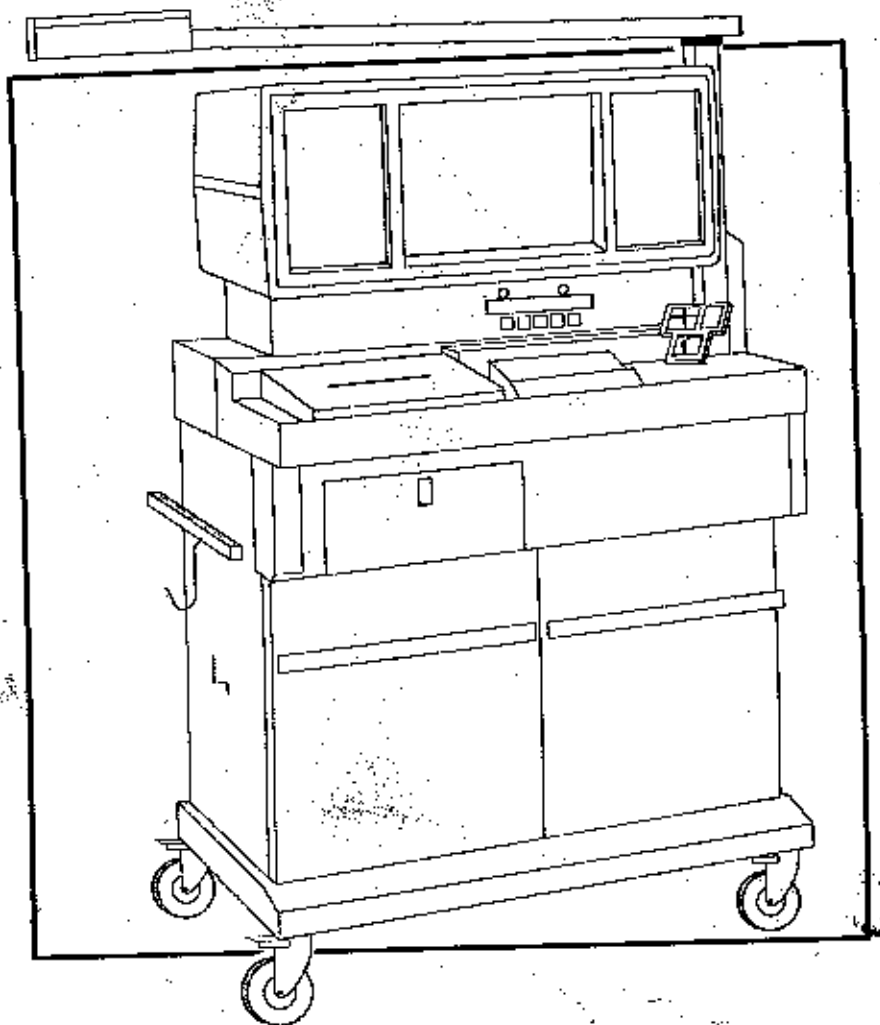

A.C.E. II

Engine Analyzer

Operation & Maintenance Instructions

Operation & Maintenance Instructions



***A.C.E. II* EngineAnalyzer**

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Introduction

The lower right corner of every page identifies each major chapter of this manual:

"Introduction" - Explains how to use the analyzer in general terms. This section describes the main analyzer components, safety precautions, and other general topics.

"Test Leads Hookup" - Explains all the analyzer's test leads and adapters and how to connect them to a vehicle.

"Service Tests" - All the choices available from the Service Tests menu are explained here. This includes everything from Charging Test and the like, to adjustment and meter screens, to ignition patterns.

"Automatic Testing" - All the choices available from the Automatic Testing menu are explained here. This includes Comprehensive and Custom Tests as well as procedures for customized, printed reports and diagnostics.

"Ignition Patterns" - Covers background information on the meaning of ignition pattern waveforms.

"Utilities/Modem" - Instructions for utilities functions such as "Set Clock" and "Leads Calibration." Also has instructions for Modem and Typewriter, both of which are main menu selections.

"Maintenance" - Includes hardware maintenance instructions, daily maintenance schedule, and explanations of fault messages.

If adding optional equipment to the analyzer, follow the operating instructions that come with that equipment.

About This Manual...

① Chapter Heading - Allows the reader to locate main section headings while "thumbing through" the manual.

② Topic Headings - Identifies major topics within the chapter.

③ Topic Sub-Headings - Calls attention to important concepts.

④ Illustrations - Explain important ideas or procedures.

⑤ Important Reader Messages:

CAUTION! When this symbol appears, the potential exists for serious injury and/or damage to the analyzer. **READ AND FOLLOW THE INSTRUCTIONS IN THIS TYPE OF NOTE CAREFULLY!**

IMPORTANT NOTE: Information in this type of note is extremely important and may affect analyzer operation and quality of test results. **READ THESE NOTES CAREFULLY!**

NOTE: Notes contain helpful hints and tips to make operating the analyzer easier.

Service Tests ①

Power Check ②

Power Check allows the operator to "kill" cylinders and watch the resulting changes in engine RPM, vacuum, HC, and exhaust temperature. This information allows the operator to evaluate the performance of individual cylinders.

IMPORTANT NOTE: Power Check does NOT apply to D.I.S. systems.

NOTE: Some computer-controlled fuel management systems attempt to compensate for RPM loss during Power Check. You can often disable this compensating feature according to the vehicle manufacturer's instructions. However, it may be easier to run a Cylinder Efficiency Performance test which does not trigger the computer compensation.

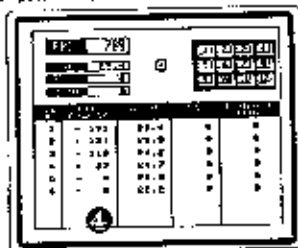


Figure 58

Leads Required: ③

Conventional Systems:

- Green #1 Pickup;
- White Clip;
- Yellow secondary lead;
- Blue Primary Clip;

For full screen, add:

- Vacuum Lead;
- Exhaust Gas Probe;
- Exhaust Gas Temperature Probe.

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Engine speed during Power Check must be at least 800 RPM, and not over 1200 RPM. Run power check as an automatic or manual test.

Automatic Test: Press [GO] on the program (green) keypad. The analyzer will automatically disable one cylinder at a time. It makes sure each cylinder test starts from a reasonably steady engine speed and stops when RPM loss stabilizes.

Manual Test: Press a number on the number (red) keypad to "kill" that number cylinder. Press the number a second time to release the primary for normal operation. The operator can "kill" any number of cylinders this way, and restore each one by pressing the keypad number again. Press [CLEAR] to restore all cylinders to normal operation.

When finished, re-connect any components disconnected from the vehicle.

⑤ IMPORTANT NOTE: Even though the Command Bar does not appear when a pattern is displayed on the screen, the command keys listed below are active. Press:

[CONTINUE] - Continues with the next step in the sequence.

[REPEAT] - Repeats a test or procedure just performed.

[BACKUP] - Backs up to a preceding text or step.

[ABORT] - Discontinues testing and returns to the menu.

Figure 1

Safety

Read all service procedures and precautions, installation instructions and equipment operating manuals thoroughly. Failure to observe these precautions, or the improper use of equipment, could result in property damage, serious injury or death. Never allow improperly trained personnel to perform these procedures or operate equipment.

Ventilation

- Provide ventilation through an exhaust gas removal system, ventilation fans or large doors. Inhalation of carbon monoxide gas emission, which is odorless, will cause a person to suffer slowed reaction and may lead to serious injury when working around an engine.
- NEVER lean over battery during testing or charging.
- When connecting battery test leads, avoid sparks which could cause the battery to explode.

Batteries

Automotive batteries contain sulfuric acid and produce explosive gases. To avoid battery explosion and serious injury or death, follow these important safety precautions whenever servicing batteries or performing tune-up procedures:

- *Wear Safety Goggles!*
- Keep lighted cigarettes, sparks, flames or other ignition sources away from battery at all times.
- DO NOT lay tools or equipment on battery. Accidentally grounding the "hot" battery terminal can cause shock, burns, and damage to wiring, battery, tools or tester.
- DO NOT wear jewelry, rings, watches or metal belt buckles when working on or around batteries.
- Cover battery vents with damp cloth to suppress explosive gases before load testing or charging.

- Avoid spilling or splashing electrolyte on skin, eyes or clothing. Electrolyte contains sulfuric acid, is poisonous and causes severe burns.
- Be sure work area is well ventilated and has access to water should flushing be required.

Make Sure the Vehicle Cannot Move During Testing and Tune-Up

- Place the automatic transmission shift lever in PARK position; manual transmission shift lever in neutral.
- Test parking or emergency brake, and then set brake securely.
- Some vehicles have an automatic release on the parking brake when the vehicle is put in gear. Disconnect and plug automatic release vacuum hose before performing any tests while vehicle is in DRIVE. If there is any doubt whether the vehicle will remain immobile, block the wheels.

- Make sure motor mounts are in good condition. Broken motor mounts can cause an engine to jump into gear, or the throttle to stick when the engine is revved up.
- Take the vehicle out of gear after setting the carburetor. DO NOT rev the engine when the transmission is in DRIVE.

Personal Injury

PROTECT FACE, HANDS AND FEET FROM BURNS AND OTHER INJURY:

- NEVER smoke or light a match when working on a vehicle, since gasoline vapor and battery gases are highly flammable and explosive.
- Make sure all electrical connections are tight. An improperly grounded condenser can cause engine backfire. NEVER look directly into the carburetor throat while the engine is cranking or running, since backfire can cause severe burns and injury.
- NEVER remove radiator pressure cap when system is under pressure or before the engine has cooled. Steam or hot coolant can cause burns if cap is removed before pressure is allowed to escape or while engine is hot.
- Avoid contact with hot surfaces such as spark plugs, exhaust manifolds and pipes, mufflers, catalytic converter, resonator, radiator and hoses, etc.
- NEVER pour gasoline down the carburetor to start the engine.
- When engine is running, DO NOT touch spark plug ignition cable wires, ignition coil or distributor cap.
- Turn off ignition key before installing, working on or adjusting contact sets, condensers, or other ignition parts.
- Handle extension lights carefully, using only bulb-protector types. Route the cord safely outside or above engine compartment.
- Use proper tools and extensions carefully to avoid cuts and bruises on sharp engine parts when installing spark plugs into hard-to-get-at cylinders.
- Wear safety goggles to protect eyes from gasoline, dust and dirt flying off moving engine parts.
- When working under the hood, make sure fan blades, belts, pulleys, etc. are in good condition. Any fan blade can break, especially when it has been bent.
- Keep out of a direct line with fan blades, especially when testing timing advance with a timing light.
- Keep hands, hair and clothes clear from any moving parts, including throttle and transmission linkages.
- NEVER wear neckties, loose clothing, wrist watches, rings or other jewelry when working on a vehicle. They could catch on moving parts or cause an electrical short circuit resulting in severe electrical shock and burns.
- Remove tools from vehicle before starting engine. Tools can fall into moving components and be propelled into the air, which could result in property damage or injury.

Continued ...

Introduction

Safety Notes (continued)

- Avoid bringing hook-up leads over engine fan, pump and belt areas. Whenever possible, route leads outside of the engine compartment.
- Electric fans are activated by a coolant temperature sensing switch. Disconnect a fan lead whenever working on a hot engine with an electric fan because the fan can start when the engine is "OFF."
- The analyzer must be plugged into a 120V, 60Hz, properly grounded outlet. DO NOT cut off the grounding prong of the AC power cord. If using a ground adapter, be sure the pigtail is grounded to the power receptacle. If an extension cord is needed, use a three-wire type with the grounding circuit in good condition.
- Some analyzers are equipped with a fused convenience outlet on the back panel. This is "hot" anytime the analyzer power cord is plugged in, even though the equipment has been switched "OFF."

Analyzer Use and Care

CAUTION: For operator safety and proper operation, the unit must be plugged into a grounded electrical outlet correct for the power requirement information on the unit serial number plate. DO NOT remove grounding prong from the AC power cord.

- Do not operate the unit in direct sunlight for extended periods.
- DO NOT expose analyzer equipment to rain or moisture, or operate it on a wet floor.
- DO NOT bypass the electrical interlocks on the service doors on the back of the analyzer.
- UNPLUG the analyzer before performing service work.
- DO NOT install fuses of a higher ampere rating than specified.

Definitions

In this manual, to "enter" a number, press or type that number and then press the ENTER key. Example: "Enter 1 from the Master Menu" means "press the [1] key, then press the [ENTER] key."

NOTE: Press the key enclosed in square brackets. In the example above, the command is "...press the [ENTER] key," meaning press the key marked ENTER on the red keypad or the typewriter keys.

The word "cursor" refers to the lighted dot on the screen, or a reverse video bar, that can be moved around using the arrow keys.

Major Components

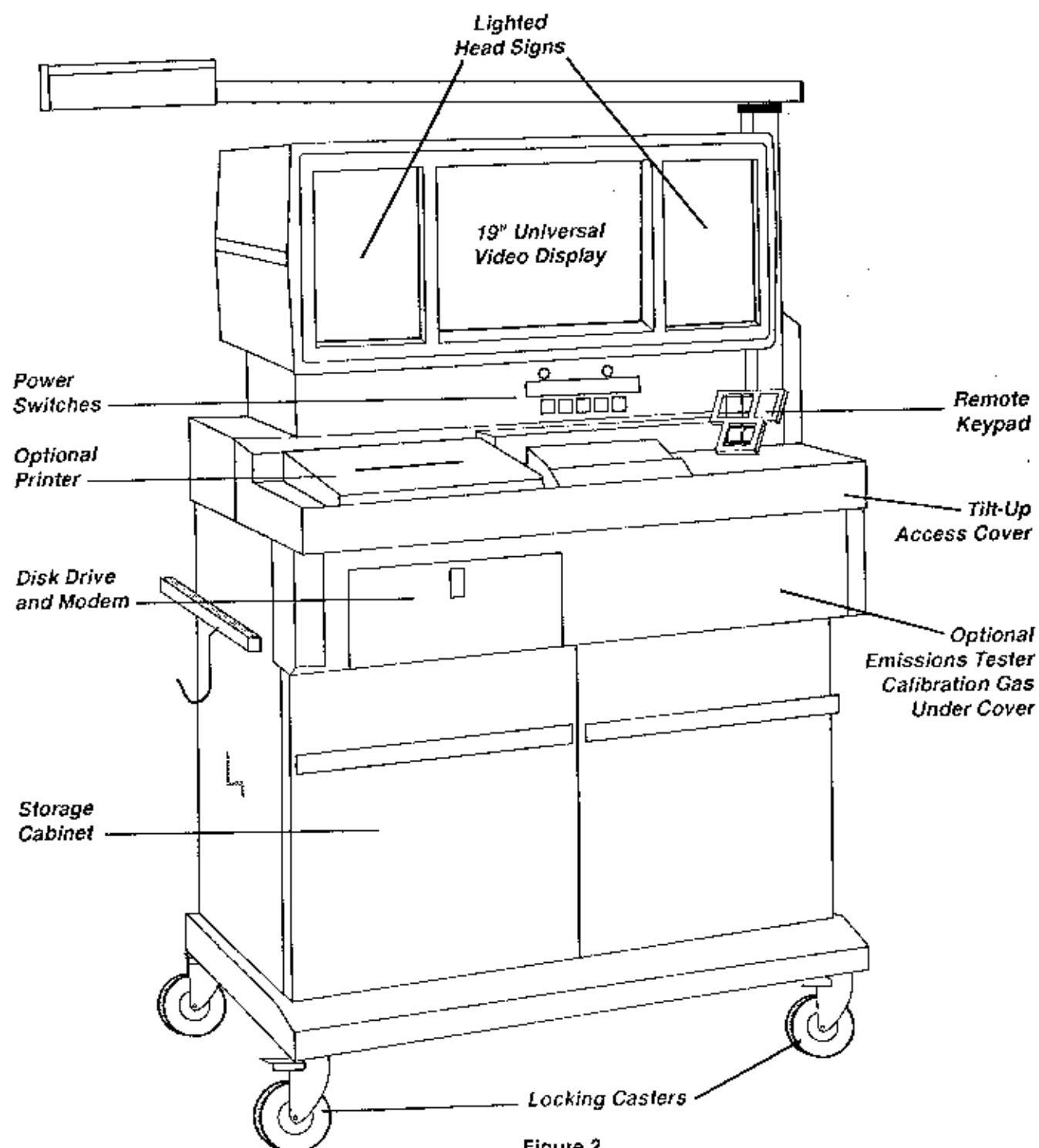


Figure 2

Analyzer Controls

Power Switches (See Figure 3)

These switches provide control over the main power circuits of the analyzer:

"VACUUM VALVE" - Regulates vacuum produced by the vacuum pump.

"VACUUM PUMP" - Supplies power to the positive displacement vacuum pump motor. This pump is separate from gas analyzer pump.

"CO/HC PUMP" - Supplies power to the positive displacement pump used in the optional gas analyzer.

"POWER" - Master power switch; controls all circuits powered by A.C. line input, with exception of the display lights.

"DISPLAY LIGHTS" - Controls power to the merchandising sign, control panel lights, and boom light independently of the "POWER" switch.

"RESET" - Returns computer to Master Menu, regardless of current operating circumstances. All test result data stored in computer memory is lost when [RESET] is pressed. Use "RESET" only to correct a keyboard lockup problem. Use the "ABORT" key to stop testing.

"VOLUME" - Controls audio signal volume.



Figure 3

Program Keypad (green)

Use this keypad to control tests. All of these keys (except "KILL") correspond to prompts which appear on the display screen at various points during testing (see Figure 4). When a prompt is displayed, that key is active. Each key is labeled with its function:

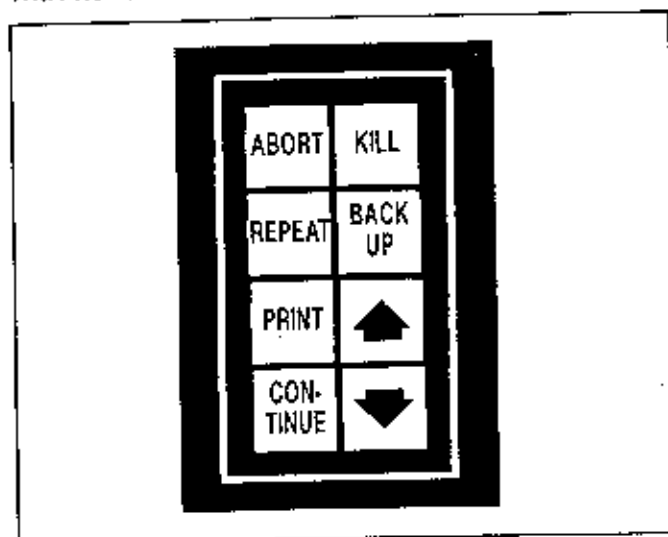


Figure 4

"ABORT" - Discontinues testing and returns to menu.

"REPEAT" - Repeats a test or procedure just performed.

"PRINT" - Produces a report printout on the (optional) paper printer. Also, causes a blank paper feed when pressed while any menu screen is displayed.

"CONTINUE" - Continues with the next step in the sequence.

"KILL" - Stops vehicle engine by temporarily disabling coil primary circuit. After 3 seconds, ignition is re-enabled. (KILL is always active. The prompt does not appear on screen.)

"BACKUP" - Backs up to a preceding test or menu.

"ARROWS" - Function changes depending on test being performed; described in operating instructions for each test.

NOTE: The "DOT" key (numeric keypad) - Isn't on the program keypad, but it has a program function: Whenever the dot prompt appears on the display screen, press [.] to print a picture of the screen.

NOTE: Press [.] to print the time and date while any menu screen is displayed on the screen.

Numeric Keypad (red)

Use the Numeric keys (see Figure 5) to make menu selections and to enter information such as specs, year, etc. as required during testing. Type in a number and then press [ENTER]. To erase the entry and start over, press [CLEAR] before pressing [ENTER].

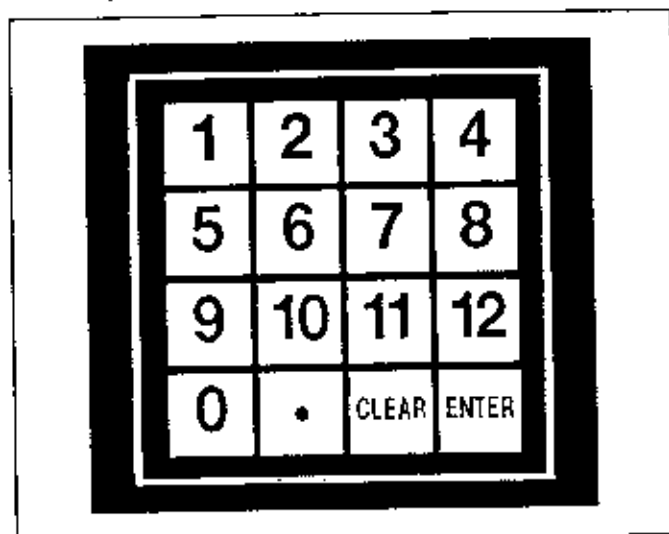


Figure 5

Continued ...

Waveform Keypad (yellow)

The Waveform keys (see Figure 6) control the appearance of the ignition pattern on the display screen. Waveform keypad functions are described in detail in the "Ignition Patterns" section.

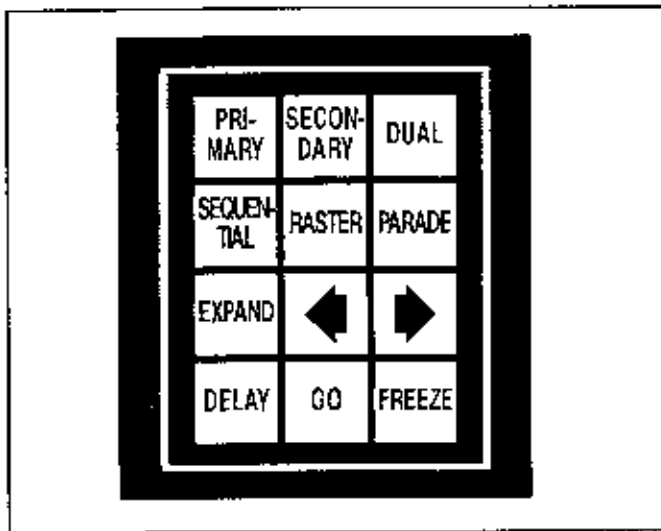


Figure 6

Typewriter Keyboard

Use the typewriter keyboard to enter customer i.d., dealer i.d., typewritten messages and to customize printed reports. If the modem option is installed, the typewriter keyboard is used to interface with other computers.

Remote Keypad

The remote keypad unit contains the Program keypad, Numeric keypad, and Waveform keypad. All keys have exactly the same functions from the remote as from the console.

Store the remote in the specially designed tray on top of the boom.

Disk Drive Information

The disk drive only operates when retrieving specs during the "Specifications" procedure. While the drive is operating, the drive light flashes.

Whenever the disk is not operating, the drive head is safely parked. Follow these simple precautions to ensure long and virtually maintenance-free drive life:

- Avoid bumping the analyzer hard or rolling it while the drive is operating.
- Do not shut analyzer power "OFF" while the drive is operating.
- It is good practice to remove the disk each night and store it in the disk bin next to the drive slots.

Standard Test Leads

The operating instructions for each test list the minimum leads required to run that test.

1. Yellow Primary Clip (see Figure 7) to positive (+) terminal on the coil. Supplies primary circuit info. (Not used in D.I.S. testing.)
2. Blue Primary Clip (see Figure 7) to negative (-) terminal on the coil. Supplies primary circuit information. (Not used in D.I.S. testing.)
3. Yellow Pickup (see Figure 7) around high tension lead from coil to distributor. Must be completely closed; not touching plug wires, metal parts, vacuum hoses or water. Supplies high voltage info. (Not used in D.I.S. testing.)
4. Green #1 Pickup (see Figure 7) around #1 spark plug wire. Supplies cylinder number information, trigger information.

