SECTION 6E
DRIVEABILITY AND EMISSIONS
CONTENTS

General Information - Section 6E
Driveability and Emissions - Fuel Injected (TBI) - Section 6E2
Driveability and Emissions - Fuel Injected (PORT) - Section 6E3

6E CONTENTS

DRIVEABILITY

The driveability diagnosis procedures apply to various systems in current GM vehicles. The procedures assume that the vehicle worked right at one time and the problem is due to time, wear, dirt or other causes. Start with the introduction that follows. This will describe a systematic diagnostic procedure.

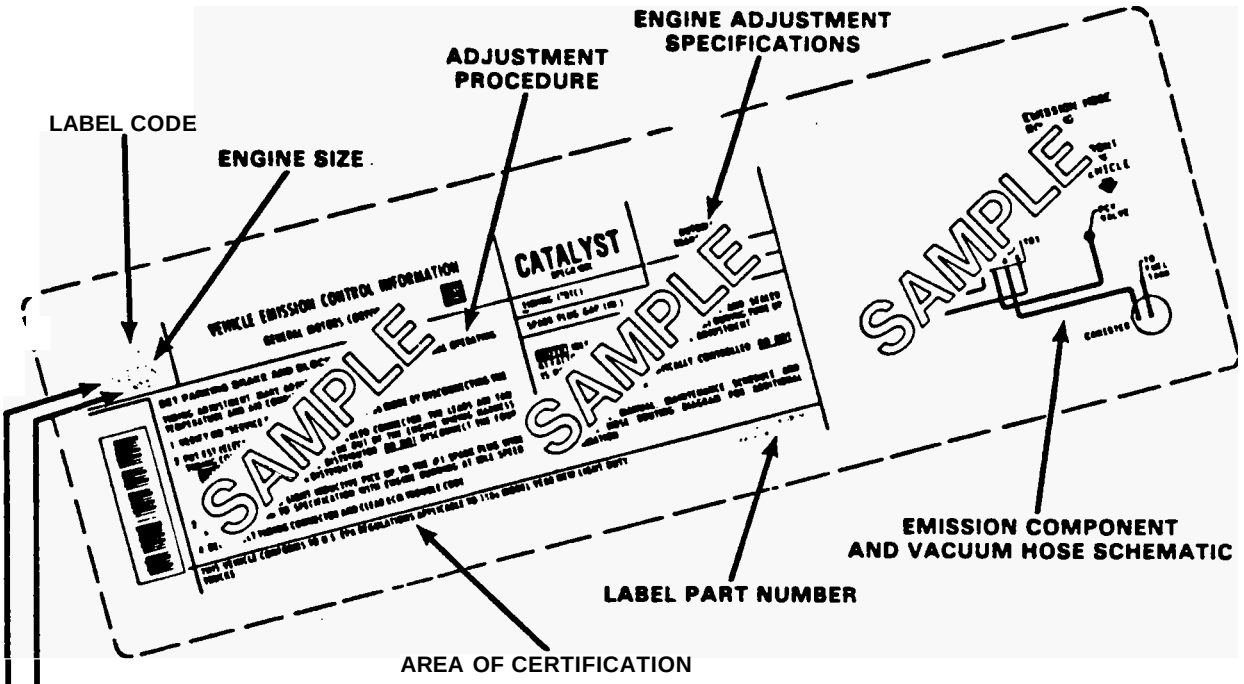
Any system disconnected during diagnosis should be reconnected. This includes wires, hoses, linkage, etc. When removing air cleaner, plug hose fittings that could cause an air leak.

EMISSIONS

The exhaust emission control systems used on General Motors engines perform a specific function to lower exhaust emissions while maintaining good fuel economy and driveability.

MAINTENANCE SCHEDULE

Refer to the General Motors Maintenance Schedule in Section 0B of the Chassis Service Manual for the maintenance service that should be performed to retain emission control performance.



"ALWAYS REFER TO THE VEHICLE EMISSION CONTROL INFORMATION LABEL FOR THE CORRECT AND MOST CURRENT SPECIFICATIONS".

EVAPORATIVE EMISSION SYSTEM

EXHAUST EMISSION SYSTEM

CHECK SUM DIGIT

Engine Family Suffix Code

CATALYST DESCRIPTION

DIVISION
1G = Chevrolet
2G = Pontiac
3G = Oldsmobile
4G = Buick
6G = Cadillac

DISPLACEMENT
Liters. Largest if more than one

VEHICLE CLASS AND STANDARDS
V = Gasoline Vehicle
W = Calif Std Gasoline Vehicle
T = Gasoline Truck
D = Diesel Vehicle
E = 100K Calif Std Diesel Vehicle
K = Diesel Truck

FUEL METERING
1 = 1bbl
2 = 2bbl
4 = 4bbl
5 = TBI
7 = MFI
8 = PFI
9 = PFI Turbo

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Figure 1 Vehicle Emission Control Information Label

VEHICLE EMISSION CONTROL INFORMATION LABEL

The Vehicle Emission Control Information label (Fig. 1) contains important emission specifications and setting procedures. In the upper left corner is exhaust emission information which identifies the year, the manufacturing division of the engine, the displacement in liters of the engine, the class of vehicle and type of fuel metering. Also there is an illustrated emission component and vacuum hose schematic. This label is located in the engine compartment of every General Motors Corporation vehicle. If the label has been removed, it can be ordered from the parts division (WDDGM).

INTRODUCTION

Electronic Engine Control

All engines have an Electronic Control Module (ECM) to control the fuel system. The ECM varies the air/fuel ratio by controlling the fuel flow through the injector(s).

In addition, the ECM controls the ignition timing, fuel pump, and various other systems.

It is important to review the component sections and wiring diagrams in section 6E2 and 6E3 for a specific engine to determine what is controlled by the ECM and what systems are non-ECM controlled.

What this section contains

Each General Motors engine has system controls to reduce exhaust emissions while maintaining good driveability and fuel economy.

This Section explains:

- How to use the Driveability and Emission Section 6E2 for TBI and 6E3 for Port Fuel engines.
- A brief description of systems used to control fuel and emissions.
- Abbreviations that are used in Driveability and Emissions.
- Wiring harness service information for harnesses used with the ECM.
- Special tools used to diagnosis and repair a system.

Before checking the system, adhere to the following information:

Blocking Drive Wheels

The vehicle drive wheels should always be blocked, and Parking Brake firmly set, while checking the system.

Cold Oxygen Sensor

On some engines, the oxygen sensor will cool off after only a short period of operation at idle. This will put the system into "Open Loop. To restore "Closed Loop" operation, run the engine at part throttle and accelerate from idle to part throttle a few times until the system goes "Closed Loop".

VISUAL/PHYSICAL UNDERHOOD INSPECTION

One of the most important checks that must be done as part of any diagnostic procedure is a careful visual/physical underhood inspection. This can often lead to fixing a problem without further steps. Inspect all vacuum hoses for correct routing, pinches, cuts, or disconnects. Be sure to inspect hoses that are difficult to see beneath the air cleaner, compressor, generator, etc. Inspect all the wires in the engine compartment for correct and good connections, burned or chaffed spots, pinched wires, or contact with sharp edges or hot exhaust manifolds. This visual/physical inspection is very important. It must be done carefully and thoroughly.

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, WHEREWER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

BASIC KNOWLEDGE REQUIRED

Before using this section of the Service Manual, there are some areas that you should be familiar with. Without this basic knowledge, you will have trouble using the diagnostic procedures contained in this section.

Basic Electric Circuits

You should understand the basic theory of electricity, and know the meaning of voltage, amps, and ohms. You should understand what happens in a circuit with an open or a shorted wire. You should be able to read and understand a wiring diagram. A short to ground is referred to as a ground to distinguish it from a short between wires.

Use of Circuit Testing Tools

You should know how to use a test light, how to connect and use a tachometer, and how to use jumper wires to by-pass components to test circuits. Care should be taken to not deform the terminal when testing.

Use of Digital Volt-Ohm Meter (DVOM)

You should be familiar with the Digital Volt-Ohm Meter, particularly essential tool J-29125-A,J34029A or equivalent. You should be able to measure voltage, resistance, and current and know how to use the meter correctly.

The Digital Volt-Ohm Meter is covered in the "Special Tools" portion of this section.

DIAGNOSTIC INFORMATION

The Electronic Control Module (ECM) is equipped with a self- diagnosis system which detects system failure and aids the technician by identifying the circuit at fault via a trouble code. Below is information about the way the ECM displays a problem and how this corresponds to a trouble code in the ECM. The ECM can also indicate an open or closed loop mode.

"SERVICE ENGINE SOON" Light

This light is on the instrument panel and has two functions:

- It is used to tell the driver that a problem has occurred, and that the vehicle should be taken for service as soon as reasonably possible.
- It is used by the technician to read out "Trouble Codes" to help diagnosis system problems.

As a bulb and system check, the light will come "ON" with the key "ON" and the engine not running. When the engine is started, the light will turn off. If the light remains on, the self-diagnostic system has detected a problem. If the problem goes away, the light will go out in most cases after 10 seconds, but a Trouble Code will remain stored in the ECM.

Intermittent "SERVICE ENGINE SOON" Light

The Diagnostic Charts in Section A are set up to check whether or not a stored trouble code is "intermittent" or "hard".

An "intermittent" code is one which does not reset itself, and is not present while you are working on the vehicle. The most probable cause for this is a loose connection. The facing page will contain diagnostic aids to help in detecting intermittents.

A "hard" code is one which is present when you are working on the vehicle and the condition still exists while working on the vehicle. The chart with the stored trouble code number will lead you to the cause of the problem.

Trouble Codes

The Electronic Control Module,(ECM), is really a computer. It uses sensors to look at many engine operating conditions. It has a memory and it knows what a certain sensor readings should be under certain conditions. These conditions are described on the facing page of each Trouble Code Chart. If a sensor reading is not what the ECM thinks it should be, the ECM will turn on the "SERVICE ENGINE SOON" light on the instrument panel, and will store a Trouble Code in the memory. The Trouble Code tells which CIRCUIT the trouble is in. A circuit consists of a sensor (such as coolant temperature), the wiring and connectors to it, and the ECM.

To get a Trouble Code out of the ECM, we use the Assembly Line Diagnostic Link (ALDL) connector.

ALDL Connector

The Assembly Line Diagnostic Link (ALDL) is a diagnostic connector located in the passenger compartment (Figure 2). It has terminals which are used in the assembly plant to check that the engine is operating properly before it leaves the plant. *Terminal "B" is the Diagnostic terminal, and it can be connected to terminal "A", or ground, to enter the Diagnostic mode, or the Field Service Mode.*

The ALDL Connector is also used by "SCAN tools to read information from the ECM via the Serial Data Line. Serial Data information is used extensively throughout the manual.

Diagnostic Mode

If the Diagnostic terminal is grounded with the ignition "ON" and the engine stopped, the system will enter the Diagnostic Mode. In this mode the ECM will:

1. Display a code **"12"** by flashing the "SERVICE ENGINE SOON" light (indicating the system is operating). A code **"12"** consists of one flash, followed by a short pause, then two flashes in quick succession. This code will be flashed three times. If no other codes are stored, code **12** will continue to flash until the Diagnostic terminal is ungrounded.

Codes can only be obtained with the engine stopped. Grounding the Diagnostic terminal with the engine running gives the "field service mode" described below.

2. Display any stored trouble codes by flashing the "SERVICE ENGINE SOON" light. Each code will be flashed three times, then code **"12"** will be flashed again. If a trouble code is displayed, a Diagnostic Code Chart is to used to find the problem. The chart will determine if the problem exists (hard failure) ,or is intermittent.

3. Energize all ECM controlled relays and solenoids except fuel Pump Relay.
4. The IAC valve also moves to the fully extended position.

Field Service Mode

If the Diagnostic terminal is grounded with the engine running, the system will enter the Field Service mode. In this mode, the "SERVICE ENGINE SOON" light will show whether the system is in Open or Closed Loop.

In Open Loop the "SERVICE ENGINE SOON" light flashes two and one-half times per second.

In "Closed Loop", the light flashes once per second: Also, in "Closed Loop", the light will stay OUT most of the time if the system is too lean. It will stay ON most of the time if the system is too rich.

While the system is in Field Service Mode, the ECM will be in the following mode:

1. New trouble codes cannot be stored in the ECM.
2. The closed loop timer is bypassed.

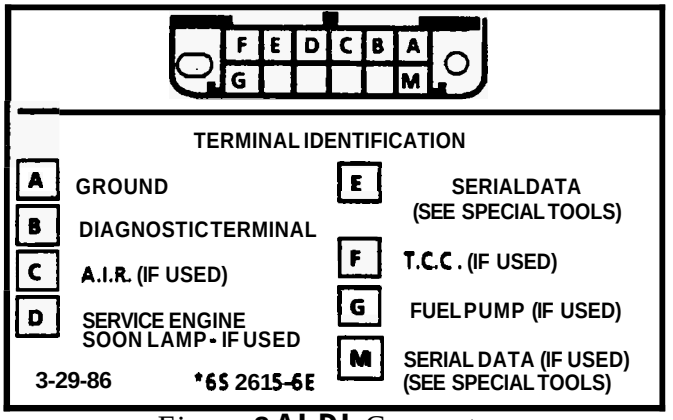


Figure 2 ALDL Connector

Clearing Trouble Codes

When the ECM sets a trouble code, the "SERVICE ENGINE SOON" light will come "ON" and a trouble code will be stored in memory. If the problem is intermittent, the light will go out after 10 seconds, when the fault goes away. However, the trouble code will stay in the ECM memory until the battery voltage to the ECM is removed. Removing battery voltage for 30 seconds will clear all stored trouble codes.

Trouble Codes should be cleared after repairs have been completed. Also, some Diagnostic Charts will tell you to clear the codes before using the chart. This allows the ECM to set the code while going thru the chart, which will help to find the cause of the problem more quickly.

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

ECM Learning Ability

The ECM has a "learning" ability which allows it to make corrections for minor variations in the fuel system to improve driveability. If the battery is disconnected to clear diagnostic codes, or for repair, the "learning" process has to begin all over again. A change may be noted in the vehicle's performance. To "teach" the vehicle, make sure the engine is at operating temperature, and drive at part throttle, with moderate acceleration and idle conditions, until normal performance returns.

DRIVEABILITY AND EMISSIONS SECTION 6E2 and 6E3 SUMMARY

The Driveability and Emissions Sections are subdivided into three sub sections:

SECTION A: STARTING POINT AND CODE CHARTS
- Diagnostic circuit check (Starting Point)
- No-start and fuel system check charts
- Code Charts

SECTION B: SYMPTOMS

Based on driveability symptoms, when no codes, or intermittent codes, are stored.

SECTION C: COMPONENT SYSTEMS
- Circuit descriptions
- On-car service
- Functional check/Diagnosis charts

SECTION "A"

Diagnostic Procedure Summary

This is the starting point for the diagnostic procedures. The diagnostic charts are related to the ECM and will determine if the ECM is working properly. This section diagnoses the fuel system controlled by the ECM and has charts to diagnosis a circuit when the ECM has displayed a trouble code.

The way to approach a problem is to follow three basic steps (shown in Figure 3):

1. Are the On-Vehicle Diagnostics working? We find this out by performing the "Diagnostic Circuit Check". Since this is the starting point for the diagnostic procedure, always begin here.

If the On-Vehicle Diagnostics aren't working, the "Diagnostic Circuit Check" will lead you to a chart in Section A to correct the problem. If the On-Vehicle Diagnostics are OK, the next step is:

2. Is there a Trouble Code stored? If a trouble code is stored, go directly to the numbered code chart in Section A. This will determine if the fault is still present. If no trouble code is stored, the third step is:

3. "Scan" Serial Data.
This involves reading the various piecies of information available on the Serial Data Stream with one of the tools available for that purpose. Information on these tools and the meaning of the various displays *can* be found in the succeeding paragraphs. Expected readings can be found on the facing page for the Diagnostic Circuit Check.

This procedure, which takes only a short time, will help lead you to repair the problem in the least amount of time.

ALOL "SCAN" TOOLS

The ALDL connector under the dash has a variety of information available on terminal "E" or "M" (depending on engine). There are several tools on the market for reading this information.

"SCAN" tools do not make the use of diagnostic charts unnecessary. They do not tell exactly where a problem is in a given circuit. However, with an understanding of what each position on the equipment measures, and knowledge of the circuit involved, the tools *can* be very useful in getting information which would be more time consuming to get with other equipment.

In some cases, *"SCAN"* Tools will provide information that is either extremely difficult or impossible to get with other equipment..

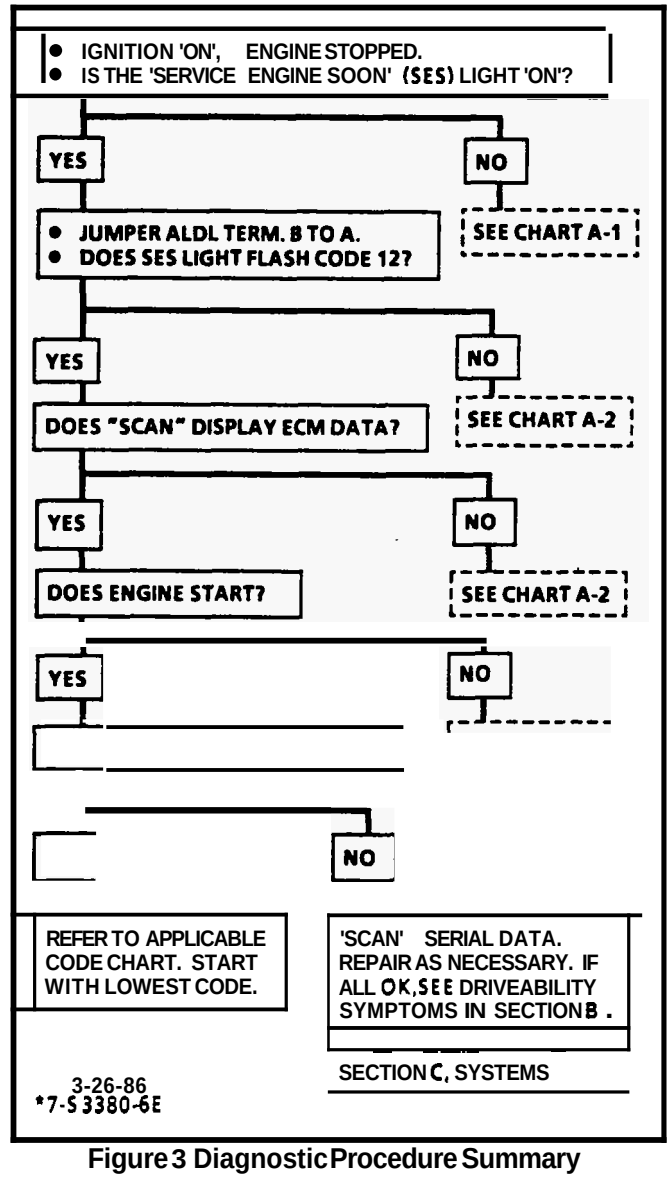


Figure 3 Diagnostic Procedure Summary

A "SCAN" TOOL THAT DISPLAYS FAULTY DATA SHOULD NOT BE USED AND THE PROBLEM SHOULD BE REPORTED TO THE MANUFACTURER. THE USE OF A FAULTY "SCAN" TOOL CAN RESULT IN MISDIAGNOSIS AND UNNECESSARY PARTS REPLACEMENT.

Trouble Tree Charts incorporate diagnosis procedures using an ALDL "SCAN" tool where possible.

Some ECMS have three modes for transmitting information but some only read data in the open mode.

The following information will describe each of the three modes where applicable and the affects they may cause.

Normal (Open) Mode

Not all engines and ECM families will transmit information on the Serial Data Line while in this mode.

On engines that can be monitored in the open mode, it allows certain parameters to be obtained without changing the engine operating characteristics. The parameters capable of being read vary from engine family to engine family. Most "SCAN" tools are programmed so that the system will go directly into the special mode if the "open" mode is not available.

ALDL (10K ,or Special) Mode (not used on all engines)

In this mode, all information incorporated into a specific engine and ECM is obtainable. However, in this mode the system operating characteristics are modified as follows.

- Closed loop timers are bypassed
- EST (spark) is advanced
- IAC will control engine idle to 1000 rpm ± - 50 RPM.
- On some engines, canister purge solenoid will be enabled
- P/N restricted functions will be disabled

Factory Test (Back-up or 3.9 K) Mode

When in this mode, the ECM is operating on the fuel back-up logic and calibrated by the Calpak. The Calpak is used to control the fuel delivery if the ECM fails. This mode verifies that the back-up feature is OK. The parameters that can be read on a "SCAN" tool in this mode are not of much use for service.

"SCAN" TOOL LIMITATIONS AND USE

The "SCAN" tool allows a quick check of sensors and switches which are inputs to the ECM. However, on some applications the data update rate makes the tool not as effective as a voltmeter when trying to detect an intermittent which lasts for a very short time. However, the "SCAN" tool allows one to manipulate wiring harnesses or components under the hood while observing the "SCAN" readout. This helps in locating intermittents with the engine not running.

Intermittent Conditions

The "SCAN" tool is helpful in cases of intermittent operation. The tool can be plugged in and observed while driving the vehicle under the condition where the light comes "ON" momentarily, or the engine driveability is poor momentarily. If the problem seems to be related to certain areas that can be checked on the "SCAN" tool, then those are the positions that should be checked while driving the vehicle. If there does not seem to be any correlation between the problem and any specific circuit, the "SCAN" tool can be checked on each position, watching for a period of time to see if there is any change in the readings that indicates intermittent operation.

The "SCAN" tool is also a useful and quick way of comparing operating parameters of a poorly operating engine with a known good one. For example; A sensor may shift in value but not set a code. Comparing with a known good vehicle may uncover the problem.

The "SCAN" tool has the ability to save time in diagnosis and prevent the replacement of good parts. The key to using the "SCAN" tool successfully for diagnosis lies in the technicians ability to understand the system he is trying to diagnose as well as an understanding of the "SCAN" tool's limitations. Therefore, the technician should read the tool operating manual to become familiar with the tool. The following information will describe most of the "SCAN" tool positions and how they can be helpful in diagnosis.

'SCAN' TOOL POSITIONS

The following positions may not be applicable to all engines. See the facing page of the diagnostic circuit check for a particular engine to decide which positions apply to engine being diagnosed.

Mode

Check with the manufacture to determine what the function of this mode is. In most cases it allows the user to place the ECM in different operating modes.

Injector Pulse Width

In this position, the reading is given in milliseconds which is the on time that the ECM is commanding to the injector(s).

Closed Loop/Open Loop

This position will indicate whether the engine control system is operating in open or closed loop. Most systems go closed loop after a certain amount of run time, when coolant temperature is high enough, and the oxygen sensor becomes active.

Trouble Codes

Will display any trouble codes stored in the ECM memory.

TPS (Throttle Position Sensor)

Values read will be the voltage as seen by the ECM. The voltage should be the TPS specification with the throttle closed and go up to about 5 volts with throttle wide open (WOT).

Throttle Angle

Displays in percent the amount the throttle is open.

Oxygen

The reading will be read out in millivolts (mv) with a range from 1 to 999 mv. If the reading is consistently below 350 (350 mv), the fuel system is running lean as seen by the ECM and if the reading is consistently above 550 (550 mv), the system is running rich.

PROM ID

In this position, information is used for assembly verification only. PROM ID is useful only when the vehicle is equipped with the original ECM and PROM or Mem-Cal.

RPM

Displays engine RPM. Often useful if extra reference pulses are suspected. A sudden high RPM indication while at a steady throttle would indicate electrical interference (EMI) in the reference circuit. This interference is usually caused by ECM wires too close to ignition secondary wires or an open distributor ground circuit.

MPH

Displays vehicle speed. Useful in Checking TCC lock up speed or speedometer accuracy.

MAF

Displays the amount of air passing the MASS AIRFLOW SENSOR (MAF) in grams per second. Useful when comparing the airflow between a problem vehicle and a known good one. Normal readings at idle are about 4 to 8 grams. If a code 33 Or 34 is set, this reading will display the ECM default value.

Airflow

This display should be the same as MAF when no failures in the MAF sensor circuit exist. When a code 33 or 34 is set however, this value will not move and will indicate the gm/sec that the failure has detected.

Coolant Temperature

Displays engine temperature in degrees centigrade. After engine is started the temperature should rise steadily to about 85-95° C then stabilize when the thermostat opens.

Manifold Air Temperature (MAT) Sensor

Displays temperature of the intake manifold air. Should read close to ambient air temperature when the engine is cold, and rise as underhood and engine temperature increases.

Manifold Absolute Pressure (MAP)

The MAP Sensor produces a low signal voltage when manifold pressure is low (high vacuum) and a high voltage when the pressure is high (low vacuum).

With the ignition on and the engine stopped, the manifold pressure is equal to atmospheric pressure and the signal voltage will be high. This information is used by the ECM as an indication of vehicle altitude and is referred to as BARO. Comparison of this BARO reading with a known good vehicle with the same sensor ** is a good way to check accuracy of a "suspect" sensor. Readings should be the same f.4 volt.

**MAP Sensors have a colored plastic insert visible in the connector cavity. Sensors with the same insert color are identical in calibration. The harness

electrical connector color should also be the same as the sensor insert color.

Baro

Displays the MAP reading before the engine was started. This value will vary depending on Barometric Pressure and altitude.

Park/Neutral Switch

The indication in this mode may vary with manufacturer so the type of reading for a particular tool should be checked in the operators manual. The important thing is that the the reading changes state (switches) when the gear selector is moved from park /neutral to drive or reverse.

Torque Convertor Clutch (TCC)

In this position, the tool will indicate when the TCC has been commanded by the ECM to turn on. This does not necessarily mean that the clutch was engaged but only that the ECM grounded the circuit internally. The best way to determine if the clutch has engaged is to monitor engine RPM when the TCC comes "on".

EGR (Duty Cycle)

The EGR system uses a valve to feed a small amount of exhaust gas back into the intake manifold to control formation of NOx. Like all ECM outputs the "SCAN" tool only indicates that the ECM has commanded the function and does not indicate that the function has really happened.

EGR Position

Indicates the position of the EGR pintle.

Integrator and Block Learn

On Fuel Injected Engines, normal readings for these positions are around 128, if higher, it indicates that the ECM is adding fuel to the base fuel calculation because the system is lean, and if the numbers are below 128 the ECM is taking out fuel from the base calculation because the system is rich. The integrator is short term corrective action while the block learn portion (which is a long term correction) will only change if the integrator has seen a condition which lasts for a calibrated period of time.

Block Learn Memory (BLM) Cell

There are from two to sixteen different cells which the ECM learns at depending on RPM and airflow or MAP. This parameter will display what cell the ECM is using for the fuel calculation at the time.

IAC (Idle Air Control)

This system is used to control engine idle speed to the desired RPM, for different operating conditions. In this mode, the numbers will indicate what position the ECM thinks the valve is in. The ECM moves the IAC in counts and these counts are are what is displayed on a *"SCAN"* tool.

Desired RPM

Indicates the RPM to which the ECM is trying to control the idle.

Shift Light

Displays "yes" when the ECM is commanding the shift light to turn "on".

PPSW

This is the voltage on the fuel pump feed circuit.

A/C Request

Displays the state of the A/C signal line to the ECM. Should read "yes" whenever the A/C is requested.

A/C Clutch

Displays "on" when the ECM has commanded the A/C Clutch "on".

Knock Retard

Indicates the number of degrees the ECM is retarding the Electronic Spark Timing.

Knock Signal

Displays a "yes" when knock is detected by the ECM and displays a "no" when knock is not detected.

AD Bat

Displays the battery voltage detected at the ECM ignition input.

Fan

Displays "on" when the cooling fan has been commanded "on".

CCP

Displays "on" when the Canister Purge Solenoid is commanding purge. Some display Duty Cycle from 0-100%.

3rd gear

Displays the state of the 3rd gear switch. Yes = 3rd gear.

4th gear

Displays state of the 4th gear switch. Yes = 4th gear.

Fan Request

Displays the state of the A/C Fan Control Switch. Should read "yes" when fan is requested.

Power Steering Pressure Switch

Displays the state of switch. This reading may vary with the tool used and the type of switch installed on the vehicle. The important thing is that the reading changes state (switches) when the steering is moved against the stops.

SECTION B - DRIVEABILITY SYMPTOMS

Always start with Section A "Diagnostic Circuit Check" before proceeding to the driveability symptoms. Section A checks the ECM which may cause the driveability problem. A definition of each symptom is included. This will then lead to the most probable causes of the driveability problem.

SECTION C - COMPONENT SYSTEMS

There are many component systems that are used to control fuel and emissions. Section C introduces each component system or control with a general description, diagnosis, and on- vehicle service.

Each of the Section C diagnosis sections will contain information on how the "Scan" tool can be used for diagnosing a particular component when a trouble code has not been set. (example: Section C-1 under diagnosis will explain how the "Scan tool" can be used for diagnosis as well as what the normal readings would be for the ECM Sensors.

Electronic Control Module (ECM)

This Section describes the ECM and the information sensors in the system. Figure 4 shows the operating conditions which the ECM may sense and the systems that the ECM may control (see specific engines to determine which are applicable to that engine).

Fuel Control System

The ECM controls the air/fuel delivery to the combustion chamber by controlling the fuel flow through the injector(s).

Electric Fuel Pump (in-tank)

The in-tank fuel pump is controlled by the ECM. When ignition is turned on, the pump will run for 2 seconds, then stop unless the engine is cranking or running.

Evaporative Emission Control

This system has a canister which stores fuel vapor from the fuel tank. The fuel vapor is removed from the canister and consumed in the normal combustion process when the engine is running. This system is used on all engines and may or may not be controlled by the ECM.

Electronic Spark Timing (EST)

This system is controlled by the ECM which controls spark advance (timing) and is used on all engines.

Electronic Spark Control (ESC)

This system uses a Knock Sensor in connection with the ECM to control spark timing to allow the engine to have maximum spark advance without spark knock. This improves driveability and fuel economy.

Air Injection Reaction (AIR)

The system provides additional oxygen to the exhaust gases to continue the combustion process. The system also supplies additional air to the catalytic converter under certain conditions. The A.I.R. system is not on all engines.

Exhaust Gas Recirculation (ECR)

The EGR system uses a valve to feed a small amount of exhaust gas back into the intake manifold to control formation of NOx.

Transmission Converter Clutch (TCC)

The TCC is ECM controlled and is used on all engines with an automatic transmission. This system reduces slippage losses in the torque convertor by coupling the engine flywheel to the output shaft of the transmission.

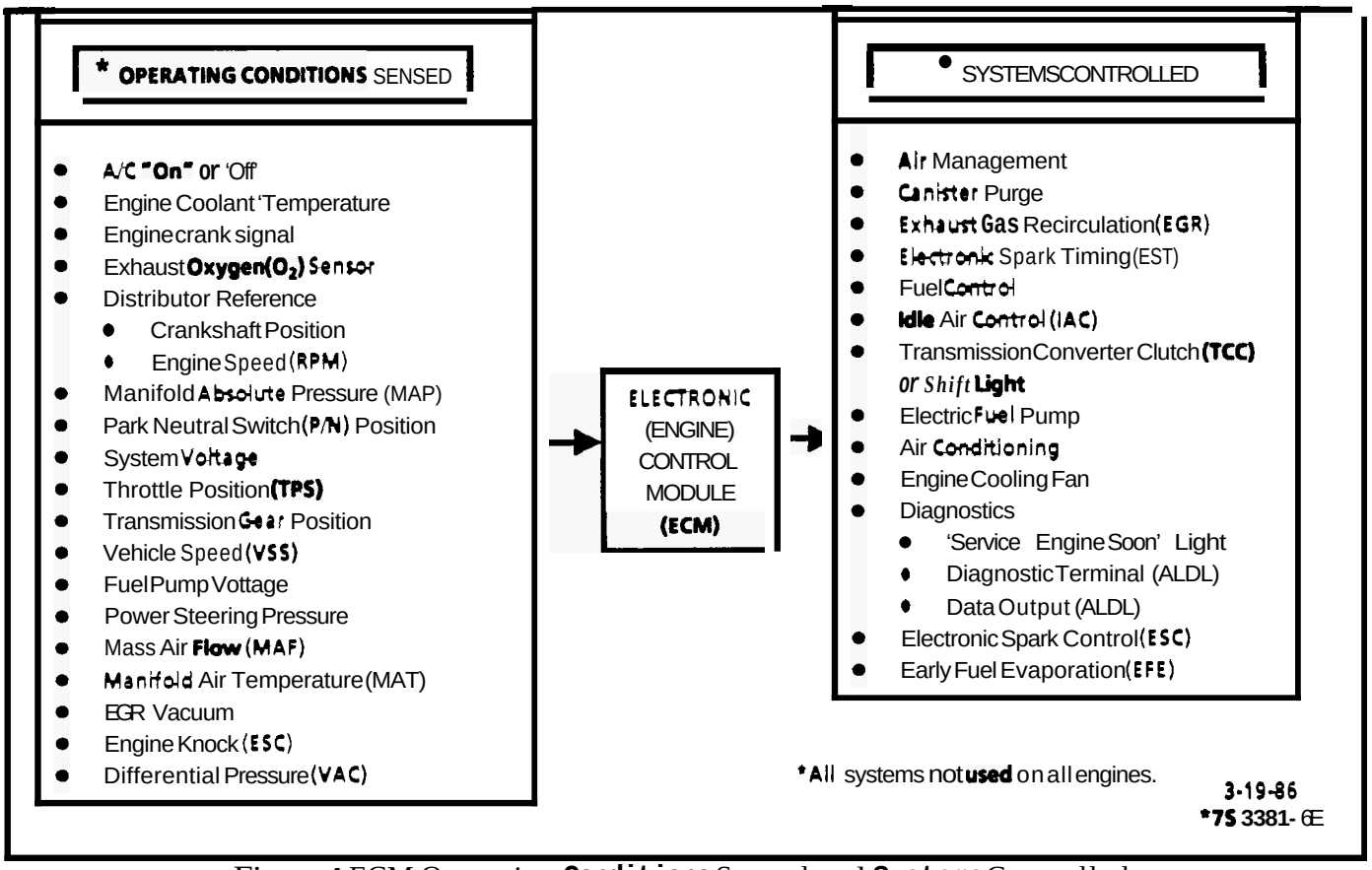


Figure 4 ECM Operating **Conditions** Sensed and **Systems** Controlled

Shift Light Control

The ECM controls the shift light on some manual transmission vehicles to indicate the best shift point for maximum fuel economy. This control is not on all applications.

A/C Clutch Control

The ECM may control the A/C clutch on the compressor to improve idle quality. This control is not on all engines.

Electric Cooling Fan Control

Under certain conditions, the ECM may control the electric cooling fan to cool the engine and A/C condenser. At cruising speed, the ECM may turn the fan off for better fuel economy. This control is on transverse engine front wheel drive vehicles.

Positive Crankcase Ventilation (PCV)

The PCV system passes crankcase vapors into the intake manifold. This system is not controlled by the ECM and is used on all engines.

ABBREVIATIONS AND GLOSSARY OF TERMS

Abbreviations used in this Section are listed below in alphabetical order with an explanation of the abbreviation. There are some variations in the use of periods and in capitalization (as mph, m.p.h., Mph, and MPH) for abbreviations used in this Section but all types are acceptable.

A/F - AIR/FUEL (A/F RATIO)

AIR - AIR INJECTOR REACTION SYSTEM - Air flow from pump is directed into engine exhaust manifold and/or converter to reduce exhaust emissions.

ALDL - ASSEMBLY LINE DIAGNOSTIC LINK- Used at assembly to evaluate Computer Command Control and for service to flash the "SERVICE ENGINE SOON" light if there are trouble codes. Also used by *"SCAN"* tools to obtain ECM serial data.

Bat + - Battery Positive Terminal (12 Volts)

CALPAK - A device used with fuel injection to allow fuel delivery in the event of a PROM or ECM malfunction.

CALIBRATOR - (PROM). An electronic component which can be specifically programmed to meet engine operating requirements for each vehicle model. It plugs into the Engine Control Module (ECM).

CCC - COMPUTER COMMAND CONTROL - has an electronic control module to control air/fuel and emission systems.

C³I - Computer Controlled Coil Ignition. Produces the ignition spark without the aid of an ignition distributor.

CCP - CONTROLLED CANISTER PURGE - ECM controlled solenoid valve that permits manifold vacuum to purge the evaporative emissions from the charcoal canister.

CID - CUBIC INCH DISPLACEMENT - Used to describe engine size.

C LOOP - CLOSED LOOP

COOLANT TEMPERATURE SENSOR - Device that senses the engine coolant temperature, and passes that information to the electronic control module.

CONV. - CATALYTIC CONVERTER, THREE-WAY - EXHAUST CONVERTER. Containing platinum and palladium to speed up conversion of HC and CO, and rhodium to accelerate conversion of NOx.

CO - CARBON MONOXIDE - One of the pollutants found in engine exhaust.

DIAGNOSTIC CODE - Pair of numbers obtained from flashing **"SERVICE ENGINE SOON"** light. **or** displaying on a "Scan" tool. This code ***can*** be used to determine the system malfunction.

DIAGNOSTIC TERM. - Lead of ALDL Connector which is grounded to get a Trouble Code. It is grounded with the engine running to enter the "Field Service Mode".

DIS - Direct Ignition System. Produces the ignition spark without the aid of an ignition distributor.

DVM (10 Meg.) - Digital Voltmeter with **10** Million ohms resistance - used for measurement in electronic systems.

EAC - ELECTRIC AIR CONTROL- Used on AIR System to direct air flow to Air Switching valve or atmosphere.

EAS -ELECTRIC AIR SWITCHING - used to direct air flow to catalytic converter or exhaust ports of the engine.

ECM - ELECTRONIC ENGINE CONTROL MODULE - A metal case (located in passenger compartment) containing electronic circuitry which electrically controls and monitors air/fuel and emission systems on Computer Command Control, and turns on the **"SERVICE ENGINE SOON"** light when a malfunction occurs in the system.

EFI - ELECTRONIC FUEL INJECTION - Computer Command Control using throttle body Fuel injection.

EGR - EXHAUST GAS RECIRCULATION- Method of reducing NOx emission levels.

EECS - EVAPORATIVE EMISSIONS CONTROL SYSTEM - Used to prevent gasoline vapors in the fuel tank from entering the atmosphere.

EFE - EARLY FUEL EVAPORATION - Method of warming the intake manifold during cold engine operation. Provides efficient air/fuel mixing.

ENERGIZE/DE-ENERGIZE - When current is passed through a coil (energized) such **as** the Canister Purge Solenoid, the plunger is pulled into the solenoid. When the voltage to the solenoid **is** turned off, (de-energized), a spring raises the plunger.

ESC - ELECTRONIC SPARK CONTROL - Used to sense detonation and retard spark advance when detonation **occurs.**

EST - ELECTRONIC SPARK TIMING - ECM controlled timing of ignition spark.

EVRV - ELECTRONIC VACUUM REGULATOR VALVE. Controls EGR vacuum.

FED - FEDERAL - Vehicle/Engine available in all states except California.

GROUND - A Wire shorted to ground.

HC - HYDROCARBONS - One of the pollutants found in engine exhaust.

HIGH IMPEDANCE VOLTMETER - Has high opposition to the flow of electrical current. ***Good*** for reading circuits **with** low current flow, such as found in electronic systems because it allows tests to be made without affecting the circuit.

HEI - HIGH ENERGY IGNITION - **A** distributor that uses an electronic module and pick-up coil in place of contact points.

Hg - MERCURY a calibration material used as a standard for vacuum measurement.

IAC - IDLE AIR CONTROL - installed in the throttle body of fuel injected systems and controlled by the **ECM** to regulate idle speed.

IDEAL MIXTURE - The air/fuel ratio which provides the best performance, while maintaining maximum conversion of exhaust emissions, typically **14.7/1.**

IGN - IGNITION

INPUTS - Information from sources (such as, coolant temperature sensors, exhaust oxygen sensor, etc.) that tell the ECM how the systems are performing.

INTERMITTENT - Occurs now and then; not continuously. In electrical circuits, refers to occasional open, short, or ground.

I.P. - INSTRUMENT PANEL

KM/HR - KILOMETER PER HOUR - A metric unit measuring distance (1000 meters) in one hour.

L - LITER - A metric unit of capacity.

L4 - FOUR CYLINDER IN-LINE ENGINE

MAF - MASS AIR FLOW - Sensor which measures the amount of air entering the engine.

MALFUNCTION - A problem that causes the system to operate incorrectly. Typical malfunctions are; wiring harness opens or shorts, failed sensors, or circuit components.

MAP - MANIFOLD ABSOLUTE PRESSURE SENSOR - Reads pressure changes in intake manifold with reference to zero pressure. It puts out a voltage which is highest when the pressure is highest. The maximum voltage is between 4-5 volts.

MAT - Manifold Air Temperature Sensor. Measures temperature of air in the intake manifold.

M/C - MIXTURE CONTROL

MEM-CAL - MEMORY CALIBRATOR - Contains specific caliobrations to meet the requirements of a specific engine..

MFI - MULTIPORT FUEL INJECTION. Individual injectors for each cylinder are mounted in the intake manifold. The injectors are fired in groups rather than individually.

MODE - A particular state of operation.

MPH - MILES PER HOUR - A unit measuring distance (5280 feet) in one hour.

N.C. - NORMALLY CLOSED. State of relay contacts or solenoid plunger when no voltage is applied.

Nom - NEWTON METERS (Torque) - A metric unit which measures force.

N.O. - NORMALLY OPEN - State of relay contacts or solenoid plunger when no voltage is applied.

NOx - NITROGEN, OXIDES OF - One of the pollutants found in engine exhaust.

O_2 - OXYGEN (Sensor) - Monitors the oxygen content of the exhaust system and generates a voltage signal to the ECM.

OPEN LOOP - Describes ECM fuel control without use of oxygen sensor information.

OUTPUT - Functions, typically solenoids, that are controlled by the ECM.

OXYGEN SENSOR, EXHAUST - Device that detects the amount of oxygen (02) in the exhaust stream.

POSITIVE CRANKCASE VENTILATION - Prevent fumes in crankcase from passing into atmosphere.

PFI - PORT FUEL INJECTION

P/N - PARK/NEUTRAL

PORT - EXHAUST OR INTAKE PORT

PROM - PROGRAMABLE READ ONLY MEMORY- an electronic term used to describe the engine calibration unit.

RPM - REVOLUTIONS PER MINUTE - A measure of rotational speed.

SELF-DIAGNOSTIC CODE - The ECM can detect malfunctions in the system. If a malfunction occurs, the ECM turns on the "SERVICE ENGINE SOON" light. A diagnostic code can be obtained from the ECM through the "SERVICE ENGINE SOON" light. This code will indicate the area of the malfunction.

SES - SERVICE ENGINE SOON LIGHT - Lights when a malfunction occurs in Computer Command Control system.

TACH - TACHOMETER

TBI - THROTTLE BODY INJECTION (Unit) - is controlled by the ECM to supply precise air/fuel mixture into the intake manifold.

TCC - TRANSMISSION / TRANSAXLE CONVERTER CLUTCH - ECM controlled solenoid in transmission which positively couples the transmission to the engine.

THERMAC - THERMOSTATIC AIR CLEANER - provides preheated air to intake manifold to provide better driveability when engine is cold.

TPS - THROTTLE POSITION SENSOR - Device that tells the ECM the throttle position.

TVS - THERMAL VACUUM SWITCH. Used to control vacuum in relationship to engine temperature.

V - VOLT

V-6 - SIX CYLINDER ENGINE - Arranged in a "V".

V-8 - EIGHT CYLINDER ENGINE - Arranged in a "V".

VACUUM - Negative pressure; less than atmospheric pressure.

VACUUM, MANIFOLD - Vacuum source in manifold below throttle plate.

VACUUM, PORTED - A vacuum source above (atmospheric side) of closed throttle plate.

VIN - VEHICLE IDENTIFICATION NUMBER.

VSS - VEHICLE SPEED SENSOR - Sensor which sends vehicle speed information to the ECM.

WASTEGATE - A means of controlling the amount of boost available for a Turbo Charged engine.

WOT - WIDE OPEN THROTTLE.

WIRING HARNESS SERVICE

The ECM wire harness electrically connects the ECM to the various solenoids, switches, and sensors in vehicle engine compartment. The ECM is located inside the vehicle passenger compartment.

Most connectors in the engine compartment are protected against moisture and dirt which could create oxidation and deposits on the terminals. This protection is important because of the very low voltage and current levels found in the electronic system. The connectors have a lock which secures the male and female terminals together. A secondary lock holds the seal and terminal into the connector.

GENERAL

Molded-on connectors require complete replacement of the connector. This means splicing a new connector assembly into the harness. Figure 5 has instructions on splicing wires.

WIRE HARNESS

Wire harnesses should be replaced with proper part number harnesses. When signal wires are spliced into a harness, use wire with high temperature insulation only,

With the low current and voltage levels found in the system, it is important that the best possible bond at all wire splices be made by soldering the splices as shown in Figure 5.

Use care when probing the connector or replacing terminals in them. It is possible to short between opposite terminals. If this happens to the wrong terminal pair, it is possible to damage certain components. Always use jumper wires between connectors for circuit checking. **NEVER** probe through the Weather-Pack seals.

When diagnosing, open circuits are often difficult to locate by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor or in the wiring harness may correct the open circuit condition. This should always be considered when an open circuit or failed sensor is indicated. Intermittent problems may also be caused by oxidized or loose connections.

Before making a connector repair, be certain of the type of connector. Weather-Pack and Compact Three connectors look similar but are serviced differently. Replacement connectors and terminals are listed in Group 8.965 of the Standard Parts Catalog.

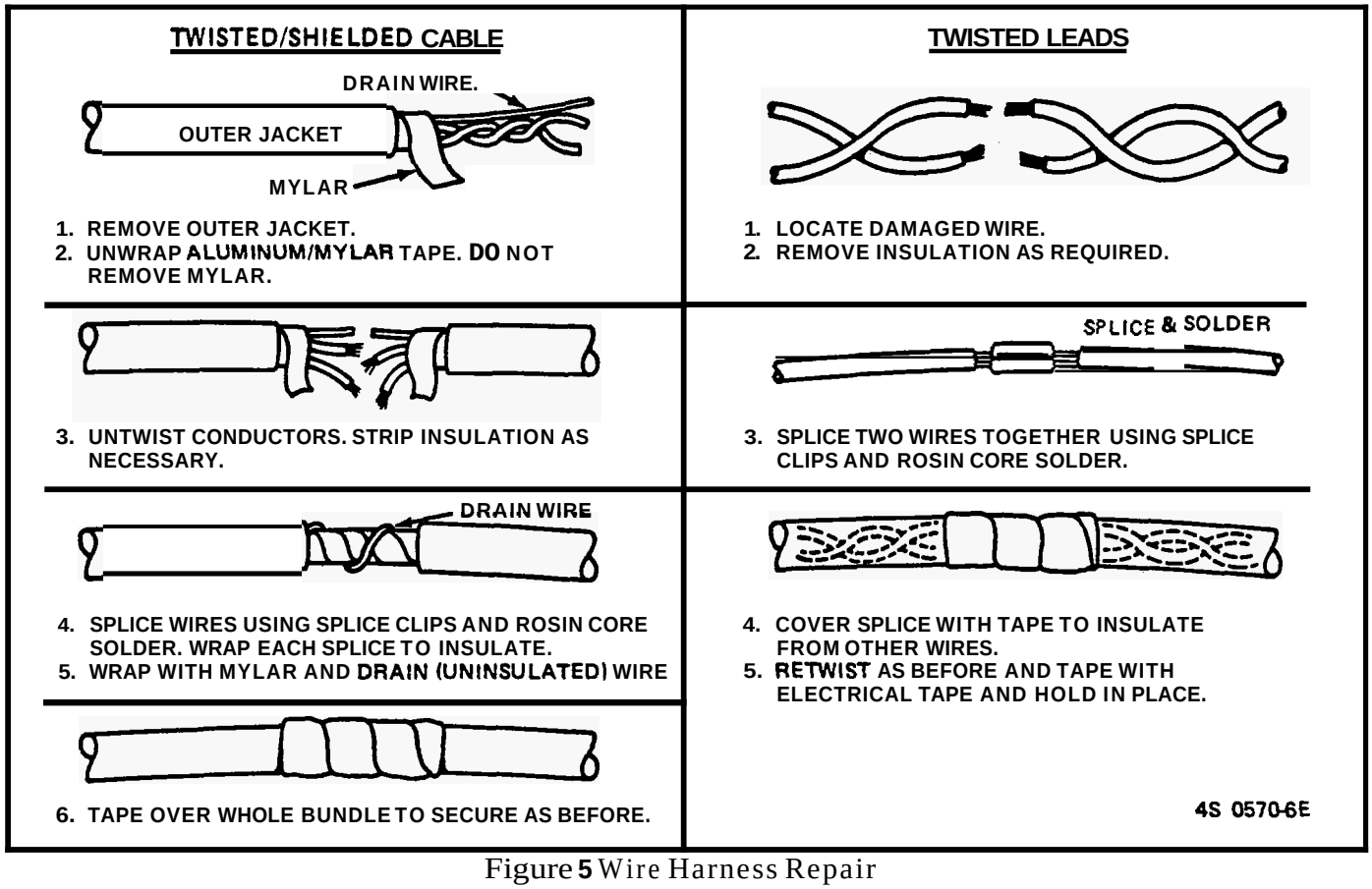


Figure 5 Wire Harness Repair

CONNECTORS

Weather-Pack

Some connectors used with an ECM are called Weather-Pack. Figure 6 shows a Weather-Pack terminal and the tool (5-28742) required to service it. This tool is used to remove the pin and sleeve terminals. If removal is attempted with an *ordinary* pick, there is a good chance that the terminal will be bent or deformed. and, unlike standard blade type terminals, these terminals cannot be straightened once they are bent.

Make certain that the connectors are properly seated and all of the sealing rings in place when connecting leads. The hinge type flap provides a backup, or secondary locking feature for the connector. They are used to improve the connector reliability by retaining the terminals if the small terminal lock tangs are not positioned properly.

Weather-Pack connections cannot be replaced with standard connections. Instructions are provided with Weather-Pack connector and terminal packages.

Compact Three

The Compact Three connector which looks similar to a Weather-Pack connector is not sealed and is used where resistance to the environment is not required. This type of connector most likely is used at the air control solenoid. Use the standard method when repairing a terminal. Do not use the Weather-Pack terminal tool 5-28742.

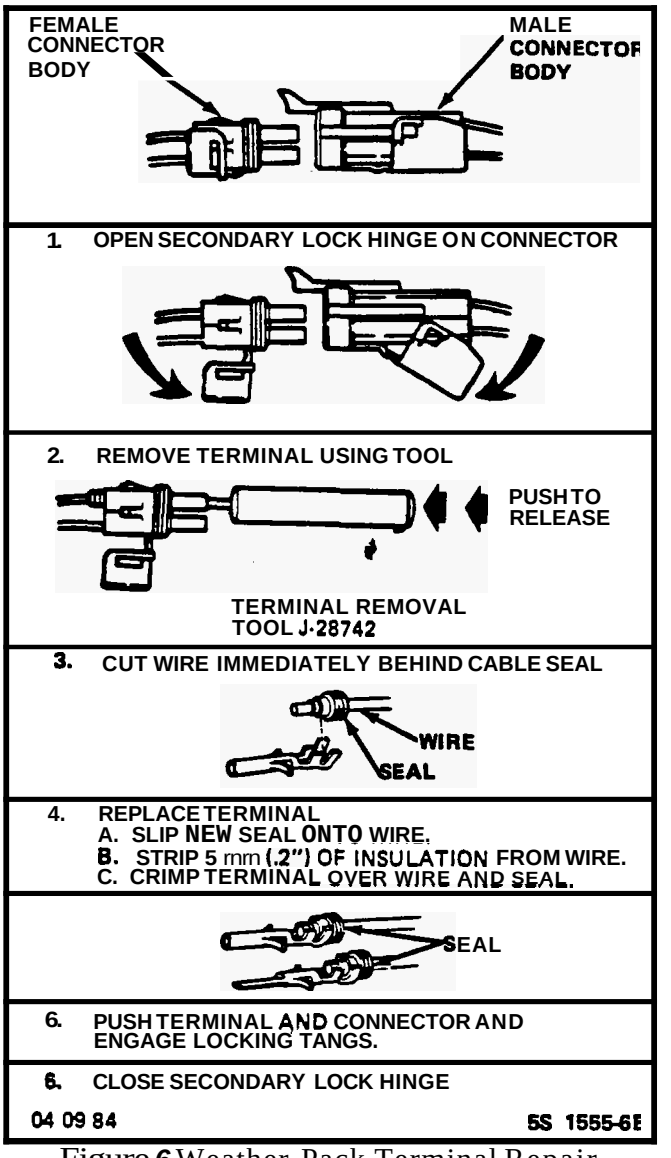


Figure 6 Weather-Pack Terminal Repair

Metri-Pack series 150 terminal removal

Some connectors used to connect various sensors to the ECM harness use terminals called "Metri-Pack" (Figure 7). These may be used at the Coolant Sensors as well as at Ignition Modules.

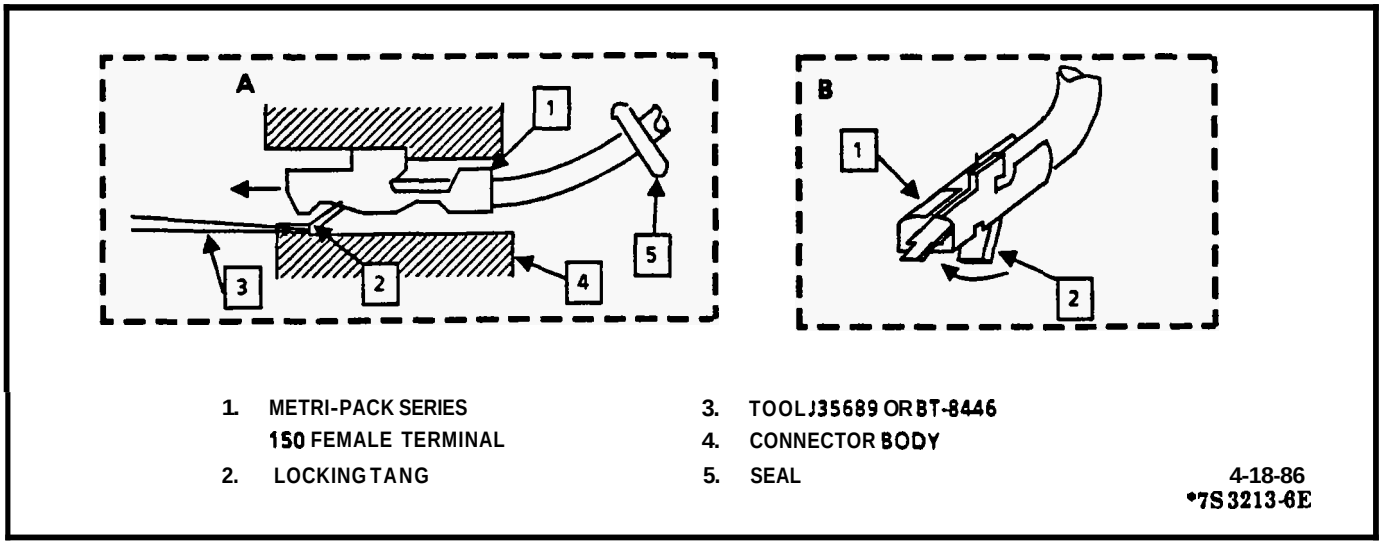
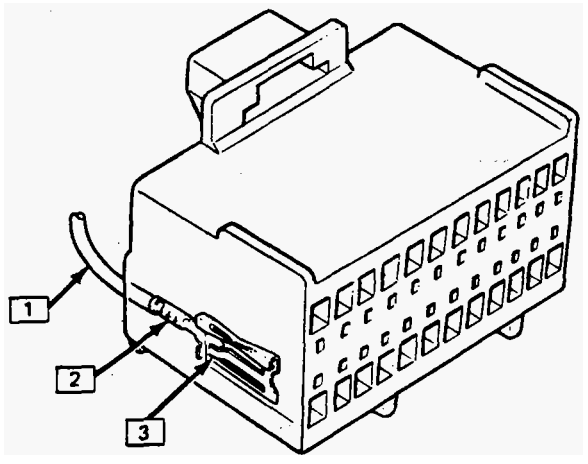
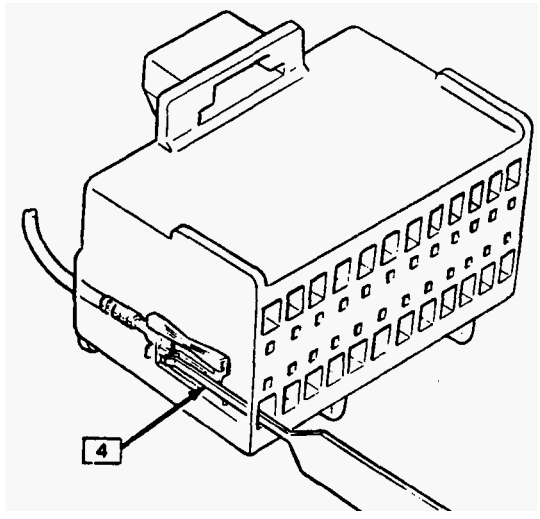


Figure 7 METRI-PACK SERIES 150 TERMINAL REMOVAL





1 CABLE
2 TERMINAL
3 LOCKING TANG
4 TOOL533095

1. GRASP CABLE AND PUSH TERMINAL TO THE MOST FORWARD POSITION.
2. INSERT TOOL 533095 STRAIGHT INTO THE FRONT OF THE CONNECTOR CAVITY. DO NOT USE CONVENTIONAL PICK TO REMOVE TERMINAL.
3. WITH TOOL IN PLACE, GENTLY PULL ON THE CABLE TO REMOVE TERMINAL.
4. VISUALLY CHECK TERMINAL AND REPLACE IF TERMINAL CAVITY OR TANG
5. INSTALL TERMINAL INTO CONNECTOR CAVITY UNTIL LOCKING TANG HAS SNAPPED INTO POSITION.

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Figure 8 Micro Pack Terminal Replacement

They are also called "Pull-To-Seat" terminals because, to install a terminal on a wire the wire is first inserted through the seal (5) and connector (4). The terminal is then crimped on the wire and the terminal pulled back into the connector to seat it in place.

To remove a terminal:

1. Slide the seal back on the wire,
2. Insert tool (3) BT-8518 or J 35689, or equivalent, as shown in insert "A" and "B" to release the terminal locking tab (2).
3. Push the wire and terminal out through the connector.

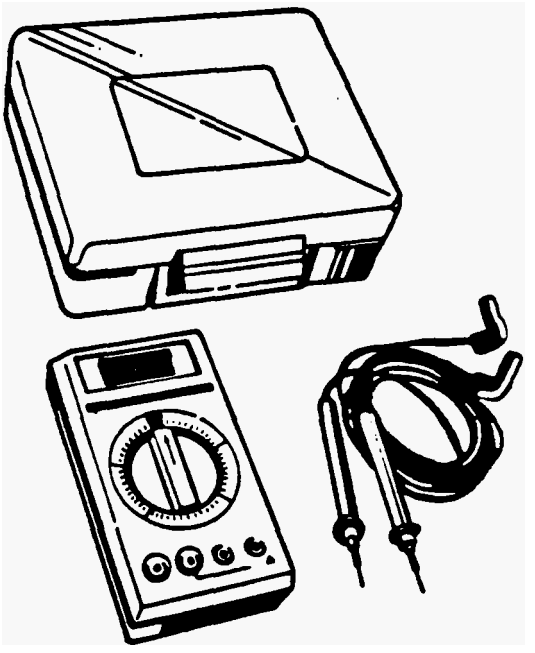
If reusing the terminal, reshape the locking tang (2).

Micro-Pack

Some connectors used on harness to connect to the ECM are called Micro-Pack (Figure 8). Terminal replacement requires the use of a special tool.

TOOLS NEEDED TO SERVICE THE SYSTEM

The system requires an ALDL read-out (Scan) tool, tachometer, test light, ohmmeter, digital voltmeter with 10 megohms impedance (J-29125A), vacuum gage and jumper wires for diagnosis. A test light or voltmeter must be used when specified in the procedures. They must NOT be interchanged. See Figures 9 through 12 for Special Tools needed to diagnosis or repair a system. For more complete information on the operation of these tools, see the manufacturer's instructions.



HIGH IMPEDANCE MULTIMETER
(DIGITAL VOLTMETER-DVM)
134029-A

VOLTMETER - Voltage Position Measures amount of voltage. When connected in parallel to an existing circuit. A digital voltmeter with 10 meg ohm input impedence is used because this type of meter will not load down the circuit and result in faulty readings.some circuits require accurate low voltage readings, and some circuits in the ECM have a very high resistance.

AMMETER - When used as ammeter, this meter also accurately measures extremely low current flow. Refer to meter instructions for more information.

- Selector must be set properly for both function and range. DC is used for most automotive measurements.

OHMMETER - Measures resistance of circuit directly in ohms. Refer to meter for more information.

- OL Display in all ranges indicates open circuit.
- Zero display in all ranges indicates a short circuit.
- Intermittent connection in circuit may be indicated by digital reading that will not stabilize on circuit.
- Range Switch.
  - 200Ω - Reads ohms directly
  - 2K,20K,200KΩ - Reads ohms in thousands
  - 2M and 20MΩ - Reads ohms in millions

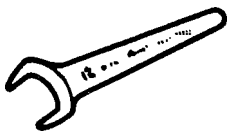
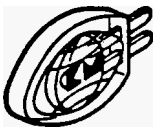
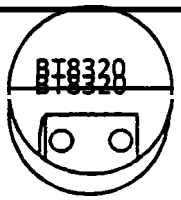
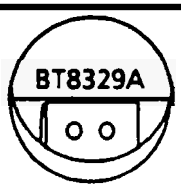
J23738

VACUUM PUMP (20 IN. HG. MINIMUM)
Use gage to monitor manifold engine vacuum and the hand pump to check vacuum sensors, solenoids and valves.

J34142-A

UNPOWERED TEST LIGHT
Used to check wiring for complete circuit and short to ground or voltage.

TACHOMETER
Use inductive trigger signal pickup type to check RPM.

 J29533A/BT8127	**OXYGEN SENSOR WRENCH** Used to remove or install the oxygen sensor.
 J33031/BT8130	**DLE AIR CONTROL WRENCH** Used to remove or install IAC valve on throttle body.
 134730-A	**PORT FUEL INJECTION DIAGNOSTIC KIT** Used to diagnose port fuel injection systems. The kit includes: ● Fuel Pressure Gage - to check fuel pump pressure and compare injector pressure drop for equal fuel distribution. ● Injector Test Light - to check electrical circuit to an injector. ● Injector Tester - to energize each fuel injector for a precise amount of time to perform injector balance test in **CHART C-2A** by checking each injector's pressure drop using pressure gage.
 J34730-1	**FUEL PRESSURE GAGE** Used to check and monitor fuel line pressure of port fuel system. Part of Diagnostic Kit **J34730-A**
 J34730-2	**INJECTOR TEST LIGHT** Used to check electrical circuit to a port fuel injector Part of Diagnostic Kit **J34730-A**
 BT8320	**INJECTOR TEST LIGHT** Used to check electrical circuit to a **TBI** fuel injector (except **TBI 700)**
 BT8329A	**INJECTOR TEST LIGHT** Used to check electrical circuit to a **TBI** 700 fuel injector and a port fuel injector.

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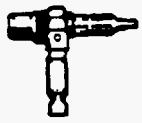
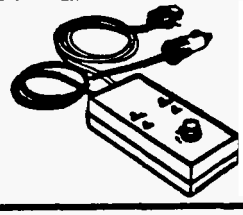
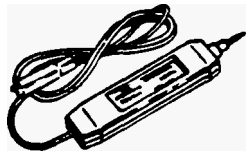
 J26792/BT7220-1	**SPARK TESTER** Use to check available secondary ignition voltage . Also called an **ST125.**
 J36101	**MASS AIR FLOW (MAF) SENSOR TESTER** Used for static test of MAF Sensor on vehicles equipped with an **A/C** type MAF Sensor.
 J36179	**CRANKSHAFT SENSOR ALIGNMENTTOOL (C3I SYSTEMS)** Used to properly align crank or combination sensor to harmonic balancer interrupter.
 J35616	**CONNECTOR TEST ADAPTER KIT** Used to make electrical test connections in current Weather Pack, Metri - Pack and Micro-Pack style terminals.
 J34636	**CIRCUIT TESTER** Used to check all relays and solenoids before connecting them to a new ECM. Measures the circuit resistance and indicates pass or fail via green or red LED. Amber LED indicates current polarity. Can also be used as a non-powered continuity checker.
 J28687-A/BT8220	**OIL PRESSURE TRANSDUCER WRENCH** Used to remove or install oil pressure transducer on engine.
 J35689	**METRI-PACK TERMINAL REMOVER** Used to remove 150 series Metri-Pack "pull-to-seat" terminals from connectors. Refer to wiring harness service in Section 6E for removal procedure.
 J28742/BT8234-A	**WEATHER PACK TERMINAL REMOVER** Used to remove Terminals from Weather Pack connectors. Refer to wiring harness service in Section 6E for removal procedure.
 J33095/BT8234-A	**ECM CONNECTOR TERMINAL REMOVER** Used to remove terminal from Micro-Pack connectors. Refer to wiring harness service Section **6E** for removal procedure.

 134730-3	**NJECTOR TESTER** to energize each fuel injector for a precise amount of time to perform injector balance test in CHART C-2A by checking each injector's pressure drop using pressure gage. Part of Diagnostic Kit **134730-A.**
 J29698-A/BT8251	**:UEL LINE WRENCH** Used to disconnector conned fuel lines at TBI unit by holding fuel nut at throttle body.
 J33179-20	**MINIMUM AIR RATE ADJUSTING WRENCH** Used to adjust throttle stop screw on TBI unit.
 J29658/BT8205	**FUEL PRESSURE GAGE** Used to check and monior fuel line pressure of port fuel system.

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GENERAL SPECIFICATIONS

Many of the specifications used in this section *are* located on the Vehicle Emission Control Information label under the hood.

Listed on the chart below are locations of specifications used in this Section.

SPECIFICATION	LOCATION OF INFORMATION
Engine Timing	Vehicle Emission Control information label.
Idle Speed, ECM Controlled	Not adjustable. ECM controls idle.
Spark Plug Type	See Owner's Manual, Section 7.
Spark Plug Gap	Vehicle Emission Control Information Label.
Engine Code	8th digit of VIN number. See Section OA. Also Owner's Manual, Section 7.
Engine Family	Vehicle Emission Control Information label.
Filter Part Numbers	See Owner's Manual, Section 7.
Part Numbers of Major Components	WDD-GM Parts Book.
Replacement of Vehicle Emission Control Information Label	WDD-GM Label Catalog.

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SECTION 6E3
DRIVEABILITY AND EMISSIONS FUEL INJECTION (PORT)

THIS SECTION APPLIES TO:
2.0L TURBO (VIN M) "J" SERIES
2.8L (VIN W) "A" SERIES
3.0L (VIN L) "N" SERIES
3.8L (VIN 3) "A, C & H" SERIES
3.8L TURBO (VIN 7) "G" SERIES

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.

CONTENTS

SECTION A2 -DIAGNOSTIC CHARTS 2.8L ENGINE

SECTION A3 -DIAGNOSTIC CHARTS 3.0L, 3.8L & 3.8L TURBO ENGINES

SECTION B -SYMPTOMS

FUNCTIONAL CHECKS/ DIAGNOSTIC CHARTS

SECTION C -COMPONENT SYSTEMS

INTRODUCTION

GENERAL DESCRIPTION

This section applies to engines which have a fuel injector in the intake manifold near the intake valve for each cylinder. It is commonly referred to as "Port Fuel Injection".

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

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

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

DIAGNOSIS PROCEDURE

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

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

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

Pages 6E3-9810 not copied; Composite Views of 3.0L "N" & 3.8L "A, C & H" Series motors

SECTION A3
3.0L, 3.8L and 3.8L Turbo Engines

DIAGNOSTIC CIRCUIT CHECK

The "Diagnostic Circuit Check" verifies the system is functioning correctly. Some special considerations to keep in mind while making the "Diagnostic Circuit Check" are:

Blocking Drive Wheels

The vehicle drive wheels should always be blocked while checking the system.

Cold Oxygen Sensor

On some engines. the Oxygen Sensor will cool off after only a short period of operation at idle. This will put the system into "Open Loop". To restore "Closed Loop" operation. run the engine at part throttle several minutes and accelerate from idle to part throttle a few times.

BASIC PROCEDURE

If you have not reviewed the Basic Information on how to use the Diagnostic Procedures. go to the Introduction of this section.

SECTION A3
ENGINE COMPONENTS/ WIRING DIAGRAMS/ DIAGNOSTIC CHARTS

DIAGNOSTIC CIRCUIT CHECK

The Diagnostic Circuit Check must be the starting point for any driveability complaint diagnosis.

The Diagnostic Circuit Check is an organized approach *to* identifying a problem created by an Electronic Engine Control System malfunction because it directs the Service Technician to the next logical step in diagnosing the complaint.

If after completing the Diagnostic Circuit Check and finding the on-board diagnostics functioning properly and no trouble codes displayed, a comparison of "Typical Scan Values", for the appropriate engine, may be used for comparison. The "Typical Values" are an average of display values recorded from normally operating vehicles and are intended to represent what a normally functioning system would display.

A "SCAN" TOOL THAT DISPLAYS FAULTY DATA SHOULD NOT BE USED, AND THE PROBLEM SHOULD BE REPORTED TO THE MANUFACTURER. THE USE OF A FAULTY "SCAN" CAN RESULT IN MISDIAGNOSIS AND UNNECESSARY PARTS REPLACEMENT.

Only the parameters listed below are used in this manual for diagnosis. If a "Scan" reads other parameters, the values are not recommended by General Motors for use in diagnosis. For more description on the values and use of the "Scan" to diagnose ECM inputs, refer *to* the applicable diagnosis section in Section C. If all values are within the range illustrated, refer to symptoms in Section B.

TYPICAL "Scan" DATA VALUES
3.0L, 3.8L, and 3.8L TURBO

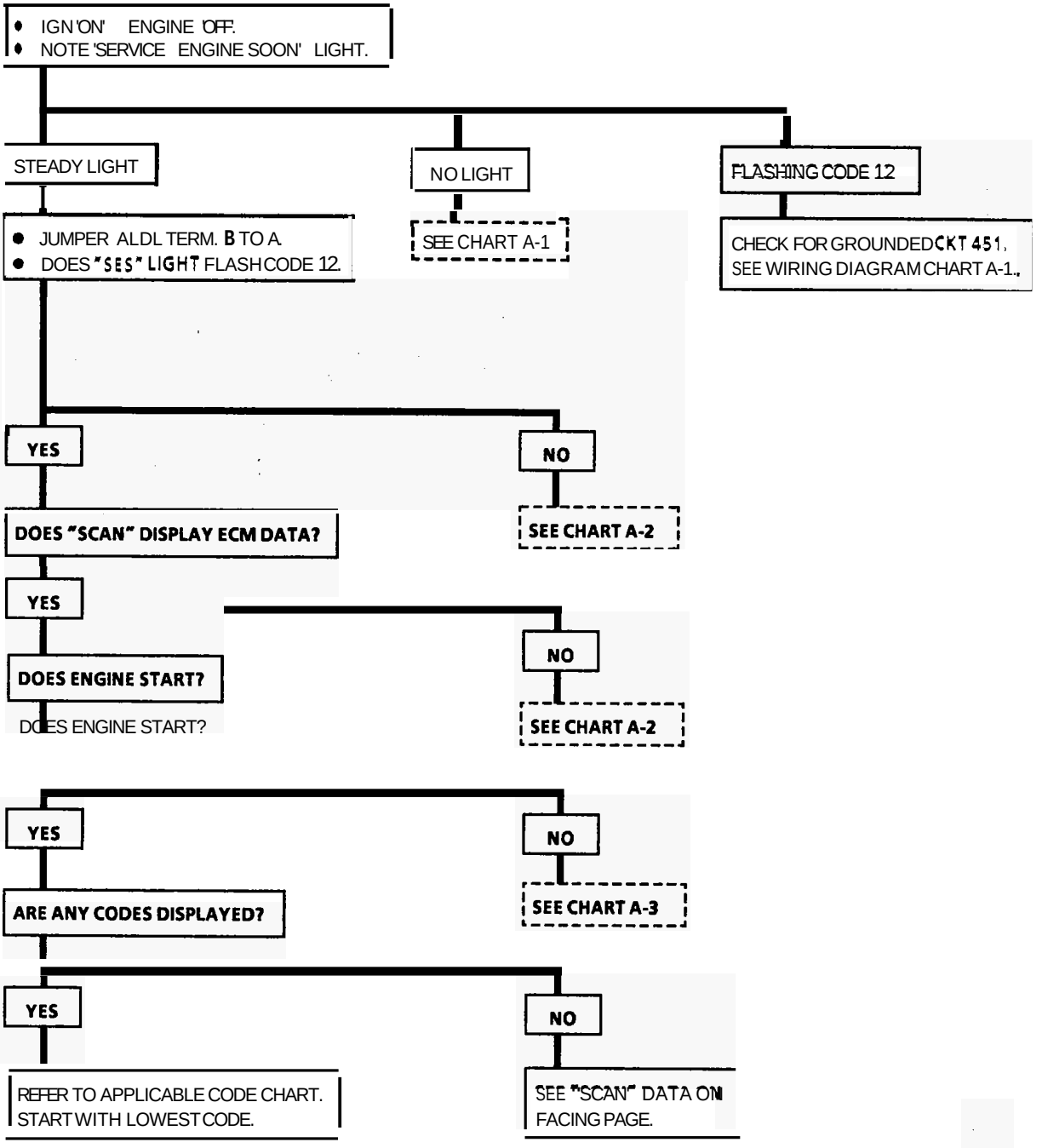
Idle / Upper Radiator Hose Hot / Closed Throttle / Park or Neutral / Closed Loop / Acc. off

"SCAN" Position	Units Displayed	Typical Data Value
Engine Speed	RPM	Varies
Coolant Temp.	C°	85" - 105"
MAT Mani Air Temp.	C°	Varies with Air Temperature
Air Flow	Gm/Sec	4 - 7
Oxygen Sensor	Millivolts	Varies
Throt. Position	Volts	.36-.44 (3.8L) .50-.59 (3.0L)
Idle Air Control	Counts (steps)	10-50
Park/Neutral	P/N and RDL	P-N
Fuel Integ.	Counts	118- 138
Block Learn	Counts	118- 138
Closed Loop Flag.	Open/Closed	Closed Loop (may go open with extended idle)
Vehicle Speed	MPH	0 (Zero)
Torque Conv. Cl.	On/Off	Off/ (On with TCC commanded)
EGR Diag. Switch	On/Off	On/Off
Spark Advance	Degrees	Varies
Knock Signal	No/Yes	Nones
Power Steering	Normal	(Normal)
3rd Gear (440-T4)	On/Off	Off
4th Gear (440-T4)	On/Off	Off
A/C Request	Yes/No	No (yes, with A/C requested)
PROM I.D.	Numbers	Internal I.D. Only
EGR Duty Cycle	%	0 - 50
LV8	0	30 - 40

NOTE: IF ALL VALUES ARE WITHIN THE RANGE ILLUSTRATED, REFER TO SYMPTOMS IN SECTION B.

