"A DIFFERENT APPROACH"

SECTION 6E3
DRIVEABILITY AND EMISSIONS
FUEL INJECTION (PORT)

SERVICE DEPARTMENT
PONTIAC DIVISION

1985 FIERO
2.8L L44
VIN CODE 9

PONTIAC

GM

INTRODUCTION

Section 6E of the Chassis Service Manual (Driveability and Emissions) contains a great deal of excellent information. The diagnostic procedures are essential for servicing engine and driveability problems related to the Electronic Control Module.

As a project to compare different approaches to repair procedures for our Pontiac technicians, this manual sets forth an alternative approach to Section 6E. The following is a restructured portion of Section 6E3, Driveability and Emissions, Fuel Injection (Port), for the 1985 Pontiac Fiero.

This restructured portion of Section 6E3, comprised of new schematics and diagnostic procedures, covers the V6, VIN Code 9, 2.8 liter engine.

The general information of this new approach section is the same as the existing section 6E3 as it appears in the 1985 Fiero Service Manual (Final). This material includes ECM descriptions, symptoms, trouble shooting hints, descriptions of systems and components, and references to diagnostic charts. However, the electrical schematics and the diagnostic charts are new.

Characteristics of this "Different Approach" method:

- Arrows connect text to the schematic -
  - fewer words tell where to perform a test.
  - significance of measurement apparent since the location of the test point is visually related to the working of the circuit by the schematic.
  - wires/switches to be checked if a voltage or ground is not present make up the line leading to that point.
  - sequence of the measurements is evident from placement around the circuit as well as identifying number.
- Overall pattern of the diagnostic procedure is to check the operation of the familiar electrical and electromechanical components and wiring. If the circuit beyond the ECM is operating correctly, then the ECM must be at fault.
- Consistent format is maintained for all schematics.

Please take the time and effort to review this manual. Become familiar with its contents and use the material when diagnosing and repairing a driveability situation on a 1985 Fiero equipped with a 2.8 liter engine.

We would appreciate it if you would compare this new formatted 6E3 section with the 6E3 format as it exists in 1985 Fiero Service Manual (Final). We will be following up in the near future in an effort to solicit your opinions and/or comments. However, if you would like to evaluate this reformatted section immediately upon its use, please send your written comments to:

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Thank you for your consideration.

Service Department
Pontiac Division
General Motors Corporation

SECTION 6E3
DRIVEABILITY AND EMISSIONS FUEL INJECTION (PORT)

THIS SECTION APPLIES TO:

2.8L L44 ("P" SERIES) VIN CODE 9

CONTENTS

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

The engine used in this vehicle has controls to reduce exhaust emissions while maintaining good driveability and fuel economy.

Refer to section 6E for information to diagnosis and repair systems in this section.

An electronic Control Module (ECM) is the heart of this control system. Figure 1 has a list of sensors the ECM uses to get information about engine operation and the various systems it controls. Details of basic operation, diagnosis, and service are covered in Section C Component Systems.

The ECM has the ability to do some diagnosis of itself. When it finds a problem, it lights a "CHECK ENGINE" light on the instrument panel. 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.

Under the instrument panel is an Assembly Line Communication Link (ALCL) connector that is used by the assembly plant for a computer check-out of the system. This connector is used in service to help diagnose the system (see "Diagnostic Procedure Terms"), Section 6E.

ENGINE EMISSION COMPONENTS

A top view location of emission components for the engine is shown in the following illustration.

- Component Locations - 2.8L .....Figure 1

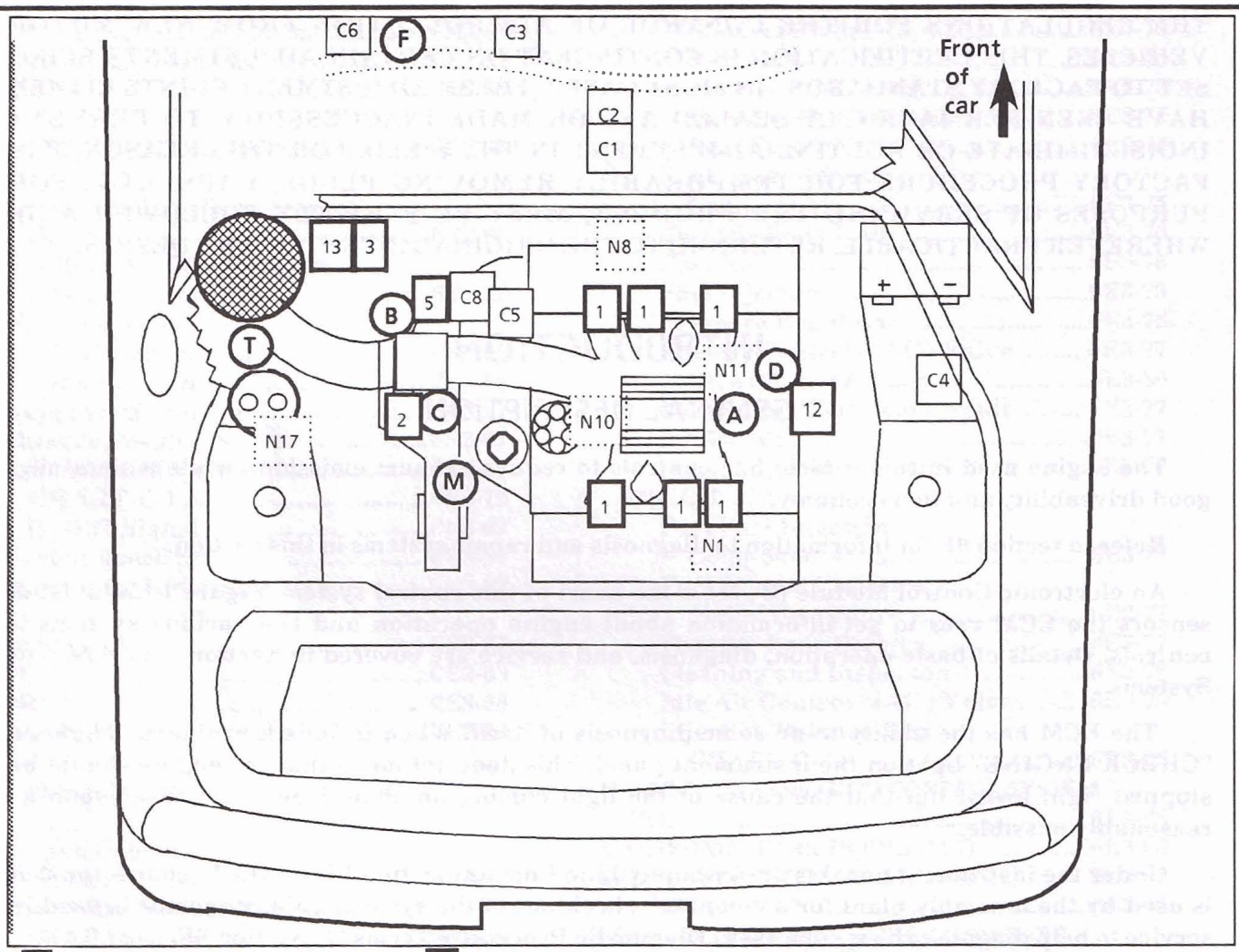
Wiring schematic diagrams for each ECM are as shown:

- Wiring Diagram - 2.8L .....Figure 2 and 3

Refer to following figure for ECM terminal end view of connector showing circuit and voltages.

- 2.8L .....Figure 4

'P' SERIES RPO:L44 VIN CODE: 9 2.8L V6 PFI



COMPUTER HARNESS

- C1 Electronic Control Module (ECM)
- C2 ALCL diagnostic connector
- C3 "CHECK ENGINE" light
- C4 ECM power
- C5 ECM harness ground
- C6 Fuse panel
- C8 Fuel pump test connector

NOT ECM CONNECTED

- N1 Crankcase vent valve (PCV)
- N8 Oil press. switch (fuel pump)
- N10 Cold start valve
- N11 Cold start thermal time switch
- N17 Fuel vapor canister

CONTROLLED DEVICES

- 1 Fuel injector
- 2 Idle air control valve
- 3 Fuel pump relay
- 5 Trans. Converter Clutch connector
- 12 Exh. Gas Recirc. vacuum solenoid
- 13 A/C compressor relay

Exhaust Gas Recirculation valve

INFORMATION SENSORS

- A Manifold pressure (M.A.P.)
- B Exhaust oxygen
- C Throttle position
- D Coolant temperature
- F Vehicle speed
- M P/N switch
- T Manifold Air Temperature

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Figure 1 Component Locations - (2.8L)

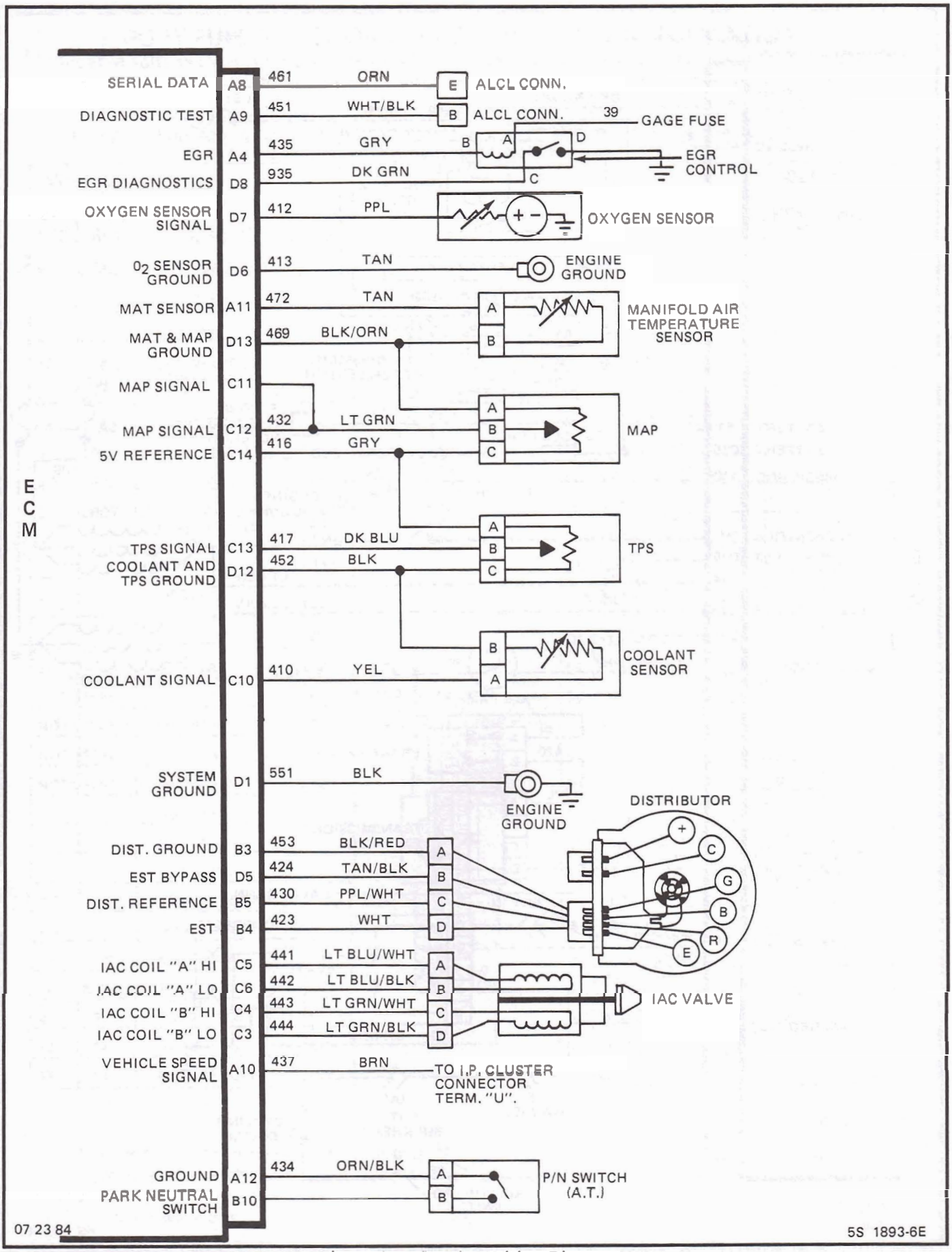


Figure 2 - 2.8L ECM Wiring Diagram

DIAGNOSTIC CIRCUIT CHECK

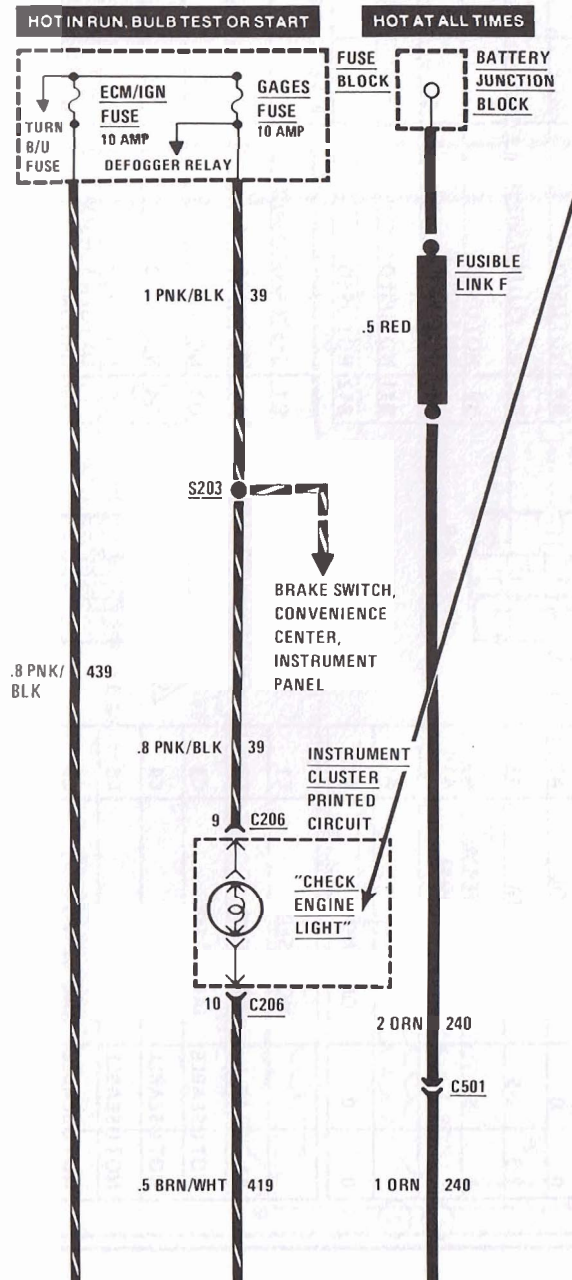
The Diagnostic Circuit Check is an organized approach to identifying a problem caused by the FUEL INJECTION SYSTEM.

Driver comments normally fall into one of the following areas:

a. Steady "CHECK ENGINE" light
b. Driveability Problem
c. Engine "cranks but will not run"

Using the Diagnostic Circuit Check will reduce diagnosis time and prevent the unnecessary replacement of parts.

When the DIAGNOSTIC TERMINAL is grounded the ECM causes the "CHECK ENGINE" light to flash Code 12 to indicate that the ECM diagnostics are working. Code 12 will flash three (3) times, followed by other stored codes. Each additional code flashes three (3) times and then the series will repeat, starting with Code 12 again. If no additional codes are stored then Code 12 will flash until the jumper wire used to ground the DIAGNOSTIC TERMINAL is removed or until the engine is started.



4 If the "CHECK ENGINE" light flashes at a rate of once per second (slow) then the ECM has confirmed "Closed Loop" operation and no fault was detected by the ECM on-board diagnostics. The system normally flashes "Open Loop" for 30 seconds to 2 minutes after the engine is started or until the OXYGEN SENSOR reaches normal operating temperature . If "Closed Loop" flashes but the problem persists then **REFER TO SECTION B.**

5 If the "CHECK ENGINE" light flashes at a rate of 2.5 times per second (fast) then the ECM has indicated "Open Loop" operation. **REFER TO THE CHART FOR CODE 13.**

6 If the "CHECK ENGINE" light is off all or most of the time, a lean exhaust is indicated. **REFER TO THE CHART FOR CODE 44.**

7 If the "CHECK ENGINE" light is on all or most of the time, a rich exhaust is indicated. **REFER TO THE CHART FOR CODE 45.**

1 With the engine stopped and the ignition "ON," note the "CHECK ENGINE" light.

a. If the light is off, **REFER TO CHART A-1.**

b. If the light is flashing Code 12, check for a short to ground between the ECM and terminal B of the ALCL Connector.

c. If the light is intermittent, **REFER TO SECTION B.**

d. If the light is steady, then ground the DIAGNOSTIC TERMINAL and note the codes. Go to step **2** or **3**.

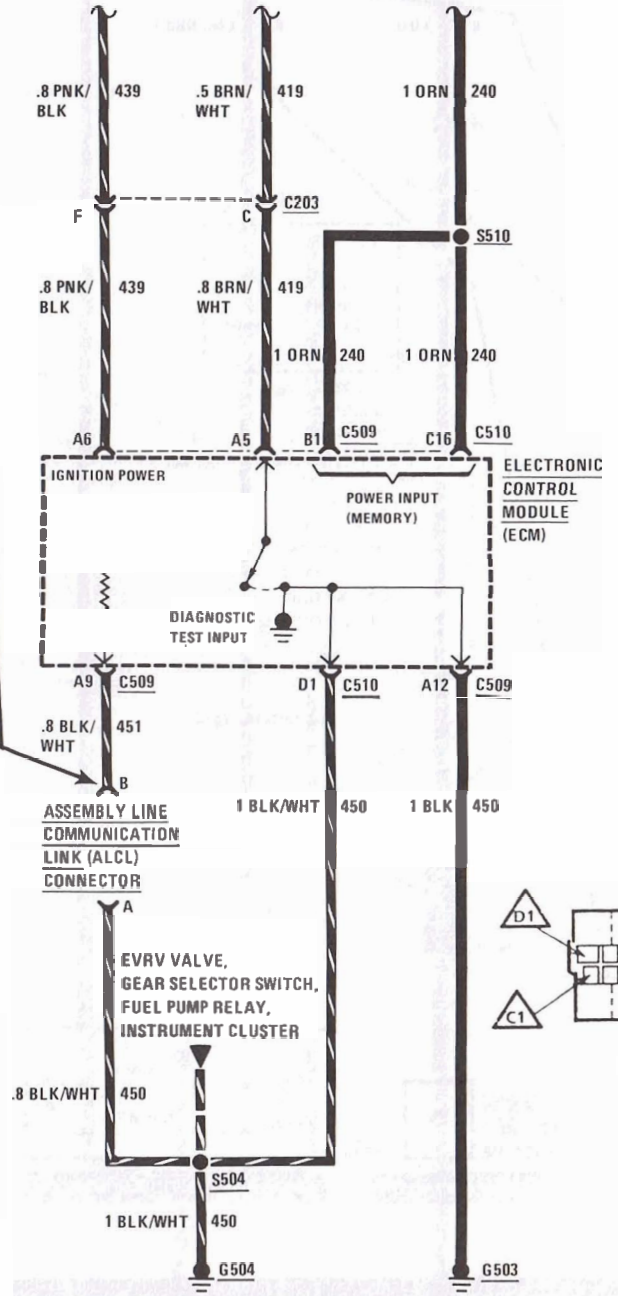
2 If Code 12 does not flash then **REFER TO CHART A-2.**

3 If Code 12 flashes then record any additional codes.

a. If the engine cranks but will not run then **REFER TO CHART A-3.**

b. If additional codes are noted then starting with the lowest code, **REFER TO THE APPLICABLE CHARTS.**

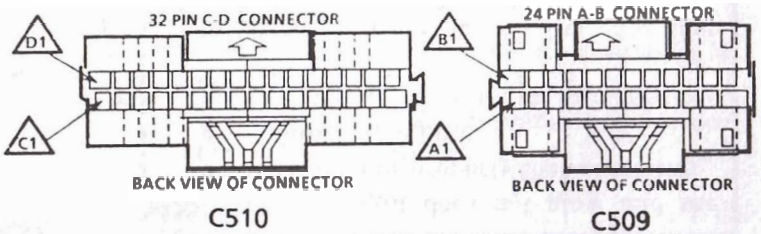
c. If only Code 12 flashes then perform the "Field Service Mode" check. Enter "Field Service Mode." Ground the DIAGNOSTIC TERMINAL and run the engine from 1200 to 1600 rpm for one minute at normal operating temperature. Note the "CHECK ENGINE" light. Go to Step **4, 5, 6,** or **7.**



Road test of the system using the Field Service Mode should be done only at steady road speeds. This can be helpful in diagnosing driveability problems where the system is rich or lean too long. Because the vehicle operates differently in the Field Service Mode, the following conditions may be observed and should be considered normal:

- Acceleration - The "CHECK ENGINE" light may be on too long due to acceleration enrichment.
- Deceleration - The "CHECK ENGINE" light may be off too long due to a lean mixture during deceleration.
- Idle - The light may be on too long with the idle below 1200 rpm.
  Surge at 35 mph - The timing changes from 10° to normal spark advance at 1600 - 1800 rpm.

Clear all codes, confirm "closed loop" operation and no "CHECK ENGINE" light.



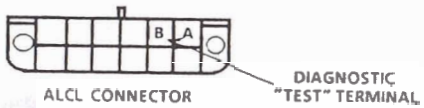
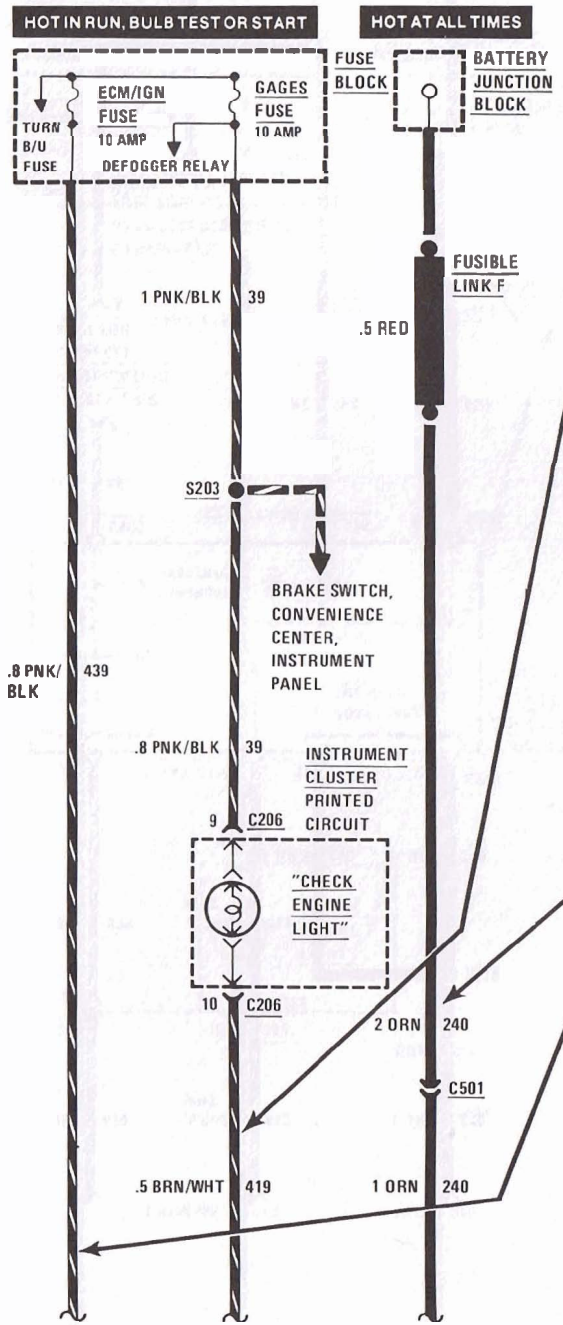


CHART A-1
NO "CHECK ENGINE" LIGHT

With the engine stopped and the ignition "ON," the "CHECK ENGINE" light should emit a steady glow. Battery voltage is supplied directly to the "CHECK ENGINE" light bulb. The ELECTRONIC CONTROL MODULE (ECM) provides a ground path for the "CHECK ENGINE" light through circuit 419 (brown/white stripe).

The ECM uses internal electronic switches called "drivers" to turn on solenoids and relays. Each driver is one of a set of four called a "Quad Driver." Failure of one driver can cause damage to another driver in the set. Solenoid and relay coil resistance must measure more than 20 ohms. Less resistance will cause early failure of an ECM "driver."

Before replacing the ECM, check the coil resistance of all solenoids and relays controlled by the ECM. When checking 125TCC solenoid, be sure to raise the drive wheels and run above 30 mph to close the third gear apply switch, if used.



2 If the test light does not glow and the engine functions properly then check for:

a. A faulty light bulb.
b. An open in circuit 419 (brown/white stripe).
c. A blown gage fuse. If the gage fuse blows, the parking brake light, the seat belt light, and other instrument panel warning lights will not operate.
d. An open in the 12 volt ignition feed.

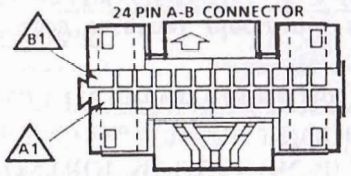
3 If the test light glows then check for:

a. Battery voltage - open fuse or fusible link.
b. An open in the ECM ignition fuse.
c. An open in circuit 240 (orange wire).
d. An open in circuit 439 (pink/black stripe).
e. A faulty ECM connection.
f. If no fault is found then go to step **4**.

1 Connect a test light and look for voltage in circuit 419 ("CHECK ENGINE" light circuit - brown/white stripe).

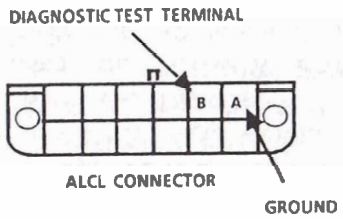
a. **DISCONNECT THE ECM CONNECTORS**.

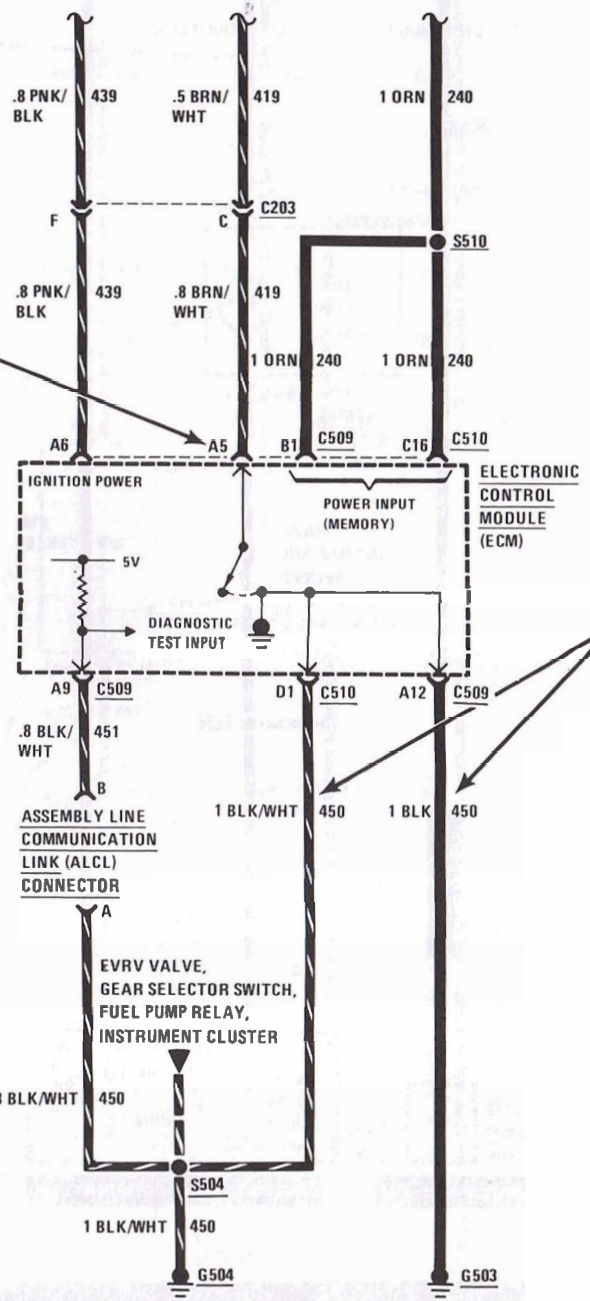
b. With the engine stopped and the ignition "ON," check circuit 419 (brown/white stripe) for voltage at pin A5. Go to step **2** or **3**.

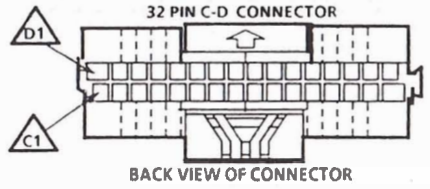


BACK VIEW OF CONNECTOR

C509







BACK VIEW OF CONNECTOR

C510

4 Check ECM ground circuits 450 (black) for an open. If no open is found then **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**

CAUTION: Before replacing the ECM, use an ohmmeter to check the resistance of each ECM controlled relay and solenoid coil. If any coil resistance is less than 20 ohms then replace that relay or solenoid.

Reconnect all connectors. Clear all codes, confirm closed loop" operation and no "CHECK ENGINE" light.

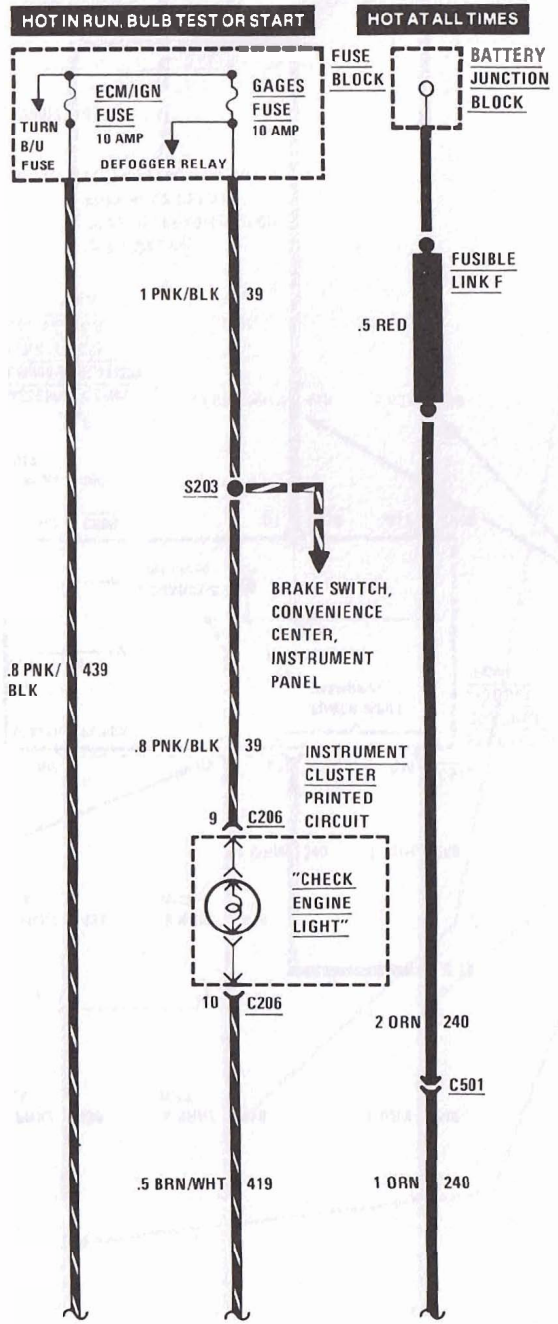
CHART A-2
"CHECK ENGINE" LIGHT ON STEADY WILL NOT FLASH CODE 12

With the engine stopped and the ignition "ON," the "CHECK ENGINE" light should emit a steady glow. With the DIAGNOSTIC TERMINAL grounded, the "CHECK ENGINE" light should flash code 12 followed by any trouble codes stored in memory.

Battery voltage is supplied directly to the "CHECK ENGINE" light bulb. The ELECTRONIC CONTROL MODULE (ECM) provides a ground path for the "CHECK ENGINE" light through circuit 419 (brown/white stripe).

The ECM uses internal electronic switches called "drivers" to turn on solenoids and relays. Each driver is one of a set of four called a "Quad Driver." Failure of one driver can cause damage to another driver in the set. Solenoid and relay coil resistance must measure more than 20 ohms. Less resistance will cause early failure of an ECM "driver."

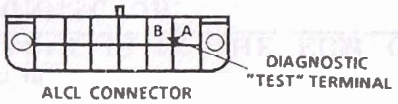
Before replacing the ECM, check the coil resistance of all solenoids and relays controlled by the ECM. When checking 125TCC solenoid, be sure to raise the drive wheels and run above 30 mph to close the third gear apply switch, if used.



5 If Code 12 does not flash then with the ignition "OFF" and the DIAGNOSTIC TERMINAL not grounded, REMOVE THE PROM.

a. With the engine stopped and the ignition "ON," ground the DIAGNOSTIC TERMINAL.

b. Note code. Go to step **6** or **7**.



6 If code 51 does not set, **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**

Caution: Before replacing the ECM, use an ohmmeter and check the resistance of each ECM controlled relay and solenoid coil. If any coil resistance is less than 20 ohms then replace that relay or solenoid.

1 Check for short to ground in Circuit 419 ("CHECK ENGINE" light circuit - brown/white stripe).

a. With the ignition "OFF," **DISCONNECT BOTH ECM CONNECTORS.**

b. With the engine stopped and the ignition "ON," verify that the check engine light went off. Go to step **2** or **3**.

2 If the "CHECK ENGINE" light remains glowing then **FIND THE SHORT TO GROUND IN CIRCUIT 419 (brown/white stripe).**

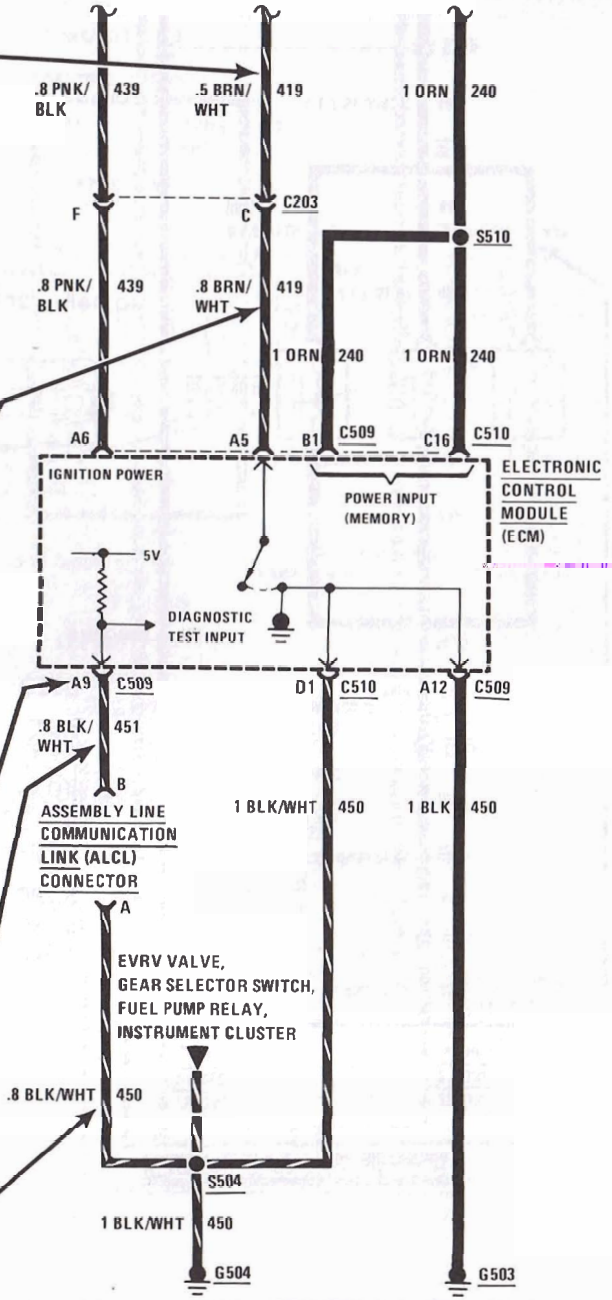
3 If the "CHECK ENGINE" light goes off then check for a properly grounded DIAGNOSTIC TERMINAL.

a. With the ignition "OFF," **RECONNECT THE ECM**. Do not ground the DIAGNOSTIC TERMINAL.

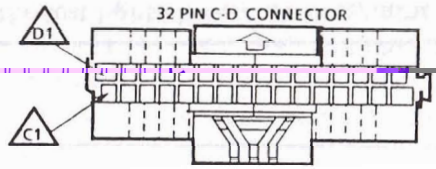
b. With the engine stopped and the ignition "ON," back probe pin A9, circuit 451 (black/white stripe), with a test light to ground.

c. Look for Code 12. Go to step **4** or **5**.

4 If Code 12 flashes then **FIND THE OPEN IN CIRCUIT 451 (black/white stripe) OR CIRCUIT 450 (black/white stripe).**



7 If Code 51 sets then substitute a known good PROM and look for Code 12. If Code 12 does not set, **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**



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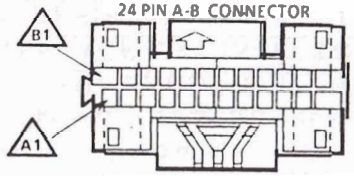


C510

Reconnect all connectors. Clear all codes, confirm "closed loop" operation and no "CHECK ENGINE" light.

CHART A-3A,
ENGINE CRANKS BUT WILL NOT RUN.

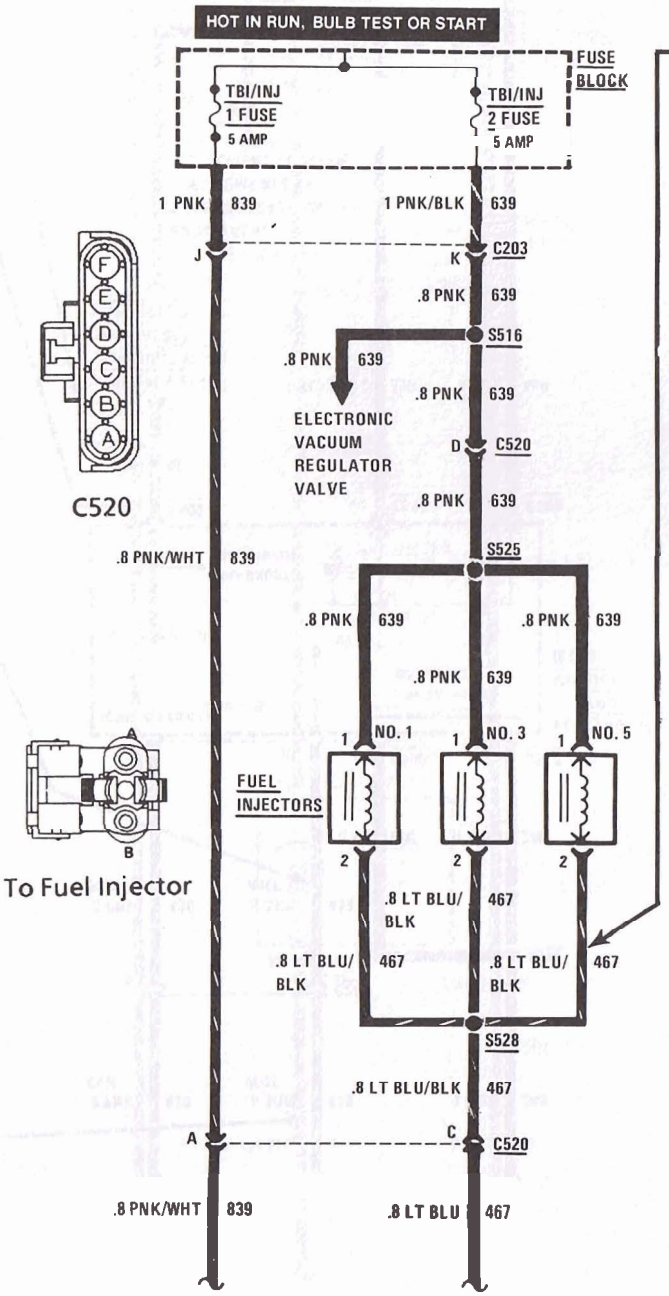
Battery condition and engine speed are OK, and there is adequate fuel in the tank. If the engine starts but immediately stalls, see symptoms Section B (Hard Start).

The fuel injector circuits (639 and 839) are supplied with 12 volts when the ignition switch is "ON" or in "start." A ground path for the fuel injector circuits is provided by the ECM.

Do not allow fuel injector harness connectors to short together while cranking or ECM damage may result. (Resistance across the fuel injectors should be at least 10 ohms.) The EFI system is under pressure. To avoid fuel spillage refer to FIELD SERVICE PROCEDURES for testing or repairs requiring fuel line disassembly.

1 If the engine starts but immediately stalls, **REFER TO SECTION B.**

2 Perform the following checks:
- a. Check the fuel level.
- b. With the engine stopped and the ignition "ON," note the "CHECK ENGINE" light. If the "CHECK ENGINE" light is off, **REFER TO CHART A-1.**



6 If the test light glows but does not blink then check Injector Driver circuit 467 (blue/black stripe) and/or circuit 468 (light

If no short to ground is found then check the resistance of each injector. The resistance should be at least 10 ohms. GO to **b** or **c**.

- b. If the resistance is more than 10 ohms then **THE FAULT IS IN THE ECM.**
- c. **REPLACE ANY INJECTOR WITH A RESISTANCE LESS THAN 10 OHMS** and recheck for a blinking test light. If the test light does not blink then **THE FAULT IS IN THE ECM.**

7 If the test light blinks then determine that delivered fuel pressure is between 234 and 310 kPa (34 to 45 psi).
- a. Install fuel pressure gage (J34730-1). Wrap a shop towel around the fuel pressure tap to absorb any small amount of fuel leakage that may occur when installing the fuel gage.
- b. With the engine stopped, turn the ignition "ON" until the fuel pump stops running and note the fuel pressure. See step **7, 8,** or **9**.

8 If there is no fuel pressure reading then **REFER TO CHART A-7A.**

3 Perform the following checks:

a. Check for fouled spark plugs.

b. Check for spark at spark plugs. Connect spark checker, ST-125 to a plug wire. Check at least two wires while cranking the engine. If there is no spark then check the HEI system. **REFER TO SECTION 6D.**

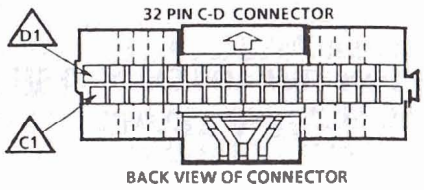
4 Check for a control signal at a fuel injector on each side of the engine.

a. **DISCONNECT ONLY ONE FUEL INJECTOR HARNESS CONNECTOR AT A TIME.**

b. Connect a 6 volt test light (J-34730-2) across the fuel injector harness connector.

c. Check for a blinking light while cranking the engine. See step **5**, **6**, or **7**.

5 If the test light does not glow then **REFER TO CHART A-3B.**



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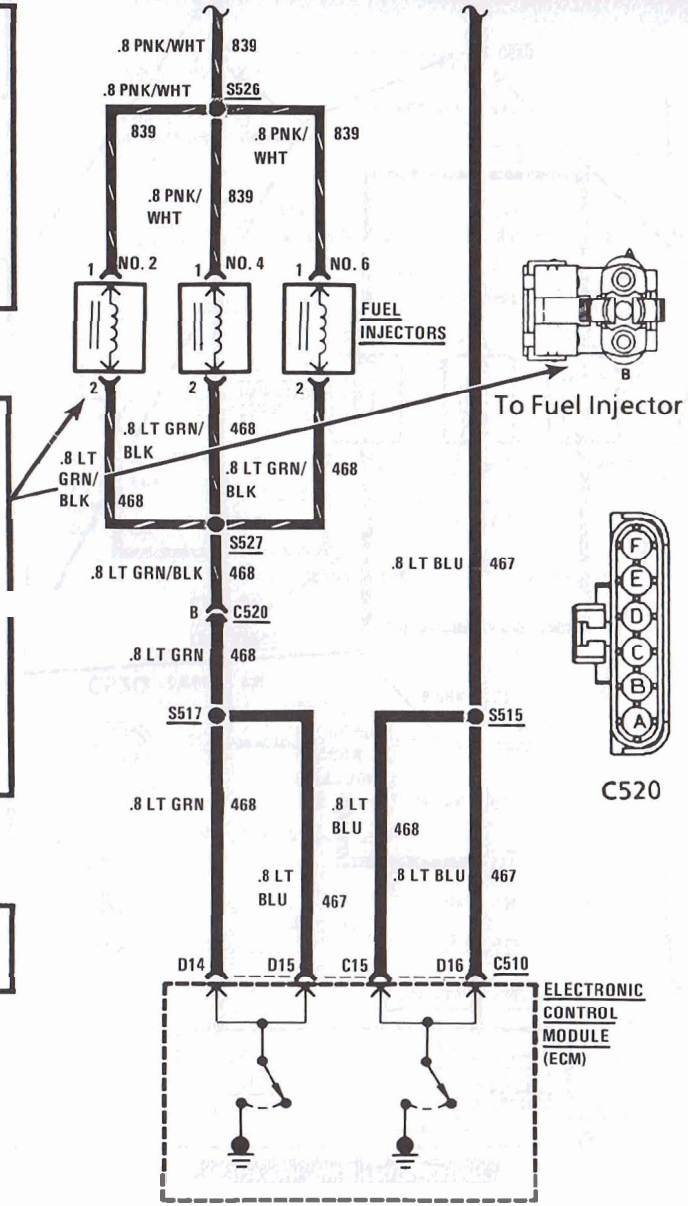


9 If the fuel pressure reading is below 234 kPa (34 psi) or more than 310 kPa (45 psi) then **REFER TO CHART A-7C.**

10 If the fuel pressure reading is good then check for the following:

a. EGR valve stuck open.

b. A defective COLD START VALVE circuit. In cold weather a defective cold start circuit or water in the fuel line can cause the engine to crank but not run. **REFER TO CHART A-9.**

c. A sticking or binding THROTTLE POSITION SENSOR (wide open position).

d. Blown injector fuses (circuit 639 and 839).

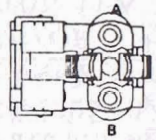
e. If the problem persists then **REFER TO "HARD START" IN SECTION B.**

Reconnect all connectors. Clear all codes, confirm "closed loop" operation and no "CHECK ENGINE" light.