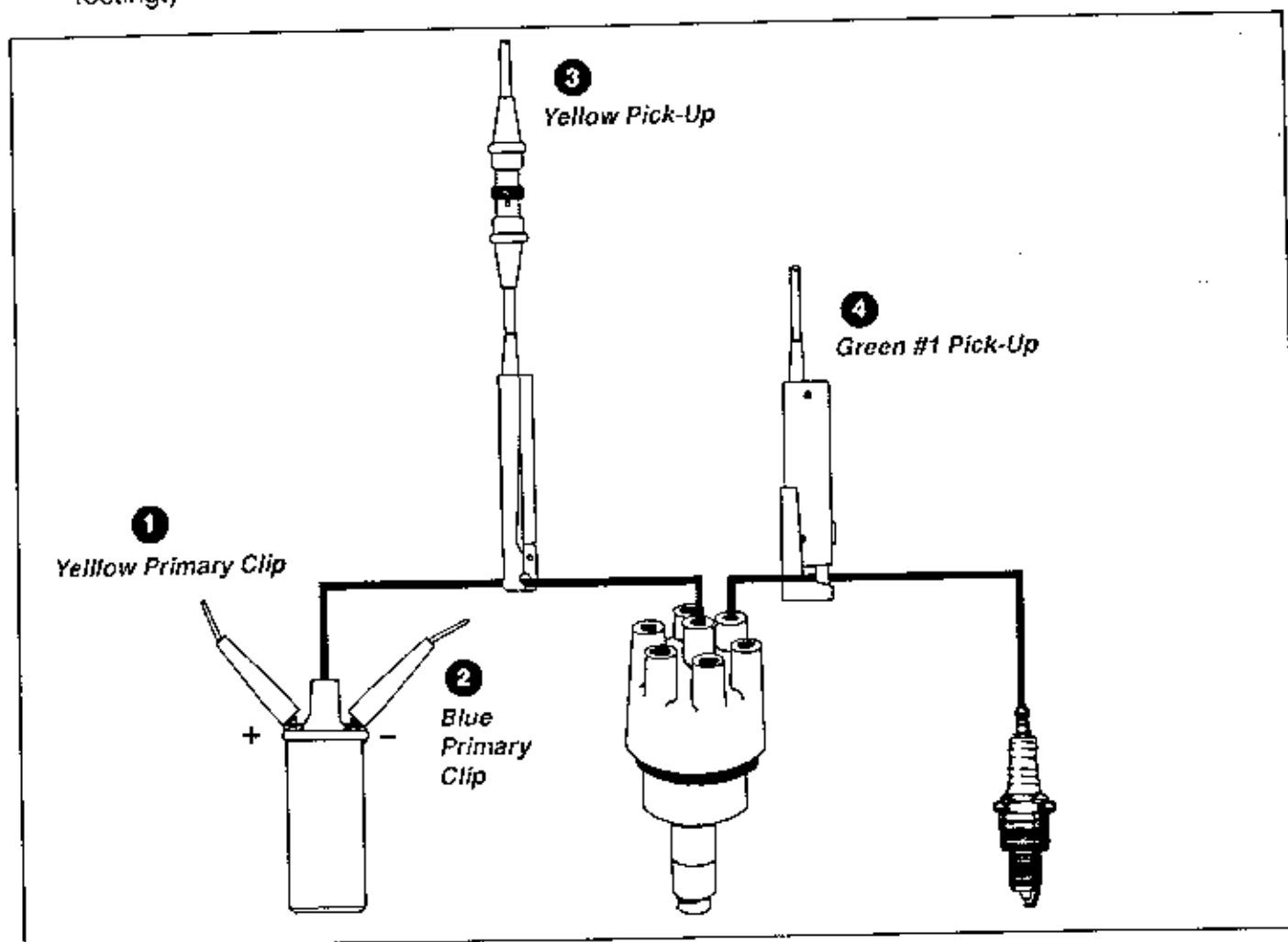


Figure 7

Continued ...

Introduction

Standard Test Leads (continued)

5. Battery Load Clamps, (see Figure 8) positive and negative, directly onto the battery posts. Provide high current testing ability and carry battery temperature sensor.
6. Red Clip (see Figure 8) to positive (+) battery terminal or (+) load clamp accessory post. Provides low voltage information.
7. White Clip (see Figure 8) to negative (-) battery terminal or (-) load clamp accessory post. MUST NOT go to any other engine ground.
8. Gray Amp-Probe (see Figure 8) around the positive or negative battery cable. Clamp must be around all wires to terminal. Disregard arrow on amp-probe casing. Supplies current information.

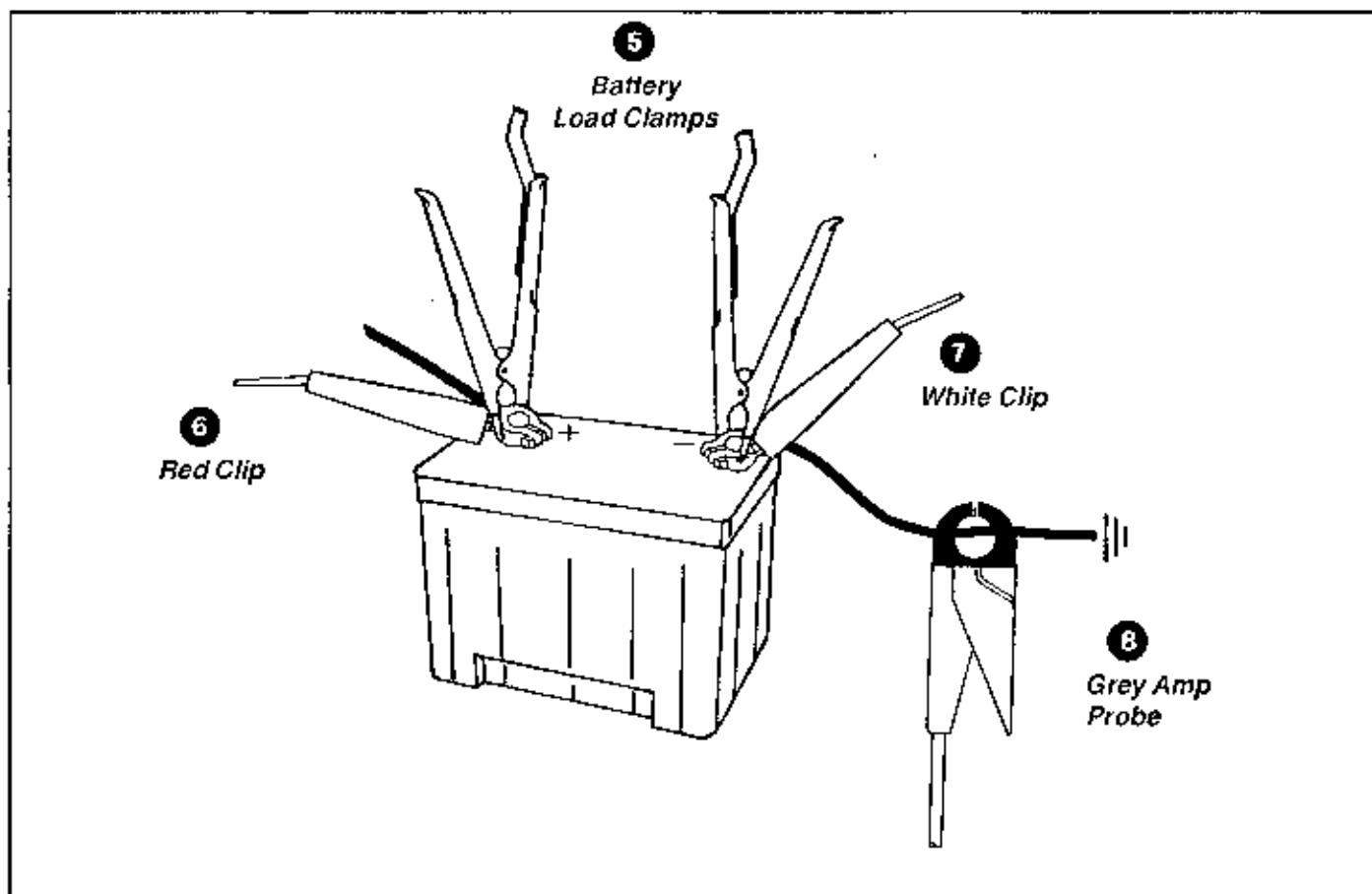


Figure 8

To "Zero" the Amp Probe...

During any test where the grey amps probe is used, a "[0]" prompt appears at the bottom of the screen. This means that the "zero current probe" feature is active. Zero the probe by taking the following steps:

- a.) Press [0] (on the red keypad). The screen message "REMOVE CURRENT PROBE" will appear. Remove the probe from around any conductor. Leave it closed and empty.
- b.) Press [CONTINUE]. The analyzer will zero the probe.

9. Vacuum Lead (see Figure 9) to manifold vacuum source.
10. Engine Temperature Probe (see Figure 9): To measure engine temperature, secure probe to upper radiator hose with velcro strap included with analyzer.
11. Magnetic Timing Probe (see Figure 9) replaces timing light in providing ignition timing information. (Magnetic timing offset must be entered through Set-Up or Specs). Insert into vehicle's magnetic timing receptacle, if vehicle has one. Adapter sometimes required.
12. Ohmmeter Leads (see Figure 9) used with multimeter.
13. Voltmeter Leads (see Figure 9) used with multimeter.
14. Accessory Leads (see Figure 9) used for module test.
15. Timing Light (see Figure 9) operates when the yellow pickup and green #1 pickup are connected and the timing test screen is displayed and engine is running.

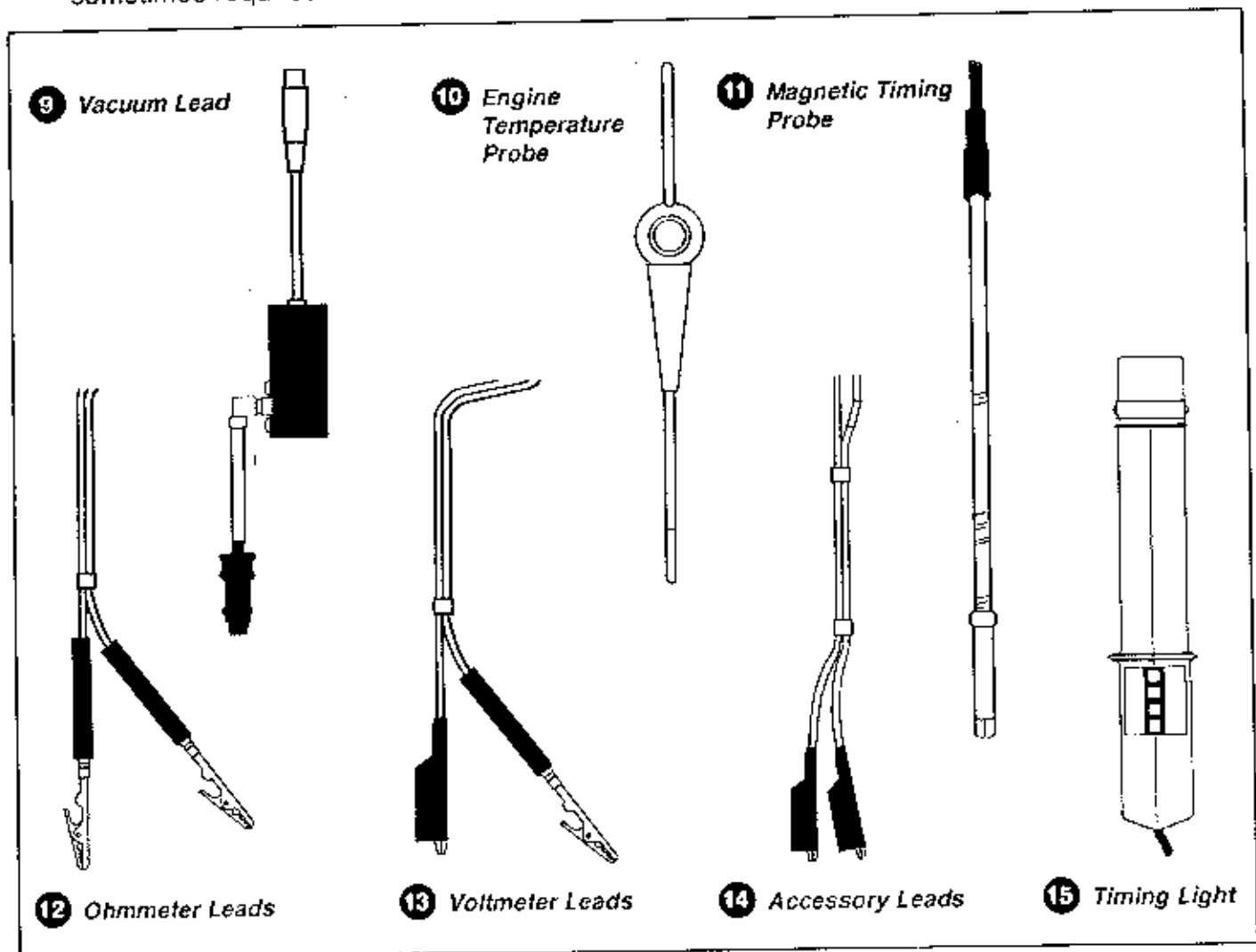


Figure 9

Adapters

The **H-Clip Adapter** (see Figure 10) provides hookup site for the yellow and blue clips on late model Fords and GM's.

On Ford vehicles: Slip the two dimpled copper prongs into the distributor coil. Connect the blue clip to the smooth copper prong on the negative side of the coil. Connect the yellow clip to the positive side.

On GM vehicles: Disconnect the coil wires at the coil. Slip the center connectors of the adapter into the socket where the coil wires were connected. Attach the disconnected coil wires to the dimpled copper prongs. Connect the blue clip to the smooth copper prong on the negative side of the coil. Connect the yellow clip to the positive side.

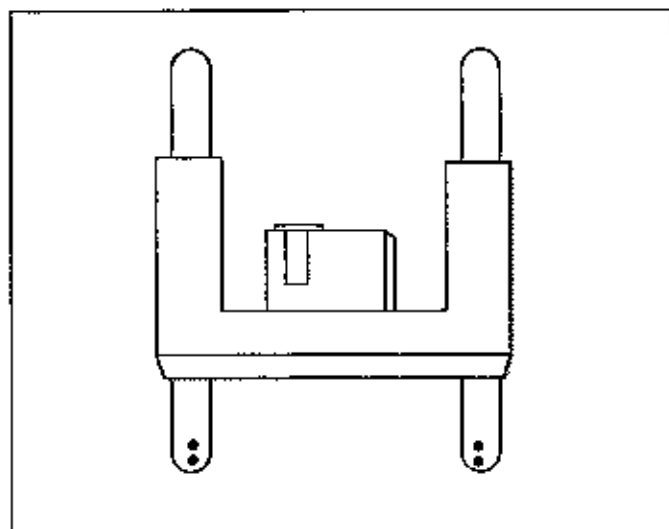


Figure 10

GM HEI (High Energy Ignition) Adapter (see Figure 11) is used in place of the yellow pickup on all GM HEI vehicles where the coil and distributor are integral. Disconnect the yellow pickup from the boom cable. Plug the HEI adapter into the boom cable and screw the connector ring over it. Attach HEI adapter to the vehicle at the coil.

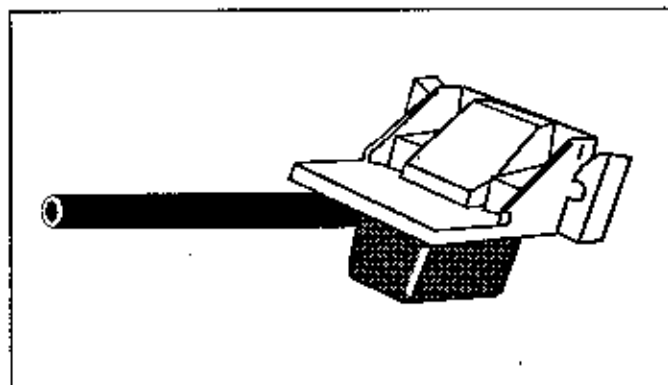


Figure 11

Magnetic Timing Adapters - There are three magnetic timing adapters: one for late model Chryslers, one for early Chryslers, and one for Fords. If magnetic timing probe does not fit a vehicle, install the appropriate adapter on the end of the probe; insert the adapter into the proper receptacle on the vehicle.

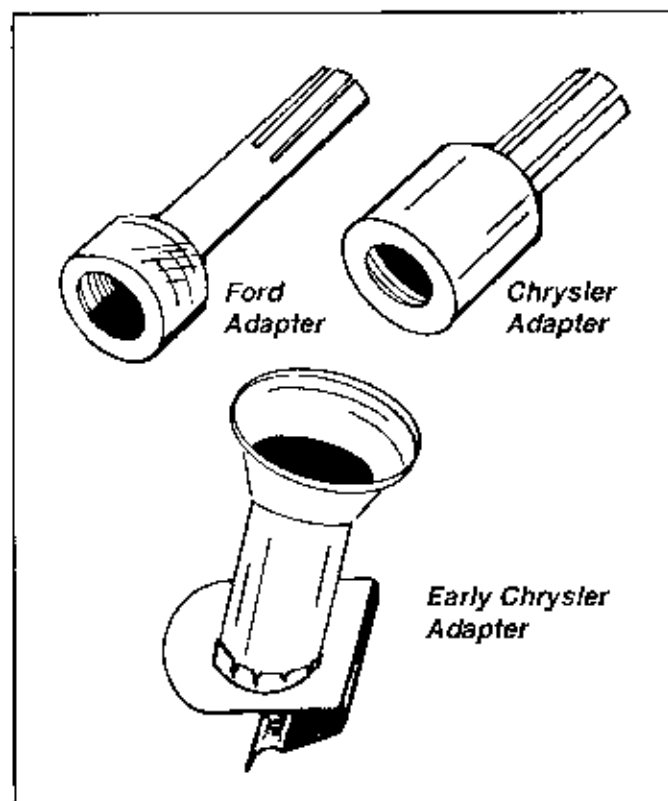


Figure 12

Toyota HEI Adapter is used in place of the yellow pickup on Toyota HEI vehicles where the coil and distributor are integral. Disconnect the yellow pickup from boom cable. Plug HEI adapter into the boom cable and screw connector ring over it.

The Toyota probe comes with two clips: a symmetrical clip and an offset clip. Select a clip according to the style of the distributor cap on the vehicle to be tested. (See illustrations.) One or the other of these two clips will fit any Toyota HEI-type distributor cap with internal coil.

The clips snap on the back of the probe and hold it up against the coil side of the distributor cap. To snap a clip onto the Toyota probe, place the small hole in the center of the clip over the small plastic stud on the back of the probe. Then just turn the clip gently into place under the long plastic tabs. After the clip is on the probe, snap the whole assembly into place on the distributor.

To remove a clip from the lead, twist it; then turn it out from under the tabs.

To adjust a clip so that it holds the probe more tightly against a distributor, simply pinch the bent ends of the clip closer together.

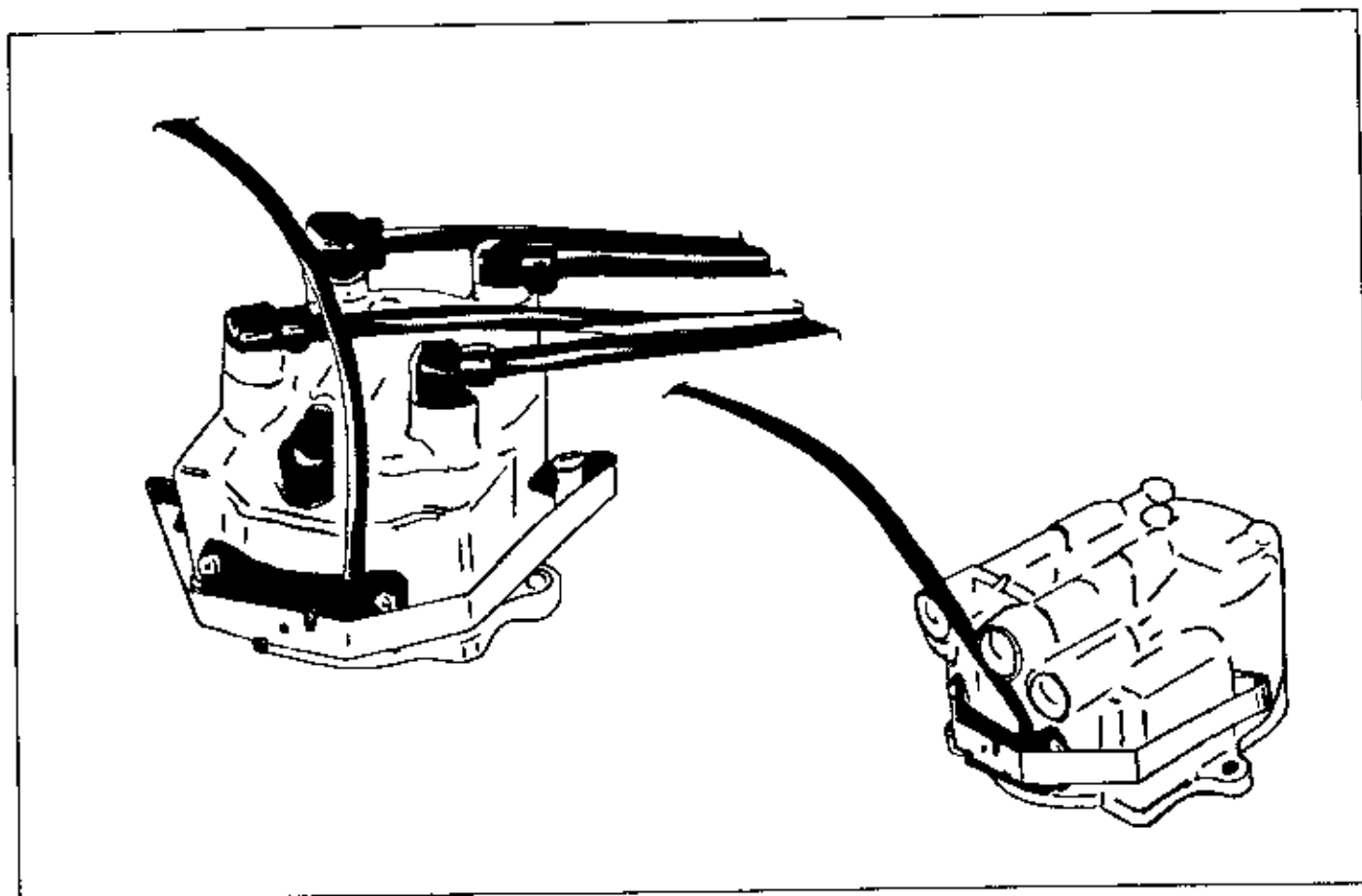


Figure 13

D.I.S. Leads

Vehicles with D.I.S. (Direct, or Distributorless, Ignition System) require special hookup, as follows:

Secondary Yellow Pickup and Blue and Yellow Primary Clips - not used on D.I.S.. DO NOT CONNECT THESE LEADS. Leave them on the boom.

D.I.S. Secondary Probe Assemblies (see Figure 14) - There are two secondary probe assemblies. One assembly is positive (red); one is negative (black). Each assembly has four small clips. These must be clipped securely around each spark plug wire on the test vehicle. On 4- and 6-cylinder systems, some clips will be dangling free. Make sure they are not touching engine block or any other wires.