DIAGNOSTIC CIRCUIT CHECK

3.0L, 3.8L & 3.8L TURBO (PORT)



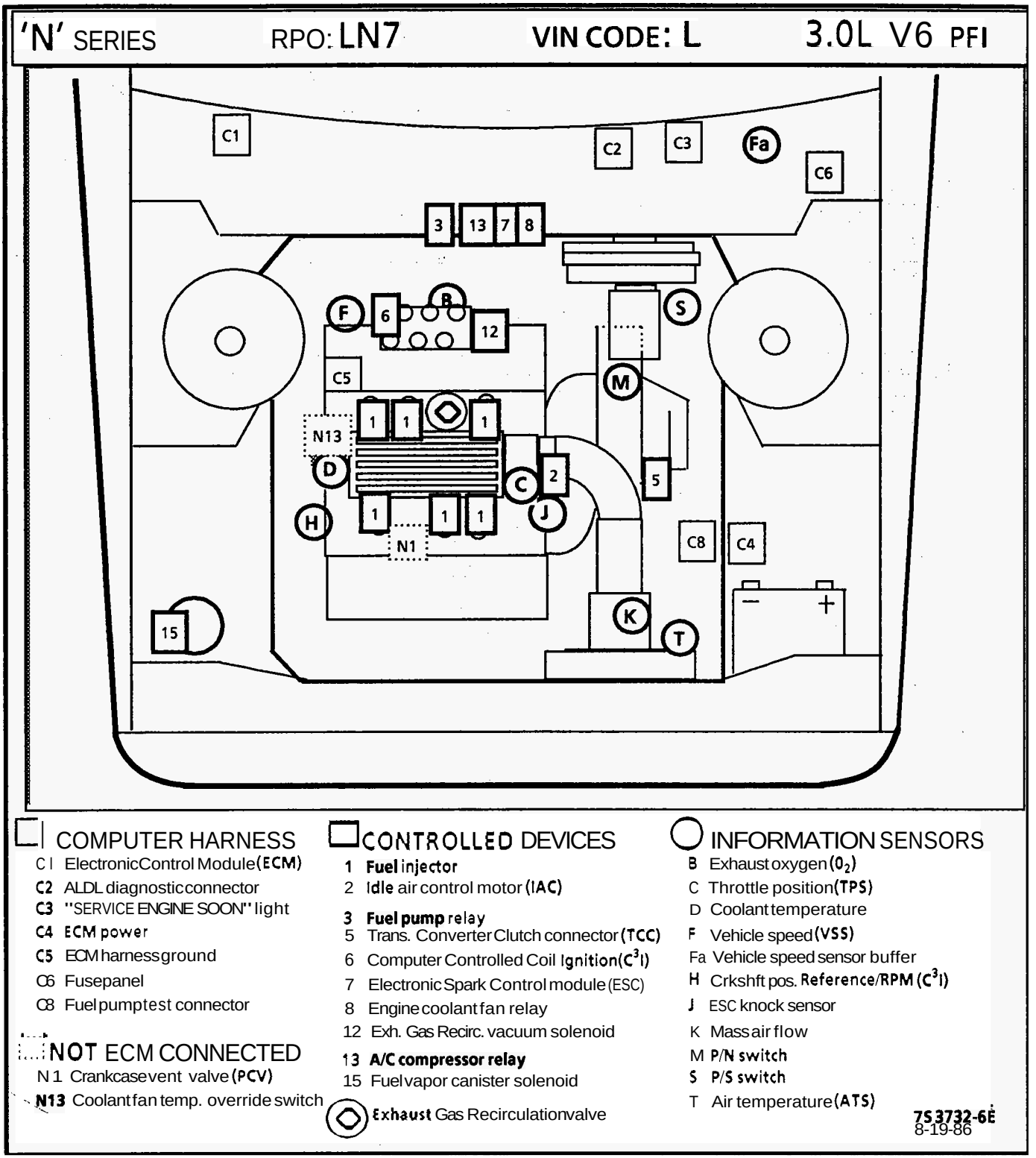
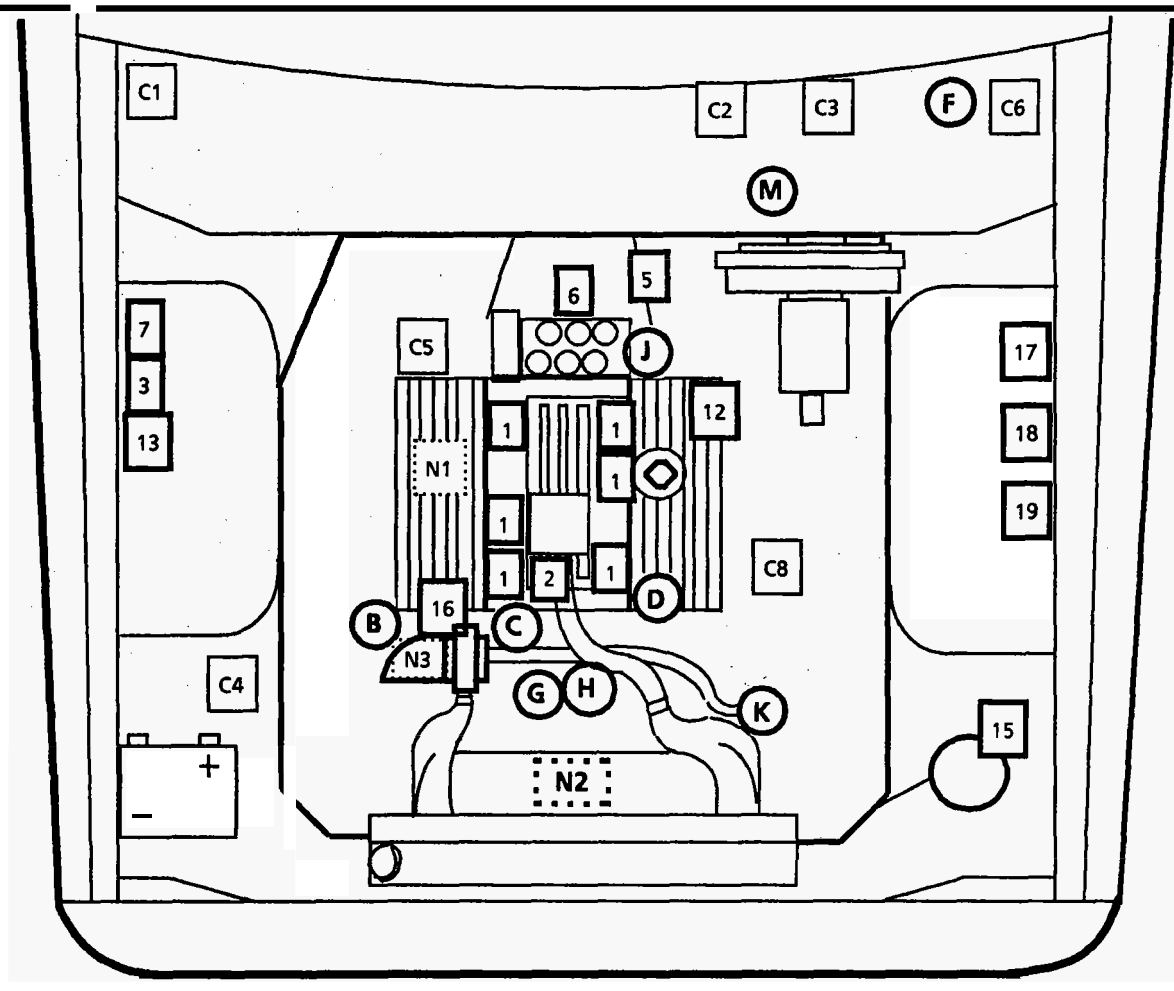


Figure A3-1 • Engine Component Location - 3.0L "N" Series

G' SERIES **RPO: LC2** **VIN CODE: 7** **3.8LT V6 PFI**



COMPUTER HARNESS

1 Electronic Control Module (ECM)
2 ALDL diagnostic connector
3 "SERVICE ENGINE SOON" light
4 ECM power
5 ECM harness ground
6 Fuse panel
8 Fuel pump test connector

NOT ECM CONNECTED

51 Crankcase vent valve (PCV)
12 Inner Cooler
53 Turbo Charger

CONTROLLED DEVICES

1 Fuel injector
2 Idle air control motor (IAC)
3 Fuel pump relay
5 Trans. Converter Clutch connector (TCC)
6 Comp. Controlled Coil Ignition (C^3I)
7 Electronic Spark Control module (ESC)
12 Exh. Gas Recirc. vacuum solenoid
13 A/C compressor relay
15 Fuel vapor canister solenoid
16 Wastegate solenoid
Exhaust Gas Recirculation valve
17 Delay Relay (Coolant Fan)
18 HiSpeed Relay (Coolant Fan)
19 Lo Speed Relay (Coolant Fan)

INFORMATION SENSORS

B Exhaust oxygen (O_2)
C Throttle position (TPS)
D Coolant temperature
F Vehicle speed (VSS)
G Camshaft position (C^3I)
H Crkshft pos. Reference/RPM (C^3I)
J ESC knock sensor
K Mass Air Flow
M P/N switch

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Figure A3-2 • Engine Component Location - 3.8L Turbo "G" Series

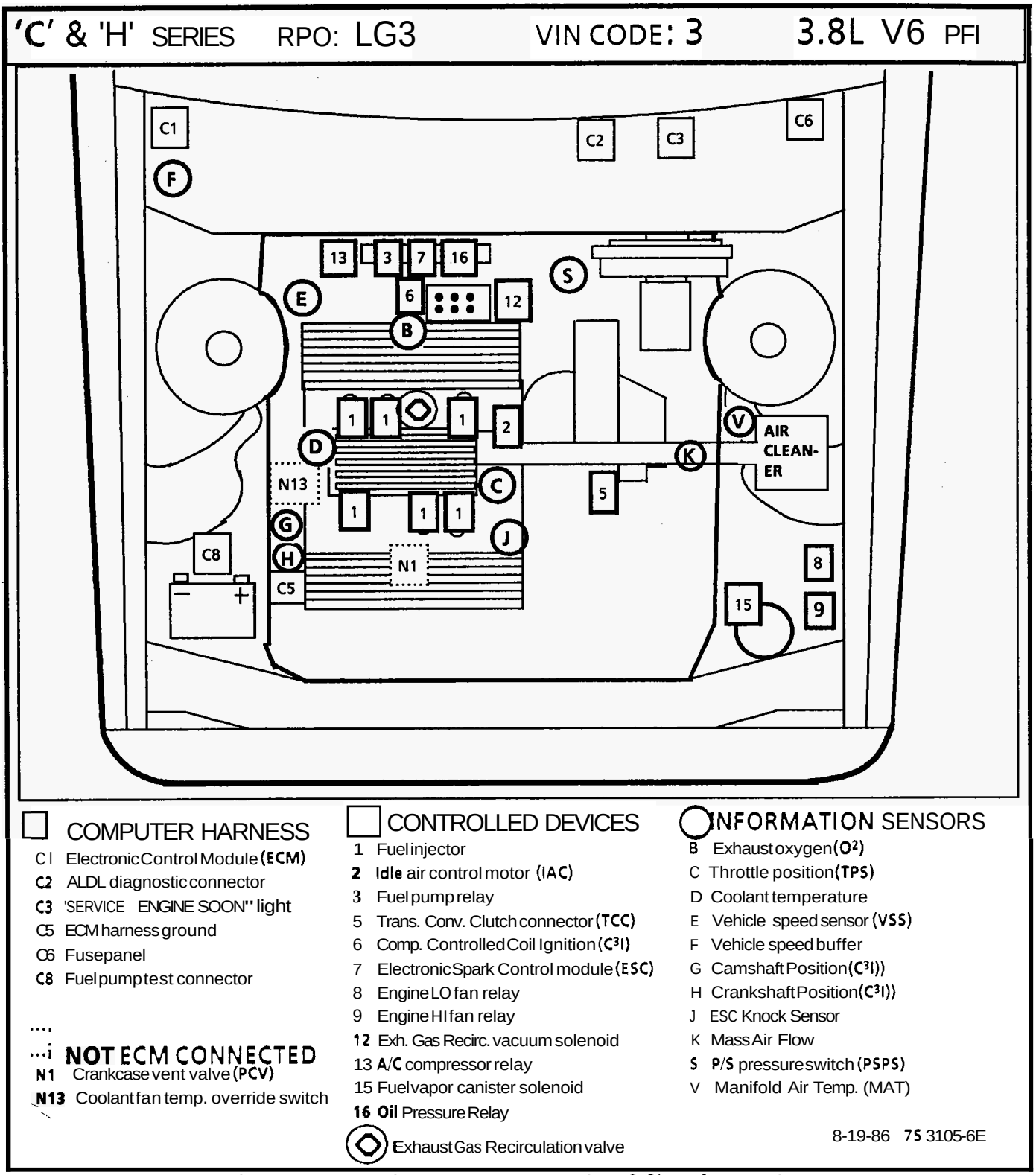


Figure A3-3 • Engine Component Location - 3.8L "C & H" Series

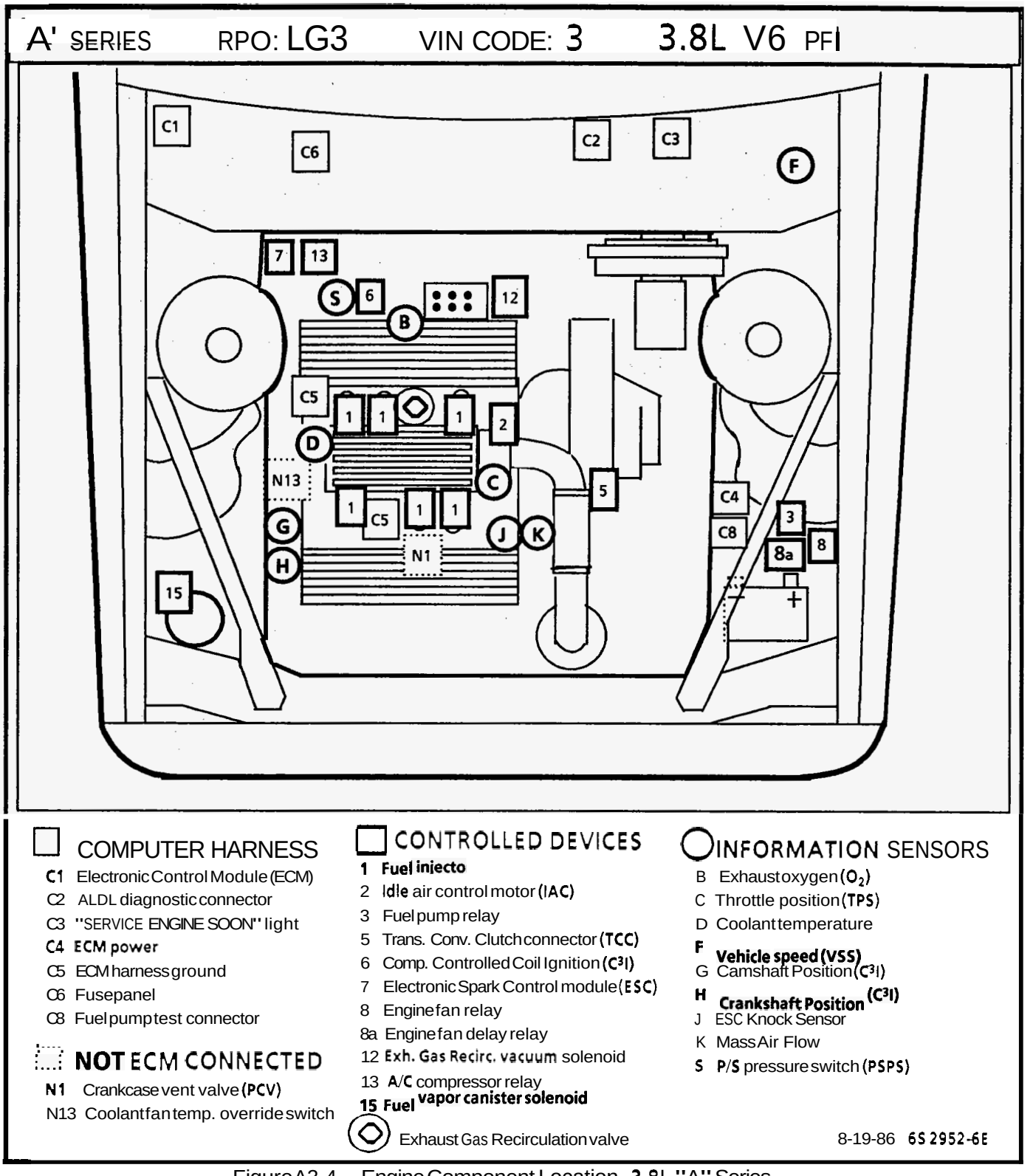


Figure A3-4 - Engine Component Location - 3.8L "A" Series

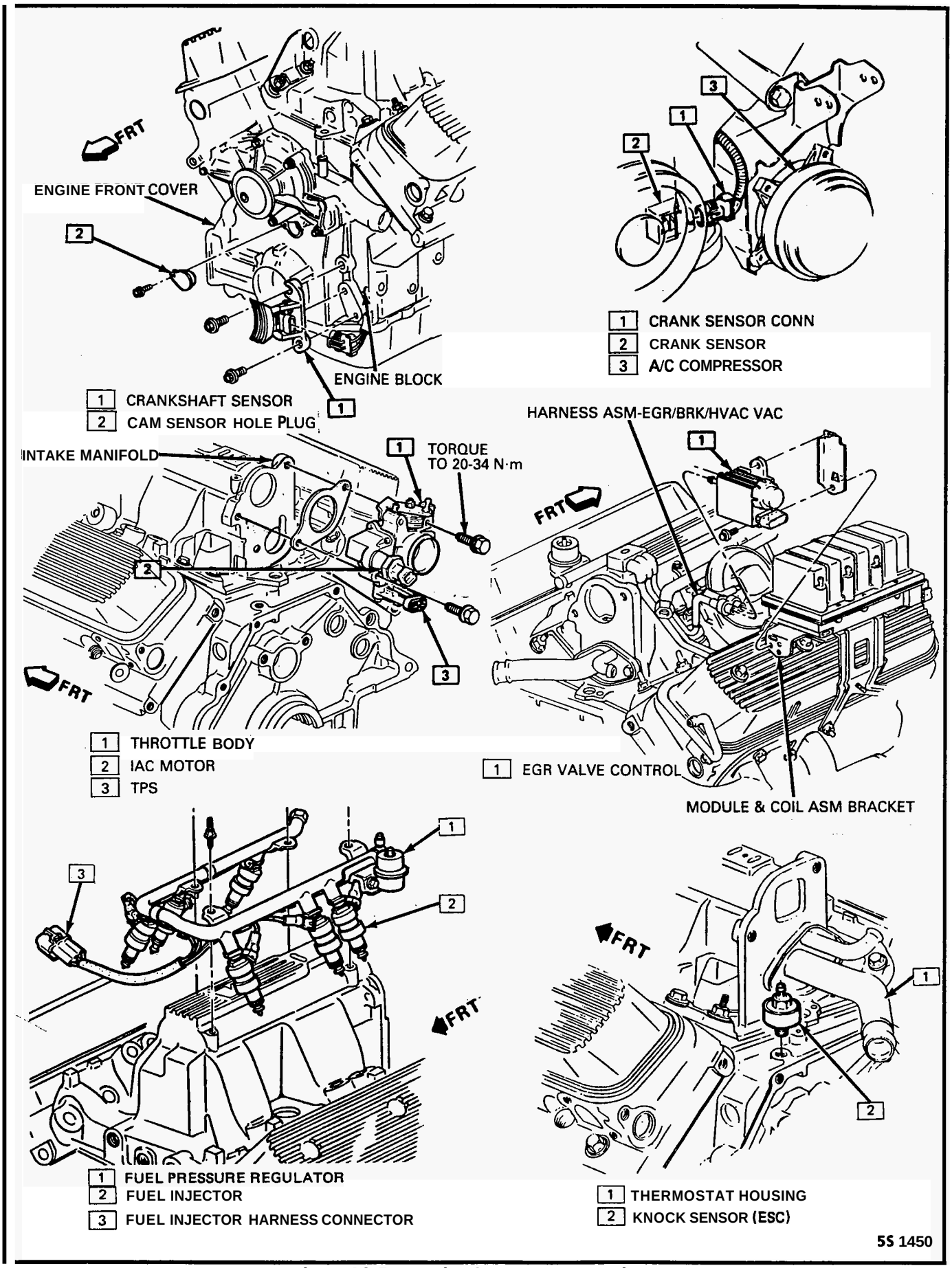
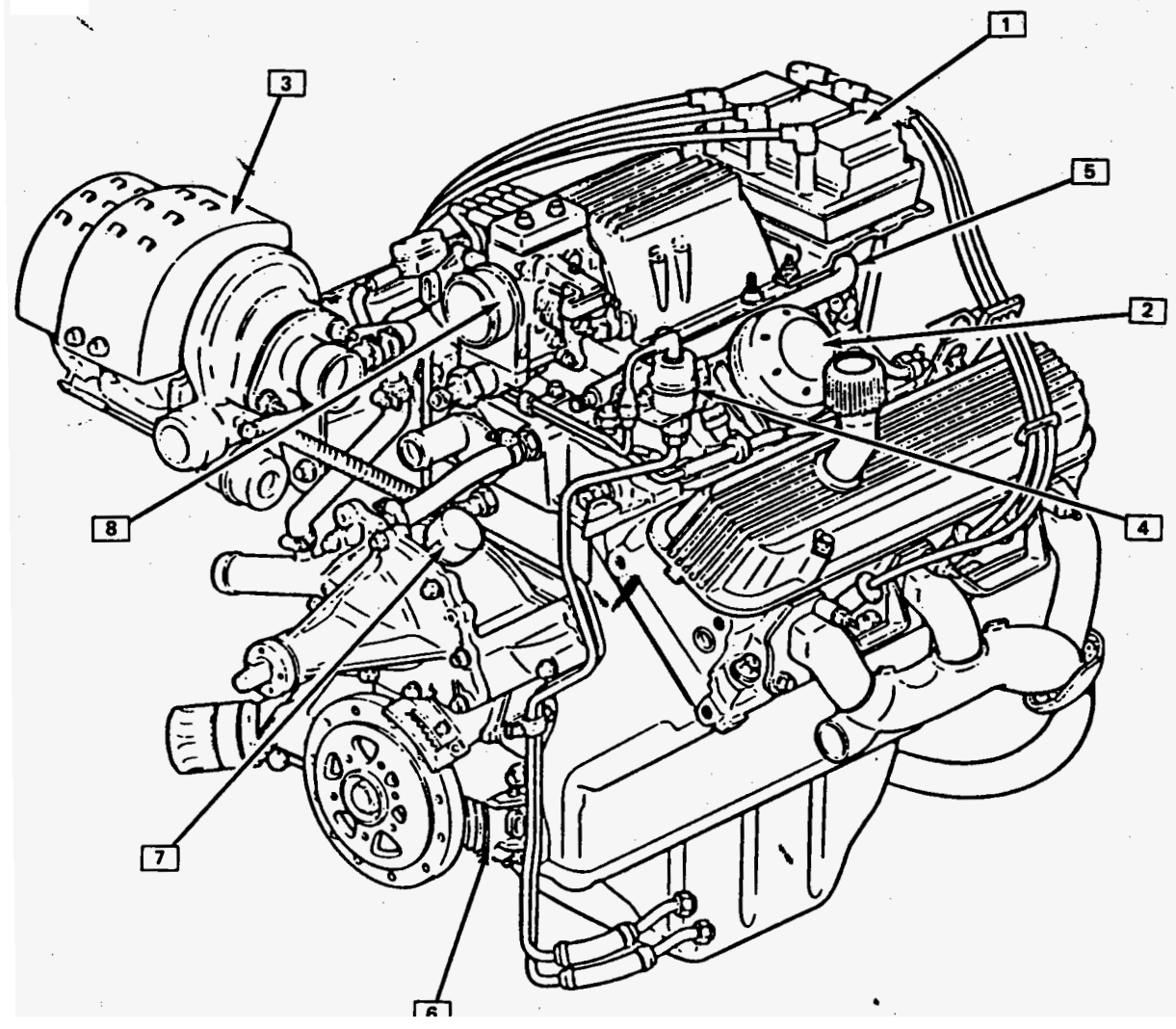


Figure A3-5 - Engine Component Location

6E3-A3-9 & 10 Not applied; Composite Views of Non 3.8 L T motors



1 C³I ASSEMBLY
2 EGR VALVE
3 TURBO ASSEBMLY
4 PRESSURE REGULATOR
5 FUEL RAIL
6 CRANKSHAFT SENSOR
7 CAMSENSOR
8 THROTTLE BODY

7S 3052

Figure A3-8 - Composite View - 3.8L Turbo "G" Series

FUEL INJECTION ECM CONNECTOR IDENTIFICATION

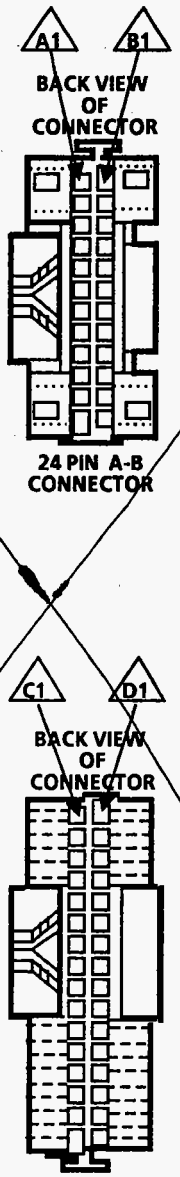
This ECM voltage chart is for use with a digital voltmeter to further aid in diagnosis. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

- Engine at operating temperature
- Engine idling in closed loop (for "Engine Run" column)
- Test terminal not grounded
- ALDL tool not installed

	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	CIRCUIT	PIN	WIRE COLOR
4	0*	B+	FUEL PUMP RELAY	A1	DK GRN/ WHT
6	B+	ON 0* OFF B+	A/C CLUTCH CONTROL	A2	LT GRN/ BLK
	B+	B+	CANISTER PURGE CONTROL	A3	DK GRN/ YEL
	B+	B+	EGR CONTROL	A4	GRY
	0*	B+	"SERVICE ENGINE SOON" CONTROL	A5	BRN/ WHT
	B+	B+	IGN (ECM) FUSE	A6	PNK/ BLK
	0*	0*	TCC CONTROL (ALDL)	A7	TAN/ BLK
3	4-3	2.5 4.5	SERIAL DATA	A8	ORN
	5.0	5.0	DIAG. TERM.	A9	BLK
1	.49	.49	VEHICLE SPEED SENSOR SIGNAL	A10	BRN/ WHT
			NOT USED	A11	
	0*	0*	SYSTEM GROUND	A12	BLK

			NOT USED	C1	
			NOT USED	C2	
	NOT USEABLE		IAC "B" LO	C3	LT GRN/ BLK
	NOT USEABLE		IAC "B" HI	C4	LT GRN/ WHT
	NOT USEABLE		IAC "A" HI	C5	LT BLU/ WHT
	NOT USEABLE		IAC "A" LO	C6	LT BLU/ BLK
	B+	B+	EGR DIAGNOSTIC	C7	RED/ WHT
			NOT USED	C8	
			NOT USED	C9	
2	2.04	2.18	COOLANT TEMP. SIGNAL	C10	YEL
			NOT USED	C11	
			NOT USED	C12	
	.36-.44	.36-.44	TPS SIGNAL	C13	DK BLU
	5	5	TPS 5 VOLT REFERENCE	C14	GRY
	B+	B+	INJECTORS # 1-3-5	C15	LT BLU
	B+	B+	BATTERY	C16	ORN



WIRE COLOR	PIN	CIRCUIT	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	
ORN	B1	BATT. 12 VOLTS	B+	B+	
	B2	NOT USED			
BLK/ RED	B3	CRANK REF. LO	0*	0*	
WHT	B4	EST CONTROL	0*	1.1	
PPL/ WHT	B5	CRANK REF. HI	0* 10.02	5.56	5
YEL	B6	MASS AIRFLOW SENSOR SIGNAL	2.5	2.48	
YEL/ BLK	B7	ESC SIGNAL	8.71	8.75	
LT BLU	B8	A/C SIGNAL (ON) (OFF)	B+ 0*	B+ 0*	6
	B9	NOT USED			
ORN/ BLK	B10	P/N SW. SIGNAL - P/N DRIVE OR REVERSE	0* B+	0* B+	
TAN	B11	AIR TEMP. SENSOR	2.89	2.96	
	B12	NOT USED			

WIRE COLOR	PIN	CIRCUIT	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	
BLK/ WHT	D1	SYSTEM GROUND	0*	0*	
DK GRN	D2	LOW SPEED FAN CONTROL	B+	B+	
BLK/ WHT	D3	CYLINDER SELECT 6 CYL.	0*	0*	
	D4	NOT USED			
TAN/ BLK	D5	BYPASS	4.56	4.55	
TAN	D6	OXYGEN SENSOR GROUND	0*	0*	
PPL	D7	02 SENSOR SIGNAL	.26	.51	3
	D8	NOT USED			
	D9	NOT USED			
BLK/ WHT	D10	SYSTEM GROUND	0*	0*	
PPL	D11	P. STEERING SIGNAL	B+	0*	
BLK	D12	TPS/CTS/ATS GROUND	0*	0*	
BLK	D13	TPS/CTS/ATS GROUND	0*	0*	
LT GRN	D14	INJECTOR # 2-4-6	B+	B+	
LT BLU	D15	INJECTOR # 1-3-5	B+	B+	
LT GRN	D16	INJECTOR # 2-4-6	B+	B+	

* Less than 1 volt.

1. Varies from .60 to battery voltage depending on position of drive wheels.
2. Normal operating temperature.
3. Varies.
4. 12V First two seconds.
5. Depends on position of vane in relation to "hall-effect" switch. Voltage will be low when vane is passing through switch.
6. Voltage will be high, or low, depending on whether A/C is "ON" or "OFF".

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Figure A3-9 - ECM Connector Terminal End View - 3.0L "N" Series

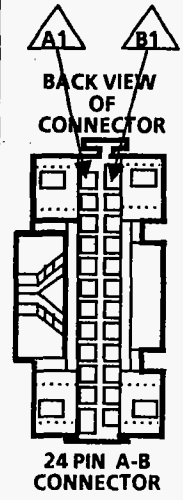
FUEL INJECTION ECM CONNECTOR IDENTIFICATION

This ECM voltage chart is for use with a digital voltmeter to further aid in diagnosis. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

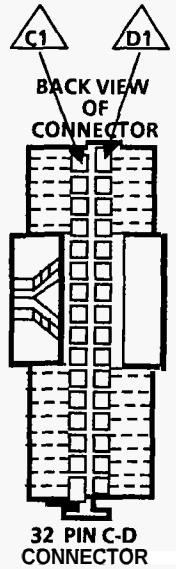
- Engine at operating temperature
- Engine idling in closed loop (for "Engine Run" column)
- Test terminal not grounded
- ALDL tool not installed

	VOLTAGE					
	KEY "ON"	ENG. RUN	CIRCUIT	PIN	WIRE COLOR	
4	0*	B+	FUEL PUMP RELAY	A1	GRN/BLK	
6	B+	ON-0* OFF B+	A/C CLUTCH CONTROL	A2	LT GRN/BLK	
	B+	B+	CANISTER PURGE CONTROL	A3	GRN/YEL	
	B+	B+	EGR CONTROL	A4	GRY	
	0*	B+	"SERVICE ENGINE SOON" CONTROL	A5	BRN/WHT	
	B+	B+	IGN - ECM FUSE	A6	PNK/BLK	
	B+	B+	TCC CONTROL ALDL	A7	TAN/BLK	
3	4.30	varies 2-5	SERIAL DATA ALDL	A8	ORN	
	5.0	5.0	DIAG. TERM. ALDL	A9	WHT/BLK	
1	0*	0*	SPEED SENSOR SIGNAL	A10	DK BRN	
5	0* B+	B+	CAM HI	A11	BLK	
	0*	0*	GROUND	A12	BLK/WHT	



	VOLTAGE					
	WIRE COLOR	PIN	CIRCUIT	KEY "ON"	ENG. RUN	
		B1	NOT USED			
		B2	NOT USED			
	BLK/RED	B3	CRANK REF LOW	0*	0*	
	WHT	B4	EST CONTROL	0*	0*	
5	PPL/WHT	B5	CRANK REF. HI	0* B+	B+	
	YEL	B6	MASS AIR FLOW SENSOR SIGNAL	2.50	2.48	
	YEL/BLK	B7	ESC SIGNAL	8.71	8.75	
6	LT BLU	B8	A/C SIGNAL ON OFF	B+ 0*	B+ 0*	
		B9	NOT USED			
	ORN/BLK	B10	PARK/NEUTRAL SW.SIGNAL	0*	0*	
		B11	NOT USED			
	BLK/WHT	B12	INJ. 5	B+	B+	

		NOT USED	C1	
		NOT USED	C2	
NOT USEABLE		IAC "B" LO	C3	GRN/BLK
NOT USEABLE		IAC "B" HI	C4	GRN/WHT
NOT USEABLE		IAC "A" HI	C5	BLU/WHT
NOT USEABLE		IAC "A" LO	C6	BLU/BLK
0*	0*	3 RD GEAR SIGNAL	C7	GRN/WHT
0*	0*	4TH GEAR SIGNAL	C8	LT BLU
		NOT USED	C9	
2 2.04	2.18	COOLANT TEMP. SIGNAL	C10	YEL
2.46	2.09	AIR TEMP.	C11	TAN
B+	B+	INJ. 6	C12	BLK/YEL
.36-.44	.36-.44	TPS SIGNAL	C13	DK BLU
5.0	5.0	TPS 5 VOLT REFERENCE	C14	GRY
B+	B+	INJ. 2	C15	BLK/GRN
B+	B+	BATTERY 12 VOLTS	C16	ORN



BLK/WHT	D1	GROUND	0*	0*
DK GRN	D2	LO SPEED FAN CNTL	B+	B+
PNK/WHT	D3	WASTEGATE CONTROL	B+	B+
	D4	NOT USED		
TAN/BLK	D5	BYPASS	4.56	4.55
TAN	D6	GROUND, (0_2)	0*	0*
PPL	D7	0^2 SENSOR SIGNAL	0*	0*
	D8	NOT USED		
PPL/WHT	D9	EGR DIAG.	B+	B+
BLK/WHT	D10	GROUND	0*	0*
	D11	NOT USED		
BLK	D12	TPS/CTS/ATS GROUND	0*	0*
	D13	NOT USED		
BLK	D14	INJ. 1	B+	B+
BLK/PNK	D15	INJ 3	B+	B+
BLK/RED	D16	INJ.4	B+	B+

* Less than 1 volt.

1. Varies from .45 to battery voltage depending on position of drive wheels.
2. Normal operating temperature.
3. Varies.
4. 12V First *two* seconds.
5. Depends on position of vane in relation to "hall-effect" switch. Voltage will be low when vane is passing through switch.
6. Engine running voltage will be high or low, depending whether A/C is on or off.

ENGINE 3.8L TURBO

CARLINE "G"

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B+, Positive Battery Voltage

Figure A3-2d - ECM Connector Terminal End View - 3.8L Turbo "G" Series

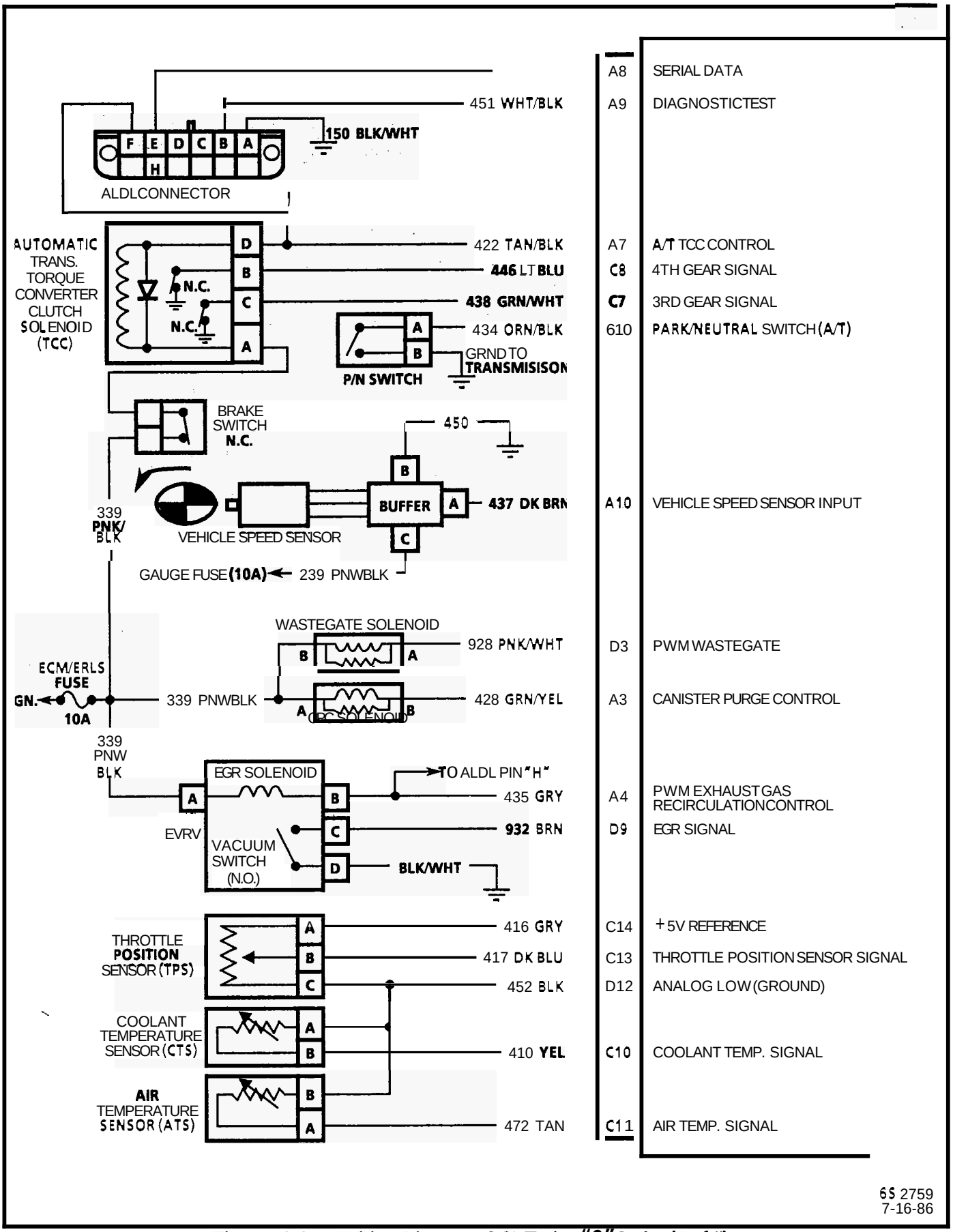


Figure A3-21 • Wiring Diagram • 3.8L Turbo "G" Series (1 of 3)

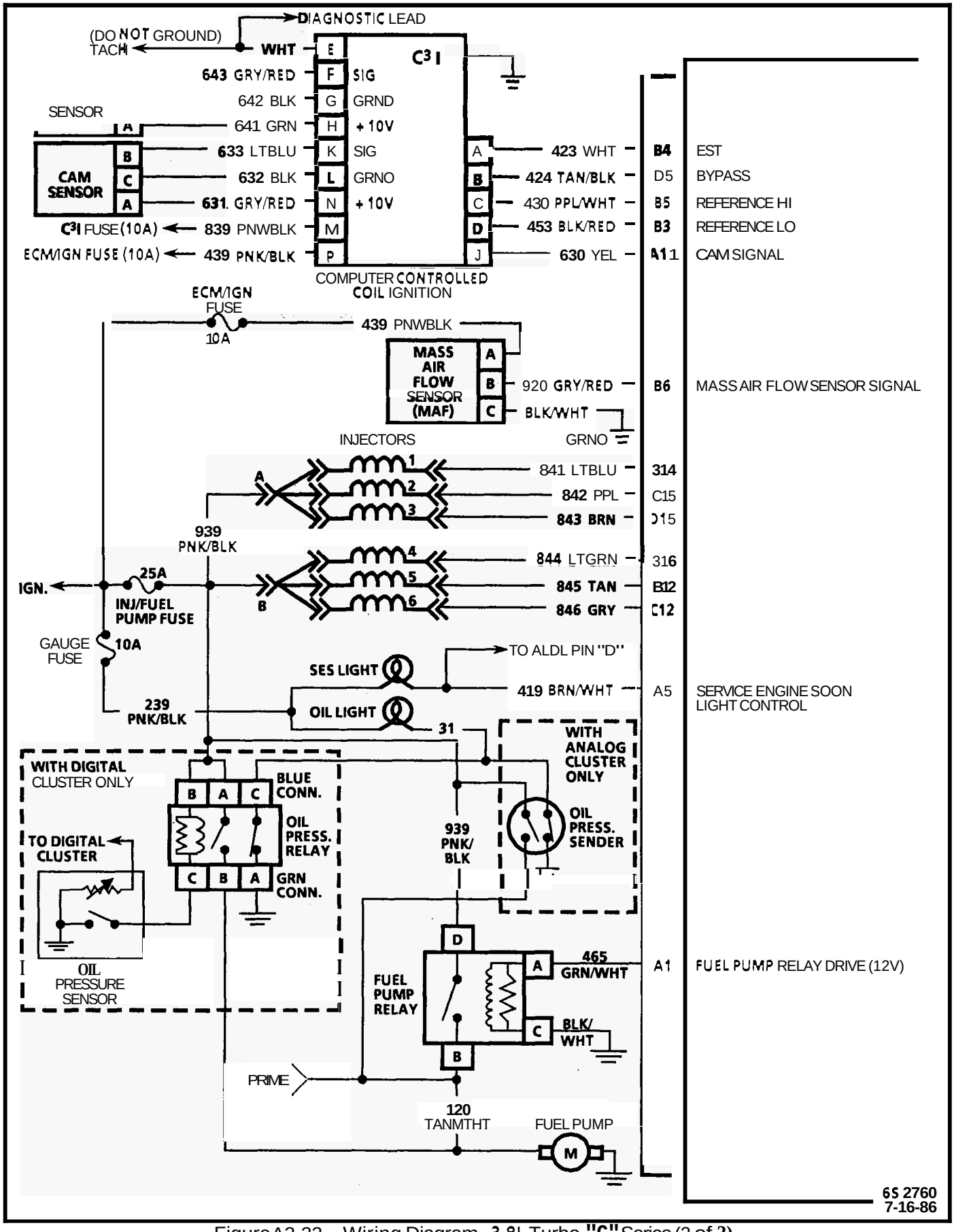


Figure A3-22 - Wiring Diagram - 3.8L Turbo "G" Series (2 of 3)

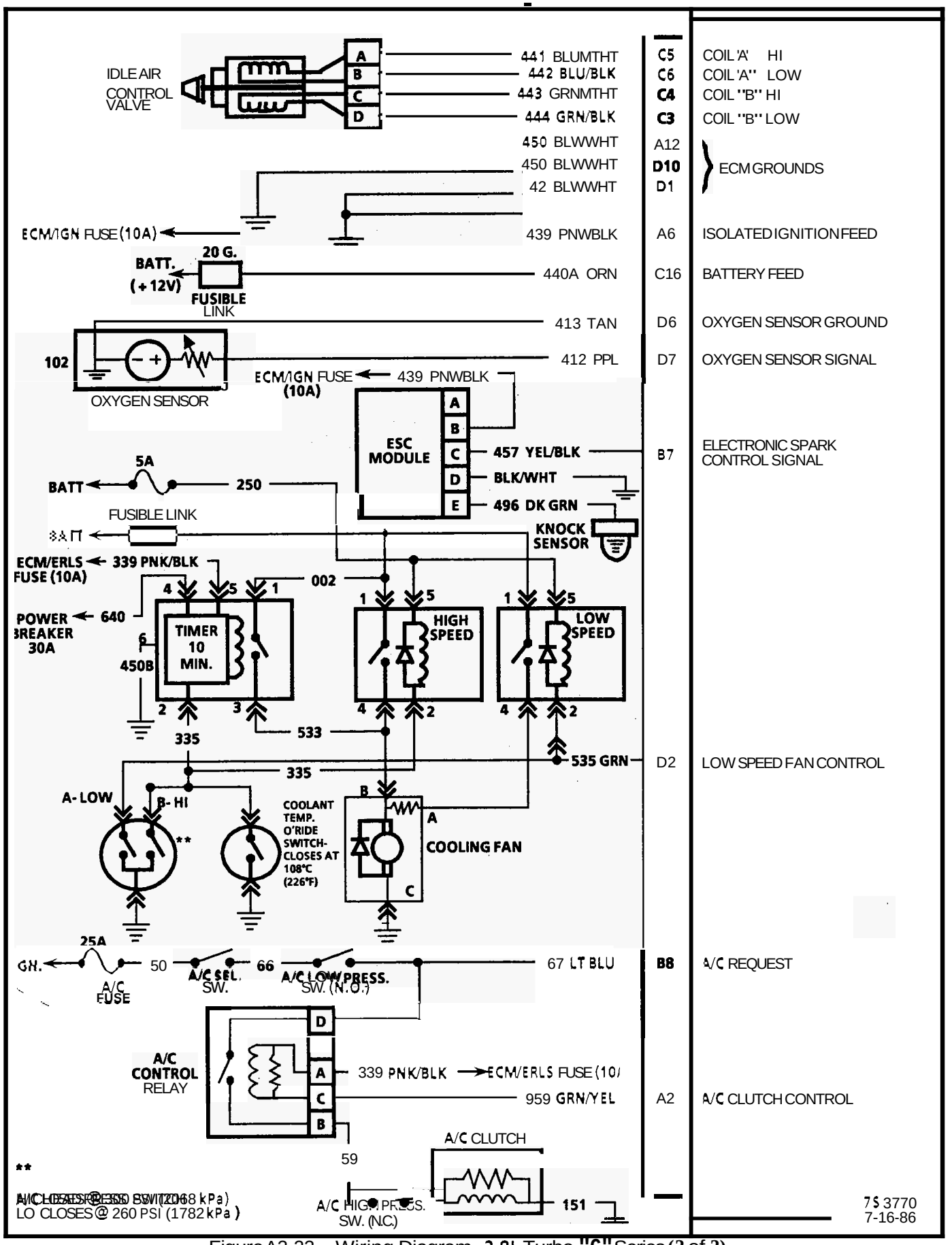


Figure A3-23 - Wiring Diagram - 3.8L Turbo "G" Series (3 of 3)

BLANK

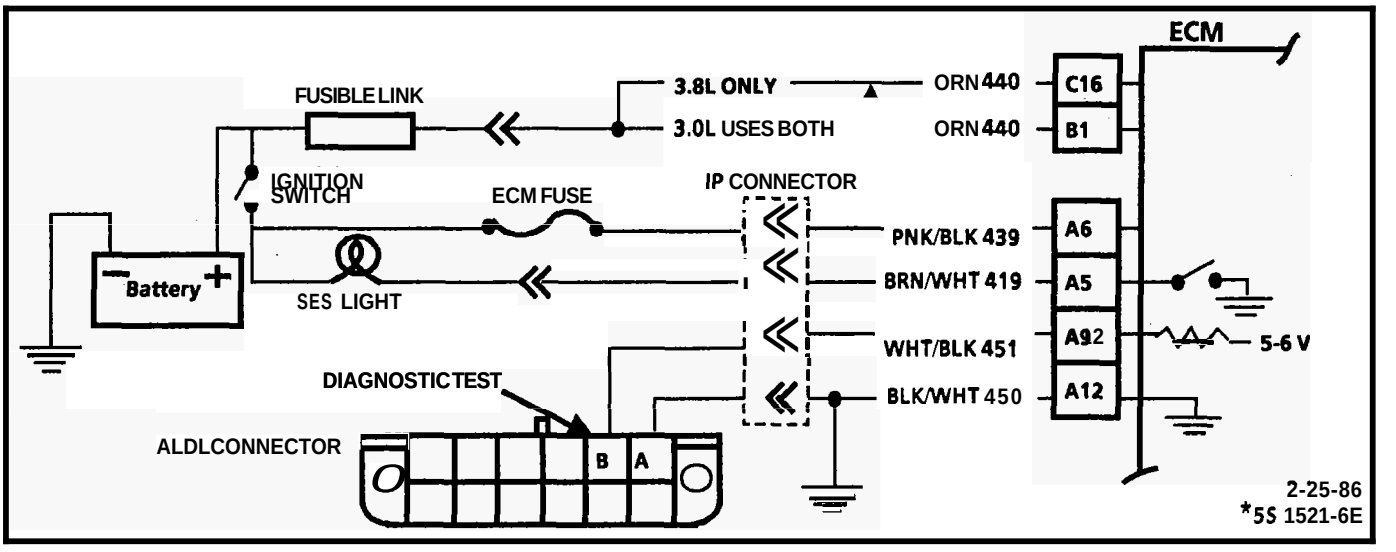


CHART A-I

NO "SERVICE ENGINE SOON" LIGHT
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

There should always be a steady "Service Engine Soon" light, when the ignition is "ON" and engine stopped. Battery is supplied directly to the light bulb. The Electronic Control Module (ECM) will control the light and turn it "ON" by providing a ground path through CKT **419** to the ECM.

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. "Service Engine Soon" light should be "ON" as the test light provides the ground.
2. Using a test light connected to **12** volts, probe each of the system ground circuits to be sure a good ground is present. See ECM terminal end view in front *of* this section for ECM pin locations of ground circuits.

Diagnostic Aids:

(Engine runs OK, check:

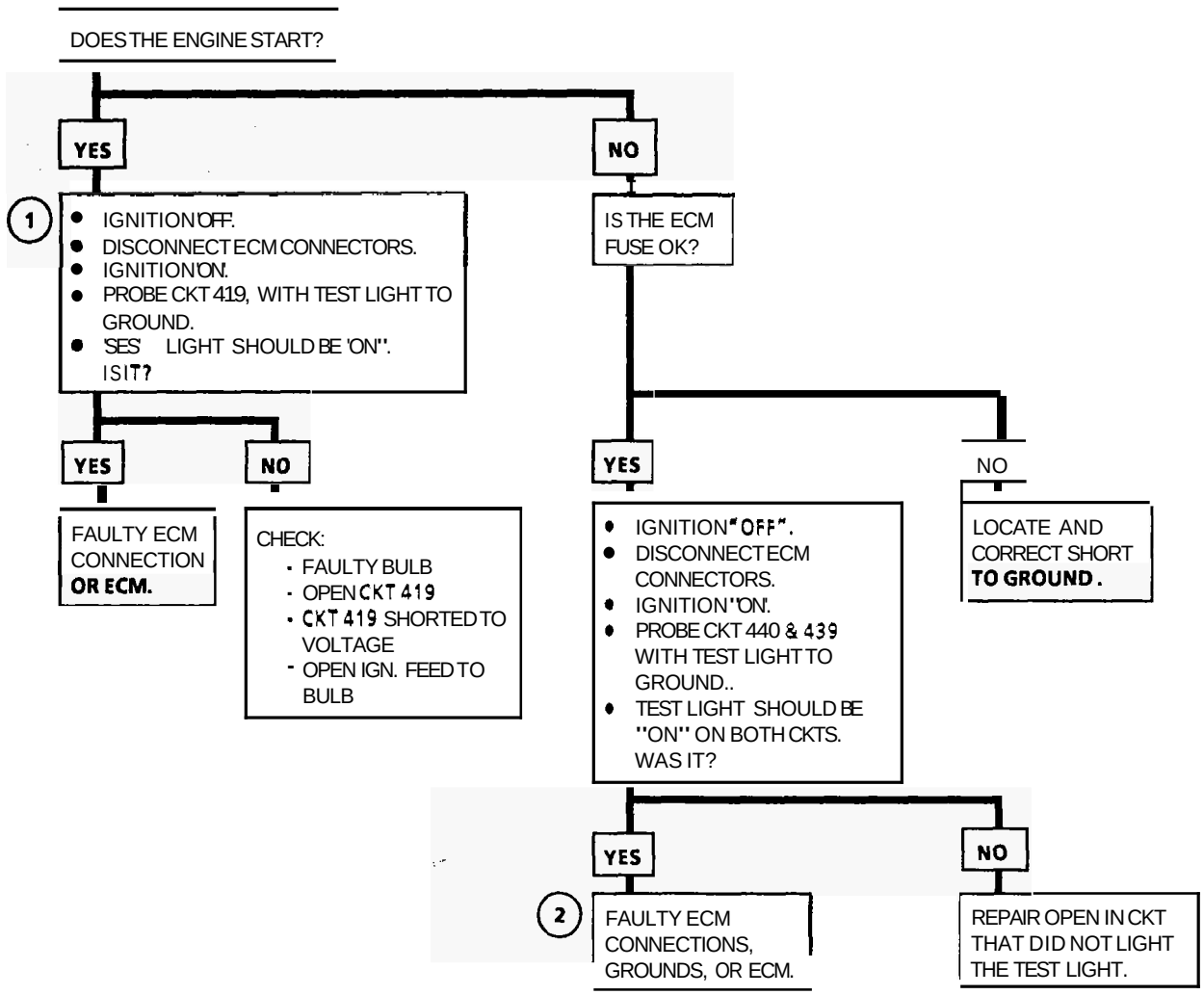
- Faulty light bulb
- CKT 419 open

Engine cranks, but will not run.

- Continuous battery - fuse or fusible link open
- ECM ignition fuse open
- Ignition CKT **439** to ECM open
- Poor connection to ECM

CHART A-1

NO "SERVICE ENGINE SOON" LIGHT
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)



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

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* 7S 3494-6E

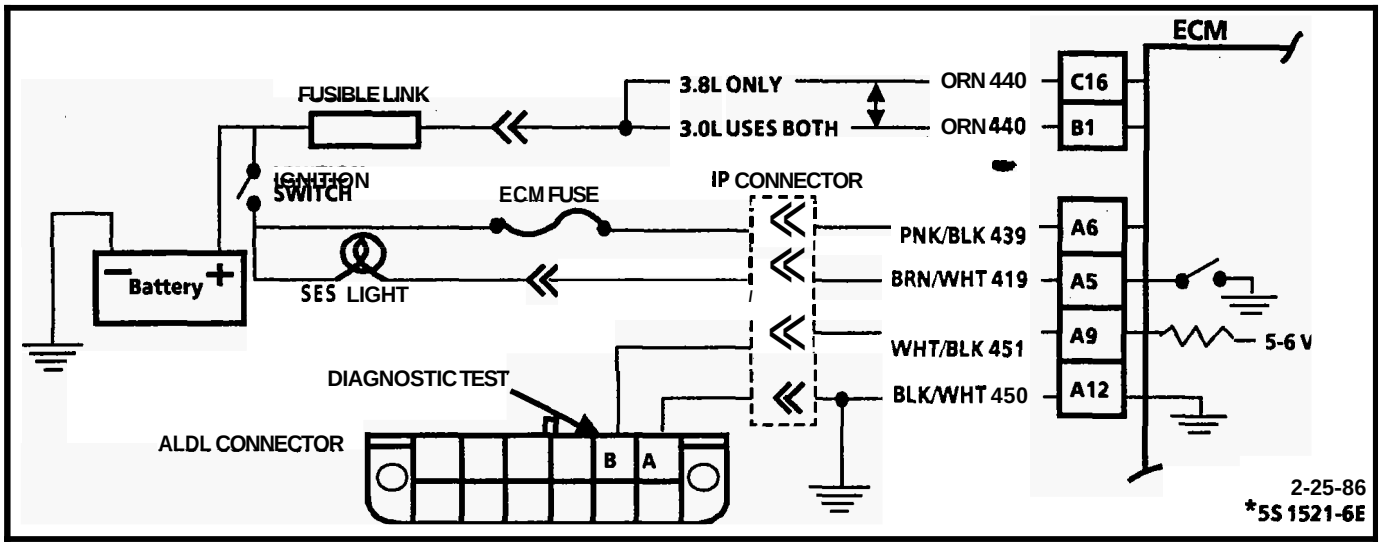


CHART A-2

NO ALDL DATA OR WON'T FLASH CODE 12 "SERVICE ENGINE SOON" LIGHT ON STEADY 3.0L "N" SERIES 3.8L "A, C & H" SERIES 3.8L TURBO "G" SERIES (PORT)

Circuit Description:

There should always be a steady "Service Engine Soon" light, when the ignition is "ON" and engine stopped. Battery is supplied directly to the light bulb. The Electronic Control Module (ECM) will turn the light "ON" by grounding CKT **419** at the ECM.

With the diagnostic terminal grounded, the light should flash a Code **12,** followed by any trouble code(s) stored in memory.

A steady light suggests a short to ground in the light control CKT **419,** or an open in diagnostic CKT **451.**

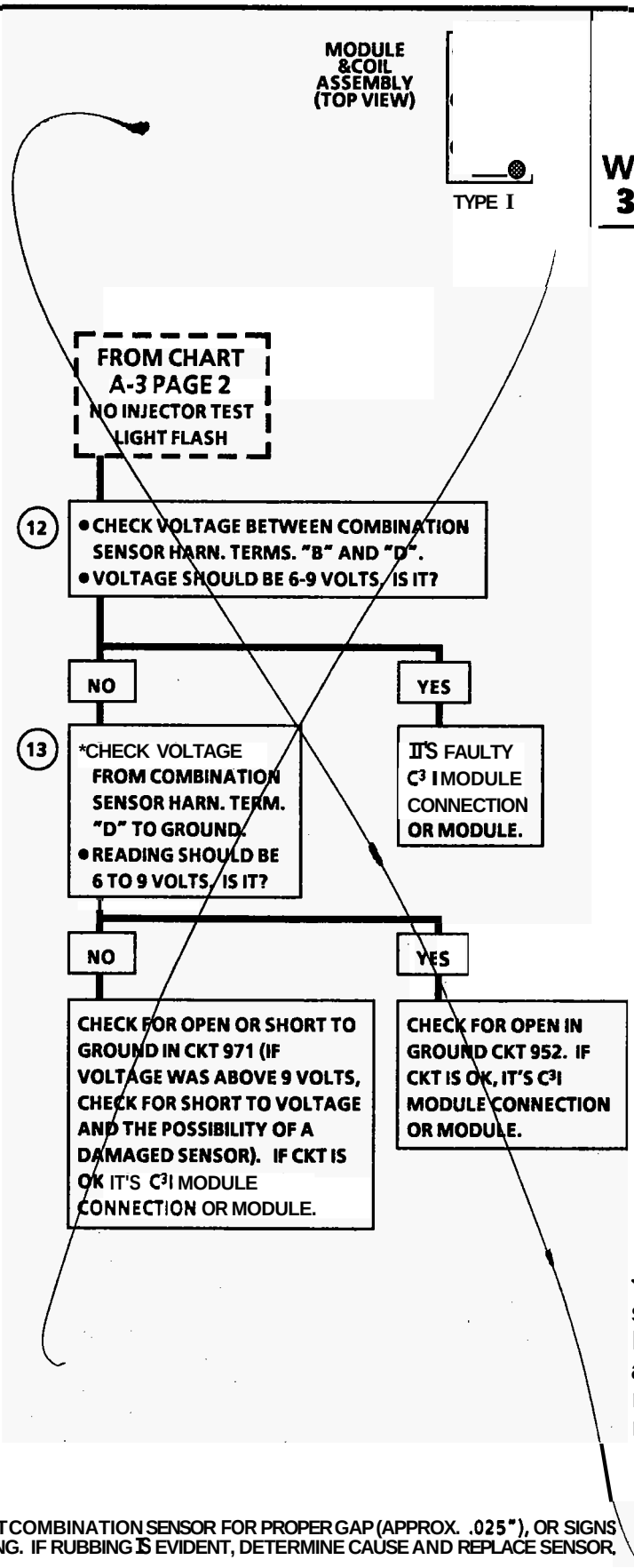
Test Description: Step numbers refer to step numbers on diagnostic chart.

1. If there is a problem with the ECM that causes a "Scan" tool to not read Serial data, then the ECM should not flash a Code **12.** If Code **12** does flash, be sure that the "Scan" tool is working properly on another vehicle. If the "Scan" is functioning properly and CKT **451** is OK, the PROM or ECM may be at fault for the NO ALDL symptom.
2. If the light goes "OFF", when the ECM connector is disconnected, then CKT **419** is not shorted to ground.
3. This step will check for an open diagnostic CKT **451.**
4. At this point, the "Service Engine Soon" light wiring is OK. The problem is a faulty ECM or PROM. If Code **12** does not flash, the ECM should be replaced using the original PROM. Replace the PROM only after trying an ECM, as a defective PROM is an unlikely cause of the problem.

CHART A-3

(Page 3 of 3)

ENGINE CRANKS BUT WON'T RUN "TYPE I C³I" 3.0L "N" SERIES (PORT)



★**CAUTION:** When jumpering sensor terminals, be sure to keep fingers clear of pulleys and belts as a slight movement of belt may occur, resulting in possible injury.

• INSPECT COMBINATION SENSOR FOR PROPER GAP (APPROX. .025"), OR SIGNS OF RUBBING. IF RUBBING IS EVIDENT, DETERMINE CAUSE AND REPLACE SENSOR.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON' LIGHT.

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7S 3492-6E

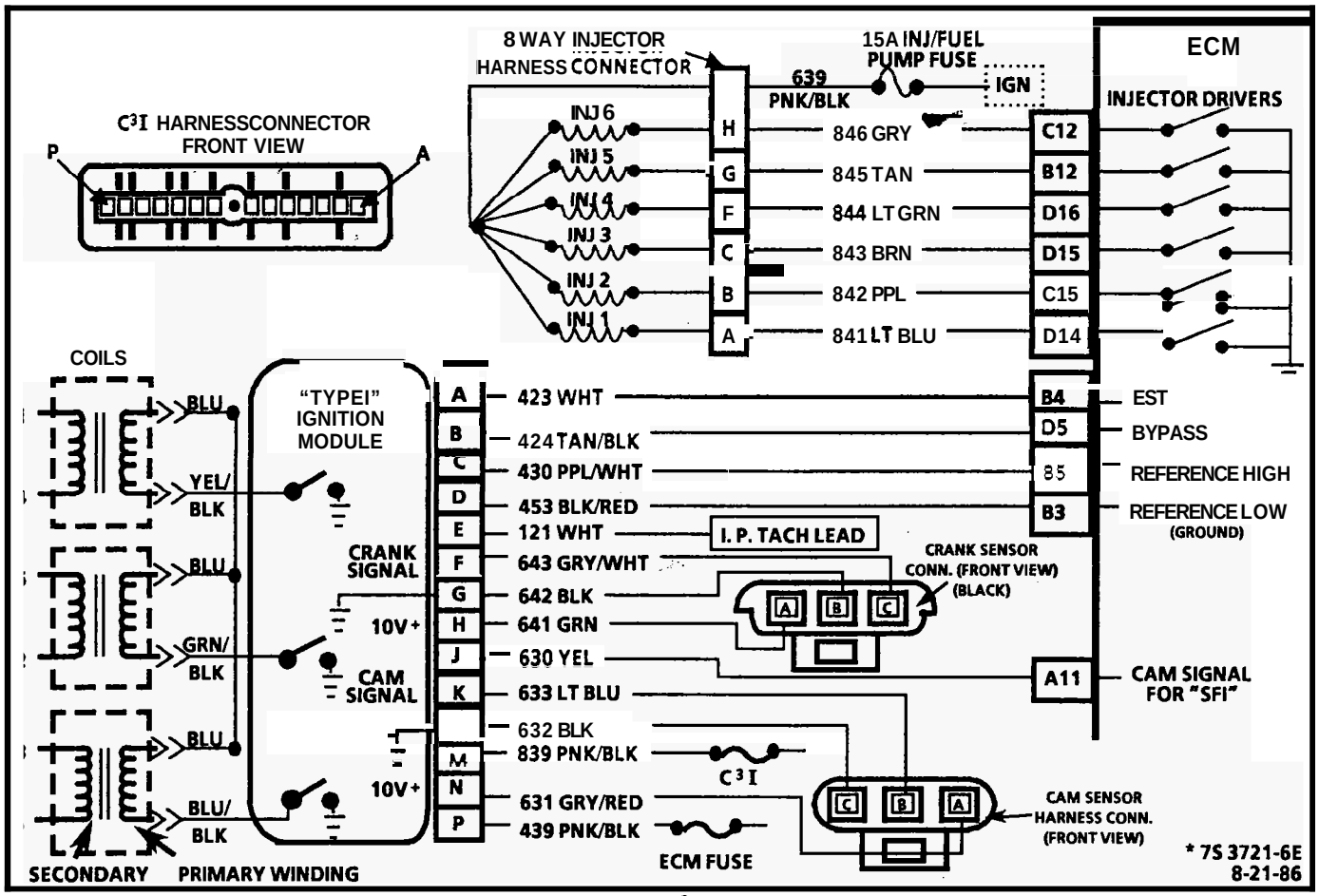


CHART A-3

(Page 1 of 3)

ENGINE CRANKS BUT WON'T RUN "TYPE I C3I" 3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The C3I uses a waste spark method of spark distribution. In this type of ignition system the ignition module triggers the #1/4 coil pair resulting in both #1 and #4 spark plugs firing at the same time. #1 cylinder is on the compression stroke at the same time #4 is on the exhaust stroke, resulting in a lower energy requirement to fire #4 spark plug. This leaves the remaining high voltage to fire #1 spark plug.

The Sequential Fuel Injection type of fuel delivery system utilizes 6 separate injector driver circuits to activate the 6 fuel injectors. While cranking, the ECM activates all 6 injectors simultaneously (all at one time). After a calibrated engine rpm is reached and a good Cam signal has been received by the ECM, the injection mode of operation is changed to Sequential (timed seperately).

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Identification of "TYPE I" or "TYPE II" ignition system is very important, because the "TYPE I" diagnostics will not work on "TYPE II" systems. Identification can be made by comparing the position of the coil towers with the drawing at the top of the chart. This step verifies "SES" light operation, TPS and Coolant Sensor signals are normal. A blinking injector test light verifies that the ECM is monitoring the C3I reference signal and attempting to activate the injectors.
2. Both the Cam and Crank Sensors have been verified as functioning properly as is evidenced by the blinking injector test light. A fuel pressure test, at this point, will separate the diagnostic path into either a fuel related fault, or ignition system malfunction.
3. The 8 terminal injector harness connector must be disconnected to avoid flooding of the engine and fouling of the spark plugs. By testing for spark on plug leads 1, 3, and 5, each ignition coil's ability to produce at least 25,000 volts is verified.
4. By testing the problem coil's control circuit with a test light, a determination can be made as to the problem coil being faulty or the module's internal driver for that coil being the source of the complaint.
5. An injector, with a resistance value of less than 10 ohms (shorted), could cause repeat ECM failures.
6. Tests for battery voltage on CKT 639. If voltage was present, the "light off" test result was caused by no activation pulse reaching the injector connector from the ECM.

CHART A93

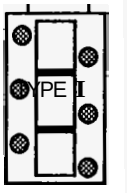
(Page 1 of 3)

ENGINE CRANKS BUT WON'T RUN "TYPE I C³I" 3.8L TURBO "G" SERIES (PORT)

NOTICE; FUEL SYSTEM IS UNDER PRESSURE. TO AVOID FUEL SPILLAGE, REFER TO FIELD SERVICE PROCEDURES FOR TESTING OR REPAIRS REQUIRING DISASSEMBLY OF FUEL LINES OR FITTINGS.

1
- VERIFY TYPE OF IGNITION SYSTEM (TYPE I OR TYPE II)
- FUEL QUANTITY OK.
- IGNITION ON, THROTTLE CLOSED.
- "SERVICE ENGINE SOON LIGHT" SHOULD BE ON. (IF NOT SEE CHART A-1.
- IF CODE 41 IS DISPLAYED, START TEST AT STEP # 9 ON PAGE 2 OF THIS CHART.
- TPS SHOULD "SCAN" LESS THAN 2.5V. (IF NOT SEE CODE CHART 21)
- COOLANT TEMPERATURE SHOULD "SCAN" BETWEEN -30°C & 130% (IF NOT SEE CHART 14 OR 15)
- DISCONNECT ANY INJECTOR CONNECTOR AND INSTALL INJECTOR TEST LIGHT J-34730-2 OR EQUIVALENT IN INJECTOR HARNESS CONNECTOR.
- CRANK ENGINE AND OBSERVE TEST LIGHT. IT SHOULD BLINK. DOES IT?

MODULE &COIL ASSEMBLY (TOP VIEW)



YES

NO

STEADY LIGHT

LIGHT "OFF"

2
- IGNITION "OFF", INSTALL FUEL PRESS. GAGE AND NOTE PRESS. AFTER IGNITION IS TURNED ON FOR 2 SECONDS, PRESSURE SHOULD BE 234-276 kPa (34-40 PSI). IS IT?

YES

NO

NO PRESSURE

INCORRECT PRESSURE

SEE CHART A 5

SEE CHART A 7

3
- DISCONNECT 8 TERM. INJ. HARNESS CONN.
- CHECK FOR SPARK WITH SPARK TESTER (ST-125) J-26792, OR EQUIV. ON PLUG WIRES 1, 3 & 5 (ONE AT A TIME) WHILE CRANKING, WITH REMAINING PLUG WIRES STILL CONNECTED.

NO SPARK ON ONE OR TWO WIRES

SPARK ON ALL

NO SPARK ON ALL

4
- VERIFY THAT PLUG WIRE RESISTANCE IS LESS THAN 30K OHMS. (IF NOT, REPLACE)
- REMOVE 6 COIL SCREWS AND TILT COIL ASSEMBLY BACK.
- DISCONNECT THE AFFECTED COIL'S CONTROL WIRE FROM THE MODULE.
- CONNECT A TEST LIGHT BETWEEN THE COMMON FEED (BLUE) AND CONTROL WIRE FOR THE COIL BEING TESTED.
- THE TEST LIGHT SHOULD BLINK WHILE CRANKING ENGINE. DOES IT?

CHECK FOR FUEL WET SPARK PLUGS. IF OK, SEE "DIAGNOSTIC AIDS" ON FACING PAGE.

CHECK CKT 839 TO C³I TERM. "M" FOR OPEN. IF CKT IS OK, IT'S FAULTY C³I MODULE CONNECTION OR MODULE.

NO

THE C³I MODULE IS FAULTY. ALSO CHECK PRIMARY COIL RESISTANCE. IF RESISTANCE IS NOT BETWEEN .5 AND .9 OHMS, REPLACE THE COIL AND THE C³I MODULE.

YES

FAULTY IGNITION COIL CONNECTION OR COIL.

6
- REMOVE TEST LIGHT.
- PROBE INJECTOR HARNESS POWER TERMINAL AT INJ. WITH A TEST LIGHT TO GROUND.
- TEST LIGHT SHOULD BE ON. IS IT?

NO

CKT 639 FROM IGN. FEED IS OPEN OR SHORTED TO GND.

YES

SEE PAGE 2 OF THIS CHART

5
- *CHECK INJECTOR DRIVER CIRCUIT FOR A SHORT TO GROUND.
- IF CKT. IS NOT SHORTED, CHECK RESISTANCE ACROSS INJECTOR.
- RESISTANCE SHOULD BE OVER 10 OHMS. IS IT?

YES

FAULTY ECM

NO

FAULTY ECM AND INJECTOR

* INSPECT CRANK SENSOR FOR PROPER GAP (APPROX. .025"), OR SIGNS OF RUBBING. IF RUBBING IS EVIDENT, DETERMINE CAUSE AND REPLACE SENSOR.

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

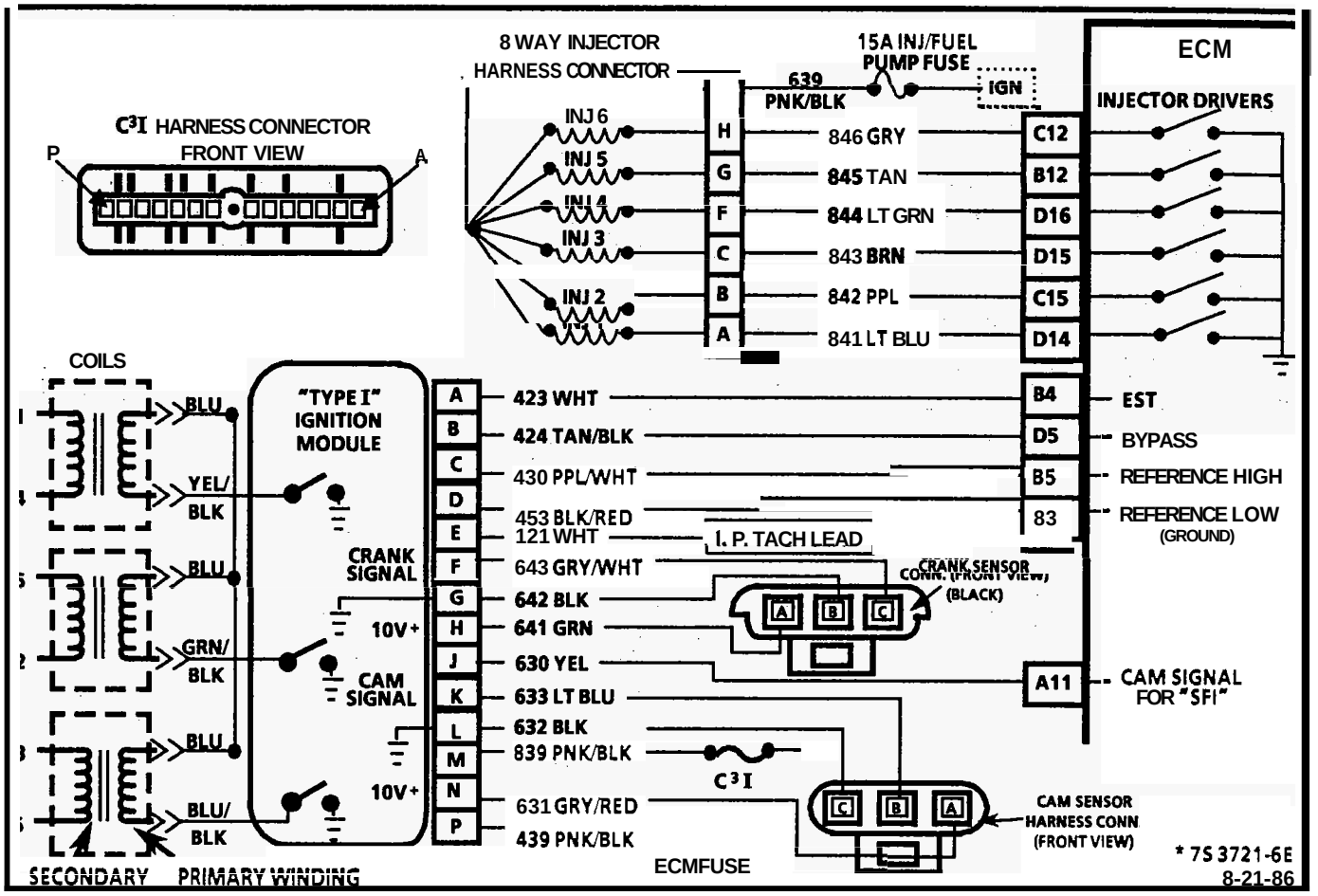


CHART A-3

(Page 2 of 3)
ENGINE CRANKS BUT WON'T RUN "TYPE I C³I"
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

For timing of spark plug firing, a cam sensor "hall effect" switch is used. The cam sensor sends a signal (Sync-Pulse) to the ignition module when cylinder #1 is 25° after top dead center on the compression stroke. This signal is used to start the correct coil firing sequence and to enable sequential fuel injection. The engine will continue to run if the cam signal is lost while running, however, will not restart after shut down and a Code 41 will be stored.

The crank sensor sends a signal to the ignition module and then to the ECM for reference rpm and crankshaft position. There are three windows in a disc (interruptor) which is mounted to the harmonic balancer. These windows pass by the sensor and as each window passes, the next coil is triggered.

Test Description: Step numbers refer to step numbers on diagnostic chart.

7. Verifies ignition feed voltage at terminal "P" of the C³I module. Less than battery voltage would be an indication of a CKT 439 fault.
8. The test light to 12 volts simulates a reference signal to the ECM which will result in an injector test light blink if the CKT 430, the ECM and the injector driver circuit are all OK.
9. If the Cam Sensor signal circuit terminal "B" is momentarily jumpered to the ground circuit terminal "C" and the engine is cranked, without turning the ignition switch "OFF", the response should be an injector test light blink. This is a result of the artificial "Cam Signal" being transmitted through the C³I module to ECM terminal "All" and the ECM activating the injector driver circuit.
10. Verifies a proper Cam signal circuit voltage of 6 to 9 volts and a good ground from the C³I module to terminal "C" of the sensor connector.
11. Determines if reason for incorrect voltage reading was due to a fault in CKT 633, an open in CKT 632 or a faulty C³I module.

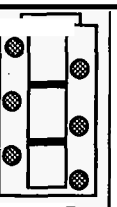
CHART A-3

(Page 2 of 3)

ENGINE **CRANKS BUT** WON'T RUN "TYPE I C31 3.8L TURBO "G" SERIES (PORT)

FROM CHART A-3 PAGE1
TEST LIGHT ON

MODULE &COIL ASSEMBLY (TOP VIEW)



TYPE I

(7) • DISCONNECT C3I MODULE 14 PIN CONNECTOR.
• IGNITION ON, CHECK VOLTAGE AT HARNESS TERMINAL "P".
• **READING SHOULD BE APPROX. BATTERY VOLTAGE. IS IT?**

YES

(8) • IGNITION ON, CONNECT A TEST LIGHT TO 12 VOLTS AND REPEATEDLY TOUCH TO C3I MODULE HARN. TERM. "C".

NO

OPEN IN IGNITION FEED CKT 439.

YES

FROM STEP #1 FOR CODE 41

(9)

NO

(10) • CHECK VOLTAGE BETWEEN CAM SENSOR HARN. TERMS. "B" AND "C".
• VOLTAGE SHOULD BE 6-9 VOLTS. IS IT?

NO

(11) • **CHECK VOLTAGE FROM CAM** SENSOR HARNESS TERM. "B" TO GROUND.
• READING SHOULD BE 6 TO 9 VOLTS. IS IT?

NO

CHECK CKT 633 FOR OPEN OR SHORT TO GROUND (IF VOLTAGE WAS ABOVE 9 VOLTS, CHECK FOR A SHORT TO VOLTAGE AND THE POSSIBILITY OF A DAMAGED SENSOR. IF CKT IS OK, IT'S C3I MODULE CONNECTION OR MODULE.

YES

CHECK CKT 632 FOR OPEN. IF CKT IS OK, IT'S FAULTY C3I MODULE CONNECTION OR MODULE.

YES

SEE PAGE 3 OF THIS CHART

YES

• CHECK VOLTAGE AT CAM SENSOR HARN. TERM. "A".
• SHOULD BE OVER 10 VOLTS. **IS IT?**

NO

CHECK FOR OPEN POWER FEED CKT 631. IF CKT IS OK, IT'S FAULTY C3I MODULE CONNECTION OR MODULE.

YES

VERIFY THAT CAM SENSOR INTERRUPTOR IS TURNING WHILE CRANKING ENGINE. IF OK, IT'S FAULTY CAM SENSOR CONNECTION OR SENSOR.*

NO

• **CHECK INJECTOR DRIVER CIRCUIT FROM** ECM FOR OPEN OR SHORT TO VOLTAGE.
• IS CIRCUIT OK?

YES

CHECK CKT 430 FOR OPEN OR SHORT TO GROUND OR TO VOLTAGE. IF CKT 430 IS OK, IT'S POOR CONNECTION

NO

REPAIR INJECTOR DRIVER CIRCUIT

★**CAUTION:** When jumping sensor terminals, be sure to keep fingers clear of pulleys and belts as a slight movement of belt may occur, resulting in possible injury.

* INSPECT CRANK SENSOR FOR PROPER GAP (APPROX. .025"), OR SIGNS OF RUBBING. IF RUBBING IS EVIDENT, DETERMINE CAUSE AND REPLACE SENSOR.

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

11-25-86
7S 3772-6E

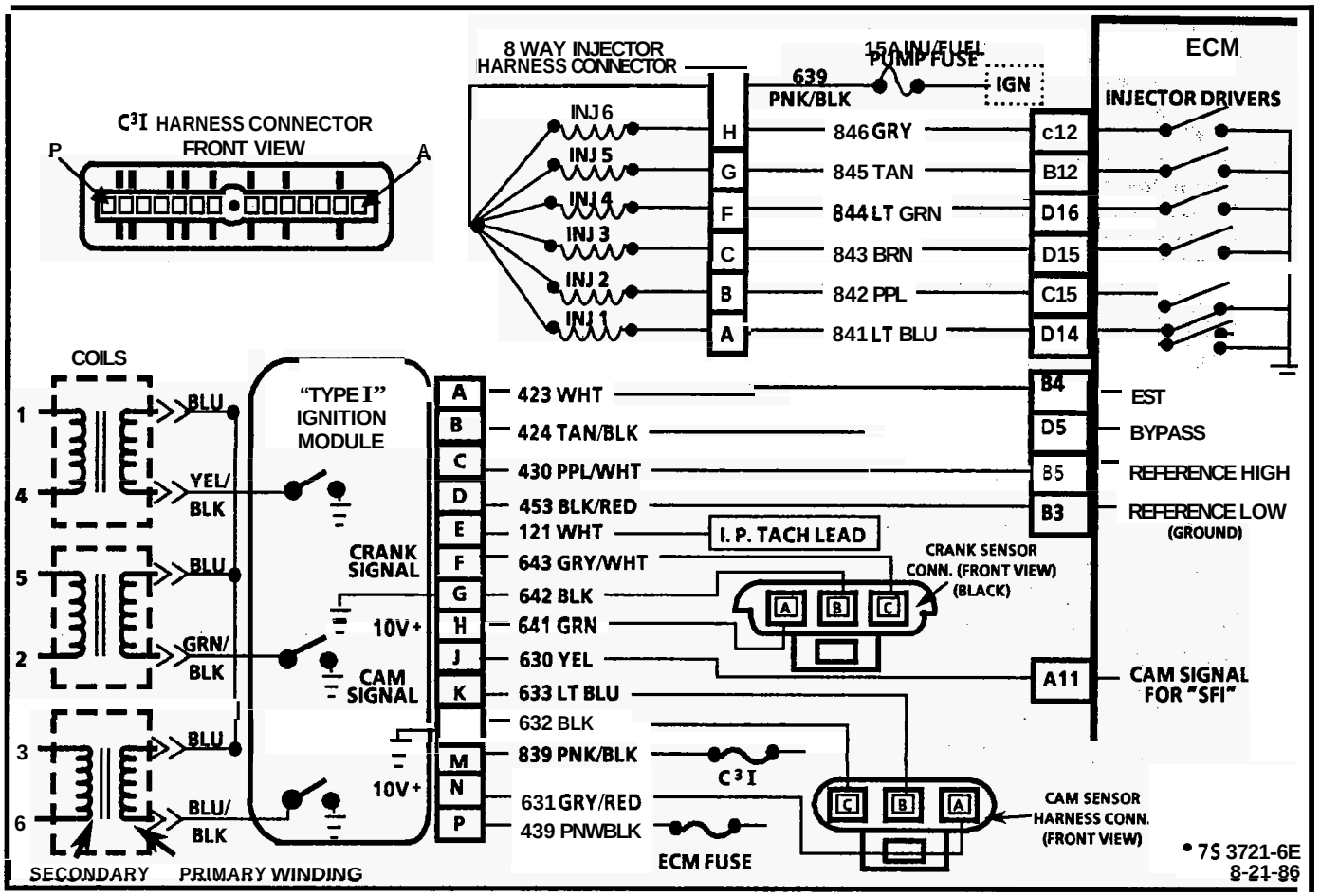


CHART A-3

(Page 3 of 3)
ENGINE CRANKS BUT WON'T RUN "TYPE I C³I"
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

For timing of spark plug firing, a cam sensor "hall effect" switch is used. The cam sensor sends a signal (Sync-Pulse) to the ignition module when cylinder #1 is 25° after top dead center on the compression stroke. This signal is used to start the correct coil firing sequence and to enable sequential fuel injection. The engine will continue to run if the cam signal is lost while running, however, will not restart after shut down and a Code 41 will be stored.

The crank sensor sends a signal to the ignition module and then to the ECM for reference rpm and crankshaft position. There are three windows in a disc (interruptor) which is mounted to the harmonic balancer. These windows pass by the sensor and as each window passes, the next coil is triggered.

Test Description: Step numbers refer to step numbers on diagnostic chart.

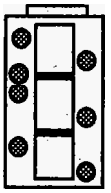
12. Jumpering the Crank Sensor harness terminals "B" and "C" together simulates a Cam signal to the C³I module. Then, by repeatedly jumping the Crank sensor harness terminals "B" and "C" together a Crank signal is simulated which should result in the injector test light blinking.

13. Verifies a proper Crank signal circuit voltage of 6 to 9 volts and a good ground from the C³I module to terminal "B" of the sensor connector.

14. Determines if reason for incorrect voltage reading was due to a fault in CKT 643, an open in CKT 642 or a faulty C³I module.

CHART A-3

(Page 3 **of 3**)
ENGINE CRANKS BUT WON'T RUN "TYPE I C³I"
3.8L TURBO "G" SERIES (PORT)



TYPE I

FROM CHART A-3 PAGE 2
NO INJECTOR TEST LIGHT FLASH

12
- IGNITION ON AND INJECTOR TEST LIGHT STILL IN PLACE.
- MOMENTARILY JUMPER CAM SENSOR HARNESS CONNECTOR (GRAY) TERMINALS "B" TO "C".
- REPEATEDLY JUMPER CRANK SENSOR HARNESS CONNECTOR (BLACK) TERMINALS "B" TO "C". ★ SEE CAUTION.
- INJECTOR TEST LIGHT SHOULD FLASH EACH TIME CRANK SENSOR HARNESS TERMINALS ARE JUMPERED. DID IT?

YES

- CHECK VOLTAGE AT CRANK SENSOR HARN. TERM. "A".
- READING SHOULD BE OVER **10 VOLTS. IS IT?**

NO

CHECK POWER FEED CKT **641** FOR OPEN **OR** SHORT TO GROUND. IF CKT. IS OK, IT'S C³I MODULE CONNECTION **OR** MODULE.

YES

IT'S CRANK SENSOR CONNECTION **OR SENSOR.***

13
- CHECK VOLTAGE BETWEEN CRANK SENSOR HARN. TERMS. "B" AND "C".
- VOLTAGE SHOULD BE 6-9 VOLTS. IS IT?

YES

IT'S FAULTY C³I MODULE CONNECTION **OR** MODULE.

14
- CHECK VOLTAGE FROM CRANK SENSOR HARN. TERM. "C" TO GROUND.
- READING SHOULD BE 6 TO 9 VOLTS. IS IT?

NO

CHECK CKT **643** FOR OPEN **OR** SHORT TO **GROUND** (IF VOLTAGE WAS ABOVE 9 VOLTS, CHECK FOR A SHORT TO VOLTAGE AND THE POSSIBILITY OF A DAMAGED SENSOR. IF CKT IS OK, IT'S C³I MODULE CONNECTION **OR** MODULE.

YES

CHECK FOR OPEN IN GROUND CKT 642. IF CKT IS OK, IT'S C³I MODULE CONNECTION **OR** MODULE.

★**CAUTION:** When jumping sensor terminals, be sure to keep fingers clear of pulleys and belts as a slight movement of belt may occur, resulting in possible injury.

- INSPECT CRANK SENSOR FOR PROPER GAP (APPROX. .025"), **OR** SIGNS OF RUBBING. IF RUBBING IS EVIDENT, DETERMINE CAUSE AND REPLACE SENSOR.

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

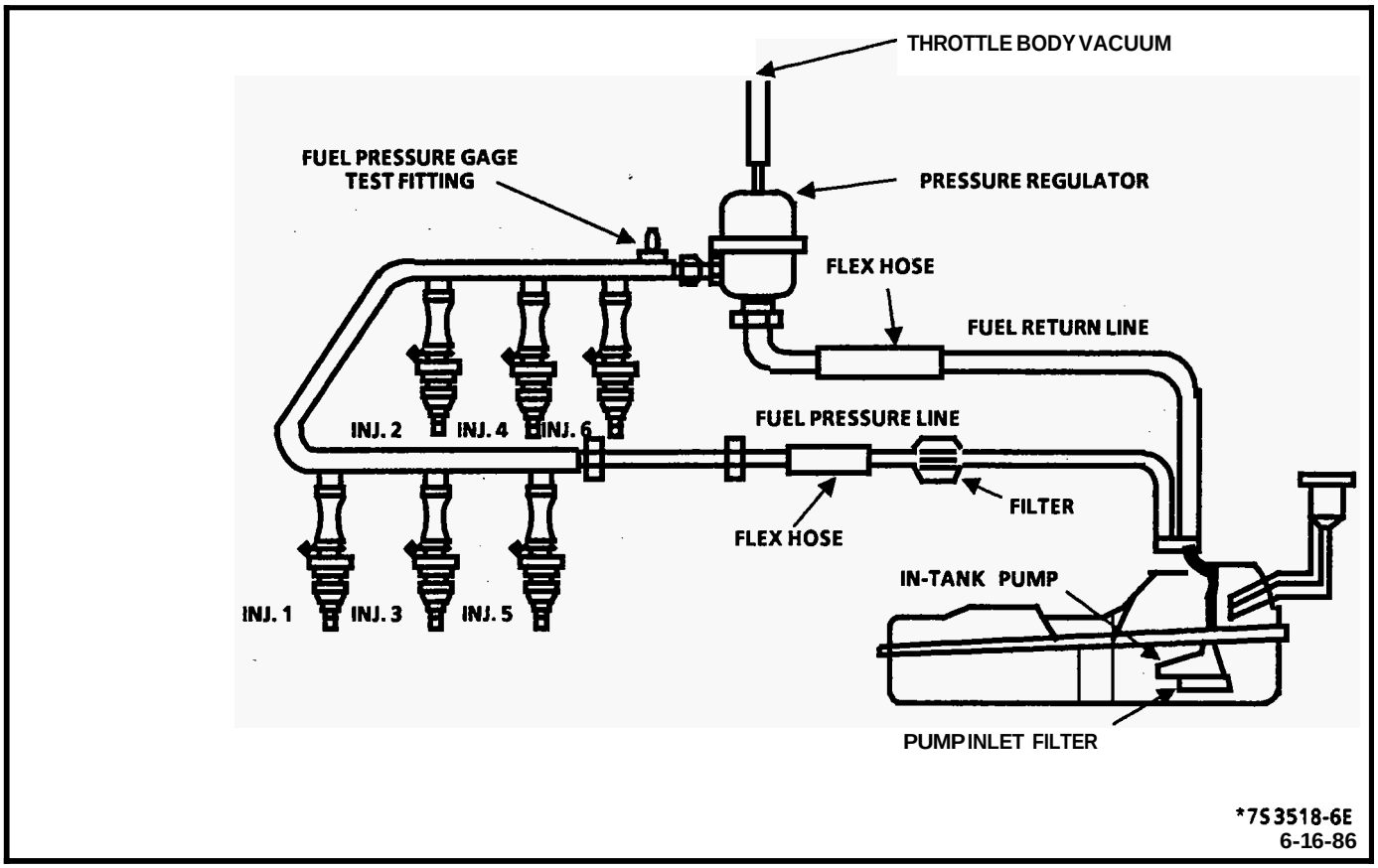


CHART A-7

(Page 1 of 2)

FUEL SYSTEM PRESSURE TEST
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The fuel pump will deliver fuel to the fuel rail and injectors, then to the pressure regulator, where the system pressure is controlled. Excess fuel pressure is bypassed back to the fuel tank. The fuel pump test terminal is located in the engine compartment. When the engine is stopped, the pump can be turned "ON" by applying battery voltage to the test terminal.

Improper fuel system pressure may contribute to one or all of the following symptoms:

- Cranks but won't run.
- Code **440r 45.**
- Cuts out, may feel like ignition problem.
- Hesitation, Loss of power, or Poor fuel economy.

Test Description: The following numbered steps correspond with the step numbers on diagnostic chart.

1. Use pressure gage **5-34730-1.** Wrap a shop towel around the fuel pressure tap to absorb any small amount of fuel leakage that may occur when installing the gage.
With ignition "ON" pump pressure is controlled by spring pressure and throttle body vacuum within the pressure regulator assembly. Pressure should not leak down after the fuel pump is shut **"OFF".**

2. When the engine is idling, the throttle body vacuum is high and is applied to the fuel regulator diaphragm. This will offset the spring and result in a lower fuel pressure.

3. The application of **12-14** inches of vacuum to the pressure regulator should result in a fuel pressure less than step **1.**

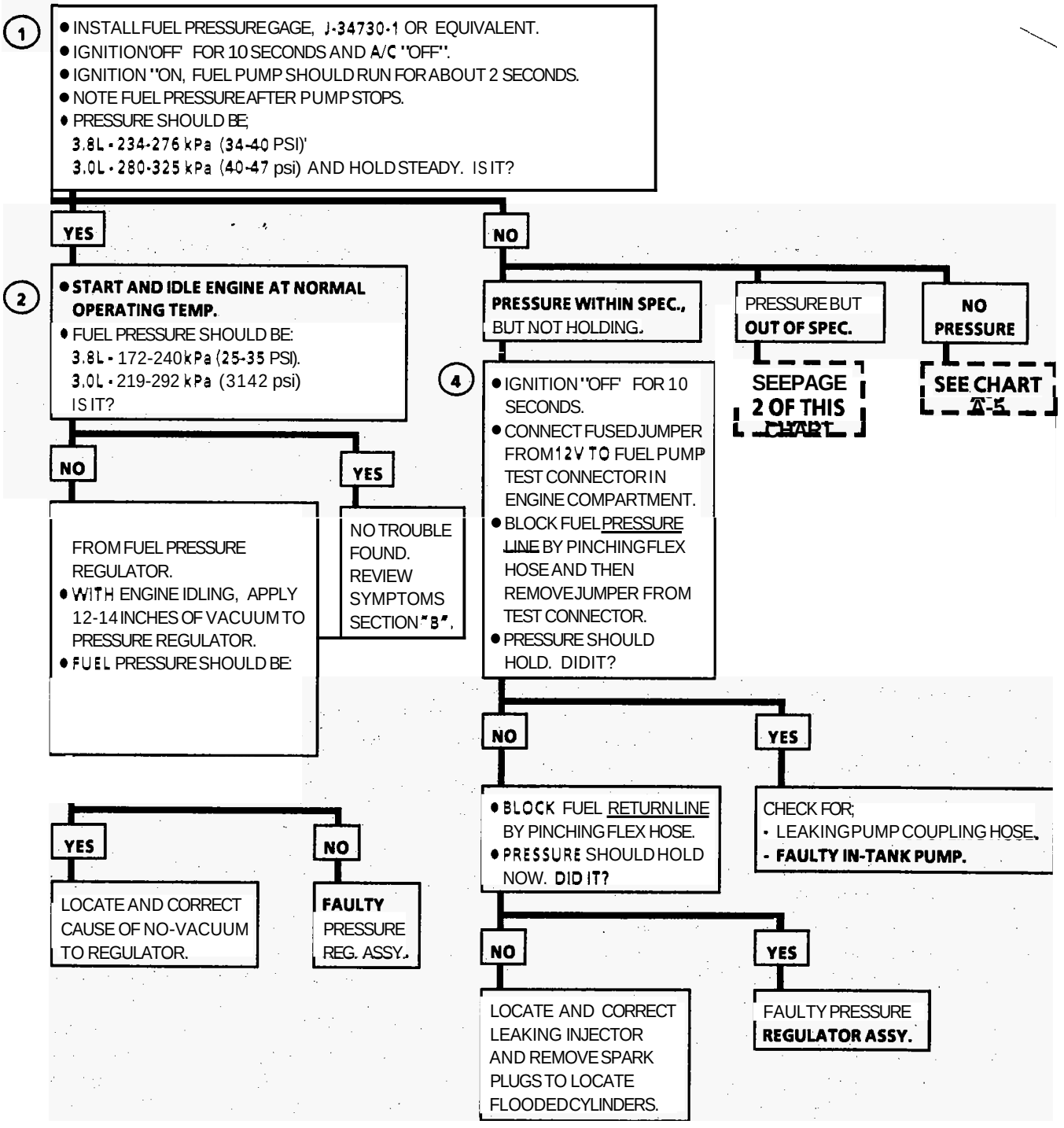
4. Pressure that leaks down may be caused by one of the following:
- In-tank fuel pump check valve not holding.
- Pump coupling hose leaking.
- Fuel pressure regulator valve leaking.
- Injector sticking open.

CHART A-7

(Page 1 of 2)

FUEL SYSTEM PRESSURE TEST
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

NOTICE: FUEL SYSTEM IS UNDER PRESSURE. TO AVOID FUEL SPILLAGE, REFER TO FIELD SERVICE PROCEDURES FOR TESTING OR REPAIRS REQUIRING DISASSEMBLY OF FUEL LINES OR FITTINGS.



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO 'SERVICE ENGINE SOON" LIGHT.

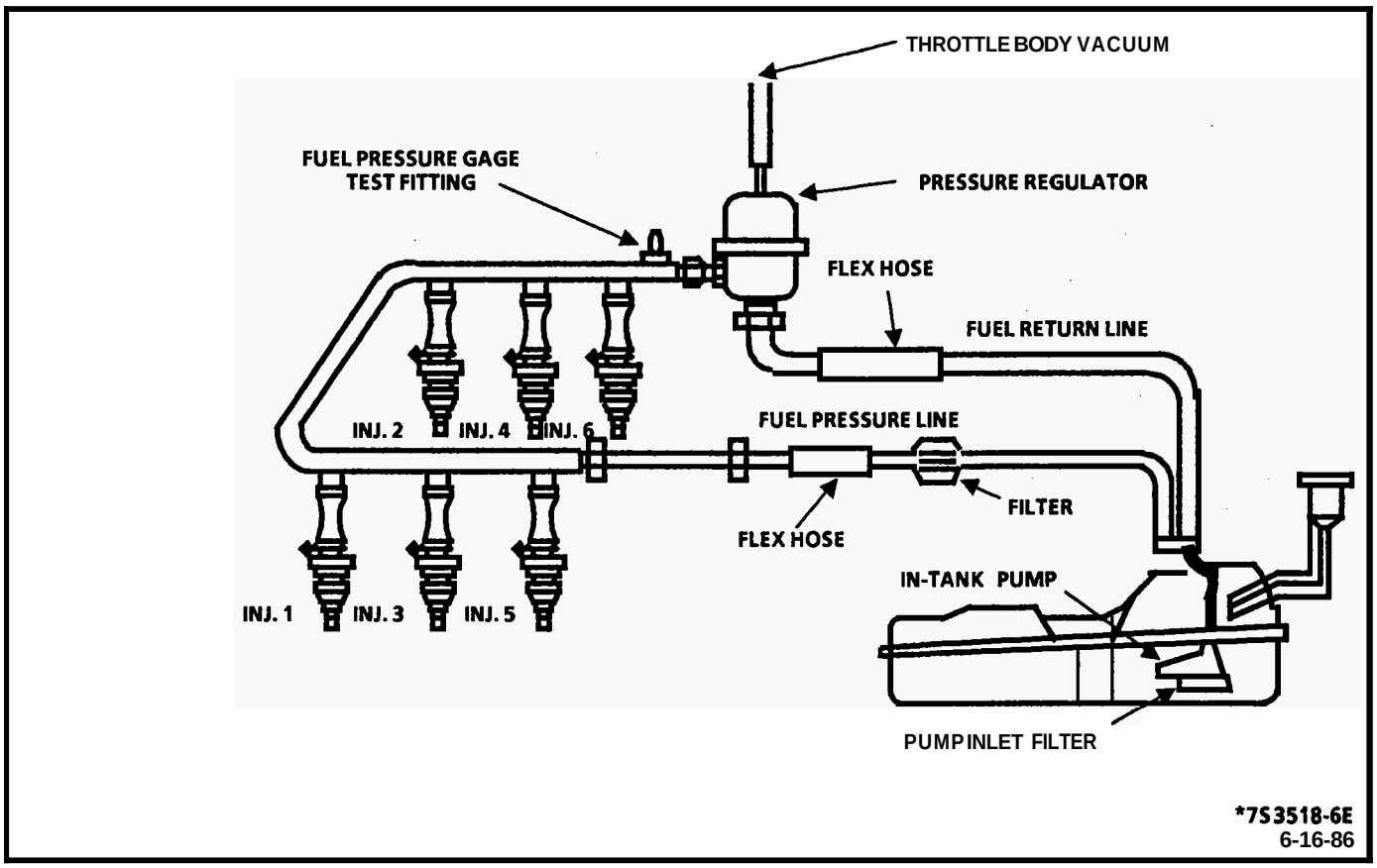


CHART A-7

(Page 2 of 2)

FUEL SYSTEM PRESSURE TEST
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The fuel pump will deliver fuel to the fuel rail and injectors, then to the pressure regulator, where the system pressure is controlled. Excess fuel pressure is bypassed back to the fuel tank. The fuel pump test terminal is located in the engine compartment. When the engine is stopped, the pump can be turned "ON" by applying battery voltage to the test terminal.

