then test data can be recorded by recalling each test page.

Then refer to the section, Area Performance Analysis Guide, for a guide to interpreting the results of area testing.

PROGRAM SET-UP PAGE

After calibration procedure is complete, push # button to obtain the PROGRAM SET-UP page.

NOTE: By going back to the calibration page after 3 minutes or more, HC and CO will be calibrated. Return to Program Set-Up page, push HOLD and push # button to get to calibration page.

Make Connections to Vehicle

1. Connect the leads from the Universal Harness as follows. See Figure 21.
   a. Install Magnetic Timing Pickup (as applicable). See Tester Operation section headings, Use Of Offset Angle and Determining Offset Angle.
   b. Connect Blue Primary lead to the negative terminal of the ignition coil (on electronic and transistor ignition, to the specified terminal).
   c. Connect Red Positive Battery lead to the positive terminal of the battery.
   d. Connect Black Engine Ground lead to negative battery terminal.
2. Clamp Chrome Pattern Pickup around the secondary coil wire (On G. M. HEI Systems with ignition coil in distributor cap, use Sun HEI Adapter #1747-102.)

   NOTE: A special extension for HEI distributors requiring a right angle pickup may be required. See Components And Accessories Section.

3. Clamp Red Trigger Pickup around number 1 spark plug wire close to the distributor cap.
4. Clamp Green Ammeter Pickup around negative battery cable (all negative cables if there are more than one) with arrow pointing away from battery.
5. Connect Vacuum Hose to a source of engine vacuum.
6. Insert Emission Sampling Probe into vehicle tail pipe.
7. Set timing advance control on timing light to off position (fully counterclockwise to latched position).

   NOTE: The Red Twinflex VOLT/OHM leads are left connected together and are not used in this Area Test sequence.

NOTE: Two connections are changed for POSITIVE GROUND SYSTEMS. The Blue Primary Pickup Boot must be connected to coil positive and the Amps Pickup connected to the positive ground battery cable with the arrow pointing toward battery.

Set Ignition Selector

Set the IGNITION SELECTOR to the number 1 position for most systems. The number 2 position is used for CD ignition systems and systems requiring special triggering (mis-trigger in position 1). See GENERAL INFORMATION section for more information.

Set 2 Or 4 Cycles

Push to set CYCLE button at 2 or 4 cycles.

NOTE: The 4 CYCLE ignition type position is used on engines that fire each spark plug once every other revolution of the crankshaft. Most automotive engines have 4 cycle ignition. The 2 CYCLE position is used on engines that fire each spark plug once for every revolution of the crankshaft. Many outboard and small engines and all rotary engines use 2 cycle ignition. Some 4-stroke cycle motorcycles and small engines use 2 cycle ignition. If the 4 cycle ignition setting is used on these

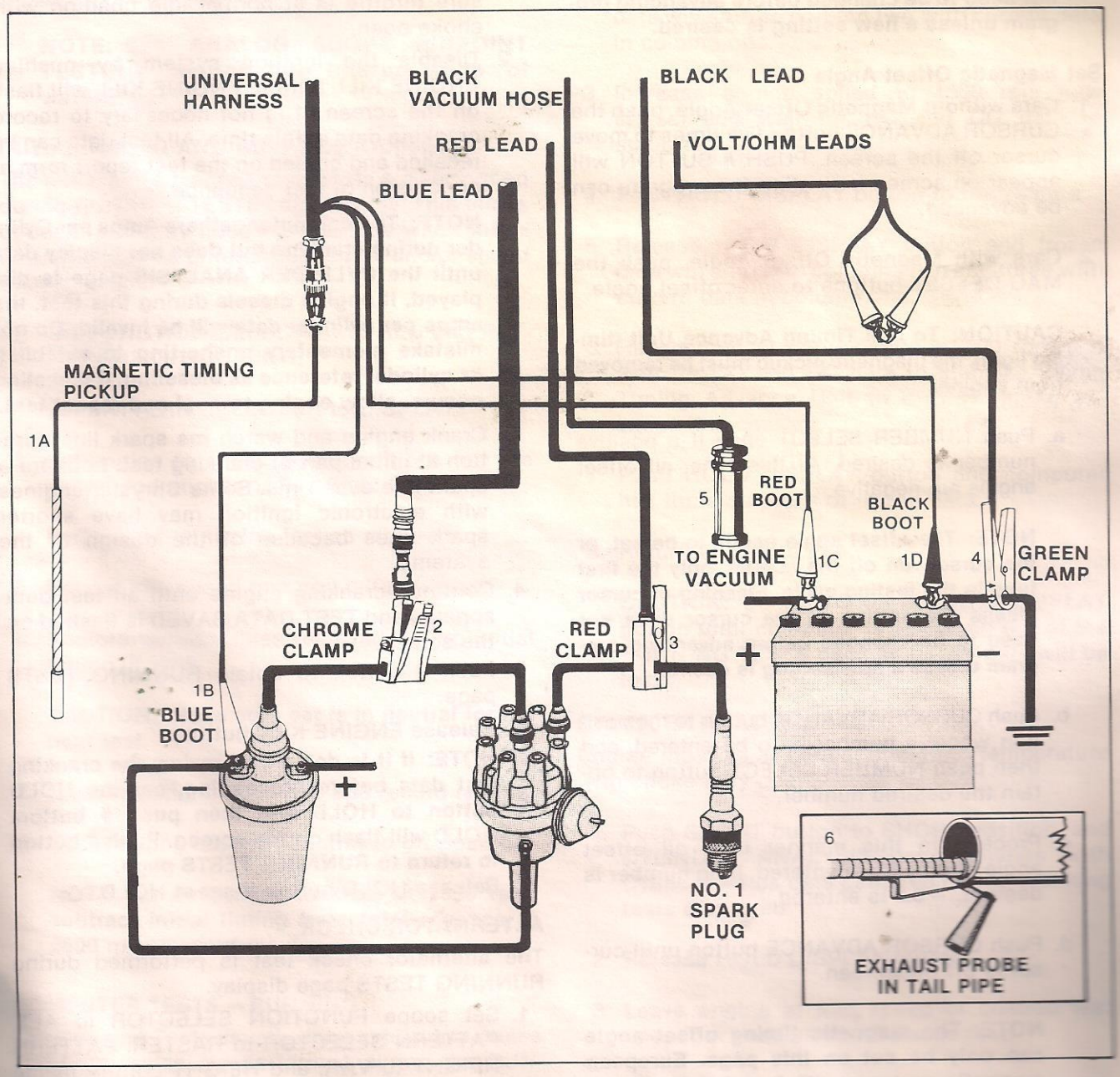


FIGURE 21—Test lead connections to engine.

engines (or on any engine with 2 cycle ignition) the tachometer will indicate twice actual engine RPM.

Set Number of Cylinders

Push to set NUMBER OF CYLINDERS button to match number of cylinders in engine being tested. Number of cylinders entered will be displayed on screen.

NOTE: The number of cylinders can only be set on this page. After initially setting number of cylinders, offset angle and returning to this page, flashing numbers on the screen means the setting of the Number of Cylinders does not need to be changed before advancing program unless a new setting is desired.

Set Magnetic Offset Angle

1. Cars without Magnetic Offset Angle, push the CURSOR ADVANCE button five times to move cursor off the screen. PUSH # BUTTON will appear on screen indicating the program can be advanced.

2. Cars with Magnetic Offset Angle, push the MAG OFFSET buttons to enter offset angle.

   CAUTION: To use Timing Advance Unit (timing light), the magnetic pickup must be removed from engine.

   a. Push NUMBER SELECT once if a positive number is desired. At this time, all offset angles are negative.

      NOTE: The offset angle needs to be set, or the cursor run off the screen, only the first time in the testing cycle. Flashing of cursor means the setting of the cursor does not need to be changed before advancing program unless a new setting is desired.

   b. Push CURSOR ADVANCE button to the position where a number is to be entered, and then push NUMBER SELECT button to obtain the desired number.

   c. Proceed in this manner until all offset angle numbers are entered. If no number is desired, – 0.0 is entered.

   d. Push CURSOR ADVANCE button until cursor is off the screen.

      NOTE: The magnetic timing offset angle can only be set on this page. European magnetic systems with 0 and – 20 offsets will automatically be sensed and displayed when present.

3. Push # button.

COMPUTER TESTS — CRANKING

The cranking tests are performed during CRANKING/PINPOINT TESTS page display. This page is displayed upon pressing # button during the PROGRAM SET-UP page display. For an explanation of test page operation, refer to TEST PAGE INFORMATION in the TESTER OPERATION section of the manual.

1. Turn off all lights and accessories, and make sure throttle is at normal idle position with choke open.
2. Disable the ignition system by pushing ENGINE KILL button. ENGINE KILL will flash on the screen. It is not necessary to record cranking data at this time. All test data can be recalled and copied on the test report form at conclusion of test sequence.

   NOTE: The computer gathers Amps per Cylinder during cranking but does not display data until the CYLINDER ANALYSIS page is displayed. If engine diesels during this test, the amps per cylinder data will be invalid. Do not mistake momentary unshorting to establish #1 cylinder reference as dieseling. If dieseling occurs, allow engine to cool and repeat test.

3. Crank engine and watch ms spark line duration at initial part of cranking test. Look for a spark line over 1 ms. Some Chrysler engines with electronic ignition may have shorter spark lines because of the design of the system.
4. Continue cranking engine until all test data appears and TEST DATA SAVED is flashed on the screen.
5. Push # button to obtain RUNNING TESTS page.
6. Release ENGINE KILL button.

   NOTE: If it is desired to review the cranking test data before proceeding, set the HOLD button to HOLD and then push # button. HOLD will flash on the screen. Push # button to return to RUNNING TESTS page.
7. Release HOLD button if set at HOLD.

ALTERNATOR CHECK

The alternator check test is performed during RUNNING TESTS page display.

1. Set scope FUNCTION SELECTOR to ALT, PATTERN SELECTOR to RASTER, PATTERN HEIGHT to VAR, and HEIGHT control inside panel door to high (fully counterclockwise).

2. Turn ignition key on and note AMPS test data for amount of current draw.

3. Start engine and accelerate to 2000 rpm while observing AMPS test data for peak reading of charging current.

4. Add amps indication of steps 2 and 3 for the alternator output check, and record results on test report form.

5. Observe waveform on scope which indicates Diode/Stator conditions. Length control can be adjusted at this time. Waveform should be even. Record results.

   NOTE: See ANALOG SCOPE PINPOINT TESTING section for interpretation of waveforms.

INITIAL TIMING AND ADVANCE (Optional)

The initial and advance timing tests are performed during RUNNING TESTS page display. This test is optional and only needs to be done when initial timing requires a different condition and/or speed than curb idle.

1. Set FUNCTION SELECTOR to SEC and PATTERN HEIGHT to HIGH.

2. Set PATTERN SELECTOR to DISPLAY.

3. Set engine to speed and conditions per the underhood sticker or Sun Spec Card.

4. Perform initial timing test as required.

5. Record idle speed rpm and initial timing.

6. Restore vacuum lines removed during initial timing (if any).

   CAUTION: Make sure car is in neutral for the next test.

7. Check timing at 2500 rpm and record results.

8. Reset timing advance control to off position.

   NOTE: To determine advance at 2500 rpm, subtract initial timing from total advance at 2500 rpm. Record results.

COMPUTER TESTS — RUNNING

The Running Tests usually done at idle, low cruise and high cruise are performed during the RUNNING TESTS page display. At the conclusion of this test, the idle speed data will appear in column three, low cruise in two and high cruise in one. The speed at which the test is performed (idle, low cruise or high cruise) determines the mode of the test.

1. With engine at idle speed, at normal operating temperature and HC and CO stabilized, push HOLD DISPLAY button. This will freeze idle data.

   NOTE: If the timing light is used and timing was not taken, use the timing advance control on timing light to display initial timing.

2. Release HOLD DISPLAY button and frozen data will shift to column two with current data in column one.

3. Increase engine speed to 1500 rpm (low cruise) and wait for HC and CO data to stabilize.

4. Push HOLD DISPLAY button to freeze data.

5. Release HOLD DISPLAY button and frozen data will shift into columns two and three with current data in column one.

6. Run engine at approximately 2500 rpm and wait for CO and HC data to stabilize. Using Timing Advance Unit to display timing advance if necessary.

7. Push HOLD DISPLAY button and computer has three columns of frozen data.

8. Return engine to idle.

   CAUTION: Do not release the HOLD DISPLAY button until computer is advanced out of the RUNNING TESTS page as frozen data will be lost.

CYLINDER ANALYSIS TESTS

Engine must be at normal operating temperature with choke fully open.

1. Push SHORT button to SHORT position, and CYLINDER ANALYSIS page appears with Cylinder Amps data gathered during cranking tests displayed.

2. Release HOLD DISPLAY button.

3. Leave engine at idle speed or desired test speed for the Cylinder Balance test.

   NOTE: Relative HC test is most valuable on fuel injected engines. To eliminate HC CHG

(Relative HC) test and provide a faster power balance test, accelerate engine above 2500 rpm and then return to desired test speed.

4. Allow engine RPM, CO and HC to stabilize.

5. Push # button to initiate automatic power balance test.

   NOTE: Base RPM and base HC and CO will be displayed. As each cylinder is shorted, its RPM data is displayed. Shorted cylinder can be identified on scope. After RPM change data appears, REL HC will appear after 10 seconds if programmed for HC.

6. Push HOLD DISPLAY button.

7. Release SHORT button to COMP position, and RUNNING TESTS page will appear with three columns of data. If no data appears, push # again to view CRANKING/PINPOINT TESTS page and push again to review saved data on RUNNING TESTS page.

8. Push # button and CRANKING/PINPOINT TESTS page appears with data saved.

9. Record test data.

10. Push # button and record RUNNING TESTS page data.

11. Push SHORT button and record CYLINDER ANALYSIS page data.

SCOPE IGNITION AND OTHER TESTS

1. Release HOLD DISPLAY button.

2. Release SHORT button to get a fresh RUNNING TESTS page.

3. Perform scope tests and record test results.

Accelerator Pump Test

4. While observing the CO indication with engine at normal idle speed, quickly open and release throttle.

5. Stop engine.

6. Analyze Test Report Form data.

ENGINE PERFORMANCE ANALYSIS GUIDE

AREA PERFORMANCE TEST ANALYSIS

Analyzing the results on the Engine Performance Test Report requires comparing the test results with manufacturer's specifications to determine which tests to mark NO-GO. Analyzing all of the tests marked NO-GO is the basis for determining what engine areas have problems, what specific Pinpoint Tests to perform, and what service recommendations to make.

The Sun Specification cards, underhood stickers and manufacturer's manuals and bulletins are used to obtain the specifications needed. Where no factory specifications are furnished, the technician must base his decision (OK or NO-GO) on what is normal for good engines of the make and model being tested based on past experience.

The following Analysis Guide lists the OK and NO-GO considerations and shows the most common Test Indications and the Action Required for each NO-GO Test Result.

ANALYSIS GUIDE

1. COMPUTER TESTS — CRANKING

CRANKING RPM TEST

OK — Cranking speed normal and even.

NO-GO — Cranking speed slow and unsteady.

Test Indications:

a. Uneven cranking could be caused by compression problems. Refer to Cylinder Analysis page tests.

Completely test engine and/or starter as required.

b. Slow cranking speed could be caused by excessive resistance in starter circuits, a bad starter, a low battery or a tight engine. Check starter circuits and engine for tightness.

STARTER CURRENT

OK — Starter Current draw is not more than specified maximum.

NO-GO — Starter Current draw is too high.

Test Indications:

a. Battery discharged, defective, or too small for application.

Make complete battery test.

Check battery rating with specifications.

b. Battery cables, starter solenoid or starter motor bad.

Make complete starting system test.

c. Tight or hot engine.

Cool off and retest.

BATTERY VOLTAGE

OK — Cranking battery voltage is at or above specified minimum.

NO-GO — Voltage is below specified minimum.

Test Indications:

a. Same test indications as Starter Current.

DISTRIBUTOR RESISTANCE

OK — Maximum voltage did not exceed 0.2 volts

NO-GO — Maximum voltage exceeded 0.2 volts.

Test Indications:

a. Ignition points dirty or worn.
Repair or replace.

b. Poor connections in primary circuit.
Check all leads and grounds.

c. Distributor defective.
Make complete distributor test in Sun Distributor Tester.

NOTE: On electronic ignition, see manufacturer's recommendations.

CRANKING DWELL

OK—A dwell reading indicated.

NO-GO—No dwell reading indicated.

Test Indications:

a. Ignition points or primary ignition circuit defective.
Correct and reset to specifications.

b. On electronic ignition systems, distributor or electronic module defective. See specific system for complete diagnosis. Test and service to manufacture's recommendations.

CRANKING TIMING
(For running pinpoint tests only)

HYDROCARBON CRANKING

OK—HC indications available, engine is getting fuel.

NO-GO—No HC indications, engine is not getting fuel.

Test Indications: (Carburetor engines)

a. Carburetor bad or choke mechanism faulty.
Correct as necessary.

b. Fuel line, fuel filter or fuel pump faulty.
Repair or replace as necessary.

c. No vacuum
Engine bad or has vacuum leaks.

NOTE: On fuel injected engines, see manufacturer's specific troubleshooting guide.

ENGINE VACUUM

OK—Vacuum reading steady at normal level.

NO-GO—Vacuum reading uneven or much lower than normal.

Test Indications:

a. Vacuum leaks.
(1) Examine all vacuum hoses including emission controls and accessories.
(2) Tighten engine manifold bolts, carburetor mounting bolts, etc.

b. Engine mechanical condition.
Test with cylinder leakage tester and compression tester.

2. ALTERNATOR CHECK

CHARGING SYSTEM

OK—Peak ammeter reading shows alternator is charging at least half of rated output, and alternator waveform on scope is normal.

NO-GO—Ammeter shows low output or no charge or alternator waveform on scope is abnormal.

NOTE: In most cases, when the alternator output is checked after making cranking tests, the ammeter reading seen at the instant the engine is started and "revved up" will be well over half of rated output. However, the condition of the battery, the length of time the engine was cranked and the speed the engine reached all can affect this reading.