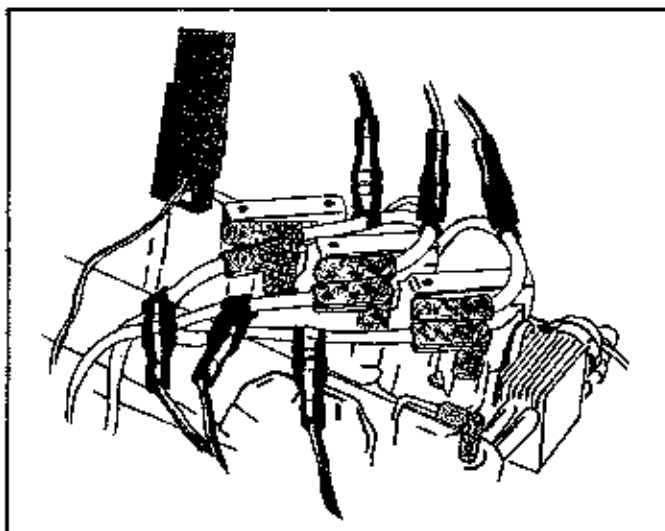


Figure 14

D.I.S. Primary Lead

The D.I.S. primary lead (see Figure 15) is usually not used. Connect the D.I.S. lead only if a Set-Up screen displays a message which indicates that the trigger is missing or faulty. Some optional I&M (gas analyzer) programs require the D.I.S. Primary.

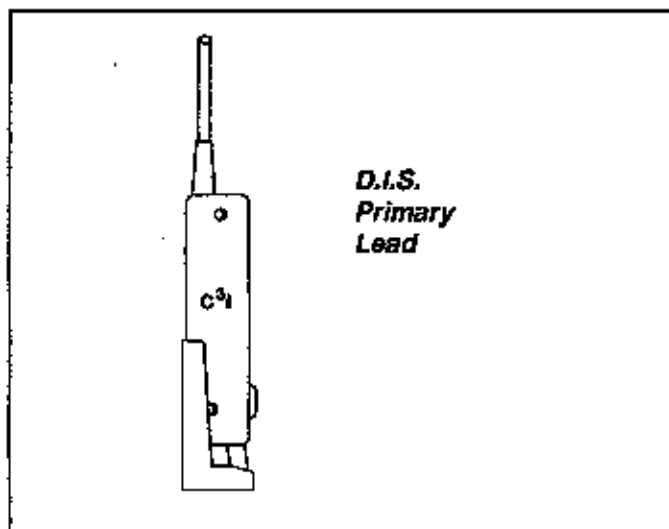


Figure 15

The D.I.S. Primary lead looks like the green #1 lead. It has a white decal which reads: "PRIMARY SIGNAL C3I." Clamp the lead around a wire at the coil connector. The table in Figure 29 lists the correct wire location on specific engines. The table also shows the wire color and coil connector pin letter, where applicable.

Gas Analyzer Leads (Optional)

For detailed operating and maintenance information, refer to the Gas Analyzer Manual that was shipped with the kit.

The optional gas analyzer checks the quantity of four gases in vehicle emissions: Carbon Monoxide (CO); Hydrocarbons (HC); Carbon Dioxide (CO₂); and Oxygen (O₂). This information is used to generate diagnostics.

There are three leads used for emissions analysis (see Figure 16):

- Exhaust Probe - draws the gas sample from the tailpipe into the analyzer.
- Anti-Dilution Adapter - used for insertion into tailpipes with screens or other obstructions.
- Temperature Probe - measures exhaust gas temperature.

Prepare the Gas Analyzer for Testing

1. For best results, allow the vehicle to warm up to normal operating temperature before testing.
2. Allow the analyzer to warm up. This takes approximately 14 minutes at 40° Fahrenheit (slightly longer at cooler temperatures).
3. Turn the pump "ON."
4. Allow a moment for the exhaust probe to collect fresh air before inserting it into the vehicle tailpipe.
5. Insert the exhaust probe into the vehicle tailpipe so the retainer clip holds it in place.
6. Slide the building exhaust removal system hose over the tailpipe. Turn on the exhaust fan.

NOTE: The analyzer must be warmed up for at least one hour before a gas calibration can be performed. Refer to gas analyzer operating instructions.

NOTE: For tailpipes equipped with screens or other obstructions, remove the flexible end of the exhaust probe and replace it with the anti-dilution adapter.

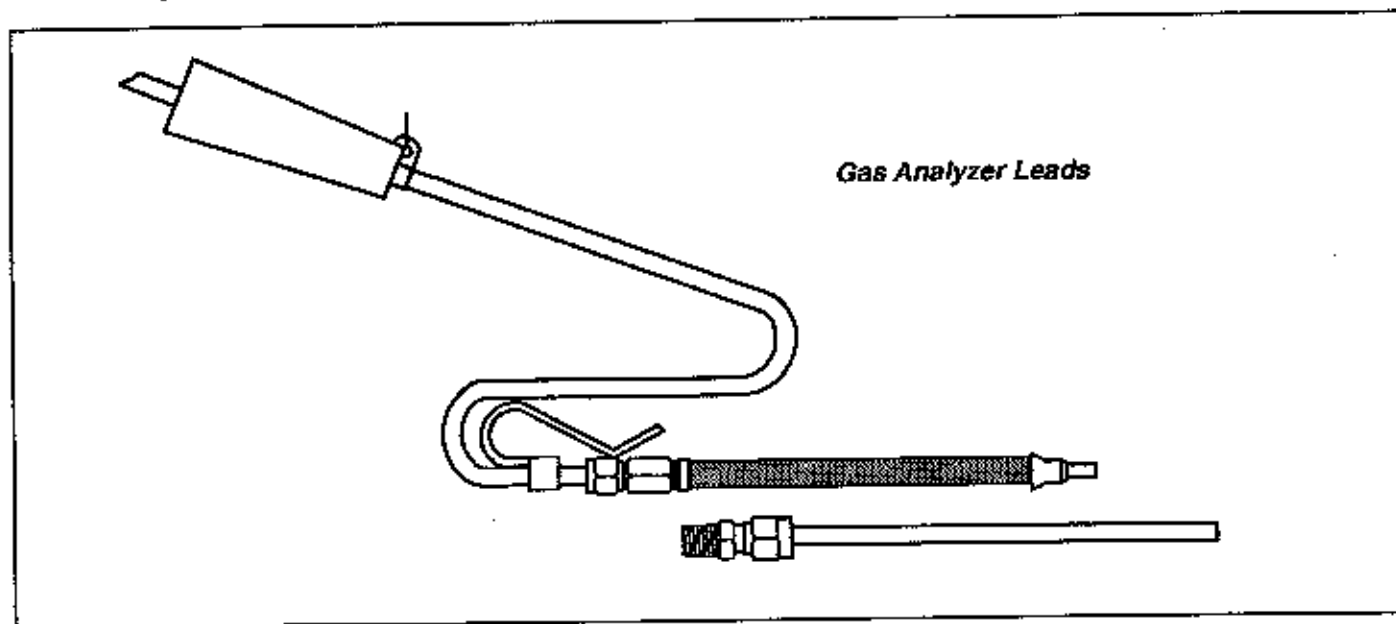


Figure 16

General Test Procedure

Master Menu

When the "POWER" switch is turned "ON," the Master Menu appears on the display screen (see Figure 17). The Master Menu may vary, depending on the optional equipment installed on the analyzer. (Any options not listed here are explained in the instructions shipped with that option.)

The options:

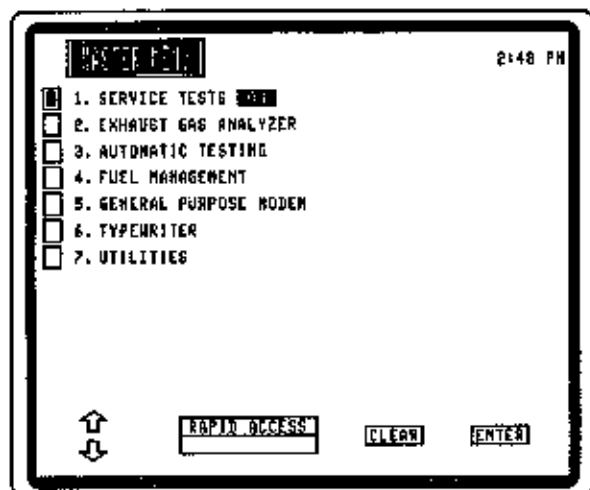


Figure 17

- Service Tests - Includes all tests except I&M tests. "Set-Up" and "Specifications" are also on the "Service Tests" menu.
- A reverse highlight bar on this menu line tells whether the analyzer is in "CONV" or "DIS" mode (**CON**ventional or **D**irect Ignition **S**ystem). See "DIS Testing" for more details.
- Automatic Tests - Includes automatic test sequences such as Comprehensive and Custom Tests, along with their support functions. (Automatic tests can be run from Service Tests menu, too.)
- Exhaust Gas Analyzer (optional) - Includes dedicated gas analyzer functions such as I&M programs. Each option package is shipped with its own manual.
- General Purpose Modem - A package for communicating data or diagnoses over telephone lines. See "Utilities/Modem."
- Typewriter - Type and print messages on the end of a customer report. See the "Utilities/Modem" section.
- Utilities - Includes housekeeping functions such as "set clock" and test lead calibration procedures.

Menu Control

There are three ways to make selections from upper level menus:

1. Type the menu selection number and press [ENTER].
2. Using the arrow keys, move the cursor (lighted box) to the desired selection and press [ENTER].
3. Rapid Access — To go directly to the desired test without passing through intermediate menus:
 - a) Type the system test number. "System test numbers" are 4-digit numbers assigned to individual test modules by the computer. The operator can print out a list of system test numbers in the "Custom Tests" menu.
 - b) Press [ENTER].

Command Bar to Control Test Flow

During testing, a command bar will appear at the bottom of the screen at various points. This bar lists "active" command keys. The bar is at the bottom of the screen shown in Figure 17.

Press:

[CONTINUE] - Continues with the next step in the sequence.

[REPEAT] - Repeats a test or procedure just performed.

[BACKUP] - Backs up to a preceding test or step.

[ABORT] - Discontinues testing and returns to the previous menu.

To Begin Testing...

1. Turn the main power switch "ON." The machine sounds a 3-tone beep, and after a few seconds the Master Menu appears on the display screen.
2. If the analyzer is equipped with the gas analyzer option, turn the (optional) CO/HC pump switch "ON."

Let the pump run for at least 15 minutes at the beginning of every day. This clears any moisture that may have accumulated overnight. While the pump is running, make sure the gas probe is up off the ground taking in fresh air (not down on the floor taking in water and dirt).

3. Insert the specifications disk in the disk drive. Gently push it all the way in until it clicks into place.
4. Select a test and turn to the appropriate instructions in this manual.
5. At the beginning of the instructions for each test there is a list of "Minimum Leads." These leads must be connected correctly to run that particular test.
6. Start the engine (or crank the engine as prompted).
7. Follow test procedure listed in this manual.

D.I.S. TESTING

In this manual, the term "D.I.S." (Distributorless Ignition System) means any system with no distributor cap. This includes GM's D.I.S. and CCC systems, Ford, Chrysler, Toyota and Nissan systems, among others.

Test Modes

The engine analyzer has two test modes: Conventional (CONV), and Direct Ignition System (D.I.S.). The current mode is displayed at the top of the service tests menu screen - "CONV" or "DIS."

To switch to the D.I.S. mode for Service Tests, select "Set-Up" from the Service Tests menu. When the Ignition Set-Up screen appears (see Figure 18), press [2] to select "DIRECT IGNITION SYSTEM." The analyzer remains in the test mode selected until:

- the power is turned "OFF;"
- the operator presses [RESET];
- the test mode is changed by the operator.

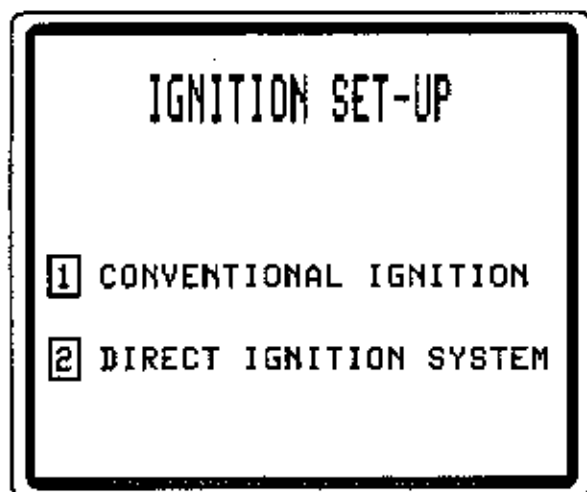


Figure 18

To run a D.I.S. Comprehensive test, select "DIS Comprehensive" from the Service Test menu (see Figure 18).

In either mode, the service tests menu looks the same. However, the following tests do not apply to D.I.S. systems:

- Primary Circuit Test
- Power Check
- Tach/Dwell Meter
- Module Test

If the operator selects one of these tests while in D.I.S. Mode, the message "TEST NOT AVAILABLE IN DIS MODE" will appear.

The procedures for the following tests are different in D.I.S. mode than in CONV mode:

- Secondary KV
- Ignition Patterns
- Cranking Test
- Cylinder Efficiency/Performance

For other tests, conventional-type test data may not be used in diagnosing D.I.S. systems. Where this is the case, "N/U" will appear on screen and printed reports.

D.I.S. procedures appear in these operating instructions immediately following the corresponding Conventional tests.

Service Tests

Overview

The Service Tests menu lists the available vehicle tests. The menu listing may differ from that shown here, depending on the options installed in the analyzer. For detailed information on those tests not shown here, refer to the Operating and Maintenance Instructions that were shipped with the optional equipment kit.

Comprehensive and Custom Tests are also included on the Service Tests menu, for convenience. For details on those tests, refer to the "Automatic Testing" section of this manual.

Set-Up

Set-Up allows the operator to make sure that test leads are properly connected and working before continuing with specific tests.

Set-Up also allows the operator to change test modes, depending on whether or not the vehicle is equipped with a conventional or D.I.S. ignition.

1. The Master Menu (see Figure 19) appears after the power is turned "ON." From the Master Menu, select Item 1, "SERVICE TESTS."

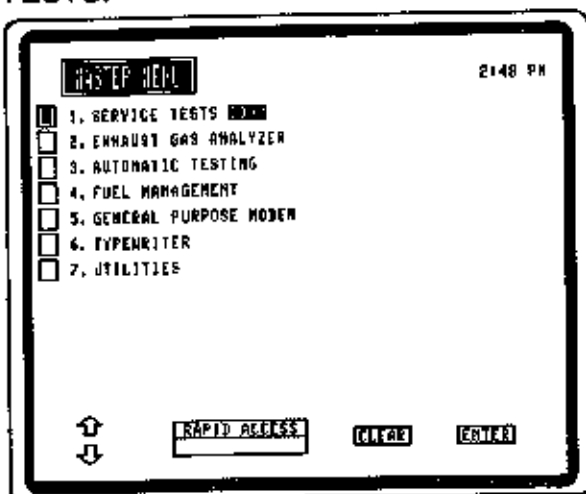


Figure 19

2. The Service Tests Menu appears (see Figure 20). Since the Set-Up test is highlighted, press [ENTER] to start the procedure.
3. Connect the leads to the engine.

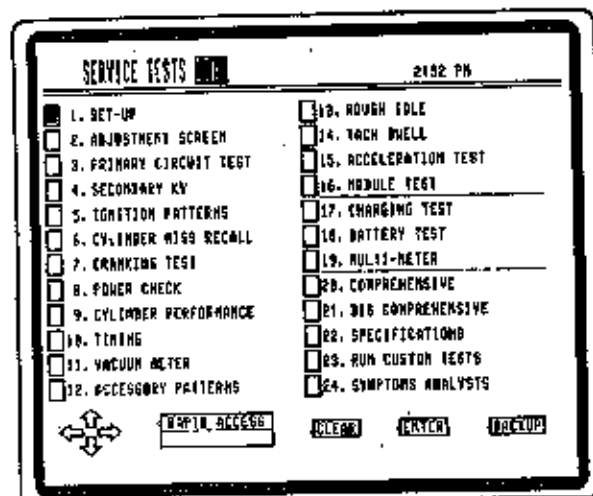


Figure 20

Minimum Leads

- Connect the Green #1 Pickup to #1 spark plug wire.
- Connect the Primary Blue Clip to negative (-) terminal on the coil.
- Connect the Yellow (secondary) Pickup around high tension lead from coil to distributor.

3. The Ignition Set-Up screen will appear (see Figure 21). Press:
 - [1] for Conventional (CONV) ignition system;
 - [2] for Direct Ignition System (D.I.S.)

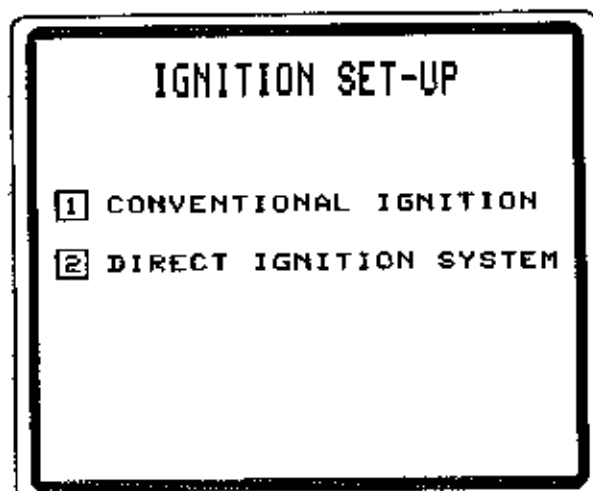


Figure 21

Set-Up: Conventional Systems

1. Press [1] "CONVENTIONAL IGNITION."
2. Start the engine.
3. The Set-Up screen will appear (see Figure 22). This screen shows whether or not the leads are connected properly, and allows the operator to change various factors being monitored.

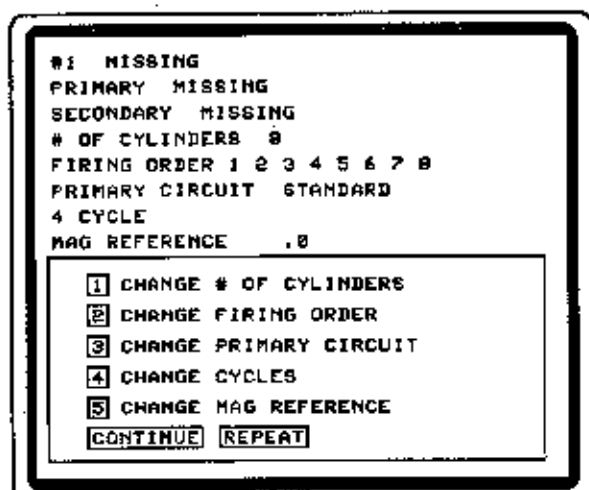


Figure 22

The top three lines on screen show whether the leads used for ignition display are "OK" or "MISSING":

"#1" - Green #1 Pickup

"PRIMARY" - primary Blue Clip

"SECONDARY" - secondary Yellow Pickup

NOTE: The engine must be running for these lead tests to be valid. If the word "MISSING" appears after the lead name on the display screen, connect that lead to the vehicle. Attach any missing leads; then press [REPEAT] to repeat the Set-Up test. If the lead is connected correctly for the vehicle being tested, check the lead for defects or bad connections.

The items listed inside the box on the display screen are specifications that can be changed manually.

"# OF CYLINDERS" - If the engine is running and leads are connected, the analyzer automatically detects the number of cylinders and displays it on screen. (If specifications were entered through the Specifications menu, the display screen will show the number of cylinders entered. If the number of cylinders item was forgotten during the entry process, the analyzer will display the default value of 8 cylinders.) Make sure the number of cylinders is correct. If not, check the connection of the green #1 pickup and secondary yellow pickup. Make sure the engine is running. Press [REPEAT] to check the setup.

To change the number of cylinders manually:

- a) Press [1].
- b) Type in the number of cylinders.

"FIRING ORDER" - Firing order is entered through "Specifications." If no specs were entered, this line reads 1, 2, 3, 4, etc. To change firing order through the Set-Up screen:

- a) Press [2].
- b) Type in the correct firing order.

"PRIMARY CIRCUIT" - This line shows which "trigger" the analyzer is using (see Figure 23). The "Trigger" is the pulse the analyzer uses to synchronize ignition patterns and RPM readings, and to perform other tasks. The analyzer is automatically set to a **Standard** trigger, which works well for most vehicles. In the rare event that the standard trigger is not right for the vehicle you're testing, you'll see these symptoms during testing:

- Nonsense RPM readings and dwell values.
- Erratic ignition patterns.

```

1 OK
PRIMARY OK
SECONDARY OK
# OF CYLINDERS 6
FIRING ORDER 1 2 3 4 5 6
PRIMARY CIRCUIT STANDARD
4 CYCLE
MAG REFERENCE .8

1 CHANGE # OF CYLINDERS
2 CHANGE FIRING ORDER
3 CHANGE PRIMARY CIRCUIT
4 CHANGE CYCLES
5 CHANGE MAG REFERENCE
CONTINUE REPEAT
  
```

Figure 23

If you are **NOT** having these problems, **DO NOT** change the trigger.

If you **ARE** having these problems, press [1], [2] or [3] on the number (red) keypad to change the trigger. Here are the three triggers available:

1. Standard - works for most vehicles.
2. Primary 1 - works for breaker point systems and most electronic systems.
3. Primary 2 - works for current-regulated systems such as H.E.I. and Prestolite.

"4 Cycle" - When testing two-cycle or rotary engines, press [4] to change this line to two-cycle. Press [4] again to change it back.

"Mag Reference" - Vehicles that have a socket for the magnetic timing probe require a magnetic reference spec (an offset value for the probe). The number will be automatically entered and appear here if specs were entered through bar codes. To enter or change mag reference here, press [5] and enter the digits.

Set-Up: D.I.S.

The D.I.S. setup procedure requires the operator to select a manufacturer and engine type (with corresponding firing order and polarity setup). The operator may enter setup information manually. D.I.S. Set-Up also allows the operator to change the trigger mode and mag reference specification. When the engine is running, it checks to see that leads are properly connected.

1. Press [2] "DIRECT IGNITION SYSTEM."
2. The first Direct Ignition System Set-Up screen will appear (see Figure 24). Press the number of the manufacturer of the vehicle being serviced.

DIRECT IGNITION SYSTEM SET-UP

MANUFACTURER

- [1] GM
- [2] FORD
- [3] TOYOTA
- [4] CHRYSLER
- [5] MITSUBISHI
- [6] OTHER (SERVICE TESTS ONLY)

Figure 24

NOTE: If the correct engine manufacturer or type is not listed here, select "Other" and enter D.I.S. system information manually. A separate screen will appear (see Figure 25). As the screen tells you, press [0] to enter [+], [1] to enter [-] for polarity setup. From that screen, press [CONTINUE] when finished.

DIRECT IGNITION SYSTEM SET-UP

ENTER FIRING ORDER:
1 3 4 2 6 5

KEY INPUTS
[0] = <->
[1] = <+>

ENTER POLARITY CODE:
[1] [] [] [] []

[ENTER] [CLEAR]

Figure 25

3. The second Direct Ignition Set-Up screen will appear (see Figure 26). Check the polarity set-up for the correct engine type for the vehicle being tested.

DIRECT IGNITION SYSTEM SET-UP

| MANUFACTURER | POLARITY SET-UP |
|--------------------------------|-----------------|
| [1] GM | 1 3 4 2 |
| [2] FORD | + - - + |
| [3] TOYOTA | 1 4 2 5 3 6 |
| [4] CHRYSLER | + - + - + - |
| [5] MITSUBISHI | 1 2 4 3 |
| [6] OTHER (SERVICE TESTS ONLY) | + - - + |

Figure 26

4. Connect the secondary clips to the engine according to the polarity set-up on the display screen. **NOTE:** Make sure that the Green #1 lead is connected!
5. Start the engine and then press the number on the number (red) keypad that corresponds to the engine type being tested.