Improper fuel system pressure may contribute to one or all of the following symptoms:

- Cranks but won't run.
- Code 440r 45.
- Cuts out, may feel like ignition problem.
- Hesitation, **Loss** of power, or Poor fuel economy.

Test Description: The following numbered steps correspond with the step numbers on diagnostic chart.

5. Pressure but less than specifications falls into two areas:

- Regulated pressure but less than specifications; The amount of fuel to injectors is OK but pressure is too low. The system will be lean running and may set Code 44. Also, possible hard starting cold and overall poor performance.
- Restricted flow causing pressure drop; Normally, a vehicle with a fuel pressure of less than **165 kPa (24** psi) at idle will not be driveable. However, if the pressure drop occurs only while driving, the engine will normally surge then stop as pressure begins to drop rapidly.

6. Restricting the fuel return line allows the fuel pump to develop its maximum pressure (dead head pressure). When battery voltage is applied to the pump test terminal, pressure should be above **517** kPa (75psi)

7. This test determines if the high fuel pressure is due to a restricted fuel return line or a pressure regulator problem.

CHART A-7

(Page 2 of 2)
FUEL SYSTEM PRESSURE TEST
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

NOTICE; FUEL SYSTEM IS UNDER PRESSURE. TO AVOID FUEL SPILLAGE, REFER TO FIELD SERVICE PROCEDURES FOR TESTING OR REPAIRS REQUIRING DISASSEMBLY OF FUEL LINES OR FITTINGS.

FROM CHART A-3
PAGE 1
OR
FROM CHART A-7
PAGE 1
PRESSURE OUT OF SPEC.
3.8L - 234-276 kPa (34-40 PSI)
3.0L - 280-325 kPa (40-47 PSI)

LOW PRESSURE

5 • CHECK FOR RESTRICTED IN-LINE FILTER.
• **IS** FILTER OK?

YES

• IGNITION "OFF".
• BLOCK FUEL RETURN LINE BY PINCHING FLEXIBLE HOSE.
• APPLY 12 VOLTS TO FUEL PUMP TEST CONNECTOR AND NOTE PRESSURE.
• PRESSURE SHOULD BE ABOVE 517 kPa (75 psi). IS IT?

YES

CHECK FOR RESTRICTED PRESSURE LINE OR FLEX HOSE BETWEEN TANK AND TEST GAGE. IF LINES ARE OK, IT'S FAULTY FUEL PRESSURE REGULATOR.

NO

CHECK IN-TANK FOR;
- FAULTY FUEL PUMP
- COUPLING HOSE
- INCORRECT PUMP

NO

REPLACE FILTER **AND RE-TEST.**

HIGH PRESSURE

7 • **DISCONNECT** FUEL RETURN LINE FLEXIBLE HOSE.
• **ATTACH A** $5/16$ I.D. FLEX HOSE TO PRESSURE REGULATOR SIDE OF RETURN LINE AND INSERT THE OTHER END IN AN APPROVED GASOLINE CONTAINER.
• NOTE FUEL PRESSURE WITHIN 2 SECONDS AFTER IGNITION IS TURNED "ON".
• PRESSURE SHOULD BE 253-297 kPa (37 43 PSI). IS IT?

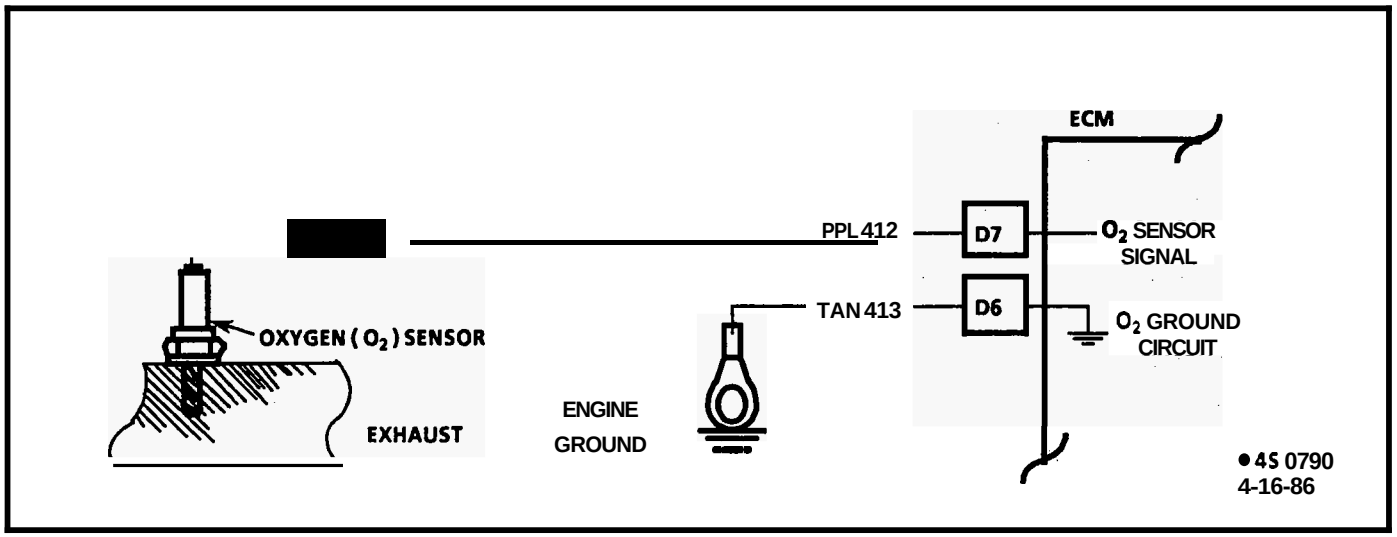
NO

CHECK FOR RESTRICTED FUEL RETURN LINE FROM FUEL PRESSURE REGULATOR. IF LINE IS OK, IT'S FAULTY FUEL **PRESSURE REGULATOR.**

YES

LOCATE AND REPAIR RESTRICTED FUEL RETURN LINE TO FUEL TANK.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO 'SERVICE ENGINE SOON" LIGHT.



CODE 13

OXYGEN SENSOR CIRCUIT (OPEN CIRCUIT) 3.0L "N" SERIES 3.8L "A, C & H" SERIES 3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The ECM supplies a voltage of about .45 volts between terminals "D6" and "D7". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts.) The O_2 sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down through about .10 volts if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360°C (600°F). An open sensor circuit or cold sensor causes "Open Loop" operation.

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. Code 13 WILL SET:
   - Engine at normal operating temperature
   - Up to 2 minutes engine time after start.
   - O_2 signal voltage steady between .35 and .55 volts.
   - Throttle position sensor signal above idle
   - All conditions must be met for about 60 seconds.

   If the conditions for a Code 13 exist the system will not go "Closed Loop".
2. This will determine if the sensor or the wiring is the cause of the Code 13.
3. In doing this test use only a high impedence digital volt ohm meter. This test checks the continuity of CKT's 412 and 413 because if CKT 413 is open the ECM voltage on CKT 412 will be over .6 volts (600 mv).

Diagnostic Aids:

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation.

Check For:

- Poor Connection or Damaged Harness Inspect ECM harness connectors for backed out terminals "D7" or "D6", improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection and damaged harness.
- Intermittent Test If connections and harness checks out OK, "Scan" O_2 sensor voltage while moving related connectors and wiring harness, with warm engine running at part throttle in "Closed Loop". If the failure is induced, the "O_2 sensor voltage" reading will change from its normal fluctuating voltage (above 600 mv and below 300 mv) to a fixed value around 460 mv. This may help to isolate the location of the malfunction.

'SCAN" DIAGNOSTICS

CODE 13

OXYGEN SENSOR CIRCUIT (OPEN CIRCUIT)
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

1. ENGINE AT NORMAL OPERATING TEMPERATURE (ABOVE 80°C).
   - RUN ENGINE ABOVE 1200 RPM FOR TWO MINUTES.
   - DOES "SCAN" INDICATE CLOSED LOOP?

NO

2. - DISCONNECT 02 SENSOR
   - JUMPER HARNESS CKT 412 TO GROUND
   - "SCAN" SHOULD DISPLAY O_2 VOLTAGE BELOW .2 VOLTS (200 MV) WITH ENGINE RUNNING.
   - DOES IT?

CODE 13 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

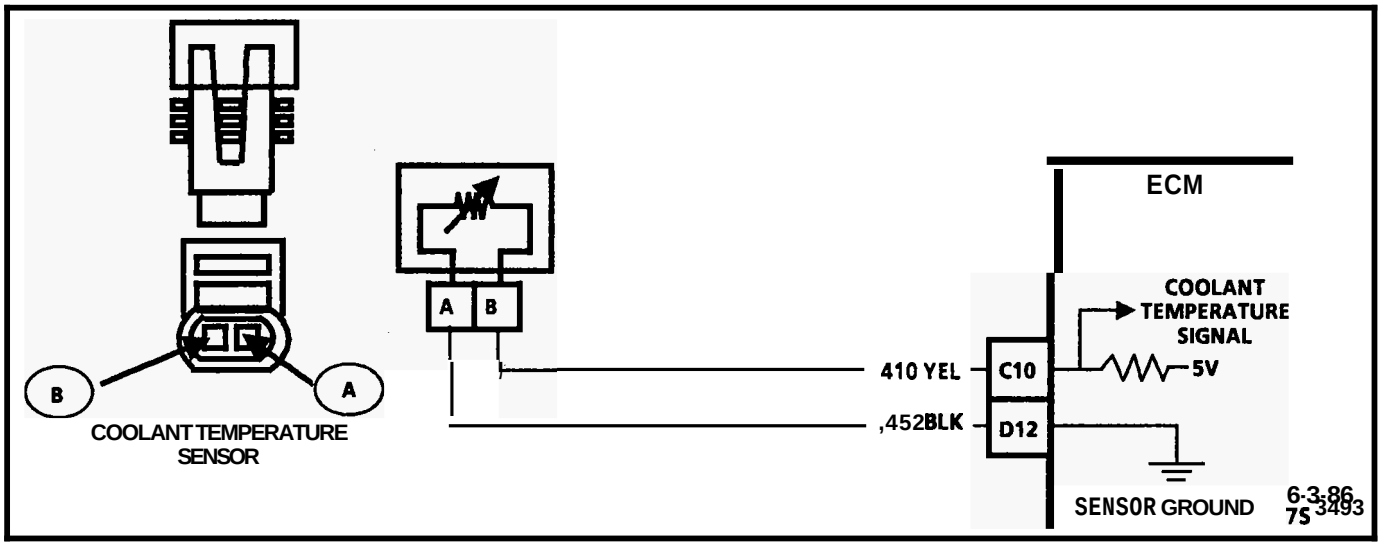
NO

3. - IGNITION "ON", ENGINE "OFF".
   - CHECK VOLTAGE OF CKT 412 AT O_2 SENSOR

FAULTY O^2 SENSOR CONNECTION OR SENSOR.

.3 - .6 VOLTS (300 - 600 MV)	OVER .6 VOLT (600 MV)	LESS THAN .3 VOLT (300 MV)
FAULTY ECM	OPEN CKT. 413, FAULTY CONNECTION OR FAULTY ECM.	

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



CODE 14

COOLANT TEMPERATURE SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The Coolant Temperature Sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage on CKT 410 to the sensor. When the engine is cold the sensor (thermistor) resistance is high, therefore the ECM will see high signal voltage.

As the engine warms, the sensor resistance becomes less, and the voltage drops. At normal engine operating temperature (85°C to 95°C) the voltage will measure about 1.5 to 2.0 volts.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Code 14 will set if:
   - Signal voltage indicates a coolant temperature above 135°C (275°F) for calibrated time.
2. This test will determine if CKT 410 is shorted to ground which will cause the conditions for Code 14.

Diagnostic Aids:

"Scan" tool displays engine temp. in degrees centigrade. After engine is started, the temperature should rise steadily to about 90°C then stabilize when thermostat opens.

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation.

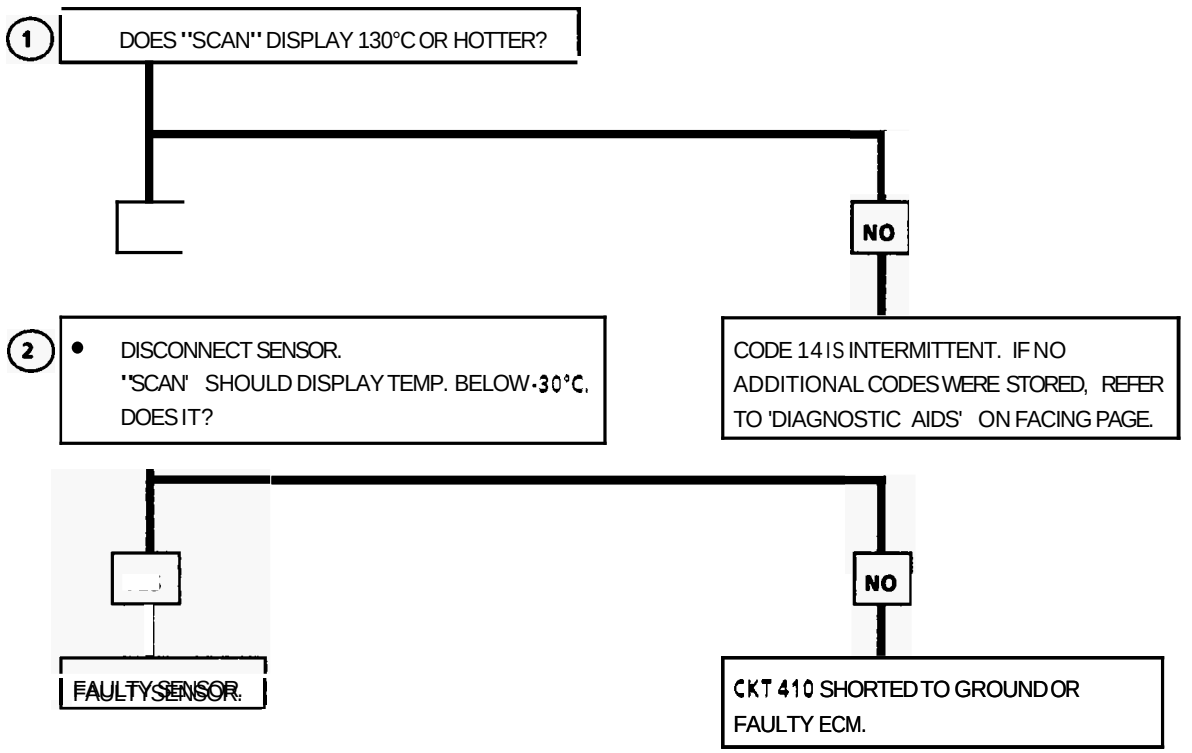
Check For:

- Poor Connection or Damaged Harness Inspect ECM harness connectors for backed out terminals "C10" or "D12", improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection and damaged harness.
- Intermittent Test. If connections and harness checks out OK, "Scan" coolant temperature while moving related connectors and wiring harness. If the failure is induced, the "coolant temperature" display will change. This may help to isolate the location of the malfunction.
- Shifted Sensor. The "Temperature To Resistance Value" scale may be used to test the coolant sensor at various temperature levels to evaluate the possibility of a "shifted" (mis-scaled) sensor which may result in driveability complaints.

"SCAN" DIAGNOSTICS

CODE 14

COOLANT TEMPERATURE SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

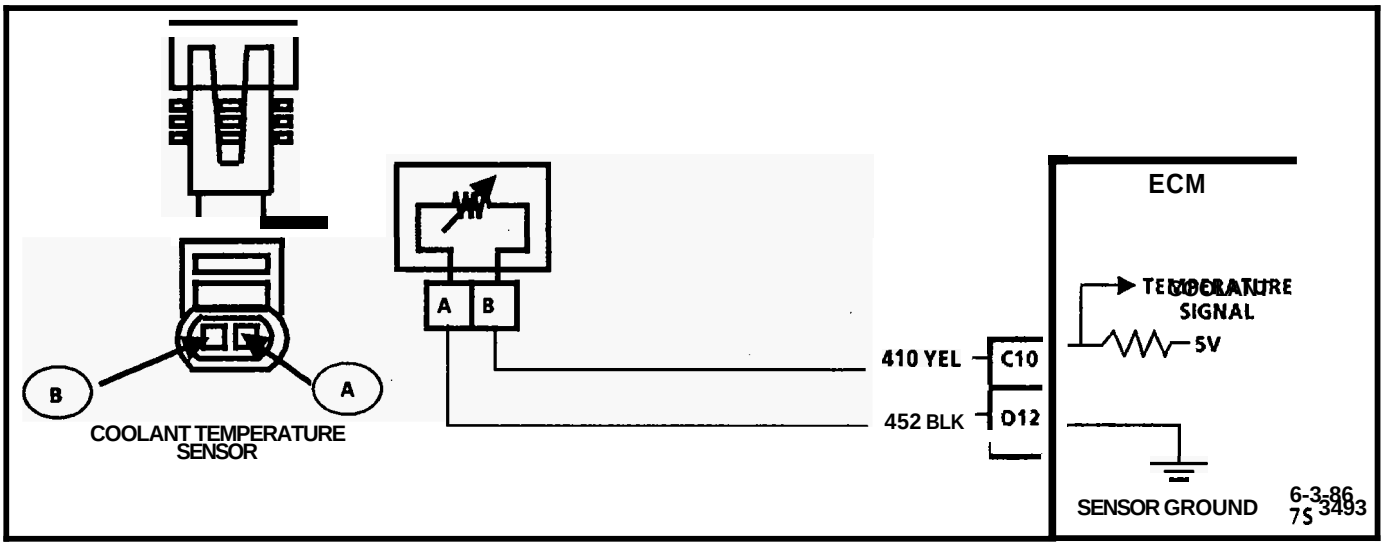


DIAGNOSTIC AID

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

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

9-10-86
● 7$ 3055



CODE 15

COOLANT TEMPERATURE SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The Coolant Temperature Sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage on CKT 410 to the sensor. When the engine is cold the sensor (thermistor) resistance is high, therefore the ECM will see high signal voltage.

As the engine warms, the sensor resistance becomes less, and the voltage drops. At normal engine operating temperature (85°C to 95°C) the voltage will measure about 1.5 to 2.0 volts at the ECM.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Code 15 will set if:
   - Signal voltage indicates a coolant temperature less than -44° C (-47° F) for at least 3 seconds.
2. This test simulates a Code 14. If the ECM recognizes the low signal voltage, (high temp.) and the "Scan" reads 130°C, the ECM and wiring are OK.
3. This test will determine if CKT. 410 is open. There should be **5** volts present at sensor connector if measured with a DVOM.

Diagnostic Aids:

A **"Scan"** tool reads engine temperature in degrees centigrade. After engine is started the temperature should rise steadily to about 90°C then stabilize when thermostat opens.

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation.

Check For:

- Poor Connection or Damaged Harness Inspect ECM harness connectors for backed out terminals "C10" or "D12", improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection and damaged harness.
- Intermittent Test If connections and harness checks out OK, "Scan" coolant temperature while moving related connectors and wiring harness. If the failure is induced, the "coolant temperature" display will change. This may help to isolate the location of the malfunction.
- Shifted Sensor The "Temperature To Resistance Value" scale may be used to test the coolant sensor at various temperature levels to evaluate the possibility of a "shifted" (mis-scaled) sensor which may result in driveability complaints.

A faulty connection, or an open in CKT **410** or **455** will result in a Code 15.

If Code 23 or 63 is also set, check CKT **455** for faulty wiring or connections. Check terminals at sensor for good contact. Refer to "Intermittents" in Section "B".

"SCAN" DIAGNOSTICS

CODE 15

COOLANT TEMPERATURE SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

NO

CODE 15 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

(2)
- DISCONNECT SENSOR
- JUMPER HARNESS TERMINALS TOGETHER
- "SCAN" SHOULD DISPLAY 130°C OR MORE. DOES IT?

YES

FAULTY CONNECTION OR SENSOR.

NO

(3)
- JUMPER CIRCUIT 410 TO GROUND.
- "SCAN" SHOULD DISPLAY OVER 130°C. DOES IT?

YES

OPEN CIRCUIT 452, FAULTY CONNECTION OR FAULTY ECM.

NO

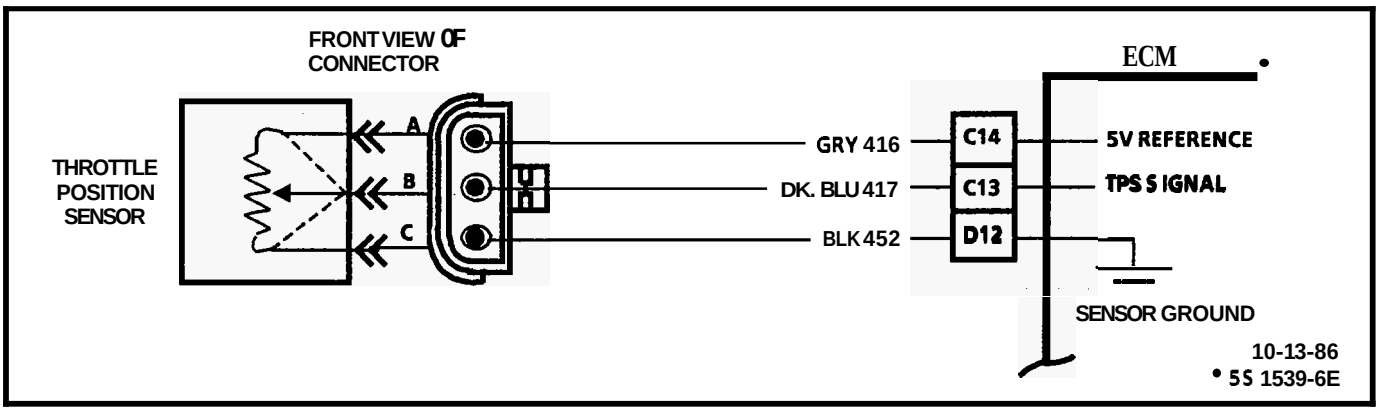
OPEN CIRCUIT 410, FAULTY CONNECTION AT ECM, OR FAULTY ECM.

DIAGNOSTIC AID

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

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

7-8-86
*7$ 3728-6E



CODE 21

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE HIGH)
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The Throttle Position Sensor (TPS) provides a voltage signal that changes relative to throttle blade angle. Signal voltage will vary from about .4 at idle to about 5 volts at wide open throttle.

The TPS signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM control outputs.

NOTE: 3.0L "N" wires A + C are reversed at TPS connector.

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. Code 21 will set if:
   - Engine is running
   - TPS signal voltage is greater than 2.5 volts.
   - Code 33 or 34 not present at first start up.
   - All conditions met for 5 seconds.

   With closed throttle, ignition "ON" or at idle, voltage should be 3.8L, 3.8L Turbo .40 volts ± .05 volts; 3.0L .55volts ± .05volts. If not check adjustment.
2. With the TPS sensor disconnected, the TPS voltage should go low if the ECM and wiring is OK.
3. Probing CKT 452 with a test light checks the sensor ground CKT, a faulty sensor ground circuit will cause a Code 21.

Diagnostic Aids:

A "Scan" tool reads throttle position in volts. With closed throttle, ignition "ON" or at idle, voltage should be 3.8L, 3.8L TURBO .40 volts ± .05 volts; 3.0L .55volts ± .05volts.

Also some "Scan" tools will read throttle angle 0% = closed throttle 100% = WOT.

An open in CKT 462 will result in a Code 21. Refer to "Intermittents" in Section "B.

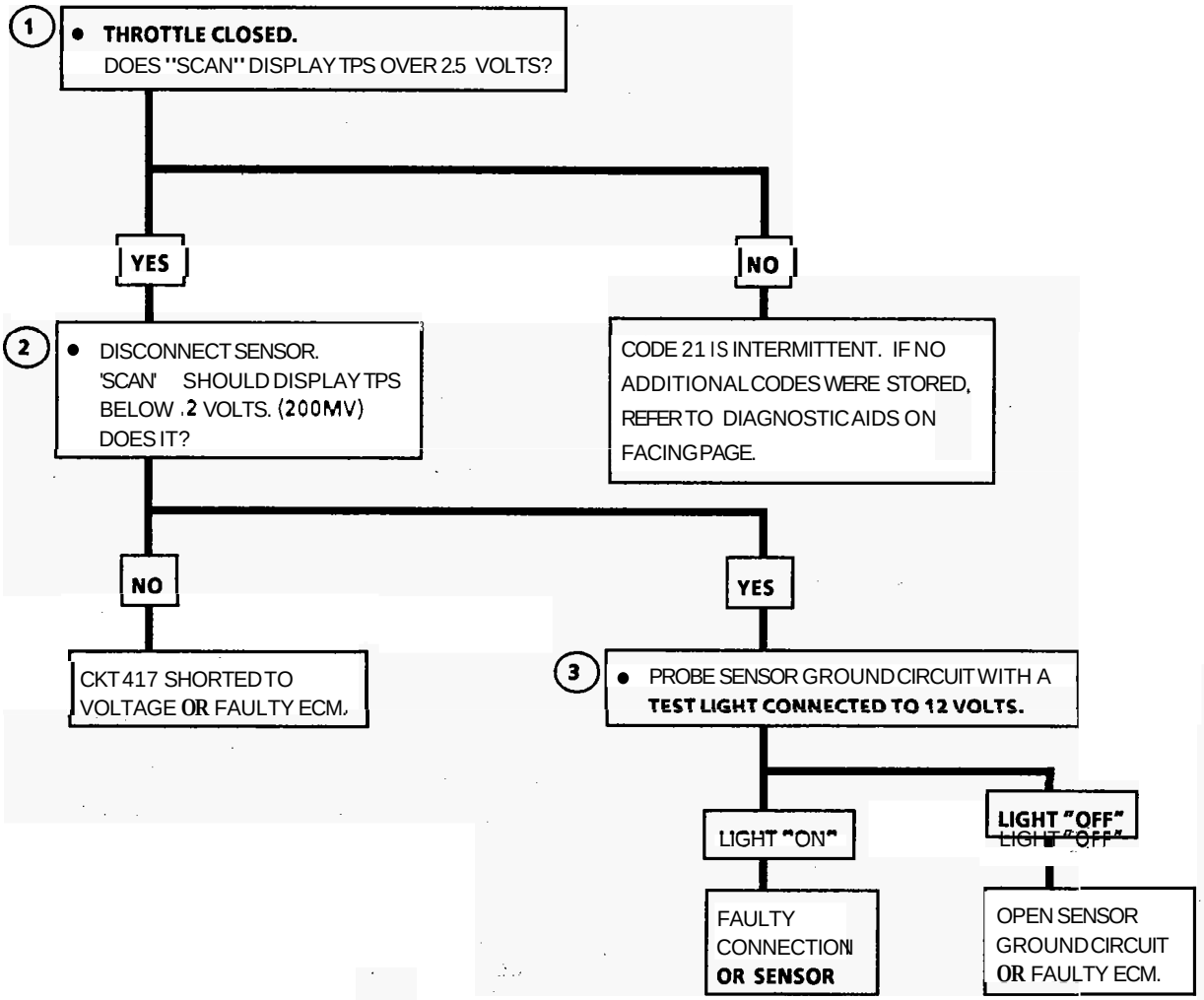
Check For:

- Poor Connection or Damaged Harness Inspect ECM harness connectors for backed out terminals "C13" or "D12", impropermating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection and damaged harness.
- Intermittent Test If connections and harness checks out OK, monitor TPS voltage display while moving related connectors and wiring harness. If the failure is induced, the "Coolant Temperature" display will change. This may help to isolate the location of the malfunction.
- TPS Scaling Observe TPS voltage display while depressing accelerator pedal with engine stopped and ignition "ON". Display should vary from closed throttle TPS voltage when throttle was closed, to over (4.5 volts) 4500 mv when throttle is held at wide open throttle position.

"SCAN" DIAGNOSTICS

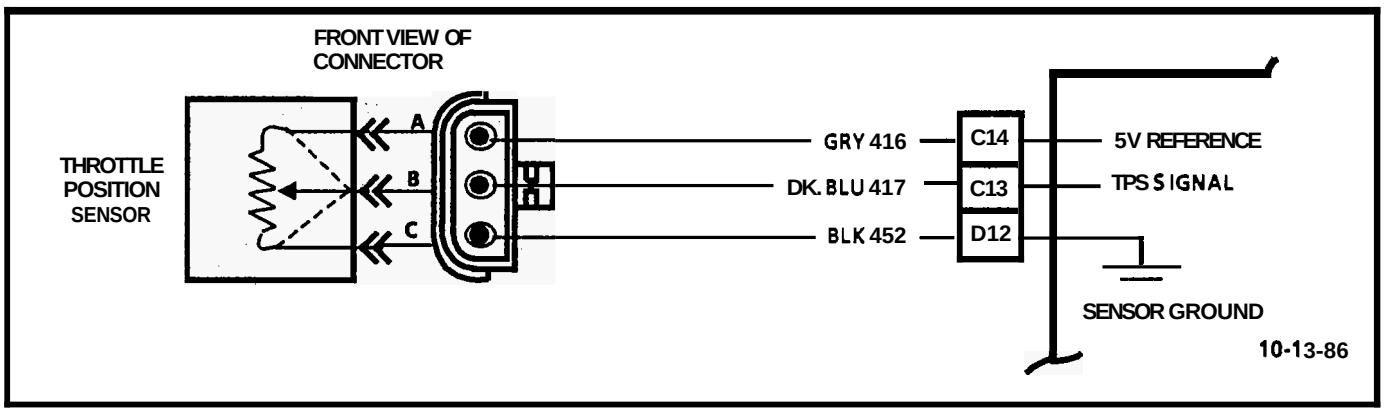
CODE 21

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE HIGH)
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)



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

9-10-86
75 3057



CODE 22

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE LOW)
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The Throttle Position Sensor (TPS) provides a voltage signal that changes relative to throttle blade angle. Signal voltage will vary from about .4 at idle to about 5 volts at wide open throttle.

The TPS signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM control outputs.

NOTE: 3.0L "N" wires **A** + C are reversed at TPS connector.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Code 22 will set if:
   - Engine is running
   - TPS signal voltage is less than .2 volts for 3 seconds.
2. Simulates Code 21: (high voltage) If ECM recognizes the high signal voltage the ECM and wiring are OK.
3. TPS adjustment: See Section **"6E3-C2"** for adjustment specifications.
4. Simulates a high signal voltage. Checks CKT 417 for an open.

Diagnostic Aids:

A "Scan" tool reads throttle position in volts. Voltage should increase at a steady rate as throttle is moved toward WOT.

Also some "Scan" tools will read throttle angle **0%=** closed throttle 100% = WOT.

An open or short to ground in CKT's 416 or 417 will result in a Code 22.

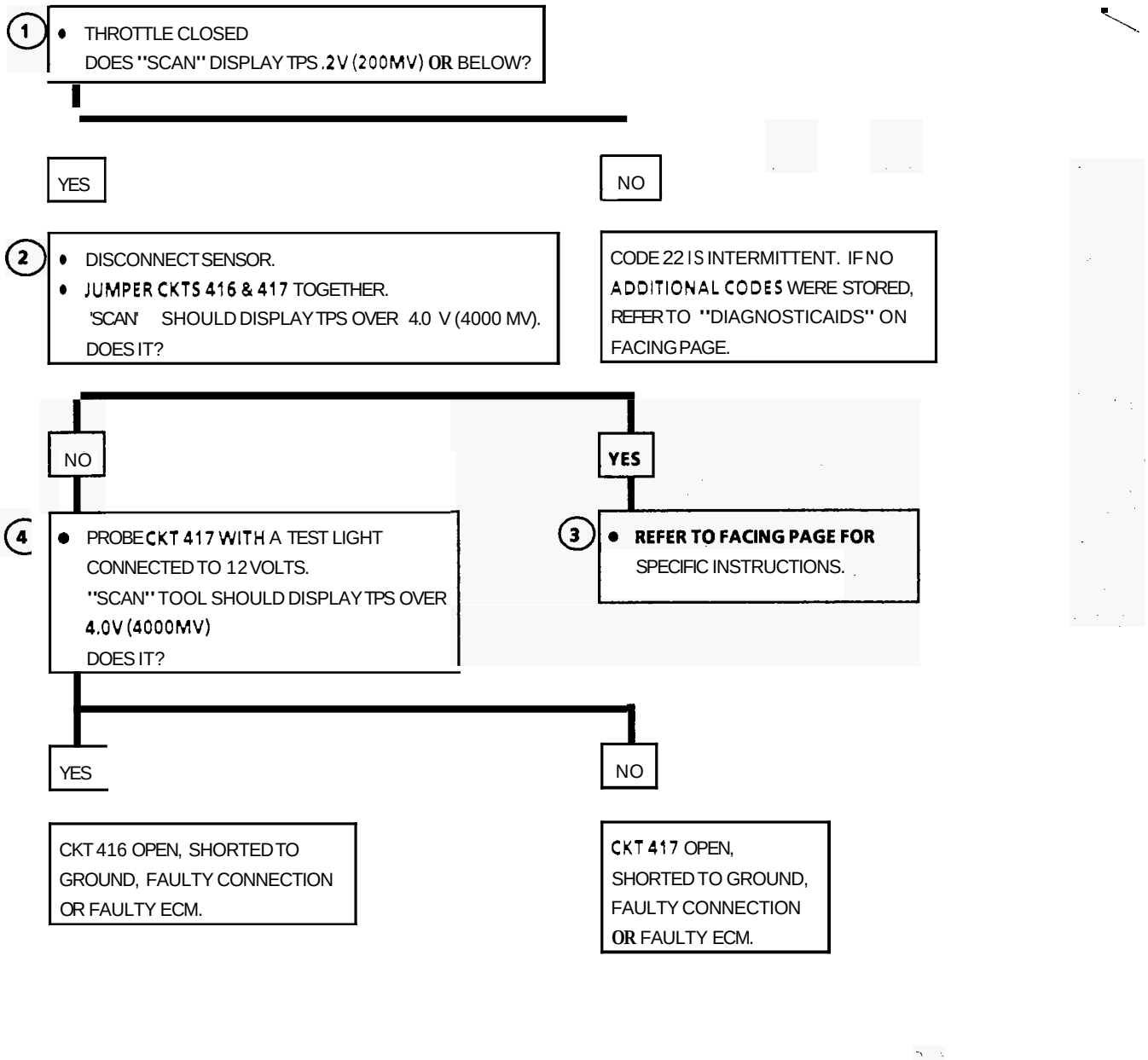
Check For:

- Poor Connection or Damaged Harness Inspect ECM harness connectors for backed out terminals "C13" or "D12", impropermating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection and damaged harness.
- Intermittent Test If connections and harness checks out OK, monitor TPS voltage display while moving related connectors and wiring harness. If the failure is induced, the "Coolant Temperature" display will change, This may help to isolate the location of the malfunction.
- TPS Scaling Observe TPS voltage display while depressing accelerator pedal with engine stopped and ignition "ON". Display should vary from closed throttle TPS voltage when throttle was closed, to over 4.5 volts (4500 mv) when throttle is held at wide open throttle position.

"SCAN" DIAGNOSTICS

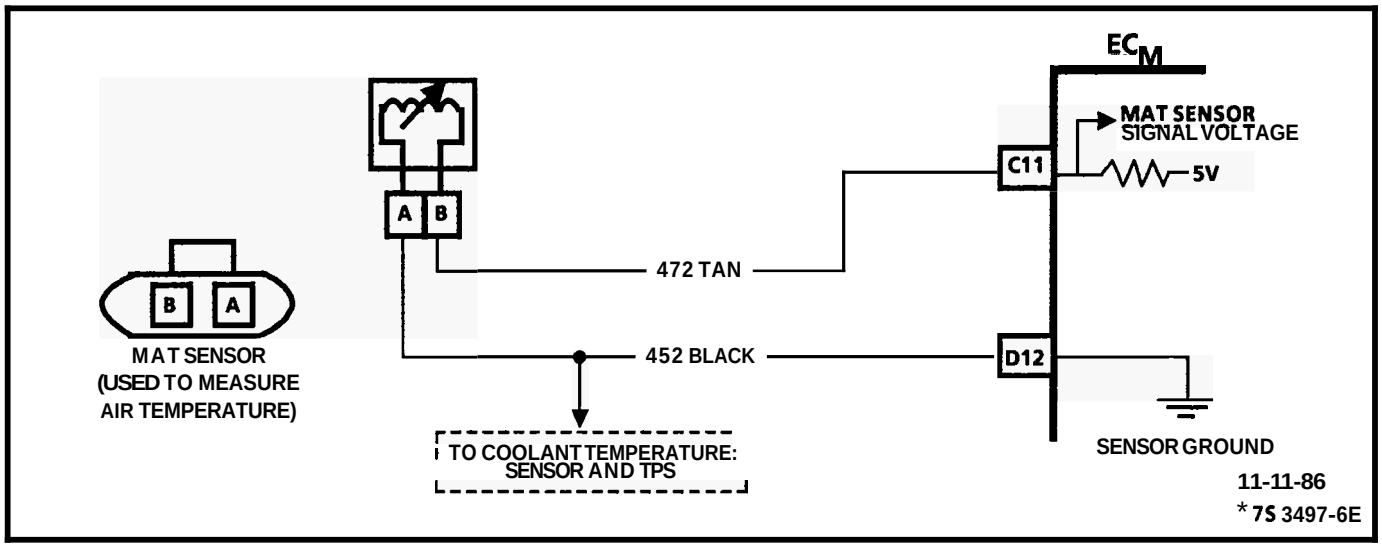
CODE 22

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE LOW)
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON' LIGHT.

10-8-86
●7S 3365



CODE 23

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The MAT sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage (about 5 volts) on CKT 472 to the sensor. When the air is cold the sensor (thermistor) resistance is high, therefore the ECM will see a high signal voltage. If the air is warm the sensor resistance is low, therefore, the ECM will see a low voltage.

The MAT Sensor is part of the MAF Sensor assembly, so, the ECM can accurately compensate air flow readings based on temperature.

Test Description: Step numbers refer to step numbers on diagnostic chart.

Code 23 will set if:

- A signal voltage indicates a manifold air temperature below −40°C (-40°F) for 4 seconds.

Due to the conditions necessary to set a Code 23, the "Service Engine Soon" light will only stay on while the fault is present.

1. A "Scan" tool may not be used to diagnose this fault, due to the ECM transmitting "default" (substitute) values, when the fault is present. A Code 23 will set, due to an open sensor, wire, or connection. This test determine if the wiring and ECM are OK.
2. If the resistance is greater than 25,000 ohms replace the sensor.

CODE 23

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

START
NON-SCAN

1. DISCONNECT MAT SENSOR.
- IGNITION "ON", ENGINE STOPPED.
- CHECK VOLTAGE BETWEEN HARNESS CONNECTOR TERMINALS, CKT 472 AND 452.

4 VOLTS OR OVER

2. CHECK RESISTANCE ACROSS MAT SENSOR TERMINALS. SHOULD BE LESS THAN 25,000 OHMS, SEE TABLE FOR APPROXIMATE TEMPERATURE TO RESISTANCE VALUES.

OK

INTERMITTENT FAULT IN SENSOR CIRCUIT OR CONNECTOR. IF ADDITIONAL CODES WERE STORED, SEE APPLICABLE CHART. IF NO CODES REFER TO INTERMITTENTS SECTION B.

NOT OK

REPLACE SENSOR

BELOW 4 VOLTS

CHECK VOLTAGE BETWEEN HARNESS CONNECTOR CKT 472 AND GROUND.

4 VOLTS OR OVER

CHECK FOR OPEN IN CKT 452 AND CHECK TERMINAL CONNECTIONS

IF WIRE AND CONNECTIONS ARE OK, IT IS A FAULTY ECM.

BELOW 4 VOLTS

CHECK FOR OPEN IN CKT 472 AND CHECK TERMINAL CONNECTIONS.

IF WIRE AND CONNECTIONS ARE OK, IT IS A FAULTY E.C.M.

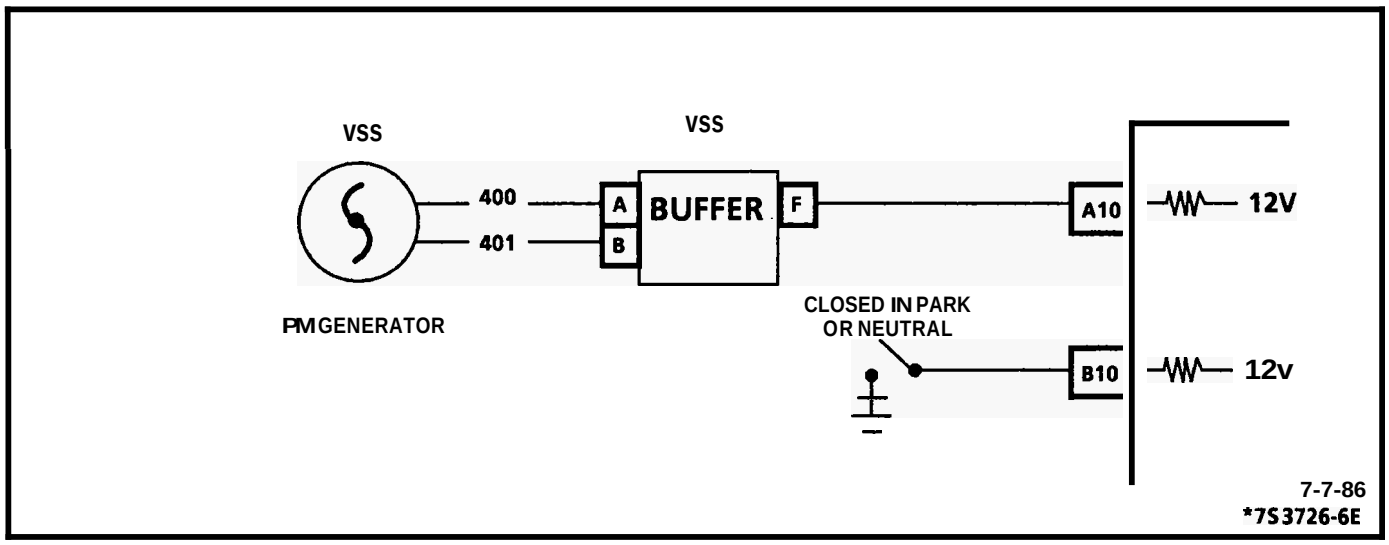
MAT SENSOR
TEMPERATURE TO RESISTANCE VALUES
(APPROXIMATE)

°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

10-8-85

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

* 6S 2986-6E



CODE 24

VEHICLE SPEED SENSOR (VSS) CIRCUIT
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The Vehicle Speed Sensor consists of a PM Generator, Buffer, Speedometer, and ECM. The PM Generator is a permenant magnet assembly attached to the transaxle. As the vehicle moves, the generator creates a "sine wave" electrical pulse, which is routed to the buffer. In the buffer, the signal is changed from a "sine wave" to a "square wave" and amplified. The square wave is an "ON/OFF" signal. The length of time between pulses determines vehicle speed. The ECM sends a 12volt signal out on CKT **437.** The frequency, by which the signal is pulsed low, is used by the ECM to determine vehicle speed.

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. Code **24** will set if vehicle speed equals 0 mph when:
   - Engine speed is between 1500and 4000 rpm.
   - TPS reading shows closed throttle.
   - **Low** load condition (Low Air Flow).
   - Not in park or neutral.
   - All conditions met for 20 seconds.
2. This step checks to see if the fault is in CKT **437,** including the ECM or the VSS/Buffer circuit covered in Section "8A". The ECM is the source of 12 volts via CKT **437** to the buffer in a normal working system.

NOTE: Disregard a Code **24** that sets when the drive wheels are not turning.

Diagnostic Aids:

An intermittent may be caused by a poor connection, rubbed through wire insulation, or a wire broken inside the insulation.

Check for:

- Poor Connection or Damaged Harness Inspect ECM harness connector terminal "A10" for improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection, and damaged harness.
- Intermittent Test If connections and harness check out OK, raise front wheels, block other wheels, idle engine in low gear and "Scan" vehicle speed, while moving related connectors and wiring harnes. If the failure is induced, the "Vehicle Speed" display will change. This may help to isolate the location of the malfunction.

"SCAN" DIAGNOSTIC

CODE 24

VEHICLE SPEED SENSOR (VSS) CIRCUIT
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

DISREGARD CODE **24,** IF SET WHILE DRIVE WHEELS ARE NOT TURNING.

1

- RAISE DRIVE WHEELS
- "NOTICE": DO NOT PERFORM THIS TEST WITHOUT SUPPORTING THE LOWER CONTROL ARMS SO THAT THE DRIVE AXLES ARE IN A NORMAL HORIZONTAL POSITION. RUNNING THE VEHICLE IN GEAR WITH THE WHEELS HANGING DOWN AT FULL TRAVEL MAY DAMAGE THE DRIVE AXLES.
- WITH ENGINE IDLING IN GEAR, "SCAN" SHOULD DISPLAY MPH ABOVE 0.

DOES IT?

NO

2

- IGNITION "OFF", DISCONNECT VSS BUFFER, IGNITION "ON".
- PROBE 8 WAY CONNECTOR TERMINAL "F" WITH A VOLTMETER TO GROUND.
- SHOULD BE 10 VOLTS OR MORE.

IS IT?

YES

SEE SECTION 8A, PAGE **33-0,** FOR VSS BUFFER AND PM GENERATOR DIAGNOSTICS.

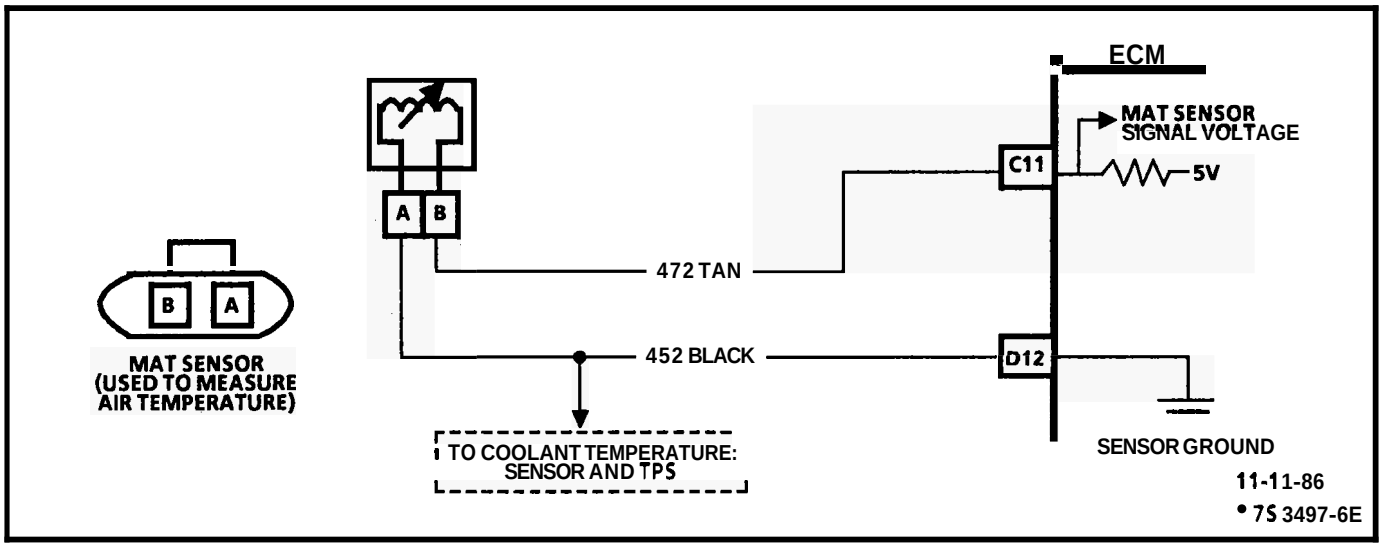
YES

CODE **24** IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

NO

CHECK **CKT 437** FOR OPENS OR SHORT TO GROUND, INCLUDING ECM TERMINAL A-10. IF CKT IS OK, REPLACE ECM.

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



CODE 25

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The MAT Sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage (4-6) on CKT 472 to the sensor. When manifold air is cold, the sensor (Thermistor) resistance is high, therefore, the ECM will see a high signal voltage. If the air warms, the sensor resistance becomes less, and the voltage drops.

The MAT Sensor is part of the MAF Sensor assembly so the ECM can accurately compensate air flow readings based on temperature.

Test Description: Step numbers refer to step numbers on diagnostic chart.

Code 25 will set if:

- Signal voltage indicates a manifold air temperature greater than 135°C (275°F).
- A vehicle speed is present.
- Both of the above requirements are met for at least 30 seconds.

Due to the conditions necessary to set a Code 25, the "Service Engine Soon" light will only stay "ON" while the fault is present.

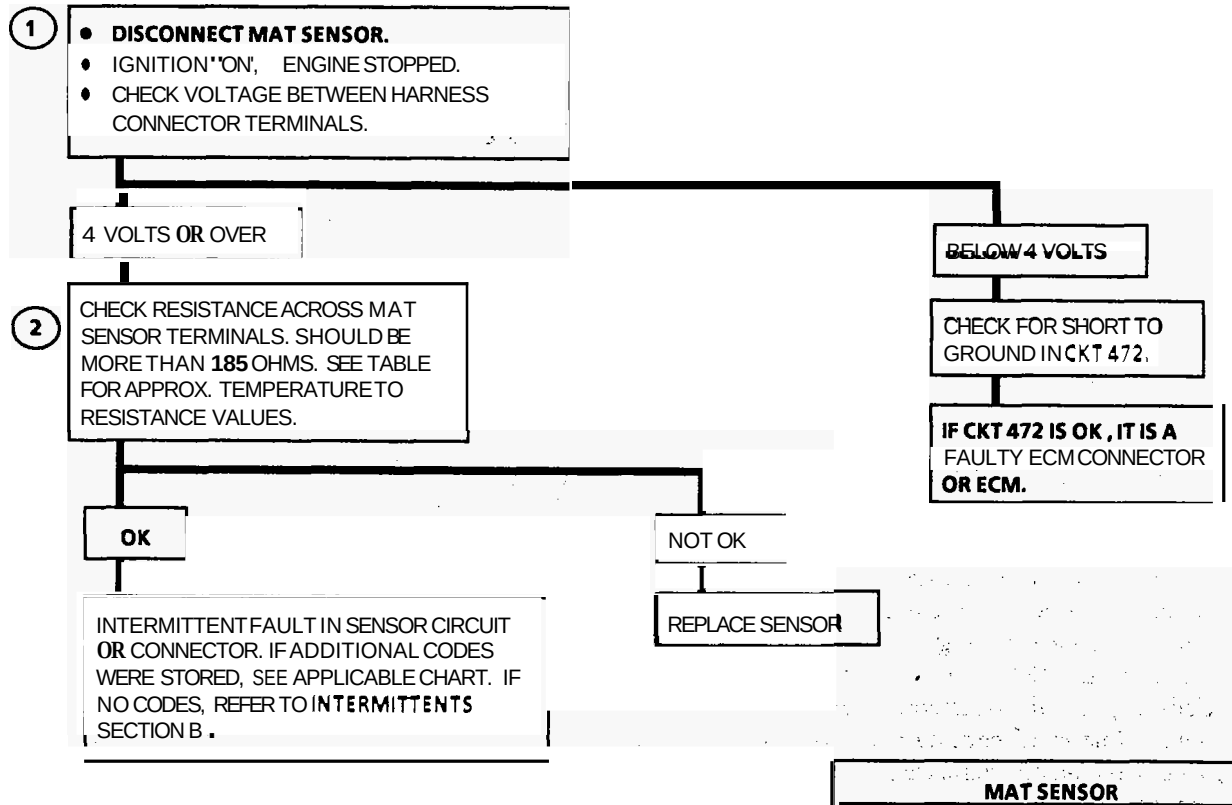
1. A "Scan" tool may not be used to diagnose this fault, due to the ECM transmitting "default" (substitute) values, when the fault is present. If voltage is above 4 volts, the ECM and wiring are OK.
2. If the resistance is less than 100 ohms, replace the sensor.

"SCAN" STEP ONLY ■

CODE 25

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT (HIGH TEMPERATURE INDICATED)

3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

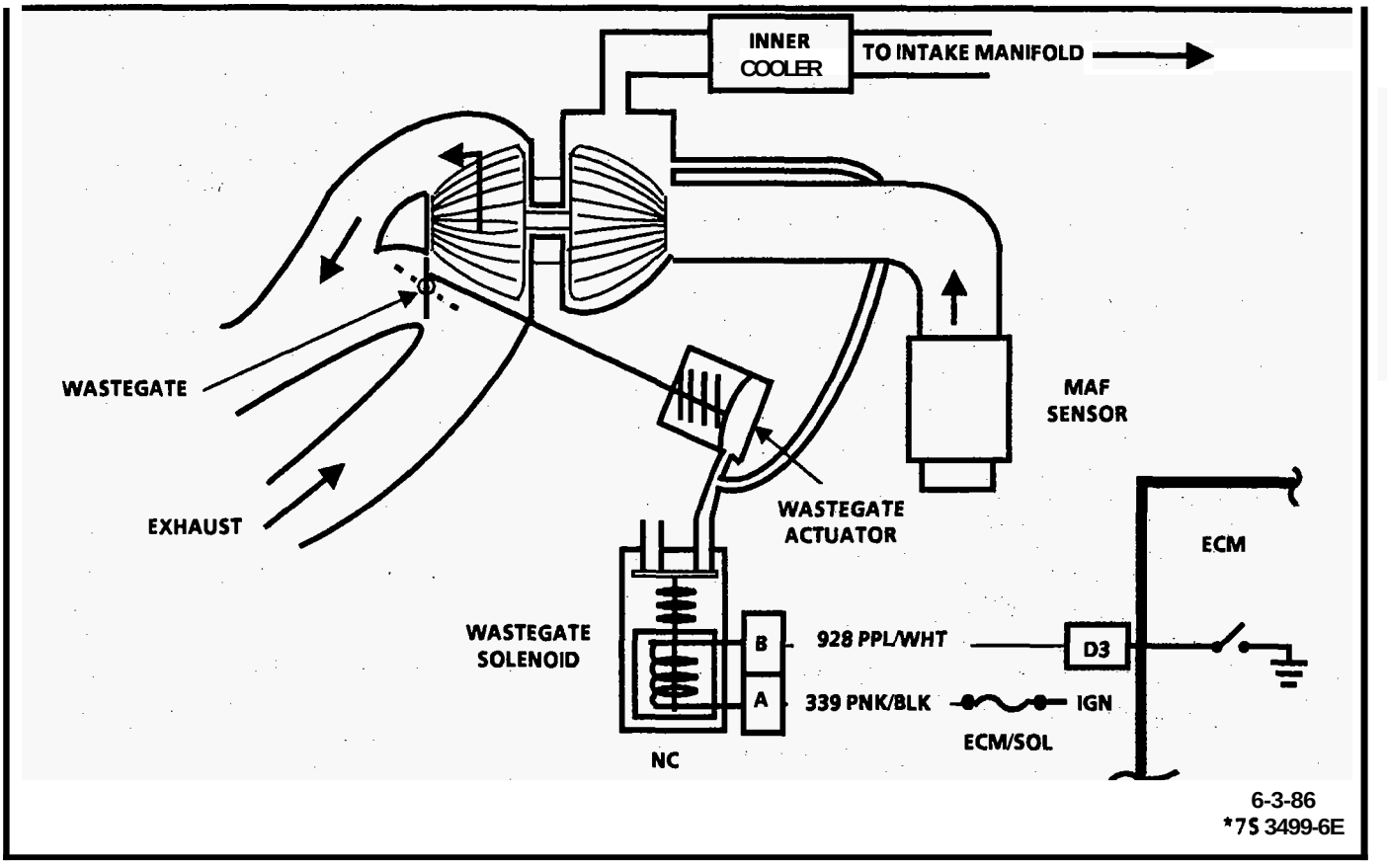


MAT SENSOR
TEMPERATURE TO RESISTANCE VALUES
(APPROXIMATE)

°F	°C	OHMS
210	**100**	**185**
160	70	450
100	**38**	**1,600**
70	20	3,400
40	4	**7,500**
20	**-7**	13,500
0	**-18**	25,000
-40	**-40**	**100,700**

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

9-9-86
7S 3669-6E



CODE 31

WASTEGATE SOLENOID ELECTRICAL
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The Wastegate Solenoid is controlled by the ECM to regulate the wastegate during boost conditions. The wastegate solenoid is pulsed at a calibrated duty cycle **for** smooth operation during boost and to prevent over boost which could seriously damage the engine. Wastegate monitor input to the ECM is received through CKT **928** and is checked by the ECM every **100** m/sec.

To set a Code **31,** the **following** conditions must exist:

- Wastegate duty cycle command between **5%** and 95%.
- **No** pulse received on wastegate monitor input.
- Conditions must be continously met for **2** seconds.

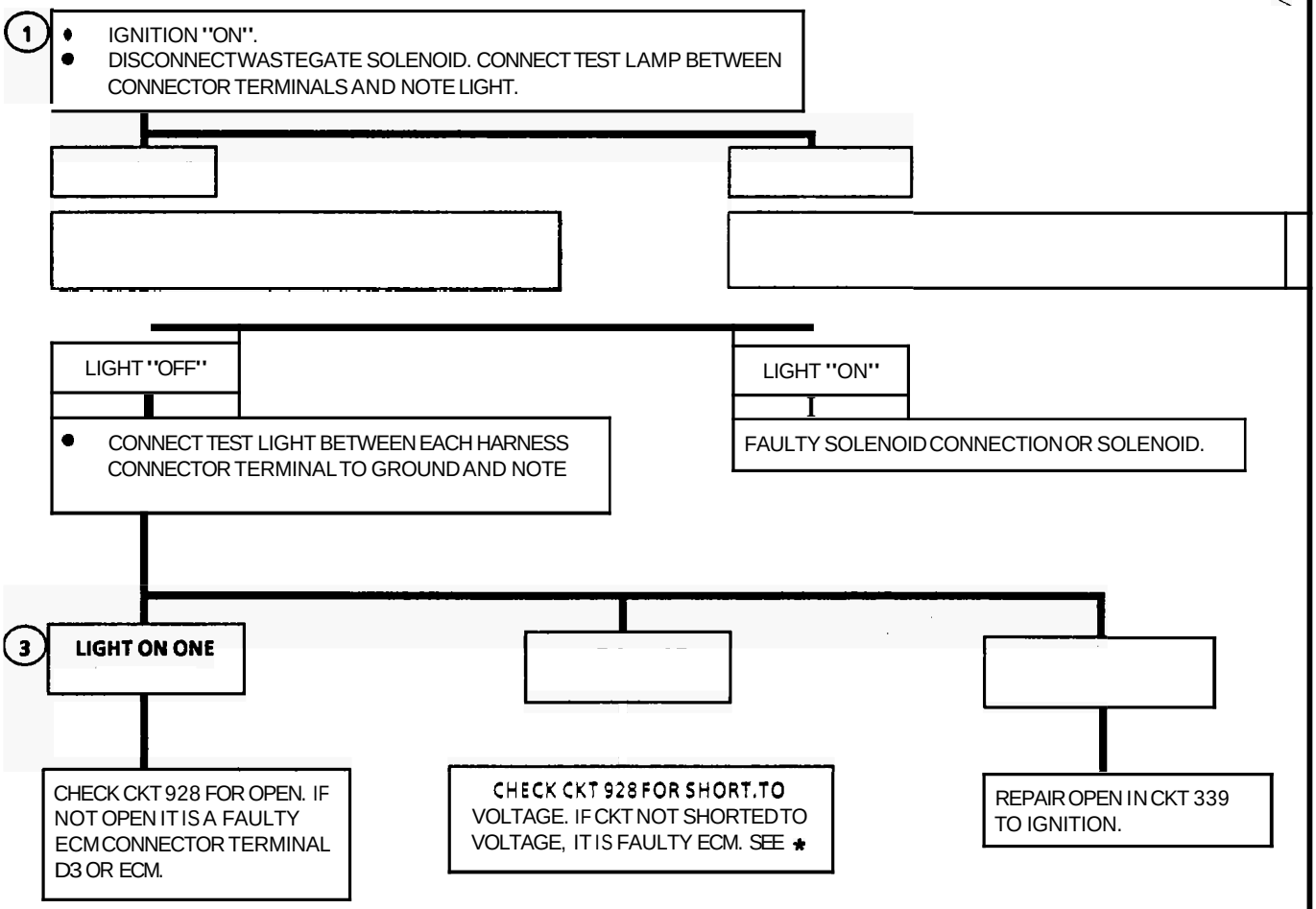
Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Checks to see if CKT **928** is shorted to ground.
2. Tests **for** open CKT **928** to the ECM, grounding the diagnostic test terminal should turn "ON" the test light.
3. Locates the source of an open or short to voltage that is the problem.

CODE 31

WASTEGATE SOLENOID ELECTRICAL 3.8L TURBO "G" SERIES (PORT)

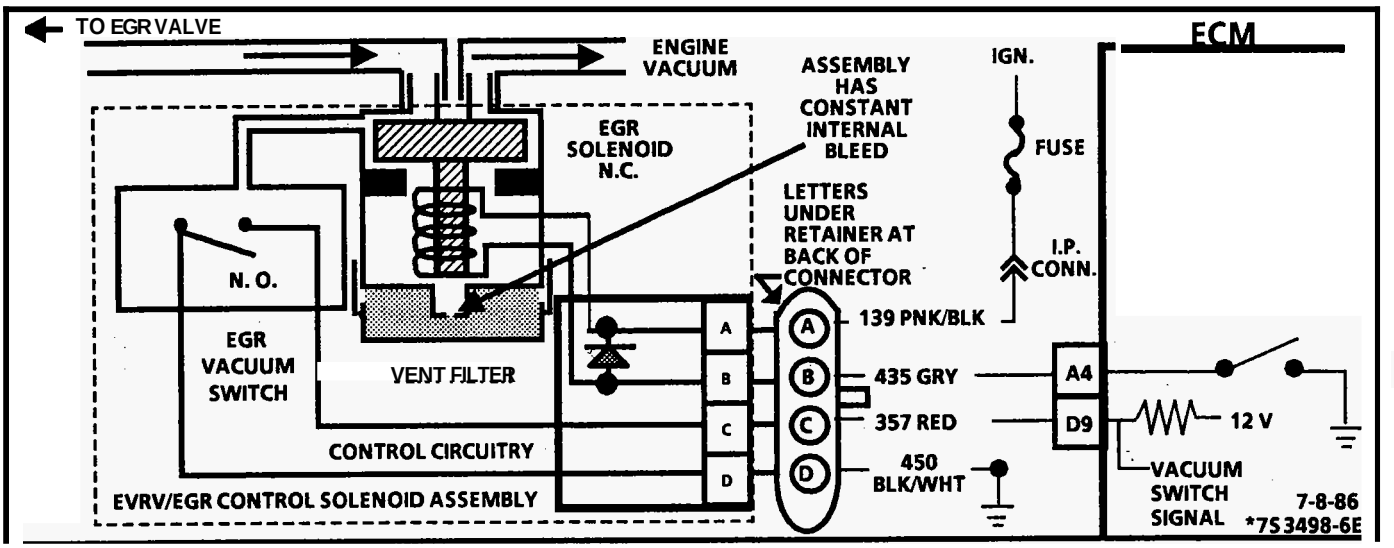
MECHANICAL CHECK SUCH AS LINKAGE AND VACUUM HOSES SHOULD BE CHECKED PRIOR TO USING THE CHART



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

84-85

9-6-85
*4S 0886-6E



CODE 32

EXHAUST GAS RECIRCULATION (EGR) CIRCUIT
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The EGR Valve is opened by engine vacuum. In order to control and monitor EGR application an Electronic Vacuum Regulator Valve is used (EVRV). The EVRV is composed of two devices: **1.** EGR Solenoid, normally closed (Vacuum Blocked). **2.** EGR Vacuum Switch, normally open, (No Current Flow).

EGR Vacuum Control is accomplished by the ECM grounding CKT **435.** This energizes the EGR Solenoid. This is done thousands of times a second. By varing the length of "ON" time, as compared to "OFF" time, Pulse Width Modulation, (PWM). The ECM controls the vacuum source to the EGR Valve.

EGR is monitored by the ECM thru the EGR vacuum switch. The EGR vacuum switch, a normally open electrical switch, has an orfice built in, which restricts the vacuum signal to the EGR vacuum switch, when sufficent vacuum reaches the EGR vacuum switch, to close the electrical switch. There should also be sufficient vacuum to open the EGR Valve.

Code **32** will set, if the vacuum switch closes at idle, or, if it does not close under load (less than WOT).

- Engine running.
- Code **33** or **34** not present
- Coolant temperature above 42.5°C (108°F).
- LV8 reading less than **144** cts.
- No vacuum to EGR (switch open).
- Conditions exist over **5** sec. (Turbo 9.6 sec.).

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. "Scan" displays the condition of the EGR diagnostic switch. In park or neutral, the display should read "NO" (open switch).
2. Under moderate engine load, the display will switch from " N O to "YES".
3. Checks the integrity of the 12 volts feed and ground circuits. If these circuits check OK, the fault is elsewhere in the EVRV/EGR Control circuit.
4. **A** test light connected between terminals "A" and "B' will verify the integrity of the ECM wiring and check for proper ECM operation.
5. If "YES" was displayed at idle, disconnect the EVRV harness. If display remains **"YES",** the fault is either a short to ground in CKT **357** or the ECM.
6. If the EGR display switches from "YES" to " N O when the EVRV is disconnected, the fault is either in the EVRV/EGR Solenoid, CKT **435** or the ECM.

Probing at terminal "B" will further isolate the fault. If the test light is on, disconnect ECM A-B connector before checking CKT **435** for a short to ground since the short could be inside the ECM.

Diagnostic Aids:

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation. Check For:

- Poor Connection or Damaged Harness Inspect ECM harness connectors for backed out terminal "D9", improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection anddamaged harness.
- Intermittent Test If connections and harness checks out OK, "Scan" EVRV switch, while moving related connectors and wiring harness. If the failure is induced, the "EVRV Switch" display will change. This may help to isolate the location of the malfunction.

"SCAN" DIAGNOSTICS

CODE 32

EXHAUST GAS RECIRCULATION (EGR) CIRCUIT
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

1
- **ENGINE IDLING.**
- CHECK VACUUM HOSES FOR LEAKS OR RESTRICTIONS AND EGR SOLENOID FILTER FOR BEING PLUGGED. (VERIFY MINIMUM OF 15" VACUUM AT THROTTLE BODY SIDE OF SOLENOID).
- "SCAN" EGR CONTROL VACUUM SWITCH.
- "NO" (SWITCH OPEN) SHOULD BE DISPLAYED. IS IT?

YES

2
- ENGINE STOPPED. RAISE DRIVE WHEELS AND BLOCK NON-DRIVE WHEELS.
- RE-START ENGINE.
- TRANS. IN DRIVE, "SCAN" EGR VACUUM SWITCH WHILE BRAKE TORQUING ENGINE TO 1800 RPM. (TIME SHOULD NOT EXCEED 15 SECONDS).
- "YES" (CLOSED SW.) SHOULD BE DISPLAYED. IS IT?

NO

3
- LOWER VEHICLE, IGN ON, ENGINE STOPPED.
- DISCONNECT EGR SOL. HARNESS AND CONNECT A TEST LIGHT BETWEEN HARNESS TERMINALS "A" AND "D".
- TEST LIGHT SHOULD BE ON. IS IT?

YES

4
- GROUND ALDL TEST TERM. "B".
- MOVE TEST LIGHT TO HARNESS TERMS. "A" AND "B"
- TEST LIGHT SHOULD BE ON. IS IT?

YES

- USING DVOM, CHECK VOLTAGE FROM HARN. TERMS. "C" TO "D".
- READING SHOULD BE APPROX. BATTERY VOLTAGE. IS IT?

NO

OPEN CKT 357, FAULTY ECM CONNECTION OR ECM.

YES

REPLACE EGR SOLENOID.

NO

OPEN CKT 435, FAULTY ECM CONNECTION OR ECM.

NO

- CONNECT TEST LIGHT FROM TERM. "A" TO GROUND.
- TEST LIGHT SHOULD BE ON. IS IT?

YES

OPEN CKT 450.

NO

OPEN CKT 139.

YES

CODE IS INTERMITTENT. IF NO ADDITIONAL CODES WERE DISPLAYED, REFER TO "DIAGNOSTIC AIDS".

NO

5
- DISCONNECT EGR SOL. HARNESS.
- "NO" (OPEN SWITCH) SHOULD BE DISPLAYED. IS IT?

YES

6
- PROBE EGR SOLENOID HARNESS TERM. "B" WITH A TEST LIGHT TO 12v.
- TEST LIGHT SHOULD BE OFF. IS IT?

YES

NO

CHECK CKT 357 FOR SHORT TO GROUND. IF OK, IT'S A FAULTY ECM.

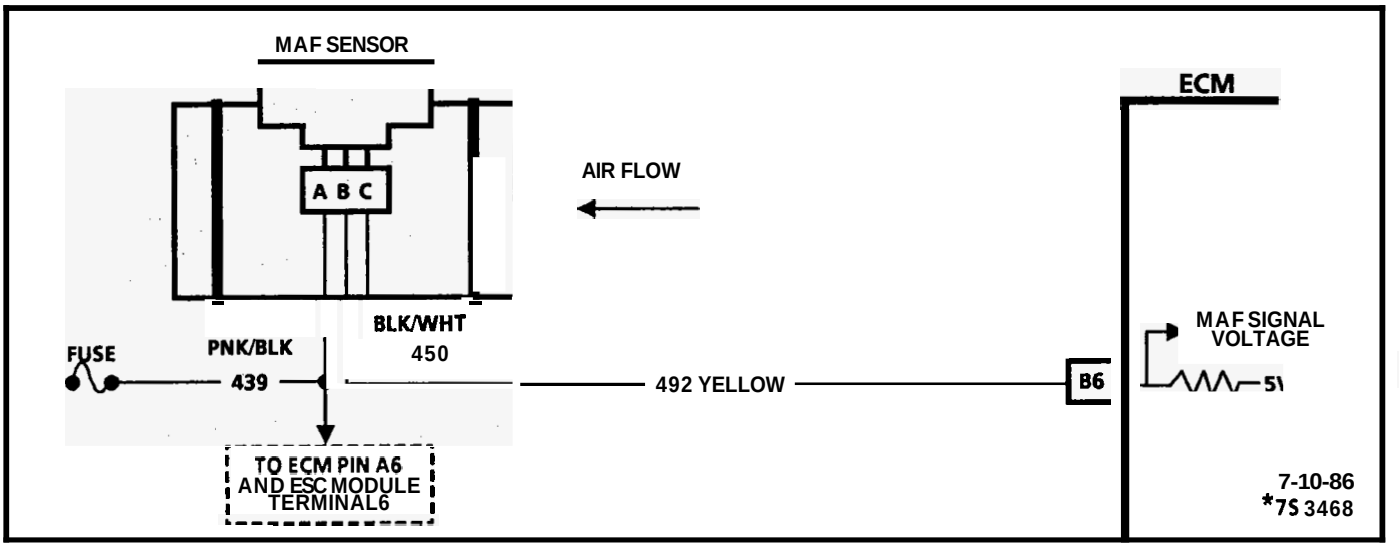
NO

IT'S A FAULTY ECM.

* *BEFORE REPLACING AN ECM, USE AN OHMMETER AND CHECK THE RESISTANCE BETWEEN TERMINALS OF;*
• EGR SOLENOID • A/C RELAY TERMINALS "A" TO "C". REPLACE WHERE RESISTANCE MEASURES LESS THAN 20 OHMS

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

* 7S 3483-6E
9-15-86



CODE 33

MASS AIR FLOW (MAF) SENSOR CIRCUIT (GM/SEC HIGH) 3.0L "N" SERIES 3.8L "A, C & H" SERIES 3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The MAF Sensor measures the flow of air entering the engine. The sensor produces a frequency output between 32 and 150 hertz (3 gm/sec to 150 gm/sec.). A large quantity (high frequency) indicates acceleration, and a small quantity (low frequency) indicates deceleration, or idle. This information is used by the ECM for fuel control and is converted by a "Scan" tool to read out the air flow in grams per second. A normal reading is about 47 grams per second at idle and increases with rpm.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Code 33 will set if:
   - IGN "ON" and air flow exceeds 20 gms/sec.
     OR
   - Engine is running less than 800 rpm.
   - TPS is 10% or less.
   - Air Flow greater than 150 grams per second (high frequency).
   - All of the above are met for 5 seconds or more.

Diagnostic Aids:

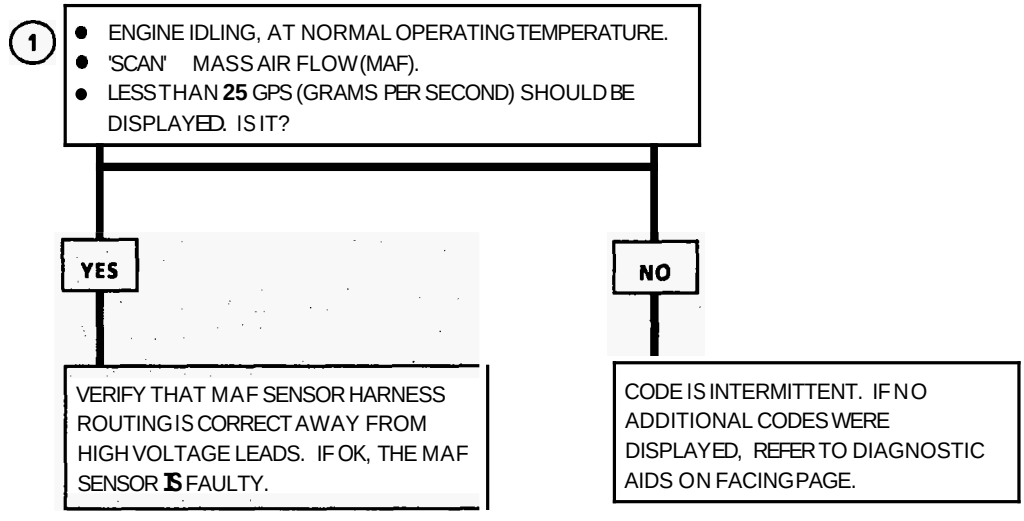
The "Scan" tool is not of much use in diagnosing this code, because, when the code sets, gm/sec will display a default value. However, it may be useful in comparing the signal of a problem vehicle with that of a known good running one.

Check For:

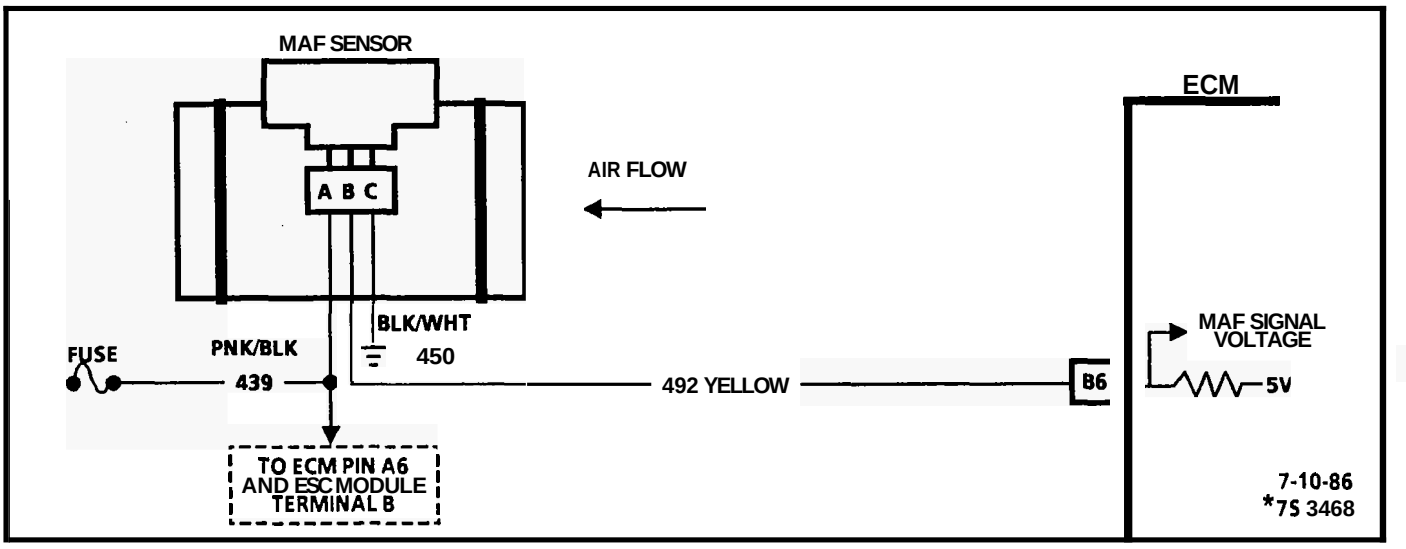
- Poor Connection or Damaged Harness Inspect ECM harness connectors for backed out terminal "B6", improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire conection, and damaged harness.
- Intermittent Test If connections and harness check out OK, "Scan" MAF, while moving related connectors and wiring harness. If the failure is induced, the MAF display will change. This may help to isolate the location of the malfunction.
- Mis-routed Harness Inspect MAF Sensor harness to insure that it is not too close to high voltage wires, such as spark plug leads.
- Miscalibrated MAF Sensor The Mass Air Flow Sensor may be tested, for being out of specification, by using a MAF Sensor test tool J-36101, or equivalent. This tester will only indicate a sensor that is shifted completely from its calibrated frequency range.

CODE 33

MASS AIR FLOW (MAF) SENSOR CIRCUIT (GM/SEC HIGH)
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO 'SERVICE ENGINE SOON" LIGHT.



CODE 34

MASS AIR FLOW (MAF) SENSOR CIRCUIT (GM/SEC LOW) 3.0L "N" SERIES 3.8L "A, C & H" SERIES 3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The Mass Air Flow (MAF) sensor measures the flow of air, which passes through it in a given time . The ECM uses this information to monitor the operating condition of the engine, in calculating fuel delivery. A large quantity of air movement indicates acceleration, while a small quantity indicates deceleration, or idle.

The MAF sensor produces a frequency signal, which cannot be easily measured. The sensor can be diagnosed using the procedures on this chart, and with the aid of MAF Sensor tester **5-36101,** or equivalent.

Code **34** will set, when either of the following sets of conditions exists:

- Engine running.
- No MAF Sensor signal for 250 msec.
  OR
- Engine running over **1400** rpm.
- TPS over **2.5** volts.
- Air Flow less than **10** grams per second (low frequency).
- Above conditions for over **10** seconds.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. This step checks for a loose or damaged air duct, which could set Code **34** and also checks to see if ECM recognizes a problem. A light **"OFF"** at this point indicates an intermittent fault.

2. A voltage reading at sensor harness connector terminal **"B"** of less than **4** or over **6** volts indicates a fault in CKT **492** or poor connection

3. Verifies that both ignition voltage and a good ground circuit are available.

Diagnostic Aids:

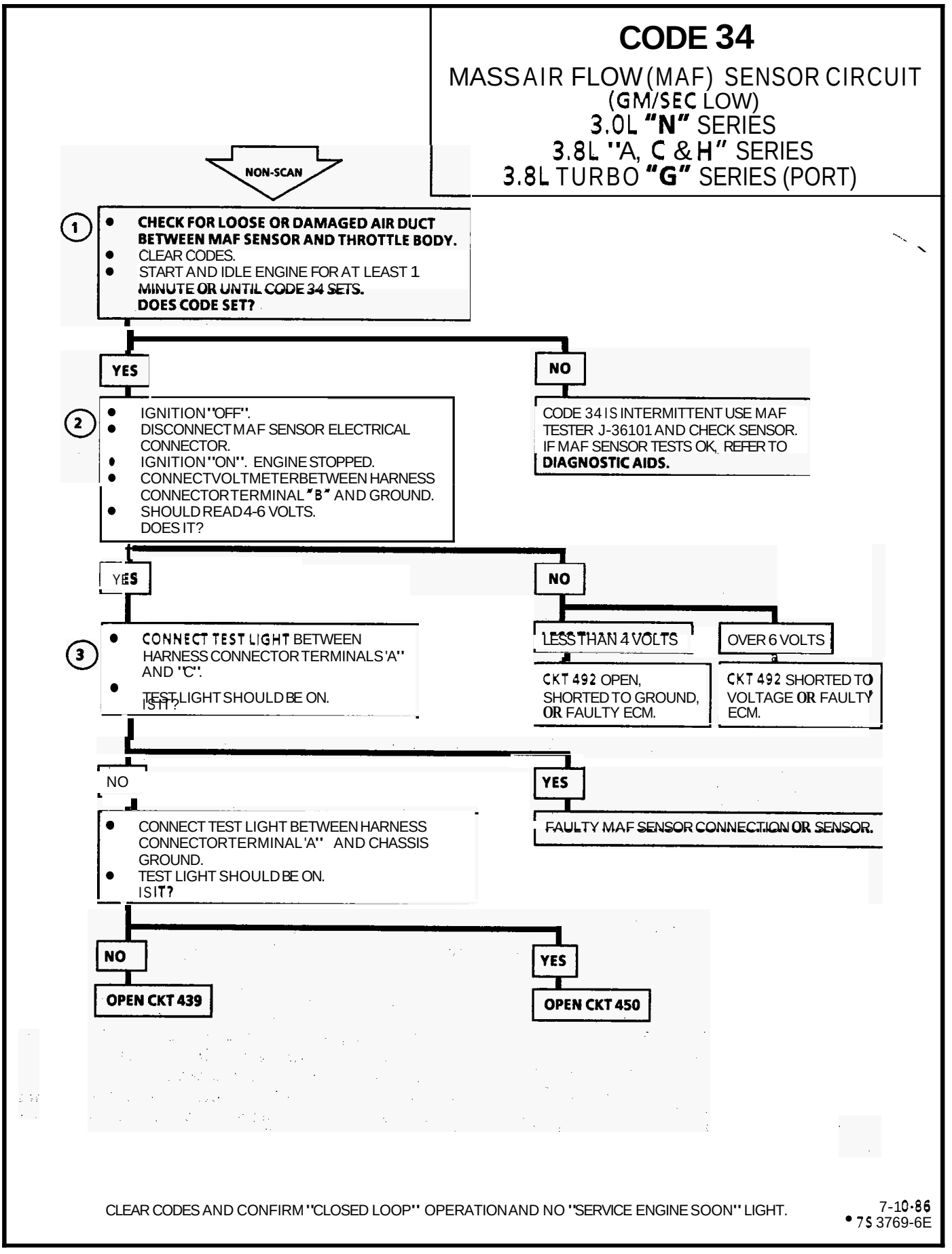
An intermittent may be caused by a poor connection, miss-routed harness, rubbed through wire insulation, or a wire broken inside the insulation.

Check For:

- Poor Connection at ECM pin "**B-6**". Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire conection.
- Mis-routed Harness Inspect MAF Sensor harness to insure that it is not too close to high voltage wires, such as spark plug leads.
- Damaged Harness Inspect harness for damage. If harness appears OK, "Scan" while moving related connectors and wiring harness. **A** change in display would indicate the intermittent fault location.
- Miscalibrated MAF Sensor The Mass Air Flow Sensor may be tested, for being out of specification, by using **a** MAF Sensor test tool **5-36101,** or equivalent.