Test Indications:

a. Fan belt loose or worn out.
Check and correct as necessary.

b. Accessory load very high.
Check current draw with key on. Add this reading to output obtained.
Compare to specifications.

c. Alternator defective.
Check alternator output with amps pickup at alternator and all accessories on.

d. Voltage regulator defective.
Use Starting and Charging System tester, bypass regulator and check alternator output.

e. Wiring harness bad.
Repair or replace as necessary.

DIODE STATOR

OK — Scope shows even ripple.

NO-GO — Scope shows uneven ripple.

Test Indications:

a. Output diodes or stator bad.
Remove and disassemble alternator and test components.

3. INITIAL TIMING AND ADVANCE

INITIAL TIMING
(Except computer controlled timing)

OK — Timing set to specifications.

NO-GO — Timing is too early or too late.

Test Indications:

a. Timing not adjusted properly.
Reset to specifications.

b. Distributor advance mechanism bad.
Remove and test distributor on Sun Distributor Tester.

c. Engine not running at proper speed.
Vacuum advance or retard not disconnected during test, if so specified. Timing must be adjusted according to specified procedure at specified rpm after dwell is set correctly.

NOTE: For computer controlled timing, see manufacturer's specific engine troubleshooting guide.

TIMING ADVANCE

OK — Timing is advanced specified amount.

NO-GO — Timing advance too little or too much.

Test Indications:

NOTE: These tests can be done with a Distributor Tester.

a. Vacuum advance chamber is leaking or inoperative.
(1) Check vacuum chamber with external vacuum source.
(2) If vehicle is equipped with transmission controlled spark, recheck advance as specified for this type of system.
(3) Check vacuum supply to distributor advance unit.

b. Mechanical advance sticking or inoperative.
Disconnect vacuum advance and repeat advance test.
This checks mechanical advance only.
Remove and repair distributor.

c. Wrong distributor for engine.
See specifications.

4. COMPUTER TESTS — RUNNING

IDLE MODE RPM

OK — Meets manufacturer's specified idle speed at specified test condition.

NO-GO — Idle speed not set to specifications.

Test Indications:

a. Carburetor idle speed and/or mixture screws not properly adjusted.
Correct as necessary.

b. Choke sticking or not fully open.
Correct as necessary.

c. Idle solenoid not adjusted correctly, if so equipped.
Correct as necessary.

d. Test not made under specified conditions. See specifications and underhood sticker.
Test as specified.

e. Mechanical Engine Condition.
Check all test results for indications of problems like fouled plugs, weak cylinders, etc.

f. Bad emission control devices, especially EGR valve.
Test and service per factory recommendations.

Engine Performance Analysis Guide

IDLE MODE DWELL

OK — Dwell is within specifications.

NO-GO — Dwell is too high or too low.

Test Indications:

a. Ignition points improperly adjusted.
Reset to spec.

b. Distributor defective.
Make complete distributor test in Sun Distributor Tester.

NOTE: On electronic ignition, see manufacturer's recommendations.

CARBON MONOXIDE AT IDLE

OK — CO readings within specifications.

NO-GO — CO readings out of specifications.

Test Indications:

a. Carburetor settings incorrect.
Correct as necessary.

b. Wrong float adjustment.
Adjust as necessary.

c. Dirty air cleaner.
Clear or replace element.

d. Improper idle speed.
Adjust as necessary.

e. Oil in crankcase diluted with gasoline or excessive engine blow-by.
Correct as necessary.

HYDROCARBON AT IDLE

OK — HC within specifications.

NO-GO — HC readings out of specifications.

Test Indications:

a. Engine mechanical problems indicated.
Service and repair as necessary.

b. Ignition problems indicated.
Test and service ignition system.

ENGINE VACUUM AT IDLE

OK — Steady at or above specified minimum.

NO-GO — Unsteady or below specified minimum.

Test Indications:

a. Same test indications as for cranking engine vacuum.

LOW CRUISE DWELL

OK — Dwell reading does not change more than specified for dwell at idle.

NO-GO — Dwell reading changed more than allowable for system being tested.

NOTE: Some electronic ignition systems incorporate a dwell change in the design. See specifications and recommendations for system being tested.

Test Indications:

a. Distributor in poor mechanical condition.
Remove and test in distributor tester.
Repair as needed.

CARBON MONOXIDE AT LOW CRUISE

OK — CO reading within specifications and less than at idle.

NO-GO — CO reading not within specifications.

Test Indications:

a. Plugged air bleeds or restricted air cleaner.
Unplug and/or replace.

b. Incorrect metering rod adjustment or incorrect metering jets.
Adjust or replace as required.

c. Leaky power valve, accelerator pump or check valve.
Correct as necessary.

d. High float level.
Adjust as required.

HYDROCARBON AT LOW CRUISE

OK — HC reading within specifications.

NO-GO — HC reading not within specifications.

Test Indications:

a. Plugged high speed passages or jets.
Unplug as required.

b. Incorrect metering jets or metering rod adjustment.
Adjust or replace as needed.

c. Manifold or carburetor air leaks.
Service as necessary.

d. Low float level.
Adjust as required.

e. Ignition system problem.
Test and service as necessary.

ENGINE VACUUM AT LOW CRUISE

OK — Reading steady and higher than idle.

NO-GO — Vacuum unsteady or lower than at idle.

Test Indications:

a. Engine problems.
Check cylinder power balance test results.

b. Exhaust system restricted.

c. Timing not advancing properly.
Check results of timing advance test.

HIGH CRUISE DWELL

OK — Dwell reading does not change more than specified from dwell at idle.

NO-GO — Dwell reading changed more than allowable for system being tested.

NOTE: Some electronic ignition systems incorporate a dwell change in the design. See specifications and recommendations for system being tested.

Test Indications:

a. Distributor in poor mechanical condition.
Remove and test in distributor tester.
Repair as needed.

CARBON MONOXIDE AT HIGH CRUISE

OK — CO reading within specifications and less than at idle.

NO-GO — CO reading not within specifications.

Test Indications:

a. Same as for Low Cruise.

HYDROCARBON AT HIGH CRUISE

OK — HC reading within specifications.

NO-GO — HC reading not within specifications.

Test Indications:

a. Same as for Low Cruise.

ENGINE VACUUM AT HIGH CRUISE

OK — Reading steady and higher than at idle.

NO-GO — Vacuum unsteady or lower than at idle.

Test Indications:

a. Same as for Low Cruise.

5. CYLINDER ANALYSIS TESTS

The Amps Per Cylinder Test is an indication of the mechanical condition of the engine. Cylinder Power Balance is an indication of the evenness of the power pulses, and the Relative HC Test is an indication of variations of fuel distribution. Interpretation of any one of these tests must be considered in relation to the other tests. The interaction of compression, vacuum, ignition and fuel distribution can be analyzed by studying the results of these three tests.

AMPS PER CYLINDER

OK — Data even with very little difference between cylinders.

NO-GO — Data uneven with large differences between cylinders.

Test Indications:

a. Engine problems.
Check compression and cylinder leakage. See Computer Pinpoint Testing section for additional information.

b. Starter or starter drive to flywheel alignment.
Check starting system.

CYLINDER POWER BALANCE TEST

OK — RPM with each cylinder shorted dropped approximately the same amount.

NOTE: Amount of drop and allowable variation depends upon type of engine, number of cylinders, and speed at which test was made.

NO-GO — RPM does not change or changes very little on one or more cylinders.

Test Indications:

a. Ignition problems.
Check results of scope tests in Low Cruise Mode.

b. Engine problems.
Check compression and cylinder leakage.

c. Fuel mixture or distribution problems.
Check for vacuum leaks.
Check carburetor adjustment and balance.

RELATIVE HC TEST

CAUTION: This test applies to cylinder power balance and fuel distribution and is not intended to test emission levels.

OK — HC for each shorted cylinder approximately the same.

NO-GO — Large difference in HC for one or more cylinders.

Test Indications:

a. Fuel not reaching some cylinders.
Test carburetor or fuel injectors and fuel delivery system.

b. Lack of compression and vacuum.
Test cylinders with compression and leakage tester.

6. SCOPE IGNITION ACCELERATOR PUMP TESTS

CRANKING SPARK MS

OK — Spark line more than one millisecond.

NO-GO — Spark line less than one millisecond. Some Chrysler engines with electronic ignition may have shorter spark lines because of the design of the system.

Test Indications:

a. Ignition system problems.
Check results of scope tests.

b. Engine problems.
Check plugs, cylinder compression, vacuum, etc.

c. Fuel system problems.
Check carburetor and fuel delivery systems.

COIL POLARITY

OK — Pattern right side up.

NO-GO — Pattern inverted (firing lines extend downward).

Test Indications:

a. Ignition coil primary wires reversed. (Should match battery ground polarity.)
Check and correct as necessary.
Make sure coil is correct one.

AVAILABLE KV

OK — Reaches or exceeds specified minimum.

NO-GO — Output is less than minimum specified.

Test Indications:

a. Dwell too low.
See Dwell Test Results in Idle Mode and High Cruise Mode.

b. Excessive resistance in ignition switch, primary circuit or points.
Check with voltmeter, ohmmeter.

c. Low voltage due to charging system problem.
See Charging Volts Test Result.

d. Insulation bad in secondary circuit.
If coil output is under 25 KV and lower extent of waveform is intermittent or missing, test for insulation breakdown in wires, cap, or rotor.

e. Coil or Condenser defective.
Test and replace as needed.

Engine Performance Analysis Guide

PLUG REQUIRED KV

OK — Firing voltages even within 3 KV and normal for engine being tested.

NO-GO — Firing voltages vary more than 3 KV. All firing lines excessively high or excessively low.

Test Indications:

a. Spark plug or rotor gaps not correct.
Bad resistor spark plugs. Rotor, distributor or wires defective.

Use grounding probe to pinpoint cause of high readings, visual inspection for narrow plug or rotor gaps.

b. Fuel mixture incorrect.
Check choke and carburetor adjustment.
Check for vacuum leaks.

c. Timing or advance incorrect.
See Initial Timing test results and Timing Advance test results.

d. Electronic distributor trigger coil connected wrong.
Reverse connections and retest.

PLUG REQUIRED MS

OK — Spark line indication at 1000 rpm approximately 1.5 ms long.

NO-GO — Spark line below 0.5 or above 1.8 ms long.

Test Indications:

a. High resistance in secondary circuit (under 0.5 ms).
Pinpoint test secondary circuit and replace faulty components.

b. Small spark plug gap or fouled plug (over 1.8 ms).
Regap or replace.

SECONDARY INSULATION

OK — Lower extent of coil waveform (down-spike) is steady and equal to about one half of upward extent.

NOTE: This does not apply to high output systems such as HEI that produce over 30 KV since the spark will jump inside the distributor cap on good systems.

NO-GO — Coil output is less than 25 KV and the down-spike is intermittent or missing.

Test Indications:

a. Wires, cap, rotor, or coil bad.
Make secondary insulation test of all cylinders to isolate problem.

SECONDARY RESISTANCE

OK — Length and slope of spark lines is normal for engine being tested.

NO-GO — One or more spark lines slants excessively and is too short.

Test Indications:

a. Excessive resistance in plugs, wires, rotor, or distributor cap, or coil tower.
Isolate problem using grounding probe.

COIL-CONDENSER CONDITION

OK — Normal number and size of oscillations in intermediate section.

NO-GO — Oscillations diminished or missing in intermediate section.

Test Indications:

a. Coil or condenser defective.
Test and replace as necessary.

b. Points, condenser, or ground pigtail loose in distributor.
Make complete distributor test.

NOTE: Some ignition systems such as Chrysler Electronic Ignition will not show oscillations.

CAM LOBE ACCURACY

OK — Point open signals even within specifications.

NO-GO — Point open signals vary more than specified (usually ± 2°).

Test Indications:

a. Distributor cam defective.
Remove and test distributor in Sun Distributor Tester.

b. Breaker plate or bushings worn or defective.
Wrong point spring tension. Remove and test distributor in Distributor Tester.

c. Problem in engine such as bad distributor bushing in block or loose timing chain.
Check and repair as needed.

PLUGS UNDER LOAD

OK — Firing lines increase moderately and evenly and firing voltages does not exceed maximum specified.

NO-GO — Firing lines do not increase evenly or firing voltages exceed maximum specified.

Test Indications:

a. Spark plugs worn out, gapped wrong, or are fouling out.
Clean and regap or replace as required.

b. Lean fuel mixtures.
Check carburetor accelerator pump and high speed circuit.

ACCELERATOR PUMP — CO

OK — Indicates an increase in CO.

NO-GO — Does not indicate an increase or decrease in CO.

Test Indications:

a. Bad accelerator pump in carburetor.
Repair carburetor.

b. Plugged accelerator pump lines.
Clean and unplug.

COMPUTER PINPOINT TESTING

DIGITAL PINPOINT TESTS

The digital pinpoint tests are performed on a vehicle that has indicated a failure or malfunction during Area Testing. Further pinpoint testing is required on many vehicles to locate the specific cause of trouble found during Area Testing.

TEST CONNECTIONS

Lead connections to the vehicle for pinpoint testing are the same as presented for Area Testing. Any special exceptions will be given in the test procedures. Likewise, the operation of the tester is the same as for Area Testing.

NOTE: See the TESTER OPERATION and AREA TESTING sections if a question comes up concerning how the tester operates.

MANUAL CYLINDER POWER BALANCE

This power balance test provides a means of shorting out cylinders individually or in combinations to determine how well the engine runs with the remaining cylinders. This test compares the change in the engine rpm with one cylinder at a time or with similar groups of cylinders shorted. The test results indicate whether or not any cylinder or combination of cylinders is developing its share of drive power.

The less power produced by a given cylinder, the less rpm will be lost when that cylinder is shorted out.

NOTE: This test must be performed using the SHORT button on the tester panel.

Set Up Tester

1. Operate tester to obtain the RUNNING TESTS page.
2. Push SHORT button to SHORT position, and CYLINDER ANALYSIS page should appear.

   Pushing any cylinder button on the CYLINDER SELECTOR control will short that cylinder as the engine is running.

Shorting In Pairs

Shorting in pairs is primarily used on 4-cylinder engines.

1. Start engine and operate at approximately 1000 rpm. (If attempting to troubleshoot a specific performance problem, operate engine at speed where problem is most noticeable.)
2. Push CANCEL button of the CYLINDER SELECTOR controls.
3. Push 1 and 3 buttons of CYLINDER SELECTOR controls.

   NOTE: The operator has 20 seconds to record a data reading. The CANCEL button should be cancelled after approximately 20 seconds.
4. Note and record rpm with cylinders shorted.
5. Perform Steps 2, 3, and 4 with buttons 2 and 4 depressed.
6. Push the CANCEL button. Allow engine base speed to stabilize, and then record engine base speed.

   NOTE: The individual rpm readings must be subtracted from the base rpm to find the change in rpm. The weak cylinders are those with the least amount of change in rpm when they are shorted out.
7. Record and evaluate the test data.

Shorting In Combinations

This test is applicable on engines with any even number of cylinders.

CAUTION: On cars with catalytic converters, consult manufacturer's instructions telling how many cylinders can be safely shorted out at one time.

The method of doing the power balance test is given under the heading, Shorting In Pairs. Other tests can be devised for shorting other combinations of cylinders, but the test procedure must conform to the test steps under Shorting In Pairs.

When testing with odd or even cylinders shorted, for example, follow the procedure under Shorting In Pairs, except short the odd numbered cylinders first and get an rpm reading. Then, short the even numbered cylinders and get an rpm reading.

Compare the engine rpm results to see if the two groups of cylinders are balanced.

The combinations of cylinders that can be shorted are many and varied. The operator can create many test combinations to fit his testing needs, provided he follows the method of operating the tester as demonstrated.

CARBURETOR POWER BALANCE TEST

This test procedure works well on most standard production V-8 engines. However, there may be some high performance engines or special intake manifolds that follow a different fuel distribution pattern.

1. Identify each engine cylinder by number on an engine chart. Cylinder numbers are identified on Sun Specification Cards and in manufacturer's engine service manuals.

   NOTE: The cylinders may be numbered like many American Motors, Chrysler and General Motors engines (Figure 22). One, three, five and seven are in the left bank, and two, four, six and eight are in the right bank, and fire in the sequence of 1, 8, 4, 3, 6, 5, 7, 2. By writing the firing order in the space provided below the Power Balance buttons, it can be readily seen that depressing the odd numbered buttons will short out the four cylinders (1, 4, 6 and 7) being fed from the left barrel of the carburetor (Figure 23). On the other hand, if the even numbered buttons are depressed,the cylinders fed by the right barrel (2, 3, 5 and 8) will be shorted out.

2. Run the engine at test speed.
3. Short out the "even" half of the cylinders and note the engine rpm. The CYLINDER ANALYSIS page of the tester is used for this test. The power balance test has been explained previously.

   CAUTION: On vehicles equipped with catalytic converters, do not run for more than 20 seconds at a time with four cylinders shorted.
4. Short out the "odd" half of the cylinders and note the engine rpm.
5. Compare these engine speeds and adjust carburetor as required.

   NOTE: Be sure engine is mechanically sound. An unsound engine will give erroneous readings on the Carburetor Balance Test.

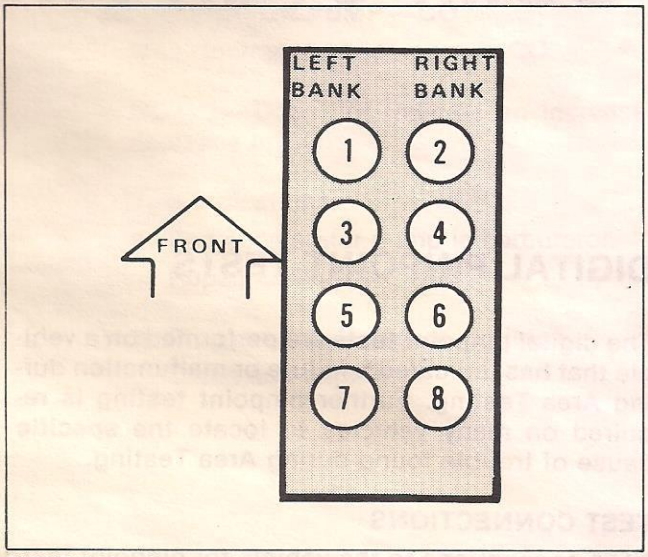


FIGURE 22—One method used in numbering cylinders.

