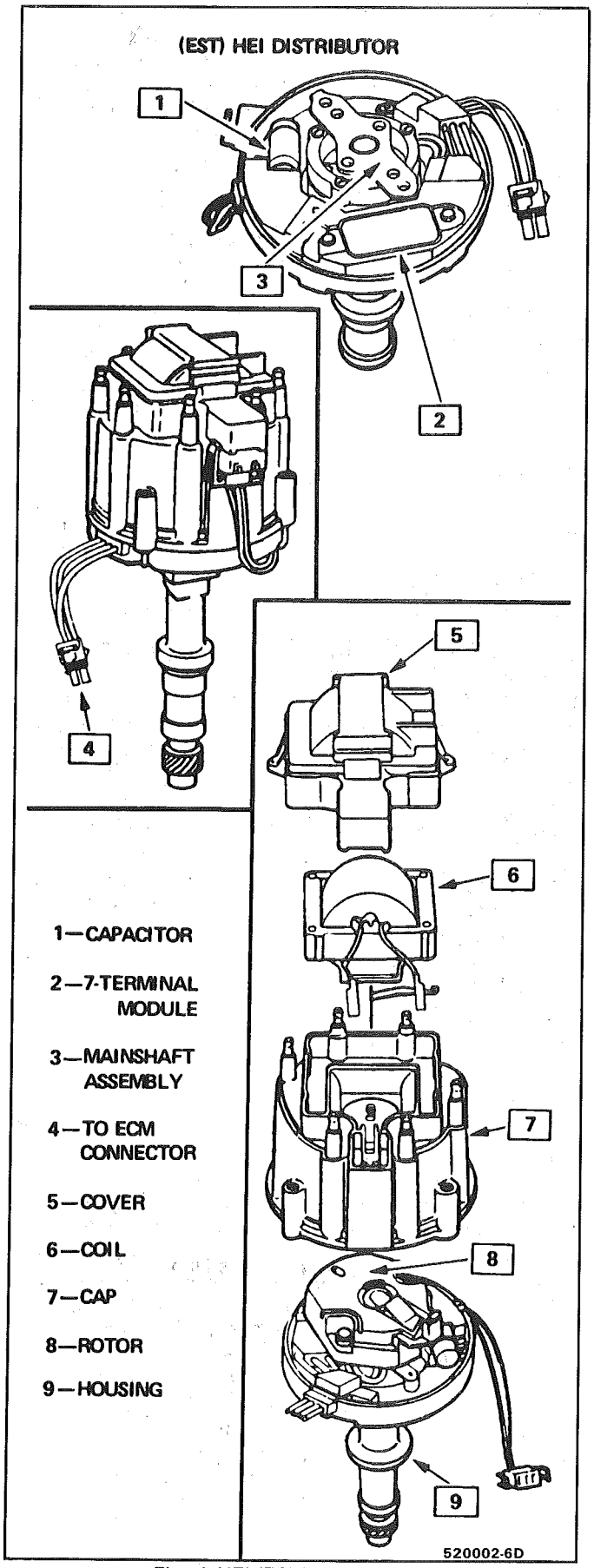


Fig. 1 HEI (EST) Distributor

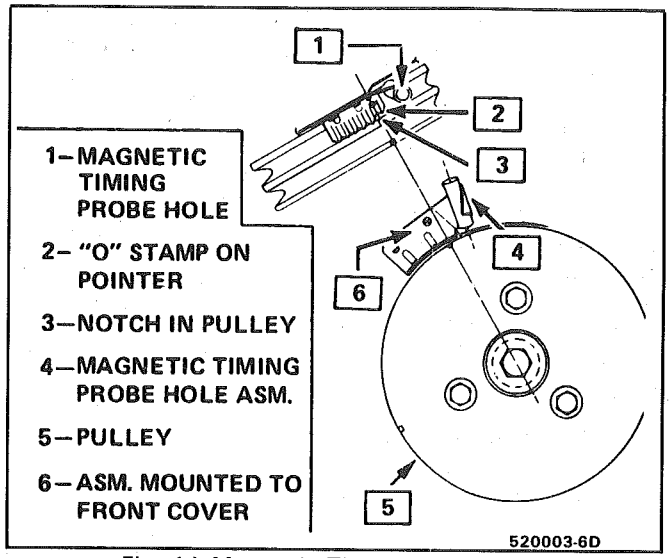


Fig. 1A Magnetic Timing Probe Hole

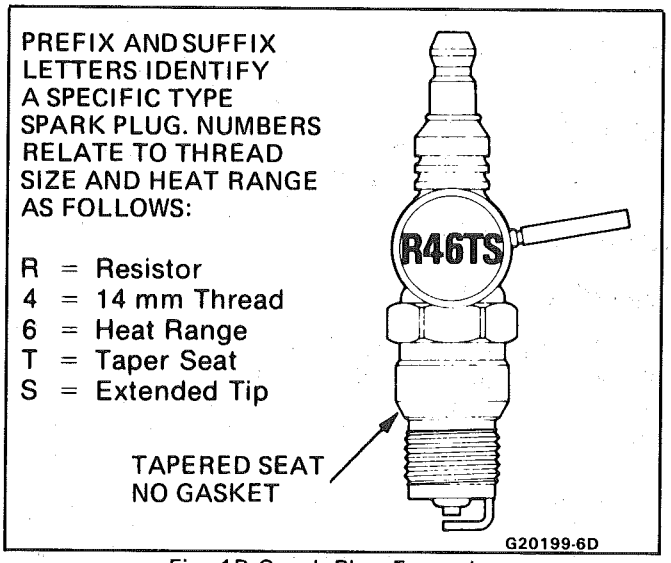


Fig. 1B Spark Plug Example

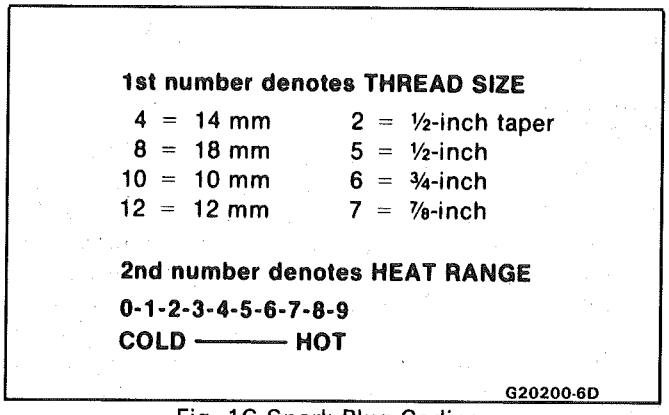


Fig. 1C Spark Plug Coding

spark plug performance. It gives increased combustion heat, burning away carbon or oxides that have built up from frequent idling, or continual stop-and-go driving. Spark plugs are protected by an insulating nipple made of special heat-resistant material, which covers the spark plug terminal and extends downward over a portion of the plug insulator. These nipples prevent

flash-over, which causes engine misfiring. Do not mistake corona discharge for flash-over, or a shorted insulator. Corona is a steady blue light appearing around the insulator, just above the shell crimp. It is the visible evidence of a high-tension field and has no effect on ignition performance. Usually it can be detected only in darkness. This discharge may repel dust particles, leaving a clear ring on the insulator just above the shell. This ring is sometimes mistakenly regarded as evidence that combustion gases have blown out between shell and insulator.

Ignition Switch

The mechanical switch is located in the steering column on the right hand side just below the steering wheel. The electrical switching portion of the assembly is separate from the key and lock cylinder. However, both are synchronized and work in conjunction with each other through the action of the actuator rod assembly.

For a complete explanation of the key and lock cylinder, and the actuator rod assembly, see STEERING, Section 3B. See Section 8 for electrical switching.

DIAGNOSIS

IGNITION SYSTEM

Spark Plugs

Worn or dirty plugs may give satisfactory operation at idling speed, but at higher RPM they frequently fail. Faulty plugs are indicated in a number of ways: poor fuel economy, power loss, loss of speed, hard starting and generally poor engine performance.

Spark plugs may also fail due to carbon fouling, excessive gap, or a broken insulator.

Fouled plugs may be indicated by black carbon deposits. The black deposits are usually the result of slow-speed driving and short runs, where sufficient engine operating temperature is seldom reached. Worn pistons, rings, faulty ignition, over-rich carburetion and spark plugs which are too cold will also result in carbon deposits.

Excessive gap wear, on plugs of low mileage, usually indicates the engine is operating at high speeds, or loads that are consistently greater than normal, or that a plug which is too hot is being used. Electrode wear may also be the result of plug overheating, caused by combustion gases leaking past the threads due to insufficient torquing of the spark plug. Excessively lean carburetion will also result in accelerated electrode wear.

Broken insulators are usually the result of improper installation, or carelessness when regapping the plug. Broken upper insulators usually result from a poor fitting wrench, or an outside blow. The cracked insulator may not show up right away, but will as soon as oil or moisture penetrates the crack. The crack is usually just below the crimped part of shell and may not be visible.

Broken lower insulators usually result from carelessness when regapping and generally are visible. This type of break may result from the plug operating too "hot", which may happen in periods of high-speed operation or under heavy loads. When regapping a spark plug, always make the gap adjustment by bending the ground (side) electrode. Spark plugs with broken insulators should always be replaced.

HEI Distributor

See Unit Repair for distributor disassembly, test and reassembly of individual distributor components, when the distributor is removed from the vehicle. See On-Car Service for distributor removal and installation and for component removal with distributor in car. See Section 6E for HEI and EST diagnosis.

SERVICE PROCEDURES

IGNITION SYSTEM

Distributor Ignition

NOTICE: This procedure is generally true for most carlines. Where procedure is different, or where additional information is required, see "ON-CAR SERVICE" for specific carline.

HEI DISTRIBUTOR

Service Precautions

1. When making compression checks, disconnect the ignition switch feed wire at the distributor. When disconnecting this connector, **do not** use a screwdriver or tool to release the locking tab, as it may break.
2. No periodic lubrication is required. Engine oil lubricates the lower bushing and an oil-filled reservoir provides lubrication for the upper bushing.
3. The tachometer (TACH) terminal is next to the ignition switch (BAT) connector on the distributor cap.

NOTICE: The tachometer terminal must NEVER be allowed to touch ground, as damage to the module and/or ignition coil can result.

Some tachometers currently in use may NOT be compatible with the High Energy Ignition System. Consult the manufacturer of the tachometer if questions arise.