Special D.I.S. Secondary Clip Connections

NOTE: For the GM 2.3L (QUAD-4) with IDI System, and the Nissan Pulsar 1.6L, a special procedure is required to connect secondary clips (see Figure 27):

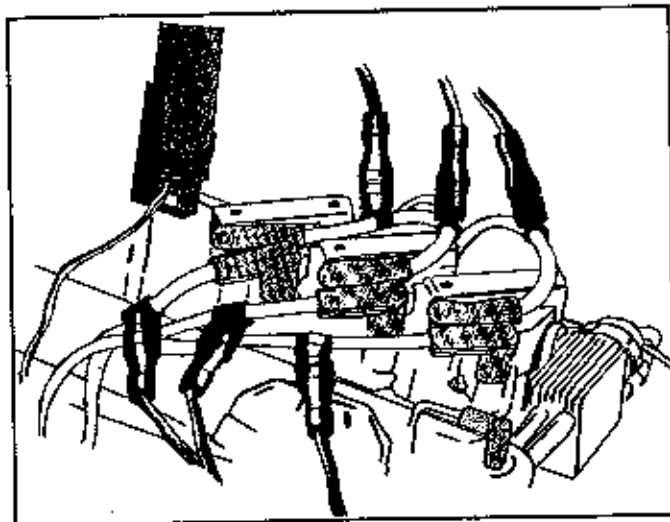


Figure 27

1. On the GM, remove the coil assembly and invert it. Then reinstall the coil so the coil terminals are accessible.

On Nissan, remove the cover, unbolt the coils and remove them from the plugs.

2. Install plug wires between the coil terminals and the spark plugs. (GM makes a kit for this purpose. The kit is available from your local dealer.)
3. Clip the secondary clips onto the spark plug leads just installed, according to the polarity setup of the vehicle.

See manufacturer's information for more details on this procedure.

Special Connections

All Fords - The primary wire is at the connector at the coil.

Ford 2.3L - This is a double spark system with a full-time pack that does most of the work, and a part time pack that only operates under certain conditions, for emissions controls. Test these ignition systems in two steps:

1. Connect D.I.S. leads to the full-time pack and run Comprehensive or Ignition service test as usual.
2. After testing full-time pack, connect D.I.S. leads to the part-time pack. Do Set-Up again, with engine running at idle (the part-time pack is always active at idle). After verifying setup on the part-time pack, run an Ignition Service test to test the part-time pack separately.

GM 2.8 Liter - For easier access, hook the lead around one of the pink and black wires in the harness at the fender well. Check the D.I.S. Set-up screen for a primary signal. If there is no signal, hook the lead around another pink and black wire, and then press [REPEAT]. Keep trying pink and black wires until the Set-up screen shows a signal.

Complete The D.I.S. Hook-Up

6. The third Direct Ignition System Set-Up screen will appear (see Figure 28). The top two lines on screen show the "Trigger Mode" and the "Trigger Status." (whether the trigger is "OK", "FAULTY," or "MISSING.")

| DIRECT IGNITION SYSTEM SET-UP | |
|---|-----------|
| TRIGGER MODE | SECONDARY |
| TRIGGER | OK |
| # OF CYLINDERS | 4 |
| FIRING ORDER | 1 3 4 2 |
| | ++ - - |
| MAG REFERENCE | .0 |
| <div> <div>1 CHANGE TRIGGER MODE</div> <div>2 CHANGE MAG REFERENCE</div> </div> | |
| <div> <div>CONTINUE</div> <div>REPEAT</div> <div>BACKUP</div> </div> | |

Figure 28

"Trigger" is the pulse the analyzer uses to synchronize ignition patterns and RPM readings, and to perform other tasks. When you select "DIS Set-Up", the trigger mode is automatically set to "Secondary" — the analyzer uses the D.I.S. Secondary Leads for the trigger.

Status line should read "OK."

If the status line reads "FAULTY": or "MISSING":

A signal is present but is irregular or inconsistent.

If the status line reads "MISSING":

No trigger signal is present.

In either case, a message appears on screen that reads "CHECK TRIGGER LEADS." Take the following steps.

- The engine should be running. If not, start it and press [REPEAT].
 - Make sure that the secondary leads are properly connected according to the polarity setup.
 - Make sure each secondary clip is securely connected to its spark plug wire.
 - Make sure the green #1 lead is connected to the #1 spark plug. The lead should be connected between the secondary clip and the plug.
 - After correcting any problems, press [REPEAT]. The analyzer will check the trigger again.
 - If trigger is still "FAULTY" or "MISSING," change to a primary trigger mode. Connect the D.I.S. primary lead.
 - The D.I.S. Primary lead looks like the green #1 lead. It has a white decal which reads: "PRIMARY SIGNAL C31." Clamp the lead around a wire at the coil connector. The table in Figure 29 lists the correct wire location on specific engines. The table also shows the wire color and coil connector pin letter, where applicable.
 - Then press [1] from this setup screen to change the mode to PRIMARY. Press [REPEAT] to make sure the primary trigger is OK.
- The next two lines show the number of cylinders, and the firing order and polarity setup. Make sure they are correct. If any of these are incorrect, press [BACKUP] to return to polarity set-up screen (the first System Set-Up screen) to make the correct selection.

MAG REFERENCE - Vehicles that have a socket for the magnetic timing probe require a magnetic reference specification (an offset value for the probe). The number will be automatically entered and appear here if specs were entered through bar codes. To enter or change the mag reference, press [2] and enter the digits.

To Complete the Set-Up Test...

"REPEAT" - If a lead is missing or if the engine is not started before calling up this screen, correct the situation and press [REPEAT]. The screen will be updated.

"BACKUP" - Press [BACKUP] to return to engine selection screen.

"CONTINUE" - Press [CONTINUE] to return to the Service Tests menu. From there, choose the next test tests to perform.

NOTE: After the DIS Set-Up Test is completed, the analyzer is set in D.I.S. mode. To change the mode:

- Turn the power "OFF" or:
- Press [RESET] or:
- Return to Set-Up and change the test mode.

D.I.S. Primary Lead Hookup Table

| MAKE/IGNITION TYPE | ENGINE SIZE | PIN LOCATION/WIRE COLOR |
|--------------------|-------------|---|
| Chrysler | 1.6L | Pin 4 - Black/White |
| Chrysler | 3.3L (1990) | Lt. Green/Black |
| Ford DIS | 4.0L, 1.9L | Wire to Pin 8 EDIS Module |
| Ford DIS | 3.0L, 3.8L | Pin 4 - Red/Lt. Green |
| Ford DIS | 2.3L | Pin R2, L2 - Red/Lt. Green |
| GM Type I | 3.0L, 3.8L | Pin P - Pink/Black At Coil Connector |
| GM Type II | 3.0L, 3.8L | Pin M - Pink/Black At Coil Connector |
| GM Type III | 3.3L, 3300 | Pin M - Pink/Black At Coil Connector |
| GM Type III | 3.8L, 3800 | Pin P - Pink/Black At Coil Connector (closest to alternator) |
| GM CPC | 2.0L, 2.5L | Pink/Black or Solid Red Two Wire Connector (Left side of coil) |
| GM CPC | 2.8L | Two wire connector - Pink/Black |
| GM IDI (Quad IV) | 2.3L | Pin L - Solid Pink Last pin on top row of connector (closest to firewall before inverting unit) |
| Mazda | 80 CID | Pin 2 - Black/Yellow |
| Mitsubishi | 1.6L | Pin 4 - Black/White |
| Nissan | 1.6L | Wire Loop - Black Wire loop next to igniter, left front of motor. |
| | | Make sure switch on DIS box is on "STD". During Gas Analyzer Setup, choose "STD" for ignition type. |
| Toyota | 3.8L | Pin 4 - brown wire Green connector 4-wire connector on left side of coil unit cover |

Figure 29- D-I-S Connection Chart for Primary Signal

Adjustment Screen

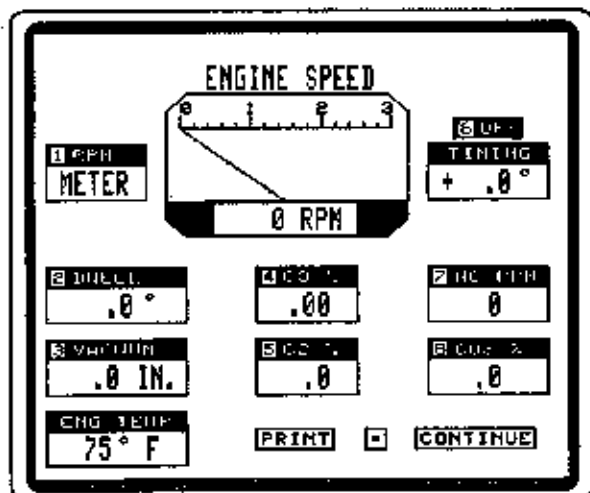


Figure 30

Leads Required:

Conventional Systems:

- Green #1 Pickup;
- White Clip;
- Yellow Pickup (standard trigger);
- Blue Primary Clip;
- Vacuum Lead;
- Engine Temperature Probe;
- Magnetic Timing Probe;
- Exhaust Gas Probe.

D.I.S. Systems:

- D.I.S. Secondary Leads
- Green #1 Pickup;
- White Clip;
- Yellow Pickup (standard trigger);
- Blue Primary Clip;
- Vacuum Lead;
- Engine Temperature Probe
- Magnetic Timing Probe;
- Exhaust Gas Probe.

A meter screen displays:

- RPM;
- Dwell;
- Vacuum;
- Engine Temperature;
- Timing;
- Exhaust gas values (if available) for:

Carbon Monoxide (percent)
Oxygen (percent)
Hydrocarbons (parts per million)
Carbon Dioxide (percent)

Check gas analyzer status before using this screen. Gas analyzer advisory messages, such as "Low Flow," and "No Gas," will not appear on this screen.

Press [6] to turn on the timing light. The vehicle must be running, and the secondary lead(s) and green #1 pickup must be connected. (If primary trigger is being used, the blue clip must be connected for conventional vehicles, or D.I.S. primary for D.I.S. vehicles.)

Display any of the above readings (except engine temperature and

- Timing
- Exhaust gas values (if available) for:

Carbon Monoxide (percent)
Oxygen (percent)
Hydrocarbons (parts per million)
Carbon Dioxide (percent)

When ready, press [CONTINUE].

Primary Circuit Test

This test does not apply to D.I.S. systems.

| PRIMARY CIRCUIT TEST | |
|---|----------------|
| PRIMARY COIL RES. | .4 Ω |
| BALLAST RESISTANCE | .3 Ω |
| PRI. IGNITION CURR. | 6.7 A |
| POSITIVE COIL VOLTS | 13.2 V |
| NEGATIVE COIL VOLTS | 10.62 V |
| BATTERY VOLTAGE | 14.3 V |
| COIL OUTPUT | 39 KV |
| DWELL VARIATION | 2.7 $^{\circ}$ |
| <div> <div>CONTINUE</div> <div>REPEAT</div> <div>PRINT</div> <div></div> </div> | |

Figure 31

Leads Required:

Conventional Systems:

- Green #1 Pickup;
- White Clip;
- Yellow Primary Clip;
- Blue Primary Clip;
- Red Clip;
- Yellow Secondary Clip.

Make sure the engine runs at a steady RPM before selecting the Primary Circuit Test. The results show the performance of components of the primary ignition circuits:

"PRIMARY COIL RESISTANCE" - Ignition coil primary winding resistance.

"BALLAST RESISTANCE" - Ballast resistance or battery to coil circuit resistance.

"PRIMARY IGNITION CURRENT" - Total primary circuit current flow.

"POSITIVE COIL VOLTS" - The voltage at the yellow primary clip when the primary coil is energized.

"NEGATIVE COIL VOLTS" - The voltage at the blue primary clip when the primary coil is energized.

"BATTERY VOLTAGE" - Battery voltage.

"COIL OUTPUT" - Ignition coil secondary output.

"DWELL VARIATION" - Dwell period for each cylinder firing is measured. The difference between the longest and shortest dwell period is displayed.

Secondary KV - Conventional

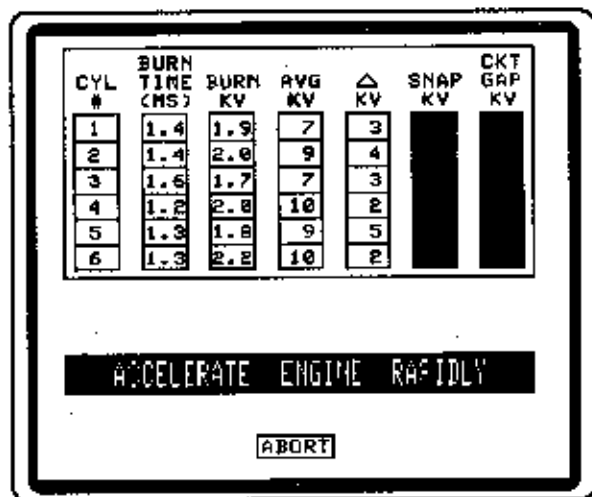


Figure 32

Leads Required:

- Green #1 Pickup;
- White Clip;
- Yellow secondary lead
- Blue Primary Clip;

The KV test samples a series of firings for each cylinder (see Figure 32), then reports on individual spark plug burn times (milliseconds) and the following KV readings (see Figure 33):

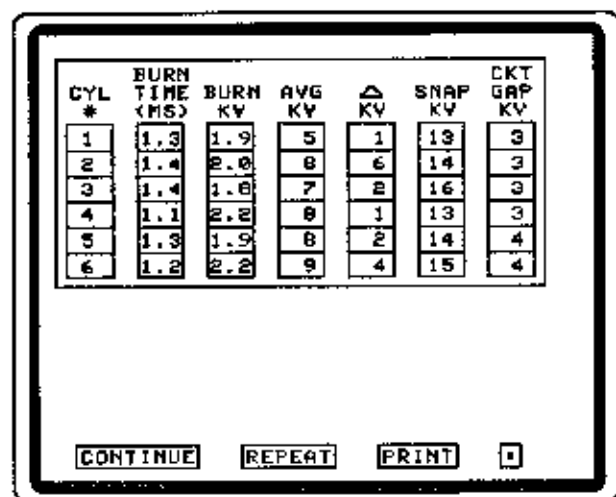


Figure 33

"BURN TIME" - The length of time in milliseconds that the spark plug is arcing.

"BURN KV" - The average KV required to maintain the spark. The amount for each cylinder's secondary circuit is stored and shown on the screen in the proper cylinder column.

"AVERAGE KV" - The average KV required to initiate a spark. The amount for each cylinder's secondary circuit is stored and shown on the screen in the proper cylinder column.

"DELTA KV" - The difference between the minimum and maximum KV.

After delta KV is displayed, the operator will be prompted to snap the throttle wide open and release it. This action is needed to obtain Snap KV and Circuit Gap values.

"SNAP KV" - Secondary KV for each cylinder is sampled under load caused by engine acceleration. The highest value is stored and shown on the screen.

"CIRCUIT GAP KV" - The voltage required to jump the largest air gap (except spark plug gap) in each cylinder secondary circuit is stored and shown on the screen.

Repeating this test may yield slightly different values. This is due to variations in mixture richness, turbulence, temperature, etc.

Secondary KV - D.I.S.

NOTE: If a D.I.S. vehicle has all negative or all positive polarity plugs, run a CONVENTIONAL secondary ignition test. See the preceding page.

Leads Required:

- D.I.S. Secondary Leads
- Green #1 Pickup;
- White Clip;
- D.I.S. Primary Pickup (when Primary Trigger is selected);

The screen displays tachometer and digital RPM readout (see Figure 34). Follow screen prompt and allow engine RPM to stabilize at idle (800 - 1000 RPM). When RPM is stable, press [CONTINUE].

Secondary data is collected from the D.I.S. system. The display screen highlights which data is being collected, as it is collected (see Figure 35).

After a few seconds, the display screen reports the following KV readings for the Compression Firings and Exhaust Firings of each cylinder (see Figure 36):

"AVERAGE KV" - The average KV required to initiate spark, averaged over a number of firings.

"DELTA KV" - The difference between the minimum and maximum KV.

"BURN TIME" - The length of time in milliseconds that the spark plug is arcing. Repeating this test may yield slightly different values. This is due to variations in mixture richness, turbulence, temperature, etc.

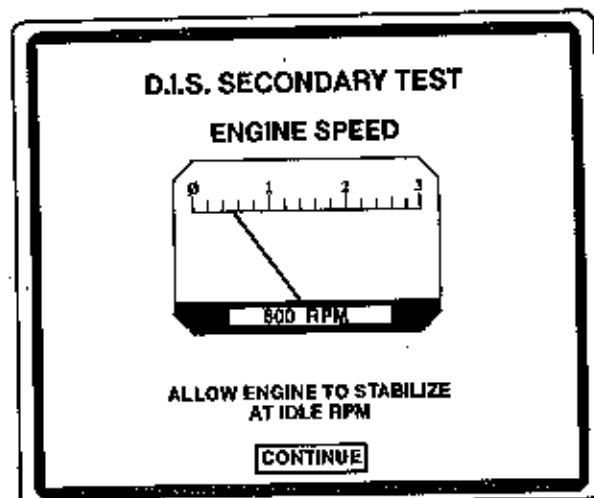


Figure 34

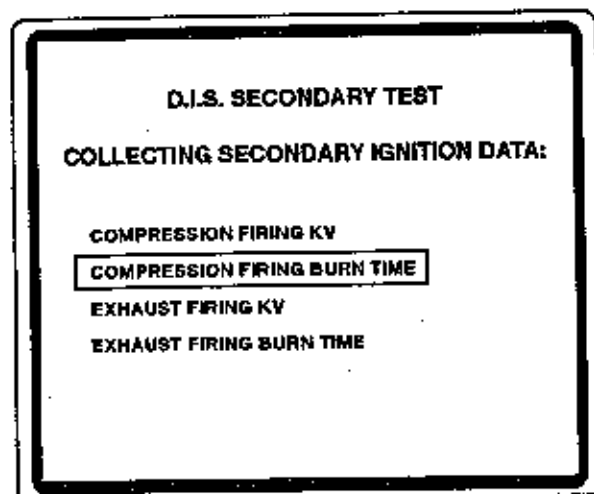


Figure 35

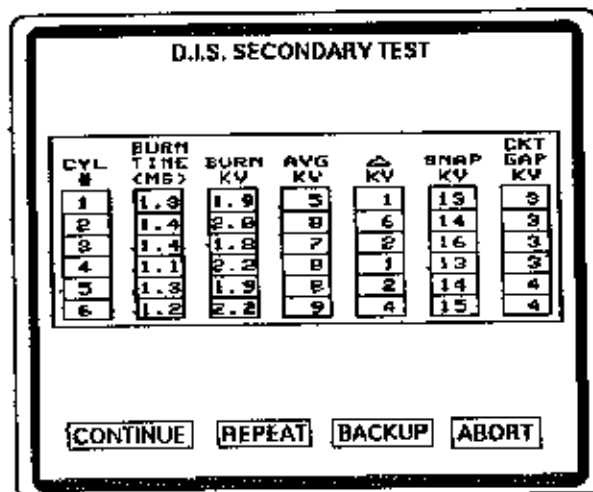


Figure 36

Ignition Patterns

IMPORTANT NOTE: Even though the Command Bar does not appear when a pattern is displayed on the screen, the command keys listed below are active. Press:

[CONTINUE] - Continues with the next step in the sequence.

[REPEAT] - Repeats a test or procedure just performed.

[BACKUP] - Backs up to a preceding test or step.

[ABORT] - Discontinues testing and returns to the menu.

Leads Required:

Conventional Systems:

- Green #1 Pickup;
- White Clip;
- Yellow secondary lead;
- Blue Primary Clip;

D.I.S. Systems:

- D.I.S. Secondary Leads
- Green #1 Pickup;
- White Clip;
- D.I.S. Primary (when Primary Trigger has been selected);

For correct results, the engine must be running. Perform the Set-Up test to make sure that lead connections and the number of cylinders are correct. For testing D.I.S. vehicles, the analyzer must get a good secondary trigger.

From the Service Tests menu, select Item 5, "IGNITION PATTERNS." The Secondary Ignition Pattern Display screen will appear, showing Secondary ignition patterns in Sequential Display Mode - displayed one cylinder after another, in firing order. Use the waveform (yellow) keypad selections described below to select different pattern displays (see Figure 37). Patterns will be displayed with the corresponding cylinder number if the firing order was entered.

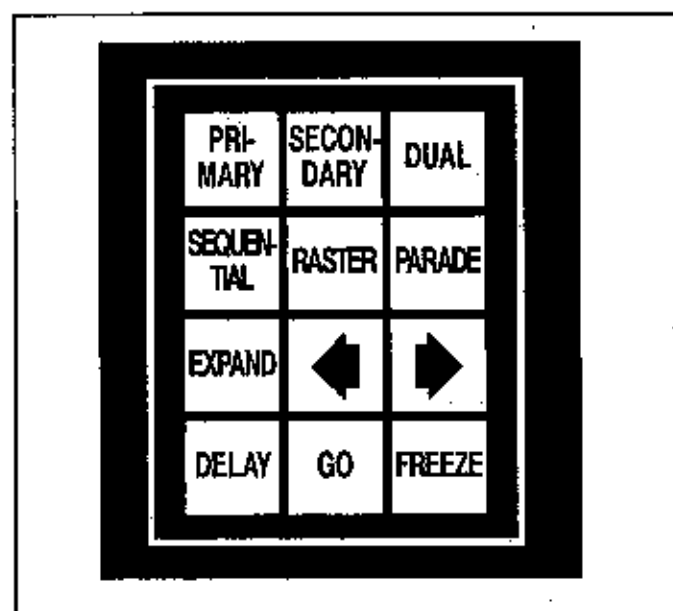


Figure 37

- In D.I.S. mode, primary patterns are not available. The Parade Patterns function displays both compression and exhaust patterns, per polarity. Other secondary waveforms show only compression firings.
- For descriptions of electronic ignition patterns, refer to "Patterns" section of this manual.
- To print a pattern from the screen, press [•] on the number keypad.

Press [SECONDARY] to display secondary ignition patterns(see Figure 38). The secondary ignition patterns will appear sequentially. Press a cylinder number on the number (red) keypad to see that cylinder alone displayed. Press [GO] to return to the Sequential Display Mode.

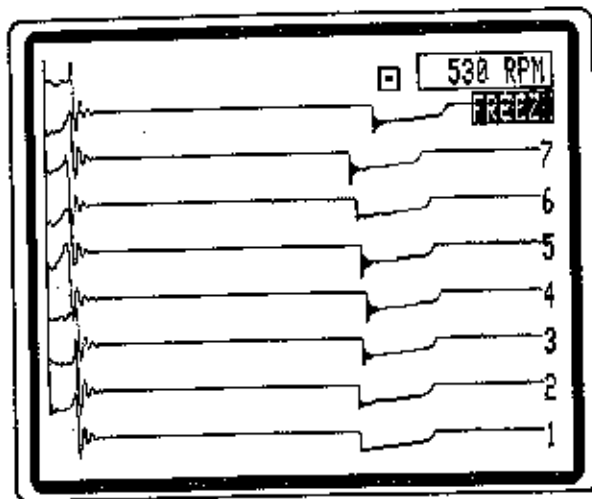


Figure 38

Press [PRIMARY] to display primary ignition patterns. Press a cylinder number on the number (red) keypad to see that number cylinder displayed alone. Press [GO] to return to Sequential Display Mode.

The format of Primary and Secondary ignition pattern displays can be changed by the options on the following pages.

"PARADE" (see Figure 39) shows KV peaks of all active cylinders. The format of this pattern cannot be changed.