CHART A-3B,
ENGINE CRANKS BUT WILL NOT RUN

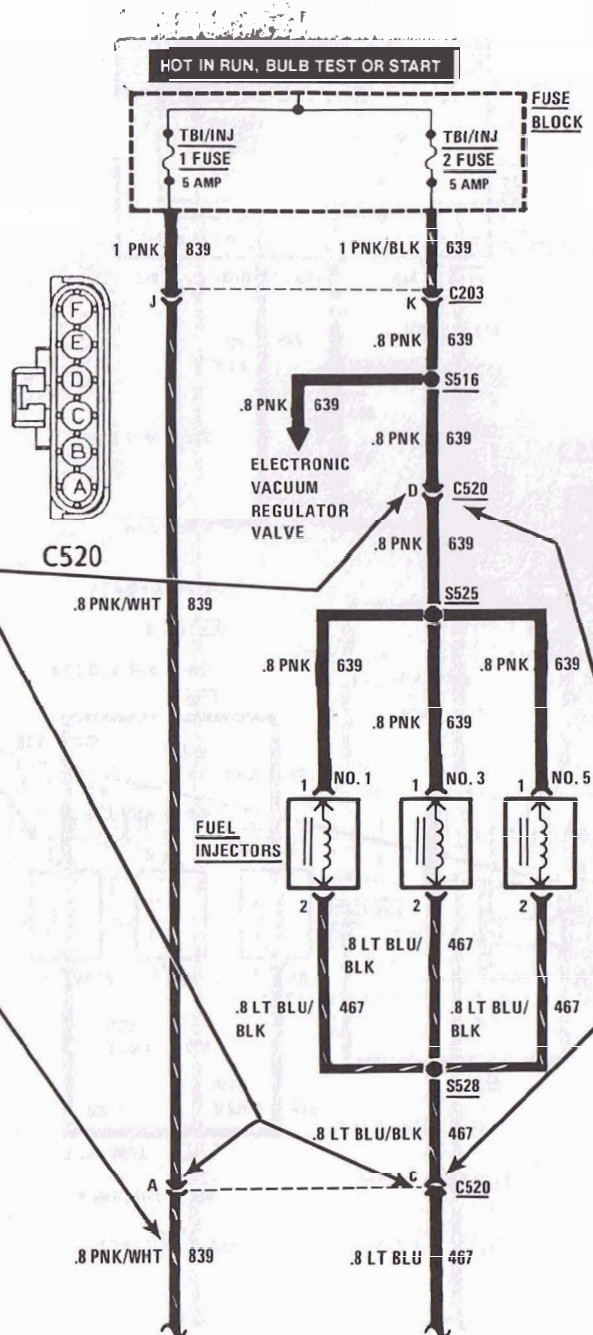
Chart A-3B continues step 4 of Chart A-3A. No light was observed when checking for a control signal at the fuel injectors.

1 Check for a 12 volt supply to the injectors.
a. Turn the ignition "ON"
b. With the Injector harness connector C520 removed probe terminals A and B, and also terminals C and D with a test light to ground. Go to step **2**, **3**, or **4**.



2 If the test light is off then **FIND AN OPEN IN THE INJECTOR FEED CIRCUIT, CIRCUIT 639 (pink wire) AND/OR CIRCUIT 839 (pink/white stripe).**

3 If the test light glows only at one terminal then **THE FAULT IS IN THE HARNESS TO THE TERMINAL THAT DID NOT LIGHT THE TEST LAMP.**



8 If the fuel pump operates or the fuel pump relay clicks then reconnect the injectors.
a. With the ignition "OFF," **DISCONNECT THE ECM.**
b. With the ignition "ON," probe terminals D15 and D16 with a test light to ground. Go to step **9** or **10**.

9 If the test light does not glow then FIND THE OPEN IN CIRCUIT 467 (blue) OR CIRCUIT 468 (light green).

10 If the test light glows then check for a possible short to voltage in circuits 467 or 468.
a. **DISCONNECT THE INJECTOR 6-WAY CONNECTOR, C520.**
b. With the ignition "ON," probe terminals B and C (circuits 467 and 468) on the ECM side of the harness with a test light to ground. Go to step **11** or **12**.

11 If the test light glows then **FIND THE SHORT TO VOLTAGE IN CIRCUIT 467 OR 468.**

4 If the test light glows at both terminals then check for a control pulse generated by the distributor module.

a. Reconnect test light (J-34730-2 or equivalent) to the injector harness terminal B and ground.

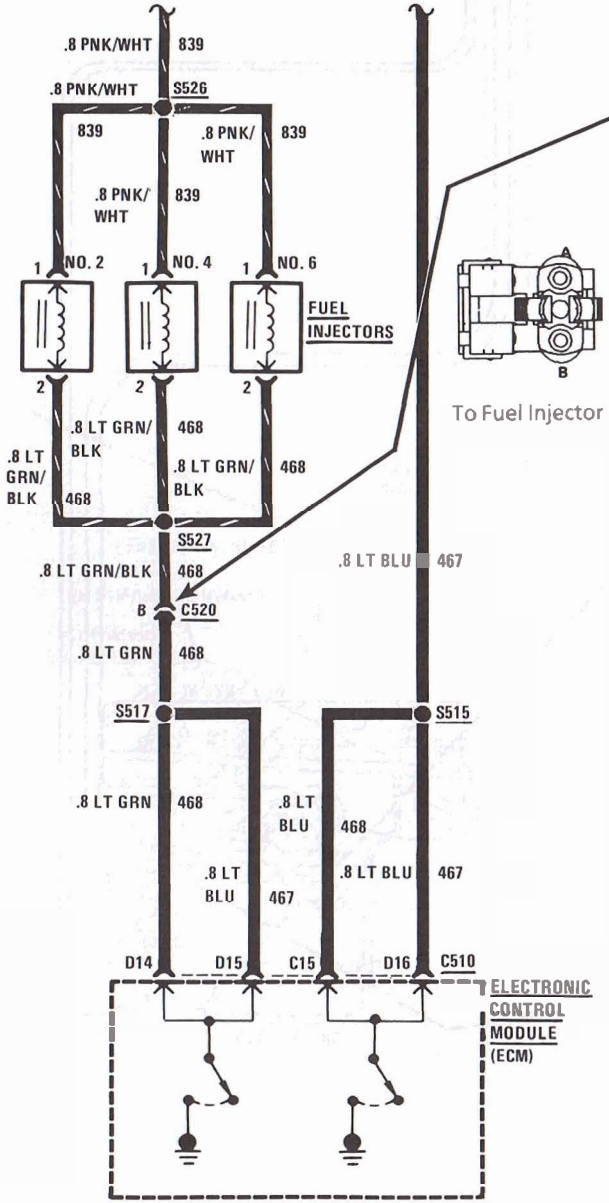
b. **DISCONNECT THE DISTRIBUTOR 4-WAY CONNECTOR, C2.** (See page 6E3-53 for schematic.)

c. Momentarily touch terminal C of Distributor Connector C2, circuit 430 (purple/white stripe) with a test light to 12 volts. Note the injector test light. Go to step **5** or **6**.

5 If the injector test light blinks then **THE FAULT IS IN THE IGNITION MODULE OR ITS CONNECTOR.**

6 If the injector test light does not blink then repeat the test in step 4 and check to see if the fuel pump relay clicks each time the test light touches circuit 430 (purple/white stripe). Go to step **7** or **8**.

7 If the fuel pump does not operate or the fuel pump relay does not click then **FIND THE SHORT TO GROUND OR THE OPEN IN CIRCUIT 430 (purple/white stripe).** If no short to ground or open is found then **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**



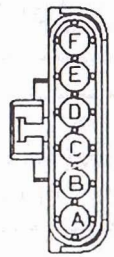
12 If the test light is off then check the resistance of the injector harness between terminals B and A, B and D, C and A, and C and D. Go to **a** or **b**.

a. If the resistance is less than 4 ohms, check for harness wires shorted together.

b. Check each injector resistance (should be greater than 10 ohms).

c. If the resistance checks show the proper resistance then **THE FAULT IS IN THE ECM.**

Reconnect all connectors. Clear all codes, confirm "closed loop" operation and no "CHECK ENGINE" light.



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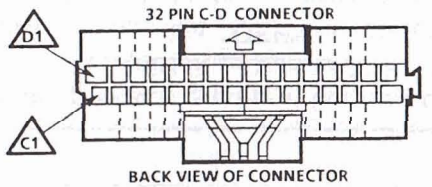

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CHART A-7
FUEL SYSTEM DIAGNOSIS
PORT FUEL INJECTION

When the ignition switch is turned "ON," the ELECTRONIC CONTROL MODULE (ECM) will turn "on" the in-tank FUEL PUMP. The FUEL PUMP remains "on" as long as the engine is cranking or running, and the ECM is receiving HEI distributor reference pulses. If there are no reference pulses then the ECM shuts "off" the FUEL PUMP within two seconds after the ignition is turned "ON" or the engine is stopped.

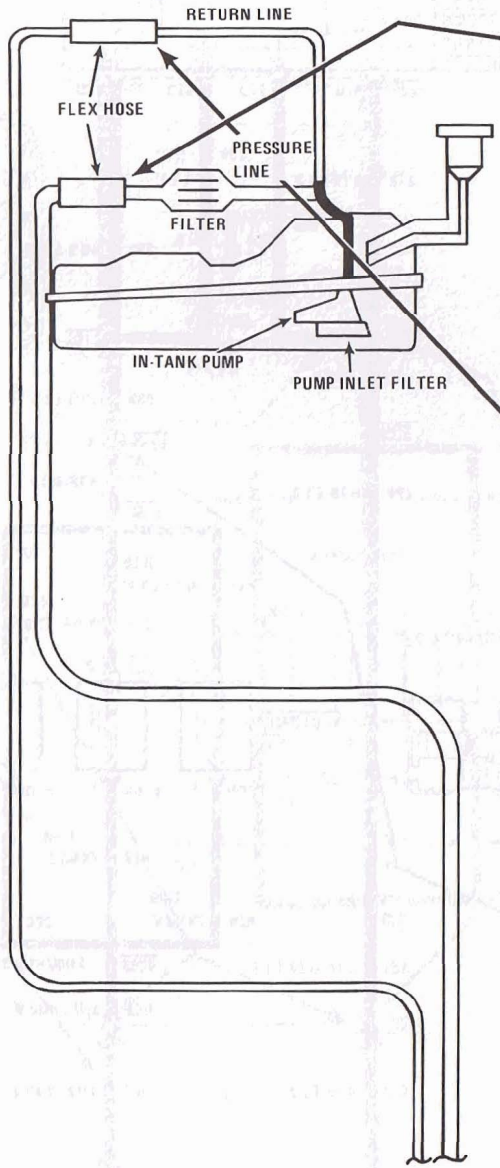
The fuel pump delivers fuel to the FUEL RAIL, the INJECTORS and then to the PRESSURE REGULATOR which regulates the fuel pressure to approximately 234 to 317 kPa (34 to 46 psi). Excess fuel is returned to the fuel tank.

1 Check fuel pressure

a. Install fuel pressure gage (J-34730-1) or equivalent. Wrap a shop towel around the fuel pressure tap to absorb any small amount of fuel leakage that may occur when installing the gage.

b. Turn the ignition "OFF" for at least 10 seconds. Turn the A/C off.

c. With the engine stopped turn the ignition "ON" for about 2 seconds to run the fuel pump. Note the fuel pressure. The FUEL PUMP may have to be cycled "on" more than once to obtain a pressure of 280 to 325 kPa (40.5 to 47 psi) with the FUEL PUMP running. The pressure may drop slightly when the pump stops. Go to step **2, 3, 4, or 5.**



5 If fuel pressure is present but fails to hold after the ignition is turned "OFF," then turn the ignition "OFF" for at least 10 seconds. A slight drop is normal after the pump stops.

a. With the engine stopped and the ignition "ON"" block the fuel line by pinching the flex hose.

c. Note the fuel pressure gage. Go to step **6** or **7**.

6 If the fuel pressure holds after pinching the flex tube then check for:

a. a leaking fuel pump coupling hose.

b. a leaking PULSATOR.

c. a faulty in-tank FUEL PUMP.

7 If the fuel pressure does not hold after pinching the flex tube then block the fuel return line by pinching the hose and note the fuel pressure. Go to step **8** or **9**.

8 If the fuel pressure holds then **THE FAULT IS IN THE FUEL PRESSURE REGULATOR.**

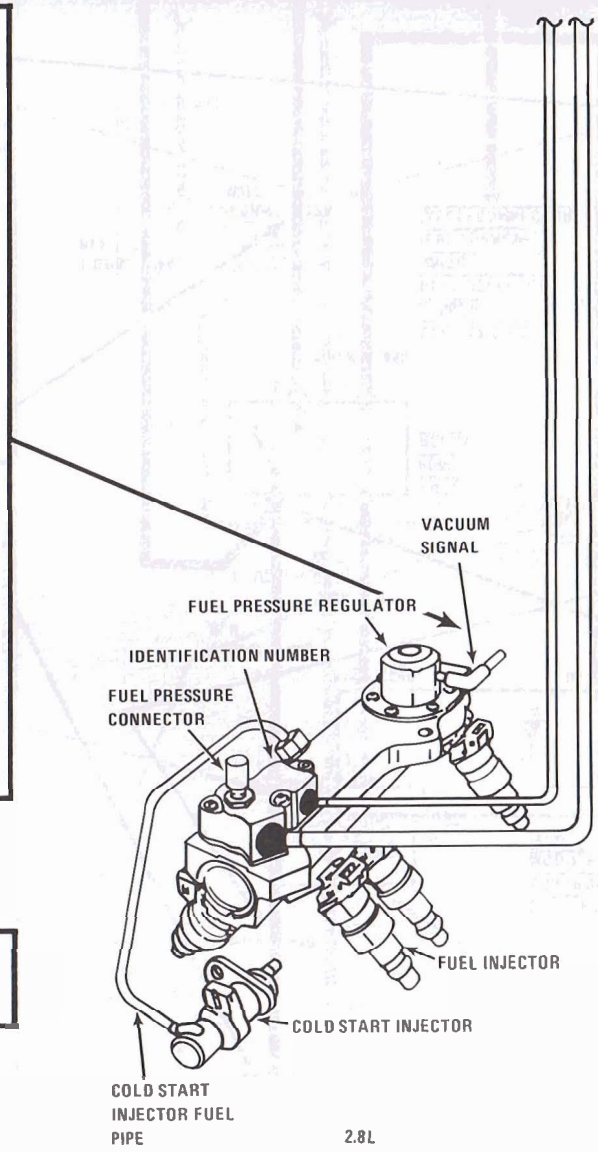
CAUTION: BE SURE THAT THE INJECTORS ARE NOT ALLOWED TO SPRAY ON THE ENGINE AND THAT THE INJECTOR RETAINING CLIPS ARE INTACT. FUEL SPRAY ON THE ENGINE PRESENTS A FIRE HAZARD.

2 If the fuel pressure reached normal levels then check the fuel pressure with the engine idling at normal operating temperature.

a. Start and run the engine at idle and note the fuel pressure. Go to **b** or **c**.
b. If the fuel pressure drops 21 to 69 kPa (3 to 10 psi), fuel pressure is within normal limits. **REFER TO SECTION B.**
c. If the fuel pressure did not drop with the engine at idle then apply 10 inches of vacuum to the PRESSURE REGULATOR and note the fuel pressure. Go to **d** or **e**.
d. If the fuel pressure drops 21 to 69 kPa (3 to 10 psi) then the **THE FAULT IS IN THE VACUUM SOURCE OR HOSE TO THE REGULATOR.**
e. If the fuel pressure did not drop then **THE FAULT IS IN THE FUEL REGULATOR ASSEMBLY.**

3 If no fuel pressure is noted then **REFER TO CHART A-7A.**

4 If the fuel pressure is less than 280 kPa (40 psi) or more than 325 kPa (47 psi) then **REFER TO CHART A-7C.**



9 If the fuel pressure is not holding then **THE FAULT IS IN A FUEL INJECTOR OR THE COLD START VALVE.** Locate and correct a leaking INJECTOR or COLD START VALVE.

a. Check for a fouled or saturated spark plug to indicate a faulty INJECTOR.
b. If a leaking INJECTOR cannot be determined by checking the spark plugs, then follow procedures in the Fuel Control Section of the Service Manual to **REMOVE THE PLENUM, THE COLD START VALVE, AND THE FUEL RAIL BOLTS.** Leave the fuel lines connected to the fuel rail.
c. **RECONNECT THE COLD START VALVE.**
d. Connect a hose to the COLD START VALVE nozzle and insert the hose into a gasoline container.
e. Lift the FUEL RAIL enough to leave the INJECTOR nozzles just in the ports so that fuel spray can be observed.
f. Pressurize the fuel system.
g. Lift each side of the rail up and observe for leaking injectors.

Reconnect all connectors. Clear all codes, confirm "closed loop" operation and no "CHECK ENGINE" light.

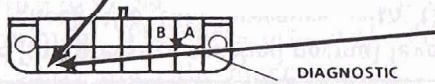
CHART A-7A
FUEL SYSTEM DIAGNOSIS
NO FUEL PRESSURE

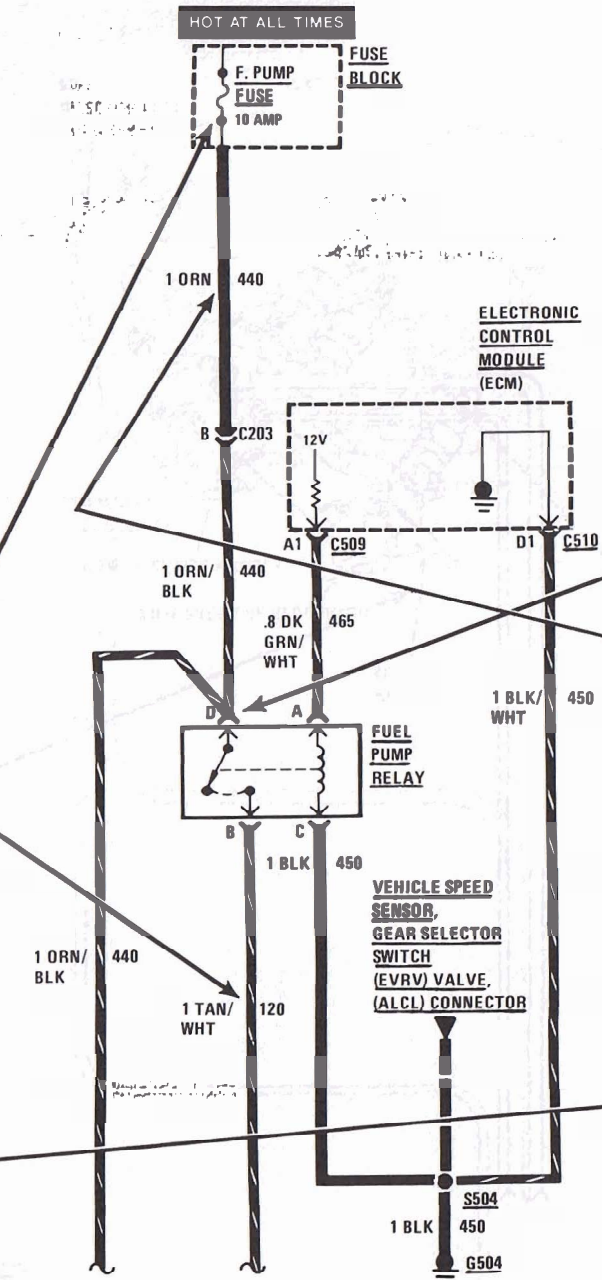
The ECM will turn "ON" the FUEL PUMP relay with the engine stopped and the ignition "ON." The FUEL PUMP will operate for 2 minutes and then turn "off" if the engine is not cranking or running. The oil pressure switch acts as a back up if the FUEL PUMP RELAY fails. It keeps the FUEL PUMP running when the oil pressure is up.

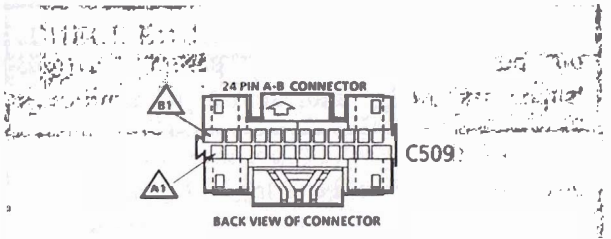
Chart A-7A continues step 7 of Chart A-3A or step 3 of Chart A-7 (No fuel pressure).

1 Check for a blown FUEL PUMP fuse. Go to step **2** or **5**.

2 If the FUEL PUMP fuse is blown check for a short to ground in circuit 120.
- a. Disconnect the rear body connector, C502.
- b. With the ignition "OFF," probe the ALCL CONNECTOR at FUEL PUMP test terminal G, circuit 120 (tan/white stripe) with a test light to 12 volts. Go to step **3** or **4**.







6 If the test light does not glow then check for battery voltage at the pump relay.
- a. Disconnect the FUEL PUMP relay.
- b. With the engine stopped and the ignition "ON," probe the relay harness connector at terminal D with a test light to ground. Go to **c** or **d**.
- c. If the test light does not glow then **FIND THE OPEN IN CIRCUIT 440 (orange wire).**
- d. If the test light glows then **REFER TO CHART A-7B.**

To Fuel Pump Relay

7 If the test light glows then see if the FUEL PUMP is working.
- a. Apply battery voltage to the ALCL TERMINAL at terminal G.
- b. Listen for the FUEL PUMP to run at the fuel tank. Go to step **8** or **9**.

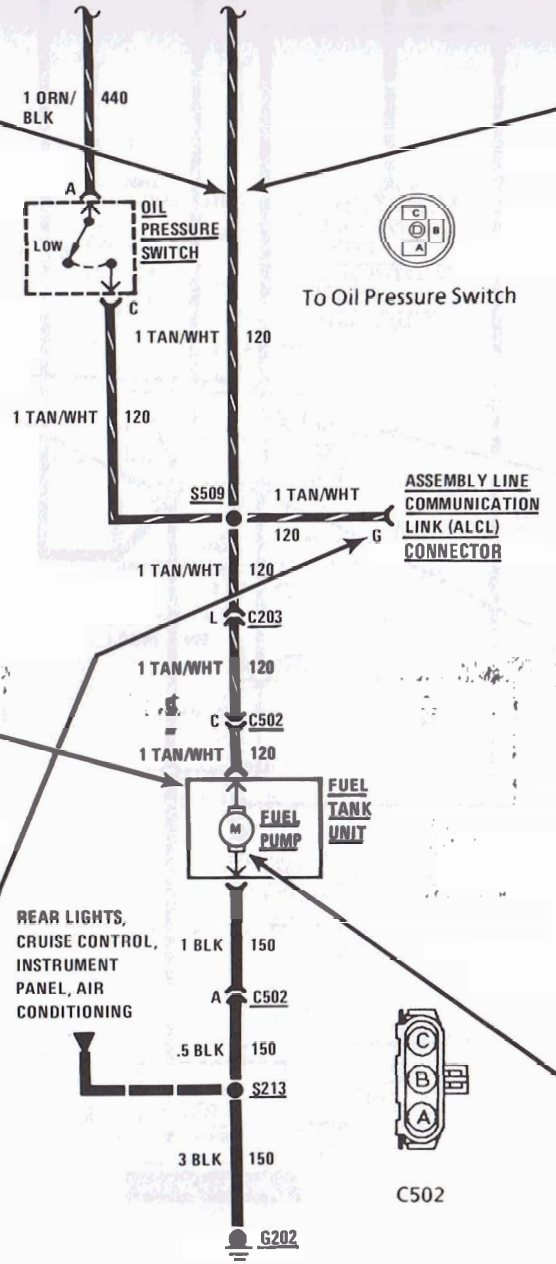
3 If the test light glows then **REPAIR THE SHORT TO GROUND IN CIRCUIT 120 (tan/white stripe).**

1 If the light does not glow then **RECONNECT THE FUEL PUMP.**

a. Replace the fuse.
b. Turn the ignition "ON" and recheck the fuse. Go to **c** or **d**.
c. If the fuse is blown then **FIND THE SHORT TO GROUND IN THE PUMP HARNESS OR THE IN-TANK FUEL PUMP.**
d. If the fuse is not blown and if the FUEL PUMP does not produce fuel pressure then **THE FAULT IS AN INTERMITTENT SHORT TO GROUND IN THE FUEL PUMP OR IN CIRCUIT 120.**

5 If the FUEL PUMP fuse is not blown, determine that the ECM is controlling the FUEL PUMP circuit.

a. Probe the ALCL TERMINAL with a test light to ground at terminal G, circuit 120 (tan/white stripe).
b. Turn the ignition "OFF" for ten seconds.
c. Turn the ignition "ON" again and observe the test light within ten seconds. Go to step **6** or **7**.



8 If the FUEL PUMP does not run then check for an open FUEL PUMP circuit.

a. Look for an open in circuit 120 (tan/white stripe).
b. Look for an open in circuit 150 (black wire).
c. If no open is found then **THE FAULT IS IN THE IN-TANK FUEL PUMP.**

9 If the FUEL PUMP runs then locate the fuel delivery problem.

a. Block the fuel return line by pinching the flexible hose.
b. Note the fuel pressure. Go to step **10** or **11**.

10 If the fuel pressure is above 280 kPa (40 psi) then **THE FAULT IS IN THE FUEL PRESSURE REGULATOR AND THE FUEL RAIL ASSEMBLY.**

11 If there is no fuel pressure then check for restricted fuel supply.

a. Check for a plugged in-line filter.
b. Check for a plugged FUEL PUMP inlet filter.
c. Check for a restricted fuel line.
d. Check for a leaking pulsator or FUEL PUMP rubber coupling.
e. If no restriction is found, **THE FAULT IS IN THE IN-TANK FUEL PUMP.**

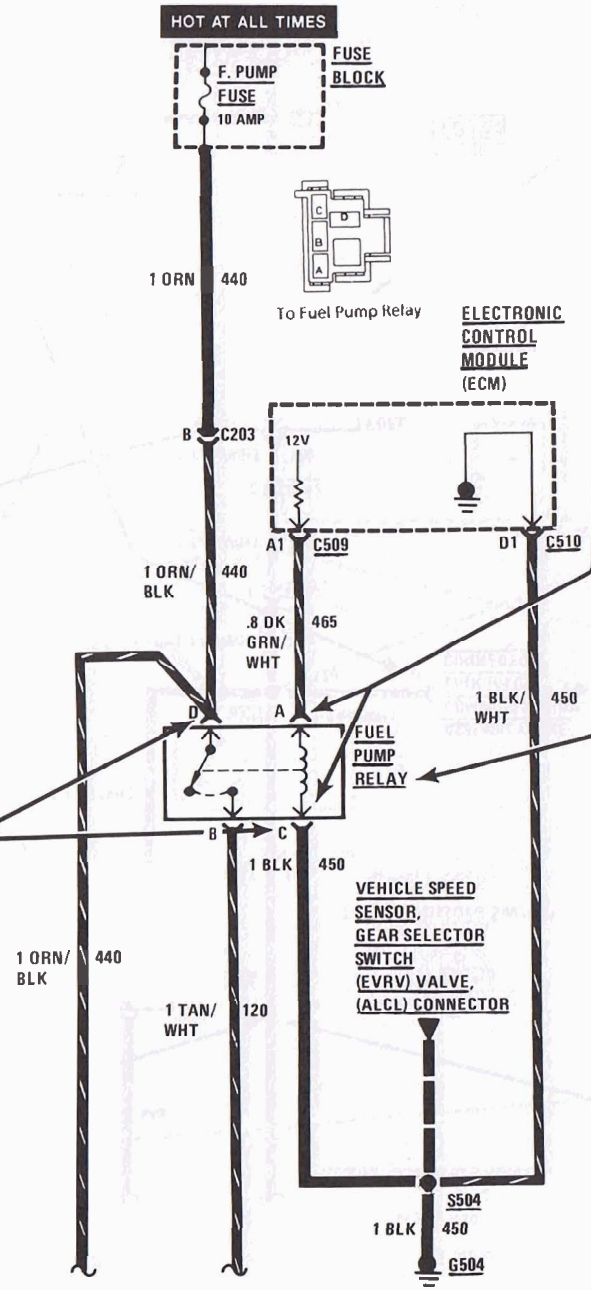
Reconnect all connectors. Clear all codes, confirm "closed loop" operation and no "CHECK ENGINE" light.

CHART A-7B
FUEL SYSTEM DIAGNOSIS
FUEL PUMP INOPERATIVE

The FUEL PUMP is turned on by the FUEL PUMP RELAY (ECM controlled). The oil pressure switch provides a back up path to keep the pump "on" if the relay fails.

If the fuel pump relay fails, a long cranking time will be needed to start the engine.

Chart A-7B continues step 6d of chart A-7A.



1 Check the ground circuit of the FUEL PUMP relay.
- a. DISCONNECT THE FUEL PUMP RELAY HARNESS CONNECTOR.
- b. Probe the FUEL PUMP RELAY connector with a test light to terminals C and D and observe the test light. Go to step **2** or **3**.

2 If the test light does not glow then **FIND THE OPEN IN GROUND CIRCUIT 450 (BLACK WIRE).**

6 If circuit 465 is good check the coil of the FUEL PUMP RELAY.
- a. Measure the resistance across terminals A and C of the relay. It should be 20 ohms or more. Go to **b** or **c**.
- b. If the resistance is good, **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**
- c. If the resistance is less than 20 ohms or infinite, **THE FAULT IS IN THE ECM OR ITS CONNECTOR AND IN THE FUEL PUMP RELAY OR ITS CONNECTOR.**

7 If the test light glows then **THE FAULT IS IN THE FUEL PUMP RELAY.** If the original problem was "The engine cranks but will not run" then verify that the parallel OIL PRESSURE SWITCH circuit is functioning properly.
- a. Run the engine at normal operating temperature.
- b. **DISCONNECT THE FUEL PUMP RELAY.** Go to step **8** or **9**.

8 If the engine stops running then **THE FAULT IS IN THE OIL PRESSURE SWITCH OR ITS CONNECTOR.**

3 If the test light glows then verify ECM control of the FUEL PUMP RELAY.

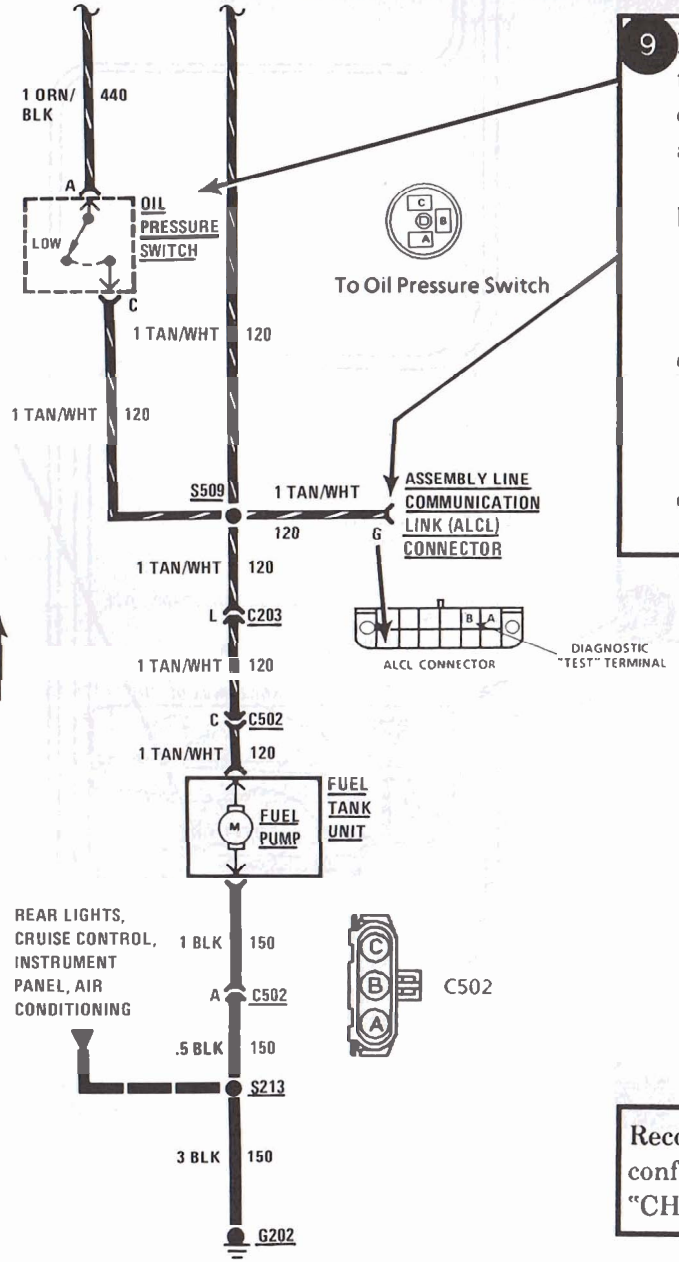
a. Turn the ignition "OFF" for 10 seconds.
b. Probe the FUEL PUMP RELAY connector with a test light to terminals C and A.
c. Turn the ignition "ON" and within two seconds observe the test light. Go to step **4** or **7**.

4 If the test light does not glow then check the ECM control circuit.

a. DISCONNECT ECM CONNECTOR C509 (blue connector).
b. Check for an open, or short to ground in circuit 465 (dark green/white). Go to step **5** or **6**.

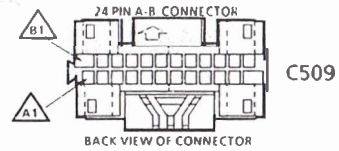
5 If circuit 465 is not OK, **REPAIR THE FAULT AND REPEAT STEP 3 WITH THE TEST LIGHT ACROSS TERMINALS A AND C OF THE FUEL PUMP RELAY CONNECTOR.**

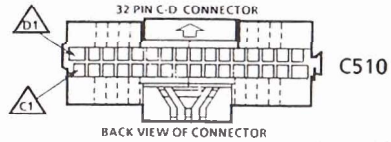
a. If the light does not glow, **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**
b. If the light glows the ECM is good. Go to step **7**.



9 If the engine continues to run verify that the oil pressure switch opens when the engine stops.

a. **RECONNECT THE FUEL PUMP RELAY.**
b. With the ignition "OFF," probe FUEL PUMP test terminal G of the ALCL connector with a test light to ground. Go to **c** or **d**.
c. If the test light comes on then **THE FAULT IS IN THE OIL PRESSURE SWITCH OR ITS CONNECTOR.-**
d. If the test light does not come on then no trouble was found.



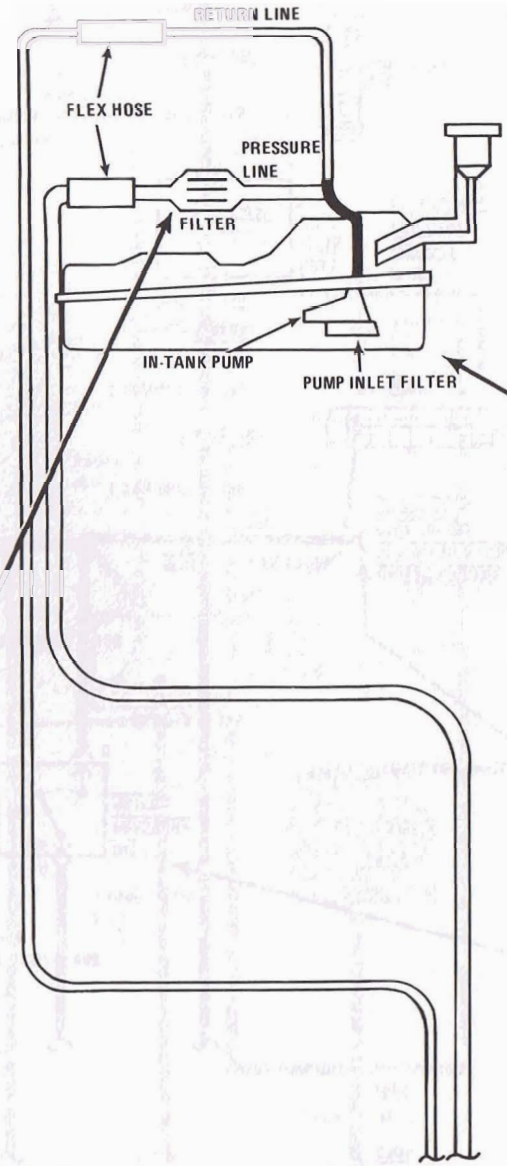


Reconnect all connectors. Clear all codes, confirm "closed loop" operation and no "CHECK ENGINE" light.

4 of Chart A-7, the 280 kPa (40 psi) or

1 If the fuel pressure is above 325 kPa (47 psi) then go to step 6. If the fuel pressure is below 280 kPa (40 psi) then check for restricted fuel flow in step 2.

2 Check for restricted flow at the fuel filter. If the filter is restricted then **REPLACE THE FUEL FILTER AND RECHECK THE FUEL PRESSURE.**



4 If the fuel pressure is above 325 kPa (47 psi) then **THE FAULT IS IN THE FUEL PRESSURE REGULATOR.**

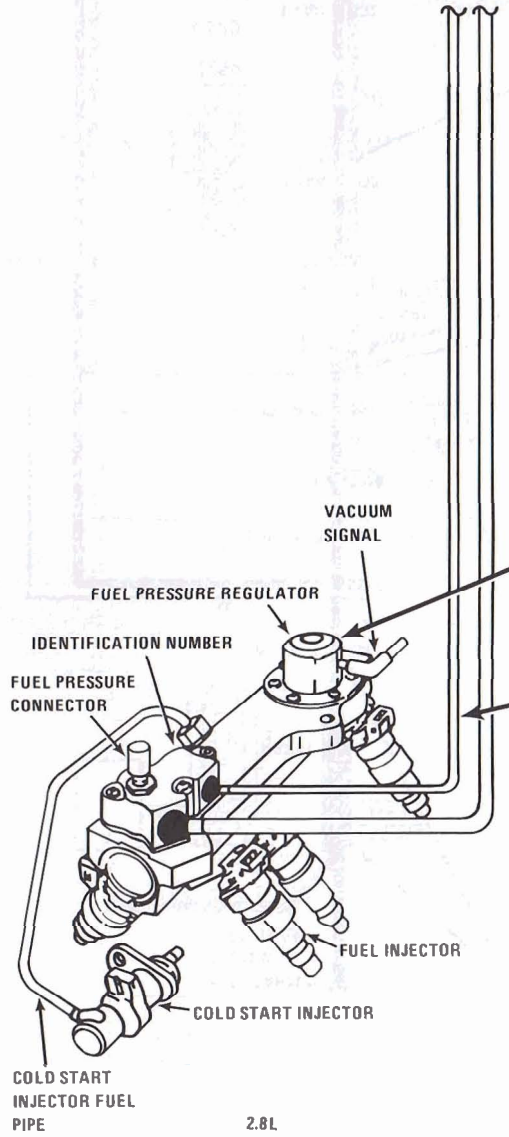
5 If the fuel pressure is below 280 kPa (40 psi) then check for faulty in-tank:

a. FUEL PUMP
b. PULSATOR
c. coupling hose
d. inlet filter
e. WRONG FUEL PUMP

3 If the fuel filter is good, check the FUEL PUMP head pressure.

a. With the engine stopped and the ignition "OFF," block the fuel return line by pinching the flex hose.

b. Apply 12 volts to terminal B of the FUEL PUMP RELAY harness connector or at terminal G of the DIAGNOSTIC TERMINAL. Note the fuel pressure. Go to step **4** or **5**.



6 Check for a restricted fuel line or a faulty FUEL PRESSURE REGULATOR.

a. Disconnect the fuel return line flexible hose and attach a 5/16 I.D. flex hose to the PRESSURE REGULATOR side of the return line. Insert the other end into an approved gasoline container.

b. With the engine stopped and the ignition "ON," note the fuel pressure within 2 seconds. Go to **c** or **d**.

c. If the fuel pressure is above 325 kPa (47 psi) then **THE FAULT IS IN THE FUEL PRESSURE REGULATOR.**

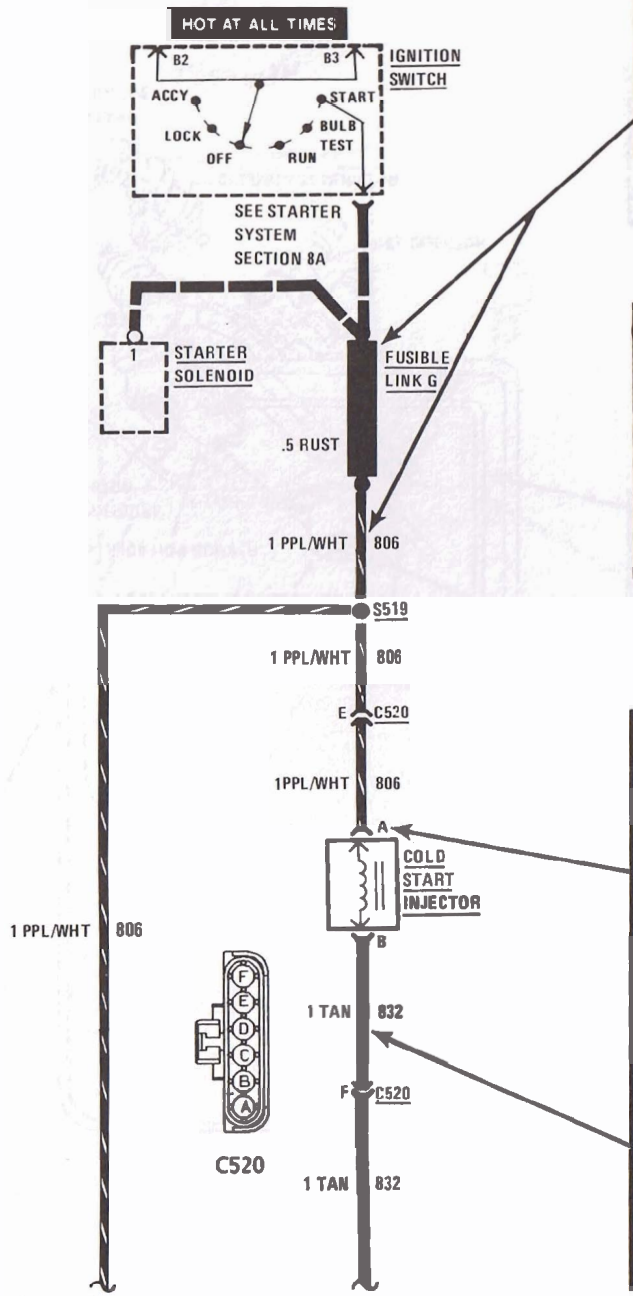
d. If the fuel pressure is between 280 to 325 kPa (40.5 to 47 psi) then **LOCATE AND CORRECT A RESTRICTED FUEL RETURN LINE.**

Reconnect all connectors. Clear all codes, confirm "closed loop" operation and no "CHECK ENGINE" light.

CHART A-9
COLD START INJECTOR TEST

The COLD START INJECTOR improves cold start-ups by providing additional fuel during crank mode when engine coolant temperature is low. The COLD START INJECTOR and the starter solenoid receive battery voltage at the same time. A bimetallic COLD START SWITCH, which opens at a specified coolant temperature of 35°C (95°F), provides a ground path for the COLD START INJECTOR circuit. The bimetallic switch is heated by both the engine coolant and a heating element. This switch opens in 8 seconds at a coolant temperature of -20°C (-5°F). As coolant temperature rises, the COLD START SWITCH opens sooner and, therefore, the COLD START INJECTOR "on" time decreases.

1 Operate the COLD START INJECTOR to check for a fuel pressure drop during cold start.
- a. With the ignition off, connect the fuel pressure gage (J-34730-1) and disconnect the distributor 4-way connector to disable the other injectors.
- b. With the engine temperature below 35°C (95°F), turn the ignition "ON" for 2 seconds. Then crank the engine for 2 seconds, and observe the fuel pressure gage for a drop greater than 20 kPa (3 psi). See step **2** or **5**.



6 If the test light does not glow while cranking then **REPAIR THE OPEN IN CIRCUIT 806 (purple/white stripe)** or the fusible link G.

To Ignition Switch

7 If the test light glows at terminal A of the COLD START SWITCH then probe circuit 832 (tan wire) with a test light connected to ground. Probe terminal B of the COLD START SWITCH harness connector and observe the light while cranking the engine. See step **8** or **9**.

8 If the test light does not glow (circuit 832) then **DISCONNECT THE COLD START INJECTOR CONNECTOR.** With the test light connected to ground, probe circuit 806 at terminal A of the Cold Start INJECTOR harness connector while cranking the engine and observe the test light.
- a. If the test light does not glow then **REPAIR THE OPEN IN CIRCUIT 806 (purple/white stripe).**
- b. If the test light glows then **REPAIR THE OPEN IN CIRCUIT 832 (tan wire).** If no open is found, **THE FAULT IS IN THE COLD START INJECTOR OR ITS CONNECTOR.**

2 If the fuel pressure drop was greater than 20 kPa (3 psi) (good) then warm up the engine (coolant temperature above 35°C / 95°F) and repeat the test in step 1.

a. If the fuel pressure does not drop during crank mode with the engine warm then the COLD START INJECTOR circuit functions properly.

b. If the pressure continues to drop when the engine is warm **DISCONNECT THE COLD START SWITCH** at the harness connector and repeat the test in step 1. See step **3** or **4**.

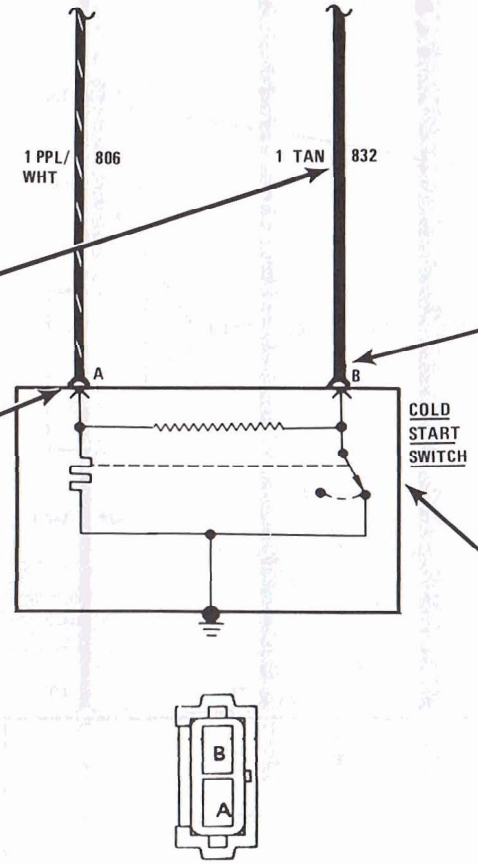
3 If no drop occurs with the COLD START SWITCH disconnected then **THE FAULT IS IN THE COLD START SWITCH.**

4 If a drop continues to occur with the COLD START SWITCH disconnected, check for a short to ground in circuit 832 (tan wire). If no short is found then **THE FAULT IS IN THE COLD START INJECTOR.**

5 If the fuel pressure drop in step 1 was less than 20 kPa (3 psi) then confirm that COLD START SWITCH, circuit 806 is getting battery voltage.

a. **DISCONNECT THE COLD START SWITCH CONNECTOR.**

b. With a test light connected to ground, probe circuit 806 (purple/white stripe) at terminal A of the COLD START SWITCH harness connector and observe the test light while cranking the engine. See step **6** or **7**.