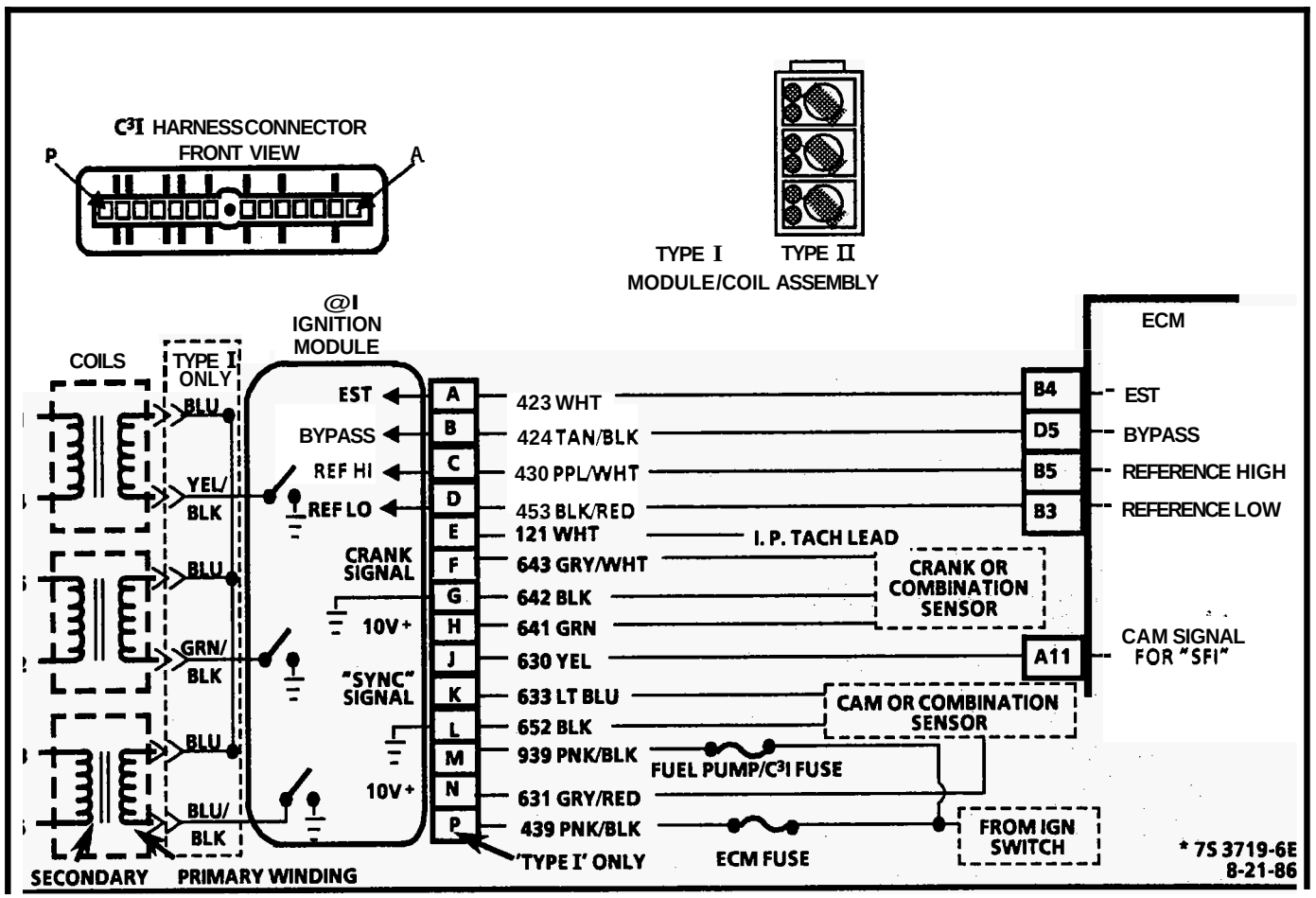
CODE 34

MASS AIR FLOW (MAF) SENSOR CIRCUIT (GM/SEC LOW)
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)



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

7-10-86
• 7S 3769-6E



CODE 41

CAM SENSOR CIRCUIT
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

For timing of spark plug firing, a cam sensor "hall effect" switch is used. The cam sensor sends a signal (Sync-Pulse) to the ignition module, when cylinder #1 is 25° after top dead center on the compression stroke. This signal is used to start the correct coil firing sequence, and to enable sequential fuel injection. The engine will continue to run if the cam signal is lost while running, however, will not restart after shut down. If the failure is in the cam signal output portion of the C³I module (terminal "J") or the "SFI" cam signal CKT 630 to ECM terminal "A11", the ECM will switch to the simultaneous fuel injection mode and continue to run. The engine can be re-started but will continue to run in the simultaneous mode as long as the fault is present. In either failure mode a Code 41 will be stored.

Code 41 is set when the following conditions are met:

- Engine is running.
- Cam sensor signal not received by ECM in last 1 second interval.

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. Checks to see if ECM recognizes a problem, and sets Code 41. If the engine cranks, but will not start and a Code 41 was displayed, the fault is in the ignition system portion of the Cam Sensor circuit and should be diagnosed using CHART A-3, "Cranks But Will Not Run".
2. The voltage to ECM terminal "A11" is supplied by the ignition module. If voltage reading is below 6 volts, the fault is in CKT 630, a poor connection at the C³I module, or a faulty C³I module.

Diagnostic Aids:

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation.

Check For:

- Poor Connection or Damaged Harness Inspect ECM harness connectors for backed out terminal "A11", improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection and damaged harness.
- Intermittent Test If connections and harness checks out OK, monitor A Digital Voltmeter connected from ECM terminal "A11" to ground while moving related connectors and wiring harness. If the failure is induced, the voltage reading will change. This may help to isolate the location of the malfunction.

"SCAN" DIAGNOSTICS

CODE 41

CAM SENSOR CIRCUIT
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

YES

NO

NO

(2)

- IGNITION OFF, DISCONNECT ECM "A-B" CONNECTOR AND CAR SENSOR HARNESS.
- IGNITION ON, ENGINE STOPPED.
- USING DVOM, CHECK VOLTAGE AT HARNESS TERMINAL "A-11".
- VOLTAGE SHOULD BE OVER 6 VOLTS. IS IT?

SEE APPLICABLE CODE CHART FOR CODE(S) DISPLAYED OTHER THAN 41.

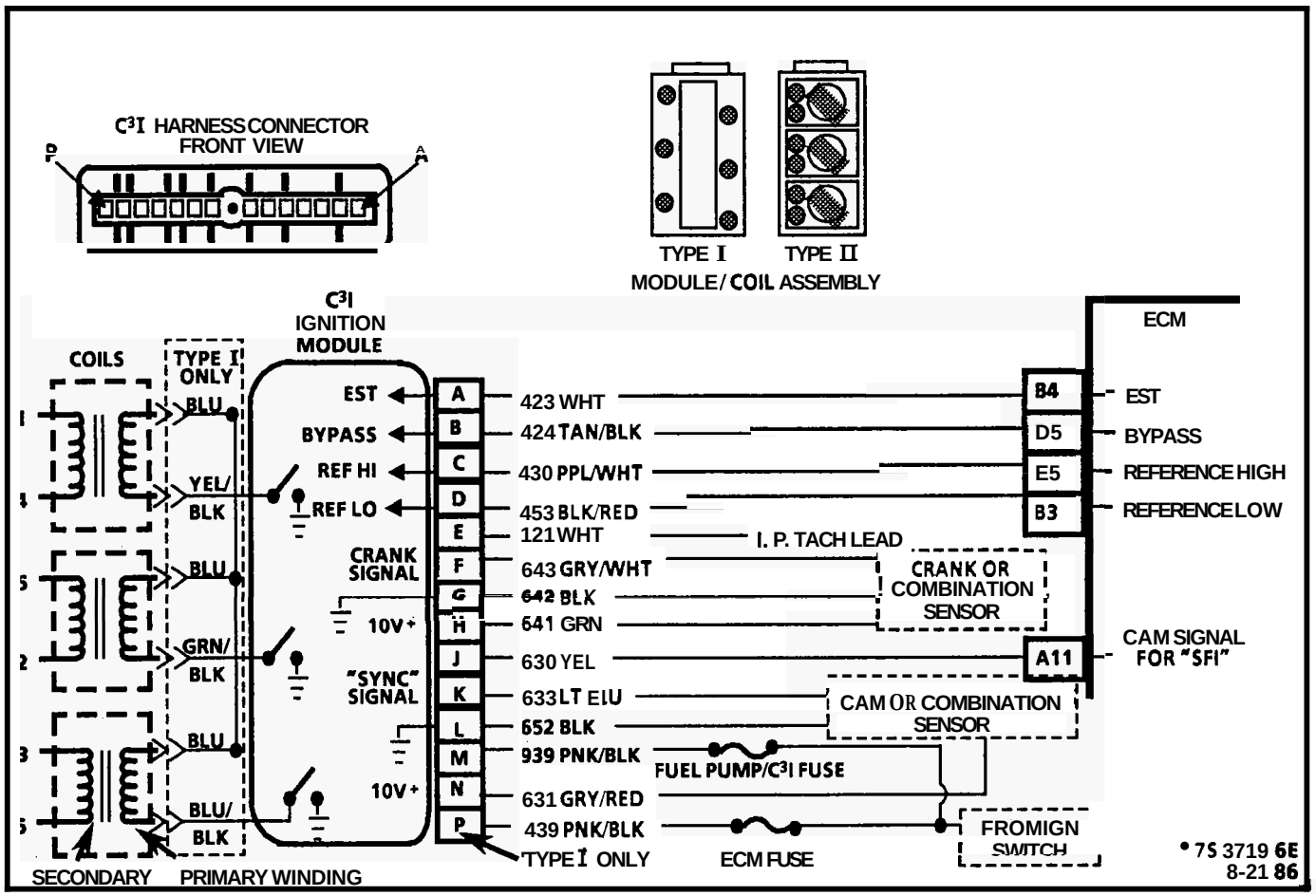
NO

POOR CONNECTION AT ECM TERMINAL "A11" OR FAULTY ECM.

CHECK CKT FROM C³I MODULE TERM. "J" TO ECM TERM. "A11" FOR OPEN OR SHORT TO GROUND. IF CKT IS OK, IT'S POOR CONNECTION AT C³I MODULE OR FAULTY C³I MODULE.

7S 3486-6E
9-5-86

CLEAR CODES AND CONFIRM 'CLOSED LOOP' OPERATION AND NO 'SERVICE ENGINE SOON" LIGHT.



CODE 42

C³I EST OR BYPASS CIRCUIT FAILURE
3.0L "N" SERIES; 3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The C31 module sends a reference signal to the ECM, when the engine is cranking. While the engine is under 400 rpm, the C31 module controls the ignition timing. When the engine speed exceeds **400** rpm, the ECM sends a **5** volt signal on the By-pass circuit (424) to switch the timing to ECM control, through the EST circuit (423). **An** open or ground in the EST circuit will stall the engine and set a Code 42. The engine can be re-started but will run on module timing.

To set a Code 42 the following conditions must be met:

- Engine speed greater than 600 rpm. with no EST pulse for 200 msec. (Open or Grounded CKT 423) or,
- ECM commanding By-pass mode. (Open or Grounded CKT 424)

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. Checks to see if ECM recognizes a problem. If it doesn't set Code 42, at this point, it is an intermittent problem and could be due to a loose connection.
2. With the ECM disconnected, the ohmmeter should be reading less than 200 ohms, which is the normal resistance of the EST circuit through the C³I module. A higher resistance would indicate a fault in CKT 423, a poor C31 module connection, or a faulty C³I module.
3. If test light was on, when connected from 12 volts to ECM harness terminal "D5", either CKT 423 is shorted to ground, or the C³I module is faulty.
4. Checks to see if C31 module switches, when the bypass circuit is energized by 12 volts, through the test light. If the C31 module actually switches, the ohmmeter reading should shift to over 8,000 ohms.
5. Disconnecting the ignition module should make the ohmmeter read as if it were monitoring an open circuit (infinite reading). Otherwise, CKT 423 is shorted to ground.

Diagnostic Aids:

An intermittent may be caused by a poor ,connection, rubbed through wire insulation or a wire broken inside the insulation. Check For:

- Poor Connection or Damaged Harness Inspect ECM harness connectors for backed out terminals "B4" or "D5", improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection and damaged harness.
- Intermittent Test If connections and harness checks out OK, a Digital Voltmeter connected from affected terminal to ground while moving related connectors and wiring harness. If the failure is induced, the voltage reading will change.

"SCAN" DIAGNOSTICS

CODE 42

C3I EST OR BYPASS CIRCUIT FAILURE
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES
(PORT)

- DID "SERVICE ENGINE SOON" LIGHT COME ON?

YES

- IGNITION ON-ENGINE STOPPED.
- "SCAN" CODES.
- WAS CODE 42 DISPLAYED?

NO

CODE IS INTERMITTENT. IF NO ADDITIONAL CODES DISPLAYED, REFER TO "DIAGNOSTICAIDS".

2

- IGNITION OFF, DISCONNECT BOTH ECM CONNECTORS.
- IGNITION ON", PROBE ECM HARNESS CONNECTOR TERMINAL "B4" WITH A OHMMETER TO GROUND.
- RESISTANCE SHOULD BE LESS THAN 200 OHMS. WAS IT?

SEE APPLICABLE CODE CHART FOR CODE(S) DISPLAYED OTHER THAN 42.

YES

NO

3

- IGNITION ON, PROBE ECM HARNESS TERMINAL "D5" WITH A TEST LIGHT TO 12 VOLTS.
- TEST LIGHT SHOULD BE OFF. IS IT?

CHECK CKT 423 FOR OPEN. IF CKT 423 IS OK, IT'S POOR CONNECTION AT IGNITION MODULE TERM. "A" OR FAULTY IGNITION MODULE.

4

- AS TEST LIGHT CONTACTED "D5", RESISTANCE FROM "B4" TO GROUND SHOULD SWITCH FROM UNDER 200 TO OVER 8,000 OHMS. DID IT?

- IGNITION OFF, DISCONNECT IGNITION MODULE.
- IGN. ON, IS TEST LIGHT OFF?

NO

YES

YES

NO

5

- IGN. OFF, DISCONNECT IGN. MODULE.
- RESISTANCE BETWEEN ECM TERM. "B4" AND GROUND SHOULD BE INFINITE (OPEN CIRCUIT). WAS IT?

- RECONNECT ECM AND IDLE ENGINE FOR 2 MIN.
- DIDSERVICE ENGINE SOON LIGHT COME ON?

"A" MODULE

CKT 424 SHORTED TO GROUND.

YES

NO

YES

CHECK CKT 424 FOR OPEN. IF CKT 424 IS OK, IT'S POOR CONNECTION AT IGN. MODULE TERM. "B" OR FAULTY IGN. MODULE.

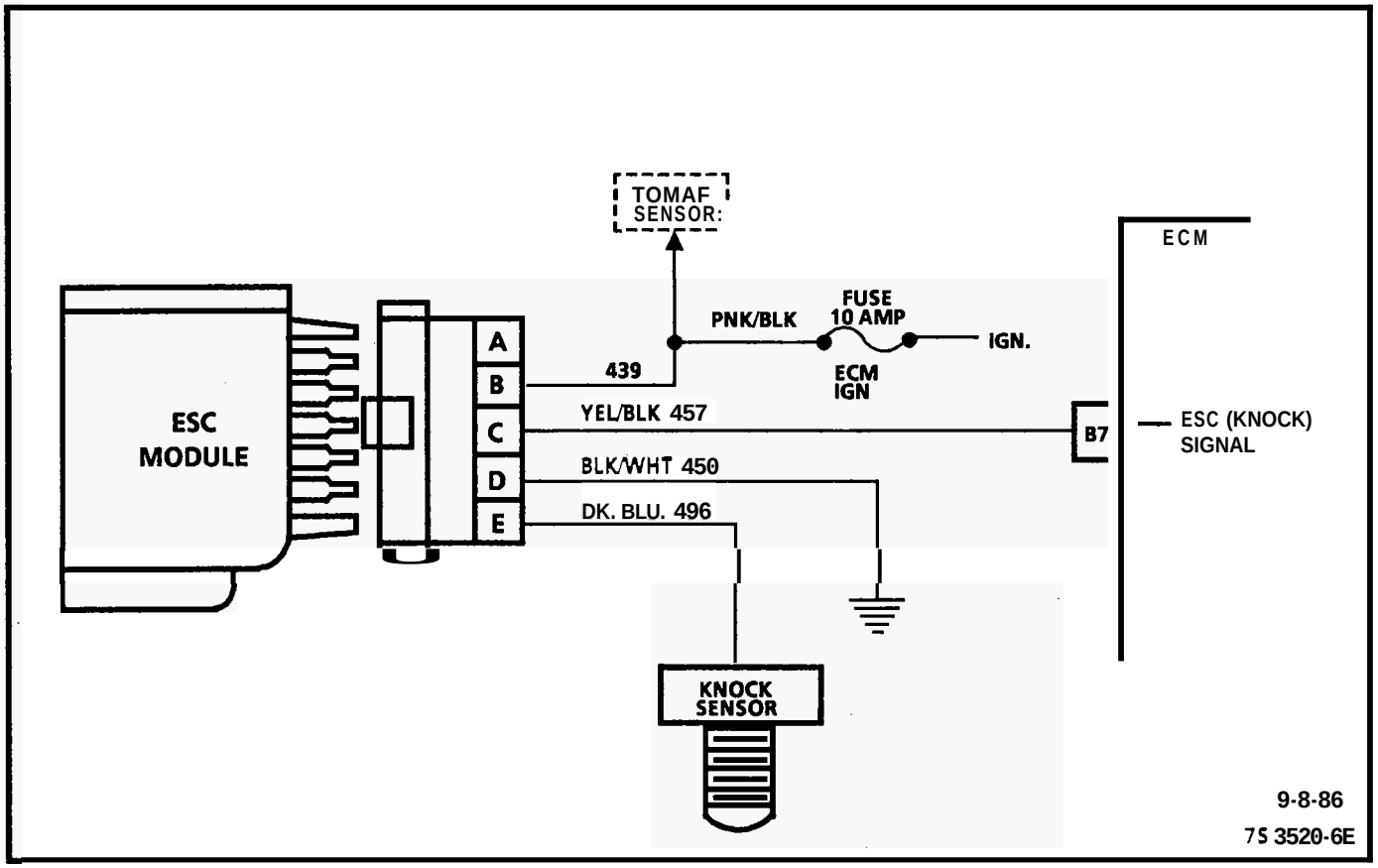
CKT 423 SHORTED TO GROUND.

IF CODE 42 IS STORED,

CHECK FOR INTERMITTENT CONNECTIONS.

CLEAR ALL CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO 'SERVICE ENGINE SOON' LIGHT

7S 3487-6E
7-15-86



CODE 43

ELECTRONIC SPARK CONTROL (ESC) CIRCUIT
3.0L "N" SERIES; 3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The ESC system is comprised of a knock sensor and an ESC module.

The ESC module sends a voltage signal (8 to 10 volts) to the ECM.

When the sensor detects detonation, the module turns "OFF" the circuit to the ECM and the voltage at ECM terminal "B7" drops to 0 volts. The ECM then retards EST as much as 20° in one (1) degree increments, to reduce detonation. This happens fast and frequently enough that if looking at this signal with a DVM, you won't see 0 volts, but an average voltage somewhat less than what is normal with no detonation.

A loss of the knock sensor signal or a loss of ground at the ESC module would cause the signal at the ECM to remain high. The ECM would control ignition timing (EST) as if no detonation were occuring. The EST would not be retarded, and detonation could become severe enough under heavy engine load conditions to result in pre-ignition and potential engine damage.

Loss of the ESC signal to the ECM would cause the ECM to constantly retard the EST to its max retard of 20° from the spark table. This could result in sluggish performance and cause a Code 43 to set.

Code 43 will set when:

- Engine Running.
- ESC input signal has been low more than 2.2 seconds.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. If the ECM Data (Knock Signal) display is fluctuating widely, the ECM is monitoring a low voltage signal on circuit (457) at ECM terminal "B7".
2. Probing ESC harness terminal "C" with a test light connected to 12 volts should result in the "OLD PA3" (knock signal) display holding a steady reading due to over 8 volts having been applied to ECM terminal "B7" through CKT 457.
3. If over 6 volts is measured at ECM terminal "B7", CKT 457 is OK and the fault is due to a poor connection at the ECM or the ECM is faulty.

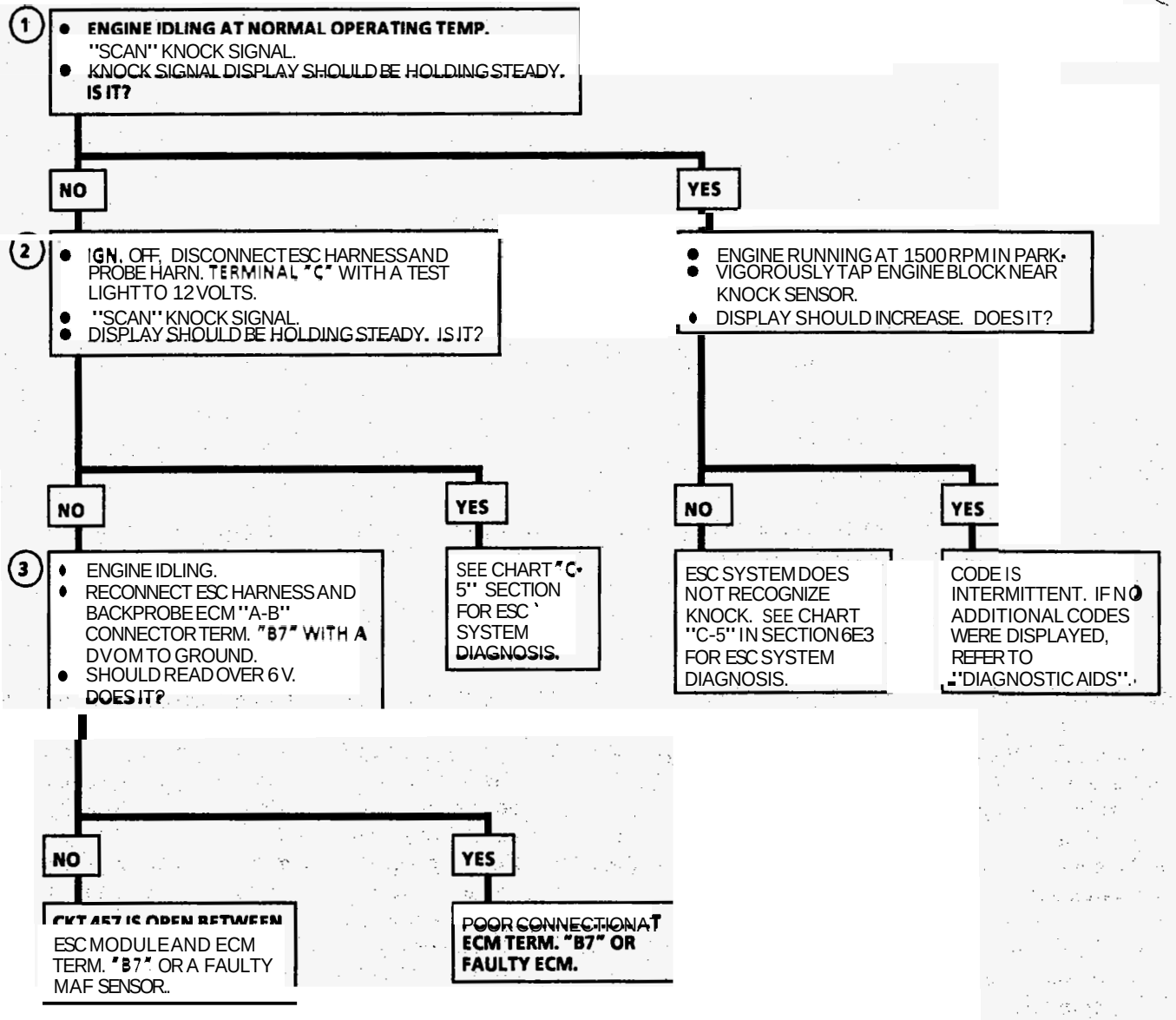
Diagnostic Aids: An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation. Check For:

- Poor Connection or Damaged Harness Inspect ECM harness connectors for backed out terminal "B7", improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection and damaged harness.
- Intermittent Test If connections and harness checks out OK, "Scan" Knock Signal (OLD PA3) while moving related connectors and wiring harness. If the failure is induced, the Knock Signal display will change. This may help to isolate the location of the malfunction.

"SCAN" DIAGNOSTICS

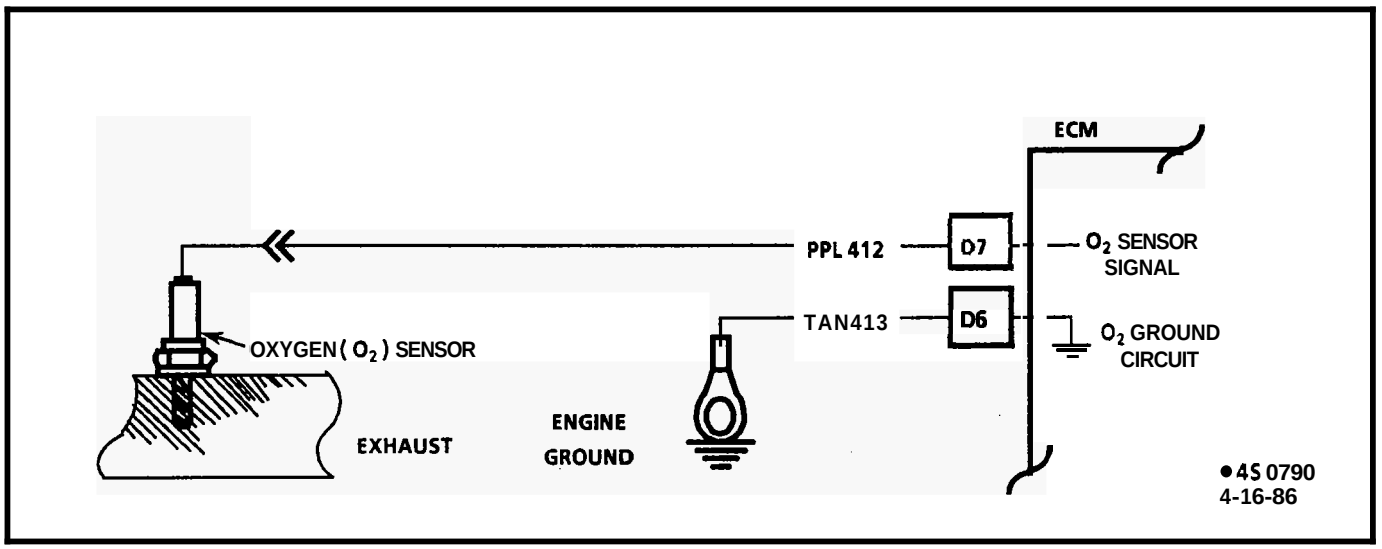
CODE 43

ELECTRONIC SPARK CONTROL (ESC) CIRCUIT
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)



CLEAR ALL CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT

7S 3488-6E
9-15-86



CODE 44

OXYGEN SENSOR CIRCUIT
(LEAN EXHAUST INDICATED)
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The ECM supplies a voltage of about .45 volts (450 mv) between terminals "D6" and "D7". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts.) The O_2 sensor varies the voltage within a range of about 1 volt, (1000 mv) if the exhaust is rich, down through about .10 volts (100 mv) if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below about 360°C (600°F) An open sensor circuit or cold sensor causes "Open Loop" operation.

Code 44 is set when the O_2 sensor signal voltage on CKT 412.

- Remains below .2 volts for 60 seconds or more:
- And the system is operating in "Closed Loop".

Diagnostic Aids:

Using the "Scan", observe the block learn values at different rpm and air flow conditions. The "Scan" also displays the block cells, so the block learn values can be checked in each of the cells to determine when the Code 44 may have been set. If the conditions for Code 44 exists the block learn values will be around 150.

- O_2 Sensor Wire. Sensor pigtail may be mispositioned and contacting the exhaust manifold.
- Check for intermittent ground in wire between connector and sensor.
- MAF Sensor. A Mass Air Flow (MAF) sensor output that causes the ECM to sense a lower than normal air flow will cause the system to go lean. Disconnect the MAF sensor and if the lean condition is gone, replace the MAF sensor or use MAF tester J-36101.
- Lean Injector(s). Perform injector balance test CHART C-2A.
- Fuel Contamination. Water, even in small amounts, near the in-tank fuel pump inlet can be delivered to the injectors. The water causes a lean exhaust and can set a Code 44.
- Fuel Pressure. System will be lean if pressure is too low. It may be necessary to monitor fuel pressure while driving the car at various road speeds and/or loads to confirm. See Fuel System diagnosis CHART A-7.
- Exhaust Leaks. If there is an exhaust leak, the engine can cause outside air to be pulled into the exhaust and past the sensor. Vacuum or crankcase leaks can cause a lean condition.
- Air System (manual trans only)
  Be sure air is not being directed to the exhaust ports while in "Closed Loop". If the block learn value goes down while squeezing air hose to exhaust ports, refer to CHART C-6.
- If the above are OK, it is a faulty oxygen sensor.

"SCAN" DIAGNOSTICS

CODE 44

OXYGEN SENSOR CIRCUIT
(LEAN EXHAUST INDICATED)
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

(1)
- RUN WARM ENGINE (75°C TO 95°C) AT 1200 RPM.
- DOES "SCAN" INDICATE O_2 VOLTAGE FIXED BELOW .35 VOLTS (350MV)?

YES

- DISCONNECT O_2 SENSOR.
- WITH ENGINE IDLING "SCAN" SHOULD DISPLAY O_2 BETWEEN .35 VOLTS AND .55 VOLTS (350MV AND 550MV).
  DOES IT?

YES

REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

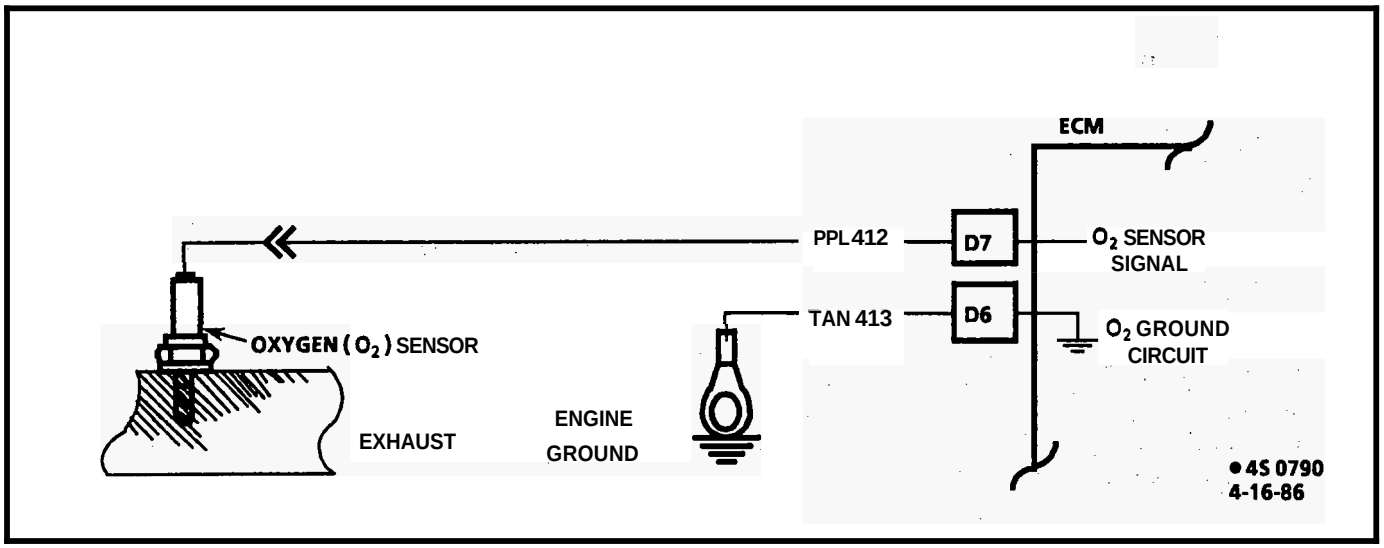
NO

CKT 412 SHORTED TO GROUND OR FAULTY ECM.

NO

CODE 44 IS INTERMITTENT.
IF NO ADDITIONAL CODES WERE STORED, REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

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



CODE 45

OXYGEN SENSOR CIRCUIT
(RICH EXHAUST INDICATED)
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The ECM supplies a voltage of about .45 volts (450 mv) between terminals "D6" and "D7". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts.) The O_2 sensor varies the voltage within a range of about 1 volt (1000 mv) if the exhaust is rich, down through about .10 volts (100 mv) if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below about 360°C (600°F) An open sensor circuit or cold sensor causes "Open Loop" operation.

Code 45 is set when the 0 2 sensor signal voltage or CKT 412.

- Remains above .7 volt for 30 seconds; and in "Closed Loop".
- Engine time after start is 1 minute or more.
- Throttle angle between 3% and 45%.

Diagnostic Aids:

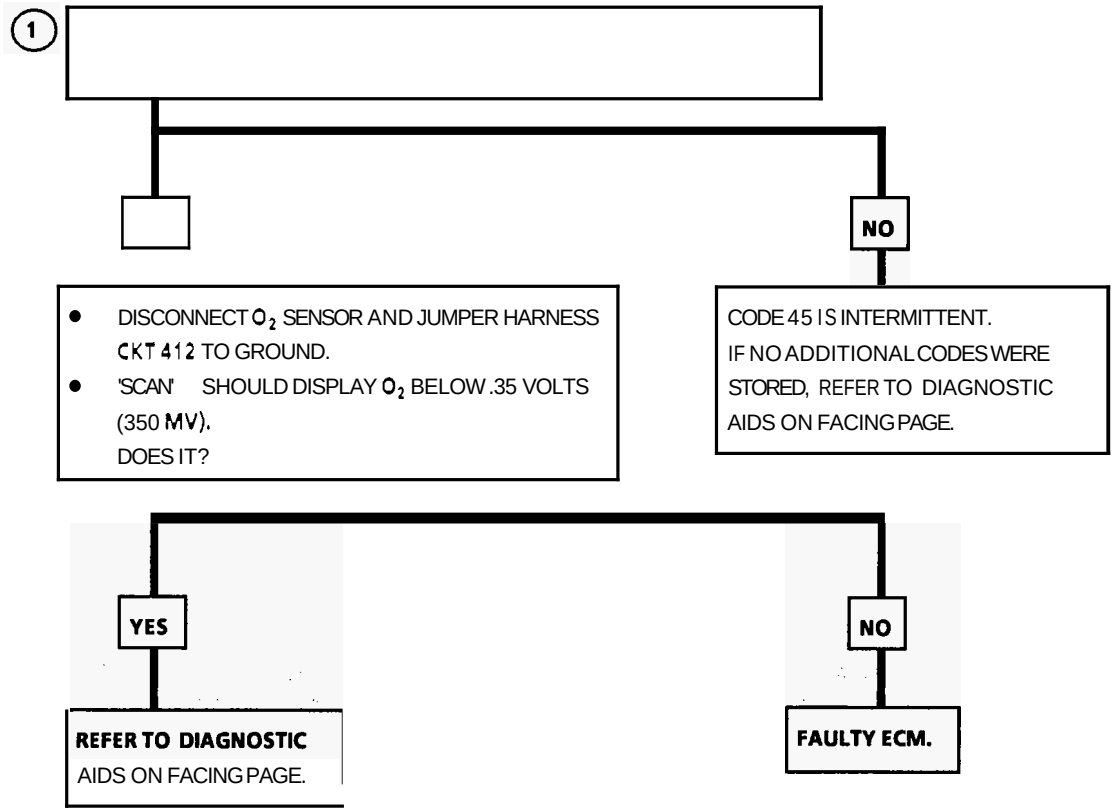
Using the "Scan", observe the block learn values at different rpm and air flow conditions. The "Scan" also displays the block cells, so the block learn values can be checked in each of the cells to determine when the Code 46 may have been set. If the conditions for Code 45 exists, the block learn values will be around 115.

- Fuel Pressure. System will go rich if pressure is too high. The ECM can compensate for some increase. However, if it gets too high, a Code 46 may be set. See Fuel System diagnosis CHART A-7.
- Rich injector. Perform injector balance test CHART C-2A.
- Leaking injector. See CHART A-7.
- Check for fuel contaminated oil.
- HEI Shielding. An open ground CKT 453 (ignition system reflow) may result in EMI, or induced electrical "noise". The ECM looks at this "noise" as reference pulses. The additional pulses result in a higher than actual engine speed signal. The ECM then delivers too much fuel, causing system to go rich. Engine tachometer will also show higher than actual engine speed, which can help in diagnosing this problem.
- Canister purge. Check for fuel saturation. If full of fuel, check canister control and hoses. See canister purge Section "C3".
- MAF sensor. An output that causes the ECM to sense a higher than normal airflow can cause the system to go rich. Disconnecting the MAF sensor will allow the ECM to set a fixed value for the sensor. Substitute a different MAF sensor if the the rich condition is gone while the sensor is disconnected or use tool J-36101 and test MAF Sensor.
- Check for leaking fuel pressure regulator diaphragm by checking vacuum line to regulator for fuel.
- TPS. An intermittent TPS output will cause the system to go rich, due to a false indication of the engine accelerating.
- EGR. An EGR staying open (especially at idle) will cause the O_2 sensor to indicate a rich exhaust, and this could result in a Code 45.

"SCAN" DIAGNOSTICS

CODE 45

OXYGEN SENSOR CIRCUIT
(RICH EXHAUST INDICATED)
3.0L "N" SERIES
3.8L **"A,** C & **H"** SERIES
3.8L TURBO **"G"** SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP' OPERATION AND NO 'SERVICE ENGINE SOON" LIGHT.

9-5-86
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CODE 51

PROM ERROR
(FAULTY OR INCORRECT PROM)

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

CLEAR ALL CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT

CODE 52

CALPAK ERROR
(FAULTY OR INCORRECT CALPAK)

CHECK THAT ALL PINS ARE FULLY INSERTED IN THE SOCKET. IF OK, REPLACE CALPAK, CLEAR MEMORY, AND RECHECK. IF CODE 52 REAPPEARS, REPLACE ECM.

CLEAR ALL CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT

CODE 55

ECM ERROR

REPLACE ELECTRONIC CONTROL MODULE (ECM)

CLEAR ALL CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT

SECTION B
SYMPTOMS

TABLE OF CONTENTS

BEFORE STARTING

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

1. The ECM and "Service Engine Soon" light are operating.
2. There are no trouble codes stored, or there is a trouble code but no "Service Engine Soon" 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/Physical Check. This check should include:

- ECM grounds for being clean and tight
- 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.

INTERMITTENTS

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

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

- Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful check as described at start of this Section. 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/physical check does not find the cause of the problem, the car may 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. If the wiring and connectors check OK and a Trouble Code was stored for a circuit having a sensor, except for Codes 43, 44, and 45, substitute a known good sensor and recheck.

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

- Ignition coil shorted to ground, arcing at spark plug wires or plugs.
- "Service Engine Soon" light wire to ECM shorted to ground. (CKT 419).
- Diagnostic "Test" Terminal wire to ECM, shorted to ground. (CKT 451)
- ECM power grounds. See ECM wiring diagrams.
- Loss of trouble code memory. To check, disconnect TPS and idle engine until "Service Engine Soon" light comes "ON". Code 22 should be stored, and kept in memory when ignition is turned "OFF". If not, the ECM is faulty.
- Check for an electrical system interference caused by a defective relay, ECM driven solenoid, or switch. They can cause a sharp electrical surge. Normally, the problem will occur when the faulty component is operated.
- Check for improper installation of electrical options, such as lights, 2-way radios, etc.
- EST wires should be kept away from spark plug wires, distributor wires, distributor housing, coil, and generator. Wire from CKT 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:
  - TPS for sticking or binding or a high TPS voltage with the throttle closed.
  - High resistance in coolant sensor circuit or sensor itself. See CODE 15 CHART OR with a "Scan" tool compare coolant temperature with ambient temperature on a cold engine.
  - Fuel pressure CHART A-7.
  - Water contaminated fuel.
  - EGR operation. Be sure valve seats properly and is not staying open. See CHART C-7.
  - Fuel pump relay - See CHART A-7A step 2.
  - Ignition system - Check distributor for:
    - Proper Output with ST-125.
    - Worn shaft.
    - Bare and shorted wires.
    - Pickup coil resistance and connections.
    - Loose ignition coil ground.
    - Moisture in distributor cap.
- If problem exists in cold weather, check cold start valve. See CHART A-9.
- 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.
- Remove spark plugs. Check for wet plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. Repair or replace as necessary.
- If engine starts but then 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.
  - Spark plugs for being fouled or faulty wiring.
  - PROM number. Also check Service Bulletins for latest PROM.
  - TPS for binding or sticking. Voltage should increase at a steady rate as throttle is moved toward W.O.T.
  - MAP Sensor - CHART C-1F.
  - Ignition timing. See Emission Control Information label.
  - Generator output voltage. Repair if less than 9 or more than **16** volts.
  - HEI ground, CKT 453.
  - Canister purge system for proper operation. See CHART C-3.
  - EGR - See CHART C-7.
  - Engine Thermostat - functioning correctly and proper heat range.
- Perform injector balance test CHART C-2A.

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 "Scan" tool is available which plugs in to the ALDL connector, make sure reading of VSS matches vehicle speedometer. See Introduction explaining "Scan" tool positions.
  - EGR - There should be no EGR at idle. See CHART C-7.
  - EGR filter for being plugged.
  - Vacuum lines for kinks or leaks.
  - Ignition timing. See Emission Control Information label.
  - In-line fuel filter. Replace if dirty or plugged.
  - Fuel pressure while condition exists. 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.

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.

- Perform careful visual check as described at start of Section "B".
- 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.
  - Restricted fuel filter, contaminated fuel or improper fuel pressure. See CHART A-7.
  - ECM power grounds - See wiring diagrams.
  - EGR operation for being **open** or partly open all the time - CHART C-7.
  - Exhaust system for possible restriction:
    - Inspect exhaust system for damaged or collapsed pipes.
    - Inspect muffler for heat distress or possible internal failure.
  - Generator output voltage. Repair if less than 9 or more than **16** volts.
  - Engine valve timing and compression.
  - Engine for proper or worn camshaft. See Section "6A".
  - Secondary voltage using a shop ocilliscope or a spark tester **J-26792 (ST-125)** or equivalent.

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.
  - Correct coolant solution - should be a 50/50 mix of GM #1052753 anti-freeze coolant (or equiv.) and water.
- **CHECK:**
  - Ignition timing. See Vehicle Emission Control Information label.
  - EGR system for not opening - CHART C-7.
  - TCC operation - CHART C-8.
  - Fuel system pressure. See CHART A-7.
  - PROM - Be sure it's the correct one. (See Service Bulletins)
  - Valve Oil seals for leaking.
- Check for incorrect basic engine parts such as cam, heads, pistons, etc.
- Check for poor fuel quality.
- Remove carbon with top engine cleaner. Follow instructions on can.

CUTS OUT, MISSES

Definition: Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. 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. Start engine. Disconnect IAC motor. 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 5-34730-2 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, or terminal.
- Perform the Injector Balance Test. See CHART C-2A.
- **CHECK:**
  - Spark plug wires by connecting ohmmeter to ends of each wire in question. If meter reads over 30,000 ohms, replace wire(s).
  - Visually inspect distributor cap and rotor for moisture, dust, cracks, burns, etc. Spray cap and plug wires with fine water mist to check for shorts.
  - Fuel System - Plugged fuel filter, water, low pressure. See CHART A-7.
  - Valve timing.
  - Secondary voltage using a shop ocilliscope or a spark tester 5-26792 (ST-125) or equivalent.
- Remove rocker covers. Check for bent pushrods, worn rocker arms, broken valve springs, worn camshaft lobes. Repair as necessary. See Section "6A".

BACKFIRE

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

- **CHECK:**
  - Compression - Look for sticking or leaking valves.
  - EGR operation for being open all the time. See CHART C-7.
  - EGR gasket for faulty or loose fit.
  - Valve timing.
  - Output voltage of ignition coil using a shop ocilliscope or spark tester J-26792 (ST-125) or equivalent.
  - Spark plugs for crossfire also inspect (distributor cap, spark plug wires, and proper routing of plug wires).
  - Ignition system for intermittent condition. (See Section "6D").
  - Engine timing - see Emission Control Information label.

POOR FUEL ECONOMY

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

- Perform careful visual check as described at start of Section **"B"**.
- **CHECK:**
  - Coolant level.
  - Engine thermostat for faulty part (always open) or for wrong heat range. See Section "6B".
  - Ignition timing. See Emission Control Information label.
  - TCC for proper operation. See CHART C-8.
  - Induction system and crankcase for air leaks.

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".
- Clean Injectors.
- **CHECK:**
  - Throttle linkage for sticking or binding.
  - TPS for sticking or binding, be sure output is stable at idle and adjustment specification is correct.
  - IAC system. See Code 35 chart.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - P/N switch circuit. See CHART C-1A, or use "Scan" Tool, and be sure tool indicates vehicle is in drive with gear selector in drive (125C), or overdrive (440-T4).
  - Injector balance. See CHART C-2A.
  - PCV valve for proper operation by placing finger over inlet hole in valve end several times. Valve should snap back. If not, replace valve. See Section "C13".
  - Evaporative Emission Control System. CHART C-3.
  - Power Steering Pressure switch input. The state of the switch should only change when wheels are turned up against the stops. See CHART C-1E.
  - Minimum Idle Speed. Incorrect minimum idle speed may be caused by foreign material accumulation in the throttle bore, on the throttle valve or on the throttle shaft. See Section "C2".
  - ECM ground circuits.
  - EGR valve: There should be no EGR at idle.
- Monitoring block learn values may help identify the cause of the problem. If the system is running lean (block learn greater than 138) refer to Diagnostic Aids on facing page of Code 44. If the system is running rich (block learn values less than 118) refer to Diagnostic Aids on facing page of Code 45.
- Run a cylinder compression check. See Section "6".
- Check for fuel in pressure regulator hose. If present, replace regulator assembly.
- Check ignition system; wires and plugs.
- Check for loose or damaged MAF duct between sensor and throttle body.
- Disconnect MAF sensor and if condition is corrected, replace sensor. "Scan" tool should read about 4-8 grams per second at idle.
- If problem exists with A/C "ON, check A/C system operation CHART C-10.

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:**
  - Fuel pressure. See CHART A-7.
  - Canister for fuel loading. See CHART C-3.
  - Injector balance. See CHART C-2A.
  - PCV valve for being plugged, stuck, or blocked PCV hose.
  - Spark plugs.
  - Check for lead contamination of catalytic converter (look for removal of fuel filler neck restrictor).
- If the system is running rich (block learn less than 118), refer to Diagnostic Aids on facing page of Code 45.
- IF TEST SHOWS EXCESSIVE NOx:
  - Check items which cause car to run LEAN, or to run too hot.
    - EGR valve for not opening or plugged passages. See CHART C-7.
    - Vacuum leaks.
    - Coolant system and coolant fan for proper operation. See CHART C-12.
    - Remove carbon with top enginecleaner. Follow instructions on can.
- If the system is running lean (block learn greater than 138), refer to Diagnostic Aids on facing page Code 44.

INTERMITTENT STALLING ON DECELERATION OR WHEN VEHICLE IS STOPPED

Definition: If this condition is experienced, it may be caused by residue from the PCV System accumulating inside the throttle body and limiting air flow past the throttle plate in the idle position.

1. Following the procedure in section **"6E3-C2",** check the minumum air rate.
2. If below **500** rpm in drive, turn the engine **"OFF"** and remove the air intake duct from the throttle body. Clean the throttle body bore in the area behind the throttle plate using a shop towel with "GM Top Engine Cleaner" (AC-Delco PART #1052626) or "AC-Delco Carburetor Tune-Up Conditioner" (part #X66-P) or equivalent product that doesn't contain methyl ethyl ketone. It should be noted that what appears to be just a small amount of accumulation can be enough to limit air flow.
3. Following the procedure in section **"6E3-C2",** remove the idle air control valve (IAC), discard the gasket, and reinstall the IAC.
4. Recheck minimum air rate and adjust, if necessary, to specified rpm.
5. Adjust throttle position sensor to specifications found in section **"6E3-C2".**
6. Inspect for crankshaft sensor-to-crankshaft balancer interrupter vane clearance. If there are any signs of contact, the sensor should be replaced following the procedure found in section **"6E3-C4".**
7. With the engine at operating temperature, reset the IAC motor by starting the engine, running at least 10-15 seconds, then shutting it "OFF" for 30 seconds. This should be done at least twice. Then, with the engine running and the vehicle in gear and the A/C **"OFF",** observe the IAC counts on a "Scan" tool. If above 25 counts, replace the IAC motor.

NOTE: If the vehicle will intermittently not stay running while driving at highway speed and not with closed throttle, the cause would more likely be a component failure (i.e. **MAF** sensor, C3I system, etc.).

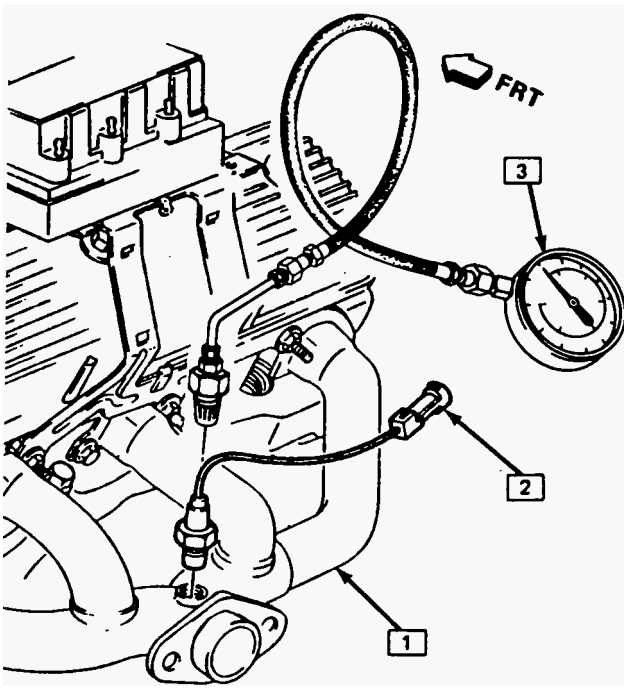
CHART B-1

RESTRICTED EXHAUST SYSTEM CHECK

Proper diagnosis for a Restricted Exhaust System is essential before any components are replaced. The following procedure may be used for diagnosis:

CHECK AT O_2 SENSOR:

1. Carefully remove O_2 sensor.
2. Install Exhaust Backpressure Tester (BT **8515** or BT **8603)** or equivalent in place of O_2 sensor (see illustration).
3. After completing test described below, be sure to coat threads of O_2 sensor with anti-seize compound P/N **5613695** or equivalent prior to re-installation.



1 EXHAUST MANIFOLD
2 O_2 SENSOR
3 BACK PRESSURE TESTER

6S 2922 6E

DIAGNOSIS:

1. With the engine at normal operating temperature and running at **2500** rpm, observe the exhaust system backpressure reading on the gauge.
2. If the backpressure exceeds **1 1/4** psi **(8.62** kPa), a restricted exhaust system is indicated.
3. Inspect the entire exhaust system for a collapsed pipe, heat distress, or possible internal muffler failure.
4. If there are no obvious reasons for the excessive backpressure, a restricted catalytic converter should be suspected, and replaced using current recommended procedures.

SECTION C
COMPONENT SYSTEMS

Section C provides information on the following:

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

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

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

DIAGNOSTIC CHARTS

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

SECTION C1

ELECTRONIC CONTROL MODULE (ECM) AND SENSORS

CONTENTS

GENERAL DESCRIPTION

ELECTRONIC CONTROL MODULE (ECM)

The Electronic Control Module (ECM), located under the instrument panel, is the control center of the fuel injection system. It constantly looks at the information from various sensors, and controls the systems that affect vehicle performance. The ECM also performs the diagnostic function of the system. It can recognize operational problems, alert the driver through the "Service Engine Soon" light, and store a code or codes which identify the problem areas to aid the technician in making repairs. See "Introduction" Section "6E" for more information on using the diagnostic function of the ECM.

For 1987, the 2.0L (Turbo) and 2.8L (Figure Cl-1) will use a new type ECM (referred to as GMP4). For service, this ECM only consists of two parts: a Controller (the ECM without a Mem-Cal) and an assembly called a Mem-Cal. (This stands for "Memory and Calibration" Unit).

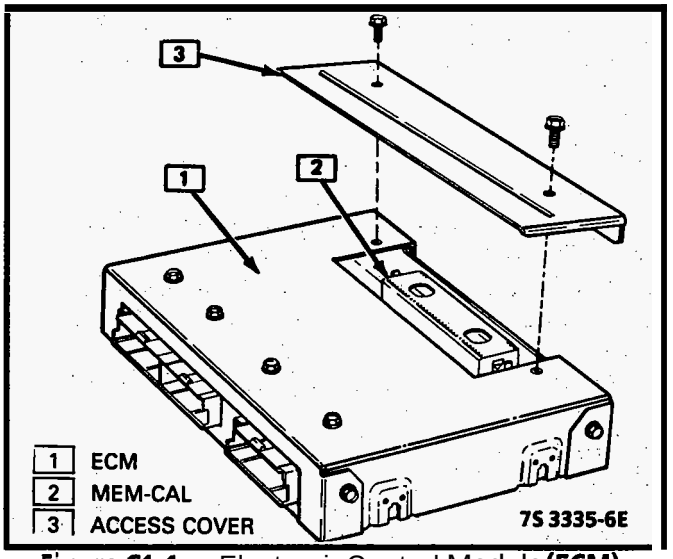


Figure C1-1 - Electronic Control Module (ECM) 2.0L (Turbo) and 2.8L

The 3.0L, 3.8L, and 3.8L Turbo (Figure C1-2) will use the standard ECM (GMCM) for service. This ECM consists of three parts: a Controller (the ECM without a PROM), a Calibrator called a PROM (Programmable read only memory), and a CALPAK.

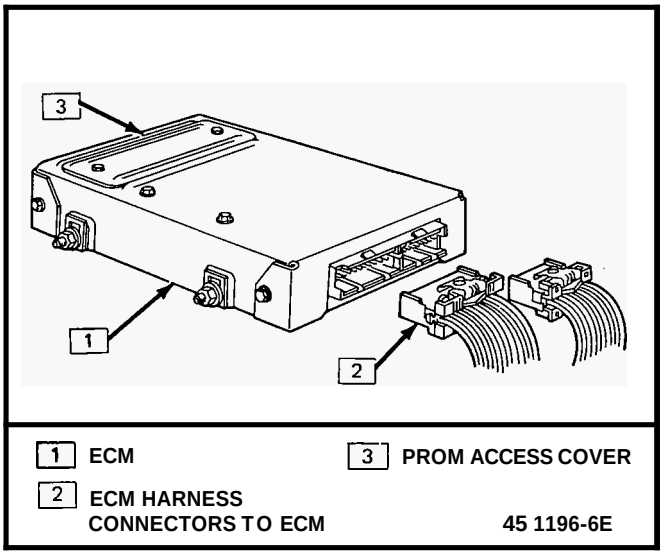


Figure C1-2 - Electronic Control Module (ECM) 3.0L, 3.8L, and 3.8L Turbo

PROM

To allow one model of ECM to be used for many different cars, a device called a Calibrator (or PROM) (Programmable Read Only Memory) is used (see Figure C1-3). 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 (Figure C1-3) is used to allow fuel delivery if other parts of the ECM are damaged. It has an access door in the ECM, and removal and replacement procedures are the same as with a PROM.

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

MEM-CAL (2.0L and 2.8L)

This assembly contains the functions of the PROM, CALPAK and the ESC module used on other GM applications. Like the PROM, it contains the calibrations needed for a specific vehicle as well as the back-up fuel control circuitry required if the rest of the ECM becomes damaged or faulty.

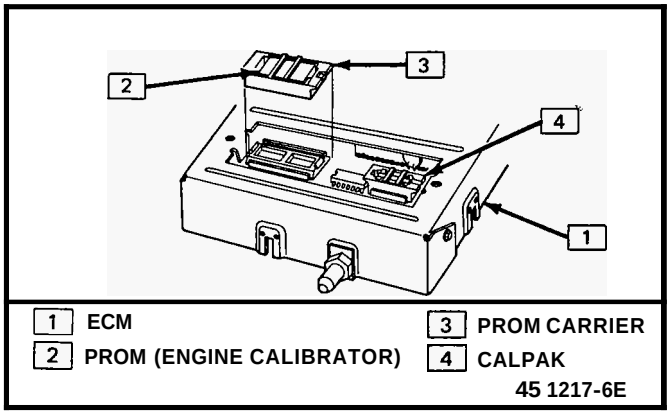


Figure C1-3 - PROM (Calibrator) and CALPAK

ECM Function

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

The ECM controls output circuits such as the Injector(s), IAC, Cooling Fan Relay, etc. by controlling the ground circuit through transistors or a device called a quad-driver.

INFORMATION SENSORS

Engine Coolant Temperature Sensor (Fig. C1-4)

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

The ECM supplies a 5-volt signal to the coolant sensor 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 calculates 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, proper use of the chart will lead to either repairing a wiring problem or replacing the sensor, to properly repair a problem.

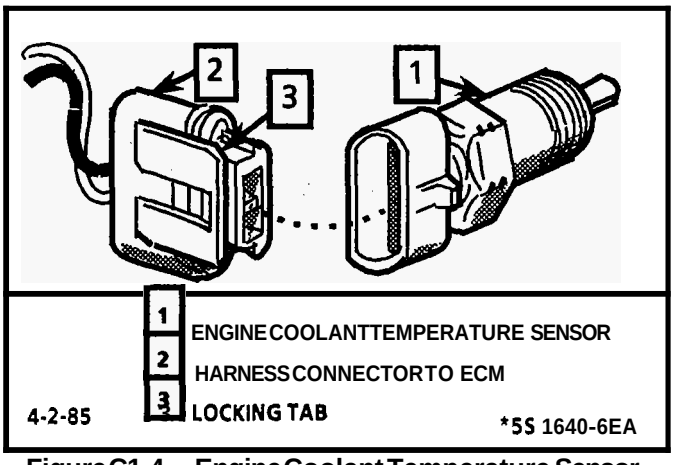


Figure C1-4 - Engine Coolant Temperature Sensor

Mass Air Flow (MAF) Sensor (2.8L, 3.0L, 3.8L, 3.8L Turbo)

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

This sensor produces a frequency output between 32 and 150 hertz. A "Scan" tool will display air flow in terms of grams of air per second (gm/sec), with a range from 3 gm/sec to 150 gm/sec.

On the 2.8L, the Manifold Air Temperature (MAT) sensor is also mounted internal to the MAF sensor. See MAT description below.

If the sensor fails at a high frequency a Code 33 should set, and, if it fails at a low frequency, or power is lost to the sensor a Code 34 should set. A Code 44 or 45 may also be set due to a faulty MAF sensor and the code chart will explain how to determine if the sensor is the cause of the lean or rich condition.

Manifold Air Temperature (MAT) Sensor

The Manifold Air Temperature Sensor (MAT) (part of MAF sensor) is a thermistor, a resistor, which changes value based on the temperature of air entering the engine. 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. By measuring the voltage, the ECM calculates the incoming air temperature, and uses this signal to compensate the MAF Sensor signal based on temperature.

The MAT sensor is also used to control spark timing.

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

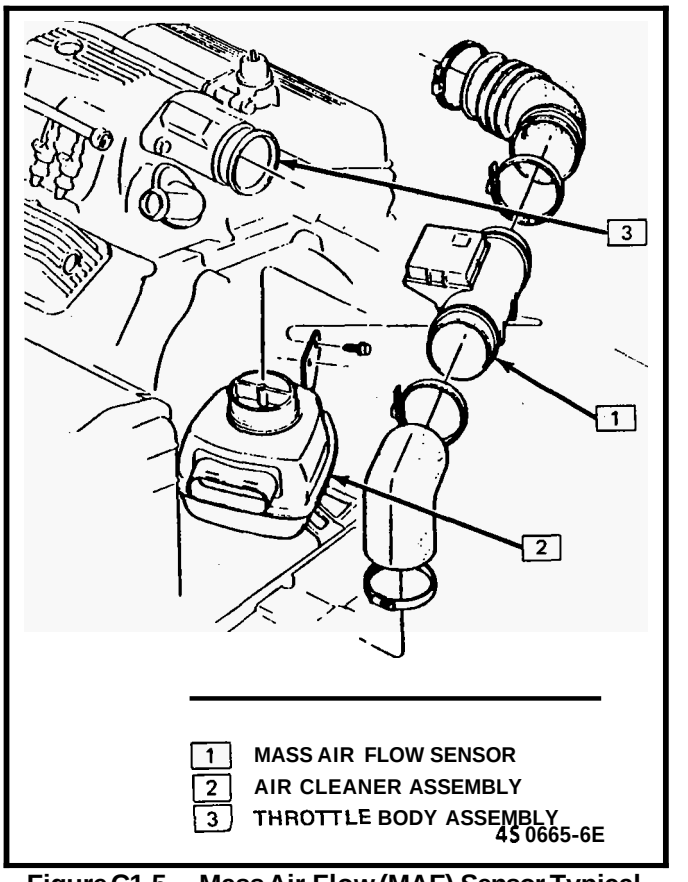


Figure C1-5 - Mass Air Flow (MAF) Sensor Typical

Oxygen (O_2) Sensor (Fig. C1-6)

The exhaust oxygen sensor (O_2) 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 sensor to produce voltage output. This voltage ranges from approximately .1 volt (high O_2 - lean mixture) to .9 volts (low O_2 - rich mixture). This voltage can be measured with a digital voltmeter having at least 10 Meg Ohms input impedance. Use of standard shop type voltmeters will result in very inaccurate readings.

By monitoring the voltage output of the O_2 sensor, the ECM calculates what fuel mixture command to give to the Injector (lean mixture-low O_2 voltage = rich command, rich mixture-high O_2 voltage = lean command).

The O_2 sensor circuit, if open, should set a Code 13. A constant low voltage in the sensor circuit should set a Code 44. While a constant high voltage in the circuit should set a Code 45. Codes 44 and 45 could also be set as a result of fuel system problems. The 2.8L, a Code 61 will set for a degraded sensor. See Code Charts for conditions that can cause a lean or rich system.

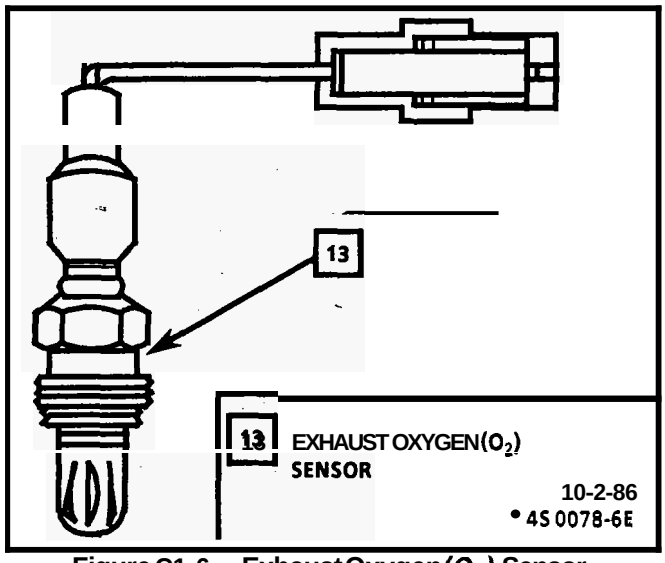


Figure C1-6 - Exhaust Oxygen (O_2) Sensor

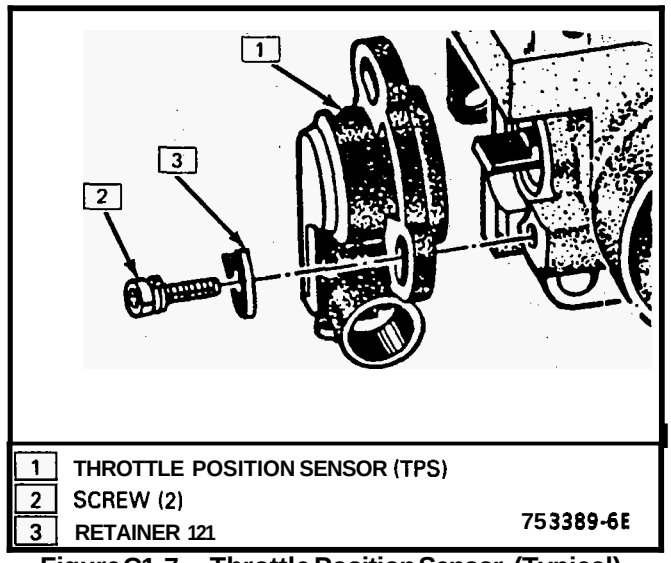


Figure C1-7 - Throttle Position Sensor (Typical)

Throttle Position Sensor (TPS) (Fig. C1-7)

The Throttle Position Sensor (TPS) is a potentiometer connected to the throttle shaft on the throttle body. The TPS electrical circuit consists of a 5 volt supply line and a ground line, both provided by the ECM. By monitoring the voltage on this signal line the ECM calculates throttle position. As the throttle valve angle is changed (accelerator pedal moved), the voltage output of the TPS also changes. At a closed throttle position, the output of the TPS is low (approximately .5 volts). As the throttle valve opens, the output increases so that, at wide-open throttle, the output voltage should be approximately 5 volts.

The ECM calculates fuel delivery based on throttle valve angle (driver demand). A broken or loose TPS can cause intermittent bursts of fuel from the injector, an unstable idle, because the ECM thinks the throttle is moving. A problem in any of the TPS circuits should set either *a* Code 21 or 22. Once a Trouble Code is set, the ECM will use an artificial default value for TPS, and some vehicle performance will return. A high idle will result when either Code 21 or 22 is set.

See On-Car Service for replacement or adjustment of TPS.

Manifold Absolute Pressure (MAP) Sensor (2.0L Turbo and 2.8L)

The Manifold Absolute Pressure (MAP) sensor (see Figure C1-8) measures the changes in the intake manifold pressure which result from engine load and speed changes, and converts this to a voltage output.

A closed throttle on engine coastdown would produce a relatively low MAP output, while a wide-open throttle would produce a high output. 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

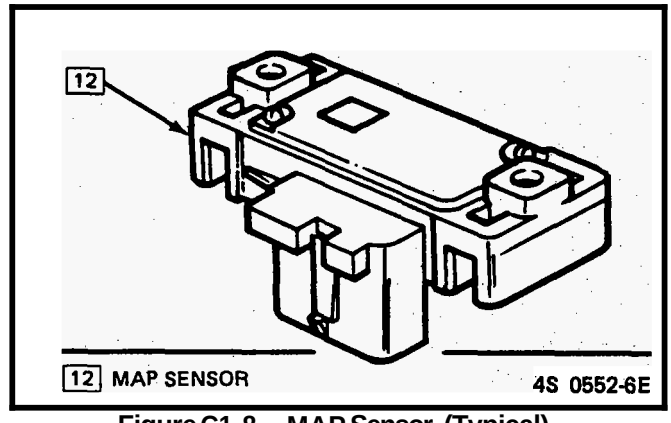


Figure C1-8 - MAP Sensor (Typical)

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** (2.0L Turbo), or a Code **63** or Code **64** (2.8L).

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. There are several different types of vehicle speed sensors. See Section "C8" (TCC), Code **24** or Section "8A" for more information.

Knock Sensor

Refer to Section "C5" for description of ESC system.

A/C "Request" Signal

This signal tells the ECM that the A/C selector Switch is turned on, and that the A/C pressure switches are closed. The ECM uses this to adjust the idle speed before turning on the A/C Clutch.

If this signal is not available to the ECM, the A/C compressor will be inoperative.

See Section "C10" for A/C wiring diagrams and diagnosis of A/C electrical system.

Power Steering Pressure Switch (PSPS)

This switch tells the ECM that the Vehicle is in a parking maneuver. The ECM uses this information to compensate for the additional engine load by moving the IAC valve. The ECM will, also, turn off the A/C clutch when high pressure is detected.

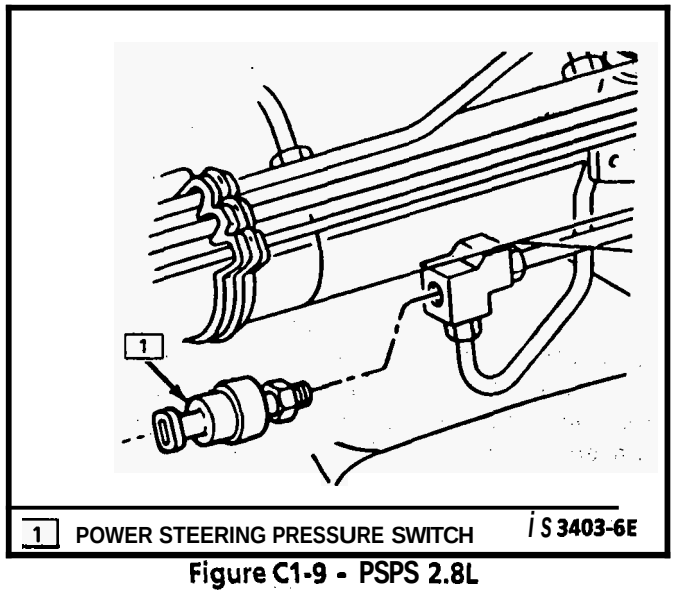


Figure C1-9 - PSPS 2.8L

Park/Neutral Switch (Auto Only)

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

Important

Vehicle should not be driven with Park/Neutral switch disconnected, as idle quality will be affected and a possible false Code 24 (VSS).

See Section "7A" for more information on the P/N switch, which is part of the neutral/start and backup light switch assembly mounted on the transaxle . See CHART C-1A for P/N switch check.

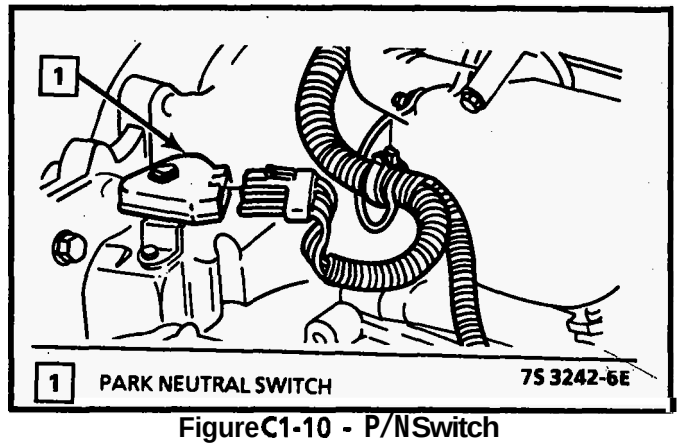


Figure C1-10 - P/N Switch

Crankshaft Sensor (2.8L, 3.0L, 3.8L, 3.8L Turbo)

The Crankshaft Sensor provides a signal, through the Ignition Module, which the ECM uses as reference to calculate rpm and crankshaft position. See Ignition System, Section "C4A" or "C4B", for further information.

Distributor Reference Signal (2.0L Turbo)

The distributor sends a signal to the ECM to tell it both engine rpm and crankshaft position. See Section "C4B" for further information.

Cam Sensor (3.8L and 3.8L Turbo Only)

The Cam Sensor sends a signal to the ECM, which uses it as a "sync pulse" to trigger the injectors in proper sequence.

See Code 41 (3.8L) for further information.

DIAGNOSIS

To read the codes, use a "Scan" tool, or ground the diagnostic terminal, with the engine not running and the ignition on. The "Service Engine Soon" light will flash Code 12 three times and then flash each code stored in memory three times. All codes stored in memory would have been read when Code 12 was flashed again. No new codes can be stored when in the Diagnostics Mode (diagnostics lead grounded). This eliminates confusion while the system is being worked on.

To clear the codes from memory:

- Ignition "OFF"
- Disconnect ECM feed fuse or fusible link for 30 seconds. Feed may be an underhood fuse holder, fusible link or if not equipped as above, an in-car ECM fuse.

Since the ECM can have a failure which may affect only one circuit, following the Diagnostic Procedures in this section will determine which circuit has a problem and where it is.

If a diagnostic chart indicates that the ECM connections or ECM is the cause of a problem, and the ECM is replaced, but does not correct the problem, one of the following may be the reason:

- There is a problem with the ECM terminal connections, - The diagnostic chart will say "ECM connections or ECM. The terminals may have to be removed from the connector in order to check them properly.
- The ECM. PROM or Mem-Cal is not correct for the application. - The incorrect components may cause a malfunction and may or may not set a code.
- The problem is intermittent. - This means that the problem is not present at the time the system is being checked. In this case, refer to the "Symptoms" portion of the manual and make a careful physical inspection of all portions of the system involved.
- Shorted solenoid, relay coil. or harness. - Solenoids and relays are turned "ON" and "OFF" by the ECM, using internal electronic switches called "Drivers". Each driver is part of a group of four called "Quad-drivers". Failure of one driver can damage any other driver in the set.

A shorted solenoid, relay coil, or harness in a **GMP4** computer will not damage the ECM but will cause the component to be inoperative.

534636 or BT **8405** testers, or equivalent, provide a fast, accurate means of checking for a shorted coil or a short to battery voltage.

- The PROM or Mem-Cal may be faulty. - Although these rarely fail, it operates as part of the ECM. Therefore, it could be the cause of the problem. Substitute a known good PROM or Mem-Cal.
- The replacement ECM **may** be faulty. - After the ECM is replaced, the system should be rechecked for proper operation. If the diagnostic chart again indicates the ECM is the problem, substitute a known good ECM. Although this is a rare condition, it could happen.

ECM

A faulty ECM will be determined in the diagnostic charts or by a Code 55.

PROM/MEM-CAL

An incorrect or faulty PROM or Mem-Cal, which is part of the ECM, may set a Code **51** or **41.**

ECM INPUTS

All of the sensors and input switches can be diagnosed by the use of a "Scan" tool. Following **is** a short description of how the sensors and switches can be diagnosed by the use of "Scan". The "Scan" can also be used to compare the values for a normal running engine with the engine you're diagnosing.

Coolant Temp. Sensor

A "Scan" tool displays engine temp. in degrees centigrade. After engine is started, the temperature should rise steadily to about 90°C then stabilize when thermostat opens. If the engine has not been run for several hours (overnight) the coolant temperature and MAT temperatures should read close to each other. A fault in the coolant sensor circuit should set a Code **14** or **15.** The code charts also contain a chart to check for sensor resistance values relative to temperature.

MAF Sensor

A "Scan" tool reads the MAF value and displays it in grams per second. Should read between **4-7** on a fully warmed up idling engine. Values should change rather quickly on acceleration, but values should remain fairly stable at any given rpm. Most "Scan" tools will have 2 positions for reading MAF sensor values on the **2.8L.** (MAF **& Air** Flow). Both values should read the same if no Code 33 or **34** is set, but if a code is set, the MAF values will be the default value and the Air Flow parameter will **lock** in on the value to which the ECM recognized the fault. The **3.0L** and **3.8L** will only read the air flow word, and will read default value when a code sets. **A** failure, in the MAF sensor or circuit should set a Code **33** or **34.** The MAF sensor could also be tested using MAF tester tool **5-36101** or equivalent.

MAT Sensor

A "Scan'' tool displays temperature of the air entering the engine and should read close to ambient air temperature when engine is cold, and rise as underhood temperature increases. If the engine has not been run for several hours (overnight) the MAT sensor temperature and coolant temperature should read close to each other. **A** failure in the MAT sensor circuit should set a Code **23** or **25.** The code charts also contain a chart to check for sensor resistance values relative to temperature.

O_2 Sensor

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

A problem in the O_2 sensor circuit, or-fuel system, should set a Code **13** (open circuit), Code **44** (lean indication), Code **45** (rich indication) or Code **61 (2.8L)** degraded, or contaminated O_2 sensor. Refer to applicable chart if any of these codes were stored in memory.

TPS

A "Scan" tool displays throttle position in volts. The 2.8L should read .55V ± .8V, with throttle closed and ignition on, or at idle. Voltage should increase at a steady rate as throttle is moved toward WOT.

Some ECM's have the ability to Auto-Zero the TPS voltage if it is below about .7V (700mv). This means that any voltage less than .7 volts will be determined by the ECM to be 0% throttle. "Scan" tools have the ability to read the throttle angle and should read 0% when the throttle is closed (2.0L and 2.8L). A failure in the TPS or circuit should set a Code 21 or 22.

MAP Sensor (2.0L Turbo & 2.8L)

"Scan" displays manifold pressure in volts. Low pressure (high vacuum) reads a low voltage while a high pressure (low vacuum) reads a high voltage. A failure in the MAP sensor circuit should set a Code 33 or 34 (2.0L Turbo) or 63 or 64 (2.8L) and using the chart will find the cause of the problem. A Code 33 (2.0L Turbo) or 63 (2.8L) may be set if a rough or unstable idle exists. CHART C-1D can also be used to check MAP sensor.

VSS

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

P/N Switch

A "Scan" tool should read P/N when in Park, or Neutral, and R-D, L, when in Drive or Overdrive. This reading may vary with different makes of tools. Refer to CHART C-1A for P/N switch diagnosis.

A/C Request Signal

If the low pressure switch is closed (A/C system charged) and A/C is on, the "Scan" tool should indicate A/C "ON" (If equipped).

See Section "C10" for electrical system diagnosis.

Power Steering Pressure Switch

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

"DIS" Reference Signal

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

ON-CAR SERVICE

ELECTRONIC CONTROL MODULE (ECM)

Service of the ECM should normally consist of either replacement of the ECM or a PROM/Mem-Cal change.

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

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.

Important

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.).

ECM OR MEM-CAL REPLACEMENT (2.0L Turbo, 2.8L)

Remove or Disconnect

1. Negative Battery Cable.
2. Right Hand Kick Panel
3. Connectors from ECM.
4. ECM Mounting hardware.
5. ECM from Passenger Compartment.
6. ECM Access Cover. (Fig. C1-11)
7. Mem-Cal Removal. (Fig. C1-12)

Important

Replacement ECM is supplied without a Mem-Cal, so care should be used when removing it from the defective ECM because it will be reused in the new ECM.

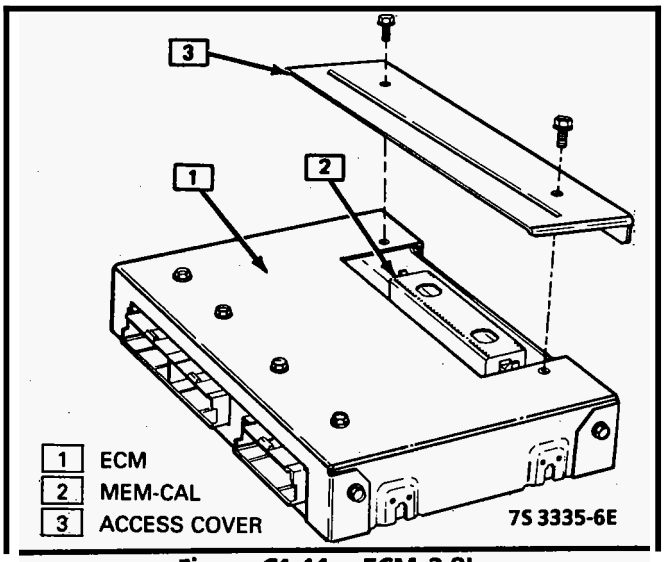


Figure C1-11 - ECM 2.8L

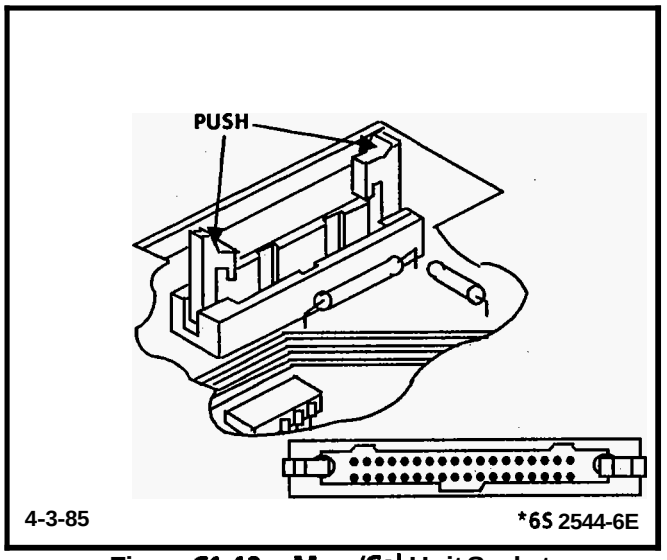


Figure C1-12 - Mem/Cal Unit Socket

Using two fingers, push both retaining clips back away from the Mem-Cal. At the same time, grasp it at both ends and lift it up out of the socket. Do not remove the cover of the Mem-Cal. Use of unapproved Mem-Cal removal methods may cause damage to the Mem-Cal or socket.

Inspect (Figure CI-13)

For alignment notches of the Mem-Cal and carefully set it aside.

Remove or Disconnect

8. New ECM from its packaging and check the service number to make sure it is the same as the defective ECM.
9. Access Cover

Install or Connect

1. Mem-Cal in Mem-Cal Socket

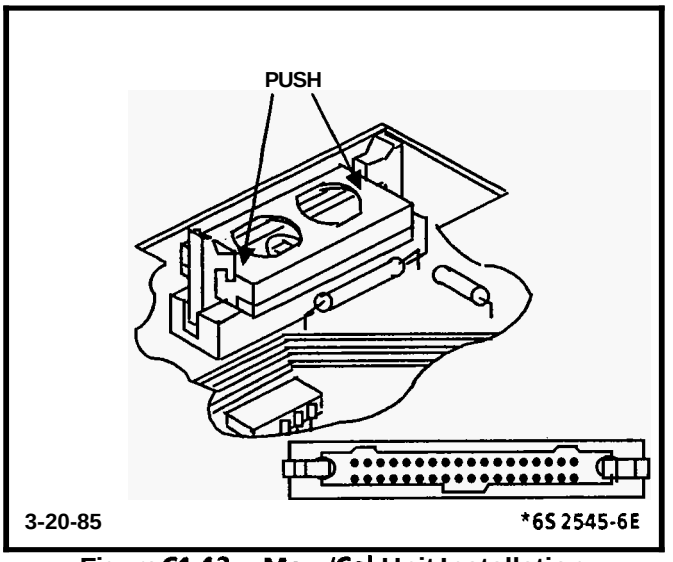


Figure C1-13 - Mem/Cal Unit Installation

Important

Press only on the ends of the Mem-Cal. Small notches in the Mem-Cal must be aligned with the small notches in the Mem-Cal socket. Press on the ends of the Mem-Cal until the retaining clips snap into the ends of the Mem-Cal. Do not press on the middle of the Mem-Cal, only on the ends.

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

Functional Check

1. Turn ignition "ON".
2. Enter diagnostics.
   A. Allow Code 12 to flash four times to verify no other codes are present. This indicates the Mem-Cal is installed properly and the ECM is functioning.
   B. If trouble Codes 41, 42, 43, or 51 occur, or if the "Service Engine Soon" light is "ON" constantly with no codes, the Mem-Cal is not fully seated or is defective.
      - If not fully seated, press firmly on the ends of the Mem-Cal.
      - If it is necessary to remove the Mem-Cal, follow the previous removal instructions.

ECM REPLACEMENT (3.0L, 3.8L and 3.8L Turbo)

Remove or Disconnect

1. Negative battery cable.
2. Right hand hush panel.
3. Connectors to ECM.
4. ECM.
5. PROM from ECM. See PROM procedure.

6. New ECM from its packaging and check the service number to make sure it is the same as the defective ECM.

Important

Replacement ECM is supplied without a PROM, so care should be used, when removing it from the defective ECM, because it will be reused in the new ECM.

Install or Connect

1. Old PROM in new ECM.
2. ECM into vehicle.
3. Connectors.
4. Hush panel.
5. Negative battery cable.

PROM (3.0L, 3.8L, and 3.8L Turbo)

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

Important

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

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 C1-14).
5. PROM assembly. (Figure C1-15).

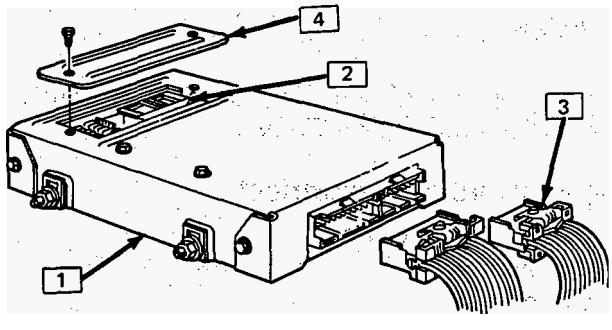


Figure C1-14 - ECM PROM Access Cover

Important

Using the rocker-type PROM removal tool, engage one end of the PROM carrier with the hook end of the tool (see Figure C1-15). 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 carrier and PROM are free of the PROM socket. The PROM carrier, with PROM in it, should lift off of the PROM socket easily. PROM carrier should only be removed by using the pictured PROM removal tool. Other methods could cause damage to the PROM or PROM socket.

Inspect

1. New PROM for same part number as old.

Important

Do Not remove PROM from carrier to check PROM number.

2. For correct reference of PROM in carrier, see Figure C1-16.

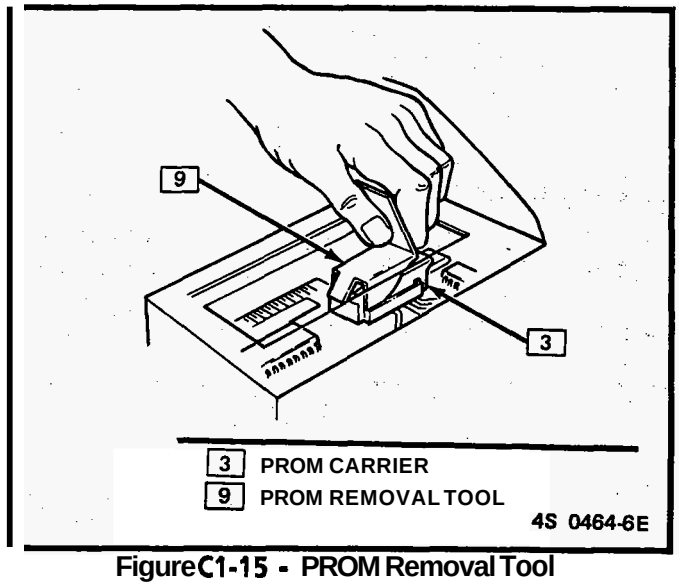


Figure C1-15 - PROM Removal Tool

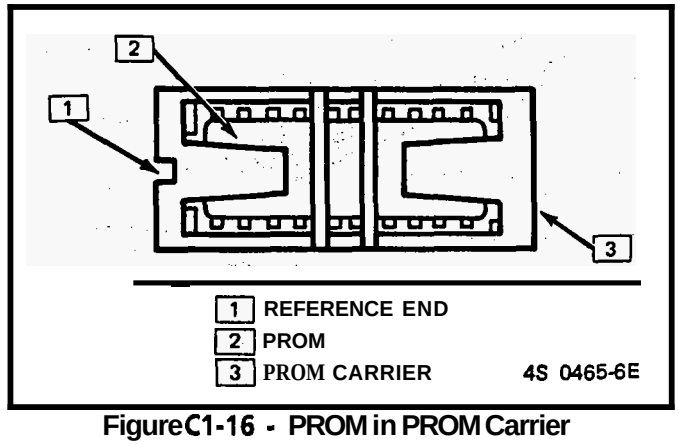


Figure C1-16 - PROM in PROM Carrier

Install or Connect

1. New PROM carrier in PROM 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.

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

Functional Check

1. Turn ignition "ON".
2. Enter diagnostics.
   A. Code 12 should flash four times (If no other codes are present). This indicates the PROM is installed properly and the ECM is functioning.
   B. If trouble Code 51 occurs, or if the "Service Engine Soon" light is on constantly with no codes, the PROM is not fully seated or is defective.
      - If not fully seated, press firmly on the ends of the PROM carrier.
      - If it is necessary to remove the PROM, follow the previous removal instructions.

Important

Any time the PROM is isntalled backward and the ignition switch turned "ON, the PROM is destroyed.

CALPAK see Figure C1-17

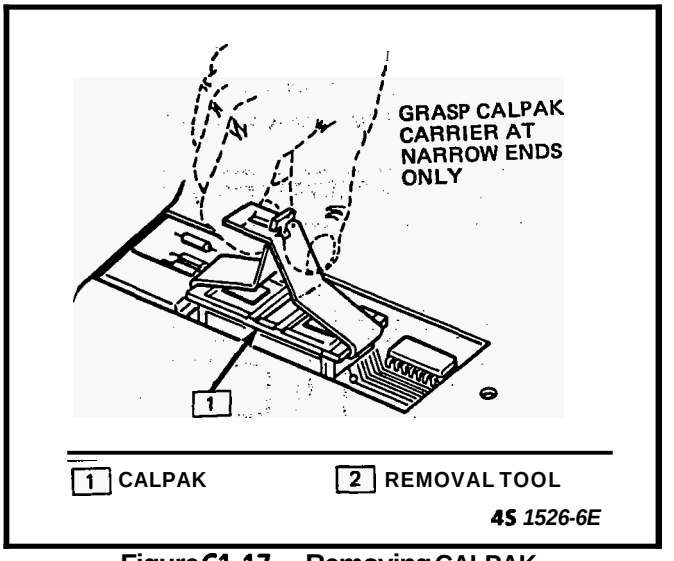


Figure C1-17 - Removing CALPAK

COOLANT SENSOR

Important

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. Relieve coolant pressure
2. Negative battery cable.
3. Electrical connector
4. Carefully back out coolant sensor.