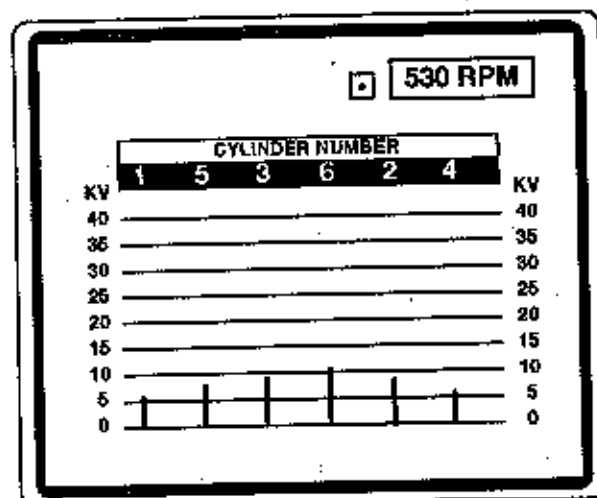


Figure 39

For D.I.S. vehicles, "PARADE" (see Figure 40) shows both the compression and exhaust firings for the positive polarity cylinders on one screen, and those for the negative polarity cylinders on another screen. Press [1] to toggle between the two screens.

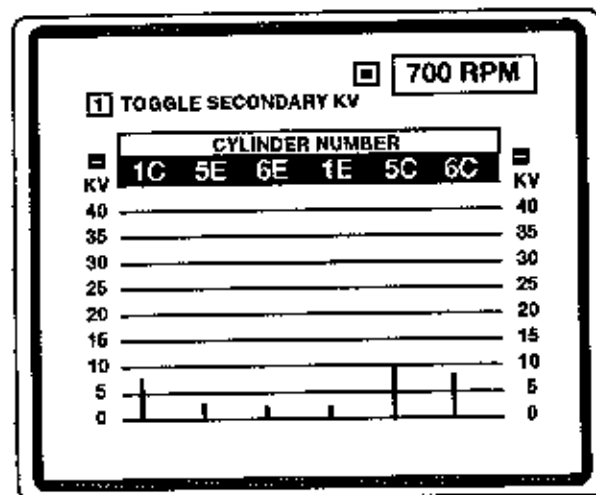


Figure 40

Continued...

Service Tests

Ignition Patterns (continued)

The next few pages show the different ways to select and manipulate the basic primary and secondary patterns. The waveform control keys are shown, along with an example of their operation. Many combinations of control are possible and practical.

Press [RASTER] to display primary or secondary patterns vertically on the screen (see Figure 41). Pressing numbers on the number (red) keypad selects the cylinders to be skipped in raster display. To return to display of all cylinders, press [CLEAR] on the number (red) keypad. To restore any single cylinder, press the number key a second time.

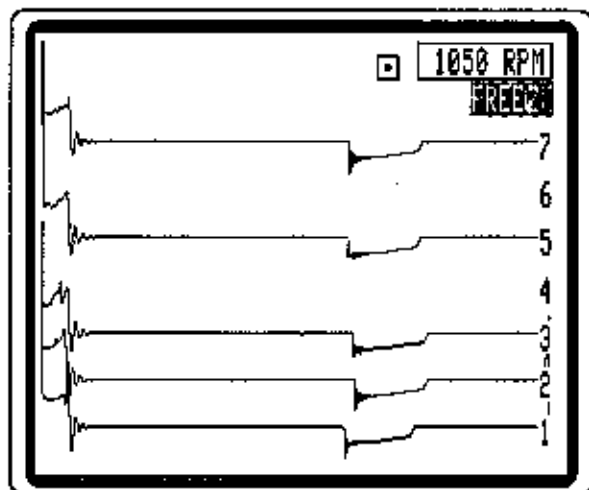


Figure 41

Press [DUAL] to display a primary and a secondary waveform for all cylinders in sequence, or for selected cylinders (see Figure 42). For D.I.S. systems, the primary wavelength is meaningless; it will be flat.

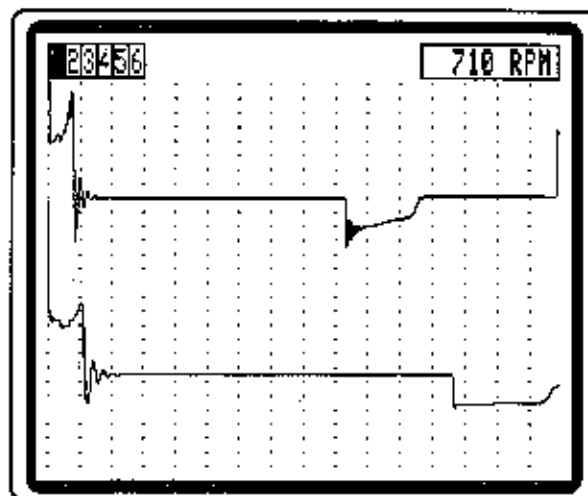


Figure 42

Press [SEQUENTIAL] to return the pattern display to Sequential Display Mode.

Press [EXPAND] to change the display of millisecond timelines.

Press [EXPAND] once, and the display shows 10 divisions, each 1 millisecond long, and enables ARROWS to change timebase (see Figure 43).

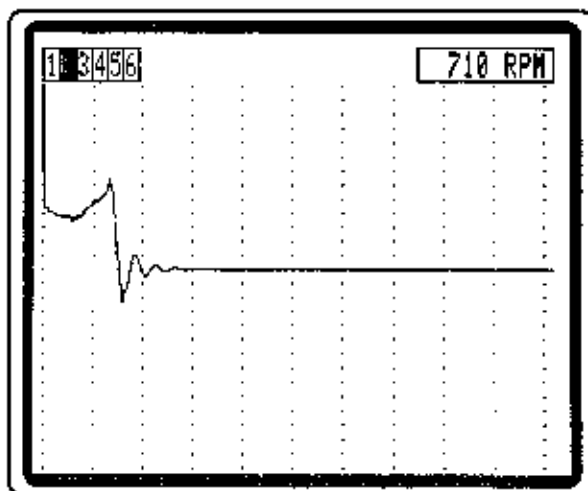


Figure 43

Press [EXPAND] a second time to remove the millisecond timelines and restores display to previous full cylinder display length.

Each time the "EXPAND" key is pressed, the timelines return to the scale last selected by the Arrow Keys.

The Arrow Keys work when "EXPAND" is active to change pattern time. Arrow Keys will work only when millisecond timelines are displayed.

The right arrow reduces the number of millisecond divisions and lengthens first portion of the pattern displayed (see Figure 44). The limit is a six millisecond display.

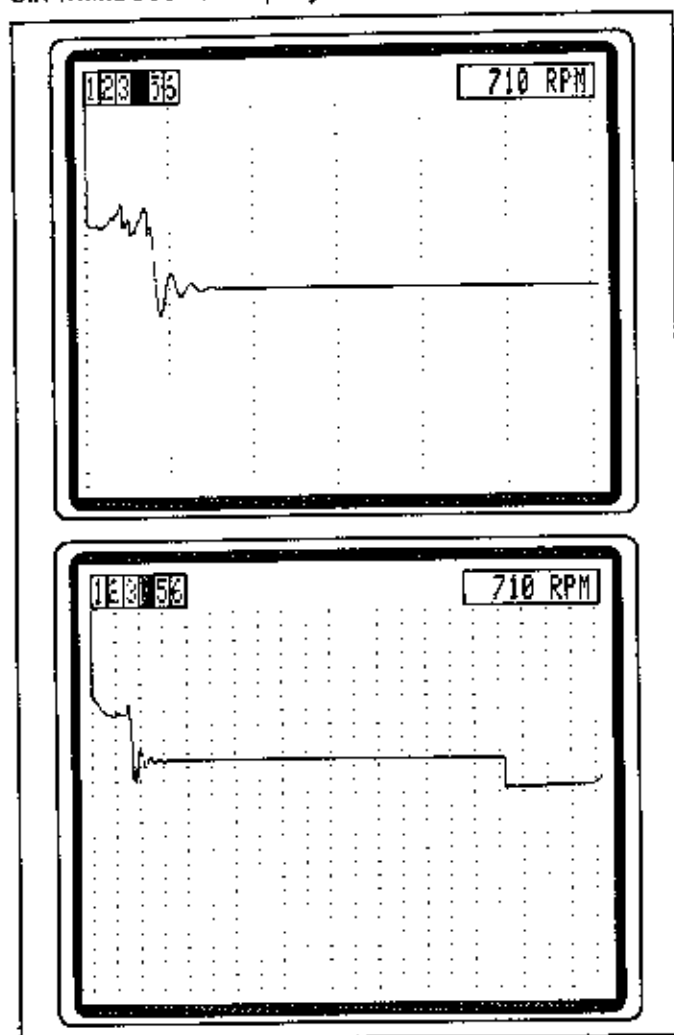


Figure 44

The left arrow increases the number of millisecond divisions, compresses patterns in from the right and displays them in a "parade" fashion. When more than one pattern is squeezed on the screen, the pattern farthest to the left is that of the displayed cylinder number. Limited to filling screen with timeline divisions (all engine cylinders).

Press [FREEZE] to hold or release (stop action) the selected waveform display (see Figure 45). Other keyboard selections made while "FREEZE" is operating will not work until "FREEZE" is released.

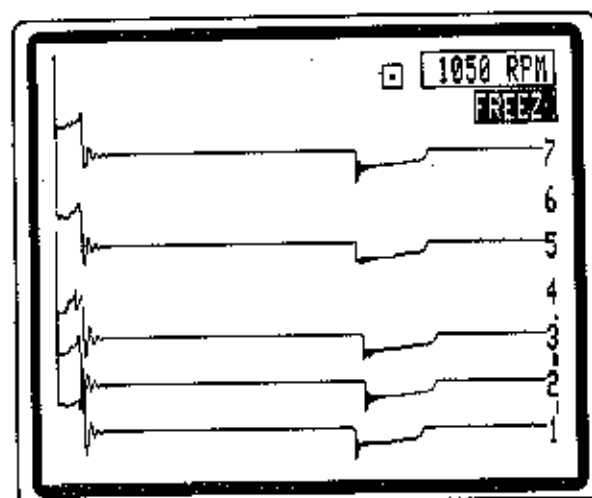


Figure 45

Press [DELAY] to slow the waveform update rate. Each time [DELAY] is pressed, 3-second delay occurs before the next update. Press [GO] to restore normal update rate.

NOTE: Press [GO] to:

- Release "FREEZE" stop action;
- Release "DELAY" and restore standard waveform update rate;
- Restore any patterns that have been "de-selected."

Cylinder Miss Recall

Leads Required:

Conventional Systems:

- Green #1 Pickup;
- White Clip;
- Yellow Secondary Pickup;
- Blue Primary Clip;

D.I.S. Systems:

- D.I.S. Secondary Leads
- Green #1 Pickup;
- White Clip;
- D.I.S. Primary Pickup (When Primary Trigger has been selected);

Before running Cylinder Miss Recall, run the Set-Up Test to make sure vehicle's correct firing order is entered in the analyzer and the analyzer is getting signals from the leads

Select Cylinder Miss Recall. While the engine is running, secondary ignition patterns for each firing are being stored.

When you hear or feel the engine miss, press [FREEZE] (see Figure 46).

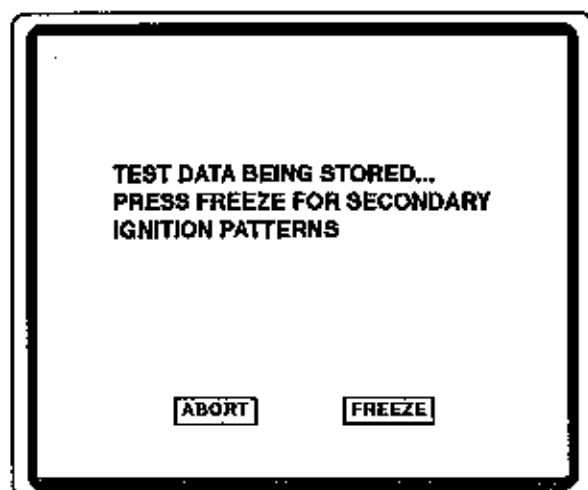


Figure 46

After pressing [FREEZE], the screen displays the secondary patterns in memory, showing the patterns of all cylinders for one engine revolution at a time (see Figure 47). The analyzer automatically pages back through the previous 30 or so engine revolutions. The revolution counter starts at #1, the most recent revolution, and counts backward from there.

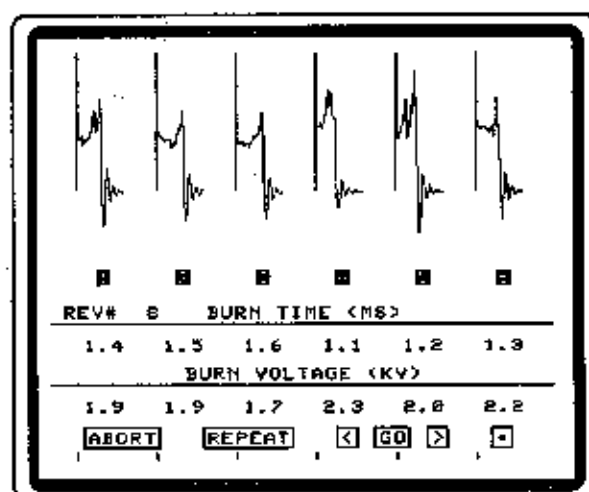


Figure 47

Watch the screen for the miss. When you see it, press [FREEZE] to stop the screen from automatically paging. Use the right and left arrows to move back and forth through the patterns. Press [GO] to start the automatic paging again.

"BURN TIME" (milliseconds) and "BURN VOLTAGE" (KV) are displayed for each cylinder and revolution (when patterns are cycling).

Cranking Test: Conventional

Leads Required:

Conventional Systems:

For Compression, Dwell, RPM:

- Green #1 Pickup;
- White Clip;
- Yellow Pickup (standard trigger);
- Blue Primary Clip;

For Complete Screen, add:

- Exhaust Gas Probe.
- Vacuum Lead;
- Battery Load Clamps

CAUTION: Place the transmission in "PARK" or, if manual, "NEUTRAL." Set the parking brake. Make sure the vehicle cannot roll. If necessary, chock the wheels.

Follow the screen prompt and crank the engine until it starts. The engine will crank for a few moments before it starts because the analyzer temporarily disables the ignition in order to read cranking information.

If the analyzer is not getting a signal from all necessary leads, a Setup screen appears (see Figure 48). This screen shows which leads are missing and allows the operator to change the trigger mode, if desired. Check any missing connections and press [CONTINUE] to repeat the cranking test.

The Cranking Test screen appears, listing test results (see Figure 49).

Each cylinder's compression is compared with the others. The best cylinder is given the value "100." The computer then converts the value of the other cylinders to a percent of the best cylinder to get a "Compression %" value. Other cranking values are listed at the bottom of the screen.

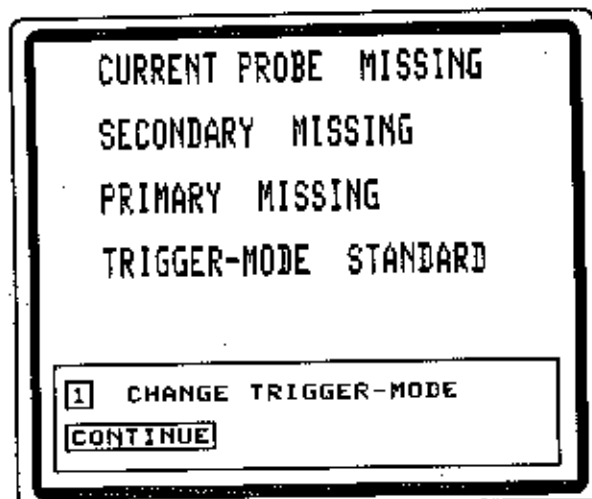


Figure 48

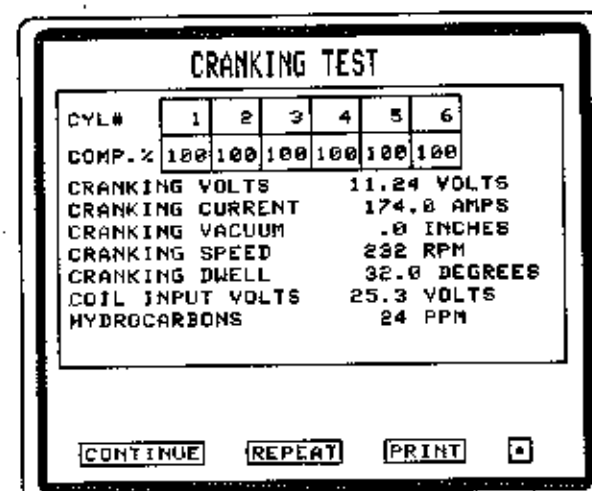


Figure 49

One of three messages may appear on the results screen:

"ENGINE DIESELED" - The engine fired without an electric spark during cranking test. Compression information is not reported.

"DISCONTINUED CRANKING" - Cranking was discontinued before test was complete, or some other irregularity occurred which makes compression results unreliable. Compression information is not reported.

"ENGINE WILL NOT START" - The engine does not start after cranking test is completed and ignition is re-enabled. Press [ABORT] to return to the menu.

Cranking Test: D.I.S.

Leads Required:

- D.I.S. Secondary Leads
- Green #1 Pickup;
- White Clip;
- Red Clip;
- Gray Amp Probe

For a complete screen, add:

- Yellow Primary Clip to the battery (+) terminal;
- Battery Load Clamps;
- Vacuum Lead,
- D.I.S. Primary Pickup (when Primary Trigger is selected);
- Exhaust Gas Probe.

CAUTION: Place transmission in "PARK" or, if manual, "NEUTRAL." Set parking brake. Make sure vehicle cannot roll.

Follow the instructions on the first cranking screen (see Figure 50) to disable ignition. The instructions shown depend on which vehicle is being tested.

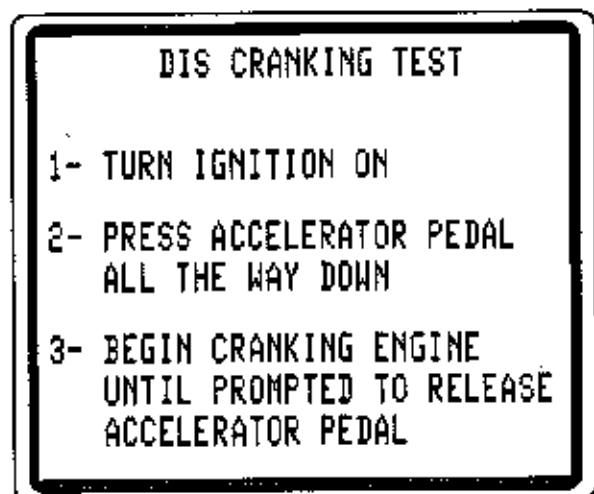


Figure 50

3.0L Toyota and GM PFE (Ported Fuel Injection) Vehicles:

1. Turn the ignition key "ON."
2. AFTER THE IGNITION KEY IS "ON", press the accelerator pedal all the way down. This will cause the computer on these vehicles to inhibit fuel flow because it is put in a flood mode.
3. HOLD THE ACCELERATOR PEDAL ALL THE WAY DOWN and crank the engine until prompted to release the pedal. The analyzer takes a few seconds to read cranking values and then displays the results on the screen. When the screen prompts "RELEASE ACCELERATOR PEDAL," do so to allow engine to start.

NOTE: If the engine starts, release the accelerator pedal, turn the ignition "OFF" and repeat the test.

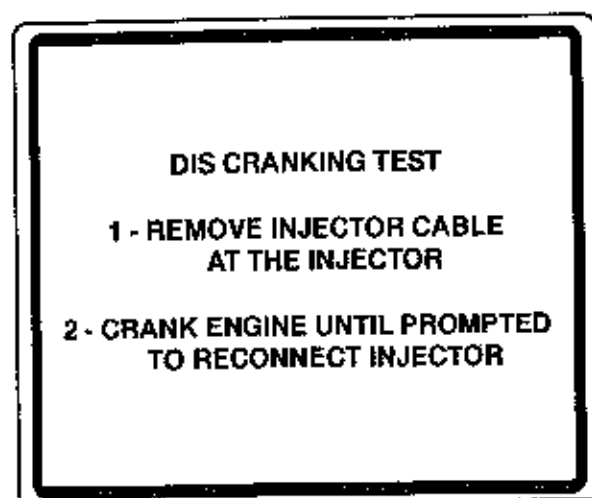
For GM TBI (Throttle Body Injection) Vehicles (See Figure 51):

Figure 51

1. Remove the injector cable at the injector. These vehicles are not automatically disabled when the throttle is wide open. Remove the rubber or plastic airflow filter over the injector, and then unplug the cable connector at the injector.
2. Crank the engine until prompted to reconnect the injector. When the test results appear on the screen, stop cranking.
3. Follow the screen prompt and reconnect the injector and start the engine.

For Ford, Chrysler/Mitsubishi, and "Other" Systems:

1. Disable the fuel system. - For instructions, press [0] to see a Help menu (see Figure 52). From the Help menu, select the type of system being tested. The Help screen shows instructions for disabling that system.

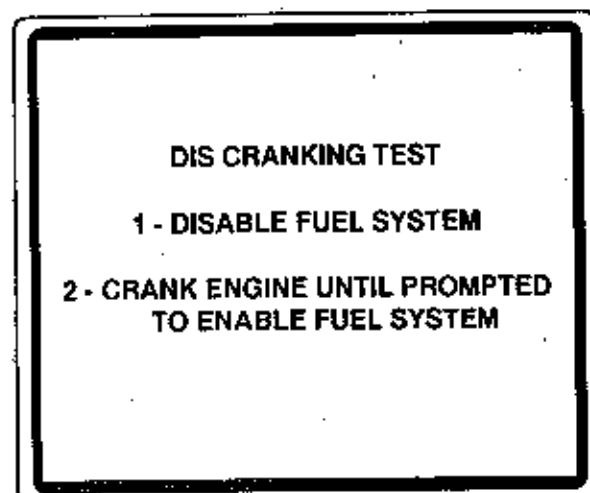


Figure 52

NOTE: Selections 4, 5, and 6 are for Ford of Europe systems.

Continued ...

Service Tests

Cranking Test: D.I.S. (continued)

Figures 53, 54 and 55 give a few examples. After disabling the system, press [0] to return to cranking screen.

HELP ON DISABLING FUEL SYSTEMS

SYSTEM TYPE

- 1 THROTTLE BODY INJECTION
- 2 CENTRAL FUEL INJECTION
- 3 PORTED FUEL INJECTION WITHOUT CLEAR FLOOD MODE
- 4 CARBURETOR w/ELECTRIC FUEL PUMP
- 5 CARBURETOR w/MECHANICAL FUEL PUMP
- 6 CARBURETOR w/ANTI-DIESEL VALVE
- 0 EXIT HELP

Figure 53

HELP ON DISABLING FUEL SYSTEMS

SYSTEM TYPE

CARBURETOR w/MECH. FUEL PUMP

PROCEDURE

CRIMP RUBBER FUEL INLET HOSE WITH HOSE PLIERS

0 EXIT HELP BACKUP

Figure 55

HELP ON DISABLING FUEL SYSTEMS

SYSTEM TYPE

PORTED FUEL INJECTION WITHOUT CLEAR FLOOD MODE

PROCEDURE

DISCONNECT THE FUEL PUMP RELAY

0 EXIT HELP BACKUP

Figure 54

2. Crank the engine until prompted to enable the fuel system. Discontinue cranking when results appear on screen. Re-enable the fuel system, as bottom of screen prompts, and start engine.

The results for the D.I.S. cranking test are shown in the same format as for conventional cranking test (see Figure 56).