4. Dwell adjustment is controlled by the module, and cannot be adjusted.
5. The material used to construct the spark plug cables is very soft. This cable will withstand more heat and carry a higher voltage, but scuffing and cutting become easier. The spark plug cables must be routed correctly to prevent chaffing or cutting. See Spark Plug Section. When removing

3. Rotor and cap.

Set Ignition Timing

1. Refer to the tune-up label located in the engine compartment. Follow all instructions on the label.

2. With ignition off, connect the pick-up lead of timing light to the number one spark plug. Use a jumper lead between the wire and plug, or an inductive type pick-up. **DO NOT** pierce the wire, or attempt to insert a wire between the boot and the wire. Connect the timing light power leads according to manufacturer's instructions.

3. Start the engine and aim the timing light at the timing mark. The line on the balancer or pulley will line up at the timing mark. If a change is necessary, loosen the distributor hold-down clamp bolt at the base of the distributor. While observing the mark with the timing light, slighty rotate the distributor until the line indicates the correct timing. Tighten the hold-down bolt and re-check the timing.

4. Turn off the engine and remove the timing light. Reconnect the number one spark plug wire, if removed.

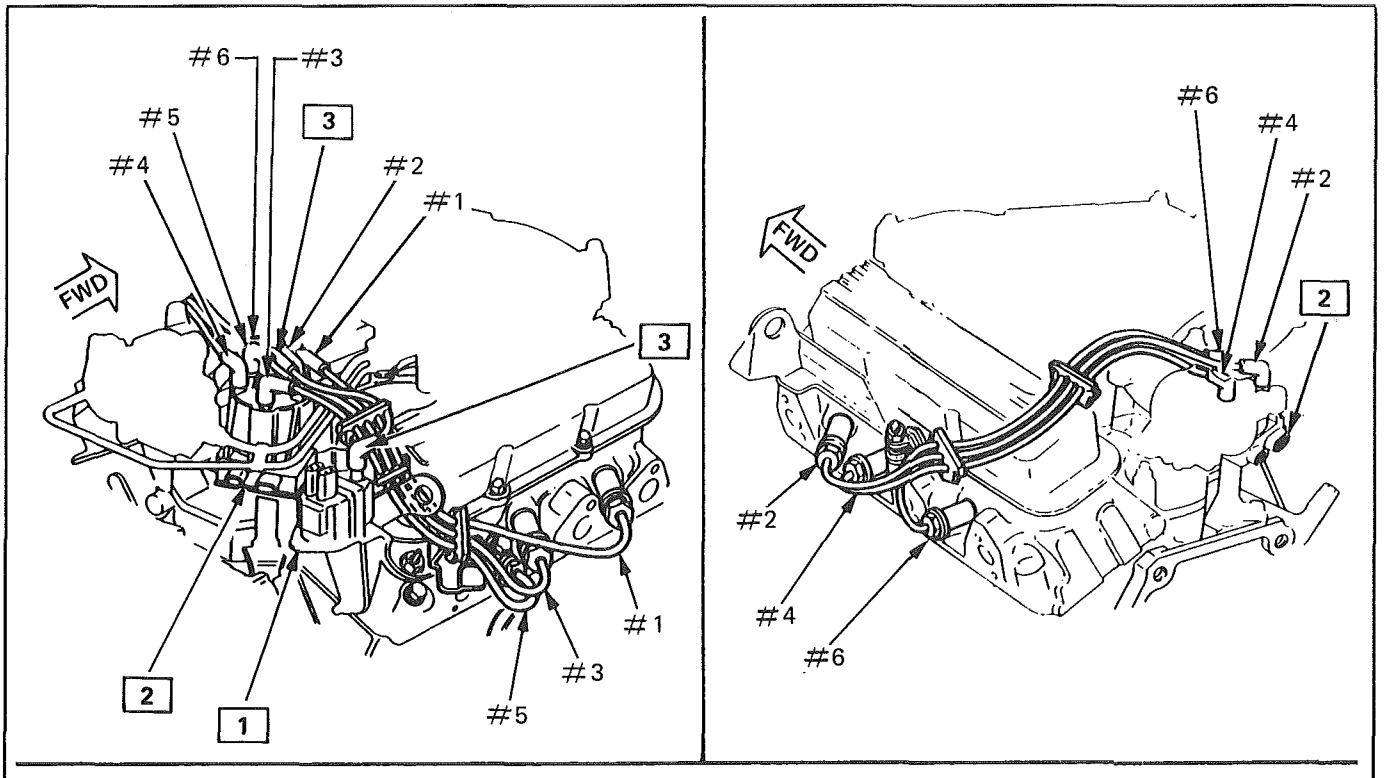
Spark Plug Wires

Use care when removing spark plug wire boots from spark plugs. Twist the boot 1/2 turn before removing and pull on the **boot only** to remove the wire.

When replacing plug wires, route the wires correctly and through the proper retainers. Failure to route the wires properly can lead to radio ignition noise and crossfiring of the plugs, or shorting of the leads to ground.

Special care should be exercised when reinstalling spark plug boots, to assure that the metal terminal within the boot is fully seated on the spark plug terminal and that the boot has not moved on the wire. If boot to wire movement has occurred, the boot will give a false visual impression of being fully seated. A good check to assure that boots have been properly assembled is to push sideways on the installed boots. If they have been correctly installed, a stiff boot, with only slight looseness, will be noted. If the terminal has not been properly seated on the spark plug, only the resistance of the rubber boot will be felt when pushing sideways.

ON-CAR SERVICE



1–COIL & BRACKET ASM. 2–DISTRIBUTOR 3–COIL WIRE

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Fig. 601 Distributor and Coil - LB8

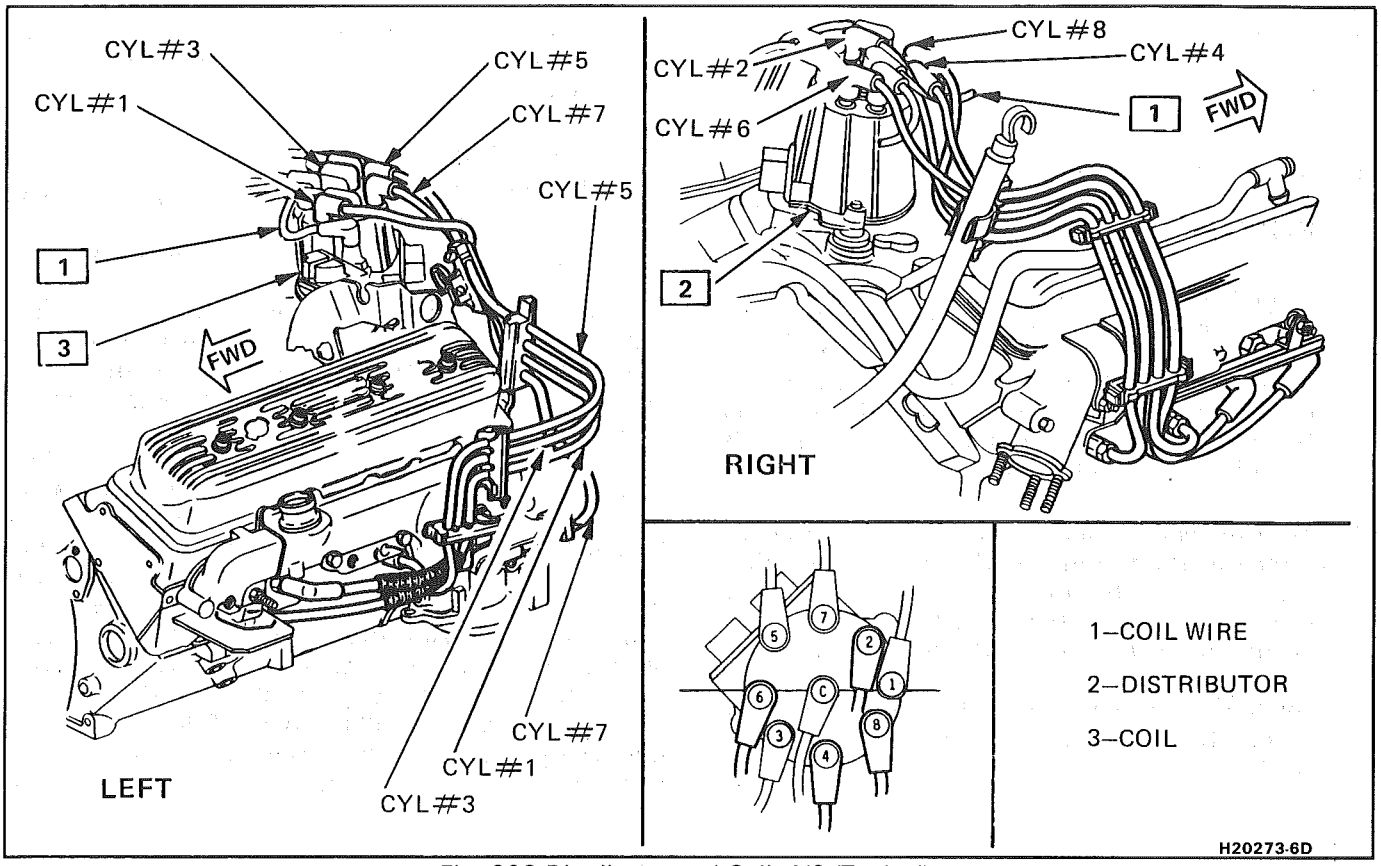
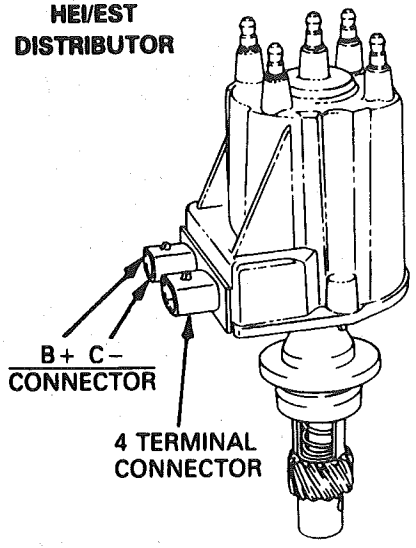


Fig. 602 Distributor and Coil - V8 (Typical)