To Cold Start Switch

9 If the test light glows (circuit 832) check the ground path through the COLD START SWITCH.

a. Connect an ohmmeter between terminal B (circuit 832) of the COLD START SWITCH and ground, and check the resistance. Go to **b**, **c** , or **d**.

b. If the resistance is less than 20 ohms then **THE FAULT IS IN THE COLD START INJECTOR.**

c. If the resistance is between 20 and 200 ohms, confirm that the coolant temperature is below 35°C (95°F). If below 35°C then **THE FAULT IS IN THE COLD START SWITCH.**

d. If the resistance is greater than 200 ohms then **THE FAULT IS IN THE COLD START SWITCH.**

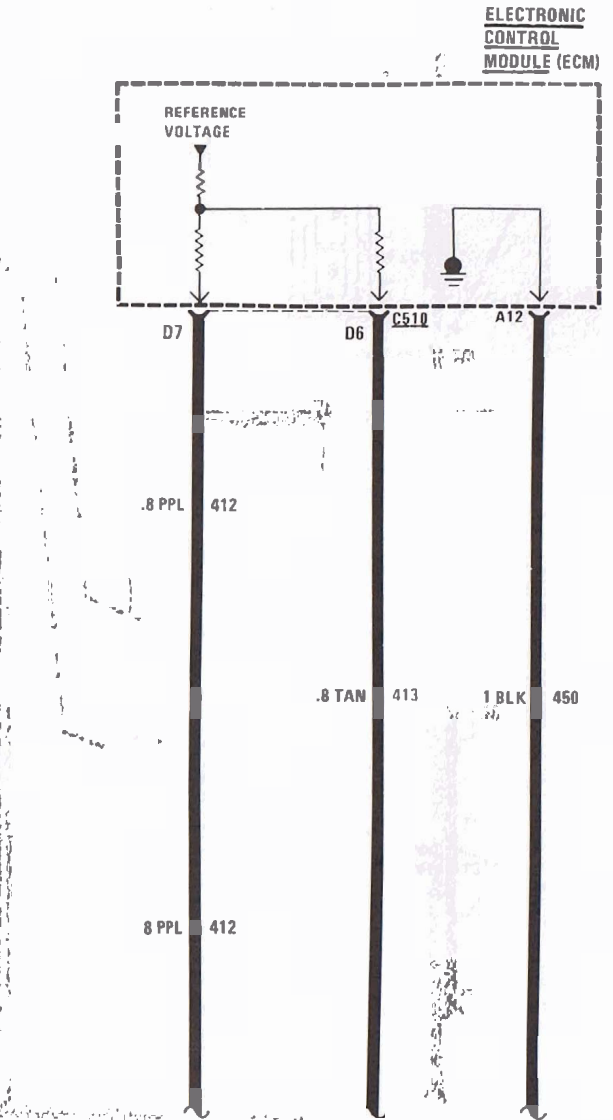
Reconnect all connectors. Clear all codes, confirm "closed loop" operation and no "CHECK ENGINE" light.

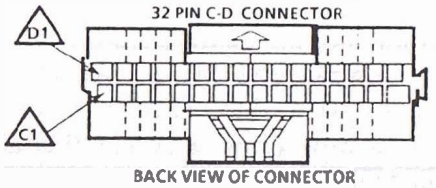
CODE 13
OXYGEN SENSOR CIRCUIT
OPEN CIRCUIT

The engine operates in open loop when it is cold, idling, or at full throttle. In closed loop, the ECM monitors the OXYGEN SENSOR output voltage and controls the fuel mixture. When code 13 sets, the system runs only in open loop mode.

OXYGEN SENSOR output is based on the oxygen content of the exhaust. Output voltage should vary from 0.1 volt (high oxygen content, lean mixture) to 1.0 volt (low oxygen content, rich mixture). The OXYGEN SENSOR produces no voltage when it is below 360°C (600°F).

Code 13 sets when the engine has been operating for a specified time after starting (about two minutes), the THROTTLE POSITION SENSOR output is above a specified value (engine above idle), and the ECM reads OXYGEN SENSOR OUTPUT as steady between 0.35 volts and 0.55 volts. All of these conditions must be met for 60 seconds. When the OXYGEN SENSOR circuit is open, or when the OXYGEN SENSOR is cold, the ECM operates in open loop. Under these two conditions, the ECM reads only the supplied reference voltage (about 4.5 volts between pins D6 and D7). This voltage will read lower than 4.5 volts when measured with a voltmeter. If this voltage is measured with a digital voltmeter, it may read as low as 0.32 volts. A regular voltmeter with a needle may read as low as 0 volts.





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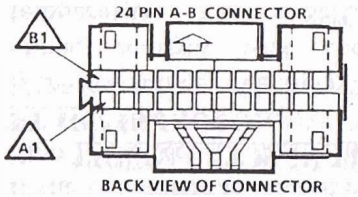
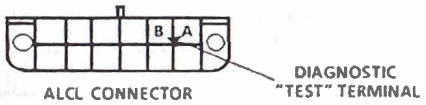
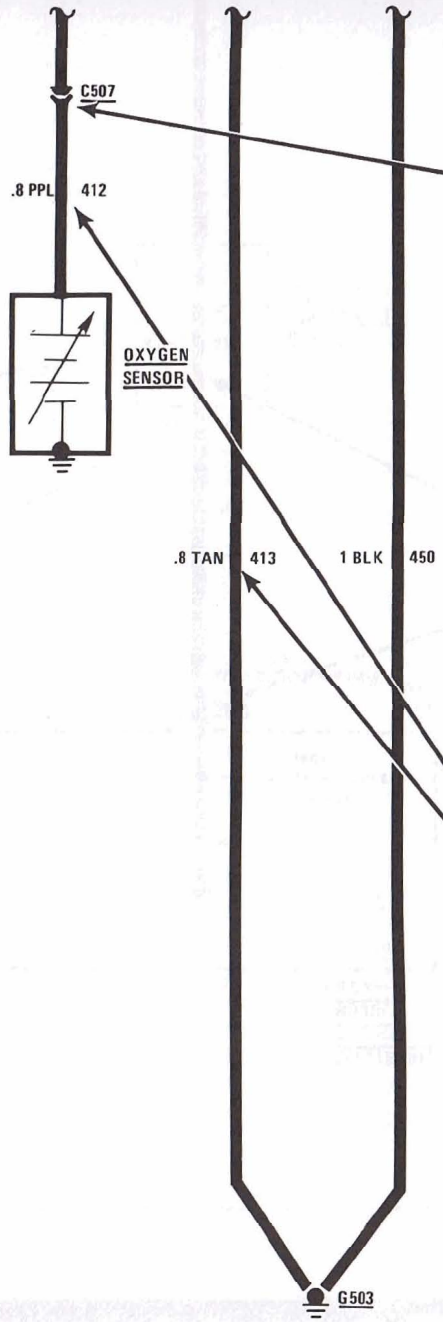


C509

1 Determine the ECM operating mode.
- a. Clear codes.
- b. With the engine at normal operating temperature, ground the DIAGNOSTIC TERMINAL.
- c. Run the engine at 1200 to 1400 rpm for two minutes.
- d. Observe "CHECK ENGINE" light to determine closed loop or open loop operation. Go to step **2** or **3**.



2 If the ECM is operating in closed loop mode, confirm that Code 13 does not set.
- a. Do not ground the DIAGNOSTIC TERMINAL. Run the engine at 1200 to 1400 rpm for two minutes. Go to **b** or **c**.
- b. If the "CHECK ENGINE" light remains off, **REFER TO SECTION B.** The problem is intermittent.
- c. If the "CHECK ENGINE" light remains on then with the engine stopped and the ignition "ON," ground the DIAGNOSTIC TERMINAL. Note the codes and **REFER TO THE APPROPRIATE CODE CHART.**



3 If the ECM is operating in open loop mode, verify correct operation of the ECM.
- a. With the ignition "OFF," ground the DIAGNOSTIC TERMINAL and **DISCONNECT THE OXYGEN SENSOR.**
- b. Jumper the harness connector for circuit 412 (purple wire) to ground. Start the engine.
- c. Observe the "CHECK ENGINE" light to determine ECM operating mode. Go to step **4** or **5**.

4 If the "CHECK ENGINE" light goes out for at least 30 seconds after flashing open loop for 1-4 seconds, **THE FAULT IS IN THE OXYGEN SENSOR OR ITS CONNECTOR.**

5 If the "CHECK ENGINE" light continues to flash open loop, check the OXYGEN SENSOR circuit.
- a. Look for an open in circuit 412 (purple wire) or circuit 413 (tan wire.)
- b. If no open is found then **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**

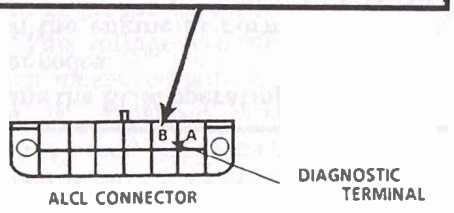
Reconnect all connectors. Clear codes. Confirm "closed loop" operation and no "CHECK ENGINE" light.

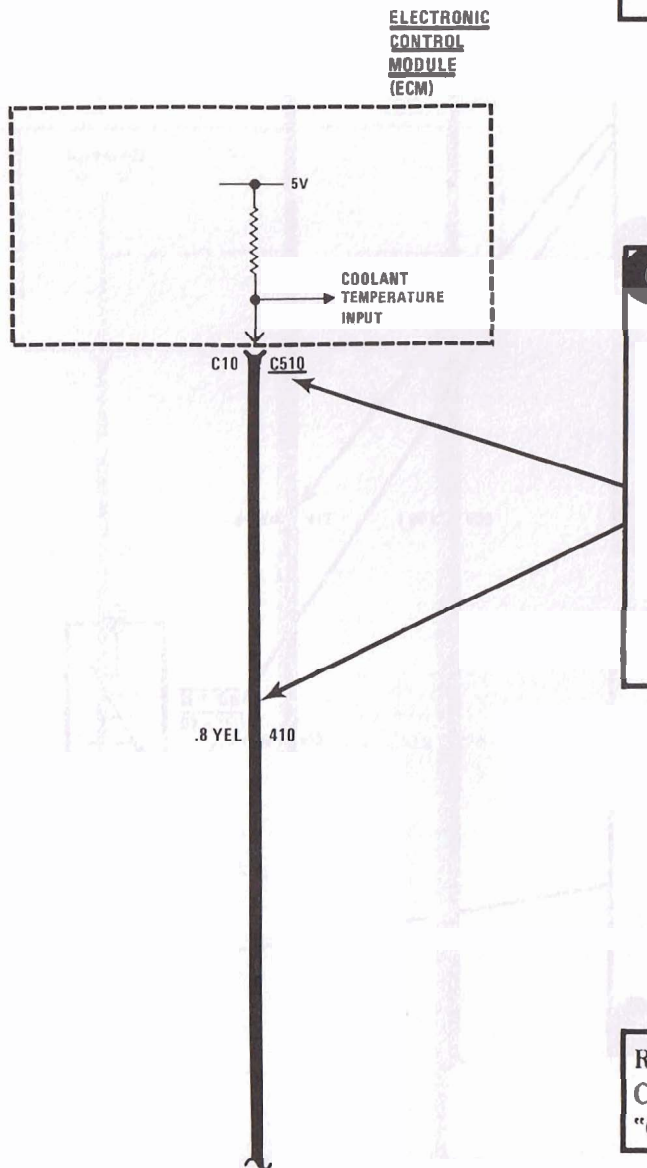
CODE 14
COOLANT SENSOR
SIGNAL VOLTAGE LOW

The ECM reads voltage across a thermistor in the COOLANT TEMPERATURE SENSOR. A high voltage is sensed by the ECM when the engine is cold. This drops to 1.5 to 2.0 volts at normal operating temperature. Code 14 will set if the signal voltage indicates a coolant temperature above 135°C (275°F) for 3 seconds.

1 Check coolant level and pressure cap.

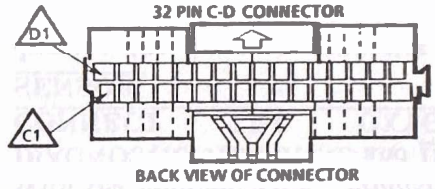
2 Verify that Code 14 is set.
- a. Clear all codes.
- b. Run the engine until the "CHECK ENGINE" light comes on.
- c. With the engine stopped and the ignition "ON," ground the diagnostic terminal.
- d. Note codes. Go to step **3** or **4**.





5 If Code 15 (open sensor) sets the ECM and wiring are good. **THE FAULT IS IN THE SENSOR OR ITS CONNECTOR.**

6 If Code 14 (shorted sensor) sets with the sensor disconnected, check for a short in circuit 410 (yellow) or the ECM.
- a. Turn the ignition "OFF" and **DISCONNECT the ECM C-D CONNECTOR (C510).**
- b. Check terminal C10 (gray connector C510) and circuit 410 (yellow) for a short to ground.
- c. If no short is found, **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**



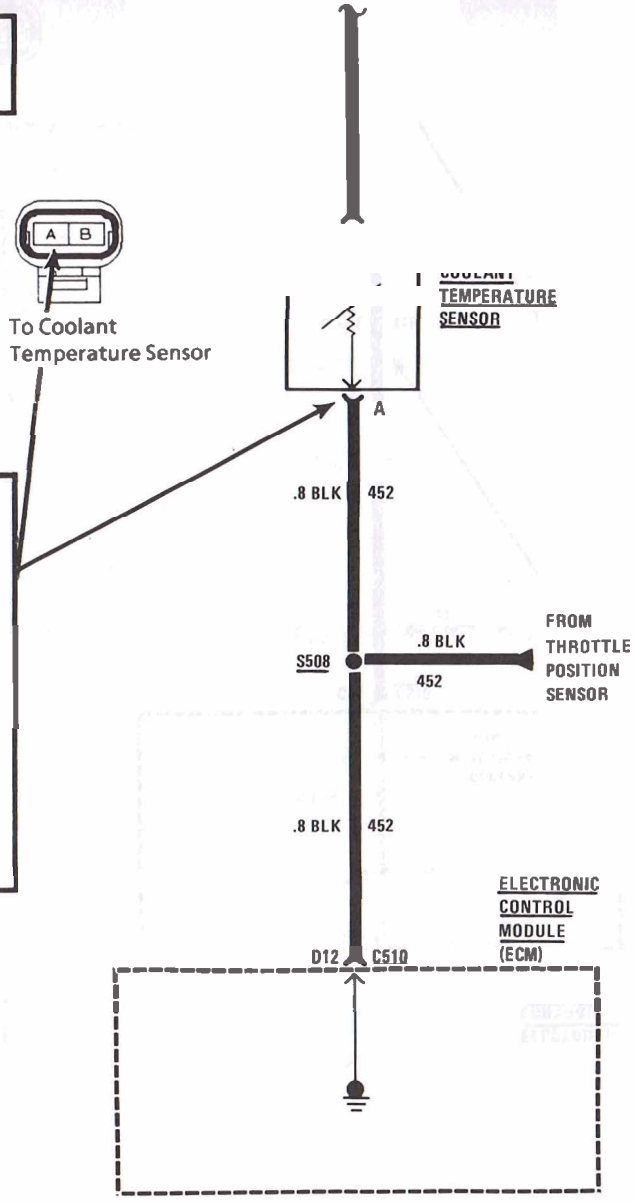
C510

Reconnect all connectors. Clear codes. Confirm "closed loop" operation and no "CHECK ENGINE" light.

3 If no code is set, **REFER TO SECTION B.** The problem is intermittent.

4 If Code 14 still sets, turn the ignition "OFF" and **DISCONNECT THE COOLANT TEMPERATURE SENSOR** Check for codes again.

a. Clear all codes.
b. Run the engine until the "CHECK ENGINE" light comes on.
c. With the engine stopped and the ignition "ON," ground the DIAGNOSTIC TERMINAL.
d. Note codes. Go to step **5** or **6**.

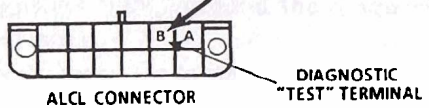


COOLANT SENSOR		
TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)		
•F	•C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	-4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

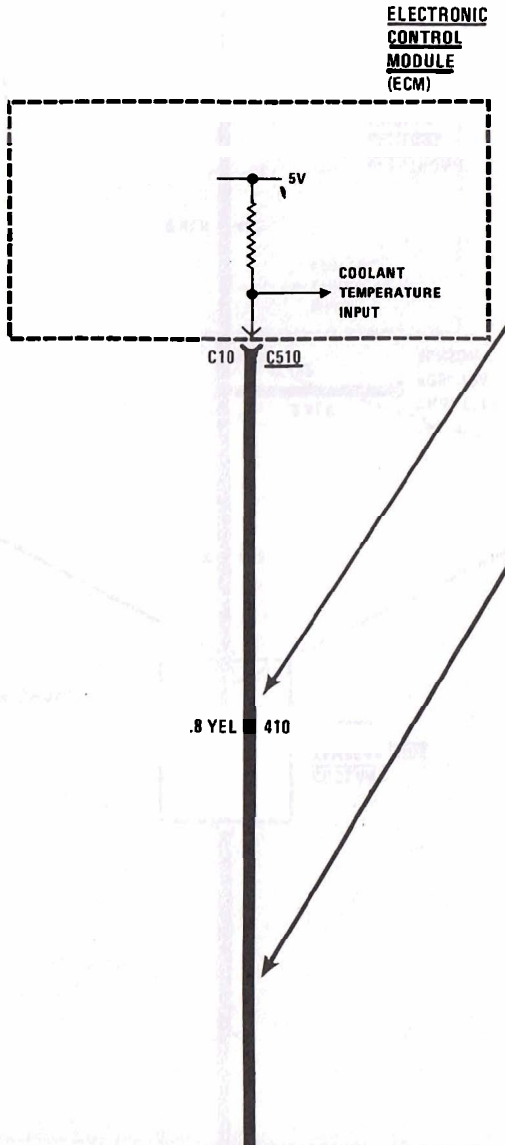
CODE 15
COOLANT SENSOR CIRCUIT
SIGNAL VOLTAGE HIGH

The ECM reads voltage across a thermistor in the COOLANT TEMPERATURE SENSOR. A high voltage is sensed by the ECM when the engine is cold. This drops to 1.5 to 2.0 volts at normal operating temperature. Code 15 will set if the signal voltage indicates a coolant temperature below (-44°F) for 3 seconds.

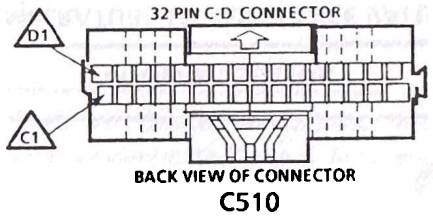
1 Verify that Code 15 is set.
- a. Clear all codes.
- b. **Run the engine until** the "CHECK ENGINE" light comes on.
- c. With the engine stopped and the ignition "ON," ground the DIAGNOSTIC TERMINAL.
- d. Note codes. Go to step **2** or **3**.



2 If no code is set, **REFER TO SECTION B.** The problem is intermittent.



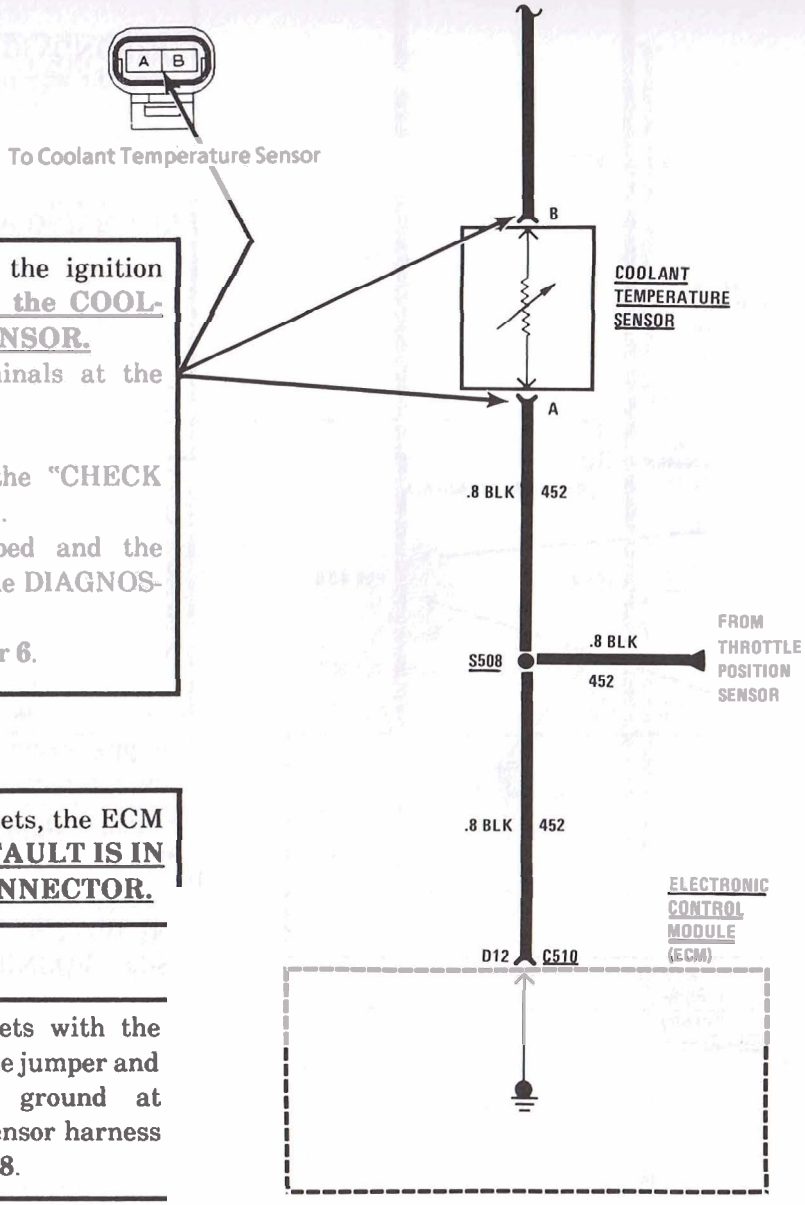
6 If above 6 volts then check circuit 410 (yellow) for a short to higher voltage. If no short is found then **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**



7 If below 4 volts then check circuit 410 (yellow) for an open. If no open is found, **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**

8 If 4-6 volts then check circuit 452 (black) for an open. If no open is found then **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**

Reconnect all connectors. Clear codes Confirm "closed loop" operation and no "CHECK ENGINE" light.



3 If Code 15 still sets, turn the ignition "OFF" and **DISCONNECT the COOLANT TEMPERATURE SENSOR.**

a. Jumper A and B terminals at the harness connector.
b. Clear all codes.
c. Run the engine until the "CHECK ENGINE" light comes on.
d. With the engine stopped and the ignition "ON," ground the DIAGNOSTIC TERMINAL.
e. Note codes. Go to step 5 or 6.

4 If Code 14 (shorted sensor) sets, the ECM and wiring are good. **THE FAULT IS IN THE SENSOR OR ITS CONNECTOR.**

5 If Code 15 (open sensor) sets with the connector shorted, remove the jumper and measure the voltage to ground at terminal B (yellow) of the sensor harness connector. Go to step 6, 7, or 8.

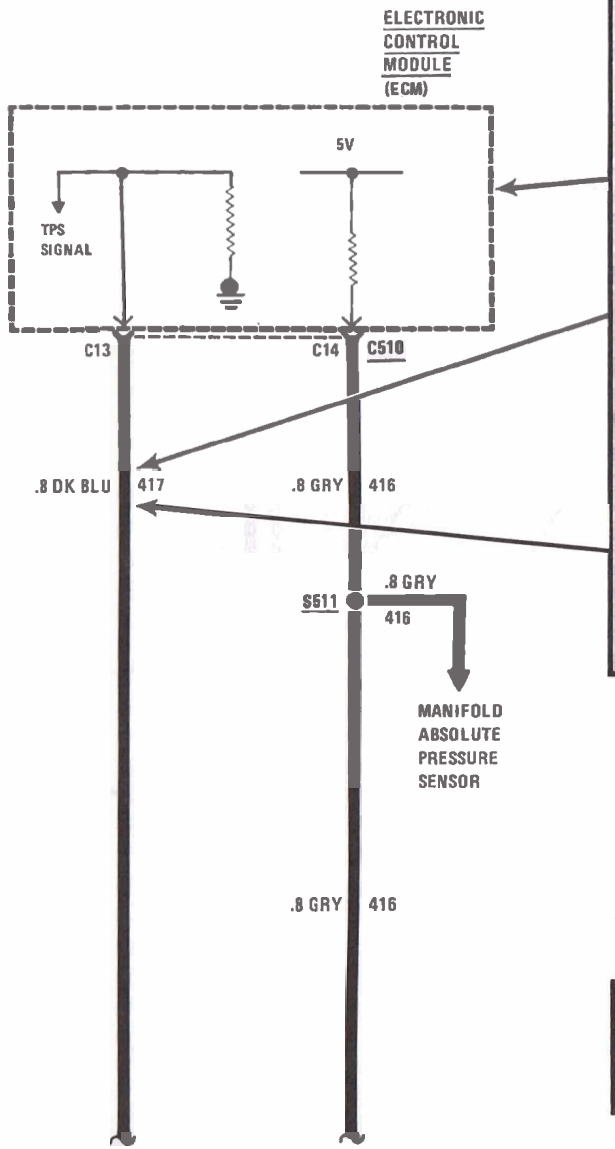
COOLANT SENSOR		
TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)		
•F	•C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	-4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CODE 21
THROTTLE POSITION SENSOR SIGNAL VOLTAGE HIGH

The THROTTLE POSITION SENSOR (TPS) provides a voltage signal that changes with the throttle valve position. Signal voltage will vary from about 0.5 volts at idle to 4.5 volts at wide open throttle. The THROTTLE POSITION SENSOR signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM controlled outputs.

Code 21 will set if the THROTTLE POSITION SENSOR signal voltage output is greater than 2.5 volts for 2 seconds with the engine running at less than 1600 rpm.

1 Verify that Code 21 is set.
- a. Do not ground the DIAGNOSTIC TERMINAL.
- b. Turn the ignition "OFF."
- c. Clear all codes.
- d. Block the wheels.
- e. **Run the engine at idle in** DRIVE with the A/C "OFF" for one minute or until the "CHECK ENGINE" light comes on.
- f. With the engine off and the ignition "ON," ground the DIAGNOSTIC TERMINAL.
- g. Note codes. Go to step **2** or **3**.



5 If Code 21 sets (signal high), voltage may be feeding into the THROTTLE POSITION SENSOR input circuit through a wrong path.
- a. With the THROTTLE POSITION SENSOR disconnected, turn the ignition "OFF" and **DISCONNECT THE ECM.**
- b. Turn the ignition "ON."
- c. Measure the voltage at terminal B of the THROTTLE POSITION SENSOR harness connector, circuit 417 (dark blue wire). Go to **d** or **e**.
- d. If less than 0.1 volt, the wiring is OK. **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**
- e. If more than 0.1 volt, **LOCATE THE SHORT TO VOLTAGE IN CIRCUIT 417 (dark blue wire).**

Reconnect all connectors. Clear codes. Confirm "closed loop" operation and no "CHECK ENGINE" light.

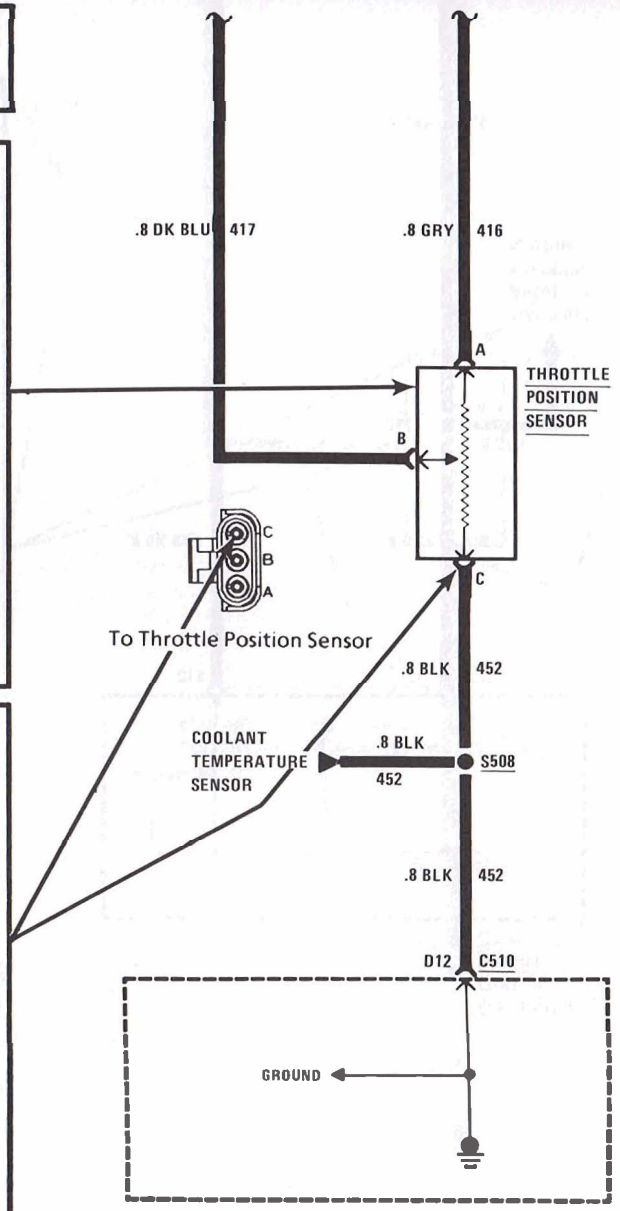
2 If no code is set, **REFER TO SECTION B.** The problem is intermittent.

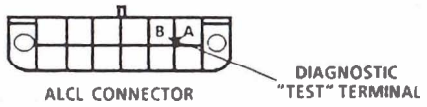
3 If Code 21 sets again, open the THROTTLE POSITION SENSOR circuit to set Code 22.

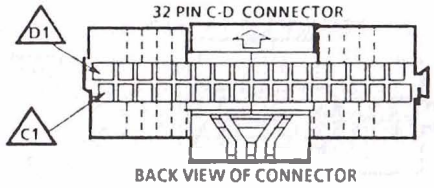
a. With the ignition "OFF" and the DIAGNOSTIC TERMINAL not grounded, clear all codes.
b. **DISCONNECT THE THROTTLE POSITION SENSOR.**
c. Run the engine at idle in DRIVE, A/C off, for 1 minute or until the "CHECK ENGINE" light comes on.
d. With the engine stopped and the ignition "ON," ground the DIAGNOSTIC TERMINAL.
e. Note codes. Go to step 4 or 5.

4 If Code 22 sets (signal low, no voltage supplied), verify that the THROTTLE POSITION SENSOR is grounded by the ECM.

a. With the THROTTLE POSITION SENSOR disconnected, connect a test light between 12 volts and terminal C of the harness connector. Go to **b** or **c**.
b. If the lamp lights, **THE FAULT IS IN THE THROTTLE POSITION SENSOR OR THE HARNESS CONNECTOR.**
c. If the lamp does not light, repair the open in circuit 452 (black wire). If circuit 452 is not open then **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**





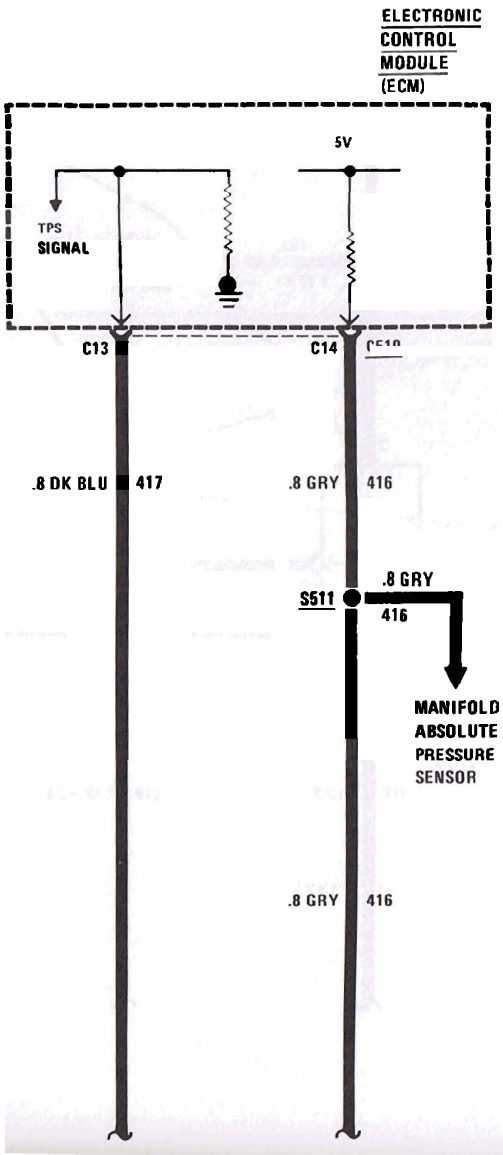


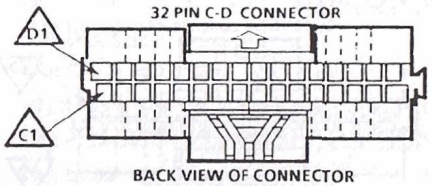
CODE 22
THROTTLE POSITION SENSOR SIGNAL VOLTAGE LOW

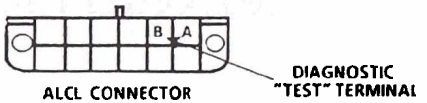
The THROTTLE POSITION SENSOR (TPS) provides a voltage signal that changes relative to the throttle valve position. Signal voltage will vary from about 0.5 volts at idle to 4.5 volts at wide open throttle. The THROTTLE POSITION SENSOR signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM controlled outputs. Code 22 sets if the signal voltage is less than 0.2 volts for 2 seconds with the engine running.

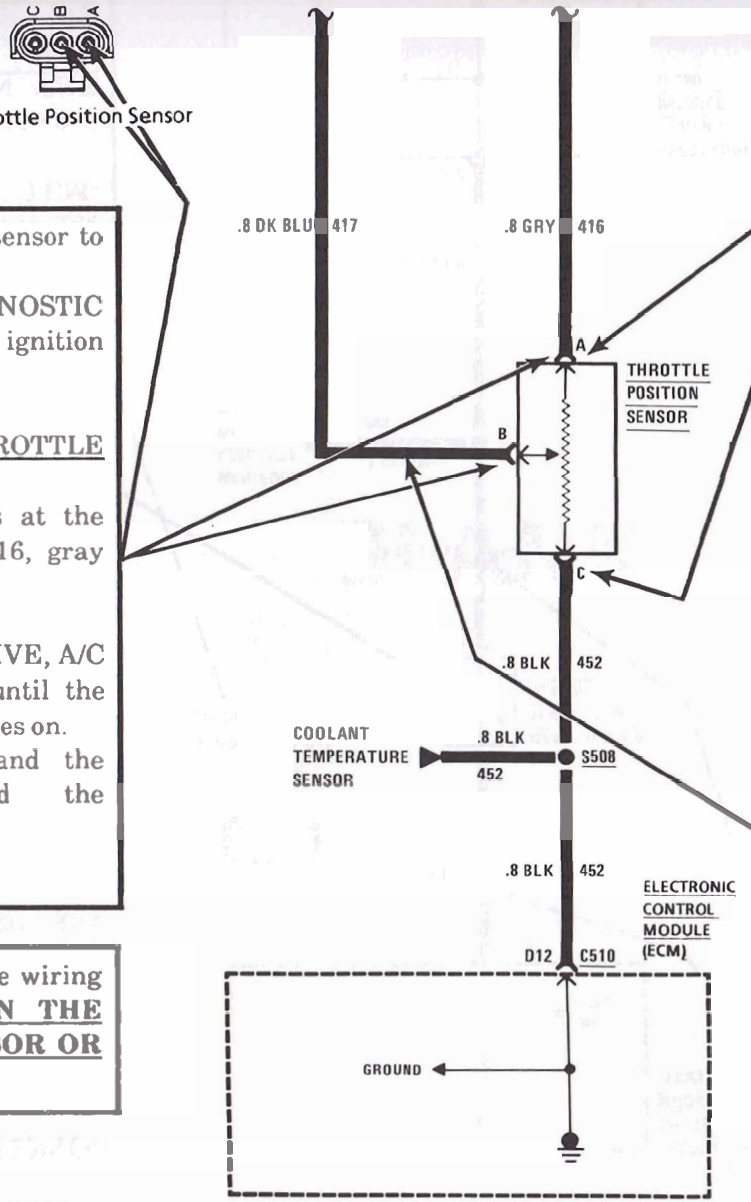
1. Verify that Code 22 is set.
   a. Do not ground the DIAGNOSTIC TERMINAL.
   b. Turn the ignition "OFF."
   c. Clear all codes.
   d. Block the wheels.
   e. **Run the engine at idle,** in DRIVE, A/C "OFF," for one minute or until the "CHECK ENGINE" light comes on.
   f. With the engine stopped and the ignition "ON," ground the DIAGNOSTIC TERMINAL.
   g. Note codes. Go to step **2** or **3**.

2. If no code is set, **REFER TO SECTION B.** The problem is intermittent.





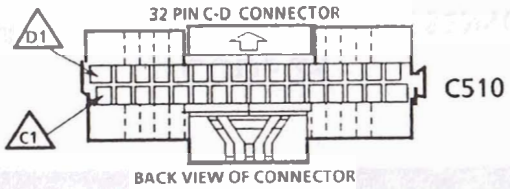




3 If Code 22 sets then jumper the sensor to set Code 21 (signal voltage high).

a. Do not ground the DIAGNOSTIC TERMINAL. Turn the ignition "OFF."
b. Clear all codes.
c. DISCONNECT THE THROTTLE POSITION SENSOR.
d. Jumper A and B terminals at the harness connector (circuit 416, gray wire to circuit 417, blue wire).
e. Block the wheels.
f. Run the engine at idle, in DRIVE, A/C "OFF," for one minute or until the "CHECK ENGINE" light comes on.
g. With the ignition "ON" and the engine stopped, ground the DIAGNOSTIC TERMINAL.
h. Note codes. Go to step 4 or 5.

4 If Code 21 sets, the ECM and the wiring are OK. **THE FAULT IS IN THE THROTTLE POSITION SENSOR OR ITS CONNECTOR.**



5 If Code 22 sets (or Codes 22 and 34) with the jumper installed, remove the jumper and measure the voltage across terminals A (circuit 416, gray wire) and C (circuit 452, black wire). Go to step 6 or 7.

6 If below 4 volts:

a. DISCONNECT THE ECM.
b. Check for an open or a short to ground in circuit 416 (gray).
c. If no open or short to ground is found then **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**

7 If from 4 to 6 volts:

a. DISCONNECT THE ECM.
b. Check for an open or short to ground in circuit 417 (blue).
c. If no open or short to ground is found then **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**

Reconnect all connectors. Clear codes. Confirm "closed loop" operation and no "CHECK ENGINE" light.

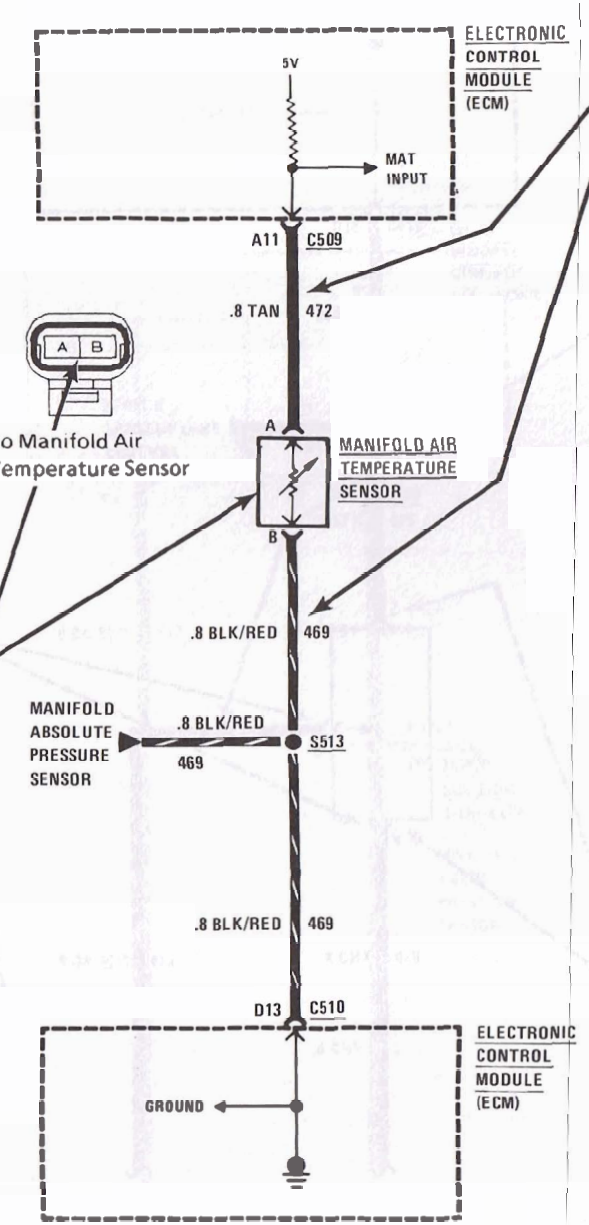
CODE 23
MANIFOLD AIR TEMPERATURE SENSOR SIGNAL VOLTAGE HIGH

The ECM reads voltage across the thermistor in the MANIFOLD AIR TEMPERATURE sensor. When the air is cold, the resistance in the sensor is high and the ECM sees a high signal voltage.

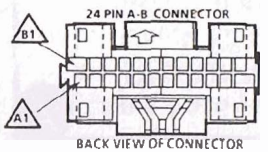
Code 23 will set if the signal voltage indicates a manifold air temperature below -40°C (-40°F) for 30 seconds and the time since starting the engine is greater than one minute.

1 Check the voltage at the MANIFOLD AIR TEMPERATURE sensor.
- a. **DISCONNECT THE MANIFOLD AIR TEMPERATURE SENSOR.**
- b. With the engine stopped and the ignition "ON," measure the voltage at harness connector terminals A and B. Go to step **2** or **3**.

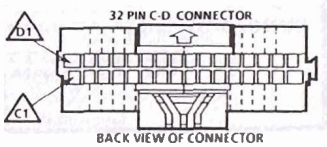
2 If the voltage is over 4 volts:
- a. Measure the resistance across the **MANIFOLD AIR TEMPERATURE SENSOR.**
- b. If the resistance is more than 100,000 ohms, **THE FAULT IS IN THE MANIFOLD AIR TEMPERATURE SENSOR OR ITS CONNECTOR.**
- c. If the resistance is OK, **REFER TO SECTION B.** The problem is



3 If the voltage is below 4 volts:
- a. Check for an open in circuit 469 (black/red stripe) and/or circuit 472 (tan).
- b. If no open is found in either circuit, **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**



C509



C510

Reconnect all connectors. Clear codes. Confirm "closed loop" operation and no "CHECK ENGINE" light.

MAT SENSOR
TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)

°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	-4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

BLANK

CODE 24
VEHICLE SPEED SENSOR
NO PULSED VOLTAGE

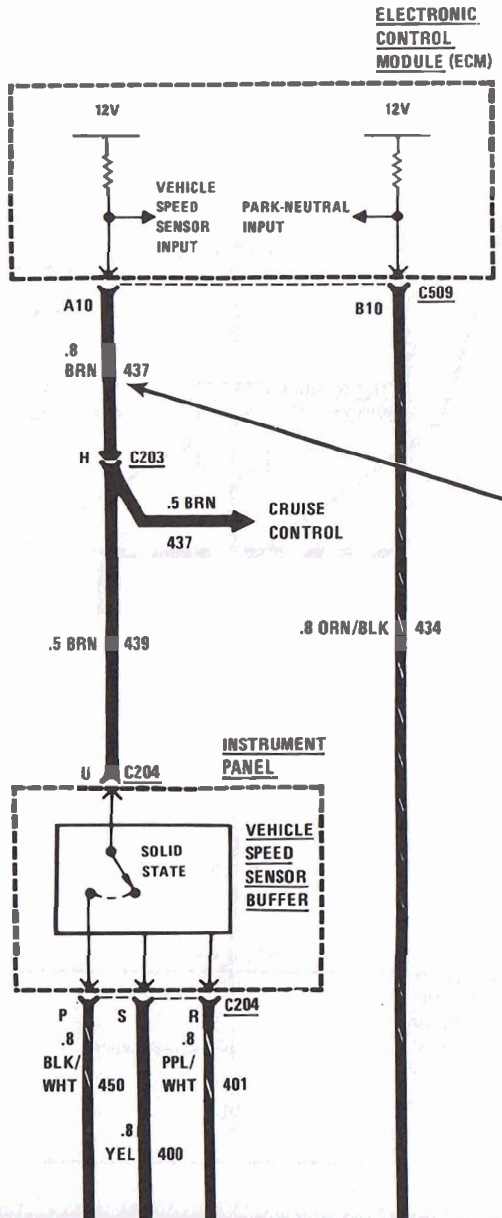
Output from the VEHICLE SPEED SENSOR is used by the SPEEDOMETER, the CRUISE CONTROL MODULE, and the ECM. As the drive wheels turn, the buffer grounds and opens circuit 437 at about 2000 times per mile, using the signal from the VEHICLE SPEED SENSOR. The ECM calculates speed based on how rapidly circuit 437 is switched to ground.

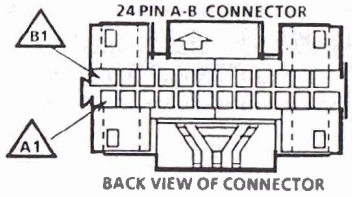
Code 24 sets when:

- Circuit 437 voltage is constant.
- Engine speed is between 1400 and 3600 rpm.
- The throttle opening is less than 2%.
- A low load condition exists (high vacuum).
- The transmission is not in "park" or "neutral."
- All conditions exist for 4 seconds.

The VEHICLE SPEED SENSOR is located at the right rear of the TRANSAXLE.

Disregard Code 24 if it is set when the drive wheels are not turning.



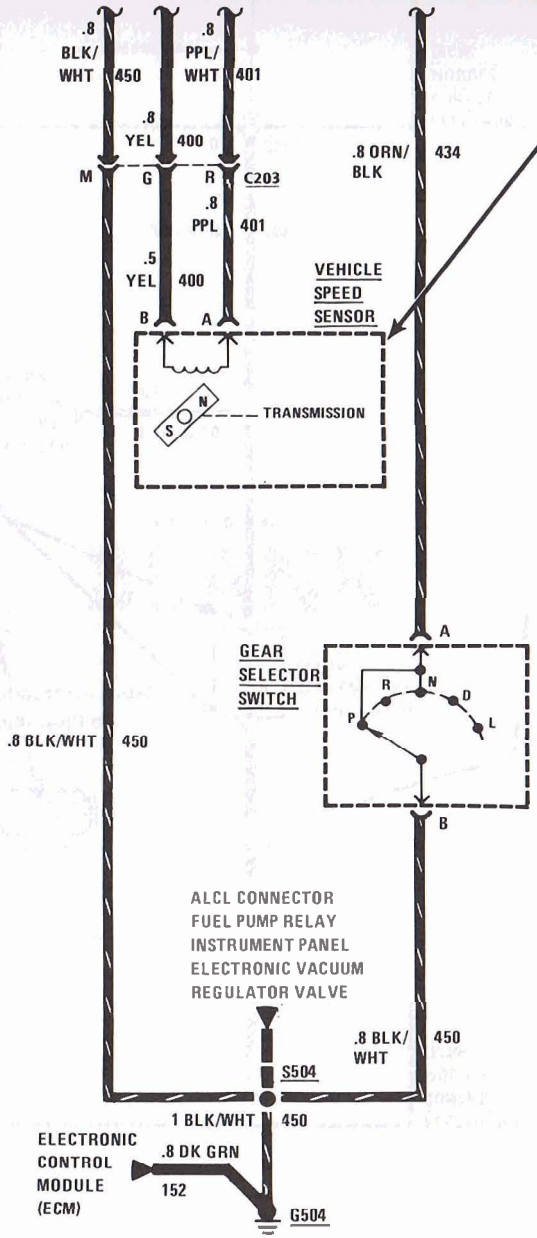


4 If the voltage is steady at less than 1 volt, check circuit 437 (brown) for a short to ground or a poor connection at the ECM. Go to step 5.