CRANKING TEST

| CYL# | 1 | 3 | 4 | 2 |
|--------|---|---|---|---|
| COMP.% | | | | |

| | |
|------------------|------------|
| CRANKING VOLTS | .01 VOLTS |
| CRANKING CURRENT | 47.8 AMPS |
| CRANKING VACUUM | .3 INCHES |
| CRANKING SPEED | 600 RPM |
| CRANKING DWELL | N/U |
| COIL INPUT VOLTS | 12.6 VOLTS |
| HYDROCARBONS | 0 PPM |

ENGINE STARTED - REPEAT TEST

CONTINUE REPEAT PRINT ●

Figure 56

Other D.I.S. Cranking Test Conditions

The following messages may appear during cranking test, under certain conditions:

"ENGINE DIESELED" - appears if a cylinder fires during cranking. This message may also appear when the trigger is bad (due to erratic RPM readings). Repeat the test. If this message appears again, go to Set-Up and check the trigger.

"ENGINE STARTED; REPEAT TEST" - appears if the engine started before cranking information could be gathered. Shut the engine "OFF." Press [REPEAT] and run the test again.

"TURN IGNITION OFF AND CHECK CURRENT PROBE" - appears at the beginning of test if the analyzer reads RPM but there is no signal from the current probe (see Figure 57). This message may also appear if the RPM is unsteady due to a faulty trigger. Check current probe (grey amp probe) and make sure it is fully closed around all vehicle wires coming from a battery terminal. Check all D.I.S. leads. Press [CONTINUE] to start test again. If the problem persists, go to Set-Up and check trigger status.

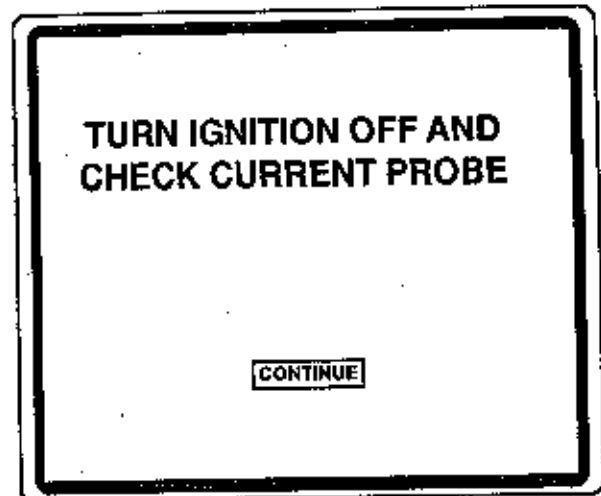


Figure 57

Power Check

Power Check allows the operator to "kill" cylinders and watch the resulting changes in engine RPM, vacuum, HC, and exhaust temperature. This information allows the operator to evaluate the performance of individual cylinders.

IMPORTANT NOTE: Power Check does NOT apply to D.I.S. systems.

NOTE: Some computer-controlled fuel management systems attempt to compensate for RPM loss during Power Check. You can often disable this compensating feature according to the vehicle manufacturer's instructions. However, it may be easier to run a Cylinder Efficiency / Performance test which does not trigger the computer compensation.

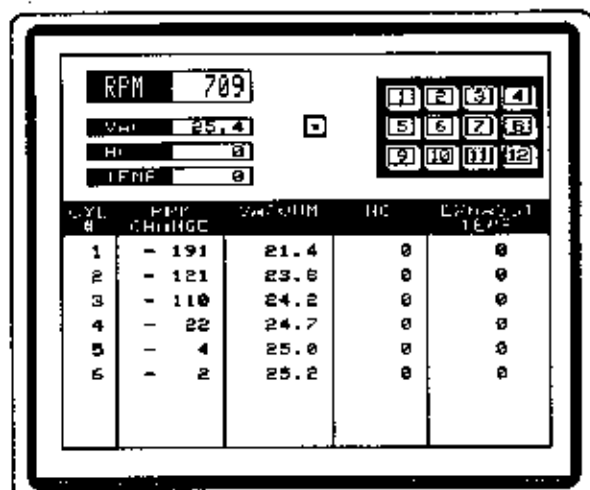


Figure 58

Leads Required:

Conventional Systems:

- Green #1 Pickup;
- White Clip;
- Yellow secondary lead;
- Blue Primary Clip;

For full screen, add:

- Vacuum Lead;
- Exhaust Gas Probe;
- Exhaust Gas Temperature Probe.

Engine speed during Power Check must be at least 900 RPM, and not over 1200 RPM. Run power check as an automatic or manual test:

Automatic Test: Press [GO] on the program (green) keypad. The analyzer will automatically disable one cylinder at a time. It makes sure each cylinder test starts from a reasonably steady engine speed and stops when RPM loss stabilizes.

Manual Test: Press a number on the number (red) keypad to "kill" that number cylinder. Press the number a second time to release the primary for normal operation. The operator can "kill" any number of cylinders this way, and restore each one by pressing the keypad number again. Press [CLEAR] to restore all cylinders to normal operation.

When finished, re-connect any components disconnected from the vehicle.

IMPORTANT NOTE: Even though the Command Bar does not appear when a pattern is displayed on the screen, the command keys listed below are active. Press:

[CONTINUE] - Continues with the next step in the sequence.

[REPEAT] - Repeats a test or procedure just performed.

[BACKUP] - Backs up to a preceding test or step.

[ABORT] - Discontinues testing and returns to the menu.

Cylinder Performance: Conventional

Leads Required:

- Green #1 Pickup;
- White Clip;
- Yellow secondary lead;
- Blue Primary Clip;

Run the engine at idle (800 - 1000 RPM). Do not exceed 1000 RPM. When RPM is stable, press [CONTINUE].

The screen displays "Cylinder Efficiency Test in Progress" (see Figure 59). Each cylinder number is highlighted as that cylinder is tested.

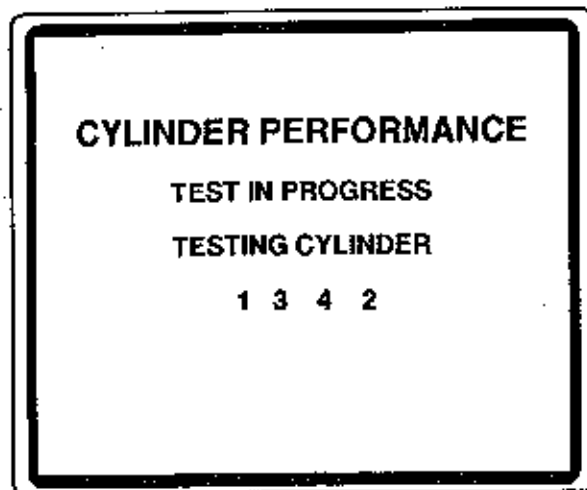


Figure 59

After the computer has looked at each cylinder, the results are displayed in the form of a bar graph (see Figure 60):

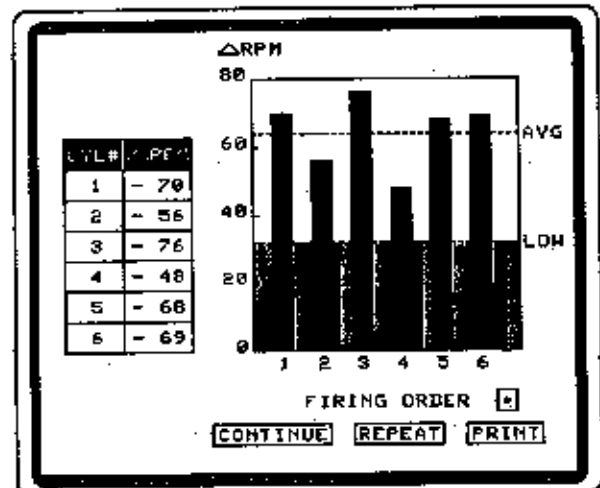


Figure 60

- The vertical bars represent the power LOST when a cylinder is "killed." The taller the bar, the greater the power loss. There is a bar for each cylinder and they are arranged in firing order.
- The "AVG" line shows the average power loss experienced during the cylinder test.
- The "LOW" line is a caution line. A vertical bar which ends below or near this line represents a weak cylinder.

Cylinder Performance: D.I.S.

Leads Required:

- D.I.S. Secondary Leads
- Green #1 Pickup;
- White Clip;
- D.I.S. Primary (if Primary Trigger is selected);

Allow engine to stabilize at idle rpm (800 - 1000 rpm), as screen prompts (see Figure 61). Do not exceed 1000 RPM. When RPM is stable, press [CONTINUE].

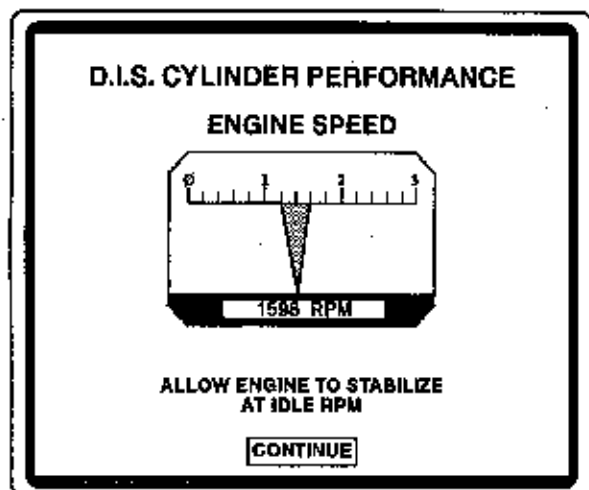


Figure 61

For GM QUAD-4 vehicles, screen prompts "STABILIZE THE ENGINE BETWEEN 1200 and 1600" (see Figure 62). A shaded background shows the range. Use a throttle adjusting tool to hold the RPM. DO NOT ATTEMPT TO HOLD IT BY HAND. RPM must be completely stable. When RPM is completely stabilized within range, press [CONTINUE].

Return QUAD-4 vehicle to idle when screen says "RETURN TO IDLE."

While test is running, the screen reads "One Moment Please" and then displays a "Calculating Cylinder Performance." message.

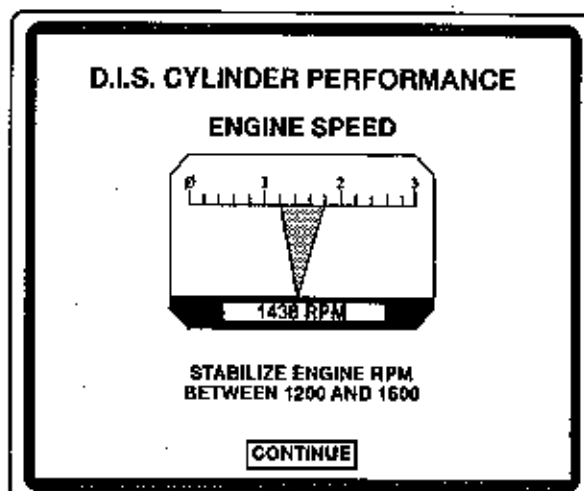


Figure 62

After the computer has looked at each cylinder, the results are displayed in the form of a bar graph (see Figure 63):

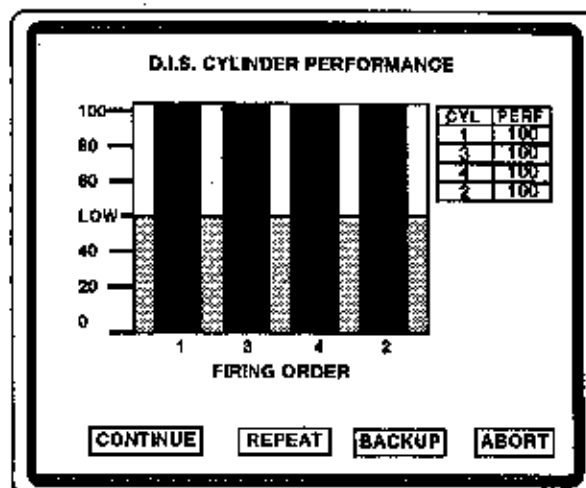


Figure 63

There is a bar for each cylinder, arranged in firing order.

The vertical bars represent the power of a cylinder. The smaller the bar, the lower the contribution of that cylinder.

The "LOW" line is a caution line, set at 50 on the performance scale. A vertical bar which ends below or near this line represents a weak cylinder.

Timing

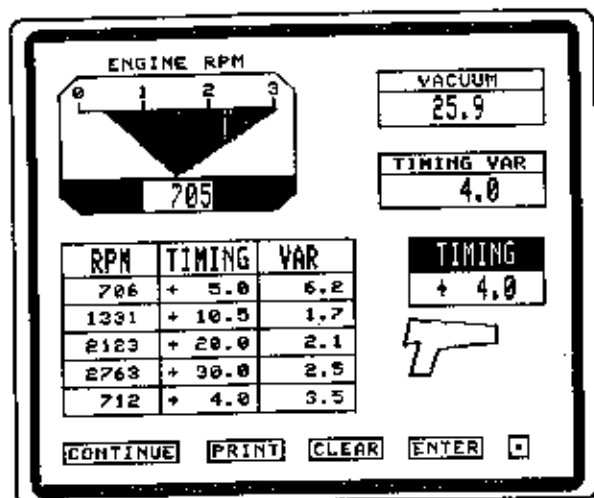


Figure 64

This test will record up to five RPM/timing/vacuum samples for use in determining distributor advance curves. If the magnetic timing probe is connected to the vehicle and the signal is good, the timing light on screen changes to a magnetic probe illustration and the analyzer uses the magnetic timing signal for timing tests.

Leads Required:

Conventional Systems:

- Green #1 Pickup;
- White Clip;
- Yellow secondary lead;
- Blue Primary Clip (when Primary Trigger is selected);
- Magnetic Timing Probe (optional - be sure to enter magnetic timing offset values through Set-Up or Specifications).

D.I.S. Systems:

- D.I.S. Secondary Leads
- Green #1 Pickup;
- White Clip;
- D.I.S. Primary Pickup;
- Magnetic Timing Probe (optional - be sure to enter magnetic timing offset values through Set-Up or Specifications).

FOR MAGNETIC TIMING, hold engine at desired RPM. When speed stabilizes, press [ENTER].

Using the timing light, hold engine at desired RPM. Press [ADVANCE] or [RETARD] on the timing light (tap for 1/2 degree—hold down for three degree changes) to bring timing pointer to zero degree mark. When the pointer is at zero, the actual timing setting of the vehicle is shown on screen (in degrees before TDC). Press [STORE] button to store the timing value along with the RPM and timing variation at the time. Repeat the procedure up to five times at different RPM. Press [CLEAR] to clear the screen and start over again.

NOTE: Some types of vacuum advance systems require supplementary vacuum from the analyzer for total advance testing. See manufacturer's recommendations.

"BUMP" button - When green #1 is connected, the timing light is synchronized off the #1 cylinder. When green #1 is not connected, press [BUMP] to change the synchronizing cylinder in order to find #1 or its companion cylinder. This feature can also be used to time vehicles (such as some GM's) which require timing to be done off of both #1 and its companion. See the manufacturer's recommendations.

TIMING VARIATION - Timing variation shows the difference in ignition timing between the earliest and latest firing cylinders. Vehicles with uneven cylinder firing (for example, some odd-fire GM V-6's) show wide variation because of engine design.

Vacuum Meter

The meter provides readings between 30 inches vacuum and 15 psi pressure (see Figure 65). A shaded background shows the range of pointer movement.

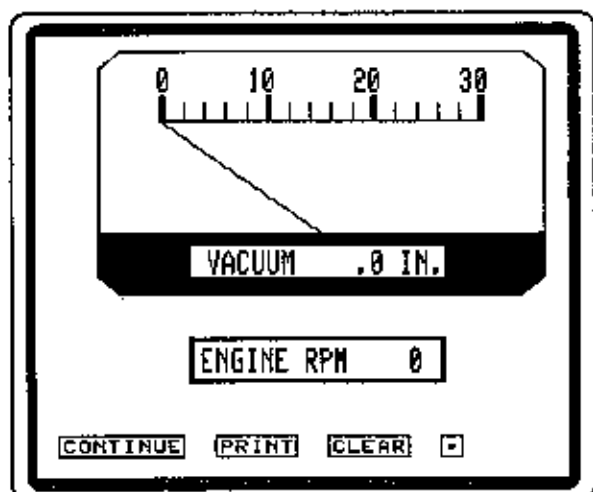


Figure 65

Leads Required:

To Test Vacuum Pressure **ONLY**:

- Vacuum Lead

For Full Screen (engine running):

Conventional Systems:

- Green #1 Pickup;
- White Clip;
- Vacuum Lead;

D.I.S. Systems:

- D.I.S. Secondary Leads
- Green #1 Pickup - **MUST** be connected to #1 cylinder;
- White Clip;
- D.I.S. Primary Pickup (if Primary Trigger is selected);
- Vacuum Lead;

Connect the vacuum lead to any air or liquid fitting on the vehicle. The meter shows readings. The label box indicates whether the reading is vacuum or pressure.

To clear shaded background, press [CLEAR] on the number (red) keypad.

Lab Scope

Lab Scope provides one of the most sophisticated means of waveform analysis found on any contemporary engine analyzer.

During this test, the analyzer will convert voltage readings from any electrical device into a waveform on the display screen. Display any electrical pattern ranging from zero to 25 volts, freeze it, and analyze it for voltage changes over millisecond time periods.

The commands and function keys work the same for all three tests.

IMPORTANT NOTE: Even though the Command Bar does not appear when a pattern is displayed on the screen, the command keys listed below are active. Press:

[CONTINUE] - Continues with the next step in the sequence.

[REPEAT] - Repeats a test or procedure just performed.

[BACKUP] - Backs up to a preceding test or step.

[ABORT] - Discontinues testing and returns to the menu.

To Synchronize the Pattern

When a pattern is not synchronized, it will often be hard to read because its position on the screen is not controlled.

To stabilize the pattern on the screen, synchronize the pattern so that it is triggered by some event, such as the beginning of an injector pulse (see Figure 66). When synchronized, the pattern begins at the left edge of the screen, where the triggering event occurs.

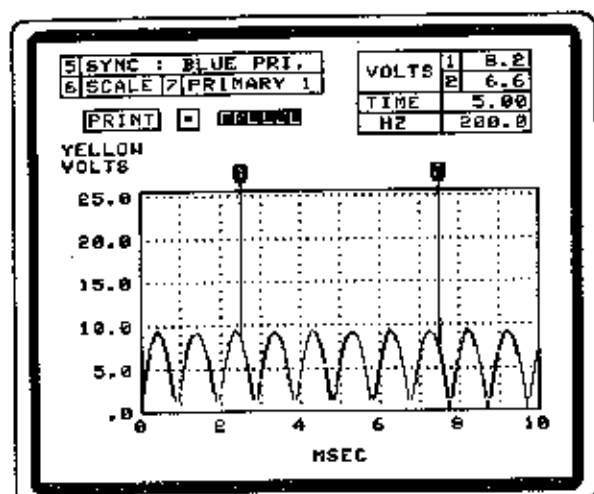


Figure 66

1. Choose a trigger:
 - Blue clip;
 - Green #1 Pickup;
 - Yellow secondary lead.
2. Connect the trigger lead to any point that will serve as a trigger. The trigger lead can even be connected to the same point as the yellow lead.

3. Press [3] to set the sync status. Keep pressing [3] to toggle through these four selections:

- "NO SYNC" - Pattern will not be synced.
- "BLUE PRI." The pattern will be synchronized to a trigger from the blue primary lead. When "Blue Pri." is set as the trigger, an additional option appears on screen: Press [5] to toggle between "primary 1" and "primary 2".
- "GREEN #1" - Trigger will be taken at green #1 pickup.
- "SECONDARY" - Trigger taken at yellow secondary lead.

The pattern will synchronize on the screen when a good signal is received from the selected trigger lead.

Format Controls

To change "VOLTAGE" scale, press [3] (red keypad). The available ranges:

- 0 - 25
- 0 - 12.5
- 0 - 6.2
- 0 - 3.1

To change "TIME" scale, press "RIGHT" and "LEFT" arrow keys (yellow keypad). The range can be expanded from 5 to 500 msec (milliseconds).

Continued...

Service Tests

Lab Scope (continued)

"Freeze" and "Flags"

Use the "FREEZE" key and on-screen FLAGS to examine a pattern as follows:

FREEZE: The yellow lead voltage signal is drawn on the time/voltage scale. To stop and hold the signal for detailed analysis, press [FREEZE] on the waveform keypad. This stops the waveform on the display and causes the #1 and #2 flags to appear at the top of the time and voltage scale. To display a new waveform sample, press [GO] on the waveform keypad.

FLAGS: Move the flags to measure the time between any two events (or points of interest) on the waveform. Press [1] (red keypad) to control the #1 flag with the right/left arrows on the waveform keypad. Press [2] to control the #2 flag with the same arrow keys. The distance between the two flags represents time, and is shown in the lower right box above the time voltage scale (see Figure 67). The voltages at flags 1 and 2 are shown in the boxes above that.

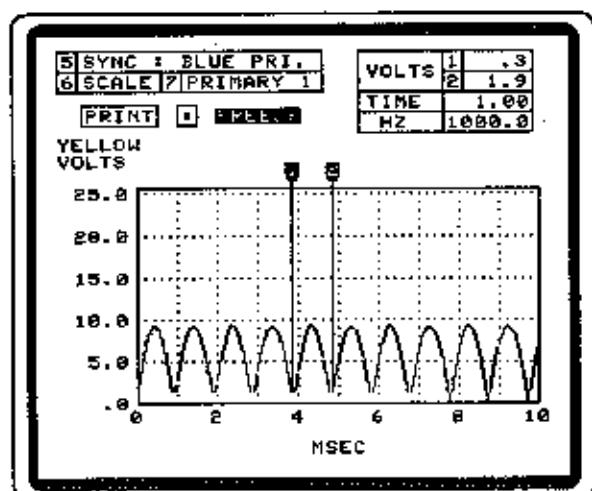


Figure 67

Single Trace

Leads Required:

- White Clip - MUST be connected to a good ground;
- Yellow Primary Clip - Connect to circuit being studied;

To Synchronize the Pattern

Use one of three leads to synchronize the pattern:

- Green #1 Pickup;
- Blue Primary Clip;
- Yellow secondary lead

1. From the Service Tests Menu, select Item 12, "LAB SCOPE."
2. The "Lab Scope" menu will appear (see Figure 68). Press [1] to select "SINGLE TRACE."

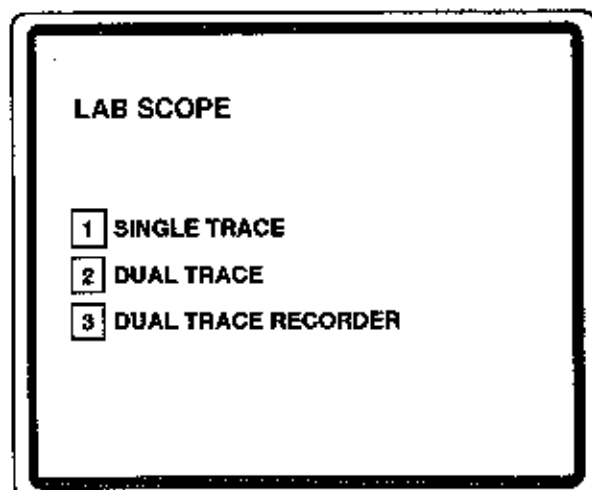


Figure 68

3. Connect white clip to ground.
4. Connect yellow primary clip to the circuit being studied.

5. A pattern appears on screen when the yellow clip is connected to a circuit in which the voltage is changing (see Figure 69).