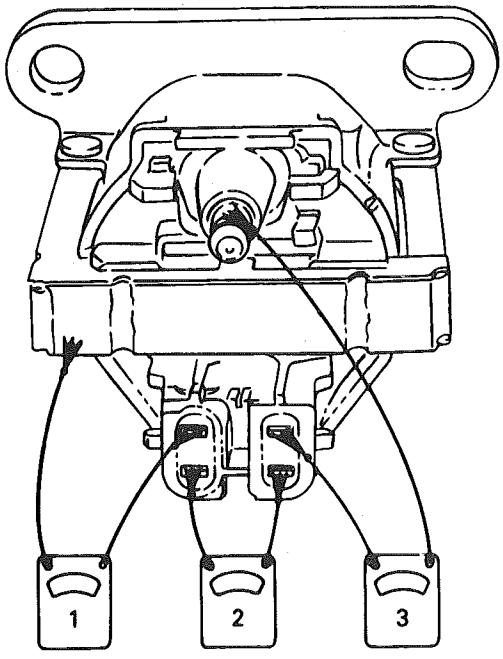
DISTRIBUTOR DISASSEMBLY TEST AND REASSEMBLY (SEPARATELY MOUNTED COIL)

HEI/EST DISTRIBUTOR



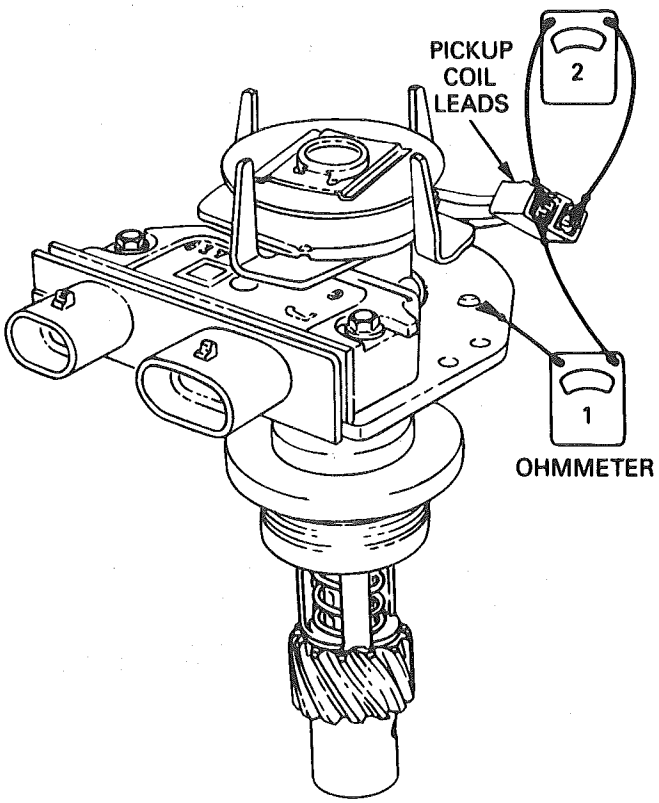
1. A TYPICAL DISTRIBUTOR USED WITH A SEPARATELY MOUNTED COIL IS SHOWN.

TESTING IGNITION COIL



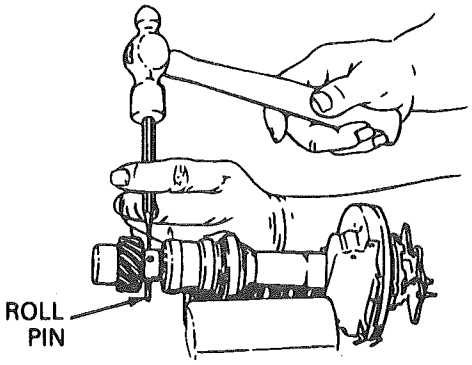
2. CHECK IGNITION COIL WITH OHMMETER FOR OPENS AND GROUNDS:
   STEP 1. — USE HIGH SCALE. SHOULD READ VERY HIGH (INFINITE). IF NOT, REPLACE COIL.
   STEP 2. — USE LOW SCALE. SHOULD READ VERY LOW OR ZERO. IF NOT, REPLACE COIL.
   STEP 3. — USE HIGH SCALE. SHOULD NOT READ INFINITE. IF IT DOES, REPLACE COIL.

TESTING PICKUP COIL



3. REMOVE ROTOR AND PICKUP COIL LEADS FROM MODULE.
4. CONNECT OHMMETER PART 1 AND PART 2.
5. OBSERVE OHMMETER. FLEX LEADS BY HAND TO CHECK FOR INTERMITTENT OPENS.
   STEP 1 — SHOULD READ INFINITE AT ALL TIMES. IF NOT, PICKUP COIL IS DEFECTIVE.
   STEP 2 — SHOULD READ ONE STEADY VALUE BETWEEN 500-1500 OHMS AS LEADS ARE FLEXED BY HAND. IF NOT, PICKUP COIL IS DEFECTIVE.

DRIVING PIN FROM SHAFT



6. DRIVE ROLL PIN FROM GEAR AND REMOVE SHAFT ASSEMBLY. MARK GEAR AND SHAFT FOR CORRECT REASSEMBLY.

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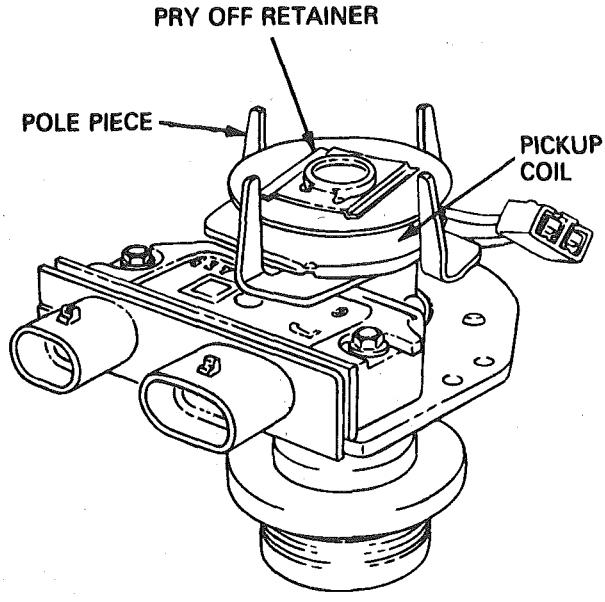
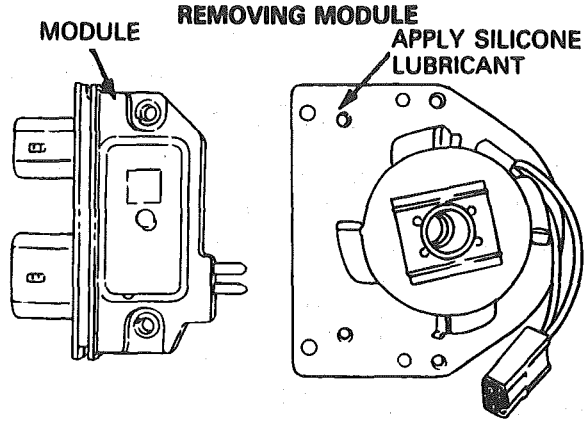
Fig. 603 Distributor Disassembly, Test and Reassembly (Separate Coil) 1 of 2

REMOVE PICKUP COIL



7. TO REMOVE PICKUP COIL, REMOVE RETAINER.
8. LIFT PICKUP COIL ASSEMBLY STRAIGHT UP TO REMOVE FROM DISTRIBUTOR.

REMOVING MODULE



9. DISCONNECT WIRING CONNECTORS FROM MODULE. REMOVE TWO SCREWS TO REMOVE MODULE TEST MODULE WITH AN APPROVED MODULE TESTER.

REASSEMBLY

10. WIPE DISTRIBUTOR BASE AND MODULE CLEAN, APPLY SILICONE LUBRICANT BETWEEN MODULE AND BASE FOR HEAT DISSIPATION.
11. ATTACH MODULE TO BASE. ATTACH PICKUP CONNECTOR TO MODULE.
12. ASSEMBLE PICKUP POLE PIECE AND RETAINER.
13. ASSEMBLE SHAFT, GEAR PARTS AND ROLL PIN.
14. SPIN SHAFT TO INSURE THAT TEETH DO NOT TOUCH.
15. INSTALL ROTOR AND CAP.

520133-6D

Fig. 604 Distributor Disassembly, Test and Reassembly (Separate Coil) 2 of 2

ALL NEW GENERAL MOTORS VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAPS, ETC., FOR PURPOSES OF SERVICING THE PRODUCT, MUST BE STRICTLY FOLLOWED AND, WHEREVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

INTRODUCTION

GENERAL DESCRIPTION

This section applies to engines which have a fuel injector mounted above a throttle body assembly. The entire assembly is mounted to the intake manifold and is referred to as "Throttle Body Injection".

These engines have controls to reduce exhaust emissions, while maintaining good driveability and fuel economy.

An engine control module (ECM) is the heart of this control system and has sensors used to provide information about engine operation and the various systems it controls. Details of basic operation, diagnosis, functional checks, and on-vehicle service are covered in Section "C", Component Systems.

The ECM has the ability to do some diagnosis of itself, and of other parts of the system. When it finds a problem, it lights a "Service Engine Soon" light on the instrument panel and a trouble code will be stored in the ECM memory. This does not mean that the engine should be stopped right away, but that the cause of the light coming "ON" should be checked as soon as reasonably possible.

DIAGNOSIS PROCEDURE

The following sections(s) are written for specific engine applications and are clearly indentified. Be sure to use only the section which applies to the engine family being diagnosed.

Before using this section of the manual, you should be familiar with the information and the proper diagnosing procedures as described in Section "6E". If the proper diagnosis procedures are not followed, as described in Section "6E", it may result in unnecessary replacement of good parts.

Trouble tree charts incorporate diagnosis procedures using an ALDL "Scan" tool, where possible. The "Scan" tool has the ability to save time in diagnosis and prevent the replacement of good parts. **The key to using the "Scan" tool successfully for diagnosis lies in the technician's ability to understand the system he is trying to diagnose, as well as an understanding of the "Scan" tool's limitations. See Section 6E for more information.**

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SECTION C
COMPONENT SYSTEMS

Section C provides information on the following:

- General description of components and systems.
- On-vehicle service.
- Part names and group numbers.
- Diagnostic charts. These include a functional check of the system as well as diagnosis of any problem found in the functional check.