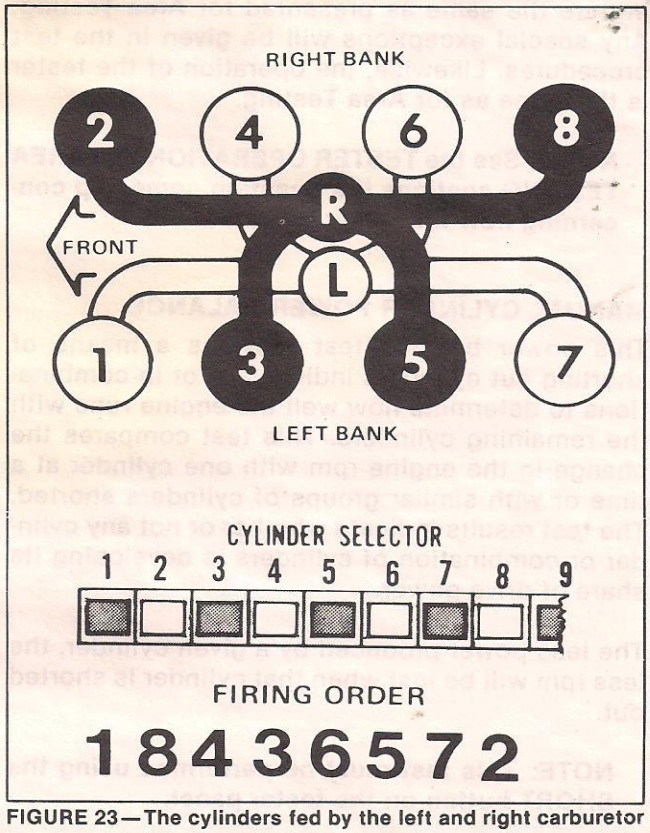


FIGURE 23—The cylinders fed by the left and right carburetor barrels related to the cylinder power balance buttons and the firing order of one engine.

Testing for mechanical soundness of engines is as follows:

6. Short out 4 cylinders (one bank on GM 1, 3, 5 & 7). Note RPM reading.

7. Short out other bank (2, 4, 6 & 8). Note RPM reading. RPM should be even within 10 rpm in order to achieve good carburetor balance.

AMPS PER CYLINDER TEST

The test lead connections for this test are the same as for Area Testing.

1. Collect amps data into the computer during CRANKING/PINPOINT TESTS page.

2. Push SHORT button to obtain CYLINDER ANALYSIS page with amps per cylinder displayed.

Data Interpretation

The Amps Per Cylinder test interpretation depends on engine, design, starter speed, etc. This is especially true of 4 cylinder engines with manual transmission. The starter current draw changes very little when one or more cylinders have **no** compression. This can be determined by testing various types of **good** engines with one or more spark plugs removed. Confirm test results with compression and cylinder leakage tests.

Interpretation of these readings is as follows: The greater the amperage spread (highest or lowest), the greater is the compression or friction differences per cylinder. A bad cylinder is normally greater than 10 percent above or below average.

NOTE: A cylinder with poor compression may show up as a low amps draw followed by a high amps draw on the next cylinder. Anytime there is a large variation between readings, it is an indication of mechanical engine problems. To accurately identify all of the weak cylinders and their problems, perform cylinder leakage and compression tests.

RELATIVE HC TEST

The HC CHG (Change) test is designed to determine how much fuel is being delivered to each cylinder and whether the cylinder is functioning properly. This test is performed on the CYLINDER ANALYSIS TESTS page as part of the Automatic Power Balance test. After the computer displays the RPM for each shorted cylinder, it displays the HC CHG for each shorted cylinder.

NOTE: The only method of eliminating the HC CHG from the Automatic Power Balance Test is to accelerate the engine above 2500 rpm just before initiating the test.

Interpreting Test Data

Two items of data are important: The overall engine HC PPM (parts per million) listed above the HC per cylinder column and the HC data column itself.

1. **Overall Engine HC PPM**

   If this number indicates a normal engine (approximately 200 PPM to 500 PPM depending on the vehicle used for engine shorting test), the column of HC readouts per cylinder will be rather high with a more noticeable difference between a good cylinder and a bad one. Conversely, if this number indicates an abnormal engine (approximately 500 PPM and above), the column of HC readouts will be much lower with a less noticeable difference between good or bad cylinders.

   NOTE: In interpreting the test data, a smaller difference between cylinders on an abnormal engine means the same as a large difference on a normal engine.

2. **HC Per Cylinder Column**

   This column of data gives the HC indicated when each cylinder is shorted. The cylinders with the smallest number are the weakest cylinders, indicating that these cylinders are receiving less fuel or are functioning improperly.

   NOTE: This Relative HC Test is especially useful on fuel injected engines.

IDLE SPEED

Follow manufacturer's procedure for setting engine idle speed. The type of engine, transmission and accessories installed will frequently determine the correct idle speed. The tester should be in the RUNNING TESTS page for this test.

1. With tester connected, start engine and run until it is at normal operating temperature (choke open).

2. Place transmission and accessories in the operating condition indicated by manufacturer's specifications for Idle Speed Test (for example: Automatic Transmission in Drive, Air Conditioning ON).

3. Observe Engine rpm and compare with manufacturer's specifications for Idle Speed.

POSITIVE CRANKCASE VENTILATION TEST

A test of the PCV system can be conducted by closing off the system at a point prior to its connection by the intake manifold and noting the change in engine rpm. The tester should be in the RUNNING TESTS page for this test.

1. Place at idle rpm and normal operating temperature (choke fully open).
2. Close off or plug the PCV hose to the intake manifold.
3. Observe the RPM reading for change in engine speed.
   a. Engine speed decreases by 50 rpm or more (unless otherwise specified by manufacturer) — indicates PCV operation normal.
   b. Engine speed does not change — indicates PCV valve, hoses, or air intake clogged.

NOTE: See other PCV tests, such as Vacuum and CO tests.

DWELL TESTS

These tests are performed on RUNNING TESTS page.

1. Operate engine at idle speed.
2. Observe the indication on the display screen. Compare with manufacturer's specifications.

Dwell Variation

(Contact Controlled Systems Only)

Dwell variation is determined by noting any dwell change as the engine is operated at different speeds. Excessive variation indicates a change in point opening that can result from shaft or bushing wear, or from the distributor plate shifting because of wear or looseness. In some cases (Chrysler and Ford) a 5° dwell variation may be normal.

1. Measure distributor dwell at idle speed.
2. Increase speed to 2500 rpm.
3. Note dwell reading at 2500 rpm; then slowly reduce speed to idle while watching digital display. Dwell reading should not change more than 3 degrees with distributor vacuum lines disconnected and plugged (except HEI and other systems with variable dwell). Compare with manufacturer's specifications.

AMPS TEST PROCEDURES

These tests are performed on CRANKING/PINPOINT TESTS or RUNNING TESTS pages.

1. Clamp the Ammeter probe around one wire of any circuit to be tested with the arrow on the probe pointing in the direction of expected current flow.
2. Read circuit amperage on display screen.

Alternator Output Test

1. Clamp the AMPS PICKUP around the alternator output wire with arrow pointing away from alternator.
2. Start engine and run at approximately 1500 rpm.
3. Turn on headlights and all accessories.
4. Observe the AMPS displayed on screen for alternator output indication.

   Testing in this manner will usually cause the alternator to charge within specification. However, it is possible that if the accessory load is not great enough, the output seen may not be maximum. If there is any question concerning the condition of the alternator, test with a Starting and Charging Tester that has an adjustable load.

VOLTAGE TEST PROCEDURES

The voltage measurements indicates the difference in electrical pressure in volts between any two points in an actuated circuit. There are two sets of leads for making voltage measurements. The Red Twinflex VOLT-OHM leads (which can be used for the CRANKING/PINPOINT TESTS page only) and the Red and Black booted leads (which can be used for the CRANKING/PINPOINT TESTS page and the RUNNING TESTS page). The cranking page presents volts after BATTERY and ohms after RESISTANCE. The running page presents volts after VOLTAGE.

Cranking Voltage Tests

1. Connect either set of volt leads to the battery posts, Red to positive and Black to negative.
2. Disable ignition system by disconnecting the secondary coil wire from the distributor cap and grounding it, or use ENGINE KILL button on tester.

3. Crank engine.

4. Observe cranking voltage, cranking speed and evenness of cranking. Indication should be even and within manufacturer's specifications.

Charging Voltage Tests

1. Connect test harness volt leads to the battery posts, Red to positive and Black to negative.

2. Operate engine at a speed of 1500 to 2000 rpm.

3. Note Voltmeter reading after the display indication stops climbing. Indications should be within manufacturer's specification.

OHMMETER TEST PROCEDURES

These tests are performed on the CRANKING PINPOINT TESTS page. These measurements indicate the resistance in ohms between any two points in a deactivated circuit. The ohmmeter functions of the computer has been calibrated when the VOLT/OHM leads were clipped together during the CALIBRATION IN PROGRESS page.

NOTE: See VOLTAGE TEST PROCEDURES test for information on VOLT-OHM test leads.

Coil Primary Resistance Test

1. Connect VOLT-OHM leads, Red to one coil primary terminal and Black to the other coil primary terminal.

2. Observe Ohmmeter indication and compare with specifications.

Coil Secondary Resistance Test

1. Install a Pickup Extension in the tower of coil.

2. Connect VOLT-OHM leads, Red to coil negative or positive primary terminal and Black to the Pickup Extension.

3. Observe digital ohm indications and compare with coil specifications.

Coil Primary Ground Test

1. Connect VOLT-OHM leads, Red to coil negative or positive primary terminal and Black to the coil case.

2. Display screen should show no indication. Otherwise, a grounded primary winding is indicated.

Secondary Ignition Circuit Resistance Test

1. Connect VOLT-OHM leads, Red to a Test Contactor and Black to an 18 inch jumper wire.

2. Remove distributor cap from the distributor and the spark plug wires from the spark plugs.

3. Connect 18 inch jumper wire (clip) to one of the distributor cap terminals.

4. Connect the Test Contactor to the spark plug end of the wire connected to this distributor cap terminal. Observe display indication.

5. Repeat Steps 3 and 4 for each spark plug wire and the coil wire. Indications should be as specified by manufacturer.

VACUUM TEST PROCEDURES

These tests are performed on the RUNNING TESTS page. Vacuum indications are measured pressure below atmospheric pressure.

Cranking Vacuum Test

1. Connect vacuum hose to a source of intake manifold vacuum. Use Tee adapter hoses as required.

2. Disable ignition by disconnecting secondary coil wire from distributor cap or use ENGINE KILL button.

3. Crank the engine and note the action of the Vacuum Bargraph. If the vacuum is very low (less than 1"), it may be necessary to back out the idle speed control or disconnect the electrical throttle stop solenoid in order to increase the cranking vacuum to a higher, more readable level.

4. At the conclusion of the test, restore ignition system operation, and make sure all engine vacuum lines are reconnected properly and securely.

Normal engine condition will result in a steady vacuum that is even and has a rhythmic pulsation.

PCV Valve Test

1. Connect the vacuum lead and disable the ignition system as for the Cranking Vacuum test.

2. While cranking the engine, pinch the PCV hose or close the end of the PCV valve to prevent air from leaking into the intake manifold.

3. Watch the VACUUM indication.

   An increase in vacuum with the PCV blocked, indicates the PCV system is open and capable of functioning.

4. Enable engine.

   NOTE: Also see PCV Test with CO indication.

Idle Vacuum Test

Idle vacuum readings aid in determining the existence of any problems relating to compression leaks in the cylinders or intake manifold, leaking or sticky valves, improper timing or fuel mixture which may affect engine operation.

1. Connect vacuum lead as for cranking vacuum test.

2. Start engine and operate at specified idle rpm.

A steady vacuum reading between 15" and 22" indicates the engine is in good condition and operating normally.

Exhaust Restriction Test

Any unusual restriction in the exhaust system will result in inefficient engine performance at higher than idle speeds. To determine whether restrictions exist, proceed as follows:

1. Connect the vacuum lead to the intake manifold in the usual manner.

2. Start engine, operate at idle rpm and note the vacuum reading.

3. Increase engine speed to approximately 2500 rpm and again note the vacuum reading.

An increase in vacuum over the vacuum obtained at idle indicates that the exhaust system is free of restrictions.

Fuel Pump Vacuum Test

The fuel pump vacuum test is an auxiliary test and is necessary only when the pump output does not meet the pressure or volume specifications. The fuel pump vacuum test is made to determine whether the defect is in the pump or in the fuel line.

1. Disconnect fuel pump flexible line from tank fuel delivery line.

2. Connect vacuum line from tester to fuel pump using adapter, if necessary.

3. Start engine and operate at idle speed.

4. Run engine for a period of time sufficient to permit vacuum to reach its maximum reading.

5. Stop engine and observe vacuum indication for ten or fifteen seconds.

If maximum vacuum is ten inches or more, and does not fall off when the engine is stopped, the pump valves are OK.

If maximum reading is less than 10 inches, or vacuum falls off rapidly, replace fuel pump.

PPM HC AND % CO TESTS

Hydrocarbon (HC) is measured as N-Hexane in parts per million (PPM) and carbon monoxide (CO) is measured in percent (%). Hydrocarbons present in the exhaust system represent unburned gasoline. An increase in the level of HC emission is a direct result of mechanical engine condition, temperature and ignition. Just one spark plug not firing will raise the HC emission by many times the normal reading in PPM. Carbon Monoxide is a by-product of fuel after it is burned in the combustion chamber. An overly-rich mixture will cause a high reading on the digital screen.

Exhaust gas samples are continuously picked up by means of a probe inserted in the vehicle's tail pipe and are conveyed to the exhaust gas analyzer by means of a hose. The Infra-Red analyzing device determines the exact amount of hydrocarbons and carbon monoxide contained in the sample. This data is then converted into electrical signals and read out on the computer screen.

Since governing bodies in several states and metropolitan localities have already set specifications limiting allowable exhaust emissions, the future trends can only be to still further lower the levels of emissions allowed. The Infra-Red exhaust analyzer has been designed and built not only to test present vehicles for compliance with established standards, but also to provide the scale ranges and accuracy necessary to test vehicles for compliance with the anticipated standards of the future.

Besides measuring emission levels to determine compliance with legal standards, you can perform emission tests at several speeds and under various conditions to quickly uncover a variety of engine, ignition and fuel system service require-

ments. This Infra-Red exhaust analyzer provides the accuracy and range for checking and adjusting carburetors, particularly on late model engines. It also serves as a valuable quality-control tool after tune-up, to aid in determining whether all work was performed properly.

TESTING PROCEDURE

These tests are performed on the RUNNING TESTS page.

NOTE: Go to the beginning of the Area Tests for calibration information.

1. Operate engine at desired speed, and note and record readings.
2. If exhaust performance tests are to be conducted at more than one engine speed, readjust engine speed as necessary and repeat Step 1 above.

ENGINE PERFORMANCE TEST

Make tests with engine at normal operating temperature. Refer to manufacturer's specifications and local exhaust emission limits.

NOTE: When testing some electronic fuel injected vehicles without a load, only idle readings will be accurate. Testing of these engines at 2500 RPM must be done on a dynamometer.

1. Measure HC and CO at 2500 RPM.
2. Measure HC and CO at idle RPM.
3. Compare readings with specifications.

GOOD: HC and CO readings within specifications at idle and 2500 RPM.

BAD: HC or CO readings exceed specifications at either idle or at 2500 RPM. Corrective service is required.

NOTE: Always refer to manufacturer's specifications when available. These specifications are usually found on a sticker under the hood. Otherwise, refer to Sun's Specification Cards.

COMMON CAUSES OF EXCESSIVE EMISSIONS

Higher than normal Hydrocarbon readings can be caused by any one or more of the following conditions:

- Improper ignition timing
- Ignition system malfunctions (misfire)
- Excessively rich or lean carburetor
- Engine problems — such as:
  - Low compession
  - Leaky gaskets
  - Defective valves, guides or lifters
  - Defective rings, pistons or cylinders
  - Incorrect thermostat

Higher than normal Carbon Monoxide readings can be caused by any one or more of the following conditions:

- Rich carburetor
- Dirty air cleaner
- Defective choke
- Improper idle speed

Higher than normal Hydrocarbon and Carbon Monoxide readings can be caused by any one or more of the following conditions:

- Inoperative PCV system
- Heat riser stuck open
- Air pump inoperative or disconnected
- Sticking air cleaner preheat door

To pinpoint specific compression and ignition system deficiencies, conduct detailed tests of these areas. After tune-up, recheck emission levels.

CARBURETOR ADJUST AND TESTING

Adjusting and testing carburetor operation with the Infra-Red requires only that you remember how each thing you are changing should affect the air/fuel mixture. If you do something to enrich the air/fuel mixture, the CO level should increase. If you make the air/fuel mixture leaner the CO should decrease. If you make the mixture so lean that one or more cylinders misfire, then the HC level will increase.

Make all carburetor idle and mixture adjustments as per manufacturer's recommended procedure. Where the manufacturer gives a CO setting, use the Infra-Red tester to make these adjustments. On vehicles where CO specifications are not available, use levels below state and local legal limits and normal for the year and make of vehicle being tested. If you are unable to attain the desired HC and CO level by following the manufacturer's adjustment procedures, there may be problems such as faulty ignition or compression. These areas should be thoroughly tested before condemning the carburetor.

IDLE ADJUSTMENT AFTER MAJOR CARBURETOR OVERHAUL OR REPAIR

1. Lightly seat idle mixture adjusting screws.
2. Back out each screw approximately 4 turns or to internal stops if so equipped.
3. Start engine and warm up to normal operating temperatures.
4. Make sure Infra-Red is calibrated.
5. Adjust engine idle speed to manufacturer's specifications.
6. Gradually adjust mixture screws equally to obtain the lowest HC reading and smoothest idle.
7. Readjust idle speed as necessary after each mixture adjustment to maintain specified idle RPM.
8. Gradually adjust idle mixture screws equally to obtain lowest CO reading without increasing the HC reading.
9. All readings should be taken with air cleaner completely installed and at normal operating temperature.
10. HC and CO readings should now be within manufacturer's specifications and/or legal limits with engine operating smoothly.