Install or Connect

1. Coat threads (only) with sealer P/N 1052080 or equivalent.
2. Sensor in engine, torque to 30 N-M (22 lbs. Ft).
3. Electrical connector.
4. Negative battery cable.
5. Refill lost coolant ns.

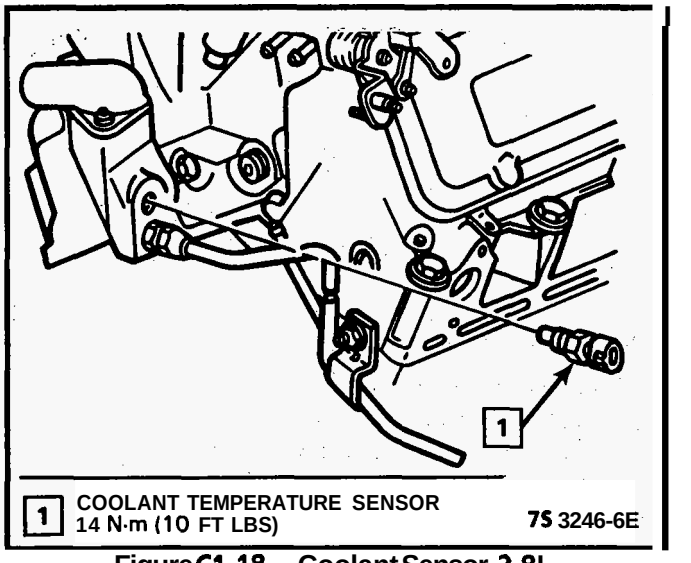


Figure C1-18 - Coolant Sensor 2.8L

MAF SENSOR

Replacement of the MAF sensor is shown in Figure C1-19 and Figure C1-20.

Remove or Disconnect

1. Electrical connector.
2. Clamps.
3. Sensor.

Install or Connect

1. Sensor.
2. Clamps.
3. Electrical connector.

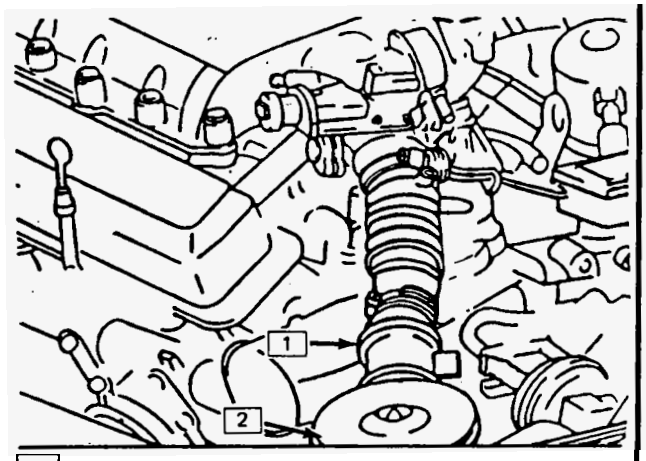


Figure C1-19 - MAF Sensor Service 2.8L

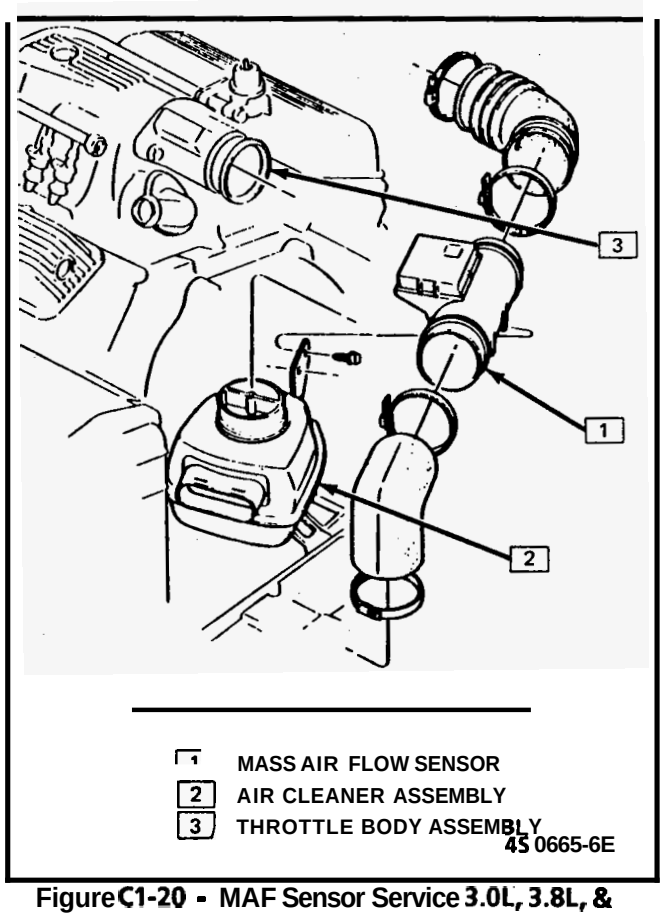


Figure C1-20 - MAF Sensor Service 3.0L, 3.8L, & 3.8L Turbo (Typical)

MAF SENSOR RELAY (2.8L)

Remove or Disconnect

1. Negative battery cable.
2. Relay bracket cover.
3. Relay electrical connector.
4. Screws securing relay.

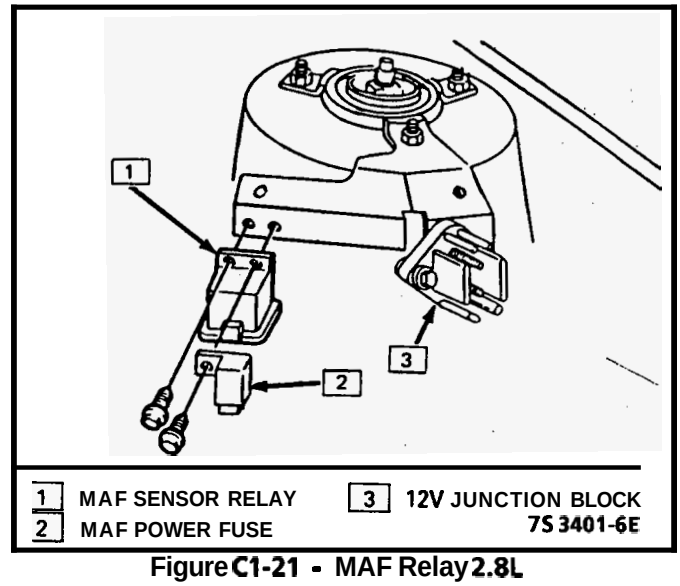


Figure C1-21 - MAF Relay 2.8L

Install or Connect

1. Relay using screws.
2. Electrical connector.
3. Cover.
4. Battery cable.

MAT SENSOR (2.8L)

The MAT sensor is part of the MAF sensor. Use MAF sensor R & R procedure.

MAT SENSOR (2.0L Turbo, 3.0L, 3.8L & 3.8L Turbo)

On the 3.0L, 3.8L, and 3.8L Turbo, the MAT Sensor is mounted in the air cleaner housing.

On the 2.0L Turbo, the MAT Sensor is mounted in the intake manifold.

Remove or Disconnect

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

Install or Connect

1. Coat threads only with sealant, P/N 1052080 or equivalent.
2. Sensor in engine.
3. Electrical connector.
4. Negative battery cable.

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.

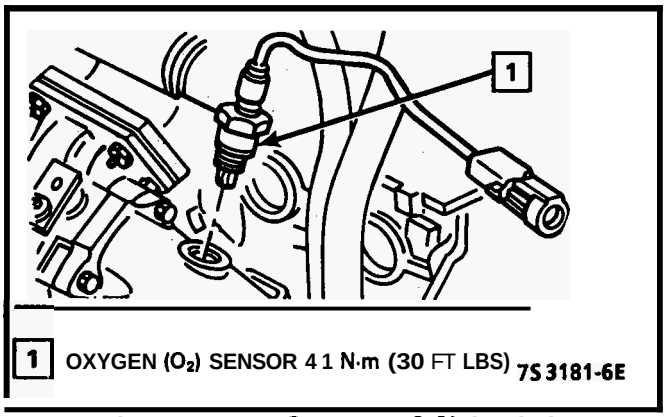


Figure C1-22 - O_2 Sensor 2.0L (Turbo)

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

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) (2.0L Turbo)

Remove or Disconnect

1. Electrical connector

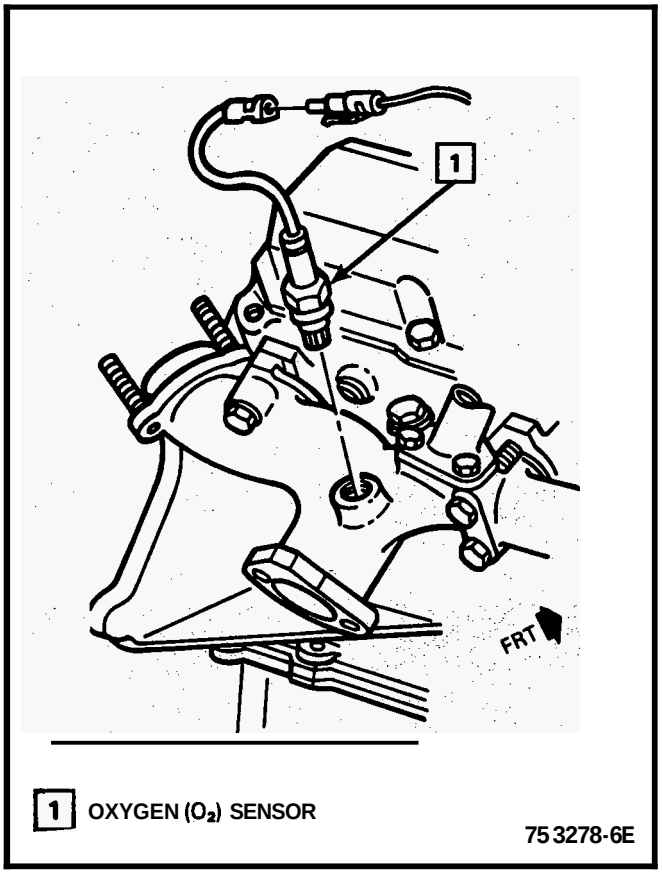


Figure C1-23 - O_2 Sensor 2.8L

2. Two TPS attaching screws, lockwashers and retainers.
3. Sensor.

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 and lockwashers
3. Tighten screws, install connector.

THROTTLE POSITION SENSOR (TPS) (2.8L)

Remove or Disconnect

1. Throttle cables.
2. Throttle body inlet boot.
3. Throttle Body Vacuum Line connector.
4 TPS Electrical connector.
5. Throttle body bolts.
6. Lift throttle body until TPS clears fuel line.
7. Remove TPS attaching screws and retainers.
8. Sensor.

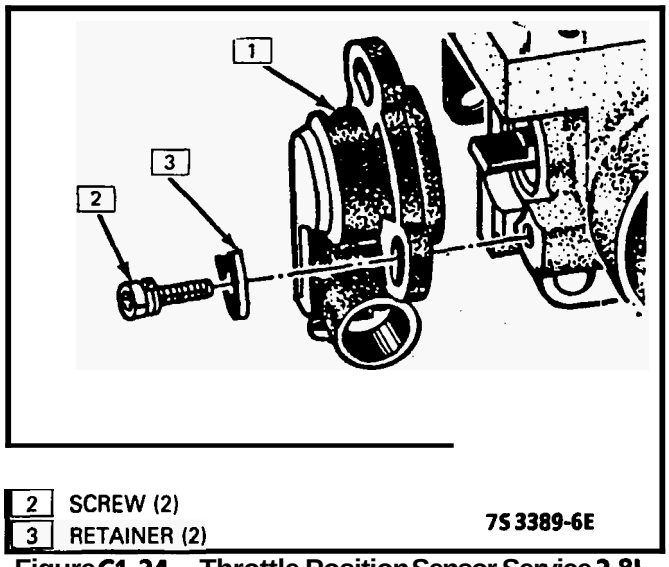


Figure C1-24 - Throttle Position Sensor Service 2.8L

Install or Connect

1. With throttle valve in the normal closed idle position, install Throttle Position Sensor on throttle body assembly (See Figure C1-24)
2. Retainers and two TPS screws.

DO NOT tighten screws until TPS is adjusted.

Adjust

1. Install "Scan" tool and select TPS.
2. With ignition "ON", adjust TPS to obtain :
   - .49 - .61 volts
3. Tighten screws, then recheck reading to insure adjustment has not changed.
4. Throttle body bolts.
5. TPS electrical connector
6. Throttle Body Vacuum Line connector.
7. Inlet boot.
8. Throttle cables.

THROTTLE POSITION SENSOR (TPS) (3.0L, 3.8L & 3.8L Turbo)

Remove or Disconnect

1. Electrical connector
2. Two TPS attaching screws and retainers
3. Sensor.

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 using a thread locking compound on the screws, Loctite 262, GM Part No. 1052624, or equivalent should be used (except 3.0L). Do not use Thread Locking Compound on the 3.0L TPS screws. Do not tighten screws until tps is adjusted.

Adjust

1. Install three jumper wires between TPS and harness connector or use a "Scan" tool.
2. (3.8L) With ignition "ON", use a digital voltmeter connected to terminals "B" and "C" and adjust TPS to obtain .36 - .44 volts.
   (3.0L) Between "A" and "B" adjust to .50 - .59 volts
4. Tighten screws, then recheck reading to insure adjustment has not changed.
5. With ignition "OFF", remove jumper wires and connect harness to TPS.

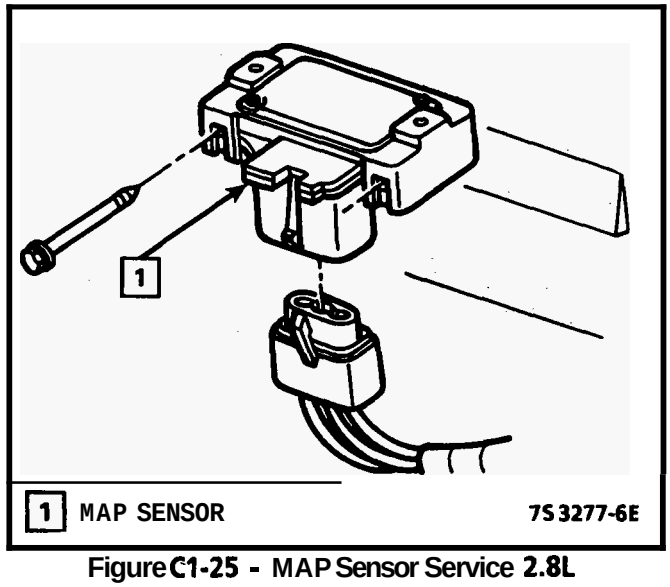


Figure C1-25 - MAP Sensor Service 2.8L

MAP SENSOR (2.0L Turbo & 2.8L)

Remove or Disconnect

1. Vacuum hose.
2. Electrical connector.
3. Attaching screws.
4. Sensor.

Install or Connect

1. Sensor using attaching screws.
2. Electrical connector.
3. Vacuum hose.

VSS

Refer to Section "7" for trans. mounted VSS.

POWER STEERING PRESSURE SWITCH

Remove or Disconnect

1. Negative battery cable.
2. Electrical connector.
3. Switch.

Install or Connect

1. Sensor.
2. Electrical connector.
3. Negative battery cable.
4. Replace lost fluid.

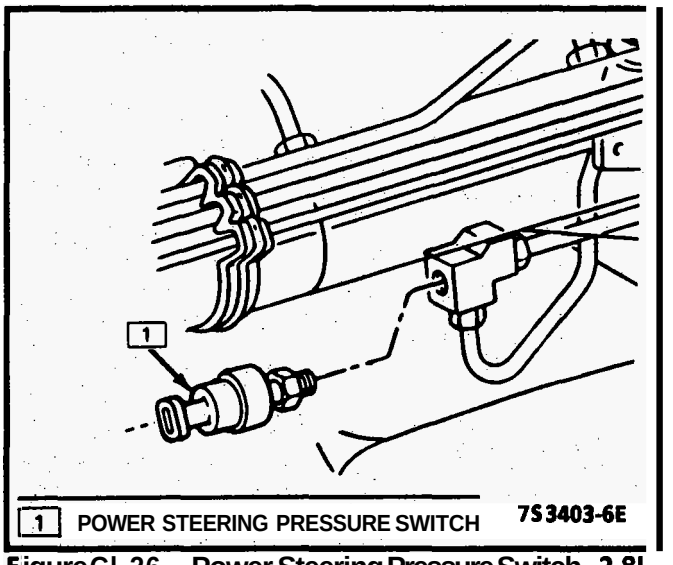


Figure C1-26 - Power Steering Pressure Switch, 2.8L

PARK/NEUTRAL SWITCH

See Section "7A" for Park/Neutral Switch. On-Car Service and Adjustment Procedures are also listed there.

PARTS INFORMATION

PART NAME	GROUP
Controller, ECM	3.670
Memory Calibration Unit, MEM/CAL or PROM)	3.670
Sensor, Coolant Temp	3.682
Sensor, Exhaust Oxygen	3.682
Sensor, Mass Air Flow (MAF)	3.682
Sensor, Throttle Position: Part of Sensor Kit, Throttle Position	3.440
Sensor, Manifold Pressure	3.682
Sensor, Vehicle Speed	3.682

BLANK

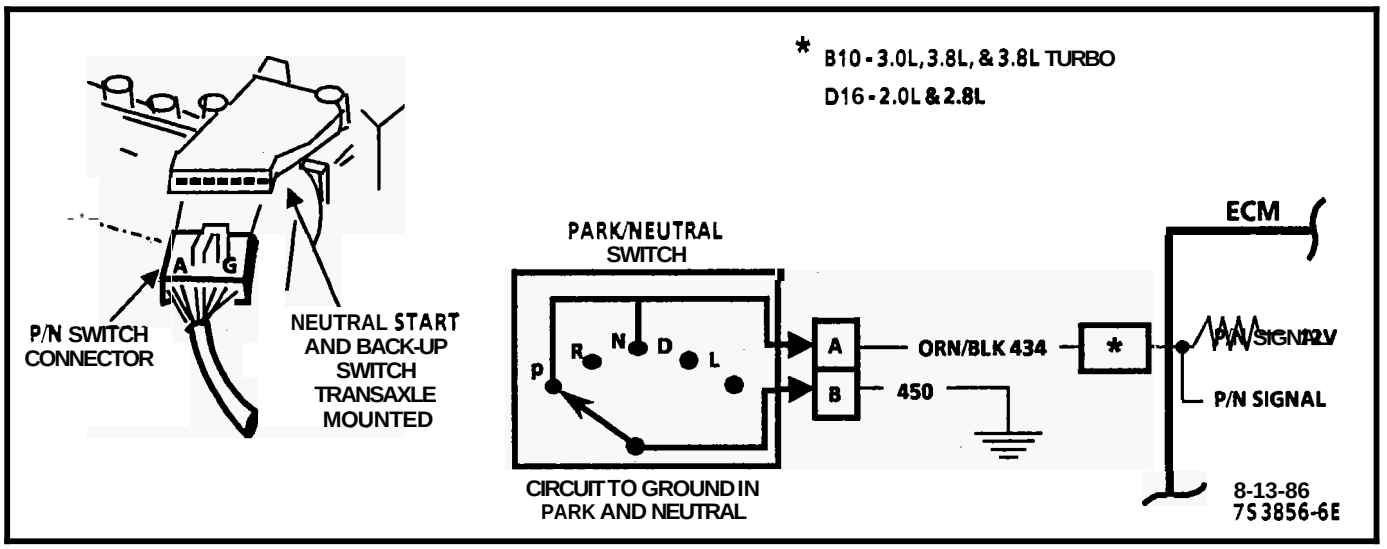


CHART C-1A

PARK/NEUTRAL SWITCH DIAGNOSIS ALL SERIES (PORT)

Circuit Description:

The Park/Neutral Switch contacts are a part of the Neutral Start switch and are closed to ground in park or neutral, and open in drive ranges.

The ECM supplies ignition voltage through a current limiting resistor to CKT **434** and senses a closed switch when the voltage on CKT **434** drops to less than one volt.

The ECM uses the P/N signal as one of the inputs to control:

Idle Air Control
VSS Diagnostics
EGR

If CKT **434** indicates P/N (grounded), while in drive range, the EGR would be inoperative, resulting in possible detonation.

If CKT **434** indicates drive (open) a dip in the idle may exist when the gear selector is moved into drive range.

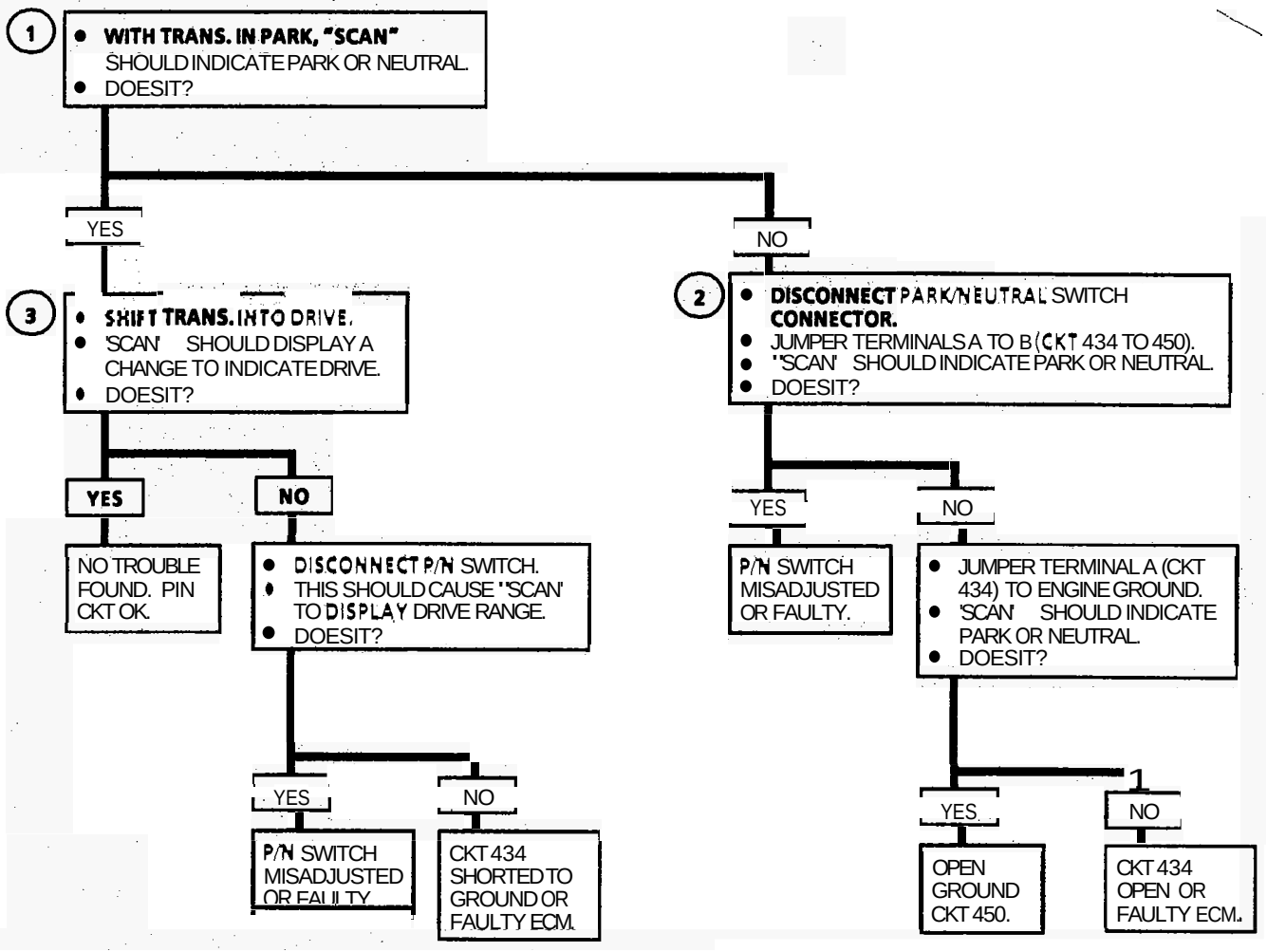
Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Checks for a closed switch to ground in park position. Different makes of "Scan" tools will read P/N differently. Refer to tool operator's manual for type of display used for a specific tool.
2. Checks for an open switch in drive range.
3. Be sure "Scan" indicates drive, even while wiggling shifter, to test for an intermittent or misadjusted switch in drive or overdrive range.

"SCAN" DIAGNOSTICS

CHART C-1A

PARWNEUTRAL SWITCH DIAGNOSIS ALL SERIES (PORT)



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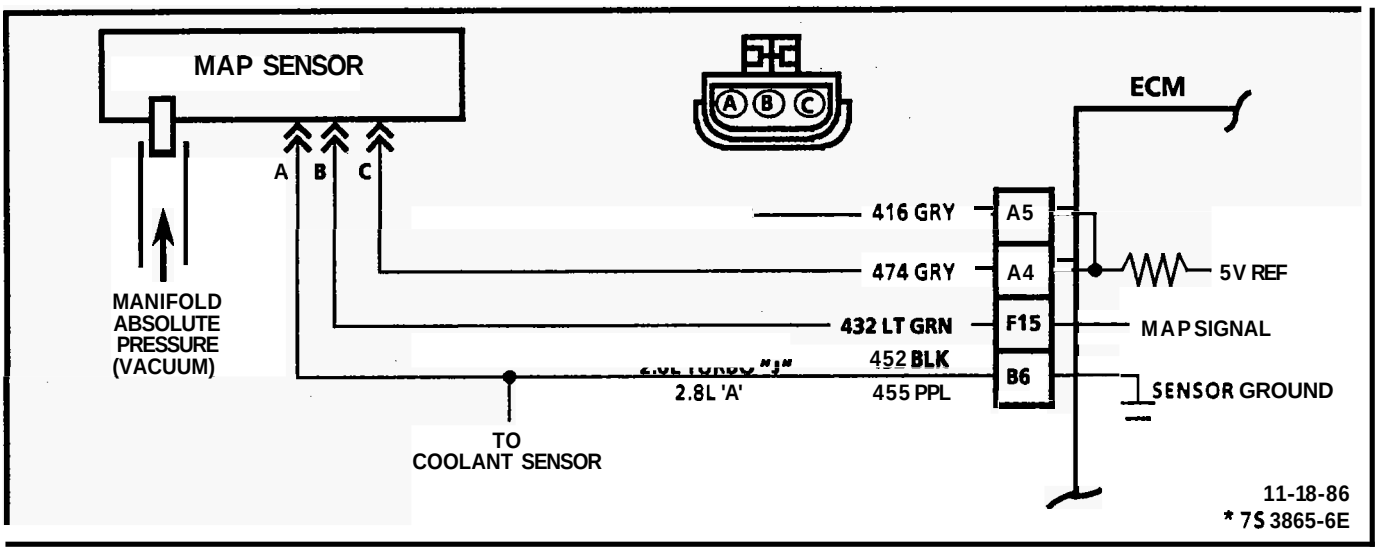


CHART C-1D

MANIFOLD ABSOLUTE PRESSURE (MAP) OUTPUT CHECK
2.0L TURBO "J" SERIES
2.8L "A" SERIES (PORT)

Circuit Description:

The Manifold Absolute Pressure Sensor (MAP) measures manifold pressure (vacuum) and sends that signal to the ECM. The MAP Sensor is mainly used for fuel calculation when the ECM is running in the throttle body backup mode. The MAP Sensor is also used to determine the barometric pressure and to help calculate fuel delivery.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Checks MAP sensor output voltage to the ECM. This voltage, without engine running, represents a barometer reading to the ECM.
2. Applying 34 kPa (10 inches Hg) vacuum to the MAP sensor should cause the voltage to be 1.2 volts less than the voltage at Step 1. Upon applying vacuum to the sensor, the change in voltage should be instantaneous. A slow voltage change indicates a faulty sensor.
3. Check vacuum hose to sensor for leaking or restriction. Be sure no other vacuum devices are connected to the MAP hose.

SECTION C2
FUEL CONTROL SYSTEM
CONTENTS

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 (O_2) Sensor, which is located in the exhaust manifold. The O_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 C2-1).

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.

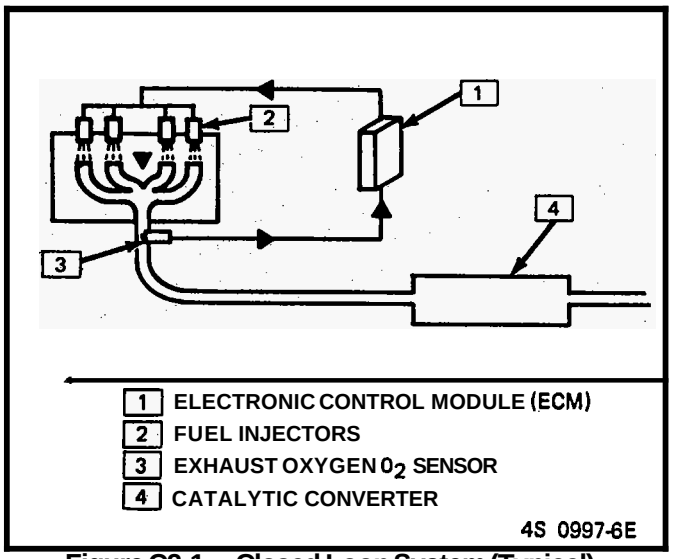


Figure C2-1 - Closed Loop System (Typical)

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 coolant temperature sensor, throttle position sensor, and crank signal, and determines The proper air / fuel ratio for starting. This ranges from 1.5 : 1 at -36°C (-33°F) to 14.7 : 1 at 94°C (201°F). The ECM controls the amount of fuel delivered in the Starting Mode by changing how long the injectors are turned "ON" and "OFF". This is done by "pulsing" the injectors for very short times.

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 600. 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".

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 (O_2) sensor, and calculate the air/fuel ratio based on inputs from the Coolant and MAP sensor (2.0L Turbo) or MAF sensor (2.8L, 3.0L & 3.8L).

The system will stay in "Open Loop" until the following conditions are met:

1. The O_2 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, (Mem-Cal on 2.8L). 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 O_2 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 or air flow, and provides extra fuel.

Deceleration Mode

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.

Converter Protection Mode

In this mode the ECM estimates the temperature of the catalytic converter, and then modifies fuel delivery to protect the converter from high temperatures.

When the ECM has determined that the converter may overheat, it will cause open loop operation, and will enrichen the fuel delivery. A slightly richer mixture will then cause the converter temperature to be reduced.

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 C2-2) 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 separate 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.

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.

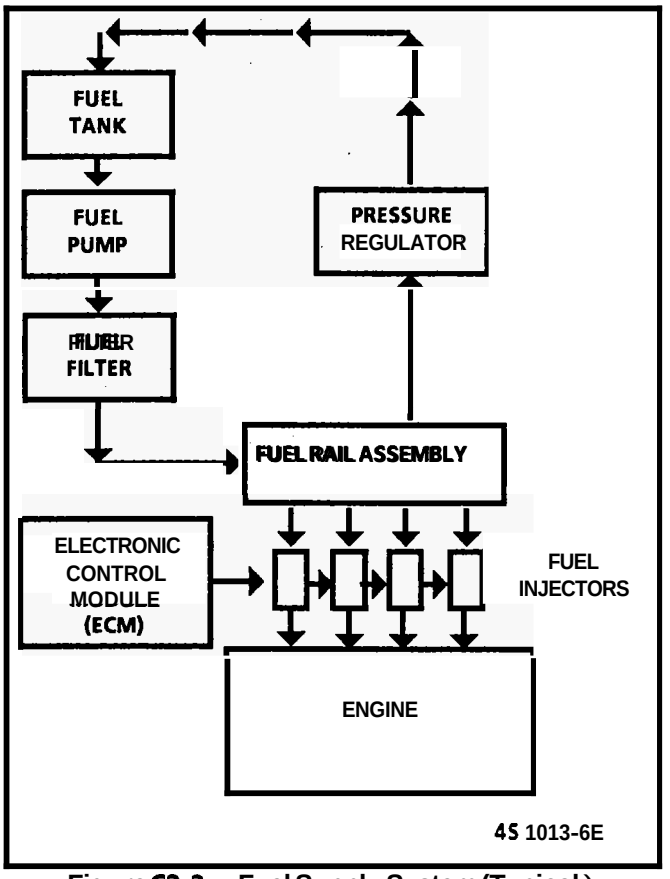


Figure C2-2 - Fuel Supply System (Typical)

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

Engine coolant is directed through the coolant cavity on the bottom of the throttle body to warm the throttle valve and prevent icing (3.0L, 3.8L, and 3.8L Turbo).

FUEL RAIL

The fuel rail 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 C2-3). 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.

An injector, which is stuck partly open, will cause loss of pressure after engine shut down, so long crank times would be noticed on some engines. Also, dieseling could occur because some fuel could be delivered to the engine after the ignition is turned "OFF".

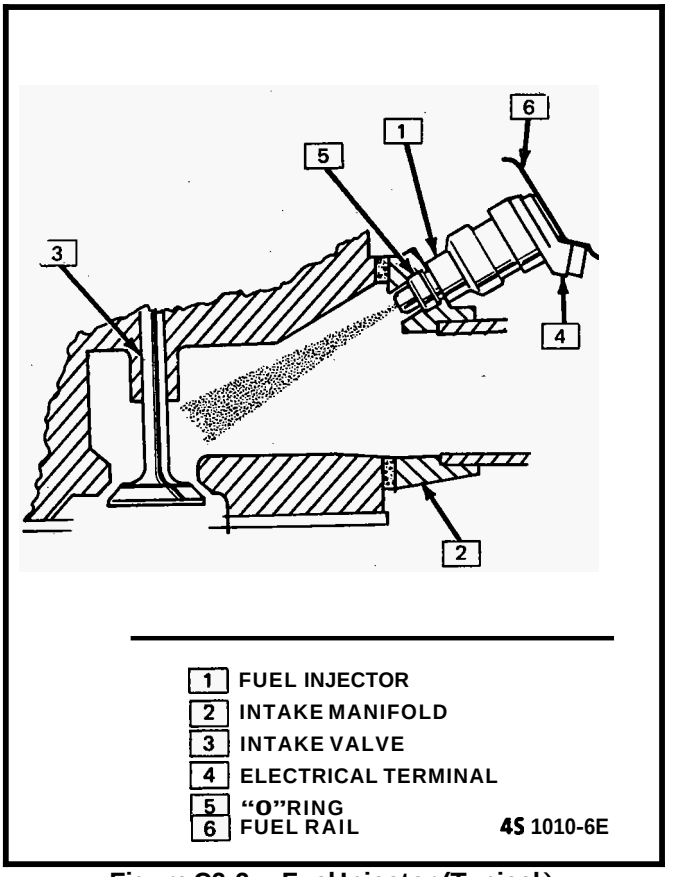


Figure C2-3 - Fuel Injector (Typical)

PRESSURE REGULATOR

The pressure regulator (see Figure C2-4) 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 The pressure regulator also compensates for engine load, by increasing fuel pressure when it sees low engine vacuum.

The pressure regulator is mounted on the fuel rail, and is serviced separately.

If the pressure is too low, poor performance could result. If the pressure is too high, excessive odor and a Code 45 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 C2-5), is to control engine idle speed, while preventing stalls due to changes in engine load.

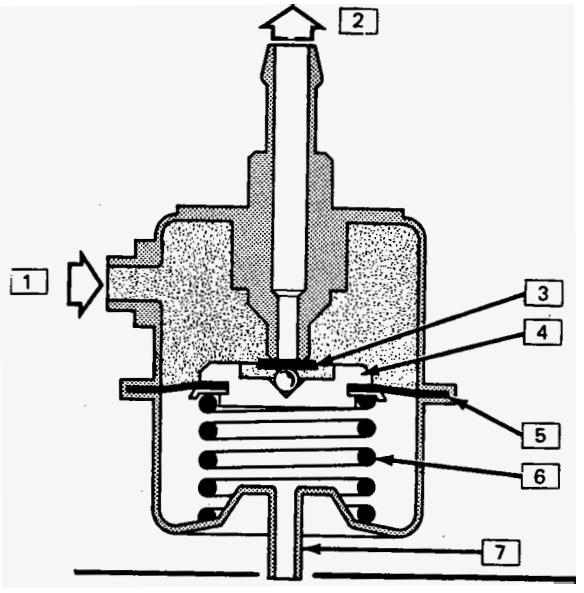


Figure C2-4 - Fuel Pressure Regulator (Typical)

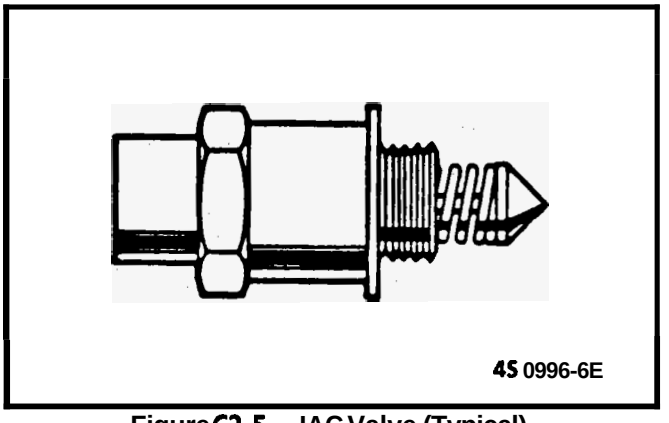


Figure C2-5 - IAC Valve (Typical)

The IAC valve, mounted in the throttle body, controls bypass air around the throttle valve. By moving a conical valve, known as a pintle, 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 a "Scan" tool.

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 value, 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.

If the IAC Valve is disconnected and reconnected with the engine running, the idle rpm may be wrong. In this case, the IAC has to be reset.

On the 2.8L engine, the IAC valve will reset when the ignition is turned "OFF", after running the engine.

On vehicles equipped with 2.0L Turbo engine, the IAC will reset by running momentarily above 35 mph.

On vehicles equipped with 3.0L, 3.8L, and 3.8L Turbo, engines the IAC resets when the ignition is turned "ON", and then **"OFF".**

When servicing the IAC, it should only be disconnected or connected with the ignition **"OFF".** This will keep from having to reset the IAC.

Different pintle designs are used for the IAC valve. Be sure to use the correct design when replacement is required.

The IAC valve affects only the idle characteristics of the vehicle. If it is open fully, too much air will be allowed into the manifold and idle speed will be high. If it is stuck closed, too little air will be allowed in the manifold, and idle speed will be too low. If it is stuck part way open, the idle may be rough, and will not respond to engine load changes.

FUEL PUMP ELECTRICAL CIRCUIT

When the key is first turned "ON without the engine running, the ECM will turn the fuel pump "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. When the engine is cranked, and the rpm signal has been read by the ECM, the ECM supplies 12 volts to the fuel pump relay. This causes the electric in-tank fuel pump to run.

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 close and run the fuel pump.

An inoperative fuel pump relay can result in long cranking times, particularly if the engine is cold.

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

FUEL CONTROL SYSTEM

Some failures of this system will result in an "Engine Cranks But Won't Run". If this condition exists see CHART A-3. This chart will determine if the problem is caused by the ignition system, ECM or fuel pump circuit. If it's determined to be a fuel problem, CHART A-7 should be used. This includes the injectors, pressure regulator, fuel pump and fuel pump relay. The fuel system wiring schematic is covered on the facing page of Code CHART A-5.

If a malfunction occurs in the fuel control system, it usually results in either a rich or lean exhaust condition. This condition is sensed by the oxygen sensor and the ECM will change the fuel calculation (injector pulse width) based on O_2 sensor reading. The change made to the fuel calculation will be indicated by a change in the block learn values which can be monitored by a "Scan" tool. The normal block learn values are around **128** and if the O_2 sensor is sensing a lean condition the ECM will add fuel and this will result in a block learn value above **128.** Some variations in block learn values are normal because all engines are not exactly the same. However, if the block learn values are **± 10** counts from **128** a system problem exists. If the block learn values are greater than **138** see Code **44** for items which can cause a lean system.

If the block learn values are less than **118,** see Code **45** for items which can cause the system to run rich. If a driveability symptom exists refer to the particular symptom in Section **"B"** for additional items to check.

IDLE AIR CONTROL VALVE

A "Scan" tool will read IAC position in steps (counts). "0" steps indicates the ECM is commanding the IAC to be driven all the way in, to a fully seated position, and this is usually caused by **a** vacuum leak.

The higher the number of counts-the more air is being allowed *to* pass the IAC valve. If the IAC valve is unable to control the idle speed within **100** rpm **of** the ECM commanded speed, a Code **35** should set. A Code CHART should be used to diagnose the IAC system. Refer to "Rough, Unstable, or Incorrect Idle, Stalling" in the Symptoms Section "B" for other possibilities for the cause of idle problems.

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 personal injury, cover the fuel line with a shop cloth to collect the fuel, and then place the cloth in an approved container.**

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.

FUEL INJECTORS

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.

Remove or Disconnect

1. Ignition "OFF", remove electrical connections.
2. Fuel rail (see procedure below).
3. Injector retaining clips (If used).
4. Injectors.

Install or Connect

1. Injectors using new O-ring. Coat O-rings with engine oil.
2. Injector retaining clips.
3. Fuel rail. Injectors are retained by the fuel rail.
4. Electrical connectors.

Plenum (2.8L)

Removing the fuel rail assembly from the engine requires removing the top portion of the tuned intake manifold, called the "Plenum''.

Remove or Disconnect

1. Negative battery cable.
2. Vacuum lines.
3. EGR to plenum nuts **(3).**

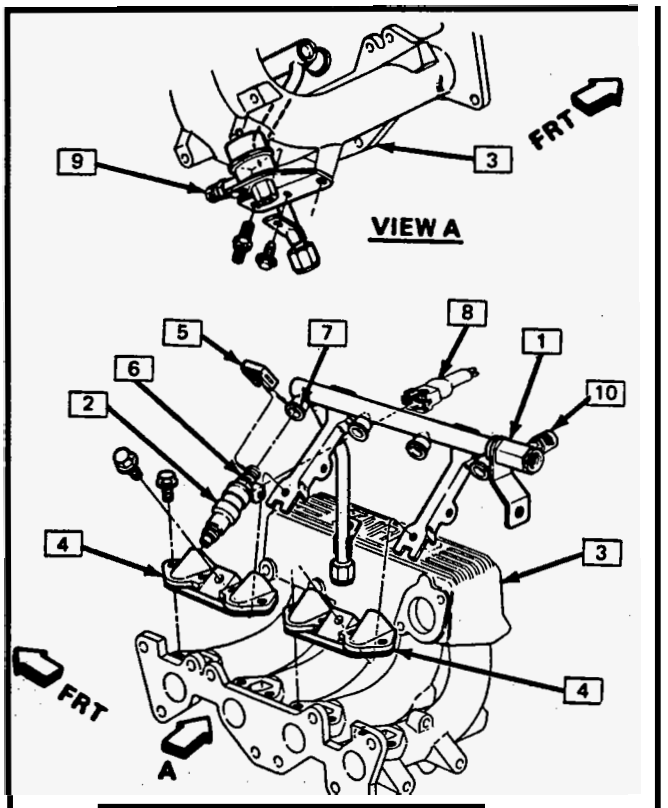
4. Two throttle body bolts.
5. Throttle cable bracket bolts.
6. Ignition wire plastic shield bolts (2).
7. Ten plenum bolts.
8. Plenum and gaskets.

Install or Connect

1. Gaskets.
2. Plenum bolts.
3. Ignition wire plastic shield bolts (2).
4. Throttle body bolts.
5. EGR to plenum nuts (3).
6. Throttle cable bracket bolts.
7. Vacuum lines.
8. Negative battery cable.

Fuel Rail

See Figure C2-6 for 2.0L Turbo fuel rail replacement, Figure C2-7 for 3.0L, 3.8L, and 3.8L Turbo, and Figure C2-8 for 2.8L.



1 FUEL RAIL ASSEMBLY
2 INJECTOR
3 INTAKE MANIFOLD
4 INJECTOR HOUSING ASSEMBLY
5 INJECTOR RETAINING CLIP
6 INJECTOR ASM. RETAINING GROOVE
7 INJECTOR CUP FLANGE
8 INJECTOR CONTROL HARNESS ASM.
9 PRESSURE REGULATOR ASM.
10 FUEL PRESSURE GAGE TEST POINT

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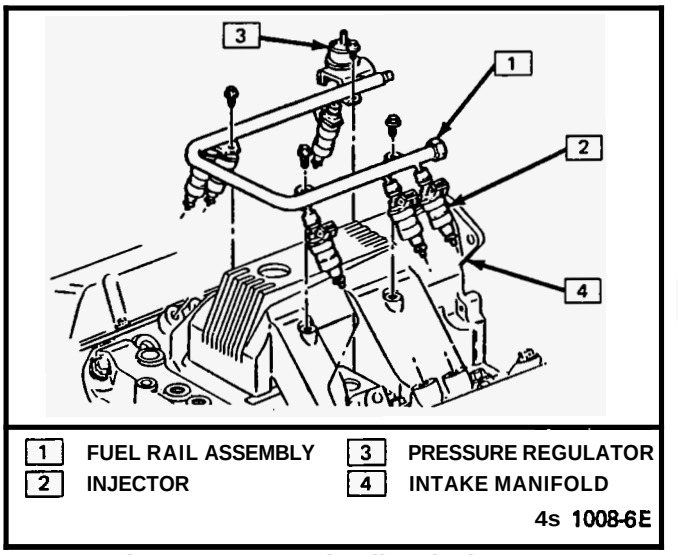
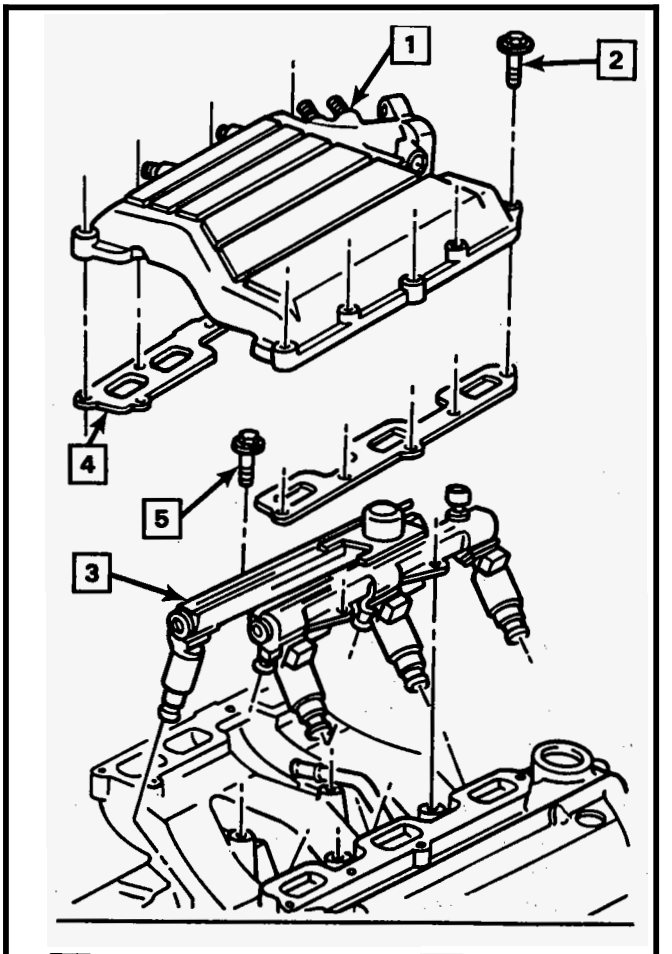
Figure C2-6 - Fuel Rail and Injectors - 2.0L Turbo



1 FUEL RAIL ASSEMBLY
2 INJECTOR
3 PRESSURE REGULATOR
4 INTAKE MANIFOLD

4s 1008-6E

Figure C2-7 - Fuel Rail and Injectors 3.0L, 3.8L & 3.8L Turbo



1 PLENUM
2 BOLT (9) 21 N·m (16 FT LBS)
3 FUEL RAIL ASM
GASKET
5 BOLT (4) 25 N·m (19 FT LBS)

7S 3238-6E

Figure C2-8 - Fuel Rail and Injectors - 2.8L

Important

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

Important

Any time the fuel system is opened for service, the O-ring seals used with related 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, following package instructions. The fuel rail should not be immersed in liquid solvent.

FUEL PRESSURE REGULATOR, Except 2.8L

Remove or Disconnect

1. Relieve fuel pressure (see procedure).
2. Pressure regulator from fuel rail. Place shop cloth around base of regulator to catch any spilled fuel.

Install or Connect

1. Pressure regulator on fuel rail

PRESSURE REGULATOR - (2.8L) (With Fuel Rail Removed)

- Support fuel rail to avoid damaging components.

Remove or Disconnect

1. Fuel inlet fitting (60) and fuel outlet fitting (61).
2. Fuel fitting gasket (62) from inlet and outlet fittings.
3. Pressure regulator bracket attaching screw assemblies (260), and pressure regulator mounting bracket (259).
4. Left hand fuel rail assembly (200), and right hand fuel rail assembly (201), from pressure regulator assembly (241).
5. Base to rail connectors (250), from pressure regulator or rails.

Disassemble

- Connector O-rings (252), from base to rail connectors (250).
- Fuel return O-ring (254) from fuel rails.

Assemble

- Lubricate new fuel return O-rings (254) with engine oil, and install on fuel rails.
  - The fuel return O-ring (254) is larger in diameter than the connector O-ring (252).
- Lubricate new connector O-rings (252) with engine oil, and install on base to rail connectors (250).

Install or Connect

1. Base to rail connectors (250) in pressure regulator assembly (241).
2. Left hand fuel rail assembly (200) and right hand fuel rail assembly (201) to pressure regulator assembly.
3. Pressure regulator mounting bracket (259) with pressure regulator bracket attaching screw assemblies (260).

Tighten

- Screw assemblies to 3.2 N·m (28.0 in. lbs.)

4. New fuel fitting gasket (62) on fuel inlet fitting (60) and on outlet fitting (61).
5. Fuel inlet and fuel outlet fittings.
   - Support fuel rail to avoid damaging components.

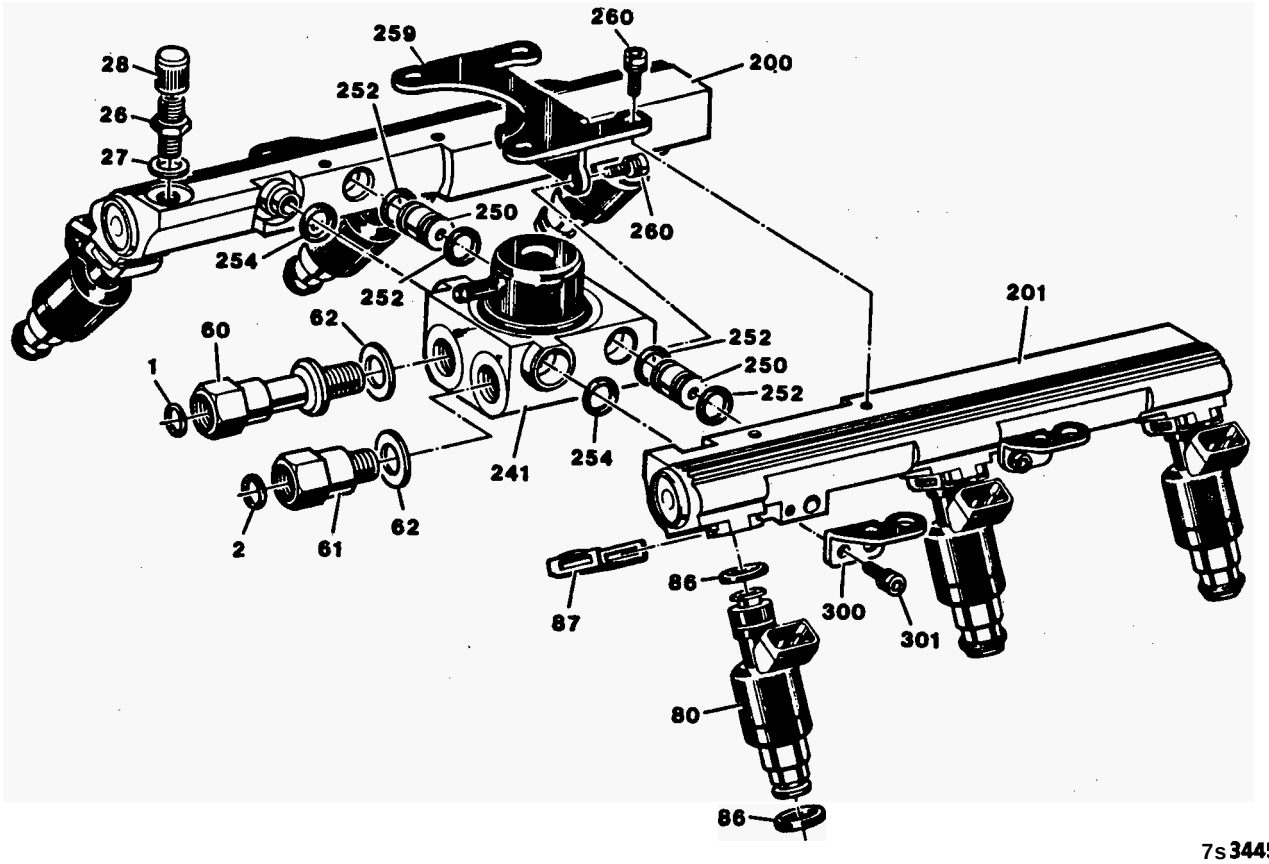
Tighten

- Fuel fittings to 27.0 N.m (20 ft. lbs.)

Names of component parts will be found on the numbered list on the exploded view. Numbers identifying parts on the exploded view also identify these parts in other figures in this section.

Install or Connect

1. Throttle body bolts.
2. Coolant hose.
3. Air inletboot.
4. Electrical connectors.
5. Throttle cables.



Fuel Rail Assembly Parts Identification

1	O-ring - Fuel Inlet Line
2	O-ring - Fuel Return Line
26	Fuel Pressure Connection Assembly
27	Seal - Fuel Pressure Connection
28	Cap - Fuel Pressure Connection
60	Fitting - Fuel Inlet
61	Fitting - Fuel Outlet
62	Gasket - Fuel Fitting
80	MPFI Multec Injector Assembly
86	Seal - O-ring - Injector
87	Clip - Injector Retainer
200	Fuel Rail & Plug Assembly - Left Hand
201	Fuel Rail & Plug Assembly - Right Hand
241	Pressure Regulator Assembly
250	Connector - Base to Rail
252	Seal - O-ring - Connector
254	O-ring - Fuel Return
259	Bracket - Pressure Regulator Mounting
260	Screw Assembly - Pressure Regulator Bracket Attaching
300	Bracket - Rail Mounting
301	Screw Assembly - Bracket Attaching

Figure C2-9 - Model F6C Fuel Rail Assembly

Part	Part Name
1	Gasket - Flange
10	Throttle Body Assembly
15	Plug - Idle Stop Screw
16	Screw Assembly - Idle Stop
17	Spring - Idle Stop Screw Assembly
20	Sensor - Throttle Position (TPS)
21	Screw Assembly - TPS Attaching
22	Retainer - TPS Attaching Screw
27	Lever - TPS
40	Cover - Coolant Cavity
45	Screw Assembly - Coolant Cover Attaching
46	O-ring - Coolant Cover to Throttle Body
60	Idle Air / Vacuum Signal Housing Assembly
65	Screw Assembly - Idle Air / Vacuum Signal Assembly
66	Screw Assembly - Idle Air / Vacuum Signal Assembly (Long)
67	Gasket - Idle Air / Vacuum Signal Assembly
70	Valve Assembly - Idle Air Control (IAC)
71	Gasket - IAC Valve Assembly

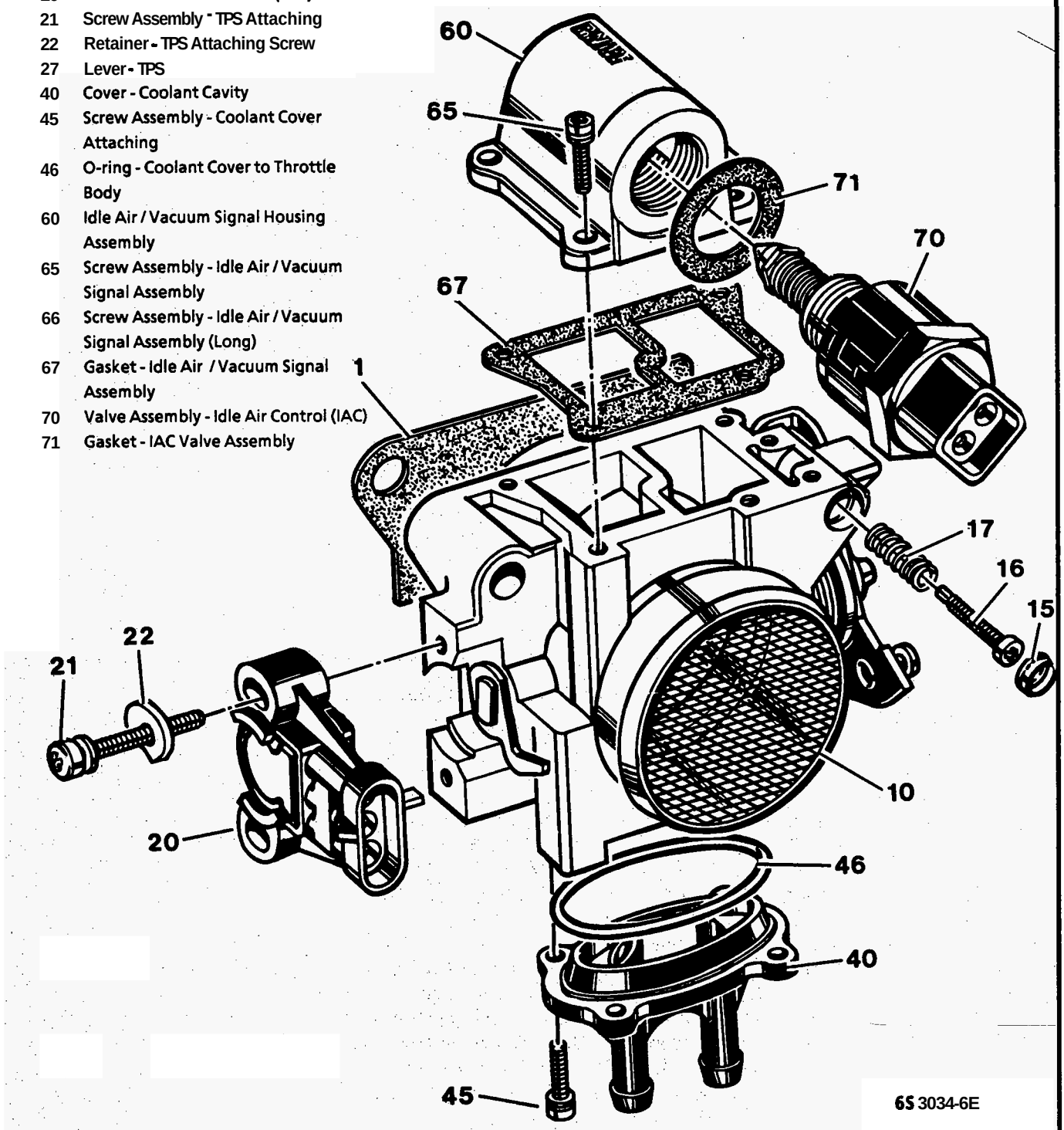
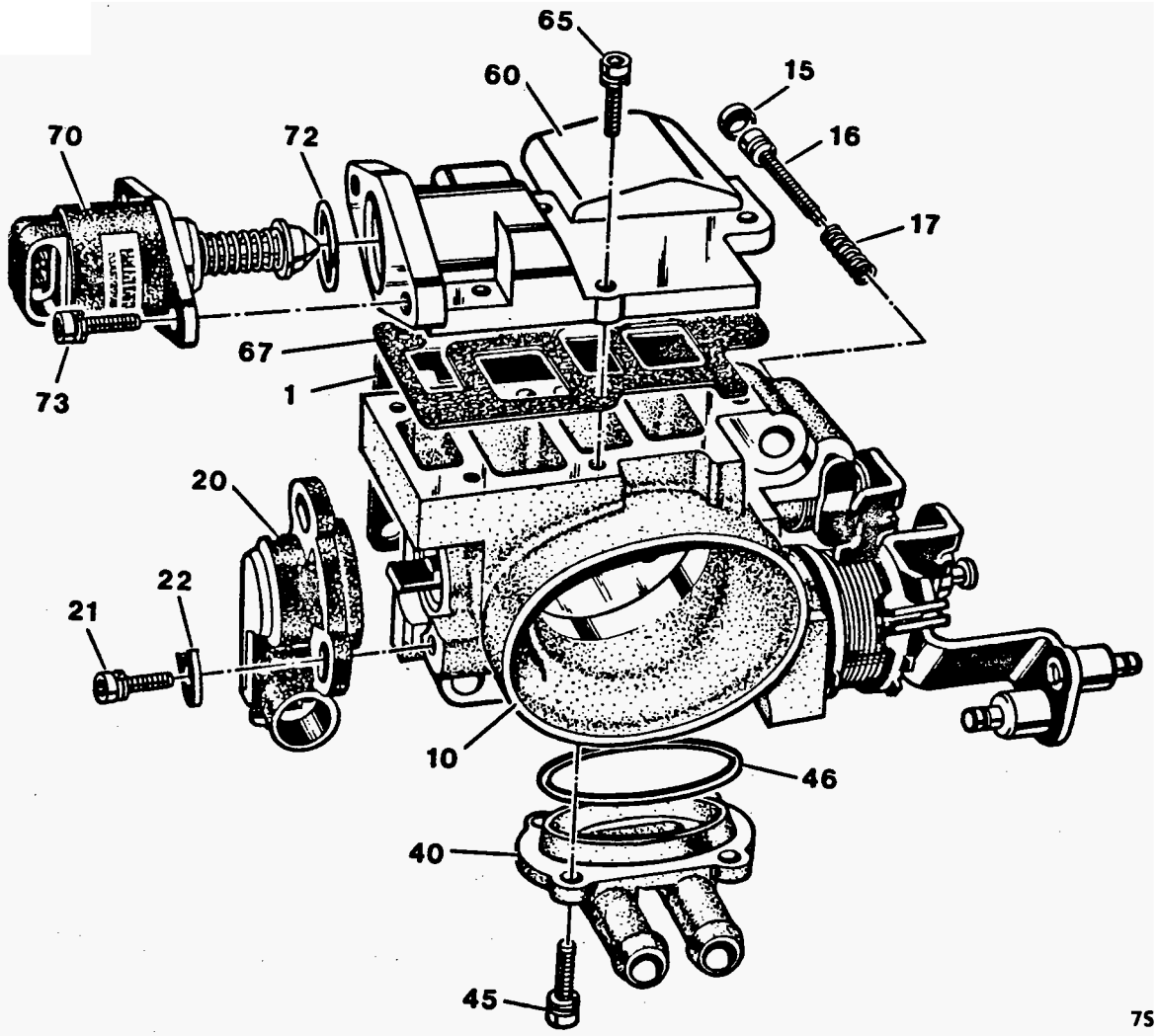


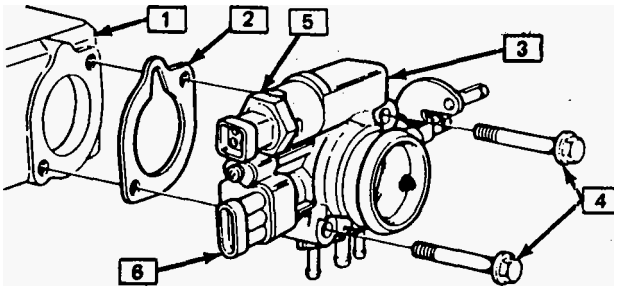
Figure C2-10 - MPFI Throttle Body - 3.0L, 3.8L, and 3.8L Turbo



Throttle Body Assembly Parts Identification

1	Gasket - Flange
10	Throttle Body Assembly
15	Plug - Idle Stop Screw
16	Screw Assembly - Idle Stop
17	Spring - Idle Stop Screw Assembly
20	Sensor - Throttle Position (TPS)
21	Screw Assembly - TPS Attaching
22	Retainer - TPS Attaching Screw
40	Cover - Coolant Cavity
45	Screw Assembly - Coolant Cover Attaching
46	O-ring - Coolant Cover to Throttle Body
60	Idle AirNacuum Signal Housing Assembly
65	Screw Assembly - Idle AirNacuum Signal Assembly
67	Gasket - Idle AirNacuum Signal Assembly
70	Valve Assembly - Idle Air Control (IAC)
72	O-ring - Idle Air Control Valve
73	Screw Assembly - Idle Air Control Valve Attaching

Figure C2-11 - 2.8L Model T1D Throttle Body Assembly



1	INTAKE MANIFOLD
2	GASKET
3	THROTTLE BODY ASM.
4	BOLTS 14-20 N·m (10-15 FT. LBS.)
5	IDLE AIR CONTROL VALVE
6	THROTTLE POSITION SENSOR

4S 0658-6E

Figure C2-12 - 2.0L Turbo Throttle Body

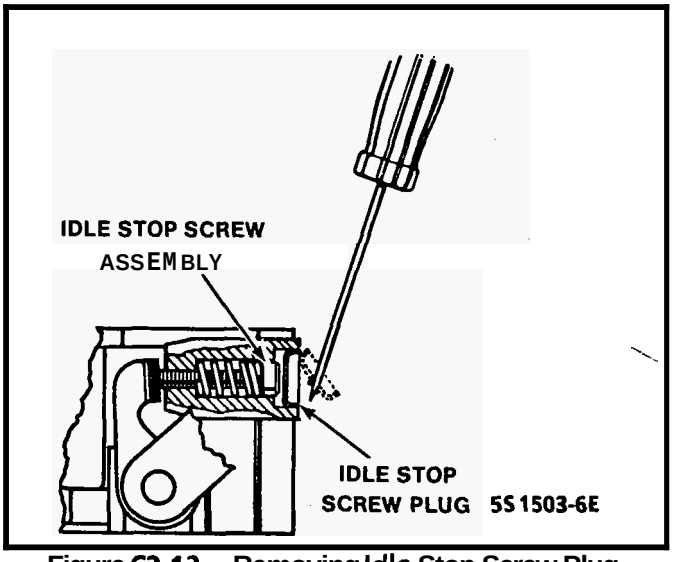


Figure C2-13 - Removing Idle Stop Screw Plug

MINIMUM IDLE SPEED ADJUSTMENT

The Idle Stop Screw, used to regulate minimum idle speed, is adjusted at the factory, then is covered with a plug to discourage unnecessary readjustment. However, if it is necessary to gain access to the Idle Stop Screw assembly, proceed as shown in Figure C2-13. (Except 3.8L & Turbo).

1. Pierce the idle stop screw plug with an awl, and apply leverage to remove it.
2. Adjust idle stop screw assembly as required using following procedure.

Adjustment should be performed only when the throttle body parts have been replaced. Engine must be at normal operating temperature before making an adiustment.

Adjust

3. With IAC motor connected, ground diagnostic lead.
4. Turn on ignition, do not start engine. Wait at least 30 seconds.
5. With ignition "ON", disconnect IAC electrical connector.
6. Remove ground from diagnostic lead and start engine.
7. Adjust idle set screw to:
   500 ± 50rpm in drive 3.0L, 3.8L, and 3.8L Turbo.
   600 ± 50rpm in neutral 2.0L Turbo.
8. Turn ignition "OFF" and reconnect connector at IAC motor.
9. Adjust TPS to :
   - .50 - .59 volts 3.0L.
   - .36 - .44 volts 3.8L.
   - The 2.0L Turbo TPS is non-adjustable. However, check for TPS output voltage to be under 1.25 volts. If higher, check for misalignment or binding in throttle lever or faulty TPS.
10. Recheck setting.
11. Start engine and inspect for proper idle operation.

THROTTLE BODY ASSEMBLY REMOVAL

Remove or Disconnect

1. Air inlet duct.
2. IAC valve and TPS connectors.
3. Vacuum lines.
4. Two coolant hoses.
5. Throttle, TV, and cruise control cables.
6. Throttle body retainingbolts.
7. Throttle body assembly.
8. Flange gasket and discard.

Clean

- Gasket surface on intake manifold and throttle body.

THROTTLE BODY ASSEMBLY INSTALLATION

Install or Connect

1. New flange gasket.
2. Throttle body assembly.
3. Throttle body retaining bolts.

Tighten

- Retaining bolts to 15 N·m (11 ft. lbs.)

Install or Connect

4. Throttle, TV and cruise control cables.
5. Two coolant hoses.
6. Vacuum lines.
7. IAC valve and TPS electrical connectors.
8. Air inlet duct.
9. Refill radiator to replace lost coolant.

THROTTLE POSITION SENSOR (TPS)

Remove or Disconnect

1. Electrical connector from throttle position sensor.
2. TPS attaching screw assemblies and retainers.
3. Throttle position sensor.

Install or Connect (Figure C2-12)

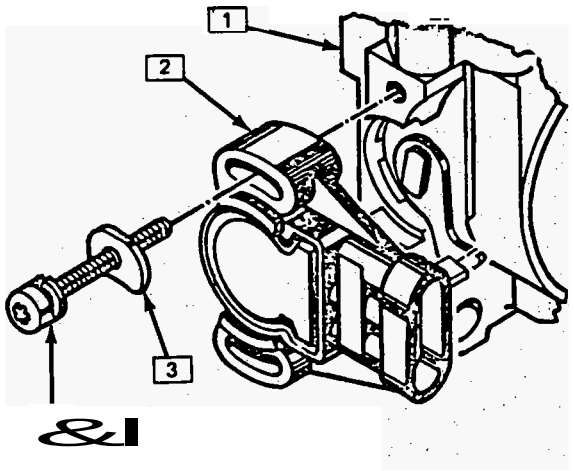
1. With throttle valve in the closed position, install the throttle position sensor on the throttle body assembly, making sure the TPS lever lines up with the TPS drive lever on the throttle shaft.
2. TPS attaching screw retainers with TPS attaching screw assemblies.

Adjust

- 2.8L & 3.0L Throttle position sensor to .50 - .59 volts.
- 3.8L Throttle position sensor to .36 - .44 volts.

Tighten

- TPS attaching screw assemblies to 2.0 N·m (18.0 in. lbs.).



1 THROTTLE BODY ASM.
2 THROTTLE POSITION SENSOR (TPS)
3 RETAINER (2)
4 SCREW (2) 2 N·m (18 IN. LBS.)

7S 3676-6E

Figure C2-14 - Throttle Position Sensor (Typical)

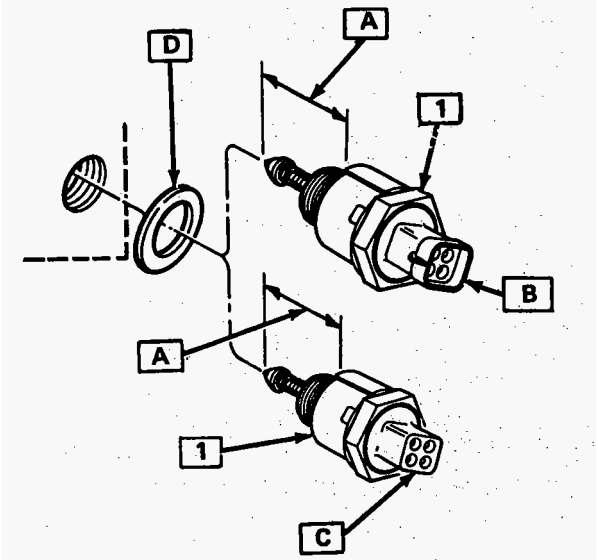
IDLE AIR CONTROL VALVE

Remove or Disconnect

1. Electrical connector from idle air control valve.
2. Idle air control valve, using a 32mm (1-1/4") wrench (J-33031 or equivalent). See Figure C2-13.

Important

Before installing new idle air control valve, measure the distance that the valve is extended (see Figure C2-14). Measurement should be made from motor housing to end of cone. Distance should be no greater than 28mm (1-1/8 in.). If the cone is extended too far, damage may occur to the valve when installed.



1 IDLE AIR CONTROL VALVE
A LESS THAN 28mm (1-1/8 IN.)
B TYPE I (WITH COLLAR)
C TYPE II (WITHOUT COLLAR)
D GASKET (PART OF IAC VALVE SERVICE KIT)

4S 0104

Figure C2-15 - IAC Valve Installation

Identify replacement IAC valve (Figure C2-11) as being either Type I (having collar at electric terminal end) or Type II (without collar). If measured dimension "A" is greater than 28mm (1-1/8"), distance must be reduced as follows:

TYPE I - Exert Firm pressure on valve to retract it. (A slight side-to-side movement may be helpful where indicated :) (See Figure C2-14.)

TYPE II - Compress retaining spring from valve while turning valve "in" with a clockwise motion. Return spring to original position with straight portion of spring end aligned with flat surface of valve.

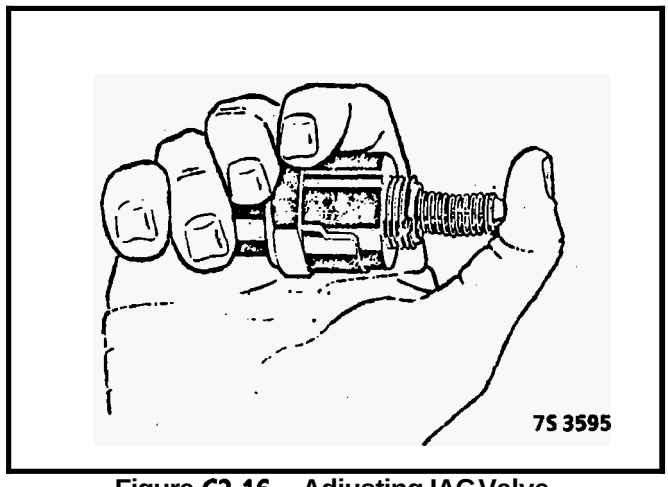


Figure C2-16 - Adjusting IAC Valve (With Collar at Electric Terminal End)

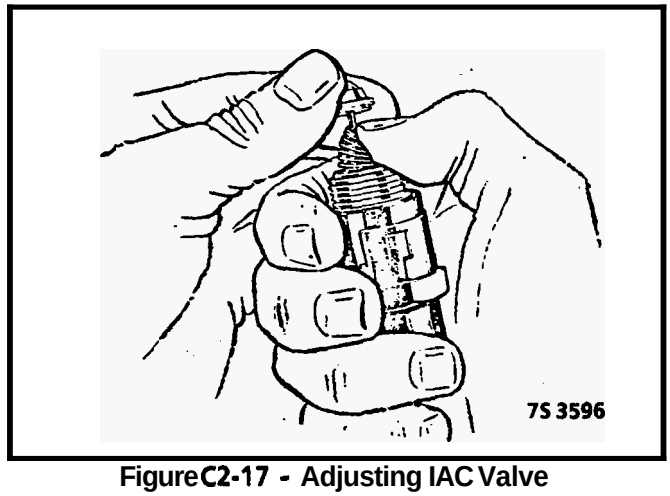


Figure C2-17 - Adjusting IAC Valve (Without Collar at Electric Terminal End)

Install

1. New idle air control valve to throttle body. Use new gasket supplied with assembly.

Tighten

- IAC valve to **18** N·m **(13 ft.** lbs.).

Install or Connect

2. Electrical connector to idle air control valve.
3. Start engine and allow engine to reach operating temperature.
4. 2.0L Turbo ECM will reset IAC valve, when vehicle is driven above **35** mph.
   3.0L, 3.8L, and 3.8L **Turbo** - The ECM will reset the, IAC, whenever the ignition switch is turned "ON, and then **"OFF".**

IDLE AIR HOUSING ASSEMBLY (With IAC Valve Removed)

Remove or Disconnect (Figure C2-18)

1. Idle air housing assembly screw assemblies.
2. Idle air housing assembly.
3. Gasket.

Clean

- Gasket mounting surfaces to ensure a good seal.

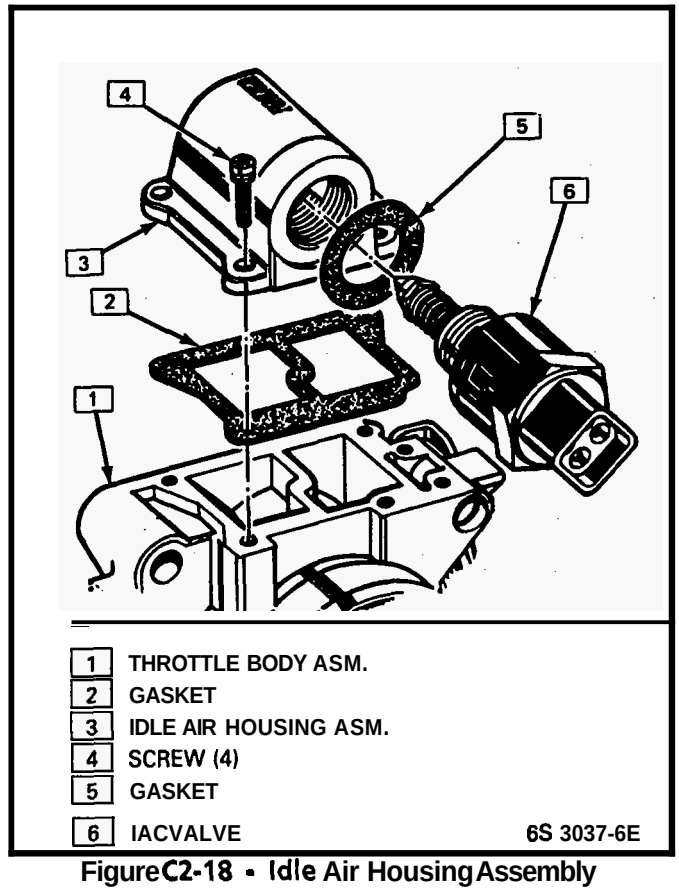


Figure C2-18 - Idle Air Housing Assembly

Install or Connect

1. New idle air housing assembly gasket.
2. Idle air housing assembly.

Tighten

- Screw assemblies to **3.4** N·m **(30.0** in. lbs.).

COOLANT CAVITY COVER AND O-RING

Remove or Disconnect (Figure C2-19)

1. Coolant cover attaching screw assemblies.
2. Coolant cavity cover.
3. Coolant cover to throttle body o-ring.

Clean

- O-ring sealing surfaces.

Inspect

- O-ring sealing surfaces, for damage and corrosion. Replace coolant cavity cover or throttle **body** ifnecessary.

Install or Connect

1. Lubricate new coolant cover to throttle body o-ring with ethylene glycol antifreeze and install in throttle body.
2. Coolant cavity cover.

Tighten

- Screw assemblies to 3.0 N·m **(27.0** in. lbs.).

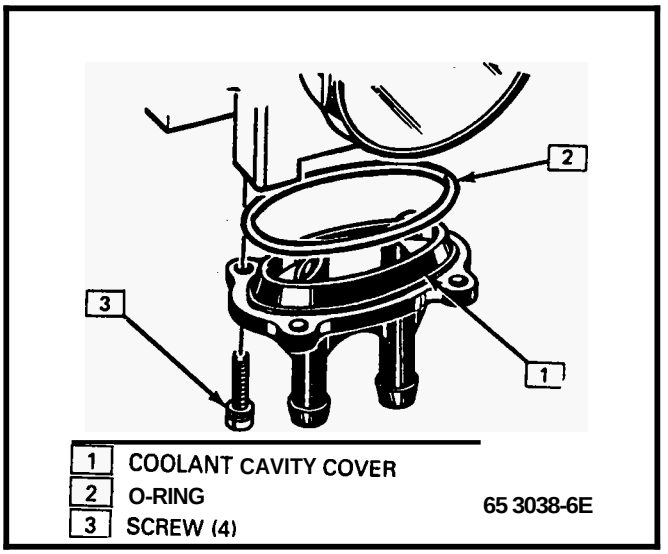


Figure C2-19 - Coolant Cavity Cover Asm. (Typical)

FUEL PUMP RELAY

The fuel pump relay is mounted in the engine compartment (see Figures C2-20 thru C2-24). Other than checking for loose connectors, the only service possible is replacement.

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
Control Kit, Idle **Air** Valve	3.820
Regulator, Fuel Pressure	3.164
Rail, Fuel Feed	3.330

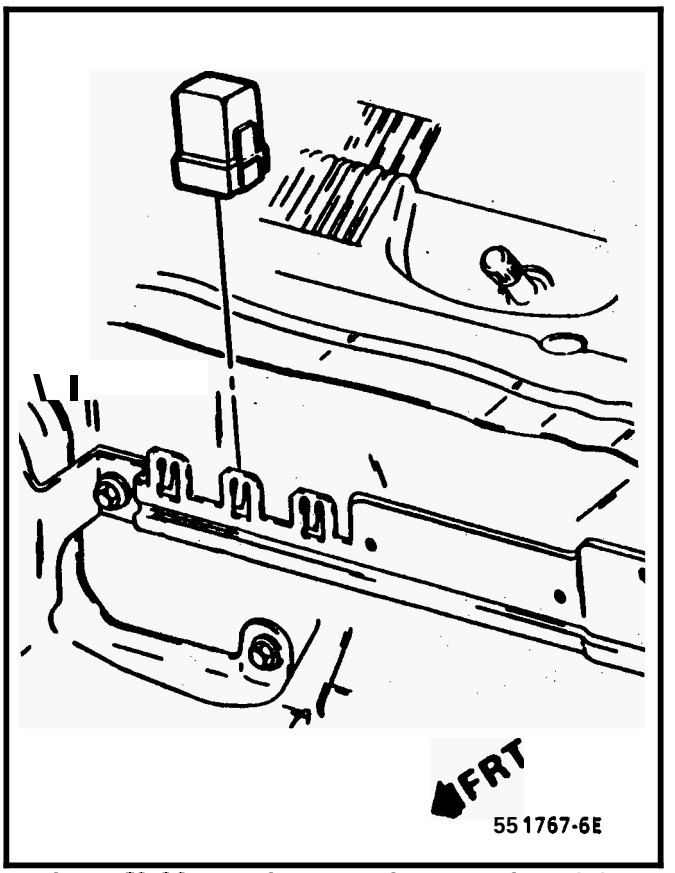


Figure C2-20 - Fuel Pump Relay - N Series - 3.01

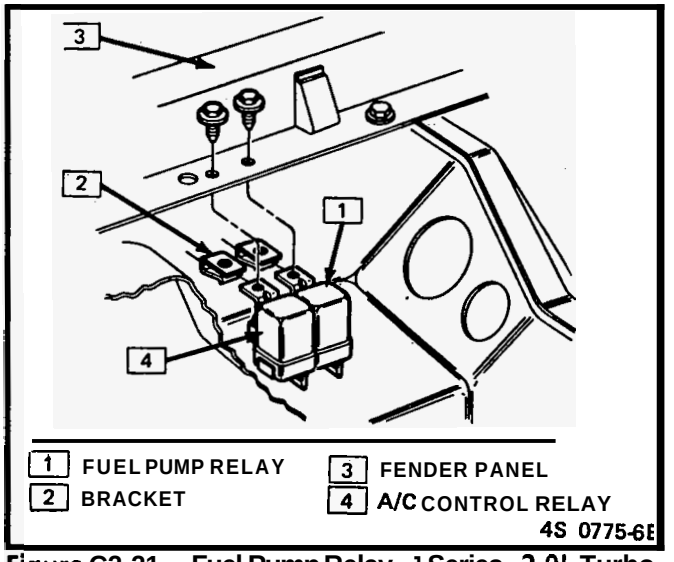


Figure C2-21 - Fuel Pump Relay - J Series - 2.0L Turbo

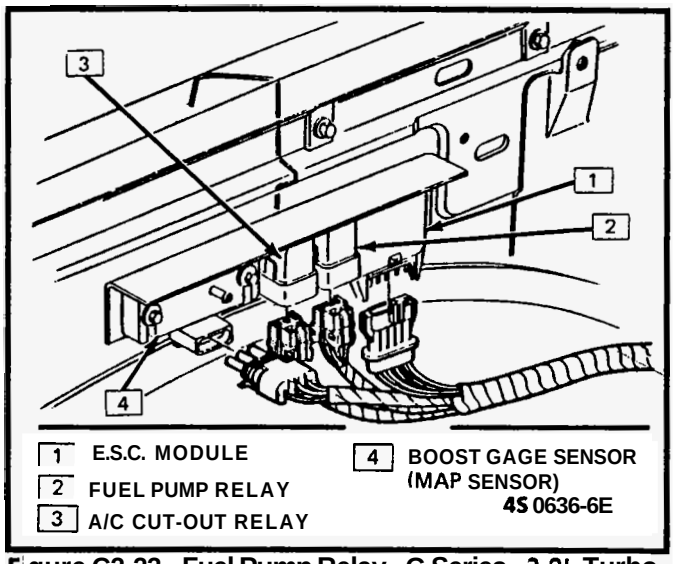


Figure C2-23 - Fuel Pump Relay - G Series - 3.8L Turbo

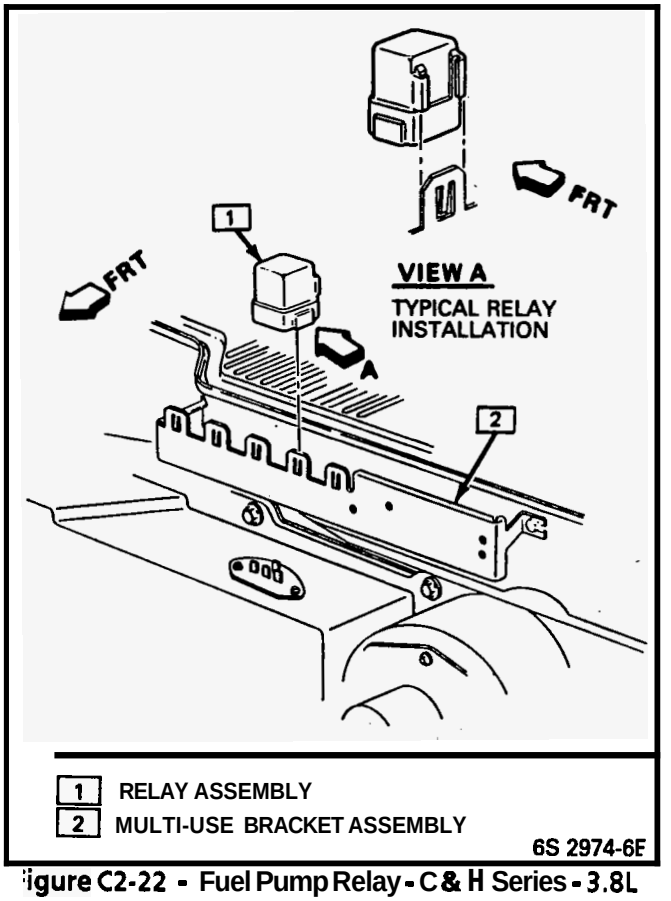


Figure C2-22 - Fuel Pump Relay - C & H Series - 3.8L

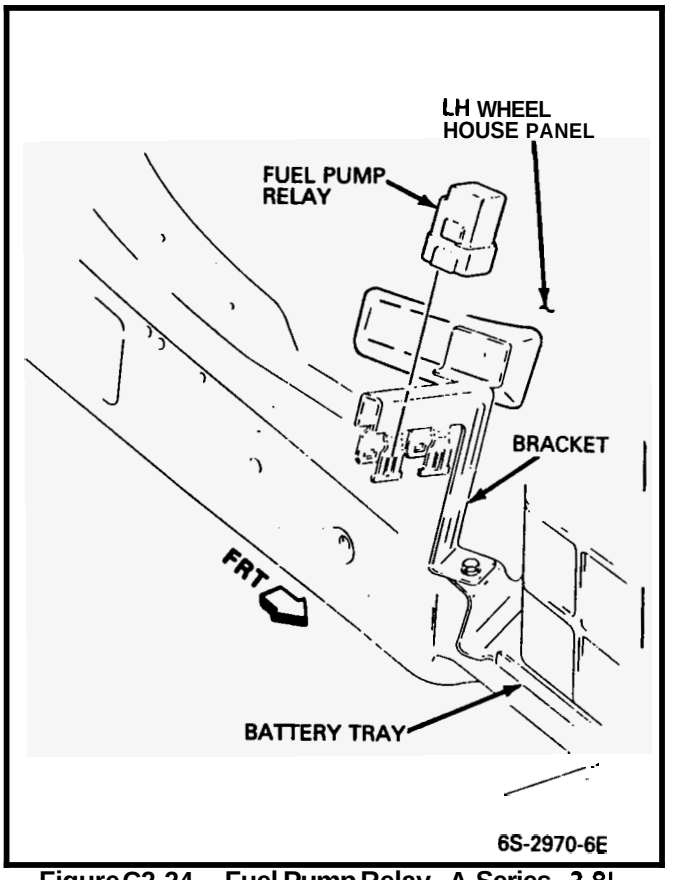


Figure C2-24 - Fuel Pump Relay - A Series - 3.8L

CHART C-2A

INJECTOR BALANCE TEST

The injector balance tester is a tool used to turn the injector on for a precise amount of time, thus spraying a measured amount of fuel into the manifold. This causes a drop in fuel rail pressure that we can record and compare between each injector. All injectors should have the same amount of pressure drop (± 10 kpa). Any injector with a pressure drop that is 10 kpa (or more) greater or less than the average drop of the other injectors should be considered faulty and replaced.