For locations of components, wiring diagrams, and ECM Terminal End View, refer to the front on the A Section of the engine being diagnosed.

Following are the sub-section identification and the system covered:

DIAGNOSTIC CHARTS

The Diagnostic Charts for each system are found after the on-car service and parts information at the back of each section. Following are the charts found in this section.

SECTION C1

ELECTRONIC CONTROL MODULE (ECM) AND SENSORS

CONTENTS

GENERAL DESCRIPTION

ELECTRONIC CONTROL MODULE (ECM)

The electronic control module (ECM) (Figure C1-1) is the control center of the fuel injection system. It constantly looks at the information from various sensors, and controls the systems that affect vehicle performance. The ECM performs the diagnostic function of the system. It can recognize operational problems, alert the driver through the "Service Engine Soon" light, and store a code or codes which identify the problem areas to aid the technician in making repairs. See "Introduction" for more information on using the diagnostic function of the ECM. For service, the ECM has three parts: a Controller (the ECM without the PROM), a separate calibrator (PROM), and a CALPAK.

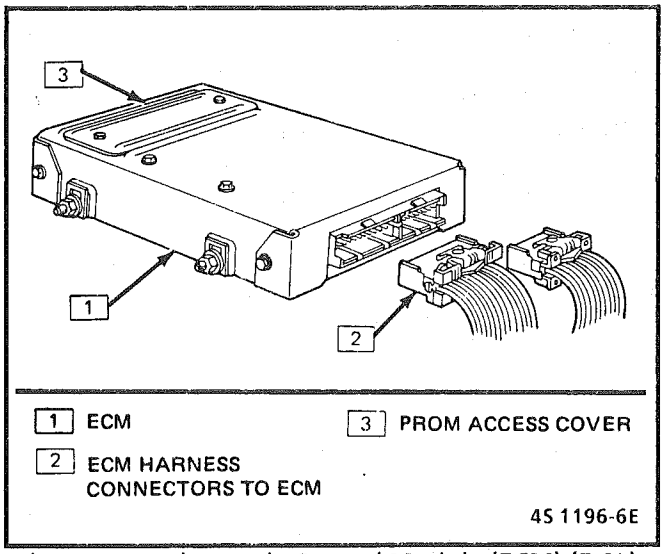

Figure C1-1 Electronic Control Module (ECM) (5.0L)

PROM

To allow one model of ECM to be used for many different cars, a device called a Calibrator (or PROM) (Programmable Read Only Memory) is used (see Figure C1-2). The PROM is located inside the ECM, and has information on the vehicle's weight, engine, transmission, axle ratio, and several others. While one ECM part number can be used by many car lines, a PROM is very specific and must be used for the right car. For this reason, it is very important to check the latest parts book and Service Bulletin information for the correct part number when replacing a PROM.

An ECM used for service (called a controller) comes without a PROM. The PROM from the old ECM must be carefully removed and installed in the new ECM (see On-Car Service).

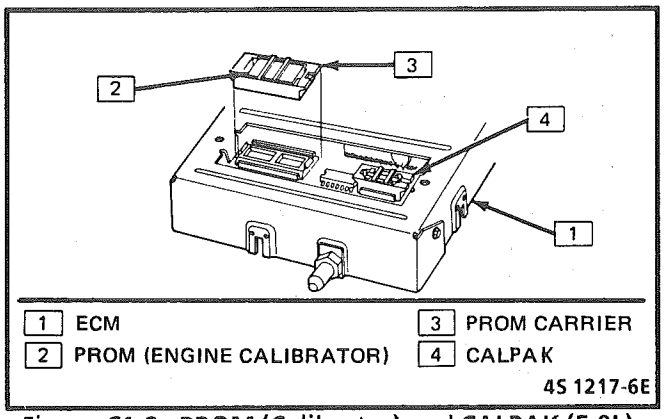

Figure C1-2 - PROM (Calibrator) and CALPAK (5.0L)

CALPAK

A device called a CALPAK is used to allow fuel delivery if other parts of the ECM are damaged. It has an access door in the ECM, and removal and replacement procedures are the same as with a PROM.

If the CALPAK is missing, it will result in a no start and run condition. The CALPAK must be transferred to a replacement ECM.

ECM FUNCTION

The ECM supplies either 5 or 12 volts to power various sensors or switches. This is done through resistances in the ECM which are so high in value that a test light will not light when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. Therefore, a 10 Meg Ohm input impedance digital voltlmeter is required to assure accurate voltage readings.

The ECM controls output circuits such as the Injector, IAC, Cooling Fan Relay, etc. by controlling the ground circuit through transistors in the ECM.

INFORMATION SENSORS

Engine Coolant Temperature Sensor

The coolant sensor (Figure C1-3) is a thermistor (a resistor which changes value based on temperature) mounted in the engine coolant stream. Low coolant temperature produces a high resistance (100,000 ohms at -40°C/-40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F)

The ECM supplies a 5-volt signal to the coolant sensor thru a resistor in the ECM and measures the voltage. The voltage will be high when the engine is cold, and low when the engine is hot. By measuring the voltage, the ECM knows the engine coolant temperature. Engine coolant temperature affects most systems the ECM controls.

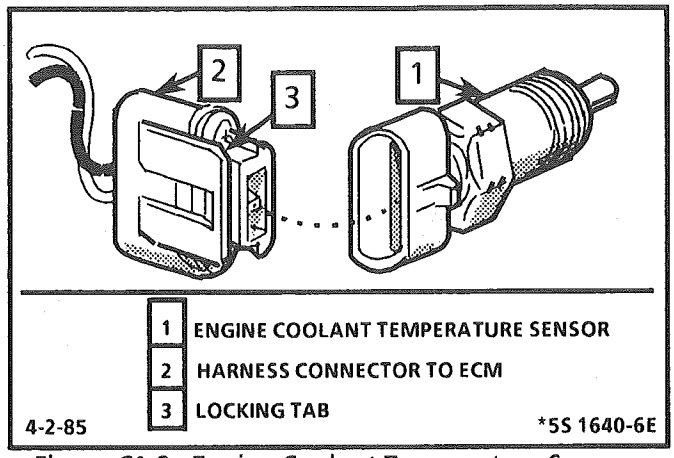

Figure C1-3 - Engine Coolant Temperature Sensor

A failure in the coolant sensor circuit should set either a Code 14 or Code 15. Remember, these codes indicate a failure in the coolant temperature circuit, so proper use of the chart will lead to either repairing a wiring problem or replacing the sensor, to properly repair a problem.

MAP Sensor

The manifold absolute pressure (MAP) sensor (Figure C1-4) measures the changes in the intake manifold pressure which result from engine load and speed changes, and converts this to a voltage output.

A closed throttle on engine coastdown would produce a relatively low MAP output, while a wide-open throttle would produce a high output. This high output is produced because the pressure inside the manifold is the same as outside the manifold, so you measure 100% of outside air pressure. Manifold absolute pressure (MAP) is the OPPOSITE of what you would measure on a vacuum gage.

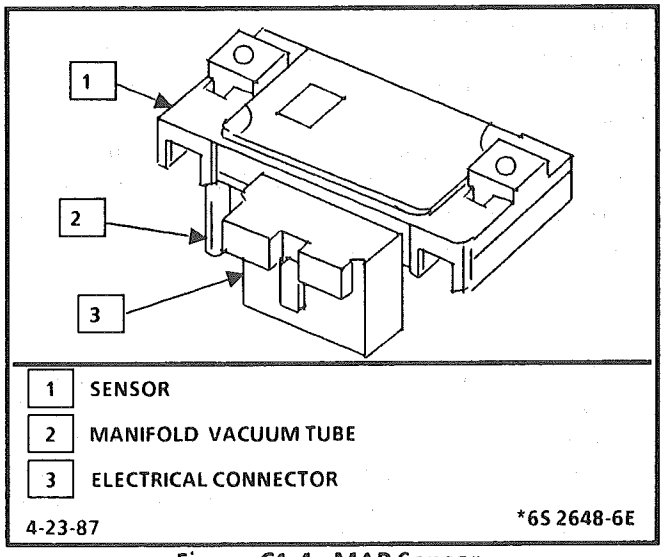

Figure C1-4 - MAP Sensor

A failure in the MAT sensor circuit should set a Code 23 or 25. The code charts also contain a chart to check for sensor resistance values relative to temperature.

MAP Sensor

A "Scan" tool reads manifold pressure and will display either volts or kPa of pressure.

Key "ON", engine stopped, (no vacuum), MAP will read high voltage or pressure, while at idle (highvacuum), MAP will read low voltage or pressure. Likewise, on accel., MAP will read high and on decel., will read low.

A failure in the MAP sensor, or circuit, should result in a Code 33 or 34.

Oxygen (O_2) Sensor

The "Scan" tool has several positions that will indicate the state of the exhaust gases, O_2 voltage, integrator, and block learn. See "Scan" tool position information in the Introduction of Section "6E".

A problem in the O_2 sensor circuit should set a Code 13 (open circuit), Code 44 (lean O_2 indication), Code 45 (rich O_2 indication). Refer to the applicable chart, if any of these codes were stored in memory.

Throttle Position Sensor (TPS)

A "Scan" tool displays throttle position in volts. The 5.0L should read under 1.25 volts, with throttle closed and ignition on, or at idle. Voltage should increase at a steady rate as throttle is moved toward WOT.

The ECM has the ability to Auto-Zero the TPS voltage, if it is below about 1.25 volts. This means that any voltage less than 1.25 volts volts will be determined by the ECM to be 0% throttle. Some "Scan" tools have the ability to read the percentage of throttle angle and should read 0%, when the throttle is closed. A failure in the TPS circuit or TPS, should set a Code 21 or 22.

Vehicle Speed Sensor (VSS)

A "Scan" tool reading should closely match with speedometer reading, with drive wheels turning. A failure in the VSS circuit should set a Code 24.

P/N Switch

A "Scan" tool should read "ON", when in park or neutral and "OFF", when in drive. This reading may vary with different makes of tools. Refer to CHART C-1A for P/N switch diagnosis.

Power Steering Pressure Switch (PSPS)

A Scan" tool should read "OFF" normally, and "ON" with high pressure. This reading may vary with different makes of tools. Refer to CHART C-1E for PSPS diagnosis.

A/C Request Signal

If the low pressure switch is closed and A/C is "ON", the "Scan" tool should indicate A/C "ON".