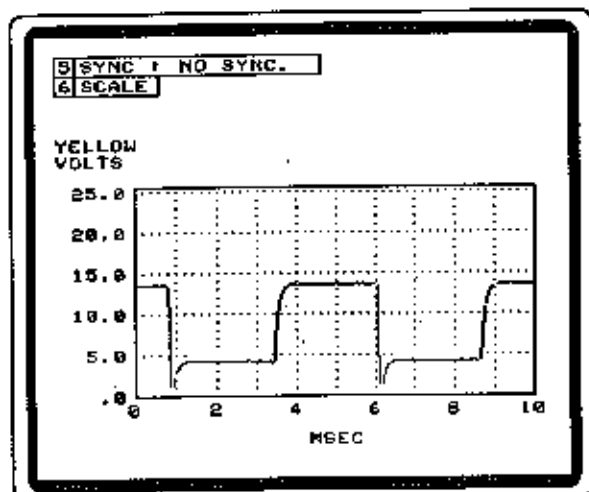


Figure 69

6. If the pattern is unstable, change the trigger (see "Synchronize Pattern" section).
7. Change the format or freeze the pattern as needed. Refer to "Change Format" and "Freeze and Flags" sections (see Figure 70).

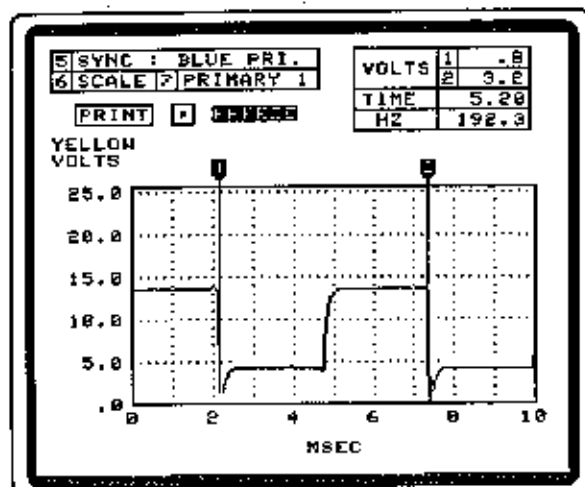


Figure 70

8. Whenever the dot appears on the display screen press [.] on the number (red) keypad to print a copy of the screen.

Dual Trace

Use the Dual Trace function to compare the patterns from two different components. For example, use the dual trace function to call up the patterns for the MAP sensor and an injector. If you know what their respective patterns should look like, you can compare the two to see whether or not the injector is firing at the wrong time because it is receiving a bad signal from the MAP sensor.

Leads Required:

- White Clip - MUST be connected to a good ground;
- Yellow Pickup - Connect to circuit being studied;

Use one of three leads to synchronize the pattern:

- Green #1 Pickup;
- Blue Primary Clip;
- Yellow secondary lead

1. From the Service Tests Menu, select Item 12, "LAB SCOPE."
2. The "Lab Scope" menu will appear (see Figure 68). Press [2] to select "DUAL TRACE."
3. Connect white clip to ground.
4. Connect yellow primary clip to one circuit to be studied. Connect the blue clip to the other circuit to be studied.

Continued ...

Service Tests

Dual Trace (continued)

5. Two patterns will appear on screen when the yellow and blue clips are connected to different circuits in which the voltage is changing (see Figure 71).

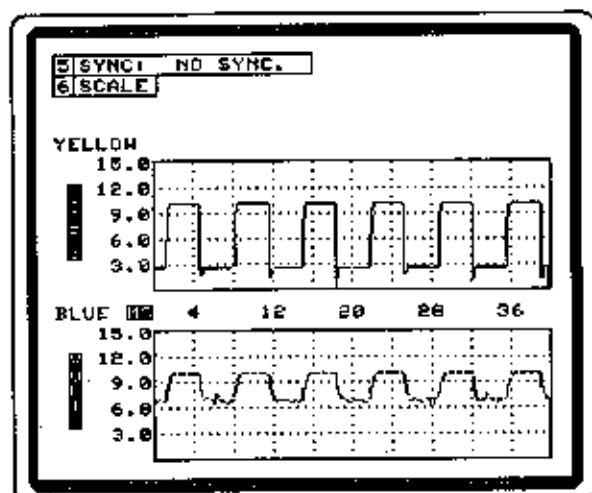


Figure 71

7. Change the format or freeze the pattern as needed. Refer to "Change Format" and "Freeze and Flags" sections (see Figure 72).

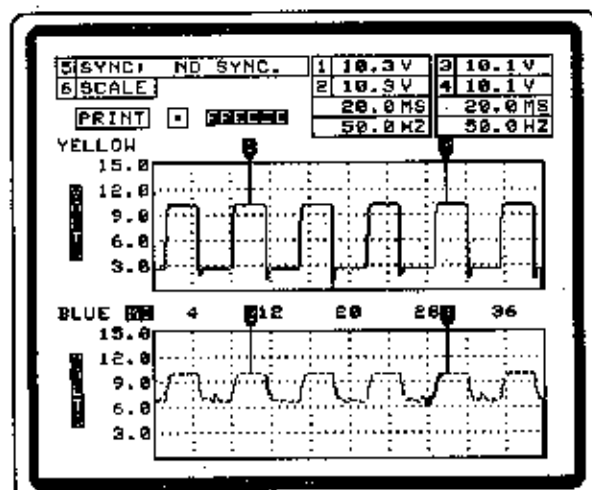


Figure 72

6. If the pattern is unstable, change the trigger (see "Synchronize Pattern" section).

8. Whenever the dot appears on the display screen press [.] on the number (red) keypad to print a copy of the screen.

Chart Recorder

The dual chart recorder allows the operator to record the patterns over an extended period of time, to allow discovery of intermittent faults.

1. From the Service Tests Menu, select Item 12, "LAB SCOPE."
2. The "Lab Scope" menu will appear. Press [3] to select "DUAL TRACE RECORDER" (see Figure 68).
3. Connect white clip to ground.
4. Connect yellow primary clip and blue clip to the circuit being studied.
5. Two patterns appear on screen when the yellow and blue clips are connected to circuits in which the voltage is changing (see Figure 73).

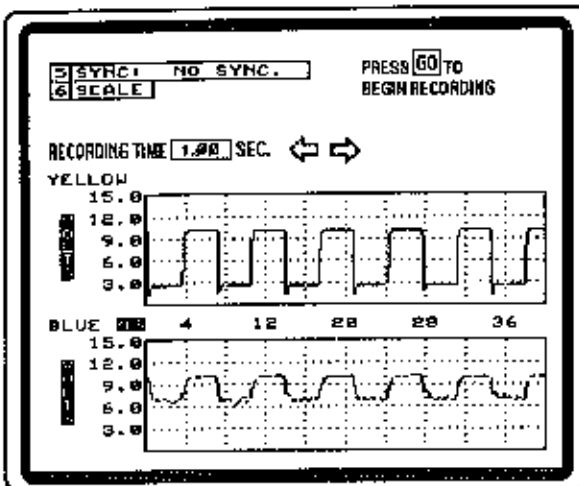


Figure 73

6. If the pattern is unstable, change the trigger (see "Synchronize Pattern" section).
7. To change "TIME" scale, press "RIGHT" and "LEFT" arrow keys (yellow keypad). The range can be expanded from 1 to 25 seconds.
8. Follow the screen prompt and press [GO] to begin recording. The analyzer displays a message indicating that it is recording as it records patterns at the range selected (see Figure 74). The analyzer records 25 frames.

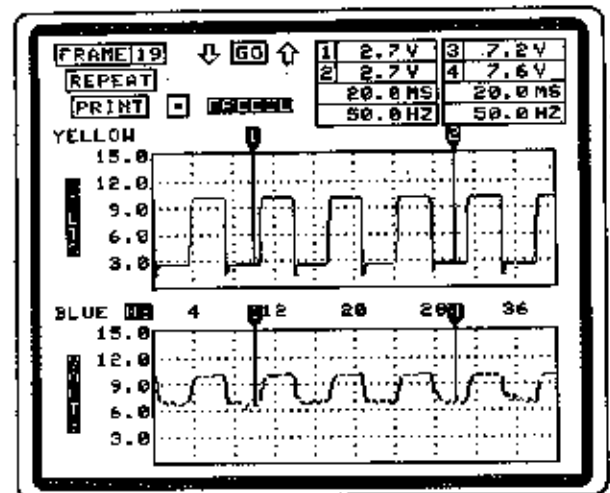


Figure 74

9. The analyzer will then play back the recording, one frame at a time. To slow the change rate, press [DELAY]. The analyzer will then add one-half second to the time each frame is displayed on the screen.

Rough Idle

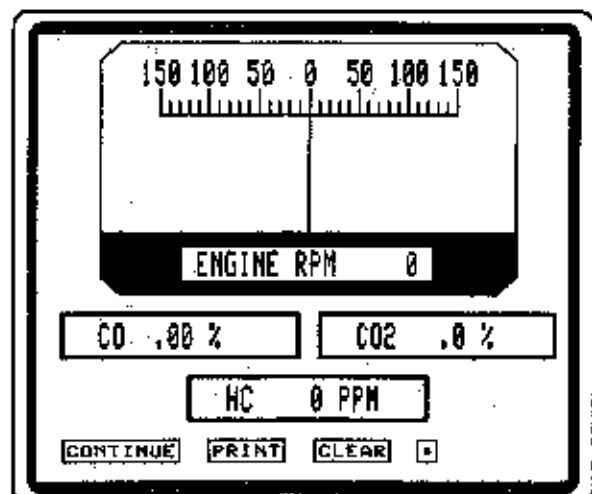


Figure 75

The Rough Idle meter shows RPM variation and emissions variations at idle. This meter is ideal for procedures such as fuel mixture adjustment or propane enrichment tests, where detailed RPM changes must be studied.

Leads Required:

Conventional Systems:

- Green #1 Pickup;
- White Clip;
- Exhaust Gas Probe.

D.I.S. Systems:

- D.I.S. Secondary Leads
- Green #1 Pickup;
- White Clip;
- D.I.S. Primary Pickup (When Primary trigger is selected);
- Exhaust Gas Probe

NOTE: Check status of gas analyzer before using this screen. Gas analyzer advisory messages, such as "Low Flow," "No Gas," "Out of Calibration," WILL NOT appear on this screen.

The engine speed when the test is selected becomes the "zero" point on the meter. Changes in the engine speed show as an RPM increase or decrease from meter zero. A shaded background shows the range of pointer movement.

To select a new RPM starting point (meter zero), or to clear the shaded background, press [CLEAR] on the number (red) keypad.

Tach/Dwell

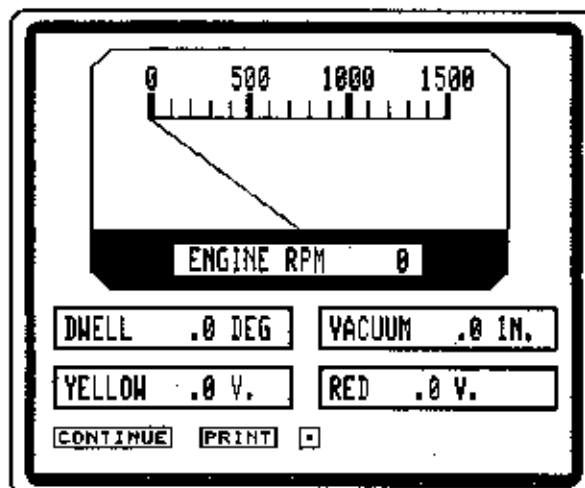


Figure 76

Tach/Dwell does not apply to D.I.S. systems.

Leads Required:

For Dwell and Auto-Range Tach Only:

- Green #1 Pickup;
- White Clip;
- Yellow Secondary Lead
- Blue Primary Clip

For complete Screen:

- Vacuum Lead;
- Yellow Engine Temperature Probe
- Magnetic Timing Probe

This tachometer has a multi-range meter, capable of reading up to 30,000 RPM.

Acceleration Test

The Acceleration Test plots engine RPM (and engine vacuum, if desired) over time. The expanded printout shows individual cylinder firings in the plot, so individual cylinder performance can be seen.

The test can be run two ways:

- (1) with a snap throttle acceleration,
- (2) at idle (or at cruise or any other set RPM)

IMPORTANT NOTE: To prevent false indications at the beginning of the plot, DO NOT run this test until the RPM reading has stabilized. If running the "Snap Throttle" version, make sure the throttle snap is clean and quick. If it's not, false indications will appear in the middle of the plot.

Leads Required:

Conventional Systems:

- Green #1 Pickup;
- White Clip;
- Yellow Pickup (standard trigger);
- Vacuum Lead:

D.I.S. Systems:

- D.I.S. Secondary Leads
- Green #1 Pickup;
- White Clip;
- Yellow Secondary Lead;
- Vacuum Lead

Follow the screen prompts and push [GO] on the waveform (yellow) keypad. Screen prompts, "ACCELERATE ENGINE WITHIN 5 SECONDS" (see Figure 77). Snap the throttle to get an acceleration plot.

When the acceleration test is complete, screen offers three selections (see Figure 78):

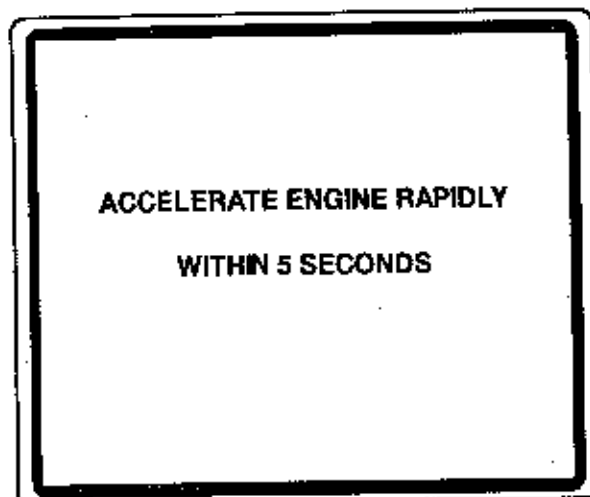


Figure 77

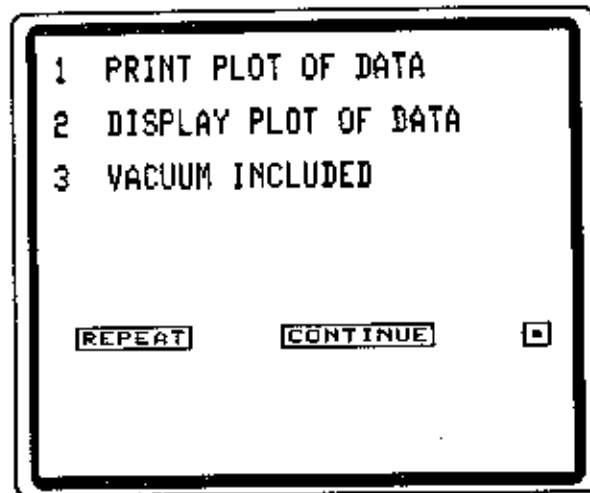


Figure 78

"1 PRINT PLOT OF DATA" - Print an expanded plot of data (see next page for details).

"2 DISPLAY PLOT OF DATA" - Display a plot of test results data on screen. The screen plot is not as detailed as the printed plot. From this screen press [3] to include vacuum data; then [2] to update the screen. Press [1] to print an expanded plot. Press [-] to print a copy of the screen. (If there was no acceleration, you cannot display plot of data on screen.)

"3 VACUUM INCLUDED" - To include vacuum data in graph, press [3] before displaying data on screen or printing. Press [3] again to remove vacuum data.

Interpreting the Printout

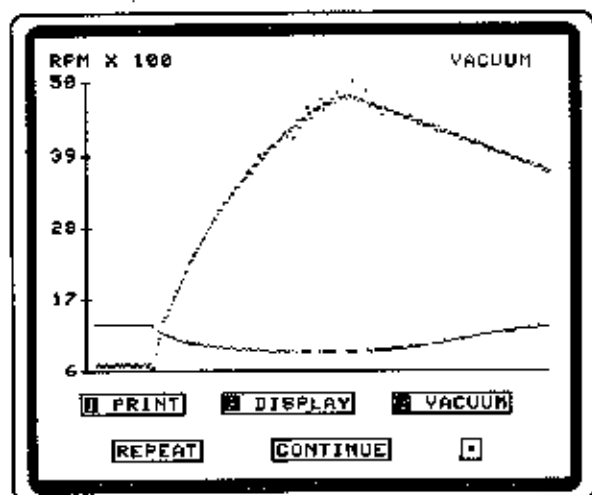


Figure 79

The expanded printout is made up of short vertical lines followed by stars. The vertical lines represent #1 cylinder firings. The stars are the other cylinders, in the order of firing. In general, severe variations or RPM drops between cylinders indicate problems in engine performance.

To pinpoint a weak cylinder, find the cylinder that appears low on the plot. Because of engine dynamics, the weak cylinder is usually the one just BEFORE the low cylinder. (If the engine is accelerated during the test and the engine is a large V-8 engine, the weak cylinder is usually 2, in rare cases 3 cylinders before.)

In the "Idle Plot" on this page, count up from #1 (the vertical line) to see that the low cylinder on the plot is #6 (see Figure 80). Since the test was run at idle, it is certain the weak cylinder is the one just before the low cylinder on the plot. Circle the fifth cylinder in the firing order. This is the weak cylinder.

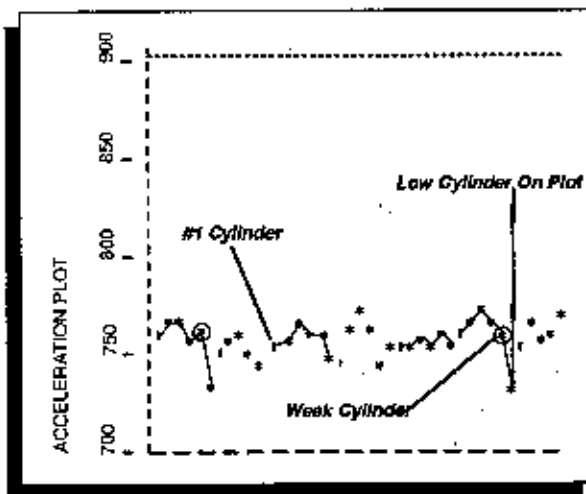


Figure 80

The acceleration plot shown in Figure 81 illustrates a "good" acceleration pattern. All of the cylinder firings are within 50 RPM of each other, with only minor variations.

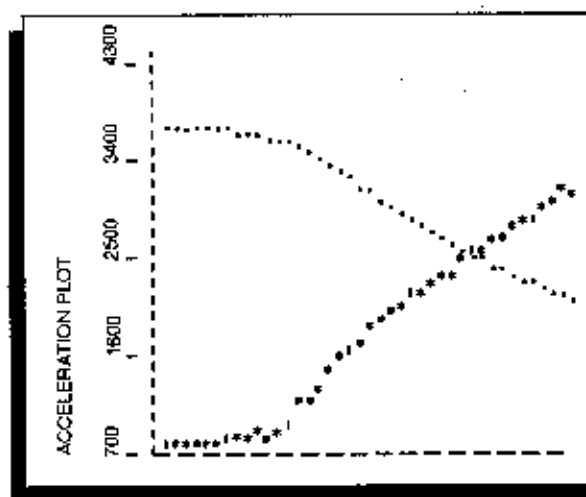


Figure 81

Module Test

The Module Test does NOT apply to D.I.S. systems.

The Module Test checks the distributor pickup coil under cranking conditions and tests the electronic ignition module and ignition coil without running the engine. These tests are useful for no-start or intermittent ignition problems and are available for:

1. General Electronic systems: GM H.E.I., Ford, Hitachi and similar magnetically triggered systems.
 2. Hall Effect triggered systems: Chrysler and similar systems.
 3. Prestolite and similar proximity switch triggered systems: International Harvester, some AMCs, Lucas and others.
 4. Others: When working on a vehicle with an unfamiliar system, try any of the three test types shown above.
- To avoid blowing the fuse in the yellow accessory test lead, make sure clips do not touch each other or vehicle ground.
 - To avoid unnecessary service operations, be sure to test the fuse in the yellow accessory test lead before replacing any vehicle part suspected of failure.
 - To avoid unnecessary service operations, confirm the diagnosis of any suspected part, according to manufacturer's recommendations, before installing a replacement module or pickup coil.
 - To avoid damage to the vehicle ignition system, be certain that the accessory test lead clips are connected only to the vehicle leads between distributor pickup coil and the module.
 - Disconnect electronic fuel injection systems to prevent possibility of seriously over-fueling the engine while testing pickup coil or module.

CAUTION:

- To prevent overheating ignition coil, causing violent rupture, place the vehicle ignition switch in the "OFF" position when not performing module tests.
- To avoid personal injury, keep arms and hands away from fan and belts during module testing. If fuel is present in cylinders, the ignition system could fire a cylinder, causing the crankshaft to turn.
- To avoid personal injury and damage to parts, make sure leads and clips are arranged so they do not interfere with rotating distributor parts.

Continued ...

Module Test Hook-Up

NOTE: Do not open any electrical connectors or disconnect any electrical wiring on the vehicle unless required by the following instructions. In order to connect to a wire you may have to insert a spade at a connector and clip a lead to the spade (spade not included with analyzer).

Hookup for General Electronic and Hall Type systems:

Leads Required:

- White Clip;
- Yellow Secondary Lead;
- Blue Primary Clip;
- Yellow accessory test lead;
- Red Clip

1. Connect the yellow accessory test lead to the positive (+) lead of the vehicle pick-up coil. Some examples of connection sites are:

H.E.I. - Yellow accessory test lead connects to the green wire of the pickup (distributor cap removed and spark gap device placed between cap center button and ground). Read CAUTION warnings under Module Test.

FORD - Yellow accessory test lead connects to the red wire of the pickup.

HALL EFFECT - Yellow accessory test lead clip connects to the grey wire of the pickup.

CHRYSLER - Yellow accessory test lead connects to the black wire of the pickup.

Hookup for Prestolite and similar proximity-switch triggered systems such as International Harvester, some AMCs, Lucas, and others:

Leads Required:

- White Clip;
- Yellow Secondary Lead;
- Blue Primary Clip;
- Red Clip;
- Yellow and Black Accessory Lead.

PICKUP COIL connections for Prestolite type:

Connect yellow accessory lead to one pickup coil wire near the distributor, and the black lead to the other pickup wire.

MODULE connections for Prestolite type:

Disconnect the distributor pickup from the ignition control module. Connect the accessory yellow and black leads to the control module connector in place of the pickup leads.

Test Procedure for Pickup Coil

1. Connect test leads (according to Module Test Leads Hookup). Select the vehicle system you are testing (see Figure 82).

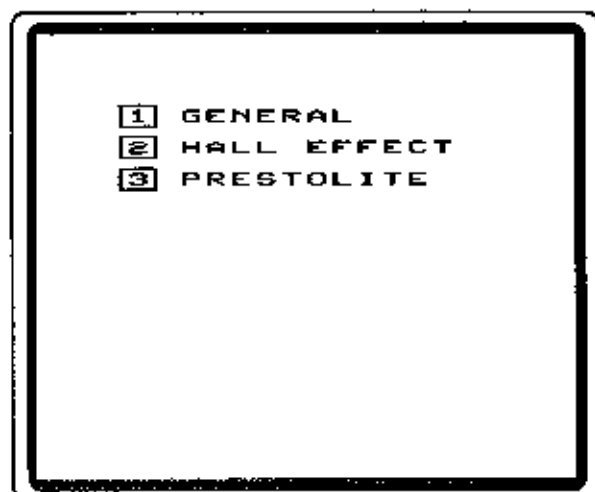


Figure 82

2. Press [1] to select "PICKUP." Crank the engine using the ignition key.
3. Observe pattern on screen (see Figure 83). In general, any pattern other than a straight line shows an output from the pickup coil. If there is no output signal, the test indicates that the pickup coil is bad. Before replacing module, make sure the yellow accessory lead fuse is good. VERIFY diagnosis, as recommended by manufacturer, before replacing the coil.