NOTE: If the idle adjustment process takes longer than two minutes, clean out engine by running it at approximately 2000 RPM for a few seconds.

CAUTION: Starting in 1977, some manufacturers have specified a "Propane Assist" method of setting curb idle. Manufacturer's specifications must be followed.

PCV TEST

Follow this procedure to determine if the PCV system is functioning properly.

1. With engine running, note CO reading.
2. Remove PCV valve from the engine but do not remove it from the hose to the carburetor or intake manifold.
3. Observe CO reading. CO reading should drop to a lesser value than previously noted.
4. Plug the open end of the PCV valve, and read CO again. The reading should be a greater (richer) value than that taken in Step 3.

   No changes in CO reading indicates the PCV system is not functioning. Clean or replace valve and hoses as necessary and retest.

AIR PUMP TEST

On vehicles so equipped, an engine-driven air pump supplies fresh air to the exhaust manifold to allow further burning of the exhaust gases before they leave the tail pipe.

Test Effectiveness of System as Follows:

1. Bring engine to normal operating temperature.
2. Make sure Infra-Red has been calibrated.
3. Operate engine at approximately 1000 RPM, and note HC and CO readings.
4. Maintaining the same engine speed, disconnect the air supply hose leading from the air pump to the exhaust manifold and again note HC and CO readings.

   An increase in HC and CO readings is to be expected with hose disconnected if the air supply system is operating normally. If little or no increase in HC and CO readings are observed, examine all components in the air supply system and make repairs and corrections necessary.

TIMING ADVANCE UNIT

The Timing Advance Unit is a power timing light equipped with a rotating indicator to measure the amount of advance of the spark due to the action of the mechanical and vacuum advance mechanism or electronic control devices. This unit is used to test or set the initial timing and to quickly test the action of the advance devices.

INITIAL TIMING

1. Connect trigger pickup to the timing cylinder, usually No. 1.
2. Place the CYCLE button to the proper position, 4 cycle or 2 cycle.
3. Remove magnetic Timing Pickup if previously placed in engine, and set PROGRAM SET-UP page offset angle to zero.

4. Start and run the engine until it reaches operating temperature.

5. Set the engine rpm to the speed specified for initial timing.

6. Remove or disconnect vacuum hoses if specified. Plug vacuum source to prevent rpm change.

7. Set Timing Light Switch to ON, and aim timing light at engine timing marks.

8. Adjust rotating control on the back of timing light assembly until the timing mark on the rotating pulley aligns with the zero mark on the engine timing scale.

   Initial Timing should be within 1 degree of specification.

9. Replace vacuum line(s) if removed.

TIMING ADVANCE

1. Adjust engine rpm to the next desired test point.

2. Readjust the rotating control on the back of the light until the timing mark is again aligned with the zero mark on the timing scale.

3. Record timing advance indicated. To determine timing advance, subtract initial timing from timing at advance test speed.

   NOTE: Reading will not include vacuum advance on vehicles equipped with a Transmission Controlled Spark (TCS) system. On most TCS systems, full vacuum advance at the distributor is not attained unless the transmission is in high gear.

4. Repeat Steps 1, 2 and 3 at each desired check point.

   Timing advance should be within specifications.

   NOTE: If desired, the operation of only the mechanical advance can be tested in the same manner as outlined above except that the vacuum line is not reconnected at the end of the initial Timing test.

TESTING SYSTEMS WITH OXYGEN SENSORS

GM COMPUTER CONTROLLED CATALYTIC CONVERTER (C-4) SYSTEM

This system contains a built-in diagnostic system which catches problems most likely to occur. A "CHECK ENGINE" light on the dash flashes "TROUBLE-CODES" when problems in the system are detected. A dwell meter connected to a special test lead on the MIXTURE CONTROL SOLENOID (MCS) is used to analyze the system. The vehicle underhood sticker and the service manual provide diagnosis procedures and "TROUBLE-CODE" charts.

C-4 systems are so designed that regardless of the number of cylinders in the engine, the C-4 system is checked by connecting a dwell meter to the MCS test terminal and using the 6 cylinder dwell scale. The specifications in the service manuals are based on the 6 cylinder dwell scale in which 60 degrees represents full scale of 100% dwell.

The vehicle's underhood sticker indicates dwell as a percent of full scale rather than degrees of dwell. Since the 1215 displays both degrees of dwell and percent of dwell, it satisfies either source.

NOTE: Connect all test leads, run complete diagnostic tests and correct any problems before attempting to diagnose problems in the C-4 system.

Tester Preparation

1. Set NUMBER OF CYLINDERS selector to match number of cylinders in engine.

2. Set IGNITION SELECTOR to #2 position.

3. Set scope controls:
   a. FUNCTION SELECTOR to Primary +.
   b. PATTERN SELECTOR to superimposed.
   c. PATTERN HEIGHT to high or low.

4. Change tester connectors as follows:
   a. Remove Red Trigger Pickup from #1 plug wire.
   b. Remove Blue Primary (dwell) lead from tach terminal and connect to the MCS test terminal (Figure 24). The mixture control solenoid test connector is attached to the vehicle wiring harness at the mixture control solenoid on the carburetor (Figure 25).

CAUTION: Do not allow this test connection to contact ground or any hoses or high tension leads.

C-4 system dwell can now be read on the scope in percent. For this reading adjust the pattern length to fill the screen. To convert dwell in percent to dwell in degrees, use the conversion chart (Figure 26).

NOTE: The scope is the preferred method to observe C-4 dwell changes.

To read correct engine RPM, set the IGNITION SELECTOR to the #1 position and then reset for dwell readings. The digital readings with IGNITION SELECTOR in the #2 position apply as follows:

6 cylinder engines — Dwell readings will be correct in percent and in degrees.

4 cylinder engines — Dwell readings will be correct in percent. Disregard degrees of dwell readings.

All engines — Disregard RPM and timing advance when testing the oxygen sensor circuit.

Reading Engine RPM — Set IGNITION SELECTOR to #1 position.

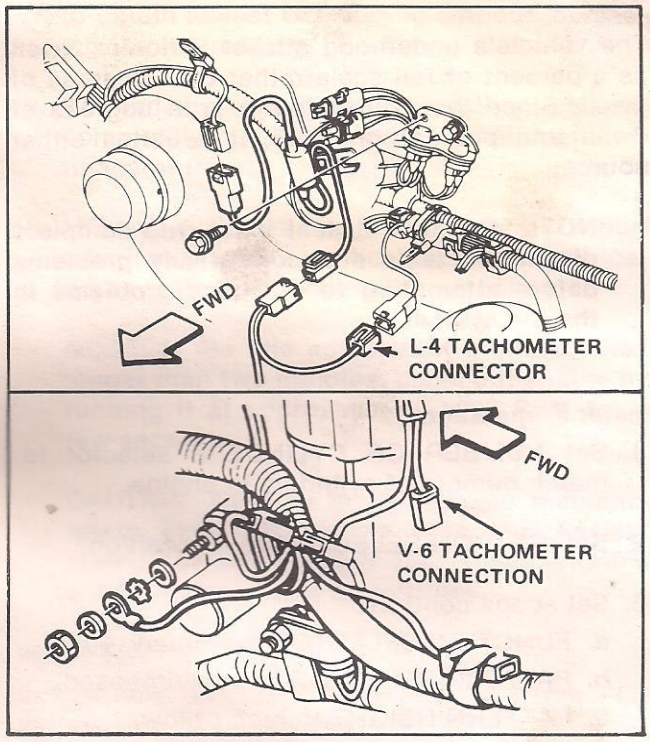


FIGURE 24—Tachometer test connections.

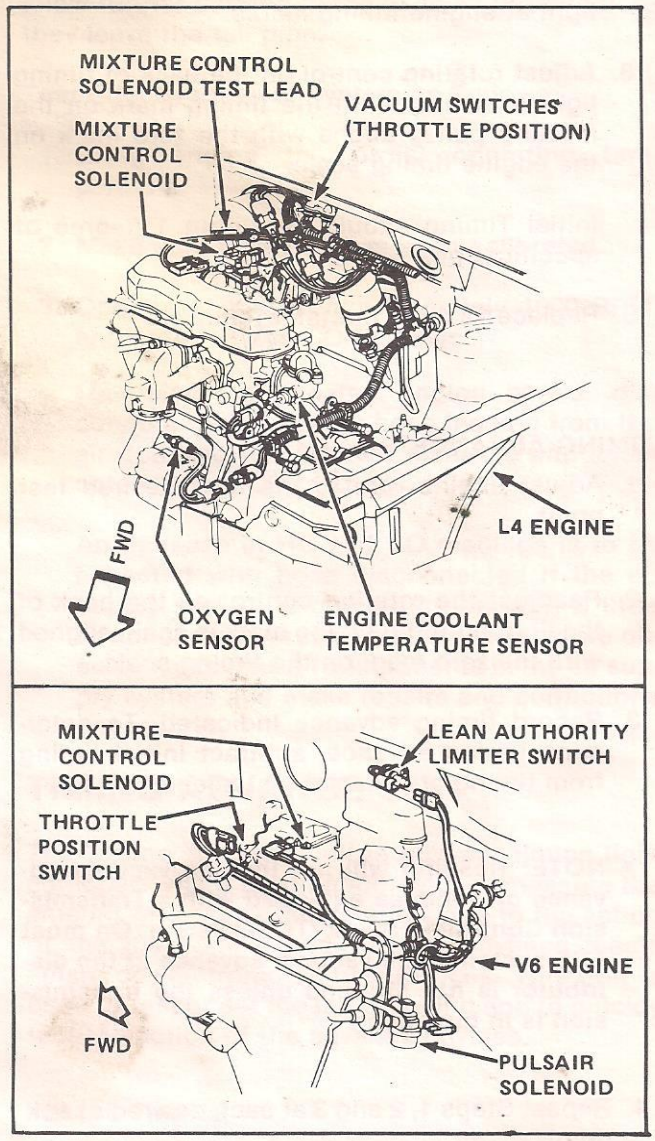


FIGURE 25—Blue primary dwell lead connected at Mixture Control Solenoid.

DWELL CONVERSION CHART

NO. OF CYLS.	PERCENT OF DWELL																			
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100%
6 CYL.	3°	6°	9°	12°	15°	18°	21°	24°	27°	30°	33°	36°	39°	42°	45°	48°	51°	54°	57°	60°

FIGURE 26—Chart for converting percent of dwell to degrees of dwell.

ANALOG SCOPE PINPOINT TESTING

OSCILLOSCOPE PATTERNS

The Sun Analog Scope provides a convenient means of observing ignition system operation while the engine is running. It displays a graphic waveform trace pattern that is easy to interpret because each part of the waveform represents a specific phase of ignition system operation.

NOTE: For an explanation on how to interpret scope waveform patterns refer to Sun's Automotive Testing and Diagnosis manual. Generally, there are three basic waveform patterns, one where there is no intermediate section, Chrysler Electronic, for example, another where there is a hump in the dwell section, HEI for example, and the old conventional ignition system waveform.

DISPLAY PATTERN

With the PATTERN POSITION button at CONV, the PATTERN SELECTOR set at DISPLAY, the PATTERN HEIGHT at HIGH, and the FUNCTION SELECTOR at SECONDARY, the scope will present a parade of all cylinders as shown in Figure 27.

NOTE: The scope patterns presented are of the secondary ignition circuit with the engine running at approximately 1500 rpm.

With the TRIGGER PICKUP clamped around the number one spark plug wire, the waveform viewed on the scope screen will begin on the left with the pattern for number one cylinder. However, it should be noted that the firing line of number one cylinder is displayed at the extreme right end of the trace. The trace moves from left to right displaying the ignition cycles of each cylinder consecutively in the engines firing order until all cylinders are displayed on the screen.

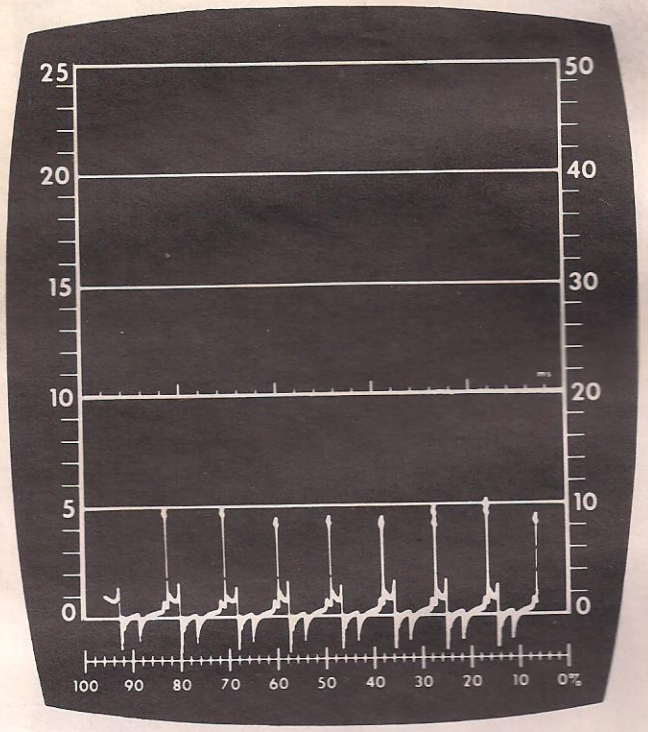


FIGURE 27—Display pattern of normal engine using HEI ignition.

If the operator wishes to move the number one cylinder's firing line from the extreme right to the left of the screen, all he need do is push the PATTERN POSITION button to SHIFT position. Now the display pattern has the firing line of the number one cylinder at the extreme left as shown in Figure 28.

If the operator wishes to move one of the cylinder traces from the parade display and extend it across the screen, he may set the SHORT button to COMP, and push the button number of the CYLINDER SELECTOR control which corresponds to the number of the cylinder that the operator wishes to view. This cylinder's display will then be traced at the top of the screen as in Figure 29, which is a display of a Chrysler Electronic Ignition system. Two or more cylinders can

be superimposed at the top of the screen for close comparison by pressing more than one CYLINDER SELECTOR button.

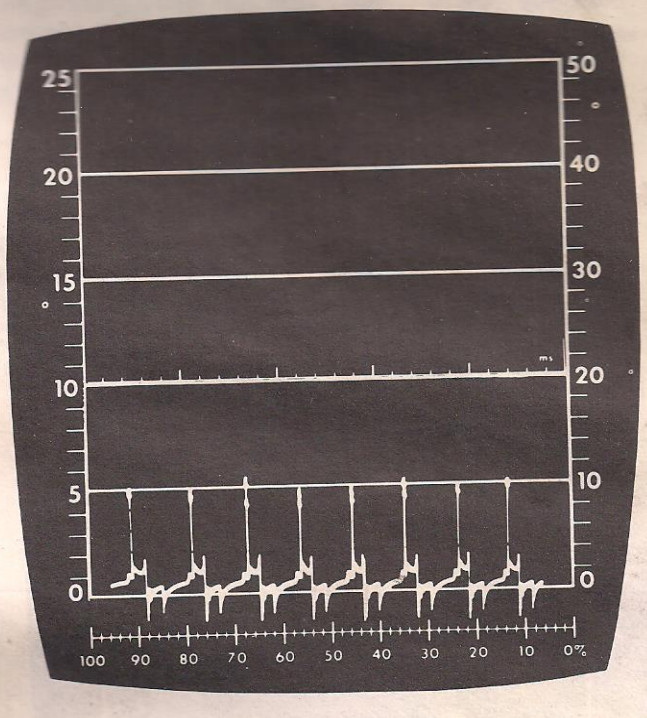


FIGURE 28—Display pattern of normal engine using HEI ignition with shift programmed.

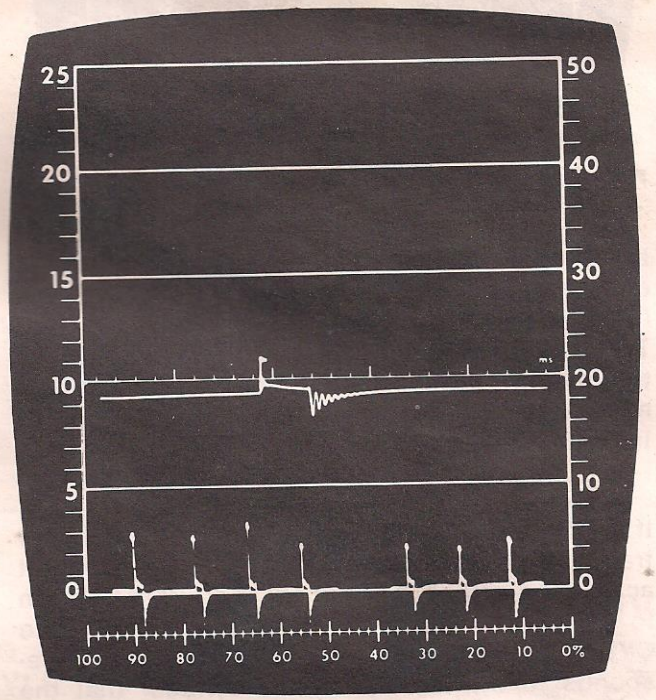


FIGURE 29—A display pattern with shift, compare, and the number five cylinder button of the cylinder selection control programmed.

The cylinder may also be displayed at the top of the screen without being in the SHIFT condition by pressing all the buttons previously depressed but with the PATTERN POSITION control set at CONV. This display is shown in Figure 30 which is of a conventional ignition system.