Distributor Reference Signal

A "Scan" tool will read this signal and is displayed in rpm. See Section "C4", for more information on the Ignition System .

Knock Signal

A "Scan" tool will indicate when the ESC module signals the ECM that knock is present. See Section "C5" for further information on the ESC System.

ON-CAR SERVICE

ELECTRONIC CONTROL MODULE (ECM)

Service of the ECM should normally consist of either replacement of the ECM or a PROM change.

If the diagnostic procedures call for the ECM to be replaced, the engine calibrator (PROM) and ECM should be checked first to see if they are the correct parts. If they are, remove the PROM from the faulty ECM and install it in the new service ECM. THE SERVICE ECM WILL NOT CONTAIN A PROM. Trouble Code "51" indicates the PROM is installed improperly or has malfunctioned. When Code "51" is obtained, check the PROM installation for bent pins or pins not fully seated in the socket. If the PROM is installed correctly and Code "51" still shows, replace the PROM.

Important

When replacing the production ECM with a service ECM (controller), it is important to transfer the Broadcast code and production ECM number to the service ECM label. Please do not record on ECM cover. This will allow positive identification of ECM parts throughout the service life of the vehicle.

SECTION C4
IGNITION SYSTEM / (EST)
CONTENTS

GENERAL DESCRIPTION

PURPOSE

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

Only the Electronic Spark Timing (EST) system will be described here. Additional information on the HEI system is found in Section 6D.

OPERATION

The standard high energy ignition (HEI) system (described in Section 6D) has a modified distributor module, which is used in connection with EST. The module has eight terminals. (See Figure C4-1).

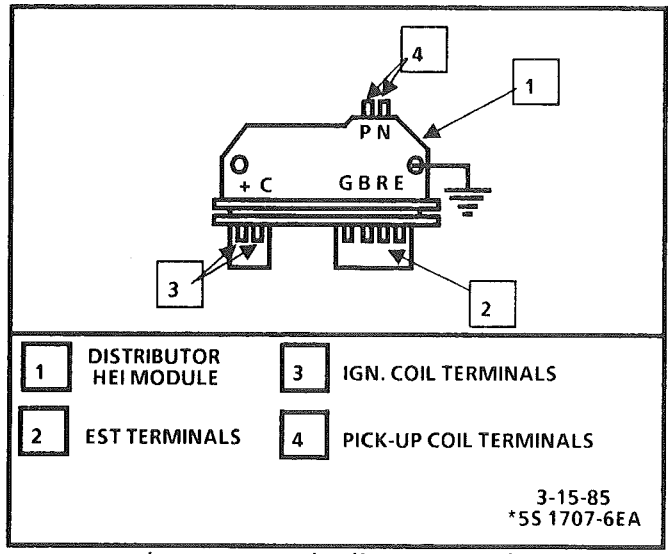

Figure C4-1 - Distributor Module

To properly control ignition/combustion timing, the ECM needs to know:

- crankshaft position
- engine speed (rpm)
- engine load (manifold pressure or vacuum)
- atmospheric (barometric) pressure
- engine temperature

The EST system consists of the distributor module, ECM, and connecting wires. The distributor has four wires, from the HEI module, connected to the ECM.

These circuits perform the following functions:

- Distributor reference. Terminal "C"
  This provides the ECM with rpm and crankshaft position information.
- Reference ground. Terminal "A"
  This wire is grounded in the distributor and makes sure the ground circuit has no voltage drop which could affect performance. If it is open, it may cause poor performance.
- Bypass. Terminal "B"
  At about 400 rpm, the ECM applies 5 volts to this circuit to switch spark timing control from the HEI module to the ECM. An open or grounded bypass circuit will set a Code 42 and the engine will run at base timing, plus a small amount of advance built into the HEI module.
- EST. Terminal "D"
  After bypass voltage is applied, the ECM uses this circuit to trigger the HEI module. The ECM uses the distributor reference signal to base its calculation of the amount of spark advance needed, under present engine conditions. If the base timing of the engine is incorrect, the entire spark curve will be incorrect.

DIAGNOSIS

RESULTS OF INCORRECT EST OPERATION

An open, or ground, in the EST circuit, will set a Code 42 and cause the engine to run on the HEI module timing. This will cause poor performance and poor fuel economy.

The ECM uses information from the MAP and coolant sensors, in addition to rpm, to calculate spark advance as follows.

Low MAP output voltage = More spark advance
Cold Engine = More spark advance
High MAP Output Voltage, = Less spark advance
Hot Engine = Less spark advance

Therefore, detonation could be caused by low MAP output or high resistance in the coolant sensor circuit.

Poor performance could be caused by high MAP output or low resistance in the coolant sensor circuit.

HOW CODE 42 IS DETERMINED

When the system is running on the HEI module, that is, no voltage on the bypass line, the HEI module grounds the EST signal. The ECM expects to see no voltage on the EST line during this condition. If it sees a voltage, it sets Code 42 and will not go into the EST mode.

When the rpm for EST is reached (about 400 rpm), the ECM applies 5 volts to the bypass line and the EST should no longer be grounded in the HEI module, so, the EST voltage should be varying.

If the bypass line is open, the HEI module will not switch to EST mode, so, the EST voltage will be low and Code 42 will be set.

If the EST line is grounded, the HEI module will switch to EST but, because the line is grounded, there will be no EST signal and the engine will not run. A Code 42 may, or may not, be set.

The description, operation, and diagnosis of the HEI system are found in Section 6D of this manual. This section will address diagnosis of that portion of the Ignition System pertaining to the EST operation.

CODE 12

Code 12 is used during the Diagnostic Circuit Check procedure to test the code display ability of the ECM. This code indicates that the ECM is not receiving the engine rpm (REFERENCE) signal. This occurs with the ignition key "ON" and the engine not running.

The "Reference" signal, also, triggers the fuel injection system. Without the "Reference" signal, the engine cannot run.

ON-CAR SERVICE

SETTING TIMING

Set timing according to instructions on Vehicle Emission Control Information label.

PARTS INFORMATION

PART NAME	GROUP
Module, Distr	2.383
Coil, Distr	2.170

BLANK

INTERMITTENTS

Problem may or may not turn "ON" the "Service Engine Soon" light, or store a code.

DO NOT use the trouble code charts in Section "A" for intermittent problems. The fault must be present to locate the problem. If a fault is intermittent, use of trouble code charts may result in replacement of good parts.

- Most intermittent problems are caused by faulty electrical connections or wiring. Perform careful check as described at start of Section "B". Check for:
  - Poor mating of the connector halves, or terminals not fully seated in the connector body (backed out).
  - Improperly formed or damaged terminals. All connector terminals in problem circuit should be carefully reformed to increase contact tension.
  - Poor terminal to wire connection. This requires removing the terminal from the connector body to check. See "Introduction" to Section "6E".
- If a visual check does not find the cause of the problem, the car can be driven with a voltmeter connected to a suspected circuit. A "Scan" tool can also be used for monitoring input signals to the ECM to help detect intermittent conditions. An abnormal voltage, or "Scan" reading, when the problem occurs, indicates the problem may be in that circuit. If the wiring and connectors check OK and a trouble code was stored for a circuit having a sensor, except for Codes 43, 44, and 45, substitute a known good sensor and recheck.

An intermittent "Service Engine Soon" light with no stored code may be caused by:

- Ignition coil shorted to ground and arcing at spark plug wires or plugs.
- "Service Engine Soon" light wire to ECM shorted to ground. (CKT 419).
- Diagnostic "Test" terminal wire to ECM, shorted to ground.(CKT 451)
- ECM power grounds. See ECM wiring diagrams.
- Loss of trouble code memory. To check, disconnect TPS and idle engine until "Service Engine Soon" light comes "ON". Code 22 should be stored, and kept in memory when ignition is turned "OFF". If not, the ECM is faulty.
- Check for an electrical system interference caused by a defective relay, ECM driven solenoid, or switch. They can cause a sharp electrical surge. Normally, the problem will occur when the faulty component is operated.
- Check for improper installation of electrical options, such as lights, 2-way radios, etc.
- EST wires should be kept away from spark plug wires, distributor wires, distributor housing, coil, and generator. Wire from ECM to distributor (CKT 453) should be a good connection.
- Check for open diode across A/C compressor clutch, and for other open diodes (see wiring diagrams).

HARD START

Definition: Engine cranks OK, but does not start for a long time. Does eventually run, or may start but immediately dies.

- Perform careful check as described at start of Section "B".
- Make sure driver is using correct starting procedure.
- **CHECK:**
  - TPS for sticking or binding or a high TPS voltage with the throttle closed (should read less than .700 volts).
  - High resistance in coolant sensor circuit or sensor itself. See Code 15 chart or with a "Scan" tool compare coolant temperature with ambient temperature on a cold engine.
  - Fuel pressure CHART A-7.
  - Water contaminated fuel.
  - EGR operation. Be sure valve seats properly and is not staying open. See CHART C-7.
  - Both injector fuses (visually inspect).
  - Ignition system - Check distributor for:
    - Proper output with ST-125.
    - Worn shaft.
    - Bare and shorted wires.
    - Pickup coil resistance and connections.
    - Loose ignition coil ground.
    - Moisture in distributor cap.
- If problem exists in cold weather, check cold start valve. See CHART A-9 .

POOR FUEL ECONOMY

Definition: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, economy is noticeably lower than it was on this car at one time, as previously shown by an actual road test.

- Perform careful visual check as described at start of Section "B".
- **CHECK:**
  - Coolant level.
  - Engine thermostat for faulty part (always open) or for wrong heat range. See Section "6B".
  - Compression
  - Ignition timing. See Emission Control Information label.
  - TCC for proper operation. A "Scan" should indicate an rpm drop when the TCC is commanded "ON". See CHART C-8.
  - Induction system and crankcase for air leaks.
- Check for exhaust restriction. See CHART B-1.

DIESELING, RUN-ON

Definition: Engine continues to run after key is turned "OFF", but runs very roughly. If engine runs smoothly, check ignition switch and adjustment.

- Check injectors for leaking. See CHART A-7.

ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING

Definition: The engine runs unevenly at idle. If bad enough, the car may shake. Also, the idle may vary in rpm (called "hunting"). Either condition may be bad enough to cause stalling. Engine idles at incorrect speed.