STEP 1

Engine "cool down" period (10 minutes) is necessary to avoid irregular readings due to "Hot Soak" fuel boiling. With ignition "OFF" connect fuel gauge 5347301 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 5-34730-3, 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 gauge and hose to insure accurate gauge operation. Repeat this step until all air is bled from gauge.

STEP 2

Turn ignition "OFF" for 10 seconds and then "ON" again to get fuel pressure to its maximum. Record this initial pressure reading. Energize tester one time and note pressure drop at its lowest point (Disregard any slight pressure increase after drop hits low point.). By subtracting this second pressure reading from the initial pressure, we have the actual amount of injector pressure drop.

STEP 3

Repeat step **2** on each injector and compare the amount of drop. Usually, good injectors will have virtually the same drop. Retest any injector that has a pressure difference of 10kPa, either more or less than the average of the other injectors on the engine. Replace any injector that also fails the retest. If the pressure drop of all injectors is within 10kPa of this average, the injectors appear to be flowing properly. Reconnect them and review Symptoms, Section **"B"**.

NOTE: ***The entire test should <u>not</u> be repeated more than once without running the engine to prevent flooding. (This includes any retest on faulty injectors).***

CHART C-2A
INJECTOR BALANCE TEST (PORT)

NOTE: **If injectors are suspected of being dirty, they should be cleaned using an approved tool and procedure prior to performing this test. The fuel pressure test in Section A, Chart A-7, should be completed prior to this test.**

Step **1.** If engine is at operating temperature, allow a **10** minute "cool down" period then connect fuel pressure gauge and injector tester.

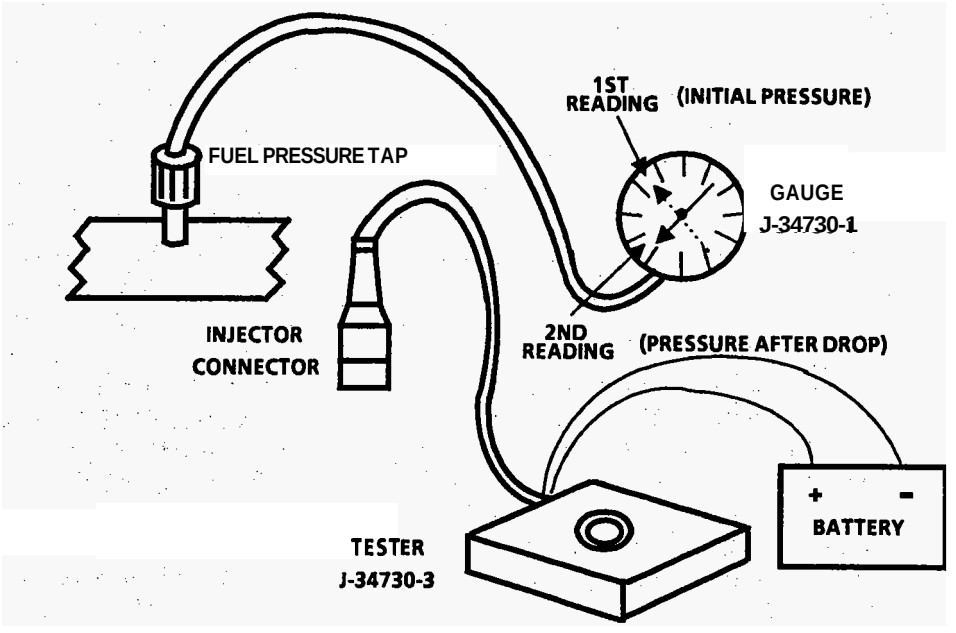
1. Ignition "OFF".
2. Connect fuel pressure gauge and injector tester.
3. Ignition "ON".
4. Bleed off air in gauge. Repeat until all air is bled from gauge.

Step 2. Run test:

1. Ignition "OFF" for **10** seconds.
2. Ignition "ON". Record gauge pressure. (Pressure must hold steady, if not see the Fuel System diagnosis, Chart A-7, in Section A) .
3. Turn injector on, by depressing button on injector tester, and note pressure at the instant the gauge needle stops.

Step **3.**

1. Repeat step **2** on all injectors and record pressure drop on each. Retest injectors that appear faulty (Any injectors that have a **10** kPa difference, either more or less, in pressure from the average). If no problem is found, review Symptoms Section B.



— EXAMPLE —

CYLINDER	1	2	3	4	5	6
1ST READING	225	225	225	225	225	225
2ND READING	100	100	100	90	100	115
AMOUNT OF DROP	125	125	125	135	125	110
	OK	OK	OK	FAULTY, RICH (TOO MUCH) (FUEL DROP)	OK	FAULTY, LEAN (TOO LITTLE) (FUEL DROP)

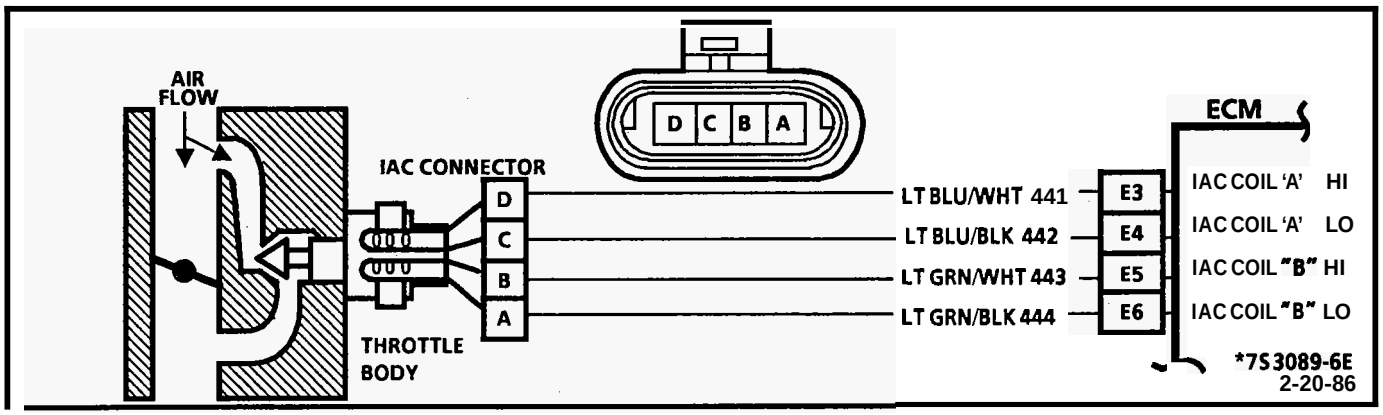


CHART C-2C

IDLE AIR CONTROL (IAC) VALVE CHECK
2.0L TURBO "J" SERIES (PORT)

Circuit Description:

The ECM controls idle rpm with the IAC valve. To increase idle rpm, the ECM moves the IAC valve out, allowing more air to pass by the throttle plate. To decrease rpm, it moves the IAC valve in, reducing air flow by the throttle plate. A "Scan" tool will read the ECM commands to the IAC valve in counts. The higher the counts, the more air allowed (higher idle). The lower the counts, the less air allowed (lower idle).

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Continue with test, even if engine will not idle. If idle is to low, "Scan" will display 80 or more counts, or steps. If idle is high, it will display "0" counts. Occasionally an erratic or unstable idle may occur. Engine speed may vary 200 rpm or more up and down. Disconnect IAC. If the condition is unchanged, the IAC is not at fault.
2. When the engine was stopped, the IAC Valve retracted (more air) to a fixed "Park" position for increased air flow and idle speed during the next engine start. A "Scan" will display 100 or more counts.
3. Be sure to disconnect the IAC valve prior to this test. The test light will confirm the ECM signals by a steady or flashing light on all circuits.
4. There is a remote possibility that one of the CKTs is shorted to voltage, which would have been indicated by a steady light. Disconnect ECM and turn the Ign. on and probe terminals to check for this condition.

Diagnostic Aids:

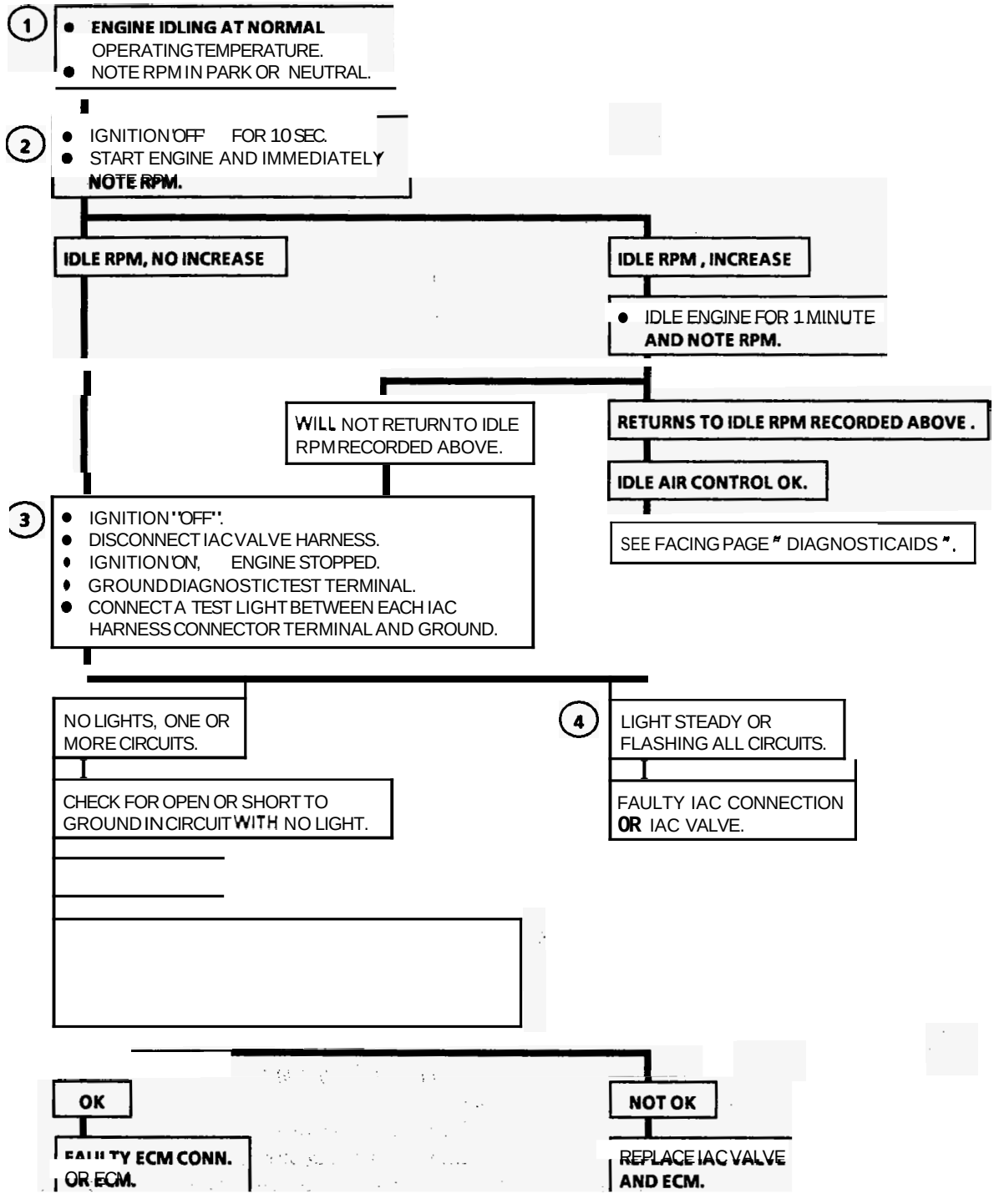
A slow unstable idle may be caused by a system problem that cannot be overcome by the IAC. "Scan" counts will be above 60 counts, if too low, and "0" counts, if too high.

If idle is too high, stop engine. Ignition "ON". Ground diagnostic terminal. Wait **45** seconds for IAC to seat, then, disconnect IAC. Unground diagnostic terminal and start engine. If idle speed is above 800 rpm, locate and correct vacuum leak.

- System too lean (High Air/Fuel Ratio)
  Idle speed may be too high or too low. Engine speed may vary up and down, disconnecting IAC does not help. May set Code **44.**
  "Scan" and/or Voltmeter will read an oxygen sensor output less than 300 mv (.3v). Check for low regulated fuel pressure or water in fuel. A lean exhaust, with an oxygen sensor output fixed above 800 mv (.8v), will be a contaminated sensor, usually silicone. This may also set a Code **45.**
- System too rich (Low Air/Fuel Ratio)
  Idle speed too low. "Scan" counts usually above 80. System obviously rich and may exhibit black smoke exhaust.
  "Scan" tool and/or Voltmeter will read an oxygen sensor signal fixed above 800 mv (.8v).
  Check:
  - High fuel pressure
  - Injector leaking or sticking
- Throttle Body - Remove IAC and inspect bore for foreign material or evidence of IAC valve dragging the bore.
- Refer to "Rough, Unstable, Incorrect Idle or Stalling" in Symptoms in Section "B".

CHART C-2C

IDLE AIR CONTROL (IAC) VALVE CHECK 2.0L TURBO "J" SERIES (PORT)



CLEAR CODES AND CONFIRM 'CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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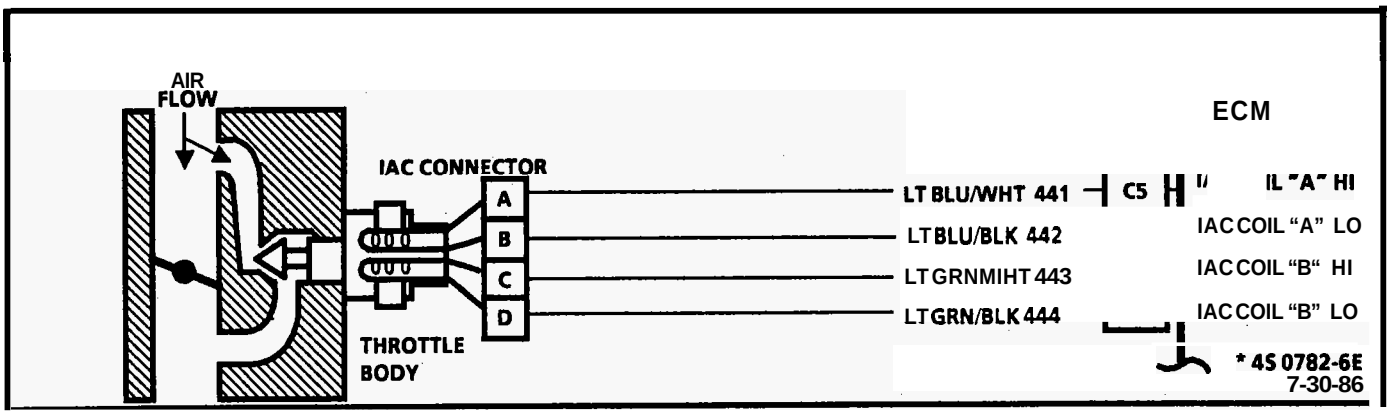


CHART C-2C

IDLE AIR CONTROL (IAC) VALVE CHECK
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The ECM controls idle rpm with the IAC valve. To increase idle rpm, the ECM moves the IAC valve out, allowing more air to pass by the throttle plate. To decrease rpm, it moves the IAC valve in, reducing air flow by the throttle plate. A "Scan" tool will read the ECM commands to the IAC valve in counts. The higher the counts, the more air allowed (higher idle). The lower the counts, the less air allowed (lower idle).

Test Description: Step numbers refer to step numbers on diagnostic chart.

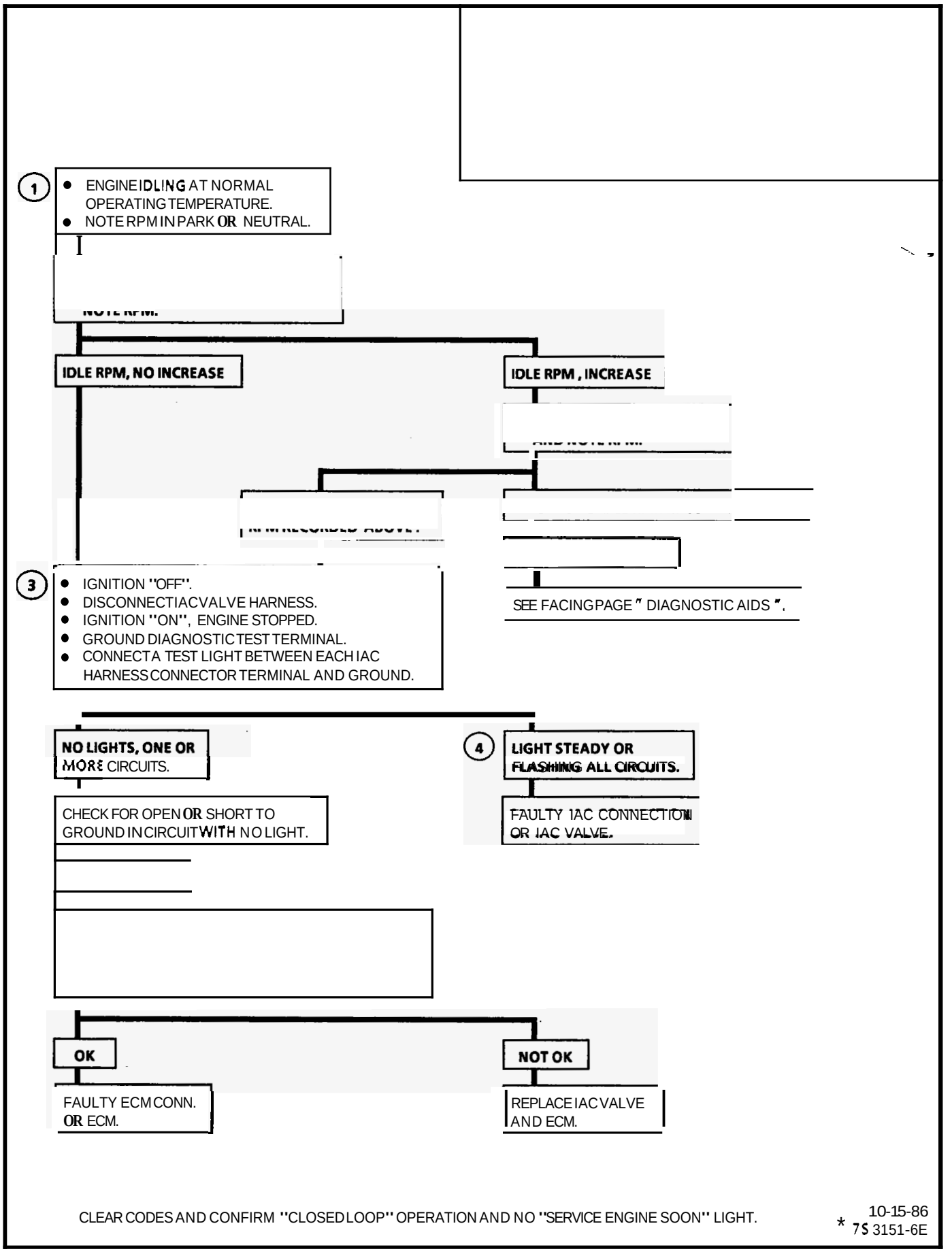
1. Continue with test, even if engine will not idle. If idle is to low, "Scan" will display 80 or more counts, or steps. If idle is high, it will display "0" counts. Occasionally an erratic or unstable idle may occur. Engine speed may vary 200 rpm or more up and down. Disconnect IAC. If the condition is unchanged, the IAC is not at fault.
2. When the engine was stopped, the IAC Valve retracted (more air) to a fixed "Park" position for increased air flow and idle speed during the next engine start. A "Scan" will display 100 or more counts.
3. Be sure to disconnect the IAC valve prior to this test. The test light will confirm the ECM signals by a steady or flashing light on all circuits.
4. There is a remote possibility that one of the CKTs is shorted to voltage, which would have been indicated by a steady light. Disconnect ECM and turn the Ign. on and probe terminals to check for this condition.

Diagnostic Aids:

A slow unstable idle may be caused by a system problem that cannot be overcome by the IAC. "Scan" counts will be above 60 counts, if too low, and "0" counts, if too high.

If idle is too high, stop engine. Ignition "ON". Ground diagnostic terminal. Wait 30 seconds for IAC to seat, then, disconnect IAC. Unground diagnostic terminal and start engine. If idle speed is above 800 ± 50 rpm, locate and correct vacuum leak.

- System too lean (High Air/Fuel Ratio)
  Idle speed may be too high or too low. Engine speed may vary up and down, disconnecting IAC does not help. May set Code 44.
  "Scan" and/or Voltmeter will read an oxygen sensor output less than 300 mv (.3v). Check for low regulated fuel pressure or water in fuel. A lean exhaust, with an oxygen sensor output fixed above 800 mv (.8v), will be a contaminated sensor, usually silicone. This may also set a Code 45.
- System too rich (Low Air/Fuel Ratio)
  Idle speed too low. "Scan" counts usually above 80. System obviously rich and may exhibit black smoke exhaust.
  "Scan" tool and/or Voltmeter will read an oxygen sensor signal fixed above 800 mv (.8v).
  Check:
  - High fuel pressure
  - Injector leaking or sticking
- Throttle Body - Remove IAC and inspect bore for foreign material or evidence of IAC valve dragging the bore.
- Refer to "Rough, Unstable, Incorrect Idle or Stalling" in Symptoms in Section "B".



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

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SECTION C3

EVAPORATIVE EMISSION CONTROL SYSTEM (EECS)

CONTENTS

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.

PURGE VALVE OPERATION 2.0L TURBO Vin "M"

The purge valve is an integral part of the canister (Figure C3-2). When the engine is running, manifold vacuum is supplied to the top of the purge valve (Control Vacuum Signal) which lifts the valve diaphragm and opens the valve. The lower tube on the purge valve (PCV tube) is connected to a timed port above the throttle valve. The rate of purge is controlled through this port by throttle location.

EVAPORATIVE SYSTEM 2.8L Vin "W"

Gasoline vapors from the fuel tank flow into the tube labeled tank. These vapors are absorbed into the carbon. Any liquid fuel goes into a reservoir in the bottom of the canister to protect the integrity of the carbon bed above (Figure C3-1). The canister is purged (by ECM control) when the engine is running above idle speed. Ambient air is allowed into the canister through the air tube in the top. The air mixes with the vapor and the mixture is drawn into the intake manifold.

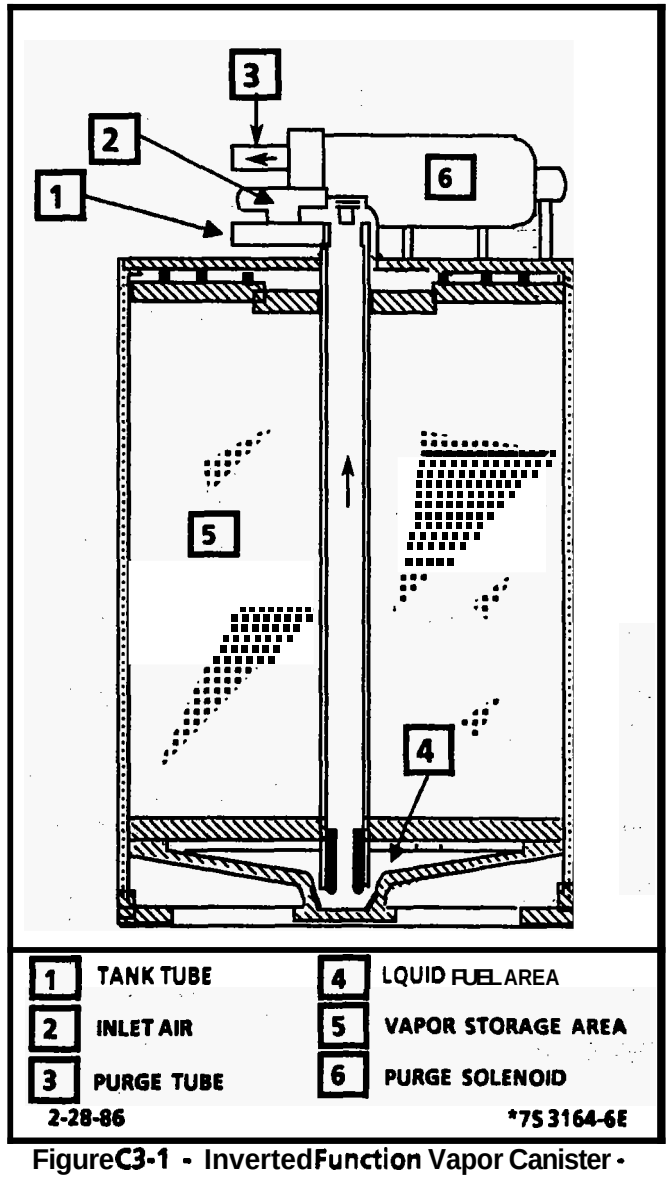
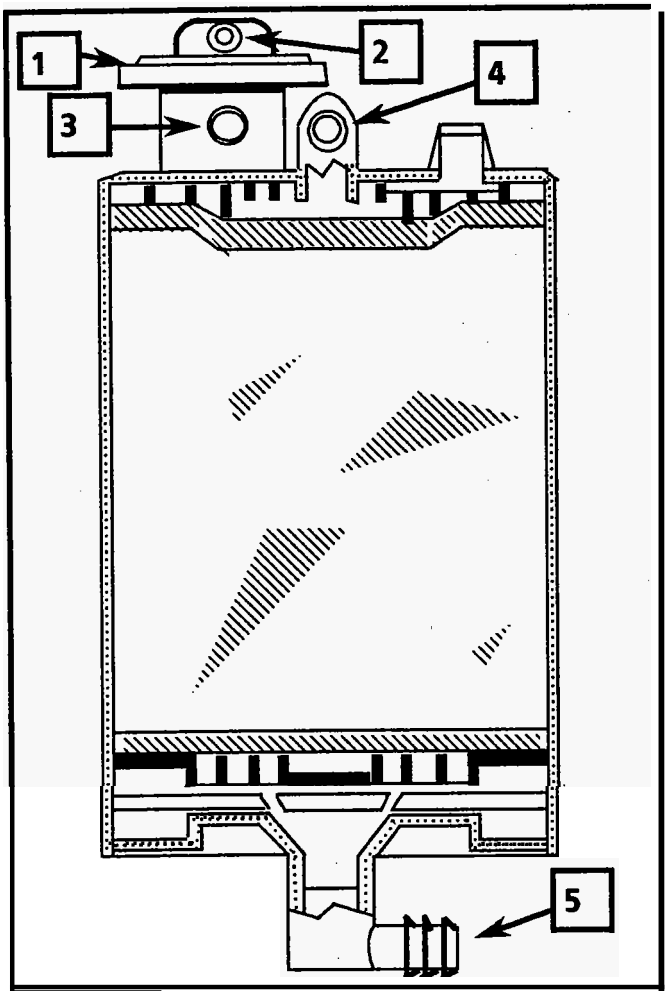
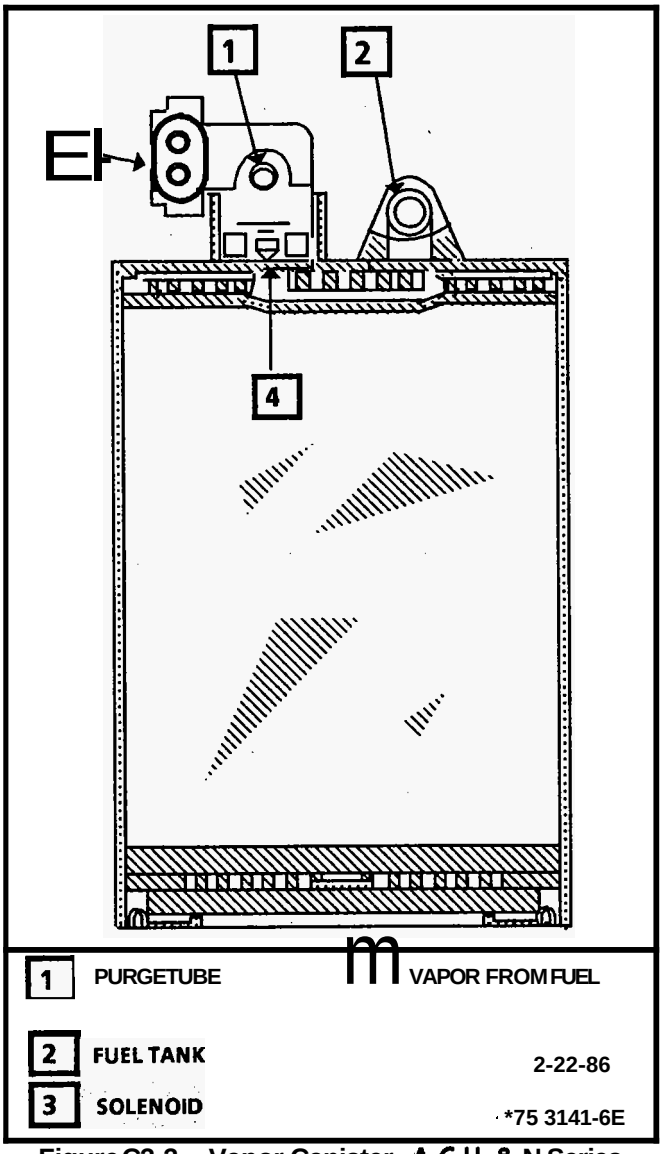


Figure C3-1 - Inverted Function Vapor Canister - With Encapsulated Purge Solenoid 2.8L Vin "W"



1	PURGEVALVE	4	VAPORFROM FUEL TANK
2	CONTROL VACUUM SIGNAL	5	AIR INLET/ DRAIN TUBE
3	PCVTUBE		65 2930-6E

igure C3-2 - Fuel Vapor Canister 2.0L Turbo Vin "M"



1	PURGETUBE		VAPOR FROM FUEL
2	FUEL TANK		2-22-86
3	SOLENOID		*75 3141-6E

Figure C3-3 - Vapor Canister - A,C,H, & N Series With Encapsulated Solenoid 3.0L Vin "L" with Non-Encapsulated Solenoid 3.8L Vin "3" & 3.8L Turbo Vin "7"

EVAPORATIVE SYSTEM 3.0L Vin "L", 3.8L Vin "3", & 3.8L Turbo Vin "7"

Gasoline vapors from the fuel tank flow into the tube labeled tank (Figure C3-3). These vapors are absorbed into the carbon. The canister is purged (by ECM control) when the engine is running above idle speed. Air is drawn into the canister through the filter at the bottom. The air mixes with the vapor and the mixture is drawn into the intake manifold.

OPERATION

The ECM operates a solenoid valve (encapsulated on the 2.8L & 3.0L and non-encapsulated on the 3.8L & 3.8L Turbo), which controls vacuum to the purge valve in the charcoal canister. Under cold engine or idle conditions, the solenoid is turned on by the ECM, which closes the valve and blocks vacuum to the canister purge valve.

The ECM turns "OFF" the solenoid valve and allows purge when:

- Engine is warm
- After the engine has been running a specified time.
- Above a specified road speed.
- Above a specified throttle opening.

TANK PRESSURE CONTROL VALVE 2.8L Vin "W"

The Fuel Tank Pressure Control Valve is a spring biased diaphragm valve, normally closed, (Figure C3-4). When the vapor pressure in the fuel tank exceeds 6.0 kPa the valve will open allowing the vapors to vent

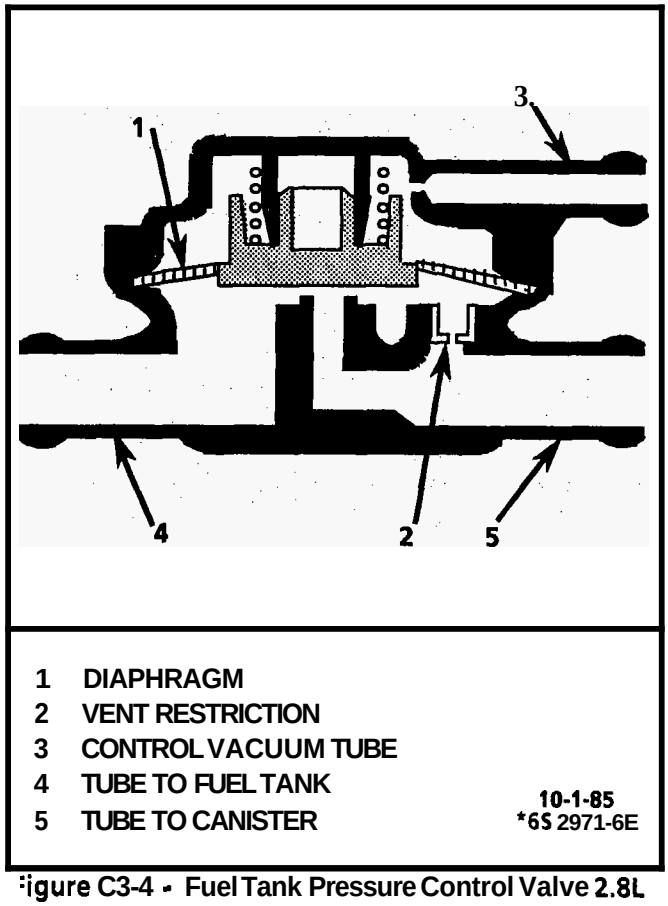


Figure C3-4 - Fuel Tank Pressure Control Valve 2.8L

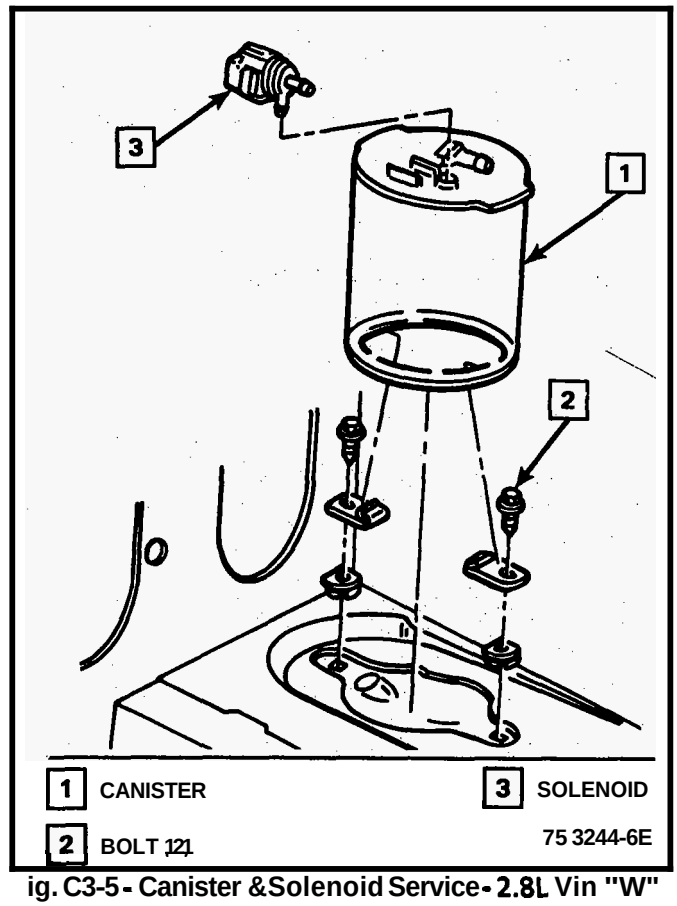


Fig. C3-5 - Canister & Solenoid Service - 2.8L Vin "W"

to the canister and then be purged. When the tank pressure drops sufficiently the tank pressure control valve will close, thus keeping the vapors in the fuel tank.

RESULTS OF INCORRECT OPERATION

- Poor idle, stalling and poor driveability can be caused by:
  - Inoperative purge solenoid
  - Damaged canister
  - Hoses split, cracked and, or not connected to the proper tubes.

- Evidence of fuel loss or fuel vapor odor can be caused by:
  - Liquid fuel leaking from fuel lines.
  - Cracked or damaged canister
  - Disconnected, misrouted, kinked, deteriorated or damaged vapor hoses, or control hoses.

If the solenoid is open, or is not receiving power, the canister will purge to the intake manifold. This may allow extra fuel at idle or during warm-up, which may cause rough or unstable idle, or too rich operation during warm-up.

DIAGNOSIS

CANISTER PURGE SOLENOID

The canister purge solenoid operation is covered in CHART C-3 at the end of this section.

VISUAL CHECK OF CANISTER

- Cracked or damaged, replace canister.
- Fuel leaking from bottom of canister (3.0L, 3.8L, & 3.8L Turbo), replace canister and check hoses and hose routings.
- Check filter at bottom of canister (3.0L, 3.8L, & 3.8L Turbo) If dirty, plugged, or damaged, replace filter.

FUNCTIONAL TEST OF FUEL VAPOR CANISTER 2.0L TURBO Vin "M"

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.

Apply a length of hose to the lower tube of purge valve, and attempt to blow through it. (Figure C3-2) Little or no air should pass into the canister. (A small 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 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.

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 as removed.
2. Hoses. Make sure connections are correct.

CANISTER PURGE SOLENOID (FIG. C3-6)

Remove or Disconnect

1. Negative battery cable.
2. Electrical connector and hoses from solenoid.
3. Solenoid from canister.

Install or Connect

1. Solenoid.
2. Hoses and electrical connector on solenoid.
3. Negative battery cable

CONTROL VALVE

Remove or Disconnect

1. Hoses from valve. Mark hoses to install on new valve.
2. Valve.

Install or Connect

1. Valve as removed.
2. Hoses. Make sure connections are correct.

CANISTER HOSES

Refer to Vehicle Emission Control Information Label for routing of canister hoses. When replacing hoses, use 6148M or its equivalent.

PARTS INFORMATION

PART NAME	GROUP
Canister, Fuel Vapor	3.130
Solenoid, Fuel Vapor Canister Purge	3.140
Valve, Tank Pressure Control	3.140

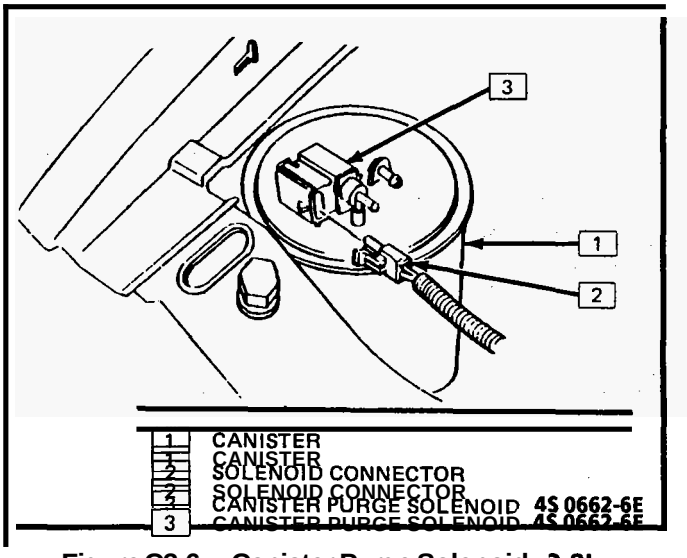


Figure C3-6 - Canister Purge Solenoid - 3.8L

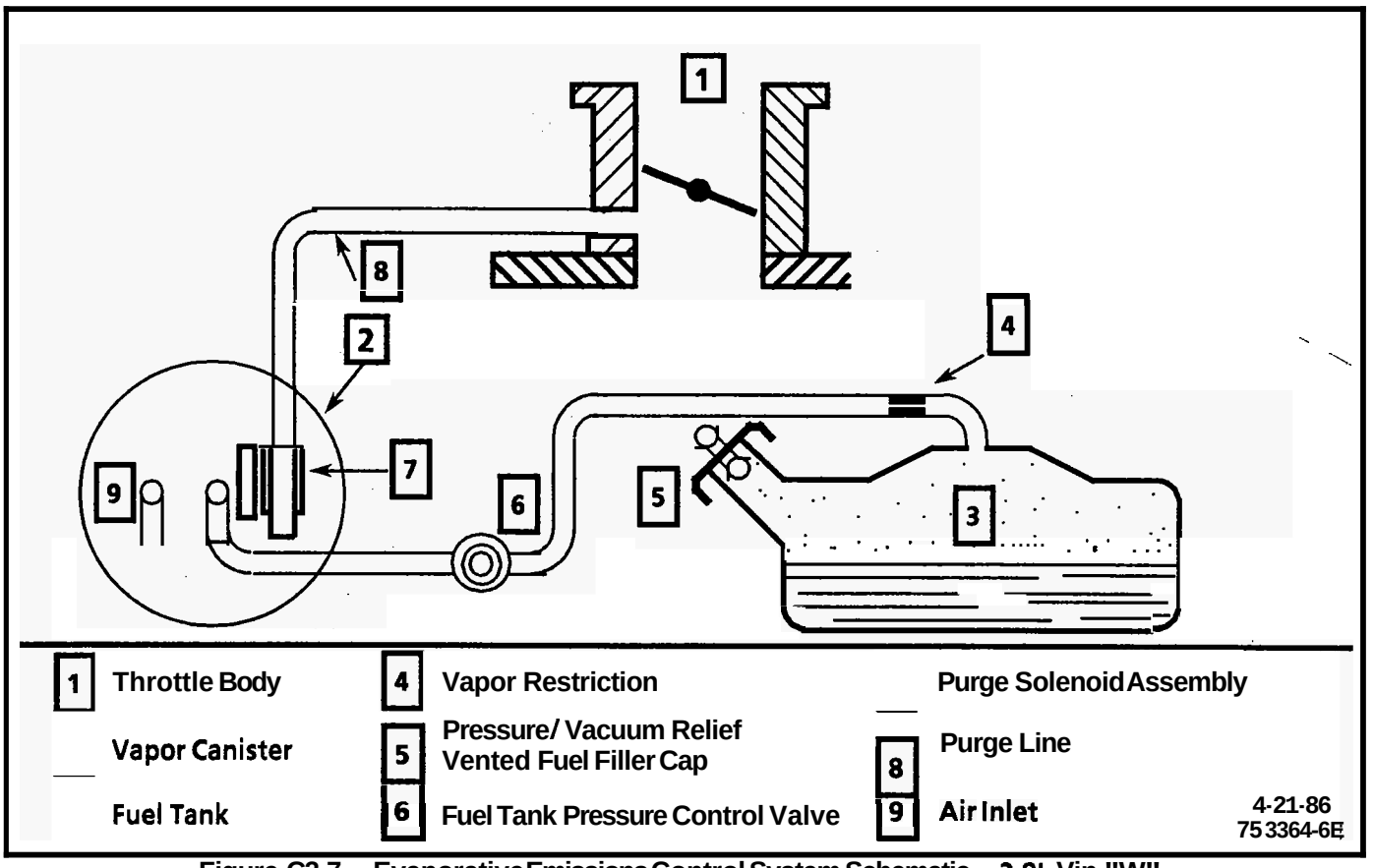


Figure C3-7 - Evaporative Emissions Control System Schematic - 2.8L Vin "W"

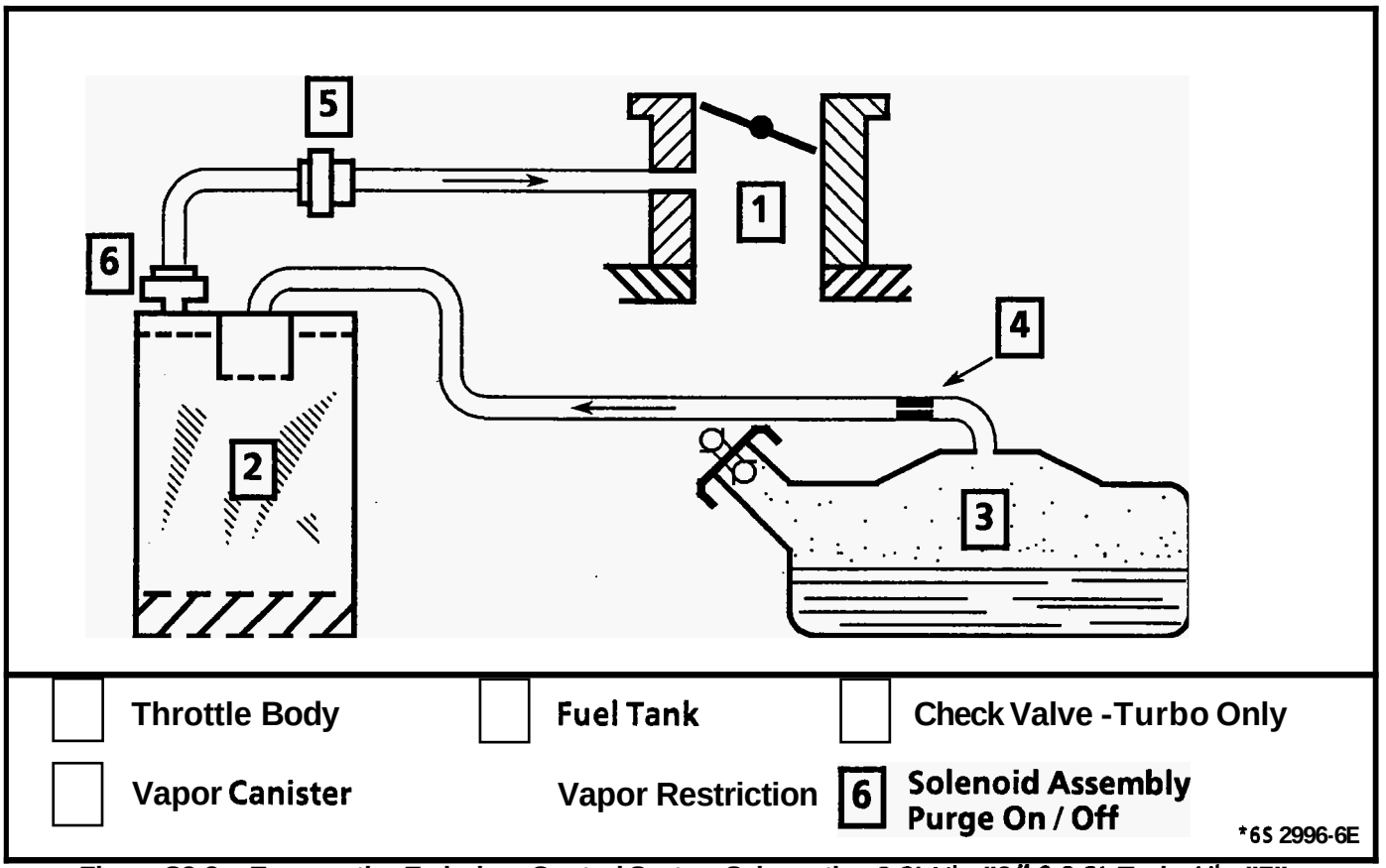


Figure C3-8 - Evaporative Emissions Control System Schematic - 3.8L Vin "3" & 3.8L Turbo Vin "7"

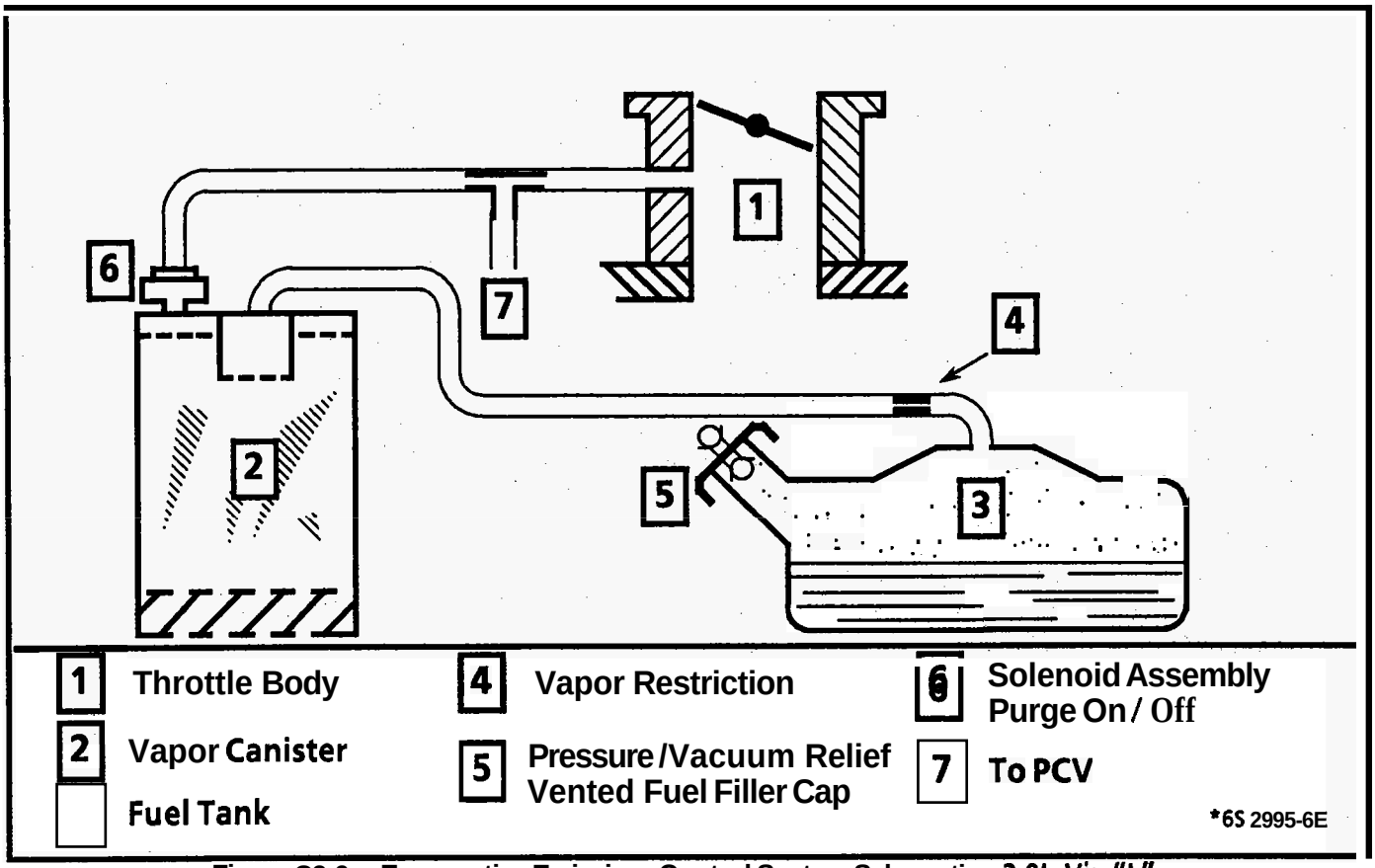
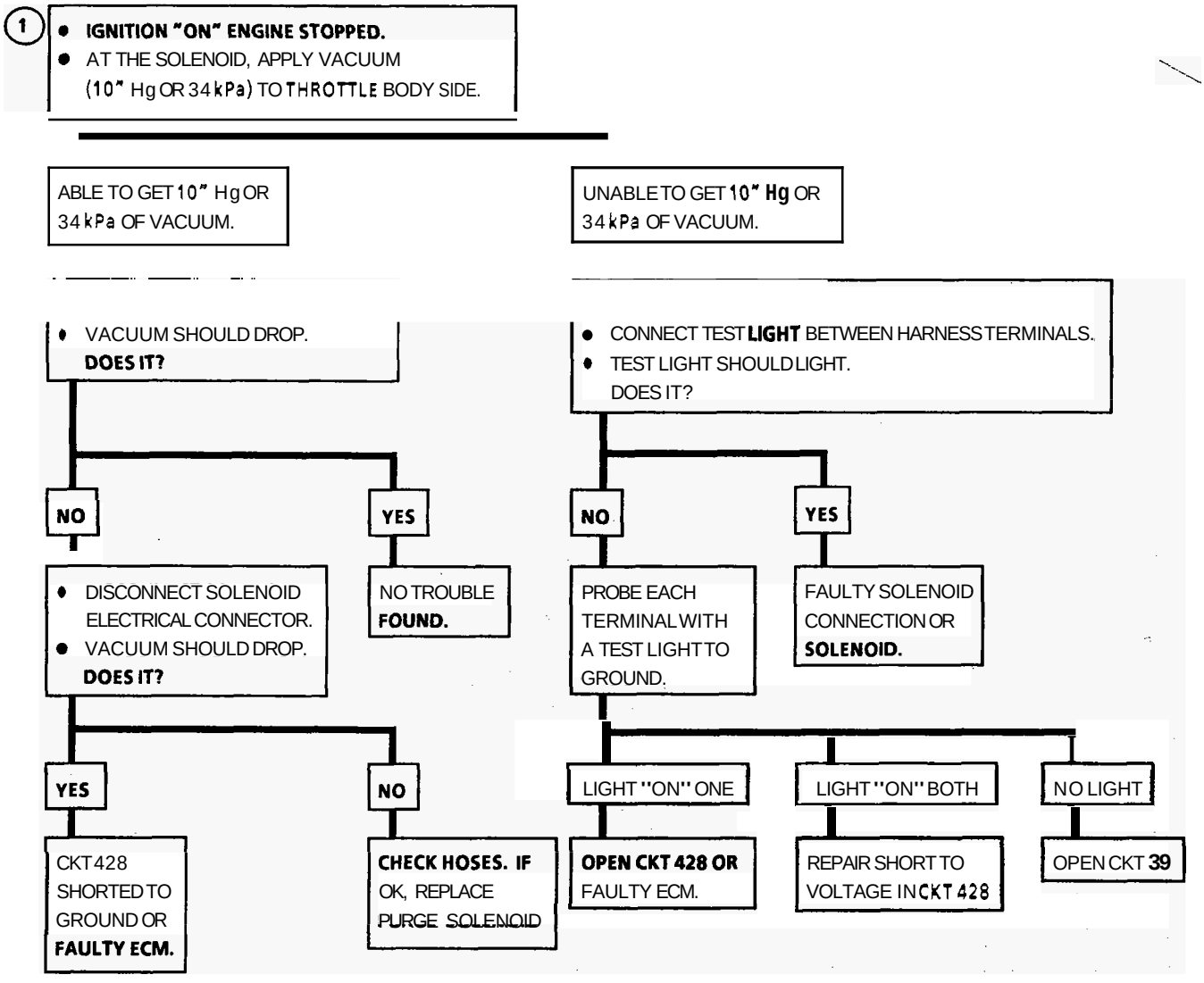


Figure C3-9 - Evaporative Emissions Control System Schematic - 3.0L Vin "L"

CHART C-3

CANISTER PURGE VALVE CHECK 2.8L "A" SERIES (PORT)



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

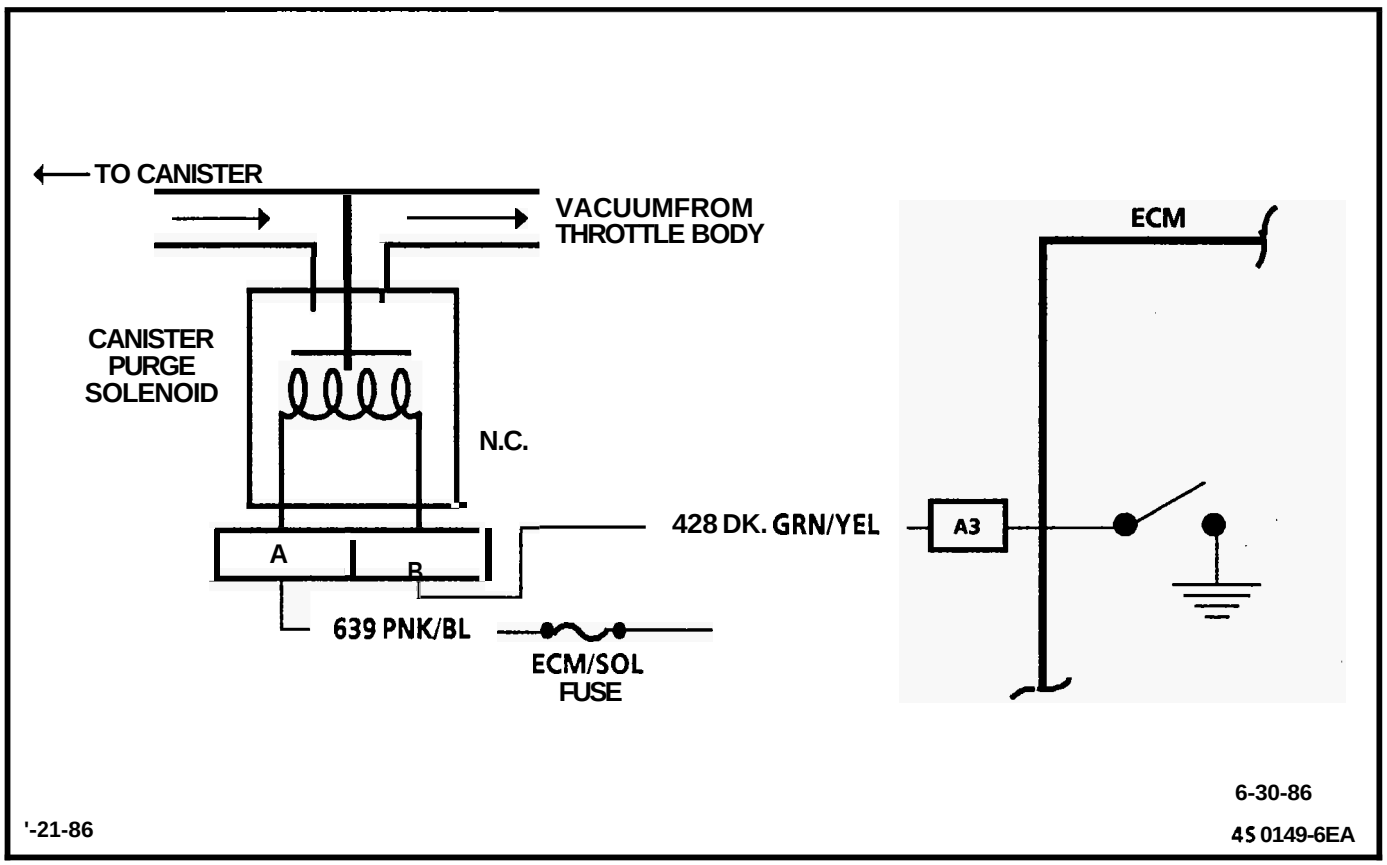


CHART C-3

CANISTER PURGE VALVE CHECK
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

Canister purge is controlled by a solenoid that allows manifold vacuum to purge the canister when energized. The ECM supplies a ground to energize the solenoid (purge "ON").

If the diagnostic test terminal is grounded with the engine stopped or the following is met with the engine running the purge solenoid is energized (purge "ON").

- Engine run time after start more than 1 minute.
- Coolant temperature above 80°C (176°F).
- Vehicle speed above 5 mph (8km/h).
- Throttle off idle. TPS signal above .75volt.

Test Description: Step numbers refer to step numbers on diagnostic chart.

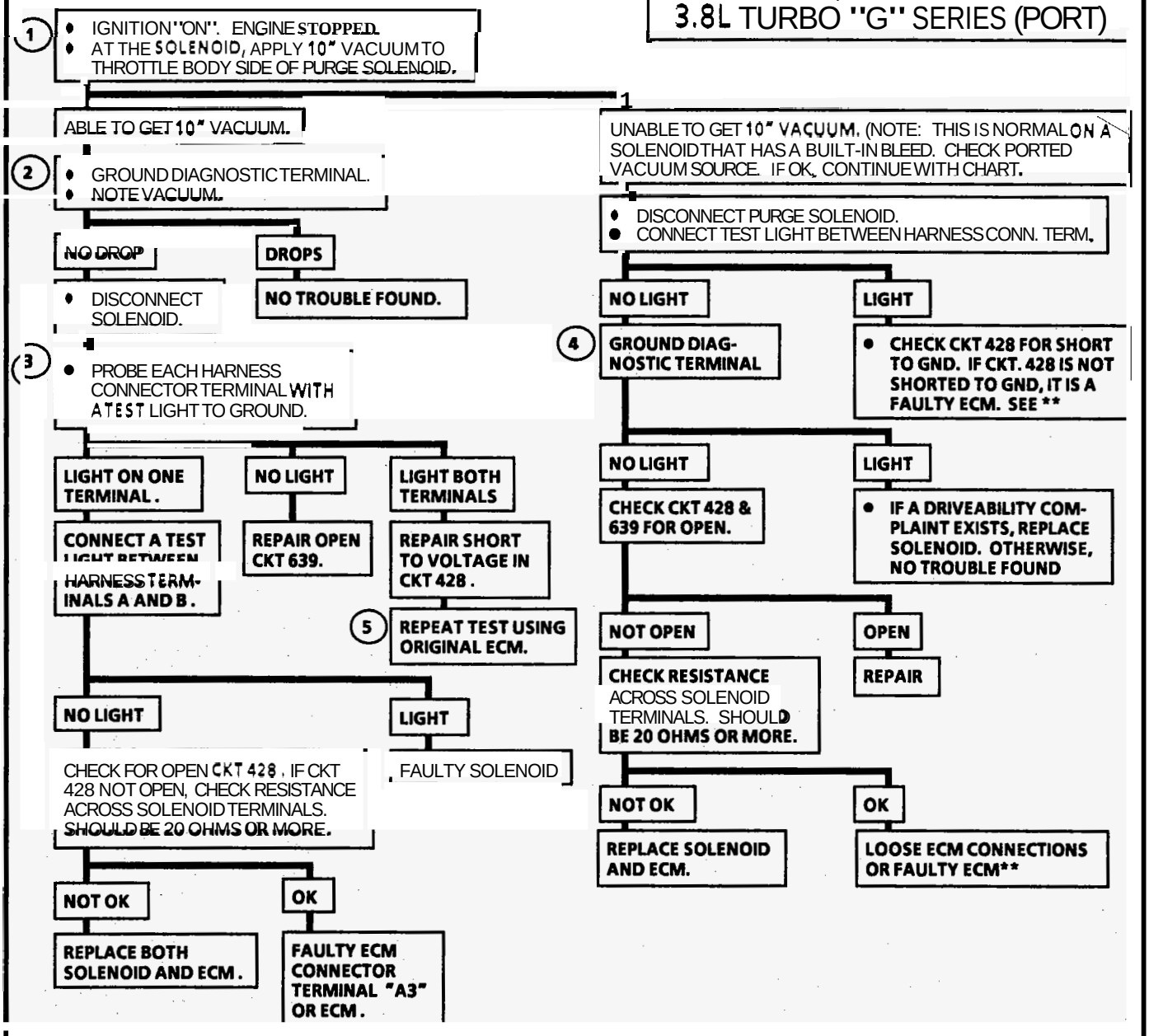
1. Checks to see if the solenoid is opened or closed. The solenoid is normally de-energized in this step, so it should be closed.
2. Completes functional check by grounding test terminal. This should normally energize the solenoid and allow the vacuum to drop (purge on).
3. Checks for open, or shorted solenoid circuit.
4. Checks to see if ECM control circuit or solenoid is at fault.

Solenoid coil resistance must measure more than 20 ohms. Less resistance will cause early failure of the ECM. Using an ohmmeter, check the purge solenoid, coolant fan relay resistance before installing a replacement ECM, because they could cause failure of the purge circuit.

5. Checks to see if short to voltage damaged original ECM.

CHART C-3

CANISTER PURGE VALVE CHECK
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)



** NOTE;

BEFORE REPLACING ECM USE OHMMETER AND CHECK RESISTANCE OF EACH ECM CONTROLLED RELAY AND SOLENOID COIL. SEE ECM WRING DIAGRAM FOR COIL TERMINAL IDENTIFICATION FOR SOLENOID(S) AND RELAY(S) TO BE CHECKED. REPLACE ANY RELAY OR SOLENOID IF THE COIL RESISTANCE MEASURES LESS THAN 20 OHMS.

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

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SECTION C4B

IGNITION SYSTEM/EST (DISTRIBUTORLESS C3I) 3.0L, 3.8L AND 3.8L TURBO

CONTENTS

GENERAL DESCRIPTION

The Computer Controlled Coil Ignition System (C3I) is an ignition system that does not use the conventional distributor and coil. The ignition system consists of three ignition coils, a (C3I) ignition module, Camshaft Sensor (3.8L), and Crankshaft Sensor (Combination Sensor on 3.0L applications) as well as the related connecting wires and the EST (Electronic Spark Timing) portion of the ECM.

A distributorless ignition system, such as this one, uses a "waste spark" method of spark distribution. Each cylinder is paired with the cylinder that is opposite it (1-4, 2-5, 3-6). The spark occurs simultaneously in the cylinder coming up on the compression stroke and in the cylinder coming up on the exhaust stroke.

The cylinder on the exhaust stroke requires very little of the available energy to fire the spark plug. The remaining energy will be used as required by the cylinder on the compression stroke. The same process is repeated when the cylinders reverse roles.

It is possible for one plug to fire even though the spark plug lead from the same coil is disconnected from the other spark plug. The disconnected spark plug lead acts as one plate of a capacitor, with the engine being the other plate. These two "capacitor plates" are charged as a current surge (spark) jumps across the gap of the connected spark plug. The "plates" are then discharged as the secondary energy is dissipated in an oscillating current across the gap of the spark plug still connected. Because of the direction of current flow in the primary winding and thus in the secondary winding, one plug will fire from the center electrode to the side electrode while the other will fire from side electrode to center electrode.

These systems utilize the EST signal from the ECM, as do distributor ignition systems equipped with EST, to control spark timing.

Under 400 rpm, the C3I module controls spark timing and the ECM operates the injectors in the simultaneous mode. Over 400 rpm, the ECM controls spark timing (EST) and on 3.8L applications the injectors operate in the Sequential Fuel Injection mode (SFI).

Ignition timing is calculated and controlled by the ECM using the following inputs:

- Crankshaft position
- Camshaft position (3.8L)
- Engine speed (rpm)
- Engine coolant (CTS) and induction air temp. (MAT)
- Amount of air entering the intake (MAF)
- Throttle position (TPS)
- ESC signal (Knock Retard)
- Park/Neutral state (P/N)
- Vehicle speed (VSS)

SYSTEM IDENTIFICATION

Two style Module/Coil assemblies are used; "TYPE I" and "TYPE II". These can be identified easily by the positioning of the coil towers (Figure C4-1). The sensors and wiring harness, with the following exception, are interchangeable between both types.

The CKT 939 fuse is used to provide a low current source to module terminal "M, providing power for the sensors, ignition coils and internal module circuitry for "Type II" systems. On "Type I" applications, a separate current source through the CKT 439 fuse to module terminal "P" is used to power the ignition coils.

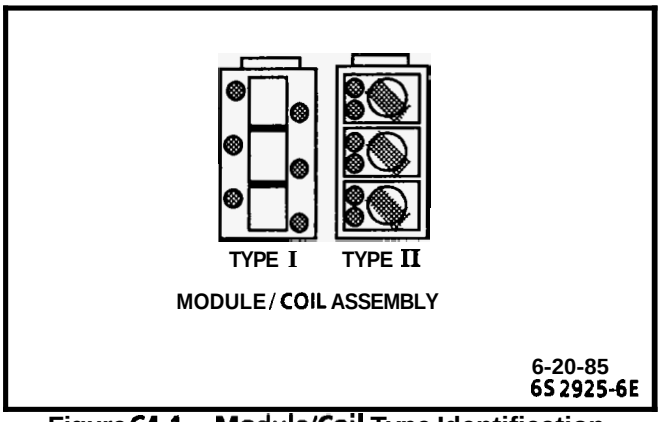


Figure C4-1 - Module/Coil Type Identification

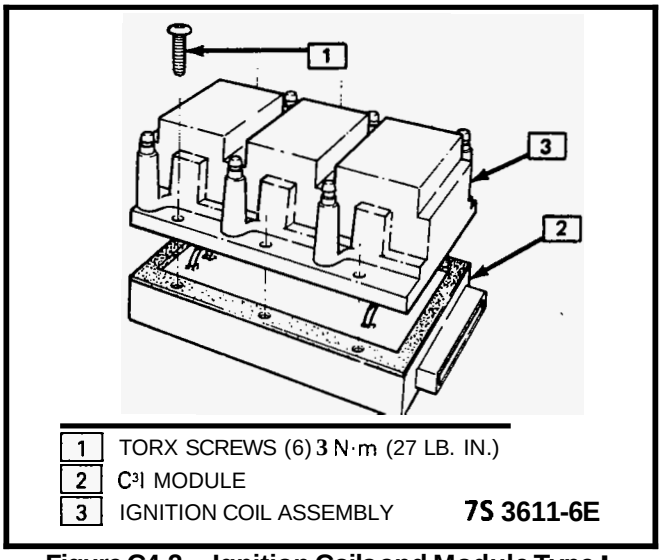


Figure C4-2 - Ignition Coils and Module Type I

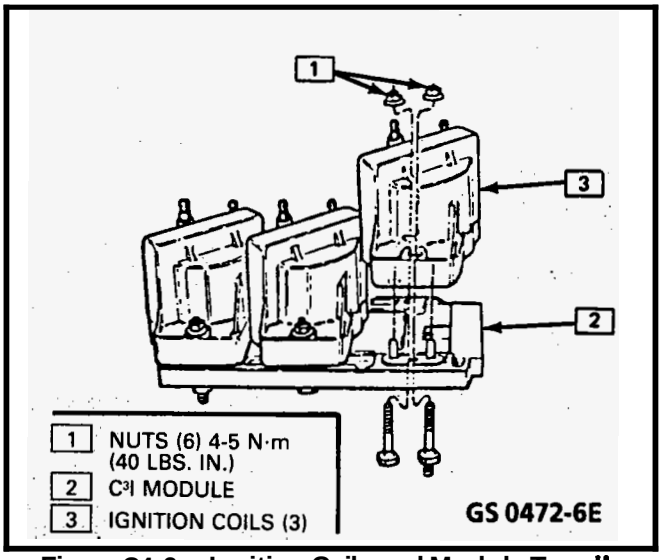


Figure C4-3 - Ignition Coils and Module Type II

SYSTEM COMPONENTS

Ignition Coils

On "Type I" applications, three twin tower ignition coils are combined into a single coil pack unit. This unit is mounted to the C³I module (Figure C4-2). Each coil provides the spark for two plugs simultaneously (waste spark distribution), however all three coils must be replaced as a unit.

On "Type II" applications, three separate coils are mounted to the C³I module (Figure C4-3). Each coil provides the spark for two plugs simultaneously (waste spark distribution) and each coil can be replaced separately.

C³I Module

The Ignition Module monitors the Cam (sync-pulse on 3.0L) and the Crank signals. This information is passed on to the ECM so that correct spark and fuel injector timing can be maintained during all driving conditions. During cranking, it monitors the Cam Signal or "sync pulse" to begin the ignition firing sequence. Below 400 rpm, the module controls spark advance by triggering each of the three coils at a pre-determined interval based on engine speed only. Above 400 rpm, the ECM controls the spark timing (EST) and compensates for all driving conditions. The C³I module must receive a Cam (sync-pulse on 3.0L) and then a Crank Signal in that order to enable the engine to start.

The C³I module is not repairable. When a module is replaced, the coil(s) must be transferred to the new module (See Figure C4-2 and C4-3).

Camshaft Sensor (3.8L)

The Cam Sensor (Figure C4-4 and C46 is located on the timing cover behind the water pump, near the camshaft sprocket. On 3.8L Turbo applications, the Cam Sensor is operated by a interrupter shaft which is driven by the camshaft (Figure C4-7).

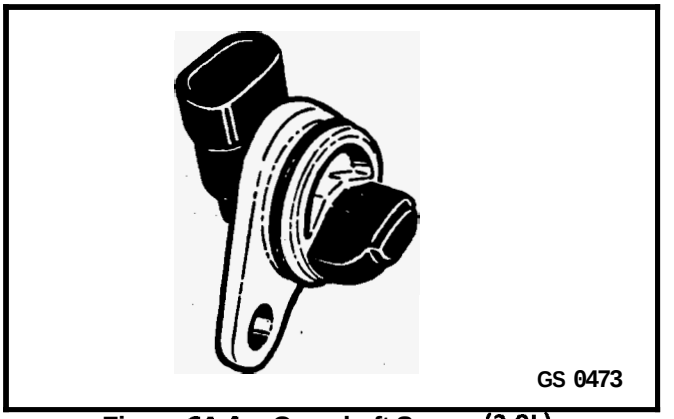


Figure C4-4 - Camshaft Sensor (3.8L)

As the camshaft sprocket turns, a magnet mounted on it (Figure C4-5) activates the "hall-effect" switch in the Cam Sensor. On the 3.8L Turbo, the Cam Sensor is activated as the interrupter rotates with it's cam driven shaft and passes between the magnet and "hall-effect" switch. When the "hall-effect" switch is activated, it grounds the signal line to the C3I module, pulling the crank signal line's applied voltage low. This is interpreted as a Cam Signal ("Synchronization-Pulse"). Because of the way the signal is created, by the crank sensor, the signal circuit is always either at a high or low voltage (square wave signal). While the camshaft sprocket continues to turn, the "hall-effect" switch turns off as the magnetic field passes the Cam Sensor resulting in one signal each time the camshaft makes one revolution. The Cam Signal is created as piston #1 and #4 reach approximately 25° after top dead center. It is then used by the C3I module to begin the ignition coil firing sequence starting with the #3/6 coil. The firing sequence begins with this coil because piston #6 is now at the correct position in the compression stroke for the spark plugs to be fired. This Cam Signal, which actually represents camshaft position due to the sensor's mounting location, is also used by the ECM to properly time it's Sequential Fuel Injection operation.

Both the Crank Sensor and Cam Sensor signals must be received by the C3I module for the engine to start. On 3.8L applications, when the Cam Signal is not received from the C3I module by the ECM Terminal **"A-11",** fuel injection is simultaneous rather than sequentially times and a Code **41** will be set.

If a Code **41** is present and the engine will start and run, the fault is in CKT 630, (CKT **951** on 3.8L Turbo), the C3I module or the ECM and the C3I module will determine the ignition timing. If the fault is in the CAM Sensor Circuit, the Cam Sensor or the Cam Signal portion of the C3I module, Code 41 may also be present but the engine will not start, since the C3I module cannot determine the position of the number one piston.

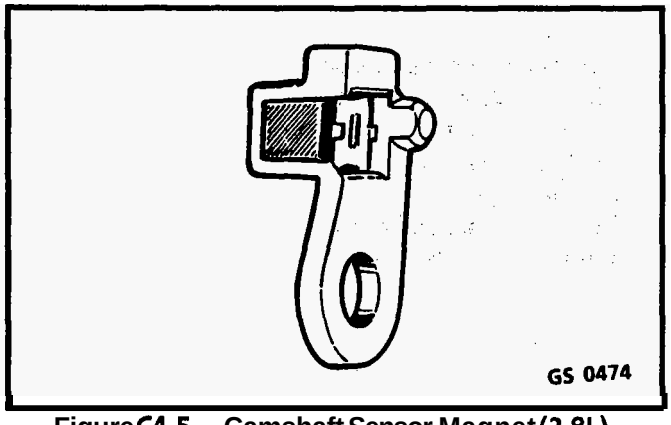
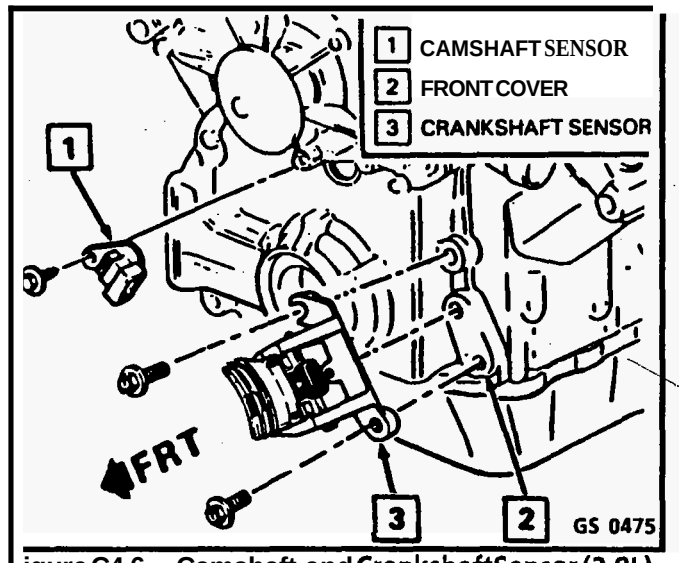


Figure C4-5 - Camshaft Sensor Magnet (3.8L)



igure C4-6 - Camshaft and Crankshaft Sensor (3.8L)

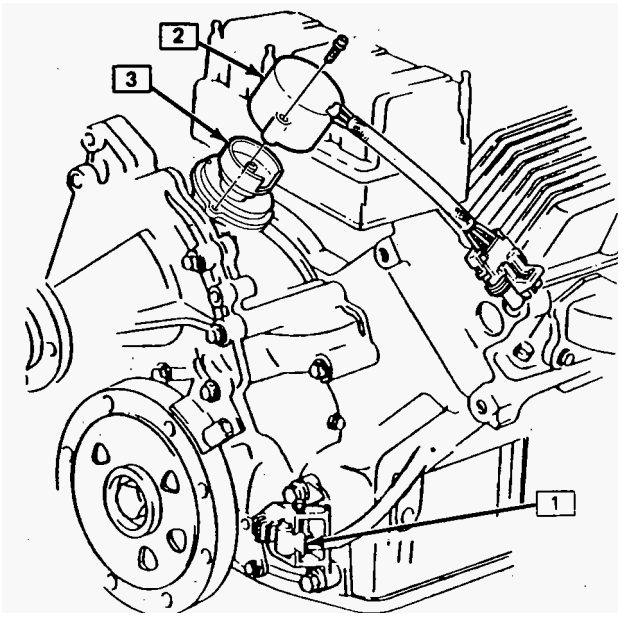
Crankshaft Sensor

The Crank Sensor (Figure C4-6 and C4-7) and Combination Sensor on 3.0L applications (Figure C4-8) is mounted in a pedestal on the front of the engine near the harmonic balaner. The sensor is a "hall-effect" switch which depends on a metal interrupter ring, mounted on the balancer (Figure C 4 9), to activate it. Windows in the interrupter activate the "hall-effect" switch as they provide a path for the magnetic field between the switch's transducer and it's magnet. When the "hall-effect" switch is activated, it grounds the signal line to the C3I module, pulling the crank signal line's applied voltage low, which is interpreted as a Crank Signal. Because of the way the signal by the Crank Sensor is created, the signal circuit is always either at a high or low voltage (square wave signal) and three signal pulses are created during each crankshaft revolution. This signal issued by the C3I module to create a Reference Signal which is also a "square wave" signal similar to the crank signal. The Reference Signal is used to calculate engine rpm and crankshaft position by the ECM. A misadjusted sensor or bent interrupter ring could cause rubbing of the sensor resulting in potential driveability problems such as rough idle, poor performance or a no start condition.

NOTICE: Failure to have the correct clearance will damage the sensor.

The Crank Sensor is not adjustable for ignition timing but positioning of the interrupter ring is very important. A clearance of .025 of an inch is required on either side of the interrupter ring. (See Crankshaft Sensor - Adjust).

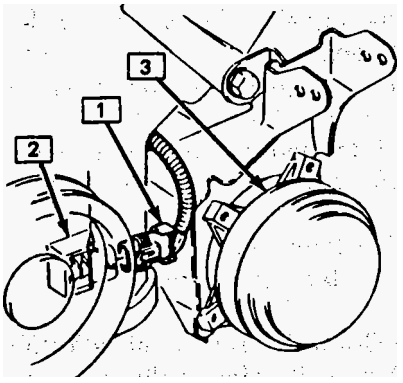
A Crank Sensor that is damaged due to mispositioning or a bent interrupter ring, can result in a hesitation, sag, stumble, or dieseling condition. To determine if the Crank Sensor could be at fault, **"Scan"** engine rpm, while driving the vehicle. An erratic display indicates that a proper reference pulse has not been received by the ECM, which may be the result of a malfunctioning crank sensor.



1 CRANKSHAFT SENSOR
2 CAMSHAFT POSITION SENSOR
3 CAMSHAFT SENSOR INTERRUPTER & SHAFT ASSEMBLY

4S 0981-6EA

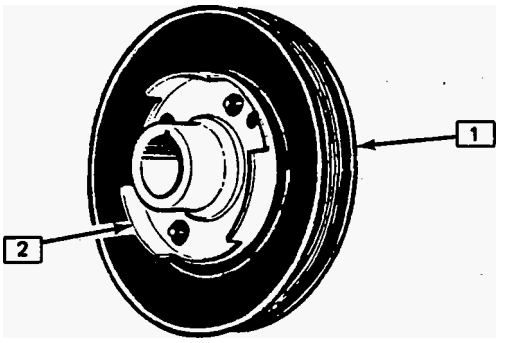
Figure C4-7 - Camshaft and Crankshaft Sensor (3.8L Turbo)



1 CRANK SENSOR CONN
2 CRANK SENSOR
3 A/C COMPRESSOR

6S 2944-6E

Figure C4-8 - Combination Sensor - 3.0L



1 HARMONIC BALANCER (CRANKSHAFT PULLEY)
2 INTERRUPTER RING (1)

GS0476BO

C4-9 - Harmonic Balancer (3.8L)

Combination Sensor "Sync-Pulse" (3.0L)

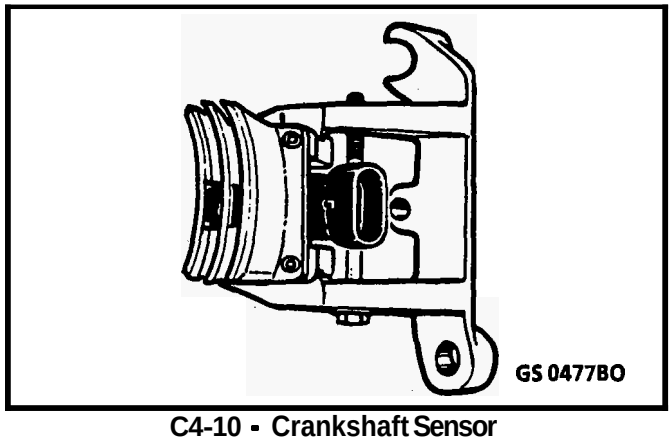
Since the 3.0L is a simultaneously injected engine, it does not require an actual Cam signal. Instead, it utilizes a "sync-pulse" signal from its combination sensor (Figure C4-8) at a rate of once per each crankshaft revolution. The combination sensor is activated and controls its signal line(s) in the same way the crankshaft sensor on the 3.8L does. The only difference is the "sync-pulse" portion of the sensor, which serves the same purpose as the Cam Sensor on the 3.8L relative to ignition operation. That is, it begins the ignition coil firing sequence starting with the #3/6 ignition coil.

Electronic Control Module (ECM)

The ECM is responsible for maintaining proper spark and fuel injection timing for all driving conditions.

To provide optimum driveability and emissions, the ECM monitors input signals from the following components in calculating Electronic Spark Timing (EST):

- Ignition Module
- Coolant Temperature Sensor
- Manifold Air Temperature Sensor
- Mass Air Flow Sensor
- Park/Neutral Switch
- ESC Module
- Throttle Position Sensor
- Vehicle Speed Sensor



C4-10 - Crankshaft Sensor

Under 400 rpm, the ECM will start injector timing (simultaneous) as soon as the C3I module receives a cam signal, synchronizes the spark and produces a reference signal for the ECM to calculate the fuel ignition timing. The C3I module controls the spark timing during this period. Over 400 rpm, the ECM controls timing (EST) and on 3.8L applications, also changes the mode of fuel injection to sequential, providing a Cam Signal is received.

Electronic Spark Control (ESC)

The ESC system is comprised of a Detonation sensor and an ESC module. The ECM monitors the ESC signal CKT (457) to determine when engine detonation occurs.

As long as the ESC module is sending a voltage signal (8 to 10 volts) to the ECM (no detonation detected by the ESC sensor) the ECM provides normal spark advance.

When the knock sensor detects detonation, the ESC module turns "OFF" the circuit to the ECM and the voltage at ECM terminal "B7" drops to 0 volts. The ECM then retards EST to reduce detonation. Retarded timing can also be a result of excessive valve lifter, pushrod or other mechanical engine or transmission noise.

Electronic Spark Timing (EST)

This system uses the same EST to ECM circuits that distributor type ignition systems with EST use. Following is a brief description for each of the EST circuits and the 3.8L Cam Signal CKT (630).