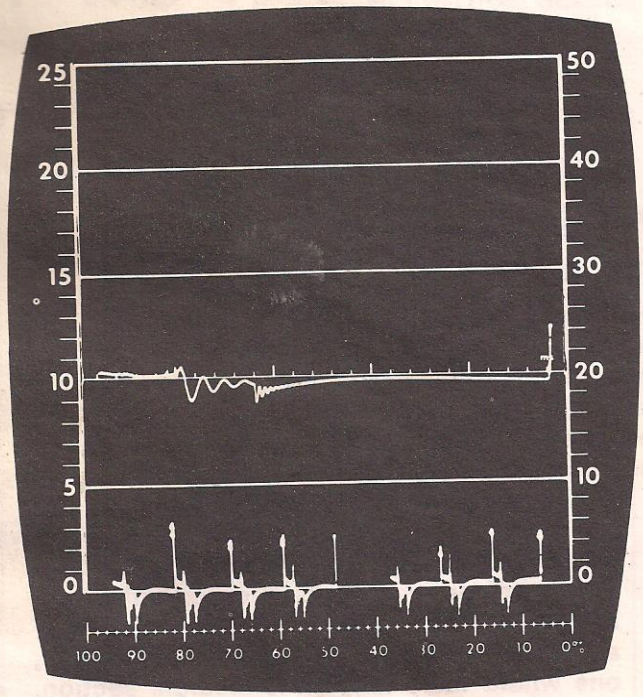


FIGURE 30—A display pattern with conventional, compare, and the number five cylinder button of the cylinder selection control programmed.

RASTER PATTERN

The raster pattern makes use of the vertical size of the scope screen by stacking the cylinder patterns one above the other. All individual patterns are vertically distributed on the screen.

This permits individual cylinder identification while viewing all cylinders at the same time. The raster pattern is especially helpful for cylinder identification of variations in the pattern waveforms observed in the superimposed pattern.

With the TRIGGER PICKUP clamped around number one spark plug wire, the number one cylinder will be displayed at the bottom of the screen. The remaining pattern waveforms will appear in the firing order sequence starting at the bottom and moving to the top of the scope screen.

By setting the PATTERN SELECTOR at RASTER, the PATTERN HEIGHT at HIGH, the FUNCTION SELECTOR at SECONDARY, and the PATTERN POSITION at CONV, the scope will display a raster

pattern (Figure 31). The DISPLAY position of the PATTERN SELECTOR must be used for viewing the firing lines for measuring voltage potentials.

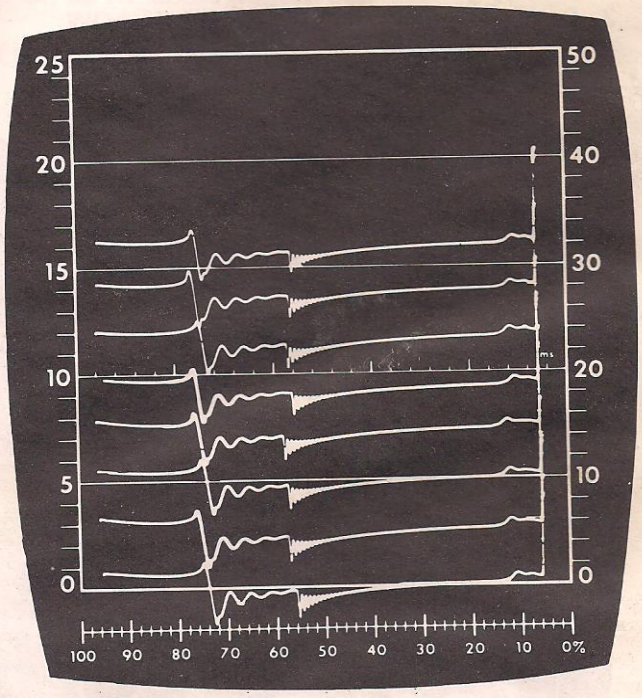


FIGURE 31 — A raster pattern of a normal operating engine with HEI ignition.

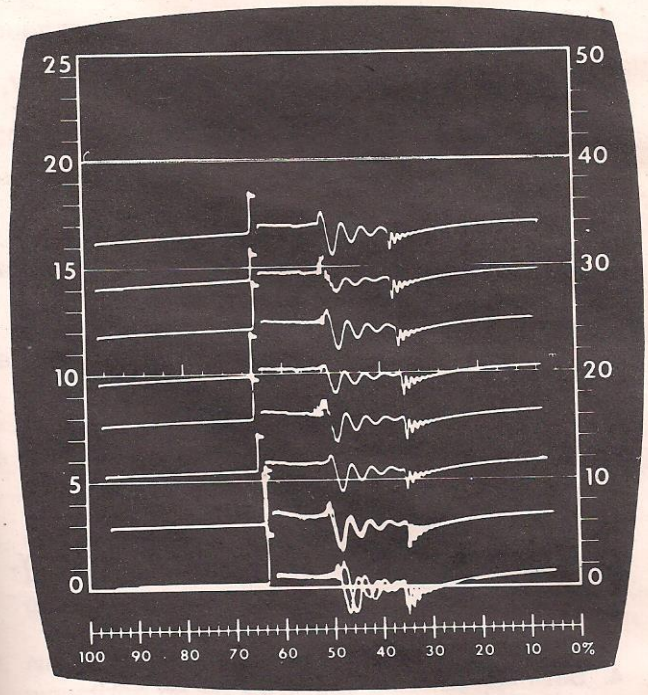


FIGURE 32 — A raster pattern in the shift position on an engine with conventional ignition.

The raster pattern in the SHIFT position does show the firing lines but this display is normally used for ease of viewing the cylinder patterns in raster. To get a raster pattern in the SHIFT position program the scope as above but press the PATTERN POSITION button to SHIFT (Figure 32).

SUPERIMPOSED PATTERN

A superimposed pattern is the display obtained by placing all cylinder patterns one in front, or on top, of the other. Superimposed cylinder patterns provide a convenient method of testing an ignition system for overall uniformity. By having all cylinder display patterns one on top of the other, any variation of any individual cylinder pattern can be easily detected.

To obtain a secondary circuit superimposed pattern, set PATTERN SELECTOR to SUPERIMPOSE, PATTERN HEIGHT to HIGH, FUNCTION SELECTOR to SECONDARY, and obtain the CONV position on PATTERN POSITION controls (Figure 26).

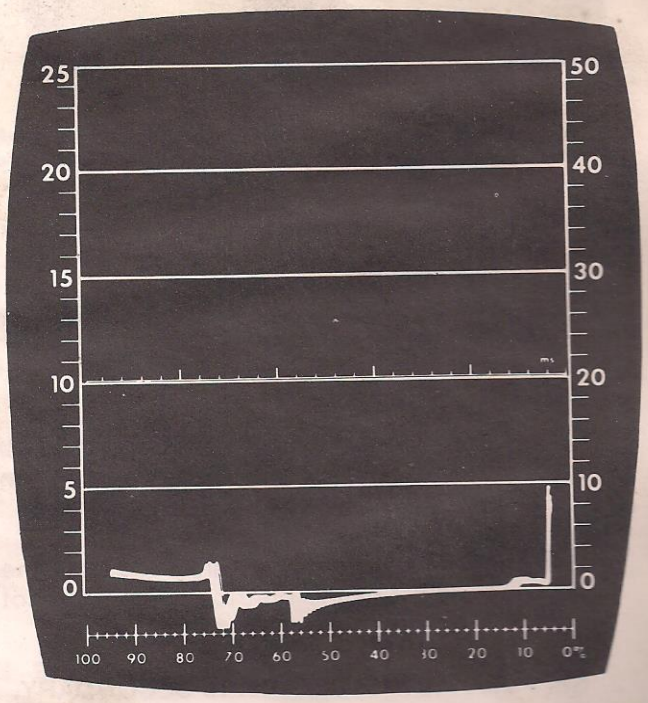


FIGURE 33 — A superimposed pattern of an engine with HEI ignition.

With the analog scope programmed for superimposed as above, a single cylinder display can be obtained by pushing the PATTERN POSITION button to COMP and one of the cylinder buttons on the CYLINDER SELECTOR. This gives a display of a single cylinder. The operator can view any single cylinder display by depressing the corresponding

cylinder button on the CYLINDER SELECTOR. This cylinder will be displayed below the zero line on the dwell scale (Figure 34).

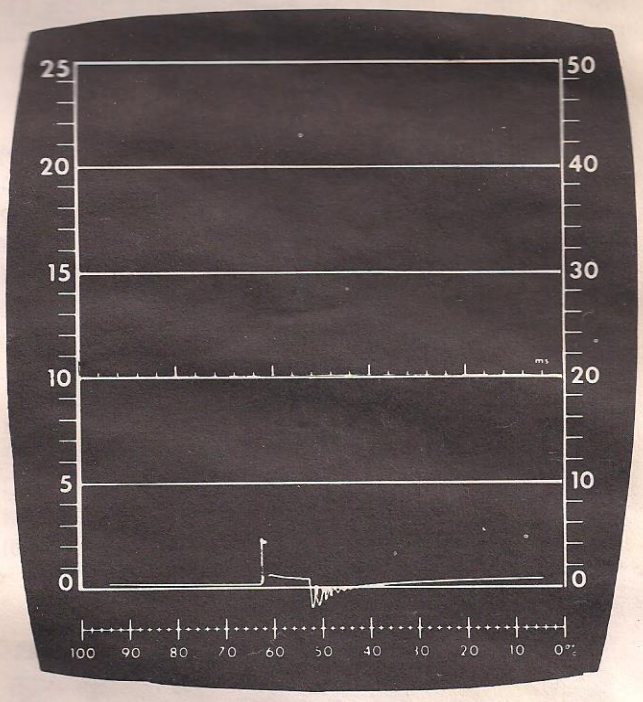


FIGURE 34—A single cylinder display obtained from superimposed pattern in compare (engine with Chrysler electronic ignition).

COIL OUTPUT CRANKING

NOTE: Some manufacturers do not recommend this test except when the engine will not start.

For scope testing, the test leads are connected to the vehicle as outlined in the Area Testing section unless otherwise stated. See Figure 21.

1. Disconnect the coil Secondary Lead from the center terminal of the distributor cap. Do not use the ENGINE KILL button.
2. Set FUNCTION SELECTOR to SECONDARY.
3. Set PATTERN HEIGHT selector to HIGH.
4. Set PATTERN SELECTOR to DISPLAY.
5. Crank engine with Ignition Key ON.
6. Note and record maximum rise of waveform on 50 KV scale.
7. Stop cranking and reconnect coil lead.

COIL POLARITY

1. Start engine and operate at 1000 to 1500 rpm.
2. Set FUNCTION SELECTOR to SECONDARY.
3. Set PATTERN HEIGHT selector to LOW.
4. Set PATTERN SELECTOR to DISPLAY.
5. Set PATTERN POSITION for either CONV or SHIFT.
6. Note and record position of waveform firing line. If pattern is upside down, the coil polarity is reversed.

IGNITION SECONDARY (Min. and Max.)

1. Operate engine at 1000 to 1500 rpm.
2. Set FUNCTION SELECTOR to SECONDARY.
3. Set PATTERN HEIGHT selector to LOW.
4. Set PATTERN SELECTOR to DISPLAY.
5. Set PATTERN POSITION for either CONV or SHIFT.
6. Note and record the height of each firing line on the 25 KV scale.

SPARK PLUG FIRING VOLTAGES

1. Operate engine at 1000 to 1500 rpm.
2. Set FUNCTION SELECTOR to SECONDARY.
3. Set PATTERN HEIGHT selector to LOW.
4. Set PATTERN SELECTOR to DISPLAY.
5. Set PATTERN POSITION for either CONV or SHIFT.
6. Note and record the height of each firing line on the 25 KV scale.

MAXIMUM COIL OUTPUT

1. Operate engine at 1000 to 1500 rpm.
2. Set FUNCTION SELECTOR to SECONDARY.
3. Set PATTERN HEIGHT selector to HIGH.
4. Set PATTERN SELECTOR to DISPLAY.
5. Set PATTERN POSITION for either CONV or SHIFT.

6. Use insulated pliers to disconnect one spark plug wire and hold wire away from engine ground.

7. Note and record maximum rise of waveform on 50 KV scale (Figure 35).

8. Reconnect spark plug wire to spark plug.

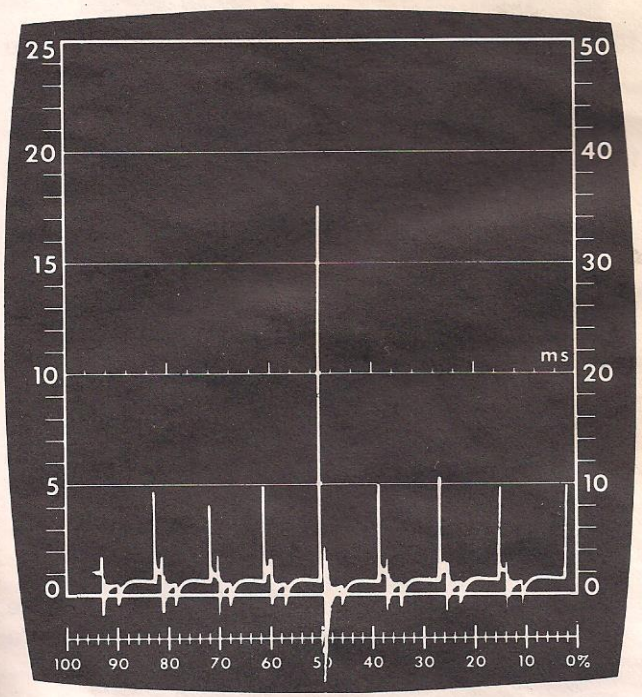


FIGURE 35 — Maximum available coil output voltage.

SECONDARY CIRCUIT INSULATION

1. Operate engine at 1000 to 1500 rpm.

2. Set FUNCTION SELECTOR to SECONDARY.

3. Set PATTERN HEIGHT selector to HIGH.

4. Set PATTERN SELECTOR to DISPLAY.

5. Set PATTERN POSITION for either CONV or SHIFT.

6. Use insulated pliers to disconnect one spark plug wire and hold wire away from engine ground.

7. Note and record maximum downspike of waveform on 50 KV scale.

8. Reconnect spark plug wire to spark plug.

NOTE: This test does not apply to high output systems such as HEI that produce over 30 KV since the spark will jump inside the distributor cap on good systems.

SECONDARY CIRCUIT RESISTANCE

1. Operate engine at 1000 to 1500 rpm.

2. Set FUNCTION SELECTOR to SECONDARY.

3. Set PATTERN HEIGHT selector to LOW.

4. Set PATTERN SELECTOR to RASTER.

5. Set PATTERN POSITION for either CONV or SHIFT.

6. Note and record the appearance of each waveform spark line.

COIL AND CONDENSER ACTION

1. Operate engine at 1000 to 1500 rpm.

2. Set FUNCTION SELECTOR to either SECONDARY or PRIMARY.

3. Set PATTERN HEIGHT selector to HIGH.

4. Set PATTERN SELECTOR to RASTER or SUPERIMPOSE.

5. Set PATTERN POSITION for either CONV or SHIFT.

6. Note and record appearance of Intermediate Section waveform.

BREAKER POINT CONDITION

1. Operate engine at 1000 to 1500 rpm.

2. Set FUNCTION SELECTOR to either PRIMARY or SECONDARY.

3. Set PATTERN HEIGHT selector to LOW.

4. Set PATTERN SELECTOR to RASTER or SUPERIMPOSE.

5. Set PATTERN POSITION for SHIFT.

6. Note and record Point Open and Point Close portion of Dwell Section.

CYLINDER TIMING ACCURACY

1. Operate engine at 1000 to 1500 rpm.

2. Set FUNCTION SELECTOR to either PRIMARY or SECONDARY.
3. Set PATTERN HEIGHT selector to LOW.
4. Set PATTERN SELECTOR to SUPERIMPOSE.
5. Set PATTERN POSITION for SHIFT.
6. Note and record the misalignment in degrees of the waveform point open signals.

SNAP ACCELERATION

1. Operate engine at idle.
2. Set FUNCTION SELECTOR to SECONDARY.
3. Set PATTERN HEIGHT selector to HIGH.
4. Set PATTERN SELECTOR to DISPLAY.
5. Set PATTERN POSITION to SHIFT.
6. Snap accelerate engine to approximately 2000 rpm; then release throttle.
7. Note and record maximum and minimum rise of firing lines on the 50 KV scale.

CYLINDER COMPARISON

Occasionally it becomes desirable to enlarge a particular waveform for detailed comparison with the others being viewed on the screen. This is easily accomplished when viewing either Secondary or Primary Patterns in the following manner.

1. Operate the engine at the desired test speed.
2. Set the FUNCTION SELECTOR to either SECONDARY or PRIMARY as desired.
3. Set the PATTERN HEIGHT selector to HIGH.
4. Set the PATTERN SELECTOR to DISPLAY.
5. Set the PATTERN POSITION for either CONV or SHIFT as desired.
6. Push the SHORT button to the COMP position.
7. Select the cylinder to be compared with the others and depress the corresponding button of the CYLINDER SELECTOR.
8. Compare the characteristics of the enlarged waveform at the top of the screen with the other waveforms being displayed.
9. Press the same CYLINDER SELECTOR button, or the CANCEL button to return the enlarged waveform to its former position in the display.
10. Repeat steps 7, 8 & 9 to enlarge any of the other cylinder waveforms for comparison.
11. Push two or more CYLINDER SELECTOR buttons and compare the cylinder waveforms. They will be superimposed at the top of the screen.

ALTERNATOR DIODE TEST

1. Set PATTERN SELECTOR to the RASTER position and set PATTERN HEIGHT to VARIABLE.
2. Set FUNCTION SELECTOR to ALT position.
3. Clamp the Green CLAMP PICKUP around the alternator output (+) lead or to the positive battery cable.
4. Start the engine and operate at approximately 1000 rpm.
5. Turn headlights on and to high beam to apply an electrical load to the alternator.
6. Observe waveform and compare to Figure 36.