- Perform careful visual check as described at start of Section "B".
- **CHECK:**
  - Throttle linkage for sticking or binding. Also check TPS adjustment. Refer to Section "C2".
  - Ignition timing. See Emission Control Information label.
  - ECM ground circuits.
  - IAC system. See CHART C-2C.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - P/N switch circuit. See CHART C-1A, or use "SCAN" tool.
  - Injector balance. See CHART C-2A.
  - PCV valve for proper operation by placing finger over inlet hole in valve end several times. Valve should snap back. If not, replace valve.
  - Evaporative Emission Control System. CHART C-3.
  - A/C signal to ECM terminal "B8" (5.0L & 5.7L). "Scan" tool should indicate A/C is being requested when ever A/C is selected and the pressure cycling switch is closed.
  - A/C system operation (2.8L) - See CHART C-10.
  - Minimum idle speed. See Section "C2".
  - Loose or damaged MAF sensor duct between sensor and throttle body.
  - Power Steering Pressure Switch (2.8L - See CHART C-1E.
  - Check AIR system. There should be no AIR to ports while in "Closed Loop". See CHART C-6.
  - EGR valve: There should be no EGR at idle.
- Run a cylinder compression check. See Section "6".
- Inspect oxygen sensor for silicon contamination from fuel, or use of improper RTV sealant. The sensor will have a white, powdery coating, and will result in a high but false signal voltage (rich exhaust indication). The ECM will then reduce the amount of fuel delivered to the engine, causing a severe driveability problem.
- Check for fuel in pressure regulator hose. If present replace regulator assembly.
- Check ignition system; wires, plugs, rotor, etc.
- Check for loose or damaged air duct between MAF sensor and throttle body.
- Disconnect MAF sensor and if condition is corrected replace sensor.
- Clean injectors.
- Monitoring block learn will help identify the cause of the problem. If the system is runnig lean (block learn greater than 138), refer to "Diagnostic Aids" on facing page of Code 44. If the system is running rich (block learn less than 118), refer to "Diagnostic Aids" on facing page of Code 45.

EXCESSIVE EXHAUST EMISSIONS OR ODORS

Definition: Vehicle fails an emission test. Vehicle has excessive "rotten egg" smell. Excessive odors do not necessarily indicate excessive emissions.

- Perform "Diagnostic Circuit Check."
- IF TEST SHOWS EXCESSIVE CO AND HC, (or also has excessive odors):
  - Check items which cause car to run RICH.
    - Make sure engine is at normal operating temperature.
- **CHECK:**
  - Fuel pressure. See CHART A-7.
  - Incorrect timing. See vehicle emission control information label.
  - Canister for fuel loading. See CHART C-3.
  - Injector balance. See CHART C-2A.
  - PCV valve for being plugged, stuck, or blocked PCV hose, or fuel in the crankcase.
  - Spark plugs, plug wires, and ignition components. See Section "6D".
  - Check for lead contamination of catalytic converter (look for removal of fuel filler neck restrictor).
  - Check for properly installed fuel cap.
  - If the system is running rich, (block learn less than 118), refer to "Diagnostic Aids" on facing page of Code 45.
- IF TEST SHOWS EXCESSIVE NOx:
  - Check items which cause car to run LEAN, or to run too hot.
    - EGR valve for not opening. See CHART C-7.
    - Vacuum leaks.
    - Coolant system and coolant fan for proper operation. See CHART C-12.
    - Remove carbon with top engine cleaner. Follow instructions on can.
    - Check ignition timing for excessive base advance. See emission control information label.
  - If the system is running lean, (block learn greater than 138), refer to "Diagnostic Aids" on facing page of Code 44.

SECTION C
COMPONENT SYSTEMS

Section C provides information on the following:

- General description of components and systems.
- On-vehicle service.
- Part names and group numbers.
- Diagnostic charts. These include a functional check of the system as well as diagnosis of any problem found in the functional check.

For locations of components, wiring diagrams and ECM Terminal End View refer to the front of the A Sections of the engine being diagnosed.

Following are the sub-section identification and the system covered:

DIAGNOSTIC CHARTS

The Diagnostic Charts for each system are found after the on-car service and parts information at the back of each section. Following are the charts found in this section.

SECTION C1

ELECTRONIC CONTROL MODULE (ECM) AND SENSORS

CONTENTS

GENERAL DESCRIPTION

ELECTRONIC CONTROL MODULE (ECM)

The electronic control module (ECM) (Figure C1-1), located under the instrument panel, is the control center of the fuel injection system. It constantly looks at the information from various sensors, and controls the systems that affect vehicle performance. The ECM performs the diagnostic function of the system. It can recognize operational problems, alert the driver through the "Service Engine Soon" light, and store a code or codes which identify the problem areas to aid the technician in making repairs. See "Introduction" for more information on using the diagnostic function of the ECM.

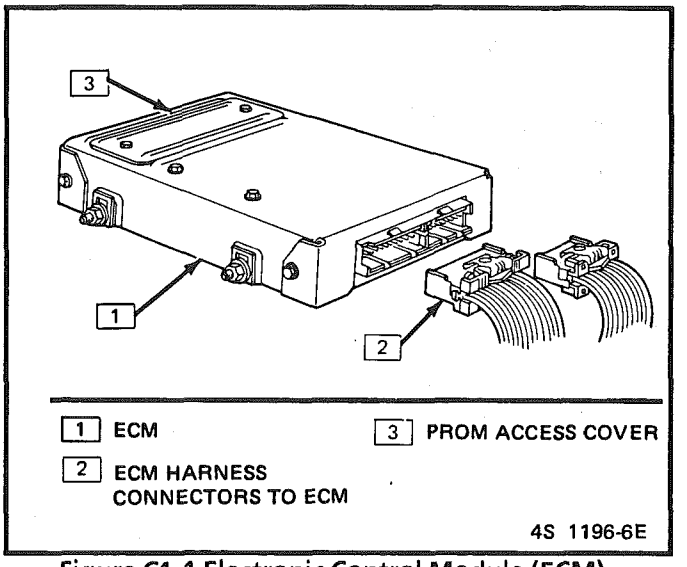

Figure C1-1 Electronic Control Module (ECM)

ECM TYPES

There are two types of ECM'S used for "F" series vehicles equipped with port fuel engines:

Vehicles equipped with a 2.8L engine will use an ECM referred to as GMCM. For service, the ECM consists of three parts: a Controller (the ECM without a PROM), a separate Calibrator (PROM), and a CALPAK.

PROM

To allow one model of ECM to be used for many different cars, a device called a Calibrator (or PROM) (Programmable Read Only Memory) is used (see Figure C1-2). The PROM is located inside the ECM, and has information on the vehicle's weight, engine,

transmission, axle ratio, and several others. While one ECM part number can be used by many car lines, a PROM is very specific and must be used for the right car. For this reason, it is very important to check the latest parts book and Service Bulletin information for the correct part number when replacing a PROM.

An ECM used for service (called a controller) comes without a PROM. The PROM from the old ECM must be carefully removed and installed in the new ECM (see On-Car Service).

CALPAK (Fig. C1-2)

A device called a CALPAK is used to allow fuel delivery if other parts of the ECM are damaged.

It has an access door in the ECM, and removal and replacement procedures are similar to the PROM removal procedures.

The CALPAK must be transferred to a replacement ECM.

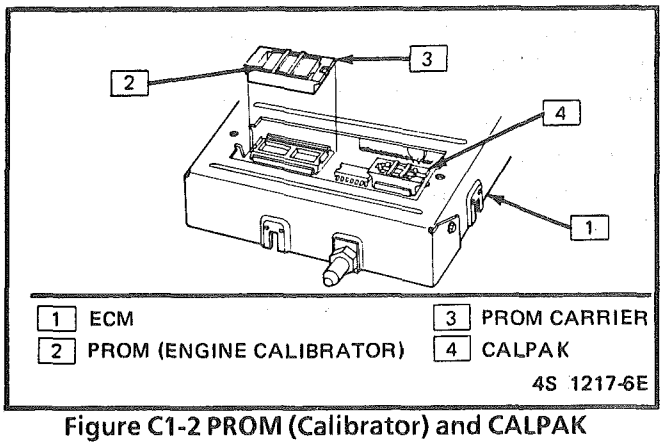

Figure C1-2 PROM (Calibrator) and CALPAK

ECM Function

The ECM supplies either 5 or 12 volts to power various sensors or switches. This is done through resistances in the ECM which are so high in value that a test light will not light when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. Therefore, a 10 Meg Ohm input impedance digital voltmeter is required to assure accurate voltage readings.

The ECM controls output circuits such as the Injector, IAC, Cooling Fan Relay, etc. by controlling the ground circuit through transistors in the ECM.

INFORMATION SENSORS

Engine Coolant Temperature Sensor (Fig.C1-3)

The coolant sensor is a thermistor (a resistor which changes value based on temperature) mounted in the engine coolant stream. Low coolant temperature produces a high resistance (100,000 ohms at -40°C/-40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F).

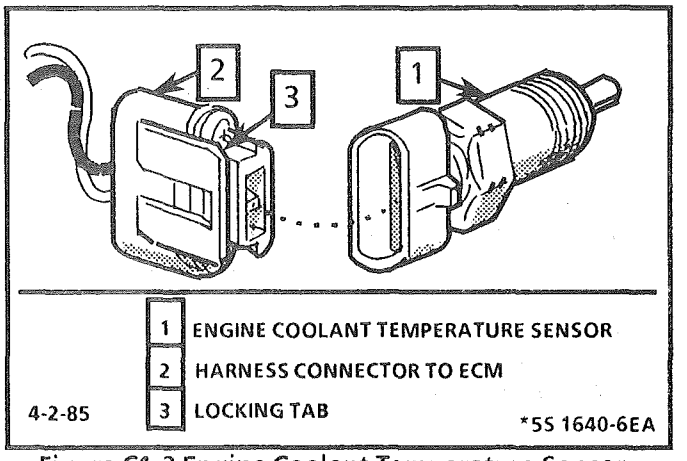

Figure C1-3 Engine Coolant Temperature Sensor

The ECM supplies a 5-volt signal to the coolant sensor thru a resistor in the ECM and measures the voltage. The voltage will be high when the engine is cold, and low when the engine is hot. By measuring the voltage, the ECM knows the engine coolant temperature. Engine coolant temperature affects most systems the ECM controls.