- Reference (CKT 430)
  This provides the ECM with rpm and crankshaft position information from the C3I module. The C3I module receives the signal from the Crank Sensor's "hall-effect" switch. (See Crankshaft Sensor).
  This signal will either be high or low depending on the position of the interrupter ring. This high-low signal is used to trigger the C3I module for ignition operation and by the ECM to calculate fuel injection timing. Both the Cam and Crank Sensor signals must be received by the C3I module in order for a reference signal to be produced on CKT 430. A loss of the reference signal would prevent the engine from running.
- By-Pass Signal (CKT 424)
  At about 400 rpm, the ECM applies 5 volts to this circuit to switch spark timing control from the C3I module to the ECM.
  An open or grounded by-pass circuit will set a Code 42 and result in the engine operating in a back-up ignition timing mode (module timing) at a calculated timing value. This may cause poor performance and reduced fuel economy.
- EST Signal (CKT 423)
  The C3I module sends a reference signal to the ECM when the engine is cranking. While the engine is under 400 rpm, the C3I module controls the ignition timing. When the engine speed exceeds 400 rpm, the ECM applies 5 volts to the bypass line to switch the timing to ECM control (EST).
  An open or ground in the EST circuit will stall the engine and set a Code 42. The engine can be re-started but will operate in a back-up ignition timing mode (module timing) at a calculated timing value. This may cause poor performance and reduced fuel economy.
- Cam Signal (CKT 630)
  The ECM uses this signal to determine the position of the #1 piston in it's compression stroke. This signal is used by the ECM to calculate the sequential fuel injection (SFI) mode of operation. A loss of this signal will set a Code 41. If the Cam signal is lost while the engine is running the fuel injection system will shift to the simultaneous injection mode of operation, and the engine will continue to run. The engine can be re-started but will continue to run in the simultaneous mode as long as the fault is present.

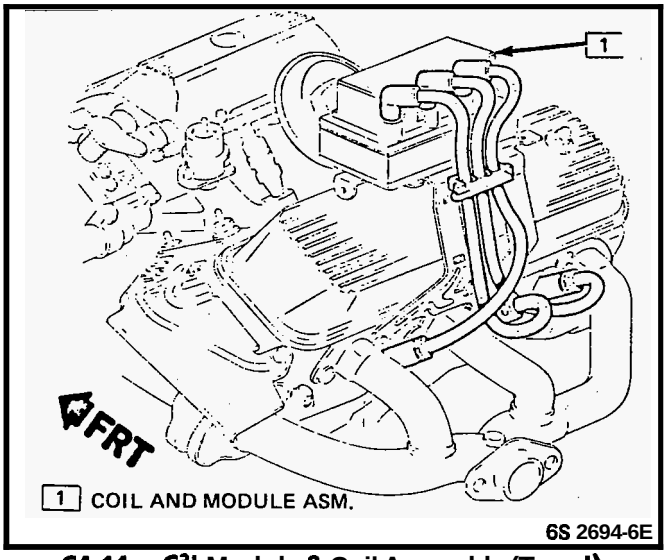
DIAGNOSIS

If the engine cranks but will not run or immediately stalls, CHART A-3 must be used to determine if the failure is in the C3I system or the fuel system.

If either a Code 41 or 42 is set, the appropriate code chart must be used for diagnosis.

If the symptom is "Engine Miss" and the C3I system is suspected, CHART C-4F will provide a systematic diagnostic procedure.

ON-CAR SERVICE



C4-11 - C3I Module & Coil Assembly (Type I)

IGNITION COIL (TYPE I)

Remove or Disconnect

1. Negative battery cable.
2. Spark plug wires.
3. 6 torx screws securing coil to ignition module.
4. Tilt coil assembly back.
5. Coil to module connectors.
6. Coil assembly.

Install or Connect

1. Coil assembly and connectors.
2. 6 torx screws torque to 3 Nm (27 lb. in.)
3. Spark plug wires
4. Negative battery cable
5. Note lead colors or mark for reassembly.

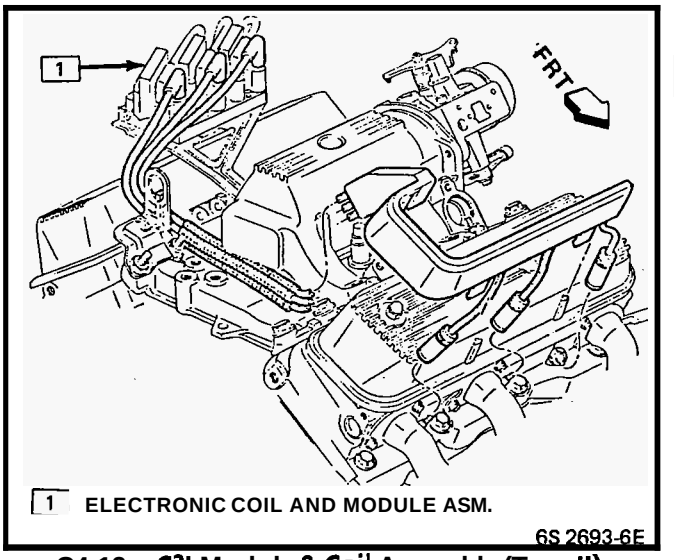
C3I MODULE (TYPE I)

Remove or Disconnect

1. Negative battery cable.
2. 14-way connector at ignition module.
3. Spark plug wires at coil assembly.
4. Nuts and washers (4) securing ignition module assembly to bracket.
5. 6 torx screws securing coil assembly to ignition module.
6. Note lead colors or mark for reassembly.
7. Disconnect connectors between coil and ignition module.
8. Ignition module.

Install or Connect

1. Coil and connectors to ignition module.
2. 6 torx screws torque to 3 Nm (27 lb. in.)
3. Nuts and washers securing assembly to bracket.
4. Plug wires.
5. 14-way connector to module.
6. Negative battery cable.



C4-12 - C3I Module & Coil Assembly (Type II)

IGNITION COIL (TYPE II)

Remove or Disconnect

1. Negative battery cable.
2. Spark plug wires.
3. Two retaining nuts.
4. Coil.

Install or Connect

1. Coil.
2. Two retaining nuts torque to 4.5 N·m (40 lb. in.).
3. Spark plug wires.
4. Negative battery cable.

C3I MODULE (TYPE II)

Remove or Disconnect

1. Negative battery cable.
2. 14-way connector at C3I module.
3. Spark plug wires at coil assembly.
4. Nuts and washers (4) securing C3I module assembly to bracket.
5. C3I module assembly.
6. Retaining nuts (6) securing coils to C3I module.

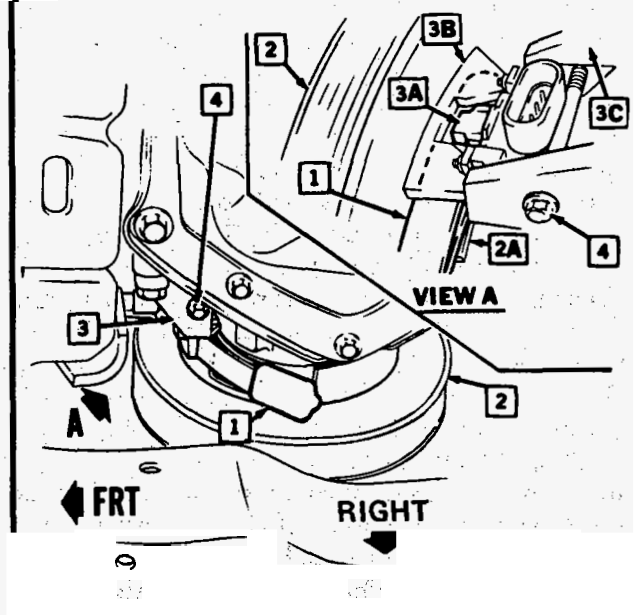
Install or Connect

1. Coils and retaining nuts (6) to C3I module torque to 4.5 N.M (40 lb. in.).
2. C3I module assembly.
3. Nuts and washers (4) securing assembly to bracket.
4. Plug wires.
5. 14-way connector to C3I module.
6. Negative battery cable.

CRANKSHAFT SENSOR

Remove or Disconnect

1. ("N" Series Only) - Remove right side lower engine compartment filler panel and the right lower wheelhouse to engine compartment bolt.
2. Disconnect crank sensor harness connector.
3. Rotate the harmonic balancer, using a 28mm socket and pull handle, until any window in the interrupter is aligned with the crank sensor.
4. Loosen the pinch bolt on the sensor pedestal until the sensor is free to slide in the pedestal.
5. Remove the pedestal to engine mounting bolts.
6. While manipulating the sensor within the pedestal, carefully remove the sensor and pedestal as a unit.



1. TOOL J 36179
2. CRANKSHAFT HARMONIC BALANCER ASSY.
   A. INTERRUPTER RING
3. CRANKSHAFT POSITION SENSOR ASSY.
   A. SENSOR
   B. DEFLECTOR
   C. PEDESTAL
4. PINCH BOLT

GS 0464-BO

Figure C4-13 - Crankshaft Sensor Adjustment

Install or Connect

1. Loosen the pinch bolt on the new sensor pedestal until the sensor is free to slide in the pedestal.
2. Verify that the window in the interrupter is still properly positioned and install sensor and pedestal as a unit while making sure that the interrupter ring is aligned within the proper slot.
3. Install pedestal to engine mounting bolts and torque to 30 N-m (22 lbs. ft).
4. ("N" Series Only) - Replace lower wheelhouse to engine compartment bolt and reinstall right lower filler panel.

Inspect

1. Rotate harmonic balancer, using a 28mm socket and pull handle, until the interrupter ring(s) fills the sensor slot(s) and edge of interrupter window is aligned with edge of the deflector on the pedestal.
2. Insert adjustment tool (536179 or equivalent) into the gap between sensor and interrupter on each side of interrupter ring. If gage will not slide past sensor on either side of interrupter ring, the sensor is out of adjustment or interrupter ring is bent. This clearance should be checked at three positions around the outer interruptor ring, approximately 120" apart. (NOTE: If found out of adjustment, the sensor should be removed and inspected for potential damage. See sensor removal and installation.

Adjust

1. Loosen the pinch bolt on sensor pedestal and insert adjustment tool (J-36179 or equivalent) into the gap between sensor and interrupter on each side of interrupter ring. (Figure C4-13)
2. Be sure that interrupter is sandwiched between blades of adjustment tool and both blades are properly inserted into sensor slot.
3. Torque sensor retaining pinch bolt to 3.4 N-m (30 lbs. in) while maintaining light pressure on sensor against gage and interrupter ring. This clearance should be checked again, at three positions around the interrupter ring, approximately 120° apart. If interrupter ring contacts sensor at any point during harmonic balancer rotation, the interrupter ring has excessive runout and must be replaced.

AMSHAFT SENSOR
3.8L Non-Turbo)

Remove or Disconnect

, Negative battery cable.
. Camshaft Sensor attaching bolt.
. Camshaft Sensor Connector.
. Camshaft Sensor.

Install or Connect

. Camshaft Sensor
. Camshaft Sensor Connector.
. Camshaft Sensor attaching bolt torque to **8.5** N·M (75lb. in.).
. Negative battery cable.

CAMSHAFT POSITION SENSOR
3.8L TURBO ONLY)

If only the Camshaft Sensor needs replacing, it is ot necessary to remove the entire drive assembly rom the engine. The sensor is replaceable separately.

Remove or Disconnect

. Negative battery cable.
. Ignition module 14way connector.
. Spark plug wires at coil assembly.
. Ignition module bracket assembly.
. Sensor 3-way connector.
. 2 screws securing sensor.

Install or Connect

.. Position sensor as removed
. 2 screws
. 3-way connector.
. Ignition module bracket assembly.
. Spark plug wires.
. Ignition module 14-way connector.
. Negative battery cable.

CAMSHAFT POSITION SENSOR DRIVE ASSEMBLY (3.8L TURBO ONLY)

Remove or Disconnect

1. Follow steps **1-6** of Cam Sensor removal procedure.
2. Note position of slot in rotating vane.
3. BOLT securing drive assembly in engine.
4. Camshaft Sensor drive assembly.

Install or Connect

1. The Cam Sensor drive assembly with the rotating vane slot facint the power steering pump (toward the drivers side of engine) when installed in the engine with **#1** cylinder T.D.C. on the compression stroke.
2. Install bolt and washer.
3. Install sensor onto drive assembly and tighten both attaching screws.
4. Time Camshaft Sensor using the following procedure:

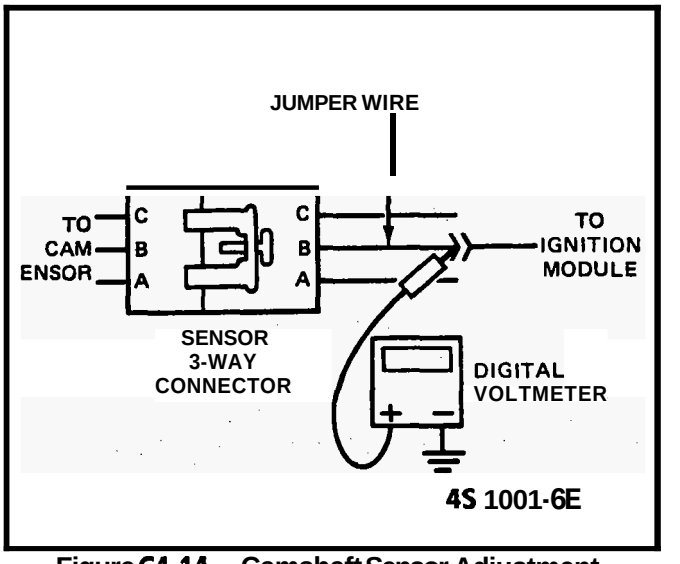


Figure C4-14 - Camshaft Sensor Adjustment (3.8L Turbo Only)

CAMSHAFT SENSOR TIMING (3.8L TURBO ONLY)

Adjust

This adjustment does not effect spark timing.

1. Remove #1 spark plug and rotate engine until #1 cylinder comes up on compression stroke.
2. Mark harmonic balancer and rotate engine to 25° after T.D.C.
3. Remove plug wires from coil assembly.
4. Using weatherpack removal tool 5-28742-A or equivalent, remove Terminal "B" of sensor 3-way connector on the module side.
5. Probe terminal B of 3-way connector by installing a jumper into "B" and reconnecting wire removed tojumper wire.
6. Connect a voltmeter between jumper wire and ground. See Figure C4-14.
7. Key on, engine stopped.
8. Rotate camshaft sensor counterclockwise until the sensor switch just closes. This is indicated by the voltage reading going from high 5-12 volts to a low voltage 0-2 volts. The low voltage indicates the switch is closed.
9. Tighten retaining bolt.
10. Reinstall plug wires and plug.
11. Remove jumper wire and reinstall wire into Terminal "B".

PARTS INFORMATION

PART NAME	GROUP
Sensor. Crankshaft Position	2.383
Pulley. Engine Crankshaft	0.646
Coil. Ignition	2.170
Module. Ignition	2.170
Sensor. Camshaft Position	2.381
Magnet. Cam Sensor (On Cam Sprocket)	2.383
Gasket. Ignition Module and Coil	2.170
Sensor. With Drive. Camshaft Position	2.381
O-ring, On Camshaft Sensor Shaft	2.363
Screw. Camshaft Sensor Cap	8.906
Screw. Coil to Ignition Module	8.906

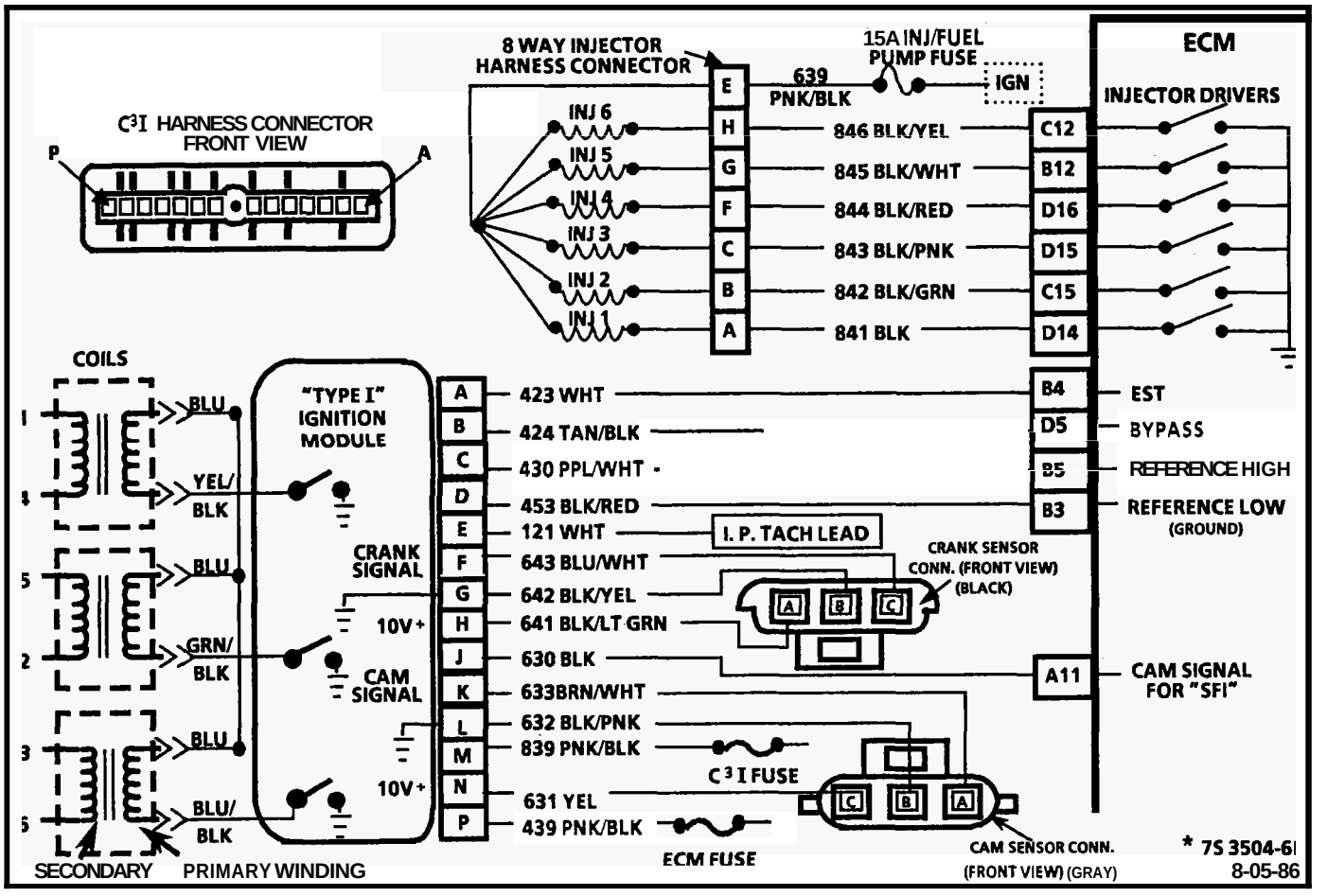


CHART C-4F-1

C³I MISFIRE AT IDLE
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The C³I uses a waste spark method of spark distribution. In this type of ignition system the ignition module triggers the #1/4 coil pair resulting in both #1 and #4 spark plugs firing at the same time. #1 cylinder is on the compression stroke at the same time #4 is on the exhaust stroke, resulting in a lower energy requirement to fire #4 spark plug. This leaves the remaining high voltage to fire #1 spark plug.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. If the "misfire" complaint exists under load only, the diagnostic chart on page 2 must be used. Engine rpm should drop approximately equally on all plug leads.
2. A spark tester such as a ST-125 must be used because it is essential to verify adequate available secondary voltage at the spark plug. (25,000 volts.).
3. By grounding the opposite plug lead of the affected coil, a faulty spark plug (extremely high resistance) may be detected.
4. If ignition coils are carbon tracked, the coil tower spark plug wire nipples may be damaged.
5. By switching a normally operating coil into the position of the malfunctioning one, a determination can be made as to fault being the coil or C³I module.

CHART C-4F-1

C3I MISFIRE AT IDLE
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

1
- IF ENGINE MISFIRES UNDER LOAD ONLY, SEE CHART C-4F-2.
- ENGINE IDLING AT NORMAL OPERATING TEMP., DISCONNECT IAC.
- MOMENTARILY DISCONNECT EACH SPARK PLUG LEAD, USING INSULATED PLIERS, WHILE OBSERVING ENGINE RPM. SEE CAUTION★
- ALL PLUG LEANS) SHOULD RESULT IN AN RPM DROP. DID THEY?

NO

2
- IGNITION OFF, INSTALL SPARK TESTER (ST-125) J-26792 OR EQUIVALENT ON PLUG LEAD(S) WHICH DID NOT RESULT IN RPM DROP.
- SPARK SHOULD JUMP TESTER GAP WHILE CRANKING ENGINE. DOES IT?

YES

SEE "ROUGH, UNSTABLE OR INCORRECT IDLE OR STALLING" IN SYMPTOMS SECTION B.

NO

3
- IGNITION OFF, GROUND THE OPPOSITE PLUG LEAD OF THE AFFECTED COIL AT SPARK PLUG.
- SPARK SHOULD JUMP TESTER GAP WHILE **CRANKING ENGINE. DOES IT?**

YES

CHECK FOR;
- FAULTY, WORN OR DAMAGED SPARK PLUG(S)
- PLUG FOULING DUE TO ENGINE MECHANICAL FAULT.

IF SPARK PLUGS CHECK OUT OK, SEE 'CUTS OUT, MISSES' IN SYMPTOMS SECTION B.

NO

- CHECK THE RESISTANCE OF EACH PLUG WIRE OF THE COIL WHICH DID NOT FIRE THE SPARK TESTER.
- WIRE RESISTANCE SHOULD BE LESS THAN 30,000 OHMS EACH AND WIRES SHOULD NOT BE GROUNDED. ARE WIRES OK?

YES

REPLACE THE SPARK PLUG FOR THE LEAD WHICH WAS JUMPERED TO GROUND. IF MISFIRE IS STILL PRESENT, START MISFIRE TEST AGAIN AT STEP #1.

YES

4
- REMOVE COIL RETAINING NUTS AND REMOVE COILS.
- COILS SHOULD BE FREE OF CARBON TRACKING. ARE THEY?

NO

REPLACE **FAULTY WIRE(S)**

YES

5
- SWITCH A NORMALLY OPERATING COIL WITH THE COIL FROM PROBLEM CYLINDER.
- SPARK SHOULD JUMP TESTER GAP AT PROBLEM **CYLINDER WHILE CRANKING ENGINE. DID IT?**

NO

FAULTY IGNITION COIL. ALSO CHECK FOR FAULTY PLUG WIRE CONNECTIONS AND **WIRE NIPPLES FOR CARBON TRACKING.**

YES

ORIGINAL IGNITION COIL IS FAULTY

NO

FAULTY C3I MODULE

★**CAUTION:** When handling secondary spark plug leads with engine running, insulated pliers must be used and care exercised to prevent a possible electrical shock.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON' LIGHT.

7931566E

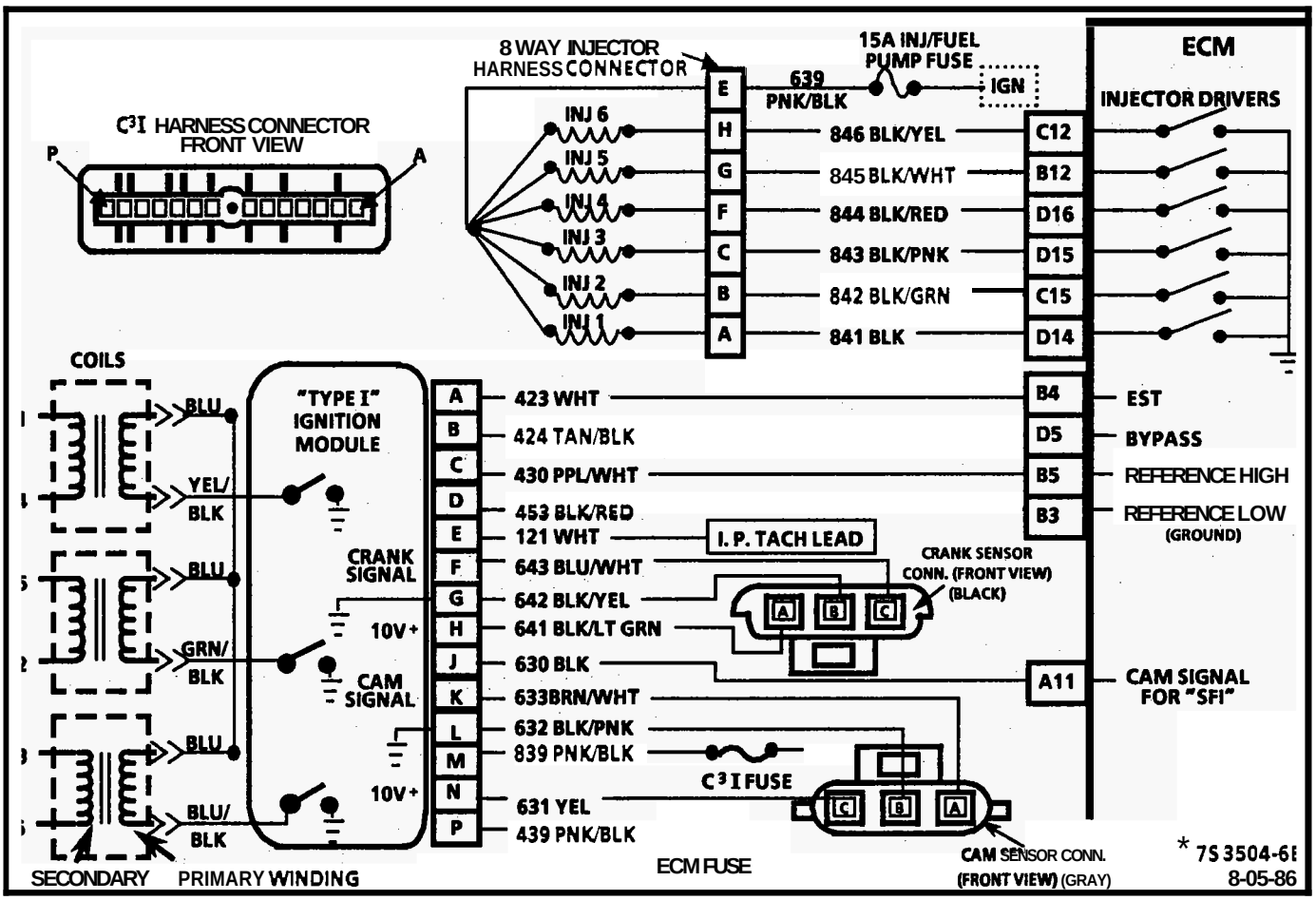


CHART C-4F-2

C3I MISFIRE UNDER LOAD
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The C3I uses a waste spark method of spark distribution. In this type of ignition system the ignition module triggers the #1/4 coil pair resulting in both #1 and #4 spark plugs firing at the same time. #1 cylinder is on the compression stroke at the same time #4 is on the exhaust stroke, resulting in a lower energy requirement to fire #4 spark plug. This leaves the remaining high voltage to fire #1 spark plug.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. If the "misfire" complaint exists at idle only, the diagnostic chart on page 1 must be used. A spark tester such as a ST-125 must be used because it is essential to verify adequate available secondary voltage at the spark plug. (25,000 volts). Spark should jump the tester gap on all 6 leads. This simulates a "load" condition.
2. By grounding the opposite plug lead of the affected coil, a faulty spark plug (extremely high resistance) may be detected.
3. If ignition coils are carbon tracked, the coil tower spark plug wire nipples may be damaged.
4. By switching a normally operating coil into the position of the malfunctioning one, a determination can be made as to fault being the coil or C3I module.

CHART C-4F-2

C3I MISFIRE UNDER LOAD
3.0L "N" SERIES
3.8L "A, C & H" SERIES

1

- **IF** ENGINE MISFIRES AT IDLE ONLY, SEE PAGE 1.
- IGNITION "OFF".
- DISCONNECT ONE SPARK PLUG LEAD AT A TIME AND, INSTALL SPARK TESTER (ST-125) J-26792 OR EQUIVALENT.
- OBSERVE SPARK TESTER WITH ENGINE IDLING. REPEAT
- SPARK SHOULD JUMP TESTER GAP ON ALL LEADS WITH ENGINE IDLING. DID IT? SEE CAUTION ★

NO

2

- IGNITION OFF, GROUND THE OPPOSITE PLUG **LEAD OF THE AFFECTED COIL AT SPARK PLUG.**
- SPARK SHOULD JUMP TESTER GAP WHILE **CRANKING ENGINE. DOES IT/**

NO

- CHECK THE RESISTANCE OF EACH PLUG WIRE OF THE COIL WHICH DID NOT FIRE THE SPARK TESTER.
- WIRE RESISTANCE SHOULD BE LESS THAN 30,000 OHMS EACH AND WIRES SHOULD NOT BE GROUNDED. ARE WIRES OW

YES

3

- REMOVE COIL RETAINING NUTS AND REMOVE COILS.
- COILS SHOULD BE FREE OF CARBON TRACKING. ARE THEY?

YES

4

- SWITCH A NORMALLY OPERATING COIL **WITH** THE COIL FROM PROBLEM CYLINDER.
- REPEAT TEST #1 ON PROBLEM CYLINDER.
- SPARK SHOULD JUMP TESTER GAP WITH ENGINE IDLING. DID IT?

YES

ORIGINAL IGNITION COIL IS FAULTY

YES

CHECK FOR;

- FAULTY, WORN OR CRACKED SPARK PLUG(S)
- PLUG FOULING DUE TO ENGINE MECHANICAL FAULT.

IF SPARK PLUGS CHECK OUT OK, SEE "CUTS OUT, MISSES' IN SYMPTOMS SECTION B.

YES

REPLACE THE SPARK PLUG FOR THE LEAD WHICH WAS JUMPERED TO GROUND. IF MISFIRE IS STILL PRESENT, START MISFIRE TEST AGAIN AT STEP ~~#~~ 1.

NO

REPLACE **FAULTY WIRE (S)**

NO

FAULTY IGNITION COIL. ALSO CHECK FOR FAULTY PLUG WIRE CONNECTIONS AND WIRE NIPPLES FOR CARBON TRACKING.

NO

FAULTY C³ I MODULE

★**CAUTION;** When handling secondary spark plug leads with engine running, insulated pliers must be used and care exercised to prevent a possible electrical **shock.**

CLEAR CODES AND CONFIRM 'CLOSED LOOP" OPERATION AND NO 'SERVICE ENGINE SOON' LIGHT.

BLANK

SECTION C5A

ELECTRONIC SPARK CONTROL (ESC) SYSTEM - 3.0L, 3.8L & 3.8L TURBO

CONTENTS

GENERAL DESCRIPTION

PURPOSE

Varying octane levels can cause excessive detonation under certain load conditions. To aid in controlling combustion detonation, an Electronic Spark Control System (ESC) is used.

The ESC system is comprised of a knock sensor and an ESC module.

OPERATION

The ESC system has two major components:

- ESCModule
- Knock Sensor

The Knock sensor's purpose is to detect detonation from the engine. The sensor is mounted near the intake manifold at the rear of the engine.

As long as the ESC module is sending a voltage signal (8 to 10 volts) to the ECM (no detonation detected by the ESC sensor) the ECM provides normal spark advance.

When the sensor detects detonation, the module turns "OFF" the circuit to the ECM and the voltage at ECM terminal "B7" drops to 0 volts. The ECM then retards EST as much as 20° to reduce detonation. This happens fast and frequently enough that if looking at this signal with a DVM, you won't see 0 volts, but an average voltage somewhat less than what is normal with no detonation.

A loss of the Detonation sensor signal or a loss of ground at ESC module would cause the signal at the ECM to remain high. This condition would result in the ECM controlling EST as if no detonation were occuring. The EST would not be retarded, and detonation could become severe enough under heavy engine load conditions to result in pre-ignition and potential engine damage.

Loss of the ESC signal to the ECM would cause the ECM to constantly retard EST. This could result in sluggish performance and cause a Code 43 to set.

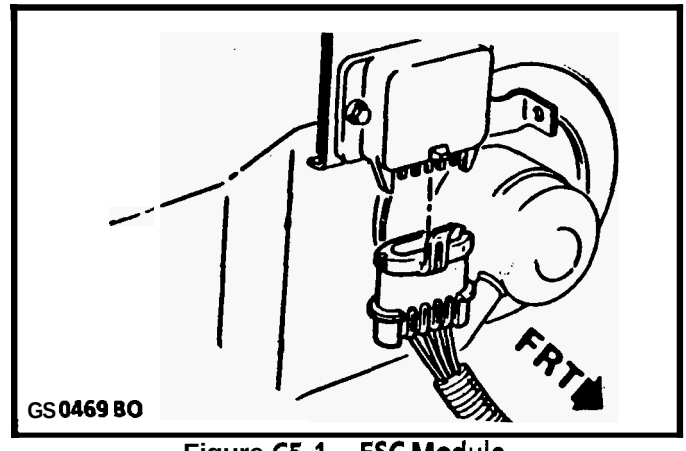


Figure C5-1 - ESC Module

DIAGNOSIS

See CHART C-5 for diagnosis of ESC System.

ON-CAR SERVICE

SENSOR

Remove or Disconnect

1. Negative battery cable.
2. ESC wiring harness connector from sensor.
3. Sensor from engine block.

Install or Connect

1. Sensor into engine block. Apply thread sealer, such as soft sealing tape, to the ESC sensor threads.
2. Wiring harness connector to the sensor.
3. Negative battery cable.

ESC MODULE

Refer to Figure C5-1 for module location

Remove or Disconnect

1. ESC module connector
2. Attaching screws
3. ESC module

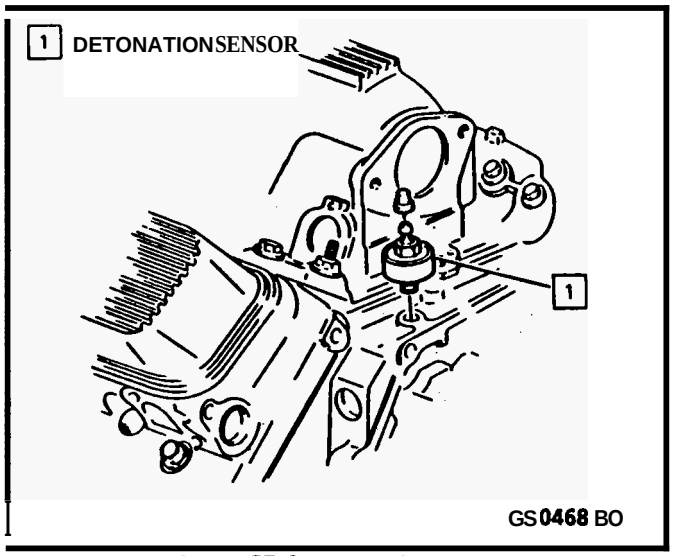


Figure C5-2 - Knock Sensor

Install or Connect

1. ESC module
2. Attaching screws
3. ESC module connector

PARTS INFORMATION

PART NAME	GROUP
Sensor, ESC Detonation	3.682
Module, Elect. Spark Cont	2.383
Bracket, Elect. Spark Cont Module	2.383

BLANK

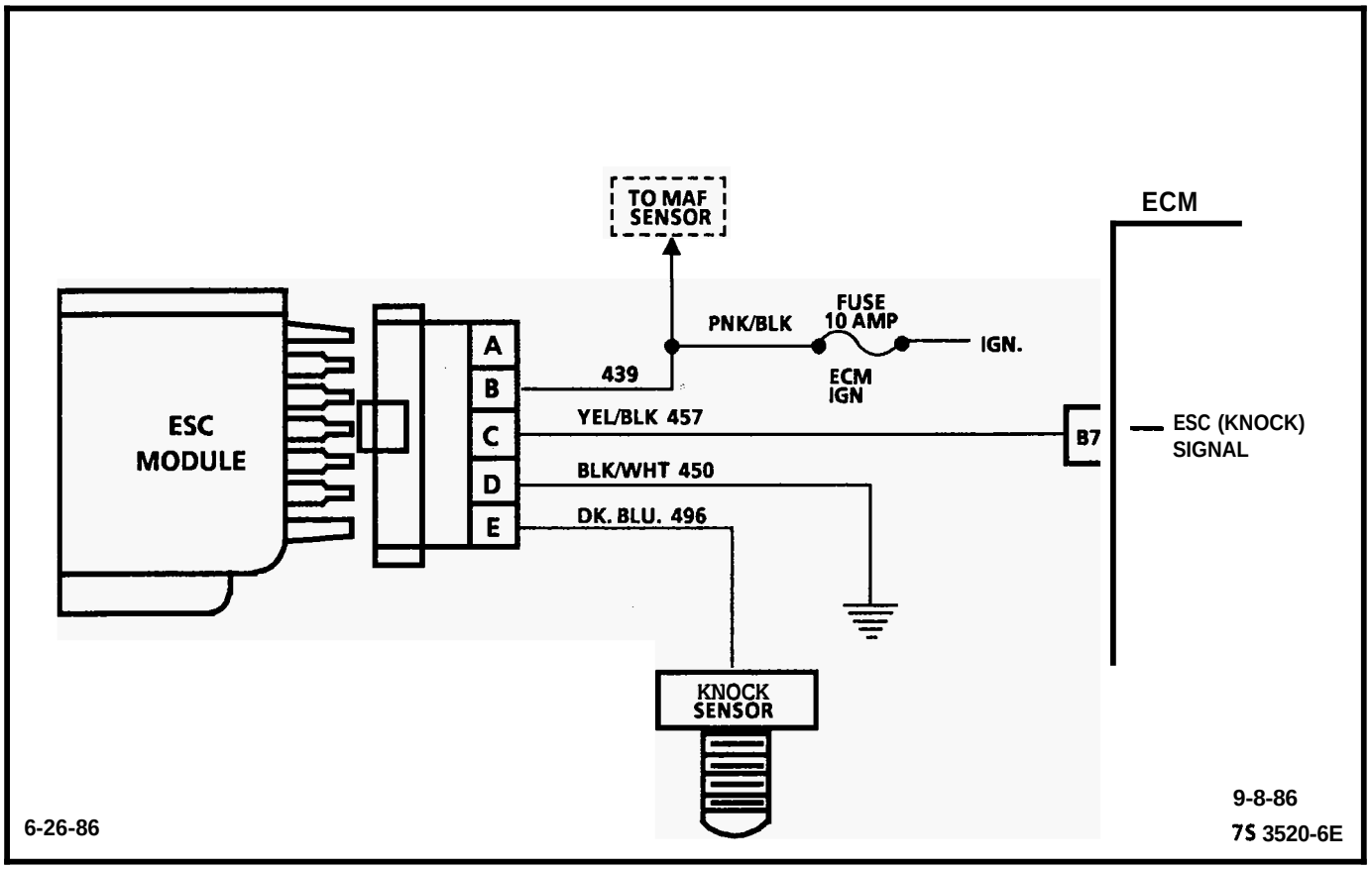


CHART C-5

ELECTRONIC SPARK CONTROL (ESC)
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The ESC system is comprised of a knock sensor and an ESC module.

As long as the ESC module is sending a voltage signal (8 to 10 volts) to the ECM (no detonation detected by the ESC sensor) the ECM provides normal spark advance.

When the sensor detects detonation, the module turns **"OFF"** the circuit to the ECM and the voltage at ECM terminal "B7" drops to 0 volts. The ECM then retards EST as much as 20° to reduce detonation. This happens fast and frequently enough that if looking at this signal with a DVM, you won't see 0 volts, but an average voltage somewhat less than what is normal with no detonation.

A loss of the knock sensor signal or a loss of ground at ESC module would cause the signal at the ECM to remain high. This condition would result in the ECM controlling EST as if no detonation were occuring. The EST would not be retarded, and detonation could become severe enough under heavy engine load conditions to result in pre-ignition and potential engine damage.

Loss of the ESC signal to the ECM would cause the ECM to constantly retard EST. This could result in sluggish performance and cause a Code **43** to set.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Tests ESC system's ability to detect detonation and retard the ignition timing.

2. By disconnecting the ESC module, the ECM monitors a low voltage at terminal "B7" and should retard the ignition timing.

3. After approximately **4** seconds, the "Service Engine Soon" light will come "ON" and Code **43** will be stored.

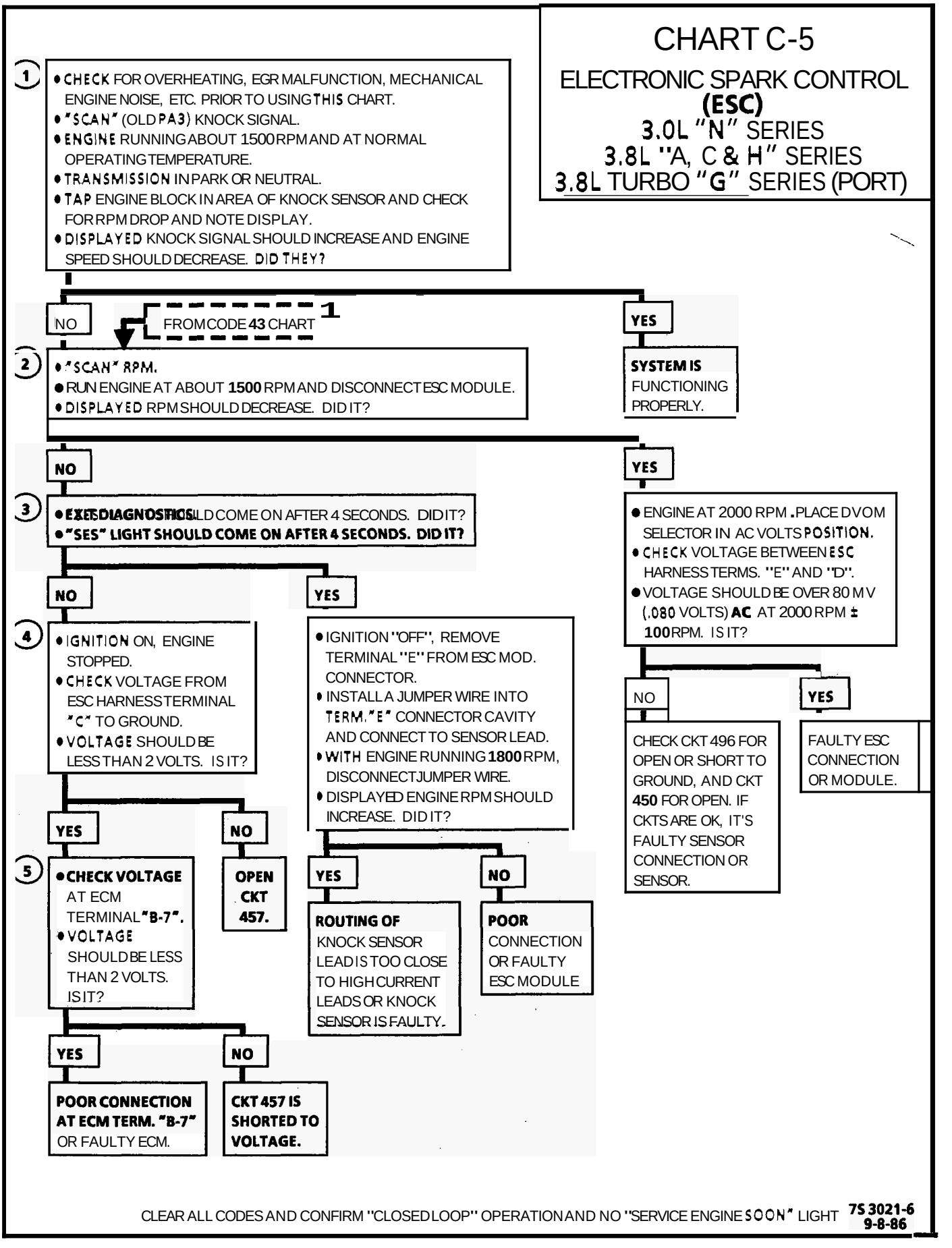
4. Checks for proper voltage output (measured on A/C scale) of knock sensor. Low or no voltage would indicate an **open** circuit to terminal **"E"** or faulty sensor.

5. Checks to see if constant retard is due to a faulty knock sensor or module, or if a false voltage signal is being transmitted on the wire from the knock sensor by induction from an adjacent wire, such as a spark plug wire, ignition wire, etc. Reroute wires as necessary.

CHART C-5

ELECTRONIC SPARK CONTROL (ESC)

3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES (PORT)



CLEAR ALL CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT

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SECTION C7A

EXHAUST GAS RECIRCULATION (EGR) SYSTEM 2.0L TURBO, 3.0L, 3.8L & 3.8L TURBO

CONTENTS

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 intake manifold.

The EGR valve feeds small amounts of exhaust gas back into the combustion chamber as shown in Figure C7-1.

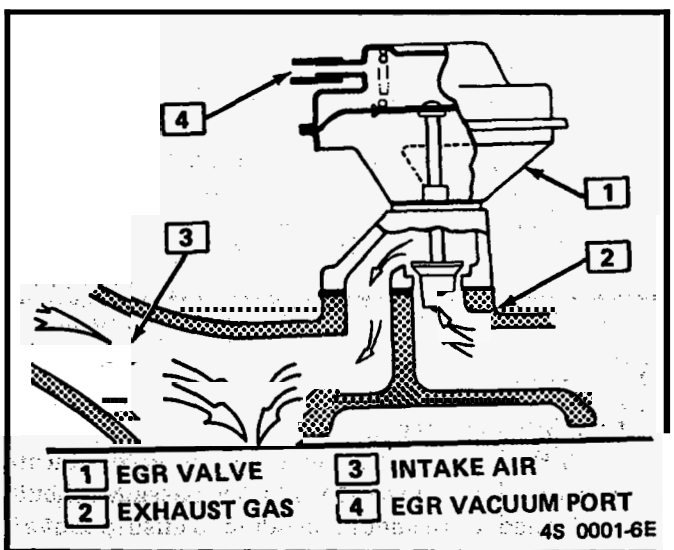


Figure C7-1 - Exhaust Gas Recirculation

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
- Above idle speed

The amount of exhaust gas recirculated is controlled by variations in vacuum and the EGR vacuum control solenoid.

EGR CONTROL

To regulate EGR flow, an ECM controlled solenoid is used in the vacuum line. The ECM uses information from the following sensors to regulate the solenoid:

- Coolant temperature
- Throttle position (TPS)
- Mass Air Flow (MAF)

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 "Service Engine Soon" light, and set a Code 32 in the event of a vacuum circuit failure.

EGR VALVE IDENTIFICATION, (Figure C7-2)

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

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

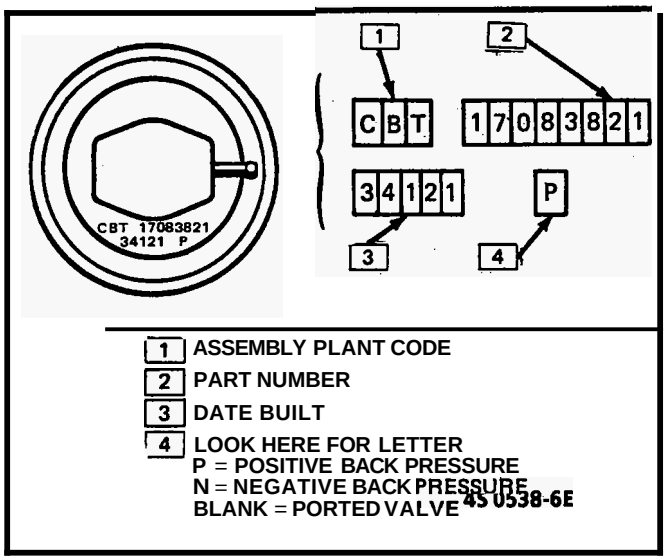


Figure C7-2 - EGR Valve Identification

PORT EGR VALVE

The port EGR valve (Figure C7-3) is controlled by a flexible 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.

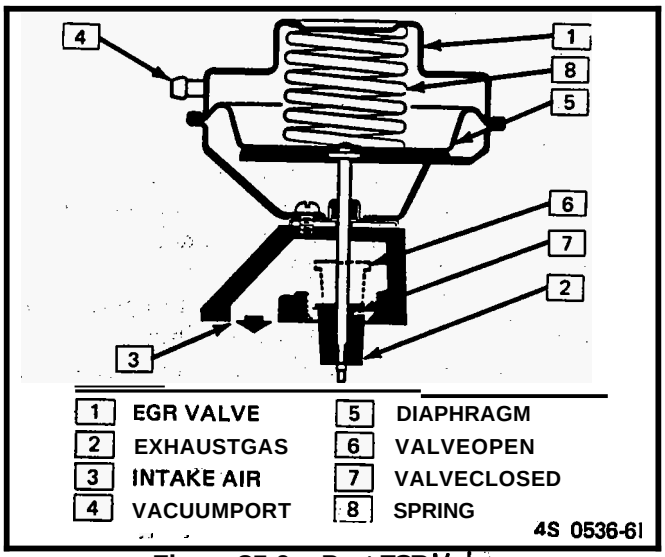


Figure C7-3 - Port EGR Valve

DIAGNOSIS

Diagnosis of the EGR system is covered in CHART C-7 at the end of this section.

RESULTS OF INCORRECT EGR SYSTEM OPERATION

Too much EGR flow at idle, cruise, or cold operation, any of the following conditions may occur:

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

Too little or no EGR flow allows combustion temperatures to get too high. This could cause:

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

ON-CAR SERVICE

EGR VALVE

Remove or Disconnect

1. EGR valve vacuum tube at valve.(Figure C7-4 for 3.8L).
2. Bolts.
3. EGR valve from manifold (Figure C7-4 for 3.0L,3.8L, 3.8L Turbo, or Figure C7-5 for 2.0L Turbo)

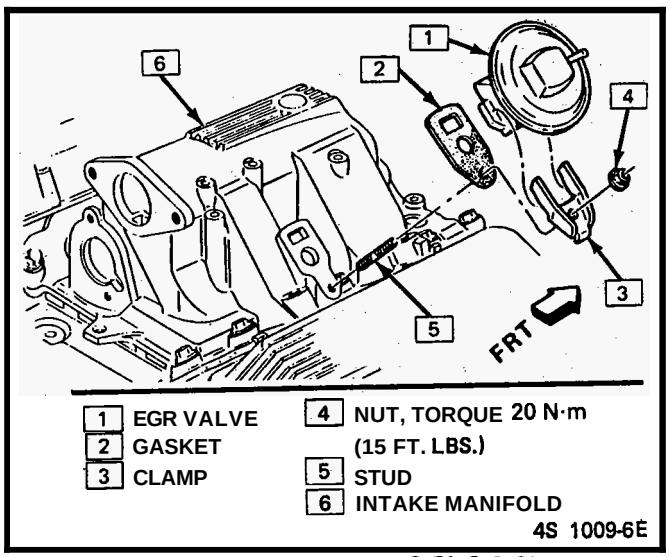


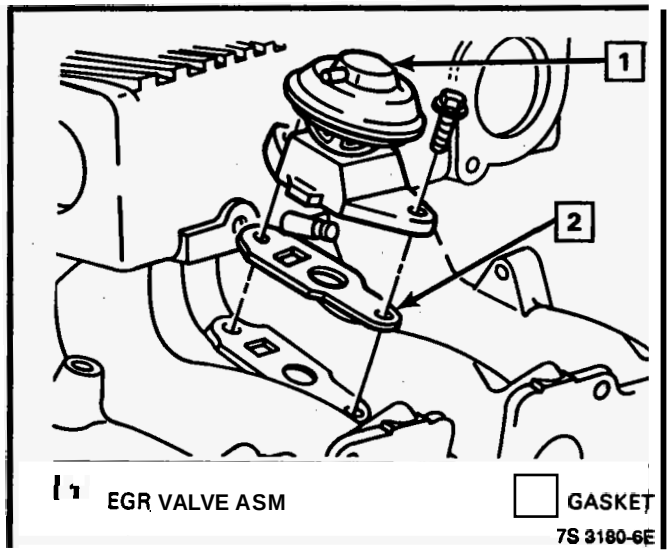
Figure C7-4 - EGR Valve 3.0L, 3.8L & 3.8L Turbo

Inspect

4. EGR Manifold Passage

If EGR passages in the inlet 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.



igure C7-5 - EGR To Manifold Mount's - 2.0L (Turbo)

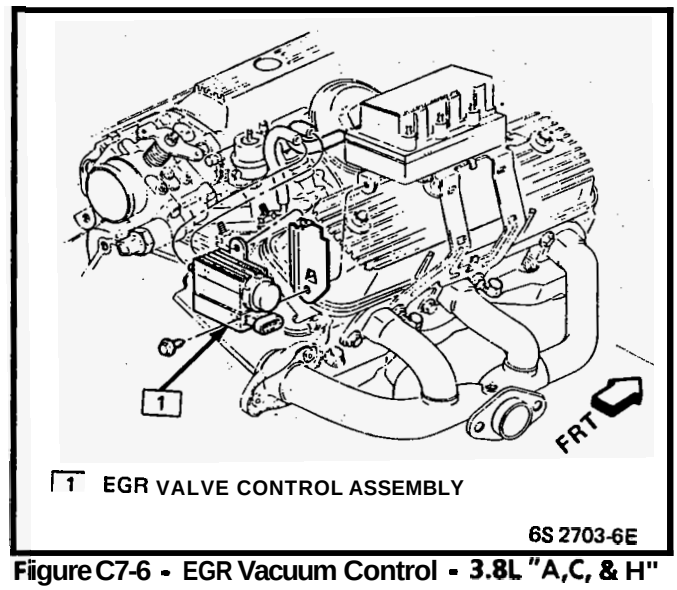


Figure C7-6 - EGR Vacuum Control - 3.8L "A,C, & H" and 3.8L Turbo "G" SERIES

Clean

5. With a wire wheel, buff the exhaust deposits from he mounting surface and around the valve.
6. Look for exhaust deposits in the valve outlet. Remove deposit build-up with a screwdriver.
7. Clean mounting surfaces of intake manifold and valve assembly.

Install or Connect

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

EGR CONTROL SOLENOID

Remove or Disconnect

1. Negative battery cable.
2. Electrical connector at solenoid (Figure C7-4, C7-6).
3. Vacuum hoses.
4. Nut and solenoid.

Install or Connect

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

EGR FILTER REPLACEMENT
3.0L, 3.8L, & 3.8L Turbo

1. Grasp and pull filter off with a rocking motion.
2. Install new filter. See Figure C7-7.

- Push new filter on making sure cut-out for wires is properly aligned,

PARTS INFORMATION

PARTS NAME	GROUP
Valve, EGR	3.670
Gasket, EGR Valve	3.680
Control, EGR Vacuum	3.670

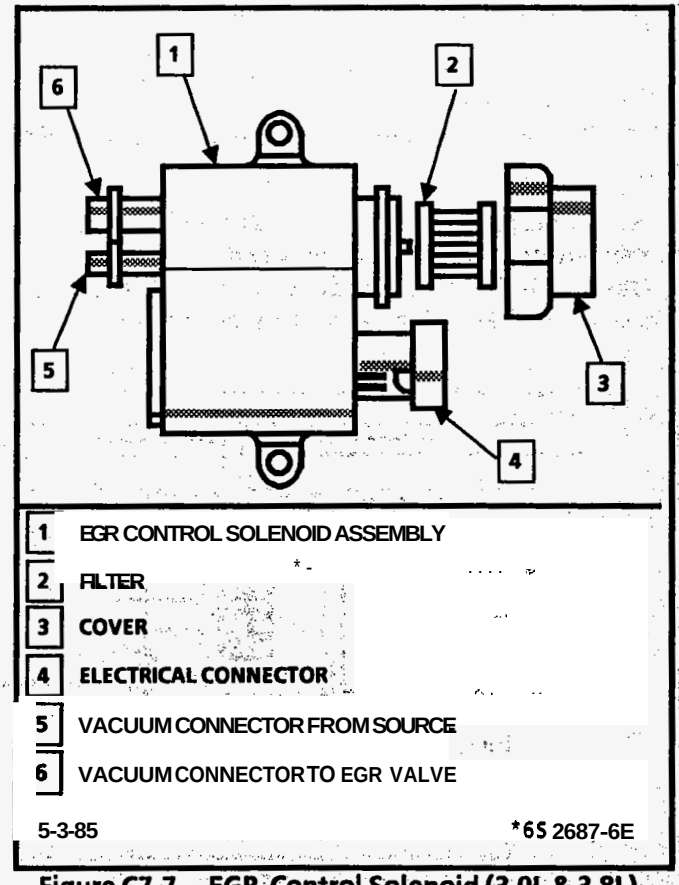
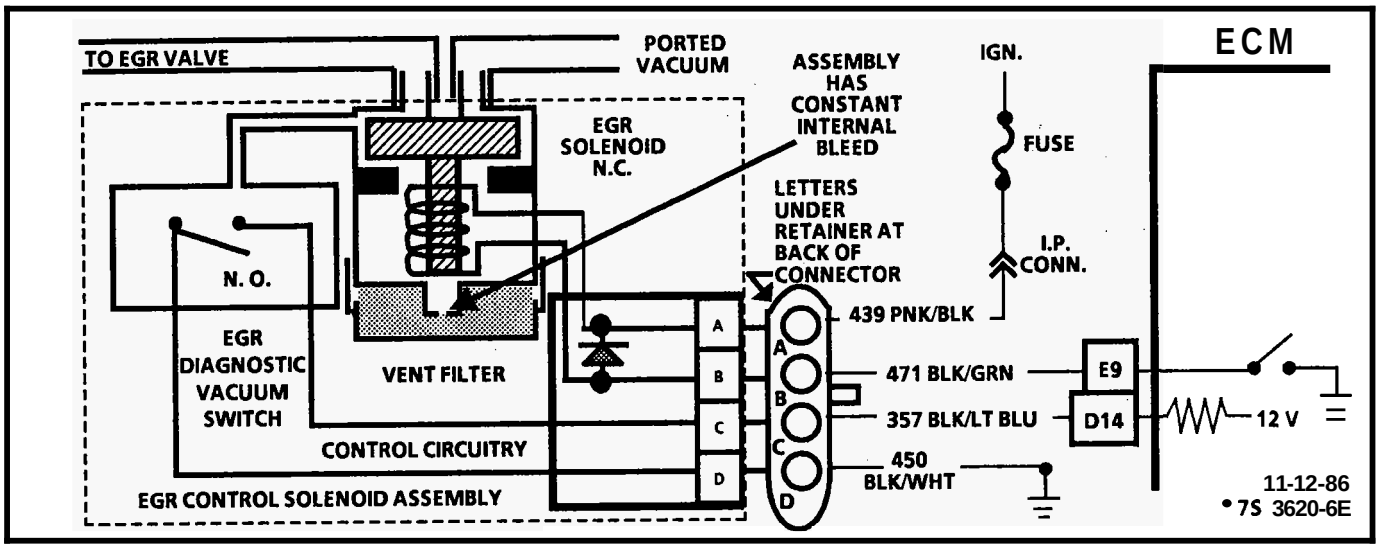


Figure C7-7 - EGR Control Solenoid (3.0L & 3.8L)



2.0L (Turbo) "J" SERIES

CHART C-7

EXHAUST GAS RECIRCULATION (EGR) CHECK
3.0L "N" SERIES, 3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES & 2.0L TURBO "J" SERIES (PORT)

Circuit Description:

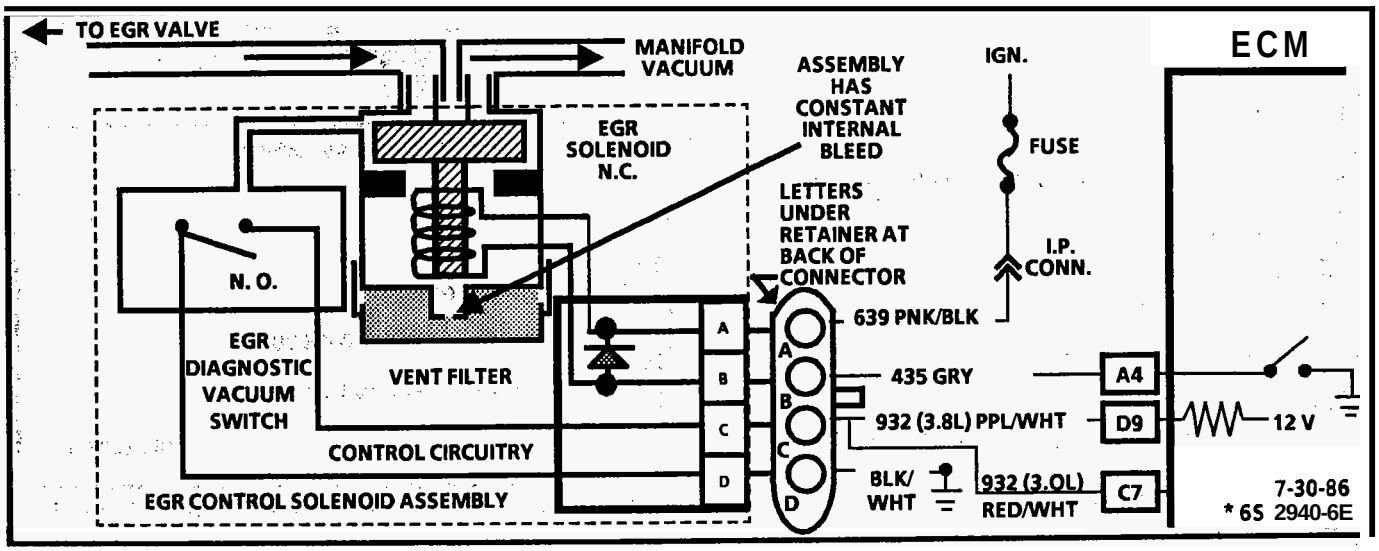
The EGR valve is opened by manifold vacuum, to let exhaust gas flow into the intake manifold. The exhaust gas then moves with the air/fuel mixture into the combustion chamber. If too much exhaust gas enters, combustion will not occur. For this reason, very little exhaust gas is allowed to pass through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

- Warm engine operation
- Above idle speed

The amount of exhaust gas recirculated is controlled by variations in vacuum and the EGR vacuum control solenoid.

Test Description: Step numbers refer to the numbered steps on the diagnostic chart.

1. Checks for a sticking EGR valve. If sticking, remove and examine valve to determine whether it can be cleaned, or must replaced. A sticking EGR valve will most likely cause a rough idle condition.
2. Checks for plugged EGR passages. If passages are plugged, the engine may have severe detonation on acceleration.

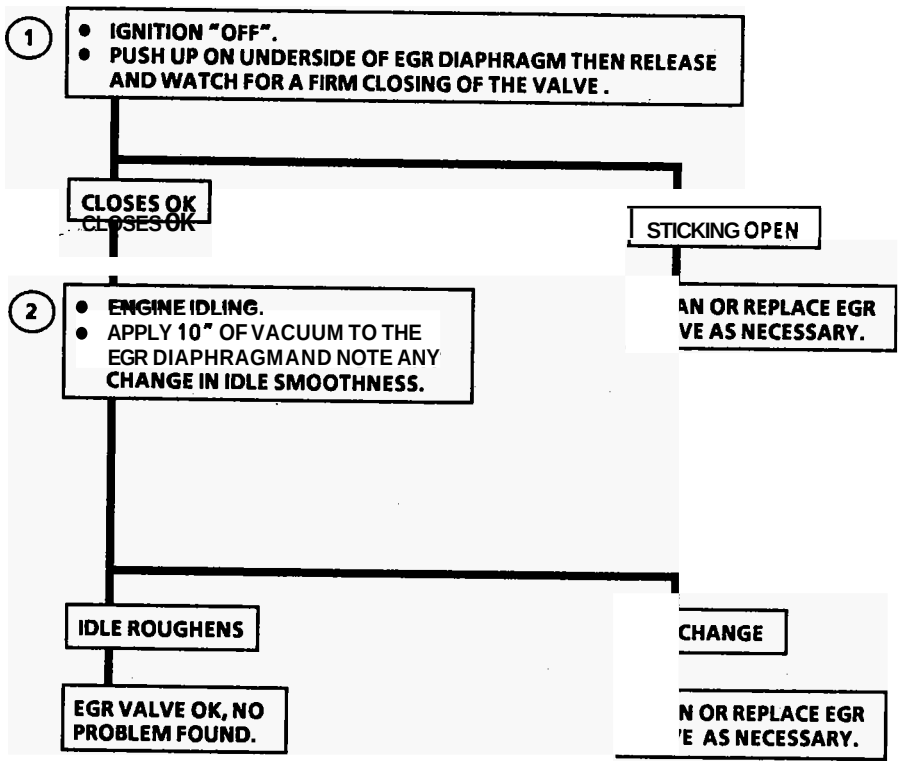


3.0L "N" SERIES - 3.8L "A, C, & H" SERIES - 3.8L TURBO "G" SERIES

CHART C-7

EXHAUST GAS RECIRCULATION (EGR) CHECK
3.0L "N" SERIES
3.8L "A, C & H" SERIES
3.8L TURBO "G" SERIES
2.0L TURBO "J" SERIES (PORT)

ASSUMES NO CODE 32 IS STORED FOR EGR VALVE. MAKE PHYSICAL INSPECTION OF EGR VACUUM HOSE FOR RESTRICTIONS.



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

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SECTION C8

TRANSMISSION/TRANSAXLE CONVERTER CLUTCH (TCC) SYSTEM

CONTENTS

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, increasing 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.

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.
- Gear Switch. 440-T4 transaxles use a 3rd & 4th gear switch to send a signal to the ECM telling it which gear the transaxle is in. The ECM uses this information to vary the conditions under which the TCC applies or releases.
- 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.

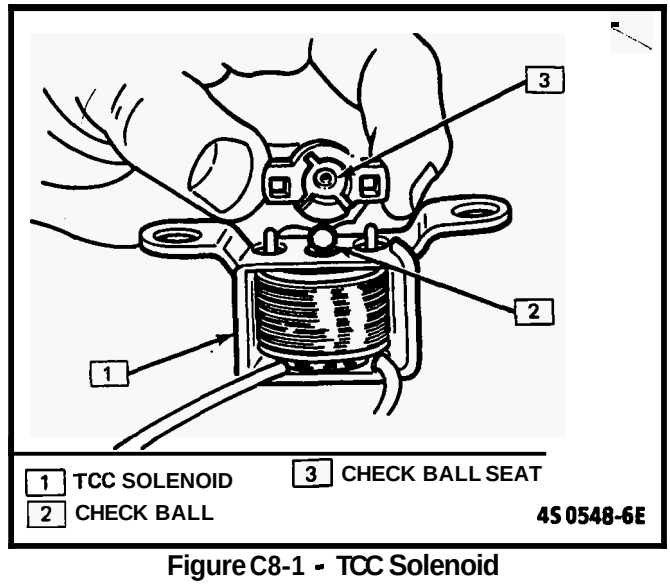

Figure C8-1 - TCC Solenoid

NOTE: A vehicle with a 3.8L engine, 440-T4 transaxle and factory installed cruise control. Engagement of the cruise control system will result in a loss of TCC in 3rd gear. However 4th gear TCC operation will be maintained.

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 economy may be lower than expected. If the Vehicle Speed Sensor fails, the TCC will not apply. If the 3rd or 4th gear switch does not operate, the TCC may not apply at the right time.

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. The Owner's Manual section on TCC operation should be reviewed with the driver.

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, but the TCCwill turn on when the ALDL terminal "F" is grounded with ignition "ON" and engine stopped, sensors such as coolant, speed, and throttle position should be checked.

ON-CAR SERVICE

- See Section "7" for TCC Solenoid.
- See Section "8C" for VSS (IP mounted).

PARTS INFORMATION

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

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485 are non-Vin 7 info

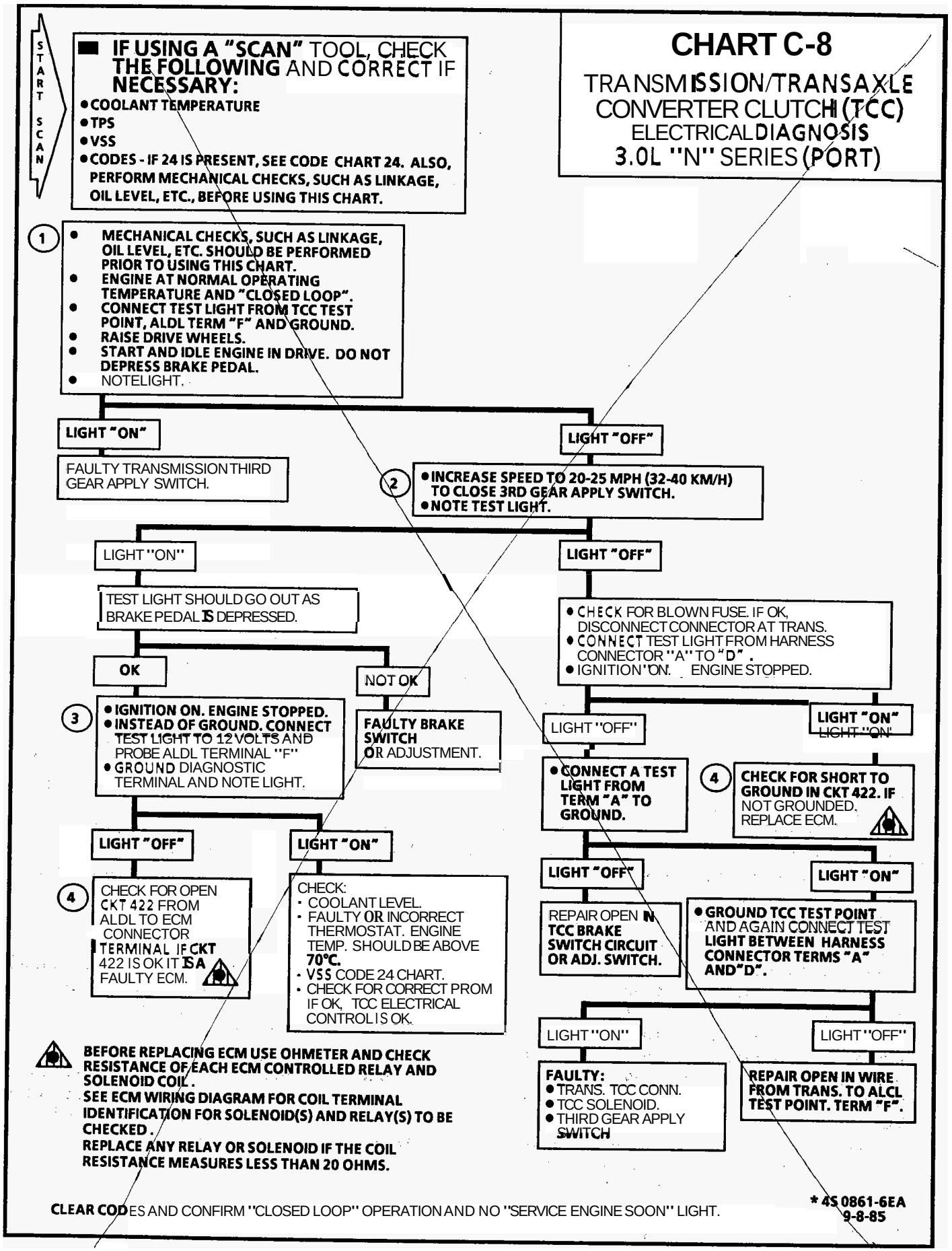


CHART C-8
TRANSMISSION/TRANSAXLE CONVERTER CLUTCH (TCC) ELECTRICAL DIAGNOSIS
3.0L "N" SERIES (PORT)
START SCAN
IF USING A "SCAN" TOOL, CHECK THE FOLLOWING AND CORRECT IF NECESSARY:
• COOLANT TEMPERATURE
• TPS
• VSS
• CODES - IF 24 IS PRESENT, SEE CODE CHART 24. ALSO, PERFORM MECHANICAL CHECKS, SUCH AS LINKAGE, OIL LEVEL, ETC., BEFORE USING THIS CHART.
1
• MECHANICAL CHECKS, SUCH AS LINKAGE, OIL LEVEL, ETC. SHOULD BE PERFORMED PRIOR TO USING THIS CHART.
• ENGINE AT NORMAL OPERATING TEMPERATURE AND "CLOSED LOOP".
• CONNECT TEST LIGHT FROM TCC TEST POINT, ALDL TERM "F" AND GROUND.
• RAISE DRIVE WHEELS.
• START AND IDLE ENGINE IN DRIVE. DO NOT DEPRESS BRAKE PEDAL.
• NOTE LIGHT.
LIGHT "ON"
FAULTY TRANSMISSION THIRD GEAR APPLY SWITCH.
LIGHT "OFF"
2
• INCREASE SPEED TO 20-25 MPH (32-40 KM/H) TO CLOSE 3RD GEAR APPLY SWITCH.
• NOTE TEST LIGHT.
LIGHT "ON"
TEST LIGHT SHOULD GO OUT AS BRAKE PEDAL IS DEPRESSED.
OK
NOT OK
FAULTY BRAKE SWITCH OR ADJUSTMENT.
3
• IGNITION ON. ENGINE STOPPED.
• INSTEAD OF GROUND, CONNECT TEST LIGHT TO 12 VOLTS AND PROBE ALDL TERMINAL "F"
• GROUND DIAGNOSTIC TERMINAL AND NOTE LIGHT.
LIGHT "OFF"
LIGHT "ON"
4
CHECK FOR OPEN CKT 422 FROM ALDL TO ECM CONNECTOR TERMINAL IF CKT 422 IS OK IT IS A FAULTY ECM.
CHECK:
- COOLANT LEVEL.
- FAULTY OR INCORRECT THERMOSTAT. ENGINE TEMP. SHOULD BE ABOVE 70°C.
- VSS CODE 24 CHART.
- CHECK FOR CORRECT PROM IF OK, TCC ELECTRICAL CONTROL IS OK.
LIGHT "OFF"
• CHECK FOR BLOWN FUSE. IF OK, DISCONNECT CONNECTOR AT TRANS.
• CONNECT TEST LIGHT FROM HARNESS CONNECTOR "A" TO "D".
• IGNITION ON. ENGINE STOPPED.
LIGHT "OFF"
LIGHT "ON"
• CONNECT A TEST LIGHT FROM TERM "A" TO GROUND.
4
CHECK FOR SHORT TO GROUND IN CKT 422. IF NOT GROUNDED, REPLACE ECM.
LIGHT "OFF"
LIGHT "ON"
REPAIR OPEN IN TCC BRAKE SWITCH CIRCUIT OR ADJ. SWITCH.
• GROUND TCC TEST POINT AND AGAIN CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMS "A" AND "D".
LIGHT "ON"
LIGHT "OFF"
FAULTY:
• TRANS. TCC CONN.
• TCC SOLENOID.
• THIRD GEAR APPLY SWITCH
REPAIR OPEN IN WIRE FROM TRANS. TO ALCL TEST POINT. TERM "F".
BEFORE REPLACING ECM USE OHMETER AND CHECK RESISTANCE OF EACH ECM CONTROLLED RELAY AND SOLENOID COIL.
SEE ECM WIRING DIAGRAM FOR COIL TERMINAL IDENTIFICATION FOR SOLENOID(S) AND RELAY(S) TO BE CHECKED.
REPLACE ANY RELAY OR SOLENOID IF THE COIL RESISTANCE MEASURES LESS THAN 20 OHMS.
CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.
* 4S 0861-6EA
9-8-85

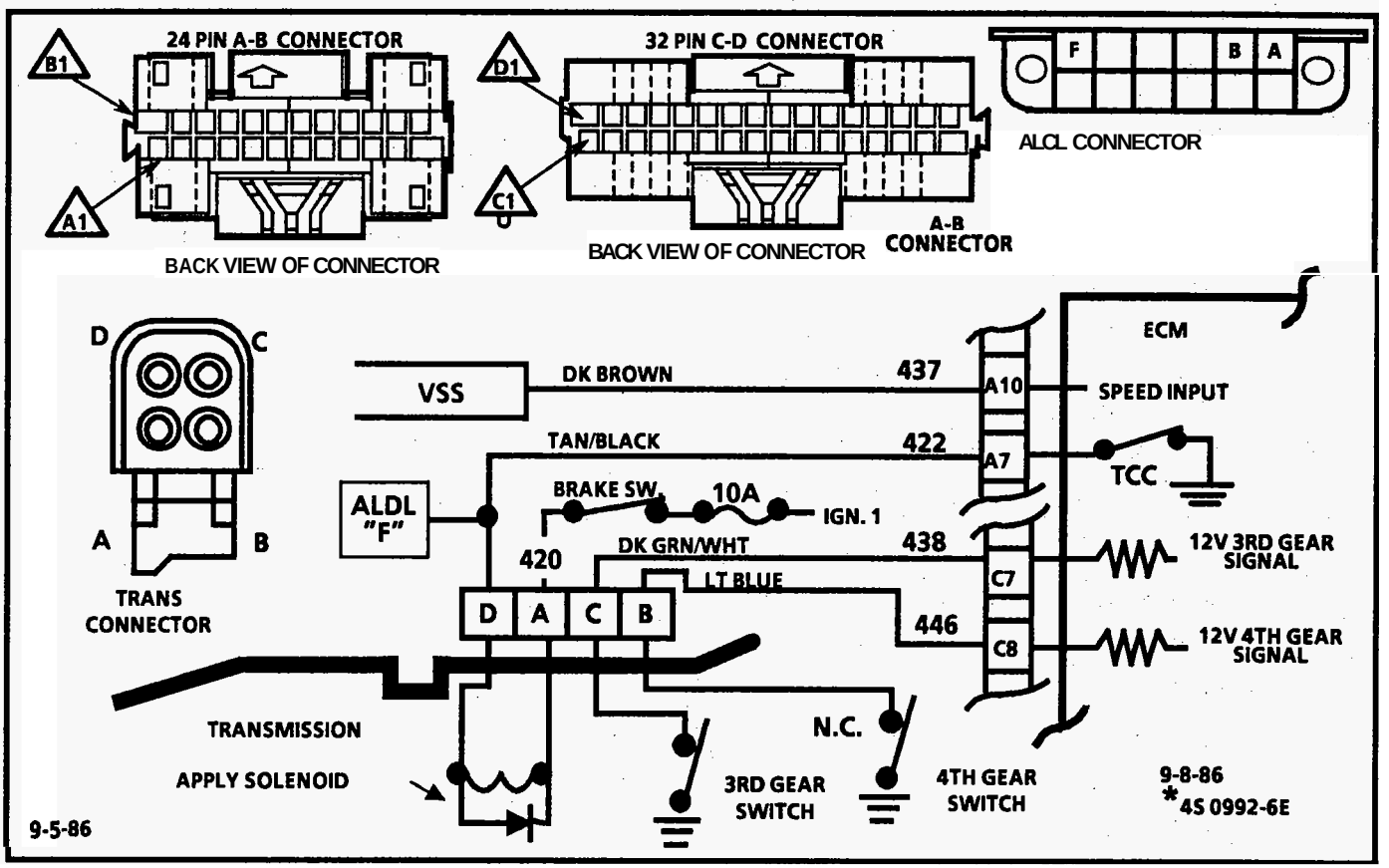


CHART C-8

TRANSMISSION CONVERTER CLUTCH (TCC)
ELECTRICAL DIAGNOSIS
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The purpose of the automatic transmission torque converter clutch feature is to eliminate the power loss of the torque converter stage when the vehicle is in a cruise condition. This allows the convenience of the automatic and the fuel economy of a manual transmission. The heart of the system is a solenoid located inside the automatic transmission which is controlled by the ECM.

When the solenoid coil is activated ("ON"), the torque converter clutch is applied which results in straight through mechanical coupling from the engine to transmission. When the transmission solenoid is deactivated, the torque converter clutch is released which allows the torque converter to operate in the conventional manner (fluidic coupling between engine and transmission).

The TCC will engage on a warm engine under given road load in 4th gear only.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. **A** test light on indicates battery voltage and continuity through the TCC solenoids is OK.
2. The vacuum hose on the throttle shaft pin increases the TPS signal **so** the TCC will engage, without excessive wheel speed. Without the hose, it would require more than **65** mph to engage the TCC.
3. Checks for vehicle speed sensor signal to ECM. Voltage should vary from under **2** to over 9 volts.
4. Checks for 3rd and 4th gear signal to ECM. These signals will not prevent TCC engagement, but could cause a change in the engage and disengage speed points.
5. Solenoids are turned "ON" or "OFF" by the ECM internal electronic switches called "drivers". Each driver is part of a group of a group of four called "Quad-Drivers". Failure of one can damage any other driver within the set.
   Solenoid coil resistance must measure more than **20** ohms. Less resistance will cause early failure of the ECM "Driver". Using an ohmmeter, check the solenoid coil resistance of the following before installing a replacement ECM.

CHART C-8

1
- ENGINE AT NORMAL OPERATING TEMPERATURE AND "CLOSED LOOP".
- CONNECT TEST LIGHT FROM TCC TEST POINT, ALDL TERM F AND GROUND.
- RAISE DRIVE WHEELS.
- START AND IDLE ENGINE IN PARK. DO NOT DEPRESS BRAKE PEDAL.
- NOTE LIGHT.

LIGHT "ON"

TEST LIGHT SHOULD GO OUT AS BRAKE PEDAL IS DEPRESSED.

OK

2 **INSTALL A PIECE OF SMALL VACUUM HOSE WITH A WALL THICKNESS OF** AT LEAST 1/16" OVER THE THROTTLE SHAFT PIN THAT CONTACTS THE TPS LEVER.

INCREASE SPEED TO 45 MPH, HIGH GEAR, AND NOTE LIGHT.

LIGHT "OFF"

REMOVE HOSE FROM THROTTLE SHAFT PIN.

4
- IGNITION "ON", ENGINE STOPPED.
- BACK PROBE ECM TERM. C7 WITH A VOLTMETER TO GROUND.

UNDER 6 VOLTS

- **START ENGINE, TRANS. IN DRIVE.**
- **INCREASE SPEED TO 55 MPH AND AGAIN NOTE VOLTAGE AT ECM** TERMINALS C7 AND C8.

BOTH OVER 6 VOLTS

NO ELECTRICAL TROUBLE **FOUND.** IF TCC DOES NOT WORK, SEE TRANS. SECTION 7

LIGHT "ON"

3
- RAISE DRIVE WHEELS.
- ENGINE IDLING IN DRIVE.
- BACK PROBE ECM A-B CONNECTOR TERM. A-10 WITH A VOLTMETER TO GROUND. VOLTAGE SHOULD VARY FROM UNDER 2 TO OVER 6 VOLTS

OK

FAULTY ECM SEE ⚠

NOT OK

SEE CODE 24

OVER 6 VOLTS

CHECK CKT 446 FOR OPEN. IF CKT NOT OPEN, IT IS FAULTY TRANS. CONNECTION OR 4TH GEAR SWITCH.

ONE OR BOTH UNDER 6 VOLTS

FAULTY TRANS. SWITCH (ES) IN APPLICABLE CKT (S).

LIGHT "OFF"

- CHECK FOR BLOWN FUSE. IF OK, DISCONNECT CONNECTOR AT TRANS. AND CONNECT TEST LIGHT FROM HARNESS CONNECTOR "A" TO "D" WITH IGNITION "ON", ENGINE STOPPED.

- CONNECT A TEST LIGHT FROM TERM "A" TO GROUND.

LIGHT "ON"

- GROUND TCC TEST POINT AND AGAIN CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMS "A" AND "D".

LIGHT "OFF"

REPAIR OPEN IN WIRE FROM TRANS. TO ALDL TEST POINT. TERM "F".

LIGHT "ON"

FAULTY:
- TRANS. TCC CONN.
- TCC SOLENOID.

5 CHECK FOR SHORT TO GROUND IN CKT 422, IF NOT GROUNDED. REPLACE ECM. ⚠

LIGHT "OFF"

REPAIR OPEN IN TCC BRAKE SWITCH CIRCUIT OR ADJ. SWITCH.

FAULTY BRAKE SWITCH OR ADJUSTMENT.

NOT OK

⚠ BEFORE REPLACING ECM USE AN OHMMETER AND CHECK THE RESISTANCE ACROSS TCC SOLENOID. REPLACE ANY SOLENOID WHERE RESISTANCE MEASURE LESS THAN 20 OHMS.

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

84-85

9-8-86
*4S 0904-6E

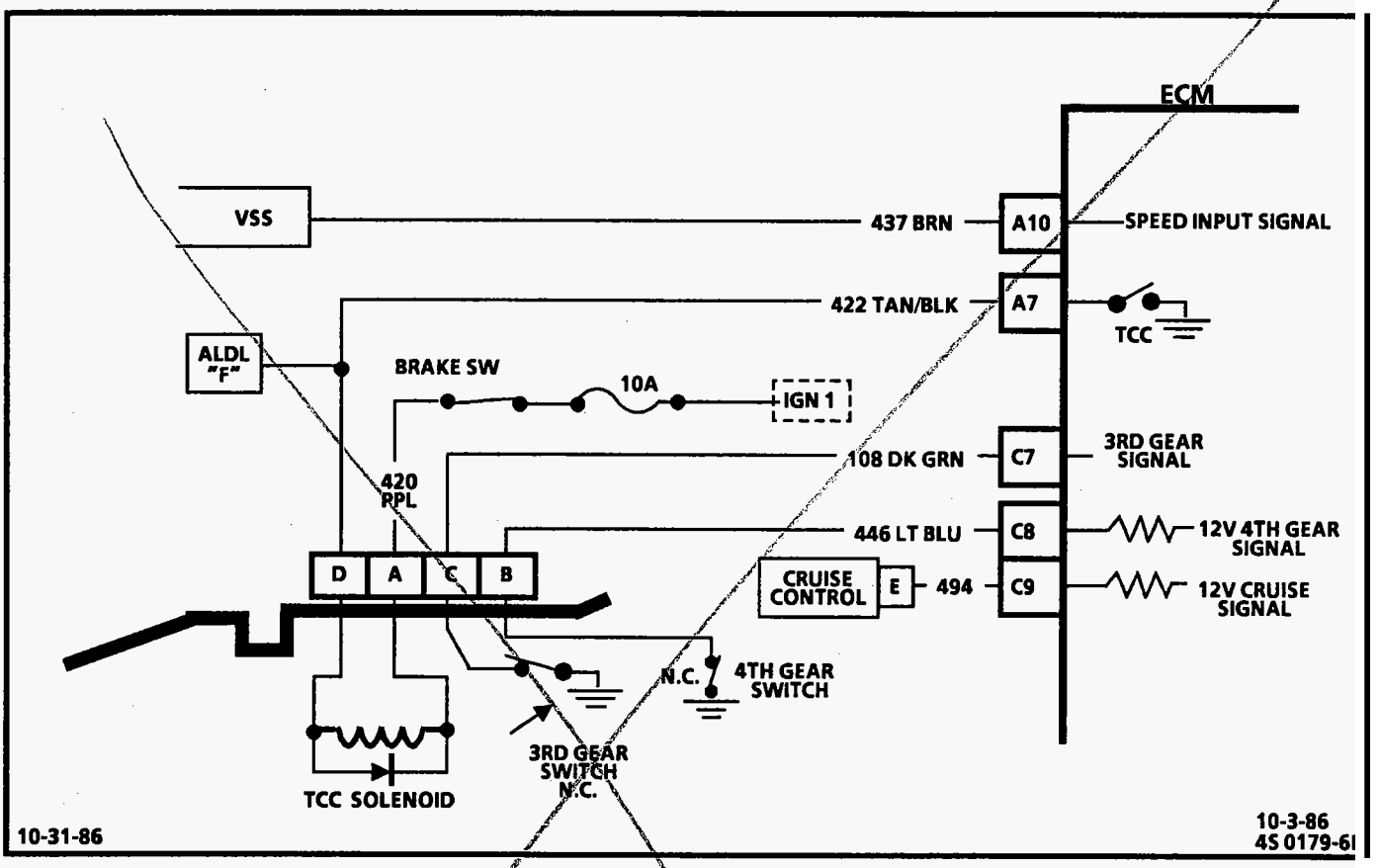


CHART C-8B

(Page 1 of 2)

TRANSMISSION/TRANSAXLE CONVERTER CLUTCH (TCC)

ELECTRICAL DIAGNOSIS

3.8L "A, C & H" SERIES (PORT)

Circuit Description:

The purpose of the automatic transmission torque converter clutch feature is to eliminate the power loss of the torque converter when the vehicle is in a cruise condition. This allows the convenience of the automatic and the fuel economy of a manual transaxle. The heart of the system is a solenoid located inside the transaxle which is controlled by the ECM.