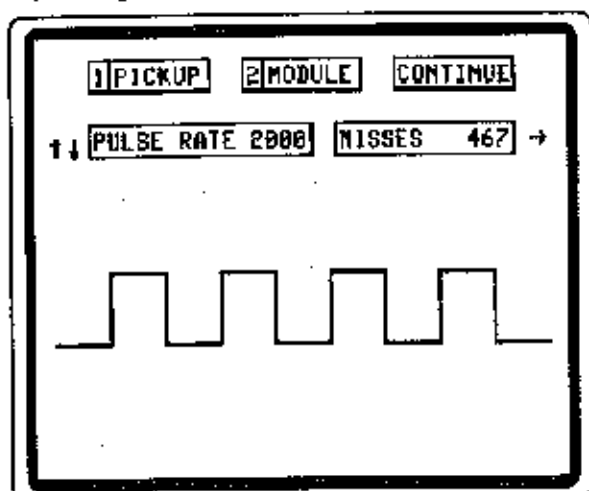


Figure 83

NOTE: Shut ignition "OFF" as soon as testing is complete.

Test Procedure for Module

1. In order to accurately test an ignition module, disable the timing signal from the vehicle's central computer. There are a number of different ways to do this. On most GM vehicles, for example, open up the EST connector. On other vehicles, it is easier to put the central computer into a "limp-in" mode. The important thing to realize is that the timing signal from the central computer must be shut off. Otherwise, that signal will confuse the test pulsing and will provide incorrect results.

Disable the central computer's timing signal according to manufacturer's recommendations.

2. Test the voltage input to the ignition system. Select "MULTI-METER" from Service Tests Menu. Using the "search volts" leads, place one search volts lead to ground, the other to the module battery terminal. When the ignition switch is "ON," system voltage should be present. Make sure the module is properly grounded.

The module test will not run if there is low or no voltage at the module, or if the module is not properly grounded. Use "search volts" to find and repair the problem. Then continue with the module test.

Continued ...

Service Tests

Module Test Procedure (continued)

3. Connect test leads (see Module Test Leads Hookup). Select the vehicle system being tested (see Figure 84).

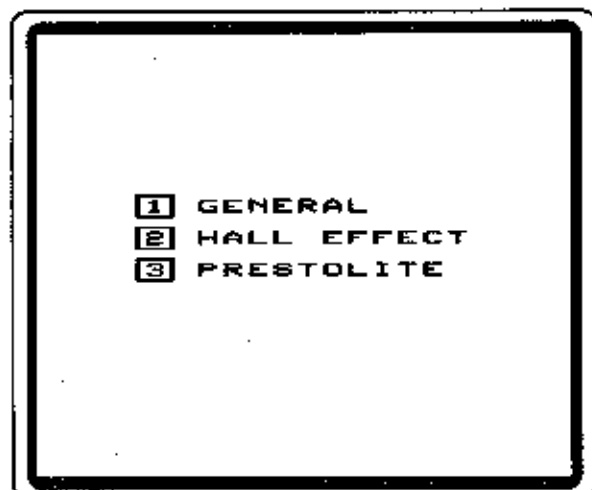


Figure 84

4. Turn on the ignition switch. The analyzer will start pulsing the module as soon as the Module Test is selected. The difference between the number of pulses sent to the module and the number of firings detected by the blue (primary) clip is called "MISSES," and appears on the screen to show how often the module failed to energize the coil primary. If vehicle ignition is turned "ON" after selecting the Module Test, the "MISSES" message will be displayed until the module receives battery power. Press the right horizontal arrow key to reset "MISSES" to zero.
5. Observe the pattern on screen (see Figure 85). The speed that the module is being triggered is displayed as the pulse rate.

If no pattern appears, this test indicates that the module is bad. Before replacing module, make sure the yellow accessory lead fuse is good. VERIFY diagnosis, as recommended by manufacturer, before replacing the coil.

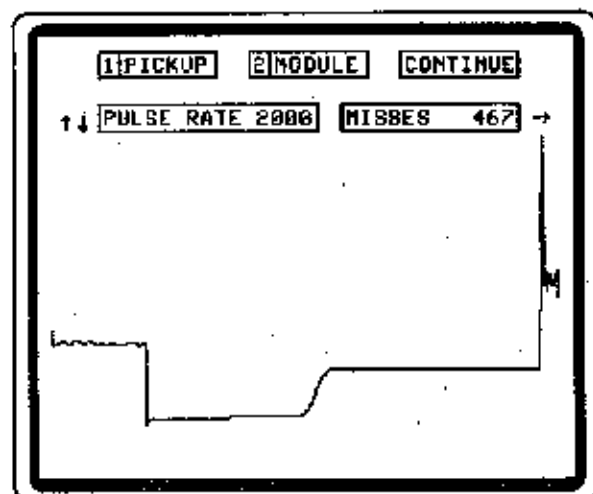


Figure 85

Change the pulse rate (faster or slower) by pressing the up/down ARROW keys on the program keypad.

Primary and secondary sequential patterns can be selected on the waveform (yellow) keypad. The patterns may be used for diagnostics. They may appear somewhat smaller than normal, as a result of the spark gap setting during this test and should not affect diagnostics.

NOTE: If the pattern is shifted from the normal position on the screen, press the right horizontal arrow key until the pattern appears in the normal position. This will also re-set "misses" to zero.

Turn ignition key "OFF" as soon as testing is complete.

Charging Test

The Charging Test examines the performance of the charging system while under load. Engine speed should be at least 1800 RPM.

The analyzer automatically applies a load, gets the information for the diode pattern, and displays the pattern (see Figure 86).

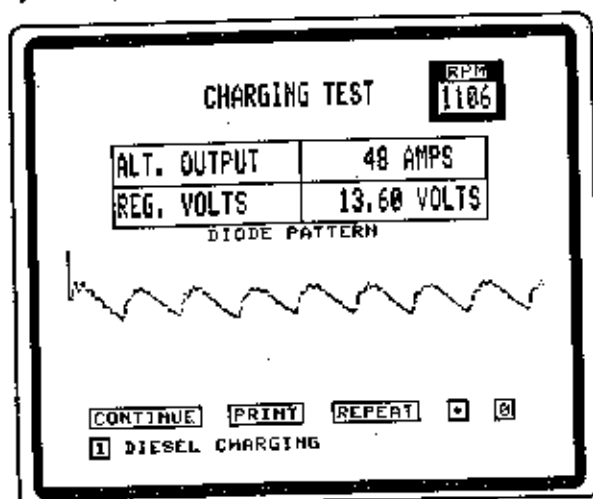


Figure 86

Explanation of Diesel Charging Test

For Diesels, press [1] to switch to Diesel Charging Test. The difference is that the diesel test gets RPM readings from magnetic timing probe; the conventional charging test gets RPM from green #1 lead.

Leads Required:

Conventional Systems:

- Green #1 Pickup (for RPM readings when testing conventional systems);
- White Clip;
- Red Clip;
- Battery Clamps (check positive and negative polarities);
- Magnetic Timing Probe (for RPM readings when testing diesel charging systems).

Triggers: All.

Alternator Output and Regulator Voltage

The alternator output and regulator voltage are continuous readings. The diode pattern and peak output current can be updated by pressing [REPEAT].

NOTE: Each time [REPEAT] is pressed, the analyzer loads the charging system to obtain maximum alternator output and produce the alternator diode pattern.

Diode Pattern

Compare the typically good pattern shown in Figure 86 with the typically bad patterns shown in Figure 87.

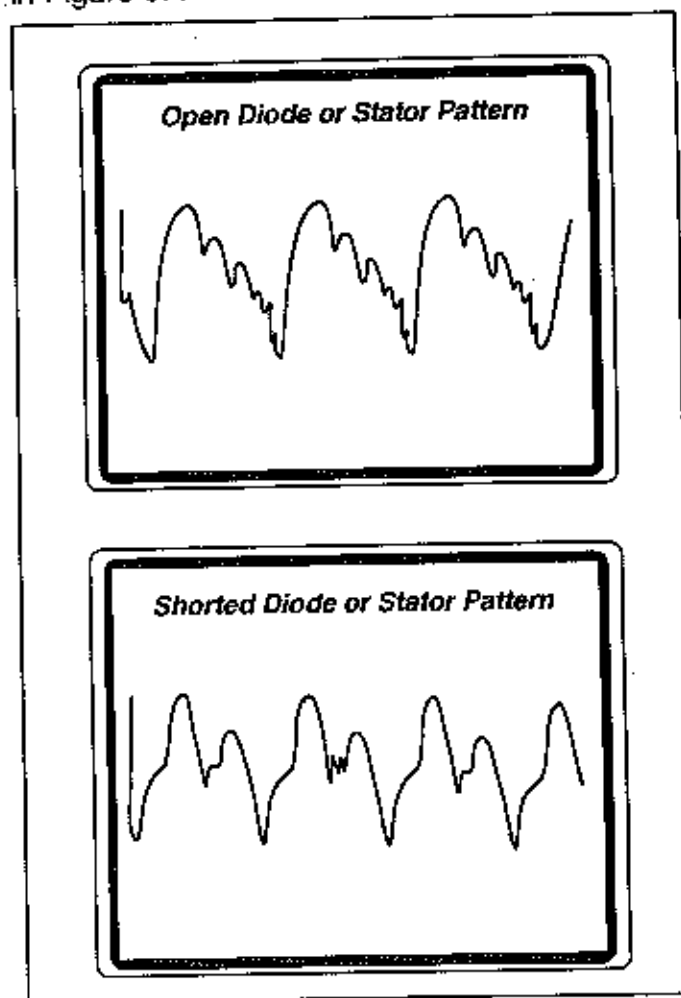


Figure 87

Battery Test

This is a series of tests to check battery performance. If battery CCA is entered through "Specifications" (from disk), diagnostic messages can be displayed or printed at the end of the test. If CCA is not entered, the battery test ends with the report screen.

WARNING: Observe the battery safety precautions listed under SAFETY in the Introduction Section of this manual.

Leads Required:

- Battery clamps
- Gray amps probe.

Test Set-Up

1. Select battery test from Service Tests menu.
2. The Battery Test Set-Up screen appears (see Figure 88). The analyzer checks battery clamp connections, zeros the current probe, and shows vehicle's battery drain.

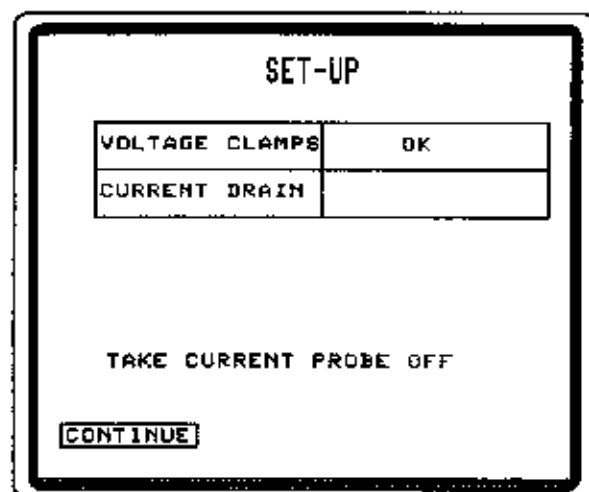


Figure 88

3. Connect battery clamps to vehicle's battery terminals.

If clamps are not connected, the screen message "CONNECT VOLTAGE CLAMPS" appears. If the clamp polarity is reversed, the screen reads "VOLTAGE CLAMPS REVERSED." Connect the clamps properly and press [REPEAT].

4. Remove the grey-amps probe from any conductor and close the clamp completely. Before pressing [CONTINUE], be sure your finger is not in the clamp, the clamp is completely closed and is not around any conductor, and you are NOT swinging the clamp.
5. Re-connect the clamp around either the positive or negative battery cable. Make sure it is around ALL conductors, big and little, attached to that battery post.
6. Make sure all vehicle accessories are "OFF," including door lights, glove-box light, hood light, etc. Press [CONTINUE]. The vehicle's battery drain is shown in the "Current Drain" box on the display screen. With all accessories "OFF," battery drain should be near zero. A drain of less than 1 amp is acceptable.
7. Press [CONTINUE] to begin the actual battery test.

Test Procedure

The analyzer measures the battery open circuit voltage. The computer makes decisions based on this voltage reading (see Figure 89):

DECISION ONE: If voltage reading is too low for complete testing, the analyzer will:

1. Display voltage,
2. Check and prompt action to determine whether the battery is available for further service.

DECISION TWO: If voltage is good for test, the analyzer will:

1. Apply load to battery for ten seconds (remove surface charge) (see Figure 90);
2. Read and save voltage reading after battery stabilization.
3. Apply load to battery for another fifteen seconds. Display screen shows "Test In Progress" message (see Figure 91).
4. Read and save load voltage as load test ends.
5. Read and save voltage reading after 5-second battery stabilization time.

BATTERY TEST

| | |
|-----------------|---------------|
| OPEN CKT. VOLTS | 12.26 VOLTS |
| LOAD VOLTS | 11.02 VOLTS |
| AVAILABLE CCA | 813 |
| BATTERY TEMP. | + 93.2 DEG. F |

BATTERY GOOD BUT LOW IN CHARGE

CONTINUE PRINT REPEAT □

Figure 89

BATTERY TEST

| |
|-----------------|
| OPEN CKT. VOLTS |
| LOAD VOLTS |
| AVAILABLE CCA |
| BATTERY TEMP. |

CAUTION: BATTERY UNDER LOAD
10 SEC.

Figure 90

BATTERY TEST

| |
|-----------------|
| OPEN CKT. VOLTS |
| LOAD VOLTS |
| AVAILABLE CCA |
| BATTERY TEMP. |

TEST IN PROGRESS

Figure 91

Continued ...

Service Tests

Battery Test (continued)

This last voltage reading may not be taken, depending on the level of the battery surface charge at the start of the second load so this 5-second wait may not occur at every test.

"OPEN CKT. (circuit) VOLTS" and "LOAD VOLTS" are shown along with a "WAITING FOR STABLE BATTERY CONDITION" message. The computer is waiting for the battery voltage to return to a normal "at rest" value.

When the battery has stabilized after the load test it is given an internal resistance test and temperature measurement. Available Cold Cranking Amps is calculated from all the values found in the battery test and presented on the display.

Diagnosis

The analyzer will calculate the battery capability using the information from the tests and the CCA value stored in memory. The correct CCA value is important for accurate diagnosis.

1. If battery marking agrees with rated CCA shown on the line under the report box (see Figure 92), press [CONTINUE] twice.

BATTERY TEST

| | |
|-----------------|-------------|
| OPEN CKT. VOLTS | 12.44 VOLTS |
| LOAD VOLTS | 10.23 VOLTS |
| AVAILABLE CCA | 221 |
| BATTERY TEMP. | +71.9 DEG.F |

RATED CCA = 0
1 CHANGE RATED CCA

[CONTINUE]

Figure 92

2. Battery marking does NOT agree with rated CCA on display, press [1] on the keypad, enter the actual battery rating, then press [CONTINUE] (see Figure 93).

BATTERY TEST

| | |
|-----------------|-------------|
| OPEN CKT. VOLTS | 12.44 VOLTS |
| LOAD VOLTS | 10.23 VOLTS |
| AVAILABLE CCA | 221 |
| BATTERY TEMP. | +71.9 DEG.F |

RATED CCA = 200 ENTER
1 CHANGE RATED CCA

[CONTINUE]

Figure 93

3. In some cases the analyzer will need to know if the battery has been charged. Answer YES or NO as appropriate when this screen appears.

NOTE: The test is complete when all four items are filled in on the display and the program control prompts appear (see Figure 94).

BATTERY TEST

| | |
|-----------------|--------------|
| OPEN CKT. VOLTS | .04 VOLTS |
| LOAD VOLTS | .00 VOLTS |
| AVAILABLE CCA | 0 |
| BATTERY TEMP. | + 91.0 DEG.F |

REPLACE BATTERY

[CONTINUE] [PRINT] [REPEAT] []

Figure 94

New Battery Testing

Testing newly-made or shelf-stock batteries may show test CCA readings below the rating of the battery. These lower ratings are sometimes found on batteries that have not been in vehicle service and result from normal manufacture and storage of new batteries. New "off-the-shelf" batteries which do not meet or exceed their CCA ratings must be discharged and charge cycled, preferably in an automotive vehicle, before diagnostic testing.

Multi-Meter

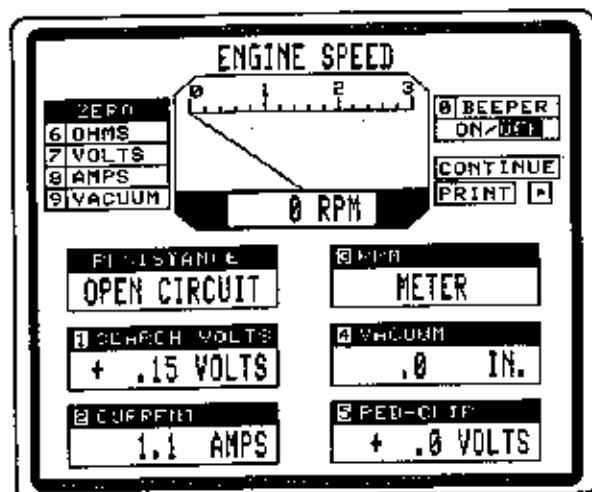


Figure 95

Readings

The Multi-meter screen shows the following electrical readings:

- Search Ohms (resistance) using red and black ohmmeter probes.
- Search Volts using volts accessory red probe and black clip.
- Current (amperes) using grey amps probe.
- Engine RPM using green #1 tachometer probe.
- Pressure using vacuum/pressure sensor.
- Red clip volts using boom red clip lead and white ground clamps.

Control of the Meter Display

To display a reading in the center meter, press the number in the reading box. For example, press [1] to show search volts in the meter; [2] to show current in the meter, etc.

Continuity Beeper

Press [0] to toggle the ohms continuity beeper "ON" or "OFF."

"Zero" the Leads (Refer to Figure 95)

1. Hold the desired lead away from any electrical or magnetic field. In the case of the amp probe, leave the clamp shut.
2. The box in the upper left-hand corner of the display screen lists all leads. Each lead has a number assigned to it. Enter the number of the desired lead on the red keypad to zero that lead. (Example: Press [8] to zero the amps probe.)

NOTE: It is good practice to perform a full Calibration using "Utilities" regularly.

Continued ...

Automatic Testing

The Automatic Testing function offers the following features:

Comprehensive - This automatic sequence of system tests provides diagnostics at the end, along with report printouts (on optional printer). The "DIS Comprehensive" is for D.I.S. vehicles.

Custom Tests - This feature allows the operator to easily program and run custom service test sequences.

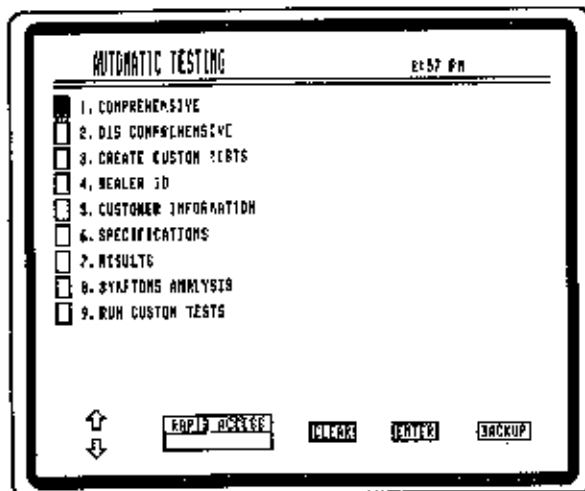
Dealer I.D. - Enter the station name, address, and a promotional message. This information is automatically printed out at the top of reports. Dealer I.D. information is retained even after power is shut "OFF."

Customer I.D. - Enter customer information for printing on reports. This information is not saved after power is shut "OFF."

Specifications - Reads vehicle specs into computer memory from disk. The computer uses these specifications during testing for diagnosis.

Results - This selection provides a menu of printed technical and customer report options. (This menu appears automatically at the end of Comprehensive test.) The Results section also lists diagnostics messages in alphabetical order, with expanded explanations for each message.

Symptoms Analysis - The operator enters information about symptoms and this program narrows down the possible causes. The program can be run alone or as a follow-up to "Comprehensive" testing.



Comprehensive

Introduction

The Comprehensive test is an automatic sequence of system tests, designed to provide an overall look at vehicle performance.

During testing, the computer collects and stores diagnostic information. At the end of testing, this information is provided in complete customer and technical reports. The reports show vehicle performance data compared to specifications. They include diagnostic messages, which point out problem areas and discuss possible causes.

See the "Results" section for alphabetical listing of diagnostic messages along with some additional explanations.

The Comprehensive test sequence is arranged so that:

- The analyzer provides a clear overall look at performance while vehicle systems are operating;
- Very little manipulation of the vehicle is required;
- Testing of all performance-related systems on the vehicle takes a minimum of time;
- The analyzer provides a Comprehensive report of test results, including diagnostic messages, on the screen display or from the optional printer.

To check specific systems further after Comprehensive testing is completed, select the appropriate test from the Service Tests menu. See the "Service Tests" section.

D.I.S. Testing

There are two Comprehensive selections on the Automatic Testing menu:

- [1] **COMPREHENSIVE** - This is the conventional comprehensive test, for vehicles with conventional ignition systems — that is, any ignition systems that have a distributor.
- [2] **D.I.S. COMPREHENSIVE** - The comprehensive test for vehicles with Direct Ignition System (D.I.S.; sometimes referred to as "Distributor-less Ignition System"). D.I.S. is any type of ignition system that sends voltage directly from coil unit(s) to spark plugs without using a distributor.

The procedure for both Comprehensive tests is almost the same. Any differences are noted at the appropriate places in these operating instructions. The test title will always indicate if a procedure applies only to D.I.S. or Conventional systems. (For example, "Cranking Tests - D.I.S.").

Some conventional Results data is not relevant to D.I.S. systems. "If the message "N/U" appears on technical reports and screen displays, that information is Not Used in diagnosing D.I.S. systems.

Variations in Comprehensive Test Procedure

The Comprehensive test procedure will vary according to vehicle specifications, as follows:

When a vehicle's specifications do not show a fast idle speed, or when the fast idle speed is the same as the normal idle speed, the Fast Idle Test will not be performed during Comprehensive testing. To perform the Fast Idle Test on such a vehicle during Comprehensive, edit the specifications to show a fast idle speed.

If specifications are not entered for Total Advance Timing and Mechanical (Centrifugal) Advance Timing, the Basic Timing Test is the ONLY test that will be performed. To perform Total Advance Timing and Mechanical Timing tests, the operator must edit the specifications to show values for these items.

When specifications indicate that ignition timing cannot be adjusted (as in the case of some D.I.S. ignitions), the entire timing procedure is skipped.

Using The Optional Gas Analyzer

The optional gas analyzer can be used during Comprehensive testing. The gas analyzer checks the quantity of four gases in vehicle emissions: Carbon Monoxide (CO); Hydrocarbons (HC); Carbon Dioxide (CO₂); and Oxygen (O₂). This information is used to generate diagnostics.

(The Comprehensive tests can be run without using the gas analyzer, if desired. However, the tests will not have the benefit of emissions values when determining diagnostics.)

To Prepare the Gas Analyzer for Testing

1. For best results, allow vehicle to warm up to normal operating temperature before testing.
2. Allow the analyzer to warm up. This takes approximately 14 minutes at 40° F (slightly longer at cooler temperatures).

NOTE: The analyzer must be warmed up for at least one hour before a gas calibration can be performed. Refer to gas analyzer operating instructions.

3. Turn the pump "ON."
4. Allow a moment for the exhaust probe to collect fresh air before inserting it into the vehicle tailpipe.
5. Insert the exhaust probe into the vehicle tailpipe so the retainer clip holds it in place.

NOTE: For tailpipes equipped with screens or other obstructions, remove the flexible end of the exhaust probe and replace it with the anti-dilution adapter.

6. Slide the building exhaust removal system hose over the tailpipe. Turn on the exhaust fan.

Proceed with Comprehensive testing. Exhaust gas values will be displayed on appropriate screens throughout the test.