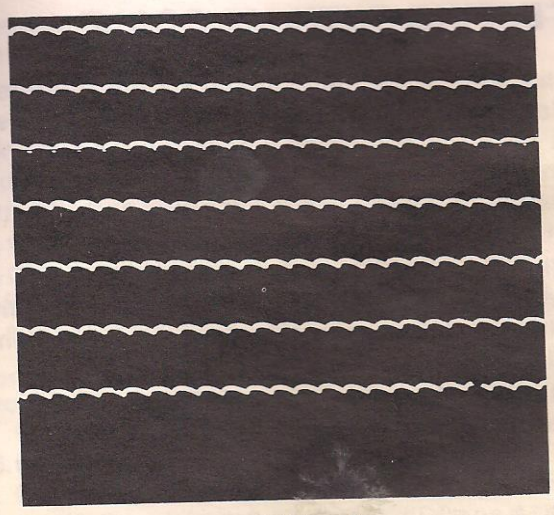
   If waveform is other than normal, alternator must be removed from vehicle for service.

COIL STRESS TEST

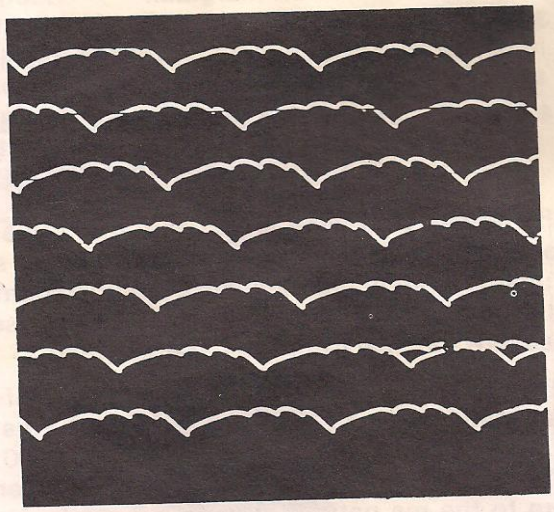
The coil can be tested either on or off the engine. With the coil on the vehicle, disconnect all leads from coil primary and secondary terminals.

Coil Test Procedure

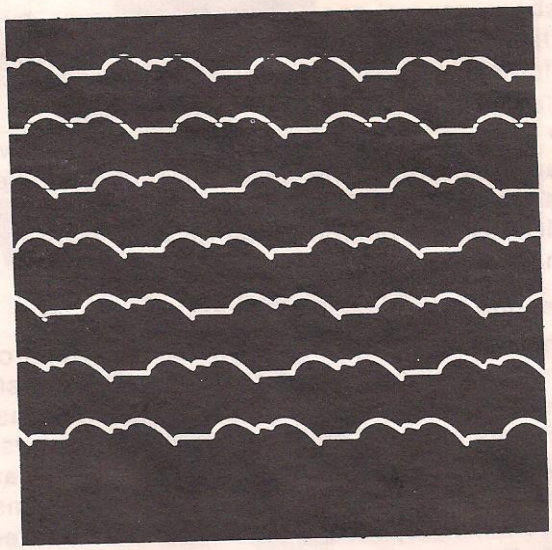
1. Set PATTERN SELECTOR to DISPLAY, FUNCTION SELECTOR to SECONDARY, and PATTERN HEIGHT to HIGH.
2. Plug Coil Test Lead connector into tester receptacle on left end side panel of tester.



Normal Alternator



Open Diode



Shorted Diode

FIGURE 36—Normal and abnormal alternator output waveforms.

3. Connect Coil Test Leads to primary terminals of coil, observing polarity, and insert coil high tension adapter in the coil tower.

4. Set COIL STRESS knob to full counterclockwise position.

5. Connect the CHROME CLAMP pickup over the adapter that is inserted into the coil tower.

6. Hold COIL TEST knob in "on" (clockwise) position.

7. Turn COIL STRESS knob until pattern extends a minimum of 25 KV on the scope screen for standard or conventional coils. Electronic ignition systems such as the General Motors HEI system may have a specification of 30 KV minimum. Check manufacturer's specifications.

8. Release COIL TEST knob at completion of test.

A series of gradually descending oscillations of the pattern on the scope at 25 KV or more indicates a good coil (Figure 37). A bad coil will either not produce the rated output or will have only one or two oscillations instead of several (Figure 38). If the first oscillation points downward, the polarity is reversed.

Delco HEI Coil Output Test

NOTE: The Coil Test Lead connector should be plugged into tester receptacle on left end side panel of tester if it has not been plugged in previously.

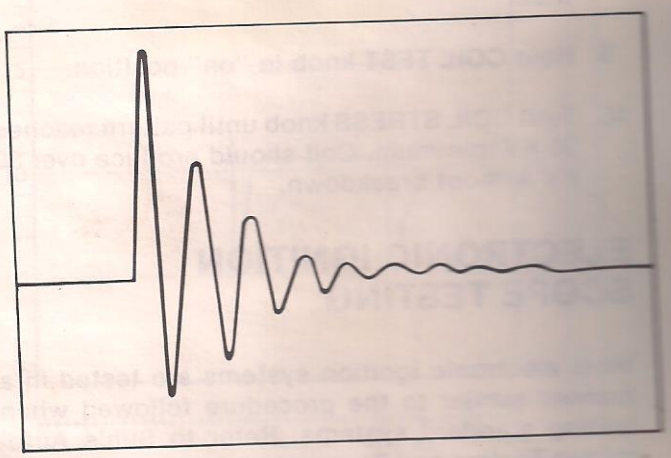


FIGURE 37—Normal coil waveform with first oscillation pointing up and with other gradually descending oscillations.

1. Connect the HEI adapter to the Chrome Clamp PATTERN PICKUP lead.

   NOTE: Late model GM systems with coil in distributor cap may require an extension. See Components And Accessories Section.

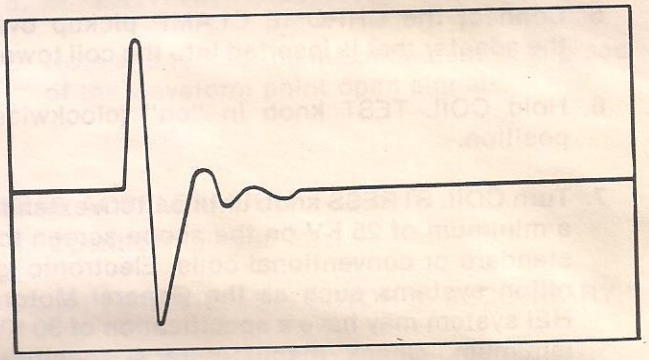


FIGURE 38—Shorted coil waveform with limited output and few oscillations.

2. Connect the Red VOLT/OHM clip to the BAT terminal adapter.
3. Connect the Black VOLT/OHM clip to the TACH terminal adapter.
4. Snap the HEI adapter into place on top of the coil cover.
5. Connect BLACK BOOT lead of Universal Harness to the GRD terminal adapter lead.
6. Set FUNCTION SELECTOR to SECONDARY.
7. Set PATTERN SELECTOR to DISPLAY.
8. Rotate COIL STRESS knob fully counterclockwise.
9. Hold COIL TEST knob in "on" position.
10. Turn COIL STRESS knob until pattern reaches 30 KV minimum. Coil should produce over 30 KV without breakdown.

ELECTRONIC IGNITION SCOPE TESTING

Most electronic ignition systems are tested in a manner similar to the procedure followed when testing standard systems. Refer to Sun's Automotive Testing and Diagnosis manual and to other Sun Publications for detailed testing and diagnostic information on these systems.

TESTING WITH MS SCALE

The use of the multisecond pattern feature provides another method of testing spark plugs that is useful in determining spark plug condition. To check for close plug gaps and fouled spark plugs, set the tester to the 5 ms position and all patterns will be superimposed below the ms scale.

With the SHORT button set to compare, each cylinder's firing section can be viewed individually by pushing each cylinder selector button and releasing it in sequence.

At idle and speeds up to 1000 rpm, the following general rules apply.

1. A normal spark line should be around 1.5 ms long.
2. A spark line that is 1.0 ms long or slightly less can be considered marginal.
3. A spark line that is less than 0.5 ms long, which indicates high secondary resistance will probably cause a miss.
4. A spark line longer than 1.8 ms indicates a very small spark plug gap or a fouled spark plug.

On engines with wide rotor gaps, firing lines are not a true indication of fouled or shorted spark plugs. The raster position can be used to compare all spark lines and the ms position can be used to measure the spark duration at any speed.

Since spark duration decreases in terms of time as speed increases, a spark line that is 1.4 ms long at 1000 rpm will be about 0.6 ms long at 5000 rpm. This can be verified by comparing the raster pattern to the ms pattern at various speeds. Not all types of ignition systems will conform to the above general specifications. However, by using the ms test position on various types of good ignition systems, one can establish standards for use in diagnosing problems.

If desired the 25 ms scale can be used to view a larger portion of the waveform through the speed range. As speed is increased, the PATTERN POSITION SHIFT position may be necessary to view the waveform.

Testing Electronic Fuel Injection

The Analog Scope has new features for troubleshooting electronic fuel injection (EFI) systems. Outlined below is a description of how to test the EFI system on Cadillac engines. Other systems classified as D-Jetronic or L-Jetronic can be tested using this method. K-Jetronic systems use mechanical operated injectors and do not require this test.

NOTE: The EFI system should not be tested until the normal ignition tests (power balance, emissions, etc.) are completed.

Analog Scope Pinpoint Testing

1. Connect the E.F.I. Adapter (Electronic Fuel Injection Adapter, Figure 39) as follows:
   a. Remove the insulator cap from one injector in each group (cylinder 1 and 3 for example).
   b. Connect one Green booted clip lead to one injector group (red wire) and the other Green booted clip lead to the other injector group (white wire).
   c. Connect the large Black booted clip lead to a good engine ground.
2. Connect tester leads to the E.F.I. Adapter as follows:
   a. Connect the Blue Primary dwell lead to the E.F.I. Adapter blue PRIMARY LEAD post.
   b. Connect the Red battery positive lead to the E.F.I. Adapter Red BATTERY LEAD post.
3. Connect the Red Trigger Pickup lead from tester to the number one injector group main feed wire in the injector wiring harness (red wire).
4. Set the tester controls as follows:
   a. Set NUMBER OF CYLINDERS to 2 position.
   b. Set IGNITON SELECTOR to 2 position (forced primary).
   c. Set PATTERN SELECTOR to 5 ms position.
   d. Push PATTERN POSITION to obtain CONV position.
   e. Set FUNCTION SELECTOR to ALT position.
5. Advance tester to RUNNING TESTS page.
6. Start engine and run at chosen RPM.
7. Adjust VERTICAL and HORIZONTAL knobs to center pattern on ms scale with the first down spike near a 1 ms scale division mark (Figure 40).
   NOTE: The waveform pattern is of two injection groups superimposed. To obtain only the #1 injector group waveform on the screen, press the #1 cylinder button of the CYLINDER SELECTOR.
8. Interpret the injector waveforms.

The millisecond waveforms indicate the duration of injection. The injectors are open and emitting fuel from the first down spike to the second down spike of the waveform. The opening time is read directly on the millisecond scale and is called the pulse width.

The pulse time varies with the greater or lesser fuel demand of the engine. A rich fuel mixture demanded by engine conditions requires a longer pulse width duration and a leaner mixture requires a shorter pulse width duration.

For information on specific duration time, refer to manufacturer's specifications for system being tested.

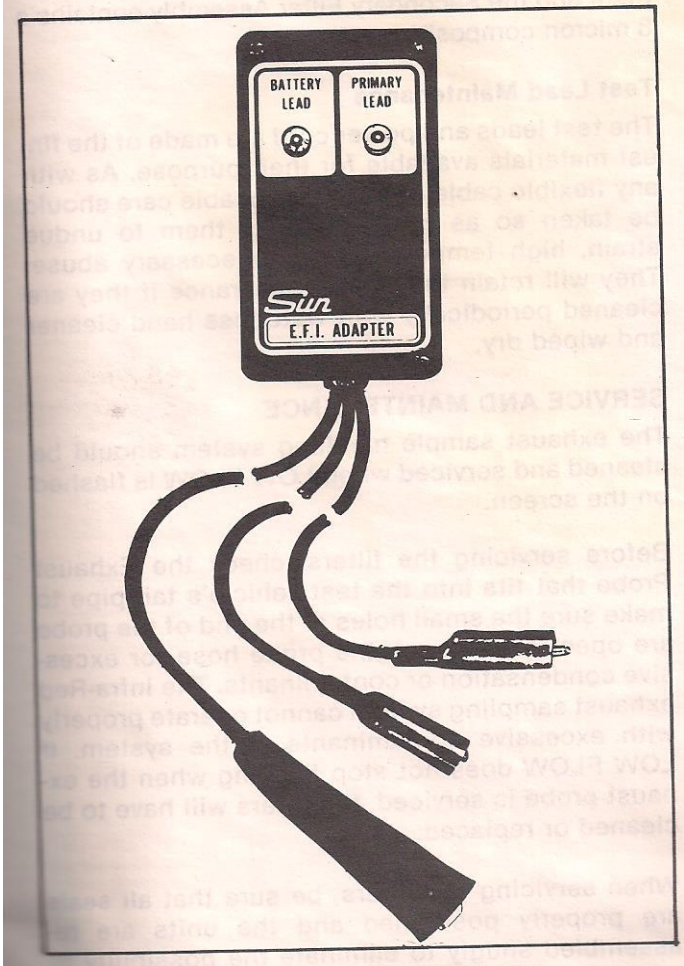


FIGURE 39—Electronic Fuel Injection Adapter.

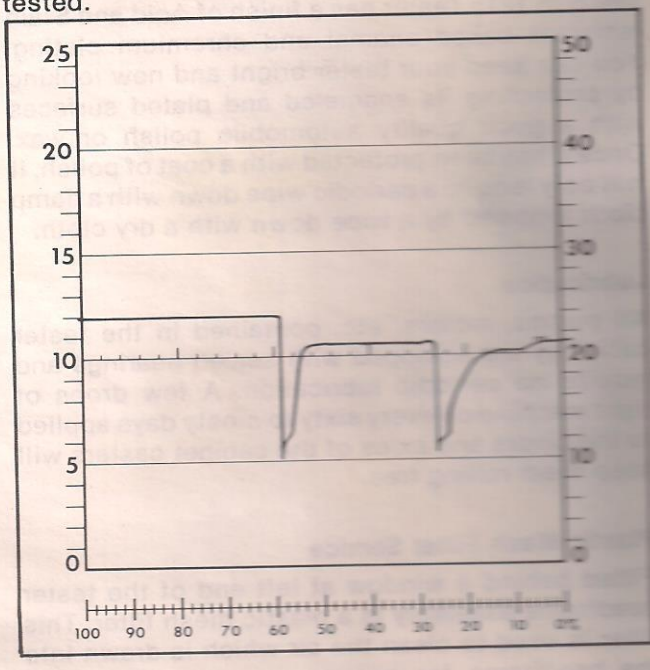


FIGURE 40—Waveform of electronic fuel injection.

MAINTENANCE AND SERVICE

OPERATOR SERVICE INSTRUCTIONS

The service and maintenance procedures presented in this section are those which the operator can perform himself. All other service should be performed by the local Sun representative. The computer will indicate on the SELF TEST page when trouble exists in the tester.

SERVICE PROCEDURE

The 1215 Computer II Tester is a precision diagnostic and service instrument. With reasonable care, it will provide many years of reliable service. The maintenance and service procedures presented herein do not require any special skills to perform. However, they do require care and attention to avoid any accidental damage to the equipment.

Maintaining Tester Finish

The Sun 1215 Tester has a finish of Acid and Stain resistant baked enamel and chromium plating. You can keep your tester bright and new looking by protecting its enameled and plated surfaces with a good quality automobile polish or wax. Once it has been protected with a coat of polish, it will only require a periodic wipe down with a damp cloth followed by a wipe down with a dry cloth.

Lubrication

All pumps, motors, etc. contained in the tester cabinetry are equipped with sealed bearings and require no periodic lubrication. A few drops of light machine oil every sixty to ninety days applied to the pivots and axles of the cabinet casters will keep them rolling free.

Plastic Mesh Filter Service

Fitted behind a window at left end of the tester headframe assembly is a plastic mesh filter. This filter is used to clean the air which is drawn into the headframe for cooling purposes. The filter should be removed every sixty to ninety days for cleaning. More frequent cleaning is desirable if extremely dusty conditions prevail. The filter should be washed in warm soapy water, rinsed and thoroughly dried before being reinstalled.

Infra-Red Filter Service

Two types of filters are part of the Infra-Red exhaust sampling system. These two filter elements are contained in the filter assemblies located in a recess in the right end of the tester headframe. The Primary Filter Assembly contains a 75 micron wire mesh element and the Secondary Filter Assembly contains a 8 micron composition element.

Test Lead Maintenance

The test leads and power cord are made of the finest materials available for their purpose. As with any flexible cable or hose reasonable care should be taken so as not to subject them to undue strain, high temperature or unnecessary abuse. They will retain their new appearance if they are cleaned periodically with waterless hand cleaner and wiped dry.

SERVICE AND MAINTENANCE

The exhaust sample handling system should be cleaned and serviced when LOW FLOW is flashed on the screen.

Before servicing the filters, check the Exhaust Probe that fits into the test vehicle's tail pipe to make sure the small holes at the end of the probe are open. Also, check the probe hose for excessive condensation or contaminants. The Infra-Red exhaust sampling system cannot operate properly with excessive contaminants in the system. If LOW FLOW does not stop flashing when the exhaust probe is serviced, the filters will have to be cleaned or replaced.

When servicing the filters, be sure that all seals are properly positioned and the units are reassembled snugly to eliminate the possibility of outside air being drawn into the analyzer during vehicle tests.

Maintenance And Service

Primary Filter Service

(Element should be cleaned or replaced as necessary.)