A failure in the coolant sensor circuit should set either a Code 14 or Code 15. Remember, these codes indicate a failure in the coolant temperature circuit, so proper use of the chart will lead to either repairing a wiring problem or replacing the sensor, to properly repair a problem.

Mass Air Flow (MAF) Sensor Figure C1-4

The mass air flow (MAF) sensor measures the amount of air which passes through it. The ECM uses this information to determine the operating condition of the engine, to control fuel delivery. A large quantity of air indicates acceleration, while a small quantity indicates deceleration or idle.

A/C MAF Sensor

The MAF sensor produces a frequency output which is proportional to the air entering the engine. The output will vary from about 32 hertz at idle to 150 hertz at WOT. If the sensor fails at a low frequency, a Code 34 should set. If the sensor fails at a high frequency, a Code 33 should set. A Code 44 or 45 may also be caused by a faulty MAF sensor.

The code charts will explain how to determine if the sensor is causing the rich or lean condition.

Manifold Air Temperature (MAT) Sensor

The manifold air temperature (MAT) sensor is a thermistor (a resistor which changes value based on temperature mounted in the air cleaner assembly. Low temperature produces a high resistance (100,000 ohms at -40°C/-40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F).

INTERMITTENTS

Problem may or may not turn "ON" the "Service Engine Soon" light, or store a code.

DO NOT use the Trouble Code Charts in Section A for intermittent problems. The fault must be present to locate the problem. If a fault is intermittent, use of Trouble Code Charts may result in replacement of good parts.

- Most intermittent problems are caused by faulty electrical connections or wiring. Perform careful check as described at start of Section "B". Check for:
  - Poor mating of the connector halves, or terminals not fully seated in the connector body (backed out).
  - Improperly formed or damaged terminals. All connector terminals in problem circuit should be carefully reformed or replaced to insure proper contact tension.
  - Poor terminal to wire connection. This requires removing the terminal from the connector body to check. See "Introduction" to Section "6E".
- If a visual check does not find the cause of the problem, the car can be driven with a voltmeter connected to a suspected circuit. A "Scan" tool can also be used for monitoring input signals to the ECM to help detect intermittent conditions. An abnormal voltage, or "Scan" reading, when the problem occurs, indicates the problem may be in that circuit. If the wiring and connectors check OK and a Trouble Code was stored for a circuit having a sensor, except for Codes 43, 44, and 45, substitute a known good sensor and recheck.

An intermittent "Service Engine Soon" light with no stored code may be caused by:

- Ignition coil shorted to ground and arcing at spark plug wires or plugs.
- "Service Engine Soon" light wire to ECM shorted to ground. (CKT 419).
- Diagnostic "Test" Terminal wire to ECM, shorted to ground.(CKT 451)
- ECM power grounds. See ECM wiring diagrams.
- Loss of trouble code memory. To check, disconnect TPS and idle engine until "Service Engine Soon" light comes on. Code 22 should be stored, and kept in memory when ignition is turned "OFF". If not, the ECM is faulty.
- Check for an electrical system interference caused by a defective relay, ECM driven solenoid, or switch. They can cause a sharp electrical surge. Normally, the problem will occur when the faulty component is operated.
- Check for improper installation of electrical options, such as lights, 2-way radios, etc.
- EST wires should be kept away from spark plug wires, distributor wires, distributor housing, coil, and generator. Wire from ECM to distributor (CKT 453) should be a good connection.
- Check for open diode across A/C compressor clutch, and for other open diodes (see wiring diagrams).

HARD START

Definition: Engine cranks OK, but does not start for a long time. Does eventually run, or may start but immediately dies.

- Perform careful check as described at start of Section "B".
- Make sure driver is using correct starting procedure.
- **CHECK:**
  - TPS for sticking or binding or a high TPS voltage with the throttle closed (should read less than .700 volts).
  - High resistance in coolant sensor circuit or sensor itself. See Code 15 chart or with a "Scan" tool compare coolant temperature with ambient temperature on a cold engine.
  - Fuel pressure CHART A-7.
  - Water contaminated fuel.
  - EGR operation. Be sure valve seats properly and is not staying open. See CHART C-7.
  - Both injector fuses (visually inspect).
  - Ignition system - Check distributor for:
    Proper Output with ST-125.
    Worn shaft.
    Bare and shorted wires.
    Pickup coil resistance and connections.
    Loose ignition coil ground.
    Moisture in distributor cap.
- If problem exists in cold weather, check cold start valve. See CHART A-9 .

POOR FUEL ECONOMY

Definition: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, economy is noticeably lower than it was on this car at one time, as previously shown by an actual road test.

- Perform careful visual check as described at start of Section "B".
- **CHECK:**
  - Coolant level.
  - Engine thermostat for faulty part (always open) or for wrong heat range. See Section "6B".
  - Compression
  - Ignition timing. See Emission Control Information label.
  - TCC for proper operation. A "Scan" should indicate an rpm drop when the TCC is commanded "ON". See CHART C-8.
  - Induction system and crankcase for air leaks.
- Check for exhaust restriction See CHART B-1.

DIESELING, RUN-ON

Definition: Engine continues to run after key is turned off, but runs very roughly. If engine runs smoothly, check ignition switch and adjustment.

- Check injectors for leaking. See CHART A-7.

ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING

Definition: The engine runs unevenly at idle. If bad enough, the car may shake. Also, the idle may vary in rpm (called "hunting"). Either condition may be bad enough to cause stalling. Engine idles at incorrect speed.

- Perform careful visual check as described at start of Section "B".
- **CHECK:**
  - Throttle linkage for sticking or binding.
  - Ignition timing. See emission control information label.
  - ECM ground circuits.
  - IAC system. See CHART C-2C.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - P/N switch circuit. See CHART C-1A, or use "Scan" tool.
  - Injector balance. See CHART C-2A.
  - PCV valve for proper operation by placing finger over inlet hole in valve end several times. Valve should snap back. If not, replace valve.
  - Evaporative emission control system. CHART C-3.
  - A/C signal to ECM terminal "B8". "Scan" tool should indicate A/C is being requested when ever A/C is selected and the pressure cycling switch is closed.
  - Minimum idle speed. See Section "C2".
  - Loose or damaged MAF sensor duct between sensor and throttle body.
  - Check A.I.R. system. There should be no A.I.R to ports while in "Closed Loop". See CHART C6.
  - EGR valve: There should be no EGR at idle.
- Run a cylinder compression check-see Section "6".
- Inspect oxygen sensor for silicon contamination from fuel, or use of improper RTV sealant. The sensor will have a white, powdery coating, and will result in a high but false signal voltage (rich exhaust indication). The ECM will then reduce the amount of fuel delivered to the engine, causing a severe driveability problem.
- Check for fuel in pressure regulator hose. If present replace regulator assembly.
- Check ignition system; wires, plugs, rotor, etc.
- Check for loose or damaged air duct between MAF sensor and throttle body.
- Disconnect MAF sensor and if condition is corrected replace sensor.
- Clean injectors.
- Monitoring block learn will help identify the cause of the problem. If the system is runnig lean (block learn greater than 138), refer to "Diagnostic Aids" on facing page of Code 44. If the system is running rich (block learn less than 118), refer to "Diagnostic Aids" on facing page of Code 45.

EXCESSIVE EXHAUST EMISSIONS OR ODORS

Definition: Vehicle fails an emission test. Vehicle has excessive "rotten egg" smell. Excessive odors do not necessarily indicate excessive emissions.

- Perform "Diagnostic Circuit Check."
- IF TEST SHOWS EXCESSIVE CO AND HC, (or also has excessive odors):
  - Check items which cause car to run RICH.
    - Make sure engine is at normal operating temperature.
- **CHECK:**
  - Fuel pressure. See CHART A-7.
  - Incorrect timing. See vehicle emission control information label.
  - Canister for fuel loading. See CHART C-3.
  - Injector balance. See CHART C-2A.
  - PCV valve for being plugged, stuck, or blocked PCV hose, or fuel in the crankcase.
  - Spark plugs, plug wires, and ignition components. See Section "6D".
  - Check for lead contamination of catalytic converter (look for removal of fuel filler neck restrictor).
  - Check for properly installed fuel cap.
  - If the system is running rich, (block learn less than 118), refer to "Diagnostic Aids" on facing page of Code 45.
- IF TEST SHOWS EXCESSIVE NOx:
  - Check items which cause car to run LEAN, or to run too hot.
    - EGR valve for not opening. See CHART C-7.
    - Vacuum leaks.
    - Coolant system and coolant fan for proper operation. See CHART C-12.
    - Remove carbon with top engine cleaner. Follow instructions on can.
    - Check ignition timing for excessive base advance. See emission control information label.
  - If the system is running lean, (block learn greater than 138), refer to "Diagnostic Aids" on facing page of Code 44.

SECTION C
COMPONENT SYSTEMS

Section "C" provides information on the following:

- General description of components and systems.
- On-vehicle service.
- Part names and group numbers.
- Diagnostic charts. These include a functional check of the system as well as diagnosis of any problem found in the functional check.

For locations of components, wiring diagrams, and ECM Terminal End View, refer to the front on the "A" section of the engine being diagnosed.

Following are the sub-section identification and the system covered:

DIAGNOSTIC CHARTS

The Diagnostic Charts for each system are found after the on-car service and parts information at the back of each section. Following are the charts found in this section.

SECTION C1

ELECTRONIC CONTROL MODULE (ECM) AND SENSORS

CONTENTS

GENERAL DESCRIPTION

ELECTRONIC CONTROL MODULE (ECM)

The electronic control module (ECM) (Figure C1-1), located under the instrument panel, is the control center of the fuel injection system. It constantly looks at the information from various sensors, and controls the systems that affect vehicle performance. The ECM performs the diagnostic function of the system.