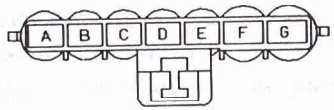
1 Check the pulsed voltage on circuit 437 (brown).
- a. Lift the drive wheels.
- b. Back probe the blue ECM connector C509 at pin A10 with a voltmeter to ground.
- c. Start and idle the engine in "DRIVE." The wheels must be turning. The voltage should vary (approximately 2 to 12 volts). Go to step **2**, **3**, or **4**.

2 If the voltage is changing then check the PARK/NEUTRAL switch (automatic transmissions only): **REFER TO CHART C-1A.** If the PARK/NEUTRAL switch is good then **REFER TO SECTION B.** The problem is intermittent.

3 If the voltage is steady at 12 volts then check circuit 437 (brown) for an open. Go to step **5**.



To Vehicle Speed Sensor



To Gear Selector Switch

5 If circuit 437 is not open or shorted to ground then check for a faulty VEHICLE SPEED SENSOR. **REFER TO SECTION 8A-34.**

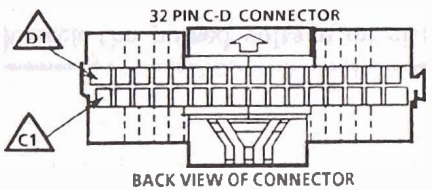
Reconnect all connectors. Clear all codes, confirm "closed loop" operation and no "CHECK ENGINE" light.

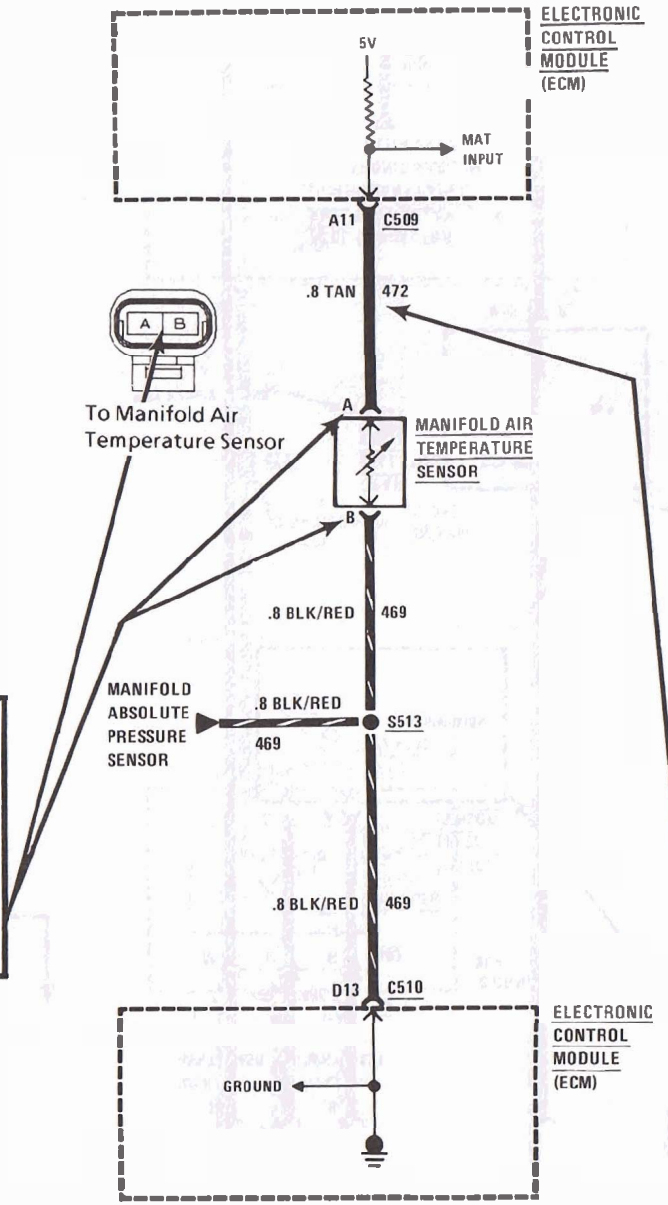
CODE 25
MANIFOLD AIR TEMPERATURE SENSOR SIGNAL VOLTAGE LOW

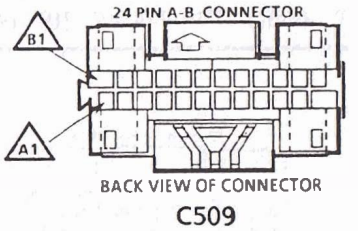
The ECM reads voltage across the thermistor in the MANIFOLD AIR TEMPERATURE SENSOR. When the air is cold, resistance is high and the ECM sees high signal voltage. Sensor resistance decreases as the air warms, and the voltage will drop. Code 25 sets when low signal voltage indicates an air temperature greater than 135°C (275°F) for 3 seconds and the time since engine start is greater than 20 seconds.

The "CHECK ENGINE" light for Code 25 will stay on only as long as the vehicle speed signal is present.

1 Measure the voltage at the MANIFOLD AIR TEMPERATURE SENSOR
- a. **DISCONNECT THE MANIFOLD AIR TEMPERATURE SENSOR.**
- b. With the engine stopped and the ignition "ON," measure the voltage at harness connector terminals A and B. Go to step **2** or **3**.







2 If the voltage is over 4 volts:
- a. Measure the resistance across the MANIFOLD AIR TEMPERATURE SENSOR.
- b. If the resistance is less than 185 ohms, replace the sensor.
- c. See the table of resistance values. If the resistance is OK, **REFER TO SECTION B.** The problem is intermittent.

3 If the voltage is below 4 volts, check for a short to ground in circuit 472 (Tan). If no short is found then **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**

Reconnect all connectors. Clear all codes. Confirm "closed loop" operation and "CHECK ENGINE" light.

BLANK

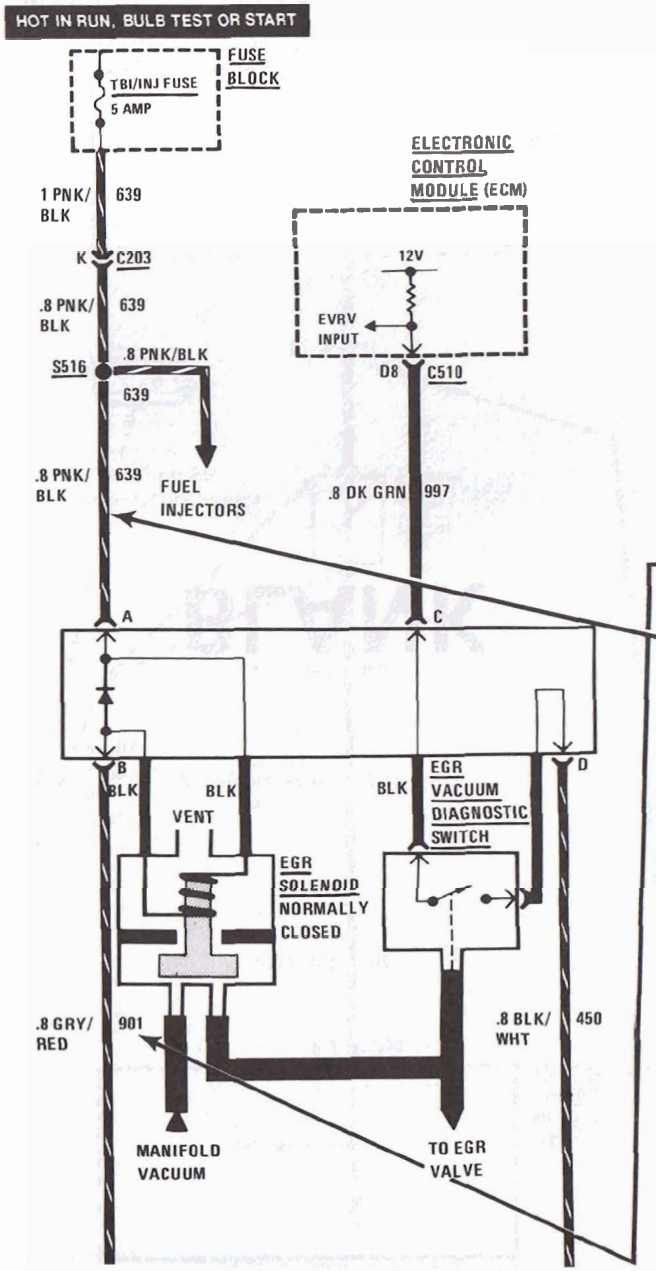
CODE 32
EXHAUST GAS RECIRCULATION VACUUM CONTROL

Code 32 sets when the EGR DIAGNOSTIC SWITCH is not closed under the following conditions:

- Coolant temperature is greater than 80°C (176°F).
- Manifold pressure is less than 25 kPa (7" vacuum).
- EGR duty cycle commanded by the ECM is greater than 50%.
- All of these conditions are met for 8 seconds.

The ECM turns the EXHAUST GAS RECIRCULATION (EGR) SOLENOID on and off (duty cycle) by grounding circuit 901. The EGR duty cycle is calculated by the ECM based on information from the COOLANT SENSOR, the MAP SENSOR, and engine rpm. The duty cycle should be 0% (no EGR) when the THROTTLE POSITION SENSOR is at WOT or below a specified value. A vacuum is allowed to pass when the normally closed EGR SOLENOID is energized. This vacuum helps to open passage of exhaust gases from the exhaust system to the intake manifold. The EGR DIAGNOSTIC VACUUM SWITCH monitors the vacuum in the ported manifold.

With the engine stopped and the ignition "ON," the EGR SOLENOID is not energized unless the DIAGNOSTIC TERMINAL is grounded.



4 If the valve does not move then check ECM control of the EGR SOLENOID.

a. **DISCONNECT THE EGR 4-WAY ELECTRICAL CONNECTOR.**
b. Connect a test light between terminals A and B of EGR connector.
c. Note the test light. Go to **d** or **e**.
d. If the test light glows then **THE FAULT IS IN THE EGR SOLENOID.**
e. If the test light does not glow then connect it between terminal A of the EGR connector and ground. Note the test light. Go to **f** or **g**.
f. If the test light glows then check for an open in circuit 901 (gray/red). If no open is found then **THE FAULT IS IN THE ECM.**
g. If the test light does not glow then **FIND THE OPEN IN CIRCUIT 639 (pink/black).**

5 If the EGR VALVE moves then check the EGR DIAGNOSTIC VACUUM SWITCH.

a. **DISCONNECT THE EGR 4-WAY CONNECTOR.**
b. Connect a voltmeter between terminals C and D of the EGR connector. Note the voltage. Go to step **6** or **7**.

1 Check for ported vacuum to the EGR SOLENOID. Also check hoses for leaks or restrictions. Vacuum should be at least 7" HG at 2000 rpm.

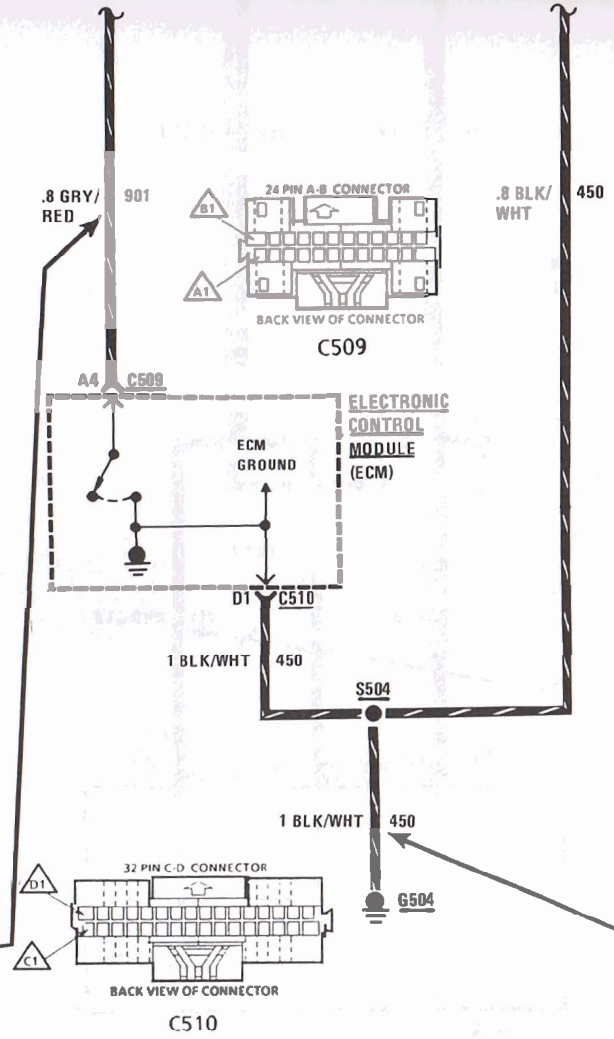
a. With the engine stopped and the ignition "ON," **DISCONNECT THE EGR SOLENOID VACUUM HARNESS.**
b. Rotate the vacuum harness and reconnect the EGR side of the harness.
c. Install a hand held vacuum pump with a gage to the manifold side of the EGR SOLENOID and apply vacuum. Observe the EGR valve. Go to step 2 or 3.

2 If the EGR VALVE moves then check to see that the ECM is energizing the EGR SOLENOID.

a. **DISCONNECT THE EGR SOLENOID ELECTRICAL CONNECTOR.**
b. Repeat the test in step 1. Go to **c** or **d**.
c. If the EGR VALVE moves then **THE FAULT IS IN THE EGR SOLENOID.**
d. If the EGR VALVE does not move then check circuit 901 (gray/red) for a short to ground. If no short is found then **THE FAULT IS IN THE ECM.**

3 If the EGR VALVE does not move then check EGR SOLENOID operation.

a. Ground the DIAGNOSTIC TERMINAL.
b. Repeat the test in step 1.
c. Observe the EGR VALVE. Go to step 4 or 5.



4 If the voltage is over 10 volts check the EGR DIAGNOSTIC VACUUM SWITCH in operation.

a. Connect an ohmmeter across terminals C and D of the EGR SOLENOID.
b. Apply 24 kPa (7") vacuum to the EGR DIAGNOSTIC SWITCH.
c. Note the resistance. Go to **d** or **e**.
d. If the resistance is low (switch closed) then check all connections and terminals. The problem is intermittent.
e. If the resistance is high (switch open) then **THE FAULT IS IN THE EGR DIAGNOSTIC SWITCH, ITS CONNECTOR, OR IN THE WIRING.**

5 If the voltage is under 10 volts then check the ECM reference voltage.

a. Connect a voltmeter between terminal C of the EGR 4-way connector and ground.
b. Note the voltage. Go to **c** or **d**.
c. If the voltage is over 10 volts then **FIND AN OPEN IN GROUND CIRCUIT 450 (black/white stripe).**
d. If the voltage is under 10 volts then check circuit 997 (dark green) for an open. If no open is found then **THE FAULT IS IN THE ECM,****

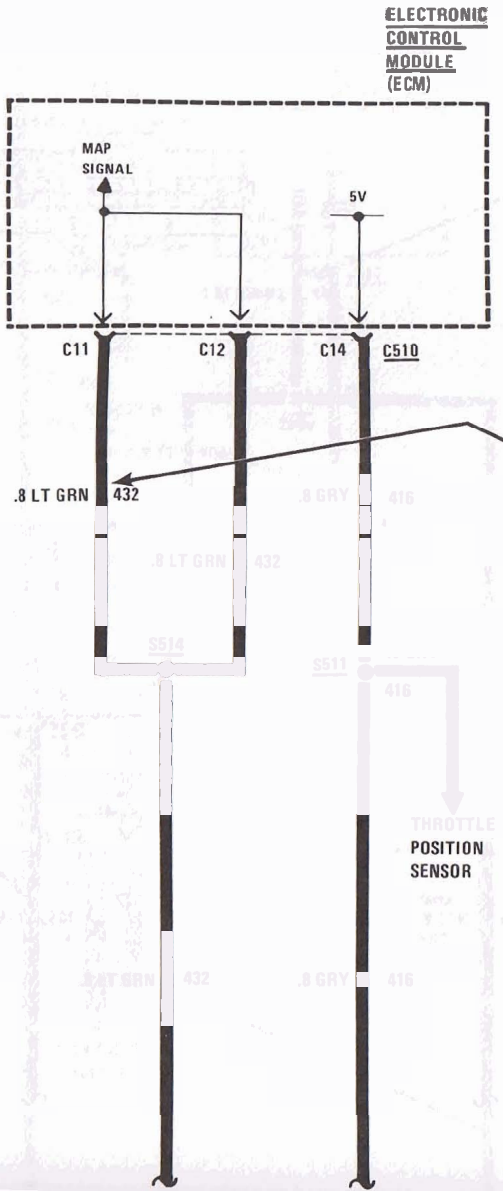
** Note: Before replacing the ECM, use an ohmmeter to check resistance of each ECM controlled relay and solenoid coil. Replace any relay or solenoid if the coil resistance is less than 20 ohms.

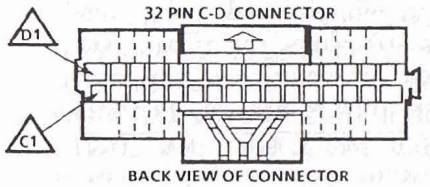
Reconnect all connectors. Clear all codes. Confirm "closed loop" operation and "CHECK ENGINE" light.

CODE 33
MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL VOLTAGE HIGH

The MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP) responds to changes in vacuum pressure in the intake manifold. The ECM receives this information as a signal voltage that will vary from about 1.0-1.5 volts at idle to 4.0-4.5 volts at full throttle. If the MANIFOLD ABSOLUTE PRESSURE SENSOR fails, the ECM will substitute a fixed manifold absolute pressure value and use the THROTTLE POSITION SENSOR to control fuel delivery.

Code 33 will set when the voltage signal is too high for more than six seconds.





C510

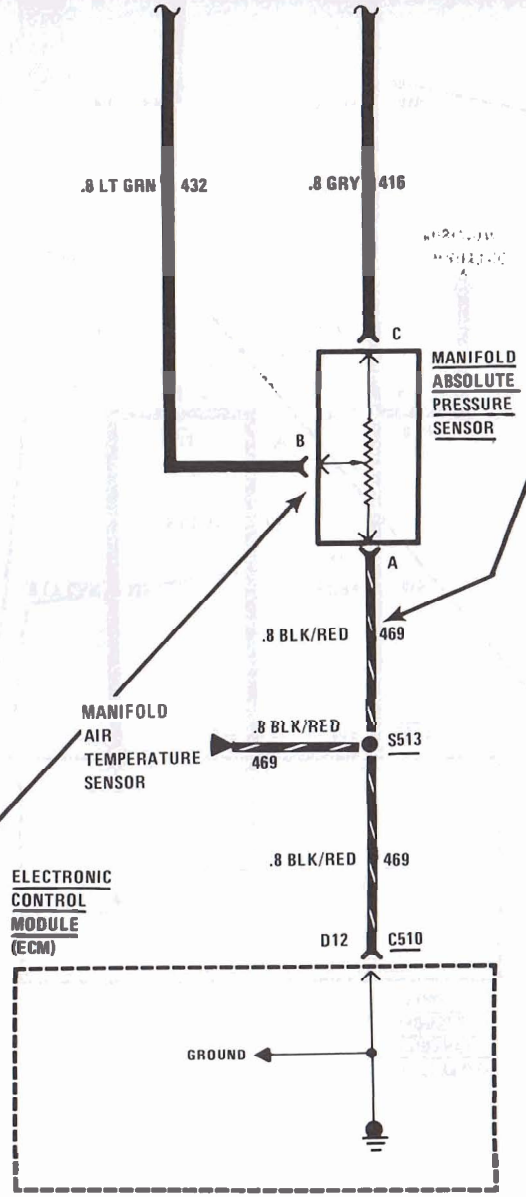
1. If the engine misfires or a low unstable idle exists and Code 33 is set:
   a. **DISCONNECT THE MANIFOLD ABSOLUTE PRESSURE SENSOR.** This puts the system in backup mode.
   b. If misfire or rough idle persists, **REFER TO SYMPTOMS IN SECTION B.**

5. If Code 33 sets with the sensor circuit open:
   a. Check for a short to voltage in circuit 432 (light green wire).
   b. If no voltage is found in circuit 432 (light green wire), **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**

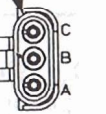
2 Verify that Code 33 is set.
- a. Ignition "OFF." Clear codes.
- b. Run the engine for one minute or until the "CHECK ENGINE" light comes on.
- c. With the engine stopped and the ignition "ON," ground the DIAGNOSTIC TERMINAL.
- d. Note codes. Go to step **3** or **4**.

3 If Code 33 does not set, **REFER TO SECTION B.** The problem is intermittent.

4 If Code 33 sets then open the circuit to set code 34.
- a. Clear all codes.
- b. **DISCONNECT THE MANIFOLD ABSOLUTE PRESSURE SENSOR.**
- c. Do not ground the DIAGNOSTIC TERMINAL.
- d. Start the engine and run it for one minute or until the "CHECK ENGINE" light comes on.
- e. With the engine stopped and the ignition "ON," ground the DIAGNOSTIC TERMINAL and note all codes. Go to step **5** or **6**.



6 If Code 34 (signal low, no voltage supplied) sets:
- a. Check for a plugged or leaking sensor vacuum hose.
- b. If no leak is found in the vacuum hose, check for an open in ground circuit 469 (black/red stripe).
- c. If no open is found in circuit 469 (black/red stripe) then **THE FAULT IS IN THE MANIFOLD ABSOLUTE PRESSURE SENSOR OR ITS CONNECTOR.**



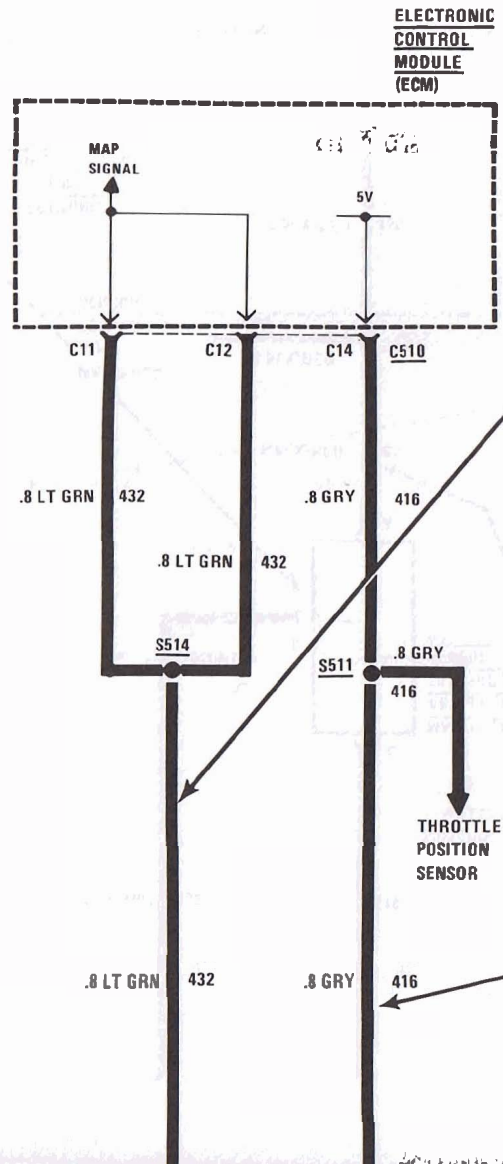
To Manifold Absolute Pressure Sensor

Reconnect all connectors. Clear all codes. Confirm "closed loop" operation and no "CHECK ENGINE" light.

CODE 34
MANIFOLD ABSOLUTE PRESSURE SENSOR
SIGNAL VOLTAGE LOW

The MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP) responds to changes in vacuum pressure in the intake manifold. The ECM receives this information as a signal voltage that will vary from about 1.0-1.5 volts at idle to 4.0-4.5 volts at full throttle. If the MANIFOLDABSOLUTE PRESSURE SENSOR fails, the ECM will substitute a fixed manifold absolute pressure value and use the THROTTLE POSITION SENSOR to control fuel delivery.

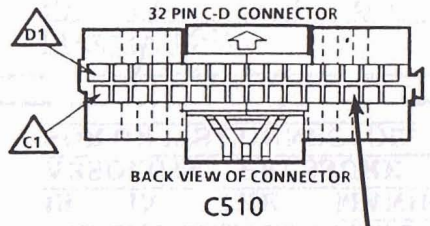
Code 34 will set when the voltage signal is too low and the ignition is "ON."



1 Verify codes:
- a. **With the** ignition "OFF," clear all codes. Do not ground the DIAGNOSTIC TERMINAL.
- b. Run the engine for one mnute or until the "CHECK ENGINE" light comes on.
- c. Ground the DIAGNOSTIC TERMINAL.
- d. Note codes. Go to step **2** or **3**.

2 If Code 34 does not set, **REFER TO SECTION B.** The problem is intermittent.

6 If the voltage reads between 4 and 6 volts (good):
- a. Check for a short to ground in circuit 432 (light green wire).
- b. If no short is found, **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**



7 If the voltage reads below 4 volts:
- a. Check for an open or a short to ground in circuit 416 (gray wire).
- b. If neither a short nor an open is found, check pin C14 of the gray, 32 pin, ECM connector (C510).
- c. If the ECM pin is OK, **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**

3 If Code 34 sets (or Codes 34 and 22):

a. With the ignition "OFF," clear all codes.

b. DISCONNECT THE MANIFOLD ABSOLUTE PRESSURE SENSOR and JUMPER PINS B AND C AT THE HARNESS CONNECTOR.

c. Do not ground the DIAGNOSTIC TERMINAL.

d. Start the engine and run for one minute or until the "CHECK ENGINE" light comes on.

e. With the engine stopped and the ignition "ON," ground the DIAGNOSTIC TERMINAL.

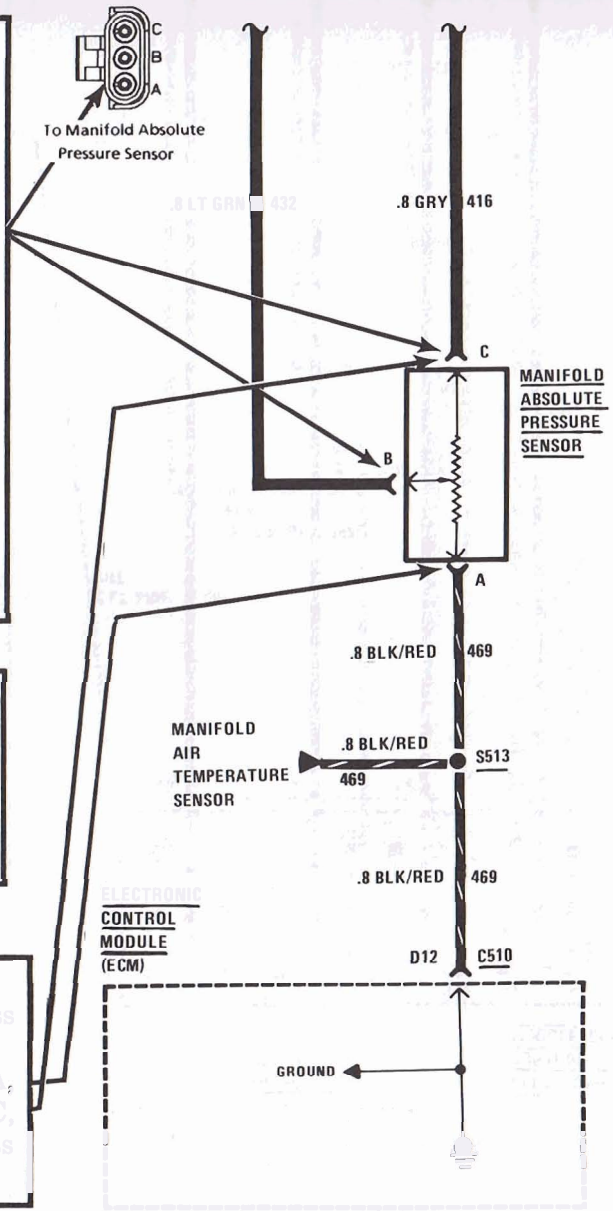
f. Note codes. Go to step 4 or 5.

4 If Code 33 (signal voltage high) sets, the ECM and wiring are good. **THE FAULT IS IN THE MANIFOLD ABSOLUTE PRESSURE SENSOR OR ITS CONNECTOR.**

5 If Code 34 sets:

a. Remove the jumper from the harness connector.

b. Check the voltage between pins A, circuit 469 (black/red stripe) and C, circuit 416 (gray wire) of the harness connector. Go to step 6 or 7.



Reconnect all connectors. Clear codes. Confirm "closed loop" operation and no "CHECK ENGINE" light.

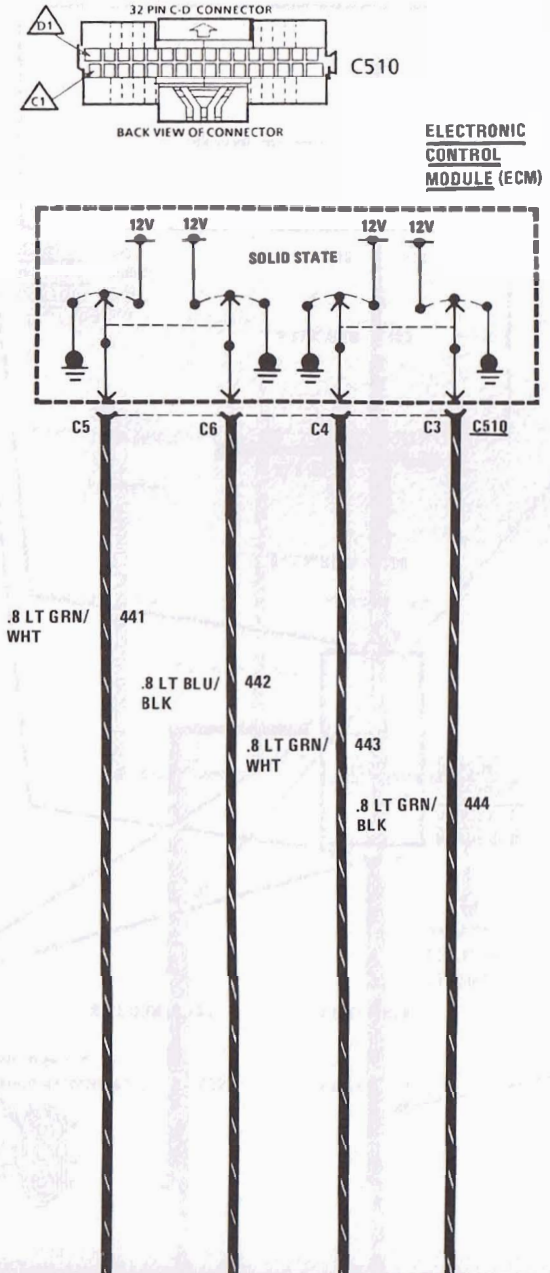
CODE 35
IDLE AIR CONTROL

The ECM controls engine speed by moving the IDLE AIR CONTROL VALVE (IAC Valve) to control air flow around the throttle plate. The ECM "learns" and maintains the correct IAC Valve position to achieve proper idle rpm. If the "learned" position is incorrect then the ECM resets the position. Reset occurs after the next engine start when vehicle speed is 35 to 45 mph.

The IAC VALVE is operated by a reversible motor. The ECM supplies voltage pulses to the motor windings and the valve moves a given distance for each pulse.

- To increase idle speed the ECM runs the motor to retract and open the IAC VALVE. More air flows through to by-pass the throttle valve plate until the idle speed reaches proper rpm.

- To decrease idle speed the ECM reverses the polarity of the pulses and extends the IAC VALVE to reduce the air flow. This lowers the engine rpm.



1 With the engine idling at normal operating temperature, note the engine rpm in Park.
   a. With the ignition "OFF," DISCONNECT THE IAC VALVE.
   b. Start the engine and note the rpm in Park. Go to step 2 or 3.

EGR Valve - If the EGR Valve is open at idle, it may cause roughness, stoppage, or hard starting. Refer to Chart C-7A.

- Battery cables and ground straps - A poor connection due to corrosion or looseness may cause a change in IAC position due to erratic voltage.
- IAC Valve will not move if the system voltage is less than 9 volts or more than 17.8 volts.

3 If there was a change in the idle rpm then check for ECM output to the IAC VALVE.
   a. With the engine stopped and the ignition "ON," ground the DIAGNOSTIC TERMINAL. The IAC VALVE is still disconnected.
   b. Connect a test light between each terminal of the IAC harness connector pin and ground.
   c. Note the test light. Go to step 4 or 5.

4 If the test light glows steady or flashing on all circuits then **THE FAULT IS IN THE IAC VALVE OR ITS CONNECTOR.**

2 If the idle rpm increased then turn the ignition "OFF," and **RECONNECT THE IAC VALVE.**

a. Start the engine and note the rpm in Park. Go to **b** or **c**.

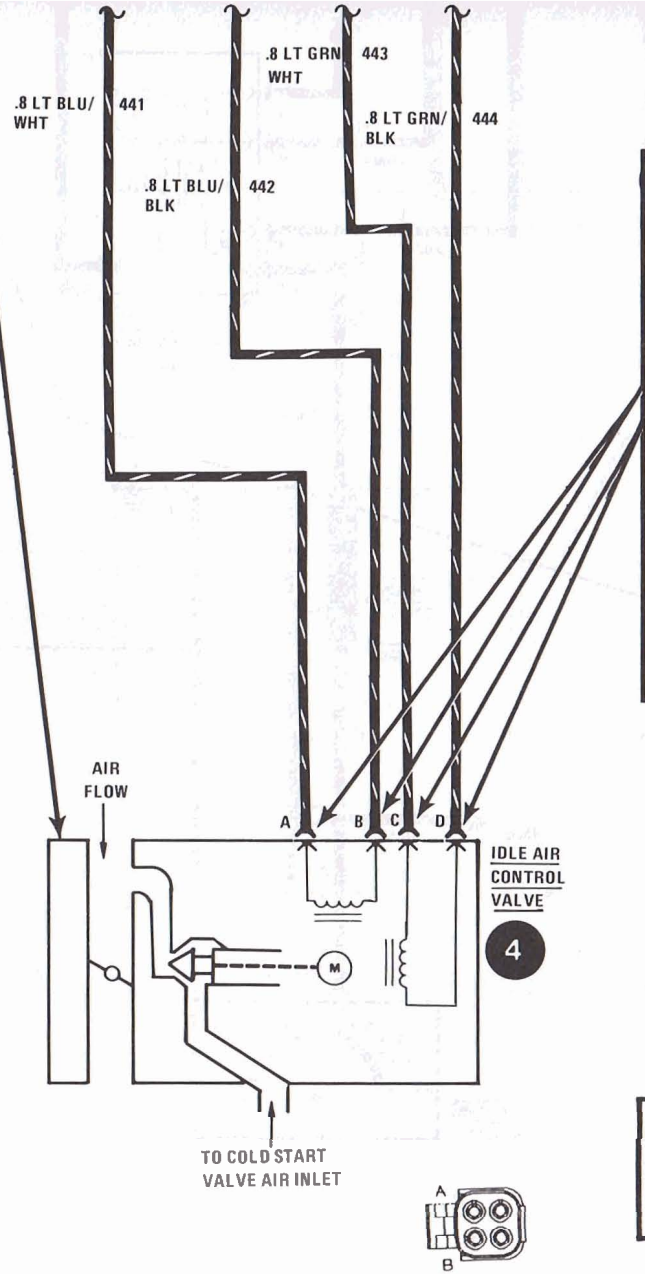
b. If the idle rpm does not return to the idle rpm noted in step 1 with the IAC Valve connected, then go to step **3**.

c. If the idle rpm returns to the first engine rpm noted in step 1 then the IAC is good. Check the following which can affect idle speed:

- Park/Neutral Switch (Automatic transmission only) - If the ECM sees the car as always in neutral then the idle speed will not be correct in Drive. Refer to Chart C-1A.

  Fuel Injectors - A leaking injector will cause poor idle quality due to excess fuel. A sticking injector will cause poor idle quality due to a lean or rich condition and may set Code 44 or 45.

- THROTTLE POSITION SENSOR voltage - A sticking throttle shaft or binding linkage causes a high TPS voltage (open throttle indication). The ECM must recognize a closed throttle to control idle. Voltage should read less than 1.2 volts with the throttle closed. (continued)



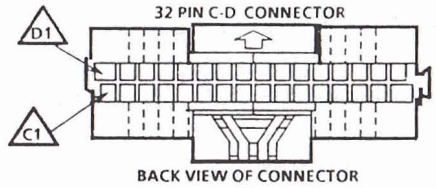
To Idle Air Control Valve

5 If the test light does not glow on one or more terminals then check for an open or a short to ground in the circuit that did not light the test light.

a. If no open or short to ground is found then check the resistance across the IAC coils at terminals A and B and at terminals C and D. Go to **b** or **c**.

b. If the resistance was above 20 ohms then **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**

c. If the resistance is less than 20 ohms then **THE FAULT IS IN THE IAC VALVE OR ITS CONNECTOR.** Also **REPLACE THE ECM.**



C510

Reconnect all connectors. Clear all codes. Confirm "closed loop" operation and no "CHECK ENGINE" light.

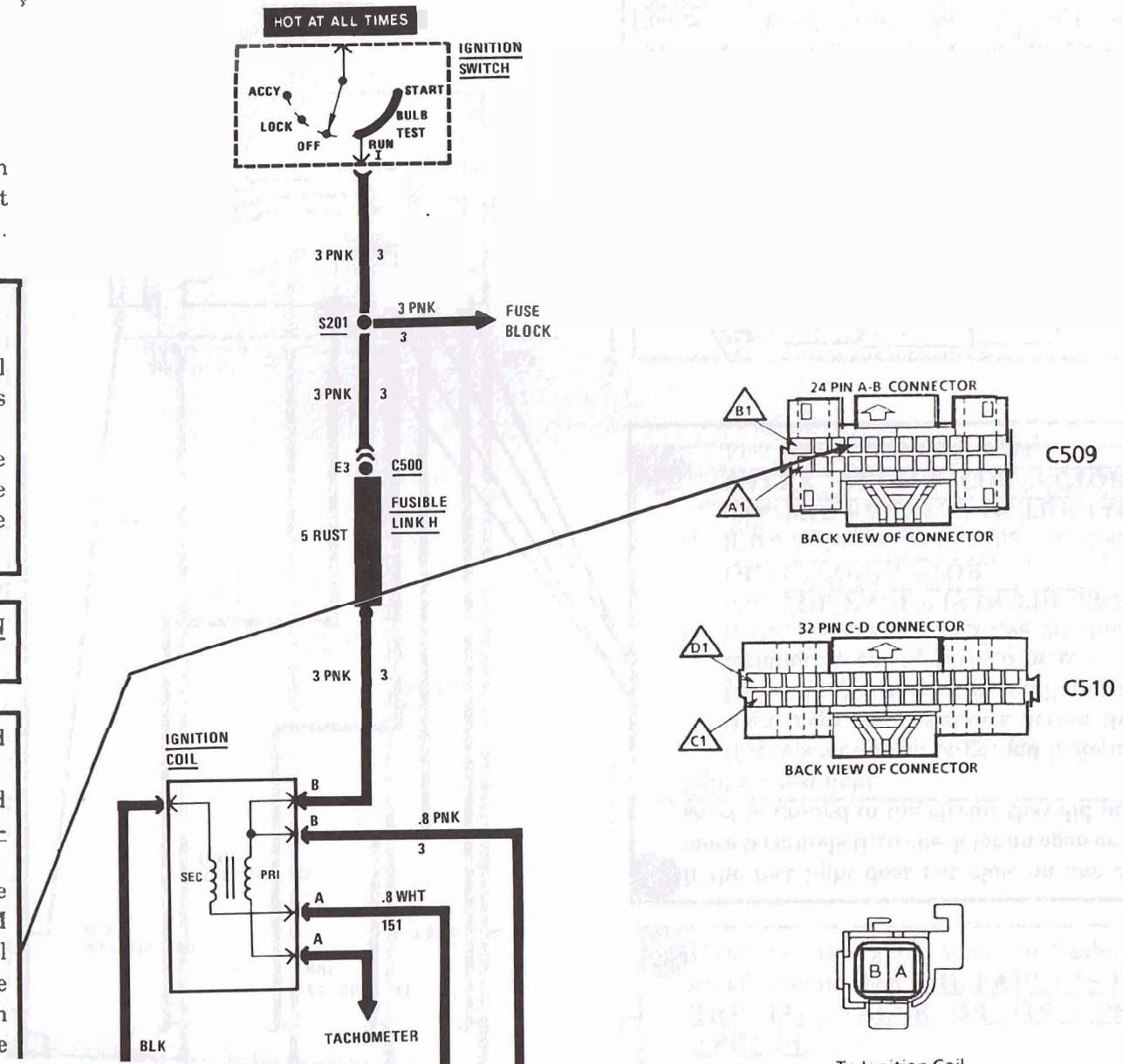
CODE 42
ELECTRONIC SPARK TIMING (EST) OPEN OR SHORT TO GROUND

Code 42 indicates that the ECM has seen an open or short to ground in the EST input (circuit 423) or the by-pass circuit (circuit 424).

1 Verify that code 42 sets.
- a. Clear codes.
- b. Idle the engine for 1 minute or until the "CHECK ENGINE" light comes on.
- c. With the engine stopped and the ignition "ON," ground the DIAGNOSTIC TERMINAL and note the codes. Go to step **2** or **3**.

2 If no code is set, **REFER TO SECTION B.** The problem is intermittent.

3 If Code 42 sets check for an EST ground path through the EST DISTRIBUTOR.
- a. Turn the ignition "OFF" and **DISCONNECT BOTH ECM CONNECTORS.**
- b. With the engine stopped and the ignition "ON," probe the ECM harness connector, **C509** (terminal B4) with an ohmmeter to ground. The ohmmeter selector switch should be in the 1000 to 2000 ohms range. The



4 If the ohmmeter reads more than 500 ohms then check for an open in circuit 423 (white). If an open is not found, **THE FAULT IS IN THE EST DISTRIBUTOR OR ITS CONNECTOR.**

5 If the ohmmeter reads less than 500 ohms then probe gray ECM harness connector C510 (terminal D5) with a test light to 12 volts. Observe the light, Go to step **6** or **7**.

6 If the test light glows then **DISCONNECT THE EST DISTRIBUTOR 4-WAY CONNECTOR** and note the test light again. Go to **a** or **b**.

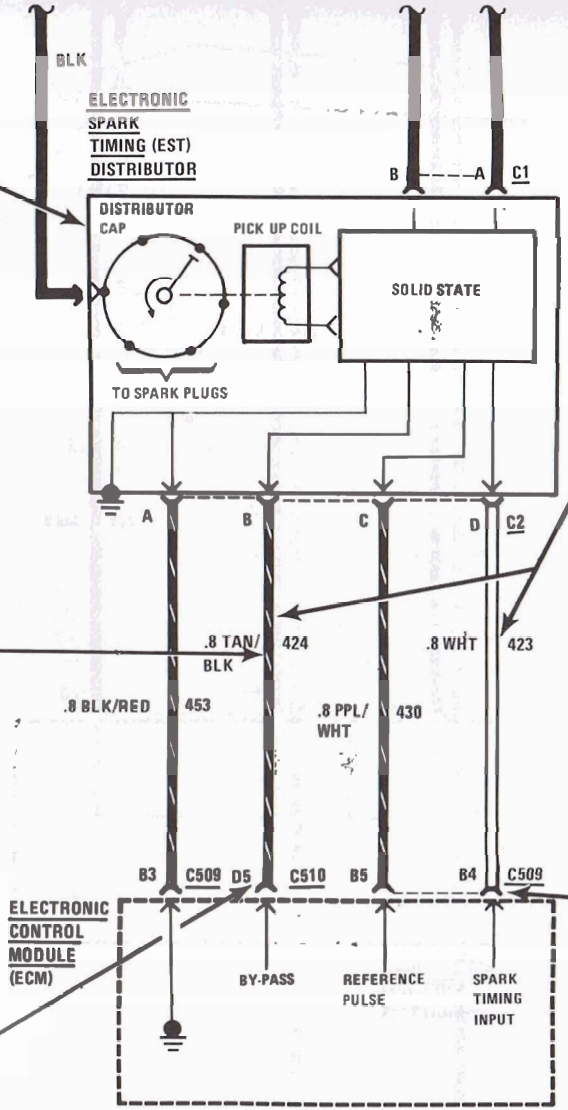
a If the test light still glows then **FIND A SHORT TO GROUND IN CIRCUIT 424 (tan/black).**

b. If the test light does not glow then **THE FAULT IS IN THE EST DISTRIBUTOR.**

7 If the test light does not glow then check the EST DISTRIBUTOR.

a. Leave the ohmmeter connected to ground and probe the blue ECM harness connector, C509 (terminal B4). Also probe gray ECM harness connector, C510 (terminal D5) with a test light connected to 12 volts.

b. Observe the ohmmeter. Check for the resistance to change from under 500 ohms to over 5000 ohms. Go to step **8** or **9**.



Reconnect all connectors. Clear all codes. Confirm "closed loop" operation and no "CHECK ENGINE" light.

8 If the resistance switched to over 5000 ohms (good) then check for an intermittent open or short to ground in circuit 423 or circuit 424.

a. **RECONNECT THE ECM.**

b. Idle the engine for 1 minute or until the "CHECK ENGINE" light comes on. Go to **c** or **d**.

c. If the "CHECK ENGINE" light does not come on, no trouble was found. Check the harness and the connectors for an intermittent open or short to ground in circuit 423 or circuit 424.

d. If the "CHECK ENGINE" light comes on then check for codes. If Code 42 sets then **THE FAULT IS IN THE ECM.**

9 If the resistance stayed less than 500 ohms then check circuit 423.

a. With the ohmmeter still connected to circuit 423 and to ground, **DISCONNECT THE EST DISTRIBUTOR 4-WAY CONNECTOR C2.**

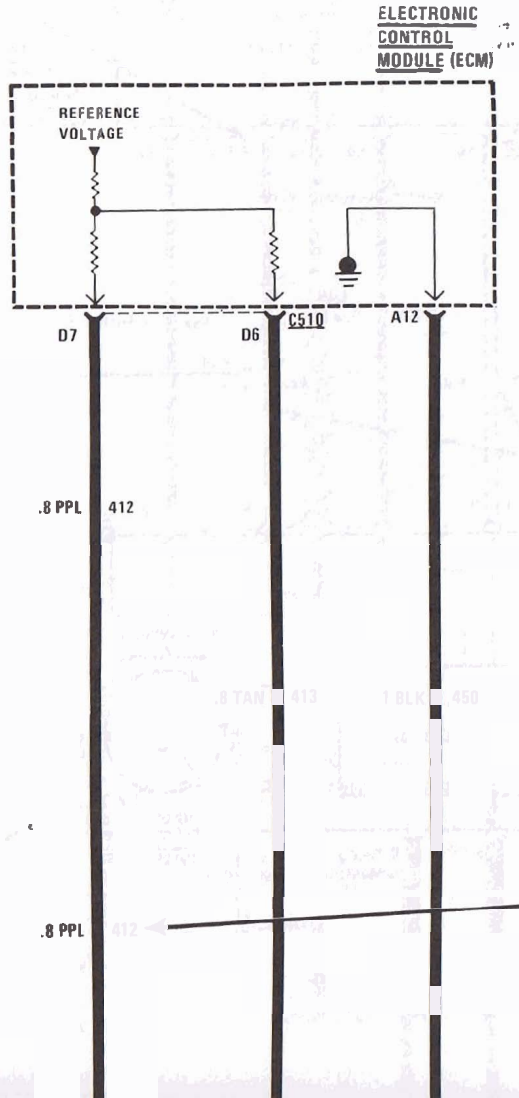
b. Again check the resistance from B4 of to ground. Go to **10** or **11**.