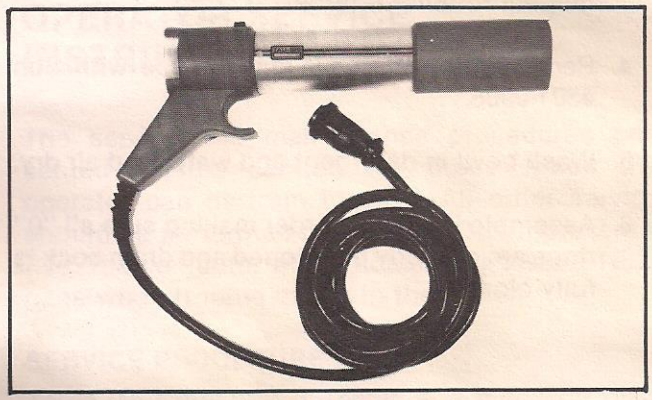
1. Remove plastic hoses from the "T" fitting on the lower part of the bowl.
2. Unscrew filter bowl from housing by turning filter bowl counterclockwise. Note position of "0" ring seal on bowl rim.
3. Turn element retainer counterclockwise and remove filter element.
4. Clean bowl and element in a solution of detergent and water and air dry. If element replacement is necessary, use Sun #301-0926 filter element.
5. Assemble in reverse order making sure "0" ring is properly positioned in groove at upper edge of bowl. Reconnect the plastic hoses to the "T" fitting. Hose from front of tester connects to the side of the "T" having the smallest opening.

Secondary Filter Service

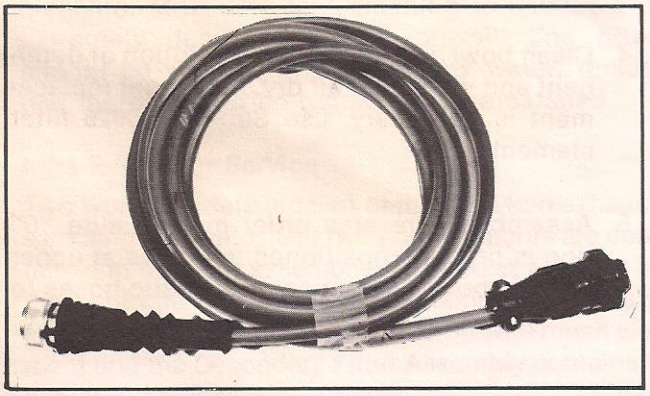
(Element should be replaced as necessary.)

1. Remove bowl retainer at bottom of bowl by turning it counterclockwise and remove bowl.
2. Inspect "0" rings on retainer nut and bowl rim.
3. Remove filter retainer by pulling downward. Inspect retainer internal "0" ring.
4. Remove filter element and replace with Sun #301-0908.
5. Wash bowl in detergent and water and air dry.
6. Assemble in reverse order making sure all "0" rings are properly positioned and drain cock is fully closed.

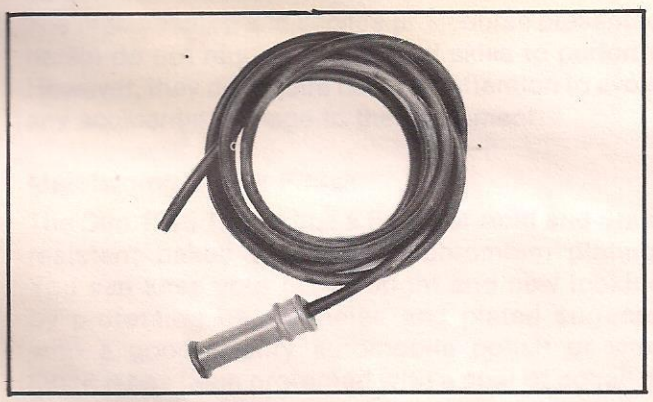
COMPONENTS AND ACCESSORIES



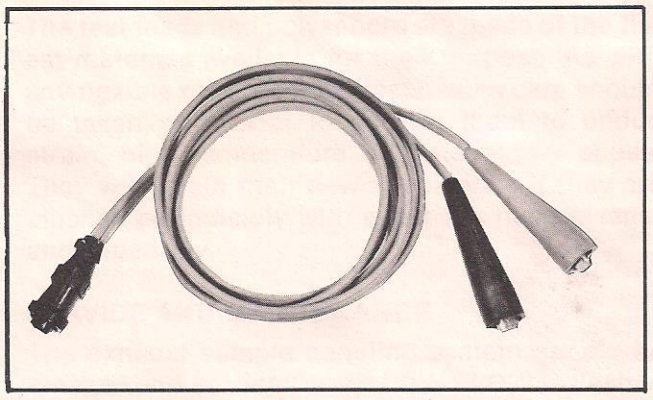
Timing Advance Unit 7009-1374-01 (TAU-130)



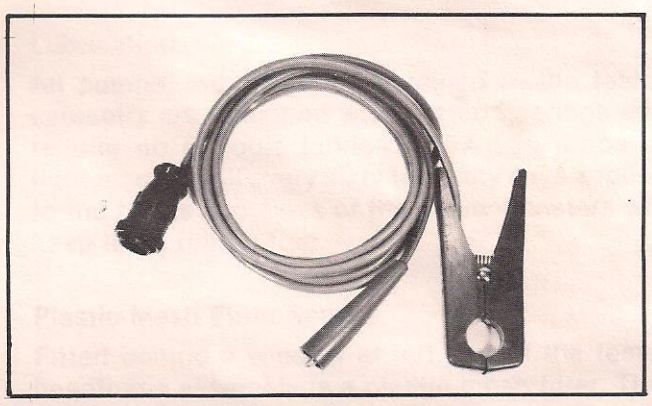
Trigger Lead 6004-262



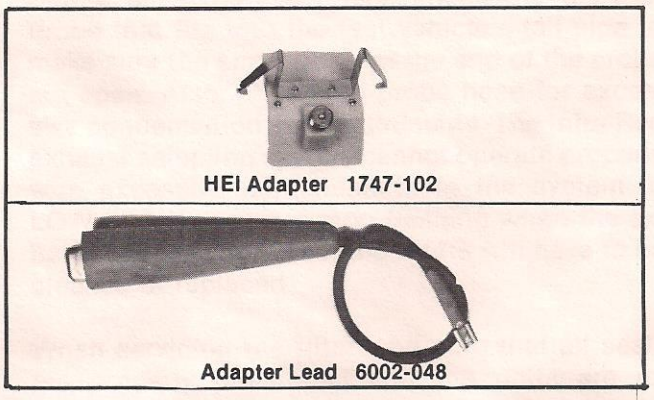
Vacuum Hose Assembly 6006-003



Volt-Ohmmeter Lead 6004-249



Ammeter Lead Assembly 6005-139

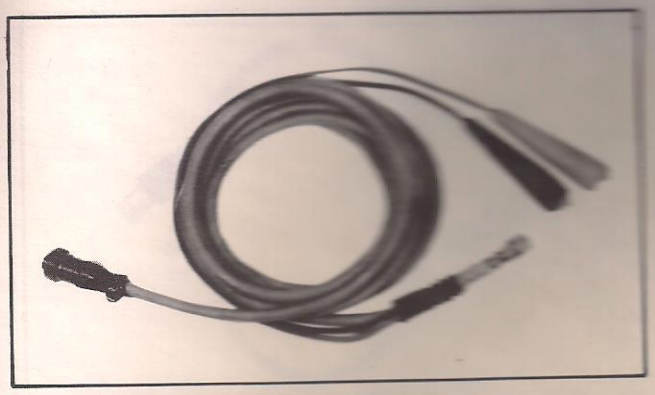


HEI Adapter 1747-102

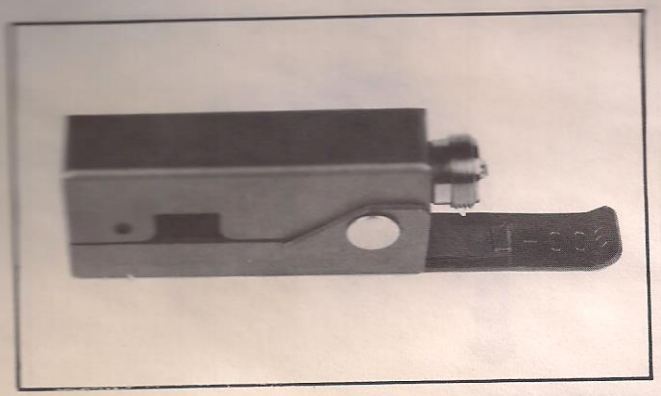
Adapter Lead 6002-048

HEI Adapter Kit 0120-0240

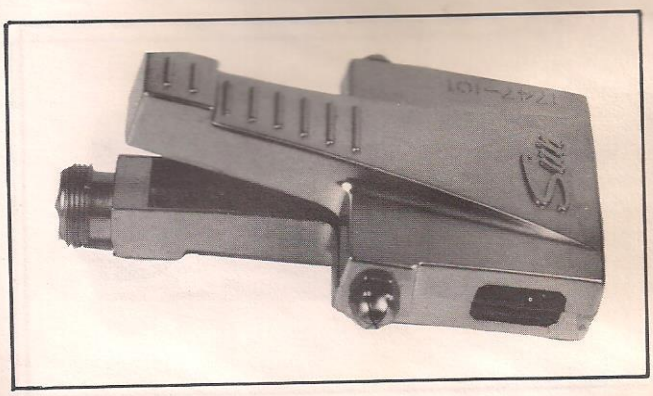
COMPONENTS AND ACCESSORIES



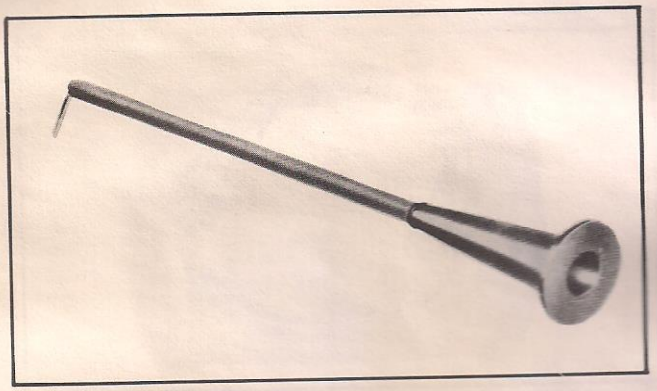
Pattern Pick-Up Lead 6005-132



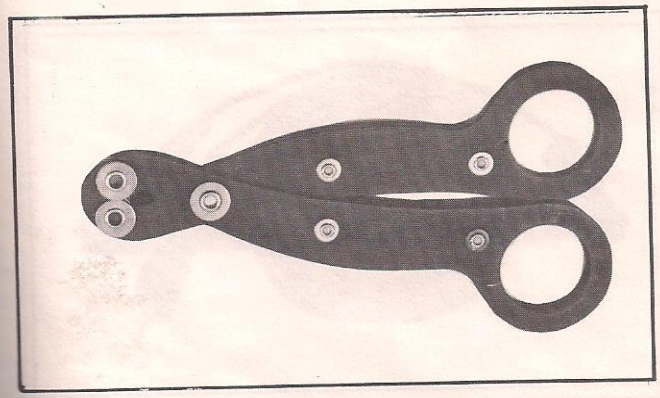
Trigger Pick-Up 507-6



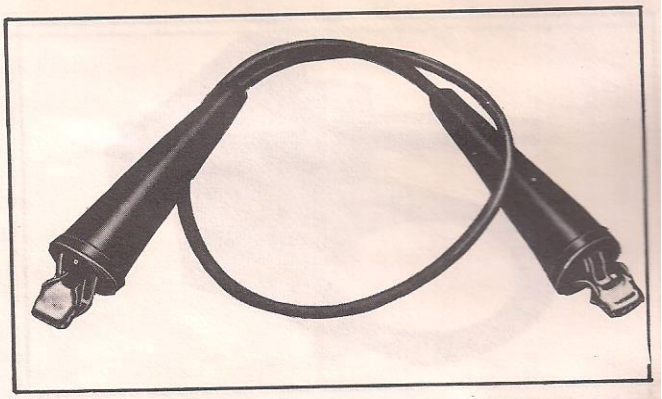
Chrome Pattern Pick-Up 1747-101



Resistance Test Contactor 4344

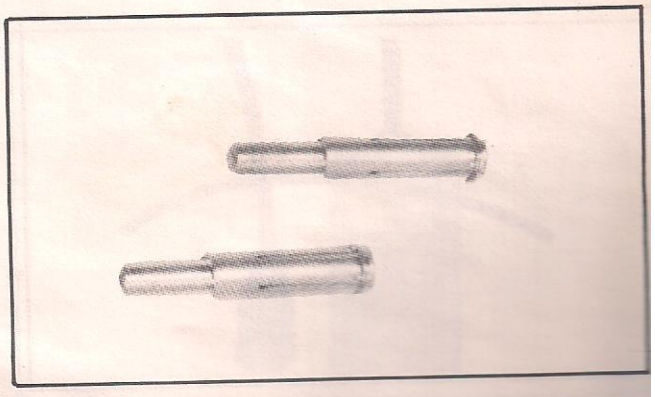


High Tension Pliers 2-1028



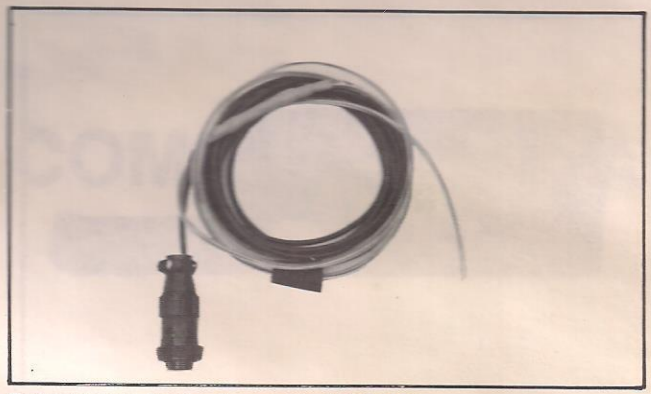
18" Jumper Lead 2-133-15

Fuel Pump Tester & Fittings #FPT-4 (2-1302)

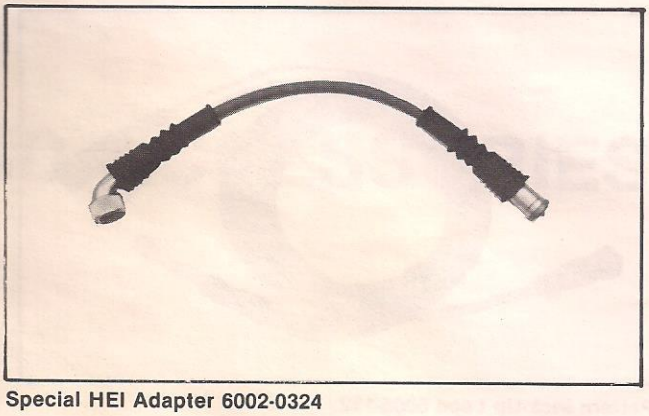


Ford Coil Adapters #3676-501 (2)