When the solenoid coil is activated ("ON"), the torque converter clutch is applied which results in straight through mechanical coupling from the engine to the wheels. When the transmission solenoid is deactivated, the torque converter clutch is released which allows the torque converter to operate in the conventional manner (fluidic coupling between engine and transmission).

TCC will engage when:

- Engine warmed up
- Vehicle speed above a calibrated value (about 28 mph 45 km/h)
- Throttle position sensor output not changing, indicating a steady road speed.
- Brake switch closed.

NOTE: A vehicle with a 3.8L engine, 440-T4 transaxle and factory installed cruise control. Engagement of the cruise control system will result in a loss of TCC in 3rd gear. However 4th gear TCC operation will be maintained.

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. This test checks the continuity of the **TCC** Circuit from the fuse to the **ALDL** connector.
2. When the brake pedal is released, the light should come back "ON" and then **go** "OFF" when the diagnostic terminal is grounded. This tests **CKT 422** and the **TCC** driver in the **ECM.**

Diagnostic Aids:

The "Scan" tool only indicates when the **ECM** has turned "ON" the **TCC** driver, and this does not confirm that the **TCC** has engaged. To determine if **TCC** is functioning properly, **engine** rpm **should** decrease **when the** "Scan" indicates **the TCC** driver **has** turned "ON".

SECTION C10

A/C CLUTCH CIRCUIT DIAGNOSIS

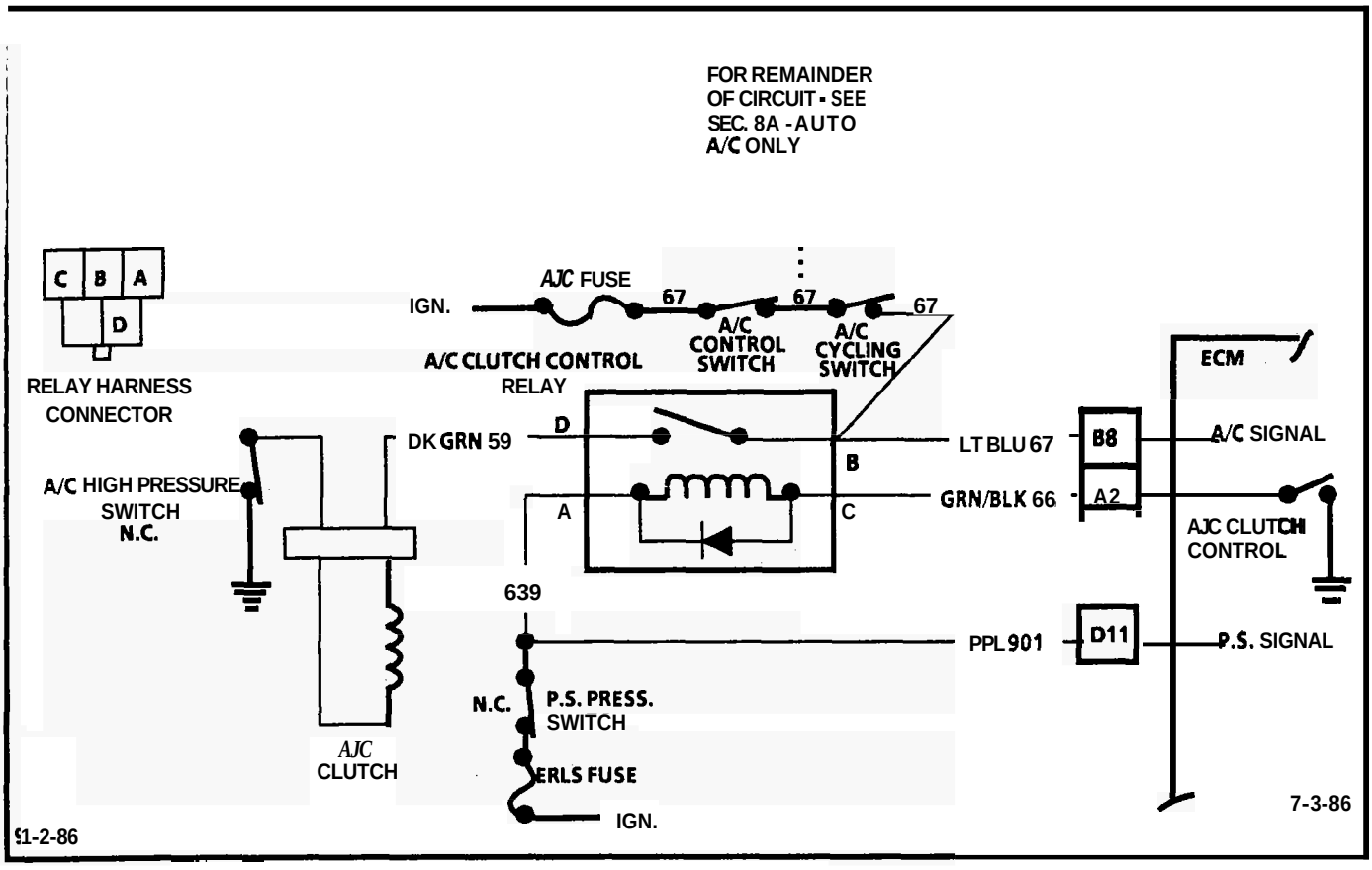


CHART C-10A

(Page 1 of 2)
A/C CLUTCH CIRCUIT DIAGNOSIS
3.0L "N" SERIES
3.8L "A, C & H" SERIES (PORT)

Circuit Description:

The A/C clutch control relay is ECM controlled to delay A/C clutch engagement .4 seconds after A/C is turned on. This allows the IAC to adjust engine rpm before the A/C clutch engages. The ECM also causes the relay to disengage the A/C clutch during WOT operation. The A/C clutch control relay is energized when the ECM provides a ground path for CKT **66.**

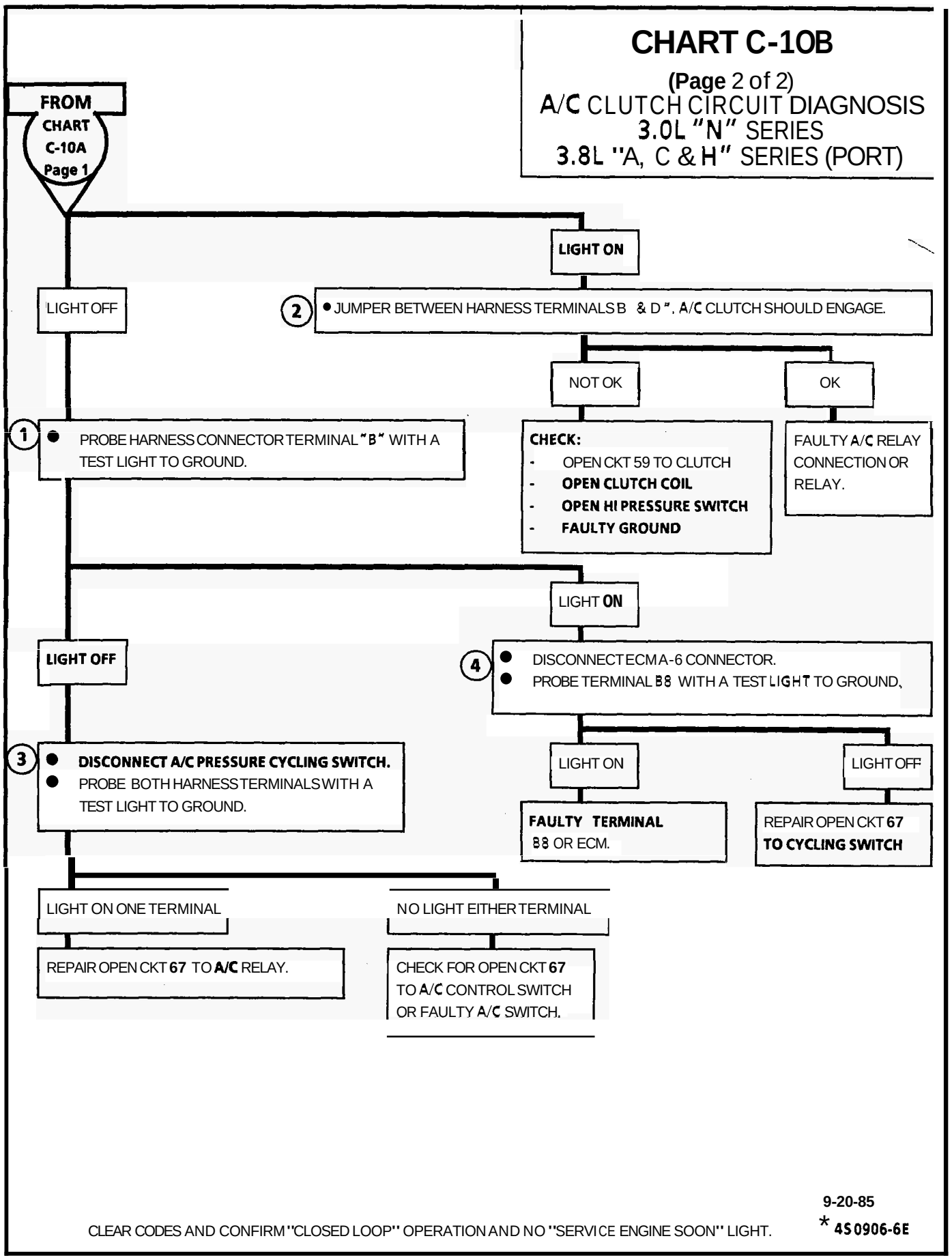
Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Checks to see if ECM is controlling A/C clutch control relay.
2. Checks operation of A/C cycling switch.
3. Checks for open circuit on either side of relay coil.

CHART C-10B

(Page 2 of 2)

A/C CLUTCH CIRCUIT DIAGNOSIS
3.0L "N" SERIES
3.8L "A, C & H" SERIES (PORT)



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

9-20-85

* 4S0906-6E

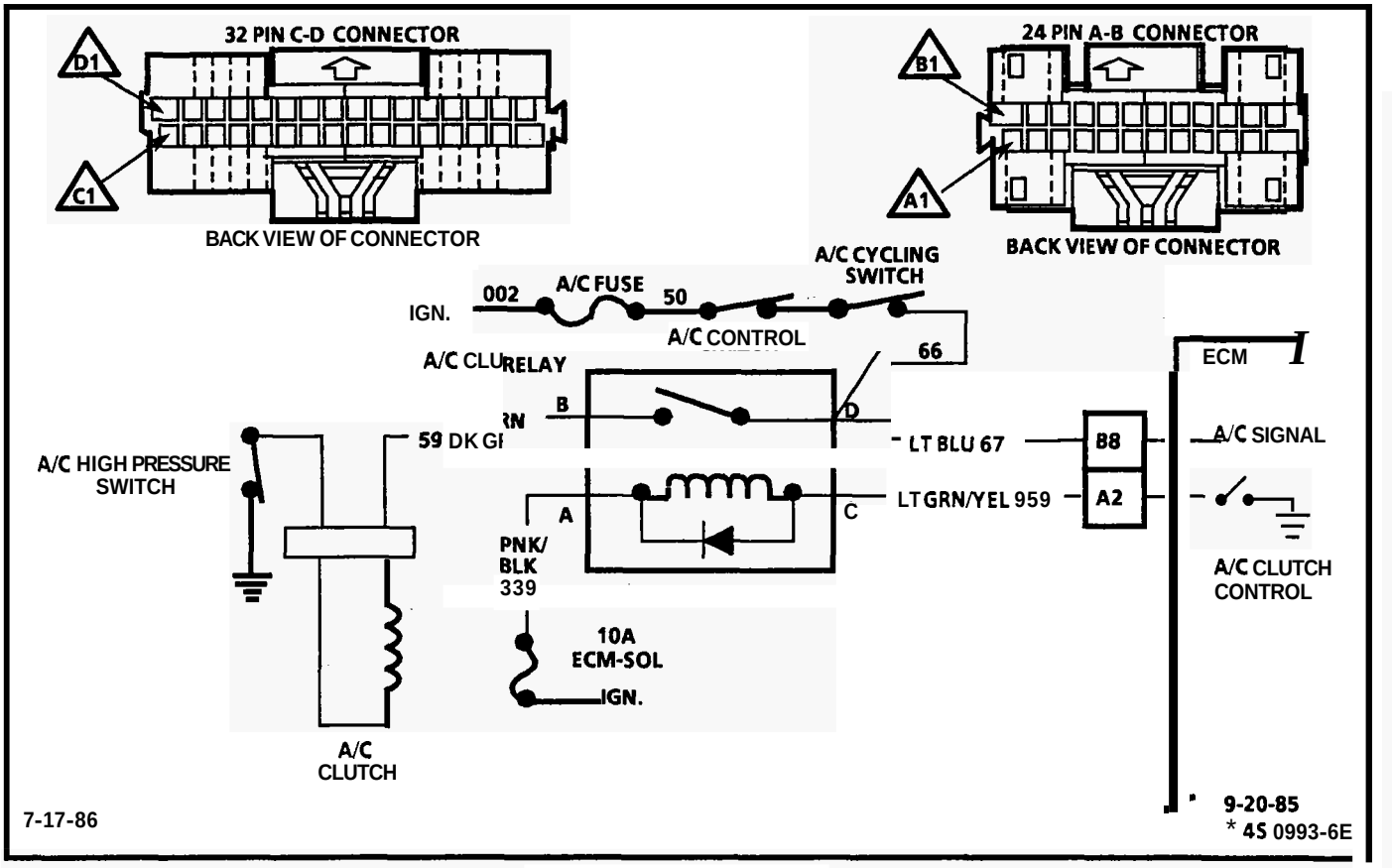


CHART C-10D

(Page 1 of 2)
A/C CLUTCH CIRCUIT DIAGNOSIS
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

The A/C clutch control relay is ECM controlled to delay A/C clutch engagement .4 seconds after A/C is turned on. This allows the IAC to adjust engine rpm before the A/C clutch engages. The ECM also causes the relay to disengage the A/C clutch during WOT operation. The A/C clutch control relay is energized when the ECM provides a ground path for CKT 959.

Test Description: Step numbers refer to step numbers on diagnostic chart.

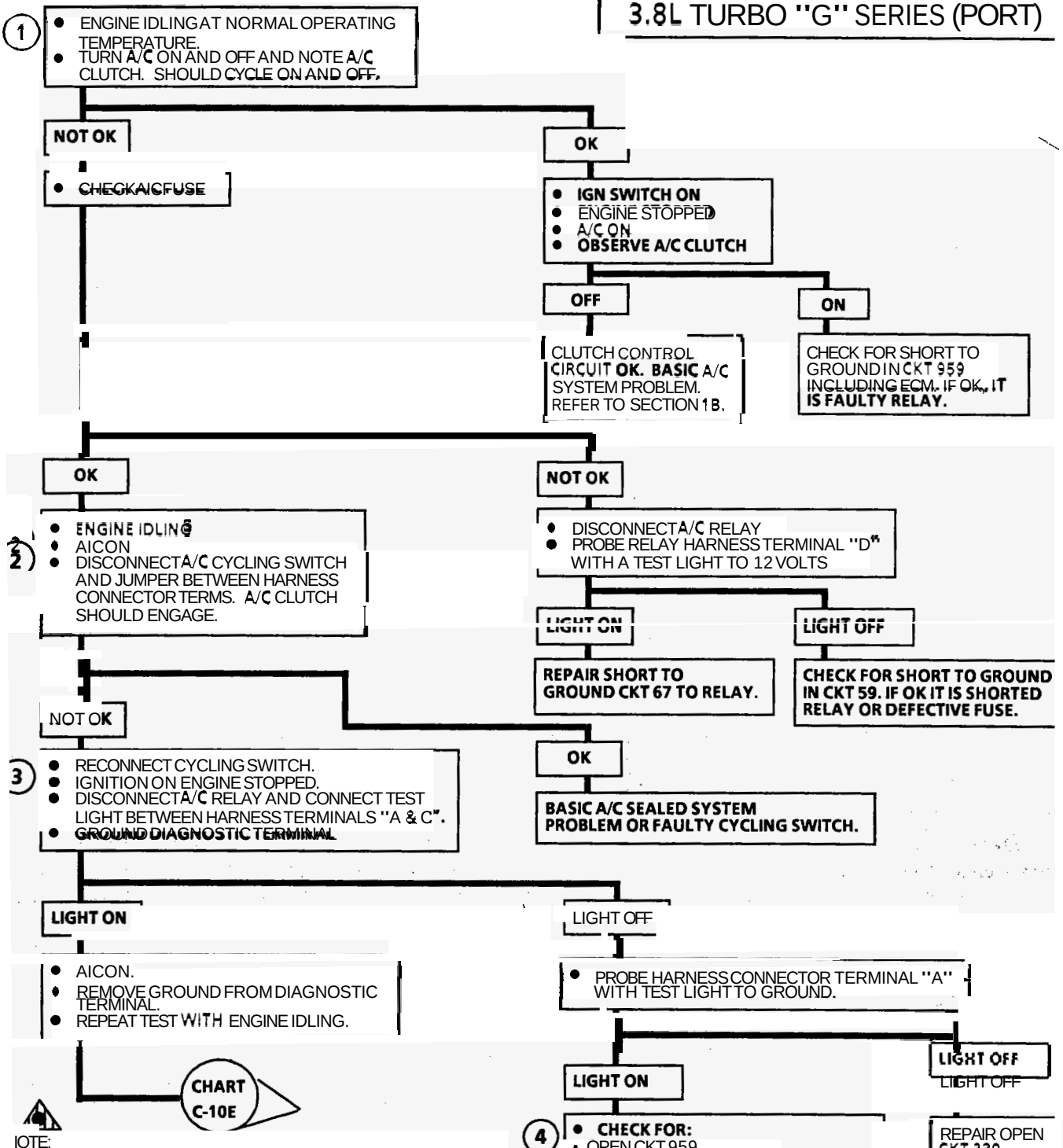
1. Checks to see if ECM is controlling A/C clutch control relay.
2. Checks operation of A/C cycling switch.
3. Checks for grounded CKT 959 to ECM. At this point the test light should be off.
4. Checks for open circuit on either side of relay coil.

IF A "SCAN" TOOL IS AVAILABLE A QUICK CHECK OF CKT 67 CAN BE MADE BY OBSERVING THE TOOLS DISPLAY WHEN A/C IS SELECTED. THE SCAN TOOL WILL DISPLAY THE STATE OF THE SIGNAL TO THE ECM.

CHART C-10D

(Page 1 of 2)

A/C CLUTCH CIRCUIT DIAGNOSIS 3.8L TURBO "G" SERIES (PORT)



NOTE;
BEFORE REPLACING ECM USE OHMETER AND CHECK RESISTANCE OF EACH ECM CONTROLLED RELAY AND SOLENOID COIL.
SEE ECM WIRING DIAGRAM FOR COIL TERMINAL IDENTIFICATION FOR SOLENOID(S) AND RELAY(S) TO BE CHECKED.
REPLACE ANY RELAY OR SOLENOID IF THE COIL RESISTANCE MEASURES LESS THAN 20 OHMS.

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

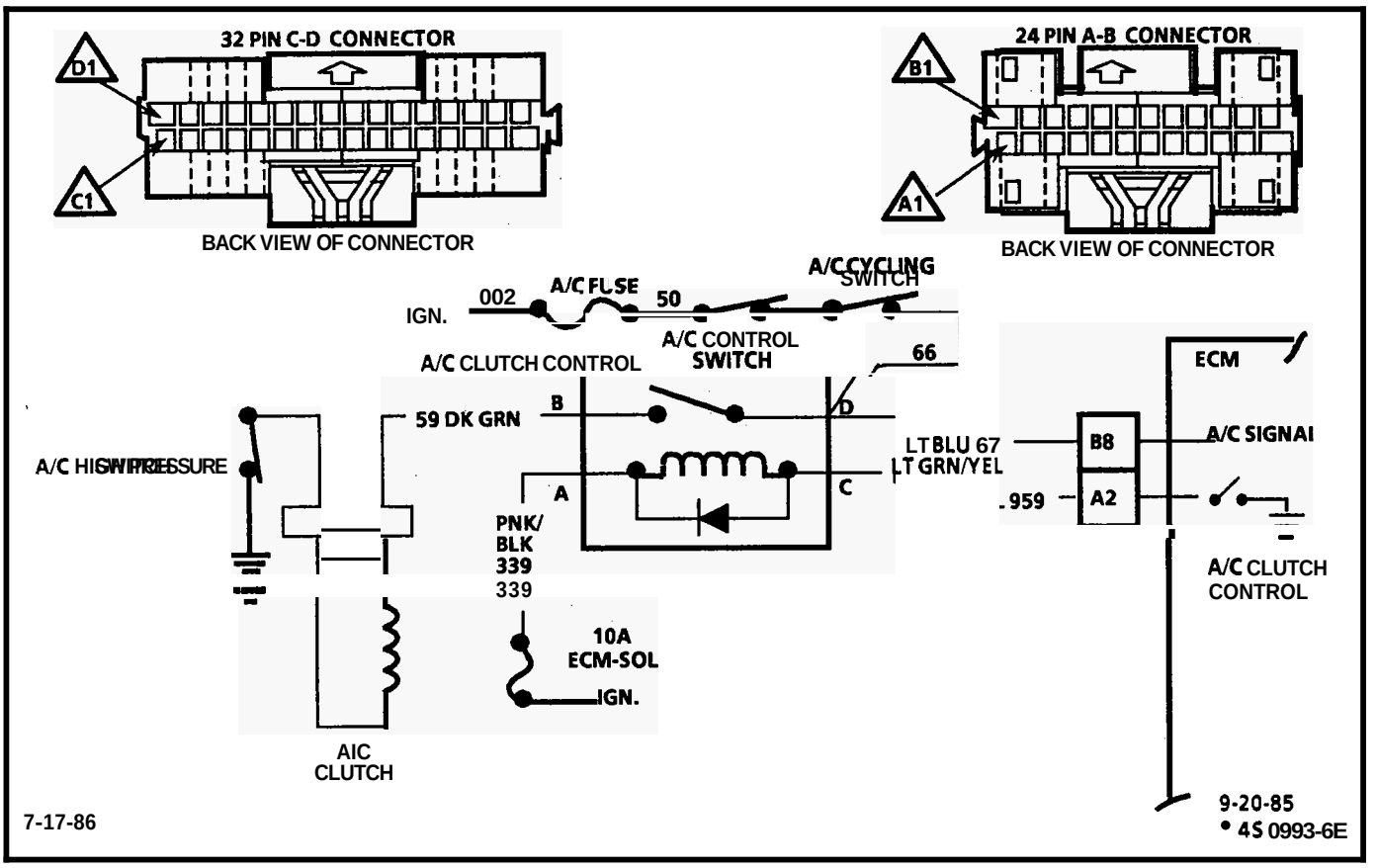


CHART C-10E

(Page 2 of 2)
A/C CLUTCH CIRCUIT DIAGNOSIS
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

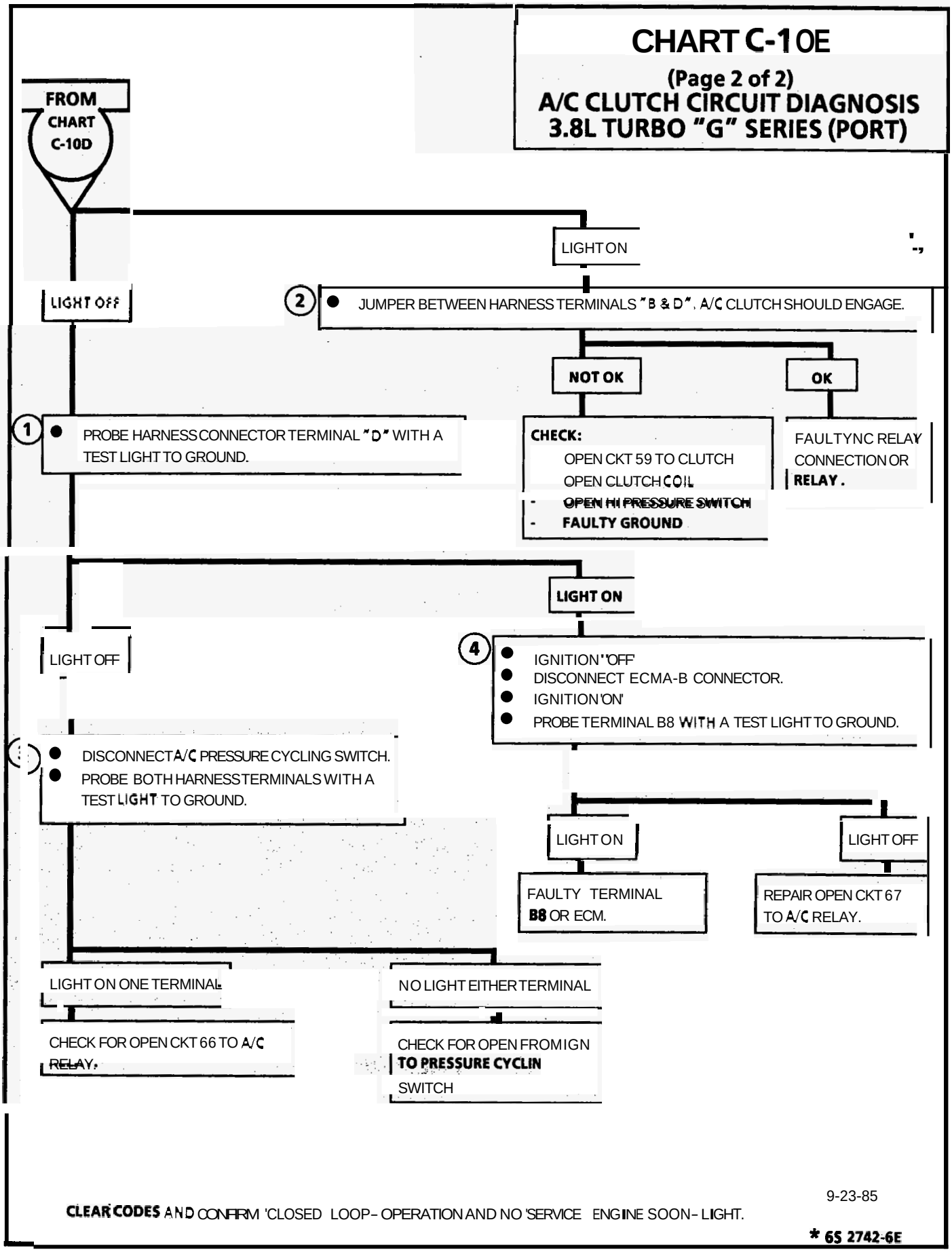
The A/C clutch control relay is ECM controlled to delay A/C clutch engagement .4 seconds after A/C is turned on. This allows the IAC to adjust engine rpm before the A/C clutch engages. The ECM also causes the relay to disengage the A/C clutch during WOT operation. The A/C clutch control relay is energized when the ECM provides a ground path for CKT 959.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Check for battery voltage to relay through CKT **67.**
   Substitutes **for** relay to determine if problem is in relay or in CKT 59, A/C clutch coil, high press, switch or ground.
3. Checks for open in CKT **67** between cycling switch and A/C fuse, or open CKT **67** to relay.
4. Check to see that "A/C ON" is getting to ECM through CKT **67.** A test light off at this time indicates CKT **67** is open between the cycling switch and the ECM.

CHART C-10E

(Page 2 of 2)
A/C CLUTCH CIRCUIT DIAGNOSIS
3.8L TURBO "G" SERIES (PORT)



9-23-85

CLEAR CODES AND CONFIRM 'CLOSED LOOP - OPERATION AND NO 'SERVICE ENGINE SOON - LIGHT.

* 6S 2742-6E

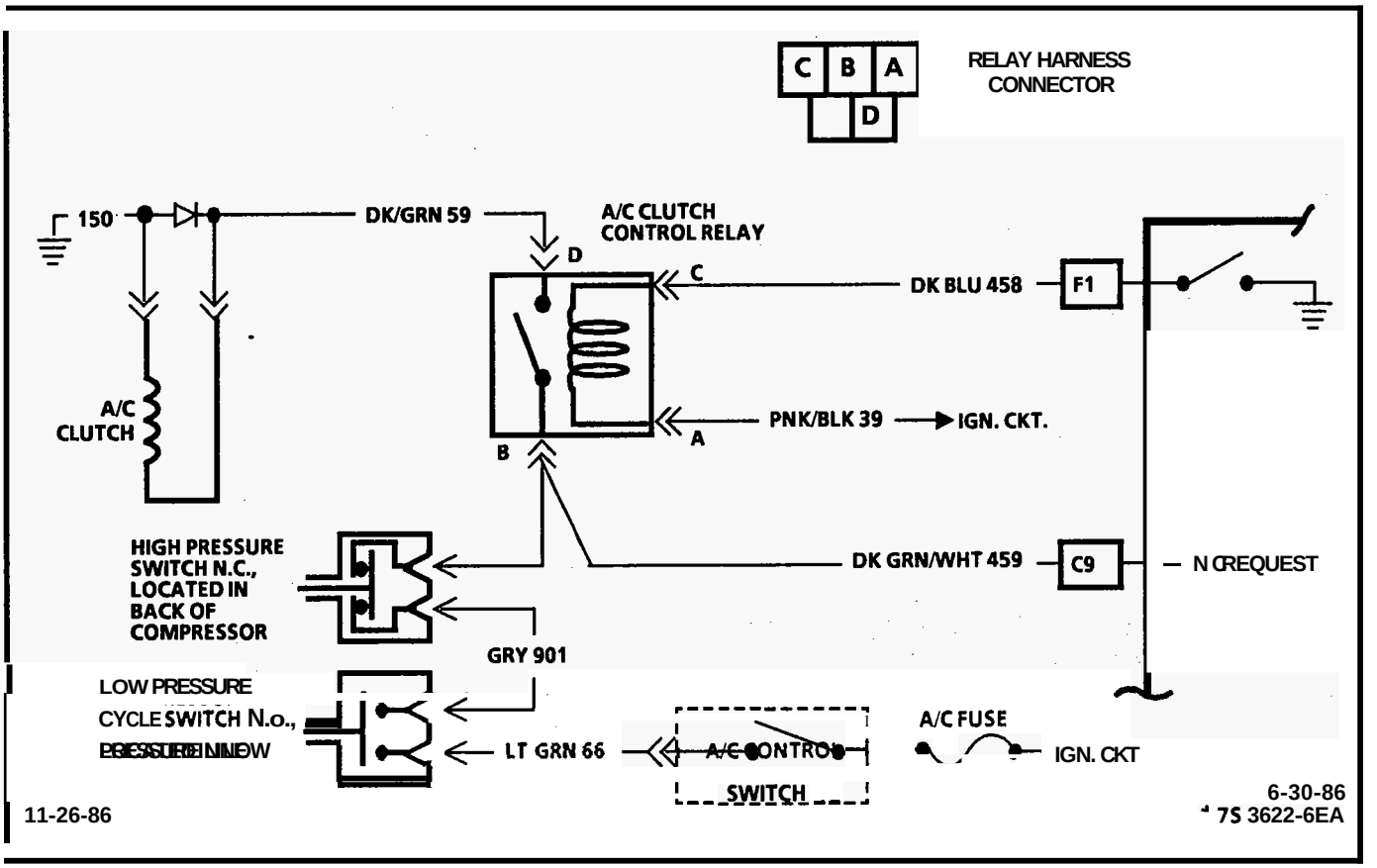


CHART C-10

A/C CLUTCH CIRCUIT DIAGNOSIS 2.0L TURBO "J" SERIES (PORT)

Circuit Description:

When an A/C Mode is selected on the A/C control switch, ignition voltage is supplied to the compressor low pressure switch. If there is sufficient A/C refrigerant pressure, the low pressure switch will be closed and complete CKT 901 to the closed high pressure cut-off switch and to CKT **459.** The voltage on CKT **459** to the ECM is shown by the "Scan" tool as A/C request "ON" (voltage present), "OFF"(no voltage). When a request for A/C is seen by the ECM, the ECM will ground CKT **458** of the A/C clutch control relay, the relay contact will close, and current will flow from CKT **459** to CKT **59** and engage the A/C compressor clutch. A "Scan" tool will show the grounding of CKT **458,** as A/C clutch "ON. Also, when voltage is seen by the ECM on CKT **459,** the cooling fan will be turned "ON".

Test Description: Step numbers refer to step numbers in diagnostic chart.

1. The ECM will only energize the A/C relay, when the engine is running. This test will determine if the relay, or CKT **459,** is faulty.
2. In order for the clutch to properly be engaged, the low pressure switch must be closed to provide 12 volts to the relay, and the high pressure switch must be closed, so the A/C request (12 volts) will be present at the ECM.
3. Determines if the signal is reaching the ECM on CKT **366** from the A/C control panel. Signal should only be present when the A/C mode or defrost mode has been selected.
4. **A** short to ground in any part of the A/C request circuit, CKT **67** to the relay, CKT **59** to the A/C clutch, or the A/C clutch, could be the cause of the blown fuse.
5. If the ECM is seeing a high power steering pressure signal, the A/C clutch will be disengaged by the ECM.
6. With the engine idling and A/C "ON", the ECM should be grounding CKT **459,** which should cause the test light to be "ON".

Diagnostic Aids:

If complaint was insufficient cooling, the problem may be caused by a inoperative cooling fan, or A/C pressure fan switch. The engine cooling fan should turn on, when A/C pressure exceeds a value to open the switch, which causes the ECM to energize the cooling fan relay. See CHART C-12, for cooling fan diagnosis. If fan operates correctly, see A/C diagnosis in Section "1".

SECTION C12
ELECTRONIC COOLING FAN
CONTENTS

GENERAL DESCRIPTION

All front wheel drive vehicles with transversely mounted engines, and some other vehicles, use an electric cooling fan. The fan is used for engine and A/C condenser cooling but the fan only operates under certain conditions.

OPERATION

All electric cooling fans operate when engine coolant temperature exceeds a certain value on some models. This is controlled by a temperature override switch installed on the engine. The switch closes at a calibrated value and completes the ground path for the winding of the coolant fan relay. The relay contacts then close and complete the circuit between the fusible link and the fan motor. When the engine cools down, the switch opens and the fan stops.

The ECM will complete the ground path for the winding of the coolant fan relay, when it sees engine temperature above a certain value or when the A/C is turned on. The ECM causes the ground path for the relay to open when car speed is over about 35 mph. This is done because enough air should be moving through the radiator at this speed.

On A/C vehicles, the A/C head pressure switch completes the ground path for the coolant fan relay, when A/C pressures exceed 260 psi.

(2.0L TURBO)

The ECM provides a ground path to energize the fan relays, which turn on the cooling fan. The ECM will command the fan on, when coolant temp. is above 108°C. When the engine cools down to about 101°C, the ECM de-energizes the fan relay, and the fan stops. If the coolant sensor fails (Code 14 or 15 set), the ECM will command constant fan.

On the 2.0L Turbo, "J" Series, when the engine is shutdown, the ECM will, also, turn on the low speed fan relay and run the fan for up to 7 minutes, if hot conditions were present, while the engine was running (based on MAT, coolant, and time from start).

On A/C equipped vehicles, when the ECM sees voltage on the A/C request line (A/C control "ON", low pressure switch closed), it will turn the cooling fan "ON".

(2.8L)

The electric cooling fan on this engine is totally controlled by the ECM.

The ECM will ground the cooling fan relay, which turns on the fan, when the following conditions are met.

- Coolant temperature sensor signal indicating a temperature greater than 106°C (223°F).
  OR
- A/C head pressure greater than 200 psi (1380 kPa).
- And vehicle speed less than 70 mph.

When the cooling fan is turned "ON, it will stay "ON" for a minimum time of 30 seconds.

DIAGNOSIS

The following C-12 circuit charts will diagnose the ECM controlled cooling fan.

For specific system description, components and wiring, see Section "8A", ETM, or the applicable C-12 CHARTS.

- 3.0L N Series ..... Page C12A-4
- 3.8L A Series
  Single Speed Fan ..... Page C12A10
- 3.8L C, H Series
  Dual Speed Fan ..... Page C12A-32
- 3.8L TURBO G Series ..... Page C12A-38

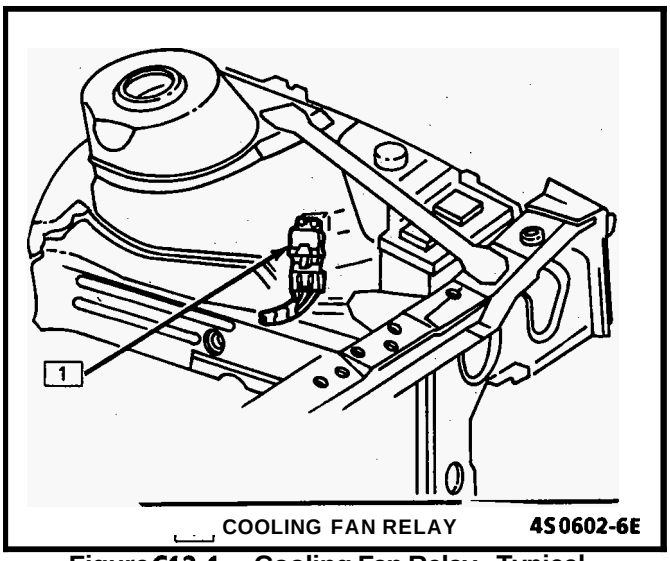


Figure C12-1 - Cooling Fan Relay - Typical

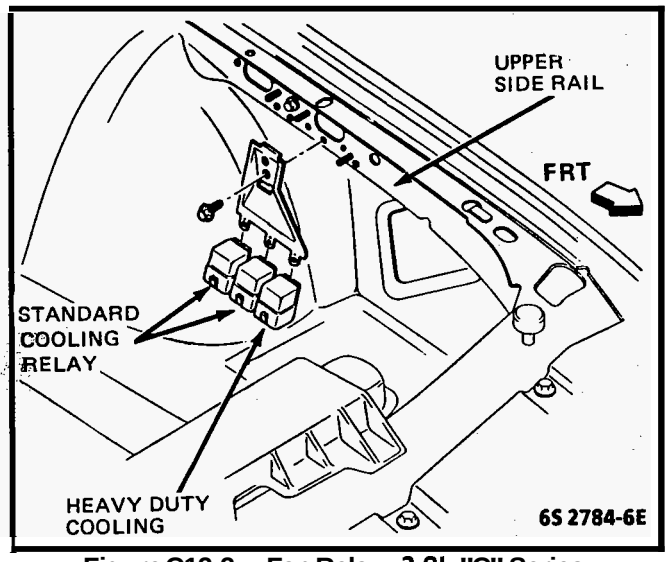


Figure C12-2 - Fan Relay - 3.8L "C" Series

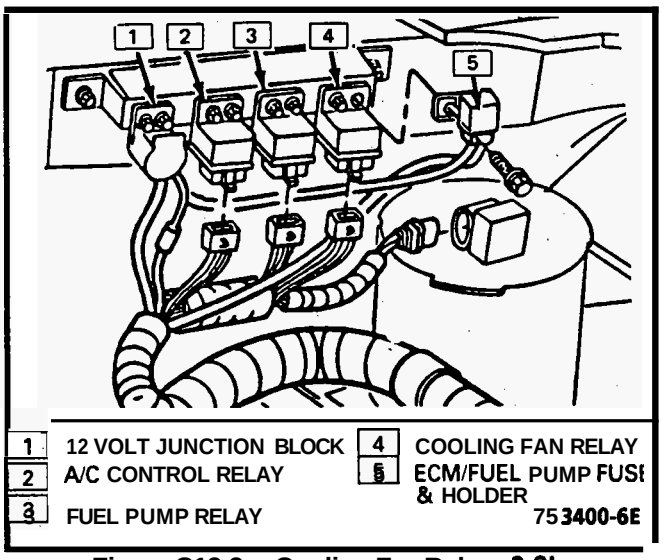


Figure C12-3 - Cooling Fan Relay - 2.8L

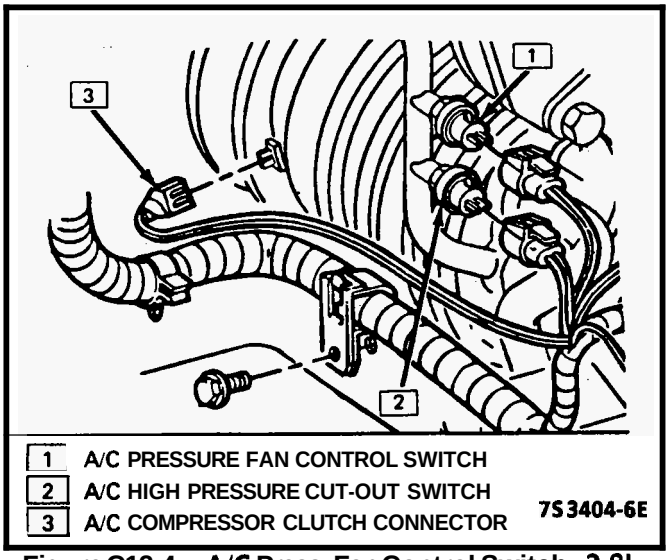


Figure C12-4 - A/C Press. Fan Control Switch - 2.8L

ON-CAR SERVICE

Cooling system component replacement can be found in Section 6B.

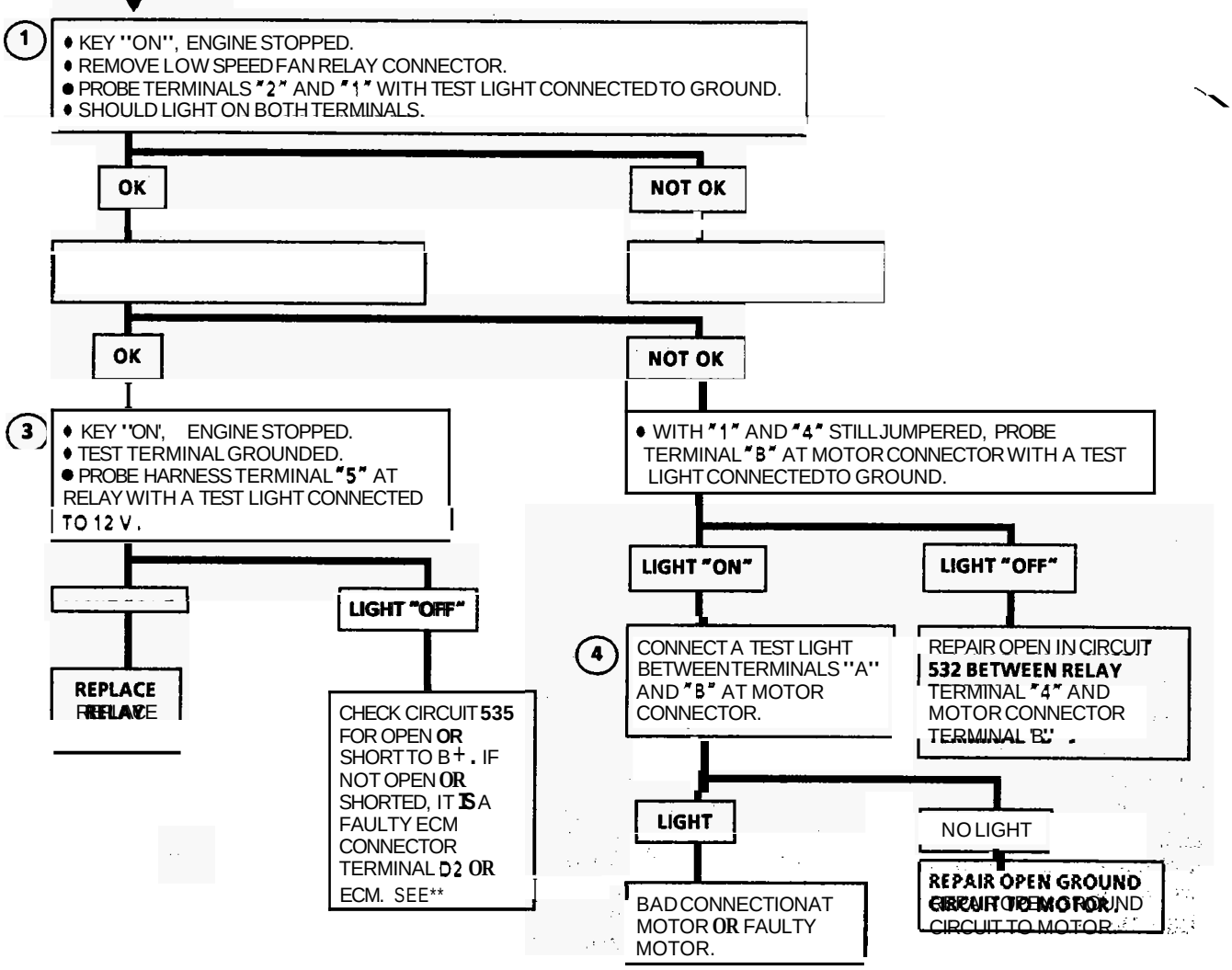
PARTS INFORMATION

PART NAME	GROUP
Fan, Engine	1.055
Motor, Fan	1.055
Relay, Engine Fan	1.055
Switch, Fan	1.055

CHART C-12N

NO LOW SPEED FAN
TWO-SPEED COOLANT FAN CHECK
3.8L "C & H" SERIES (PORT)

FROM CHART C-12L



** BEFORE REPLACING AN ECM, USE AN OHMMETER TO CHECK THE RESISTANCE OF:
- COOLANT FAN RELAY.
- CANISTER PURGE SOLENOID.

REPLACE WHERE RESISTANCE MEASURES LESS THAN 20 OHMS.

2-14-86

* 652960-6E

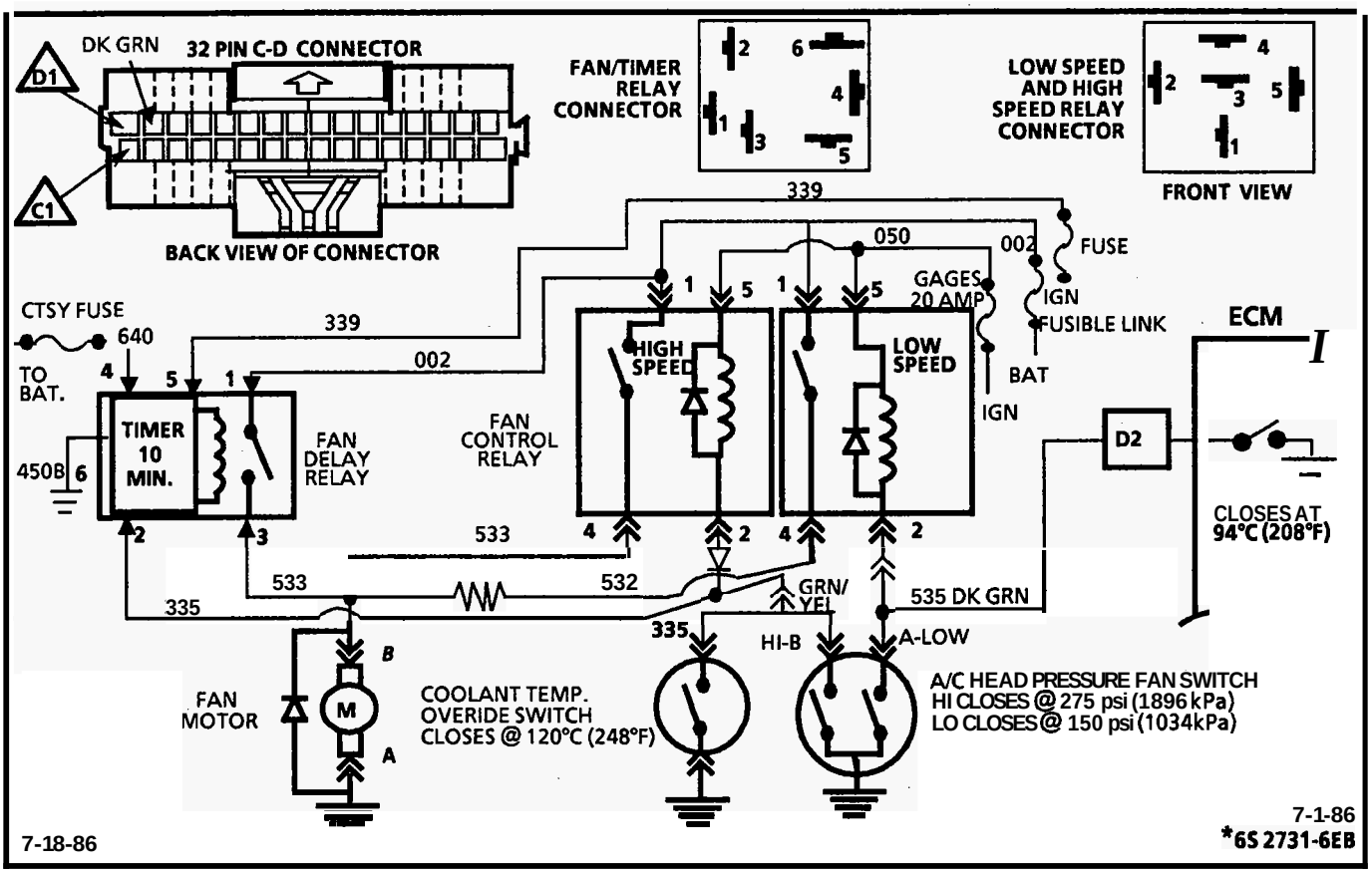


CHART C-12A

TWO-SPEED COOLANT FAN CHECK
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

Two coolant fans are energized through a Low Speed, High Speed, and Delay Relay.

Power for the fan motors comes through the fusible link to terminal "1" on all relays. The relays are energized, when current flows to ground, through the activation of the A/C coolant switches and/or the ECM.

- Low Speed Relay - The Low Speed Relay is energized by the ECM or the A/C Pressure Fan Switch. The ECM energizes the relay through terminal **"D2",** when the coolant temp. reaches 98°C **(208°F),** and vehicle speed is below 45 mph. The Low Speed Relay is, also, energized through the A/C Pressure Fan Switch, terminal "B", when refrigerant pressure reaches 150psi (1034kPa).

High Speed Relay - The High Speed Relay is energized by the A/C High Pressrue Fan Switch and Coolant Temp. Override Switches. If the A/C refrigerant press. reaches 27 psi (1876 kPa), or the coolant temp. reaches **108°C (226°F),** the High Speed Fan Relay is energized. The ECM has no control of the High Speed Fan Relay.

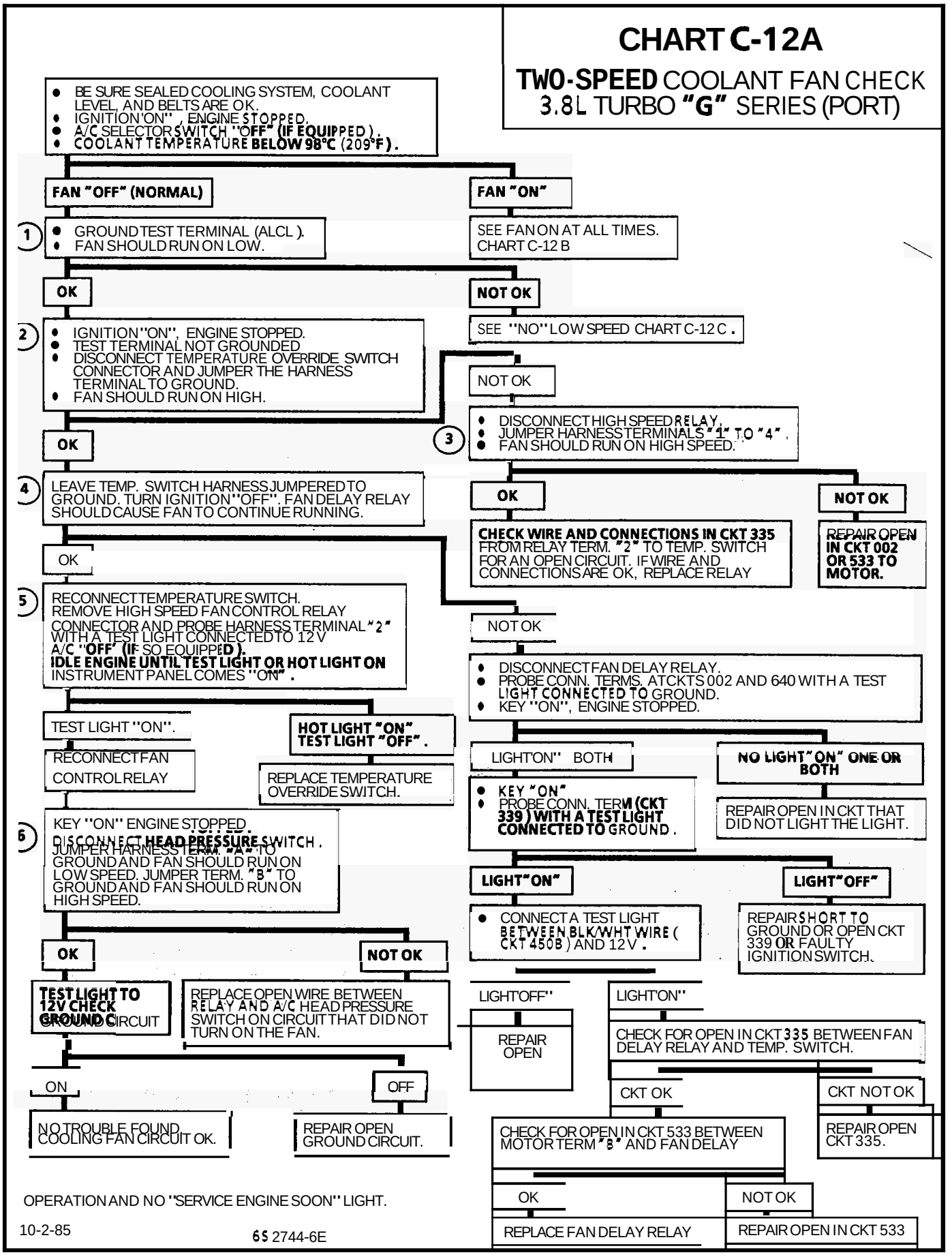
Timer Relay - The Timer Relay is energized by the temp. switch. If the coolant temp. is 108°C (226°F), or higher, when the ignition switch is turned "OFF", the Timer Relay is energized for 10 min, or until the coolant temp. is lowered below 108°C (226°F). The 150 W. fan is the only fan that will run with the IGN **Sw.** "OFF".

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Grounding the diagnositc test terminal should cause the ECM to ground CKT 535 and, the fan should run in low speed.
2. Grounding the temp. switch harness terminal will check CKT 335 and will also check the High Speed Fan Control Relay.
3. Checks CKT 533, between high speed relay terminal "4" and the motor. If the fan does not operate, CKT 533 is open, or motor is faulty.
4. When the ignition is turned "OFF", with the temp. **Sw.** grounded, the delay relay is activated. This will cause the fan to turn "ON", for up to 10 min., after engine shutdown.
5. This step checks to see if the temp. sw. is grounding and is grounded, when the light comes "ON. The switch should close at 108°C (226°F).
6. If the vehicle is equipped with A/C, the following steps will check the head pressure switches related wiring, from the switch to the fan control relay. If poor A/C performance is noted, the A/C press. switches should be checked by a qualified A/C repair person. The low speed fan should come "ON", if head press. exceeds 260 psi, and the high speed fan should turn "ON" at 300 psi.

CHART C-12A

TWO-SPEED COOLANT FAN CHECK 3.8L TURBO "G" SERIES (PORT)



OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

10-2-85

6S 2744-6E

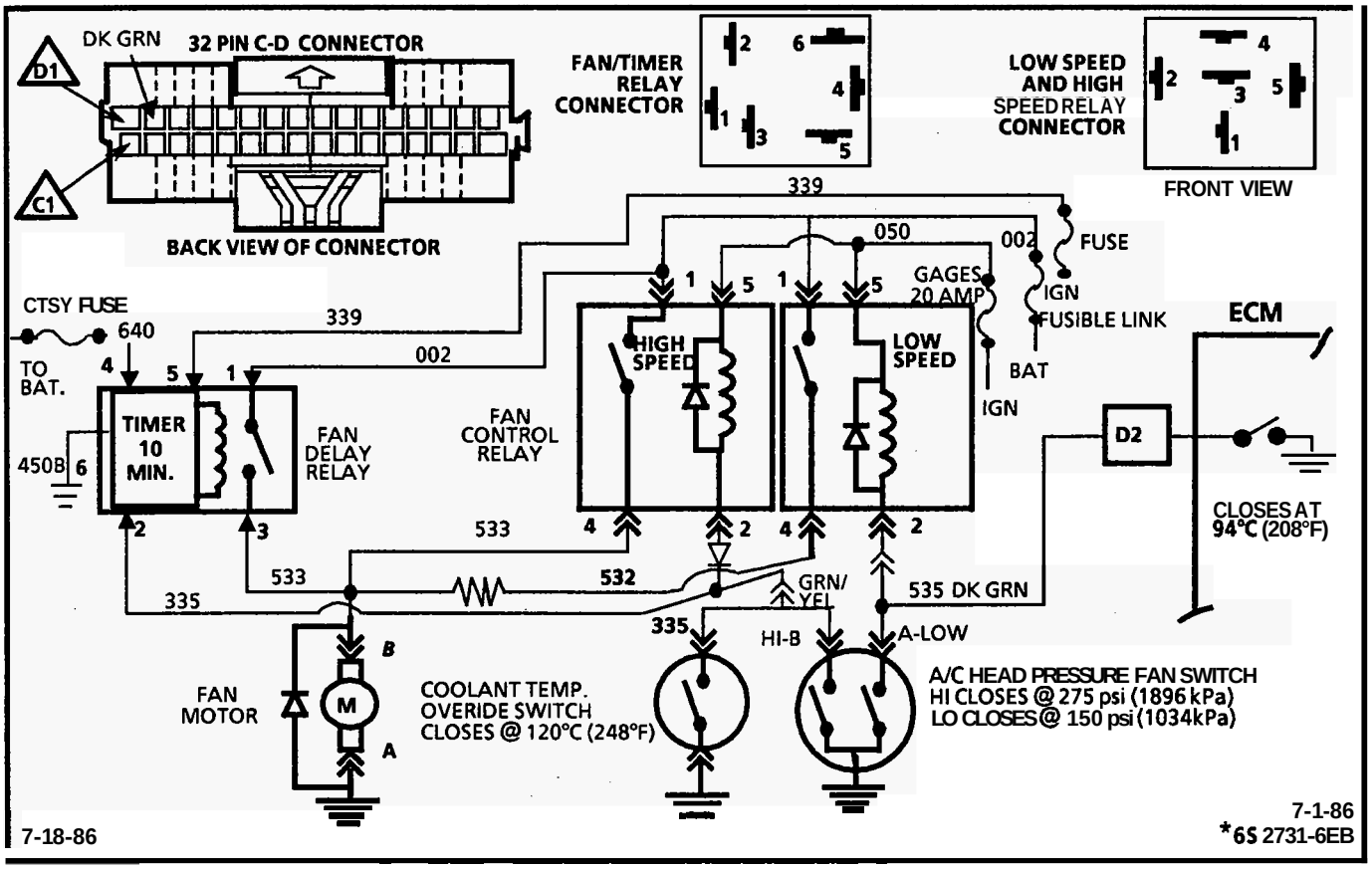


CHART C-12B

FAN "ON" AT ALL TIMES
TWO-SPEED COOLANT FAN CHECK
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

Two coolant fans are energized through a Low Speed, High Speed, and Delay Relay.

Power for the fan motors comes through the fusible link to terminal "1" on all relays. The relays are energized, when current flows to ground, through the activation of the A/C coolant switches and/or the ECM.

Low Speed Relay - The Low Speed Relay is energized by the ECM or the A/C Pressure Fan Switch. The ECM energizes the relay through terminal "D2", when the coolant temp. reaches 98°C (208°F), and vehicle speed is below **45** mph. The LowSpeed Relay is, also, energized through the A/C Pressure Fan Switch, terminal "B", when refrigerant pressure reaches 150psi (1034kPa).

High Speed Relay - The High Speed Relay is energized by the A/C High Pressrue Fan Switch and Coolant Temp. Override Switches. If the A/C refrigerant press. reaches 27 psi (1876kPa), or the coolant temp. reaches 108°C**(226°F),** the High Speed Fan Relay is energized. The ECM has no control of the High Speed Fan Relay.

Timer Relay - The Timer Relay is energized by the temp. switch. If the coolant temp. is 108°C**(226°F),** or higher, when the ignition switch is turned "OFF", the Timer Relay is energized for 10 min, or until the coolant temp. is lowered below 108°C(226°F). The 150W. fan is the only fan that will run with the IGN Sw. "OFF".

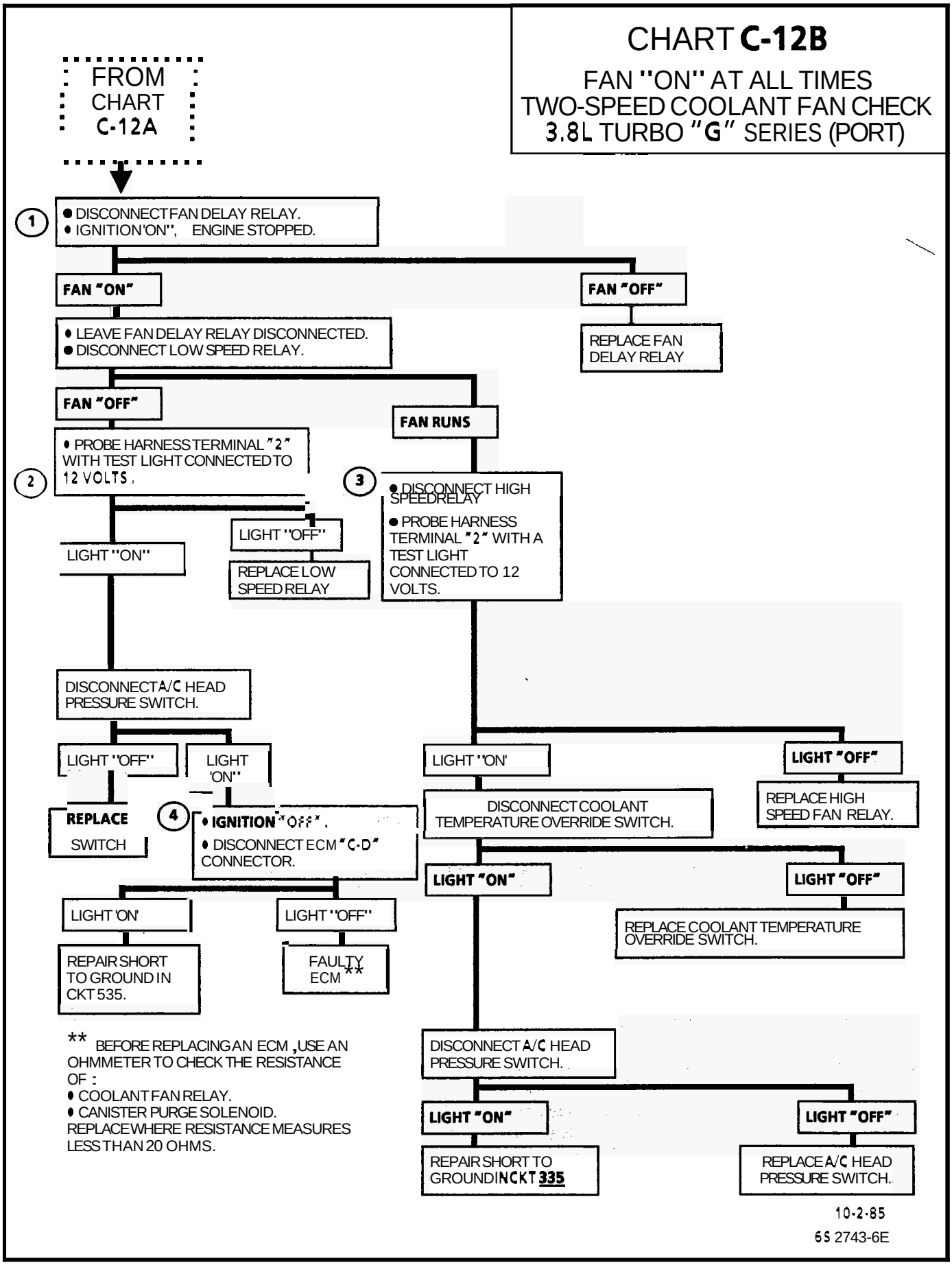
Test Description:

. Step numbers refer to step numbers on diagnostic chart.

1. This step will separate the problem between the delay or the fan control relays.
2. Check to see if CKT 535 is shorted to ground, which would keep the relay grounded at all times.
3. Checks to see if CKT 335 is shorted to ground. A light indicates the wire is shorted to ground, and the following steps will isolate the short.
4. If the test light is "OFF", after disconnecting, the ECM is shorted internally. Before replacing the ECM, be sure and check the resistance value of the Low Speed Fan Control Relay. Replace, if resistance is less than 20 ohms. Also, be sure that CKT 535 is not shorted to B+, and check the resistance of the canister purge solenoid and replace, if under 20 ohms.

CHART C-12B

FAN "ON" AT ALL TIMES TWO-SPEED COOLANT FAN CHECK 3.8L TURBO "G" SERIES (PORT)



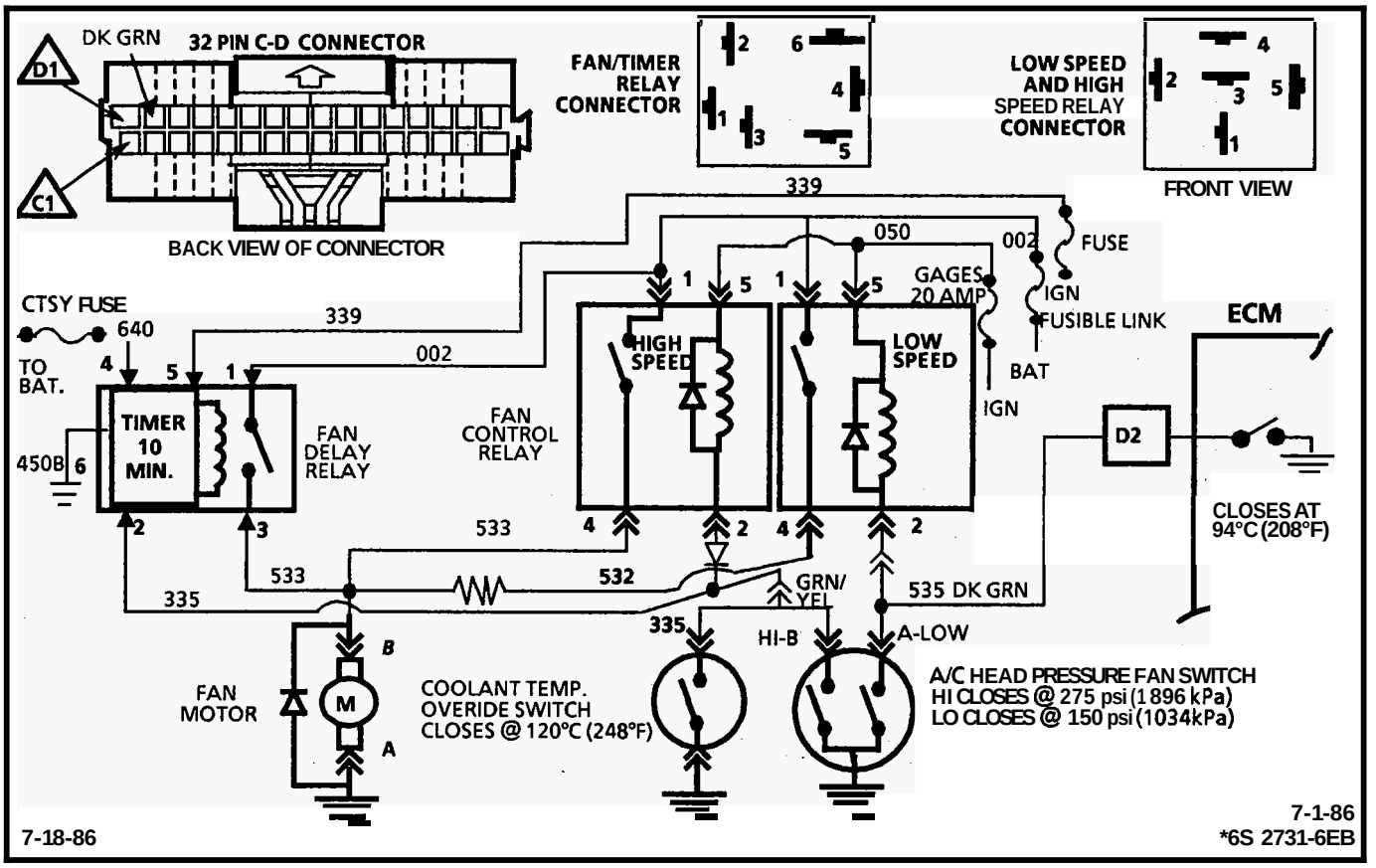


CHART C-12C

NO LOW SPEED FAN
TWO-SPEED COOLANT FAN CHECK
3.8L TURBO "G" SERIES (PORT)

Circuit Description:

Two coolant fans are energized through a Low Speed, High Speed, and Delay Relay.

Power for the fan motors comes through the fusible link to terminal "1" on all relays. The relays are energized, when current flows to ground, through the activation of the A/C coolant switches and/or the ECM.

Low Speed Relay - The Low Speed Relay is energized by the ECM or the A/C Pressure Fan Switch. The ECM energizes the relay through terminal "D2", when the coolant temp. reaches 98°C **(208°F),** and vehicle speed is below 45 mph. The Low Speed Relay is, also, energized through the A/C Pressure Fan Switch, terminal "B", when refrigerant pressure reaches 150 psi (1034 kPa).

High Speed Relay - The High Speed Relay is energized by the A/C High Pressrue Fan Switch and Coolant Temp. Override Switches. If the A/C refrigerant press. reaches 27 psi (1876 kPa), or the coolant temp. reaches 108°C (226°F), the High Speed Fan Relay is energized. The ECM has no control of the High Speed Fan Relay.

Timer Relay - The Timer Relay is energized by the temp. switch. If the coolant temp. is 108°C **(226°F),** or higher, when the ignition switch is turned "OFF"", the Timer Relay is energized for 10 min, or until the coolant temp. is lowered below 108°C (226°F). The 150W. fan is the only fan that will run with the **IGN** Sw. "OFF".

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Checks for battery + at relay harness connector.
2. Jumpering terminals "1" to "4" bypasses the relay, which should cause the fan to run, if fan motor and wiring to the motor are good.
3. Grounding the test terminal should cause the ECM to ground CKT 535. At this point, the test light should light, if the ECM is good and CKT 535 isn't open.
4. This checks for battery + and ground to the fan motor. A test light "ON", at this point, indicates a faulty fan motor connection or motor.

CHART C-12C

NO LOW SPEED FAN
TWO-SPEED COOLANT FAN CHECK
3.8L TURBO "G" SERIES (PORT)

FROM CHART C-12A

NOT OK

OK

NOT OK

3

- KEY "ON", ENGINE STOPPED.
- TEST TERMINAL GROUNDED.
- PROBE TERMINAL "2" AT RELAY WITH A TEST LIGHT CONNECTED TO 12 V.

- WITH "1" AND "4" STILL JUMPERED, PROBE TERMINAL "B" AT MOTOR CONNECTOR WITH A TEST LIGHT CONNECTED TO GROUND.

LIGHT "ON"

LIGHT "OFF"

REPLACE RELAY.

CHECK CKT 535 FOR OPEN

TERMINAL D2 OR ECM.

4

CONNECT A TEST LIGHT BETWEEN TERMINALS "A" AND "B" AT MOTOR CONNECTOR.

REPAIR OPEN IN CIRCUIT 532 BETWEEN RELAY TERMINAL "4" AND MOTOR CONNECTOR TERMINAL "B".

LIGHT

NO LIGHT

REPAIR OPEN GROUND CIRCUIT.

** BEFORE REPLACING AN ECM, USE AN OHMMETER TO CHECK THE RESISTANCE OF:
- COOLANT FAN RELAY.
- CANISTER PURGE SOLENOID.

REPLACE WHERE RESISTANCE MEASURES LESS THAN 20 OHMS.

10-2-85

6S 2741-6E

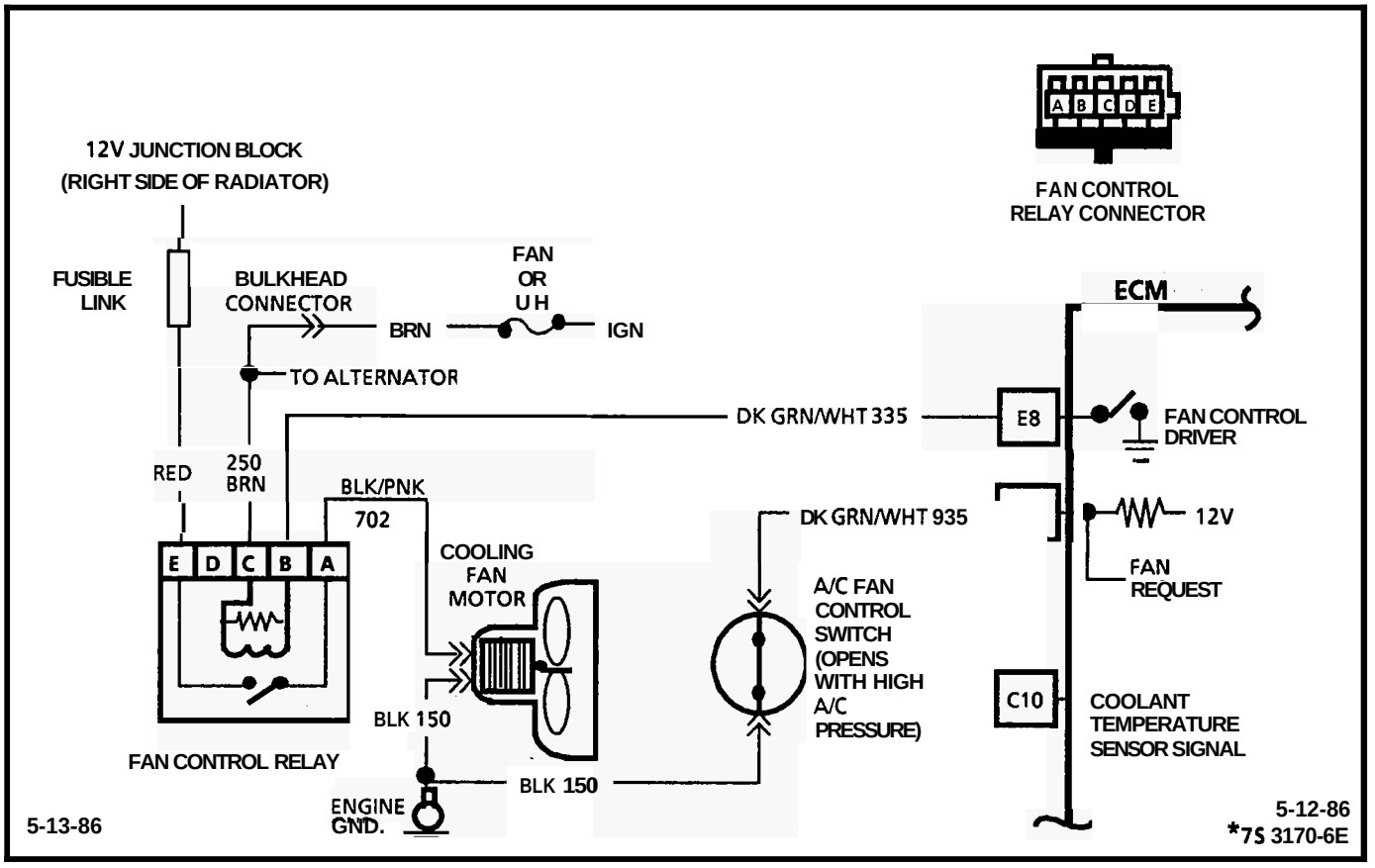


CHART C-12A

(Page 1 of 2)
COOLANT FAN CONTROL CIRCUIT DIAGNOSIS
2.8L "A" SERIES (PORT)

Circuit Description:

The electric cooling fan is controlled by the ECM, based on inputs from the coolant temperature sensor, the A/C fan control switch, and vehicle speed. The ECM controls the fan by grounding CKT 335, which energizes the fan control relay. Battery voltage is then supplied to the fan motor.

The ECM grounds CKT 335, when coolant temp. is over about 106°C (223°F), or when A/C has been requested, and the fan control switch opens with high A/C pressure, about 200 psi (1380 kPa). Once the ECM turns the relay "ON", it will keep it "ON" for a minimum of 30 seconds, or until vehicle speed exceeds 70 mph.

Also, if Code 14 or 15 sets, or the ECM is in throttle body back up, the fan will run at all times.

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. With the diagnostic terminal grounded, the cooling fan control driver will close, which should energize the fan control relay.
2. If the A/C fan control switch or circuit is open, the fan would run whenever A/C is requested.
3. With A/C clutch engaged, the A/C fan control switch should open, when A/C high pressure exceeds about 200 psi (1380 kPa). This signal should cause the ECM to energize the fan control relay.

Diagnostic Aids:

If the owner complained of an overheating problem, it must be determined if the complaint was due to an actual boilover, or the hot light, or temp. gage indicated over heating.

If the gage, or light, indicates overheating, but no boilover is detected, the gage circuit should be checked. The gage accuracy can, also, be checked by comparing the coolant sensor reading using a "Scan" tool and comparing its reading with the gage reading.

If the engine is actually overheating, and the gage indicates overheating, but the cooling fan is not coming "ON", the coolant sensor has probably shifted out of calibration and should be replaced.

If the engine is overheating, and the cooling fan is "ON", the cooling system should be checked.

SECTION C13
POSITIVE CRANKCASE VENTILATION (PCV)
CONTENTS

GENERAL DESCRIPTION

A Positive Crankcase Ventilation (PCV) system is used to consume crankcase vapors in the combustion process instead of venting to atmosphere. Fresh air from the air cleaner is supplied to the crankcase, mixed with blow-by gases and then passed through a positive crankcase ventilation (PCV) valve into the intake manifold (Figure C13-1).

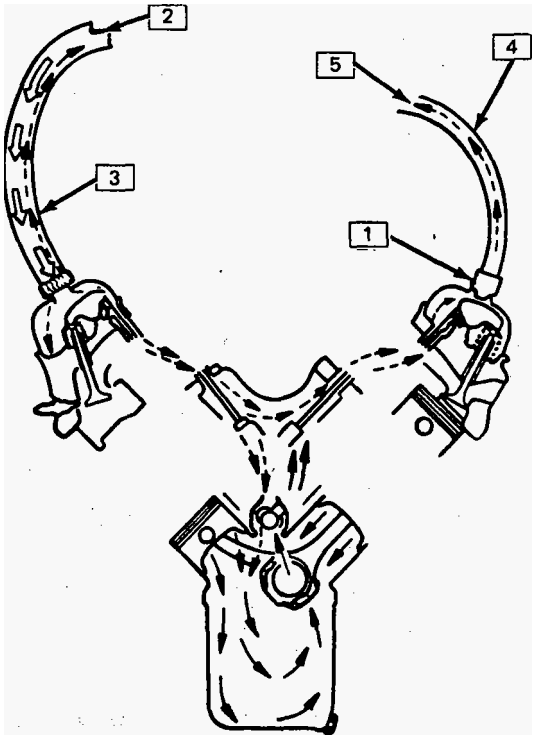


Figure C13-1 - PCV Flow

OPERATION

The primary control is through the PCV valve (Figure C13-2) 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.

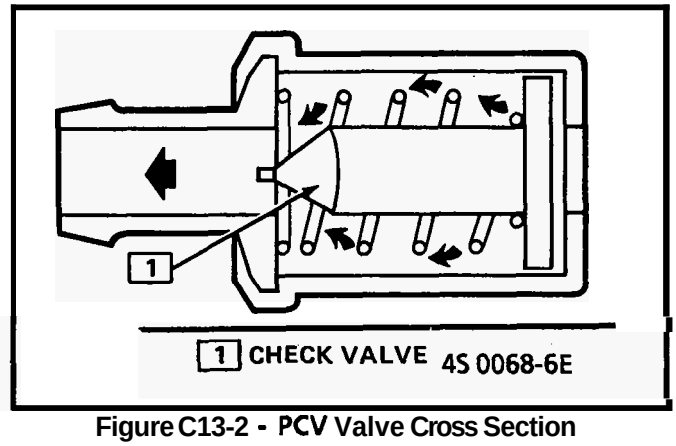


Figure C13-2 - PCV Valve Cross Section

RESULTS OF INCORRECT OPERATION

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

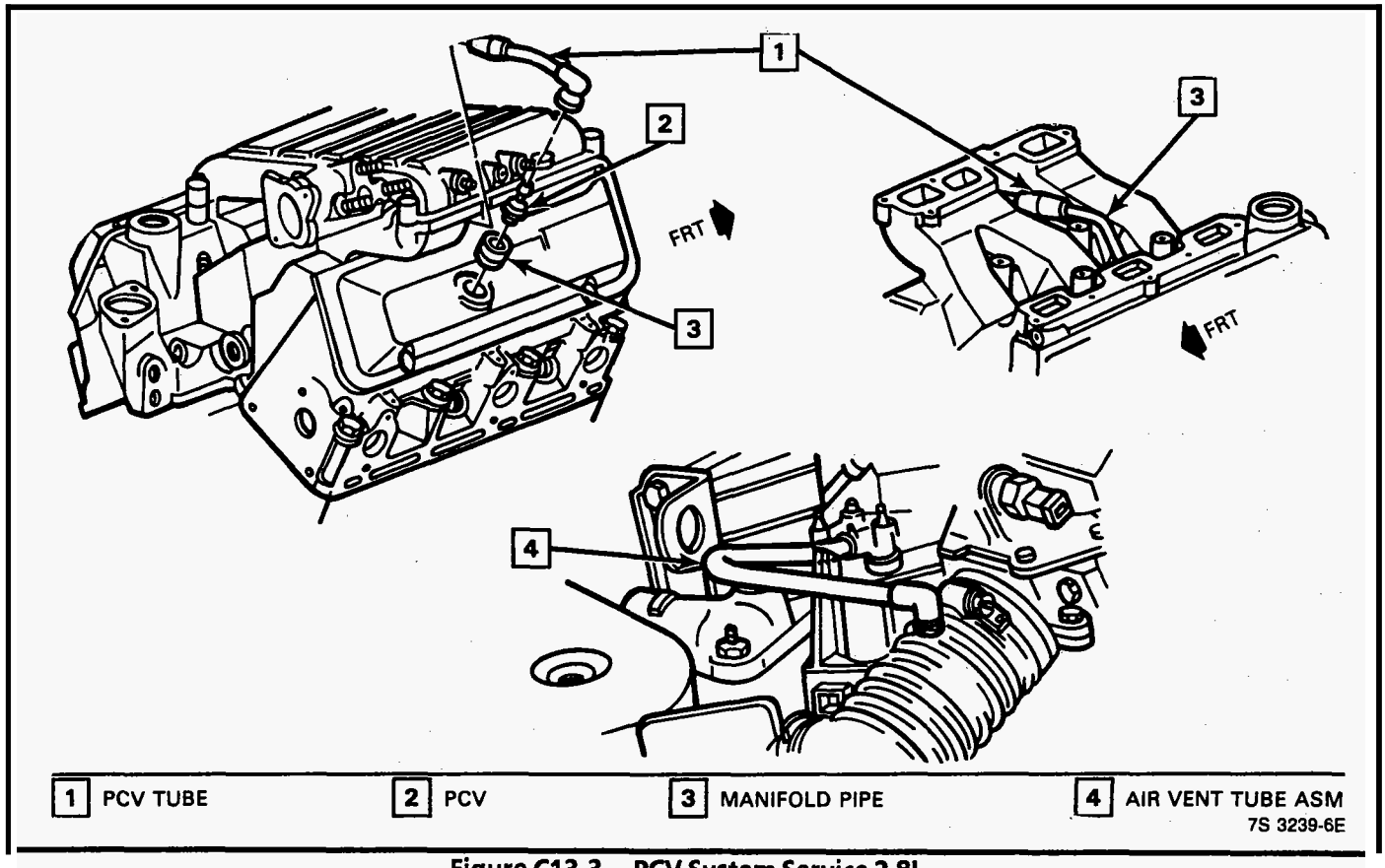


Figure C13-3 - PCV System Service 2.8L

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 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.

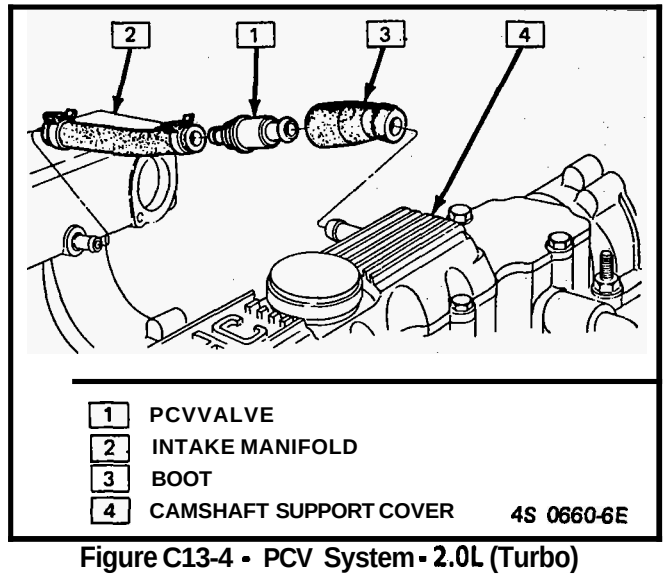


Figure C13-4 - PCV System - 2.0L (Turbo)

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 inlet filter/separator (where used) at intervals shown in Section OB.

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

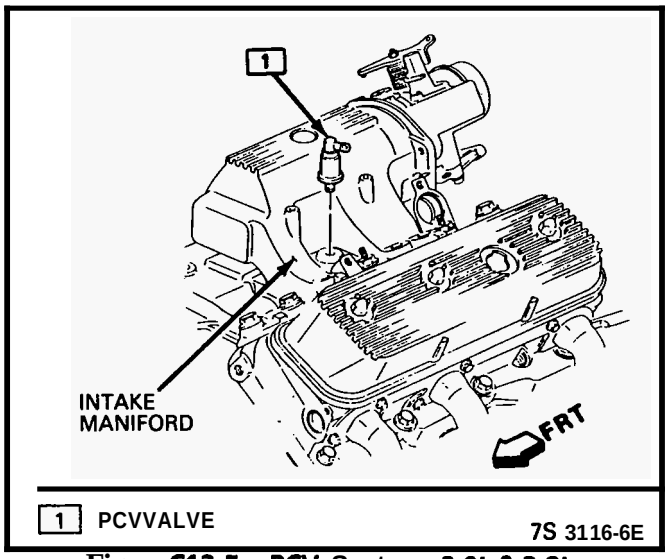


Figure C13-5 - PCV System - 3.0L & 3.8L

PARTS INFORMATION

PART NAME	GROUP
Air Cleaner	3.402
Valve Asm, Cr/Case Vent	1.745
Tube, Cr/Case Vent	1.762