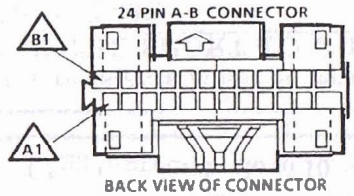
10 If the resistance is low or zero ohms then **FIND THE SHORT TO GROUND IN CIRCUIT 423.**

11 If the resistance is high (open circuit) check for an open in circuit 424 (tan/black). If no open is found then **THE FAULT IS IN THE IGNITION MODULE OR ITS CONNECTOR.**

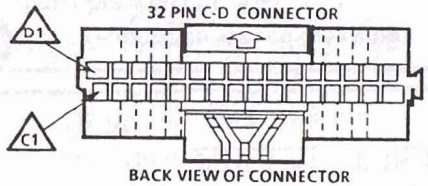
CODE 44
OXYGEN SENSOR CIRCUIT LEAN EXHAUST CONDITION

The engine operates in open loop when it is cold, idling, or at full throttle. In closed loop, the ECM monitors the OXYGEN SENSOR output voltage and controls the fuel mixture. The OXYGEN SENSOR produces no voltage when it is below 360°C (600°F). OXYGEN SENSOR output is based on the oxygen content of the exhaust. Output voltage should vary from 0.1 volt (high oxygen content, lean mixture) to 1.0 volt (low oxygen content, rich mixture). Code 44 sets when the engine has been operating for a specified time after starting (about two minutes), and the OXYGEN SENSOR output remains below 0.2 volts for 50 seconds or more. The ECM supplies a reference voltage (about 4.5 volts) to the OXYGEN SENSOR circuit (between pins D6 and D7 of ECM connector C510). This voltage will read lower than 4.5 volts when measured with a voltmeter. If the voltage is measured with a digital voltmeter, it may read as low as 0.32 volts. A regular voltmeter with a needle may read as low as 0 volts.





C509

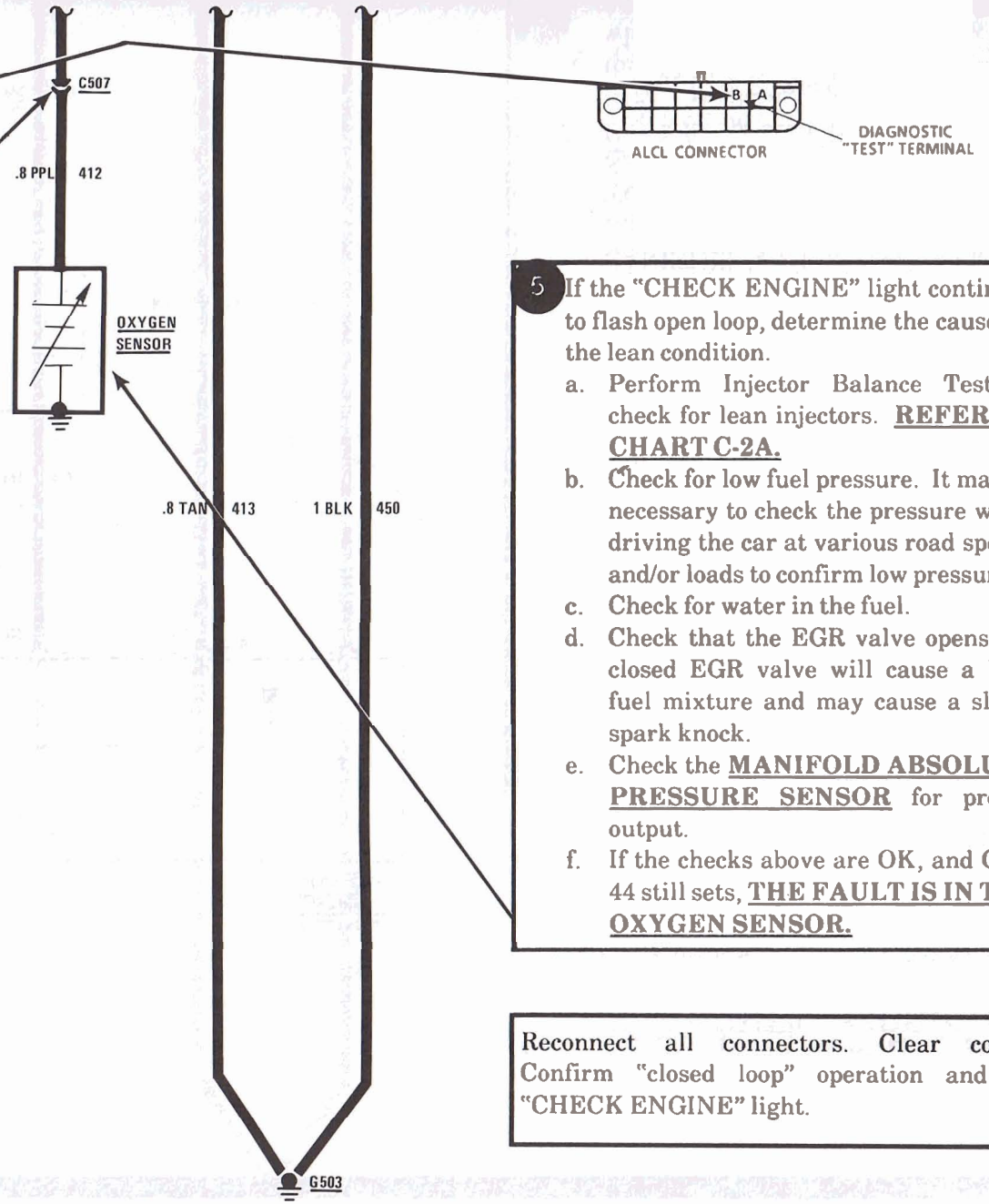


4 If the "CHECK ENGINE" light goes out for at least 30 seconds, check for a short to ground in circuit 412 (purple wire). If no short is found then, THE FAULT IS IN THE OXYGEN SENSOR OR ITS CONNECTOR.

1 Determine the ECM operating mode.
- a. With the engine at normal operating temperature, ground the DIAGNOSTIC TERMINAL.
- b. Run the engine at 1200 to 1800 rpm for one minute.
- c. Observe the "CHECK ENGINE" light to determine closed loop or open loop operation. Go to step **2** or **3**.

2 If the ECM is operating in closed loop mode, (slow flashes), **REFER TO SECTION B.** The problem is intermittent.

3 If the ECM is operating in open loop mode, (fast flashes), verify correct operation of the ECM.
- a. With the ignition "OFF," ground the DIAGNOSTIC TERMINAL and **DISCONNECT THE OXYGEN SENSOR.**
- b. Jumper the harness connector for circuit 412 (purple) to ground and start the engine.
- c. Observe the "CHECK ENGINE" light. Go to step **4** or **5**.



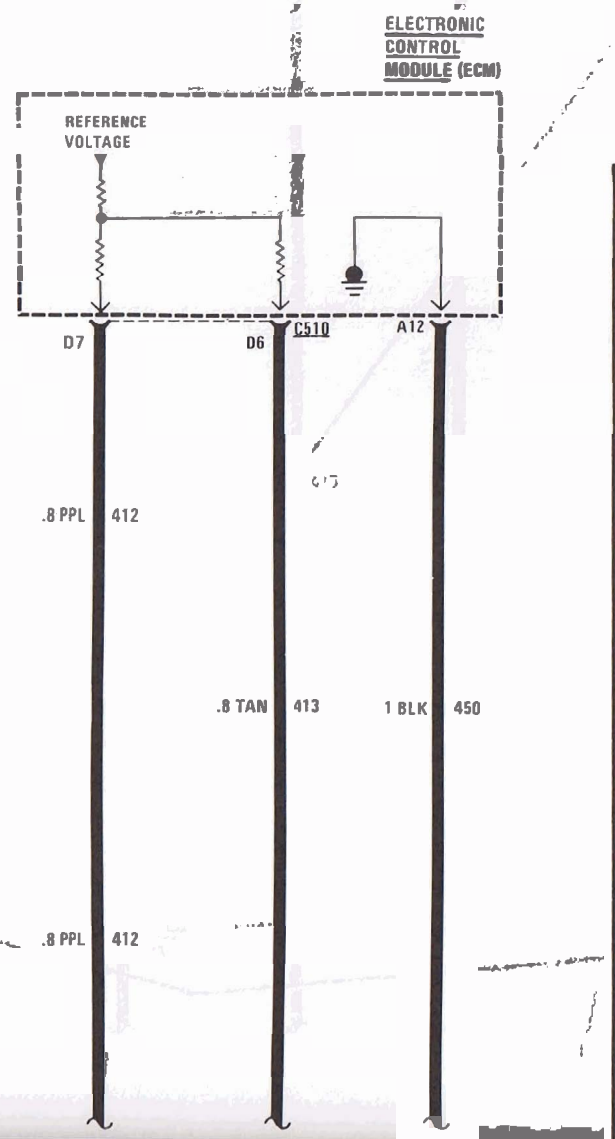
5 If the "CHECK ENGINE" light continues to flash open loop, determine the cause for the lean condition.
- a. Perform Injector Balance Test to check for lean injectors. **REFER TO CHART C-2A.**
- b. Check for low fuel pressure. It may be necessary to check the pressure while driving the car at various road speeds and/or loads to confirm low pressure.
- c. Check for water in the fuel.
- d. Check that the EGR valve opens. A closed EGR valve will cause a lean fuel mixture and may cause a slight spark knock.
- e. Check the **MANIFOLD ABSOLUTE PRESSURE SENSOR** for proper output.
- f. If the checks above are OK, and Code 44 still sets, **THE FAULT IS IN THE OXYGEN SENSOR.**

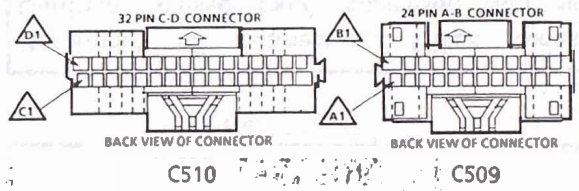
Reconnect all connectors. Clear codes. Confirm "closed loop" operation and no "CHECK ENGINE" light.

CODE 45
OXYGEN SENSOR CIRCUIT
RICH EXHAUST CONDITION

The engine operates in open loop when it is cold, idling, or at full throttle. In closed loop, the ECM monitors the OXYGEN SENSOR output voltage and controls the fuel mixture. The OXYGEN SENSOR produces no voltage when it is below 360°C (600°F). OXYGEN SENSOR output is based on the oxygen content of the exhaust. Output voltage should vary from 0.1 volt (high oxygen content, lean mixture) to 1.0 volt (low oxygen content, rich mixture).

Code 45 sets when the engine has been operating for a specified time after starting (about two minutes), and the OXYGEN SENSOR output remains above 0.7 volts for 30 seconds or more. The ECM supplies a reference voltage (about 4.5 volts) to the OXYGEN SENSOR circuit (between terminals D6 and D7 of ECM connector C510). This voltage will read lower than 4.5 volts when measured with a voltmeter. If the voltage is measured with a digital voltmeter, **it may read as low as 0.32 volts. A regular voltmeter with a needle may read as low as 0 volts.**





5 If the "CHECK ENGINE" light goes off for at least 30 seconds then determine the cause for the rich condition.

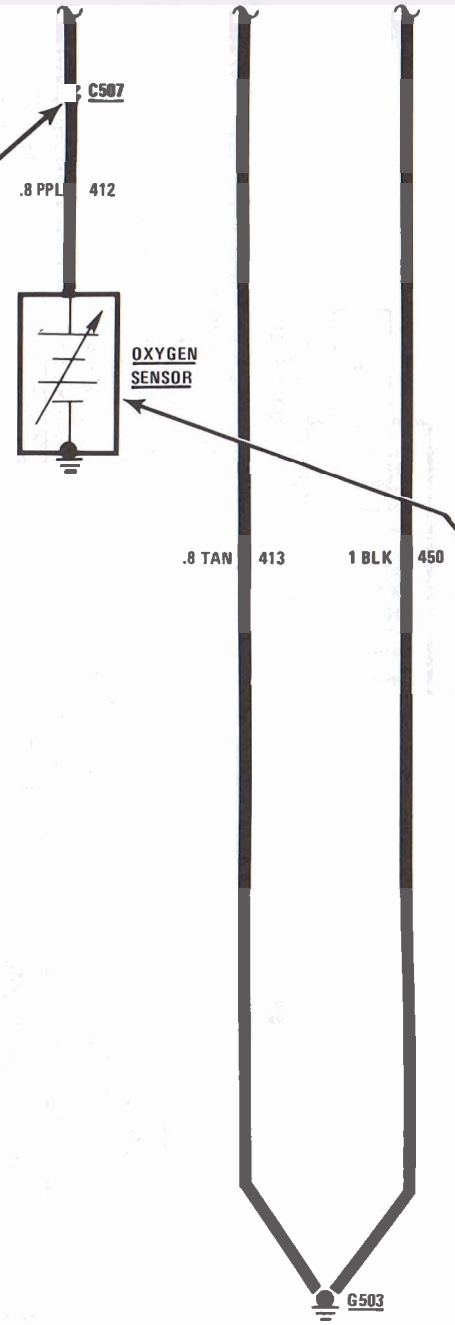
a. Perform Injector Balance Test to check for rich injectors. **REFER TO CHART C-2A.**
b. Check for a leaking injector. **REFER TO CHART A-7A.**
c. Check for high fuel pressure. **REFER TO CHART A-7.**
d. Check for a leaking FUEL PRESSURE REGULATOR diaphragm by checking the vacuum line to the regulator for fuel.
e. Check for fuel saturation of the VAPOR CANISTER. If the VAPOR CANISTER is full of fuel, check the canister control and hoses. **REFER TO THE CANISTER PURGE SECTION.**
f. Check for an open distributor ground (HEI shielding) or circuit 453 (black/red). A tachometer reading which shows a higher than actual engine speed could result in a false engine speed signal causing the ECM to meter too much fuel.

1 Determine the ECM operating mode.
a. With the engine at normal operating temperature, ground the DIAGNOSTIC TERMINAL.
b. Run the engine at 1200 to 1800 rpm for one minute.
c. Observe the "CHECK ENGINE" light to determine closed loop or open loop operation. Go to step 2 or 3.

2 If the ECM is operating in closed loop mode, (slow flashes), **REFER TO SECTION B.** The problem is intermittent.

3 If the ECM is operating in open loop mode, (fast flashes), verify correct operation of the ECM.
a. With the ignition "OFF," ground the DIAGNOSTIC TERMINAL and **DISCONNECT THE OXYGEN SENSOR.**
b. Jumper the harness connector for circuit 412 (purple) to ground and start the engine.
c. Observe the "CHECK ENGINE" light. Go to step 4 or 5.

4 If the "CHECK ENGINE" light remains on, **THE FAULT IS IN THE ECM.**



5
g. Check for intermittent THROTTLE POSITION SENSOR output. A false acceleration signal can cause the ECM to meter too much fuel.
h. Check for a high MANIFOLD ABSOLUTE PRESSURE SENSOR signal output. **DISCONNECT THE MANIFOLD ABSOLUTE PRESSURE SENSOR.** If the rich condition is gone with the sensor disconnected, **THE FAULT IS IN THE MANIFOLD ABSOLUTE PRESSURE SENSOR.**
i. Silicone contamination of the OXYGEN SENSOR (white powdery coating) can result in a high but false signal output.
j. If the checks above in step 5 are OK, **THE FAULT IS IN THE OXYGEN SENSOR.**

Reconnect all connectors. Clear codes. Confirm "closed loop" operation and no "CHECK ENGINE" light.

CODE 51
CODE 52
CODE 53
CODE 55
2.8L "P" SERIES
FUEL INJECTION (PORT)

CODE 51

CHECK THAT ALL PINS ARE FULLY INSERTED IN THE SOCKET. IF OK, REPLACE PROM, CLEAR MEMORY, AND RECHECK. IF CODE 51 REAPPEARS, REPLACE ECM.

CODE 52

FUEL CALPAK MISSING

- ENGINE IDLING.
- NOTE "CHECK ENGINE" LIGHT AFTER 10 SECONDS.

LIGHT ON

- IGNITION ON, ENGINE STOPPED.
- GROUND TEST TERMINAL AND NOTE CODE.

CODE 52

INSTALL CALPAK PROM IN ECM.

OTHER CODES

REFER TO APPLICABLE CHARTS.

LIGHT OFF

NO TROUBLE FOUND. CHECK CALPAK PROM TO INSURE PROPER INSTALLATION.

CODE 53

SYSTEM OVER VOLTAGE

THIS CODE INDICATES THERE IS A BASIC GENERATOR PROBLEM.

- CODE 53 WILL SET IF VOLTAGE AT ECM TERMINAL B2 IS GREATER THAN 17.1 VOLTS FOR 2 SECONDS.
- CHECK AND REPAIR CHARGING SYSTEM. SEE SECTION 6D.

CODE 55

REPLACE ELECTRONIC CONTROL MODULE (ECM)

9-10-84

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "CHECK ENGINE" LIGHT. *5S 1516-6E

SECTION B - SYMPTOMS

BEFORE STARTING

Before using this section you should have performed the DIAGNOSTIC CIRCUIT CHECK and found out that:

1. The ECM and "CHECK ENGINE" light are operating.
2. There are no trouble codes stored, or there is a trouble code but no "CHECK ENGINE" light.
3. The fuel control system is operating OK (by performing Field Service Mode Check).

Verify the customer complaint, and locate the correct SYMPTOM below. Check the items indicated under that symptom.

If the ENGINE CRANKS BUT WILL NOT RUN, see CHART A-3.

Several of the symptom procedures below call for a careful visual check. This check should include:

- Vacuum hoses for splits, kinks, and proper connections, as shown on Emission Control Information label.
- Air leaks at throttle body mounting and intake manifold.
- Air leaks between MAF sensor and throttle body.
- Ignition wires for cracking, hardness, proper routing, and carbon tracking.
- Wiring for proper connections, pinches, and cuts.

The importance of this step cannot be stressed too strongly - it can lead to correcting a problem without further checks and can save valuable time.

The following symptoms cover several engines. To determine if a particular system or component is used refer to the ECM wiring diagrams for application .

INTERMITTENTS

Problem may or may not turn "on" the "check engine" light, or 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. An abnormal voltage reading when the problem occurs indicates the problem may be in that circuit .

An intermittent "check engine" light with no stored code may be caused by;

- Ignition coil to ground and arcing at spark plug wires or plugs.
- "CHECK ENGINE " light wire to ECM for short to ground. (CKT 419).
- Diagnostic "Test" Terminal wire to ECM, for short to ground.(CKT 451)
- ECM power grounds. See ECM wiring diagrams.
- Loss of trouble code memory. To check, disconnect TPS and idle engine until "CHECK ENGINE" 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 circuit 453 to distributor should be a good ground.
- 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 for water contaminated fuel.
- Check fuel pressure CHART A-7.
- If problem exists in cold weather, check cold start valve. See CHART A-9 .
- Check TPS for sticking or binding.
- Check for high resistance in coolant sensor circuit or sensor itself. See CODE 15 CHART-
- A faulty in-tank fuel pump check valve will allow the fuel in the lines to drain back to the tank after the engine is stopped. To check for this condition:
  - Perform Fuel System Diagnosis, CHART A-7.
- •Check EGR operation chart.
- •Check both injector fuses.
- •Check 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.
- Remove spark plugs. Check for wet plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. Repair or replace as necessary.
- If engine then but immediately stalls open distributor by-pass line. If engine then starts and runs OK, replace pickup coil.

HESITATION, SAG, STUMBLE

Definition: Momentary lack of response as the accelerator is pushed down. Can occur at all car speeds. Usually most severe when first trying to make the car move, as from a stop sign. May cause the engine to stall if severe enough.

- Perform careful visual check as described at start of Section B.
- Check fuel pressure. See CHART A-7. Also Check for water contaminated fuel.
- Check for fouled Spark plugs.
- Check for correct PROM number. Also check Service Bulletins for latest PROM.
- Check TPS for binding or sticking.
- Check ignition timing. See Emission Control Information label.
- Check generator output voltage. Repair if less than 9 or more than 16 volts.
- Check for open HEI ground, circuit 453.
- Check canister purge system for proper operation. See table of contents for page .
- Check EGR valve operation CHART C-7.

SURGES AND/OR CHUGGLE

Definition: Engine power variation under steady throttle or cruise. Feels like the car speeds up and slows down with no change in the accelerator pedal.

- Be sure driver understands Transmission Converter Clutch and A/C compressor operation in Owner's Manual.
- Perform careful visual inspection as described at start of Section B.
- Check generator output voltage. Repair if less than 9 or more than 16 volts.
- If a tool is available which plugs in to the ALCL connector, make sure reading of VSS matches vehicle speedometer. See "Special Information", Section 6E.
- Check for intermittent EGR at idle. See CHART C-7.
- Check EGR filter for being plugged .
- Check ignition timing. See Emission Control Information label.
- Check in-line fuel filter. Replace if dirty or plugged.
- Check fuel pressure. See CHART A-7.
- Inspect Oxygen sensor for silicon contamination from fuel, or use of improper RTV sealant. The sensor may have a white, powdery coating and 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.
- Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, or heavy deposits. Also check condition of distributor cap, rotor, and spark plug wires.
- Check secondary voltage. Use shop scope or J-26792 (ST.125) or equivelant.

LACK OF POWER, SLUGGISH, OR SPONGY

Definition: Engine delivers less than expected power. Little or no increase in speed when accelerator pedal is pushed down part way.

- Compare customer's car to similar unit. Make sure the customer's car has an actual problem.
- Remove air cleaner and check air filter for dirt, or for being plugged. Replace as necessary.
- Check ignition timing. See Emission Control Information label.
- Check for restricted fuel filter, contaminated fuel or improper fuel pressure. See CHART A-7.
- Check EGR operation for being open or partly open all the time - See Chart C-7.
- Check for an exhaust system restriction:
  - Inspect exhaust system for damaged or collapsed pipes.
  - Inspect muffler for heat distress or possible internal failure.
- Check generator output voltage. Repair if less than 9 or more than 16 volts.
- Check engine valve timing and compression.
- Check engine for proper or worn camshaft. See Section 6A.

DETONATION /SPARK KNOCK

Definition: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening. Sounds like popcorn popping.

- Check for obvious overheating problems:
  - Low coolant.
  - Loose water pump belt.
  - Restricted air flow to radiator, or restricted water flow thru radiator.
  - Inoperative electric cooling fan circuit.
- Check ignition timing. See Vehicle Emission Control Information label.
- Check EGR system for not opening - CHART C-7.
- Check fuel system pressure. See CHART A-7,
- Remove carbon with top engine cleaner. Follow instructions on can.
- Check for correct PROM. (See Service Bulletins)
- Check for leaking valve oil seals.
- Check for improper operation of transmission and TCC.
- Check for incorrect basic engine parts such as cam, heads, pistons, etc.
- Check for poor fuel quality, proper octane rating.

CUTS OUT, MISSES

Definition: Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. Not normally felt above 1500 rpm or 30 MPH (48 km/h). The exhaust has a steady spitting sound at idle or low speed.

- Perform careful visual check as described at start of Section B.
- Check for missing cylinder by:
  1. Disconnect IAC motor. Start engine. Remove one spark plug wire at a time using insulated pliers.
  2. If there is an RPM drop on all cylinders (equal to within 50 RPM), go to ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING symptom. Reconnect IAC motor.
  3. If there is no RPM drop on one or more cylinders, or excessive variation in drop, check for spark on the suspected cylinder(s) with J 26792 (ST-125) Spark Gap Tool or equivalent. If no spark, see Section 6D for Intermittent Operation or Miss. If there is spark, remove spark plug(s) in these cylinders and check for:
     - Cracks
     - Wear
     - Improper Gap
     - Burned Electrodes
     - Heavy Deposits
- Perform compression check on questionable cylinder(s) found above. If compression is low,repair as necessary. See Section 6.
- Disconnect all injector harness connectors. Connect J-34730-2 Injector Test Light or equivalent 6 volt test light between the harness terms, of each injector connector and note light while cranking. If test light fails to blink at any connector, it is a faulty injector drive circuit harness, connector, terminal, or ECM.
- Perform the Injector Balance Test. See CHART C-2A.
- Check spark plug wires by connecting ohmmeterto ends of each wire in question. If meter readsover 30,000 ohms, replace wire(s).
- Visually check distributor cap and rotor for moisture, dust, cracks, burns, etc. Spray cap and plug wires with fine water mist to check for shorts.
- Check for restricted fuel filter. Also check fuel tank for water.
- Check for low fuel pressure. See CHART A-7,
- Remove rocker covers. Check for bent pushrods, worn rocker arms, broken valve springs, worn camshaft lobes. Repair as necessary. See Section 6A.
- Check for proper valve timing.
- Check secondary voltage using an oscilliscope or J-26792 (ST-125) or equivalent.

BACKFIRE

Definition: Fuel ignites in intake manifold, or in exhaust system, making a loud popping noise.

- Perform a compression check - look for sticking or leaking valves.
- Check EGR operation for being open all the time. See Chart C-7.
- Check for faulty or loose fit of EGR gasket.
- Check for proper valve timing.
- Check output voltage of ignition coil. See Section 6D.
- Check for crossfire between spark plugs (distributor cap, spark plug wires,and proper routing of plug wires).
- Check for intermittent condition in ignition system (see Section 6D).
- Check engine timing - see Emission Control Information label.
- Check for faulty spark plugs and/or plug wires or boots.

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 engine coolant level.
- Check engine thermostat for faulty part (always open) or for wrong heat range. See Section 6B.
- Check ignition timing. See Emission Control Information label.
- Check TCC for proper operation. See CHART C-8

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.
- Check ignition timing. See Emission Control Information label.
- Check IAC system. See CODE 35.
- Check generator output voltage. Repair if less than 9 or more than 16 volts.
- Check P/N switch circuit. See CHART C-1A,
- Check injector balance. See CHART C-2A,
- If ROUGH IDLE only occurs HOT, perform these additional checks:
- 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 (port).
- With Air Managemaent Systems check for intermittent Air to Ports while in closed loop.
- Check PCV valve for proper operation by placing finger over inlet hole in valve end several times. Valve should snap back. If not, replace valve.

EXCESSIVE EXHAUST EMISSIONS (ODORS)

- If test shows higher than normal CO and HC, (also has excessive odors):
  - Check items which cause car to run RICH.
    - Make sure engine is at normal operating temperature.
    - Check for high fuel pressure. See CHART A-7,
    - Check for incorrect timing. See Vehicle Emission Control Information Label.
    - Check canister for fuel loading
    - Check injector balance. See CHART C-2A.
    - Check for stuck PCV valve or blocked PCV hose.
    - Check condition of spark plugs, plug wires, and distributor cap. See Section 6D.
    - Check for lead contamination of catalytic converter (look for removal of fuel filler neck restrictor).
- IF TEST SHOWS EXCESSIVE NOx:
  - Check items which cause car to run LEAN, or to run too hot.
    - Check EGR valve for not opening. See CHART C-7.
    - Check for vacuum leaks.
    - Check 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.

SECTION C - COMPONENT SYSTEMS
ELECTRONIC CONTROL MODULE (ECM) AND SENSORS

GENERAL DESCRIPTION

ELECTRONIC CONTROL MODULE (ECM)

The Electronic Control Module (ECM) (Figure 6), is the control center of the fuel injection system. It constantly looks at the information from various sensors, and controls the various systems that affect vehicle performance. For service, the ECM has three parts: a seperate Controller (the ECM without the PROM), a separate calibrator (PROM), and a CALPAK .

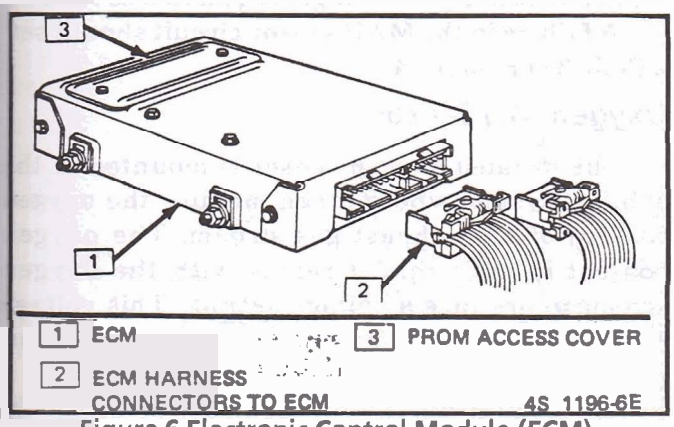


Figure 6 Electronic Control Module (ECM)

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 7). The PROM is located inside the ECM, and has information on the vehicle's weight, engine, transmission, axle ratio, and other components. 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

A device called a CALPAK is used to allow fuel delivery if certain parts of the ECM should fail. It has an access door in the ECM, and

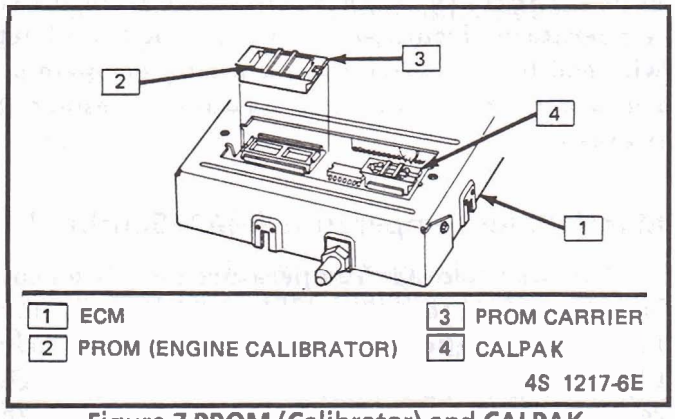


Figure 7 PROM (Calibrator) and CALPAK

removal and replacement procedures are the same as with a PROM.

If the CALPAK is missing, a Code 52 will be set.

INFORMATION SENSORS

Engine Coolant Temperature Sensor

The coolant sensor (Figure 8) 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).

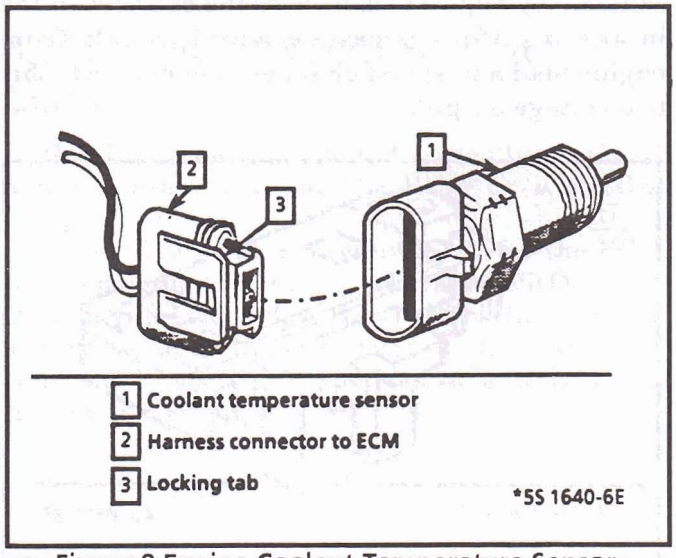


Figure 8 Engine Coolant Temperature Sensor

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.

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 Assy. 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 thru a resistor in the ECM and measures the voltage. The voltage will be high when the incoming air is cold, and low when the air is hot. This signal is used for spark calculations under high ambient air temperature conditions.

A failure in the MAT sensor circuit should set either a Code 23 or Code 25.

Manifold Absolute Pressure (MAP) Sensor

The Manifold Absolute Pressure (MAP) sensor (see Figure 9) measures the changes in the intake manifold pressure which result from engine load and speed changes, and converts this to a voltage output.

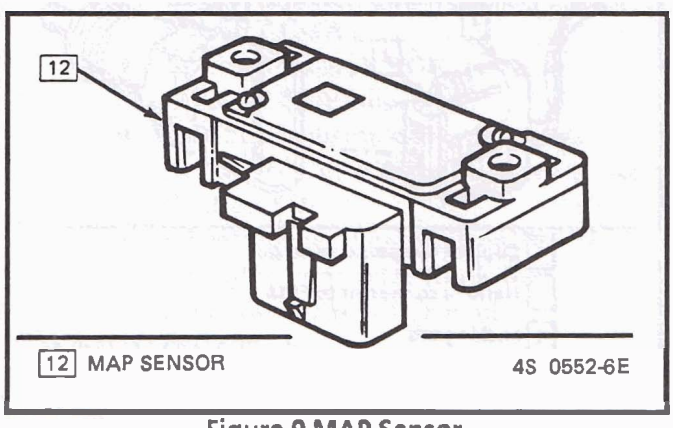


Figure 9 MAP Sensor

A closed throttle on engine coastdown would produce a relatively low MAP output, while a wide-open throttle would produce a high output. Manifold Absolute Pressure (MAP) is the OPPOSITE of what you would measure on a vacuum gage. When manifold pressure is high, vacuum is low. The MAP sensor is also used to measure barometric pressure under certain conditions, which allows the ECM to automatically adjust for different altitudes.

The ECM sends a 5-volt reference signal to the MAP sensor. As the manifold pressure changes, the electrical resistance of the sensor also changes. By monitoring the sensor output voltage, the ECM knows the manifold pressure. A higher pressure, low vacuum (high voltage) requires more fuel, while a lower pressure, higher vacuum (low voltage) requires less fuel.

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

Oxygen (O_2) Sensor

The exhaust oxygen sensor is mounted in the exhaust system where it can monitor the oxygen content of the exhaust gas stream. The oxygen content in the exhaust reacts with the oxygen sensor to produce a voltage output. This voltage ranges from approximately .1 volts (high 0_2 - lean mixture) to .9 volts (low 0_2 - rich mixture).

By monitoring the voltage output of the 0_2 sensor, the ECM will know what fuel mixture command to give to the injector (lean mixture-low voltage-rich command, rich mixture-high voltage-lean command).

The O_2 sensor, if open, should set a Code 13. A shorted sensor circuit should set a Code 44. A high voltage in the circuit should set a Code 45. When any of these codes are set, the car should run in the Open Loop Mode.

Throttle Position Sensor (TPS)

The Throttle Position Sensor (TPS) is connected to the throttle shaft on the throttle body (see Figure 11) It is a potentiometer with one end connected to 5 volts from the ECM and the other to ground. A third wire is connected to the ECM to measure the voltage from the TPS. As the throttle valve angle is changed (accelerator pedal moved), the Output of the TPS also changes. At closed throttle position, the output of the TPS is low. As the throttle valve opens, the output increases so that, at wide-open throttle, the output voltage should be approximately 5 volts.

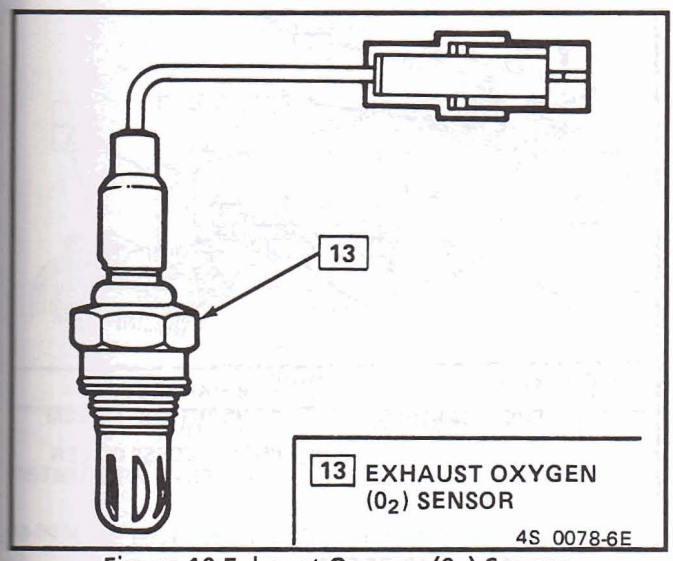


Figure 10 Exhaust Oxygen (0_2) Sensor

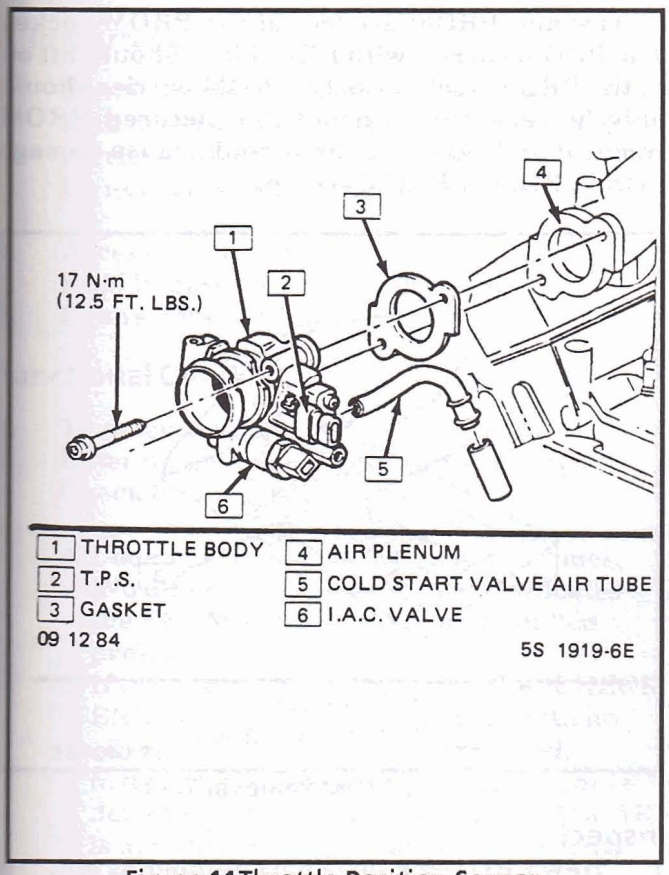


Figure 11Throttle Position Sensor

By monitoring the output voltage from the TPS, the ECM can determine fuel delivery based on throttle valve angle (driver demand).

Failure in the TPS circuit will set a Code 22 (low voltage) or Code 21 (Voltage too high)

Park/Neutral Switch (Auto Trans. only)

The Park/Neutral (P/N) switch indicates to the ECM when the transmission is in Park or Neutral. This information is used for the TCC system, IAC valve operation, and EGR control.

NOTICE: *Vehicle should not be driven with Park/Neutral switch disconnected as idle quality may be affected.*

An inoperative P/N switch could cause improper idle speed, TCC operation, or EGR control.
See Section 8A for more information on the P/N switch.

A/C "On" Signal

This signal tells the ECM that the A/C selector Switch is turned on, and that the pressure cycling switch is closed. The ECM uses this to adjust the idle Speed before turning on the A/C relay and to determine when A/C is requested. The ECM has total control of the A/C clutch.

Vehicle Speed Sensor

The Vehicle Speed Sensor (VSS) sends a pulsing voltage signal to the ECM, which the ECM converts to miles per hour. This sensor mainly controls the operation of the TCC system. See "TCC System" for more information.

Distributor Reference Signal

The distributor sends a signal to the ECM to tell it both engine RPM and crankshaft position. See "EST System" for further information.

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 and CALPAK from the faulty ECM and install them in the new service ECM.

THE SERVICE ECM WILL NOT CONTAIN A PROM or CALPAK.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.

NOTICE: *To prevent internal ECM damage, the ignition must be "OFF" when disconnecting or reconnecting power to ECM (for example, battery cable, ECM pigtail, ECM fuse, jumper cables, etc.).*

See Section 8C for ECM removal and installation procedures. Section 8A also shows the location of the ECM. The ECM is located behind the instrument panel.

PROM

Code 51 indicates a faulty PROM, bent pins, or incorrect installation.

! Important

It is possible to install a PROM backwards. If the PROM is installed backwards and the ignition key turned to "ON," the PROM circuitry will be destroyed, requiring PROM replacement.

NOTICE: *THE IGNITION SHOULD ALWAYS BE OFF WHEN INSTALLING OR REMOVING THE ECM CONNECTORS.*

Remove or Disconnect

1. Connectors from ECM.
2. ECM mounting hardware.
3. ECM from passenger compartment.
4. ECM access cover (see Figure 12).
5. Remove PROM assembly.

! Important

Using the rocker-type PROM removal tool, engage one end of the PROM carrier with the hook end of the tool (see Figure 13). Press on the vertical bar end of the tool and rock the engaged end of the PROM carrier up as far as possible. Engage the opposite end of the PROM carrier in the same manner and rock this end up as far as possible. Repeat this process until the PROM

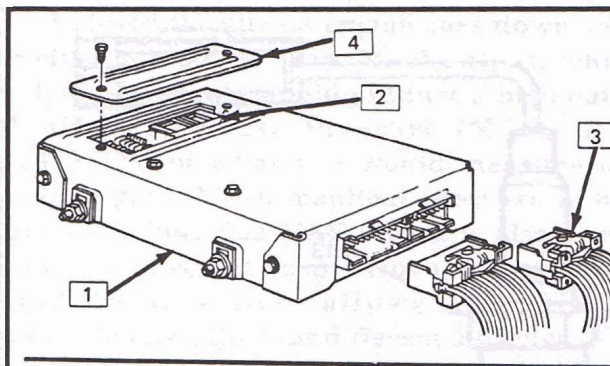


Figure 12 PROM Access Cover

carrier and PROM are free of the PROM soc The PROM carrier with PROM in it Should li of the PROM socket easily. PROM carrier sh only be removed by using the pictured PR removal tool. Other methods could cause dam to the PROM or PROM socket.

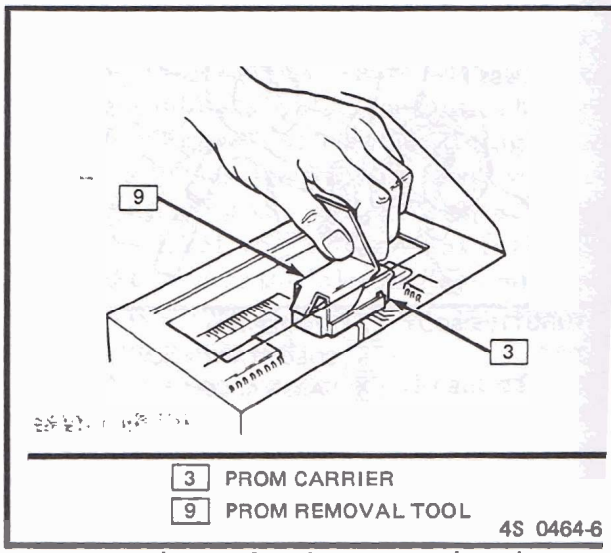


Figure 13 PROM Removal Tool

Inspect

1. New PROM for same part number as old

! Important

Do not remove PROM from carrier to check I number.

2. For correct reference of PROM in carrier, Figure 14 .
3. Using the removal tool, pictured in Figure grasp the carrier at the narrow ends. Gent rock the carrier from end to end while app a firm upward force and remove the CALP and carrier. Use of unapproved CALPAK removal tools or methods will cause dama the CALPAK or CALPAK socket.

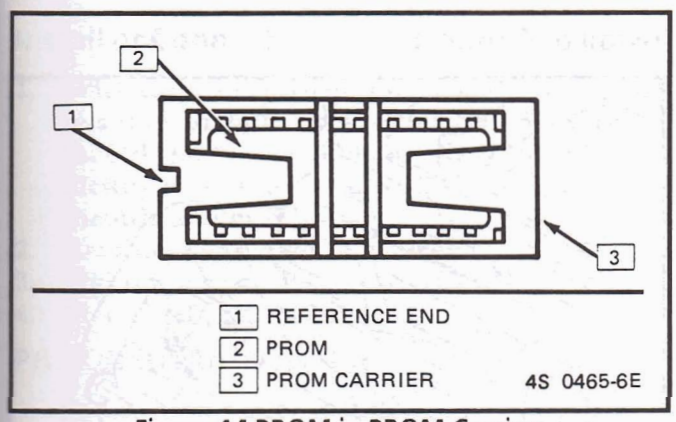


Figure 14 PROM in PROM Carrier

Install or Connect

1. New PROM carrier in PROM socket.
2. CALPAK in CALPAK socket.

! Important

Small notch of carrier should be aligned with small notch in socket. Press on PROM carrier until it is firmly seated in the socket. Do not press on PROM; only the carrier.

3. Access cover on ECM.
4. ECM in passenger compartment.
5. Connectors to ECM.

Functional Check

1. Turn ignition on.
2. Enter diagnostics (see Diagnostic Circuit Check for procedure).

A. Code 12 should flash at least four times. (No other codes present). This indicates the PROM and CALPAK are installed properly.

B. If trouble code 51 occurs or if the "CHECK ENGINE" light is on constantly with no codes, the PROM is not fully seated, installed backwards, has bent pins, or is defective. If Code 52 occurs, the CALPAK is not fully seated, installed backwards, had bent pins, or is defective.

- If not fully seated, press firmly on PROM or CALPAK carrier.
- If it is necessary to remove the PROM, follow instructions
- If installed backwards, REPLACE THE PROM. The CALPAK may be removed and reinstalled correctly.
- If pins bend, remove PROM or CALPAK, straighten pins, and reinstall. If bent pins break or crack during straightening, discard PROM OR CALPAK and replace it.

! Important

ANY TIME THE PROM IS INSTALLED BACKWARDS AND THE IGNITION SWITCH TURNED ON, THE PROM IS DESTROYED

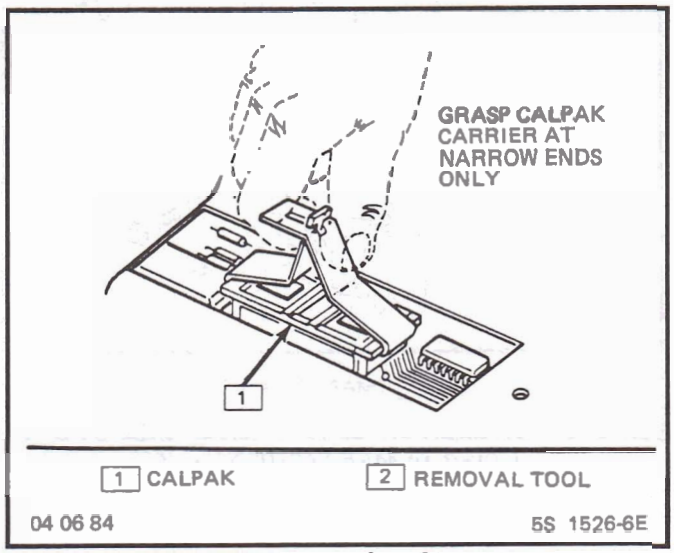


Figure 15 Removing CALPAK

COOLANT SENSOR

NOTICE: *Care must be taken when handling coolant sensor. Damage to coolant sensor will affect proper operation of the Fuel Injection system.*

Remove or Disconnect

1. Negative battery cable.
2. EGR Solenoid bracket.
3. Electrical connector.
4. Carefully back out coolant sensor.

Install or Connect

1. Sensor in engine.
2. Electrical connector.
3. EGR Solenoid bracket.
4. Negative battery cable.

MAP SENSOR

Other than checking for loose vacuum hose and electrical connection the only service possible is unit replacement if diagnosis shows sensor to be faulty. Figure 16 shows location and replacement of MAP sensor.

MAT SENSOR

Replacement of the MAT Sensor mounted in the air cleaner assembly uses the same procedure as for the coolant sensor.