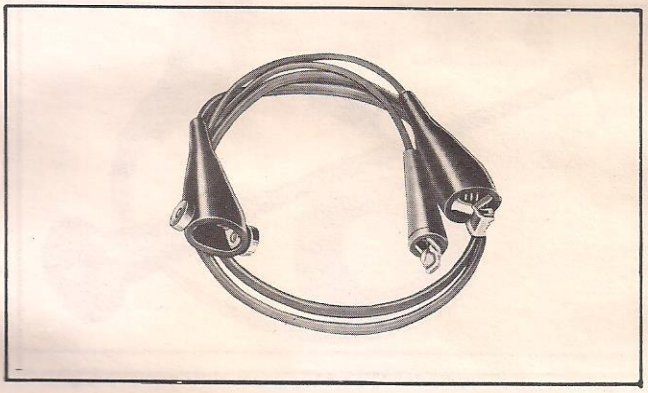
COMPONENTS AND ACCESSORIES



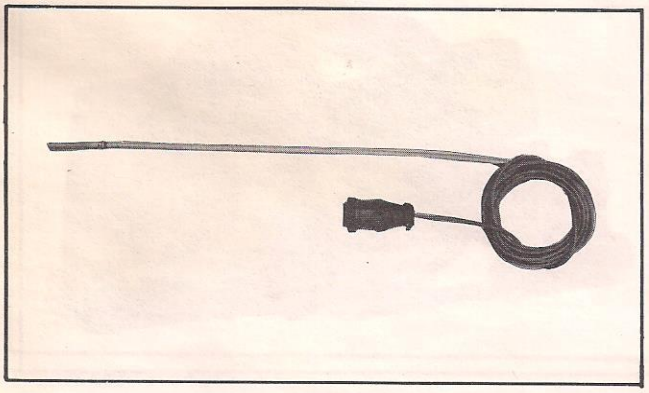
Temperature Probe Assembly 6004-0336



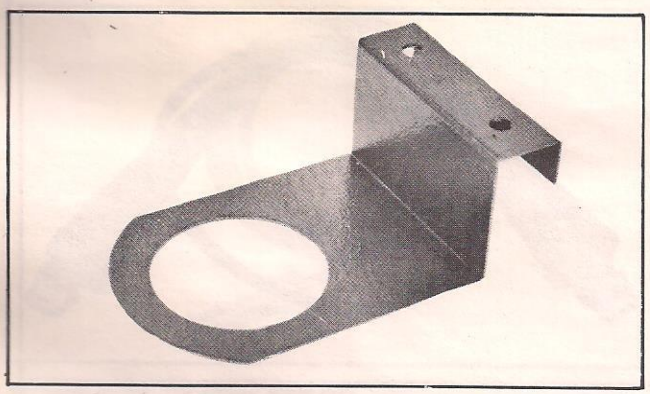
Special HEI Adapter 6002-0324



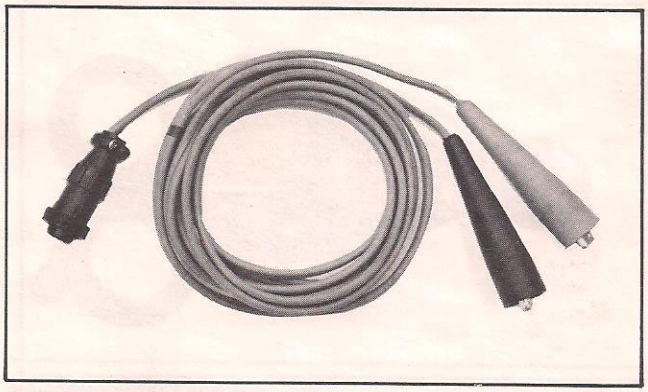
Solenoid Starter Switch #1438-2



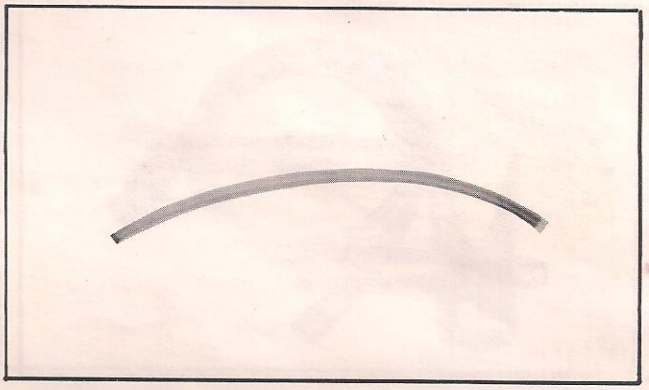
Mag Lead Assembly 7009-1386



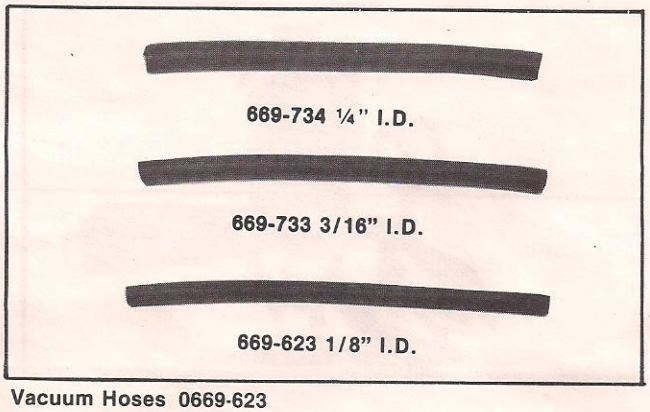
Ignition Coil Bracket 7012-0511-02



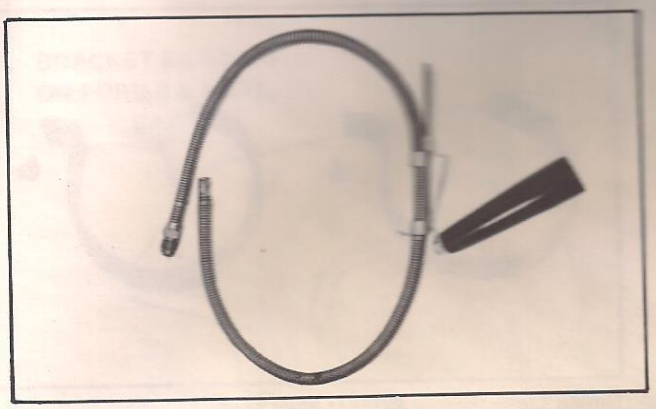
Coil Test Lead Assembly 6002-0265



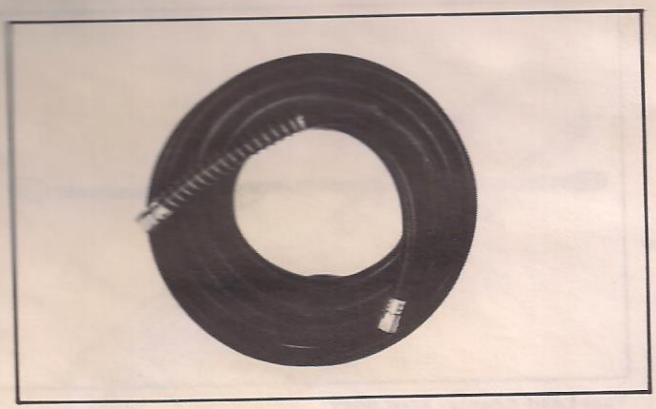
12" Hose 669-220



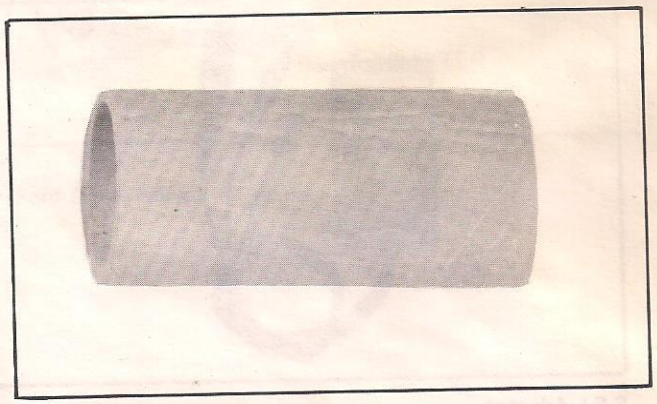
Vacuum Hoses 0669-623
0669-733
0669-734



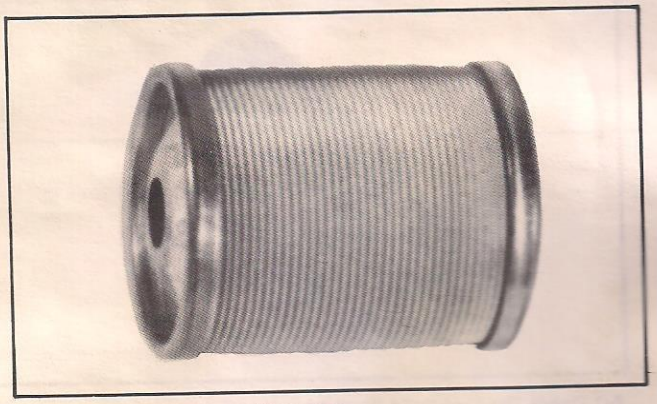
Exhaust Probe Assembly #7009-0511



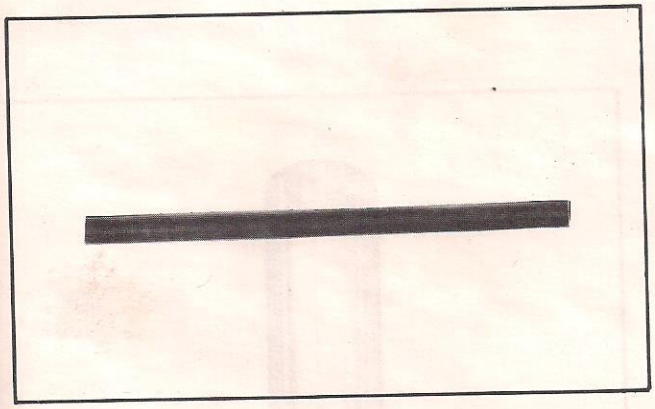
Exhaust Hose #3988-0202



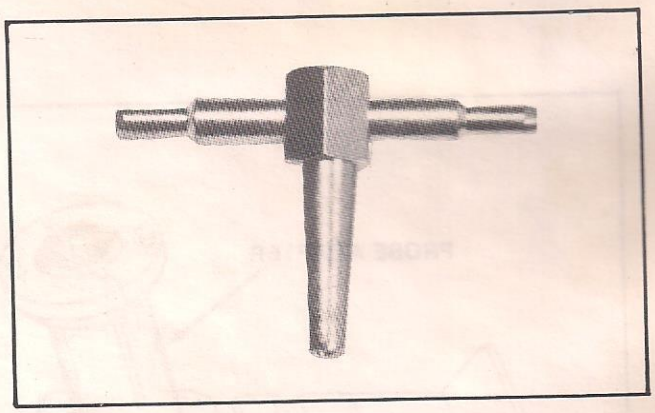
Secondary Filter Element #301-908



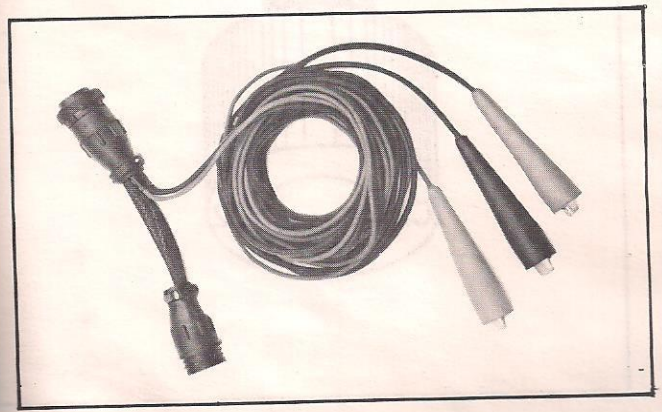
Primary Filter Element #301-926

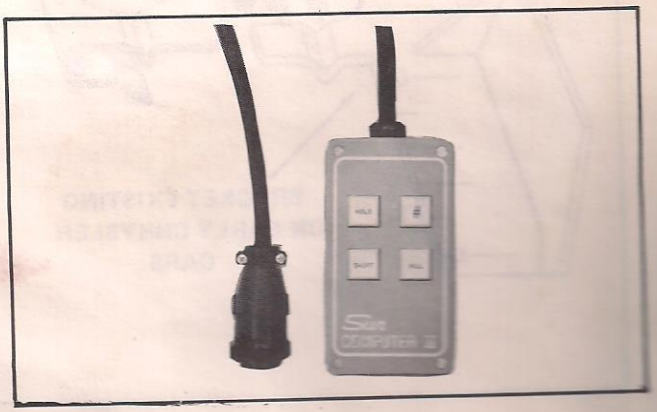


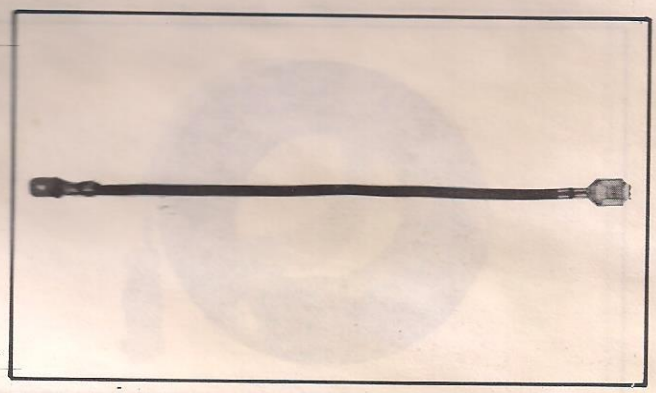
6" Vacuum Hose #669-623



"T" Connector #2894-501

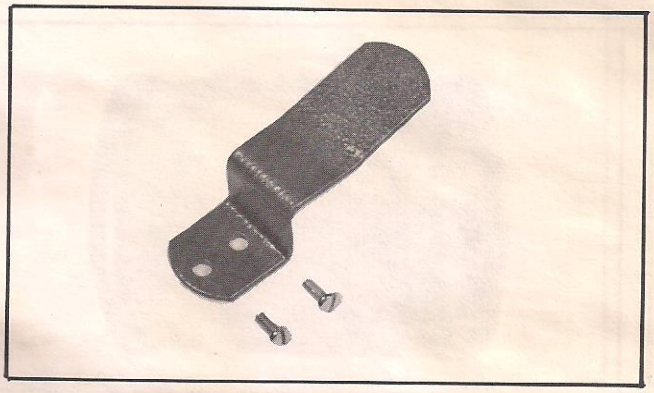




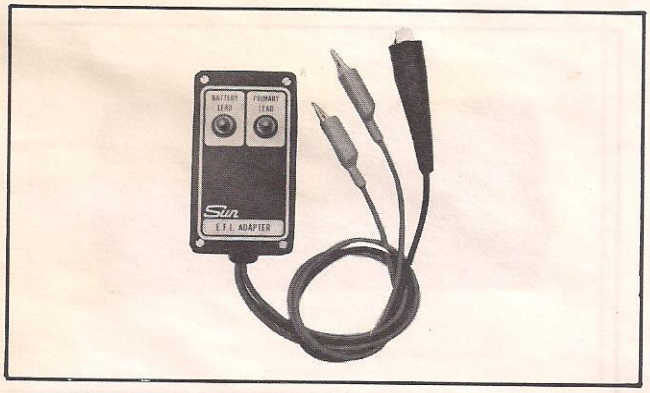


Test Lead Adapter 6005-0067

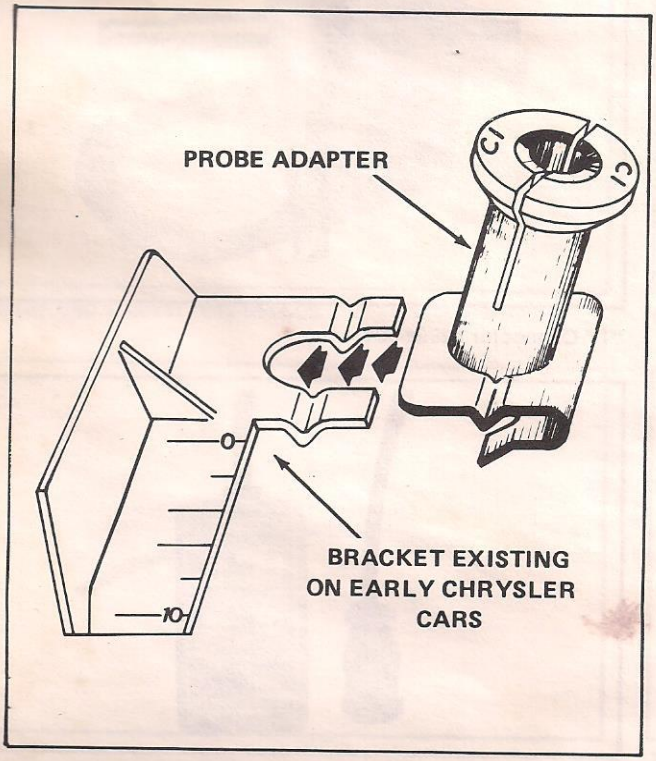
Timing Light Hanger Bracket 7032-0119



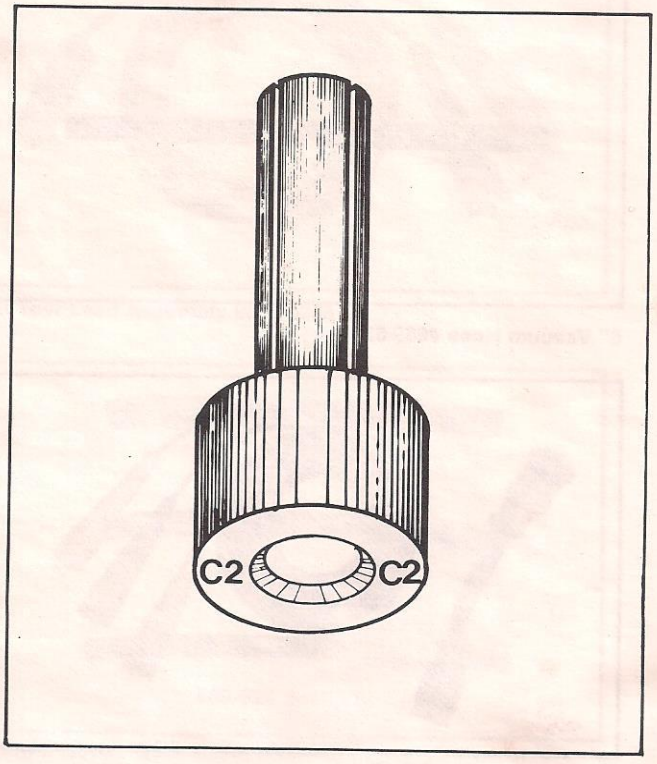
AC Cable Bracket 2161-0005-03



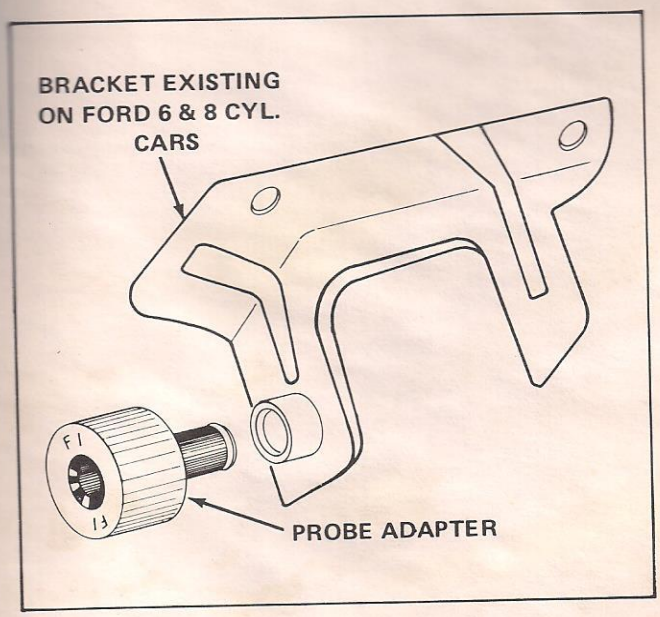
E.F.I. Adapter



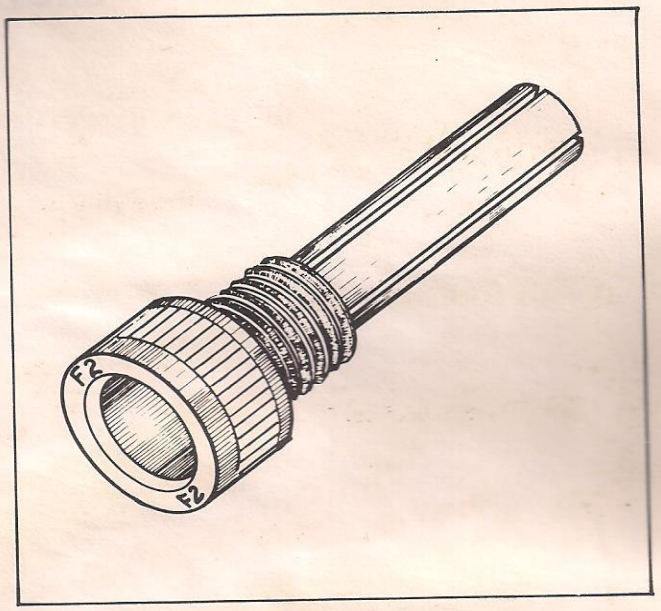
Early Chrysler Probe Adapter C1—7054-0057



Late Chrysler Probe Adapter C2—7054-0062



Ford Probe Adapter F-1—7054-0056



Ford Probe Adapter F-2—7054-0060