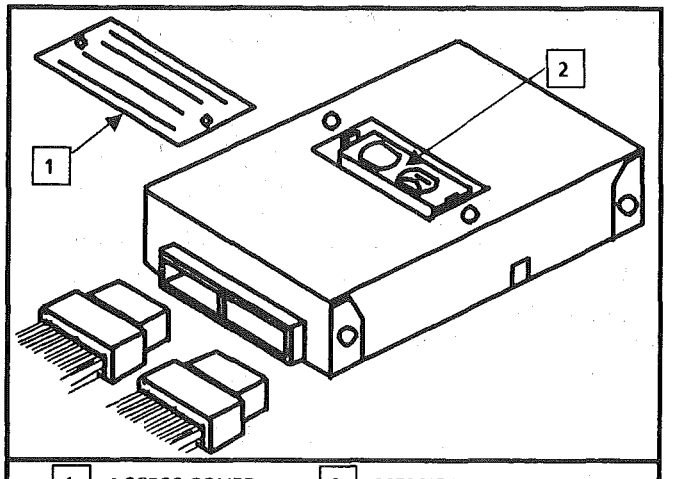

Figure C1-1 - Electronic Control Module (ECM)

It can recognize operational problems, alert the driver through the "Service Engine Soon" light, and store a code or codes which identify the problem areas to aid the technician in making repairs. See Section "6E" for more information on using the diagnostic function of the ECM.

For service, this ECM only consists of two parts: a controller (the ECM without a Mem-Cal) and an assembly called a Mem-Cal. (This stands for "Memory and Calibration" Unit).

MEM-CAL

This assembly contains both the functions of the PROM and CalPak. Like the PROM, it contains the calibrations needed for a specific vehicle as well as the back-up fuel control circuitry required if the rest of the ECM becomes damaged or faulty.

ECM Function

The ECM supplies either 5 or 12 volts to power various sensors or switches. This is done through resistances in the ECM which are so high in value that a test light will not light when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. Therefore, a 10 meg ohm input impedance digital voltmeter is required to assure accurate voltage readings.

The ECM controls output circuits such as the injector, IAC, cooling fan relay, etc. by controlling the ground circuit through transistors in the ECM.

INFORMATION SENSORS

Engine Coolant Temperature Sensor (Figure C1-2)

The coolant sensor is a thermistor (a resistor which changes value based on temperature) mounted in the engine coolant stream. Low coolant temperature produces a high resistance (100,000 ohms at -40°C/-40°F), while high temperature causes low resistance (70 ohms at 130°C/266°F).

The ECM supplies a 5-volt signal to the coolant sensor through a resistor in the ECM and measures the voltage. The voltage will be high when the engine is cold, and low when the engine is hot. By measuring the voltage, the ECM knows the engine coolant temperature. Engine coolant temperature affects most systems the ECM controls.

A failure in the coolant sensor circuit should set either a Code 14 or Code 15. Remember, these codes indicate a failure in the coolant temperature circuit, so proper use of the chart will lead to either repairing a wiring problem or replacing the sensor, to properly repair a problem.

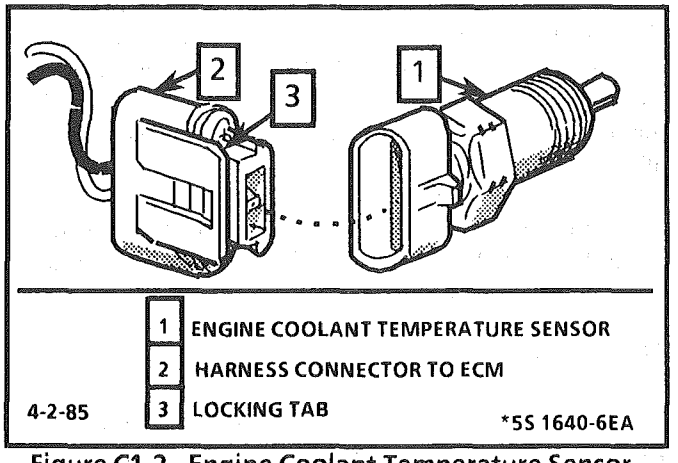

Figure C1-2 - Engine Coolant Temperature Sensor

Mass Air Flow (MAF) Sensor (Figure C1-3)

The mass air flow (MAF) sensor measures the amount of air which passes through it. The ECM uses this information to determine the operating condition of the engine, to control fuel delivery. A large quantity of air indicates acceleration, while a small quantity indicates deceleration or idle.

The Bosch mass air flow (MAF) sensor used in this vehicle is of the hot wire type. Current is supplied to the sensing wire to maintain a calibrated temperature, and as air flow increases or decreases the current will vary. This varying of current causes a voltage drop within the meter circuitry which isdirectly proportional to air mass. The ECM supplies a current limiting 5-volt source on the signal line, and the MAF sensor pulls the voltage low (about .4V) with low air flow and up to about 5 volts with high air flow such as WOT. The voltage drop is then processed by the ECM for calculating fuel delivery. If the sensor fails, a Code 33 or 34 should be stored in memory.

Due to the sensor's hot wire being exposed to air, which always contains some contaminants, there can be deposits form on the sensing wire. This can affect the accuracy of the meters measurement. To keep the system functioning properly, the wire is heated to about 1000°F after engine shut down. This burn-off cycle is controlled by the ECM, which energizes the burn-off relay. The ECM will ground the relay winding after engine shut down, if the engine had been running a specified amount of time. With the relay energized, the ECM then monitors the MAF signal line to determine if the burn-off function took place. If it didn't, then a Code 36 will be stored and the "Service Engine Soon" light will come "ON" the next time the engine is started.

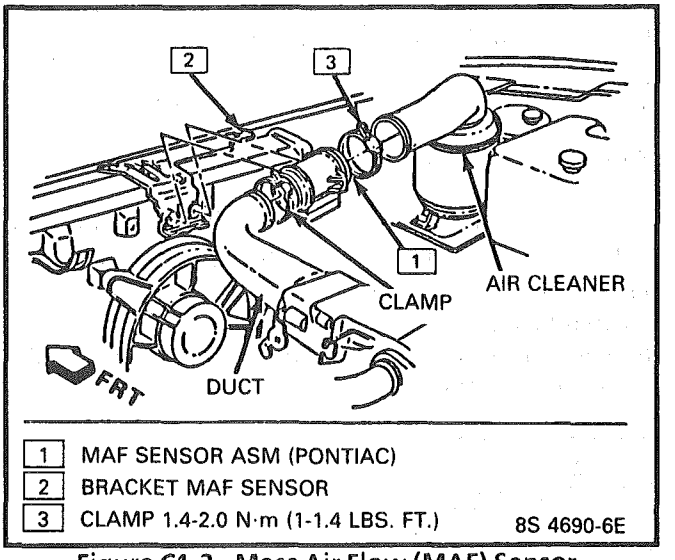

Figure C1-3 - Mass Air Flow (MAF) Sensor

Manifold Air Temperature (MAT) Sensor

The air temperature sensor (MAT) is a thermistor (a resistor which changes value based on temperature) is mounted in the plenum. Low temperature produces a high resistance (100,000 ohms at -40°C/-40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F).

The ECM supplies a 5-volt signal to the sensor through a resistor in the ECM and measures the voltage. The voltage will be high when the manifold air is cold, and low when the air is hot. By measuring the voltage, the ECM knows the manifold air temperature.

SECTION C4

IGNITION SYSTEM / EST

CONTENTS

GENERAL DESCRIPTION

PURPOSE

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

Only the electronic spark timing (EST) system will be described here. Additional information on the HEI system is found in Section "6D".

To properly control ignition/combustion timing the ECM needs to know:

- Crankshaft position
- Engine speed (rpm)
- Mass Air Flow
- Engine temperature

OPERATION

The EST system consists of the distributor module, ECM, and connecting wires. The connector terminals are lettered as shown in CHART C-4.

These circuits perform the following functions:

- Distributor reference (CKT 430).

This provides the ECM with rpm and crankshaft position information. If the wire becomes open or grounded the engine will not run, because the ECM will not operate the injectors. If the engine cranks but won't run, see CHART A-3.

- Reference ground (CKT 453).

This wire is grounded in the distributor and makes sure the ground circuit has no voltage drop which could affect performance. If it is open, it may cause poor performance.

- Bypass (CKT 424).

At about 400 rpm, the ECM applies 5 volts to this circuit to switch spark timing control from the HEI module to the ECM. The wire goes through a connector between the 4 wire connector and the ECM. This is disconnected to the set base timing.

An open or grounded bypass circuit will set a Code 42 and the engine will run at base timing, plus a small amount of advance built into the HEI module.

- EST (CKT 423).

This circuit triggers the HEI module after the engine is started and no Code 42 detected. The ECM does not know what the actual timing is, but it does know when it gets the reference signal. It then advances or retards the spark from that point. Therefore, if the base timing is set incorrectly, the entire spark curve will be incorrect.

RESULTS OF INCORRECT OPERATION

An open or ground in the EST circuit will set a Code 42 and cause the engine to run on the HEI module timing. This will cause reduced performance and poor fuel economy.

The ECM uses information from the MAF and coolant sensors in addition to rpm to calculate spark advance as follows:

- Cold engine = more spark advance.
- Engine under minimum load based on rpm and low amount of air flow- more spark advance.
- Hot engine = less spark advance.
- Engine under heavy load based on rpm and high amount of air flow- less spark advance.

DIAGNOSIS

The description, operation, and repair procedures of the HEI system are found in Section "6D" of this manual. For an ignition system check, refer to CHART C-4 at the end of this section.

CODE 12

Code 12 is used during the diagnostic circuit check procedure to test the code display ability of the ECM. This code indicates that the ECM is not receiving the engine rpm (REFERENCE) signal. This occurs with the ignition key "ON", and the engine not running.

The "Reference" signal also triggers the fuel injection system. Without the "Reference" signal the engine cannot run. This signal can be checked by using a "Scan" tool which will help determine the cause of an engine that cranks but won't start.

ON-CAR SERVICE

SETTING TIMING

The initial base timing is set by disconnecting the timing connector. Then set the timing to the specification shown on emmision control information label. This will cause Code 42 to be stored in the memory of the ECM. The memory must be cleared after setting timing.

How Code 42 Is Determined

When the system is running on the HEI module, that is, no voltage on the bypass line, the HEI module grounds the EST signal. The ECM expects to see no voltage on the EST line during this condition. If it sees a voltage, it sets code 42 and will not go into the EST mode.

When the rpm for EST is reached, (about 400 rpm), the ECM applies 5 volts to the bypass line and the EST should no longer be grounded in the HEI module, so the EST voltage should be varying.

If the bypass line is open or grounded, the HEI module will not switch to EST mode, so the EST voltage will be low and Code 42 will be set.

PARTS INFORMATION

PART NAME	GROUP
Coil, Distr	2.170
Controller, ECM (Remanufactured)	3.670
Distributor	2.361
Module, Distr	2.383

BLANK