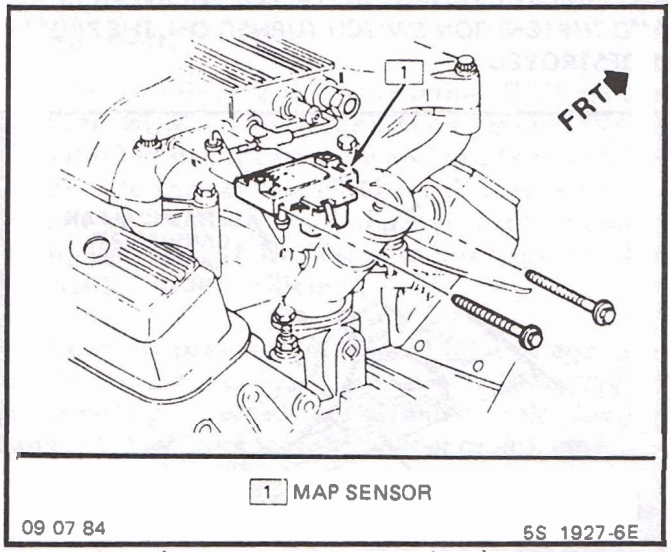


Figure 16 MAP Sensor Service

OXYGEN SENSOR

NOTICE: *The oxygen sensor uses a permanently attached pigtail and connector. This pigtail should not be removed from the oxygen sensor. Damage or removal of the pigtail or connector could affect proper operation of the oxygen sensor.*

! Important

Take care when handling the oxygen sensor. The in-line electrical connector and louvered end must be kept free of grease, dirt or other contaminants. Also, avoid using cleaning solvents of any type. Do not drop or roughly handle the oxygen sensor.

Remove or Disconnect

The oxygen sensor may be difficult to remove when engine temperature is below 48°C (120°F).

Excessive force may damage threads in exhaust manifold or exhaust pipe.

1. Negative battery cable.
2. Electrical connector.
3. Carefully back out Oxygen Sensor.

Install or Connect

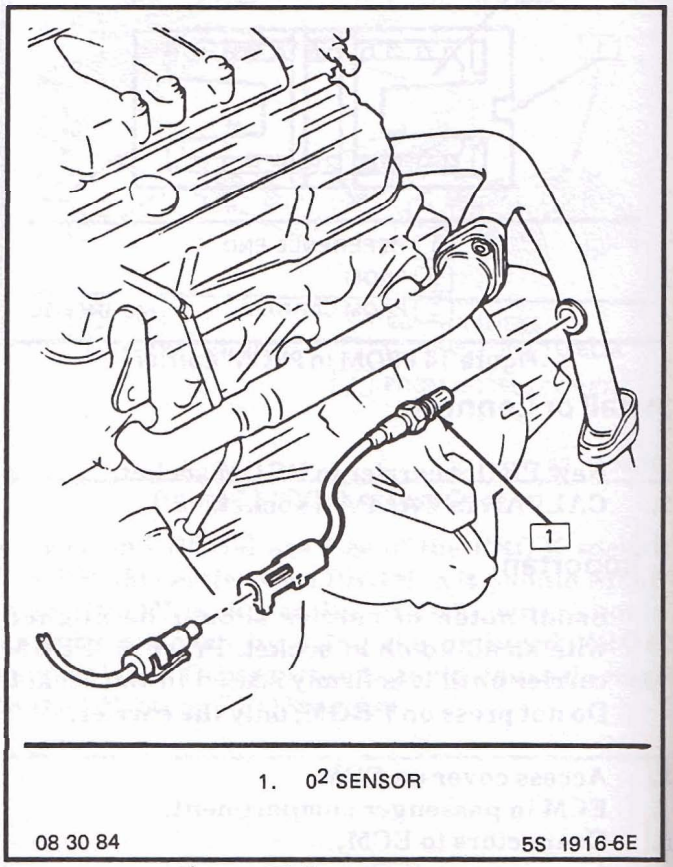


Figure 17 Oxygen Sensor

! Important

A special anti-seize compound is used on the oxygen sensor threads. The compound consists of a liquid graphite and glass beads. The graphite will burn away, but the glass beads will remain, making the sensor easier to remove.

New or service sensors will already have the compound applied to the threads. If a sensor is removed from an engine, and, if for any reason it is to be reinstalled, the threads must have anti-seize compound applied before reinstallation.

1. Coat threads of oxygen sensor with anti-seize compound P/N 5613695 or equivalent if necessary.
2. Sensor, and torque to 41 N-m (30 ft. lbs.).
3. Electrical connector.
4. Negative battery cable.

Throttle Position Sensor (TPS)

Remove or Disconnect

1. Electrical connector.
2. Two TPS attaching screws and lockwashers.

Install or Connect

1. With throttle valve in the normal closed idle position, install Throttle Position Sensor on throttle body assembly, making sure TPS pickup lever is located ABOVE tang on throttle actuator lever.
2. Retainers and Two TPS screws.
3. Tighten screws to 2.0 N.m (18 in. lbs.)
4. Electrical Connector

PARK/NEUTRAL SWITCH

See Section 8A for location of Park/NeutralSwitch. On-Car Service and Adjustment Procedures are also listed in Section 3B 4 or 7A.

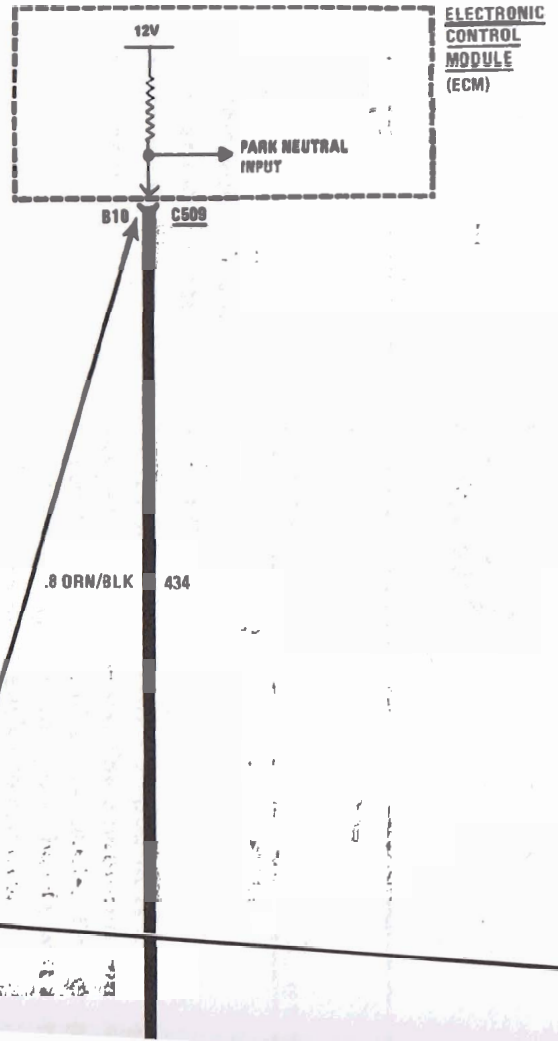
PARTS INFORMATION

PART NAME	GROUP
Controller, ECM	3.670
Calibrator, PROM	3.670
CALPAK,	3.670
Sensor, Coolant Temp.	3.682
Sensor, Exhaust Oxygen	3.682
Sensor, Manif Absolute Sensor (MAP)	3.682
Sensor, Manif Air Temp (MAT)	3.682
Sensor, Throttle Position: Part of Sensor Kit, Throttle Position	3.440
Sensor, Vehicle Speed	3.682

CHART C-1A
PARK/NEUTRAL SWITCH

The PARK/NEUTRAL SWITCH contacts are closed to ground in Park or Neutral and are open in the drive ranges. The ECM supplies ignition voltage through a current limiting resistor to circuit 434 (orange/black) and senses a closed switch when the voltage on circuit 434 is less than one volt.

The ECM uses the PARK/NEUTRAL SWITCH signal as input to control the IDLE AIR CONTROL VALVE and the VEHICLE SPEED SENSOR diagnostics.

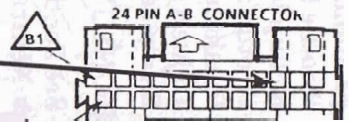


1 Check for a closed switch to ground in the Park and Neutral position.
- a. DISCONNECT ECM CONNECTOR **C509 (blue 24 pin A-B connector).**
- b. With the transmission in Park, probe terminal B10 of ECM Connector C509 with a test light to 12 volts. Go to step **3 or 6.**

5 If the test light does not come on then locate the open in the P/N switch or the wiring.
- a. RECONNECT THE ECM
- b. DISCONNECT THE P/N SWITCH.
- c. With the engine stopped and the **ignition "ON," connect a voltmeter** between terminal A and terminal B at the harness connector. Note the **voltage. Go to step 7 or 8.**

6 **If the voltage is 10 volts or more then** THE **FAULT IS IN THE PARK/NEUTRAL** SWITCH.

7 If no voltage was read then connect the voltmeter between terminal A at the harness connector and a chassis ground. Note the voltage. Go to step **9** or **10.**



2 If the test light comes on in Park and Neutral, then check for an open switch in the drive ranges. Move the transmission gear selector into "Drive" and observe the test light. Go to step **4** or **5**.

3 If the test light stays on then check the PARK/NEUTRAL SWITCH.

a. **DISCONNECT THE PARK/ NEUTRAL SWITCH** and observe the test light. Go to **b** or **c**.

b. If the test light stays on then **FIND A SHORT TO GROUND IN CIRCUIT 434 (orange/black).**

c. If the test light goes off then **THE FAULT IS IN THE PARK/ NEUTRAL SWITCH.**

4 If the test light goes off then check for a voltage from the ECM to the switch.

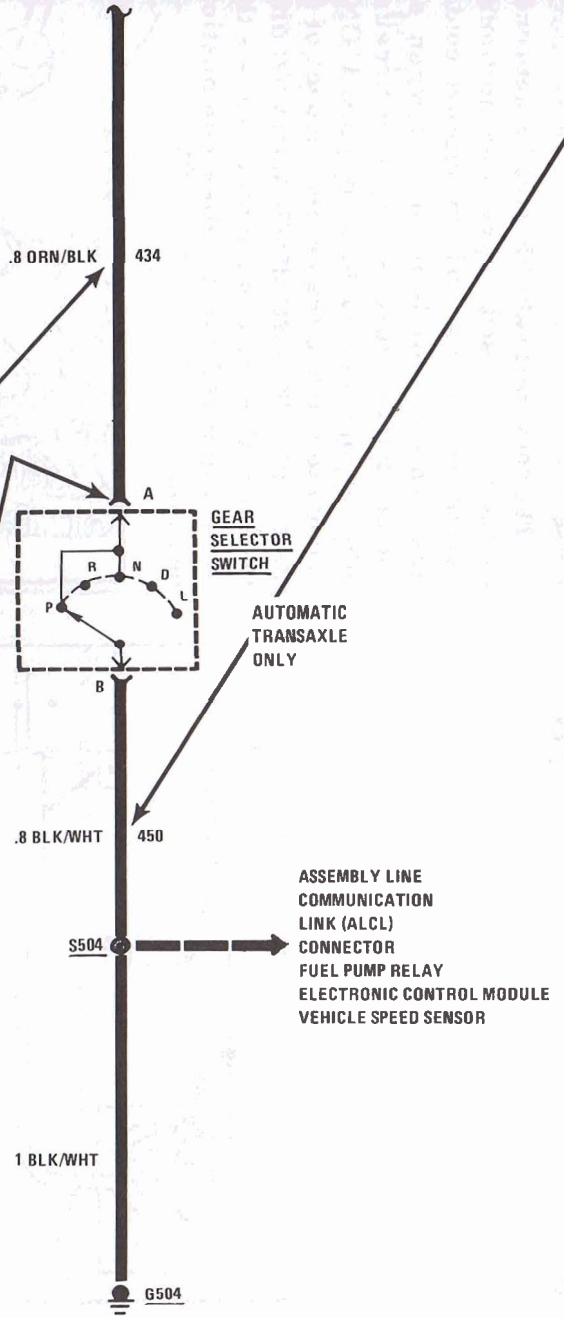
a. **RECONNECT THE ECM CONNECTOR.**

b. **DISCONNECT THE PARK/ NEUTRAL SWITCH.**

c. With the engine stopped and the ignition "ON," probe the P/N SWITCH (terminal A) connector with a voltmeter to ground. Go to **d** or **e**.

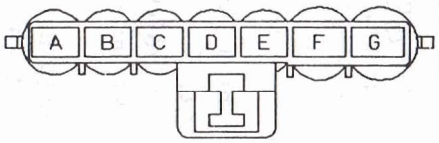
d. If the voltage is 1 volt or less then **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**

e. If the voltage is over 10 volts, the ECM, P/N switch, and wiring are good. No trouble has been found.

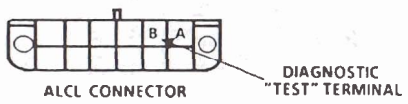


8 If the voltage is 10 volts or more then **FIND AN OPEN IN CIRCUIT 450 (black/white).**

9 If no voltage was read then **FIND AN OPEN IN CIRCUIT 434 (orange/ black).**



To Gear Selector Switch



Reconnect all connectors. Clear all codes. Confirm "closed loop" operation and no "CHECK ENGINE" light.

FUEL CONTROL SYSTEM
GENERAL DESCRIPTION

PURPOSE

The basic function of the fuel control system is to control fuel delivery to the engine.

Fuel is delivered to the engine by individual fuel injectors mounted in the intake manifold near each cylinder.

The main control sensor is the Oxygen (0_2) Sensor, which is located in the exhaust manifold. The 0_2 sensor tells the ECM how much oxygen is in the exhaust gas, and the ECM changes the Air/Fuel ratio to the engine by controlling the fuel injectors. The best mixture to minimize exhaust emissions is 14.7 to 1, which allows the Catalytic Converter to operate the most efficiently. Because of the constant measuring and adjusting of the air/fuel ratio, the Fuel Injection system is called a "Closed Loop" System (shown in Figure 18).

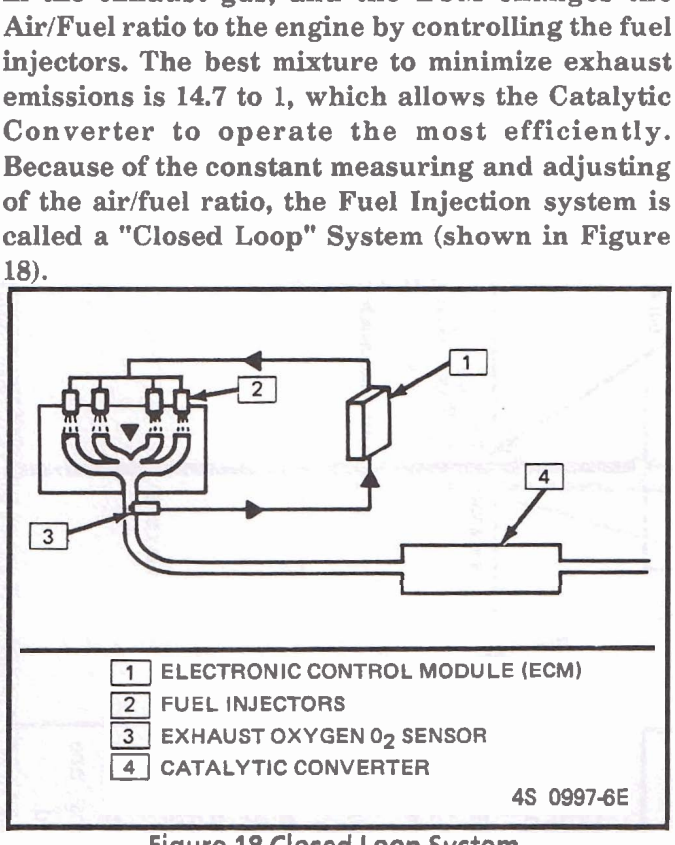


Figure 18 Closed Loop System

MODES OF OPERATION

The ECM looks at voltages from several sensors to determine how much fuel to give the engine. The fuel is delivered under one of several conditions, called "modes". All the modes are controlled by the ECM, and are described below.

STARTING MODE

When the ignition is first turned "on", the ECM will turn on the fuel pump relay for two seconds, and the fuel pump will build up Pressure. The ECM then checks the coola temperature sensor, throttle position sensor, a crank signal, and determines The proper air / fu ratio for starting . This ranges from 1.5 : 1 at -36 (-33°F) to 14.7 : 1 at 94°C (201°F) .

The ECM controls the amount of fu delivered in the STARTING mode by changi how long the injectors are turned on and off. Th is done by "pulsing" the injectors for very sho times.

The cold start valve (Figure 19) not controll by the ECM is used to provide additional fu during the starting mode to improve cold sta ups. This circuit is important when engi coolant temperature is very low because t other six injectors would not be pulsed "ON" lo enough to provide the needed amount of fuel start. The cold start valve is somewhat differe from the other injectors in that it causes the fu to be vaporized for a better combustionab mixture.

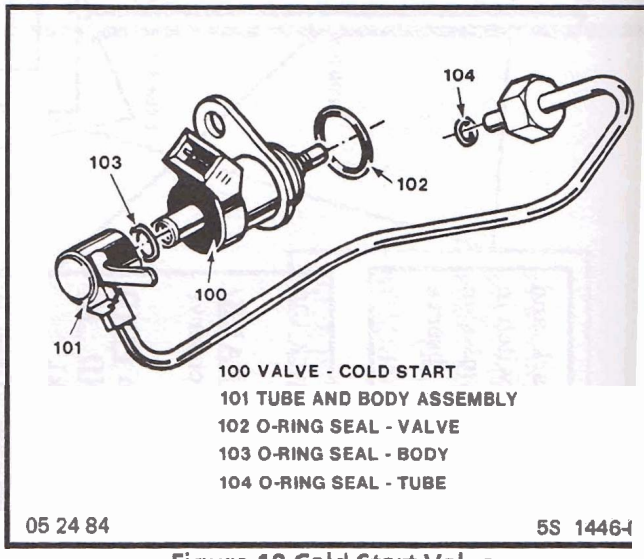


Figure 19 Cold Start Valve

The Circuit is activated only in the cra mode. The power is supplied directly from starter solenoid and is protected by the cra fuse. The system is controlled by a Thermal Ti Switch which provides a ground path for valve during cranking whenever engine cool is below 35°C.

The Thermal Switch is made of a bimetal material which opens circuit at specified coolant temperature. This bimetal is also heated by the winding in the Thermal Switch which would allow the injector to stay "ON" 8 seconds at -20°C or below. Above (-20°C), the maximum time the switch will stay closed is proportional to the coolant remperature. In other words, as the coolant temperature goes up the maximum cold start valve "ON" time goes down.

CLEAR FLOOD MODE

If the engine floods, clear it by pushing the accelerator pedal down all the way. The ECM then pulses the injectors at an air/fuel ratio of 20:1. The ECM holds this injector rate as long as the throttle stays wide open, and the engine RPM is below 400. If the throttle position becomes less than 80%, the ECM returns to the STARTING mode.

RUN MODE

The RUN mode has two conditions called OPEN LOOP and CLOSED LOOP.

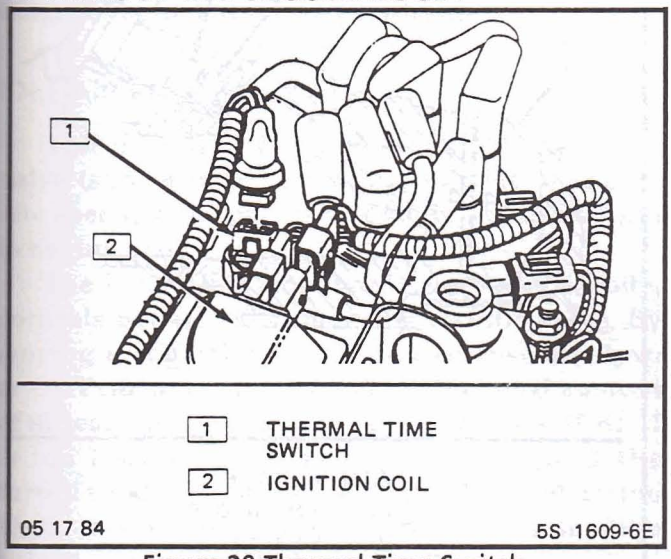


Figure 20 Thermal Time Switch

When the engine is first started, and RPM is above 400 RPM, the system goes into OPEN LOOP operation. In open loop, the ECM will ignore the signal from the Oxygen (02) sensor, and calculate the air/fuel ratio based on inputs from the Coolant and MAP sensors.

The system will stay in open loop until the following conditions are met:

1. The 02 sensor has varying voltage output, showing that it is hot enough to operate properly. (This depends on temperature.)
2. The Coolant Sensor is above a specified temperature.
3. A specific amount of time has elapsed after starting the engine.

The specific values for the above conditions vary with different engines, and are stored in the PROM. When these conditions are met, the system goes into CLOSED LOOP operation. In closed loop, the ECM will calculate the air/fuel ratio (injector on-time) based on the signal from the O2 sensor. This allows the air / fuel ratio to stay very close to 14.7:1 .

ACCELERATION MODE

The ECM looks at rapid changes in throttle position and manifold pressure (vacuum) and provides extra fuel.

DECELERATION MODE

When deceleration occurs, the fuel remaining in the intake port can cause excessive emissions and backfiring. Again,the ECM looks at changes in throttle position and manifold pressure, and reduces the amount of fuel. When deceleration is very fast, the ECM can cut off fuel completely for short periods.

Battery Voltage Correction Mode

When battery voltage is low, the ECM can compensate for the weak spark delivered by the distributor by:

- Increasing the amount of fuel delivered;
- Increasing the idle RPM; and
- Increasing ignition dwell time.

Fuel Cutoff Mode

No fuel is delivered by the injector when the ignition is off. This prevents dieseling. Also, fuel is not delivered if no reference pulses are seen from the distributor, which means the engine is not running. This prevents flooding.

FUEL CONTROL SYSTEM COMPONENTS

The Fuel Control System is made up of the following parts:

- Fuel Injectors
- Throttle Body
- Fuel Rail
- Fuel Pressure Regulator
- Idle Air Control (IAC) Valve
- Fuel pump
- Fuel pump relay

BASIC SYSTEM OPERATION

The fuel control system (Figure 21) starts with the fuel in the fuel tank. An electric fuel pump, located in the fuel tank with the gage sending unit, pumps fuel to the fuel rail through an in-line fuel filter. The pump is designed to provide fuel at a pressure above the pressure needed by the injectors. A pressure regulator in the fuel rail keeps fuel available to the injectors at a constant pressure. Unused fuel is returned to the fuel tank by a seperate line. For further information on the fuel tank, in-line filter, and fuel lines, see Section 6C.

The injectors, are controlled by the ECM. They deliver fuel in one of several modes, as described above.

In order to properly control the fuel supply, the fuel pump is operated by the ECM thru the fuel pump relay and oil pressure switch (see Fuel Pump Electrical Circuit).

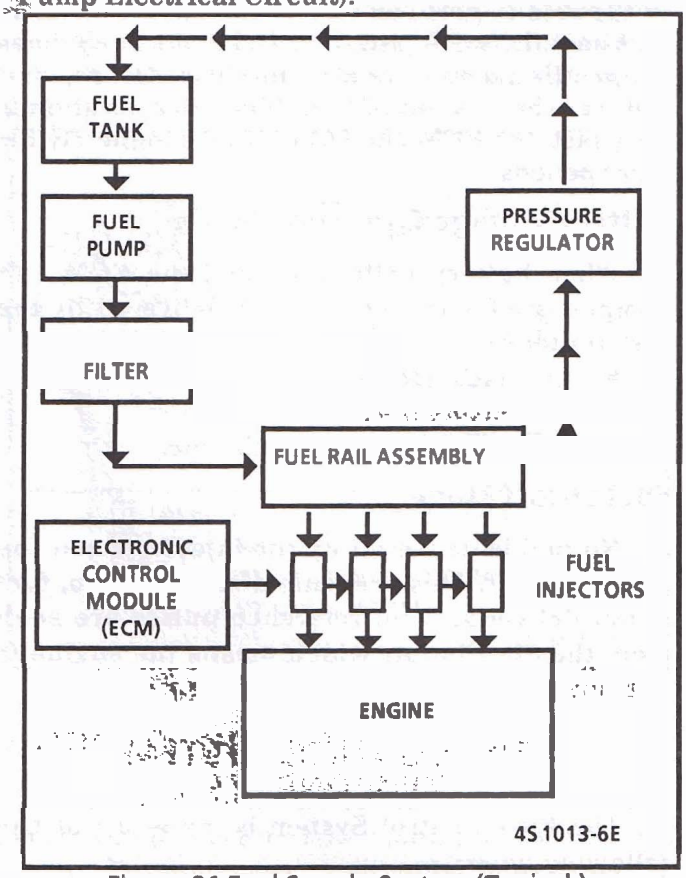


Figure 21 Fuel Supply System (Typical)

THROTTLE BODY UNIT

The throttle body has a throttle valve to control the amount of air delivered to the engine. The TPS and IAC valve are also mounted on the throttle body.

The throttle body contains vacuum ports located at, above, or below the throttle valve. These ports generate the vacuum signals needed by various components.

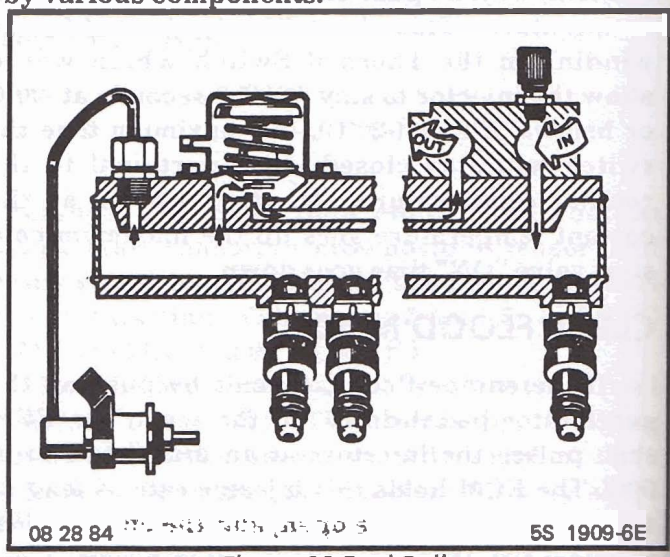


Figure 22 Fuel Rail

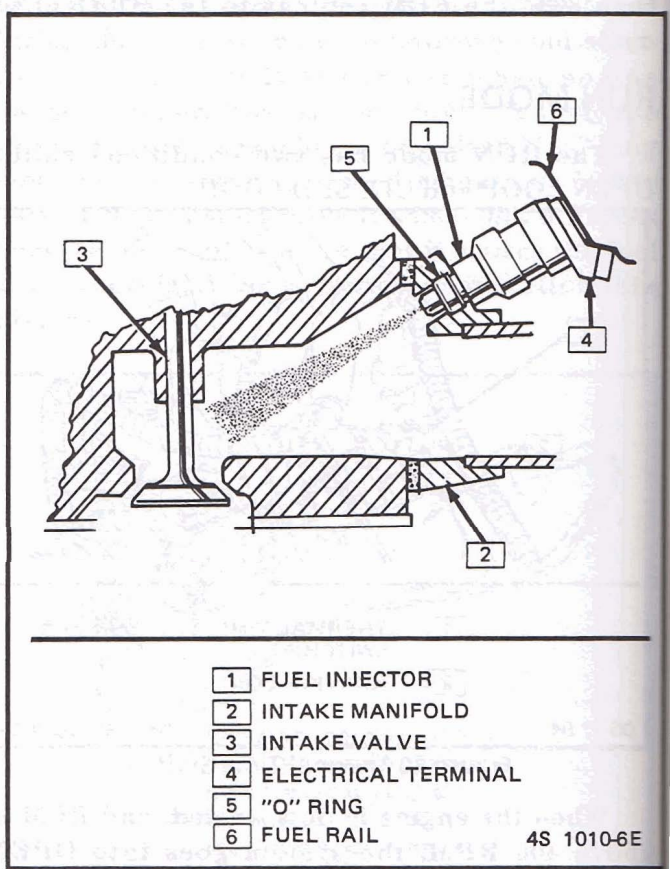


Figure 23 Fuel Injector

FUEL RAIL

The fuel rail (Figure 22) is mounted to the top of the engine. It distributes fuel to the individual injectors. Fuel is delivered to the input end of the rail by the fuel lines, goes thru the rail, then to the pressure regulator. The regulator keeps the pressure to the injectors at a constant pressure. Remaining fuel is then returned to the fuel tank.

FUEL INJECTOR

The fuel injector is a solenoid operated device controlled by the ECM (See Figure 23). The ECM turns on the solenoid, which opens a valve to allow fuel delivery. The fuel, under pressure, is injected in a conical spray pattern at the opening of the intake valve. The fuel which is not used by the injectors passes through the pressure regulator before being returned to the fuel tank..

PRESSURE REGULATOR

The pressure regulator is a diaphragm-operated relief valve with injector pressure on one side and manifold pressure on the other. The function of the regulator is to maintain a constant pressure at the injector at all times, by controlling the flow in the return line (i.e., a calibrated leak).

The pressure regulator is mounterd to the fuel rail and is replaced as an assembly.

If the pressure is too low, poor performance could result. If the pressure is too high, excessive odor may result. CHART A-7 has information on diagnosing fuel pressure conditions.

IDLE AIR CONTROL (IAC) VALVE

The purpose of the Idle Air control (IAC) valve (shown in Figure 24), is to control engine idle speed, while preventing stalls due to changes in engine load.

The IAC valve, mounted in the throttle body, controls bypass air around the throttle valve. By moving a conical valve IN (to decrease air flow) or OUT (to increase air flow), a controlled amount of air can move around the throttle plate. If RPM is too low, more air is bypassed around the throttle valve to increase RPM. If RPM is too high, less air is bypassed around the throttle valve to decrease RPM.

The IAC Valve moves in small steps called "counts", which can be measured by some test equipment which plugs into the ALCL.

During idle, the proper position of the IAC valve is calculated by the ECM based on battery voltage, coolant temperature, engine load, and engine RPM. If the RPM drops below a specified RPM, and the throttle plate is closed, the ECM senses a near stall condition. The ECM will then calculate a new valve position to prevent stalls.

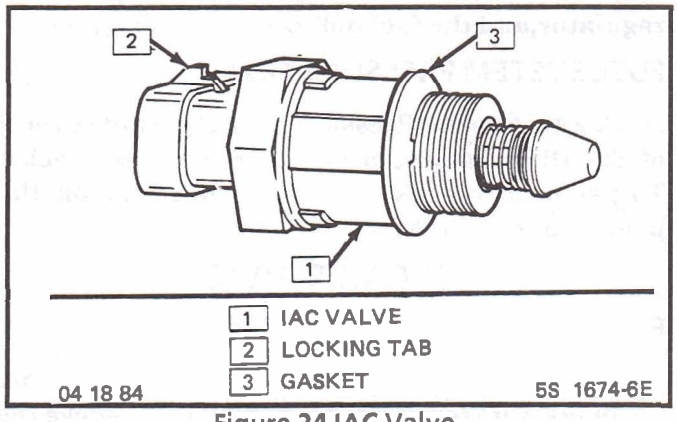


Figure 24 IAC Valve

FUEL PUMP ELECTRICAL CIRCUIT

When the key is first turned on without the engine running, the ECM will turn the fuel pump relay on for two seconds. This builds up the fuel pressure quickly. If the engine is not started within two seconds, the ECM will shut the fuel pump off and wait until the engine starts. As soon as the engine is cranked, the ECM will turn the relay on and run the fuel pump.

As a backup system to the fuel pump relay, the fuel pump can also be turned on by the oil pressure switch. The oil pressure switch is a normally open switch which closes when oil pressure reaches about 28 kPa (4 psi). If the fuel pump relay fails, the oil pressure switch will run the fuel pump.

An inoperative fuel pump relay can result in long cranking times, particularly if the engine is cold. The oil pressure switch acts as a back-up to the relay and will turn on the fuel pump as soon as oil pressure reaches about 4 psi.

An inoperative fuel pump would cause a no start condition. A fuel pump which does not provide enough pressure can result in poor performance.

DIAGNOSIS

The diagnosis of the fuel control system is covered in CHART A-3 "Engine Cranks But Won't Run". The electrical portion is covered in CHARTS A-7, called "Fuel system Diagnoisis". This includes the fuel injectors, the pressure regulator,and the fuel pump.

FUEL SYSTEM PRESSURE TEST

A Fuel System Pressure Test is part of several of the Diagnostic Charts and Symptom checks. To perform this test, use the procedure on the page opposite CHART A-7.

ON-CAR SERVICE

PORT FUEL INJECTION COMPONENTS

CAUTION: *Before servicing an injector, fuel rail, or pressure regulator, it is necessary to relieve the pressure in the fuel system, to minimize the risk of fire and personal injury. (See "Fuel Pressure Relief Procedure" below). To reduce the chance of fuel spillage, cover the fuel line with a shop cloth to collect the fuel, and then place the cloth in an approved container. After servicing the fuel system, cycle the ignition "on" and "off" several times (wait 10 seconds between cycles) and check system for leaks.*

FUEL PRESSURE RELIEF PROCEDURE

1. Connect fuel gage J 34730-1 or equivalent to fuel pressure valve. Wrap a shop towel around fitting while connecting gage to avoid spillage.
2. Install bleed hose into an approved container and open valve to bleed system pressure.

THROTTLE BODY SERVICE

Remove or Disconnect

1. Negative battery cable
2. TPS and IAC electrical connectors.
3. Coolant lines.
4. Throttle linkages.
5. Air inlet duct.
6. Throttle body bolts.

Install or Connect

1. Reverse removal procedures.
2. See Figure 25

UNIT REPAIR PROCEDURES

The unit repair procedures cover component replacement with the unit on the vehicle. However, throttle body replacement requires

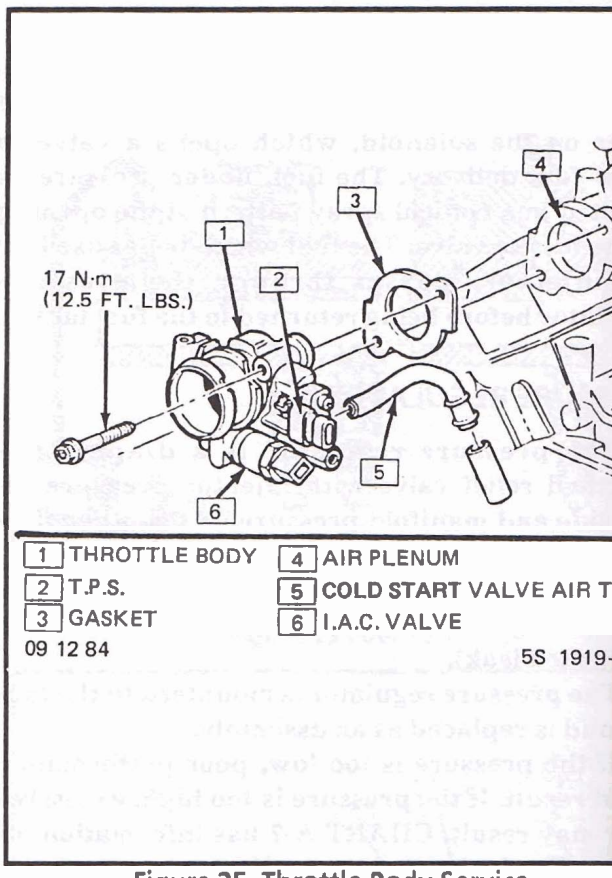


Figure 25 Throttle Body Service

that the complete unit be removed from engine. If removed, it may be placed on a hol fixture, such as J-9789-118, BT-3553, equivalent, to prevent damage to the thro valve.

CLEANING AND INSPECTION

Throttle body parts, except as noted be may be cleaned in a cold immersion-type cle such as AC Delco X-55 or equivalent.

NOTICE: *The Throttle Position Sensor (TPS), Air Control (IAC) valve, throttle body with and seals or gaskets in place, should NO soaked in liquid solvent or cleaner, as they m damaged. If TPS or IAC valve is still mounted i throttle body, do not immerse throttle body.*

1. Clean all metal parts throughly and blow with shop air. Be sure all air passages are of burrs and dirt.
2. Inspect mating casting surfaces for da that could affect gasket sealing.

Idle Air Control Valve

Remove or Disconnect

1. Electrical connector from idle air contro (IAC) valve assembly . (70)

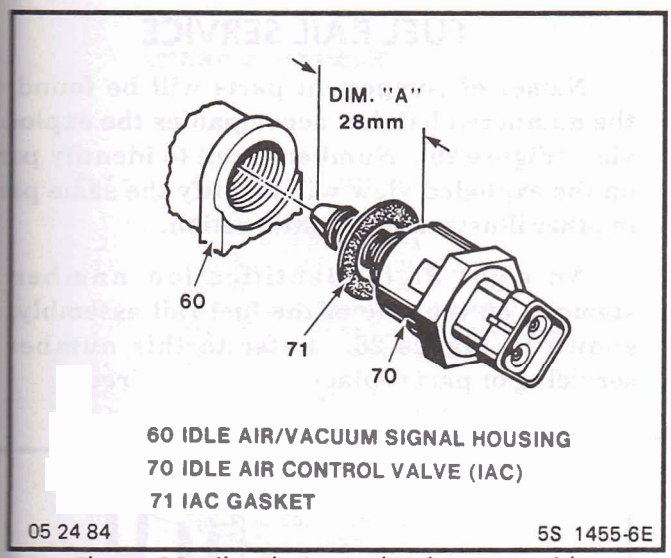


Figure 26 Idle Air Control Valve Assembly

2. IAC valve assembly from idle air/vacuum signal housing assembly. (60)
   - Do not remove any thread locking compound from threads.
3. IAC valve assembly gasket (71), and discard.

NOTICE: *The IAC valve assembly is an electrical component, and must not be soaked in any liquid cleaner or solvent, as damage may result.*

Clean

- Gasket mounting surface of idle air/vacuum signal housing assembly to ensure a good seal.

NOTICE: *Before installing the IAC valve assembly, the position of its pintle MUST be checked. If pintle is extended too far, damage to the assembly may occur.*

Measure

- Distance from gasket mounting surface of IAC valve assembly (70) to tip of pintle, Dimension :"A" in Figure 26.

Adjust if necessary

If distance is greater than 28 mm (1 1/8 in.) reduce it as follows:

a. If IAC valve assembly has a "collar" around electrical connector end, use firm hand pressure on pintle to retract (A slight side-to-side motion may help.)
b. If IAC valve assembly has "no collar", compress pintle-retaining spring toward body of the IAC, and try to turn pintle clockwise.
   - If pintle will turn, continue turning until 28 mm(1 1/8 in.) is reached. Return spring to original position, with straight part of spring end lined up with flat surface under the pintle head.
   - If pintle will not turn, use firm hand pressure to retract it.

Install or Connect

1. New IAC valve assembly gasket (71) on IAC valve assembly (70)
2. IAC valve assembly in idle air/vacuum signal housing assembly (60).

Tighten

- IAC valve assembly to 18 N·m (13 ft. lbs.) with wrench on hex surface only.

3. Electrical connector at IAC valve assembly (70).

! Important

No physical adjustment is made to the IAC assembly after installation.IAC resetting occurs after reinstallation on the vehicale, and is controlled by ECM action when the vehicle is operated.

Plenum

Remove or Disconnect

1. Negative battery cable.
2. Vacuum lines.
3. EGR Pipe to EGR valve base bolts (2)
4. Throttle body bolts (2)
5. Plenum bolts (10).
6. Plenum and gaskets.

Install or Connect

1. Gaskets.
2. Plenum bolts.
3. Throttle body bolts.
4. EGR pipe.
5. Throttle cable bracket bolts.
6. Vacuum lines.
7. Negative battery cable.

! Important

Use care in removing injectors to prevent damage to the electrical connector pins on the injector and the nozzle. The fuel injector is serviced as a complete assembly only. The fuel injector is an electrical component and should not be immersed in any type of cleaner.

Fuel Rail

Remove or Disconnect

1. Negative battery cable.
2. Plenum.

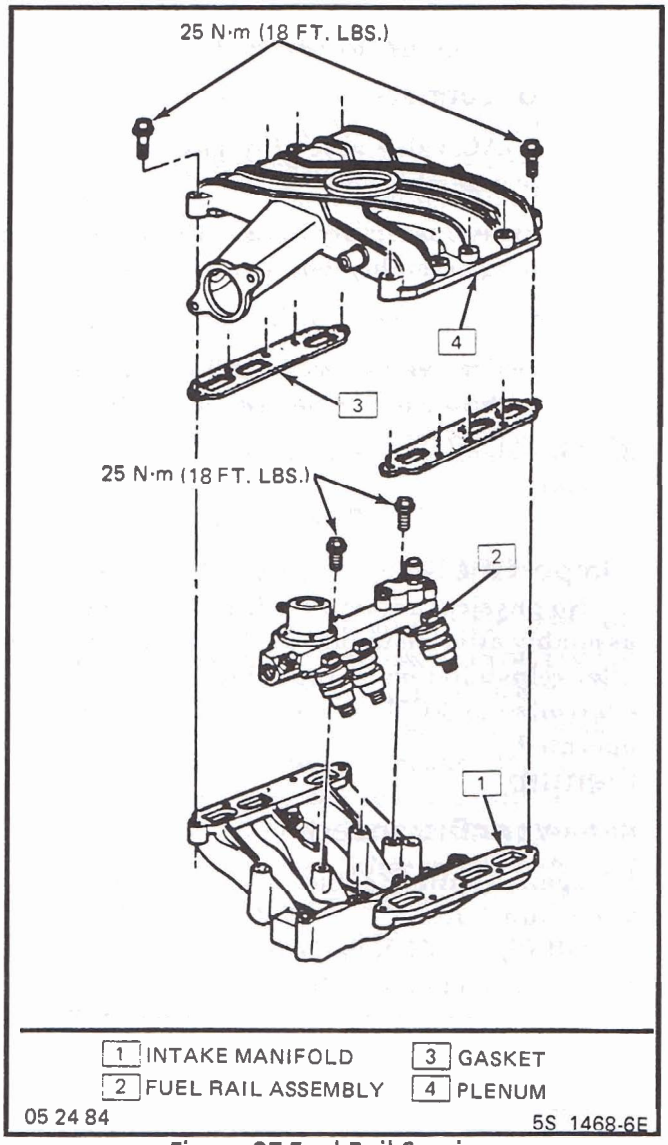


Figure 27 Fuel Rail Service

3. Cold start valve line at rail.
4. Fuel lines at rail.
5. Vacuum line at regulator.
6. Injector electrical connectors.
7. Rail retaining bolts (2).
8. Rail and injectors.

Clean

- Fuel rail and pressure regulator assembly and adjacent fuel lines with AC-Delco X-30A or equivalent.

! Important

Use care when handling fuel rail assembly to avoid damaging injectors.

Install or Connect

- Lubricate all injector O-ring seals with engine oil.
- Reverse removal procedure.
- See Figure 27

FUEL RAIL SERVICE

Names of component parts will be found o the numbered list that accompanies the explode view (Figure 29). Numbers used to identify par on the exploded view will identify the same par in other illustrations of this section.

An eight digit identification number stamped on the side of the fuel rail assembly, shown in Figure 28. Refer to this number servicing or part replacement is required.

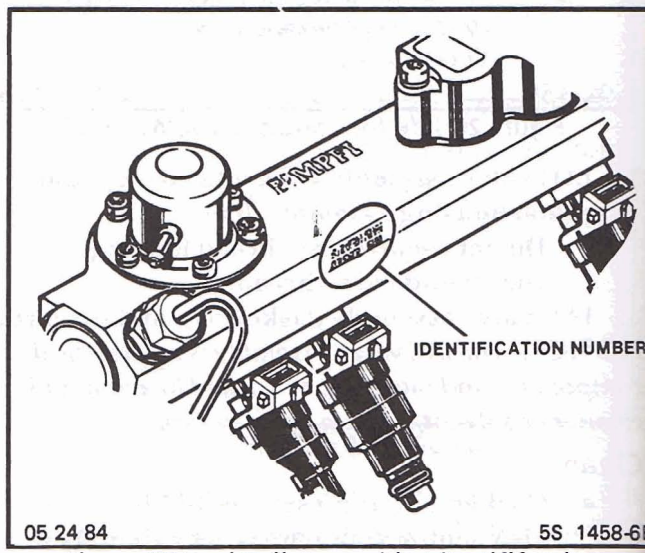


Figure 28 Fuel Rail Assembly Identififcation

UNIT SERVICE PROCEDURES

! Important

When servicing the fuel rail assembl precautions must be taken to prevent dirt an other contaminants from entering the fu passages. It is recommended that fittings b capped, and holes be plugged, during servicing.

! Important

At any time the fuel system is opened fo service, the O-ring seals used with relate component(s) should be replaced.

CLEANING AND INSPECTION

Before disassembly, the fuel rail assembly may be cleaned with a spray type engine cleaner such as AC-Delco X-30A or equivalent, followin package instructions. The fuel rail should not be immersed in liquid solvent.

Part #	Part Name
1	O-ring—Fuel Inlet Line
2	O-ring—Fuel Return Line
11	Fuel Rail and Pressure Regulator Assembly
26	Fuel Pressure Connection Assembly
27	Seal—Fuel Pressure Connection Assembly
28	Cap—Fuel Pressure Connection
55	Fuel Block
56	Seal—Fuel Block
57	Screw Assembly—Fuel Block Attaching
85	Injector—Port
86	Seal—O-ring—Injector
87	Clip—Injector Retainer
100	Valve—Cold Start
101	Tube and Body Assembly
102	O-Ring Seal—Valve
103	O-Ring Seal—Body
104	O-Ring Seal—Tube
105	Fitting—Cold Start

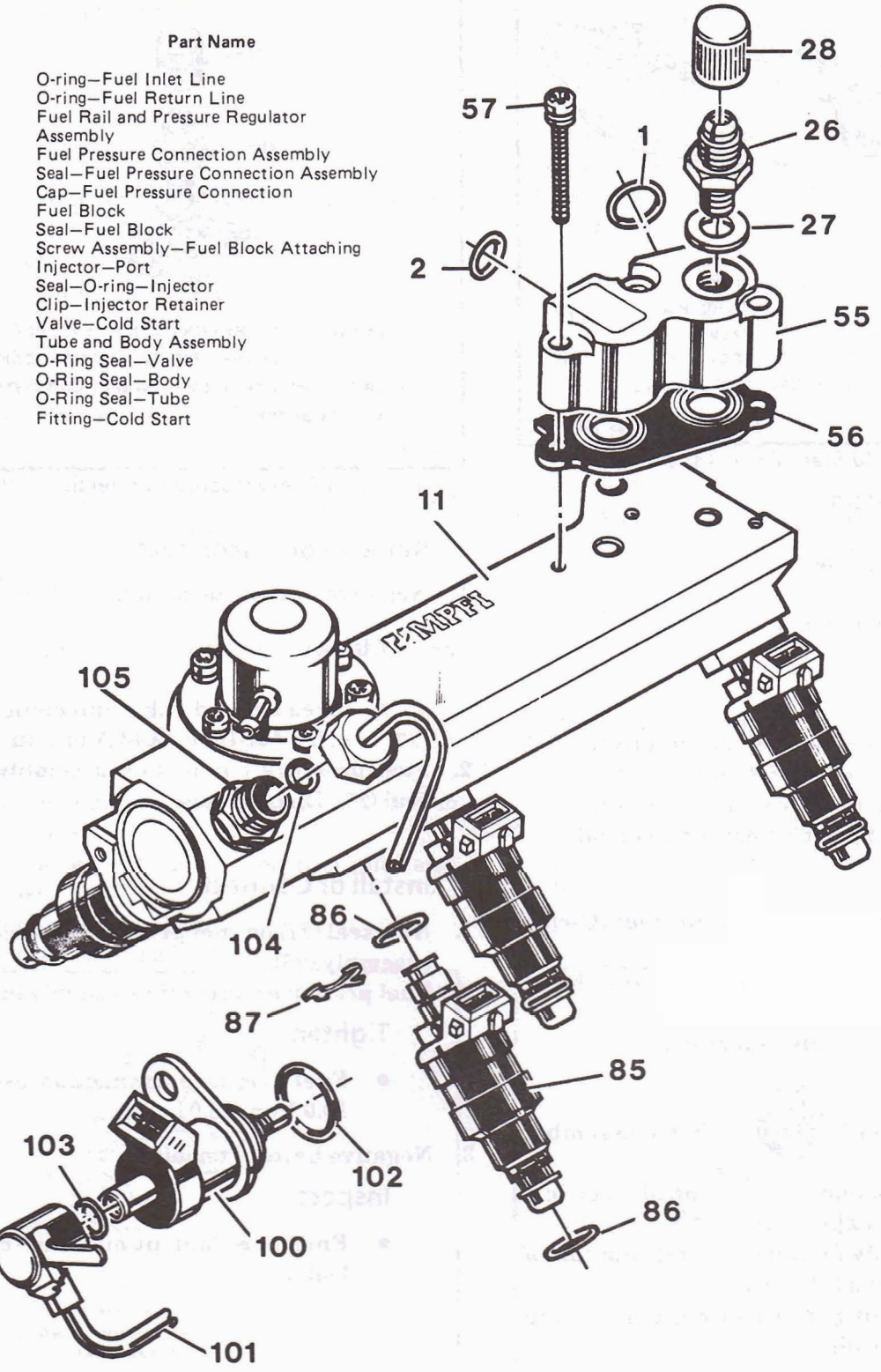


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Figure 29 Fuel Rail Assembly

COLD START TUBE AND VALVE ASSEMBLY

(Figure 32)

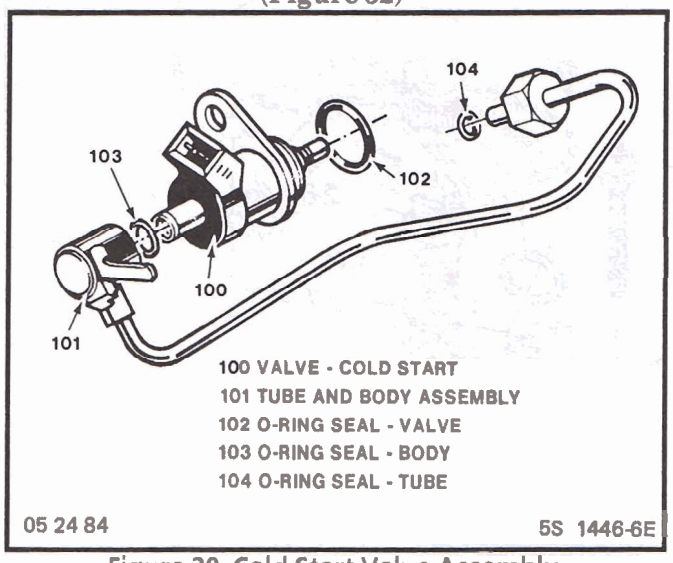


Figure 30 Cold Start Valve Assembly

Remove or Disconnect.

1. Negative battery cable.
2. Fuel line at rail.
3. Valve electrical connector.
4. Valve retaining bolt.

Clean

- Areas around valve and connection with AC = Delco X-30A or equivalent.
- Valve from tube and body assembly (101).
- Bend tab back to permit unsrewing of valve.

Install or Connect

1. New valve O-ring seal (102) and body O-ring seal (103), on cold start valve (100)
2. Tube O-ring seal (104) on tube and body assembly (101).
3. Cold start valve in body assembly.

Adjust

1. Turn valve completely into body.assembly (101)
2. Turn valve back one full turn, until electrical connector is at top position.
3. Bend tang of body forward to limit rotation of valve to less than a full turn.
4. Before re-installing into engine, coat o-ring seals with engine oil.

FUEL PRESSURE CONNECTION ASSEMBLY

(Figure 33)

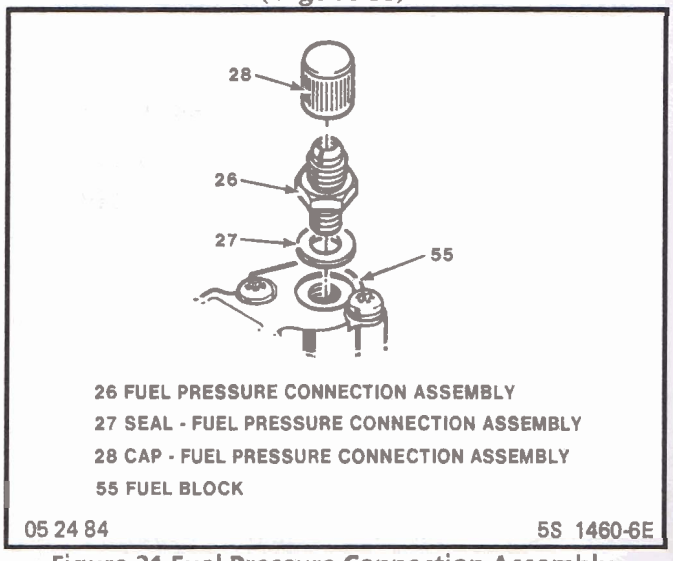


Figure 31 Fuel Pressure Connection Assembly

Remove or Disconnect

1. Negative battery terminal.

Clean

- Area around valve and connection with AA-Delco X-30A or equivalent.

2. Fuel pressure connection assembly (26) and seal (27). Discard seal.

Install or Connect

1. New seal (27) on fuel pressure connection assembly (26).
2. Fuel pressure connection assemly in fuel rail.

Tighten

- Fuel pressure connection assembly to 10.0 N.m (88.0 in. lbs.).

3. Negative battery terminal.

Inspect

- Energize fuel pump and check for leaks.

FUEL BLOCK AND SEAL

Figure 32

Remove or Disconnect

1. Negative battery terminal.
2. Plenum.

Clean

- Fuel block (55) and adjacent fuel line connections with AC-Delco Xd30A or equivalent.

3. Fuel inlet and return lines, and O-ring seals (1) and (2).
   - Discard -ring seals.
4. Fuel block attaching screw assemblies (57).
5. Fuel block (55) and seals (56). Discard seal.

Clean

- Sealing surfaces of fuel block and fuel rail assembly to ensure a good seal.

Install or Connect

1. New-O-ring seals (1) and (2) on fuel inlet and return lines.
2. fuel block (55) on seal.
3. Fuel block attaching screw assemblies (57).
   Tighten
   - Attaching screw assemblies to 5.0 N·m (44.0 in. lbs.).
4. New O-ring seals (1) and (2) on fuel inlet and return lines.
5. Fuel inlet and return lines.
6. Battery negative terminal.

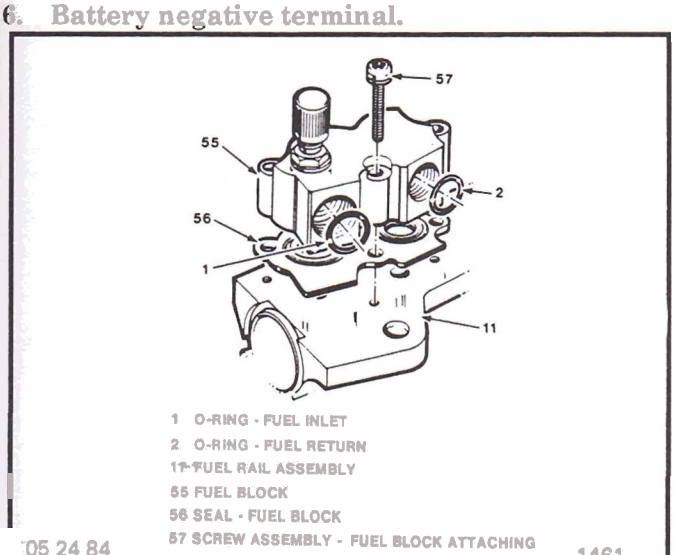


Figure 32 Fuel Block Assembly

Inspect

- Energize fuel pump and check for fuel leaks.

FUEL INJECTORS

NOTICE: *To prevent dirt from entering the engine the area around the injectors should be clean before servicing.*

Each port injector is located and held in position by a retainer clip that must be rotated to release and/or lock the injector in place, as shown in Figure 33.

Remove or Disconnect

1. Rotate injector retaining clip(s) (87) to unlocked position.
2. Port injectors (85).

Inspect

- All injector O-ring seals (86).
  - Replace if damaged.

Assemble

- New O-ring seals (86) as required, on port injectors (85).

Install or Connect

1. Lubricate all injector -ring seals with engine oil.
2. Port injectors to fuel rail and pressure regulator assembly (11).
3. Rotate injector retainer clips (87) to locking position (figure 35)

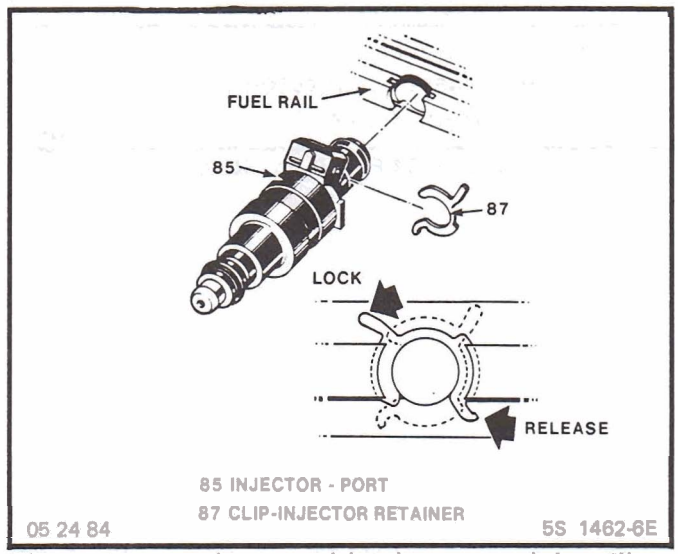


Figure 33 Port Injectors with Injector Retaining Clips

PRESSURE REGULATOR

(!) Important

The Pressure Regulator is factory adjusted and is not serviceable. Do not attempt to remove the regulator form the Fuel Rail.

Thermal Time Switch

Remove or Disconnect

1. Negative battery cable.
2. Connector.
3. Switch

Install or Connect

1. Coat threads with pipe sealant.
2. Switch.
3. Connector.
4. Negative battery cable.

FUEL PUMP RELAY

The fuel pump relay is mounted in the engine compartment (see figure 34). Other than checking for loose connectors, the only service possible is replacement.

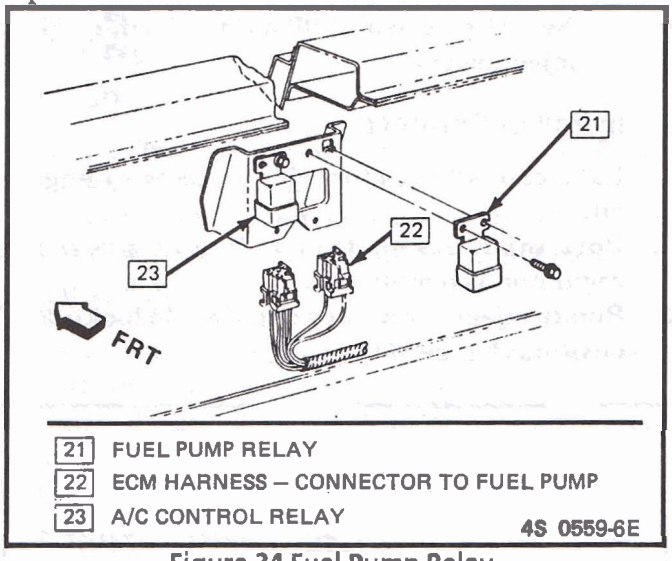


Figure 34 Fuel Pump Relay

PARTS INFORMATION

PART NAME	GROUP
Injector, fuel	3.330
Pump, Fuel (In-Tank)	3.900
Relay, Fuel Pump	3.900
Switch, Oil Pressure	1.800
Valve Asm, Idle Air Control : Part Of Control Kit, Idle Air Valve	3.820
Regulator, Fuel Pressure	3.164
Rail, Fuel Feed	3.330

BLANK

CHART C-2A,

INJECTOR BALANCE TEST

The injector tester is a timer used to turn each injector on for precisely .5 seconds. This time allows a measured amount of fuel to be sprayed into the intake manifold thereby reducing the pressure in the fuel rail. All injectors in the engine should measure about the same pressure drop.

STEP 1

Connect fuel gage J347301 or equivalent to fuel pressure tap. Wrap a shop towel around fitting while connecting gage to avoid fuel spillage.

Disconnect harness connectors at all injectors, and connect injector tester J-34730-3 or equivalent to one injector. On Turbo equipped engines, use adaptor harness furnished with injector tester to energize injectors that are not accessible. Follow manufacturers instructions for use of adaptor harness. Ignition must be off at least 10 seconds to complete ECM shutdown cycle. Fuel pump should run about 2 seconds after ignition is turned on. At this point, insert clear tubing attached to vent valve into a suitable container and bleed air from gage and hose to insure accurate gage operation.

STEP 2

Turn ignition off for 10 seconds and then on again to get fuel pressure to its maximum. This insures that fuel pressure is precisely the same for each injector test. Energize tester one time and note pressure drop the instant the gage needle stops. The pressure may increase for a few seconds after the initial pressure drop. This increase should not be considered in he test, as it will vary depending on temperature.

STEP 3

This example shows how faulty injectors would appear, as compared to good ones. Retest any injector that appears to be faulty and replace any injector that has a pressure difference of 10kPa, either more or less than the other injectors on the engine. If all injectors test within a 10 kPa range in pressure drop, reconnect injectors and review Symptoms, Section B.

CHART C-2A

INJECTOR BALANCE TEST
FUEL INJECTION (PORT)

Before performing this test,the items listed below must be done.

- Check spark plugs and wires
- Check compression
- Check fuel injection harness for being open or shorted.

Step 1. Connect fuel pressure gage and injector tester.

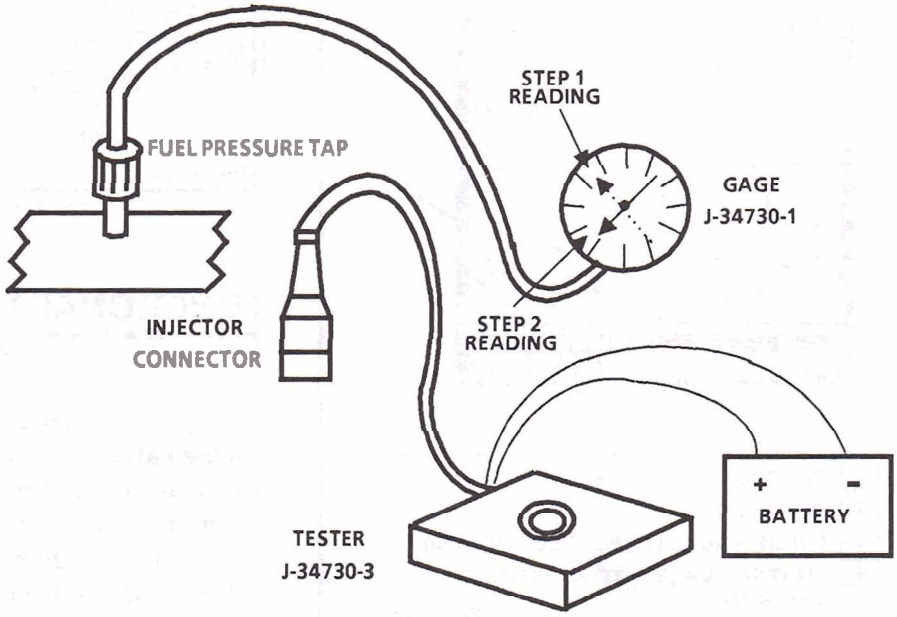
1. Ignition "OFF" for 10 sec.
2. Ignition "ON".
3. Note pressure. (Pressure should be between 234- 317 KPA after ignition is turned on.)
   If not in this range see :Chart A7.

Step 2. Run test.

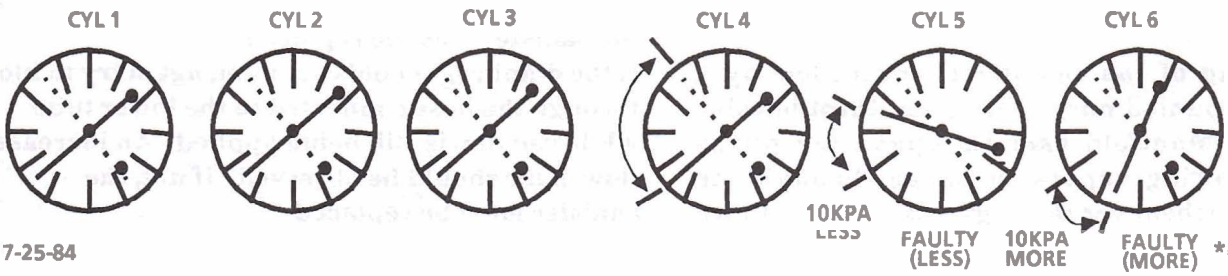
1. Ignition "OFF" for 10 sec.
2. Ignition "ON".
3. Turn injector on by depressing button on injector tester and note pressure at the instant the gage needle stops.

Step 3.

1. Repeat step 2 on all injectors and record pressure drop on each. Retest injectors that appear faulty. Replace any injectors that have a 10 KPA difference (either more or less) in pressure.



EXAMPLE



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EVAPORATIVE EMISSION CONTROL SYSTEM (EECS)

GENERAL DESCRIPTION

PURPOSE

The basic Evaporative Emission Control System (EECS) used on all vehicles is the charcoal canister storage method. This method transfers fuel vapor from the fuel tank to an activated carbon (charcoal) storage device (canister) to hold the vapors when the vehicle is not operating. When the engine is running, the fuel vapor is purged from the carbon element by intake air flow and consumed in the normal combustion process.

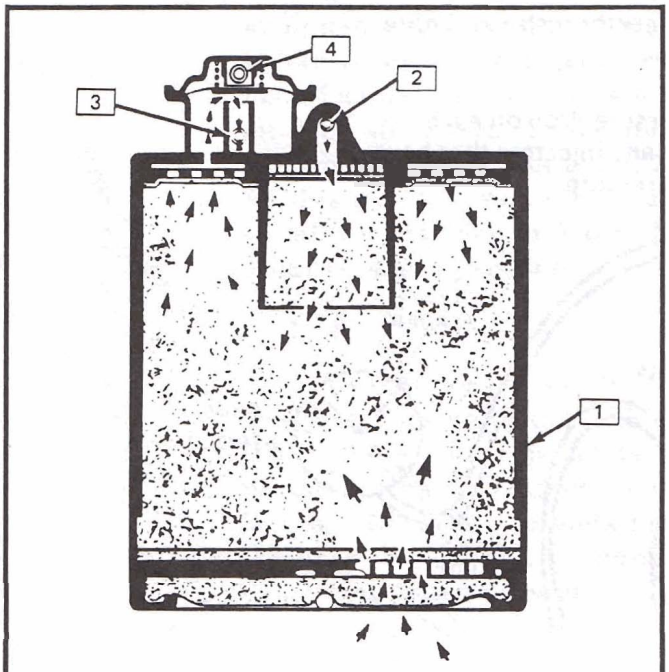


Figure 35 Charcoal Canister- Purge Valve 2.8L

2.8L EVAPORATIVE SYSTEM

Purging of the canister is controlled by a canister-mounted purge valve, and throttle valve position. Manifold vacuum opens the purge valve, allowing vapors to purge through the purge line whenever the engine is running above idle.

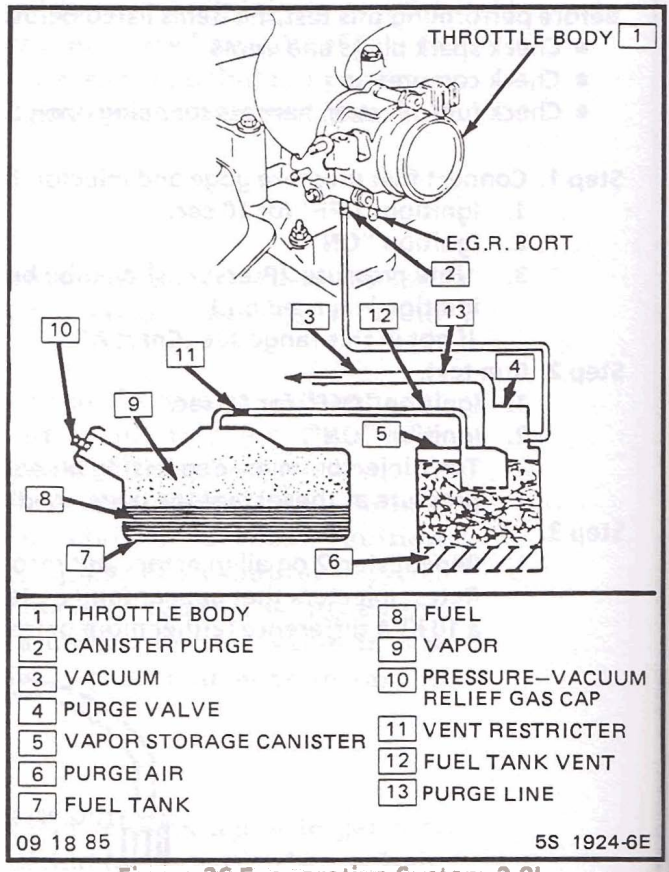


Figure 36 Evaporative System-2.8L

FUNCTIONAL TEST OF FUEL VAPOR CANISTER

Apply a short length of hose to the lower tube of purge valve, and attempt to blow through it. Little or no air should pass into the canister. (Asmall amount of air will pass if the canister has a constant purge hole).

With hand vacuum pump, apply vacuum (15"Hg. or 51 kPa) through the control valve tube (upper tube). If the diaphragm does not hold vacuum for at least 20 seconds, the diaphragm is leaking, and the canister must be replaced.

If the diaphragm holds vacuum, again try to blow through the hose connected to the lower tube while vacuum is still being applied. An increased flow of air should be observed. If not, the canister must be replaced

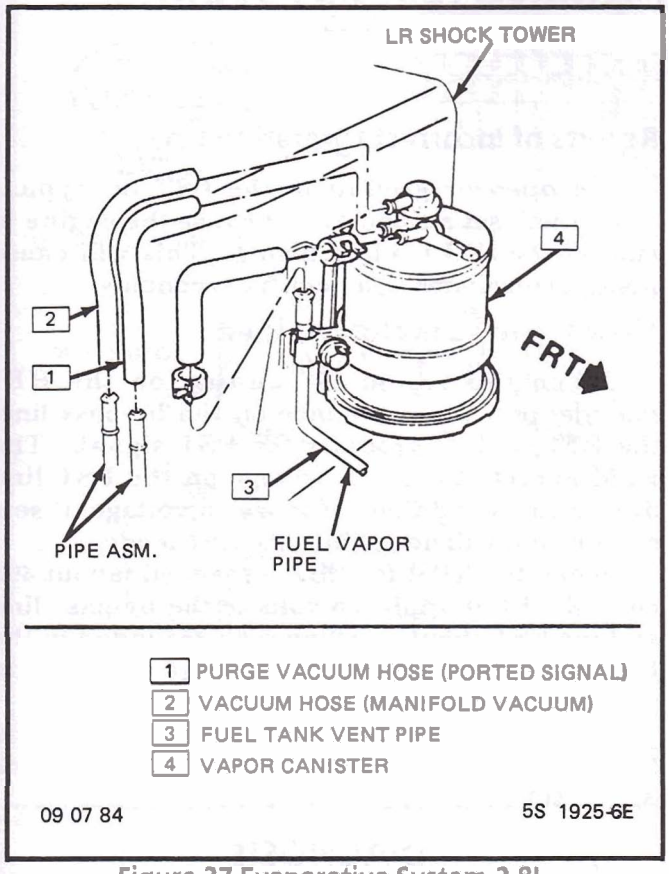


Figure 37 Evaporative System-2.8L

ON-CAR SERVICE

FUEL VAPOR CANISTER

Remove or Disconnect

1. Hoses from canister. Mark hoses to install on new canister.
2. Canister.

Install or Connect

1. Canister.
2. Hoses. Make sure connections are correct

PARTS INFORMATION

PART NAME	GROUP
Canister, Fuel Vapor	3.130

ELECTRONIC SPARK TIMING (EST) SYSTEM

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)
- Manifold pressure
- Engine temperature

The EST system consists of the distributor module, ECM, and connecting wires. The distributor has module terminals which are connected directly to the engine harness connectors. The connector terminals are lettered as shown in figure 38.

These circuits perform the folowing functions:

- Distributor reference (CKT 430).
  This provides the ECM with RPM and crankshaft position information.
- Reference ground (CKT 453).
  This wire is grounded in the distributor and makes sure the ground circuit has no voltage drop, between the distributor and ECM, which could affect performance.
- By-Pass (CKT 424).
  At about 400 RPM, and ECM applies 5 volts to this circuit to switch spark timing control from the HEI module to the ECM. An open or grounded bypsss 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. 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 or bypass 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.

How Code 42 is Determined

When the system is running on the HEI module, that is , no voltage on the by-pass 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 by-pass line and the EST should no longer be grounded in the HEI module so the EST voltage should be varying.

If the by-pass line is open or grounded, the HEI module will not switch to EST and Code 42 will be set.

DIAGNOSIS

The description, operation, and diagnosis of the HEI system are found in Section 6D of this manual.

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.

CHECKING EST PERFORMANCE

The ECM will set timing at a specified value when the diagnostic "Test" terminal in the ALCL connector is grounded. To check for EST operation, the timing should be checked at 1500 RPM with the terminal ungrounded. Then ground the "Test" terminal. If the timing changes at 1500 RPM, the EST is operating.

A fault in the EST system will usually set a trouble code 42. Use that chart to diagnose the system.

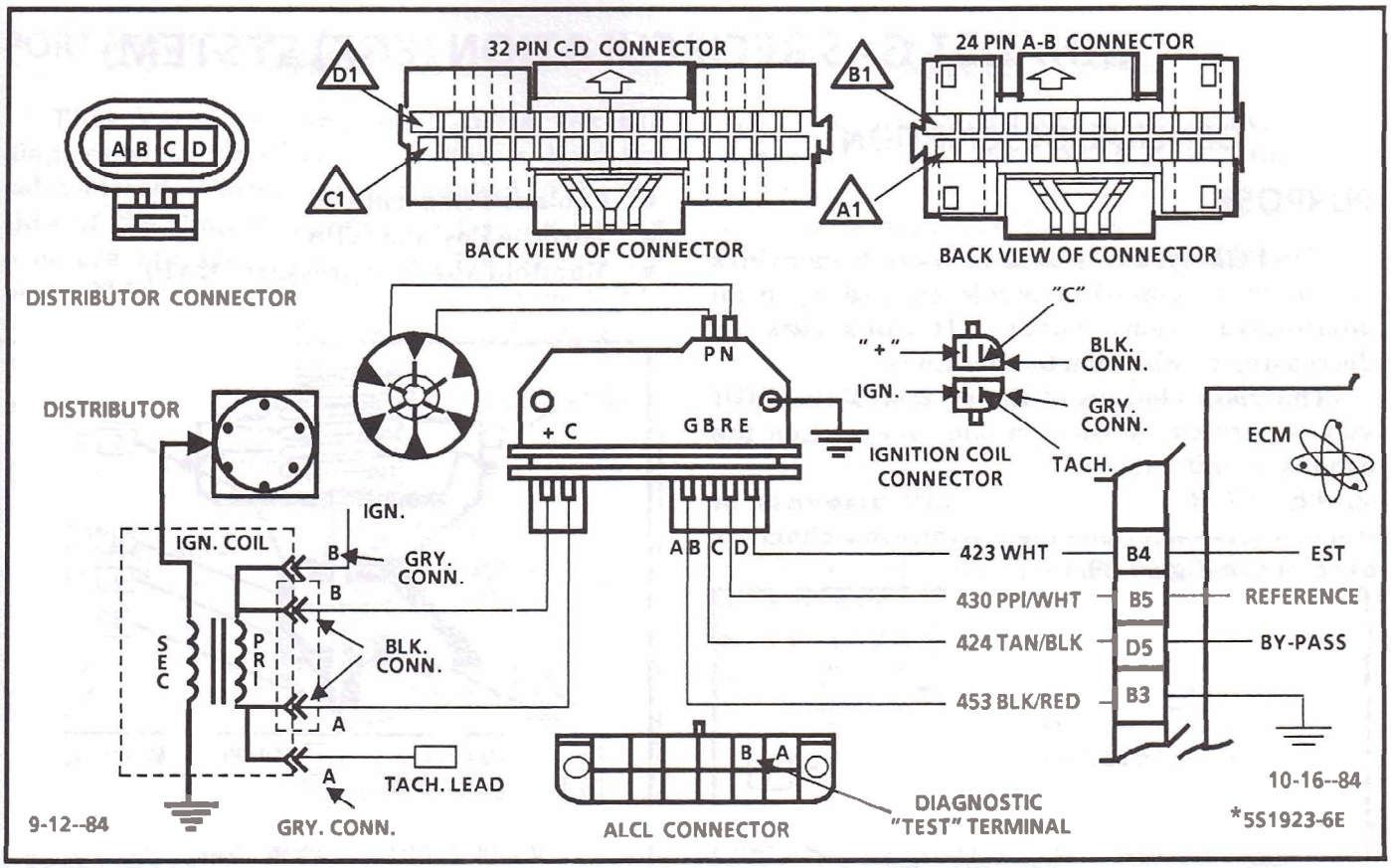


Figure 38 EST System

ON-CAR SERVICE

SETTING TIMING

The timing is set by following the procedures on the Vehicle Emission Control Information label.

PARTS INFORMATION

PART NAME	GROUP
Module, Distr	2.383
Coil, Distr	2.170

EXHAUST GAS RECIRCULATION (EGR) SYSTEM)

GENERAL DESCRIPTION

PURPOSE

The EGR system is used to lower NOx (oxides of nitrogen) emission levels caused by high combustion temperature. It does this by decreasing combustion temperature.

The main element of the system is the EGR valve operated by vacuum and mounted on the exhaust manifold.

The EGR valve feeds small amounts of exhaust gas back into the combustion chamber as shown in Figure 39.

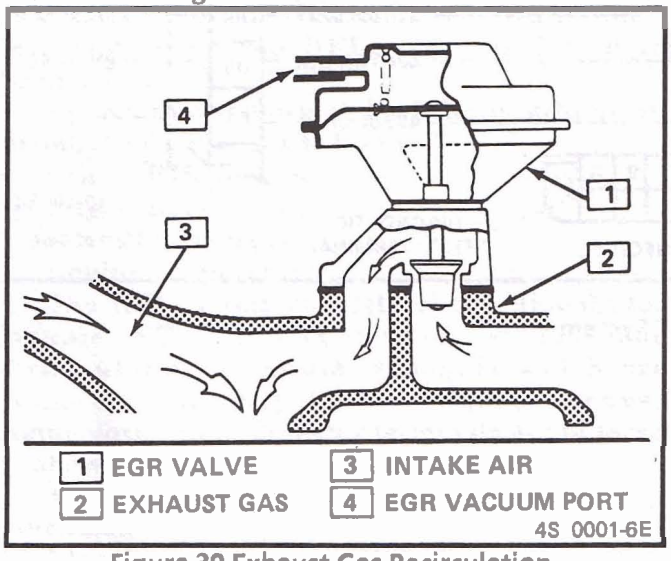


Figure 39 Exhaust Gas Recirculation

OPERATION

The EGR valve is opened by manifold vacuum to let exhaust gas flow into the intake manifold. The exhaust gas then moves with the air/fuel mixture into the combustion chamber. If too much exhaust gas enters, combustion will not occur. For this reason, very little exhaust gas is allowed to pass through the valve, especially at idle. The EGR valve is usually open under the following conditions:

- Warm engine operation
- In drive ranges (A/T)
- Above idle speed

To more closely regulate EGR flow, an ECM controlled solenoid is used in the vacuum line (see Figure 42). The ECM uses information from the following sensors to regulate the vacuum solenoid:

- Coolant Temperature
- Throttle Position (TPS)
- Manifold absolute pressure (MAP)

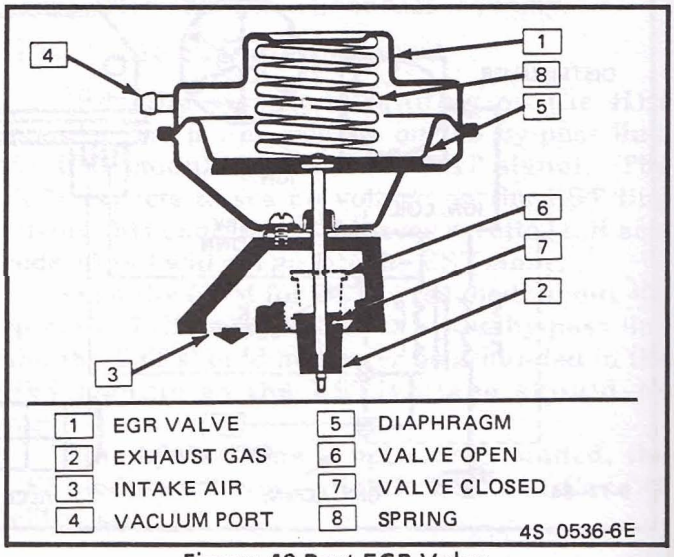


Figure 40 Port EGR Valve

EGR VALVE IDENTIFICATION, FIG. 40

- *Positive backpressure* EGR valves will have a "P" stamped on the top side of the valve after the part number.
- Negative backpressure EGR valves will have an "N" stamped on the top side of the valve after the part number.
- Port EGR valves have no identification stamped after the part number.

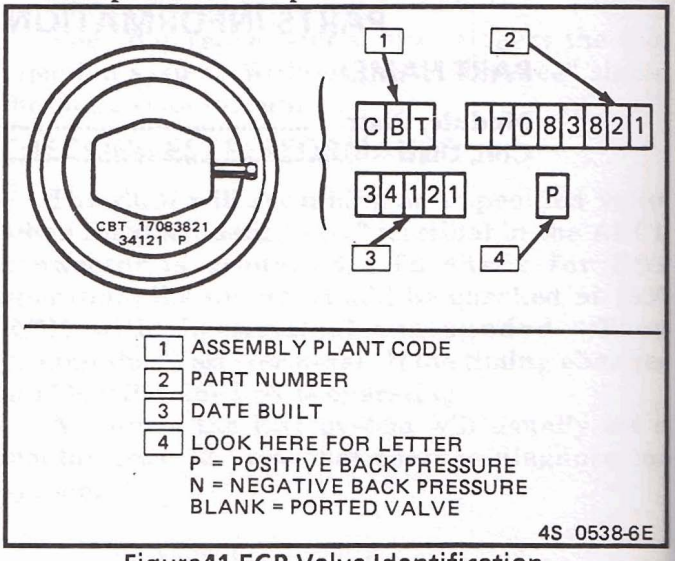


Figure41 EGR Valve Identification

PORT EGR VALVE (2.8L)

This valve is controlled by a fexible diaphragm which is spring loaded to hold the valve closed. Ported vacuum applied to the top side of the diaphragm overcomes the spring pressure and opens the valve in the exhaust gas port. This allows exhaust gas to be pulled into the intake manifold and enter the engine cylinders.

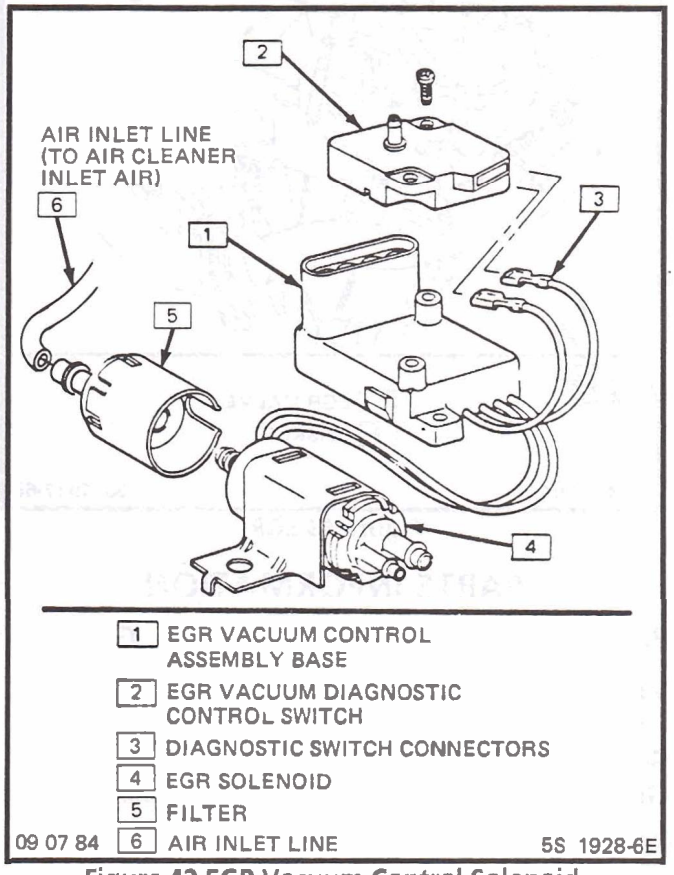


Figure 42 EGR Vacuum Control Solenoid

The EGR Vacuum control has a vacuum solenoid that uses "pulse width modulation". This means the ECM turns the solenoid on and off many times a second and varies the amount of "on" time ("pulse width") to vary the amount of EGR.

A diagnostic switch is part of the control and monitors vacuum to the EGR valve. This switch will trigger a "CHECK ENGINE" light, and set a Code 32 in the event of a vacuum circuit failure.

Results of Incorrect EGR System Operation

Too much EGR flow tends to weaken combustion, causing the engine to run roughly or stop.

With too much EGR flow at idle, cruise, or cold operation, any of the following conditions may happen:

- **Engine stops after cold start.**
- Engine stops at idle after deceleration.
- Car surges during cruise.
- Rough idle.

If the EGR valve should stay open all of the time, the engine may not idle.

Too little or no EGR flow allows combustion temperatures to get too high during acceleration and load conditions. This could cause:

- Spark knock (detonation).
- Engine overheating.
- Emission test failure.

DIAGNOSIS

Diagnosis of the EGR System is covered in Chart C-7 at the end of this section.

ON-CAR SERVICE

EGR VALVE

Remove or Disconnect

1. Vacuum line.
2. Bolts.
3. Valve

Install or Connect

1. Valve
2. Bolts.
3. Vacuum line.

If EGR passages to the manifold indicate excessive build-up of deposits, the passages should be cleaned. Care should be taken to ensure that all loose particles are completely removed to prevent them from clogging the EGR valve or from being ingested into the engine.

Do not wash EGR valve in solvents or degreaser - permanent damage to valve diaphragm may result. Also, sand blasting of the valve is not recommended since this can affect the operation of the valve.

EGR Manifold Passage

Clean

1. With a wire wheel, buff the exhaust deposits from the mounting surface and around the valve.
2. Look for exhaust deposits in the valve outlet. Remove deposit build-up with a screwdriver.
3. Clean mounting surfaces

Install or Connect

1. Reinstall valve or replacement EGR valve using new gasket.
2. Bolts and tighten to 18 N.m (14 ft.lbs.).
3. Vacuum hose to valve.

EGR CONTROL SOLENOID

Remove or Disconnect

1. Negative battery cable.
2. Electrical connector at solenoid (Figure 105).
3. Vacuum hoses.
4. Nut and solenoid.

Install or Connect

1. Solenoid and bracket. Tighten nut to 24 N·m (17 ft.lbs.).
2. Vacuum hoses.
3. Electrical connector.
4. Negative battery cable.

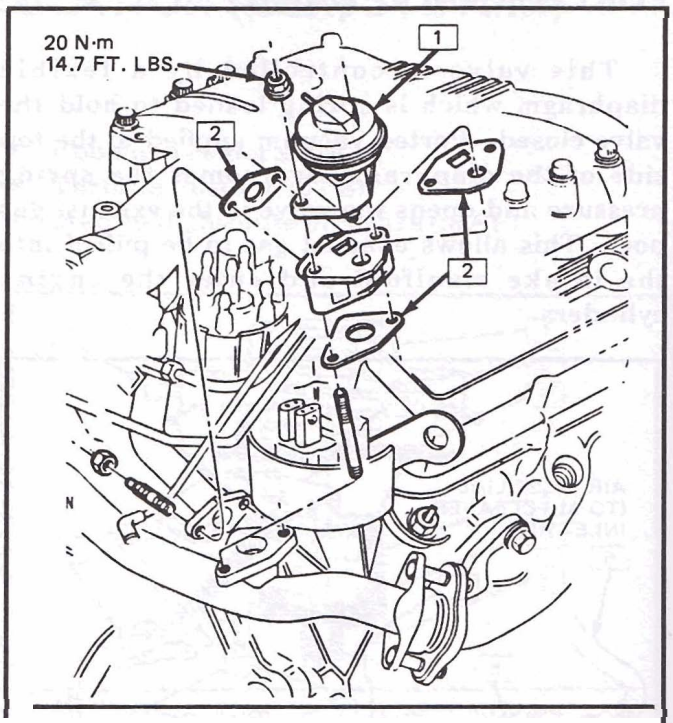


Figure 43 EGR

PARTS INFORMATION

PARTS NAME	GROUP
Valve, EGR	3.670
Control, EGR Vacuum	3.670
Solenoid, EGR Cont VLV	3.670
Gasket, EGR Valve	3.680

EGR Valve Identification.

When replacing an EGR valve, always check for correct part number in the parts catalog or supplemental bulletin.

BLANK

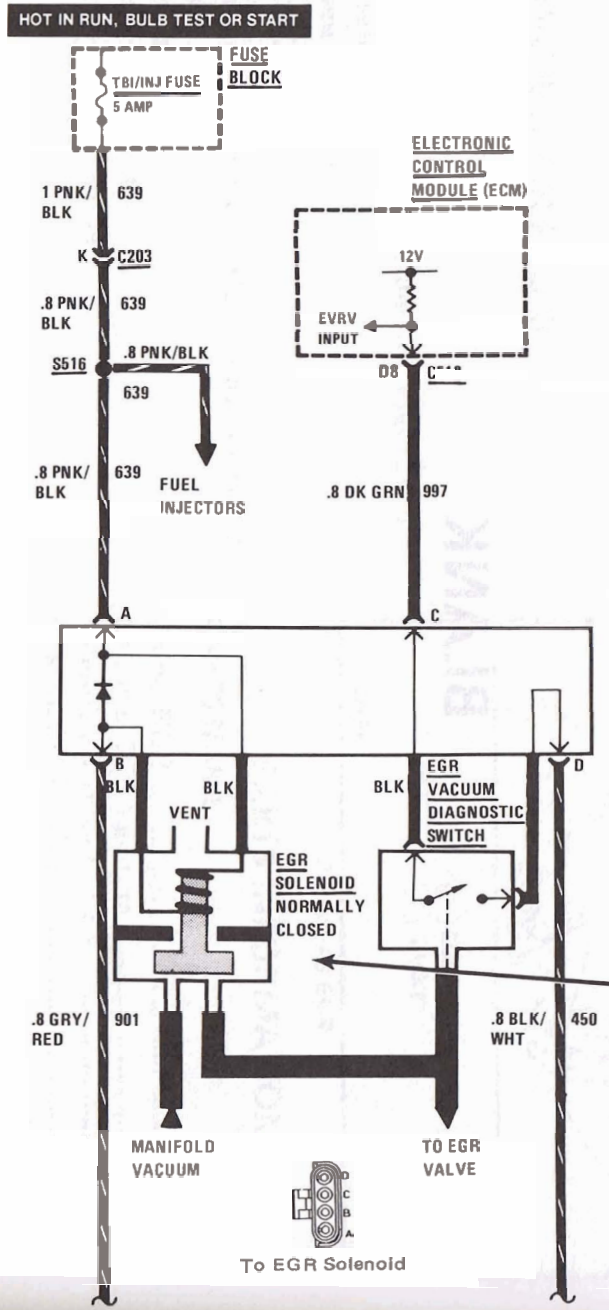
CHART C-7
EXHAUST GAS RECIRCULATION CHECK

The ECM turns the EXHAUST GAS RECIRCULATION (EGR) SOLENOID on and off (duty cycle) by grounding circuit 901. The EGR duty cycle is calculated by the ECM based on information from the COOLANT SENSOR, the MAP SENSOR, and engine rpm. The duty cycle should be 0% (no EGR) when the THROTTLE POSITION SENSOR is at WOT or below a specified value. A vacuum is allowed to pass when the normally closed EGR SOLENOID is energized. This vacuum helps to open the EGR Valve. The EGR Valve permits passage of exhaust gases from the exhaust system to the intake manifold. The EGR DIAGNOSTIC SWITCH monitors the vacuum in the ported manifold.

With the engine stopped and the ignition "ON," the EGR SOLENOID is not energized unless the DIAGNOSTIC TERMINAL is grounded.

Chart C-7 checks for plugged EGR passages, a sticking EGR valve, or an open EGR Solenoid which does not close.

Code 32 will detect a faulty EGR Solenoid, EGR DIAGNOSTIC SWITCH, or not enough vacuum. Code 32 sets when the EGR DIAGNOSTIC SWITCH does not close.



3 If the EGR VALVE does not move then check the operation of the EGR VALVE.
- a. Ground the DIAGNOSTIC TERMINAL.
- b. Repeat the test in step 1.
- c. Observe the EGR VALVE. Go to step **4** or **5**.

4 If the EGR VALVE does not move then **THE FAULT IS IN THE EGR VALVE.**

5 If the EGR VALVE moves then check for plugged EGR passages.
- a. Start and idle the engine.
- b. Lift up on the EGR Valve and observe the idle. Go to step **6** or **7**.

6 If there is no change in the idle then **REMOVE THE EGR VALVE** and check the passages for blockage. If no plug is found then **THE FAULT IS IN THE EGR VALVE.**

7 If the idle roughens then check the PARK/NEUTRAL SWITCH input to the ECM.
- a. **RECONNECT THE EGR SOLENOID.**
- b. Connect a vacuum gage to the vacuum harness at the EGR VALVE.
- c. With the engine at normal operating temperature and the transmission in Drive, hold the brakes and accelerate momentarily to 1800 rpm.
- d. Observe the vacuum gage. Go to step **8**, **9**, or **10**.

1 Check for an open vacuum circuit.

a. With the engine stopped and the ignition "ON," **DISCONNECT THE EGR SOLENOID VACUUM HARNESS.** Do not ground the DIAGNOSTIC TERMINAL.

b. Rotate the vacuum harness and reconnect the EGR side of the harness.

c. Check for leaks in the hose from the ported manifold to the EGR SOLENOID.

d. Install a hand held vacuum pump with a gage to the manifold side of the EGR SOLENOID and apply vacuum. Observe the EGR valve; it should not move. Go to step **2** or **3**.

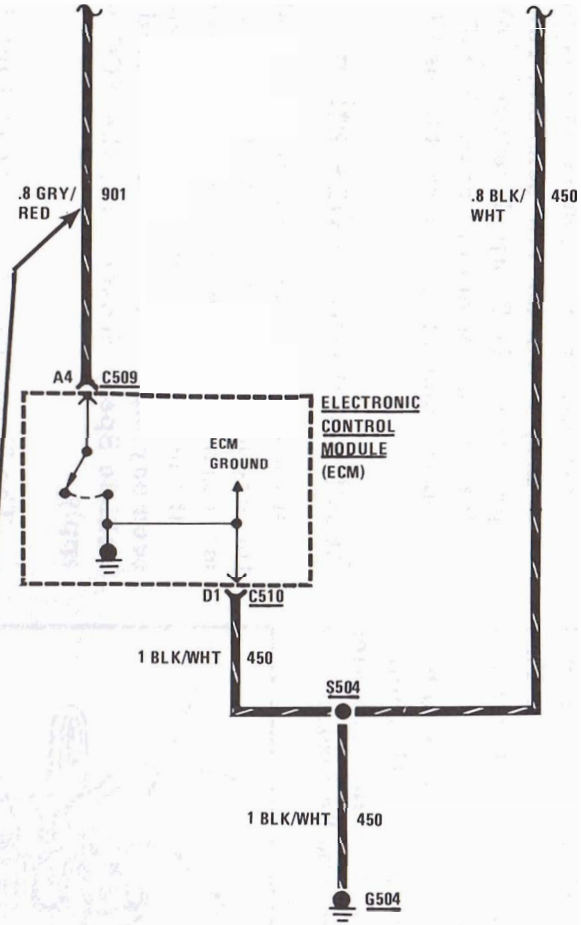
2 If the EGR VALVE moves then check ECM control of the EGR SOLENOID.

a. **DISCONNECT THE EGR SOLENOID ELECTRICAL CONNECTOR.**

b. Repeat the test in step 1. Go to **c** or **d**.

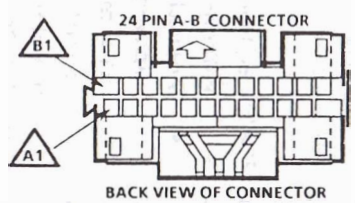
c. If the EGR VALVE moves then **THE FAULT IS IN THE EGR SOLENOID.**

d. If the EGR VALVE does not move then check circuit 901 (gray/red) for a short to ground. If no short is found then **THE FAULT IS IN THE ECM.**

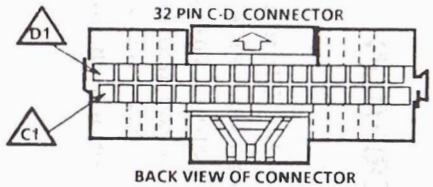


8 If the vacuum is over 2" but less than 10" then no trouble was found.

9 If the vacuum is less than 2" and there are no restrictions in the vacuum lines then **REFER TO CHART A-1, PARK/ NEUTRAL SWITCH** (automatic transmission only).



C509



C510

10 If the vacuum is over 10" then **THE FAULT IS IN THE EGR FILTER.**

Reconnect all connectors. Clear all codes. Confirm "closed loop" operation and no "CHECK ENGINE" light.

TRANSMISSION/TRANSAXLE CONVERTER CLUTCH (TCC)

GENERAL DESCRIPTION

PURPOSE

The Transmission Converter Clutch (TCC) System uses a solenoid operated valve in the automatic transmission to couple the engine flywheel to the output shaft of the transmission thru the torque converter. This reduces the slippage losses in the converter, which increases fuel economy.

OPERATION

For the converter clutch to apply, two conditions must be met:

- Internal transmission fluid pressure must be correct. For information on internal transmission operation, see Section 7A. This section will cover only the electrical operation of the TCC system.
- The ECM grounds a switch internally to turn on a solenoid in the transmission. This moves a check ball, which will allow the converter clutch to apply, if the hydraulic pressure is correct, as described above.

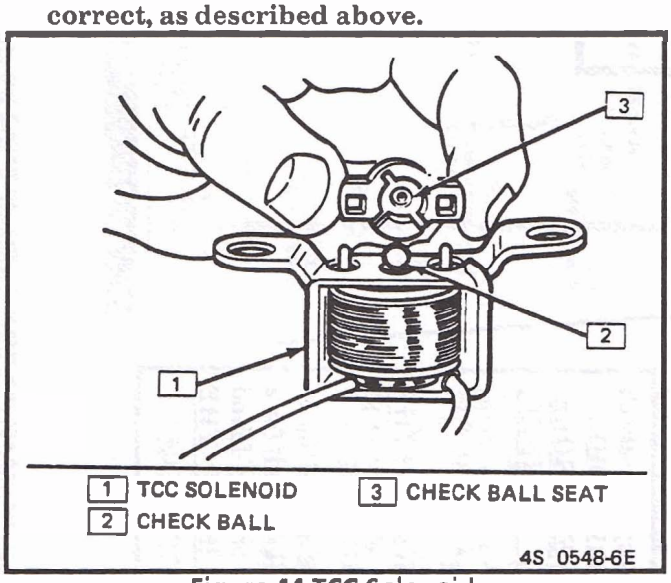


Figure 44 TCC Solenoid

The ECM controls the TCC apply solenoid by looking at several sensors:

- Vehicle Speed Sensor (VSS). Speed must be above a certain value before the clutch can apply.
- Coolant Temperature Sensor. Engine must be warmed up before clutch can apply.
- Throttle Position Sensor (TPS). After the converter clutch applies, the ECM uses the information from the TPS to release the clutch when the car is accelerating or decelerating at a certain rate.
- Another switch used in the TCC circuit is a brake switch which opens the 12 volt supply to the TCC solenoid when the brake is depressed.
- On 125C transmissions a third gear switch (normally open) is placed in series on the battery side of the TCC solenoid. This switch prevents TCC application until the transmission is in third gear. Then the switch closes, completing the circuit to the ECM.

Results of Incorrect Operation

If the converter clutch is applied at all times, the engine will stall immediately, just as in a manual transmission with the clutch applied.

If the converter clutch does not apply, fuel ecomony may be lower than expected. If the Vehicle Speed Sensor fails, the TCC will not apply.

The Transmission Converter Clutch (TCC) system has different operating characteristics than an automatic transmission without TCC. If the driver complains of a "chuggle" or "surge" condition, the car should be road tested and compared to a similar car to see if a real problem exists. Another TCC complaint may be a downshift felt when going up a grade, especially with cruise control. This may be clutch disengagement rather than a downshift, due to the change in TPS to maintain cruising speed.

DIAGNOSIS

The diagnosis of the TCC system is covered in CHART C-8 . If the ECM detects a problem in the VSS system, a code 24 should set. In this case see CODE 24 CHART.

If the ECM doesn't switch the TCC on when it should,sensors such as coolant, speed, and throttle position should be checked.

ON-CAR SERVICE

- See Section 7 for TCC Solenoid.
- See Section 8B for VSS (IP mounted) and brake system.

PARTS INFORMATION

PART NAME	GROUP
Sensor, Vehicle Speed	9.761
Solenoid, TCC	4.122

CHART C-8
TRANSAXLE CONVERTER CLUTCH (TCC)

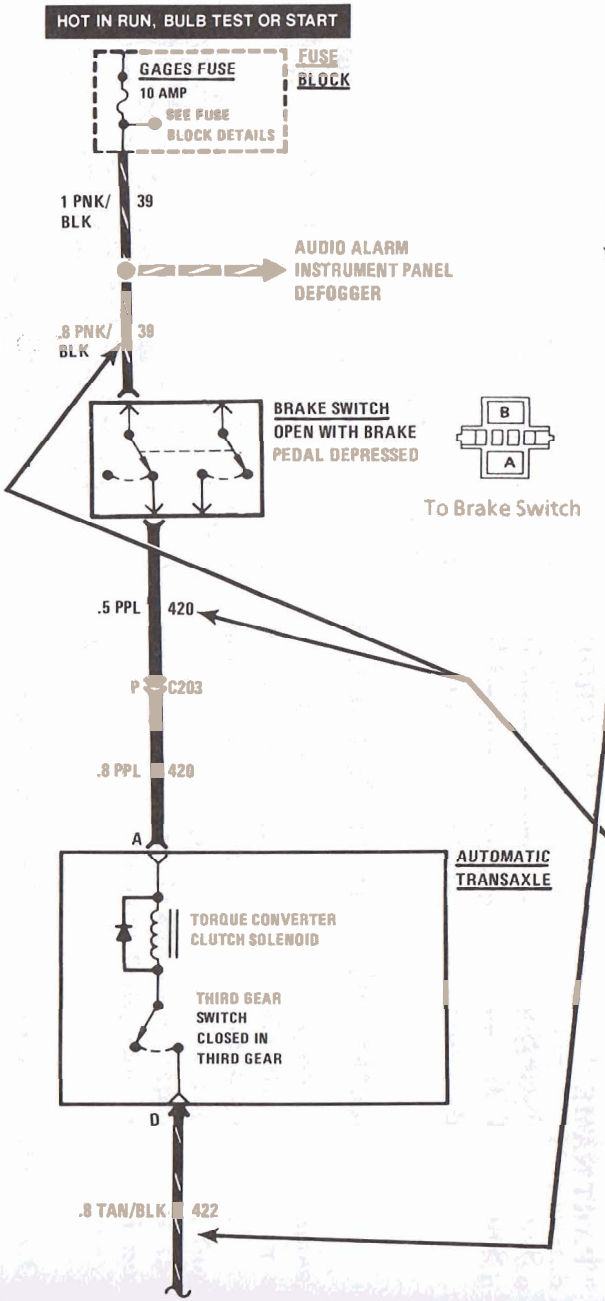
The TRANSAXLE CONVERTER CLUTCH (TCC) eliminates power loss by engaging the CLUTCH when the vehicle is cruising. The TCC will engage when:

- The engine is at normal operating temperature.
- Vehicle speed is above a specified value.
- The THROTTLE POSITION SENSOR output does not change.
- The transmission third gear switch is closed.
- The brake switch is closed (no pressure on brake pedal).

The ECM grounds the TCC solenoid to engage the clutch. 12 volts is supplied to the TCC solenoid from the gages fuse through the BRAKE SWITCH and the THIRD GEAR SWITCH.

Solenoids and relays are turned on and off by ECM internal switches called "drivers." Each driver is part of a group of four called "Quad-drivers." Failure of one can damage any other driver in the set.

1 Make mechanical checks such as linkage, oil level, etc. before starting the electrical diagnosis.



7 If the test light does not glow then check ECM control of the TCC Solenoid.

With the engine stopped and the ignition "ON," connect a test light to 12 volts and probe terminal F of the ALCL connector.

b. Note the test light. Go to c or d.

c. If the test light does not glow then check for an open in circuit 422 (tan/black). If no open is found then **THE FAULT IS IN THE ECM.**

d. If the test light glows then check:

- Coolant level.
- Faulty or incorrect thermostat. Engine temperature should be above 70°C (158°F).
- VSS, Code 24. **REFER TO THE CHART FOR CODE 24 IF THE SPEEDOMETER IS NOT WORKING.**
- Check for correct PROM. If no trouble is found then review the symptoms and **REFER TO SECTION B.**

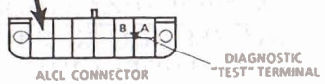
8 If the test light does not glow then check for an open in circuits 420 (purple) and 39 (pink/black).

a. Check for a blown fuse.

b. If the fuse is good then with the engine stopped and the ignition "ON," connect a test light to terminals A or D of the TCC harness connector. Note the test light. Go to step 9 or 10.

2 Check the THIRD GEAR SWITCH.

a. Check that the engine is at normal operating temperature and is operating in "closed loop."
b. Raise the drive wheels.
c. Connect a test light between terminal F of the ALCL connector and ground.
d. Start and idle the engine in Park. Do not depress the brake pedal. Note the test light. Go to step 3 or 4.



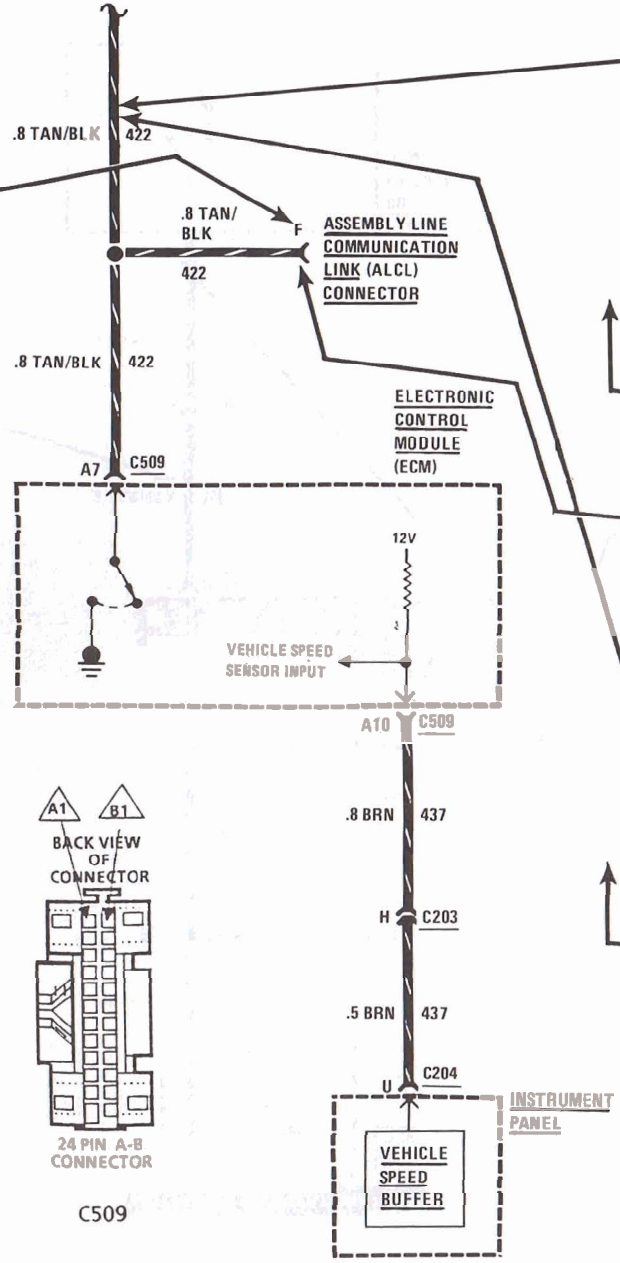
3 If the test light comes on then **THE FAULT IS IN THE TRANSMISSION THIRD GEAR SWITCH.**

4 If the test light does not come on then check for battery voltage and a closed BRAKE SWITCH.

a. Place the transmission in Drive.
b. Increase speed above 25 mph to close the TRANSMISSION THIRD GEAR SWITCH.
c. Note the test light. Go to step 5 or 8.

5 If the light glows then depress the brake pedal and note the test light. Go to step 6 or 7.

6 If the test light continues to glow then adjust the brake switch.



9 If the test light glows then check for a short to ground in circuit 422 (tan/black). If no short to ground is found then **THE FAULT IS IN THE ECM.**

10 If the test light does not glow then connect the test light from terminal A of the TCC harness connector to ground. Note the test light. Go to a or b.

a. If the test light does not glow then **THE FAULT IS IN THE TCC BRAKE SWITCH.**
b. If the test light glows then connect the test light between terminals A and D of the TCC harness connector.
c. Ground terminal F of the DIAGNOSTIC CONNECTOR.
d. Note the test light. Go to step 11 or 12.

11 If the test light does not glow then **FIND AN OPEN IN CIRCUIT 422 (pink/black) BETWEEN THE DIAGNOSTIC TERMINAL AND THE TCC SOLENOID.**

12 If the test light glows then **THE FAULT IS IN THE THIRD GEAR SWITCH, THE TCC SOLENOID, OR THE TCC SOLENOID CONNECTOR.**

Before replacing the ECM, check the coil resistance of all solenoids and relays controlled by the ECM.

Reconnect all connectors. Clear all codes. Confirm "closed loop" operation and no "CHECK ENGINE" light.

CHART C-8B
SHIFT LIGHT

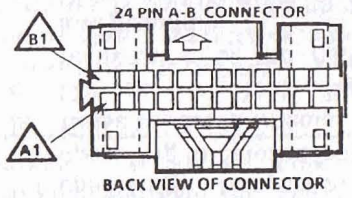
The SHIFT LIGHT indicates the best transmission shift point for maximum fuel economy. The ECM grounds circuit 456 (tan/black) to control the SHIFT LIGHT.

1 With the engine stopped and the ignition "ON," note the SHIFT LIGHT. It should be off. Go to step **2** or **3**.

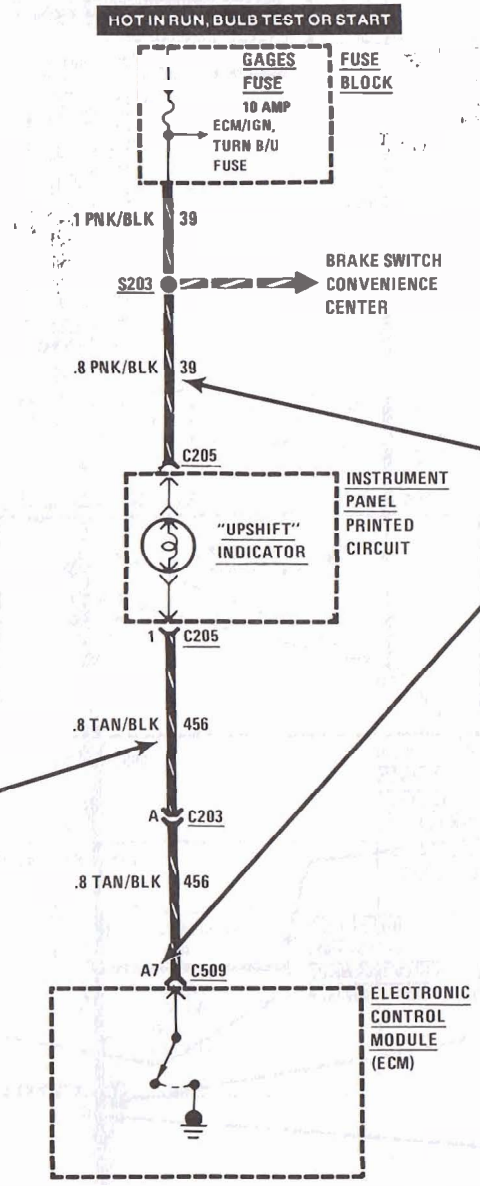
2 If the SHIFT LIGHT is on then **DISCONNECT BLUE ECM CONNECTOR C509** and note the SHIFT LIGHT. Go to **a** or **b**.

a. If the SHIFT LIGHT remains on then **FIND A SHORT TO GROUND IN CIRCUIT 456 (tan/black).**

b. If the SHIFT LIGHT goes off then **THE FAULT IS IN THE ECM.**



3 If the SHIFT LIGHT is off then ground the DIAGNOSTIC TERMINAL and note the SHIFT LIGHT. Go to step **4** or **5**.



4 If the SHIFT LIGHT goes on then check for a faulty THERMOSTAT or a THERMOSTAT with an incorrect heat range. If the THERMOSTAT is correct then **REFER TO THE CHART FOR CODE 24, VEHICLE SPEED SENSOR.**

5 If the SHIFT LIGHT remains off then check the bulb. If the bulb is good then back probe pin A7 of the blue ECM connector, **C509** with a test light to 12 volts. Go to step **6** or **7**.

6 If the test light glows then check for an open in circuit 456 (tan/black) or circuit 39 (pink/black).

7 If the test light does not glow then **THE FAULT IS IN THE ECM OR ITS CONNECTOR.**

Reconnect all connectors. Clear all codes. Confirm "closed loop" operation and no "CHECK ENGINE" light.

BLANK

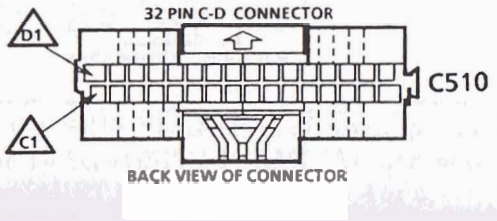
CHART C-10
A/C CLUTCH CONTROL

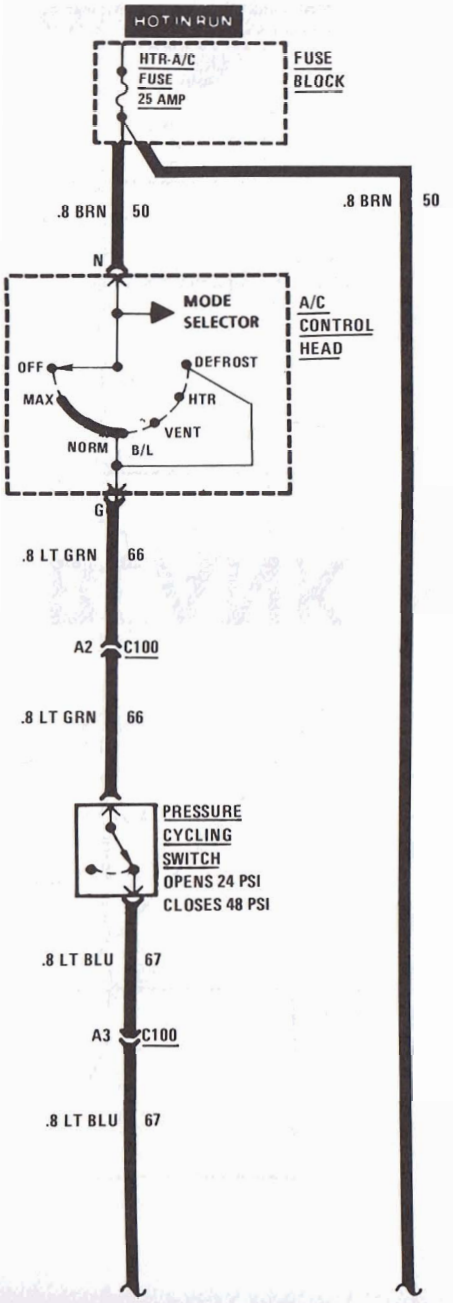
ECM control of the A/C COMPRESSOR CLUTCH improves idle quality and performance by:

- delaying clutch application for about ½ second until the idle air flow rate is increased.
- providing additional fuel when the clutch is applied.
- releasing the clutch when the idle air flow rate is too low.
- releasing the clutch at wide open throttle.

The ECM turns on the A/C COMPRESSOR CLUTCH by grounding the coil of the A/C CLUTCH CONTROL RELAY. The relay contacts then close to apply battery voltage to the clutch. The ECM opens this ground path to turn the compressor off.

The ECM closes this ground path when battery voltage is present at the A/C-ON input. Both the MODE SELECTOR and the PRESSURE CYCLING SWITCH must be closed (calling for cooling) for this voltage to be present on the A/C input.





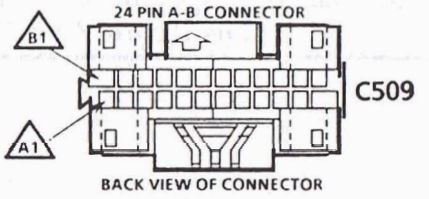
IF THE SYMPTOM IS "NOT ENOUGH COOLING," CHECK OUT THE ENTIRE A/C SYSTEM AS FOLLOWS:

A. Operate the HOT-COLD control on the A/C CONTROL HEAD. Move it rapidly from one end to the other. You should hear the temperature door hit the stop at each end.

B. Check the blower and the air doors. **PERFORM THE SYSTEM CHECK ON PAGE 61-2 OF SECTION 8A.**

C. With the engine idling, turn on the A/C and note the A/C Compressor Clutch.
   - If the clutch engages, the electrical circuits are good.
   - If the clutch does not engage, perform the electrical diagnosis starting with step 1

D. With the compressor running feel the high side (hot) and suction (cold) pipes of the compressor. If there is no temperature difference, **REFER TO SECTION 1B** to check for a compressor or refrigerant problem.

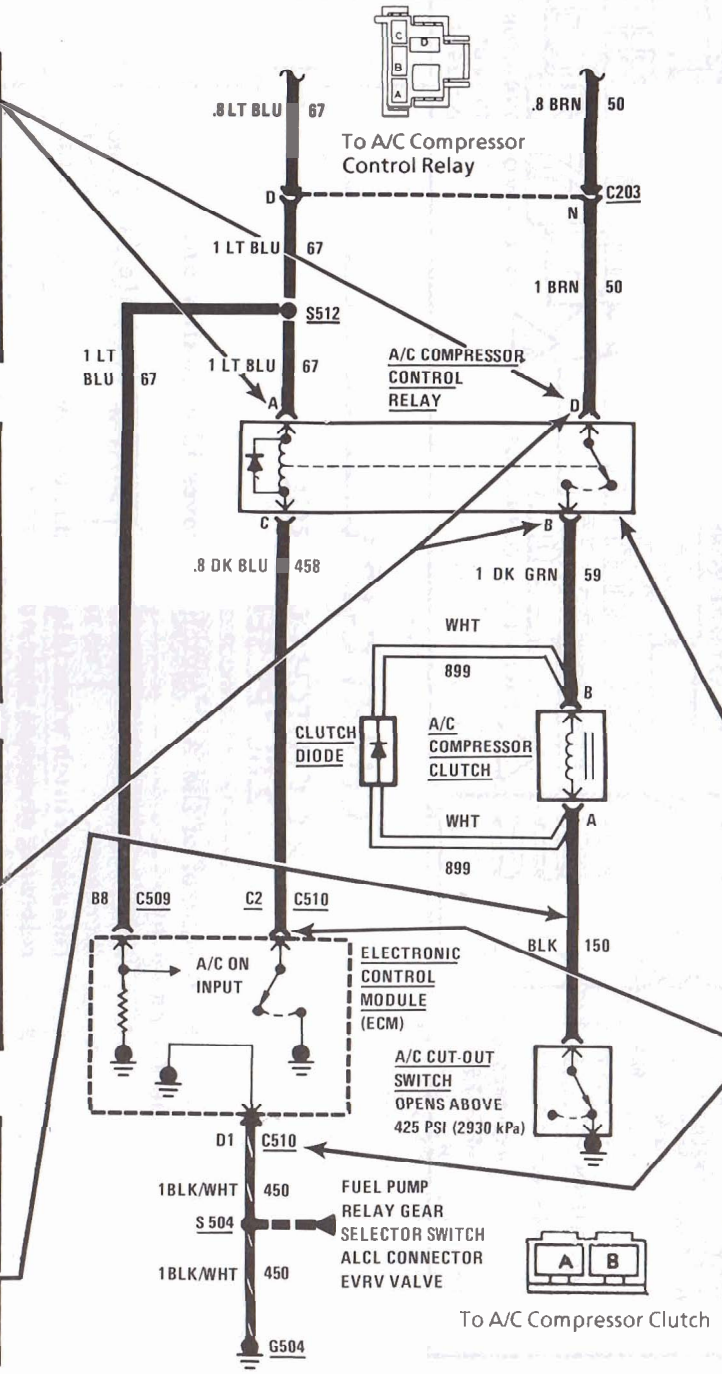


1 Check for battery voltage at terminals A and D of the relay connector.
- a. **DISCONNECT THE A/C COMPRESSOR CONTROL RELAY CONNECTOR.**
- b. With the engine off and the ignition "ON," place the Mode Selector in "Norm." Check for voltage. Go to **2** or **3**.

2 If voltage is not present then troubleshoot the wiring and switches back to the fuse.
- a. If the HTR-A/C fuse is blown, check for a shorted CLUTCH DIODE with an ohmmeter. If the diode is shorted the resistance across the compressor clutch will be zero or low in both directions.

3 If the voltage is good then check for A/C COMPRESSOR CLUTCH operation.
- a. Connect a fused jumper between terminals B and D of the A/C COMPRESSOR CONTROL RELAY Connector (still disconnected). Note the A/C COMPRESSOR CLUTCH. The Clutch should engage. Go to **4** or **5**.

4 If the Clutch does not engage then check the circuit to ground through the A/C COMPRESSOR CLUTCH and the A/C CUT-OUT SWITCH, circuits 59 (dark green) and 150 (black).
- a. If the ground circuit is good install a new A/C COMPRESSOR CLUTCH.



5 If the Clutch engages then check the operation of the A/C COMPRESSOR CONTROL RELAY.
- a. **RECONNECT THE A/C COMPRESSOR CONTROL RELAY CONNECTOR.**
- b. Connect a fused jumper from terminal C of the A/C COMPRESSOR CONTROL RELAY Connector to ground.
- c. With the engine stopped and the ignition "ON," place the Mode Selector in "NORM." Note the A/C COMPRESSOR CLUTCH. The A/C COMPRESSOR CONTROL RELAY should operate and the Clutch should engage. Go to **6** or **7**.

6 If the Relay does not operate then install a new A/C COMPRESSOR CONTROL RELAY.

7 If the Relay is good then check for correct voltages and ground at the ECM.
- a. With the engine stopped and the ignition "ON," check the baattery voltage at terminal B8 of blue ECM connector, C509 and at terminal C2 of gray ECM connector, C510.
- b Check for ground at terminal D1 of gray ECM connector, C510.
- c If the voltages and the ground are good then **THE FAULT IS IN THE ECM.**

Reconnect all connectors. Clear all codes. Confirm "closed loop" operation and no "CHECK ENGINE" light.

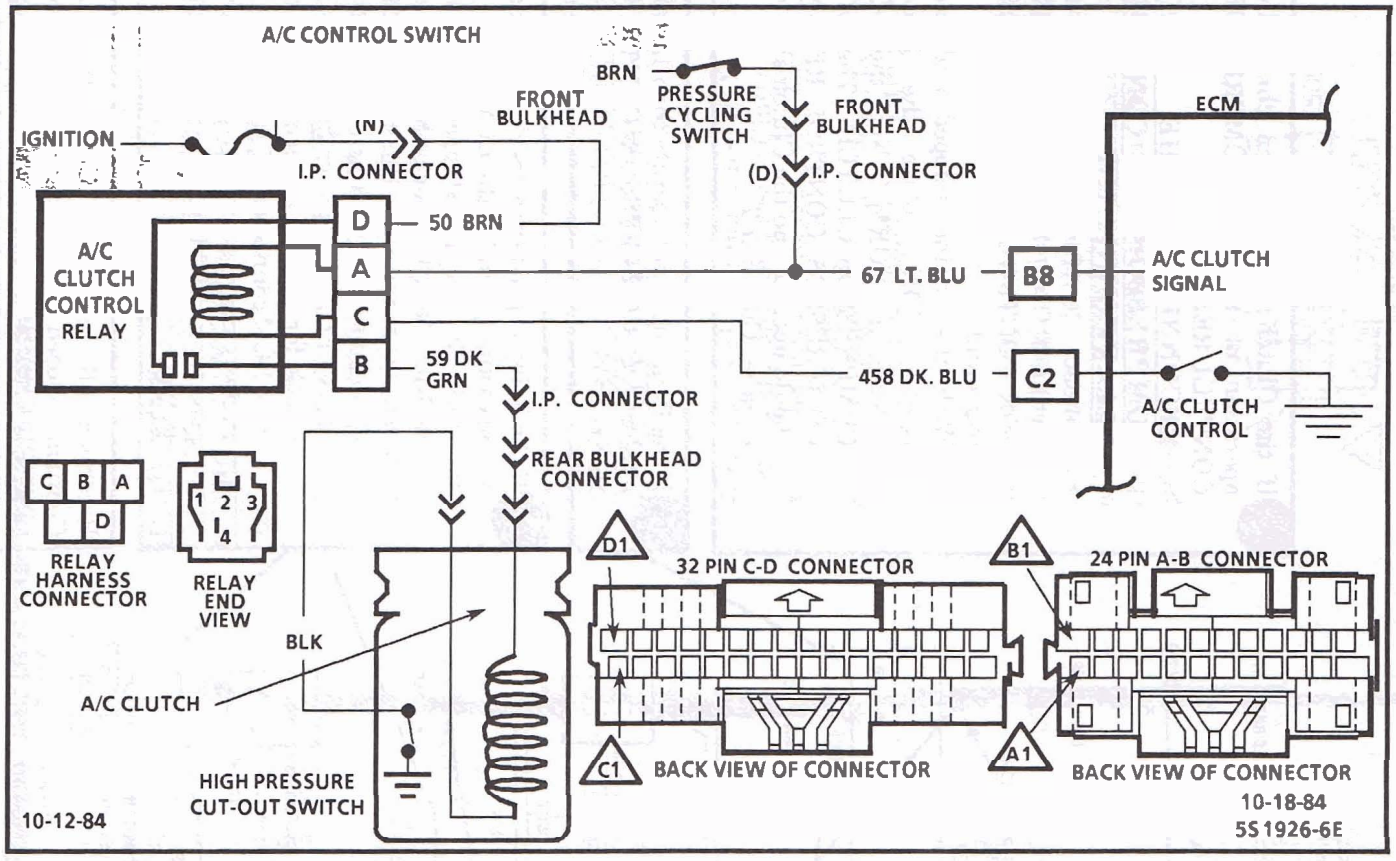


CHART C-10A

A/C CLUTCH CONTROL 2.8L "P" SERIES

ECM control of the A/C clutch improves idle quality and performance by;

- delaying clutch apply until the idle air rate is increased.
- releasing clutch when idle speed is too low.
- releasing clutch at wide open throttle.
- smooths cycling of the compressor by providing additional fuel at the instant clutch is applied.

Ignition is supplied directly to the A/C Clutch Control relay on CKT 50. When the A/C is turned on, voltage is supplied to the A/C relay coil on CKT 67 through the closed pressure cycling switch. This same voltage is supplied as a signal to ECM pin B8. After a time delay of about 1/2 second the ECM will ground terminal C2, CKT 458, and close the A/C relay.

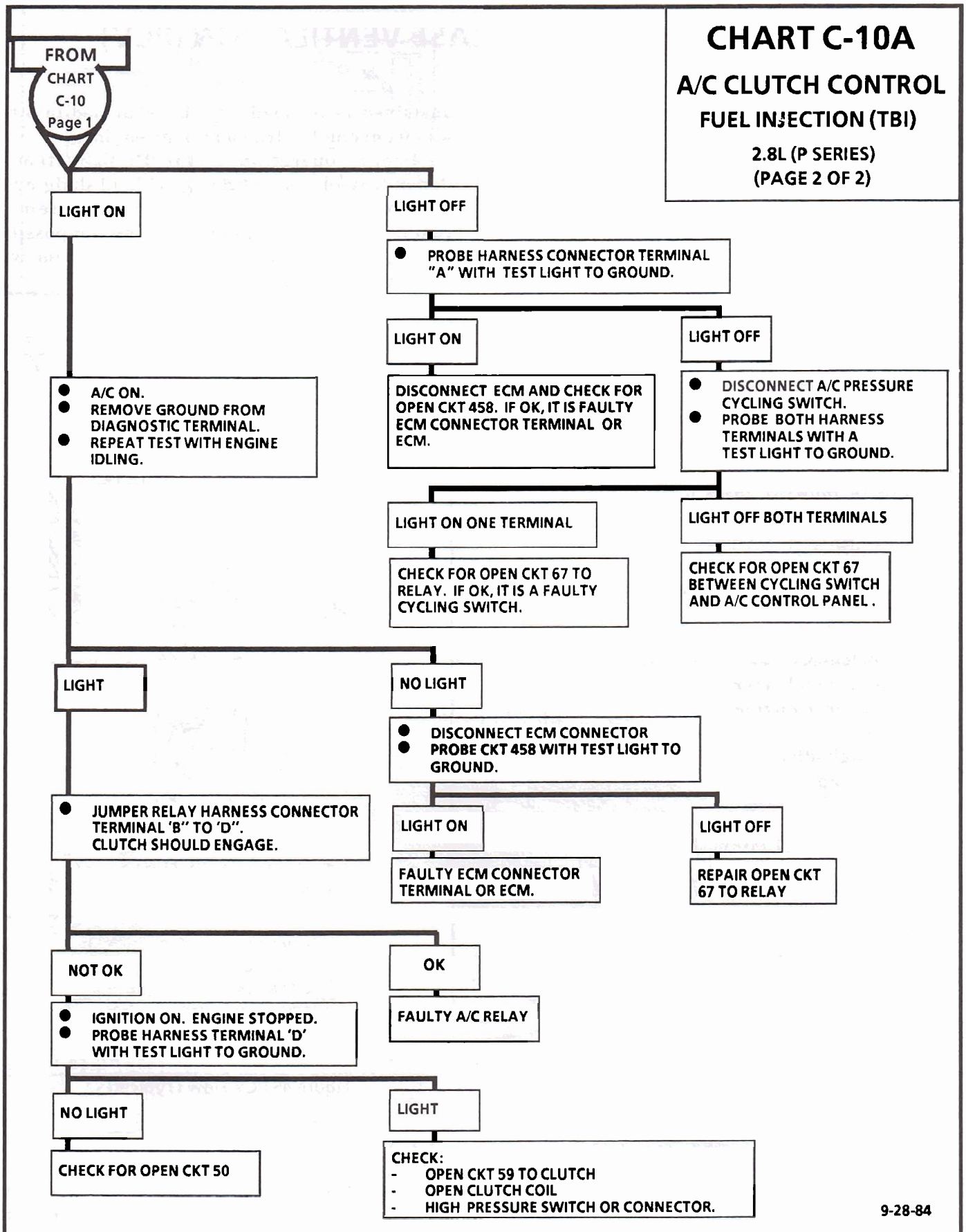
When relay is energized battery voltage from CKT 50 is supplied to the A/C clutch through the relay and CKT 59.

CHART C-10A

A/C CLUTCH CONTROL

FUEL INJECTION (TBI)

2.8L (P SERIES)
(PAGE 2 OF 2)



9-28-84

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "CHECK ENGINE" LIGHT.

4S 1330-6E

POSITIVE CRANKCASE VENTILATION (PCV)

GENERAL DESCRIPTION

A Positive Crankcase Ventilation (PCV) system is used to provide more complete scavenging of crankcase vapors. Fresh air from the air intake duct is supplied to the crankcase, mixed with blow-by gases and then passed through a positive crankcase ventilation (PCV) valve into the Air Plenum (Figure 45).

The primary control is through the PCV valve (Figure 46) which meters the flow at a rate depending on manifold vacuum.

To maintain idle quality, the PCV valve restricts the flow when intake manifold vacuum is high. If abnormal operating conditions arise, the system is designed to allow excessive amounts of blow-by gases to back flow through the crankcase vent tube into the air cleaner to be consumed by normal combustion.

Results of Incorrect Operation

- A plugged valve or hose may cause:
  - Rough idle.
  - Stalling or slow idle speed.
  - Oil leaks.
  - Oil in air cleaner.
  - Sludge in engine.

A leaking valve or hose would cause:

- Rough idle.
- Stalling.
- High idle speed.

DIAGNOSIS

FUNCTIONAL CHECK OF PCV VALVE

If an engine is idling rough, check for a clogged PCV valve or plugged hose. Replace as required. Use the following procedure:

1. Remove PCV valve from rocker arm cover.
2. Run the engine at idle.
3. Place your thumb over end of valve to check for vacuum. If there is no vacuum at valve, check for plugged hoses or manifold port, or PCV valve. Replace plugged or deteriorated hoses.
4. Turn off the engine and remove PCV valve. Shake valve and listen for the rattle of check needle inside the valve. If valve does not rattle, replace valve.

With this system, any blow-by in excess of the system capacity (from a badly-worn engine, sustained heavy load, etc.) is exhausted into the air cleaner and is drawn into the engine.

Proper operation of the PCV System is dependent upon a sealed engine. If oil sludging or dilution is noted, and the PCV System is functioning properly, check engine for possible cause and correct to ensure that system will function as intended.

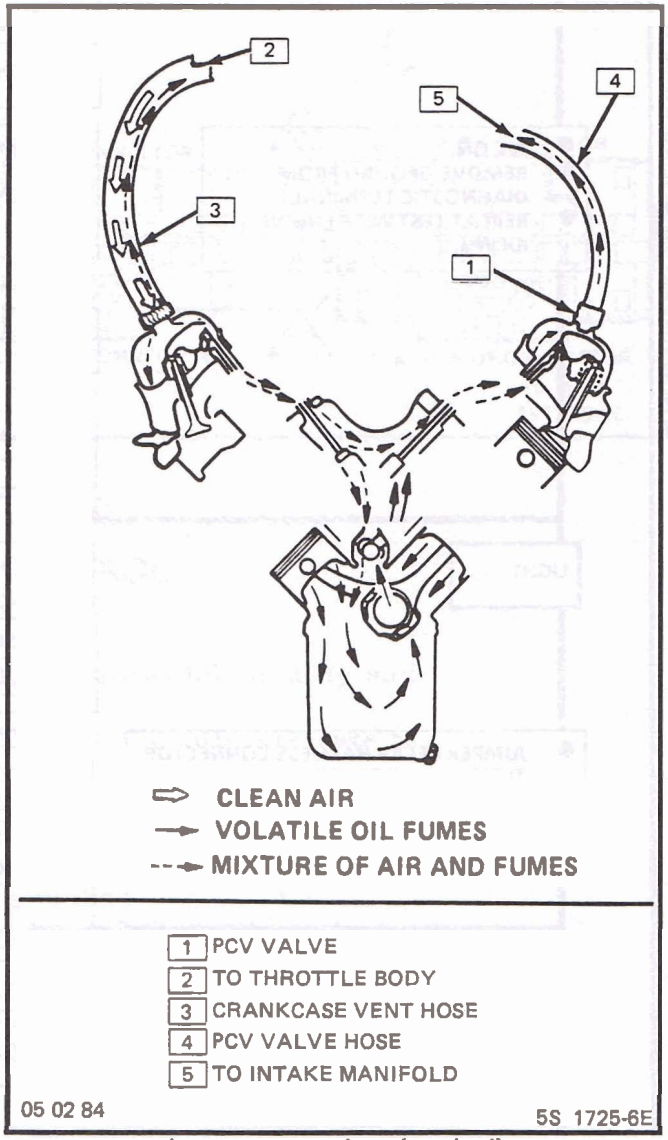


Figure 45 PCV Flow (Typical)

ON-CAR SERVICE

An engine which is operated without any crankcase ventilation can be damaged. Therefore, it is important to replace the PCV valve and air cleaner breather at intervals shown in Section OB.

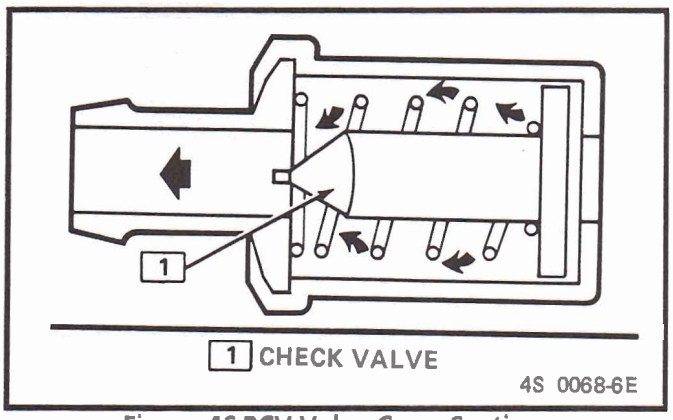


Figure 46 PCV Valve Cross Section

Periodically, inspect the hoses and clamps and replace any showing signs of deterioration.

PARTS INFORMATION

PART NAME	GROUP
Air Cleaner	3.402
Valve Asm, C/Case Vent	1.745
Tube, C/Case Vent	1.762
Hose, C/Case Vent Valve	11.162

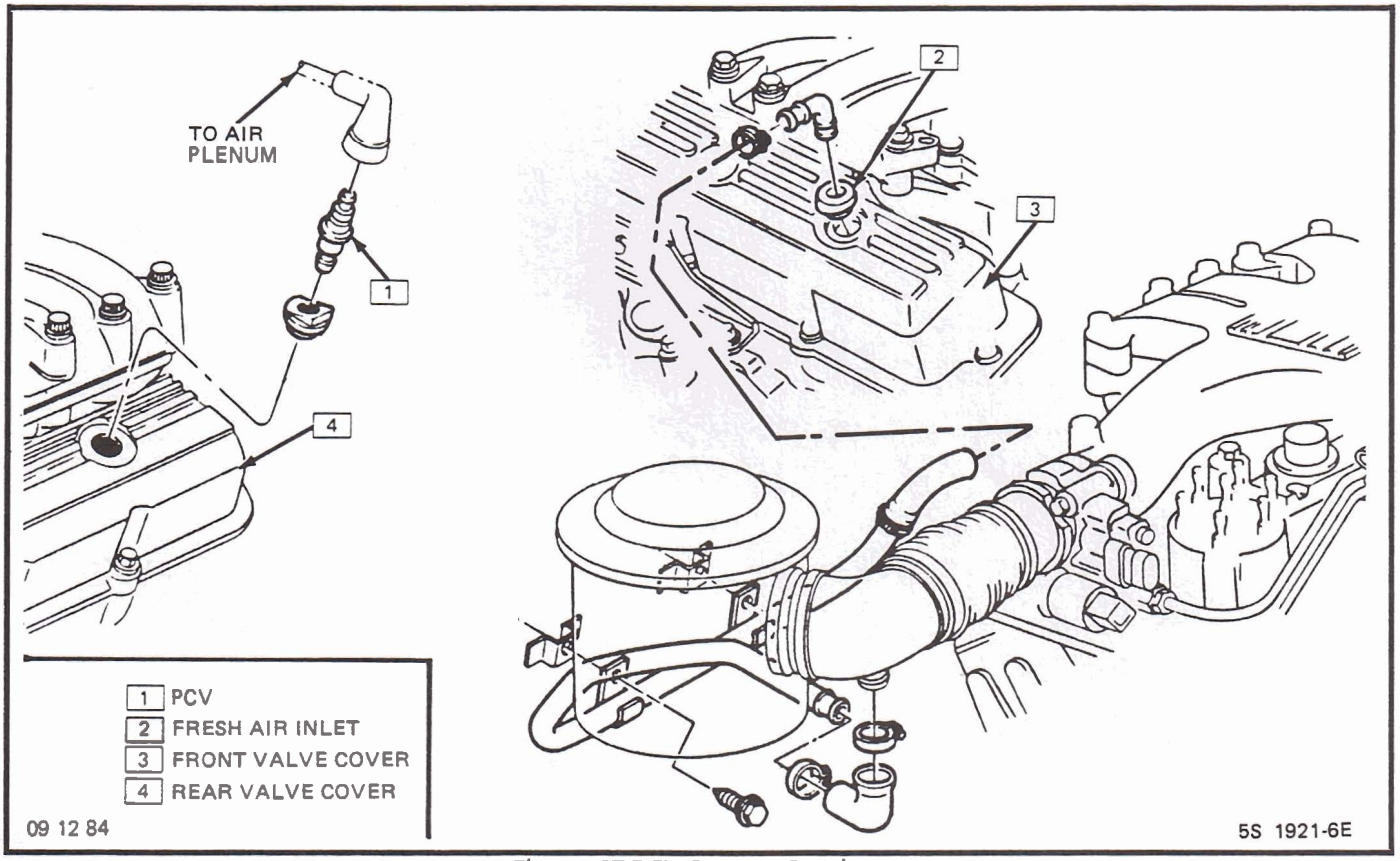


Figure 47 PCV System Service